



2005 SERVICE MANUAL ALL MODELS



FE FG FK FM

FE.FG

SERVICE MANUAL 2005 Model FOREWORD

This Service Manual contains maintenance and repair methods for the Mitsubishi Fuso Truck FE. FG Series. Read this manual carefully as an aid in providing correct, efficient maintenance. Please note that the information and specifications contained within this manual may change without notice. This is due to product modifications and continued vehicle improvements that are made throughout the model years. Should you encounter any discrepancy in the information provided, please do not hesitate to contact your nearest Mitsubishi Fuso Dealer or Mitsubishi Fuso Truck of America, Inc.

May 2004

HOME

GROUP INDEX

GENERAL	00
MAINTENANCE SCHEDULE	01
ENGINE.....	11
LUBRICATION	12
FUEL AND ENGINE CONTROL.....	13A
ELECTRONICALLY CONTROLLED FUEL SYSTEM	13E
COOLING.....	14
INTAKE AND EXHAUST	15
EMISSION CONTROL	17
CLUTCH.....	21
MANUAL TRANSMISSION	22
AUTOMATIC TRANSMISSION.....	23
TRANSFER.....	24
PROPELLER SHAFT	25
FRONT AXLE	
<FE>	26A
<FG>.....	26B
REAR AXLE.....	27
WHEEL AND TIRE	31
FRONT SUSPENSION	33
REAR SUSPENSION.....	34
BRAKE.....	35A
ANTI-LOCK BRAKE SYSTEM	35E
PARKING BRAKE	36
STEERING	37
FRAME.....	41
CAB.....	42
DOOR.....	43
EXTERIOR	51
INTERIOR	52
ELECTRICAL.....	54
AIR-CONDITIONER.....	55A
HEATER.....	55B



Group 00

General

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

EQUIPMENT TYPE CODES LIST	00-2
POWER TRAIN LIST	00-3
HOW TO READ THIS MANUAL	00-4
CHASSIS NUMBER, ENGINE NUMBER, POWER TRAIN LABEL	00-10
VEHICLE IDENTIFICATION NUMBER	00-11
PRECAUTIONS FOR MAINTENANCE OPERATION	00-12
JACKING UP THE VEHICLE	00-24
DIAGNOSIS CODES	
1. Connecting Multi-Use Tester	00-26
2. Accessing / Erasing Diagnosis Codes <Common Rail, Exhaust Gas Recirculation, Pre-heater>	00-30
3. Accessing / Erasing Diagnosis Codes <Automatic Transmission>	00-32
4. Accessing / Erasing Diagnosis Codes <Anti-lock Brake System>	00-34
TABLE OF STANDARD TIGHTENING TORQUES.....	00-36

EQUIPMENT TYPE CODES LIST

Component	Name plate marking					Code description
Engine						
4M50-T	4	M	5	0	T	
	↑	↑	↑	↑	↑	Turbocharged Order of development within same series Order of development among different series Diesel engine No. of cylinders (4)
Clutch						
C5W33	C	5	W	33		
	↑	↑	↑	↑		Disc OD Facing material (W: Woven) Load carrying capacity of truck class (tonnage) on which the clutch is primarily used Initial letter of the clutch
Transmission						
M036S5W	M	036	S	5	W	
	↑	↑	↑	↑	↑	Variation (W: With directly-mounted transfer) Forward speeds Type of mesh (S: Synchromesh) Load carrying capacity of truck class (tonnage) on which the clutch is primarily used Initial letter of the transmission
Propeller shaft						
P3	P	3				
	↑	↑				Load carrying capacity of truck class (tonnage) on which the clutch is primarily used Initial letter of the propeller shaft
Front axle						
F200T	F	200	T			
	↑	↑	↑			Vehicle type (T: Truck) Load carrying capacity of truck class (tonnage) on which the clutch is primarily used Initial letter of the front axle
Rear axle						
R033T	R	03	3	T		
	↑	↑	↑	↑		Vehicle type (T: Truck) Order of development within same series Load carrying capacity of truck class (tonnage) on which the clutch is primarily used Initial letter of the rear axle
Reduction and differential						
D033H	D	03	3	H		
	↑	↑	↑	↑		Tooth profile (H: Hypoid gear) Order of development within same series Load carrying capacity of truck class (tonnage) on which the clutch is primarily used Initial letter of the reduction & differential

Vehicle model	Engine	Clutch	Transmission	Propeller shaft	Rear axle	Reduction & differential
FE83DDZSLSUA	4M50-T7	C5W33	M036S5	P3	R033T	D033H
FE83DEZSLSUA	4M50-T7	C5W33	M036S5	P3	R033T	D033H
FE83DGZSLSUA	4M50-T7	C5W33	M036S5	P3	R033T	D033H
FE83DDZSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE83DEZSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE83DGZSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DDZSLSUA	4M50-T7	C5W33	M036S5	P3	R033T	D033H
FE84DEZSLSUA	4M50-T7	C5W33	M036S5	P3	R033T	D033H
FE84DGZSLSUA	4M50-T7	C5W33	M036S5	P3	R033T	D033H
FE84DHZSLSUA	4M50-T7	C5W33	M036S5	P3	R033T	D033H
FE84DDZSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DEZSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DGZSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DHZSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE84DHWSLSUB	4M50-T8	Torque converter	M036A6	P3	R033T	D033H
FE85DDZSLSUC	4M50-T8	C5W33	M036S6	P3	R035T	D035H
FE85DEZSLSUC	4M50-T8	C5W33	M036S6	P3	R035T	D035H
FE85DGZSLSUC	4M50-T8	C5W33	M036S6	P3	R035T	D035H
FE85DHZSLSUC	4M50-T8	C5W33	M036S6	P3	R035T	D035H
FE85DJZSLSUC	4M50-T8	C5W33	M036S6	P3	R035T	D035H
FE85DDZSLSUB	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DEZSLSUB	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DGZSLSUB	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DHZSLSUB	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FE85DJZSLSUB	4M50-T8	Torque converter	M036A6	P3	R035T	D035H
FG84DC6SLSUA	4M50-T7	C5W33	M036S5W	Front: P2 Rear: P3	R033T	Front: D1H Rear: D033H
FG84DE6SLSUA	4M50-T7	C5W33	M036S5W	Front: P2 Rear: P3	R033T	Front: D1H Rear: D033H

HOW TO READ THIS MANUAL

This manual consists of the following parts:

- Specifications
- Structure and Operation
- Troubleshooting
- On-vehicle Inspection and Adjustment
- Service procedures

On-vehicle Inspection and Adjustment

- Procedures for inspection and adjustment of individual parts and assemblies as mounted on the vehicle are described including specific items to check and adjust. Specified or otherwise, inspection should be performed for looseness, play, backlash, crack, damage, etc.

Service procedure

- Procedures for servicing components and parts off the vehicle are described centering on key points in their removal, installation, disassembly, reassembly, inspection, etc.

Inspection

- Check items subject to acceptance or otherwise on the basis of service standards are all given.
- Some routine visual checks and cleaning of some reused parts are not described but must be always included in actual service work.

Caution

- This service manual contains important cautionary instructions and supplementary information under the following four headings which identify the nature of the instructions and information:

DANGER ⚠ ————— Precautions that should be taken in handling potentially dangerous substances such as battery fluid and coolant additives.

WARNING ⚠ ————— Precautionary instructions, which, if not observed, could result in serious injury or death.

CAUTION ⚠ ————— Precautionary instructions, which, if not observed, could result in damage to or destruction of equipment or parts.

NOTE ————— Suggestions or supplementary information for more efficient use of equipment or a better understandings.

Terms and Units

● Front and rear

The forward running direction of the vehicle is the front and the reversing direction is the rear.

● Left and right

Left hand side and right hand side, when facing the forward running direction of the vehicle, are respectively left and right.

● Standard value

Standard value dimensions in designs indicating: the design dimensions of individual parts, the standard clearance between two parts when assembled, and the standard value for an assembly part, as the case may be.

● Limit

When the value of a part exceeds this, it is no longer serviceable in respect of performance and strength and must be replaced or repaired.

● Tightening torque

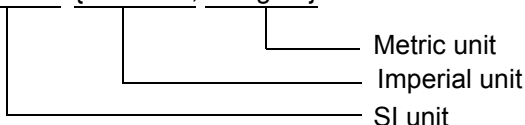
- Values are directly specified for out-of-standard tightening torques for bolts and nuts.
- Where there is no specified figure for tightening torque, follow the table covering standard tightening torques. (Values for standard tightening torques are based on thread size and material.)
- When the item is to be tightened in a wet state, "wet" is indicated. Where there is no indication, read it as dry.

● Units

Tightening torques and other parameters are given in SI* units with imperial unit and metric units added in brackets { }.

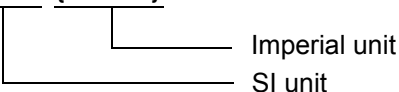
*SI: Le Système International d'Unités

Example: 390 N·m {290 ft.lbs, 40 kgf·m}



Unit		SI unit {imperial unit, metric unit}	Conversion factor
Force		N {lbs, kgf}	9.80665 N {2.2046 lbs, 1 kgf}
Moment of force		N·m {ft.lbs, kgf·m}	9.80665 N·m {7.2329 ft.lbs, 1 kgf·m}
Pressure	Positive pressure	kPa {psi, kgf/cm ² }	98.0665 kPa {14.22 psi, 1 kgf/cm ² }
	Vacuum pressure	kPa {in.Hg, mmHg}	0.133322 kPa {0.03937 in.Hg, 1 mmHg}
Volume		J {BTU, kcal}	4186.05 J {3.96825 BTU, 1 kcal}
Heat quantity		W {BTU/h, kcal/h}	1.16279 W {3.96825 BTU/h, 1 kcal/h}

Example: 30 mm {1.18 in.}



Unit		SI unit {imperial unit}	Conversion factor
Length		mm {in.}	1 mm {0.03937 in.}
		m {ft.}	1 m {3.2808 ft.}
		km {mile}	1 km {0.6214 mile}
Mass		kg {lb}	1 kg {2.2046 lb}
		g {oz}	1 g {0.035274 oz}
Temperature (in degree Celsius)		°C {° F}	1°C {(1°C × 1.8 + 32)° F}
Velocity		km/h {mph}	1 km/h {0.6214 mph}
		m/s {ft/s}	1 m/s {3.281 ft/s}
Volume		L {qts}, L {gal}	1 L {1.05336 qts}, 1 L {0.2642 gal}
		cm ³ {cu.in.}	1 cm ³ {0.061023 cu.in.}
Area		m ² {in ² }, m ² {ft ² }	1 m ² {1.550 × 10 ³ in ² }, 1 m ² {1.076 × 10 ft ² }

HOW TO READ THIS MANUAL

Symbol	Denotation	Application	Remarks
Ta	Tightening torque	Parts not tightened to standard torques (standard torques specified where necessary for servicing)	Specified values shown in table See Table of Standard Tightening Torques for parts for which no tightening torques are specified.
P	Locating pin	Parts to be positioned for installation	
×	Non-reusable parts	Parts not to be reused	
△a	Lubricant and/or sealant	Parts to be coated with lubricant or sealant for assembly or installation	Necessary lubricant and/or sealant, quantity required, etc. are specified in table.
Ca	Special tool	Parts for which special tools are required for service operation	Tool name/shape and part number are shown in table.
*a	Associated part	Parts associated with those removed/disassembled for servicing	

Denotes that tightening torque is specified.

WHEEL HUB AND BRAKE DRUM

Indicates position of locating pin.

Identifies non-reusable parts.

Denotes that coating with lubricant or sealant is required.

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● Disassembly sequence

- 1 Brake pipe
- 2 Brake hose
- 3 Wheel speed sensor
- 4 Hub cap
- 5 Lock nut
- 6 Lock washer
- 7 Outer bearing inner race
- 8 Anti-lock brake system rotor
- 9 Oil seal
- 10 Inner bearing inner race
- 11 Inner bearing outer race
- 12 Outer bearing outer race
- 13 Brake drum
- 14 Wheel hub
- 15 Hub bolt
- 16 Front drum brake (See Gr.35A)
- 17 Spacer

* a: Knuckle
P: Locating pin
×: Non-reusable parts

● Assembly sequence
Follow the disassembly sequence in reverse.

These location numbers correspond with disassembly sequence numbers.

Service standards (unit: mm [in.])

Location	Maintenance item	Standard value	Limit	Remedy
7, 10, 11, 12	Starting torque of wheel hub bearing (Tangential force at hub bolt position with oil seal fitted in)	1 to 3.5 N·m {0.7 to 2.6 ft.lbs., 0.10 to 0.35 kgf·m} (Tangential force: 8.8 to 28.4 N {2.0 to 6.4 lbs., 0.9 to 2.9 kgf})	-	Adjust or replace
14	Brake drum	Inside diameter 320 {12.6}	322 {12.7}	Repair or replace
		Cylindricity	0.05 {0.0020}	0.05 {0.0079}

"Wet" is indicated when part is to be tightened with oil or grease applied to its threaded part.

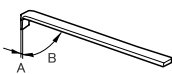
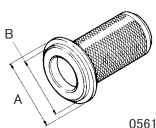
Tightening torque (unit: N·m [ft.lbs, kgf·m])

Mark	Part to be tightened	Tightening torque	Remarks
Ta	Brake force tightening	13 to 17 [9.6 to 13, 1.3 to 1.7]	—
Tb	Lock nut	113 ± 15 [83 ± 11, 11.5 ± 1.5]	Wet
Tc	Nut (brake drum and wheel hub mounting)	343 ± 39 [250 ± 29, 35 ± 4]	—
Td	Nut (front drum brake mounting)	118 ± 20 [87 ± 15, 12 ± 2]	—

Lubricant and/or sealant

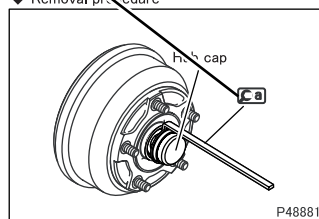
Mark	Point of application	Specified lubricant and/or sealant	Quantity
Aa	Between rolls of outer bearing inner race and inner bearing inner race	Mitsubishi wheel bearing grease	As required
	Inside wheel hub		395 ± 40 g (13.9 ± 1.41 oz)

Special tools (unit: mm [in.])

Special Tools (Unit: mm [in.])							
Mark	Tool name and shape	Part No.	Application				
 	Hub Cap Wrench <table><tr><td>A</td><td>B</td></tr><tr><td>0.5°</td><td>78°</td></tr></table>  P49261	A	B	0.5°	78°	MB999108	Removal of hub cap
	A	B					
0.5°	78°						
 	Oil Seal Installer <table><tr><td>A</td><td>B</td></tr><tr><td>φ 84 [3.31]</td><td>φ 70 [2.76]</td></tr></table>  05619	A	B	φ 84 [3.31]	φ 70 [2.76]	MB999097	Installation of oil seal
A	B						
φ 84 [3.31]	φ 70 [2.76]						

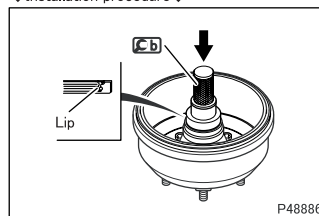
Identification marks for special tools are the same as used in the text.

◆ Removal procedure



■ Removal: Hub cap

◆ Installation procedure ◆



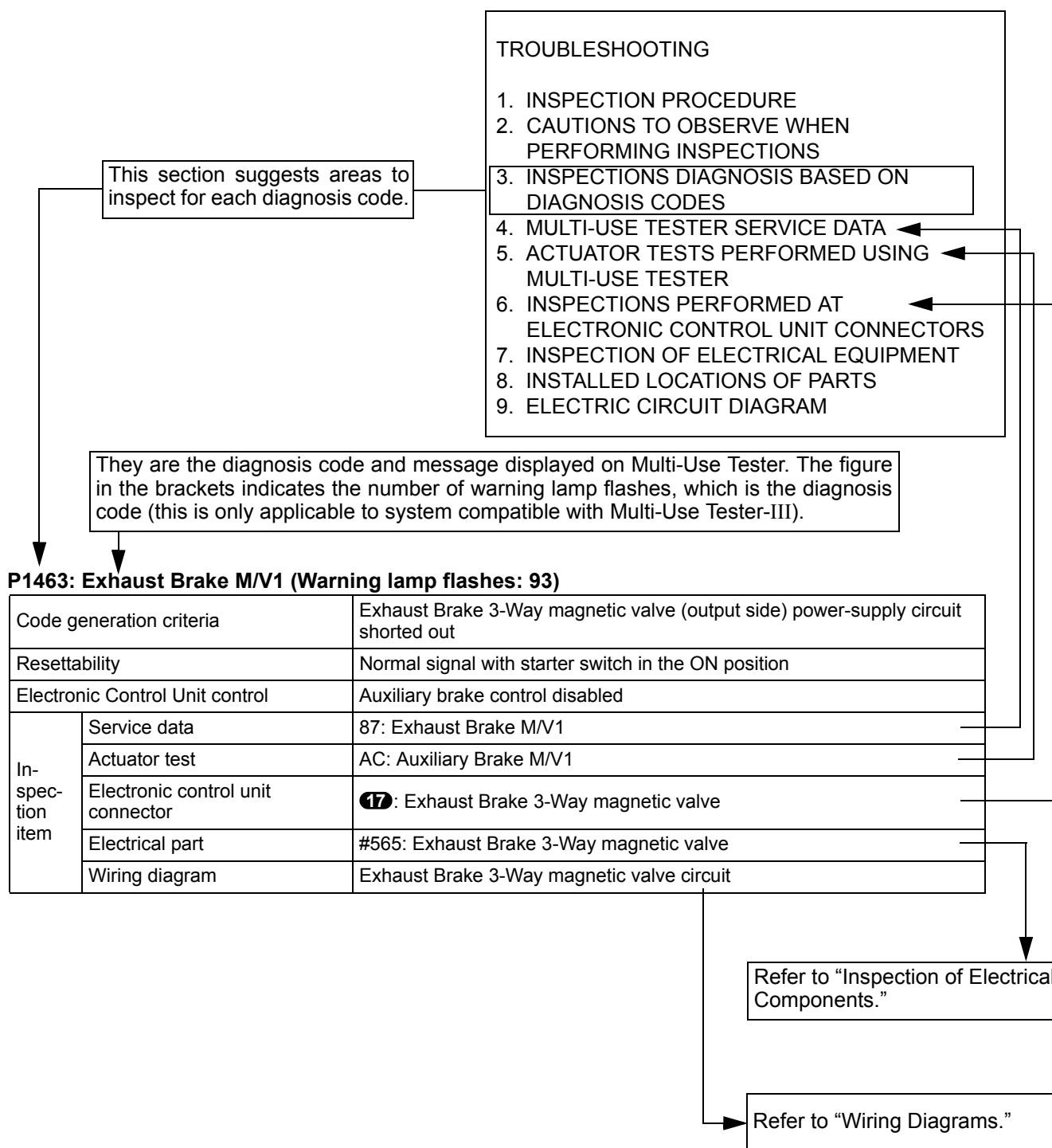
■ Installation: Oil seal

Apply grease to the lip of the oil seal, then fit the oil seal onto the wheel hub in the illustrated direction.

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HOW TO READ THIS MANUAL

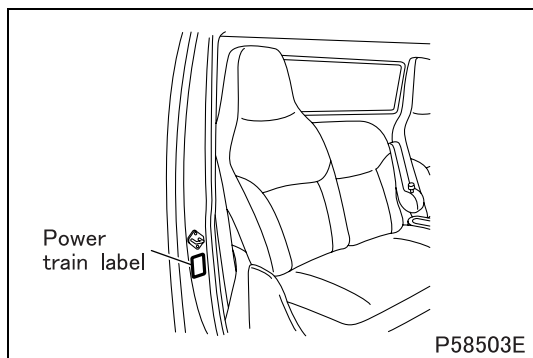
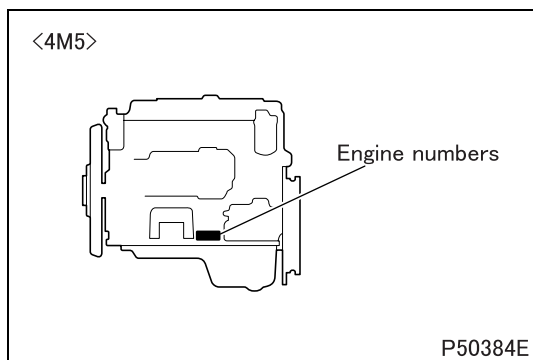
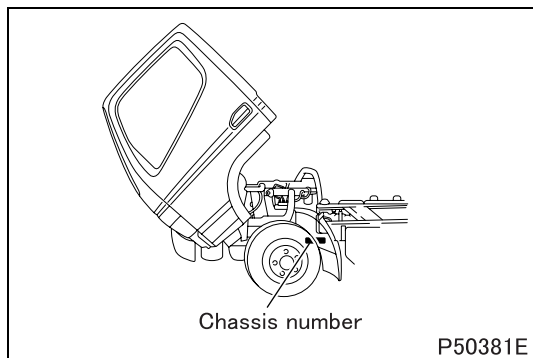
How to Use Diagnosis Codes <Electronic Control System (Gr13E, Gr17, Gr23, Gr35E, Gr54)>



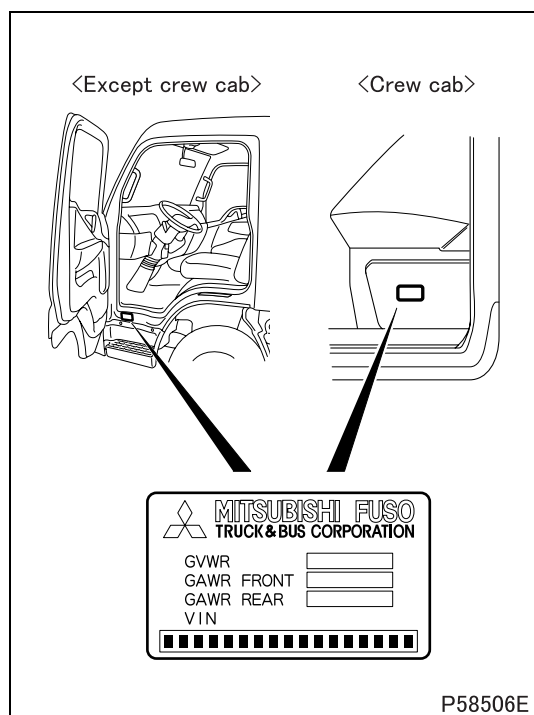
M E M O

CHASSIS NUMBER, ENGINE NUMBER, POWER TRAIN LABEL

- Chassis and engine numbers are allocated to each vehicle and engine respectively in the order of production. These numbers are required at vehicle inspection for registration.



- Power train label located in the position illustrated indicates the vehicle model, chassis number and information relevant to the vehicle's power - train components.



- The vehicle identification number is punch-marked on the plate, which is attached in the position as illustrated. The vehicle identification number consists of a 17-digit set of alphanumeric characters. Each digit represents the following specifications.

J L 6 A A D 1 S ■ 5 K ■ ■ ■ ■ ■ ■

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12)

- | | |
|---|---|
| (1) Country | J: Japan |
| (2) Make | L: Mitsubishi Fuso |
| (3) Type | 6: Incomplete vehicle |
| (4) Gross vehicle weight / Brake system | A: 10,001 to 14,000 lbs. / Hydraulic |
| | B: 14,001 to 16,000 lbs. / Hydraulic |
| | C: 16,001 to 19,500 lbs. / Hydraulic |
| (5) Line | A: FE83D |
| | B: FE84D |
| | C: FE85D |
| (6) Series (Wheel base) | D: 2.9 to 3.19 m (9.51 to 10.46 ft.) |
| | E: 3.2 to 3.49 m (10.49 to 11.44 ft.) |
| (7) Cab chassis type | 1: Chassis cab |
| (8) Engine | S: 4.899 L Diesel turbo charged and charge air cooled |
| (9) Check digit | |
| (10) Model year | 5: 2005 |
| (11) Plant | K: Kawasaki |
| (12) Plant sequential number | |

PRECAUTIONS FOR MAINTENANCE OPERATION

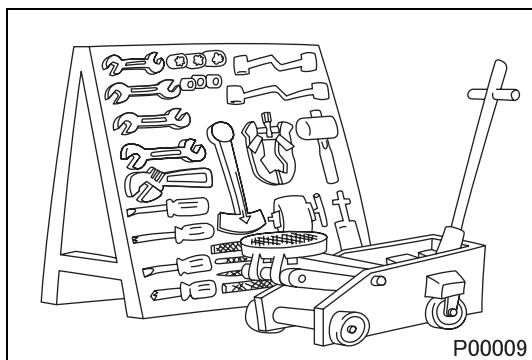
DANGER ⚠

This product contains or emits chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Before performing service operations, inquire into the customer's complaints and ascertain the condition by checking the total distance traveled, the conditions under which the vehicle is operated, and other relevant factors on the vehicle. And note the necessary information. This information will help you to service the vehicle efficiently.
- Check the location of the fault, and identify its cause. Based on your findings, determine whether parts must be removed or disassembled. Then, follow the service procedure given in this manual.



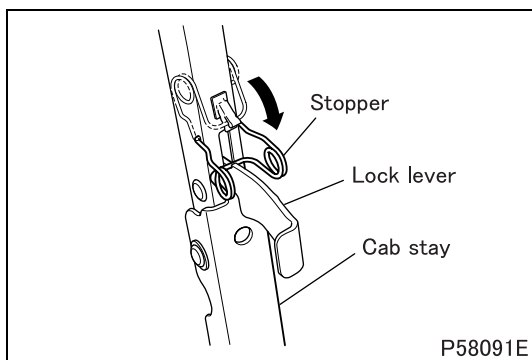
- Perform service operations on a level surface. Before starting, take the following preparatory steps:
 - To prevent soiling and damage, place covers over the seats, trim and floor in the cab and over the paintwork of the body.



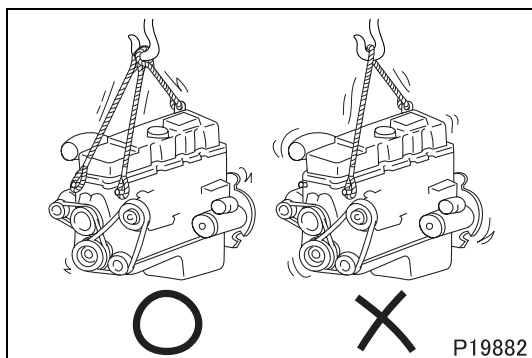
- Prepare all the general and special tools necessary for the job.

WARNING ⚠

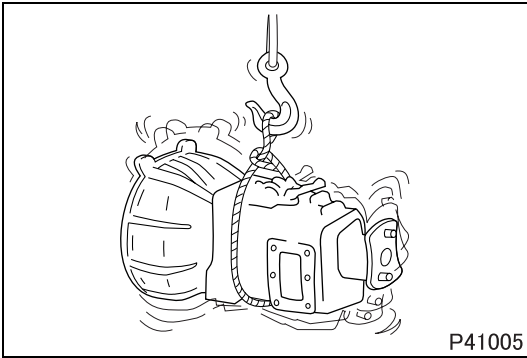
- **Special tools must be used wherever specified in this manual. Do not attempt to use other tools since they could cause injuries and/or vehicle damage.**



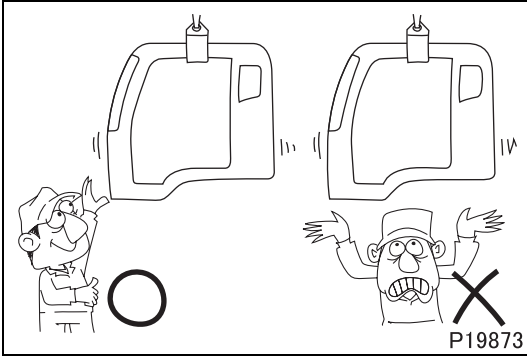
- After manually tilting the cab, be sure to engage the stopper with the lock lever to secure the cab stay in a rigid state.



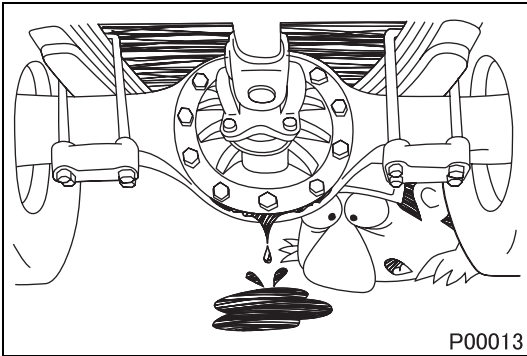
- Take extreme care when removing/installing heavy items such as engine, transmission and axle. When lifting heavy items using a cable etc., observe the following precautions.
 - Identify the mass of the item being lifted. Use the cable that is strong enough to support the mass.



- If lifting eyes are not provided on the item being lifted, tie a cable around the item taking into account the item's center of gravity.

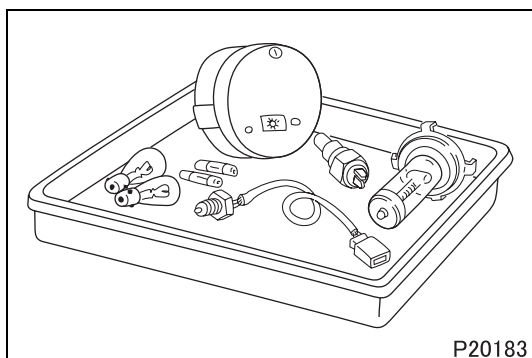


- Do not allow anyone to pass or stay under a lifted item which may possibly fall.

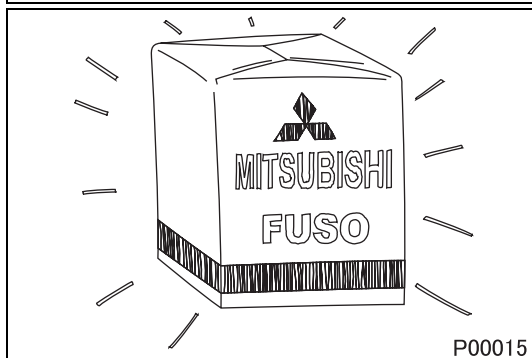


- Inspect for oil leakage etc. before washing the vehicle. If the order is reversed, any oil leakage or fault that may exist could go unnoticed during inspection.

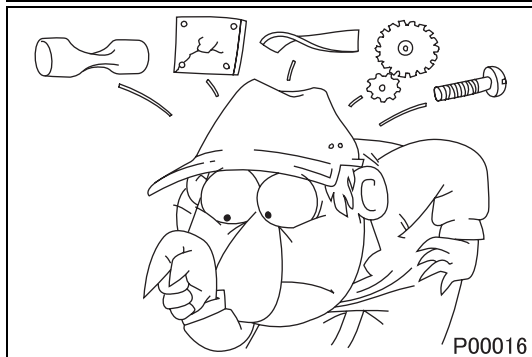
PRECAUTIONS FOR MAINTENANCE OPERATION



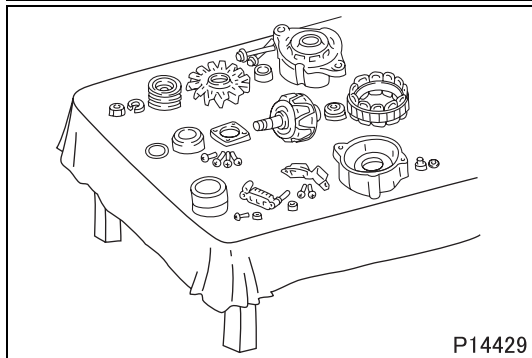
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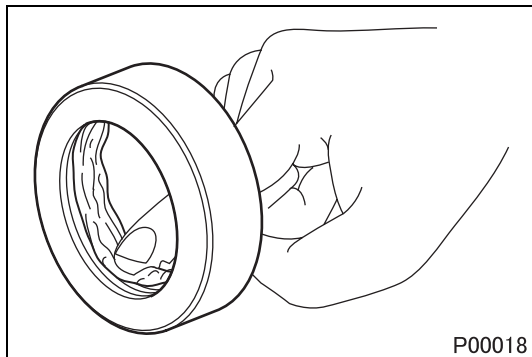
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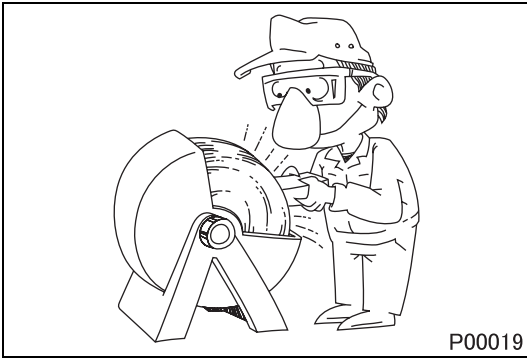


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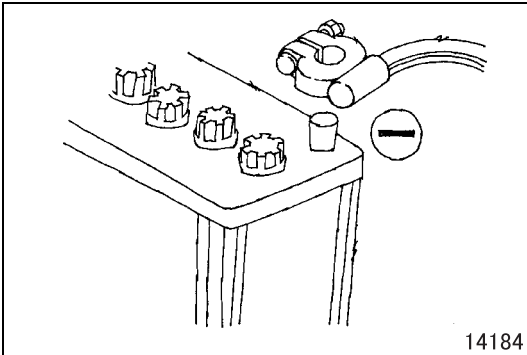
- Prepare replacement parts ready for installation.
- Oil seals, packings, O-rings and other rubber parts, gaskets, and split pins must be replaced with new ones after removal. Use only genuine MITSUBISHI replacement parts.
- When disassembling parts, visually check them for wear, cracks, damage, deformation, deterioration, rust, corrosion, defective rotation, fatigue, clogging and any other possible defect.
- To facilitate correct reassembly of parts, make alignment marks on them before disassembly and arrange disassembled parts neatly. Make punch marks and other alignment marks where they will not detract from parts' functionality and appearance.
- After removing parts from the vehicle, cover the area to keep it free of dust.

CAUTION

- **Be careful not to mix up identical parts, similar parts and parts that have left/right alignments.**
- **Keep new replacement parts and original (removed) parts separately.**
- Apply the specified oil or grease to U-seals, oil seals, dust seals and bearings before reassembly.
- Always use the specified oils and greases when performing inspection or replacement. Immediately wipe away any excess oil or grease with a rag.



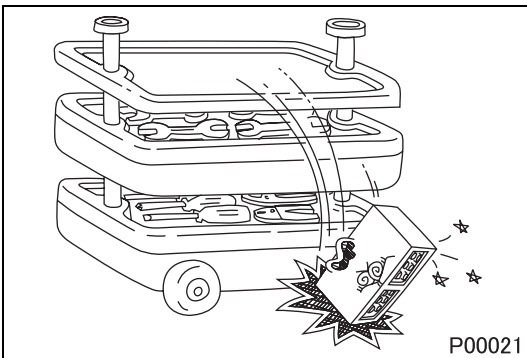
- Wear safety goggles when using a grinder or welder. Wear gloves when necessary, and watch out for sharp edges and other items that might wound your hands.



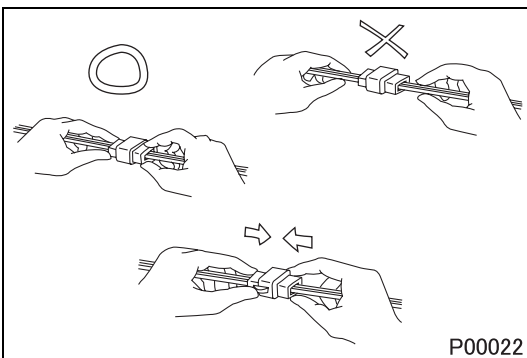
- Before working on the electrical system, disconnect the battery (–) terminal to prevent short circuits.

CAUTION

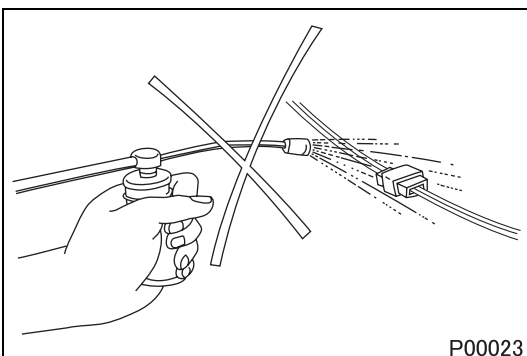
- **Make sure the starter switch and lighting switches are OFF before disconnecting or connecting battery terminals. Semiconductor components may otherwise be damaged.**



- Carefully handle sensors relays, and other items that are sensitive to shock and heat. Do not remove or paint the cover of any control unit.

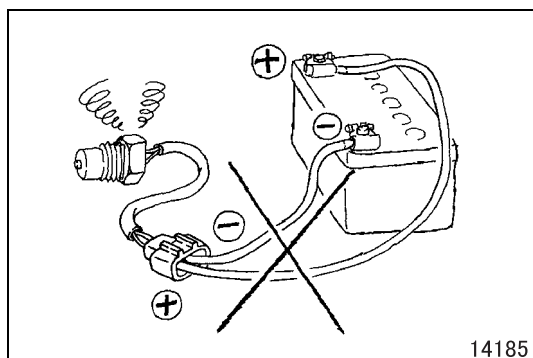


- When separating connectors, grasp the connectors themselves rather than the harnesses.
- To separate locking connectors, first push them in the direction of the arrows. To reconnect locking connectors, push them together until they click.



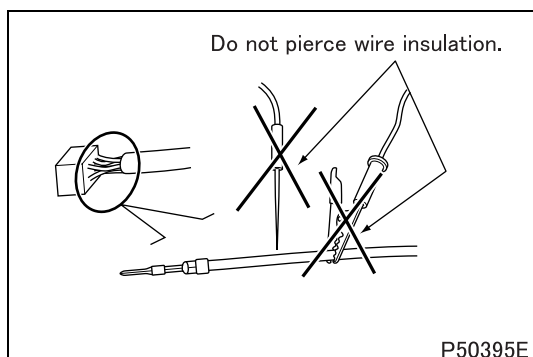
- Before washing the vehicle, cover electrical parts to keep them dry. (Use plastic sheets or the like.) Keep water away from harness connectors and sensors and immediately wipe off any water that gets on them.

PRECAUTIONS FOR MAINTENANCE OPERATION



- When applying a voltage to a part for inspection purposes, check that the (+) and (-) cables are connected properly then gradually increase the voltage from zero. Do not exceed the specified voltage.
Remember that control units and sensors do not necessarily operate on the battery voltage.

1. Handling Precautions for Electric Circuits



CAUTION

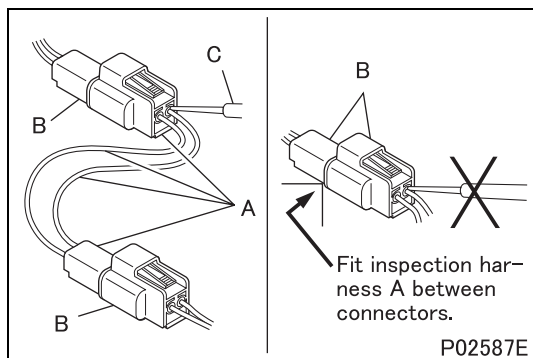
- Do not pierce wire insulation with test probes or alligator clips when performing electrical inspections. Doing so can, particularly with the chassis harness, hasten corrosion.

1.1 Inspection of harnesses

(1) Inspections with connectors fitted together

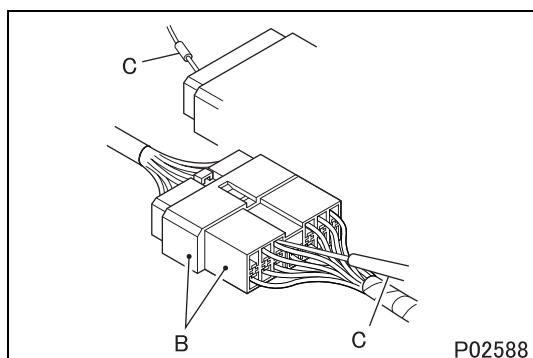
(1.1) Waterproof connectors

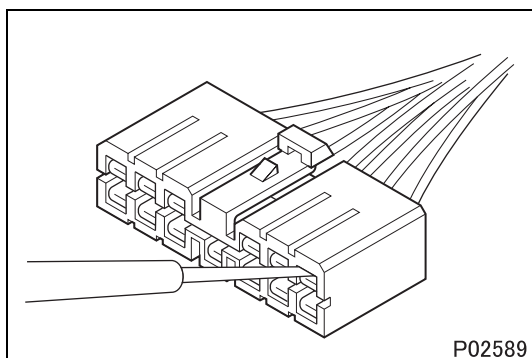
- Connect an inspection harness and connector **A** between the connectors **B** of the circuit to be inspected. Perform the inspection by applying a test probe **C** to the connectors of the inspection harness. Do not insert the test probe **C** into the wire-entry sides of the waterproof connectors since this would damage their waterproof seals and lead to rust.



(1.2) Non-waterproof connectors

- Perform the inspection by inserting a test probe **C** into the wire-entry sides of the connectors. An extra-narrow probe is required for control unit connectors, which are smaller than other types of connector. Do not force a regular-size probe into control unit connectors since this would cause damage.

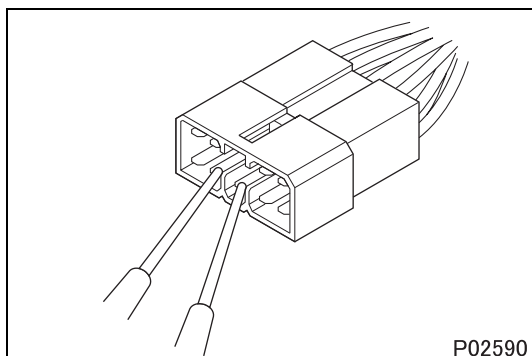




(2) Inspections with connectors separated

(2.1) Inspections on female terminals

- Perform the inspection by carefully inserting a test probe into the terminals. Do not force the test probe into the terminals since this could deform them and cause poor connections.

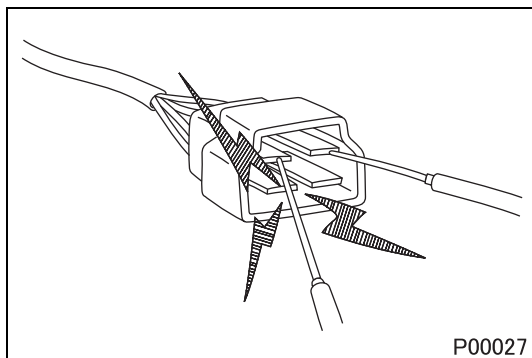


(2.2) Inspections on male terminals

- Perform the inspection by applying test probes directly to the pins.

CAUTION ⚠

- Be careful not to short-circuit pins together with the test probes. With control unit connectors, short-circuiting of pins can cause damage to the control unit's internal circuitry.

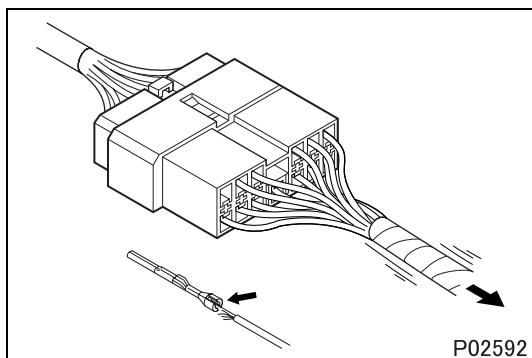
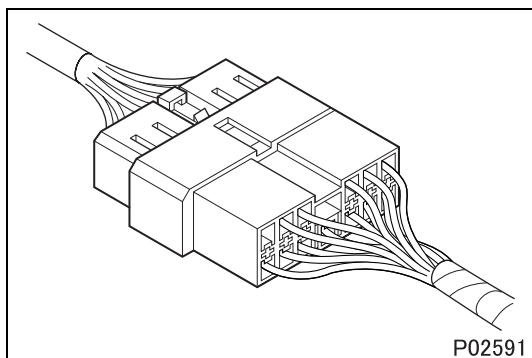


- When using a multimeter to check continuity, do not allow the test probes to touch the wrong terminals.

1.2 Inspection of connectors

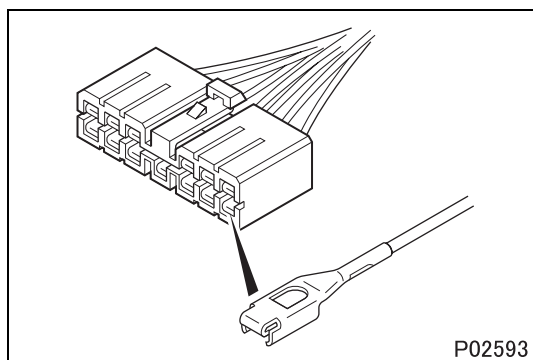
(1) Visual inspection

- Check that the connectors are fitted together securely.

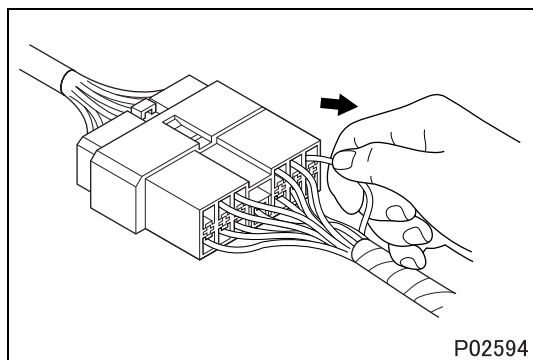


- Check whether wires have been separated from their terminals due to pulling of the harness.

PRECAUTIONS FOR MAINTENANCE OPERATION



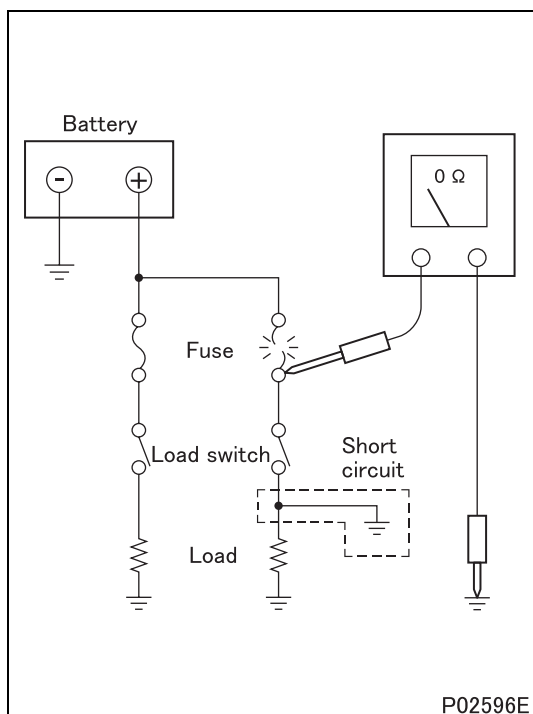
- Check that male and female terminals fit together tightly.



- Check for defective connections caused by loose terminals, by rust on terminals, or by contamination of terminals by foreign substances.

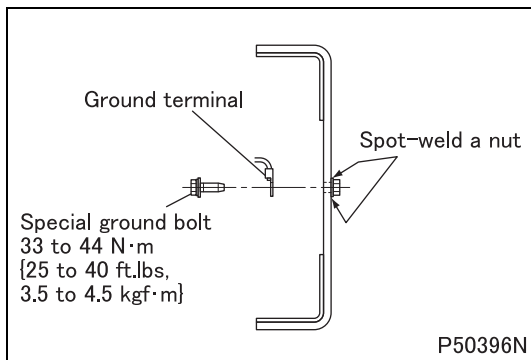
(2) Checking for loose terminals

- If connector terminal retainers become damaged, male and female terminals may not mate with each other when the connector bodies are fitted together. To check for such terminals, gently pull each wire and see whether any terminals slip out of their connector housings.



1.3 Inspections when a fuse blows

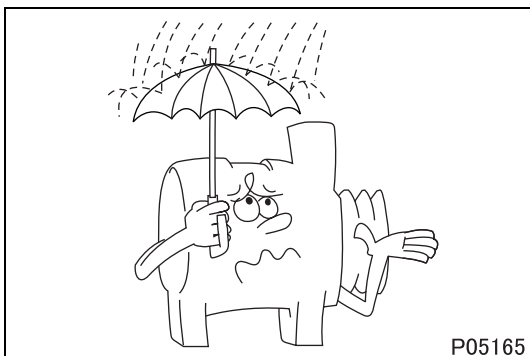
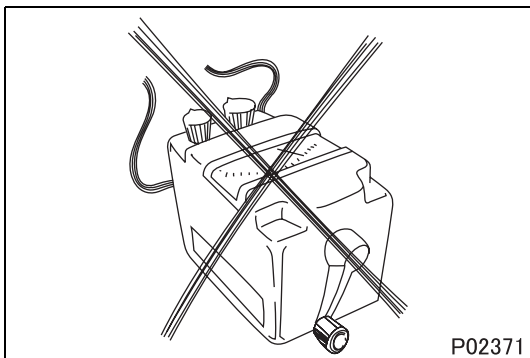
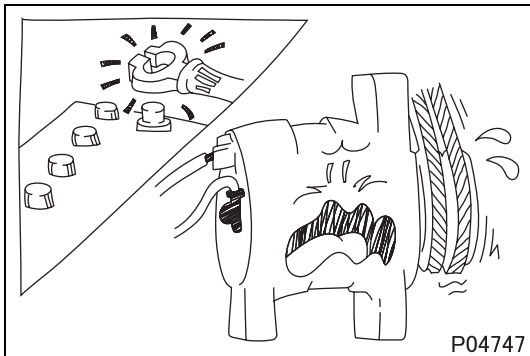
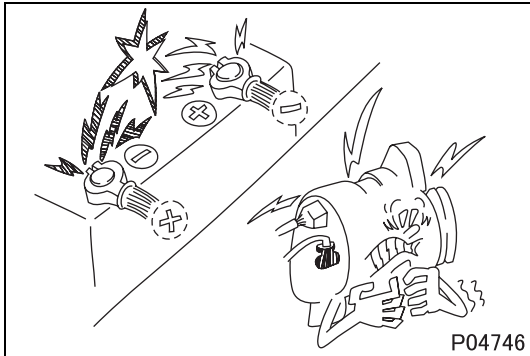
- Remove the fuse, then measure the resistance between ground and the fuse's load side.
Next, close the switch of each circuit connected to the fuse. If the resistance measurement between any switch and ground is zero, there is a short circuit between the switch and the load. If the resistance measurement is not zero, the circuit is not currently short-circuited; the fuse probably blew due to a momentary short circuit.
- The main causes of short circuits are as follows:
 - Harnesses trapped between chassis parts
 - Harness insulation damage due to friction or heat
 - Moisture in connectors or circuitry
 - Human error (accidental short-circuiting of components)



1.4 Inspection of chassis ground

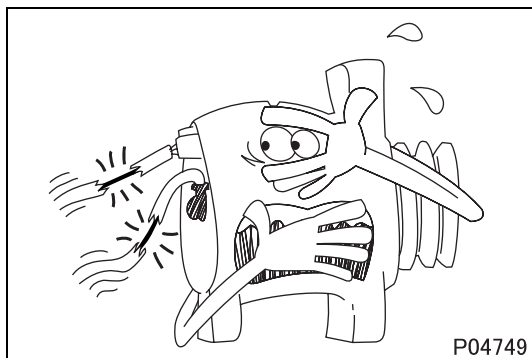
- A special ground bolt is used to tighten a ground terminal. When servicing the ground point, be sure to follow the procedures described below:
 - When reinstalling the ground bolt
Tighten the ground bolt to the specified torque.
 - When relocating the ground point
A special ground bolt must be used. Spot-weld a nut to a frame and tighten the ground bolt to the specified torque. Be sure to apply touch-up paint to the welded point.

2. Service Precautions for Alternators

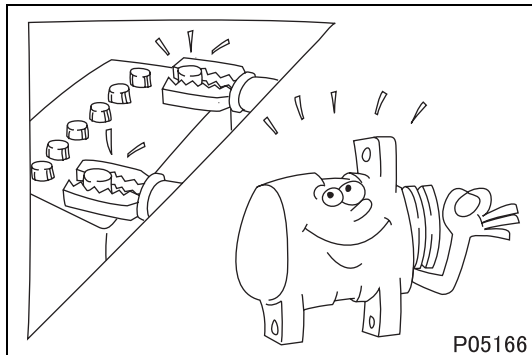


- When servicing alternators, observe the following precautions:
 - Never reverse the polarity of battery connections.
If the polarity of the battery connections was reversed, a large current would flow from the battery to the alternator, damaging the diodes and regulator.
 - Never disconnect the battery terminals with the engine running.
Disconnection of the battery terminals during engine operation would cause a surge voltage, leading to deterioration of the diodes and regulator.
 - Never perform inspections using a high-voltage multimeter.
The use of a high-voltage multimeter could damage the diodes and regulator.
 - Keep alternators dry.
Water on alternators can cause internal short circuits and damage.

PRECAUTIONS FOR MAINTENANCE OPERATION

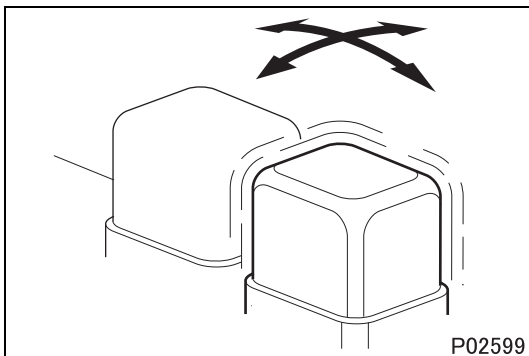
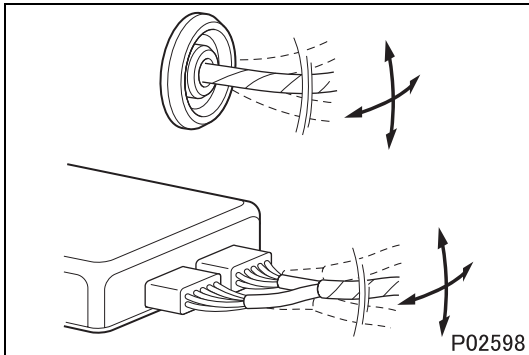
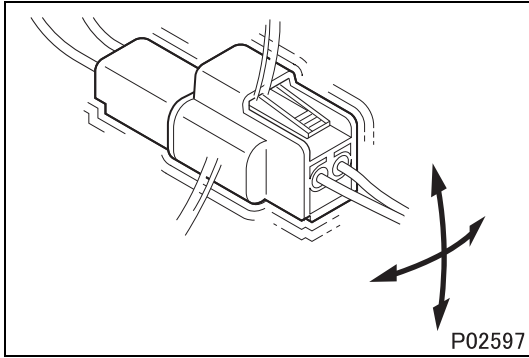


- Never operate an alternator with the **B** and **L** terminals short-circuited. Operation with the **B** and **L** terminals connected together would damage the diode trio.



- Disconnect the battery terminals before quick-charging the battery with a quick charger. Unless the battery terminals are disconnected, quick-charging can damage the diodes and regulator.

3. Intermittent Faults

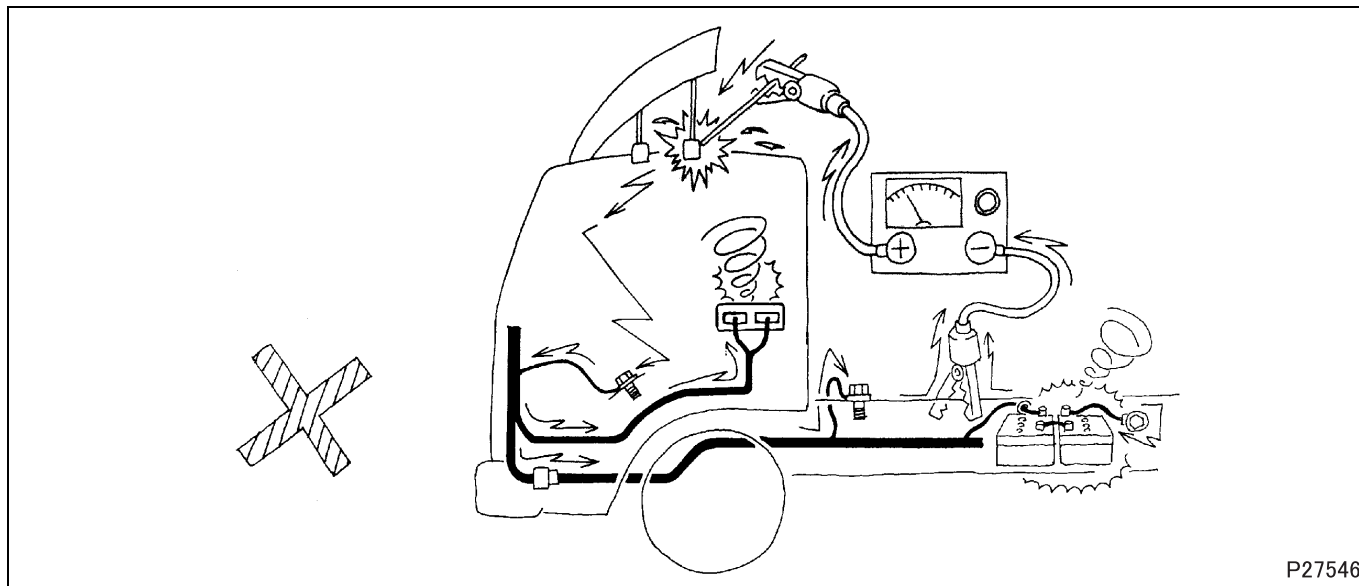


- An intermittent fault typically occurs only under certain operating conditions. Once these conditions have been identified, the cause of the intermittent fault can be ascertained easily. First, ask the customer about the vehicle operating conditions and weather conditions under which the fault occurs. Also ask about the frequency with which the fault occurs and about the fault symptoms. Then, reproduce the fault based on this information. In accordance with the conditions under which the fault occurs, determine whether the fault is caused by vibration, heat or other factors. If vibration is a possible factor, see if the fault can be reproduced by performing the following checks on individual connectors and other parts:
 - Gently move connectors up and down and to left and right.
 - Gently move wiring harnesses up and down and to left and right.
 - Gently wiggle sensors and other devices by hand.
 - Gently wiggle wiring harnesses on suspension systems and other moving parts.
- Connectors and other parts to be checked are those included or given as likely fault locations in inspection procedures corresponding to diagnosis codes and/or fault symptoms.

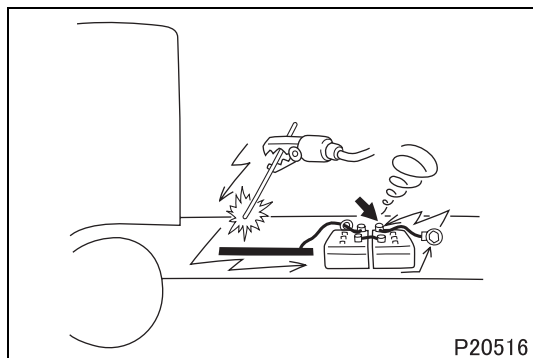
PRECAUTIONS FOR MAINTENANCE OPERATION

4. Precautions for Arc Welding

- When arc welding is performed, current from the welder flows to ground via the vehicle's metal parts. Unless appropriate steps are taken, this current can damage control units, other electrical devices and wiring harnesses. And, any electrical device near the point on vehicle, to which the negative cable of the welder is connected might be largely damaged.



- Current flows backward as shown below.



4.1 From battery (–) terminal

To prevent damage to the battery and to electrical devices that are connected directly to the battery, it is essential to disconnect the battery's (–) terminal.

4.2 Procedure

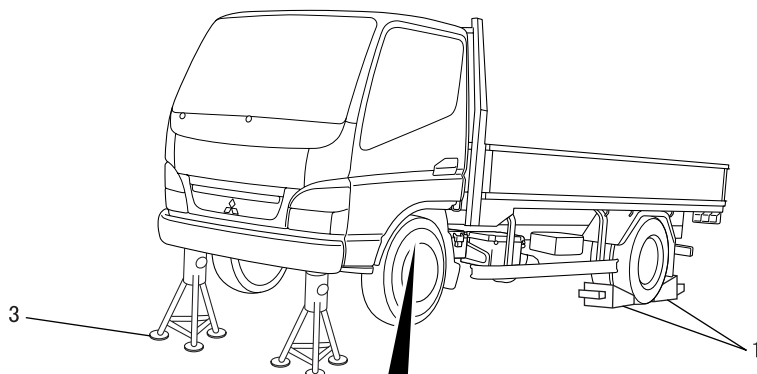
- Turn the starter switch to the LOCK position.
↓
- Disconnect the battery's (–) terminal.
↓
- Cover all parts of the vehicle that may be damaged by welding sparks.
↓
- Connect the welder's (–) cable to the vehicle as close as possible to the area being welded. Do not connect the welder's (–) cable to the cab if the frame is being welded, and vice versa.
↓
- Set the welding current in accordance with the part being welded.

M E M O

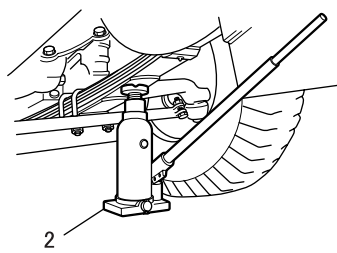
JACKING UP THE VEHICLE

<Front of vehicle>

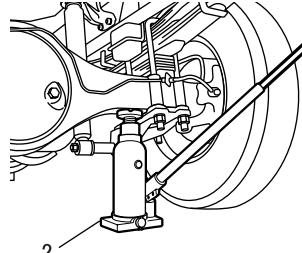
<Column type jack>



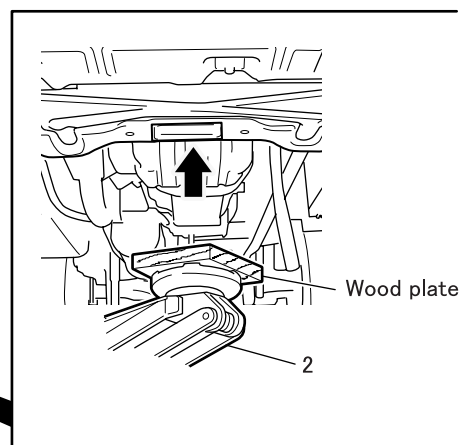
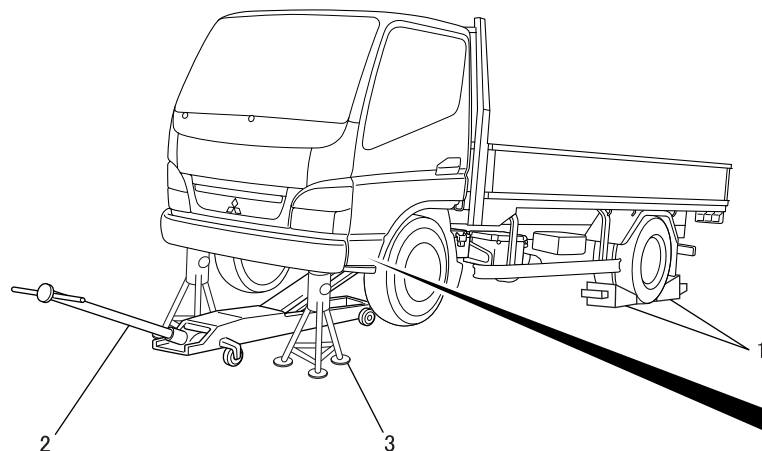
<FE>



<FG>



<Garage jack>



P59035E

Jacking up procedure

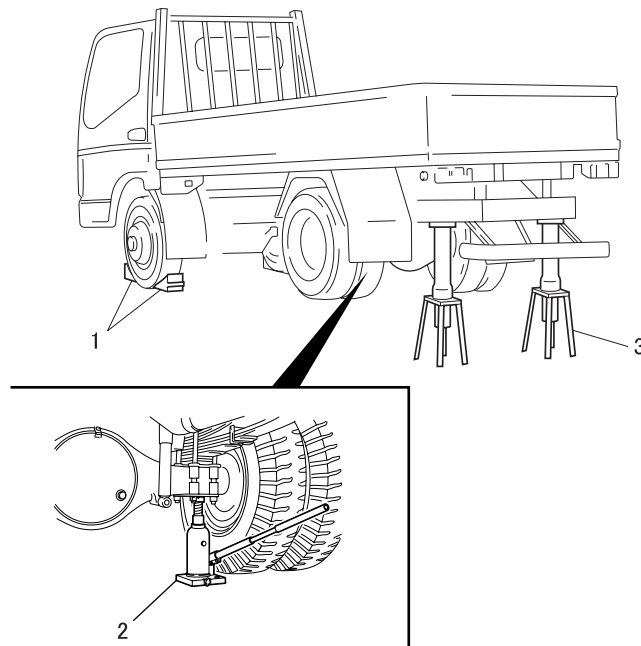
- 1 Place chocks against the rear wheels.
- 2 Set a bottle jack or garage jack and jack up the front of the vehicle.
- 3 Support the front of the vehicle frame on jack stands.

WARNING

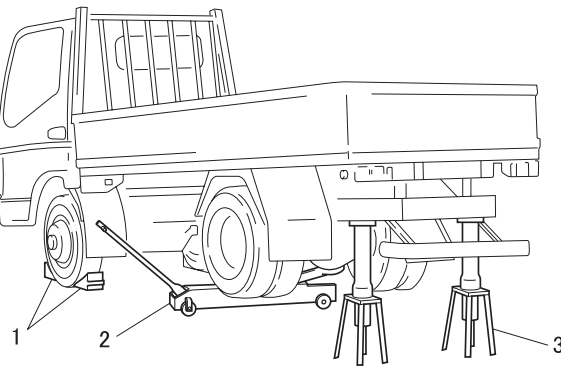
- Chock the wheels firmly to prevent the vehicle from rolling away.
- Do not attempt to remove the chocks until the operation is completed.
- It is extremely dangerous to support the vehicle with only bottle jack or garage jack. Be sure to additionally support the front of the vehicle frame on rigid racks.
- Never attempt to remove any of the bottle jack, garage jack, or jack stands until the operation is completed.

<Rear of Vehicle>

<Column type jack>



<Garage jack>



P58509E

Jacking up procedure

- 1 Place chocks against the rear wheels.
- 2 Set a bottle jack or garage jack and jack up the rear of the vehicle.
- 3 Support the vehicle frame on jack stands on both sides.

WARNING ⚠

- Chock the wheels firmly to prevent the vehicle from rolling away.
- Do not attempt to remove the chocks until the operation is completed.
- It is extremely dangerous to support the vehicle with only bottle jack or garage jack. Be sure to additionally support the vehicle frame on jack stands on both sides.
- Never attempt to remove any of the bottle jack, garage jack, or jack stands until the operation is completed.

DIAGNOSIS CODES

1. Connecting Multi-Use Tester

- The type of Multi-Use Tester to be used varies depending on which system is being inspected. Select and connect the correct type of Multi-Use Tester to the system being inspected by referring to the following tables.

System compatible with Multi-Use Tester-III

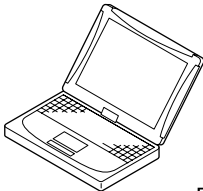
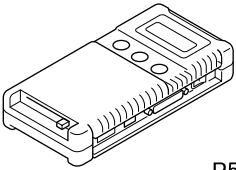
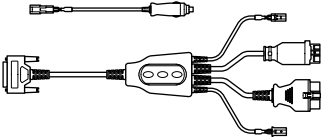
System	Reference Gr	Multi-Use Tester to be used
Common rail	13E	Multi-Use Tester-III only
Exhaust gas recirculation	17	
Automatic transmission	23	
Pre-heater	54	

System compatible with Multi-Use Tester-II

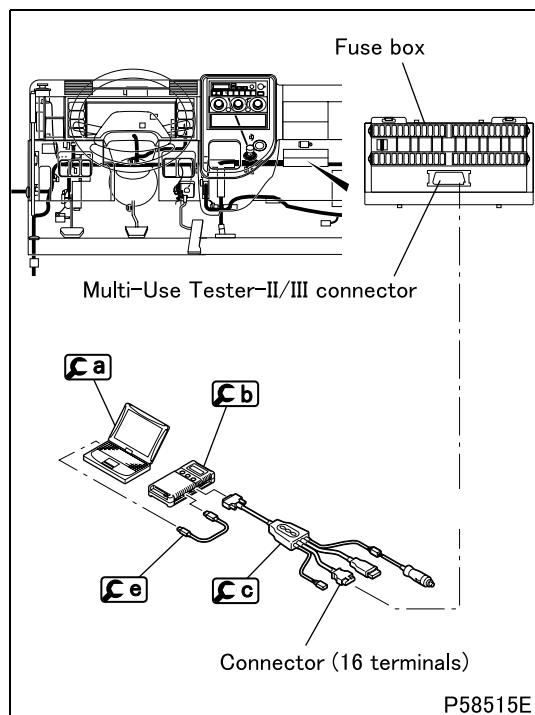
System	Reference Gr	Relevant electronic control unit
Anti-lock Brake System	35E	Multi-Use Tester-II or Multi-Use Tester-III

1.1 Connecting Multi-Use Tester-III

Special tools

Mark	Tool name and shape	Part No.	Application
 a	PC  P57295	FMS-E04-1 (Multi-Use Tester-III version)	Data transmission to/from V.C.I.
 b	V.C.I.  P57296	MH062927	Data transmission between electronic control unit and PC
 c	Multi-Use Tester-III Test Harness B (used for communication)  P57298	MH062929	Power supply to V.C.I. and communication with electronic control unit
 d	Multi-Use Tester -III Test Harness D (used for extension)  P57299	MH062951	Multi-Use Tester-III test harness B extension

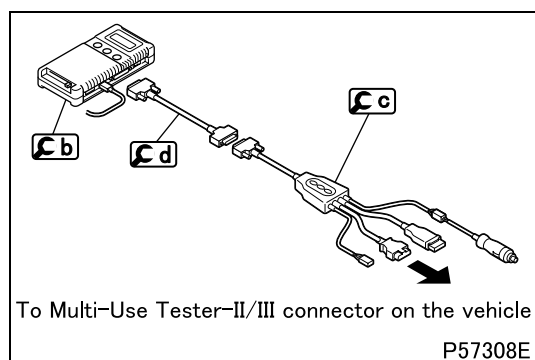
Mark	Tool name and shape	Part No.	Application
	USB cable  P57300	MB991827	Communication between V.C.I. and PC



- Move the starter switch to the LOCK position.
- Connect , ,  and  as illustrated.
- Connect the Multi-Use Tester-II/III connector with the connector (16 terminals) on the vehicle.

NOTE

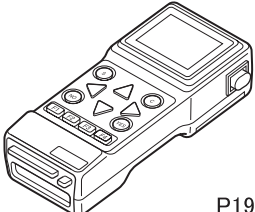
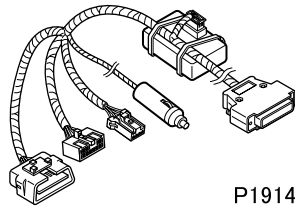
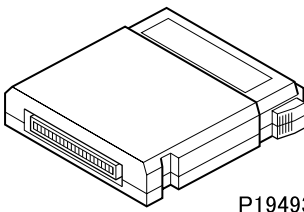
For Multi-Use Tester operations, refer to the Multi-Use Tester instruction book.

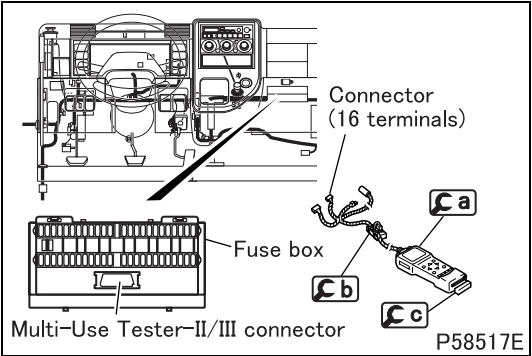


- Use  to extend the cable if  is not long enough such as when using Multi-Use Tester outside the vehicle.

DIAGNOSIS CODES

1.2 Connecting Multi-Use Tester-II Special tools

Mark	Tool name and shape	Part No.	Application
	Multi-Use Tester  P19492	MB991946	System check
	Multi-Use Tester Har- ness (used for communica- tion)  P19141	MK327601	Power supply to Multi-Use Tester unit and communication with vehicle elec- trical equipment
	ROM Pack (MRT-E11)  P19493	MH062942	Electronic control unit inspection/con- trol data



- Move the starter switch to the LOCK position.
- Connect  with . Insert .
- Connect the connector (16 terminals) with the Multi-Use Tester II/III connector (16 terminals) in the fuse box.

NOTE

For Multi-Use Tester operations, refer to the Multi-Use Tester instruction book.

M E M O

DIAGNOSIS CODES

2. Accessing / Erasing Diagnosis Codes <Common Rail, Exhaust Gas Recirculation, Pre-heater>

2.1 Diagnosis codes

- There are two types of diagnosis codes: present codes and past codes.

(1) Present diagnosis codes

- When an error occurs after the starter switch has been turned on (when electronic control unit being energized), the relevant diagnosis code is generated and stored in electronic control unit. This is a present diagnosis code.

(2) Past diagnosis codes

- A present diagnosis code becomes a past diagnosis code and is stored in electronic control unit when it is reset, or when the starter switch is turned OFF and then ON.

2.2 Accessing and erasing diagnosis codes

- Diagnosis codes can be accessed or erased either by using Multi-Use Tester-III, or by using vehicle functions without using Multi-Use Tester-III.
- Removing/installing the dedicated fuses will turn the diagnosis and memory clear switches ON/OFF.

NOTE

- Be sure to restore the fuse to the original location after accessing and/or erasing diagnosis codes.

(1) Accessing/erasing diagnosis codes using Multi-Use Tester

(1.1) Present diagnosis codes

- Turn the starter switch ON.
- With the memory clear switch in the fuse box closed and using Multi-Use Tester, access present diagnosis codes and, if they exist, identify the faults.

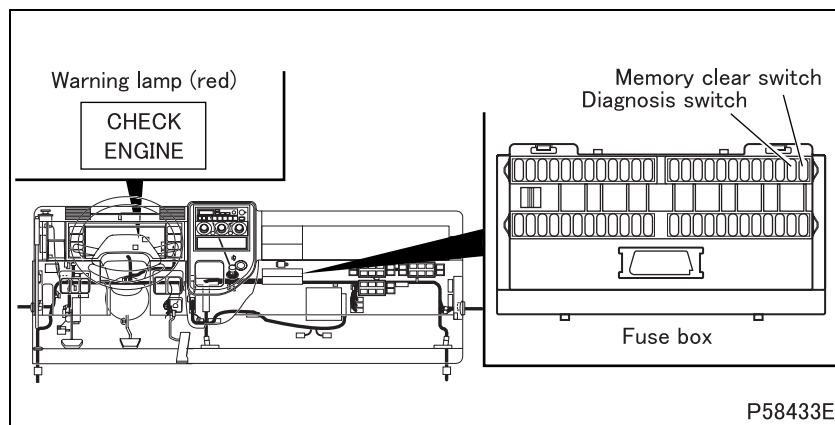
(1.2) Past diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, access past diagnosis codes and, if they exist, identify the faults.

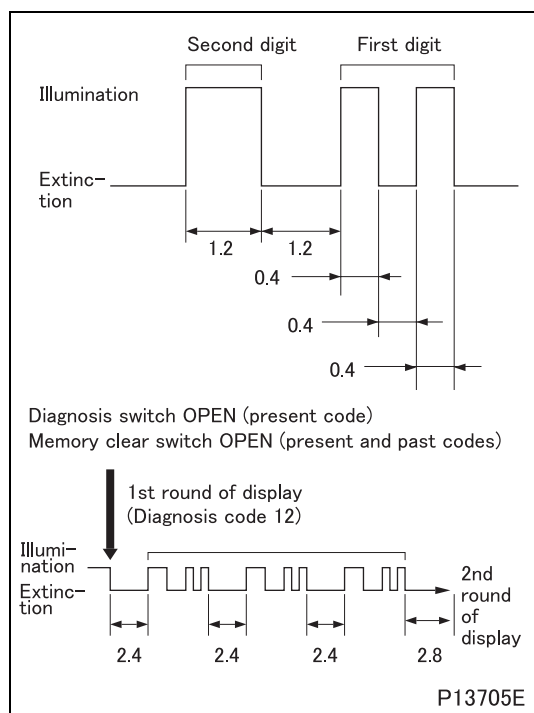
(1.3) Erasing diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, erase diagnosis codes that may have been stored in electronic control unit.

(2) Accessing/erasing diagnosis codes without using Multi-Use Tester

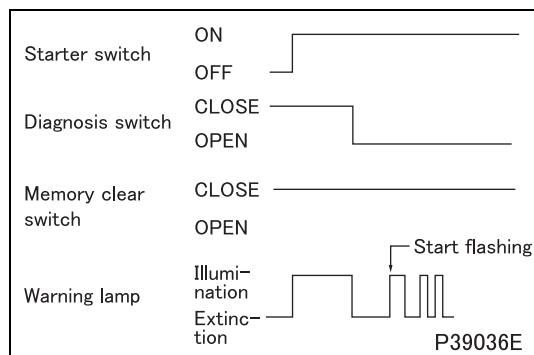


- Using the diagnosis and memory clear switches, display diagnosis codes that may have been stored in electronic control unit.



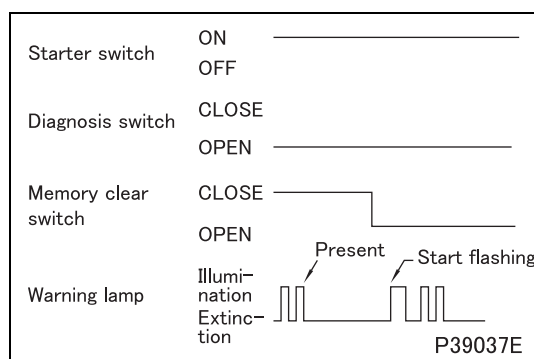
(2.1) Reading diagnosis codes

- To read a diagnosis code, observe how many times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.2 sec.
 - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.
- When the diagnosis switch is connected, electronic control unit will immediately stop (terminate) displaying diagnosis codes.



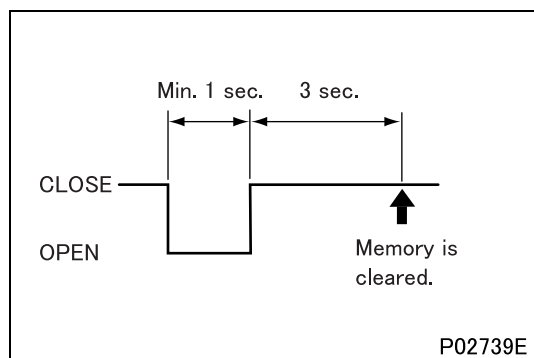
(2.2) Present diagnosis codes

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Diagnosis codes will be displayed (flashing of the warning lamp).



(2.3) Present and past diagnosis codes

- After present diagnosis codes are displayed, (with the diagnosis switch still removed) remove the memory clear switch.
- This will cause the warning lamp to start flashing again to indicate present and past diagnosis codes. Observe the codes that will be displayed, and identify the faults.



(2.4) Erasing diagnosis codes

- All diagnosis codes stored in electronic control unit can be erased by removing the memory clear switch and then installing it again.

NOTE

- **Be careful not to erase diagnosis codes by mistake. They can easily be erased simply by operating the memory clear switch only.**
- **If you do not wish to erase diagnosis codes after they have been displayed, turn the starter switch OFF with the memory clear switch still removed, and then connect the memory clear switch.**

DIAGNOSIS CODES

3. Accessing / Erasing Diagnosis Codes <Automatic Transmission>

3.1 Diagnosis codes

- There are two types of diagnosis codes: present codes and past codes.

(1) Present diagnosis codes

- When an error occurs after the starter switch has been turned on (when electronic control unit being energized), the relevant diagnosis code is generated and stored in electronic control unit. This is a present diagnosis code.

(2) Past diagnosis codes

- A present diagnosis code becomes a past diagnosis code and is stored in electronic control unit when it is reset, or when the starter switch is turned OFF and then ON.

3.2 Accessing and erasing diagnosis codes

- Diagnosis codes can be accessed or erased either by using Multi-Use Tester-III, or by using vehicle functions without using Multi-Use Tester-III.
- Removing/installing the dedicated fuses will turn the diagnosis and memory clear switches ON/OFF.

NOTE

- **Be sure to restore the fuse to the original location after accessing and/or erasing diagnosis codes.**

(1) Accessing/erasing diagnosis codes using Multi-Use Tester

(1.1) Present diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, access present diagnosis codes and, if they exist, identify the faults.

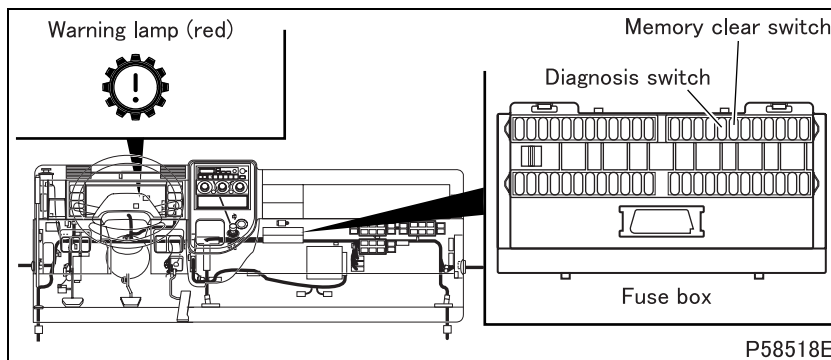
(1.2) Past diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, access past diagnosis codes and, if they exist, identify the faults.

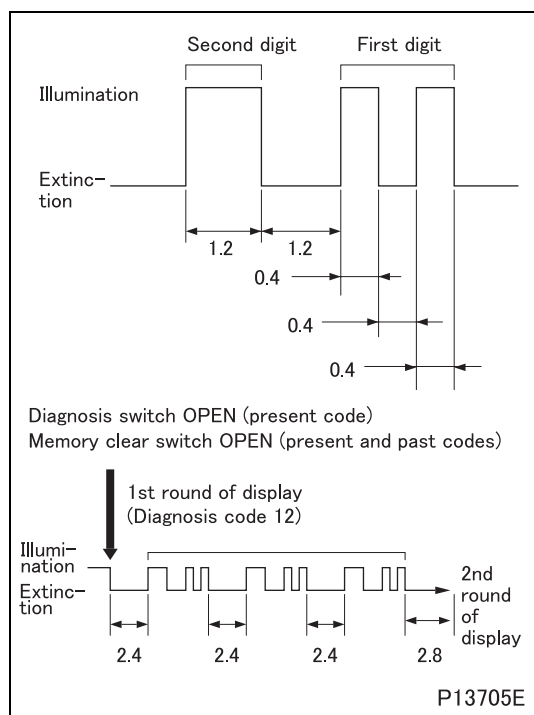
(1.3) Erasing diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, erase diagnosis codes that may have been stored in electronic control unit.

(2) Accessing/erasing diagnosis codes without using Multi-Use Tester

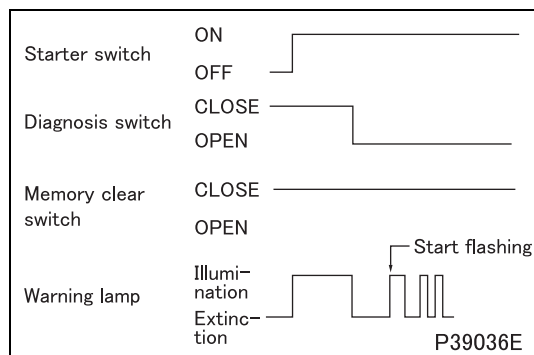


- Using the diagnosis and memory clear switches, display diagnosis codes that may have been stored in electronic control unit.



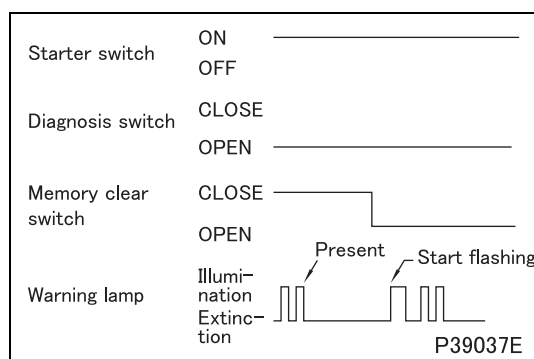
(2.1) Reading diagnosis codes

- To read a diagnosis code, observe how many times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.2 sec.
 - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.
- When the diagnosis switch is connected, electronic control unit will immediately stop (terminate) displaying diagnosis codes.



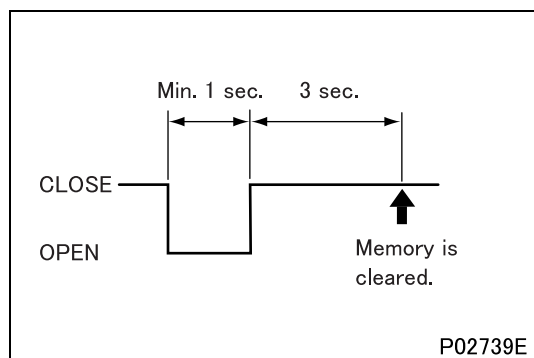
(2.2) Present diagnosis codes

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Diagnosis codes will be displayed (flashing of the warning lamp).



(2.3) Present and past diagnosis codes

- After present diagnosis codes are displayed, (with the diagnosis switch still removed) remove the memory clear switch.
- This will cause the warning lamp to start flashing again to indicate present and past diagnosis codes. Observe the codes that will be displayed, and identify the faults.



(2.4) Erasing diagnosis codes

- All diagnosis codes stored in electronic control unit can be erased by removing the memory clear switch and then installing it again.

NOTE

- Be careful not to erase diagnosis codes by mistake. They can easily be erased simply by operating the memory clear switch only.
- If you do not wish to erase diagnosis codes after they have been displayed, turn the starter switch OFF with the memory clear switch still removed, and then connect the memory clear switch.

DIAGNOSIS CODES

4. Accessing / Erasing Diagnosis Codes <Anti-lock Brake System>

4.1 Diagnosis codes

- There are two types of diagnosis codes: present codes and past codes.

(1) Present diagnosis codes

- When an error occurs after the starter switch has been turned on (when electronic control unit being energized), the relevant diagnosis code is generated and stored in electronic control unit. This is a present diagnosis code.

(2) Past diagnosis codes

- A present diagnosis code becomes a past diagnosis code and is stored in electronic control unit when it is reset, or when the starter switch is turned OFF and then ON.

4.2 Accessing and erasing diagnosis codes

- Diagnosis codes can be accessed or erased either by using Multi-Use Tester-II or Multi-Use Tester-III, or by using vehicle functions without using Multi-Use Tester.
- Removing/installing the dedicated fuses will turn the diagnosis and memory clear switches ON/OFF.

NOTE

- **Be sure to restore the fuse to the original location after accessing and/or erasing diagnosis codes.**

(1) Accessing/erasing diagnosis codes using Multi-Use Tester

(1.1) Present diagnosis codes

- Turn the starter switch ON.
- With the memory clear switch connected in the fuse box, use Multi-Use Tester to access present diagnosis codes and, if they exist, identify the faults.

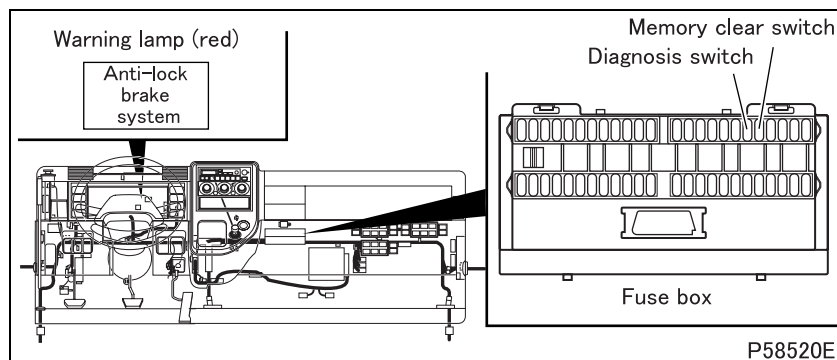
(1.2) Past diagnosis codes

- Turn the starter switch ON.
- With the memory clear switch removed, use Multi-Use Tester to access past diagnosis codes and, if they exist, identify the faults.

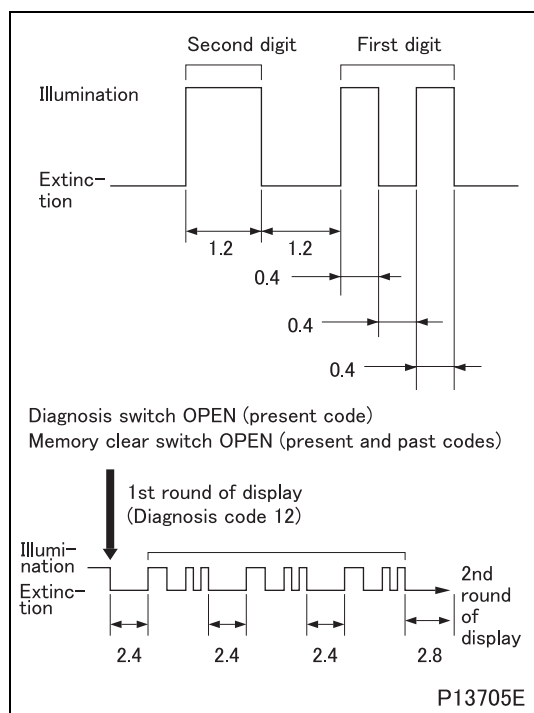
(1.3) Erasing diagnosis codes

- Turn the starter switch ON.
- Use Multi-Use Tester to erase diagnosis codes that may have been stored in electronic control unit.

(2) Accessing/erasing diagnosis codes without using Multi-Use Tester

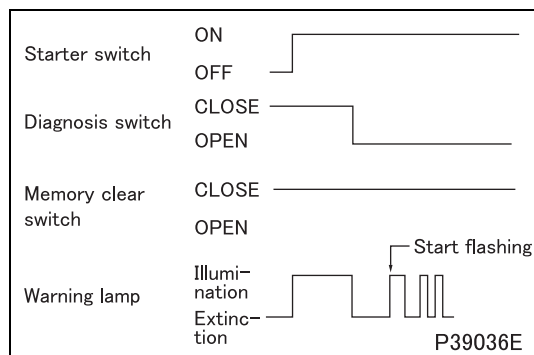


- Using the diagnosis and memory clear switches, display diagnosis codes that may have been stored in electronic control unit.



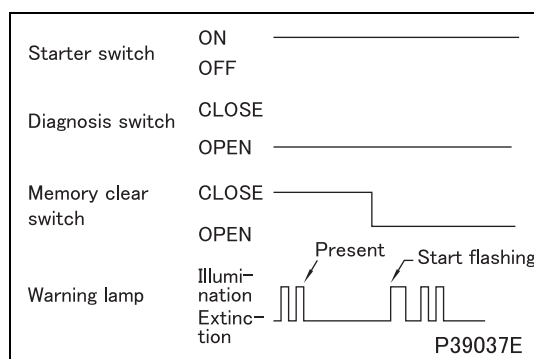
(2.1) Reading diagnosis codes

- To read a diagnosis code, observe how many times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.2 sec.
 - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.
- When the diagnosis switch is connected, electronic control unit will immediately stop (terminate) displaying diagnosis codes.



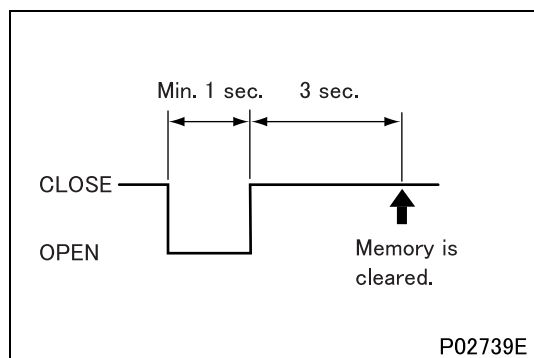
(2.2) Present diagnosis codes

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Diagnosis codes will be displayed (flashing of the warning lamp).



(2.3) Present and past diagnosis codes

- After present diagnosis codes are displayed, (with the diagnosis switch still removed) remove the memory clear switch.
- This will cause the warning lamp to start flashing again to indicate present and past diagnosis codes. Observe the codes that will be displayed, and identify the faults.



(2.4) Erasing diagnosis codes

- All diagnosis codes stored in electronic control unit can be erased by removing the memory clear switch and then installing it again.

NOTE

- **Be careful not to erase diagnosis codes by mistake. They can easily be erased simply by operating the memory clear switch only.**
- **If you do not wish to erase diagnosis codes after they have been displayed, turn the starter switch OFF with the memory clear switch still removed, and then connect the memory clear switch.**

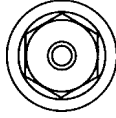
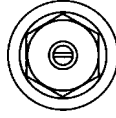
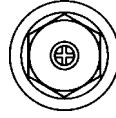
TABLE OF STANDARD TIGHTENING TORQUES

- Use specified bolts and nuts, tightening them to the torques specified in this section unless otherwise stated.
- Threaded portions and bearing surfaces should be dry.
- Where the property class differs between the nut and bolt (or stud bolt), use the tightening torque specified in the table for the bolt.

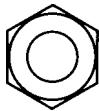
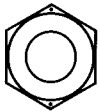
Hexagon Headed Bolt, Stud Bolt (Unit: N·m {ft.lbs, kgf·m})

Strength	4T		7T		8T	
Identification symbol						
Nominal diameter		(Stud)		(Stud)		(Stud)
M5	2 to 3 {1.5 to 2.2, 0.2 to 0.3}	–	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	5 to 7 {3.7 to 5.2, 0.5 to 0.7}	–
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	7 to 10 {5.2 to 7.4, 0.7 to 1.0}	–	8 to 12 {5.9 to 8.9, 0.8 to 1.2}	–
M8	9 to 13 {6.6 to 9.6, 0.9 to 1.3}	–	16 to 24 {12 to 18, 1.7 to 2.5}	–	19 to 28 {14 to 21, 2.0 to 2.9}	–
M10	18 to 27 {13 to 20, 1.8 to 2.7}	17 to 25 {13 to 18, 1.8 to 2.6}	34 to 50 {25 to 37, 3.5 to 5.1}	32 to 48 {24 to 35, 3.3 to 4.9}	45 to 60 {33 to 44, 4.5 to 6.0}	37 to 55 {27 to 41, 3.8 to 5.7}
M12	34 to 50 {25 to 37, 3.4 to 5.1}	31 to 45 {23 to 33, 3.1 to 4.6}	70 to 90 {52 to 66, 7.0 to 9.5}	65 to 85 {48 to 63, 6.5 to 8.5}	80 to 105 {59 to 77, 8.5 to 11}	75 to 95 {55 to 70, 7.5 to 10}
M14	60 to 80 {44 to 59, 6.0 to 8.0}	55 to 75 {41 to 55, 5.5 to 7.5}	110 to 150 {81 to 110, 11 to 15}	100 to 140 {74 to 105, 11 to 14}	130 to 170 {96 to 125, 13 to 17}	120 to 160 {89 to 120, 12 to 16}
M16	90 to 120 {66 to 89, 9 to 12}	90 to 110 {66 to 81, 9 to 11}	170 to 220 {125 to 160, 17 to 23}	160 to 210 {120 to 155, 16 to 21}	200 to 260 {145 to 190, 20 to 27}	190 to 240 {140 to 175, 19 to 25}
M18	130 to 170 {96 to 125, 14 to 18}	120 to 150 {89 to 110, 12 to 16}	250 to 330 {185 to 245, 25 to 33}	220 to 290 {160 to 215, 23 to 30}	290 to 380 {215 to 280, 30 to 39}	250 to 340 {185 to 250, 26 to 35}
M20	180 to 240 {130 to 175, 19 to 25}	170 to 220 {125 to 160, 17 to 22}	340 to 460 {250 to 340, 35 to 47}	310 to 410 {230 to 300, 32 to 42}	400 to 530 {295 to 390, 41 to 55}	360 to 480 {265 to 355, 37 to 49}
M22	250 to 330 {185 to 245, 25 to 33}	230 to 300 {170 to 220, 23 to 30}	460 to 620 {340 to 455, 47 to 63}	420 to 560 {310 to 415, 43 to 57}	540 to 720 {400 to 530, 55 to 73}	490 to 650 {360 to 480, 50 to 67}
M24	320 to 430 {235 to 315, 33 to 44}	290 to 380 {215 to 280, 29 to 39}	600 to 810 {440 to 595, 62 to 83}	540 to 720 {400 to 530, 55 to 73}	700 to 940 {515 to 695, 72 to 96}	620 to 830 {455 to 610, 63 to 85}

Hexagon Headed Flange Bolt (Unit: N·m {ft.lbs, kgf·m})

Strength	4T		7T		8T	
Identification symbol						
Nominal diameter						
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	8 to 12 {5.9 to 8.9, 0.8 to 1.2}	–	10 to 14 {7.4 to 10, 1.0 to 1.4}	–
M8	10 to 15 {7.4 to 11, 1.0 to 1.5}	–	19 to 28 {14 to 21, 2.0 to 2.9}	–	22 to 33 {16 to 24, 2.3 to 3.3}	–
M10	21 to 31 {15 to 23, 2.1 to 3.1}	20 to 29 {15 to 21, 2.0 to 3.0}	45 to 55 {33 to 41, 4.5 to 5.5}	37 to 54 {27 to 40, 3.8 to 5.6}	50 to 65 {37 to 48, 5.0 to 6.5}	50 to 60 {37 to 44, 5.0 to 6.5}
M12	38 to 56 {28 to 41, 3.8 to 5.5}	35 to 51 {26 to 38, 3.5 to 5.2}	80 to 105 {59 to 77, 8.0 to 10.5}	70 to 95 {52 to 95, 7.5 to 9.5}	90 to 120 {66 to 89, 9 to 12}	85 to 110 {63 to 81, 8.5 to 11}

Hexagon Nuts (Unit: N·m {ft.lbs, kgf·m})

Strength	4T		6T	
Identification symbol			   	
Nominal diameter	Standard screw thread	Coarse screw thread	Standard screw thread	Coarse screw thread
M5	2 to 3 {1.5 to 2.2, 0.2 to 0.3}	—	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—	7 to 10 {5.2 to 7.4, 0.7 to 1.0}	—
M8	9 to 13 {6.6 to 9.6, 0.9 to 1.3}	—	16 to 24 {12 to 18, 1.7 to 2.5}	—
M10	18 to 27 {13 to 20, 1.8 to 2.7}	17 to 25 {13 to 18, 1.8 to 2.6}	34 to 50 {25 to 37, 3.5 to 5.1}	32 to 48 {24 to 35, 3.3 to 4.9}
M12	34 to 50 {25 to 37, 3.4 to 5.1}	31 to 45 {23 to 33, 3.1 to 4.6}	70 to 90 {52 to 66, 7.0 to 9.5}	65 to 85 {48 to 63, 6.5 to 8.5}
M14	60 to 80 {44 to 59, 6.0 to 8.0}	55 to 75 {41 to 55, 5.5 to 7.5}	110 to 150 {81 to 110, 11 to 15}	100 to 140 {74 to 105, 11 to 14}
M16	90 to 120 {66 to 89, 9 to 12}	90 to 110 {66 to 81, 9 to 11}	170 to 220 {125 to 160, 17 to 23}	160 to 210 {120 to 155, 16 to 21}
M18	130 to 170 {96 to 125, 14 to 18}	120 to 150 {89 to 110, 12 to 16}	250 to 330 {185 to 245, 25 to 33}	220 to 290 {160 to 215, 23 to 30}
M20	180 to 240 {130 to 175, 19 to 25}	170 to 220 {125 to 160, 17 to 22}	340 to 460 {250 to 340, 35 to 47}	310 to 410 {230 to 300, 32 to 42}
M22	250 to 330 {185 to 245, 25 to 33}	230 to 300 {170 to 220, 23 to 30}	460 to 620 {340 to 455, 47 to 63}	420 to 560 {310 to 415, 43 to 57}
M24	320 to 430 {235 to 315, 33 to 44}	290 to 380 {215 to 280, 29 to 39}	600 to 810 {440 to 595, 62 to 83}	540 to 720 {400 to 530, 55 to 73}

Hexagon Flange Nuts (Unit: N·m {ft.lbs, kgf·m})

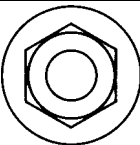
Strength	4T	
Identification symbol		
Nominal diameter	Standard screw thread	Coarse screw thread
M6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
M8	10 to 15 {7.4 to 11, 1.0 to 1.5}	—
M10	21 to 31 {15 to 23, 2.1 to 3.1}	20 to 29 {15 to 21, 2.0 to 3.0}
M12	38 to 56 {28 to 41, 3.8 to 5.6}	35 to 51 {26 to 38, 3.5 to 5.2}

TABLE OF STANDARD TIGHTENING TORQUES

Tightening Torque for General-Purpose Flare Nut (Unit: N·m {ft.lbs, kgf·m})

Pipe diameter	φ4.76 mm {0.19 in.}	φ6.35 mm {0.25 in.}	φ8 mm {0.31 in.}	φ10 mm {0.39 in.}	φ12 mm {0.47 in.}	φ15 mm {0.59 in.}
Tightening torque	17 {13, 1.7}	25 {18, 2.6}	39 {29, 4.0}	59 {44, 6.0}	88 {65, 9.0}	98 {72, 10}

Tightening Torque for General-Purpose Air Piping Nylon Tube (DIN Type) (Unit: N·m {ft.lbs, kgf·m})

Nominal diameter × wall thickness	6 × 1 mm {0.24 × 0.039 in.}	10 × 1.25 mm {0.39 × 0.049 in.}	12 × 1.5 mm {0.47 × 0.059 in.}	15 × 1.5 mm {0.59 × 0.059 in.}
Tightening torque	20 ⁺⁶ ₀ {15 ^{+4.4} ₀ 2.0 ^{+0.6} ₀ }	34 ⁺¹⁰ ₀ {25 ^{+7.4} ₀ 3.5 ^{+1.0} ₀ }	49 ⁺¹⁰ ₀ {36 ^{+7.4} ₀ 5.0 ^{+1.0} ₀ }	54 ⁺⁵ ₀ {40 ^{+3.7} ₀ 5.5 ^{+0.5} ₀ }

Tightening Torque for General-Purpose Air Piping Nylon Tube (SAE Type) (Unit: N·m {ft.lbs, kgf·m})

Nominal diameter	1/4 in.	3/8 in.	1/2 in.	5/8 in.
Tightening torque	13 ⁺⁴ ₀ {9.6 ^{+3.0} ₀ 1.3 ^{+0.4} ₀ }	29 ⁺⁵ ₀ {21 ^{+3.7} ₀ 3.0 ^{+0.5} ₀ }	49 ⁺⁵ ₀ {36 ^{+3.7} ₀ 5.0 ^{+0.5} ₀ }	64 ⁺⁵ ₀ {47 ^{+3.7} ₀ 6.5 ^{+0.5} ₀ }



Group 01

Maintenance Schedule

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

HOW TO READ THE MAINTENANCE SCHEDULE TABLES	01-2
MAINTENANCE SCHEDULE TABLES	01-4
MAINTENANCE OPERATIONS	01-8
LUBRICATION TABLES	01-14
LUBRICATION	01-16

HOW TO READ THE MAINTENANCE SCHEDULE TABLES

Example Table:

Ⓔ : Exhaust emission items.

Ⓖ : Noise control items.

Item (1)	Time of inspection and maintenance (2)									Working procedures (3)	Reference Gr (4)
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval								
			Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150 ,000 miles		
ENGINE											
Fuel, oil, or coolant leaks from engine	×									Check engine for fuel, oil and coolant leaks.	Gr11, 12 13A, 14
ⒺⒼ Engine conditions	×									Check the engine for smooth starting and quiet running.	Gr11, 13 15, 17, 54
Manifold bolts and nuts torque							×			Check inlet exhaust manifold bolts and nuts for looseness.	Gr15
Ⓔ Check and adjust valve clearance		×					×			Check valve clearance with thickness gauge.	Gr11
Ⓔ Oil filter replacement			Every 10,000 km/6,000 miles or 12 months							Replace oil filters	Gr12

(1) This column contains the maintenance and inspection items.

(2) The periods between inspection and service are based on the assumption that the vehicle will be driven approximately 60,000 kilometers (36,000 miles) per year.

Inspections which must be made are indicated by an “×” or by the appropriate period between servicing.

(3) This column provides a simplified explanation of the operational procedures involved for each inspection or maintenance item.

(4) The Gr. No. refers to the “group number” in this Service Manual. For visual checks and simple inspections, see the sections labelled “Working Procedures”.

M E M O

MAINTENANCE SCHEDULE TABLES

Ⓔ: Exhaust emission items.

Ⓖ: Noise control items.

Item	Time of inspection and maintenance									Working procedures	Reference Gr
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval								
			Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
ENGINE											
Fuel, oil, or coolant leaks from engine	×									Check engine for fuel, oil and coolant leaks.	Gr11, 12, 13A, 14
㊦㊮ Engine conditions	×									Check the engine for smooth starting and quiet running.	Gr11, 13, 15, 17, 54
Manifold bolts and nuts torque							×			Check inlet exhaust manifold bolts and nuts for looseness.	Gr15
㊦ Check and adjust valve clearance		×					×			Check valve clearance with thickness gauge.	Gr11
㊦ Oil filter replacement			Every 10,000 km/6,000 miles or 12 months							Replace oil filters.	Gr12
㊦ Fuel filter replacement			Every 20,000 km/12,000 miles or 12 months							Replace fuel filter.	Gr13A
㊦ Fuel line			Every 20,000 km/12,000 miles or 12 months							Inspect the fuel tank, cap and lines for damage causing leakage.	Gr13A
㊦㊮ Belts tension and damage	×		Every 10,000 km/6,000 miles or 12 months							Inspect belts for crack, wear and tension.	Gr14
㊦ Cooling system				×						Check radiator and pressure cap for sealing performance and mounting condition. Inspect hoses for looseness, deterioration, damage causing leakage. Remove dust and foreign matter deposit from radiator and inter-cooler front.	Gr14
Coolant level and leaks from cooling system	×									Check coolant level and if level is low, check for coolant leaks.	Gr14
Coolant replacement			Every 24 months							Replace coolant.	Gr14
㊦ Turbocharger rotor play									×	Check turbocharger rotor play.	Gr15
Air cleaner element			Every 5,000 km/3,000 miles							Clean air cleaner element by blowing clean compressed air.	Gr15
㊦㊮ Air cleaner element replacement						×				Replace air cleaner element.	Gr15
㊦㊮ Exhaust system				×						Inspect the exhaust system for damage, corrosion and loose connection causing leakage.	Gr15
POWER TRAIN											
Clutch pedal and clutch disc wear	×		×							Check the pedal for free play. Check clutch disc wear.	Gr21

Item	Time of inspection and maintenance									Working procedures	Reference Gr
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval								
			Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
Propeller shaft flange torque and universal joint looseness			×							Check flange yoke bolts for loose- ness and universal joint for play.	Gr25
Propeller shaft center bearing								×		Check center bearing if trace of grease flowing out is evident. Check center bearing for wear, damage and play.	Gr25
FRONT AND REAR AXLE											
Wheel hub bearing					×					Check wheel hub bearing for play.	Gr26, 27
Wheel hub bearing hub seals re- placement					×					When wheel hub bearing grease is replaced, also replace the wheel hub bearing hub seals.	Gr26, 27
Wheel and tire	×		×							Check disc wheel for corrosion, deformation and cracks. Measure inflation pressure with tire gauge. Check tire tread and side wall for cracks and damage. Measure tire tread groove depth to make sure it is deep enough. Check tire tread for uneven wear, stepped wear and other abnormal wear. Rotate tires if there is a difference in the amount of wear on each tire.	See later section.
Retightening wheel nuts		×	×							Check wheel nuts for looseness. Check at the first 50 to 100 km/30 to 60 miles after changing a wheel.	See later section.
SUSPENSION SYSTEM											
Suspension springs	×									Check for broken springs and tilt of vehicle body toward either side.	Gr33, 34
Retightening U-bolts		×		×						Check U-bolt nuts for looseness. Check at the first 1,000 km/600 miles after removing and retight- ening U-bolt nuts.	Gr33, 34
BRAKING SYSTEM											
Service brake ped- al	×									Check brake pedal play and stroke.	Gr35A
Brake performance	×									Depress the brake pedal and check that the brakes work effec- tively and evenly on all wheels.	Gr35A
Disc brake pad and disc			×							Check disc brake pad and disc for damage and wear.	Gr35A

MAINTENANCE SCHEDULE TABLES

Item	Time of inspection and maintenance									Working procedures	Reference Gr
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval								
			Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
Brake lining			×							Check lining for wear through inspection hole.	Gr35A
Brake drum					×					Disassemble and check drum for wear, crack and damage.	
Parking brake lever stroke	×									Check parking brake lever stroke.	Gr36
Looseness, play and damage of brake system parts			×							Inspect brake lines and hoses looseness, play and damage. Inspect wheel cylinder and brake master cylinder for looseness, play and damage.	Gr35A
STEERING SYSTEM											
Steering wheel play	×									Turn steering wheel right and left to measure play at steering wheel rim. Measure while engine is running.	Gr37
Steering wheel operation	×									Check that the steering wheel does not vibrate or pull to one side and that it is not unduly heavy. Also make sure that the steering wheel returns to its neutral position smoothly.	Gr37
Steering system			×							Check steering system for looseness, steering wheel play and operating condition. Inspect for oil leaks, booster and oil pump function.	Gr37
CAB											
Defroster	×									Make sure that warm air blows properly onto the windshield.	Gr55
Rearview mirrors	×									Seated in the driver's seat, adjust the angles for clear views of the sides and rear. Make sure the mirrors are clean.	Gr51
License plate and reflector condition	×									Check the license plate and reflectors for loose installation, damage, and dirt.	—
Door locks	×									Push down the lock knob and verify that the door does not open even when the inner handle is operated.	Gr43
Seat belts	×									Confirm that the seat belt buckles function correctly when fastening and unfastening.	Gr52
ELECTRICAL SYSTEM											
Horn operation	×									Press the horn button to check that the horn is working properly.	Gr54

Item	Time of inspection and maintenance									Working procedures	Reference Gr
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval								
			Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles	Every 90,000 km/ 54,000 miles	Every 250,000 km/ 150,000 miles		
Windshield washer fluid level	×									Confirm that the windshield washer fluid level is above the bottom of the inspection window.	—
Windshield wiper and washer operation	×									Check the washer for proper fluid spray direction and the wipers for normal action.	Gr51, 54
Lighting system	×									Make sure that each lamp lights up or flashes properly. Check lamp lenses for dirt and damage.	Gr54
Gauge, warning/indicator lamp operation	×									Check that gauges, warning lamps and indicators are working properly.	Gr54

MAINTENANCE OPERATIONS

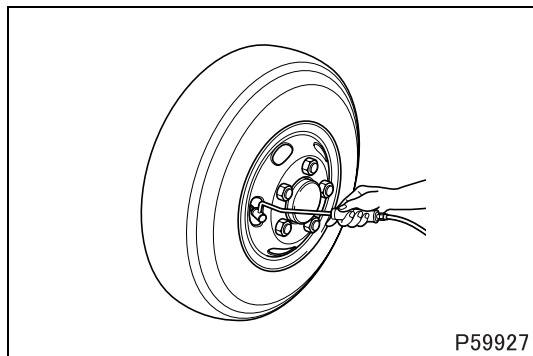
Tire

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Depth of tire tread grooves	–	1.6 {0.063}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

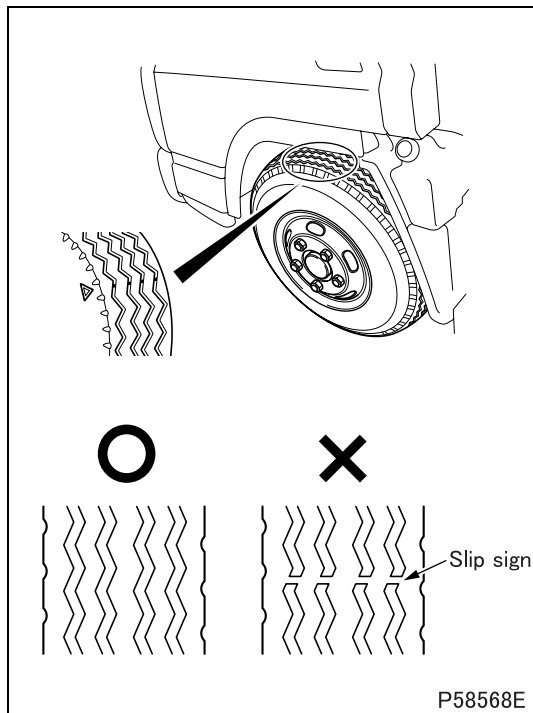
Mark	Parts to be tightened	Tightening torque	Remarks
–	Wheel nut	490 ± 49 {360 ± 36, 50 ± 5}	–



Air pressure

Tire air pressure should be checked before the vehicle is driven, while the tires are still cool.

Vehicle model \ Item	Tire size	Air pressure kPa {psi, kgf/cm ² }
FE83, FE84	LT215/85R16-10PR (Load range E)	550 {80, 5.5}
FE85	215/75R17.5 124/123L (Load range F)	690 {100, 7.0}
FG	LT235/85R16-10PR (Load range E)	550 {80, 5.5}



CAUTION ⚠

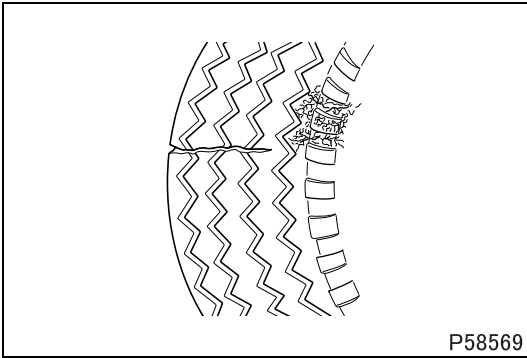
- Make certain that there is no difference in the air pressure between the inner and outer rear tires.
- Make certain you use valve caps on the air valves.
- It is not necessary to increase the air pressure for high-speed driving.

Checking tread depth

- Check all around the tire treads to make sure that the depth of the tread grooves is above the wear limit.
- If the tread grooves are not deep enough, slip sign appears at the position of the ▲ mark, where the tread groove has worn away.

WARNING ⚠

If the depth of the tread grooves is not adequate, the tires will slip on wet roads and present a hazard. Such tires are also extremely dangerous because they are more susceptible to hydroplaning when the vehicle is running at high speeds in the rain. Such tires must be replaced with new ones as soon as possible.

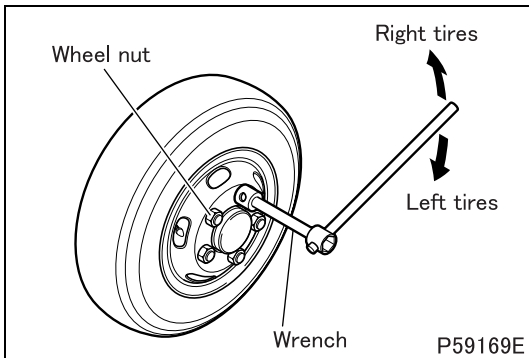


Checking for cracks, damage, and objects embedded in the treads

- Check the tire treads and walls for cracks and damage.
- Check tire treads for uneven wear or other abnormal wear.
- Check if metal objects or nails have penetrated the tires.
- Check for stones embedded between double tires.

WARNING ⚠

Badly damaged or worn tires are extremely dangerous, because they can be punctured more easily when the vehicle is running, they must be replaced with new ones as soon as possible.



Removing tires

- Loosen wheel nuts slightly. The wheel nuts for right tires have right-hand threads "R", and the wheel nuts for left tires have left-hand threads "L".

WARNING ⚠

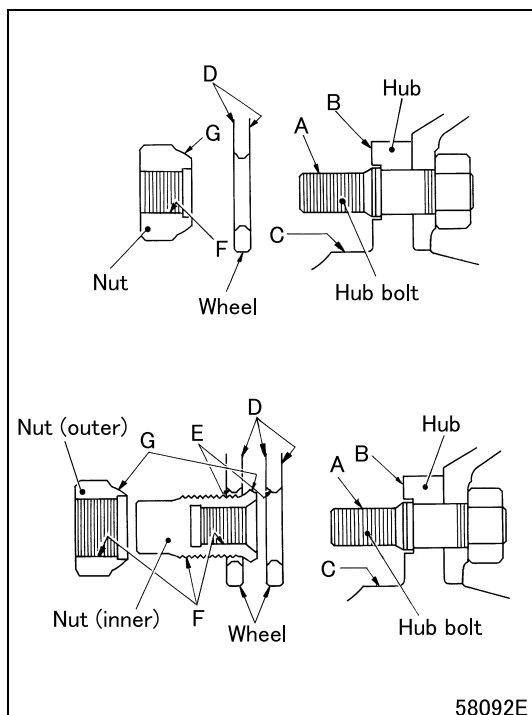
Make certain that wheel nut wrench is fully engaged, all the way to the back of nuts. If it is not, it could slip.

CAUTION ⚠

Only loosen wheel nuts slightly. Do not remove them.

- Jack up the vehicle carefully, until the tire is slightly off the ground.
Remove wheel nuts, then remove the tire.
- When working on the double tires at the rear of the vehicle, first remove the outside tire, then lower the vehicle and loosen the nuts on the inside tire. After doing this, jack the vehicle back up and remove the tire.

MAINTENANCE OPERATIONS



Mounting tires

To prevent wheel nuts and hub bolt from becoming loose and to prevent mounted parts (tire assemblies and hub) from being damaged, remove rust, dust, additional coatings of paint, and foreign particles from the following areas:

- A: Hub bolt thread area
- B: Wheel mounting surface of hub
- C: Wheel alignment area of hub
- D: Disc wheel mating surface
- E: Disc wheel nut mounting surface
- F: Wheel nut thread area
- G: Wheel nut spherical area

- Install the dual rear tires as follows:
 - After mounting inner tire and fully tightening inner wheel nuts, jack the vehicle up and mount on outer tire, then tighten outer wheel nuts.
 - Even if only outside tire is to be changed, do not mount it until inner wheel nuts have been fastened at the specified torque.
 - Slide the air valves on the inside and outside tires down when mounting the tires.

WARNING ⚠

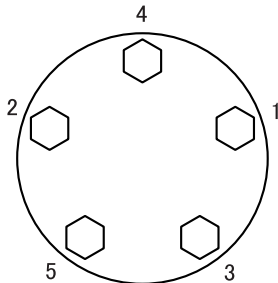
If the threads are scored, or the disc wheel is deformed or cracked, change bolts, nuts and disc. Driving the truck before correcting such problems can cause the tire in question to come loose, which could be the source of major accidents.

CAUTION ⚠

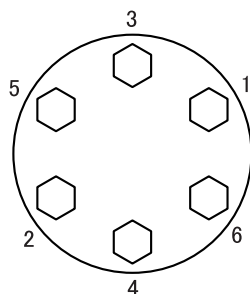
Check hub bolt threads carefully for damage before putting the tire on.

- Place the tapered end of wheel nuts towards the disc wheel and fasten temporarily. Center so that there is no eccentricity between bolts and the disc wheel bolt holes.
- Lower the vehicle.

<FE83>



<Except FE83>



P59922E

- Tighten the nuts in the order as illustrated, tightening each nut two or three times. To finish, tighten each nut at the specified torque.

WARNING ⚠

- Always use the specified torque when tightening the wheel nuts. If the wheel nuts are not tightened properly, the wheels could come loose while the vehicle is being driven, which could result in life threatening accidents or the truck being disabled.
- Do not coat the threads with grease when tightening the nuts. This could result in over-tightening force, which could be dangerous.

CAUTION ⚠

Over-tightening the wheel nuts can damage them.

Checking the wheel nuts for looseness

The wheel nuts should be checked for looseness every 10000 km (6000 miles). All nuts should be tightened at the specified torque.

- Check the double rear tires for looseness as follows:

- (1) Loosen outer wheel nuts.
- (2) Tighten inner wheel nuts at specified torque.
- (3) Tighten outer wheel nuts at specified torque.

CAUTION ⚠

If outer wheel nuts are tightened without first being loosened, it might not be possible to tighten them at the specified torque.

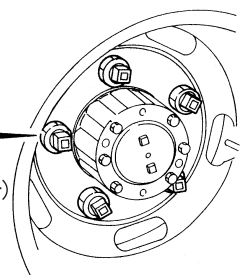
Nut (outer)



Nut (inner)



Nut (outer)

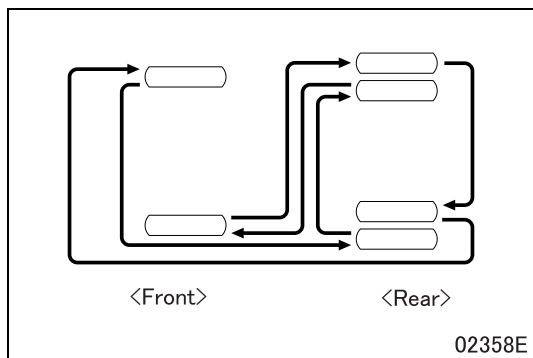


14224E

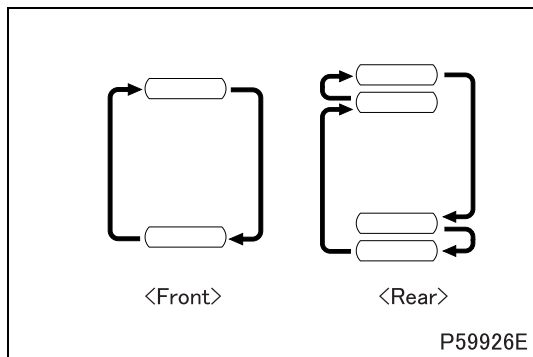
MAINTENANCE OPERATIONS

Tire rotation

Tires wear differently, according to the location where they are mounted. To make this wear uniform and prolong the life of your tires, they should be rotated every 10000 km (6000 miles) in the rotation order shown below:



- When the tread patterns for all tires are identical:



- When the tread patterns are different for the front and rear tires:

CAUTION

- Always adjust air pressure after running-in new tires.
 - When using tires of different tread patterns, use rib-type patterns for the front tires and traction type patterns for the rear tires.
 - Avoid using both radial and biased tires on the same vehicle.
-

M E M O

LUBRICATION TABLES

⑤: Exhaust emission items.

Items	Time of inspection and maintenance							Lubricant specifications	Reference Gr
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval						
			Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles		
Ⓔ Engine oil contamination and oil level	×							Engine oil API classification, CD, CD/SF, CE, CE/SF or CF-4 or JASO classification DH-1 Over 30°C {86°F} SAE 40 40 to −5°C {104 to 23°F} SAE 30 15 to −15°C {59 to 5°F} SAE 20W-20 Over −15°C {5°F} SAE 15W-40 Below 0°C {32°F} SAE 10W-30	Gr12
Ⓔ Engine oil replacement		×	×						
Manual transmission oil level			×					Engine oil Vehicle operated continuously at high speed API classification CC SAE 30 or SAE 40 Gear oil API classification GL-3 SAE 80 (General) GL-3 SAE 90 (Warm region) GL-4 SAE 90 (Tropical region)	Gr22
Manual transmission oil replacement		×	Every 60,000 km/36,000 miles						
Automatic transmission fluid level			×					Mobil ATF3309 manufactured by Exxon Mobil	Gr23
Automatic transmission fluid replacement						×			
Transfer gear oil level <FG Model only>			×					Gear oil API classification GL-3 SAE 80 (General) GL-3 SAE 90 (Warm region) GL-4 SAE 90 (Tropical region)	Gr24
Transfer gear oil replacement <FG Model only>		×			×				
Rear axle housing gear oil level			×					Gear oil API classification GL-5 Below 40°C {104°F} SAE 90 Over 40°C {104°F} SAE 140 Use SAE 140 when operating vehicle at high load, such as continuous ascent on slopes and when the outside temperature is 10°C {50°F} or more <Limited slip differential only> Limited slip differential oil API classification GL-5 SAE 90	Gr27
Rear axle housing gear oil replacement		×			×				
Front axle housing gear oil level <FG Model only>			×					Gear oil API classification GL-5 Below 40°C {104°F} SAE 90 Over 40°C {104°F} SAE 140 Use SAE 140 when operating vehicle at high load, such as continuous ascent on slopes and when the outside temperature is 10°C {50°F} or more	Gr26B
Front axle housing gear oil replacement <FG Model only>		×			×				
Hub bearing grease replacement					×			Wheel bearing grease [NLGI No. 2 (Li soap)]	Gr26, 27
Front axle birfield joint grease replacement <FG Model only>					×			Wheel bearing grease [NLGI No. 2 (Li soap)]	Gr26B
Front axle kingpin bearing grease replacement <FG Model only>					×			Wheel bearing grease [NLGI No. 2 (Li soap)]	Gr26B
Front axle steering knuckle grease replacement <FG Model only>					×			Wheel bearing grease [NLGI No. 2 (Li soap)]	Gr26B
Brake reservoir tank fluid level	×							Brake fluid <SAE J1703f or FMVSS No. 116 DOT3>	Gr35A
Brake fluid replacement							×		

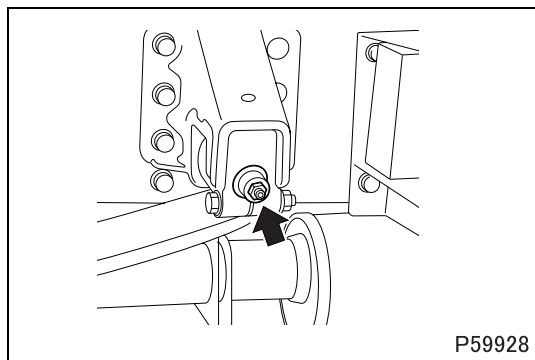
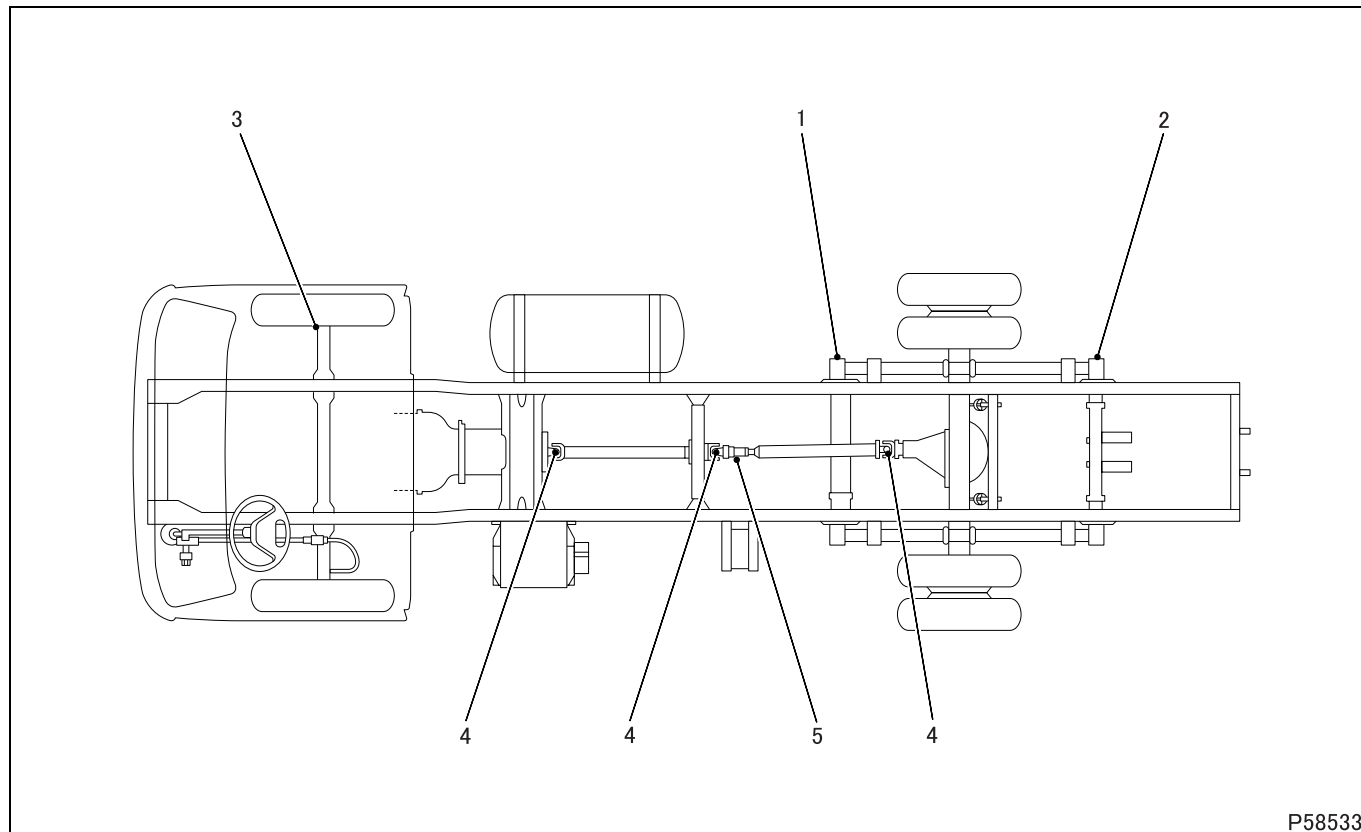
Items		Time of inspection and maintenance							Lubricant specifications	Reference Gr
		Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval						
				Every 10,000 km/ 6,000 miles	Every 20,000 km/ 12,000 miles	Every 30,000 km/ 18,000 miles	Every 40,000 km/ 24,000 miles	Every 50,000 km/ 30,000 miles		
Power steering fluid level				×					Automatic transmission fluid <DEXRON, DEXRON II or DEXRON III type>	Gr37
Power steering fluid replacement								×		
Lubrication of propeller shaft	Center bearing							×	Bearing grease [NLGI No. 3 (Li soap)]	Gr25
	Universal joint, slip joint			×					Wheel bearing grease [NLGI No. 2 (Li soap)]	See later section.
	Double Cardan joint <FG Model only>			×						
Lubrication of rear suspension spring pin				×					Chassis grease [NLGI No. 1 (Li soap)]	See later section.
Lubrication of kingpins				×					Wheel bearing grease [NLGI No. 2 (Li soap)]	See later section.
Lubrication of door hinge				×					Chassis grease [NLGI No. 1 (Li soap)]	Gr43
Lubrication of anchor hook <except crew cab>				×					Chassis grease [NLGI No. 1 (Li soap)]	Gr42

LUBRICATION

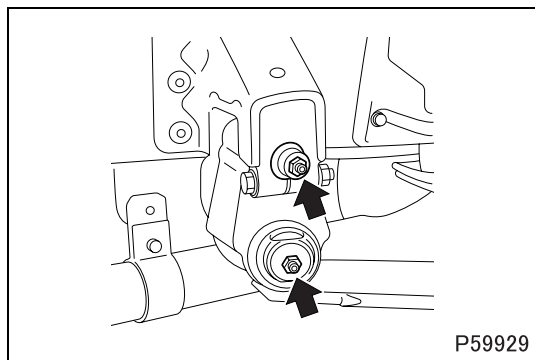
Greasing Various Areas of Chassis

Carefully clean away all dust and dirt from the grease nipples, and use the specified type of grease. The areas to be greased are shown in the following illustration.

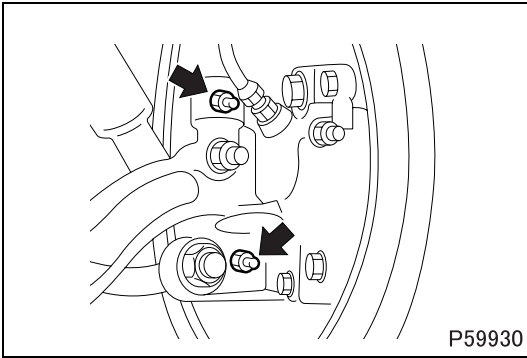
<FE>



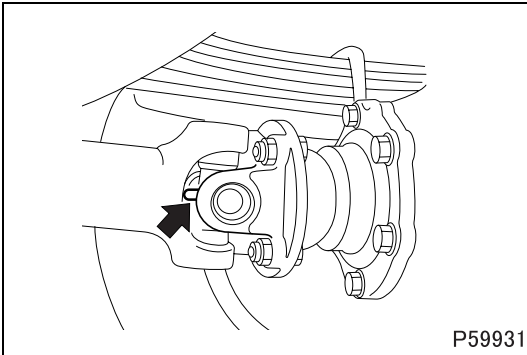
1. Rear spring pin front (left and right, 2 points)



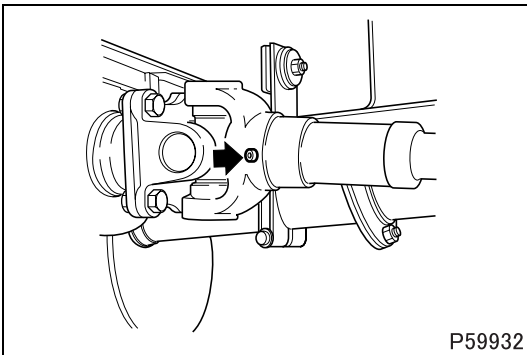
2. Rear spring pin rear (left and right, 4 points)



3. Kingpin bearing (left and right, 4 points)



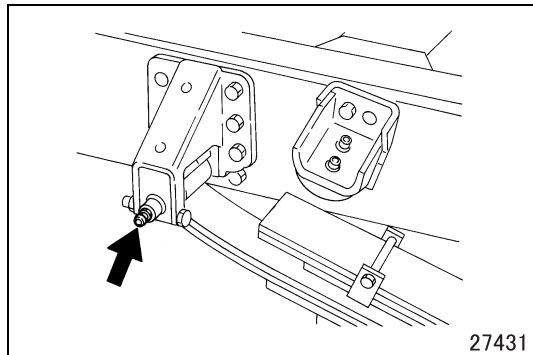
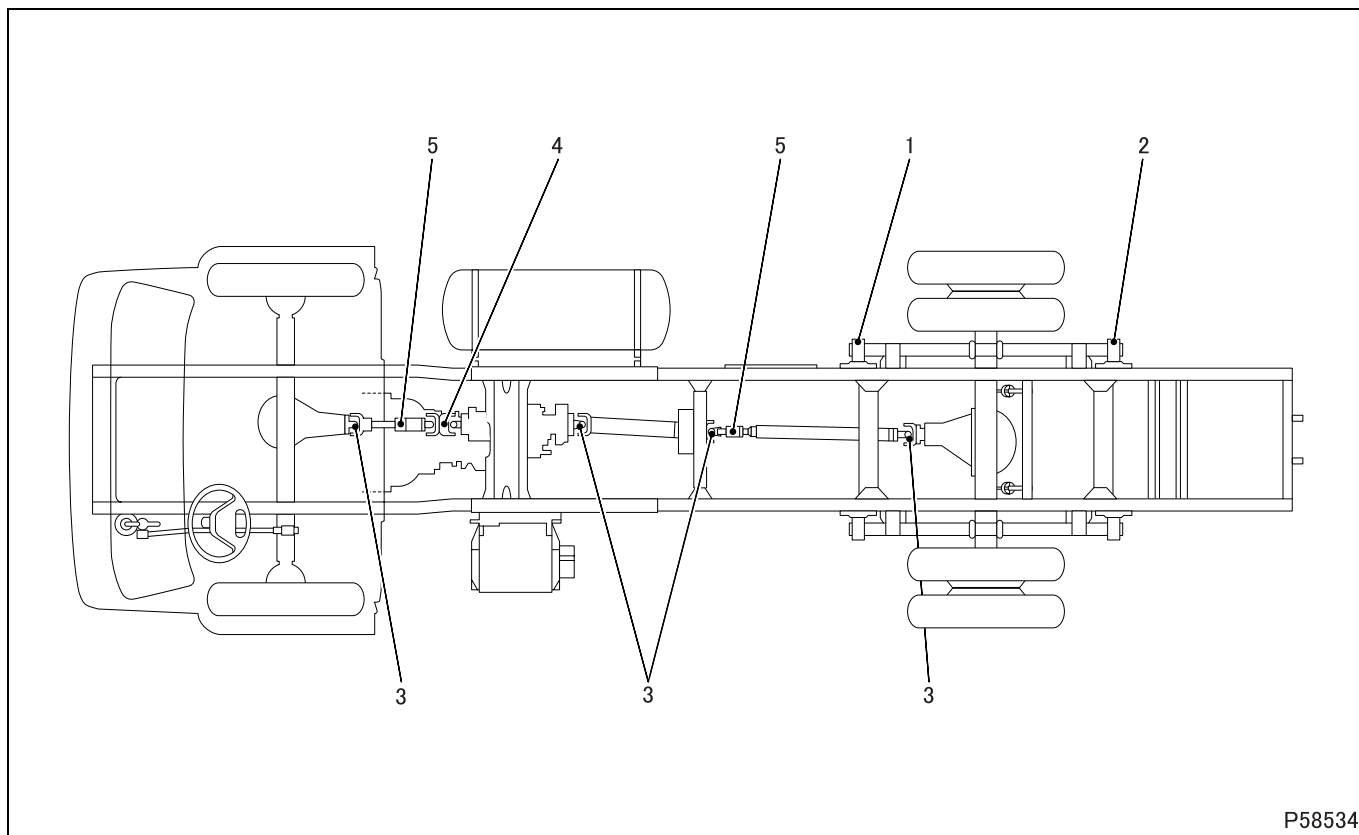
4. Propeller shaft universal joint's-all



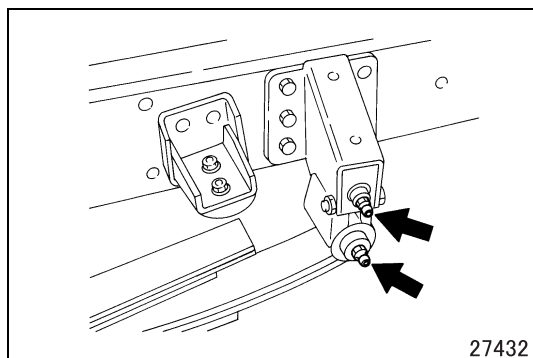
5. Propeller shaft slip joint

LUBRICATION

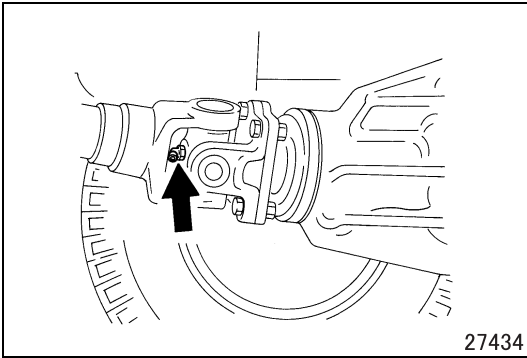
<FG>



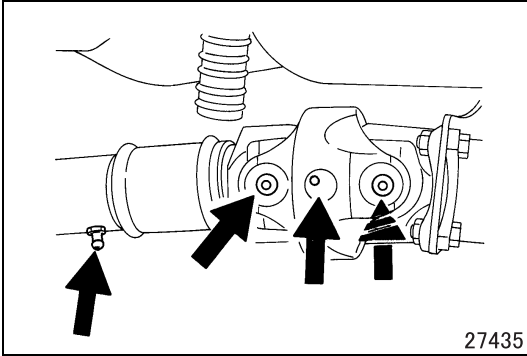
1. Rear spring pin front (left and right, 2 points)



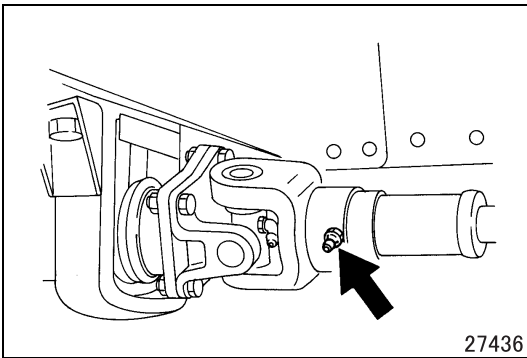
2. Rear spring pin rear (left and right, 4 points)



3. Propeller shaft universal joint's-all



4. Double Cardin joint, propeller shaft slip joint, propeller shaft universal joint



5. Propeller shaft slip joint



Group 11

Engine

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

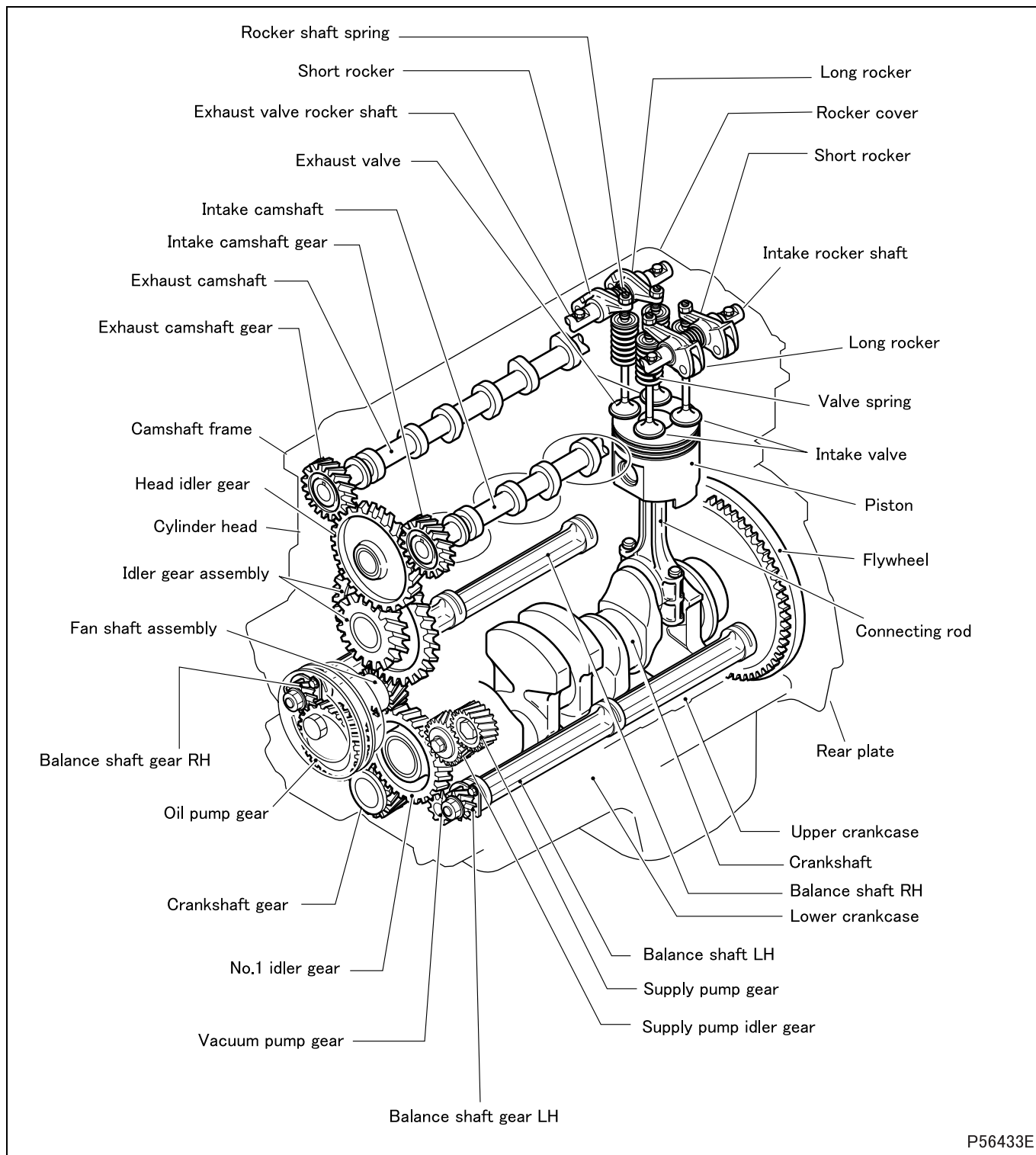
INDEX

SPECIFICATIONS	11-2	PISTONS, CONNECTING ROD AND CYLINDER LINERS	11-56
STRUCTURE AND OPERATION		FLYWHEEL	11-70
1. Exploded View	11-3	FRONT CASE	11-74
2. Cylinder Head, Cylinder Head Gasket, Camshaft, and Camshaft Frame	11-4	TIMING GEARS AND BALANCE SHAFTS	11-76
3. Valve Mechanism	11-5	CRANKSHAFT AND CRANKCASE.....	11-84
4. Connecting Rod	11-6	BALANCE SHAFT BUSHINGS	11-92
5. Piston	11-6		
6. Timing Gears	11-7		
7. Flywheel.....	11-7		
8. Balance Shafts	11-8		
9. Crankcase and Main Bearings	11-9		
10.Oil Seals	11-11		
TROUBLESHOOTING	11-12		
ON-VEHICLE INSPECTION AND ADJUSTMENT			
1. Measuring Compression Pressure	11-14		
2. Inspection and Adjustment of Valve Clearances	11-16		
ENGINE REMOVAL AND INSTALLATION			
<TILT CAB>	11-18		
<FIXED CAB>	11-26		
ROCKER COVER	11-28		
ROCKERS AND CAMSHAFTS	11-30		
CYLINDER HEAD AND VALVE MECHANISM	11-42		

SPECIFICATIONS

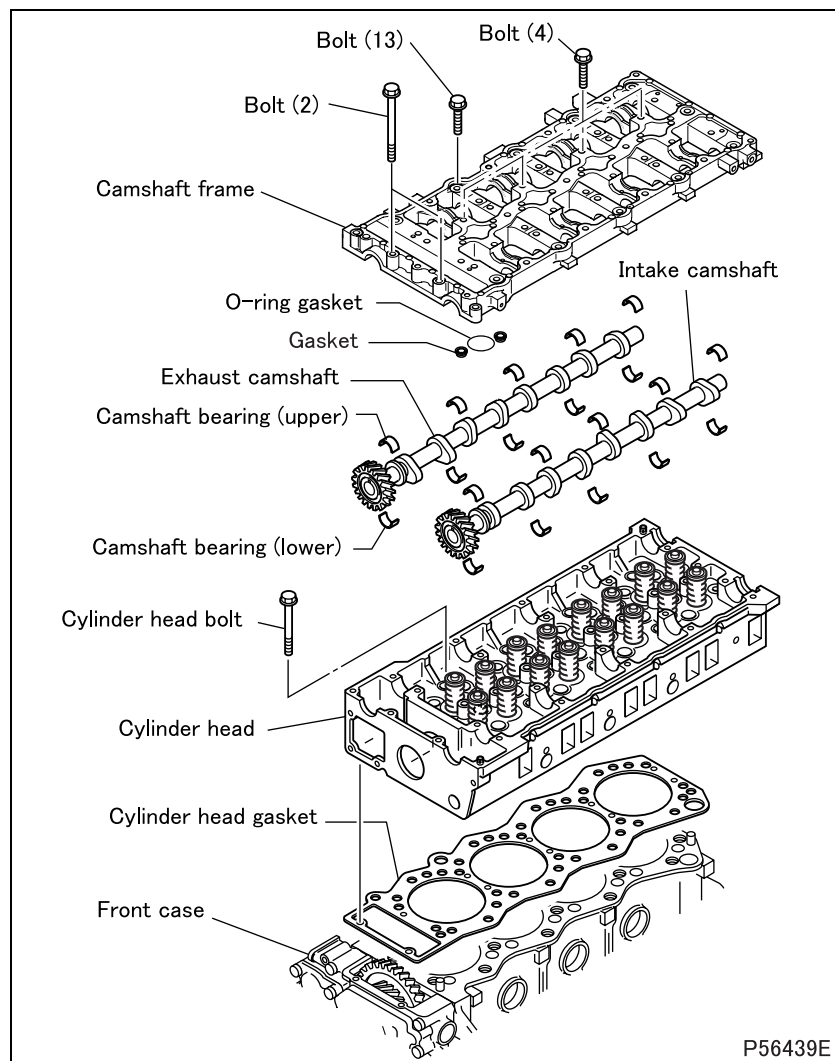
Item		Specifications	
Engine model		4M50T7	4M50T8
Type		4-cylinder, in-line, water-cooled, 4-cycle diesel engine	
Combustion chamber		Direct injection type	
Valve mechanism		Double overhead camshaft (DOHC)	
Maximum output	HP / rpm	147 / 2700	175 / 2700
Maximum torque	ft.lbf / rpm	347 / 1600	391 / 1600
Bore × stroke	mm {in.}	φ114 × 120 {φ4.49 × 4.72}	
Total displacement	L {qts}	4.899 {4899}	
Compression ratio		17.5	

1. Exploded View

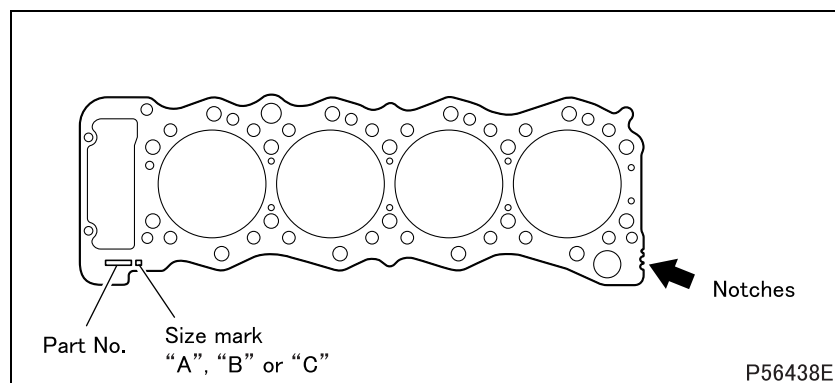


STRUCTURE AND OPERATION

2. Cylinder Head, Cylinder Head Gasket, Camshaft, and Camshaft Frame



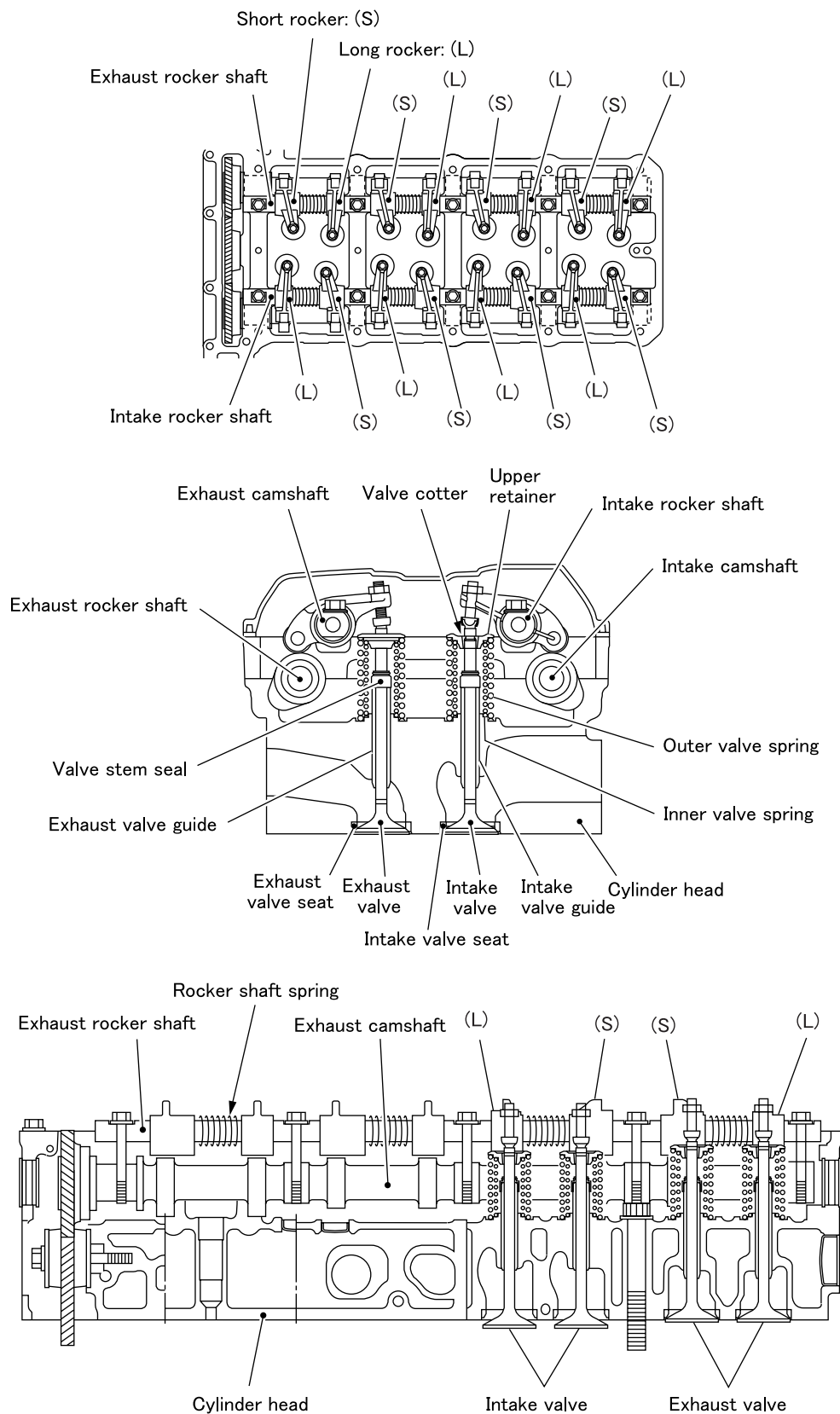
- The camshaft is supported at its journals from below by the cylinder head and retained from above by the camshaft frame.
- The upper and lower camshaft bearings are identical, but cannot be interchanged when they are reinstalled.
- The exhaust camshaft and the intake camshaft have identical gears but different cams.
- The thirteen shortest bolts and four shorter bolts fasten the camshaft frame onto the cylinder head.
- The two long bolts fasten the camshaft frame to the front case.



2.1 Cylinder head gasket

- Select and use a cylinder head gasket of a thickness that can accommodate the piston projection.
- The size (thickness) class of the gasket can be identified by the shape of the notches and size mark cut on the edge of each gasket.

3. Valve Mechanism

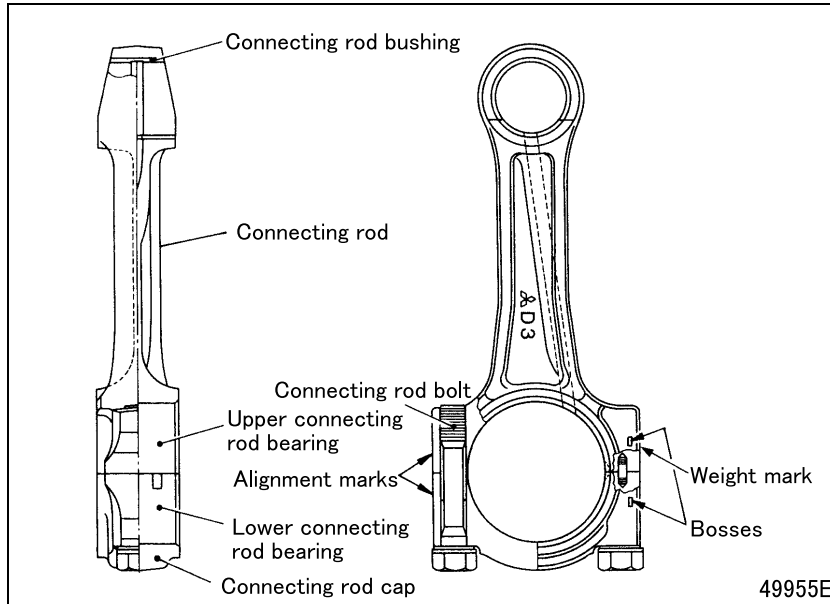


P49222E

- The short rockers and the long rockers are installed differently, as shown in the illustration.
- Each valve has an inner valve spring and an outer valve spring.

STRUCTURE AND OPERATION

4. Connecting Rod

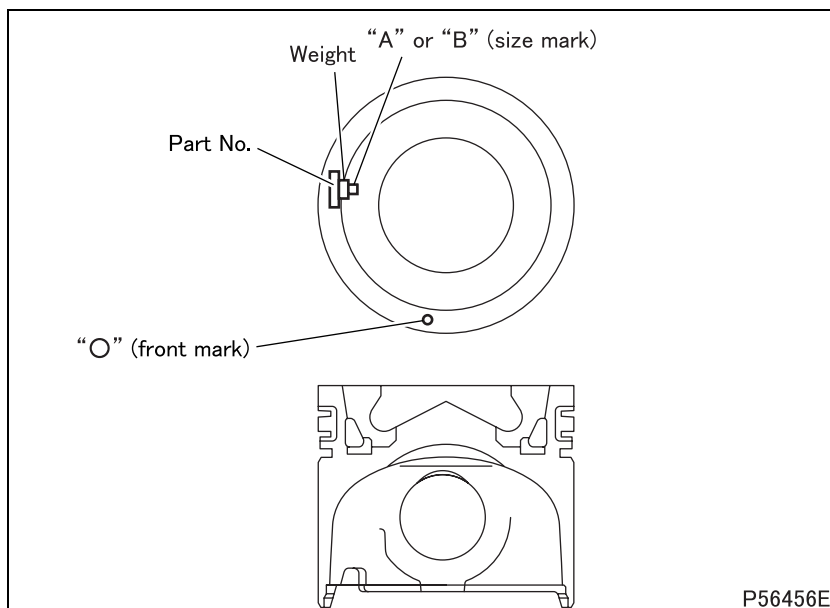


Weight mark:

“C” to “G”

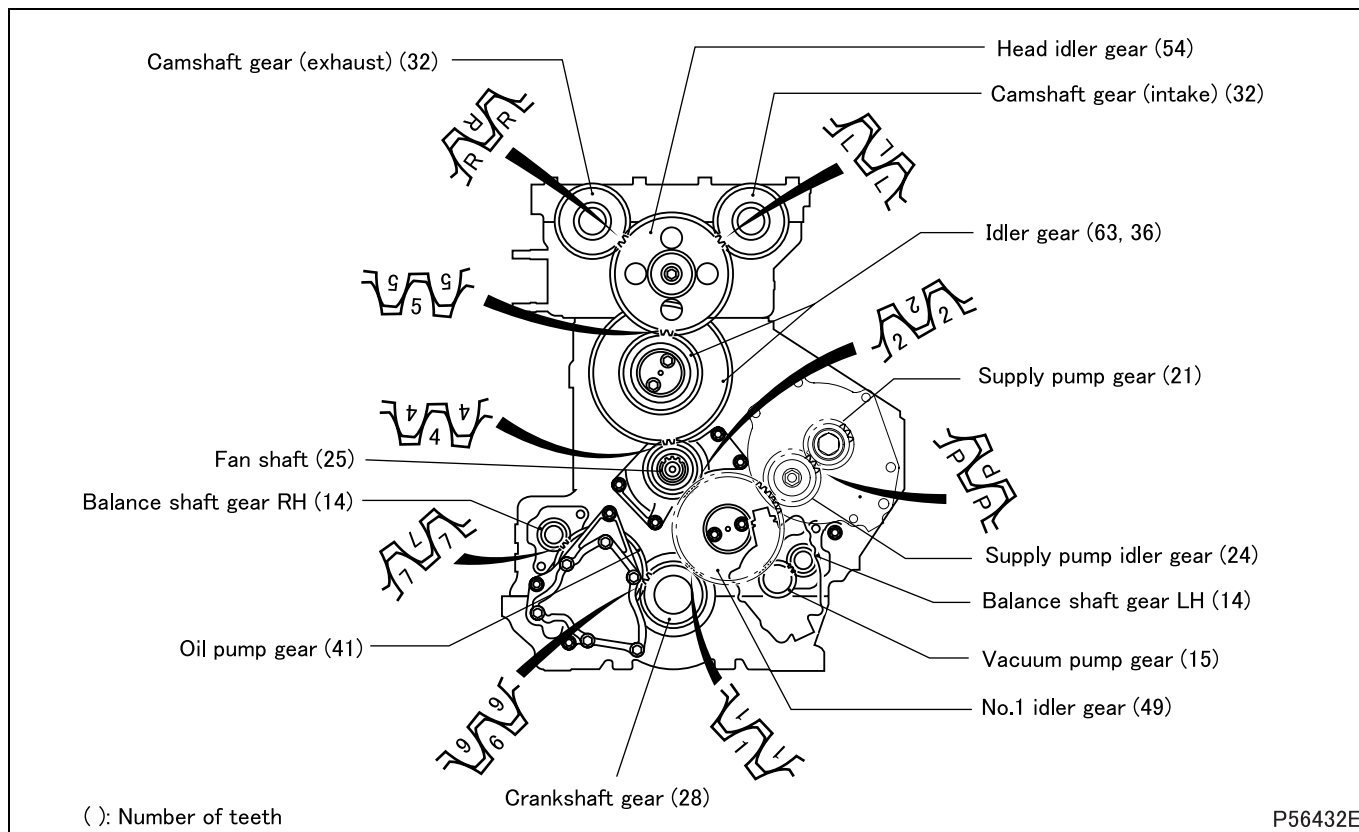
(with “G” as the maximum)

5. Piston



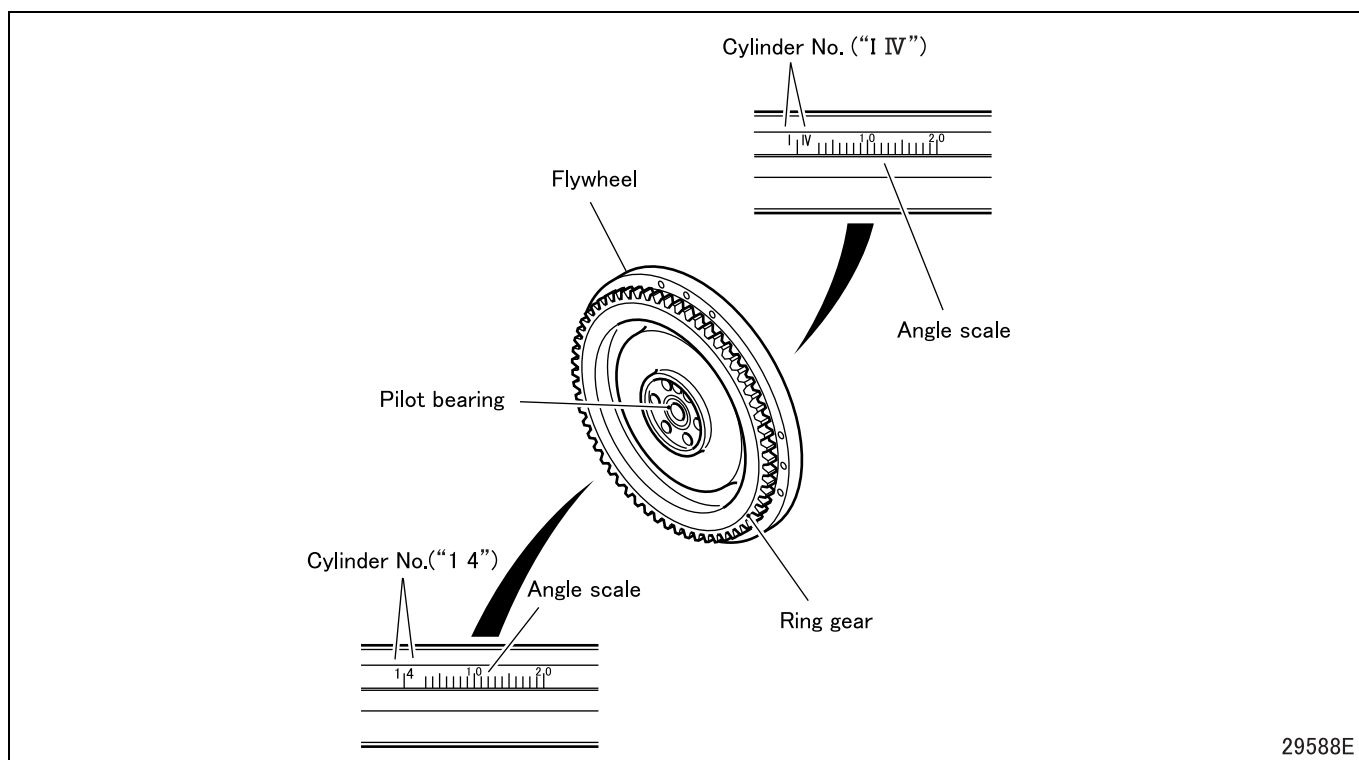
- Each piston must be mated with a cylinder in the upper crankcase that has the same size mark as the piston. The pistons are marked with either “A” or “B”, where “B” stands for the larger and “A” for the smaller of the two available diameters.
- The pistons have been made light-weight by use of a special aluminum alloy, as well as by the reduction of their height.

6. Timing Gears



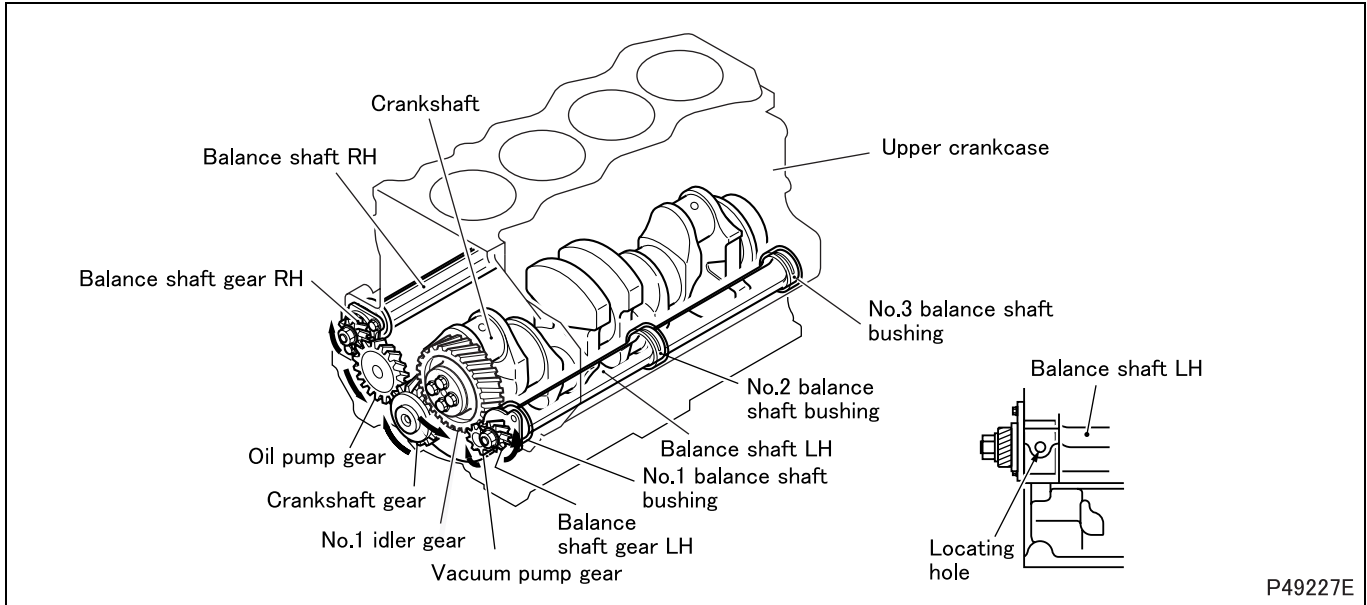
- All gears, except the vacuum pump gear, each has timing mark(s) to ensure correct engagement during assembly.

7. Flywheel

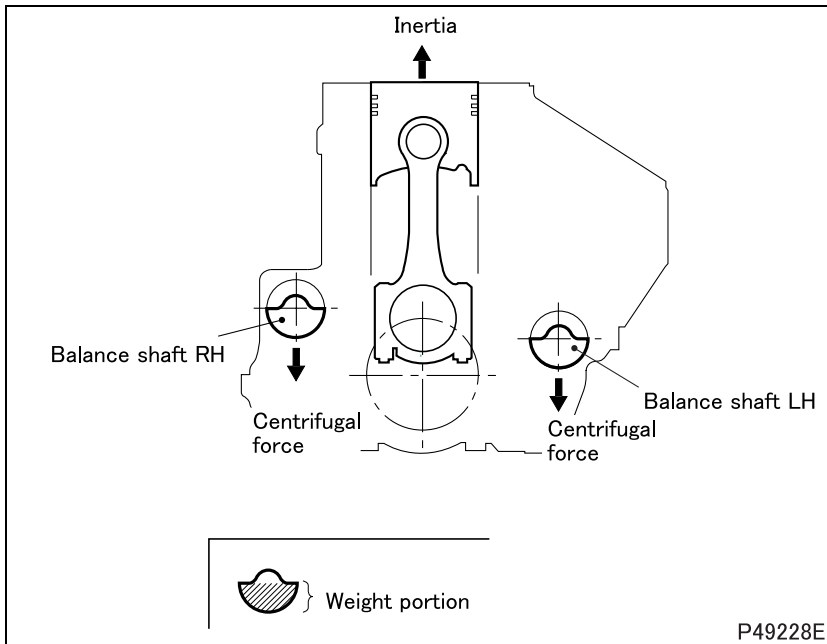


STRUCTURE AND OPERATION

8. Balance Shafts



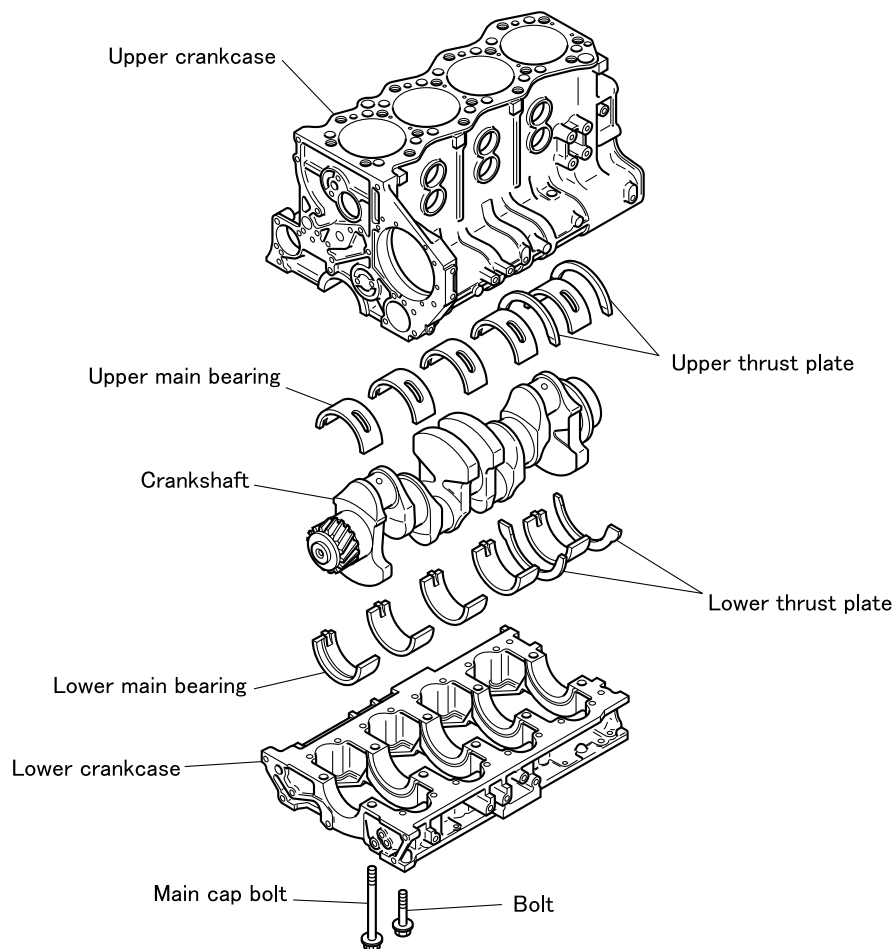
- The balance shaft RH and balance shaft LH are mounted in the upper crankcase on the right and left sides of the crankshaft. The balance shafts reduce the vibration of the engine caused by the rotation of the crankshaft.
- The balance shaft RH and balance shaft LH are both driven by timing gears. Each balance shaft is held in the upper crankcase by way of three balance shaft bushings.
- The balance shaft LH has a locating hole to enable correct installation.



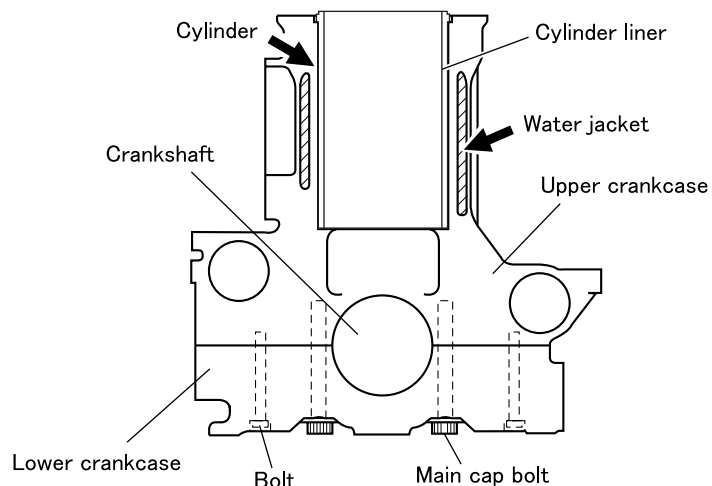
8.1 Reduction of vertical vibration (secondary vibration element)

- When the piston moves up and down, vertical vibrations are generated at the top dead center (TDC) and bottom dead center (BDC) due to inertia.
- The balance shaft LH and the balance shaft RH rotate so that their weight portions are at the bottom positions when a piston is at TDC and at the top positions when the piston is at BDC, i.e., the weight portions are always on the opposite side to the piston head.
- This creates centrifugal forces in the balance shaft RH and balance shaft LH, the total of which is equal in amount to the inertia force that the piston creates when it is at TDC or BDC. These centrifugal forces in the balance shafts cancel out the inertia forces resulting from piston's movements and reduce the amount of vertical vibration.
- The balance shafts also reduce the moment created around the crankshaft (which constitutes secondary vibration elements) when the engine is running in the middle-to-high speed range.

9. Crankcase and Main Bearings



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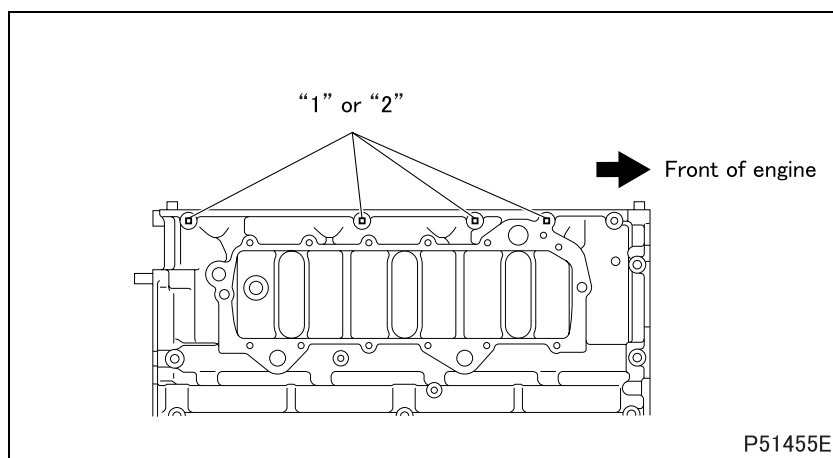


P57193E

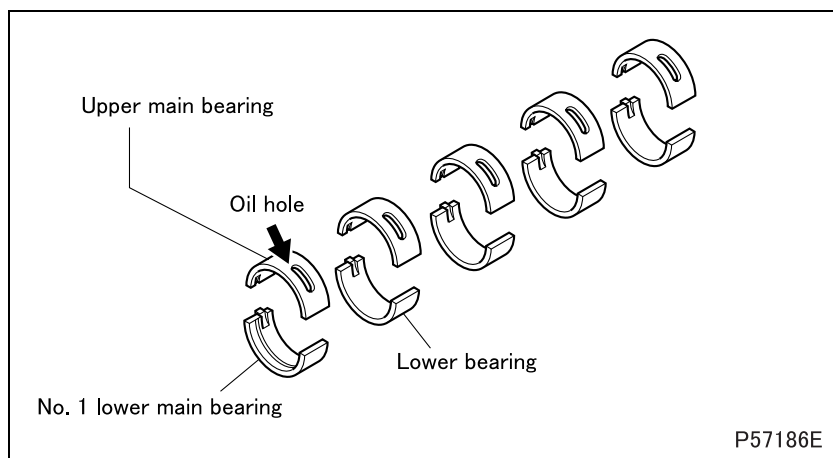
9.1 Crankcase

- The crankcase is a two-piece type consisting of an upper crankcase and a lower crankcase, which hold the crankshaft in between.
- Cylinder liners are inserted into the cylinder bores in the upper crankcase.
- An water jacket is formed in the walls of these cylinders to cool them down.
- The main cap bolts and the bolts that fasten the upper and lower crankcases together are tightened using a special method.

STRUCTURE AND OPERATION

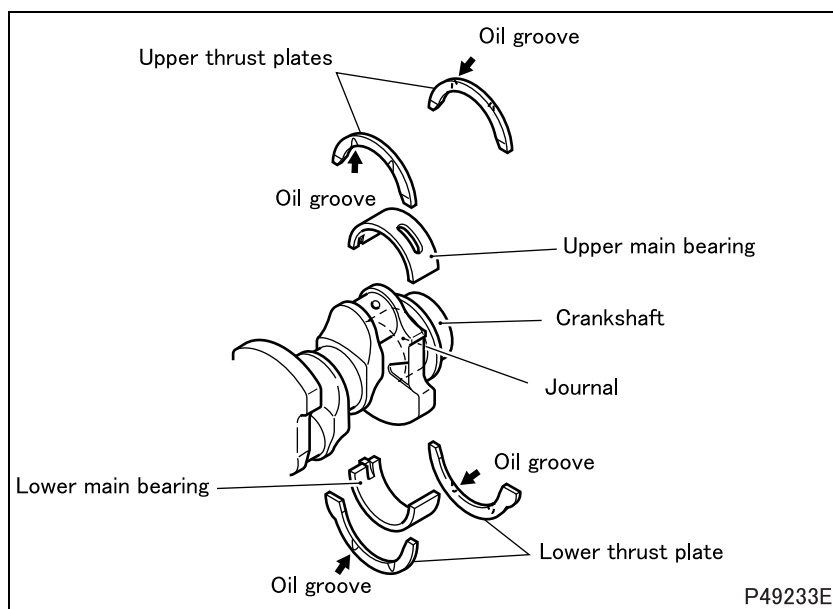


- The upper crankcase is marked with a size mark ("1" or "2") to be used as a reference in selecting cylinder liners.
- The first to fourth size marks from the front of the engine correspond to the No. 1 to No. 4 cylinders.



9.2 Main bearing

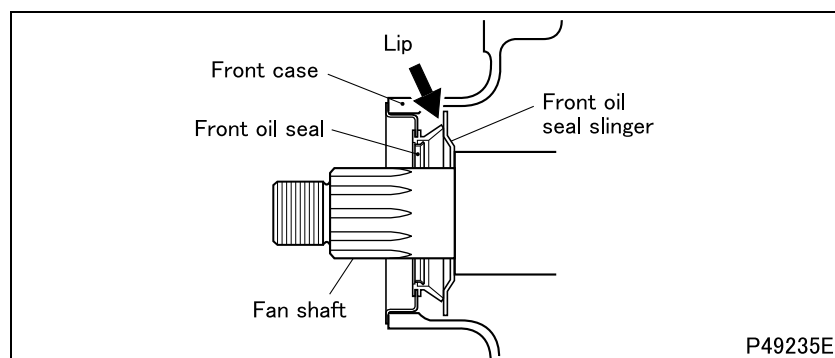
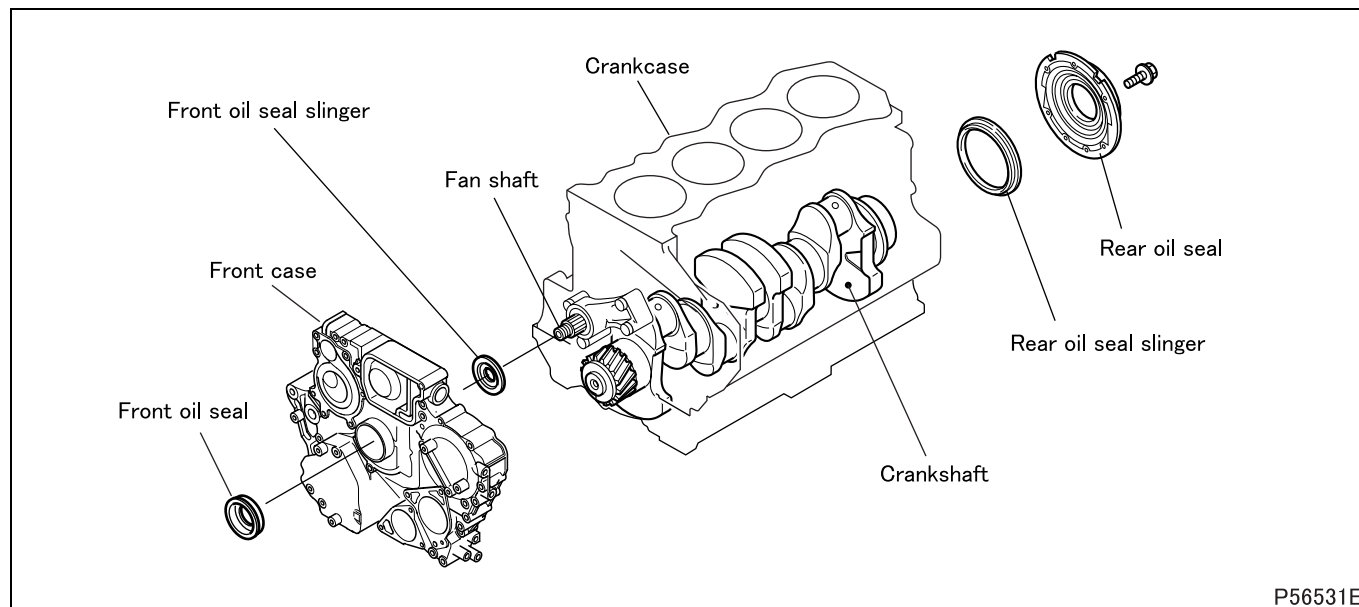
- The upper main bearings have oil holes through which engine oil is supplied to the crankshaft journals.
- An oil groove is provided in the No. 1 lower bearing.



9.3 Thrust plates

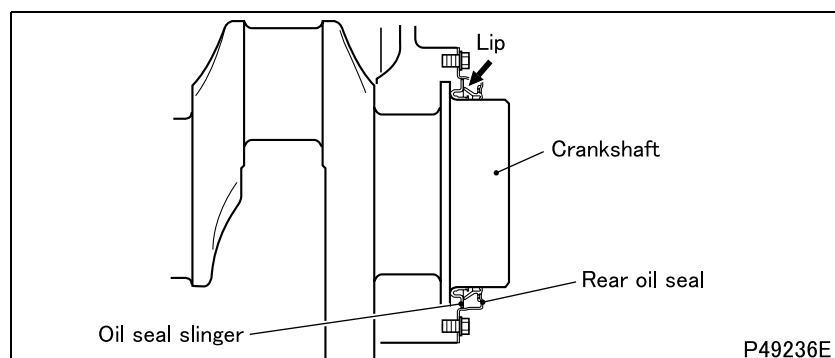
- Two upper and lower thrust plate pairs are installed on both sides of the upper and lower main bearings at the rearmost journal of the crankshaft.
- Select the thrust plates of a thickness that can accommodate the crankshaft end play. The thrust plates each have two oil grooves, which assures their minimum friction against the crankshaft journal.

10. Oil Seals



10.1 Front oil seal

- The front oil seal is fitted in the front case and prevents oil from leaking by contact of its lip with the front oil seal slinger.
- The front oil seal slinger is press-fitted onto the fan shaft.



10.2 Rear oil seal

- The rear oil seal is fitted in the crankcase assembly and prevents oil from leaking by contact of its lip with the rear oil seal slinger.
- The rear oil seal slinger is press-fitted onto the rear end of the crankshaft.

TROUBLESHOOTING

Symptoms		Low power output	Abnormal engine noise	Reference Gr
Possible causes				
Cylinder head and valve mechanism	Incorrect valve clearance	O	O	
	Defective cylinder head gasket	O	O	
	Worn valve and valve seat; carbon deposits	O	O	
	Weakened valve spring	O	O	
	Defective rocker shaft and camshaft frame		O	
	Poor lubrication of rocker shaft and camshaft frame		O	
Timing gears	Incorrect backlash in timing gears		O	
	Poor lubrication of timing gears and idler shaft		O	
Camshaft	Excessive end play in camshaft		O	
	Worn camshaft		O	
Pistons and connecting rods	Worn/damaged piston ring groove(s)	O	O	
	Worn/damaged piston ring(s)	O	O	
	Worn piston pin and connecting rod small end		O	
Crankshaft	Excessive end play in crankshaft		O	
	Incorrectly fitted crankshaft		O	
	Worn/damaged crankshaft pins and connecting rod bearings		O	
	Worn/damaged crankshaft journals and main bearings		O	
Fuel system	Defective supply pump	O	O	Gr13E
	Faulty fuel spray from injector	O	O	Gr13A
	Air trapped in fuel system	O		
Cooling system	Malfunctioning cooling system components	O		Gr14
	Loose/damaged V-belts		O	
Intake and exhaust system	Clogged air cleaner	O	O	Gr15
	Clogged muffler	O	O	
Incorrect oil viscosity		O		Gr12
Improper fuel		O		
Incorrectly fitted piping and hoses			O	
Defective/incorrectly fitted alternator and other auxiliaries			O	

M E M O

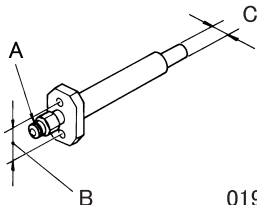
ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Measuring Compression Pressure

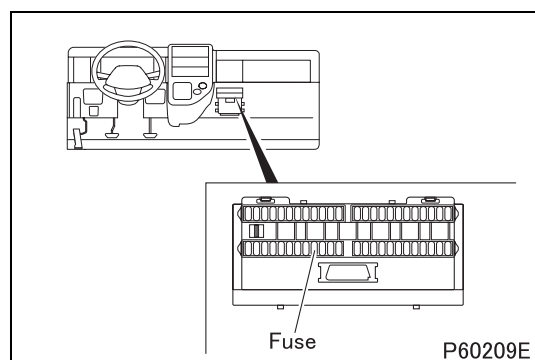
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
-	Compression pressure	Each cylinder (at 200 rpm)	2550 kPa {370 psi, 26 kgf/cm ² }	1960 kPa {285 psi, 20 kgf/cm ² }	Inspect
		Cylinder-to-cylinder pressure difference	-	390 kPa {57 psi, 4 kgf/cm ² } or less	Inspect

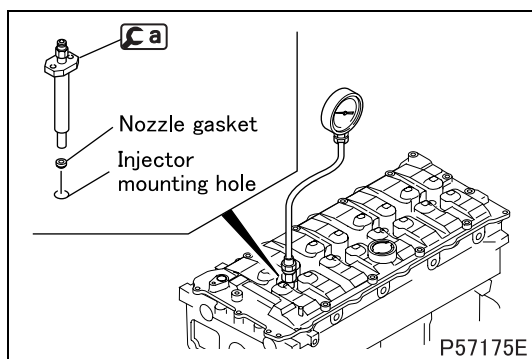
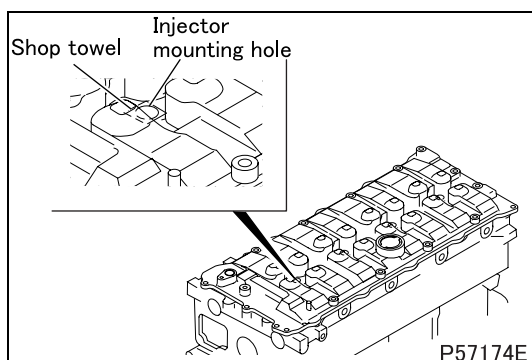
Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application						
	Compression gauge adapter	MH063434	Measuring compression pressure						
	<table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>W 16</td><td>58</td><td>φ7.2</td></tr><tr><td>H 18</td><td>{2.28}</td><td>{φ0.28}</td></tr></tbody></table>  01942			A	B	C	W 16	58	φ7.2
A	B	C							
W 16	58	φ7.2							
H 18	{2.28}	{φ0.28}							

- A drop in compression pressure can be used as a guide to determine when the engine should be overhauled.
- Measure the compression pressure at regular intervals. Keeping track of its transitions can provide a useful tool for troubleshooting. On new vehicles and vehicles with newly replaced parts, the compression pressure will be somewhat higher depending on the break-in condition of piston rings, valve seats, etc., but this will return to normal as the parts wear down.
- Before the compression measurement, confirm that the engine oil, starter, and battery are in normal condition.
- Place the vehicle in the following conditions.
 - Warm up the engine until the coolant temperature reaches approximately 75 to 85°C {167 to 185°F}.
 - Turn off the lights and auxiliaries.
 - Place the transmission in neutral (in the parking range P for automatic transmissions).
 - Place the steering wheel in the straight-ahead position.



- Remove the fuse (M9) to prevent fuel from being injected when the engine is cranked by the starter.



- Disconnect the injector connector and remove all injectors.
- Cover the injector mounting holes with shop towels. After cranking the engine by the starter, check that no foreign substances are deposited on the shop towels.
- If there are deposits (such as engine oil or coolant) on the shop towels, the following may be the cause:
 - Deposits of engine oil alone can mean a defective piston ring seal; the piston rings must be inspected.
 - Deposits of both engine oil and coolant can mean cracks in the cylinders; the crankcase must be replaced.

WARNING

- When coolant and engine oil deposits are evident, cranking the engine could be dangerous as these substances, heated to high temperatures, will blow out from the injector mounting holes. Make sure to stay away from the injector mounting holes when the engine is being cranked.

CAUTION

- Never cut off the engine electronic control unit power supply when cranking the engine.
- Attach the gasket and  to one of the injector mounting holes. Then, connect a compression gauge to .
- Crank the engine and measure the compression pressure for all the cylinders one after another. Determine the compression pressure difference between the cylinders.
- If the compression pressure is below the limit or the cylinder-to-cylinder pressure differences is not within the limit, pour a small amount of engine oil into the corresponding injector mounting hole and remeasure the compression pressure.
 - If the compression pressure increases, the piston rings and cylinder surfaces may be badly worn or otherwise damaged.
 - If the compression pressure remains unchanged, there may be seizure in the valves, the valves may be incorrectly seated or the cylinder head gasket may be defective.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Inspection and Adjustment of Valve Clearances

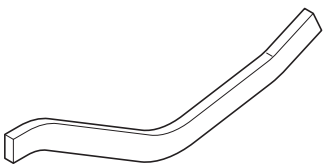
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Valve clearance (when cold)	Intake valve	0.4 {0.016}	Adjust
		Exhaust valve	0.5 {0.020}	

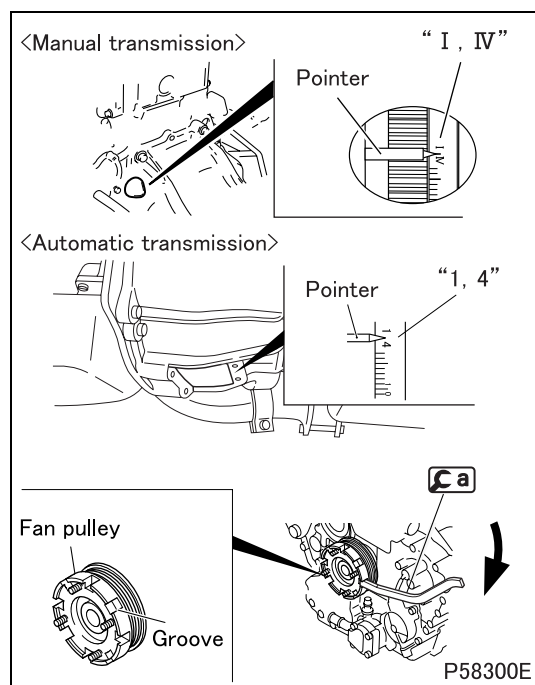
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Lock nut (adjusting screw stopping)	20.6 {15, 2.1}	–

Special tools

Mark	Tool name and shape	Part No.	Application
	Cranking handle  P58299	MH063704	Turning the fan pulley

- Valve clearances should be checked and adjusted as follows while the engine is still cold.

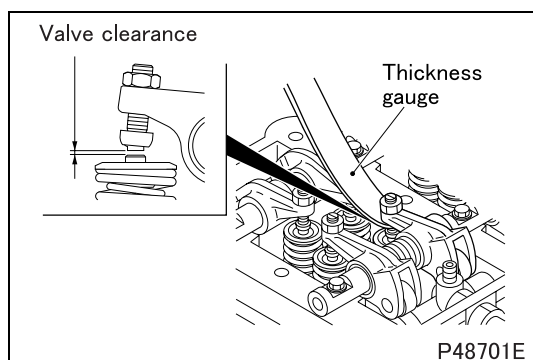


[Inspection]

CAUTION

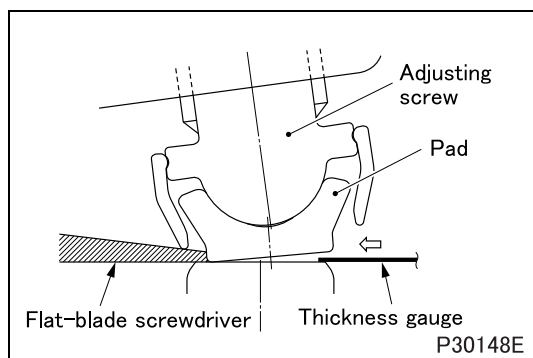
- Never cut off the engine electronic control unit power supply when cranking the engine.

- Remove the rocker cover.
- Disconnect the injector connector.
- Bring the No. 1 or No. 4 cylinder piston to the top dead center (TDC) on the compression stroke by the following procedure:
 - Hook  onto the grooves in the fan pulley.
 - Turn the fan pulley in the illustrated direction to align the pointer with the “I, IV” or “1” to “4” mark on the flywheel.
 - This will place either the No. 1 or No. 4 cylinder piston at TDC on the compression stroke. The cylinder in which the rocker arms for both the intake and exhaust valves can be pushed down by hand by the valve clearance amounts has its piston at TDC. Rotate the engine by one full turn to switch the TDCs of the No. 1 and No. 4 cylinder pistons.

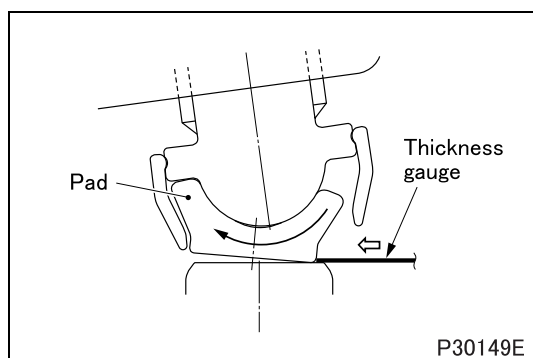


- With the No. 1 or No. 4 cylinder piston at TDC, measure the clearance of the valves marked with a circle in the table below.

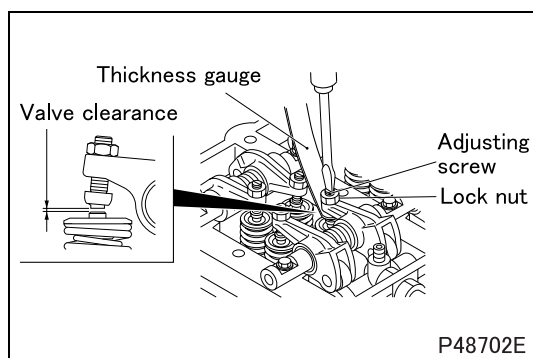
Cylinder No.	1		2		3		4	
Valve	IN	EX	IN	EX	IN	EX	IN	EX
No. 1 cylinder piston at TDC on compression stroke	O	O	O	-	-	O	-	-
No. 4 cylinder piston at TDC on compression stroke	-	-	-	O	O	-	O	O



- To insert the thickness gauge under the adjusting screw pad, push the pad at the bottom on one side with a flat-blade screwdriver or a similar tool. Insert the thickness gauge into the small space created under the other side of the pad, as shown in the illustration.



- The thickness gauge cannot be inserted under the adjusting screw pad without carrying out the above step, as the pad will block the thickness gauge as shown in the illustration.
- The thickness gauge must have a slight drag when taking measurements.
- If the thickness gauge can be moved without any resistance, the measurement will be incorrect.
- If the measurements are not within the standard value range, adjust the value clearance by the following procedures.

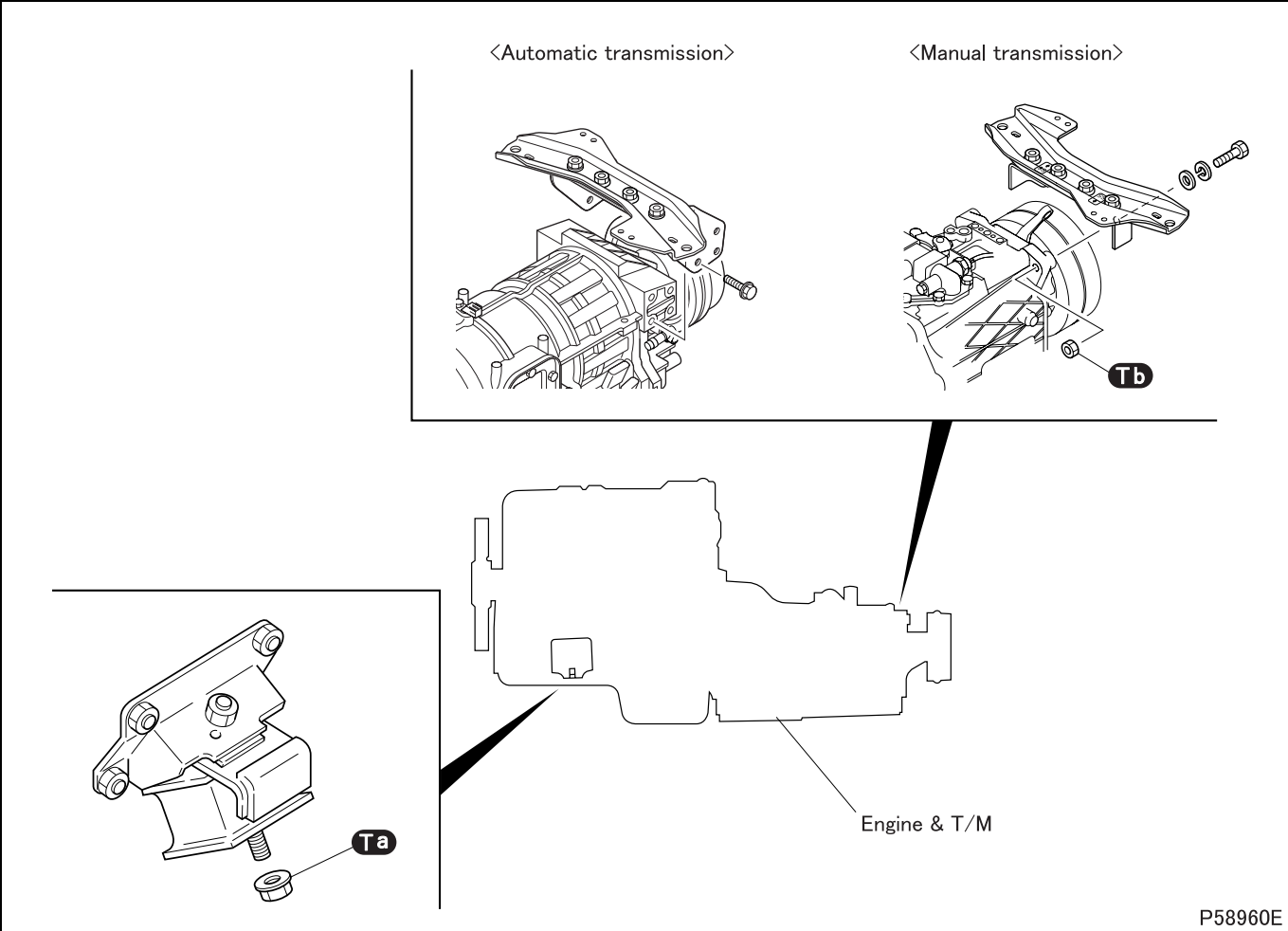


[Adjustment]

- Adjust the valve clearance by loosening the lock nut and rotating the adjusting screw so that the thickness gauge can only be moved with a slight drag.
- After the adjustment, hold the adjusting screw in position with a screwdriver and tighten the lock nut to the specified torque.
- Recheck the valve clearance with the thickness gauge, and re-adjust if the measurements are not within the specified value range.

ENGINE REMOVAL AND INSTALLATION <TILT CAB>

<Except for FG>



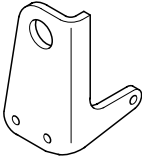
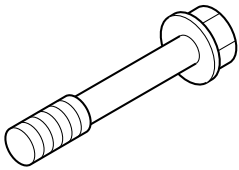
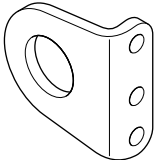
CAUTION ⚠

- Only use hoisting equipment appropriate for the engine and transmission weight (approximately 600 kg {1320 lb}).

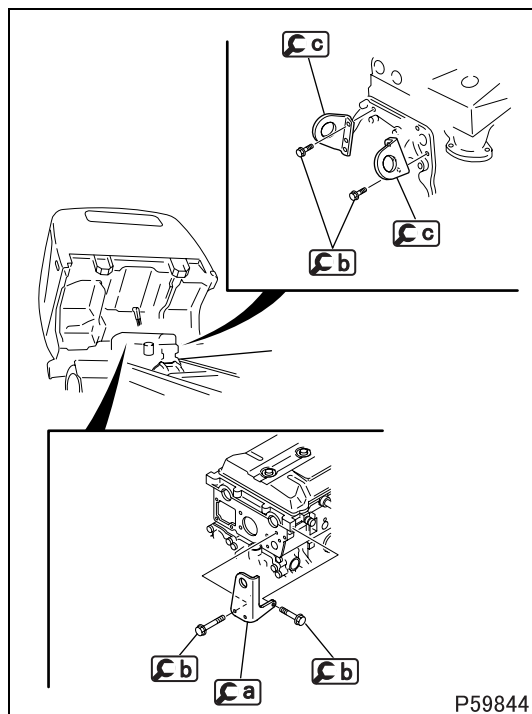
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (front mounting installation)	69 to 88 {51 to 65, 7 to 9}	–
Tb	Nut (rear mounting installation)	130 to 170 {96 to 125, 13 to 17}	–

Special tools

Mark	Tool name and shape	Part No.	Application
	Engine front hanger  P57188	MH063636	Removal and installation of engine
	Flange bolt  P29984	MF140429 MF140433 MF140421	Installation of engine front hanger
	Engine rear hanger  P58957	MH063711	Removal and installation of engine

◆ Work before removal ◆

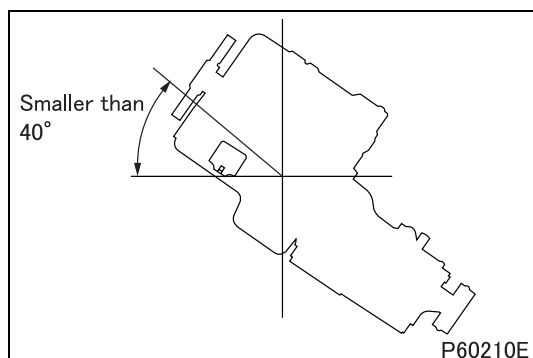
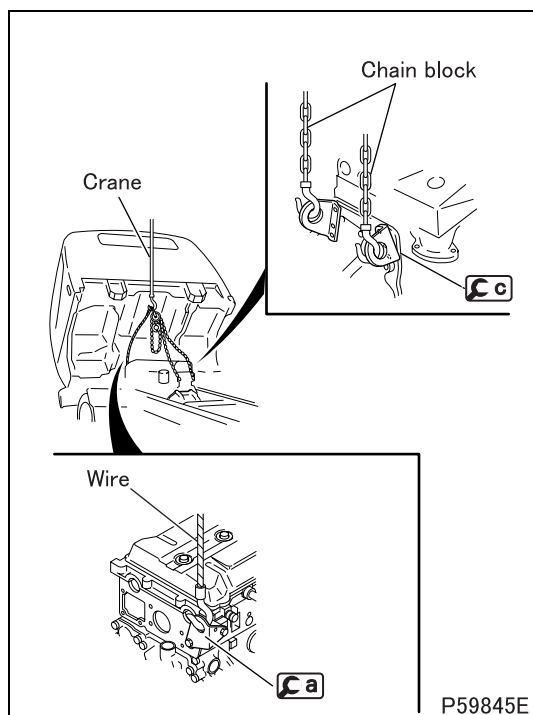


■ Preparing for engine removal: Installation of engine front hanger and flange bolt

- Install ,  and  on the engine.

ENGINE REMOVAL AND INSTALLATION <TILT CAB>

◆ Removal procedure ◆



■ Removal: Engine and transmission

- Hook the wire rope on **Ca** and hitch the chain block to **Cc**. Then, pull all the slack out of the slings by a crane.

CAUTION ⚠

- The slings must be strong enough to hang the engine and transmission assembly (weighing approximately 600 kg {1320 lb}).
- Be sure to keep the slings away from the exhaust gas recirculation pipes.

- Make sure that all harnesses and pipes are disconnected.
- Lift the engine and transmission assembly slowing. Take care not to bump the assembly against the frame and cab.

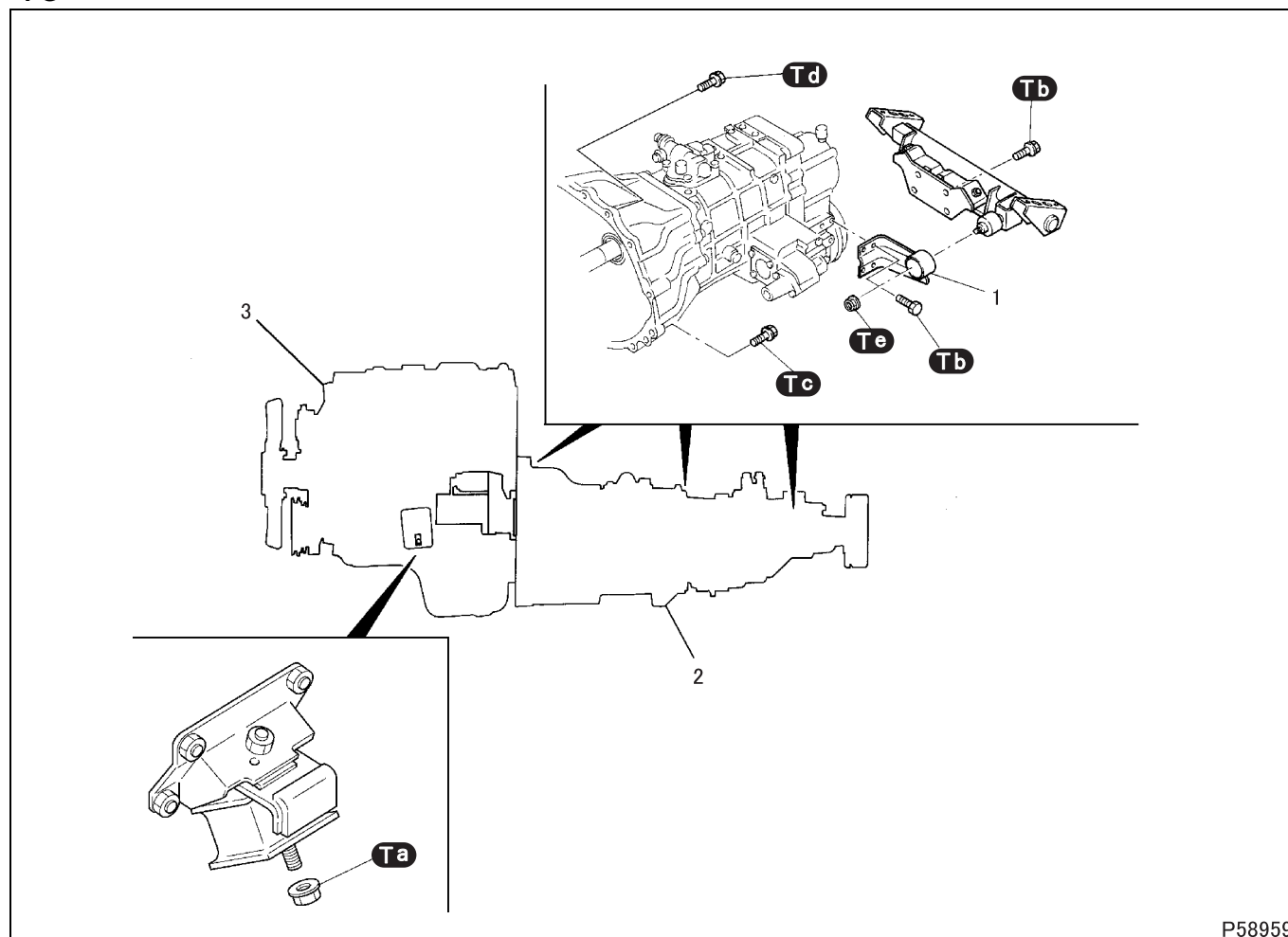
CAUTION ⚠

- When lifting the engine and transmission assembly, do not incline it larger than 40°.

M E M O

ENGINE REMOVAL AND INSTALLATION <TILT CAB>

<FG>



P58959

● Removal sequence

- 1 Roll stopper
- 2 Transmission
- 3 Engine

● Installation sequence

Follow the removal sequence in reverse.

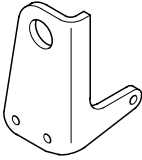
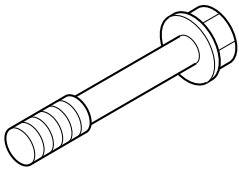
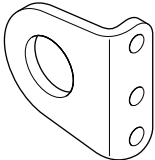
CAUTION ⚠

- Be careful not let the engine hit the cab or the rear body when hoisting the engine.
- Only use hoisting equipment appropriate for the engine weight (approximately 500 kg {110 lb}).

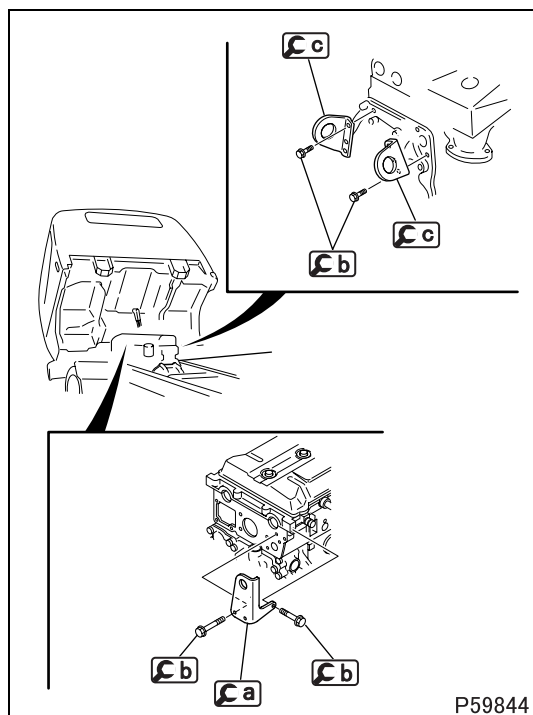
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Front mounting installation)	69 to 88 {51 to 65, 7 to 9}	—
Tb	Bolt (Roll stopper bracket installation)	45 to 65 {33 to 48, 4.6 to 6.6}	—
	Bolt (Rear mounting installation)		
Tc	Bolt (Transmission installation)	82.4 {61, 8.4}	—
Td	Bolt (Transmission installation)	47.1 {35, 4.8}	—
Te	Nut (Roll stopper bracket installation)	38 to 54 {28 to 40, 3.9 to 5.5}	—

Special tools

Mark	Tool name and shape	Part No.	Application
	Engine front hanger  P57188	MH063636	Removal and installation of engine
	Flange bolt  P29984	MF140429 MF140433 MF140421	Installation of engine front hanger
	Engine rear hanger  P58957	MH063711	Removal and installation of engine

◆ Work before removal ◆

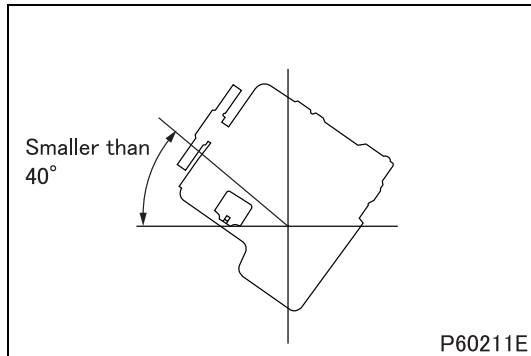
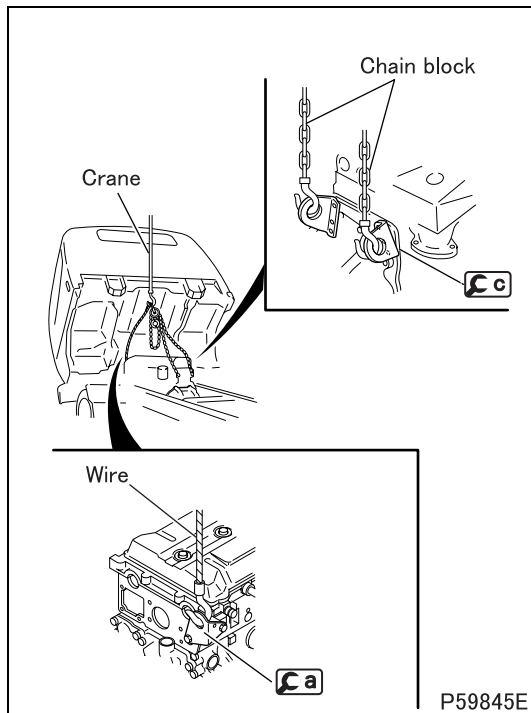


■ Preparing for engine removal: Installation of engine front hanger and flange bolt

- Install ,  and  on the engine.

ENGINE REMOVAL AND INSTALLATION <TILT CAB>

◆ Removal procedure ◆



■ Removal: Engine

- Hook the wire rope on **Ca** and hitch the chain block to **Ca**. Pull all the slack out of the slings.

CAUTION ⚠

- The slings must be strong enough to hang the engine (weighing approximately 500 kg {1100 lb}).
- Be sure to keep the slings away from the exhaust gas recirculation pipes.

- Make sure that all harnesses and pies are disconnected.
- Hoist the engine slowly, taking care not to let the engine hit the frame and the cab.

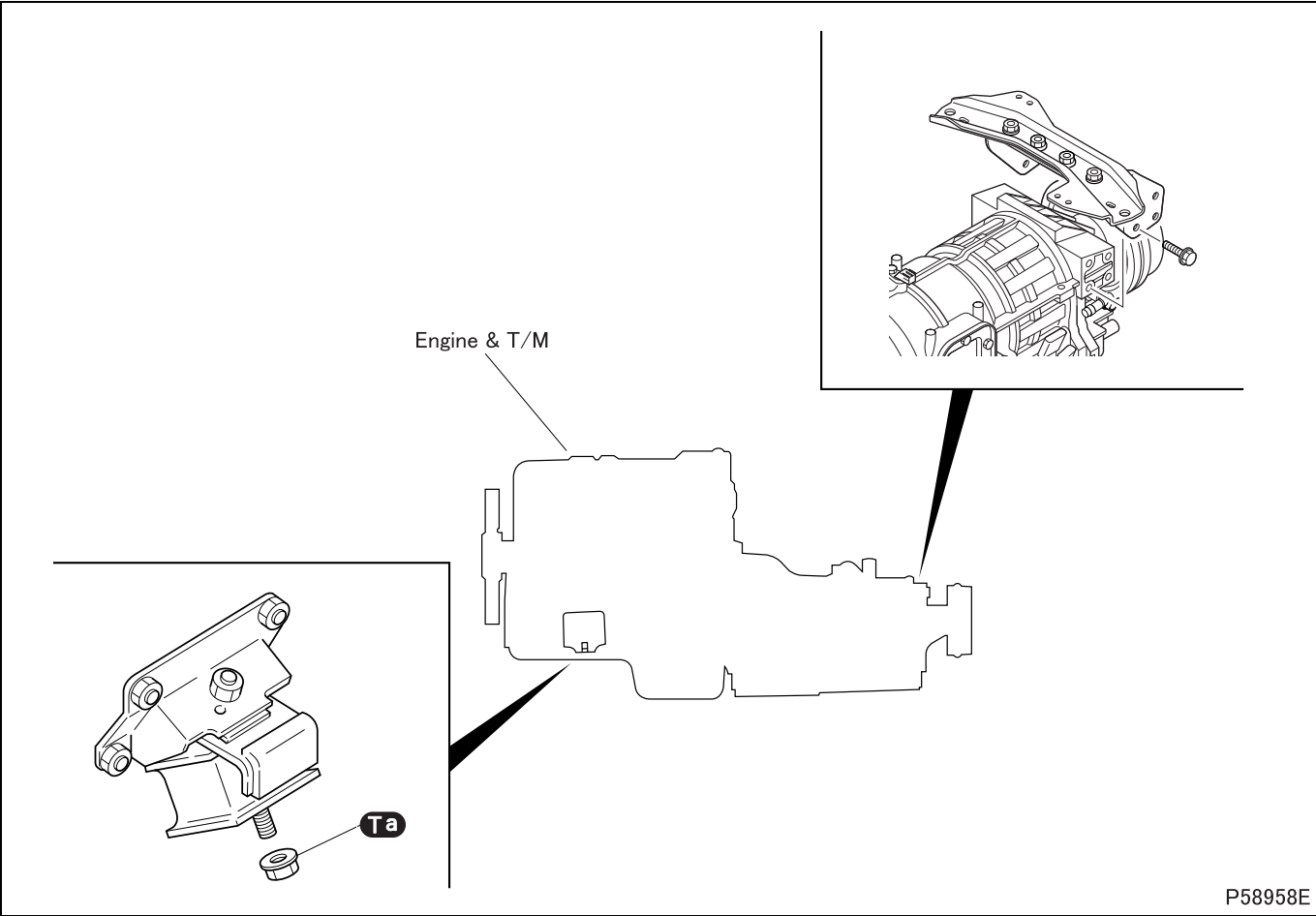
CAUTION ⚠

- When lifting the engine and transmission assembly, do not incline it larger than 40°.

- Once the bottom of the engine is out of the frame, turn the engine by 90 degrees and remove it out of the vehicle.

M E M O

ENGINE REMOVAL AND INSTALLATION <FIXED CAB>



CAUTION ⚠

- Before removing each part, support the engine and transmission assembly in place using an engine lifter and a transmission jack.

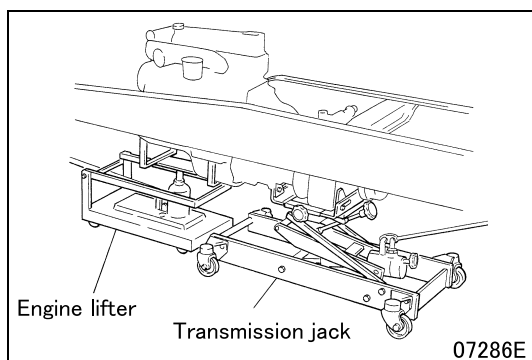
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

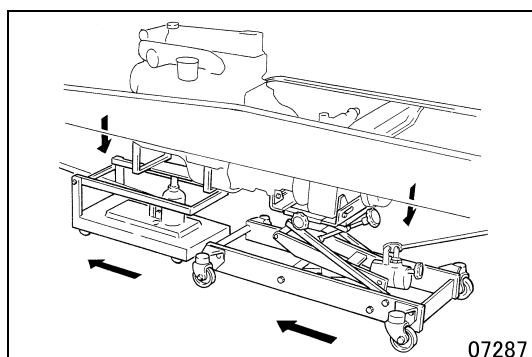
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Front mounting installation)	69 to 88 {51 to 65, 7 to 9}	—

◆ Removal procedure ◆

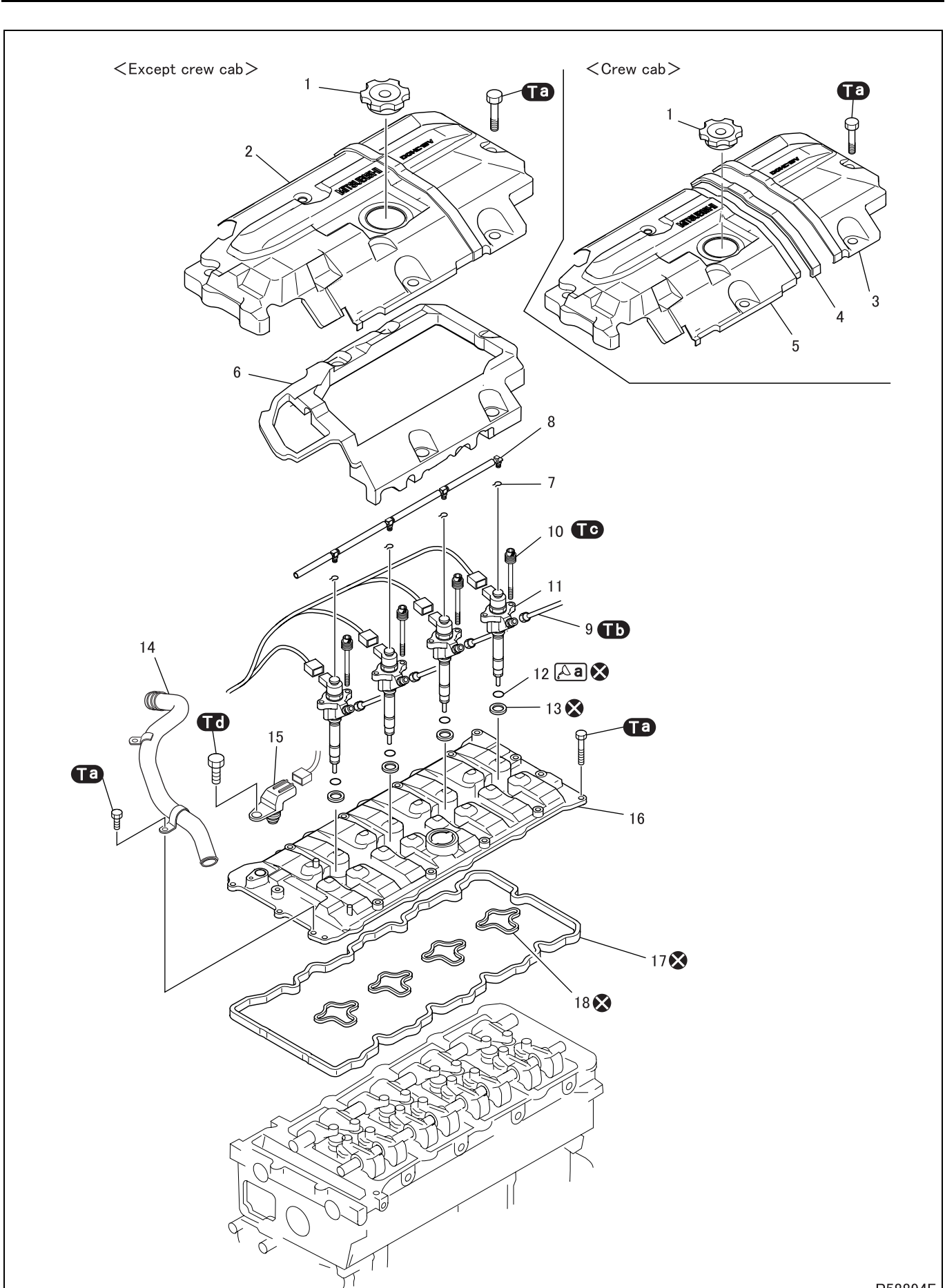


■ Removal: Engine and transmission assembly

- Support the engine and transmission assembly with an engine lifter and a transmission jack.
- Check that all wiring and piping have been disconnected from the engine.



- Lower the engine and transmission assembly to the greatest extent possible while keeping it horizontally balanced.
- Jack up the vehicle and slide the engine and transmission assembly forward.



11-28

● Disassembly sequence

- | | | |
|--------------------------------|-------------------------------|-------------------------------------|
| 1 Oil filler cap | 8 Fuel return hose | 15 Cylinder sensor |
| 2 Cover <except crew cab> | 9 Injection pipe | 16 Rocker cover |
| 3 Rear cover <crew cab> | 10 Bolt (with hexagonal hole) | 17 Rocker cover gasket A |
| 4 Rear cover gasket <crew cab> | 11 Injector | 18 Rocker cover gasket B |
| 5 Front cover <crew cab> | 12 O-ring | |
| 6 Rocker cover rubber | 13 Tip gasket | ⊗: Non-reusable parts |
| 7 Snap ring | 14 PCV pipe | PCV: Positive Crankcase Ventilation |

● Assembly sequence

Follow the disassembly sequence in reverse.

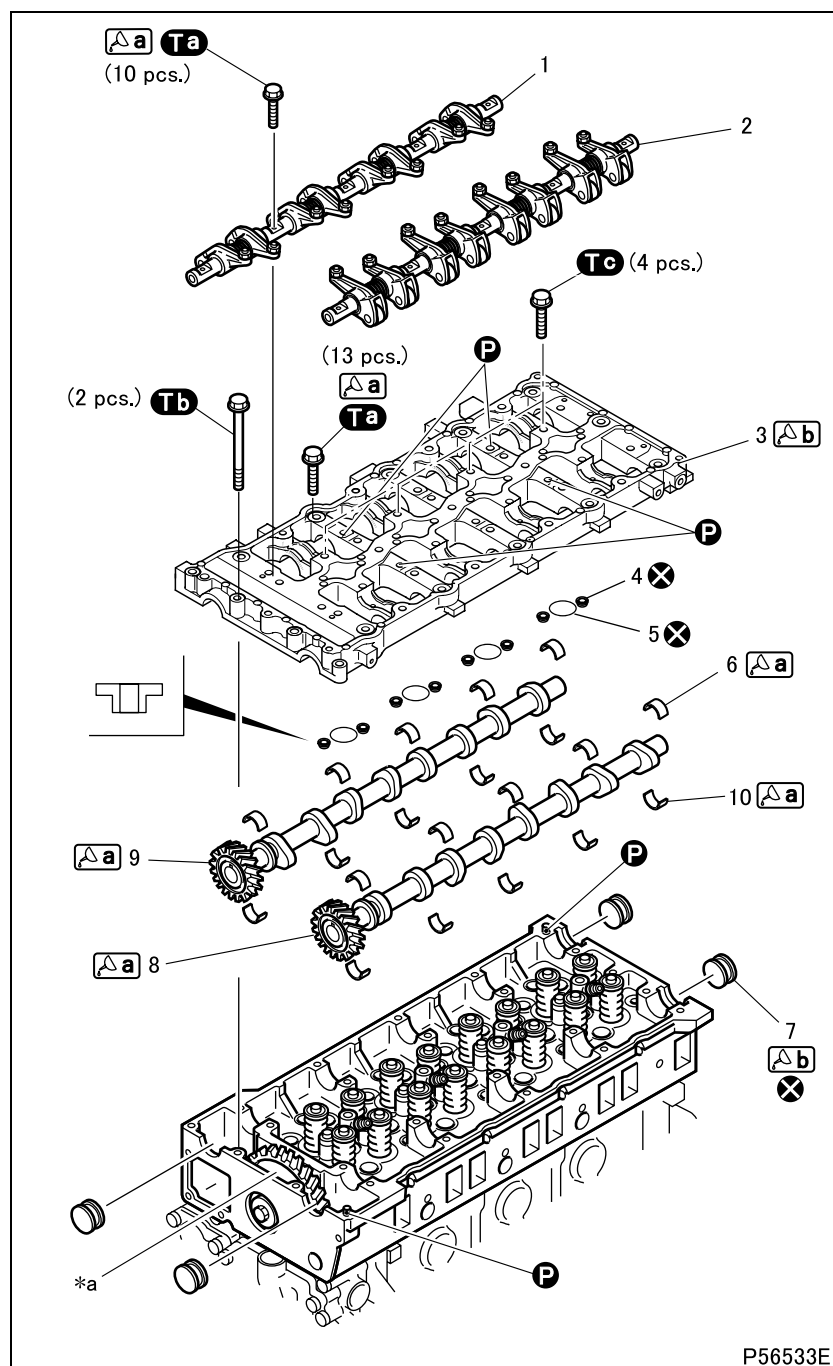
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (cover installation)	23.2 {17, 2.4}	—
	Bolt (rocker cover installation)		
	Bolt (PCV pipe installation)		
Tb	Injection pipe (union nut installation)	30.4 to 35 {22 to 26, 3.1 to 3.6}	—
Tc	Bolt (injector installation)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	—
Td	Bolt (cylinder sensor installation)	8 {5.9, 0.82}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Engine oil	As required

ROCKERS AND CAMSHAFTS



● Disassembly sequence

- 1 Exhaust rocker shaft
(See later sections.)
- 2 Intake rocker shaft
(See later sections.)
- 3 Camshaft frame
- 4 Gasket
- 5 O-ring
- 6 Upper camshaft bearing
- 7 Packing
- 8 Intake camshaft
(See later sections.)
- 9 Exhaust camshaft
(See later sections.)
- 10 Lower camshaft bearing

*a: Head idler gear

P: Locating pin

⊗: Non-reusable parts

CAUTION ⚠

- The camshaft frame and cylinder head are manufactured as a matched set. Never replace the camshaft frame or the cylinder head individually.
- Do not change the upper and lower camshaft bearing combinations. Do not interchange the position of an upper and lower camshaft bearing set with that of another.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
-	Backlash	Head idler gear-to-camshaft gear	0.080 to 0.126 {0.0031 to 0.0050}	0.3 {0.012}	Replace
		Head idler gear-to-idler gear	0.103 to 0.158 {0.0041 to 0.0062}	0.3 {0.012}	
-	End play	Camshaft	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	Inspect
		Head idler gear	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	
6, 8, 10	Camshaft bearing-to-intake camshaft clearance		0.07 to 0.12 {0.0028 to 0.0047}	0.16 {0.024}	Replace
6, 8, 10	Camshaft bearing-to-exhaust camshaft clearance		0.07 to 0.12 {0.0028 to 0.0047}	0.16 {0.024}	Replace
6, 10	Camshaft bearing span (when free)		-	35.5 {1.40} or less	Replace

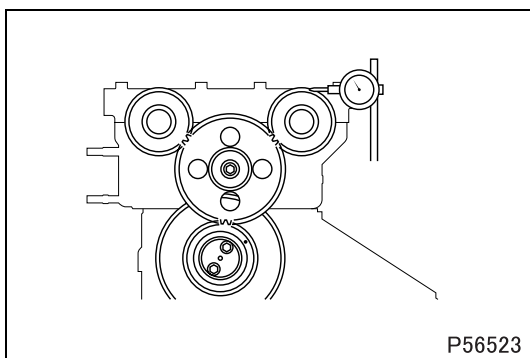
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (rocker shaft installation: 10 places)	27.5 {20, 2.8}	Wet
	Bolt (camshaft frame installation: 13 places)		
Tb	Bolt (camshaft installation: 2 places)	23.5 {17, 2.4}	–
Tc	Bolt (camshaft frame installation: 4 places)	23.2 {17, 2.4}	–

Lubricant and/or sealant

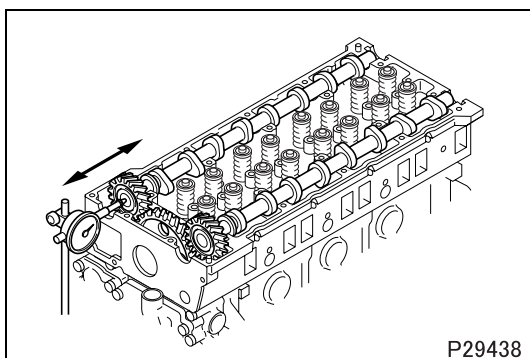
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads and seat	Engine oil	As required
	Camshaft bearing inner surface		
	Camshaft journals and cams		
b	Cylinder head mounting surface of camshaft frame	THREEBOND 1207C or D	As required
	Entire periphery of packing		

◆ Work before removal ◆



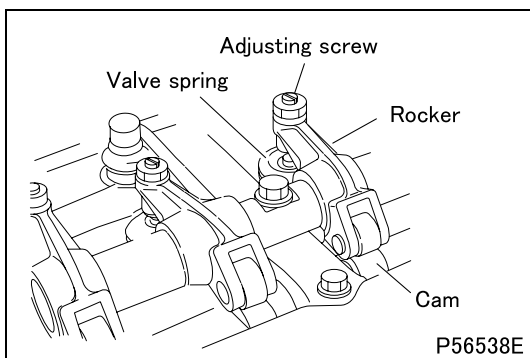
■ Inspection: Backlash between gears

- Measure the backlash at three or more locations for each pair of gears.
- If any of the measurements exceeds the specified limit, replace the defective part(s).



■ Inspection: Camshaft end play

- If the end play exceeds the specified limit, replace the defective part(s).

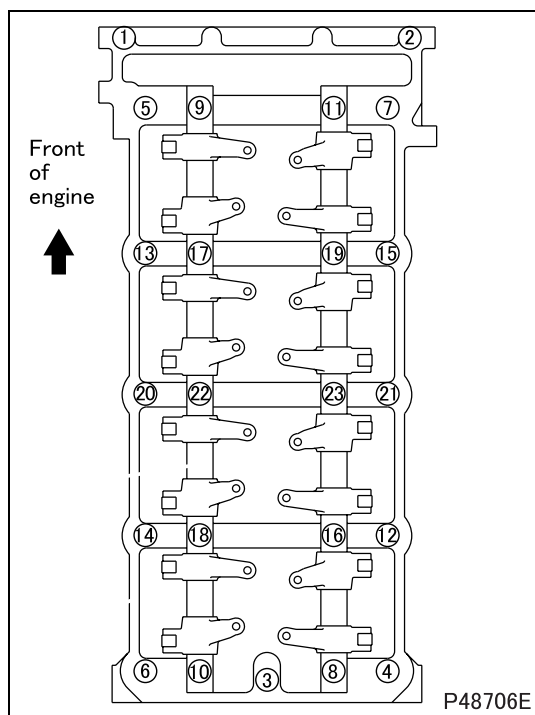


■ Releasing valve spring tension

- Before removing the bolts in the next process, loosen the adjusting screws on the rockers whose valve springs are compressed (due to the cams lifting these rockers). This operation is necessary to release the tension in the valve springs, thus preventing other parts from undue forces when the bolts are removed.

ROCKERS AND CAMSHAFTS

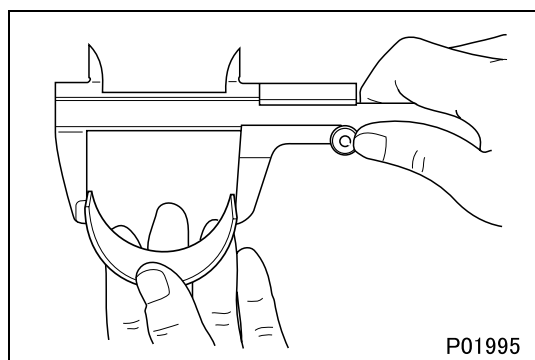
◆ Removal procedure ◆



■ Removal: Rocker shafts and camshaft frame

- Loosen the rocker shaft installation bolts (10 places) and the camshaft frame installation bolts (13 places) in several passes in the order indicated in the illustration (1 to 23). Then, remove the rocker shafts and the camshaft frame.

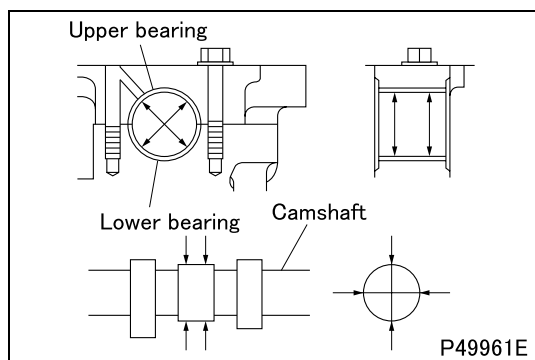
◆ Inspection procedure ◆



■ Inspection: Camshaft bearing free span

CAUTION ⚠

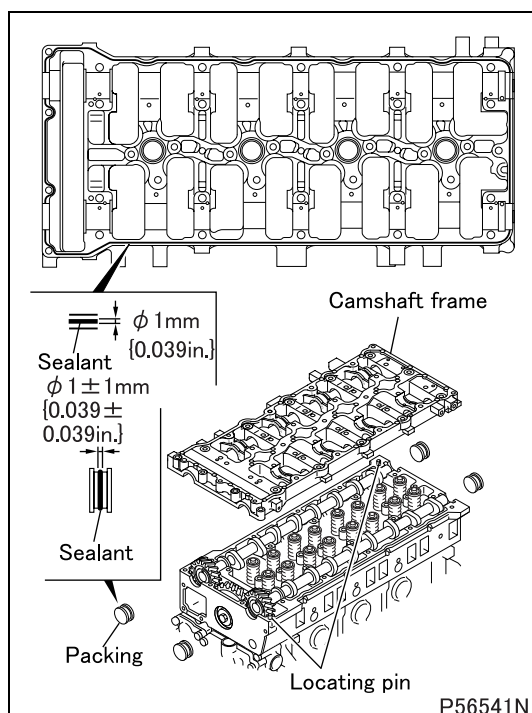
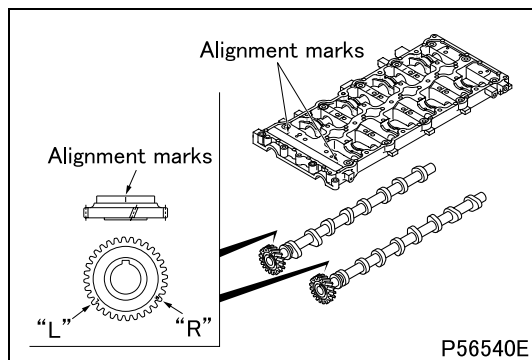
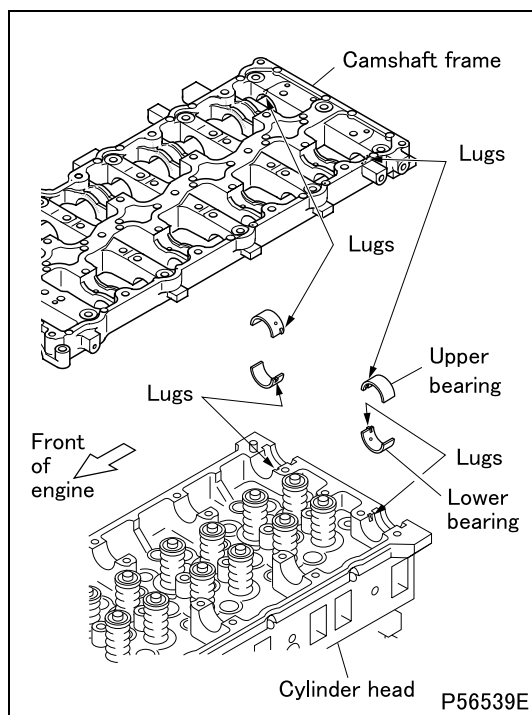
- Do not force the bearings open.
 - When replacing the bearings, always replace the upper and lower bearings as a set.
-
- Replace the bearings if the measurement is not within the standard value range.



■ Inspection: Camshaft bearing-to-camshaft clearance

- If the measurement is not within the standard value range, replace the defective part(s).

◆ Installation procedure ◆



■ Installation: Camshaft

- Install the upper camshaft bearing on the camshaft frame and the lower camshaft bearing on the cylinder head by fitting their lugs into the notches in the camshaft frame and cylinder head.

- Place the No. 1 cylinder piston at the top dead center on the compression stroke.
- Align the mating marks on the camshaft gears with those on the camshaft frame when installing the camshafts.

NOTE

- Each camshaft gear also has mating mark "L" or "R" for alignment with the head idler gear. This mark may not be exactly aligned with that on the head idler gear, as the position that the head idler gear takes when it is installed may make it impossible to align them. Such a misalignment does not lead to any undesirable consequences.

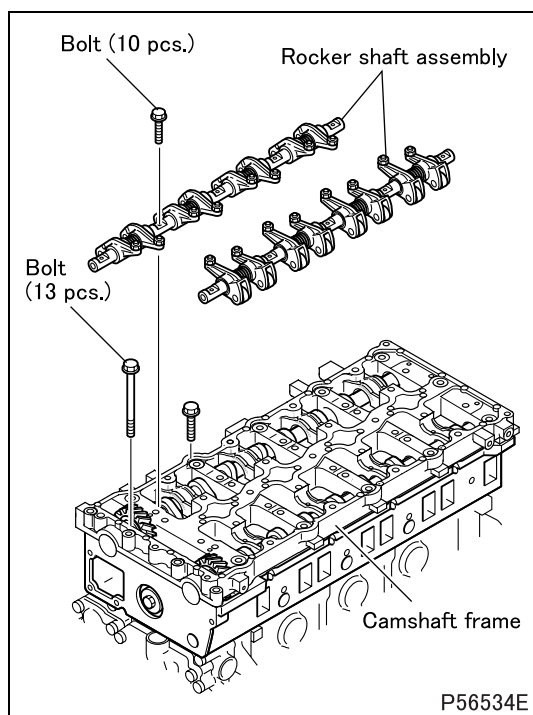
■ Installation: Rocker shafts and camshaft frame

- Clean the sealant application surfaces on each part.
- Apply sealant to the entire periphery of the four packings evenly and without any breaks.
- Apply sealant to the camshaft frame evenly and without any breaks.
- Mount the camshaft frame and packing on the cylinder head within three minutes of applying the sealant, being careful not to dislodge the sealant in the process.

CAUTION ⚠

- Do not run the engine within one hour of installing the rocker shafts and camshaft frame.

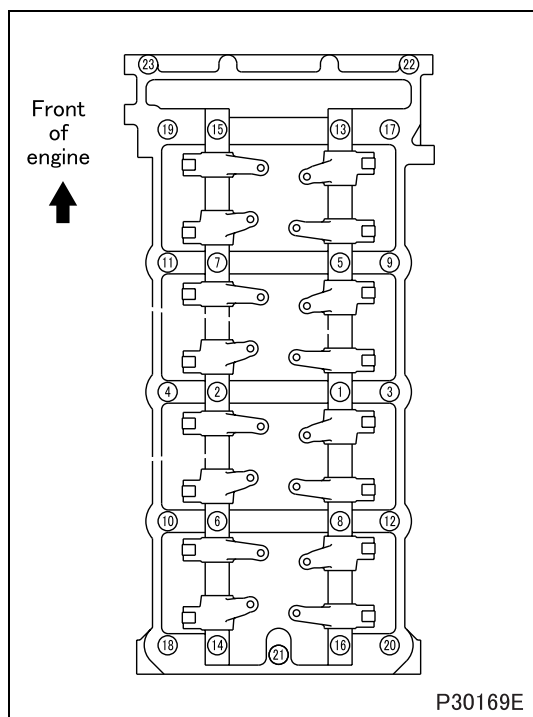
ROCKERS AND CAMSHAFTS



- When installing the camshaft frame on the cylinder head, also install the rocker shafts. Then, tighten the rocker shaft bolts (10 places) and the camshaft frame bolts (13 places) in the order indicated below.

CAUTION ⚠

- Reapply sealant to the areas specified above if any of the bolts is loosened or removed after the rocker shafts and camshaft frame are installed.

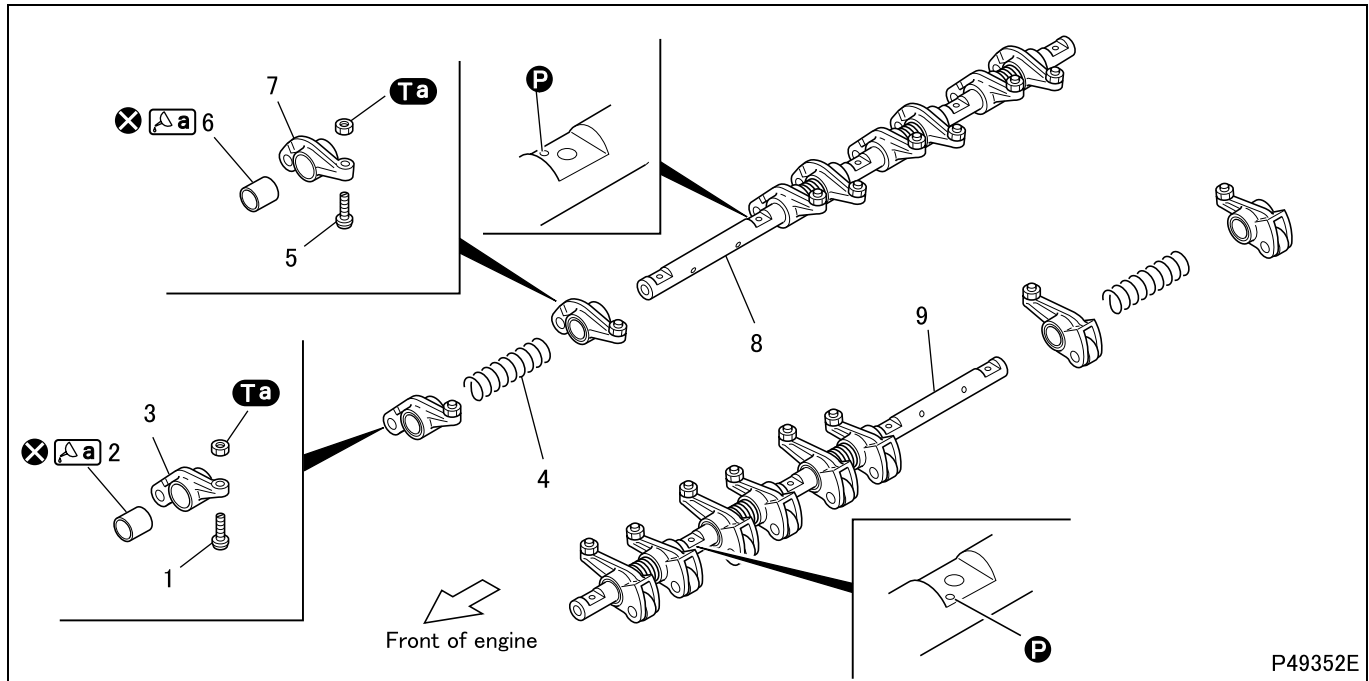


- Tighten the bolts (1 to 23) to the specified torque in the order indicated in the illustration.

M E M O

ROCKERS AND CAMSHAFTS

Rocker Shafts and Rockers



● Disassembly sequence

- 1 Adjusting screw
- 2 Rocker bushing
- 3 Short rocker
- 4 Rocker shaft spring
- 5 Adjusting screw
- 6 Rocker bushing

- 7 Long rocker
- 8 Exhaust rocker shaft
- 9 Intake rocker shaft

- P**: Hole for camshaft frame locating pin
×: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- The short rockers and long rockers must be installed alternately. Be aware that the order of installation for the intake rockers is different from the order of installation for the exhaust rockers.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3, 7	Rocker (roller) radial play	0.038 to 0.100 {0.0015 to 0.0039}	—	Replace
2, 6, 8, 9	Rocker bushing-to-rocker shaft clearance	0.01 to 0.08 {0.00039 to 0.0031}	0.12 {0.0047}	Replace

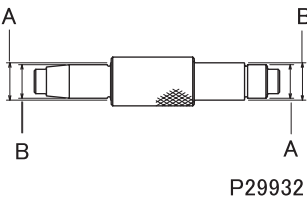
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (adjusting screw stopping)	20.6 {15, 2.1}	—

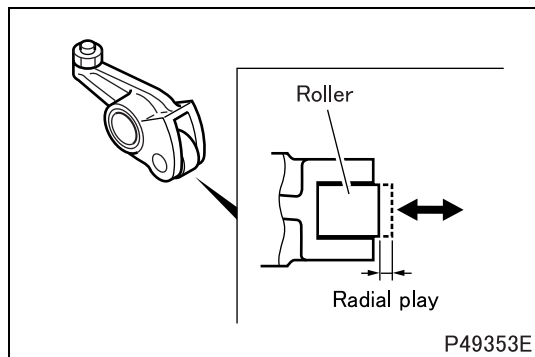
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Rocker bushing inner surface	Engine oil	As required

Special tools (Unit: mm {in.})

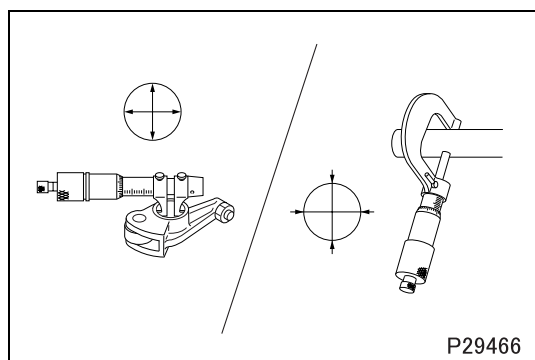
Mark	Tool name and shape	Part No.	Application						
	Rocker bushing puller <table><tr><td>A</td><td>B</td></tr><tr><td>φ22</td><td>φ24.5</td></tr><tr><td>{φ0.87}</td><td>{φ0.96}</td></tr></table>  P29932	A	B	φ22	φ24.5	{φ0.87}	{φ0.96}	MH062536	Removal and installation of rocker bushing
A	B								
φ22	φ24.5								
{φ0.87}	{φ0.96}								

◆ Inspection procedure ◆



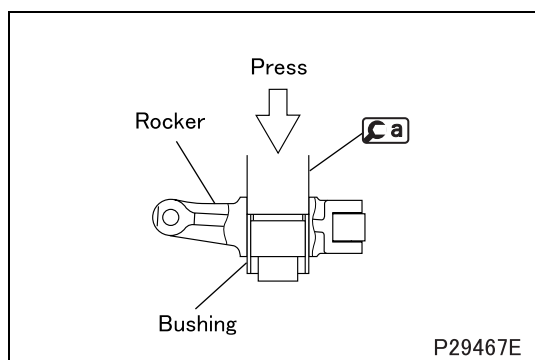
■ Inspection: Rocker (roller) radial clearance

- Replace the rocker if the radial play measurement is not within the standard value range.



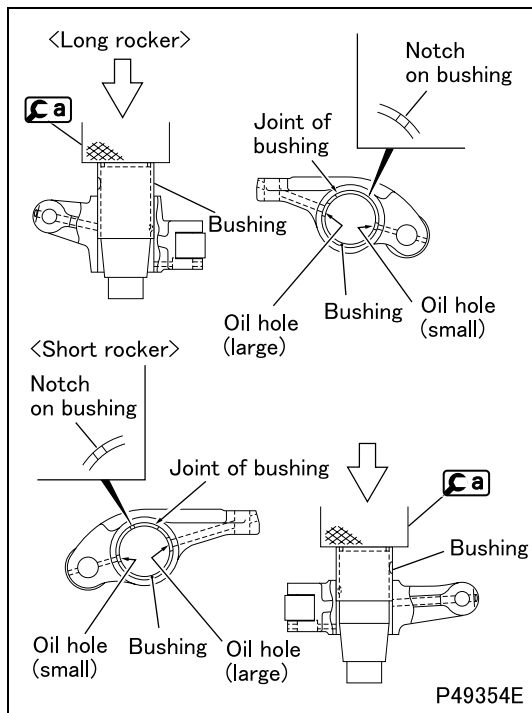
■ Inspection: Rocker bushing-to-rocker shaft clearance

- Replace the bushing if the measurement exceeds the specified limit.



Replacement of rocker bushing [Removal]

ROCKERS AND CAMSHAFTS



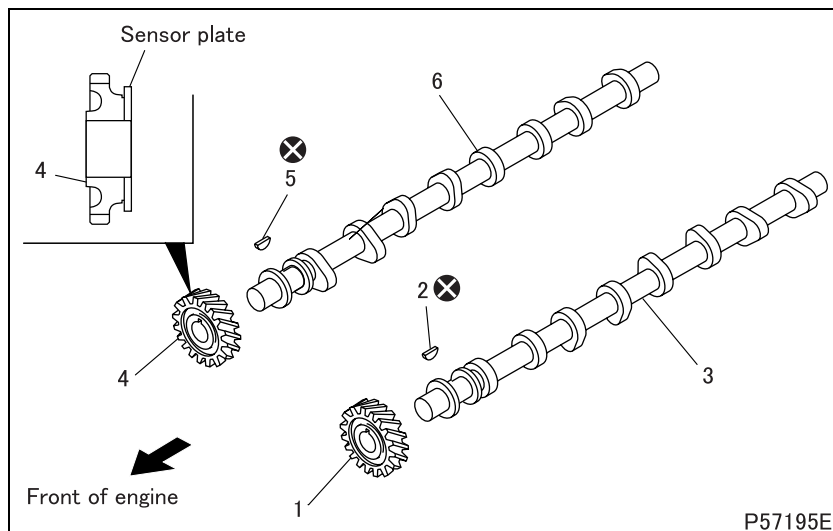
[Installation]

- Press-fit each rocker bushing in the rocker with its ends facing in the illustrated directions.

M E M O

ROCKERS AND CAMSHAFTS

Camshafts



Disassembly sequence

- 1 Intake camshaft gear
- 2 Key
- 3 Intake camshaft
- 4 Exhaust camshaft gear
- 5 Key
- 6 Exhaust camshaft

⊗: Non-reusable parts

NOTE

- Do not remove the camshaft gears unless defects are evident.

Assembly sequence

Follow the disassembly sequence in reverse.

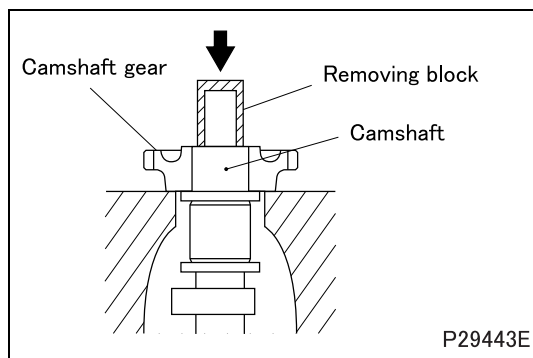
NOTE

- The exhaust camshaft gear has the sensor plate. Do not mistake it for the intake camshaft gear. If the gears are incorrectly installed, engine malfunction will occur.

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy	
1, 3, 4, 6	Camshaft gear-to-camshaft interference			0.007 to 0.041 {0.00028 to 0.0016}	—	Replace	
3	Intake camshaft	Cam lift	Cams for long rockers	7.21 {0.284}	7.16 {0.282}	Re- place	Lobe height: 42.219 {1.66} Base circle diameter: 35.009 {1.38}
			Cams for short rockers	9.269 {0.365}	9.219 {0.363}		Lobe height: 44.281 {1.74} Base circle diameter: 35.012 {1.38}
		Bend		0.01 {0.00039}	0.03 {0.0012}	Replace	
6	Exhaust camshaft	Cam lift	Cams for long rockers	7.184 {0.283}	7.134 {0.281}	Re- place	Lobe height: 42.279 {1.66} Base circle diameter: 35.095 {1.38}
			Cams for short rockers	9.242 {0.364}	9.192 {0.362}		Lobe height: 44.359 {1.75} Base circle diameter: 35.117 {1.38}
		Bend		0.01 {0.00039}	0.03 {0.0012}	Replace	

Removal procedure



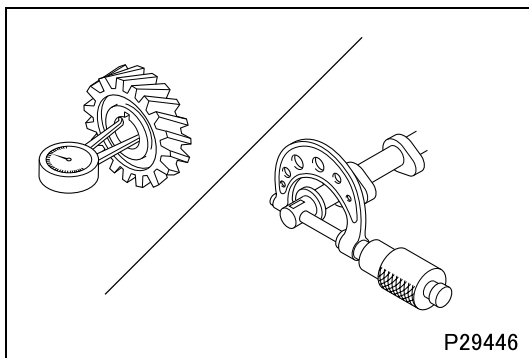
Removal: Camshaft gears

- Remove the camshaft gear by pushing on the camshaft using a press.

CAUTION

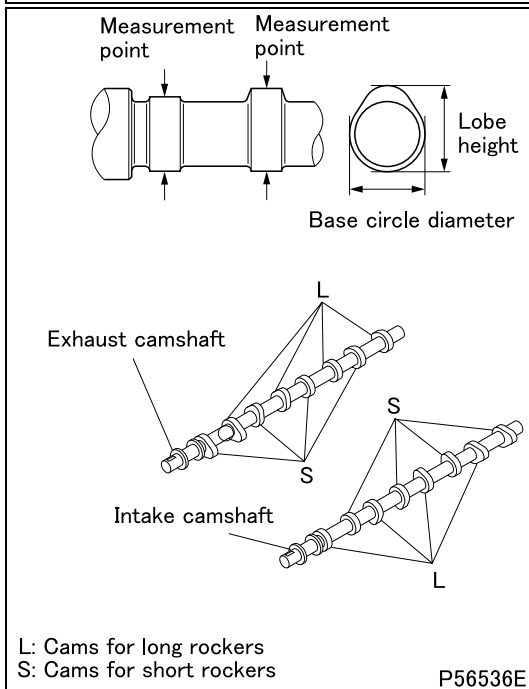
- Do not use a hammer to remove the camshaft gear. Be sure to use a press for this purpose.

◆ Inspection procedure ◆



■ Inspection: Camshaft gear-to-camshaft interference

- If the measurement is not within the standard value range, replace the defective part(s).



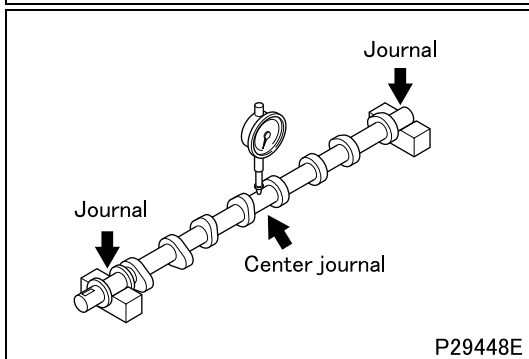
■ Inspection: Camshaft

(1) Cam lift

- Replace the camshaft if the difference between the cam lobe height and base circle diameter measurements is less than the specified limit.

NOTE

- The cams for the long rockers (L) are different from the cams for the short rockers (S).



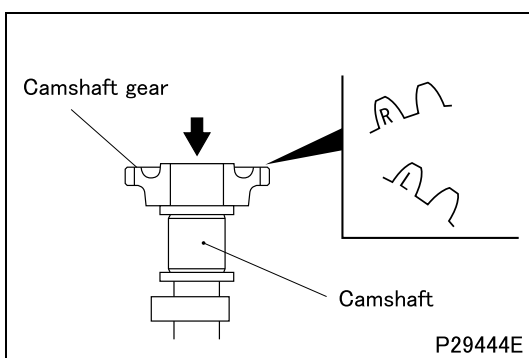
(2) Bend

- Place supports under the journals at the ends of the camshaft and measure the bend of the camshaft at the central journal.
- If the measurement exceeds the specified limit, replace the camshaft.

NOTE

- Turn the camshaft by one turn and read the dial gauge. Divide the reading by two to obtain the amount of camshaft bend.

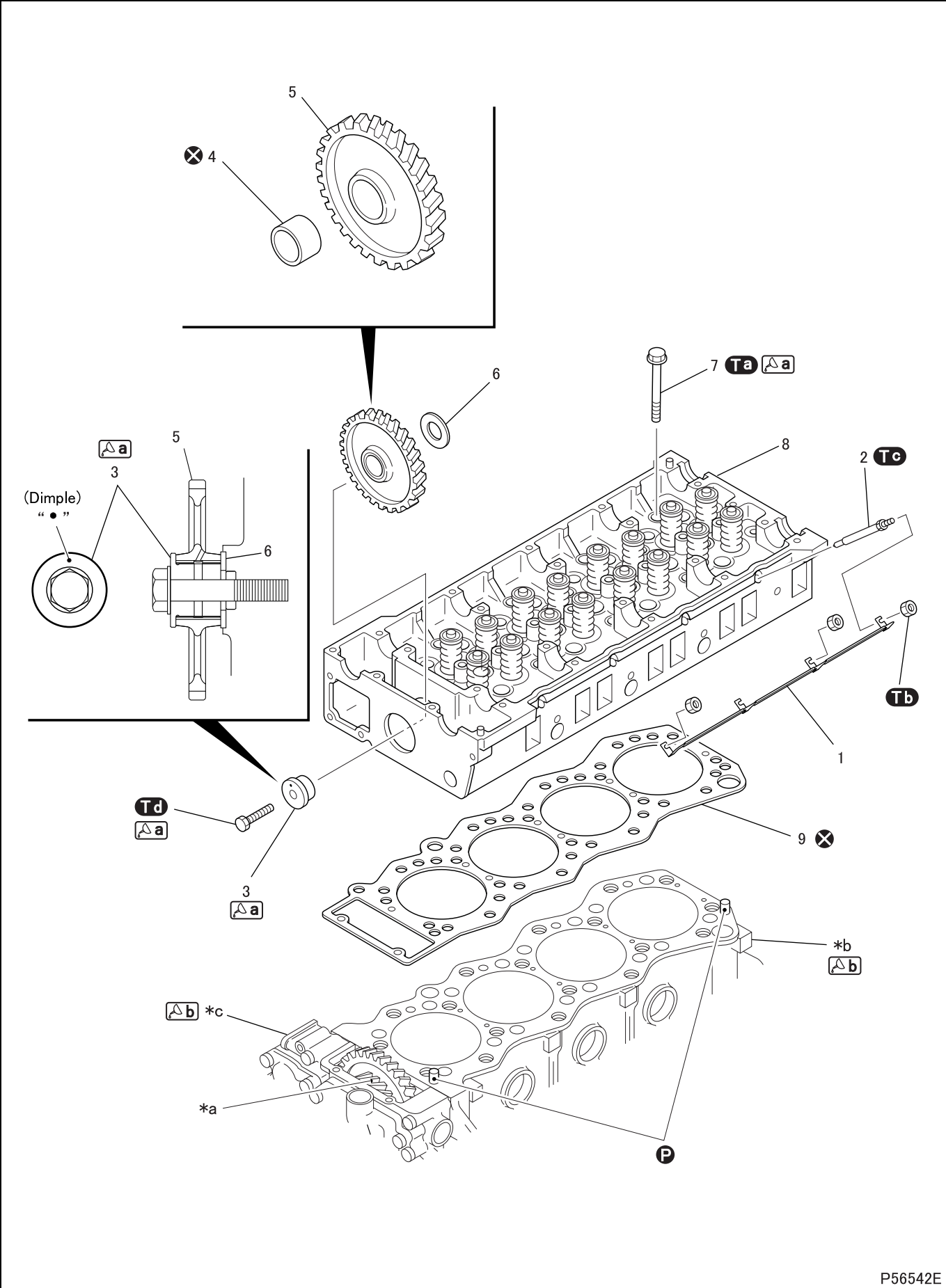
◆ Installation procedure ◆



■ Installation: Camshaft gears

- Heat the camshaft gears to approximately 150°C {302°F} with a gas burner.
- Install the camshaft gear on the camshaft with a mating mark ("R" or "L") facing in the illustrated direction.
- Press the gear until its end comes in close contact with the flange on the camshaft.

CYLINDER HEAD AND VALVE MECHANISM



P56542E

● Disassembly sequence

- | | | |
|---------------------------|------------------------|-----------------------|
| 1 Connection plates | 6 Thrust plate | *a: Idler gear |
| 2 Glow plug | 7 Cylinder head bolt | *b: Upper crankcase |
| 3 Head idler shaft | 8 Cylinder head | *c: Front case |
| 4 Head idler gear bushing | (See later sections.) | P: Locating pin |
| 5 Head idler gear | 9 Cylinder head gasket | ⊗: Non-reusable parts |

CAUTION

- Be careful not to damage the glow plugs and injectors when placing the cylinder head on the worktable, as they are protruding out of the bottom of the cylinder head.
- The cylinder head bolts are tightened using the torque-turn method. Any cylinder head bolt that has three marks indicating that the bolt has been tightened three times already must be replaced with a new one.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- Do not forget to install the thrust plate.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Head idler gear end play	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	Replace
3, 4	Head idler shaft-to-head idler gear bushing clearance	0.01 to 0.05 {0.00039 to 0.0020}	0.1 {0.0039}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

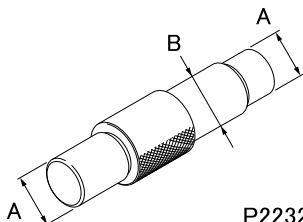
Mark	Parts to be tightened	Tightening torque	Remarks
	Cylinder head bolt	147 {110, 15} + 90°	Wet
	Nut (connection plate installation)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.15}	–
	Glow plug	19.6 to 24.5 {14 to 18, 2 to 2.5}	–
	Bolt (head idler shaft installation)	51.0 {38, 5.2}	–

Lubricant and/or sealant

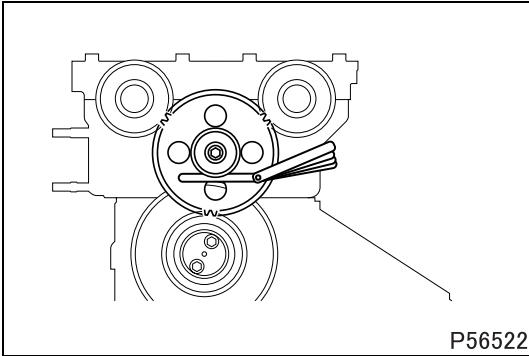
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	O-ring	Engine oil	As required
	Bolt (head idler gear installation) threads and seating surface under head		
	Head idler shaft outer peripheral surface		
	Cylinder head bolt threads		
	Top surfaces of joints between upper crankcase and front case	THREEBOND 1207C	As required

CYLINDER HEAD AND VALVE MECHANISM

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application			
	Idler gear bushing puller	MH061779	Removal and installation of idler gear bushing			
	<table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ32</td><td>φ35</td></tr><tr><td>{φ1.26}</td><td>{φ1.38}</td></tr></table>  P22322			A	B	φ32
A	B					
φ32	φ35					
{φ1.26}	{φ1.38}					

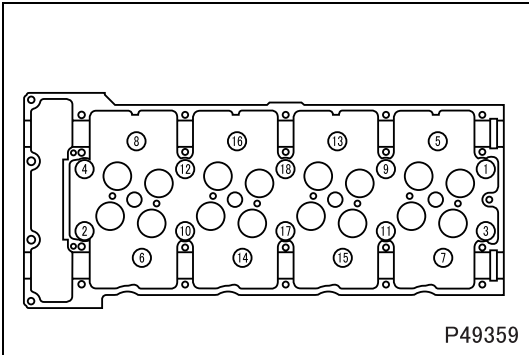
◆ Inspection before removal ◆



■ Inspection: Head idler gear end play

- If the measurement exceeds the specified limit, replace the defective part(s).

◆ Removal procedure ◆



■ Removal: Cylinder head

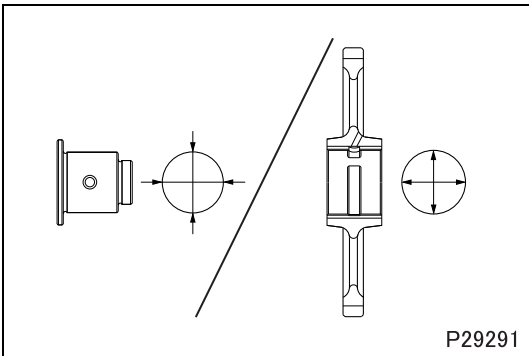
- Loosen the cylinder head bolts (1 to 18) in several passes in the order indicated in the illustration and remove the cylinder head.

■ Removal: Cylinder head gasket

CAUTION

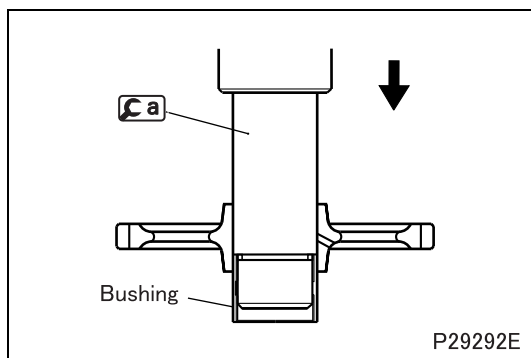
- When removing the cylinder head gasket, be careful not to scratch the cylinder head, the upper crankcase and the front case.

◆ Inspection procedure ◆

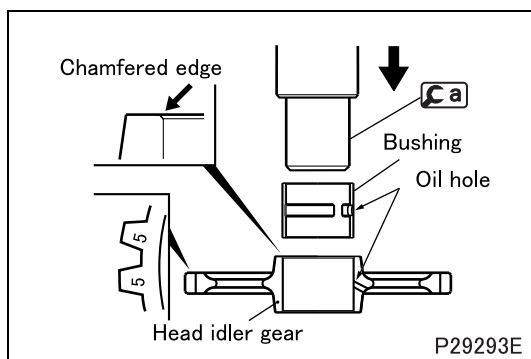


■ Inspection: Head idler shaft-to-head idler gear bushing clearance

- Replace the bushing if the measurement exceeds the specified limit.



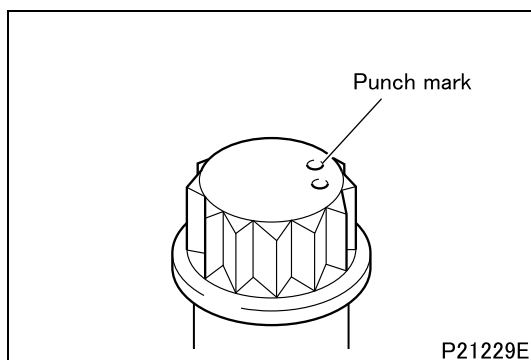
Replacement of head idler gear bushing [Removal]



[Installation]

- Position the bushing on the head idler gear with their ends facing the illustrated directions and their oil holes on the same line.
- Using **Ca**, press the bushing into the head idler gear until it is flush with the lower edge of the chamfer on the head idler gear.
- Remeasure the clearance between the bushing and head idler shaft.
- Ream the bushing if the measurement is less than the standard value.

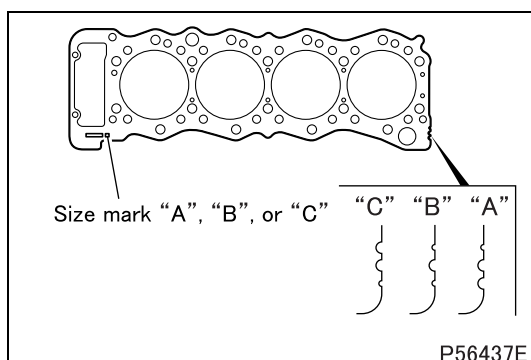
◆ Installation procedure ◆



■ Installation: Cylinder head

CAUTION ⚠

- Before fitting the cylinder head bolts, check the punch marks on each bolt's head. Do not use the bolt if there are three punch marks.
- The punch marks indicate the number of times each bolt has been tightened using the torque-turn tightening method. Any bolt that already has three punch marks must be replaced.



- The cylinder head gasket comes in three sizes. Choose the gasket appropriate for the cylinder head by the following procedure.
- Measure the amount of piston projection for every cylinder. (See the **"PISTONS, CONNECTING RODS AND CYLINDER LINERS"** section.)
- Select a cylinder head gasket with the appropriate thickness for the average of the piston projection measurements from the table below.
- If any of the piston projection measurements is more than 0.05 mm {0.0020 in.} larger than the average value, then use the gasket one class higher than that class (A→B, B→C).

Unit: mm {in.}

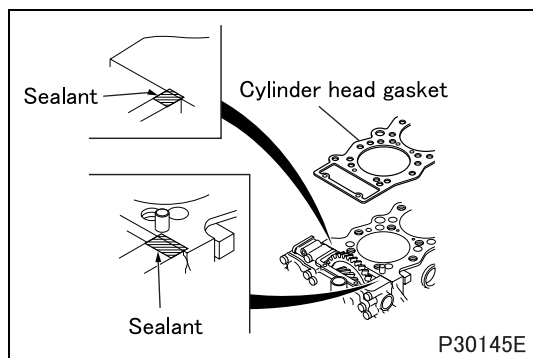
Piston projection	Cylinder head gasket	
	Size	Thickness when tightened
-0.088 to -0.027 {-0.0035 to -0.0011}	"A"	0.75 ± 0.03 {0.030 ± 0.0012}
-0.027 to 0.033 {-0.0011 to 0.0013}	"B"	0.80 ± 0.03 {0.031 ± 0.0012}
0.033 to 0.094 {0.0013 to 0.0037}	"C"	0.85 ± 0.03 {0.033 ± 0.0012}

CYLINDER HEAD AND VALVE MECHANISM

- The size class of the cylinder head gasket can be determined from the size mark or the shape of the notches cut on the gasket edge.

CAUTION

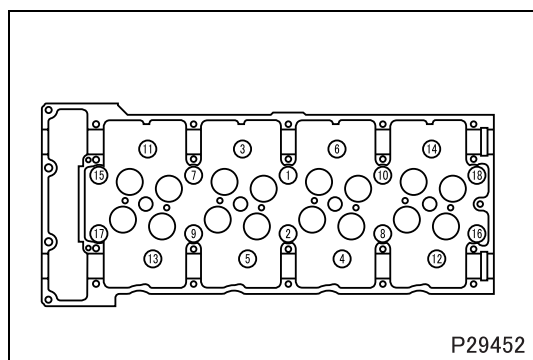
- Replacement of the piston or connecting rod alters the piston projection. Always measure the amount of piston projection after either or both of them are replaced.



- Clean the sealant application surfaces of each part.
- Apply sealant to the top surfaces of the joints between the upper crankcase and front case (at two places).
- Install the cylinder head and its gasket on the upper crankcase within three minutes of applying the sealant, being careful not to dislodge the sealant.

CAUTION

- Do not run the engine within one hour of mounting the cylinderhead. If any cylinder head bolts are loosened or removed, be sure to reapply sealant to the surfaces specified above.



- Tighten the cylinder head bolts (1 to 18) to a torque of 147 N·m {110 ft.lbs, 15 kgf·m} (wet) in the order indicated in the illustration. Then, tighten them further by 90° in the same order.
- After tightening each bolt, make a punch mark on the head of the bolt to indicate the number of times that it has been used.

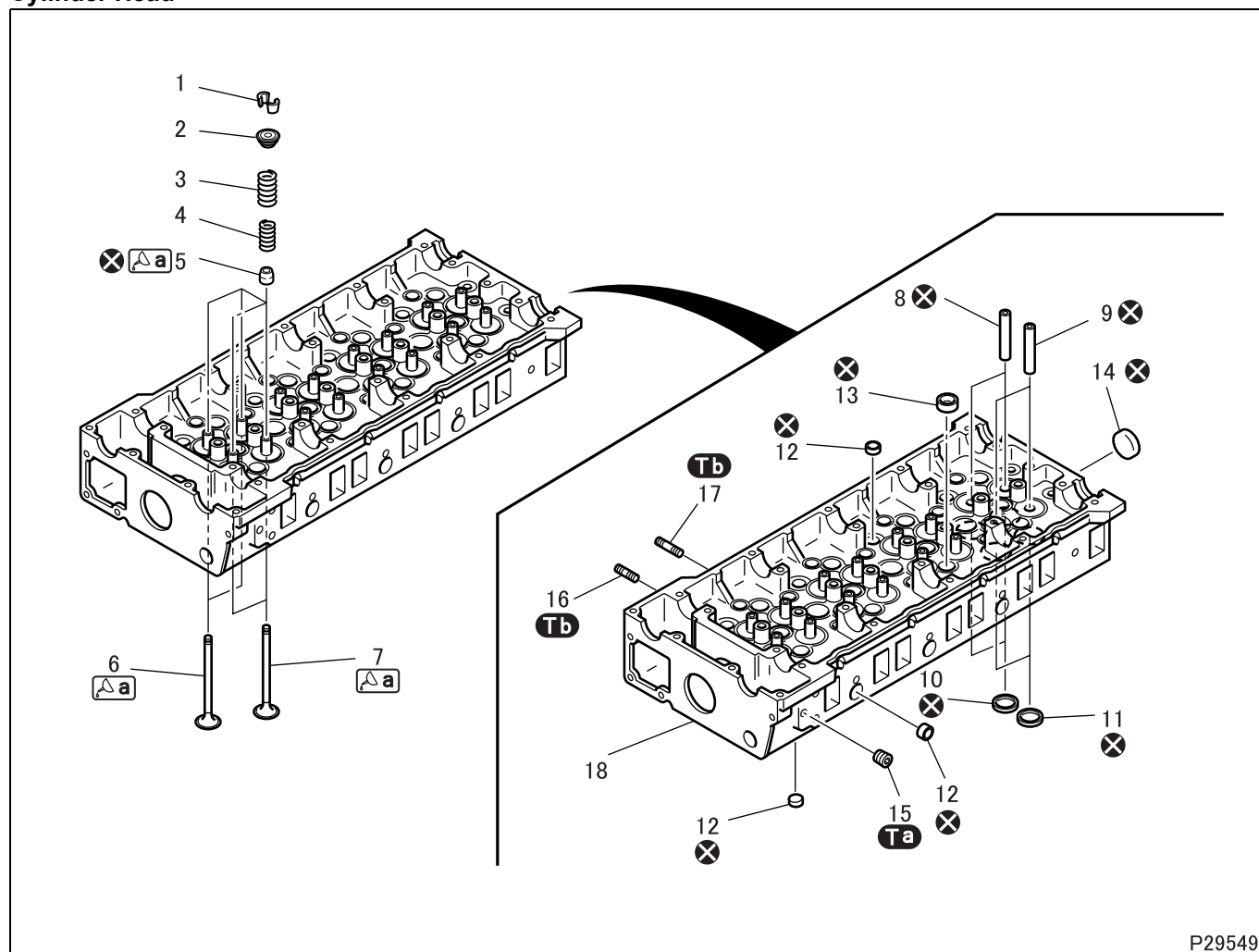
CAUTION

- Cylinder head bolts that have been tightened using the torque-turn method must never be additionally tightened after the final angular tightening.

M E M O

CYLINDER HEAD AND VALVE MECHANISM

Cylinder Head



P29549

● Disassembly sequence

- | | |
|-----------------------|--|
| 1 Valve cotter | 10 Exhaust valve seat |
| 2 Upper retainer | 11 Intake valve seat |
| 3 Outer valve spring | 12 Sealing cap
(diameter: 22 mm {0.87 in.}) |
| 4 Inner valve spring | 13 Sealing cap
(diameter: 30 mm {1.18 in.}) |
| 5 Valve stem seal | 14 Sealing cap
(diameter: 40 mm {1.57 in.}) |
| 6 Exhaust valve | 15 Taper plug |
| 7 Intake valve | |
| 8 Exhaust valve guide | |
| 9 Intake valve guide | |

- | |
|------------------|
| 16 Stud (short) |
| 17 Stud (long) |
| 18 Cylinder head |

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- When an intake valve or exhaust valve have been removed, make sure to replace the valve stem seal.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
3	Outer valve spring	Free length	87.8 {3.46}	—	Replace
		Installed load (57 {2.24} in installed length)	360 N {81 lbs, 36.7 kgf}	—	
		Squareness	—	2.5 {0.098}	
4	Inner valve spring	Free length	78.8 {3.10}	—	Replace
		Installed load (52.3 {2.06} in installed length)	168 N {38 lbs, 17.1 kgf}	—	
		Squareness	—	2.5 {0.098}	
6	Exhaust valve	Stem outside diameter	$\phi 8 \begin{smallmatrix} -0.060 \\ -0.075 \end{smallmatrix} \{ \phi 0.31 \begin{smallmatrix} -0.0024 \\ -0.0030 \end{smallmatrix} \}$	—	Replace
		Sinkage from cylinder head bottom surface	1.5 ± 0.25 {0.059 $\pm$ 0.0098}	—	Inspect
		Valve margin	1.5 {0.059}	—	Reface or replace
		Seat angle	45° $\pm$ 15'	—	Reface
6, 8	Exhaust valve stem-to-valve guide clearance		0.07 to 0.10 {0.0028 to 0.0039}	0.2 {0.0079}	Replace
7	Intake valve	Stem outside diameter	$\phi 8 \begin{smallmatrix} -0.025 \\ -0.040 \end{smallmatrix} \{ \phi 0.31 \begin{smallmatrix} -0.00098 \\ -0.0016 \end{smallmatrix} \}$	—	Replace
		Sinkage from cylinder head bottom surface	1.5 ± 0.25 {0.059 $\pm$ 0.0098}	—	Inspect
		Valve margin	1.5 {0.059}	—	Reface or replace
		Seat angle	45° $\pm$ 15'	—	Reface
7, 9	Intake valve stem-to-valve guide clearance		0.03 to 0.06 {0.0012 to 0.0024}	0.2 {0.0079}	Replace
10	Exhaust valve seat width		2.5 ± 0.2 {0.098 $\pm$ 0.0079}	3.5 {0.14}	Correct or replace
11	Intake valve seat width		2 ± 0.2 {0.079 $\pm$ 0.0079}	2.8 {0.11}	Correct or replace
18	Cylinder head	Bottom surface distortion	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Height from top surface to bot- tom surface	107 $\pm$ 0.5 {4.21 $\pm$ 0.020}	106.5 {4.19}	Replace

Tightening torque (Unit: N·m {kgf·m})

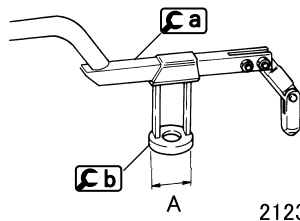
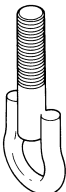
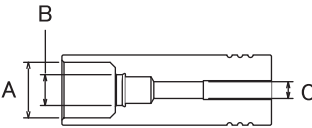
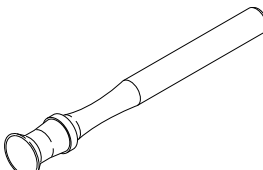
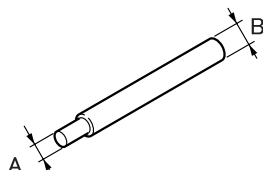
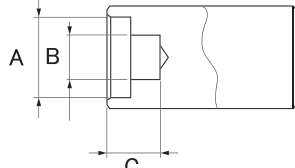
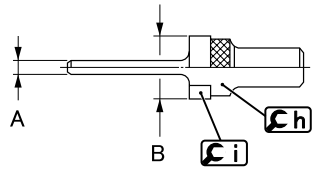
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Tapered plug	14 {10, 1.4}	—
Tb	Stud	20 {15, 2.0}	—

Lubricant and/or sealant

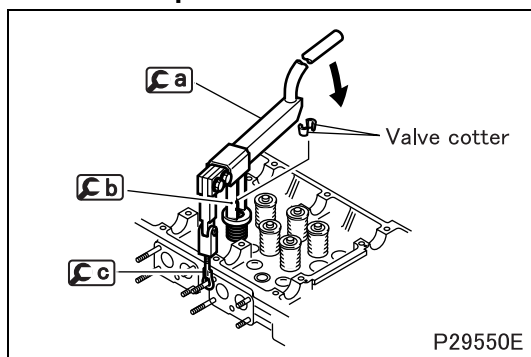
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Lip of valve stem seal	Engine oil	As required
	Valve stem and valve end		

CYLINDER HEAD AND VALVE MECHANISM

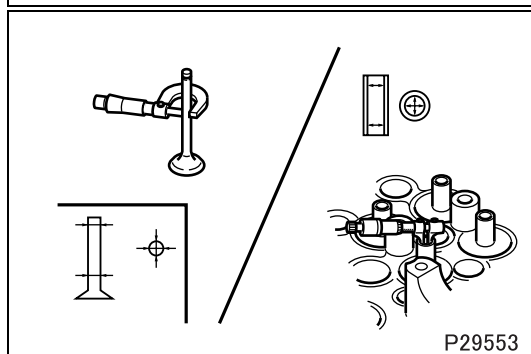
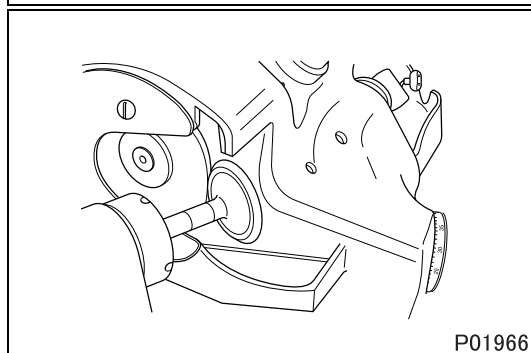
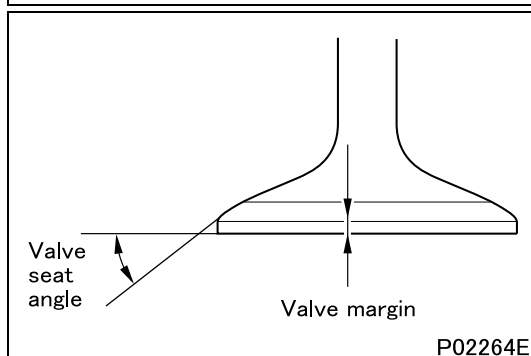
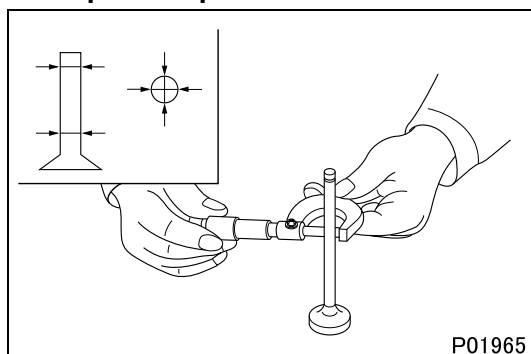
Special tools (Unit: mm {in.})

Mark	Tool name and shape		Part No.	Application									
	Valve lifter	 21239	MH061668	Removal and installation of valve cutters									
	Valve lifter seat <table border="1"><tr><td>A</td></tr><tr><td>φ38</td></tr><tr><td>{φ1.50}</td></tr></table>		A		φ38	{φ1.50}	MH061772						
A													
φ38													
{φ1.50}													
	Valve lifter hook	 21240	MH061679										
	Valve stem seal installer <table border="1"><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>φ26.5</td><td>φ14.7</td><td>φ8</td></tr><tr><td>{φ1.04}</td><td>{φ0.58}</td><td>{φ0.31}</td></tr></table>	A	B	C	φ26.5	φ14.7	φ8	{φ1.04}	{φ0.58}	{φ0.31}	 P29931	MH063607	Installation of valve stem seals
A	B	C											
φ26.5	φ14.7	φ8											
{φ1.04}	{φ0.58}	{φ0.31}											
	Valve lapper	 P01958	30091-07500	Lapping valves and valve seats									
	Valve guide remover <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ8</td><td>φ12</td></tr><tr><td>{φ0.31}</td><td>{φ0.47}</td></tr></table>	A	B	φ8	φ12	{φ0.31}	{φ0.47}	 P01959	31391-10500	Removal of valve guides			
A	B												
φ8	φ12												
{φ0.31}	{φ0.47}												
	Valve guide installer <table border="1"><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>φ25.5</td><td>φ13</td><td>29</td></tr><tr><td>{φ1.00}</td><td>{φ0.51}</td><td>{φ1.14}</td></tr></table>	A	B	C	φ25.5	φ13	29	{φ1.00}	{φ0.51}	{φ1.14}	 P01960	MH063604	Installation of valve guides
A	B	C											
φ25.5	φ13	29											
{φ1.00}	{φ0.51}	{φ1.14}											
	Caulking tool body <table border="1"><tr><td>A</td></tr><tr><td>φ8</td></tr><tr><td>{φ0.31}</td></tr></table>	A	φ8	{φ0.31}	 P01961B	31391-13100	Installation of valve seat						
A													
φ8													
{φ0.31}													
	Installer ring <table border="1"><tr><td>B</td></tr><tr><td>φ38</td></tr><tr><td>{φ1.50}</td></tr></table>	B	φ38	{φ1.50}	MH063605								
B													
φ38													
{φ1.50}													

◆ Removal procedure ◆



◆ Inspection procedure ◆



■ Removal: Valve cotters

- Remove the valve cotters by evenly compressing the valve springs.

■ Inspection: Intake valves and exhaust valves

(1) Inspection of valve stem

- Replace the valve if the stem's outside diameter is below the limit or is severely worn.
- When the valve has been replaced with a new one, make sure to lap the valve and valve seat.

(2) Valve seat angle and valve margin

- Reface or replace the valve if the valve seat angle or valve margin exceeds the specified limits.

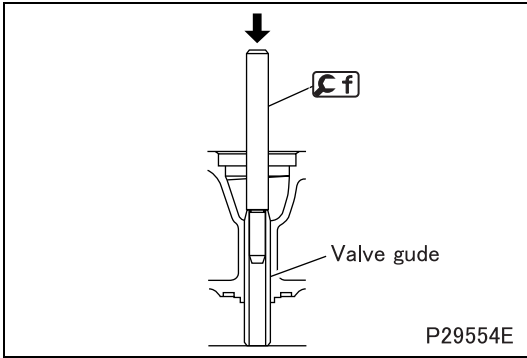
Refacing

- Limit grinding to a necessary minimum.
- If the valve margin is below the limit after grinding, replace the valve.
- After grinding, make sure to lap the valve and valve seat.

■ Inspection: Valve-to-valve guide clearance

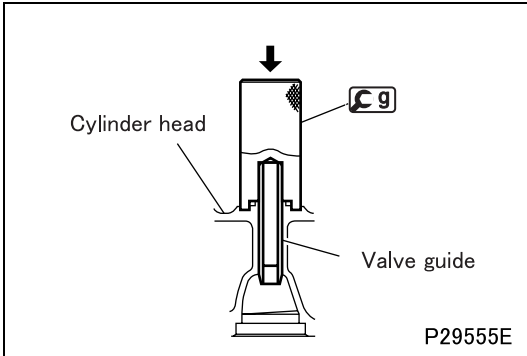
- If the clearance exceeds the specified limit, replace the defective part(s).

CYLINDER HEAD AND VALVE MECHANISM



Replacement of valve guides

[Removal]

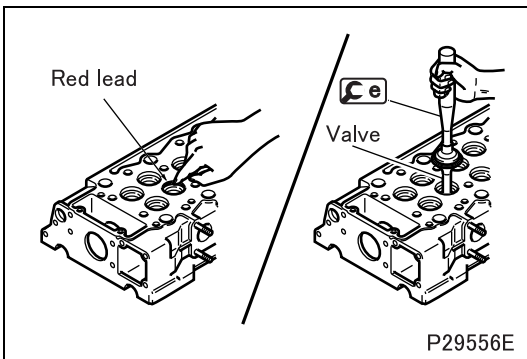


[Installation]

- Install the valve guide until **C g** sits snugly on the cylinder head.

CAUTION ⚠

- The valve guides must be pressed to the specified depth. Be sure to use **C g** for this operation.
- Exhaust valve guides are longer than intake valve guides. Make sure to install the correct type of guide in each location.

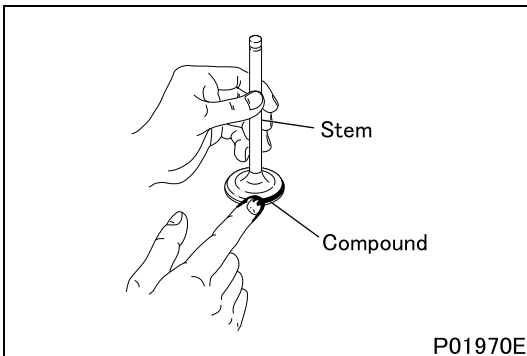
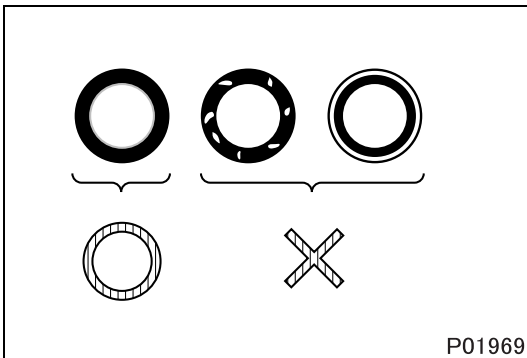


■ Inspection: Contact between valve and valve seat

- Before starting inspection, check that the valve and valve guide are intact.
- Apply an even coat of red lead to the valve contact surface of the valve seat.
- Strike the valve once against the valve seat. Do not rotate the valve during this operation.

- If the red lead deposited on the valve indicates a poor contact pattern, take either of the following corrective actions.

	Corrective action
Minor defect	Lapping
Serious defect	Reface or replace valve and valve seat

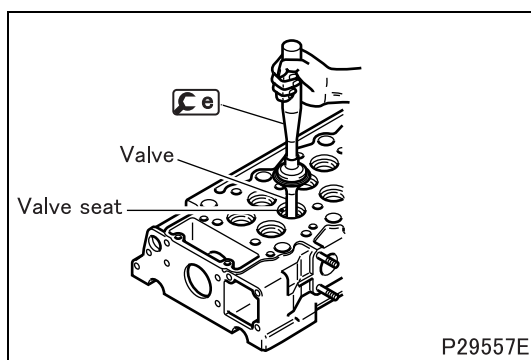


Lapping

- Perform the valve lapping in the following procedure.
- Apply a thin coat of lapping compound to the seat contact surface of the valve.

CAUTION ⚠

- Do not put any compound on the stem.
- Start with an intermediate-grit compound (120 to 150 grit) and finish with a fine-grit compound (200 grit or more). Do not put any compound on the stem.
- Adding a small amount of engine oil to the lapping compound can facilitate even application.



- Strike the valve several times against the valve seat while rotating the valve a little at a time.
- Wash away the compound with diesel fuel.
- Apply engine oil to the valve contact surface of the valve seat and rub in the valve and seat well.
- Inspect the contact pattern of the valve and valve seat again.
- If the contact pattern is still defective, replace the valve seat.

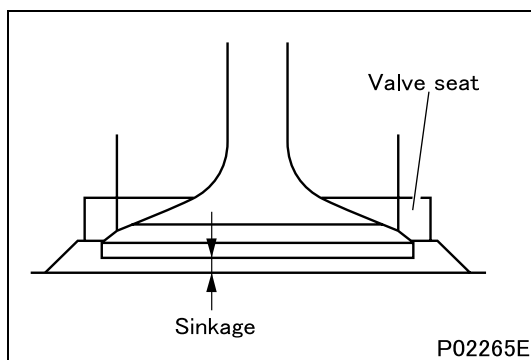
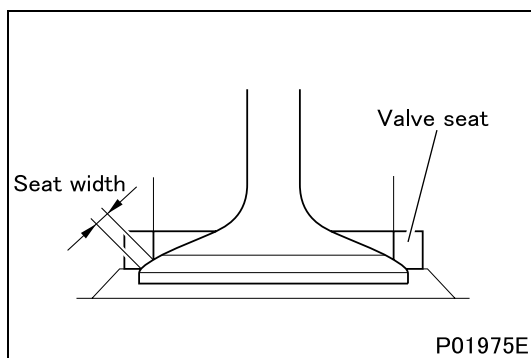
■ Inspection: Valve seats

(1) Valve seat width

- If the measurement exceeds the limit, reface or replace the valve seat.

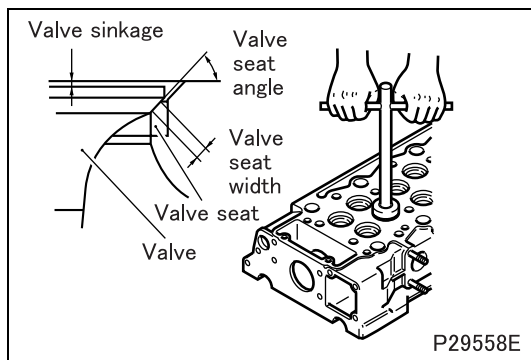
CAUTION ⚠

- After refacing or replacing the valve seat, make sure to lap the valve seat and valve.



(2) Valve sinkage from cylinder head bottom surface

- Make sure that the valve and valve seat are pressed together tightly when measuring the sinkage.
- If the measurement exceeds the limit, reface or replace the defective part(s).



Refacing the valve seat

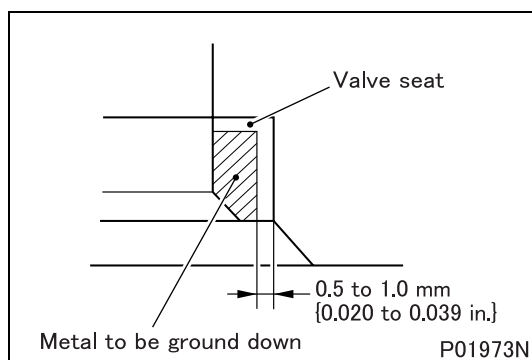
- Grind the valve seat using a valve seat cutter or valve seat grinder.
- Place a sandpaper of around #400 between the cutter and valve seat and grind the valve seat lightly.
- Use a 15° or 75° cutter to cut the valve seat to a width within the standard range. If the valve seat cannot be refaced to a width within the standard range, replace it.

CAUTION ⚠

- Make sure that the valve seat refacing does not cause the valve sinkage to exceed the specified limit.

- Lap the valve and valve seat.

CYLINDER HEAD AND VALVE MECHANISM



Replacement of valve seat

[Removal]

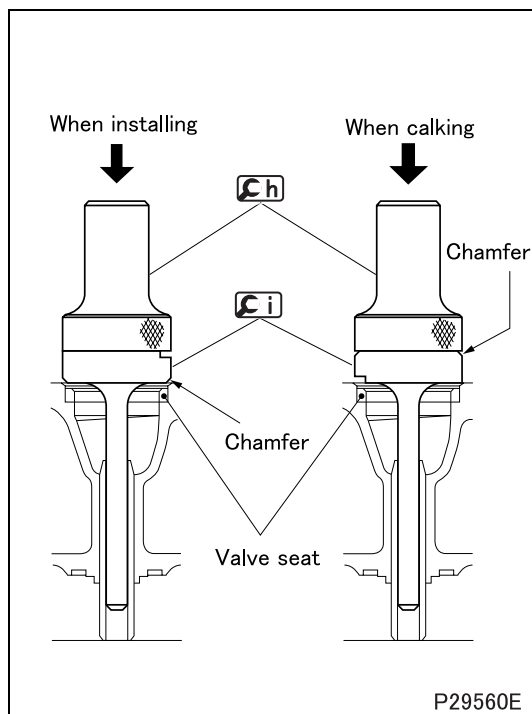
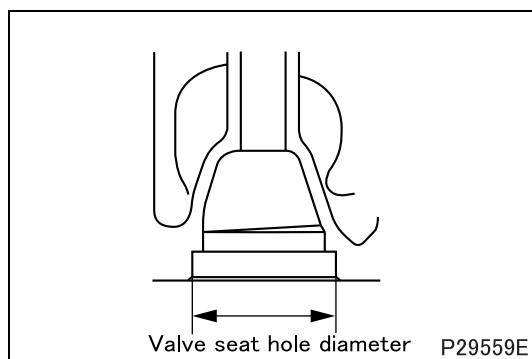
- The valve seats are installed by expansion fitting. To remove a valve seat, grind inside the metal stock to reduce the wall thickness, then remove the valve seat at room temperature.

[Installation]

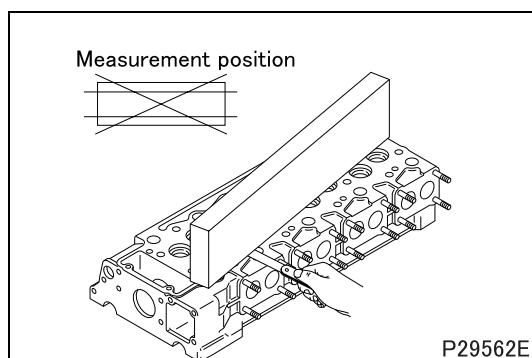
- Check that the diameter of the valve seat hole in the cylinder head conform with the value shown below.

Valve seat hole diameter	$\phi 38^{+0.025}_0$ mm { $\phi 1.50^{+0.00098}_0$ in.}
--------------------------	---

- Replace the cylinder head if the measurement deviates from specification.



- Chill the valve seat thoroughly by immersing it in liquid nitrogen.
- Install the valve seat in the cylinder head using **CH** and **CI**, with the chamfered edge of **CI** toward the valve seat.
- Turn **CI** over so that its chamfered edge is toward **CH**, and calk the valve seat.
- Lap the valve seat and valve.



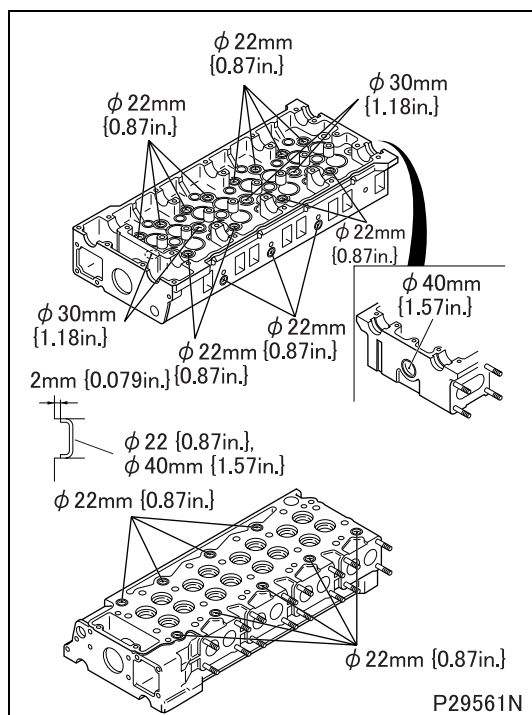
■ Inspection: Cylinder head bottom surface distortion

- If the distortion exceeds the specified limit, rectify it using a surface grinder.

CAUTION ⚠

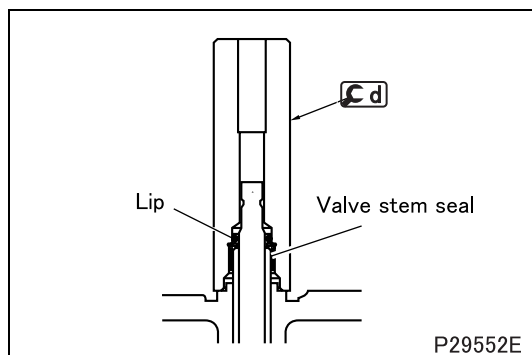
- When grinding the cylinder head bottom surface, make sure that the height of the cylinder head (from the top surface to the bottom surface) is not reduced to a value below the specified limit.

◆ Installation procedure ◆



■ Installation: Sealing caps

- Drive the sealing caps into the cylinder head to the specified depth.



■ Installation: Valve stem seal

- Apply engine oil to the lip of the valve stem seal.
- Install the valve stem seal until **Cd** sits snugly on the cylinder head.

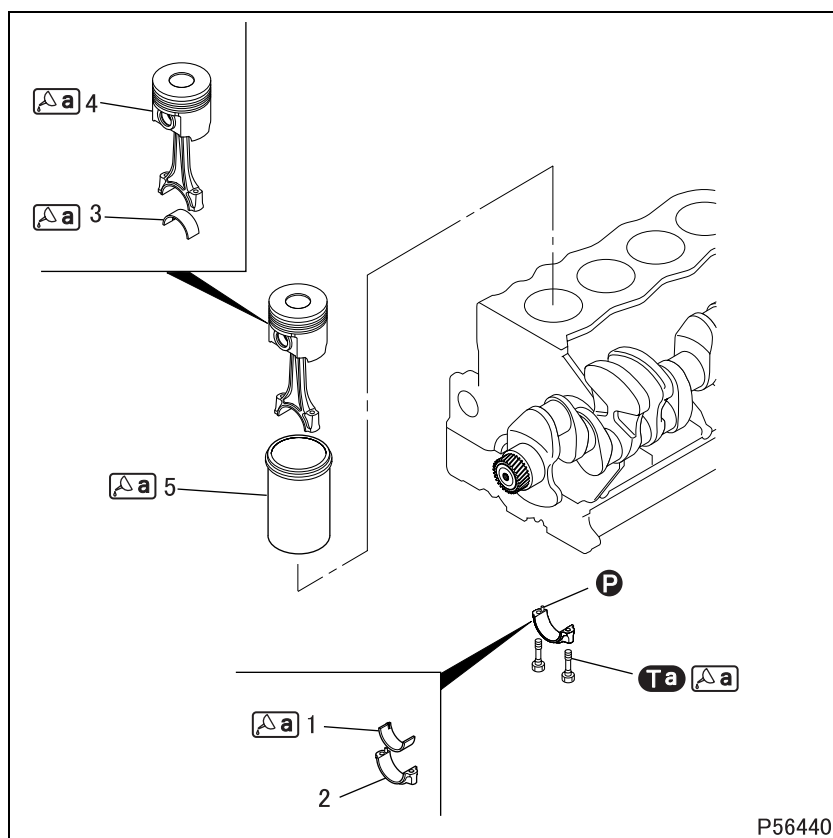
CAUTION ⚠

- After installing the valve stem seal, check that its spring is not deformed or damaged.

■ Installation: Valve cotter

- To install the valve cotter, follow the removal procedure. (See “■ Removal: Valve cotter”.)

PISTONS, CONNECTING ROD AND CYLINDER LINERS



● Disassembly sequence

- 1 Lower connecting rod bearing
- 2 Connecting rod cap
- 3 Upper connecting rod bearing
- 4 Piston and connecting rod assembly (See later sections.)
- 5 Cylinder liner

P: Locating pin

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Piston projection from crankcase top surface (average value)		–0.088 to 0.094 {–0.0035 to 0.037}	–	Inspect
–	Connecting rod end play		0.15 to 0.45 {0.0059 to 0.018}	0.6 {0.024}	Inspect
1, 3	Connecting rod bearing	Span when free	–	Less than 69.5 {2.74}	Replace
		Oil clearance	0.034 to 0.093 {0.0013 to 0.0037}	0.2 {0.0079}	
4, 5	Piston-to-cylinder liner clearance		0.181 to 0.201 {0.0071 to 0.0079}	–	Replace
5	Cylinder liner	Flange projection above crankcase top surface	0.01 to 0.07 {0.00039 to 0.0028}	–	Replace
		Bore diameter	φ114 to 114.02 {φ4.4881 to 4.4889}	φ114.25 {φ4.50}	
		Out-of-roundness	0.08 {0.0031} or less	–	
		Taper	0.03 {0.0012} or less	–	
		Difference in flange projection from neighboring cylinder liner	0.04 {0.0016} or less	–	

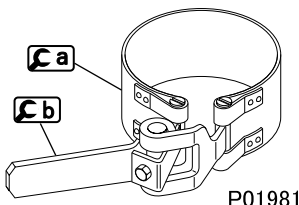
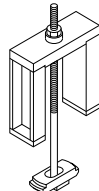
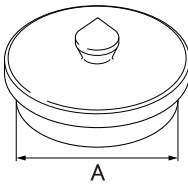
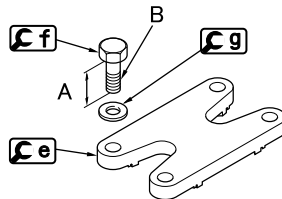
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (connecting rod cap installation)	29 {2.1, 3.0} + 90° ± 5°	Wet

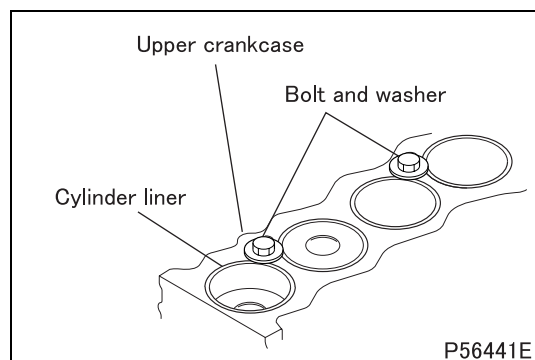
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Bolt threads	Engine oil	As required
	Connecting rod bearing inside surface		
	Upper crankcase contact surface of cylinder liner		
	Piston outside surface		
	Cylinder liner wall surface		

Special tools (Unit: mm {in.})

Mark	Tool name and shape		Part No.	Application				
 a	Piston guide clamp	 P01981	MH064332	Installation of piston and connecting rod assembly				
 b	Piston guide lever		MH061658					
 c	Cylinder liner extractor	 P30008	MH062537	Removal of cylinder liner				
 d	Cylinder liner installer <table border="1"><tr><td>A</td></tr><tr><td>φ113.5 {φ4.47}</td></tr></table>	A	φ113.5 {φ4.47}	 P30010	MH063606	Installation of cylinder liner		
A								
φ113.5 {φ4.47}								
 e	Adapter	 P30009	MH063433	Measurement of cylinder liner flange projection above upper crankcase top surface and difference in flange projection between neighboring cylinder liners				
 f	Bolt <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>40 {1.57}</td><td>M14 × 2</td></tr></table>		A		B	40 {1.57}	M14 × 2	MF130625
A	B							
40 {1.57}	M14 × 2							
 g	Washer	MH005012						

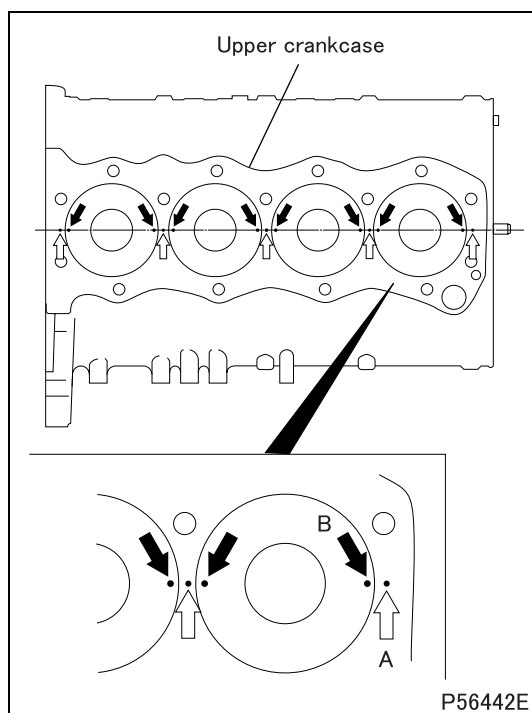
◆ Inspection before removal ◆



■ Retaining cylinder liners

- The cylinder liners slip out of the upper crankcase easily when the upper crankcase is turned over or the crankshaft is rotated with pistons inside liners. To prevent this from happening, retain the flange of each cylinder liner in position with a bolt and washer.

PISTONS, CONNECTING ROD AND CYLINDER LINERS



■ Inspection: Piston projection from upper crankcase top surface

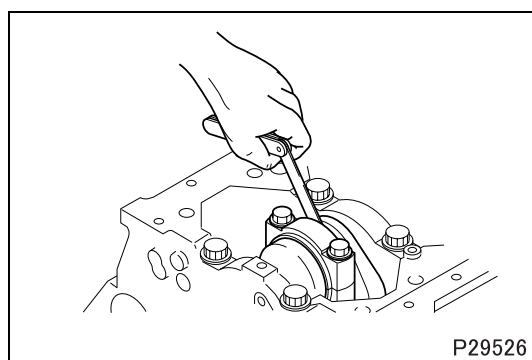
CAUTION ⚠

- The amount of piston projection affects engine performance and must therefore be inspected without fail.

- Set the piston at the top dead center.
- Mark reference points **A** (five points in total) on the top surface of the upper crankcase as shown in the illustration. Using each of the marks as a zero point, measure the amount of piston projection relative to the zero point (height of measurement point **B** – height of reference point **A**).
- Make the measurements at the two measurement points **B** for each cylinder (eight points in total) using the reference point **A** nearest to each measurement point, and calculate the average value of all the measurements.
- If the average value is out of the standard value range, check the clearances between all relevant parts.
- Select and use a cylinder head gasket that can accommodate the average piston projection (average value of the eight measurements).

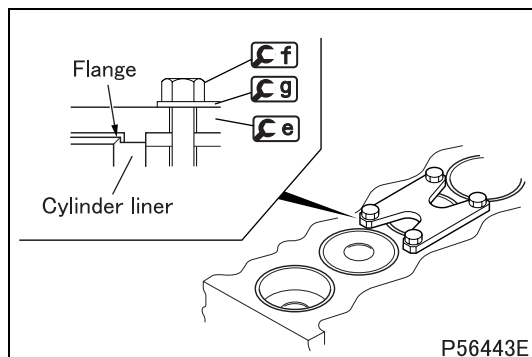
■ Inspection: Connecting rod end play

- Measure the end play for every connecting rod.
- If any measurement exceeds the specified limit, replace the defective part(s).



■ Inspection: Difference in flange projection between neighboring cylinder liners

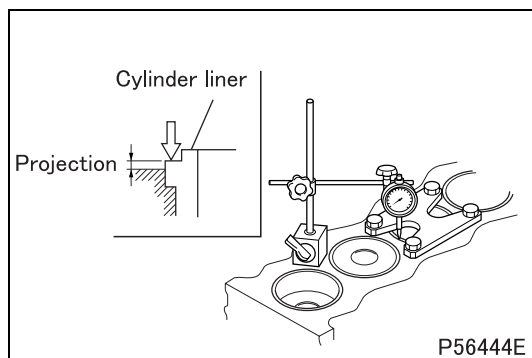
- Install **Ⓒe** on the upper crankcase so that it is not lying on top of any part of the flanges. Tighten **Ⓒf** to a torque of 49 N·m {36 ft.lbs, 5 kgf·m}.



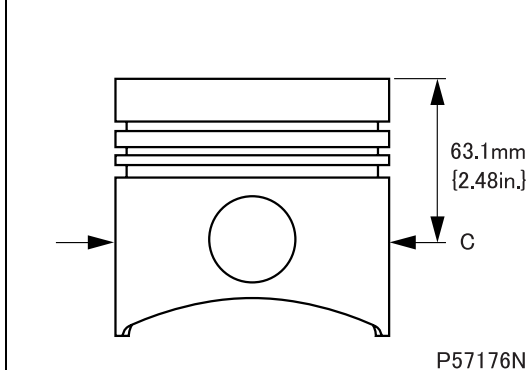
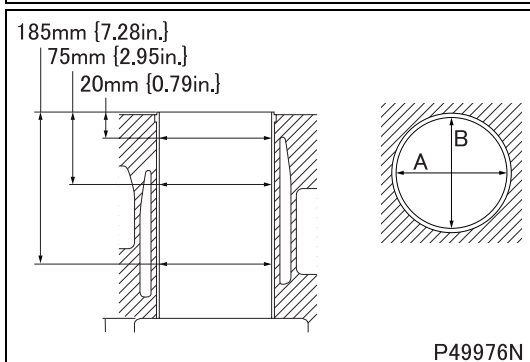
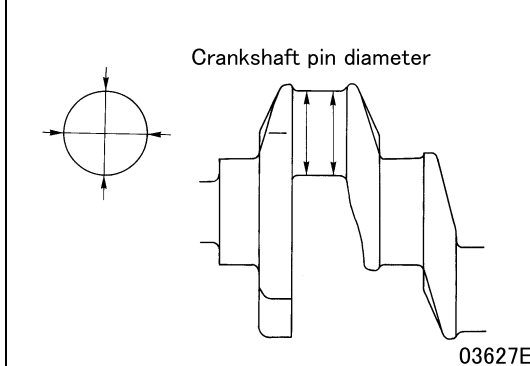
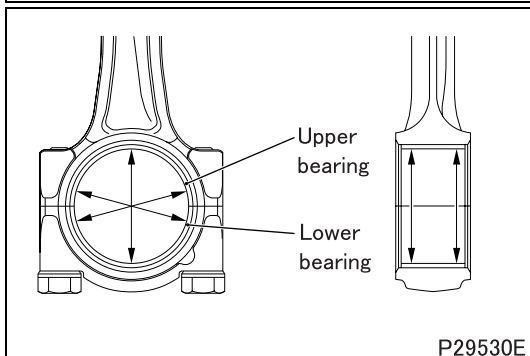
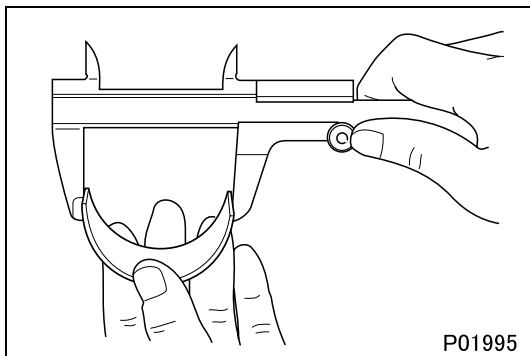
- Measure the amount of projection of the cylinder liner flange above the upper crankcase top surface.
- If the measurement is not within the standard value range, inspect the state of installation of the cylinder liner and then replace the defective part(s).

CAUTION ⚠

- Insufficient projection of the flange can lead to a reduced pressure around the bore of the cylinder head gasket, causing gas leakage.



◆ Inspection procedure ◆



■ Inspection: Connecting rod bearing span when free

CAUTION ⚠

- Do not attempt to manually expand the bearings.
- The upper and lower connecting rod bearings must be replaced as a set.

- If the span is less than the specified limit, replace both the upper and lower bearings.

■ Inspection: Connecting rod bearing-to-crankshaft clearance (oil clearance)

- Fit the lower bearing to the connecting rod cap and the upper bearing to the connecting rod, then tighten the bolts to a torque of 30 N·m {22 ft.lbs, 3.1 kgf·m}.
- Measure the inside diameter of the bearing and the diameter of the crankshaft pin.
- If the clearance exceeds the limit, replace the defective part(s).
- If a bearing has to be replaced with an undersized one, machine the crankshaft pin to the specified undersize diameter.

■ Inspection: Piston-to-cylinder liner clearance

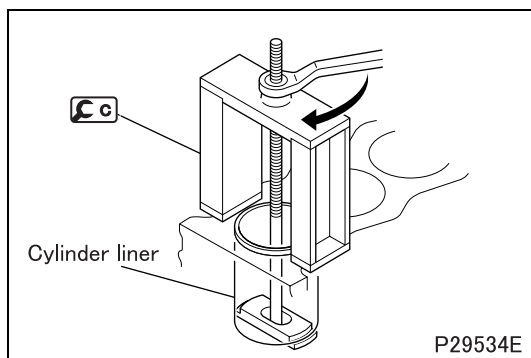
- If the measurement is not within the standard value range, replace the defective part(s).

A: Cylinder bore measurement (in direction of crankshaft axis)

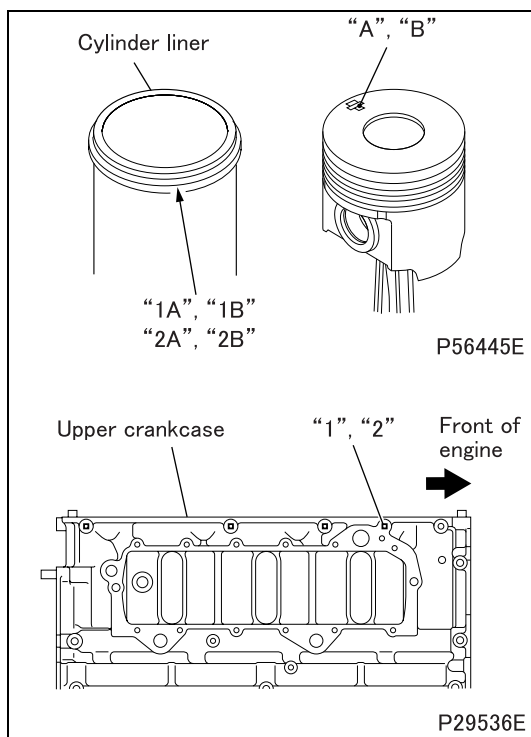
B: Cylinder bore measurement (in direction perpendicular to crankshaft axis)

C: Piston diameter measurement (in direction perpendicular to piston pin hole)

PISTONS, CONNECTING ROD AND CYLINDER LINERS

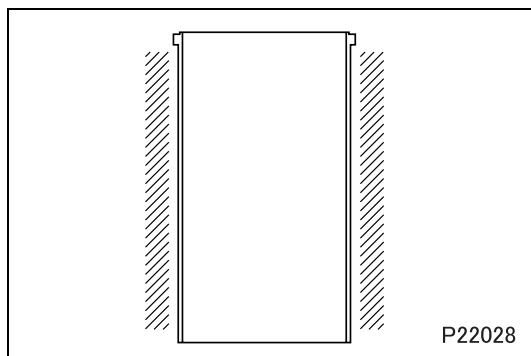
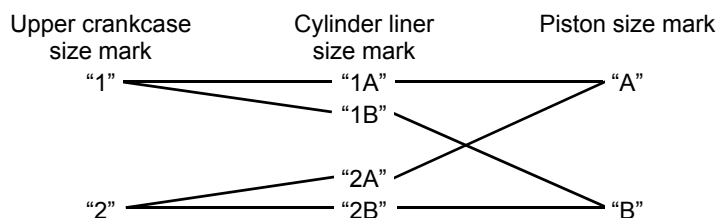


Replacement of cylinder liner [Removal]

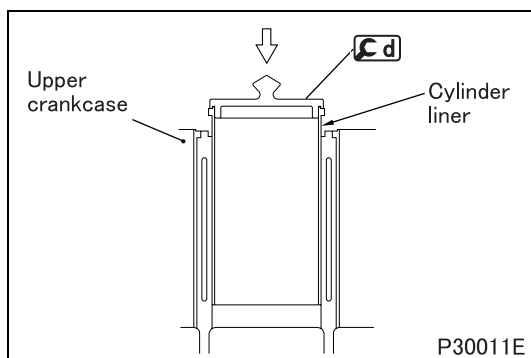


[Installation]

- Select cylinder liners with the same size marks as those on the upper crankcase and the pistons.
- The size marks on the upper crankcase are marked in the order of No. 1 cylinder, No. 2 cylinder, No. 3 cylinder and No. 4 cylinder starting with the front of the engine.



- Apply a thin coat of engine oil to the surfaces surrounding the cylinder liner of the upper crankcase (the shaded areas in the illustration).

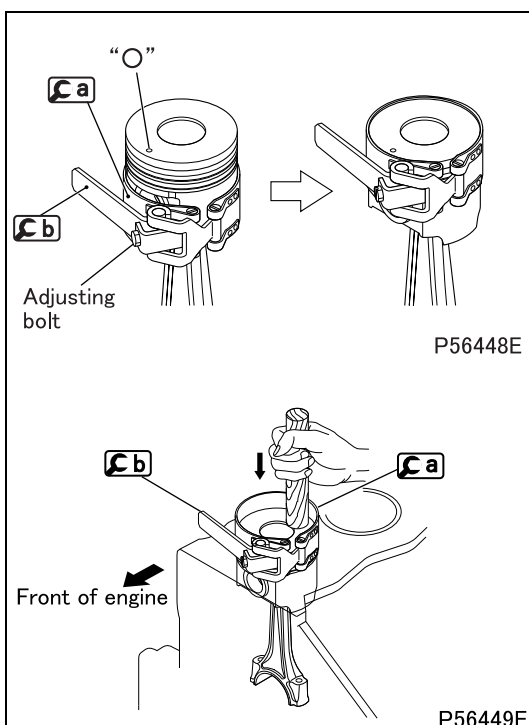
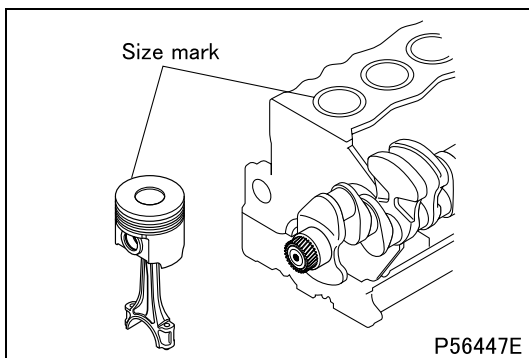
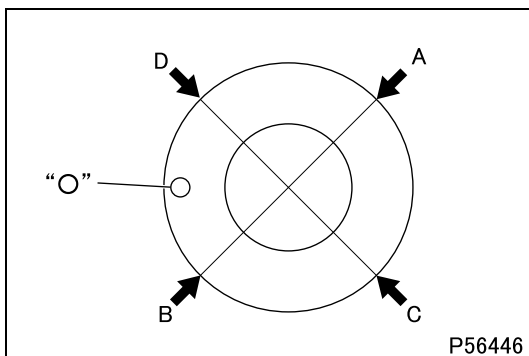
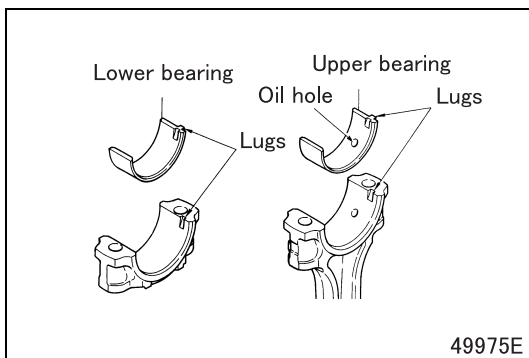


- Insert the cylinder liner into the upper crankcase by pushing down on **C d** by hand slowly and evenly.

CAUTION

- Handle the cylinder liner extremely carefully, as its wall is relatively thin and can be easily damaged.

◆ Installation procedure ◆



■ Installation: Connecting rod bearings

CAUTION ⚠

- Do not reverse the positions of the lower bearing and the upper bearing (with oil hole) when installing, as this may cause seizure in the engine.

■ Installation: Piston and connecting rod assembly

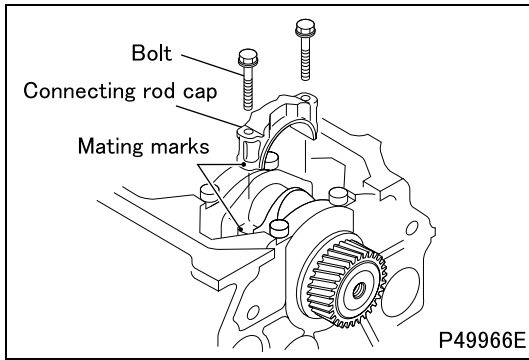
- Check that the piston ring end gaps are in their correct positions.
A: 1st compression ring gap
B: 2nd compression ring gap
C: Oil ring gap
D: Oil ring expander spring gap

“O”: Front mark on piston

- Check that the pistons and the cylinder liners have identical size marks (“A” or “B”).
- Install the pistons in the cylinder liners. Be careful not to scratch the inner surface of the liner and the crankshaft pins.

- Face the front mark “O” of the piston toward the front of the engine.
- Using the adjusting bolt of **b**, adjust the inside diameter of **a** such that it matches the piston's skirt diameter.
- Remove the tools from the piston and apply engine oil to the following parts before reinstalling the tools around the piston rings:
 - Outside surface of piston
 - Inside surface of **a**
 - Inside surface of cylinder liner

PISTONS, CONNECTING ROD AND CYLINDER LINERS

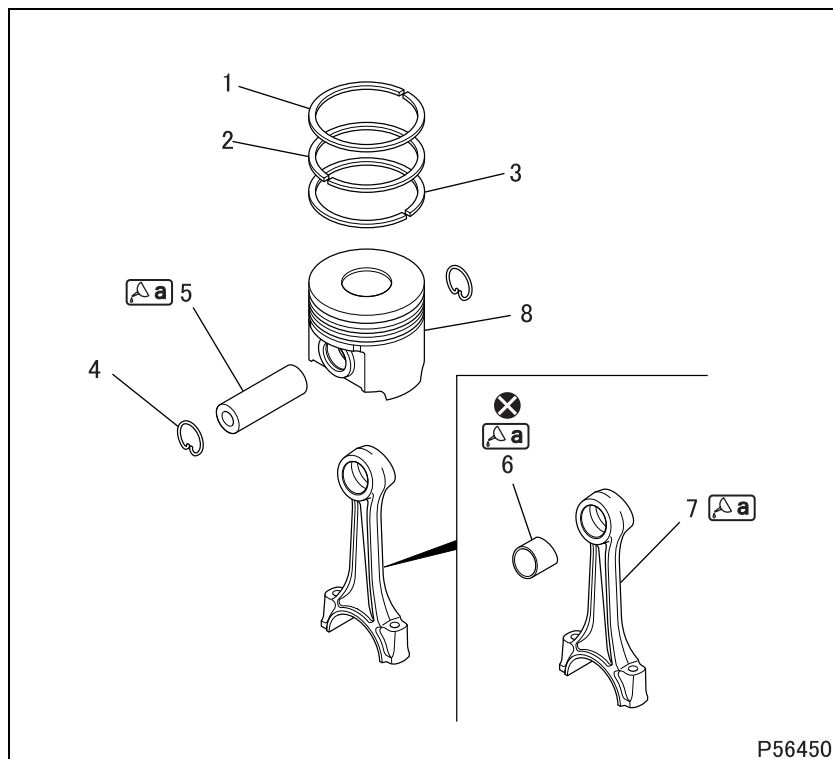


- After installing the piston and connecting rod assembly, align the mating marks on the connecting rod and connecting rod cap and tighten the bolts alternately in the following manner.
- First tighten the bolt to a torque of 29 N·m {21 ft.lbs, 3.0 kgf·m}.
- Tighten the bolt further by turning it clockwise by $90^\circ \pm 5^\circ$.

M E M O

PISTONS, CONNECTING ROD AND CYLINDER LINERS

Piston and Connecting Rod



● Disassembly sequence

- 1 1st compression ring
- 2 2nd compression ring
- 3 Oil ring
- 4 Snap ring
- 5 Piston pin
- 6 Connecting rod bushing
- 7 Connecting rod
- 8 Piston

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

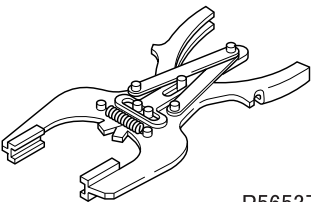
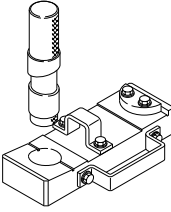
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
1 to 3	Piston ring end gap	1st compression ring	0.3 to 0.45 {0.012 to 0.018}	1.5 {0.059}	Replace
		2nd compression ring	0.4 to 0.55 {0.016 to 0.022}		
		Oil ring	0.3 to 0.5 {0.012 to 0.020}		
1 to 3, 8	Piston ring side clearance in piston groove	1st compression ring	0.129 to 0.178 {0.0051 to 0.0070}	0.2 {0.0079}	Replace
		2nd compression ring	0.065 to 0.105 {0.0026 to 0.0041}	0.15 {0.0059}	
		Oil ring	0.025 to 0.065 {0.00098 to 0.0026}		
4, 6	Piston pin-to-connecting rod bushing clearance		0.020 to 0.055 {0.00079 to 0.0022}	0.1 {0.0039}	Replace
4, 8	Piston pin-to-piston clearance		0.004 to 0.022 {0.00016 to 0.00087}	0.05 {0.0020}	Replace
7	Connecting rod	Bend	—	0.05 {0.0020}	Replace
		Twist	—	0.1 {0.0039}	

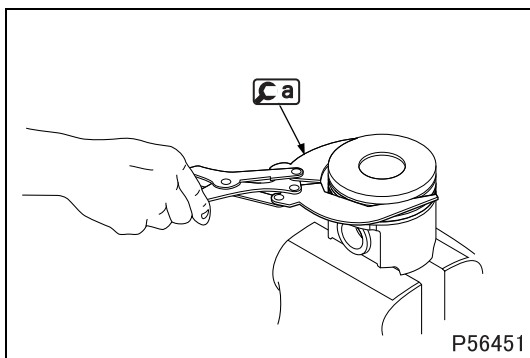
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Piston pin outside surface	Engine oil	As required
	Connecting rod bushing outside surface		
	Connecting rod bushing fitting surface of connecting rod		

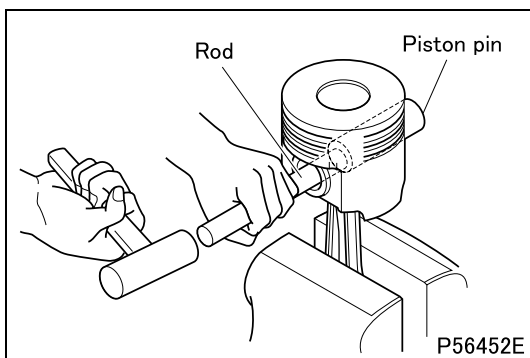
Special tools

Mark	Tool name and shape	Part No.	Application
	Piston ring tool 	MH060014	Removal and installation of piston rings
	Connecting rod bushing puller kit 	MH062225	Removal and installation of connecting rod bushings

◆ Removal procedure ◆



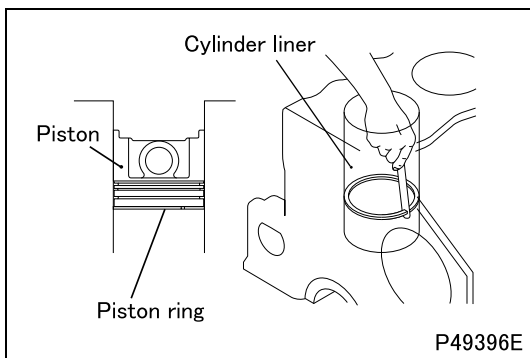
■ Removal: Piston ring



■ Removal: Piston pin

- Remove the piston pin by striking it with a rod and hammer.
- If the piston pin is difficult to remove, first heat the piston in hot water or with a piston heater.

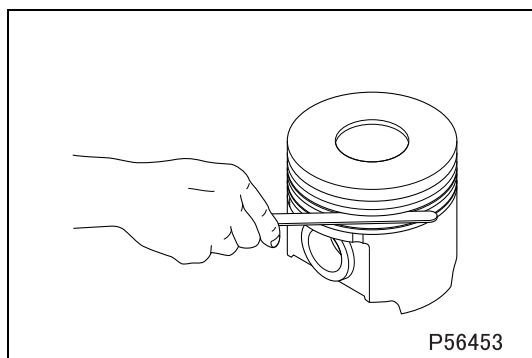
◆ Inspection procedure ◆



■ Inspection: Piston ring end gap

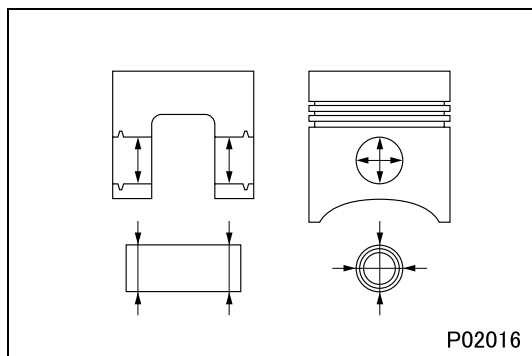
- Using the crown of a piston, push the piston ring horizontally into a cylinder in the cylinder liner until it reaches the lower part of the cylinder liner, where there is relatively small wear.
- Taking care not to move the piston ring, measure the end gap.
- If any of the rings has a gap exceeding the specified limit, replace all the piston rings as a set.

PISTONS, CONNECTING ROD AND CYLINDER LINERS



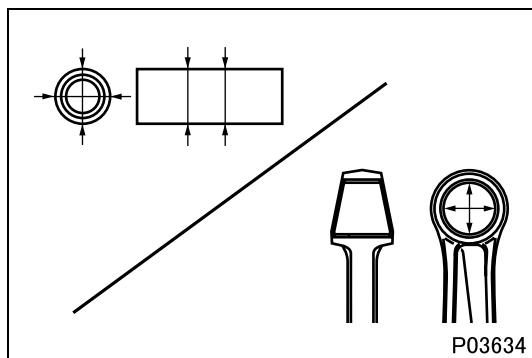
■ Inspection: Piston ring side clearance in piston groove

- Remove any carbon deposits from the ring groove in the piston.
- Measure the side clearance of each ring around the piston's entire periphery.
- If any of the measurements exceeds the specified limit, replace the defective part(s). If any of the piston rings is defective, replace all the rings on the piston as a set.



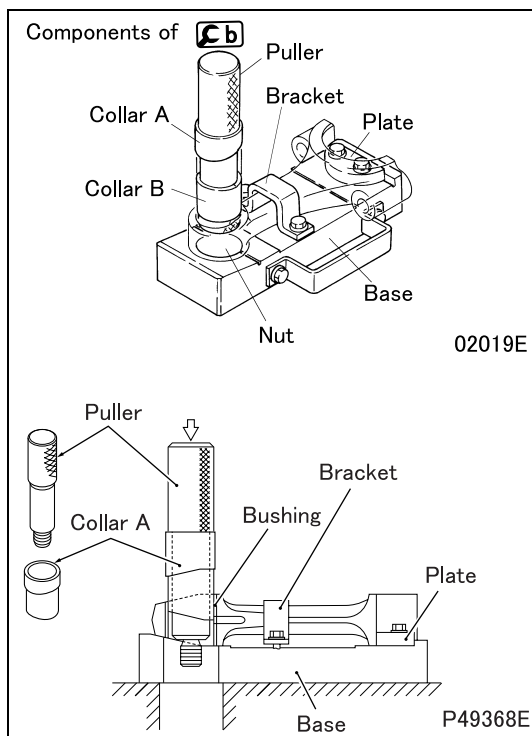
■ Inspection: Piston pin-to-piston clearance

- If the measurement exceeds the specified limit, replace the defective part(s).



■ Inspection: Piston pin-to-connecting rod bushing clearance

- If any of the measurements exceeds the specified limit, replace the bushing.

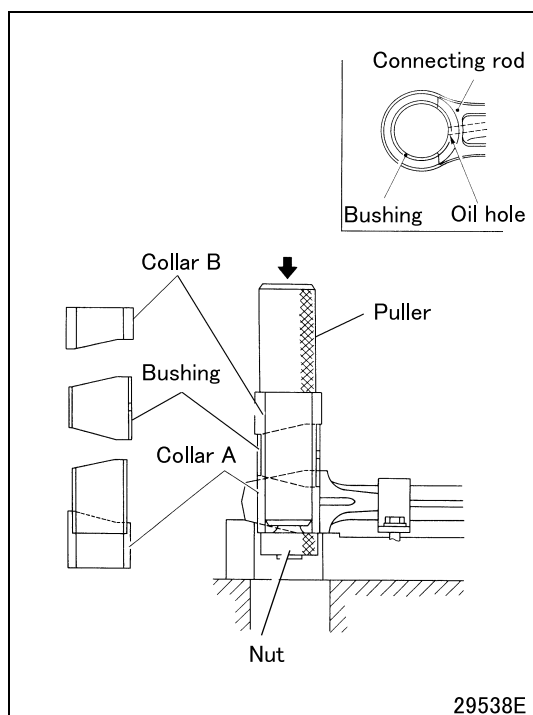


Replacement of connecting rod bushing

- Replace the connecting rod bushing using **Cb**.

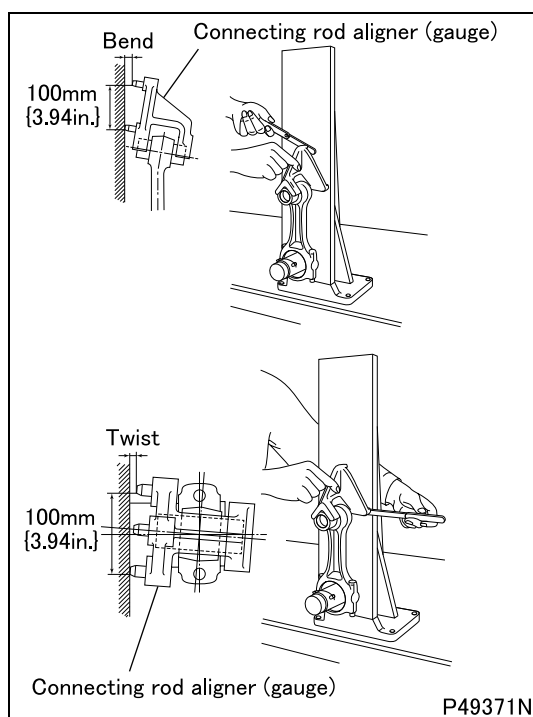
[Removal]

- Remove the upper bearing (if fitted) from the big end of the connecting rod.
- Mount the connecting rod on the base and lock it in position with the bracket and plate.
- Fit collar A over the puller with its ends facing in the illustrated directions. Then, slowly apply a pressure of approximately 49 kN {11020 lbs, 5000 kgf} to the puller with a press to force out the connecting rod bushing.



[Installation]

- Apply engine oil to the outside surface of the connecting rod bushing and the bushing fitting surface of the connecting rod.
- Fit collar B, the bushing, and collar A over the puller in the illustrated directions and lock this arrangement together with the nut.
- Align the oil holes in the connecting rod bushing and the connecting rod. Then, use a press to slowly apply a pressure of approximately 49 kN {11020 lbs, 5000 kgf} to the puller until the bushing is forced into place.
- After press-fitting the connecting rod bushing, measure the clearance between the piston pin and connecting rod bushing.
- If the measurement is less than the standard clearance range, ream the bushing.

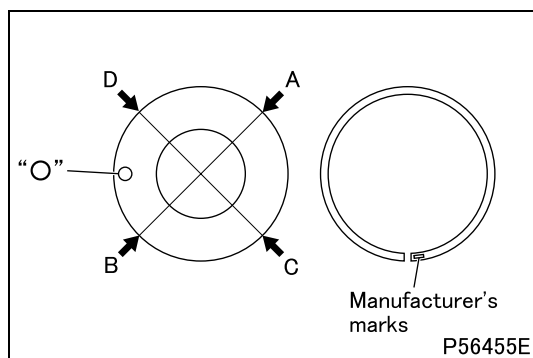
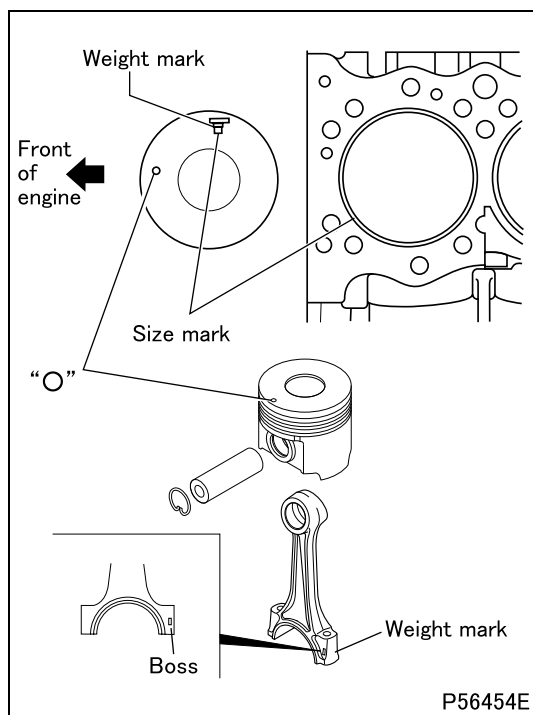


■ Inspection: Connecting rod bend and twist

- Mount the connecting rod on the connecting rod aligner. Also mount the connecting rod bearings, piston pin, and connecting rod cap to create the same conditions as are expected when the connecting rod is mounted on a crankshaft. Tighten the bolts of the connecting rod bearing cap to a torque of 30 N·m {22 ft.lbs, 3.1 kgf·m}.
- Measure the extent of bend and twist in the connecting rod.
- If either measurement exceeds the specified limit, replace the connecting rod.

PISTONS, CONNECTING ROD AND CYLINDER LINERS

◆ Installation procedure ◆



■ Installation: Piston and connecting rod

- When replacing a piston and connecting rod assembly, select and install a new piston and connecting rod by the following procedure.
- Choosing pistons
 - Choose pistons of the same weight for all cylinders.
 - Check that the size marks ("A" or "B") on the piston and cylinder liner are identical.

CAUTION ⚠

- **Make sure to use pistons and cylinder liners of the same size. Failure to do so may result in seizures in the engine.**

- Choose connecting rod of the same weight for every cylinder.
- Apply engine oil to the piston pin, and assemble the piston and connecting rod with their marks facing in the illustrated directions.

"O": Front mark

- If the piston pin is difficult to insert, heat the piston in hot water or with a piston heater.

■ Installation: Piston rings

- With the manufacturer's marks (found near the piston ring end gaps) facing up, install the piston rings so that the end gap of each ring is positioned as illustrated.

A: 1st compression ring end gap

B: 2nd compression ring end gap

C: Oil ring end gap

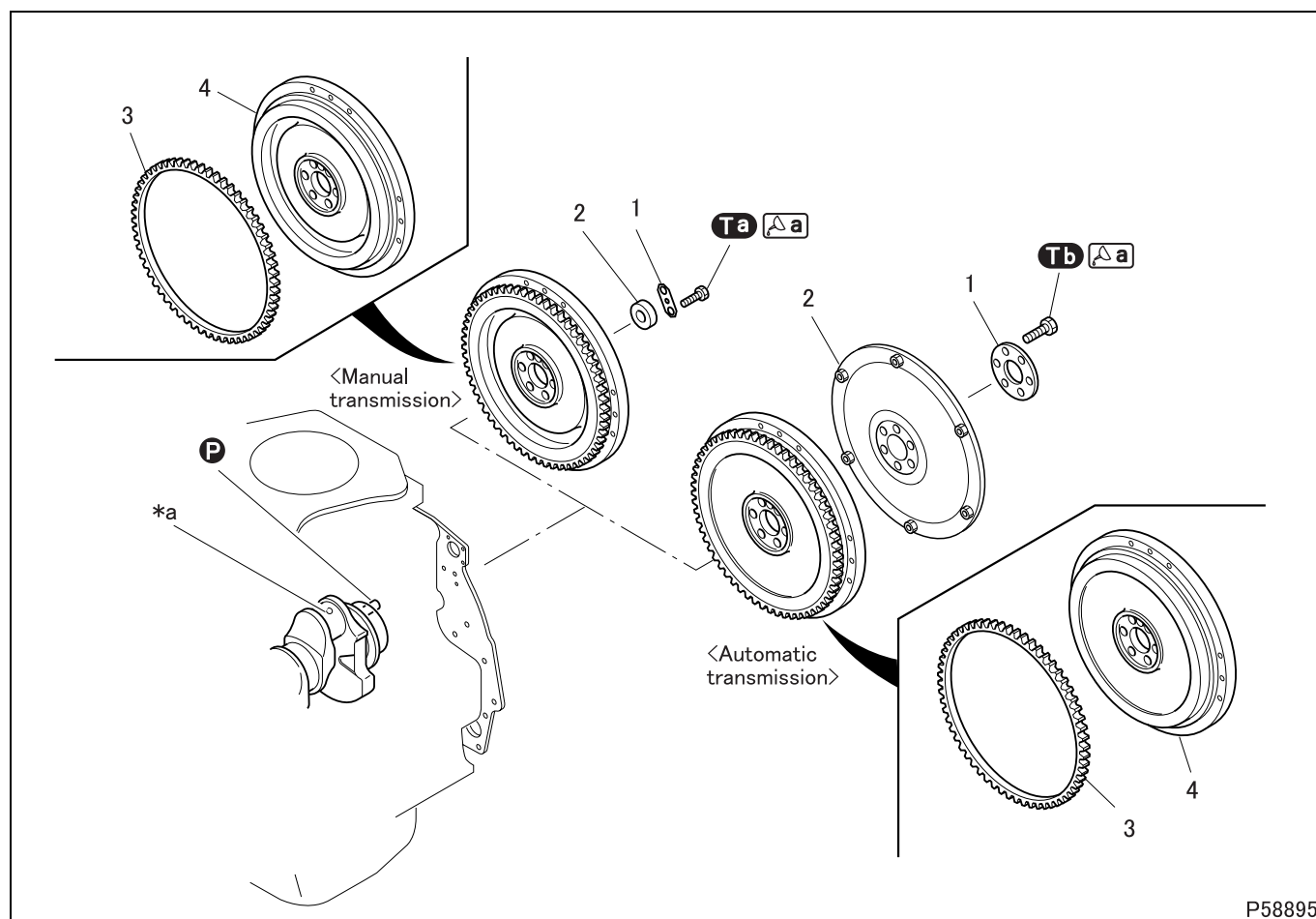
D: Oil ring's expander spring end gap

"O": Front mark on piston

The manufacturer's marks are present only on the 1st and 2nd compression rings.

M E M O

FLYWHEEL



P58895

● Disassembly sequence

- | | |
|---|---------------------|
| 1 Plate <Manual transmission>
Wear plate <Automatic transmission> | 3 Ring gear |
| 2 Bearing <Manual transmission>
Drive plate <Automatic transmission> | 4 Flywheel assembly |
| | *a: Crankshaft |
| | P: Locating pin |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
4	Flywheel assembly <Manual transmission>	Friction surface runout (when fitted)	—	0.2 {0.0079}	Rectify or replace
		Friction surface height	19.5 {0.77}	18.5 {0.73}	
		Friction surface distortion	0.05 {0.0020} or less	0.2 {0.0079}	

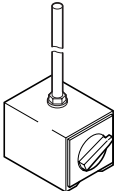
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (flywheel assembly installation)	39 {44, 6.0} + 40°	Wet
Tb	Bolt (flywheel assembly installation)	118 {87, 12} + 90°	Wet

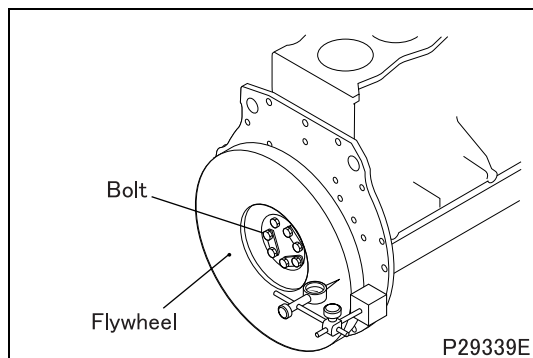
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	Engine oil	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
	Socket wrench  A Bolt head width across flats: 22 {0.87} P01984	MH062183	Installation of flywheel assembly
	Magnet base  P00471	MH062356	

◆ Inspection before removal ◆



■ Inspection: Flywheel runout <Manual transmission>

- If the runout exceeds the specified limit, check that the bolts are tightened correctly and that there are no abnormalities on the crankshaft mounting surface. If the runout is still excessive even after necessary steps have been taken according to the check results, rectify or replace the flywheel assembly.

◆ Removal procedure ◆

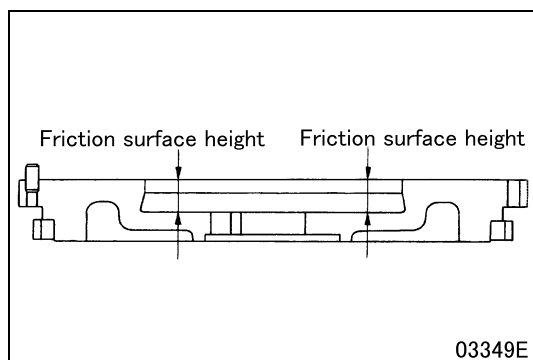
■ Removal: Ring gear

- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C {390°F}, then remove it from the flywheel assembly.

WARNING

- You could get burnt if you touch the heated ring gear.

◆ Inspection procedure ◆

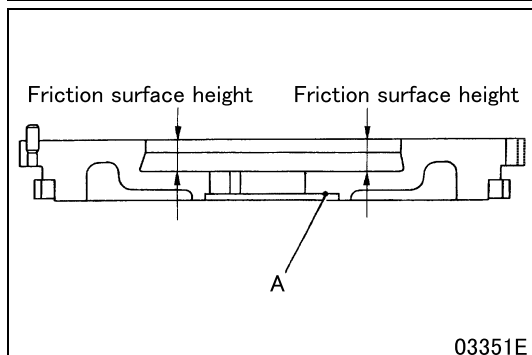
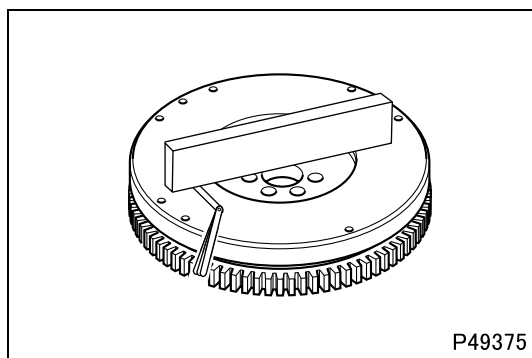


■ Inspection: Flywheel assembly <Manual transmission>

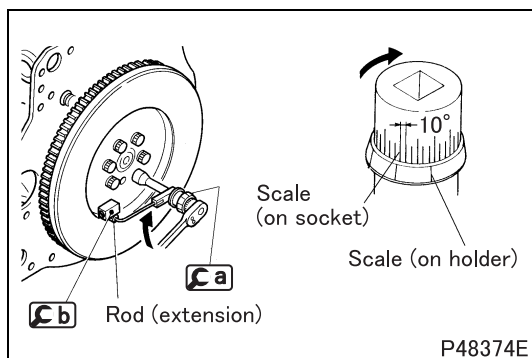
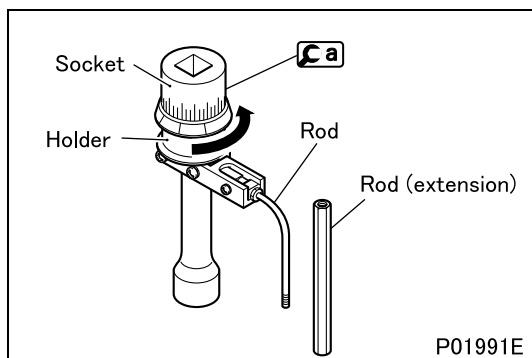
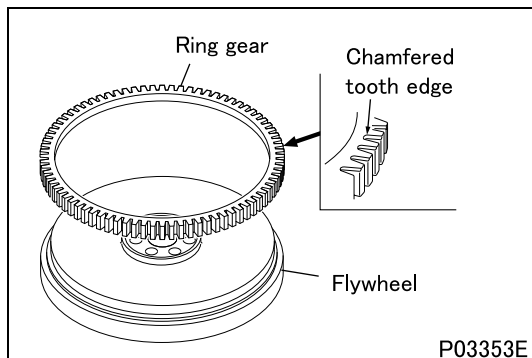
(1) Friction surface height

- If the height is below the specified limit, rectify or replace the flywheel assembly.

FLYWHEEL



◆ Installation procedure ◆



(2) Friction surface distortion

- If the measured amount of distortion is above the specified limit, rectify or replace the flywheel assembly.

Rectification of friction surface

- Rectify the friction surface so that its height is not below the specified limit, and it is parallel with surface **A** with an error not exceeding 0.1 mm {0.0039 in.}.

■ Installation: Ring gear

- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C {390°F}.

WARNING ⚠

- You could get burnt if you touch the heated ring gear.

- Fit the ring gear with the side having non-chamfered tooth edges toward the flywheel.

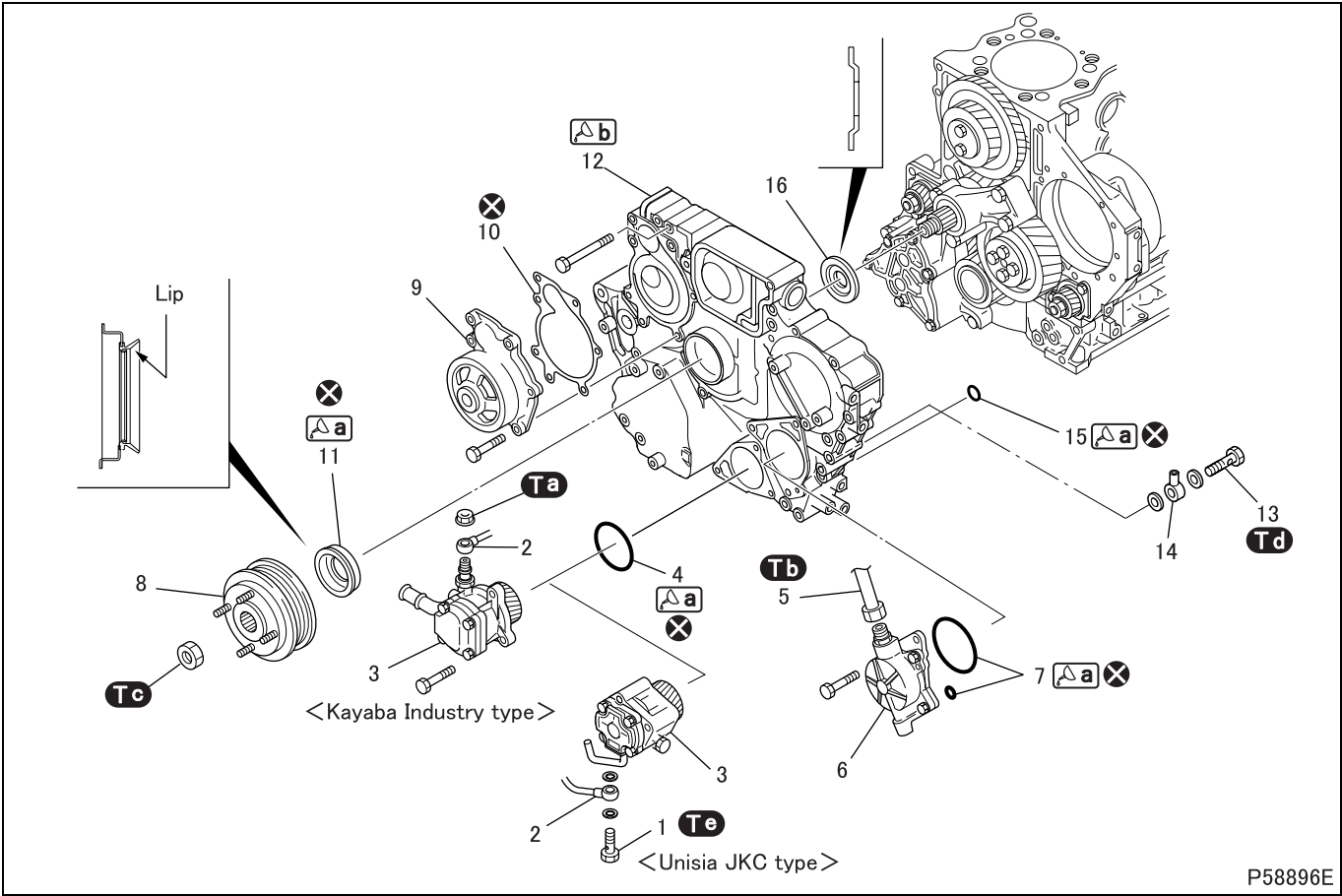
■ Installation: Flywheel <Manual transmission>

- Tighten all the bolts to 59 N·m {44 ft.lbs, 6.0 kgf·m} and then additionally tighten them by the following procedure.
- Rotate the holder of **Ca** counterclockwise to pretension the internal spring.

- Fit **Ca** on the bolt and set **Cb** so that the rod (extension) is held pressed against it by the spring force.
- Align a scale mark on the socket with a scale mark on the holder. (This point will be the point of reference, or the 0° point.)
- Starting with this point of reference, turn the socket clockwise with a wrench by 40° ± 5° (one graduation on the socket scale represents 10°).

M E M O

FRONT CASE



● Disassembly sequence

- | | | |
|---|-------------------------|---------------------------|
| 1 Eye bolt <Unisia JKC type> | 7 O-ring | 14 Oil jet |
| 2 Power steering pipe | 8 Fan pulley | 15 O-ring |
| 3 Power steering oil pump
(See Gr37) | 9 Water pump (See Gr14) | 16 Front oil seal slinger |
| 4 O-ring | 10 Gasket | |
| 5 Vacuum pipe | 11 Front oil seal | ⊗: Non-reusable parts |
| 6 Vacuum pump (See Gr35A) | 12 Front case | |
| | 13 Eye bolt | |

CAUTION

- Do not remove the front oil seal unless defects are evident.

● Assembly sequence

Follow the disassembly sequence in reverse.

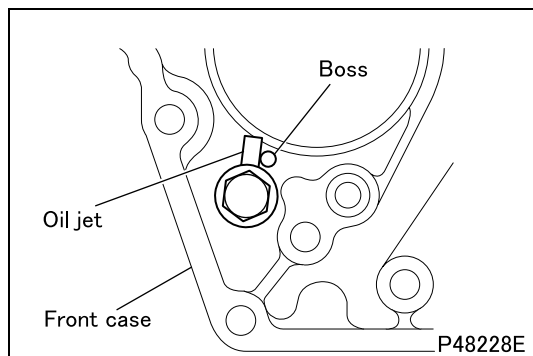
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (power steering pipe installation)	29.4 to 39.2 {22 to 29, 3 to 4}	—
Tb	Vacuum pipe	29.4 {22, 3.0}	—
Tc	Nut (fan pulley installation)	196.1 {145, 20.0}	—
Td	Eye bolt (oil jet installation)	10 {7.4, 1.0}	—
Te	Eye bolt (power steering pipe installation)	49.0 to 63.7 {36 to 47, 5.0 to 6.5}	—

Lubricant and/or sealant

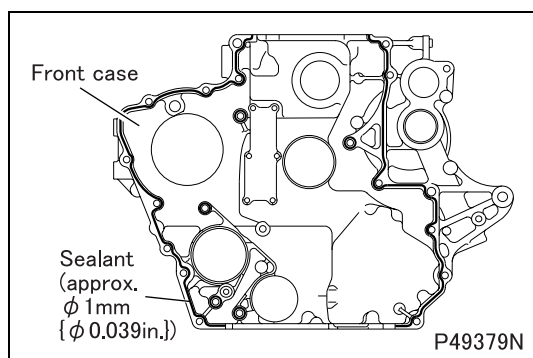
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	O-ring	Engine oil	As required
	Front oil seal lip		
	Front case installation surfaces	THREEBOND 1207C or D	As required

◆ Installation procedure ◆



■ Installation: Oil jet

- When installed, the oil jet must be in contact with the front case and its nozzle must face in the illustrated direction.

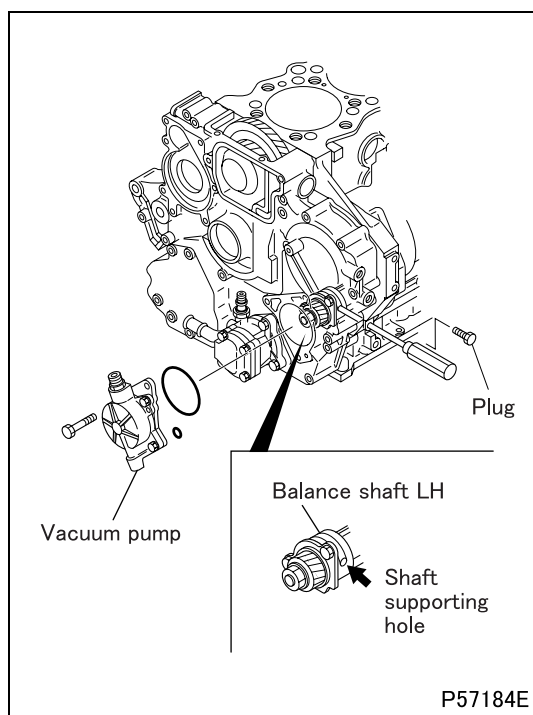


■ Installation: Front case

- Clean the sealant application surfaces of each part.
- Apply evenly thick beads of sealant to the upper crankcase mounting surface of the front case without any breaks.
- Mount the front case within three minutes of applying the sealant, being careful not to dislodge the sealant.

CAUTION

- Do not run the engine within one hour of installing the front case.
- If the front case mounting bolts are loosened or removed, be sure to reapply sealant to the front case.



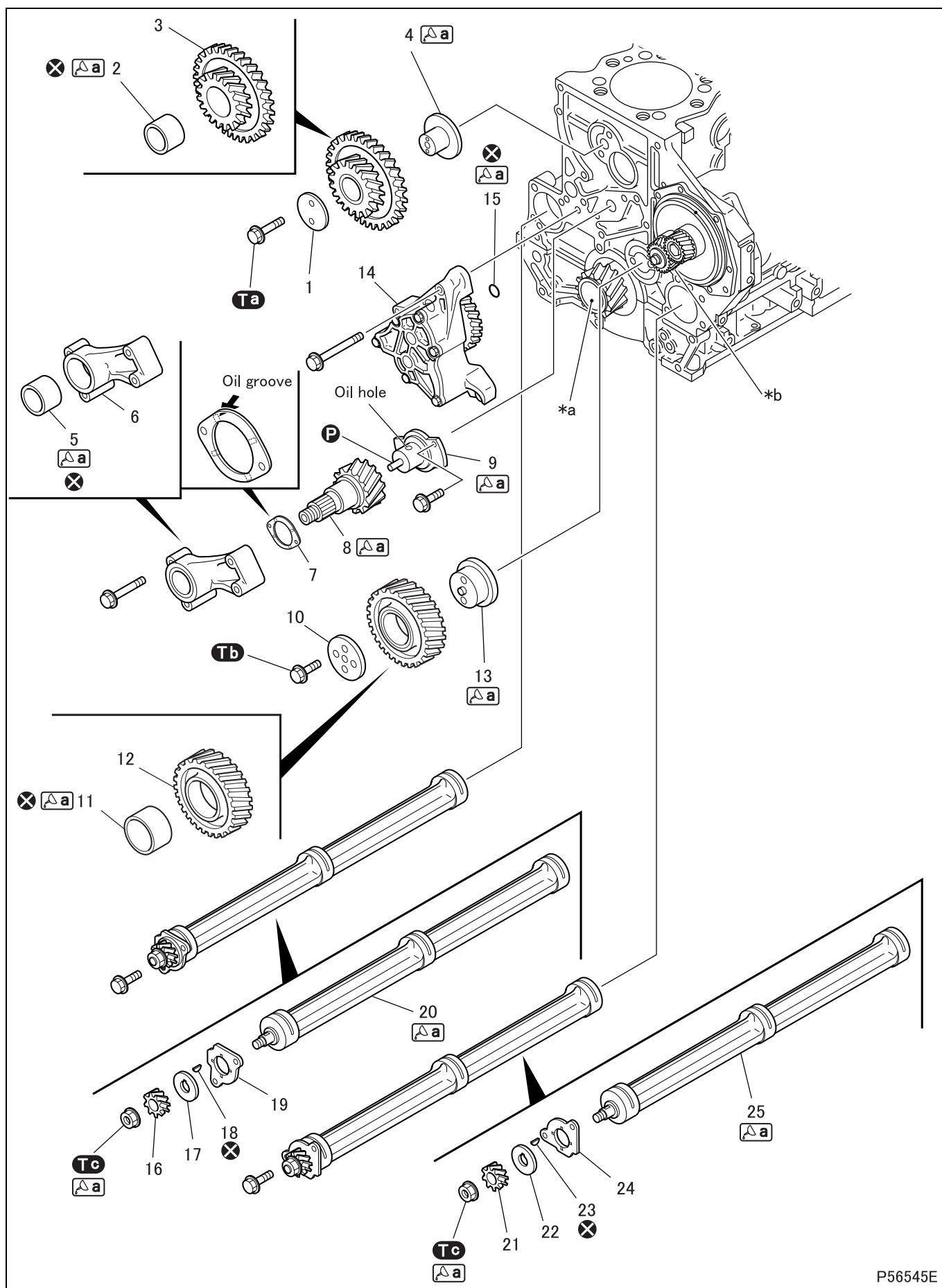
■ Installation: Vacuum pump

- The vacuum pump also serves as an element holding the balance shaft LH in place. Therefore, before installing the vacuum pump, hold the balance shaft LH in the correct position by the following procedure.
 - Place the No. 1 cylinder piston at the top dead center on compression stroke.
 - Remove the upper crankcase plug.
 - Insert a screwdriver or a similar tool into the plug hole until it lightly touches the balance shaft LH.

CAUTION

- Do not press the screwdriver strongly against the balance shaft LH, as this may damage the No. 1 journal of the balance shaft.
- Turn the balance shaft LH slowly until the screwdriver aligns with the shaft support hole at the No. 1 journal and insert the screwdriver into the hole.
- Install the vacuum pump.
- After installing the vacuum pump, remove the screwdriver and reinstall the plug.

TIMING GEARS AND BALANCE SHAFTS



P56545E

● Disassembly sequence

- | | | |
|-----------------------------|--------------------------|----------------------------|
| 1 Thrust plate | 12 No. 1 idler gear | 23 Key |
| 2 Idler gear bushing | 13 No. 1 idler shaft | 24 Thrust plate |
| 3 Idler gear | 14 Oil pump (See Gr12) | 25 Balance shaft LH |
| 4 Idler shaft | 15 O-ring | |
| 5 Fan shaft case bushing | 16 Balance shaft gear RH | *a: Crankshaft gear |
| 6 Fan shaft case | 17 Thrust spacer | *b: Supply pump idler gear |
| 7 Thrust plate | 18 Key | |
| 8 Fan shaft | 19 Thrust plate | ⒫: Locating pin |
| 9 Fan gear shaft | 20 Balance shaft RH | ⊗: Non-reusable parts |
| 10 Thrust plate | 21 Balance shaft gear LH | |
| 11 No. 1 idler gear bushing | 22 Thrust spacer | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
-	Backlash between gears	Idler gear and fan shaft	0.09 to 0.14 {0.0035 to 0.0055}	0.3 {0.012}	Replace
		Fan shaft and No. 1 idler gear	0.06 to 0.10 {0.0024 to 0.0039}	0.3 {0.012}	
		No. 1 idler gear and crankshaft gear	0.11 to 0.13 {0.0043 to 0.0051}	0.3 {0.012}	
		No. 1 idler gear and supply pump idler gear	0.12 to 0.15 {0.0047 to 0.0059}	0.3 {0.012}	
		Oil pump gear and crankshaft gear	0.12 to 0.15 {0.0047 to 0.0059}	0.3 {0.012}	
		Oil pump gear and balance shaft gear RH	0.19 to 0.22 {0.0075 to 0.0087}	0.3 {0.012}	
-	End play of gears and shafts	Idler gear	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	Replace
		Fan shaft	0.07 to 0.19 {0.0028 to 0.0075}	0.3 {0.012}	
		No. 1 idler gear	0.15 to 0.25 {0.0059 to 0.0098}	0.3 {0.012}	
		Balance shaft RH	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	
		Balance shaft LH	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	
2, 4	Idler gear bushing-to-idler shaft clearance		0.02 to 0.06 {0.00079 to 0.0024}	0.1 {0.0039}	Replace
5, 8	Fan shaft case bushing-to-fan shaft clearance		0.03 to 0.07 {0.0012 to 0.0028}	0.1 {0.0039}	Replace
8, 9	Fan shaft-to-fan gear shaft clearance		0.01 to 0.05 {0.00039 to 0.0020}	0.1 {0.0039}	Replace
11, 13	No. 1 idler gear bushing-to-No. 1 idler shaft clearance		0.03 to 0.07 {0.0012 to 0.0028}	0.1 {0.0039}	Replace
20	Balance shaft RH bend		0.025 {0.00098}	0.05 {0.0020}	Replace
25	Balance shaft LH bend		0.025 {0.00098}	0.05 {0.0020}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

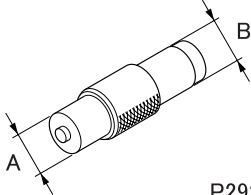
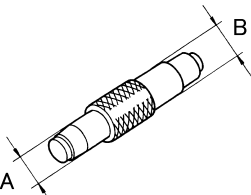
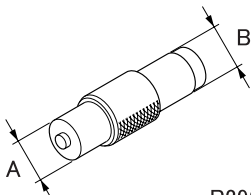
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (idler shaft installation)	32.3 {24, 3.3}	—
Tb	Bolt (No. 1 idler shaft installation)	53.9 {40, 5.5}	—
Tc	Nut (balance shaft gear installation)	96.1 {71, 9.8}	Wet

TIMING GEARS AND BALANCE SHAFTS

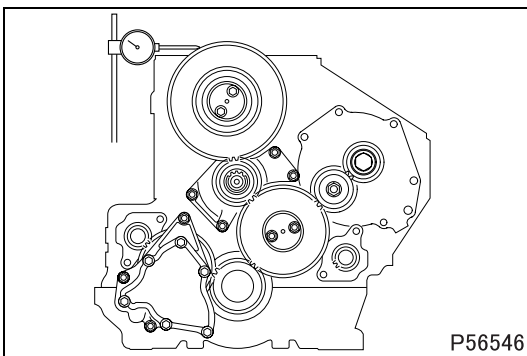
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Inner surface of every bushing	Engine oil	As required
	Outside surface of every shaft		
	O-rings		
	Nut threads		
	Balance shaft journals		

Special tools (Unit: mm {in.})

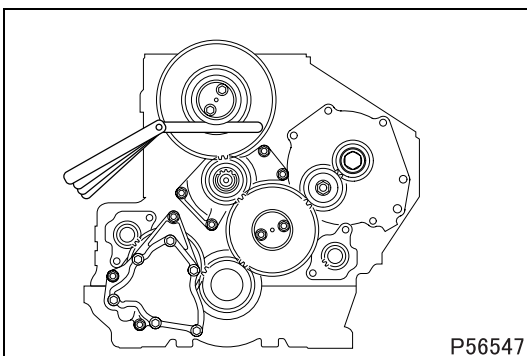
Mark	Tool name and shape	Part No.	Application				
 a	Idler gear bushing puller <table><tr><th>A</th><th>B</th></tr><tr><td>φ46.5 {φ1.83}</td><td>φ50 {φ1.97}</td></tr></table>  P29270	A	B	φ46.5 {φ1.83}	φ50 {φ1.97}	MH062540	Removal and installation of idler gear bushing
A	B						
φ46.5 {φ1.83}	φ50 {φ1.97}						
 b	Idler gear bushing puller <table><tr><th>A</th><th>B</th></tr><tr><td>φ37 {φ1.46}</td><td>φ40 {φ1.57}</td></tr></table>  02066	A	B	φ37 {φ1.46}	φ40 {φ1.57}	MH062601	Removal and installation of fan shaft case bushing
A	B						
φ37 {φ1.46}	φ40 {φ1.57}						
 c	Idler gear bushing puller <table><tr><th>A</th><th>B</th></tr><tr><td>φ54.5 {φ2.15}</td><td>φ58 {φ2.28}</td></tr></table>  P29270	A	B	φ54.5 {φ2.15}	φ58 {φ2.28}	MH062541	Removal and installation of No. 1 idler gear bushing
A	B						
φ54.5 {φ2.15}	φ58 {φ2.28}						

◆ Inspection before removal ◆



■ Inspection: Backlash between gears

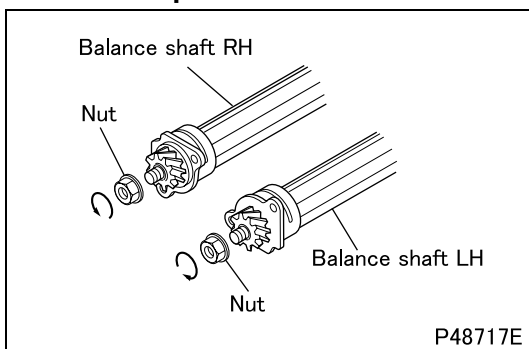
- For each pair of gears, measure the backlash at more than three teeth.
- If any of the measurements exceeds the specified limit, replace the defective part(s).



■ Inspection: End play of each gear and shaft

- If the measurement exceeds the specified limit, replace the defective part(s).

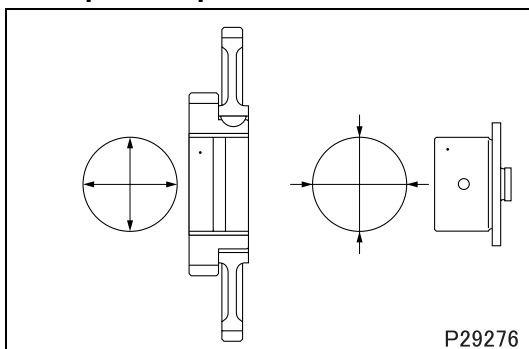
◆ Removal procedure ◆



■ Removal: Balance shaft

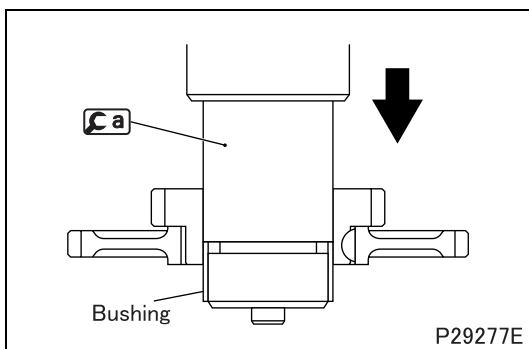
- Remove the balance shaft RH by turning its nut counterclockwise, and the balance shaft LH by turning its nut clockwise.

◆ Inspection procedure ◆

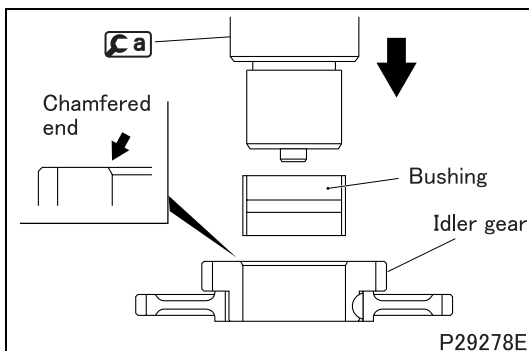


■ Inspection: Idler gear bushing-to-idler shaft clearance

- If the measurement exceeds the specified limit, replace the bushing.

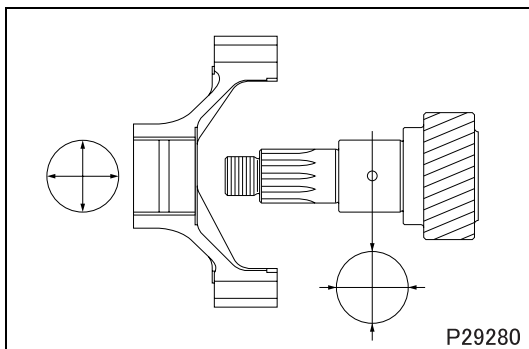


Replacement of idler gear bushing [Removal]



[Installation]

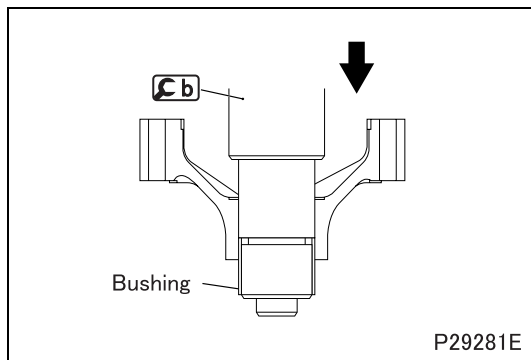
- Place the idler gear with its ends facing as illustrated.
- Press-fit the idler gear bushing until **Ca** sits snugly on the chamfered end of the idler gear.
- After press-fitting the bushing, measure the clearance.
- If the measurement is less than the minimum of the standard value range, ream the idler gear bushing until the clearance falls within the standard value range.



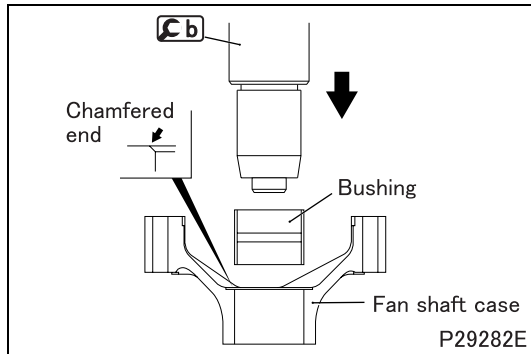
■ Inspection: Fan shaft case bushing-to-fan shaft clearance

- Replace the fan shaft case bushing if the measurement exceeds the specified limit.

TIMING GEARS AND BALANCE SHAFTS

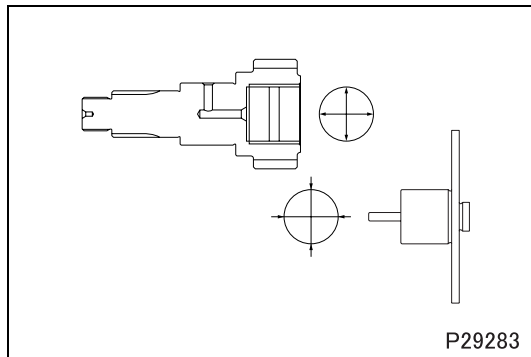


Replacement of fan shaft case bushing [Removal]



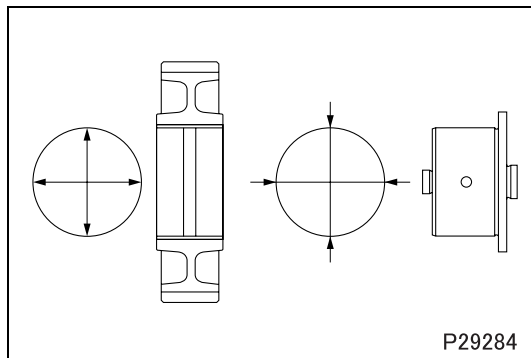
[Installation]

- Position the fan shaft case with its ends facing in the illustrated directions.
- Press in the bushing until **C b** rests snugly on the chamfered end of the fan shaft case.
- After press-fitting the bushing, remeasure the clearance between it and the fan shaft.
- Ream the bushing if the measurement is below the standard value range.



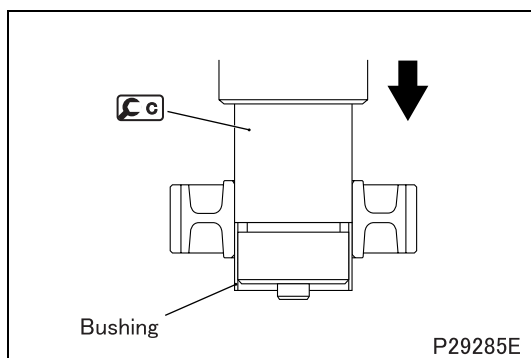
■ Inspection: Fan shaft-to-fan gear shaft clearance

- Replace the fan shaft if the measurement exceeds the specified limit.

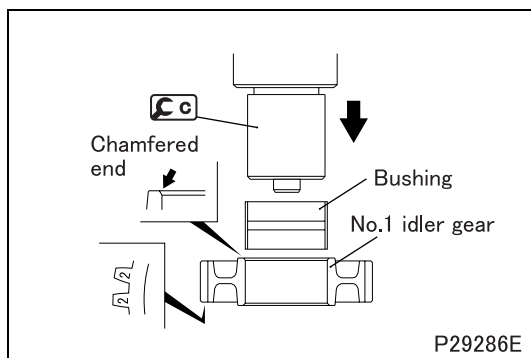


■ Inspection: No. 1 idler gear bushing-to-No. 1 idler shaft clearance

- Replace the bushing if the measurement exceeds the specified limit.

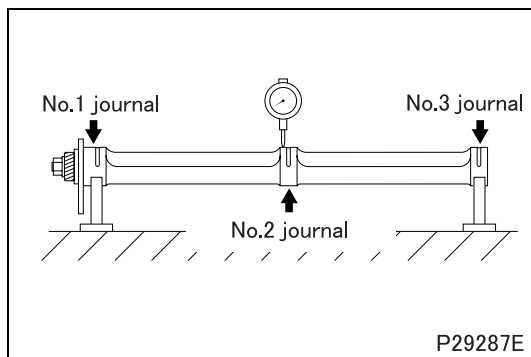


Replacement of No. 1 idler gear bushing [Removal]



[Installation]

- Position the No. 1 idler gear with its ends facing in the illustrated directions.
- Press in the gear bushing until  sits snugly on the chamfered end of the No. 1 idler gear.
- After press-fitting the bushing, remeasure the clearance between it and the No. 1 idler shaft.
- Ream the bushing if the measurement is below the standard value range.



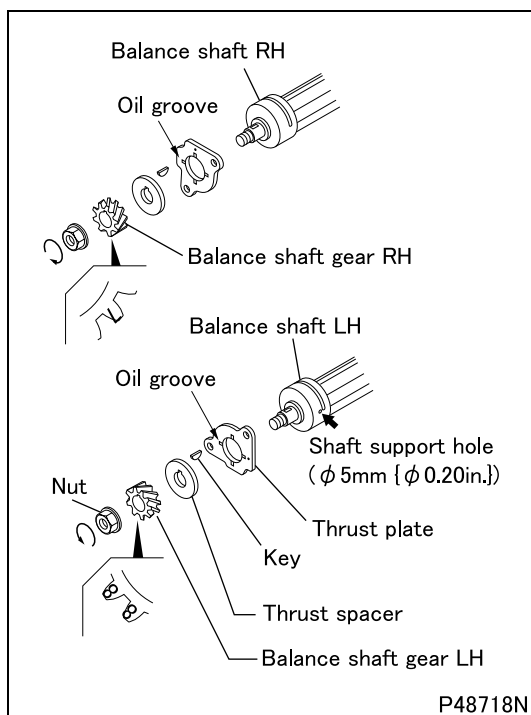
■ Inspection: Balance shaft bend

- Place supports under the No. 1 and No. 3 journals of the balance shaft and measure the bend of the balance shaft at the No. 2 journal.

NOTE

- **Turn the balance shaft by one turn and read the dial gauge. Divide the reading by two to obtain the balance shaft bend.**
- If the measurement exceeds the specified limit, replace the balance shaft.

◆ Installation procedure ◆

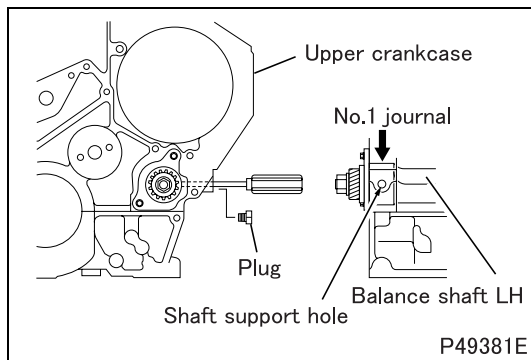


■ Installation: Balance shafts

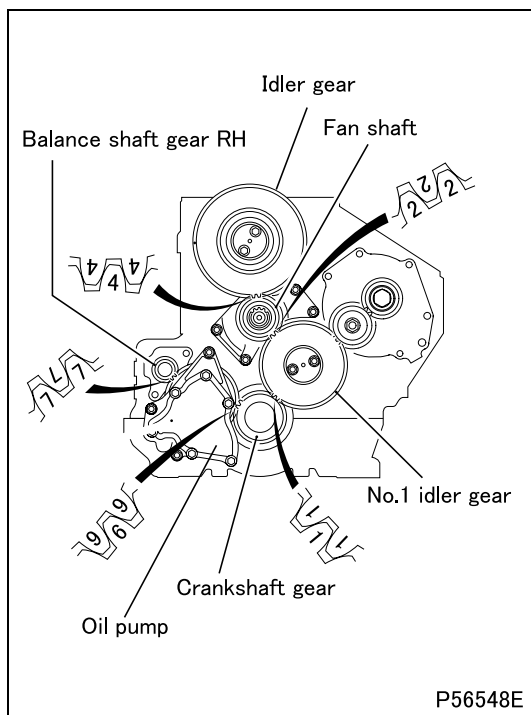
- Install all the indicated parts on each balance shaft with their ends facing in the illustrated directions.
- Install the balance shaft RH by turning its nut clockwise, and the balance shaft LH by turning its nut counterclockwise.

- Install the balance shaft RH assembly and the balance shaft LH assembly into the crankcase according to the following procedures, which include different instructions between the two balance shafts.
 - The balance shaft RH can be installed in the crankcase without following any special procedure. (The positioning of the gear of the balance shaft RH will be finally determined by installing the oil pump.)

TIMING GEARS AND BALANCE SHAFTS



- The gear of the balance shaft LH can be engaged with other gears only after the front case is installed and then the vacuum pump is installed on the crankcase. This necessitates performing the following steps before installing the front case and vacuum pump. (The balance shaft LH cannot be rotated to adjust the gear position after the front case is installed on the crankcase.)
- Remove the plug on the upper crankcase.
- Insert a screwdriver through the plug hole and into the shaft support hole (diameter: 5 mm {0.20 in.}) on the No. 1 journal of the balance shaft LH to hold the shaft against rotation.
- Align the mating marks on each timing gear.
- This positions the balance shaft LH correctly. Leave the balance shaft in this state until installation of the front case and vacuum pump is completed.

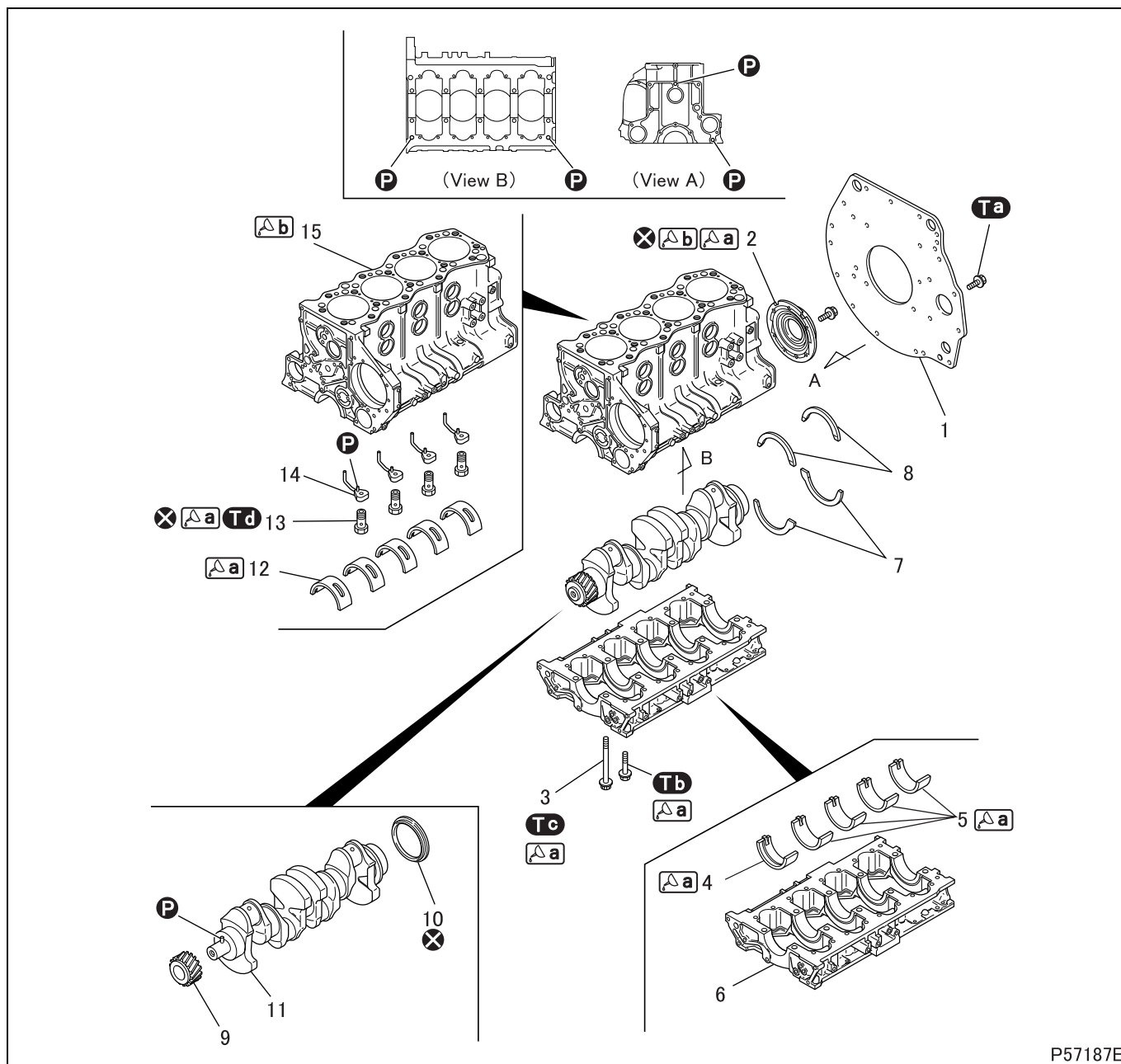


■ Installation: Timing gears

- Place the No. 1 cylinder piston at top dead center to position the crankshaft gear.
- Install the oil pump gear by aligning mating mark “6” with that on the crankshaft gear, and mating mark “7” with that on the balance shaft gear RH.
- Install the No. 1 idler gear by aligning mating mark “1” with that on the crankshaft gear.
- Install the fan shaft by aligning mating mark “2” with that on the No. 1 idler gear.
- Install the idler gear by aligning mating mark “4” with that on the fan shaft.

M E M O

CRANKSHAFT AND CRANKCASE



● Disassembly sequence

- | | | |
|-------------------------|----------------------------|--------------------|
| 1 Rear plate | 7 Lower thrust plate | 13 Check valve |
| 2 Rear oil seal | 8 Upper thrust plate | 14 Oil jet |
| 3 Main bearing cap bolt | ★ 9 Crankshaft gear | 15 Upper crankcase |
| 4 No.1 Lower bearing | ★ 10 Rear oil seal slinger | |
| 5 Lower main bearing | 11 Crankshaft | |
| 6 Lower crankcase | 12 Upper main bearing | |
- (P): Locating pin
 (X): Non-reusable parts

NOTE

- Do not remove the parts marked ★ unless defects are evident.
- The lower crankcase and the upper crankcase are machined as a matched set, and cannot be replaced individually.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- The main bearing cap bolts are tightened using the torque-turn tightening method. Any bolt that has three punch marks must be replaced.
- Do not overtighten the check valve. If it is tightened to a torque exceeding the specification, the check valve may malfunction, resulting in seizures in the engine.
- The No. 1 lower bearing has a oil groove. Be sure to install it in the correct position, otherwise a crankshaft seizure may result.

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
—	Crankshaft end play			0.10 to 0.28 {0.0039 to 0.011}	0.4 {0.016}	Replace thrust plate
4, 5, 12	Main bearing	Oil clearance	All except No. 3	0.038 to 0.1 {0.0015 to 0.0039}	0.15 {0.0059}	Replace
			No. 3	0.058 to 0.12 {0.0023 to 0.0047}		
		Span when free		—	Less than 91.5 {3.60}	
11	Crankshaft	Bend		0.02 {0.00079} or less	0.05 {0.0020}	Replace
		Pins and journals	Out-of-round-ness	0.01 {0.00039} or less	0.03 {0.0012}	Rectify or replace
			Taper	0.006 {0.00024} or less	—	
15	Distortion of upper crankcase top surface			0.07 {0.0028} or less	0.2 {0.0079}	Rectify or replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

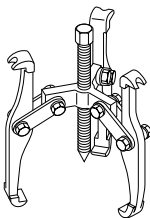
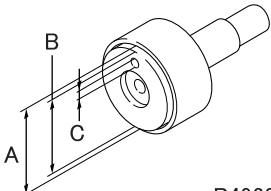
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (rear plate installation)	63.7 {47, 6.5}	–
Tb	Bolt (lower crankcase installation)	23.5 {17, 2.4}	Wet
Tc	Main cap bolt (lower crankcase installation)	49 {36, 5.0} +90°	Wet Reusable up to 3 times
Td	Check valve	29.4 {22, 3.0}	Wet

Lubricant and/or sealant

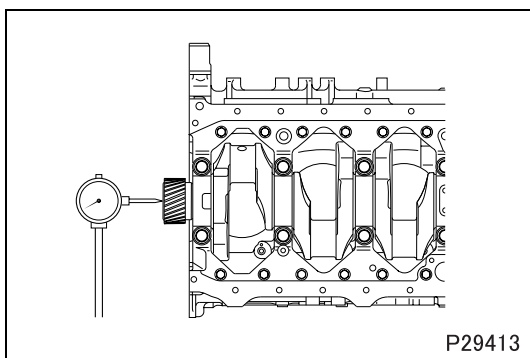
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Rear oil seal lip	Engine oil	As required
	Bolt and main bearing cap bolt threads and seating surface of head		
	Main bearing inside surface		
	Check valve threads		
	Upper and lower crankcase mating surface of rear oil seal	THREEBOND 1207C or D	As required
	Lower crankcase mounting surface of upper crankcase		

CRANKSHAFT AND CRANKCASE

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application						
	Gear puller  P02065	MH061326	Removal of crankshaft gear						
	Rear oil seal slinger installer <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ103 {φ4.06}</td><td>φ100 {φ3.94}</td><td>φ15 {φ0.59}</td></tr></tbody></table>  P49383	A	B	C	φ103 {φ4.06}	φ100 {φ3.94}	φ15 {φ0.59}	MH062677	Installation of rear oil seal slinger
A	B	C							
φ103 {φ4.06}	φ100 {φ3.94}	φ15 {φ0.59}							

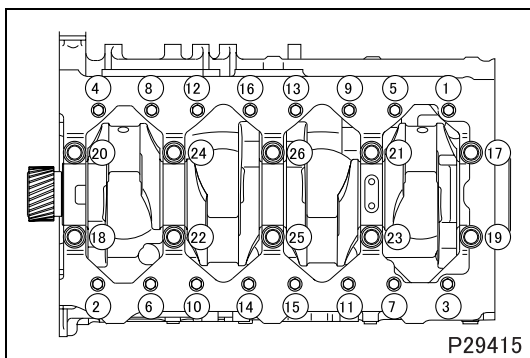
◆ Inspection before removal ◆



■ Inspection: Crankshaft end play

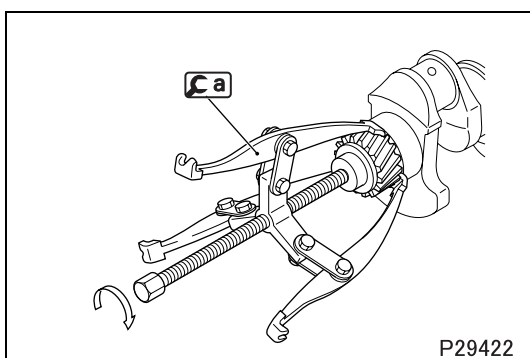
- If the measurement exceeds the specified limit, replace the thrust plates with oversize ones.
- Available oversizes:
+0.15 mm, +0.30 mm, +0.45 mm {0.0059, 0.012, 0.018 in.}
- Replace the crankshaft if the end play is too large to adjust using oversize thrust plates.

◆ Removal procedure ◆



■ Removal: Lower crankcase

- Loosen the bolts little by little in the order indicated in the illustration (1 to 16).
- After loosening the bolts, loosen the main cap bolts little by little in the order indicated in the illustration (17 to 26), then remove the main cap bolts.



■ Removal: Crankshaft gear

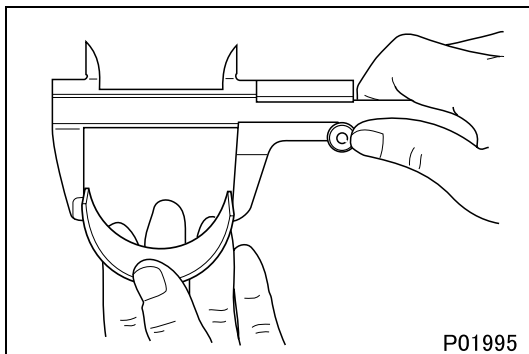
CAUTION ⚠

- Do not tap off the crankshaft gear as this can damage it.

■ Removal: Rear oil seal slinger

- Taking care not to damage the crankshaft, split the rear oil seal slinger using a chisel or a similar tool.

◆ Inspection procedure ◆

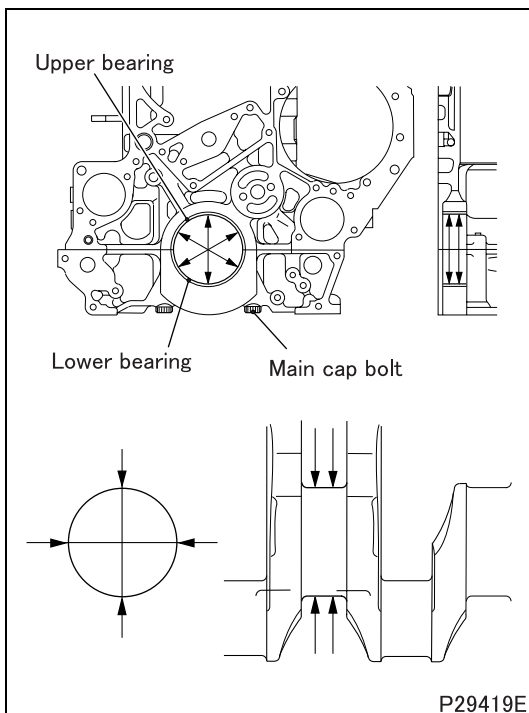


■ Inspection: Main bearing span when free

CAUTION ⚠

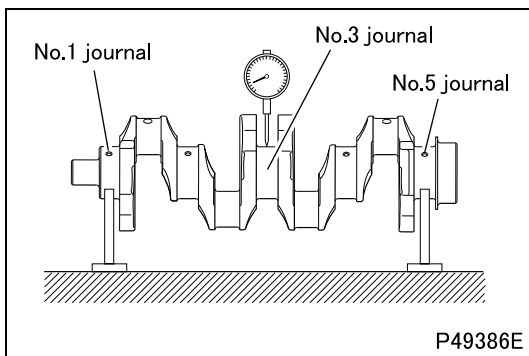
- Do not attempt to manually expand the bearings.
- Always replace the upper and lower bearings as a set.

- If the measurement exceeds the specified limit, replace the bearing.



■ Inspection: Main bearing-to-crankshaft clearance

- Fit the upper bearing into the upper crankcase and the lower bearing into the lower crankcase.
- Tighten the main bearing cap bolts to a torque of 49 N·m {36 ft.lbs, 5.0 kgf·m}.
- Measure the inside diameter of the main bearing and the diameter of the corresponding crankshaft journal.
- If the difference between the measurements exceeds the specified limit, machine the crankshaft journal to one of the specified undersize dimensions indicated on the next page.



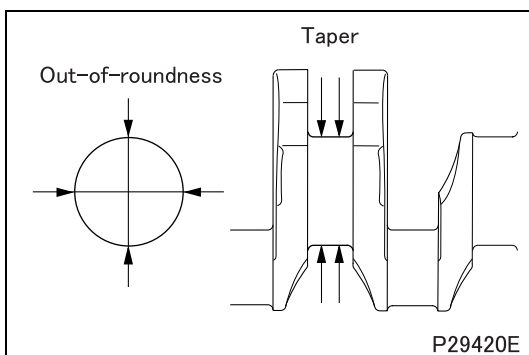
■ Inspection: Crankshaft

(1) Bend

- Support the crankshaft at its No. 1 journal and No. 5 journal. Measure the extent of bending in the crankshaft at the center of the No. 3 journal.
- If the measurement exceeds the specified limit, replace the crankshaft.

NOTE

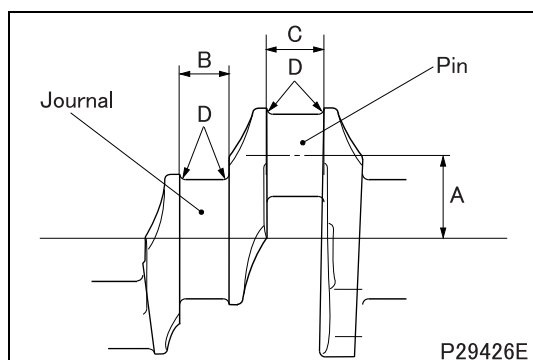
- Turn the crankshaft through one revolution. One-half of the dial indicator reading represents the extent of bending.



(2) Out-of-roundness and taper of crankshaft journals and pins

- If any of the measurements exceeds the specified limits, grind the crankshaft journal(s) and/or pin(s) to undersize(s) or replace the crankshaft.

CRANKSHAFT AND CRANKCASE



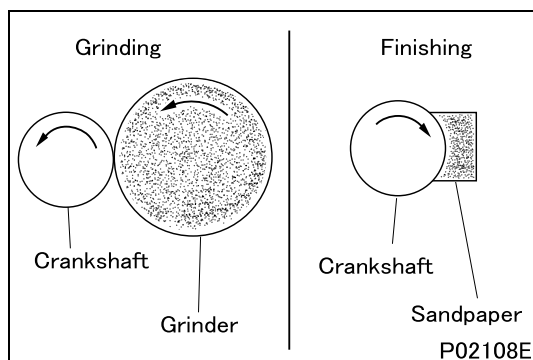
Grinding of crankshaft

CAUTION ⚠

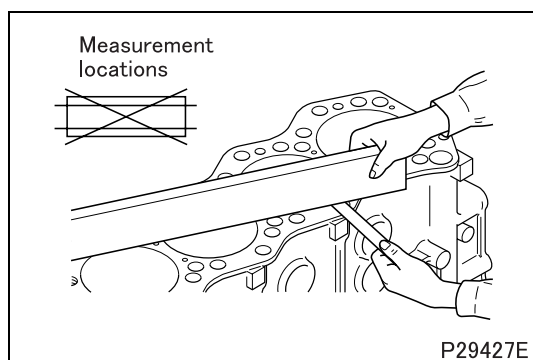
- If the crankshaft is ground to an undersize, the main bearings must be replaced with the undersize ones of the corresponding undersize.
- Do not change the center-to-center distance **A** between the journal and pin.
A: 60 ± 0.05 mm { 2.36 ± 0.0020 in.}
- Do not change the journal width **B** and the pin width **C**.
B: 33.5 mm {1.32 in.} (No. 1 journal)
35 mm {1.38 in.} (No. 2 to No. 4 journals)
 $35^{+0.039}_0$ mm { $1.38^{+0.0015}_0$ in.} (No. 5 journal)
C: $41^{+0.2}_0$ mm { $1.61^{+0.0079}_0$ in.} (No. 5 journal)
- Finish the fillets **D** smoothly.
D: R4 mm {R0.16 in.}
- Carry out a magnetic inspection to check for cracks possibly caused by grinding. Also, check that the hardness of the surface has not dropped below Shore hardness number (Hs) 75.
- Replace the crankshaft if defects are evident.

Crankshaft undersize dimensions (Unit: mm {in.})

		Undersizes			
		0.25 {0.0098}	0.50 {0.020}	0.75 {0.030}	1.00 {0.039}
Finished journal diameter	No. 1, 2, 4, 5	85.68 to 85.70 {3.37 to 3.37}	85.43 to 85.45 {3.36 to 3.36}	85.18 to 85.20 {3.35 to 3.35}	84.93 to 84.95 {3.34 to 3.34}
	No. 3	85.66 to 85.68 {3.37 to 3.37}	85.41 to 85.43 {3.36 to 3.36}	85.16 to 85.18 {3.35 to 3.35}	84.91 to 84.93 {3.34 to 3.34}
Finished pin diameter		64.69 to 64.71 {2.55 to 2.55}	64.44 to 64.46 {2.54 to 2.54}	64.19 to 64.21 {2.53 to 2.53}	63.94 to 63.96 {2.52 to 2.52}
Out-of-roundness		0.01 {0.00039} or less			
Taper		0.006 {0.00024} or less			



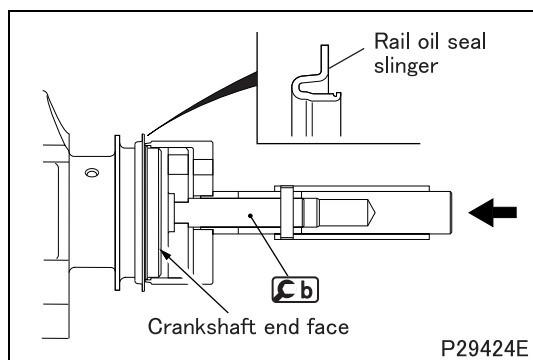
- When grinding, turn both the crankshaft and the grinder counter-clockwise as viewed from the crankshaft front end.
- When finishing the crankshaft with whetstone or sandpaper, rotate the crankshaft clockwise.



■ Inspection: Distortion of upper crankcase top surface

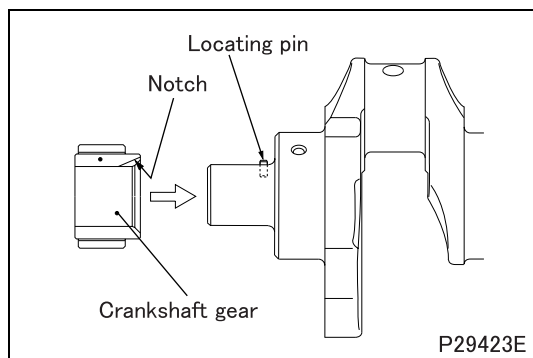
- If the measurement exceeds the specified limit, grind the crankcase top surface with a surface grinder.
- Limit the amount of removed metal to make sure that the amount of piston projection above the crankcase top surface stays within the standard value range.

◆ Installation procedure ◆



■ Installation: Rear oil seal slinger

- Press in the rear oil seal slinger until **C b** sits snugly on the crankshaft end surface.

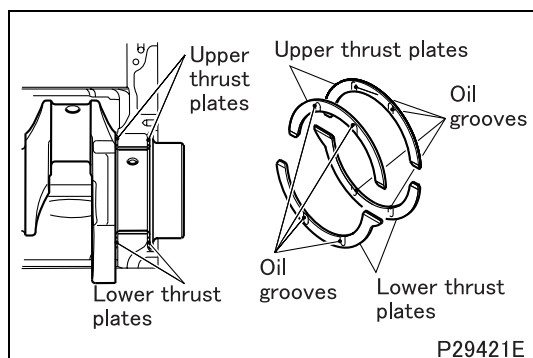


■ Installation: Crankshaft gear

- Heat the crankshaft gear to approximately 150°C {300°F} with a gas burner or the like.

CAUTION ⚠

- Be careful not to get burned.**
- Align the locating pin in the crankshaft with the slot in the crankshaft gear. Drive the gear into position by lightly striking its end face with a plastic hammer.

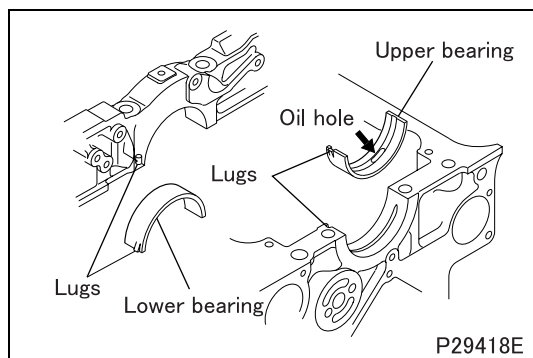


■ Installation: Thrust plate

- Install the thrust plates on both sides of the rearmost main bearing with the oil grooves on the inner plates facing inward and those on the outer plates outward as shown in the illustration.

CAUTION ⚠

- Be sure to orient the oil grooves as indicated above, otherwise seizures may occur in the engine.**
- Use oversize thrust plates when adjusting the crankshaft end play. The upper and lower thrust plates on the same side must be of the same size. The thrust plates on one side may differ in size from those on the other side.



■ Installation: Main bearings

- Install the main bearings with their lugs aligned as shown in the illustration. When the crankshaft journals have been ground to an undersize, use undersize main bearings.

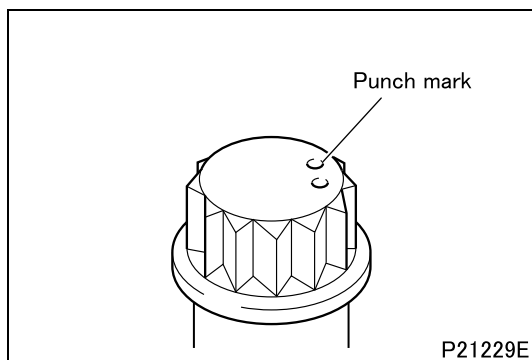
Available main bearing undersizes:

0.25 mm {0.0098 in.}, 0.50 mm {0.020 in.}, 0.75 mm {0.030 in.}, 1.00 mm {0.039 in.}

CAUTION ⚠

- The upper main bearing has an oil hole. The lower main bearing has no oil hole. Do not confuse the upper and lower bearings, as this can cause seizure in the engine.**

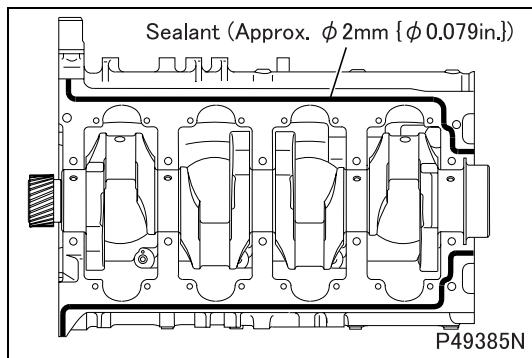
CRANKSHAFT AND CRANKCASE



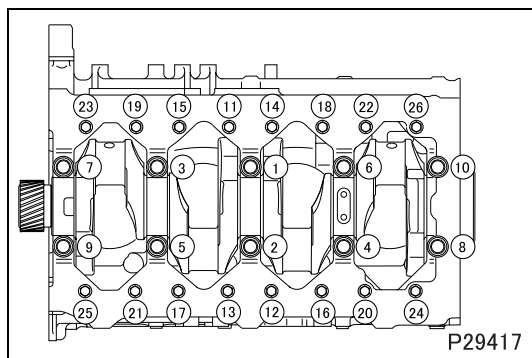
■ Installation: Lower crankcase

CAUTION ⚠

- Before installing the main bearing cap bolts, check the number of punch marks on the head of each bolt. (A bolt with two or less marks is reusable.)
- The number of punch marks corresponds with the number of times the main cap bolt has been tightened using the torque-turn tightening method. Any bolt that has three marks (i.e. that has been used three times) must be replaced.



- Clean all sealant application surfaces.
- Apply evenly thick beads of sealant to the upper crankcase without any breaks as shown in the illustration.
- Install the lower crankcase within three minutes of applying the sealant, being careful not to dislodge the sealant.



- Apply engine oil to the main cap bolt threads and seating surfaces of the bolt heads, then tighten them to a torque of 49 N·m {36 ft.lbs, 5.0 kgf·m} in the order indicated in the illustration (1 to 10).
- Tighten each main cap bolt further by 90° in the same order.
- Finally, tighten each bolt to the specified torque in the order indicated in the illustration (11 to 26).

CAUTION ⚠

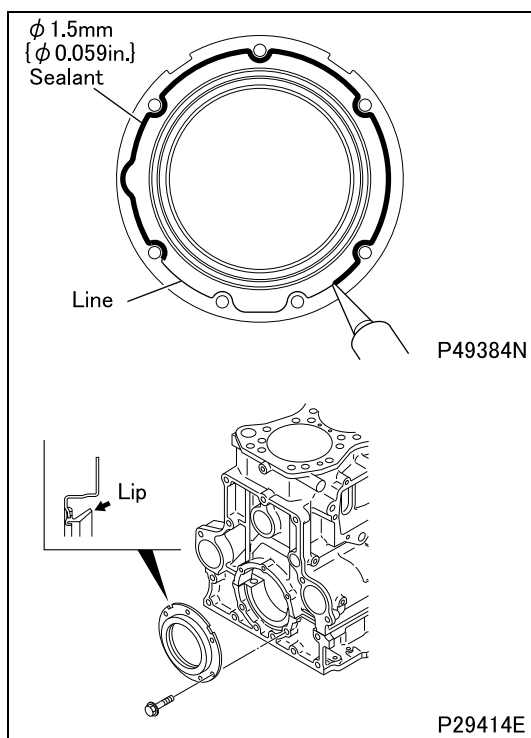
- After installing the bolts, wait at least an hour before starting the engine.
- Apply new beads of sealant whenever the main cap bolts have been loosened or removed.

- After tightening the bolts using the above torque-turn tightening method, make a punch mark on the head of each bolt to indicate the number of times that it has been used.

CAUTION ⚠

- The bolts that have been tightened using the torque-turn method must never be additionally tightened after the final angular tightening.

- After installing the main bearing caps, rotate the crankshaft by hand. If it cannot be rotated smoothly, inspect the main bearing caps for correct installation.



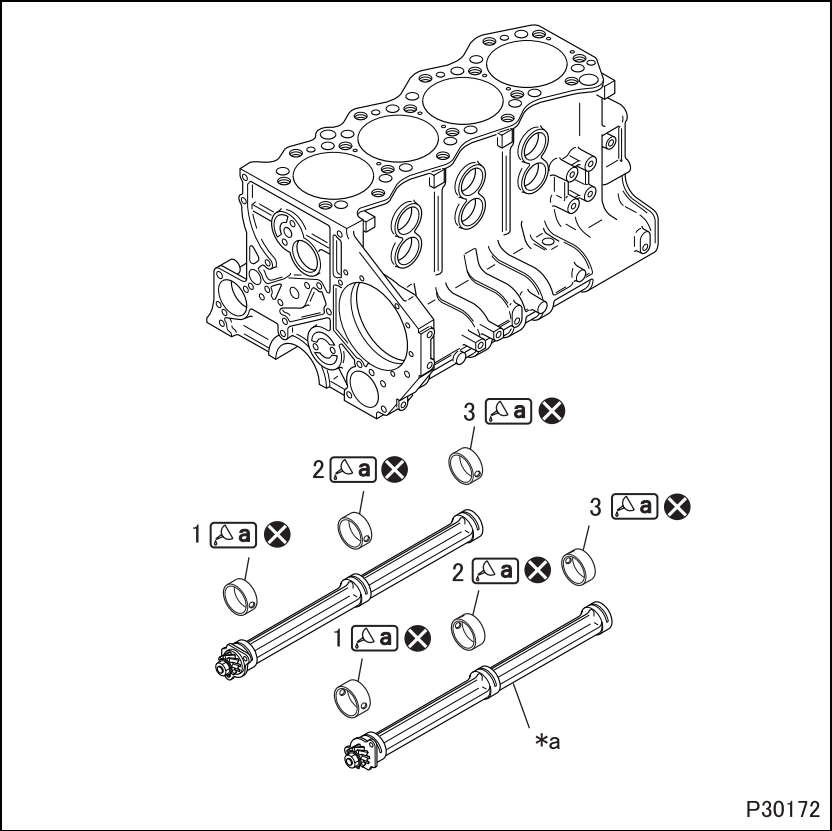
■ Installation: Rear oil seal

- Apply engine oil to the lip of the rear oil seal.
- Clean the seal surface of the crankshaft.
- Apply a bead of sealant along the line on the rear oil seal evenly without any breaks.
- Install the rear oil seal within three minutes after applying the sealant. Be careful not to let the applied sealant slip out of place during installation.

CAUTION

- After fitting the rear oil seal, wait at least an hour before starting the engine.
- Apply a new bead of sealant whenever the mounting bolts of the rear oil seal have been loosened.

BALANCE SHAFT BUSHINGS



Disassembly sequence

- 1 No. 1 balance shaft bushing
- 2 No. 2 balance shaft bushing
- 3 No. 3 balance shaft bushing

*a: Balance shaft
⊗: Non-reusable parts

NOTE

- Do not remove the balance shaft bushings unless defects are evident.

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1 to 3, *a	Balance shaft journal-to-balance shaft bushing clearance	No. 1 0.055 to 0.099 {0.0022 to 0.0039}	0.15 {0.0059}	Replace
		No. 2 0.075 to 0.119 {0.030 to 0.0047}		
		No. 3 0.055 to 0.099 {0.0022 to 0.0039}		

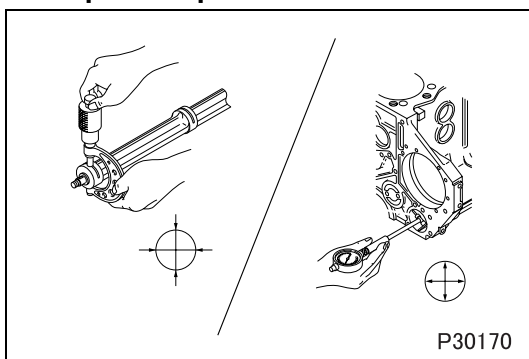
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Balanceshaft bushing inner surface	Engine oil	As required

Special tools

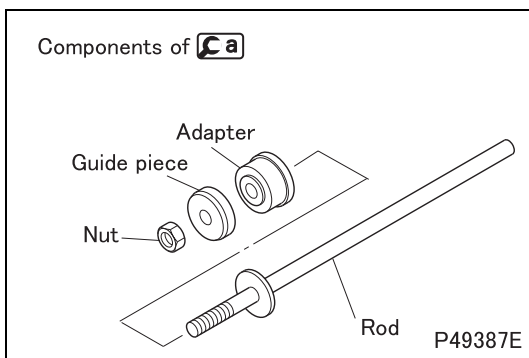
Mark	Tool name and shape	Part No.	Application
	Balance shaft bushing installer and extractor Rod Guide piece Adapter P49941E	MH062782	Removal and installation of balance shaft bushing

◆ Inspection procedure ◆



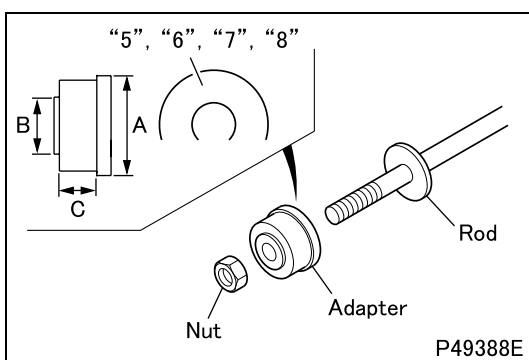
■ Inspection: Balance shaft-to-balance shaft bushing clearance

- Replace the bushing if the measurement exceeds the specified limit.



Replacement of balance shaft bushing

- Replace the bushing using **Ca**.

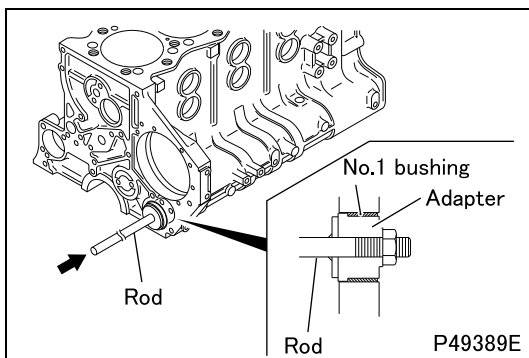


[Removal]

- To remove the bushings, use the rod fitted with an adapter corresponding to the size of each bushing.

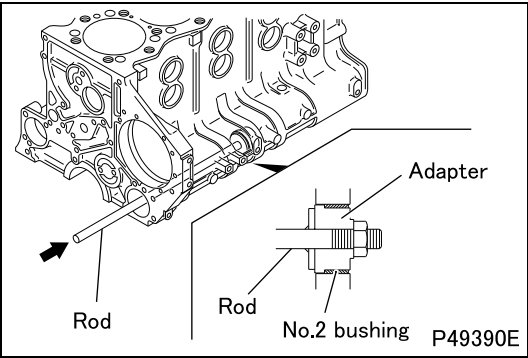
Unit: mm {in.}

Bushing		Adapter			
		Identification mark	A	B	C
No. 1	Left	"5"	$\phi 55.25$ { $\phi 2.18$ }	$\phi 51.5$ { $\phi 2.03$ }	26.5 {1.04}
	Right	"6"			
No. 2		"7"	$\phi 55$ { $\phi 2.17$ }	$\phi 51$ { $\phi 2.01$ }	21.5 {0.85}
No. 3		"8"	$\phi 54.75$ { $\phi 2.16$ }	$\phi 50.5$ { $\phi 1.99$ }	

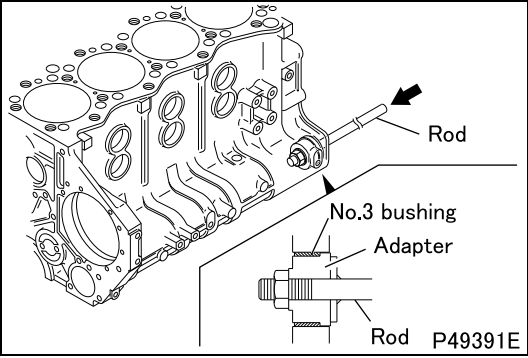


- Remove the No. 1 bushing by tapping on the rod from the front of the engine.

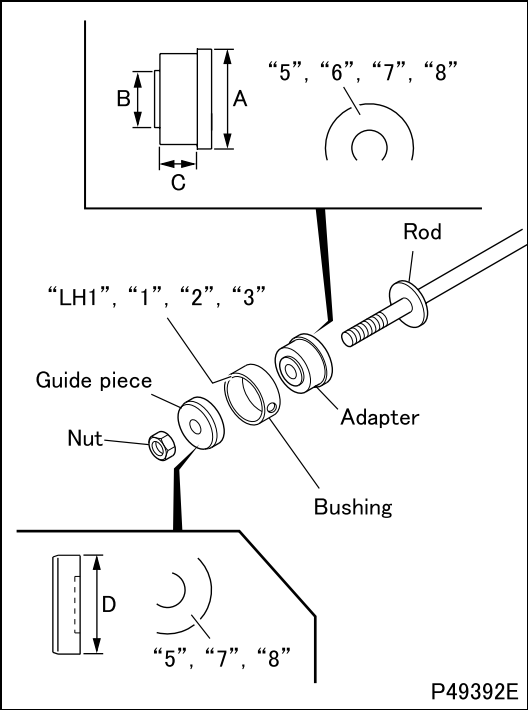
BALANCE SHAFT BUSHINGS



- Remove the No. 2 bushing by tapping on the rod from the front of the engine.



- Remove the No. 3 bushing by tapping on the rod from the back of the engine.

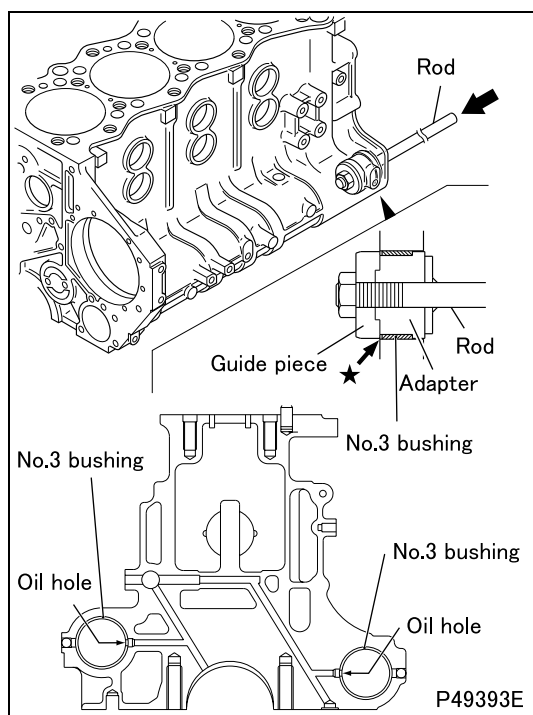


[Installation]

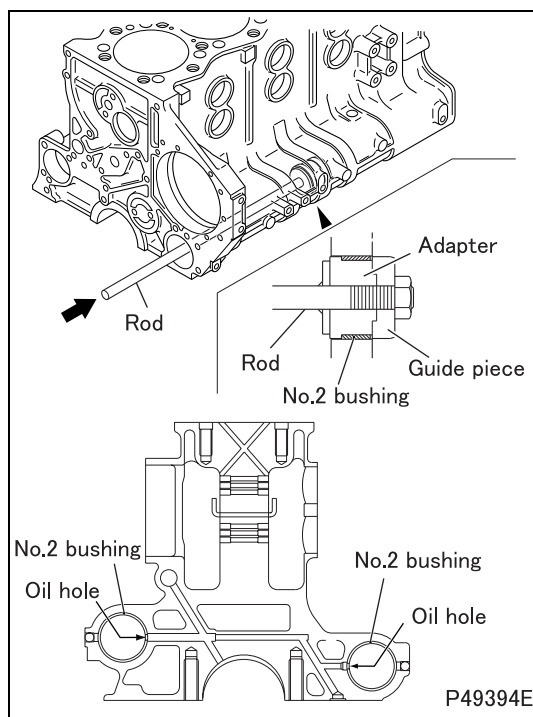
- To install the bushings, use the rod fitted with an adapter corresponding to the size of each bushing. Each bushing has an identification mark. These identification marks are used to distinguish between the No. 1, No. 2 and No. 3 bushings. If the identification mark is not clear, measure the outside diameter of the bushing and use the measurement as a means of identification.

Unit: mm {in.}

Bushing				Adapter				Guide piece	
		Identi- fica- tion mark	Out- side di- ameter	Identi- fica- tion mark	A	B	C	Identi- fica- tion mark	D
No. 1	Left	“LH1”	ϕ 55.25 { ϕ 2.18}	“5”	ϕ 55.25 { ϕ 2.18}	ϕ 51.5 { ϕ 2.03}	26.5 {1.04}	“5”	ϕ 55.25 { ϕ 2.18}
	Right	“1”	ϕ 55.25 { ϕ 2.18}	“6”			21.5 {0.85}	“6”	
No. 2		“2”	ϕ 55 { ϕ 2.17}	“7”	ϕ 55 { ϕ 2.17}	ϕ 51 { ϕ 2.01}		21.5 {0.85}	“7”
No. 3		“3”	ϕ 54.75 { ϕ 2.16}	“8”	ϕ 54.75 { ϕ 2.16}	ϕ 50.5 { ϕ 1.99}	“8”		ϕ 54.75 { ϕ 2.16}

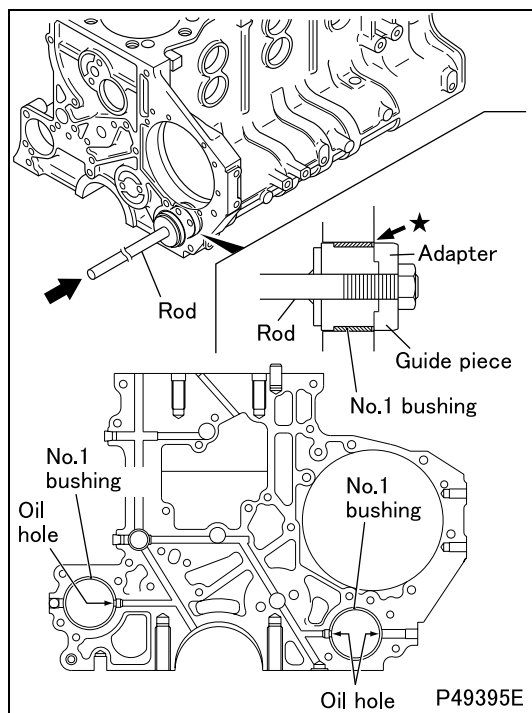


- Align the oil hole in the No. 3 bushing with the oil hole in the upper crankcase.
- Force the No. 3 bushing into the upper crankcase as deep as the ★ mark in the illustration by tapping on the rod from the rear of the engine.



- Align the oil hole in the No. 2 bushing with the oil hole in the upper crankcase.
- Force the No. 2 bushing into the upper crankcase to the illustrated position by tapping on the rod from the front of the engine.

BALANCE SHAFT BUSHINGS



- Align the oil hole(s) in the No. 1 bushing with the oil hole(s) in the upper crankcase.
- Force the No. 1 bushing into the upper crankcase as deep as the ★ mark in the illustration by tapping on the rod from the front of the engine.

CAUTION ⚠

- The left and right No. 1 bushings are different from each other, and should not be installed in reverse positions.
- The left No. 1 bushing has two oil holes, whereas the right No. 1 bushing has only one oil hole.



Group 12

Lubrication

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

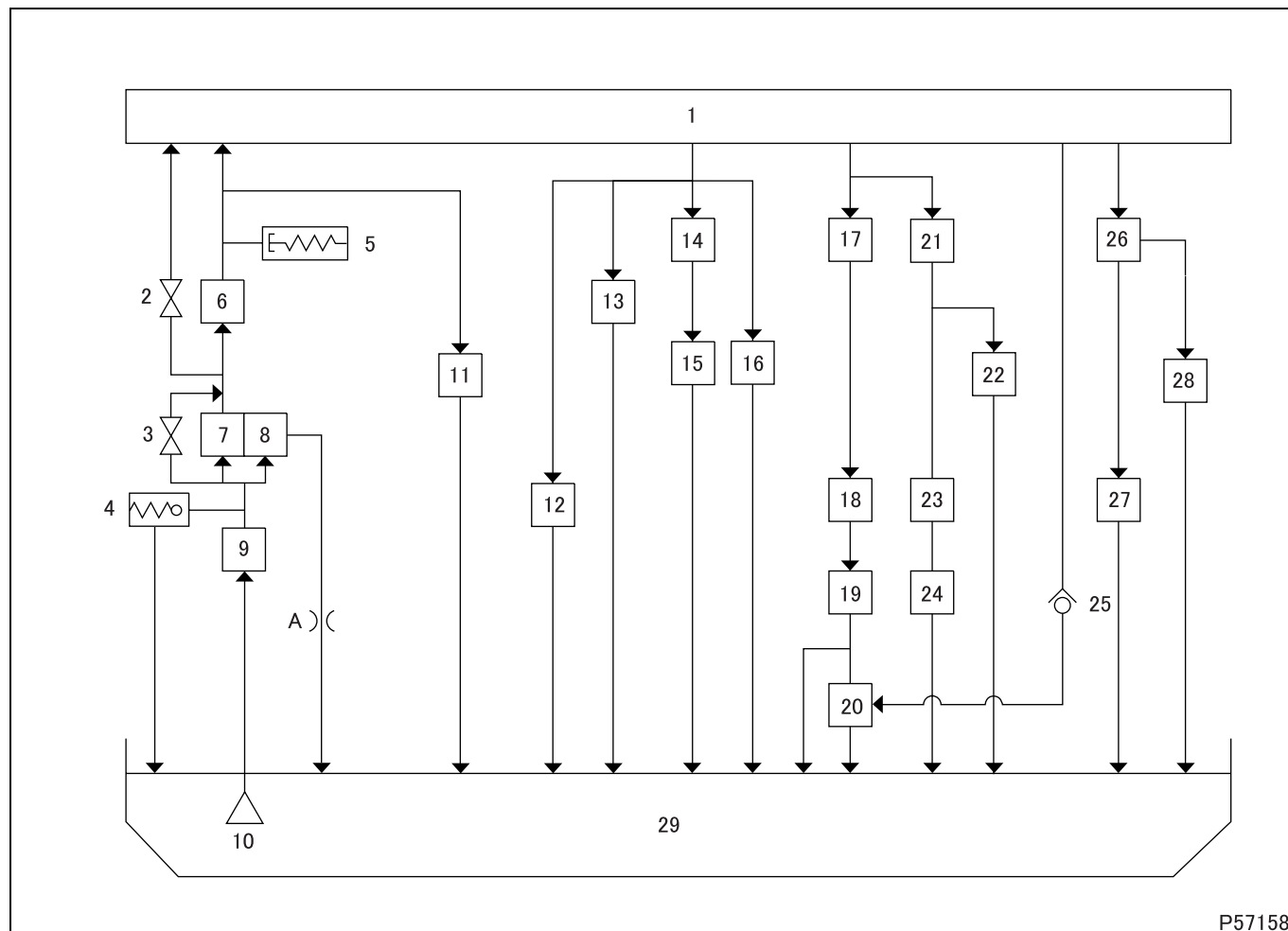
INDEX

SPECIFICATIONS	12-2
STRUCTURE AND OPERATION	
1. Lubrication System	12-3
2. Oil Pump	12-4
3. Oil Cooler.....	12-5
4. Oil Filter	12-6
5. Lubrication of Engine Components	12-7
TROUBLESHOOTING.....	12-10
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Oil Filter Replacement.....	12-12
2. Engine Oil Replacement.....	12-16
3. Oil Pressure Measurement	12-18
OIL PAN, OIL STRAINER AND OIL JETS.....	12-20
OIL PUMP	12-22
OIL FILTER.....	12-26
OIL COOLER.....	12-30

SPECIFICATIONS

Item			Specifications
Method of lubrication			Forced lubrication by oil pump
Oil filter			Spin-on filter paper type
Oil cooler			Shell and plate type (multiple-plate type)
Engine oil	Grade		API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1
	Quantity L (qts)	Oil pan	Approx. 9
		Oil filter	Approx. 1
Regulator valve opening pressure		kPa {psi, kgf/cm ² }	600 ⁺¹⁰⁰ ₀ {87 ⁺¹⁵ ₀ , 6 ⁺¹ ₀ }
Bypass valve opening pressure		kPa {psi, kgf/cm ² }	390 ± 29 {57 ± 4.2, 4.0 ± 0.3}

1. Lubrication System

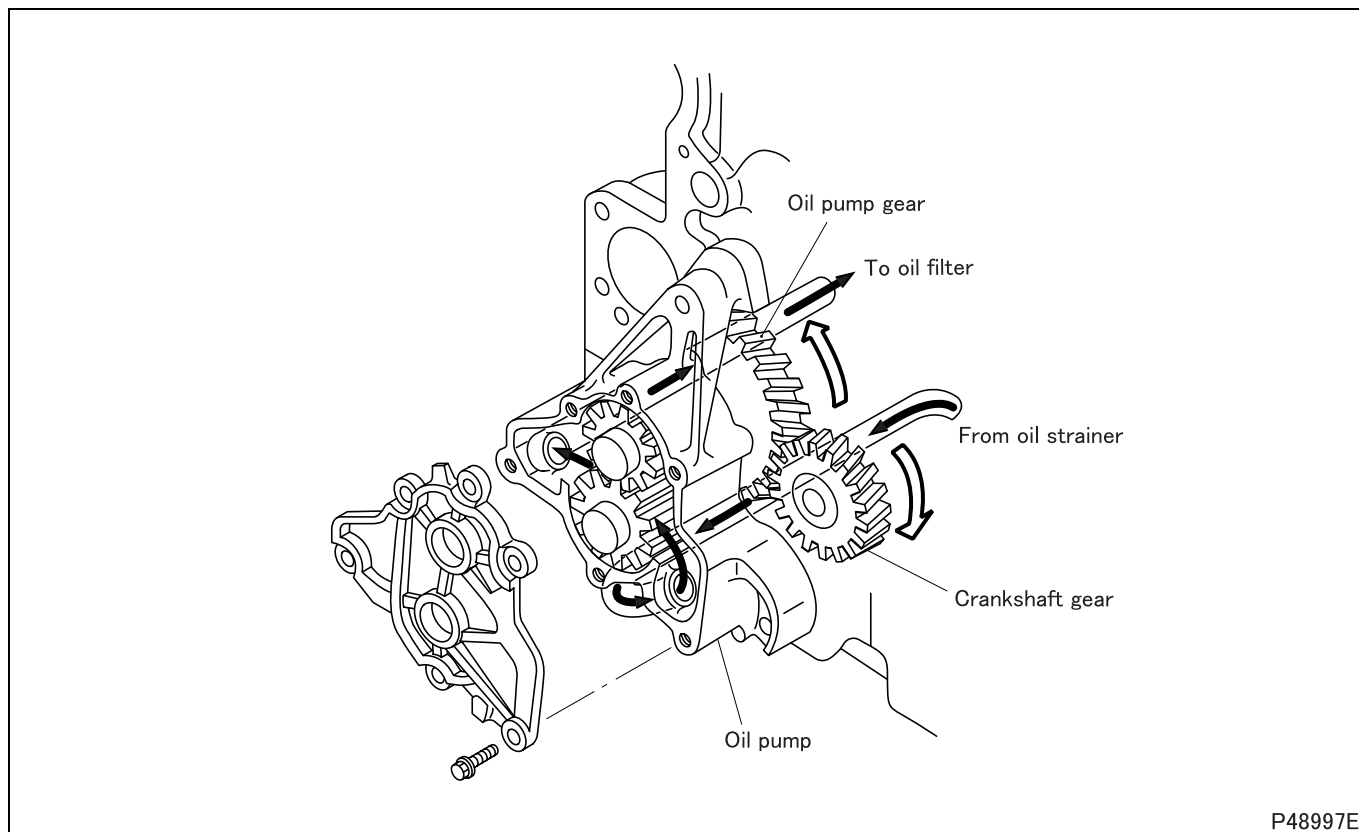


P57158

- | | |
|------------------------------|-----------------------------------|
| 1 Main oil gallery | 17 Crankshaft main bearing |
| 2 Bypass valve | 18 Connecting rod bearing |
| 3 Bypass valve | 19 Connecting rod bushing |
| 4 Regulator valve | 20 Piston |
| 5 Engine oil pressure switch | 21 Balance shaft bushing RH |
| 6 Oil cooler | 22 Supply pump gear bushing |
| 7 Full-flow filter element | 23 Supply pump idler gear bushing |
| 8 Bypass filter element | 24 Supply pump idler gear shaft |
| 9 Oil pump | 25 Check valve for oil jet |
| 10 Oil strainer | 26 Rocker bushing |
| 11 Turbo charger | 27 Camshaft bushing |
| 12 Oil jet for gear | 28 Rocker roller |
| 13 Vacuum pump | 29 Oil pan |
| 14 Idler bushing | |
| 15 Timing gear | |
| 16 Balance shaft bushing LH | |
- A: Orifice

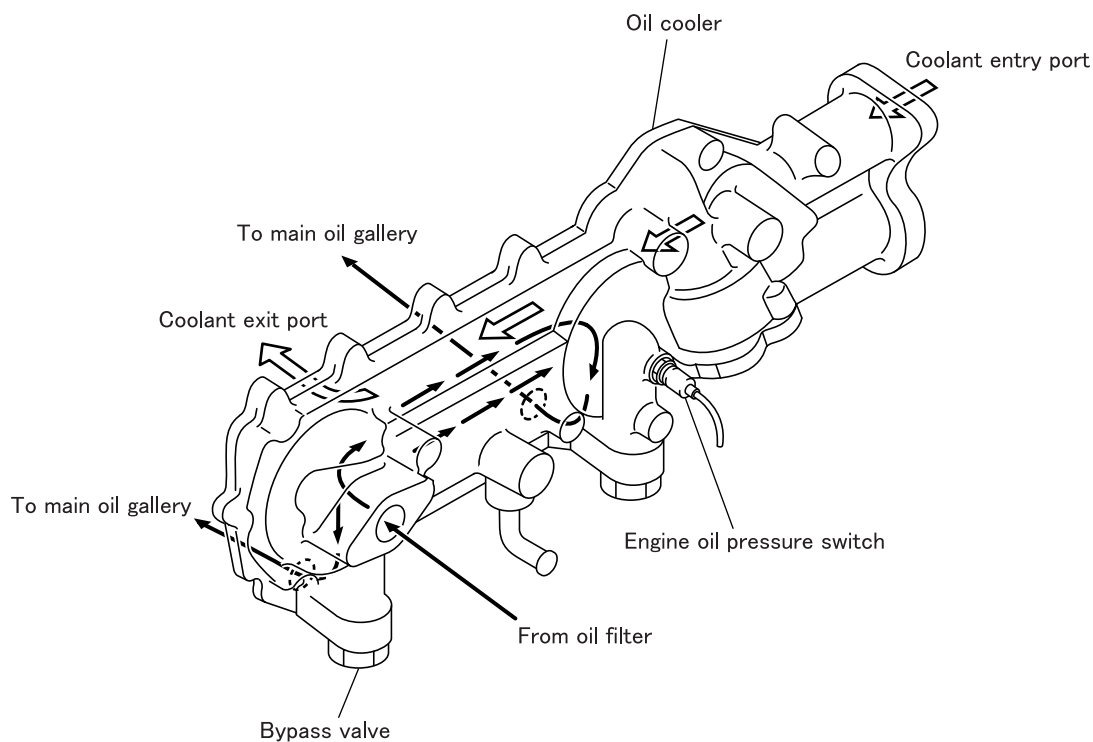
STRUCTURE AND OPERATION

2. Oil Pump

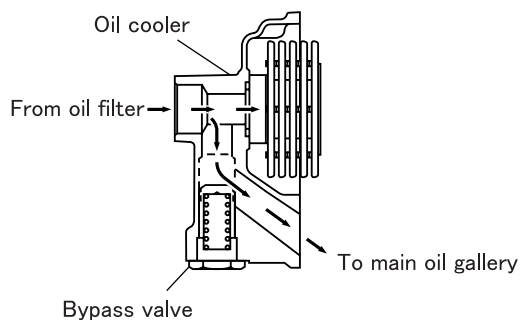


- This engine uses a gear-type oil pump driven by the rotation of the crankshaft transmitted through the engagement of the crankshaft gear and the oil pump gear.

3. Oil Cooler



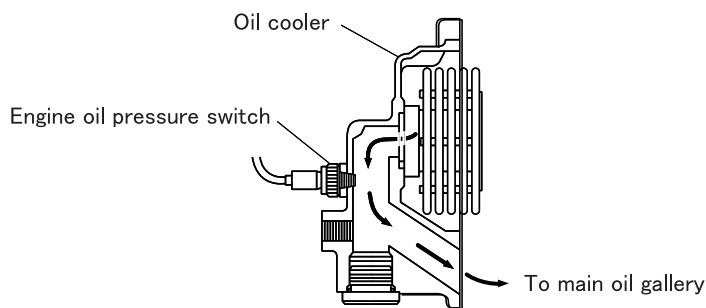
P57159E



P48999E

3.1 Bypass valve

- When the engine oil is cool and its viscosity is high, or when the oil cooler element becomes clogged and restricts the flow of the engine oil, the bypass valve opens to let the engine oil bypass the oil cooler and flow directly to the main oil gallery.



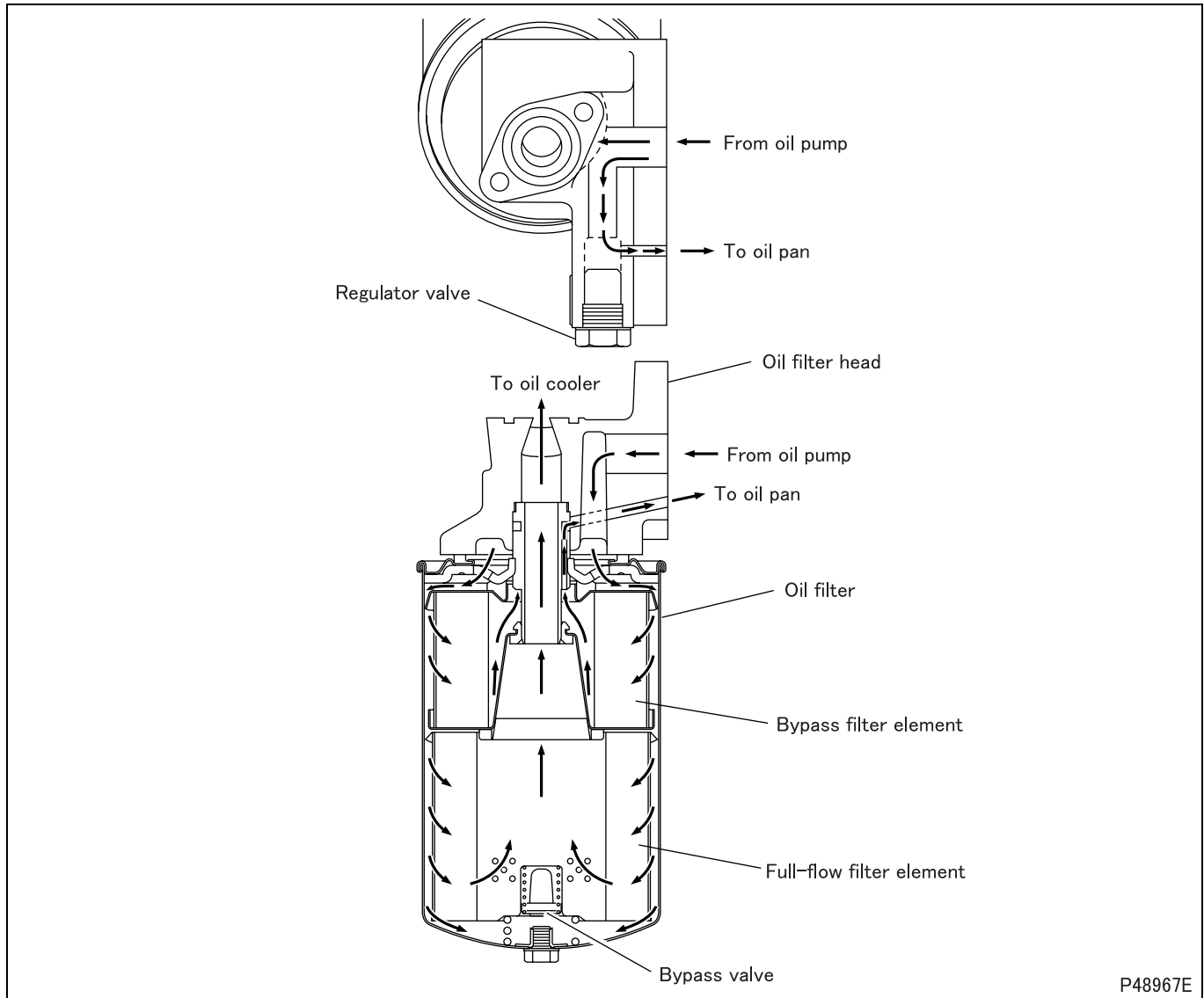
P49000E

3.2 Engine oil pressure switch

- When the pressure of the engine oil to the main oil gallery drops below the specified level, an electrical contact inside the engine oil pressure switch closes.
- This causes a warning lamp on the meter cluster to illuminate and notify the operator of the excessive pressure drop.

STRUCTURE AND OPERATION

4. Oil Filter

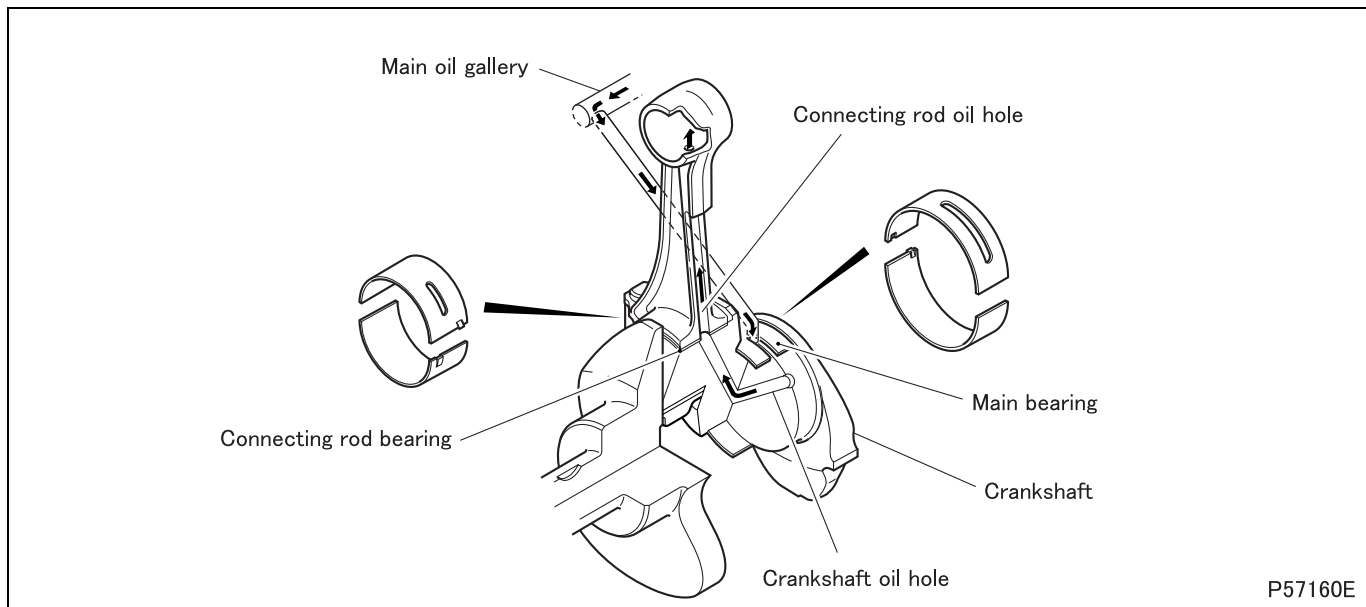


- The oil filter used in this engine is a spin-on, paper-filter type that incorporates both a bypass filter and a full-flow filter.
- A bypass valve is installed in the lower part of the oil filter. When the filter elements are clogged, this valve opens to let the engine oil bypass the filter elements and flow directly to the oil cooler, thereby preventing seizures in the engine.
- A regulator valve is installed on the oil filter head. When the oil pressure in the main oil gallery exceeds the specified level, the regulator valve opens to adjust the oil pressure by returning part of the engine oil to the oil pan.

5. Lubrication of Engine Components

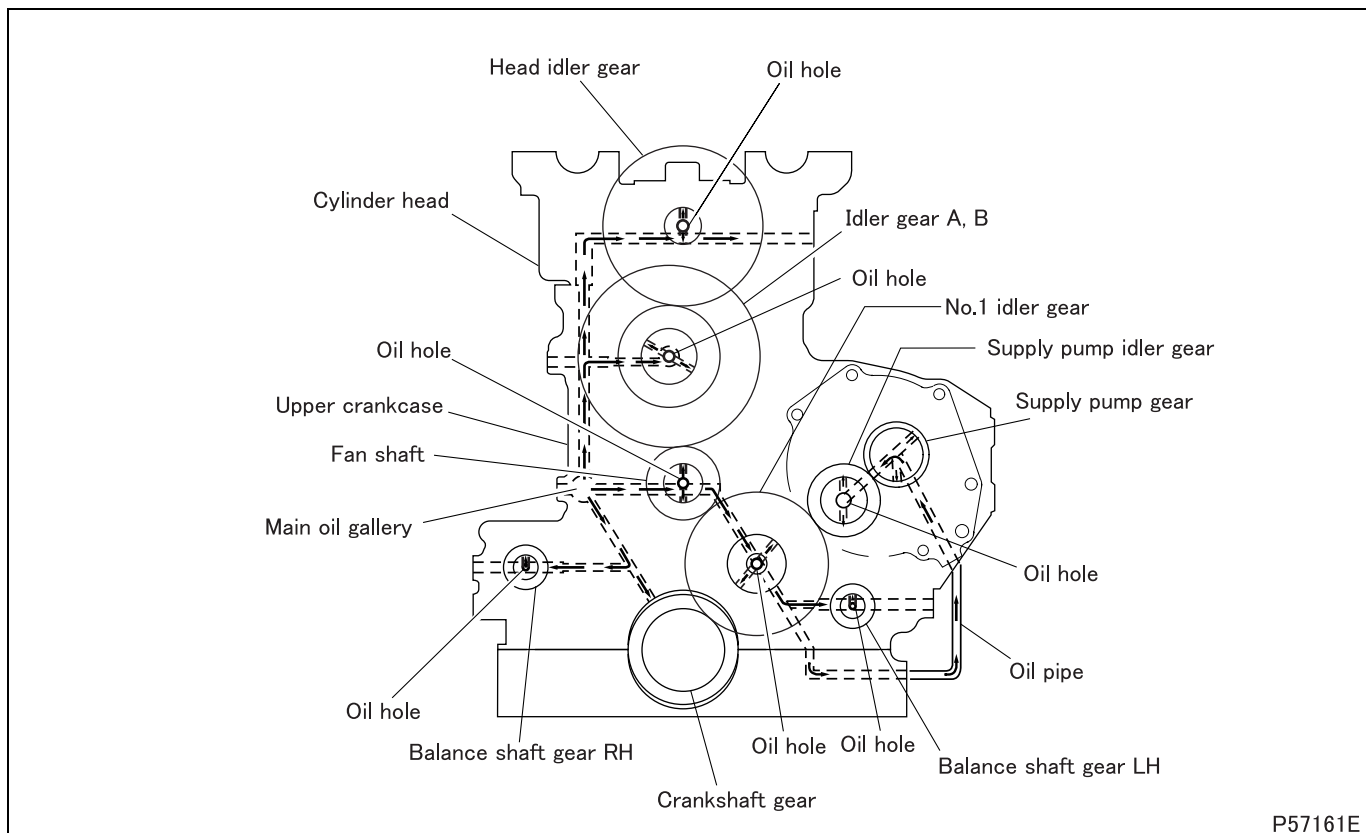
- The engine oil in the main oil gallery lubricates the engine components in the following ways.

5.1 Main bearing and connecting rod bearing



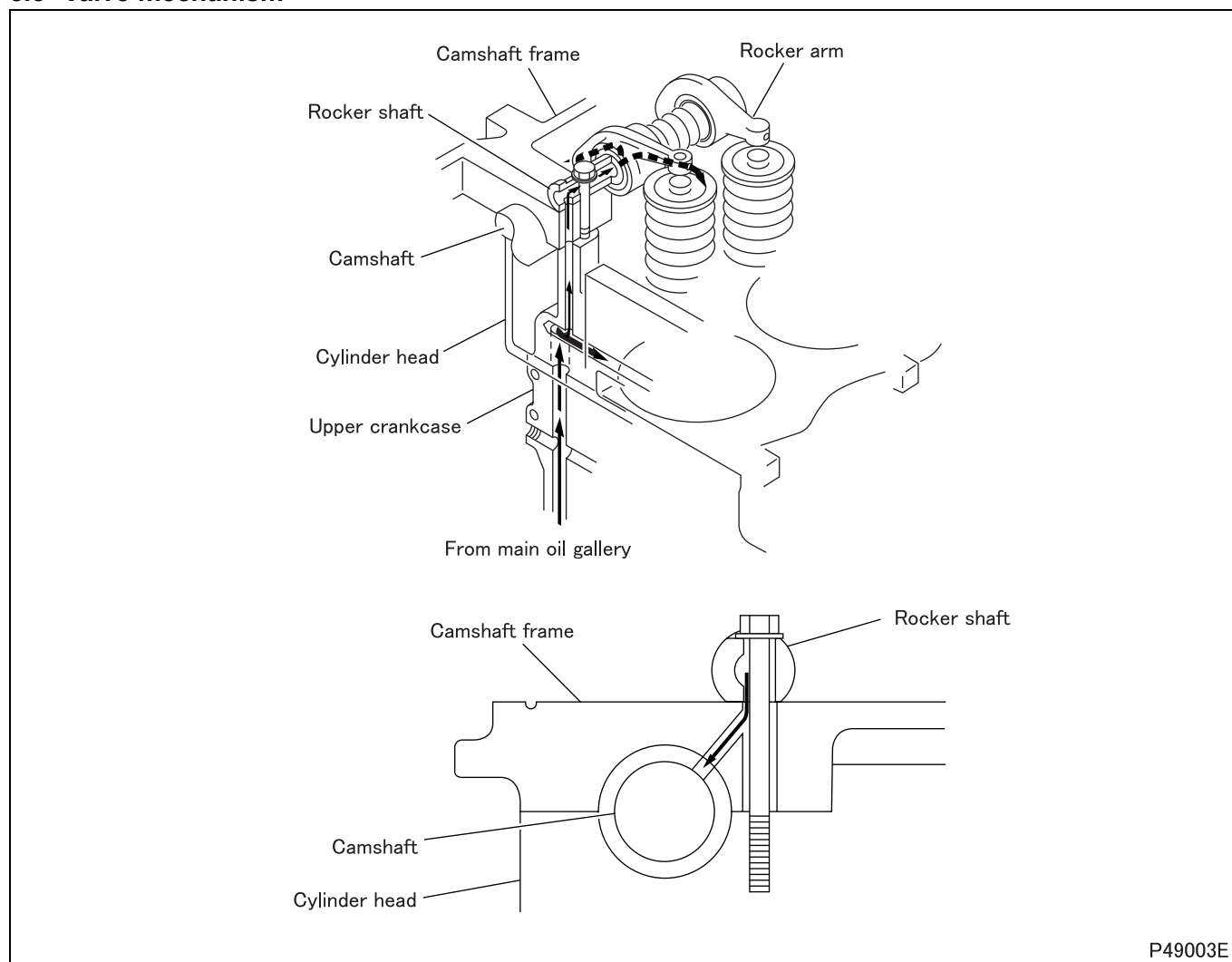
- Engine oil supplied through an oil passage in the crankshaft lubricates the big end (connecting rod bearing) of each connecting rod. Simultaneously, engine oil supplied through an oil passage in the connecting rod lubricates the connecting rod's small end.

5.2 Timing gears



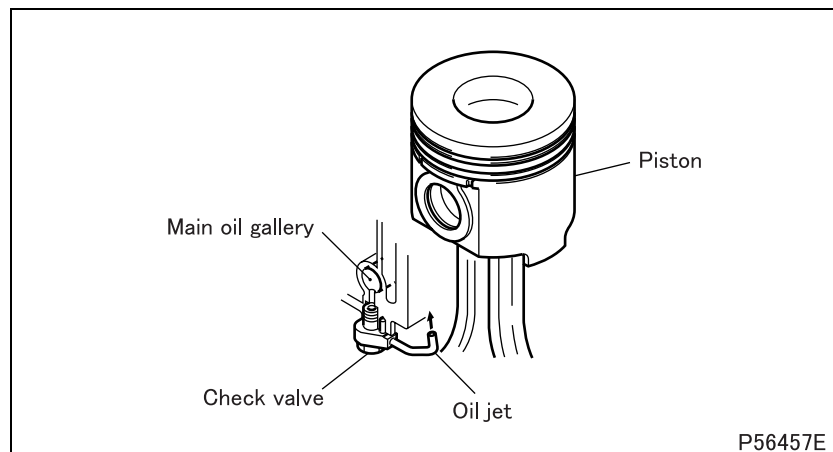
STRUCTURE AND OPERATION

5.3 Valve mechanism



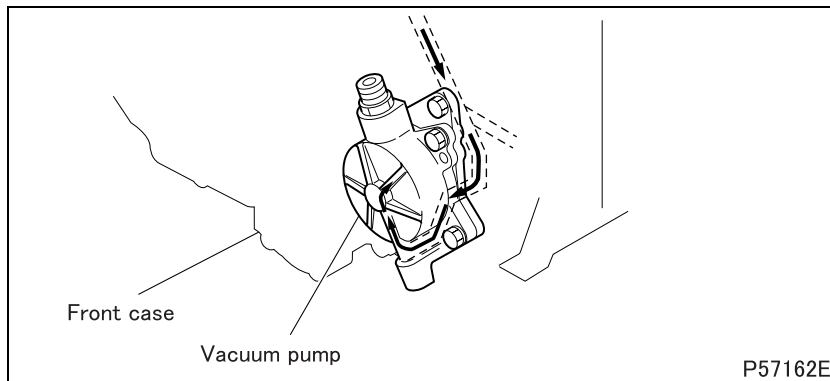
- The engine oil flows from the main oil gallery to the rocker shaft through the oil passages in the upper crankcase, cylinder head, and camshaft frame.
- The engine oil in the rocker shaft lubricates the rocker arms and camshaft, then returns to the oil pan.

5.4 Check valves and oil jets



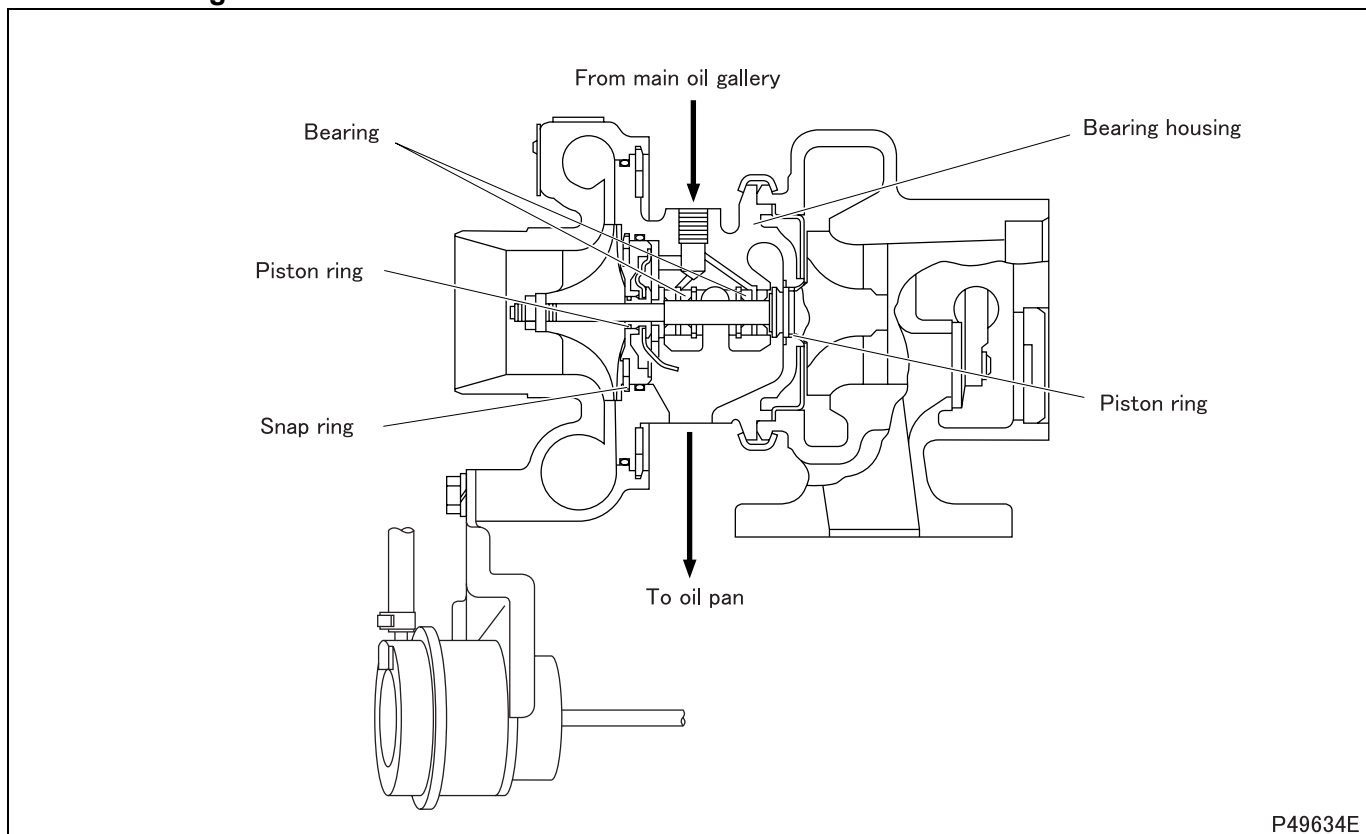
- An oil jet is fitted in the lower part of the main oil gallery for each cylinder.
- Engine oil is sprayed out of the oil jet into the piston to cool the piston.
- Each oil jet is fitted with a check valve that opens and closes at predetermined oil pressure levels. At low engine speeds, the check valve closes to maintain the required volume of oil in the lubrication system and prevent reductions in oil pressure.

5.5 Vacuum pump



- Engine oil flows through the oil passages in the front case to the vacuum pump.
- The oil in the pump lubricates the vanes, and then is discharged into the front case from the air discharge port of the vacuum pump along with air, and returns to the oil pan.

5.6 Turbocharger



- Engine oil flows from the main oil gallery through the oil pipes to the turbocharger bearing housing and lubricates the inner surfaces of the bearing housing.
- The piston rings mounted on both sides of the turbine wheel shaft act as oil seals.

TROUBLESHOOTING

Symptoms		Engine is difficult to start	Overheating	Low oil pressure	Excessive oil consumption (oil leakage)	Reference Gr
Possible causes						
Oil cooler	Incorrectly mounted element		O	O	O	
	Defective gasket		O	O	O	
	Defective O-ring		O	O	O	
	Clogged element		O	O		
	Damaged element		O	O	O	
	Weakened bypass valve spring		O			
Oil pump	Malfunctioning oil pump		O	O		
	Interference between oil pump gear and oil pump case and/or cover	O		O		
Oil filter	Incorrect installation				O	
	Clogged element		O	O		
	Defective gasket			O		
Weakened regulator valve spring				O		
Incorrectly mounted and/or clogged oil strainer			O	O		
Defective fan shaft front oil seal					O	Gr11
Defective crankshaft rear oil seal					O	
Incorrectly mounted front case					O	
Defective piston cooling oil jet(s)			O	O		
Incorrectly mounted gear lubrication oil jet				O		
Oil working its way up into combustion chamber(s) through piston rings					O	
Oil working its way down into combustion chamber(s) through valves					O	
Too high oil viscosity		O				
Poor oil quality			O			
Deterioration of oil			O			
Fuel mixed with oil			O			

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

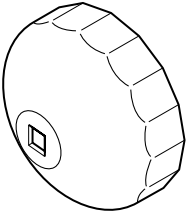
1. Oil Filter Replacement

<Downward type>

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
-	Oil filter	Engine oil (API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1)	Approx. 1 L {1.1 qts}

Special tools

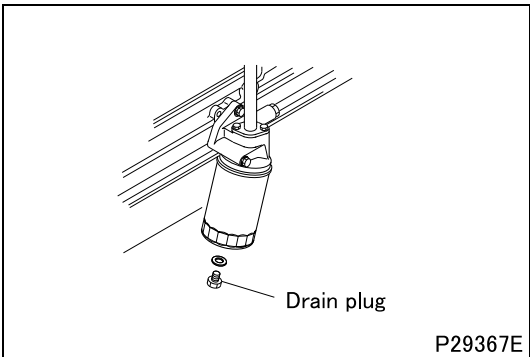
Mark	Tool name and shape	Part No.	Application
	Oil filter element socket  P08550	MH061566	Removal of oil filter

WARNING

- Wipe up any spilled engine oil, as it can cause fires.

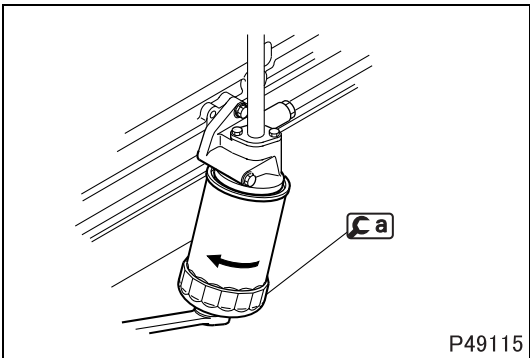
CAUTION

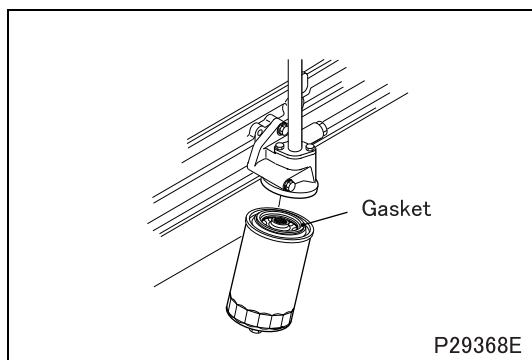
- Make sure not to put any engine oil on the V-belt when working on the oil filter. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.



[Removal]

- Remove the drain plug and drain the oil out of the oil filter.



**[Installation]**

- Clean the oil filter mounting surfaces of the oil filter head.
- Apply a thin coat of engine oil on the oil filter gasket.
- Screw in the oil filter by hand until the gasket touches the oil filter head. Then, tighten the filter by turning it further by three quarters (3/4) of a turn.
- After installing the oil filter, start the engine and check that there are no oil leaks.
- Remove and reinstall the oil filter if it is leaky.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

ON-VEHICLE INSPECTION AND ADJUSTMENT

<Upward type>

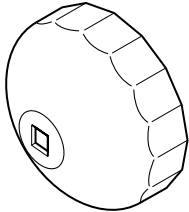
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug (oil pipe)	34.3 to 39.2 {25 to 29, 3.5 to 3.9}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Oil filter	Engine oil (API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1)	Approx. 1 L {1.1 qts}

Special tools

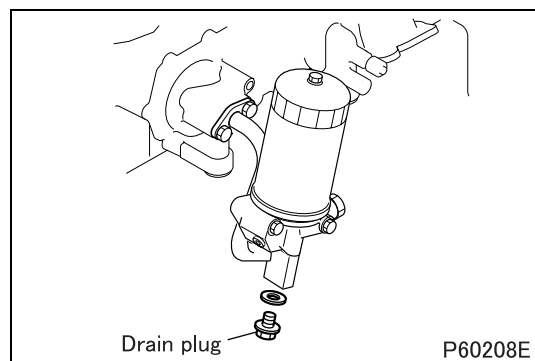
Mark	Tool name and shape	Part No.	Application
	Oil filter element socket  P08550	MH061566	Removal of oil filter

WARNING

- Wipe up any spilled engine oil, as it can cause fires.

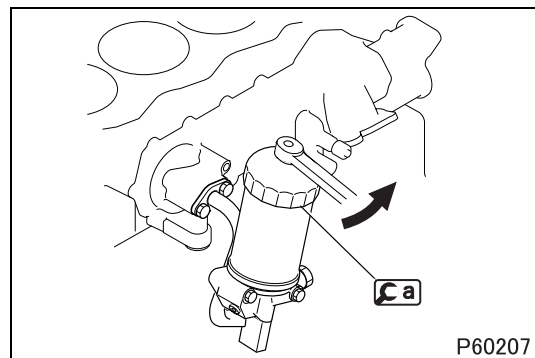
CAUTION

- Make sure not to put any engine oil on the V-belt when working on the oil filter. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.



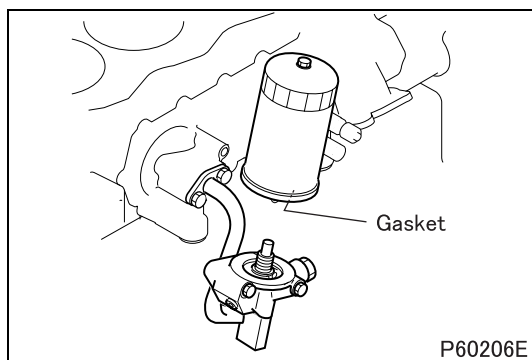
[Removal]

- Remove the drain plug and drain the oil out of the oil filter.



NOTE

- When the oil filter is removed, a small amount of engine oil may spill out. Before proceeding to the removal procedure, keep a piece of waste cloth ready for catching any spilled oil.

**[Installation]**

- Clean the oil filter mounting surfaces of the oil filter head.
- Apply a thin coat of engine oil on the oil filter gasket.
- Screw in the oil filter by hand until the gasket touches the oil filter head. Then, tighten the filter by turning it further by three quarters (3/4) of a turn.
- After installing the oil filter, start the engine and check that there are no oil leaks.
- Remove and reinstall the oil filter if it is leaky.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Engine Oil Replacement

<Downward type>

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug (oil filter)	9.8 ± 1.96 {7.2 ± 1.4, 1.0 ± 0.2}	–
–	Drain plug (oil pan)	34.3 to 43.1 {25 to 32, 3.5 to 4.4}	–

Lubricant and/or sealant

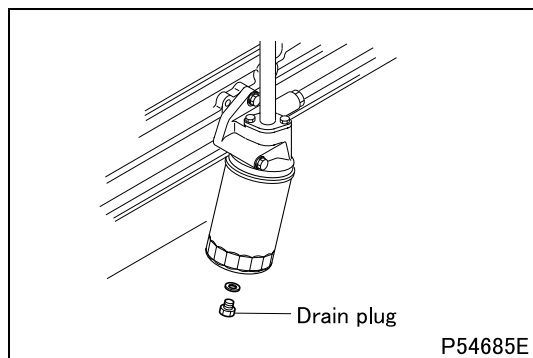
Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Oil filter	Engine oil (API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1)	Approx. 1 L {1.1 qts}
	Oil pan		Approx. 9 L {9.5 qts}

WARNING

- Wipe up any spilled engine oil, as it can cause fires.

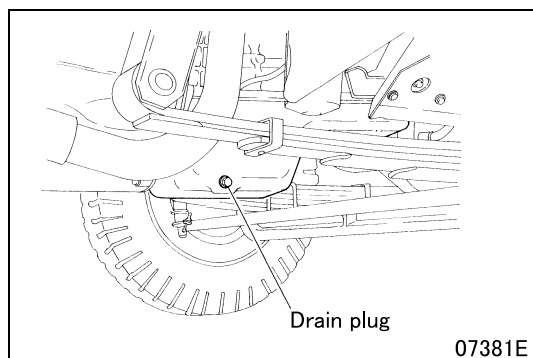
CAUTION

- Make sure not to put any engine oil on the V-belt during engine oil replacement. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.



[Draining]

- Remove the filler cap.
- Remove the drain plugs of the oil filter and oil pan to drain out the engine oil.



[Refilling]

- Tighten the drain plug to the specified torque, then pour a specified amount of new engine oil into the engine.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

<Upward type>

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug (oil pipe)	34.3 to 39.2 {25 to 29, 3.5 to 3.9}	–
–	Drain plug (oil pan)	34.3 to 43.1 {25 to 32, 3.5 to 4.4}	–

Lubricant and/or sealant

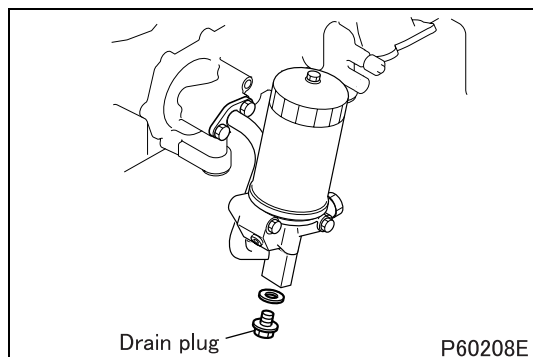
Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Oil filter	Engine oil (API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1)	Approx. 1 L {1.1 qts}
	Oil pan		Approx. 9 L {9.5 qts}

WARNING ⚠

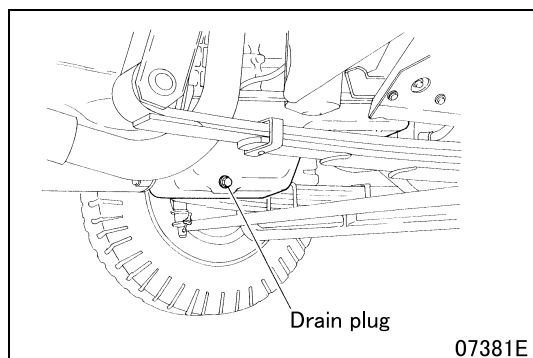
- Wipe up any spilled engine oil, as it can cause fires.

CAUTION ⚠

- Make sure not to put any engine oil on the V-belt during engine oil replacement. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.

**[Draining]**

- Remove the filler cap.
- Remove the drain plugs of the oil filter and oil pan to drain out the engine oil.

**[Refilling]**

- Tighten the drain plug to the specified torque, then pour a specified amount of new engine oil into the engine.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Oil Pressure Measurement

Service standards

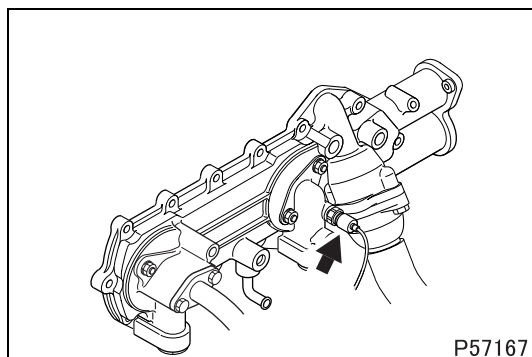
Location	Maintenance item		Standard value	Limit	Remedy
-	Oil pressure (oil temperature at 70 to 90°C {158 to 195°F})	No-load minimum speed	195 kPa {28 psi, 2.0 kgf/cm ² }	98 kPa {14 psi, 1.0 kgf/cm ² }	Inspect
		No-load maximum speed	295 to 490 kPa {43 to 71 psi, 3 to 5 kgf/cm ² }	195 kPa {28 psi, 2.0 kgf/cm ² }	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

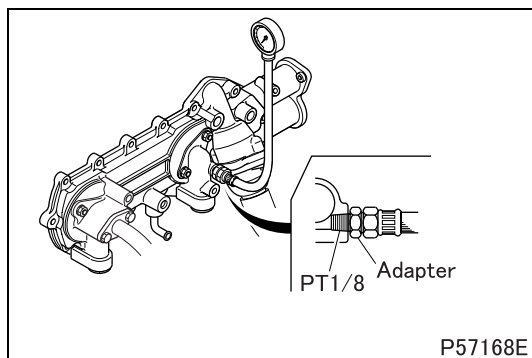
Mark	Parts to be tightened	Tightening torque	Remarks
-	Engine oil pressure switch	7.8 to 14.7 {5.8 to 11, 0.8 to 1.5}	Sealant With cold engine

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
-	Engine oil pressure switch threads	THREEBOND 1215	As required



- Remove the engine oil pressure switch.



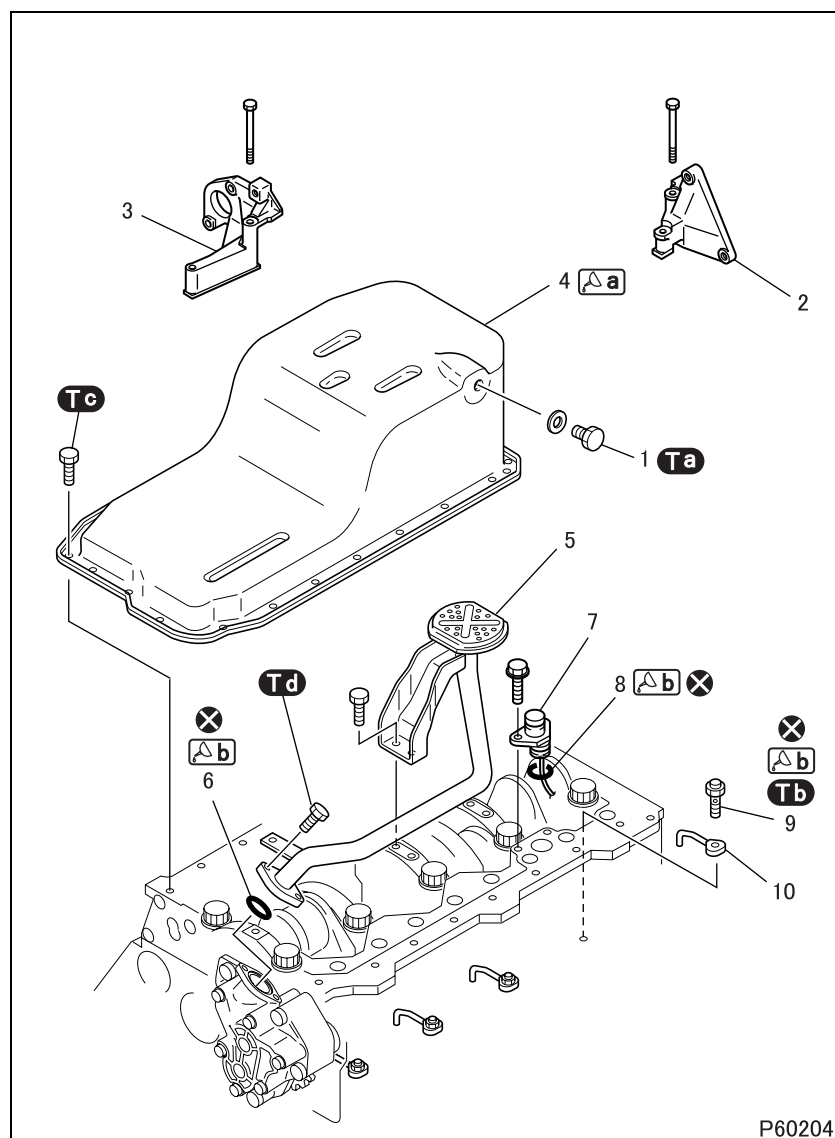
- Using an adapter, connect an oil pressure gauge to the engine oil pressure switch mounting hole.
- Warm up the engine until the oil temperature reaches 70 to 90°C {158 to 195°F}.
- Measure the oil pressure while running the engine at a minimum speed and then at maximum speed, both under no load.
- If the measurements are below the specified limits, overhaul the lubrication system.
- After taking the measurements, apply sealant to the threads of the oil pressure switch and tighten the switch to the specified torque.

CAUTION

- Reinstall the oil pressure switch only when the engine is cold.

M E M O

OIL PAN, OIL STRAINER AND OIL JETS



● Disassembly sequence

- 1 Drain plug
- 2 Stiffner RH
- 3 Stiffner LH
- 4 Oil pan
- 5 Oil strainer
- 6 O-ring
- 7 Engine oil level sensor
- 8 O-ring
- 9 Check valve
- 10 Oil jet

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

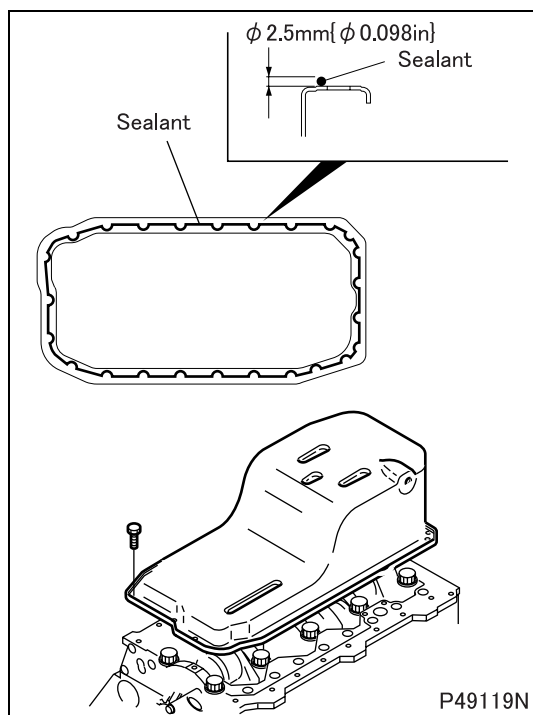
- Make sure to tighten the check valve only to the specified torque. Overtightening it can cause defective operation, resulting in engine seizure.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	34.3 to 43.1 {25 to 32, 3.5 to 4.4}	–
Tb	Check valve	29.4 {22, 3.0}	Wet
Tc	Bolt (oil pan mounting)	23.5 {17, 2.4}	–
Td	Bolt (oil strainer mounting)	23.2 {17, 2.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Crankcase mounting surface of oil pan	THREEBOND 1207C	As required
b	O-ring	Engine oil	As required
	Check valve threads		

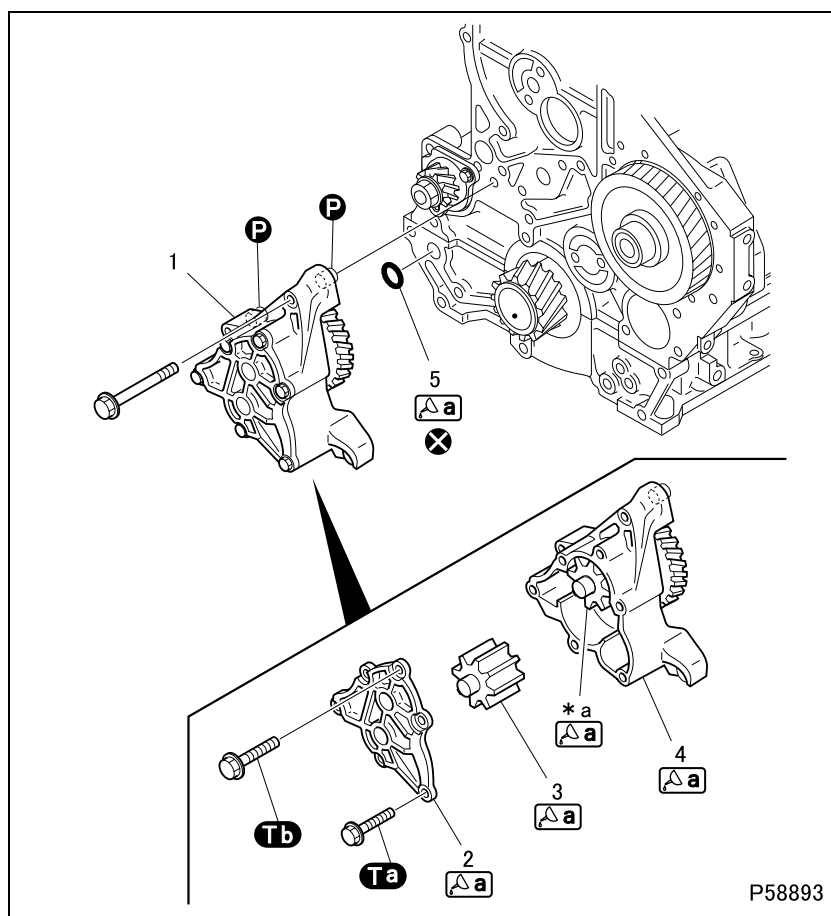
◆ Installation procedure ◆**■ Installation: Oil pan**

- Clean the mating surfaces of each part.
- Apply a bead of sealant to the mating surface of the oil pan evenly and without any breaks as shown in the illustration.
- Mount the oil pan within three minutes of applying the sealant. Make sure that the sealant stays in place.

CAUTION

- Do not start the engine less than an hour after installation.
- If the oil pan mounting bolts were loosened or removed, be sure to reapply sealant.

OIL PUMP



● Disassembly sequence

- 1 Oil pump
- 2 Oil pump cover
- 3 Driven gear
- 4 Gear and case assembly
- 5 O-ring

- *a: Drive gear
 P: Locating pin
 X: Non-reusable parts

● Assembly sequence

Follow the disassembly procedure in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
2, 3	Oil pump cover-to-driven gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
2, *a	Oil pump cover-to-drive gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
3, 4	Gear and case assembly-to-driven gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
3, 4, *a	Sinkage of each gear from gear and case assembly end surface	0.05 to 0.11 {0.0020 to 0.0043}	0.15 {0.0059}	Replace
	Gear and case assembly-to-tooth tip clearance for each gear	0.13 to 0.22 {0.0051 to 0.0087}	0.23 {0.0091}	Replace

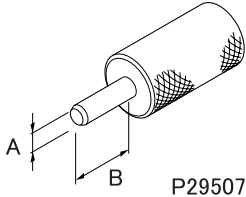
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (oil pump cover mounting)	8.2 ± 2.46 {6.0 ± 1.8, 0.8 ± 0.25}	M6 × 20
Tb	Bolt (oil pump cover mounting)	9.8 ± 2.0 {7.2 ± 1.5, 1.0 ± 0.2}	M6 × 25

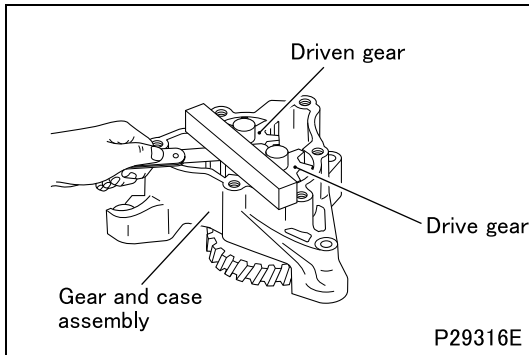
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Oil pump contact surfaces	Engine oil	As required
	O-ring		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application	
	Pump cover pin	MH063431	Installation of oil pump cover	
	<table><tr><th>A</th><th>B</th></tr><tr><td>$\phi 7 \begin{smallmatrix} 0 \\ -0.14 \end{smallmatrix}$ $\{\phi 0.28 \begin{smallmatrix} 0 \\ -0.0055 \end{smallmatrix}\}$</td><td>20 {0.79}</td></tr></table>  P29507			A
A	B			
$\phi 7 \begin{smallmatrix} 0 \\ -0.14 \end{smallmatrix}$ $\{\phi 0.28 \begin{smallmatrix} 0 \\ -0.0055 \end{smallmatrix}\}$	20 {0.79}			

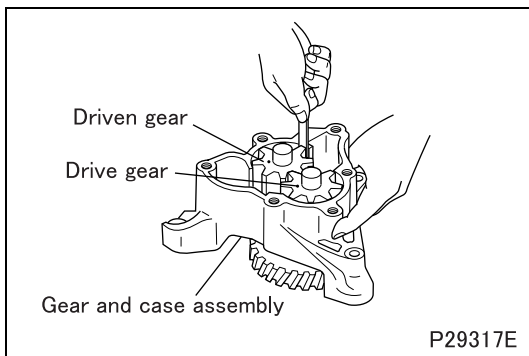
◆ Inspection procedure ◆



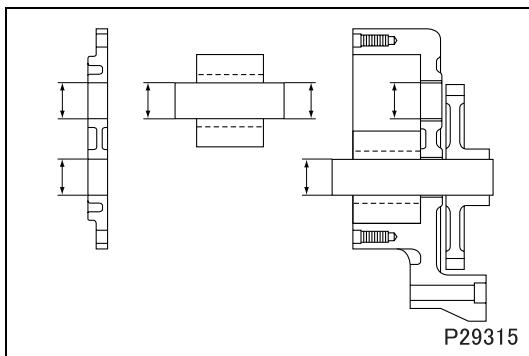
■ Inspection: Driven gear, drive gear and gear and case assembly

- Carry out the following inspection. Replace the oil pump if any defects are found.

(1) Sinkage of each gear from gear and case assembly end surface



(2) Gear and case assembly-to-tooth tip clearance for each gear

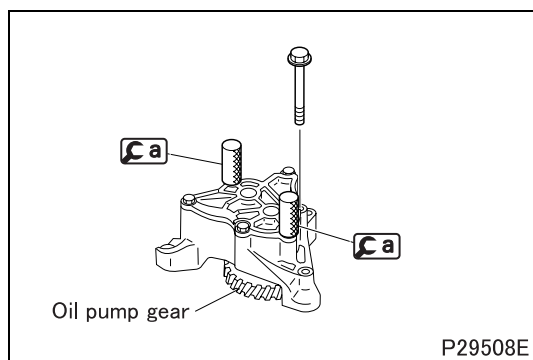


■ Inspection: Oil pump cover, driven gear, and gear and case assembly

- Measure the clearance between each gear's shaft and the oil pump cover, as well as between each gear's shaft and the gear and case assembly.
- If the measurements are not within the standard value range, replace the oil pump.

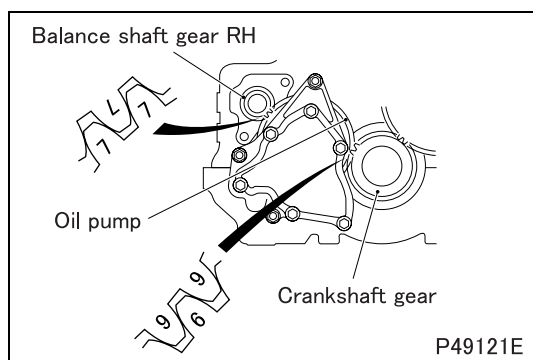
OIL PUMP

◆ Installation procedure ◆



■ Installation: Oil pump cover and gear and case assembly

- Apply engine oil to each component.
- Hold the oil pump cover in place on the gear and case assembly by fitting two **Ca**s in the illustrated locations.
- Install a bolt into an empty bolt hole and tighten it to the specified torque.
- Remove the two **Ca**s. Install the rest of the bolts and tighten them to the specified torque.
- After installing all the bolts, turn the oil pump gear by hand and check that it rotates smoothly.
- Disassemble and reassemble the oil pump cover and gear and case assembly if the oil pump gear does not rotate smoothly.



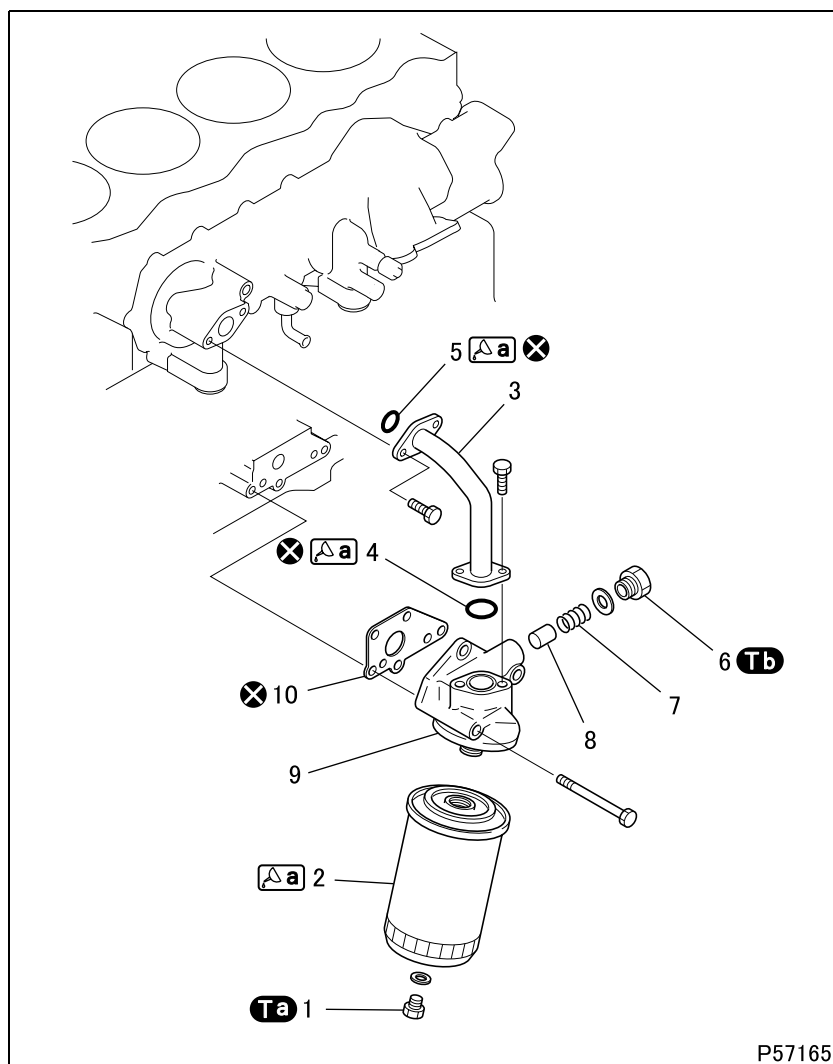
■ Installation: Oil pump

- Place the No.1 cylinder piston at top dead center to bring the crankshaft gear to an appropriate position.
- Inject approximately 5 cm³ {0.3 cu. in.} of engine oil.
- Align the mating mark "6" on the crankshaft gear and the mating mark "7" on the balance shaft gear RH with the corresponding mating marks on the oil pump gear, and then install the oil pump gear.

M E M O

OIL FILTER

<Downward type>



● Disassembly sequence

- 1 Drain plug
- 2 Oil filter
- 3 Oil pipe
- 4 O-ring
- 5 O-ring
- 6 Plug
- 7 Regulator valve spring
- 8 Regulator valve
- 9 Oil filter head
- 10 Gasket

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- Wipe up any spilled engine oil, as it can cause fires.

CAUTION ⚠

- Make sure not to put any engine oil on the V-belt when working on the oil cooler and oil filter. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.
- Make sure to install the gasket in the correct position so that it does not cover up the oil hole.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
7	Load of installed regulator valve spring (installed length: $39^{+0.3}_0$ { $1.54^{+0.012}_0$ })	93.5 ± 0.5 N { 21 ± 0.1 lbs, 9.5 ± 0.05 kgf}	—	Replace

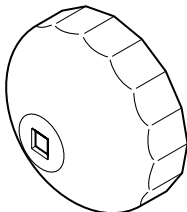
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	9.8 ± 1.96 { 7.2 ± 1.4 , 1.0 ± 0.2 }	—
Tb	Plug (regulator valve mounting)	60 {44, 6.0}	—

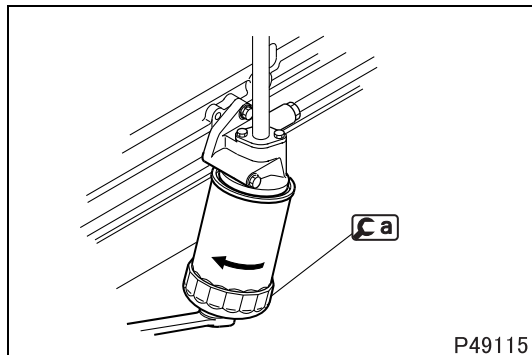
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Oil filter gasket	Engine oil	As required
	O-ring		

Special tools

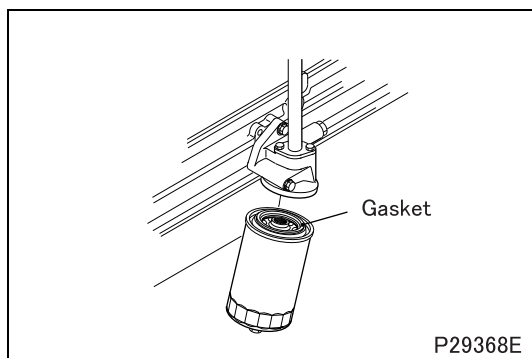
Mark	Tool name and shape	Part No.	Application
	Oil filter element socket  P08550	MH061566	Removal of oil filter

◆ Removal procedure ◆



■ Removal: Oil filter

◆ Installation procedure ◆

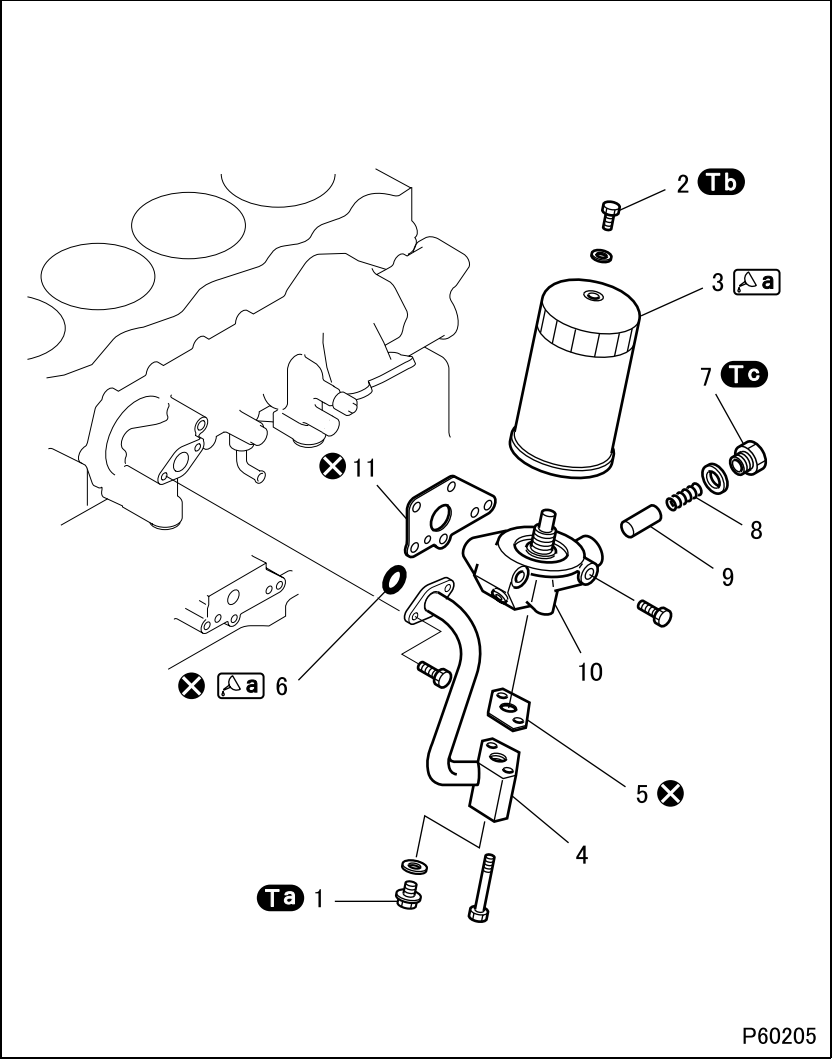


■ Installation: Oil filter

- Clean the oil filter mounting surface of the oil filter head.
- Apply a thin coat of engine oil on the oil filter gasket.
- Screw in the oil filter by hand until the gasket touches the oil filter head. Then, tighten the filter by turning further by three quarters (3/4) of a turn.
- After installing the oil filter, start the engine and check that there are no oil leaks from the gasket.
- Remove and reinstall the oil filter if it is leaky.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

OIL FILTER

<Upward type>



Disassembly sequence

- 1 Drain plug
- 2 Drain plug
- 3 Oil filter
- 4 Oil pipe
- 5 Gasket
- 6 O-ring
- 7 Plug
- 8 Regulator valve spring
- 9 Regulator valve
- 10 Oil filter head
- 11 Gasket

⊗: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

- Wipe up any spilled engine oil, as it can cause fires.

CAUTION

- Make sure not to put any engine oil on the V-belt when working on the oil cooler and oil filter. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.
- Make sure to install the gasket in the correct position so that it does not cover up the oil hole.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
8	Load of installed regulator valve spring (installed length: $39^{+0.3}_0$ { $1.54^{+0.012}_0$ })	93.5 ± 0.5 N { 14 ± 0.1 psi, 9.5 ± 0.05 kgf}	–	Replace

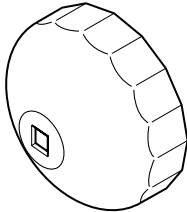
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug (oil pipe)	34.3 to 39.2 { 25 to 29 , 3.5 to 3.9 }	–
Tb	Drain plug (oil filter)	9.8 ± 1.96 { 7.2 ± 1.4 , 1.0 ± 0.2 }	–
Tc	Plug (regulator plug mounting)	60 { 44 , 6.0 }	–

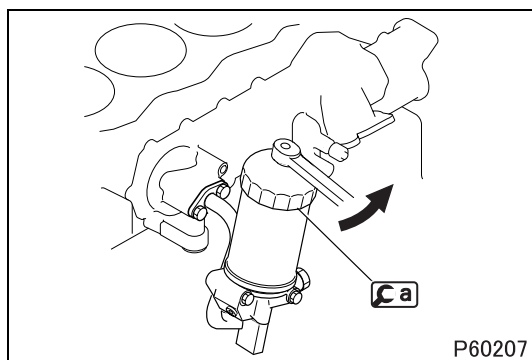
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Oil filter gasket	Engine oil	As required
	O-ring		

Special tools

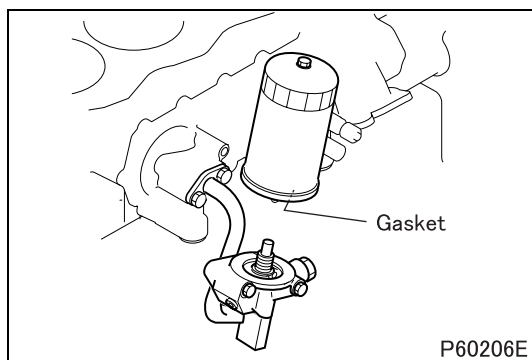
Mark	Tool name and shape	Part No.	Application
 a	Oil filter element socket  P08550	MH061566	Removal of oil filter

◆ Removal procedure ◆



■ Removal: Oil filter

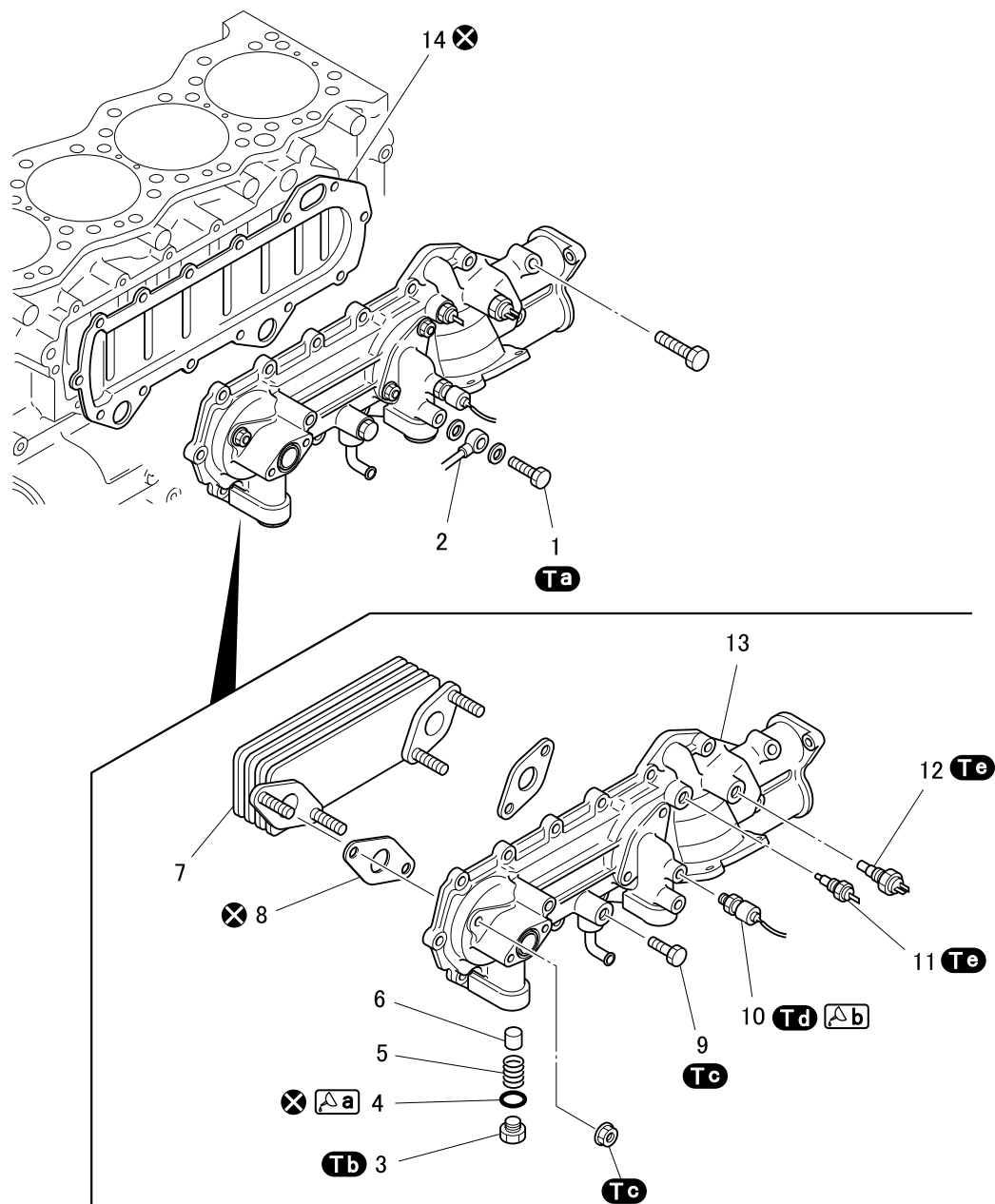
◆ Installation procedure ◆



■ Installation: Oil filter

- Clean the oil filter mounting surface of the oil filter head.
- Apply a thin coat of engine oil on the oil filter gasket.
- Screw in the oil filter by hand until the gasket touches the oil filter head. Then, tighten the filter by turning further by three quarters (3/4) of a turn.
- After installing the oil filter, start the engine and check that there are no oil leaks from the gasket.
- Remove and reinstall the oil filter if it is leaky.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

OIL COOLER



P57166

● Disassembly sequence

- | | | |
|-----------------------|---|---|
| 1 Eye bolt | 7 Oil cooler element | 12 Coolant temperature sensor
(for engine control) |
| 2 Oil pipe | 8 Gasket | 13 Oil cooler body |
| 3 Plug | 9 Water drain valve | 14 Gasket |
| 4 O-ring | 10 Engine oil pressure switch | |
| 5 Bypass valve spring | 11 Coolant temperature sensor
(for water temperature gage) | |
| 6 Bypass valve | | |

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
5	Load of bypass valve spring (installed length: $48^{+0}_{-0.5}$ { $1.89^{+0}_{-0.02}$ })	95.3 ± 4.9 N { 21 ± 1.1 lbs, 9.7 ± 0.5 kgf}	–	Replace
7	Air leakage from oil cooler element (air pressure: 980 kPa {140 psi, 10 kgf/cm ² } for 15 seconds)	0 cm ³ {0 cu. in.}	–	Replace

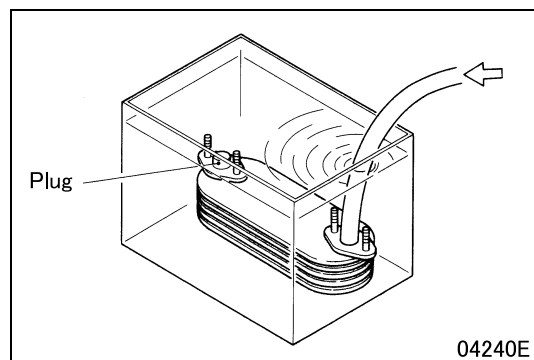
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eye bolt (oil pipe mounting)	21.6 {16, 2.2}	–
Tb	Plug	34.3 ± 4.9 { 25 ± 3.6 , 3.5 ± 0.5 }	–
Tc	Nut (oil cooler element mounting)	24.5 ± 4.9 { 18 ± 3.6 , 2.5 ± 0.5 }	–
	Water drain valve		
Td	Engine oil pressure switch	7.8 to 14.7 {5.8 to 11, 0.8 to 1.5}	Sealant With cold engine
Te	Coolant temperature sensor (for water temperature gage)	34.3 {25, 3.5}	–
	Coolant temperature sensor (for engine control)		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Engine oil	As required
 b	Engine oil pressure switch threads	THREEBOND 1215	As required

◆ Inspection procedure ◆



■ Inspection: Oil cooler element

- Plug the outlet of the oil cooler element and connect a hose to the engine oil inlet port. Then, immerse the oil cooler element in a tank of water.
- Apply an air pressure of 980 kPa {140 psi, 10 kgf/cm²} for 15 seconds through the hose, and check for any air leaks.
- Replace the element if it leaks air.



13A - Fuel and Engine Control

13E - Electronically Controlled Fuel System

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 13A

Fuel and Engine Control

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

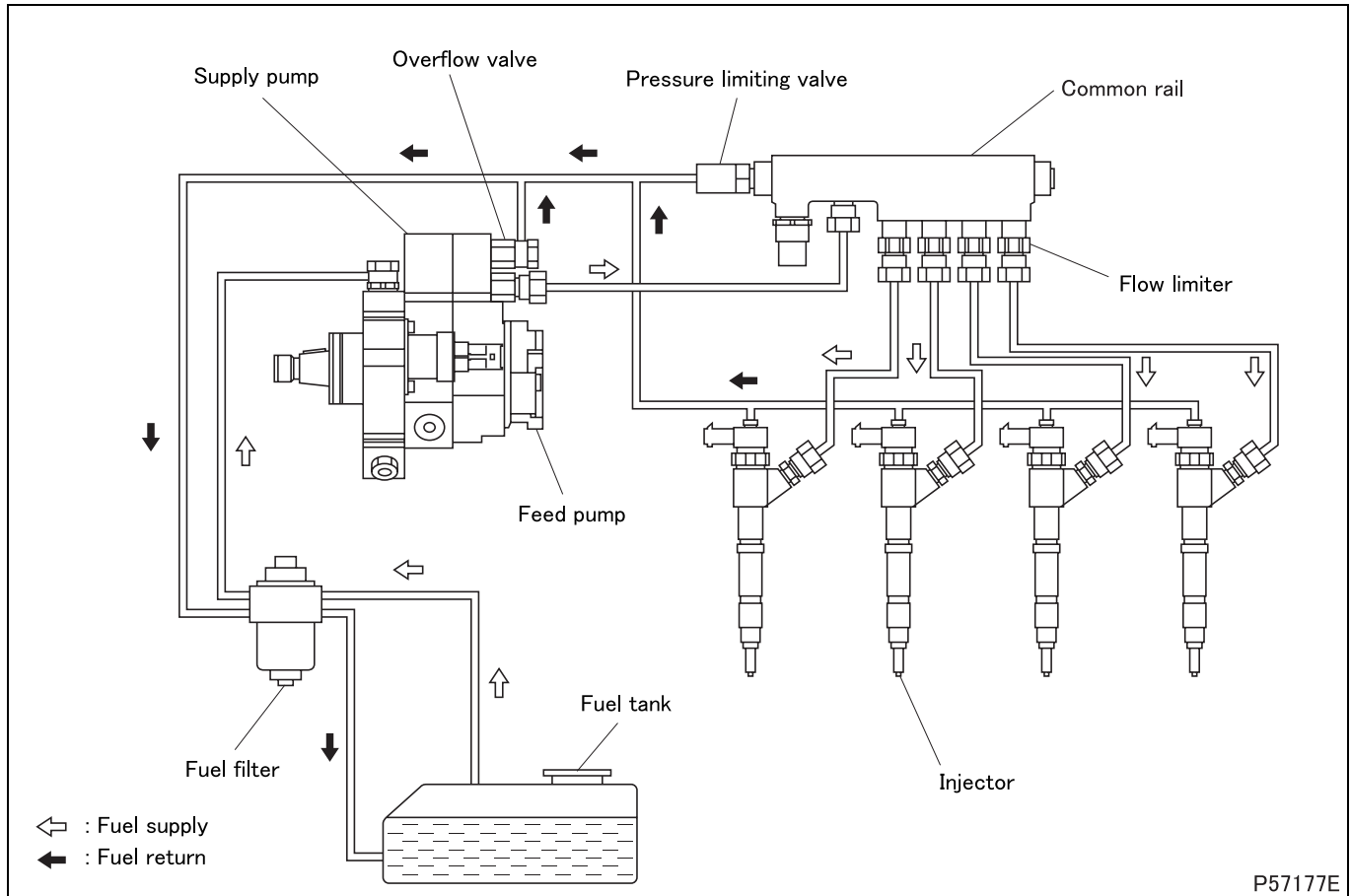
INDEX

SPECIFICATIONS	13A-2
STRUCTURE AND OPERATION	
1. Fuel System (Flow of Fuel).....	13A-3
2. Engine Control.....	13A-4
3. Fuel Filter.....	13A-5
TROUBLESHOOTING.....	13A-6
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Inspecting and Adjusting No-load Minimum and Maximum Speeds.....	13A-8
2. Air-bleeding of Fuel System.....	13A-9
3. Fuel Filter Replacement	13A-10
FUEL TANK	13A-12
FUEL FILTER	13A-14
ENGINE CONTROL.....	13A-16
COMMON RAIL	13A-19
SUPPLY PUMP	13A-20
INJECTOR	13A-22

SPECIFICATIONS

Item			Specifications
Supply pump	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Model		CP3.3
	Control method		Electronic
	Type		Radial, 3-cylinder
	Type		External gear type
	Injection quantity adjustment valve	Model	MPROP
		Rated voltage V	12
Max. common rail pressure MPa {psi, kgf/cm ² }		160 {23200, 1631}	
Common rail	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Common rail volume cm ³ {cu.in., ml}		16.5 {1.01, 16.5}
	Pressure limiting valve opening pressure MPa {psi, kgf/cm ² }		185 to 195 {26830 to 28280, 1886 to 1988}
	Common rail pressure sensor supply voltage V		5
Injectors	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Control method		Electrical
	Max. operating pressure MPa {psi, kgf/cm ² }		160 {23200, 1631}
	Min. operating pressure MPa {psi, kgf/cm ² }		25 {3630, 255}
Common rail electronic control unit	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Rated voltage		

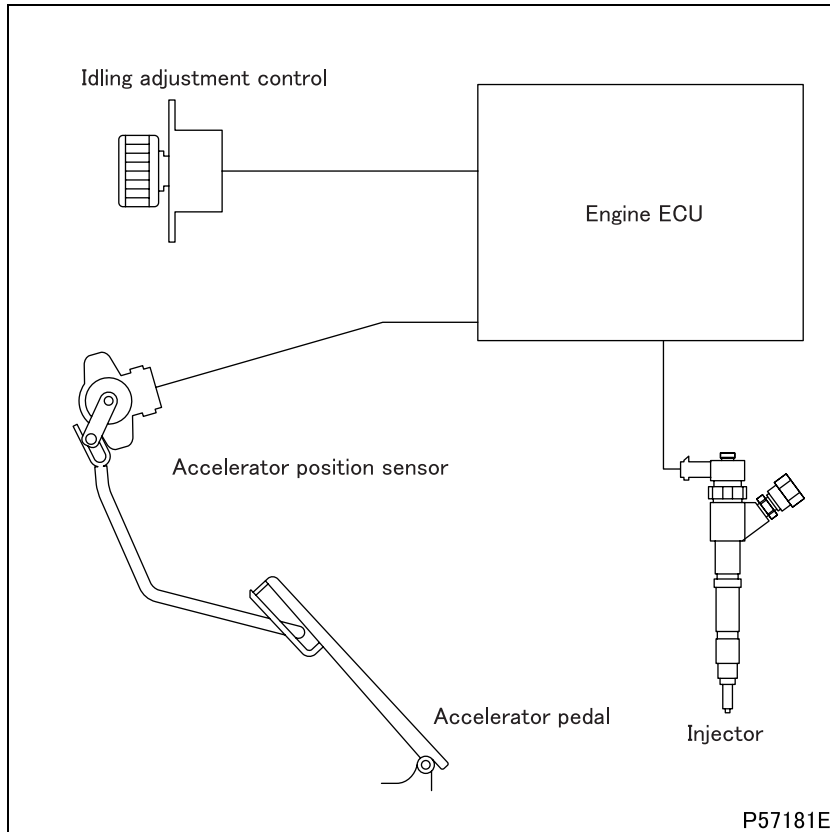
1. Fuel System (Flow of Fuel)



- The feed pump, which is driven by the camshaft inside the supply pump, draws up the fuel from inside the fuel tank and sends it through the fuel filter, where dust and other impurities in the fuel are filtered out.
- The filtered fuel is then sent to the supply pump, where it is compressed. The compressed fuel is accumulated in the common rail for a time, then sprayed out through the injection nozzles into the combustion chamber.
- If fuel leaks from an injection pipe at the pipe joint, the flow limiter is activated to close the fuel passage, preventing the fuel from flowing elsewhere.
- The excess fuel from the injectors returns to the fuel tank through the fuel return hose.
- When the internal fuel pressure of the Common Rail exceeds the limit, the pressure limiting valve opens to allow part of the fuel to return to the fuel tank.
- When the internal fuel pressure of the supply pump exceeds the limit, the overflow valve opens to allow part of the fuel to return to the fuel tank.

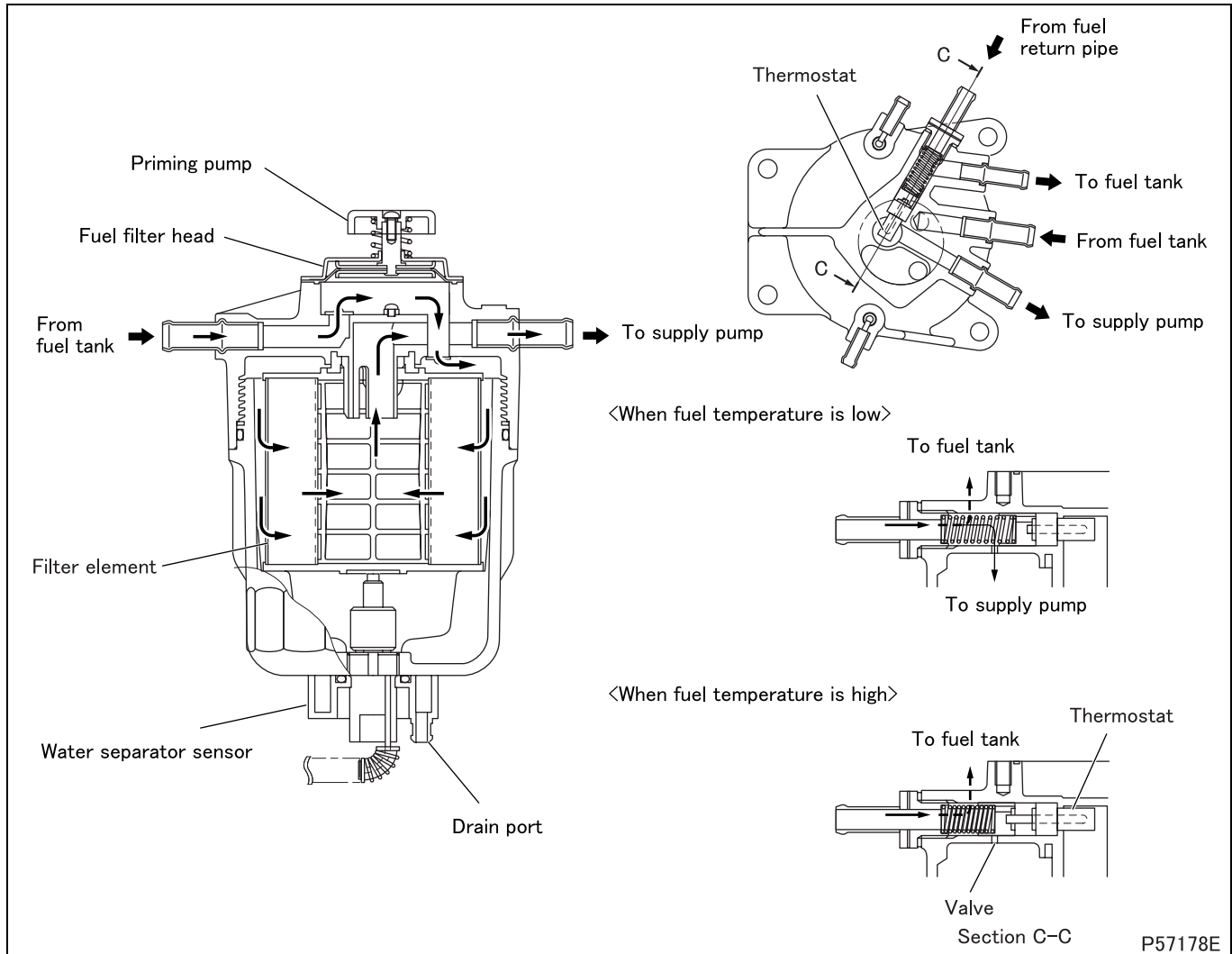
STRUCTURE AND OPERATION

2. Engine Control



- The engine is electronically controlled by the engine electronic control unit (ECU).
- The accelerator position sensor detects how much the accelerator pedal is depressed and sends the corresponding electronic signal to the engine electronic control unit, which calculates an appropriate amount of fuel based on the signals and controls fuel injection accordingly.

3. Fuel Filter



- The fuel filter removes impurities in the fuel through the filter element and also separates water from fuel.
- The water that has been separated from the fuel collects at the bottom of the fuel filter. A water separator sensor is installed in the fuel filter, which activates the warning lamp on the meter cluster when the water reaches a certain level.
- The water can be drained through the drain port by loosening the water separator sensor.
- A priming pump is provided at the fuel filter head. The priming pump is used for air-bleeding the fuel system.
- When the fuel temperature rises, the thermostat swells and the valve of the fuel filter head is closed. The high-temperature fuel entirely returns to the fuel tank through the fuel return pipe.
- When the fuel temperature lowers, the thermostat does not swell and the valve to the fuel filter remains open. The high-temperature fuel returning through the fuel return pipe is let through the valve to mix into the fuel around the element. The fuel around the element is warmed as a result and wax in it (precipitated when the fuel temperature is low) is dissolved to prevent clogging of the element.

TROUBLESHOOTING

Symptoms		Engine refuses to start	Engine is difficult to start	Engine knocks	Engine output is unstable	Engine output is insufficient	Engine maximum speed is too high	Engine is idling unstably	Engine stops soon after starting	Engine does not reach maximum speed	Engine does not stop	Accelerator pedal is too stiff	Fuel supply is insufficient	warning lamp illuminates	Reference Gr
Possible causes															
Faulty electronic fuel control system														O	Gr13E
Supply pump	Malfunctioning feed pump check valve		O			O			O		O				*
	Defective feed pump		O			O			O		O				*
	Poorly airtight supply pump overflow valve		O			O			O		O				*
	Open or short circuit failure, poor contact of supply pump M/V		O			O			O		O			O	*
	Defective supply pump M/V, defective supply pump		O			O			O		O				*
Injectors	Open or short circuit failure, poor contact of injector M/V		O	O		O					O			O	*
	Defective injector, defective injector M/V, defective nozzle		O	O		O					O				*
Clogged fuel filter		O			O			O	O						
No fuel in fuel tank		O													
Clogged fuel pipe and/or leaky pipe joints		O													
Air or water in fuel system		O			O			O	O						
Use of low quality fuel			O	O		O		O							
Open or short circuit failure, poor contact of common rail pressure sensor, defective sensor		O	O		O	O			O					O	*
Flow limiter activated				O		O								O	*
Fuel leakage from high pressure pipe joint			O	O	O	O					O				*
Engine control	Poorly adjusted accelerator pedal stopper bolt					O				O					
	Defective accelerator pedal position sensor													O	
Cracked fuel pipe and/or hose													O		

*: Contact a Bosch Automotive Systems service station for repair.

Symptoms														Reference Gr
	Engine refuses to start	Engine is difficult to start	Engine knocks	Engine output is unstable	Engine output is insufficient	Engine maximum speed is too high	Engine is idling unstably	Engine stops soon after starting	Engine does not reach maximum speed	Engine does not stop	Accelerator pedal is too stiff	Fuel supply is insufficient	 warning lamp illuminates	
Possible causes														
Inappropriate oil viscosity		O					O							Gr12
Poorly adjusted valve clearance		O					O							Gr11
Defective cylinder head gasket		O					O							
Wear of and/or carbon deposits on valve and valve seat		O					O							
Distorted valve springs		O					O							
Worn or damaged piston rings		O					O							
Worn or damaged piston ring groove		O												
Worn piston and/or cylinder liner		O					O							Gr14
Poorly functioning cooling system		O					O							
Defective starter switch	O	O												Gr54
Defective glow plug		O												
Open-circuited, short-circuited or poorly connected engine speed sensor and/or cylinder sensor	O	O											O	Gr13E
Open-circuited, short-circuited or poorly connected boost pressure sensor			O	O	O				O				O	
Open-circuited, short-circuited or poorly connected coolant temperature sensor	O	O											O	
Poorly connected injection rate adjusting resistor			O		O								O	
Poorly connected idling adjustment control			O				O						O	
Blown fuse	O	O						O					O	Gr54

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspecting and Adjusting No-load Minimum and Maximum Speeds

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	No-load minimum speed (idling speed)	650 ± 25 rpm	–	Adjust
–	No-load maximum speed	3,100 ± 50 rpm	–	Adjust

[Work before inspection and adjustment]

- Before starting the inspection and adjustment, carry out the following preparatory steps:
- Warm up the engine until the engine coolant temperature is approximately 80 to 95°C {176 to 203°F};
- turn off all lamps and accessories;
- put the transmission in neutral (P-range for automatic transmission);
- set the steering wheel at the straight-ahead position; and
- attach the probe of the tachometer to an injector.

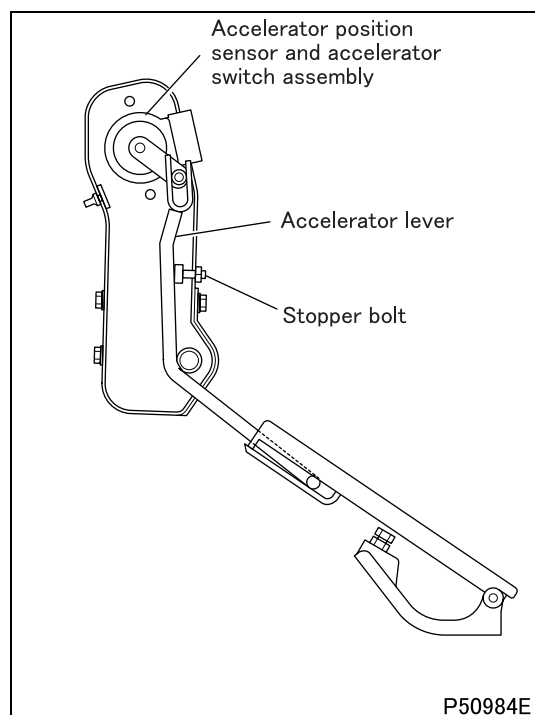
[Inspection and adjustment]

(1) No-load minimum speed

- Without depressing the accelerator pedal, measure the engine speed.
- If the speed is not within the standard value range, inspect the accelerator position sensor and accelerator switch assembly. (See Gr13E)
- If no defects are evident during the above inspection, check for any diagnosis codes related with the fuel system and inspect the supply pump and engine electronic control unit. (See Gr13E)

(2) No-load maximum speed

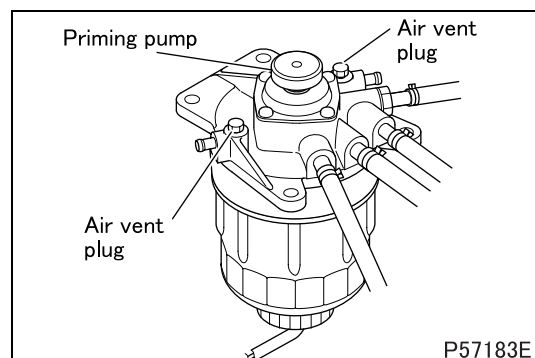
- Depress the accelerator pedal as far as it will go.
- With the accelerator lever touching the stopper bolt, measure the engine speed.
- If the speed is not within the standard value range, inspect the accelerator position sensor and accelerator switch assembly. (See Gr13E)
- If no defects are evident during the above inspection, check for any diagnosis codes related with the fuel system and inspect the supply pump and engine electronic control unit. (See Gr13E)



2. Air-bleeding of Fuel System

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
—	Air vent plug	10 ± 2 { 7.4 ± 1.5 , 1 ± 0.2 }	—



- Loosen one of the air vent plugs on the fuel filter.
- Move the priming pump up and down to pump out the fuel.
- Continue operating the priming pump until the fuel flowing out of the air vent plug is free of air bubbles.
- When no more air bubbles are evident, tighten the air vent plug to the specified torque.
- Feed the fuel some more by operating the priming pump further until a strong resistance is felt.

NOTE

- **When the fuel temperature is low, you may not feel the resistance. Be sure to operate the priming pump several times even in such a case.**

- Wipe up any spilled fuel and start the engine.
- Check that there is no fuel leakage.

WARNING

- **Fuel is highly flammable. Keep it away from flames and sources of heat.**
- **To avoid risk of fire, wipe up any spilled fuel.**

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Fuel Filter Replacement

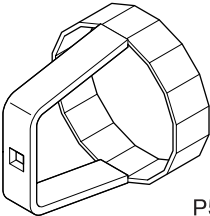
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

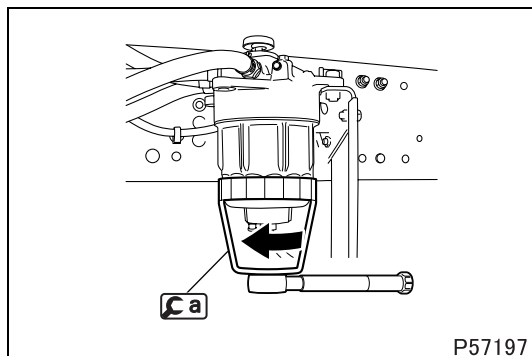
Mark	Parts to be tightened	Tightening torque	Remarks
–	Water separator sensor	5 ± 1 { 3.7 ± 0.7 , 0.5 ± 0.1 }	–
–	Case	30 ± 2 { 22 ± 1.5 , 3.1 ± 0.2 }	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Fuel filter gasket	Engine oil	As required

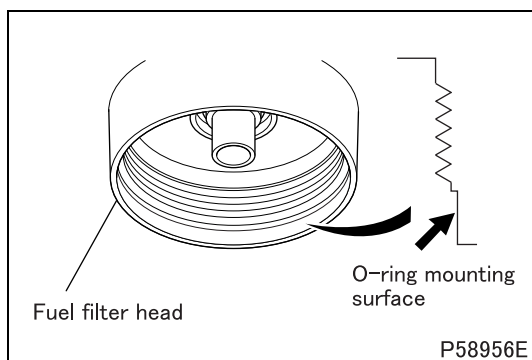
Special tools

Mark	Tool name and shape	Part No.	Application
	Filter wrench  P57179	MH063203	Removal and installation of case



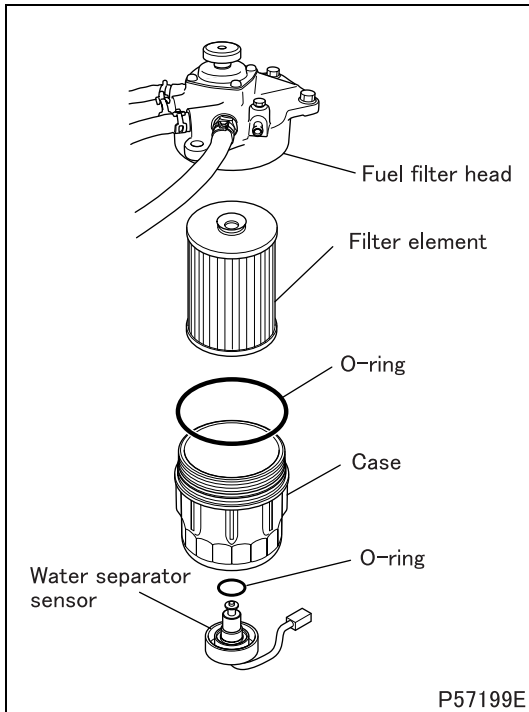
[Removal]

- Loosen the water separator sensor and drain fuel from the case.
- Remove the case using .



[Installation]

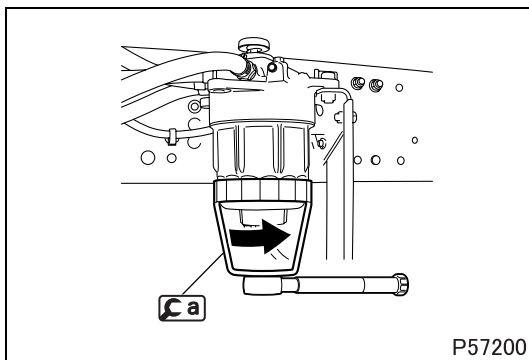
- Clean the O-ring mounting surface of the fuel filter head.



- Replace the filter element and O-ring with new one.
- Apply a thin coat of engine oil to the O-ring, and install it on the case and water separator sensor.

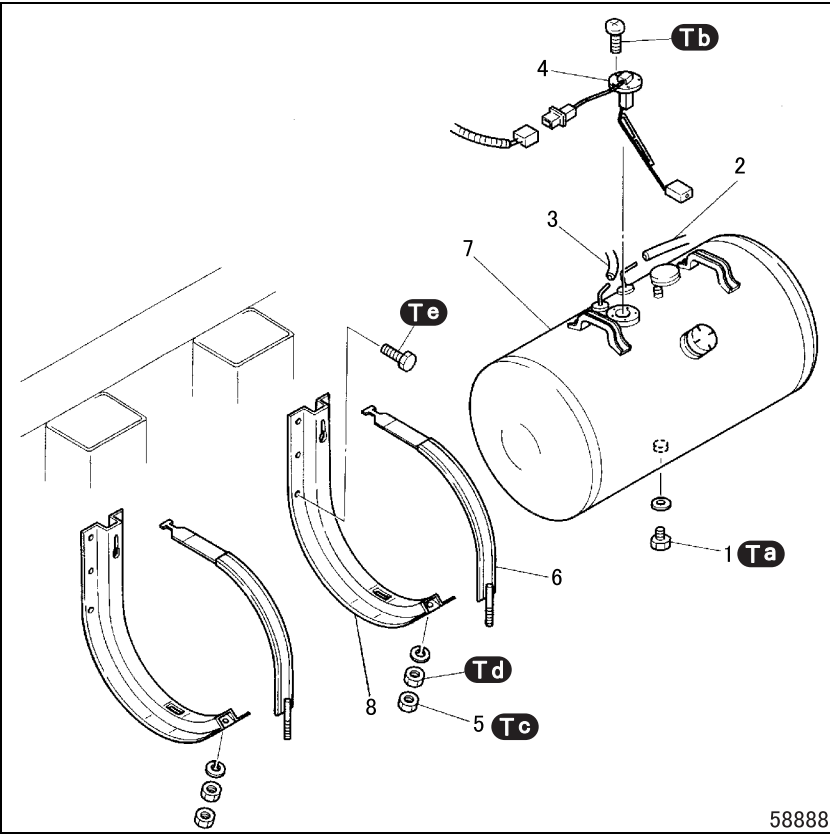
CAUTION

- **Be sure to use only genuine MITSUBISHI filter elements. The use of non-genuine fuel filters can cause engine failure.**
- **Prevent fine dust particles from entering the fuel filter and fuel pipe, as they can cause problems such as faulty fuel injection.**



- Use  to tighten the case to the specified torque.
- Install the water separator sensor, and then air-bleed the fuel system.
- Start the engine, and check that there is no fuel leakage.
- Reinstall the fuel filter if there is any leakage.

FUEL TANK



● Removal sequence

- 1 Drain plug
- 2 Suction hose
- 3 Return hose
- 4 Fuel level sensor
- 5 Lock nut
- 6 Fuel tank band
- 7 Fuel tank
- 8 Fuel tank bracket

● Installation sequence

Follow the removal sequence in reverse.

DANGER ⚠

- Do not allow any flames or sources of heat near the fuel tank, as it may explode.

WARNING ⚠

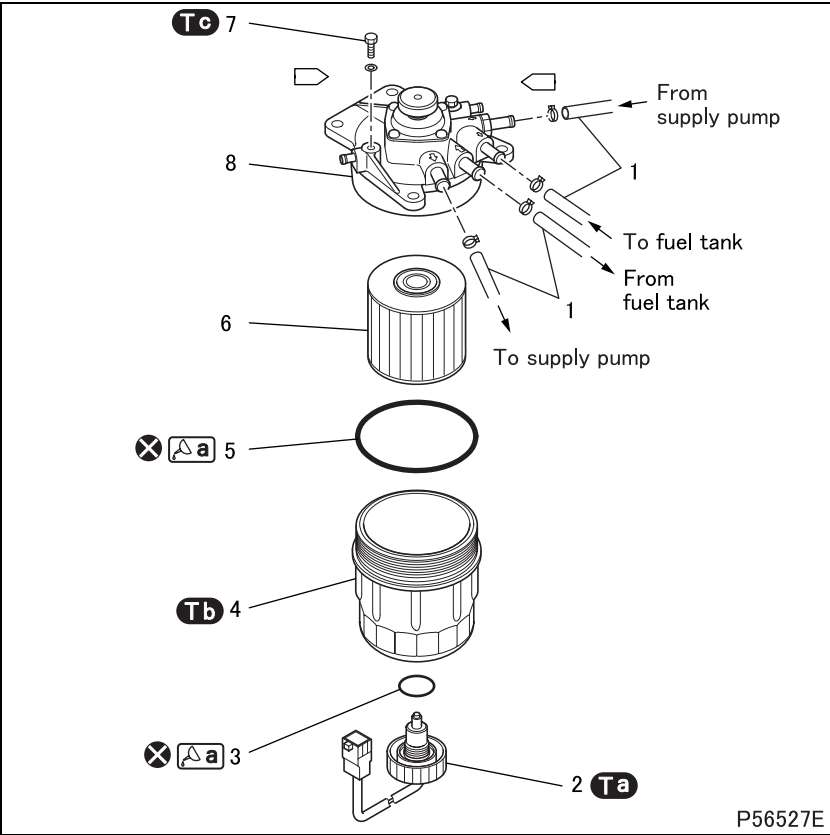
- Fuel is highly flammable. Keep it away from flames and sources of heat.
- To avoid risk of fire, wipe up any spilled fuel.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	49 to 88.2 {36 to 65, 5.0 to 9.0}	—
Tb	Screw (fuel level sensor mounting)	0.98 to 1.47 {0.7 to 1.1, 0.10 to 0.15}	—
Tc	Lock nut (fuel tank band mounting)	9 to 28 {6.6 to 21, 0.9 to 2.8}	—
Td	Nut (fuel tank band mounting)	6 to 10 {4.4 to 7.4, 0.6 to 1.0}	—
Te	Bolt (fuel tank bracket mounting)	70 to 90 {52 to 66, 7.1 to 9.2}	—

M E M O

FUEL FILTER



Disassembly sequence

- 1 Fuel hose
- 2 Water separator sensor
- 3 O-ring
- 4 Case
- 5 O-ring
- 6 Filter element
- 7 Plug
- 8 Fuel filter head

⊗: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

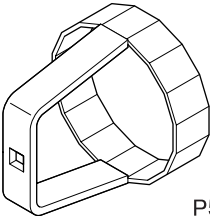
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

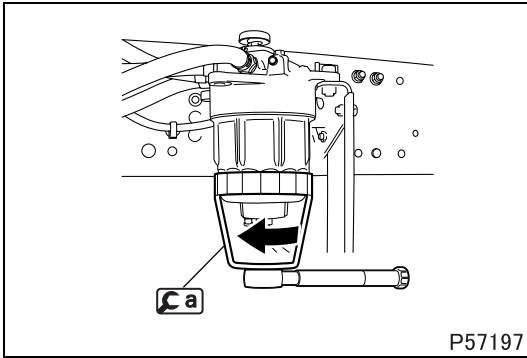
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Water separator sensor	5 ± 1 { 3.7 ± 0.7 , 0.5 ± 0.1 }	–
Tb	Case	30 ± 2 { 22 ± 1.5 , 3.1 ± 0.2 }	–
Tc	Plug	10 ± 2 { 7.4 ± 1.5 , 1 ± 0.2 }	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

Special tools

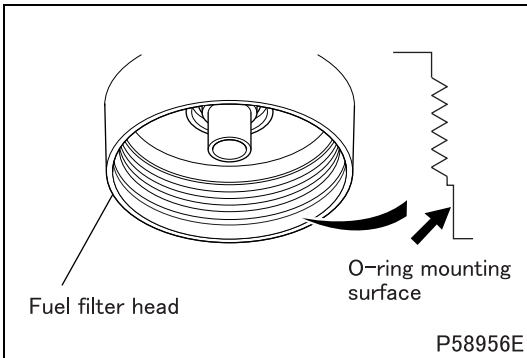
Mark	Tool name and shape	Part No.	Application
ca	Filter wrench  P57179	MH063203	Removal and installation of case



■ Removal: Case

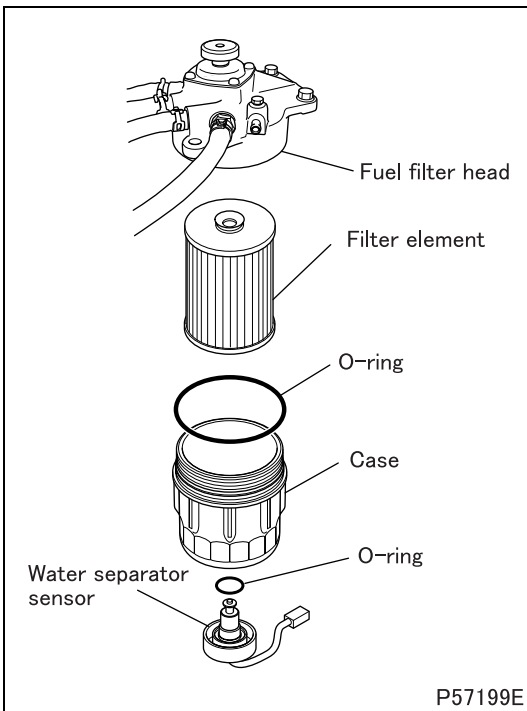
- Loosen the water separator sensor and drain fuel from the case.
- Remove the case using **Ca**.

◆ Installation procedure ◆



■ Installation: Case

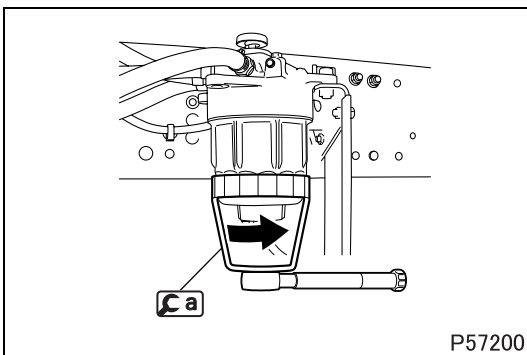
- Clean the O-ring mounting surface of the fuel filter head.



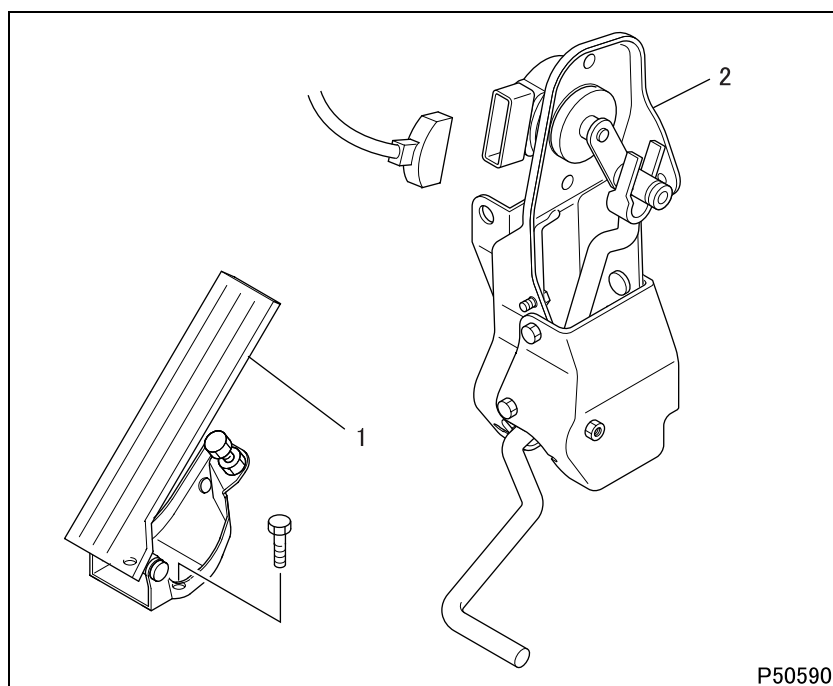
- Replace the filter element and O-ring with new one.
- Apply a thin coat of engine oil to the O-ring, and install it on the case and water separator sensor.

CAUTION ⚠

- **Be sure to use only genuine MITSUBISHI filter elements. The use of non-genuine fuel filters can cause engine failure.**
- **Prevent fine dust particles from entering the fuel filter and fuel pipe, as they can cause problems such as faulty fuel injection.**



- Use **Ca** to tighten the case to the specified torque.
- Install the water separator sensor, and then air-bleed the fuel system.
- Start the engine, and check that there is no fuel leakage.
- Reinstall the fuel filter if there is any leakage.



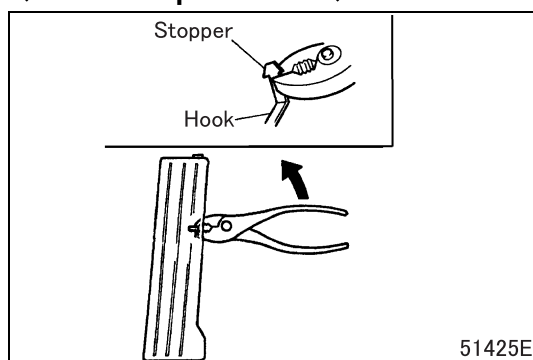
● Removal sequence

- 1 Accelerator pedal (See later sections.)
- 2 Accelerator link (See later sections.)

● Installation sequence

Follow the removal sequence in reverse.

◆ Removal procedure ◆



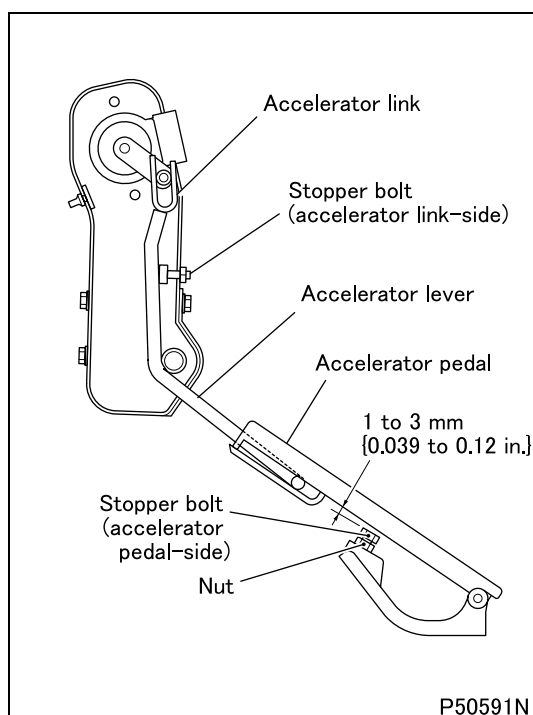
■ Removal: Accelerator pedal

- Using pliers, pinch the hook of the stopper on the accelerator pedal. Separate the stopper from the pedal while turning the hook by about 15 degrees.

CAUTION ⚠

- Do not yank on the stopper, as this may damage it.

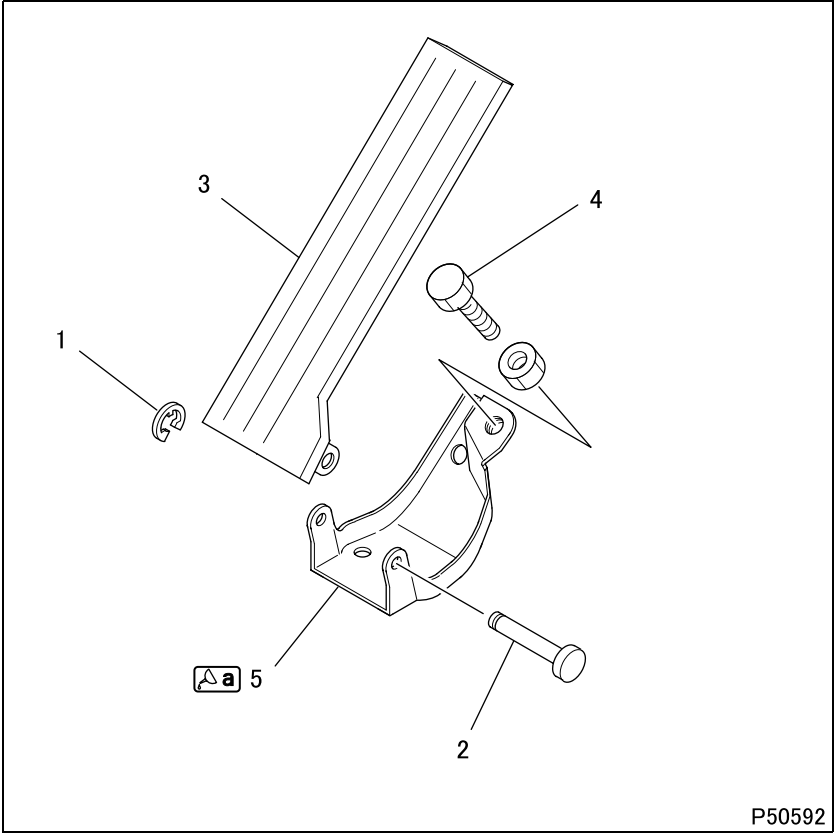
◆ Installation procedure ◆



■ Installation: Accelerator pedal

- Depress the accelerator pedal until the accelerator lever touches the accelerator link stopper bolt.
- Check that the clearance between the stopper and the stopper bolt contact surface of the pedal is as indicated in the illustration.
- If the clearance is not within the indicated value range, adjust the stopper bolt and lock it with the nut.

Accelerator Pedal



● Disassembly sequence

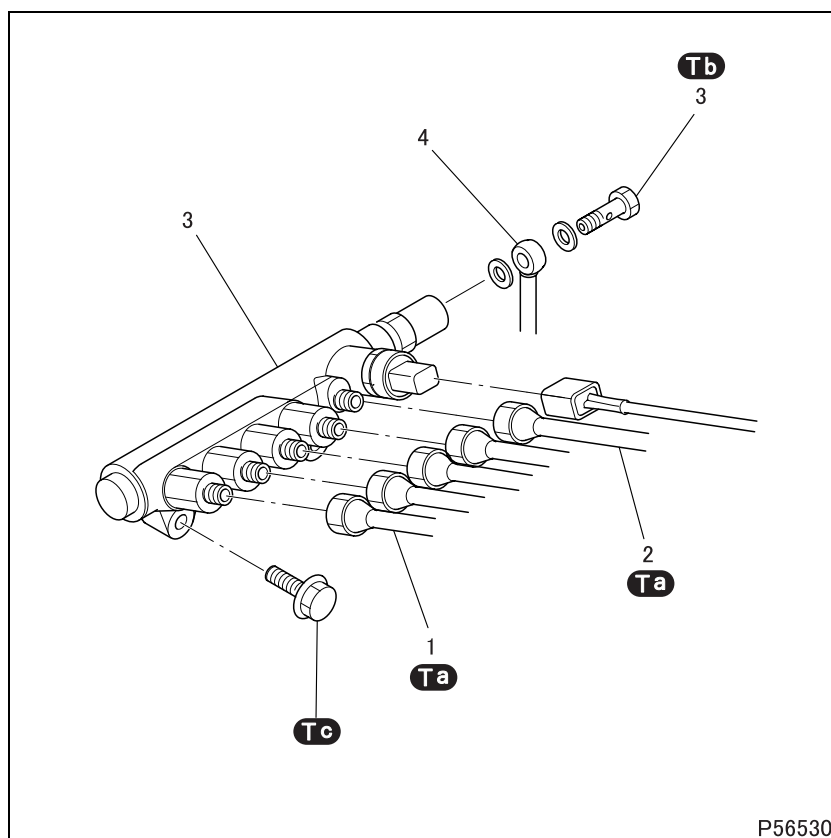
- 1 E-ring
- 2 Clevis pin
- 3 Accelerator pedal
- 4 Stopper bolt
- 5 Accelerator pedal bracket

● Assembly sequence

Follow the disassembly sequence in re-verse.

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Accelerator pedal and bracket contact surfaces	Chassis grease [NLGI No. 1 (Li soap)]	As required



● Disassembly sequence

- 1 Injection pipe
- 2 Fuel pipe
- 3 Eyebolt
- 4 Fuel return pipe
- 5 Common rail

● Assembly sequence

Follow the disassembly sequence in reverse.

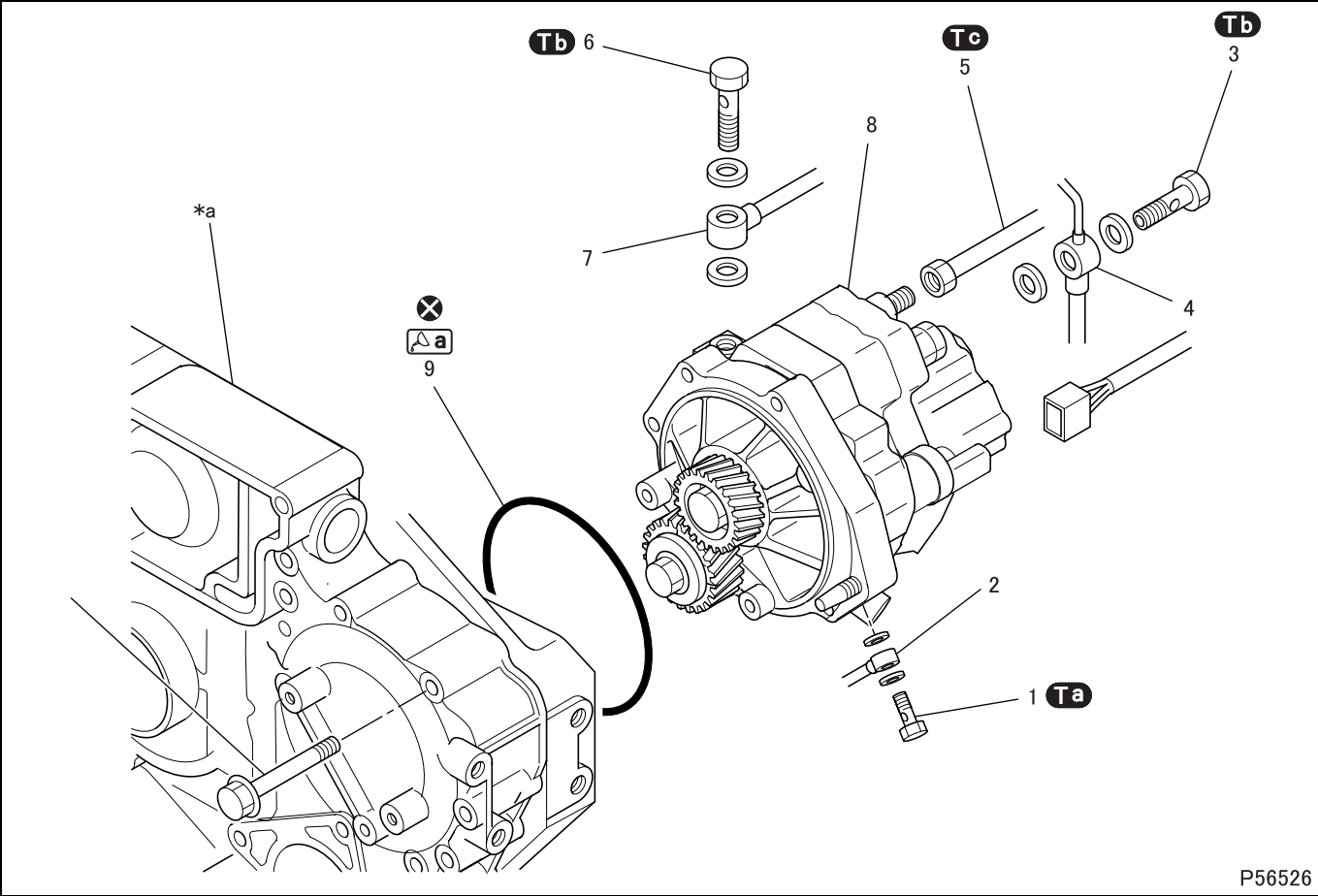
CAUTION

- Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.
- For servicing the common rail, contact a Bosch Automotive Systems service station.
- If dust enters the common rail, the engine performance will be greatly affected. To prevent it, be sure to cover up openings left after pipes and other parts are removed. Also, wash eyebolts, gaskets, etc. in light oil to clear of dirt.
- Before installing, make sure that the seat surfaces of fuel pipes and injection pipes are free of scratches and irregularities.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Location	Parts to be tightened	Tightening torque	Remarks
Ta	Injection pipe (union nut tightening)	30.4 to 35 {22 to 26, 3.1 to 3.6}	—
	Fuel pipe (union nut tightening)		
Tb	Eyebolt (fuel return pipe attaching)	25 to 29 {18 to 21, 2.6 to 3.0}	—
Tc	Bolt (common rail attaching)	23.2 {17, 2.4}	—

SUPPLY PUMP



● Removal sequence

- | | | |
|--------------------|---------------------|-----------------------|
| 1 Eye bolt | 5 Fuel pipe | 9 O-ring |
| 2 Oil pipe | 6 Eye bolt | |
| 3 Eye bolt | 7 Fuel suction pipe | *a: Front case |
| 4 Fuel return pipe | 8 Supply pump | X: Non-reusable parts |

CAUTION ⚠

- Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.
- Have the injection pump assembly serviced by a Bosch Automotive Systems service station.
- Dirt and dust in the injection pump assembly can seriously detract from engine performance. To prevent this from happening, fully cover all open joints after removing any pipes or hoses.

● Installation sequence

Follow the removal sequence in reverse.

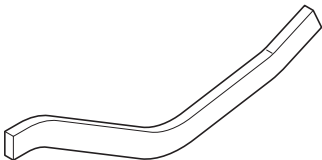
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eye bolt (Oil pipe mounting)	23.5 {17, 2.4}	–
Tb	Eye bolt (fuel return pipe mounting)	38.2 {28, 3.9}	–
	Eye bolt (fuel pipe mounting)		
Tc	Fuel pipe (union nut mounting)	20.5 {15, 2.1}	–

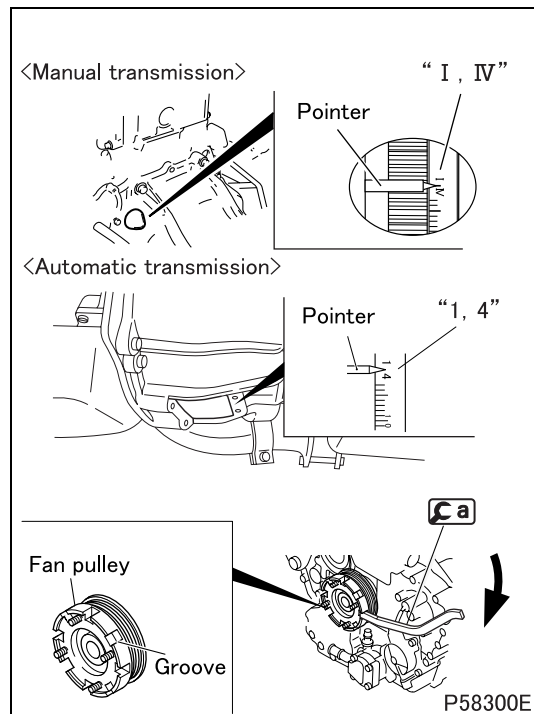
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

Special tools

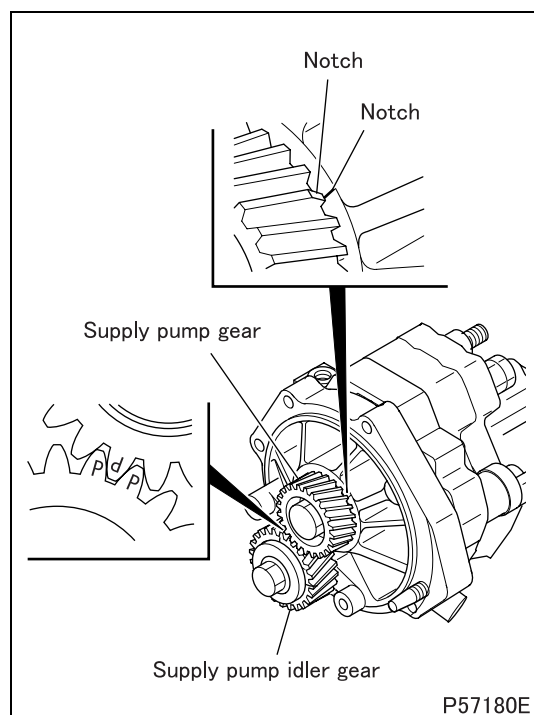
Mark	Tool name and shape	Part No.	Application
	Cranking handle  P58299	MH063704	Rotating the fan pulley

◆ Installation procedure ◆



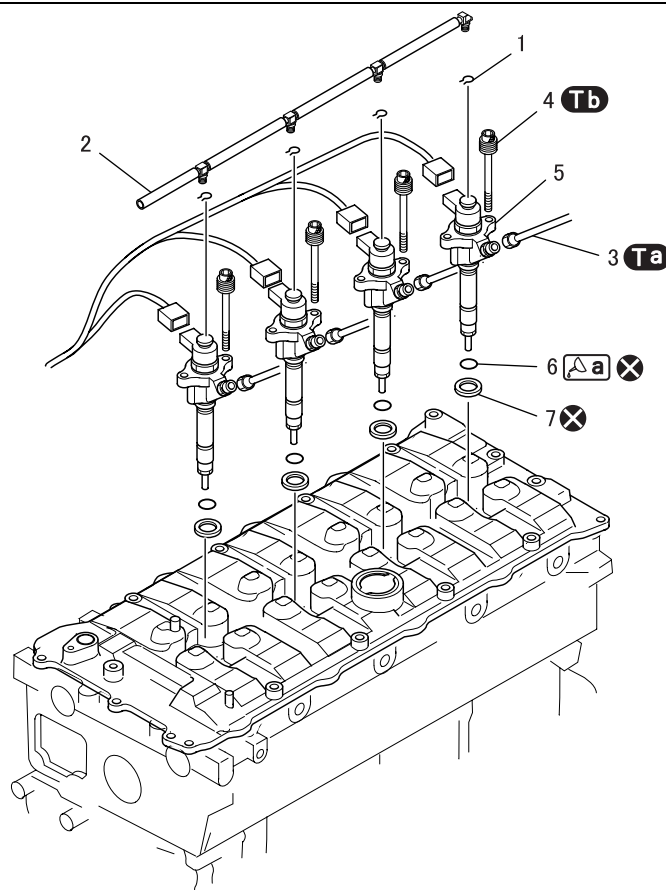
■ Installation: Supply pump

- Remove the rocker cover.
- Bring the No. 1 cylinder piston to the top dead center (TDC) on the compression stroke by the following procedure:
- Hook  on a groove in the fan pulley.
- Turn the fan pulley in the illustrated direction so that the pointer is aligned with the "I – IV" or "1 – 4" mark on the inscribed scale on the flywheel.
- This will place either the No. 1 or No. 4 cylinder piston at TDC on the compression stroke. The cylinder in which the rocker arms for both the intake and exhaust valves can be pushed down by hand by the valve clearance amounts has its piston at TDC. Rotate the engine by one full turn to switch the TDCs of the No. 1 and No. 4 cylinder pistons.



- Align the match mark "P" on the supply pump idler gear with that of the supply pump gear.
- Align the notch on the flange plate with the notch on the supply pump gear.
- Check that the notch on the flange plate and the notch on the supply pump gear are correctly aligned, and then push the supply pump.

INJECTOR



P57169

● Disassembly sequence

- 1 Snap ring
- 2 Fuel return hose
- 3 Injection pipe
- 4 Bolt (with hexagonal hole)

- 5 Injector
- 6 O-ring
- 7 Nozzle gasket
- X: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- The harnesses and connectors between injectors and engine ECU contain high voltage. Be careful not to receive an electric shock. Before removing the injectors, always turn the starter switch to the LOCK position.
- Fuel is highly flammable. Wipe up spilled fuel to avoid the risk of fire.

CAUTION ⚠

- Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.
- When removing the injectors, take care not to strike them with the tool, etc.
- To prevent an injection failure or any other trouble, make sure that no dust enters the injectors and injection pipes.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
 Ta	Injection pipe (union nut mounting)	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
 Tb	Bolt (injector mounting)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Engine oil	As required



Group 13E

Electronically Controlled Fuel System

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

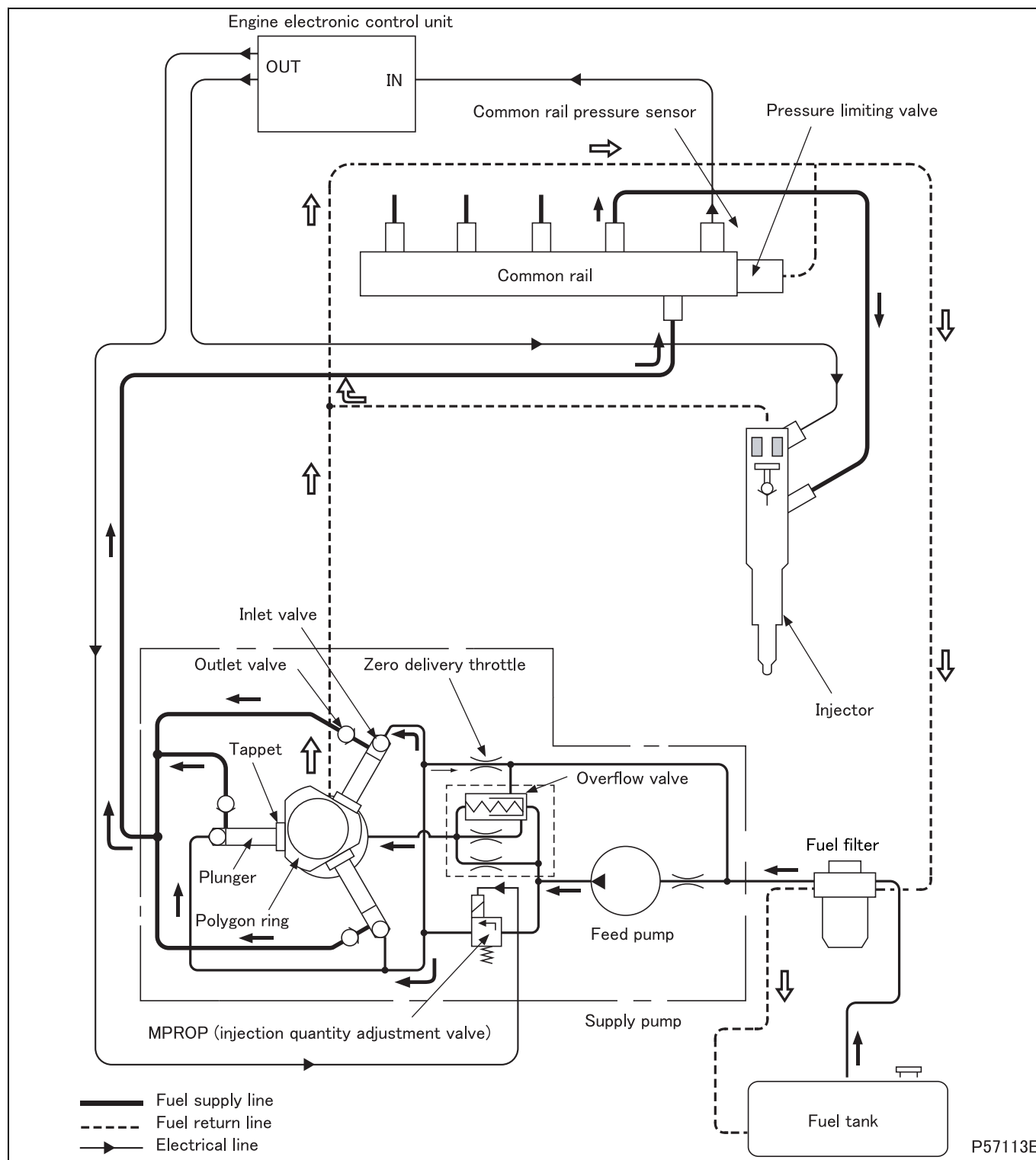
SPECIFICATIONS	13E-2
STRUCTURE AND OPERATION	
1. Overview	13E-3
2. Electronic Control System	13E-12
3. Electronic Control Unit Connection Diagram.....	13E-18
TROUBLESHOOTING	
1. Inspection Procedure	13E-20
2. Cautions to Observe when Performing Inspections	13E-21
3. Inspections Based on Diagnosis Codes	13E-22
4. Multi-Use Tester Service Data.....	13E-36
5. Actuator Tests Performed Using Multi-Use Tester	13E-38
6. Inspections Performed at Electronic Control Unit Connectors ..	13E-40
INSPECTION OF ELECTRICAL EQUIPMENT	13E-43
INSTALLED LOCATIONS OF PARTS	13E-50
ELECTRIC CIRCUIT DIAGRAM	13E-56

SPECIFICATIONS

Item			Specifications
Supply pump	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Model		CP3.3
	Control method		Electronic
	Type		Radial, 3-cylinder
	Type		External gear type
	MPROP (injection quantity adjustment valve)	Rated voltage V	12
	Max. common rail pressure MPa {psi, kgf/cm ² }		160 {23200, 1631}
Common rail	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Common rail volume	cm ³ {cu. in., ml}	16.5 {1.01, 16.5}
	Pressure limiting valve opening pressure MPa {psi, kgf/cm ² }		185 to 195 {26830 to 28280, 1886 to 1988}
	Common rail pressure sensor supply voltage	V	5
Injectors	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Control method		Electrical
	Max. operating pressure MPa {psi, kgf/cm ² }		160 {23200, 1631}
	Min. operating pressure MPa {psi, kgf/cm ² }		25 {3630, 255}
Common rail electronic control unit	Manufacturer		BOSCH AUTOMOTIVE SYSTEMS
	Rated voltage		V 12

1. Overview

- In the common rail system, an electronic control unit monitors various aspects of the engine (engine speed, throttle opening, coolant temperature, etc.) using information from sensors. In accordance with these data, the electronic control unit effects control over the fuel injection quantity, fuel injection timing, and fuel injection pressure in order to optimize the engine's operation.
- The electronic control unit has a diagnosis function that enables it to recognize abnormalities in the common rail system's major components and alert the driver to them.
- The common rail system consists mainly of an electronically controlled supply pump; injectors; a common rail; and the electronic control unit and sensors that are used to control the other components.

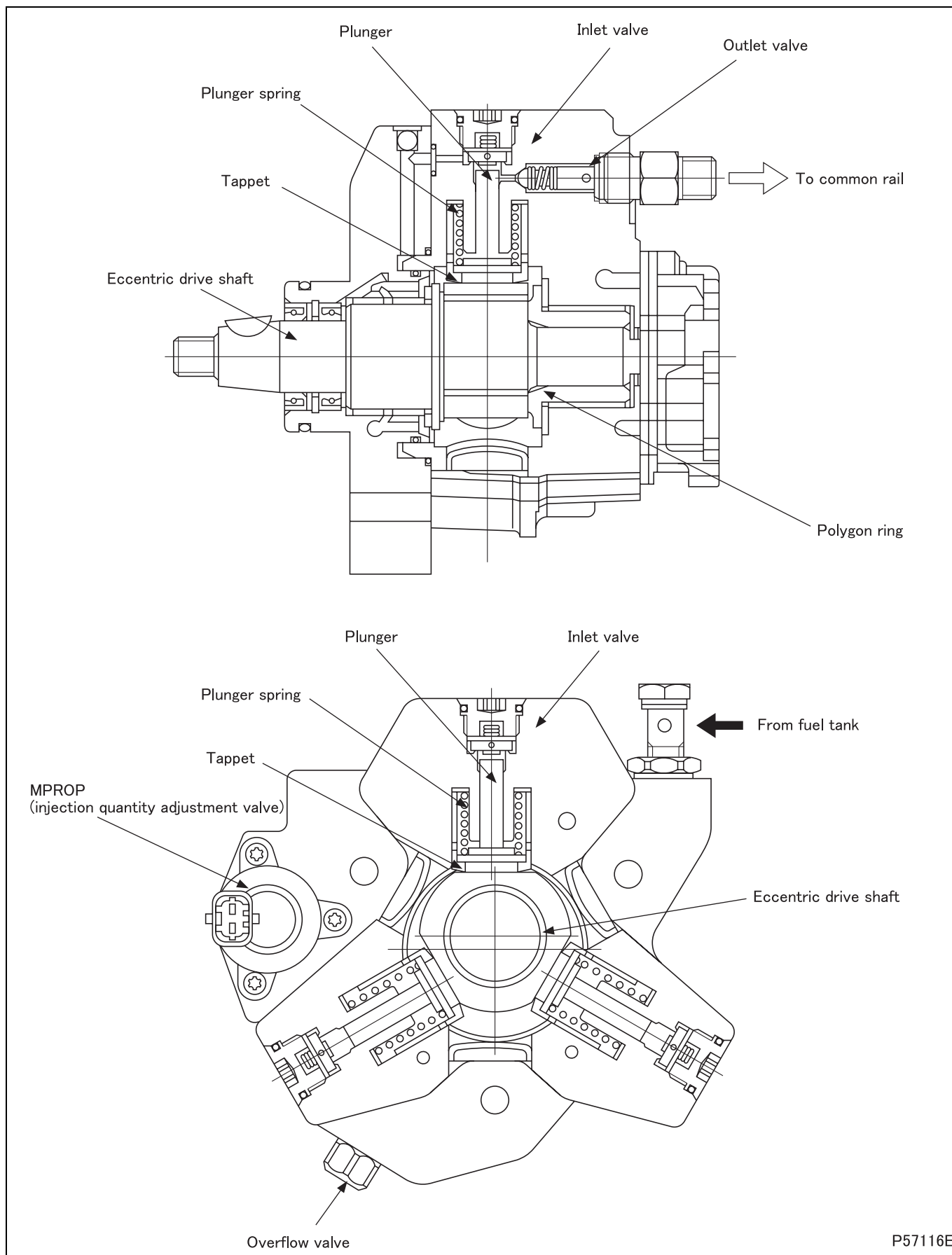


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STRUCTURE AND OPERATION

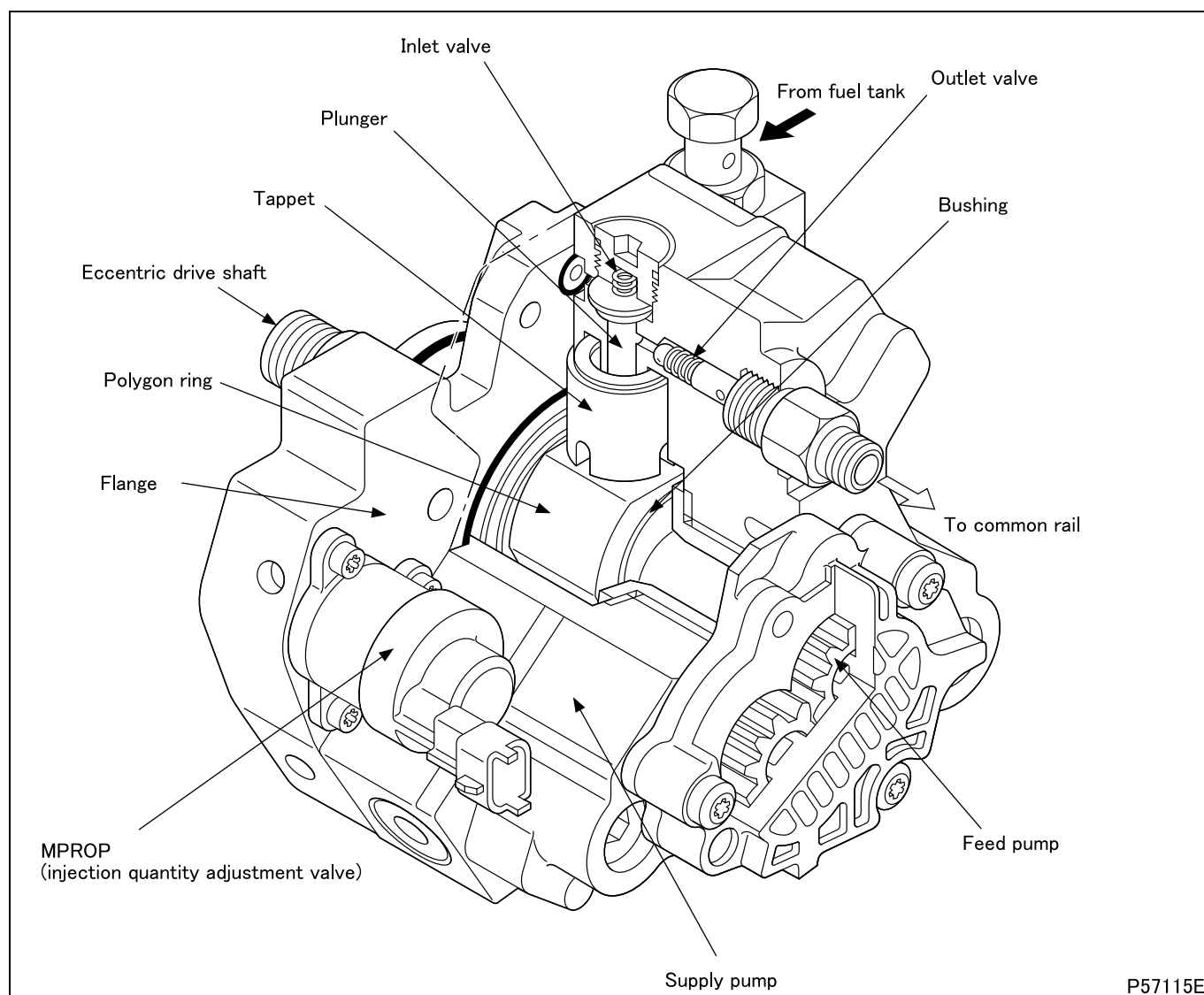
- When the engine is cranked by means of the starter switch, the feed pump (this is located inside the supply pump) simultaneously draws fuel from the fuel tank and feeds it via the fuel filter to the MPROP (injection quantity adjustment valve). A quantity of fuel metered by the MPROP is supplied via the inlet valves to the plunger chambers.
- The fuel in the plunger chambers is pressurized. The outlet valves are then opened, and the fuel is fed under pressure to the common rail.
- The pressurized fuel is held in the common rail and then uniformly fed to the injectors.
- In response to signals from the engine electronic control unit, a magnetic valve in each injector causes the injector to inject fuel into the relevant combustion chamber at the optimal timing and in the optimal quantity.

1.1 Supply pump



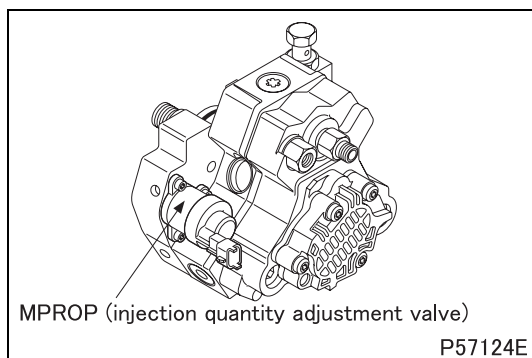
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STRUCTURE AND OPERATION



CAUTION

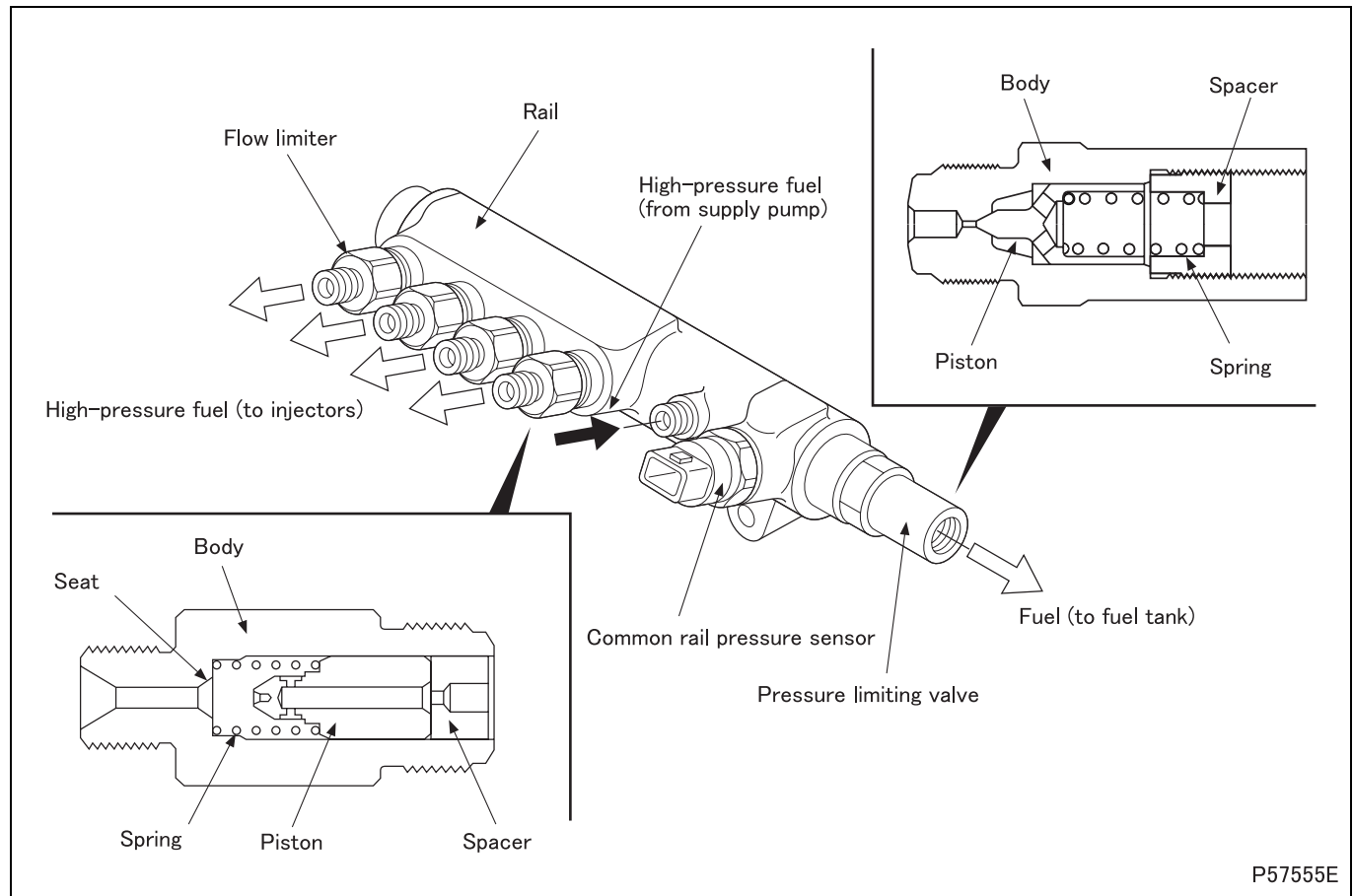
- **Be sure to connect the MPROP (injection quantity adjustment valve) connector to the engine harness before starting the engine. If the engine were started with the MPROP connector not connected, control of the supply pump by the engine electronic control unit would not be possible and a fault would ensue.**
- The supply pump pressurizes fuel and supplies it in a highly pressurized state.
- Fuel drawn from the fuel tank by the feed pump is not supplied directly to the plungers. It is supplied first to the MPROP (injection quantity adjustment valve), which controls the amount of fuel reaching the plungers.
- If the fuel pressure exceeds a certain level, the overflow valve returns fuel to the inlet side of the feed pump. This operation keeps the fuel pressure constant.
- Rotation of the eccentric drive shaft causes (via the tappets) up-down movement of the plungers. Fuel in the plunger chambers is thus highly pressurized.

**(1) MPROP (injection quantity adjustment valve)**

- The MPROP receives fuel from the feed pump and feeds fuel toward the plungers of the supply pump in such a quantity that the fuel pressure corresponds to that required by the engine electronic control unit.
- When the MPROP is not operating, i.e., when current is not flowing, fuel flows at its maximum rate. When current flows, the piston in the MPROP is pressed down such that fuel is not fed toward the plungers.

STRUCTURE AND OPERATION

1.2 Common rail

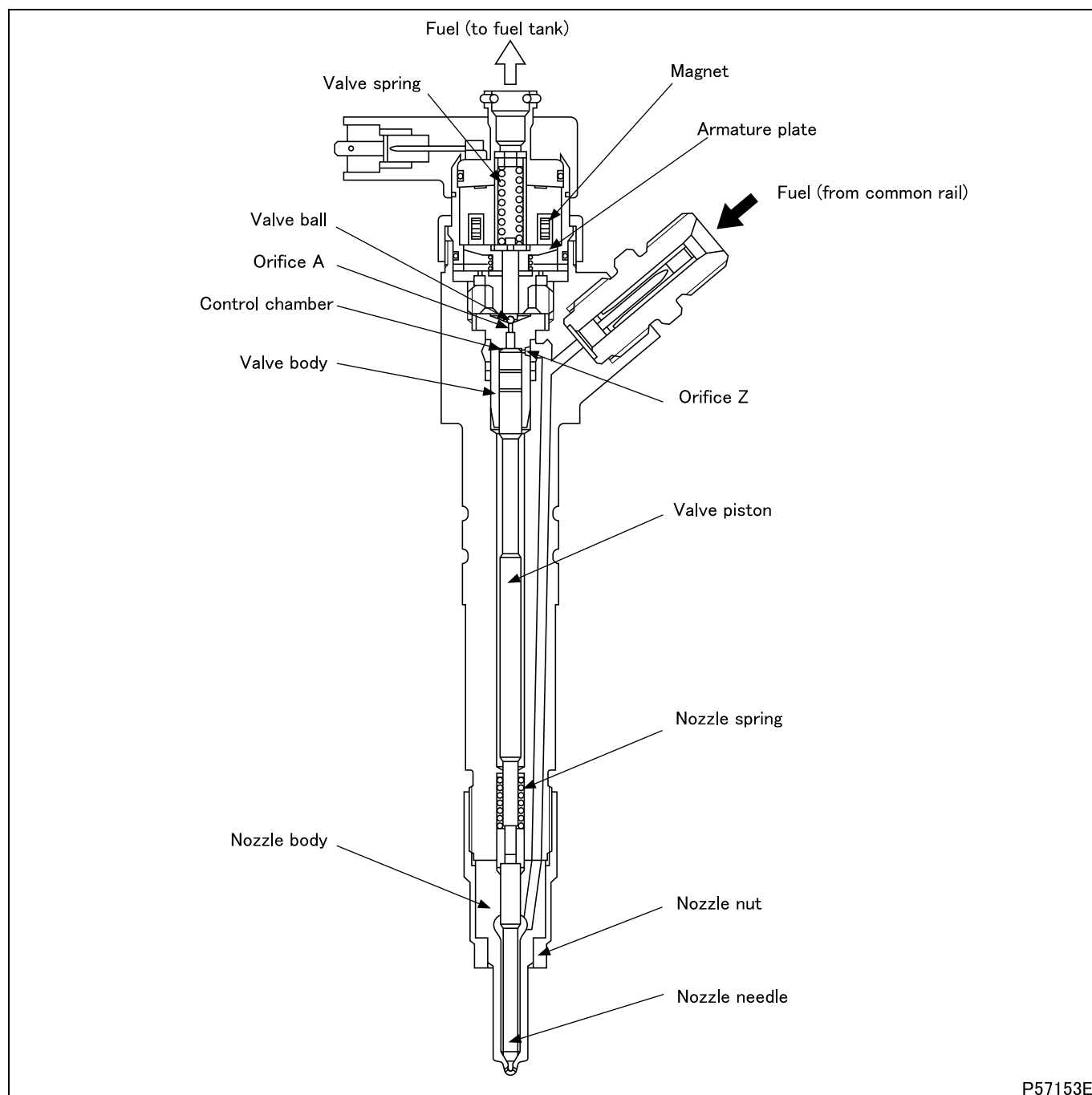


- The common rail distributes to the injectors high-pressure fuel that has been fed from the supply pump.
- Each flow limiter prevents an abnormal outflow of fuel. It does so by blocking the fuel passage in the event of fuel leakage from the injection pipe or excessive injection of fuel from the injector.
- The common rail pressure sensor is used in feedback control. It senses the fuel pressure inside the common rail and feeds a corresponding signal to the electronic control unit.
- If the fuel pressure in the common rail exceeds a certain, set level, the piston in the pressure limiting valve pushes and compresses the spring such that fuel is able to escape. The pressure limiting valve thus prevents the fuel pressure from becoming higher than the set pressure.

Flow limiter

- During normal operation, the piston moves (thus pushing and compressing the spring) to the extent necessary for one injection quantity to pass through. The piston does not make contact with the seat at this time. When injection is complete, the piston is returned to its initial position by the spring.
- If the amount of fuel passing through the flow limiter becomes excessively great, the piston presses against the seat, thereby closing the fuel passage and preventing an abnormal outflow of fuel. When the piston has pressed against the seat, it does not return to its original position until the engine has been stopped and the pressure in the common rail has come down.

1.3 Injector



P57153E

- In accordance with electrical signals from the engine electronic control unit, each injector supplies high-pressure fuel from the common rail to the relevant combustion chamber of the engine at the optimal timing and in the optimal quantity.
- The valve body and valve piston together form the control chamber.
- The functional units of each injector can be broadly defined as follows:

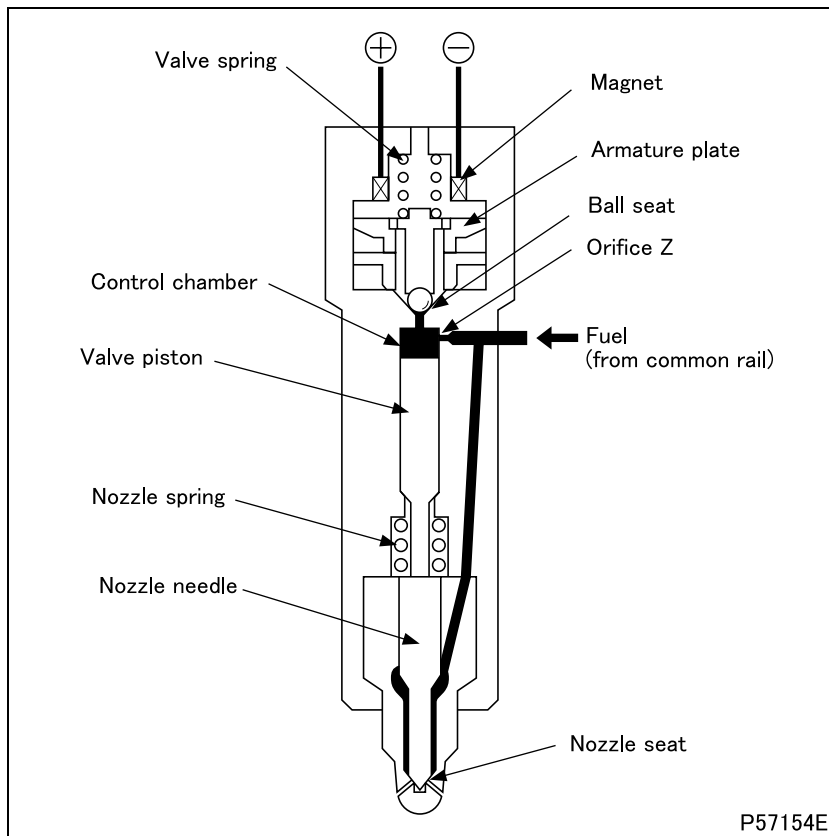
(1) Control section

- The control section consists of the control chamber, magnet, valve spring, armature plate, valve ball, valve body, valve piston, orifice A, and orifice Z. The valve piston is located between the control section and the injection section.

(2) Injection section

- The injection section consists of the nozzle body, nozzle needle, nozzle spring, and nozzle nut.

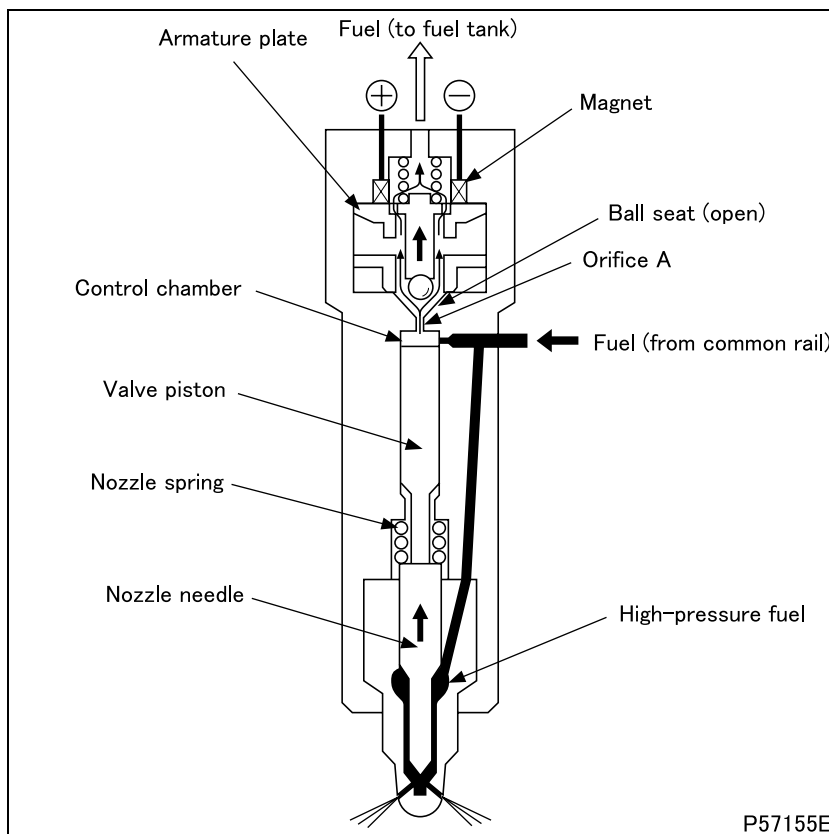
STRUCTURE AND OPERATION



(3) Operation

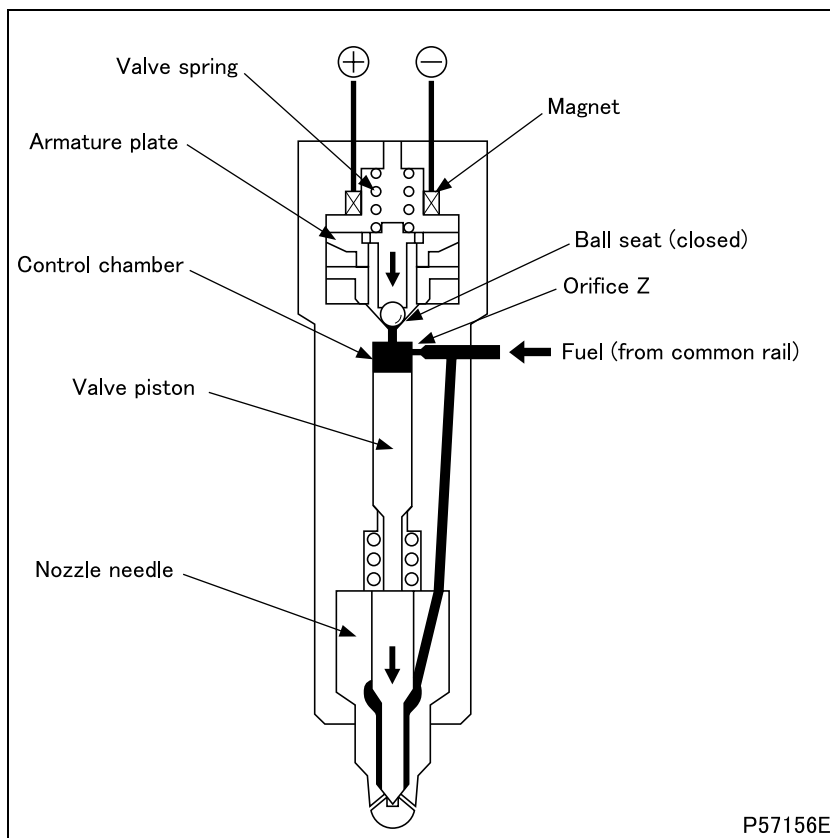
(3.1) Injection not taking place

- With the magnet not energized, the armature plate is pushed up by the valve spring such that the ball seat is closed.
- The high-pressure fuel acts upon the control chamber via orifice Z. The same pressure acts upon the nozzle needle.
- The fuel pressure acting on the nozzle needle cannot overcome the valve piston and nozzle spring, so the nozzle needle stays in its downward-pushed position and injection does not take place.



(3.2) Start of injection

- When the magnet is energized, the resulting electromagnetic force draws the armature plate upward, causing the ball seat to open.
- Fuel in the control chamber passes through the ball seat and orifice A and flows to the fuel tank.
- With the pressure in the control chamber reduced, the fuel acting on the nozzle needle overcomes the valve piston and nozzle spring, pushing up the nozzle needle such that injection starts.
- If the magnet remains energized, the injection rate reaches its maximum level.



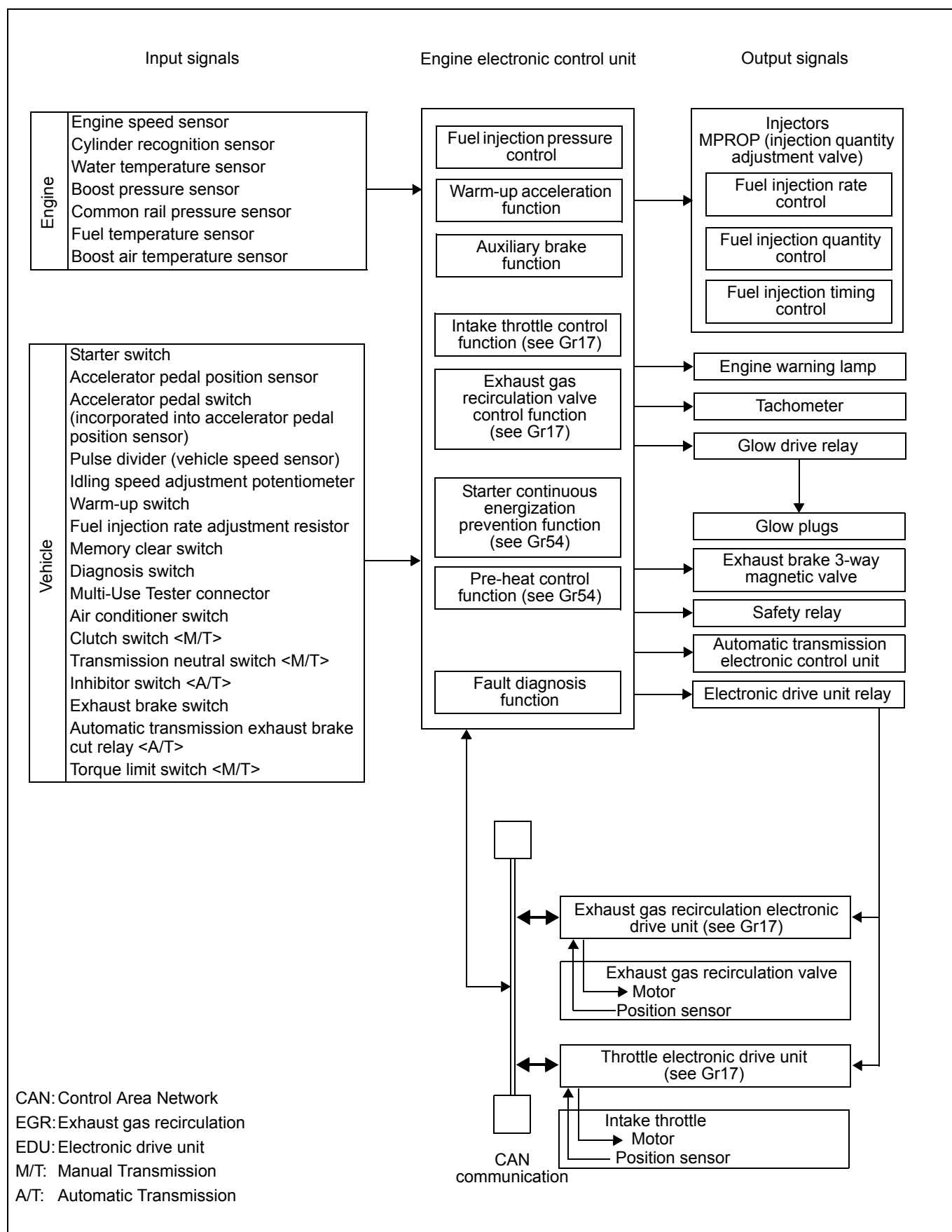
(3.3) End of injection

- When energization of the magnet is stopped, the armature plate is pushed downward by the valve spring such that the ball seat closes. At this time, fuel flows into the control chamber via orifice Z, pushing down the valve piston and nozzle needle such that injection finishes.

STRUCTURE AND OPERATION

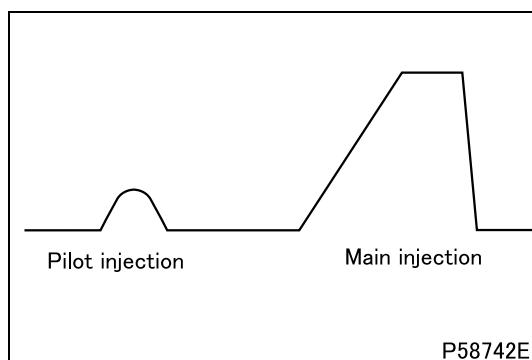
2. Electronic Control System

2.1 System block diagram



Part	Main function/operation
Engine speed sensor	Sensing of engine speed
Cylinder recognition sensor	Cylinder recognition
Water temperature sensor	Sensing of coolant temperature
Boost pressure sensor	Sensing of boost pressure
Common rail pressure sensor	Sensing of common rail pressure
Fuel temperature sensor	Sensing of fuel temperature
Boost air temperature sensor	Sensing of boost air temperature
Starter switch	Senses that the engine is in starting condition with the starter switch in START position.
Accelerator pedal position sensor	Sensing of extent of accelerator pedal depression
Accelerator pedal switch (incorporated into accelerator pedal position sensor)	Sensing of released/depressed condition of accelerator pedal (ON with pedal released)
Pulse divider (vehicle speed sensor)	Sensing of vehicle speed
Idling speed adjustment potentiometer	Acceleration of warm-up
Warm-up switch	
Fuel injection rate adjustment resistor	Correction of fuel injection rate
Diagnosis switch	Output of diagnosis codes
Memory clear switch	Deletion of diagnosis codes; output of past diagnosis codes
Multi-Use Tester connector	Communication between Multi-Use Tester and common rail system
Air conditioner switch	ON when air conditioner is operating
Clutch switch <manual transmission>	Sensing of released/depressed condition of clutch pedal (OFF with pedal released)
Transmission neutral switch <manual transmission>	Detection of transmission neutral condition (OFF with transmission in neutral)
Inhibitor switch <automatic transmission>	Detection of transmission neutral condition (high idle inhibited with transmission in any range except 'N')
Exhaust brake switch <manual transmission>	Exhaust brake ON/OFF control
Automatic transmission exhaust brake cut relay <automatic transmission>	
Torque limit switch <manual transmission>	Detection of 1st and reverse positions
Injectors	Control of fuel injection rate, fuel injection quantity, and fuel injection timing
MPROP (injection quantity adjustment valve)	Control of fuel injection pressure
Engine warning lamp	Indication of system abnormalities
Tachometer	Indication of engine speed (in meter cluster)
Glow drive relay	ON/OFF control of glow plugs
Exhaust brake 3-way magnetic valve	ON/OFF control of exhaust brake valve
Safety relay	Control of starter continuous energization prevention function
Automatic transmission electronic control unit	Output of signals corresponding to engine speed and extent of accelerator pedal depression
Electronic drive unit relay	Supply of power to exhaust gas recirculation electronic drive unit and throttle electronic drive unit
CAN communication (exhaust gas recirculation electronic drive unit and throttle electronic drive unit)	Engine data recognized by the engine electronic control unit are outputted to the CAN bus to enable systems to obtain data that they need for control. Each electronic drive unit issues signals to the engine electronic control unit via the CAN bus to enable it to effect engine control appropriate for each type of system control.

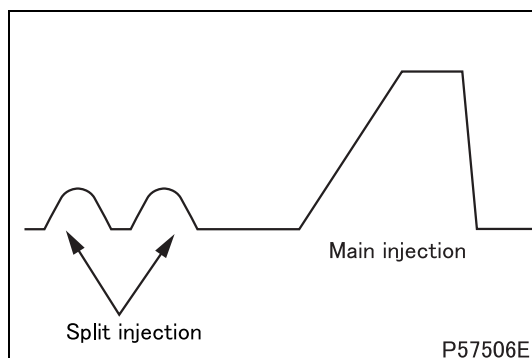
STRUCTURE AND OPERATION



2.2 Fuel injection rate control

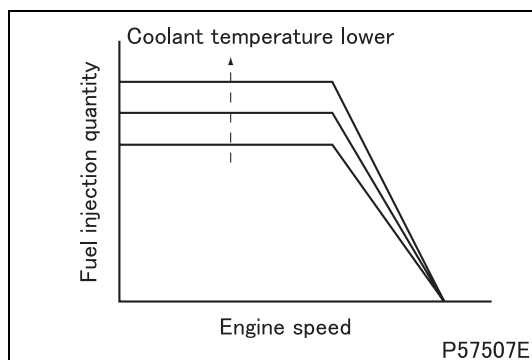
(1) Pilot injection

- Pilot injection entails the injection of an extremely small amount of fuel ahead of the main injection.
- Pilot injection suppresses heat generation early in the injection cycle and thus suppresses NOx generation and noise at the start of combustion.



(2) Split injection control

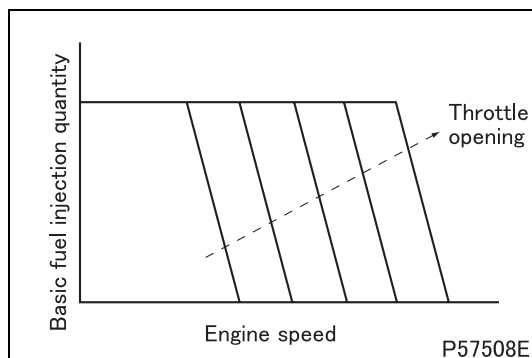
- Split injection entails the injection of an extremely small amount of fuel two or more times ahead of the main injection.
- Split injection increases the fuel's combustibility and thus enhances the engine's cold startability.



2.3 Fuel injection quantity control

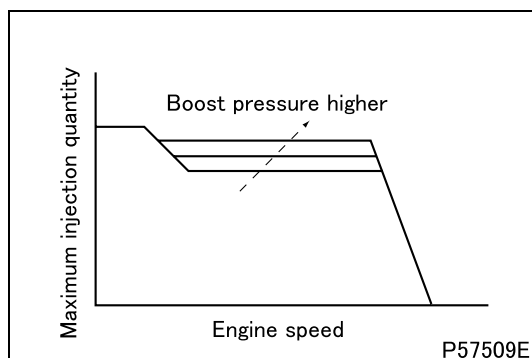
(1) Fuel injection quantity during engine startup

- During engine startup, the fuel injection quantity is determined in accordance with the engine speed and coolant temperature.



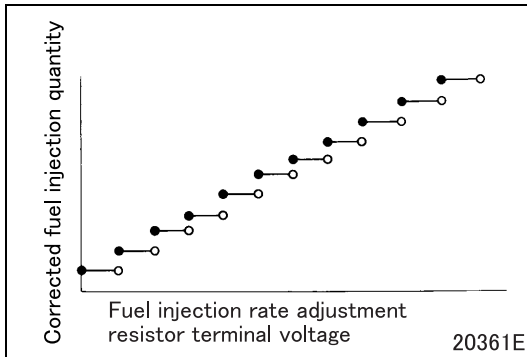
(2) Basic fuel injection quantity

- The basic fuel injection quantity is determined in accordance with the engine speed and throttle opening.



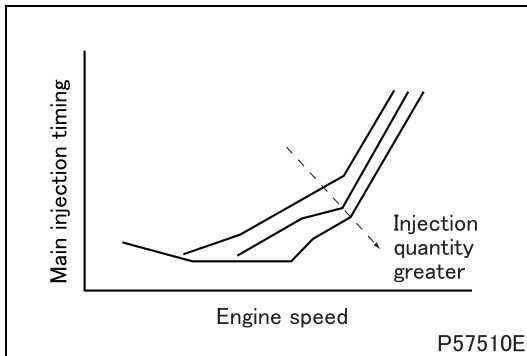
(3) Maximum injection quantity

- The maximum injection quantity is calculated from the engine speed and boost pressure.



(4) Fuel injection rate adjustment resistor correction amount

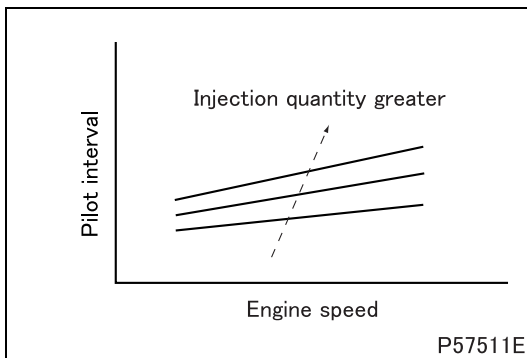
- To limit inconsistency in the injection quantity, the injection quantity is corrected by the fuel injection rate adjustment resistor.



2.4 Fuel injection timing control

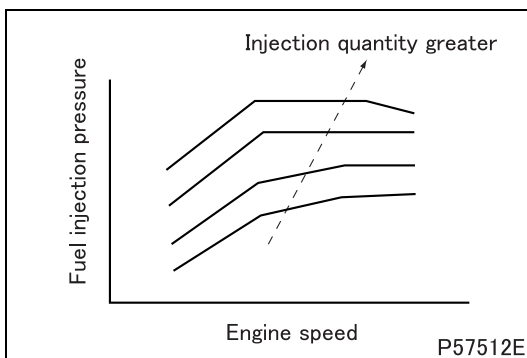
(1) Main injection timing

- The main injection timing is calculated from the fuel injection quantity and engine speed.



(2) Pilot injection timing (pilot interval)

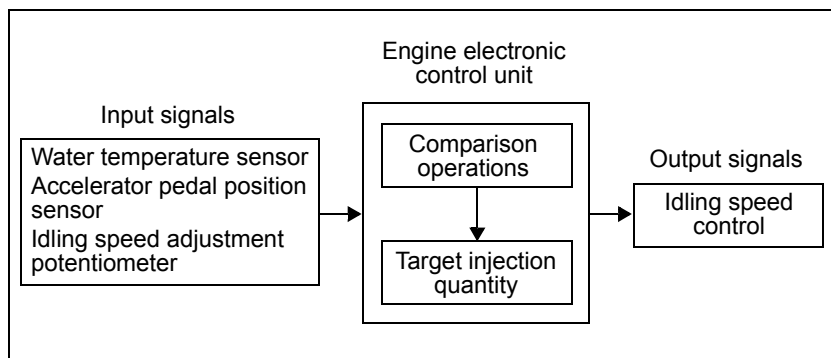
- The pilot interval is calculated from the fuel injection quantity and engine speed.



2.5 Fuel injection pressure control

- The fuel injection pressure is calculated from the fuel injection quantity and engine speed.

STRUCTURE AND OPERATION



2.6 Warm-up acceleration function

- The warm-up acceleration function increases engine warm-up by varying the engine's idling speed in accordance with the engine's coolant temperature. It can operate either automatically or manually. Selection is made using the idling speed adjustment potentiometer.

2.7 Fault diagnosis function

- While the starter switch is in the ON position, the sensors and other components are continuously monitored for faults. In the event that a component is found faulty, an indication is made in the meter cluster to alert the driver, the fault location is memorized in the form of a diagnosis code, and the control during fault is initiated.
- While the control during fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

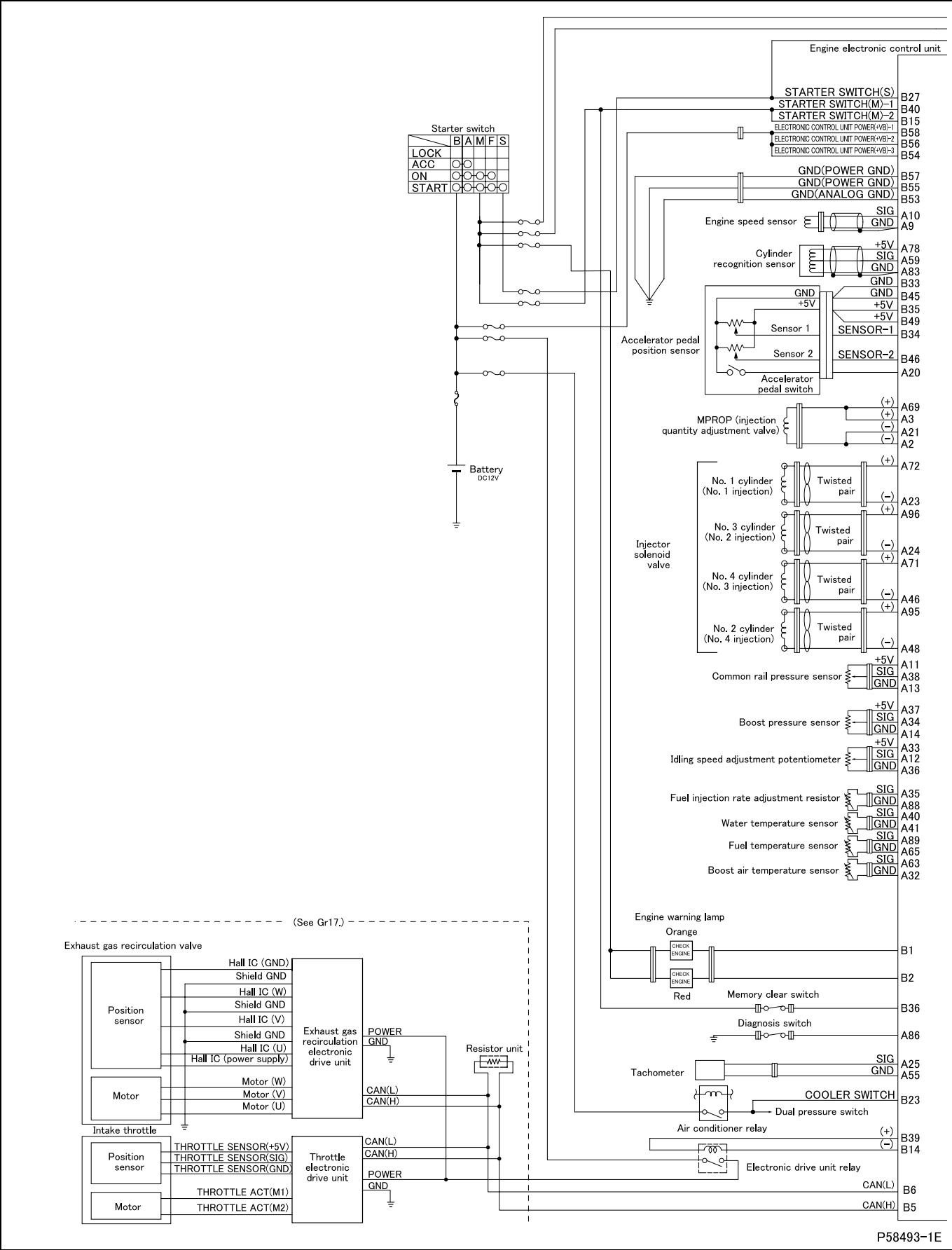
NOTE

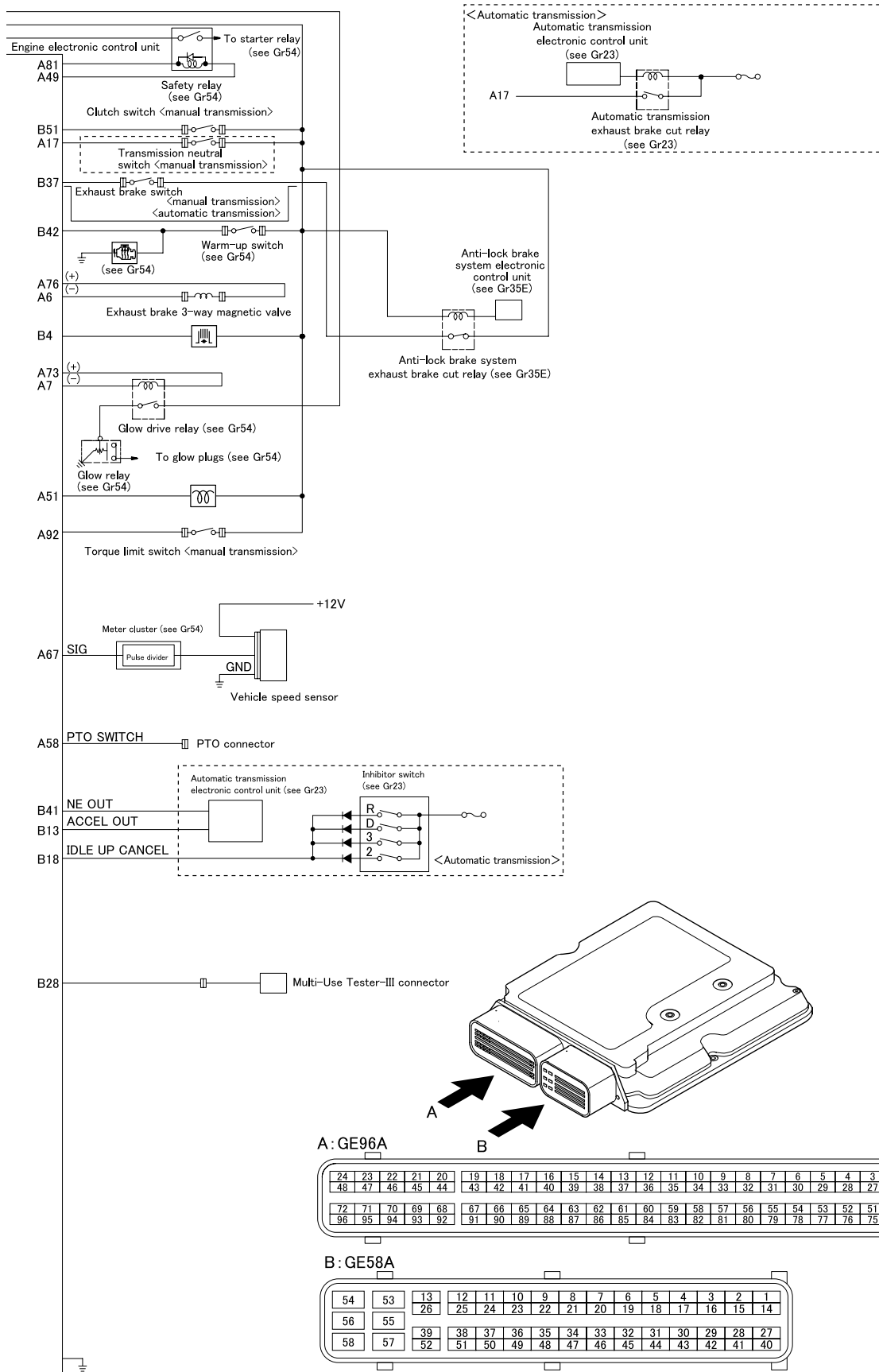
- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

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STRUCTURE AND OPERATION

3. Electronic Control Unit Connection Diagram

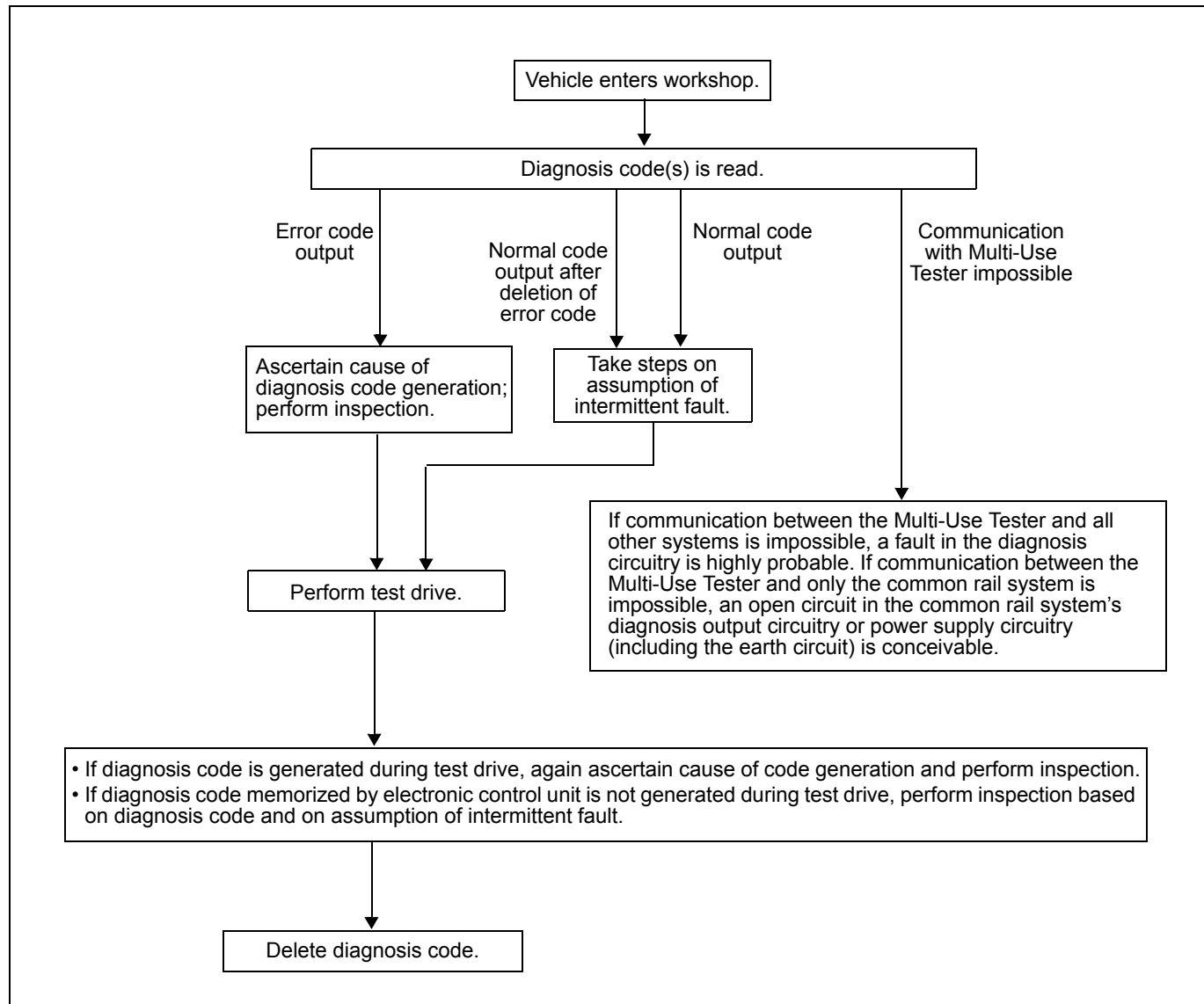




TROUBLESHOOTING

1. Inspection Procedure

- System inspection can be performed most effectively using a Multi-Use Tester-III. Types of system inspection are broadly classified in accordance with fault symptoms and diagnosis codes as follows:
 - Inspection based on diagnosis code memorized by electronic control unit
 - Inspection performed on assumption of intermittent fault



2. Cautions to Observe when Performing Inspections

CAUTION

- The battery voltage must be the standard voltage.
 - Make sure no harness connector or component connector is loose. Before disconnecting any connector, place the starter switch in the LOCK position and wait 20 seconds.
 - After making a repair, delete the diagnosis code using the Multi-Use Tester or memory clear switch.
 - As a general rule, inspection work should be performed with the starter switch in the LOCK position. However, it may be necessary to perform certain tasks with the starter switch in the ON position. At these times, be careful not to cause short circuits between connector terminals and between terminals and the vehicle body.
 - Indicated component resistances may not fall within the standard ranges if they are unduly affected by the temperature and/or by the accuracy of the tester. Standard values in the text are given on the assumption of room temperature (10 to 35°C {50 to 95°F}).
 - After rectification of an abnormality, the system's ability or inability to automatically return to normal control from the control during fault that begins when a fault occurs depends upon the diagnosis code, i.e., the fault location. When the system resumes normal control, the warning lamp goes off.
 - Even when an abnormality has been rectified and the system has automatically returned to normal control, the diagnosis code corresponding to the fault location remains in the memory of the electronic control unit as a past diagnosis code.
 - Following a fault that does not permit an automatic return to normal control from the control during fault that begins when a fault occurs, it is necessary to clear the diagnosis code from memory in order for the system to recover.
-

TROUBLESHOOTING

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

NOTE

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Flashes	Remarks
P0107	Atmospheric Pressure Sensor	19	
P0108	Atmospheric Pressure Sensor	19	
P0112	INT Air Temp. SNSR (Upstream)	44	
P0113	INT Air Temp. SNSR (Upstream)	44	
P0117	Water Temperature Sensor	21	
P0118	Water Temperature Sensor	21	
P0121	Accel Pedal Check (Plausibility)	58	
P0122	Accel Pedal Sensor 1	24	
P0123	Accel Pedal Sensor 1	24	
P0182	Fuel Temp. Sensor (inlet)	41	
P0183	Fuel Temp. Sensor (inlet)	41	
P0192	Common Rail Pressure Sensor	11	
P0193	Common Rail Pressure Sensor	11	
P0200	Injector Circuit 1	82	
P0201	Injector M/V-Cylinder 1	37	
P0202	Injector M/V-Cylinder 2	38	
P0203	Injector M/V-Cylinder 3	39	
P0204	Injector M/V-Cylinder 4	08	
P0219	Engine Overrunning	07	
P0222	Accel Pedal Sensor 2	16	
P0223	Accel Pedal Sensor 2	16	
P0237	Boost Pressure Sensor	32	
P0238	Boost Pressure Sensor	32	
P0251	Common Rail Pressure Defect	36	
P0253	Common Rail Pressure Defect	22	
P0254	Common Rail Pressure Defect	23	
P0335	Engine Revolution Sensor	15	
P0340	Camshaft Position Sensor	12	
P0380	Relay for Glow Relay	26	Gr54
P0381	Glow Lamp	89	Gr54
P0403	EGR 1	67	Gr17
P0404	EGR System	02	Gr17
P0500	Vehicle Speed Sensor	25	

Code	Message	Flashes	Remarks
P0506	Idle Volume	31	
P0507	Idle Volume	31	
P0510	Accel SW	65	
P0560	M/V Supply Voltage	79	
P0605	ECU System (Hardware)	33	
P0615	Starter Safety Relay	48	Gr54
P0616	Starter Safety Relay	48	Gr54
P0617	Starter Safety Relay	48	Gr54
P1121	Intake Throttle 1	28	Gr17
P1171	Q Adjustment Resister	34	
P1172	Q Adjustment Resister	34	
P1200	Injector Circuit 2	82	
P1251	Common Rail Pressure M/V 1	63	
P1255	Common Rail Pressure M/V 1	63	
P1256	Common Rail Pressure M/V 1	63	
P1335	Revolution & Position Sensor	14	
P1460	Exhaust Brake M/V 1	93	
P1462	Exhaust Brake M/V 1	93	
P1463	Exhaust Brake M/V 1	93	
P1562	Sensor Supply Voltage 1	81	
P1563	Sensor Supply Voltage 1	81	
P1567	Sensor Supply Voltage 2	81	
P1568	Sensor Supply Voltage 2	81	
P1572	Sensor Supply Voltage 3	81	
P1573	Sensor Supply Voltage 3	81	
P1577	Segment Sensor Supply Voltage	81	
P1578	Segment Sensor Supply Voltage	81	
P1605	ECU System (EEPROM)	33	
P1606	ECU System (Software)	33	
P1625	EDU Relay	84	Gr17
P1630	CAN (EGR)	95	Gr17
P1635	CAN (Intake Throttle)	96	Gr17
P1700	Torque Cut SW	86	

3.2 Diagnosis code generation conditions and inspection items

P0107: Atmospheric Pressure Sensor (warning lamp flashes: 19)

Generation condition		Atmospheric pressure sensor (incorporated into engine electronic control unit) voltage is below standard value (2 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using backup value of 101.3 kPa {15 psi, 1.03 kgf/cm²}. (Exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Service data	38: Atmospheric Pressure
	Electrical equipment	Engine electronic control unit

P0108: Atmospheric Pressure Sensor (warning lamp flashes: 19)

Generation condition		Atmospheric pressure sensor (incorporated into engine electronic control unit) voltage is below standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using backup value of 101.3 kPa {15 psi, 1.03 kgf/cm²}. (Exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Service data	38: Atmospheric Pressure
	Electrical equipment	Engine electronic control unit

P0112: INT Air Temp. SNSR (Upstream) (warning lamp flashes: 44)

Generation condition		Boost air temperature sensor voltage is below standard value (0.15 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (25°C {77°F}).
Inspection	Service data	27: Intake Air Temperature
	Electronic control unit connector	01 : Boost air temperature sensor
	Electrical equipment	#305: Boost air temperature sensor
	Electric circuit diagram	Boost air temperature sensor system

P0113: INT Air Temp. SNSR (Upstream) (warning lamp flashes: 44)

Generation condition		Boost air temperature sensor voltage is below standard value (4.85 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (25°C {77°F}).
Inspection	Service data	27: Intake Air Temperature
	Electronic control unit connector	01 : Boost air temperature sensor
	Electrical equipment	#305: Boost air temperature sensor
	Electric circuit diagram	Boost air temperature sensor system

TROUBLESHOOTING

P0117: Water Temperature Sensor (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage is below standard value (0.2 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Water temperature is assumed as constant -20°C $\{-4^{\circ}\text{F}\}$ during engine start-up and as constant 80°C $\{175^{\circ}\text{C}\}$ while vehicle is being driven. (Exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped. - Glow control is stopped.
Inspection	Service data	35: Water Temperature
	Electronic control unit connector	02 : Water temperature sensor
	Electrical equipment	#262: Water temperature sensor
	Electric circuit diagram	Water temperature sensor system

P0118: Water Temperature Sensor (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage is above standard value (4.85 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Water temperature is assumed as constant -20°C $\{-4^{\circ}\text{F}\}$ during engine start-up and as constant 80°C $\{175^{\circ}\text{C}\}$ while vehicle is being driven. (Exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped. - Glow control is stopped.
Inspection	Service data	35: Water Temperature
	Electronic control unit connector	02 : Water temperature sensor
	Electrical equipment	#262: Water temperature sensor
	Electric circuit diagram	Water temperature sensor system

P0121: Accel Pedal Check (Plausibility) (warning lamp flashes: 58)

Generation condition		Accelerator pedal position sensor output voltages 1 and 2 are outside standard range; or compared value is out of specification.
Recoverability		– (Low output)
Control effected by electronic control unit		Control is effected using value of 30 % with accelerator pedal depressed and using value of 0 % with accelerator pedal not depressed. (Output is reduced.)
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 24: Accel Pedal Sensor Voltage 1, 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor system

P0122: Accel Pedal Sensor 1 (warning lamp flashes: 24)

Generation condition		Accelerator pedal position sensor 1 voltage is below standard value (0.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 2.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 24: Accel Pedal Sensor Voltage 1
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 1 system

P0123: Accel Pedal Sensor 1 (warning lamp flashes: 24)

Generation condition		Accelerator pedal position sensor 1 voltage is below standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 2.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 24: Accel Pedal Sensor Voltage 1
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 1 system

P0182: Fuel Temp. Sensor (inlet) (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor voltage is below standard value (0.15 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value.
Inspection	Service data	36: Fuel Temperature (inlet)
	Electronic control unit connector	04 : Fuel temperature sensor
	Electrical equipment	#323: Fuel temperature sensor
	Electric circuit diagram	Fuel temperature sensor system

P0183: Fuel Temp. Sensor (inlet) (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor voltage is below standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value.
Inspection	Service data	36: Fuel Temperature (inlet)
	Electronic control unit connector	04 : Fuel temperature sensor
	Electrical equipment	#323: Fuel temperature sensor
	Electric circuit diagram	Fuel temperature sensor system

P0192: Common Rail Pressure Sensor (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage is below standard value (0.2 V).
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Common rail pressure open loop control is effected. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P0193: Common Rail Pressure Sensor (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage is below standard value (4.8 V).
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Common rail pressure open loop control is effected. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

TROUBLESHOOTING

P0200: Injector Circuit 1 (warning lamp flashes: 82)

Generation condition		Injector circuit is short-circuited, open-circuited, or overloaded.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Faulty circuit is stopped, resulting in two-cylinder operation. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator tests	BB: Injector Test 1, BD: Injector Test 3
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 1 cylinder) or (No. 3 cylinder) system

P0201: Injector M/V-Cylinder1 (warning lamp flashes: 37)

Generation condition		Injector magnetic valve (No. 1 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Intake throttle control is stopped. - Open circuit: Energization is stopped. - Short circuit: Injector magnetic valves 1 and 4 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
Inspection	Actuator test	BB: Injector Test 1
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 1 cylinder) system

P0202: Injector M/V-Cylinder2 (warning lamp flashes: 38)

Generation condition		Injector magnetic valve (No. 2 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Intake throttle control is stopped. - Open circuit: Energization is stopped. - Short circuit: Injector magnetic valves 2 and 3 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
Inspection	Actuator test	BC: Injector Test 2
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 2 cylinder) system

P0203: Injector M/V-Cylinder3 (warning lamp flashes: 39)

Generation condition		Injector magnetic valve (No. 3 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Intake throttle control is stopped. - Open circuit: Energization is stopped. - Short circuit: Injector magnetic valves 2 and 3 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
Inspection	Actuator test	BD: Injector Test 3
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 3 cylinder) system

P0204: Injector M/V-Cylinder4 (warning lamp flashes: 08)

Generation condition		Injector magnetic valve (No. 4 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Intake throttle control is stopped. - Open circuit: Energization is stopped. - Short circuit: Injector magnetic valves 1 and 4 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
Inspection	Actuator test	BE: Injector Test 4
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 4 cylinder) system

P0219: Engine Overrunning (warning lamp flashes: 07)

Generation condition		Engine speed is higher than specified level.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Injectors are turned OFF. - MPROP stops feeding fuel.
Inspection	Electronic control unit connector	Engine electronic control unit

P0222: Accel Pedal Sensor 2 (warning lamp flashes: 16)

Generation condition		Accelerator pedal position sensor 2 voltage is below standard value (0.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 1.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 2 system

TROUBLESHOOTING

P0223: Accel Pedal Sensor 2 (warning lamp flashes: 16)

Generation condition		Accelerator pedal position sensor 2 voltage is above standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 1.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 2 system

P0237: Boost Pressure Sensor (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage is below standard value (0.3 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value of 101.3 kPa {1.03 kgf/cm ² }. (Output is reduced, and fuel economy worsens.)
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

P0238: Boost Pressure Sensor (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage is above standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value of 101.3 kPa {1.03 kgf/cm ² }. (Output is reduced, and fuel economy worsens.)
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

P0251: Common Rail Pressure Defect (warning lamp flashes: 36)

Generation condition		Difference between target rail pressure and actual rail pressure is above standard value.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Injectors are turned OFF. (Engine is stopped.)
Inspection	Actuator test	B9: Fuel Leak Check
	Other	• Air-bleeding of fuel system (See Gr13.) • Inspection of fuel piping (See Gr13.) • Fuel filter (See Gr13.) • Supply pump (Have work performed by Bosch Automotive Systems.) • Pressure limiting valve (Have work performed by Bosch Automotive Systems.) • Injectors (Have work performed by Bosch Automotive Systems.)

P0253: Common Rail Pressure Defect (warning lamp flashes: 22)

Generation condition		Actual rail pressure is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Injectors are turned OFF. (Engine is stopped.)
Inspection	Actuator test	B9: Fuel Leak Check
	Other	• Air-bleeding of fuel system (See Gr13.) • Inspection of fuel piping (See Gr13.) • Fuel filter (See Gr13.) • Supply pump (Have work performed by Bosch Automotive Systems.) • Pressure limiting valve (Have work performed by Bosch Automotive Systems.) • Injectors (Have work performed by Bosch Automotive Systems.)

P0254: Common Rail Pressure Defect (warning lamp flashes: 23)

Generation condition		Actual rail pressure is high even with delivery rate of zero; or actual rail pressure is above standard value.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Injection quantity is limited. (Output is reduced.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Other	Supply pump (Have work performed by Bosch Automotive Systems.)

P0335: Engine Revolution Sensor (warning lamp flashes: 15)

Generation condition		Engine speed sensor emits no pulses or too many pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using cylinder recognition sensor. (Output decreases owing to reduced control accuracy.)
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	06 : Engine speed sensor
	Electrical equipment	#263: Engine speed sensor
	Electric circuit diagram	Engine speed sensor system

P0340: Camshaft Position Sensor (warning lamp flashes: 12)

Generation condition		Cylinder recognition sensor emits no pulses or too many pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using engine speed sensor.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Cylinder recognition sensor
	Electrical equipment	#320: Cylinder recognition sensor
	Electric circuit diagram	Cylinder recognition sensor system

P0500: Vehicle Speed Sensor (warning lamp flashes: 25)

Generation condition		Vehicle speed sensor signal is missing or indicates an abnormally high speed.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Engine is controlled normally.
Inspection	Service data	3C: Vehicle Speed
	Electronic control unit connector	08 : Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Vehicle speed sensor system

TROUBLESHOOTING

P0506: Idle Volume (warning lamp flashes: 21)

Generation condition		Idling speed adjustment potentiometer voltage is below standard value (0.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected with auto idle permanently selected.
Inspection	Service data	3B: Idle Volume Voltage
	Electronic control unit connector	09 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer
	Electric circuit diagram	Idling speed adjustment potentiometer system

P0507: Idle Volume (warning lamp flashes: 31)

Generation condition		Idling speed adjustment potentiometer voltage is above standard value (4.6 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected with auto idle permanently selected.
Inspection	Service data	3B: Idle Volume Voltage
	Electronic control unit connector	09 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer
	Electric circuit diagram	Idling speed adjustment potentiometer system

P0510: Accel SW (warning lamp flashes: 65)

Generation condition		Accelerator pedal switch signal is abnormal when compared with accelerator pedal position sensor outputs 1 and 2.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Normal control is effected.
Inspection	Service data	73: Accel SW
	Electronic control unit connector	10 : Accelerator pedal switch
	Electrical equipment	#324: Accelerator pedal switch (incorporated into accelerator pedal position sensor)
	Electric circuit diagram	Accelerator pedal switch system

P0560: M/V Supply Voltage (warning lamp flashes: 79)

Generation condition		Circuit (magnetic valve power supply) in electronic control unit is abnormal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		No specific control is effected. Failure occurs owing to circuit abnormality.
Inspection	Other	Engine electronic control unit

P0605: ECU System (Hardware) (warning lamp flashes: 33)

Generation condition		Circuit (hardware power supply) in electronic control unit is abnormal.
Recoverability		System recovers if signal becomes normal with starter switch in ON position. System does not recover unless diagnosis code is deleted.
Control effected by electronic control unit		No specific control is effected. Failure occurs owing to circuit abnormality.
Inspection	Other	Engine electronic control unit

P1171: Q Adjustment Resistor (warning lamp flashes: 34)

Generation condition		Fuel injection rate adjustment resistor voltage is below standard value (0.2 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (No. 1). (Output is slightly reduced.)
Inspection	Service data	3E: Q Adjustment Resistor No.
	Electronic control unit connector	11 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor

P1172: Q Adjustment Resistor (warning lamp flashes: 34)

Generation condition		Fuel injection rate adjustment resistor voltage is above standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (No. 1). (Output is slightly reduced.)
Inspection	Service data	3E: Q Adjustment Resistor No.
	Electronic control unit connector	11 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor

P1200: Injector Circuit 2 (warning lamp flashes: 82)

Generation condition		Injector circuit is short-circuited, open-circuited, or overloaded.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty circuit is stopped, resulting in two-cylinder operation. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator tests	BC: Injector Test 2, BE: Injector Test 4
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 2 cylinder) or (No. 4 cylinder) system

P1251: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		Current flowing to MPROP (injection quantity adjustment valve) is above standard value.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	12 : MPROP (injection quantity adjustment valve)
	Electrical equipment	#574: MPROP (injection quantity adjustment valve)
	Electric circuit diagram	MPROP (injection quantity adjustment valve) system

TROUBLESHOOTING

P1255: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		MPROP (injection quantity adjustment valve) voltage is below standard value.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.) - Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	12 : MPROP (injection quantity adjustment valve)
	Electrical equipment	#574: MPROP (injection quantity adjustment valve)
	Electric circuit diagram	MPROP (injection quantity adjustment valve) system

P1256: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		MPROP (injection quantity adjustment valve) voltage is above standard value.
Recoverability		High voltage: System recovers if signal becomes normal with starter switch in ON position. Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.) - Exhaust gas recirculation control and intake throttle control are stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	12 : MPROP (injection quantity adjustment valve)
	Electrical equipment	#574: MPROP (injection quantity adjustment valve)
	Electric circuit diagram	MPROP (injection quantity adjustment valve) system

P1335: Revolution & Position Sensor (warning lamp flashes: 14)

Generation condition		Engine speed sensor and cylinder recognition sensor emit no pulses or too many pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Injectors are turned OFF. (Engine is stopped.)
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	06 : Engine speed sensor, 07 : Cylinder recognition sensor
	Electrical equipment	#263: Engine speed sensor, #320: Cylinder recognition sensor
	Electric circuit diagram	Engine speed sensor and cylinder recognition sensor systems

P1460: Exhaust Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Current flowing to exhaust brake 3-way magnetic valve is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Operation of exhaust brake is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Auxiliary Brake M/V 1
	Electronic control unit connector	13 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

P1462: Exhaust Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Exhaust brake 3-way magnetic valve voltage is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Operation of exhaust brake is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Auxiliary Brake M/V 1
	Electronic control unit connector	13 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

P1463: Exhaust Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Exhaust brake 3-way magnetic valve voltage is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Operation of exhaust brake is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Auxiliary Brake M/V 1
	Electronic control unit connector	13 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

P1562: Sensor Supply Voltage 1 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 1) in electronic control unit is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	24: Accel Pedal Sensor Voltage 1, 3B: Idle Volume Voltage
	Electronic control unit connector	03 : Accelerator pedal position sensor 1, 09 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer, #324: Accelerator pedal position sensor 1
	Electric circuit diagram	Boost air temperature sensor, accelerator pedal position sensor 1, and idling speed adjustment potentiometer systems

P1563: Sensor Supply Voltage 1 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 1) in electronic control unit is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	24: Accel Pedal Sensor Voltage 1, 3B: Idle Volume Voltage
	Electronic control unit connector	03 : Accelerator pedal position sensor 1, 09 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer, #324: Accelerator pedal position sensor 1
	Electric circuit diagram	Boost air temperature sensor, accelerator pedal position sensor 1, and idling speed adjustment potentiometer systems

TROUBLESHOOTING

P1567: Sensor Supply Voltage 2 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 2) in electronic control unit is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	25: Accel Pedal Sensor Voltage 2, 26: Boost Pressure
	Electronic control unit connector	03 : Accelerator pedal position sensor 2
	Electrical equipment	#318: Boost pressure sensor, #324: Accelerator pedal position sensor 2
	Electric circuit diagram	Boost pressure sensor, accelerator pedal position sensor 2, and fuel temperature sensor systems

P1568: Sensor Supply Voltage 2 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 2) in electronic control unit is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	25: Accel Pedal Sensor Voltage 2, 26: Boost Pressure
	Electronic control unit connector	03 : Accelerator pedal position sensor 2
	Electrical equipment	#318: Boost pressure sensor, #324: Accelerator pedal position sensor 2
	Electric circuit diagram	Boost pressure sensor, accelerator pedal position sensor 2, and fuel temperature sensor systems

P1572: Sensor Supply Voltage 3 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 3) in electronic control unit is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P1573: Sensor Supply Voltage 3 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 3) in electronic control unit is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P1577: Segment Sensor Supply Voltage (warning lamp flashes: 81)

Generation condition		Cylinder recognition sensor supply voltage is below standard value (0 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Cylinder recognition sensor
	Electrical equipment	#320: Cylinder recognition sensor
	Electric circuit diagram	Cylinder recognition sensor system

P1578: Segment Sensor Supply Voltage (warning lamp flashes: 81)

Generation condition		Cylinder recognition sensor supply voltage is above standard value (5 V).
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Cylinder recognition sensor
	Electrical equipment	#320: Cylinder recognition sensor
	Electric circuit diagram	Cylinder recognition sensor system

P1605: ECU System (EEPROM) (warning lamp flashes: 33)

Generation condition		Reading or writing error occurs during access.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Other	Engine electronic control unit

P1606: ECU System (Software) (warning lamp flashes: 33)

Generation condition		- System overload occurs. - Task execution time exceeds limit duration.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Other	Engine electronic control unit

P1700: Torque Cut SW (warning lamp flashes: 86)

Generation condition		Error occurs in comparison with VN ratio.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Normal control is effected.
Inspection	Service data	7F: Torque Cut Switch
	Electronic control unit connector	14 : Torque limit SW
	Electrical equipment	#163: Torque limit switch
	Electric circuit diagram	Torque limit switch system

TROUBLESHOOTING

4. Multi-Use Tester Service Data

NOTE

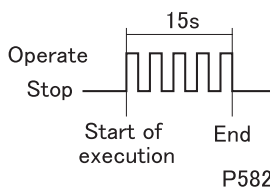
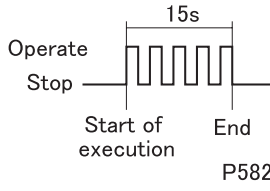
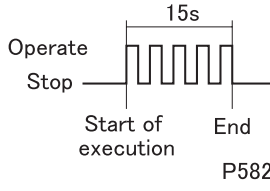
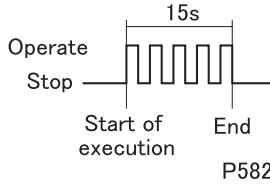
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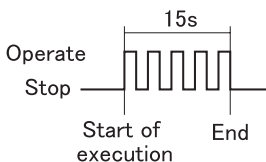
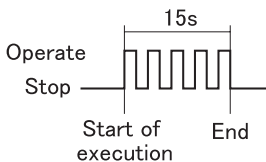
No.	Item	Data	Inspection condition	Requirement
01	Engine Revolution	■■■■.■ .rpm	Racing (engine running)	Value corresponds to tachometer indication.
02	Reference Injection Quantity	■■■■.■ %	Starter switch ON	0 %
0C	Difference Common Rail Pressure	■■■■.■ %	Engine idling	0 % or lower
1F	EGR Position	■■■■.■ %	See Gr17.	—
20	Intake Throttle Position	■■■■.■ %	See Gr17.	—
22	Accel Pedal Position (unfiltered)	■■■■.■ %	Accelerator pedal not depressed	0 %
			Accelerator pedal gradually depressed	Value gradually increases.
			Accelerator pedal fully depressed	100 %
23	Accel Pedal Position (filtered)	■■■■.■ %	Accelerator pedal not depressed	0 %
			Accelerator pedal gradually depressed	Value gradually increases.
			Accelerator pedal fully depressed	100 %
24	Accel Pedal Sensor Voltage 1	■.■■■ V	Accelerator pedal gradually depressed from released position	0.85 to 4.15 V
25	Accel Pedal Sensor Voltage 2	■.■■■ V	Accelerator pedal gradually depressed from released position	0.85 to 4.15 V
26	Boost Pressure	■■■■.■ inHg	High idle	10.3 in.Hg
27	Intake Air Temperature	■■■■.■ °F	Engine cold	Value corresponds to ambient temperature.
35	Water Temperature	■■■■.■ °F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
36	Fuel Temperature (inlet)	■■■■.■ °F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
38	Atmospheric Pressure	■■■■.■ inHg	Altitude: 0 m {0 ft.}	29.8 in.Hg
			Altitude: 600 m {1,970 ft.}	28.1 in.Hg
3B	Idle Volume Voltage	■.■■■ V	SLOW to FAST	2.6 to 1.2 V
3C	Vehicle Speed	■■■■.■ .MPH	Vehicle in motion	Value corresponds to speedometer indication.
3E	Q Adjustment Resistor No.	1/2/3/4/5/6/7/8/9/10/11/NON	—	Number matches number marked on fuel injection rate adjustment resistor.
42	Power Supply Voltage	■■.■■■ V	Starter switch ON	Value matches battery voltage.
71	Starter SW (S)	ON/OFF	Engine cranked by means of starter switch	ON
			Starter switch in position except START	OFF
72	Starter SW (M)	ON/OFF	Starter switch in ON position	ON
			Starter switch in position except ON	OFF
73	Accel SW	ON/OFF	Accelerator pedal depressed	ON
			Accelerator pedal not depressed	OFF

No.	Item	Data	Inspection condition	Requirement
76	Auxiliary Brake SW 1	ON/OFF	- Combination switch ON <manual transmission> - Accelerating <automatic transmission>	ON
			- Combination switch OFF <manual transmission> - Decelerating <automatic transmission>	OFF
78	Clutch SW	ON/OFF	Clutch pedal depressed	ON
			Clutch pedal not depressed	OFF
7A	Neutral SW	ON/OFF	- Transmission in neutral <manual transmission> - Shift lever in D position <automatic transmission>	ON
			- Transmission not in neutral <manual transmission> - Shift lever in N position <automatic transmission>	OFF
7B	Idle Up Cancel SW	ON/OFF	Shift lever in D position <automatic transmission>	ON
			- Continuously <manual transmission> - Shift lever in N position <automatic transmission>	OFF
			[Actuator test] B8: Idle Up Cancel SW	
7C	Air Conditioner SW 1	ON/OFF	Air conditioner compressor running	ON
			Air conditioner compressor not running	OFF
			[Actuator test] B6: Air Conditioner SW 1	
7E	Cold Start SW	ON/OFF	See Gr54.	—
7F	Troque Cut SW	ON/OFF	Transmission in 1st or reverse	ON
			Transmission not in 1st or reverse	OFF
82	PTO SW	ON/OFF	Switch ON	ON
			Switch OFF	OFF
83	Diagnosis SW	ON/OFF	Diagnosis switch OFF (fuse fitted)	ON
			Diagnosis switch ON (fuse removed)	OFF
84	Memory Clear SW	ON/OFF	Memory clear switch OFF (fuse fitted)	ON
		ON/OFF	Memory clear switch ON (fuse removed)	OFF
87	Exhaust Brake M/V 1	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
			[Actuator test] AC: Auxiliary Brake M/V 1	
8C	Auxiliary Brake Indicator Lamp	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
			[Actuator test] AE: Auxiliary Brake Indicator Lamp	
8D	Glow Relay	ON/OFF	See Gr54.	—
8E	Glow Relay Indicator Lamp	ON/OFF	See Gr54.	—
8F	Starter Safety Relay	ON/OFF	See Gr54.	—
90	EDU Power Relay	ON/OFF	See Gr54.	—
91	MIL Lamp	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B3: MIL Lamp	
92	Diagnosis Lamp	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B4: Diagnosis Lamp	

TROUBLESHOOTING

5. Actuator Tests Performed Using Multi-Use Tester

No.	Item	Explanation	Confirmation method
A1	EGR 1	See Gr17.	—
A7	Intake Throttle 1	See Gr17.	—
AC	Auxiliary Brake M/V 1	Exhaust brake 3-way magnetic valve drive signal (Can be executed with engine not running.)  P58223E	Operating sound of magnetic valve [Service data] 87: Exhaust brake M/V 1
AE	Auxiliary Brake Indicator Lamp	Exhaust brake indicator lamp drive signal (Can be executed with engine not running.)  P58223E	ON/OFF condition of indicator lamp [Service data] 8C: Auxiliary Brake Indicator Lamp
AF	Relay for Glow Relay	See Gr54.	—
B0	Glow Indicator Lamp	See Gr54.	—
B1	Starter Safety Relay	See Gr54.	—
B2	EDU Relay	See Gr17.	—
B3	MIL Lamp	Warning lamp (orange) drive signal  P58223E	ON/OFF condition of warning lamp (orange) [Service data] 91: MIL Lamp
B4	Diagnosis Lamp	Warning lamp (orange) drive signal  P58223E	ON/OFF condition of warning lamp (red) [Service data] 92: Diagnosis Lamp

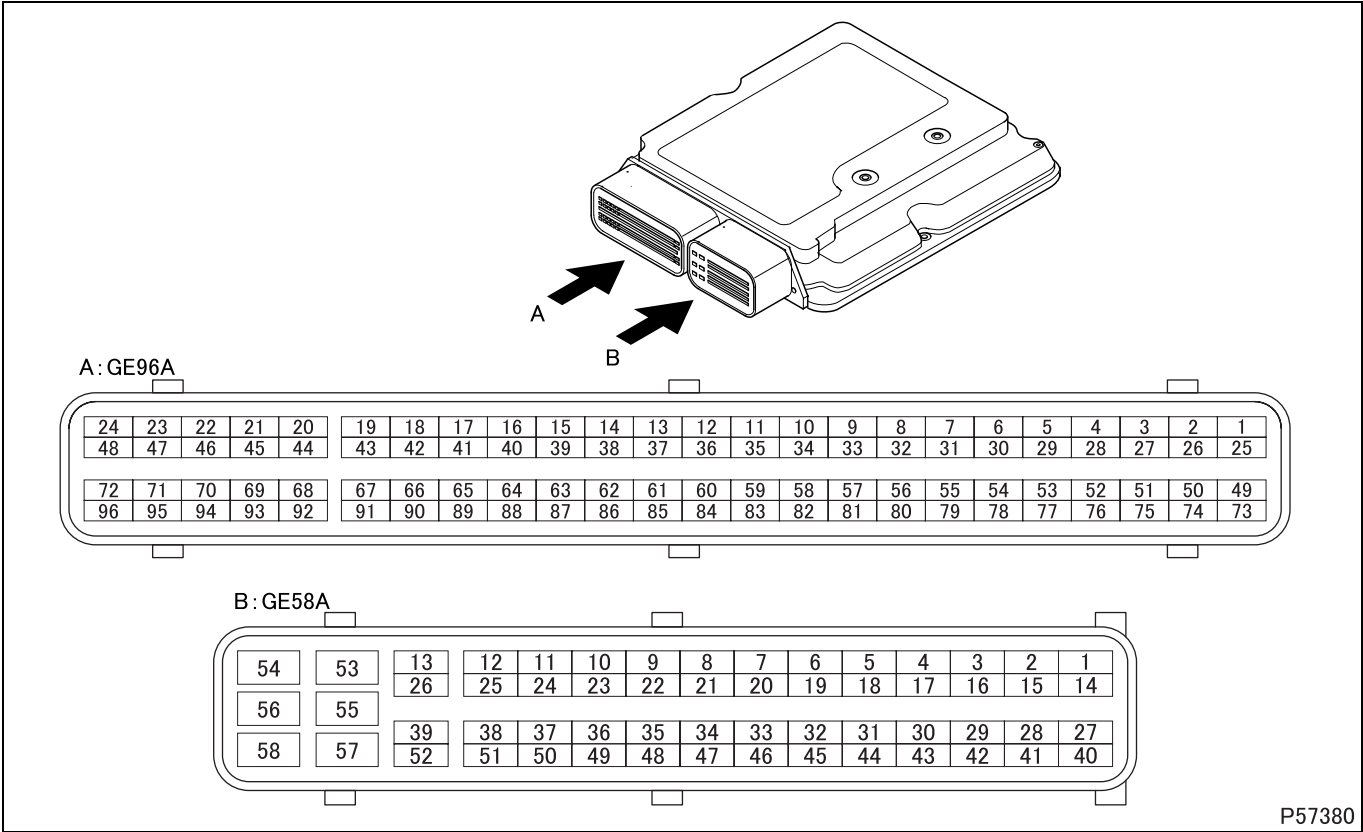
No.	Item	Explanation	Confirmation method
B6	Air Conditioner SW 1	Idle up control reproduced by means of dummy signal (air conditioner operation). (Can be executed with vehicle speed of zero and with transmission in neutral.)  P58223E	Increase in idling speed [Service data] 7C: Air conditioner SW 1
B8	Idle Up Cancel SW	Idle up cancel condition reproduced by means of dummy signal (idle up cancel). (Can be executed with vehicle speed of zero and with transmission in neutral.)  P58223E	Idling speed low idle [Service data] 7B: Idle Up Cancel SW
B9	Fuel Leak Check	Rail pressure increased on constant slope (Can be executed with vehicle speed of zero and transmission in neutral and diagnosis switch open.)	Check that no fuel leaks from fuel system.
BB	Injector Test 1	Injector 1 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease
BC	Injector Test 2	Injector 2 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease
BD	Injector Test 3	Injector 3 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease
BE	Injector Test 4	Injector 4 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease

TROUBLESHOOTING

6. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.
The white-on-black numbers (**01**, **02**, and so on) correspond to the similarly printed reference numbers in section “3. Inspections based on diagnosis codes”.

6.1 Electronic control unit connector terminal layout



6.2 Inspection instructions

CAUTION ⚠

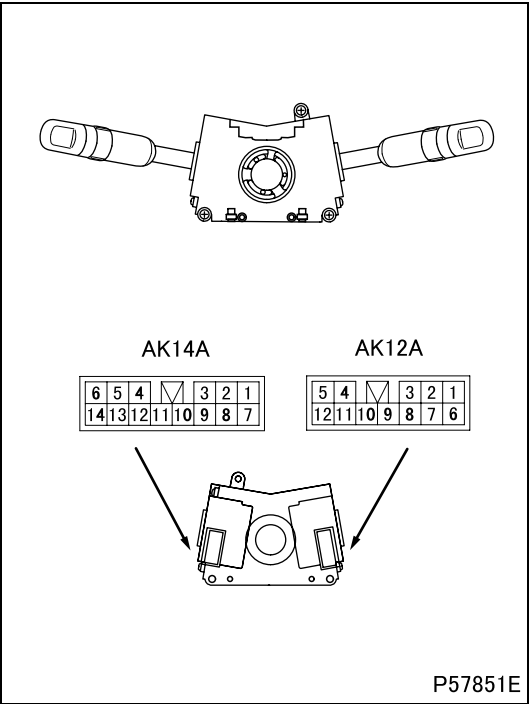
- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:
- Do not touch any terminal except those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.

Check item	Measurement method
01 Resistance of boost air temperature sensor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A63-A32 0°C {32°F}: 15^{+3.78}_{-2.94} kΩ 20°C {68°F}: 6.514^{+1.473}_{-1.147} kΩ 80°C {176°F}: 0.874^{+0.136}_{-0.115} kΩ

Check item	Measurement method
02 Resistance of water temperature sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A40-A41 • 20°C {68°F}: 2.3 to 2.6 kΩ • 80°C {176°F}: 0.30 to 0.34 kΩ
03 Output voltage of accelerator pedal position sensor	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-) B34-B33 and B45 (accelerator pedal position sensor 1) B46-B33 and B45 (accelerator pedal position sensor 2) • With accelerator pedal not depressed: 0.85 ± 0.1 V • With accelerator pedal depressed: 4.15 ± 0.1 V
04 Resistance of fuel temperature sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A89-A65 • 20°C {68°F}: $2.45^{+0.14}_{-0.13}$ kΩ • 80°C {176°F}: 0.318 ± 0.01 kΩ • 110°C {230°F}: 0.1417 ± 0.01 kΩ
05 Resistance of injector magnetic valve	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A72-A23 (injector magnetic valve: No. 1 cylinder) A95-A48 (injector magnetic valve: No. 2 cylinder) A96-A24 (injector magnetic valve: No. 3 cylinder) A71-A46 (injector magnetic valve: No. 4 cylinder) • 0.255 ± 0.04 Ω
06 Resistance of engine speed sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A10-A9 • 860 ± 86 kΩ (20°C {68°F})
07 Resistance of cylinder recognition sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A78-A83 (+5 V to GND) • 200 to 1800 kΩ
08 Output voltage of vehicle speed sensor	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) • Turn wheels slowly using chassis dynamometer. [Requirements] Terminals (+)-(-): A67-chassis earth • High pulse voltage: Approx. 8 ± 1 V • Low pulse voltage: 0.5 V or lower
09 Output voltage of idling speed adjustment potentiometer	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A12-A36 • AUTO position: 4.0 ± 0.1 V • SLOW position: 3.0 ± 0.2 V • FAST position: 1.0 ± 0.1 V

TROUBLESHOOTING

Check item	Measurement method
10 Operating voltage of accelerator pedal switch	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A20-B33 and B45 • With accelerator pedal depressed: 0 V • With accelerator pedal not depressed: 5 V
11 Resistance of fuel injection rate adjustment resistor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A35-A88 • No. 1 resistor: $270 \pm 13.5 \Omega$ • No. 2 resistor: $510 \pm 25.5 \Omega$ • No. 3 resistor: $820 \pm 41 \Omega$ • No. 4 resistor: $1,300 \pm 65 \Omega$ • No. 5 resistor: $2,000 \pm 100 \Omega$ • No. 6 resistor: $3,300 \pm 165 \Omega$ • No. 7 resistor: $5,600 \pm 280 \Omega$ • No. 8 resistor: $15,000 \pm 750 \Omega$ • No. 9 resistor: $390 \pm 19.5 \Omega$ • No. 10 resistor: $4,300 \pm 215 \Omega$ • No. 11 resistor: $9,100 \pm 455 \Omega$
12 Resistance of MPROP (injection quantity adjustment valve)	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A69-A21, A69-A2, A3-A21, A3-A2 2.6 to 3.15Ω
13 Voltage of exhaust brake 3-way magnetic valve	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A76-A6 • With exhaust brake operating: Corresponding to battery voltage • With exhaust brake not operating: 0 V
14 Voltage of torque limit switch	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A92-chassis earth • Transmission in 1st or reverse: Corresponding to battery voltage • Transmission not in 1st or reverse: 0 V

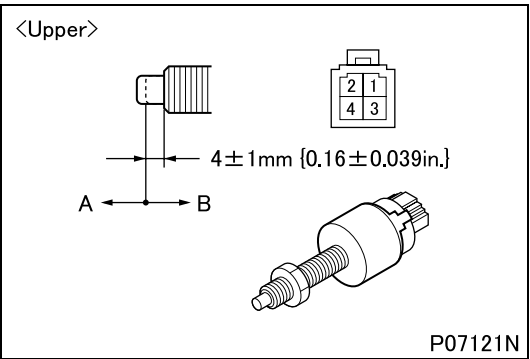


#001 Inspection of combination switch

AK14A connector connection table

Switch position		Terminals with continuity
Exhaust brake switch	OFF	—
	ON	8 - 9

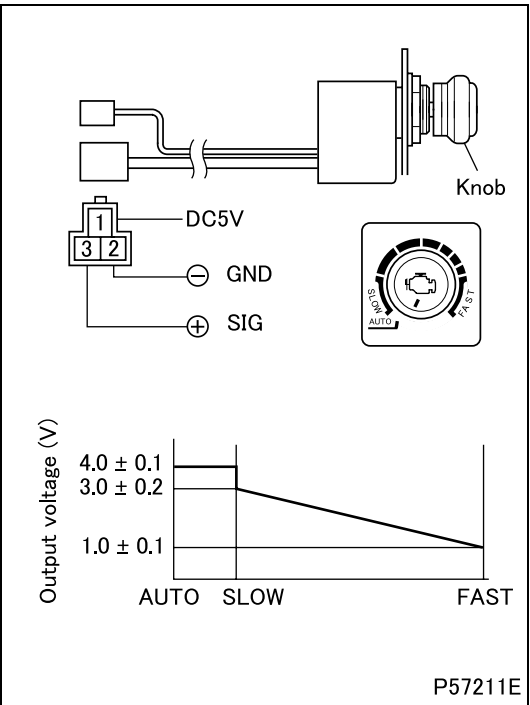
- If there is any abnormality, replace the switch.



#031 Inspection of clutch switch

Switch position	Terminals with continuity
A	1 - 4
B	2 - 3

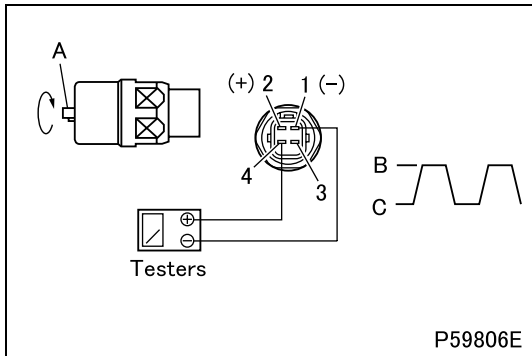
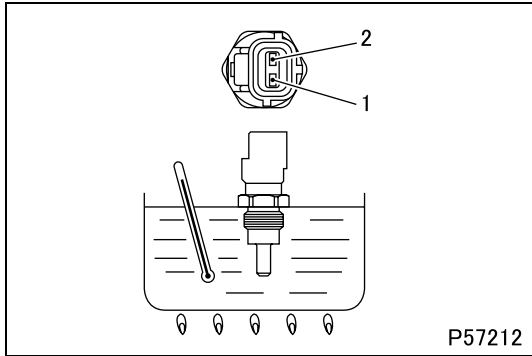
- If there is any abnormality, replace the switch.



#157 Inspection of idling speed adjustment potentiometer

- Apply 5 V DC to terminals 1 and 2 of the idling speed adjustment potentiometer.
- Turn the knob fully counterclockwise. Then, measure the output voltage across terminals 2 and 3 (see the diagrams on the left) while slowly turning the knob clockwise.
- If any measurement is out of specification, replace the idling speed adjustment potentiometer.

Standard value	Knob position	Output voltage
	AUTO (0°)	4.0 ± 0.1 V
	SLOW (30°)	3.0 ± 0.2 V
	FAST (300°)	1.0 ± 0.1 V



Switch position	Terminals with continuity
OFF	–
ON	1 - 2

- ## #262 Inspection of water temperature sensor

- | | | |
|----------------|--------------|-----------------|
| Standard value | 20°C {68°F} | 2.3 to 2.6 kΩ |
| | 80°C {176°F} | 0.30 to 0.34 kΩ |

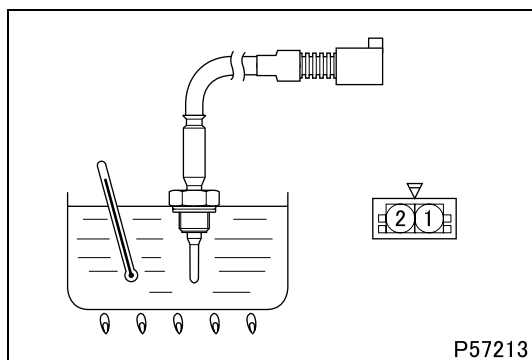
- ## #263 Inspection of engine speed sensor

- | | |
|---------------------------------|------------|
| Standard value (at 20°C {68°F}) | 860 ± 86 Ω |
|---------------------------------|------------|

- ## #265 Inspection of vehicle speed sensor

- | Terminals | Inspection condition | Standard value |
|---------------------------------------|----------------------|----------------|
| 25-pulse output:
terminals 1 and 4 | Low pulse voltage | 0.5 V or lower |
| | High pulse voltage | 8 ± 1 V |

- If any measurement is out of specification, replace the sensor.

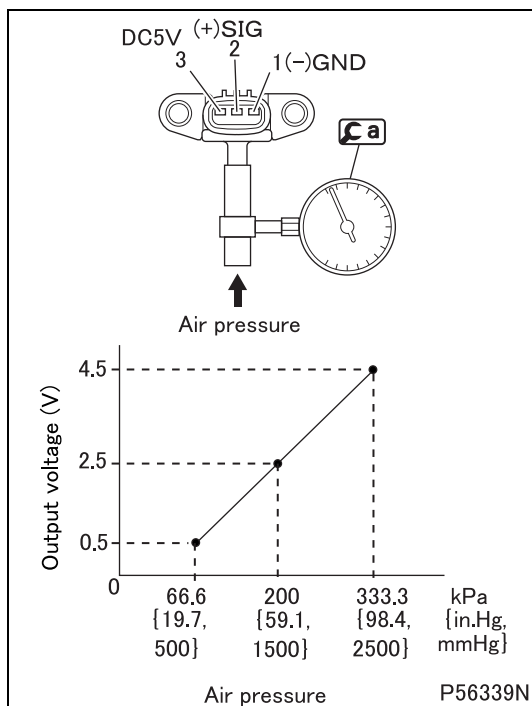


#305 Inspection of boost air temperature sensor

- Place the boost air temperature sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	0°C {32°F}	15 ^{+3.78} / _{-2.94} kΩ
	20°C {68°F}	6.514 ^{+1.437} / _{-1.147} kΩ
	80°C {176°F}	0.874 ^{+0.136} / _{-0.115} kΩ

- If either measurement is out of specification, replace the sensor.



#318 Inspection of boost pressure sensor

- Apply 5 V DC to terminals 3 and 1.
- Apply air pressure A. Gradually increase it and, while doing so, measure the output voltage occurring at terminals 2 and 1 (see the diagram on the left).

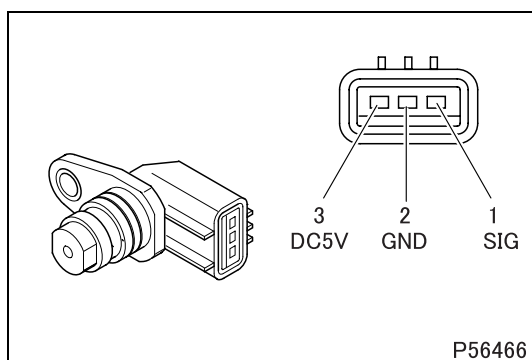
Part	Name and shape of tool	Part No.
a	Pressure gauge	MH061366
	P01524	

Standard value	Air pressure	Voltage
	66.6 kPa {19.7 in.Hg, 500 mmHg}	Approx. 0.5 V
	200 kPa {59.1 in.Hg, 1500 mmHg}	Approx. 2.5 V
	333.3 kPa {98.4 in.Hg, 2500 mmHg}	Approx. 4.5 V

- If any measurement is out of specification, replace the sensor.

#319 Inspection of common rail pressure sensor

- The sensor cannot easily be inspected in isolation, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the common rail.



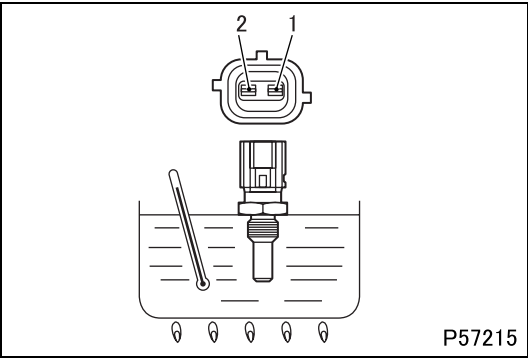
#320 Inspection of cylinder recognition sensor

- Measure the resistance between terminals 2 and 3.

Standard value	200 to 1800 Ω
----------------	---------------

- If the measurement is out of specification, replace the sensor.

INSPECTION OF ELECTRICAL EQUIPMENT



#323 Inspection of fuel temperature sensor

- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	$2.45^{+0.14}_{-0.13} \text{ k}\Omega$
	80°C {176°F}	$0.318 \pm 0.01 \text{ k}\Omega$
	110°C {230°F}	$0.1417 \pm 0.01 \text{ k}\Omega$

- If any measurement is out of specification, replace the sensor.

#324 Inspection of accelerator pedal position sensor

[Inspection]

- Apply 5 V DC to terminals 4 and 2 of the accelerator pedal position sensor.
- Measure the output voltage at terminals 2 and 5 (sensor 1) and the output voltage at terminals 1 and 2 (sensor 2) with the accelerator lever in each specified position.

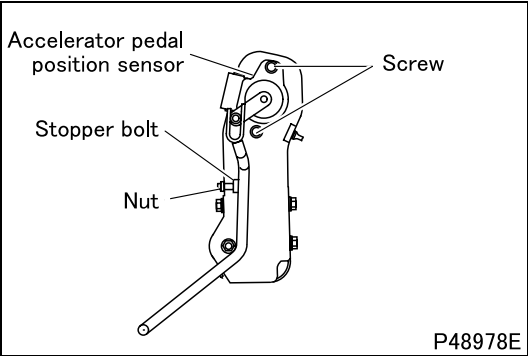
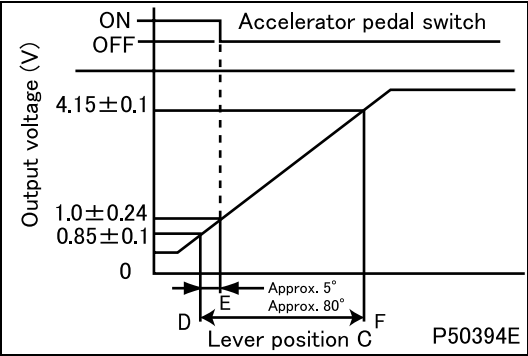
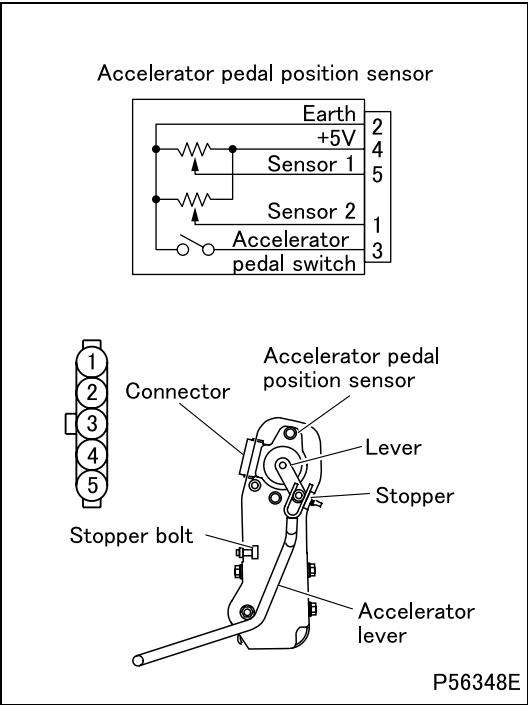
Standard value	Accelerator lever position	Output voltage
	Idling position A	$0.85 \pm 0.1 \text{ V}$
	Accelerator pedal switch operating position B	$1.0 \pm 0.24 \text{ V}$
	Full load position C	$4.15 \pm 0.1 \text{ V}$

A: Position in which accelerator lever is touching stopper

B: Position at which continuity between terminals 2 and 3 disappears as accelerator pedal is pushed downward

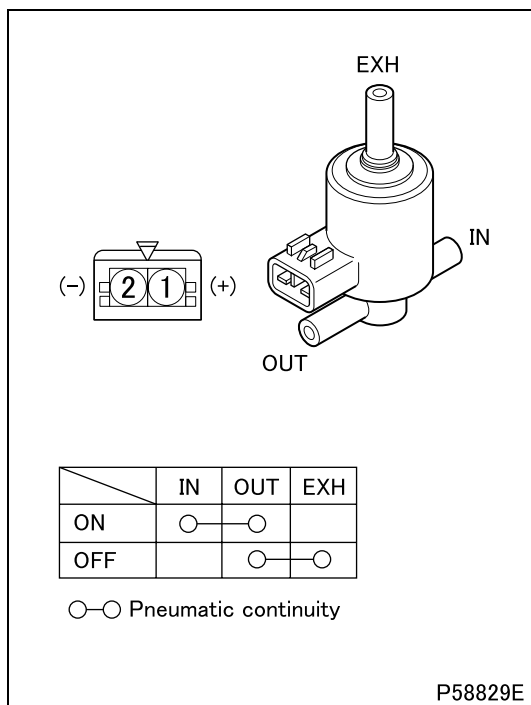
C: Position in which accelerator lever is touching stopper bolt

- If any output voltage is out of specification, make an adjustment.
- If any output voltage is still out of specification when you have made an adjustment, replace the sensor.



[Adjustment]

- To adjust the output voltage for the idling position A, loosen the screws and move the accelerator pedal position sensor. Tighten the screws after making the adjustment.
- To adjust the output voltage for the full load position C, loosen the nut and make the adjustment using the stopper bolt. After making the adjustment, lock the stopper bolt in position with the nut.



#565 Inspection of exhaust brake 3-way magnetic valve

- Perform the following checks. If there is any abnormality, replace the exhaust brake 3-way magnetic valve.

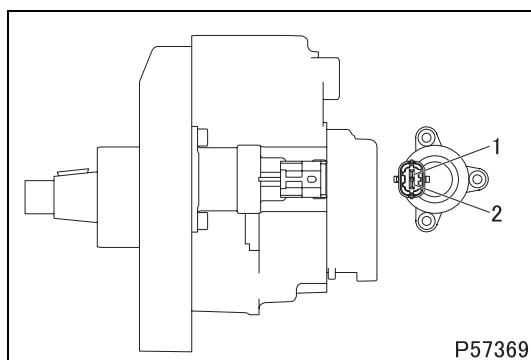
(1) Check of operation

- Gradually increase from zero the voltage applied to terminals 1 and 2.
- Observe the voltage when the exhaust brake 3-way magnetic valve operates.
(Determine the magnet valve's OFF-ON operation from the operating sound.)

Standard value (min. operating voltage)	11 V or lower
---	---------------

(2) Check of continuity and airtightness

- Vacuum pressure applied during check:
-100 kPa {-29.5 in.Hg, -750 mmHg}



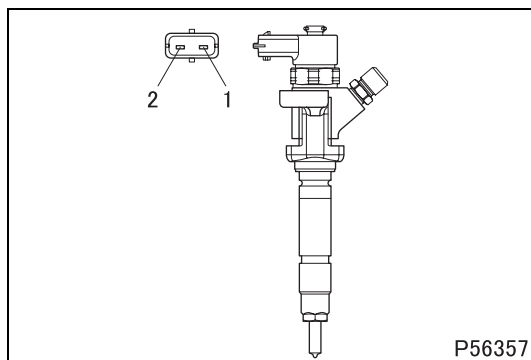
#574 Inspection of MPROP

(injection quantity adjustment valve)

- Measure the resistance between terminals 1 and 2.

Standard value	2.6 to 3.15 Ω
----------------	---------------

- If the measurement is out of specification, replace the supply pump.



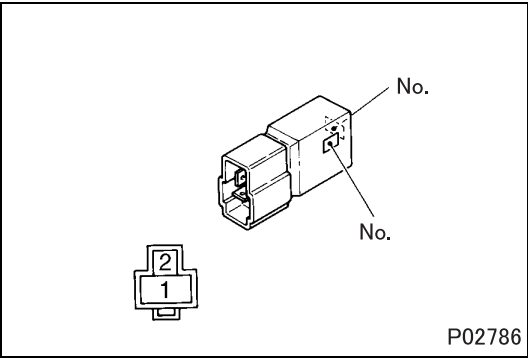
#582 Inspection of injector magnetic valve

- Measure the resistance between terminals 1 and 2.

Standard value (at 20°C {68°F})	0.255 ± 0.04 Ω
---------------------------------	----------------

- If the measurement is out of specification, replace the injector.

INSPECTION OF ELECTRICAL EQUIPMENT



#828 Inspection of fuel injection rate adjustment resistor

- Measure the resistance of the resistor number marked on the fuel injection rate adjustment resistor.

Standard value (at 20°C {68°F})	Resistor No.	1	270 ± 13.5 Ω
		2	510 ± 25.5 Ω
		3	820 ± 41 Ω
		4	1300 ± 65 Ω
		5	2000 ± 100 Ω
		6	3300 ± 165 Ω
		7	5600 ± 280 Ω
		8	15000 ± 750 Ω
		9	390 ± 19.5 Ω
		10	4300 ± 215 Ω
		11	9100 ± 455 Ω

- If the measurement is out of specification, replace the fuel injection rate adjustment resistor with one that has the same resistor number and same specified resistance.

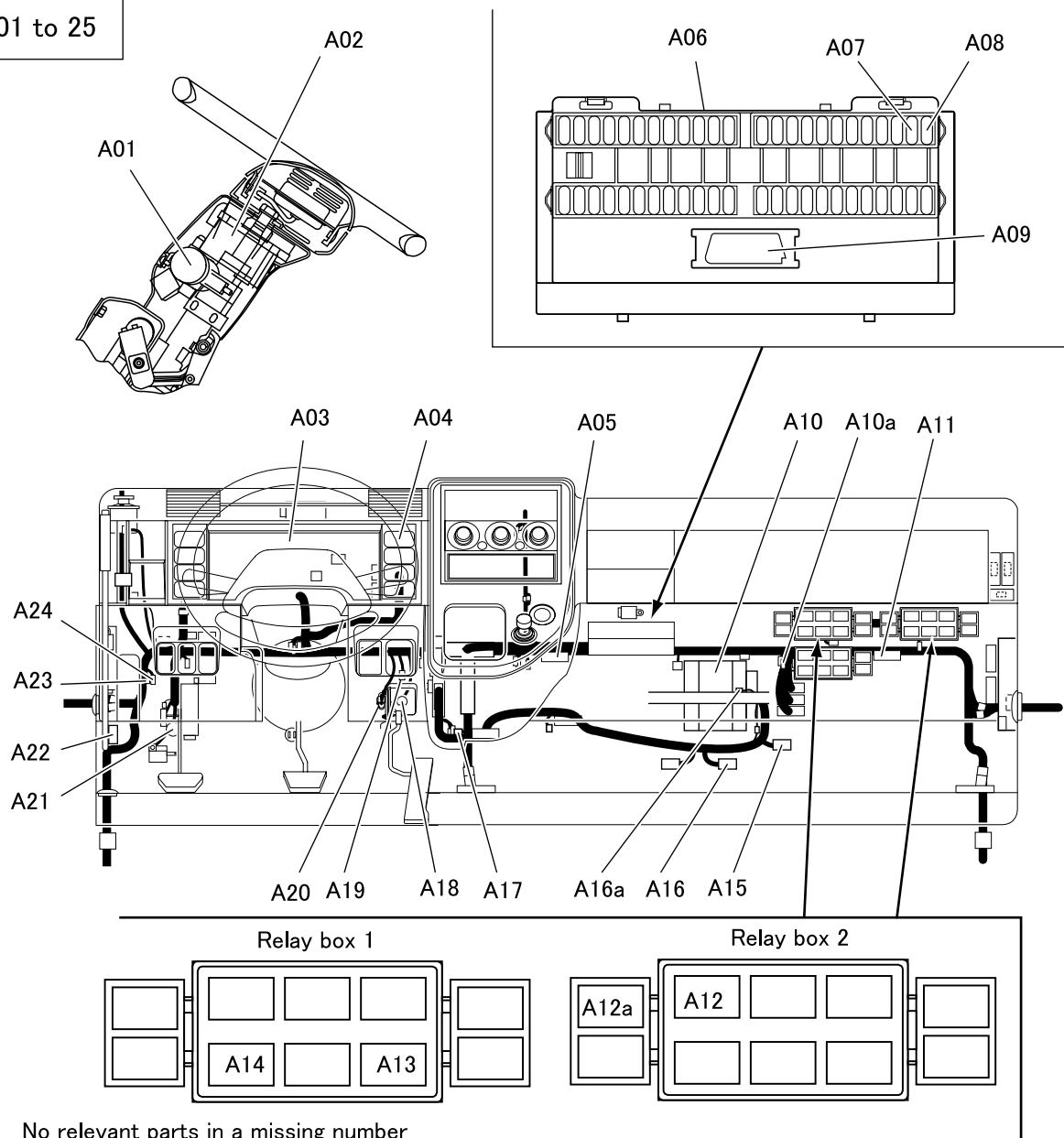
CAUTION ⚠

- The fuel injection rate adjustment resistor is matched to the engine. If you replace it, be sure to replace it with one that has the same resistor number.

M E M O

INSTALLED LOCATIONS OF PARTS

A01 to 25



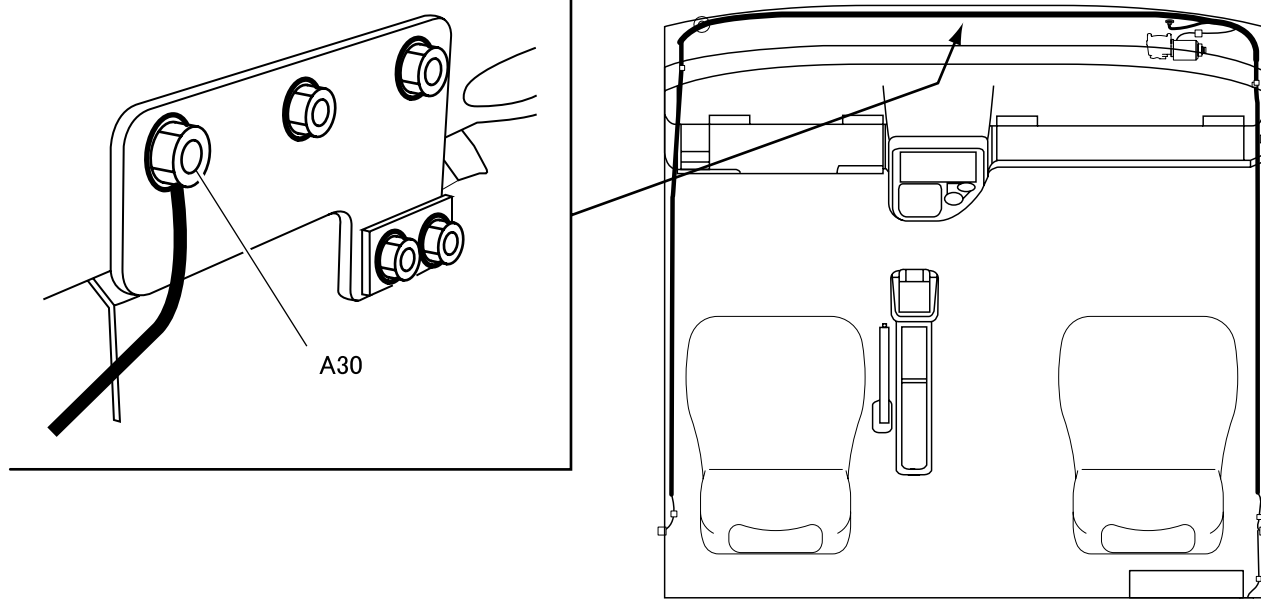
No relevant parts in a missing number

- | | | | |
|------|---|------|---|
| A01 | Starter switch | A16 | Resister unit |
| A02 | Combination switch | A16a | Ground |
| A03 | Meter cluster | A17 | Diode |
| A04 | Warm-up switch | A18 | Idling speed adjustment potentiometer |
| A05 | Joint connector (J/C-1) | A19 | PTO resistor |
| A06 | Fuse box | A20 | Accelerator pedal position sensor |
| A07 | Diagnosis switch | A21 | Clutch switch |
| A08 | Memory clear switch | A22 | Multi-use tester-III connector (for inspection) |
| A09 | Multi-use tester-III connector (for recorder) | A23 | Fuel injection rate adjustment resistor |
| A10 | Engine ECU | | |
| A10a | Diode | | |
| A11 | Joint connector (J/C-2, 3) | | |
| A12 | ABS exhaust brake cut relay | | |
| A12a | Engine start relay | | |
| A13 | Exhaust brake cut relay <A/T> | | |
| A14 | Safety relay | | |
| A15 | Joint connector (J/C-4) | | |
- ABS : Anti-lock brake system
 A/T : Automatic transmission
 ECU : Electronic control unit
 PTO : Power take-off

L00182

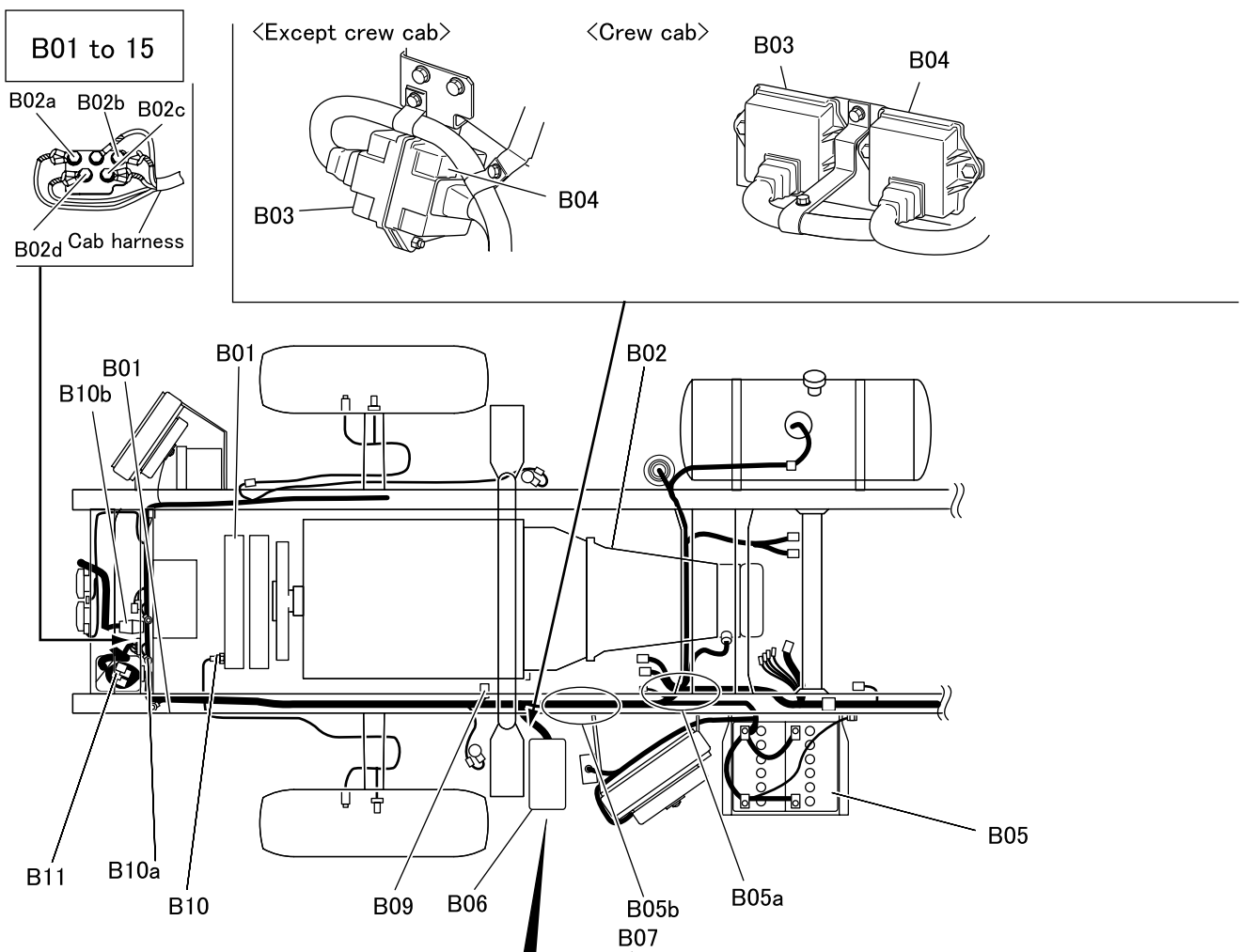
A30

<Inside of instrument panel>



A30 Ground

INSTALLED LOCATIONS OF PARTS



No relevant parts in a missing number

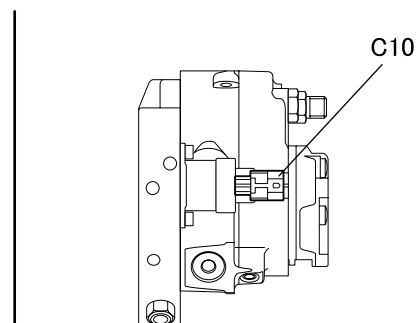
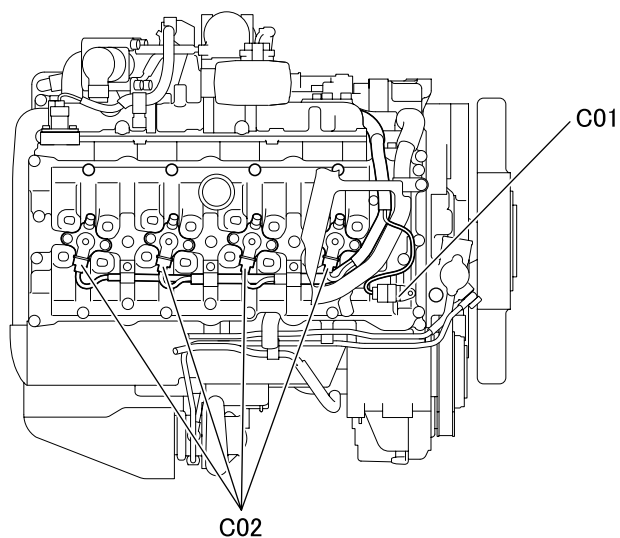
- B01 Hydraulic unit
- B01a Ground
- B02 Exhaust brake 3-way magnetic valve
- B02a Ground
- B02b Throttle EDU
- B02c EGR EDU
- B02d Cab harness
- B03 Throttle EDU
- B04 EGR EDU
- B05 Battery
- B05a JOINT3
- B05b JOINT2
- B06 High-current fuse box
- B07 High-current fuse
- B08 EDU relay
- B09 Joint connector
- B10 Boost air temperature sensor
- B10a Ground
- B10b Connection of cab harness and engine harness
- B11 Connection of chassis harness and cab harness or engine harness

EGR : Exhaust-gas recirculation
EDU : Electronic drive unit

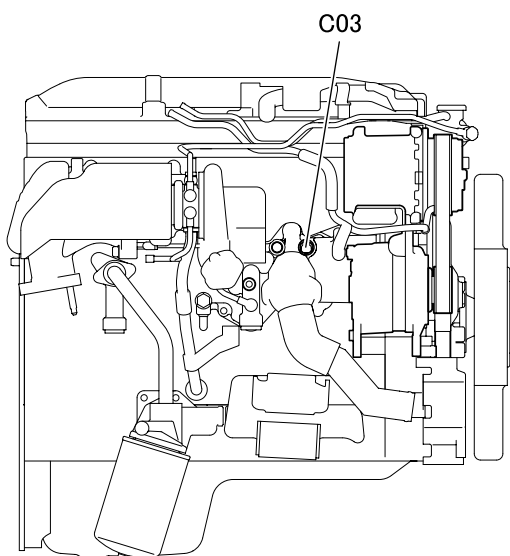
L00184

C01 to 10

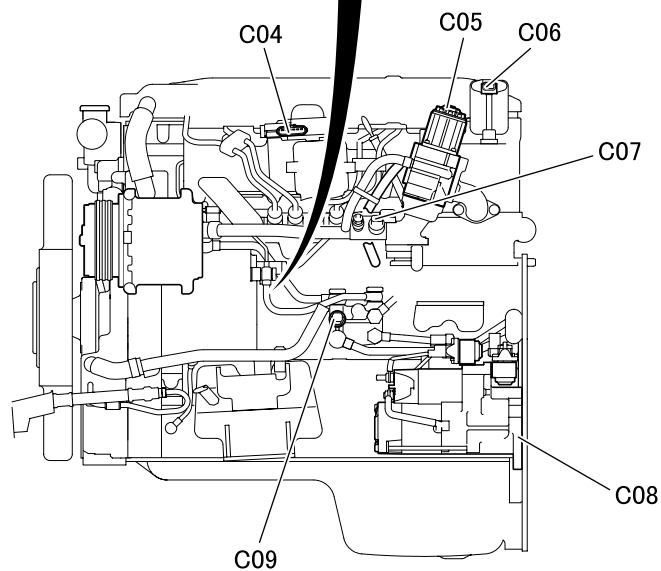
Upper view



Right side view



Left side view



C01 Cylinder recognition sensor

C02 Injector

C03 Water temperature sensor
(Connects to engine ECU)C04 Throttle actuator
(Building into motor, position sensor)C05 EGR valve
(Building into motor, position sensor)

C06 Boost pressure sensor

C07 Common rail pressure sensor

C08 Starter

C09 Fuel temperature sensor

C10 MPROP (Injection quantity adjustment valve)

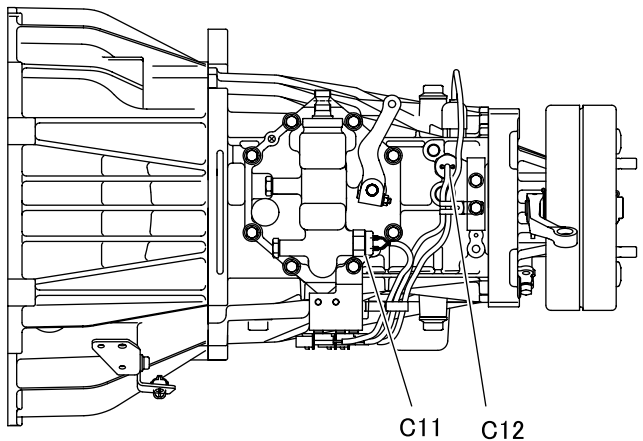
ECU : Electronic control unit

INSTALLED LOCATIONS OF PARTS

C11 to 15

Manual transmission

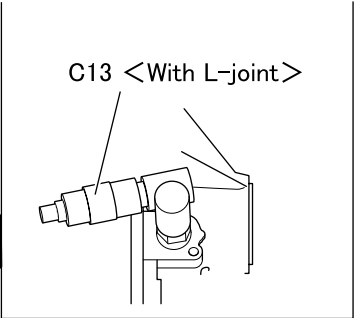
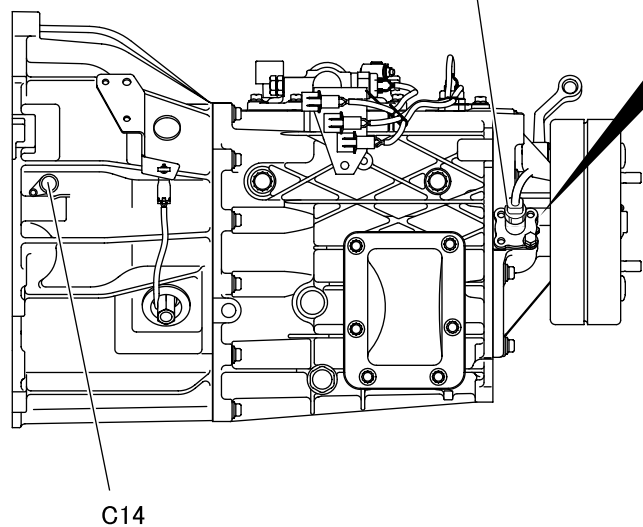
Upper view



No relevant parts in a missing number

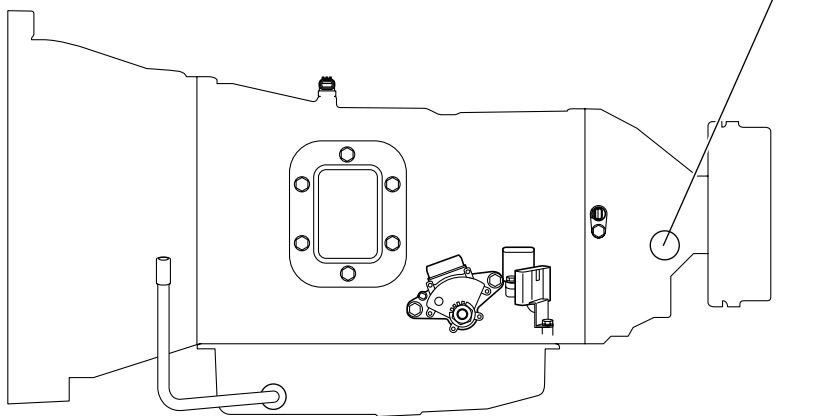
- C11 Transmission neutral switch
- C12 Torque limit switch
- C13 Vehicle speed sensor
- C14 Engine speed sensor

Left side view



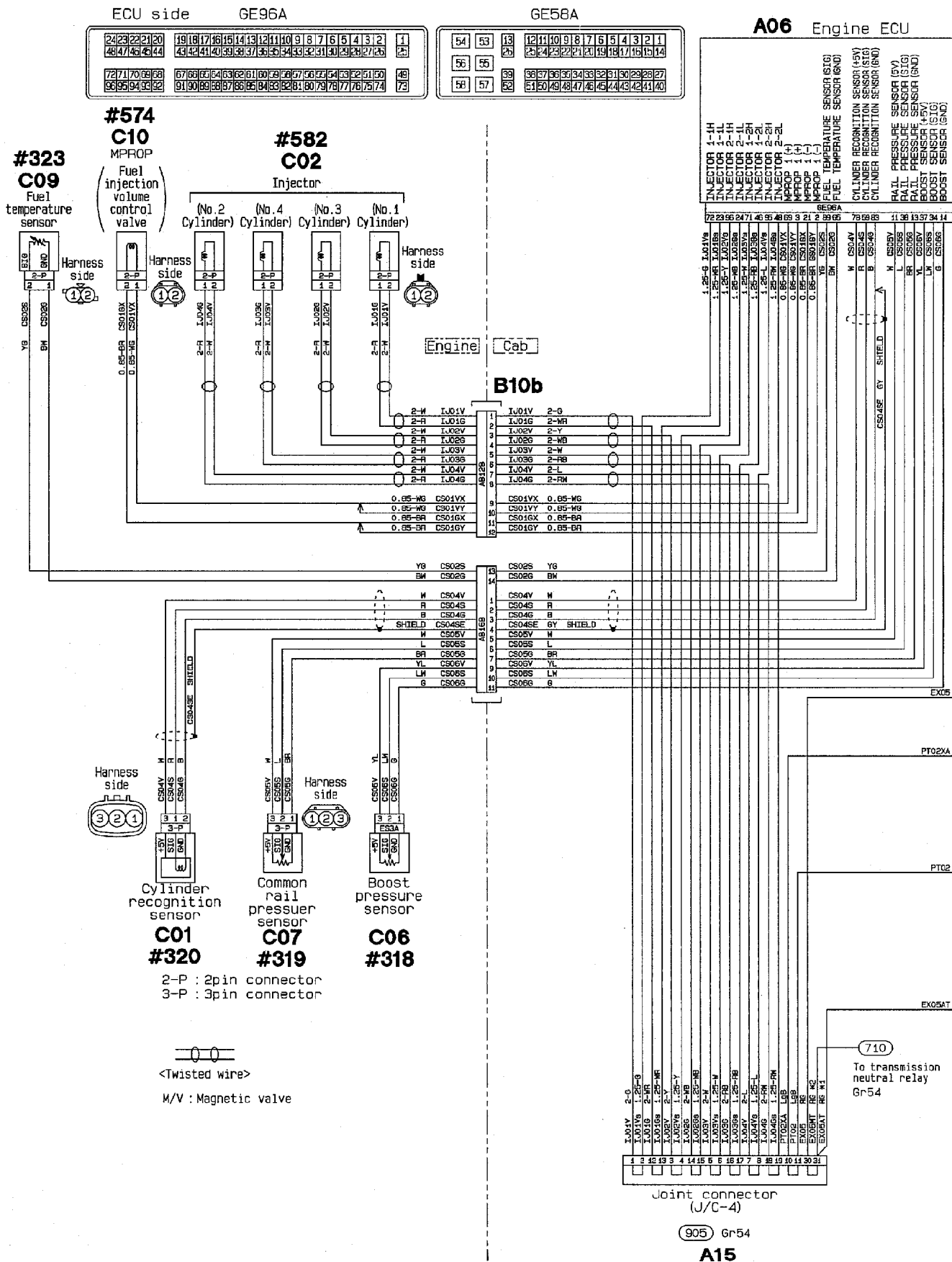
Automatic transmission

Left side view

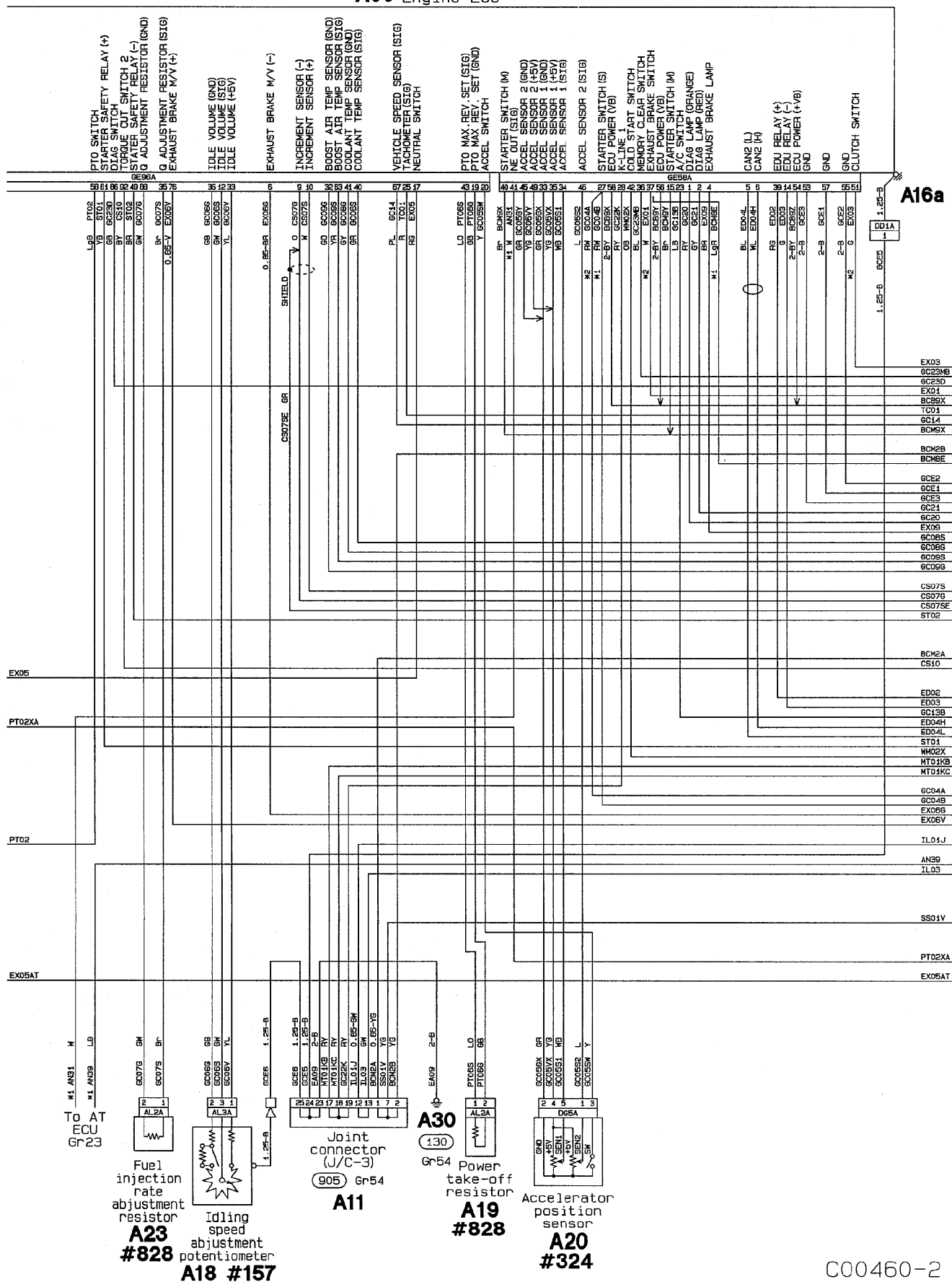


M E M O

ELECTRIC CIRCUIT DIAGRAM

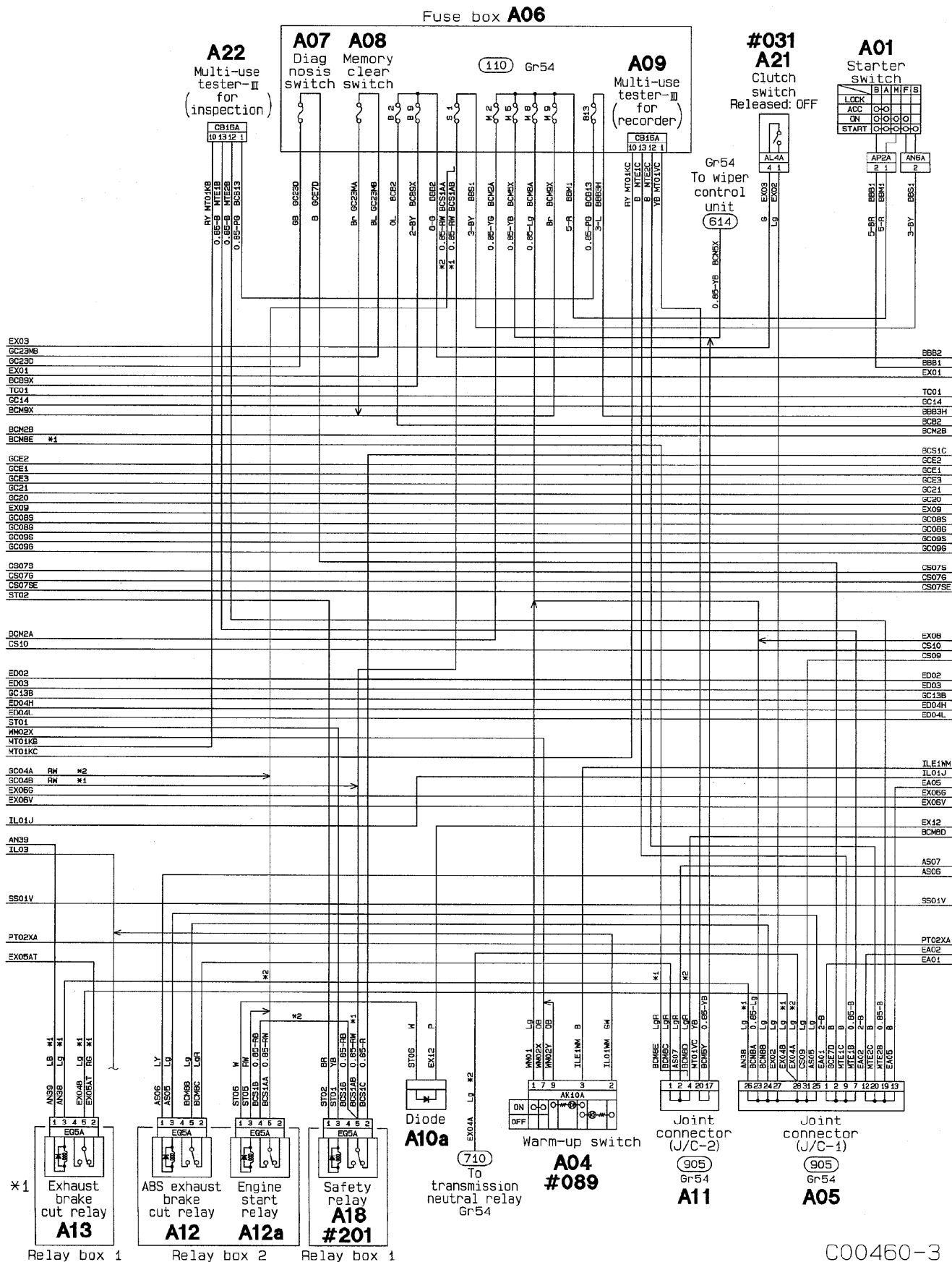


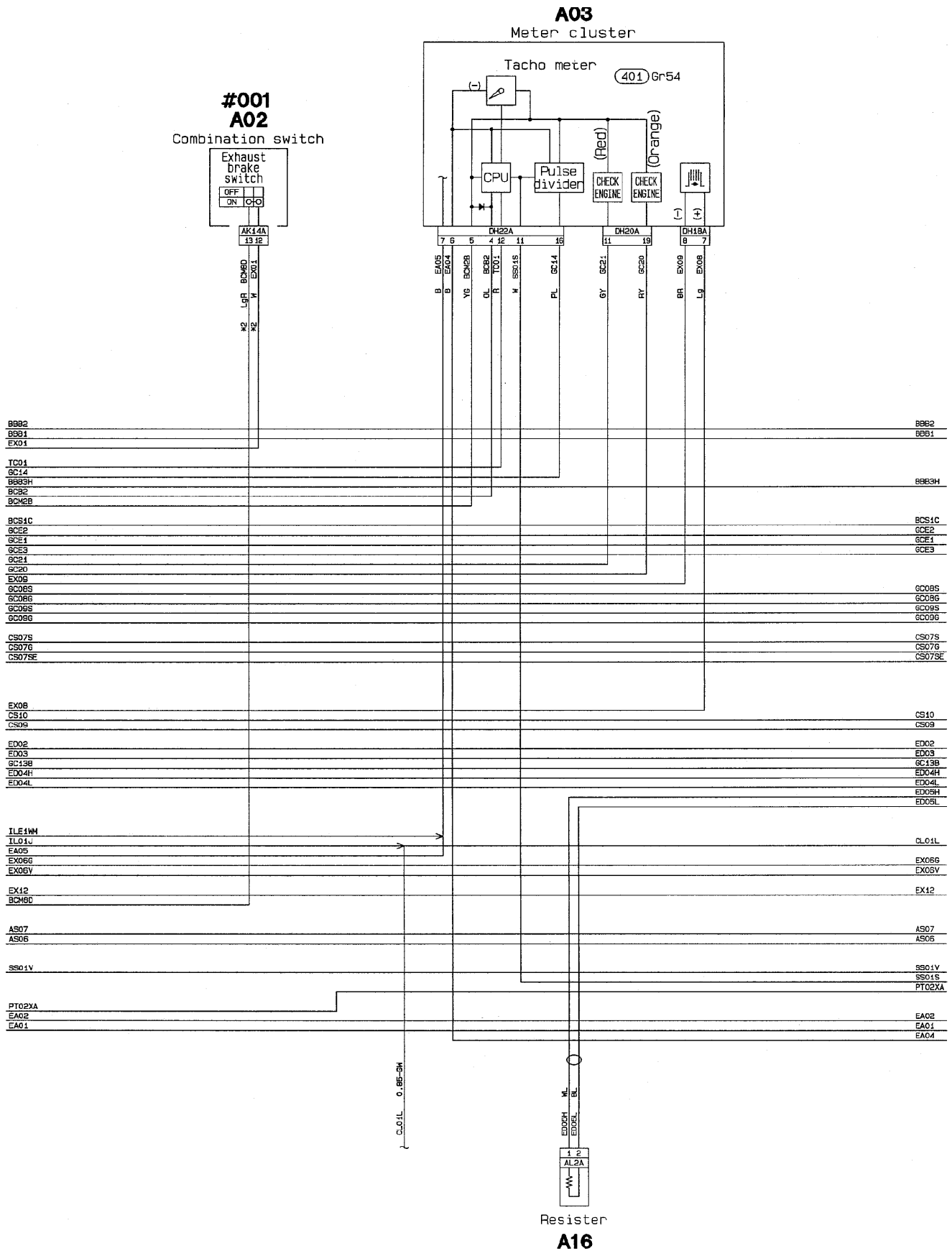
A06 Engine ECU



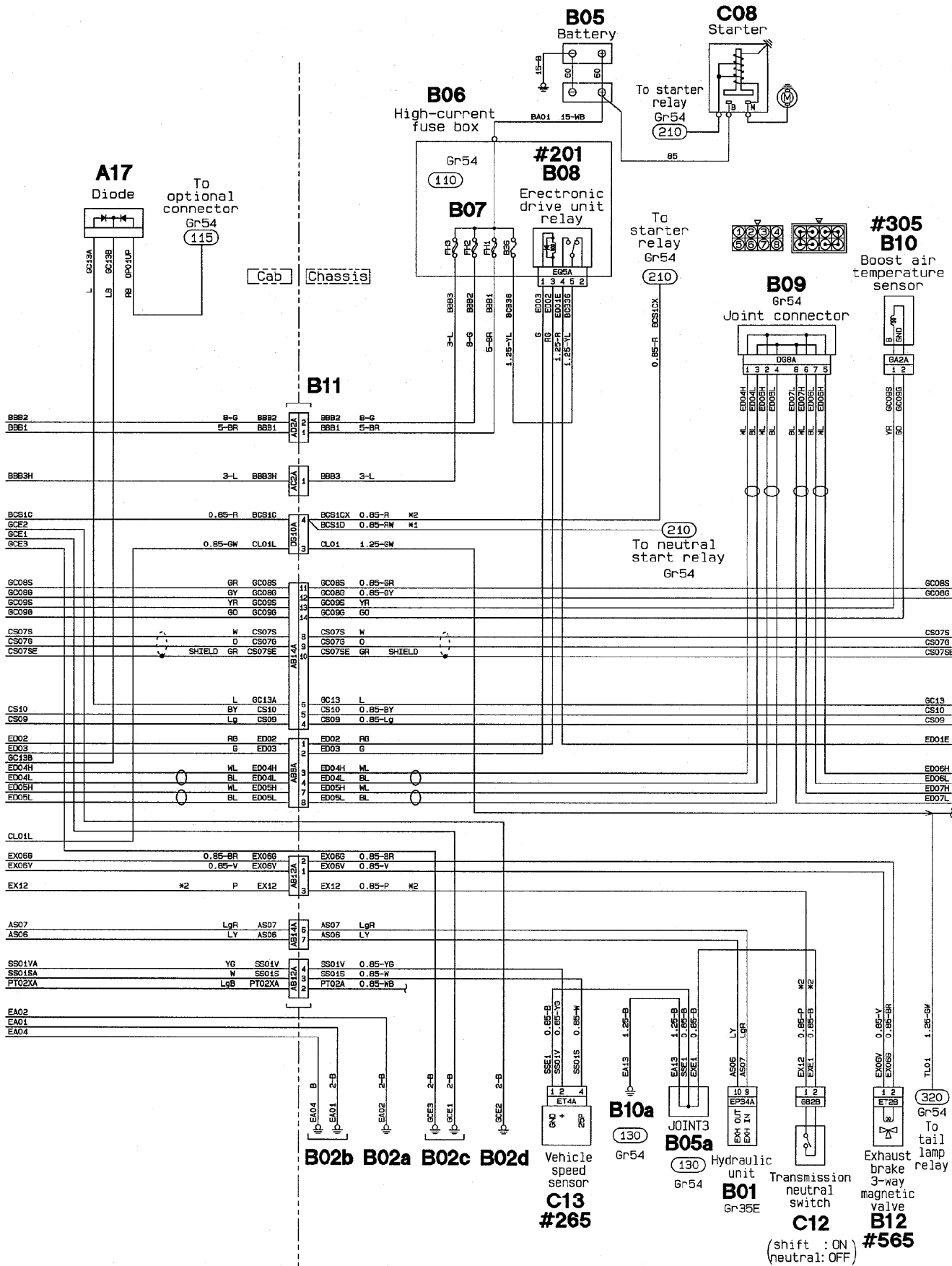
C00460-2

ELECTRIC CIRCUIT DIAGRAM

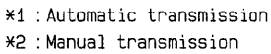




ELECTRIC CIRCUIT DIAGRAM



C00460-5





Group 14

Cooling

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	14-2
STRUCTURE AND OPERATION	
1. Cooling System (Flow of Coolant).....	14-4
2. Thermostat.....	14-5
3. Water Pump	14-5
TROUBLESHOOTING.....	14-6
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Coolant Replacement and Cleaning of Cooling System	14-8
2. Air Bleeding of Cooling System	14-10
3. Air/Gas Leakage Test	14-10
DISCONNECTION AND CONNECTION OF HOSES AND PIPES ...	14-12
RADIATOR.....	14-16
COOLING FAN, V-BELT AND WATER PUMP.....	14-24
TENSION PULLEY	14-27
THERMOSTAT	14-28
PRESSURE CAP AND WATER OUTLET CASE	14-30

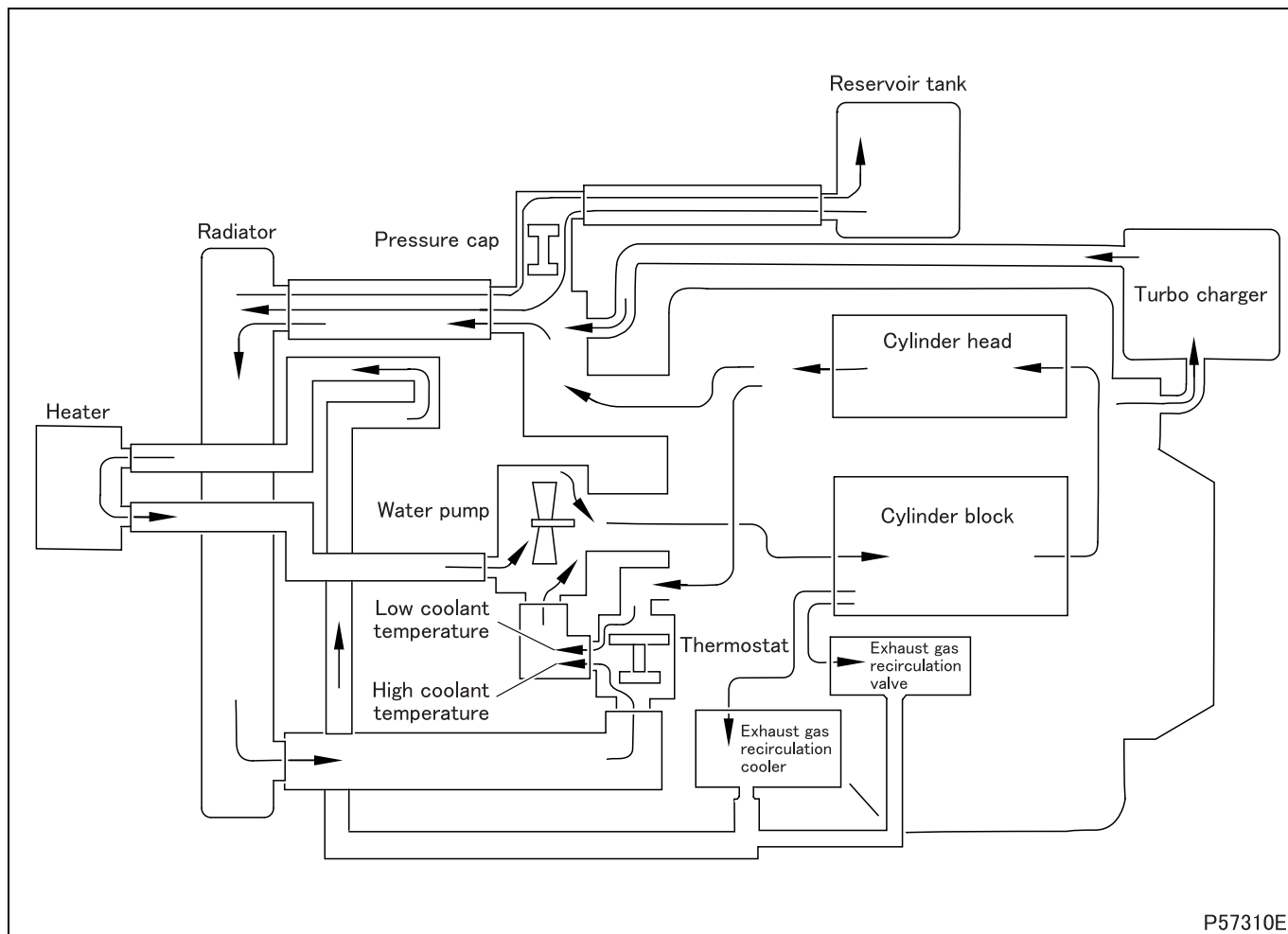
SPECIFICATIONS

Item	Specifications
Cooling system	Forced water circulation system
Water pump	Belt-driven involute type
Thermostat	Wax pellet, bottom bypass type (with jiggle valve)
Automatic cooling fan coupling	Continuous control type
Radiator	Tube and corrugated fin type
Coolant capacity	L {qts} 16.0 {17}

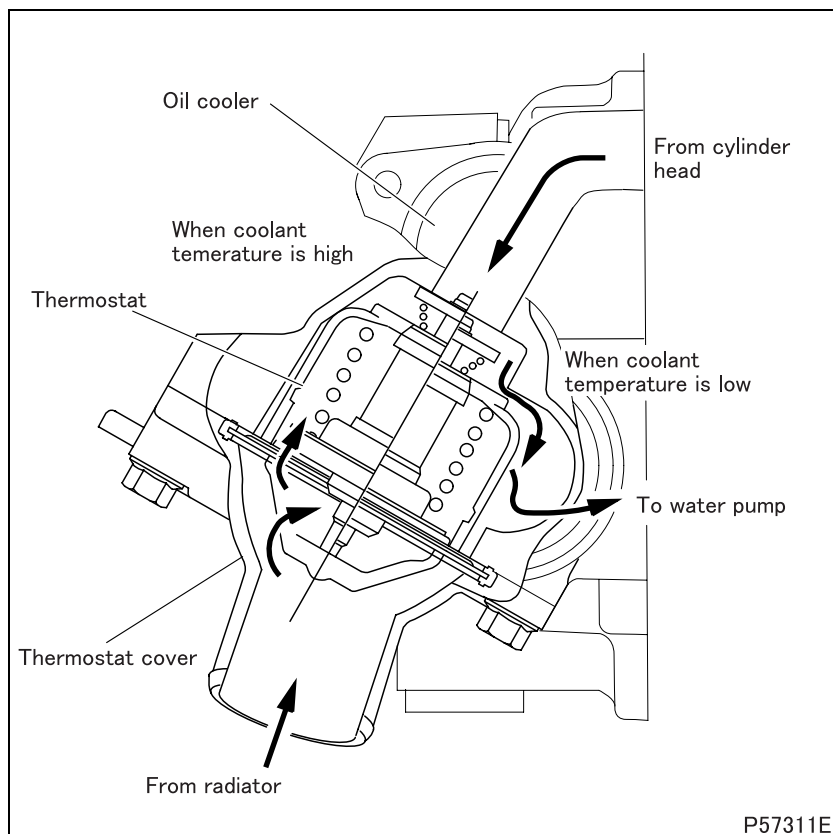
M E M O

STRUCTURE AND OPERATION

1. Cooling System (Flow of Coolant)

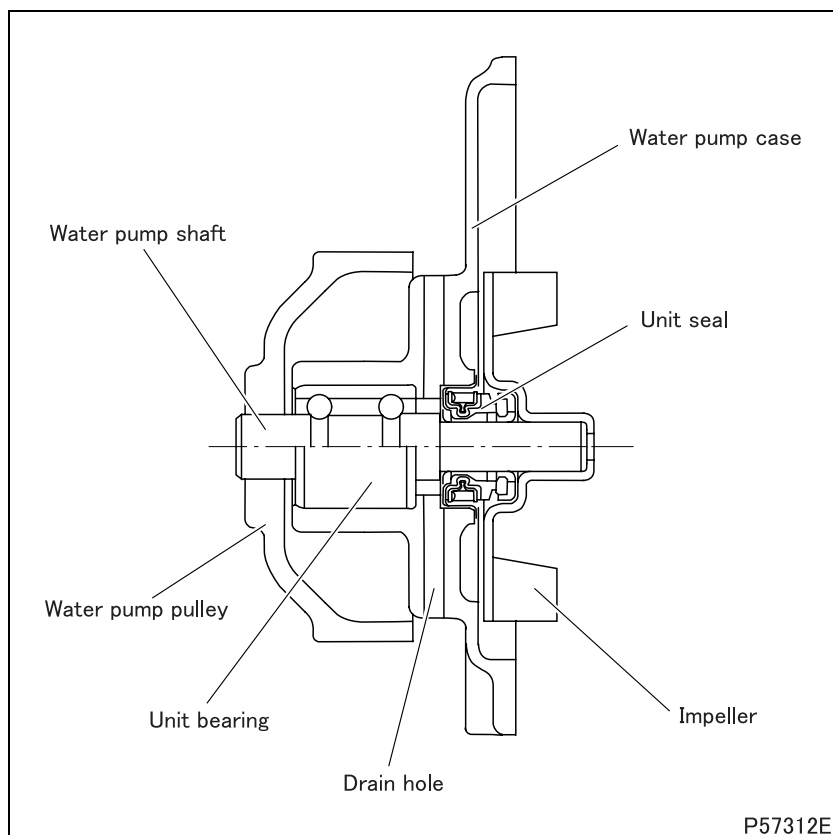


2. Thermostat



- It is a bottom bypass type that uses a wax-filled pellet as its flow-regulating element. When the wax is heated, it melts from solid to liquid, changing its total volume. This allows the valve to open or close in accordance with the coolant temperature, regulating and adjusting the flow of coolant to the radiator and to the cylinder head (bypassing the radiator).

3. Water Pump



- The water pump has a drain hole to prevent coolant from entering the unit bearing in the case of defect of the unit seal.

TROUBLESHOOTING

Symptoms		Overheating (poor cooling)	Overcooling	Abnormal noise	Excessive coolant loss	Reference Gr
Possible causes						
V-belt	Loose or damaged	O		O		
	Excessive tension			O		
	Oil on belt	O				
Water pump	Incorrectly mounted water pump	O			O	
	Defective gasket	O			O	
	Defective unit bearing	O		O		
	Defective impeller	O				
	Defective unit seal	O			O	
	Too loose fit of unit bearing on flange and impeller	O		O		
Thermostat	Incorrectly mounted case	O			O	
	Valve opening temperature too high (valve remains closed)	O				
	Valve opening temperature too low (valve remains open)		O			
Radiator	Clogged core	O				
	Cracked core and/or separation in welds	O			O	
	Cracks in upper tank and/or lower tank	O			O	
	Poor clinching of upper tank and/or lower tank	O			O	
	Defective packing of upper tank and/or lower tank	O			O	
Automatic cooling fan coupling	Defective bearing	O		O		
	Damaged bimetal	O				
	Contaminated bimetal	O	O			
	Silicon oil leakage	O		O		
Cylinder head	Incorrectly mounted cylinder head	O			O	Gr11
	Defective gasket	O			O	
Oil cooler	Incorrectly mounted oil cooler	O			O	Gr12
	Defective gasket	O			O	
	Leakage from coolant temperature sensor	O			O	
Exhaust gas recirculation system	Poor installation of exhaust gas recirculation cooler bracket	O			O	Gr17
	Poor installation of exhaust gas recirculation cooler	O			O	
	Poor installation of connectors	O			O	
	Poor installation of adapter	O			O	
	Damaged O-rings	O			O	

Possible causes		Symptoms				Reference Gr
		Overheating (poor cooling)	Overcooling	Abnormal noise	Excessive coolant loss	
Breather cover	Poor installation of breather cover	O			O	Gr17
	Poor installation of gaskets	O			O	
	Damaged O-rings	O			O	
Poorly airtight pressure cap		O				
Insufficient coolant amount		O				
Clogged or scaled coolant passage		O				
Incorrectly connected hoses		O			O	
Poor installation of pipes		O			O	
Excessively low exterior temperature			O			

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Coolant Replacement and Cleaning of Cooling System

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

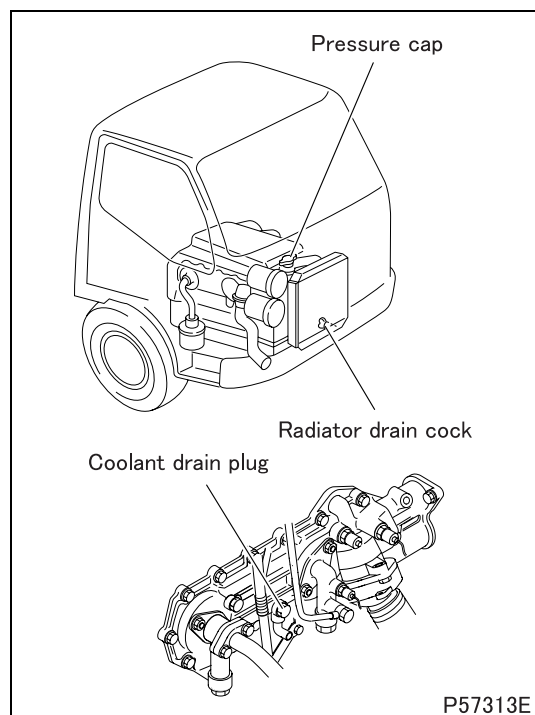
Mark	Parts to be tightened	Tightening torque	Remarks
–	Radiator drain cock	15 ± 0.3 { 1.1 ± 0.2 , 0.15 ± 0.03 }	–
–	Water drain plug	24.5 ± 4.9 { 18 ± 3.6 , 2.5 ± 0.5 }	–

- Using the radiator for extended periods of time without cleaning can increase chance of rust and scale formation, which may cause engine overheating. The cooling system must be cleaned periodically.

NOTE

- Coolants containing FUSO DIESEL LONGLIFE COOLANT require replacement every two years. This replacement interval can be extended to a maximum of six years by adding FUSO DIESEL LONGLIFE COOLANT ADDITIVE to the coolant once every year for the four years following the first two-year limit. For instructions on the use of this product, refer to the Owner's Handbook.

1.1 Draining of coolant



- Before draining the coolant, loosen the pressure cap to reduce the pressure in the cooling system. Remember to drain the coolant out of the reservoir tank as well.

WARNING ⚠

- Drain the coolant only after it has cooled sufficiently to avoid getting scalded.
- Opening the pressure cap while the coolant temperature is still high can cause hot coolant to spray out. Cover the pressure cap with a cloth, and loosen it slowly to let the pressure out before opening it fully.

1.2 Cleaning procedure

- Keep the coolant temperature at approximately 90°C {195°F} so that the thermostat valve remains open and the coolant continues to circulate in the radiator.
- For the sake of convenience you can raise the coolant temperature quickly by covering the front of the radiator with corrugated cardboard or something similar.
- Set the temperature adjusting lever of the heater controller at maximum so that the coolant can circulate freely in the heater piping area.
- In cases where a great amount of rust has accumulated it often happens that as a result of cleaning the radiator starts leaking. Conduct a thorough check for leakage after cleaning.
- Soft water to be used should have the following properties.

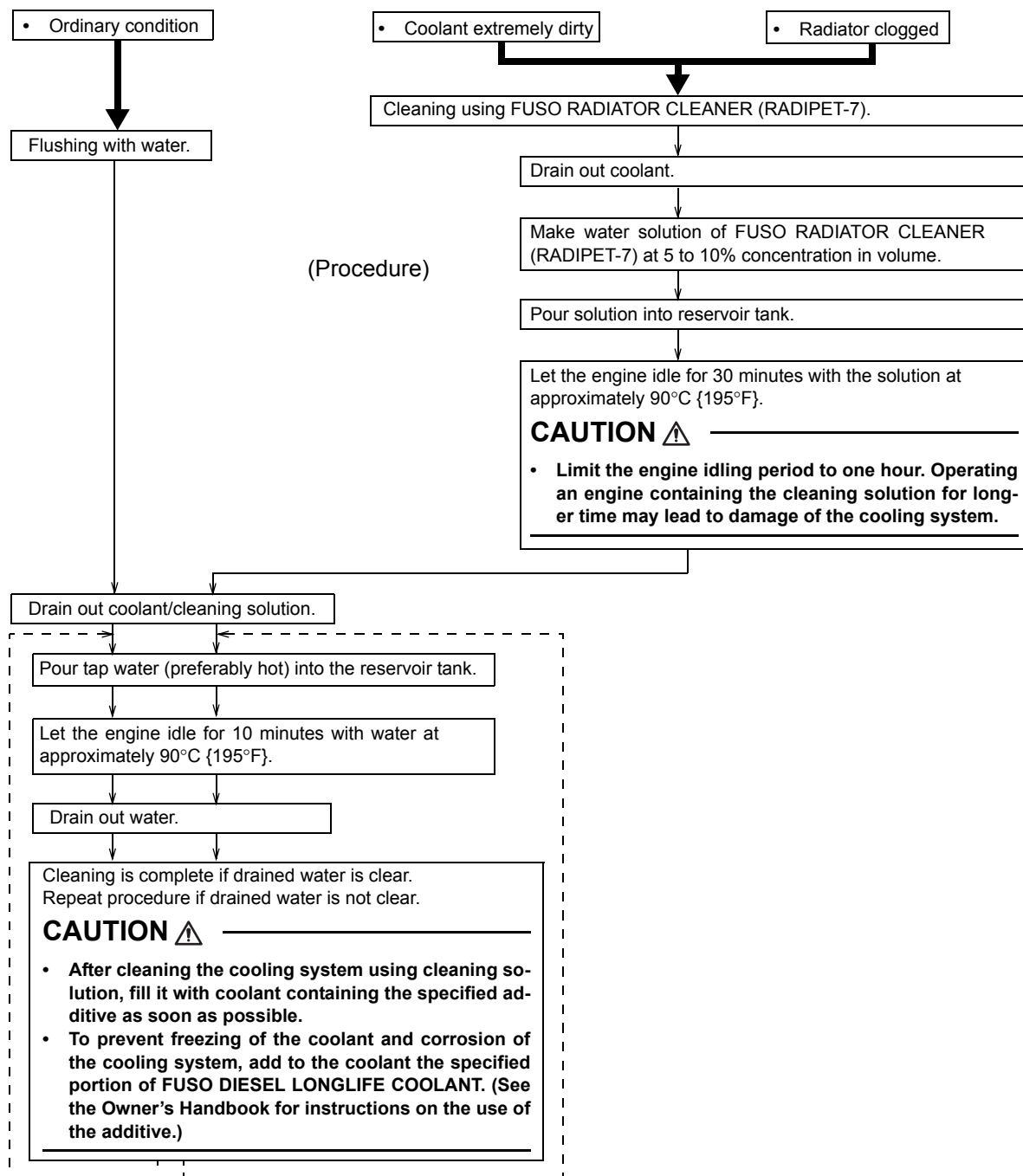
CAUTION ⚠

- Do not use hard water as it causes scale and rust.

Required properties of soft water

Total hardness	300 ppm or less
Sulfate SO_4^-	100 ppm or less
Chloride Cl^-	100 ppm or less
Total dissolved solids	500 ppm or less
pH	6 to 8

- Select an appropriate cleaning method according to the condition of the cooling system as shown below.



DANGER ⚠

- If you accidentally splash FUSO DIESEL LONGLIFE COOLANT, FUSO ANTIFREEZE, or RADIATOR ANTI-RUST (RADIPET 9) in your eyes, wash it out immediately with water and seek medical attention.

WARNING ⚠

- FUSO DIESEL LONGLIFE COOLANT is flammable. Keep them away from heat and flames.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Air Bleeding of Cooling System

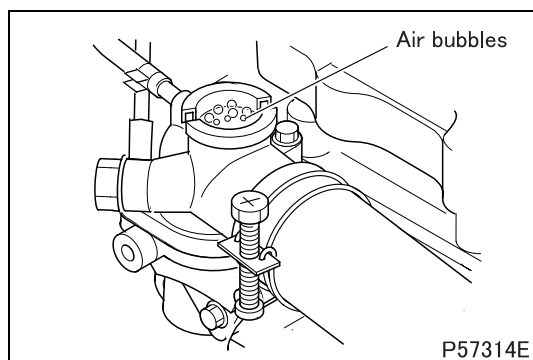
- With the pressure cap removed and the coolant temperature at 90°C {195°F}, let the engine idle in order to bleed air completely out of the cooling system.
- After air bleeding is completed, refill the reservoir tank with coolant as needed.

3. Air/Gas Leakage Test

- Presence of air or exhaust gas in coolant accelerates corrosion of the cooling system components. To prevent this, carry out air/gas leakage tests in accordance with the following procedure.
- Remove the pressure cap.

WARNING ⚠

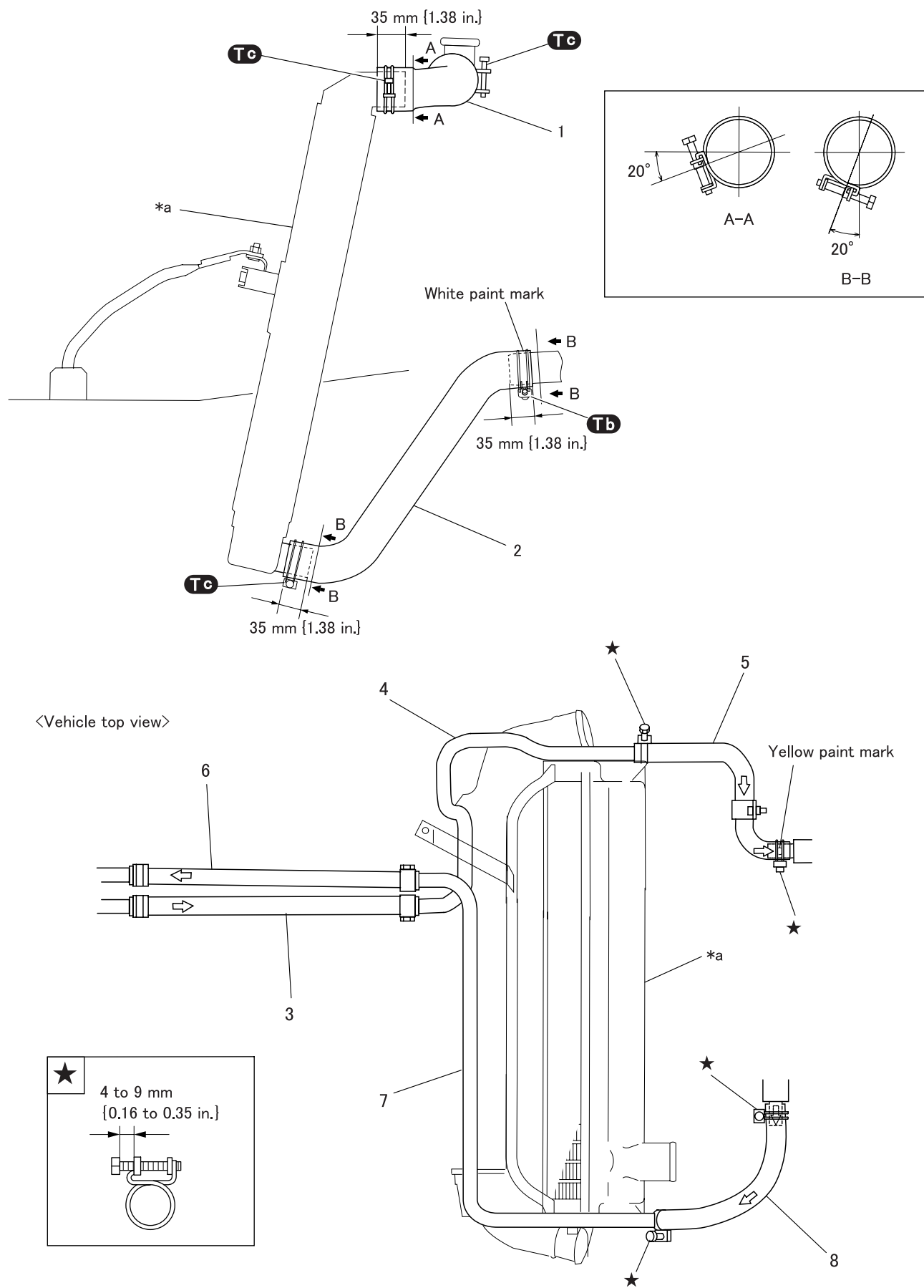
- **If the engine is hot, boiling coolant may spurt out from the filler port when the pressure cap is loosened. To avoid a scold, make sure to remove the pressure cap only when the coolant is cold.**
-



- Run the engine until the coolant temperature rises to approximately 90°C {195°F}.
- If air bubbles appear continuously through the filler port, there is air or exhaust gas penetrating into the cooling system.
- Presence of air in coolant can be an indication of loose cylinder head bolts, loose water pump mounting bolts, loose hose connections, and/or a damaged hose.
- Presence of exhaust gas in coolant can be an indication of a damaged cylinder head gasket and/or cracks in the cylinder head.

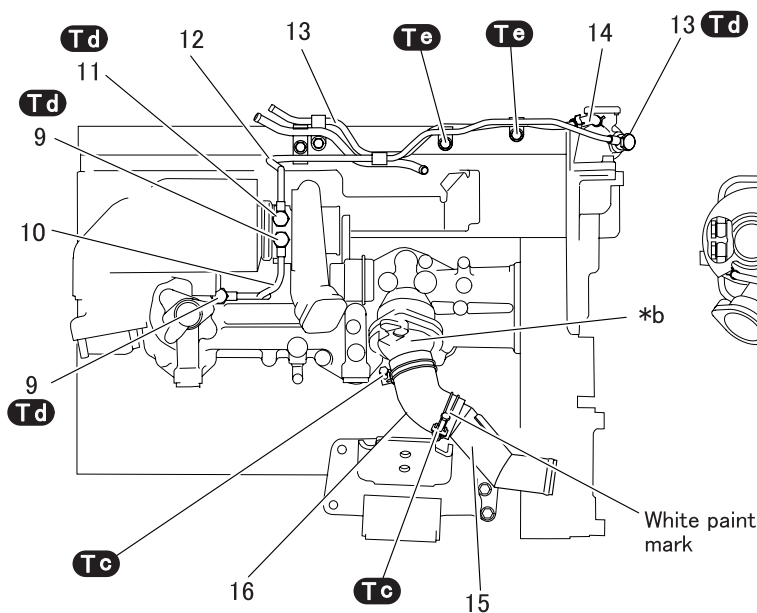
M E M O

DISCONNECTION AND CONNECTION OF HOSES AND PIPES

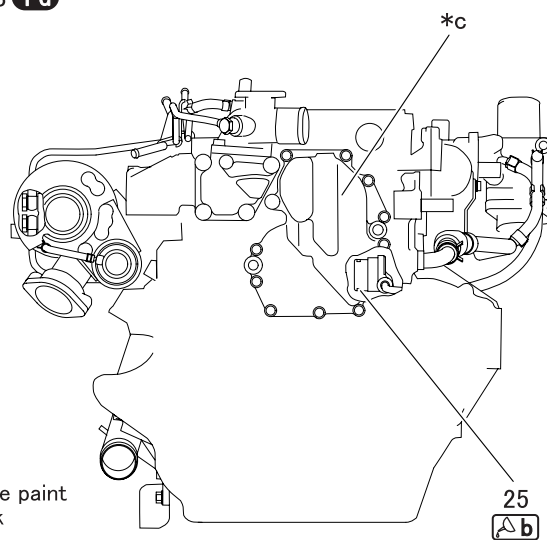


P58889N

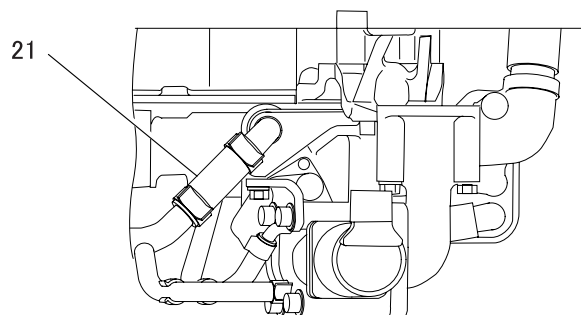
<Engine right side view>



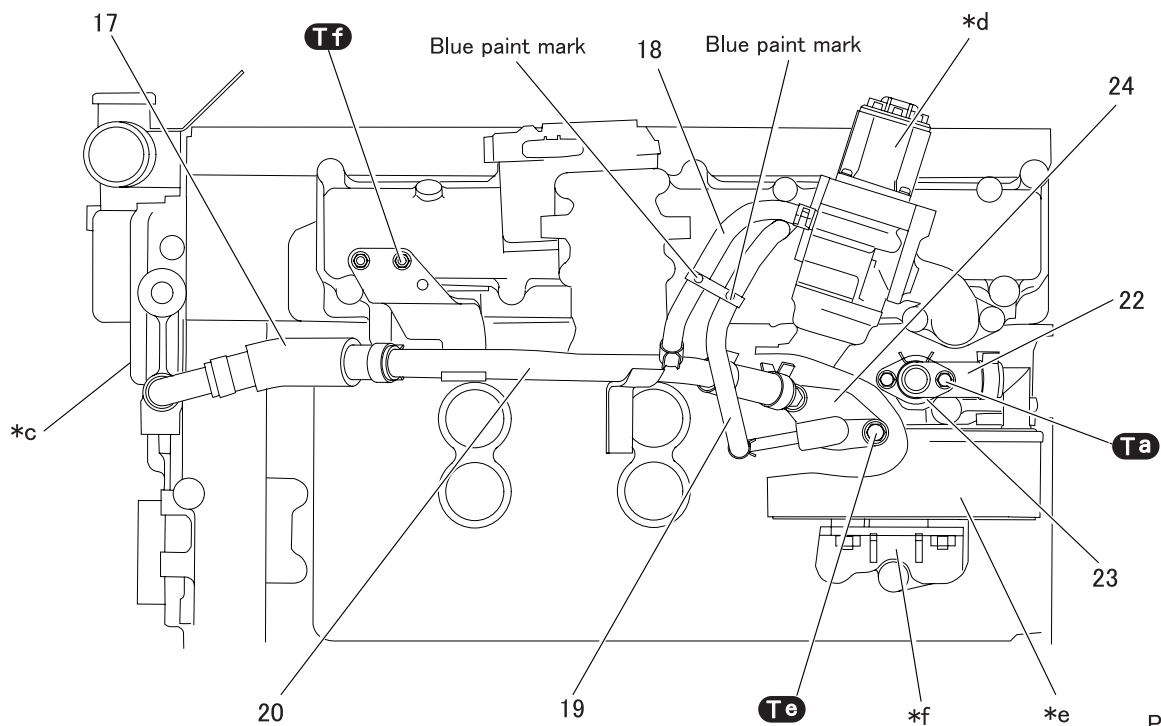
<Engine front view>



<Engine top view>



<Engine left side view>



DISCONNECTION AND CONNECTION OF HOSES AND PIPES

● Removal sequence

1 Upper radiator hose	13 Water pipe	25 O-ring
2 Lower radiator hose	14 Water hose	
3 Heater hose	15 Water pipe	*a: Radiator
4 Heater pipe	16 Water hose	*b: Thermostat cover
5 Heater hose	17 Water hose	*c: Breather cover
6 Heater hose	18 Water hose	*d: Exhaust gas recirculation valve
7 Heater pipe	19 Water hose	*e: Exhaust gas recirculation cooler
8 Heater hose	20 Water pipe	*f: Exhaust gas recirculation cooler bracket
9 Eyebolt	21 Water-out hose	⊗: Non-reusable parts
10 Water pipe	22 Water-in hose	
11 Eyebolt	23 Connector	
12 Water and vacuum pipe	24 Adapter	

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

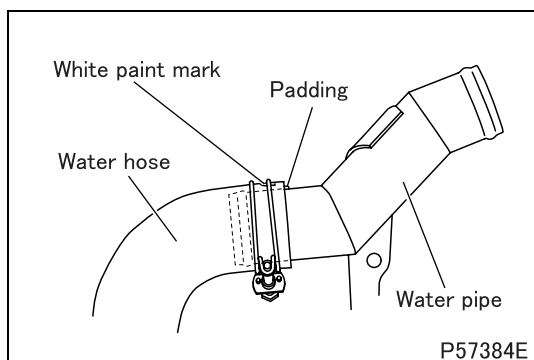
- Install each hose clamp to the angle indicated in the illustration so that sufficient clearance is assured between the hose clamp and its surrounding parts.
- Keep the O-ring free of engine oil. Engine oil will make the O-ring swell, which may cause leakage.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (connector mounting)	8 {5.9, 0.82}	–
Tb	Clamp	1.5 to 2.0 {1.1 to 1.5, 0.15 to 0.2}	Wet
Tc	Clamp	3.0 to 4.5 {2.2 to 3.3, 0.3 to 0.5}	–
Td	Eyebolt (water pipe mounting)	25.5 {19, 2.6}	–
	Eyebolt (water and vacuum pipe mounting)		
Te	Bolt (water and vacuum pipe mounting)	23.2 {17, 2.4}	–
	Bolt (water pipe mounting)		
	Bolt (adapter mounting)		
Tf	Nut (water pipe mounting)	4.9 {3.6, 0.5}	–

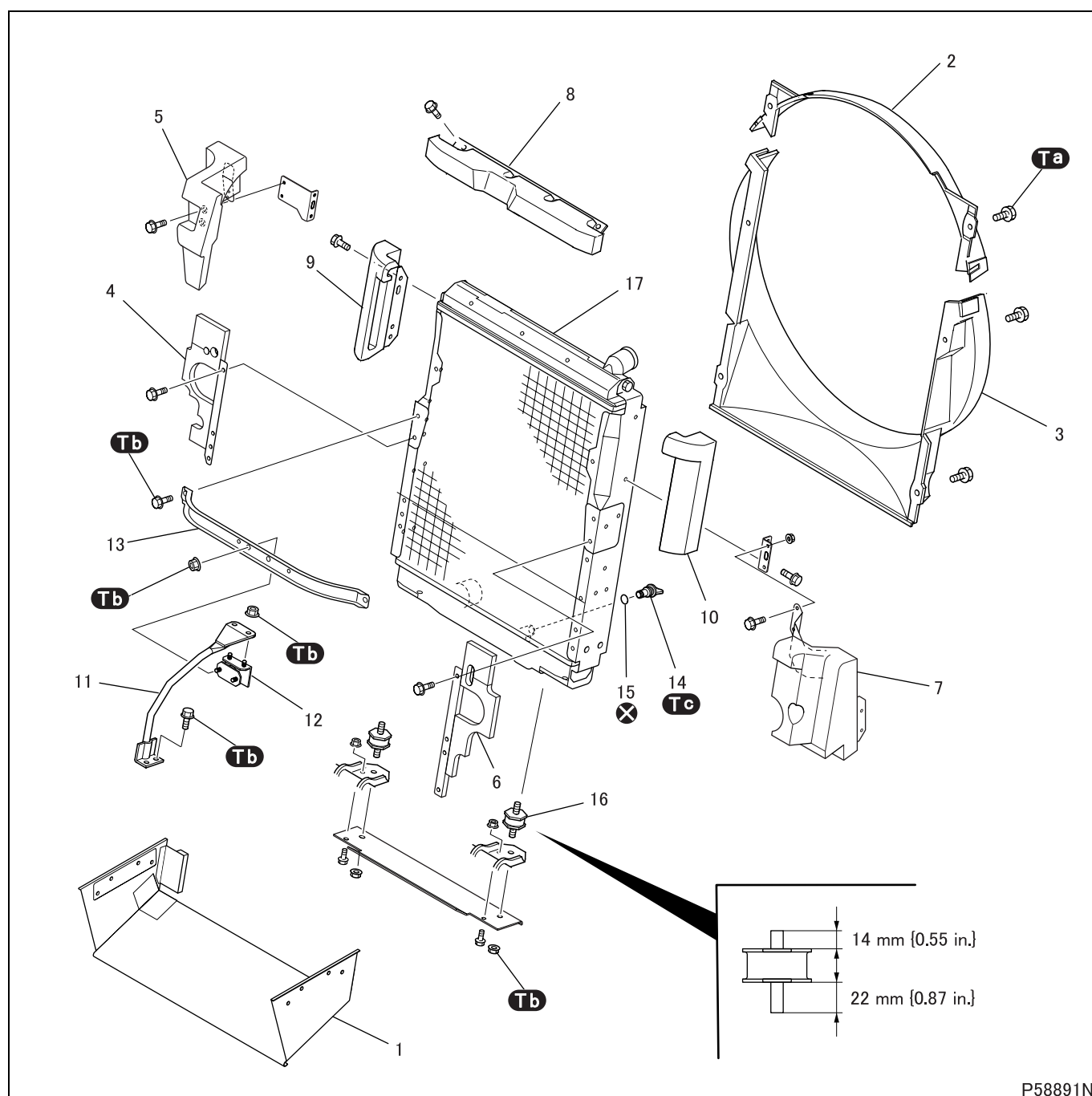
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Clamp screw threads	Engine oil	As required
 b	O-ring	Soapy water	As required

◆ Installation procedure ◆**■ Installation: Water hose**

- Install the water hose with the white mark on its end aligned with the padding on the water pipe.

RADIATOR



P58891N

● Removal sequence

- | | |
|-------------------|------------------------|
| 1 Air scoop | 8 Baffle plate upper |
| 2 Upper shroud | 9 Baffle plate RH |
| 3 Lower shroud | 10 Baffle plate LH |
| 4 Baffle plate RH | 11 Support rod |
| 5 Baffle plate RH | 12 Support cushion |
| 6 Baffle plate LH | 13 Upper support |
| 7 Baffle plate LH | 14 Radiator drain cock |

- | |
|--|
| 15 O-ring |
| 16 Support cushion
(See later section.) |

⊗: Non-reusable parts

● Installation sequence

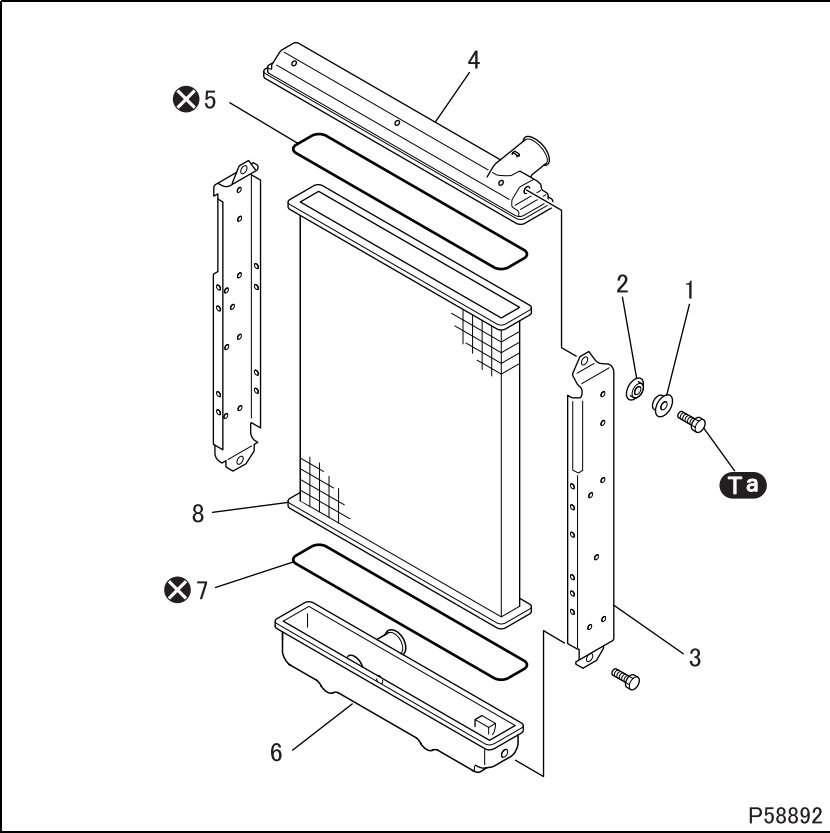
Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (upper shroud mounting)	5 to 7 {3.7 to 5.2, 0.5 to 0.7}	—
	Bolt (lower shroud mounting)		
Tb	Bolt (support rod mounting)	12 to 15 {8.9 to 11, 1.18 to 1.47}	—
	Nut (support cushion mounting)		
	Bolt (upper support mounting)		
	Nut (support cushion mounting)		
Tc	Radiator drain cock	2.5 ± 0.5 {1.8 ± 0.4, 0.25 ± 0.05}	—

RADIATOR

Radiator



● Disassembly sequence

- 1 Pipe
- 2 Bush
- 3 Side member
- 4 Upper tank
- 5 Packing
- 6 Lower tank
- 7 Packing
- 8 Core

⊗: Non-reusable parts

CAUTION ⚠

- Do not disassemble the radiator unless defects are evident.
- Handle the upper tank and lower tank carefully, as they are made of plastic and may crack under impact.
- Check the number of paint marks put near the upper tank and lower tank mounting tabs. The number of paint marks corresponds to the number of times the tabs have been unbent and re-clinched. If the core has already two paint marks, replace it with a new one.

● Assembly sequence

Follow the disassembly sequence in reverse.

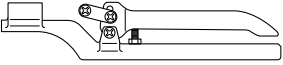
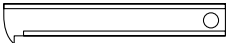
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Air leakage from radiator (air pressure 147 kPa {21 psi, 1.47 kgf/cm ² })	0 cm ³ {0 mL}	–	Repair or replace

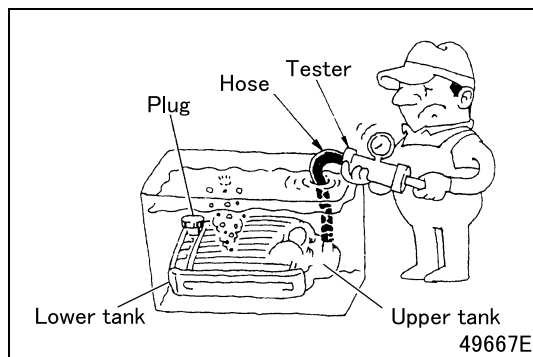
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (side member mounting)	13 {9.6, 1.3}	–

Special tools

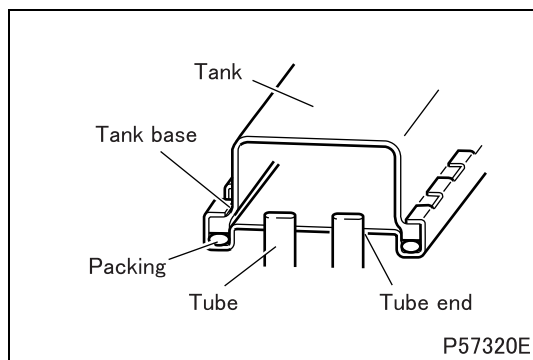
Mark	Tool name and shape	Part No.	Application
 a	Overhaul handle  P51240	MH062875	Installation and removal of upper tank and lower tank
 b	Claw  P51241	MH062876	
 c	Punch assembly  P51242	MH062877	

◆ Inspection before removal ◆



■ Inspection: Radiator air leakage

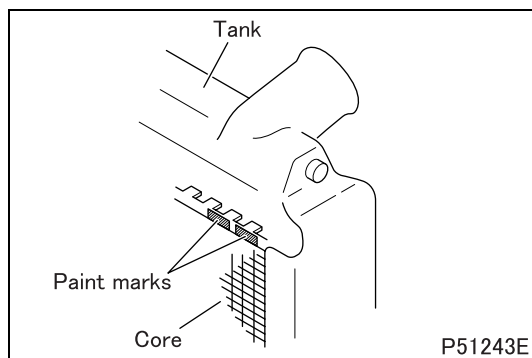
- Connect a hose and radiator cap tester to the upper tank.
- Plug the lower tank and put the entire radiator into a tank filled with water.
- Use the radiator cap tester to apply an air pressure of 147 kPa {21 psi, 1.47 kgf/cm²} and check for air leakage.
- If air leakage is found, repair or replace the radiator.



- Replace the following parts according to the area of leakage.

Area of leakage		Cause
Upper tank Lower tank	Tank body	Cracks in tank
	Tank base	Defective tabs Defective packing Cracks in tank
Tube body, tube ends		Cracks in tube

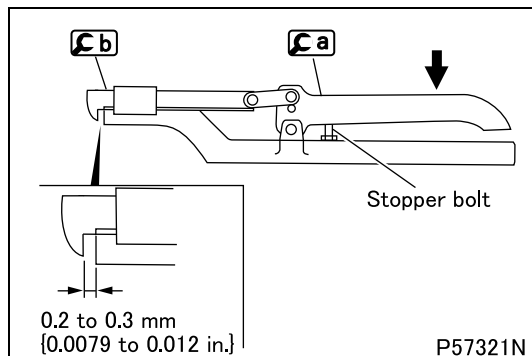
RADIATOR



NOTE

- The core may have paint marks that indicate the number of times the upper tank and lower tank mounting tabs have been unbent and re-clinched. Replace the core if it has already two paint marks.
- One paint mark is made every time the tabs are unbent and re-clinched. Upper tank paint marks should be counted separately from lower tank paint marks.

◆ Removal procedure ◆

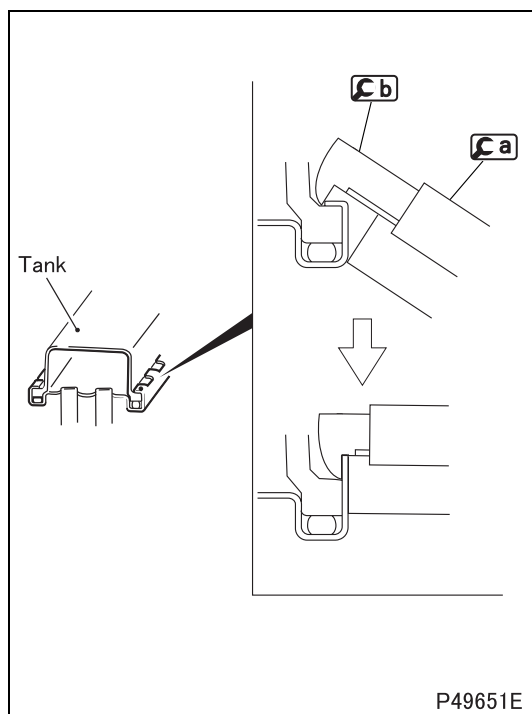


■ Removal: Upper tank and lower tank

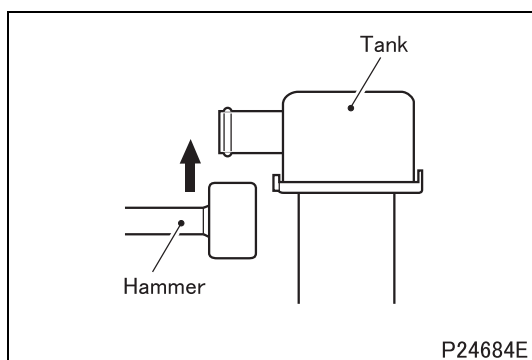
- Attach **(C b)** onto **(C a)**.
- Using the stopper bolt on **(C a)**, adjust the jaw span of **(C b)** to the dimension indicated in the illustration.

CAUTION ⚠

- Make sure to adjust the stopper bolt before using the tools. Failure to do so may cause damage to **(C b)**.



- Using **(C b)**, undo the tabs that are holding the tank in place.
- Once each tab is unbent, grip **(C a)** more tightly to straighten it out completely.
- Undo all the tabs on the entire periphery of the tank, then remove the tank using the inlet hose fitting as a grip.

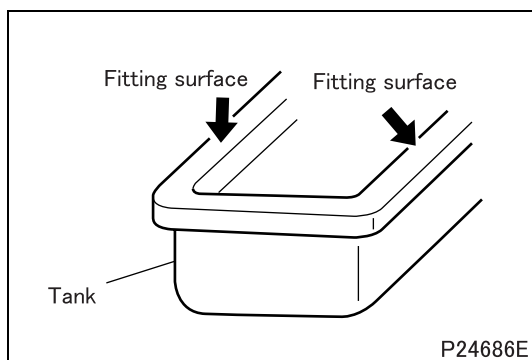


- If the tank does not come off easily, tap it lightly with a soft-face hammer (rubber or plastic hammer) to loosen it.

CAUTION

- Handle the tanks carefully, as they are made of plastic and may crack easily under impact.

◆ Inspection procedure ◆

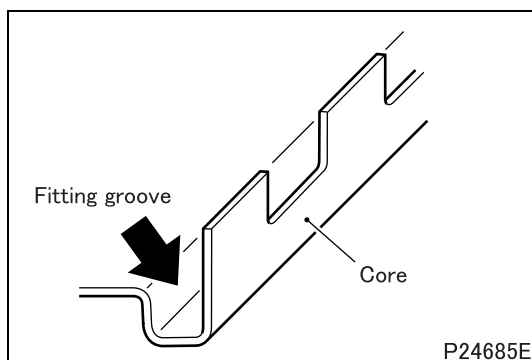


■ Inspection: Core fitting surfaces of tank

- Inspect the core fitting surfaces of the tank for any dirt or damage. If necessary, clean them thoroughly.
- Replace the tank(s) if defective.

CAUTION

- Carry out the inspection with your bare hands to avoid putting foreign matter on the fitting surfaces.

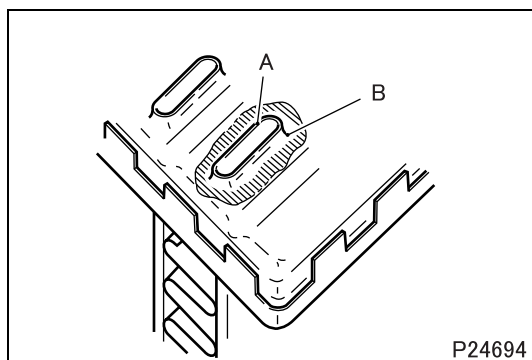


■ Inspection: Tank fitting groove of core

- Check the tank fitting groove of the core for any foreign matter or cracks.
- If foreign matter is found on the groove surfaces, lightly scrub it off with a No.1000 sandpaper taking care not to damage the surfaces, or blow it off with compressed air.
- If a crack is found on the groove surfaces, repair the crack or replace the core.

CAUTION

- Installing a packing and tank on the core without removing foreign matter from the groove surfaces can lead to coolant leakage. Make sure to inspect the entire groove surfaces extremely carefully. Even one strand of hair is enough to cause leakage.



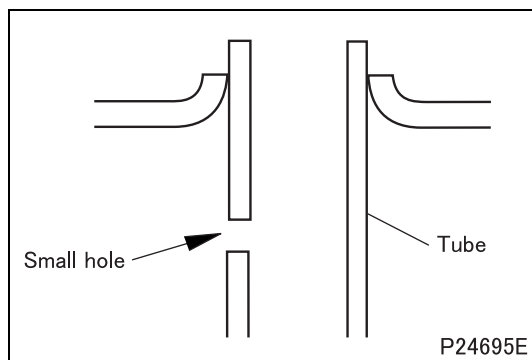
Repair of core

CAUTION

- The following core repair procedure involves tungsten inert gas arc welding (TIG arc welding). Only personnel competent for doing this type of welding should carry out the job.
- Dry the core completely before performing welding. Welding wet parts could be extremely dangerous.

- Scrub both ends **A** of a leaky tube as well as the surrounding areas **B** of each end with a stainless wire brush. Continue scrubbing until the aluminum layer becomes exposed.

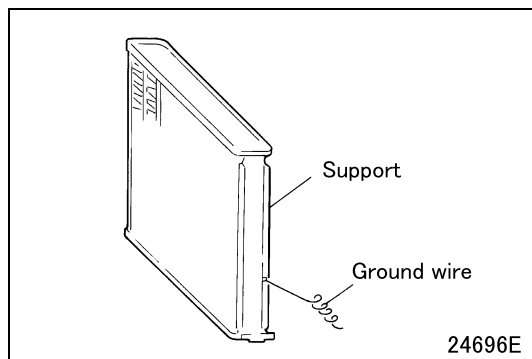
RADIATOR



- Drill a small hole in the tube to let the air out when both ends of the tube are welded closed.

CAUTION

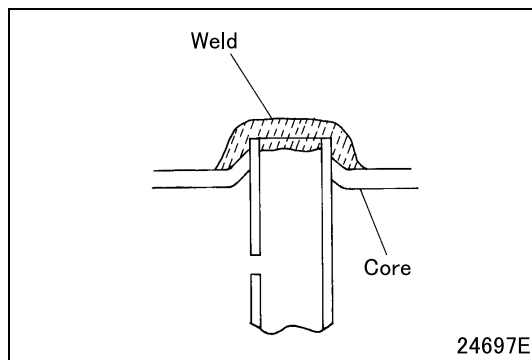
Failure to drill an air release hole in the tube may cause pinholes to form in the welds.



- Connect one of the support edges of the core to ground with a wire.

CAUTION

- **Inadequate connection of the ground wire can cause a short circuit to a part of the core, which may cause the part to melt.**

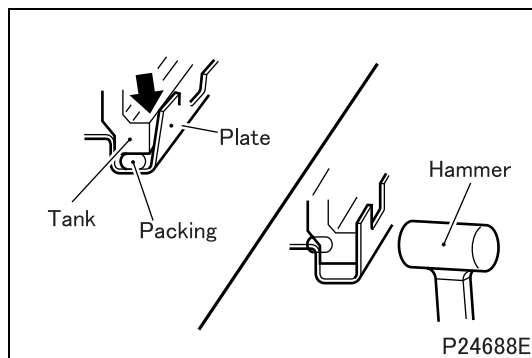


- Close both ends of the tube by TIG arc welding.
- Welding conditions
- Welding rod: A4043
(diameter approximately 2 mm { $\phi 0.079$ in.})
 - Welding current: AC80A
 - After the welding is completed, check for the following defects. If any of these defects are spotted, repair the defect or replace the core.
 - Undercuts
 - Cracks in weld bead
 - Cracks in base metal

CAUTION

- **Make sure that welds are proper. Any defect in welding can lead to recurrence of leakage.**

◆ Installation procedure ◆

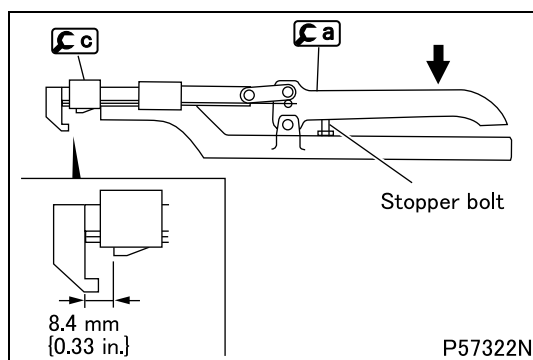


■ Installation: Upper tank and lower tank

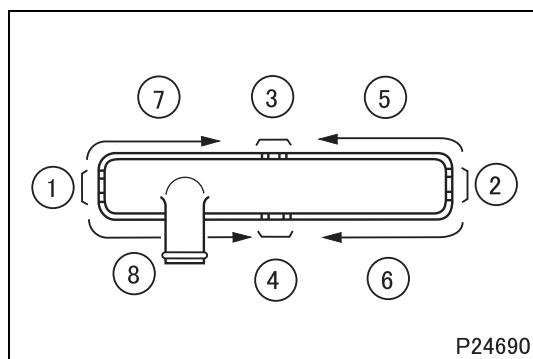
- If there is a gap between the tank and core's tank holding plate when the tank is placed in position, lightly tap the plate with a rubber or plastic hammer to eliminate the gap.

CAUTION

- **When installing the tank and packing, use your bare hands to avoid putting foreign matter on the parts.**



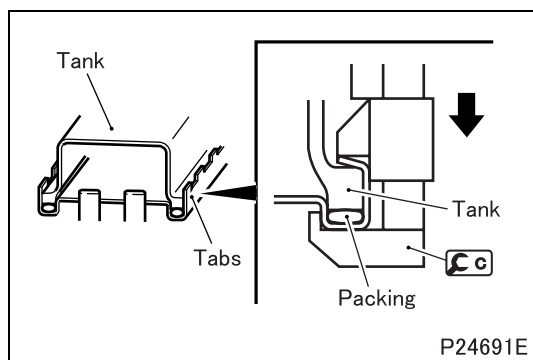
- Attach **[c]** onto **[a]**.
- Using the stopper bolt on **[a]**, adjust the jaw span of **[c]** to the dimension indicated in the illustration.



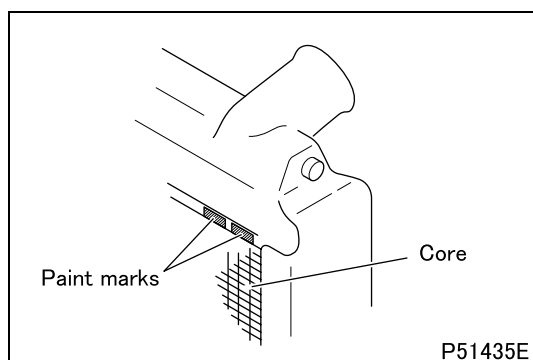
- Bend and clinch the tabs of the core over the brim of the tank in the sequence indicated in the illustration.
1 to 4: Clinch the two tabs at the center on each side of the tank.
5 to 8: Clinch the rest of the tabs in the order indicated by the arrows.

CAUTION

- The tabs on sides 1 and 2 cannot be clinched using **[c]**. Use a pair of pliers with the noses wrapped with vinyl tape to clinch these tabs.



- After clinching all the tabs, check for leakage.

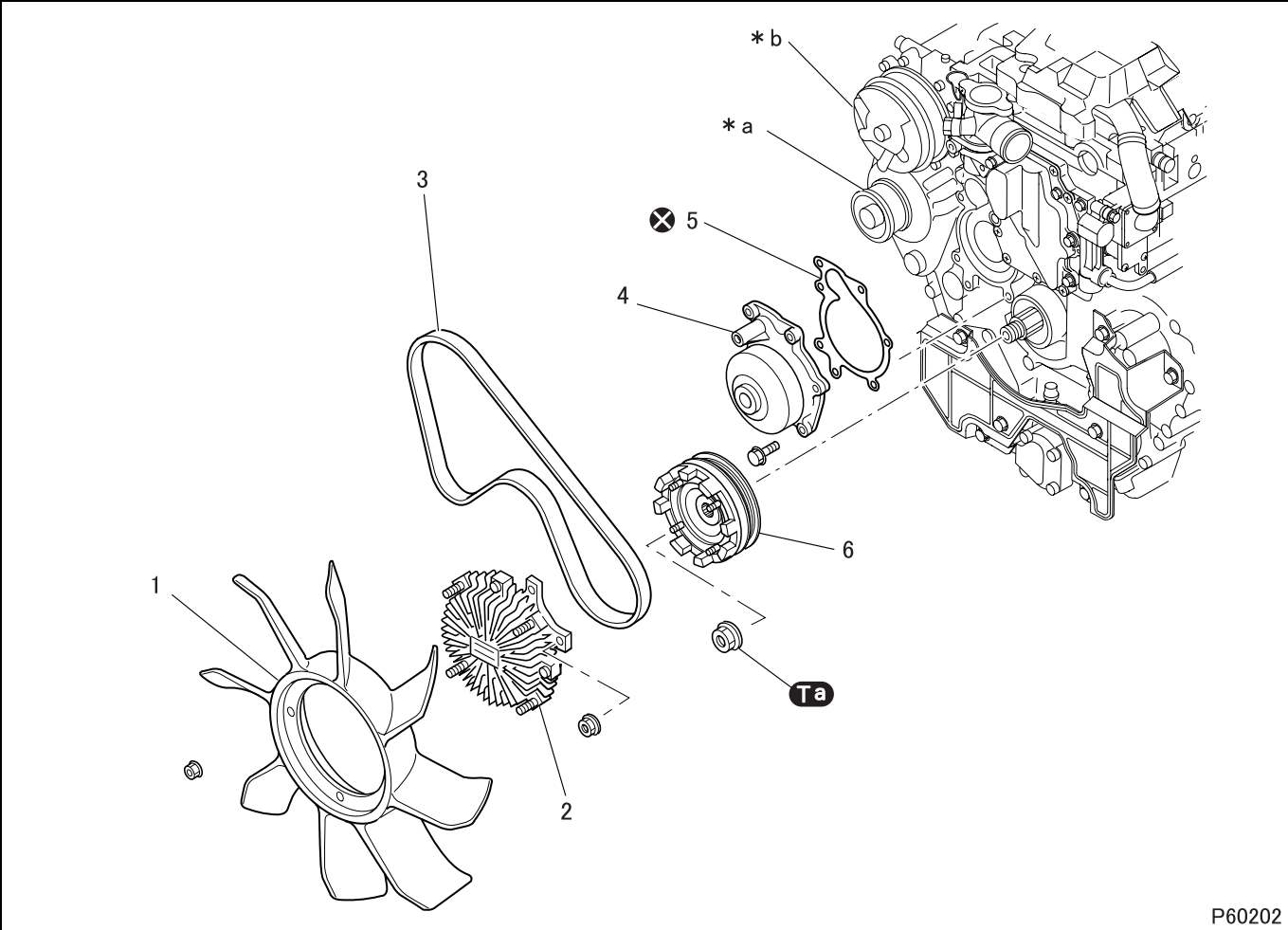


- Put a paint mark on a clearly visible area of the core to indicate the number of times the tabs have been unbent and re-clinched.

CAUTION

- One paint mark should be made for each of the upper and lower tanks every time the tabs for it are unbent and re-clinched.

COOLING FAN, V-BELT AND WATER PUMP



P60202

● Removal sequence

- | | | |
|----------------------------------|--------------|---------------------------|
| 1 Cooling fan | 4 Water pump | *a: Alternator |
| 2 Automatic cooling fan coupling | 5 Gasket | *b: Compressor |
| 3 V-belt | 6 Fan pulley | <with air conditioner> |
| | | Tension pulley |
| | | <without air conditioner> |
- ⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- The automatic cooling fan coupling and the water pump cannot be disassembled. It must be replaced if defective.
- Make sure that there is no oil or grease on the V-belts. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
3	V-belt tension	with air conditioner	New	7.5 to 8.5 {0.30 to 0.33}	—	Adjust
			Reused	9.5 to 10.5 {0.37 to 0.41}		
		without air conditioner	New	8 to 10 {0.31 to 0.39}		
			Reused	10 to 12 {0.39 to 0.47}		

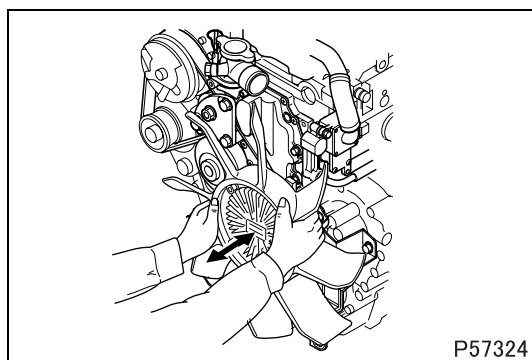
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (fan pulley mounting)	196.1 {145, 20}	—

Special tools

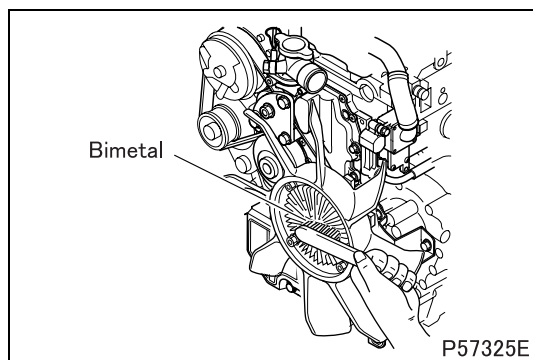
Mark	Tool name and shape	Part No.	Application
Ca	Belt tension gauge  P03612	MH062345	Measurement of tension of V-belt

◆ Inspection and cleaning procedure ◆



■ Inspection: Automatic cooling fan coupling

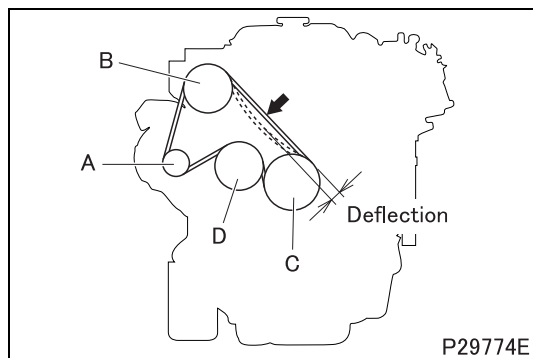
- Make an inspection of the following points. Replace the automatic cooling fan coupling if defective.
Check that:
 - the hydraulic oil sealed inside the coupling is not leaking;
 - the coupling does not make any abnormal noise or rotate unevenly due to defects in the inside bearing when rotated manually; and
 - the automatic cooling fan coupling does not move too much when pushed and pulled in the axial directions when the engine is cold.



■ Cleaning: Automatic cooling fan coupling

- When removing foreign matter from the bimetal, be careful not to press too hard against the bimetal.

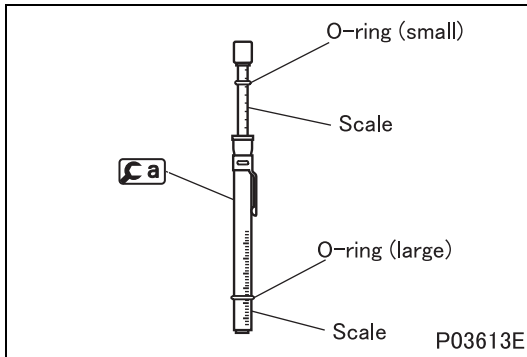
◆ Inspection after installation ◆



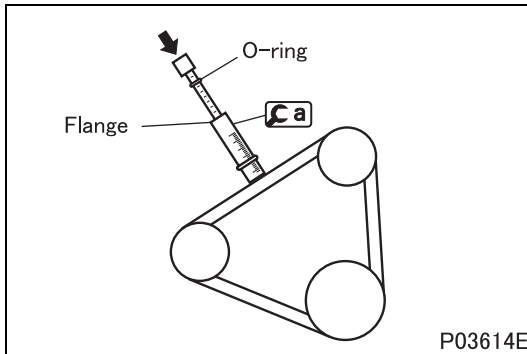
■ Inspection: Tension of V-belts

- Press each V-belt at a central portion between pulleys with a force of approximately 98 N {22 lbs, 10 kgf} as shown in the illustration and measure the amount of deflection of the belt.
A: Alternator pulley
B: Air conditioner compressor pulley or tension pulley
C: Fan pulley
D: Water pump pulley

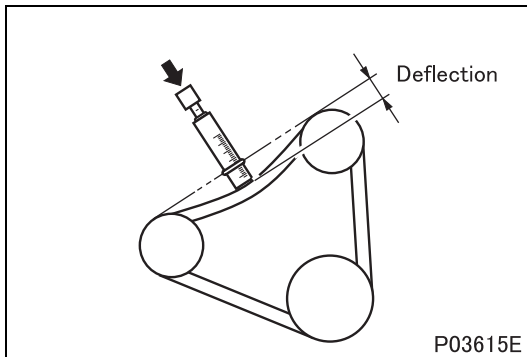
COOLING FAN, V-BELT AND WATER PUMP



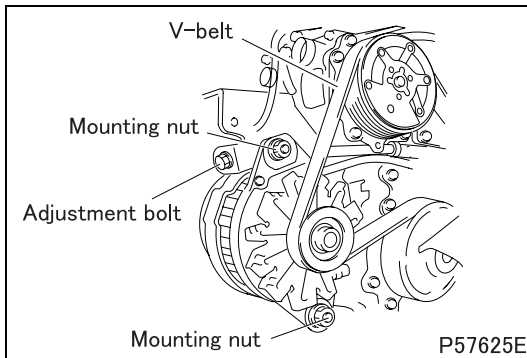
- Place the small O-ring on **Ca** at the scale mark corresponding to 98 N {22 lbs, 10 kgf} (press force).
- Place the large O-ring on **Ca** at the scale mark corresponding to the maximum permissible deflection value specified for the belt.



- Place **Ca** at a central portion between pulleys of the V-belt and push the handle (indicated by the arrow in the illustration) until the O-ring touches the flange.



- Measure the amount of deflection of the V-belt.
- If the measured value deviates from the standard value range, adjust the tension of the belt as follows.



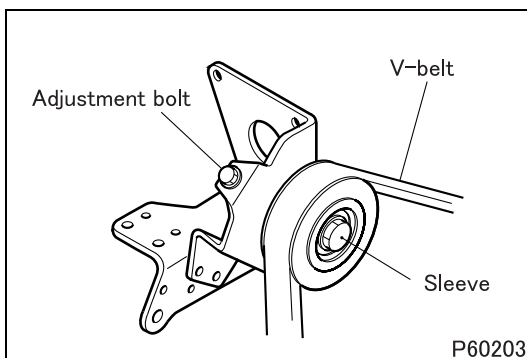
Adjustment of V-belt

(1) Vehicles with air conditioner

- Loosen the alternator mounting nuts (2 locations) and adjust the tension of the V-belt by tightening or loosening the adjustment bolt.
- After the adjustment is completed, retighten the mounting nuts firmly.

CAUTION

- **Excessive tension in the V-belt may damage not only the belt itself but also the bearings of the related components.**

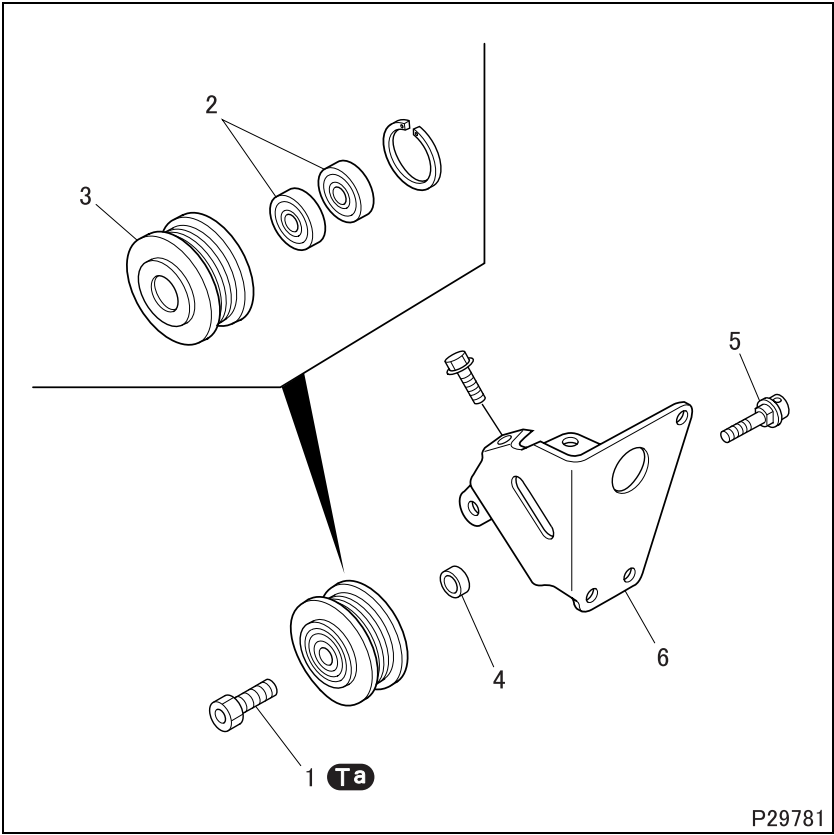


(2) Vehicles without air conditioner

- Loosen the tension pulley mounting sleeve and turn in or out the adjustment bolt to adjust the tension of the V-belt.
- After the adjustment is completed, retighten the mounting sleeve firmly.

CAUTION

- **Excessive tension in the V-belt may damage not only the belt itself but also the bearings of the related components.**



● Disassembly sequence

- 1 Sleeve
- 2 Bearing
- 3 Tension pulley
- 4 Spacer
- 5 Shaft
- 6 Tension pulley bracket

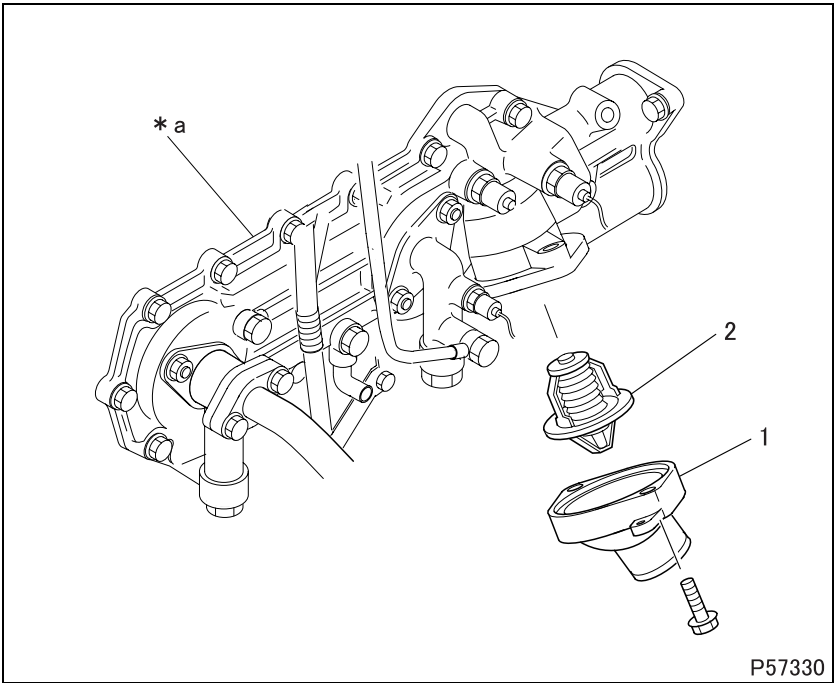
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Sleeve	49 {36, 5.0}	—

THERMOSTAT



● Disassembly sequence

- 1 Thermostat cover
- 2 Thermostat

*a: Oil cooler

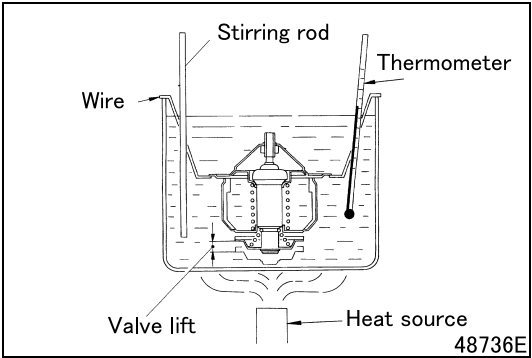
● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
2	Thermostat	Valve opening temperature	$82 \pm 2^{\circ}\text{C}$ { $180 \pm 3.6^{\circ}\text{F}$ }	—	Replace
		Valve lift / temperature	10 {0.39} or more / 95°C { 205°F }		

◆ Inspection procedure ◆



■ Inspection: Thermostat

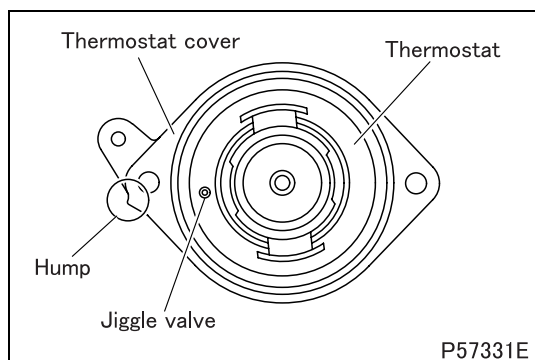
- Stir the water using a stirring rod to maintain an even water temperature in the container, then conduct the tests indicated below.
- If the measured values deviate from the standard value ranges, replace the thermostat.

(1) Valve opening temperature

- Hold the thermostat with wire to keep it away from the heat source.
- Heat the water gradually to the valve opening temperature.
- Maintain this temperature for five minutes and make sure that the valve is completely open.
- Make sure that the valve closes completely when the water temperature drops below 65°C { 150°F }.

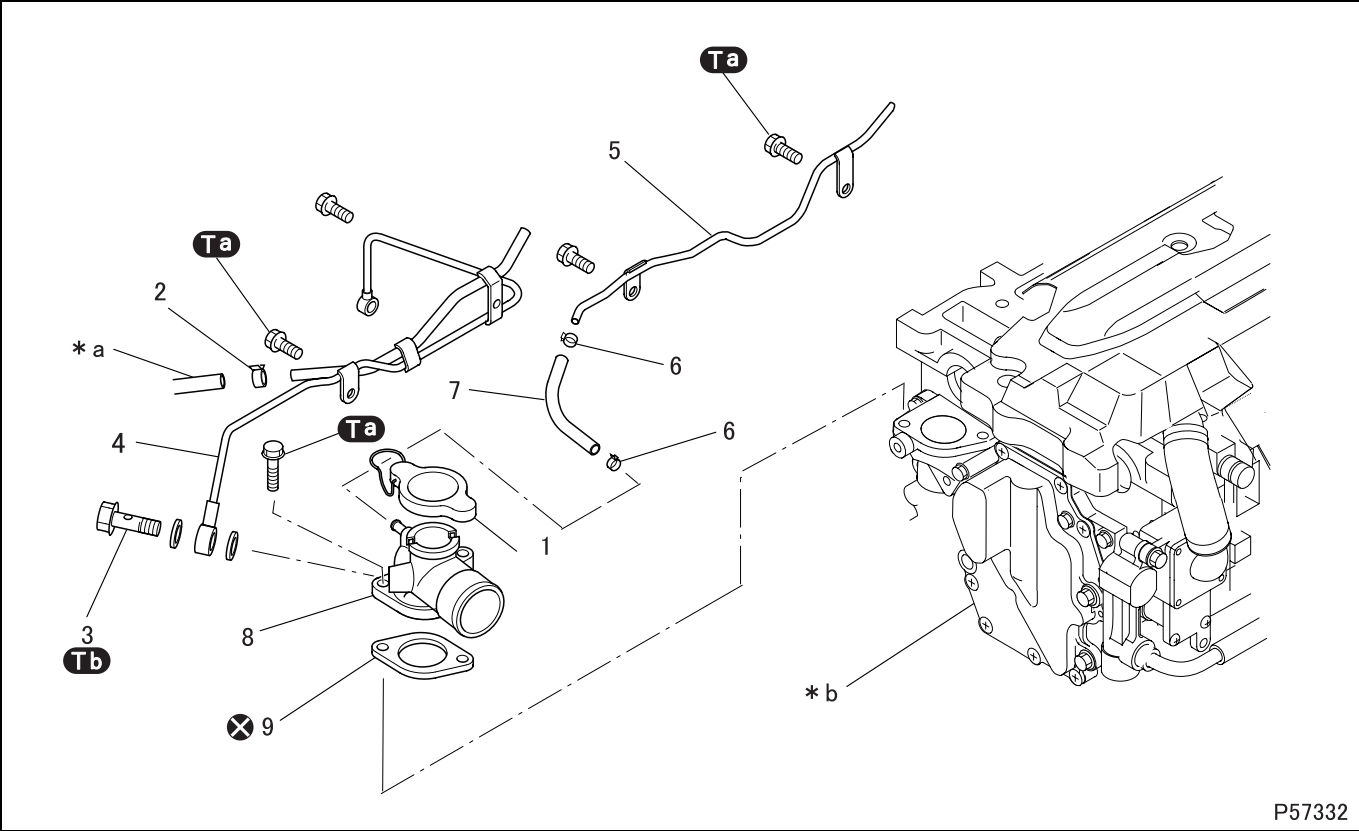
(2) Valve lift

- Heat the water to a temperature slightly higher than the valve opening temperature. Maintain this temperature for five minutes and measure the valve lift.

◆ Installation procedure ◆**■ Installation: Thermostat**

- Mount the thermostat on the thermostat cover in the illustrated direction.

PRESSURE CAP AND WATER OUTLET CASE



Disassembly sequence

- | | | |
|-------------------------|---------------------|-----------------------|
| 1 Pressure cap | 6 Clip | *a: Vacuum hose |
| 2 Clip | 7 Water hose | *b: Breather cover |
| 3 Eyebolt | 8 Water outlet case | ⊗: Non-reusable parts |
| 4 Water and vacuum pipe | 9 Gasket | |
| 5 Water pipe | | |

Assembly sequence

Follow the disassembly sequence in reverse.

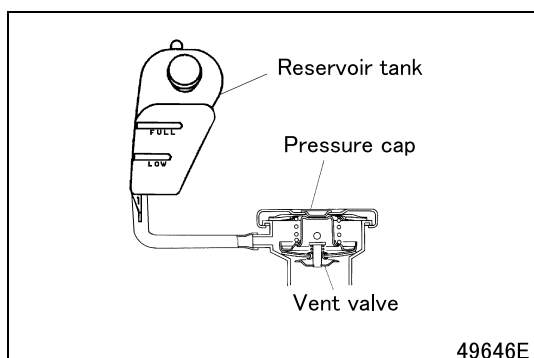
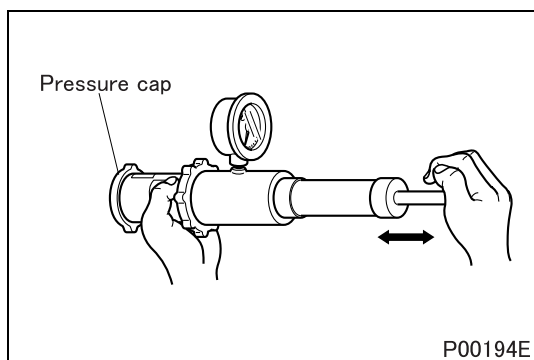
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Pressure cap valve opening pressure	110 ± 15 kPa {16 ± 2.2 psi, 1.1 ± 0.15 kgf/cm ³ }	—	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (water and vacuum pipe mounting)	23.2 {17, 2.4}	—
	Bolt (water pipe mounting)		
	Bolt (water outlet pipe mounting)		
Tb	Eyebolt (water and vacuum pipe mounting)	25.5 {19, 2.6}	—

◆ Inspection procedure ◆



■ Inspection: Pressure cap

(1) Pressure valve opening pressure

- Replace the pressure cap if the measured value deviates from the standard value range.

(2) Inspection of vent valve

- Before starting the inspection, check the level of coolant in the reservoir tank.
- Run the engine at full speed. Stop the engine when the level of coolant in the reservoir tank noticeably rises.
- Wait until the coolant temperature drops to the ambient temperature. Then, check if the coolant in the reservoir tank has returned to the same level as that confirmed before the engine was started.
- If the coolant has failed to return to its original level, the vent valve is defective. In this case, replace the pressure cap.

CAUTION ⚠

- Be aware that removing the pressure cap before the coolant cools down to the ambient temperature will result in loss of vacuum in the radiator, which disables the coolant from being returned to the reservoir tank.



Group 15

Intake and Exhaust

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	15-2
STRUCTURE AND OPERATION	
1. Air Cleaner.....	15-2
2. Turbocharger.....	15-3
3. Muffler.....	15-4
TROUBLESHOOTING.....	15-5
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Measurement of Turbocharger Boost Pressure.....	15-6
AIR DUCT AND AIR CLEANER <EXCEPT CREW CAB>	15-8
AIR DUCT AND AIR CLEANER <CREW CAB>.....	15-12
TURBOCHARGER	15-16
INTERCOOLER	15-22
INTAKE MANIFOLD	15-24
EXHAUST MANIFOLD	15-25
EXHAUST PIPE.....	15-26
MUFFLER	15-28

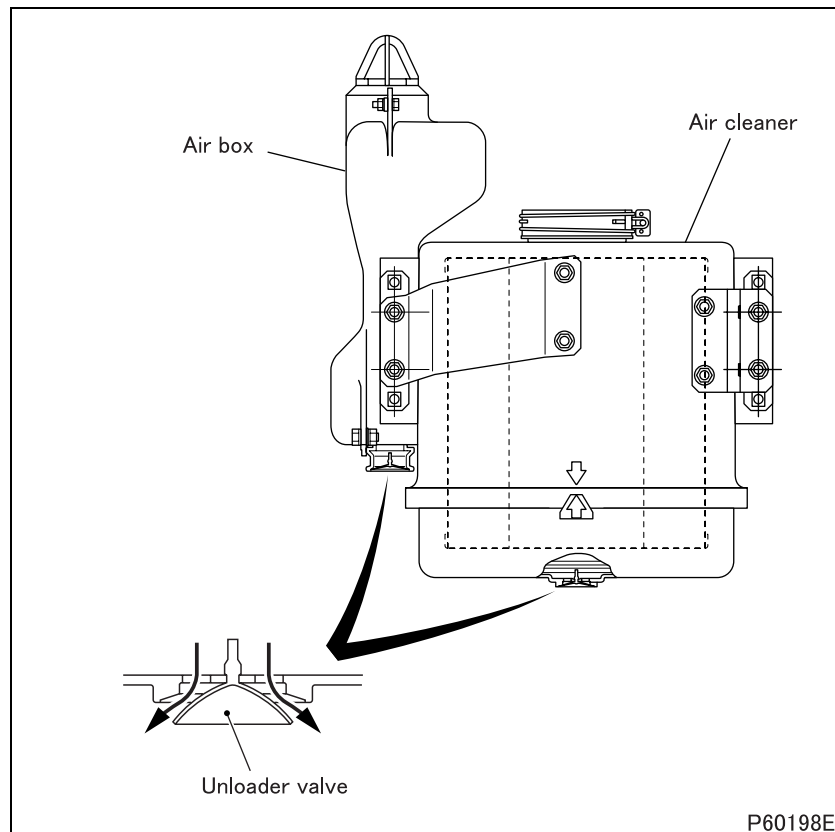
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item		Specifications
Air cleaner element		Filter paper type
Turbocharger	Model	TD04
	Manufacturer	Mitsubishi Heavy Industries, Ltd.
Intercooler		Tube and corrugated fin type air-to-air heat exchanger

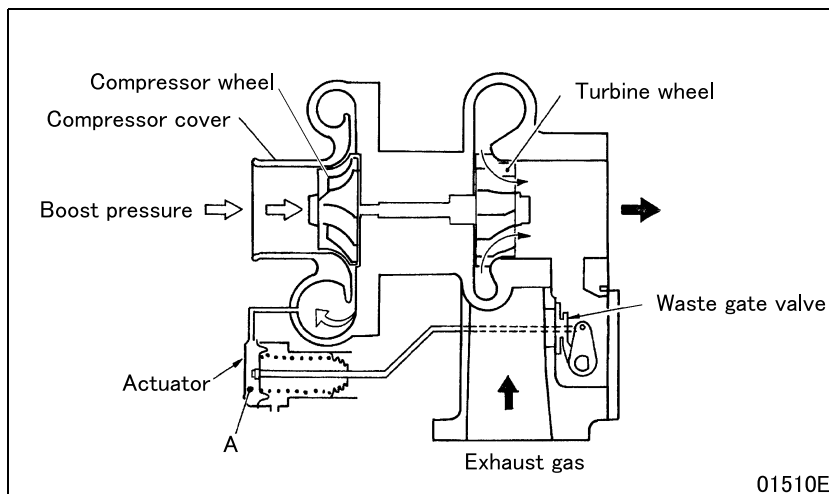
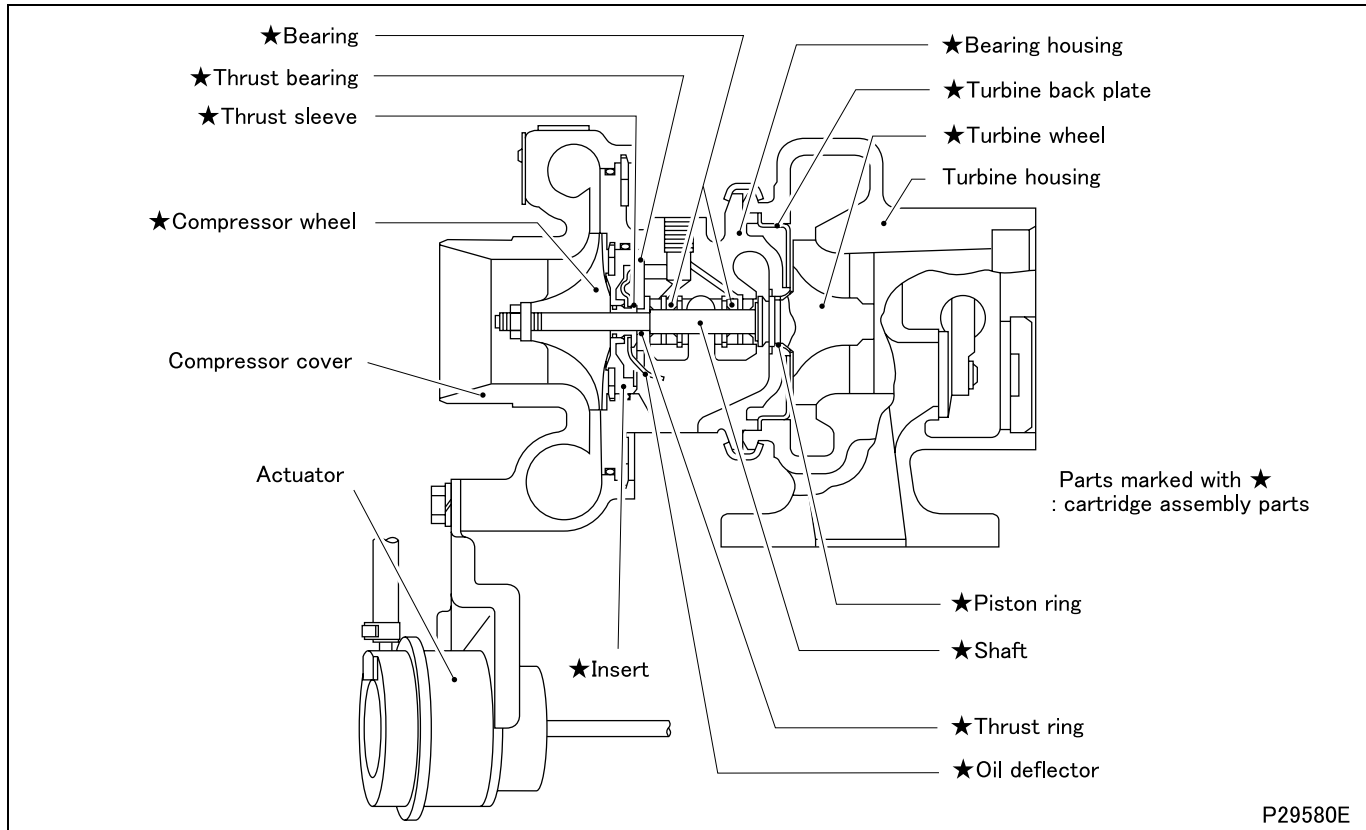
STRUCTURE AND OPERATION

1. Air Cleaner



- The air cleaner is a single element type.
- When the engine slows down below the predetermined speed, the level of vacuum changes and causes the unloader valve to vibrate. Vibration of the unloader valve allows the air cleaner to automatically discharge any water and dust that has accumulated in its inside.

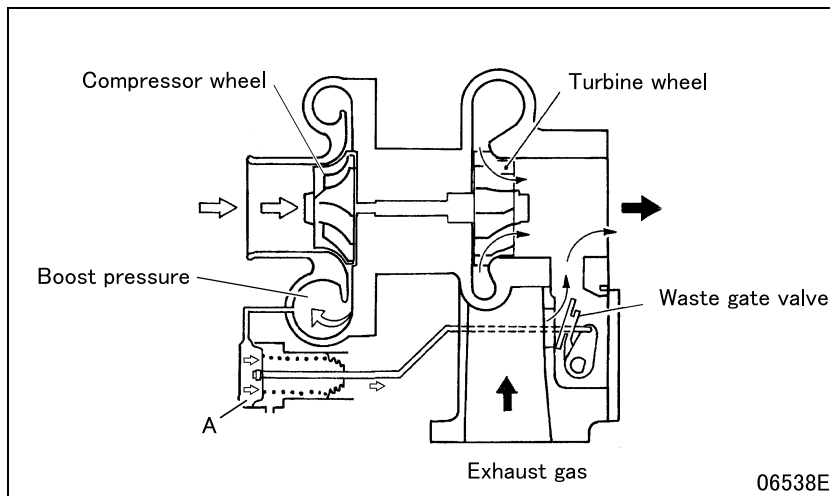
2. Turbocharger



2.1 Waste gate mechanism

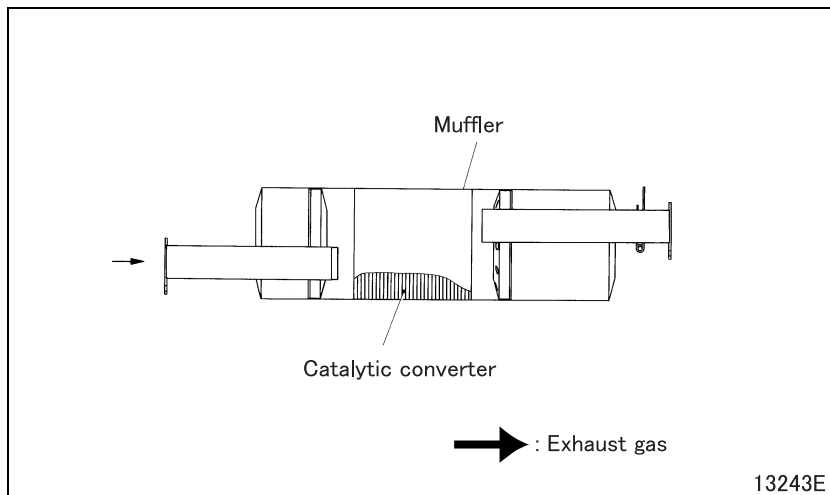
- The waste gate mechanism allows excess exhaust gas to escape from the turbocharger by means of an actuator in order to maintain the boost pressure at an appropriate level. This prevents overrunning of the turbocharger and excessive pressure buildups in the intake manifold.
- The boost pressure is led via a rubber hose from the compressor cover to chamber **A** in the actuator. When the boost pressure in chamber **A** is less than the predetermined value, the actuator does not function and the waste gate valve remains closed. All exhaust gas then flows toward the turbine wheel.

STRUCTURE AND OPERATION



- When the boost pressure in chamber **A** exceeds the predetermined value, the waste gate valve opens, reducing the amount of exhaust gas flowing toward the turbine wheel. As a result, the speed of the compressor wheel and thus the boost pressure are reduced.

3. Muffler



- Converter is built into muffler to decrease the amount of particulate matter (PM) in the exhaust gas.

Possible causes		Symptoms	Engine is difficult to start	Exhaust gas is black	Exhaust gas is white	Engine output is insufficient	Fuel consumption is too high	Intake and exhaust system vibrates and/or makes abnormal noises	Reference Gr
Air cleaner		Clogged air cleaner element	O	O		O			
Turbocharger	Cartridge assembly	Defective bearing		O		O		O	
		Carbon deposits on turbine wheel		O		O			
		Interference between turbine wheel and turbine back plate		O		O		O	
		Interference between turbine wheel and turbine housing		O		O		O	
		Bent shaft		O		O		O	
		Damaged turbine wheel		O		O		O	
		Interference between compressor wheel and compressor cover		O		O		O	
		Seizure of thrust sleeve and/or thrust bearing		O		O		O	
		Damaged compressor wheel		O		O		O	
		Oil leakage due to worn piston ring and/or insert		O	O		O		
		Poorly installed piston ring					O		
		Unsmooth sliding of inner parts due to clogged lubricating oil pipe and/or eye bolt		O		O			
		Damaged oil seals due to clogged oil return pipe			O		O		
	Poorly mounted compressor cover			O		O	O	O	
	Poorly mounted turbine housing					O		O	
Intercooler					O				
Throttle actuator	Butterfly valve stuck in closed position		O	O	O			Gr13E	
	Poorly adjusted butterfly valve		O	O	O				
Deformed front pipe, muffler, and/or tail pipe							O		
Poorly installed front pipe, muffler, and/or tail pipe							O		
Inappropriate valve clearance			O					Gr11	
Defective cylinder head gasket			O						
Worn valve and valve seat and/or carbon deposits			O						
Weakened valve springs			O						
Worn and/or damaged piston rings				O		O			
Worn and/or damaged piston ring grooves				O		O			
Malfunctioning cooling system			O					Gr14	
Excessive engine oil level				O				Gr12	
Seizure of main moving parts			O					Gr11	
Uneven or excessive fuel injection			O					Gr13E	

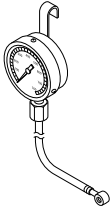
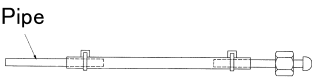
ON-VEHICLE INSPECTION AND ADJUSTMENT

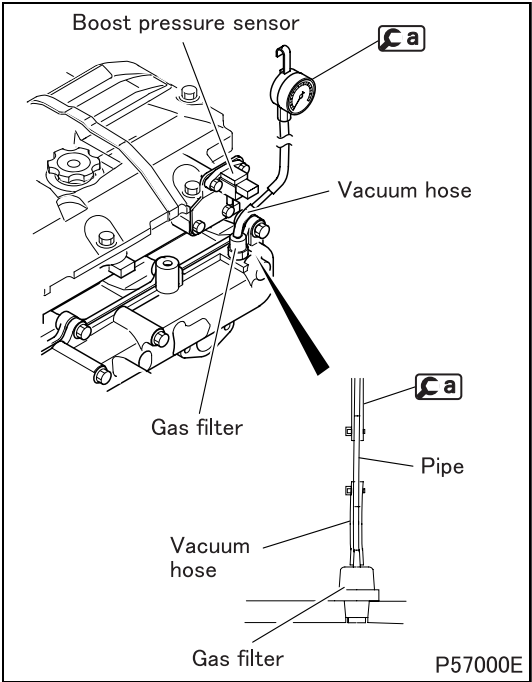
1. Measurement of Turbocharger Boost Pressure

Service standards (Unit: mm {in.})

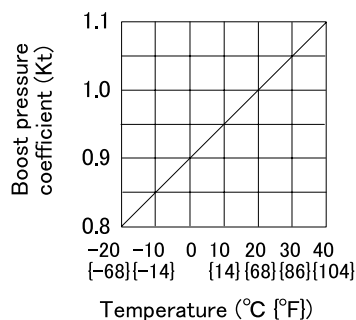
Location	Maintenance item	Standard value	Limit	Remedy
-	Boost pressure (temperature: 20°C {68°F}; air pressure: 100 kPa {29.9 in. Hg, 760 mmHg})	-	67.8 kPa {20 in. Hg, 509 mmHg} /3100 rpm	Inspect or adjust

Special tools

Mark	Tool name and shape	Part No.	Application
	Boost pressure gauge 	MH061366	Measurement of turbocharger boost pressure
	Boost pressure gauge adapter 	MH062047	



- Before measuring the turbocharger boost pressure, clean or replace the air cleaner element.
- Disconnect the vacuum hose from the boost pressure sensor.
- Connect the pipe  between the vacuum hose connected to the gas filter and .
- Warm up the engine well, then measure the boost pressure at no-load maximum speed. Also measure the engine speed and atmospheric temperature.

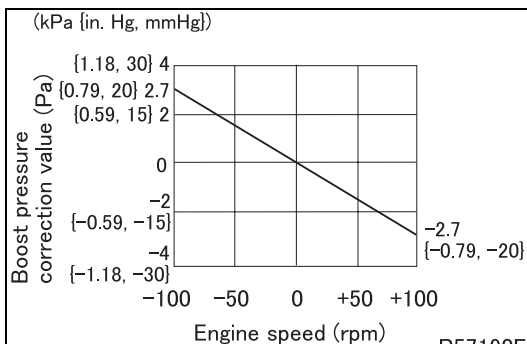


P57189E

- Adjust the boost pressure to the standard value (boost pressure changes according to the atmospheric temperature and the engine speed).

[Atmospheric temperature correction of boost pressure]

- Based on the current atmospheric temperature, determine the appropriate boost pressure correction coefficient in the graph.



P57190E

[Engine speed correction of boost pressure]

- Subtract the median of the no-load maximum speed values from the engine speed at the time of boost pressure measurement. Use the difference to determine the necessary boost pressure correction value (Pa) in the graph.

Median: 3200 rpm

[Calculation of corrected boost pressure]

- With **P** as the measured boost pressure, determine the corrected boost pressure **Pb** using the following equation:

$$P_b = K_t P + P_a$$

Pb: Corrected boost pressure

P: Measured boost pressure

Kt: Ambient temperature correction coefficient for boost pressure

Pa: Boost pressure correction value

- The turbocharger must be inspected and/or adjusted if **Pb** is below the specified limit.



1. A: i l l i l l i

- | | |
|-------------------------|-------------------------------|
| 1 Air inlet duct | 7 Connector |
| 2 Connector | 8 Air box |
| 3 PCV hose | 9 Rubber seal |
| 4 Air hose | 10 Air cleaner cap |
| 5 Insulator | 11 Air cleaner element |
| 6 Air duct | 12 Air cleaner case |

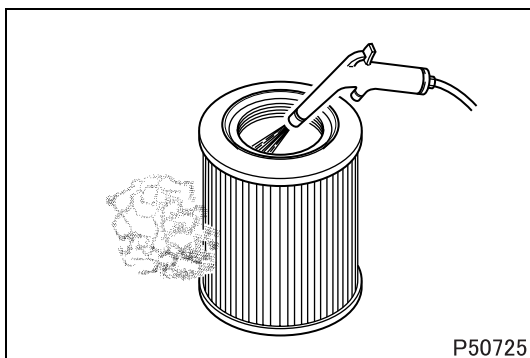
- 1** Air inlet duct **7** Connector ***a:** Turbocharger
2 Connector **8** Air box **⊗:** Non-reusable parts
3 PCV hose **9** Rubber seal PCV: Positive Crankcase Ventilation

Follow the disassembly sequence in reverse.

--	--

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3.0 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	—

◆ Cleaning procedure ◆



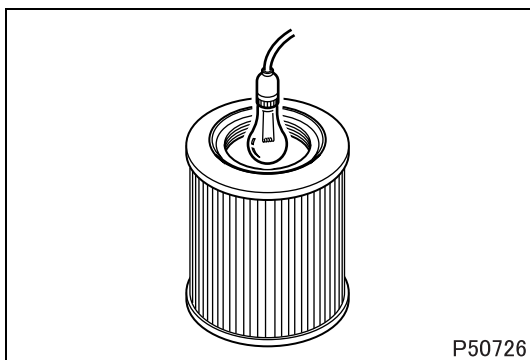
■ Cleaning: Filter element

- Blow a jet of compressed air at a pressure not higher than 685 kPa {100 psi, 7 kgf/cm²} against the inside surfaces of the element.
- Move the compressed air jet up and down along all pleats of the filter paper element.

CAUTION ⚠

- Do not strike the element or hit it against another object to remove dust.
- Do not blow compressed air against outside surfaces of the element.

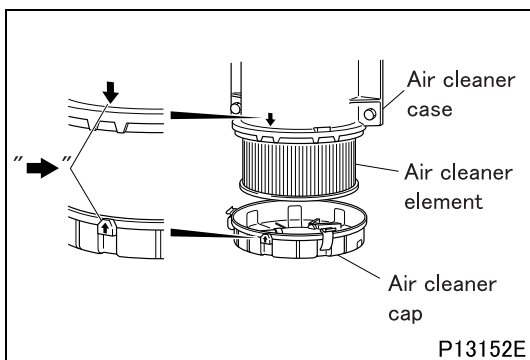
◆ Inspection procedure ◆



■ Inspection: Element

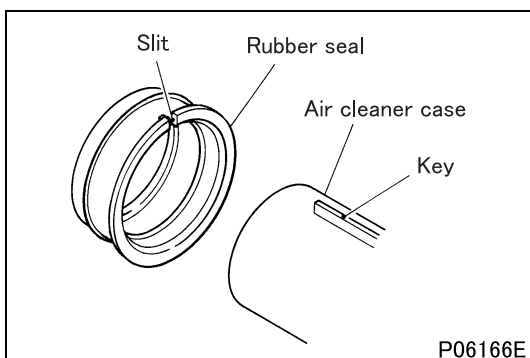
- Shine some electric light inside the element.
 - Replace the element if thin spots or broken parts are evident in the filter paper, or if the packing at the top of the element is damaged.
- Also replace the element if the dust on the element is damp with oily smoke or soot, regardless of the replacement schedule.

◆ Installation procedure ◆



■ Installation: Air cleaner cap

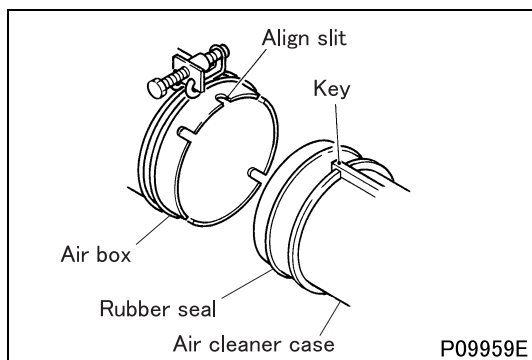
➡ : Alignment mark



■ Installation: Rubber seal

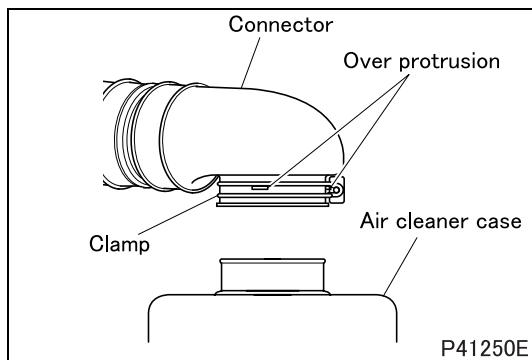
- Align slit of rubber seal with key of air cleaner case.

AIR DUCT AND AIR CLEANER <EXCEPT CREW CAB>



■ Installation: Air box

- Align slit of air box with key of air cleaner case.

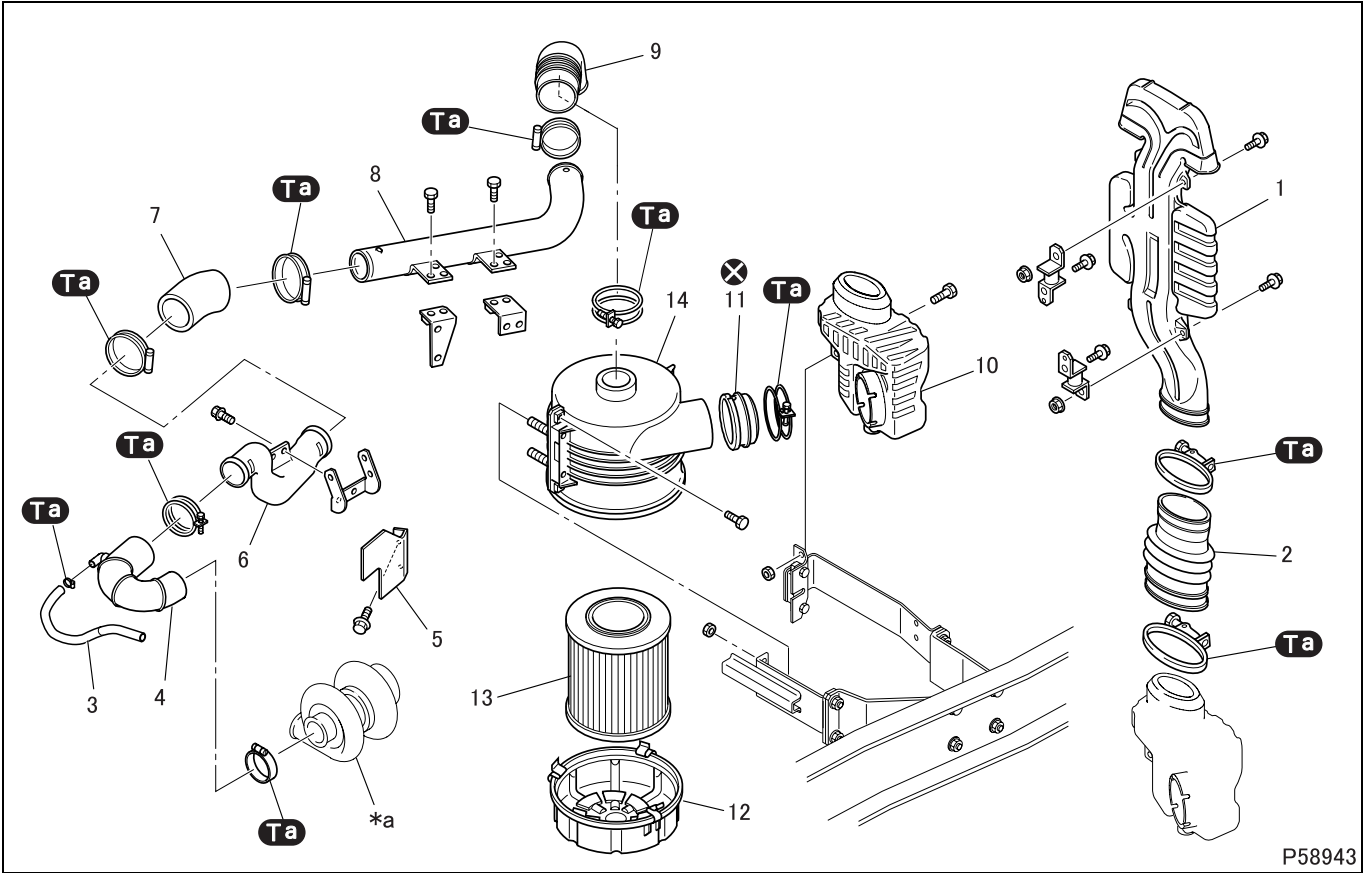


■ Installation: Air duct

- Fit clamp over protrusions of connector.
- Push air duct in until it hits air cleaner case.

M E M O

AIR DUCT AND AIR CLEANER <CREW CAB>



● Disassembly sequence

- | | | |
|------------------|--------------------|-------------------------------------|
| 1 Air inlet duct | 7 Air hose | 13 Air cleaner element |
| 2 Connector | 8 Air pipe | 14 Air cleaner case |
| 3 PCV hose | 9 Connector | |
| 4 Air hose | 10 Air box | *a: Turbocharger |
| 5 Insulator | 11 Rubber seal | ⊗: Non-reusable parts |
| 6 Air duct | 12 Air cleaner cap | PCV: Positive Crankcase Ventilation |

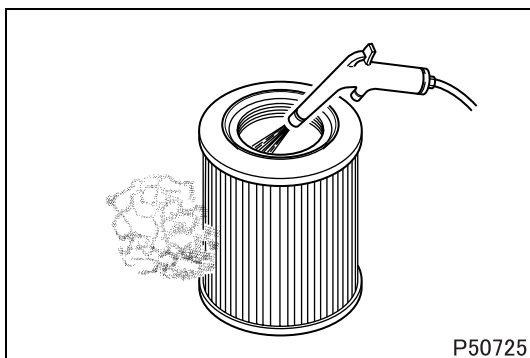
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3.0 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	—

◆ Cleaning procedure ◆



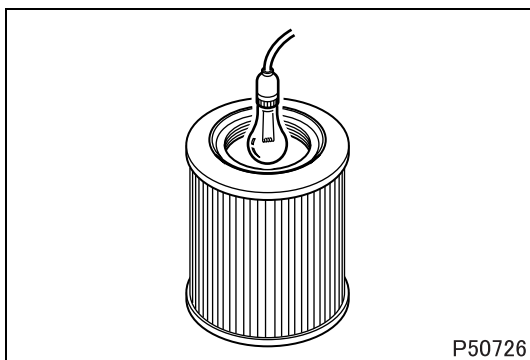
■ Cleaning: Filter element

- Blow a jet of compressed air at a pressure not higher than 685 kPa {100 psi, 7 kgf/cm²} against the inside surfaces of the element.
- Move the compressed air jet up and down along all pleats of the filter paper element.

CAUTION ⚠

- Do not strike the element or hit it against another object to remove dust.
- Do not blow compressed air against outside surfaces of the element.

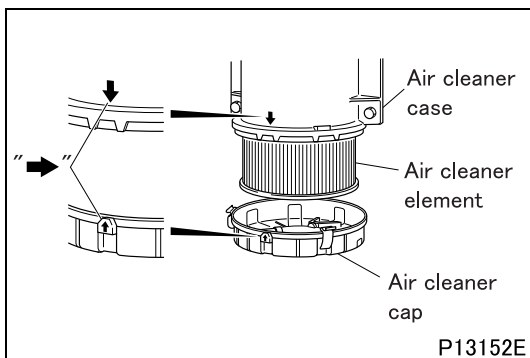
◆ Inspection procedure ◆



■ Inspection: Element

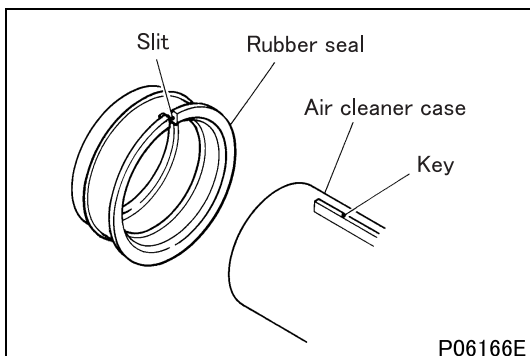
- Shine some electric light inside the element.
 - Replace the element if thin spots or broken parts are evident in the filter paper, or if the packing at the top of the element is damaged.
- Also replace the element if the dust on the element is damp with oily smoke or soot, regardless of the replacement schedule.

◆ Installation procedure ◆



■ Installation: Air cleaner cap

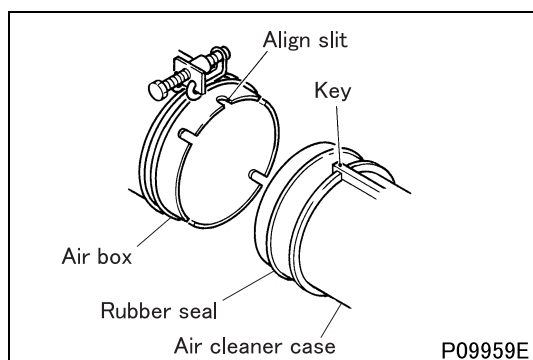
➡ : Alignment mark



■ Installation: Rubber seal

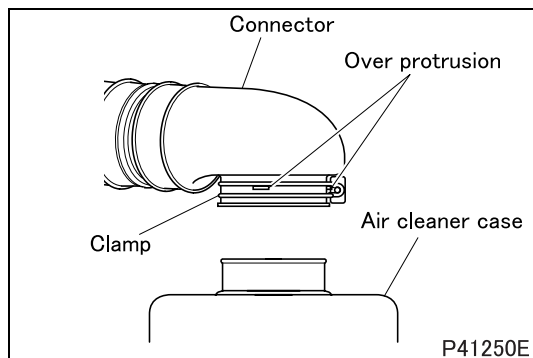
- Align slit of rubber seal with key of air cleaner case.

AIR DUCT AND AIR CLEANER <CREW CAB>



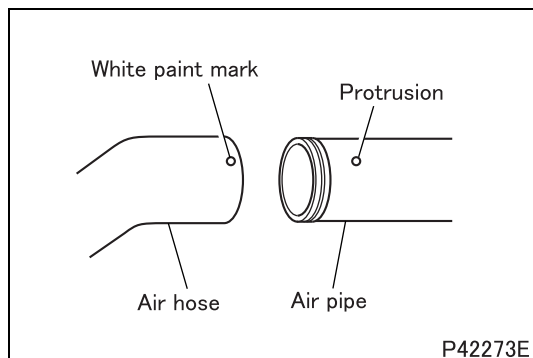
■ Installation: Air box

- Align slit of air box with key of air cleaner case.



■ Installation: Air duct

- Fit clamp over protrusions of connector.
- Push air duct in until it hits air cleaner case.

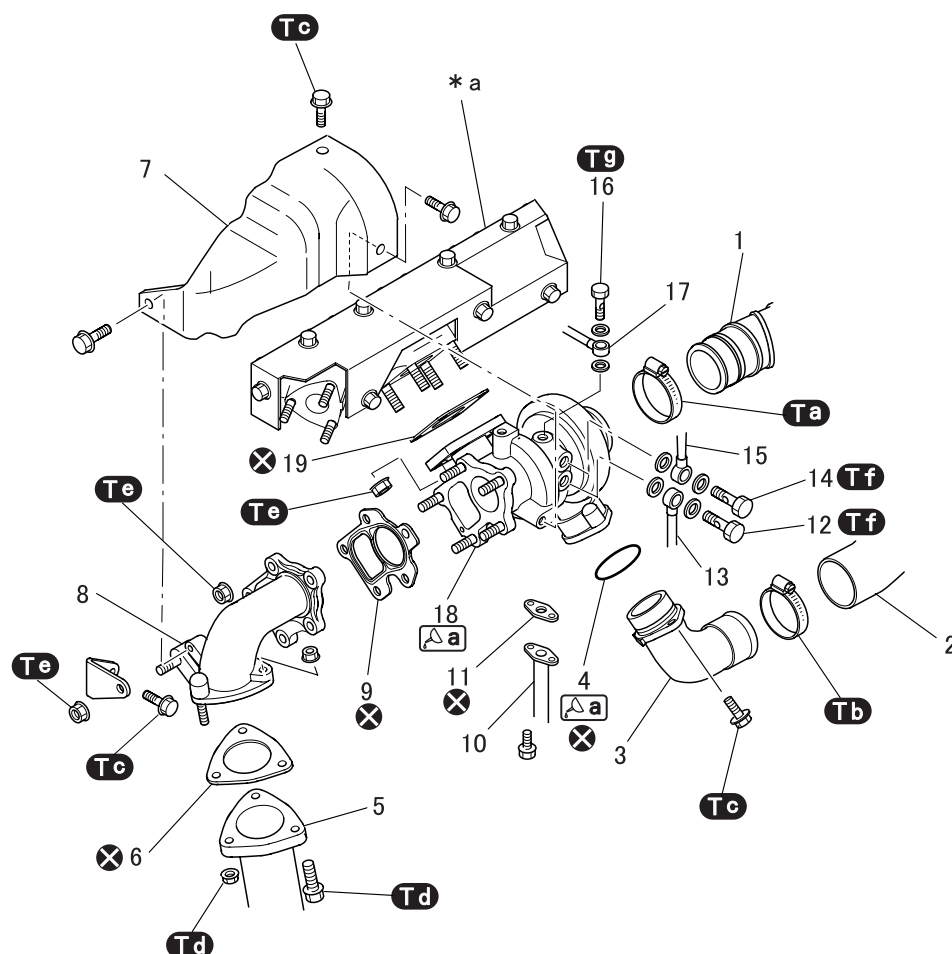


■ Installation of connector

- Align paint mark on connector with protrusion on air pipe, and push in the Air hose.

M E M O

TURBOCHARGER



P58898

● Removal sequence

- | | | |
|------------------------|--------------------------|---|
| 1 Air hose | 9 Gasket | 17 Oil pipe |
| 2 Air inlet hose | 10 Oil return pipe | 18 Turbocharger
(See later section.) |
| 3 Turbocharger coupler | 11 Gasket | 19 Gasket |
| 4 O-ring | 12 Eye bolt | |
| 5 Front pipe | 13 Water pipe | |
| 6 Gasket | 14 Eye bolt | *a : Exhaust manifold |
| 7 Insulator | 15 Water and vacuum pipe | ⊗ : Non-reusable parts |
| 8 Exhaust coupler | 16 Eye bolt | |

● Installation sequence

Follow the removal sequence in reverse.

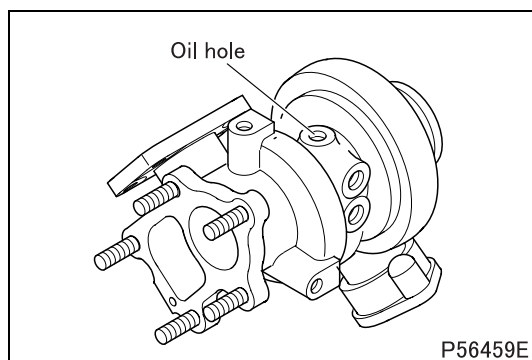
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	–
Tb	Clamp	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	–
Tc	Bolt (Turbocharger coupler mounting)	23.2 {17, 2.4}	–
	Bolt (Insulator mounting)		
	Bolt (Exhaust pipe stay mounting)		
Td	Bolt (Front pipe mounting)	25 to 30 {18 to 22, 2.5 to 3.1}	–
	Nut (Front pipe mounting)		
Te	Nut (Exhaust coupler stay mounting)	53 {39, 5.4}	–
	Nut (Exhaust coupler mounting)		
	Nut (Turbocharger mounting)		
Tf	Eye bolt (water pipe mounting)	25.5 {19, 2.6}	–
	Eye bolt (water and vacuum pipe mounting)		
Tg	Eye bolt (Oil pipe mounting)	23.5 {17, 2.4}	–

Lubricant and/or sealant

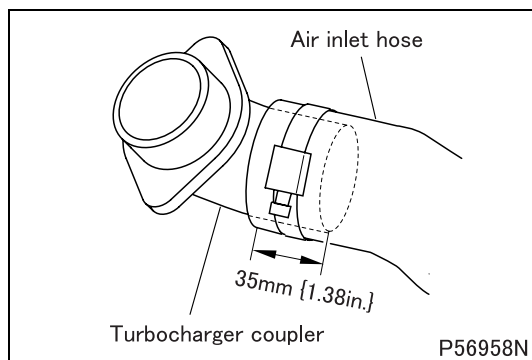
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	O-ring	Engine oil	As required
	Turbocharger		

◆ Installation procedure ◆



■ Installation: Turbocharger

- When installing the turbocharger, fill adequate amount of engine oil through the oil hole for smooth operation.

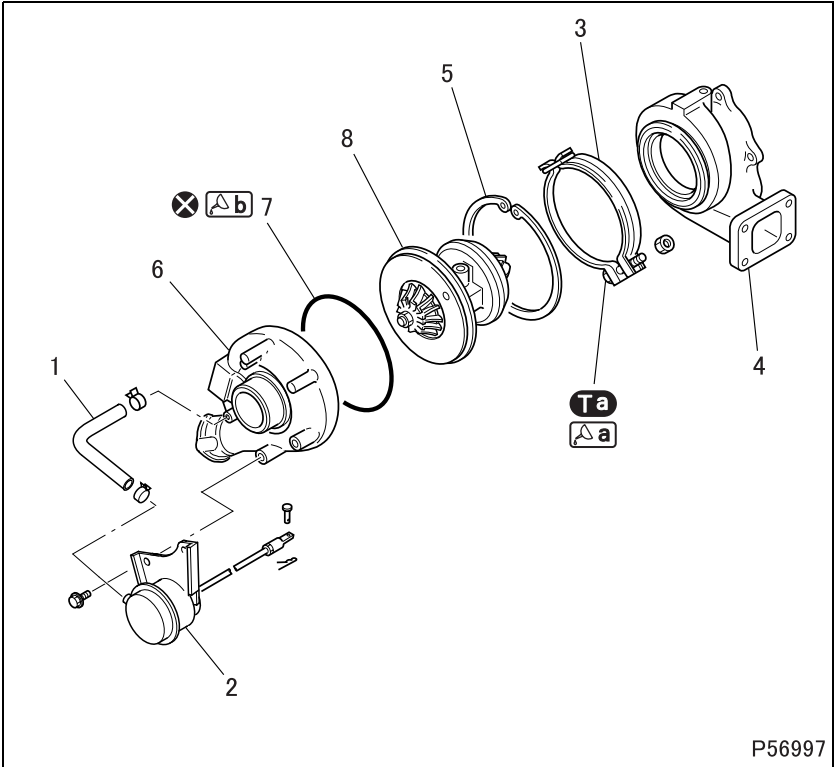


■ Installation: Air inlet hose

- Install the air inlet hose on the turbocharger coupler to the indicated dimension.

TURBOCHARGER

Turbocharger



● Disassembly sequence

- 1 Hose
- 2 Actuator
- 3 Coupling
- 4 Turbine housing
- 5 Snap ring
- 6 Compressor cover
- 7 O-ring
- 8 Cartridge assembly

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- The cartridge assembly cannot be disassembled. If the turbine wheel or the compressor cover is damaged or does not rotate smoothly, replace the entire cartridge assembly.

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
8	Cartridge assembly	Play in axial directions		0.03 to 0.10 {0.0012 to 0.0039}	0.11 {0.0043}	Replace
		Play in radial directions	Turbine wheel end	0.40 to 0.53 {0.016 to 0.021}	0.58 {0.023}	Replace
			Compressor wheel end	0.55 to 0.66 {0.022 to 0.026}	0.72 {0.028}	Replace

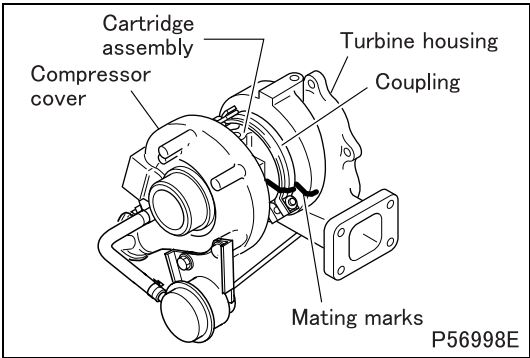
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (coupling fastening)	7.8 to 8.8 {5.8 to 6.5, 0.8 to 0.9}	Wet

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	MoriCoat BR-2 Plus	As required
b	O-ring	Engine oil	As required

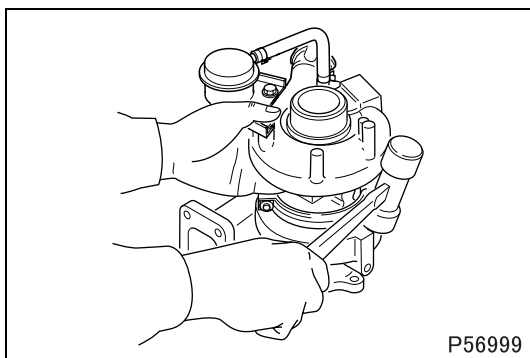
◆ Work before removal ◆



■ Mating marks

- Draw a line across the coupling, turbine housing, compressor cover, and cartridge assembly. This line will serve as mating marks in the installation procedure.

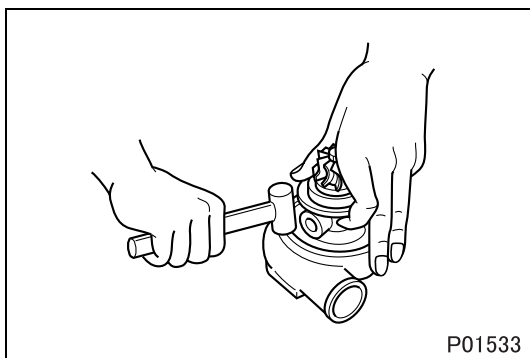
◆ Removal procedure ◆



■ Removal: Turbine housing

CAUTION ⚠

- Tap all around the end of the turbine housing with a rubber hammer or a similar tool, being careful not damage the turbine housing.
- Do not let the blades of the cartridge assembly hit the turbine housing, as they are easily bent.

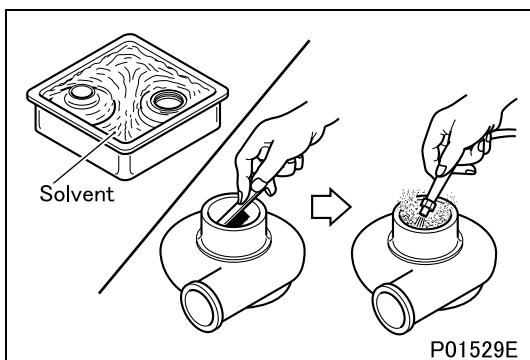


■ Removal: Compressor cover

CAUTION ⚠

- Tap all around the end of the turbine housing with a rubber hammer or a similar tool, being careful not damage the turbine housing.
- Do not let the blades of the cartridge assembly hit the turbine housing, as they are easily bent.

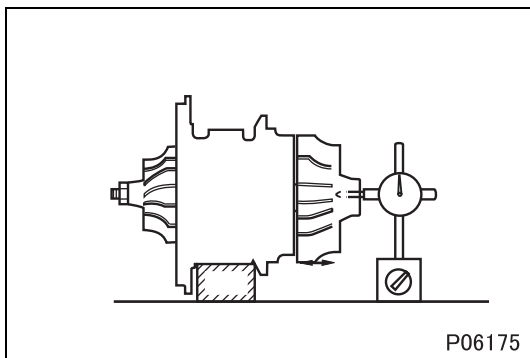
◆ Work after disassembly ◆



■ Cleaning

- Before cleaning the parts, carry out a visual inspection for any marks of burns or wear that may become difficult to find after the cleaning. If any defects are evident, replace the part(s).
- Immerse the disassembled parts in an inflammable solvent (Dai-cleaner-T-30 by Daido Chemical Industry Co., Ltd.). Remove the parts from the solvent, and dry them with compressed air. If there is any solid matter remaining on the parts, remove them with a plastic scraper or a bristle brush.
- Reimmerse the parts in the solvent.
- Dry each part with compressed air.

◆ Inspection procedure ◆



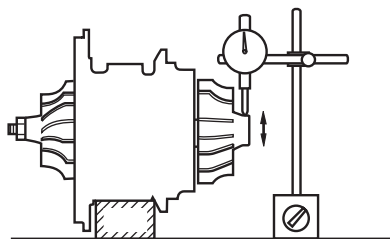
■ Inspection: Cartridge assembly

(1) Play in axial directions

- If the measurement exceeds the specified limit, replace the cartridge assembly.

TURBOCHARGER

<Turbine wheel end>

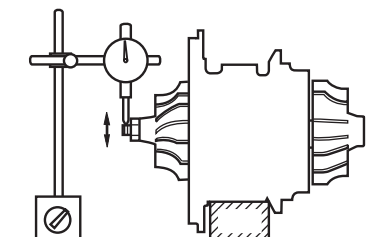


P06176E

(2) Play in radial directions

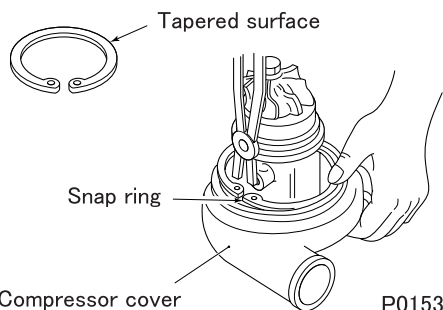
- If the measurement exceeds the specified limit, replace the cartridge assembly.

<Compressor wheel end>



P06177E

◆ Installation procedure ◆



P01532E

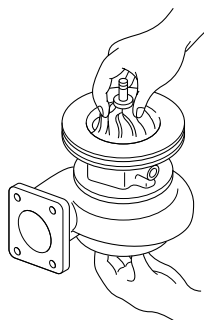
■ Installation: Snap ring

- Fit the snap ring into the compressor cover with the tapered surface on top.

CAUTION ⚠

- Always keep one hand on the snap ring to prevent it from flying off.

◆ Work after installation ◆



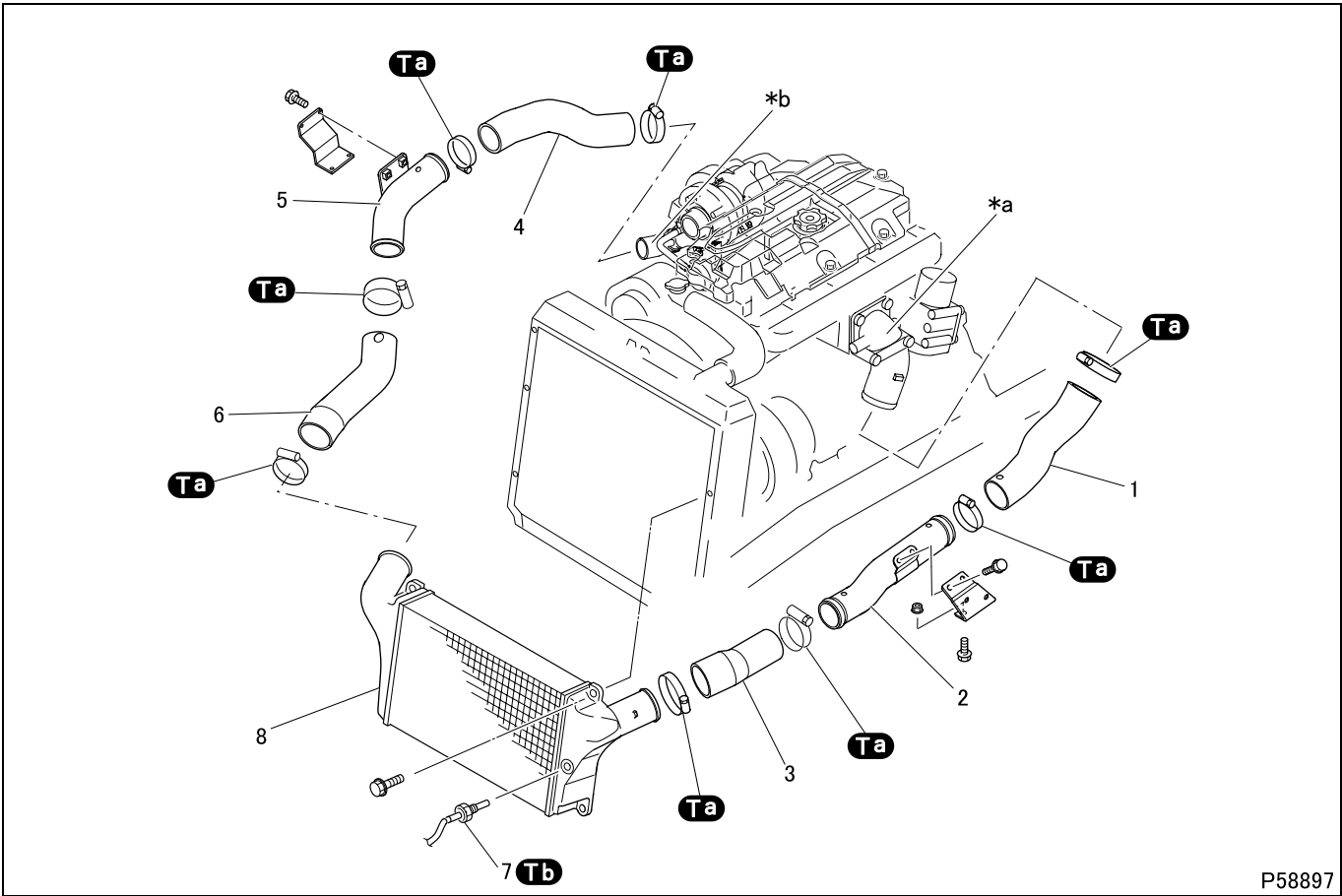
P06170

■ Inspection: Rotation of cartridge assembly

- Turn both wheels of the cartridge assembly to check that they rotate smoothly.
- If anything abnormal is found, disassemble the cartridge assembly and perform necessary service.

M E M O

INTERCOOLER



P58897

● Disassembly sequence

- | | |
|---------------------|-----------------------------|
| 1 Air inlet hose | 5 Air inlet pipe RH |
| 2 Air inlet pipe LH | 6 Air inlet hose |
| 3 Air inlet hose | 7 Intake temperature sensor |
| 4 Air inlet hose | 8 Intercooler |

***a:** Air inlet duct
***b:** Turbocharger coupler

CAUTION

- Do not remove forcibly the air inlet hose using a screwdriver or other similar tool. Doing so could damage the fluorine treatment layer on the inside surface of the hose, deteriorating the resistance to oil of the hose.

● Assembly sequence

Follow the disassembly sequence in reverse.

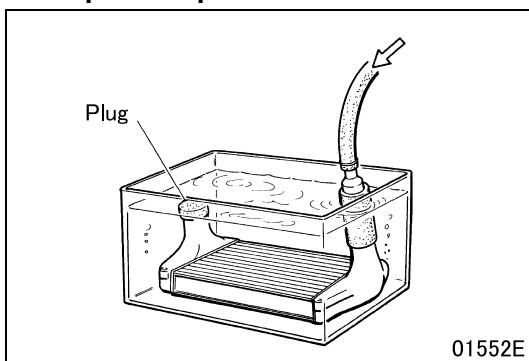
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
8	Intercooler air leakage (air pressure: 200 kPa {29 psi, 2.0 kgf/cm ² } maintained for 30 seconds)	0 cm ³ {0 cu.in.}	–	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

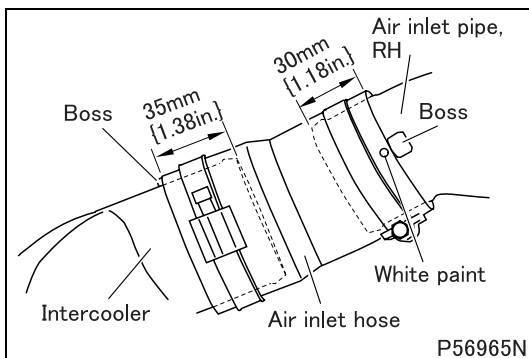
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	–
Tb	Intake temperature sensor	24.5 {18, 2.5}	–

◆ Inspection procedure ◆



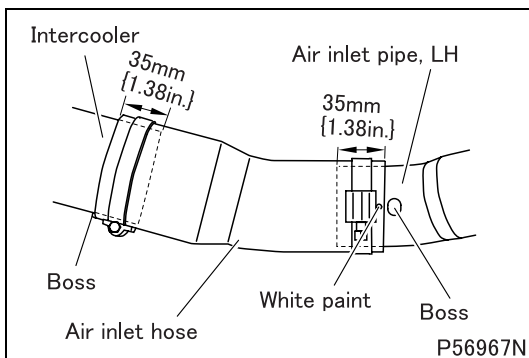
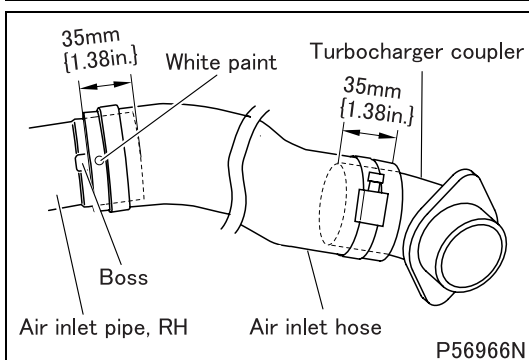
■ Inspection: Intercooler

- Plug one of the air ports on the intercooler and connect an air source to the other port. Place the intercooler in a tank of water and apply air pressure of the specified level (200 kPa {29 psi, 2.0 kgf/cm²}) to the intercooler and retain the pressure for 30 seconds.
- Replace the intercooler if any air leakage is evident.

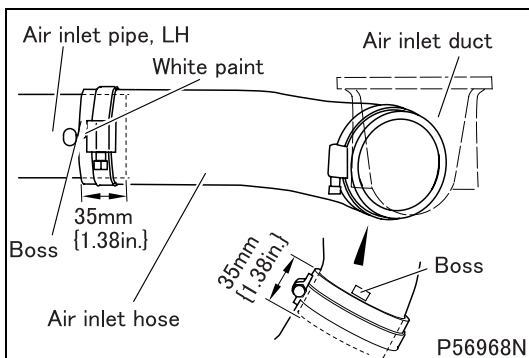


■ Installation: Air inlet hose

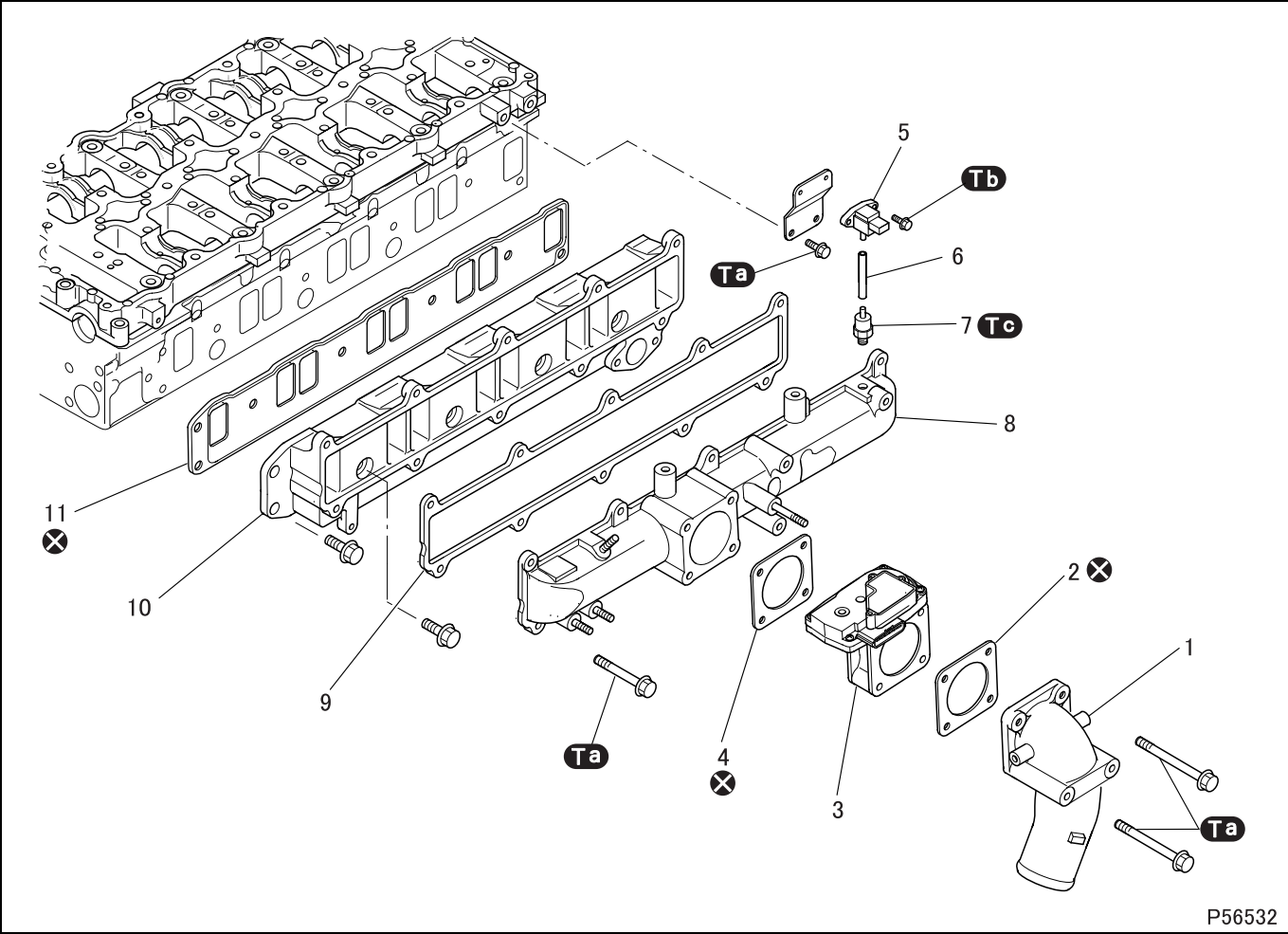
- Connect the air inlet hose to the RH air inlet pipe with the white paint on the hose aligned with the boss on the pipe.
- Connect the air inlet hoses to the intercooler, RH air inlet pipe and turbocharger coupler to the dimensions indicated in the illustrations.



- Connect the air inlet hose to the LH air inlet pipe with the white paint on the hose aligned with the boss on the pipe.
- Connect the air inlet hoses to the intercooler, LH air inlet pipe and air inlet duct to the dimensions indicated in the illustrations.



INTAKE MANIFOLD



P56532

Disassembly sequence

- | | |
|-------------------------|----------------------|
| 1 Air inlet duct | 6 Vacuum hose |
| 2 Gasket | 7 Gas filter |
| 3 Intake throttle | 8 Intake manifold B |
| 4 Gasket | 9 Gasket B |
| 5 Boost pressure sensor | 10 Intake manifold A |

11 Gasket A

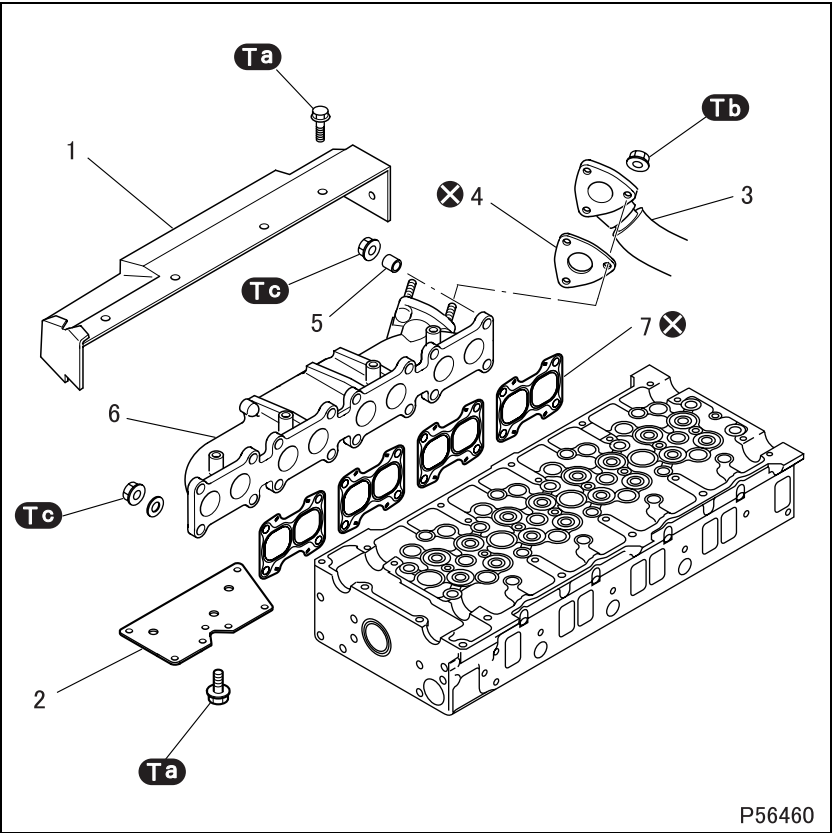
⊗: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Air inlet duct and throttle actuator mounting)	23.2 {17, 2.4}	—
	Bolt (Boost pressure sensor bracket mounting)		
	Bolt (Intake manifold B mounting)		
Tb	Bolt (Boost pressure sensor mounting)	12.7 {9.4, 1.3}	—
Tc	Gas filter	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	—



● Disassembly sequence

- 1 Insulator
- 2 Under insulator
- 3 Exhaust gas recirculation pipe
- 4 Gasket
- 5 Distance piece
- 6 Exhaust manifold
- 7 Gasket

⊗: Non-reusable parts

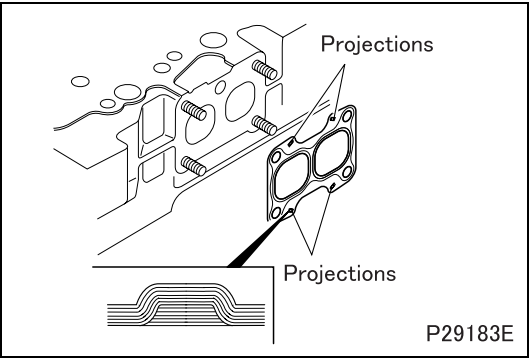
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (insulator mounting)	11.8 {8.7, 1.2}	—
Tb	Nut (exhaust gas recirculation pipe mounting)	20.6 {15, 2.1}	—
Tc	Nut (exhaust manifold mounting)	41.2 {30, 4.2}	—

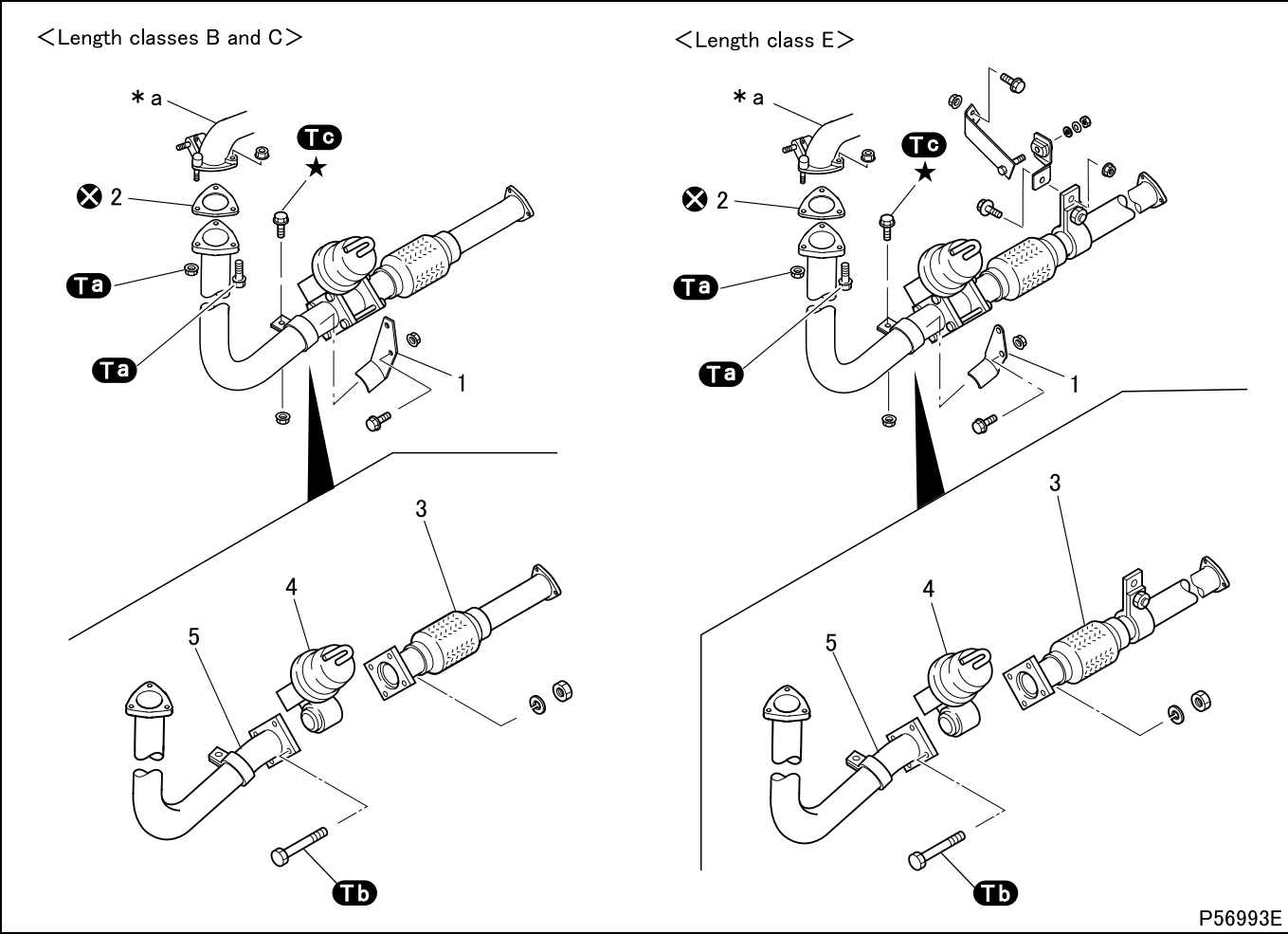
◆ Installation procedure ◆



■ Installation: Gasket

- Install the gasket on the cylinder head with their surfaces facing in the illustrated directions.

EXHAUST PIPE



P56993E

● Disassembly sequence

- 1 Brace bracket
- 2 Gasket
- 3 Front pipe
- 4 Exhaust brake unit
- 5 Front pipe

- *a Exhaust manifold
- ⊗ Non-reusable parts

CAUTION ⚠

- Loosen the ★ marked bolt first to prevent undue forces from being applied to the exhaust pipe.

● Assembly sequence

Follow the disassembly sequence in reverse.

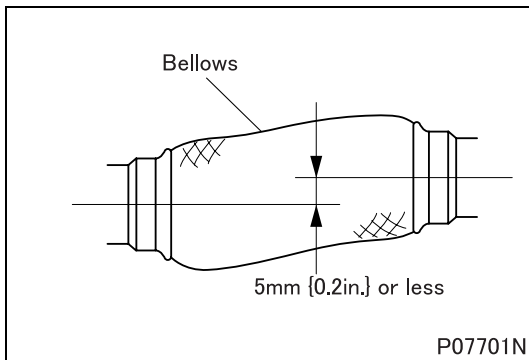
CAUTION ⚠

- Tighten the ★ marked bolt last to prevent undue forces from being applied to the exhaust pipe.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (front pipe mounting)	25 to 30 {18 to 22, 2.5 to 3.1}	—
	Bolt (front pipe mounting)		
Tb	Bolt (exhaust brake unit mounting)	27 {20 to 29, 2.75}	—

◆ Installation procedure ◆



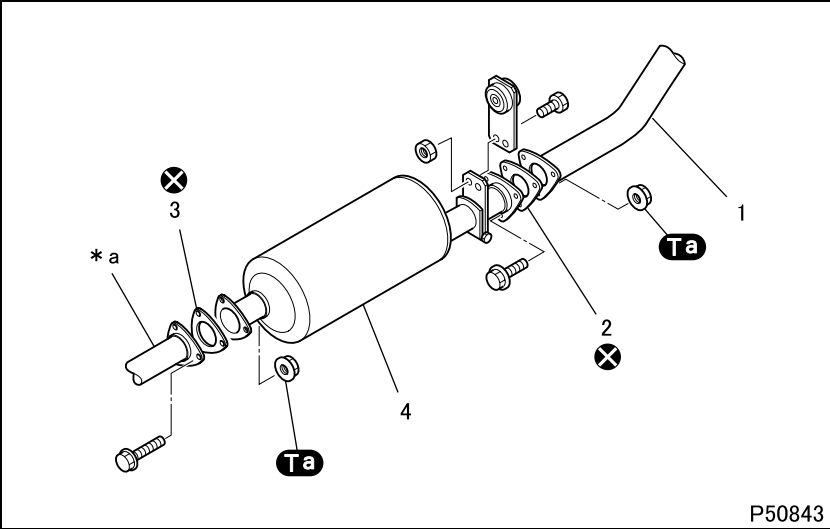
■ Installation: Front pipe

- Install the front pipe so that the amounts of offset in both vertical and horizontal directions between the pipes in front of and behind the bellows are smaller than the dimension indicated in the illustration.

CAUTION ⚠

- The bellows on the front pipe have the purpose of reducing the level of noise from the vehicle. It is not intended for compensating for misalignment that may result from improper installation of the front pipe. Install the front pipe properly to avoid excessive tension or other stress on the bellows.

MUFFLER



● Disassembly sequence

- 1 Tail pipe
- 2 Gasket
- 3 Gasket
- 4 Muffler

*a: Front pipe
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- Do not touch any of the water that may have accumulated inside the muffler. If you accidentally get some on your skin, wash it off immediately with water.

CAUTION ⚠

- Do not kick or strike the muffler, as this can cause damage to the catalyzer inside the muffler.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (tail pipe mounting)	26 to 33 {19 to 24, 2.7 to 3.2}	—
	Nut (muffler mounting)		



Group 17

Emission Control

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

STRUCTURE AND OPERATION

- 1. Exhaust Gas Recirculation System 17-2
- 2. Crankcase Emission Control System 17-7

EXHAUST GAS RECIRCULATION SYSTEM

- 1. Inspection Procedure 17-8
- 2. Cautions to Observe When Performing Inspections 17-9
- 3. Inspections Based on Diagnosis Codes 17-10
- 4. Multi-Use Tester Service Data 17-12
- 5. Actuator Tests Performed Using Multi-Use Tester 17-12
- 6. Inspections Performed at Electronic Control Unit Connectors 17-13
- 7. Inspection of Electrical Equipment 17-14
- 8. Installed Locations of Parts 17-15
- 9. Electric Circuit Diagram 17-20

EXHAUST GAS RECIRCULATION VALVE, PIPE AND COOLER... 17-24

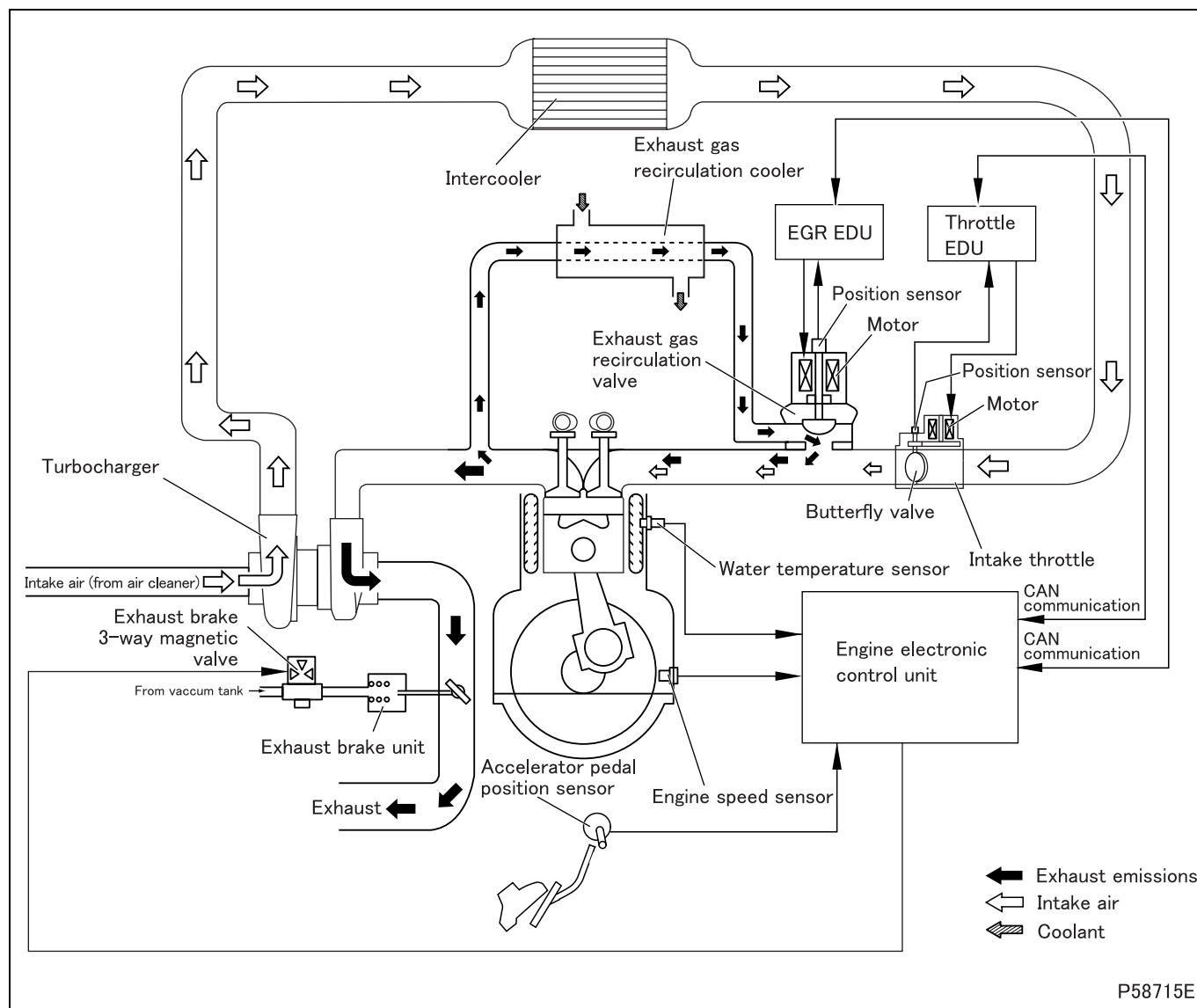
CRANKCASE EMISSION CONTROL SYSTEM 17-26

STRUCTURE AND OPERATION

1. Exhaust Gas Recirculation System

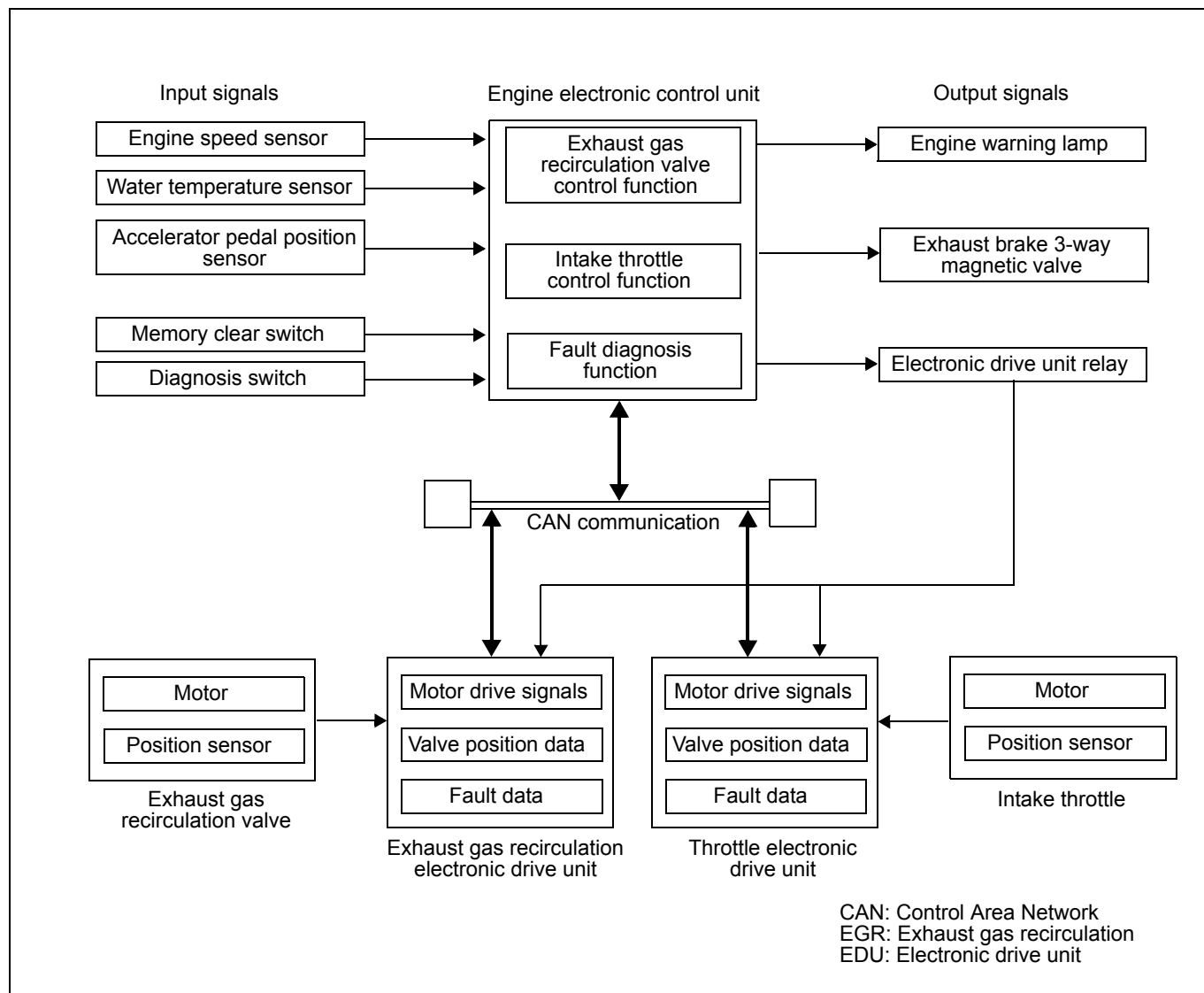
1.1 Overview

- In the exhaust gas recirculation system, the engine electronic control unit and multiple electronic drive units control the exhaust gas recirculation valve and intake throttle in accordance with information from sensors on various aspects of the engine (engine speed, coolant temperature, throttle opening, etc.).
- Exhaust gas recirculation involves the introduction of inert gases in the post-combustion exhaust emissions into the intake manifold. By reducing the combustion temperature, it reduces the amount of nitrogen oxides (NO_x), which are harmful, in the exhaust emissions. Further, an exhaust gas recirculation cooler cools the recirculated exhaust emissions, thereby reducing the peak combustion temperature.
- The intake air quantity is adjusted by means of intake throttle control such that the effectiveness of exhaust gas recirculation is maximized.



1.2 Electronic control system

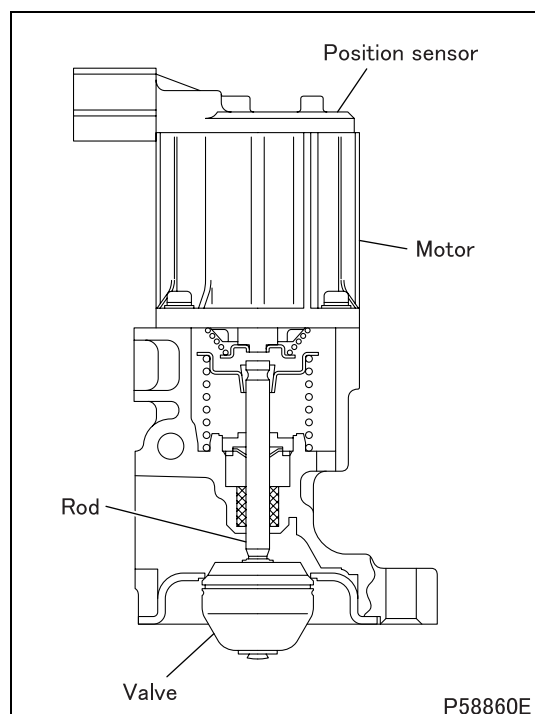
(1) System block diagram



STRUCTURE AND OPERATION

(2) Exhaust gas recirculation valve control function

- In accordance with data from sensors, the engine electronic control unit determines the exhaust gas recirculation valve opening that suits the operating condition and sends a control signal (this indicates the target exhaust gas recirculation valve opening) to the exhaust gas recirculation electronic drive unit.
When necessary to prevent black smoke emissions and engine speed instability (for example, when the engine is heavily loaded, when the engine is lightly loaded, and when the exhaust brake is operating), the engine electronic control unit stops exhaust gas recirculation valve control.
- The exhaust gas recirculation electronic drive unit activates the exhaust gas recirculation valve motor. At the same time, it monitors the extent of valve lift using a position sensor and sends this information (this indicates the actual exhaust gas recirculation valve opening) to the engine electronic control unit.
This operation makes it possible for the target exhaust gas recirculation valve opening indicated by the engine electronic control unit to be precisely maintained.

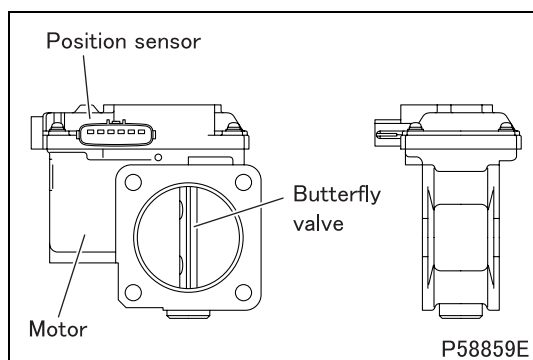


(2.1) Exhaust gas recirculation valve

- A motor in the exhaust gas recirculation valve is driven by control signals from the exhaust gas recirculation electronic drive unit. Via a rod, the motor's operation opens and closes the valve.

(3) Intake throttle control function

- When the engine electronic control unit determines from sensor data on the engine speed and engine loading that the vacuum pressure in the intake manifold is low, it increases the amount of exhaust emissions introduced into the intake manifold by determining an appropriate butterfly valve opening and by sending corresponding control signals (these indicate the target throttle opening) to the throttle electronic drive unit.
- The throttle electronic drive unit activates the valve motor. At the same time, it monitors the valve opening using a position sensor and sends this information (this indicates the actual throttle opening) to the engine electronic control unit.
This operation makes it possible for the target throttle opening indicated by the engine electronic control unit to be precisely maintained.



(3.1) Intake throttle

- In accordance with signals from the throttle electronic drive unit, the motor opens and closes the butterfly valve, thereby adjusting the intake air amount such that the effectiveness of exhaust gas recirculation is maximized.

(4) Fault diagnosis function

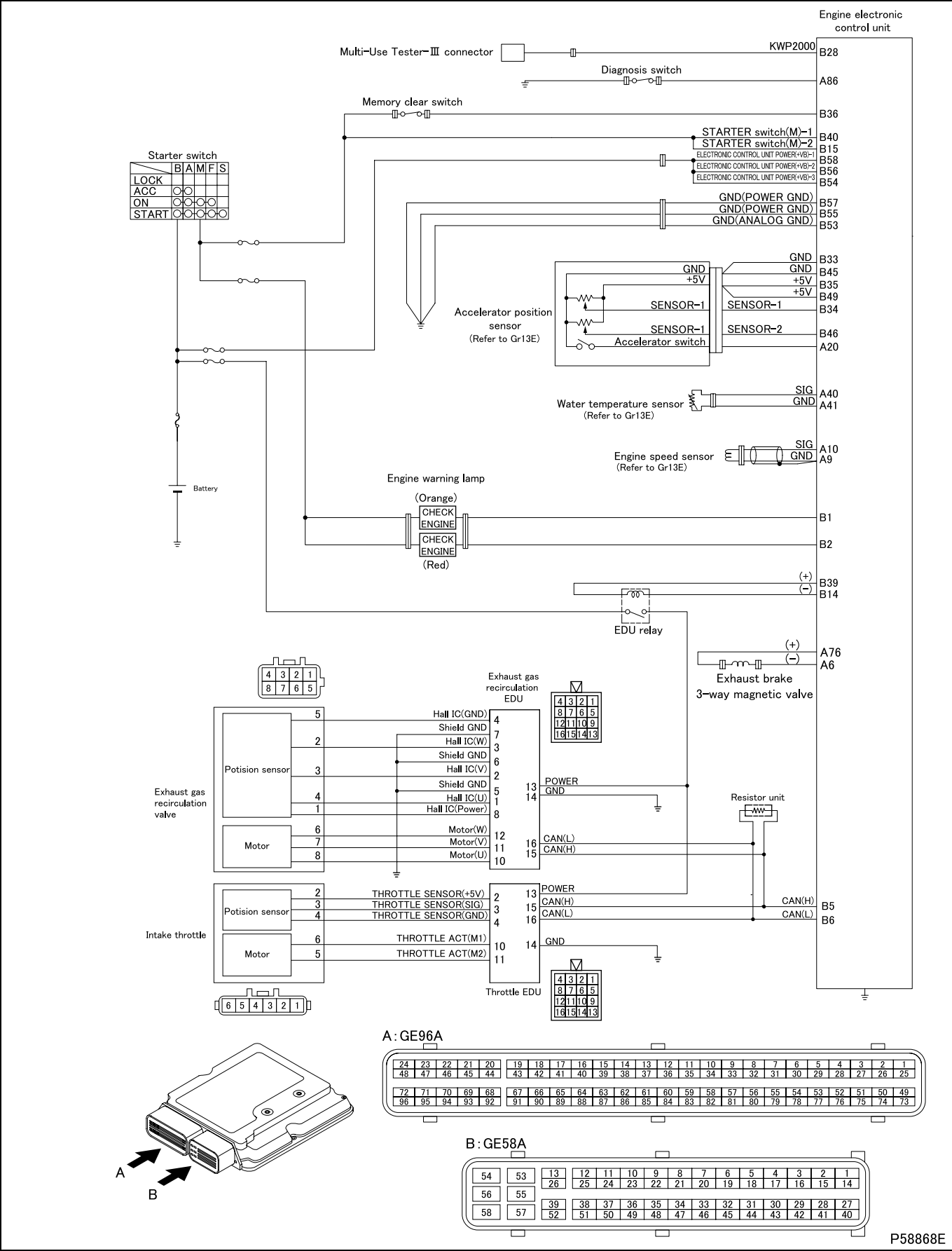
- While the starter switch is in the ON position, the engine electronic control unit continuously monitors the electronic drive units and sensors for faults. In the event that the engine electronic control unit finds a component faulty, it causes an indication to be made in the meter cluster to alert the driver. At the same time, it memorizes the fault location in the form of a diagnosis code and starts a control during fault.
- While the engine is running, the exhaust gas recirculation electronic drive unit and throttle electronic drive unit continuously monitor communication with the position sensor and motor of the exhaust gas recirculation valve, communication with the position sensor and motor of the intake throttle, and communication with the engine electronic control unit. In the event that they identify a fault, they send fault data to the engine electronic control unit.
- While control necessitated by a fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

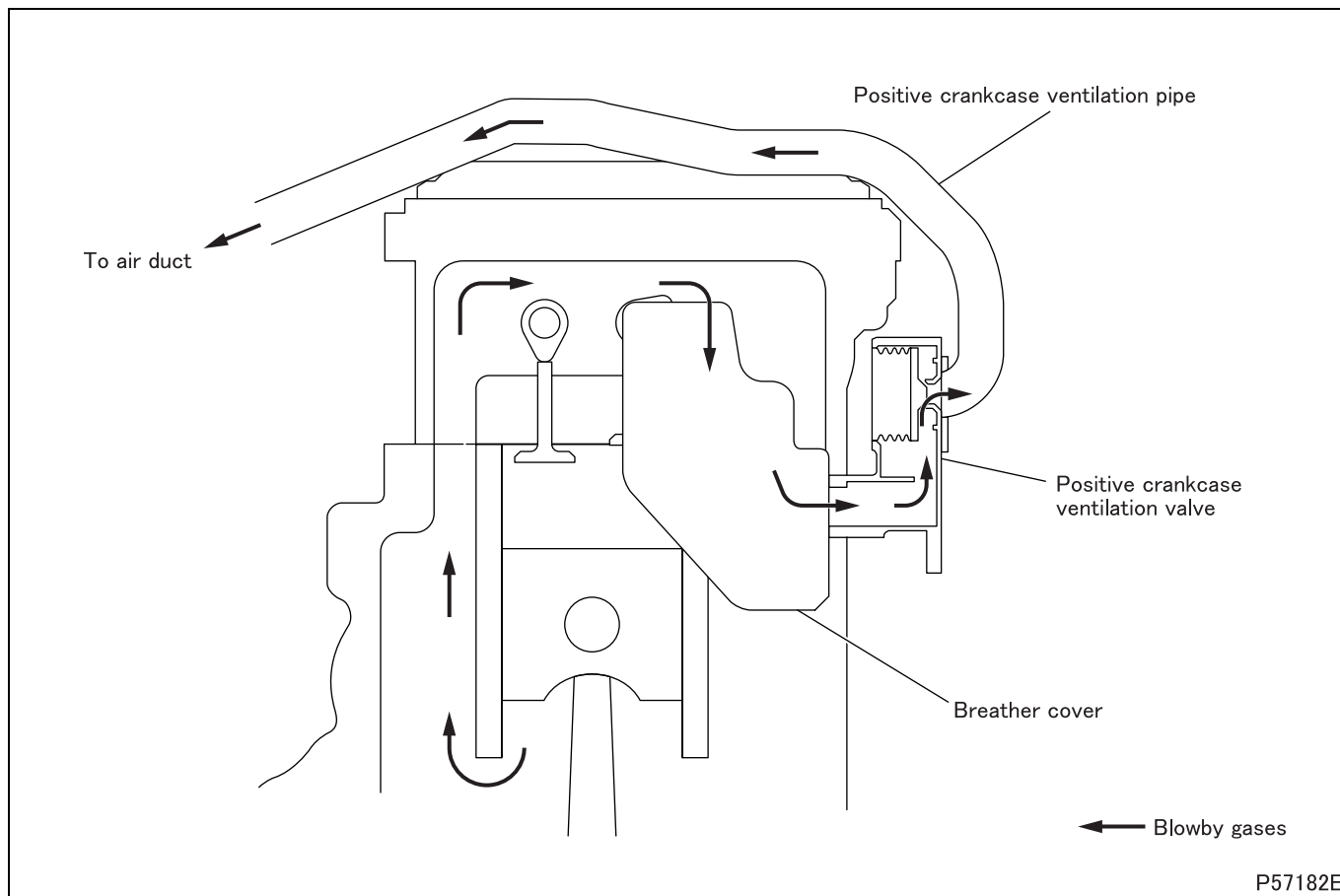
STRUCTURE AND OPERATION

1.3 Electronic control unit connection diagram



P58868E

2. Crankcase Emission Control System

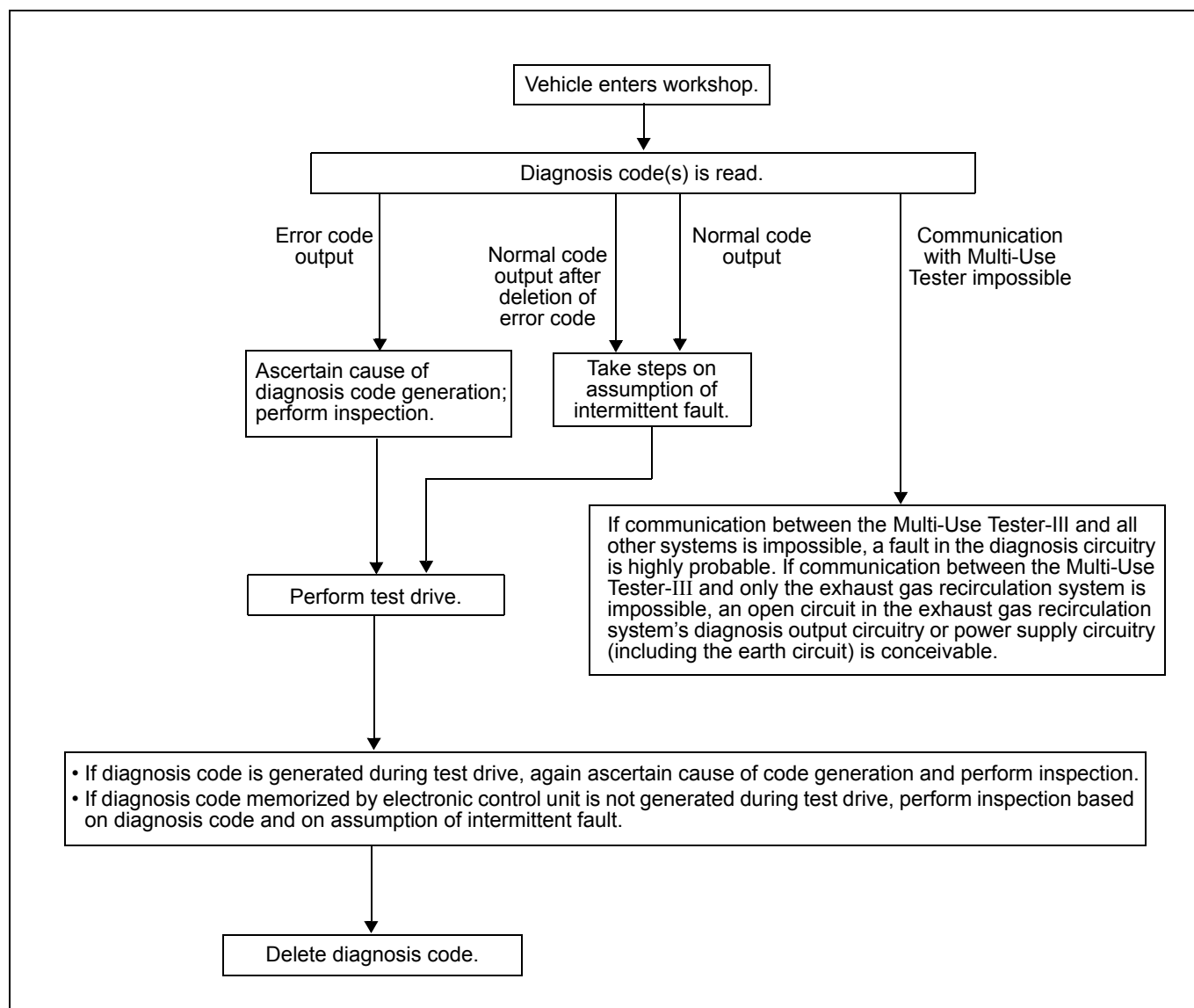


- The crankcase emission control system returns blowby gases to an air duct to prevent them from being released to the outside air.
- The positive crankcase ventilation valve keeps constant the pressure inside the crankcase.

EXHAUST GAS RECIRCULATION SYSTEM

1. Inspection Procedure

- System inspection can be performed most effectively using a Multi-Use Tester-III. Types of system inspection are broadly classified in accordance with fault symptoms and diagnosis codes as follows:
 - Inspection based on diagnosis code memorized by electronic control unit
 - Inspection performed on assumption of intermittent fault



2. Cautions to Observe When Performing Inspections

CAUTION

- The battery voltage must be the standard voltage.
 - Make sure no harness connector or component connector is loose. Before disconnecting any connector, place the starter switch in the LOCK position and wait 20 seconds.
 - After effecting a repair, delete the diagnosis code using the Multi-Use Tester-III or memory clear switch.
 - As a general rule, inspection work should be performed with the starter switch in the LOCK position. However, it may be necessary to perform certain tasks with the starter switch in the ON position. At these times, be careful not to cause short circuits between connector terminals and between terminals and the vehicle body.
 - Indicated component resistances may not fall within the standard ranges if they are unduly affected by the temperature and/or by the accuracy of the tester. Standard values in the text are given on the assumption of room temperature (10 to 35°C {50 to 95°F}).
 - After rectification of an abnormality, the system's ability or inability to automatically return to normal control from the special control that begins when a fault occurs depends upon the diagnosis code, i.e., the fault location. When the system resumes normal control, the warning lamp goes off.
 - Even when an abnormality has been rectified and the system has automatically returned to normal control, the diagnosis code corresponding to the fault location remains in the memory of the electronic control unit.
 - Following a fault that does not permit an automatic return to normal control from the special control that begins when a fault occurs, it is necessary to clear the diagnosis code from memory in order for the system to recover.
-

EXHAUST GAS RECIRCULATION SYSTEM

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

NOTE

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Flashes
P0403	EGR 1	67
P0404	EGR System	02
P1121	Intake Throttle 1	28
P1625	EDU Relay	84
P1630	CAN (EGR)	95
P1635	CAN (Intake Throttle)	96

3.2 Diagnosis code generation conditions and inspection items

P0403: EGR 1 (warning lamp flashes: 67)

Generation condition		• Any of the following items: • Exhaust gas recirculation motor is short-circuited to earth, short-circuited to power supply line, or open-circuited. • Exhaust gas recirculation position sensor is open-circuited. • Abnormality (target position data outside range, data not received, etc.) occurs in communication between electronic drive unit and exhaust gas recirculation valve. • Power supply voltage is abnormal (excessively high or excessively low).
Recoverability		• Motor or sensor abnormality: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. • Communication or power supply voltage abnormality: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control and throttle control are stopped. • Exhaust gas recirculation system error evaluation is stopped.
Inspection	Service data	1F: EGR Position
	Actuator test	A1: EGR 1
	Electrical equipment	• #530: Exhaust gas recirculation valve • Exhaust gas recirculation electronic drive unit • Engine electronic control unit
	Electric circuit diagram	Engine electronic control unit, exhaust gas recirculation electronic drive unit, and exhaust gas recirculation valve systems

P0404: EGR System (warning lamp flashes: 02)

Generation condition		Motor abnormality (permanent)
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Normal control is effected.
Inspection	Service data	1F: EGR Position
	Actuator test	A1: EGR 1
	Electrical equipment	• #530: Exhaust gas recirculation valve • Exhaust gas recirculation electronic drive unit • Engine electronic control unit
	Electric circuit diagram	Exhaust gas recirculation electronic drive unit and exhaust gas recirculation valve systems

P1121: Intake Throttle 1 (warning lamp flashes: 28)

Generation condition		Intake throttle abnormality (motor abnormality, position sensor abnormality, or motor seizure)
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Normal control is effected.
Inspection	Actuator test	A7: Intake Throttle 1
	Electrical equipment	• #529: Intake throttle • Throttle electronic drive unit • Engine electronic control unit
	Electric circuit diagram	Engine electronic control unit, throttle electronic drive unit, and intake throttle systems

P1625: EDU Relay (warning lamp flashes: 84)

Generation condition		Electronic drive unit relay is short-circuited, open-circuited, or overloaded.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control and throttle control are stopped. (Exhaust emissions worsen.)
Inspection	Service data	90: EDU Power Relay
	Actuator test	B2: EDU Relay
	Electronic control unit connector	01 : Electronic drive unit relay
	Electrical equipment	#201: Electronic drive unit relay
	Electric circuit diagram	Electronic drive unit relay system

P1630: CAN (EGR) (warning lamp flashes: 95)

Generation condition		Communication with exhaust gas recirculation electronic drive unit is impossible. (CAN messages are not received for certain period, or CAN bus is off.)
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control and throttle control are stopped. (Exhaust emissions worsen.)
Inspection	Actuator test	A1: EGR 1
	Electrical equipment	• Exhaust gas recirculation electronic drive unit • Engine electronic control unit
	Electric circuit diagram	CAN communication circuitry to engine electronic control unit and exhaust gas recirculation electronic drive unit

P1635: CAN (Intake Throttle) (warning lamp flashes: 96)

Generation condition		Communication with throttle electronic drive unit is impossible. (CAN messages are not received for certain period, or CAN bus is off.)
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control and throttle control are stopped. (Exhaust emissions worsen.)
Inspection	Actuator test	A7: Intake Throttle 1
	Electrical equipment	• Throttle electronic drive unit • Engine electronic control unit
	Electric circuit diagram	CAN communication circuitry to engine electronic control unit and throttle electronic drive unit

EXHAUST GAS RECIRCULATION SYSTEM

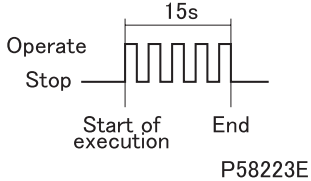
4. Multi-Use Tester Service Data

NOTE

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
1F	EGR Position	■■■■.■ %	Idling	0 %
20	Intake Throttle Position	■■■■.■ %	Idling	50 %
90	EDU Power Relay	ON/OFF	Starter switch ON	ON
			Starter switch OFF	OFF
			[Actuator test] B2: EDU relay	

5. Actuator Tests Performed Using Multi-Use Tester

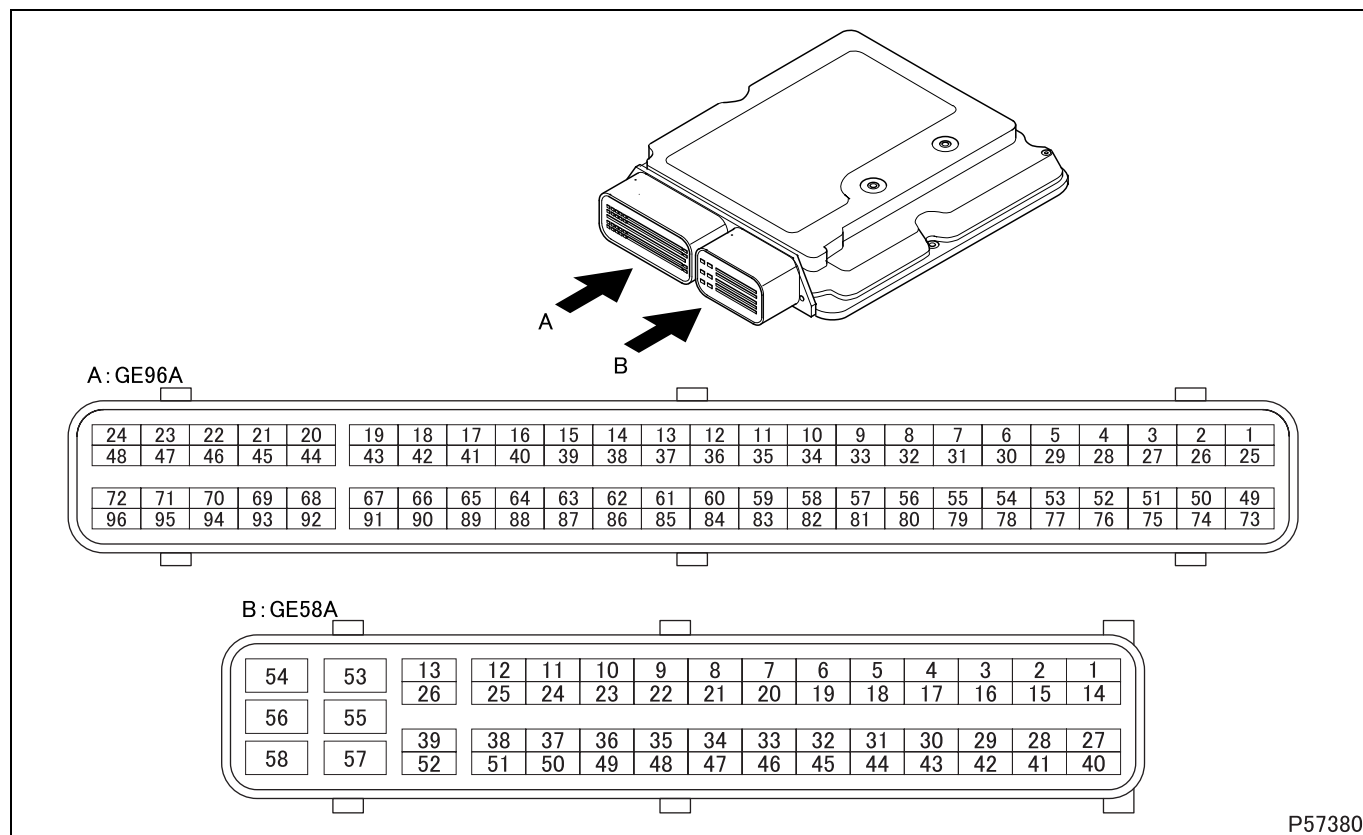
No.	Item	Explanation	Confirmation method
A1	EGR 1	Maintain exhaust gas recirculation valve opening indicated by Multi-Use Tester.	[Service data] 1F: EGR Position
A7	Intake Throttle 1	Maintain intake throttle opening indicated by Multi-Use Tester.	[Service data] 20: Intake Throttle position
B2	EDU Relay	Electronic drive unit relay drive signal (Errors related to exhaust gas recirculation and to the intake throttle can be detected when this actuator test is executed.)  P58223E	Relay operating sound [Service data] 90: EDU Power Relay

6. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.

The white-on-black number **01** corresponds to the similarly printed reference number in section “3. Inspections based on diagnosis codes”.

6.1 Electronic control unit connector terminal layout



P57380

6.2 Inspection instructions

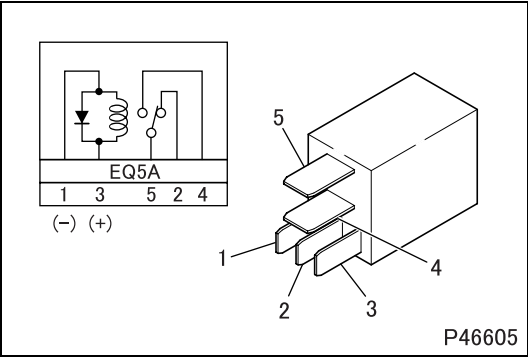
CAUTION ⚠

- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:
- Do not touch any terminal except those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.

Check item	Measurement method
01 Voltage of electronic drive unit relay	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): B39-B14 - With relay operating: Corresponding to battery voltage - With relay not operating: 0V

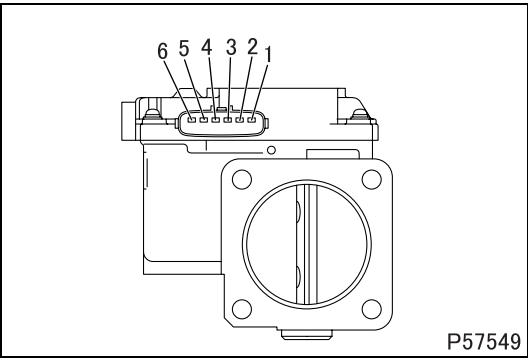
EXHAUST GAS RECIRCULATION SYSTEM

7. Inspection of Electrical Equipment



#201 Inspection of relay (normally open, 5 pins)

- Perform a continuity check and an operation check. If there is any abnormality, replace the relay.



#529 Inspection of intake throttle

- Perform the following checks. If there is any abnormality, replace the throttle.

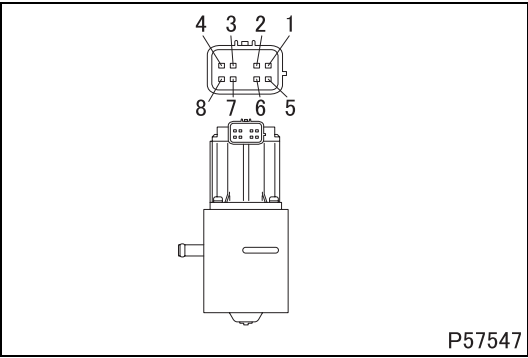
(1) Coil resistance of motor

- Measure the resistance between terminals 5 and 6.

Standard value	$1.45 \pm 0.21 \Omega$
----------------	------------------------

(2) Position sensor

- The sensor cannot easily be inspected in isolation, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the intake throttle.



#530 Inspection of exhaust gas recirculation valve

- Perform the following checks. If there is any abnormality, replace the exhaust gas recirculation valve.

(1) Coil resistance of motor

- Measure the resistance between terminals 8 and 7, the resistance between terminals 8 and 6, and the resistance between terminals 7 and 6.

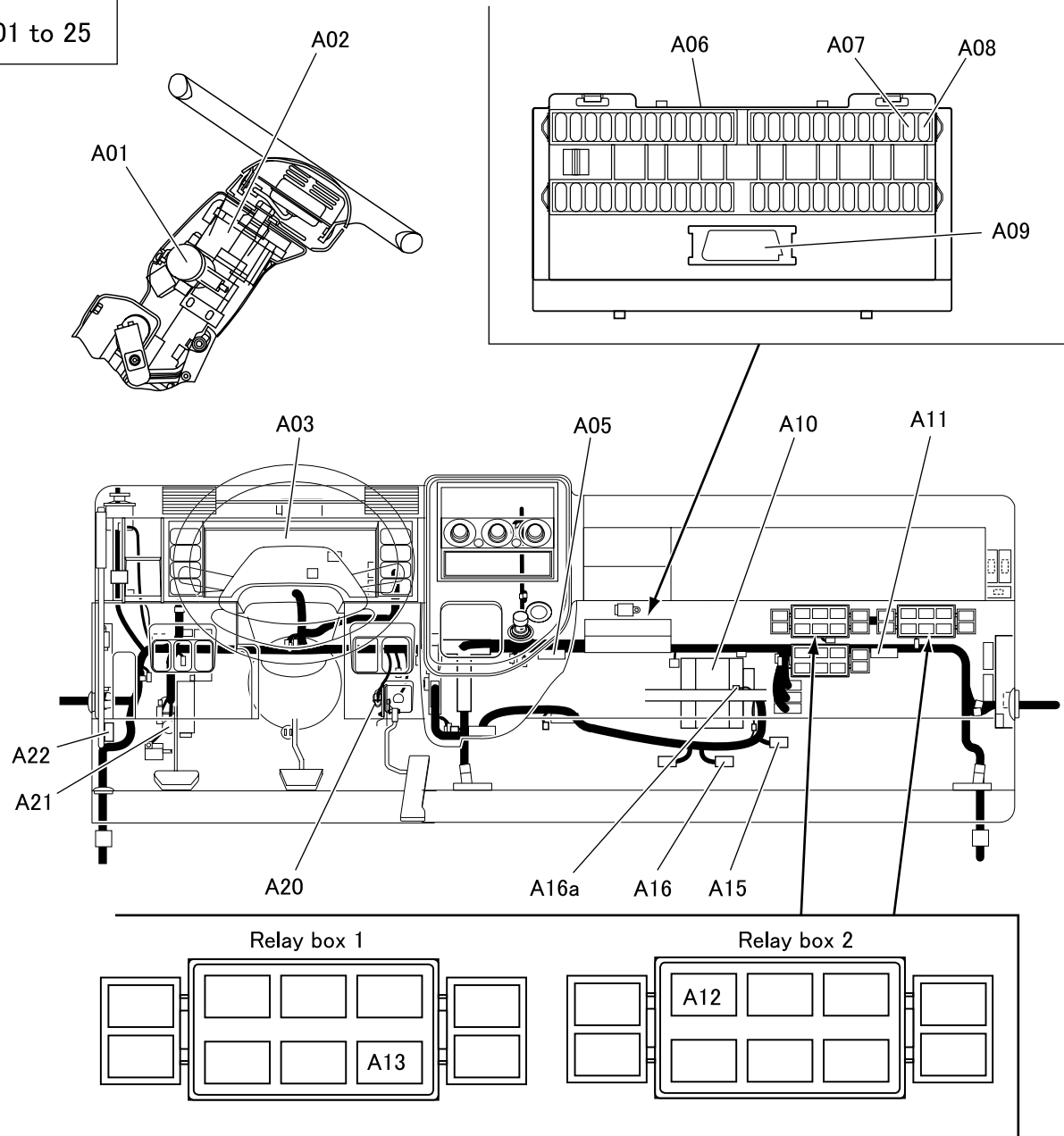
Standard value	$2.1 \pm 0.3 \Omega$
----------------	----------------------

(2) Position sensor

- The sensor cannot easily be inspected in isolation, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the exhaust gas recirculation valve.

8. Installed Locations of Parts

A01 to 25



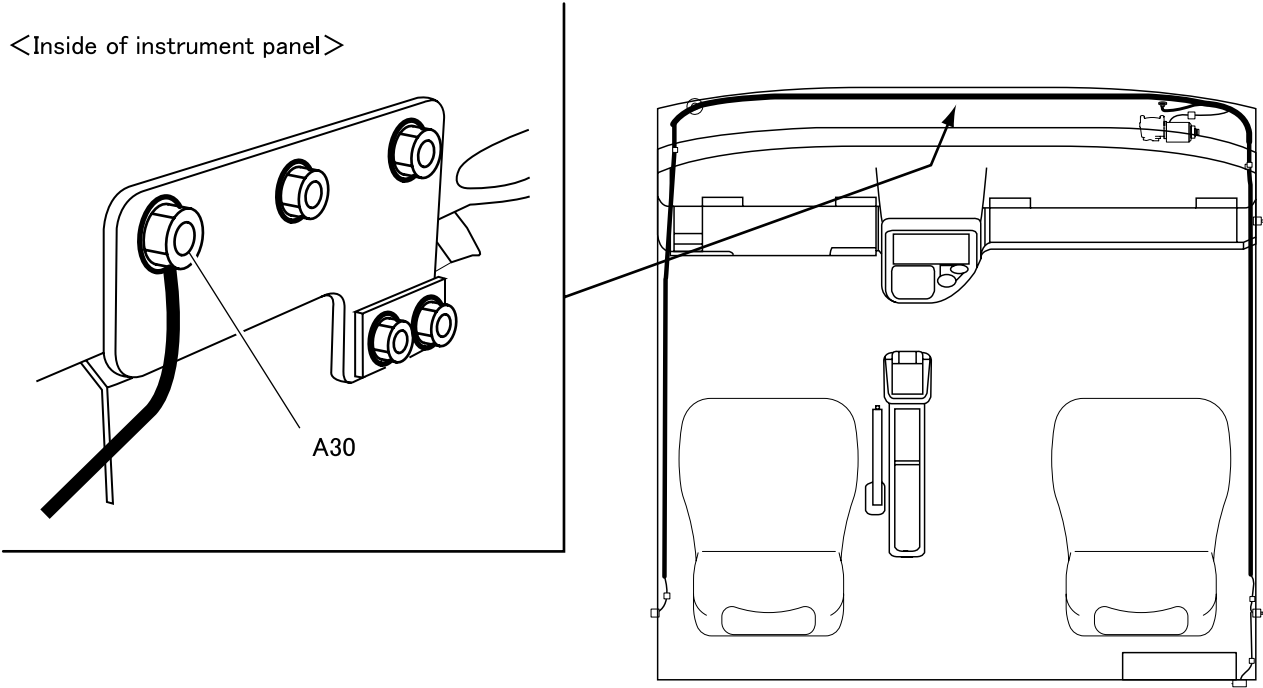
No relevant parts in a missing number

- | | |
|---|---|
| A01 Starter switch | A16 Resister unit |
| A02 Combination switch | A16a Ground |
| A03 Meter cluster | A20 Accelerator pedal position sensor |
| A05 Joint connector (J/C-1) | A21 Clutch switch |
| A06 Fuse box | A22 Multi-Use Tester-III connector (for inspection) |
| A07 Diagnosis switch | |
| A08 Memory clear switch | ABS : Anti-lock brake system |
| A09 Multi-Use Tester-III connector (for recorder) | A/T : Automatic transmission |
| A10 Engine ECU | ECU : Electronic control unit |
| A11 Joint connector (J/C-2, 3) | PTO : Power take-off |
| A12 ABS exhaust brake cut relay | |
| A13 Exhaust brake cut relay <A/T> | |
| A15 Joint connector (J/C-4) | |

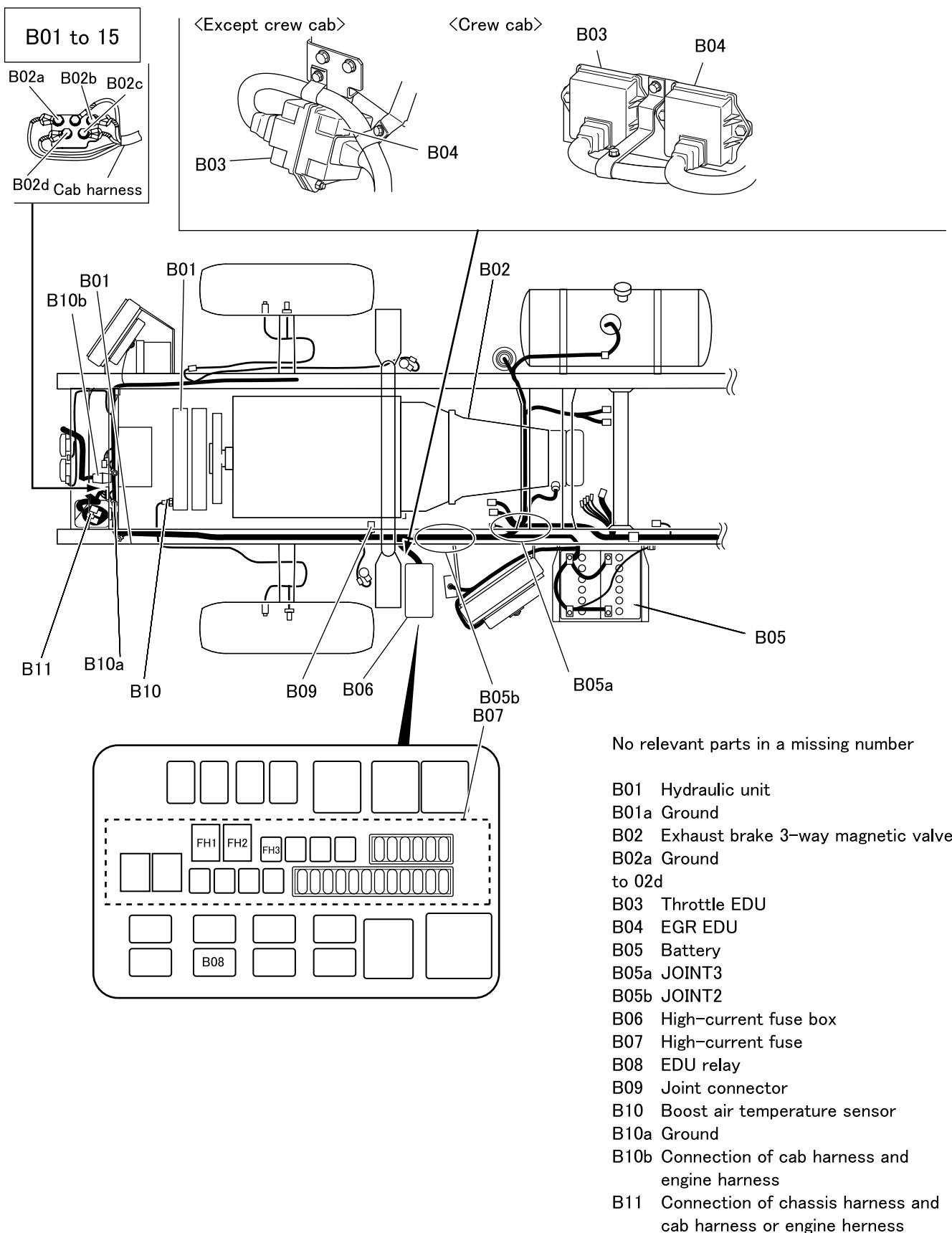
EXHAUST GAS RECIRCULATION SYSTEM

A30

<Inside of instrument panel>



A30 Ground



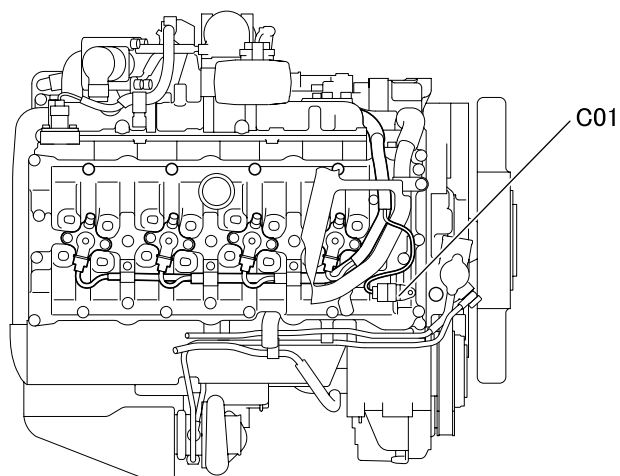
EGR : Exhaust-gas recirculation

EDU : Electronic drive unit

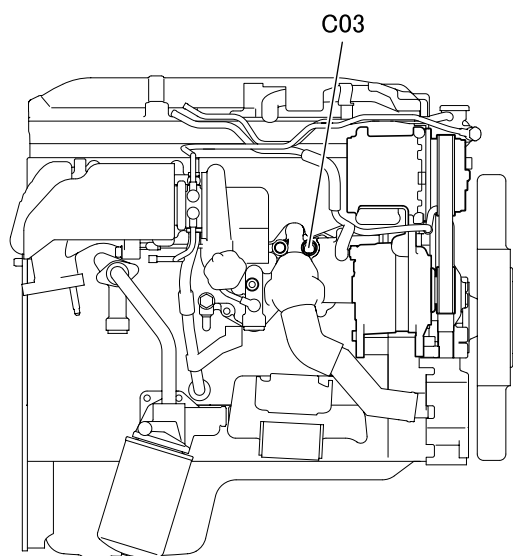
EXHAUST GAS RECIRCULATION SYSTEM

C01 to 10

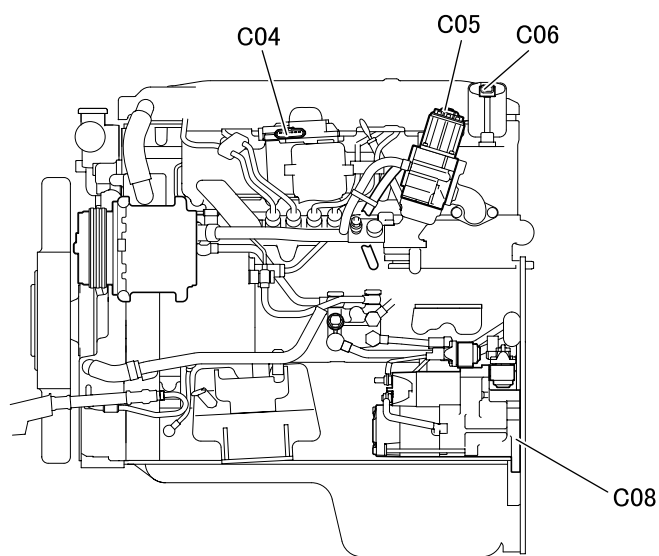
Upper view



Right side view



Left side view



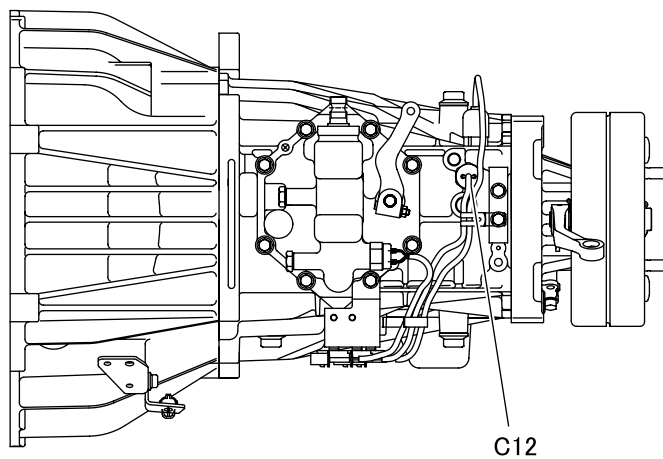
- C01 Cylinder recognition sensor
- C03 Water temperature sensor
(Connects to engine ECU)
- C04 Throttle actuator
(Building into motor, position sensor)
- C05 EGR valve
(Building into motor, position sensor)
- C06 Boost pressure sensor
- C08 Starter

ECU : Electronic control unit
EGR : Exhaust-gas recirculation

C11 to 15

Manual transmission

Upper view

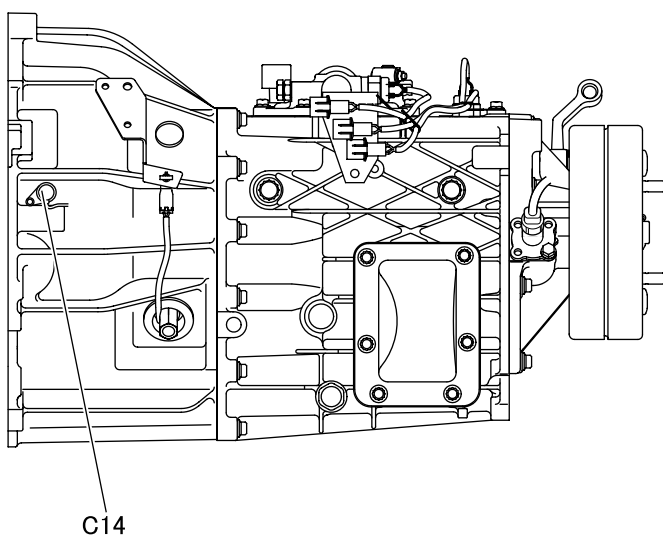


No relevant parts in a missing number

C12 Transmission neutral switch

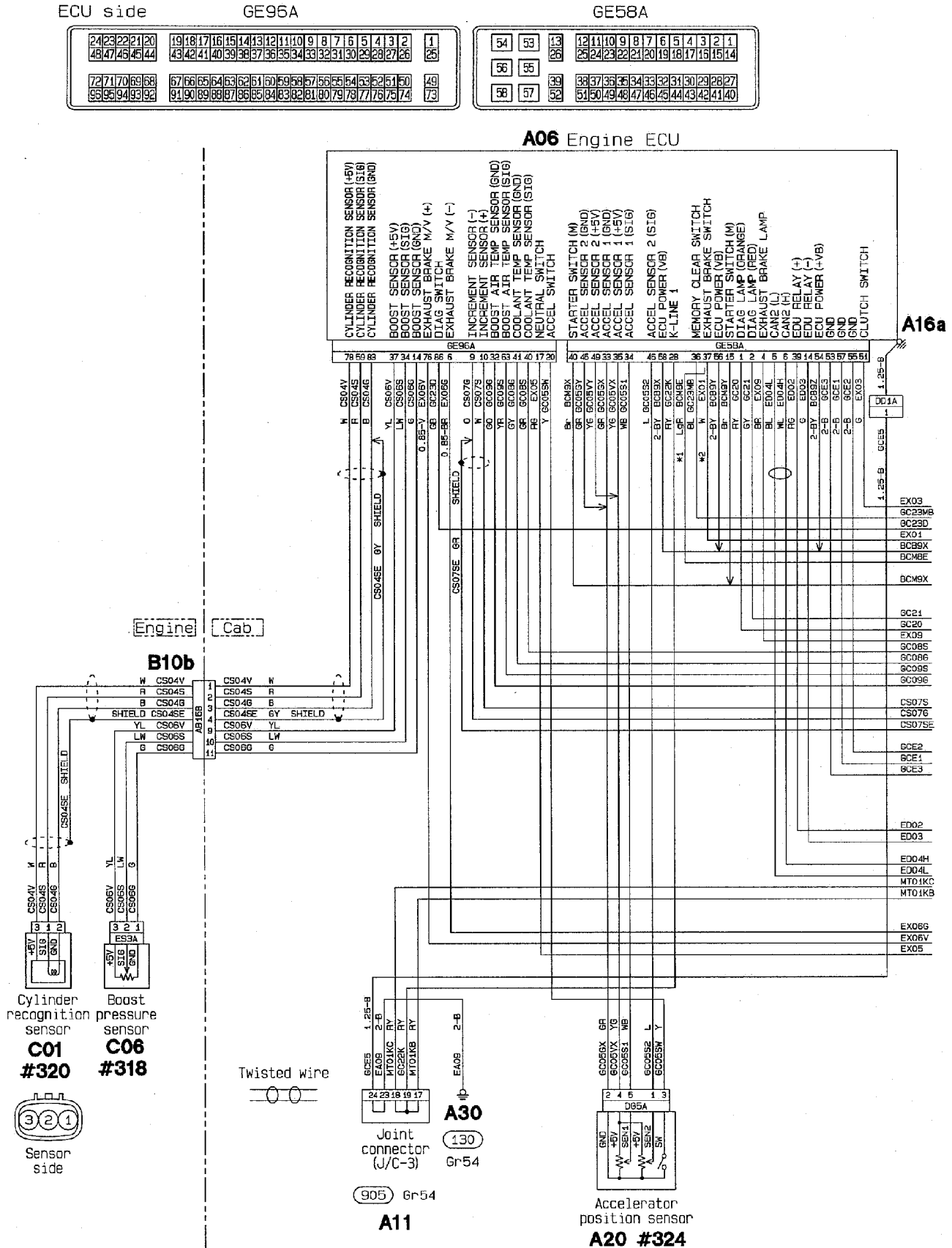
C14 Engine speed sensor

Left side view



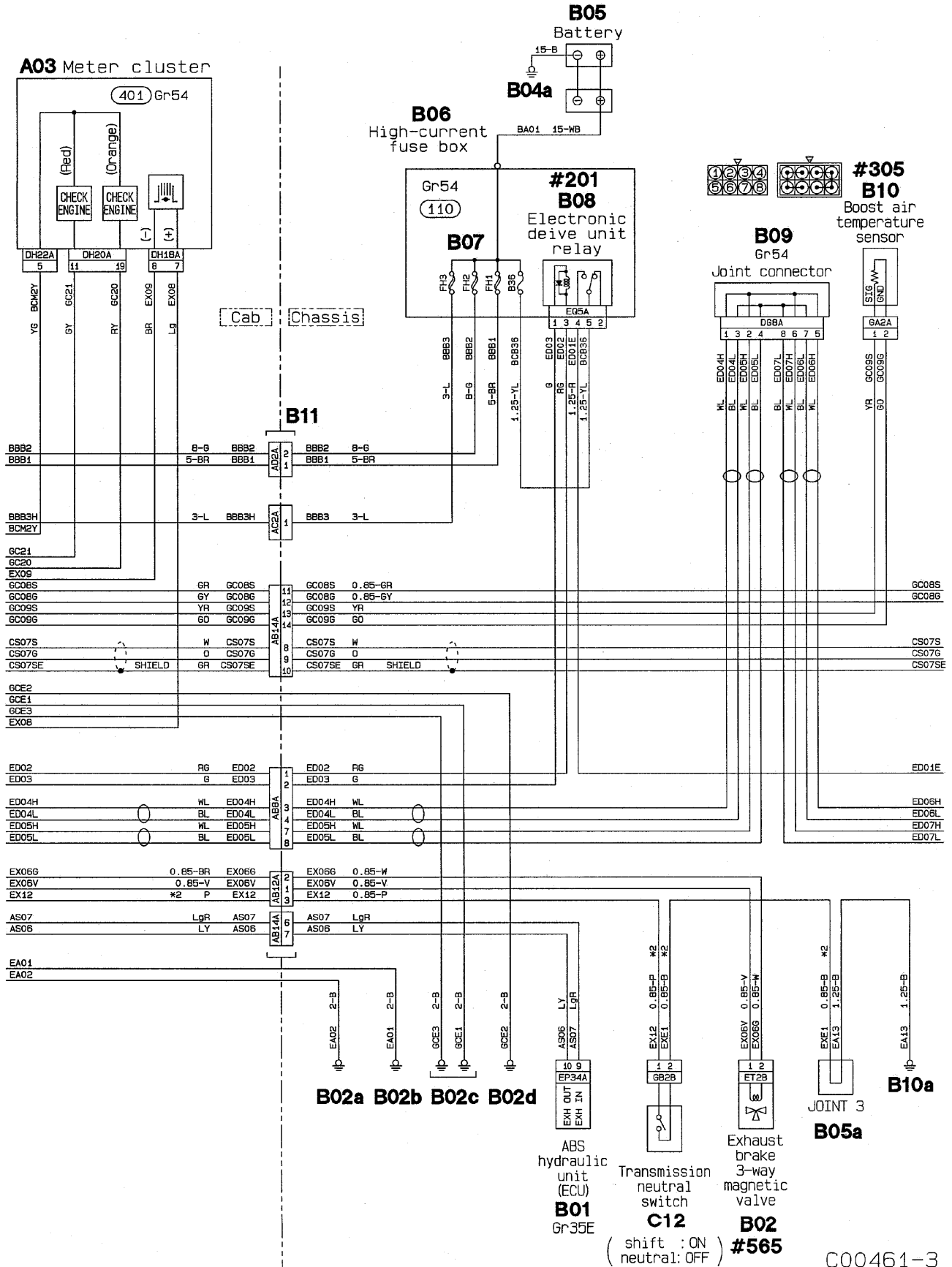
EXHAUST GAS RECIRCULATION SYSTEM

9. Electric Circuit Diagram

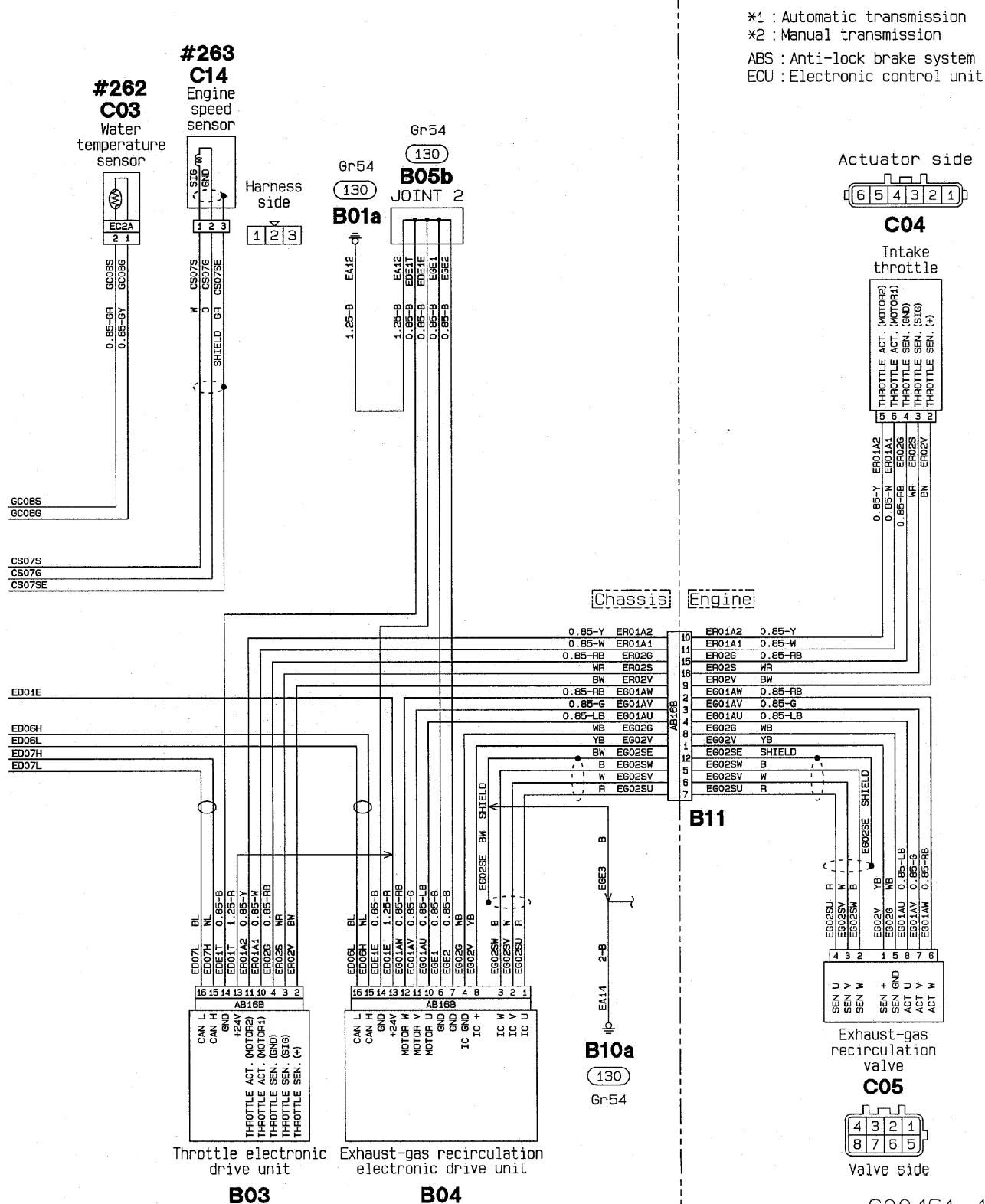




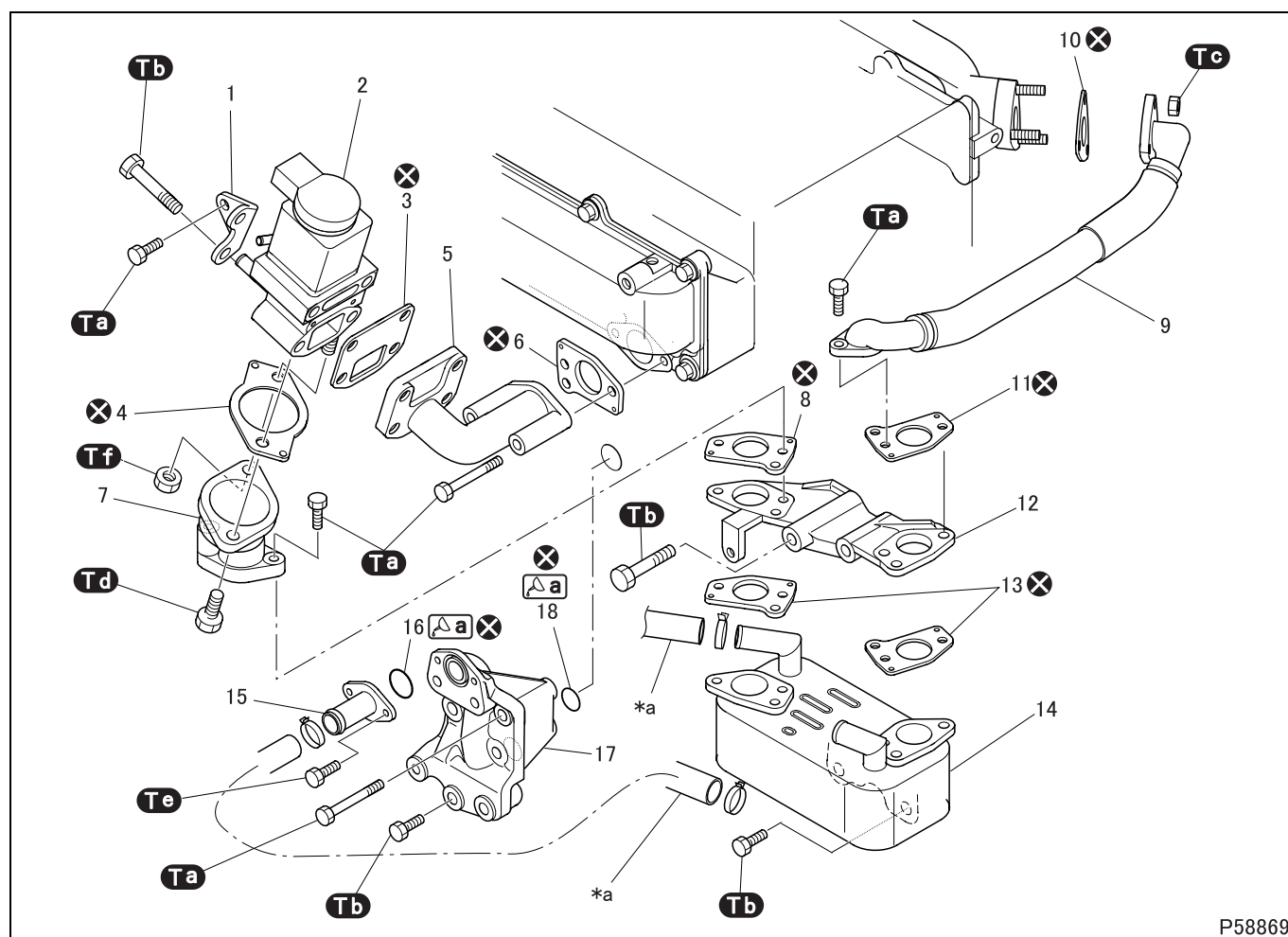
EXHAUST GAS RECIRCULATION SYSTEM



C00461-3



EXHAUST GAS RECIRCULATION VALVE, PIPE AND COOLER



P58869

● Removal sequence

- | | | |
|--|---|---|
| 1 Exhaust gas recirculation bracket | 7 Exhaust gas recirculation cooler adapter A | 14 Exhaust gas recirculation cooler |
| 2 Exhaust gas recirculation valve | 8 Exhaust gas recirculation gasket | 15 Connector |
| 3 Exhaust gas recirculation valve gasket B | 9 Exhaust gas recirculation pipe | 16 O-ring |
| 4 Exhaust gas recirculation valve gasket A | 10 Exhaust gas recirculation pipe gasket | 17 Exhaust gas recirculation cooler bracket A |
| 5 Exhaust gas recirculation cooler adapter B | 11 Exhaust gas recirculation gasket | 18 O-ring |
| 6 Exhaust gas recirculation gasket | 12 Exhaust gas recirculation cooler bracket B | |
| | 13 Exhaust gas recirculation gasket | |

*a: Water hose

⊗: Non-reusable parts

NOTE

- Even when all coolant in the crankcase has been drained out, approximately 1L {1.1qt.} of coolant remains in the exhaust gas recirculation cooler. Before removing the exhaust gas recirculation cooler, make ready a container to catch the coolant.

● Installation sequence

Perform installation by following the removal sequence in reverse.

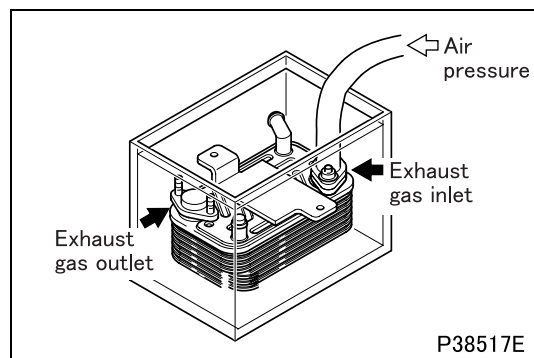
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (mounting of exhaust gas recirculation bracket)	23.2 {17, 2.4}	—
	Bolt (mounting of exhaust gas recirculation cooler adapter A)		
	Bolt (mounting of exhaust gas recirculation cooler adapter B)		
	Nut (mounting of exhaust gas recirculation pipe)		
	M8 bolt (mounting of exhaust gas recirculation cooler bracket A)		
Tb	Bolt (mounting of exhaust gas recirculation valve)	44.5 {33, 4.5}	—
	Bolt (mounting of exhaust gas recirculation cooler)		
	M10 bolt (mounting of exhaust gas recirculation cooler bracket A)		
	Bolt (mounting of exhaust gas recirculation cooler bracket B)		
Tc	Nut (mounting of exhaust gas recirculation pipe)	20.6 {15, 2.1}	—
Td	Bolt (mounting of exhaust gas recirculation valve)	57.5 {42, 5.9}	—
Te	Bolt (mounting of connector)	8 {5.9, 0.82}	—
Tf	Nut (mounting of exhaust gas recirculation valve)	57.5 {42, 5.9}	—

Lubricants and sealants

Mark	Point of application	Type	Quantity
 a	O-ring	Soapy water	As required

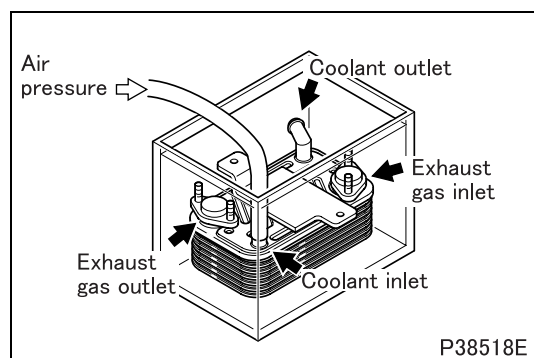
◆ Inspection procedures ◆



■ Inspection: Exhaust gas recirculation cooler

(1) Exhaust gas passage side

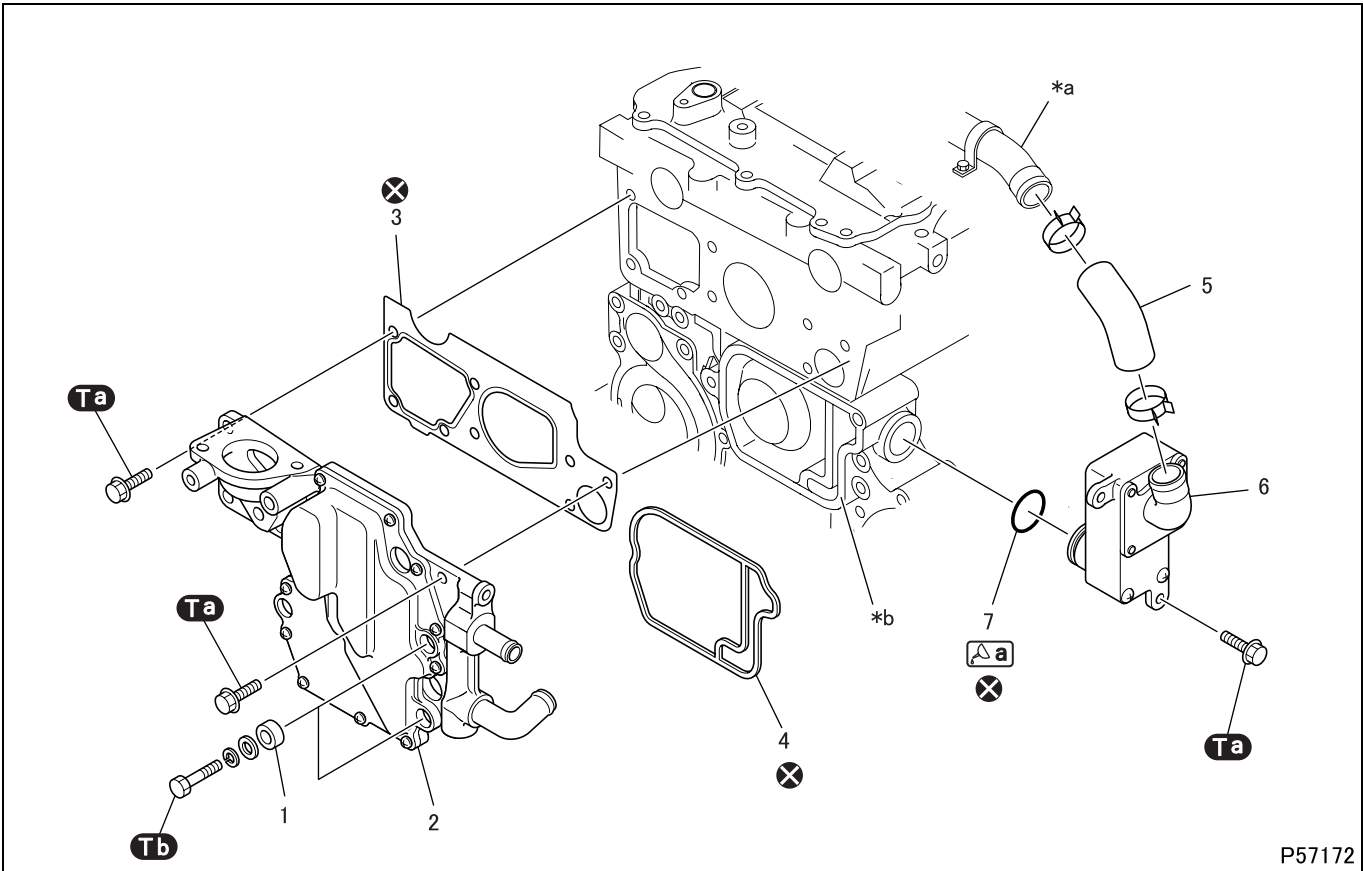
- Fit a cover over the exhaust gas outlet of the exhaust gas recirculation cooler, and connect a hose to the exhaust gas inlet. Then, submerge the exhaust gas recirculation cooler in a container of water. Make sure the coolant passage is full of water.
- Apply air pressure of 294 kPa {43 psi, 3 kgf/cm²} through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler.
- If there is any abnormality, replace the exhaust gas recirculation cooler.



(2) Coolant passage side

- Fit covers over the exhaust gas recirculation cooler's exhaust gas inlet, exhaust gas outlet, and coolant outlet, and connect a hose to the coolant inlet. Then, submerge the exhaust gas recirculation cooler in a container of water.
- Apply air pressure of 196 kPa {28 psi, 2 kgf/cm²} through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler.
- If there is any abnormality, replace the exhaust gas recirculation cooler.

CRANKCASE EMISSION CONTROL SYSTEM



● Removal sequence

- | | | |
|--|-------------------|-------------------------------------|
| 1 Spacer | 4 Breather gasket | *a: PCV pipe |
| 2 Breather cover
(See later section.) | 5 PCV hose | *b: Front case |
| 3 Gasket | 6 PCV valve | ⊗: Non-reusable parts |
| | 7 O-ring | PCV: Positive crankcase ventilation |

● Installation sequence

Perform installation by following the removal sequence in reverse.

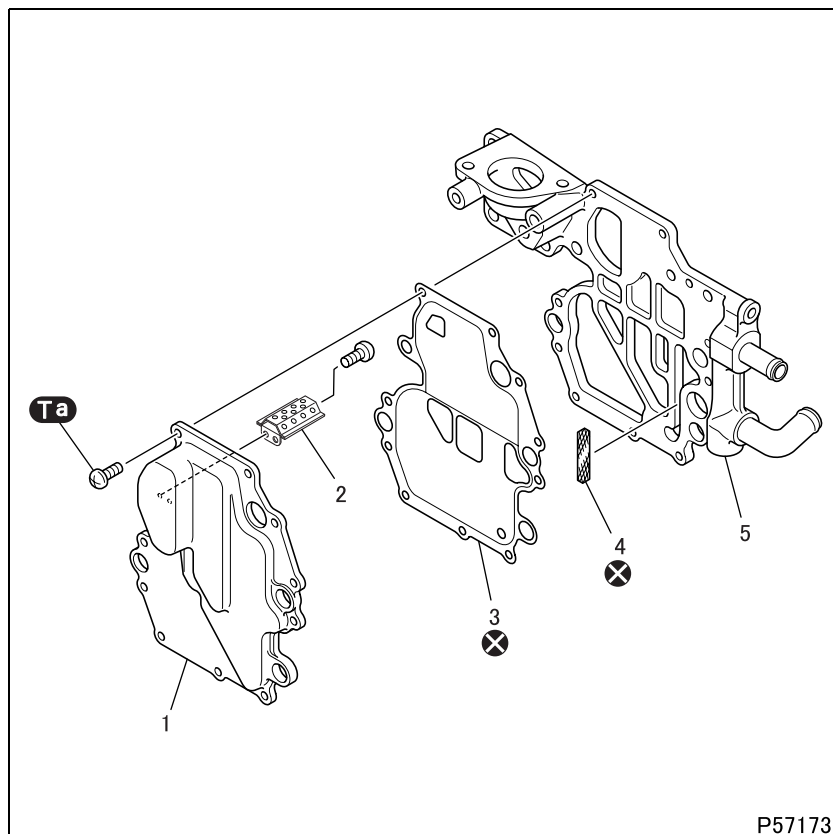
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (mounting of breather cover)	23.2 {17, 2.4}	—
	Bolt (mounting of PCV valve)		
Tb	Bolt (mounting of breather cover)	9.8 {7.2, 1.0}	—

Lubricant and for sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	—

Breather cover



● Removal sequence

- 1 Breather cover A
- 2 Separator plate
- 3 Gasket
- 4 Element
- 5 Breather cover B

⊗:Non-reusable parts

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (mounting of breather cover)	7.8 to 11.8 {5.8 to 8.7, 0.8 to 1.2}	—



Group 21

Clutch

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

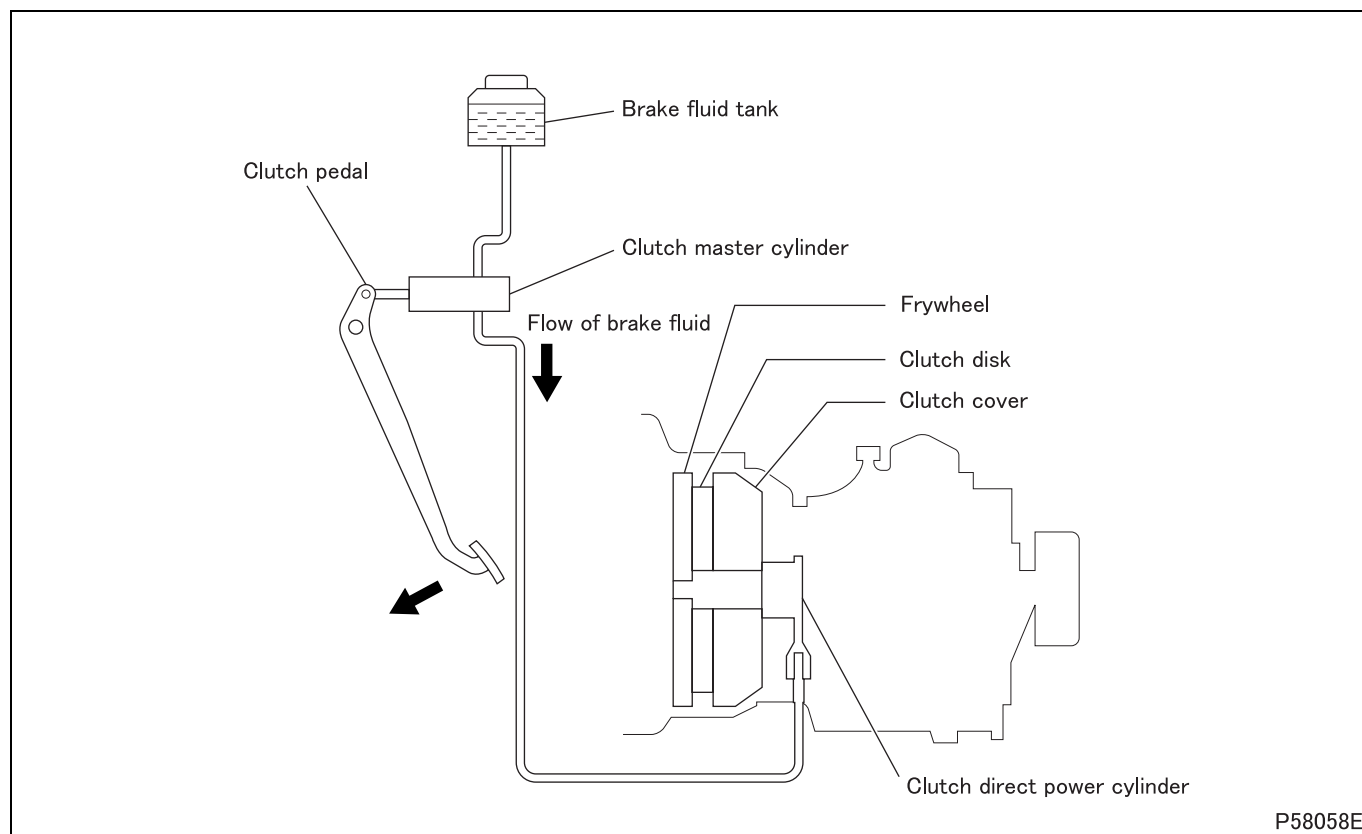
INDEX

SPECIFICATIONS	21-2
STRUCTURE AND OPERATION	
1. Clutch Control	21-3
2. Clutch Master Cylinder	21-4
3. Clutch Proper and Clutch Direct Power Cylinder.....	21-6
TROUBLESHOOTING	21-8
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Replacement of Brake Fluid (Clutch System)	21-10
2. Air Bleeding of Brake Fluid (Clutch System)	21-12
3. Inspection of Clutch Disk Wear Limit	21-14
CLUTCH PEDAL	21-16
CLUTCH MASTER CYLINDER.....	21-20
CLUTCH PROPER	21-22
CLUTCH CONTROL.....	21-26

SPECIFICATIONS

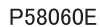
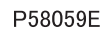
Item	Specifications
Clutch model	C5W33
Drive type	Strap drive
Clutch disc type	Dry, single plate type
Pressure plate type	Diaphragm spring type
Control system	Hydraulic pressure type
Clutch master cylinder manufacturer	NISSIN KOGYO CO., LTD
Clutch direct power cylinder manufacturer	NISSIN KOGYO CO., LTD

1. Clutch Control

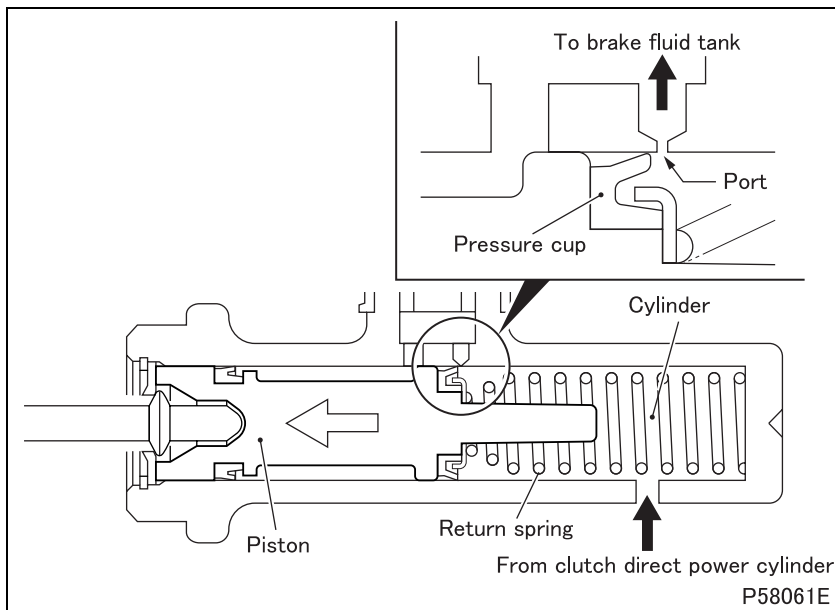


- Hydraulic pressure is used to control the clutch operation.
- When the clutch pedal is depressed, the boosted force is then applied to the clutch master cylinder. This pressurizes the brake fluid inside the clutch master cylinder, pushing the clutch direct power cylinder and disengaging the clutch.

2. Clutch Master Cylinder



- The piston is pushed to the right by the push rod, pressurizing the brake fluid in the cylinder.
- This brake fluid pressure is transmitted to the clutch direct power cylinder.

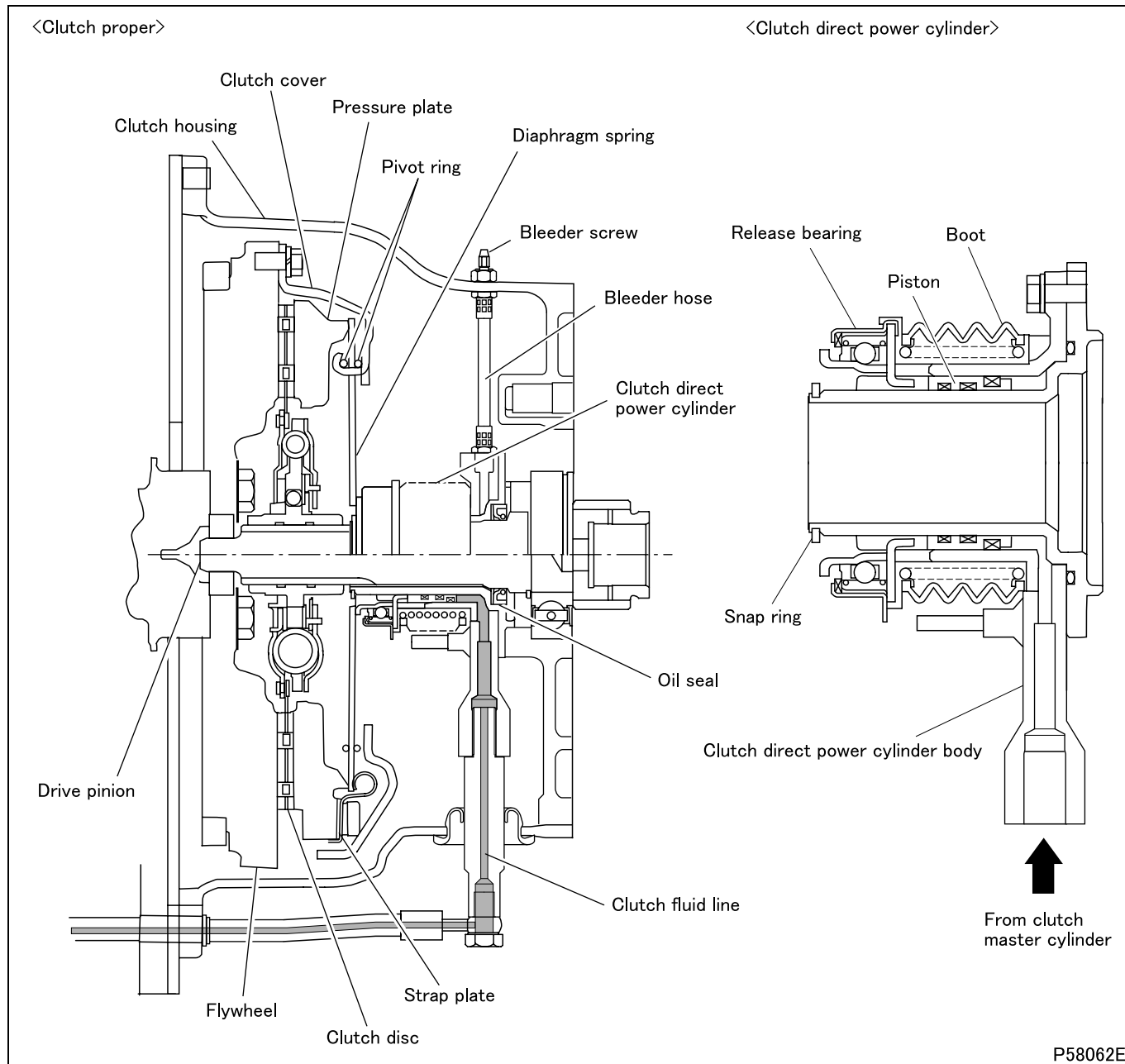


2.2 When clutch pedal is released

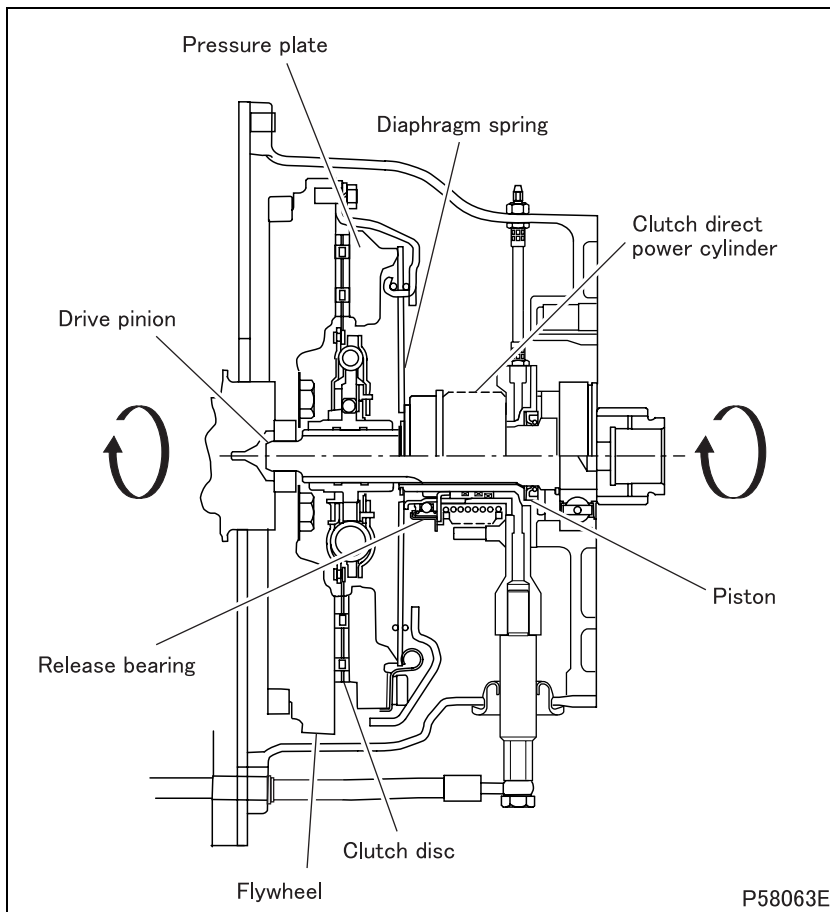
- The piston is pushed back to the left by the combined force of oil pressure from the clutch direct power cylinder and the return spring.
- This opens up the port that has been blocked by the pressure cup, connecting the cylinder to the brake fluid tank. This allows the oil pressure to completely drain to the tank.

STRUCTURE AND OPERATION

3. Clutch Proper and Clutch Direct Power Cylinder

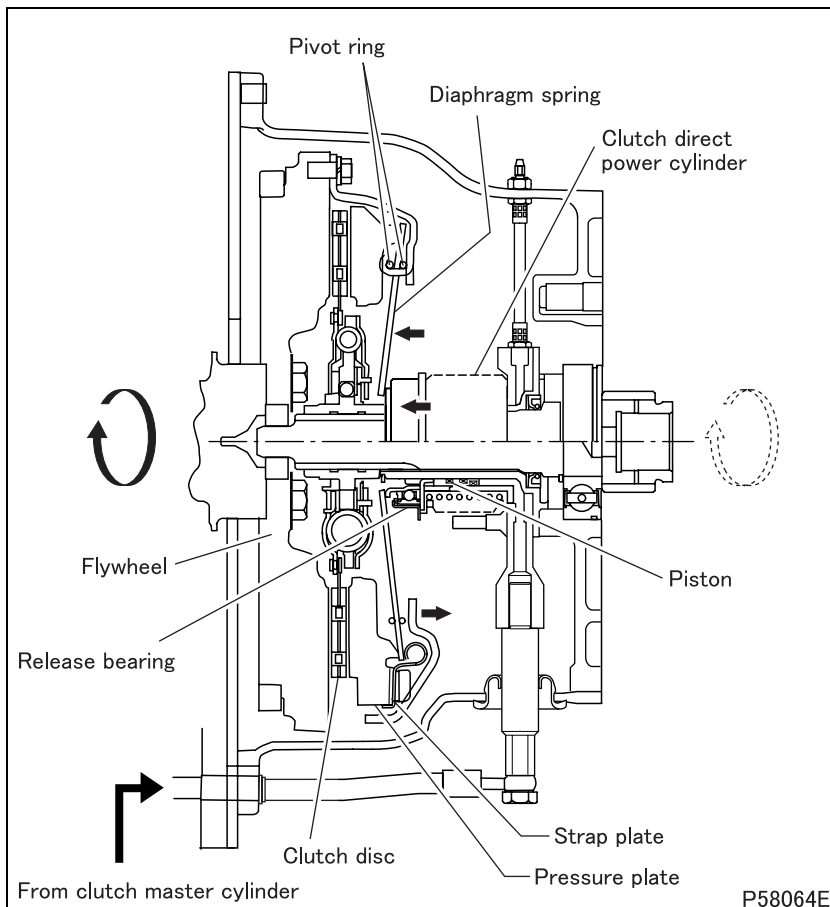


- Clutch engagement and disengagement are controlled by the brake fluid pressure from the clutch master cylinder acting on the piston of the clutch direct power cylinder, and are achieved by the operation of the piston and the release bearing.



3.1 When clutch pedal is released

- There is no brake fluid pressure acting on the clutch direct power cylinder. The piston and release bearing remain in their home positions.
- The force of the diaphragm spring acts on the pressure plate, which in turn keeps the clutch disc pressed against the flywheel.
- Pressed against the flywheel, the clutch disc rotates together with the flywheel and transmits the engine power to the transmission drive pinion.



3.2 When clutch pedal is depressed

- Brake fluid pressure from the clutch master cylinder moves the piston in the clutch direct power cylinder.
- As it moves, the piston pushes the release bearing, which in turn pushes the diaphragm spring.
- The diaphragm spring pivots around the pivot ring. This movement, via the strap plate, causes the pressure plate to retract from the flywheel. As a result, the clutch disc separates from the flywheel, cutting off the transmission of engine power to the transmission.

TROUBLESHOOTING

Symptoms									Reference Gr
Possible causes		Clutch disengaged but drags	Clutch slips	Clutch does not engage smoothly	Clutch makes noise on disengagement	Clutch makes noise on engagement	Judder when vehicle starting	Clutch pedal requires too much effort	
Clutch cover	Diaphragm spring heights uneven	O	O	O			O		
	Diaphragm spring fatigued		O	O					
	Pressure plate warped or faulty	O	O	O			O		
	Loose rivets	O		O			O		
	Strap plate bent	O		O	O		O		
Clutch disc	Disc deformed	O		O			O		
	Disc rivets loose			O			O		
	Disc torsion spring fatigued or damaged					O			
	Spline worn	O		O			O		
	Spline rusted	O		O			O		
	Facing worn		O						
	Facing surface hardened		O	O			O		
	Facing oily or greasy		O	O					
Clutch pedal	Pedal free play insufficient		O						
	Pedal free play excessive	O							
	Pedal stroke insufficient	O							
	Pedal sliding part faulty			O			O	O	
Clutch master cylinder	Piston and pressure cup sliding movement faulty	O	O	O				O	
	Spring fatigued		O						
	Brake fluid passage port clogged	O	O	O				O	
Clutch direct power cylinder	Piston and piston cup sliding movement faulty	O	O	O				O	
	Brake fluid passage port clogged	O	O	O				O	
	Release bearing faulty	O			O	O			
Transmission drive pinion spline worn		O		O					Gr22
Engine idling speed too low		O				O			Gr13A
Engine mounting fatigued							O		Gr11
Flywheel warped, deformed or worn forming steps		O	O	O			O		
Flywheel pilot bearing faulty		O							
Air mixed in clutch hydraulic system		O							
Clutch hydraulic system leaking		O							

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Replacement of Brake Fluid (Clutch System)

- Clutch fluid (brake fluid) is shared by the clutch and brake systems, and is divided in the brake fluid tank into the two systems. This section describes the replacement of the clutch fluid (brake fluid) for the clutch system. In order to completely replace the clutch fluid (brake fluid), the brake fluid in the brake system should also be replaced. (See Gr35A.)

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

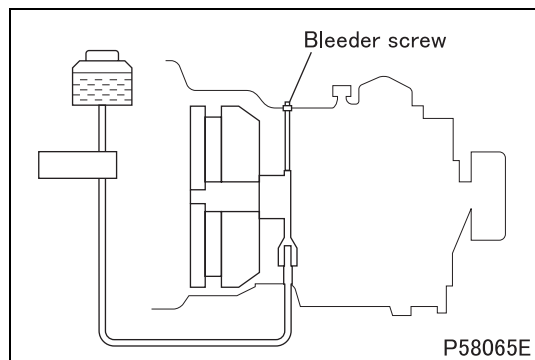
Mark	Parts to be tightened	Tightening torque	Remarks
–	Bleeder screw	6.8 to 8.8 {5.0 to 6.5, 0.7 to 0.9}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Brake fluid tank	Brake fluid (SAE J1703f or FMVSS No. 116 DOT3)	As required

CAUTION

- Brake fluid is corrosive on paintwork. Be careful not to spill it onto the paintwork.
- If brake fluid is spilled onto the paintwork, immediately wipe it off.
- Be sure to use new FUSO Brake Fluid (DOT3). Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the clutch rubber parts to swell. Faulty operation of the clutch will result.
- Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty clutch operation.
- Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.



1.1 Work before replacement

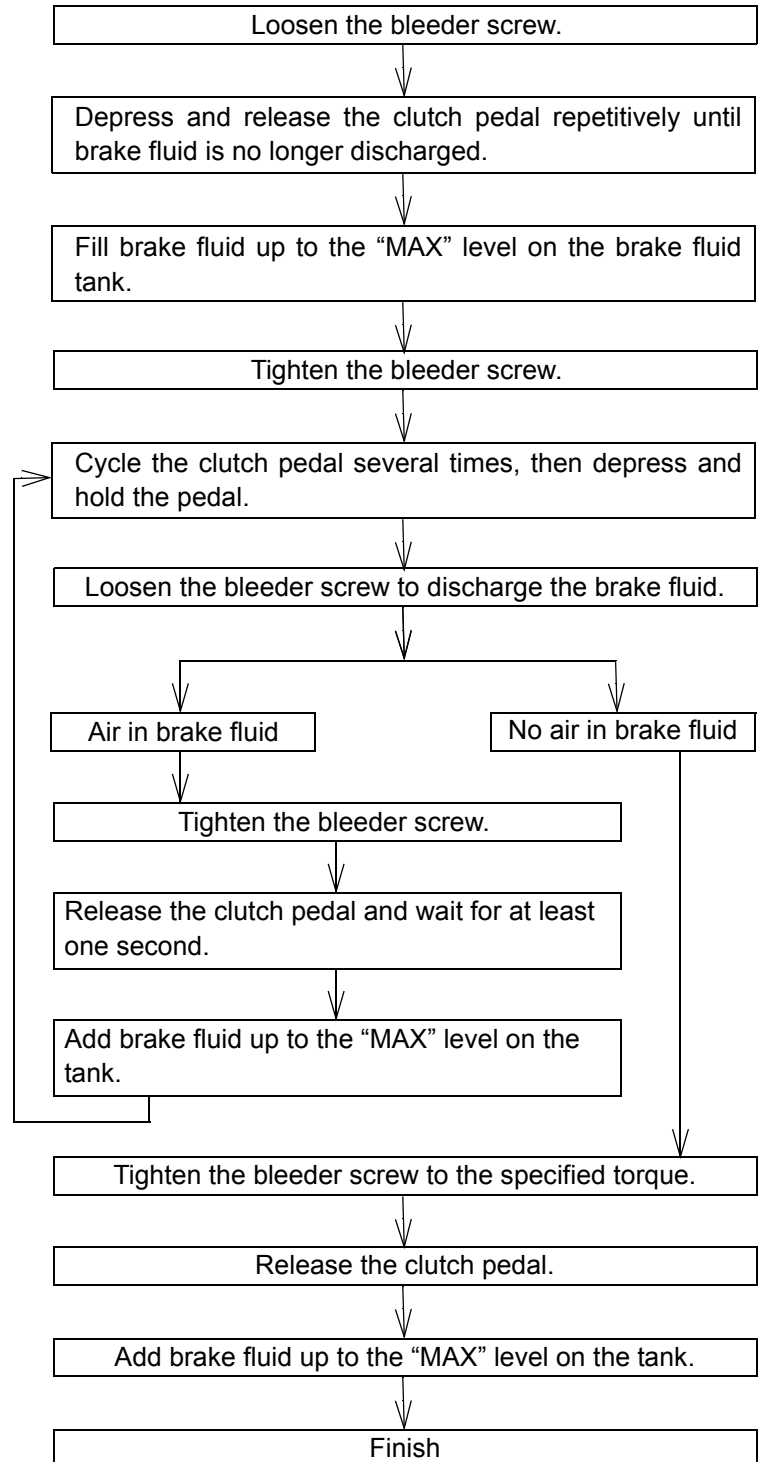
- Install one end of a vinyl pipe onto the bleeder screw. Place the loose end into a container.

1.2 Replacement of brake fluid

- Replace the brake fluid in the following sequence.

CAUTION

- Replacement of old brake fluid with new brake fluid in the clutch fluid line can be recognized by a change in color of the brake fluid being discharged through the vinyl pipe.



ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Air Bleeding of Brake Fluid (Clutch System)

- Clutch fluid (brake fluid) is shared by the clutch and brake systems, and is divided in the brake fluid tank into the two systems. This section describes the air bleeding procedures for the clutch system. For air bleeding procedures for the brake system (See Gr35A.)

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

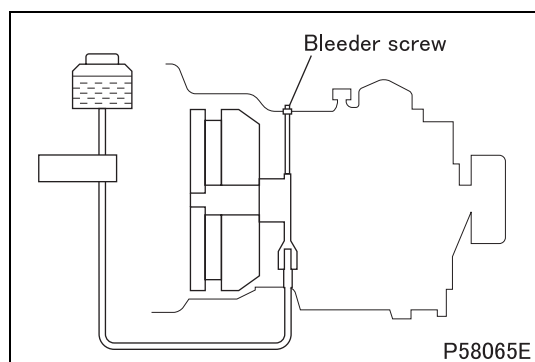
Mark	Parts to be tightened	Tightening torque	Remarks
–	Bleeder screw	6.8 to 8.8 {5.0 to 6.5, 0.7 to 0.9}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Brake fluid tank	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required

CAUTION

- Brake fluid is corrosive on paintwork. Be careful not to spill it onto the paintwork.
- If brake fluid is spilled onto the paintwork, immediately wipe it off.
- Be sure to use new FUSO Brake Fluid (DOT3). Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the clutch rubber parts to swell. Faulty operation of the clutch will result.
- Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty clutch operation.
- Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.

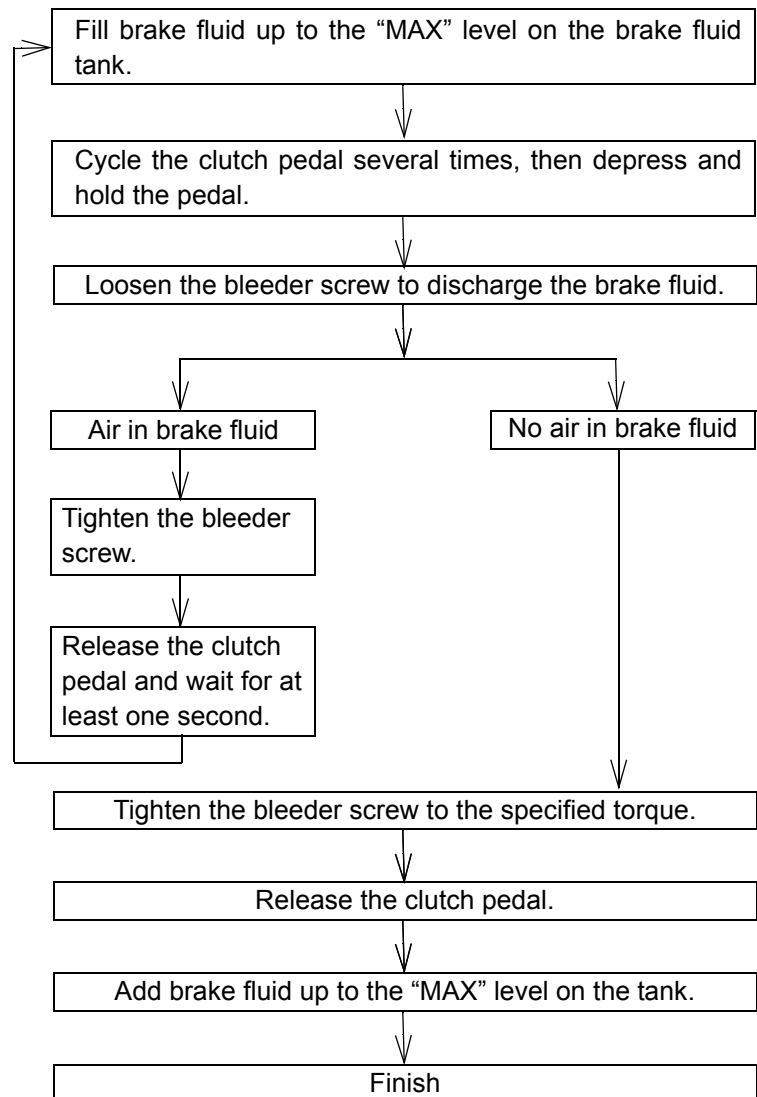


2.1 Work before air bleeding

- Install one end of a vinyl pipe onto the bleeder screw. Place the loose end into a container.

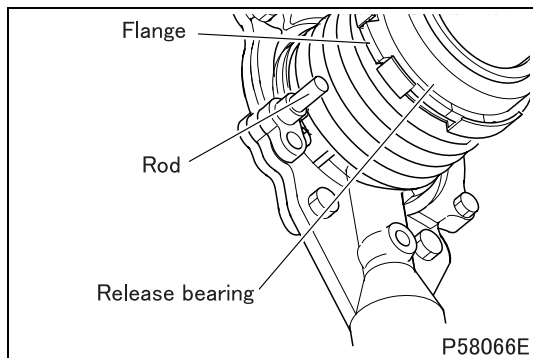
2.2 Air bleeding of brake fluid

- Bleed the air in the following sequence.



ON-VEHICLE INSPECTION AND ADJUSTMENT

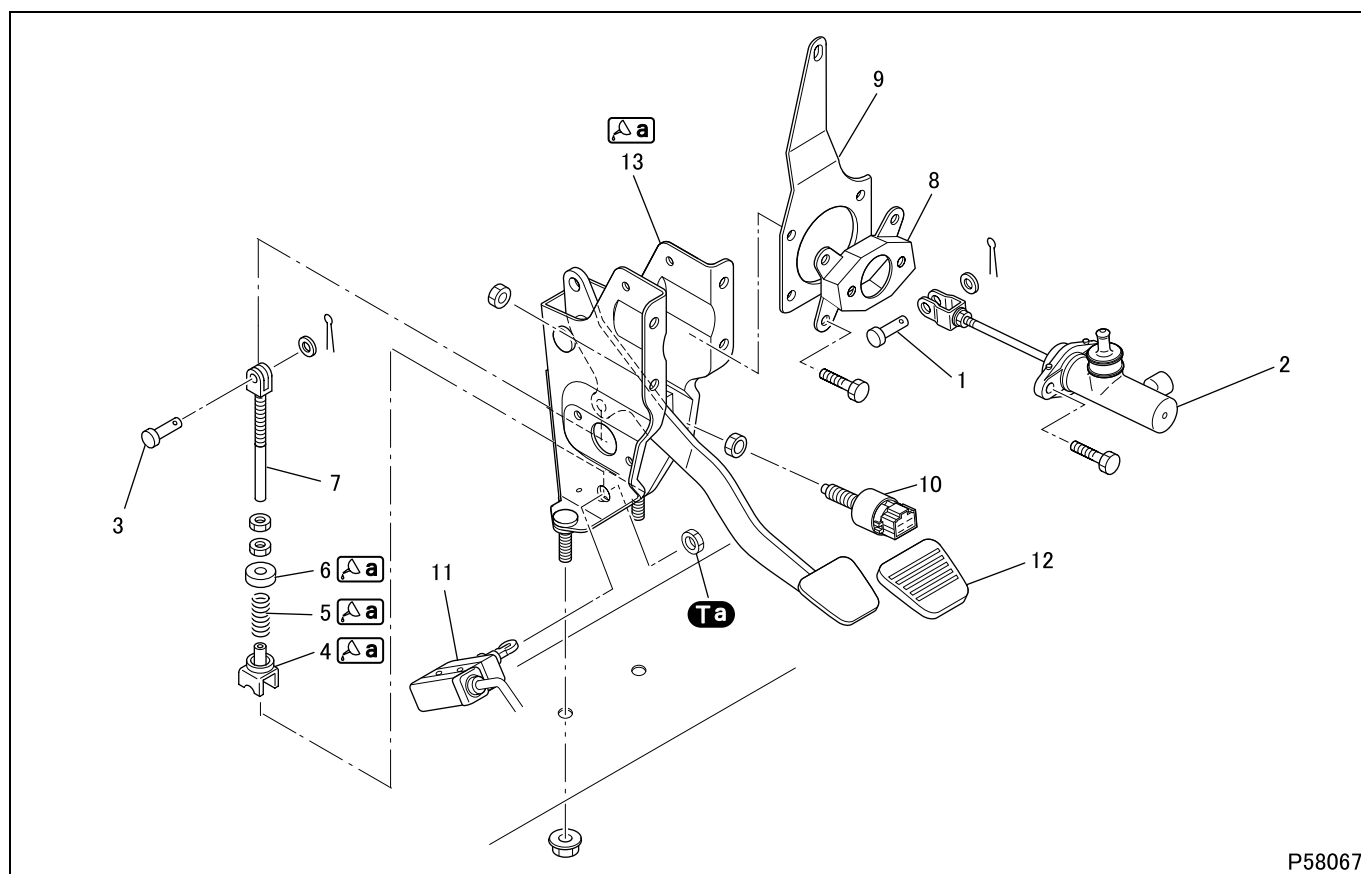
3. Inspection of Clutch Disk Wear Limit



- Remove the grommet from the clutch housing and make sure that the rod of the clutch direct power cylinder does not reach the flange of the release bearing.
- If the rod reaches the flange, replace the clutch disc.

M E M O

CLUTCH PEDAL



P58067

● Removal sequence

- | | |
|---|--------------------------------------|
| 1 Clevis pin | 8 Cylinder bracket |
| 2 Clutch master cylinder (See later section.) | 9 Booster bracket |
| 3 Clevis pin | 10 Clutch switch <for exhaust brake> |
| 4 Spring holder | 11 Clutch switch <with PTO> |
| 5 Return spring | 12 Pedal pad |
| 6 Plate | 13 Clutch pedal |
| 7 Spring assist rod | |

● Installation sequence

Follow the removal sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
2	Clearance between push rod and piston of clutch master cylinder	0.2 to 1.2 {0.0079 to 0.047}	—	Adjust
5	Return spring load (installed length: 35.6 {1.40})	225 N {51 lbs., 23.1 kgf}	205 N {46 lbs., 20.8 kgf}	Replace
10	Installed clearance of clutch switch (for exhaust brake)	0.1 to 1.5 {0.0039 to 0.059}	—	Adjust
13	Clutch pedal free play	0.2 to 4.0 {0.0079 to 0.16}	—	Replace

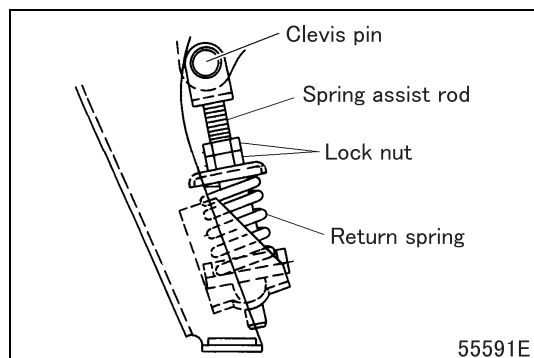
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (clutch switch <with PTO> mounting)	2.9 to 4.9 {2.1 to 3.6, 0.3 to 0.5}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Sliding surface of spring holder	Chassis grease [NLGI No. 1 (Ca soap)]	As required
	Sliding surface of return spring		
	Sliding surface of plate		
	Clutch master cylinder and spring assist rod mounting clevis-pin hole bushing's inner face of clutch pedal.		

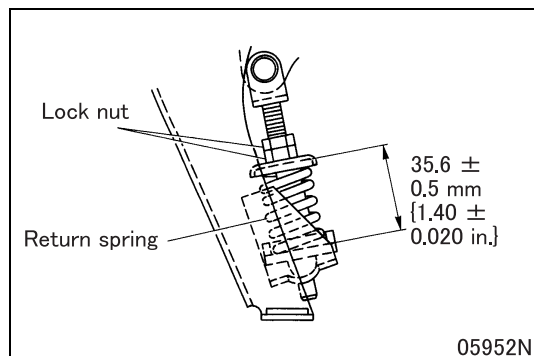
◆ Removal procedure ◆



■ Removal: Spring assist rod

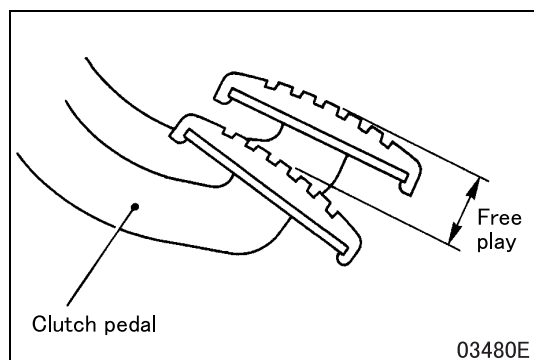
- Loosen the lock nut to release the load on the return spring. Then, remove the clevis pin and remove the spring assist rod.

◆ Work after installation ◆



■ Adjustment: Return spring

- Tighten the lock nut such that the return spring is set to the illustrated length.



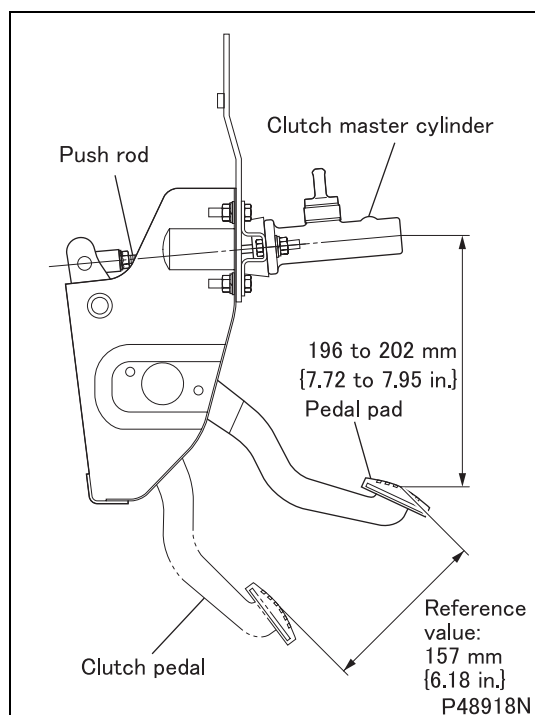
■ Inspection: Clutch pedal free play

- Before installing the clutch master cylinder, check the clutch pedal free play as follows.
- Using a finger, press the clutch pedal pad in the center until resistance is felt. Measure the distance that the pedal has traveled.

NOTE

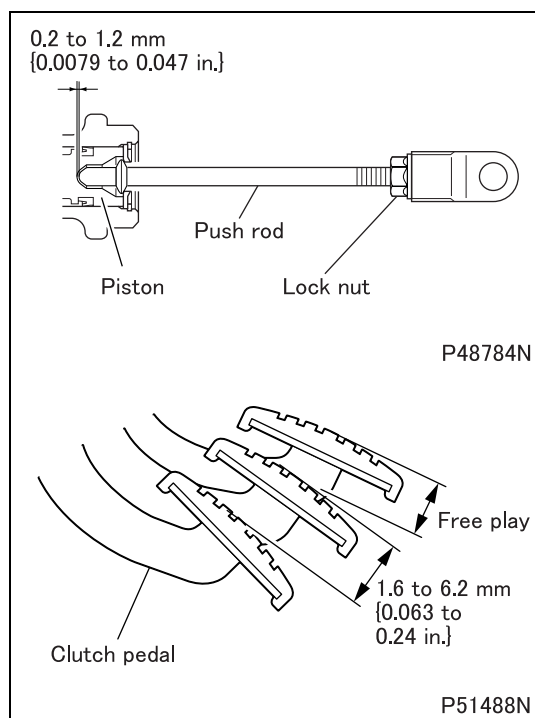
- Do not press the clutch pedal pad until a second resistance is felt (which is the point at which the clutch master cylinder's push rod contacts the piston).**
- If the measured distance does not conform to the standard value, replace the clutch pedal.

CLUTCH PEDAL



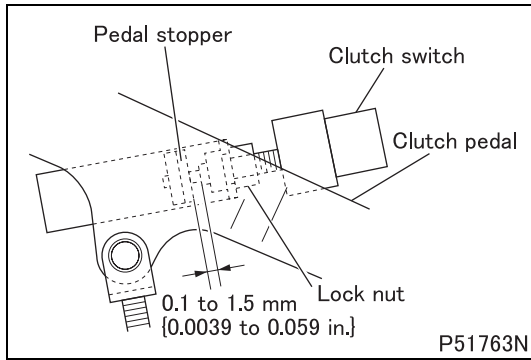
■ Adjustment: Clutch pedal

- Adjust the push rod of the clutch master cylinder such that the distance between the center of the clutch pedal pad and the center of the clutch master cylinder is set to the value indicated in the drawing.



■ Adjustment: Clearance between clutch master cylinder's push rod and piston

- Adjust the clearance between the clutch master cylinder's push rod and piston by using the clutch pedal as follows.
- Using a finger, press the clutch pedal in the center.
- Set the pedal travel, from the point at which the first resistance is felt to the point at which the second resistance is felt, to the illustrated value. (This distance corresponds to the clearance between the push rod and the piston.) This is done by turning the push rod in or out.
- With the pedal travel set to the illustrated value, the push rod-to-piston clearance should conform to the standard value.
- After the adjustment, tighten the lock nut to the specified torque.



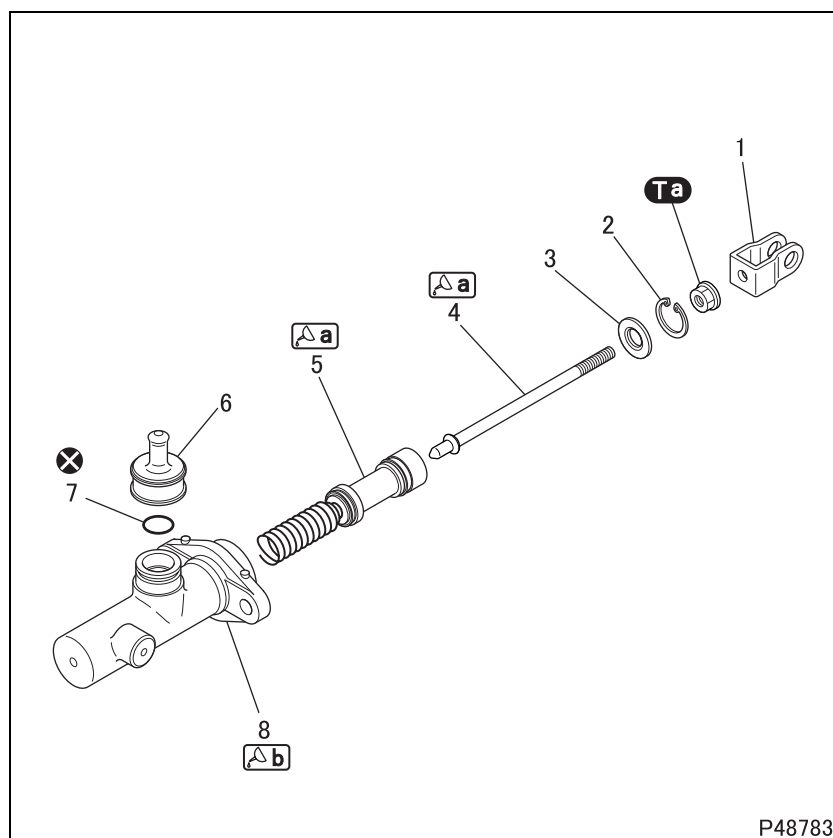
■ **Adjustment: Clearance between clutch switch (for exhaust brake) and pedal**

- With the clutch pedal adjusted as above, set the clearance between the end of the threaded portion of the clutch switch and the pedal stopper to the value indicated in the drawing. Tighten the locknut.

CAUTION ⚠

- **Do not allow the threaded end of the clutch switch to come into contact with the clutch pedal stopper during the adjustment operation.**

CLUTCH MASTER CYLINDER



Disassembly sequence

- 1 Clevis
- 2 Circlip
- 3 Stop plate
- 4 Push rod
- 5 Piston
- 6 Union collar
- 7 O-ring
- 8 Cylinder body

⊗: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Clutch master cylinder kit

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
5, 8	Clearance between piston and cylinder body	0.02 to 0.1 {0.00079 to 0.0039}	0.2 {0.0079}	Replace

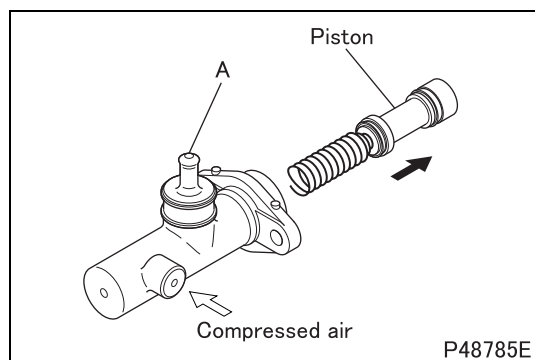
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut	15 to 20 {11 to 15, 1.5 to 2.0}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Push rod end contact face with piston Piston cup sliding face against cylinder body	COSMO Rubber Grease	0.1 to 0.3 g {0.0035 to 0.011 oz.}
b	Cylinder body inner face	Metal rubber #20 (rust preventive oil)	As required

Removal procedure



Removal: Piston

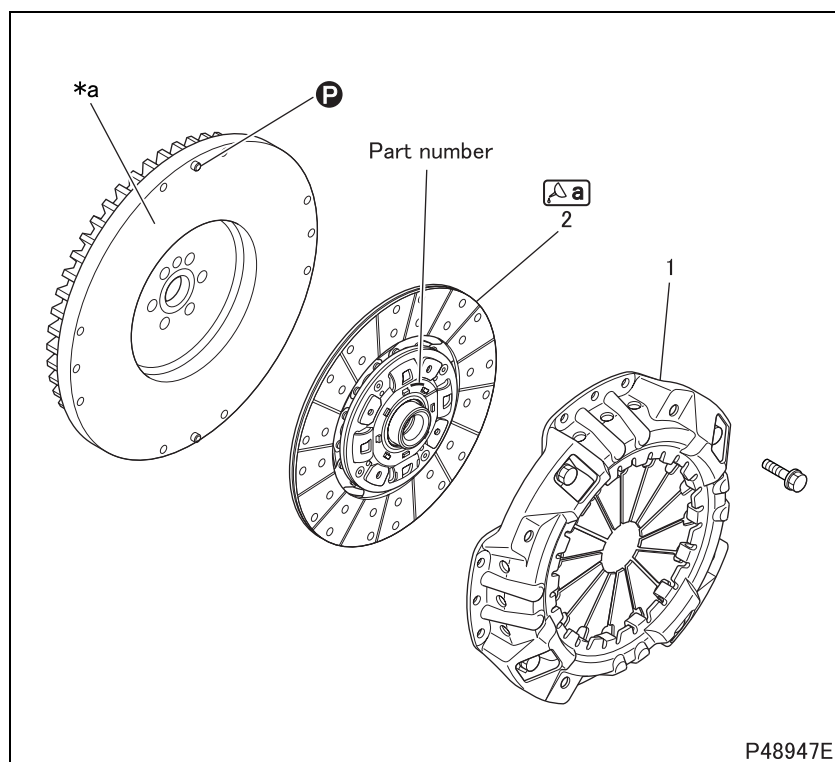
- With opening A blocked, feed compressed air gradually starting from 0 kPa {0 psi, 0 kgf/cm²} to remove the piston.

WARNING

- Do not apply compressed air suddenly at high pressure. Otherwise, the piston will fly out with full force.

M E M O

CLUTCH PROPER



● Removal sequence

- 1 Clutch cover
- 2 Clutch disc

*a: Flywheel

P: Locating pin

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

- To prevent clutch slippage, keep the surfaces of the clutch cover, clutch disc and flywheel free from oil and grease.

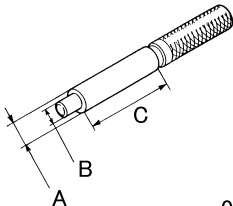
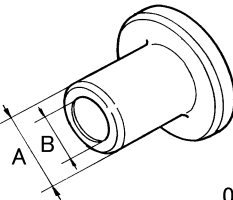
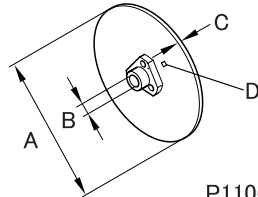
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
1	Pressure plate flatness		—	0.05 {0.0020}	Replace
	Diaphragm spring finger height unevenness		—	1.0 (0.039)	
2	Clutch disc	Depth from facing surface to rivet	1.8 to 2.4 {0.071 to 0.094}	0.2 {0.0079}	Replace
		Play in revolving direction in splines	0.05 to 0.23 {0.0020 to 0.0091}	0.5 {0.020}	
		Vertical runout	1.0 {0.039} or less	1.5 {0.059}	
		Lateral runout	0.8 {0.031} or less	1.5 {0.059}	

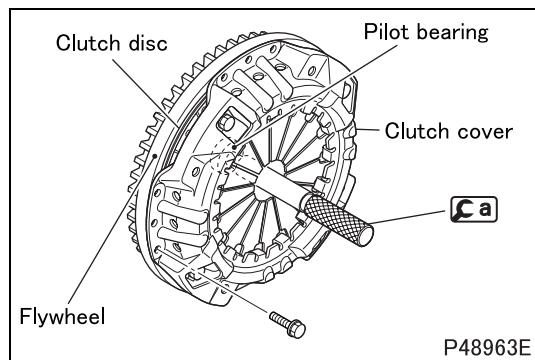
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Entire surface of splines	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	0.8 to 1.1 g {0.028 to 0.039 oz.}
	Fill in the grease grooves of splines		3.2 to 4.2 g {0.11 to 0.15 oz.}

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application								
	Clutch alignment arbor <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ28.94 {1.14}</td><td>φ20 {0.79}</td><td>120 {4.72}</td></tr></tbody></table>  01270	A	B	C	φ28.94 {1.14}	φ20 {0.79}	120 {4.72}	MH061387	Holding clutch disc		
A	B	C									
φ28.94 {1.14}	φ20 {0.79}	120 {4.72}									
	Sleeve <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ45 {1.77}</td><td>φ28.94 {1.14}</td></tr></tbody></table>  03509	A	B	φ45 {1.77}	φ28.94 {1.14}	MH061425	Checking diaphragm spring for installed height				
A	B										
φ45 {1.77}	φ28.94 {1.14}										
	Clutch master plate <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr></thead><tbody><tr><td>φ325 {12.8}</td><td>φ32 {1.26}</td><td>9.2 {0.36}</td><td>"5"</td></tr></tbody></table>  P11065	A	B	C	D	φ325 {12.8}	φ32 {1.26}	9.2 {0.36}	"5"	MH062291	Checking diaphragm spring for installed height
A	B	C	D								
φ325 {12.8}	φ32 {1.26}	9.2 {0.36}	"5"								

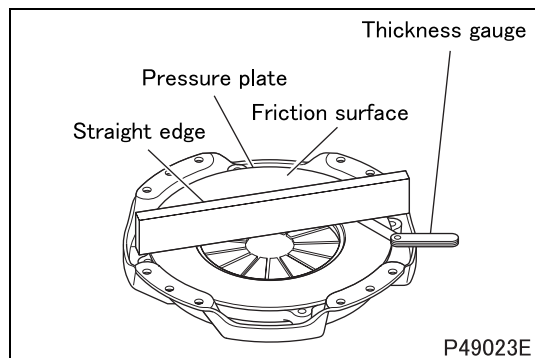
◆ Removal procedure ◆



■ Removal: Clutch cover

- Insert  into the flywheel pilot bearing. While supporting the clutch disc with , remove the clutch cover.

◆ Inspection procedure ◆

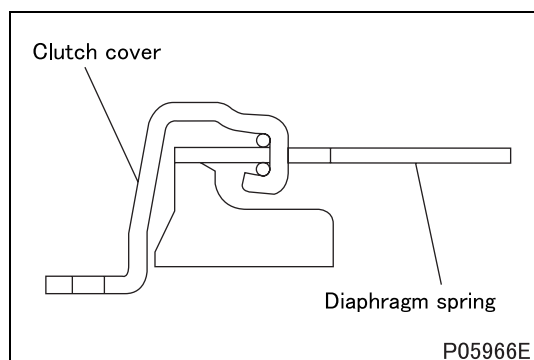


■ Inspection: Clutch cover

(1) Pressure plate flatness

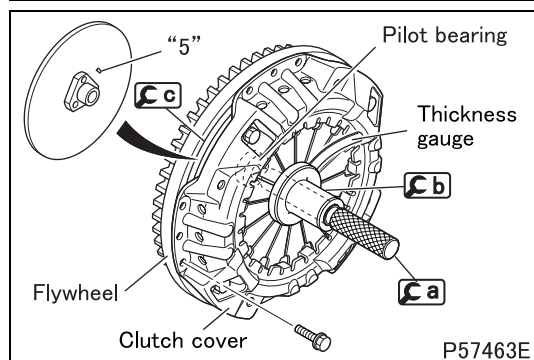
- Place a straight edge across the friction surface of the pressure plate. Using a thickness gauge, measure the clearance between the gauge and the surface in several locations selected randomly.
- Obtain the flatness of the pressure plate by subtracting the smallest clearance measured from the greatest clearance measured.
- If the flatness is equal to or exceeds the specified limit, replace the clutch cover.

CLUTCH PROPER



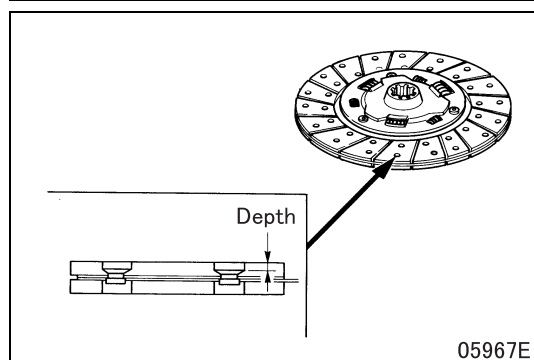
(2) Inspection of diaphragm spring

- Inspect the diaphragm spring for play.
- If the spring has play, the clutch cover needs to be replaced.



(3) Installed height of diaphragm spring

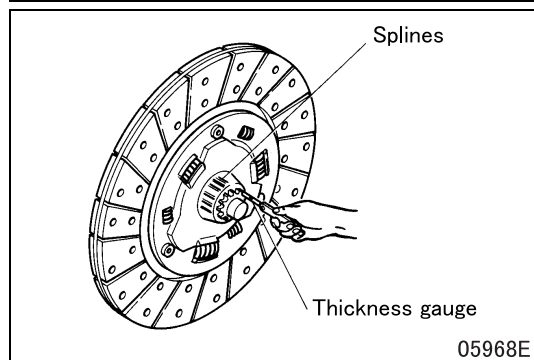
- Using **C a**, install **C c** (in place of the clutch disc) and the clutch cover.
- Install **C b** and check for unevenness in height of the fingers using a thickness gauge.
- If the unevenness exceeds the limit, replace the clutch cover.



■ Inspection: Clutch disc

(1) Depth from facing surface to rivet

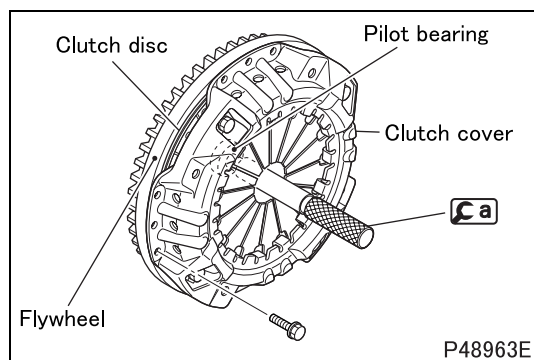
- Measure depth from the clutch disc facing surface to the rivet.
- If the measured value is equal to or less than the limit, replace the clutch disc.



(2) Play in revolving direction in splines

- Reshape a thickness gauge such that it can be inserted into the drive pinion splines. Then, using the gauge, measure the splines for play in revolving direction.
- If the measured value is equal to or exceeds the limit, replace the faulty part.

◆ Installation procedure ◆

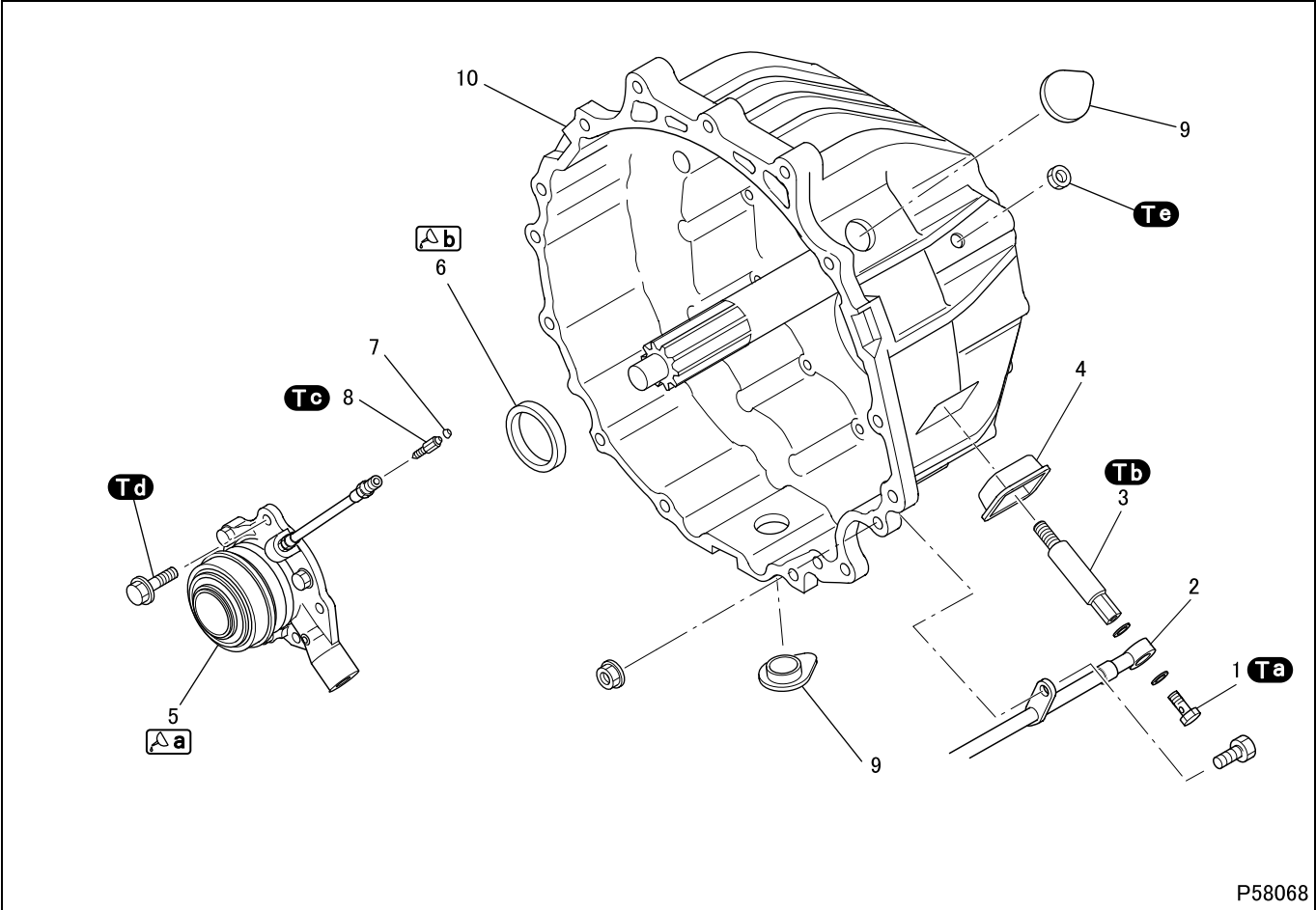


■ Installation: Clutch disc

- Insert **C a** into the flywheel pilot bearing to support the clutch disc.
- Install the clutch cover by tightening the bolts diagonally and gradually.

M E M O

CLUTCH CONTROL



P58068

● Removal sequence

- | | |
|--|-------------------|
| 1 Eye bolt | 6 Oil seal |
| 2 Clutch hose | 7 Bleeder cap |
| 3 Connector | 8 Bleeder screw |
| 4 Grommet | 9 Dust plug |
| 5 Clutch direct power cylinder
(See later section.) | 10 Clutch housing |

CAUTION

- When handling the clutch direct power cylinder, be careful not to smear it with mineral oil such as engine oil and transmission oil. A smeared cylinder can cause brake fluid leakage.

● Installation sequence

Follow the removal sequence in reverse.

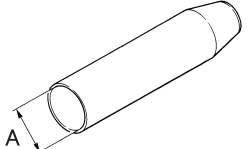
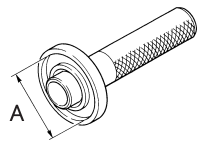
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eye bolt (clutch hose mounting)	25 {19, 2.6}	—
Tb	Connector	40 {30, 4.1}	—
Tc	Bleeder screw	6.8 to 8.8 {5.0 to 6.5, 0.7 to 0.9}	—
Td	Bolt (clutch direct power cylinder mounting)	40 {30, 4.1}	—
Te	Nut (bleeder hose mounting)	51 to 60 {37 to 43, 5.1 to 6.0}	—

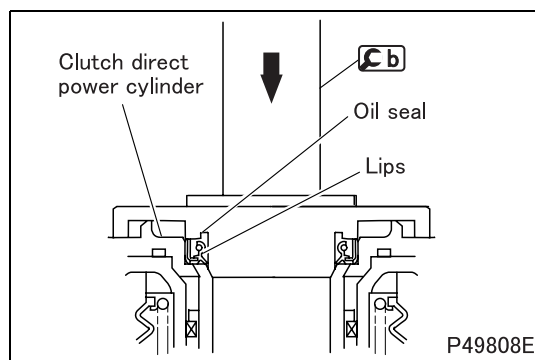
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Clutch direct power cylinder mating face with clutch housing	THREEBOND 1215	As required
	Oil seal lips	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools (Unit: mm {in.})

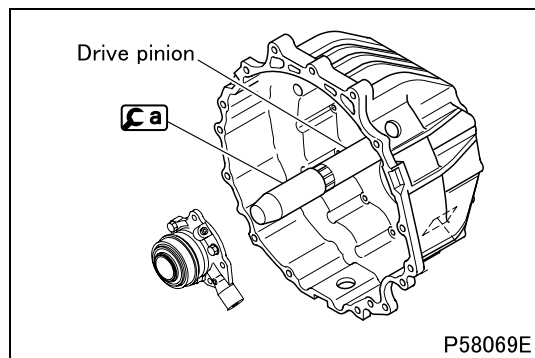
Mark	Tool name and shape	Part No.	Application
	Oil seal guide A $\phi 36.5 \{1.44\}$  09918	MH063322	Protecting oil seal during clutch direct power cylinder installation
	Oil seal installer A $\phi 89 \{3.50\}$  09917	MH062714	Oil seal installation

◆ Installation procedure ◆



■ Installation: Oil seal

- Apply grease onto the oil seal lips. Then, install the oil seal onto the clutch direct power cylinder making sure that the seal faces as shown in the drawing.

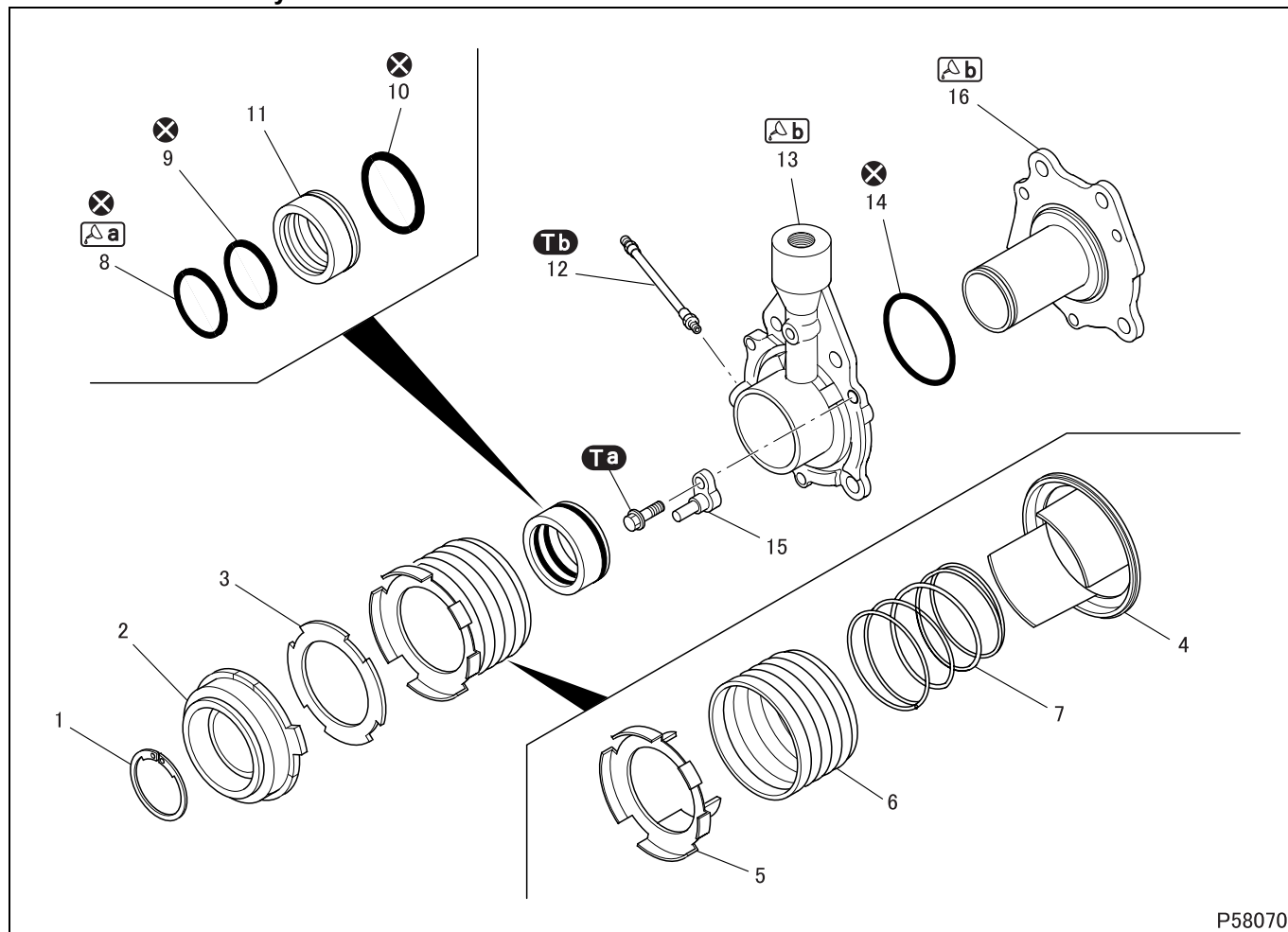


■ Installation: Clutch direct power cylinder

- After cleaning the sealant application surfaces, apply sealant as required.
- Install  onto the drive pinion to protect the oil seal previously installed onto the clutch direct power cylinder.

CLUTCH CONTROL

Clutch Direct Power Cylinder



P58070

● Disassembly sequence

- | | |
|------------------------|--------------------|
| 1 Snap ring | 10 Outer cup |
| 2 Release bearing | 11 Piston |
| 3 Oil seal | 12 Bleeder hose |
| 4 Rear spring stopper | 13 Cylinder body A |
| 5 Front spring stopper | 14 O-ring |
| 6 Boots | 15 Rod |
| 7 Spring | 16 Cylinder body B |
| 8 Front inner cup | |
| 9 Rear inner cup | |

⊗: Non-reusable parts

CAUTION ⚠

- Remove the bleeder hose only when cylinder body A is being replaced. Removing the pipe needlessly can cause brake fluid leakage.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

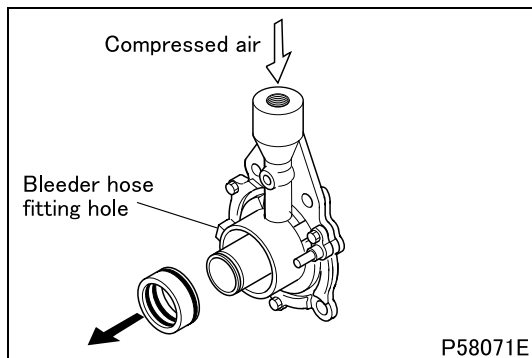
- Install the piston correctly: It needs to be faced as shown in the drawing, and the cups should not be dislodged. An incorrectly installed piston causes brake fluid leakage and clutch drag.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Mounting of cylinder bodies A, B and rod)	6.9 to 8.8 {5.1 to 6.5, 0.7 to 0.9}	—
Tb	Bleeder hose	16 to 18 {12 to 13, 1.6 to 1.8}	—

Lubricant and/or sealant

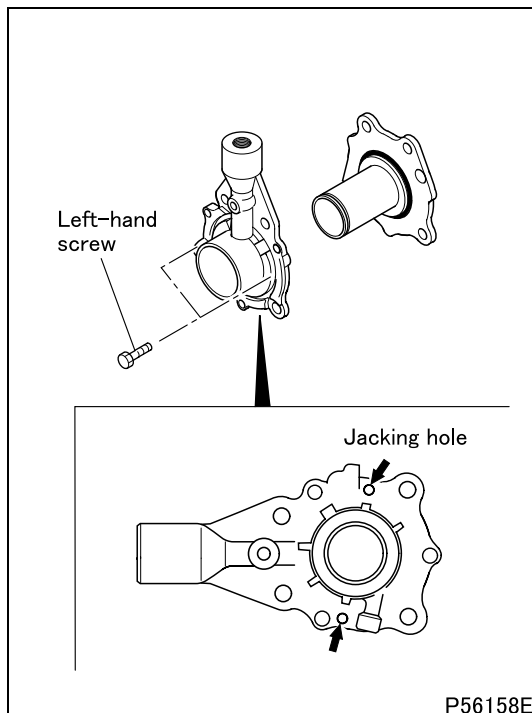
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Front inner cup sliding face with cylinder body B	COSMO Rubber Grease	0.1 to 0.2 g {0.0035 to 0.0071 oz.}
 b	Cylinder body A sliding face	Metal rubber #20 (rust preventive oil)	As required
	Cylinder body B sliding face		

◆ Removal procedure ◆**■ Removal: Piston**

- With the bleeder hose fitting hole of cylinder body A blocked, feed compressed air gradually starting from 0 kPa {0 psi, 0 kgf/cm²} to remove the piston.

WARNING ⚠

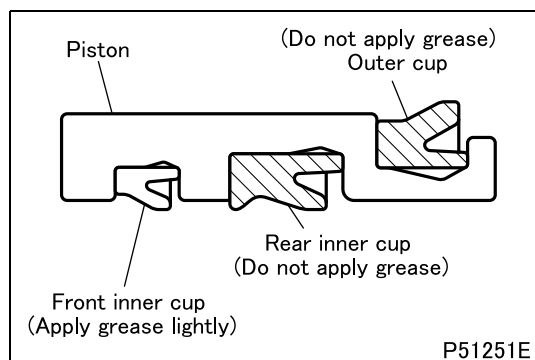
- Do not apply compressed air suddenly at high pressure, or the piston will fly out with full force.

**■ Removal: Cylinder body A**

- Install left-hand screws (M8 × 1.25 mm) evenly into the jacking holes on cylinder body A and remove the body.

CLUTCH CONTROL

◆ Installation procedure ◆

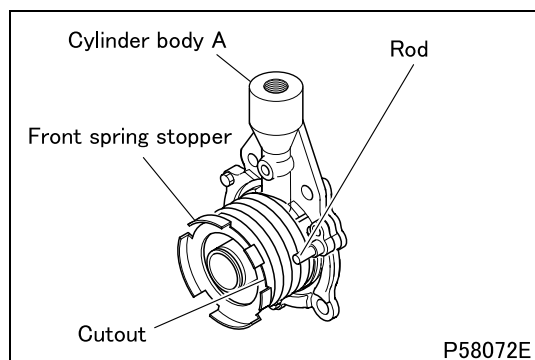


■ Installation: Front inner cup, rear inner cup and outer cup

- Install the front inner cup, rear inner cup, and outer cup onto the piston, facing them in the illustrated directions.

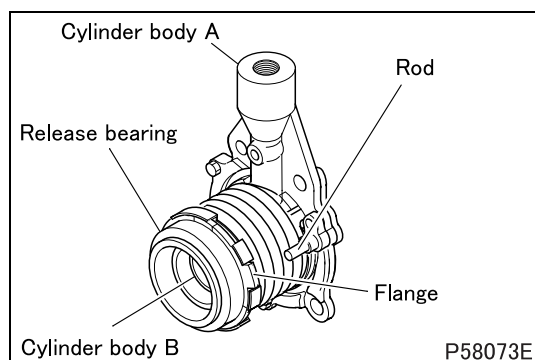
CAUTION ⚠

- Install the front inner cup, rear inner cup, and outer cup correctly, facing them in the illustrated directions. Incorrectly installed cups cause brake fluid leakage and clutch drag.
- Do not apply grease onto the rear inner cup or the outer cup. Otherwise, brake fluid will leak.
- Apply only a thin coat of grease to the front inner cup. Greasing it too much can cause brake fluid leakage.



■ Installation: Front spring stopper

- Install the front spring stopper onto cylinder body A such that its cutout aligns with the rod on the body and that it faces in the illustrated direction.



■ Installation: Release bearing

- Install the release bearing onto cylinder body B such that its flange aligns with the rod on cylinder body A and that it faces in the illustrated direction.



Group 22

Manual Transmission

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	22-2	TRANSMISSION CONTROL	22-70
STRUCTURE AND OPERATION		BEARING PULLER AND	
1. Transmission	22-4	INSTALLER.....	22-75
2. Synchromesh Mechanism	22-6		
3. Interlock Mechanism	22-9		
4. Speedometer Gear Bushing	22-9		
TROUBLESHOOTING	22-10		
ON-VEHICLE INSPECTION AND			
ADJUSTMENT			
1. Inspection and Replacement			
of Transmission Oil	22-12		
REMOVAL AND INSTALLATION OF			
TRANSMISSION ASSEMBLY	22-14		
GEAR SHIFTER UPPER	22-16		
REAR COVER <S5> AND PARKING			
BRAKE	22-22		
EXTENSION HOUSING <S6> AND			
PARKING BRAKE	22-26		
REVERSE IDLER GEAR.....	22-30		
6TH GEAR <S6>	22-34		
TRANSMISSION BODY	22-40		
DRIVE PINION	22-56		
MAINSHAFT	22-58		
COUNTERSHAFT	22-68		

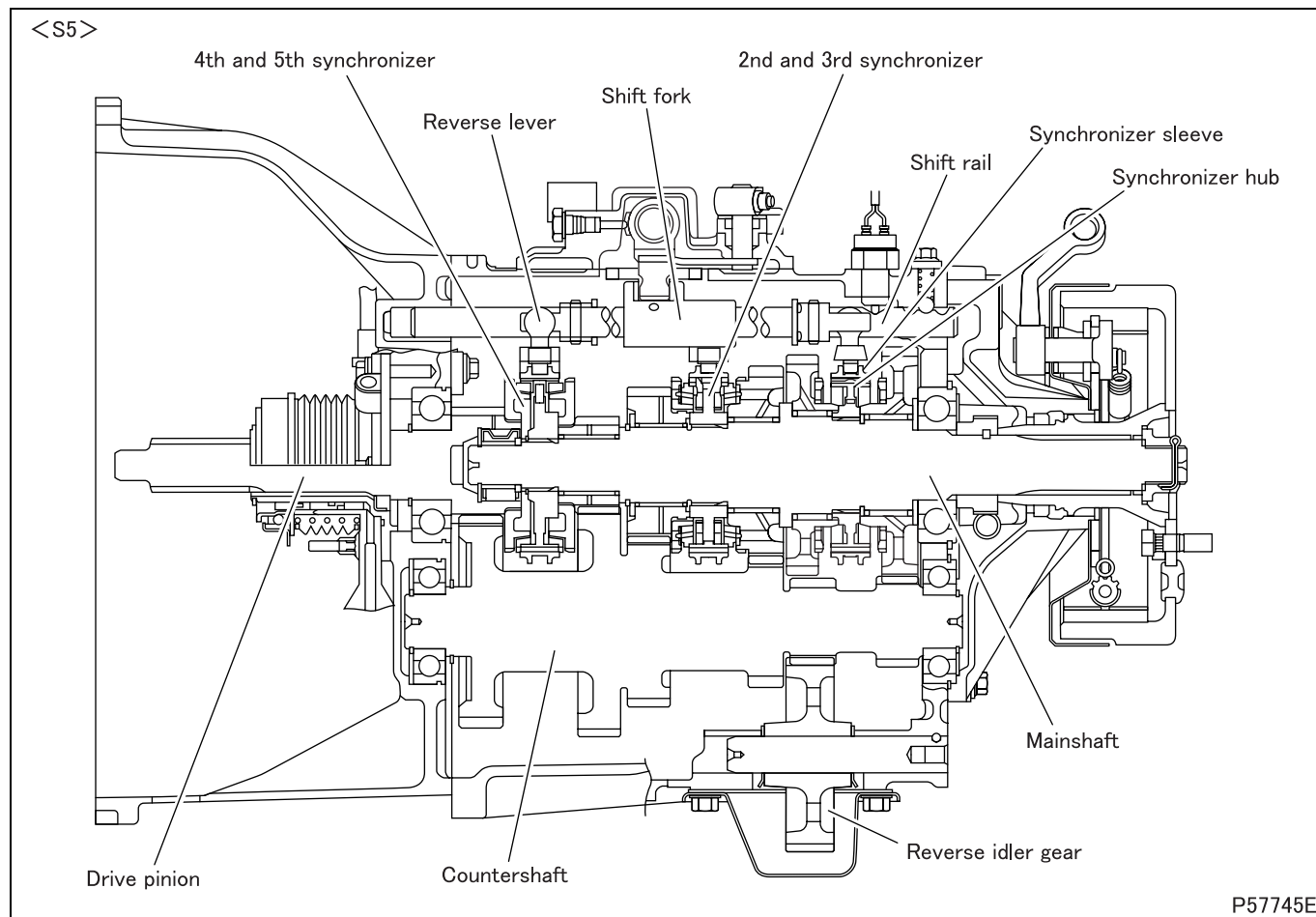
SPECIFICATIONS

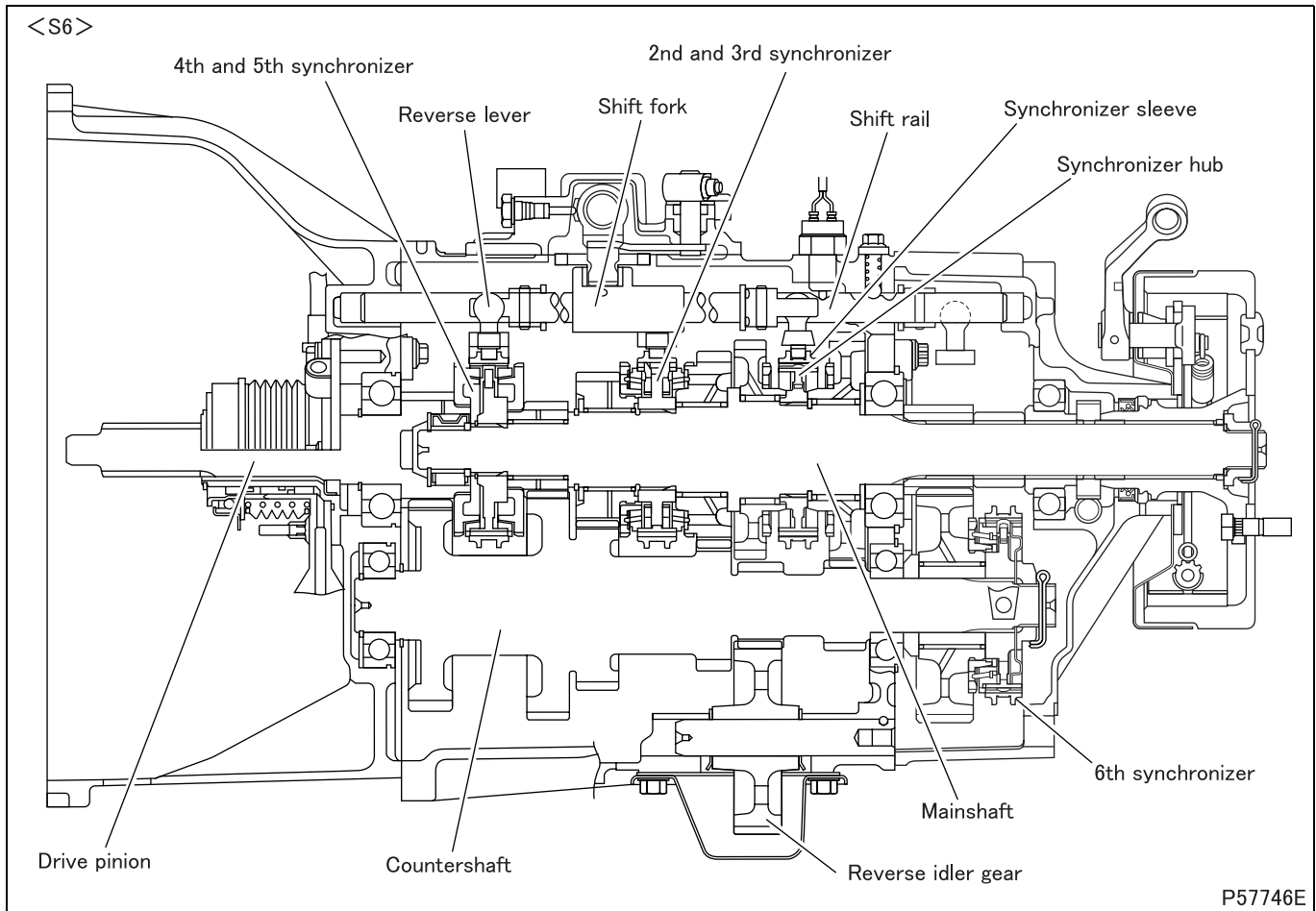
Item		Specifications	
Mode of control		Instrument panel shift remote control	
Transmission model		M036S5 (5.175/0.715)	M036S6 (5.175/0.669)
Gear ratio	1st	5.175	5.175
	2nd	2.913	2.913
	3rd	1.682	1.682
	4th	1.000	1.000
	5th	0.715	0.793
	6th	—	0.669
	Rev	5.175	5.175
Transmission oil	Gear oil		General: API GL-3 SAE80 or API GL-4 SAE80 Warm region: API GL-3 SAE90 Tropical region: API GL-4 SAE90
	Engine oil		Long period of high-speed driving API CC SAE30 or SAE40
	Quantity	L {qts.}	3.6 {3.8} 4.4 {4.6}
Mass		kg {lb}	89 {195} 101 {220}

M E M O

STRUCTURE AND OPERATION

1. Transmission





- The transmission changes revolution and torque generated by the engine into those that match the vehicle's power requirement (driving force). The power requirement (driving force) is increased or decreased by making a selection from several sets of engaged gears.
- The transmission uses an interlock mechanism to avoid double engagement.

STRUCTURE AND OPERATION

2. Synchromesh Mechanism

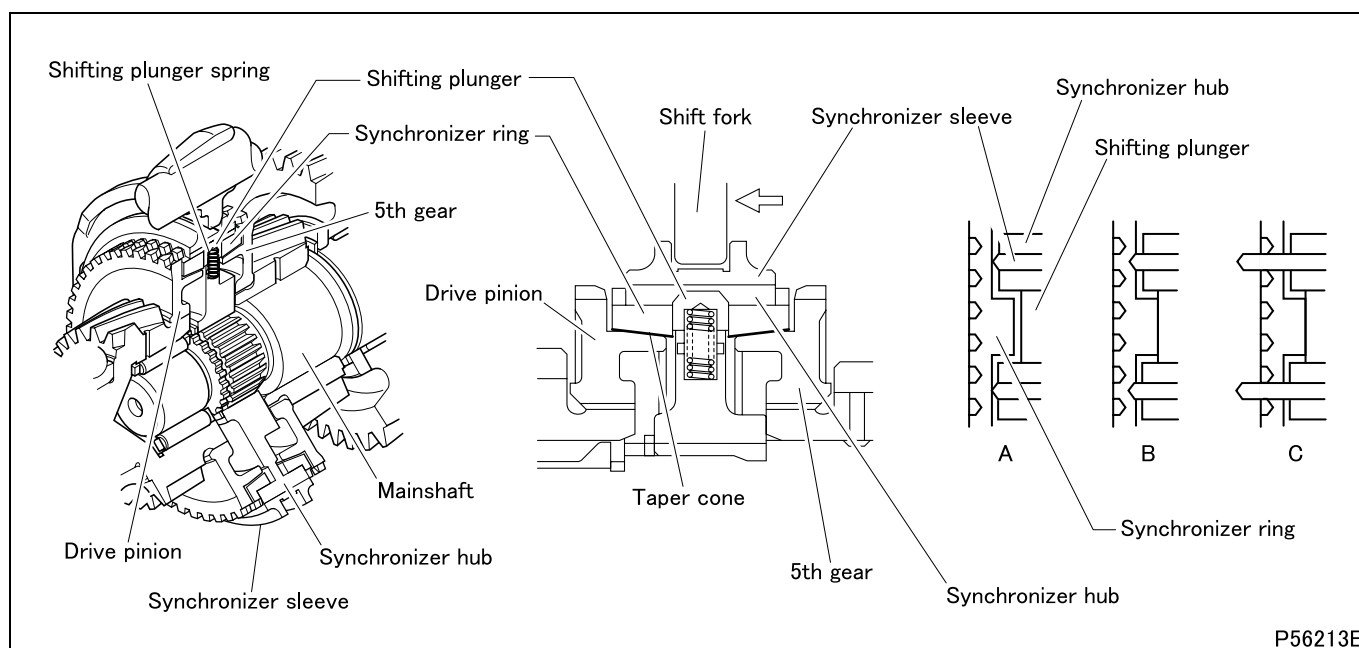
- The synchromesh mechanism, when a shift change is made, synchronizes the rotation speed of the mainshaft, drive pinion and synchronizer hub that rotates integrally with the mainshaft with the rotation speed of the gear to be shifted.
- This vehicle has two synchromesh mechanisms, a Warner synchromesh type and a lever synchromesh type. The Warner synchromesh type or the lever synchromesh type is used depending on the gear position as shown below:

Transmission type		M036S5	M036S6
Synchromesh type			
Warner synchromesh type	Single cone type	4th, 5th	4th, 5th
	Triple cone type	—	6th
Lever synchromesh type	Triple cone type	2nd, 3rd	2nd, 3rd

2.1 Warner synchromesh type

(1) Single cone type

The following descriptions are for 4th gear of 4th and 5th synchronizer assembly.

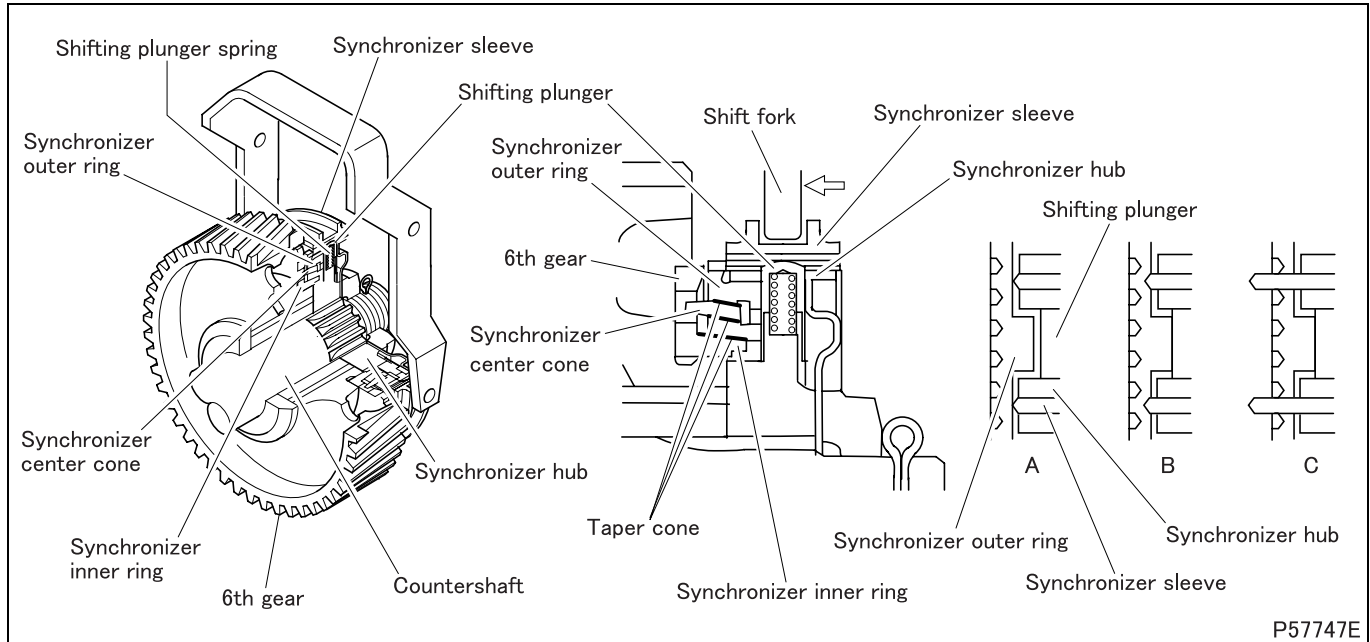


- The inside of the synchronizer hub engages the spline of the mainshaft and rotates with it. The outside of the synchronizer hub has a spline that engages the synchronizer sleeve and three grooves.
- Shifting plungers are inserted into these grooves. When the gear shift is in neutral, the shifting plungers engage grooves in the synchronizer sleeve and are pressed against the inside of the synchronizer sleeve by shifting plunger springs.
- Synchronizer rings are inserted into the respective taper cone of each gear.
- The outer splines of the synchronizer rings engage the synchronizer sleeve. On the synchronizer hub are three grooves in which protrusions of the synchronizer rings are inserted. These grooves are wider than the width of protrusions of the synchronizer rings.
- Synchronizer rings rotate relative to the synchronizer sleeve by the amount of play.
- When the gear shift is in neutral (Figure A), moving the shift fork in the direction of the arrow as illustrated, moves the synchronizer sleeve slightly to the pinion drive. At the same time, the shifting plunger, the central protrusion of which engages the synchronizer sleeve, moves to the drive pinion and presses the synchronizer ring against the taper cone of the drive pinion (Figure B).
- The taper cones of synchronizer rings, which act as cone clutches, generate friction torque and perform synchronous operation.

- The rotation speed of the synchronizer hub becomes gradually closer to that of the drive pinion gear due to the synchronous operation, and eventually they rotate at the same speed. This allows the synchronizer sleeve to move smoothly to engage the synchronizer hub and gear, completing the shift change (Figure C).

(2) Triple cone type

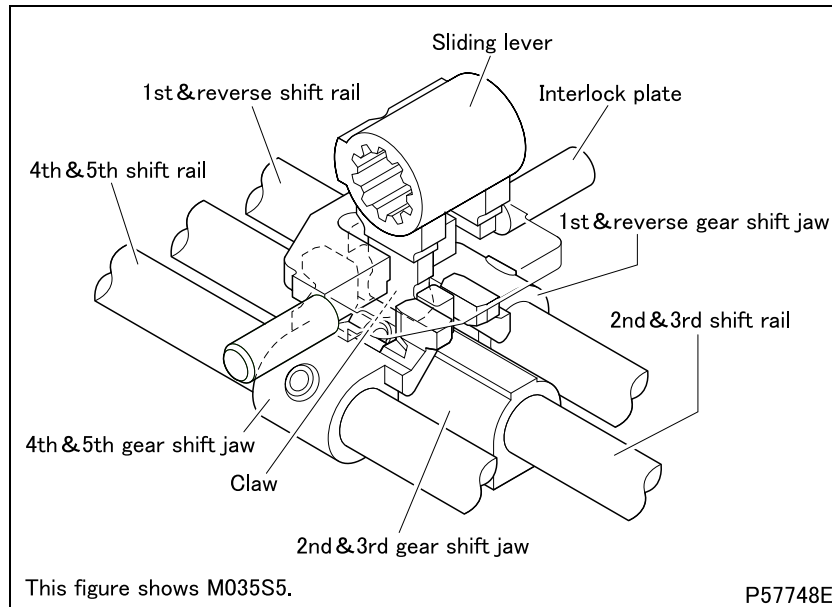
The following descriptions are for 2nd gear of 2nd and 3rd synchronizer assembly.



- The synchromesh structure and operation of the triple cone type are basically the same as for the single cone type. The synchronizer ring is divided into three parts (synchronizer inner ring, synchronizer center cone and synchronizer outer ring) and the center cone (both the inside and outside surfaces are tapered) and the inner ring (both the inside and outside surfaces are tapered) are sandwiched between the outer ring and the taper cone of each gear to shorten the timex required for synchronization with cone clutches at three locations.
- Six protrusions on the outside of the synchronizer center cone fit into corresponding gear holes. As in the taper cone of the single cone type, the center cone and the gear are installed as if integrated.
- The inside of the synchronizer hub engages the spline of the mainshaft and rotates with it. The outside of the synchronizer hub has a spline that engages the synchronizer sleeve and three grooves.
- Shifting plungers are inserted into these keyways. When the gear shift is in neutral, the shifting plungers engage grooves in the synchronizer sleeve and are pressed against the inside of the synchronizer sleeve by shifting plunger springs.
- The synchronizer outer ring and synchronizer inner ring are inserted into synchronizer center cones, respectively.
- The outer spline of the synchronizer outer ring engages the synchronizer sleeve. On the synchronizer hub are three grooves in which protrusions of the synchronizer outer ring are inserted. These grooves are wider than the width of protrusions of the synchronizer outer ring.
- The synchronizer outer ring rotates relative to the synchronizer sleeve by the amount of play.
- When the gear shift is in neutral (Figure A), moving the shift fork in the direction of the arrow as illustrated, moves the synchronizer sleeve slightly to the 2nd gear. At the same time, the shifting plunger, the central protrusion of which engages the synchronizer sleeve, moves to the 2nd gear and presses the synchronizer outer ring and the center cone against the taper cone of the synchronizer center cone and the synchronizer inner ring, respectively and in addition, presses the inner ring against the 2nd gear (Figure B).
- The taper cones of synchronizer rings, which act as cone clutches, generate friction torque and perform synchronous operation.
- The rotation speed of the synchronizer hub becomes gradually closer to that of the gear of the 2nd gear due to the synchronous operation, and eventually they rotate at the same speed. This allows the synchronizer sleeve to move smoothly to engage the synchronizer hub and gear, completing the shift change (Figure C).

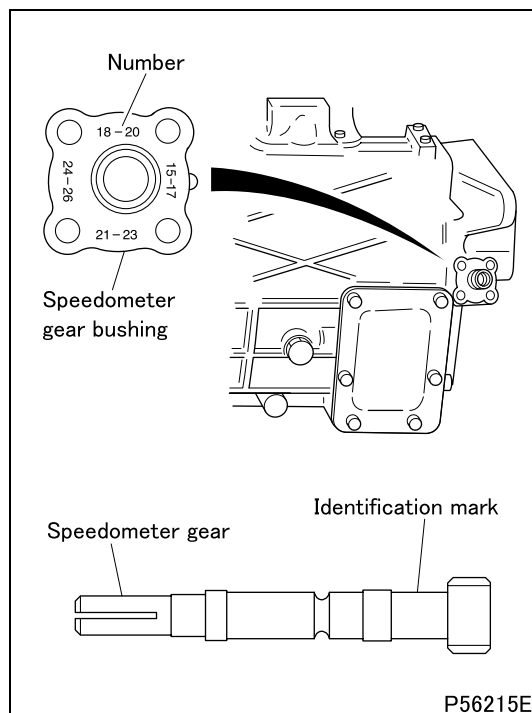
- The rotation speed of the synchronizer hub becomes gradually closer to that of the gear of the 2nd gear due to the synchronous operation, and eventually they rotate at the same speed. This allows the synchronizer sleeve to push in the synchronizer levers on the inside slant and to move smoothly while turning the synchronizer outer ring to engage the synchronizer hub and gear, completing the shift change (Figure C).

3. Interlock Mechanism



- The interlock mechanism prevents double engagement of gears.
- When the 2nd and 3rd shift rail is shifted, the finger of the gear shift sliding lever engages with the 2nd & 3rd gear shift jaw, and the rail on the bottom surface of the interlock plate locks the other gear shift jaws.

4. Speedometer Gear Bushing



- The speedometer gear bushing is eccentric, and displacing the installed position allows it to correspond to the different number of tooth of the speedometer gear.
- The numbers marked on the front at four locations show the range of the number of tooth of the corresponding speedometer gear.
"15-17": Number of tooth 15 to 17
- An identification mark showing the number of tooth is marked on the speedometer gear.

Identification mark	A	B	C	D	L	E
Number of tooth	15	16	17	18	19	20
Gear ratio	3.0	3.2	3.4	3.6	3.8	4.0

TROUBLESHOOTING

Symptoms		Gears slip out of engagement	Gears hard to engage	Noise when engine is idling	Noise when cruising	Noise when changing gear	Reference Gr
Possible causes							
Transmission body faulty	Mainshaft rear lock nut loose	O	O				
	Mainshaft thrust washer worn	O	O				
	Mainshaft bearing worn or damaged	O	O				
	Synchronizer ring and synchronizer sleeve spline worn	O					
	Synchronizer ring and gears taper cone area worn		O				
	Mainshaft pilot bearing worn or damaged			O	O		
	Drive pinion bearing worn or damaged			O			
	Countershaft bearing worn or damaged			O			
	Needle bearings of gears worn or damaged			O	O		
	Mainshaft and countershaft gears worn or damaged				O		
	Mainshaft and countershaft gears backlash excessive				O		
	Spline of gears worn					O	
	Gears damaged				O		
	Transmission oil insufficient				O		
Control mechanisms faulty	Control cable adjustment faulty		O				
	Control cable routing inadequate		O				
	Control cable length inadequate		O				
	Bushings worn	O	O				
	Steel ball and groove of shift rail worn	O					
	Poppet spring of shift rail fatigued or damaged	O					
	Shift rail sliding movement faulty		O				
	Shift fork jaws worn		O				
	Shift fork bent		O				

Symptoms				Gears slip out of engagement	Gears hard to engage	Noise when engine is idling	Noise when cruising	Noise when changing gear	Reference Gr
Possible causes									
Clutch faulty	Clutch disengagement faulty				O			O	Gr21
	Clutch pedal play faulty				O			O	
Synchronizer faulty	Warner syn- chromesh type	Single cone type	Contacting surface of synchronizer ring and gear taper cone worn		O			O	
		Triple cone type	Contacting surface of synchronizer inner and outer rings and center cone worn		O			O	
			Contacting surface of synchronizer inner ring and gear taper cone worn		O			O	
	Lever synchromesh type	Synchronizer lever worn or damaged			O			O	
		Contacting surface of synchronizer inner and outer rings and center cone worn			O			O	
		Contacting surface of synchronizer inner ring and gear taper cone worn			O			O	
	Synchronizer ring spline chamfer worn <Warner synchromesh type>							O	
	Shifting key worn <Warner synchromesh type>							O	
	Shifting key spring deteriorated or damaged <Warner synchromesh type>							O	
	Synchronizer spring deteriorated or damaged <lever synchromesh type>							O	
	Synchronizer sleeve worn or damaged						O	O	

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Replacement of Transmission Oil

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

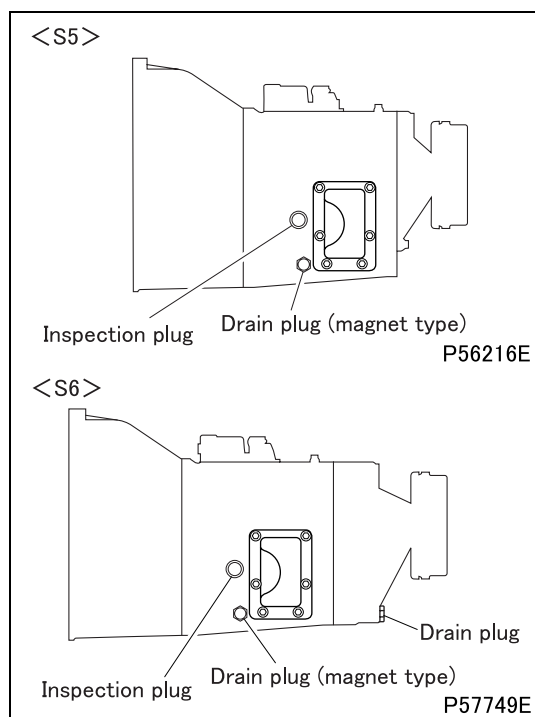
Mark	Parts to be tightened	Tightening torque	Remarks
-	Inspection plug	68.8 ± 14.7 {51 ± 11, 7.0 ± 1.5}	-
	Drain plug		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
-	Thread area of inspection plug	THREEBOND 1105	As required
	Thread area of drain plug		
-	Transmission case and extension housing	Gear oil General: API GL-3 SAE80 Warm region: API GL-3 SAE90 Tropical region: API GL-4 SAE90 Engine oil Vehicle operated continuously at high-speed: API CC SAE30 or SAE40	3.6 L {3.8 qts.}

WARNING

- Temperature of transmission oil is high immediately after driving. Perform work when oil is cold.



[Inspection]

(1) Inspection of oil quantity

- Remove the inspection plug, and check that oil is filled up to the neck.
- If oil is not sufficient, fill oil from the inspection plug hole up to the neck.
- After filling, apply sealant to the inspection plug and tighten it to the specified torque.

(2) Inspection of oil quality and inclusions

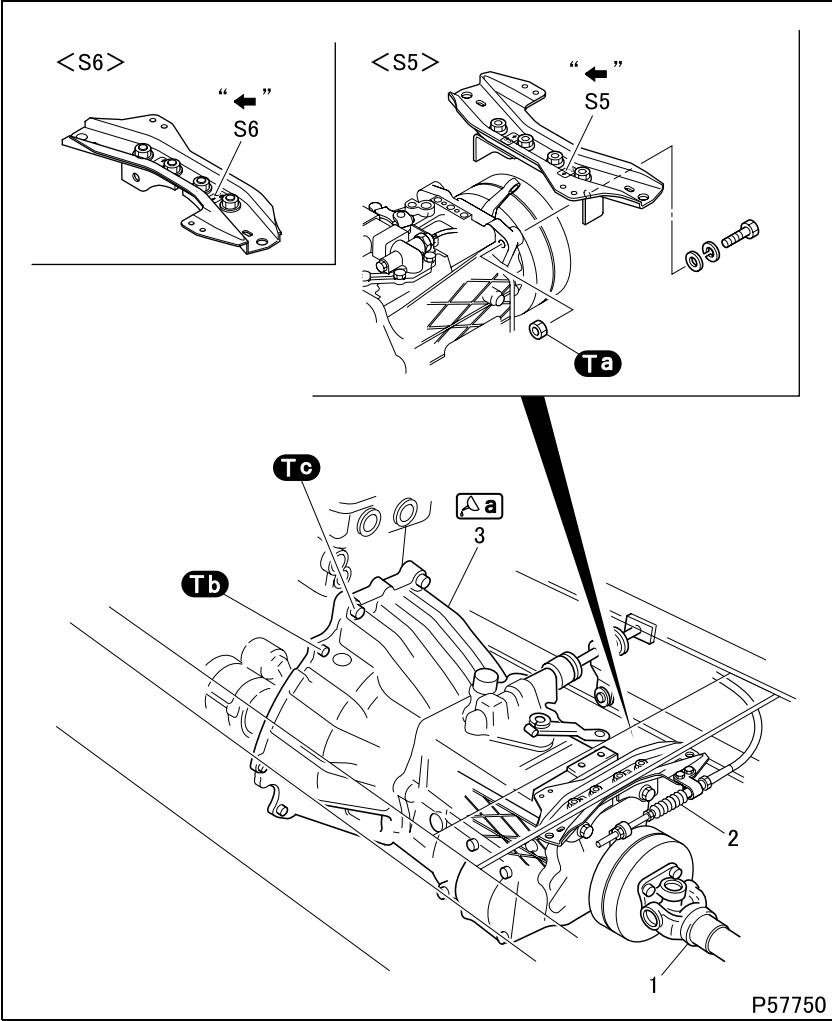
- When draining transmission oil, check for oil quality, metal chips and metal powder.
- If an abnormally large amount of metal chips and metal powder is found, disassemble the transmission assembly for service, as abnormalities may be caused inside.

[Replacement]

- Remove the drain plug to drain transmission oil. Drainage can be made quickly with the inspection plug removed.
- After draining transmission oil, apply sealant to the drain plug and tighten it to the specified torque. In case of the drain plug of magnet type, clean it before installation.
- Fill transmission oil of the specified quantity from the inspection plug hole.
- After filling, check that oil is filled up to the neck. If oil is not sufficient, replenish it.
- After completing work, apply sealant to the inspection plug and tighten it to the specified torque.

M E M O

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY



● Removal sequence

- 1 Propeller shaft
- 2 Parking cable
- 3 Transmission

● Installation sequence

Follow the removal sequence in reverse.

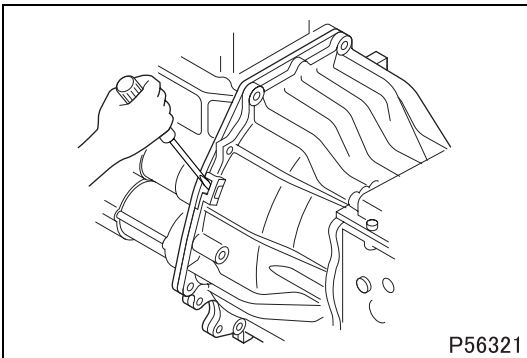
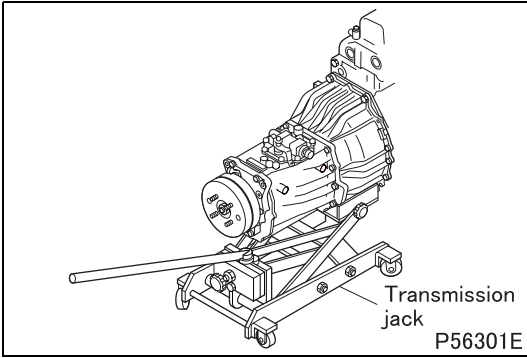
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (transmission mounting)	130 to 180 {96 to 130, 13 to 18}	–
Tb	Bolt (transmission mounting)	47.1 {35, 4.8}	M10
Tc	Bolt (transmission mounting)	82.4 {61, 8.4}	M12

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Drive pinion spline	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required

◆ Removal procedure ◆



■ Removal: Transmission

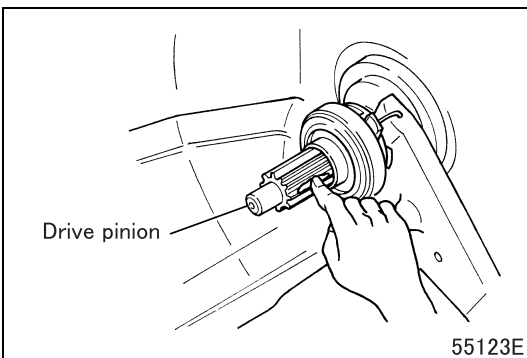
- Support the transmission on the transmission jack and remove transmission mounting bolts.

- Insert a screwdriver into the three removal grooves and remove the transmission from the engine.
- Move the transmission backward until the spline of the drive pinion is detached from the clutch.

CAUTION ⚠

- **Make sure that you pull the transmission out in a straight line. If you seesaw the transmission violently, you will damage the spline that connects the drive pinion and the clutch.**

◆ Installation procedure ◆

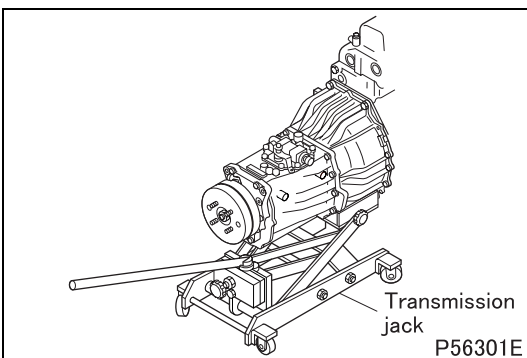


■ Installation: Transmission

- Check the spline of the drive pinion for rust.
- If rust is found, remove it using a wire brush.
- Rub grease evenly onto the clutch disc sliding surface of the drive pinion using your hand.

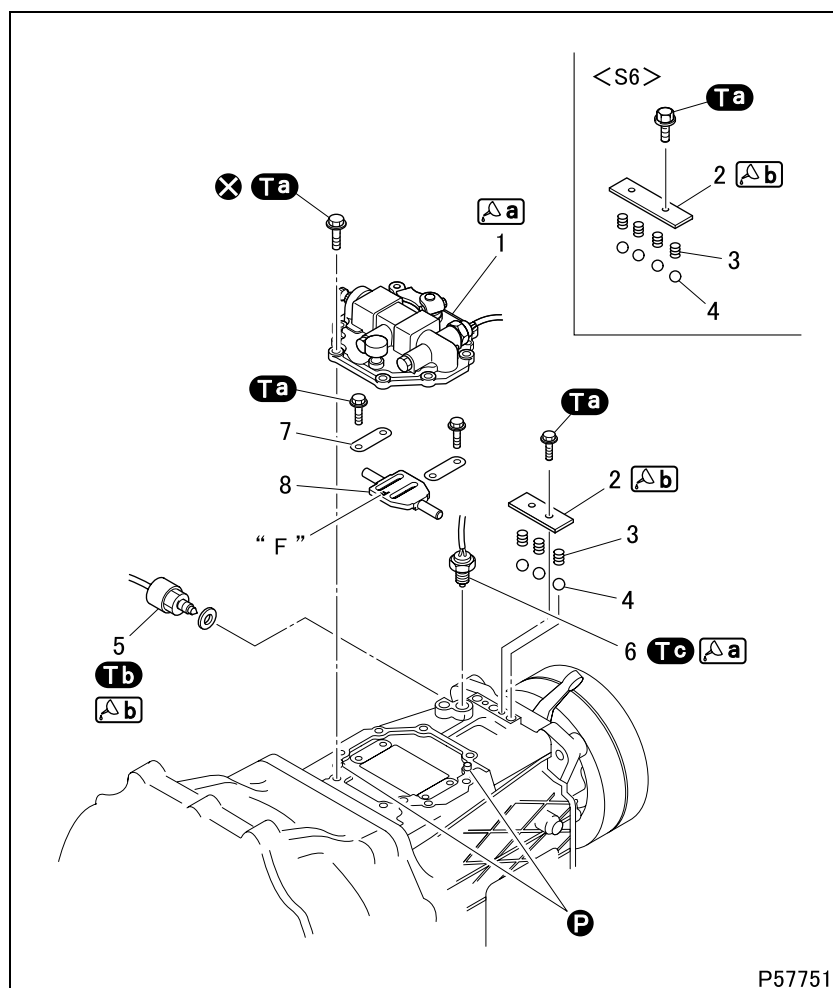
CAUTION ⚠

- **Make sure that you apply only the necessary amount of grease because too much grease would drip and cause clutch slip.**



- Support the transmission on the transmission jack, and insert the transmission into the pilot bearing of the flywheel paying attention to the drive pinion spline.
- Tighten transmission mounting bolts to the specified torque.

GEAR SHIFTER UPPER



● Removal sequence

- 1 Gear shifter upper
(See later section.)
- 2 Poppet spring plate
- 3 Poppet spring
- 4 Steel ball
- 5 Backup lamp switch
- 6 Torque limit switch
- 7 Plate
- 8 Interlock plate

(P): Locating pin

(X): Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3	Poppet spring installed load (installed length 21.7 {0.85})	61.2 N {14 lbs, 6.2 kgf}	43 N {9.7 lbs, 4.4 kgf}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Gear shifter upper mounting)	23.5 {17, 2.4}	—
	Bolt (Poppet spring plate mounting)		
	Bolt (Plate mounting)		
Tb	Backup lamp switch	29.4 to 39.2 {22 to 29, 3 to 4}	—
Tc	Torque limit switch	49 ± 2.9 {36 ± 2.1, 5 ± 0.3}	—

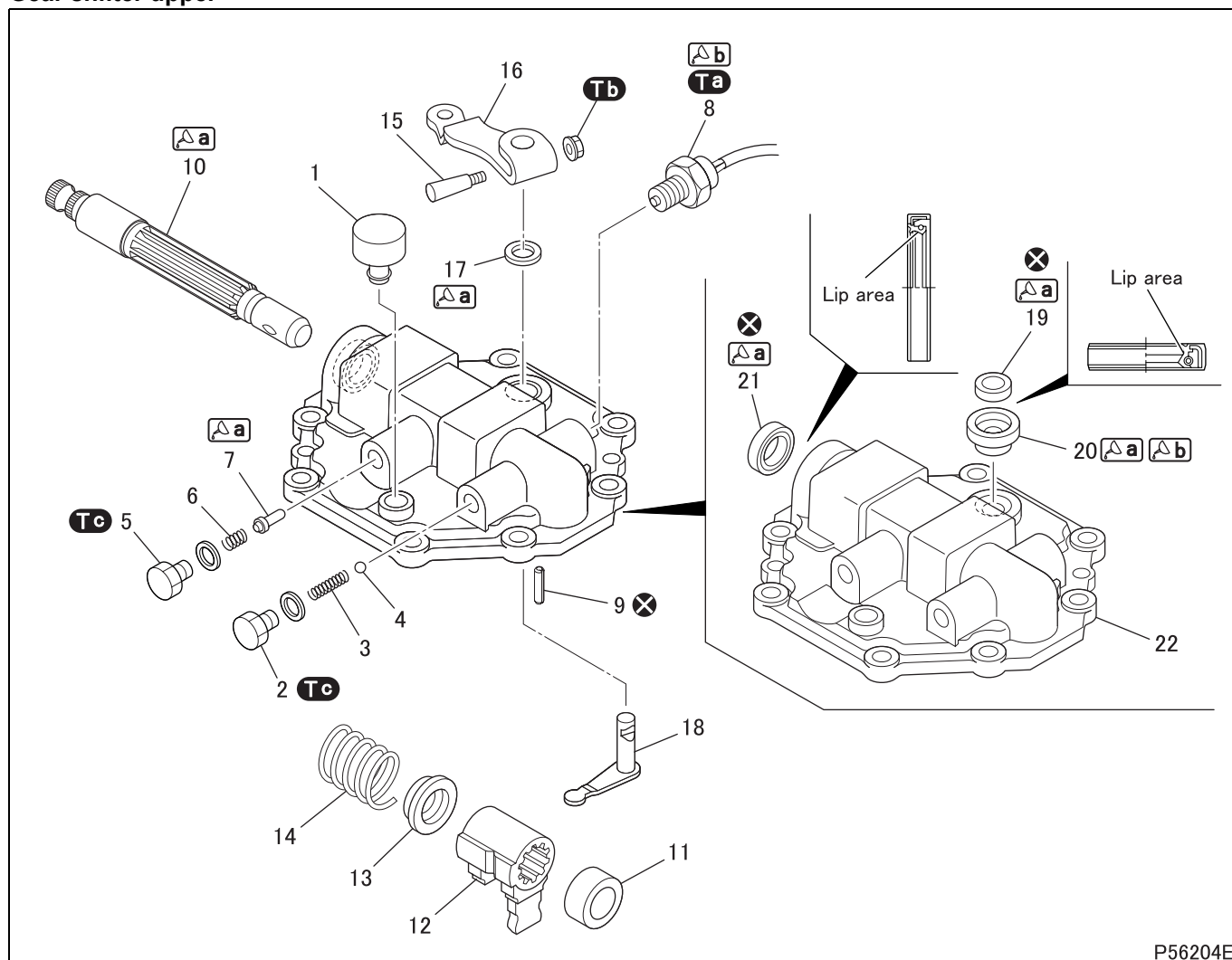
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Mating surface of gear shifter upper and transmission case	THREEBOND 1104	As required
	Thread area of torque limit switch		
b	Mating surface of poppet spring plate and transmission case	THREEBOND 1215	As required
	Thread area of backup lamp switch		

M E M O

GEAR SHIFTER UPPER

Gear shifter upper



P56204E

● Disassembly sequence

- | | | |
|-------------------------|-----------------------------|------------------------|
| 1 Air breather | 9 Spring pin | 17 Washer |
| 2 Plug | 10 Torsion shaft | 18 Gear selector lever |
| 3 Neutral poppet spring | 11 Spacer <S5> | 19 Oil seal |
| 4 Steel ball | 12 Gear shift sliding lever | 20 Bushing |
| 5 Plug | 13 Spring retainer | 21 Oil seal |
| 6 Select poppet spring | 14 Return spring | 22 Selector lever case |
| 7 Select poppet pin | 15 Lock pin | |
| 8 Neutral switch | 16 Gear selector lever | ⊗: Non-reusable parts |

NOTE

- Do not remove bushing except for replacement.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3	Neutral poppet spring installed load (installed length 26.8 {1.10})	71.3 N {16 lbs, 7.28 kgf}	50 N {11 lbs, 5.1 kgf}	Replace
6	Select poppet spring installed load (installed length 11 {0.43})	19.6 N {4.4 lbs, 1.99 kgf}	14 N {3.1 lbs, 1.4 kgf}	Replace
14	Return spring installed load (installed length 26.8 {1.06})	71.3 N {16 lbs, 7.28 kgf}	50 N {11 lbs, 5.1 kgf}	Replace

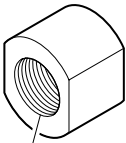
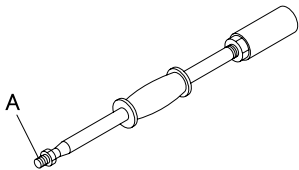
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Neutral switch	49 ± 2.9 {36 ± 2.1, 5 ± 0.3}	—
Tb	Nut (Lock pin mounting)	6.9 {5.1, 0.7}	—
Tc	Plug	33 to 49 {24 to 36, 3.4 to 5.0}	—

Lubricant and/or sealant

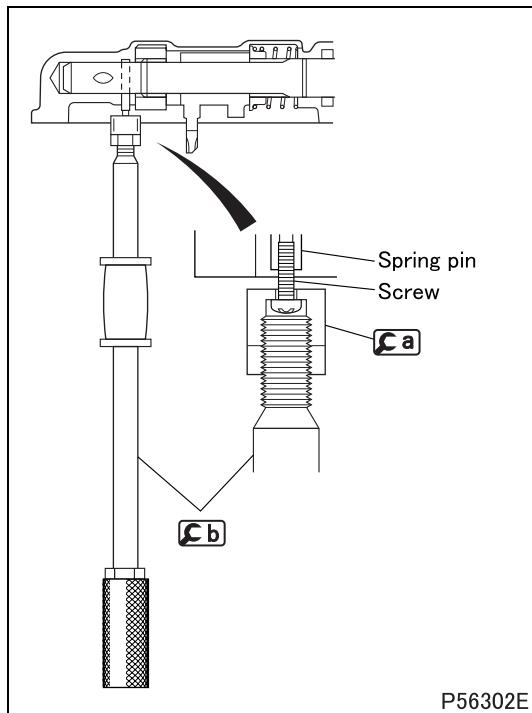
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Sliding area of select poppet pin	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Neutral switch of torsion shaft and steel ball mounting groove		
	Sliding area of washer		
	Lip area of oil seal		
	Sliding area of bushing inner surface and gear selector lever shaft		
	Thread area of neutral switch	THREEBOND 1104	As required
	Contact surface of bushing outer surface and selector lever case		

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application
	Spring pin puller A M12 × 1.25  P02399	MH062445	Removal of spring pin
	Reverse shaft puller A M12 × 1.25  P02118		

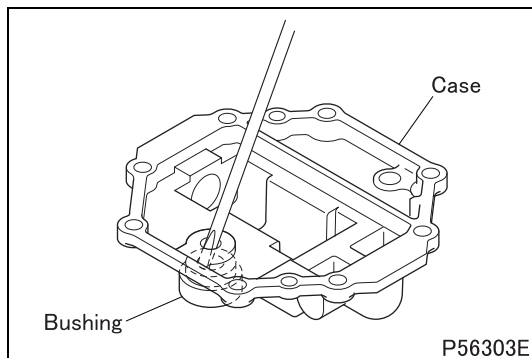
GEAR SHIFTER UPPER

◆ Removal procedure ◆



■ Removal: Spring pin

- Tap the spring pin using an M4 tap.
- Insert **C a** spring pin puller with an M4 screw of appropriate length into the spring pin, and remove the spring pin using **C b** reverse shaft puller.



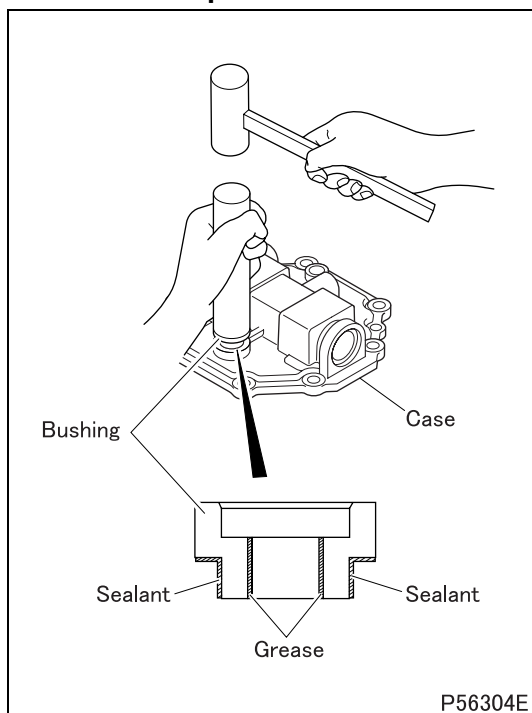
■ Removal: Bushing

- Remove the bushing using a screwdriver.

CAUTION ⚠

- Be careful not to damage the selector lever case.

◆ Installation procedure ◆

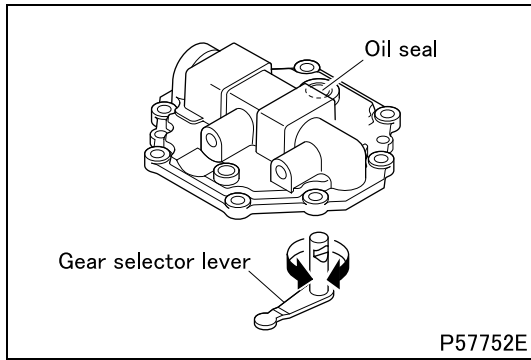


■ Installation: Bushing

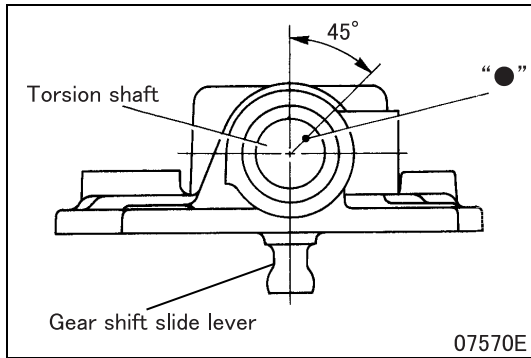
- Clean the bushing and bushing mounting surface of the selector lever case.
- Apply grease to the inner surface of the bushing and sealant to its outer surface.

NOTE

- Do not allow sealant to adhere to the inner surface of the bushing.
- Mount the bushing by evenly tapping it using a round bar of outer diameter of approximately 30 mm {1.18 in.}.

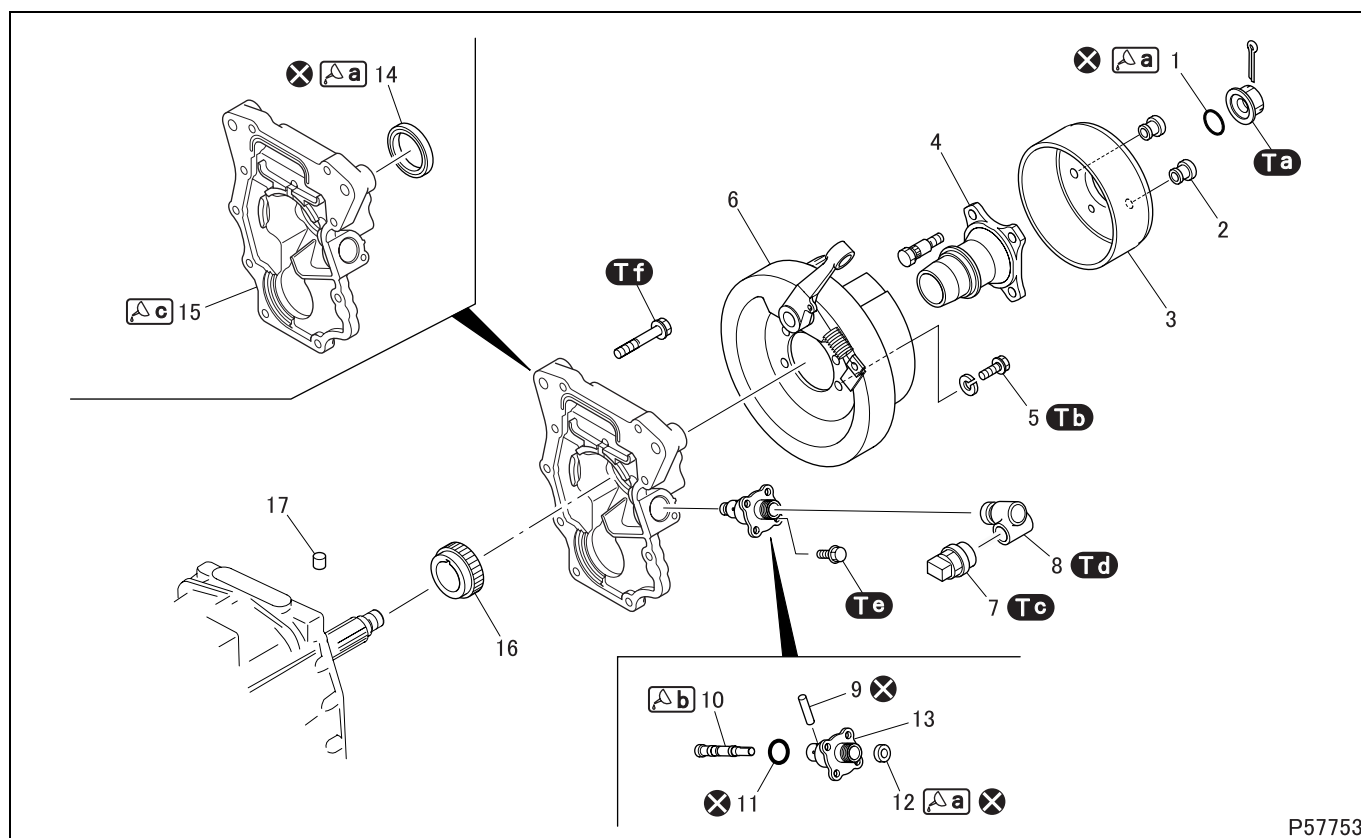
**■ Installation: Gear selector lever**

- Turn the gear selector lever when installing it in order to avoid damage to the oil seal lip.

**■ Installation: Torsion shaft**

- Install the torsion shaft so that the angle the punch mark “●” at the tip of the torsion shaft forms with the gear shift slide lever is as illustrated.

REAR COVER <S5> AND PARKING BRAKE



P57753

● Disassembly sequence

- | | | |
|-----------------------------|-----------------------------|-----------------------|
| 1 O-ring | 8 L-joint | 15 Rear cover |
| 2 Dust plug | 9 Spring pin | 16 Speedometer worm |
| 3 Parking brake drum | 10 Speedometer gear | 17 Pin |
| 4 Companion flange | 11 O-ring | |
| 5 Reamer bolt | 12 Oil seal | ⊗: Non-reusable parts |
| 6 Parking brake (See Gr36.) | 13 Speedometer gear bushing | |
| 7 Vehicle speed sensor | 14 Oil seal | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
3	Parking brake drum	Inner diameter	$\phi 203.2^{+0.3}_0 \{8.00^{+0.012}_0\}$	$\phi 205 \{8.07\}$	Replace
		Squareness	0.05 {0.0020} or less	—	
		Concentricity	0.2 {0.0079} or less	—	
		Cylindricity	0.05 {0.0020} or less	—	
		Static rotation imbalance	0.0049 N·m {0.004 ft.lbs, 0.5 gf·m} or less	—	
4	Runout at socket portion of companion flange		0.15 {0.0059} or less	0.5 {0.020}	Replace
10, 13	Clearance between speedometer gear and speedometer gear bushing		0.04 to 0.09 {0.0016 to 0.0035}	0.15 {0.0059}	Replace

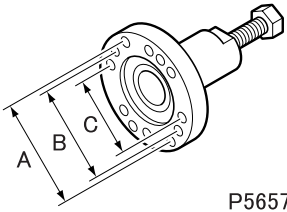
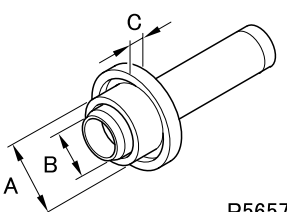
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut	245 to 343 {180 to 250, 25 to 35}	—
Tb	Reamer bolt	52 to 66.7 {38 to 48, 5.3 to 6.8}	—
Tc	Vehicle speed sensor	14.7 to 29.4 {11 to 22, 1.5 to 3}	—
Td	L-joint	34 to 49 {25 to 36, 3.5 to 5}	—
Te	Bolt (Speedometer gear bushing mounting)	23.5 {17, 2.4}	—
Tf	Bolt (Rear cover mounting)	44.5 {33, 4.5}	—

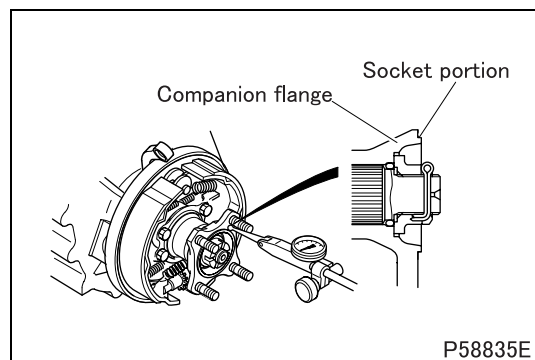
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Lip area of oil seal		
 b	Sliding area of speedometer gear and speedometer gear bushing	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required
 c	Contact surface of transmission case and rear cover	THREEBOND 1215	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application			
 a	Flange puller  P56577	MH061848	Removal of companion flange			
	<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ95 {3.74}</td><td>φ100 {3.94}</td><td>φ90 {3.54}</td></tr></table>			A	B	C
A	B	C				
φ95 {3.74}	φ100 {3.94}	φ90 {3.54}				
 b	Oil seal installer  P56578	MH062691	Installation of oil seal			
	<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ64 {2.52}</td><td>φ50 {1.97}</td><td>φ17 {0.67}</td></tr></table>			A	B	C
A	B	C				
φ64 {2.52}	φ50 {1.97}	φ17 {0.67}				

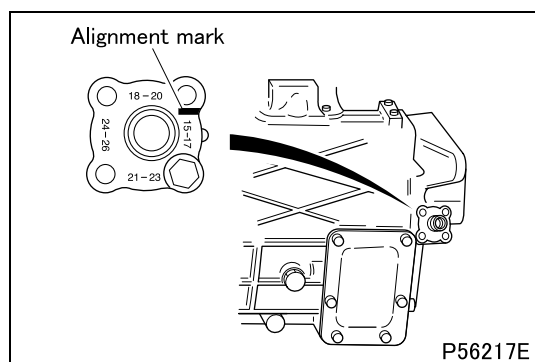
◆ Work before removal ◆



■ Inspection: Runout at socket portion of companion flange

- If the measured value exceeds the limit, replace the companion flange.

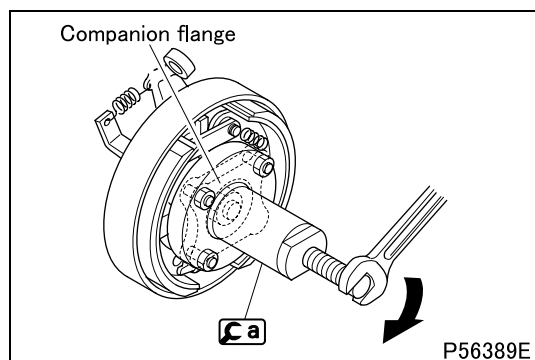
REAR COVER <S5> AND PARKING BRAKE



■ Alignment marks: Speedometer gear bushing

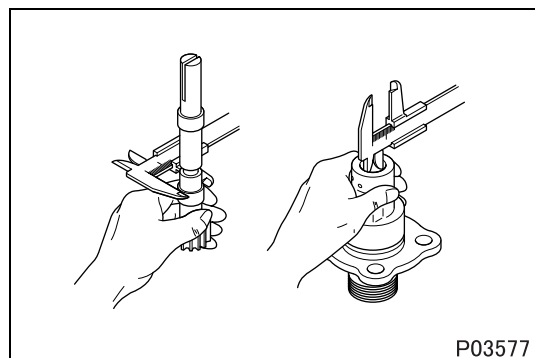
- The installed direction of the speedometer gear bushing is determined by the number of the speedometer gear teeth.
- Put alignment marks to prevent misassembly.

◆ Removal procedure ◆



■ Removal: Companion flange

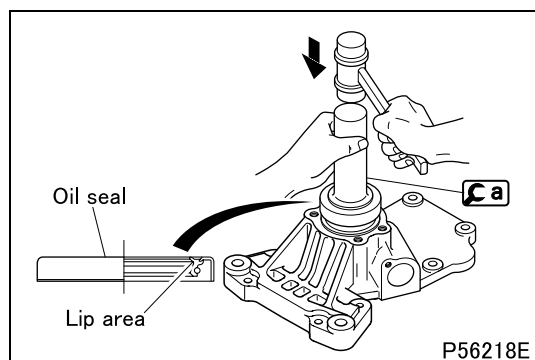
◆ Inspection procedure ◆



■ Inspection: Clearance between speedometer gear and speedometer gear bushing

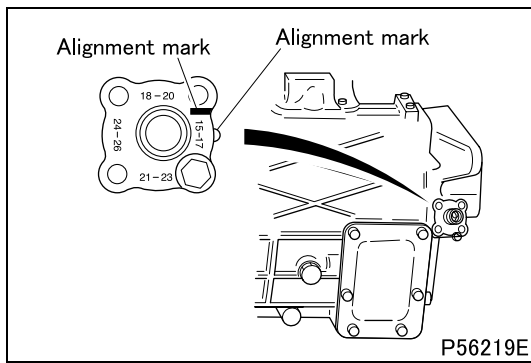
- If the measured value exceeds the limit, replace defective parts.

◆ Installation procedure ◆



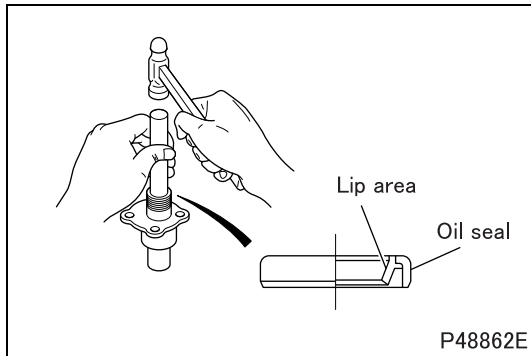
■ Installation: Oil seal

- Apply grease to the lip area of the oil seal, and install it in the illustrated direction.



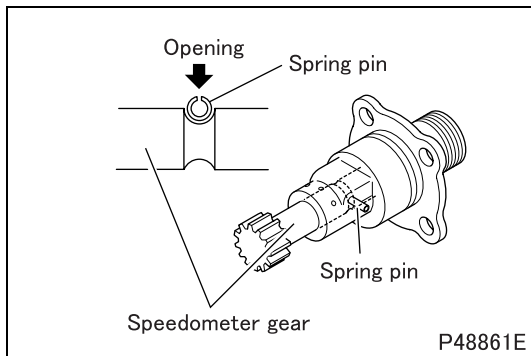
■ Installation: Speedometer gear bushing

- When replacing the speedometer gear bushing, align the alignment mark of the old part with that of the rear cover to install.



■ Installation: Oil seal

- Apply grease to the lip area of the oil seal.
- Install the oil seal evenly in the illustrated direction using a round bar of outer diameter of approx. 14 mm {0.55 in.}.



■ Installation: Spring pin

- Install the spring pin in the illustrated direction to prevent the speedometer gear from slipping off.

1 Drain plug

Follow the disassembly se

Location	Maintenance item
----------	------------------

4	Parking brake drum	Inner diameter	$\phi 203.2^{+0.3}_0 \{8.00^{+0.012}_0\}$	$\phi 205 \{8.07\}$	Replace
		Squareness	0.05 {0.0020} or less	—	
		Concentricity	0.2 {0.0079} or less	—	
		Cylindricity	0.05 {0.0020} or less	—	
		Static rotation imbalance	0.0049 N·m {0.004 ft.lbs, 0.5 gf·m} or less	—	
5	Runout at socket portion of companion flange		0.15 {0.0059} or less	0.5 {0.020}	Replace
11, 14	Clearance between speedometer gear and speedometer gear bushing		0.04 to 0.09 {0.0016 to 0.0035}	0.15 {0.0059}	Replace

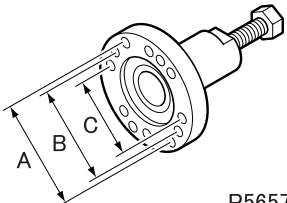
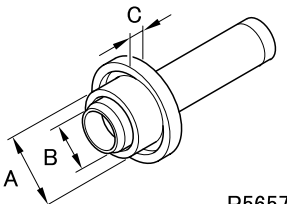
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut	245 to 343 {180 to 250, 25 to 35}	—
Tb	Reamer bolt	52 to 66.7 {38 to 49, 5.3 to 6.8}	—
Tc	Vehicle speed sensor	14.7 to 29.4 {11 to 22, 1.5 to 3}	—
Td	L-joint	34 to 49 {25 to 36, 3.5 to 5}	—
Te	Bolt (Speedometer gear bushing mounting)	23.5 {17, 2.4}	—
Tf	Bolt (Rear cover mounting)	44.5 {33, 4.5}	—
Tg	Lever set bolt	160 {120, 16.3}	—

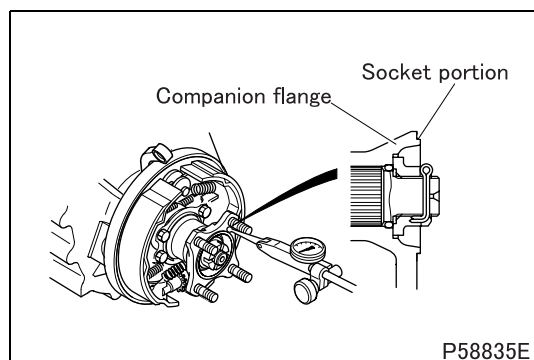
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Wheel bearing grease	As required
	Lip area of oil seal		
b	Sliding surface of speedometer gear and speedometer gear bushing	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required
c	Mating surface of extension housing and transmission case	THREEBOND 1215	As required
d	Thread area of drain plug	THREEBOND 1105	As required
e	Thread area of lever set bolt	LOCTITE 271	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application						
 a	Flange puller <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ95 {3.74}</td><td>φ100 {3.94}</td><td>φ90 {3.54}</td></tr></tbody></table>  P56577	A	B	C	φ95 {3.74}	φ100 {3.94}	φ90 {3.54}	MH061848	Removal of companion flange
A	B	C							
φ95 {3.74}	φ100 {3.94}	φ90 {3.54}							
 b	Oil seal installer <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ64 {2.52}</td><td>φ50 {1.97}</td><td>17 {0.67}</td></tr></tbody></table>  P56578	A	B	C	φ64 {2.52}	φ50 {1.97}	17 {0.67}	MH062691	Installation of oil seal
A	B	C							
φ64 {2.52}	φ50 {1.97}	17 {0.67}							

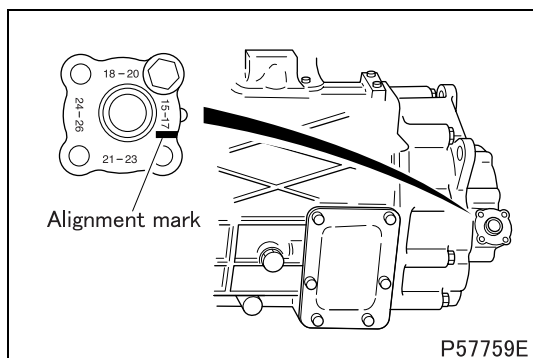
◆ Work before removal ◆



■ Inspection: Runout at socket portion of companion flange

- If the measured value exceeds the limit, replace the companion flange.

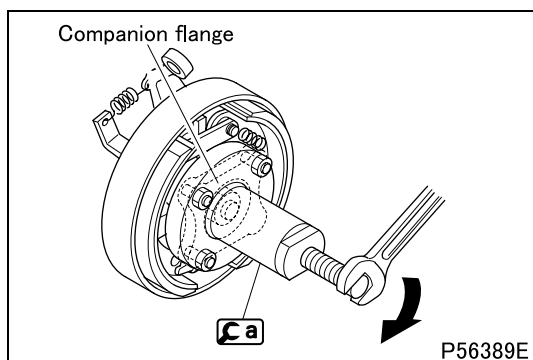
EXTENSION HOUSING <S6> AND PARKING BRAKE



■ Alignment marks: Speedometer gear bushing

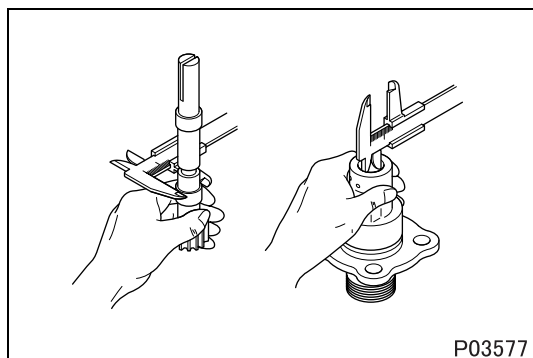
- The installed direction of the speedometer gear bushing is determined by the number of the speedometer gear teeth.
- Put alignment marks to prevent misassembly.

◆ Removal procedure ◆



■ Removal: Companion flange

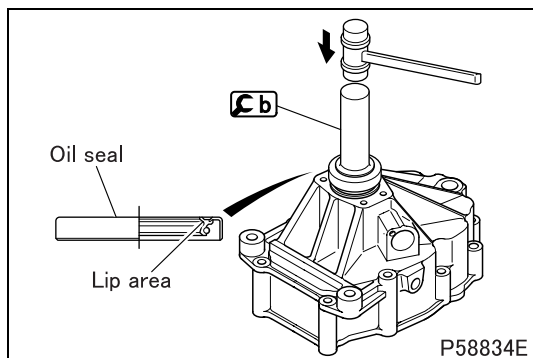
◆ Inspection procedure ◆



■ Inspection: Clearance between speedometer gear and speedometer gear bushing

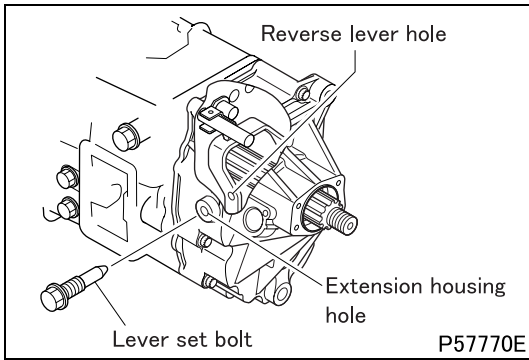
- If the measured value exceeds the limit, replace defective parts.

◆ Installation procedure ◆



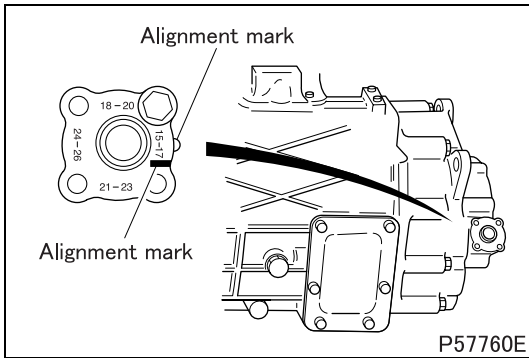
■ Installation: Oil seal

- Apply grease to the lip area of the oil seal, and install it on the extension housing in the illustrated direction.



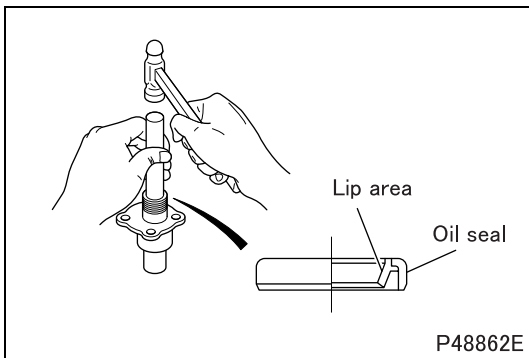
■ Installation: Lever set bolt

- Apply sealant to the thread areas of the lever set bolts to install them onto the extension housing holes and reverse lever hole.



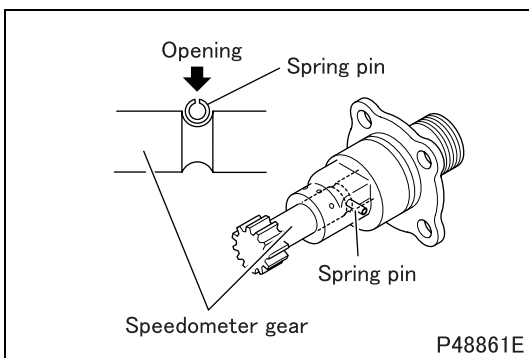
■ Installation: Speedometer gear bushing

- When replacing the speedometer gear bushing, align the alignment mark of the old part with that of the rear cover to install.



■ Installation: Oil seal

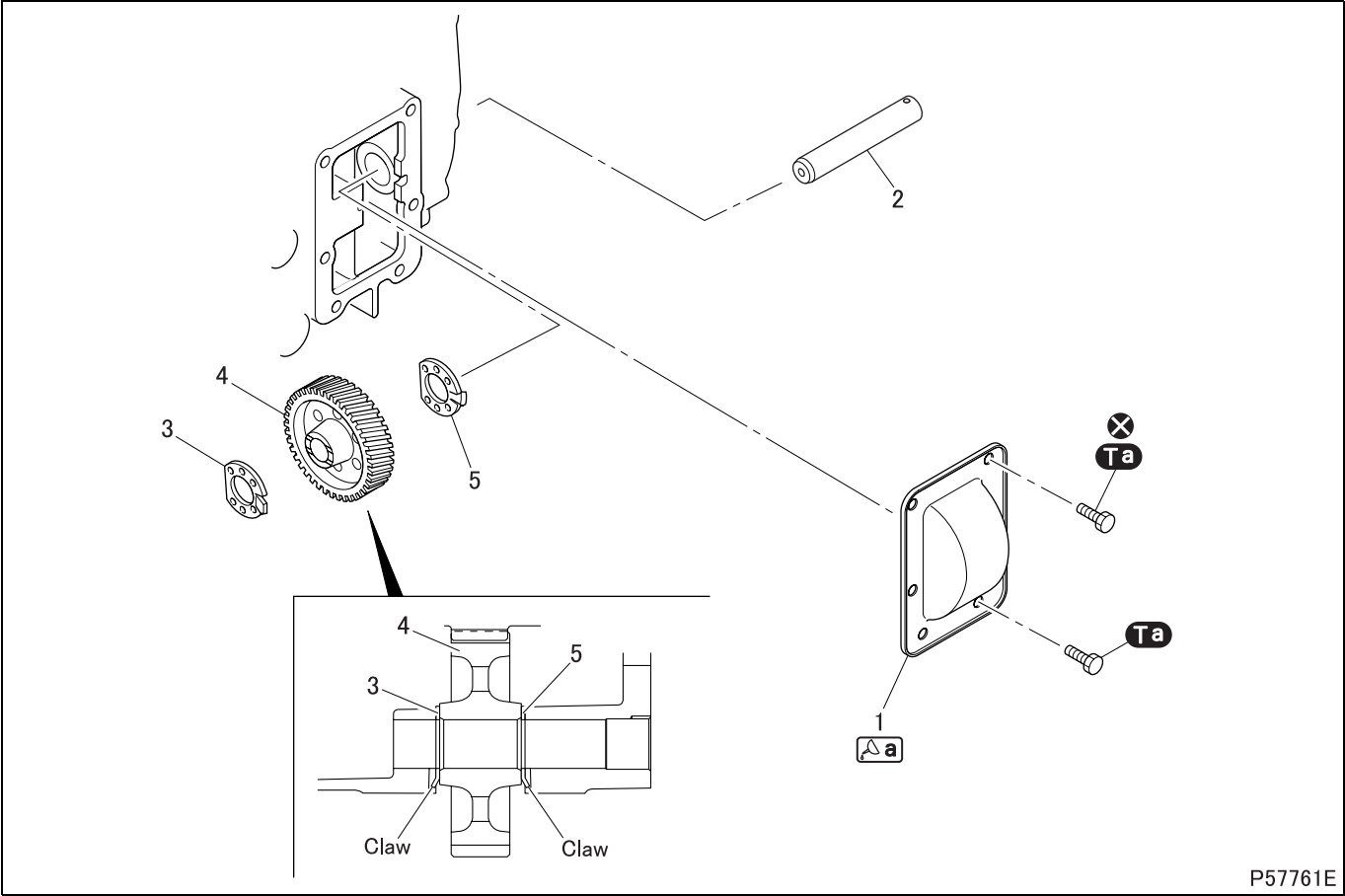
- Apply grease to the lip area of the oil seal.
- Install the oil seal evenly in the illustrated direction using a round bar of outer diameter of approx. 14 mm {0.55 in.}.



■ Installation: Spring pin

- Install the spring pin in the illustrated direction to prevent the speedometer gear from slipping off.

REVERSE IDLER GEAR



Disassembly sequence

- 1 PTO cover
- 2 Reverse idler gear shaft
- 3 Side washer
- 4 Reverse idler gear

5 Side washer

⊗: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
2, 4	Play of reverse idler gear in diameter direction	0.045 to 0.107 {0.0018 to 0.0042}	0.4 {0.016}	Replace

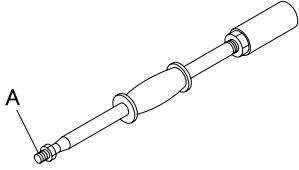
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (PTO cover)	44.5 {33, 4.5}	—

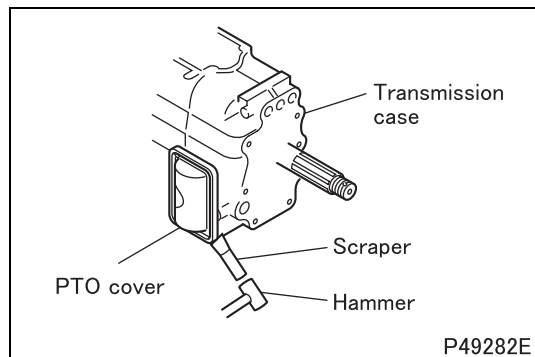
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Mating surface of PTO cover and transmission case	LOCTITE 5999	As required

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application
Ca A M12 × 1.25	Reverse shaft puller  P02118	03726-82000	Removal of reverse idler gear shaft

◆ Removal procedure ◆

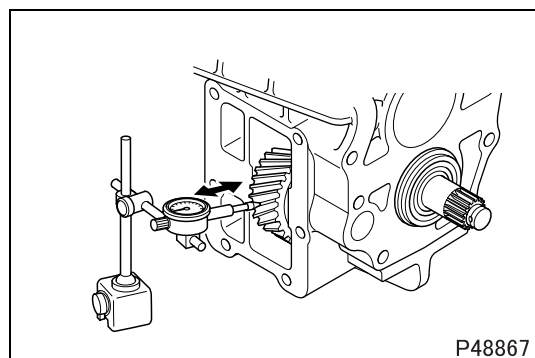


■ Removal: PTO cover

- Insert a scraper from the lower right or lower left of the PTO cover to remove the PTO cover.

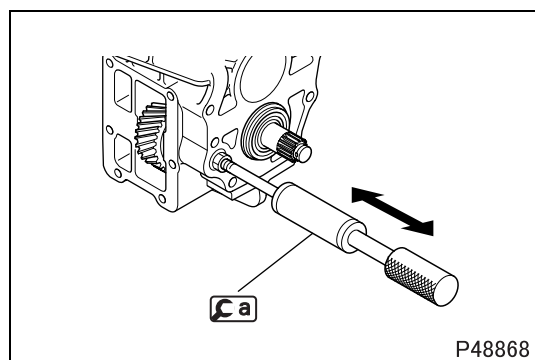
CAUTION

- Be careful that prying the scraper halfway could deform the PTO cover or damage the transmission case.



■ Inspection: Play of reverse idler gear in diameter direction

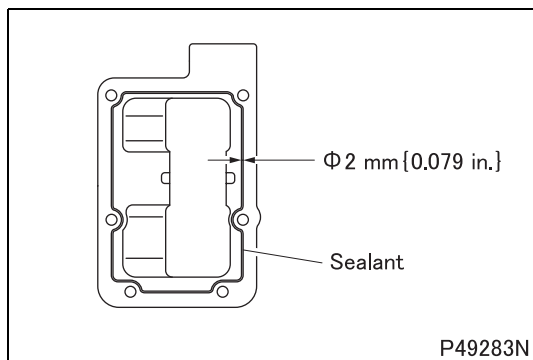
- If the measured value exceeds the limit, replace defective parts.
- Check the play again after assembly and make sure it does not exceed the limit.



■ Removal: Reverse idler gear shaft

REVERSE IDLER GEAR

◆ Installation procedure ◆



■ Installation: PTO cover

- Clean the seal surface of each part.
- Apply the sealant to the transmission case mounting surface of the PTO cover evenly and without breaks.
- Install the PTO cover within three minutes after applying the sealant. Be sure not to allow the sealant to be displaced.

CAUTION ⚠

- **Do not start the engine within one hour after installing the PTO cover.**
 - **When loosening or removing PTO cover mounting bolts, be sure to reapply the sealant.**
-

M E M O

- 1 Spring pin
- 2 6th shift rail jaw B
- 3 6th reverse lever
- 4 Gear shift fork piece
- 5 Shifting key retainer
- 6 Synchronizer inner ring
- 7 Synchronizer center cone

- 8 Synchronizer outer ring
- 9 Synchronizer sleeve
- 10 Shifting plunger
- 11 Shifting plunger spring
- 12 Synchronizer hub
- 13 Countershaft 6th gear
- 14 Needle bearing

- 15** Countershaft 6th gear sleeve
- 16** Thrust washer
- 17** Countershaft rear bearing
- 18** Mainshaft 6th gear

***a:** Countershaft

⊗: Non-reusable parts

Follow the disassembly sequence in reverse.

- **Place the synchronizer sleeve in neutral position before installing the 6th reverse lever.**

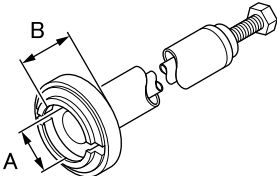
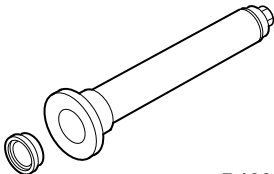
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
4, 9	Clearance between 6th gear shift fork piece and synchronizer sleeve	0.3 to 0.6 {0.012 to 0.024}	1.0 {0.039}	Replace
8, 12	Clearance between protrusion of synchronizer outer ring and synchronizer hub groove	3.0 to 3.3 {0.12 to 0.13}	4.0 {0.16}	Replace
8, 13	Clearance between synchronizer outer ring and countershaft 6th gear	0.96 to 1.54 {0.038 to 0.061}	0.5 {0.020}	Replace
13	End play of countershaft 6th gear	0.25 to 0.35 {0.0098 to 0.014}	0.7 {0.028}	Replace
13 to 15	Play of countershaft 6th gear in diameter direction	0.08 to 0.14 {0.0031 to 0.0055}	0.2 {0.0079}	Replace

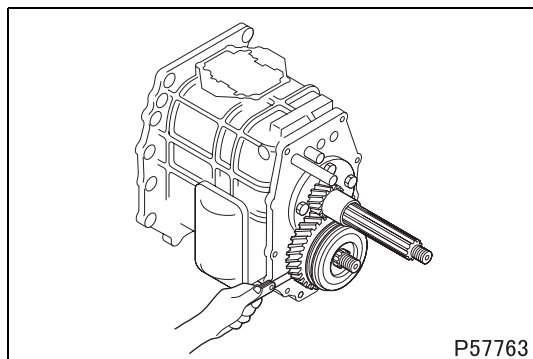
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut	295 to 392 {215 to 290, 30 to 40}	—

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application				
	Bearing puller and installer <table border="1"><tr><th>A</th><th>B</th></tr><tr><td>φ68 {2.68}</td><td>73.5 {2.89}</td></tr></table>  P56306	A	B	φ68 {2.68}	73.5 {2.89}	MH062697	Removal of countershaft 6th gear sleeve, thrust washer and countershaft rear bearing
A	B						
φ68 {2.68}	73.5 {2.89}						
	Bearing puller and installer  P46331	MH062696	Installation of countershaft 6th gear sleeve, thrust washer and countershaft rear bearing				

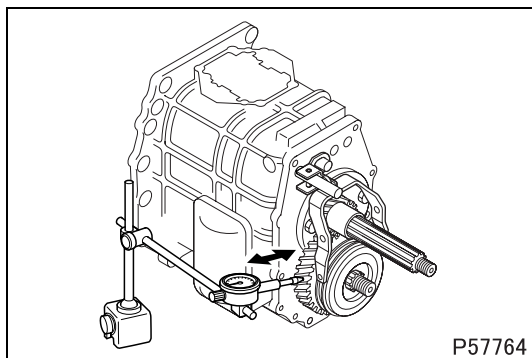
◆ Work before removal ◆



■ Inspection: End play of countershaft 6th gear

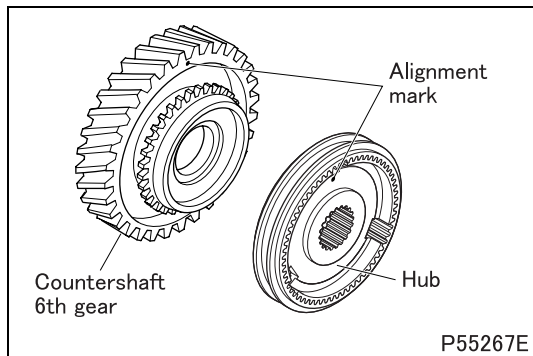
- If the measured value exceeds the limit, replace defective parts.

6TH GEAR <S6>



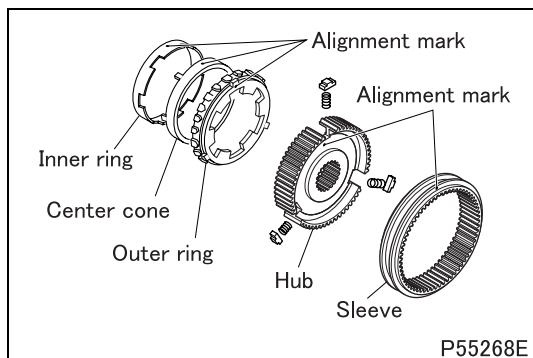
■ Inspection: Play of countershaft 6th gear in diameter direction

- If the measured value exceeds the limit, replace defective parts.

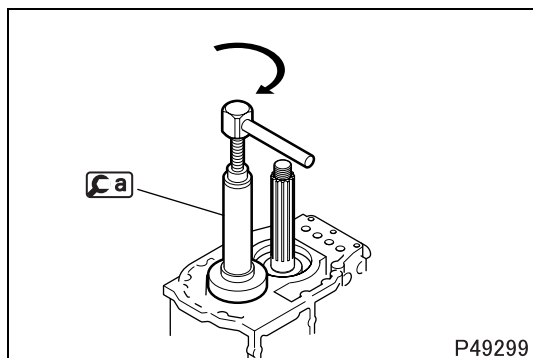


■ Alignment marks: Synchronizer hub and countershaft 6th gear

- Put alignment marks on the synchronizer hub and countershaft 6th gear, each at one location before disassembly.
- Put alignment marks on the synchronizer inner ring, center cone, outer ring and sleeve, each at one location, aligning with the alignment mark put on the synchronizer hub before disassembly.



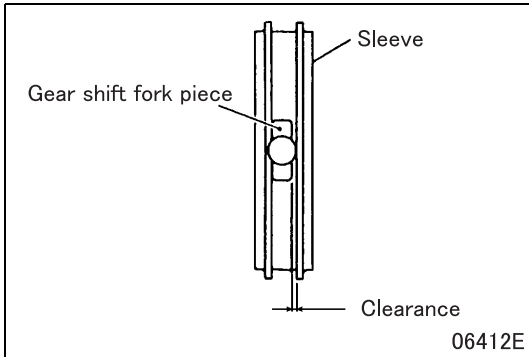
◆ Removal procedure ◆



■ Removal: Countershaft 6th gear sleeve, thrust washer and countershaft rear bearing

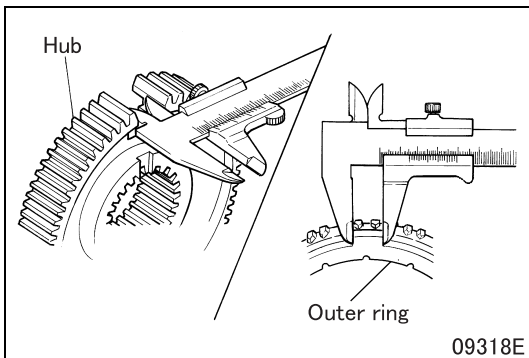
- Remove the countershaft rear bearing together with the sleeve and washer.

◆ Inspection procedure ◆



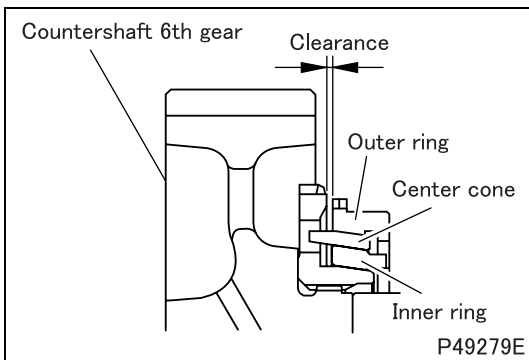
■ Inspection: Clearance between gear shift fork piece and synchronizer sleeve of mainshaft

- If the measured value exceeds the limit, replace defective parts.



■ Inspection: Clearance between synchronizer outer ring and synchronizer hub

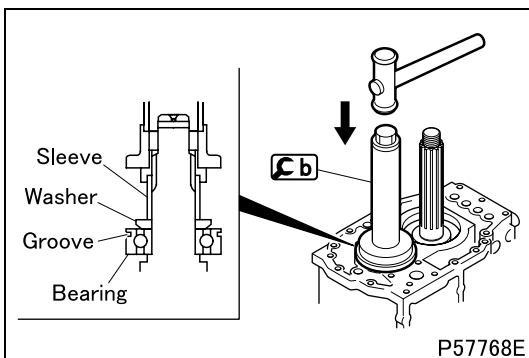
- If the measured value exceeds the limit, replace defective parts.



■ Inspection: Clearance between synchronizer outer ring and countershaft 6th gear

- When measuring the clearance, press each synchronizer ring and center cone evenly against the gear and measure all around the circumference.
- If the measured value exceeds the limit, replace defective parts.

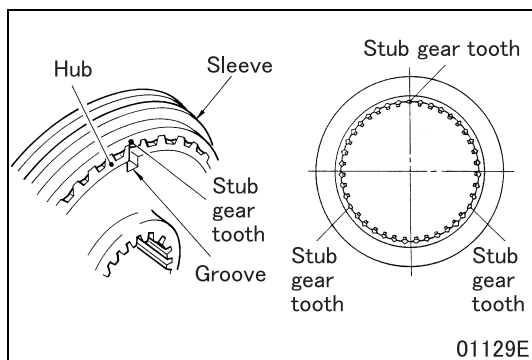
◆ Installation procedure ◆



■ Installation: Countershaft 6th gear sleeve, thrust washer and countershaft bearing

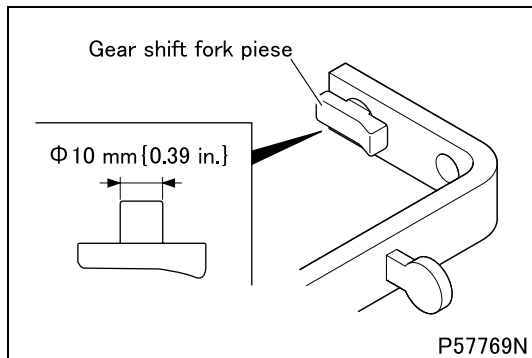
- Install the countershaft bearing together with the sleeve and washer with their ends facing as shown in the illustration.

6TH GEAR <S6>



■ Installation: Synchronizer sleeve and synchronizer hub

- When replacing the synchronizer sleeve or synchronizer hub with a new one, align the three keyways of the synchronizer hub with three locations of the stub gear tooth of the synchronizer sleeve to install.

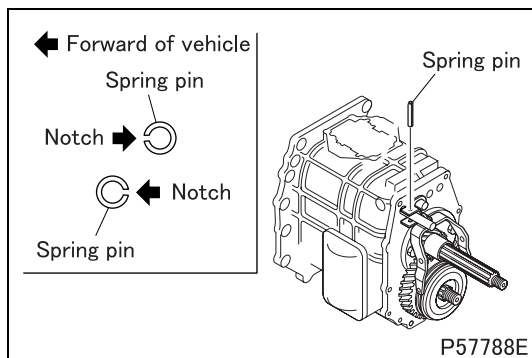


■ Installation: Gear shift fork piece

- Install the gear shift fork piece on the reverse lever as shown in the illustration after checking that its shaft diameter is appropriate.

CAUTION ⚠

- Never fail to check the shaft diameter of the gear shift fork piece. Installation of any gear shift fork piece with a smaller diameter shaft is possible but not permitted.



■ Installation: Spring pin

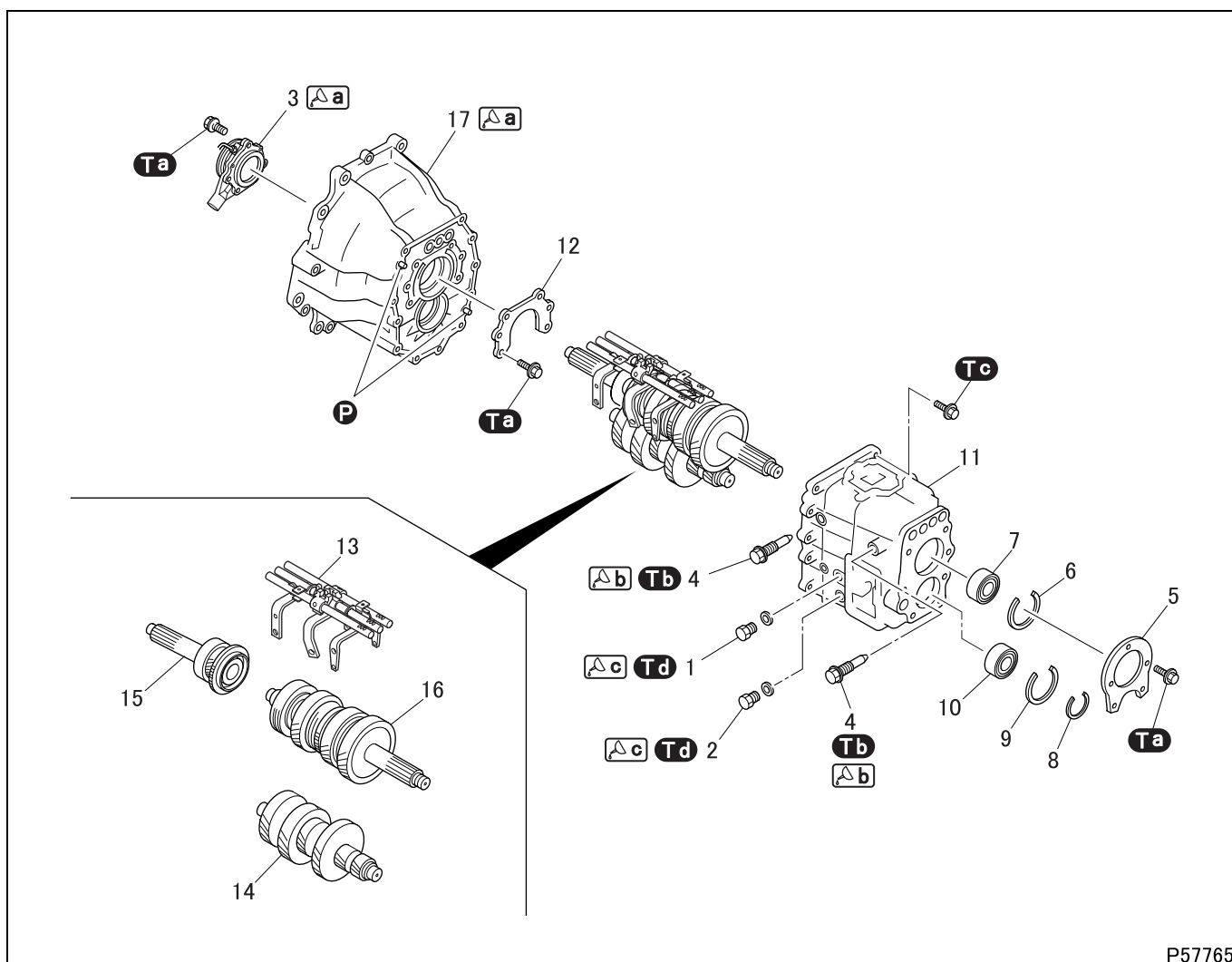
- Install the spring pin in the illustrated direction (the spring pin notch to be positioned forward or rearward of the vehicle). When installing the spring pin, leave 0 to 0.5 mm {0 to 0.020 in.} outside from the transmission shift rail.

CAUTION ⚠

- Drive the spring pin carefully not to impose too much load on the transmission shift rail.

M E M O

TRANSMISSION BODY



P57765

● Disassembly sequence

- | | |
|-------------------------------------|---|
| 1 Inspection plug | 11 Transmission case |
| 2 Drain plug | 12 Bearing retainer |
| 3 Direct power cylinder (See Gr21.) | 13 Shift rail and shift fork (See later section.) |
| 4 Lever set bolt | 14 Countershaft (See later section.) |
| 5 Rear bearing retainer <S6> | 15 Drive pinion (See later section.) |
| 6 Snap ring | 16 Mainshaft (See later section.) |
| 7 Mainshaft rear bearing | 17 Clutch housing |
| 8 Snap ring <S5> | |
| 9 Snap ring | |
| 10 Countershaft rear bearing <S5> | |

- P**: Locating pin
×: Non-reusable parts

NOTE

- After removing direct power cylinder, perform work with the transmission body laid vertically on its clutch housing side.
- If the countershaft, drive pinion and mainshaft are not disassembled, the shift rail and shift fork can be disassembled on its own while mounted on the clutch housing.
- For the removal and installation procedures of the countershaft bearings of the M035S6 transmission, refer to the "6TH GEAR <S6>" section.

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

- Place the synchronizer sleeve of the mainshaft in the neutral position before installing the shift rail and shift fork on the mainshaft.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

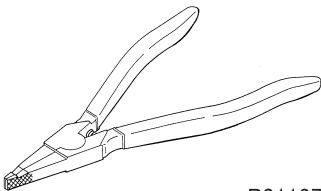
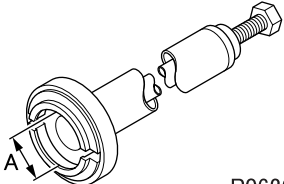
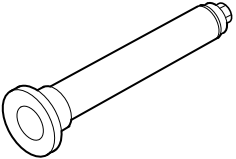
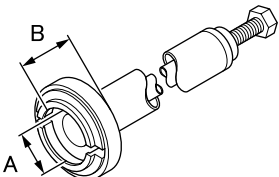
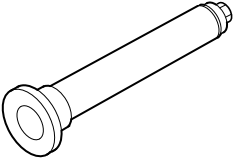
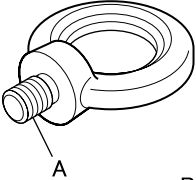
Mark	Parts to be tightened	Tightening torque	Remarks
 Ta	Bolt (Bearing retainer mounting)	44.5 {33, 4.5}	–
	Bolt (Rear bearing retainer mounting)		
	Bolt (Direct power cylinder mounting)		
 Tb	Lever set bolt	160 {120, 16.3}	–
 Tc	Bolt (Transmission case mounting)	54 {40, 5.5}	–
 Td	Inspection plug	68.6 ± 14.7 {51 ± 11, 7.0 ± 1.5}	–
	Drain plug		

Lubricant and/or sealant

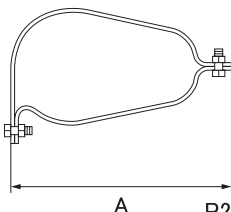
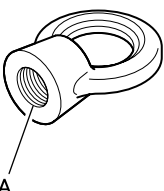
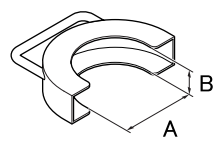
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Clutch housing mounting surface of direct power cylinder	THREEBOND 1215	As required
	Transmission case mounting surface of clutch housing		
 b	Thread area of lever set bolt	LOCTITE 271	As required
 c	Thread area of inspection plug	THREEBOND 1105	As required
	Thread area of drain plug		

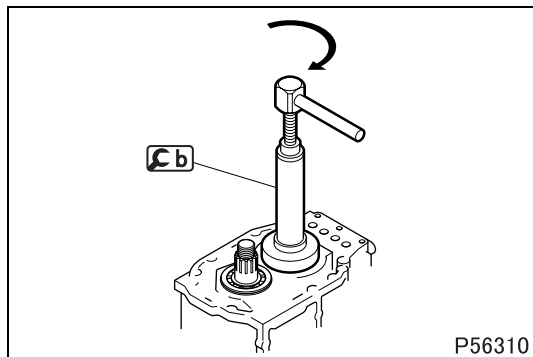
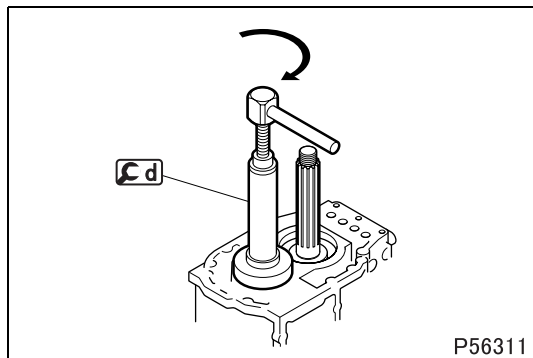
TRANSMISSION BODY

Special tools (Unit: mm {in.})

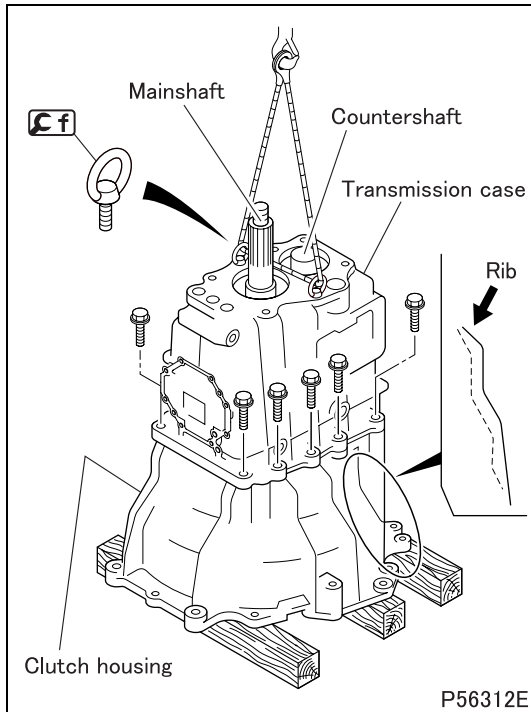
Mark	Tool name and shape	Part No.	Application				
	Snap ring expander  P01137	MH061268	Removal and installation of snap ring				
	Bearing puller and installer <table border="1"><tr><td>A</td></tr><tr><td>φ96.8 {3.81}</td></tr></table>  P06266	A	φ96.8 {3.81}	MH062697	Removal and installation of mainshaft rear bearing		
A							
φ96.8 {3.81}							
	Bearing puller and installer  P49555						
	Bearing puller and installer <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ76.8 {3.02}</td><td>25 {0.98}</td></tr></table>  P56306	A	B	φ76.8 {3.02}	25 {0.98}	MH062696	Removal of countershaft rear bearing
A	B						
φ76.8 {3.02}	25 {0.98}						
	Bearing puller and installer  P49555	MH062696	Installation of countershaft rear bearing				
	Eye bolt <table border="1"><tr><td>A</td></tr><tr><td>M10 × 1.5</td></tr></table>  P01140	A	M10 × 1.5	MH062340	Lifting of transmission case		
A							
M10 × 1.5							

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application								
	Steel lifting band <table border="1"><tr><td>A</td></tr><tr><td>251 {9.88}</td></tr></table>  A P22884	A	251 {9.88}	MH063410	Removal and installation of counter-shaft, mainshaft and drive pinion						
A											
251 {9.88}											
	Eye nut <table border="1"><tr><td>A</td></tr><tr><td>M24 × 1.5</td></tr></table>  A P01142	A	M24 × 1.5	MH063308							
A											
M24 × 1.5											
	Synchromesh guard <table border="1"><tr><td></td><td>A</td><td>B</td></tr><tr><td>S5</td><td>98 {3.86}</td><td>30 {1.18}</td></tr><tr><td>S6</td><td>98 {3.86}</td><td>31 {1.22}</td></tr></table>  A B P51250		A	B	S5	98 {3.86}	30 {1.18}	S6	98 {3.86}	31 {1.22}	<S5> MH062888 <S6> MH062889
	A	B									
S5	98 {3.86}	30 {1.18}									
S6	98 {3.86}	31 {1.22}									

◆ Removal procedure ◆

■ Removal: Mainshaft rear bearing

■ Removal: Countershaft rear bearing

TRANSMISSION BODY

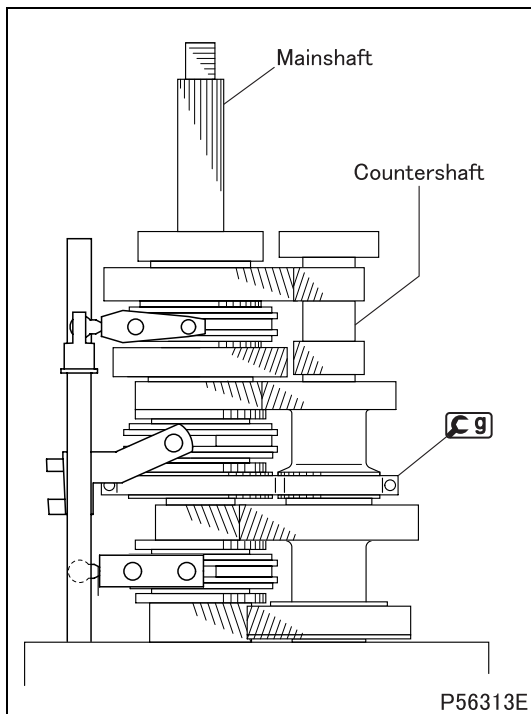


■ Removal: Transmission case

- Install  on the transmission case and make preparations for lifting it up with a crane.
- After removing the bolts, lift up the transmission case while hitting the rear ends of the countershaft and mainshaft and the rear ribs of the clutch housing with a plastic hammer to remove the transmission case.

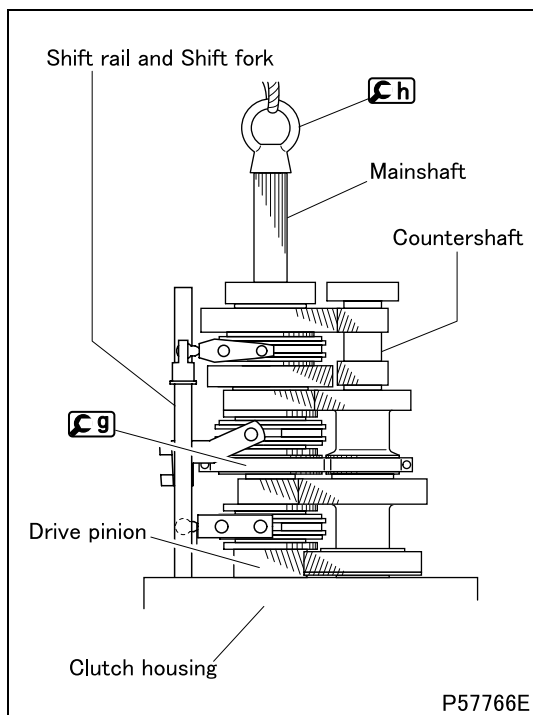
CAUTION

- Be sure to hit the ribs as illustrated because hitting other areas may break the clutch housing.

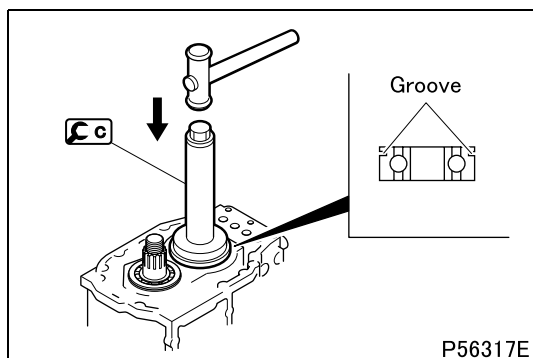
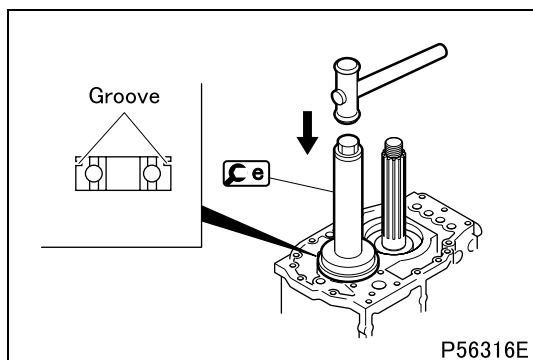
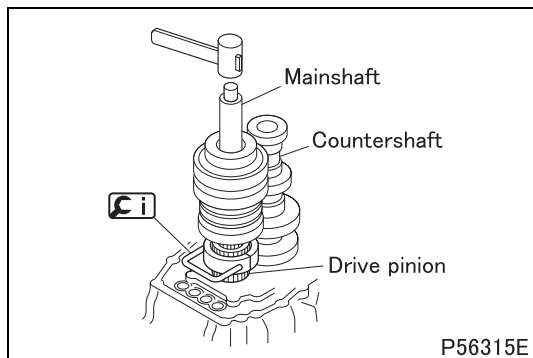


■ Removal: Shift rail and shift fork, countershaft, drive pinion and mainshaft

- Secure the countershaft and the 2nd gear area of the mainshaft with  for safety. Be sure to tighten the steel lifting band adequately enough to prevent it from coming undone, but not excessively.



◆ Installation procedure ◆



- Leave the countershaft and mainshaft secured with **(Cg)**.
- Install **(Ch)** on the mainshaft and make preparations for lifting it up with a crane.
- Secure the shift rail and shift fork with a rubber band to prevent it from coming undone from the mainshaft.
- Put a piece of wood on the clutch housing and lift it up while hitting it with a plastic hammer to remove.

CAUTION ⚠

- When lifting up, be sure to support the drive pinion with your hand to prevent it from falling.

■ Installation: Shift rail and shift fork, countershaft, drive pinion and mainshaft

- When driving in the drive pinion, mainshaft and countershaft, install **(Ci)** to prevent the drive pinion and synchronizer of the mainshaft from sticking.

NOTE

- Be sure to remove all the special tools used.

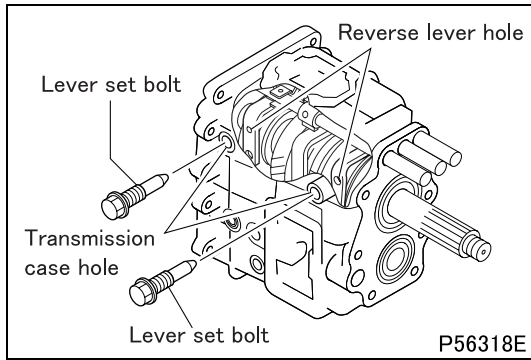
■ Installation: Countershaft rear bearing

- Install the countershaft rear bearing on the transmission case in the illustrated direction.

■ Installation: Mainshaft rear bearing

- Install the mainshaft rear bearing on the transmission case in the illustrated direction.

TRANSMISSION BODY



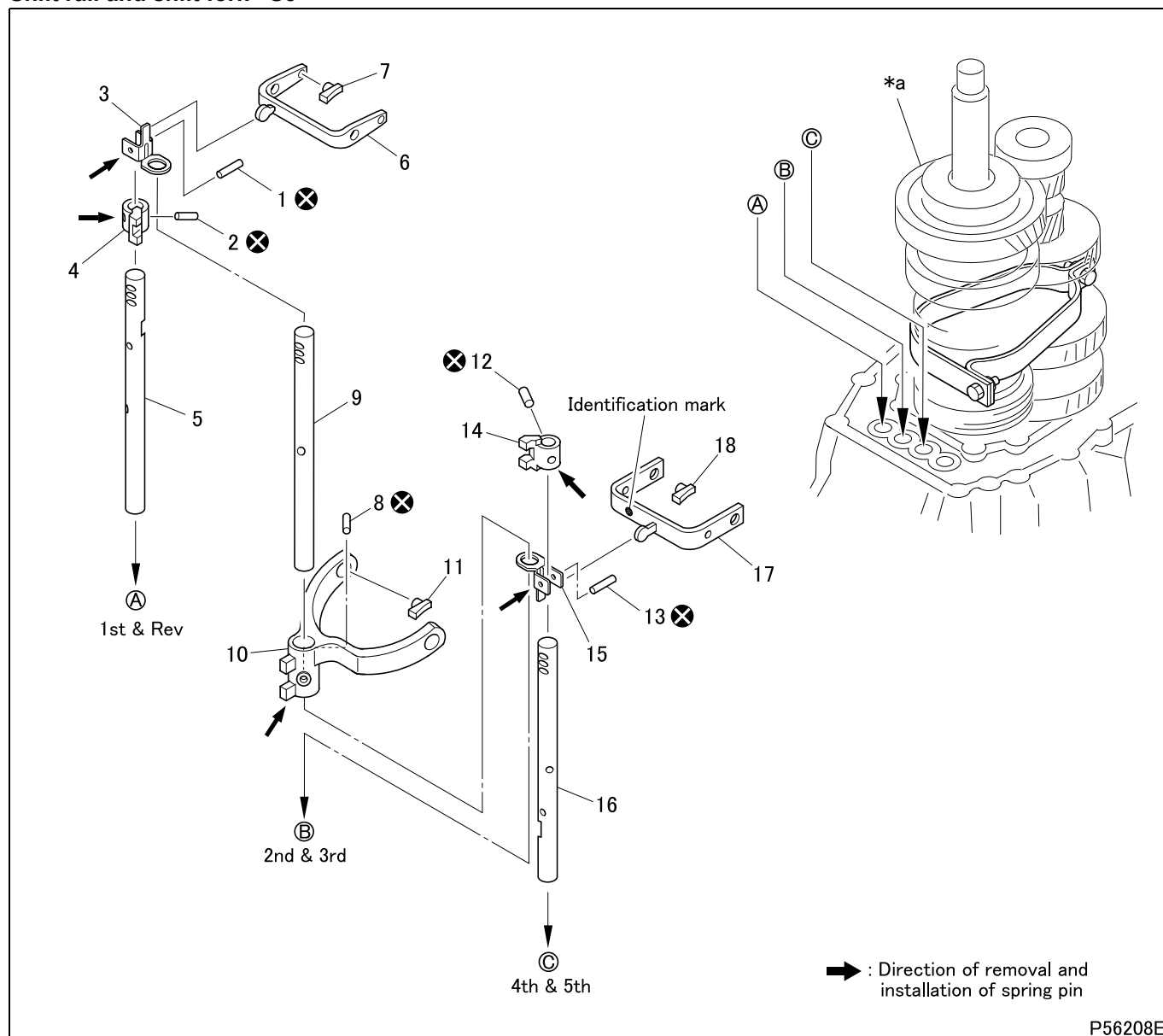
■ Installation: Lever set bolt

- Apply sealant to the thread areas of the lever set bolts to install them onto the transmission case holes and reverse lever hole.

M E M O

TRANSMISSION BODY

Shift rail and shift fork <S5>



P56208E

● Disassembly sequence

- | | |
|------------------------------------|---------------------------------|
| 1 Spring pin | 12 Spring pin |
| 2 Spring pin | 13 Spring pin |
| 3 1st and reverse shift rail jaw B | 14 4th and 5th shift rail jaw A |
| 4 1st and reverse shift rail jaw A | 15 4th and 5th shift rail jaw B |
| 5 1st and reverse shift rail | 16 4th and 5th shift rail |
| 6 1st and reverse reverse lever | 17 4th and 5th reverse lever |
| 7 Gear shift fork piece | 18 Gear shift fork piece |
| 8 Spring pin | |
| 9 2nd and 3rd shift rail | |
| 10 2nd and 3rd shift fork | |
| 11 Gear shift fork piece | |

*a: Mainshaft

⊗: Non-reusable parts

● Assembly sequence

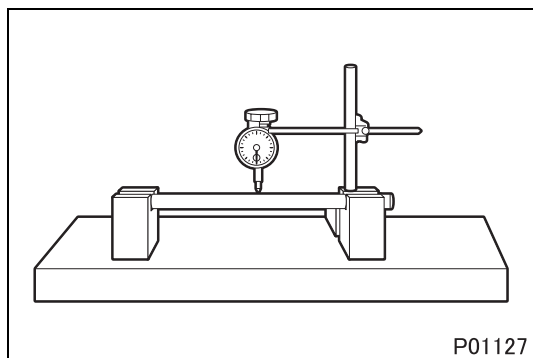
Follow the disassembly sequence in reverse.

NOTE

- Place the synchronizer sleeve of the mainshaft in neutral position before installing the reverse lever on the mainshaft.

Service standards (Unit: mm {in.})

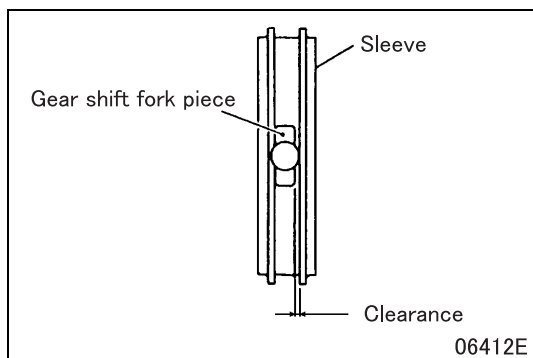
Location	Maintenance item	Standard value	Limit	Remedy
5, 9, 16	Bend of shift rail	0.04 {0.0016} or less	0.05 {0.0020}	Correct or replace
7, 11, 18, *a	Clearance between gear shift fork piece and synchronizer sleeve	0.3 to 0.6 {0.012 to 0.024}	1.0 {0.039}	Replace

◆ Inspection procedure ◆**■ Inspection: Bend of shift rail**

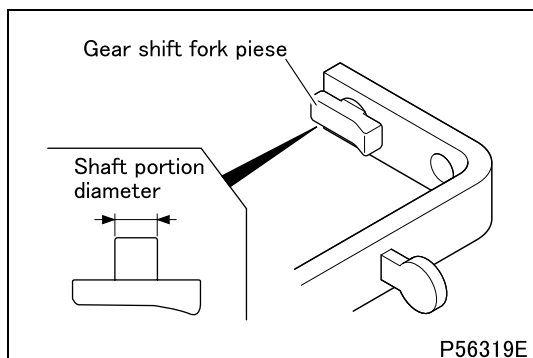
- Measure the extent of bending at the middle of each of shift rail.
- If any measured value exceeds the limit, correct or replace the shift rail.

NOTE

- Give each of the shift rails one complete turn and read the dial gauge at that time. The extent of bending is half of the reading.

**■ Inspection: Clearance between gear shift fork piece and synchronizer sleeve of mainshaft**

- If the measured value exceeds the limit, replace defective parts.

◆ Installation procedure ◆**■ Installation: Gear shift fork piece**

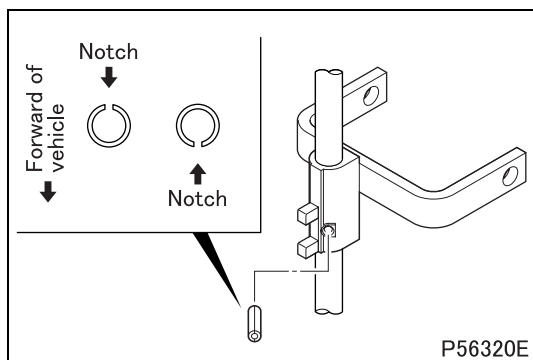
- Install the gear shift fork piece on the reverse lever as shown in the illustration after checking that its shaft diameter is appropriate.

	Shaft portion diameter (mm {in.})
1st & Rev	10 {0.39}
2nd & 3rd, 4th & 5th	15 {0.59}

CAUTION ⚠

- Never fail to check the shaft diameter of the gear shift fork piece. Installation of any gear shift fork piece with a smaller diameter shaft is possible but not permitted.

TRANSMISSION BODY



■ Installation: Spring pin

- Install the spring pin in the illustrated direction (the spring pin notch to be positioned forward or rearward of the vehicle). When installing the spring pin, leave 0 to 0.5 mm {0 to 0.020 in.} outside from each shift rail or each shift rail jaw.

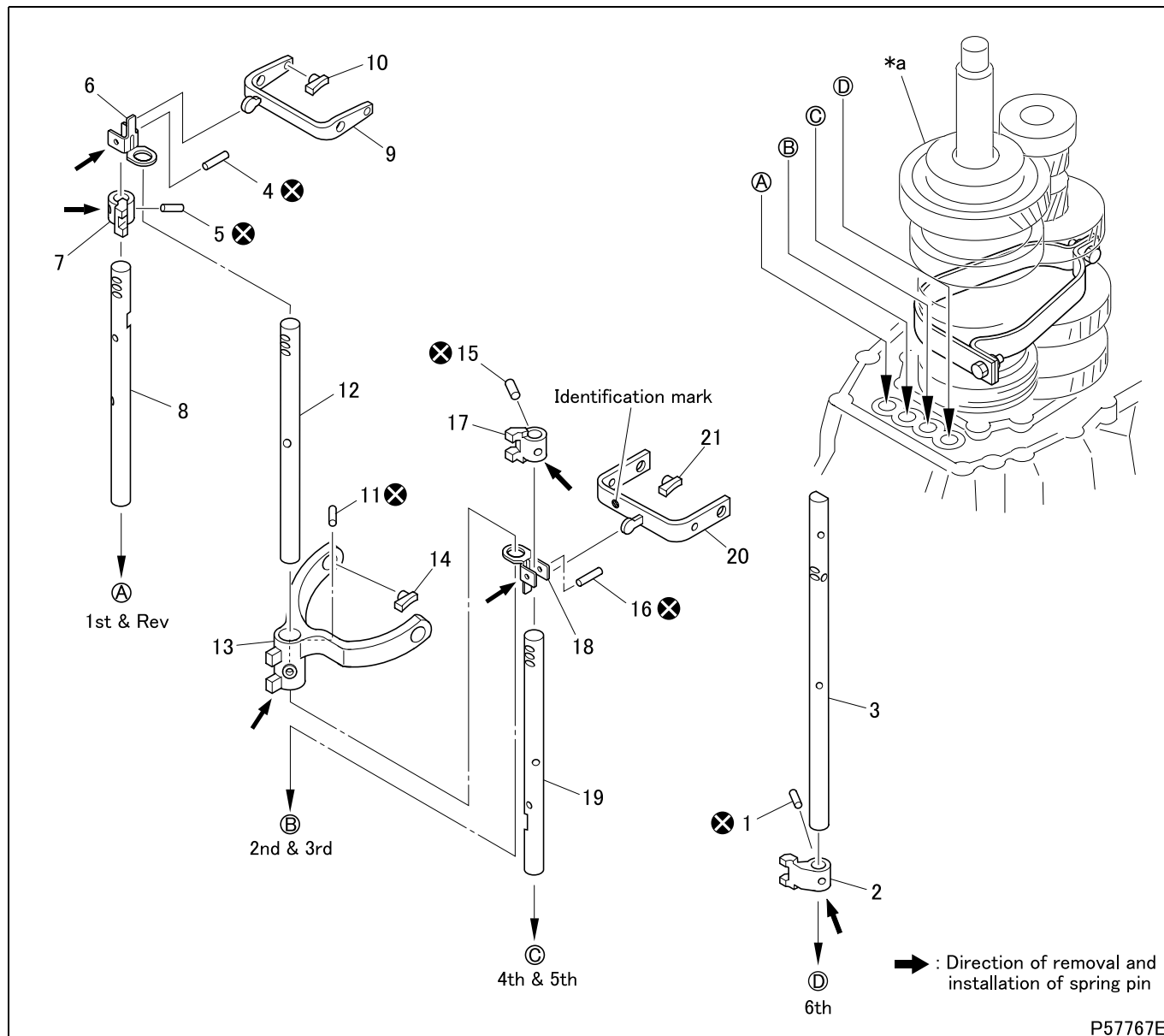
CAUTION ⚠

- Drive the spring pin carefully not to impose too much load on each shift rail and each shift rail jaw.
-

M E M O

TRANSMISSION BODY

Shift rail and shift fork <S6>



P57767E

● Disassembly sequence

- | | | |
|------------------------------------|---------------------------------|---------------------------------|
| 1 Spring pin | 9 1st and reverse reverse lever | 17 4th and 5th shift rail jaw A |
| 2 6th shift rail jaw | 10 Gear shift fork piece | 18 4th and 5th shift rail jaw B |
| 3 6th shift rail A | 11 Spring pin | 19 4th and 5th shift rail |
| 4 Spring pin | 12 2nd and 3rd shift rail | 20 4th and 5th reverse lever |
| 5 Spring pin | 13 2nd and 3rd shift fork | 21 Gear shift fork piece |
| 6 1st and reverse shift rail jaw B | 14 Gear shift fork piece | |
| 7 1st and reverse shift rail jaw A | 15 Spring pin | |
| 8 1st and reverse shift rail | 16 Spring pin | |

*a: Mainshaft

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

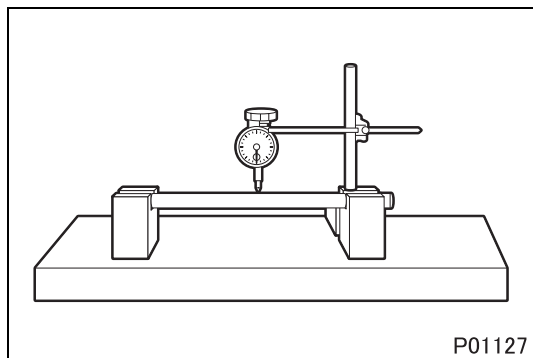
NOTE

- Place the synchronizer sleeve of the mainshaft in neutral position before installing the reverse lever on the mainshaft.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3, 8, 12, 19	Bend of shift rail	0.04 {0.0016} or less	0.05 {0.0020}	Correct or replace
10, 14, 21, *a	Clearance between gear shift fork piece and synchronizer sleeve	0.3 to 0.6 {0.012 to 0.024}	1.0 {0.039}	Replace

◆ Inspection procedure ◆

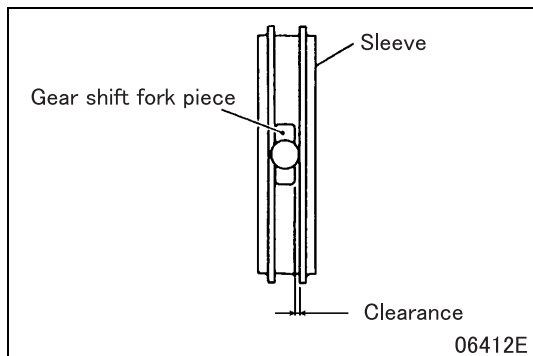


■ Inspection: Bend of shift rail

- Measure the extent of bending at the middle of each of shift rail.
- If any measured value exceeds the limit, correct or replace the faulty shift rails.

NOTE

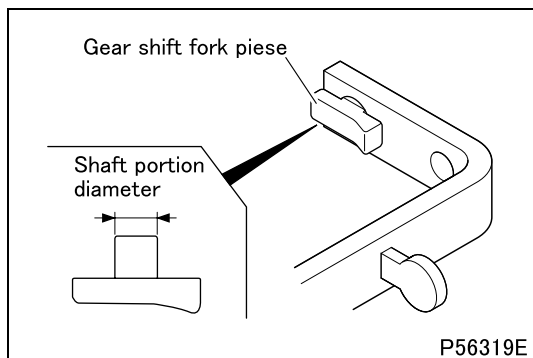
- Give each of the shift rails one complete turn and read the dial gauge at that time. The extent of bending is half of the reading.



■ Inspection: Clearance between gear shift fork piece and synchronizer sleeve of mainshaft

- If the measured value exceeds the limit, replace defective parts.

◆ Installation procedure ◆



■ Installation: Gear shift fork piece

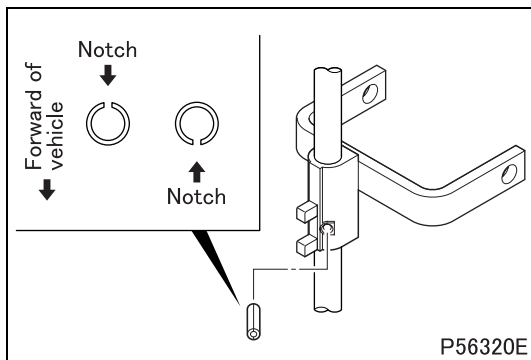
- Install the gear shift fork piece on the reverse lever as shown in the illustration after checking that its shaft diameter is appropriate.

	Shaft portion diameter (mm {in.})
1st & Rev	10 {0.39}
2nd & 3rd, 4th & 5th	15 {0.59}

CAUTION ⚠

- Never fail to check the shaft diameter of the gear shift fork piece. Installation of any gear shift fork piece with a smaller diameter shaft is possible but not permitted.

TRANSMISSION BODY



■ Installation: Spring pin

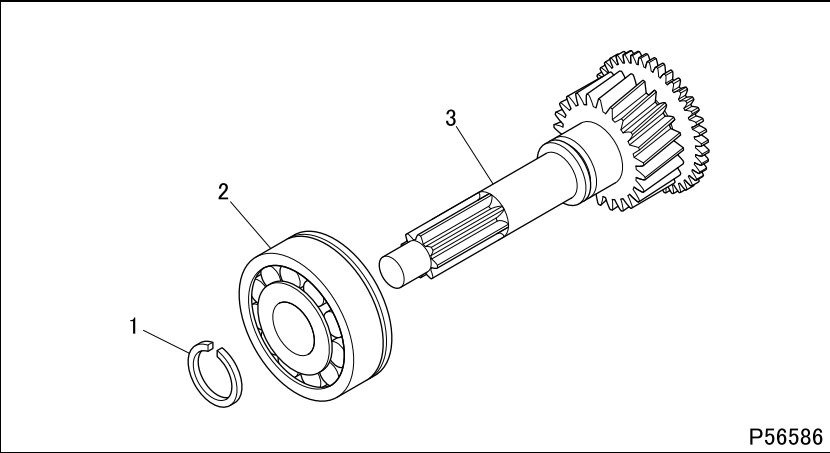
- Install the spring pin in the illustrated direction (the spring pin notch to be positioned forward or rearward of the vehicle). When installing the spring pin, leave 0 to 0.5 mm {0 to 0.020 in.} outside from each shift rail or each shift rail jaw.

CAUTION ⚠

- Drive the spring pin carefully not to impose too much load on each shift rail and each shift rail jaw.
-

M E M O

DRIVE PINION



● Disassembly sequence

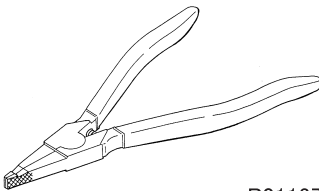
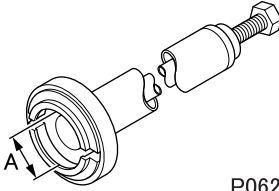
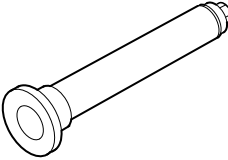
- 1 Snap ring
- 2 Drive pinion bearing
- 3 Drive pinion

⊗: Non-reusable parts

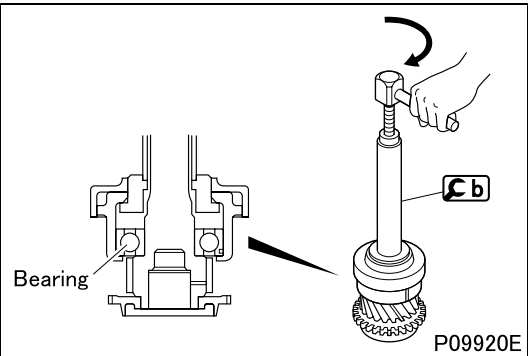
● Assembly sequence

Follow the disassembly sequence in reverse.

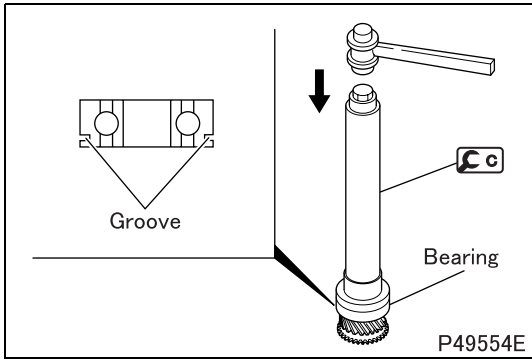
Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application		
 a	Snap ring expander  P01137	MH061268	Removal and installation of snap ring		
 b	Bearing puller and installer <table border="1"><tr><td>A</td></tr><tr><td>φ92.5 {3.64}</td></tr></table>  P06266	A	φ92.5 {3.64}	MH062697	Removal and installation of drive pinion bearing
A					
φ92.5 {3.64}					
 c	Bearing puller and installer  P49555				

◆ Removal procedure ◆

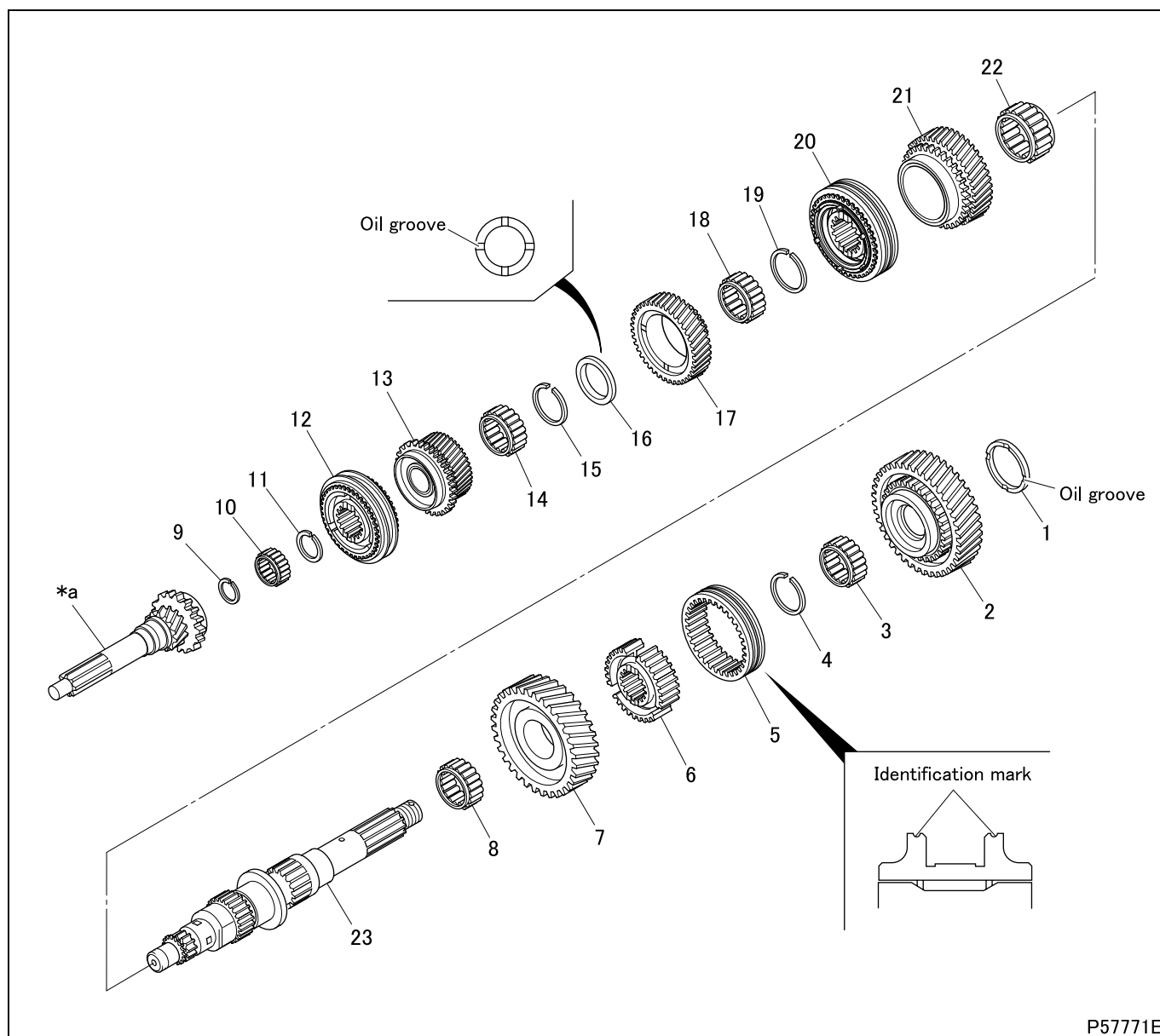


■ Removal: Drive pinion bearing

◆ Installation procedure ◆**■ Installation: Drive pinion bearing**

- Install the drive pinion bearing on the drive pinion in the illustrated direction.

MAINSHAFT



P57771E

● Disassembly sequence

- | | |
|--|--|
| 1 1st gear thrust washer | 14 Needle bearing |
| 2 1st gear | 15 Snap ring |
| 3 Needle bearing | 16 3rd gear thrust washer |
| 4 Snap ring | 17 3rd gear |
| 5 Synchronizer sleeve | 18 Needle bearing |
| 6 Synchronizer hub | 19 Snap ring |
| 7 Reverse gear | 20 2nd and 3rd synchronizer (See later section.) |
| 8 Needle bearing | 21 2nd gear |
| 9 Snap ring | 22 Needle bearing |
| 10 Pilot bearing | 23 Mainshaft |
| 11 Snap ring | |
| 12 4th and 5th synchronizer (See later section.) | |
| 13 5th gear | |

*a: Drive pinion

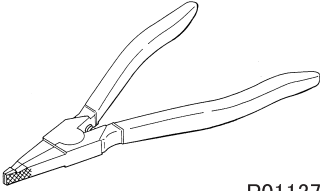
● Assembly sequence

Follow the disassembly sequence in reverse.

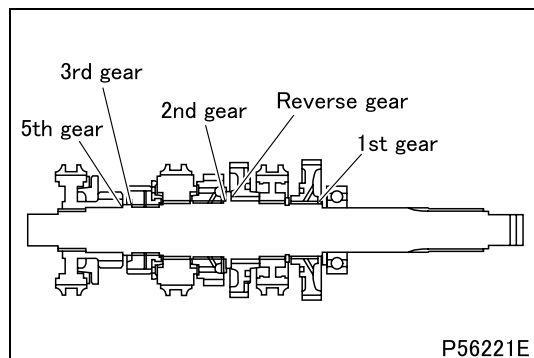
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
-	End play	1st gear	0.15 to 0.46 {0.0059 to 0.018}	0.7 {0.028}	Replace
		2nd gear	0.15 to 0.61 {0.0059 to 0.024}	0.8 {0.031}	
		3rd gear	0.15 to 0.46 {0.0059 to 0.018}	0.7 {0.028}	
		5th gear	0.2 to 0.56 {0.0079 to 0.022}	0.8 {0.031}	
		Reverse gear	0.15 to 0.46 {0.0059 to 0.018}	0.7 {0.028}	
-	Play in the diameter direction	1st gear	0.02 to 0.05 {0.0079 to 0.0020}	0.12 {0.0047}	Replace
		2nd gear	0.02 to 0.05 {0.0079 to 0.0020}	0.12 {0.0047}	
		3rd gear	0.02 to 0.06 {0.0079 to 0.0024}	0.12 {0.0047}	
		5th gear	0.05 to 0.09 {0.0020 to 0.0035}	0.2 {0.0079}	
		Reverse gear	0.04 to 0.07 {0.0016 to 0.0028}	0.12 {0.0047}	
12, 13	Clearance between synchronizer ring of 4th and 5th synchronizer and 5th gear		1.23 to 1.47 {0.048 to 0.058}	0.5 {0.020}	Replace
12, *a	Clearance between synchronizer ring of 4th and 5th synchronizer and drive pinion		1.23 to 1.47 {0.048 to 0.058}	0.5 {0.020}	Replace
17, 20	Clearance between 3rd gear and synchronizer outer ring of 2nd and 3rd synchronizer		1.16 to 1.74 {0.046 to 0.069}	0.7 {0.028}	Replace
20, 21	Clearance between synchronizer outer ring of 2nd and 3rd synchronizer and 2nd gear		1.16 to 1.74 {0.046 to 0.069}	0.7 {0.028}	Replace

Special tools

Mark	Tool name and shape	Part No.	Application
	Snap ring expander  P01137	MH061268	Removal and installation of snap ring

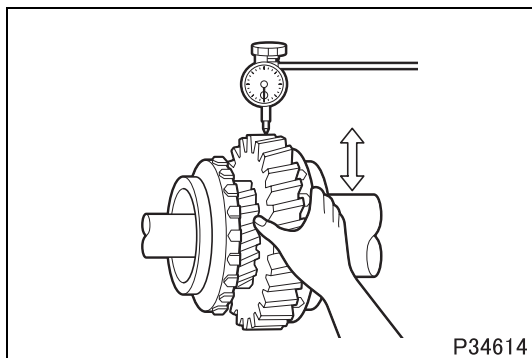
◆ Work before removal ◆



■ Inspection: End play of gears

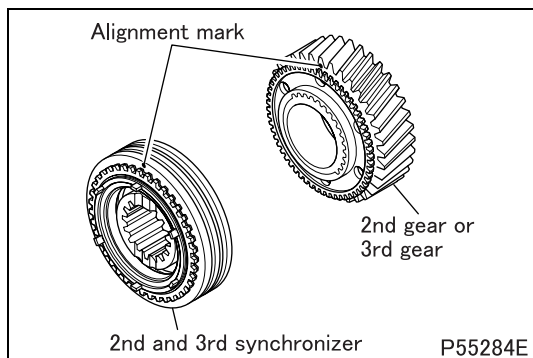
- If the measured value exceeds the limit, replace defective parts.

MAINSHAFT



■ Inspection: Play of gears in diameter direction

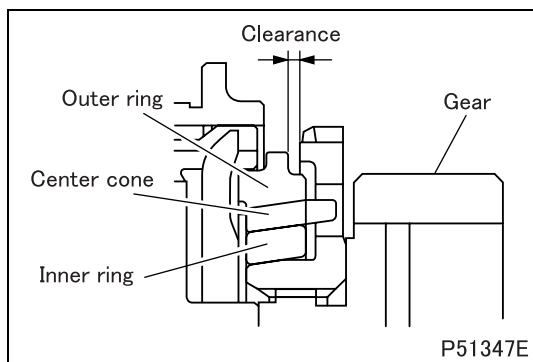
- If the measured value exceeds the limit, replace defective parts.



■ Alignment marks: 2nd gear, 2nd and 3rd synchronizer and 3rd gear

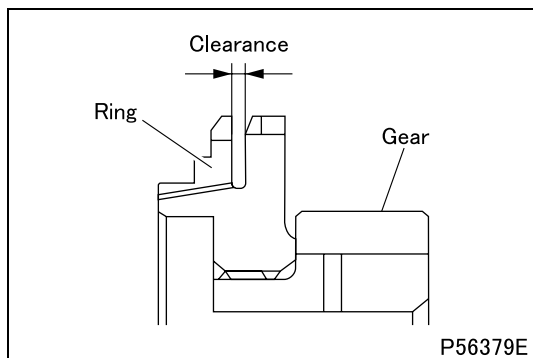
- Put alignment marks on the synchronizer sleeve of the 2nd and 3rd synchronizer, 2nd gear and 3rd gear, each at one location before disassembly.

◆ Inspection procedure ◆



■ Inspection: Clearance between synchronizer outer ring of 2nd and 3rd synchronizer and 2nd gear or 3rd gear

- When measuring the clearance, press each ring and the center cone evenly against the gear and measure all around the circumference.
- If the measured value exceeds the limit, replace defective parts.



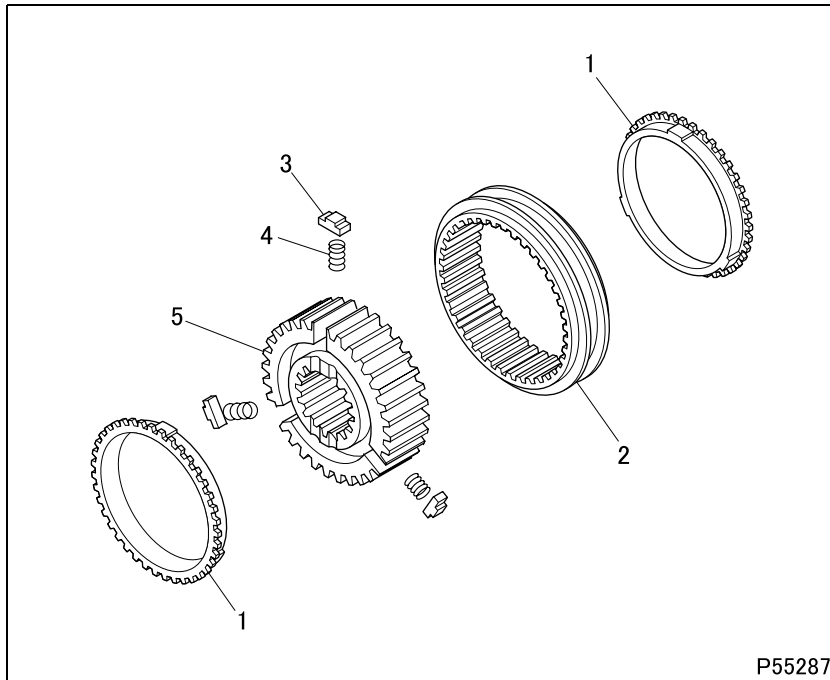
■ Inspection: Clearance between synchronizer ring of 4th and 5th synchronizer and 5th gear or drive pinion

- When measuring the clearance, press each ring evenly against the gear and measure all around the circumference.
- If the measured value exceeds the limit, replace defective parts.

M E M O

MAINSHAFT

4th and 5th synchronizer



P55287

● Disassembly sequence

- 1 Synchronizer ring
- 2 Synchronizer sleeve
- 3 Shifting plunger
- 4 Shifting plunger spring
- 5 Synchronizer hub

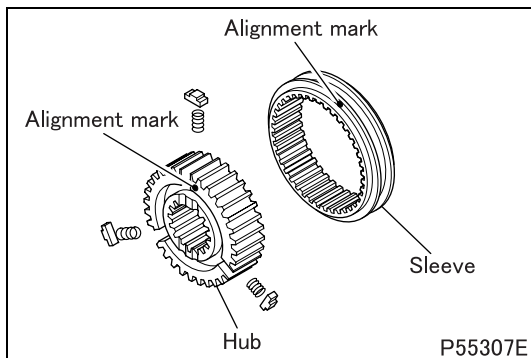
● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1, 5	Clearance between protrusions of synchronizer ring and synchronizer hub groove	3.0 to 3.3 {0.12 to 0.13}	4.0 {0.16}	Replace

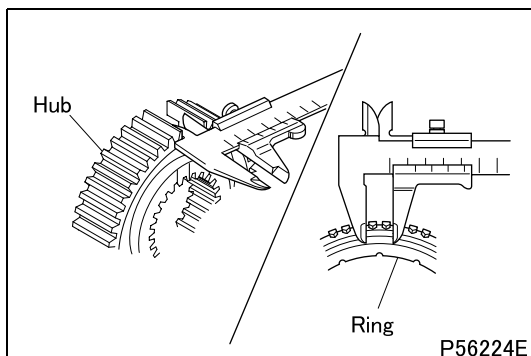
◆ Work before removal ◆



■ Alignment marks: Synchronizer sleeve and synchronizer hub

- Put alignment marks on the synchronizer ring and synchronizer hub, each at one location before disassembly.

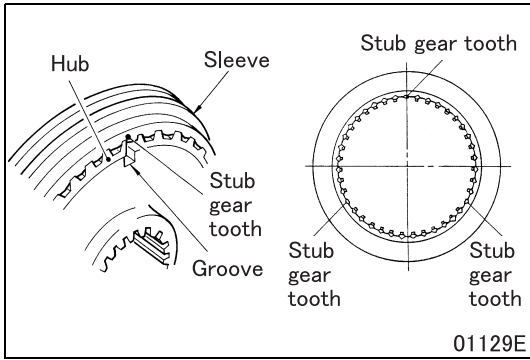
◆ Inspection procedure ◆



■ Inspection: Clearance between synchronizer ring or synchronizer outer ring and synchronizer hub

- If the measured value exceeds the limit, replace defective parts.

◆ Installation procedure ◆

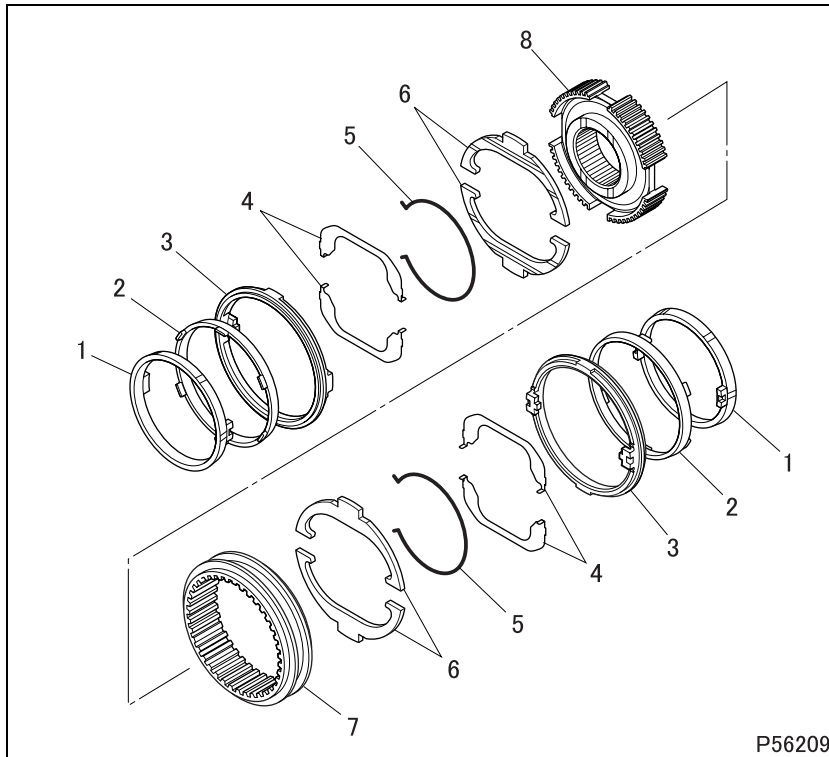


■ Installation: Synchronizer sleeve and synchronizer hub

- When replacing the synchronizer sleeve or synchronizer hub with a new one, align the three keyways of the synchronizer hub with three locations of the stub gear tooth of the synchronizer sleeve to install.

MAINSHAFT

2nd and 3rd synchronizer



● Disassembly sequence

- 1 Synchronizer inner ring
- 2 Synchronizer center cone
- 3 Synchronizer outer ring
- 4 Synchronizer plate
- 5 Synchronizer spring
- 6 Synchronizer lever
- 7 Synchronizer sleeve
- 8 Synchronizer hub

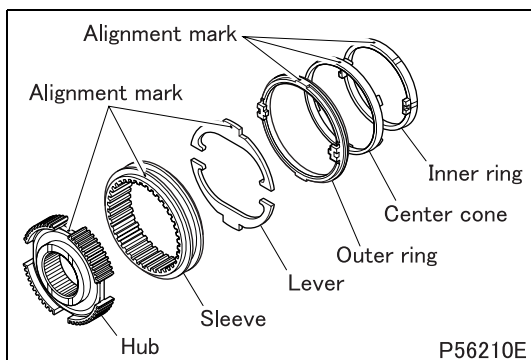
● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3	Width of claws of synchronizer outer ring	13.8 to 14.0 {0.54 to 0.55}	13 {0.51}	Replace

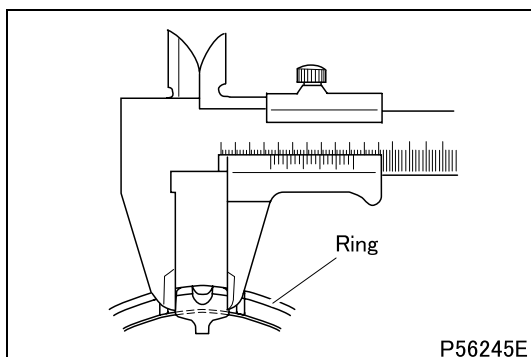
◆ Work before removal ◆



■ Alignment marks: Synchronizer inner ring, center cone, outer ring, lever and hub

- Put alignment marks on the synchronizer inner ring, center cone, outer ring, lever and hub, each at one location, aligning with the alignment mark put on the synchronizer sleeve before disassembly.

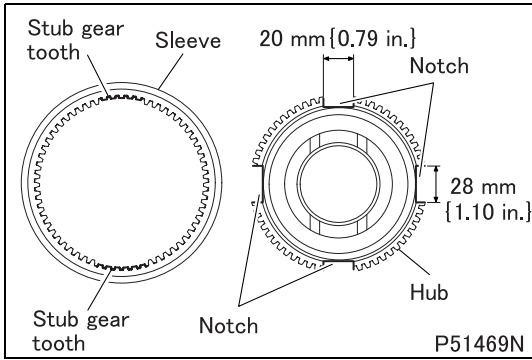
◆ Inspection procedure ◆



■ Inspection: Width of claws of synchronizer outer ring

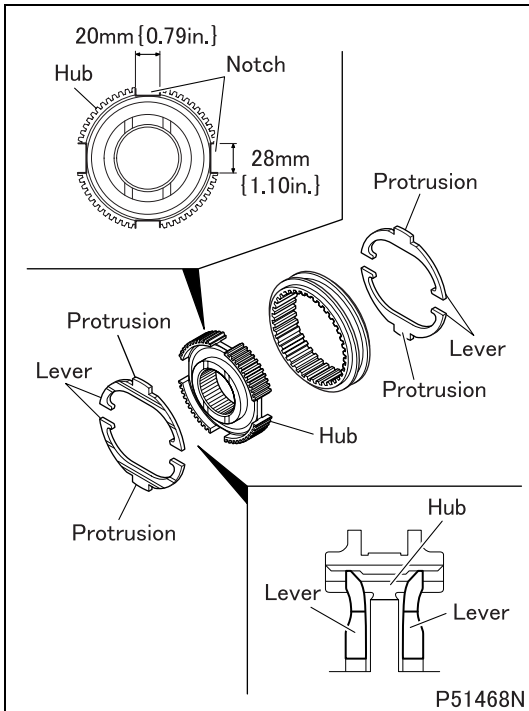
- If the measured value exceeds the limit, replace defective parts.

◆ Installation procedure ◆



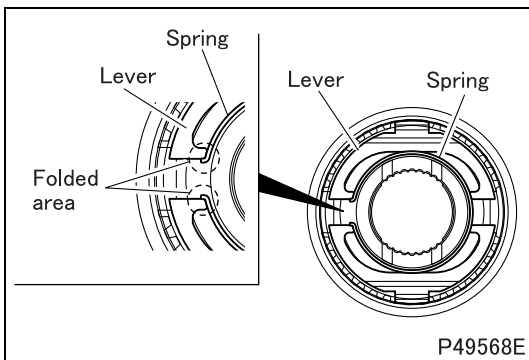
■ Installation: Synchronizer sleeve and synchronizer hub

- When replacing the synchronizer sleeve or synchronizer hub with a new one, align the stub gear tooth (2 locations) of the synchronizer sleeve and the notch (2 locations) of the synchronizer hub to install.
- Install the stub gear teeth, aligning with the notches with narrow width (20 mm {0.79 in.}) of the synchronizer hub.



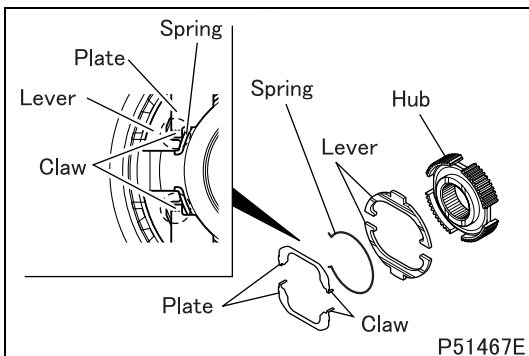
■ Installation: Synchronizer lever

- Install the synchronizer lever on the synchronizer hub in the illustrated direction.
- To install the synchronizer lever, install its protrusions on the notches with narrow width (20 mm {0.79 in.}) of the synchronizer hub.



■ Installation: Synchronizer spring

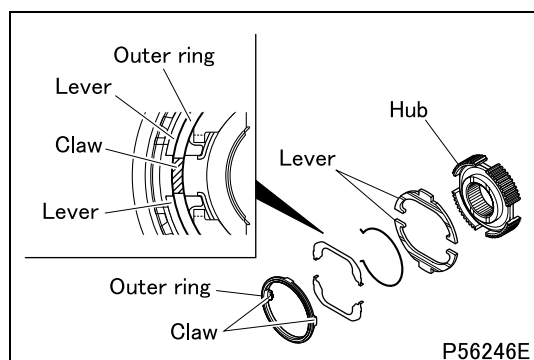
- Hang the folded area on the synchronizer lever to install the synchronizer spring.



■ Installation: Synchronizer plate

- Install the synchronizer plate facing the claws toward the synchronizer hub so that it may be inserted between the synchronizer lever and synchronizer spring.

MAINSHAFT

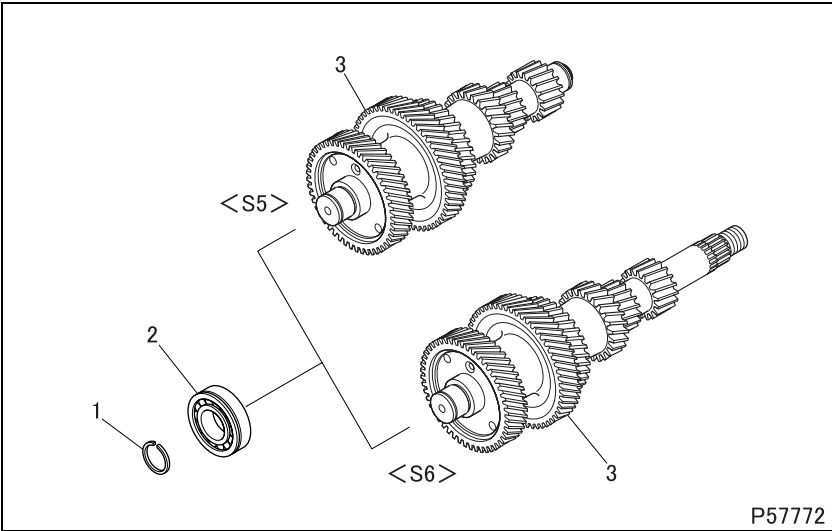


■ Installation: Synchronizer outer ring

- Install the synchronizer ring facing the claws toward the synchronizer hub so that it may be inserted between the two synchronizer levers.

M E M O

COUNTERSHAFT



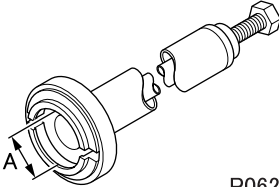
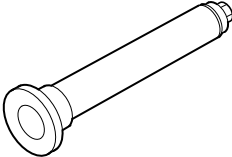
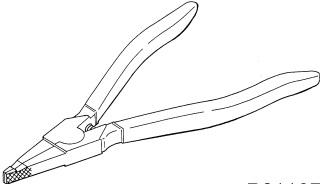
● **Disassembly sequence**

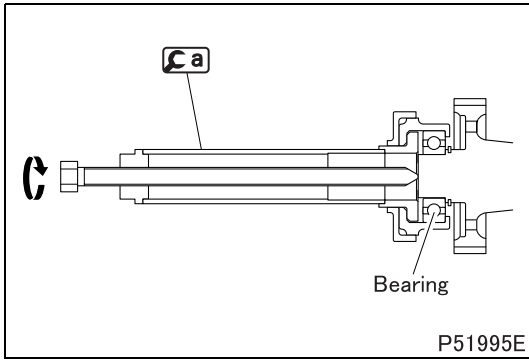
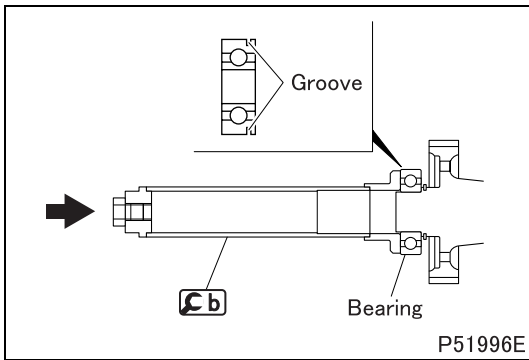
- 1 Snap ring
- 2 Countershaft front bearing
- 3 Countershaft gear

● **Assembly sequence**

Follow the disassembly sequence in reverse.

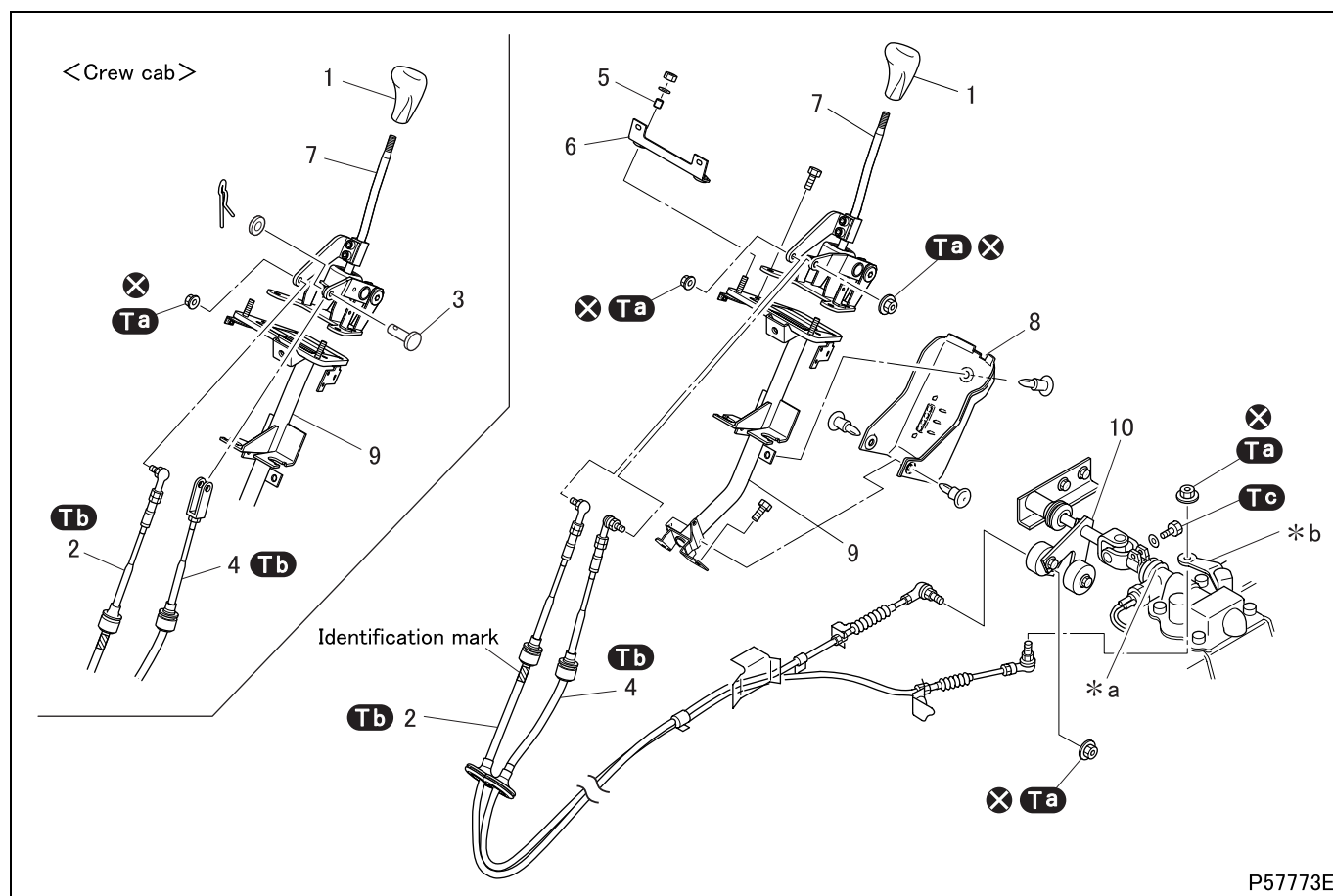
Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
 a	Bearing puller and installer A φ72 {2.83}  P06266	MH062696	Removal of countershaft front bearing
 b	Bearing puller and installer  P49555		Installation of countershaft front bearing
 c	Snap ring expander  P01137	MH061268	Removal and installation of snap ring

◆ Removal procedure ◆**■ Removal: Countershaft front bearing****◆ Installation procedure ◆****■ Installation: Countershaft front bearing**

- Install the countershaft front bearing on the countershaft in the illustrated direction.

TRANSMISSION CONTROL



● Removal sequence

- | | |
|---|-------------------------------------|
| 1 Gear shift lever knob | 8 Gear shift lever cover |
| 2 Shift cable | 9 Gear shift lever bracket |
| 3 Clevis pin <Crew cab> | 10 Cross shaft (See later section.) |
| 4 Select cable | |
| 5 Collar | |
| 6 Instrument panel bracket | |
| 7 Gear shift lever (See later section.) | |
| | *a: Torsion shaft |
| | *b: Gear selector lever |
| | ⊗: Non-reusable parts |

● Installation sequence

Follow the removal sequence in reverse.

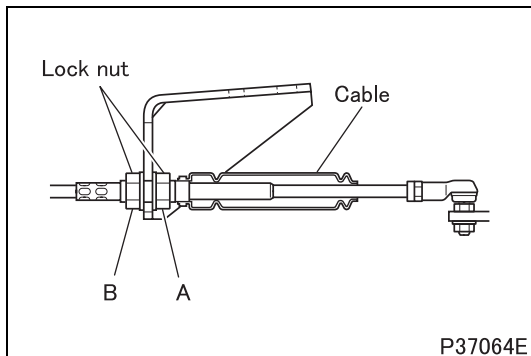
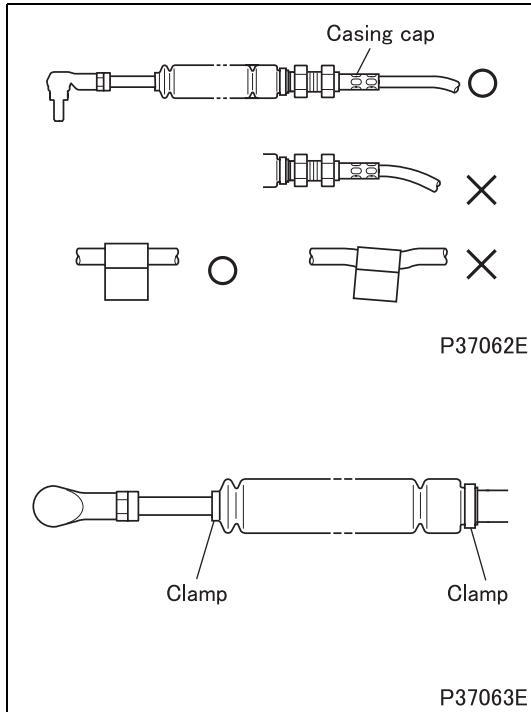
NOTE

- All the nuts used for securing the shift and select cables are coated with thread locking product. These nuts must be replaced with new ones whenever they are loosened or removed.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Nut (Shift cable mounting)		19 to 24 {14 to 18, 1.9 to 2.4}	—
	Nut (Select cable mounting)			
Tb	Shift cable	Lock nut on transmission side	59 to 83 {44 to 61, 6 to 8.5}	—
	Select cable	Lock nut on transmission side		
Tc	Bolt (Cross shaft mounting)		15 to 20 {11 to 15, 1.5 to 2.0}	—

◆ Installation procedure ◆



■ Installation: Shift cable and select cable

CAUTION ⚠

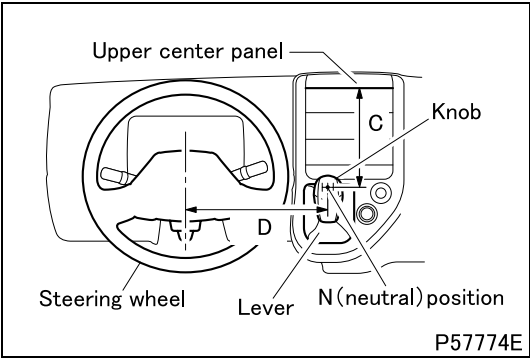
- Install the casing cap portion as a straight line.
- The radius of the cable bend shall be 200 mm {7.87 in.} or more.
- Make sure that there is no obstruction in movement of the cable.
- Install the clamp at right angles to the cable.
- Do not twist clamps at either ends of the boot.
- Check for the identification mark on the shift cable.
- The twist angle of ball joints at both ends of the cables shall be 15 degrees or less.
- Make sure that the ball joints face the correct direction. Installing them in the wrong direction can remarkably reduce durability of the cables.

- Connect the shift cable and select cable with each clamp temporarily tightened.
- Permanently tighten the lock nuts and each clamp of the cables in this order with no excessive force applied to the shift cable and select cable.

NOTE

- When tightening lock nuts, tighten B without moving A on the transmission.

TRANSMISSION CONTROL



- Make sure when operating the gear shift lever that it shifts and selects smoothly each position.
- Adjust the gear shift lever with the lock nut on the transmission and turn buckle or clevis on the gear shift lever.

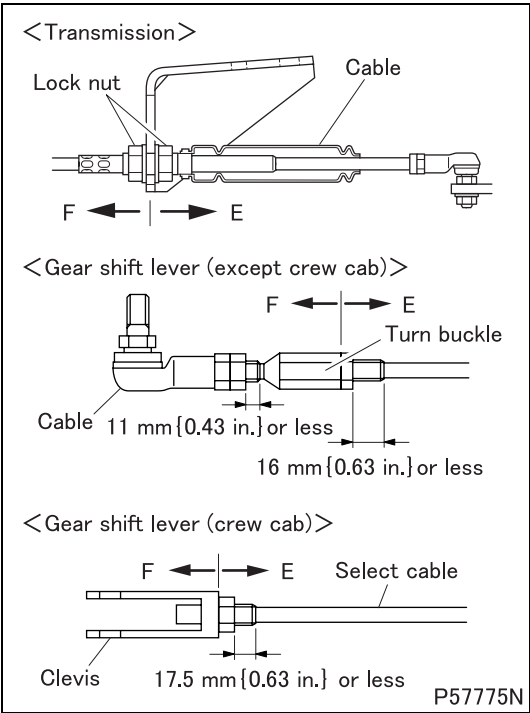
Fore-and-aft direction **C**: Distance from the upper center panel

Right-and-left direction **D**: Distance from the steering wheel center

N (neutral) position on the 2nd-3rd line of the gear shift lever
<S5>

N (neutral) position on the 4th-5th line of the gear shift lever
<S6>

	Fore-and-aft direction C (mm {in.})	Right-and-left direction D (mm {in.})
S5	274 ± 15 {10.8 ± 0.59}	303 ± 5 {11.9 ± 0.20}
S6		333 ± 5 {13.1 ± 0.20}



	Shift cable	Select cable
Tilt forward	E	—
Tilt backward	F	—
Tilt to the right	—	F
Tilt to the left	—	E

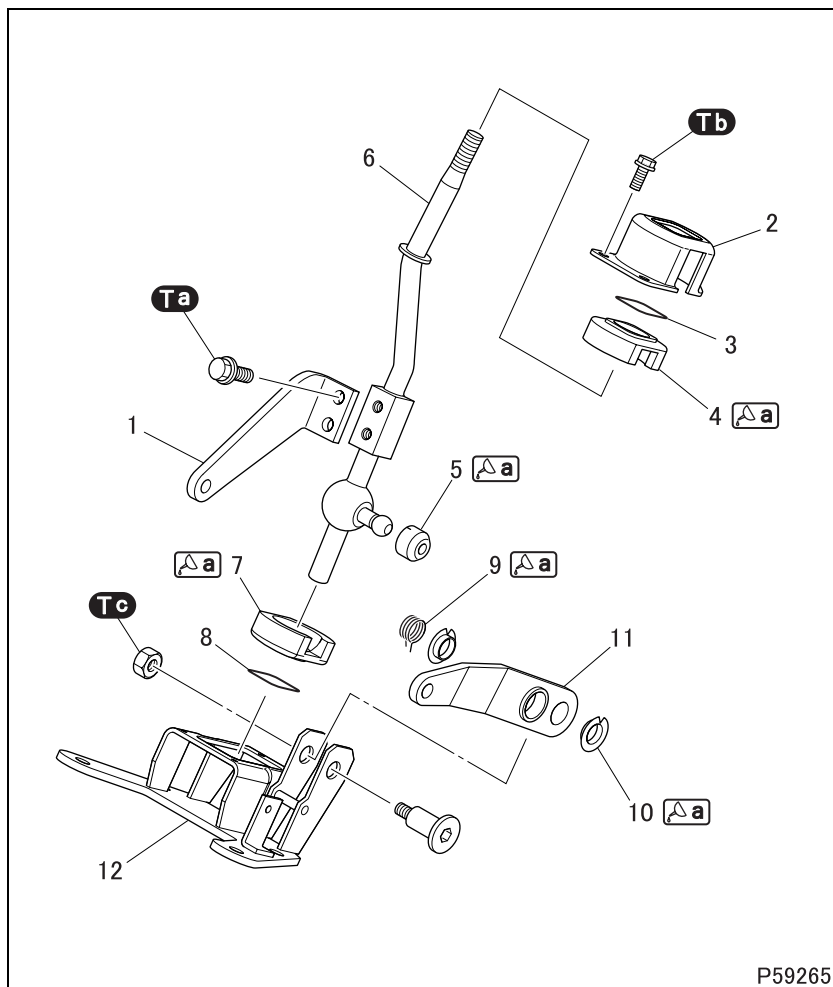
E Move the lock nut and turn buckle or clevis to the transmission direction.

F Move the lock nut and turn buckle or clevis to the gear shift lever direction.

NOTE

- When adjusting cable length, do not move the torsion shaft and gear selector lever from the neutral position.
- When adjusting the select position, align N (neutral) position of the transmission with N (neutral) position of the gear shift lever.

Gear shift lever



● Disassembly sequence

- 1 Shift lever
- 2 Lever support
- 3 Insulator
- 4 Case
- 5 Bushing
- 6 Shift rod
- 7 Case
- 8 Insulator
- 9 Return spring
- 10 Shift bushing
- 11 Selector lever
- 12 Plate

● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

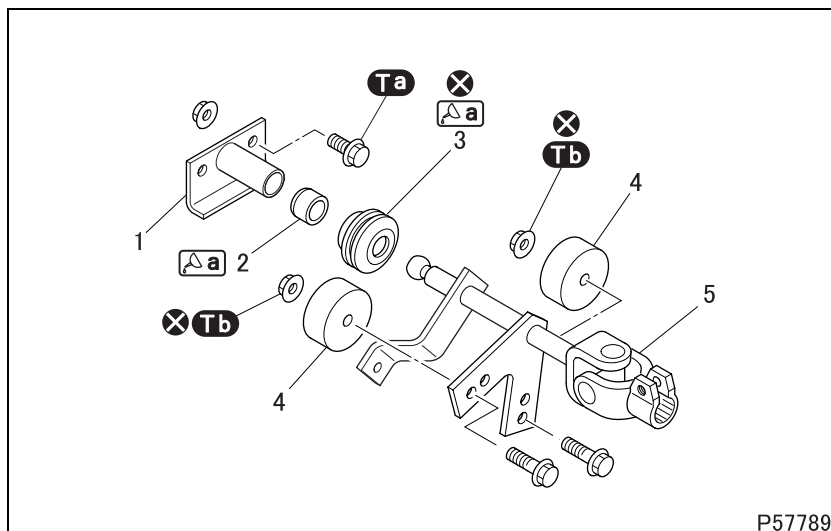
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Shift lever mounting)	19 to 28 {14 to 20, 1.9 to 2.8}	—
Tb	Bolt (Lever support mounting)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
Tc	Nut (Selector lever mounting)	10 to 15 {7.4 to 11, 1 to 1.5}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Sliding area of case and shift rod	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
	Internal circumference and circumference of bushing		
	Entire return spring		
	Internal circumference and circumference of shift bushing		

TRANSMISSION CONTROL

Cross shaft



● Disassembly sequence

- 1 Cross shaft bracket
- 2 Cross shaft bushing
- 3 Cross shaft boot
- 4 Counter weight
- 5 Cross shaft

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

- The counter weight mounting nut is coated with thread locking product. The nut must be replaced with a new one whenever it is loosened or removed.

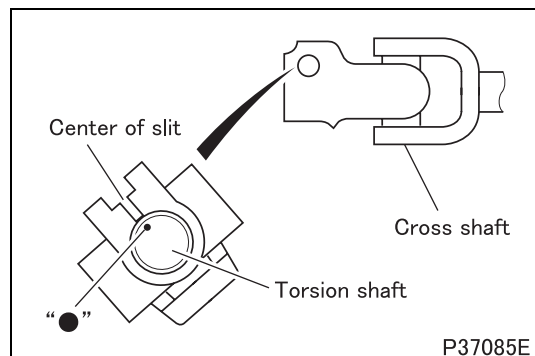
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Cross shaft bracket mounting)	59 to 78 {44 to 61, 6 to 8}	–
Tb	Nut (Counter weight mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Internal circumference and circumference of cross shaft bushing	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Filling in cross shaft boot		

◆ Installation procedure ◆



■ Installation: Cross shaft

- Insert the cross shaft so that the punch mark “●” of the torsion shaft on the transmission is positioned at the center of the slit of the cross shaft.

- Bearing pullers and installers are special tools used for removing and installing bearings listed in the table below which are used in this group.
- For each puller (for removing) and each installer (for installing), use the components of the bearing pullers and installers in combination.

Application			Drive pinion bearing		Mainshaft rear bearing		Countershaft front bearing		Countershaft rear bearing <S5>		Countershaft rear bearing and 6th gear sleeve <S6>	
Component												
Bearing puller and installer	Component	Part No.	Puller	In-staller	Puller	In-staller	Puller	In-staller	Puller	In-staller	Puller <S6>	In-staller <S6>
MH062696	Adapter	MH062590										O
	Plug	03726-81017						O		O		O
	Bolt	MH062700					O		O			
	Body	MH062701					O	O	O	O		O
	Protector	MH061306					O		O			
	Countershaft bearing claw	03726-81012							O			
	Bearing claw	MH062707					O					
	Mainshaft bearing claw	MH061305										
	Bearing claw	MH062706										
MH062697	Bearing claw	MH062589									O	
	Plug	03726-81017		O		O						
	Bolt	MH062700	O		O						O	
	Body	MH062702	O	O	O	O					O	
	Protector	ME624229	O		O						O	
	Mainshaft bearing claw	ME624226			O							
	Bearing claw	MH062636	O									



Group 23

Automatic Transmission

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

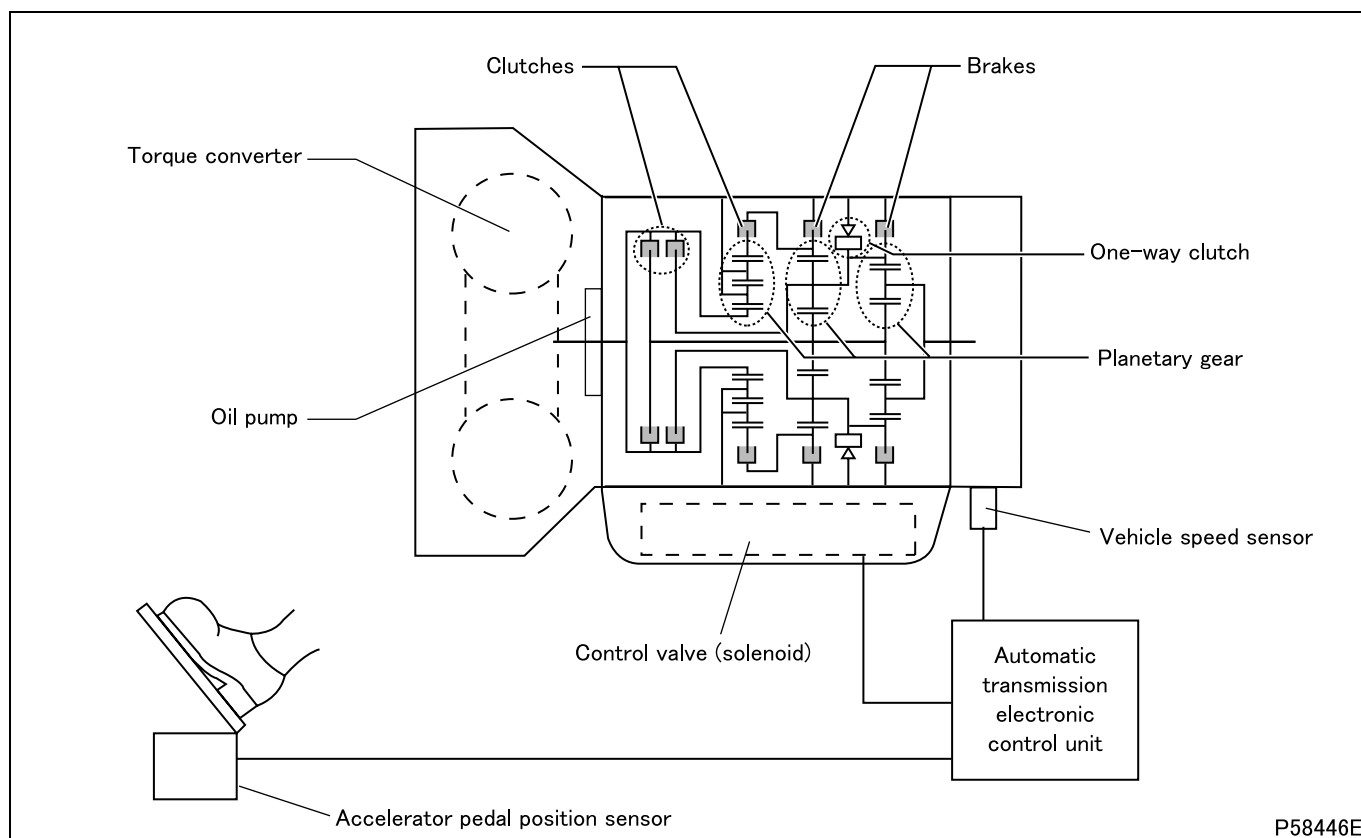
SPECIFICATIONS	23-2	REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION	23-56
STRUCTURE AND OPERATION		AUTOMATIC TRANSMISSION CONTROL	23-64
1. Overview	23-3	OIL COOLER	
2. Electronic Control System	23-14	<MODELS EXCEPT CREW CAB> ...	23-72
3. Electronic Control Unit Connection Diagram	23-20	<CREW CAB>	23-74
TROUBLESHOOTING		REPLACEMENT OF PARTS OF AUTOMATIC TRANSMISSION MAIN BODY	23-76
1. Inspection Procedure	23-22	INSPECTION OF ELECTRICAL EQUIPMENT	23-80
2. Cautions to Observe When Performing Inspections	23-23	INSTALLED LOCATIONS OF PARTS	23-84
3. Inspections Based on Diagnosis Codes	23-24	ELECTRIC CIRCUIT DIAGRAM	23-88
4. Multi-Use Tester Service Data	23-33		
5. Inspections Performed at Electronic Control Unit Connectors	23-36		
6. Likely Causes of Symptoms	23-39		
ON-VEHICLE INSPECTION AND ADJUSTMENT			
1. Stall Test	23-44		
2. Time Lag Test	23-45		
3. Line Pressure Test	23-46		
4. Road Test	23-48		
5. Inspection of ATF	23-49		
6. Replacement of ATF	23-50		
7. Dealer Adjust	23-52		

SPECIFICATIONS

Item			Specifications
Manufacturer			Aisin Seiki Co., Ltd.
Transmission model			M036A6
Torque converter	Type		3-element, single-stage, 2-phase (with lockup clutch)
	Stall torque ratio		1.60
Transmission	Type		Planetary gear type; 6 forward gears, 1 reverse gear
	Gear ratios	1st	3.742
		2nd	2.003
		3rd	1.343
		4th	1.000
		5th	0.773
		6th	0.634
		Rev	3.539
Range selection pattern			P-R-N-D-3-2 (engine startup possible in P and N only)
Automatic transmission fluid	Type		Mobil ATF3309
	Total quantity L {qts.}		13 {14}
	Quantity at time of replacement L {qts.}		Approx. 8.4 {8.9}

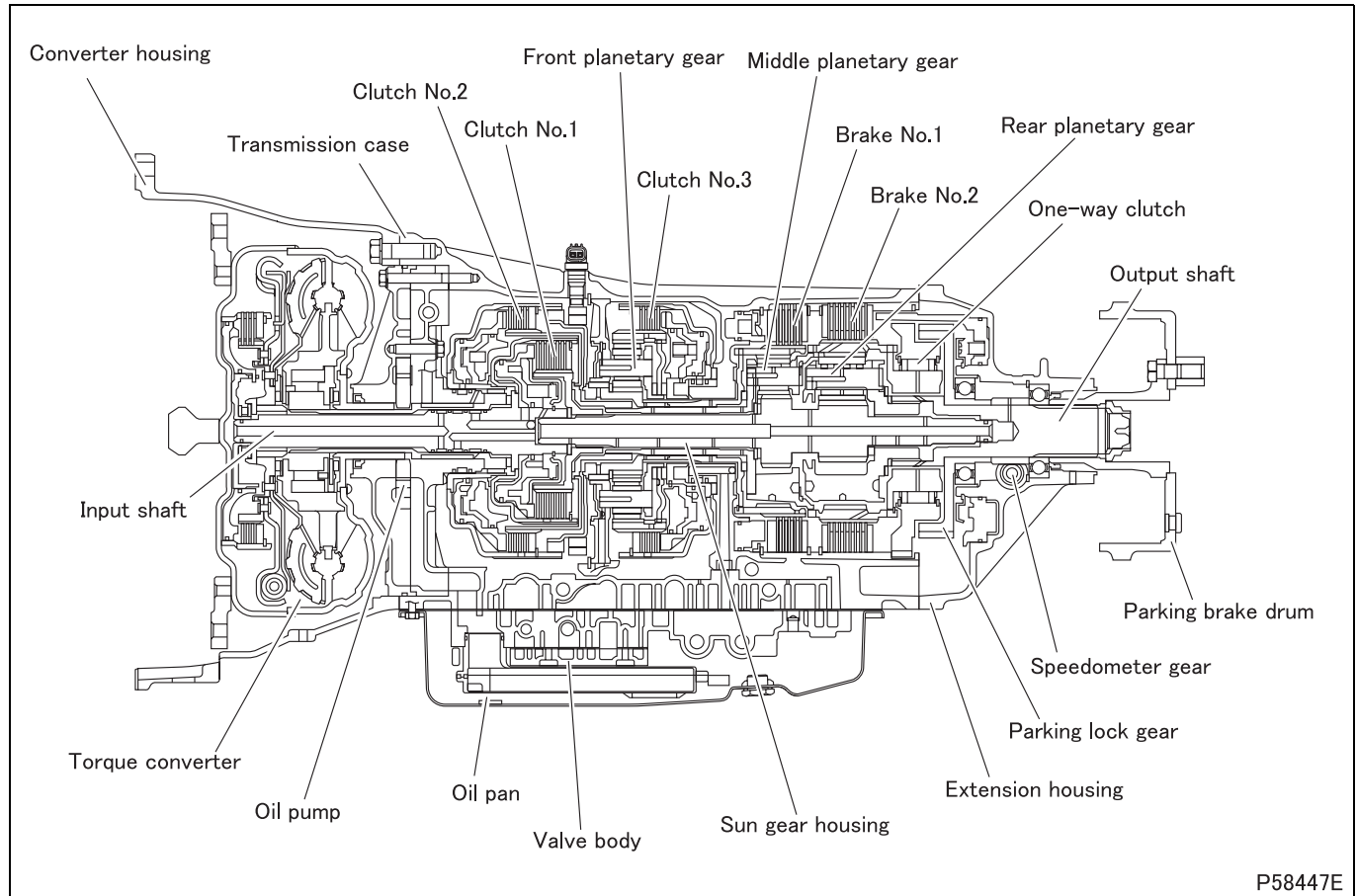
1. Overview

- The automatic transmission forms a system in which gearshifts are automatically realized through direction of automatic transmission fluid (ATF) on various paths by solenoid valves in accordance with sensor information on the vehicle speed, throttle opening, and other aspects of vehicle operation.
- The automatic transmission electronic control unit provides various control functions. These include a diagnosis function (here, the automatic transmission electronic control unit monitors the main components and warns the driver of any abnormality), a failsafe function (here, the automatic transmission electronic control unit stops control of the automatic transmission when necessitated by an abnormality), and a function (here, the automatic transmission electronic control unit changes the control method to enable continued driving in the event of a relevant abnormality).
- The system consists mainly of electronically controlled control valves (solenoid valves), a torque converter, planetary gears, brakes, clutches, and the automatic transmission electronic control unit and sensors that are used for control of the aforementioned components.



STRUCTURE AND OPERATION

1.1 Automatic transmission



- The automatic transmission combines a torque converter (this has a lockup mechanism) and a fully automatic 6-speed gear system.

(1) Torque converter

- The torque converter serves as the input device for the transmission. It functions as a fluid coupling that increases the torque transmitted from the engine and absorbs shock during standing starts and during gearshifts. At vehicle speeds above a certain level, a lockup mechanism in the torque converter eliminates slippage and thus improves transmission efficiency.

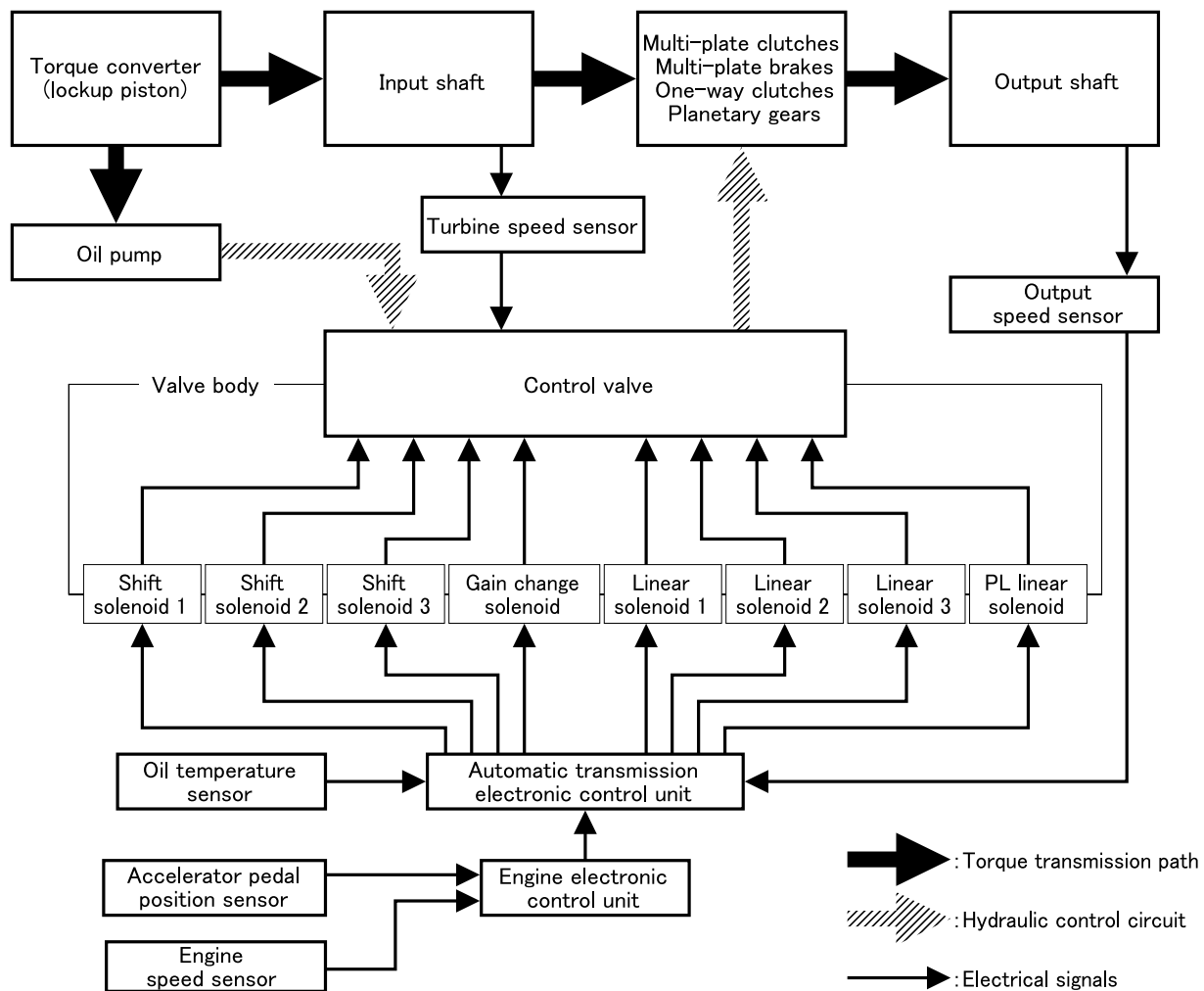
(2) Transmission

- The transmission consists of a gear system with 6 forward gears and 1 reverse gear. It effects gearshifts using 1 one-way clutch, 3 planetary gear sets (each of these consists of a sun gear, pinion gears, and a ring gear), 3 hydraulically activated, wet, multi-plate clutches, and 2 hydraulically activated, wet, multi-plate brakes.

(3) Hydraulic control arrangement

- Extensive electronic control effected by a microcomputer (the automatic transmission electronic control unit) over the hydraulic circuitry enables precise control over gearshifts.

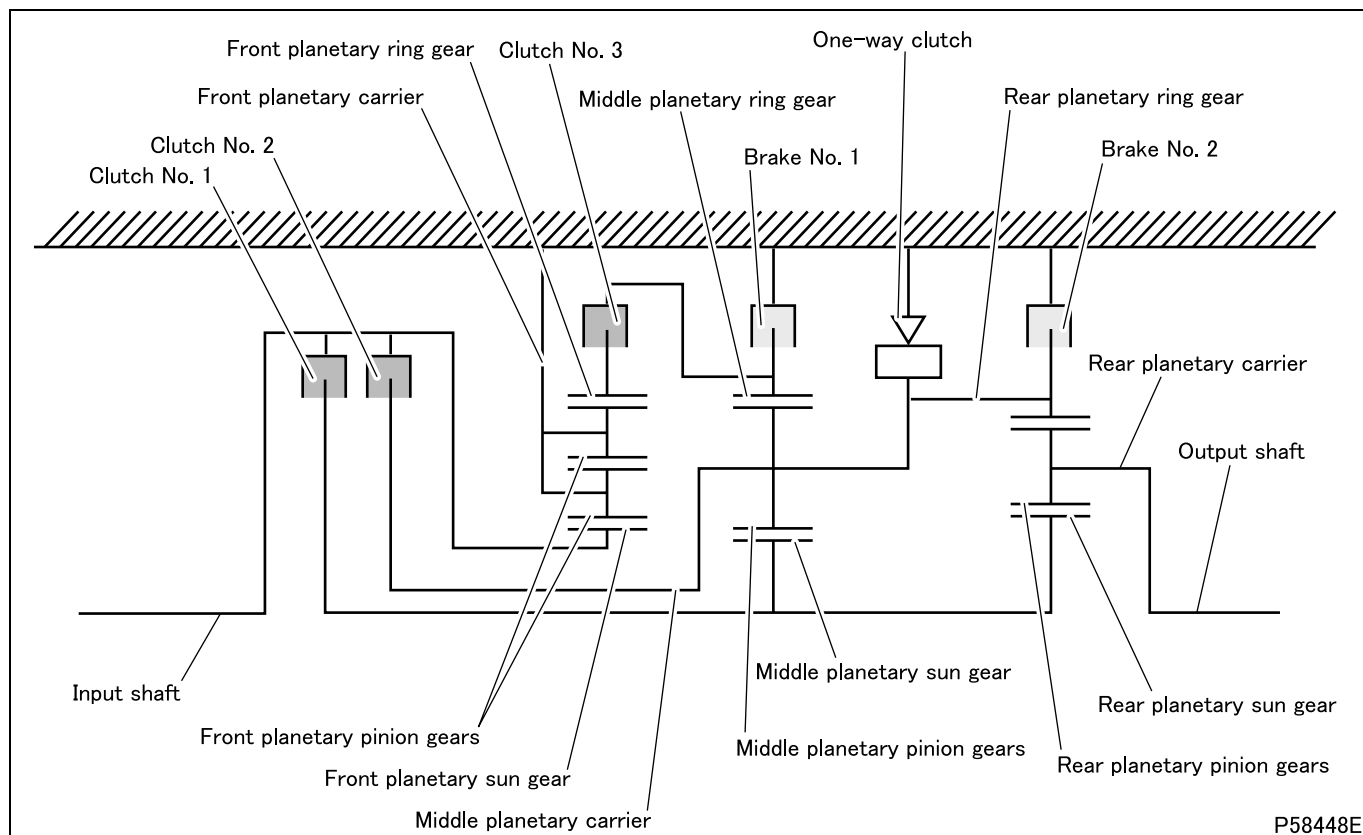
1.2 Automatic transmission block diagram



P58562E

STRUCTURE AND OPERATION

1.3 Transmission



P58448E

(1) Functions of clutches and brakes

Component	Function
Clutch No. 1	Engage input shaft with middle and rear planetary sun gears
Clutch No. 2	Engage input shaft with middle planetary carrier and rear planetary ring gear
Clutch No. 3	Engage front planetary ring gear with middle planetary ring gear
Brake No. 1	Lock middle planetary ring gear
Brake No. 2	Lock front planetary carrier and rear planetary ring gear
One-way clutch	Lock front planetary carrier and rear planetary ring gear against counterclockwise rotation (only allowing them to rotate clockwise)

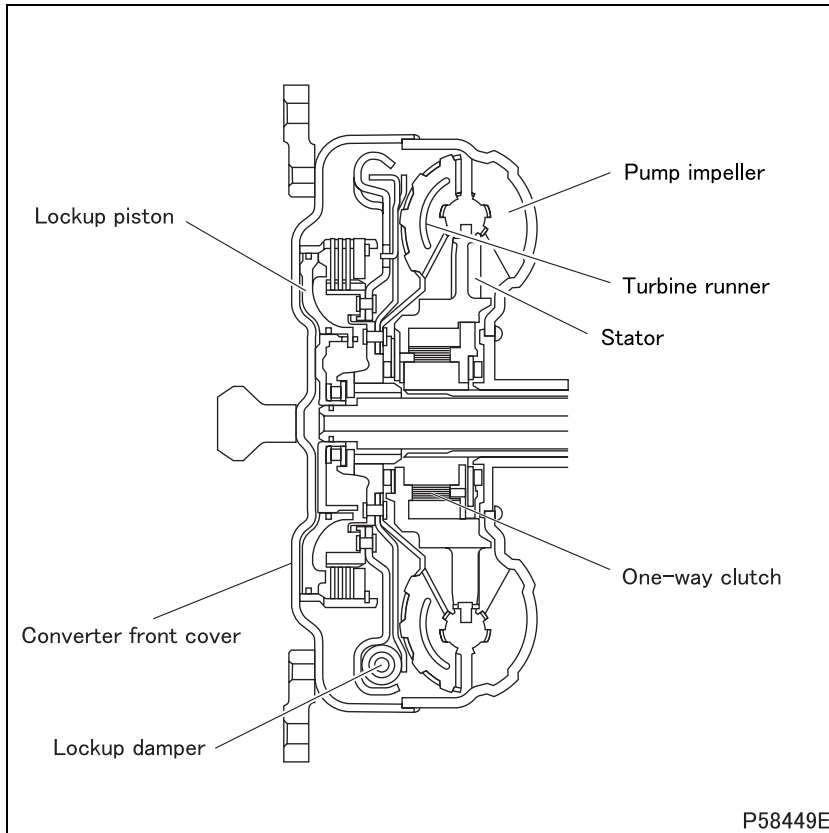
(2) Operation timing of clutches, brakes and solenoids

Shifter position		Shift solenoid			Linear solenoid			Clutch No.			Brake No.		One-way clutch
		1	2	3	1	2	3	1	2	3	1	2	
P	Parking		O	O		O						O	
R	Rev (high torque)	O		O		O	O			O		O	
	Rev (low torque)	O	O	O		O	O			O		O	
N	Neutral		O	O		O						O	
D	1st			O		O		O				O	●
	2nd				O			O			O		
	3rd	O				O		O		O			
	4th	O	O		O			O		O			
	5th		O			O			O	O			
	6th		O		O				O		O		

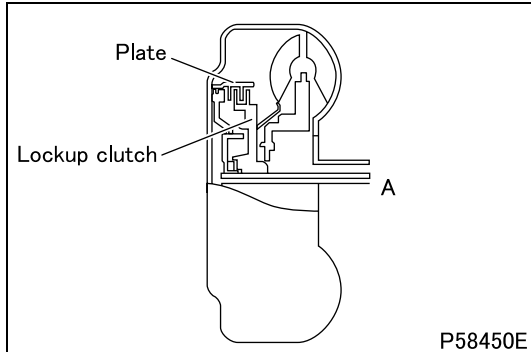
O :In operation

● :Only in operation when driven

(3) Torque converter

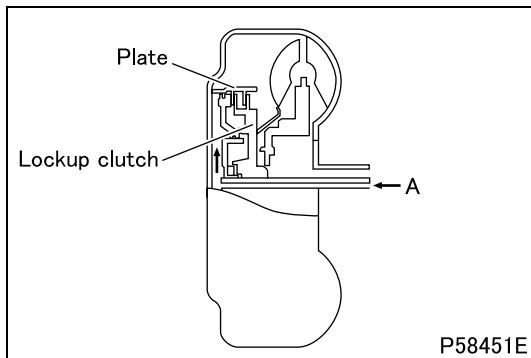


- The torque converter transmits engine torque to the transmission. When it is not locked up, it transmits the torque by means of oil. When it is locked up, it transmits the torque by means of the lockup piston.
- The lockup damper is designed to soften the impact as the torque converter locks up.
- The torque converter is a 3-element, single-stage, 2-phase type.
- The term 'single-stage' indicates that there is 1 turbine runner (output element). The term '2-phase' indicates that the mechanism works as a torque converter when the turbine runner is turning slowly relative to the pump impeller and as a fluid coupling when the turbine runner is turning quickly relative to the pump impeller.



(3.1) When not locked up

- The torque converter activation pressure is not supplied between the converter front cover and lockup piston via passage **A**. The lockup clutch and the plate are therefore disengaged and the lockup function is inactive.

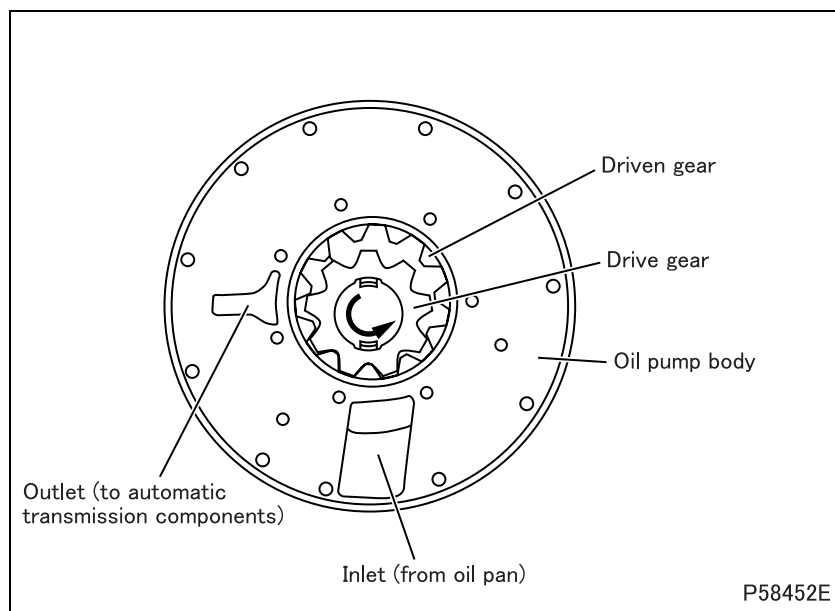


(3.2) When locked up

- The torque converter activation pressure is supplied between the converter front cover and lockup piston via passage **A**. The lockup clutch and the plate are therefore engaged and the lock-up function is active.

STRUCTURE AND OPERATION

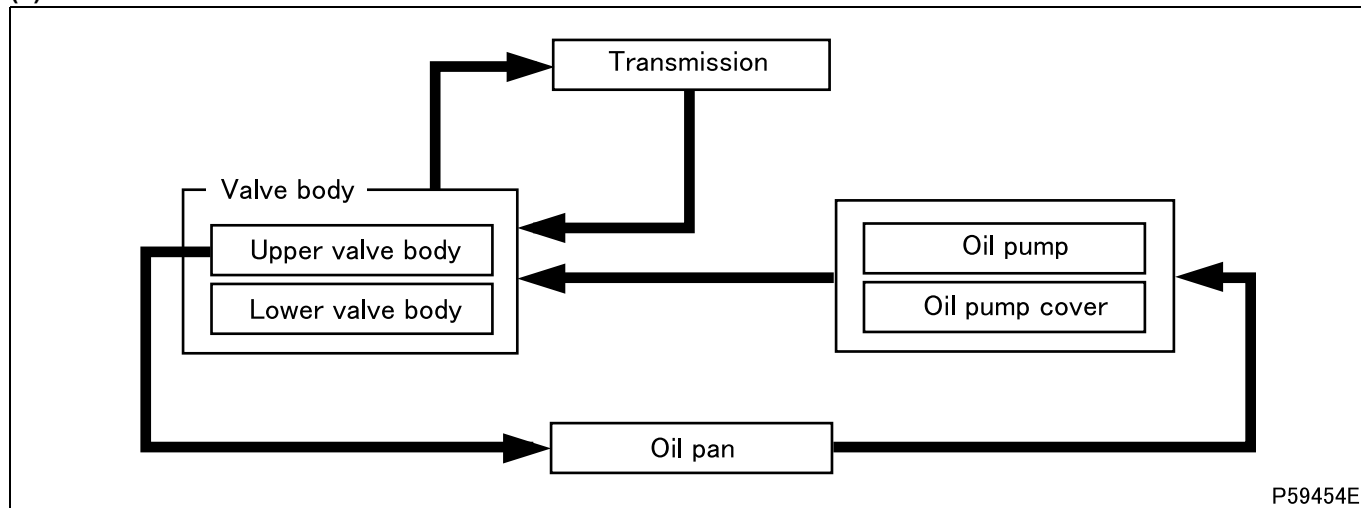
(4) Oil pump



- The oil pump is a high-performance gear-type pump with a small number of specially designed gear teeth.
- The drive gear is fitted onto the extension sleeve of the torque converter, so it turns in the direction of the arrow (the same direction as the engine output). Oil drawn into the pump is compressed and then expelled.

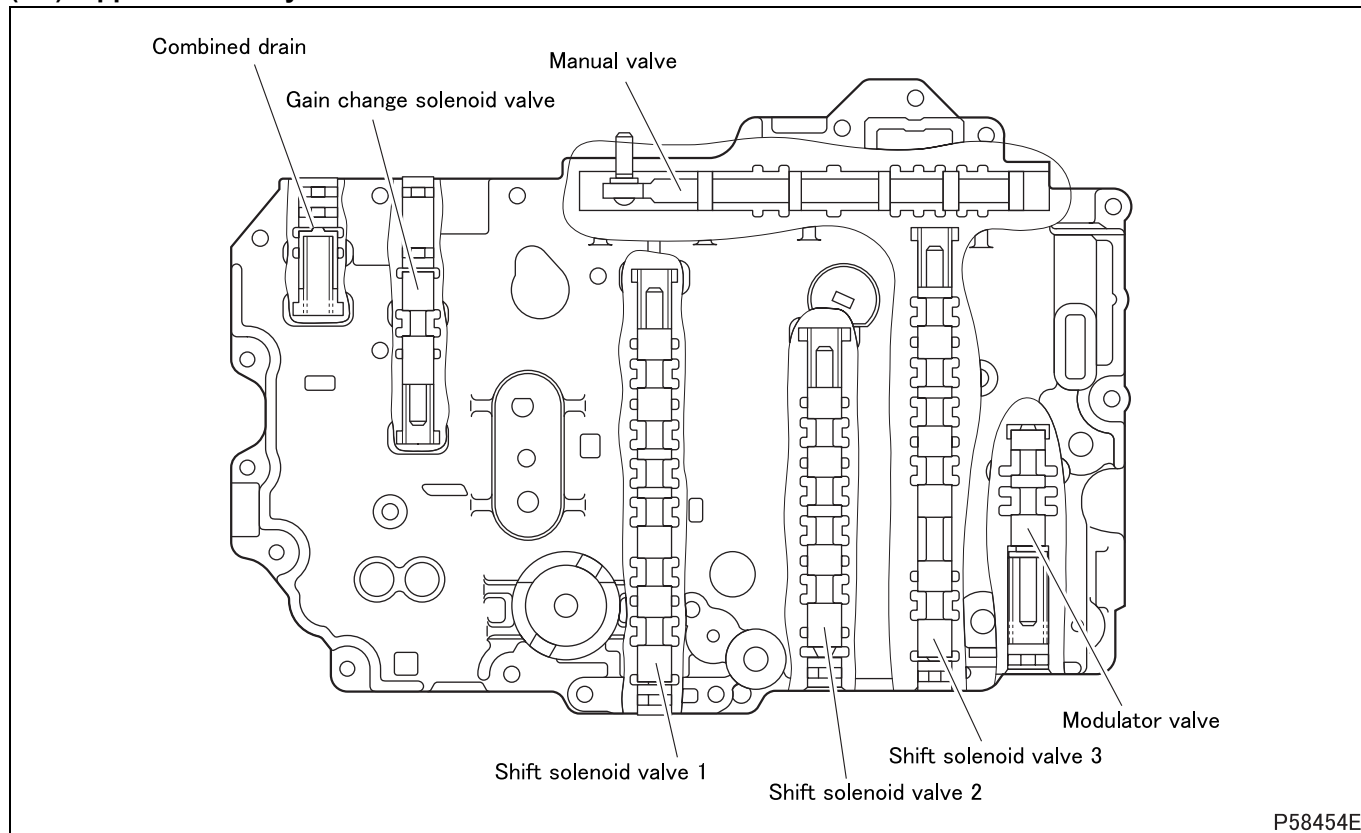
1.4 Hydraulic control components

(1) Overview



(2) Valve layout drawings

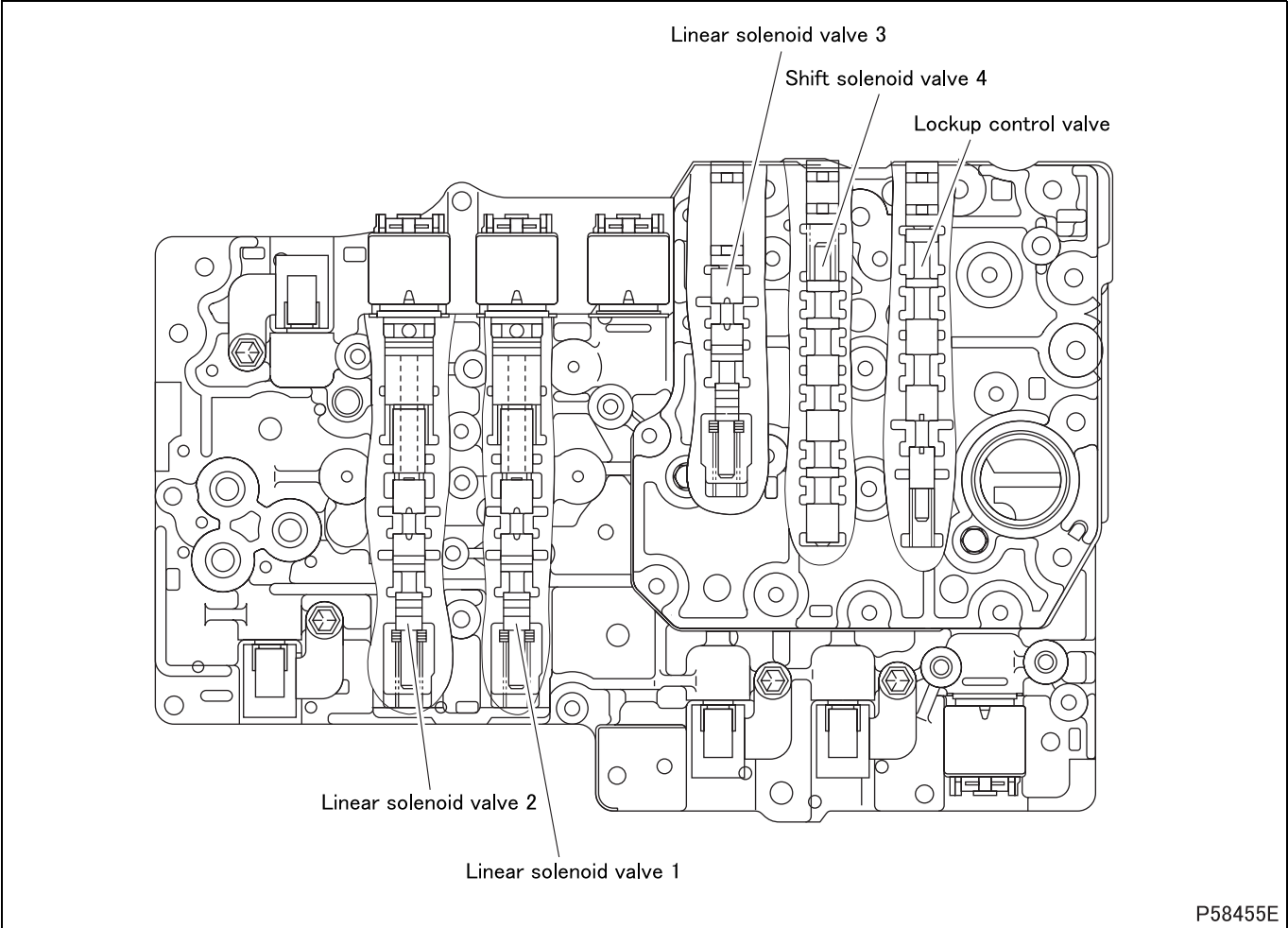
(2.1) Upper valve body



Valve	Function
Manual valve	Selects N, R, and D passages in accordance with driver's movement of shift lever.
Modulator valve	Regulates line pressure and supplies it to linear solenoids and shift solenoids.
Shift solenoid valve 1	Directs line pressure and control pressure for clutch and brake engagement.
Shift solenoid valve 2	Directs line pressure and control pressure for clutch and brake engagement.
Shift solenoid valve 3	Directs line pressure and control pressure for clutch and brake engagement.
Gain change solenoid valve	Changes pressure from control pressure to line pressure.
Combined drain	Enables fluid emerging from clutch passages and brake passages to drain away.

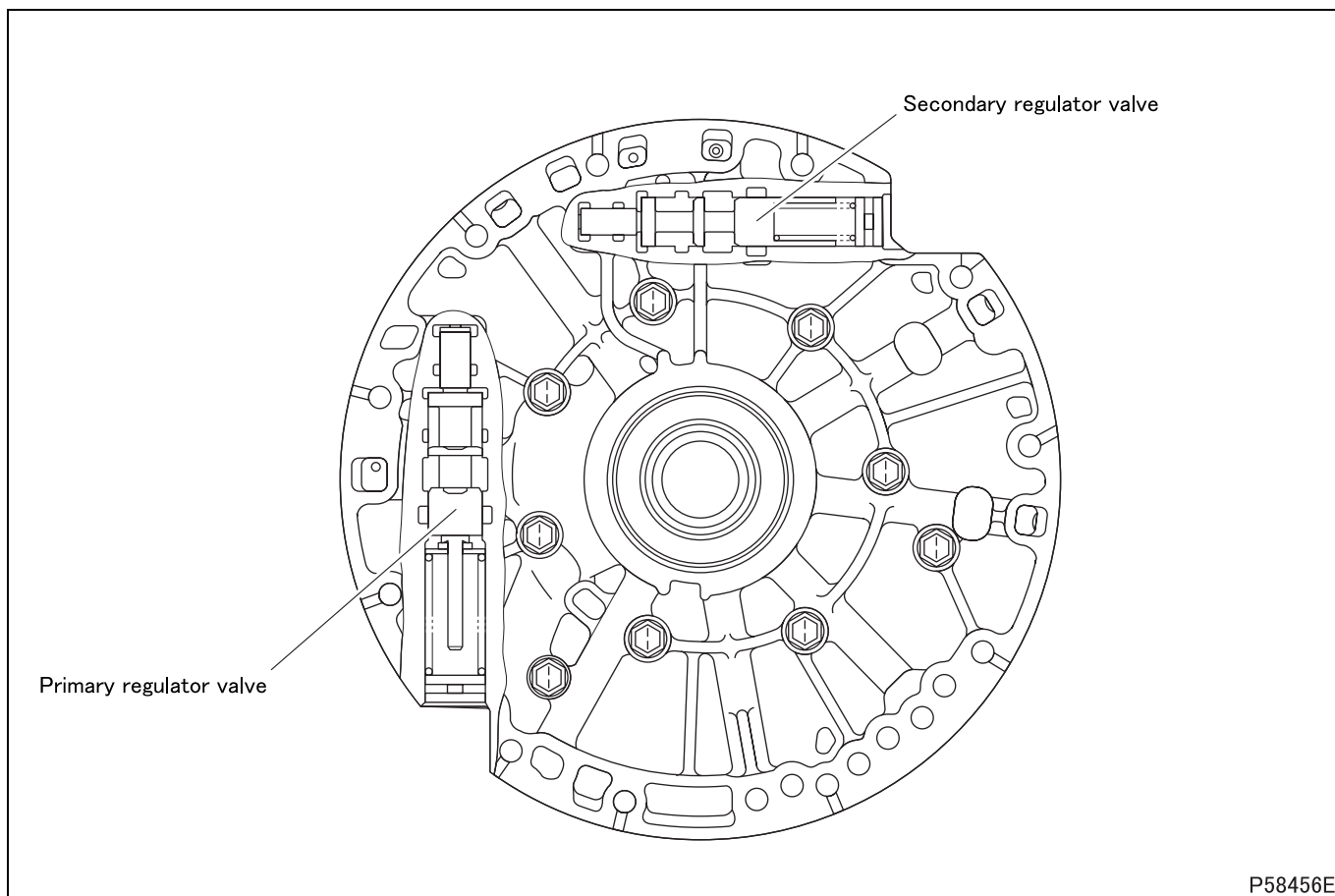
STRUCTURE AND OPERATION

(2.2) Lower valve body



Valve	Function
Lockup control valve	Controls pressure (lockup pressure) fed to torque converter.
Linear solenoid valve 1	Controls pressure (control pressure) fed to clutches No. 1 and No. 2 and brake No. 1
Linear solenoid valve 2	Controls pressure (control pressure) fed to clutch No. 3 and brake No. 2
Linear solenoid valve 3	Controls pressure (control pressure) fed to clutches No. 1 and No. 3
Shift solenoid valve 4	Directs line pressure and control pressure for clutch and brake engagement.

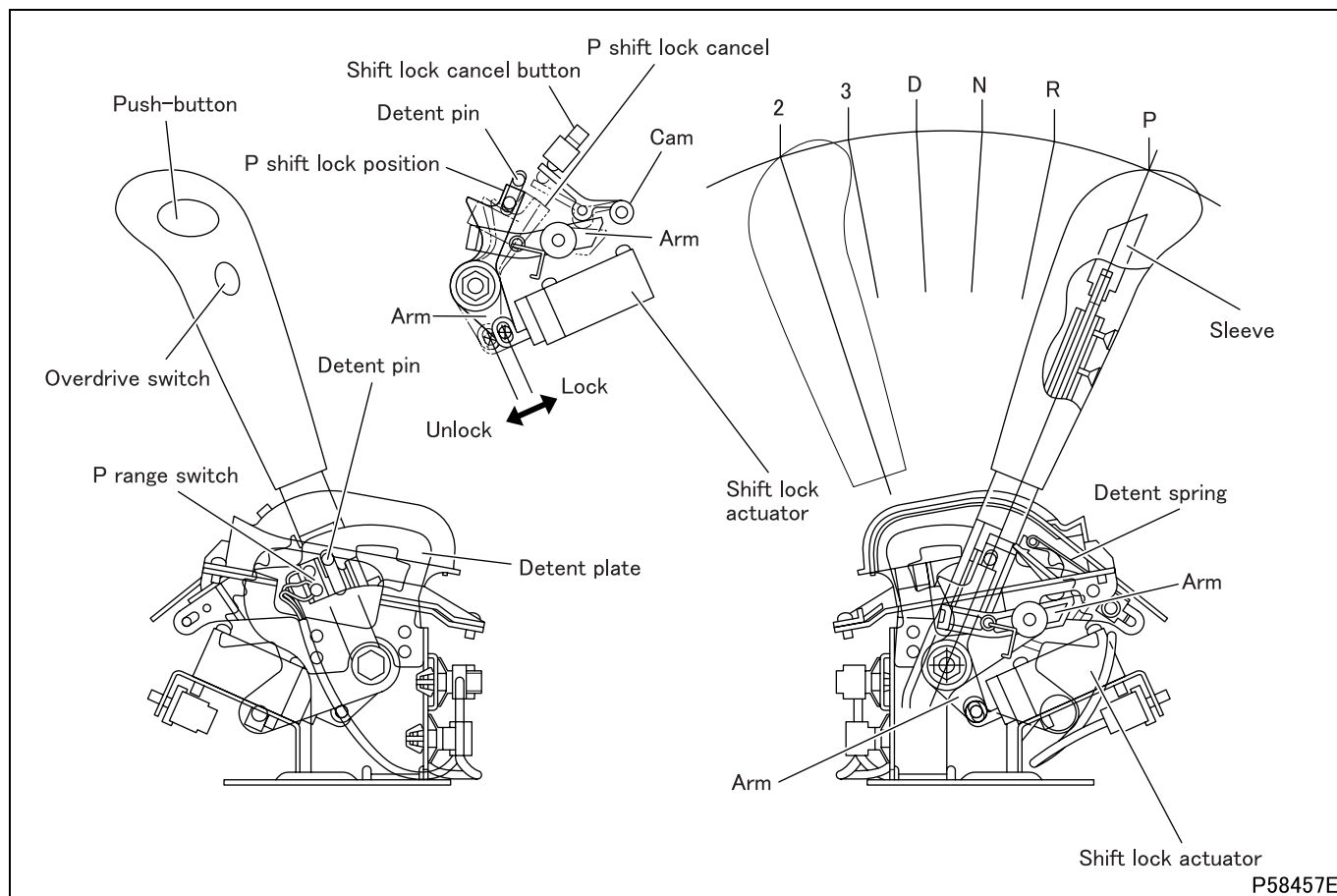
(2.3) Oil pump cover



Valve	Function
Primary regulator valve	Controls pressure (line pressure) fed to elements.
Secondary regulator valve	Controls pressure fed from primary regulator valve to torque converter, and controls lubrication pressure for various parts.

STRUCTURE AND OPERATION

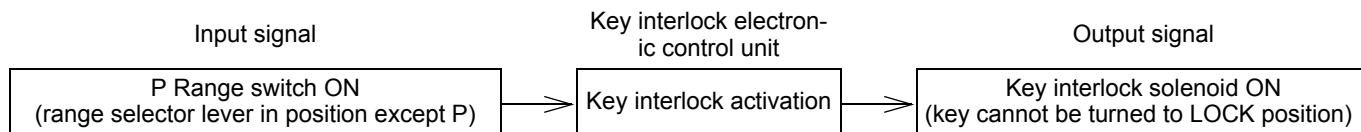
1.5 Range selector lever



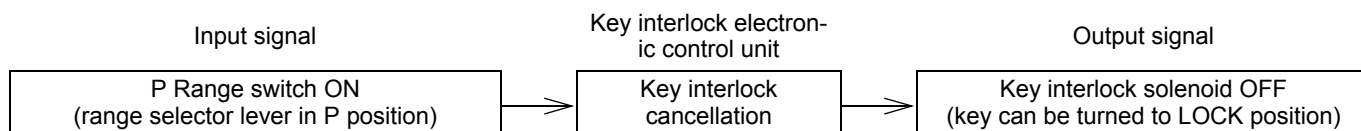
- The P range switch indicates whether the P range is selected. It is used for the key interlock function, which prevents the starter key from being removed when any range except P is selected.
- The shift lock actuator is used in control of the P shift lock function, which prevents the push-button from being pushed (and thus prevents movement of the lever from the P position) when the required condition (brake pedal depressed) is not satisfied.
- The shift lock cancel button cancels the P shift lock function in a way that bypasses the shift lock actuator. It is used in the event of a fault.

(1) Key interlock function

(1.1) Locked condition



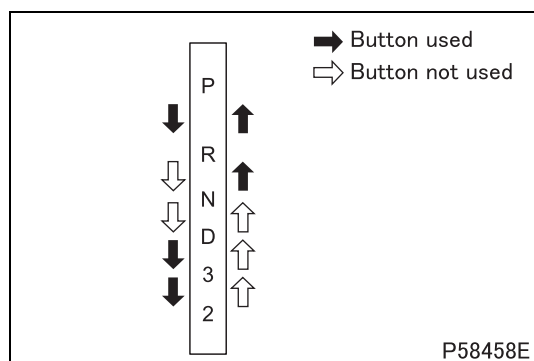
(1.2) Lock cancellation



(2) P shift lock function

- When the required condition is not satisfied, the shift lock actuator operates to prevent the push-button from being pushed, effectively preventing movement of the lever from the P position.
- The shift lock actuator's operating conditions are shown in the table below.

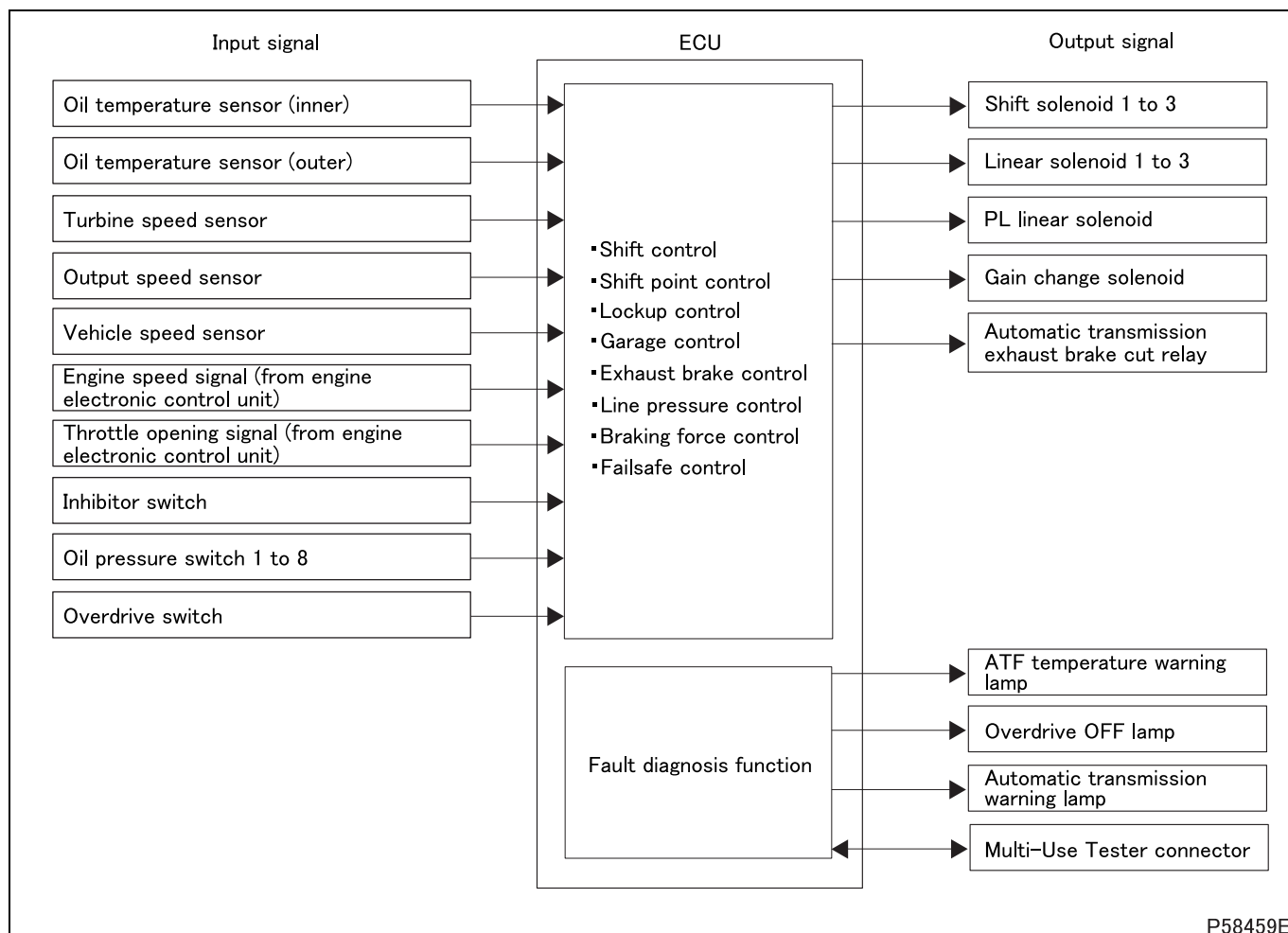
Power supply		Switches		Operating mode	
IG ("O": starter switch in ON position)	+B (power supply con- stantly connected to battery)	Brake ("O": brake pedal depressed)	P range ("O": brake pedal depressed)	Unlock ("O": push-button can be pushed)	Lock ("O": push-button cannot be pushed)
O	O	O	O	O	
O	O		O		O
O	O	O		O	
O	O			O	
	O	O	O		O
	O		O		O
	O	O		O	
	O			O	

(3) Shift pattern

STRUCTURE AND OPERATION

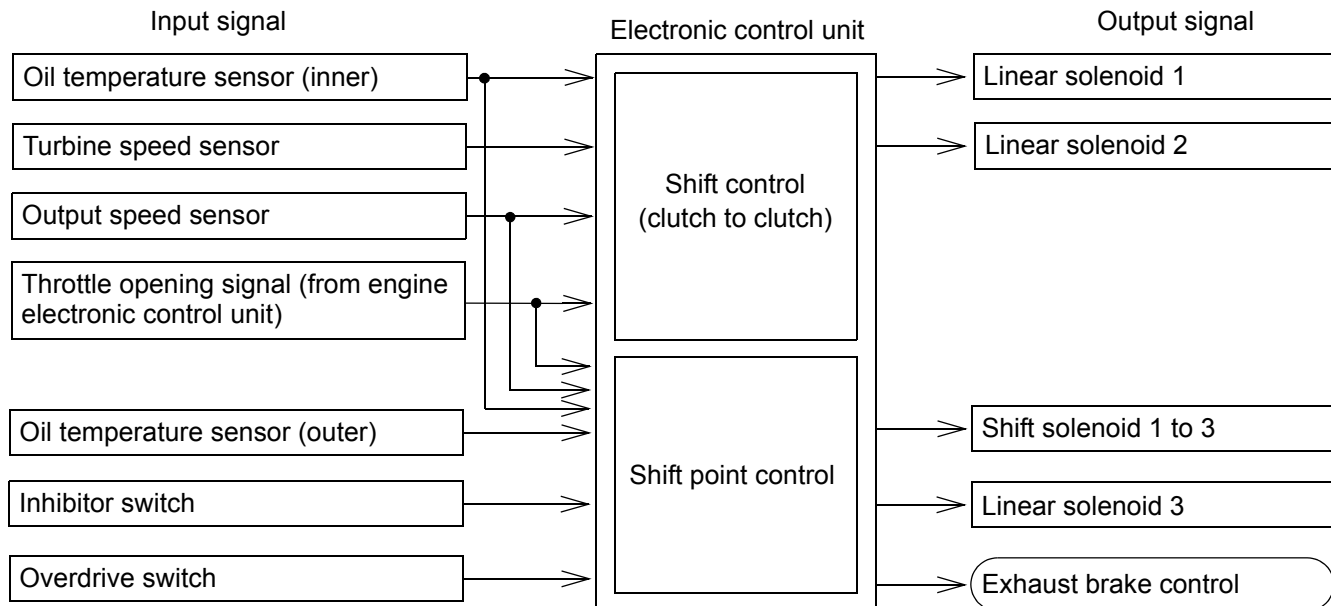
2. Electronic Control System

2.1 System block diagram



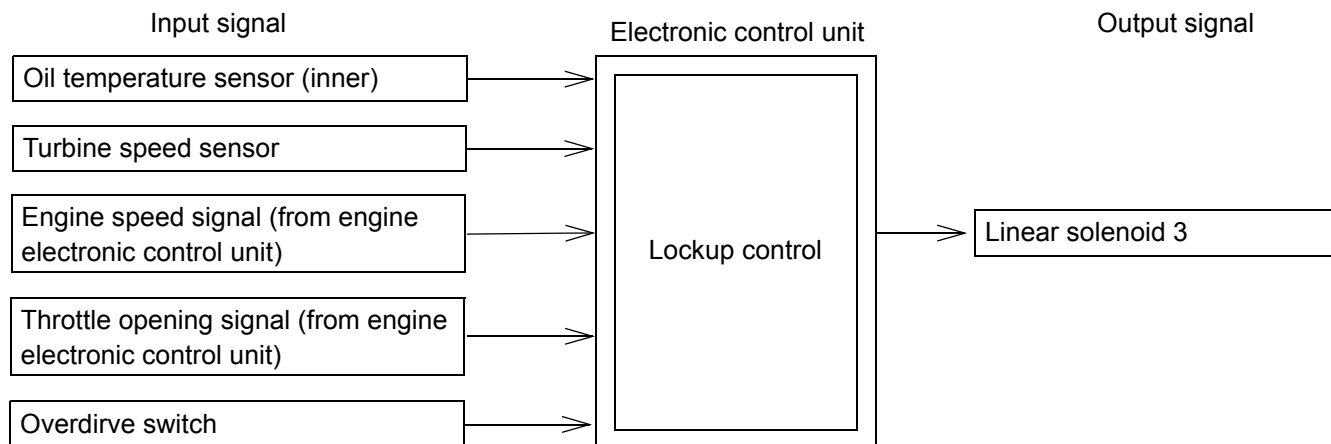
Part name	Major function or operation
Oil temperature sensor	Detection of ATF temperature
Turbine speed sensor	Detection of input shaft speed
Output speed sensor	Detection of output shaft speed
Vehicle speed sensor	Detection of vehicle speed
Engine electronic control unit (engine speed signal)	Detection of engine speed
Engine electronic control unit (throttle opening signal)	Detection of throttle opening angle
Inhibitor switch	Detection of range selector lever position
Oil pressure switch	Detection of oil pressure
Overdrive switch	Detection of overdrive OFF condition
Automatic transmission exhaust brake cut relay	Cut-off of exhaust brake
ATF temperature warning lamp	Display of abnormal ATF (automatic transmission fluid) temperature
Overdrive OFF lamp	Display of overdrive OFF
Automatic transmission warning lamp	Display of system fault and diagnosis codes
Multi-Use Tester connector	Communication with Multi-Use Tester; displaying and overdriveasing diagnosis codes

2.2 Shift control and shift point control



- For automatic selection of the optimal gear, the throttle opening signal and the output speed sensor signals (which correspond to the vehicle speed) cause the automatic transmission electronic control unit to issue relevant signals in accordance with a predetermined shift map to shift solenoid 1-3 and linear solenoid 1 and 2, which are mounted on the valve body.
- Clutch selection for shift control is performed by means of clutch-to-clutch control, whereby one clutch is disengaged as another is engaged.

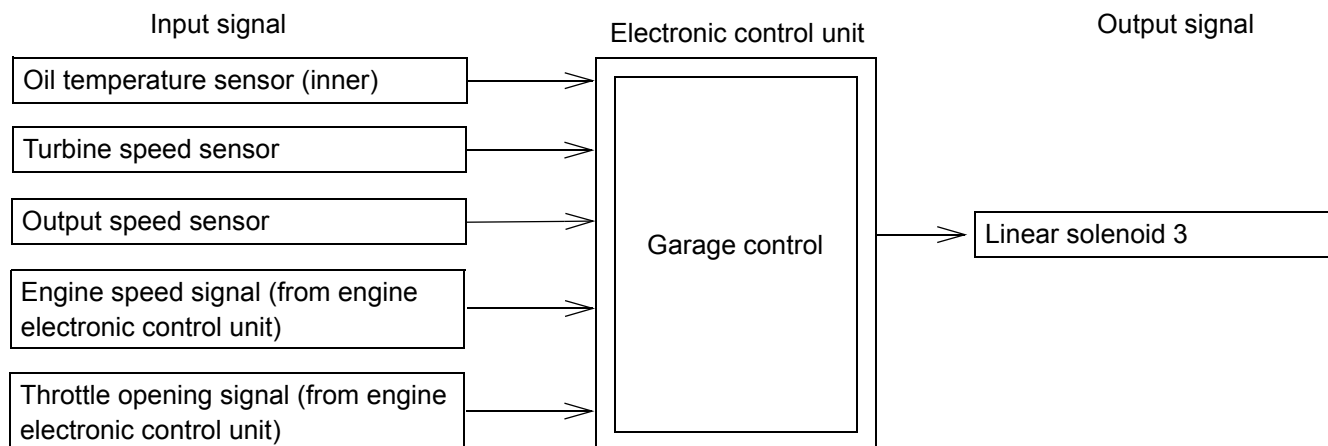
2.3 Lockup control



- Lockup control enables slippage in the torque converter to be eliminated for increased transmission efficiency. The throttle opening signal and the output speed sensor signals (which correspond to the vehicle speed) cause the automatic transmission electronic control unit to issue relevant signals in accordance with a predetermined shift map to linear solenoid 3 (this is mounted on the valve body) for lockup ON-OFF-slip selection.

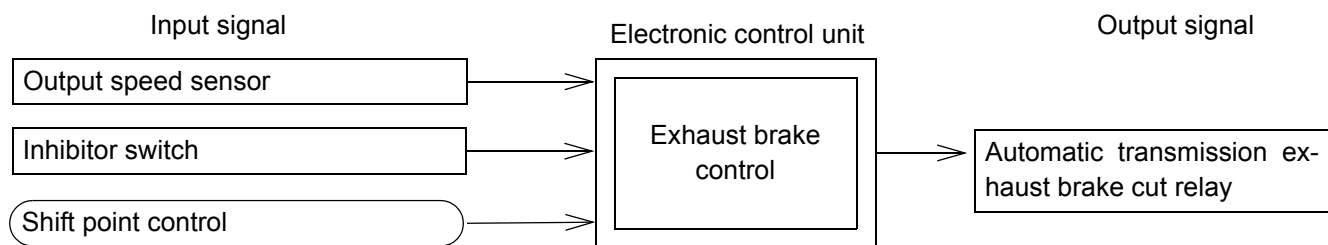
STRUCTURE AND OPERATION

2.4 Garage control



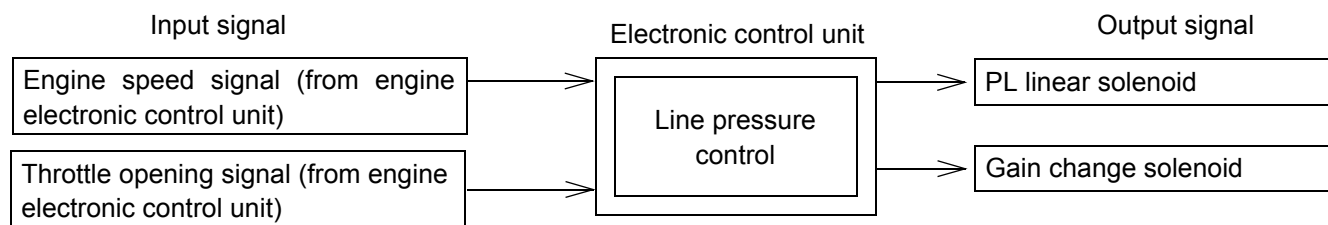
- When the inhibitor switch signal changes from N to a driving range (D or R), a signal is issued by the automatic transmission electronic control unit to linear solenoid 3 (this is mounted on the valve body) to realize a forward or reverse gear.

2.5 Exhaust brake control



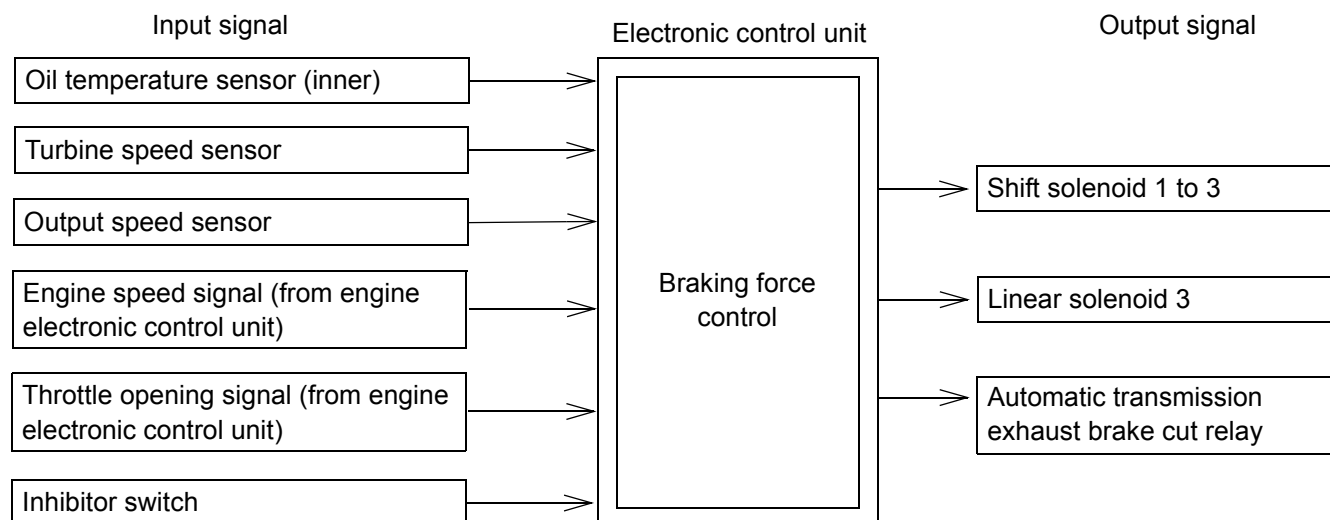
- The exhaust brake is released under any of the following conditions.
 - Range selector lever is in P or N
 - Low speed driving
 - During automatic transmission shifting
 - ATF temperature is high

2.6 Line pressure control



- The line pressure control optimizes the automatic transmission line pressure in accordance with the throttle opening signal and engine speed signal.

2.7 Braking force control



- If the accelerator pedal is released when the vehicle speed is higher than a certain level, a gear is selected in accordance with the road grade and cargo weight to realize optimal engine braking.

2.8 Failsafe control

- Failsafe control is designed to maintain the highest possible level of driveability in the event of an abnormality in either output speed sensor, in the engine speed signal, throttle opening signal, oil temperature sensor, or inhibitor switch, or in any solenoid or mechanical valve.

(1) Inhibitor switch

If, with the vehicle either stationary or moving, an inhibitor switch abnormality occurs such that no signals are applied to the automatic transmission electronic control unit, the automatic transmission electronic control unit selects and holds 3rd gear. If multiple signals are applied to the automatic transmission electronic control unit, the automatic transmission electronic control unit maintains driveability by effecting control in the following order of range precedence: P > N > range signals prior to duplicate signal input. The selected hydraulic circuit in the valve body is determined by the manual valve in accordance with the range selector lever position, so the actual vehicle condition is as shown below.

Actual range selector lever position	Inhibitor switch input signals	Vehicle operating condition
P	P and another select signal	P
R	R and another select signal (except P or N range signal)	R
N	N and another select signal	N
D	D and another select signal (except P or N range signal)	3rd gear
3	3 and another select signal (except P or N range signal)	3rd gear
2	2 and another select signal (except P or N range signal)	3rd gear

2.9 Fault diagnosis function

- While the starter switch is in the ON position, the sensors and other components are continuously monitored for faults. In the event that a component is found faulty, an indication is made in the meter cluster to alert the driver, the fault location is memorized in the form of a diagnosis code, and special control necessitated by the fault is initiated.
- While the special control is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

STRUCTURE AND OPERATION

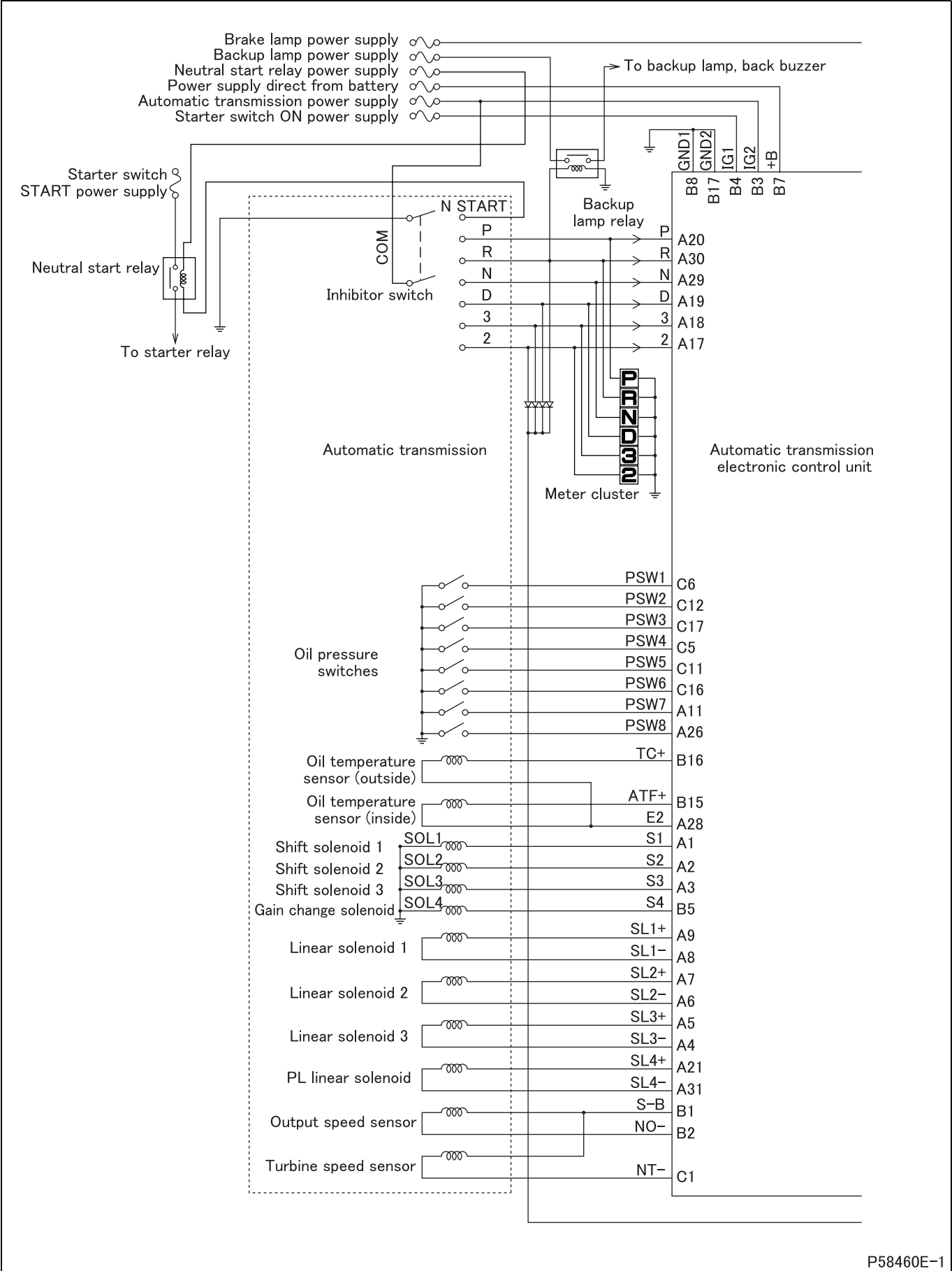
NOTE

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

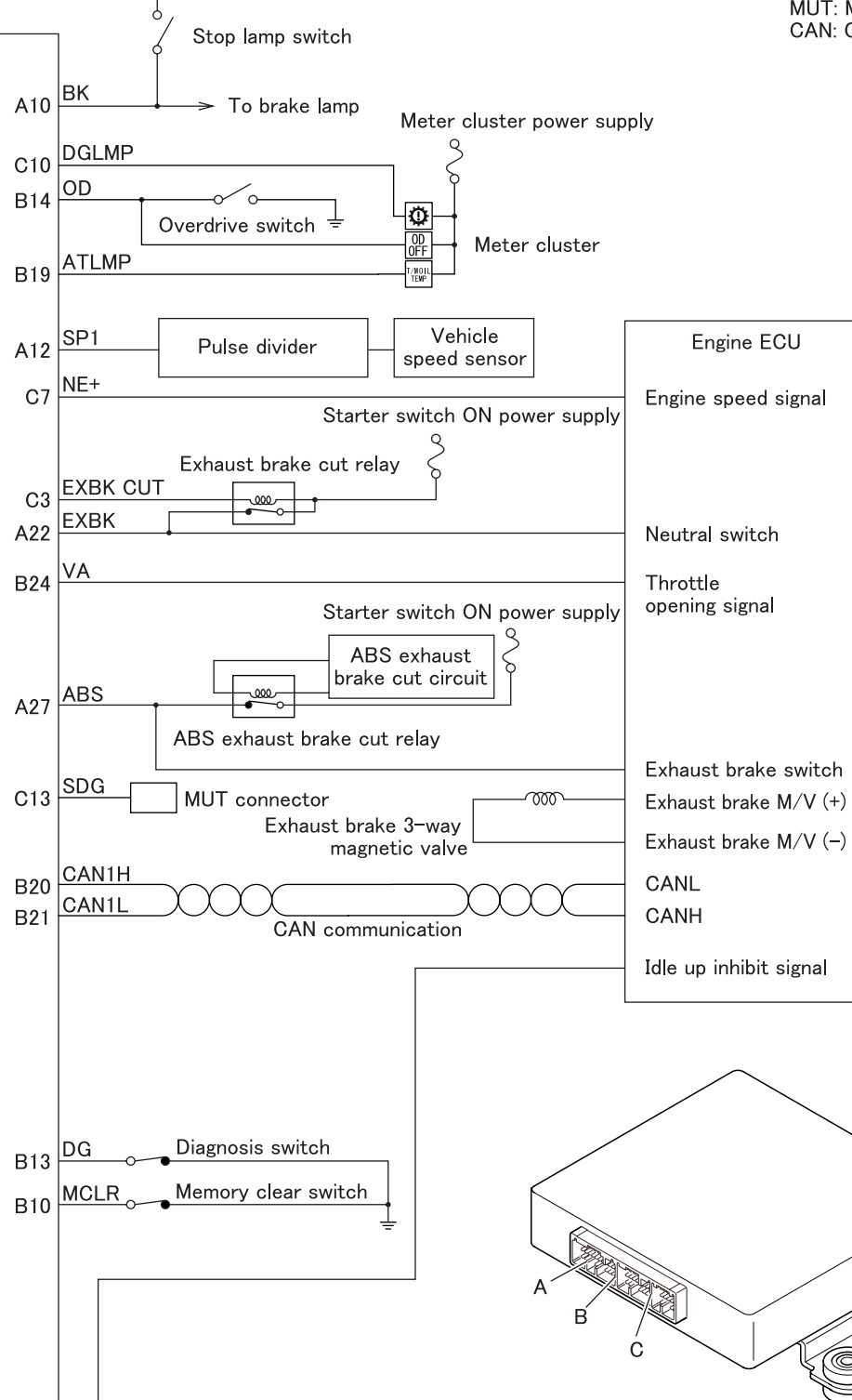
M E M O

STRUCTURE AND OPERATION

3. Electronic Control Unit Connection Diagram



ECU: Electronic control unit
 ABS: Anti-lock brake system
 MUT: Multi-Use Tester
 CAN: Controller area network

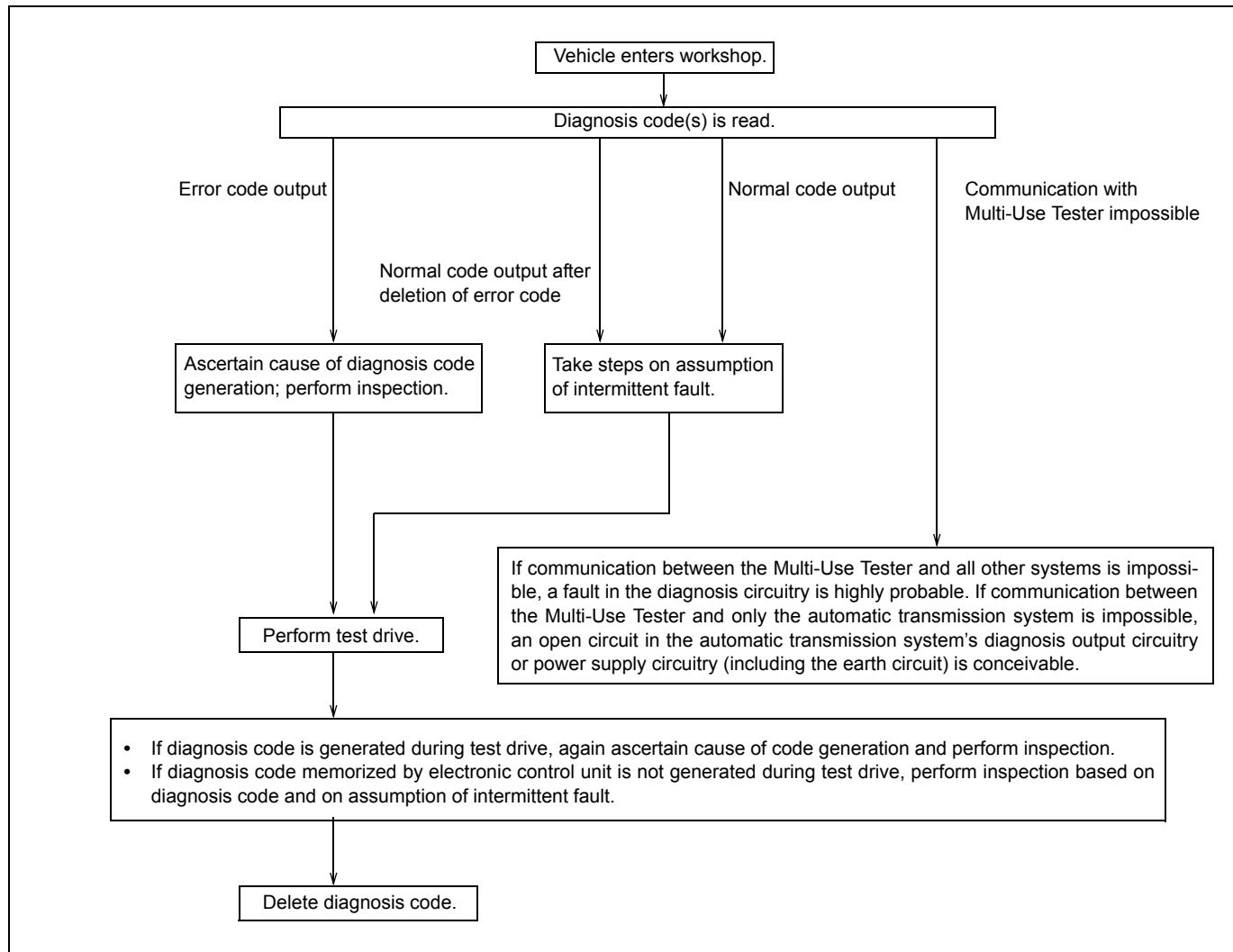


A										B										C										
9	8	7	6	5	4	3				2	1									6	5	4	3	2	1					
21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	12	11	10	9	8	7	6	5	4	3
31	30	29		28	27		26	25	24	23	22	24	23	22		21	20	19	18	17	17	16		15	14	13				

TROUBLESHOOTING

1. Inspection Procedure

- System inspection can be performed most effectively using a Multi-Use Tester-III. Types of system inspection are broadly classified in accordance with fault symptoms and diagnosis codes as follows:
 - Inspection based on diagnosis code memorized by electronic control unit
 - Inspection performed on assumption of intermittent fault



2. Cautions to Observe When Performing Inspections

CAUTION

- The battery voltage must be the standard voltage.
 - Make sure no harness connector or component connector is loose. Before undoing any connector, place the starter switch in the LOCK position and wait 20 seconds.
 - After making a repair, delete the diagnosis code using the Multi-Use Tester or memory clear switch.
 - As a general rule, inspection work should be performed with the starter switch in the LOCK position. However, it may be necessary to perform certain tasks with the starter switch in the ON position. At these times, be careful not to cause short circuits between connector terminals and between terminals and the vehicle body.
 - Indicated component resistances may not fall within the standard ranges if they are unduly affected by the temperature and/or by the accuracy of the tester. Inspection values in the text are given on the assumption of room temperature (10 to 35°C {50 to 95°F}).
 - After rectification of an abnormality, the system's ability or inability to automatically return to normal control from the special control that begins when a fault occurs depends upon the diagnosis code, i.e., the fault location. When the system resumes normal control, the warning lamp goes off.
 - Even when an abnormality has been rectified and the system has automatically returned to normal control, the diagnosis code corresponding to the fault location remains in the memory of the electronic control unit as a past diagnosis code.
 - Following a fault that does not permit an automatic return to normal control from the special control that begins when a fault occurs, it is necessary to clear the diagnosis code from memory in order for the system to recover.
-

TROUBLESHOOTING

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

NOTE

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Flashes	Code	Message	Flashes
–	Normal	01	P0778	Linear Solenoid Valve2	27
P0078	EXH Brake Cut Signal	54	P0796	Oil Pressure SW7	48
P0500	Vehicle Speed Sensor	12	P0863	Can Communication	88
P0562	Power Supply Voltage	11	P0973	Shift Solenoid1-Low	31
P0705	Shift Position SW	43	P0974	Shift Solenoid1-High	31
P0706	Oil Pressure SW8	49	P0976	Shift Solenoid2-Low	32
P0710	Oil Temperature Sensor "OP"	13	P0977	Shift Solenoid2-High	32
P0715	Input/Turbine Speed Sensor	16	P0979	Shift Solenoid3-Low	33
P0720	Output Speed Sensor	25	P0980	Shift Solenoid3-High	33
P0725	Engine Speed Sensor	15	P0985	Shift Solenoid4-Low	52
P0730	Incorrect Gear Ratio	37	P0986	Shift Solenoid4-High	52
P0746	Oil Pressure SW1	41	P1604	Accel Sensor	24
P0748	Linear Solenoid Valve1	26	P1911	PTO Solenoid-Low	51
P0751	Oil Pressure SW3	45	P2716	Linear Solenoid Valve4	34
P0756	Oil Pressure SW4	46	P2740	Oil Temperature Sensor "TC"	17
P0761	Oil Pressure SW5 or SW6	47	P2757	Lockup Clutch	61
P0776	Oil Pressure SW2	42	P2759	Linear Solenoid Valve3	35

3.2 Diagnosis code generation conditions and inspection items

P0078: EXH Brake Cut Signal (warning lamp flashes: 54)

Generation condition		Exhaust brake operation signal input occurs during exhaust brake cut signal output.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Braking force control is inhibited.
Inspection	Service data	54: Exh Brake Cut SIG
	Electrical equipment	#201: Exhaust brake cut relay
	Electric circuit diagram	Exhaust brake cut relay system

P0500: Vehicle Speed Sensor (warning lamp flashes: 12)

Generation condition		Pulse input from vehicle speed sensor is missing while output speed sensor is outputting pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Normal control is effected using output speed sensor.
Inspection	Service data	12: VEH Speed1
	Electronic control unit connector	01 : Vehicle speed sensor
	Electric circuit diagram	Vehicle speed sensor system (between vehicle speed sensor, pulse divider, and electronic control unit)
	Other	• Vehicle speed sensor (see Gr54)

P0562: Power Supply Voltage (warning lamp flashes: 11)

Generation condition		Engine speed does not become 0 rpm within 15s after starter switch has been placed in OFF position.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Shift solenoid 3 and linear solenoid 2 are turned OFF to maintain driveability. (Fixed to 3rd)
Inspection	Electronic control unit connector	02 : Power supply voltage of electronic control unit
	Electric circuit diagram	Starter switch ON power supply system
	Other	Starter switch (see Gr54)

P0705: Shift Position SW (warning lamp flashes: 43)

Generation condition		No signal exists; or duplicate signals exist from inhibitor switch.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		<No signal exists.> - If oil pressure switch 8 is ON, range signal that existed before signal disappeared is recognized and the gear is fixed to 3rd in forward driving. - If oil pressure switch 8 has been OFF for 2 seconds, N range is selected. <Duplicate signals exist.> - Solenoid pattern is fixed; range selector lever operation yields R, N, and 3rd gear.
Inspection	Service data	19: P Pos. SW, 20: R Pos. SW, 21: N Pos. SW, 22: D Pos. SW, 23: 4 Pos. SW, 24: 3 Pos. SW, 55: Selector Pos., 78: 2 Pos. SW, 79: L Pos. SW
	Electronic control unit connector	03 : Inhibitor switch
	Electrical equipment	#159: Inhibitor switch
	Electric circuit diagram	Inhibitor switch system

P0706: Oil Pressure SW8 (warning lamp flashes: 49)

Generation condition		Input from oil pressure switch 8 (feedback) is inconsistent with inhibitor switch output signal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Refer to inhibitor switch failsafe control.
Inspection	Service data	68: Oil Press SW8
	Electronic control unit connector	04 : Oil pressure switch 8
	Electrical equipment	#140: Oil pressure switch 8
	Electric circuit diagram	Oil pressure switch 8 system

P0710: Oil Temperature Sensor "OP" (warning lamp flashes: 13)

Generation condition		Resistance of oil temperature sensor (inside) is out of specified range.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected on basis of low oil temperature for 5 minutes after starter switch has been placed in ON position. - Braking force control is inhibited
Inspection	Service data	13: Automatic transmission Oil Temp (OP)
	Electronic control unit connector	05 : Oil temperature sensor (inside)
	Electrical equipment	#312: Oil temperature sensor (inside)
	Electric circuit diagram	Oil temperature sensor (inside) system

TROUBLESHOOTING

P0715: Input/Turbine Speed Sensor (warning lamp flashes: 16)

Generation condition		Turbine speed sensor pulse input is missing during vehicle operation.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Shift control and garage control are effected on open-loop basis. - Lockup control and braking force control is inhibited.
Inspection	Service data	16: Turbine Speed
	Electronic control unit connector	06 : Turbine speed sensor
	Electrical equipment	#293: Turbine speed sensor
	Electric circuit diagram	Turbine speed sensor system

P0720: Output Speed Sensor (warning lamp flashes: 25)

Generation condition		Output speed sensor pulse input is missing during vehicle speed sensor pulse output.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using vehicle speed sensor. - Shift control and garage control are effected on open-loop basis. - Braking force control is inhibited.
Inspection	Service data	25: VEH Speed 2
	Electronic control unit connector	07 : Output speed sensor
	Electrical equipment	#265: Output speed sensor
	Electric circuit diagram	Output speed sensor system

P0725: Engine Speed Sensor (warning lamp flashes: 15)

Generation condition		Pulse input from engine speed sensor is missing.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is performed based on the specified engine speed. (Specified engine speed varies by the types of the control.) - Lockup control and braking force control is inhibited.
Inspection	Service data	15: Engine Speed
	Electric circuit diagram	Engine electronic control unit (engine speed signal) system
	Other	Engine speed sensor (see Gr13E)

P0730: Incorrect Gear Ratio (warning lamp flashes: 37)

Generation condition		Relationship between engine speed and vehicle speed in each gear is incorrect.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- PL linear solenoid is turned OFF. (Line pressure becomes maximum.) - Gear ratio is fixed.
Inspection	Service data	12: VEH Speed1, 15: Engine Speed, 25: VEH Speed2, 56: Gear Pos.
	Other	Automatic transmission assembly (Have work performed by Aisin service station.)

P0746: Oil Pressure SW1 (warning lamp flashes: 41)

Generation condition		Input from oil pressure switch 1 (feedback) is inconsistent with linear solenoid 1 output signal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Lockup is turned OFF. • Gear ratio is fixed.
Inspection	Service data	61: Oil Press SW1
	Electronic control unit connector	04 : Oil pressure switch 1
	Electrical equipment	#140: Oil pressure switch 1
	Electric circuit diagram	Oil pressure switch 1 system

P0748: Linear Solenoid Valve1 (warning lamp flashes: 26)

Generation condition		Open circuit or short circuit is detected; or fault caused by hydraulic switch is detected of linear solenoid 1.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Faulty solenoid is turned OFF. • Lockup is turned OFF. • Gear ratio is fixed.
Inspection	Service data	26: Linear Sol Press1
	Electronic control unit connector	08 : Linear solenoid 1
	Electrical equipment	#585: Linear solenoid 1
	Electric circuit diagram	Linear solenoid 1 system

P0751: Oil Pressure SW3 (warning lamp flashes: 45)

Generation condition		Input from oil pressure switch 3 (feedback) is inconsistent with shift solenoid 1 output signal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Faulty solenoid is turned OFF. • Lockup is turned OFF. • Gear ratio is fixed.
Inspection	Service data	63: Oil Press SW3
	Electronic control unit connector	04 : Oil pressure switch 3
	Electrical equipment	#140: Oil pressure switch 3
	Electric circuit diagram	Oil pressure switch 3 system

P0756: Oil Pressure SW4 (warning lamp flashes: 46)

Generation condition		Input from oil pressure switch 4 (feedback) is inconsistent with shift solenoid 2 output signal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Faulty solenoid is turned OFF. • Lockup is turned OFF. • Gear ratio is fixed.
Inspection	Service data	64: Oil Press SW4
	Electronic control unit connector	04 : Oil pressure switch 4
	Electrical equipment	#140: Oil pressure switch 4
	Electric circuit diagram	Oil pressure switch 4 system

TROUBLESHOOTING

P0761: Oil Pressure SW5 or SW6 (warning lamp flashes: 47)

Generation condition		Input from oil pressure switch 5 or 6 (feedback) is inconsistent with shift solenoid 3 output signal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lock up is turned OFF. - Gear ratio is fixed.
Inspection	Service data	65: Oil Press SW5, 66: Oil Press SW6
	Electronic control unit connector	04 : Oil pressure switches 5 and 6
	Electrical equipment	#140: Oil pressure switches 5 and 6
	Electric circuit diagram	Oil pressure switches 5 and 6 system

P0776: Oil Pressure SW2 (warning lamp flashes: 42)

Generation condition		Input from oil pressure switch 2 (feedback) is inconsistent with linear solenoid 2 output signal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	62: Oil Press SW2
	Electronic control unit connector	04 : Oil pressure switch 2
	Electrical equipment	#140: Oil pressure switch 2
	Electric circuit diagram	Oil pressure switch 2 system

P0778: Linear Solenoid Valve2 (warning lamp flashes: 27)

Generation condition		Open circuit or short circuit is detected; or fault caused by hydraulic switch is detected of linear solenoid 2.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	27: Linear Sol Press 2
	Electronic control unit connector	08 : Linear solenoid 2
	Electrical equipment	#585: Linear solenoid 2
	Electric circuit diagram	Linear solenoid 2 system

P0796: Oil Pressure SW7 (warning lamp flashes: 48)

Generation condition		Input from oil pressure switch 7 (feedback) is inconsistent with linear solenoid 3 output signal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Faulty solenoid is turned OFF.
Inspection	Service data	67: Oil Press SW7
	Electronic control unit connector	04 : Oil pressure switch 7
	Electrical equipment	#140: Oil pressure switch 7
	Electric circuit diagram	Oil pressure switch 7 system

P0863: CAN Communication (warning lamp flashes: 88)

Generation condition		Data check abnormality
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Inspection	Electric circuit diagram	CAN communication system

P0973: Shift Solenoid1-Low (warning lamp flashes: 31)

Generation condition		Short circuit is detected; or fault caused by hydraulic switch is detected of shift solenoid 1.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	31: Shift Valve 1, 71: Shift Valve Press 1
	Electronic control unit connector	08 : Shift solenoid 1
	Electrical equipment	#585: Shift solenoid 1
	Electric circuit diagram	Shift solenoid 1 system

P0974: Shift Solenoid1-High (warning lamp flashes: 31)

Generation condition		Open circuit is detected; or fault caused by hydraulic switch is detected of shift solenoid 1.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	31: Shift Valve 1, 71: Shift Valve Press 1
	Electronic control unit connector	08 : Shift solenoid 1
	Electrical equipment	#585: Shift solenoid 1
	Electric circuit diagram	Shift solenoid 1 system

P0976: Shift Solenoid2-Low (warning lamp flashes: 32)

Generation condition		Short circuit is detected; or fault caused by hydraulic switch is detected of shift solenoid 2.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	32: Shift Valve 2, 72: Shift Valve Press 2
	Electronic control unit connector	08 : Shift solenoid 2
	Electrical equipment	#585: Shift solenoid 2
	Electric circuit diagram	Shift solenoid 2 system

TROUBLESHOOTING

P0977: Shift Solenoid2-High (warning lamp flashes: 32)

Generation condition		Open circuit is detected; or fault caused by hydraulic switch is detected of shift solenoid 2.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	32: Shift Valve 2, 72: Shift Valve Press 2
	Electronic control unit connector	08 : Shift solenoid 2
	Electrical equipment	#585: Shift solenoid 2
	Electric circuit diagram	Shift solenoid 2 system

P0979: Shift Solenoid3-Low (warning lamp flashes: 33)

Generation condition		Short circuit is detected; or fault caused by hydraulic switch is detected of shift solenoid 3.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	33: Shift Valve 3, 73: Shift Valve Press 3
	Electronic control unit connector	08 : Shift solenoid 3
	Electrical equipment	#585: Shift solenoid 3
	Electric circuit diagram	Shift solenoid 3 system

P0980: Shift Solenoid3-High (warning lamp flashes: 33)

Generation condition		Open circuit is detected; or fault caused by hydraulic switch is detected of shift solenoid 3.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Lockup is turned OFF. - Gear ratio is fixed.
Inspection	Service data	33: Shift Valve 3, 73: Shift Valve Press 3
	Electronic control unit connector	08 : Shift solenoid 3
	Electrical equipment	#585: Shift solenoid 3
	Electric circuit diagram	Shift solenoid 3 system

P0985: Shift Solenoid4-Low (warning lamp flashes: 52)

Generation condition		Short circuit is detected; or fault caused by hydraulic switch is detected of gain change solenoid.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Request is made to engine electronic control unit to omit output.
Inspection	Service data	52: Shift Valve 4, 74: Shift Valve Press 4
	Electronic control unit connector	08 : Gain change solenoid
	Electrical equipment	#585: Gain change solenoid
	Electric circuit diagram	Gain change solenoid system

P0986: Shift Solenoid4-High (warning lamp flashes: 52)

Generation condition		Open circuit is detected; or fault caused by hydraulic switch is detected of gain change solenoid.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Request is made to engine electronic control unit to omit output.
Inspection	Service data	52: Shift Valve 4, 74: Shift Valve Press 4
	Electronic control unit connector	08 : Gain change solenoid
	Electrical equipment	#585: Gain change solenoid
	Electric circuit diagram	Gain change solenoid system

P1604: Accel Sensor (warning lamp flashes: 24)

Generation condition		Abnormal throttle opening signal
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Oil pressure is controlled on basis of throttle opening of 100%. - Shift point is controlled on basis of throttle opening of 0%. - Braking force control is inhibited.
Inspection	Service data	58: Accel Percent
	Electric circuit diagram	Engine electronic control unit (throttle opening signal system)
	Other	Accelerator pedal position sensor (see Gr13E)

P1911: PTO Solenoid-Low (warning lamp flashes: 51)

Generation condition		PTO M/V short circuit is detected.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• PTO M/V is turned OFF (PTO inoperative)
Inspection	Service data	50: PTO Valve
	Electric circuit diagram	PTO M/V system
	Other	PTO M/V (see Gr54)

P2716: Linear Solenoid Valve4 (warning lamp flashes: 34)

Generation condition		Open circuit or short circuit is detected; or fault caused by hydraulic switch is detected of PL linear solenoid.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Faulty solenoid is turned OFF. (Line pressure rises to max.)
Inspection	Service data	34: Linear Sol Press4
	Electronic control unit connector	08 : PL linear solenoid
	Electrical equipment	#585: PL linear solenoid
	Electric circuit diagram	PL linear solenoid system

P2740: Oil Pressure Sensor "TC" (warning lamp flashes: 17)

Generation condition		Resistance of oil pressure sensor (outside) is out of specified range.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected on basis of oil temperature of 80°C. - Braking force control is inhibited.
Inspection	Service data	17: Automatic transmission Oil Temp (TC)
	Electronic control unit connector	05 : Oil temperature sensor (outside)
	Electrical equipment	#312: Oil temperature sensor (outside)
	Electric circuit diagram	Oil temperature sensor (outside) system

TROUBLESHOOTING

P2757: Lockup Clutch (warning lamp flashes: 61)

Generation condition		During lockup, engine speed and turbine speed do not match.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Lockup is turned OFF.
Inspection	Service data	12: VEH Speed1, 15: Engine Speed, 25: VEH Speed2
	Other	Automatic transmission assembly (Have work performed by Aisin service station.)

P2759: Linear Solenoid Valve3 (warning lamp flashes: 35)

Generation condition		Open circuit or short circuit is detected; or fault caused by hydraulic switch is detected of linear solenoid 3.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Faulty solenoid is turned OFF. - Gear ratio is fixed.
Inspection	Service data	35: Linear Sol Press3
	Electronic control unit connector	08 : Linear solenoid 3
	Electrical equipment	#585: Linear solenoid 3
	Electric circuit diagram	Linear solenoid 3 system

4. Multi-Use Tester Service Data

NOTE

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
12	VEH Speed 1	■■■■. ■MPH	Vehicle being driven	Value corresponds to speedometer indication.
13	A/T Oil Temp (OP)	■■■■° F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
15	Engine Speed	■■■■rpm	Racing (engine running)	Value corresponds to tachometer indication.
16	Turbine Speed	■■■■rpm	Vehicle stationary with shift lever in D position	0 rpm
			Vehicle driven from abovementioned condition	Value increases.
17	A/T Oil Temp (TC)	■■■■° F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
19	P Pos. SW	ON/OFF	Shift lever in P position	ON
			Shift lever in position except P	OFF
20	R Pos. SW	ON/OFF	Shift lever in R position	ON
			Shift lever in position except R	OFF
21	N Pos. SW	ON/OFF	Shift lever in N position	ON
			Shift lever in position except N	OFF
22	D Pos. SW	ON/OFF	Shift lever in D position	ON
			Shift lever in position except D	OFF
23	4th Pos. SW	ON/OFF	All times	OFF
24	3rd Pos. SW	ON/OFF	Shift lever in 3 position	ON
			Shift lever in position except 3	OFF
25	VEH Speed 2	■■■■. ■MPH	Vehicle being driven	Value corresponds to speedometer indication.
26	Linear Sol Press 1	■■■■. ■lbf/in2	Gearshift in progress	Value changes.
27	Linear Sol Press 2	■■■■. ■lbf/in2	Gearshift in progress	Value changes.
28	OD-OFF SW	ON/OFF	Overdrive switch ON	ON
			Overdrive switch OFF	OFF
31	Shift Valve 1	ON/OFF	In 3rd gear and in 4th gear	ON
			In any gear except above	OFF
32	Shift Valve 2	ON/OFF	In 4th gear, in 5th gear and in 6th gear	ON
			In any gear except above	OFF
33	Shift Valve 3	ON/OFF	In 1st gear	ON
			In any gear except above	OFF
34	Linear Sol Press 4	■■■■. ■lbf/in2	In R range and 1st gear	260 lbf/in2
			In any range/gear except above	100 lbf/in2
35	Linear Sol Press 3	■■■■. ■lbf/in2	Shift from N to D	Value changes
			Lockup in 6th gear	100 lbf/in2

TROUBLESHOOTING

No.	Item	Data	Inspection condition	Requirement
36	Oil Temp Lamp	ON/OFF	Oil temperature abnormal (excessively high)	ON
			Oil temperature normal	OFF
37	Brake SW	ON/OFF	Brake pedal depressed	ON
			Brake pedal not depressed	OFF
38	Exh. Brake SIG	ON/OFF	Decelerating (engine braking in progress)	ON
			Accelerating	OFF
47	ABS SW	ON/OFF	Anti-lock brake system operating	ON
			Anti-lock brake system not operating	OFF
48	M Clear SW	ON/OFF	Fuse removed	ON
			Fuse fitted	OFF
49	Diagnosis SW	ON/OFF	Fuse removed	ON
			Fuse fitted	OFF
50	PTO Valve	ON/OFF	PTO operating (accelerator pedal not depressed; shift lever in P or N position)	ON
			PTO not operating	OFF
52	Shift Valve 4	ON/OFF	In R range (large throttle opening)	ON
			In R range (small throttle opening)	OFF
53	DG Lamp	ON/OFF	Warning lamp illuminated	ON
			Warning lamp not illuminated	OFF
54	Exh Brake Cut SIG	ON/OFF	Decelerate and stop	OFF → ON
			Accelerating	OFF
55	Selector Pos.	P-Range/R-Range/ N-Range/D-Range/ 3-Range/2-Range	Shift lever in P position	P-Range
			Shift lever in R position	R-Range
			Shift lever in N position	N-Range
			Shift lever in D position	D-Range
			Shift lever in 3 position	3-Range
			Shift lever in 2 position	2-Range
56	Gear Pos.	1ST/2ND/3RD/ 4TH/5TH/6TH/N/R	In 1st gear	1ST
			In 2nd gear	2ND
			In 3rd gear	3RD
			In 4th gear	4TH
			In 5th gear	5TH
			In 6th gear	6TH
			In neutral (shift lever in P or N position)	N
			Reversing	R
58	Accel Percent	■■■■%	Accelerator pedal not depressed (throttle fully closed)	0%
			Accelerator pedal depressed (throttle wide open)	100%
61	Oil Press SW1	ON/OFF	In 1st gear, in 2nd gear, in 5th gear and in 6th gear	ON
			In 3rd gear and in 4th gear	OFF

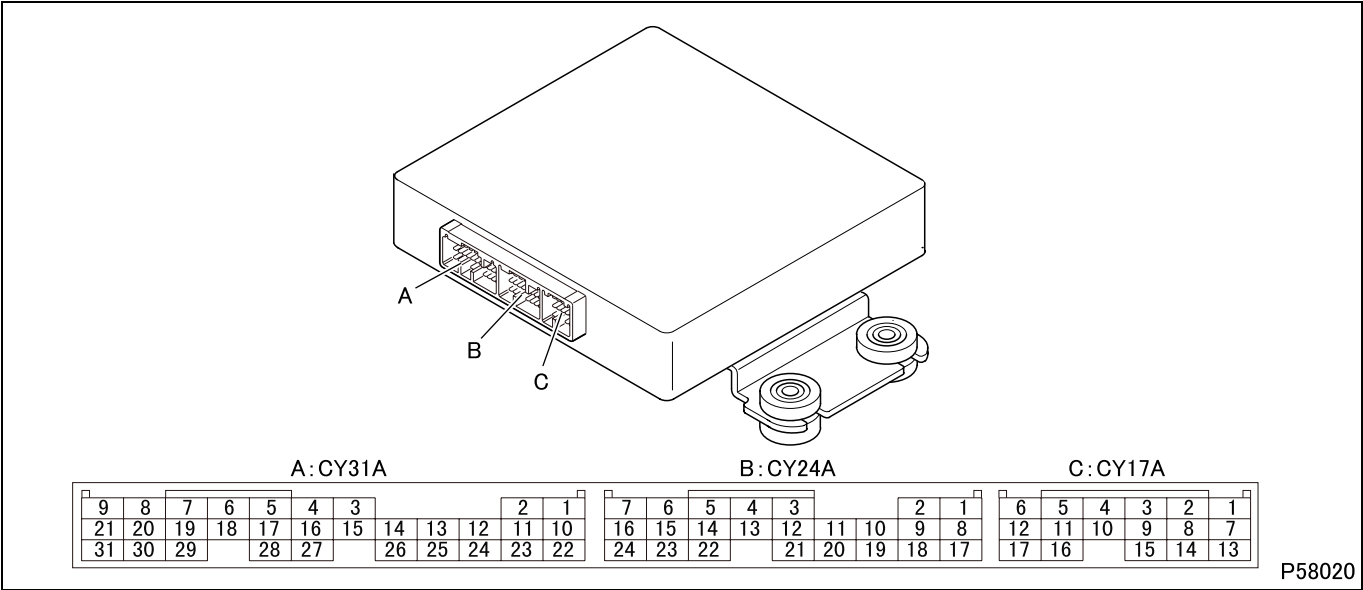
No.	Item	Data	Inspection condition	Requirement
62	Oil Press SW2	ON/OFF	In 1st gear, in 2nd gear and in 3rd gear	ON
			In 4th gear, in 5th gear and in 6th gear	OFF
63	Oil Press SW3	ON/OFF	In 2nd gear, in 3rd gear, in 4th gear, in 5th gear and in 6th gear	ON
			In 1st gear	OFF
64	Oil Press SW4	ON/OFF	In 1st gear, in 3rd gear and in 5th gear	ON
			In 2nd gear, in 4th gear and in 6th gear	OFF
65	Oil Press SW5	ON/OFF	In 1st gear, in 2nd gear, in 4th gear and in 6th gear	ON
			In 3rd gear and in 5th gear	OFF
66	Oil Press SW6	ON/OFF	In 1st gear	ON
			In 2nd gear, in 3rd gear, in 4th gear, 5th gear and in 6th gear	OFF
67	Oil Press SW7	ON/OFF	Shift from N to D	OFF → ON → OFF
68	Oil Press SW8	ON/OFF	In D range	ON
			In P, R, N range	OFF
71	Shift Valve Press 1	HIGH/LOW	In 3rd gear and in 4th gear	HIGH
			In any gear except above	LOW
72	Shift Valve Press 2	HIGH/LOW	In 4th gear, in 5th gear and 6th gear	HIGH
			In any gear except above	LOW
73	Shift Valve Press 3	HIGH/LOW	In 1 gear	HIGH
			In any gear except above	LOW
74	Shift Valve Press 4	HIGH/LOW	In R range (large throttle opening)	HIGH
			In R range (small throttle opening)	LOW
78	2 Pos. SW	ON/OFF	Shift lever in 2 position	ON
			Shift lever in position except 2	OFF
79	L Pos. SW	ON/OFF	All times	OFF

TROUBLESHOOTING

5. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.
The white-on-black numbers (**01**, **02**, etc.) correspond to the similarly printed reference number in section “3. Inspections based on diagnosis codes”.

5.1 Electronic control unit connector terminal layout



5.2 Inspection instructions

NOTE

- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following cautions:
- Do not touch any terminal except those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.

Check item	Measurement method
01 Voltage of vehicle speed sensor	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) - Slowly rotate the wheels using a chassis dynamometer, etc. [Requirements] Terminals (+)-(-): A12-B8 - Hi: Approx. 8V - Lo: 0.5V or lower
02 Power supply voltage of electronic control unit	[Conditions] - Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] <Power supply directly from the battery> Terminals (+)-(-): B7-B8: 12V <Starter switch ON power> Terminals (+)-(-): B4-B8, B3-B17 - Starter switch OFF: 0V - Starter switch ON: 12V

Check item	Measurement method
03 Voltage of inhibitor switch	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] <P range system> Terminals (+)-(-): A20-B8 • P range: 12V • Ranges except P: 0V <R range system> Terminals (+)-(-): A30-B8 • R range: 12V • Ranges except R: 0V <N range system> Terminals (+)-(-): A29-B8 • N range: 12V • Ranges except N: 0V <D range system> Terminals (+)-(-): A19-B8 • D range: 12V • Ranges except D: 0V <3 range system> Terminals (+)-(-): A18-B8 • 3 range: 12V • Ranges except 3: 0V <2 range system> Terminals (+)-(-): A17-B8 • 2 range: 12V • Ranges except 2: 0V
04 Continuity of oil pressure switch	[Conditions] • Starter switch OFF • Remove connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: • C6-chassis earth (oil pressure switch 1) • C12-chassis earth (oil pressure switch 2) • C17-chassis earth (oil pressure switch 3) • C5-chassis earth (oil pressure switch 4) • C11-chassis earth (oil pressure switch 5) • C16-chassis earth (oil pressure switch 6) • A11-chassis earth (oil pressure switch 7) • A26-chassis earth (oil pressure switch 8) • No continuity
05 Resistance of oil temperature sensors	<Oil temperature sensor (inside)> [Conditions] • Starter switch OFF • Remove connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: B15-A28 • 10°C {50° F}: 6445 Ω • 110°C {230° F}: 247 Ω <Oil temperature sensor (outside)> [Conditions] • Starter switch OFF • Remove connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: B16-A28 • 120°C {250° F}: 616 Ω • 145°C {295° F}: 357 Ω

TROUBLESHOOTING

Check item	Measurement method
06 Current of turbine speed sensor	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) • Slowly rotate the wheels using a chassis dynamometer, etc. [Requirements] Terminals: B1-C1 • Hi: 12 to 16 mA • Lo: 4 to 8 mA
07 Current of output speed sensor	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) • Slowly rotate the wheels using a chassis dynamometer, etc. [Requirements] Terminals: B1-B2 • Hi: 12 to 16 mA • Lo: 4 to 8 mA
08 Resistance of solenoids	[Conditions] • Starter switch OFF • Remove connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: - A1-chassis earth (shift solenoid 1): 13 Ω - A2-chassis earth (shift solenoid 2): 13 Ω - A3-chassis earth (shift solenoid 3): 13 Ω - B5-chassis earth (gain change solenoid): 13 Ω - A9-A8 (linear solenoid 1): 5.5 Ω - A7-A6 (linear solenoid 2): 5.5 Ω - A5-A4 (linear solenoid 3): 5.5 Ω - A21-A31 (PL linear solenoid): 5.5 Ω

23-39

TROUBLESHOOTING

Symptom	Shift abnormality													
	Downshifts from 6th gear to 5th gear do not take place.	Downshifts from 5th gear to 4th gear do not take place.	Downshifts from 4th gear to 3rd gear do not take place.	Downshifts from 3rd gear to 2nd gear do not take place.	Downshifts from 2nd gear to 1st gear do not take place.	Upshifts from 5th gear to 6th gear do not take place.	Upshifts from 4th gear to 5th gear do not take place.	Upshifts from 3rd gear to 4th gear do not take place.	Upshifts from 2nd gear to 3rd gear do not take place.	Upshifts from 1st gear to 2nd gear do not take place.	Engine revs during shifts from 2nd gear to 3rd gear.	Engine revs during shifts from 3rd gear to 4th gear.	Engine revs during shifts from 4th gear to 5th gear.	Engine revs during shifts from 5th gear to 6th gear.
Likely cause														
Abnormality in inhibitor switch								O	O					
Abnormality in throttle opening signal											O	O	O	O
Abnormality in vehicle speed sensor	O	O	O	O	O	O	O	O	O	O				
Abnormality in engine speed sensor											O	O	O	O
Abnormality in linear solenoid 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in linear solenoid 2	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in shift solenoid 1	O	O	O	O	O	O	O	O	O	O				
Abnormality in shift solenoid 2	O	O	O	O	O	O	O	O	O	O				
Abnormality in shift solenoid 3	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in oil pressure switch 2	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in oil pressure switch 3	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 4	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 5	O	O	O	O	O	O	O	O	O	O				
Abnormality in oil pressure switch 6	O	O	O	O	O	O	O	O	O	O				
Abnormality in overdrive OFF switch						O	O							
Abnormality in automatic transmission electronic control unit	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in automatic transmission-proper	O	O	O	O	O	O	O	O	O	O	O	O	O	O

Symptom	Excessive shift shock													
	During lockup	During shifts from 6th gear to 5th gear	During shifts from 5th gear to 4th gear	During shifts from 4th gear to 3rd gear	During shifts from 3rd gear to 2nd gear	During shifts from 2nd gear to 1st gear	During shifts from 5th gear to 6th gear	During shifts from 4th gear to 5th gear	During shifts from 3rd gear to 4th gear	During shifts from 2nd gear to 3rd gear	During shifts from 1st gear to 2nd gear	During shifts from N range to R range and from N range to D range	During shifts from N range to R range	During shifts from N range to D range
Likely cause														
Abnormality in throttle opening signal	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in turbine speed sensor	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in engine speed sensor	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in linear solenoid 1		O	O	O	O	O	O	O	O	O	O			
Abnormality in linear solenoid 2		O	O	O	O		O	O	O					
Abnormality in linear solenoid 3	O											O	O	O
Abnormality in oil pressure switch 1											O			
Abnormality in automatic transmission electronic control unit	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Abnormality in torque converter	O													
Abnormality in automatic transmission-proper	O	O	O	O	O	O	O	O	O	O	O	O	O	O

TROUBLESHOOTING

Symptom	Clutch slippage, judder							Other				
	In 6th gear	In 5th gear	In 4th gear	In 3rd gear	In 2nd gear	In 1st gear	In R range	During forward movement and during reverse movement	Transmission overheats; oil emerges from breather.	Engine stalls when R, D, or 3, 2 range is selected or when vehicle is stationary.	Engine can be started in range except N and P.	Engine cannot be started in N and P ranges.
Likely cause												
Abnormality in ATF level and condition									O			
Abnormality in control linkage											O	O
Abnormality in inhibitor switch											O	O
Abnormality in throttle opening signal	O	O	O	O	O	O	O	O				
Abnormality in turbine speed sensor	O	O	O	O	O	O	O	O				
Abnormality in linear solenoid 1	O	O	O	O	O							
Abnormality in linear solenoid 2	O	O	O	O	O		O	O				
Abnormality in linear solenoid 3						O	O	O		O		
Abnormality in PL linear solenoid	O	O	O	O	O	O	O	O	O			
Abnormality in shift solenoid 3										O		
Abnormality in gain change solenoid	O	O	O	O	O	O	O	O				
Abnormality in automatic transmission electronic control unit	O	O	O	O	O	O	O	O	O			
Abnormality in torque converter									O	O		
Abnormality in automatic transmission-proper	O	O	O	O	O	O	O	O	O	O		

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Stall Test

1.1 Purpose of stall test

- A stall test is performed to check for slipping of the frictional elements in the transmission and of the one-way clutch in the torque converter. It gives an indication of the torque converter's operating condition and of the engine's overall performance.

1.2 Test procedure

- Before performing a stall test, inspect the engine coolant, engine oil, and automatic transmission fluid levels. Then, allow the engine and transmission to warm up.
- To prevent the vehicle from moving, apply the parking brake and place chocks before and after the front and rear wheels. Also, hold down the brake pedal firmly when depressing the accelerator pedal during the test.
- Start the engine and move the range selector lever to the D position.
- Gradually depress the accelerator pedal until it reaches the end of its stroke. When the engine speed stabilizes, promptly read the engine speed (this is the stall speed) and release the accelerator pedal.

CAUTION

- **The period during which the accelerator pedal is fully depressed must be shorter than 5 seconds. Complete the measurement within this period.**
- **If the engine speed does not stabilize (if the engine speed continues to gradually increase or the engine suddenly revs), immediately stop the test.**

- Move the range selector lever to the N position, then allow the engine to cool down by running it at 1,200 rpm for one minutes or longer.
- Perform the test procedure similarly for the R range.

Stall speed

Standard value (rpm)	2000 ± 150 rpm
----------------------	----------------

1.3 Evaluation of test results

Test result	Main causes
Stall speed is lower than standard value in each range.	Engine output is insufficient.
	One-way clutch in torque converter is malfunctioning.
Stall speed is higher than standard value in D range.	Clutch No. 1 is slipping.
	One-way clutch is malfunctioning.
	Line pressure is too low.
Stall speed is higher than standard value in R range.	Clutch No. 3 is slipping.
	Brake No. 2 is slipping.
	Line pressure is too low.

2. Time Lag Test

2.1 Purpose of time lag test

- A time lag test is performed to check the respective conditions of the one-way clutch, clutch No. 1, clutch No. 3, and brake No. 2.

2.2 Test procedure

- Raise the oil temperature to 50 to 80°C {120 to 175°F} (the range that corresponds to normal vehicle operation).
- Start the engine and check the idling speed.
- Move the range selector lever from the N position to the D position. Use a stopwatch to measure the time (time lag) that elapses until you feel shock.
- In a similar manner, measure the time lag for a shift from the N range to the R range.

	Standard value (rpm)
With shift from N to D	0.7 s or shorter
With shift from N to R	1.2 s or shorter

2.3 Evaluation of results

Test result	Conceivable cause
Time lag with shift from N to D is too long.	Line pressure is too low.
	Clutch No. 1 is slipping.
	One-way clutch is malfunctioning.
Time lag with shift from N to R is too long.	Line pressure is too low.
	Clutch No. 3 is slipping.
	Brake No. 2 is slipping.

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Line Pressure Test

Service standards

Mark	Maintenance item			Standard value	Limit	Remedy
—	Line pressure	At idling speed	D range	560 to 870 kPa {81 to 125 psi, 5.7 to 8.9 kgf/cm ² }	—	Inspect the suspected faulty sections.
			R range			
		At stalling speed	D range	1660 to 2010 kPa {240 to 290 psi, 17 to 20 kgf/cm ² }		
			R range			

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
-	Pressure sensing plug	27 {20, 2.8}	1/2-20 UNF

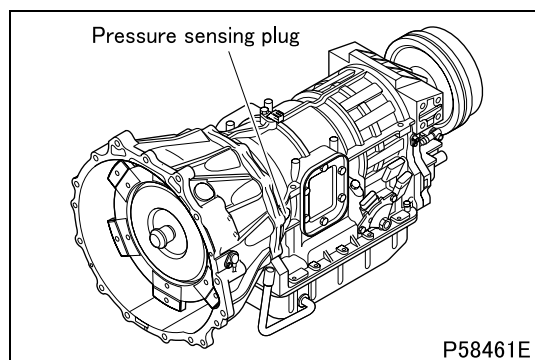
3.1 Purpose of line pressure test

- A line pressure test is performed to check the performance of the oil pump, to check the functionality of the control valve, and to check parts for oil leakage.

3.2 Test procedure

CAUTION ⚠

- The line pressure test should be performed by two people. One person moves away from the vehicle and checks the condition of the tires and wheel chocks. The other person performs the test.



- Fully apply the parking brake.
- Apply chocks to the wheels.
- Remove the pressure sensing plug and fit the oil pressure gauge.
- Start the engine. Allow it to warm up until the ATF reaches a temperature of 50 to 80°C {120 to 175°F}. Check the idling speed.
- Depress the brake pedal firmly with your left foot. While holding down the brake pedal, shift to the D range. Then, measure the oil pressure while the engine is idling.
- Fully depress the accelerator pedal. Quickly measure the oil pressure at the stall speed.

CAUTION ⚠

- If the engine speed does not reach the stall level and the rear wheels start to turn, ease off the accelerator pedal and stop the test.

- Take a measurement in a similar manner for the R range.
- If the measured value does not conform to the standard value, locate the possible cause by referring to the following table and inspect.

3.3 Locating possible causes

Test result	Conceivable cause
Measured value is higher than standard value in all ranges.	Regulator valve is sticking.
Measured value is lower than standard value in all ranges.	Regulator valve is sticking.
	Oil pump is worn.
Measured value is lower than standard value in D range only.	Oil leak exists in D range system.
	Clutch No. 1 is abnormal.
Measured value is lower than standard value in R range only.	Oil leak exists in R range system.
	Clutch No. 3 is abnormal.
	Brake No. 2 is abnormal.

- After taking the measurements, fit the pressure sensing plug and tighten it to the specified torque.

ON-VEHICLE INSPECTION AND ADJUSTMENT

4. Road Test

4.1 Test procedure

- Before performing a road test, check the fluid level and ATF condition and make sure the selector cable and accelerator control cable are correctly adjusted.
- During the road test, operate the automatic transmission in each range. Check the slip feel and other changes during shifts.
- Check whether the shift feel gets firmer and softer.
- Check the shift points where upshifts and downshifts occur.
- Check the vehicle speeds at which shifts occur under various driving conditions.

4.2 Vehicle speeds during shifts

Throttle opening	Shift	Vehicle speed
Half open	D1 → D2	8 to 10 km/h {4.97 to 6.21 mph}
	D2 → D3	23 to 25 km/h {14.3 to 15.5 mph}
	D3 → D4	36 to 38 km/h {22.4 to 23.6 mph}
	D4 → D5	47 to 49 km/h {29.2 to 30.4 mph}
	D5 → D6	59 to 61 km/h {36.7 to 37.9 mph}
Fully open	D1 → D2	15 to 17 km/h {9.32 to 10.6 mph}
	D2 → D3	34 to 36 km/h {21.1 to 22.4 mph}
	D3 → D4	53 to 55 km/h {32.9 to 34.2 mph}
	D4 → D5	73. to 75 km/h {45.4 to 46.6 mph}
	D5 → D6	95 to 96 km/h {59.0 to 59.7 mph}
Fully closed	D1 → D2	8 to 10 km/h {4.97 to 6.21 mph}
	D2 → D3	18 to 20 km/h {11.2 to 12.4 mph}
	D3 → D4	28 to 30 km/h {17.4 to 18.6 mph}
	D4 → D5	39 to 41 km/h {24.2 to 25.5 mph}
	D5 → D6	55 to 57 km/h {34.2 to 35.4 mph}

4.3 Vehicle speeds during lockup

Throttle opening	Shift	Vehicle speed
Half open	2nd gear ON	15 to 17 km/h {9.32 to 10.6 mph}
	3rd gear ON	23 to 25 km/h {14.3 to 15.5 mph}
	4th gear ON	33 to 35 km/h {20.5 to 21.7 mph}
	5th gear ON	40 to 42 km/h {24.9 to 26.1 mph}
	6th gear ON	49 to 51 km/h {30.4 to 31.7 mph}
Fully open	2nd gear ON	22 to 24 km/h {13.7 to 14.9 mph}
	3rd gear ON	34 to 36 km/h {21.1 to 22.4 mph}
	4th gear ON	46 to 48 km/h {28.6 to 29.8 mph}
	5th gear ON	60 to 62 km/h {37.3 to 38.5 mph}
	6th gear ON	73 to 75 km/h {45.4 to 46.6 mph}
Fully closed	2nd gear OFF	14 to 16 km/h {8.70 to 9.94 mph}
	3rd gear OFF	21 to 23 km/h {13.0 to 14.3 mph}
	4th gear OFF	28 to 30 km/h {17.4 to 18.6 mph}
	5th gear OFF	37 to 39 km/h {23.0 to 24.2 mph}
	6th gear OFF	45 to 47 km/h {28.0 to 29.2 mph}

- All data correspond to a differential ratio of 5.285 and to a tire radius of 0.372 m (215/75R17.5).
- If the differential ratio or tire radius is different, the speeds will be concomitantly slower or higher. Adjust the values in the table accordingly.

5. Inspection of ATF

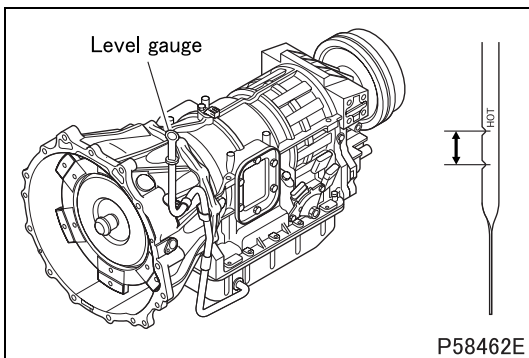
- If the ATF level is too low, the pump can draw in air together with the ATF, and the resulting air bubbles can make the ATF spongy, resulting in a pressure reduction that causes the clutches in the automatic transmission to slip.
- If the ATF level is too high owing to incorrect replenishment, rotating parts can agitate it, resulting in air bubbles that, as with an excessively low ATF level, make the ATF spongy, resulting in a pressure reduction that causes the clutches in the automatic transmission to slip.
- Whether the ATF level is too low or too high, air bubbles lead to overheating and to oxidation of and varnish formation by the oil, thereby impeding proper operation of the valves and clutches.
- Air bubbles can also cause foaming such that ATF emerges from the vent hole and filler tube of the automatic transmission. This phenomenon can be mistaken for ATF leakage.
- To prevent the above mentioned problems, you must check the ATF level accurately in accordance with the following instructions.

5.1 Inspection of ATF condition

- If the ATF smells burned and contains particles of metal and friction material, a complete overhaul of the automatic transmission is necessary. Carefully inspect the ATF that adheres to the level gauge. If you have any doubts about the condition of the ATF, take a sample and perform another check.

5.2 Inspection of ATF level

- Drive the vehicle until the ATF is adequately warm (70 to 80°C {160 to 175°F}).
- Stop the vehicle on a level surface, securely apply the parking brake, and apply chocks to the wheels.
- With the engine idling, slowly move the range selector lever from the P position to each position through L then back to the P position to ensure that the hydraulic circuit is filled with ATF.
- With the engine still idling, withdraw the level gauge, wipe the ATF off it, and re-insert it. Then, withdraw the level gauge again and check the ATF level.
- The ATF level is acceptable if the level on the level gauge is within the HOT range.



CAUTION

- **Be sure to inspect the ATF level with the vehicle parked on a level surface.**
- **Be sure to inspect the ATF level with the engine idling and with the N range selected. If the engine was not running during the inspection, the ATF level would look higher.**
- **Remove all dirt from the top of the filler tube before withdrawing the level gauge.**
- **Since the engine is running, you must pay attention to safety. Be careful not to get trapped or burned.**
- **Keep the engine idling until you have finished adjusting the ATF level. Do not increase the engine speed.**

- If the ATF level is too low, add Mobil ATF3309 through the filler tube until it reaches the specified part of the level gauge.

CAUTION

- **Never use ATF except Mobil ATF3309.**

ON-VEHICLE INSPECTION AND ADJUSTMENT

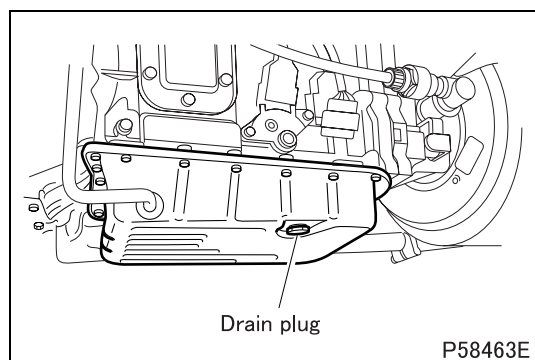
6. Replacement of ATF

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug	265 {195, 27}	–

Lubricant and/or sealant

Mark	Points of application		Specified lubricant and/or sealant	Quantity
–	ATF poured into automatic transmission	Replaced with oil pan removed	Mobil ATF3309	Approx. 8.4 L {8.9 qts}
		Replaced with drain plug removed	Mobil ATF3309	Approx. 6.4 L {6.8 qts}



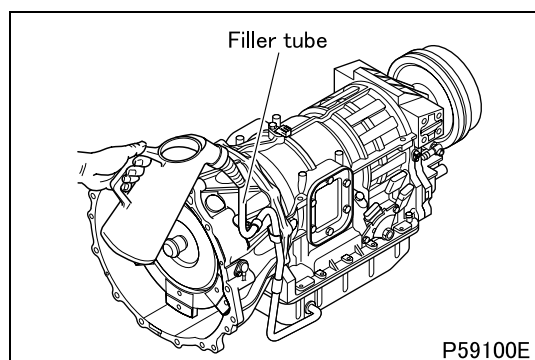
6.1 Draining

- Place a container under the transmission oil pan. Remove the drain plug near the front of the oil pan and allow the ATF to drain out.

CAUTION ⚠

- The ATF is extremely hot immediately after driving. To avoid the risk of being scalded, wait for the ATF to cool to a safe temperature before starting work.
- The ATF will drain out more quickly if you warm it by allowing the engine to warm up.
- It is not possible to drain out the ATF that is in the hydraulic circuit, torque converter, and oil cooler.
- Check whether the drained ATF is dirty and whether it contains metallic particles.

- At this point, approximately 2 L {2.1 qts} of ATF remains in the oil pan. If you wish to replace this ATF, remove the oil pan.



6.2 Filling

- Make ready the new ATF.
- Fit the oil pan drain plug and gasket in their original conditions.
- Supply new ATF through the filler tube in a quantity equivalent to that of the ATF that drained out.

CAUTION ⚠

- Never use the ATF except the specified one.
- Be careful not to allow dirt and other foreign matter to enter.

- Place the range selector lever in the P position. Start the engine and allow it to idle for at least 2 minutes.
- Place the range selector lever in each other position then return it to the P position.

CAUTION ⚠

- Keep the engine idling. Do not rev the engine.

- Check the ATF level.

6.3 Fluid leakage

- Check the torque converter housing for fluid leakage. If fluid leakage is found, locate the origin of the leakage.
- If leakage is found on the torque converter or the surrounding area, it is not necessarily ATF but can possibly be leaked engine oil.
- ATF is red in color and therefore is distinguishable from engine oil.
- If the fluid that is leaking is ATF, check carefully whether it is from the torque converter, or from the transmission (through the oil seal of the oil pump housing or from between the oil pump housing and transmission case).

ON-VEHICLE INSPECTION AND ADJUSTMENT

7. Dealer Adjust

- What is Dealer Adjust?

Individual automatic transmissions have different characteristics from each other. By carrying out Adjust Steps 1 to 4, electronic control unit will learn specific characteristics of the automatic transmission that it controls and thereby compensate for improved gear shift quality.

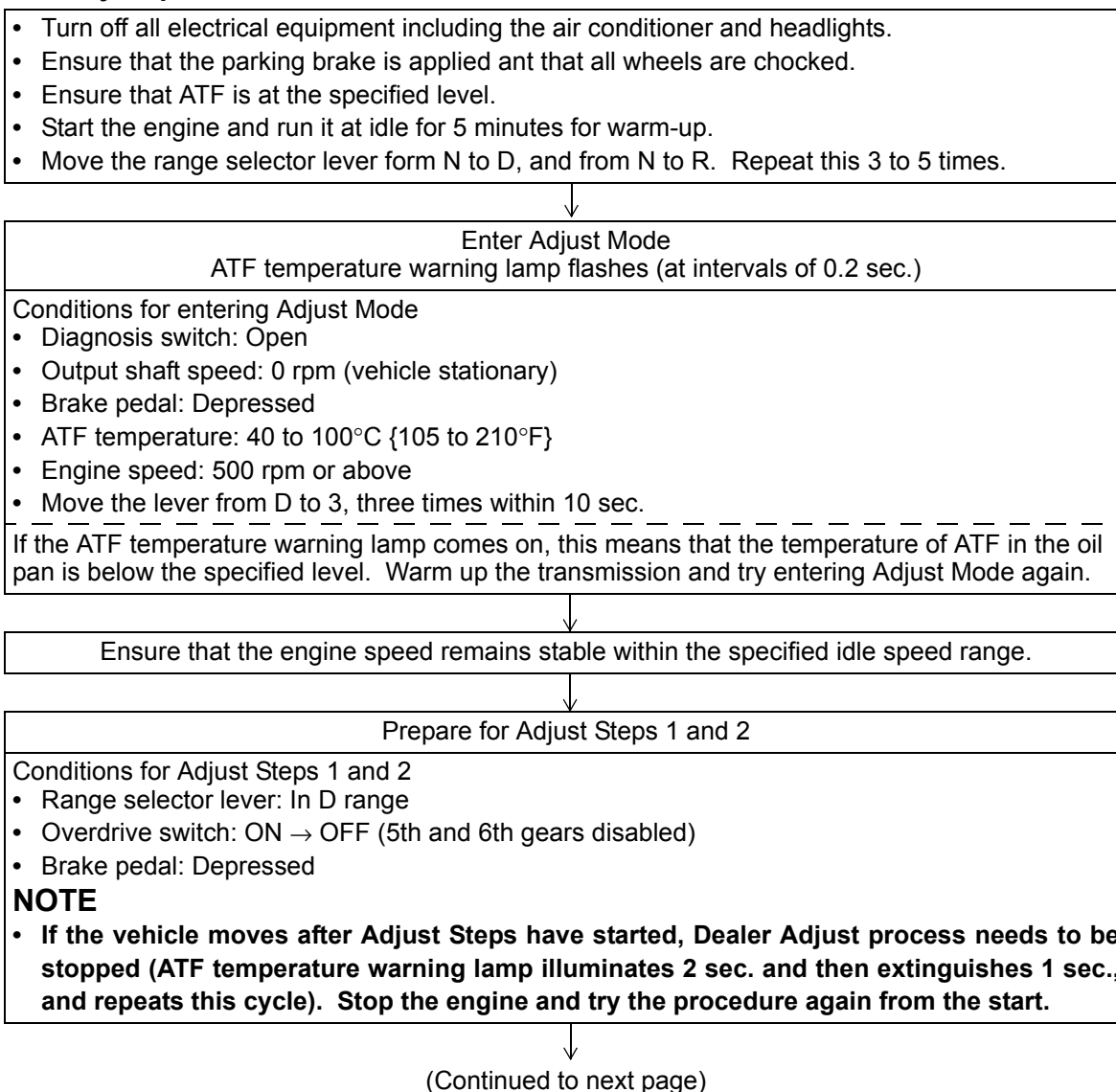
Dealer Adjust must be performed whenever:

- The automatic transmission has been replaced.
- The electronic control unit has been replaced.

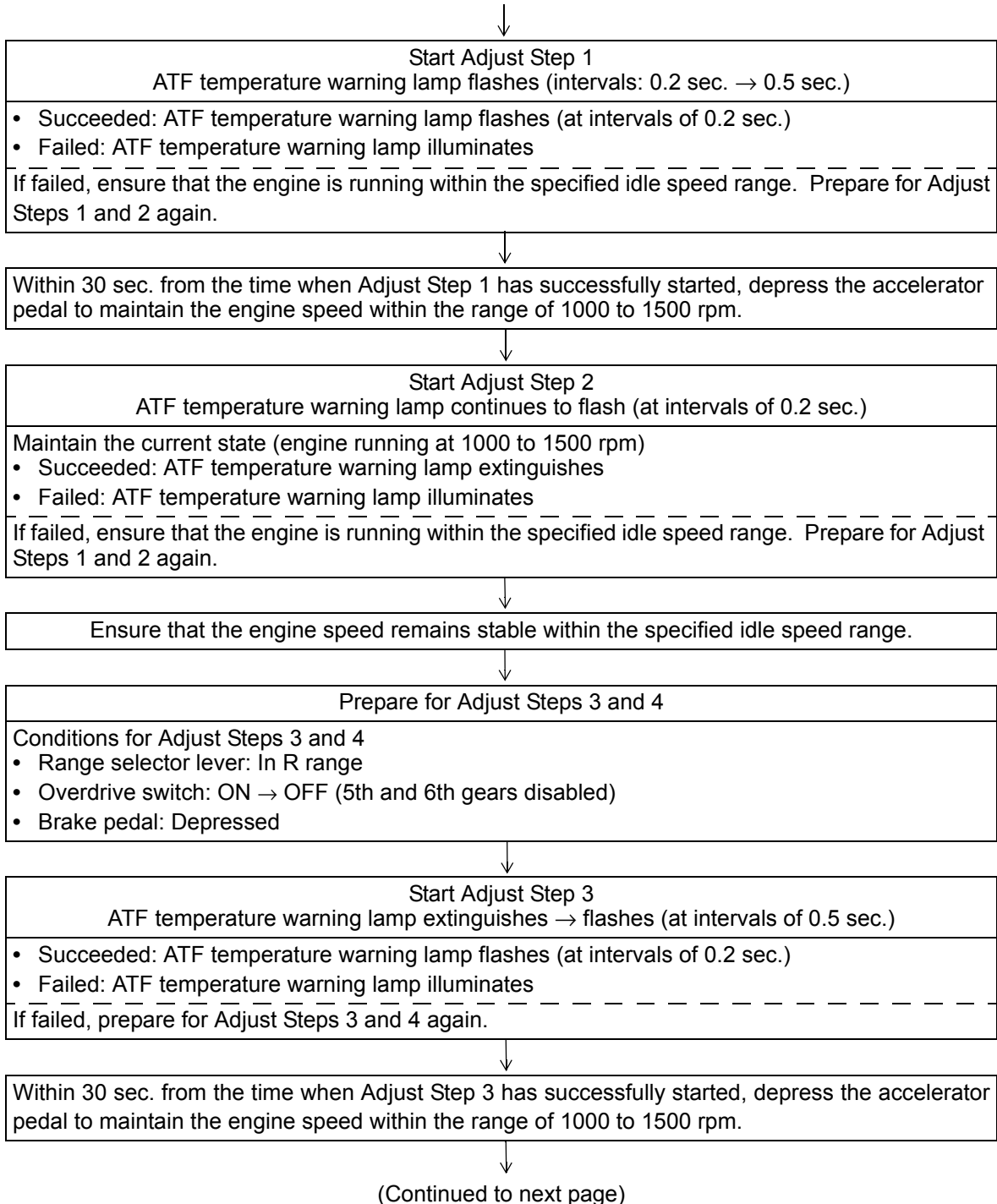
NOTE

- **If the dealer adjustment has not performed, ATF temperature warning lamp stays on.**
- **During Dealer Adjust process, the clutches will be activated, which may generate shock loads and/or clutch noise.**
- **To ensure safety, chock all of the front and rear wheels and firmly apply the parking brake.**
- **When the engine speed is set at 1000 to 1500 rpm during Dealer Adjust, firmly depress the brake pedal with your left foot.**

7.1 Dealer Adjust procedure

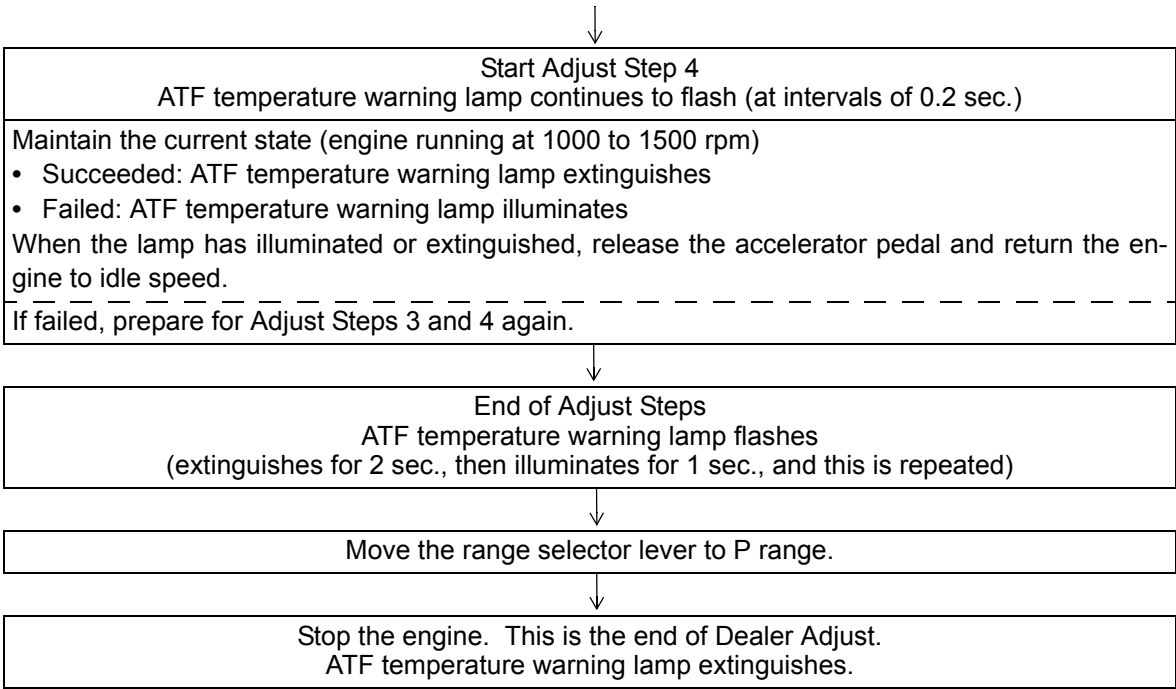


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ON-VEHICLE INSPECTION AND ADJUSTMENT

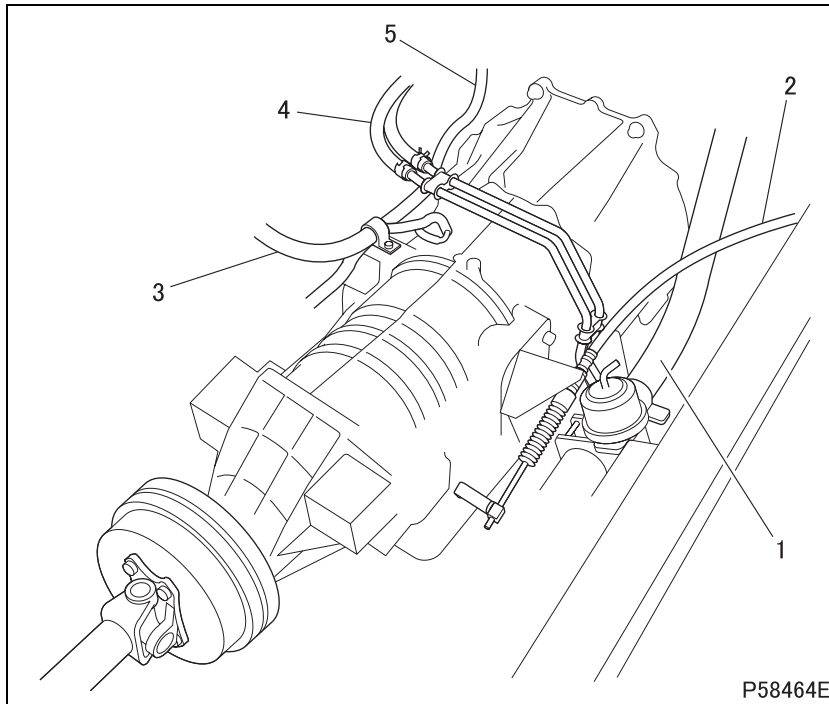
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M E M O

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION

Preparatory work



● Removal sequence

- 1 Exhaust pipe
- 2 Selector cable
- 3 Electrical harness
- 4 Oil cooler hose
- 5 Filler tube

● Installation sequence

Perform installation by following the removal sequence in reverse.

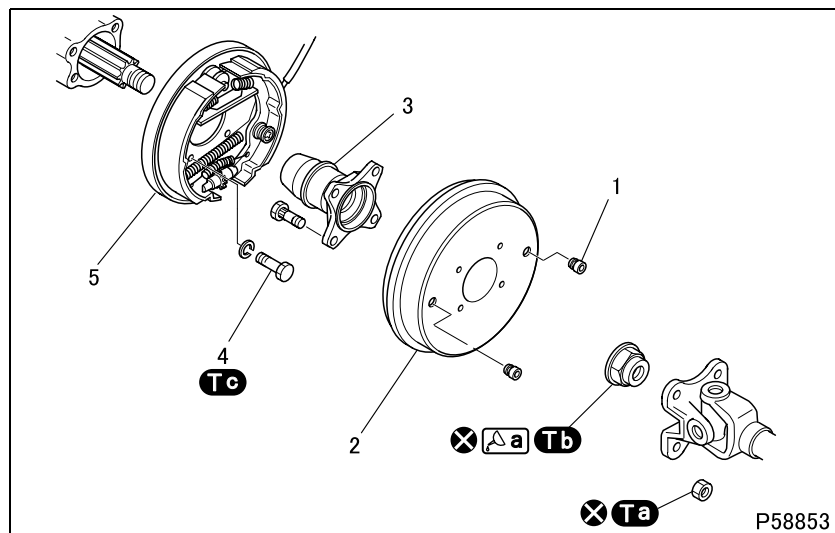
CAUTION

- If the ATF contains a large amount of impurities when you replace the automatic transmission because of an abnormality in the main body of the automatic transmission, flush the oil cooler circuit.

M E M O

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION

Parking brake



● Removal sequence

- 1 Dust plug
- 2 Parking brake drum
- 3 Companion flange
- 4 Reamer bolt
- 5 Parking brake (See Gr36.)

⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- After removing the propeller shaft, tie it to the frame with rope to keep it at its original height.
- To prevent poor working of the brake, do not smear the inner surface of the parking brake drum and the brake lining surface of parking brake with grease or oil.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
2	Parking brake drum	Inner diameter	$\phi 190^{+0.2}_0 \{7.48^{+0.0079}_0\}$	$\phi 191 \{7.52\}$	Replace
		Squareness	0.05 {0.0020} or less	—	
		Concentricity	0.1 {0.0039} or less	—	
		Cylindricity	0.05 {0.0020} or less	—	
		Static rotation imbalance	0.0049 N·m {0.004 ft.lbs, 0.5 gf·m} or less	—	
3	Runout at socket portion of companion flange		0.15 {0.0059} or less	0.5 {0.020}	

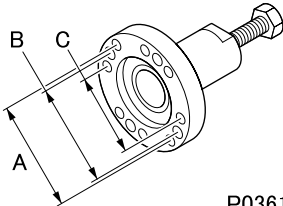
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Propeller shaft mounting)	100 to 120 {74 to 89, 10 to 12}	—
Tb	Lock nut (Companion flange mounting)	190 {140, 19}	—
Tc	Bolt (Backing plate and shoe mounting)	52 to 66.7 {38 to 49, 5.3 to 6.8}	—

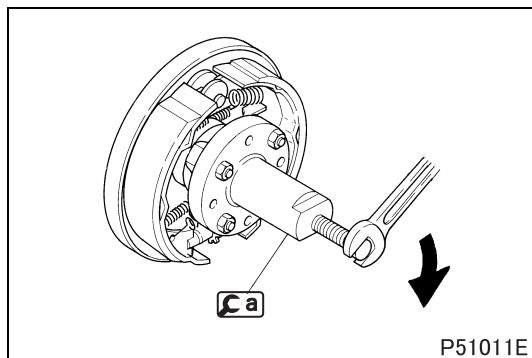
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
△a	Flange surface and thread of lock nut	Threebond 1215	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application						
	Flange puller <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ95 {3.74}</td><td>φ100 {3.94}</td><td>φ90 {3.54}</td></tr></table>  P03618	A	B	C	φ95 {3.74}	φ100 {3.94}	φ90 {3.54}	MH061848	Removal of parking brake drum and companion flange
A	B	C							
φ95 {3.74}	φ100 {3.94}	φ90 {3.54}							

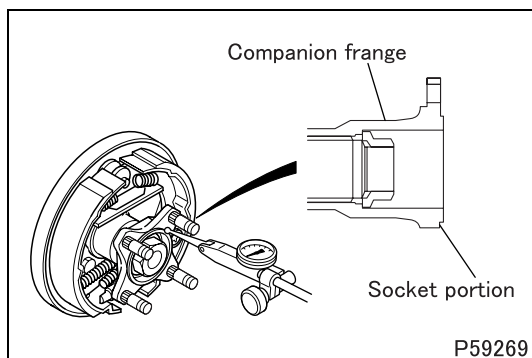
◆ Removal procedure ◆



■ Removal: Parking brake drum, companion flange

- Attach the special tool  to the companion flange with nuts. Using , remove the companion flange.

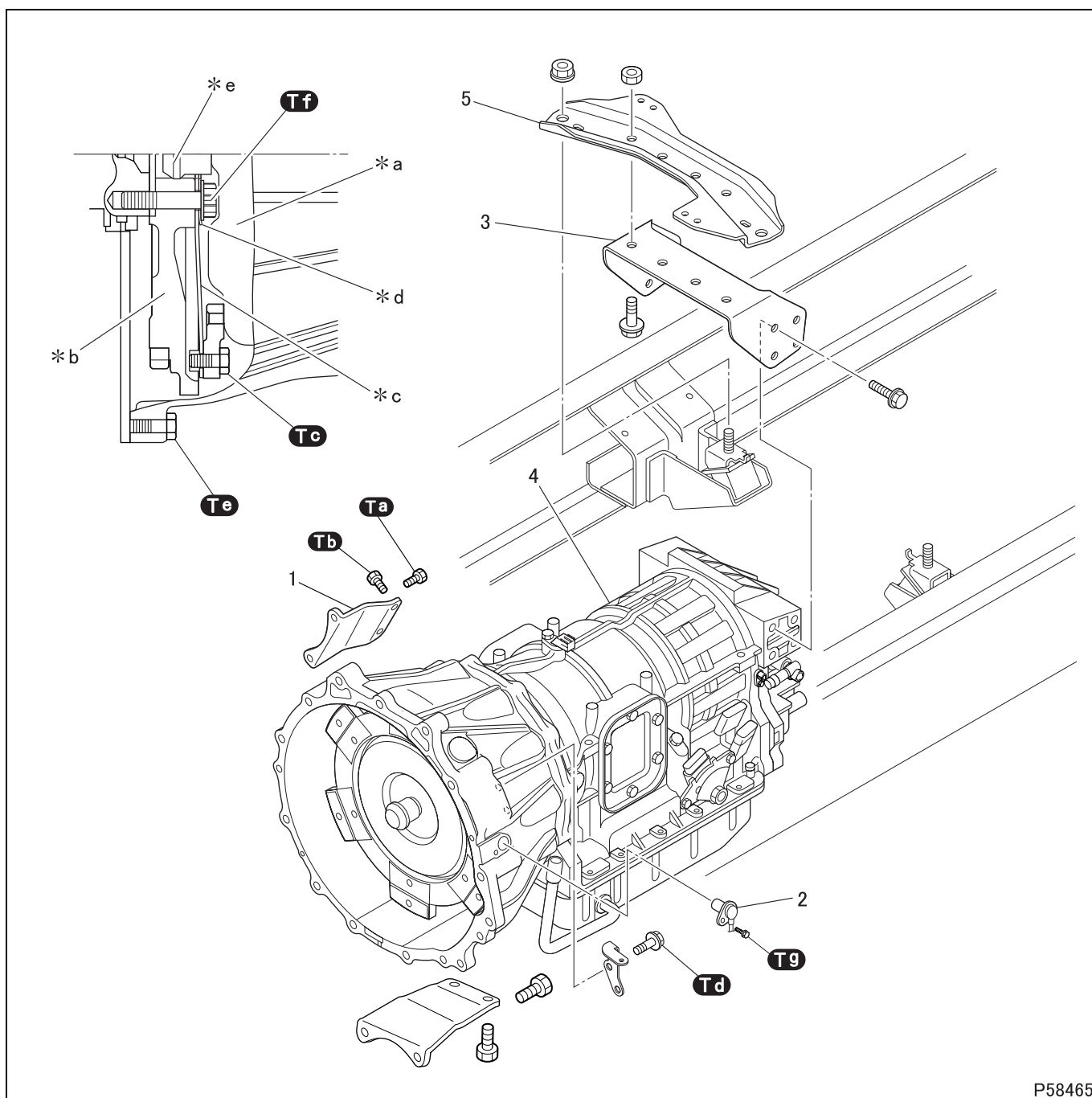
◆ Work before removal ◆



■ Inspection: Runout of socket portion of companion flange

- If the measured value exceeds the limit, replace the companion flange.

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION



P58465

● Removal sequence

- 1 Dust cover
- 2 Engine speed sensor
- 3 Mounting bracket
- 4 Automatic transmission
- 5 Mounting support

- *a**: Torque converter
- *b**: Flywheel
- *c**: Drive plate
- *d**: Wear plate
- *e**: Pilot

● Installation sequence

Follow the removal sequence in reverse.

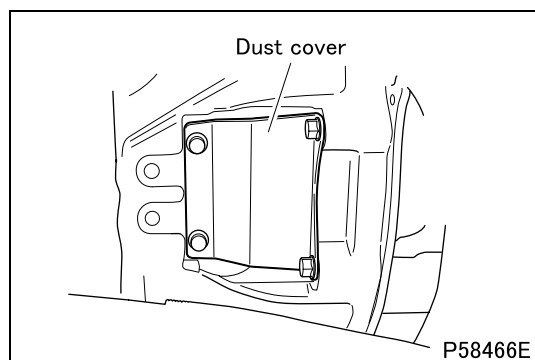
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (dust cover and automatic transmission mounting)	47 {35, 4.8}	–
Tb	Bolt (dust cover mounting)	13 {9.6, 1.3}	–
Tc	Bolt (flywheel and drive plate mounting)	50 {37, 5.1}	–
Td	Bolt (bracket mounting)	40 {30, 4.1}	–
Te	Bolt (automatic transmission mounting)	82 {60, 8.4}	M12
		47 {35, 4.8}	M10
Tf	Bolt (drive plate mounting)	118 {87, 12} +90°	–
Tg	Bolt (engine speed sensor mounting)	8 {5.9, 0.82}	–

Lubricant and/or sealant

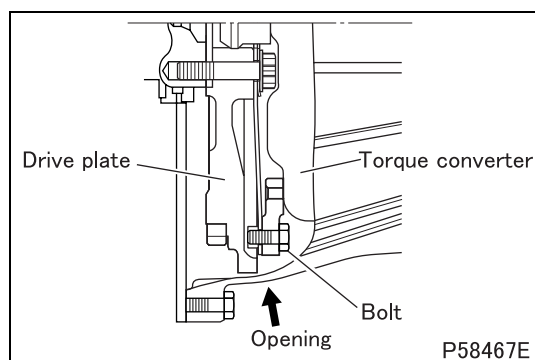
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Pilot of torque converter	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required

◆ Removal procedure ◆

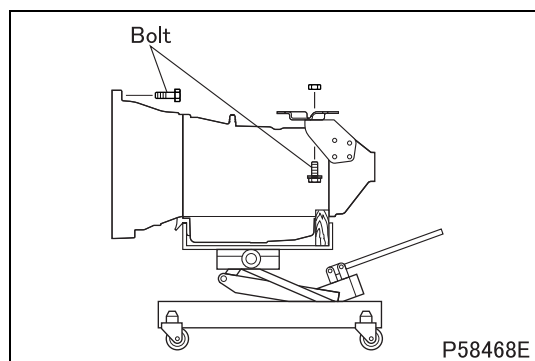


■ Removal: Automatic transmission

- Remove the dust cover.



- Crank the engine to bring one of the bolts to the opening.
- Remove the bolt that is accessible through the opening. Also remove all of the rest of the six bolts, cranking the engine to bring each one to the opening in turn.



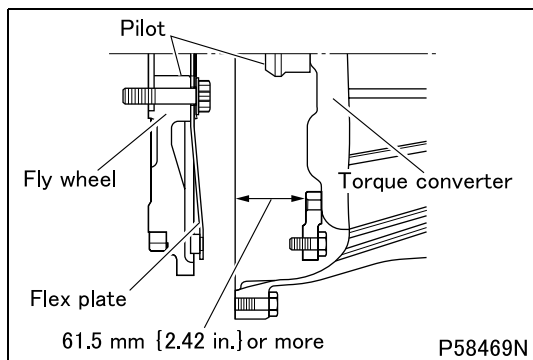
- Support the automatic transmission with a jack and remove each of the bolts.
- Move the automatic transmission rearward to remove it.

CAUTION

- Do not apply the jack to the oil pan. Doing so would deform the oil pan and the oil pan gasket.
- The torque converter will come away by itself. Be careful not to let it drop.
- The bolts that join the automatic transmission to the engine are not all the same length. Make a note of the position of each one as you remove it.

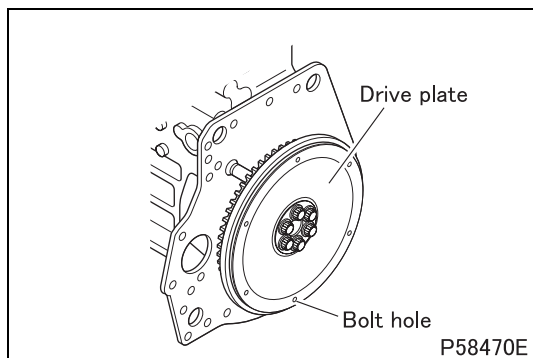
REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION

◆ Installation procedure ◆

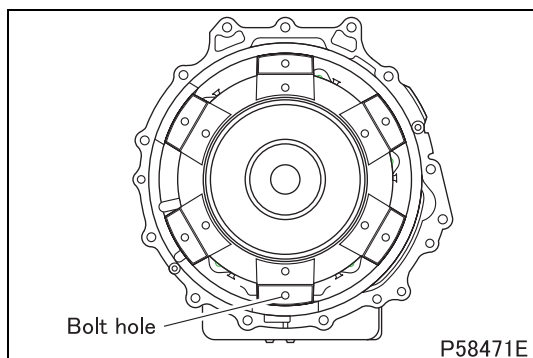


■ Installation: Automatic transmission

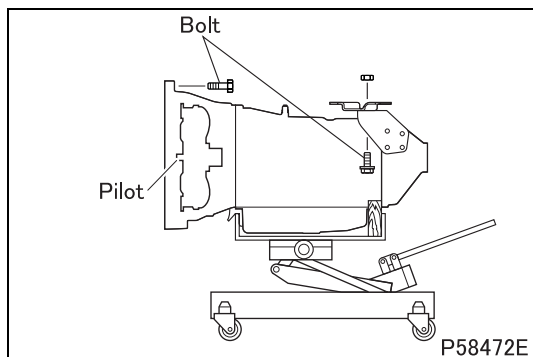
- Make sure the torque converter is correctly installed on the automatic transmission. With the torque converter correctly installed, the dimension from the drive plate surface to the case mounting surface is as shown in the diagram.
- Apply grease to the pilot.



- Position one of the drive plate's mounting bolt holes at the very bottom.



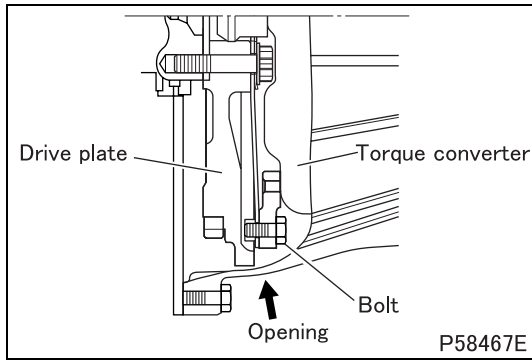
- Position one of the torque converter's mounting bolt holes at the very bottom.



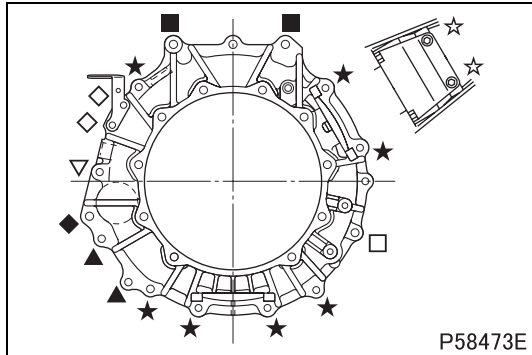
- With the pilot of the torque converter and the dowel pin of the rear plate aligned with each other, slowly move the assembly onto the engine.
- Fit several of the bolts that join the automatic transmission to the engine, then tighten the rear mounting bolt to the specified torque.

CAUTION ⚠

- The torque converter can easily come off by itself. Slightly lower the rear of the automatic transmission to keep the torque converter correctly positioned.
- Before mounting the automatic transmission, wipe all oil and grease off the inside wall of the torque converter housing.

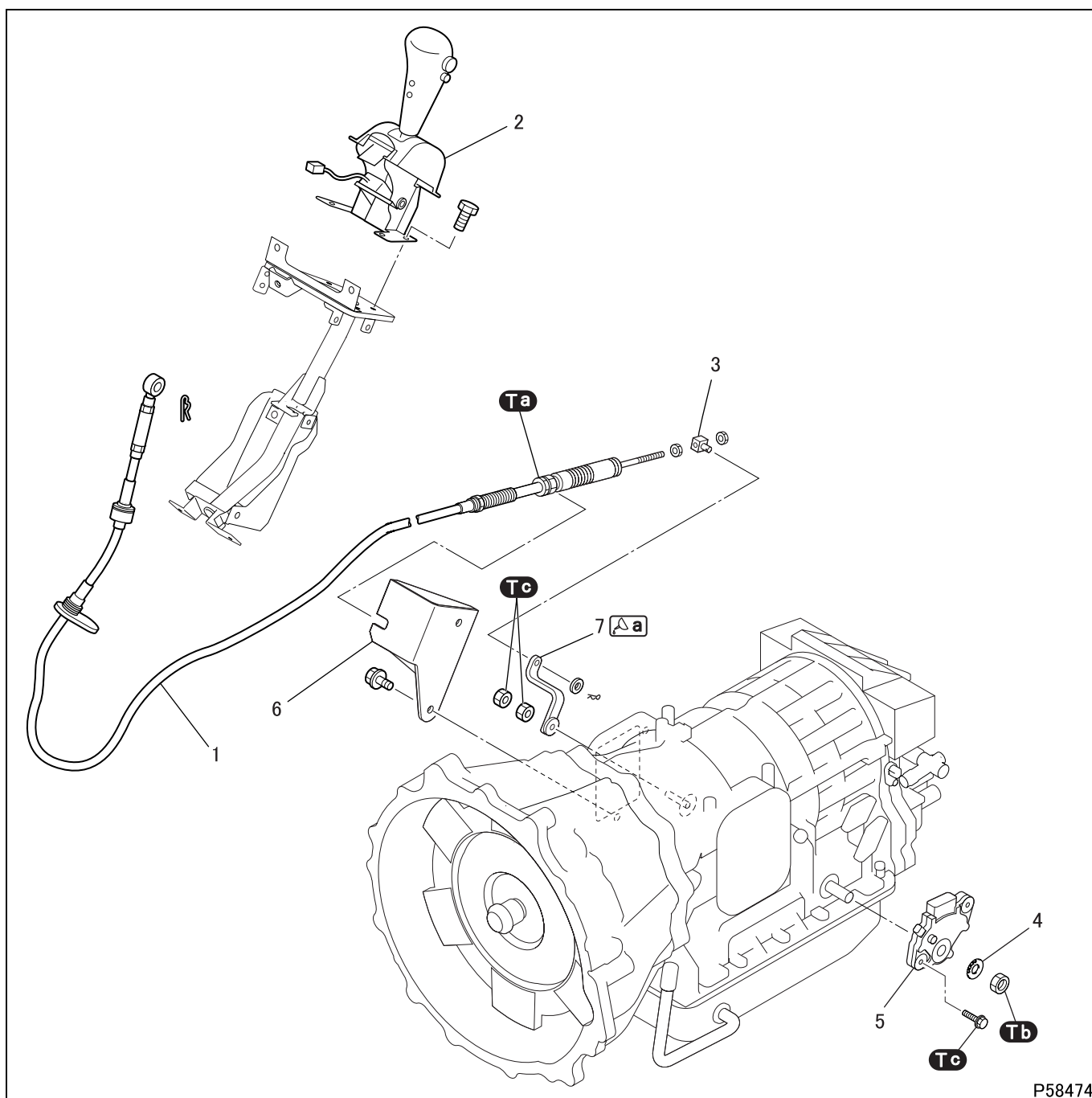


- Through the opening, align the holes for one of the bolts that join the drive plate and the torque converter and fit the bolt.
- Fit all of the rest of the six bolts, cranking the engine to bring the holes to the opening for each one. Next, tighten each bolt to specification, cranking the engine to bring each bolt to the opening in turn.



- With the dust cover and bracket mounted using the same bolts, tighten to torque all of the bolts that join the automatic transmission and engine.
- ▲: M10 × 1.25 - 55
 ★: M10 × 1.25 - 80
 □: M10 × 1.25 - 95
 ◇: M10 × 1.5 - 20 (for bracket)
 ◆: M12 × 1.75 - 45
 ■: M12 × 1.75 - 60
 ▽: M12 × 1.75 - 100
- Tighten the dust cover's remaining mounting bolts (marked ☆) to the specified torque to retain the dust cover.

AUTOMATIC TRANSMISSION CONTROL



● Removal sequence

- | | |
|--|------------------------------|
| 1 Selector cable | 5 Inhibitor switch |
| 2 Range selector lever (See later page.) | 6 Bracket |
| 3 Adjuster | 7 Transmission control lever |
| 4 Lock washer | |

● Installation sequence

Follow the removal sequence in reverse.

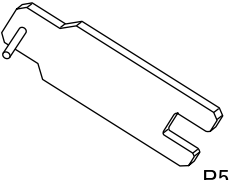
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Selector cable (mounting on bracket)	59 to 83 {44 to 61, 6.0 to 8.5}	–
Tb	Nut (inhibitor switch mounting)	7 {5.2, 0.7}	–
Tc	Bolt (inhibitor switch mounting)	12.5 {9.2, 1.3}	–
	Nut (transmission control shift lever mounting)		–

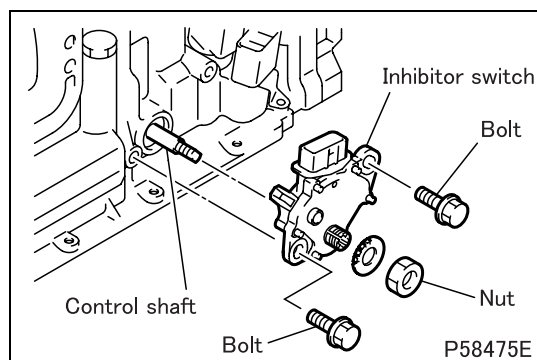
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Part of transmission control lever that slides against adjuster	Chassis grease [NLGI No .1 (Ca soap)]	As required

Special tools

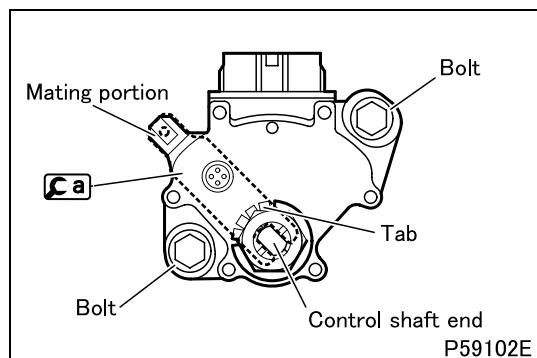
Mark	Tool name and shape	Part No.	Application
 a	Plate  P59101	MH063642	Locating inhibitor switch

◆ Installation procedure ◆



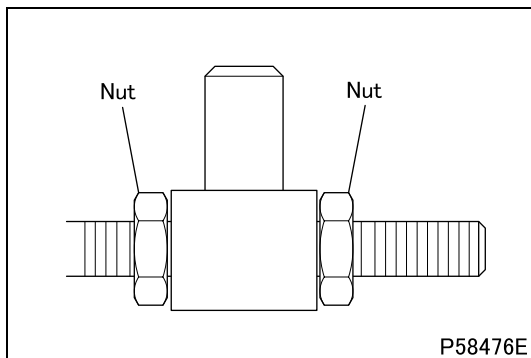
■ Installation: Inhibitor switch

- Position the inhibitor switch onto the control shaft.
- Loosely tighten the bolts (× 2).
- Tighten the nut to the specified torque.



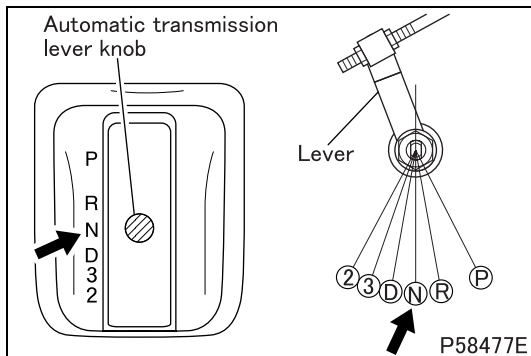
- Loosen the two bolts to enable the special tool  **a** to be installed such that one end of the tool with a pin engages with the mating portion of the inhibitor switch while the other end of the tool engages with the end of the control shaft.
- While holding the inhibitor switch with one hand, tighten the two bolts to the specified torque.
- Stake the nut by bending over two of the tabs on the inhibitor switch.

AUTOMATIC TRANSMISSION CONTROL

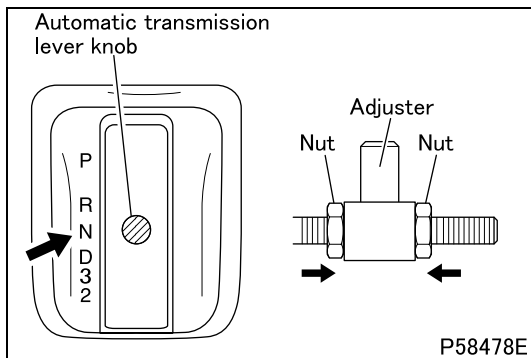


■ Installation: Selector cable

- Fit but do not fully tighten the nuts.



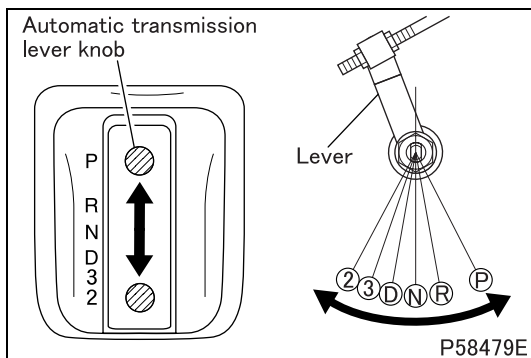
- Place the automatic transmission lever knob inside the cab in the N position. Also, place the lever on the automatic transmission main body side in the N position.



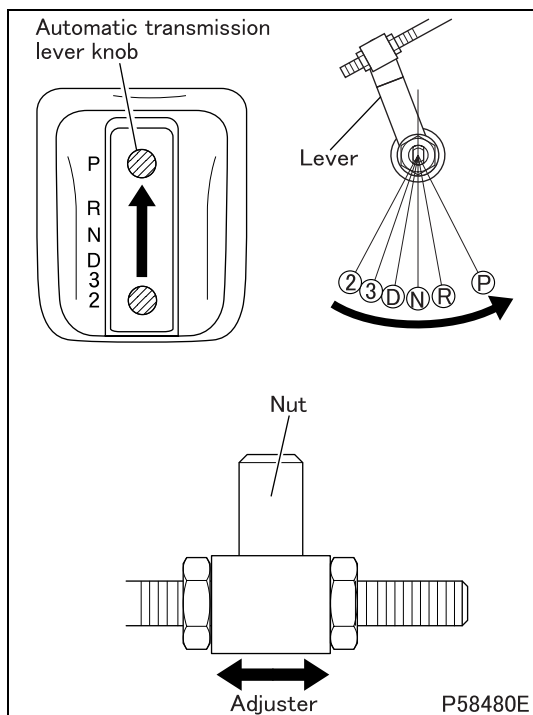
- Confirm that the automatic transmission lever knob inside the cab is in the N position, then tighten the nuts to the specified torque.

CAUTION ⚠

- Do not move the selector cable's set position when tightening the nuts.



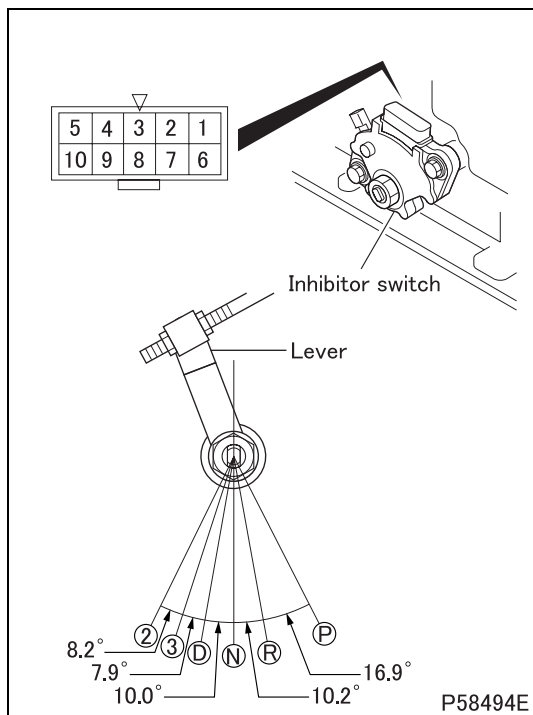
- Move the automatic transmission lever knob from the P position to the 2 position and back to the P position two or three times and check that the automatic transmission lever knob inside the cab and the lever on the automatic transmission main body side correctly enter their respective P and 2 positions.
- Confirm that the starter key can be removed with the automatic transmission lever knob in the P position.



[Adjustment]

- If, when you move the automatic transmission lever knob inside the cab through the full stroke from the 2 position to the P position, the positions of the automatic transmission lever knob inside the cab and the positions of the lever on the automatic transmission main body side do not match each other or the lever knob inside the cab does not have a positive in-position feel in any range position, adjust the position of the adjuster.
- After making an adjustment, move the automatic transmission lever knob inside the cab and confirm that the positions of the automatic transmission lever knob inside the cab and the positions of the lever on the automatic transmission main body side match each other and that the lever knob inside the cab has a positive in-position feel in each range position. Also, confirm that the starter key can be removed with the automatic transmission lever knob inside the cab in the P position.

◆ Inspection after installation ◆



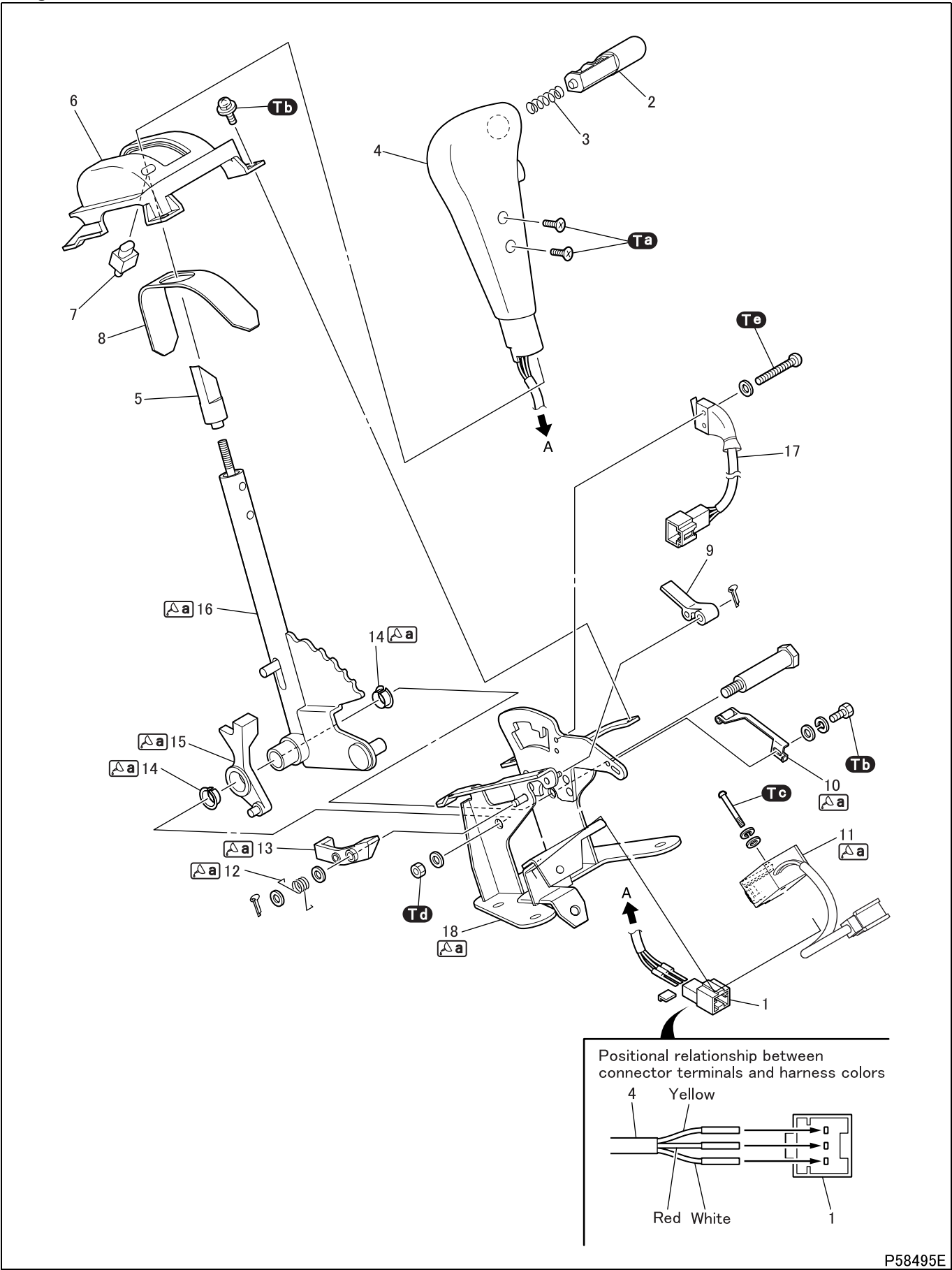
■ Inspection: Inhibitor switch

Transmission control lever position	Terminals with continuity
P	4-5, 6-10
R	4-9
N	1-4, 6-10
D	4-8
3	2-4
2	4-7

- If there is any abnormality, replace the inhibitor switch.

AUTOMATIC TRANSMISSION CONTROL

Range selector lever



P58495E

● Removal sequence

- | | | |
|---------------------------------------|----------------------------|-------------------|
| 1 Connector
(for overdrive switch) | 7 Shift lock cancel button | 14 Bushing |
| 2 Push-button | 8 Slider | 15 Arm |
| 3 Spring | 9 Cam | 16 Lever |
| 4 Knob | 10 Detent spring | 17 P range switch |
| 5 Sleeve | 11 Shift lock actuator | 18 Bracket |
| 6 Indicator panel | 12 Spring | |
| | 13 Arm | |

● Assembly sequence

Follow the disassembly sequence in reverse.

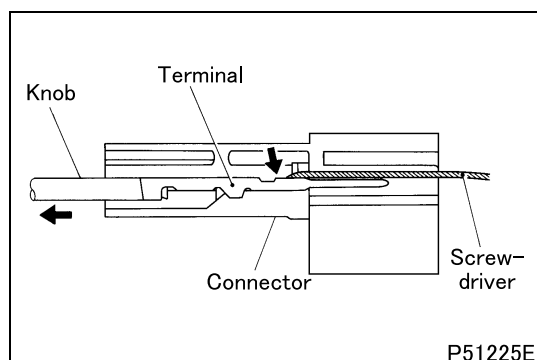
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (knob mounting)	1.5 to 2 {1.1 to 1.5, 0.15 to 0.20}	–
Tb	Screw (indicator panel mounting)	1 to 1.5 {0.7 to 1.1, 0.10 to 0.15}	–
	Screw (detent spring mounting)		
Tc	Screw (shift lock actuator mounting)	1 to 2 {0.7 to 1.5, 0.10 to 0.20}	–
Td	Nut (lever mounting)	9 to 14 {6.6 to 10, 0.92 to 1.4}	–
Te	Screw (P range switch mounting)	0.1 to 0.15 {0.074 to 0.11, 0.01 to 0.02}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Sliding part of detent spring	Chassis grease [NLGI No. 1 (Ca soap)]	As required
	Sliding parts of shift lock actuator and arm		
	Sliding parts of spring and arm		
	Bushing		
	Detent pin of lever		
	Part of bracket that makes contact with detent pin		
	Part of sleeve that makes contact with push-button, and sliding part of sleeve		

◆ Removal procedure ◆

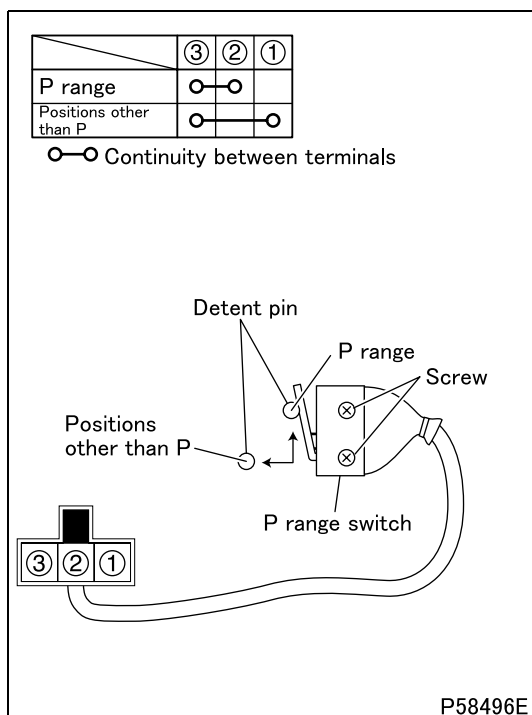


■ Removal: Connector

- Use a screwdriver to free the terminal on the knob in the connector, then remove the connector.

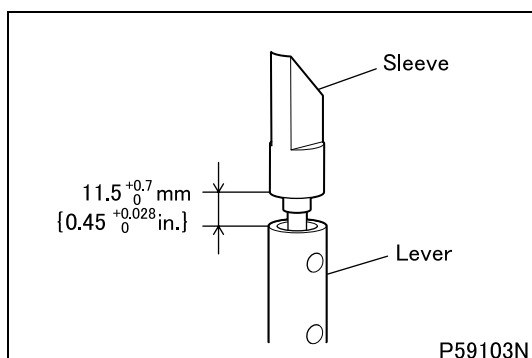
AUTOMATIC TRANSMISSION CONTROL

◆ Installation procedure ◆



■ Installation: P range switch

- Tighten the screws to the specified torque with the P range switch positioned such that the continuity of the P range switch for the P range and for positions except P is as shown in the illustration.

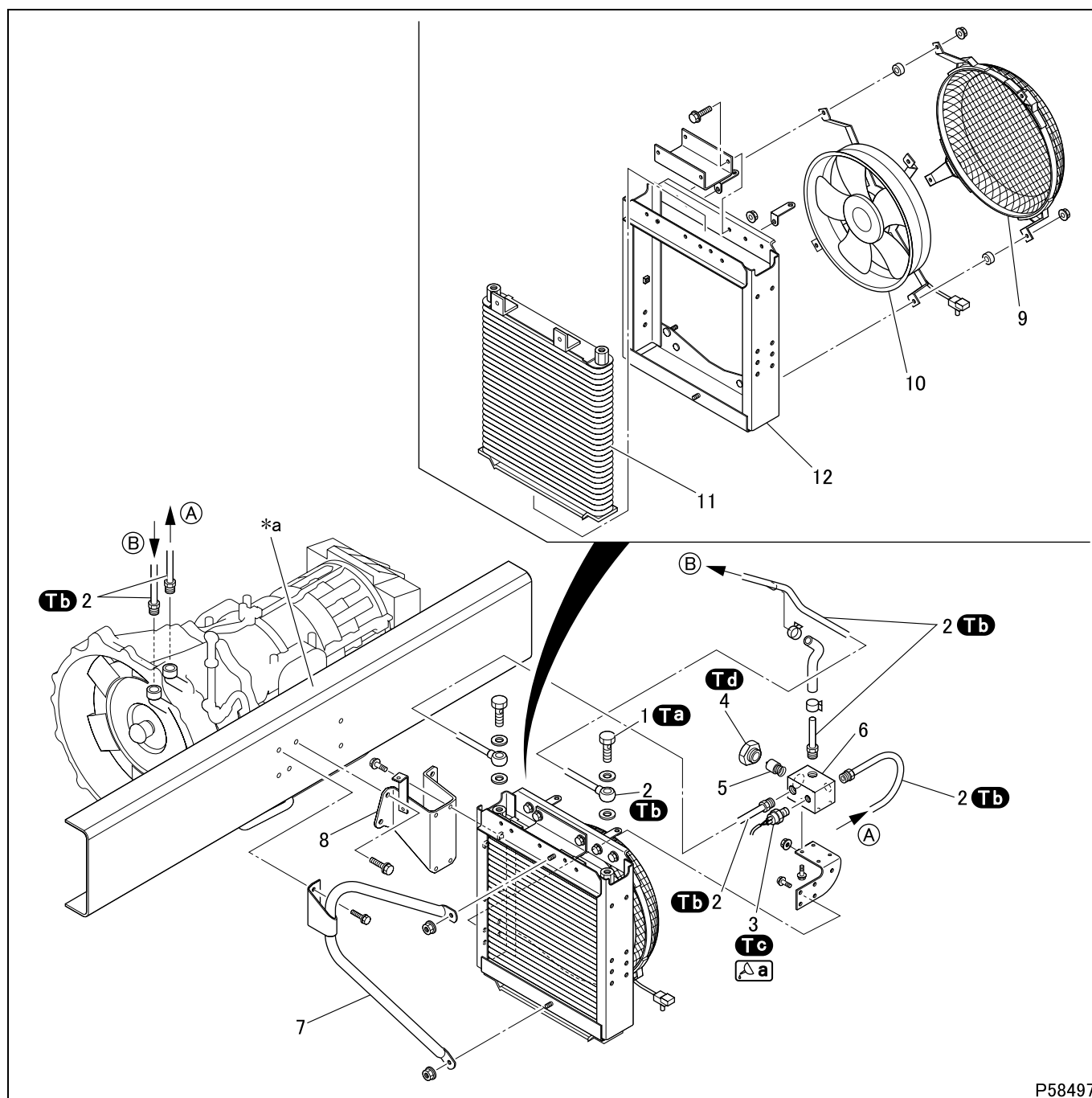


■ Installation: Sleeve

- Turn the sleeve to install it such that the dimension between the sleeve and the end of the lever is as shown in the illustration when the lever is in the R position.
- Install the sleeve with its tapered part on the same side as the push-button.

M E M O

OIL COOLER <MODELS EXCEPT CREW CAB>



P58497

● Removal sequence

- | | | |
|---------------------|-------------------------|---------------------|
| 1 Eye bolt | 6 Connector | 11 Oil cooler |
| 2 Oil cooler tube | 7 Oil cooler stay | 12 Oil cooler mount |
| 3 ATF thermo switch | 8 Oil cooler bracket | |
| 4 Plug | 9 Fan cover | |
| 5 Thermo valve | 10 ATF cooler fan motor | |

*a: Frame

CAUTION

- Be sure to check the ATF level before disconnecting an oil line.

● Installation sequence

Perform installation by following the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eye bolt	29 to 34 {21 to 25, 3.0 to 3.5}	–
Tb	Oil cooler tube (flare nut)	53 {39, 5.4}	WET
Tc	ATF thermo switch	29 to 39 {21 to 29, 3.0 to 4.0}	–
Td	Plug	167 ± 20 {125 ± 15, 17 ± 2.0}	WET

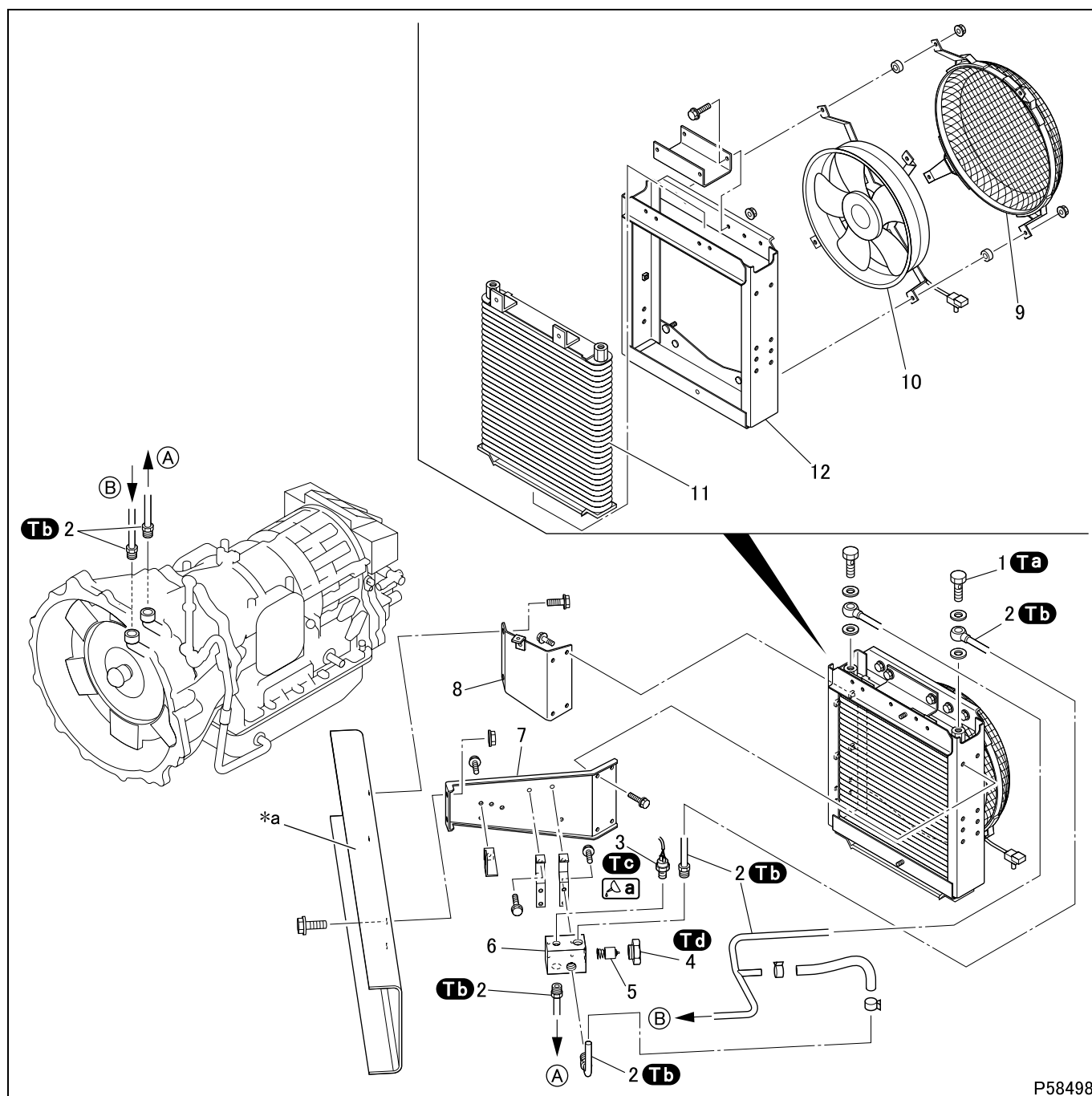
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Thread of ATF thermo switch	Threebond 1110B	As required

◆ Work before installation ◆**■ Flushing: Oil cooler circuit**

- If the oil cooler circuit contains a large amount of impurities, flush the cooler circuit.
- Remove the cooler tubes from the automatic transmission and oil cooler.
- Blow compressed air into the oil cooler and cooler tubes to clean them.

OIL COOLER <CREW CAB>



P58498

● Removal sequence

- | | | |
|---------------------|----------------------------|---------------------|
| 1 Eye bolt | 6 Connector | 11 Oil cooler |
| 2 Oil cooler tube | 7 Oil cooler front support | 12 Oil cooler mount |
| 3 ATF thermo switch | 8 Oil cooler rear support | |
| 4 Plug | 9 Fan cover | |
| 5 Thermo valve | 10 ATF cooler fan motor | |

*a: Frame

CAUTION

- Be sure to check the ATF level before disconnecting an oil line.

● Installation sequence

Perform installation by following the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eye bolt	29 to 34 {21 to 25, 3.0 to 3.5}	–
Tb	Oil cooler tube (flare nut)	53 {39, 5.4}	WET
Tc	ATF thermo switch	29 to 39 {21 to 29, 3.0 to 4.0}	–
Td	Plug	160 ± 20 {125 ± 15, 17 ± 2.0}	WET

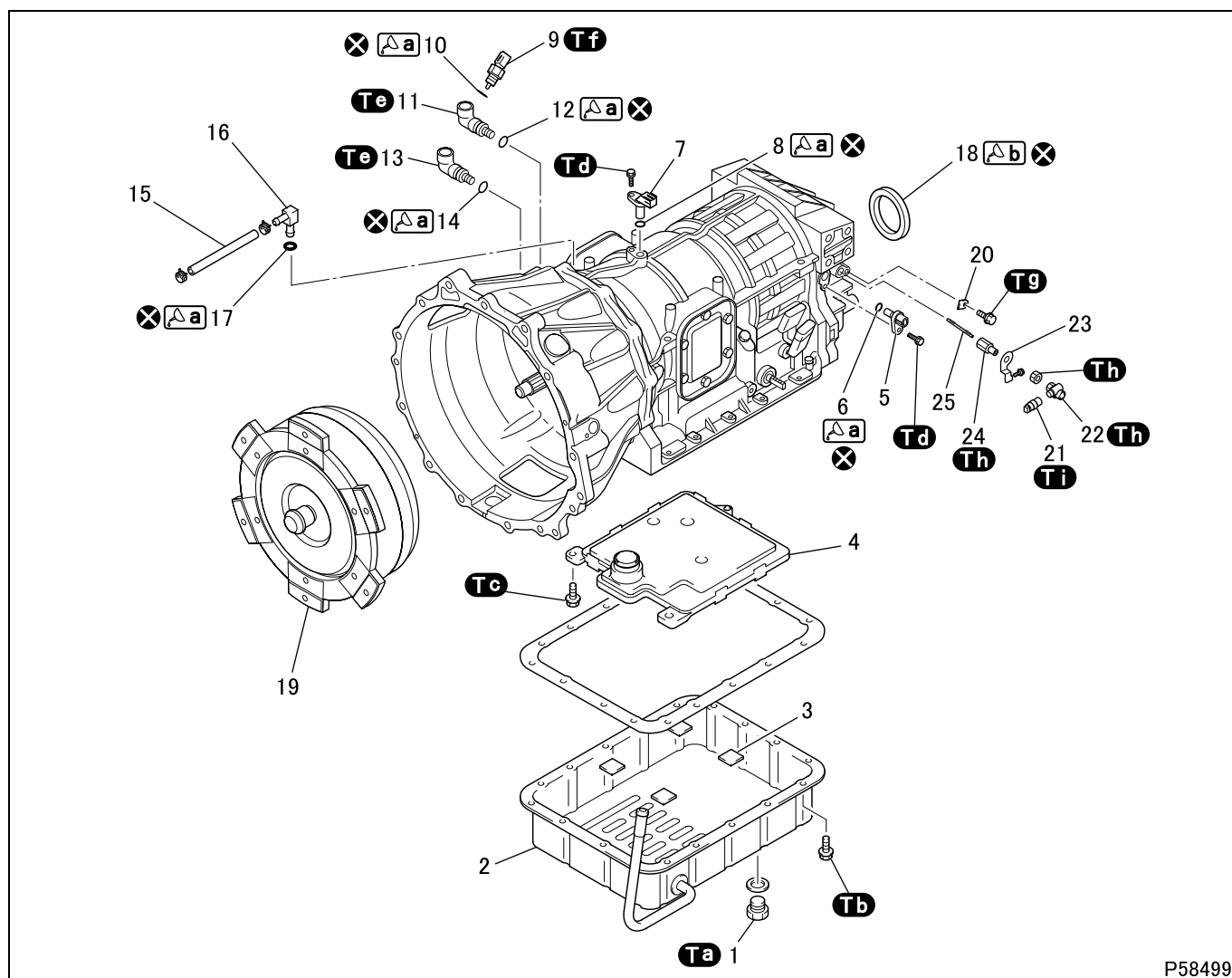
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Thread of ATF thermo switch	Threebond 1110B	As required

◆ Work before installation ◆**■ Flushing: Oil cooler circuit**

- If the oil cooler circuit contains a large amount of impurities, flush the cooler circuit.
- Remove the cooler tubes from the automatic transmission and oil cooler.
- Blow compressed air into the oil cooler and cooler tubes to clean them.

REPLACEMENT OF PARTS OF AUTOMATIC TRANSMISSION MAIN BODY



P58499

● Removal sequence

- | | | |
|------------------------------------|---------------------|-------------------------|
| 1 Drain plug | 10 O-ring | 20 Lock plate |
| 2 Oil pan | 11 Elbow | 21 Vehicle speed sensor |
| 3 Oil cleaner magnet | 12 O-ring | 22 L-joint |
| 4 Oil strainer | 13 Elbow | 23 Bracket |
| 5 Output speed sensor | 14 O-ring | 24 Speedometer joint |
| 6 O-ring | 15 Hose | 25 Speedometer shaft |
| 7 Turbine speed sensor | 16 Breather plug | |
| 8 O-ring | 17 O-ring | |
| 9 Oil temperature sensor (outside) | 18 Rear oil seal | |
| | 19 Torque converter | |

⊗: Non-reusable parts

● Installation sequence

Perform installation by following the removal sequence in reverse.

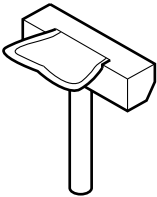
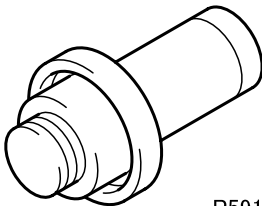
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	27 {20, 2.8}	Magnet attached
Tb	Bolt (oil pan mounting)	7 {5.2, 0.7}	—
Tc	Bolt (oil strainer mounting)	10 {7.4, 1.0}	—
Td	Bolt (output speed sensor and turbine speed sensor mounting)	8 {5.9, 0.8}	—
Te	Elbow mounting	32 {24, 3.3}	—
Tf	Oil temperature sensor (outside) mounting	34 {25, 3.5}	—
Tg	Bolt (lock plate mounting)	12.5 {9.2, 1.3}	—
Th	L-joint	34 to 39 {25 to 29, 3.5 to 4.0}	—
	Nut (speedometer joint mounting)		
	Speedometer joint		
Ti	Vehicle speed sensor	14.7 to 29.4 {11 to 22, 1.5 to 3.0}	—

Lubricant and/or sealant

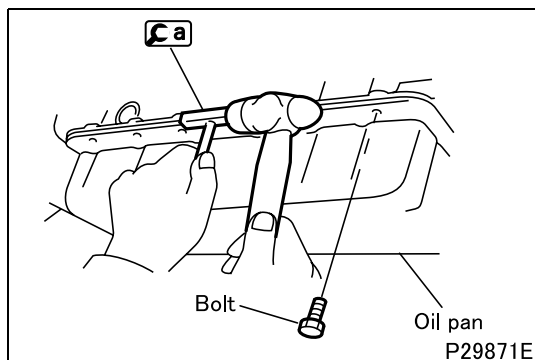
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Mobil ATF3309	As required
 b	Rear oil seal lips	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

Mark	Tool name and shape	Part No.	Application
 a	Oil pan remover  P29856	MD998727	Removal of oil pan
 b	Oil seal installer  P59105	MH063641	Installing rear oil seal

REPLACEMENT OF PARTS OF AUTOMATIC TRANSMISSION MAIN BODY

◆ Removal procedure ◆



■ Removal: Oil pan

- Remove the bolts.

CAUTION ⚠

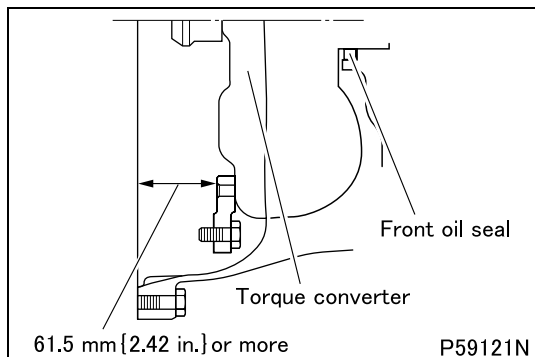
- To prevent the oil pan from falling when removing it from the cylinder block, fit (but do not tighten) a bolt in every third hole.

- Remove the oil pan using the special tool **Ca** as illustrated. Insert the special tool at one corner of the oil pan.

CAUTION ⚠

- Do not deform the oil pan when tapping in the special tool **Ca**.
- Oil remains in the oil pan. Do not tip the oil pan when removing it.

◆ Installation procedure ◆



■ Installation: Torque converter

- If the torque converter is new, fill it with new ATF.
Amount to supply: approx. 2 L {2.1 qts}
- Apply ATF to the front oil seal, then install the torque converter on the oil pump.

CAUTION ⚠

- Do not damage the oil seal when installing the torque converter.

- Measure the dimension from the torque converter housing to the torque converter's set block. Confirm that the torque converter is correctly positioned.

■ Installation: Rear oil seal

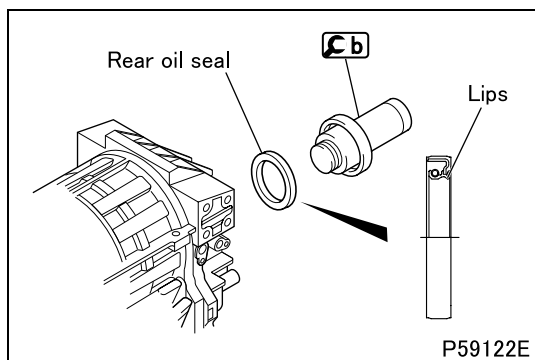
CAUTION ⚠

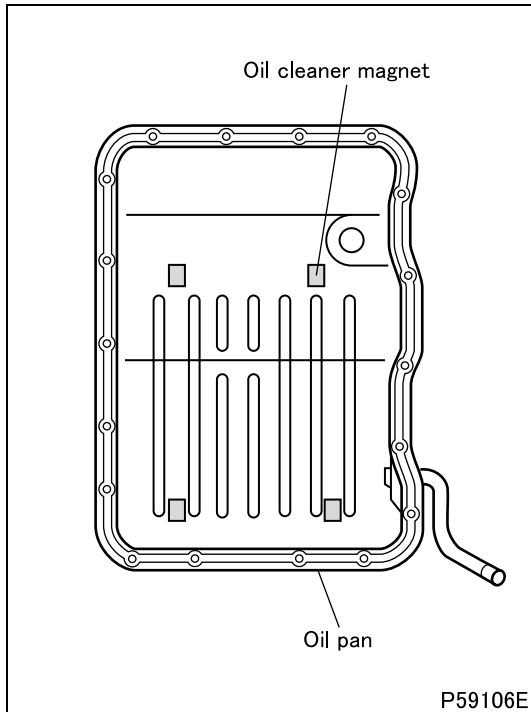
- Before installing the rear oil seal, ensure that the seal mounting face on the automatic transmission is clean.

- Apply grease to the rear oil seal lips.
- Install the rear oil seal. Ensure that the seal is firmly against the extension housing end face of the automatic transmission main body.

CAUTION ⚠

- Install the rear oil seal evenly throughout its periphery.
- Be careful not to deform or otherwise damage the rear oil seal.





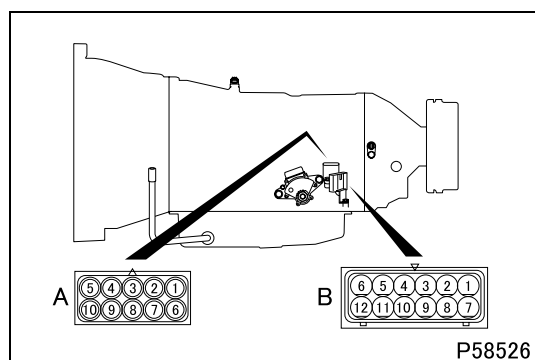
■ Installation: Oil pan

- Remove any gasket that may be remaining on the mating faces of the automatic transmission main body and the oil pan.
- Clean the oil cleaner magnet and install it onto the oil pan.
- Install new gasket onto the oil pan, then install them onto the automatic transmission main body.
- Tighten the bolts to the specified torque.

CAUTION ⚠

- Ensure that the mating faces of the oil pan and the automatic transmission main body are free from ATF spill.
- Tighten the bolts evenly in several steps, in each step tightening individual bolts a little in a set sequence.

INSPECTION OF ELECTRICAL EQUIPMENT



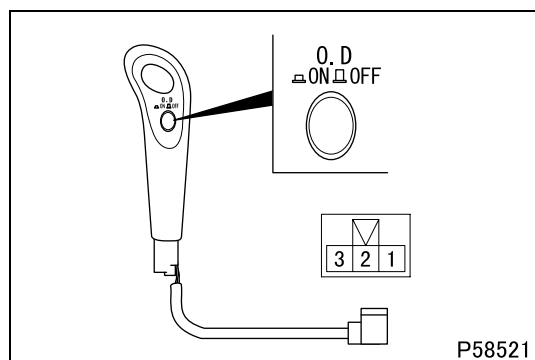
#140 Inspection of oil pressure switch

- Measure the resistance between the indicated terminals.

Standard value	Oil pressure switch 1	B1-*	No continuity (When starter switch is OFF)
	Oil pressure switch 2	B7-*	
	Oil pressure switch 3	B8-*	
	Oil pressure switch 4	A7-*	
	Oil pressure switch 5	A2-*	
	Oil pressure switch 6	B2-*	
	Oil pressure switch 7	A1-*	
	Oil pressure switch 8	A6-*	

*: Automatic transmission case

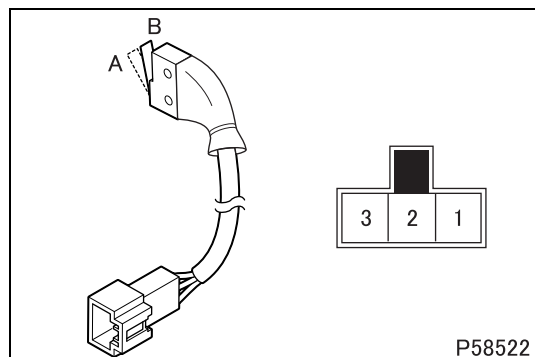
- If any measured value is out of specification, replace the relevant oil pressure switch. Have replacement performed by an Aisin service station.



#150 Inspection of overdrive switch

Switch position	Terminals with continuity
OFF	1-2
ON	1-3

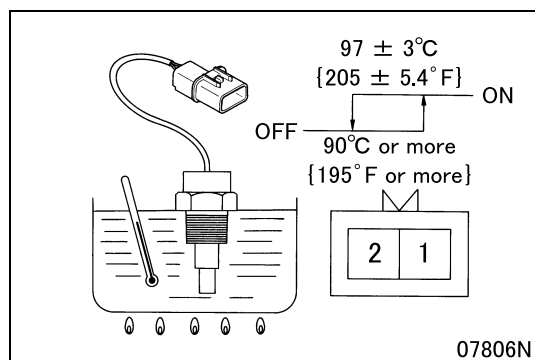
- If there is any abnormality, replace the knob.



#151 Inspection of P range switch

Switch position	Terminals with continuity
A	1-3
B	2-3

- If there is any abnormality, replace the P range switch.



#153 Inspection of ATF thermo switch

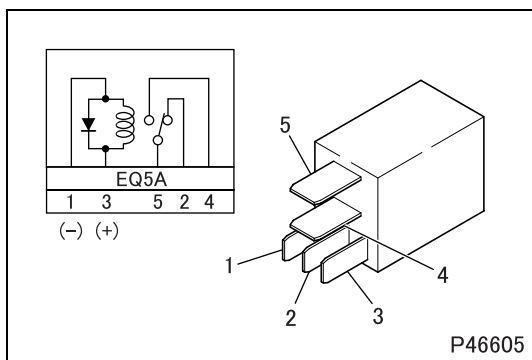
- Place the ATF thermo switch in a container filled with ATF. Vary the temperature of the ATF.

Switch position	Terminals with continuity
OFF	—
ON	1-2

- If there is any abnormality, replace the ATF thermo switch.

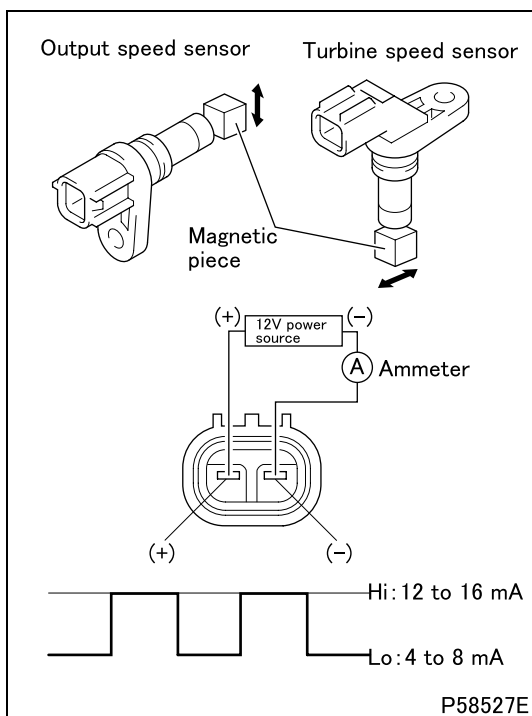
#159 Inspection of inhibitor switch

- The inhibitor switch must be inspected with the switch installed onto the automatic transmission.
(Refer to “**AUTOMATIC TRANSMISSION CONTROL**”.)



#201 Inspection of relay (normally open, 5-pin type)

- Perform a continuity check and an operation check. If there is any abnormality, replace the relay.



#293 Inspection of speed sensors

- Connect the speed sensor to the power source and an ammeter as illustrated.
- While moving a magnetic piece (metal that attaches to magnet) in the illustrated directions near the end of the speed sensor, read the ammeter. (Distance between sensor and magnetic piece: 5 mm {0.20 in.} or less)

Standard value (at normal temperature)	Hi	12 to 16 mA
	Lo	4 to 8 mA

- If the measured value does not conform to the standard value, replace the speed sensor.

INSPECTION OF ELECTRICAL EQUIPMENT

#312 Inspection of oil temperature sensor

<outside>

- Immerse the oil temperature sensor in a container filled with ATF.
- Measure the resistance at the temperatures listed below. (To obtain the correct reading, the sensor needs to be exposed to the specified temperature for at least 5 minutes.)

Standard value	115°C {240°F}	655 to 730 Ω
	120°C {250°F}	585 to 645 Ω
	145°C {295°F}	340 to 375 Ω
	155°C {310°F}	280 to 305 Ω

- If there is any abnormality, replace the oil temperature sensor.

<Inside>

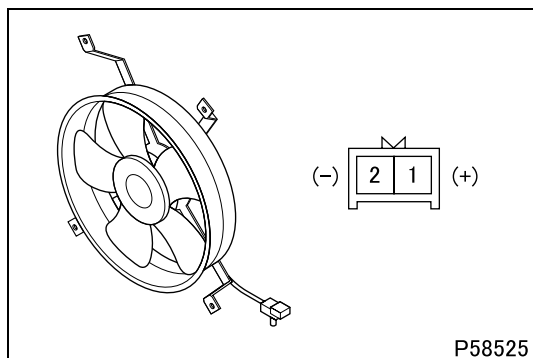
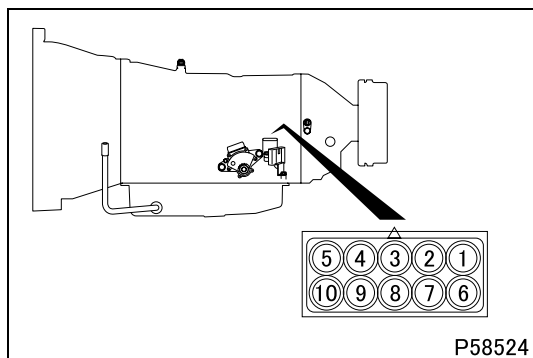
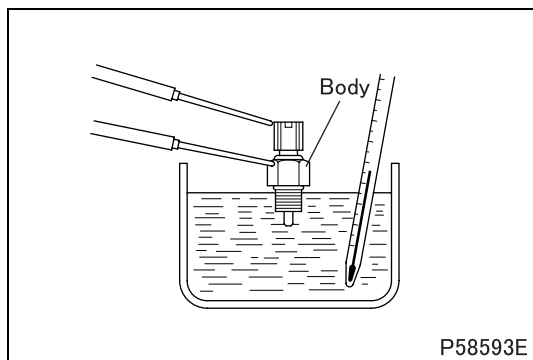
- Measure the resistance between terminals 3 and 8 on the automatic transmission.

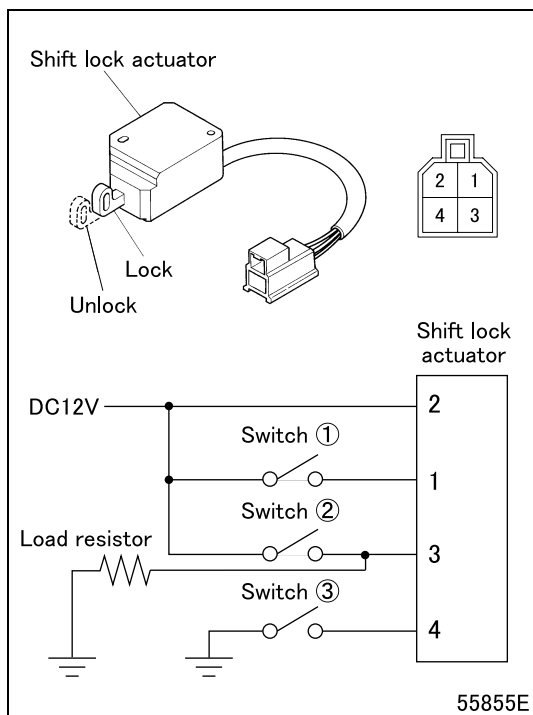
Standard value	-30°C {-24°F}	Approx. 44 k Ω
	10°C {50°F}	Approx. 6.4 k Ω
	110°C {230°F}	Approx. 0.2 k Ω
	145°C {295°F}	Approx. 0.1 k Ω

- If a measured value differs greatly from the standard value or the resistance does not change when the temperature is changed, have an Aisin service station perform the necessary work.

#489 Inspection of ATF cooler fan motor

- Check that the ATF cooler fan motor runs when the battery voltage is applied to terminals 1 and 2.
- If there is any abnormality, replace the ATF cooler fan motor.



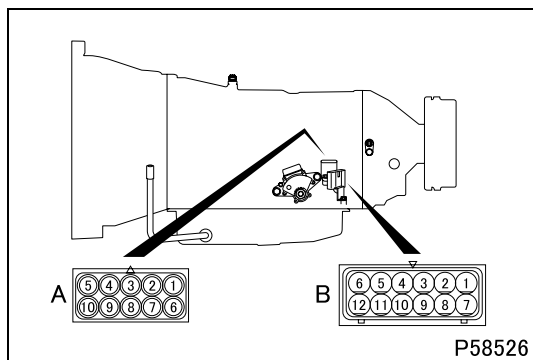


#535 Inspection of shift lock actuator

- Wire the shift lock actuator as illustrated.
- Check the lever position with each combination of switch conditions shown in the following table.

Switch 1	Switch 2	Switch 3	Lever position
ON	ON	ON	Unlock
ON	OFF	ON	Lock
ON	ON	OFF	Unlock
ON	OFF	OFF	Unlock
OFF	ON	ON	Lock
OFF	OFF	ON	Lock
OFF	ON	OFF	Unlock
OFF	OFF	OFF	Unlock

- If there is any abnormality, replace the shift lock actuator.



#585 Inspection of solenoid valves

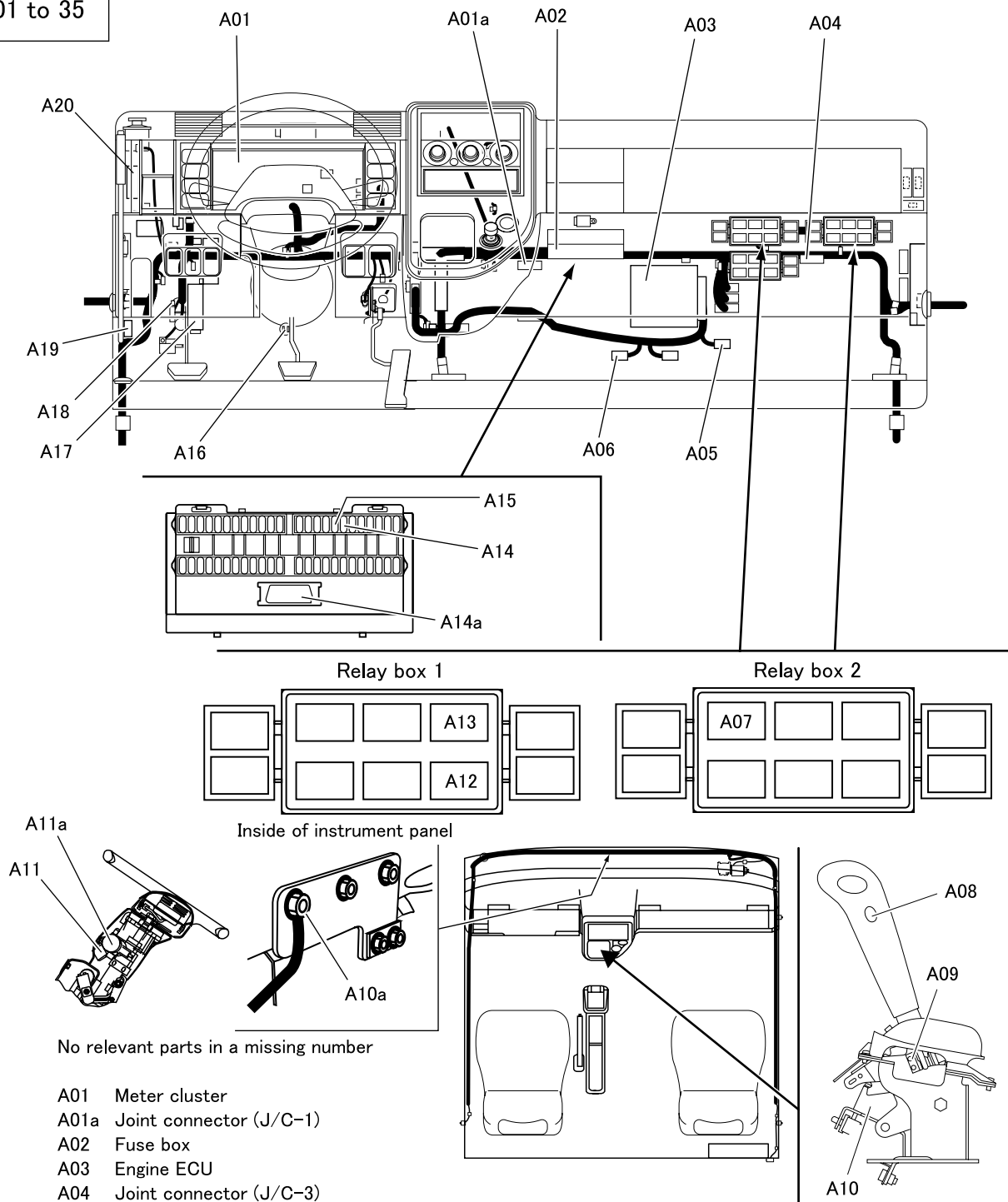
- Measure the resistance between the indicated terminals.

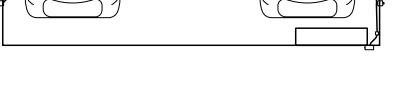
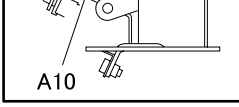
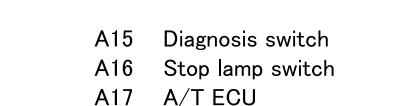
Standard value (at normal temperature)	Shift solenoid 1	B10-*	$13 \pm 2 \Omega$
	Shift solenoid 2	B3-*	
	Shift solenoid 3	B9-*	
	Gain change solenoid	B4-*	
	Linear solenoid 1	A5-A10	$5.5 \pm 0.5 \Omega$
	Linear solenoid 2	B6-B12	
	Linear solenoid 3	A4-A9	
	PL linear solenoid	B5-B11	

*: Automatic transmission case

- If any measured value is out of specification, replace the relevant solenoid valve. Have replacement performed by an Aisin service station.

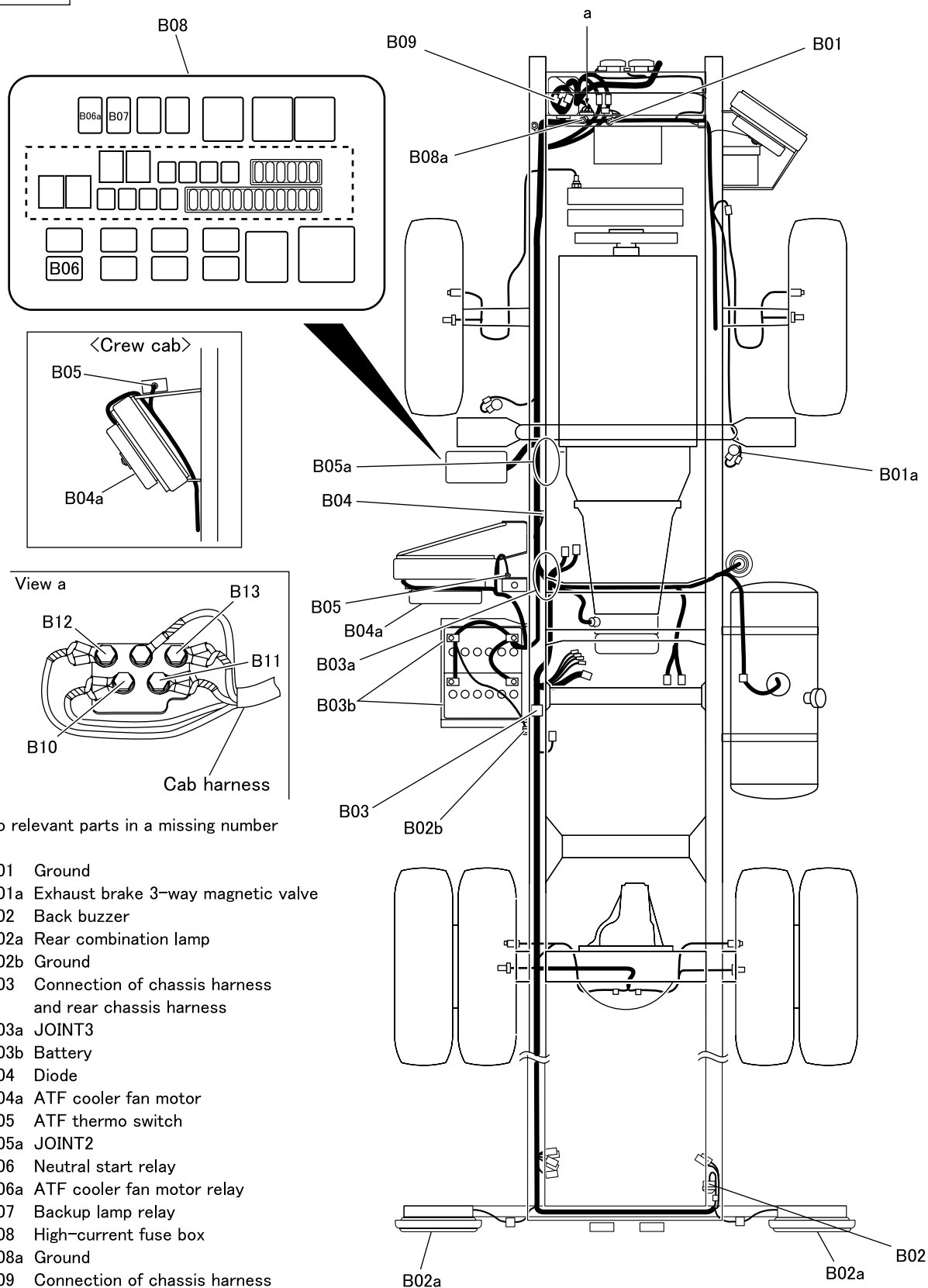
A01 to 35



- | | | |
|------|---|---|
| A01 | Meter cluster |  |
| A01a | Joint connector (J/C-1) | |
| A02 | Fuse box | |
| A03 | Engine ECU | |
| A04 | Joint connector (J/C-3) | |
| A05 | Joint connector (J/C-4) | |
| A06 | Resistor unit | |
| A07 | ABS exhaust brake cut relay | |
| A08 | O/D switch | |
| A09 | P range switch | |
| A10 | Shift lock actuator |  |
| A10a | Ground | |
| A11 | Key-interlock solenoid | |
| A11a | Starter switch | |
| A12 | Exhaust brake cut relay | |
| A13 | Stop lamp relay | |
| A14 | Memory clear switch | |
| A14a | Multi-Use Tester-III connector (for recorder) | |
| A15 | Diagnosis switch | |
| A16 | Stop lamp switch | |
| A17 | A/T ECU |  |
| A18 | Diode | |
| A19 | Multi-Use Tester-III connector (for inspection) | |
| A20 | Key interlock control unit | |
| ECU | Electronic control unit | |
| ABS | Anti-lock brake system | |
| A/T | Automatic transmission | |
| ATF | Automatic transmission fluid | |
| O/D | Overdrive | |

ECU:Electronic control unit
ABS:Anti-lock brake system
A/T:Automatic transmission
ATF:Automatic transmission fluid
O/D:Overdrive

B01 to 20



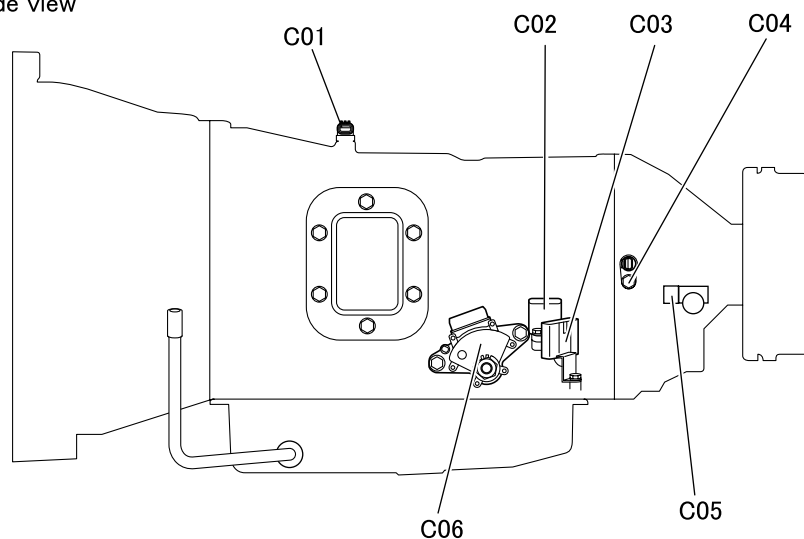
- B01 Ground
 - B01a Exhaust brake 3-way magnetic valve
 - B02 Back buzzer
 - B02a Rear combination lamp
 - B02b Ground
 - B03 Connection of chassis harness and rear chassis harness
 - B03a JOINT3
 - B03b Battery
 - B04 Diode
 - B04a ATF cooler fan motor
 - B05 ATF thermo switch
 - B05a JOINT2
 - B06 Neutral start relay
 - B06a ATF cooler fan motor relay
 - B07 Backup lamp relay
 - B08 High-current fuse box
 - B08a Ground
 - B09 Connection of chassis harness and cab harness
 - B10 Ground
- to 13

INSTALLED LOCATIONS OF PARTS

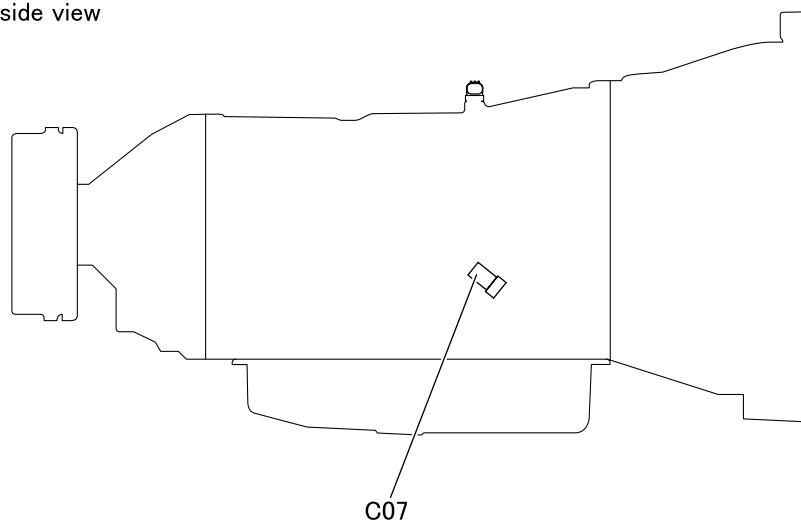
C01 to 12

Automatic transmission

Left side view



Right side view



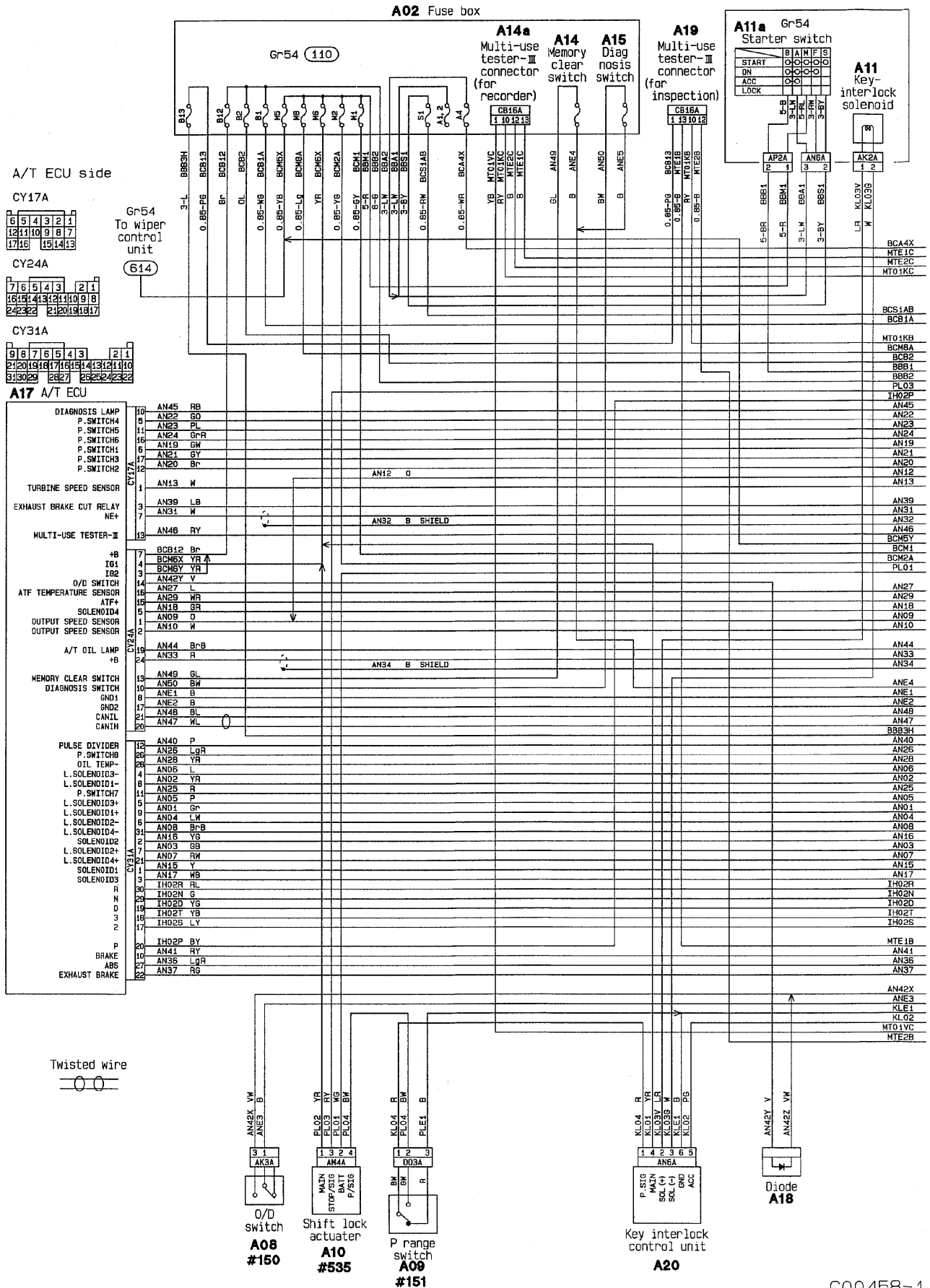
No relevant parts in a missing number

- C01 Turbine speed sensor
- C02 A/T solenoid connector [ET10A]
- C03 A/T solenoid connector [DC12A]
- C04 Output speed sensor
- C05 Vehicle speed sensor
- C06 Inhibitor switch
- C07 Oil temperature sensor (outside)

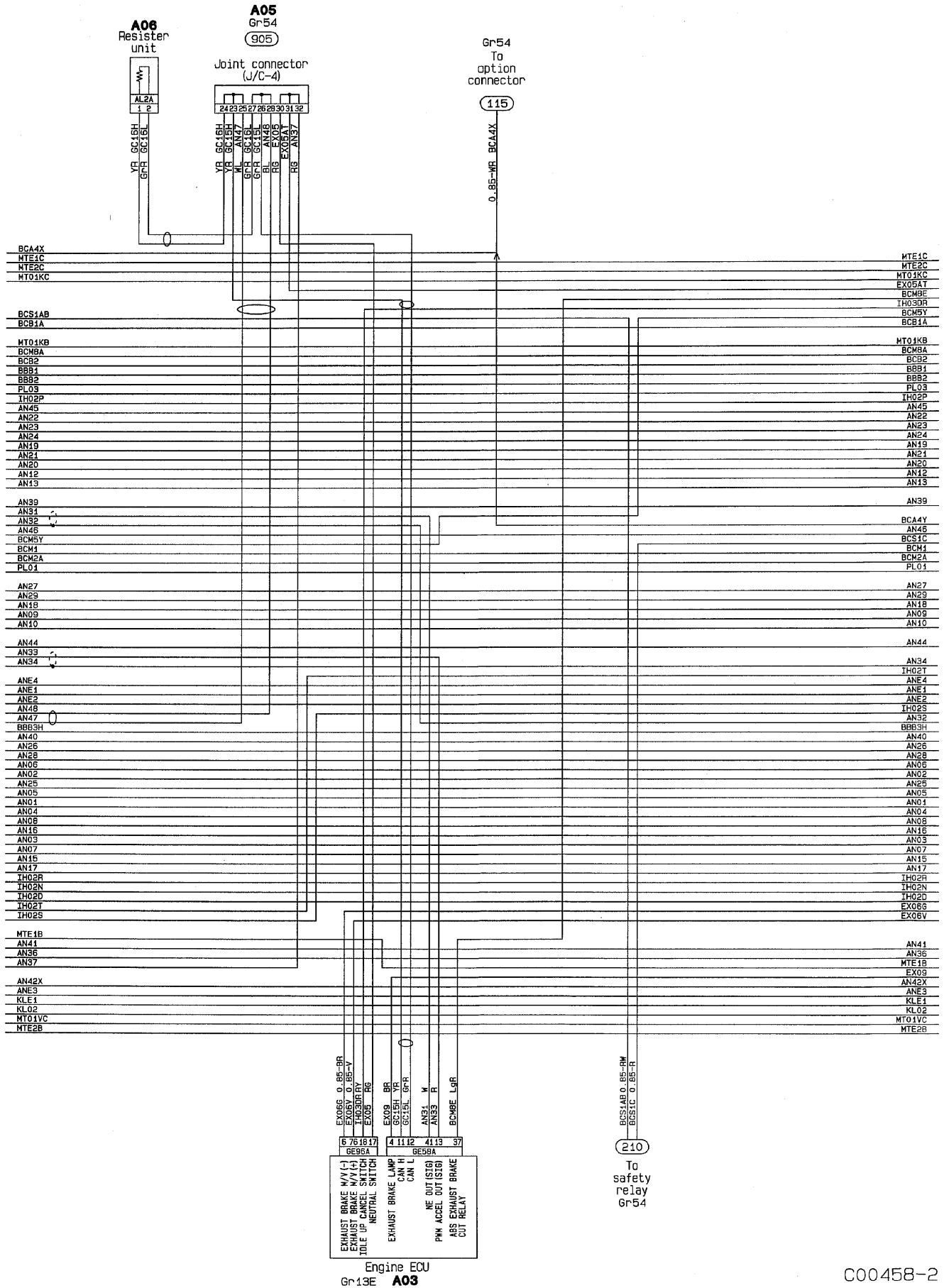
A/T : Automatic transmission

M E M O

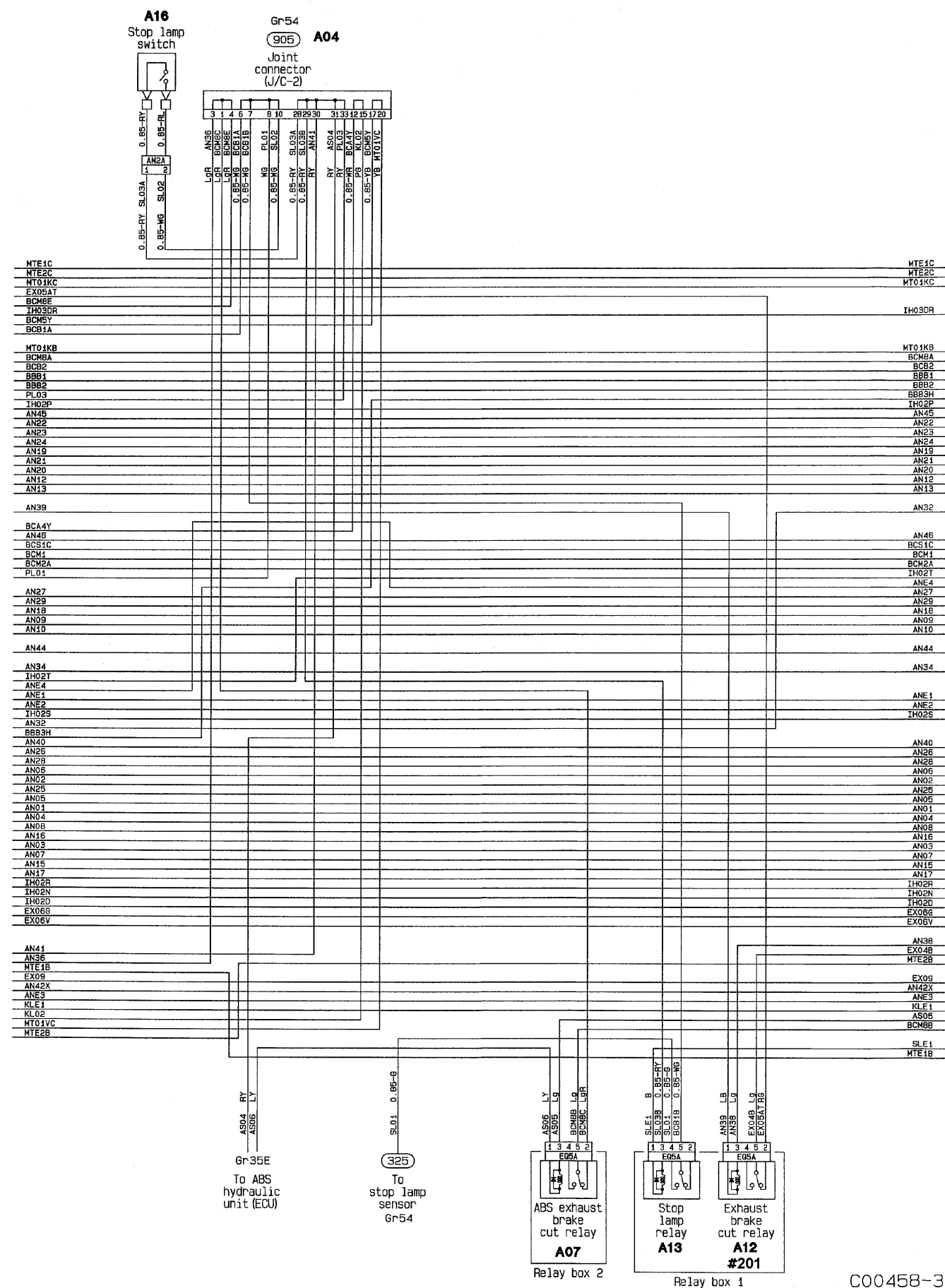
ELECTRIC CIRCUIT DIAGRAM

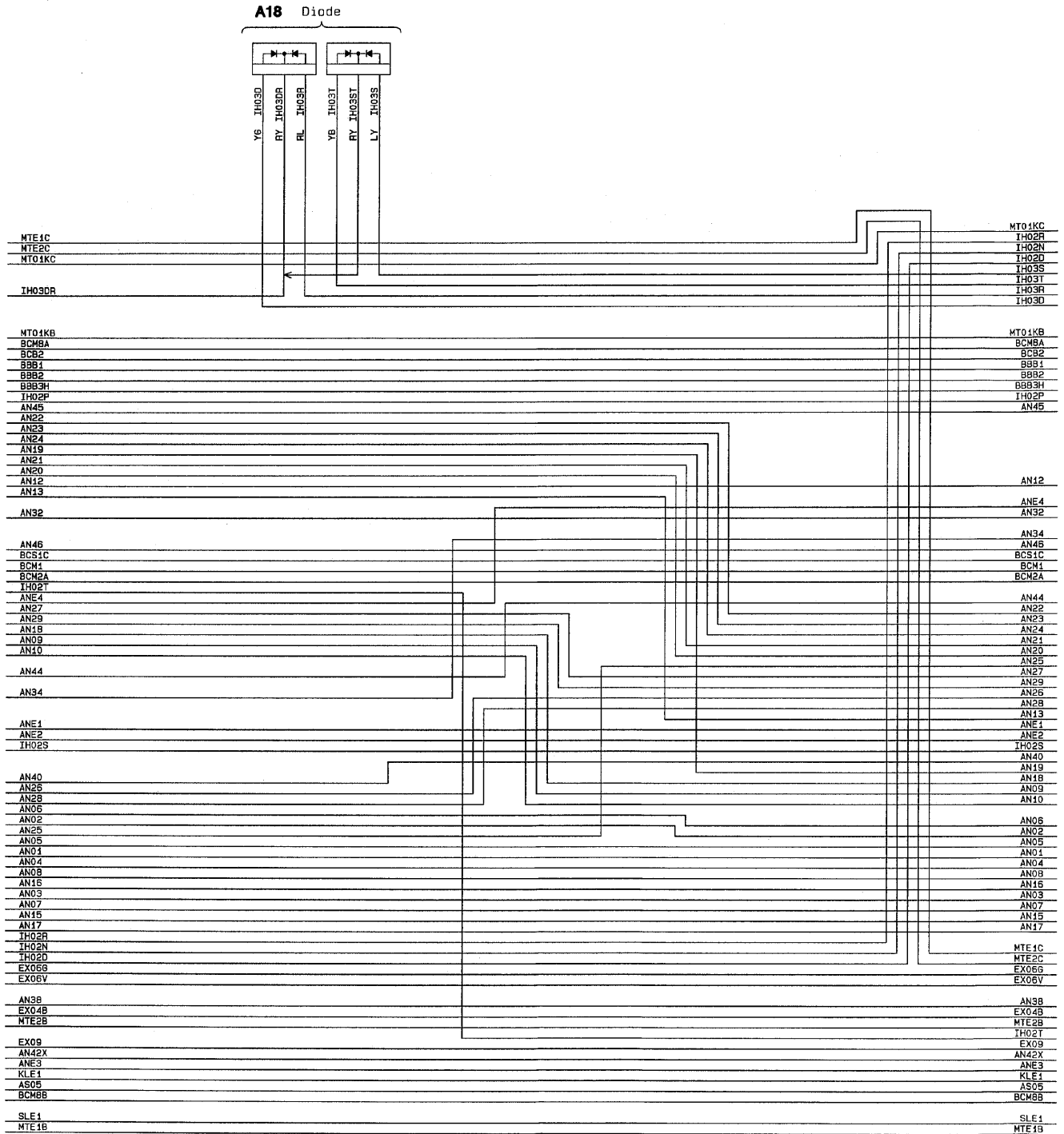


C00458-1

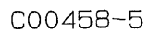


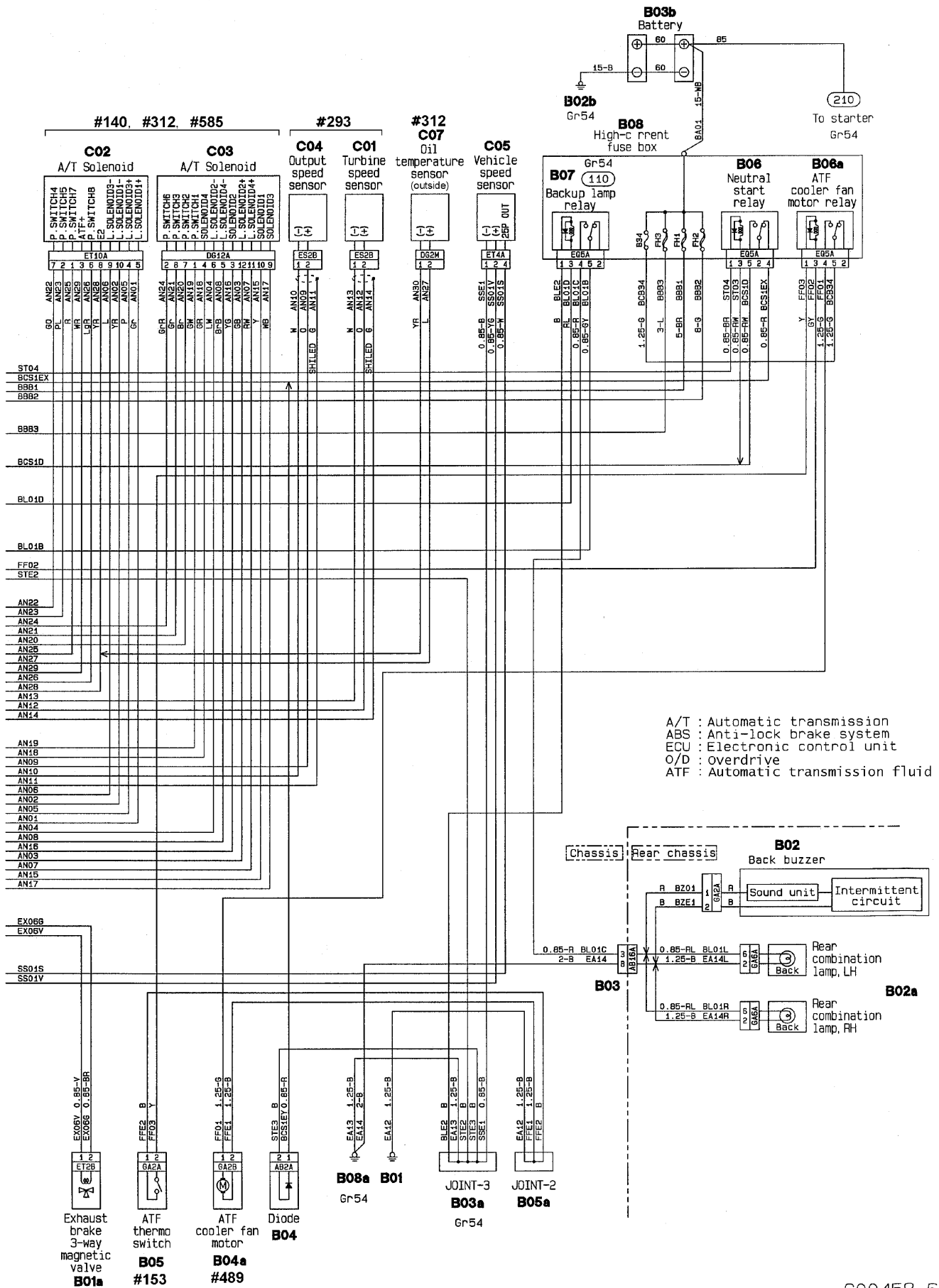
ELECTRIC CIRCUIT DIAGRAM





23-92







Group 24

Transfer

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

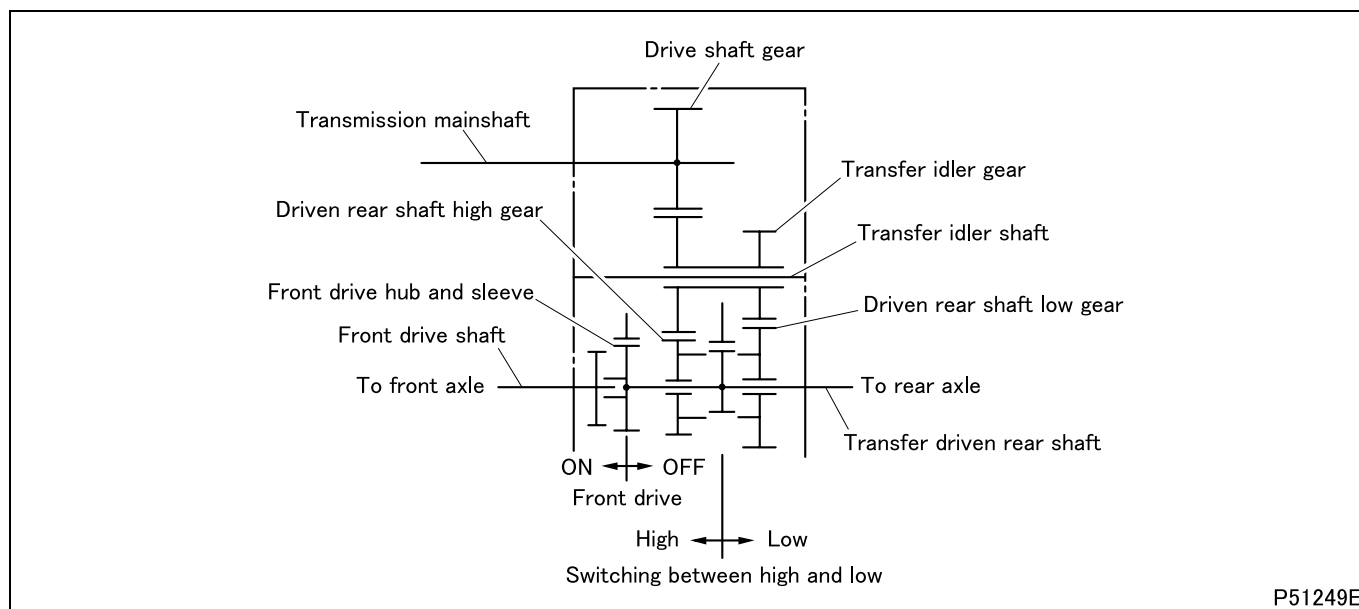
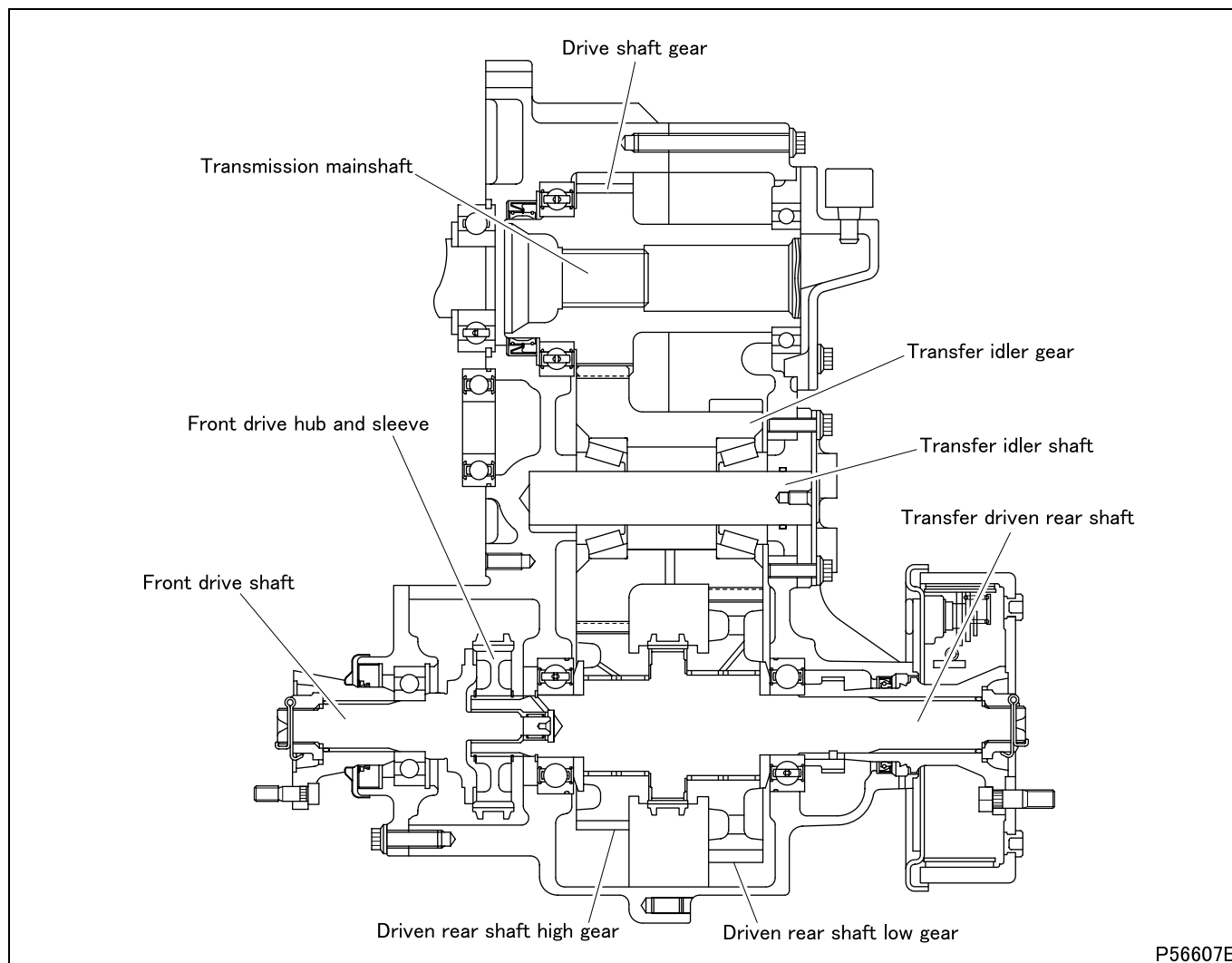
INDEX

SPECIFICATIONS	24-2
STRUCTURE AND OPERATION	
1. Transfer	24-3
2. Speedometer Gear Bushing	24-4
TROUBLESHOOTING	24-5
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Inspection and Replacement of Transfer Oil	24-6
REMOVAL AND INSTALLATION OF TRANSMISSION (WITH TRANSFER)	24-8
REMOVAL AND INSTALLATION OF TRANSFER	24-10
FRONT DRIVE	24-12
REAR DRIVE	24-16
TRANSFER	24-22
TRANSFER CONTROL	24-30

SPECIFICATIONS

Item		Specifications
Model		TF3
Transfer type		Part-time
Drive type		Gear
Gear ratio	High	1.090
	Low	1.987
Transfer oil	Gear oil	General: API GL-3 SAE 80 Warm region: API GL-3 SAE 90 Tropical region: API GL-4 SAE 90
	Oil quantity L {qts.}	3.1 {3.3}
Mass (including transmission body) kg {lb}		160 {350}
Control	Front drive switching	Electric and vacuum type
	HIGH-LOW switching	Floor change remote control type

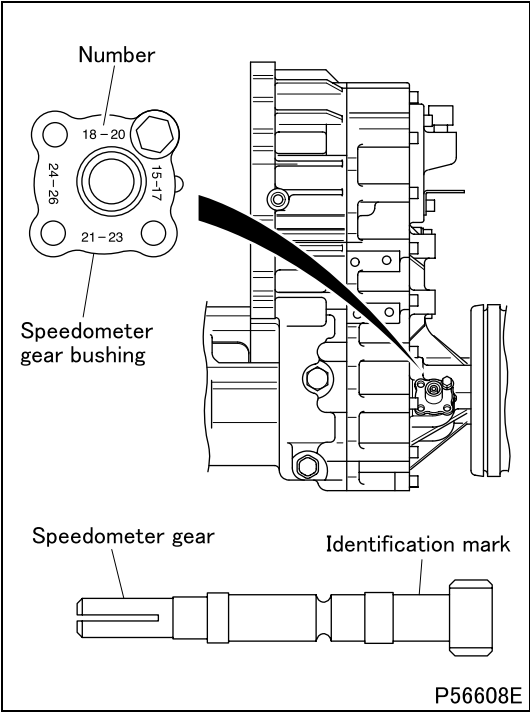
1. Transfer



- The transfer has two functions of distribution of all-wheel drive and a subtransmission with a reduction gear.
- The transfer is of a three-shaft constant-mesh type.
- The switch of a driver seat enables switching between the high and low range and engagement and disengagement of the front drive.

STRUCTURE AND OPERATION

2. Speedometer Gear Bushing



- The speedometer gear bushing is eccentric, and displacing the installed position allows it to correspond to the different number of teeth of the speedometer gear.
- The numbers marked on the front at four locations show the range of the number of teeth of the corresponding speedometer gear.
“15-17”: Number of teeth 15 to 17.
- An identification mark showing the number of teeth is marked on the speedometer gear.

Identification mark	A	B	C	D
Number of tooth	15	16	17	18
Gear ratio	3.0	3.2	3.4	3.6

Possible causes		Symptoms									
		Noise when cruising	Gears cannot be engaged when switching to front drive	Gears cannot be engaged when switching between high and low gear	Gears slip out of engagement during driving with front drive engaged	Gears slip out of engagement during driving	Gears cannot be disengaged when switching to front drive	Gears cannot be disengaged when switching between high and low	Indicator does not light though front drive is engaged	Indicator does not light though low gear is engaged	Indicator lights though front drive is not engaged
Transfer body faulty	Front drive shaft and spline of constant sleeve worn				O						
	Hub and spline of high and low constant sleeve worn					O					
	Transfer idler bearing worn or damaged	O									
	Transfer drive gear bearing worn or damaged	O									
	Transfer driven rear shaft bearing worn or damaged	O									
	Transfer driven rear shaft needle bearing worn or damaged	O									
	Gears damaged	O									
	Backlash of low gear and high gear of driven shaft excessive	O									
	Transfer oil insufficient	O									
	Transfer oil viscosity inadequate	O									
	Constant sleeve and dog clutch broken		O		O						
	High and low constant sleeve and hub broken			O		O					
Control mechanism faulty	Shift rail bent		O	O							
	Shift rail sliding movement faulty		O	O							
	Shift fork bent		O	O							
	Shift fork claws worn		O	O							
	Steel ball and groove of shift rail poppet worn					O					
	Poppet spring fatigued or damaged					O					
Transfer control system faulty	Low switch faulty								O		O
	Transfer four-wheel drive switch faulty							O		O	
	Blowout of fuse and high-current fuse		O					O			
	Battery overcharge		O								
	3-way magnet valve faulty		O		O	O					
	Broken wire, poor connection							O	O		
	Air leakage in vacuum piping		O		O						
	Vacuum actuator faulty		O		O	O					
	Control cable faulty			O				O			

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Replacement of Transfer Oil

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

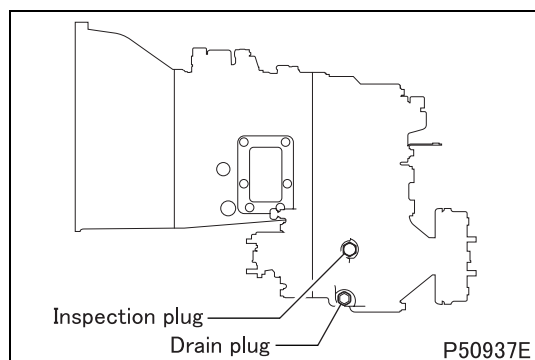
Mark	Parts to be tightened	Tightening torque	Remarks
-	Inspection plug	68.6 ± 14.7 {51 ± 11, 7.0 ± 1.5}	-
	Drain plug (magnet type)		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
-	Thread area of inspection plug	THREEBOND 1105	As required
	Thread area of drain plug		
-	Transfer case	General: API GL-3 SAE 80 Warm region: API GL-3 SAE 90 Tropical region: API GL-4 SAE 90	3.1 L {3.3 qts.}

WARNING

- Temperature of transfer oil is high immediately after driving. Perform work when oil is cold.



[Inspection]

(1) Inspection of oil quantity

- Remove the inspection plug, and check that transfer oil is filled up to the neck.
- If oil is not sufficient, fill oil from the inspection plug hole up to the neck.
- After filling, apply sealant to the inspection plug and tighten it to the specified torque.

(2) Inspection of oil quality and inclusions

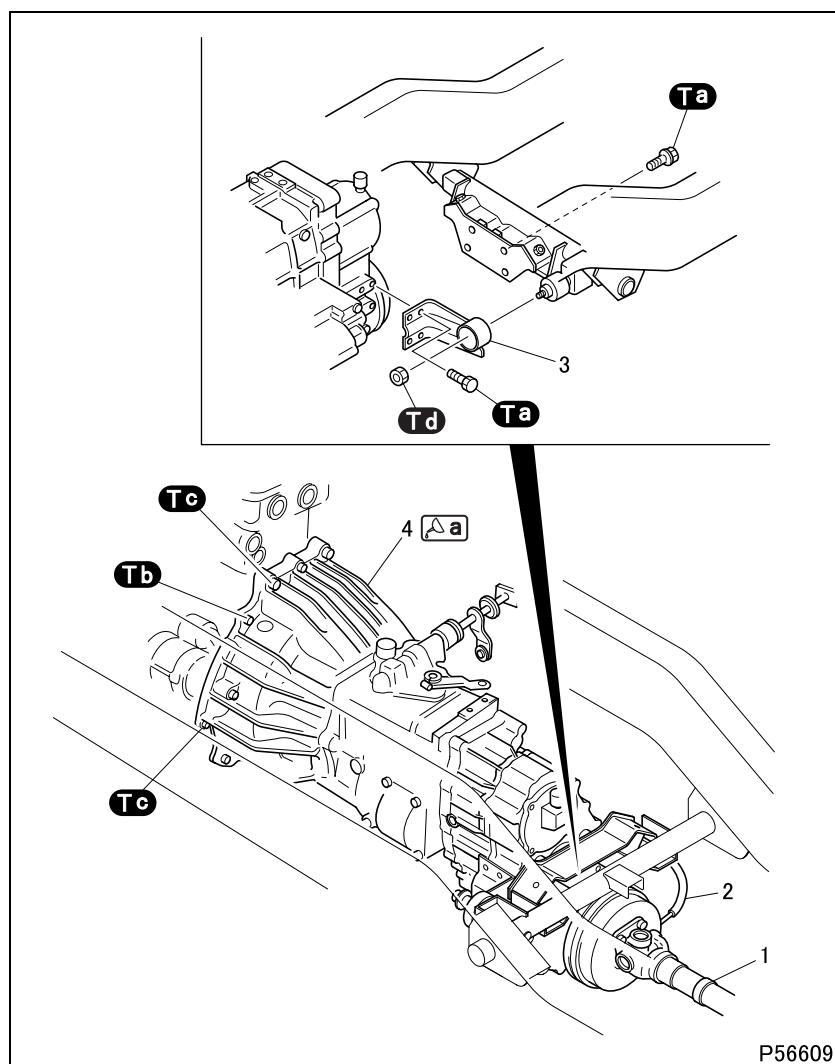
- When draining transfer oil, check for oil quality, metal chips and metal powder.
- If an abnormally large amount of metal chips and metal powder is found, disassemble the transfer assembly for service, as abnormalities may be caused inside.

[Replacement]

- Remove the drain plug to drain transfer oil. Drainage can be made quickly with the inspection plug removed.
- After draining transfer oil, apply sealant to the drain plug and tighten it to the specified torque. In case of the drain plug of magnet type, clean it before installation.
- Fill transfer oil of the specified quantity from the inspection plug hole.
- After filling, check that transfer oil is filled up to the neck. If oil is not sufficient, replenish it.
- After completing work, apply sealant to the inspection plug and tighten it to the specified torque.

M E M O

REMOVAL AND INSTALLATION OF TRANSMISSION (WITH TRANSFER)



● Removal sequence

- 1 Propeller shaft
- 2 Parking brake cable
- 3 Roll stopper bracket
- 4 Transmission

● Installation sequence

Follow the removal sequence in reverse.

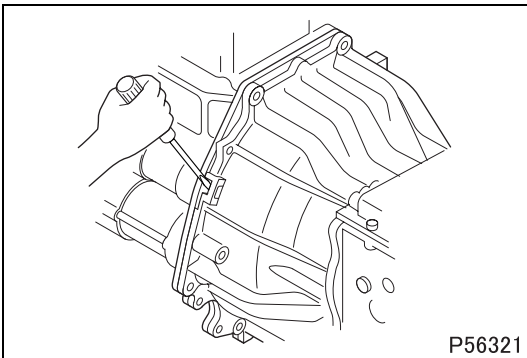
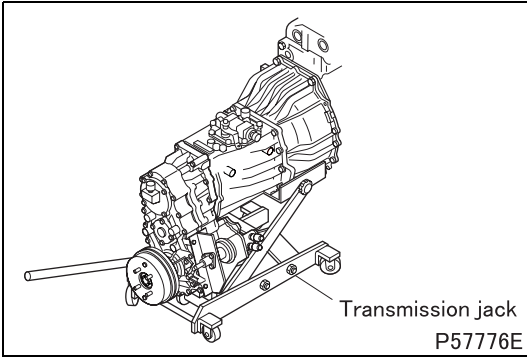
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Transmission mounting)	45 to 65 {33 to 48, 4.6 to 6.6}	–
Tb	Bolt (Transmission mounting)	47.1 {35, 4.8}	M10
Tc	Bolt (Transmission mounting)	82.4 {61, 8.4}	M12
Td	Nut (Roll stopper bracket mounting)	38 to 54 {28 to 40, 3.9 to 5.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Drive pinion spline	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required

◆ Removal procedure ◆



■ Removal: Transmission

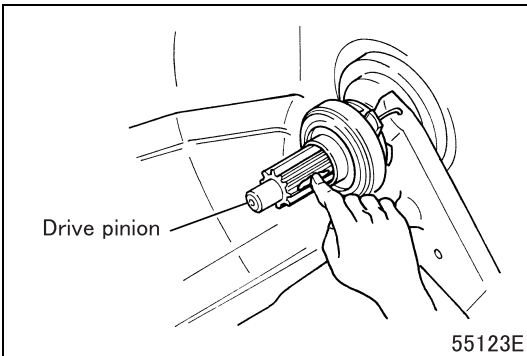
- Support the transmission on the transmission jack and remove transmission mounting bolts.

- Insert a screwdriver into the three removal grooves and pry the transmission from the engine.
- Move the transmission backward until the spline of the drive pinion is detached from the clutch.

CAUTION ⚠

- **Make sure that you pull the transmission out in a straight line. If you seesaw the transmission violently, you will damage the spline that connects the drive pinion and the clutch.**

◆ Installation procedure ◆

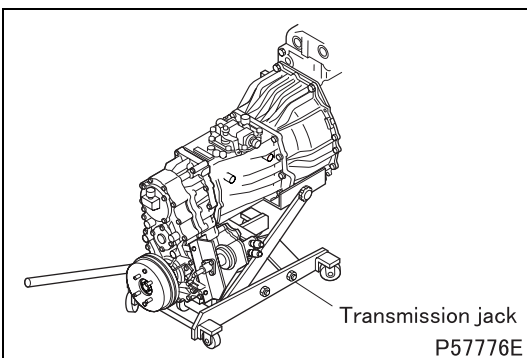


■ Installation: Transmission

- Check the spline of the drive pinion for rust.
- If rust is found, remove it using a wire brush.
- Rub grease evenly onto the clutch disc sliding surface of the drive pinion using your hand.

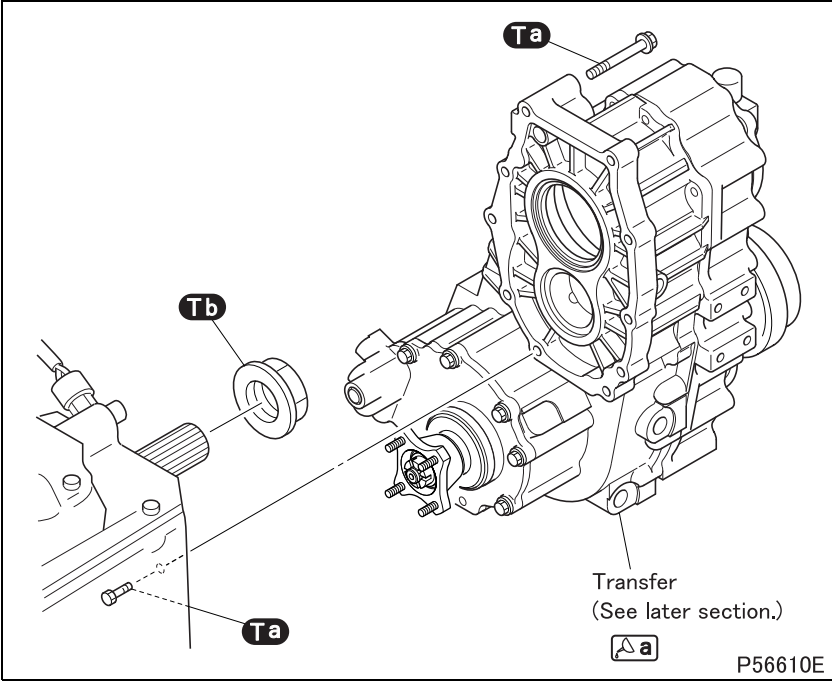
CAUTION ⚠

- **Make sure that you apply only the necessary amount of grease because too much grease would drip and cause clutch slip.**



- Support the transmission on the transmission jack, and insert the transmission into the pilot bearing of the flywheel paying attention to the drive pinion spline.
- Tighten transmission mounting bolts to the specified torque.

REMOVAL AND INSTALLATION OF TRANSFER



CAUTION ⚠

- Do not shake the transmission violently when removing the transfer from it, as doing so may damage the mainshaft end and gears.

NOTE

- The lock nut does not need to be removed if the transfer alone is removed.

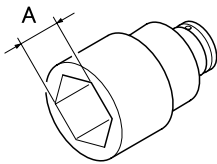
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Transfer mounting)	44.5 {33, 4.5}	–
Tb	Lock nut	490 ± 49 {360 ± 36, 50 ± 5}	–

Lubricant and/or sealant

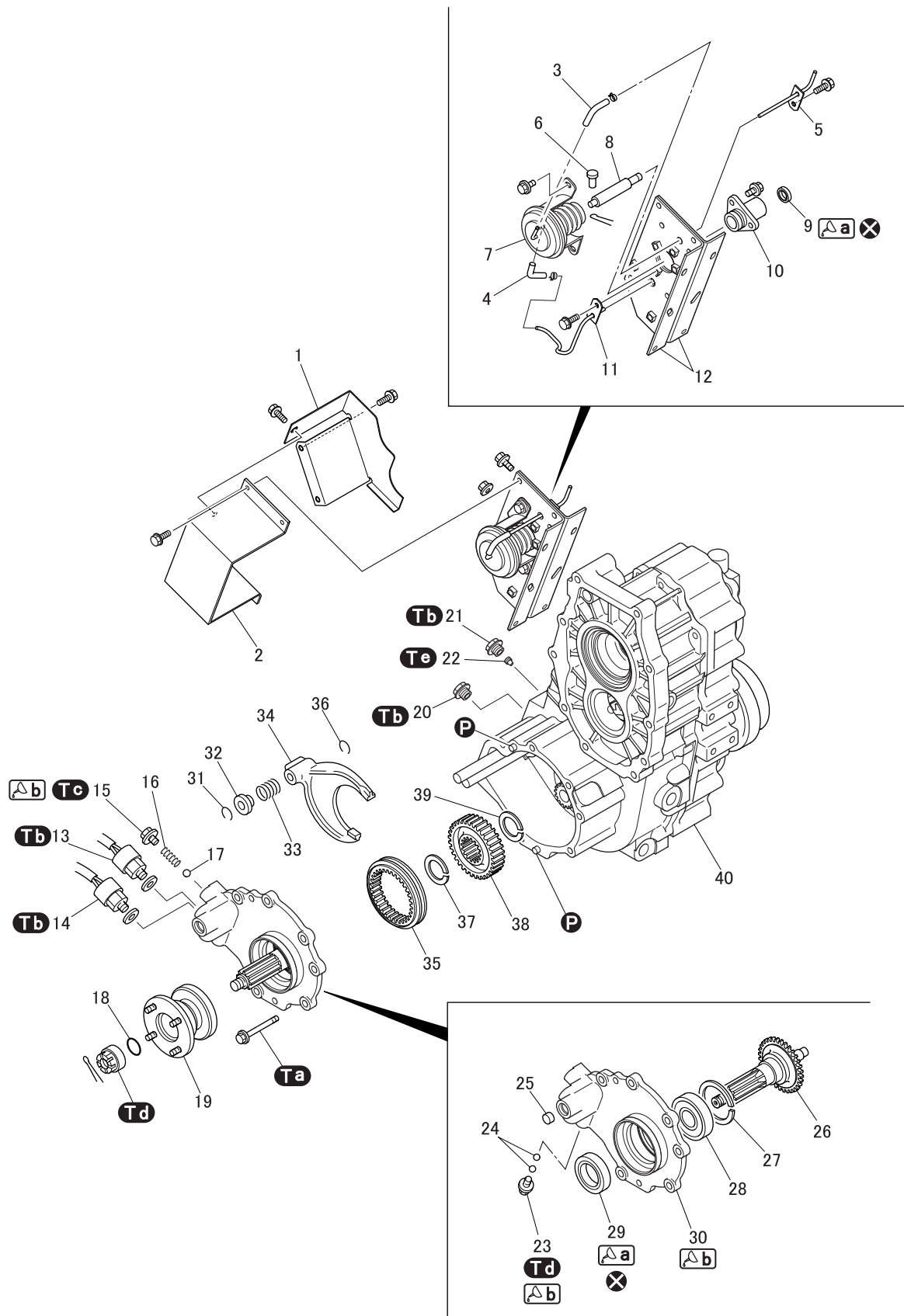
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Transmission mounting surface of transfer	THREEBOND 1215	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Socket wrench A 60 {2.36} 	MH063006	Removal and installation of lock nut

M E M O

FRONT DRIVE



● Disassembly sequence

1	Actuator rear cover	16	Poppet spring	31	Snap ring
2	Actuator front cover	17	Steel ball	32	Lug spring retainer
3	Vacuum hose	18	O-ring	33	Shift lug spring
4	Vacuum hose	19	Companion flange	34	Front drive shift fork
5	Pipe	20	Plug	35	Synchronizer sleeve
6	Clevis pin	21	Plug	36	Snap ring
7	Vacuum actuator	22	Set bolt	37	Snap ring
8	Shift rod	23	Screw plug	38	Front drive hub
9	Oil seal	24	Interlock ball	39	Snap ring
10	Shift rod bracket	25	Dust plug	40	Transfer (See later section.)
11	Pipe	26	Front drive shaft		
12	Actuator bracket	27	Snap ring		
13	High and low switch	28	Bearing	⊗	Non-reusable parts
14	Transfer four-wheel drive switch	29	Oil seal	Ⓟ	Locating pin
15	Screw plug	30	Front drive case cover		

● Assembly sequence

Follow the disassembly sequence in reverse except for the following.

23→24→25

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
7	Airtightness of vacuum actuator	63.3 kPa {18.7 in.Hg, 475 mmHg}	—	Replace
16	Poppet spring installed load (installed length 22 {0.87})	81 N {18 lbs, 8.26 kgf}	57 N {13 lbs, 5.8 kgf}	Replace
33	Shift lug spring installed load (installed length 20.6 {0.81})	22 N {5.0 lbs, 2.25 kgf}	15 N {3.5 lbs, 1.6 kgf}	Replace
34, 35	Clearance between front drive shift fork and synchronizer sleeve	0.3 to 0.5 {0.012 to 0.020}	1.0 {0.039}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

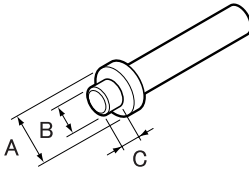
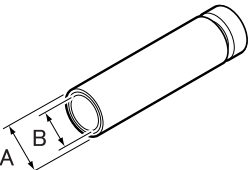
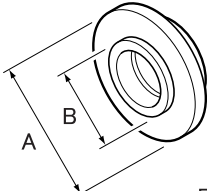
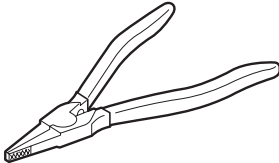
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Shift rail cover mounting)	44.5 {33, 4.5}	—
	Bolt (Front drive case cover mounting)		
Tb	High and low switch	34.3 ± 4.9 {25 ± 3.6, 3.5 ± 0.5}	—
	Transfer four-wheel drive switch		
	Plug		
Tc	Screw plug	39.2 {29, 4}	—
Td	Lock nut	294 ± 49 {215 ± 36, 30 ± 5}	—
Te	Set bolt	29.4 {22, 3}	After tightening, caulk it at three locations.

Lubricant and/or sealant

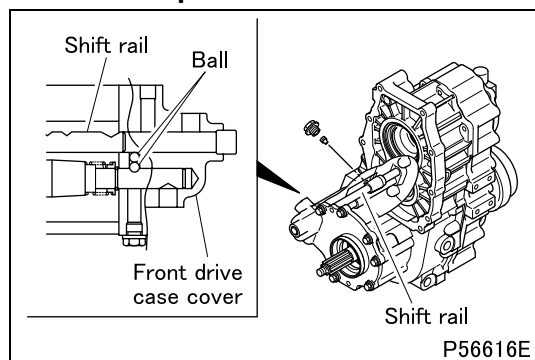
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
 b	Thread area of screw plug	THREEBOND 1215	As required
	Transfer mounting surface of front drive case cover		

FRONT DRIVE

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application						
	Oil seal installer <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ35 {1.38}</td><td>φ15.5 {0.61}</td><td>9 {0.35}</td></tr></tbody></table>  P56613	A	B	C	φ35 {1.38}	φ15.5 {0.61}	9 {0.35}	MH061923	Installation of oil seal
A	B	C							
φ35 {1.38}	φ15.5 {0.61}	9 {0.35}							
	Bearing installer <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ52 {2.05}</td><td>φ42 {1.65}</td></tr></tbody></table>  P56614	A	B	φ52 {2.05}	φ42 {1.65}	MB999104	Installation of oil seal		
A	B								
φ52 {2.05}	φ42 {1.65}								
	Differential bearing inner race installer adapter <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ88 {3.46}</td><td>φ50 {1.97}</td></tr></tbody></table>  P56615	A	B	φ88 {3.46}	φ50 {1.97}	MB999105			
A	B								
φ88 {3.46}	φ50 {1.97}								
	Snap ring expander  P01137	MH061268	Removal and installation of snap ring						

◆ Removal procedure ◆



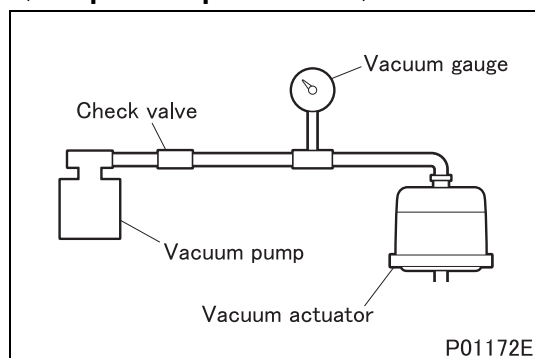
■ Removal: Front drive case cover

- After removing the plug and set bolt, displace the high and low shift rail to the illustrated position to remove the front drive case cover.

NOTE

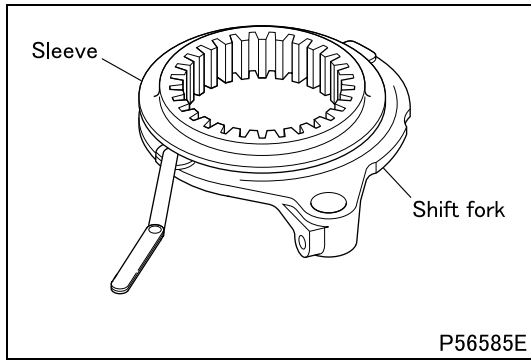
- Be careful that the interlock balls may fall when the front drive case cover is removed.

◆ Inspection procedure ◆



■ Inspection: Vacuum actuator

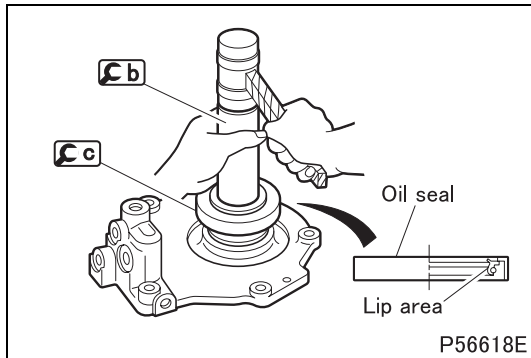
- Pipe the vacuum pump, check valve and vacuum gauge, apply negative pressure of 66.7 kPa {19.7 in.Hg, 500 mmHg} to the vacuum actuator, and stop the vacuum pump. After 15 seconds, measure the negative pressure with the vacuum gauge.
- If the measured value deviates from the standard value, replace the vacuum actuator.



■ **Inspection: Clearance between front drive shift fork and synchronizer sleeve**

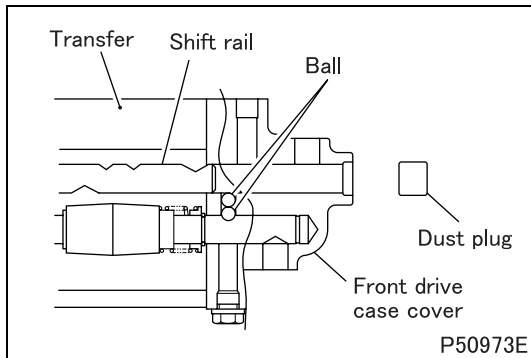
- If the measured value exceeds the limit, replace defective parts.

◆ **Installation procedure** ◆



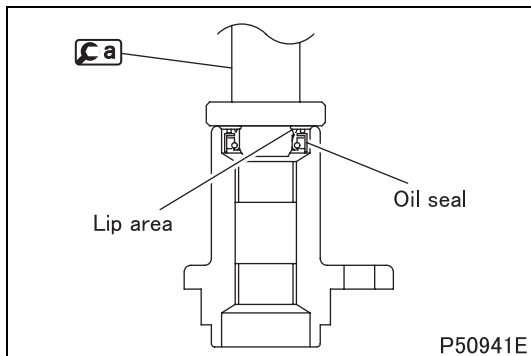
■ **Installation: Oil seal**

- Apply grease to the lip area of the oil seal and install it on the front drive case cover in the illustrated direction.



■ **Installation: Interlock ball**

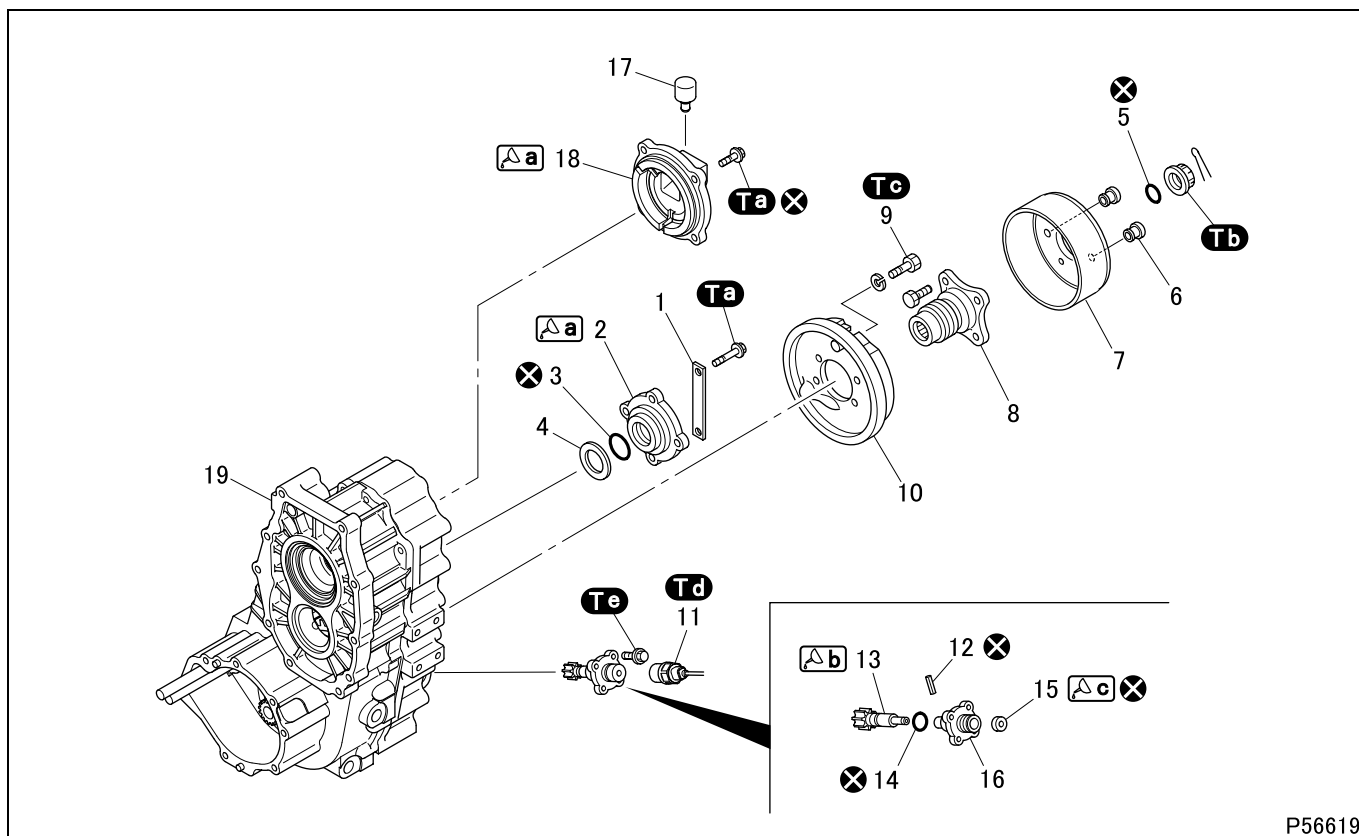
- Install the front drive case cover on the transfer.
- Push in the high and low shift rail to the illustrated position, and roll in the interlock balls from the dust plug to install.



■ **Installation: Oil seal**

- Apply grease to the lip area of the oil seal and install it in the illustrated direction.

REAR DRIVE



P56619

● Disassembly sequence

- | | |
|------------------------------|----------------------------------|
| 1 Plate | 12 Spring pin |
| 2 Idler rear cover | 13 Speedometer gear |
| 3 O-ring | 14 O-ring |
| 4 Shim | 15 Oil seal |
| 5 O-ring | 16 Speedometer gear bushing |
| 6 Dust plug | 17 Air breather |
| 7 Parking brake drum | 18 Input rear cover |
| 8 Companion flange | 19 Transfer (See later section.) |
| 9 Reamer bolt | |
| 10 Parking brake (See Gr36.) | |
| 11 Vehicle speed sensor | |

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Startup torque of idler gear bearing (measure with tangential force at outer diameter position of parking brake drum)		0 to 2 N·m {0 to 1.5 ft.lbs, 0 to 0.2 kgf·m} Tangential force: 0 to 26.9 N {0 to 20 ft.lbs, 0 to 2.7 kgf}	–	Adjust or replace
7	Parking brake drum	Inside diameter	$\phi 180^{+0.2}_{-0} \{7.09^{+0.0079}_{-0}\}$	$\phi 171 \{7.13\}$	Replace
		Out of square	0.05 {0.0020} or less	–	
		Concentricity	0.1 {0.0039} or less	–	
		Taper	0.1 {0.0039} or less	–	
		Static rotational imbalance	0.0049 N·m {0.004 ft.lbs, 0.5 gf·m} or less	–	
8	Runout at socket portion of companion flange		0.15 {0.0059} or less	0.5 {0.020}	Replace
13, 16	Clearance between speedometer gear and speedometer gear bushing		0.04 to 0.09 {0.0016 to 0.0035}	0.15 {0.0059}	Replace

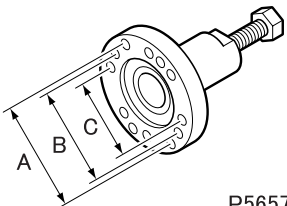
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Idler rear cover mounting)	44.5 {33, 4.5}	–
	Bolt (Input rear cover mounting)		
Tb	Lock nut	294 ± 49 {215 ± 36, 30 ± 5}	–
Tc	Reamer bolt	52 to 66.7 {38 to 49, 5.3 to 6.8}	–
Td	Vehicle speed sensor	14.7 to 29.4 {11 to 22, 1.5 to 3}	–
Te	Bolt (Speedometer gear bushing mounting)	23.2 {17, 2.4}	–

Lubricant and/or sealant

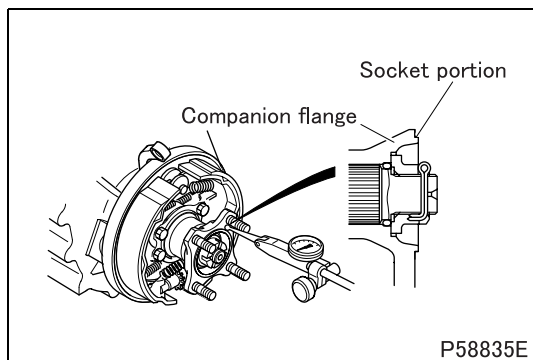
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Transfer mating surface of idler rear cover	THREEBOND 1215	As required
	Transfer mating surface of input rear cover		
	Speedometer gear bushing sliding area of speedometer gear	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required
	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application						
	Flange puller <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ95 {3.74}</td><td>φ100 {3.94}</td><td>φ90 {3.54}</td></tr></table>  P56577	A	B	C	φ95 {3.74}	φ100 {3.94}	φ90 {3.54}	MH061848	Removal of companion flange
A	B	C							
φ95 {3.74}	φ100 {3.94}	φ90 {3.54}							

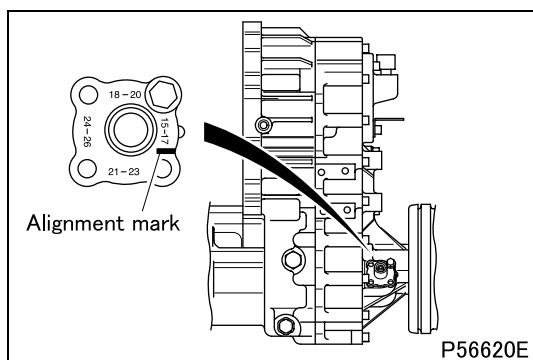
REAR DRIVE

◆ Work before removal ◆



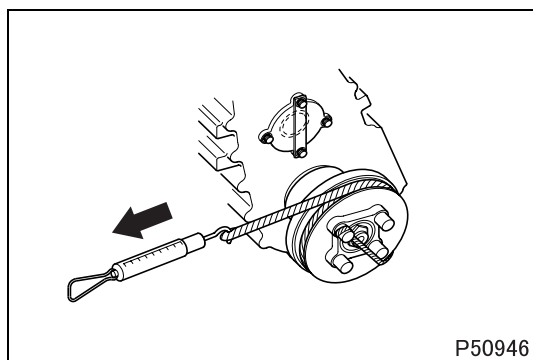
■ Inspection: Runout at socket portion of companion flange

- Measure runout at the socket portion of the companion flange.
- If the measured value exceeds the limit, replace the companion flange.



■ Alignment marks: Speedometer gear bushing

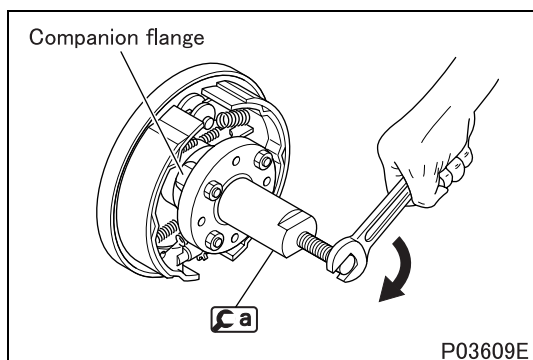
- The installed direction of the speedometer gear bushing is determined by the number of the speedometer gear tooth.
- Put alignment marks to prevent misassembly.



■ Inspection: Startup torque of idler gear bearing

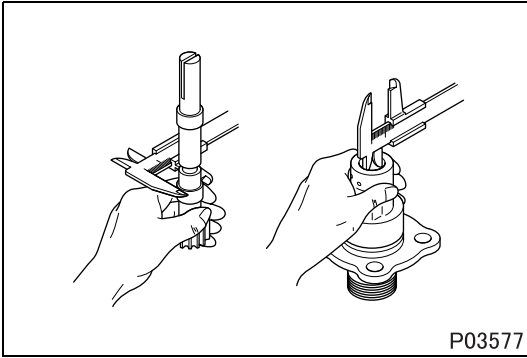
- Measure the tangential force at the outer diameter of the parking brake drum using a spring balancer.

◆ Removal procedure ◆



■ Removal: Companion flange

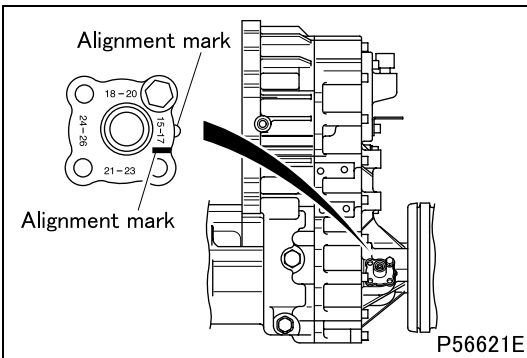
◆ Inspection procedure ◆



■ Inspection: Clearance between speedometer gear and speedometer gear bushing

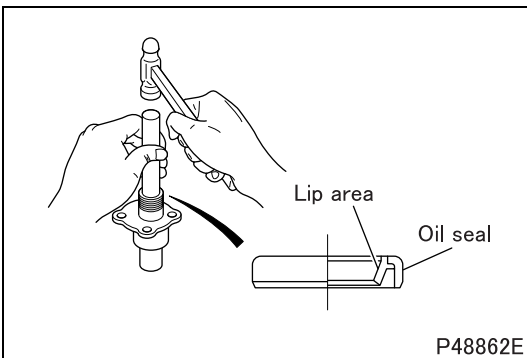
- If the clearance exceeds the limit, replace defective parts.

◆ Installation procedure ◆



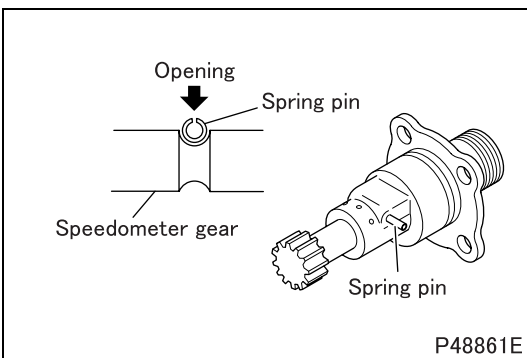
■ Installation: Speedometer gear bushing

- When replacing the speedometer gear bushing, align the alignment mark of the old part with that of the transfer to install.



■ Installation: Oil seal

- Apply grease to the lip area of the oil seal.
- Install the oil seal evenly in the illustrated direction using a round bar of outer diameter of approx. 15 mm {0.59 in.}.

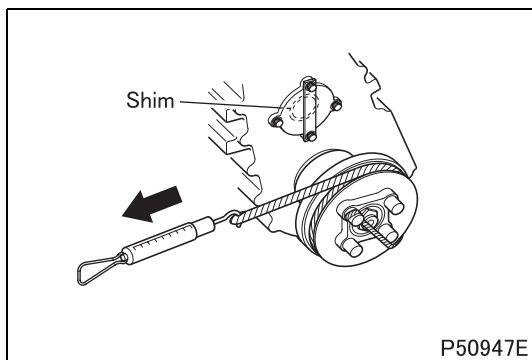


■ Installation: Spring pin

- Install the spring pin on the speedometer gear bushing in the illustrated direction.

REAR DRIVE

◆ Inspection after installation ◆



■ Inspection: Starting torque of pinion bearing

- Measure the tangential force at the outer diameter of the parking brake drum using a spring balancer.
 - If the tangential force meets the specified value, the startup torque becomes the standard value.
 - If the measured value deviates from the standard value, adjust by changing thickness of the shim.
- Kinds of shim: 0.10, 0.15, 0.20, 0.50 mm {0.0039, 0.0059, 0.0079, 0.020 in.}

M E M O



● Disassembly sequence

- | | |
|---|---|
| 1 Oil seal | 11 Set bolt |
| 2 Oil seal | 12 Shift rail stopper |
| 3 Oil seal | 13 Front drive shift rail |
| 4 Transfer case | 14 Transfer driven rear shaft (See later section.) |
| 5 Transfer idler gear (See later section.) | 15 Oil gutter |
| 6 Transfer drive gear (See later section.) | 16 Oil seal |
| 7 Speedometer worm | 17 Transfer case |
| 8 Pin | |
| 9 High and low shift fork | P : Locating pin |
| 10 High and low shift rail | X : Non-reusable parts |

● Assembly sequence

Follow the disassembly sequence in reverse.
24-22

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	End play	Driven rear shaft low gear	0.25 to 0.40 {0.0098 to 0.016}	0.6 {0.024}	Replace
		Driven rear shaft high gear			
9	Tilt of high and low shift fork claws		0.1 {0.0039} or less	0.2 {0.0079}	Replace
9, 14	Clearance between high and low shift fork and synchronizer sleeve of transfer driven rear shaft		0.3 to 0.5 {0.012 to 0.020}	1.0 {0.039}	Replace
10, 13	Bend of shift rail		0.02 {0.00079} or less	0.03 {0.0012}	Correct or replace

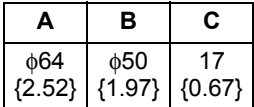
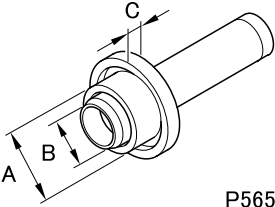
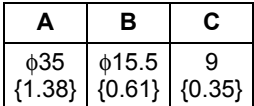
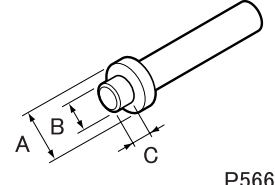
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Transfer cover mounting)	44.5 {33, 4.5}	–
Tb	Set bolt	29.4 {22, 3}	After tightening, caulk it at three locations.

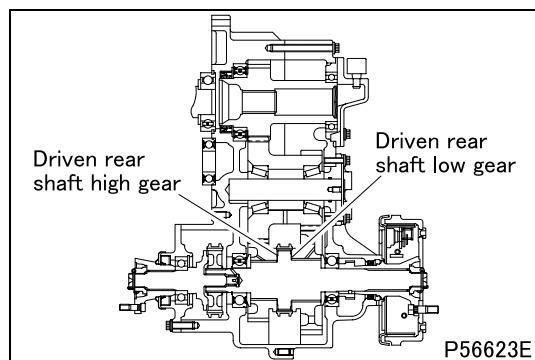
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Transfer case mating surface of transfer cover	THREEBOND 1215	As required
 b	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
 a	Oil seal installer   P56578	MH062691	Installation of oil seal
 b	Oil seal installer   P56613	MH061923	Installation of oil seal

◆ Work before removal ◆

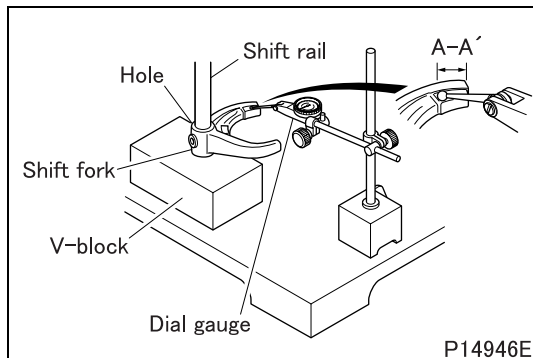


■ Inspection: End play of gears

- If the measured value exceeds the limit, replace defective parts.
- Check the play again after assembly and make sure it does not exceed the limit.

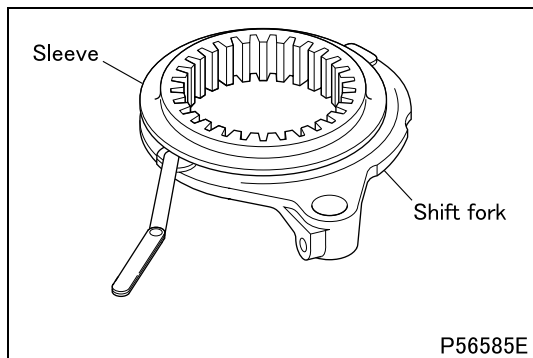
TRANSFER

◆ Inspection procedure ◆



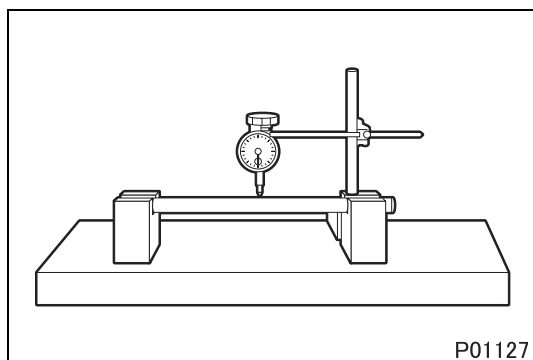
■ Inspection: Tilt of high and low shift fork claws

- Measure the tilt (difference between **A** and **A'**) of claw **A-A'** of the high and low shift fork against the high and low shift rail hole with the shift rail upright.
- If the measured value exceeds the limit, replace the high and low shift fork.



■ Inspection: Clearance between high and low shift fork and synchronizer sleeve of transfer driven rear shaft

- Measure clearance between the shift fork claws and synchronizer sleeve groove.
- If the measured value exceeds the limit, replace defective parts.



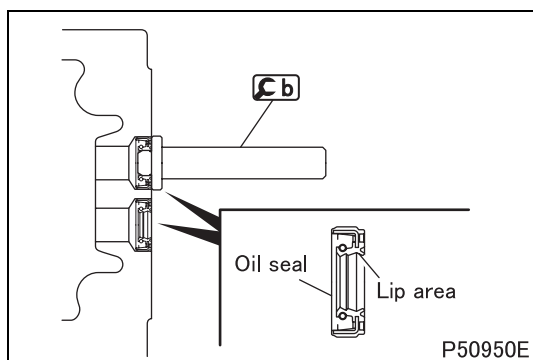
■ Inspection: Bend of shift rail

- Measure the extent of bending at the middle of the shift rail.
- If the measured value exceeds the limit, correct or replace defective parts.

NOTE

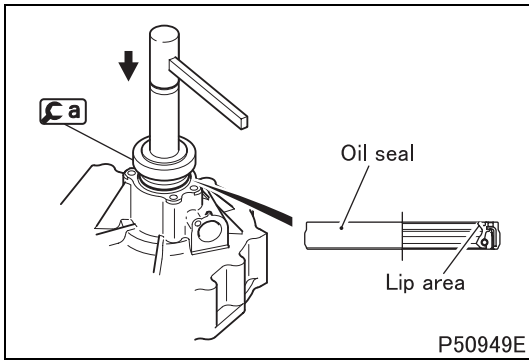
- Give the shift rail one complete turn and read the dial gauge at that time. The extent of bending is half of the reading.

◆ Installation procedure ◆



■ Installation: Oil seal

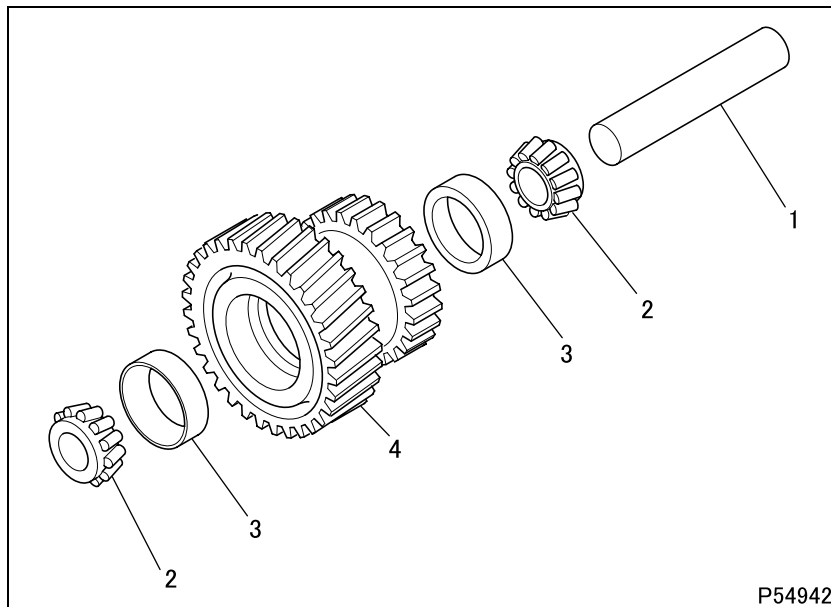
- Apply grease to the lip area of the oil seal and install it on the transfer cover in the illustrated direction.

**■ Installation: Oil seal**

- Apply grease to the lip area of the oil seal and install it on the transfer cover in the illustrated direction.

TRANSFER

Transfer idler gear



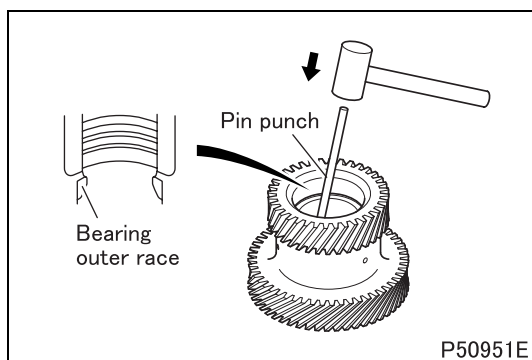
● Disassembly sequence

- 1 Transfer idler shaft
- 2 Bearing inner race
- 3 Bearing outer race
- 4 Transfer idler gear

● Assembly sequence

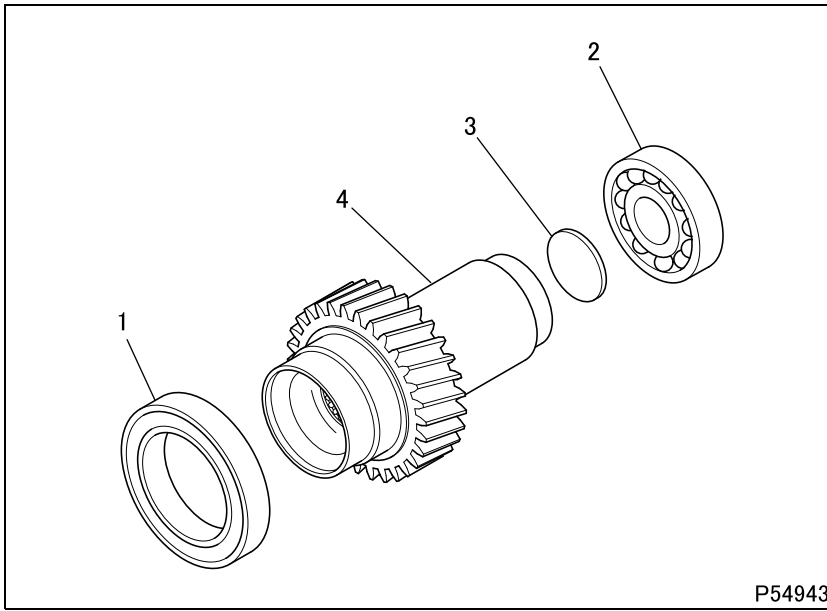
Follow the disassembly sequence in reverse.

◆ Removal procedure ◆



■ Removal: Bearing outer race

- Evenly tap the bearing outer race to take it out from the transfer idler gear.

Transfer drive gear**● Disassembly sequence**

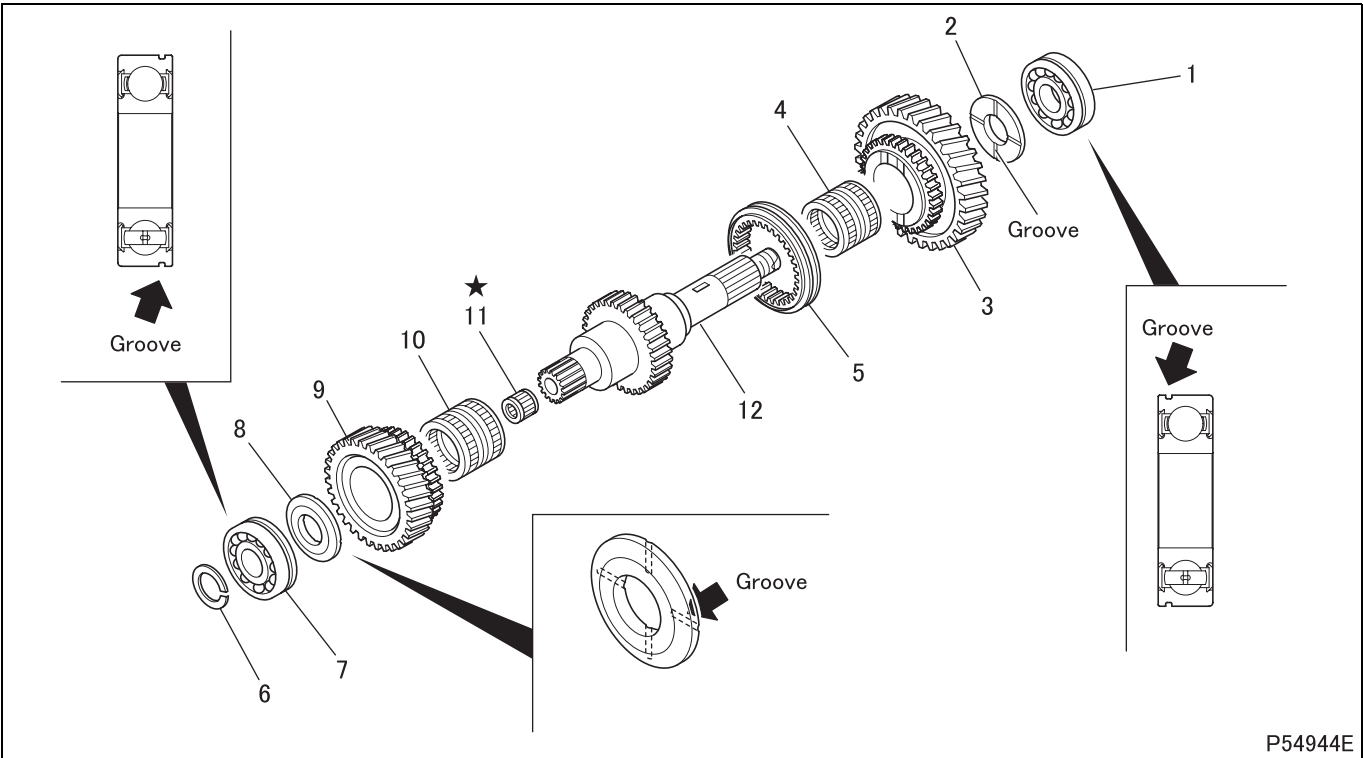
- 1 Bearing
- 2 Bearing
- 3 Plug
- 4 Transfer drive gear

● Assembly sequence

Follow the disassembly sequence in reverse.

TRANSFER

Transfer driven rear shaft



● Disassembly sequence

- | | |
|------------------------------|-------------------------------|
| 1 Bearing | 7 Bearing |
| 2 Thrust washer | 8 Thrust washer |
| 3 Driven rear shaft low gear | 9 Driven rear shaft high gear |
| 4 Needle bearing | 10 Needle bearing |
| 5 Synchronizer sleeve | 11 Needle bearing |
| 6 Snap ring | 12 Transfer driven shaft |

NOTE

- Do not remove the needle bearing marked with ★ from the transfer driven rear shaft unless any abnormality is found.

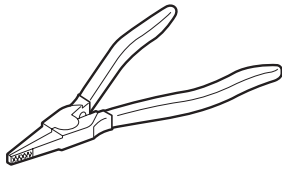
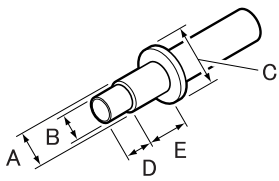
● Assembly sequence

Follow the disassembly sequence in reverse.

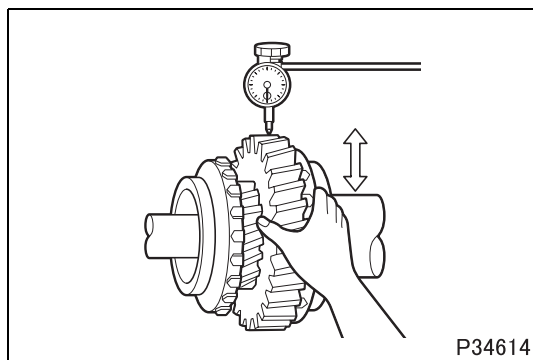
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Play of transfer driven rear shaft in diameter direction	0.02 to 0.06 {0.00079 to 0.0024}	0.12 {0.0047}	Replace

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application										
	Snap ring expander  P01137	MH061268	Removal and installation of snap ring										
	Needle roller bearing installer  P56625 <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th></tr></thead><tbody><tr><td>φ18.5 {0.73}</td><td>φ13 {0.51}</td><td>φ40 {1.57}</td><td>15 {0.59}</td><td>28 {1.10}</td></tr></tbody></table>	A	B	C	D	E	φ18.5 {0.73}	φ13 {0.51}	φ40 {1.57}	15 {0.59}	28 {1.10}	MH061927	Installation of needle bearing
A	B	C	D	E									
φ18.5 {0.73}	φ13 {0.51}	φ40 {1.57}	15 {0.59}	28 {1.10}									

◆ Inspection before removal ◆



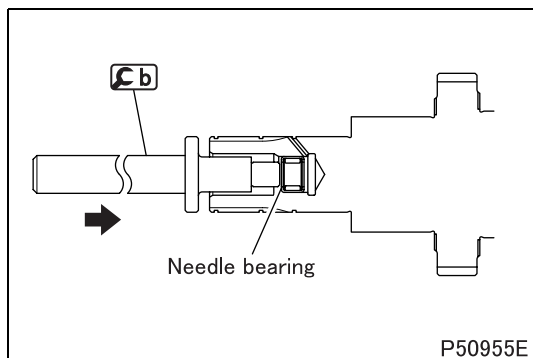
■ Inspection: Play of driven rear shaft gears in diameter direction

- If the measured value exceeds the limit, replace defective parts.
- Check the play again after assembly and make sure it does not exceed the limit.

NOTE

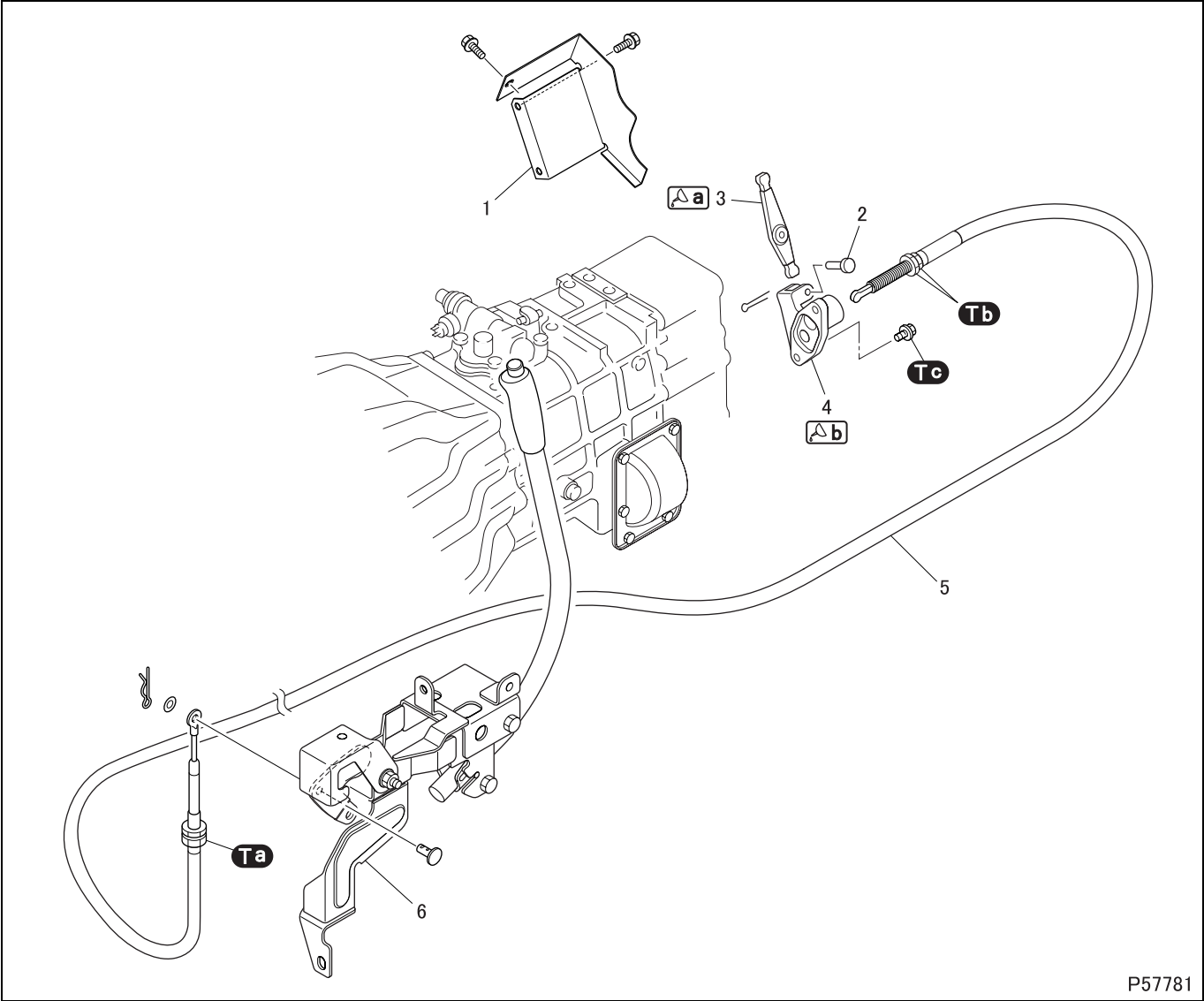
- When either of the needle bearings of a gear needs to be replaced, replace both of them at the same time. Make sure the new needle bearings have the same package color.

◆ Installation procedure ◆



■ Installation: Needle bearing

TRANSFER CONTROL



● Disassembly sequence

- | | |
|-----------------------------|---|
| 1 Actuator rear cover | 4 Shift rail cover |
| 2 Clevis pin | 5 Transfer control cable |
| 3 Transfer gear shift lever | 6 Transfer control lever (See later section.) |

● Assembly sequence

Follow the disassembly sequence in reverse.

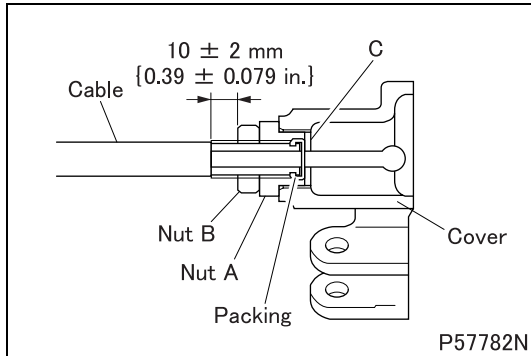
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut of transfer control cable on transfer control lever	28.7 to 38.7 {21 to 29, 2.9 to 3.9}	—
Tb	Lock nut of transfer control cable on transfer body	44 to 59 {32 to 44, 4.5 to 6.0}	—
Tc	Bolt (shift rail cover mounting)	44.5 {33, 4.5}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Both ends and fulcrum of transfer gear shift lever	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
 b	Transfer mounting surface of shift rail cover	THREEBOND 1215	As required

◆ Installation procedure ◆

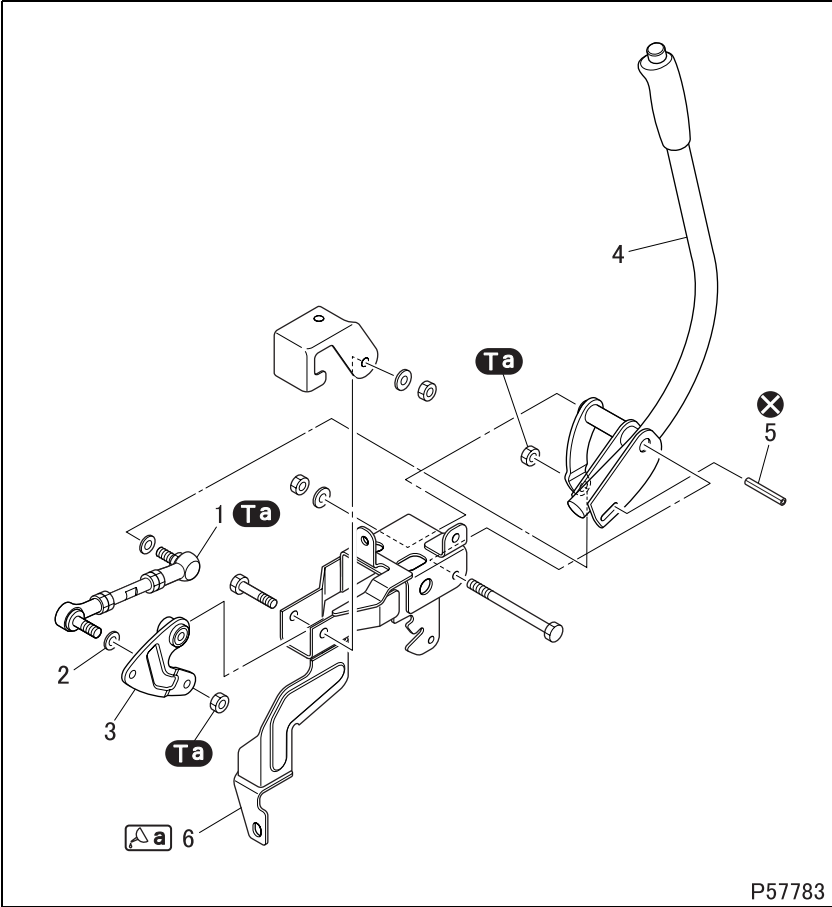


■ Installation: Transfer control cable

- Install the cable in the shift rail cover being careful not to let the packing project from surface C in the cover, and then tighten nut A to the specified torque.
- Tighten nut B to the specified torque and to the dimension indicated in the illustration.

TRANSFER CONTROL

Transfer control lever



Disassembly sequence

- 1 Rod
- 2 Lever
- 3 Transfer lever
- 4 Spring pin
- 5 Transfer control bracket

⊗: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

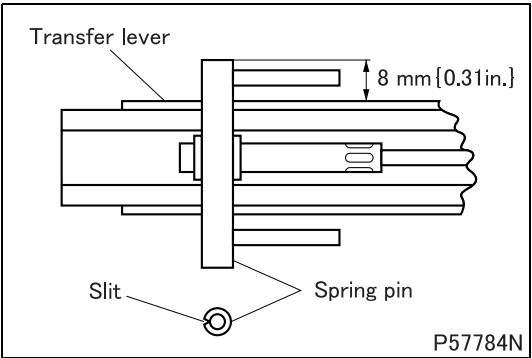
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Rod mounting)	39 to 50 {29 to 37, 4.0 to 5.1}	—
Tb	Lock nut of rod	18.6 to 27.5 {14 to 20, 1.9 to 2.8}	

Lubricant and/or sealant

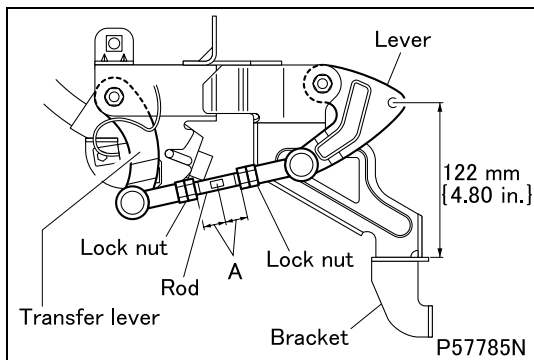
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Spring pin mating area of transfer control bracket	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Installation procedure



Installation: Spring pin

- Install the spring pin so that the protruding distance from the transfer lever in the illustrated direction and the slit are as illustrated.



■ Installation: Rod

- Install the rod on the lever and transfer lever.
- Loosen the lock nuts on the rod and turn the rod until the distance between the lever and transfer control bracket is as indicated in the illustration. Make sure that distance A in the illustration does not exceed 32.3 mm {1.27 in.}.
- Tighten the lock nuts after the above adjustment.



Group 25

Propeller Shaft

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	25-2
STRUCTURE AND OPERATION	
1. Configuration of Propeller Shaft Connection	25-2
2. Propeller Shaft <without Center Bearing>	25-3
3. Propeller Shaft <with Center Bearing>	25-4
TROUBLESHOOTING	25-5
REMOVAL AND INSTALLATION OF PROPELLER SHAFT	
<BETWEEN T/M (OR T/F) AND REAR AXLE>	25-6
REMOVAL AND INSTALLATION OF PROPELLER SHAFT	
<BETWEEN FRONT AXLE AND T/F>	25-10
PROPELLER SHAFT <P2>	25-12
PROPELLER SHAFT <P3>	25-18

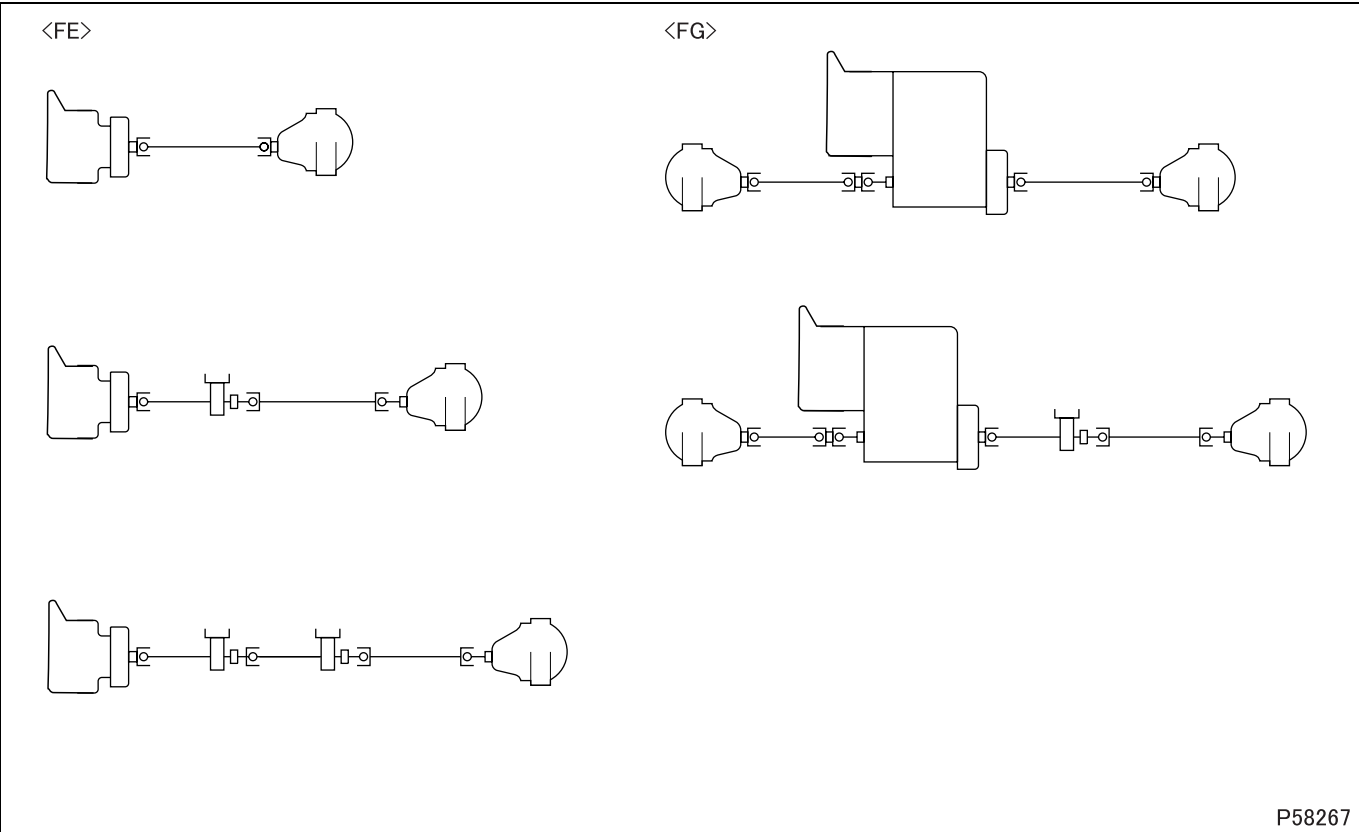
SPECIFICATIONS / STRUCTURE AND OPERATION

SPECIFICATIONS

Item		Specifications	
		FG84DC <Front axle>	FE, FG
Propeller shaft	Model	P2	P3

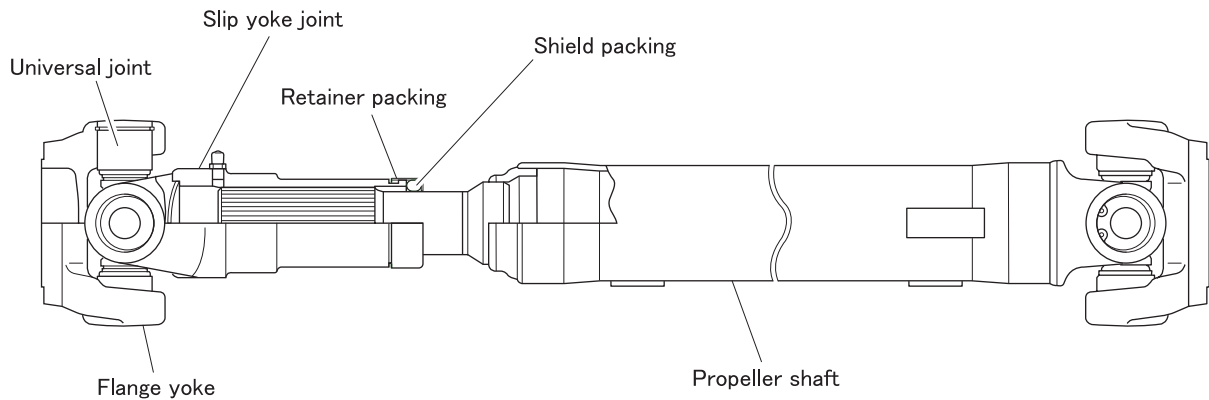
STRUCTURE AND OPERATION

1. Configuration of Propeller Shaft Connection



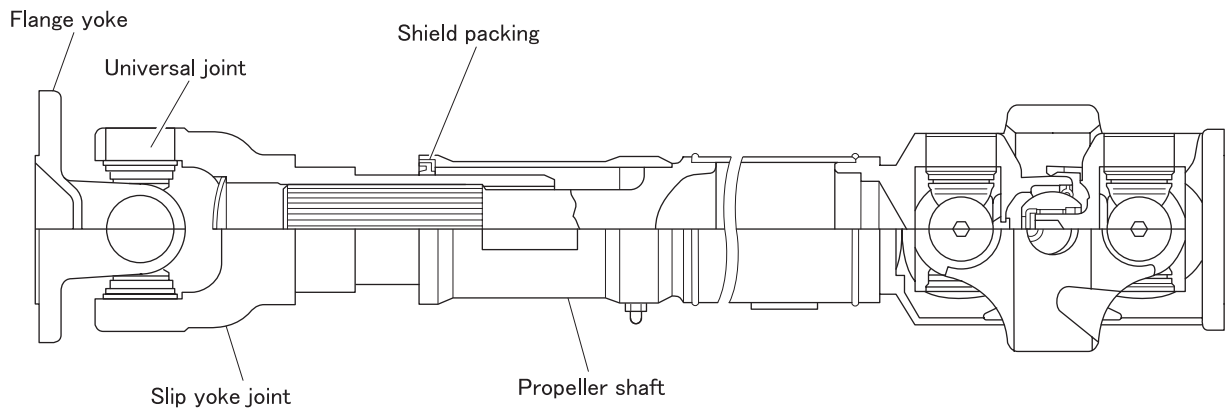
2. Propeller Shaft <without Center Bearing>

<Except double Cardan type>



P48635E

<Double Cardan type>

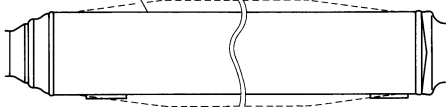


P48633E

- Propeller shafts used with FG84 front axles are of double Cardan type suited for suppressing vibrations caused by angle changes in universal joint.

Straight type
(standard)

Swage type

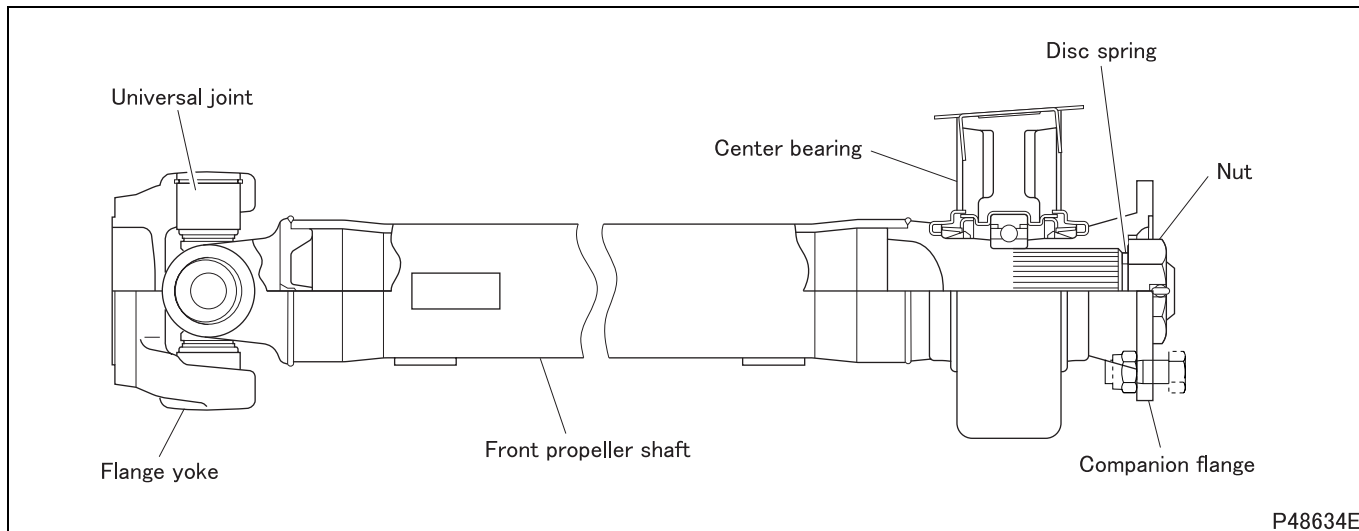


03278E

- Propeller shafts are available in straight (standard) type and swage type.

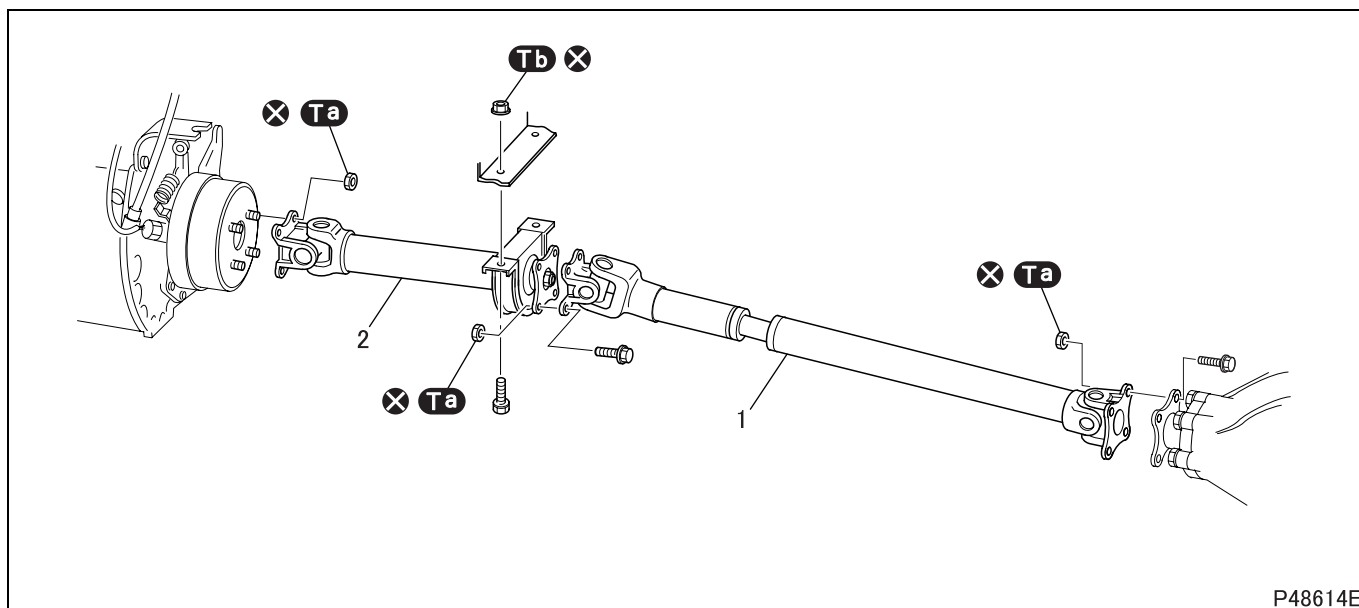
STRUCTURE AND OPERATION

3. Propeller Shaft <with Center Bearing>



Symptoms		Propeller shaft vibrates		Abnormal noise from propeller shaft	
		Vibration at high speed	Vibration at low speed	Abnormal noise at acceleration from zero or at coasting	Abnormal noise at normal running
Possible causes					
Wrong combination of flange yoke directions		O			
Slip yoke joint	Insufficient grease				O
	Excessive play at spline		O	O	
Universal joint	Excessive clearance in axial direction of spider shaft		O		O
	Insufficient needle bearing greasing				O
	Worn out needle bearing	O		O	O
Center bearing	Insufficient grease				O
	Seizure, wear or improper rotation	O			O
	Deteriorated or deformed cushion rubber			O	
	Loose hanger mounting bolt			O	
Propeller shaft	Loose mounting bolts	O		O	
	Bent	O			
	Dynamic balance improper	O			
T/M in high speed gear			O		

REMOVAL AND INSTALLATION OF PROPELLER SHAFT <BETWEEN T/M (OR T/F) AND REAR AXLE>



P48614E

Shown above is a tandem propeller shaft for FE. The illustration applies to other propeller shafts.

● Removal sequence

- 1 Propeller shaft <without center bearing> (See later section.)
- 2 Propeller shaft <with center bearing> (See later section.)

⊗: Non-reusable parts

CAUTION ⚠

- Securely chock the wheels so that the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.

● Installation sequence

Follow the removal sequence in reverse.

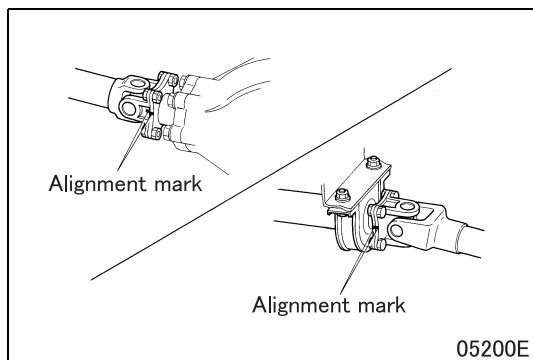
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Permissible amount of unbalance of propeller shaft <without center bearing>	10 g {0.35 oz.} max./3000 rpm (periphery of pipe portion of shaft)	—	Adjust
2	Permissible amount of unbalance of propeller shaft <with center bearing>	5 g {0.18 oz.} max./3000 rpm (periphery of pipe portion of shaft)	—	Adjust

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Propeller shaft mounting)	100 to 120 {74 to 89, 10 to 12}	—
Tb	Nut (Front propeller shaft hanger mounting)	47 to 65 {35 to 48, 4.8 to 6.6}	—

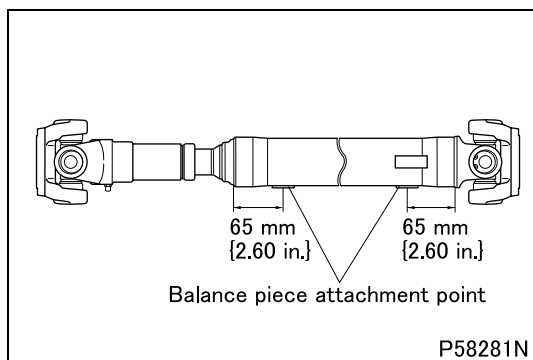
◆ Work before removal ◆



■ Alignment mark: Propeller shaft

- Be sure to make alignment marks before removal.

◆ Inspection procedure ◆



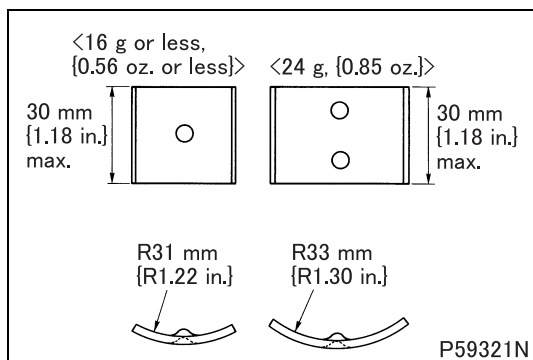
■ Inspection: Propeller shaft <without center bearing>

[Inspection]

- Measure the amount of balance (dynamic balance) of completed propeller shaft on a balancing machine.
- If measured value exceeds the standard value, make adjustment as follows.

[Adjustment]

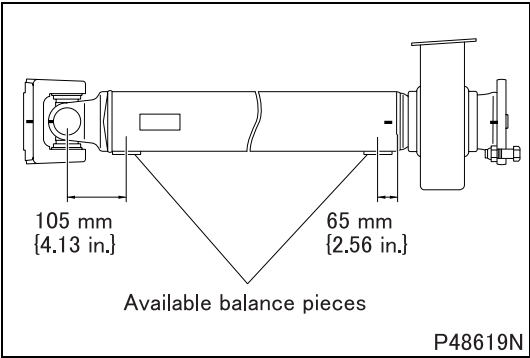
- Attach appropriate balance pieces at the illustrated points so that the amount of unbalance comes within the specified standard value.
- Maximum balance piece allowance for one point is 100 g {3.53 oz.}.
- Use a combination that keeps the number of balance pieces to a minimum.



Available balance pieces

Mass
2 g {0.071 oz.}
4 g {0.14 oz.}
6 g {0.21 oz.}
8 g {0.28 oz.}
10 g {0.35 oz.}
12 g {0.42 oz.}
16 g {0.56 oz.}
24 g {0.85 oz.}

REMOVAL AND INSTALLATION OF PROPELLER SHAFT <BETWEEN T/M (OR T/F) AND REAR AXLE>



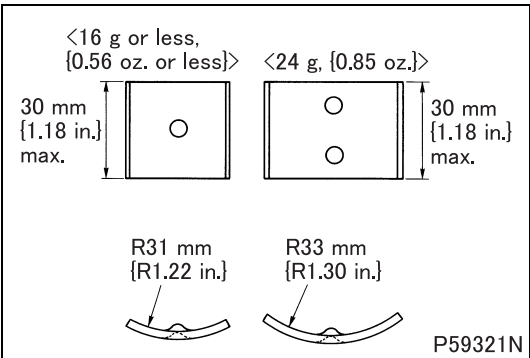
■ Inspection: Propeller shaft <with center bearing>

[Inspection]

- Measure the amount of balance (dynamic balance) of completed propeller shaft on a balancing machine.
- If measured value exceeds the standard value, make adjustment as follows.

[Adjustment]

- Attach appropriate balance pieces at the illustrated points so that the amount of unbalance comes within the standard value.
- Maximum balance piece allowance for one point is 100 g {3.53 oz.}.
- Use a combination that keeps the number of balance pieces to a minimum.

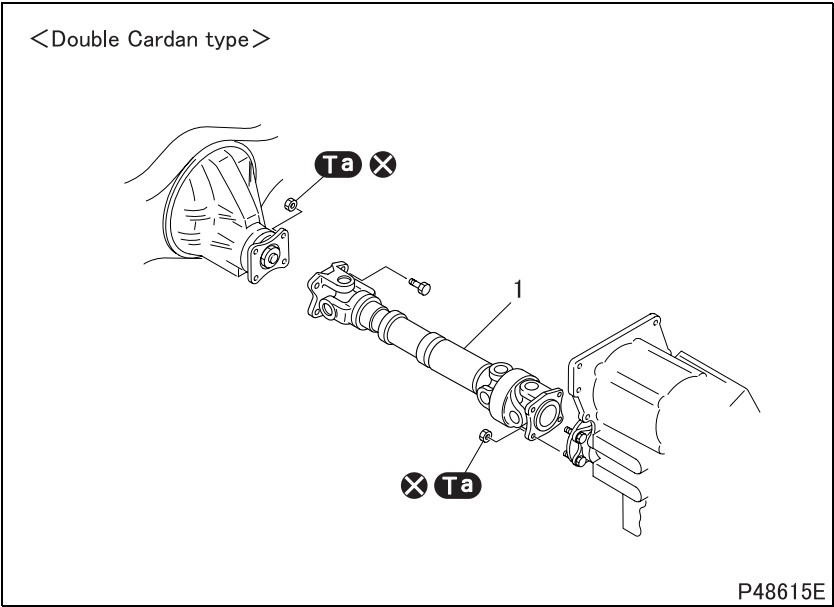


Available balance pieces

Mass
2 g {0.071 oz.}
4 g {0.14 oz.}
6 g {0.21 oz.}
8 g {0.28 oz.}
10 g {0.35 oz.}
12 g {0.42 oz.}
16 g {0.56 oz.}
24 g {0.85 oz.}

M E M O

REMOVAL AND INSTALLATION OF PROPELLER SHAFT <BETWEEN FRONT AXLE AND T/F>



● Removal sequence

- 1 Propeller shaft (See later pages.)

⊗: Non-reusable parts

CAUTION ⚠

- Securely chock the wheels so that the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.

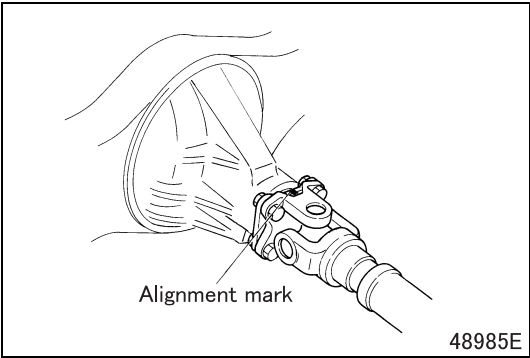
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Permissible amount of unbalance of propeller shaft	10 g {0.35 oz.} max./3000 rpm (periphery of pipe portion of shaft)	—	Adjust

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Propeller shaft mounting)	60 to 75 {44 to 55, 6.1 to 7.6}	—

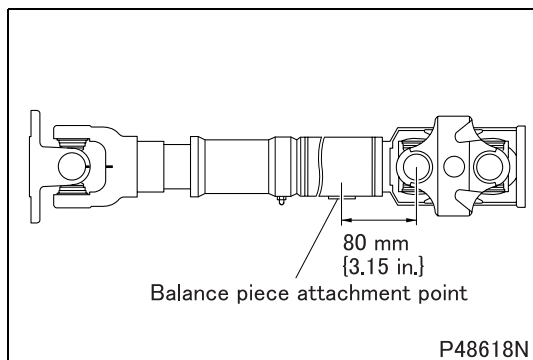
◆ Work before removal ◆



■ Alignment mark: Propeller shaft

- Be sure to make alignment marks before removal.

◆ Inspection procedure ◆



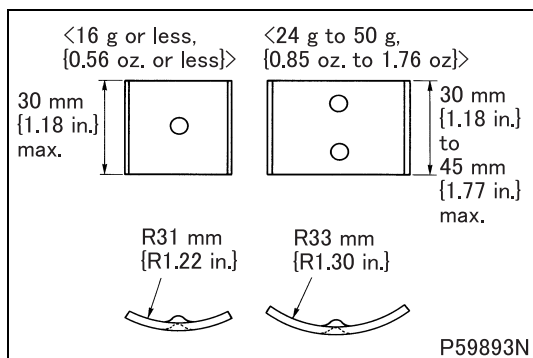
■ Inspection: Propeller shaft

[Inspection]

- Measure the amount of balance (dynamic balance) of completed propeller shaft assembly on a balancing machine.
- If measured value exceeds the standard value, make adjustment as follows.

[Adjustment]

- Attach appropriate balance pieces at the illustrated points so that the amount of unbalance comes within the specified standard value.
- Maximum balance piece allowance for one point is 100 g {3.53 oz.}.
- Use a combination that keeps the number of balance pieces to a minimum.

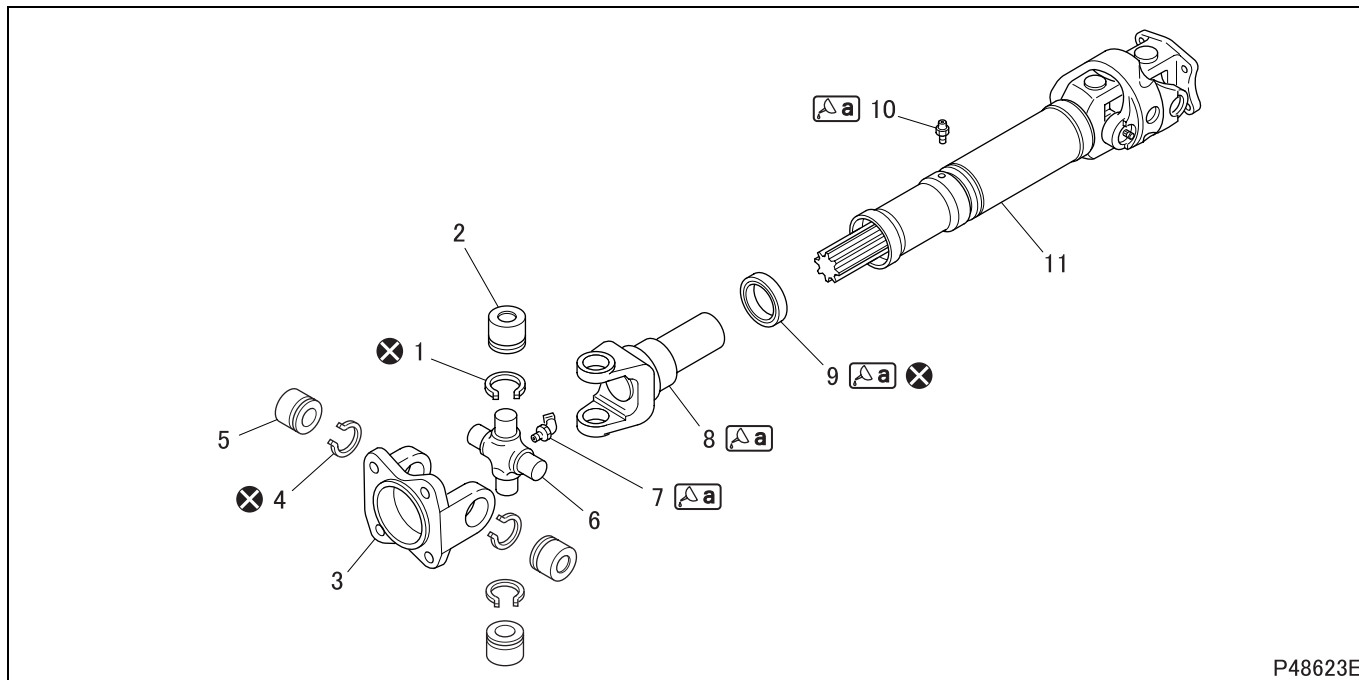


• Available balance pieces

Mass
2 g {0.071 oz.}
4 g {0.14 oz.}
6 g {0.21 oz.}
8 g {0.28 oz.}
10 g {0.35 oz.}
12 g {0.42 oz.}
16 g {0.56 oz.}
24 g {0.85 oz.}
30 g {1.06 oz.}
35 g {1.23 oz.}
40 g {1.41 oz.}
45 g {1.59 oz.}
50 g {1.76 oz.}

PROPELLER SHAFT <P2>

<Without center bearing>



● Disassembly sequence

- | | | |
|------------------|-------------------|--------------------|
| 1 Snap ring | 5 Needle bearing | 9 Shield packing |
| 2 Needle bearing | 6 Spider | 10 Grease nipple |
| 3 Flange yoke | 7 Grease nipple | 11 Propeller shaft |
| 4 Snap ring | 8 Slip yoke joint | |
- ⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Universal joint spider kit

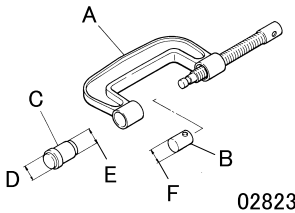
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Axial clearance of spider	0 to 0.06 {0 to 0.0024}	–	Adjust
3, 5	Clearance between needle bearing and flange yoke	–0.003 to –0.037 {–0.00012 to –0.0015}	0.1 {0.0039}	Replace
2, 5, 6	Play between needle bearing and spider	0.02 to 0.05 {0.00079 to 0.0020}	0.1 {0.0039}	Replace
2, 8	Clearance between needle bearing and slip joint	–0.003 to –0.037 {–0.00012 to –0.0015}	0.1 {0.0039}	Replace
8, 11	Play in rotating direction between slip yoke joint and propeller shaft spline	0.01 to 0.09 {0.00039 to 0.0035}	0.3 {0.012}	Replace
	Play in diametric direction between slip yoke joint and propeller shaft spline	0.02 to 0.16 {0.00079 to 0.0063}	0.3 {0.012}	Replace
11	Bend of propeller shaft	–	0.4 {0.016}	Correct or replace

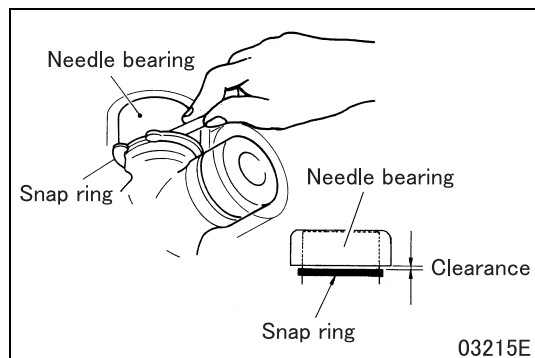
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Supply through grease nipple	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Shield packing contact surface of slip yoke joint		
	Shield packing lips		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application			
 a	Universal joint tool set A: Yoke assembly B: Push rod C: Guide	MB999024 A: MB999025 B: MB999026 C: MB999010	Removal and installation of needle bearing			
	<table border="1"><thead><tr><th>D</th><th>E</th><th>F</th></tr></thead><tbody><tr><td>φ29 {1.14}</td><td>φ29 {1.14}</td><td>φ27.7 {1.09}</td></tr></tbody></table> 			D	E	F
D	E	F				
φ29 {1.14}	φ29 {1.14}	φ27.7 {1.09}				

◆ Work before removal ◆



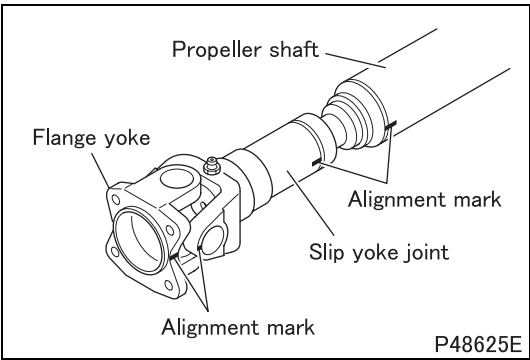
■ Inspection: Axial clearance of spider

- Press down on the needle bearing, and measure clearances between snap ring and flange yoke, slip yoke joint and propeller shaft.
- If measured value exceeds the standard value, change snap ring thickness for adjustment.
To adjust, use snap rings for both ends with the same thickness. Select optimal combination of snap rings from the table below if necessary.

PROPELLER SHAFT <P2>

Variety and combination of snap rings (solid line indicates best combination)

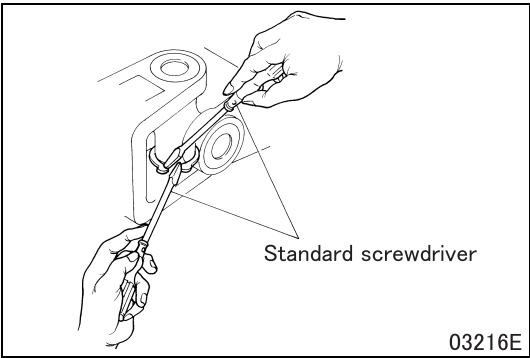
Thickness	Identification color	Combination	Thickness	Identification color
1.5 mm {0.059 in.}	None		1.5 mm {0.059 in.}	None
1.55 mm {0.061 in.}	Yellow		1.55 mm {0.061 in.}	Yellow
1.6 mm {0.063 in.}	Blue		1.6 mm {0.063 in.}	Blue
1.65 mm {0.065 in.}	Purple		1.65 mm {0.065 in.}	Purple



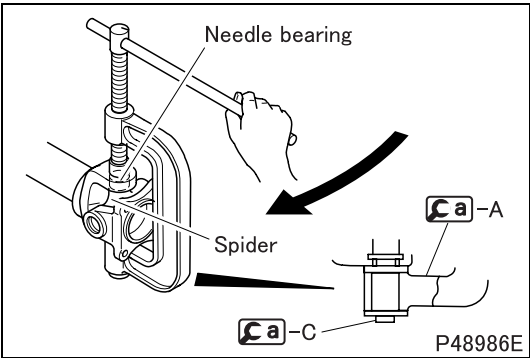
■ Alignment mark: Propeller shaft

- To prevent assembly of wrong parts, make alignment marks on flange yoke, slip yoke joint and propeller shaft.

◆ Removal procedure ◆



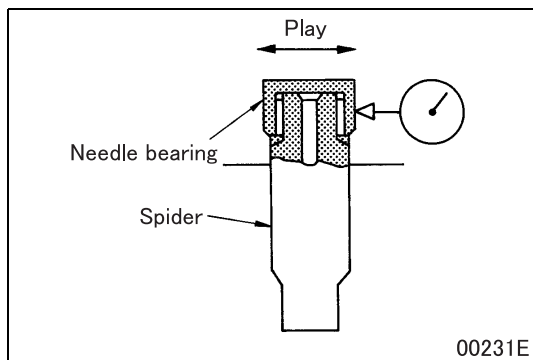
■ Removal: Snap ring



■ Removal: Needle bearing

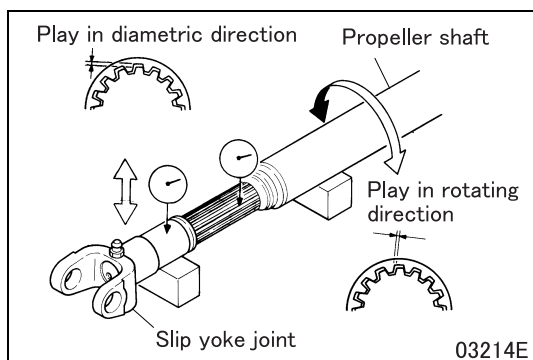
- Fit **Ca-C** into **Ca-A** from outside.
- Applying **Ca-C** to spider, screw **Ca-A** to force out spider and remove needle bearing.

◆ Inspection procedure ◆



■ Inspection: Clearance between needle bearing and spider

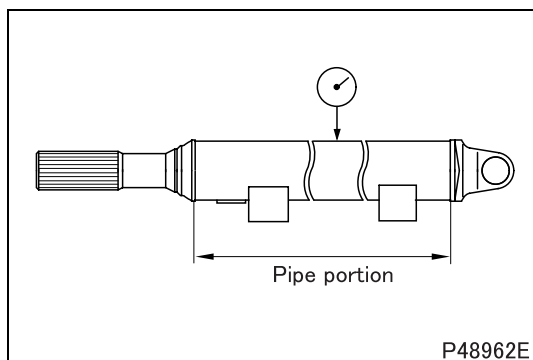
- If the measurement exceeds the limit, replace with the universal joint spider kit.



■ Inspection: Play between slip yoke joint and propeller shaft spline

- Check the following, and if the measurement is higher than the limit, replace the faulty part.

- (1) Play of spline in rotating direction
- (2) Play of spline in diametric direction



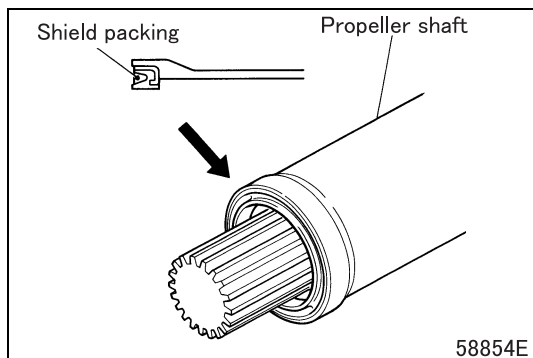
■ Inspection: Bend of propeller shaft

- Measure bend of propeller shaft at the center of its pipe portion.
- If the measurement is higher than the limit, correct the bend with a press or replace the propeller shaft.

NOTE

- To measure the bend of propeller shaft, turn it fully once and read the dial gauge indicator. The bend is one half of the indicated value.
- Check the propeller shaft for cracks in the welded area after correcting the bend using a press. If cracking is found, replace the shaft.

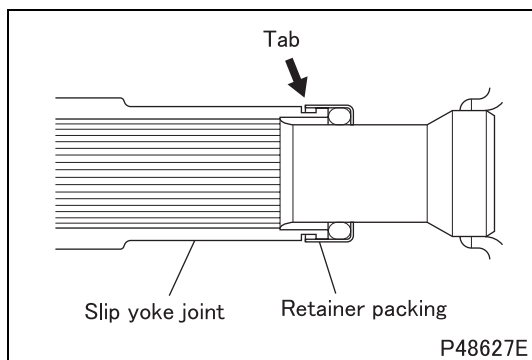
◆ Installation procedure ◆



■ Installation: Shield packing

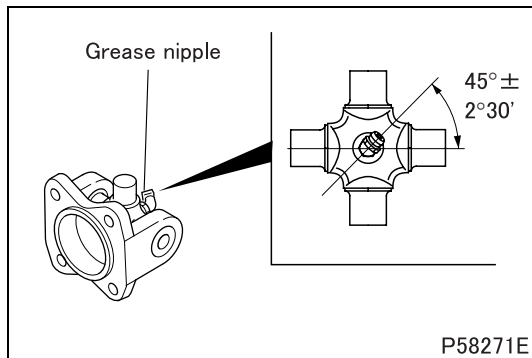
- Install shield packing flush onto propeller shaft in the illustrated direction.

PROPELLER SHAFT <P2>



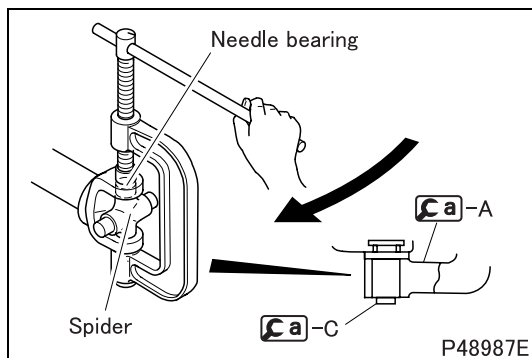
■ Installation: Retainer packing <except double Cardan type>

- Hold retainer packing against slip yoke joint and crimp tabs (at eight places).



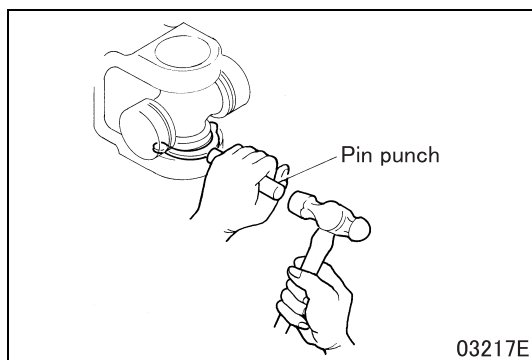
■ Installation: Grease nipple

- Install the grease nipple on the spider at an angle conforming to the indication in the illustration.

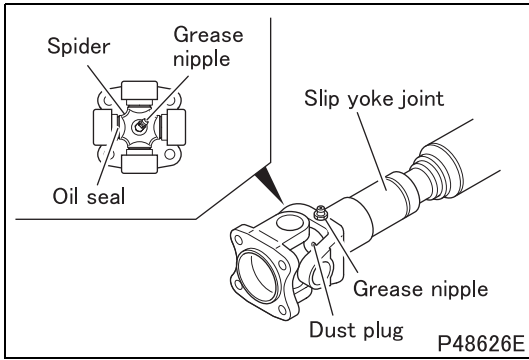


■ Installation: Needle bearing

- Fit Ca-C into Ca-A from inside.
- Operating Ca-A, install needle bearing into place.



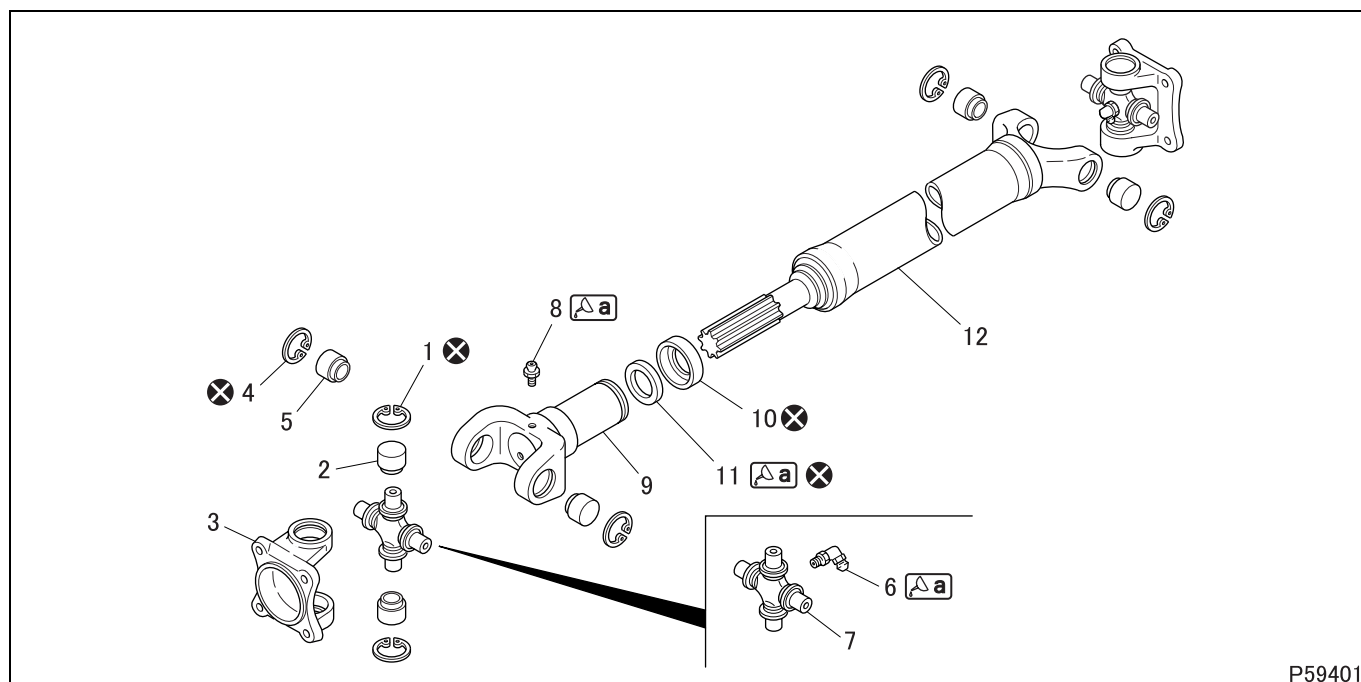
■ Installation: Snap ring

◆ Work after installation ◆**■ Lubrication: Grease nipple**

- Fill grease through grease nipple until clean grease overflows from oil seal of spider.
- Fill grease through grease nipple until clean grease overflows from the hole in dust plug of slip yoke joint.

PROPELLER SHAFT <P3>

<Without center bearing>



P59401

● Disassembly sequence

- | | | |
|------------------|---------------------|-----------------------|
| 1 Snap ring | 6 Grease nipple | 11 Shield packing |
| 2 Needle bearing | 7 Spider | 12 Propeller shaft |
| 3 Flange yoke | 8 Grease nipple | |
| 4 Snap ring | 9 Slip yoke joint | ⊗: Non-reusable parts |
| 5 Needle bearing | 10 Retainer packing | |

● Assembly sequence

Follow the disassembly sequence in reverse, excepting:

12→10→11→9

Repair kit: Universal joint spider kit

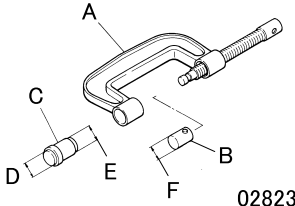
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Axial clearance of spider	0 to 0.06 {0 to 0.0024}	–	Adjust
2, 3	Clearance between needle bearing and flange yoke	0.008 to –0.033 {0.00031 to –0.0013}	0.1 {0.0039}	Replace
2, 5, 6	Play between needle bearing and spider	0.01 to 0.06 {0.00039 to 0.0024}	0.1 {0.0039}	Replace
5, 9	Clearance between needle bearing and slip joint	0.008 to –0.033 {0.00031 to –0.0013}	0.1 {0.0039}	Replace
9, 12	Play in rotating direction between slip yoke joint and propeller shaft spline	0.01 to 0.09 {0.00039 to 0.0035}	0.3 {0.012}	Replace
	Play in diametric direction between slip yoke joint and propeller shaft spline	0.02 to 0.16 {0.00079 to 0.0063}	0.3 {0.012}	Replace
12	Bend of propeller shaft	–	0.4 {0.016}	Correct or re-place

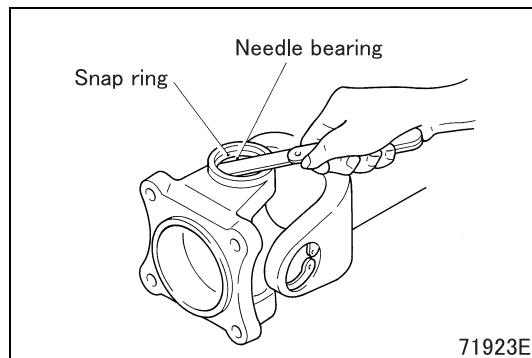
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Supply through grease nipple	Wheel bearing grease [NGLI No. 2 (Li soap)]	As required
	Shield packing lips		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application			
	Universal joint tool set A: Yoke assembly B: Push rod C: Guide	MB999024 A: MB999025 B: MB999026 C: MB999010	Removal and installation of needle bearing			
	<table><tr><th>D</th><th>E</th><th>F</th></tr><tr><td>φ29 {1.14}</td><td>φ29 {1.14}</td><td>φ27.7 {1.09}</td></tr></table>  02823			D	E	F
D	E	F				
φ29 {1.14}	φ29 {1.14}	φ27.7 {1.09}				

◆ Work before removal ◆



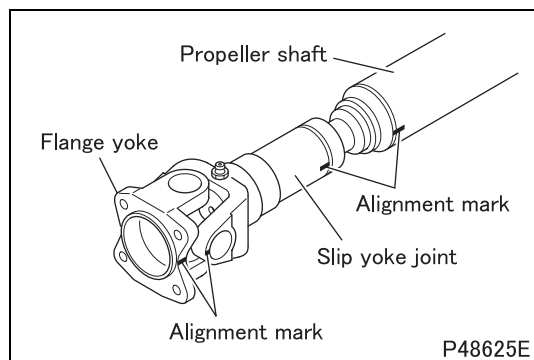
■ Inspection: Axial clearance of spider

- Press down on the needle bearing, and measure clearance between snap ring and needle bearing.
- If measured value exceeds the standard value, change snap ring thickness for adjustment.
To adjust, use snap rings for both ends with the same thickness. Select optimal combination of snap rings from the table below if necessary.

Variety and combination of snap rings (solid line indicates best combination)

Thickness	Identification color	Combination	Thickness	Identification color
1.49 mm {0.059 in.}	None	↔	1.49 mm {0.059 in.}	None
1.52 mm {0.060 in.}	Black	↔	1.52 mm {0.060 in.}	Black
1.55 mm {0.061 in.}	Blue	↔	1.55 mm {0.061 in.}	Blue
1.58 mm {0.062 in.}	Yellow	↔	1.58 mm {0.062 in.}	Yellow
1.61 mm {0.063 in.}	Purple	↔	1.61 mm {0.063 in.}	Purple
1.64 mm {0.065 in.}	None	↔	1.64 mm {0.065 in.}	None
1.67 mm {0.066 in.}	Black	↔	1.67 mm {0.066 in.}	Black
1.70 mm {0.067 in.}	Blue	↔	1.70 mm {0.067 in.}	Blue

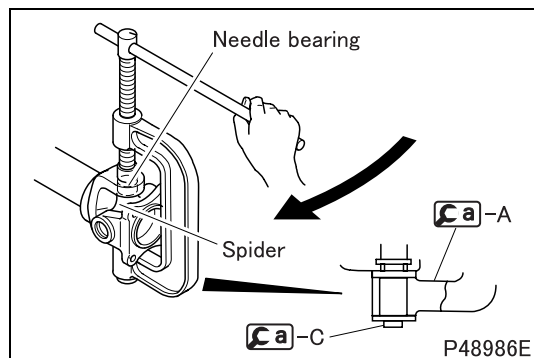
PROPELLER SHAFT <P3>



■ Alignment mark: Propeller shaft

- To prevent assembly of wrong parts, make alignment marks on flange yoke, slip yoke joint and propeller shaft.

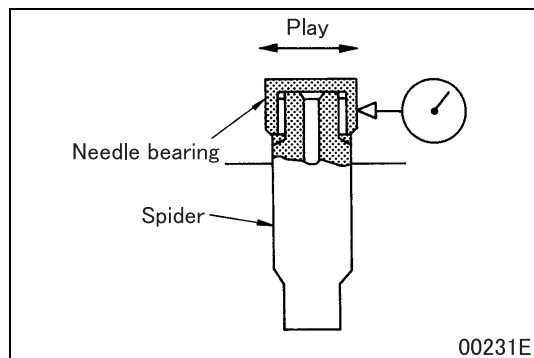
◆ Removal procedure ◆



■ Removal: Needle bearing

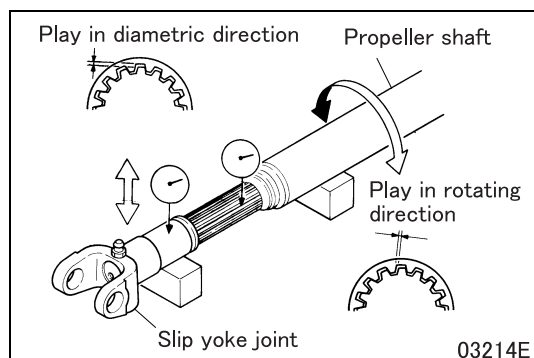
- Fit **Ca-C** into **Ca-A** from outside.
- Applying **Ca-C** to spider, operate **Ca-A** to force out spider and remove needle bearing.

◆ Inspection procedure ◆



■ Inspection: Clearance between needle bearing and spider

- If the measurement is higher than the limit, replace with the universal joint spider kit.

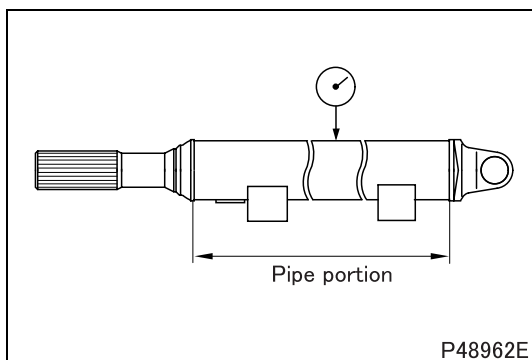


■ Inspection: Play between slip yoke joint and propeller shaft spline

- Check the following, and if the measurement is higher than the limit, replace the faulty part.

(1) Play of spline in rotating direction

(2) Play of spline in diametric direction



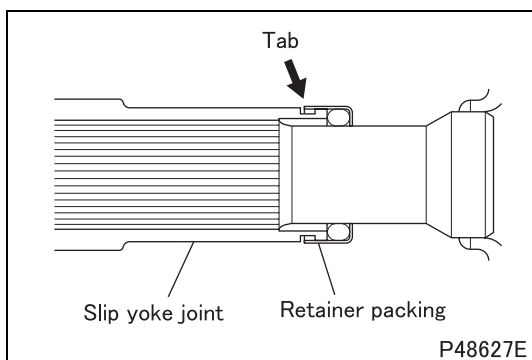
■ Inspection: Bend of propeller shaft

- Measure bend of propeller shaft at the center of its pipe portion.
- If the measurement is higher than the limit, correct the bend with a press or replace the propeller shaft.

CAUTION ⚠

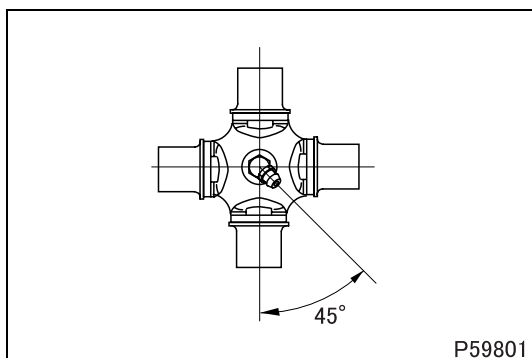
- To measure the bend of propeller shaft, turn it fully once and read the dial gauge indicator. The bend is one half of the indicated value.
- Check the propeller shaft for cracks in the welded area after correcting the bend using a press. If cracking is found, replace the shaft.

◆ Installation procedure ◆



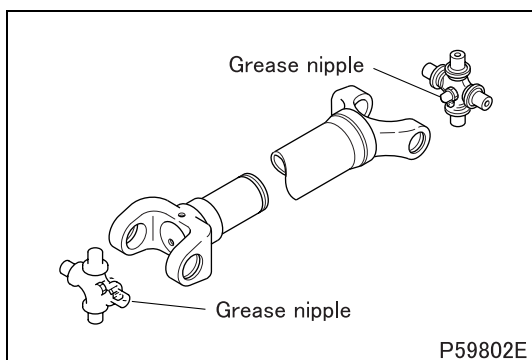
■ Installation: Retainer packing

- Hold retainer packing against slip yoke joint and caulk tabs (at eight places).



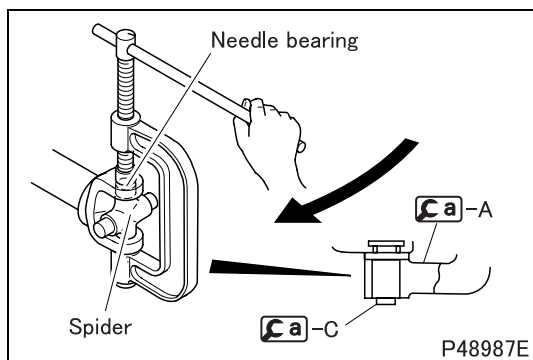
■ Installation: Spider

- Install the grease nipple on the spider at an angle conforming to the indication in the illustration.



- Install the spiders on the both ends of propeller shaft so that the direction of grease nipples must be the same.

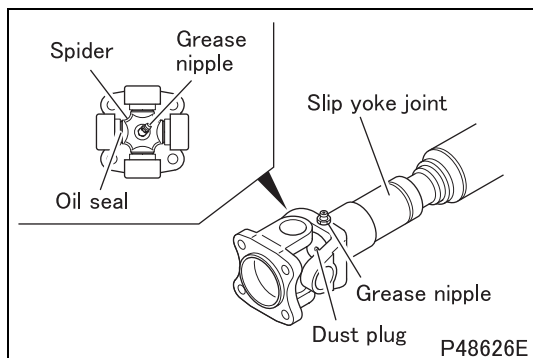
PROPELLER SHAFT <P3>



■ Installation: Needle bearing

- Fit **ca-C** into **ca-A** from inside.
- Operating **ca-A**, install needle bearing into place.

◆ Work after installation ◆



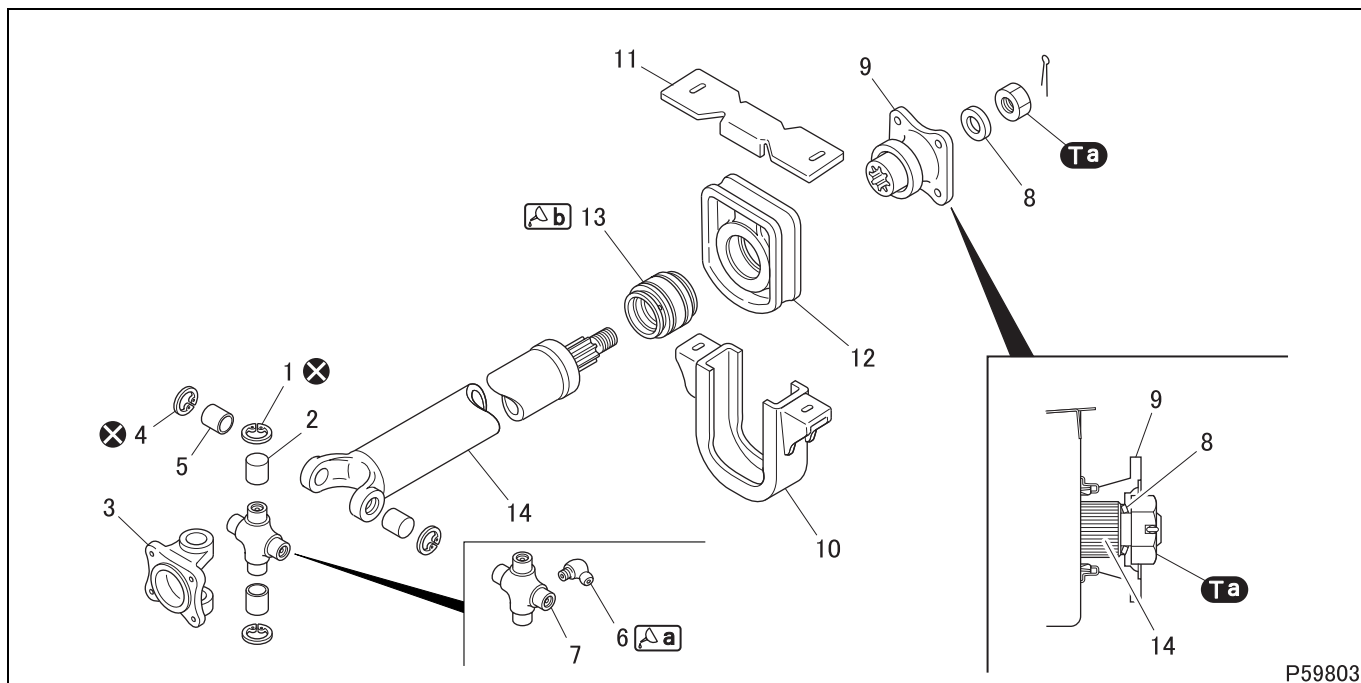
■ Lubrication: Grease nipple

- Fill grease through grease nipple until clean grease overflows from oil seal of spider.
- Fill grease through grease nipple until clean grease overflows from the hole in dust plug of slip yoke joint.

M E M O

PROPELLER SHAFT <P3>

<With center bearing>



● Disassembly sequence

- | | | |
|------------------|--------------------|-----------------------|
| 1 Snap ring | 7 Spider | 13 Center bearing |
| 2 Needle bearing | 8 Washer | 14 Propeller shaft |
| 3 Flange yoke | 9 Companion flange | |
| 4 Snap ring | 10 Holder | ⊗: Non-reusable parts |
| 5 Needle bearing | 11 Hanger | |
| 6 Grease nipple | 12 Cushion rubber | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Universal joint spider kit

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Axial clearance of spider	0 to 0.06 {0 to 0.0024}	–	Adjust
2, 3	Clearance between needle bearing and flange yoke	0.008 to –0.033 {0.00031 to –0.0013}	0.1 {0.0039}	Replace
2, 5, 6	Play between needle bearing and spider	0.01 to 0.06 {0.00039 to 0.0024}	0.1 {0.0039}	Replace
5, 14	Clearance between needle bearing and propeller shaft	0.008 to –0.033 {0.00031 to –0.0013}	0.1 {0.0039}	Replace
14	Bend of propeller shaft	–	0.4 {0.016}	Correct or replace

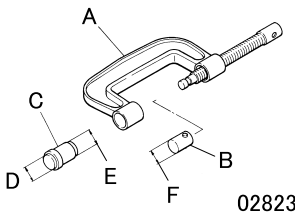
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (companion flange mounting)	290 to 390 {215 to 285, 30 to 40}	–

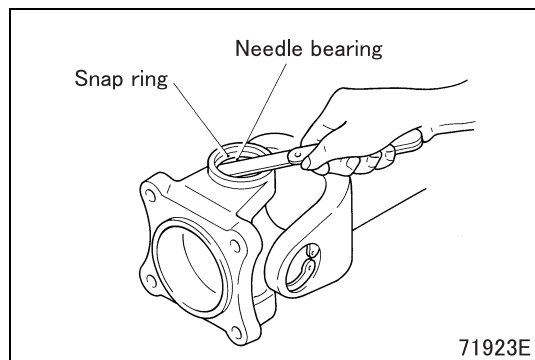
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Supply through grease nipple	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
 b	Fill space in center bearing housing	Heat-resisting grease [NLGI No. 3]	70 to 100% of space capacity (20 to 29 g) {0.71 to 1.0 oz.}
	Center bearing seal lips		As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application			
 a	Universal joint tool set A: Yoke assembly B: Push rod C: Guide	MB999024 A: MB999025 B: MB999026 C: MB999010	Removal and installation of needle bearing			
	<table border="1"><thead><tr><th>D</th><th>E</th><th>F</th></tr></thead><tbody><tr><td>φ29 {1.14}</td><td>φ29 {1.14}</td><td>φ27.7 {1.09}</td></tr></tbody></table> 			D	E	F
D	E	F				
φ29 {1.14}	φ29 {1.14}	φ27.7 {1.09}				

◆ Work before removal ◆



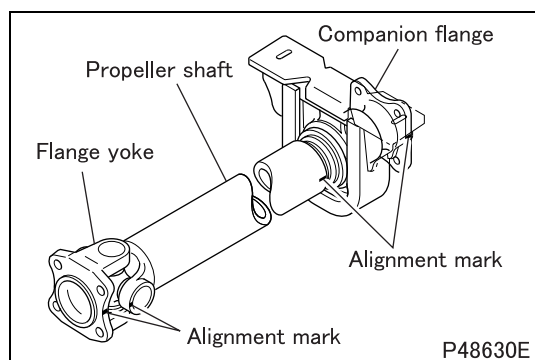
■ Inspection: Axial clearance of spider

- Press down on the needle bearing, and measure clearance between snap ring and needle bearing.
- If measured value exceeds the standard value, change snap ring thickness for adjustment.
To adjust, use snap rings for both ends with the same thickness. Select optimal combination of snap rings from the table below if necessary.

Variety and combination of snap rings (solid line indicates best combination).

Thickness	Identification color	Combination	Thickness	Identification color
1.49 mm {0.059 in.}	None	↔	1.49 mm {0.059 in.}	None
1.52 mm {0.060 in.}	Black	↔	1.52 mm {0.060 in.}	Black
1.55 mm {0.061 in.}	Blue	↔	1.55 mm {0.061 in.}	Blue
1.58 mm {0.062 in.}	Yellow	↔	1.58 mm {0.062 in.}	Yellow
1.61 mm {0.063 in.}	Purple	↔	1.61 mm {0.063 in.}	Purple
1.64 mm {0.065 in.}	None	↔	1.64 mm {0.065 in.}	None
1.67 mm {0.066 in.}	Black	↔	1.67 mm {0.066 in.}	Black
1.70 mm {0.067 in.}	Blue	↔	1.70 mm {0.067 in.}	Blue

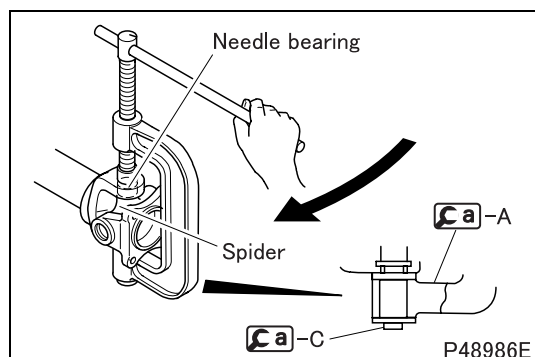
PROPELLER SHAFT <P3>



■ Alignment mark: Propeller shaft

- To prevent assembly of wrong parts, make alignment marks on flange yoke, companion flange and propeller shaft.

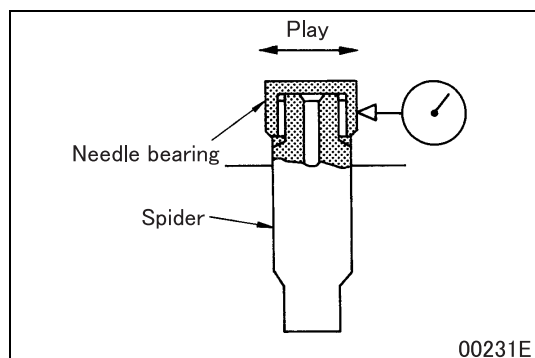
◆ Removal procedure ◆



■ Removal: Needle bearing

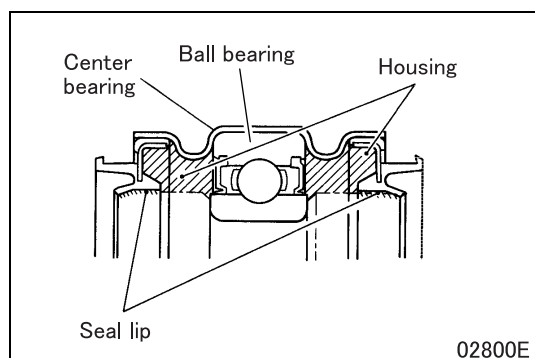
- Fit Ca-C into Ca-A from outside.
- Applying Ca-C to spider, operate Ca-A to force out spider and remove needle bearing.

◆ Inspection procedure ◆



■ Inspection: Clearance between needle bearing and spider

- If the measurement is higher than the limit, replace with the universal joint spider kit.

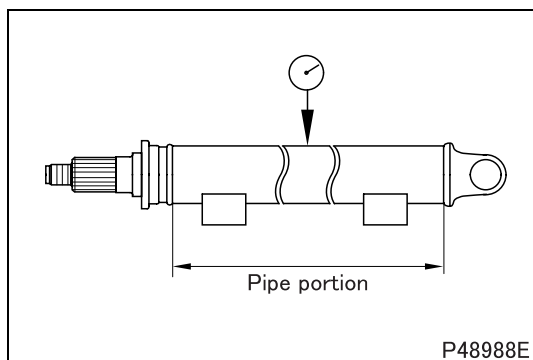


■ Inspection: Center bearing

- Check at every 50,000 km {31070 mile} or each official vehicle inspection. If excessive grease outflow is evident, pack grease in center bearing housing up to 70 to 100% (20 to 29 g {0.71 to 1.02 oz.}) of space capacity.
- Apply grease to seal lips.

NOTE

- The ball bearing portion of center bearing is provided with oil seal and requires no supply of grease.



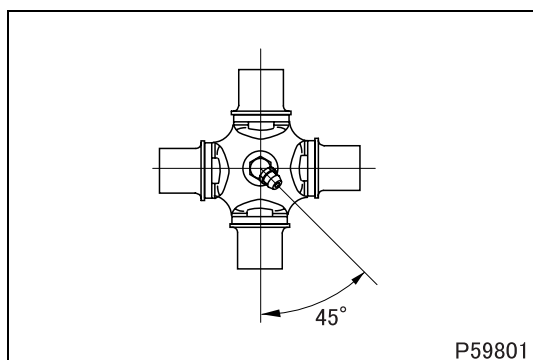
■ Inspection: Bend of propeller shaft

- Measure end of propeller shaft at the center of its pipe portion.
- If the measurement is higher than the limit, correct the bend with a press or replace propeller shaft.

NOTE

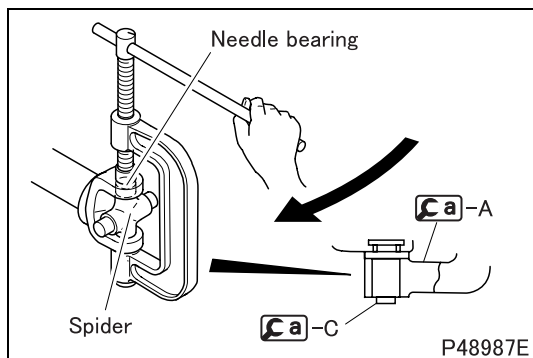
- To measure the bend of propeller shaft, turn it fully once and read the dial gauge indicator. The bend is one half of the indicated value.
- Check propeller shaft for cracks in welded area after correcting the bend with a press. If cracking is found, replace propeller shaft.

◆ Installation procedure ◆



■ Inspection: Grease nipple

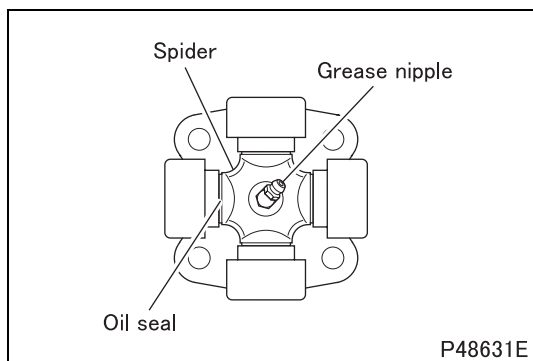
- Install the grease nipple on the spider at an angle conforming to the indication in the illustration.



■ Installation: Needle bearing

- Fit **Ca-C** into **Ca-A** from inside.
- Operating **Ca-A**, install needle bearing into place.

◆ Work after installation ◆



■ Lubrication: Grease nipple

- Fill grease through grease nipple until grease overflows from oil seal of spider.



26A - Front Axle <FE>

26B - Front Axle <FG>

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 26A

Front Axle <FE>

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

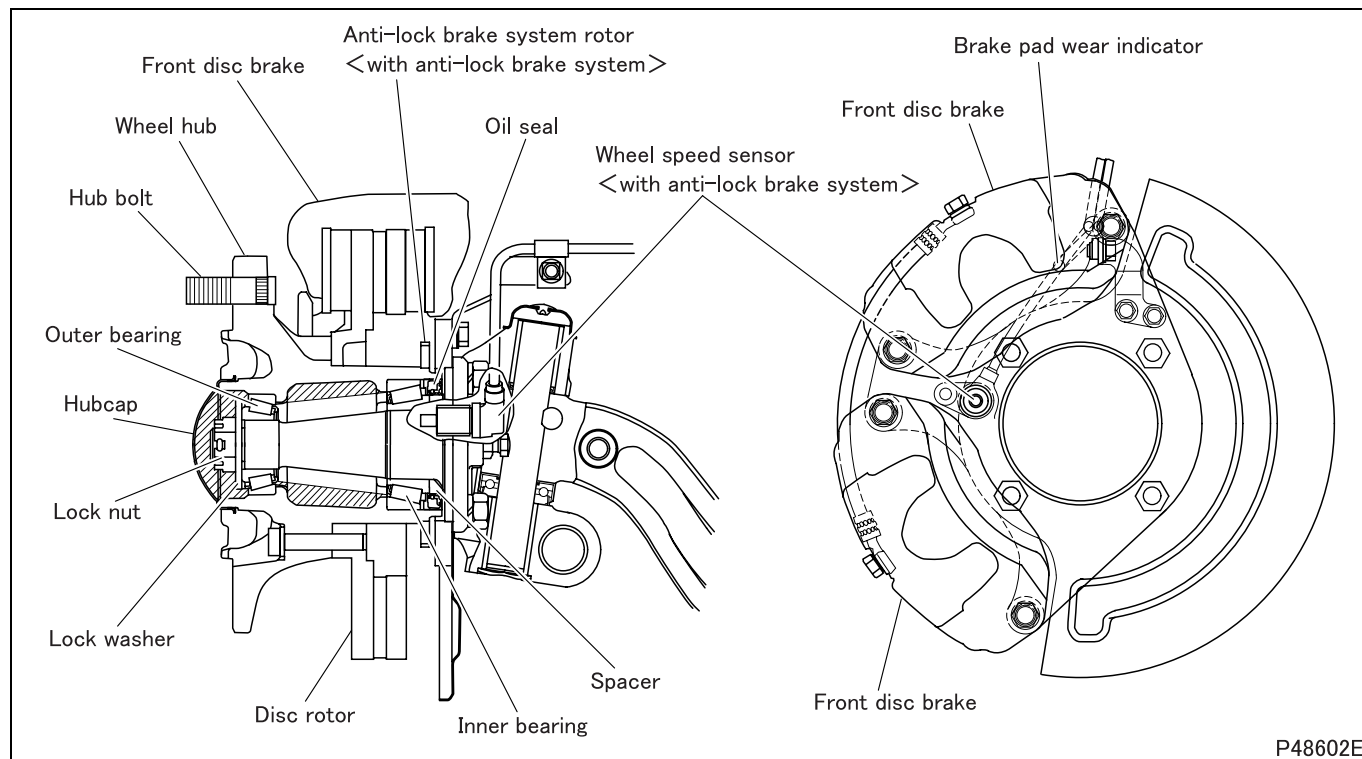
INDEX

SPECIFICATIONS	26A-2
STRUCTURE AND OPERATION	
1. Wheel Hub and Rotor	26A-3
2. Knuckle and Kingpin, Front Axle	26A-4
TROUBLESHOOTING	26A-5
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Inspection and Adjustment of Wheel Alignment	26A-6
2. Inspection and Adjustment of Steering Angle	26A-10
3. Inspection of Side Slip	26A-11
4. Inspection of Play in Tie Rod End Ball Joint	26A-11
WHEEL HUB AND ROTOR	26A-12
KNUCKLE AND KINGPIN, FRONT AXLE	26A-20
TIE ROD	26A-28

SPECIFICATIONS

Item		Specifications		
		FE8		
		2 to 3.5 ton		4 ton or more
Front axle	Model	F200T	F300T	F350T
	Type	Reverse Elliot, "I" beam		
Kingpin Outer diameter × Length mm {in.}		28 × 180 {1.10 × 7.09}		
Tread (dimension notified to the authorities) mm {in.}		1655 {65, 16}		
Mass (with disc brakes) kg {lb}		Approx. 150 {331}	Approx. 155 {342}	Approx. 165 {365}

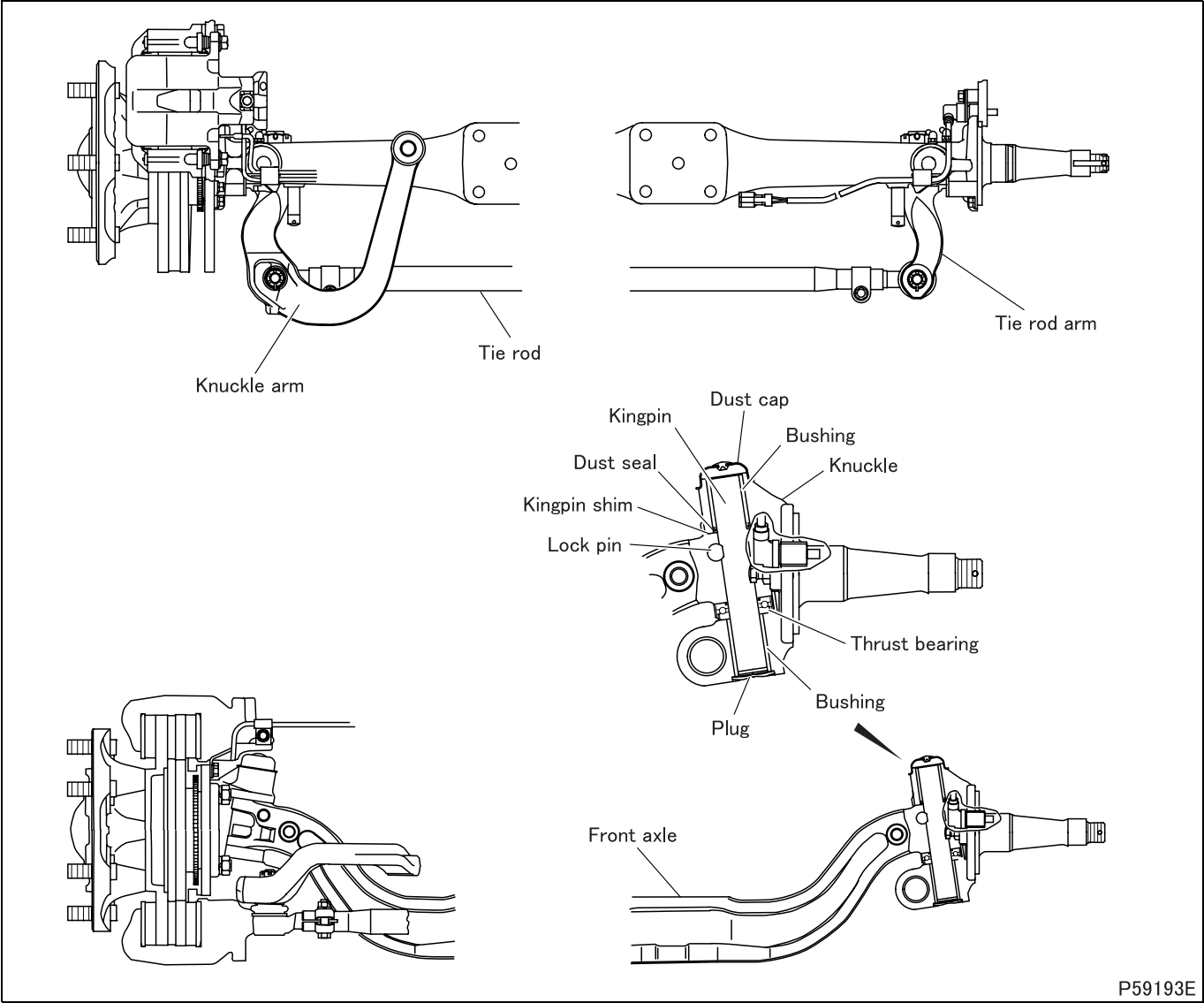
1. Wheel Hub and Rotor



- The brake pad wear indicator is installed on the right wheels or on both the right and left wheels.

STRUCTURE AND OPERATION

2. Knuckle and Kingpin, Front Axle



Symptoms										Reference Gr
		Continuous noise while cruising	Intermittent noise while cruising	Steering wheel shakes	Steering feels stiff	Steering wheel return poor	Unable to steer the steering wheel	Steering pulls to one side	Uneven wear or early wear of front tires	
Possible causes										
Wheel hub, knuckle and kingpin, front axle	Wheel alignment misaligned			O	O	O			O	
	Steering angle adjustment faulty						O			
	Wheel hub bearing seized, worn or rotation faulty	O		O						
	Wheel hub bearing broken		O							
	Kingpin worn			O						
	Clearance between kingpin and kingpin bushing excessive			O	O					
	Greasing to kingpin insufficient				O					
	Kingpin thrust bearing seized, worn or rotation faulty				O					
	Vertical clearance between knuckle and front axle excessive			O						
	Knuckle arm and tie rod arm tightening nuts loose			O						
	Ball stud tightening nut of tie rod end loose			O						
	Tie rod end ball stud worn			O						
	Tie rod bent						O			
	Knuckle bent							O		
	Front axle bent							O		
	Various parts of front axle tightened excessively					O				
Front suspension	U-bolt nut of front suspension loose			O						Gr33
	One of front springs worn-out or broken							O		
Tire	Tire inflation pressure uneven			O					O	Gr31
	Tire inflation pressure too little				O					
	Inflation pressure uneven for right and left tires							O		
	Size and type of right and left tires different							O	O	
	Outer diameters of right and left tires remarkably different							O		
	Handling of tires inadequate								O	

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Adjustment of Wheel Alignment

Before carrying out inspection and adjustment of wheel alignment, set the vehicle to the following condition.

- Park the vehicle unloaded on a level place.
- The vehicle needs to be equipped with proper size tires.
- If the wear condition of tires on the right is remarkably different from that of tires on the left, replace tires.
- Tires need inflation to specified pressure.
- Correct if the vehicle tilts due to faulty suspension.
- Service all parts of the front axle and ensure that there is no fault such as the following.
 - Play at or loose kingpin
 - Loose front wheel hub
 - Loose bolts used for tightening various parts of tie rod arm, knuckle arm and tie rod
 - Bend of knuckle and front axle
- Adjust play at steering wheel properly.
- For wheel alignment, which is related to the side slip amount, both wheel alignment and the side slip amount must conform to the standard values.

Service standards (Unit: mm {in.})

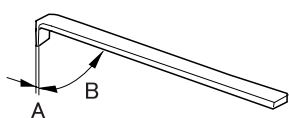
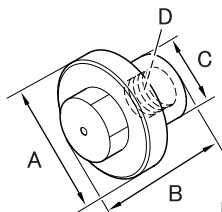
Location	Maintenance item	Standard value	Limit	Remedy
-	Toe-in	0 to 6 (3 ± 3) {0 to 0.24 (0.12 ± 0.12)}	—	Adjust
	Camber	1°00' ± 30'	—	*
	Caster	1°15' ± 1°00'	—	Replace
	Kingpin inclination angle	8° ± 10'	—	Replace

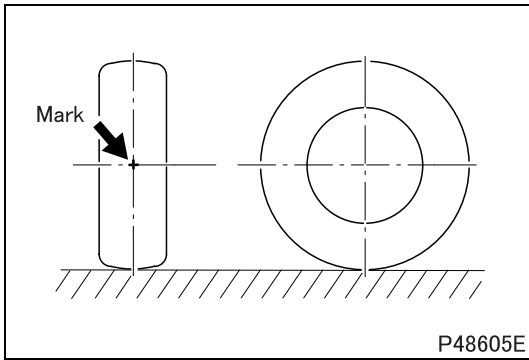
*: If the measured value deviates from the standard value, abnormalities such as wear of kingpin and kingpin bushing, loose hub bearing, and bend of knuckle and front axle are suspected. Inspect each part and replace defective parts.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
-	Clamp nut (Tie rod end clamp fastening)	25 ± 5 {18 ± 3.6, 2.5 ± 0.5}	—
-	Alignment gauge adapter	113 ± 15 {83 ± 11, 11.5 ± 1.5}	—

Special tools (Unit: mm {in.})

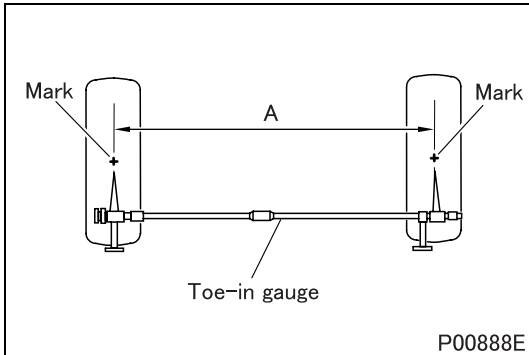
Mark	Tool name and shape	Part No.	Application								
 a	Hubcap wrench  <table><tr><th>A</th><th>B</th></tr><tr><td>0.5 {0.020}</td><td>78°</td></tr></table> P49261	A	B	0.5 {0.020}	78°	MB999108	Removal of hubcap				
A	B										
0.5 {0.020}	78°										
 b	Alignment gauge adapter  <table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>φ80 {3.15}</td><td>69 {2.72}</td><td>φ45 {1.77}</td><td>M24 × 1.5</td></tr></table> P48604	A	B	C	D	φ80 {3.15}	69 {2.72}	φ45 {1.77}	M24 × 1.5	MH063428	Measurement of camber, caster and kingpin inclination angle
A	B	C	D								
φ80 {3.15}	69 {2.72}	φ45 {1.77}	M24 × 1.5								



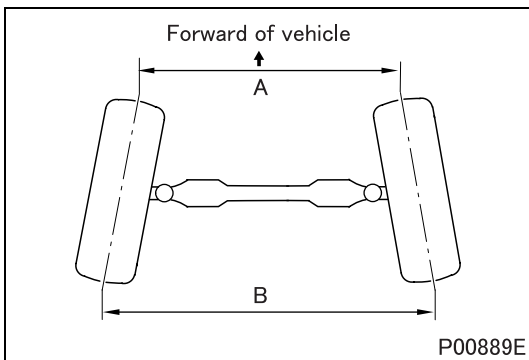
1.1 Inspection and adjustment of toe-in

[Inspection]

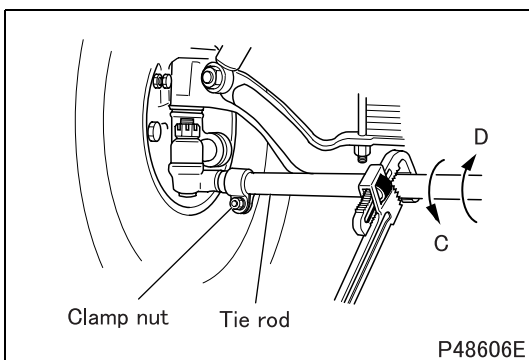
- Direct the front wheels exactly to forward running position.
- Put a mark to each tire of right and left at the height of front wheel axis and in the middle of tire width.



- Align the two points of the toe-in gauge with respective marks and measure distance **A** between the marks.

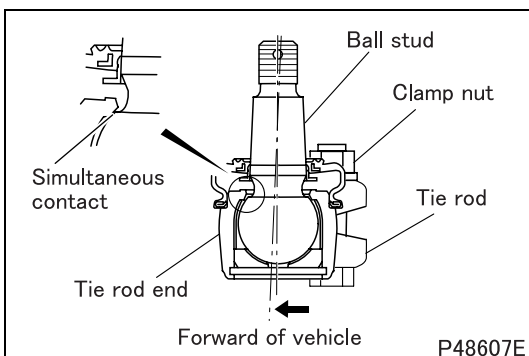


- Push the vehicle to roll the tires 180 degrees.
- Measure distance **B** between the marks that have moved to the rear of the vehicle.
- If toe-in (difference between **A** and **B**) deviates from the standard value, adjust.



[Adjustment]

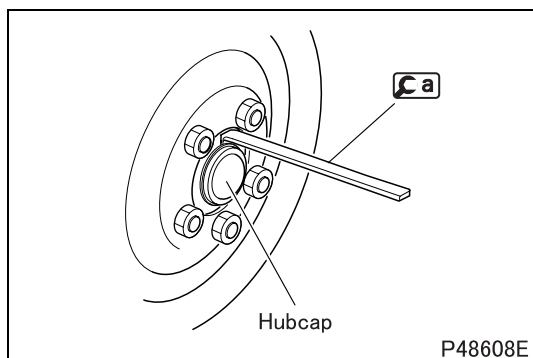
- Loosen the clamp nuts on the right and left.
- Turn the tie rod with a pipe wrench to adjust the toe-in.
C: When adjusting to the toe-out direction
D: When adjusting to the toe-in direction
- After adjustment, tighten the clamp nut to the specified torque.



CAUTION ⚠

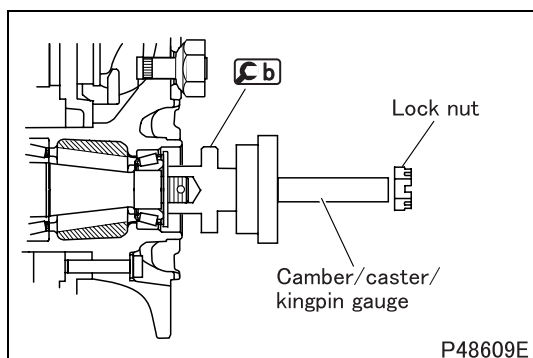
- Hold down the tie rod end toward the front of the vehicle with the front wheels directed to forward running position so that the right and left tie rod ends are in contact with the ball studs at the same time. In this state adjust so that the specified toe-in is achieved and tighten the clamp nut to secure the tie rod.

ON-VEHICLE INSPECTION AND ADJUSTMENT



1.2 Inspection of camber

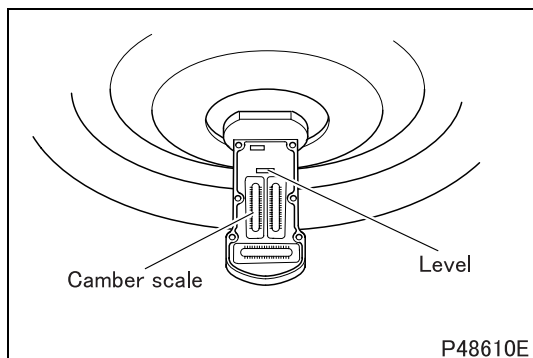
- Direct the front wheels exactly to forward running position.
- Remove the hubcap using **a**.



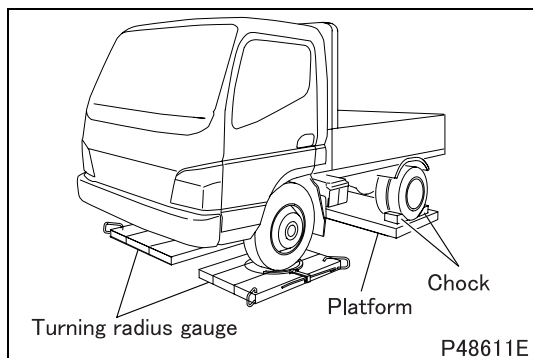
- Remove the lock nut.

CAUTION

- **Do not apply a vehicle weight to the hub bearing with the lock nut loosened.**

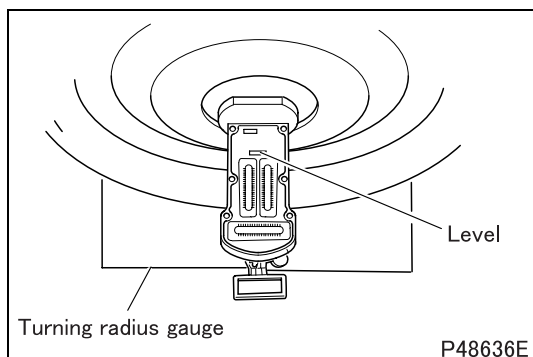


- Wipe off grease from the knuckle end, attach **b** and tighten it to the specified torque.
- Attach the camber/caster/kingpin gauge.
- Place the level in order to have bubble stay in the middle.
- Read center of bubble on camber scale to find the camber. Do the same way for the right and left front tires.
- If the measured value deviates from the standard value, disassemble the front axle for service.

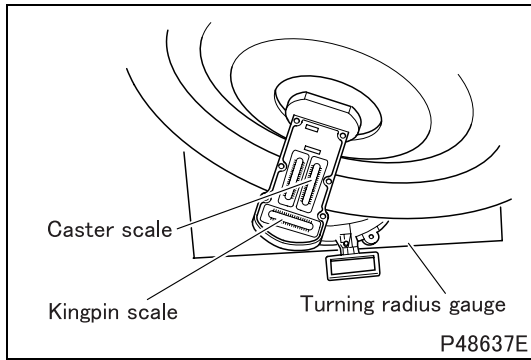


1.3 Inspection of caster and kingpin inclination angle

- Prepare a platform with the same height as the turning radius gauge and place it under the rear wheels so that the vehicle may be placed level.
- Apply chocks to the rear wheels.
- Keep the turning radius gauge locked.
- Jack up the vehicle, and set the right and left front wheels so that respective ground contact area centers of two wheels and turn table centers may meet.



- Unfasten locking of the turning radius gauge, and set the scale to 0 degrees.
- In the same manner as in case of measuring camber in Section 1.2, attach the camber/caster/kingpin gauge, and set the level so that the bubble comes in the middle.



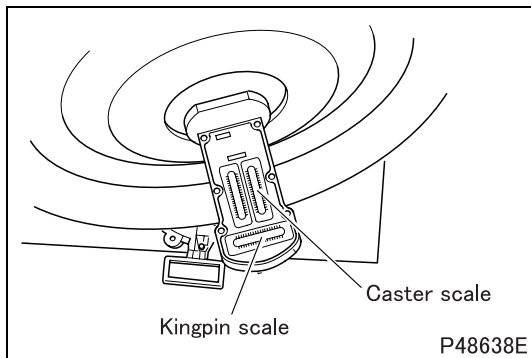
- Apply brake, and with brake applied to the front wheels, turn steering wheel slowly from the point of 0 degrees on the turning radius gauge, until the direction is changed by 20 degrees each to the right side in case of the right front wheel and to the left in case of the left front wheel.

NOTE

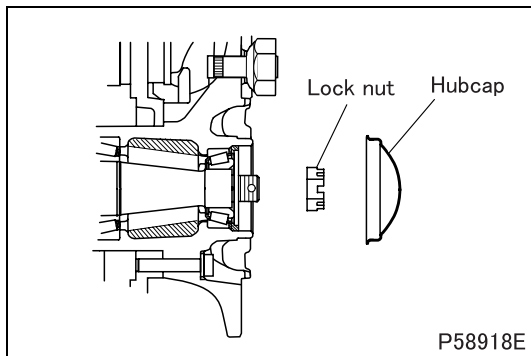
- **It is not possible to make exact measurement unless brake is kept applied, because otherwise wheels will turn slightly.**
- At the point where steering has been steered 20 degrees, set the caster scale and the center of the bubble of the kingpin scale to 0 degrees by turning the adjuster.

NOTE

- **Pay attention to the kingpin scale because it has scales for right and left: align the right kingpin scale in case of the right front wheel, and left kingpin scale in case of the left front wheel.**



- Reverse this position, turn the steering wheel slowly until the direction of the front wheels changes by 20 degrees in the opposite direction.
- Read the center of bubbles at this position at the caster scale and kingpin scale to find caster and kingpin inclination angles.
- If the measured value deviates from the standard value, disassemble the front axle for service.



- After inspection, install the lock nut and measure the starting torque of the wheel hub bearing. If the starting torque deviates from the standard value, check the wheel bearings and perform expedient adjustment.
- Fill the specified amount of grease into wheel hub by using nozzle so that the outer bearing is covered with the grease and then install a new hubcap.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Inspection and Adjustment of Steering Angle

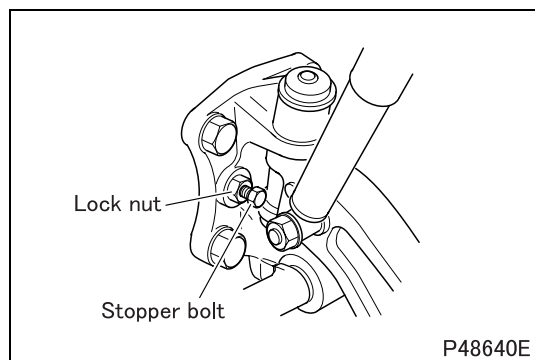
- Perform steering angle inspection and adjustment only after wheel alignment inspection and adjustment has been completed.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Steering angle	Inside (Outside steering angle is for reference only)	45° (34°)	–	Adjust

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Lock nut (Knuckle stopper bolt mounting)	46.5 ± 7 {34 ± 5.4, 4.75 ± 0.75}	–



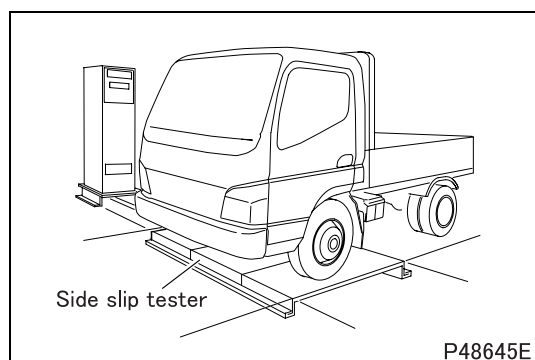
- Set the turning radius gauge and a platform on the vehicle in the same manner as in case of caster and kingpin inclination angle measurement performed in Section 1.3.
- Turn the steering wheel right or left completely from the position where the turning radius gauge is set to 0 degrees, and read the scale of the turning radius gauge to measure the steering angle.
- If the measured value deviates from the standard value, adjust with the knuckle stopper bolt and tighten the lock nut to the specified torque.

3. Inspection of Side Slip

- Perform side slip inspection only after wheel alignment inspection and adjustment has been completed.
- For the side slip amount, which is related to wheel alignment, both the side slip amount and wheel alignment must conform to the standard values.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Side slip amount	0 ± 3 { 0 ± 0.12 }	–	Adjust



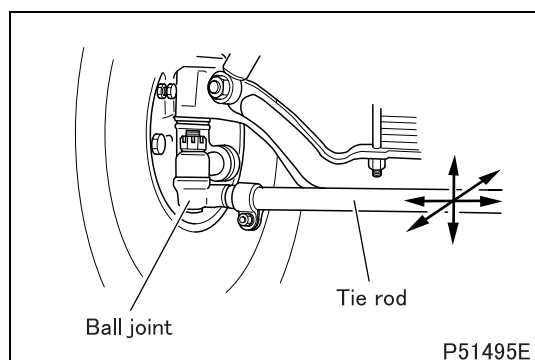
- Set the front wheels exactly to forward running position.
- Move the vehicle forward past the side slip tester as slowly as possible to inspect side slip.

NOTE

- Pay attention to the following when moving over the side slip tester.
- Be sure to hold steering exactly at the forward running position, and make no turn.
- Do not apply brake.
- Keep the speed constant.

- If the measured value deviates from the standard value, inspect and adjust wheel alignment.

4. Inspection of Play in Tie Rod End Ball Joint

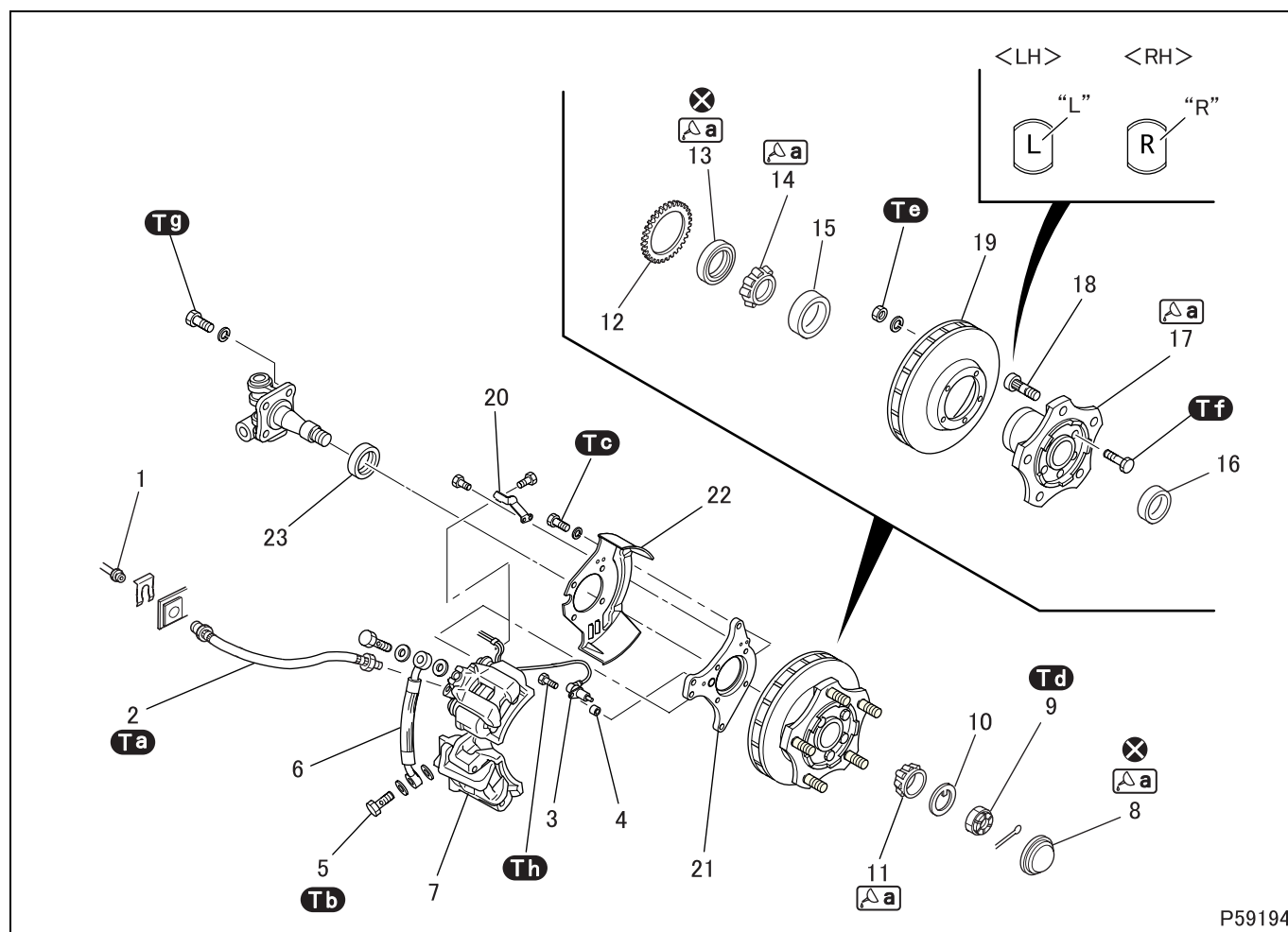


- Hold the tie rod section of the tie rod with the vehicle kept stationary, and move it in the back-and-forth, up-and-down and right-and-left directions to check for play at ball joints of the tie rod end.

NOTE

- Be sure to check for play at ball joints of both right and left sides of the tie rod.
- If there is play, replace the tie rod end of the tie rod.

WHEEL HUB AND ROTOR



● Disassembly sequence

- | | |
|---------------------------------|-----------------------------|
| 1 Brake pipe | 14 Inner bearing inner race |
| 2 Brake hose | 15 Inner bearing outer race |
| 3 Wheel speed sensor | 16 Outer bearing outer race |
| 4 Spacer | 17 Wheel hub |
| 5 Eyebolt | 18 Hub bolt |
| 6 Brake hose | 19 Disc rotor |
| 7 Front disc brake (See Gr35A.) | 20 Bracket |
| 8 Hubcap | 21 Adapter |
| 9 Lock nut | 22 Dust shield |
| 10 Lock washer | 23 Spacer |
| 11 Outer bearing inner race | |
| 12 Anti-lock brake system rotor | |
| 13 Oil seal | |

⊗: Non-reusable parts

CAUTION

- Plug the brake hose to prevent entry of dust and dirt after it has been removed.
- Be careful not to damage the tip of the wheel speed sensor after removing it.

NOTE

- Do not remove the anti-lock brake system rotor unless replacing it.
- Do not disassemble the wheel hub and disc rotor unless replacing them.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- Make sure that the disc rotor surface and disc brake pad surface are free from grease to avoid malfunction of brakes.
- Make sure that the brake hose is not twisted when installing it.
- Inspect the drag torque of disc brakes after assembly. (See Gr35A.)

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of wheel hub bearing (tangential force at hub bolt position with oil seal assembled)		1 to 3.5 N·m {0.7 to 2.6 ft.lbs, 0.10 to 0.35 kgf·m} (tangential force: 8.8 to 28.4 N {8.8 to 6.4 lbs., 0.9 to 2.9 kgf})	–	Adjust or replace
19	Disc rotor	Runout (measure, assembling it into front axle)	0.07 {0.0028} or less	0.10 {0.0039}	Replace
		Thickness	40 {1.57}	38 {1.50}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

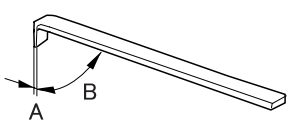
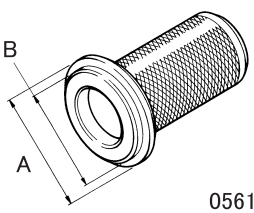
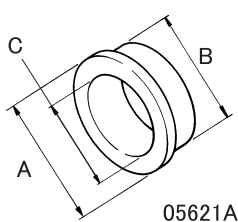
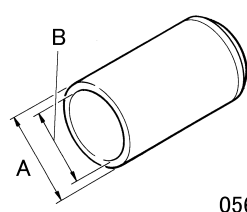
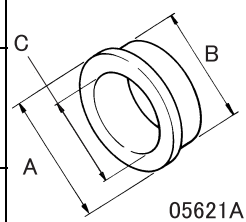
Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Brake hose		13 to 17 {9.6 to 13, 1.3 to 1.7}	–
Tb	Eyebolt		22 ± 2 {16 ± 1.5, 2.25 ± 0.25}	–
Tc	Bolt (Front disc brake mounting)		152 ± 25 {112 ± 18, 15.5 ± 2.5}	–
Td	Lock nut	Primary tightening	113 ± 15 {83 ± 11, 11.5 ± 1.5}	–
		Secondary tightening after complete tightening	59 {44, 6}	Back-off angle 45° (1/8 of a turn)
Te	Nut (Wheel hub and disc rotor mounting) <FE83>		95.6 ± 12 {71 ± 8.9, 9.75 ± 1.25}	–
Tf	Bolt (Wheel hub and disc rotor mounting) <FE84, FE85>		85.8 ± 12 {63 ± 8.9, 8.75 ± 1.25}	–
Tg	Bolt (Adapter mounting)		118 ± 20 {87 ± 1.5, 12 ± 2}	–
Th	Bolt (Speed sensor mounting)		12.3 ± 2.5 {9.1 ± 1.8, 1.25 ± 0.25}	–

Lubricant and/or sealant

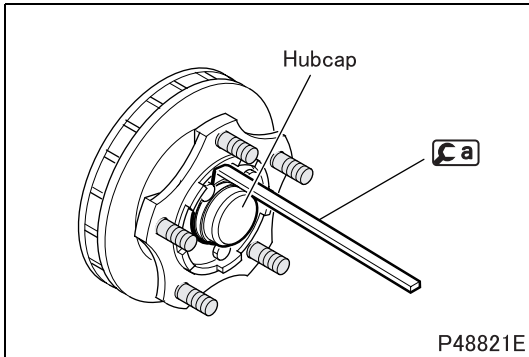
Mark	Points of application		Specified lubricant and/or sealant	Quantity
	Pack outside of wheel hub	FE83	Wheel bearing grease [NLGI No. 2 (Li soap)]	65 ± 10 g {2.29 ± 0.35 oz}
		FE84, FE85		90 ± 10 g {3.17 ± 0.35 oz}
	Pack inside of wheel hub	FE83		210 ± 20 g {7.41 ± 0.71 oz}
		FE84		130 ± 10 g {4.59 ± 0.35 oz}
		FE85		155 ± 10 g {5.47 ± 0.35 oz}
	Pack space between rollers of outer bearing inner race and inner bearing inner race			As required
	Lip area of oil seal			

WHEEL HUB AND ROTOR

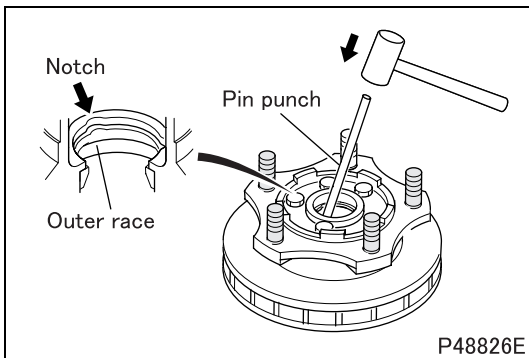
Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application														
	Hubcap wrench  <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>0.5 {0.020}</td><td>78°</td></tr></tbody></table> P49261	A	B	0.5 {0.020}	78°	MB999108	Removal of hubcap										
	A	B															
0.5 {0.020}	78°																
	Oil seal installer  <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ84 {3.31}</td><td>φ70 {2.76}</td></tr></tbody></table> 05619	A	B	φ84 {3.31}	φ70 {2.76}	MB999097											
	A	B															
φ84 {3.31}	φ70 {2.76}																
	Bearing installer  <table border="1"><thead><tr><th>Part No.</th><th>A</th><th>B</th><th>C</th><th>Vehicle model</th></tr></thead><tbody><tr><td>MB999099</td><td>φ88.5 {3.48}</td><td>φ71 {2.80}</td><td>φ51 {2.01}</td><td>Five studs</td></tr><tr><td>MB999069</td><td>φ94.5 {3.72}</td><td>φ92.5 {3.64}</td><td>φ60 {2.36}</td><td>Six studs</td></tr></tbody></table> 05621A	Part No.	A	B	C	Vehicle model	MB999099	φ88.5 {3.48}	φ71 {2.80}	φ51 {2.01}	Five studs	MB999069	φ94.5 {3.72}	φ92.5 {3.64}	φ60 {2.36}	Six studs	MB999099 MB999069
	Part No.	A	B	C	Vehicle model												
MB999099	φ88.5 {3.48}	φ71 {2.80}	φ51 {2.01}	Five studs													
MB999069	φ94.5 {3.72}	φ92.5 {3.64}	φ60 {2.36}	Six studs													
	Bearing installer  <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ70 {2.76}</td><td>φ57 {2.24}</td></tr></tbody></table> 05668	A	B	φ70 {2.76}	φ57 {2.24}	MB999100											
	A	B															
φ70 {2.76}	φ57 {2.24}																
	Bearing installer  <table border="1"><thead><tr><th>Part No.</th><th>A</th><th>B</th><th>C</th><th>Vehicle model</th></tr></thead><tbody><tr><td>MB999099</td><td>φ88.5 {3.48}</td><td>φ71 {2.80}</td><td>φ51 {2.01}</td><td>Inner side of five-stud models and outer side of all models</td></tr><tr><td>MB999069</td><td>φ94.5 {3.72}</td><td>φ92.5 {3.64}</td><td>φ60 {2.36}</td><td>Inner side of six-stud models</td></tr></tbody></table> 05621A	Part No.	A	B	C	Vehicle model	MB999099	φ88.5 {3.48}	φ71 {2.80}	φ51 {2.01}	Inner side of five-stud models and outer side of all models	MB999069	φ94.5 {3.72}	φ92.5 {3.64}	φ60 {2.36}	Inner side of six-stud models	MB999099 MB999069
	Part No.	A	B	C	Vehicle model												
MB999099	φ88.5 {3.48}	φ71 {2.80}	φ51 {2.01}	Inner side of five-stud models and outer side of all models													
MB999069	φ94.5 {3.72}	φ92.5 {3.64}	φ60 {2.36}	Inner side of six-stud models													

◆ Removal procedure ◆

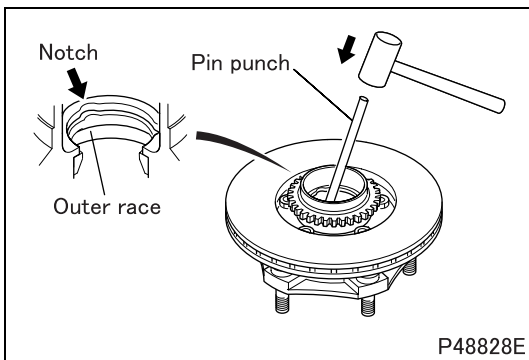


■ Removal: Hubcap



■ Removal: Inner bearing outer race

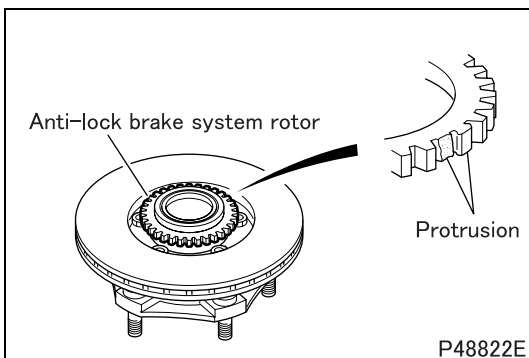
- Drive out the inner bearing outer race by tapping evenly at three indented parts in the wheel hub.



■ Removal: Outer bearing outer race

- Drive out the outer bearing outer race by tapping evenly at three indented parts in the wheel hub.

◆ Inspection procedure ◆

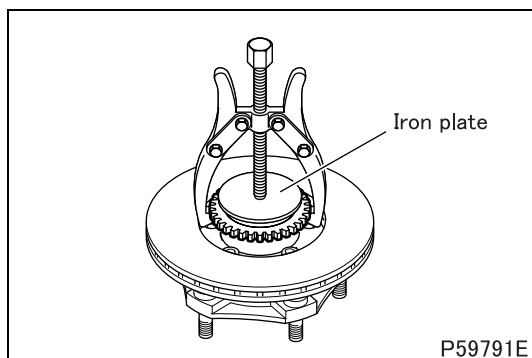


■ Inspection: Anti-lock brake system rotor

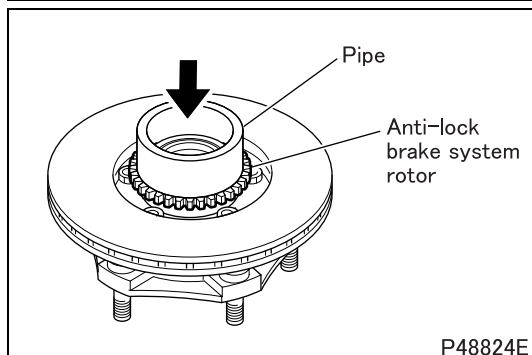
[Inspection]

- Check protrusions of the anti-lock brake system rotor for chipping and flattening.
- If any abnormality is found, replace the anti-lock brake system rotor.

WHEEL HUB AND ROTOR



[Removal]



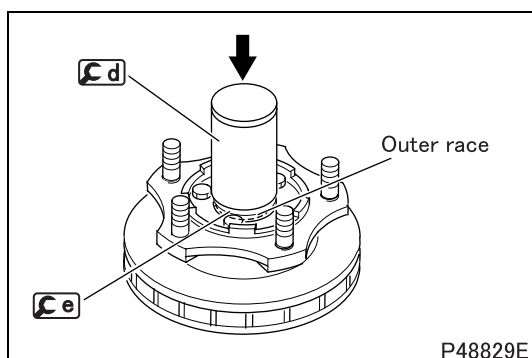
[Installation]

- Warm the anti-lock brake system rotor to approximately 150°C.
- Install the anti-lock brake system rotor and wheel hub evenly using a pipe so as not to allow them to tilt.

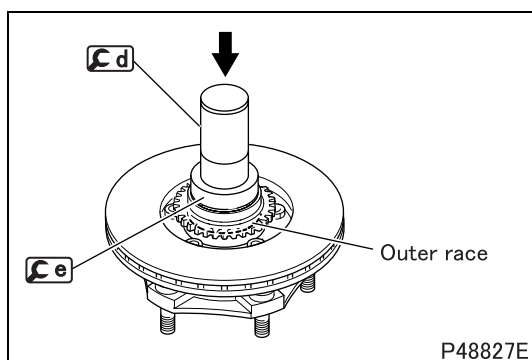
WARNING ⚠

- Handling the warmed rotor by bare hand causes scald.

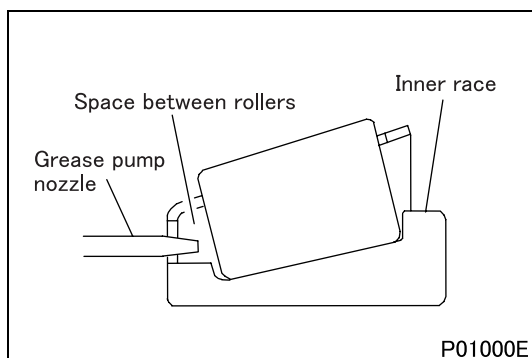
◆ Installation procedure ◆



■ Installation: Outer bearing outer race

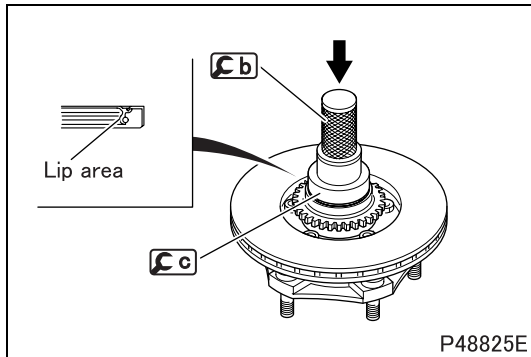


■ Installation: Inner bearing outer race



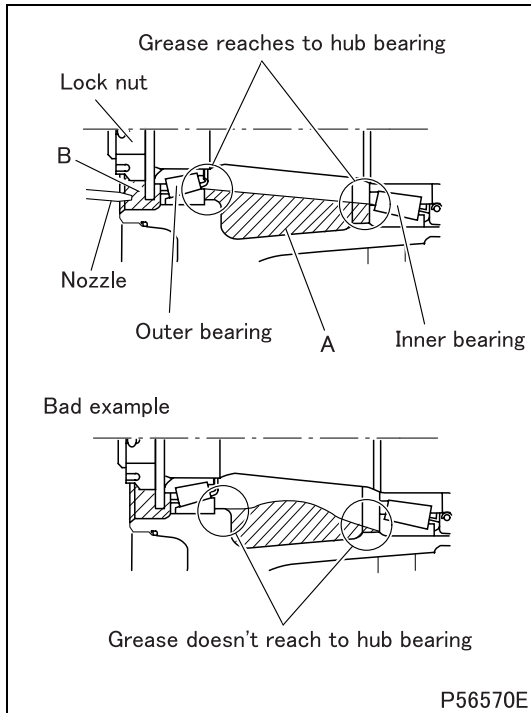
■ Installation: Packing grease in inner bearing inner race

- Insert the grease pump nozzle into the space between rollers of the inner bearing inner race to pack grease sufficiently.



■ Installation: Oil seal

- Apply grease to the lip area of the oil seal and install it on the wheel hub in the illustrated direction.

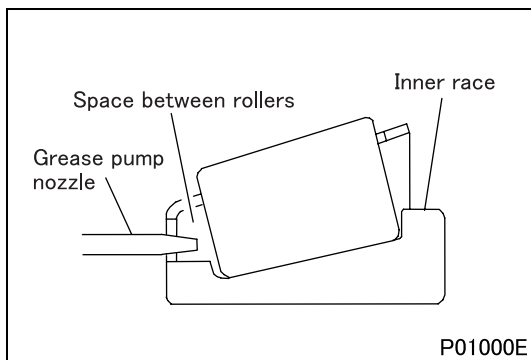


■ Installation: Wheel hub and rotor

- Apply specified amount of grease to inside **A** of wheel hub so that the grease reaches to inner bearing and outer bearing as illustrated.
- After installing lock nut, insert grease pump nozzle into outside **B** of wheel hub and fill specified amount of grease so as to make a grease wall outside of the outer bearing.

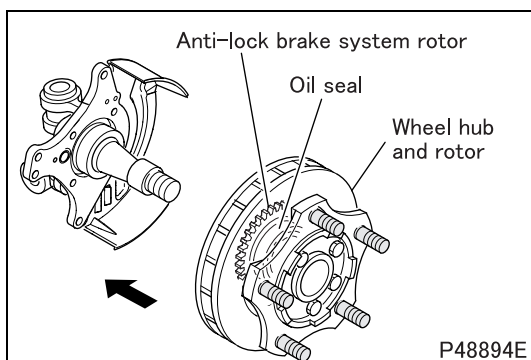
CAUTION ⚠

- Applying grease like the bad example in illustration causes wheel hub bearing seized.



■ Installation: Packing grease in outer bearing inner race

- Insert the grease pump nozzle into the space between rollers of the outer bearing inner race to pack grease sufficiently.

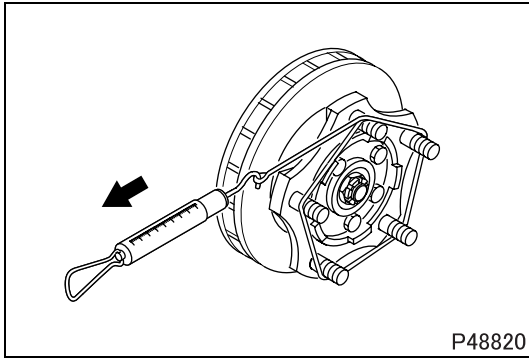


- Slowly install the wheel hub and rotor assembly so as not to cause damage to the oil seal and anti-lock brake system rotor.

CAUTION ⚠

- If the anti-lock brake system rotor is damaged, wheel speed sensor signals become abnormal, causing the anti-lock brake system to malfunction.

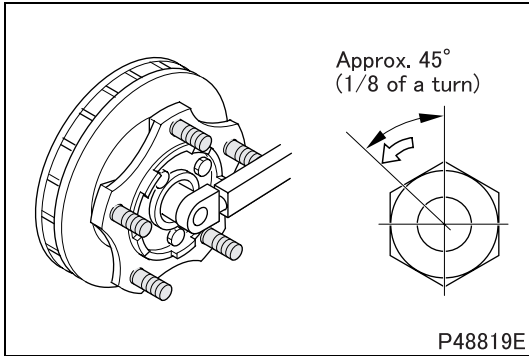
WHEEL HUB AND ROTOR



■ Inspection: Starting torque of wheel hub bearing

[Inspection]

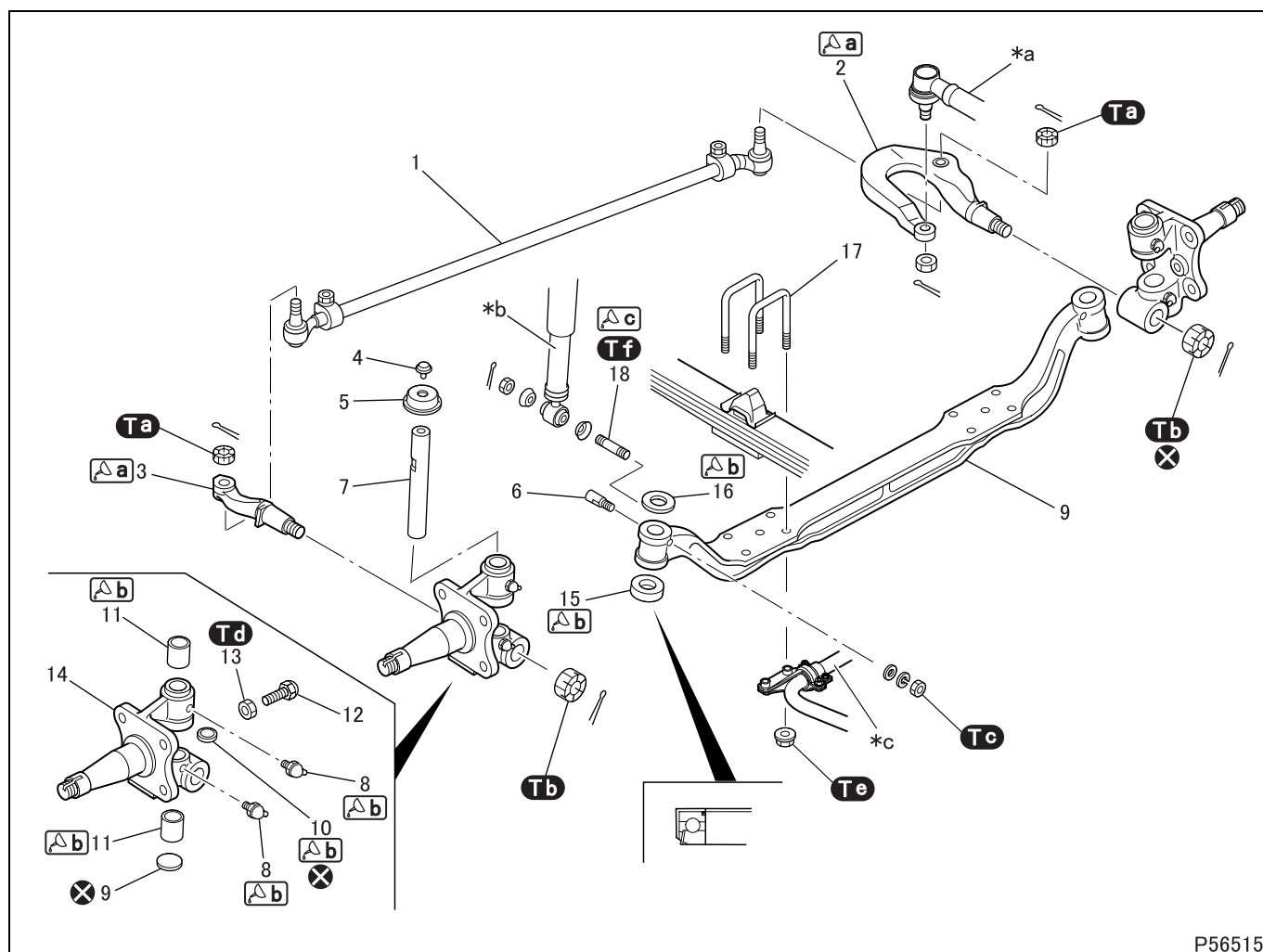
- After installing the lock nut, perform the following inspection.
- Measure the tangential force at the hub bolt position using a spring balancer.
- If the tangential force is within the specified value, the starting torque conforms to the standard value. If the measured value deviates from the specified value, adjust.



[Adjustment]

- Tighten the lock nut to the specified torque (primary tightening) while turning the wheel hub and rotor, and then loosen it completely.
- Smooth operation of the outer bearing and inner bearing by turning the wheel hub and rotor several times, and then tighten the lock nut to the specified torque (secondary tightening).
- Return the lock nut by approximately 45 degrees (1/8 of a turn) and secure it with a split pin. If pin holes do not align, align them in the course of loosening. Make sure that there is no play in the axial direction.
- Perform measurement again after adjustment. If any fault is found, replace the outer and inner bearings.

M E M O



P56515

- | | |
|--------------------------------|-----------------------|
| 1 Tie rod (See later section.) | 13 Lock nut |
| 2 Knuckle arm | 14 Knuckle |
| 3 Tie rod arm | 15 Thrust bearing |
| 4 Dust plug | 16 Kingpin shim |
| 5 Dust cap | 17 U-bolt |
| 6 Lock pin | 18 Stud bolt |
| 7 Kingpin | 19 Front axle |
| 8 Grease nipple | |
| 9 Plug | *a: Drag link |
| 10 Dust seal | *b: Shock absorber |
| 11 Bushing | *c: Stabilizer |
| 12 Knuckle stopper bolt | ⊗: Non-reusable parts |

- When removing the tie rod, take care not to deform or damage the dust cover.

Follow the disassembly sequence in reverse.

Repair kit: Kingpin kit

Service standards (Unit: mm {in.})

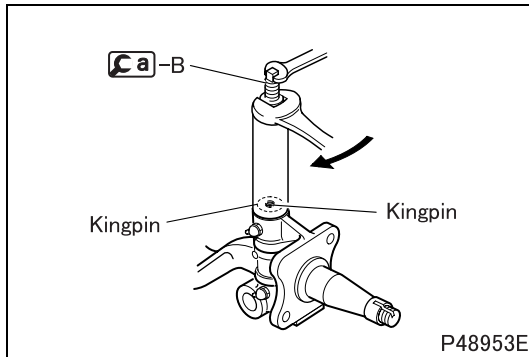
Location	Maintenance item		Standard value	Limit	Remedy
7	Outer diameter of kingpin		27.947 to 27.980 {1.100 to 1.102}	27.9 {1.098}	Replace
7, 11	Clearance between kingpin and bushing		0.020 to 0.086 {0.00079 to 0.0034}	0.15 {0.0059}	Replace
11	Inner diameter of bushing (after having been pressed into knuckle)		28.000 to 28.033 {1.102 to 1.103}	—	Replace
14, 19	Vertical clearance between knuckle and front axle		0.02 to 0.10 {0.00079 to 0.0039}	0.20 {0.0079}	Adjust
19	Front axle	Horizontal bend	—	2 {0.079}	Replace
		Vertical bend	—	2 {0.079}	
		Kingpin inclination angle	8° ± 10'	—	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Nut (Tie rod mounting)		93 ± 25 {69 ± 18, 9.5 ± 2.5}	–
Tb	Nut (Knuckle arm mounting)		345 ± 49 {254 ± 36, 35 ± 5}	–
	Nut (Tie rod arm mounting)			
Tc	Nut (Lock pin mounting)		33 ± 5 {25 ± 3.6, 3.4 ± 0.5}	–
Td	Lock nut (Knuckle stopper bolt tightening)		46.5 ± 7 {34 ± 5.4, 4.75 ± 0.75}	–
Te	Nut (U-bolt mounting)		162 ± 15 {120 ± 11, 16.5 ± 1.5}	–
Tf	Stud bolt	Stud	88 {65, 9} or more	–
		Nut (return)	137 {101, 14} or more	–

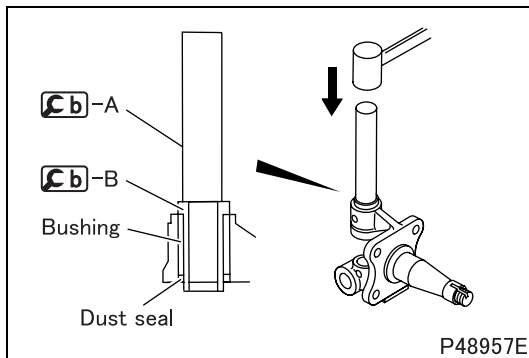
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Knuckle arm and tie rod arm threads	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required when parts are reused
 b	Lip area of dust seal		As required
	Inside surface of bushing		
	Top face of thrust bearing		
	Both sides of kingpin shim		
	Fill from grease nipple		Until grease starts overflowing from dust plug
 c	Stud threads of stud bolt	LOCTITE 271	As required



■ Removal: Kingpin

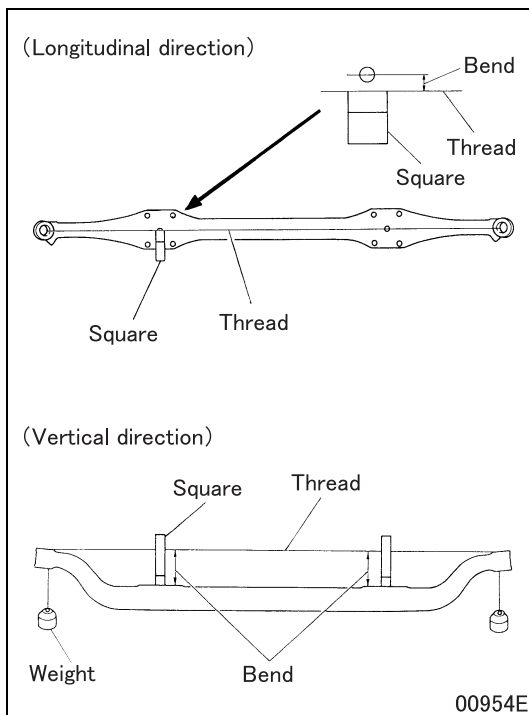
- Screw **Ca**-B into the kingpin threads to remove the kingpin.



■ Removal: Dust seal and bushing

- Remove the upper bushing and dust seal at the same time using **Cb**.

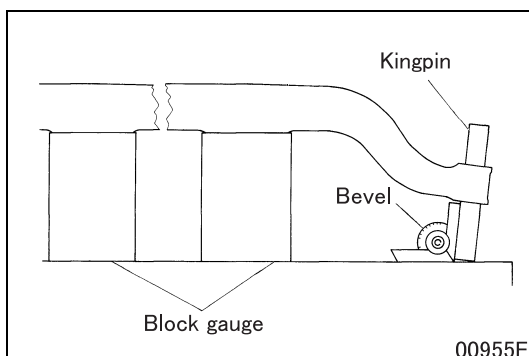
◆ Inspection procedure ◆



■ Inspection: Front axle

(1) Bend of front axle in the back-and-forth direction and vertical direction

- Put a piece of thread through kingpin holes of the front axle and hang weights at both ends.
- Use a square to find bend to each of back-and-forth and vertical directions.
- If the measured value exceeds the limit, replace the front axle.

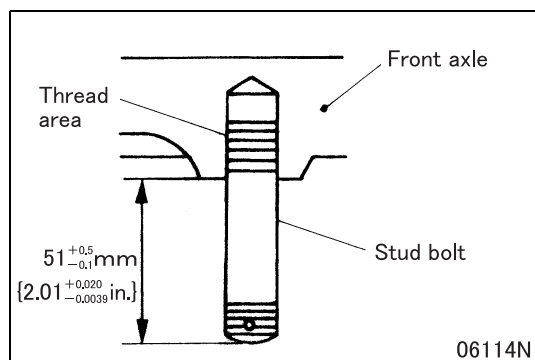


(2) Kingpin inclination angle

- Set the kingpin on the front axle as illustrated to measure the angle.
- If the measured value deviates from the standard value, replace the front axle.

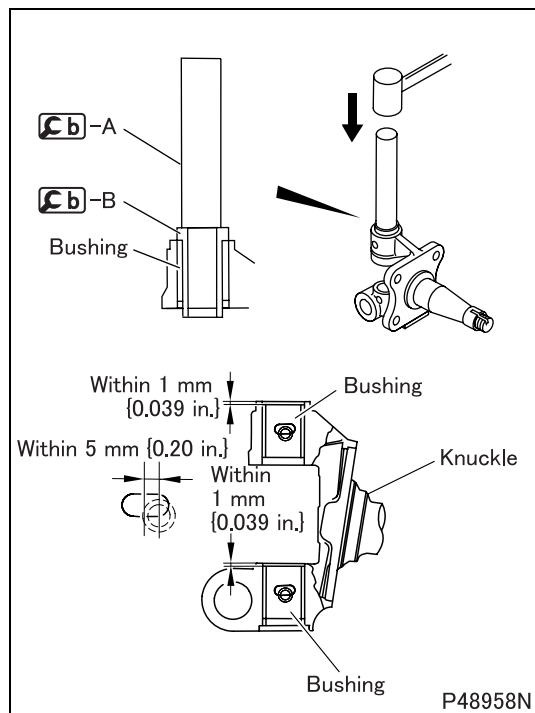
KNUCKLE AND KINGPIN, FRONT AXLE

◆ Installation procedure ◆



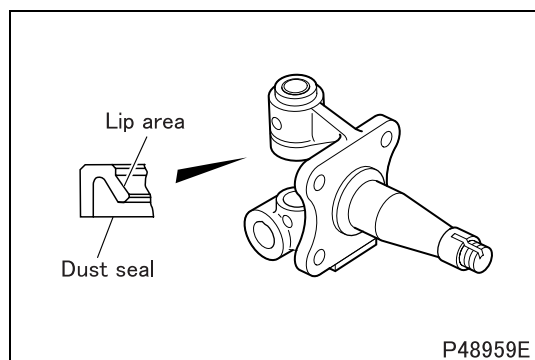
■ Installation: Stud bolt

- Apply LOCTITE to front axle mounting threads of the stud bolt.
- Install the stud bolt to the dimension as illustrated.



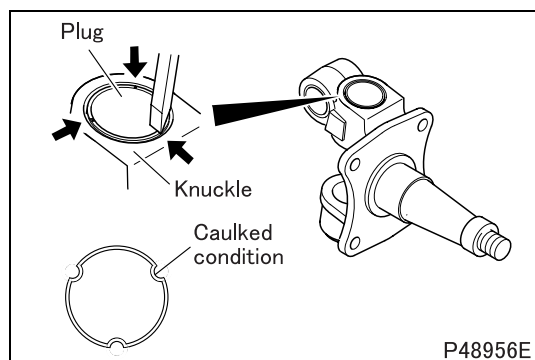
■ Installation: Bushing

- Install the bushing using **Cb** so that a step height between the bushing and knuckle is within 1 mm {0.039 in.}.
- The oil hole of the bushing must not deviate from the screw hole of the knuckle more than 5 mm {0.20 in.}.



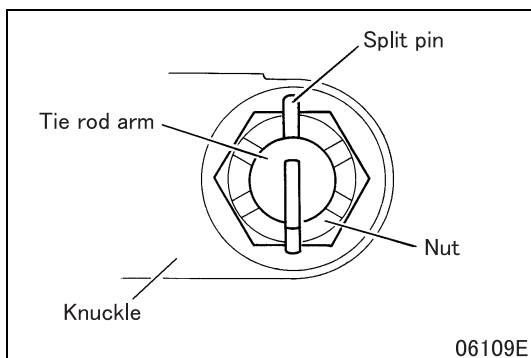
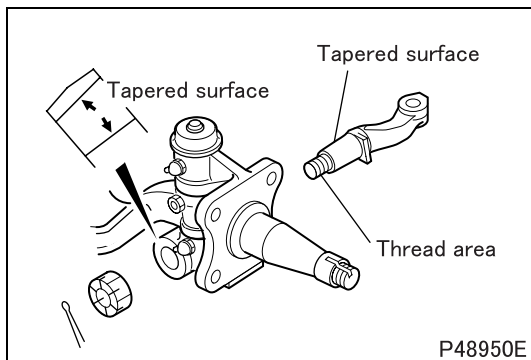
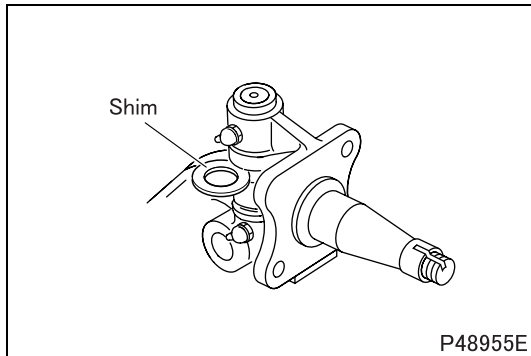
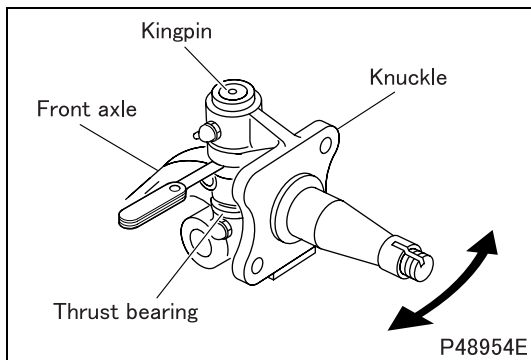
■ Installation: Dust seal

- Apply grease to the lip area of the dust seal and install it on the knuckle in the illustrated direction.



■ Installation: Plug

- After installing the plug, caulk the knuckle at three evenly spaced points of the plug circumference avoiding previously caulked points.



■ Installation: Knuckle

- After temporarily assembling the thrust bearing, knuckle and kingpin into the front axle, move the knuckle several times to smooth its operation.
- Measure clearance between the front axle top face and the knuckle bottom.

- If the measured value exceeds the limit, adjust with a kingpin shim.

Thickness of kingpin shims available

0.10, 0.15, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70 mm

{0.0039, 0.0059, 0.0079, 0.012, 0.016, 0.020, 0.023, 0.028 in.}

(Eight thickness)

CAUTION ⚠

- Select a kingpin shim so that the clearance is as small as possible within the range of the standard value.
- After assembly, make sure that the knuckle moves smoothly.

■ Installation: Tie rod arm and knuckle

(1) When one or both of the tie rod arm and knuckle need re-assembly making use of existing parts

- Polish the entire tapered surfaces of the tie rod arm and knuckle evenly by means of sand paper #120 or above until sand paper score is visible on polished surfaces. (This does not apply to new replacement parts.)
- Clean the tapered surfaces and thread areas of the tie rod arm and knuckle.

NOTE

- Use acetone, cleaning fluid for color check, or equivalent as solvent.

- Apply grease to the thread area of the tie rod arm and install it.

CAUTION ⚠

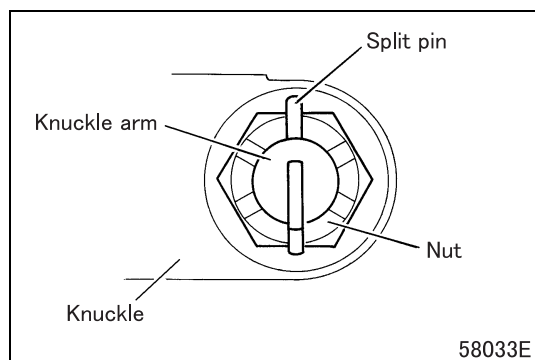
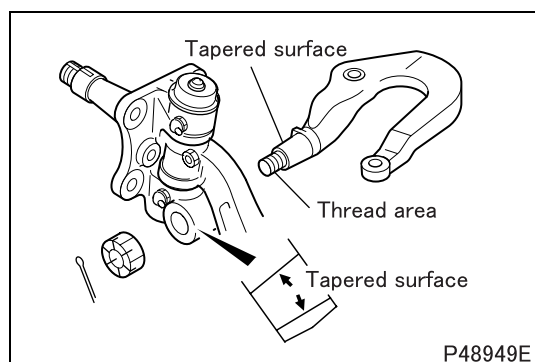
- When installing the tie rod arm, make sure that tapered surfaces of the tie rod arm and knuckle are free from grease.

- Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.

(2) When both of the tie rod arm and knuckle for assembling are new parts

- Clean tapered surfaces and thread areas of the tie rod arm and knuckle.
- Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.

KNUCKLE AND KINGPIN, FRONT AXLE



■ Installation: Knuckle arm and knuckle

(1) When one or both of the knuckle arm and knuckle need re-assembly making use of existing parts

- Polish the entire tapered surfaces of the knuckle arm and knuckle evenly by means of sand paper #120 or above until sand paper score is visible on polished surfaces. (This does not apply to new replacement parts.)
- Clean the tapered surfaces and thread areas of the knuckle arm and knuckle.

NOTE

- Use acetone, cleaning fluid for color check, or equivalent as solvent.

- Apply grease to the thread area of the knuckle arm and install it.

CAUTION ⚠

- When installing the knuckle arm, make sure that tapered surfaces of the knuckle arm and knuckle are free from grease.

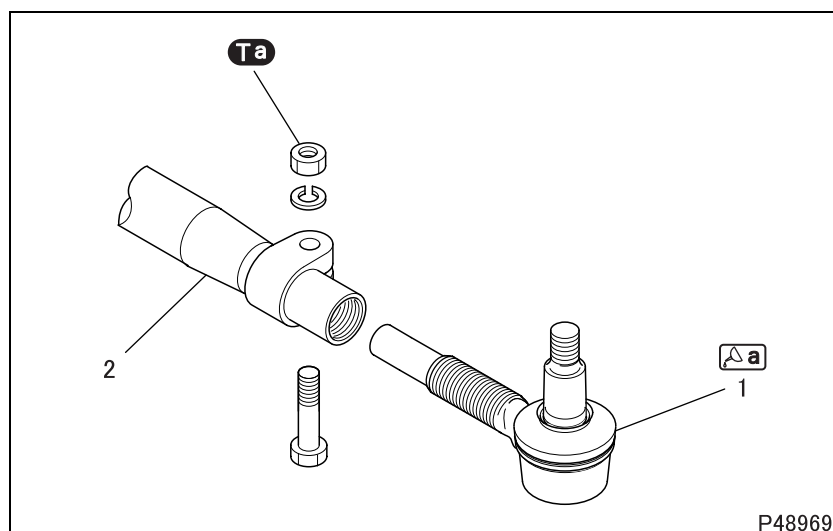
- Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.

(2) When both of the knuckle arm and knuckle for assembling are new parts

- Clean tapered surfaces and thread areas of the knuckle arm and knuckle.
- Tighten the nut to the specified torque. Be sure to align pin holes in the course of tightening and insert the split pin as illustrated.

M E M O

TIE ROD



● Disassembly sequence

- 1 Tie rod end
- 2 Tie rod

CAUTION

- If any abnormality such as tear is found in the dust boot of the tie rod end, replace the tie rod end.

NOTE

- Do not disassemble the tie rod end, as it is of non-disassembly type.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1	Rotation torque of tie rod end	1.0 to 5.9 N·m {0.1 to 0.6 kgf·m}	–	Replace
2	Bend of tie rod	–	1 {0.039} or less	Correct or re- place

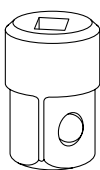
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
	Nut (Tie rod end tightening)	25 ± 5 {18 ± 3.7, 2.5 ± 0.5}	–

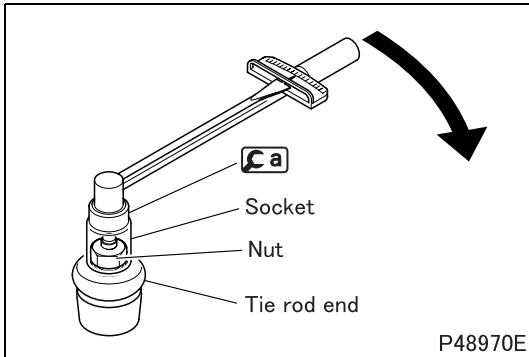
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Lip area of dust cover of tie rod end	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

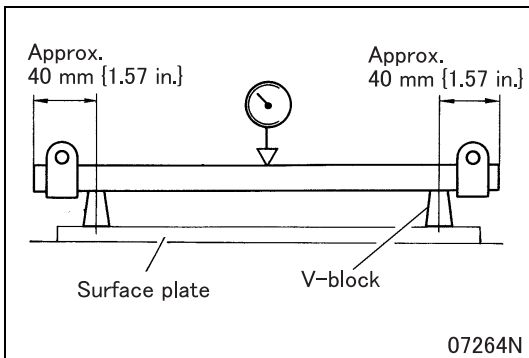
Mark	Tool name and shape	Part No.	Application
	Preload socket  P48876	MB999326	Measurement of rotation torque of tie rod end

◆ Inspection procedure ◆



■ Inspection: Tie rod end

- Install the tie rod mounting nut on the tie rod end.
- Install the socket, **C a** and torque wrench to measure the rotation torque.
- If the measured value deviates from the standard value, replace the tie rod end.



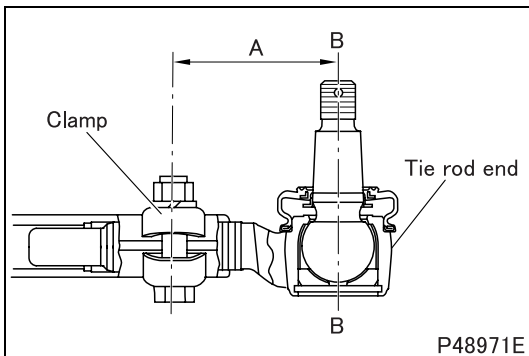
■ Inspection: Bend of tie rod

- Measure the bend of the tie rod at its center.

NOTE

- **Give the tie rod one complete turn and read the dial gauge at this time. The bend is one half of the reading.**
- If the measured value exceeds the limit, correct or replace the tie rod.

◆ Installation procedure ◆



■ Installation: Tie rod end

- Screw in the tie rod end so that difference of dimension **A** between the tie rod end and the clamp is within 1.5 mm {0.059 in.} between right and left.
A: Approximately 74 mm {2.91 in.}

CAUTION ⚠

- **Ensure that difference of an amount of screwing in the tie rod end between right and left is within one turn.**
- **Secure the tie rod ends so that illustrated axis B-B on the right is parallel to that on the left.**



Group 26B

Front Axle <FG>

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	26B-2
STRUCTURE AND OPERATION	
1. Wheel Hub and Brake Drum	26B-2
2. Free Wheel Hub	26B-3
3. Drive Shaft and Steering Knuckle, Axle Housing	26B-4
4. Reduction and Differential	26B-5
TROUBLESHOOTING	26B-6
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Inspection and Adjustment of Wheel Alignment	26B-10
2. Inspection and Adjustment of Steering Angle	26B-14
3. Inspection of Side Slip	26B-14
4. Inspection of Play at Tie Rod End Ball Joint	26B-15
5. Inspection and Replacement of Axle Oil	26B-15
WHEEL HUB AND BRAKE DRUM	26B-18
DRIVE SHAFT AND STEERING KNUCKLE	26B-28
TIE ROD.....	26B-34
AXLE HOUSING.....	26B-36
REDUCTION AND DIFFERENTIAL	26B-38

SPECIFICATIONS / STRUCTURE AND OPERATION

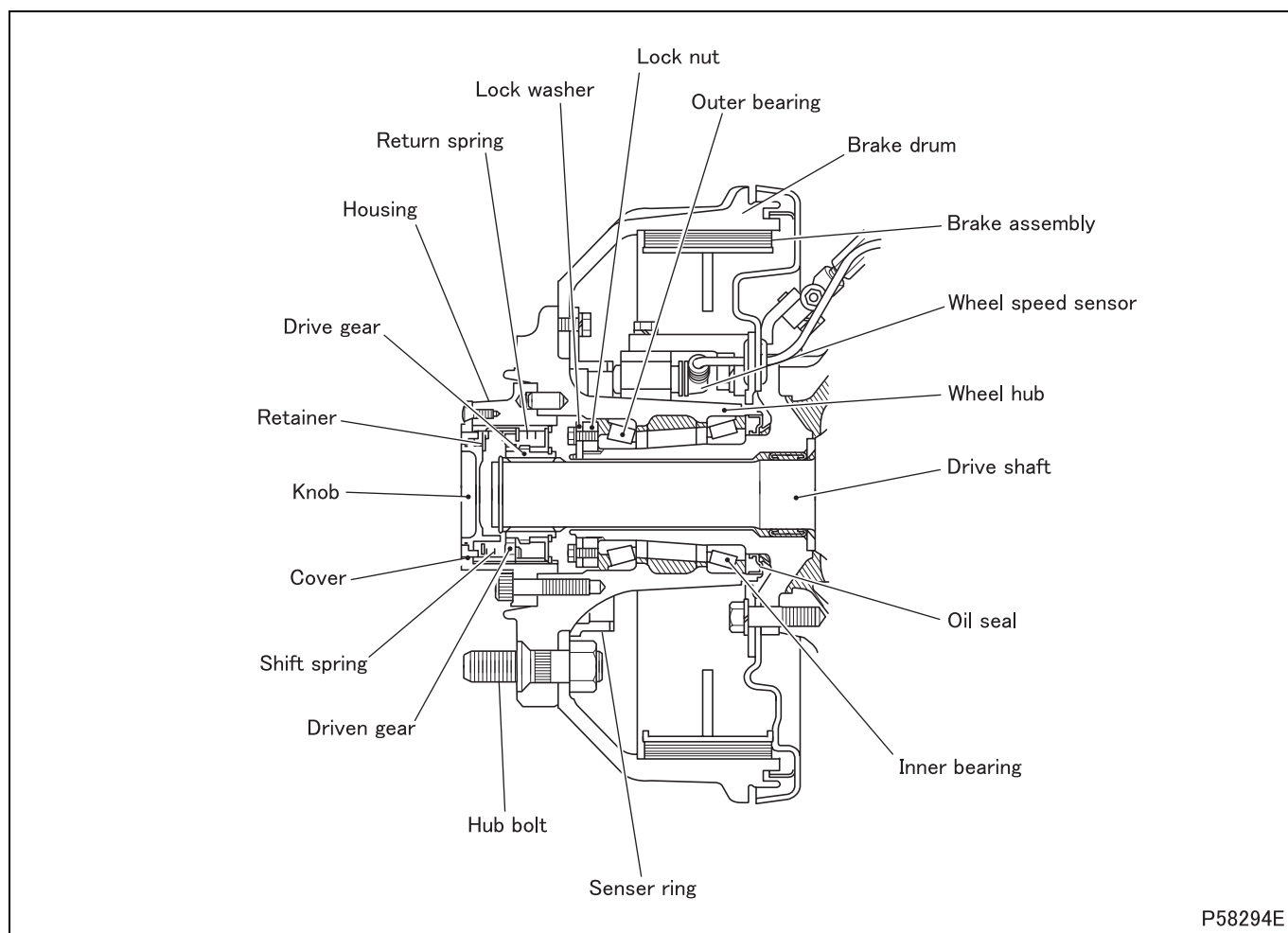
SPECIFICATIONS

Item		Specifications
Front axle	Model	F200TW
	Type	Banjo type, full floating, with Birfield joint
Tread (dimension notified to the authorities) mm {in.}		1665
Reduction	Model	D1H modified
	Type	Single-reduction hypoid gear
	Gear ratio	4.875
Differential	Tooth shape	Straight bevel gear
Gear oil	Grade	Normal: Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot area: Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140
	Quantity dm ³ {qts., L}	3.0 {3.2, 3.0}
Mass	kg {lb.}	Approx. 250 {550}

- Use the gear oil with a SAE viscosity grade of 140 when a vehicle is used under heavily-loaded, severe conditions such as continuous driving on uphill grades. However, the air temperature must be above 10°C {50°F}.

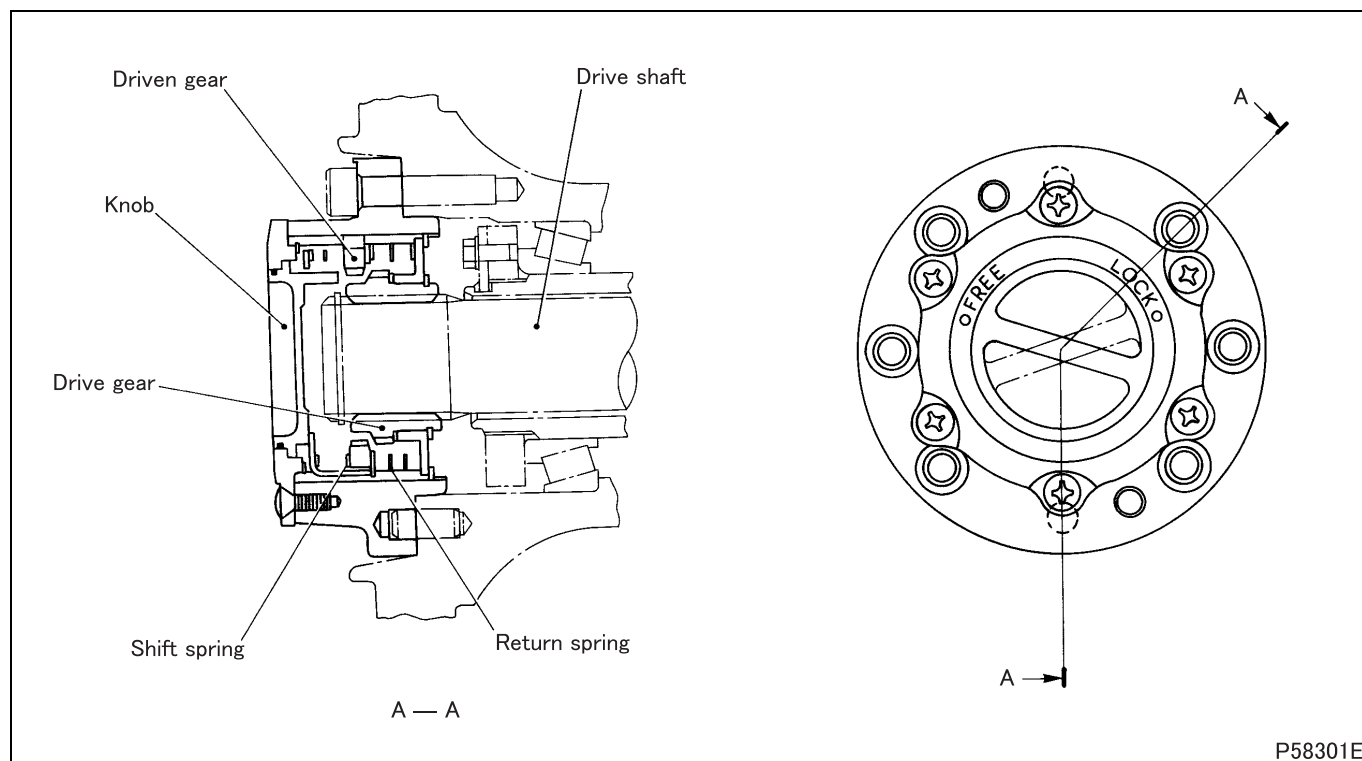
STRUCTURE AND OPERATION

1. Wheel Hub and Brake Drum

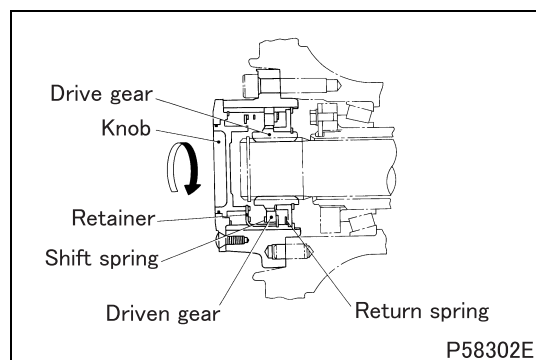


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2. Free Wheel Hub



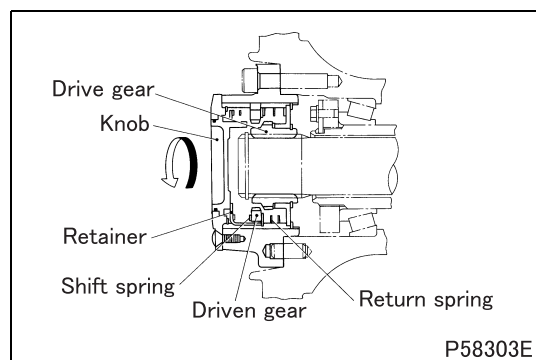
- In the case of a four-wheel drive vehicle, even when it is running in rear-wheel drive only, the drive shaft, differential, propeller shaft, and driving parts of the transfer front drive shaft continue to run due to transmission of rotation from the wheels. This subjects the vehicle drive to a load, and it causes loss of driving power. Now, with a free wheel hub, transmission of rotation from the front wheels to the drive shaft is cut, reducing driving loss when running in rear-wheel drive only. This improves fuel efficiency and reduces vibration and noise.
- With a free wheel hub, FREE (cutting of driving power) ↔ LOCK (transmission of driving power) is made easily by manual operation.



Operating mechanism

● From FREE to LOCK

When knob is turned to LOCK, retainer shifts to the inside along with the shape of the knob, pressing return spring. At this instance, driven gear, being pressed by shift spring, engages with drive gear at the spline, and transmits the driving power.

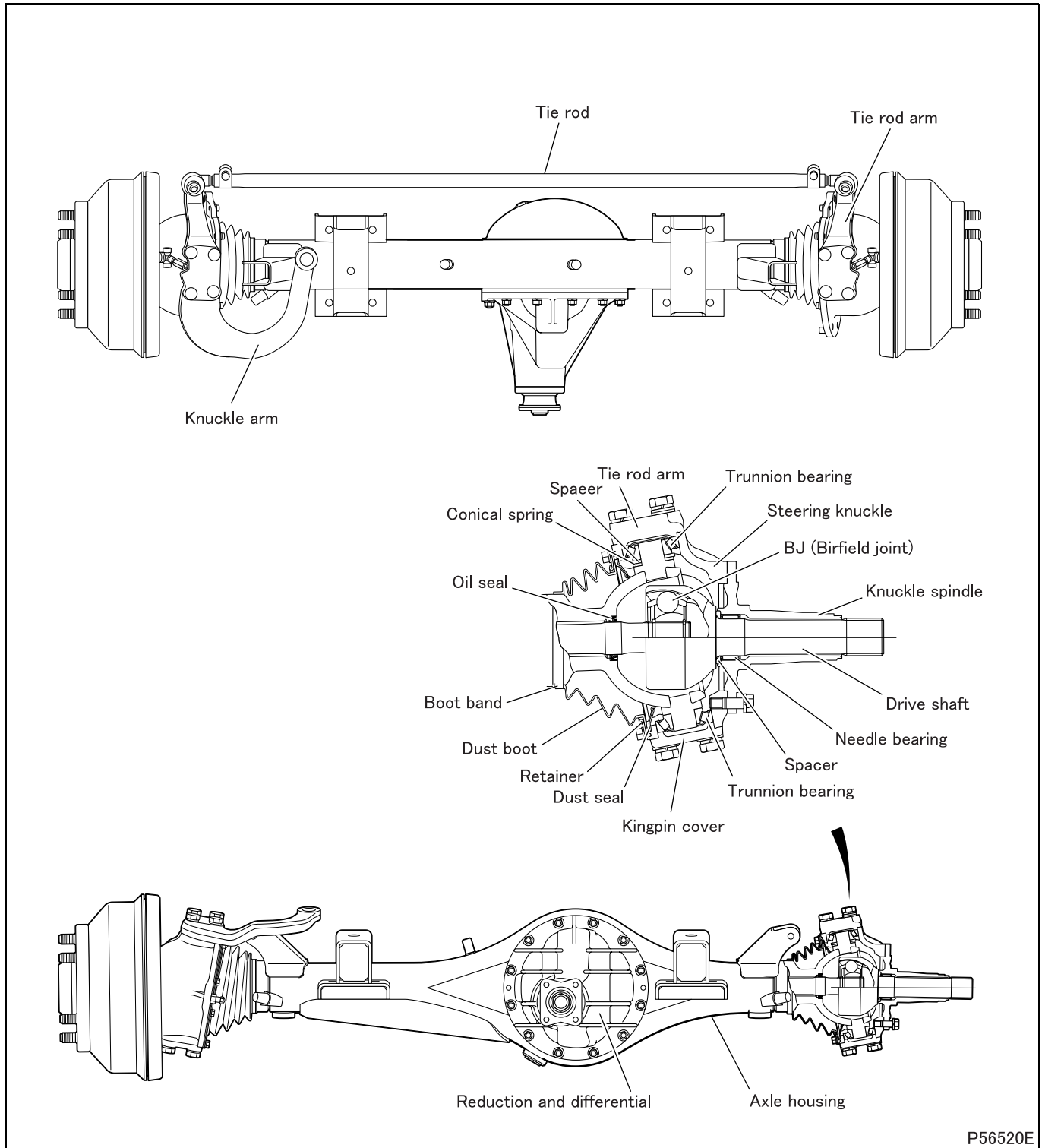


● From LOCK to FREE

When knob is turned to FREE, the action is the reverse of FREE to LOCK, and the driving power is disengaged.

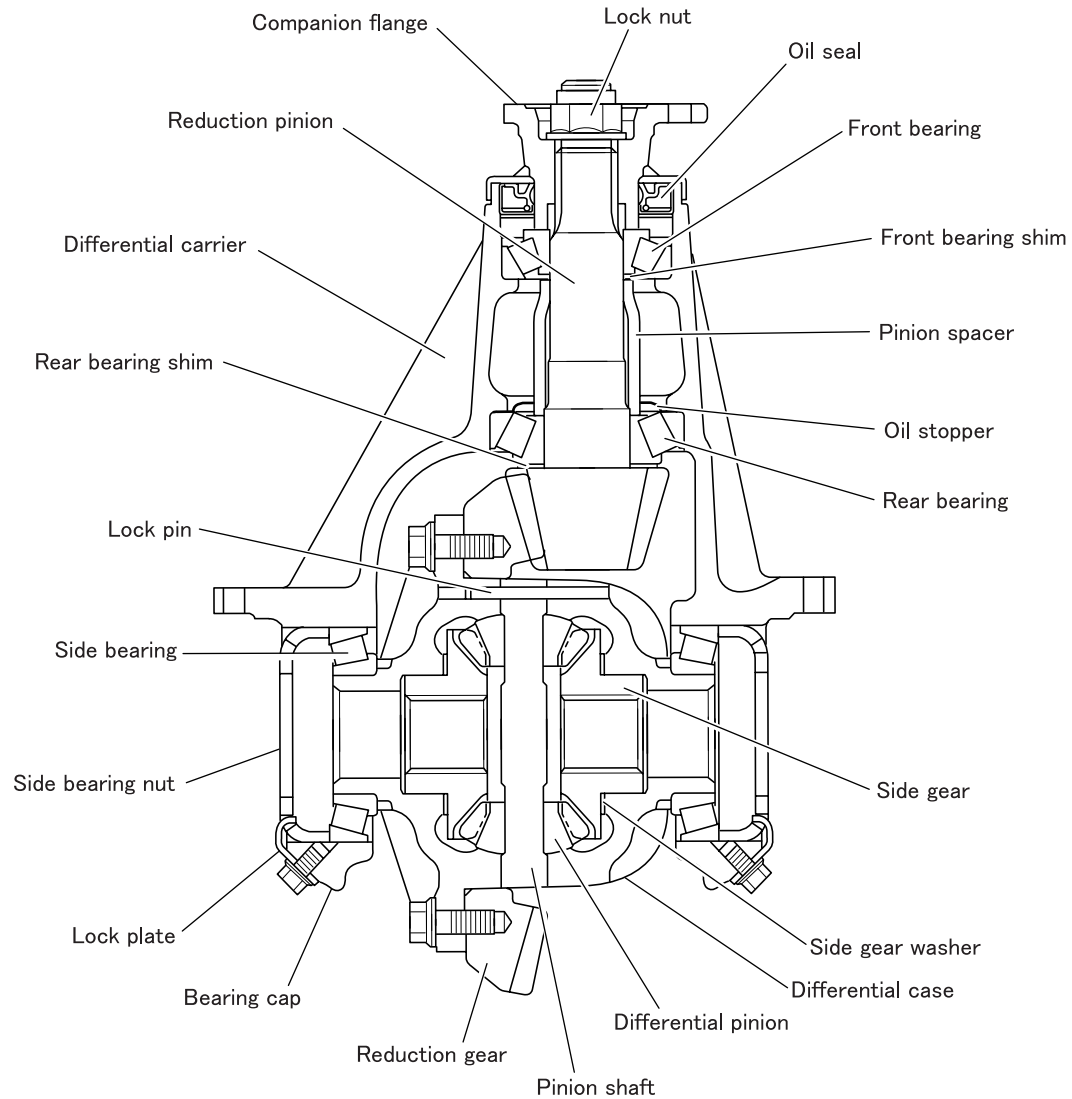
STRUCTURE AND OPERATION

3. Drive Shaft and Steering Knuckle, Axle Housing



- The drive shaft must transfer power according to rotation speed fluctuations caused by change of steering angle when a vehicle is steered. Therefore, a constant velocity universal joint, which eliminates rotation speed fluctuations between the drive shaft and the driven shaft and transfers power evenly, is used for the Birfield joint of the drive shaft.

4. Reduction and Differential



P05607E

TROUBLESHOOTING

Possible causes		Symptoms							Power transmission insufficient							Reference Gr		
		Noise when starting and changing gears	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Propeller shaft turns but front tires do not turn (on a bench tester)	Oil leakage from companion flange	Oil leakage from differential carrier and axle housing	Oil leakage from drive shaft	Steering wheel shakes	Steering feels stiff	Steering wheel return poor	Unable to steer the steering wheel	Steering pulls to one side		Uneven wear or early wear of front tires	
Free wheel hub, wheel hub, drive shaft and steering knuckle, axle housing	Wheel alignment misaligned											O	O	O			O	
	Steering angle adjustment faulty														O			
	Free wheel hub loose	O	O	O														
	Spline of free wheel hub loose	O																
	Wheel hub bearing seized, worn or rotation faulty		O															
	Wheel hub bearing broken			O														
	Drive shaft bent		O															
	Drive shaft broken						O											
	Drive shaft slips out of spline of side gear						O											
	Drive shaft to spline of side gear backlash excessive	O																
	Birfield joint of drive shaft faulty	O	O				O											
	Trunnion bearing loose				O													
	Trunnion bearing seized, worn or rotation faulty											O						
	Needle bearing of knuckle spindle worn		O															
	Knuckle spindle bent															O		
	Oil seal faulty									O								
	Knuckle arm and tie rod arm tightening nuts loose										O							
	Ball stud tightening nut of tie rod end loose										O							
	Ball stud of tie rod end worn										O							
	Tie rod bent														O			
Axle housing bent		O																
Inspection plug and drain plug loose								O										
Vent plug clogged							O		O									

[illegible]

TROUBLESHOOTING

[illegible]

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Adjustment of Wheel Alignment

Before performing inspection and adjustment of wheel alignment, set the vehicle to the following condition.

- Park the vehicle unloaded on a level place.
- The vehicle needs to be equipped with proper size tires.
- If the wear condition of tires on the right is remarkably different from that of tires on the left, replace tires.
- Tires need inflation to specified pressure.
- Correct if the vehicle tilts due to faulty suspension.
- Service all parts of the front axle and ensure that there is no fault such as the following.
 - Loose trunnion bearing
 - Loose front wheel hub
 - Loose bolts used for tightening various parts of tie rod arm, knuckle arm and tie rod
 - Bend of knuckle spindle and axle housing
- Adjust play at steering wheel properly
- For wheel alignment, which is related to the side slip amount, both wheel alignment and the side slip amount must conform to the standard values.

Service standards (Unit: mm {in.})

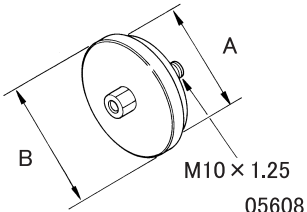
Location	Maintenance item	Standard value	Limit	Remedy
-	Toe-in	0 to 6 (3 ± 3) {0 to 0.24 (0.12 ± 0.12)}	—	Adjust
	Camber	1°00' ± 30'	—	*
	Caster	0°30' ± 1°00'	—	Replace
	Kingpin inclination angle	9°30' ± 30'	—	Replace

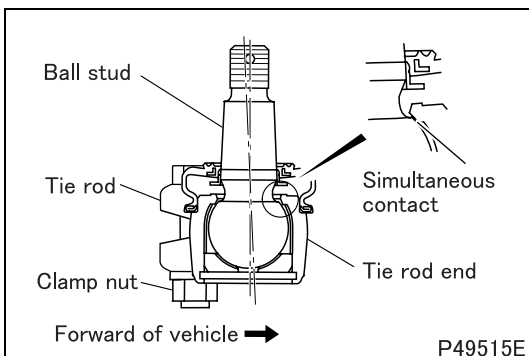
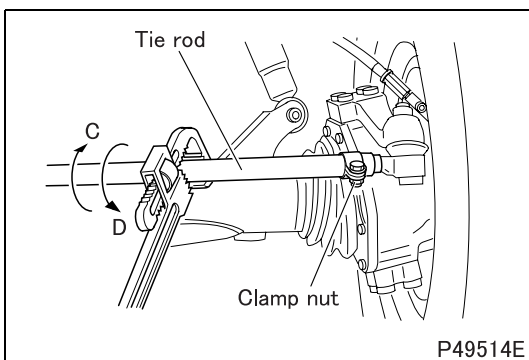
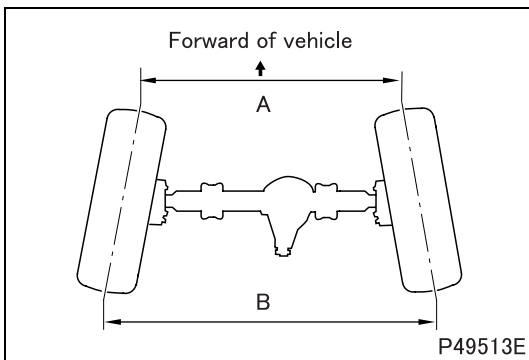
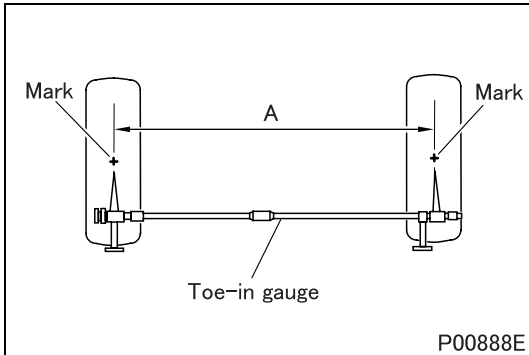
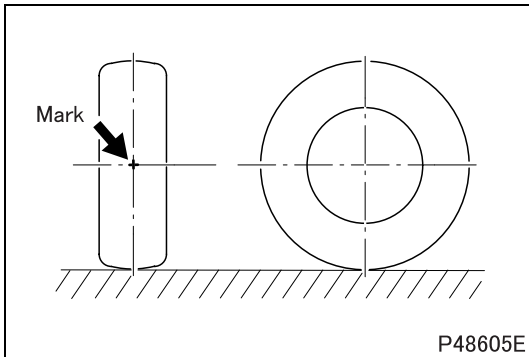
*: If the measured value deviates from the standard value, abnormalities such as loose trunnion bearing, loose hub bearing and bend of knuckle and front axle housing are suspected. Inspect each part and replace defective parts.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
-	Clamp nut (Tie rod end clamp fastening)	25 ± 5 {18 ± 3.6, 2.5 ± 0.5}	—

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
	Alignment gauge adapter 	MH062337	Measurement of camber, caster and kingpin inclination angle



1.1 Inspection and adjustment of toe-in

[Inspection]

- Direct the front wheels exactly to forward running position.
- Put a mark to each tire of right and left at the height of front wheel axis and in the middle of tire width.

- Align the two points of the toe in gauge with respective marks and read distance **A** between the marks.

- Push the vehicle to roll the tires 180 degrees.
- Measure distance **B** between the marks that have moved to the rear of the vehicle.
- If toe-in (difference between **A** and **B**) deviates from the standard value, adjust.

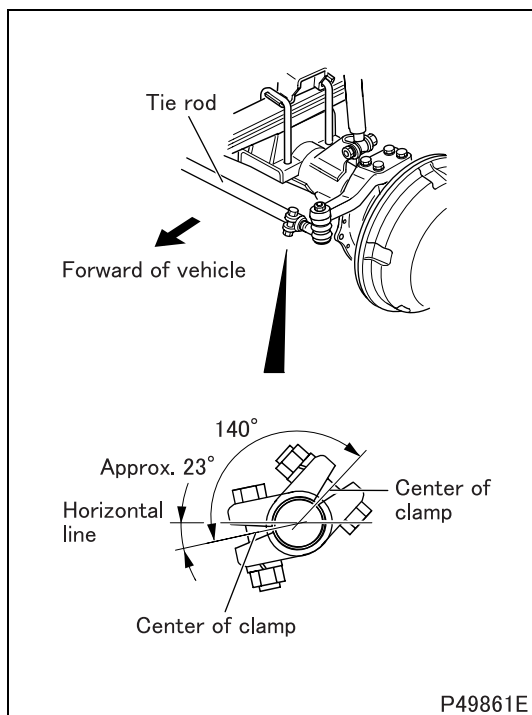
[Adjustment]

- Loosen the clamp nuts on the right and left.
- Turn the tie rod with a pipe wrench to adjust the toe-in.
C: When adjusting to the toe-out direction
D: When adjusting to the toe-in direction
- After adjustment, tighten the clamp nut to the specified torque.

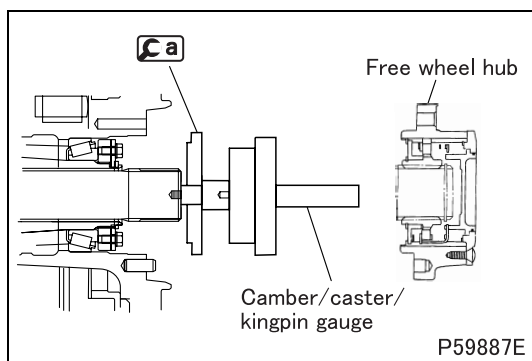
CAUTION ⚠

- Hold down the tie rod end toward the front of the vehicle with the front wheels directed to forward running position so that the right and left tie rod ends are in contact with the ball studs at the same time. In this state adjust so that the specified toe-in is achieved and tighten the clamp nut to secure the tie rod.

ON-VEHICLE INSPECTION AND ADJUSTMENT

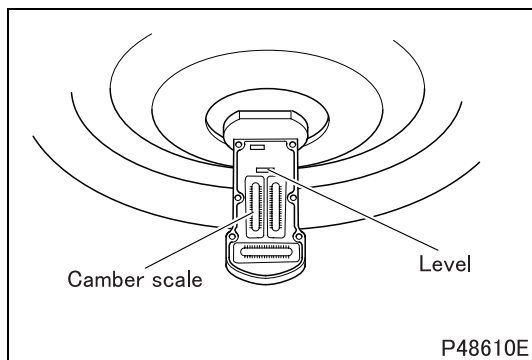


- Make sure that the center of the tie rod clamp is within the illustrated range.
- If it is out of the illustrated range, change the center position of the clamp.

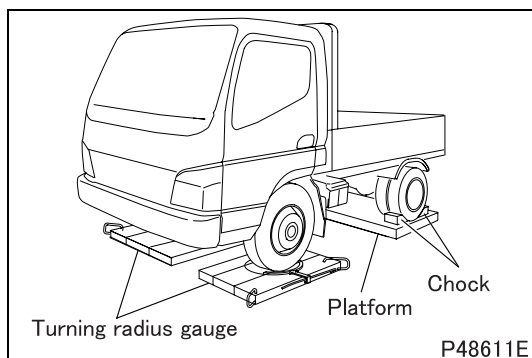


1.2 Inspection of camber

- Direct the front wheels exactly to forward running position.
- Remove the free wheel hub.
- Install **Ca** on the drive shaft tip.
- Install the camber/caster/kingpin gauge.

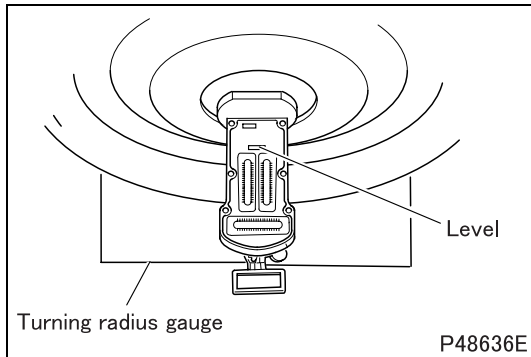


- Place the level in order to have bubble stay in the middle.
- Read center of bubble on camber scale to find the camber. Do the same way for the right and left front tires.
- If the measured value deviates from the standard value, disassemble the front axle for service.

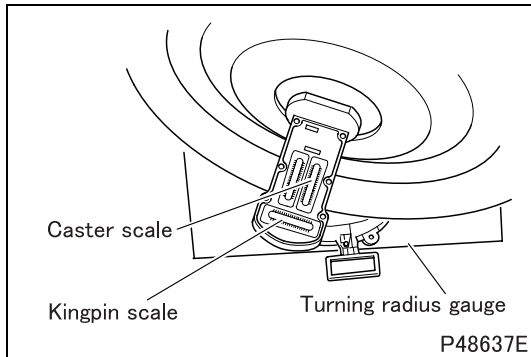


1.3 Inspection of caster and kingpin inclination angle

- Prepare a platform with the same height as the turning radius gauge and place it under the rear wheels so that the vehicle may be placed level.
- Apply chocks to the rear wheels.
- Keep the turning radius gauge locked.
- Jack up the vehicle, and set the right and left front wheels so that respective ground contact area centers of two wheels and turntable centers may meet.



- Unfasten locking of the turning radius gauge, and set the scale to 0 degrees.
- In the same manner as in case of measuring camber in Section 1.2, attach the camber/caster/kingpin gauge, and set the level so that the bubble comes in the middle.



- Apply brake, and with brake applied to the front wheels, turn steering wheel slowly from the point of 0 degrees on the turning radius gauge, until the direction is changed by 20 degrees each to the right side in case of the right front wheel and to the left in case of the left front wheel.

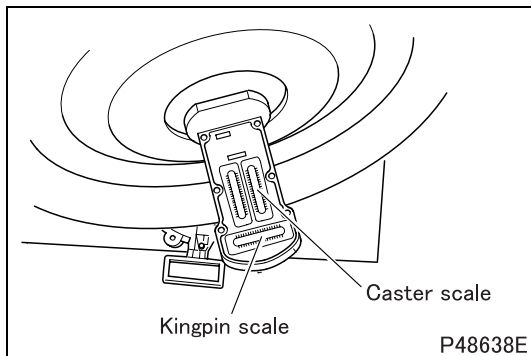
NOTE

- **It is not possible to make exact measurement unless brake is kept applied, because otherwise wheels will turn slightly.**

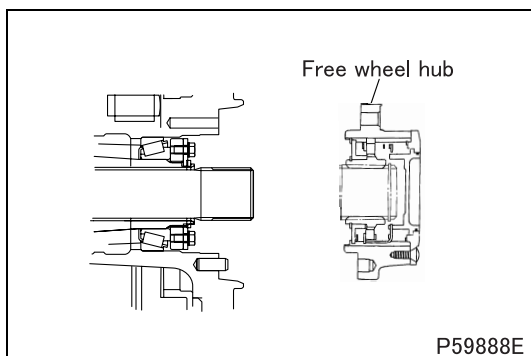
- At the point where steering has been steered 20 degrees, set the caster scale and the center of the bubble of the kingpin scale to 0 degrees by turning the adjuster.

NOTE

- **Pay attention to the kingpin scale because it has scales for right and left: align the right kingpin scale in case of the right front wheel, and left kingpin scale in case of the left front wheel.**



- Reverse this position, turn the steering wheel slowly until the direction of the front wheels changes by 20 degrees in the opposite direction.
- Read the center of bubbles at this position at the caster scale and kingpin scale to find caster and kingpin inclination angles.
- If the measured value deviates from the standard value, disassemble the front axle for service.



- After inspection, install the free wheel hub.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Inspection and Adjustment of Steering Angle

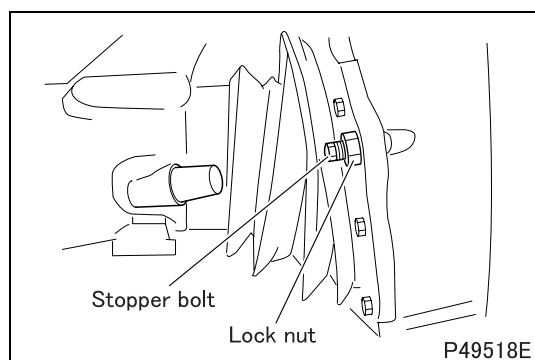
- Perform steering angle inspection and adjustment only after wheel alignment inspection and adjustment has been completed.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Steering angle	Inside (Outside steering angle is for reference only)	$35^{\circ} \begin{smallmatrix} 0 \\ -2^{\circ} \end{smallmatrix}$ (34°)	–	Adjust

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Lock nut (Knuckle stopper bolt tightening)	96 ± 12 { 71 ± 9 , 9.75 ± 1.25 }	–



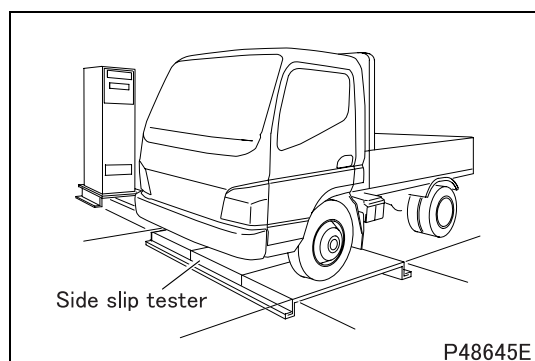
- Set the turning radius gauge and a platform on the vehicle in the same manner as in case of caster and kingpin inclination angle measurement performed in Section 1.3.
- Turn the steering wheel right or left completely from the position where the turning radius gauge is set to 0 degrees, and measure the steering angle, reading the scale of the turning radius gauge.
- If the measured value deviates from the standard value, adjust with the knuckle stopper bolt and tighten the lock nut to the specified torque.

3. Inspection of Side Slip

- Perform side slip inspection only after wheel alignment inspection and adjustment has been completed.
- For the side slip amount, which is related to wheel alignment, both the side slip amount and wheel alignment must conform to the standard values.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Side slip amount	0 ± 3 { 0 ± 0.12 }	–	Adjust

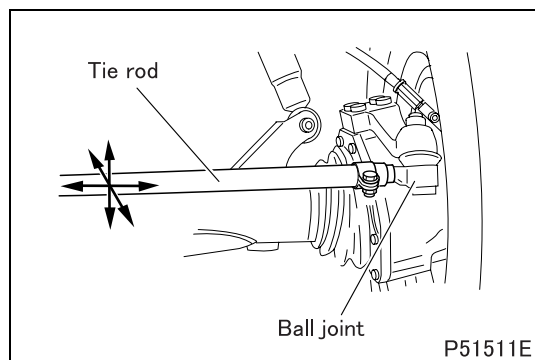


- Set the front wheels exactly to forward running position.
- Move the vehicle forward past the side slip tester as slowly as possible to inspect side slip.

NOTE

- Pay attention to the following when moving over the side slip tester.
 - Be sure to hold steering exactly at the forward running position, and make no turn.
 - Do not apply brake.
 - Keep the speed constant.
-
- If the measured value deviates from the standard value, inspect and adjust wheel alignment.

4. Inspection of Play at Tie Rod End Ball Joint



- Hold the tie rod section of the tie rod with the vehicle kept stationary, and move it in the back-and-forth, up-and-down and right-and-left directions to check for play at ball joints of the tie rod end.

NOTE

- **Be sure to check for play at ball joints of both right and left sides of the tie rod.**
- If there is play, replace the tie rod end of the tie rod.

5. Inspection and Replacement of Axle Oil

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
-	Inspection plug	110 ± 10 {81 ± 7.4, 11 ± 1}	-
	Drain plug		

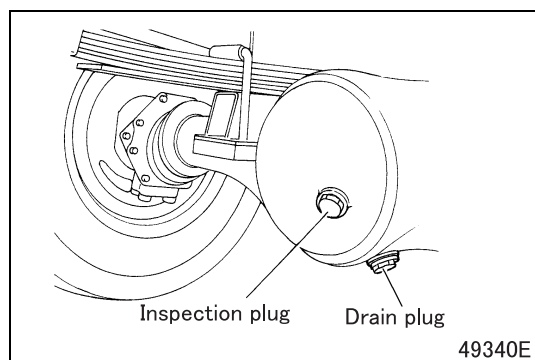
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
-	Axle housing	Normal: Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot area: Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140	3 dm ³ {3.2 qts., 3 L}

- Use the gear oil with a SAE viscosity grade of 140 when a vehicle is used under heavily-loaded, severe conditions such as continuous driving on uphill grades. However, the air temperature must be above 10°C {50°F}.

WARNING

- **The oil temperature is high immediately after the vehicle has stopped, so take care not to scald yourself.**



[Inspection]

(1) Inspection of oil quantity

- Remove the inspection plug, and check that gear oil is filled up to the neck.
- If gear oil is not sufficient, fill oil from the inspection plug hole up to the neck.

(2) Inspection of oil quality and inclusions

- When draining gear oil, check for oil quality, metal chips and metal powder.
- If an abnormally large amount of metal chips and metal powder is found, disassemble the assembly for service, as abnormalities may be caused inside.

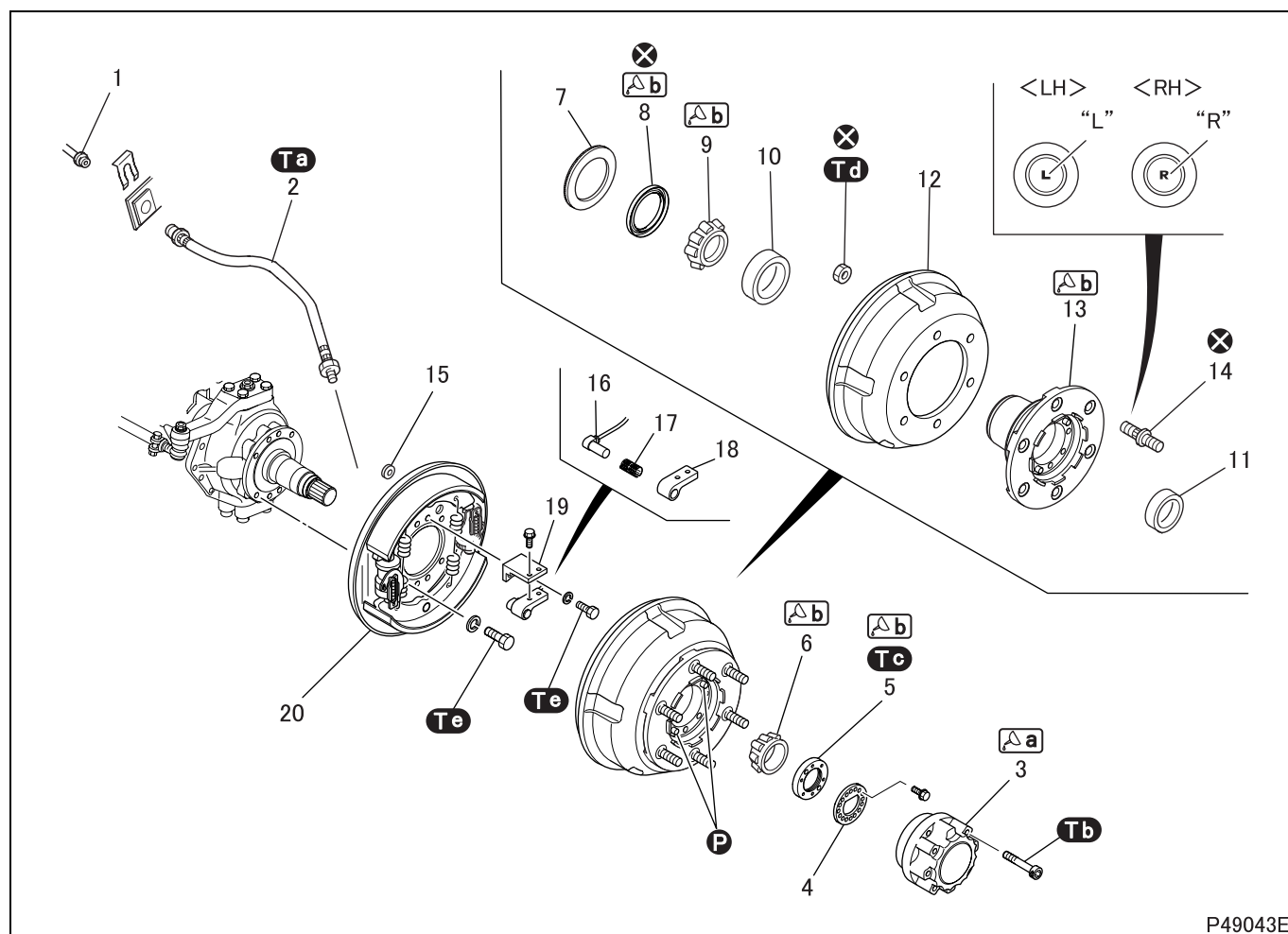
ON-VEHICLE INSPECTION AND ADJUSTMENT

[Replacement]

- Remove the drain plug to drain gear oil. Drainage can be made quickly with the inspection plug removed.
- As the drain plug is a magnet, clean it before installation.
- Fill the specified quantity of gear oil from the inspection plug hole.
- After filling, check that gear oil is filled up to the neck. If oil is not sufficient, replenish it.

M E M O

WHEEL HUB AND BRAKE DRUM



● Disassembly sequence

- | | |
|--------------------------------|----------------------------------|
| 1 Brake pipe | 13 Wheel hub |
| 2 Brake hose | 14 Hub bolt |
| 3 Free wheel hub | 15 Grommet |
| 4 Lock washer | 16 Wheel speed sensor |
| 5 Lock nut | 17 Spring spacer |
| 6 Outer bearing inner race | 18 Sensor holder |
| 7 Anti-lock brake system rotor | 19 Bracket |
| 8 Oil seal | 20 Front drum brake (See Gr35A.) |
| 9 Inner bearing inner race | |
| 10 Inner bearing outer race | |
| 11 Outer bearing outer race | |
| 12 Brake drum | |
- P**: Locating pin
X: Non-reusable parts

CAUTION

- Plug the brake hose to prevent entry of dust and dirt after it has been removed.

NOTE

- Do not remove the anti-lock brake system rotor unless replacing it.
- Do not disassemble the brake drum and wheel hub unless replacing them.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- Make sure that the brake lining surface of the front drum brake and the inner surface of the brake drum are free from grease to avoid malfunction of brakes.
- Make sure that the brake hose is not twisted when installing it.
- Adjust brake shoe clearance after assembly. (See Gr35A.)

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of wheel hub bearing (tangential force at hub bolt position with oil seal assembled)		2 to 3.9 N·m {1.5 to 2.9 ft.lbs, 0.20 to 0.40 kgf·m} (tangential force: 17.7 to 34.3 N {4.0 to 7.7 lbs., 1.8 to 3.3 kgf})	–	Adjust or replace
13	Brake drum	Inside diameter	320 {12.60}	322 (※ 321) {12.68 (※ 12.64)}	Correct or replace
		Cylindricity	0.05 {0.0020}	0.20 {0.079}	

※ shows the correction limit value.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

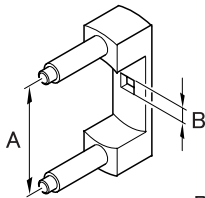
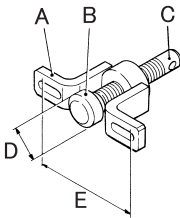
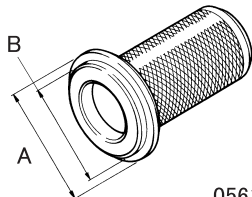
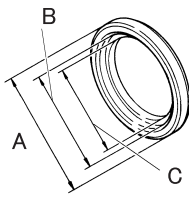
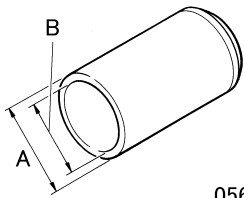
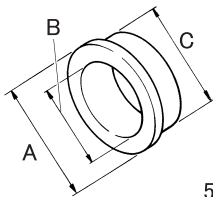
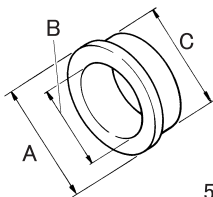
Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Brake hose		13 to 17 {9.4 to 12, 1.3 to 1.7}	–
Tb	Bolt (Free wheel hub mounting)		68.6 ± 4.9 {51 ± 3.6, 7.0 ± 0.5}	–
Tc	Lock nut	Primary tightening	113 ± 15 {83 ± 11, 11.5 ± 1.5}	–
		Secondary tightening after complete tightening	25 ± 5 {18 ± 3.6, 2.5 ± 0.5}	–
Td	Nut (Brake drum and wheel hub mounting)		343 ± 39 {253 ± 29, 35 ± 4}	–
Te	Bolt (Bracket mounting)		123 ± 5 {90 ± 3.6, 12.5 ± 0.5}	–
	Bolt (Front drum brake mounting)			

Lubricant and/or sealant

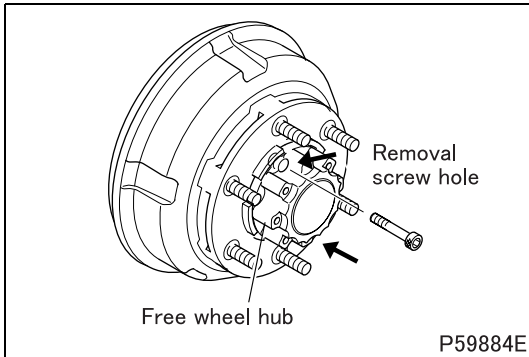
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Wheel hub contact surface of free wheel hub	THREEBOND 1104 or 1215	As required
 b	Thread area of lock nut	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Pack space between rollers of outer bearing inner race and inner bearing inner race		
	Lip area of oil seal		
	Pack inside of wheel hub		65 ± 10 g {2.29 ± 0.35 oz.}

WHEEL HUB AND BRAKE DRUM

Special tools (Unit: mm {in.})

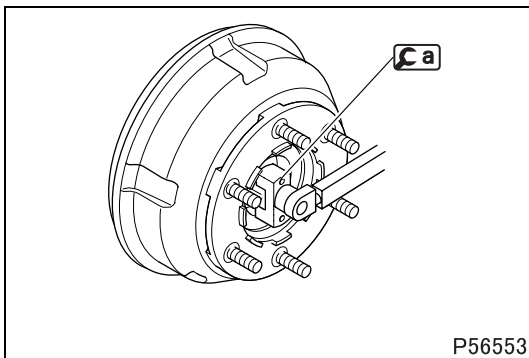
Mark	Tool name and shape	Part No.	Application						
	Lock nut adjust tool <table><tr><th>A</th><th>B</th></tr><tr><td>70 {2.76}</td><td>12.7 {0.50}</td></tr></table>  P49612	A	B	70 {2.76}	12.7 {0.50}	MB999151	Removal and installation of lock nut		
A	B								
70 {2.76}	12.7 {0.50}								
	Hub puller A: Hub puller body B: Attachment C: Bolt <table><tr><th>D</th><th>E</th></tr><tr><td>φ50 {1.97}</td><td>16.5 {6.50}</td></tr></table>  05618	D	E	φ50 {1.97}	16.5 {6.50}	MB999070 A: MB999071 B: MB999073 C: MB999072	Removal of wheel hub and brake drum		
D	E								
φ50 {1.97}	16.5 {6.50}								
	Oil seal installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ84 {3.31}</td><td>φ70 {2.76}</td></tr></table>  05619	A	B	φ84 {3.31}	φ70 {2.76}	MB999097	Installation of oil seal (to be used in combination)		
A	B								
φ84 {3.31}	φ70 {2.76}								
	Oil seal installer <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ105 {4.13}</td><td>φ84 {3.31}</td><td>φ71 {2.80}</td></tr></table>  51038	A	B	C	φ105 {4.13}	φ84 {3.31}	φ71 {2.80}	MB999153	
A	B	C							
φ105 {4.13}	φ84 {3.31}	φ71 {2.80}							
	Bearing installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ70 {2.76}</td><td>φ57 {2.24}</td></tr></table>  05668	A	B	φ70 {2.76}	φ57 {2.24}	MB999100	Installation of inner bearing outer race (to be used in combination with ) Installation of outer bearing outer race (to be used in combination with )		
A	B								
φ70 {2.76}	φ57 {2.24}								
	Bearing installer <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ94.5 {3.72}</td><td>φ60 {2.36}</td><td>φ92.5 {3.64}</td></tr></table>  51039	A	B	C	φ94.5 {3.72}	φ60 {2.36}	φ92.5 {3.64}	MB999069	Installation of inner bearing outer race (to be used in combination with )
A	B	C							
φ94.5 {3.72}	φ60 {2.36}	φ92.5 {3.64}							
	Bearing installer <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ88.5 {3.48}</td><td>φ51 {2.01}</td><td>φ71 {2.80}</td></tr></table>  51039	A	B	C	φ88.5 {3.48}	φ51 {2.01}	φ71 {2.80}	MB999099	Installation of outer bearing outer race (to be used in combination with )
A	B	C							
φ88.5 {3.48}	φ51 {2.01}	φ71 {2.80}							

◆ Removal procedure ◆

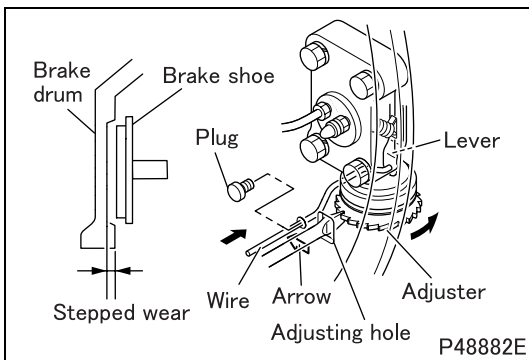


■ Removal: Free wheel hub

- Screw two bolts evenly into the free wheel hub removal screw holes to remove the free wheel hub.



■ Removal: Lock nut

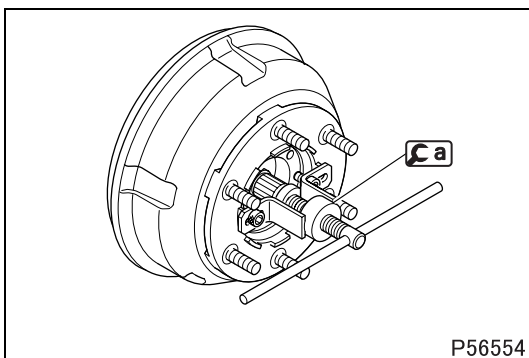


■ Removal: Wheel hub and brake drum

- If the brake drum has stepped wear and the wear prevents the wheel hub and brake drum from being removed, the removal can still be effected by taking the following procedure.
 - Insert a wire of approx. $\phi 2$ mm {0.079 in.} into the hole from which the plug has been removed, and lift up the adjust lever of the wheel cylinder.
 - Turn the adjuster from the adjust hole in the opposite direction to the arrow on the backing plate to increase the clearance between the brake drum and the brake shoe. Then, remove the wheel hub and brake drum.

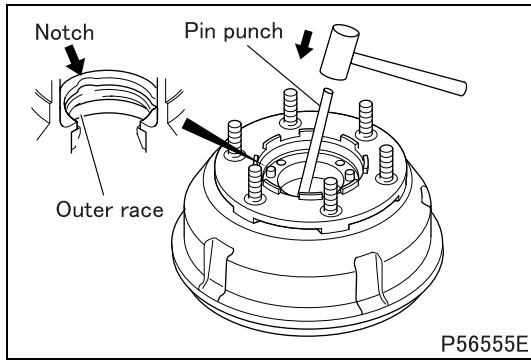
CAUTION ⚠

- Correct or replace the brake drum if any fault is found.



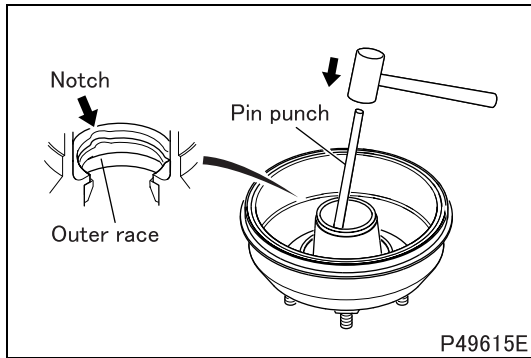
- Install **Ca** using automatic free wheel hub mounting bolts to remove the wheel hub and brake drum.

WHEEL HUB AND BRAKE DRUM



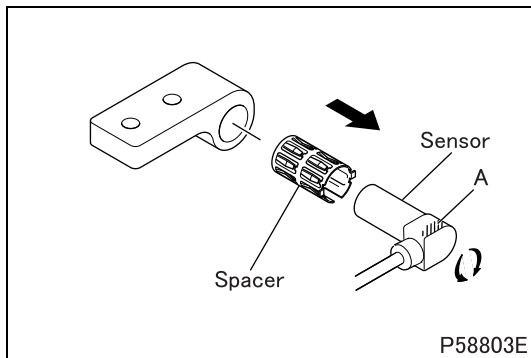
■ Removal: Inner bearing outer race

- Drive out the inner bearing outer race by tapping evenly at three indented parts in the wheel hub.



■ Removal: Outer bearing outer race

- Drive out the outer bearing outer race by tapping evenly at three indented parts in the wheel hub.



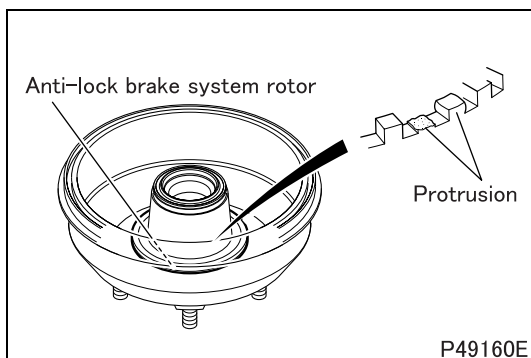
■ Removal: Wheel speed sensor

- Hold shaded section **A** of wheel speed sensor with pliers, and remove the sensor by twisting it slightly in left and right directions.

CAUTION ⚠

- When removing the wheel speed sensor, never apply a force to it such as tapping it with a hammer, prying it with a screwdriver and pulling the harness, as doing so causes the wire to be broken.
- If the wheel speed sensor pulls out lightly, replace the spring spacer.

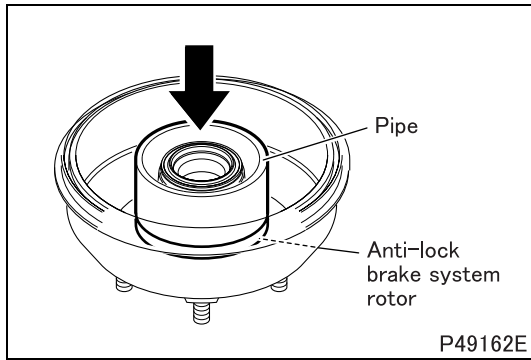
◆ Inspection procedure ◆



■ Inspection: Anti-lock brake system rotor

[Inspection]

- Check protrusions of the anti-lock brake system rotor for chipping and flattening.
- If any abnormality is found, replace the anti-lock brake system rotor.



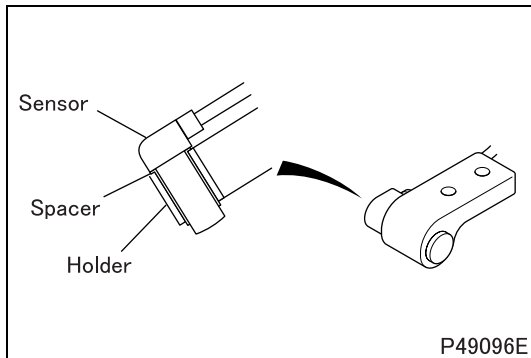
[Installation]

- Warm the anti-lock brake system rotor to approximately 150°C {302°F}.
- Install the anti-lock brake system rotor and wheel hub evenly using a pipe so as not to allow them to tilt.

WARNING

- **Handling the warmed rotor by bare hand causes scald.**

◆ Installation procedure ◆



■ Inspection: Brake drum

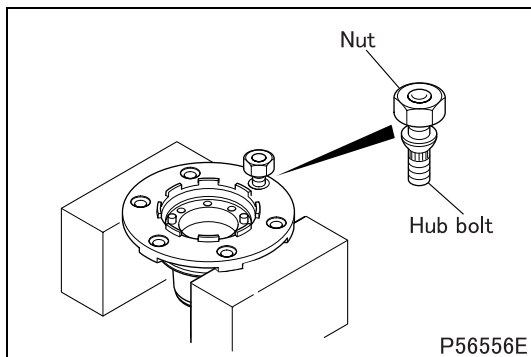
- If cylindricity of the brake drum exceeds the limit or the brake drum has seams, cut the brake drum integrally with the wheel hub within the range of the correction limit.

■ Installation: Wheel speed sensor

- Install the wheel speed sensor so that it securely contacts the sensor holder together with the spring spacer.

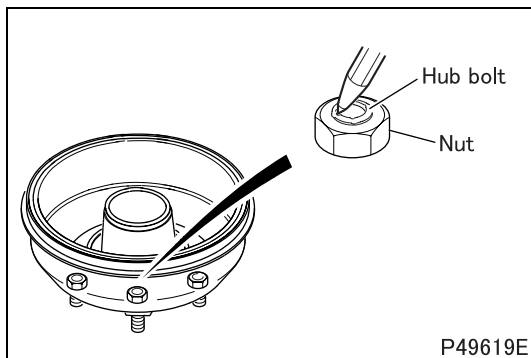
CAUTION

- **When installing the wheel speed sensor, never apply a force to it such as tapping it with a hammer, prying it with a screwdriver and pulling the harness, as doing so causes the wire to be broken.**



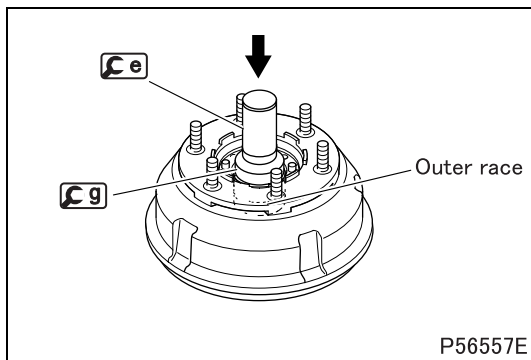
■ Installation: Hub bolt

- Screw the nut into the hub bolt until just before they become flush.
- Drive the hub bolt into the wheel hub vertically by hitting the end face of the nut.

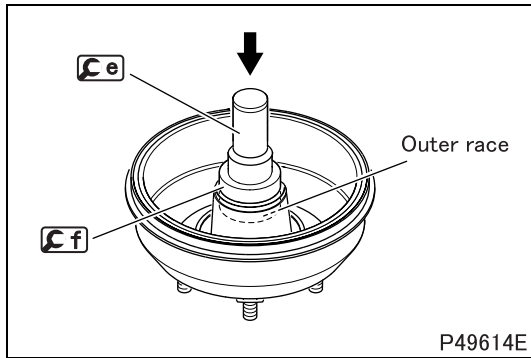


- Assemble the brake drum and wheel hub with the hub bolt. After tightening the nut to the specified torque, caulk it with a punch.

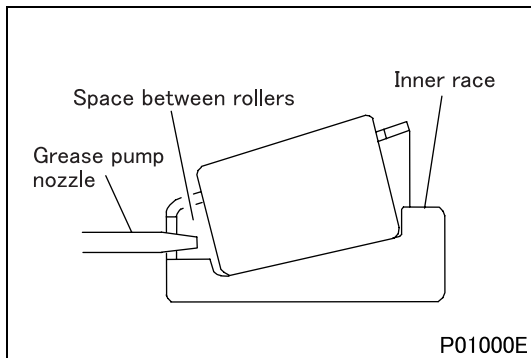
WHEEL HUB AND BRAKE DRUM



■ Installation: Outer bearing outer race

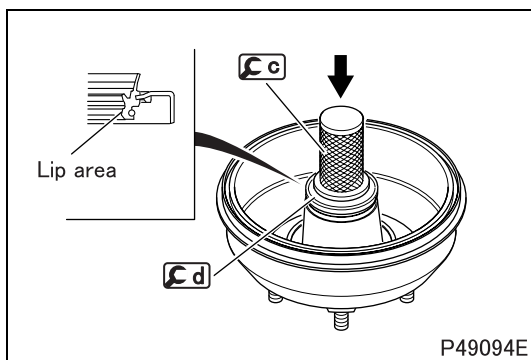


■ Installation: Inner bearing outer race



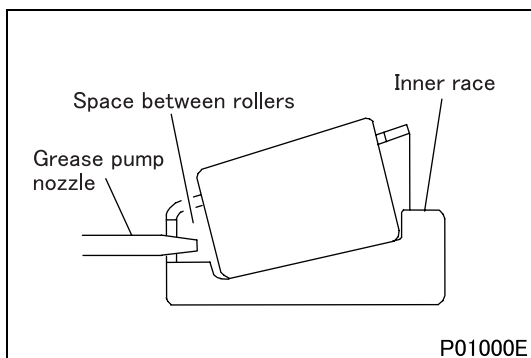
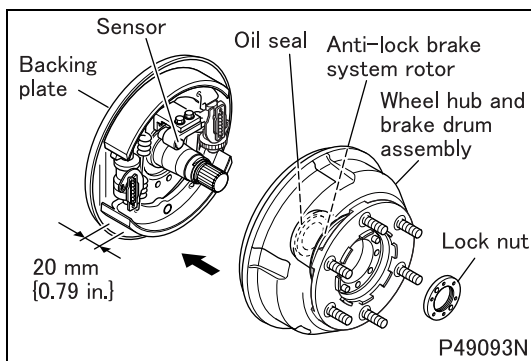
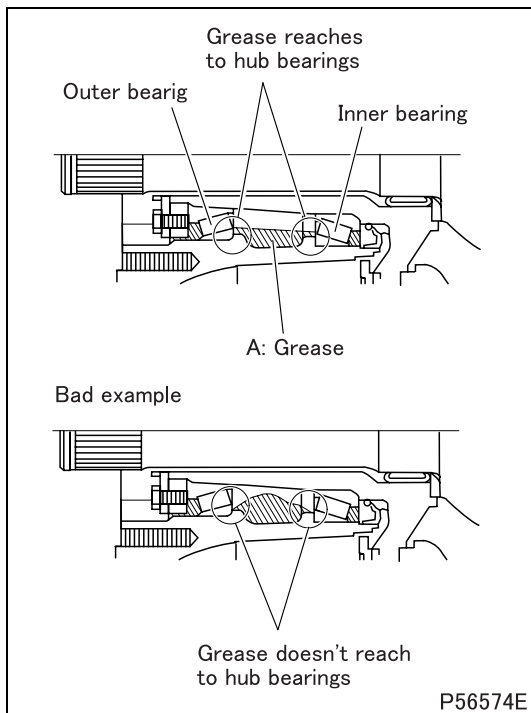
■ Installation: Packing grease in inner bearing inner race

- Insert the grease pump nozzle into the space between rollers of the inner bearing inner race to pack grease sufficiently.



■ Installation: Oil seal

- Apply grease to the lip area of the oil seal and install it on the wheel hub in the illustrated direction.



■ Installation: Wheel hub and brake drum

- Apply specified amount of grease to inside **A** of wheel hub so that the grease reaches to inner bearing and outer bearing as illustrated.

CAUTION ⚠

- Applying grease like the bad example in illustration causes wheel hub bearing seized.

- Slowly install the wheel hub and brake drum assembly so as not to cause damage to the oil seal and anti-lock brake system rotor.

CAUTION ⚠

- If the anti-lock brake system rotor is damaged, wheel speed sensor signals become abnormal, causing the anti-lock brake system to malfunction.

- Position the wheel hub and brake drum assembly only 20 mm {0.79 in.} before the backing plate, and hereafter slowly tighten the lock nut to install the wheel hub and brake drum assembly.

CAUTION ⚠

- Be careful that installing the wheel hub and brake drum assembly without leaving a clearance with the backing plate may damage the wheel speed sensor.

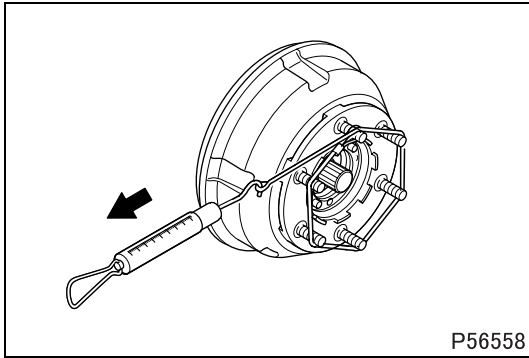
■ Installation: Packing grease in outer bearing inner race

- Insert the grease pump nozzle into the space between rollers of the outer bearing inner race to pack grease sufficiently.

■ Installation: Lock nut

- Install the lock nut in the same manner as for removal. (See ■ Removal: Lock nut)

WHEEL HUB AND BRAKE DRUM



■ Inspection: Starting torque of wheel hub bearing

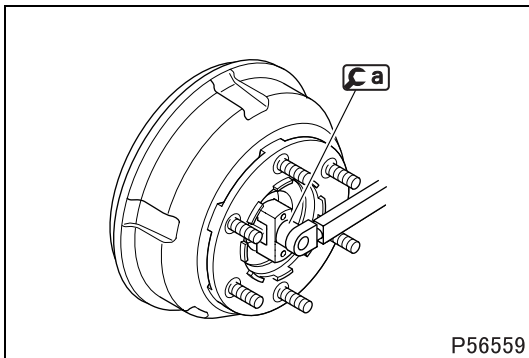
[Inspection]

- Make sure that there is no drag in the brake lining and brake drum.
- If any abnormality is found, adjust the brake shoe clearance.
- Measure the tangential force at the hub bolt position using a spring balancer.

CAUTION ⚠

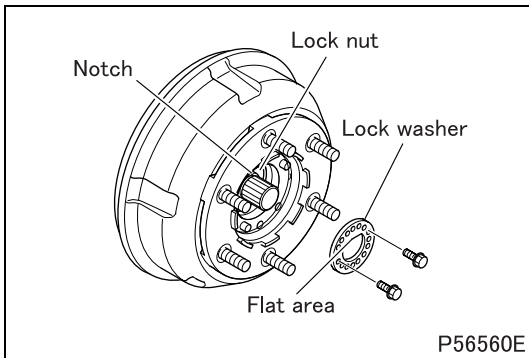
- **Do not assemble the automatic free wheel hub when inspecting.**

- If the tangential force is within the specified value, the starting torque conforms to the standard value. If the measured value deviates from the specified value, adjust.



[Adjustment]

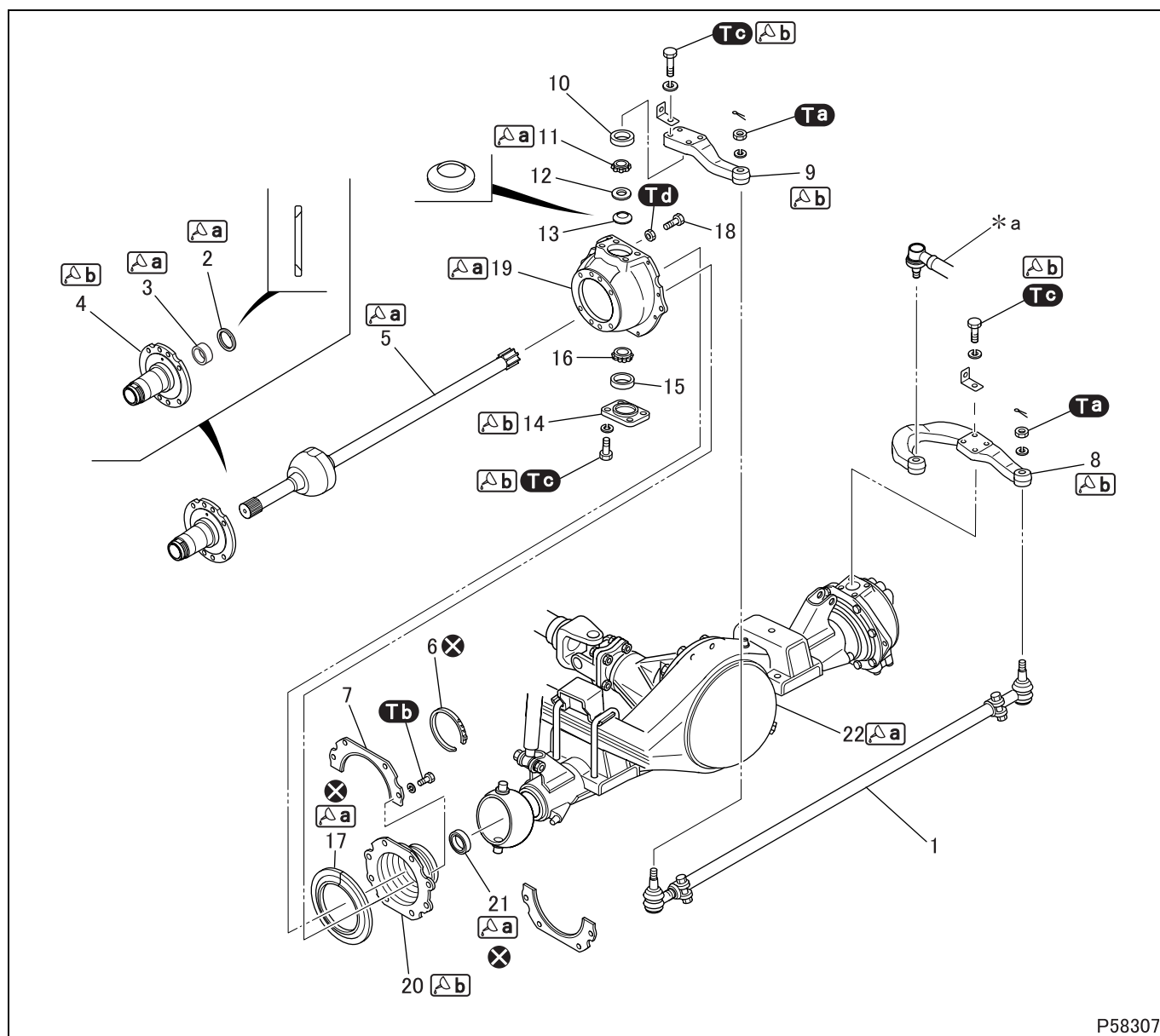
- Tighten the lock nut to the specified torque (primary tightening) while turning the wheel hub and brake drum assembly, and then loosen it completely.
- Smooth operation of the outer bearing and inner bearing by turning the wheel hub and brake drum assembly several times, and then tighten the lock nut to the specified torque (secondary tightening).



- Insert the flat area of the lock washer, aligning it with the notch of the knuckle spindle, and mount two bolts diagonally to the lock nut.
- If the lock nut does not align with a screw hole of the lock washer, align by loosening the lock nut. Make sure that there is no play in the axial direction.
- Perform measurement again after adjustment. If any fault is found, replace the outer and inner bearings.

M E M O

DRIVE SHAFT AND STEERING KNUCKLE



● Disassembly sequence

- | | | |
|--------------------------------|--------------------------------|---|
| 1 Tie rod (See later section.) | 10 Trunnion bearing outer race | 19 Steering knuckle |
| 2 Spacer | 11 Trunnion bearing inner race | 20 Dust boot |
| 3 Needle bearing | 12 Spacer | 21 Oil seal |
| 4 Knuckle spindle | 13 Conical spring | 22 Axle housing
(See later section.) |
| 5 Drive shaft | 14 Kingpin cover | |
| 6 Boot band | 15 Trunnion bearing outer race | *a: Drag link |
| 7 Retainer | 16 Trunnion bearing inner race | ⊗: Non-reusable parts |
| 8 Knuckle arm | 17 Dust seal | |
| 9 Tie rod arm | 18 Knuckle stopper bolt | |

CAUTION

- When removing the tie rod, take care not to deform or damage the dust cover.

NOTE

- Do not disassemble the drive shaft.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Repair kit grease

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of steering knuckle (tangential force at knuckle arm and tie rod arm end on tie rod)		4.8 ± 1.3 N·m {3.57 ± 0.98 ft.lbs, 0.49 ± 0.136 kgf·m} (tangential force: 28 ± 7.8 N {6.3 ± 1.8 lbs, 2.9 ± 0.8 kgf})	–	Adjust or replace
5	Drive shaft	Bend (inner shaft)	0.75 or less	1.5	Replace
		Play in Birfield joint axial direction	0.8 or less	–	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

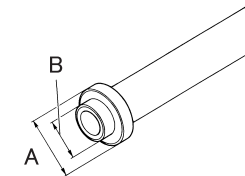
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Tie rod mounting)	93.2 ± 24.5 {69 ± 18, 9.5 ± 2.5}	–
Tb	Bolt (Retainer and dust boot mounting)	4 ± 1 {2.9 ± 0.7, 0.4 ± 0.1}	–
Tc	Bolt (Knuckle arm and tie rod arm mounting)	191 ± 15 {140 ± 11, 19.5 ± 1.5}	–
	Bolt (Kingpin cover mounting)		
Td	Lock nut (Knuckle stopper bolt tightening)	96 ± 12 {71 ± 9, 9.75 ± 1.25}	–

Lubricant and/or sealant

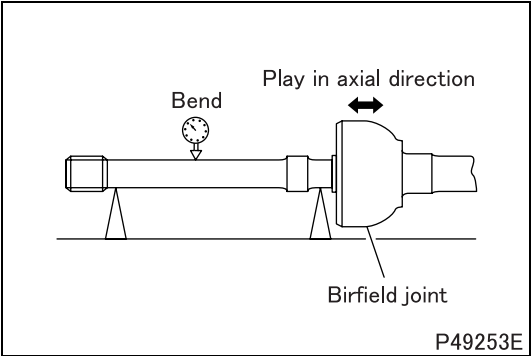
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Chamfered side of inside surface of spacer in knuckle spindle	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Pack space between rollers of needle bearing		
	Pack space between rollers of trunnion bearing inner race		
	Lip area of dust seal		
	Lip area of oil seal		
	Periphery of trunnion bearing mounting area of axle housing ball yoke and outside surface of ball		
	Pack inside of steering knuckle		365 ± 35 g {12.87 ± 1.23 oz.}
	Pack inside of Birfield joint of drive shaft		120 ± 10 g {4.23 ± 0.35 oz.}
 b	Steering knuckle mounting surface of knuckle spindle	THREEBOND 1104 or 1215	As required
	Thread area of bolt mounting knuckle arm and tie rod arm		
	Steering knuckle mounting surface of knuckle arm		
	Steering knuckle mounting surface of tie rod arm		
	Steering knuckle mounting surface of kingpin cover		
	Steering knuckle mounting surface of dust boot		

DRIVE SHAFT AND STEERING KNUCKLE

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application				
	Oil seal installer	MB999152	Installation of oil seal				
	<table><tr><th>A</th><th>B</th></tr><tr><td>φ55 {2.17}</td><td>φ34 {1.34}</td></tr></table>			A	B	φ55 {2.17}	φ34 {1.34}
	A			B			
φ55 {2.17}	φ34 {1.34}						
 51042							

◆ Inspection procedure ◆



■ Inspection: Drive shaft

- Carry out the following inspections. If any abnormality is found, replace the drive shaft.

(1) Bend of drive shaft

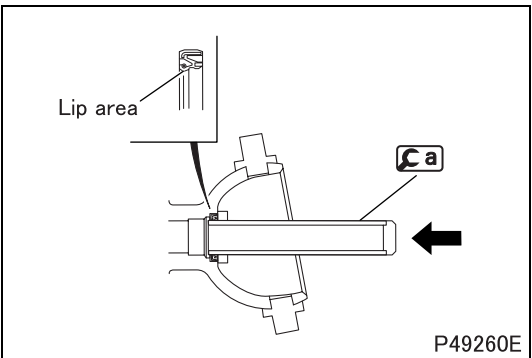
- Measure the bend at the center of the inner shaft of the drive shaft.

NOTE

- Give the drive shaft one complete turn and read the dial gauge at this time. The bend is one half of the reading.

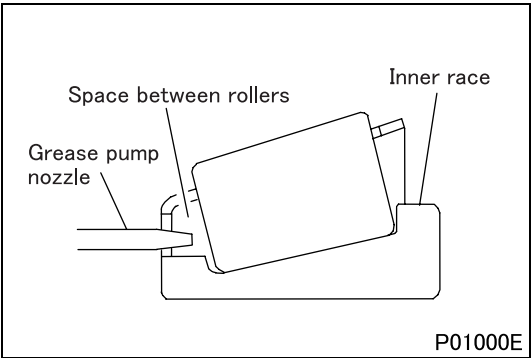
(2) Play in Birfield joint axial direction

◆ Installation procedure ◆



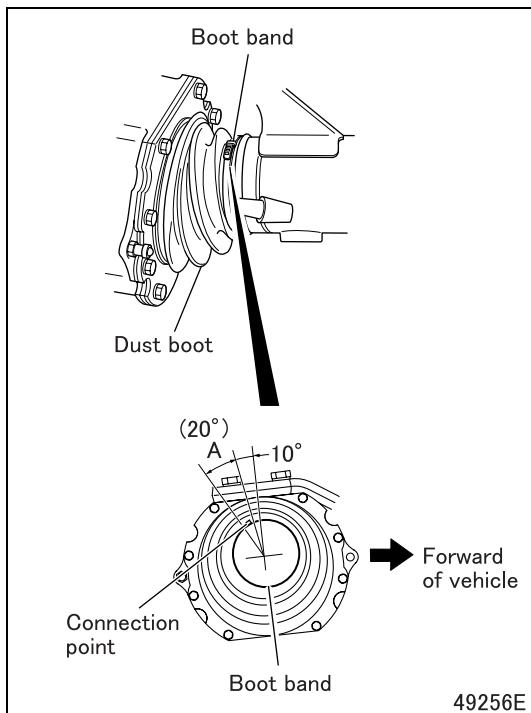
■ Installation: Oil seal

- Apply grease to the lip area of the oil seal and install it on the axle housing in the illustrated direction.



■ Installation: Packing grease in trunnion bearing inner race

- Insert the grease pump nozzle into the space between rollers of the trunnion bearing inner race to pack grease sufficiently.

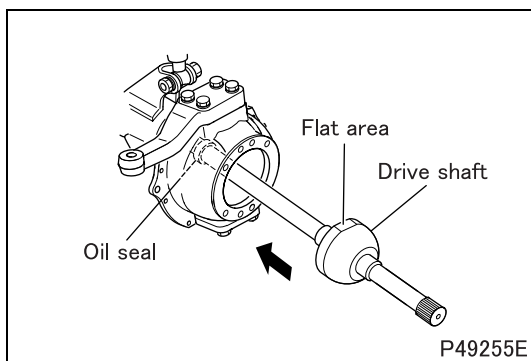


■ Installation: Boot band

- Install the boot band within illustrated range A.

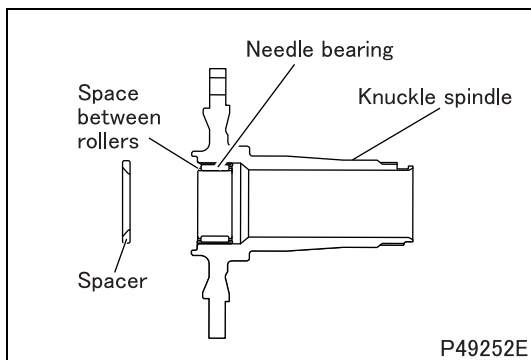
CAUTION ⚠

- When installing the boot band, do not tighten the dust boot excessively so as not to allow the dust boot to stick out of the mating surface remarkably.



■ Installation: Drive shaft

- Install the drive shaft with the flat area of the Birfield joint of the drive shaft placed in a vertical direction.
- Slowly install the drive shaft to avoid damage to the oil seal.

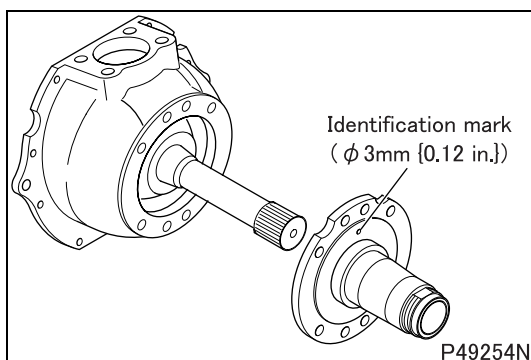


■ Installation: Spacer and needle bearing

- Pack grease sufficiently in the space between rollers of the needle bearing, and install the needle bearing so that it is flush with the end face of the knuckle spindle.

CAUTION ⚠

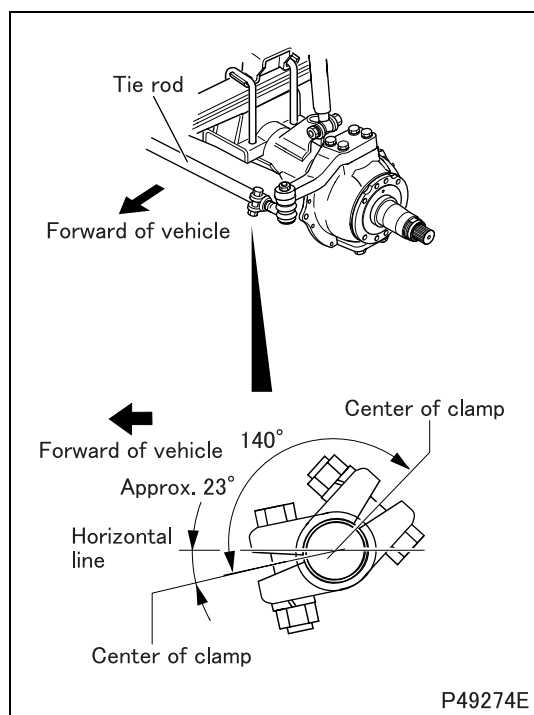
- Do not drive in the needle bearing excessively.



■ Installation: Knuckle spindle

- Install the knuckle spindle on the steering knuckle in the illustrated direction.

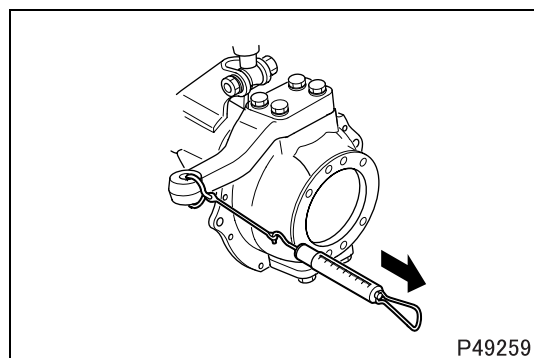
DRIVE SHAFT AND STEERING KNUCKLE



■ Installation: Tie rod

- When installing the tie rod, make sure that the center of the tie rod clamp is within the illustrated range.
- If it is out of the illustrated range, change the center position by loosening the clamp.

◆ Inspection after installation ◆



■ Inspection: Starting torque of steering knuckle

[Inspection]

- Measure the tangential force at the tie rod arm and knuckle arm end on the tie rod side using a spring balancer.

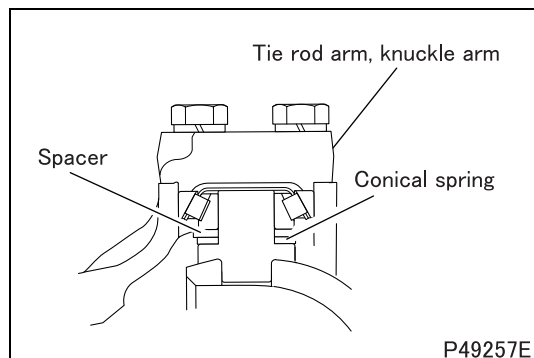
CAUTION ⚠

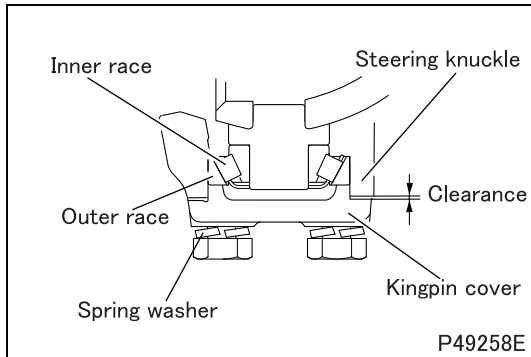
- Do not assemble the dust boot and dust seal when measuring.

- If the tangential force is within the specified value, the starting torque conforms to the standard value.
If the measured value deviates from the specified value, adjust.
- Perform measurement again after adjustment. If any fault is found, replace the trunnion bearing.

[Adjustment]

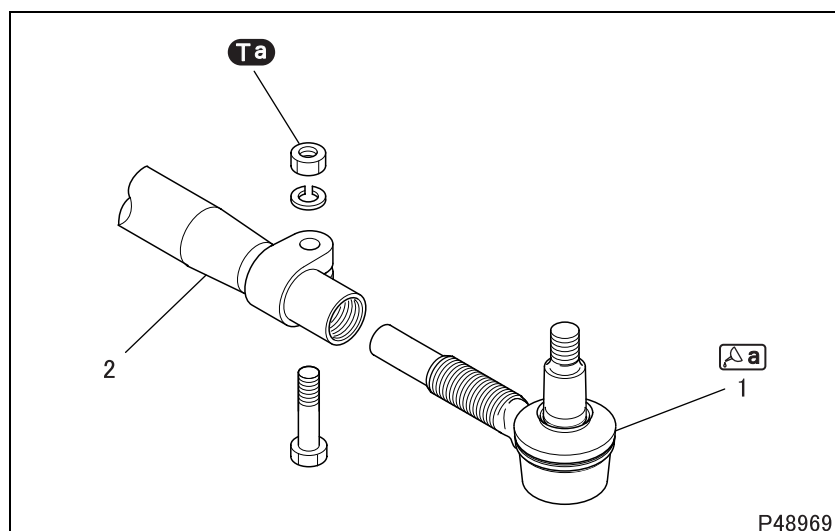
- Insert the conical spring and spacer ($t = 3.2 \text{ mm}$ {0.13 in.}) as illustrated and assemble the tie rod arm and knuckle arm as illustrated. Then, temporarily tighten them with bolts.





- Install the kingpin cover on the steering knuckle and tighten bolts to such extent that no tension is applied to the spring washers.
- Lift up the kingpin cover by hand until it securely contacts the trunnion bearing outer race and trunnion bearing inner race.
- Measure clearance between the steering knuckle and kingpin cover and select a spacer.
When clearance is 0.6 mm {0.024 in.} or more: Spacer of 3.2 mm {0.13 in.}
When clearance is less than 0.6 mm {0.024 in.}: Spacer of 3.6 mm {0.14 in.}
- Install the selected spacer and tighten bolts to the specified torque.

TIE ROD



● Disassembly sequence

- 1 Tie rod end
- 2 Tie rod

CAUTION

- If any abnormality such as tear is found in the dust boot of the tie rod end, replace the tie rod end.

NOTE

- Do not disassemble the tie rod end, as it is of non-disassembly type.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1	Rotation torque of tie rod end	1.0 to 5.9 N·m {0.7 to 4.4 ft.lbs, 0.1 to 0.6 kgf·m}	–	Replace
2	Bend of tie rod	–	1 or less	Correct or replace

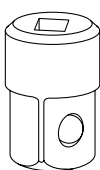
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
	Nut (Tie rod end tightening)	20 to 29 {15 to 21, 2 to 3}	–

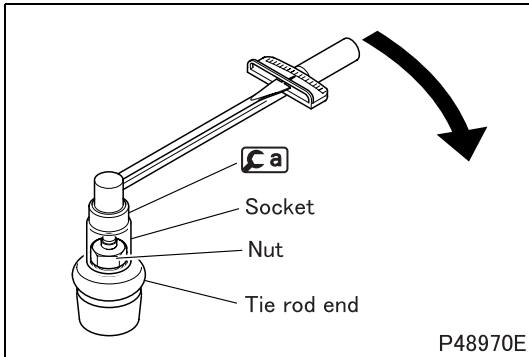
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Lip area of dust cover of tie rod end	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools (Unit: mm {in.})

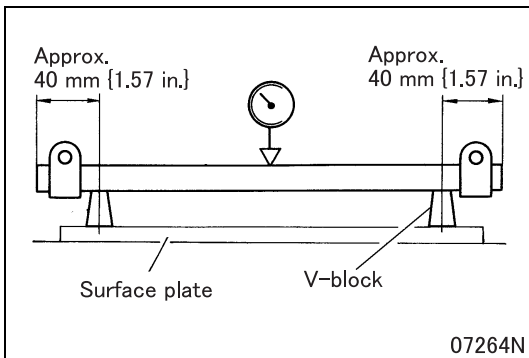
Mark	Tool name and shape	Part No.	Application
	Preload socket  P48876	MB990326	Measurement of rotation torque of tie rod end

◆ Inspection procedure ◆



■ Inspection: Tie rod end

- Install a tie rod mounting nut on the tie rod end.
- Install the socket, **Ca** and torque wrench and measure the rotation torque.
- If the measured value deviates from the standard value, replace the tie rod end.



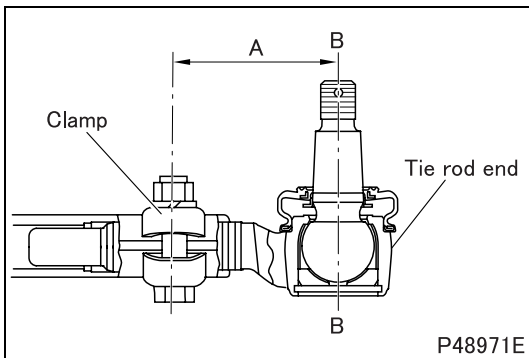
■ Inspection: Bend of tie rod

- Measure the bend of the tie rod at its center.

NOTE

- Give the tie rod one complete turn and read the dial gauge at this time. The bend is one half of the reading.
- If the measured value exceeds the standard value, correct or replace the tie rod.

◆ Installation procedure ◆



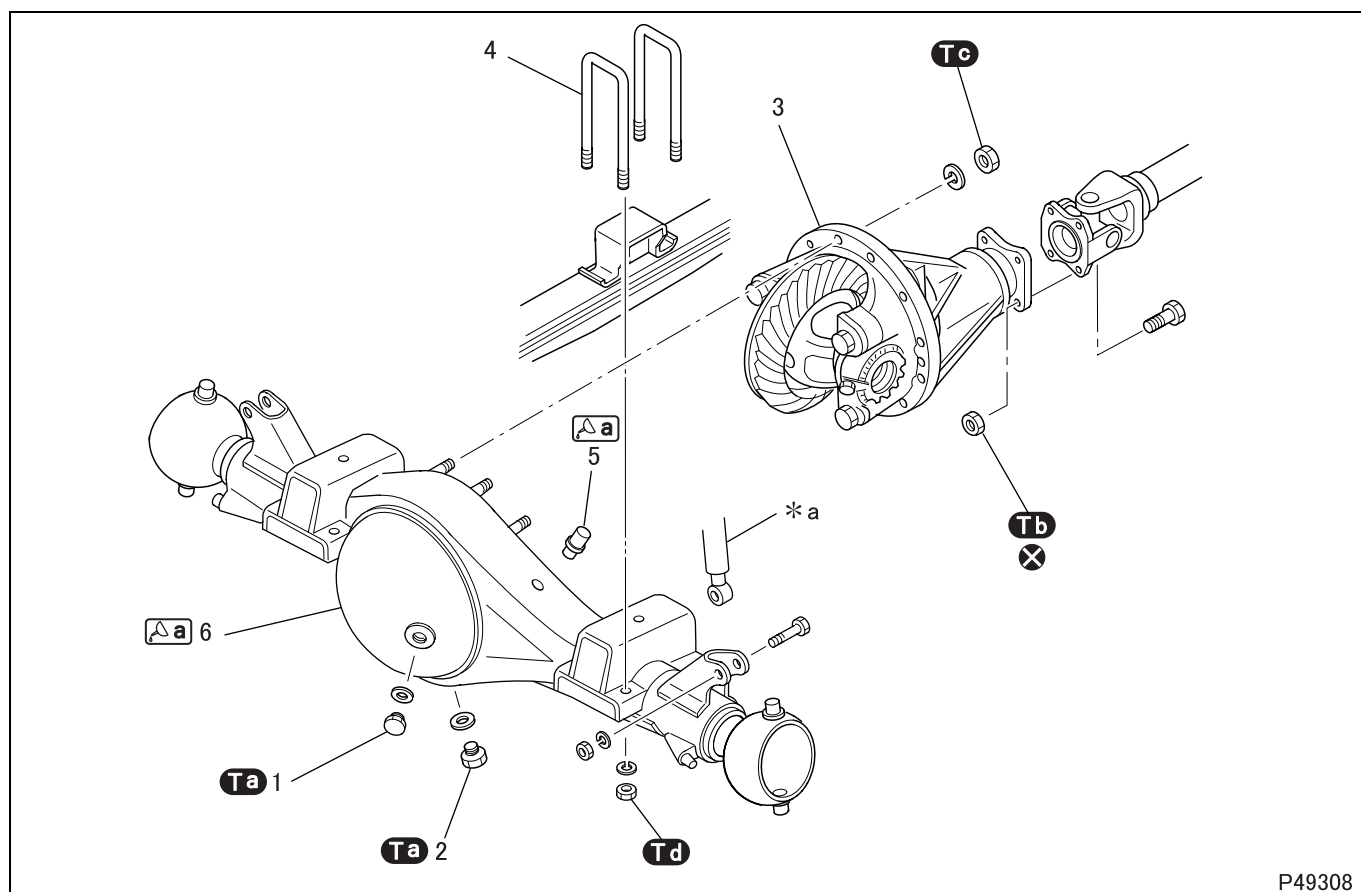
■ Installation: Tie rod end

- Screw in the tie rod end so that difference of dimension **A** between the tie rod end and the clamp is within 1.5 mm {0.059 in.} between right and left.
A: Approximately 74 mm {2.91 in.}

CAUTION ⚠

- Ensure that difference of an amount of screwing in the tie rod end between right and left is within one turn.
- Secure the tie rod ends so that illustrated axis B-B on the right is parallel to that on the left.

AXLE HOUSING



● Disassembly sequence

- 1 Inspection plug
- 2 Drain plug
- 3 Reduction and differential (See later section.)
- 4 U-bolt
- 5 Vent plug

6 Axle housing

*a: Shock absorber

⊗: Non-reusable parts

NOTE

- Do not remove the axle housing unless any abnormality is found.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
5	Injection-valve opening pressure of vent plug	4.9 kPa {0.7 psi, 0.05 kgf/cm ² } or less	—	Replace

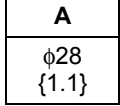
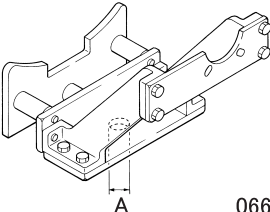
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Inspection plug	110 ± 10 {81 ± 7.4, 11 ± 1}	—
	Drain plug		
Tb	Nut (Propeller shaft mounting)	60 to 75 {44 to 55, 6 to 7.5}	—
Tc	Nut (Reduction and differential mounting)	41 ± 6 {30 ± 4.4, 4.15 ± 0.65}	—
Td	Nut (U-bolt mounting)	106 ± 8 {78 ± 5.9, 10.8 ± 0.8}	—

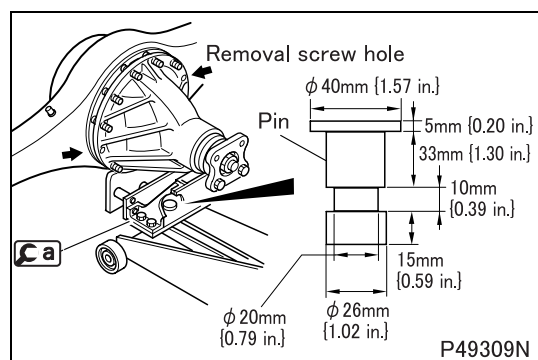
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Axle housing mounting surface of vent plug	THREEBOND 1215	As required
	Reduction and differential mounting surface of axle housing		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
	Differential carrier base   06679	MB999102	Removal and installation of reduction and differential assembly

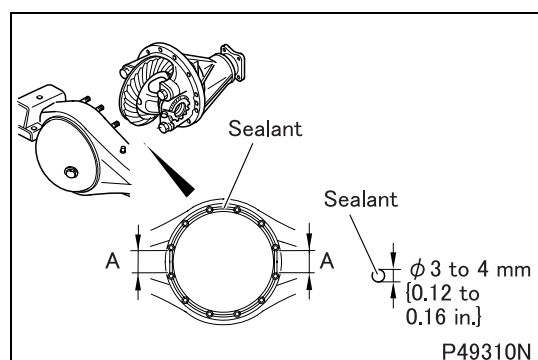
◆ Removal procedure ◆



■ Removal: Reduction and differential

- Remove the saucer of the garage jack and place  on it. Fabricate the pin as illustrated, insert and fix it with bolts that have fixed the saucer.
- Screw two M10 × 1.25 mm bolts evenly into the reduction and differential removal screw holes (as shown in illustration) to remove the reduction and differential.

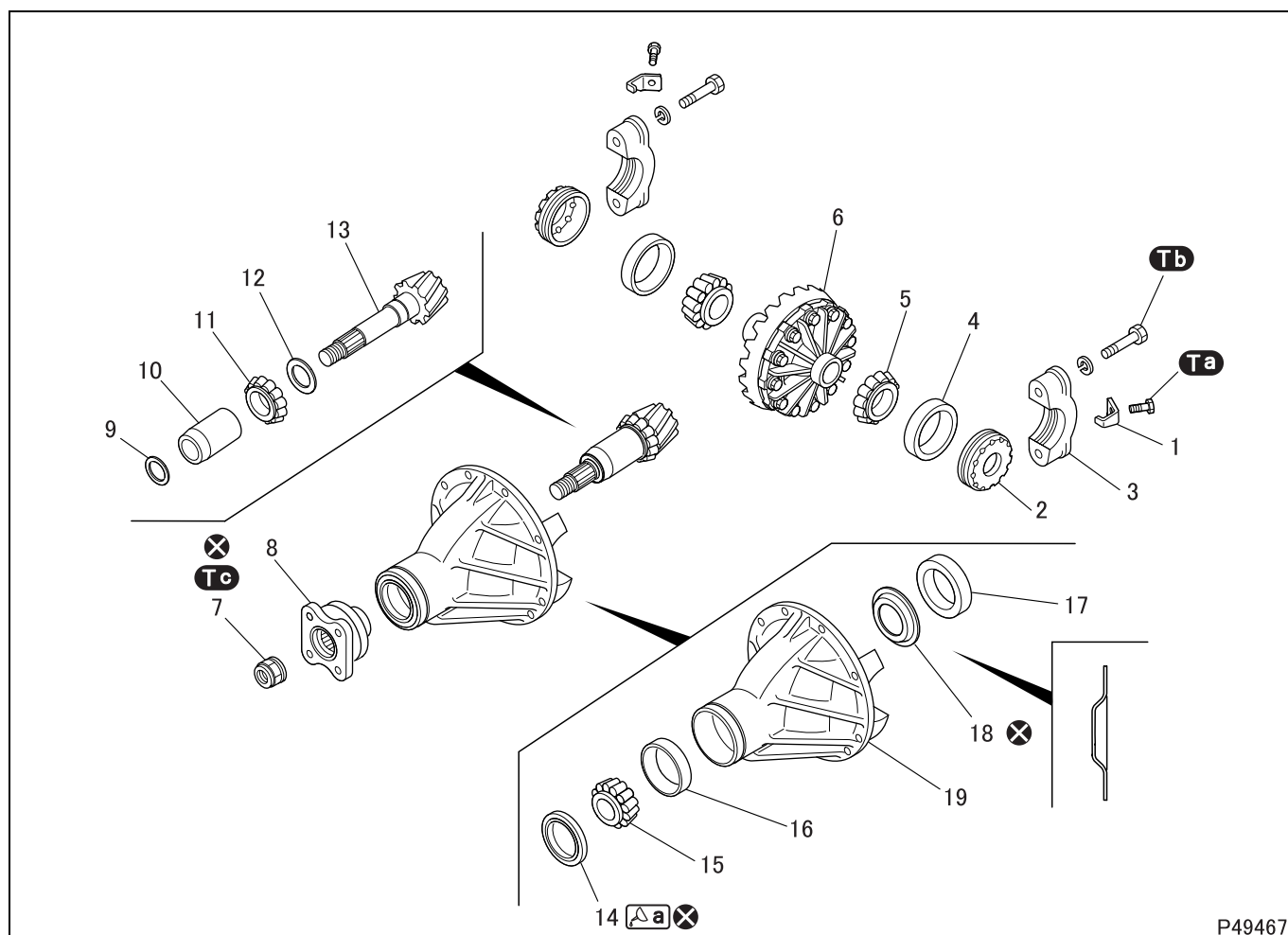
◆ Installation procedure ◆



■ Installation: Reduction and differential

- Clean a seal surface of each part.
- Apply sealant to the reduction and differential mounting surface of the axle housing evenly and without breaks. Apply sealant in a straight line direction for illustrated position **A**.

REDUCTION AND DIFFERENTIAL



● Disassembly sequence

- | | |
|-------------------------------------|-----------------------------|
| 1 Lock plate | 12 Rear bearing shim |
| 2 Side bearing nut | 13 Reduction pinion |
| 3 Bearing cap | 14 Oil seal |
| 4 Side bearing outer race | 15 Front bearing inner race |
| 5 Side bearing inner race | 16 Front bearing outer race |
| 6 Differential (See later section.) | 17 Rear bearing outer race |
| 7 Lock nut | 18 Oil stopper |
| 8 Companion flange | 19 Differential carrier |
| 9 Front bearing shim | |
| 10 Pinion spacer | |
| 11 Rear bearing inner race | |
- ⊗: Non-reusable parts

CAUTION ⚠

- Keep side bearings, which have been removed, separately from each other and ensure that the correct one is placed at the right place at installation.
- Be sure to replace the bearing cap, differential carrier and bolts as a differential carrier set.
- Be sure to replace the reduction gear and reduction pinion of the differential as a reduction gear set.

NOTE

- Record the number, thickness and height of front bearing shims, pinion spacers and rear bearing shims to use them as reference at assembly.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Starting torque of pinion bearing (with no oil seal installed)	0.69 to 1.27 N·m {0.5 to 0.94 ft.lbs, 0.07 to 0.13 kgf·m}	–	Adjust or replace
6	Wobble at back face of reduction gear	0.1 {0.0039} or less	–	Replace
6, 13	Backlash between reduction gear and reduction pinion	0.15 to 0.20 {0.0059 to 0.0079}	–	Adjust or replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

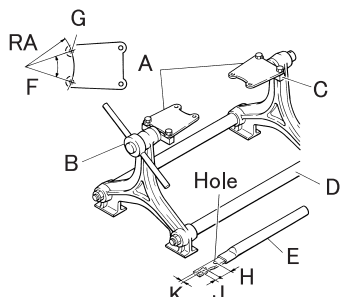
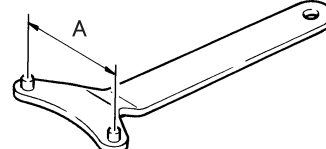
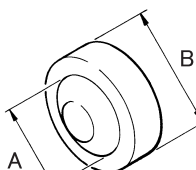
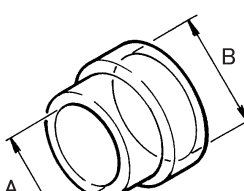
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Lock plate mounting)	19.6 to 26.5 {14.5 to 19.5, 2.0 to 2.7}	–
Tb	Bolt (Bearing cap mounting)	68.6 to 78.4 {50.6 to 57.8, 7 to 8}	–
Tc	Lock nut (Companion flange mounting)	313.6 to 411.6 {231 to 304, 32 to 42}	–

Lubricant and/or sealant

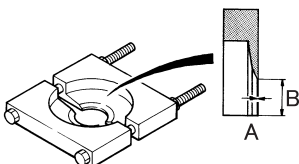
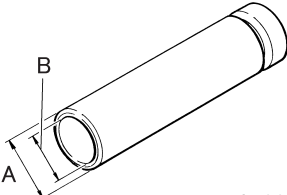
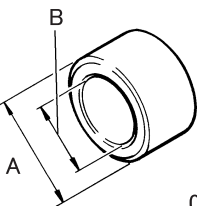
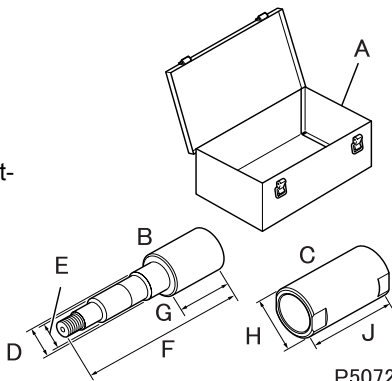
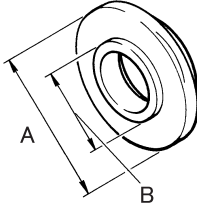
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

REDUCTION AND DIFFERENTIAL

Special tools (Unit: mm {in.})

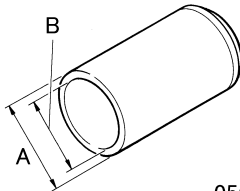
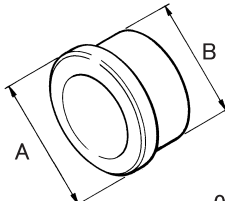
Mark	Tool name and shape	Part No.	Application																																																							
Differential working base assembly  05656E <table><thead><tr><th colspan="4">Component</th><th>Part No.</th></tr></thead><tbody><tr><td rowspan="3">A</td><td colspan="3">Attachment</td><td>—</td></tr><tr><td>RA</td><td>F</td><td>G</td><td>—</td></tr><tr><td>R134.5 {5.30}</td><td>30°</td><td>φ13 {0.51}</td><td>MB999074</td></tr><tr><td>B</td><td colspan="3">Holder</td><td>MB999036</td></tr><tr><td>C</td><td colspan="3">Holder</td><td>MB999037</td></tr><tr><td>D</td><td colspan="3">Working base</td><td>MB999035</td></tr><tr><td>E</td><td colspan="3">Flange stopper</td><td>MB999096</td></tr></tbody></table> <table><thead><tr><th>H</th><th>J</th><th>K</th></tr></thead><tbody><tr><td>40 {1.57}</td><td>20 {0.79}</td><td>11 {0.43}</td></tr></tbody></table> MB999117 Workbench for reduction and differential Flange stopper to be used for removal and installation of companion flange	Component				Part No.	A	Attachment			—	RA	F	G	—	R134.5 {5.30}	30°	φ13 {0.51}	MB999074	B	Holder			MB999036	C	Holder			MB999037	D	Working base			MB999035	E	Flange stopper			MB999096	H	J	K	40 {1.57}	20 {0.79}	11 {0.43}	Preload socket  P48876 MB990326 Measurement of starting torque of pinion bearing	Differential side bearing adjust tool <table><thead><tr><th>A</th></tr></thead><tbody><tr><td>φ83.5 {3.29}</td></tr></tbody></table>  05657 MB999012 Removal and installation of side bearing nut	A	φ83.5 {3.29}	Adapter <table><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ44 {1.73}</td><td>φ53 {2.1}</td></tr></tbody></table>  05658 MB999077 Removal of side bearing inner race (to be used in combination with commercial bearing puller)	A	B	φ44 {1.73}	φ53 {2.1}	Bearing installer <table><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ46 {1.81}</td><td>φ56 {2.20}</td></tr></tbody></table>  05659 MB999079 Installation of side bearing inner race	A	B	φ46 {1.81}	φ56 {2.20}
Component				Part No.																																																						
A	Attachment			—																																																						
	RA	F	G	—																																																						
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Special tools (Unit: mm {in.})

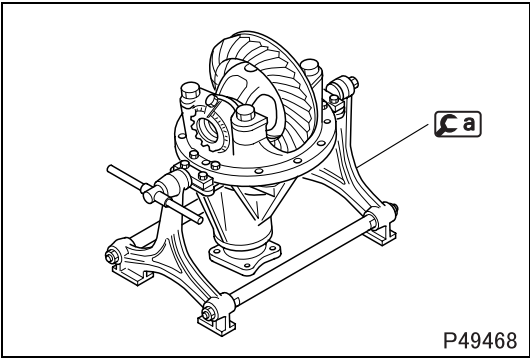
Mark	Tool name and shape	Part No.	Application																																												
	Pinion rear bearing remover <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>0.5 {0.020}</td><td>25.5 {1.0}</td></tr></tbody></table>  02956	A	B	0.5 {0.020}	25.5 {1.0}	MB999045	Removal of rear bearing inner race																																								
A	B																																														
0.5 {0.020}	25.5 {1.0}																																														
	Bearing installer <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ52 {2.05}</td><td>φ42 {1.65}</td></tr></tbody></table>  05661	A	B	φ52 {2.05}	φ42 {1.65}	MB990104	Installation of rear bearing inner race (to be used in combination with ) Installation of oil seal (to be used in combination with ) Installation of front bearing inner race																																								
A	B																																														
φ52 {2.05}	φ42 {1.65}																																														
	Bearing installer <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ57 {2.24}</td><td>φ46 {1.81}</td></tr></tbody></table>  05662	A	B	φ57 {2.24}	φ46 {1.81}	MB999044	Installation of rear bearing inner race (to be used in combination with )																																								
A	B																																														
φ57 {2.24}	φ46 {1.81}																																														
	Reduction pinion setting gauge set  P50721 <table border="1"><thead><tr><th colspan="5">Component</th><th>Part No.</th></tr></thead><tbody><tr><td>A</td><td colspan="4">Tool box</td><td>MB990824</td></tr><tr><td rowspan="3">B</td><td colspan="4">Pinion gauge</td><td>—</td></tr><tr><td>D</td><td>E</td><td>F</td><td>G</td><td>—</td></tr><tr><td>φ39.9 {1.57}</td><td>φ34.8 {1.37}</td><td>254.5 {10.02}</td><td>73 {2.87}</td><td>MB999086</td></tr><tr><td rowspan="3">C</td><td colspan="4">Cylinder gauge</td><td>—</td></tr><tr><td colspan="2">H</td><td colspan="2">J</td><td>—</td></tr><tr><td colspan="2">φ100 {3.94}</td><td colspan="2">184 {7.24}</td><td>MB999087</td></tr></tbody></table>	Component					Part No.	A	Tool box				MB990824	B	Pinion gauge				—	D	E	F	G	—	φ39.9 {1.57}	φ34.8 {1.37}	254.5 {10.02}	73 {2.87}	MB999086	C	Cylinder gauge				—	H		J		—	φ100 {3.94}		184 {7.24}		MB999087	MB999084	Selection of rear bearing shim (pinion height adjustment)
Component					Part No.																																										
A	Tool box				MB990824																																										
B	Pinion gauge				—																																										
	D	E	F	G	—																																										
	φ39.9 {1.57}	φ34.8 {1.37}	254.5 {10.02}	73 {2.87}	MB999086																																										
C	Cylinder gauge				—																																										
	H		J		—																																										
	φ100 {3.94}		184 {7.24}		MB999087																																										
	Bearing installer adapter <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ88 {3.46}</td><td>φ50 {1.97}</td></tr></tbody></table>  05667	A	B	φ88 {3.46}	φ50 {1.97}	MB999015	Installation of oil seal (to be used in combination with )																																								
A	B																																														
φ88 {3.46}	φ50 {1.97}																																														

REDUCTION AND DIFFERENTIAL

Special tools (Unit: mm {in.})

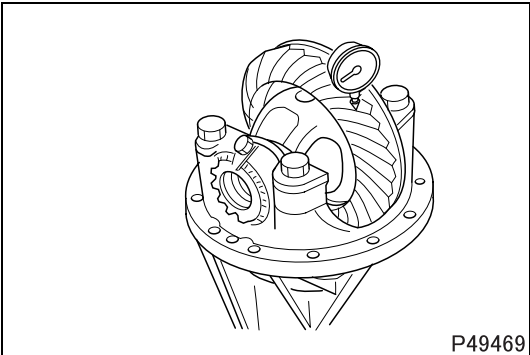
Mark	Tool name and shape	Part No.	Application				
	Bearing installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ70 {2.76}</td><td>φ57 {2.24}</td></tr></table>  05668	A	B	φ70 {2.76}	φ57 {2.24}	MB999100	Installation of front bearing outer race and rear bearing outer race (to be used in combination)
	A	B					
φ70 {2.76}	φ57 {2.24}						
	Bearing installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ89 {3.50}</td><td>φ79 {3.11}</td></tr></table>  05669	A	B	φ89 {3.50}	φ79 {3.11}	MB999089	
A	B						
φ89 {3.50}	φ79 {3.11}						

◆ Work before removal ◆



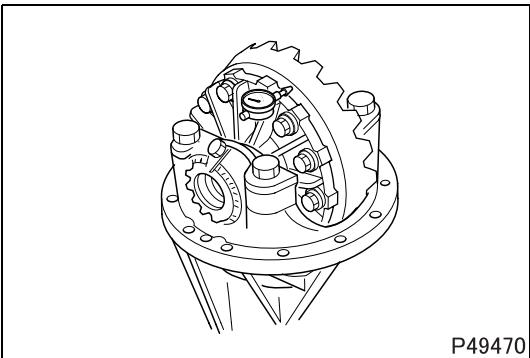
■ Preparatory work: Installation of differential working base assembly

- Install the reduction and differential on .



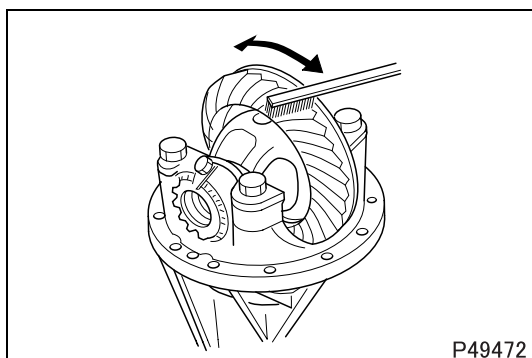
■ Inspection: Backlash between reduction gear and reduction pinion

- If backlash is found faulty, the tightening amount of the side bearing nut is probably inappropriate.



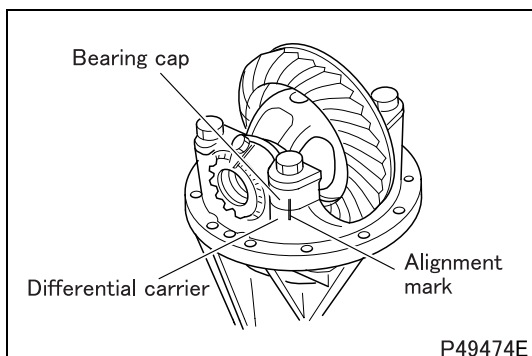
■ Inspection: Wobble at back face of reduction gear

- Measure wobble at the illustrated position of the reduction gear.



■ Inspection: Tooth contact of reduction gear

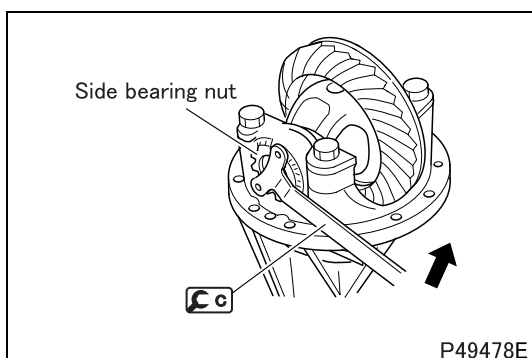
- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn the reduction gear several times to check for tooth contact.



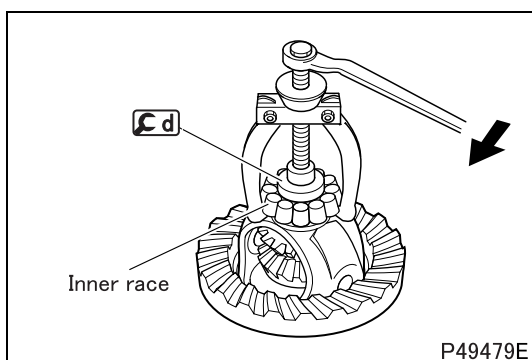
■ Alignment marks: Bearing cap and differential carrier

- Put alignment marks on the bearing cap and differential carrier for correct identification of right and left parts.

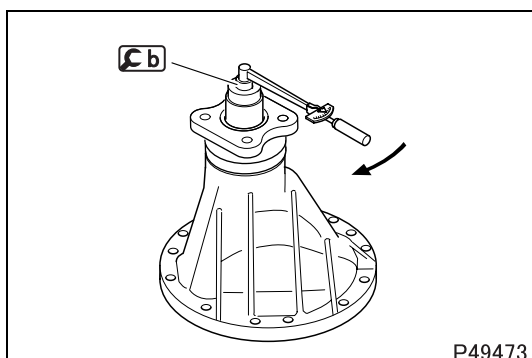
◆ Removal procedure ◆



■ Removal: Side bearing nut



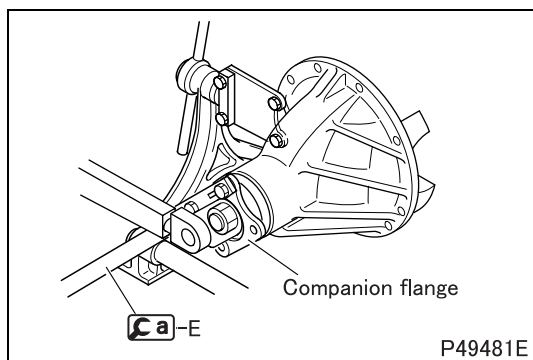
■ Removal: Side bearing inner race



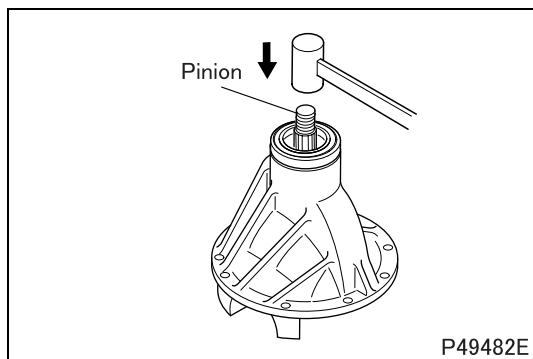
■ Inspection: Starting torque of pinion bearing

- After removing the differential, measure the starting torque of the pinion bearing.

REDUCTION AND DIFFERENTIAL

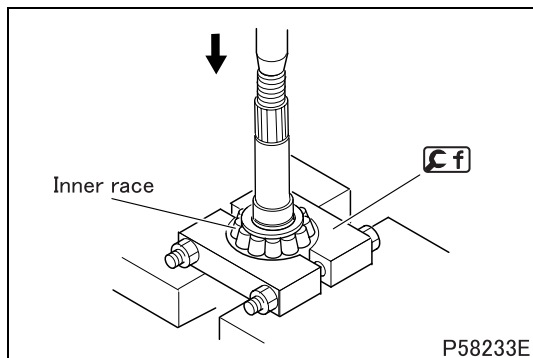


■ Removal: Companion flange

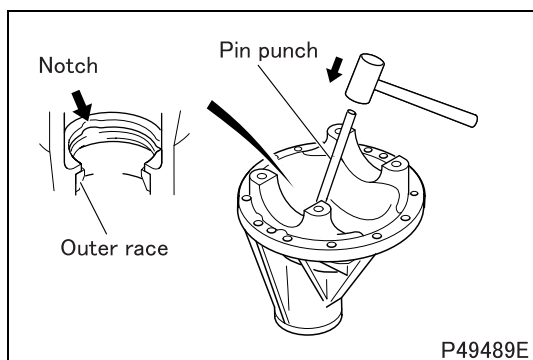


■ Removal: Reduction pinion

- Tap the reduction pinion with a plastic hammer and hold the reduction pinion with your hand to prevent it from falling.

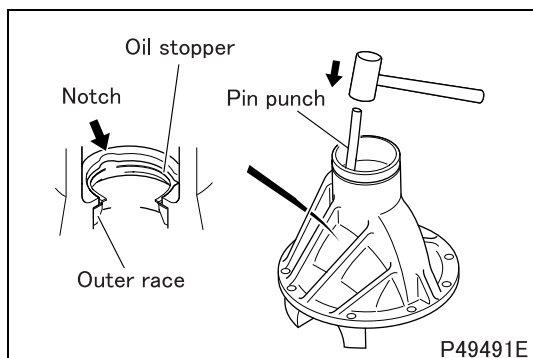


■ Removal: Rear bearing inner race



■ Removal: Front bearing outer race

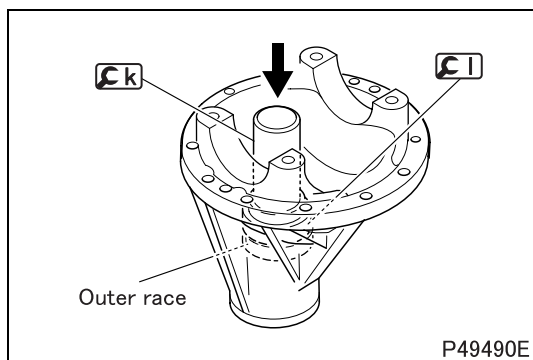
- Drive out the front bearing outer race by tapping evenly at three indented parts in the differential carrier.



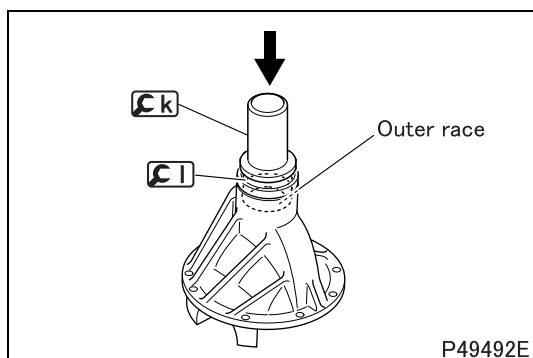
■ Removal: Rear bearing outer race

- Drive out the rear bearing outer race, together with the oil stopper, by tapping evenly at three indented parts in the differential carrier.

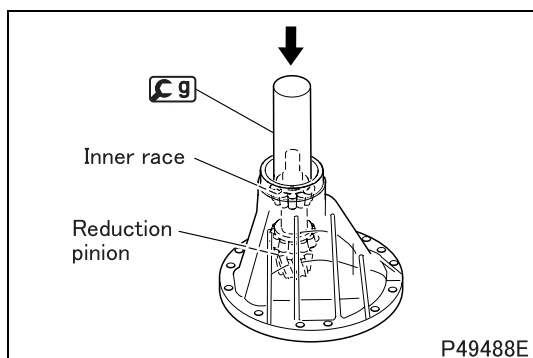
◆ Installation procedure ◆



■ Installation: Rear bearing outer race

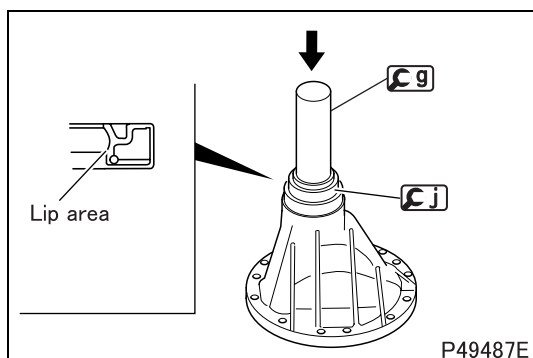


■ Installation: Front bearing outer race



■ Installation: Front bearing inner race

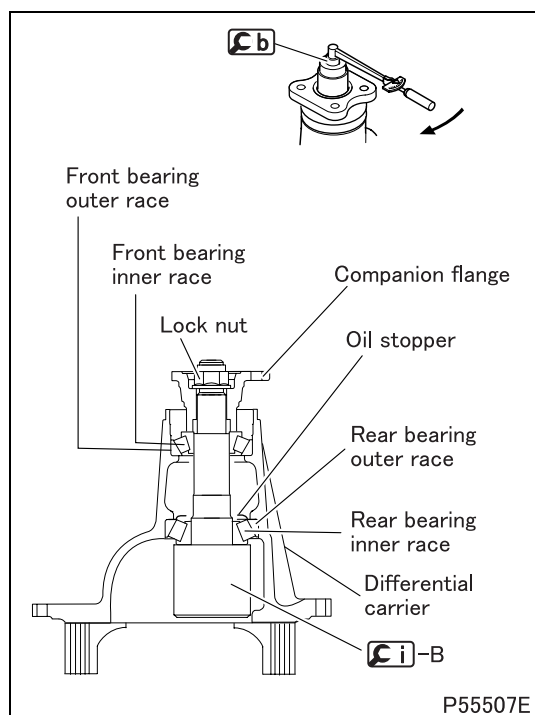
- Install the front bearing inner race with the reduction pinion assembled into the differential carrier.



■ Installation: Oil seal

- Apply grease to the lip area of the oil seal and install it on the differential carrier in the illustrated direction.

REDUCTION AND DIFFERENTIAL



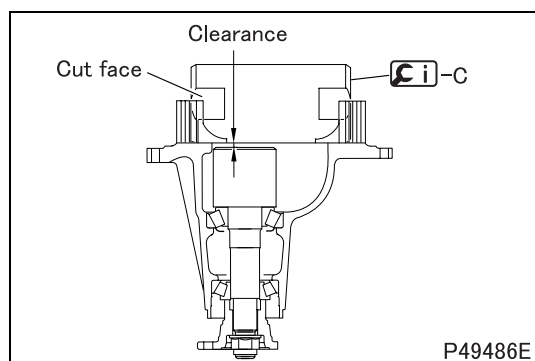
■ Installation: Rear bearing shim

[Selection (pinion height adjustment)]

- Temporarily assemble **Ⓒi-B** together with the illustrated parts into the differential carrier.

CAUTION ⚠

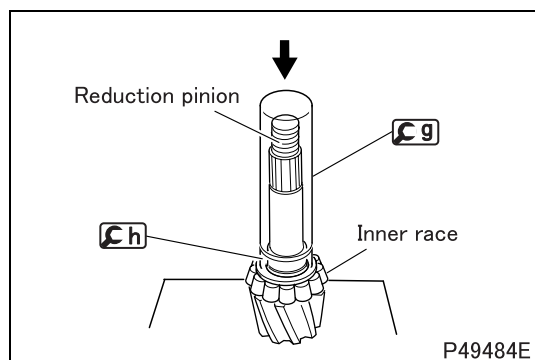
- Do not assemble parts except the illustrated ones.
- Tighten the lock nut so that the starting torque of the pinion bearing at **Ⓒi-B** conforms to the standard value.



- Set **Ⓒi-C** in the illustrated direction and measure clearance as illustrated.
- Select shims so that clearance becomes 1.5 mm {0.059 in.}. Thickness of shims available 0.30 and 1.38 to 1.65 mm {0.012 and 0.054 to 0.065 in.} (10 thickness in 0.03 mm {0.012 in.} increments)

CAUTION ⚠

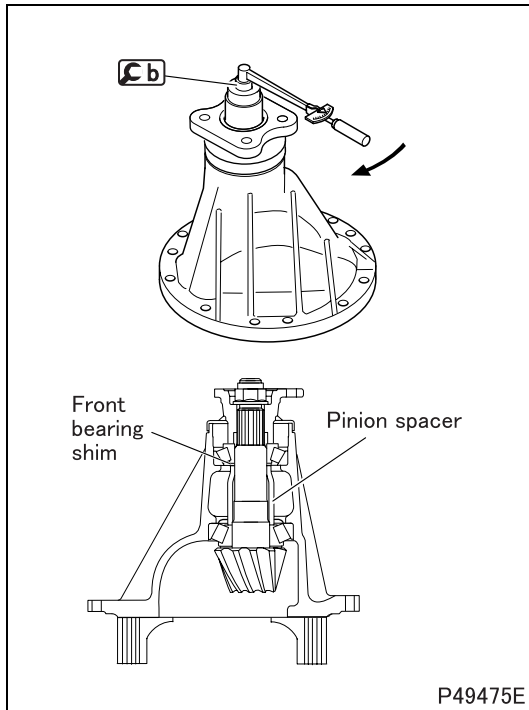
- Select the number of rear bearing shims as least as possible.



■ Installation: Rear bearing inner race

■ Installation: Companion flange

- Install the companion flange in the same manner as for removal. (See ■ Removal: Companion flange)



■ Inspection: Starting torque of pinion bearing

- After installing front bearing shims, measure the starting torque of the pinion bearing with no oil seal assembled.
- If the measured value deviates from the standard value, adjust by changing a pinion spacer and front bearing shims.

Thickness of pinion spacers available

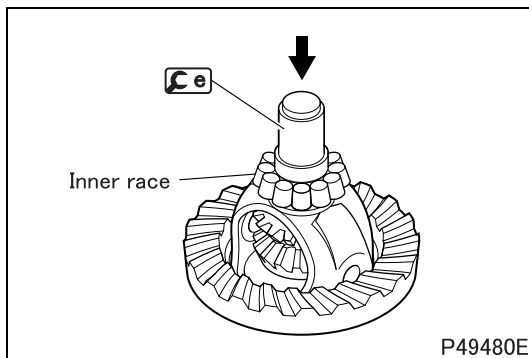
64.07, 64.40 mm {2.52, 2.54 in.} (painted in white)

Thickness of front bearing shims available

0.03 and 2.00 to 2.33 mm {0.0012 and 0.079 to 0.092 in.} (12 thickness in 0.03 mm {0.012 in.} increments)

CAUTION ⚠

- Select a pinion spacer so that the number of front bearing shims becomes as least as possible.



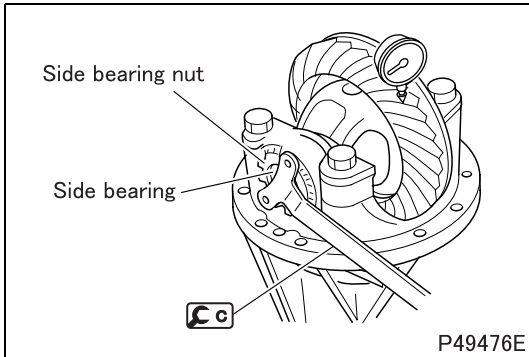
■ Installation: Side bearing inner race

■ Installation: Side bearing nut

- Install the side bearing nut in the same manner as for removal. (See ■ Removal: Side bearing nut)

REDUCTION AND DIFFERENTIAL

◆ Work after installation ◆

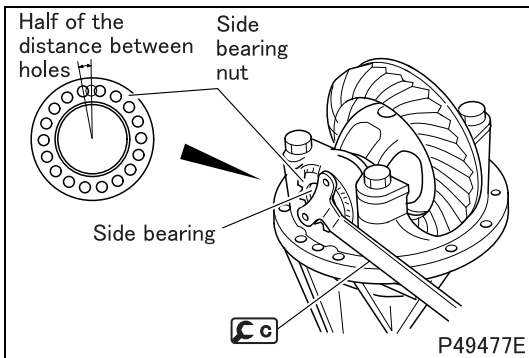


■ Adjustment: Backlash between reduction gear and reduction pinion

- Tighten the side bearing nut for adjustment to such extent that no preload is applied to the side bearing.

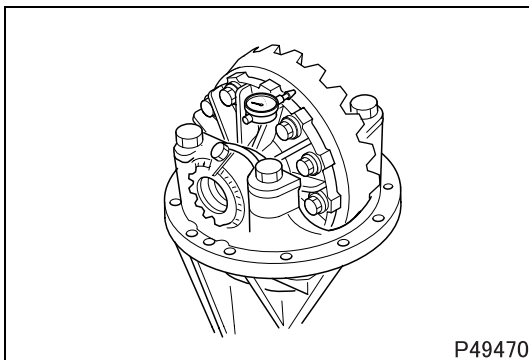
CAUTION ⚠

- When one side bearing nut is loosened, be sure to tighten the other one the same amount to prevent the side bearing preload from changing.



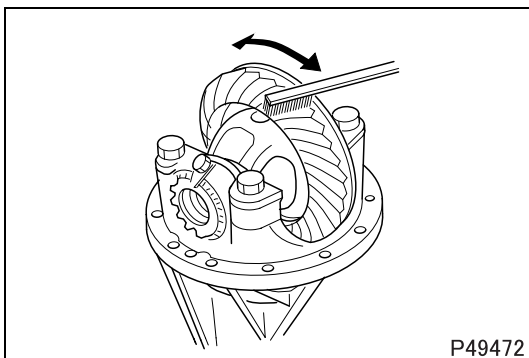
■ Adjustment: Side bearing preload

- After adjusting backlash between the reduction gear and reduction pinion, further tighten both of the side bearing nuts within the range of backlash to provide preload to the side bearing.
- The tightening amount of preload must be limited to the distance between two holes for combination of right and left sides.



■ Inspection: Wobble at back face of reduction gear

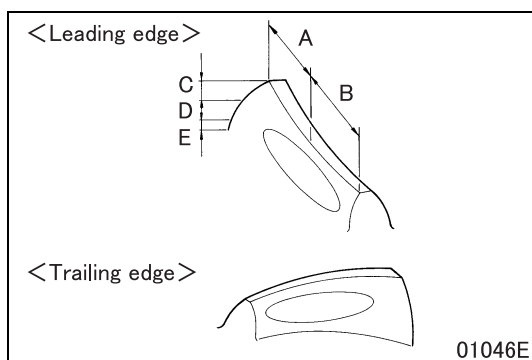
- Measure wobble at the illustrated position of the reduction gear.
- If the measured value deviates from the standard value, replace the reduction gear and reduction pinion of the differential as a set.



■ Inspection: Tooth contact of reduction gear

[Inspection]

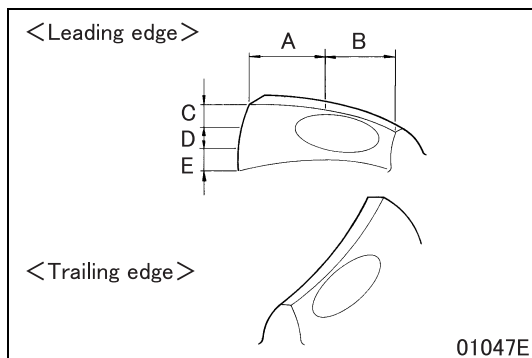
- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn the reduction gear several times to check for tooth contact.
- Adjust tooth contact if it is remarkably offset.



● Correct tooth contact at no load

<Reduction gear>

- A: Heel
- B: Toe
- C: Face
- D: Flank
- E: Clearance



<Reduction pinion>

- A: Heel
- B: Toe
- C: Face
- D: Flank
- E: Clearance

Maintenance item			Assembly standards
At no load	Tooth contact position	Lengthwise direction of tooth	From center towards toe
		Vertical direction	From center towards top of tooth for reduction gear and center for reduction pinion
	Tooth contact shape	Length	Approximately 50 to 70% of tooth width
		Width	Approximately 50 to 70% of tooth depth
	Degree of tooth contact		It becomes weaker as it nears tooth root and tooth tip

NOTE

- When tooth contact is near the toe at no load, it becomes middle area contact at load.

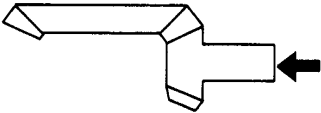
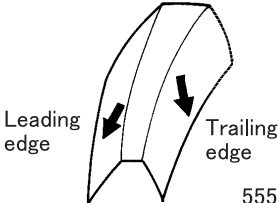
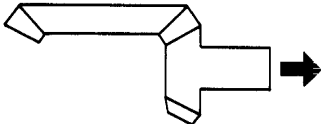
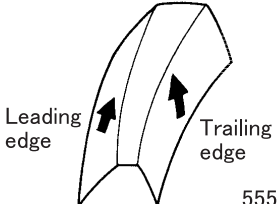
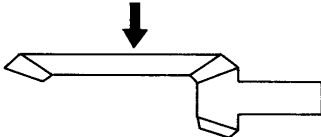
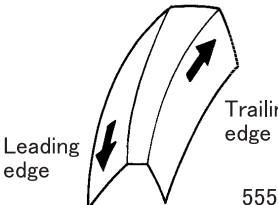
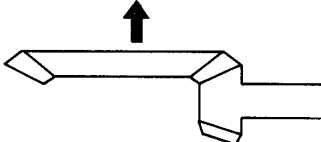
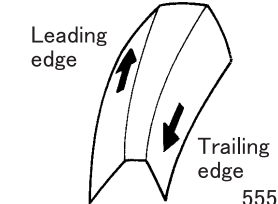
[Adjustment]

- Adjust by backlash between reduction gear and reduction pinion (to be adjusted with the side bearing nut) and addition or reduction of rear bearing shims.

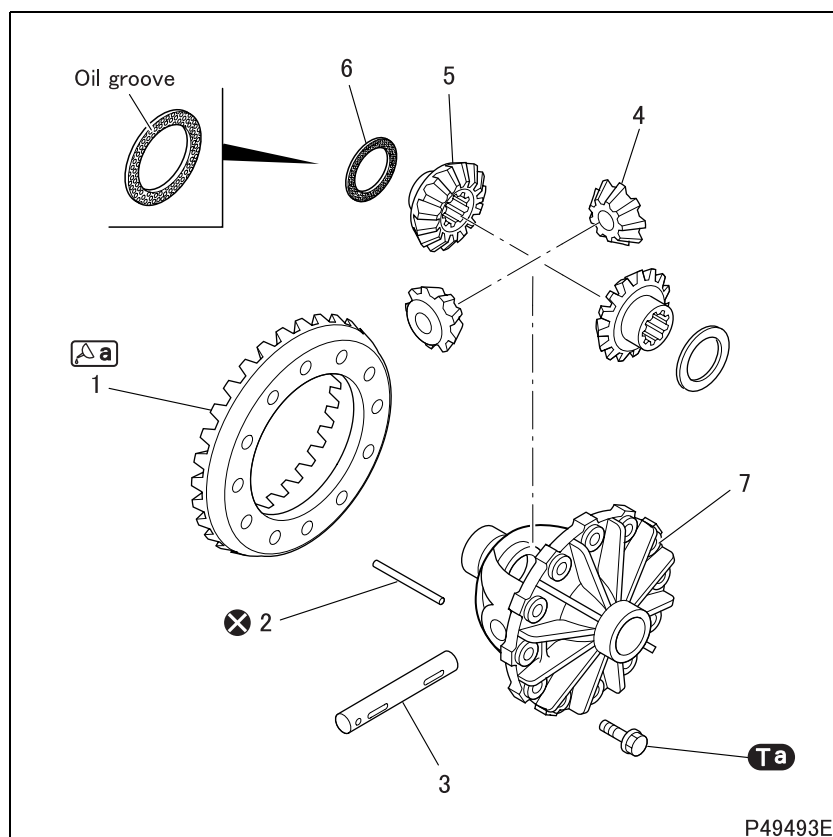
CAUTION

- Make sure to replace as a reduction gear set (reduction gear and reduction pinion), when replacing the gear because of excessive teeth wear.

REDUCTION AND DIFFERENTIAL

	Method of adjustment	Moving direction	
Tooth contact by addition or reduction of shims	Advance reduction pinion to reduction gear (Shims are added)  55497	 55501E	Tooth contact moves towards tooth root
	Retard reduction pinion from reduction gear (Shims are reduced)  55498	 55502E	Tooth contact moves towards tooth tip
Tooth contact by adjustment with side bearing nut	Advance reduction gear to reduction pinion center (Less backlash)  55499	 55503E	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to toe and slightly nearer to root of tooth Trailing edge: Nearer to heel and slightly nearer to top of tooth
	Retard reduction gear from reduction pinion center (More backlash)  55500	 55504E	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to heel and slightly nearer to top of tooth Trailing edge: Nearer to toe and slightly nearer to root of tooth

Differential



● Disassembly sequence

- 1 Reduction gear
- 2 Lock pin
- 3 Pinion shaft
- 4 Differential pinion
- 5 Side gear
- 6 Side gear washer
- 7 Differential case

⊗: Non-reusable part

CAUTION

- Be sure to replace the differential pinion and the side gear as a side gear set.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
4, 5	Backlash between differential pinion and side gear	0.15 to 0.20 {0.0059 to 0.0078}	0.3 {0.012}	Adjust or replace
5	Backlash between side gear and spline of drive shaft	0.07 to 0.16 {0.0028 to 0.0063}	0.5 {0.020}	Replace

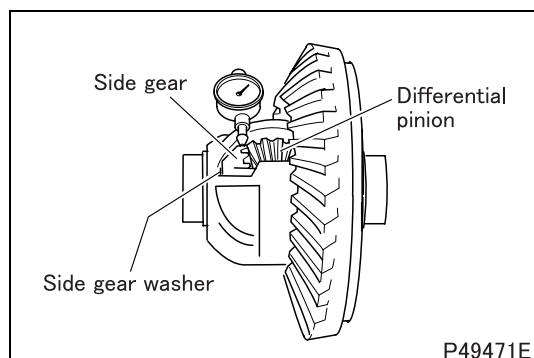
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
 Ta	Bolt (Reduction gear mounting)	137.2 to 166.6 {101 to 122, 14 to 17}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Bolt threads of reduction gear	LOCTITE 271	As required

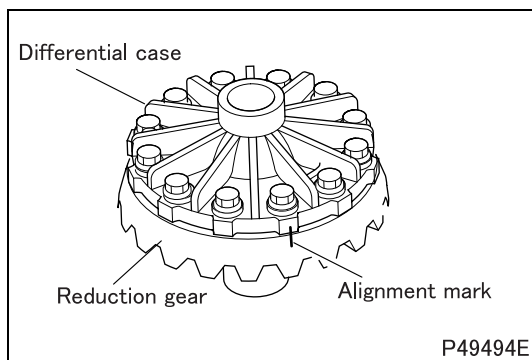
◆ Work before removal ◆



■ Inspection: Backlash between differential pinion and side gear

- If backlash is found faulty, thickness of the side gear washer is probably inappropriate.

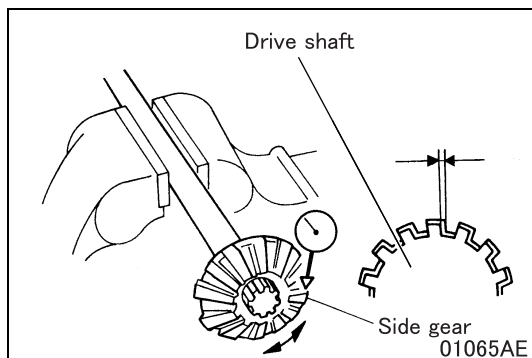
REDUCTION AND DIFFERENTIAL



■ Alignment marks: Reduction gear and differential case

- Put alignment marks on the reduction gear and the differential case.

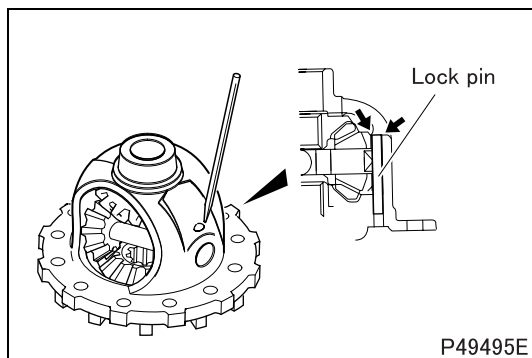
◆ Inspection procedure ◆



■ Inspection: Backlash between side gear and spline of drive shaft

- If the measured value exceeds the limit, replace defective parts.

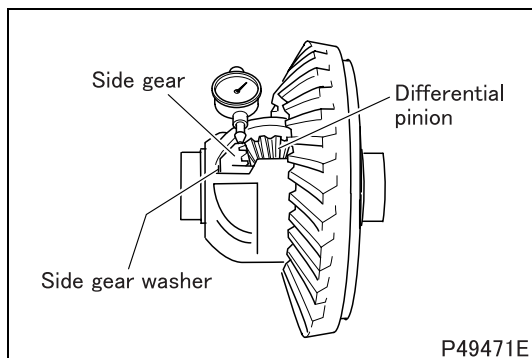
◆ Installation procedure ◆



■ Installation: Lock pin

- After installing the lock pin, caulk it with a punch (two locations).

◆ Inspection after installation ◆



■ Inspection: Backlash between differential pinion and side gear

- If the measured value deviates from the standard value, adjust by changing thickness of the side gear washer.

Thickness of side gear washers available

1.4, 1.5, 1.6 mm {0.055, 0.059, 0.063 in.} (three thickness)

CAUTION ⚠

- Use side gear washers of the same thickness for the right and left sides.



Group 27

Rear Axle

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

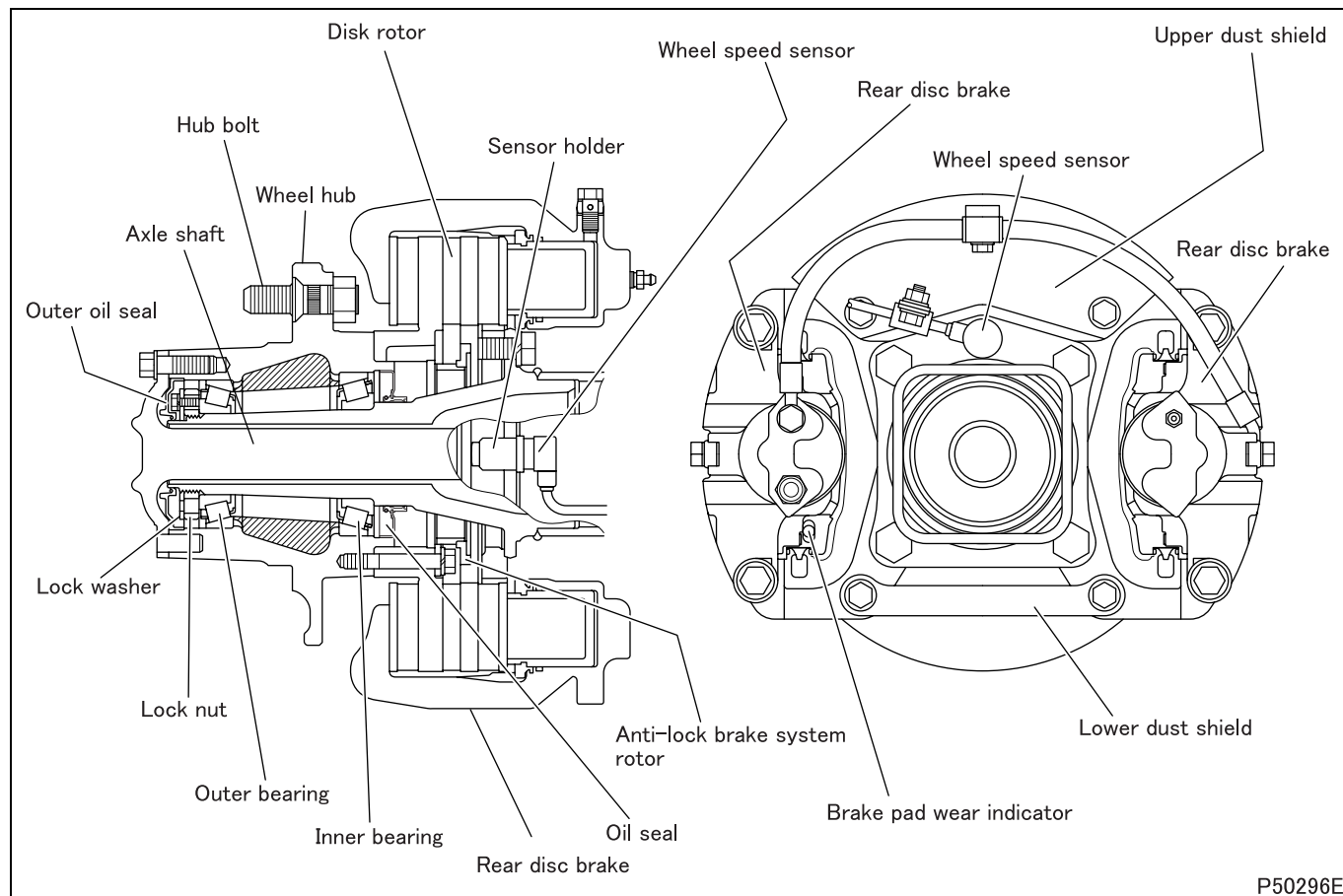
SPECIFICATIONS	27-2
STRUCTURE AND OPERATION	
1. Wheel Hub and Rotor	27-3
2. Wheel Hub and Brake Drum	27-4
3. Reduction and Differential	27-5
4. Limited Slip Differential	24-6
TROUBLESHOOTING	27-8
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Inspection and Replacement of Axle Oil	27-10
WHEEL HUB AND ROTOR	27-12
WHEEL HUB AND BRAKE DRUM	27-22
AXLE HOUSING	27-32
REDUCTION AND DIFFERENTIAL	27-36

SPECIFICATIONS

Item		Specifications	
		FE83 FE84 FG	FE85
Rear axle	Model	R033T	R035T
	Type	Banjo type, full floating	
Reduction	Model	D033H	D035H
	Type	Single-reduction hypoid gear	
	Gear ratio	4.875 5.285	5.285 5.714
Differential	Tooth shape	Straight bevel gear	
Gear oil	Grade	Normal : Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot area : Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140	
	Quantity dm ³ {qts, L}	4.5 {4.8, 4.5}	
Mass	kg {lb}	180 to 220 {395 to 485} (Approximately)	250 {550} (Approximately)

- Use the gear oil with a SAE viscosity of 140 when a vehicle is used under heavily-loaded, severe conditions such as continuous driving on uphill grades. However, the air temperature must be above 10°C.
- Limited slip differential oil API GL-5 SAE 90 is used for models with LSD (Limited Slip Differential).
- The mass differs between vehicle models.

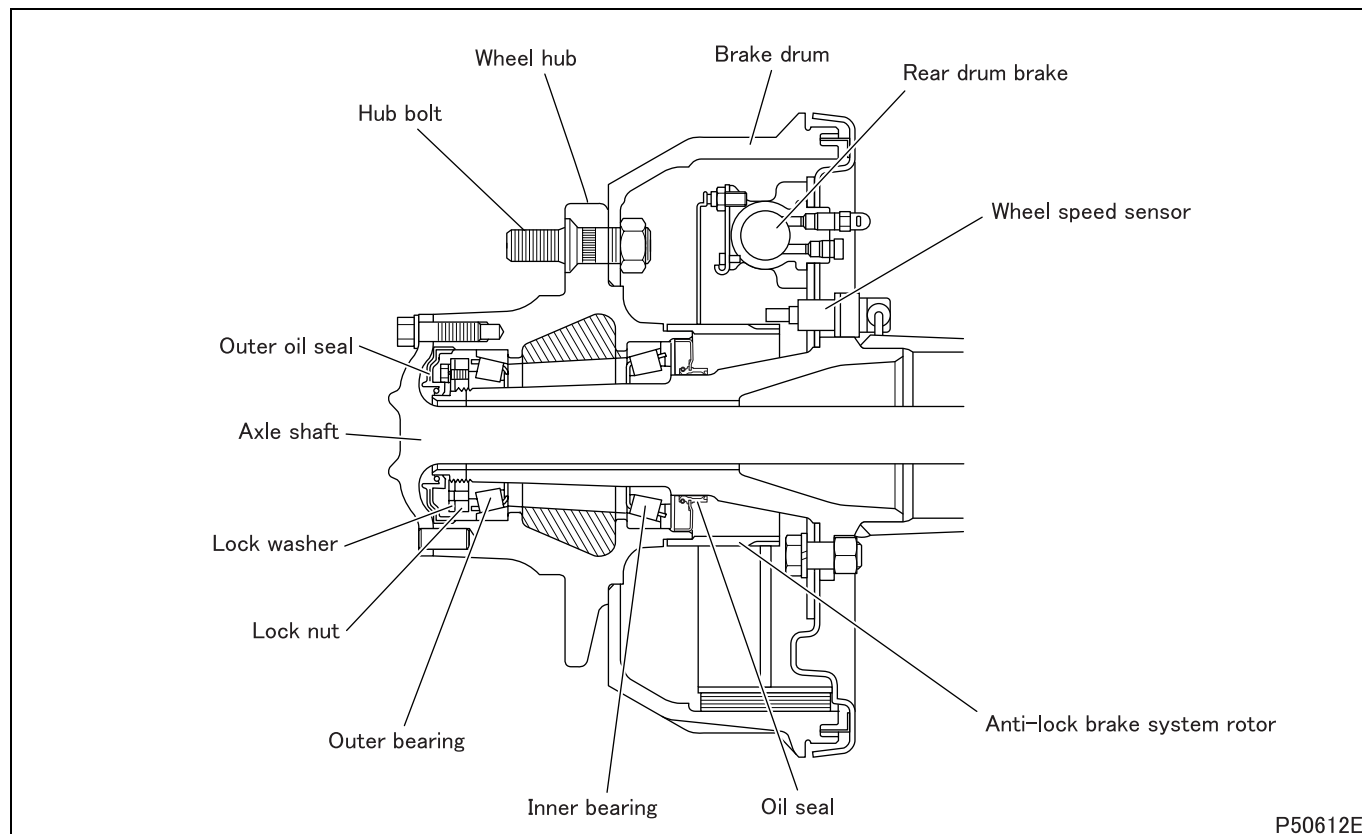
1. Wheel Hub and Rotor



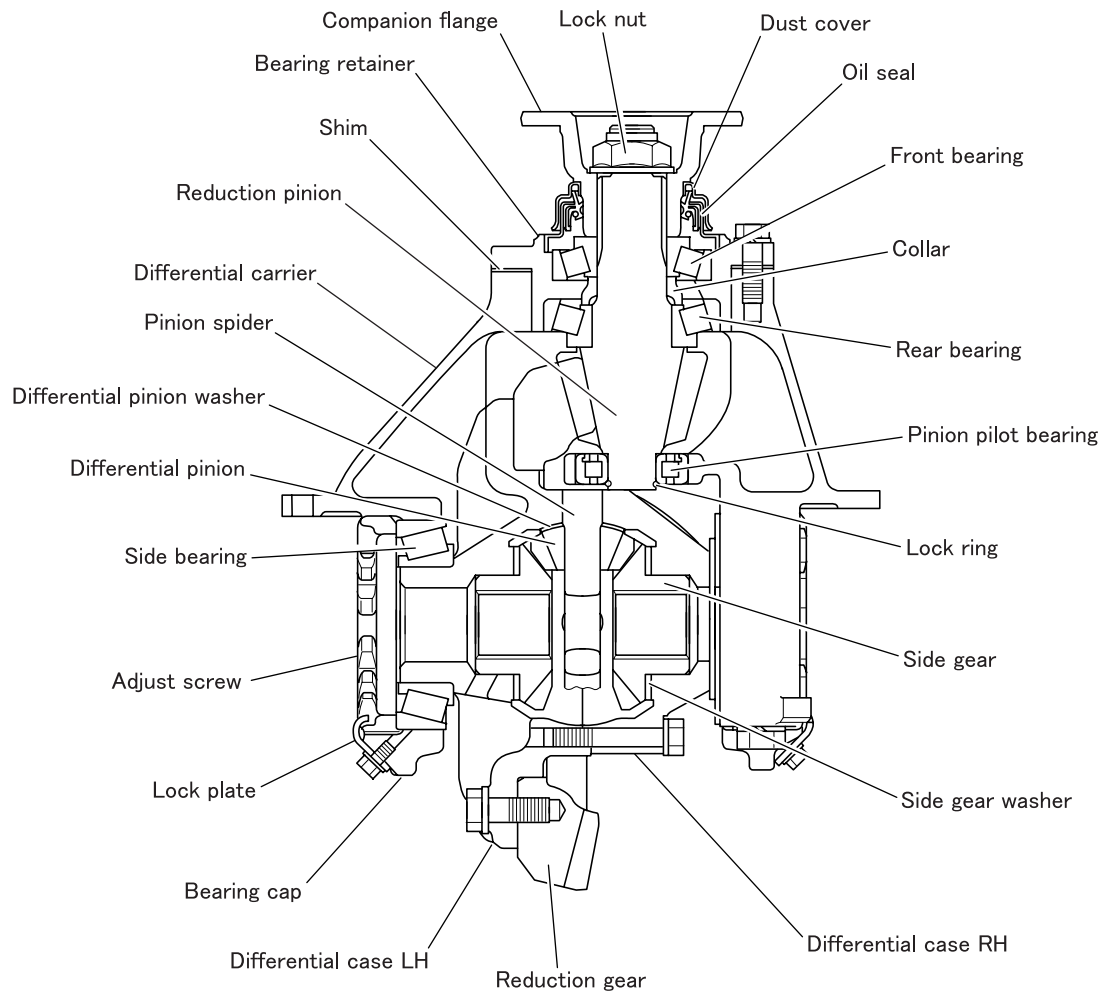
- The brake pad wear indicator is installed only on the right wheels.

STRUCTURE AND OPERATION

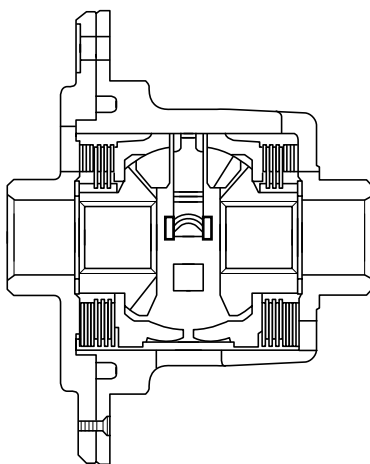
2. Wheel Hub and Brake Drum



3. Reduction and Differential

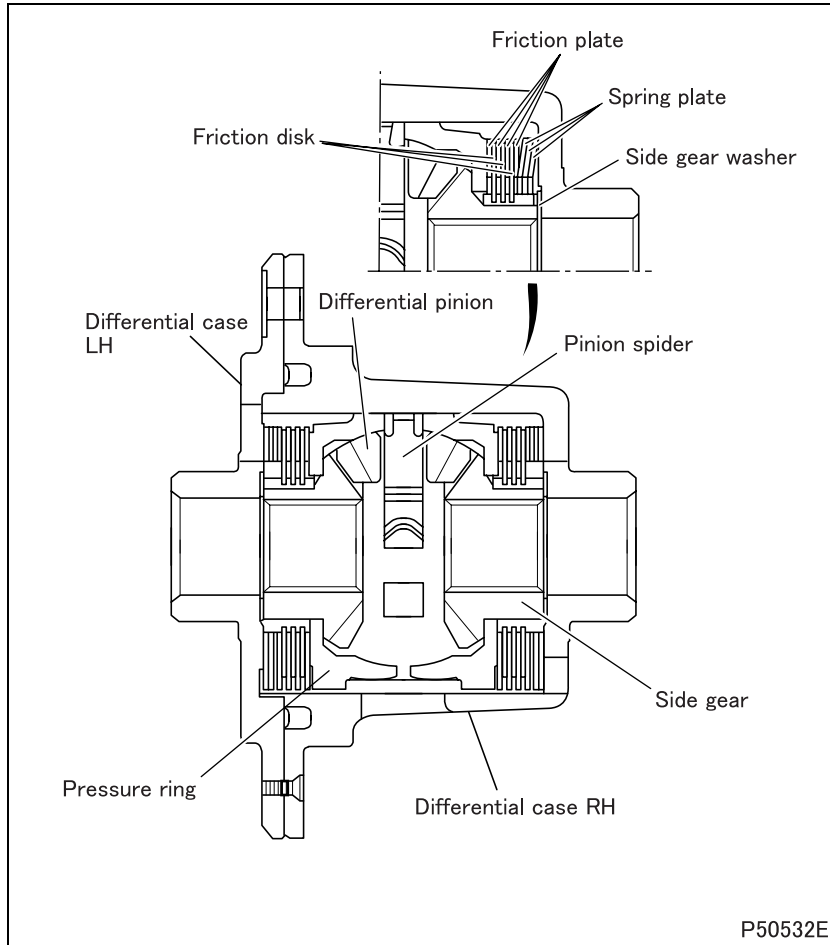


Limited slip differential



STRUCTURE AND OPERATION

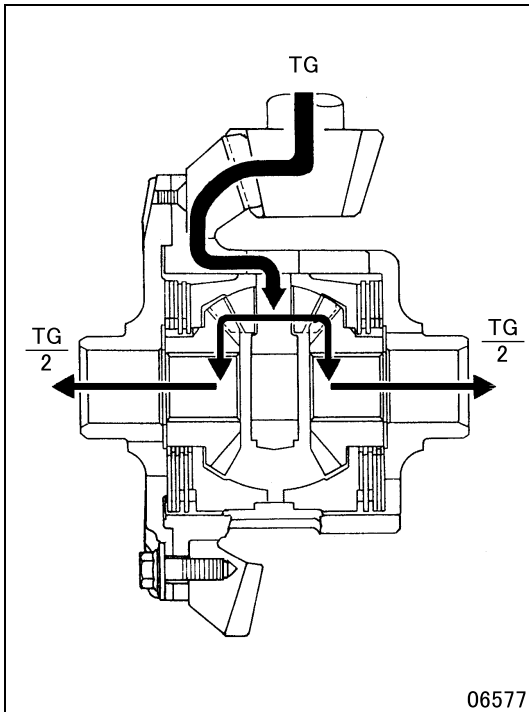
4. Limited Slip Differential



- The friction discs and spring discs, which are fitted in the side gears, and the friction plates, which are fitted in the differential case RH, are pushed against the pressure rings by the spring plates.
- The pressure rings fit in the groove inside the differential case RH and always rotate at the same speed.

4.1 Operating mechanism

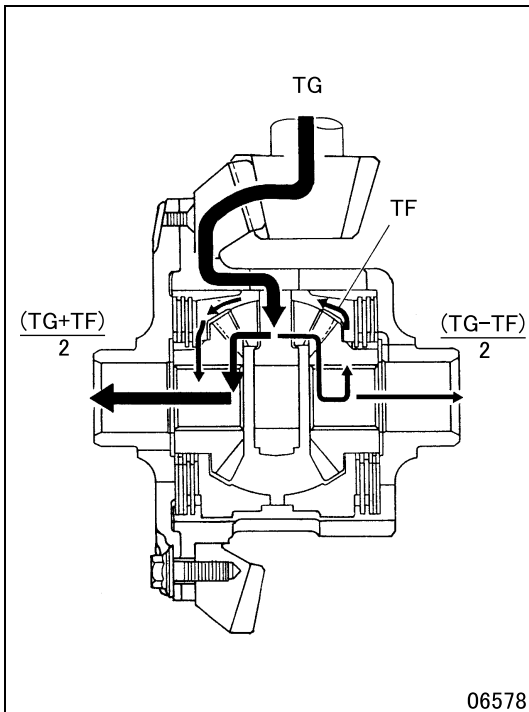
- When one wheel spins, a difference in the revolution speed generates between the side gear and the differential case, LH and RH, which causes the friction discs, spring discs and friction plates to revolve relatively to each other. This relative revolution produces a friction torque between the friction discs and friction plates.



4.2 Operation during straight driving

- During straight driving, the right and left axle shafts rotate at the same speed, and no friction torque generates.

TG: input torque



4.3 Operation when there is a difference in rotation speed between right and left wheels

- If one wheel is on a slippery surface such as mud and the other wheel is not, the differential function becomes effective due to a difference in surface resistance. In this state, friction torque **TF** is generated and this torque works in such a manner as to reduce the difference in rotations between right and left wheels. That is, the faster axle shaft is forced to slow down, and the slower axle shaft is forced to turn faster.

If one wheel spins due to mud and the like, a large friction torque generates because such a spinning makes large rotational speed difference. Accordingly, a small torque is distributed to the spinning wheel while a large torque is distributed to the non-spinning wheel, which makes it easier for the vehicle to get out of the mud.

$\frac{TG-TF}{2}$ High-speed side (spinning side)

$\frac{TG+TF}{2}$ Low-speed side

TROUBLESHOOTING

Symptoms		Power transmission insufficient						Oil leakage from companion flange assembly	Oil leakage from differential carrier and axle housing	Oil leakage from axle shaft	Reference Gr
		Noise when starting and changing gears	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Propeller shaft turns but vehicle does not move				
Possible causes											
Wheel hub, axle shaft, axle housing	Wheel hub bearing seized, worn or rotation faulty		O								
	Wheel hub bearing broken			O							
	Axle shaft mounting bolts loose			O						O	
	Axle shaft broken						O				
	Axle shaft slips out of spline of side gear						O				
	Axle shaft to spline of side gear backlash excessive	O									
	Oil seal faulty									O	
	Axle housing bent		O								
	Inspection plug and drain plug loose								O		
	Air breather and vent plug clogged							O		O	
Reduction and differential	Gear oil excessive							O			
	Gear oil insufficient	O	O								
	Oil seal faulty							O			
	Sealant faulty								O		
	Reduction and differential assembly mounting nuts and bolts loose			O					O		
	Differential carrier cracked or damaged								O		
	Bearing cap mounting bolts loose			O							
	Side bearing seized, worn or rotation faulty		O		O						
	Side bearing broken			O							
	Side bearing preload adjusted incorrectly		O								
	Reduction pinion or reduction gear broken	O		O	O		O				
	Reduction pinion or reduction gear worn		O		O						
	Reduction pinion or reduction gear damaged		O								
	Reduction gear backlash excessive	O									
	Reduction gear backlash or tooth contact adjusted incorrectly		O								

Possible causes		Symptoms	Power transmission insufficient						Oil leakage from companion flange assembly	Oil leakage from differential carrier and axle housing	Oil leakage from axle shaft	Reference Gr
			Noise when starting and changing gears	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Propeller shaft turns but vehicle does not move				
Reduction and differential	Starting torque of pinion bearing faulty		O	O								
	Lock nut loose		O	O								
	Front and rear bearings seized			O								
	Front and rear bearings worn			O								
	Front and rear bearings broken				O							
	Pinion pilot bearing worn			O								
	Pinion pilot bearing seized or broken				O							
	Pinion shaft and pinion spider broken							O				
	Reduction gear and differential case mounting bolt and nut loose		O		O							
	Side gear backlash excessive		O									
	Side gear or differential pinion broken				O	O	O	O				
	Side gear or differential pinion seized						O	O				
	Side gear or differential pinion worn					O	O					
	Side gear washer worn or damaged				O	O	O					
	Limited Slip Differential (LSD) broken <with LSD>		O	O	O	O		O				

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Replacement of Axle Oil

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
-	Inspection plug	110 ± 10 {81 ± 7.4, 11 ± 1}	-
	Drain plug		

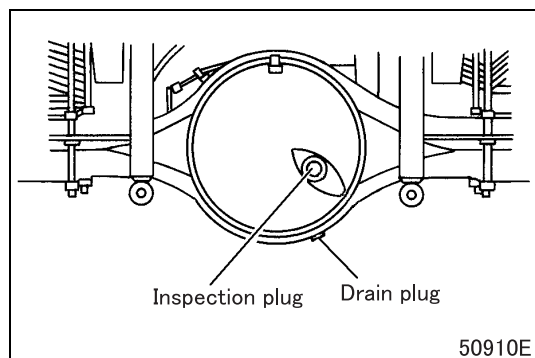
Lubricant and/or sealant

Mark	Points of application		Specified lubricant and/or sealant	Quantity
-	Axle housing	D033H, D035H	Normal : Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot area : Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140	4.5 dm ³ {4.8 qts, 4.5 L}

- Use the gear oil with a SAE viscosity of 140 under heavily-loaded, severe conditions such as continuous driving on uphill grades. However, the air temperature must be above 10°C.
- Limited slip differential oil API GL-5 SAE 90 is used for models with limited slip differential.

WARNING

- The oil temperature is high immediately after the vehicle has stopped, so take care not to scald yourself.



[Inspection]

(1) Inspection of oil quantity

- Remove the inspection plug, and check that oil is filled up to the neck.
- If oil is not sufficient, fill oil from the inspection plug hole up to the neck.

(2) Inspection of oil quality and inclusions

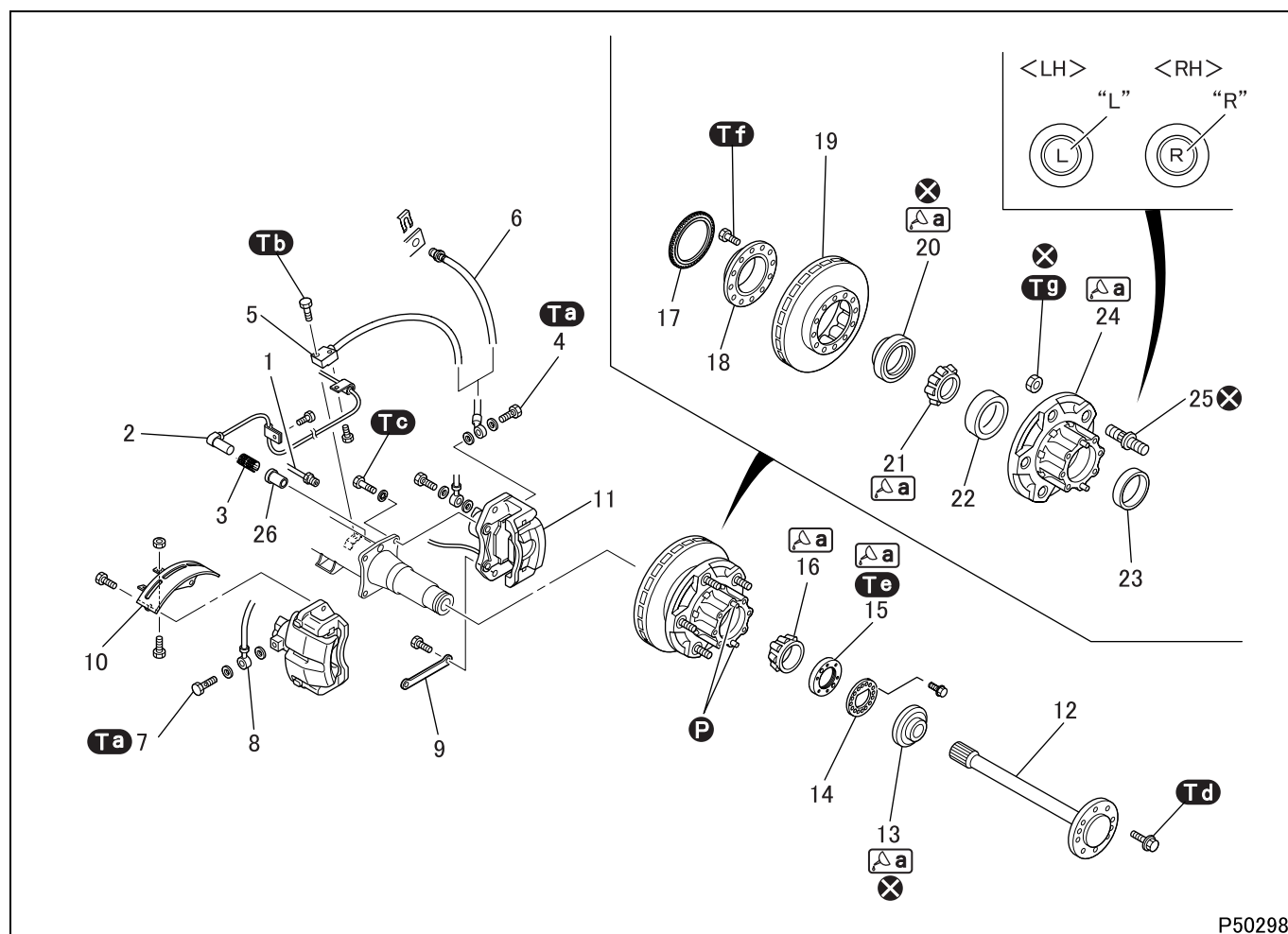
- When draining gear oil, check for oil quality, metal chips and metal powder.
- If an abnormally large amount of metal chips and metal powder is found, disassemble the assembly for service, as abnormalities may be caused inside.

[Replacement]

- Remove the drain plug to drain gear oil. Drainage can be made quickly with the inspection plug removed.
- As the drain plug (magnet type) is a magnet, clean it before installation.
- Fill the specified quantity of gear oil from the inspection plug hole.
- After filling, check that oil is filled up to the neck. If oil is not sufficient, replenish it.

M E M O

WHEEL HUB AND ROTOR



● Disassembly sequence

- | | |
|----------------------------------|--|
| 1 Brake pipe | 16 Outer bearing inner race |
| 2 Wheel speed sensor | 17 Anti-lock brake system rotor |
| 3 Spring spacer | 18 Anti-lock brake system rotor flange |
| 4 Eye bolt | 19 Disc rotor |
| 5 Brake hose (with connector) | 20 Oil seal |
| 6 Brake hose (without connector) | 21 Inner bearing inner race |
| 7 Eye bolt | 22 Inner bearing outer race |
| 8 Brake hose | 23 Outer bearing outer race |
| 9 Lower dust shield | 24 Wheel hub |
| 10 Upper dust shield | 25 Hub bolt |
| 11 Rear disc brake (See Gr35A.) | 26 Sensor holder |
| 12 Axle shaft | |
| 13 Outer oil seal | |
| 14 Lock washer | |
| 15 Lock nut | |

P: Locating pin

X: Non-reusable parts

CAUTION

- Plug the brake hose to prevent entry of dust and dirt after it has been removed.

NOTE

- Do not remove the anti-lock brake system rotor and sensor holder unless replacing them.
- Do not disassemble the disc rotor and wheel hub unless replacing them.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- Make sure that the disc rotor surface and disc brake pad surface are free from grease to avoid malfunction of brakes.
- Make sure that the brake hose is not twisted when installing it.
- Inspect the drag torque of disc brakes after assembly. (See Gr35A.)

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of wheel hub bearing (tangential force at hub bolt position with oil seal assembled)		2.0 to 3.9 N·m {1.4 to 2.9 ft.lbs, 0.2 to 0.4 kgf·m} (tangential force: 18 to 32 N {4.0 to 7.2 lbs, 1.8 to 3.3 kgf})	–	Adjust or replace
12	Axle shaft	Bend	1 {0.039} or less	2	Replace
		Bend at flange face	0.03 {0.0012} or less	0.05	
19	Disc rotor	Runout (measure runout, assembling disc rotor in rear axle)	0.07 {0.0028} or less	0.10	Replace
		Thickness	40	38	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Eye bolt		22 ± 2 {16 ± 1.5, 2.25 ± 0.25}	–
Tb	Bolt (Brake hose mounting) (with connector)		43.2 ± 10 {32 ± 7.4, 4.4 ± 1.0}	–
Tc	Bolt (Rear disc brake mounting)		98 to 140 {72 to 103, 10 to 14}	–
Td	Bolt (Axle shaft mounting)		98 to 120 {72 to 87, 10 to 12}	–
Te	Lock nut	Primary tightening	98 to 130 {72 to 96, 10 to 13}	–
		Secondary tightening after complete tightening	30 to 40 {22 to 29, 3 to 4}	–
Tf	Bolt (Wheel hub and disc rotor mounting)		34 to 54 {25 to 40, 3.5 to 5.5}	–
Tg	Nut (Hub bolt mounting)		340 ± 40 {251 ± 30, 35 ± 4}	–

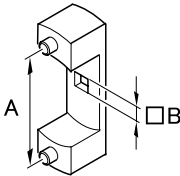
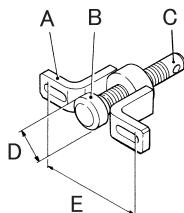
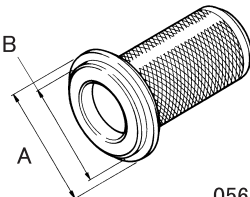
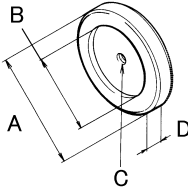
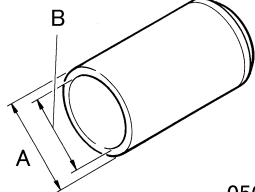
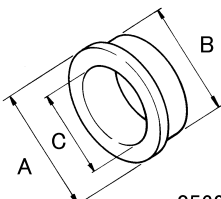
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Lip area of outer oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Thread area of lock nut		
	Pack space between rollers of outer bearing inner race and inner bearing inner race		
	Lip area of oil seal		
	Pack interior of wheel hub		370 ± 37 g ※ {13.1 ± 1.31 oz}

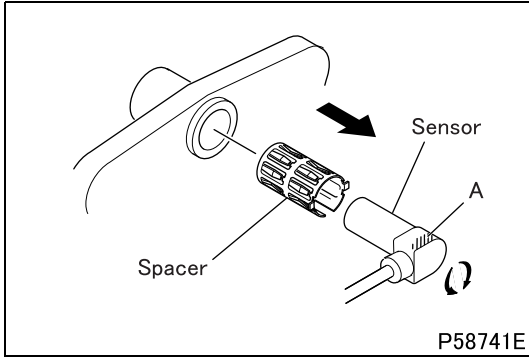
※ : For a wheel hub

WHEEL HUB AND ROTOR

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application							
	Lock nut adjust tool <table><tr><th>A</th><th>B</th></tr><tr><td>70 {2.76}</td><td>12.7 {0.50}</td></tr></table>  P05617	A	B	70 {2.76}	12.7 {0.50}	MB999150	Removal and installation of lock nut			
A	B									
70 {2.76}	12.7 {0.50}									
	Hub puller A: Hub puller body B: Attachment C: Bolt <table><tr><th>D</th><th>E</th></tr><tr><td>φ50 {1.97}</td><td>165 {6.50}</td></tr></table>  05618	D	E	φ50 {1.97}	165 {6.50}	MB999070 A: MB999071 B: MB999073 C: MB999072	Removal of wheel hub and rotor			
D	E									
φ50 {1.97}	165 {6.50}									
	Oil seal installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ84 {3.31}</td><td>φ70 {2.76}</td></tr></table>  05619	A	B	φ84 {3.31}	φ70 {2.76}	MB999097	Installation of oil seal (to be used in combination)			
A	B									
φ84 {3.31}	φ70 {2.76}									
	Oil seal installer  51705 <table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>φ117 {4.61}</td><td>φ84 {3.31}</td><td>20 {0.79}</td><td>M10 × 1.25</td></tr></table>	A	B	C	D	φ117 {4.61}	φ84 {3.31}	20 {0.79}	M10 × 1.25	MH062607
A	B	C	D							
φ117 {4.61}	φ84 {3.31}	20 {0.79}	M10 × 1.25							
	Bearing installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ70 {2.76}</td><td>φ57 {2.24}</td></tr></table>  05668	A	B	φ70 {2.76}	φ57 {2.24}	MB999100				
A	B									
φ70 {2.76}	φ57 {2.24}									
	Bearing installer <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ109 {4.29}</td><td>φ99 {3.90}</td><td>φ77 {3.03}</td></tr></table>  05621	A	B	C	φ109 {4.29}	φ99 {3.90}	φ77 {3.03}	MB999098	Installation of inner and outer bearing outer races (to be used in combination)	
A	B	C								
φ109 {4.29}	φ99 {3.90}	φ77 {3.03}								

◆ Removal procedure ◆

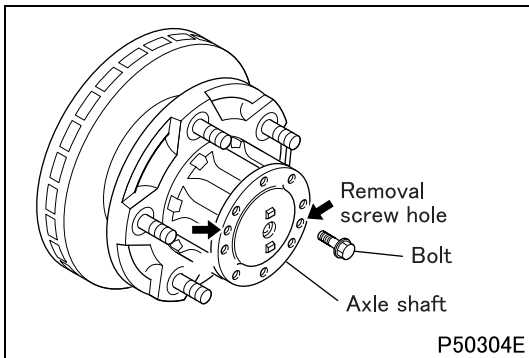


■ Removal: Wheel speed sensor

- Hold shaded section A of wheel speed sensor with pliers, and remove the sensor by twisting it slightly in left and right direction.

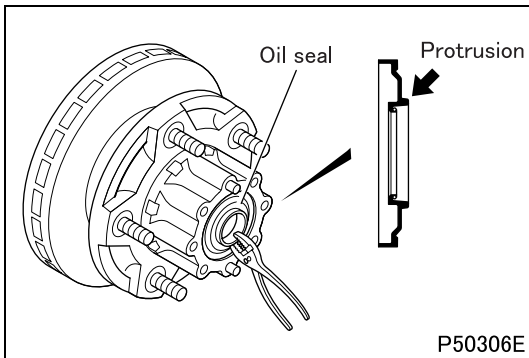
CAUTION ⚠

- When removing the wheel speed sensor, never apply a force to it such as tapping it with a hammer, prying it with a screwdriver and pulling the harness, as doing so causes the wire to be broken.
- If the wheel speed sensor pulls out lightly, replace the spring spacer.



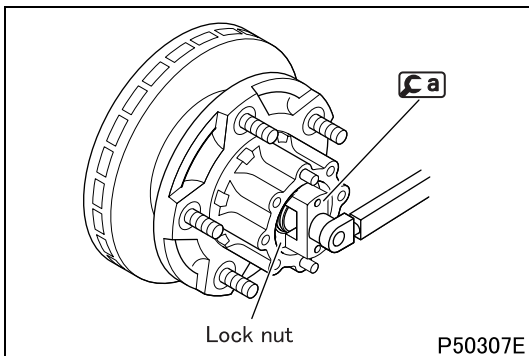
■ Removal: Axle shaft

- Screw two axle shaft mounting bolts evenly into the axle shaft removal screw holes to remove the axle shaft.



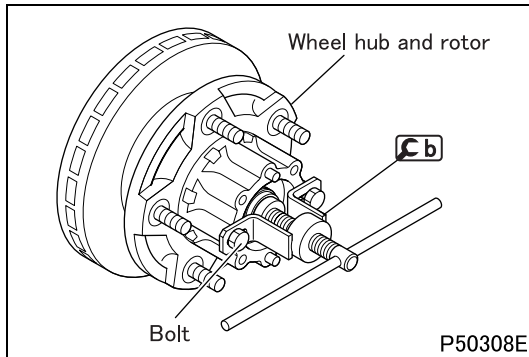
■ Removal: Outer oil seal

- To remove the outer oil seal, pull protrusions on the outer periphery of the outer oil seal evenly around the whole circumference with pliers.



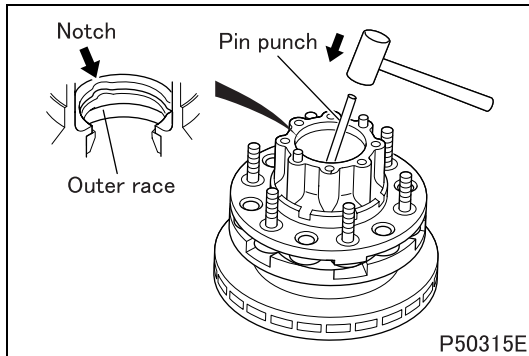
■ Removal: Lock nut

WHEEL HUB AND ROTOR



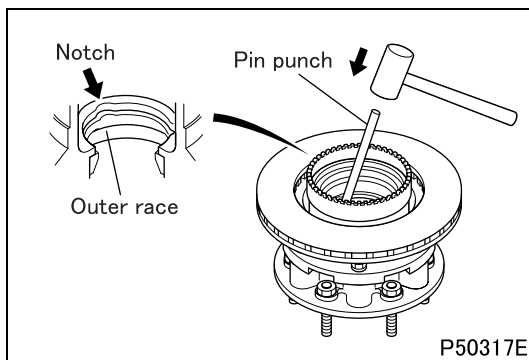
■ Removal: Wheel hub and rotor

- Install  using axle shaft mounting bolts and remove the wheel hub and rotor assembly.



■ Removal: Inner bearing outer race

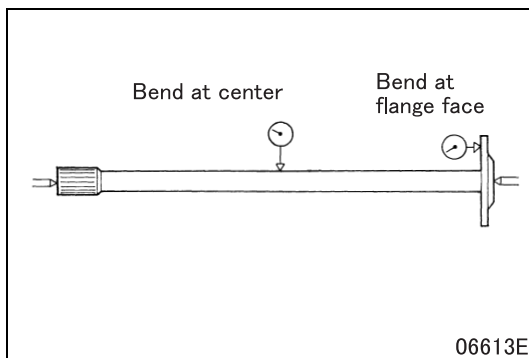
- Drive out the inner bearing outer race by tapping evenly at three indented parts in the wheel hub.



■ Removal: Outer bearing outer race

- Drive out the outer bearing outer race by tapping evenly at three indented parts in the wheel hub.

◆ Inspection procedure ◆

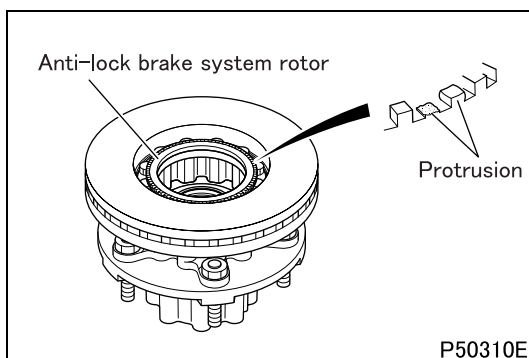


■ Inspection: Axle shaft

- Measure the bend of the axle shaft at its center.

NOTE

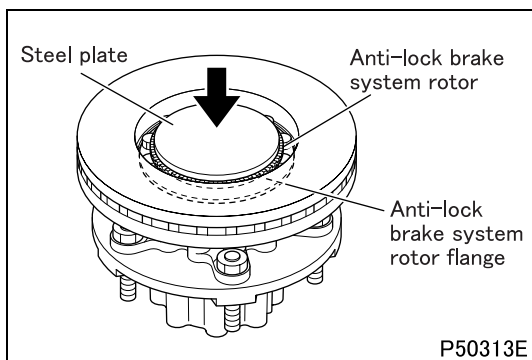
- Give the axle shaft one complete turn and read the dial gauge at this time. The bend is one half of the reading.
- If the measured value exceeds the limit, replace the axle shaft.
- Measure the bend of the flange face of the axle shaft.
- If the measured value exceeds the limit, replace the axle shaft.



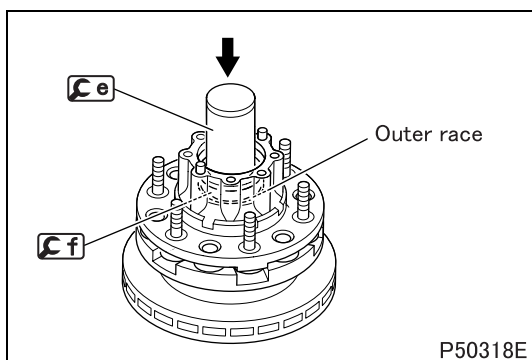
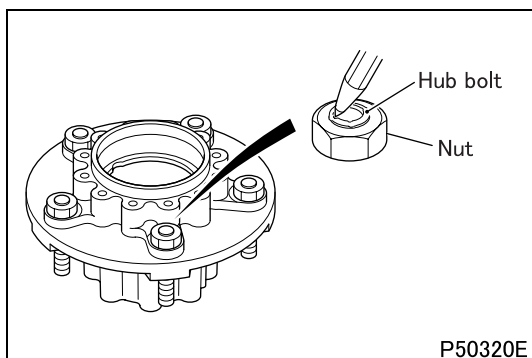
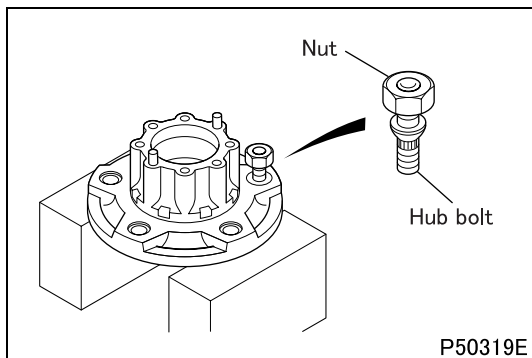
■ Inspection: Anti-lock brake system rotor

[Inspection]

- Remove any debris on the anti-lock brake system rotors and check protrusions of the anti-lock brake system rotor for chipping and flattening.
- If any abnormality is found, replace the anti-lock brake system rotor.



◆ Installation procedure ◆



[Installation]

- Warm the anti-lock brake system rotor to approximately 150°C.
- Install the anti-lock brake system rotor and anti-lock brake system rotor flange evenly using a steel plate so as not to allow them to tilt.

WARNING ⚠

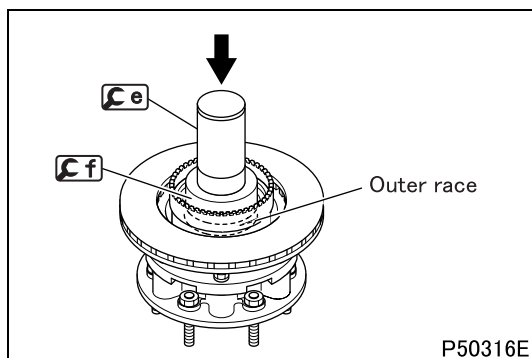
- Handling the warmed rotor by bare hand causes scald.

■ Installation: Hub bolt

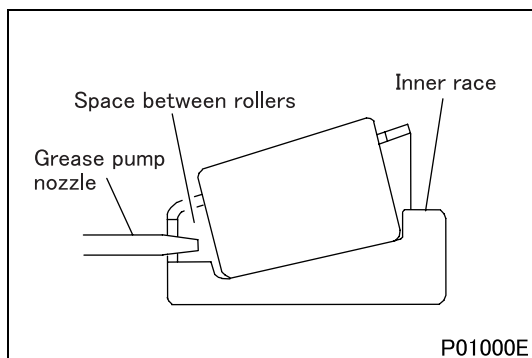
- Screw the nut into the hub bolt until just before they become flush.
- Drive the hub bolt into the wheel hub vertically by hitting the end face of the nut with a brass punch or the like.
- After tightening the nut to the specified torque, caulk it with a punch.

■ Installation: Outer bearing outer race

WHEEL HUB AND ROTOR

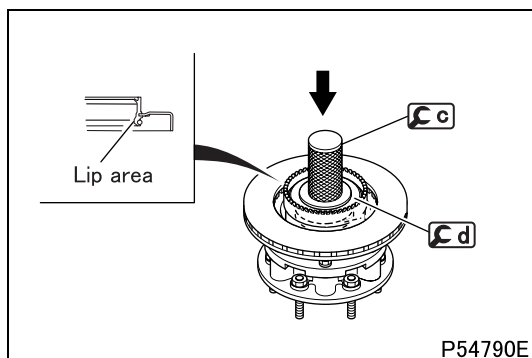


■ Installation: Inner bearing outer race



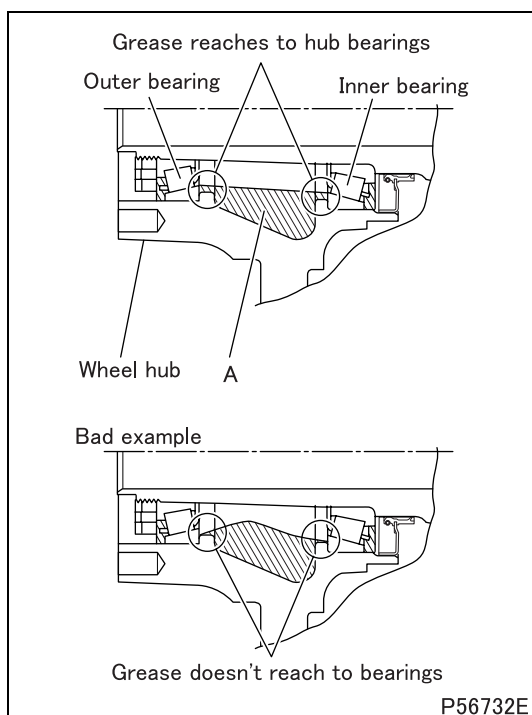
■ Installation: Packing grease in inner bearing inner race

- Insert the grease pump nozzle into the space between rollers of the inner bearing inner race to pack grease sufficiently.



■ Installation: Oil seal

- Apply grease to the lip area of the oil seal and install it on the wheel hub in the illustrated direction.

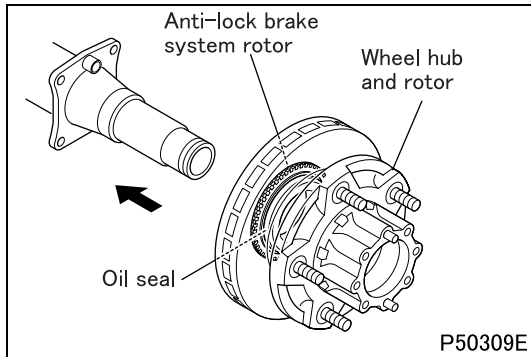


■ Installation: Wheel hub and rotor

- Apply specified amount of grease to inside A of wheel hub so that the grease reaches to inner bearing and outer bearing as illustrated.

CAUTION ⚠

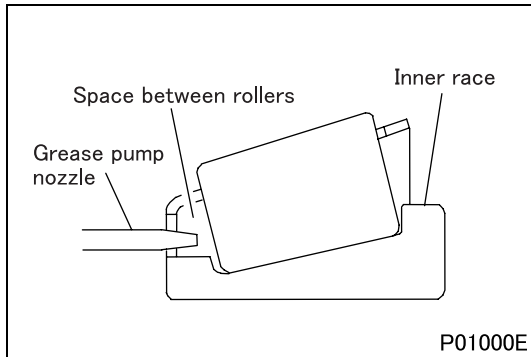
- The bad example of applying grease causes wheel hub bearing seized.



- Slowly install the wheel hub and rotor assembly so as not to cause damage to the oil seal and anti-lock brake system rotor.

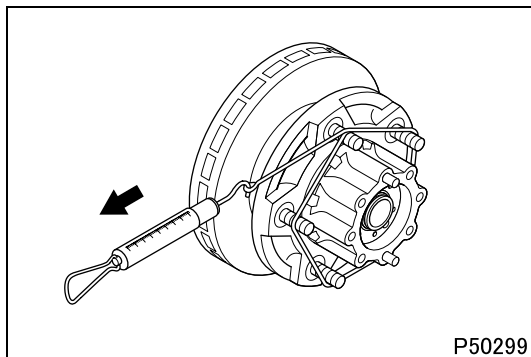
CAUTION

- If the anti-lock brake system rotor is damaged, wheel speed sensor signals become abnormal, causing the anti-lock brake system to malfunction.



■ Installation: Packing grease in outer bearing inner race

- Insert the grease pump nozzle into the space between rollers of the outer bearing inner race to pack grease sufficiently.



■ Installation: Lock nut

- Install the lock nut in the same manner as for removal. (see ■ Removal: Lock nut)

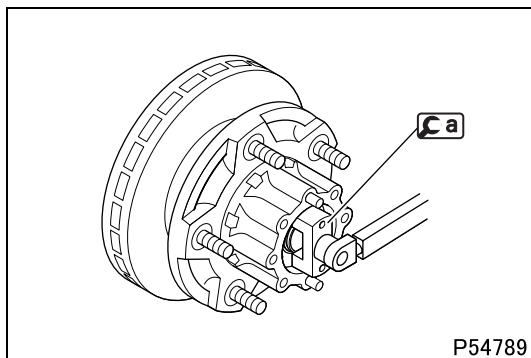
■ Inspection: Starting torque of wheel hub bearing

[Inspection]

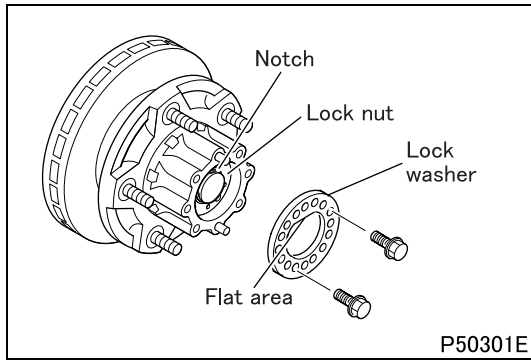
- After installing the lock washer, carry out the following inspections.
- Measure the tangential force at the hub bolt position using a spring balancer.
- If the tangential force is within the specified value, the starting torque conforms to the standard value. If the measured value deviates from the specified value, adjust.

[Adjustment]

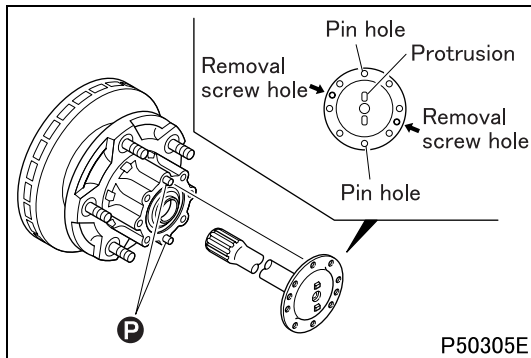
- Tighten the lock nut to the specified torque (primary tightening) while turning the wheel hub and rotor, and then loosen it completely.
- Smooth operation of the outer bearing and inner bearing by turning the wheel hub and rotor several times, and then tighten the lock nut to the specified torque (secondary tightening).



WHEEL HUB AND ROTOR



- Insert the flat area of the lock washer, aligning it with the notch of the axle housing, and mount two bolts diagonally to the lock nut.
- If the lock nut does not align with a screw hole of the lock washer, align by loosening the lock nut. Make sure that there is no play in the axial direction.
- Carry out measurement again after adjustment. If any fault is found, replace the outer and inner bearings.

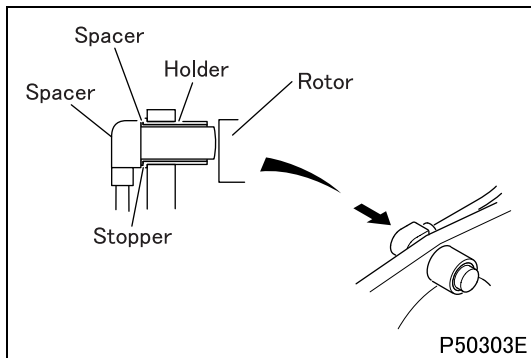


■ Installation: Axle shaft

- Align the pin hole of the locating pin with that of the axle shaft to install the axle shaft.

NOTE

- A pin hole is not necessarily located at the position of a protrusion on the axle shaft flange face as illustrated. The second hole from a removal screw hole clockwise is a pin hole.



■ Installation: Wheel speed sensor

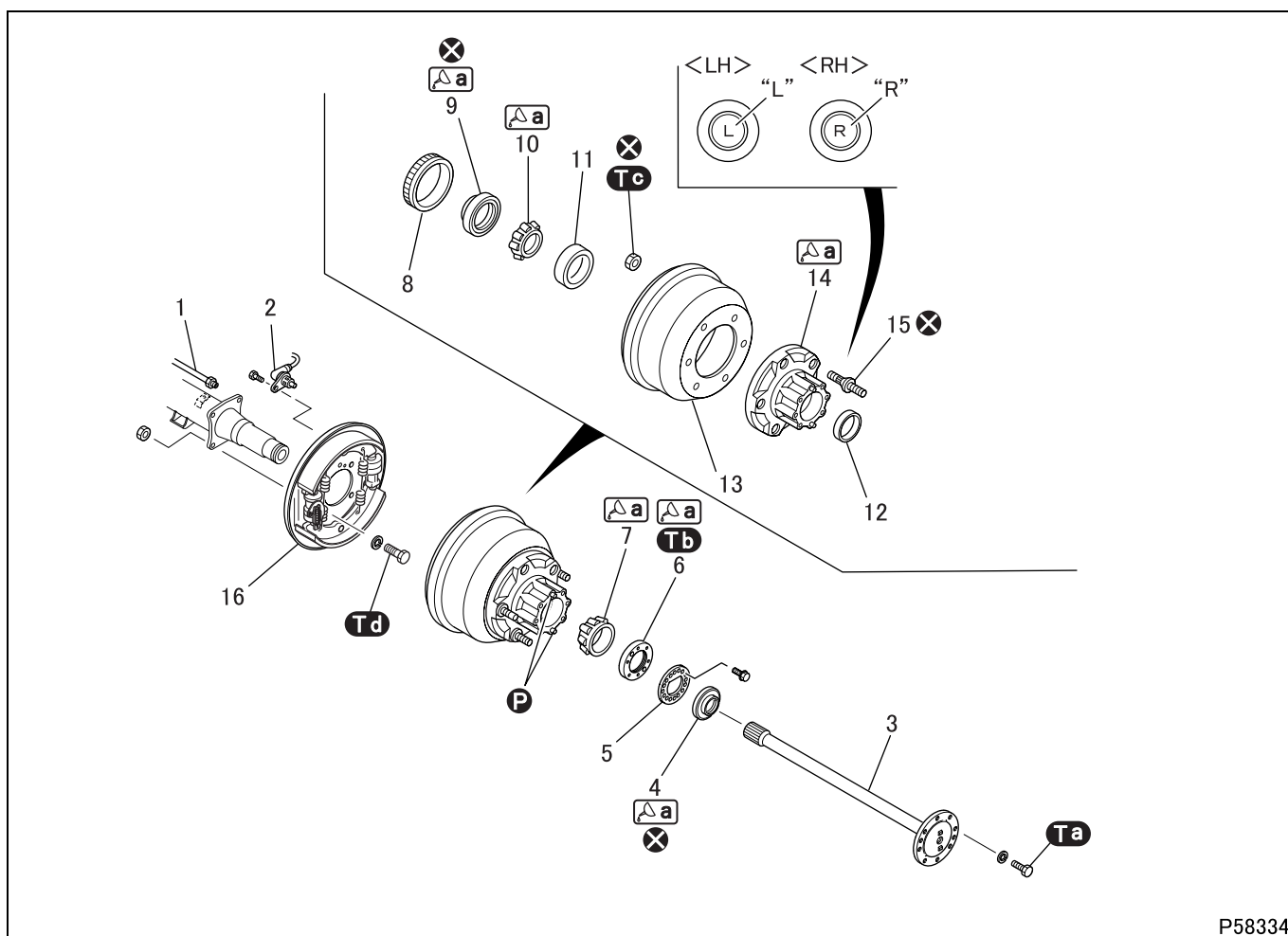
- Install the wheel speed sensor so that it securely contacts the sensor holder together with the spring spacer.

CAUTION ⚠

- When installing the wheel speed sensor, never apply a force to it such as tapping it with a hammer, prying it with a screwdriver and pulling the harness, as doing so causes the wire to be broken.

M E M O

WHEEL HUB AND BRAKE DRUM



P58334

● Disassembly sequence

- | | |
|--------------------------------|---------------------------------|
| 1 Brake pipe | 11 Inner bearing outer race |
| 2 Wheel speed sensor | 12 Outer bearing outer race |
| 3 Axle shaft | 13 Brake drum |
| 4 Outer oil seal | 14 Wheel hub |
| 5 Lock washer | 15 Hub bolt |
| 6 Lock nut | 16 Rear drum brake (See Gr35A.) |
| 7 Outer bearing inner race | |
| 8 Anti-lock brake system rotor | |
| 9 Oil seal | |
| 10 Inner bearing inner race | |
- P: Locating pin
 X: Non-reusable parts

CAUTION

- Be careful not to damage the tip of the wheel speed sensor after removing it.

NOTE

- Do not remove the anti-lock brake system rotor unless replacing it.
- Do not disassemble the brake drum and wheel hub unless replacing them.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- Make sure that the brake lining surface of the rear drum brake and the inner surface of the brake drum are free from grease to avoid malfunction of brakes.
- Adjust brake shoe clearance after assembly. (See Gr35A.)

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Starting torque of wheel hub bearing (tangential force at hub bolt position with oil seal assembled)		2.0 to 3.9 N·m {1.4 to 2.9 ft.lbs, 0.2 to 0.4 kgf·m} (tangential force: 20 to 32 N {4.5 to 7.2 lbs., 2.0 to 3.3 kgf})	–	Adjust or replace
4	Axle shaft	Bend at center	1 {0.039} or less	2 {0.079}	Replace
		Bend at flange face	0.03 {0.0012} or less	0.05 {0.0020}	Replace
14	Brake drum	Inside diameter	320 {12.60}	322 {12.68} (※ 321 {12.64})	Correct or re- place
		Cylindricity	0.05	0.20	

※ shows the correction limit value.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Bolt (Axle shaft mounting)		98 to 120 {10 to 12}	–
Tb	Lock nut	Primary tightening	98 to 130 {72 to 96, 10 to 13}	–
		Secondary tightening after complete tightening	30 to 40 {22 to 30, 3 to 4}	–
Tc	Nut (Brake drum and wheel hub mounting)		340 ± 40 {250 ± 30, 35 ± 4}	–
Td	Bolt (Rear drum brake mounting)		98 to 140 {72 to 103, 10 to 14}	–

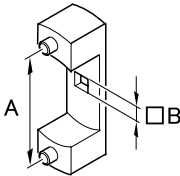
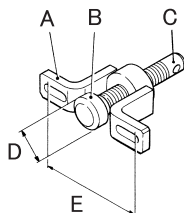
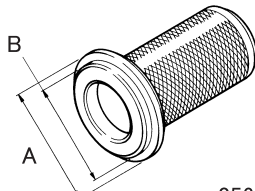
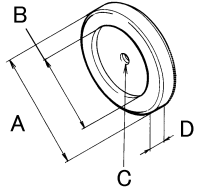
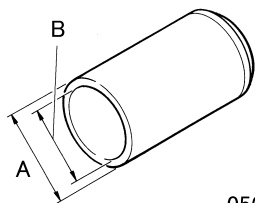
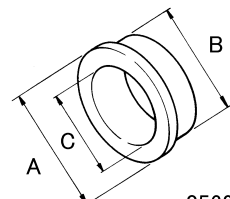
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Lip area of outer oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Thread area of lock nut		
	Pack space between rollers of outer bearing inner race and inner bearing inner race		
	Lip area of oil seal		
	Pack interior of wheel hub		370 ± 37 g ※ {13.1 ± 1.31 oz}

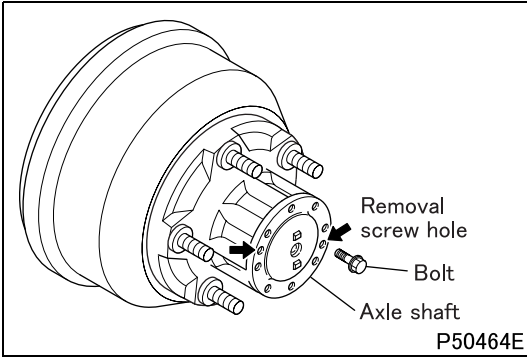
※ : For a wheel hub

WHEEL HUB AND BRAKE DRUM

Special tools (Unit: mm {in.})

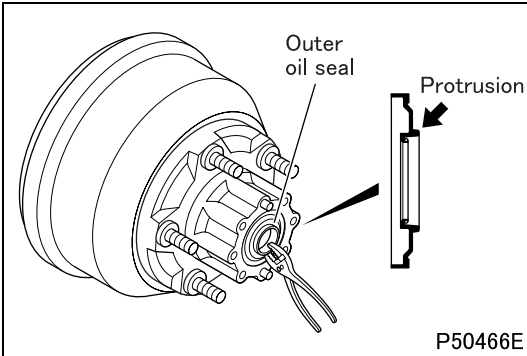
Mark	Tool name and shape	Part No.	Application							
	Lock nut adjust tool <table><tr><th>A</th><th>B</th></tr><tr><td>70 {2.76}</td><td>12.7 {0.50}</td></tr></table>  P05617	A	B	70 {2.76}	12.7 {0.50}	MB999150	Removal and installation of lock nut			
A	B									
70 {2.76}	12.7 {0.50}									
	Hub puller A: Hub puller body B: Attachment C: Bolt <table><tr><th>D</th><th>E</th></tr><tr><td>φ50 {1.97}</td><td>16.5 {6.50}</td></tr></table>  05618	D	E	φ50 {1.97}	16.5 {6.50}	MB999070 A: MB999071 B: MB999073 C: MB999072	Removal of wheel hub and brake drum			
D	E									
φ50 {1.97}	16.5 {6.50}									
	Oil seal installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ84 {3.31}</td><td>φ70 {2.76}</td></tr></table>  05619	A	B	φ84 {3.31}	φ70 {2.76}	MB999097	Installation of oil seal (to be used in combination)			
A	B									
φ84 {3.31}	φ70 {2.76}									
	Oil seal installer  51705 <table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>φ117 {4.61}</td><td>φ84 {3.31}</td><td>M10 × 1.25</td><td>20 {0.79}</td></tr></table>	A	B	C	D	φ117 {4.61}	φ84 {3.31}	M10 × 1.25	20 {0.79}	MH062607
A	B	C	D							
φ117 {4.61}	φ84 {3.31}	M10 × 1.25	20 {0.79}							
	Bearing installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ70 {2.76}</td><td>φ57 {2.24}</td></tr></table>  05668	A	B	φ70 {2.76}	φ57 {2.24}	MB999100	Installation of inner and outer bearing outer races (to be used in combination)			
A	B									
φ70 {2.76}	φ57 {2.24}									
	Bearing installer <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ109 {4.29}</td><td>φ99 {3.90}</td><td>φ77 {3.03}</td></tr></table>  05621	A	B	C	φ109 {4.29}	φ99 {3.90}	φ77 {3.03}	MB999098		
A	B	C								
φ109 {4.29}	φ99 {3.90}	φ77 {3.03}								

◆ Removal procedure ◆



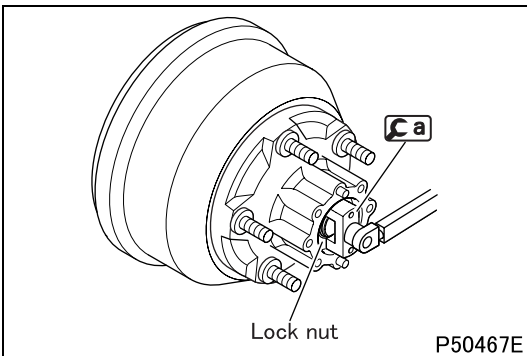
■ Removal: Axle shaft

- Screw two axle shaft mounting bolts evenly into the axle shaft removal screw holes to remove the axle shaft.

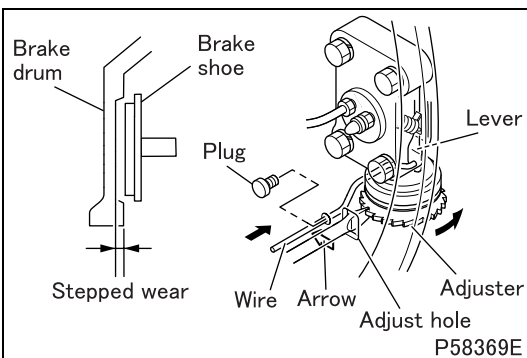


■ Removal: Outer oil seal

- To remove the outer oil seal, pull protrusions on the outer periphery of the outer oil seal evenly around the whole circumference with pliers.



■ Removal: Lock nut



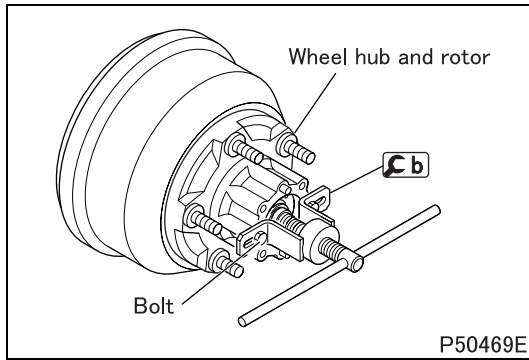
■ Removal: Wheel hub and brake drum

- If the brake drum has stepped wear and the wear prevents the wheel hub and brake drum assembly from being removed, the removal can still be effected by taking the following procedure.
- Insert a wire of approx. $\phi 2$ mm {0.079 in.} into the hole from which the plug has been removed, and lift up the adjust lever of the wheel cylinder.
- Turn the adjuster from the adjust hole in the opposite direction to the arrow on the backing plate to increase the clearance between the brake drum and the brake shoe. Then, remove the wheel hub and brake drum assembly.

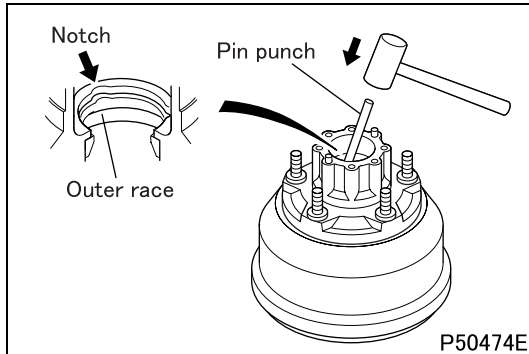
CAUTION ⚠

- Correct or replace the brake drum if any fault is found.

WHEEL HUB AND BRAKE DRUM

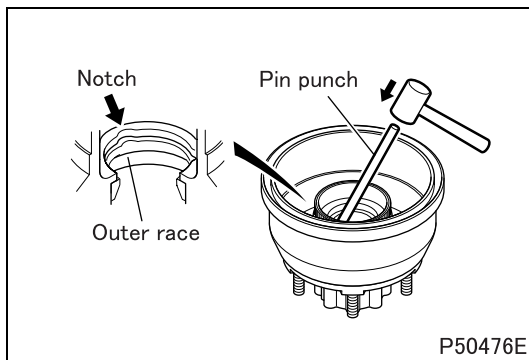


- Install **Cb** using axle shaft mounting bolts to remove the wheel hub and brake drum assembly.



■ Removal: Inner bearing outer race

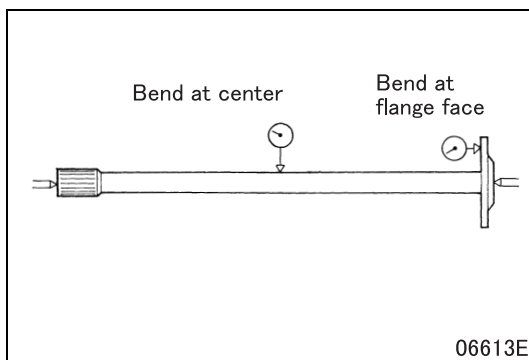
- Drive out the inner bearing outer race by tapping evenly at three or four indented parts in the wheel hub.



■ Removal: Outer bearing outer race

- Drive out the outer bearing outer race by tapping evenly at three or four indented parts in the wheel hub.

◆ Inspection procedure ◆



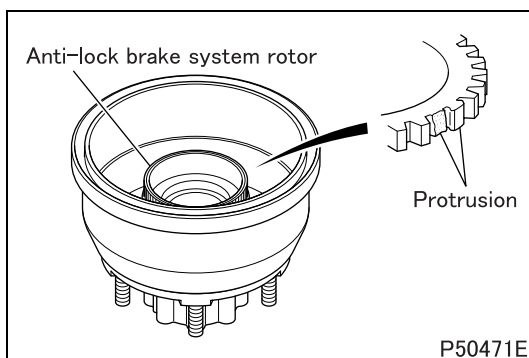
■ Inspection: Axle shaft

- Measure the bend of the axle shaft at its center.

NOTE

- Give the axle shaft one complete turn and read the dial gauge at this time. The bend is one half of the reading.

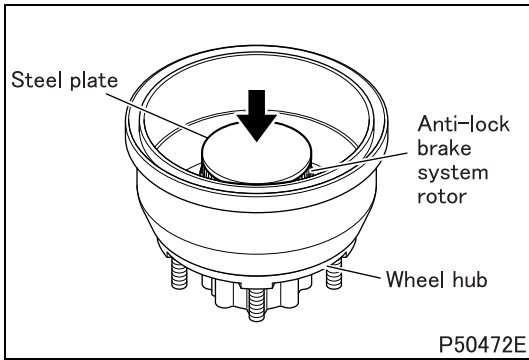
- If the measured value exceeds the limit, replace the axle shaft.
- Measure the bend of the flange face of the axle shaft.
- If the measured value exceeds the limit, replace the axle shaft.



■ Inspection: Anti-lock brake system rotor

[Inspection]

- Remove any debris on the anti-lock brake system rotor and check protrusions of the anti-lock brake system rotor for chipping and flattening.
- If any abnormality is found, replace the anti-lock brake system rotor.



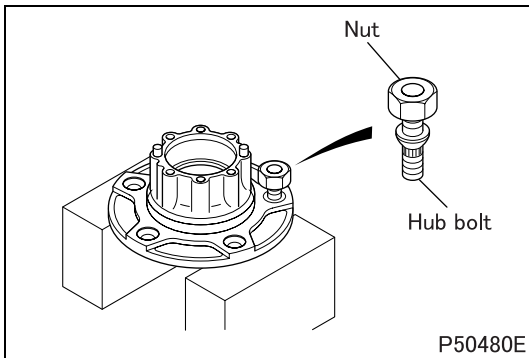
[Installation]

- Warm the anti-lock brake system rotor to approximately 150°C.
- Install the anti-lock brake system rotor and anti-lock brake system rotor flange evenly using a steel plate so as not to allow them to tilt.

WARNING ⚠

- Handling the warmed rotor by bare hand causes scald.

◆ Installation procedure ◆

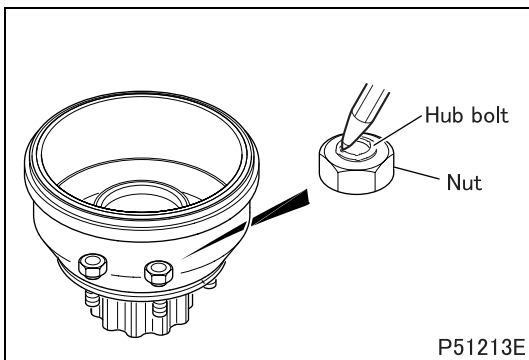


■ Inspection: Brake drum

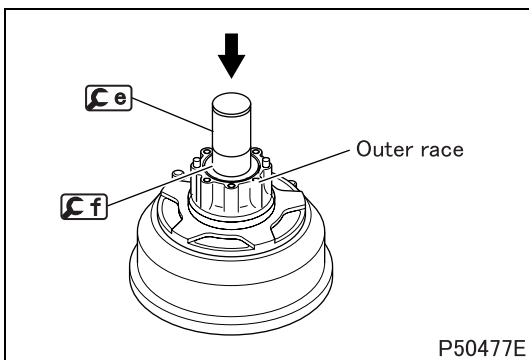
- If cylindricity of the brake drum exceeds the limit or the brake drum has seams, correct the brake drum integrally with the wheel hub within the range of the correction limit.

■ Installation: Hub bolt <double tire>

- Screw the nut into the hub bolt until just before they become flush.
- Drive the hub bolt into the wheel hub vertically by hitting the end face of the nut with a brass punch or the like.

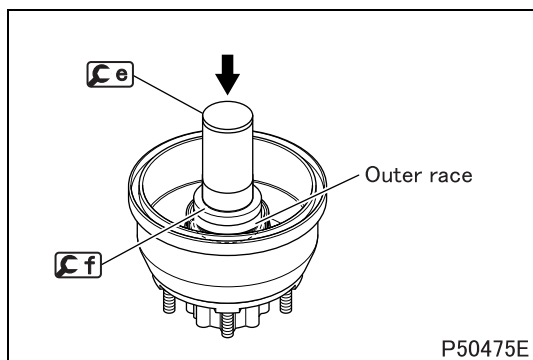


- Assemble the brake drum and wheel hub with the hub bolt. After tightening the nut to the specified torque, crimp it with a punch.

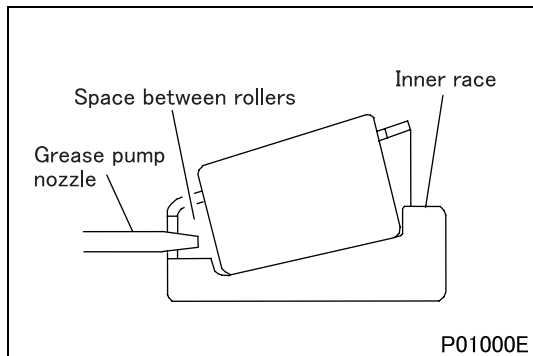


■ Installation: Outer bearing outer race

WHEEL HUB AND BRAKE DRUM

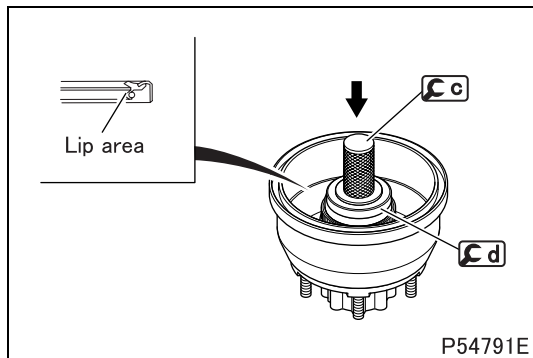


■ Installation: Inner bearing outer race



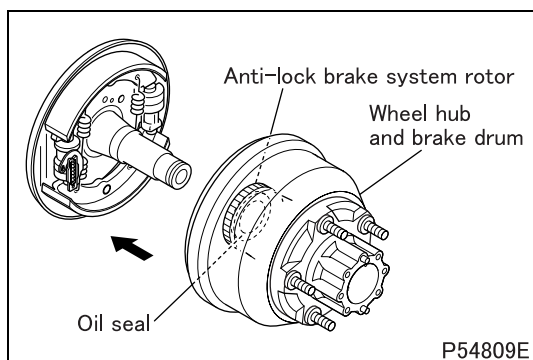
■ Installation: Packing grease in inner bearing inner race

- Insert the grease pump nozzle into the space between rollers of the inner bearing inner race to pack grease sufficiently.



■ Installation: Oil seal

- Apply grease to the lip area of the oil seal and install it on the wheel hub in the illustrated direction.

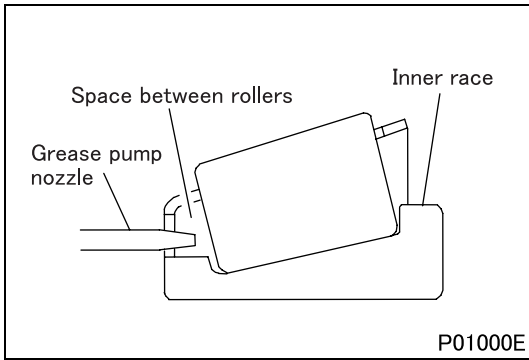


■ Installation: Wheel hub and brake drum

- Slowly install the wheel hub and brake drum assembly so as not to cause damage to the oil seal and anti-lock brake system rotor.

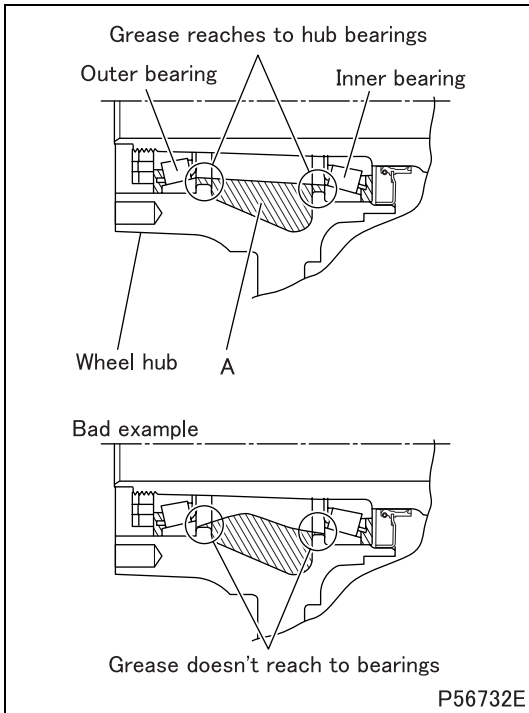
CAUTION ⚠

- If the anti-lock brake system rotor is damaged, wheel speed sensor signals become abnormal, causing the anti-lock brake system to malfunction.



■ Installation: Packing grease in outer bearing inner race

- Insert the grease pump nozzle into the space between rollers of the outer bearing inner race to pack grease sufficiently.

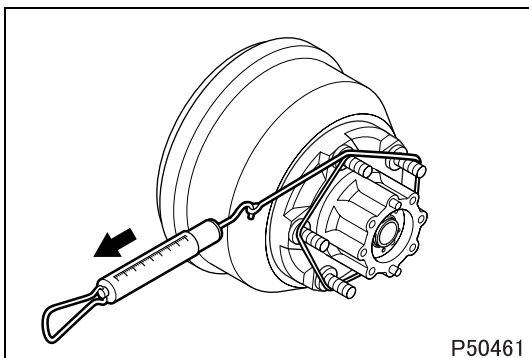


■ Installation: Wheel hab and brake drum

- Apply specified amount of grease to inside A of wheel hub so that the grease reaches to inner bearing and outer bearing as illustrated.

CAUTION ⚠

- The bad example of applying grease causes wheel hub bearing seized.



■ Installation: Lock nut

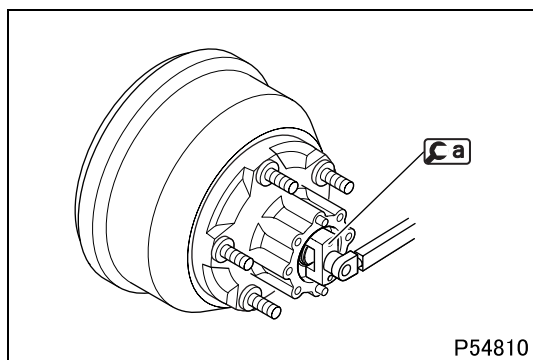
- Install the lock nut in the same manner as for removal. (see ■ Removal: Lock nut)

■ Installation: Starting torque of wheel hub bearing

[Inspection]

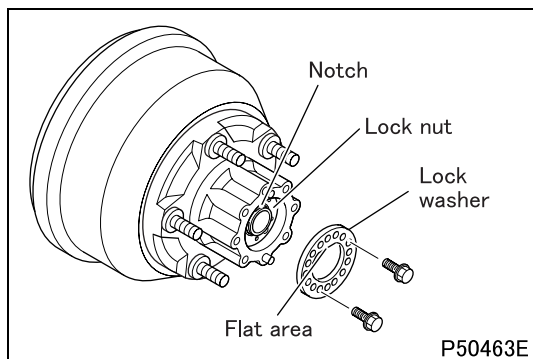
- After installing the lock washer, carry out the following inspections.
- Make sure that there is no drag in the brake lining and brake drum.
- If any abnormality is found, adjust the brake shoe clearance.
- Measure the tangential force at the hub bolt position using a spring balancer.
- If the tangential force is within the specified value, the starting torque conforms to the standard value. If the measured value deviates from the specified value, adjust.

WHEEL HUB AND BRAKE DRUM

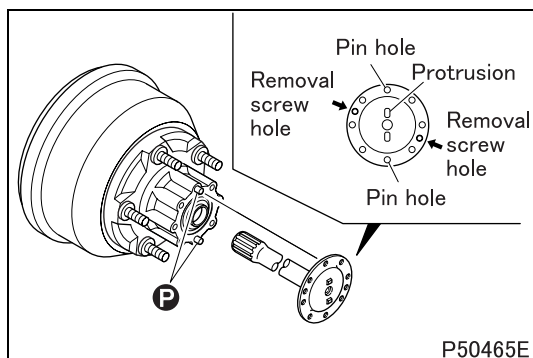


[Adjustment]

- Tighten the lock nut to the specified torque (primary tightening) while turning the wheel hub and brake drum, and then loosen it completely.
- Smooth operation of the outer bearing and inner bearing by turning the wheel hub and brake drum several times, and then tighten the lock nut to the specified torque (secondary tightening).



- Insert the flat area of the lock washer, aligning it with the notch of the axle housing, and mount two bolts diagonally to the lock nut.
- If the lock nut does not align with a screw hole of the lock washer, align by loosening the lock nut. Make sure that there is no play in the axial direction.
- Carry out measurement again after adjustment. If any fault is found, replace the outer and inner bearings.



■ Installation: Axle shaft

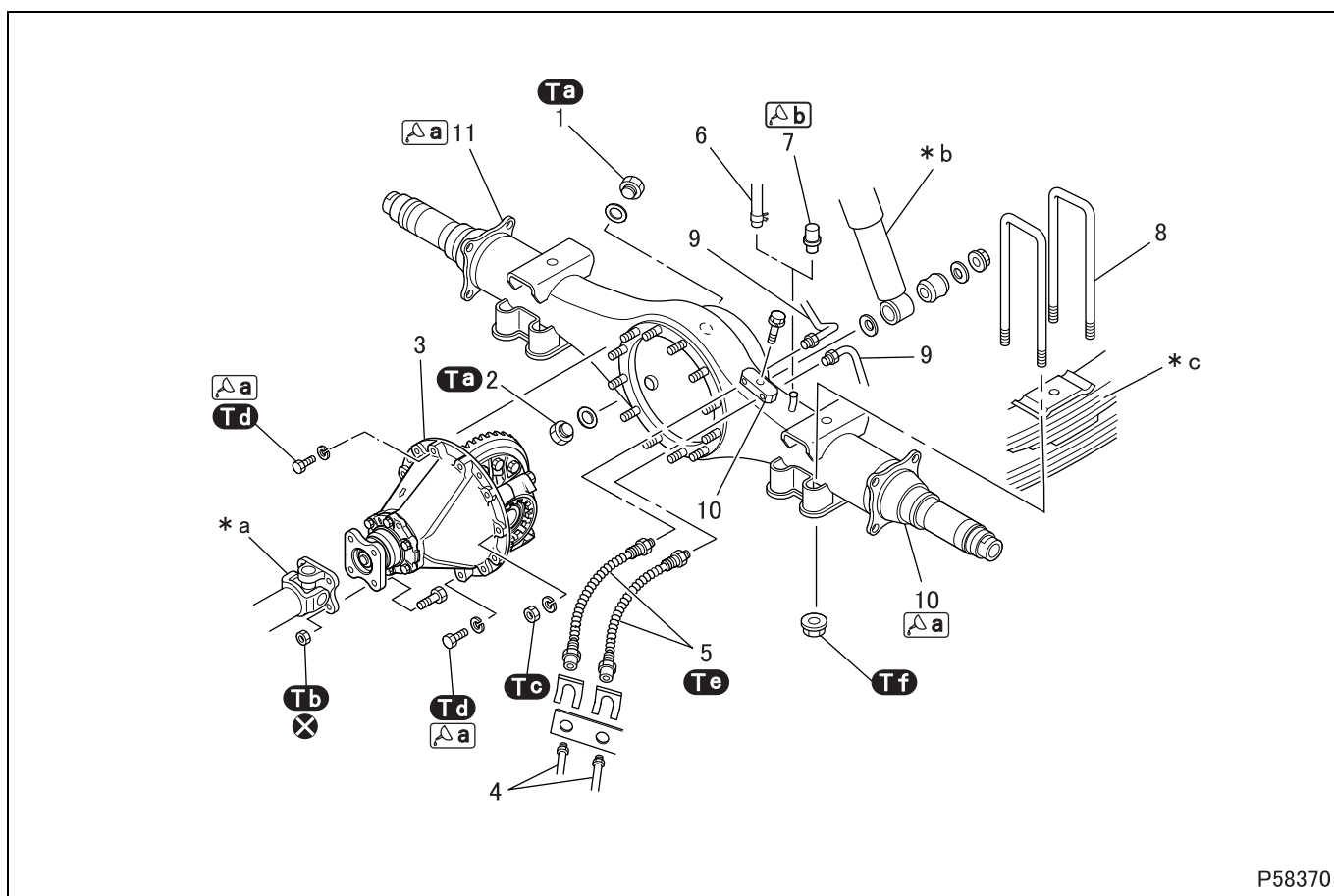
- Align the pin hole of the locating pin with that of the axle shaft to install the axle shaft.

NOTE

- A pin hole is not necessarily located at the position of a protrusion on the axle shaft flange face. The second hole from a removal screw hole clockwise is a pin hole.

M E M O

AXLE HOUSING



● Removal sequence

- 1 Inspection plug
- 2 Drain plug
- 3 Reduction and differential (See later sections.)
- 4 Brake pipe
- 5 Brake hose
- 6 Hose <FG>
- 7 Vent plug <except FG>
- 8 U-bolt
- 9 Brake pipe

- 10 Connector
- 11 Axle housing

- *a: Propeller shaft
 *b: Shock absorber
 *c: Leaf spring

⊗: Non-reusable parts

CAUTION ⚠

- Plug the brake hose and the brake pipe to prevent entry of dust and dirt after they have been removed.

NOTE

- Do not remove the axle housing unless it is found faulty.

● Installation sequence

Follow the removal sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
7	Injection-valve opening pressure of vent plug		4.9 kPa {0.7 psi, 0.05 kgf/cm ² } or less	–	Replace
11	Axle housing	Runout at outer bearing portion	0.5 {0.020} or less	1 {0.039}	Replace
		Difference between before and after rotation at center <except dead axle>	1 {0.039} or less	5 {0.20}	

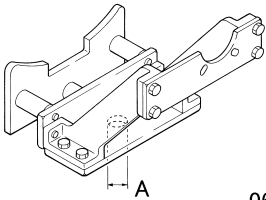
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Inspection plug	110 ± 10 {81 ± 7.4, 11 ± 1}	–
	Drain plug		
Tb	Nut (Propeller shaft mounting)	100 to 120 {74 to 89, 10 to 12}	M12
Tc	Nut (Reduction and differential mounting)	69 to 93 {51 to 69, 7 to 9.5}	–
Td	Bolt (Reduction and differential mounting)	83 to 108 {61 to 80, 8.5 to 11}	–
Te	Brake hose	13 to 17 {9.6 to 13, 1.3 to 1.7}	–
Tf	Nut (U-bolt mounting)	240 ± 15 {175 ± 11, 24.5 ± 1.5}	M16

Lubricant and/or sealant

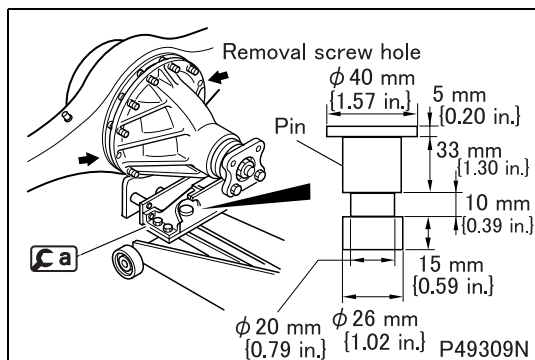
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Thread area of bolt	THREEBOND 1215	As required
	Reduction and differential mounting surface of axle housing		
 b	Axle housing mounting surface of vent plug <Except FG>	THREEBOND 1216	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
 a	Differential carrier base  A $\phi 28$ {1.10} 06679	MB999102	Removal and installation of reduction and differential

AXLE HOUSING

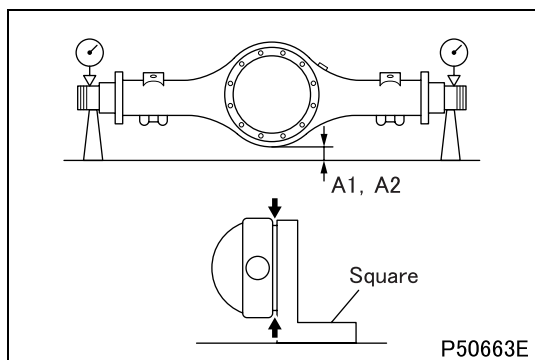
◆ Removal procedure ◆



■ Removal: Reduction and differential

- Remove the saucer of the garage jack and place **C a** on it. Fabricate the pin as illustrated, insert and fix it with bolts that have fixed the saucer.
- Screw two bolts evenly into the reduction and differential removal screw holes (as shown in illustration) to remove the reduction and differential.
Bolt size: M12 × 1.25 mm

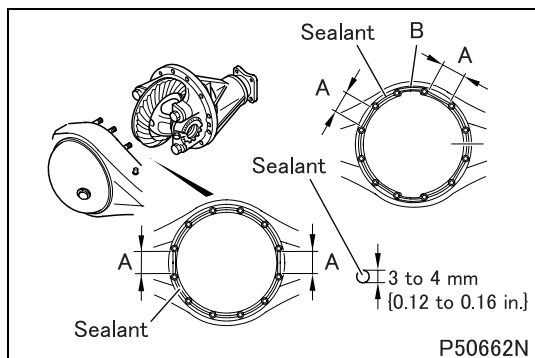
◆ Inspection procedure ◆



■ Inspection: Axle housing

- Horizontally support the inner bearing fittings at both ends of the housing spindle of the axle housing.
- Apply a dial gauge to the outer bearing fitting and turn it 360 degrees to measure runout.
- For measurement of **A1** and **A2**, place the axle housing at right angles using a square and measure **A1**. Then, turn it 180 degrees and measure **A2**.
- If the measured value exceeds the limit, replace the axle housing.

◆ Installation procedure ◆

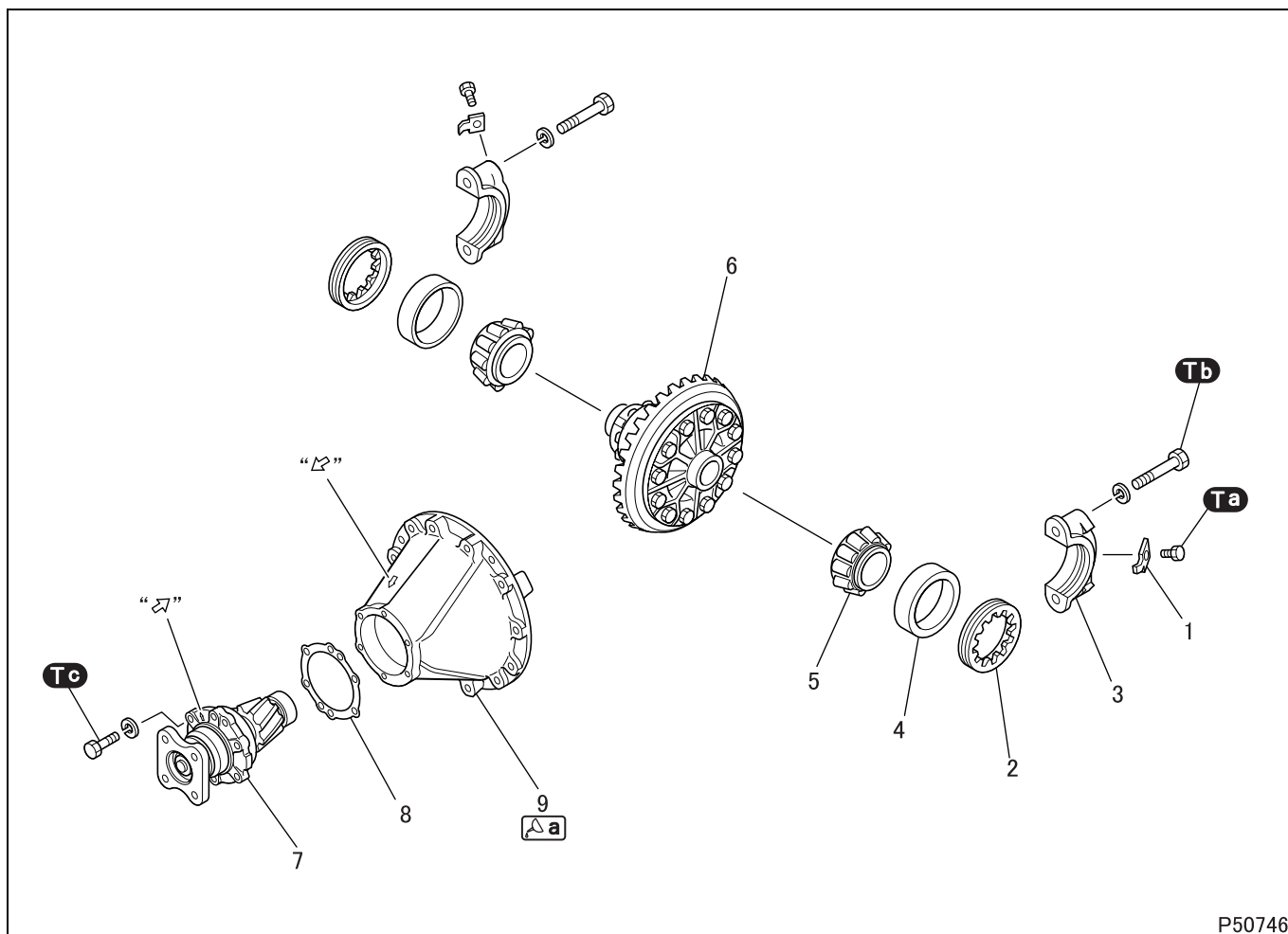


■ Installation: Reduction and differential

- Clean a seal surface of each part.
- Apply sealant to the reduction and differential mounting surface of the axle housing evenly and without breaks. Apply sealant in a straight line direction for illustrated position **A** and along the outer periphery for notches of illustrated position **B**.

M E M O

REDUCTION AND DIFFERENTIAL



● Disassembly sequence

- | | |
|---------------------------|--------------------------------------|
| 1 Lock plate | 6 Differential (See later sections.) |
| 2 Side bearing nut | 7 Pinion (See later sections.) |
| 3 Bearing cap | 8 Shim |
| 4 Side bearing outer race | 9 Differential carrier |
| 5 Side bearing inner race | |

CAUTION ⚠

- Keep side bearings, which have been removed, separately from each other and ensure that the correct one is placed at the right place at installation.
- Be sure to replace the bearing cap, differential carrier and bolts as a differential carrier set.
- Be sure to replace the reduction gear of the differential and reduction pinion of the pinion as a reduction gear set.

NOTE

- Record the number and thickness of shims to use them as reference at assembly.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
7, 8	Starting torque of side bearing	2.0 to 2.9 N·m {1.4 to 2.2 ft.lbs, 0.2 to 0.3 kgf·m} (tangential force: 25 to 38 N {5.6 to 8.5 lbs., 2.6 to 3.9 kgf})	–	Adjust
9	Wobble at back face of reduction gear	0.1 {0.0039} or less	–	Replace
9, 11	Backlash between reduction gear and reduction pinion	0.20 to 0.28 {0.0079 to 0.011}	0.5 {0.020}	Adjust or replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

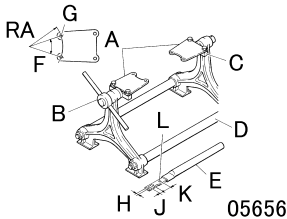
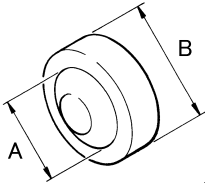
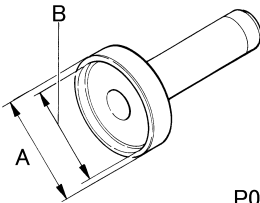
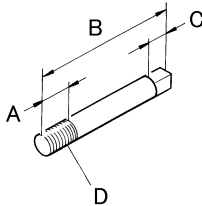
Mark	Parts to be tightened	Tightening torque	Remarks
 Ta	Bolt (Lock plate mounting)	20 to 26 {19.6 to 26.5, 2.0 to 2.7}	–
 Tb	Bolt (Bearing cap mounting)	200 {150, 20.5}	–
 Tc	Bolt (Pinion mounting)	67 to 90 {49 to 67, 6.8 to 9.2}	–

Lubricant and/or sealant

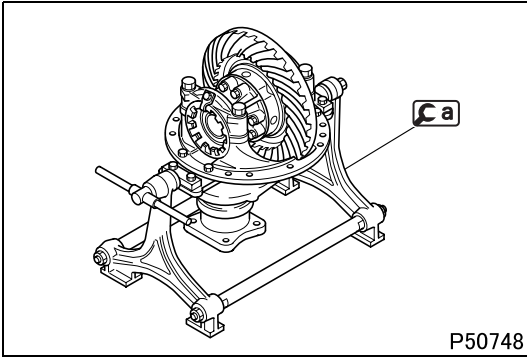
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Pinion pilot bearing mounting surface of differential carrier	LOCTITE 601	As required

REDUCTION AND DIFFERENTIAL

Special tools (Unit: mm {in.})

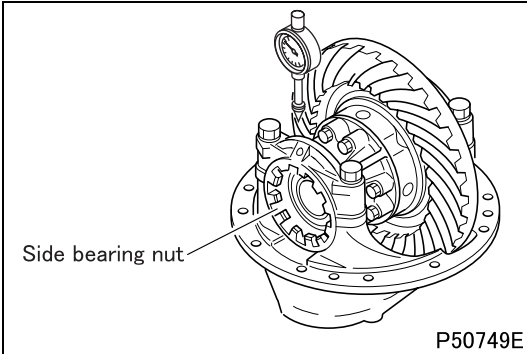
Mark	Tool name and shape	Part No.	Application																																														
	Differential working base assembly  <table><tr><th colspan="4">Component</th><th>Part No.</th></tr><tr><td rowspan="3">A</td><td colspan="3">Attachment</td><td>—</td></tr><tr><td>RA</td><td>F</td><td>G</td><td>—</td></tr><tr><td>R158</td><td>30°</td><td>φ13</td><td>MB999040</td></tr><tr><td>B</td><td colspan="3">Holder</td><td>MB999036</td></tr><tr><td>C</td><td colspan="3">Holder</td><td>MB999037</td></tr><tr><td>D</td><td colspan="3">Working base</td><td>MB999035</td></tr><tr><td>E</td><td colspan="3">Flange stopper</td><td>MB999096</td></tr></table> <table><tr><th>H</th><th>J</th><th>K</th><th>L</th></tr><tr><td>11 {0.43}</td><td>20 {0.79}</td><td>40 {1.57}</td><td>φ11 {0.43}</td></tr></table>	Component				Part No.	A	Attachment			—	RA	F	G	—	R158	30°	φ13	MB999040	B	Holder			MB999036	C	Holder			MB999037	D	Working base			MB999035	E	Flange stopper			MB999096	H	J	K	L	11 {0.43}	20 {0.79}	40 {1.57}	φ11 {0.43}	MB999034	Workbench for reduction and differential (Flange stopper is unused)
	Component				Part No.																																												
	A	Attachment			—																																												
		RA	F	G	—																																												
		R158	30°	φ13	MB999040																																												
	B	Holder			MB999036																																												
	C	Holder			MB999037																																												
	D	Working base			MB999035																																												
	E	Flange stopper			MB999096																																												
	H	J	K	L																																													
11 {0.43}	20 {0.79}	40 {1.57}	φ11 {0.43}																																														
	Adapter <table><tr><th>A</th><th>B</th></tr><tr><td>φ45 {1.77}</td><td>φ59 {2.32}</td></tr></table>  05658	A	B	φ45 {1.77}	φ59 {2.32}	MB999076	Removal of side bearing inner race (to be used in combination with commercial bearing puller)																																										
	A	B																																															
φ45 {1.77}	φ59 {2.32}																																																
	Bearing installer <table><tr><th>A</th><th>B</th></tr><tr><td>φ80 {3.15}</td><td>φ70 {2.76}</td></tr></table>  P01039	A	B	φ80 {3.15}	φ70 {2.76}	MH061748	Installation of side bearing inner race																																										
	A	B																																															
φ80 {3.15}	φ70 {2.76}																																																
	Bearing retainer guide pin  P01041 <table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>18 {0.71}</td><td>85 {3.35}</td><td>12 {0.47}</td><td>M12 × 1.25</td></tr></table>	A	B	C	D	18 {0.71}	85 {3.35}	12 {0.47}	M12 × 1.25	MH061745	Installation of pinion (two pieces are used)																																						
	A	B	C	D																																													
18 {0.71}	85 {3.35}	12 {0.47}	M12 × 1.25																																														

◆ Work before removal ◆



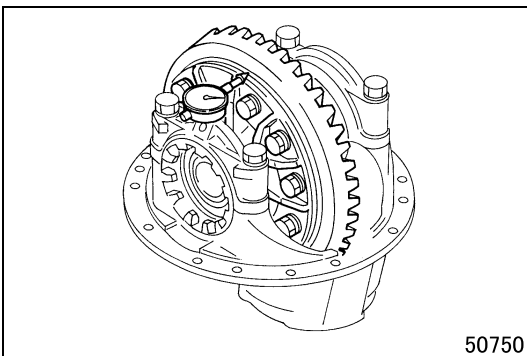
■ Preparatory work: Installation of differential working base assembly

- Install the reduction and differential on .



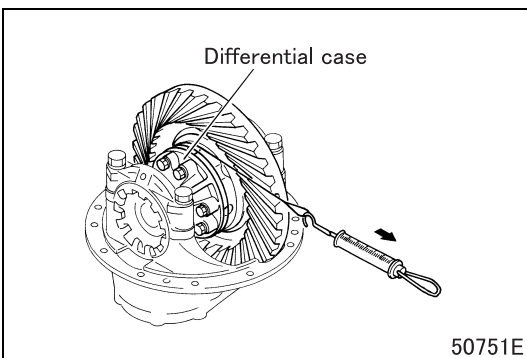
■ Inspection: Backlash between reduction gear and reduction pinion

- If backlash is found faulty, the tightening amount of the side bearing nut is probably inappropriate.



■ Inspection: Wobble at back face of reduction gear

- Measure wobble at the illustrated position of the reduction gear.

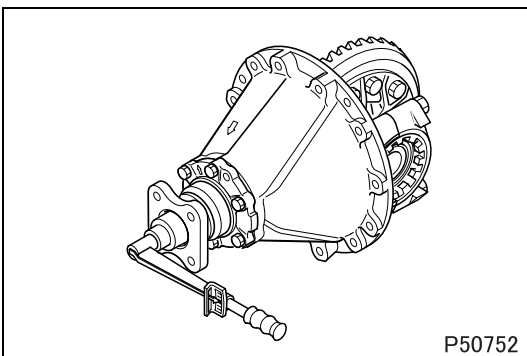


■ Inspection: Starting torque of side bearing

- Measure the tangential force at the outer periphery point of the differential case using a spring balancer.
- If the tangential force is within the range of the measured value, the starting torque conforms to the standard value.

NOTE

- **Measure the starting torque within the range of backlash between the reduction gear and reduction pinion.**



- Starting torque may be measured of the pinion assembly by using a torque wrench.

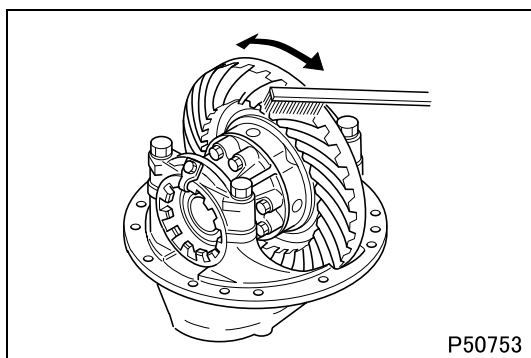
$$(\text{Total starting torque} - \text{Pinion bearing starting torque}) \times$$

$$\text{Final ratio} = \text{Side bearing starting torque}$$

NOTE

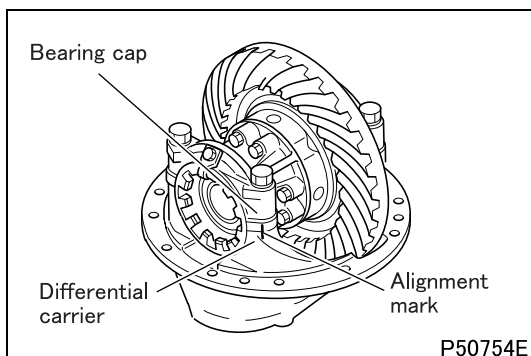
- **Always measure the starting torque within the range of backlash between the reduction gear and reduction pinion.**

REDUCTION AND DIFFERENTIAL



■ Inspection: Tooth contact of reduction gear

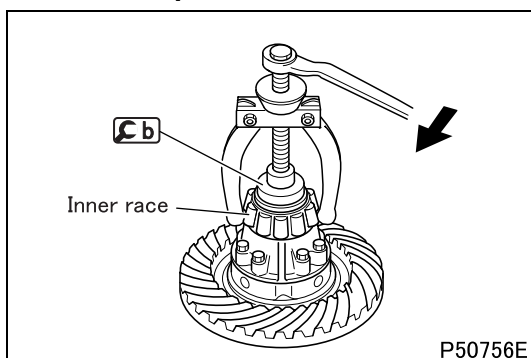
- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn the reduction gear several times to check for tooth contact.



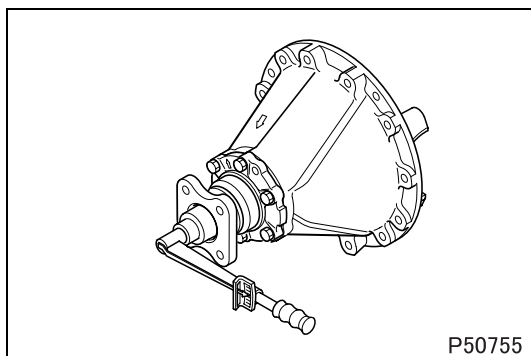
■ Alignment marks: Bearing cap and differential carrier

- Put alignment marks on the bearing cap and differential carrier for correct identification of right and left parts.

◆ Removal procedure ◆

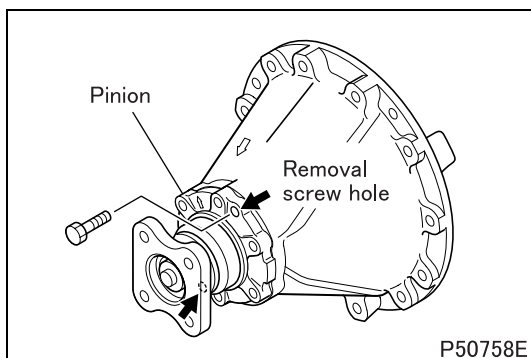


■ Removal: Side bearing inner race



■ Inspection: Starting torque of pinion bearing

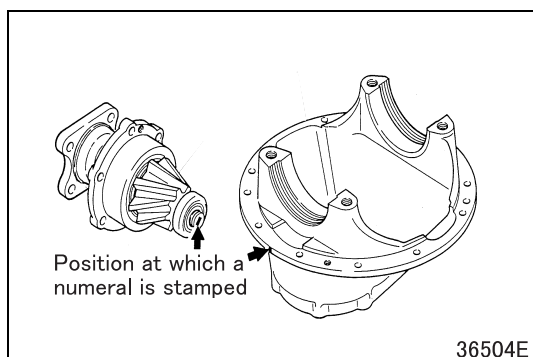
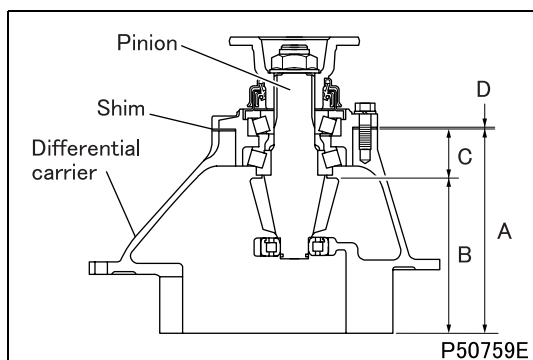
- After removing the differential, measure the starting torque of the pinion bearing.



■ Removal: Pinion

- Screw two bolts evenly into the pinion removal screw holes to remove the pinion.

◆ Adjustment procedure ◆



■ Adjustment: Pinion

- Perform the following steps to adjust **A**, **B** and **C** within the specified dimensions.
- Calculate shim thickness **D** by using the following formula based on the machining error data stamped on pinion assembly and differential carrier.
- Formula:

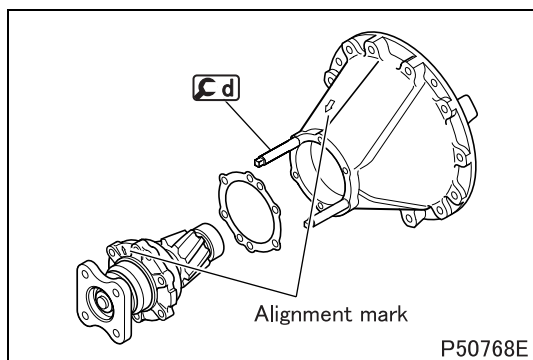
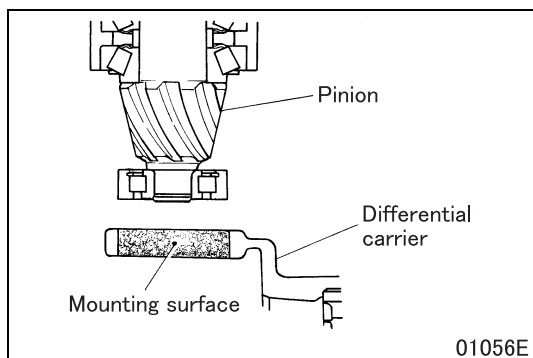
$$D = 0.5 \{0.020\} - a + b + c$$
a = Deviation from standard dimension **A**
b = Deviation from standard dimension **B**
c = Deviation from standard dimension **C**

Unit: mm {in.}

Location	Standard dimension	How to calculate deviation
Shim thickness	0.5 {0.020}	—
A	203 {7.99}	A numeral, multiplied by 100, is stamped on the outer periphery of the flange of the differential carrier.
B	157 {0.18}	A numeral is stamped on the top of the pinion assembly.
C	46.5 {1.8}	Measure deviation from dimension C using a dial gauge. Taking measurement is usually not feasible and assume a value from 0 to 0.2 mm.

- Select a shim based on shim thickness **D**.
 Thickness of shims available
 0.1 mm {0.0039 in.}, 0.2 mm {0.0079 in.} (two thickness)

◆ Installation procedure ◆



■ Installation: Pinion

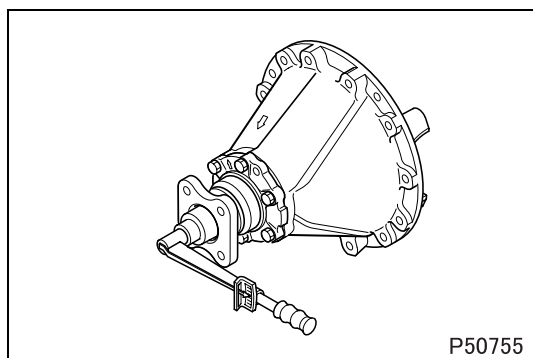
- Apply sealant to the pilot bearing mounting surface of the differential carrier.

- Aligning the embossed alignment mark on the bearing retainer of the pinion assembly with that on the differential carrier, mount the pinion assembly.

CAUTION ⚠

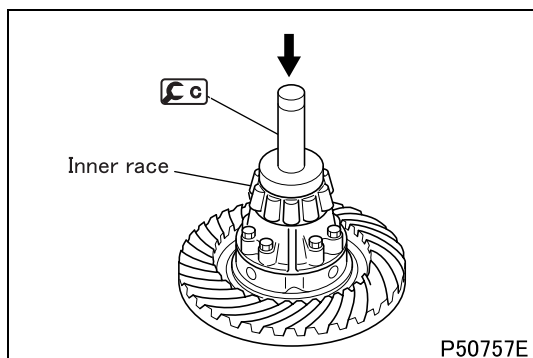
- Leave for 30 minutes to 2 hours after installation to let the sealant harden.
- Wait at least three hours or, if feasible 24 hours, before running the vehicle to let the sealant harden.

REDUCTION AND DIFFERENTIAL



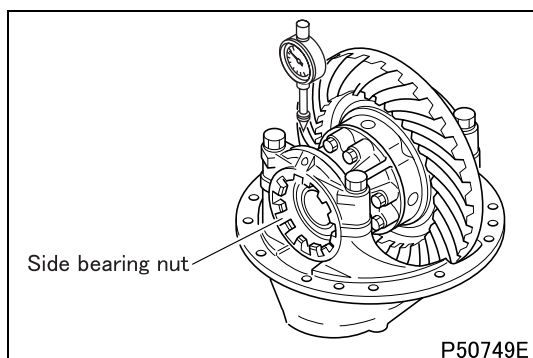
■ Inspection: Starting torque of pinion bearing

- After installing the pinion, measure the starting torque of the pinion bearing.
- If the measured value deviates from the standard value, adjust.



■ Installation: Side bearing inner race

◆ Work after installation ◆

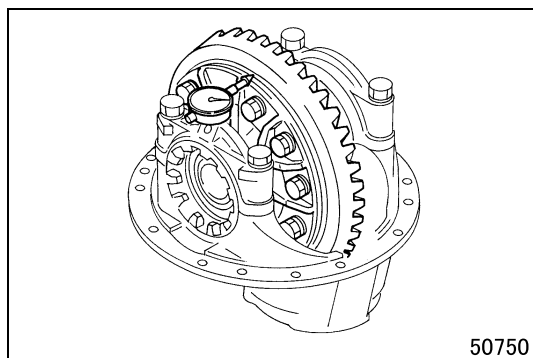


■ Adjustment: Backlash between reduction gear and reduction pinion

- Adjust backlash with the side bearing nut, using care not to allow the side bearing starting torque to change.

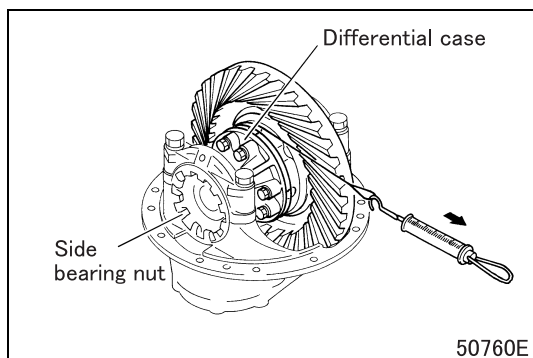
CAUTION ⚠

- When one side bearing nut is loosened, be sure to tighten the other one the same amount to prevent the side bearing starting torque from changing.



■ Inspection: Wobble at back face of reduction gear

- Measure wobble at the illustrated position of the reduction gear.
- If the measured value deviates from the standard value, replace the reduction gear and reduction pinion of the differential as a set.

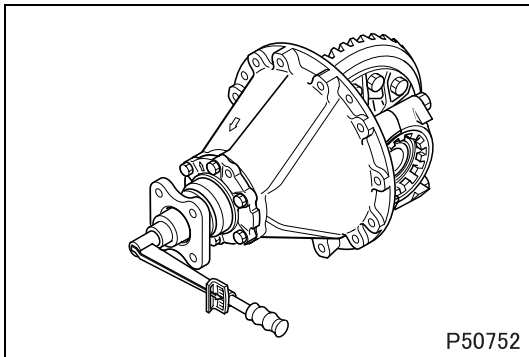


■ Inspection: Starting torque of side bearing

- Measure the tangential force at the outer periphery point of the differential case using a spring balancer.
- If the tangential force is within the range of the specified value, the starting torque conforms to the standard value.
- If the measured value deviates from the standard value, adjust with the side bearing nut.

NOTE

- Measure the starting torque within the range of backlash between reduction gear and reduction pinion.

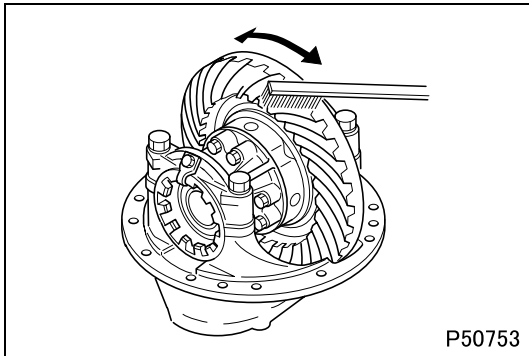


- Starting torque may be measured of the pinion assembly by using a torque wrench.

$$\text{Final ratio} = \frac{\text{Total starting torque} - \text{Pinion bearing starting torque}}{\text{Side bearing starting torque}}$$

NOTE

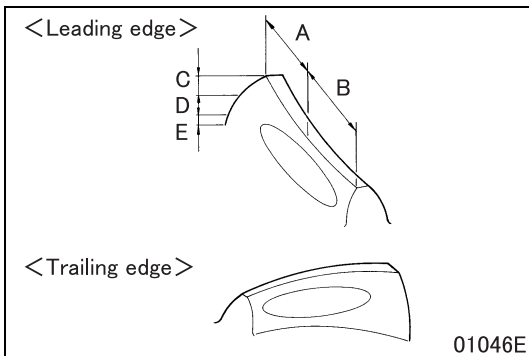
- Always measure the starting torque within the range of backlash between the reduction gear and reduction pinion.**



■ Inspection: Tooth contact of reduction gear

[Inspection]

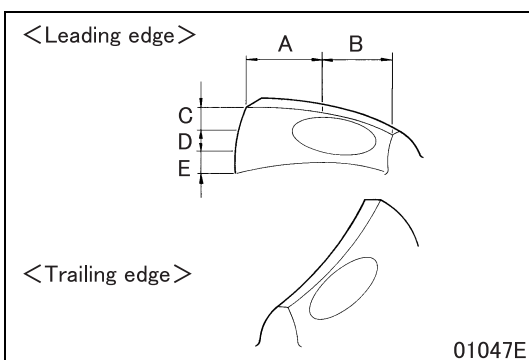
- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn the reduction gear several times to check for tooth contact.
- Adjust tooth contact if it is remarkably offset.



● Correct tooth contact at no load

<Reduction gear>

- A: Heel
- B: Toe
- C: Face
- D: Flank
- E: Clearance



<Reduction pinion>

- A: Heel
- B: Toe
- C: Face
- D: Flank
- E: Clearance

Maintenance item			Assembly standards
At no load	Tooth contact position	Lengthwise direction of tooth	From center towards toe
		Vertical direction	From center towards top of tooth for reduction gear and center for reduction pinion
	Tooth contact shape	Length	Approximately 50 to 70% of tooth width
		Width	Approximately 50 to 70% of tooth depth
	Degree of tooth contact		It becomes weaker as it nears tooth root and tooth tip

REDUCTION AND DIFFERENTIAL

NOTE

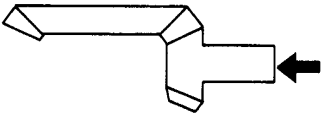
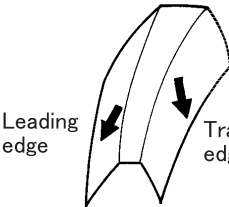
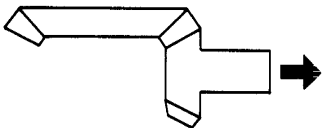
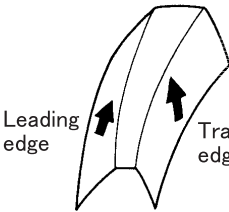
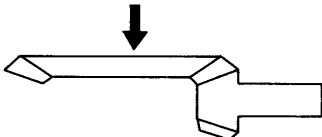
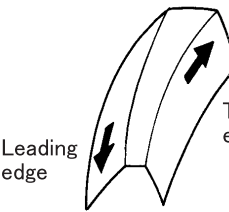
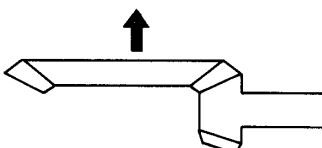
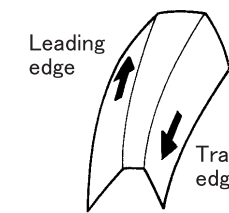
- When tooth contact is near the toe at no load, it becomes middle area contact at load.

[Adjustment]

- Adjust by backlash between reduction gear and reduction pinion (to be adjusted with the side bearing nut) and addition or reduction of rear bearing shims.

CAUTION

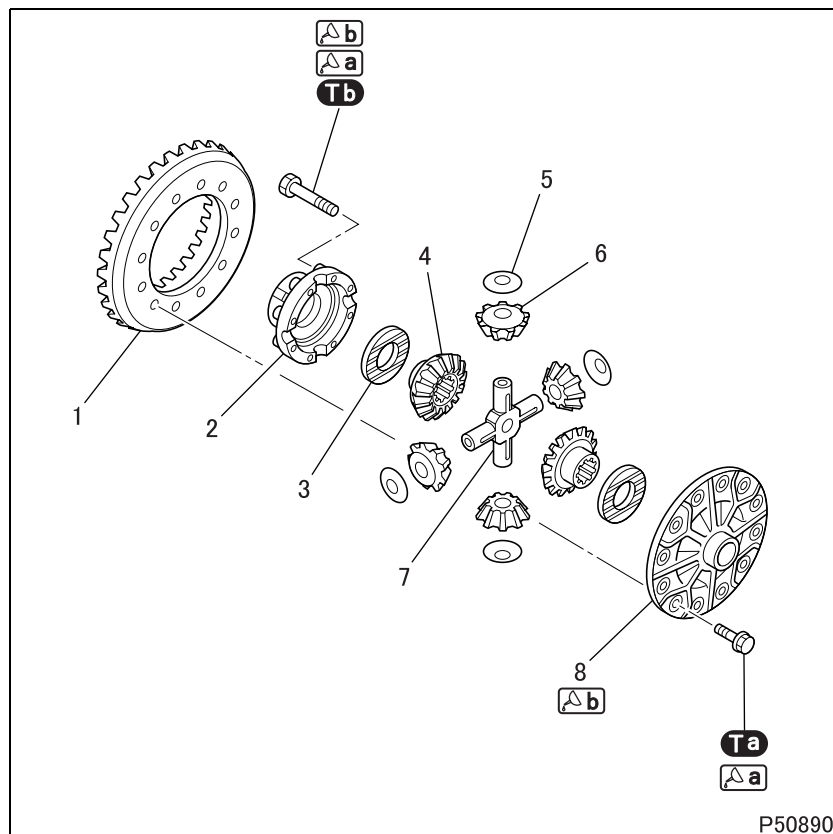
- Make sure you replace as a reduction gear set (reduction gear and reduction pinion), when you replace the gear because of excessive teeth wear.

	Method of adjustment	Moving direction	
Tooth contact by addition or reduction of shims	Advance reduction pinion to reduction gear (Shims are reduced)  55497	 55501E	Tooth contact moves towards tooth root
	Retard reduction pinion from reduction gear (Shims are added)  55498	 55502E	Tooth contact moves towards tooth tip
Tooth contact by adjustment with side bearing nut	Advance reduction gear to reduction pinion center (Less backlash)  55499	 55503E	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to toe and slightly nearer to root of tooth Trailing edge: Nearer to heel and slightly nearer to top of tooth
	Retard reduction gear from reduction pinion center (More backlash)  55500	 55504E	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to heel and slightly nearer to top of tooth Trailing edge: Nearer to toe and slightly nearer to root of tooth

M E M O

REDUCTION AND DIFFERENTIAL

Differential



● Disassembly sequence

- 1 Reduction gear
- 2 Differential case RH
- 3 Side gear washer
- 4 Side gear
- 5 Pinion washer
- 6 Differential pinion
- 7 Pinion spider
- 8 Differential case LH

CAUTION ⚠

- Be sure to replace the differential case RH and the differential case LH as a differential case set.
- Be sure to replace the side gear and the differential pinion as a side gear set.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
4	Backlash between side gear and spline of axle shaft	0.05 to 0.15 {0.0020 to 0.0059}	0.5 {0.020}	Replace
4, 6	Backlash between side gear and differential pinion	0.15 to 0.20 {0.0059 to 0.0079}	0.5 {0.020}	Replace
6, 7	Clearance between differential pinion and pinion spider	0.17 to 0.27 {0.0067 to 0.011}	0.5 {0.020}	Replace

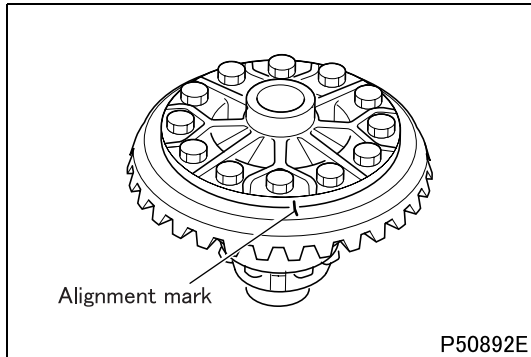
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Reduction gear mounting)	166.6 to 225.4 {120 to 165, 17 to 23}	—
Tb	Bolt (Differential case RH and differential case LH mounting)	83.3 to 112.7 {61 to 83, 8.5 to 11.5}	—

Lubricant and/or sealant

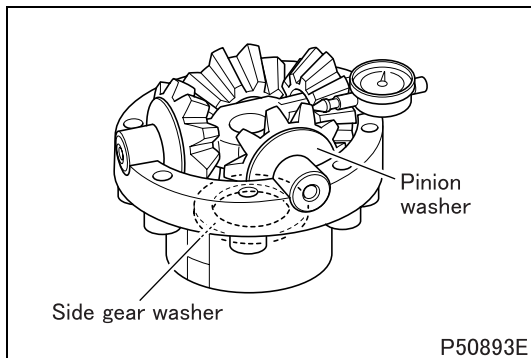
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Entire bolt	Rust preventive	As required
b	Thread area of bolt	LOCTITE 271	As required
	Bolt tip of differential case LH		

◆ Work before removal ◆



■ Alignment marks: Reduction gear and differential case LH

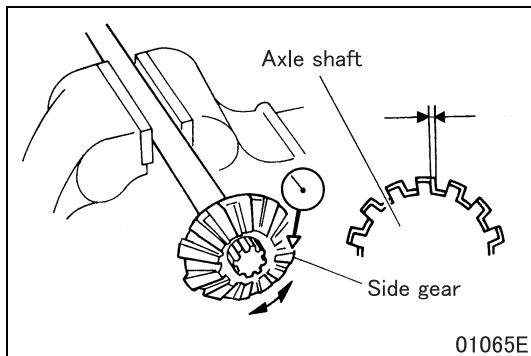
- Put alignment marks on the reduction gear and differential case LH.



■ Inspection: Backlash between side gear and differential pinion

- If backlash is found faulty, thickness of the side gear washer and pinion washer is probably inappropriate.

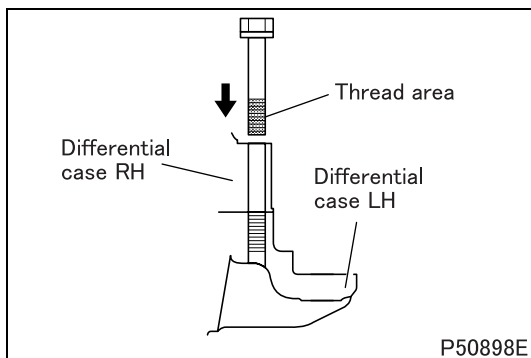
◆ Inspection procedure ◆



■ Inspection: Backlash between side gear and axle shaft

- If the measured value exceeds the limit, replace defective parts.

◆ Installation procedure ◆



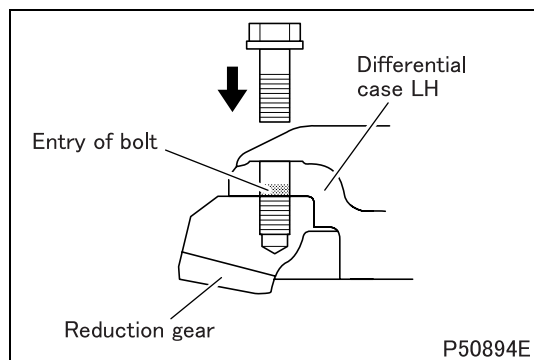
■ Installation: Differential case RH and differential case LH

- Apply rust preventive to the entire surface of the bolt.
- Apply thread lock cement to the bolt threads.
- Tighten the bolt to the specified torque.

CAUTION ⚠

- Make sure to apply rust preventive when tightening the bolt to the specified torque.
- Wait at least one hour after installation before actually running the vehicle to let the thread lock cement harden.
- Wait at least four hours after installation before operating the vehicle at full torque to let the thread lock cement harden.

REDUCTION AND DIFFERENTIAL



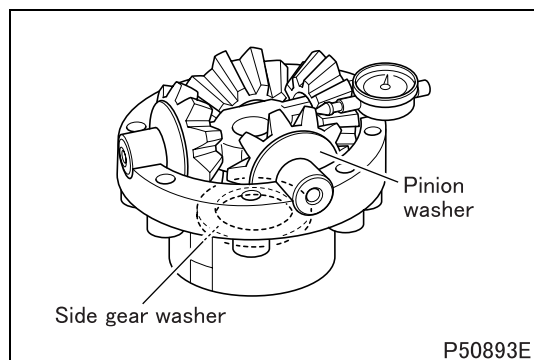
■ Installation: Reduction gear and differential case LH

- Apply rust preventive to the entire surface of the bolt.
- Apply thread lock cement at the entry of bolt holes on differential case LH.
- Tighten the bolt to the specified torque.

CAUTION ⚠

- **Make sure to apply rust preventive when tightening the bolt to the specified torque.**
- **Wait at least one hour after installation before actually running the vehicle to let the thread lock cement harden.**
- **Wait at least four hours after installation before operating the vehicle at full torque to let the thread lock cement harden.**

◆ Work after installation ◆



■ Inspection: Backlash between side gear and differential pinion

- If the measured value deviates from the standard value, replace the side gear washer and pinion washer.
Thickness of side gear washers available
3.0 mm {0.11 in.} (one thickness)
Thickness of pinion washers available
1.6 mm {0.063 in.} (one thickness)

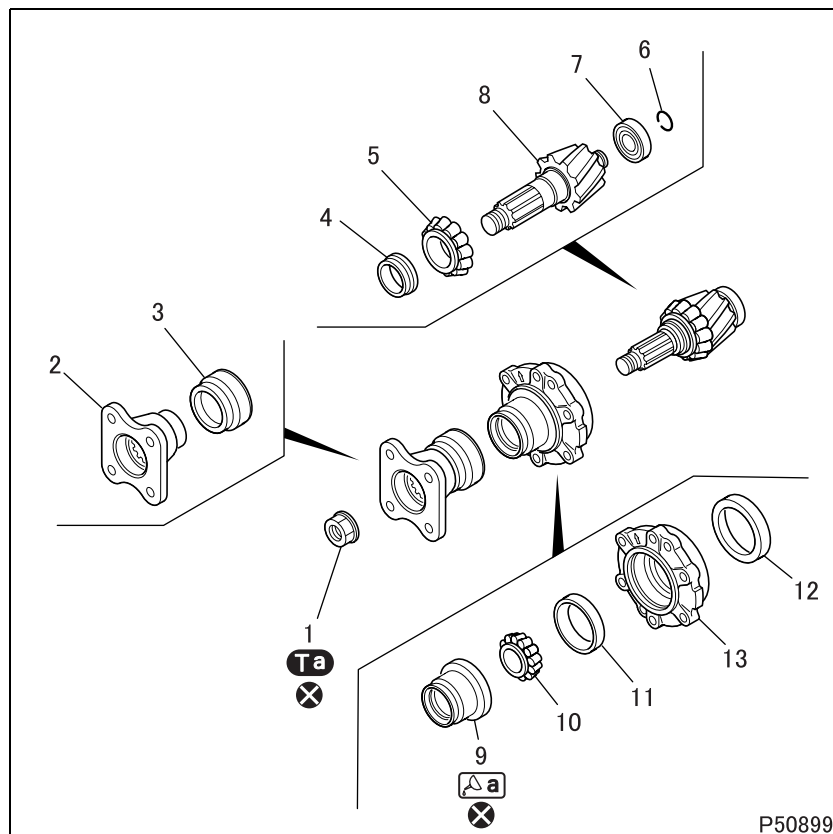
CAUTION ⚠

- **Use side gear washers of the same thickness for the right and left sides.**
- **Use pinion washers of the same thickness at four locations.**

M E M O

REDUCTION AND DIFFERENTIAL

Pinion



● Disassembly sequence

- 1 Lock nut
- 2 Companion flange
- 3 Dust cover
- 4 Collar
- 5 Rear bearing inner race
- 6 Lock ring
- 7 Pinion pilot bearing
- 8 Reduction pinion
- 9 Oil seal
- 10 Front bearing inner race
- 11 Front bearing outer race
- 12 Rear bearing outer race
- 13 Bearing retainer

⊗: Non-reusable parts

NOTE

- Record the height of the collar to use it as reference at assembly.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
-	Starting torque of pinion bearing (Tangential force at outer periphery point of bearing retainer)	When new bearing is used	2.0 to 2.9 N·m {1.4 to 2.2 ft.lbs, 0.20 to 0.30 kgf·m} (tangential force: 34 to 52 N {7.6 to 11 lbs., 3.5 to 5.3 kgf})	—	Adjust or replace
		When old bearing is reused	1.6 to 2.4 N·m {1.2 to 1.7 ft.lbs, 0.16 to 0.24 kgf·m} (tangential force: 27 to 41 N {6.1 to 9.2 lbs., 2.8 to 4.2 kgf})	—	Adjust or replace

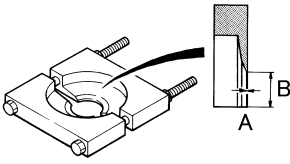
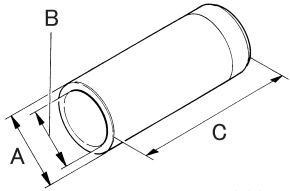
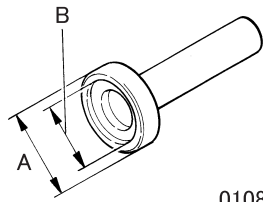
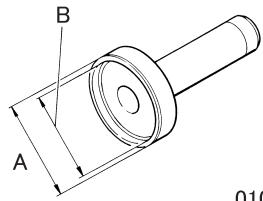
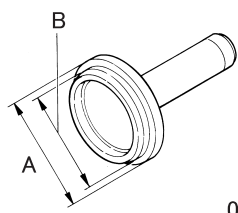
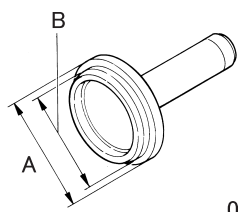
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (Companion flange mounting)	372.4 to 470.4 {275 to 345, 38 to 48}	—

Lubricant and/or sealant

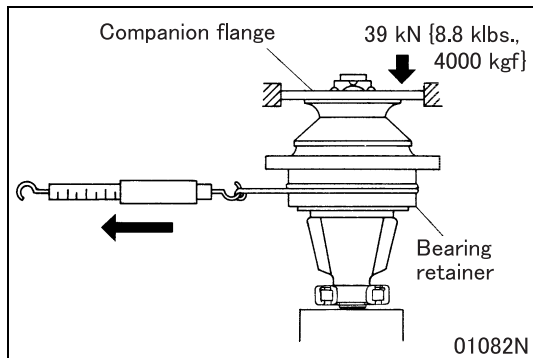
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application						
 a	Pinion bearing remover <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>0.5 {0.020}</td><td>25.6 {1.00}</td></tr></tbody></table>  02956	A	B	0.5 {0.020}	25.6 {1.00}	MB999045	Removal of rear bearing inner race		
A	B								
0.5 {0.020}	25.6 {1.00}								
 b	Pinion bearing installer <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ62 {2.44}</td><td>φ52 {2.05}</td><td>φ125 {4.92}</td></tr></tbody></table>  01077	A	B	C	φ62 {2.44}	φ52 {2.05}	φ125 {4.92}	MH061005	Installation of rear bearing inner race and front bearing inner race
A	B	C							
φ62 {2.44}	φ52 {2.05}	φ125 {4.92}							
 c	Pinion pilot bearing installer <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ45.2 {1.78}</td><td>φ39.2 {1.54}</td></tr></tbody></table>  01081	A	B	φ45.2 {1.78}	φ39.2 {1.54}	MH061976	Installation of pinion pilot bearing		
A	B								
φ45.2 {1.78}	φ39.2 {1.54}								
 d	Oil seal installer <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ112 {4.41}</td><td>φ88 {3.46}</td></tr></tbody></table>  01076	A	B	φ112 {4.41}	φ88 {3.46}	MH061750	Installation of oil seal		
A	B								
φ112 {4.41}	φ88 {3.46}								
 e	Pinion bearing installer <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ89 {3.50}</td><td>φ78 {3.07}</td></tr></tbody></table>  01078	A	B	φ89 {3.50}	φ78 {3.07}	MH061977	Installation of front bearing outer race		
A	B								
φ89 {3.50}	φ78 {3.07}								
 f	Pinion bearing installer <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ99 {3.90}</td><td>φ88 {3.46}</td></tr></tbody></table>  01078	A	B	φ99 {3.90}	φ88 {3.46}	MH061264	Installation of rear bearing outer race		
A	B								
φ99 {3.90}	φ88 {3.46}								

REDUCTION AND DIFFERENTIAL

◆ Work before removal ◆



■ Inspection: Starting torque of pinion bearing

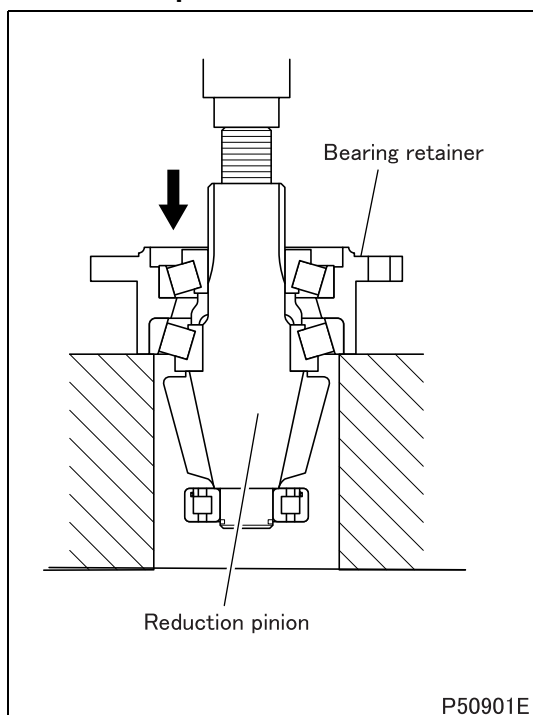
- Apply the specified load to the companion flange or tighten the lock nut to the specified torque.
- Measure the tangential force at outer periphery point of the bearing retainer using a spring balancer.

CAUTION ⚠

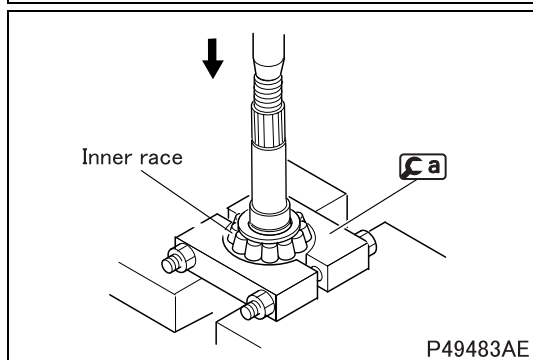
- Securely fix the companion flange to measure.

- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.

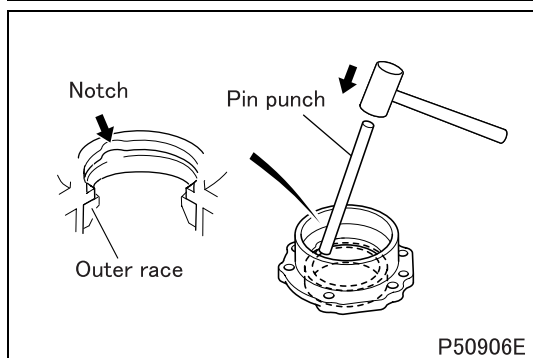
◆ Removal procedure ◆



■ Removal: Reduction pinion

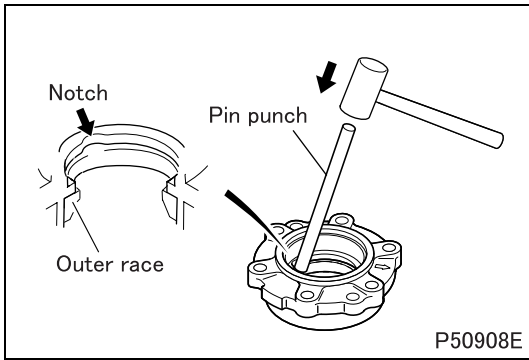


■ Removal: Rear bearing inner race



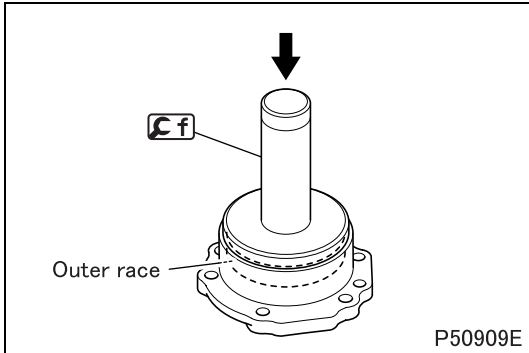
■ Removal: Front bearing outer race

- Drive out the front bearing outer race by tapping evenly at three indented parts in the bearing retainer.

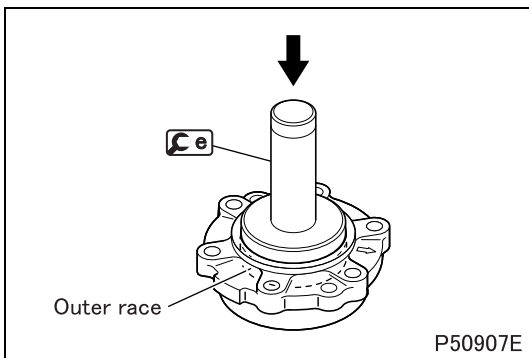


■ Removal: Rear bearing outer race

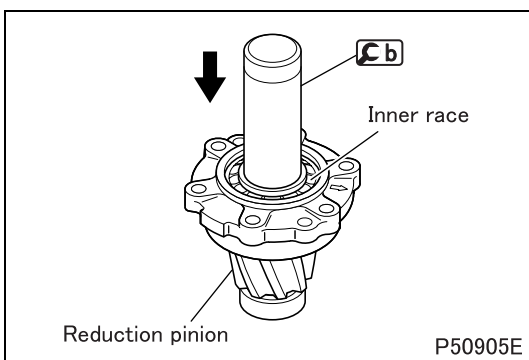
- Drive out the rear bearing outer race by tapping evenly at three indented parts in the bearing retainer.



■ Installation: Rear bearing outer race

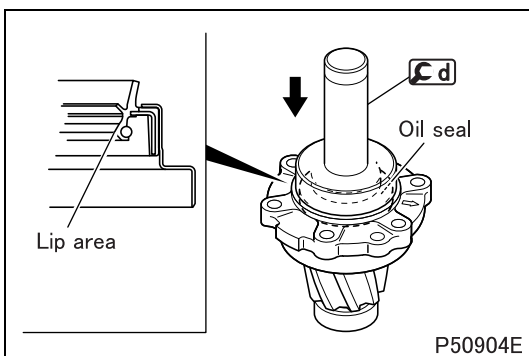


■ Installation: Front bearing outer race



■ Installation: Front bearing inner race

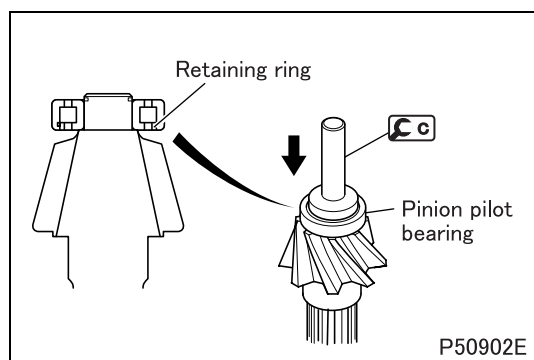
- Install the front bearing inner race with the pinion assembled into the bearing retainer.



■ Installation: Oil seal

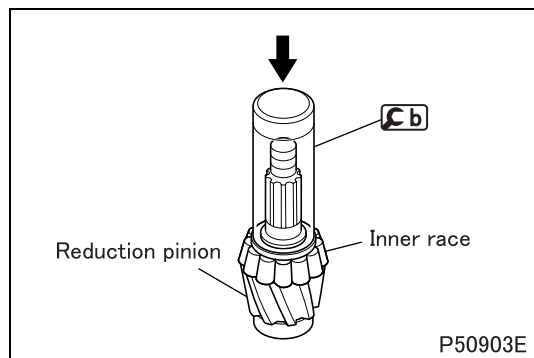
- Apply grease to the lip area of the oil seal and install it on the bearing retainer in the illustrated direction.

REDUCTION AND DIFFERENTIAL



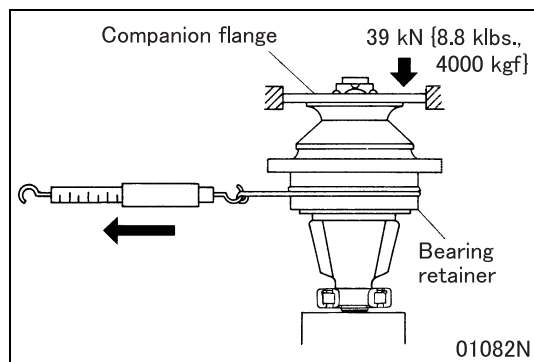
■ Installation: Pinion pilot bearing

- Install the pinion pilot bearing with its retaining ring placed on the gear.



■ Installation: Rear bearing inner race

◆ Inspection after installation ◆



■ Inspection: Starting torque of pinion bearing

- Apply the specified load to the companion flange or tighten the lock nut to the specified torque.
- Measure the tangential force at outer periphery point of the bearing retainer using a spring balancer.

CAUTION ⚠

- Securely fix the companion flange to measure.
- Do not assemble the oil seal when measuring the tangential force.

- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
- If the measured value deviates from the standard value, adjust by changing a collar.

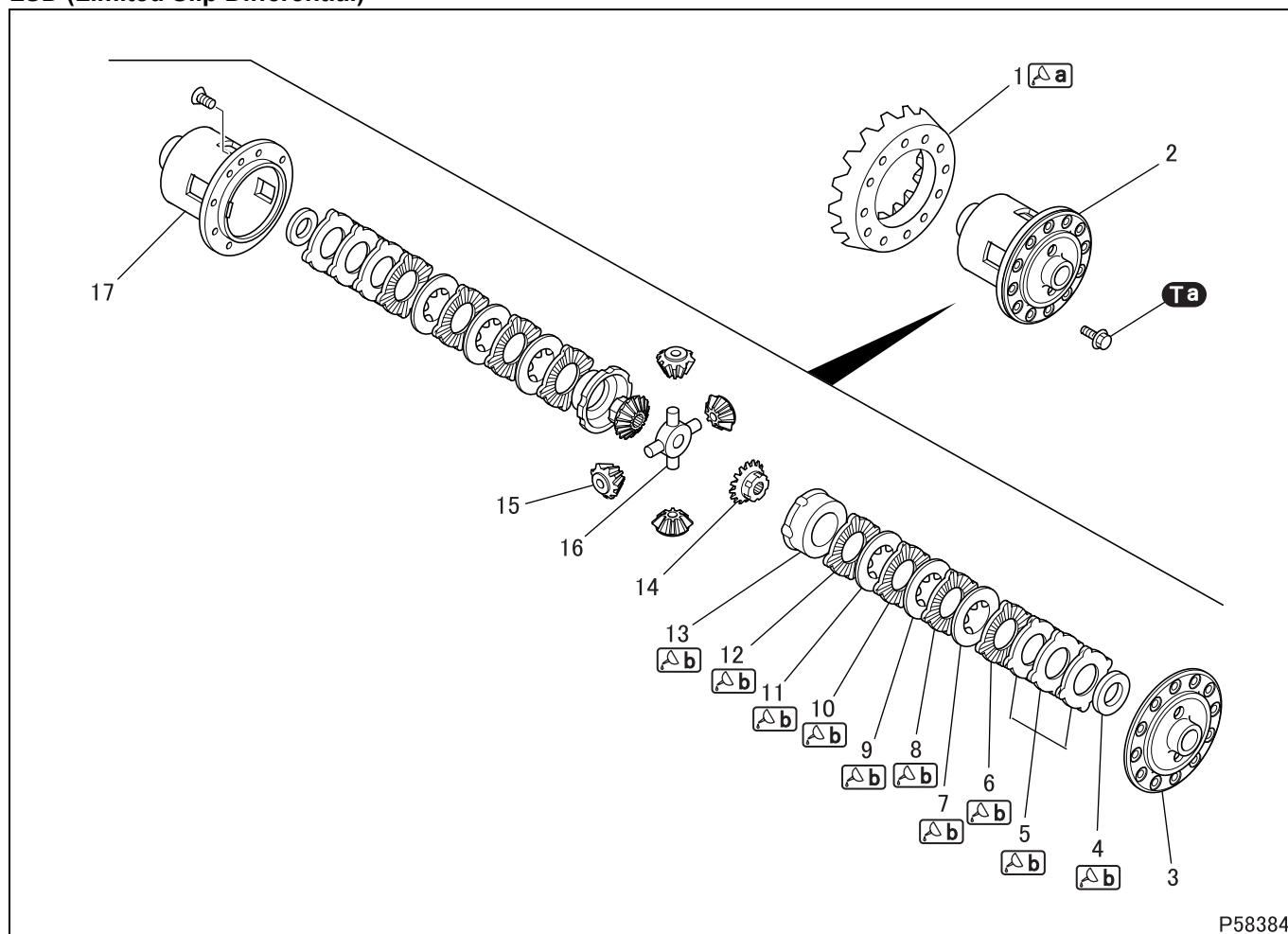
Thickness of collars available

15.600 to 16.200 mm {0.61 to 0.64 in.} (25 thickness in 0.025 mm {0.00098 in.} increments)

M E M O

REDUCTION AND DIFFERENTIAL

LSD (Limited Slip Differential)



● Disassembly sequence

- | | | |
|-----------------------------------|-------------------|-------------------------|
| 1 Reduction gear | 7 Friction disc | 13 Pressure ring |
| 2 LSD (Limited Slip Differential) | 8 Friction plate | 14 Side gear |
| 3 Differential case LH | 9 Friction disc | 15 Differential pinion |
| 4 Side gear washer | 10 Friction plate | 16 Pinion spider |
| 5 Spring plate | 11 Friction disc | 17 Differential case RH |
| 6 Friction plate | 12 Friction plate | |

CAUTION

- Make sure to replace the side gear and the differential pinion as a side gear set.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
2	LSD	Rotation torque of clutch plate	When new clutch plate is assembled	201 to 298 N·m {150 to 220 ft.lbs, 15 to 27 kgf·m}	—	Replace
			When old clutch plate is reassembled	117 to 298 N·m {86 to 220 ft.lbs, 19 to 27 kgf·m}	—	
		Clearance in side gear axial direction		0.05 to 0.20 {0.0020 to 0.0079}	—	
		Clearance in differential case axial direction		0.05 to 0.20 {0.0020 to 0.0079}	—	
4, 11 to 14	Difference in dimensions from side gear washer end face to pressure ring back face between right and left			0 to 0.05 {0 to 0.0020}	—	Replace
7 to 10	Friction disc and friction plate		Distortion	—	0.08 {0.0031}	Replace
			Wear	—	0.1 {0.0039}	
			Difference in thickness of right and left combination	0 to 0.05 {0 to 0.0020}	—	Adjust

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
 a	Bolt (Reduction gear mounting)	167 to 225 {120 to 165, 17 to 23}	–

Lubricant and/or sealant

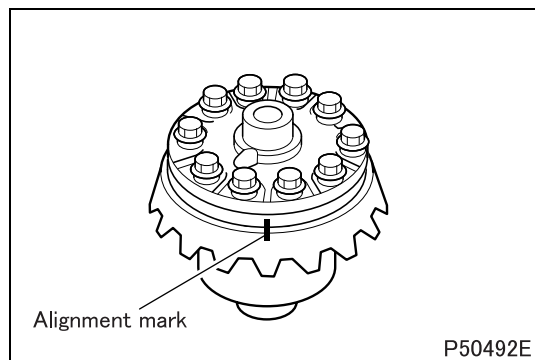
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Bolt threads of reduction gear	LOCTITE 271	As required
 b	Each part	Limited slip differential oil API GL-5 SAE 90	As required

REDUCTION AND DIFFERENTIAL

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application					
	Side gear holding tool se D 20 {0.79} A B C D P50488AE	MB999140	Measure rotation torque of LSD clutch plate					
				Component		Part No.	Applied type	
				A	Gauge case	MB990551	—	
				B	Side gear holding base	MB999141	—	
				C	Side gear holding tool		—	—
					Outer diameter	Number of tooth	Spline diameter	—
					φ39 {1.54}	16 {0.63}	φ35.6 {1.40}	—
					φ42 {1.65}	18 {0.71}	φ39.6 {1.56}	D033H
					φ42 {1.65}	20 {0.79}	φ42 {1.65}	—

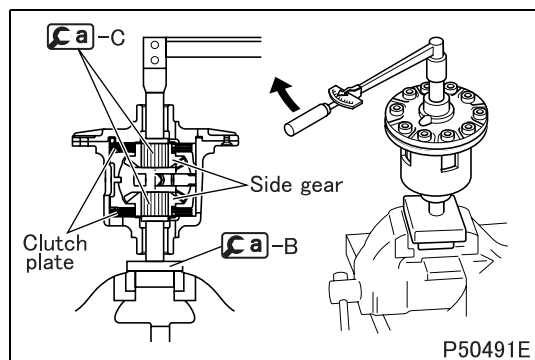
◆ Work before removal ◆



■ Alignment marks: Reduction gear and limited slip differential

- Put alignment marks on the reduction gear and limited slip differential.

◆ Inspection procedure ◆

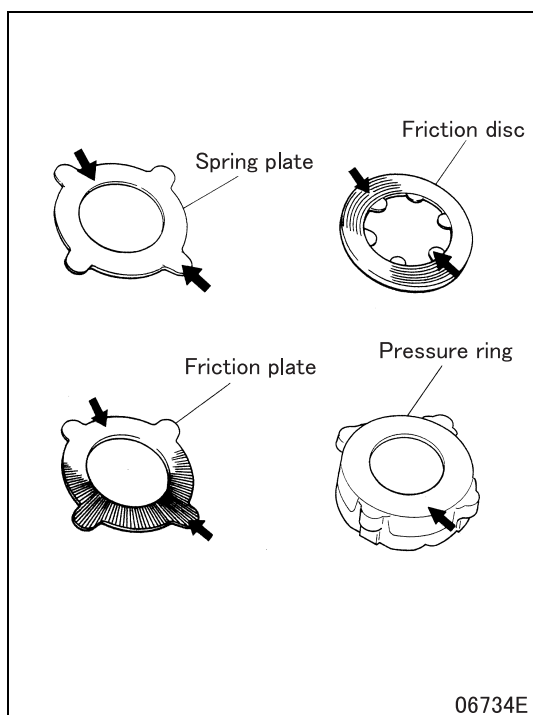


■ Inspection: Rotation torque of LSD clutch plate

- After removing the reduction gear, carry out the following inspection.
- Measure the rotation torque to check for the friction force of the clutch plate.

NOTE

- For measurement of rotation torque, rotate the side gears to sufficiently smooth their operation and measure the value during their rotation.



■ Inspection: Limited slip differential

(1) Inspection of contacting and sliding surfaces

- If heat discoloration and remarkable wear are found on friction surfaces and sliding surfaces of the spring plates, spring discs, friction discs and friction plates, replace defective parts.

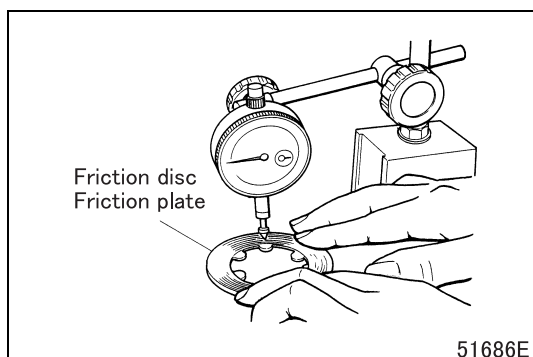
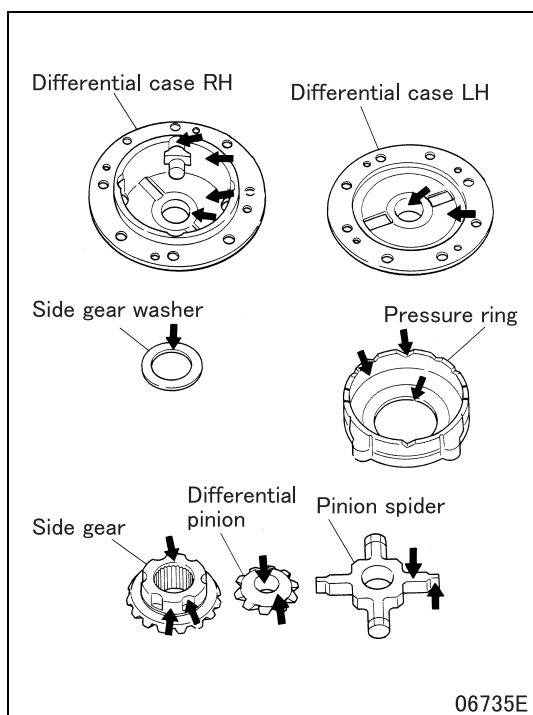
NOTE

- **Strong contact on the inner periphery of friction surfaces is caused by the spring force of each plate and disc. Do not mistake that it is caused by abnormal wear.**

- If cracks and damage are found on protrusions on the inside and outside periphery of the spring plates, friction discs and friction plates, replace defective parts.
- If dents and damage are found on the friction surfaces and sliding surfaces of the pressure rings to friction discs, polish them with an oilstone, and lap and correct them with a compound on a surface plate.

NOTE

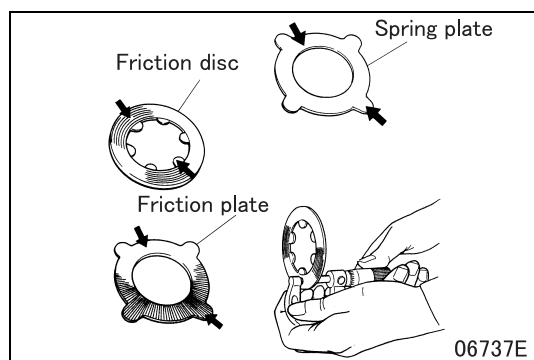
- **Strong contact on the inner periphery of friction surfaces is caused by the spring force of each plate and disc. Do not mistake that it is caused by abnormal wear.**
- Inspect contacting and sliding areas ← of the differential case LH, side gear washers, pressure rings, side gears, differential pinion, pinion spider and differential case RH, and correct burrs and dents with an oilstone.



(2) Inspection of distortion

- Apply a dial gauge to the friction disc and friction plate on a surface plate and measure their distortion (flatness) while turning them. If the measured value exceeds the limit, replace.

REDUCTION AND DIFFERENTIAL



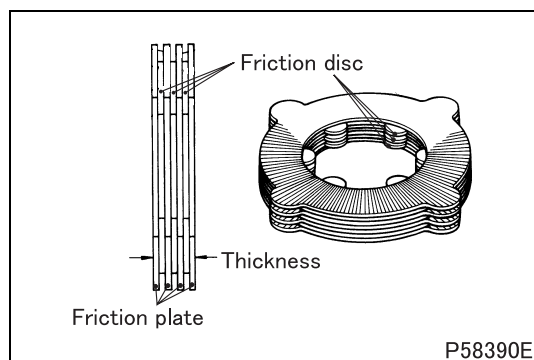
(3) Inspection of thickness

- Measure thickness of the friction surfaces and protrusions ◀ of the spring plate, friction disc and friction plate, and find the difference. If it exceeds the limit, replace defective parts.

NOTE

- Take measurement at several points for each part.

◆ Work before assembly ◆



- Before assembling the limited slip differential, adjust the dimensional difference (friction force of clutch plate) in the axial direction and the clearance in the side gear axial direction, when assembling integral parts of the differential cases LH and RH, in the following procedure.

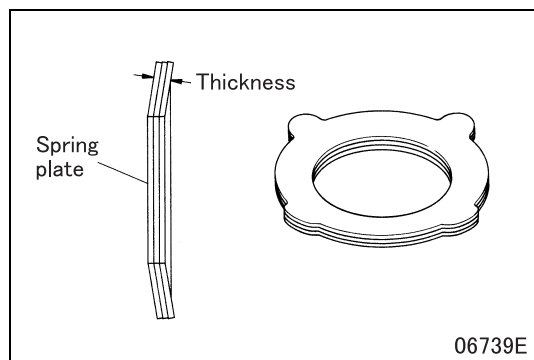
- Pile friction discs and friction plates as illustrated and measure thickness with a micrometer. Select the combination so that the difference in thickness between the right and left combination falls within the range of the standard value.

Thickness of friction discs available

1.9, 2.0, 2.1 mm {0.075, 0.079, 0.083 in.} (three sizes)

Thickness of friction plates available

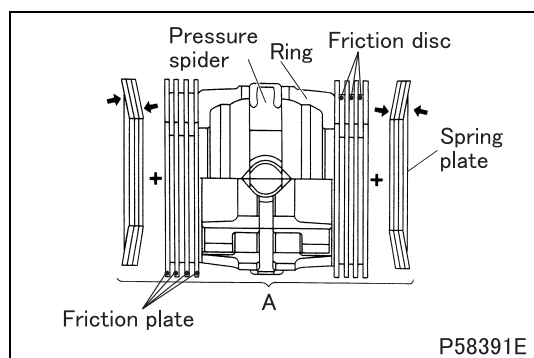
2.0 mm {0.079 in.} (one size)



- Pile a spring plate and a spring disc as illustrated and measure thickness with a micrometer. Select the combination so that the difference in thickness between the right and left combination is as small as possible.

Thickness of spring plates available

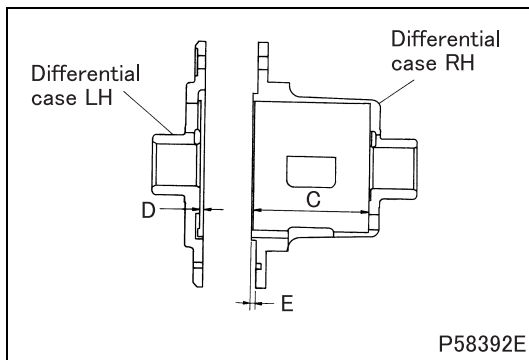
2.0 mm {0.079 in.} (one size)



- Assemble the pressure rings, pinion spiders, friction discs, friction plates, spring plates and spring discs and measure overall width A with a micrometer.

NOTE

- Measure the overall width with the V-shaped groove of the pressure ring pressed against the pinion spider from both sides to obtain secure contact.



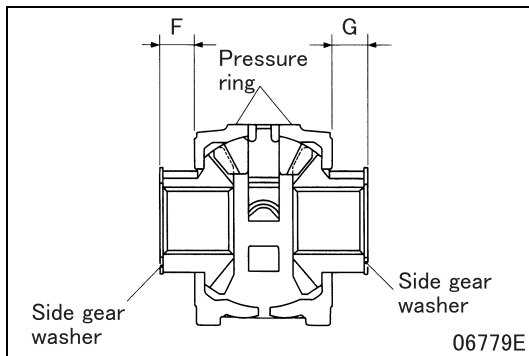
- Find dimension **B** between spring plate contact faces when the differential cases LH and RH are combined.

$$B = C + D - E$$

- If overall width **A** measured in the previous item and the clearance (**B-A**) between the differential cases LH and RH deviate from the standard value, adjust by changing a friction plate.

Thickness of friction plates available

1.9, 2.0, 2.1 mm {0.075, 0.079, 0.083 in.} (three sizes)



- After installing the side gear washers as illustrated, make sure that the difference between **F** and **G** dimensions from the back face of the pressure rings to the end face of the side gear washers falls within the range of the standard value.

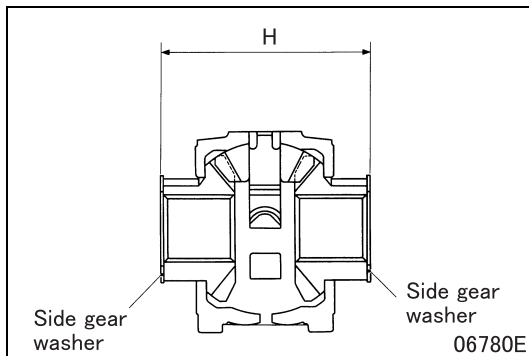
NOTE

- Measure the dimensions with the V-shaped groove of the pressure ring pressed against the pinion spider from both sides to obtain secure contact.

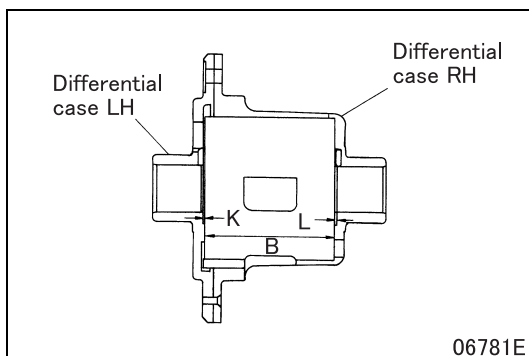
- If the difference in dimension deviates from the standard value, adjust by changing the side gear washer.

Thickness of side gear washers available

1.5, 1.6, 1.7 mm {0.059, 0.063, 0.067 in.} (three sizes)



- Measure overall width **H**.



- Find dimension **J** between side gear washer contact faces when the differential cases LH and RH are combined.

$$J = B + K + L$$

NOTE

- For dimension **B**, refer to the difference between spring plate contact surfaces found in the previous item when the differential cases LH and RH are combined.

- Check that clearance in the side gear axial direction is within the range of the standard value.

- If the clearance deviates from the standard value, adjust by changing the side gear washer.

Thickness of side gear washer available

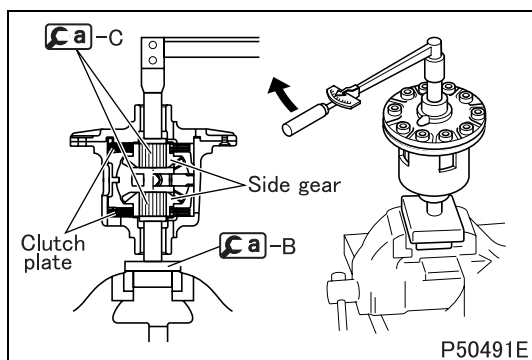
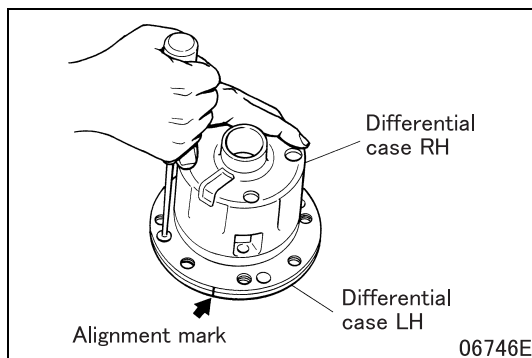
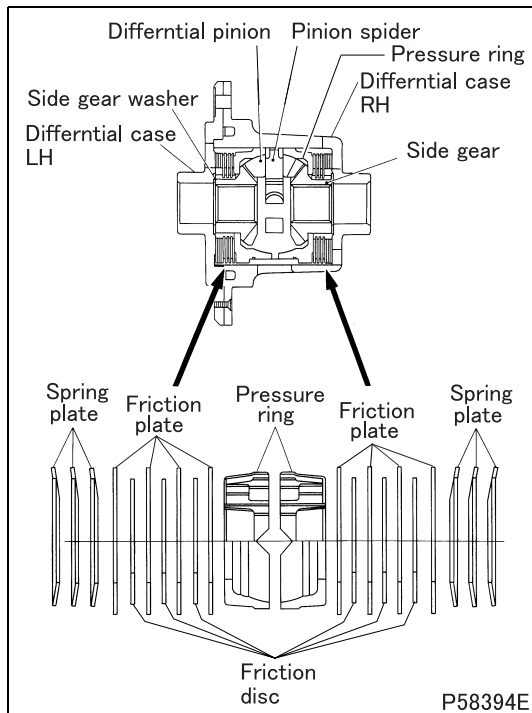
1.5, 1.6, 1.7 mm {0.059, 0.063, 0.067 in.} (three sizes)

NOTE

- Select side gear washers so that the right and left dimensional difference from the back face of the pressure rings to the end face of the side gear washers conforms to the standard value.

REDUCTION AND DIFFERENTIAL

◆ Assembly procedure ◆



■ Assembly: LSD (Limited Slip Differential)

- Assemble each part into the differential case RH in the illustrated direction.

NOTE

- Take care not to install the friction discs and friction plates in a wrong sequence and the spring plates in a wrong direction.
- When assembling, apply gear oil to each part. Especially, apply gear oil carefully to contact surfaces and sliding surfaces.

- Aligning the alignment mark (the same Arabic numeral) of the differential case LH with that of the differential case RH, tighten screws in the diagonal sequence gradually and evenly.

NOTE

- If the differential cases LH and RH do not contact positively each other even after screws have been tightened fully, improperly assembled side gear washers and spring plates are suspected. In that case, reassemble these parts.

■ Inspection: Rotation torque of limited slip differential clutch plate

- After assembling LSD, carry out the following inspection.
- Measure the rotation torque to check for the friction force of the clutch plate.

NOTE

- For measurement of rotation torque, rotate the side gears to sufficiently smooth their operation and measure the value during their rotation.
- If the measured value deviates from the standard value, replace defective parts of the internal components.



Group 31

Wheel and Tire

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	31-2
TROUBLESHOOTING	31-3
WHEEL AND TIRE	31-4

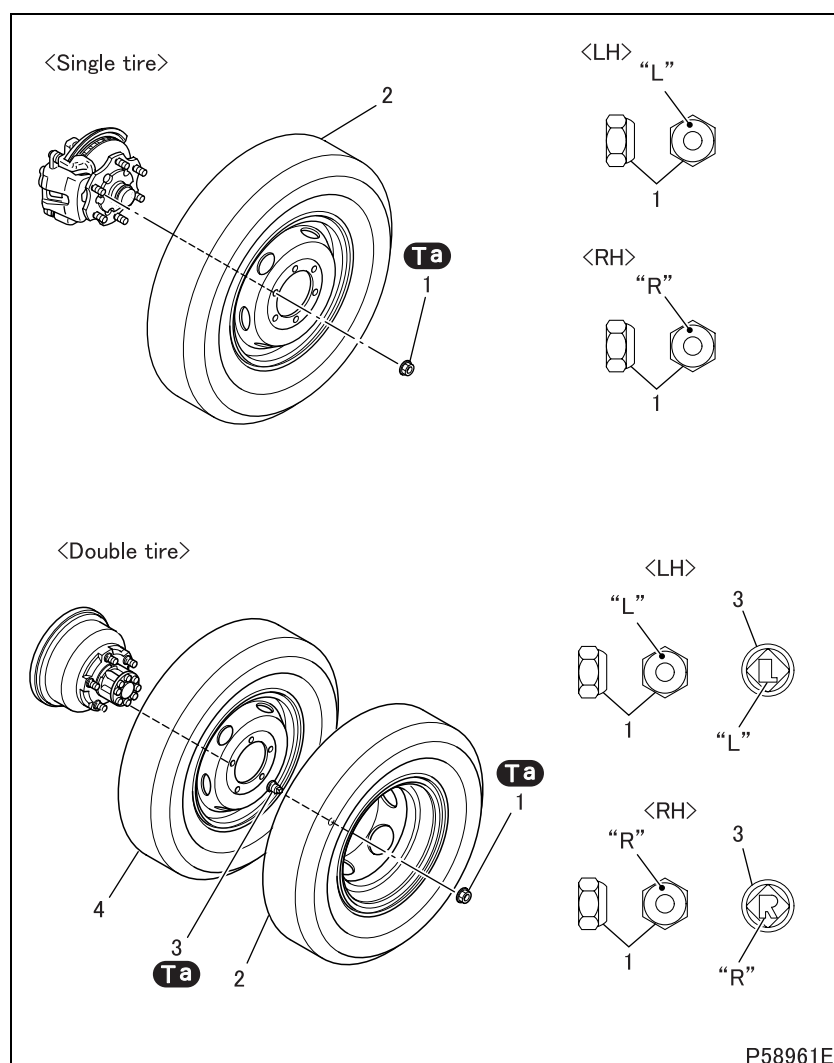
SPECIFICATIONS

Tire size	Wheel type
215/85R16	16 × 6K-127
215/75R17.5	17.5 × 6.00-127
235/85R16	16 × 6K-135

- Tire pressures specified for each tire size are shown on the tire pressure label.

Symptoms		Tire tread wear										Reference Gr
		Both shoulders worn	Center worn	Outside worn	Inside worn	Worn in feather pattern from outside in	Worn in feather pattern from inside out	Worn in wave pattern	Worn in concave (one spot or more)	Worn in pit over the entire periphery	Worn in serration	
Probable causes												
Overload		O										
Tire pressure	Too low	O						O	O	O	O	
	Too high		O									
Wheel alignment	Toe-in	Excessive		O		O						Gr26
		Insufficient			O							
	Camber	Excessive		O								
		Insufficient			O							
	Excessive toe-out				O		O					
	Multiple misalignment		O		O	O	O	O	O	O		
Knuckle arm bent				O	O	O	O					
Left and right tie-rods different in length						O						
Wheels out of balance								O	O	O	O	
Wheel bearing loose								O	O	O	O	Gr26, 27
Ball joint loose									O			Gr26
Tie-rod end loose									O			Gr37
Brake drum eccentrically mounted <drum brake>									O	O		Gr35
Axle bent <rigid axle suspension>								O	O			Gr26, 27
Left and right wheels steered at improper angles											O	Gr26
Hard acceleration, braking, or steering											O	
Specific road surface conditions				O	O							

WHEEL AND TIRE



CAUTION

- Use right-hand threaded wheel nuts marked "R" for right side wheels and left-hand threaded wheel nuts marked "L" for left side wheels.

● Removal sequence

- 1 Wheel nut <Single tire>
Wheel nut (Outer) <Double tire>
- 2 Tire (See later section.)
- 3 Wheel nut (Inner) <Double tire>
- 4 Tire <Double tire>
(See later section.)

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

- The wheel nuts are designed to be tightened without any coating of grease. Never grease the wheel nuts. Even if tightened to the specified torques, greased wheel nuts can become loose.

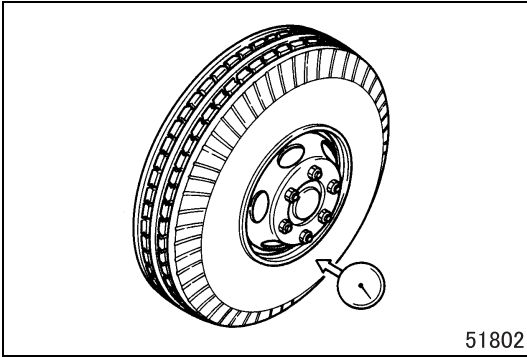
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
2, 4	Tire lateral runout (sideway deflection)	3.5 {0.14} or less	—	Correct or re-place

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

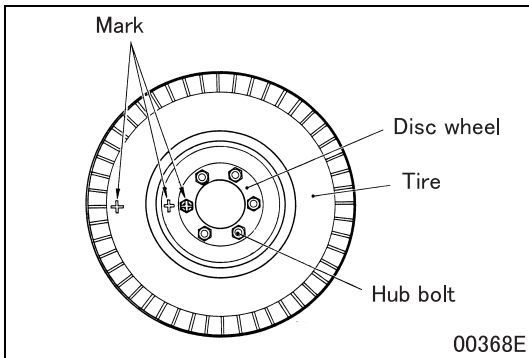
Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Wheel nut	16 × 6K-127 16 × 6K-135 17.5 × 6.00-127	490 ± 49 {360 ± 36, 50 ± 5.0}	—
		17.5 × 6.00-127	390 ± 20 {285 ± 15, 40 ± 2.0}	WET

◆ Inspection procedure ◆



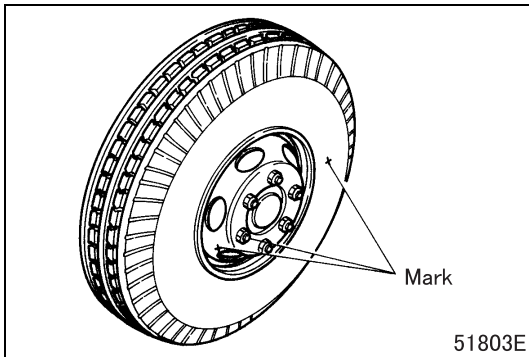
■ Inspection: Tire

- Measure the tire for lateral runout (sideway deflection).
- If the measured value is equal to or exceeds the standard value, correct as follows.



■ Correction: Tire

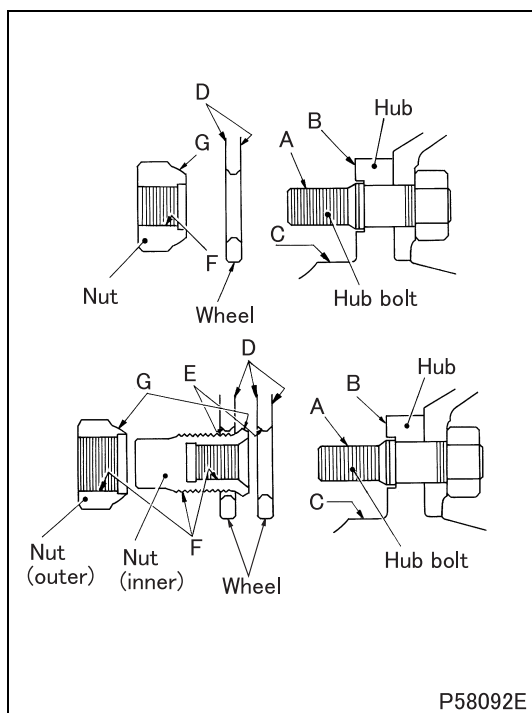
- Mark the tire, disc wheel, and one of the hub bolts in the illustrated locations.
- Remove the tire from the disc wheel.



- Measure the disc wheel for lateral runout.
- If the disc wheel's maximum runout is located near the mark on the wheel, install the tire such that the mark on the tire is 180° away from the mark on the disc wheel.
- Measure the tire again for lateral runout.
- If the measured value still does not conform to the standard value, replace the tire.

WHEEL AND TIRE

◆ Installation procedure ◆

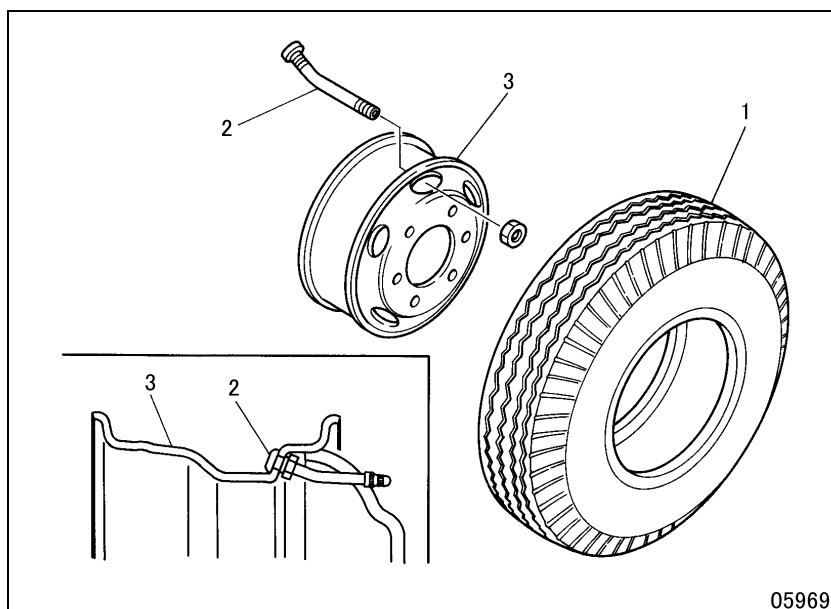


■ Installation: Tire

- To prevent hardware and parts from becoming loose and/or damaged, thoroughly clean the following areas, removing rust, dirt, paint and foreign matter, before installing the tire.

- A:** Threaded portion of hub bolt
B: Wheel mounting surface of hub
C: Wheel alignment area of hub
D: Mating surfaces of disc wheel
E: Wheel nut mounting surface of disc wheel
F: Threaded portion of wheel nut
G: Spherical portion of wheel nut

Tire <Tubeless>



● Disassembly sequence

- 1 Tire
- 2 Air valve
- 3 Disc wheel

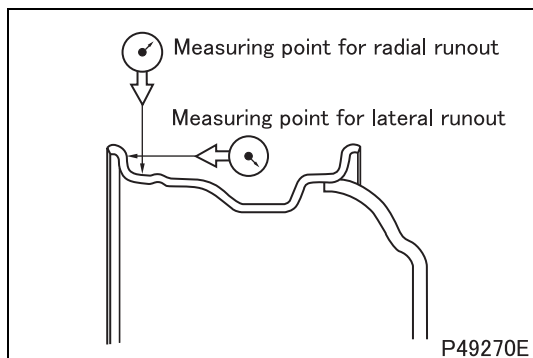
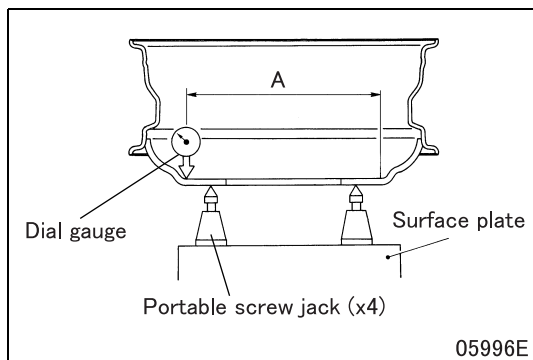
● Assembly sequence

Follow the disassembly sequence in reverse.

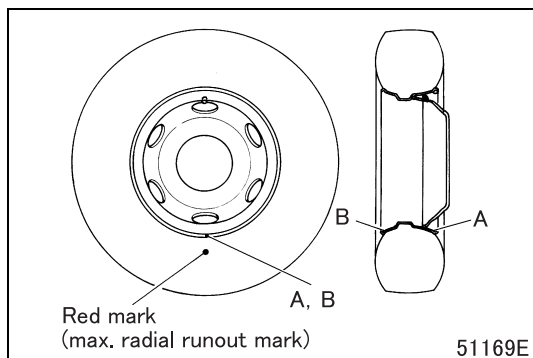
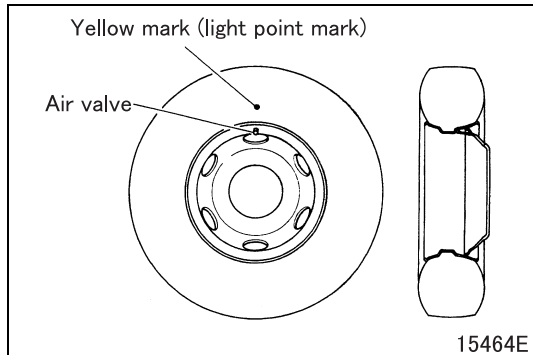
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Tire assembly static unbalance tolerance		70 g {2.47 oz} or less	–	Correct
3	Disc wheel	16 × 6K-127 16 × 6K-135 17.5 × 6.00-127	Flatness (at hub surface)	0.3 {0.012} or less	Replace
			Lateral runout (sideway deflection)	1.5 {0.059} or less	
			Radial runout (vertical deflection)	1.5 {0.059} or less	

◆ Inspection procedure ◆



◆ Installation procedure ◆



■ Inspection: Disc wheel

(1) Flatness

- Using a dial gauge, measure the disc wheel for flatness (difference between the maximum and minimum values measured) at specified distance **A** from the center of the wheel, at 5 locations for 5-stud units and 6 locations for 6-stud units that are equally divided around the specified circumference on the wheel.

A: $\phi 170$ mm, 270 mm {6.69, 10.6 in.} 16 $\times$ 6K-127

16 $\times$ 6K-135

$\phi 175$ mm, 275 mm {6.89, 10.8 in.} 17.5 $\times$ 6.00-127

- If the measured flatness is equal to or exceeds the specified value, replace the disc wheel.

(2) Runout

- If the measured value is equal to or exceeds the standard value, replace the disc wheel.

■ Installation: Tire

<Tire with no red mark>

- Install the tire such that the yellow mark (light point mark) on the tire is aligned with the air valve on the disc wheel.

<Tire with red mark>

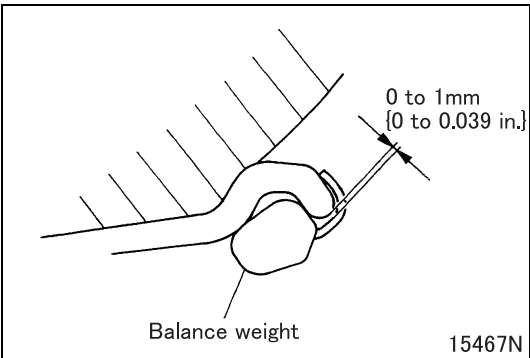
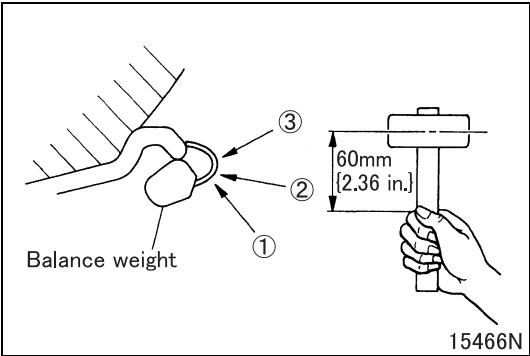
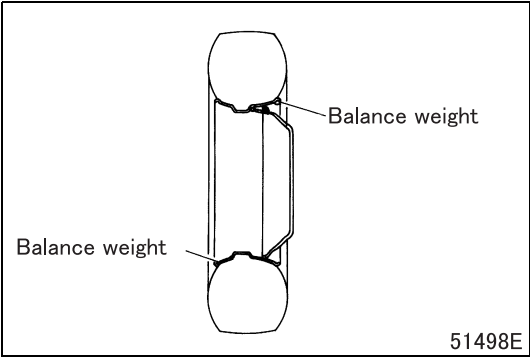
- Install the tire such that the red mark (max. radial runout mark) on the tire is aligned with mark **A** or **B** on the disc wheel.

A: Front face of disc wheel <all wheels except 17.5-inch wheel>

B: Back face of disc wheel <17.5-inch wheel>

WHEEL AND TIRE

◆ Installation procedure ◆



■ Installation: Balance weight

- Install balance weights onto the front and back sides of the disc of the tires listed in the table below. Ensure that the static unbalance of the tire being balanced remains within the standard value.

Tires being balanced	Vehicle model
Tires on front axle	FE
Tires on front axle, tires on rear axle	FG

- Use a 1-pound resin hammer to drive balance weights into position.
- To install a balance weight, tap the clip of the weight in the center at 1, 2 and 3 in that order.

- Leave a clearance of approx. 0 to 1 mm {0 to 0.039 in.} between the clip and the disc wheel. Ensure that the balance weight is not loose after installation.
- Do not use a balance weight that has been improperly tapped or dropped to the floor during installation attempt.
- When 2 weights are being installed, these weights should be as much equal to each other as possible in weight. Also remember that the center point between the weights will become the support point for a balancer.



Group 33

Front Suspension

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

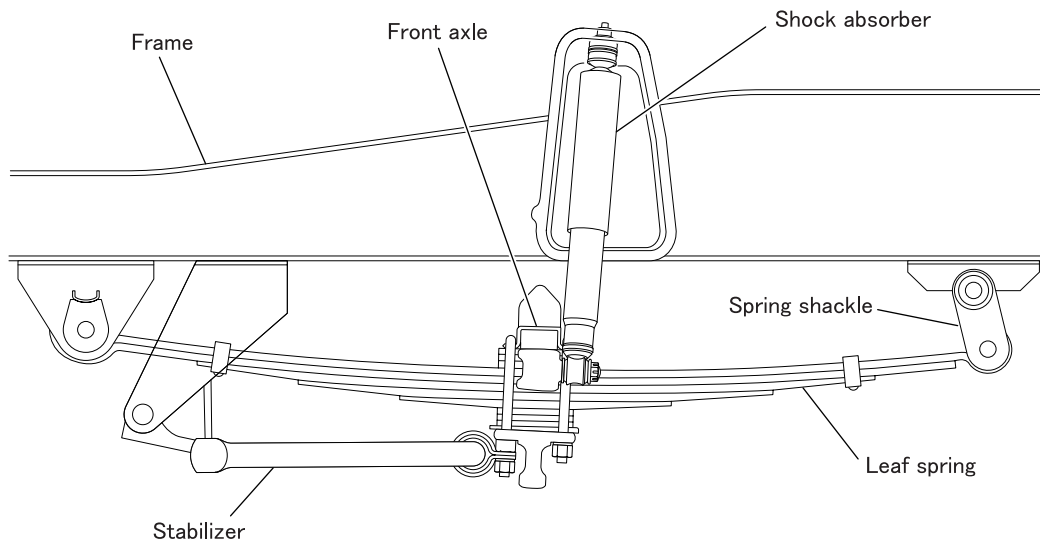
INDEX

STRUCTURE AND OPERATION	
1. Front Suspension Elements.....	33-2
TROUBLESHOOTING	33-3
STABILIZER <FE>.....	33-4
SHOCK ABSORBER <FE>	33-6
SHOCK ABSORBER <FG>	33-8
LEAF SPRING <FE>	33-10
LEAF SPRING <FG>	33-14

STRUCTURE AND OPERATION

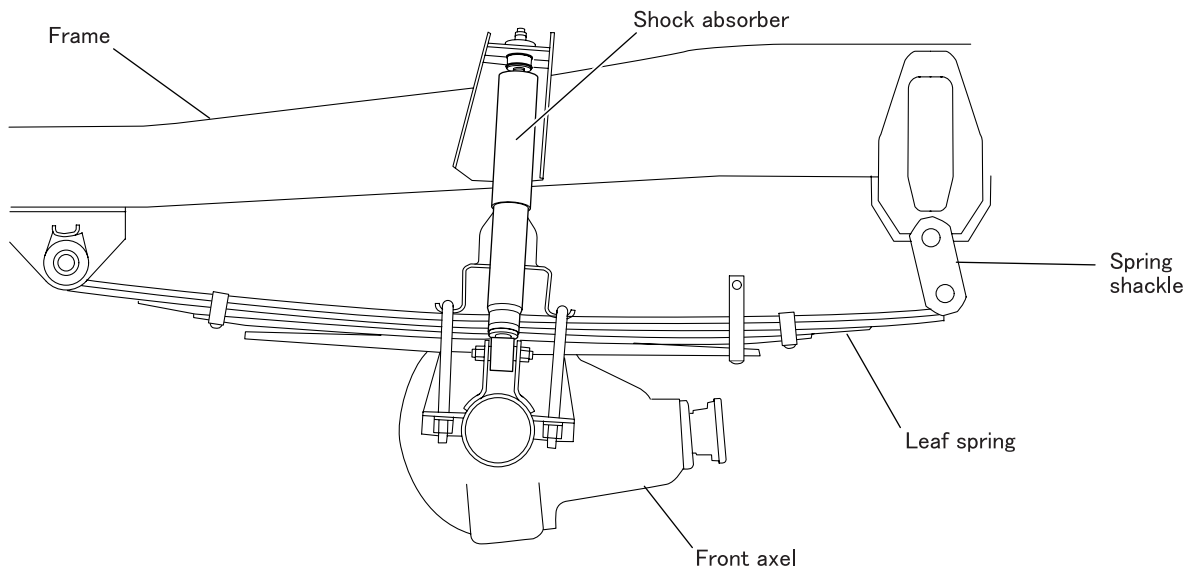
1. Front Suspension Elements

<FE>



P58481E

<FG>

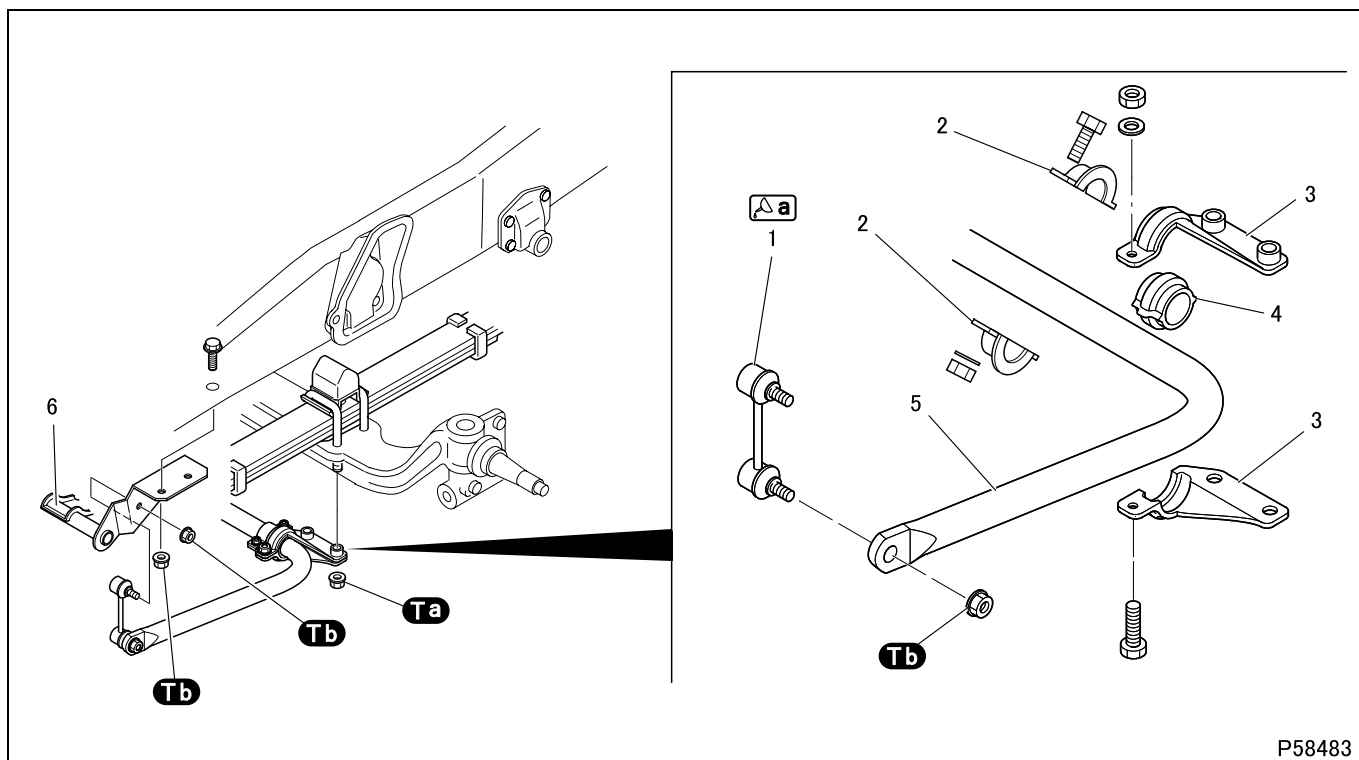


P59142E

- The front suspensions shown above both use a spring shackle connected to the rear end of the leaf spring (shackle-link type suspension).
- The stabilizer prevents the vehicle from pitching, keeping it parallel with the ground.

Symptoms		Feels as if floating	Tends to be noisy	Road bumps/pits received as shocks	Heavy rolling	Cyclical shocks from underneath	Vehicle tilted	Poor linearity	Reference Gr
Probable causes									
Deformed stabilizer bar or link					O				
Shock absorber	Substantial loss of oil and damping capacity	O							
	Rubber bushing worn		O						
	Loose fitting		O						
Leaf spring	Cracks or other damage			O			O		
	Broken		O				O		
	Loose U-bolt		O				O		
	Spring bushing worn		O				O		
Tire	Uneven wear				O			O	Gr31
	Tire and wheel needs balancing					O		O	
	Excessive tire pressure			O					
Wheels out of alignment								O	Gr26

STABILIZER <FE>



P58483

● Removal sequence

- | | |
|-----------------------|--------------------------|
| 1 Stabilizer link | 4 Stabilizer bushing |
| 2 Stabilizer retainer | 5 Stabilizer bar |
| 3 Stabilizer clamp | 6 Stabilizer bar bracket |

● Installation sequence

Follow the removal sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
1	Stabilizer link	Starting torque	0.68 to 1.96 N·m {0.5 to 1.4 ft.lbs, 0.7 to 2.0 kgf·m}	—	Replace
		Play	0.2 {0.0079} or less	—	

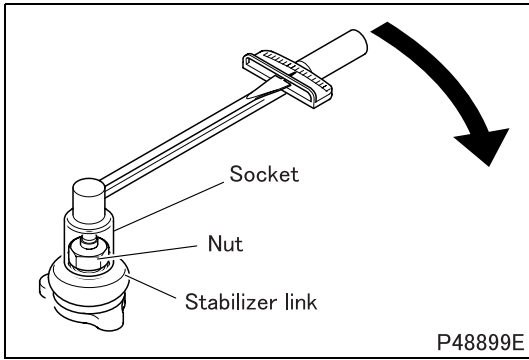
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (U-bolt mounting)	162 ± 15 {120 ± 11, 16.5 ± 1.5}	—
Tb	Nut (Stabilizer mounting)	90 to 120 {66 to 89, 9.0 to 12}	—
	Nut (Stabilizer link mounting)		
	Nut (Stabilizer bar bracket mounting)		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Dust cover lips on stabilizer link	Mitsubishi wheel bearing gease [NLGI No. 2 (Li soap)]	As required

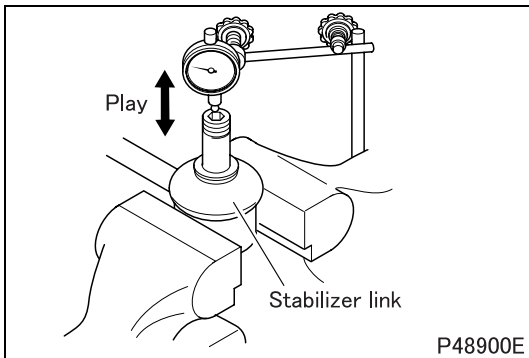
◆ Inspection procedure ◆



■ Inspection: Stabilizer link

(1) Starting torque

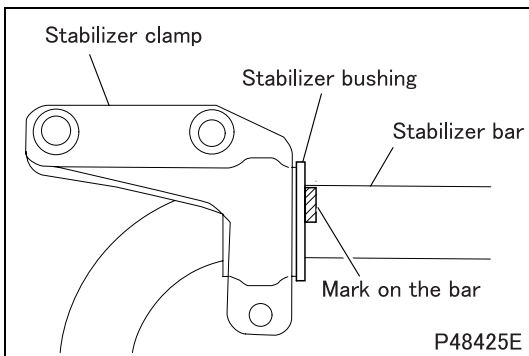
- Install a nut onto the stabilizer link.
- Install a socket and a torque wrench onto the nut. Measure the starting torque of the stabilizer link.
- If the measured value does not conform to the standard value, replace the stabilizer link.



(2) Play

- If the measured value does not conform to the standard value, replace the stabilizer link.

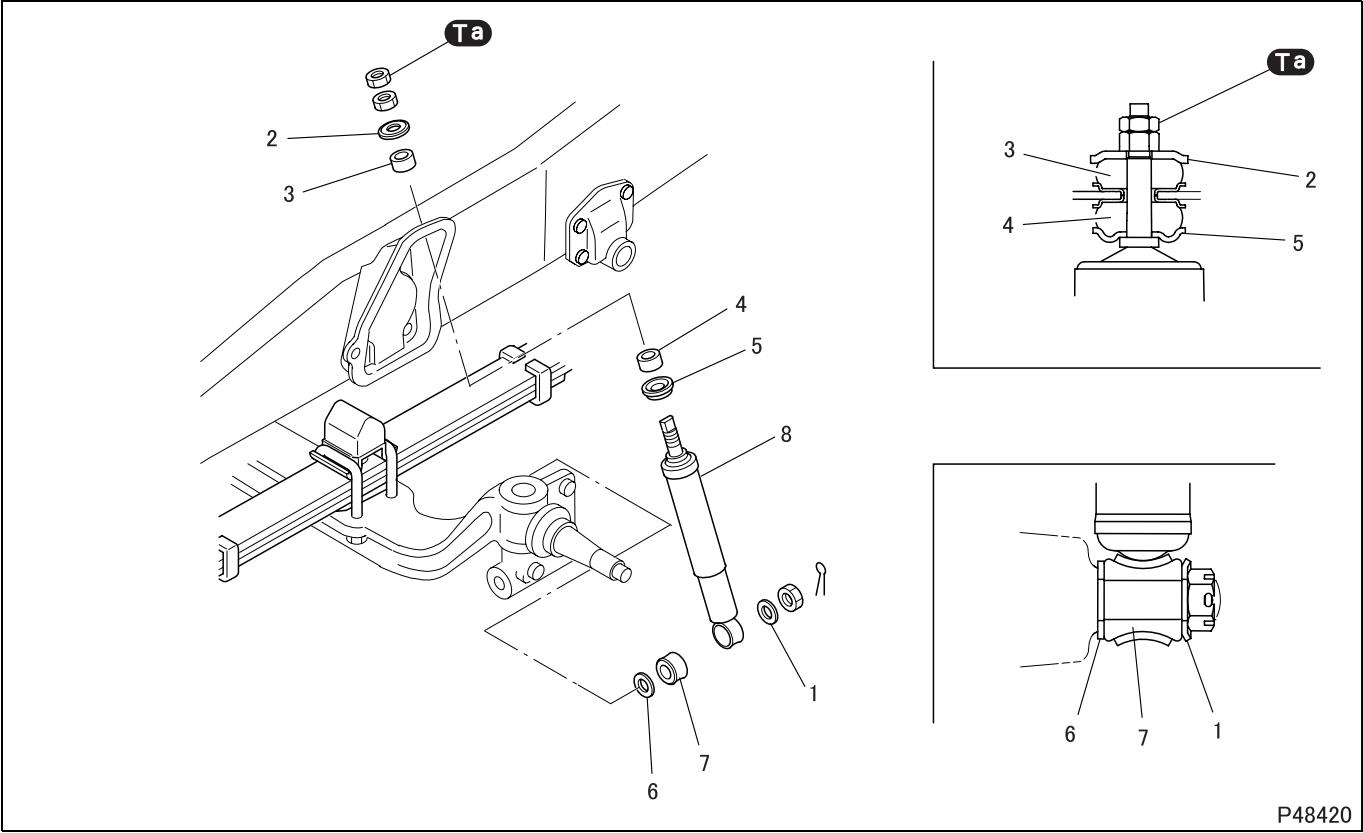
◆ Installation procedure ◆



■ Installation: Stabilizer clamp and bushing

- Position the stabilizer bushing onto the stabilizer bar such that the end of the bushing aligns with the mark on the bar. Clamp them in place with the stabilizer clamp.

SHOCK ABSORBER <FE>



P48420

● Removal sequence

- | | |
|------------------|------------------|
| 1 Washer | 5 Washer |
| 2 Washer | 6 Washer |
| 3 Rubber bushing | 7 Rubber bushing |
| 4 Rubber bushing | 8 Shock absorber |

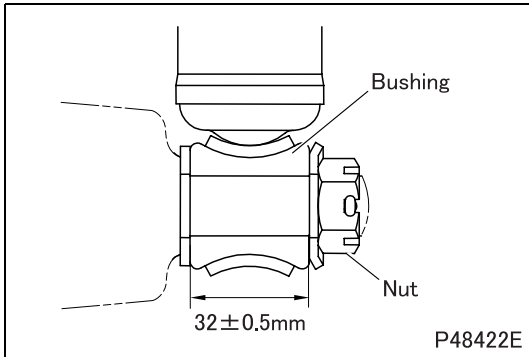
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (Rubber bushing mounting)	13 to 17 {9.6 to 13, 1.3 to 1.7}	—

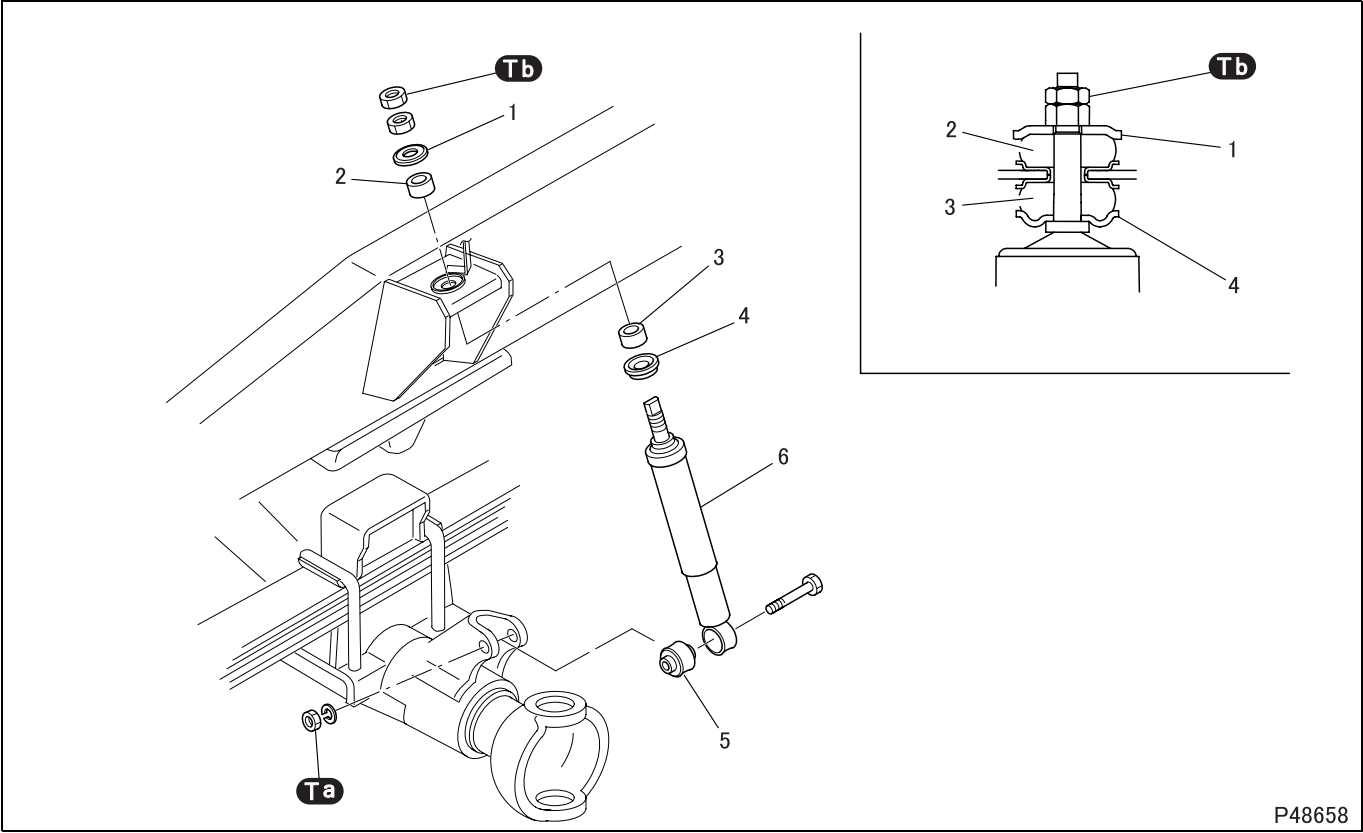
◆ Installation procedure ◆



■ Installation: Rubber bushing

- Tighten the nut until the rubber bushing is squeezed to the illustrated dimension.

SHOCK ABSORBER <FG>



● Removal sequence

- | | |
|------------------|------------------|
| 1 Washer | 4 Washer |
| 2 Rubber bushing | 5 Rubber bushing |
| 3 Rubber bushing | 6 Shock absorber |

● Installation sequence

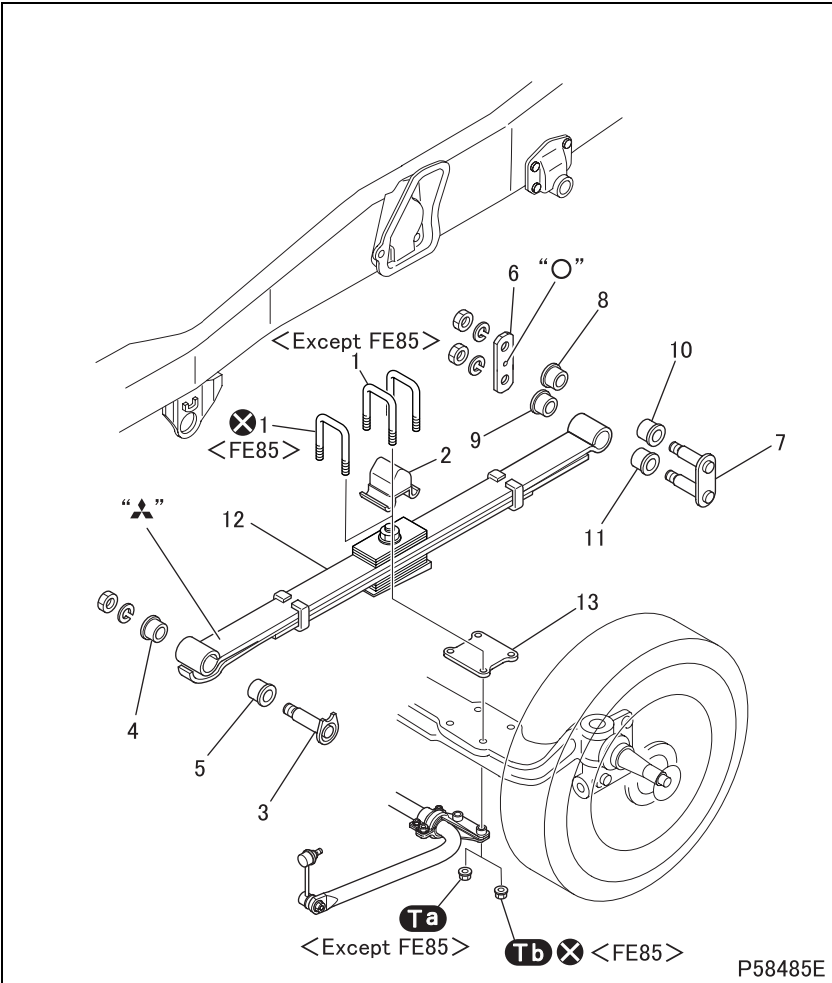
Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Shock absorber mounting)	33 to 49 {24 to 36, 3.4 to 5.0}	–
Tb	Lock nut (Rubber bushing mounting)	13 to 17 {9.6 to 13, 1.3 to 1.7}	–

M E M O

LEAF SPRING <FE>



● Removal sequence

- 1 U-bolt
- 2 Front axle bumper
- 3 Spring pin
- 4 Rubber bushing
- 5 Rubber bushing
- 6 Shackle plate
- 7 Spring shackle
- 8 Rubber bushing
- 9 Rubber bushing
- 10 Rubber bushing
- 11 Rubber bushing
- 12 Leaf spring (See later section.)
- 13 Spacer

⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- U-bolt and mounting nut are non-reusable. <FE85>
- Make sure to jack the vehicle up when tightening the U-bolt mounting nut to specified torque.
- Make sure to tighten the U-bolt mounting nut in dry tightening. If putting any oil or solvent on the nut, never use it.

NOTE

- The right-hand and left-hand leaf spring assemblies have different cambers from each other. Ensure that both assemblies are installed correctly. Reversed installation results in a slanted vehicle.

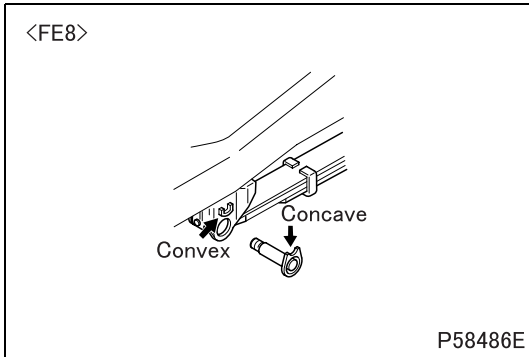
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3 to 5	Clearance between spring pin and rubber bushings	0 to 0.03 {0.0012}	–	Replace
7 to 11	Clearance between spring shackle and rubber bushings	0 to 0.03 {0.0012}	–	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

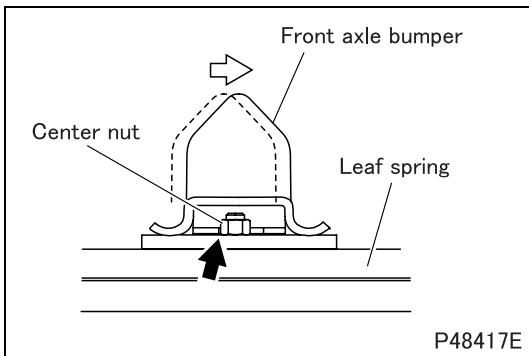
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (U-bolt mounting)	162 ± 15 {119 ± 11, 16.5 ± 1.5}	Nut color: Yellow
Tb	Nut (U-bolt mounting)	175 ± 5 {129 ± 3.7, 17.8 ± 0.5}	Nut color: Green

◆ Installation procedure ◆



■ Installation: Spring pin

- Install the spring pin such that the concave on the pin engages with the convex on the frame.

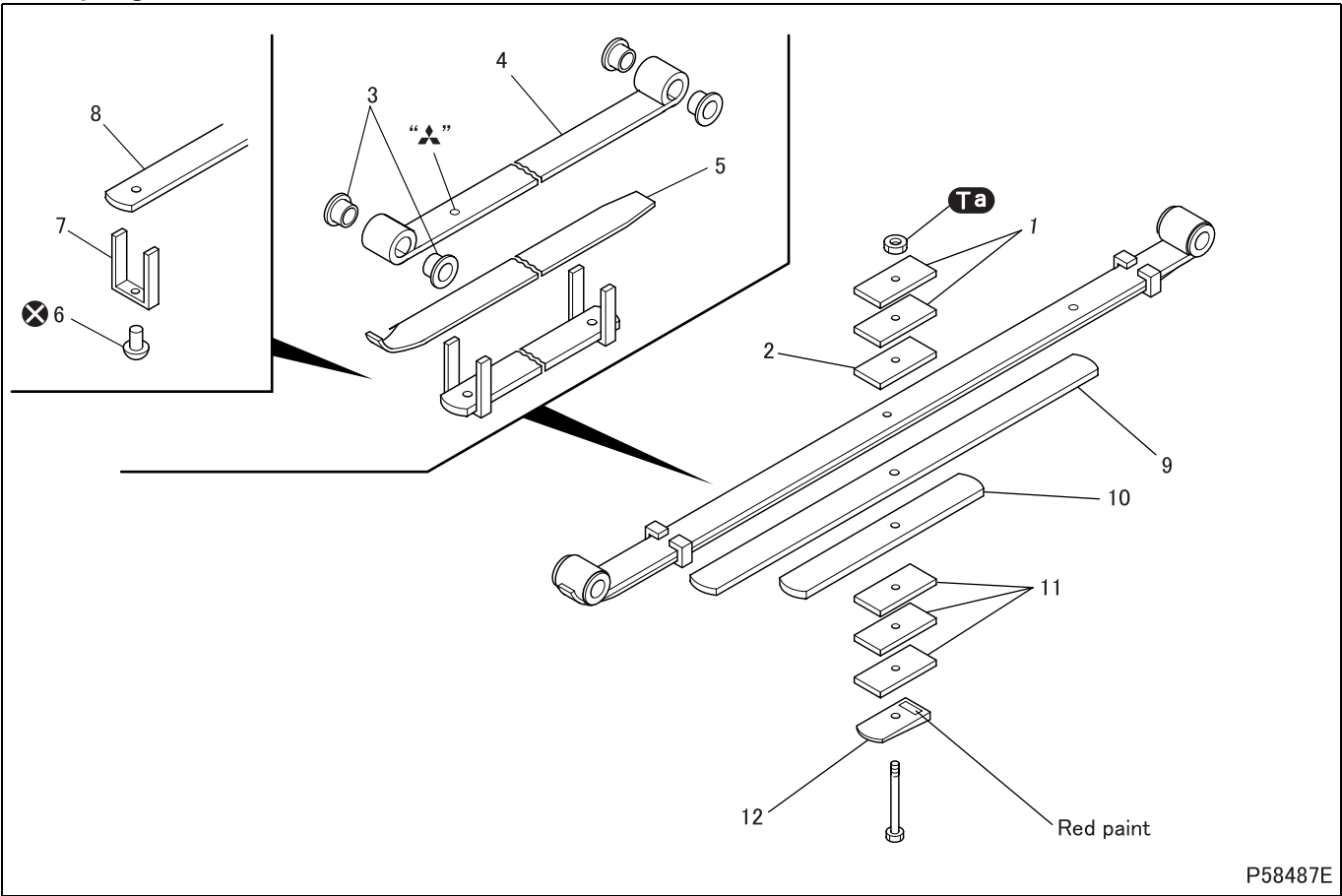


■ Installation: Front axle bumper

- With the unloaded vehicle, slide the front axle bumper on the leaf spring to the rear of the vehicle until it is against the center nut of the leaf spring. Then, install the bumper using U-bolts.

LEAF SPRING <FE>

Leaf Spring



● Disassembly sequence

- | | |
|----------------------------------|----------------------------------|
| 1 Sheet (8 mm {0.31 in.} thick) | 8 Leaf spring (No. 3) |
| 2 Sheet (10 mm {0.39 in.} thick) | 9 Leaf spring (No. 4) |
| 3 Collar | 10 Leaf spring (No. 5) |
| 4 Leaf spring (No. 1) | 11 Sheet (8 mm {0.31 in.} thick) |
| 5 Leaf spring (No. 2) | 12 Caster shim |
| 6 Rivet | |
| 7 Clip | ⊗: Non-reusable parts |

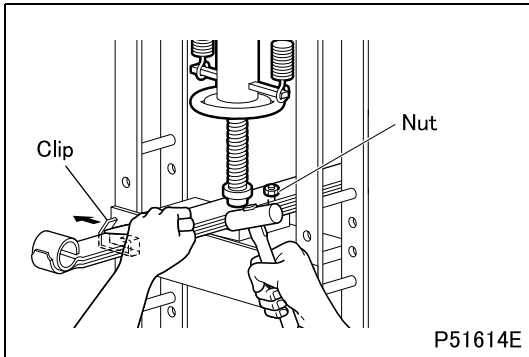
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Assembly of leaf spring)	34 to 54 {25 to 40, 3.5 to 5.5}	—

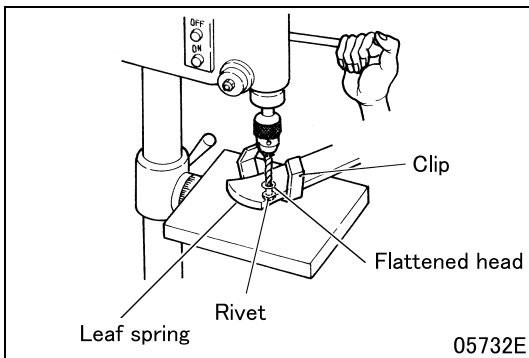
◆ Work before removal ◆



■ Compression: Leaf spring

- Using a press, compress the leaf spring as illustrated for subsequent operations.
- Using a chisel or the like, open the bent ends of the clip.

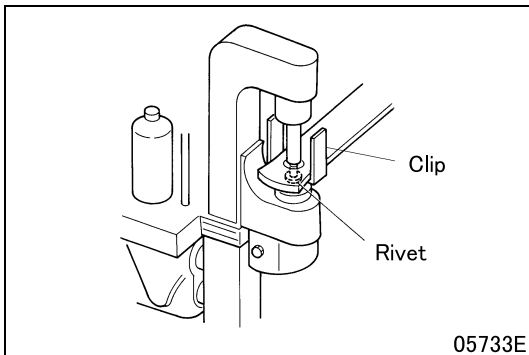
◆ Removal procedure ◆



■ Removal: Clip

- Using a drill press, break the flattened head of the rivet and remove the clip from the leaf spring (No. 3).

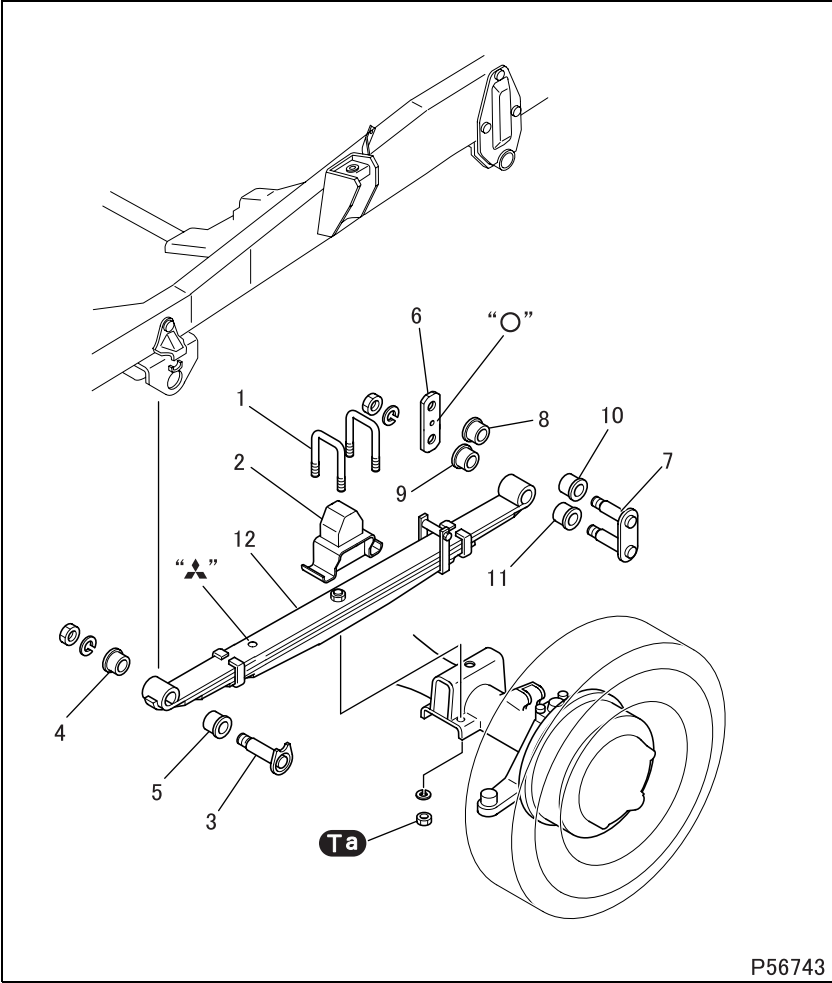
◆ Installation procedure ◆



■ Installation: Clip

- Using a riveting machine, rivet a clip onto the leaf spring.

LEAF SPRING <FG>



● Removal sequence

- 1 U-bolt
- 2 Front spring pad
- 3 Spring pin
- 4 Rubber bushing
- 5 Rubber bushing
- 6 Shackle plate
- 7 Spring shackle
- 8 Rubber bushing
- 9 Rubber bushing
- 10 Rubber bushing
- 11 Rubber bushing
- 12 Leaf spring (See later section.)

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- Make sure to jack the vehicle up when tightening the U-bolt mounting nut to specified torque.
- Make sure to tighten the U-bolt mounting nut in dry tightening. If putting any oil or solvent on the nut, never use it.

NOTE

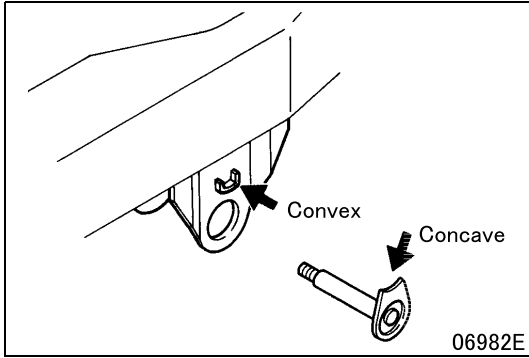
- The right-hand and left-hand leaf spring assemblies have different cambers from each other. Ensure that both assemblies are installed correctly. Reversed installation results in a slanted vehicle.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3 to 5	Clearance between spring pin and rubber bushings	0 to 0.03 {0.0012}	–	Replace
7 to 11	Clearance between spring shackle and rubber bushings	0 to 0.03 {0.0012}	–	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

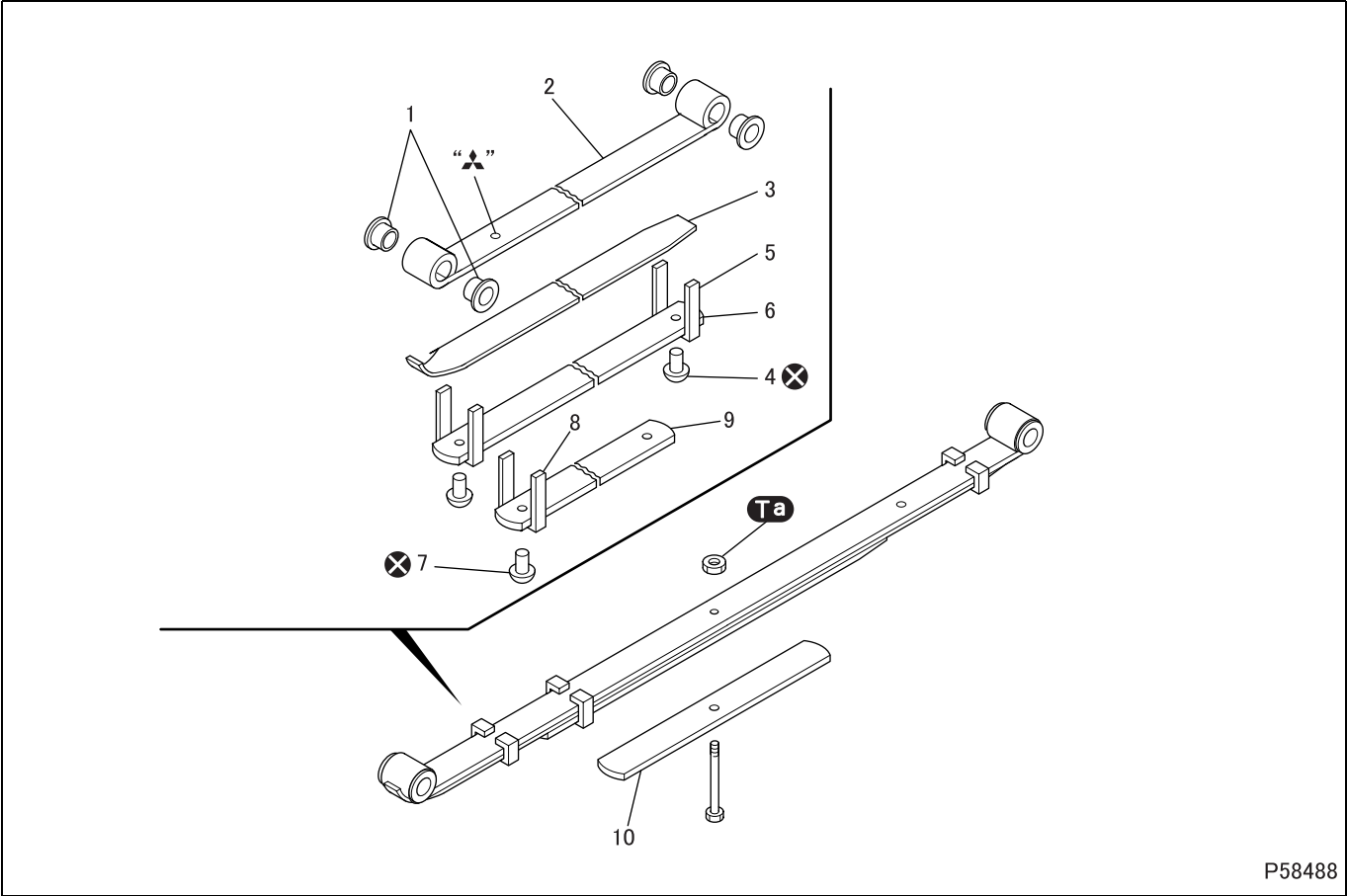
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (U-bolt mounting)	106 ± 8 {78 ± 5.9, 10.8 ± 0.8}	–

◆ Installation procedure ◆**■ Installation: Spring pin**

- Install the spring pin such that the concave on the pin engages with the convex on the frame.

LEAF SPRING <FG>

Leaf Spring



P58488

● Disassembly sequence

- | | |
|-----------------------|------------------------|
| 1 Collar | 7 Rivet |
| 2 Leaf spring (No. 1) | 8 Clip |
| 3 Leaf spring (No. 2) | 9 Leaf spring (No. 4) |
| 4 Rivet | 10 Leaf spring (No. 5) |
| 5 Clip | |
| 6 Leaf spring (No. 3) | ⊗: Non-reusable parts |

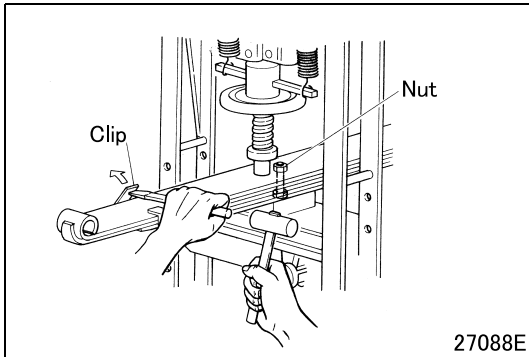
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Location	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Assembly of leaf spring)	34 to 54 {25 to 38, 3.5 to 5.5}	—

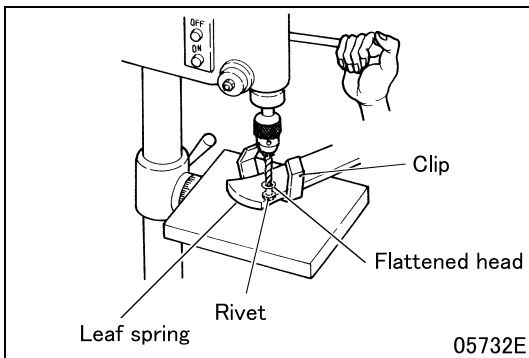
◆ Work before removal ◆



■ Compression: Leaf spring

- Using a press, compress the leaf spring as illustrated for subsequent operations.
- Using a chisel or the like, open the bent ends of the clip.

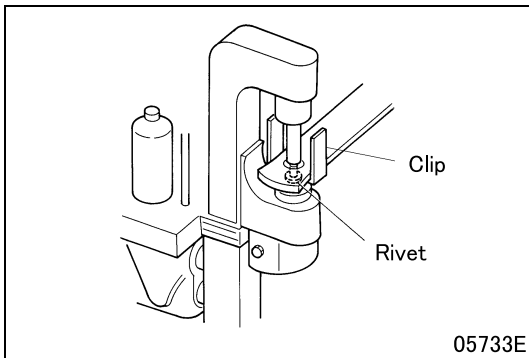
◆ Removal procedure ◆



■ Removal: Clip

- Using a drill press, break the flattened head of the rivet and remove the clip from the leaf spring (No. 4 or 5).

◆ Installation procedure ◆



■ Installation: Clip

- Using a riveting machine, rivet a clip onto the leaf spring.



Group 34

Rear Suspension

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

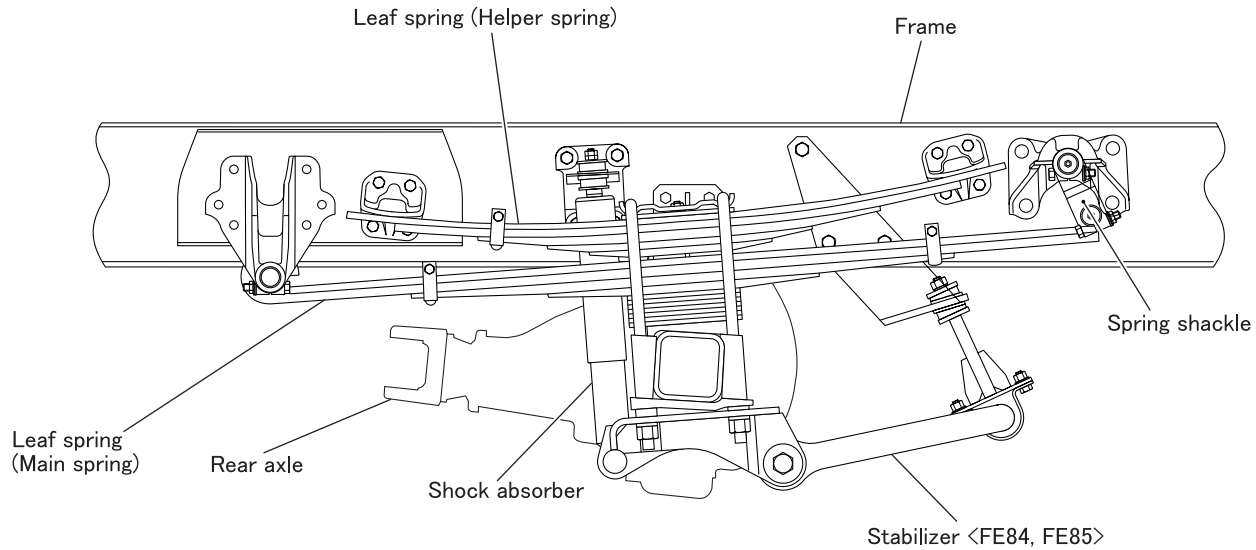
INDEX

STRUCTURE AND OPERATION	
1. Rear Suspension Elements	34-2
TROUBLESHOOTING	34-3
SHOCK ABSORBER	34-4
LEAF SPRING	34-6
STABILIZER	34-24

STRUCTURE AND OPERATION

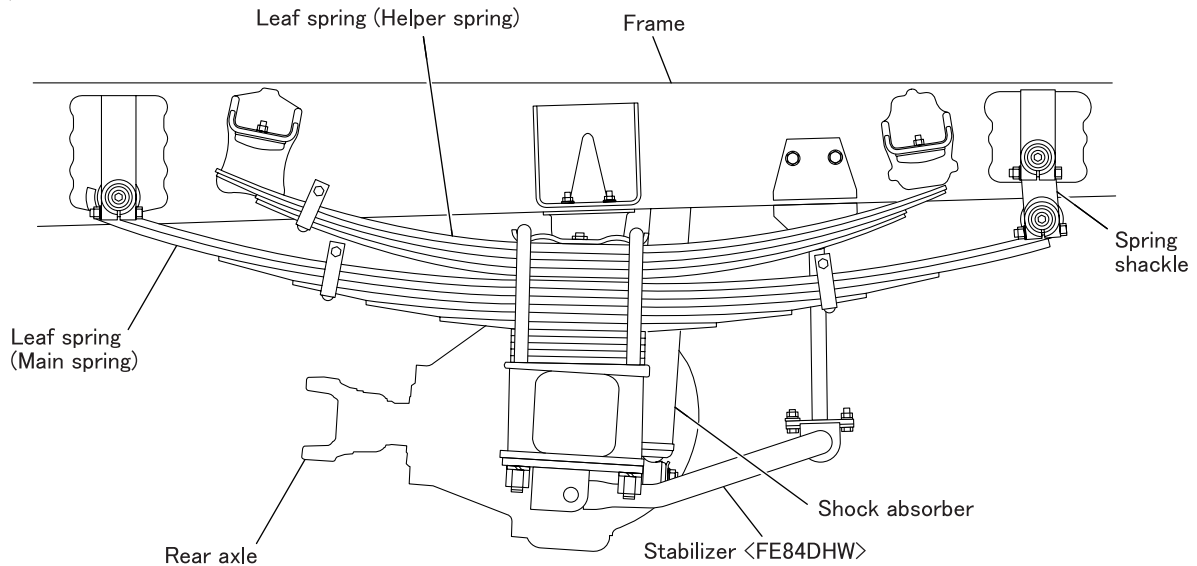
1. Rear Suspension Elements

<FE (Except FE84DHW)>



P58510E

<FE84DHW, FG>



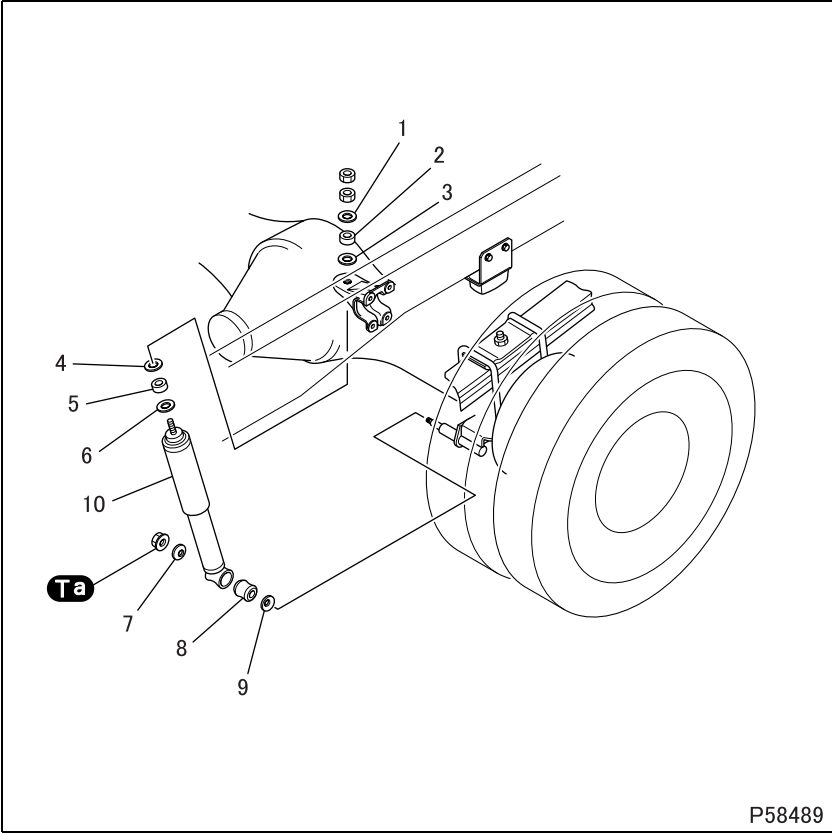
P58511E

- The rear suspensions shown above both use a spring shackle connected to the rear end of the leaf spring assembly (shackle-link type suspension).
- The above schematics are only examples. Details may differ depending on vehicle models, such as the number of spring leaves, the shape of spring shackle, and the location of shock absorber.

Symptoms		Feels as if floating	Tends to be noisy	Road bumps/pits received as shocks	Heavy rolling	Cyclical shocks from underneath	Excessive rolling while cruising	Reference Gr
Probable causes								
Shock absorber	Substantial loss of oil and damping capacity	O						
	Rubber bushing worn		O					
	Loose fitting		O					
Tire	Tire and wheel needs balancing					O		Gr31
	Excessive tire pressure			O				
Leaf spring	Cracks or other damage			O				
	Broken		O					
	Loose U-bolt		O					
	Spring bushing worn		O					
Thrust clearance of metal bushing-type spring pin or shackle pin			O					
Helper rubber or helper spring stopper damaged or broken			O					
Spring pin over-tightened			O					
Stabilizer deformed, bushing worn							O	

SHOCK ABSORBER

<FE (Except FE84DHW)>



● Removal sequence

- 1 Washer
- 2 Rubber bushing
- 3 Washer
- 4 Washer
- 5 Rubber bushing
- 6 Washer
- 7 Washer
- 8 Rubber bushing
- 9 Washer
- 10 Shock absorber

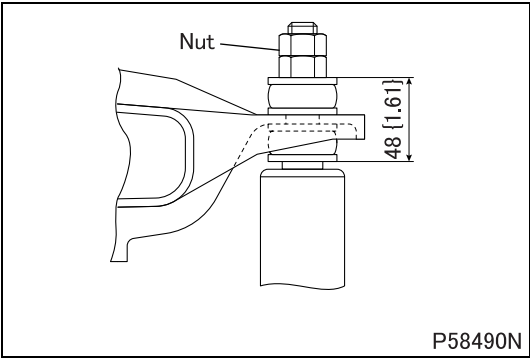
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Shock absorber mounting)	90 to 130 {66 to 96, 9.5 to 13}	—

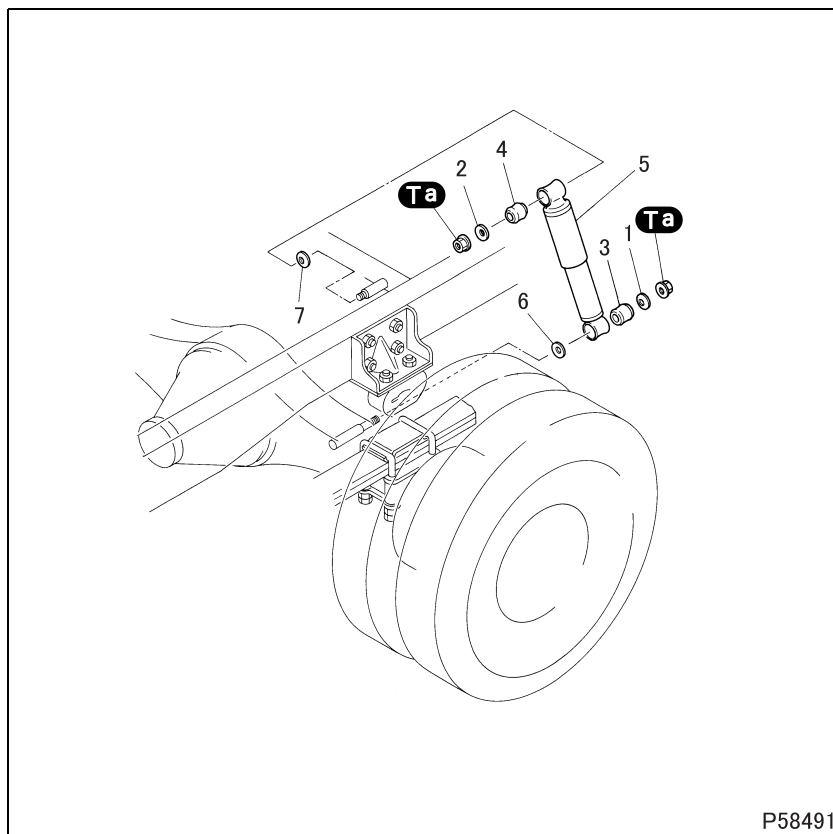
◆ Installation procedure ◆



■ Installation: Shock absorber

- Tighten the nut until the distance between top washer and low washer becomes the amount as illustrated.

<FE84DHW, FG>



● Removal sequence

- 1 Washer
- 2 Washer
- 3 Rubber bushing
- 4 Rubber bushing
- 5 Shock absorber
- 6 Washer
- 7 Washer

● Installation sequence

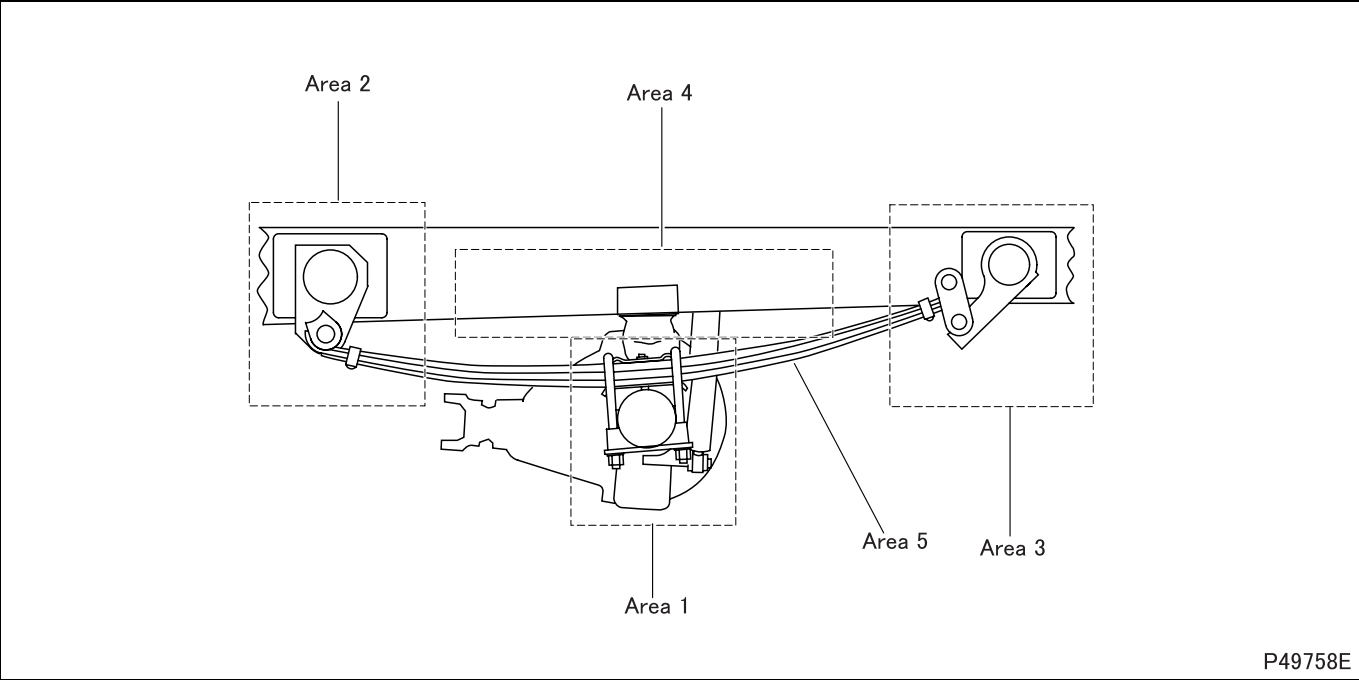
Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Shock absorber mounting)	26 to 33 {2.7 to 3.4}	—

LEAF SPRING

Leaf Spring Assembly Layout



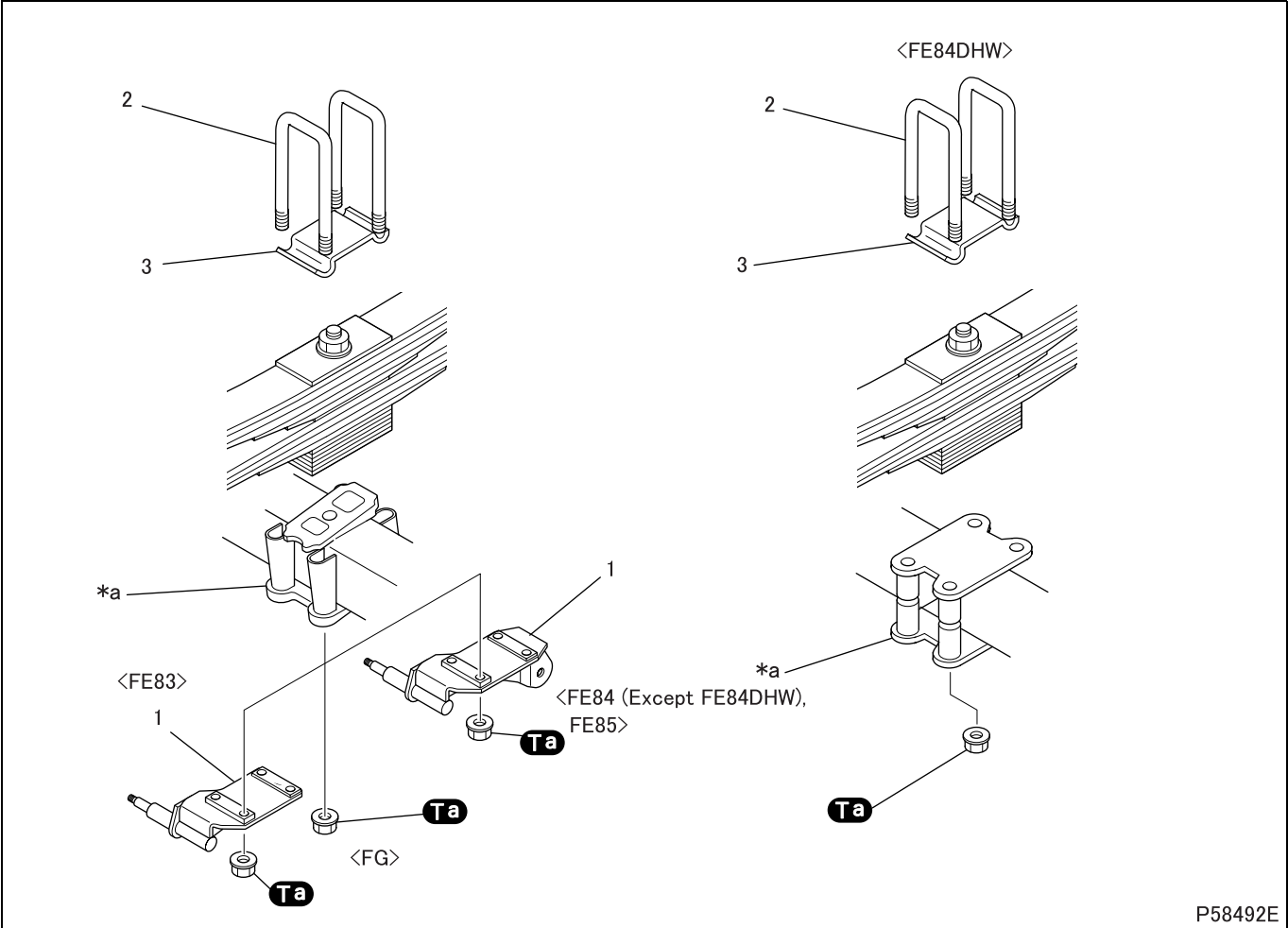
- This section divides the leaf spring in 5 areas and describes removal and installation procedures for each area. For information on specific components, refer to the corresponding area descriptions.

U-bolt	☐	Area 1 (Center section of leaf spring)
U-bolt nut	☐	
Spring pin	☐	Area 2 (Front section of leaf spring)
Bushing	☐	
Spring shackle	☐	Area 3 (Rear section of leaf spring)
Bushing	☐	
Helper rubber	☐	Area 4 (Stoppers)
Helper spring stopper	☐	
Leaf spring	☐	Area 5 (Leaf springs)

M E M O

LEAF SPRING

Area 1 (Center Section of Leaf Spring)



P58492E

● Removal sequence

- 1 Bracket <FE83>
Stabilizer bracket lower
<FE84 (Except FE84DHW), FE85>
- 2 U-bolt

3 Spring pad

*a: Rear axle

● Installation sequence

Follow the removal sequence in reverse.

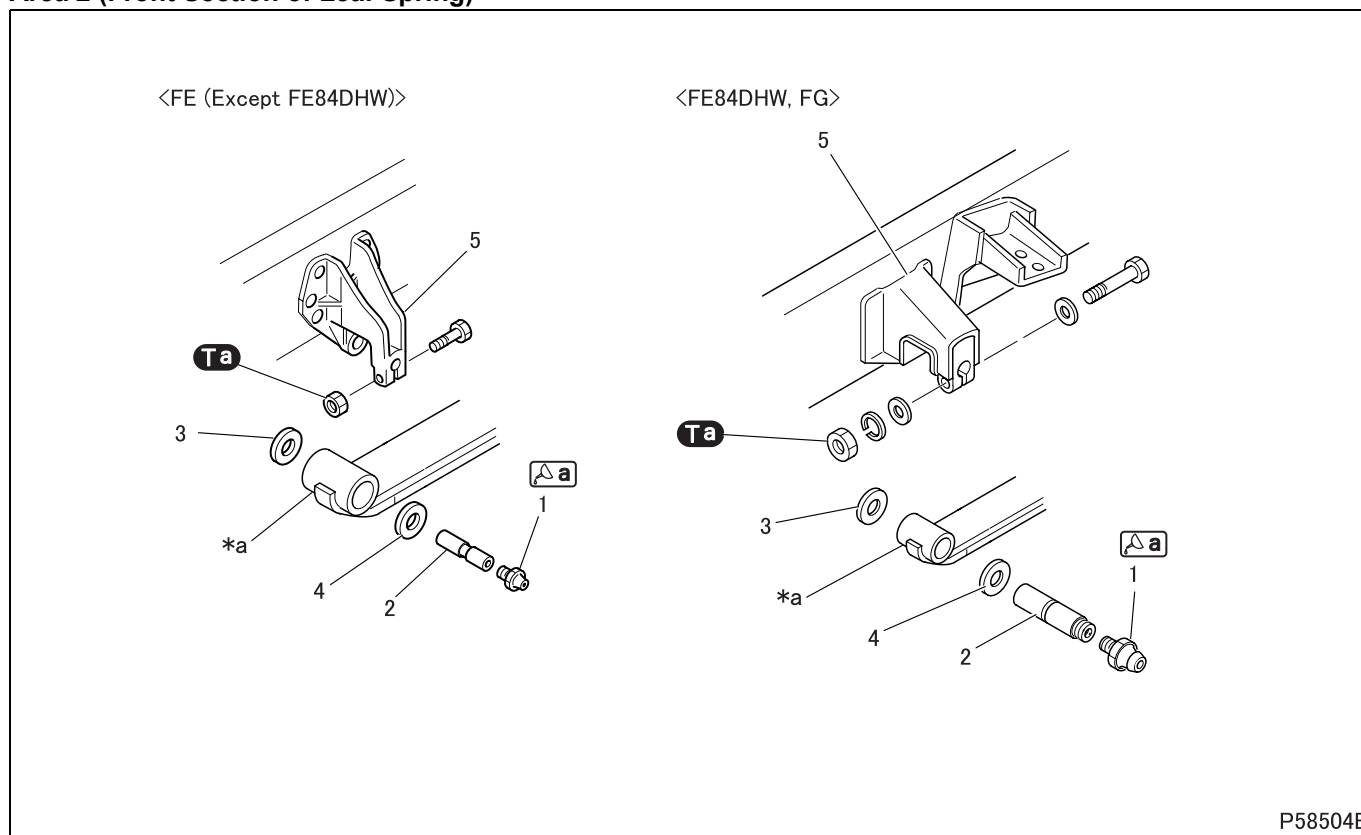
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened			Tightening torque	Remarks
Ta	Nut (U-bolt mounting)	M18	FE (Except FE84DHW)	292 to 394 {215 to 290, 29.8 to 40.2}	—
			FE84DHW	339.1 ± 51 {250 ± 38, 34.6 ± 5.2}	—
		M16	FG	240 ± 15 {175 ± 11, 24.5 ± 1.5}	—

M E M O

LEAF SPRING

Area 2 (Front Section of Leaf Spring)



P58504E

● Removal sequence

- | | |
|--------------------------------|----------------------|
| 1 Grease nipple | 5 Rear spring hanger |
| 2 Spring pin | |
| 3 Side washer (for adjustment) | |
| 4 Side washer (for adjustment) | *a: Leaf spring |

● Installation sequence

Follow the removal sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
2, 5	Clearance between spring pin and rear spring hanger		0 to 0.04 {0.0016}	0.3 {0.012}	Replace
2, *a	Clearance between spring pin and leaf spring bushing	FE (Except FE84DHW)	0 to 0.12 {0.0047}	0.3 {0.012}	Replace
		FE84DHW, FG	0.04 to 0.14 {0.0016 to 0.0055}	0.5 {0.020}	
5, *a	Clearance between rear spring hanger and leaf spring	FE (Except FE84DHW)	0.07 to 1.03 {0.0028 to 0.041}	1.3 {0.051}	Adjust or replace
		FE84DHW, FG	0.1 to 1.0 {0.0039 to 0.039}	1.0 {0.039}	

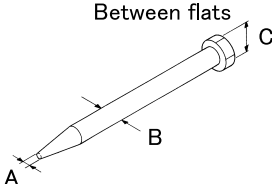
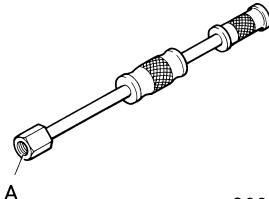
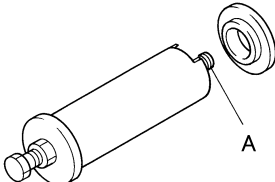
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

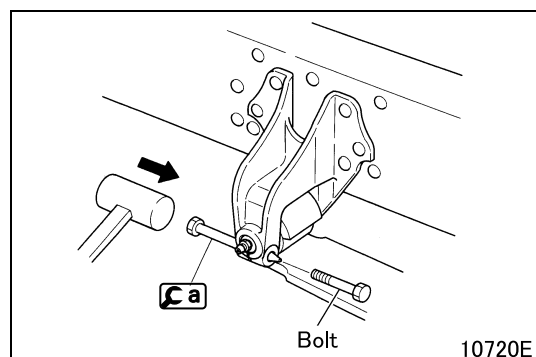
Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Nut (Spring pin mounting)	FE84DHW, FG	29 to 37 {21 to 27, 3.0 to 3.8}	—
		FE (Except FE84DHW)	80 to 110 {59 to 81, 8.0 to 11}	

Lubricant and/or sealant

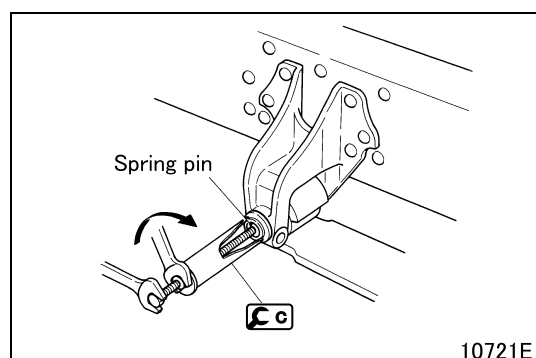
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Supply from grease nipple	Chassis grease [NLGI No. 1 (Li soap)]	As required

Special tools (Unit: mm {in.})

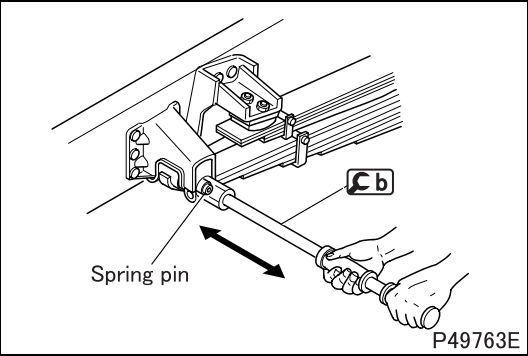
Mark	Tool name and shape	Part No.	Application						
	<FE (Except FE84DHW)> Shackle pin setting bar <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ4 {0.16}</td><td>φ12 {0.47}</td><td>17 {0.67}</td></tr></tbody></table>  Between flats 00452E	A	B	C	φ4 {0.16}	φ12 {0.47}	17 {0.67}	MC023419	Removal and installation of spring pin mounting bolt
	A	B	C						
φ4 {0.16}	φ12 {0.47}	17 {0.67}							
	<FE84DHW, FG> Spring pin remover <table border="1"><thead><tr><th>A</th></tr></thead><tbody><tr><td>M22 × 1.5</td></tr></tbody></table>  A 06350	A	M22 × 1.5	MB999112					
A									
M22 × 1.5									
	<FE (Except FE84DHW)> Spring pin remover <table border="1"><thead><tr><th>A</th></tr></thead><tbody><tr><td>PT 1/8</td></tr></tbody></table>  A 00453	A	PT 1/8	MH061452					
A									
PT 1/8									



■ Removal: Spring pin <FE (Except FE84DHW)>

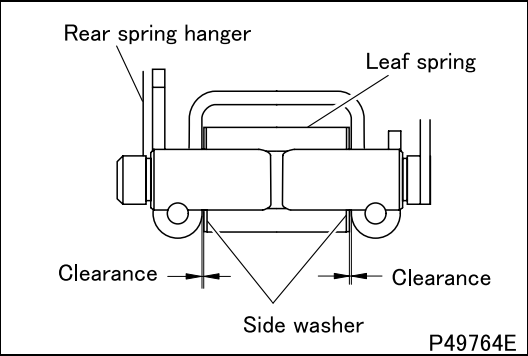


LEAF SPRING



<FE84DHW, FG>

◆ Inspection procedure ◆



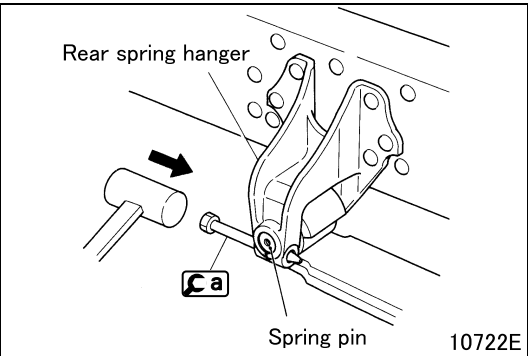
■ Inspection: Clearance between rear spring hanger and leaf spring

- Measure the spring-to-hanger clearance on both sides of the leaf spring. If the measured value is equal to or exceeds the limit, adjust by means of side washers.

Side washer sizes available (mm {in.})

FE (Except FE84DHW)	2.8, 3.2, 3.5, 3.8, 4.0 {0.11, 0.13, 0.14, 0.15, 0.16}
FE84DHW, FG	0.5, 1.0 {0.020, 0.039}

◆ Installation procedure ◆



■ Installation: Spring pin

<FE (Except FE84DHW)>

- Using **Ca**, align the bolt hole in the rear spring hanger with the bolt groove in the spring pin.

<FE84DHW, FG>

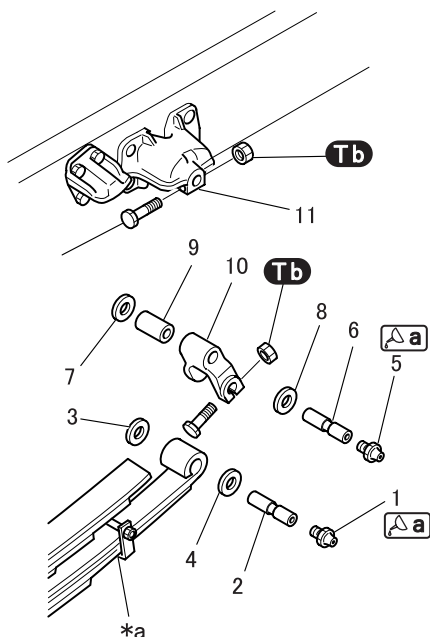
- Substitute an appropriate bolt or the like for **Ca**.

M E M O

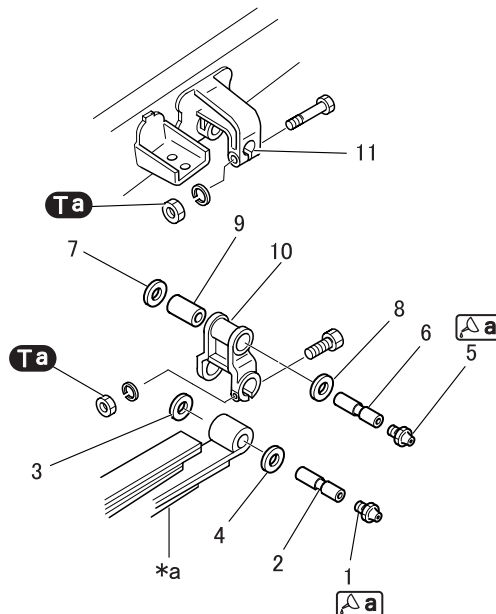
LEAF SPRING

Area 3 (Rear Section of Leaf Spring)

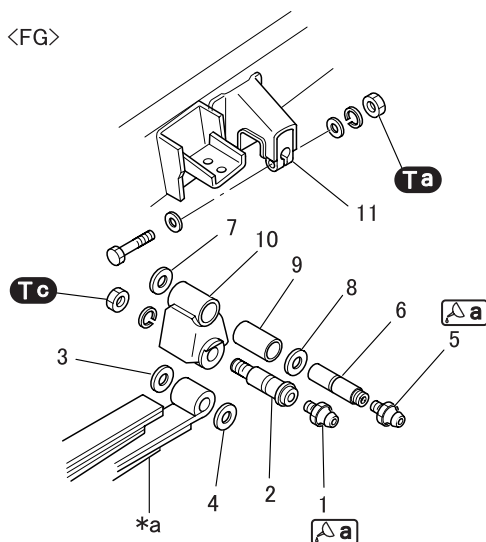
<FE (Except FE84DHW)>



<FE84DHW>



<FG>



P58505E

● Disassembly sequence

- | | |
|--------------------------------|--------------------------------|
| 1 Grease nipple | 8 Side washer (for adjustment) |
| 2 Spring pin | 9 Bushing |
| 3 Side washer (for adjustment) | 10 Spring shackle |
| 4 Side washer (for adjustment) | 11 Rear shackle hanger |
| 5 Grease nipple | |
| 6 Spring pin | |
| 7 Side washer (for adjustment) | |

*a: Leaf spring

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
2, 10	Clearance between spring pin and spring shackle		0 to 0.04 {0.0016}	0.3 {0.012}	Replace
2, *a	Clearance between spring pin and leaf spring	FE (Except FE84DHW)	0 to 0.12 {0.0047}	0.3 {0.012}	Replace
		FE84DHW, FG	0.04 to 0.14 {0.0016 to 0.0055}	0.5 {0.020}	
6, 9	Clearance between spring pin and bushing	FE (Except FE84DHW)	0.02 to 0.14 {0.00079 to 0.0055}	0.3 {0.012}	Replace
		FE84DHW, FG	0.04 to 0.14 {0.0016 to 0.0055}	0.5 {0.020}	
6, 11	Clearance between spring pin and rear shackle hanger		0 to 0.04 {0.0016}	0.3 {0.012}	Replace
10, 11	Clearance between spring shackle and rear shackle hanger	FE (Except FE84DHW)	0.07 to 0.73 {0.0028 to 0.029}	1.0 {0.039}	Adjust or replace
		FE84DHW	0.1 to 0.9 {0.0039 to 0.035}	1.0 {0.039}	
		FG	0.1 to 0.7 {0.0039 to 0.028}	1.0 {0.039}	
10, *a	Clearance between spring shackle and leaf spring	FE (Except FE84DHW)	0.07 to 1.03 {0.0028 to 0.041}	1.3 {0.051}	Adjust or replace
		FE84DHW	0.5 to 1.2 {0.020 to 0.047}	1.5 {0.059}	
		FG	0.1 to 0.7 {0.0039 to 0.028}	1.0 {0.039}	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

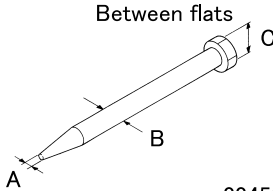
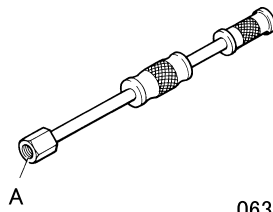
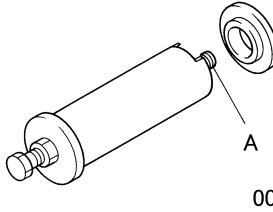
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Spring pin mounting)	29.4 to 37.2 {22 to 27, 3.0 to 3.8}	—
Tb	Nut (Spring pin mounting)	80 to 112 {59 to 83, 8.0 to 11}	—
Tc	Nut (Spring pin mounting)	148 to 201 {110 to 150, 15.1 to 20.5}	—

Lubricant and/or sealant

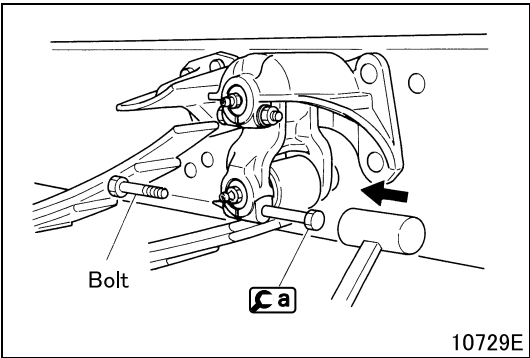
Mark	Points of application	Specified lubricant and/or sealant	Quantity
Ca	Supply from grease nipple	Chassis grease [NLGI No. 1 (Li soap)]	As required

LEAF SPRING

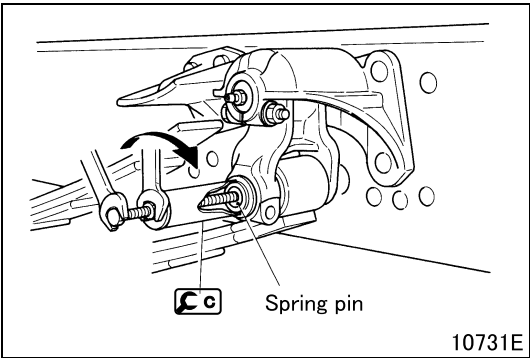
Special tools (Unit: mm {in.})

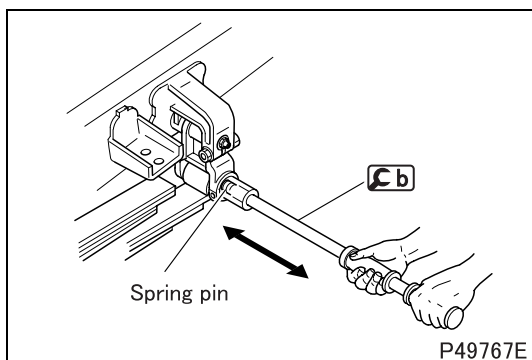
Mark	Tool name and shape	Part No.	Application						
 a	<FE (Except FE84DHW)> Shackle pin setting bar <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ4 {0.16}</td><td>φ12 {0.47}</td><td>17 {0.67}</td></tr></tbody></table>  00452E	A	B	C	φ4 {0.16}	φ12 {0.47}	17 {0.67}	MC023419	Removal and installation of spring pin mounting bolt
	A	B	C						
φ4 {0.16}	φ12 {0.47}	17 {0.67}							
 b	<FE84 , FG> Spring pin remover <table border="1"><thead><tr><th>A</th></tr></thead><tbody><tr><td>M22 × 1.5</td></tr></tbody></table>  06350	A	M22 × 1.5	MB999112					
A									
M22 × 1.5									
 c	<FE (Except FE84DHW)> Spring pin remover <table border="1"><thead><tr><th>A</th></tr></thead><tbody><tr><td>PT 1/8</td></tr></tbody></table>  00453	A	PT 1/8	MH061452					
A									
PT 1/8									

◆ Removal procedure ◆

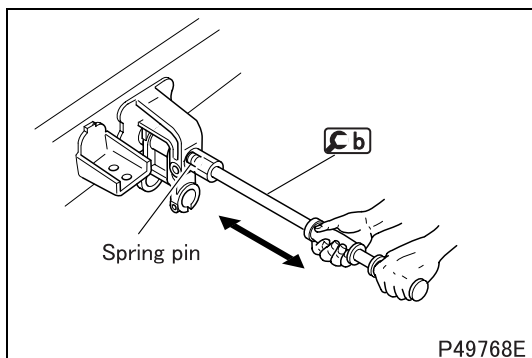


■ Removal: Spring pin <FE (Except FE84DHW)>



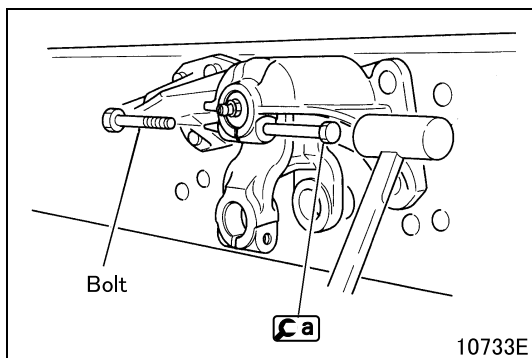


<FE84DHW>

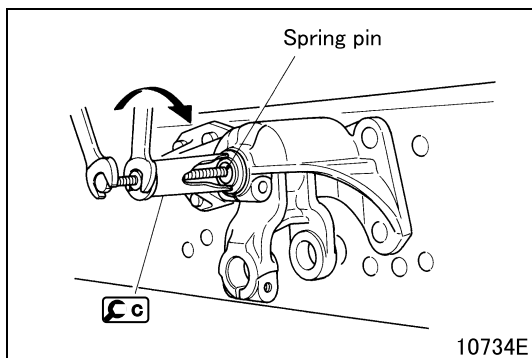


■ Removal: Spring pin

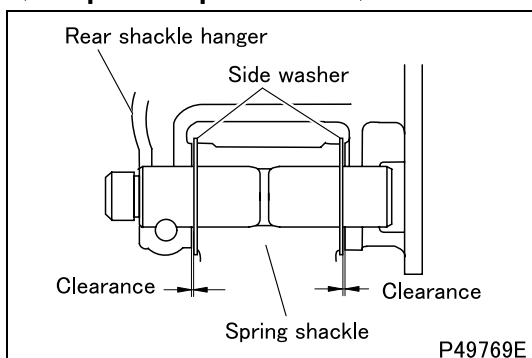
<FE84DHW, FG>



<FE (Except FE84DHW)>



◆ Inspection procedure ◆



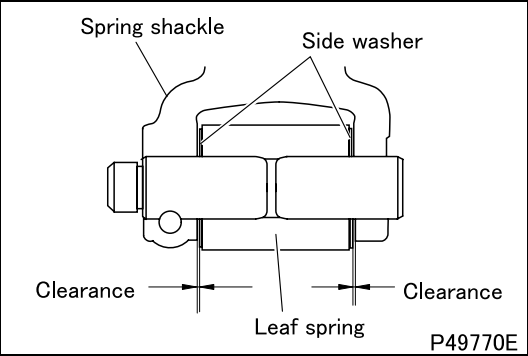
■ Inspection: Clearance between spring shackle and rear shackle hanger

- Measure the spring-to-hanger clearance on both sides of the leaf spring. If the measured value is equal to or exceeds the limit, adjust by means of side washers.

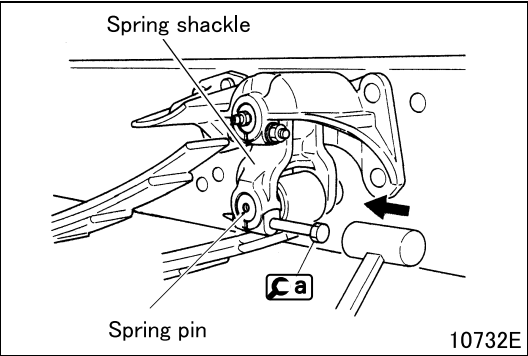
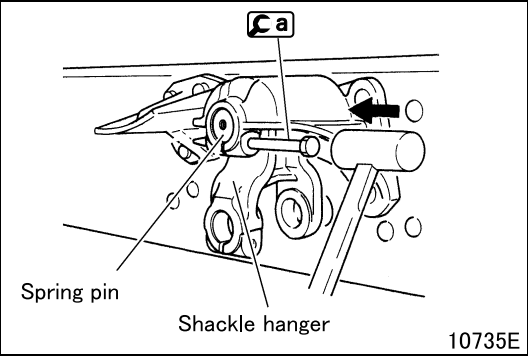
Side washer sizes available (mm {in.})

FE84DHW, FG	0.5, 1.0 {0.020, 0.039}
FE (Except FE84DHW)	2.8, 3.2, 3.5, 3.8, 4.0 {0.11, 0.13, 0.14, 0.15, 0.16}

LEAF SPRING



◆ Installation procedure ◆



■ Inspection: Clearance between spring shackle and leaf spring

- Measure the spring-to-hanger clearance on both sides of the leaf spring. If the measured value is equal to or exceeds the limit, adjust by means of side washers.

Side washer sizes available (mm {in.})

FE84DHW, FG	0.5, 1.0 {0.020, 0.039}
FE (Except FE84DHW)	2.8, 3.2, 3.5, 3.8, 4.0 {0.11, 0.13, 0.14, 0.15, 0.16}

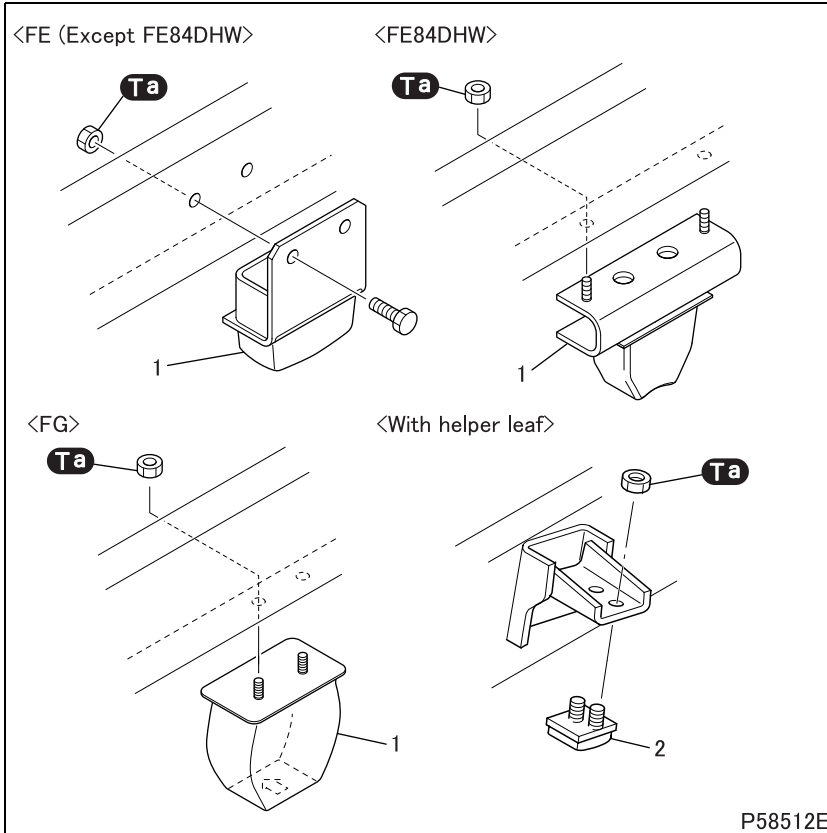
■ Installation: Spring pin

- <FE (Except FE84DHW)>
Using , align the bolt hole in the shackle hanger with the bolt groove in the spring pin.
- <FE84DHW, FG>
Substitute an appropriate bolt or the like for .

■ Installation: Spring pin

- <FE (Except FE84DHW)>
Using , align the bolt hole in the spring shackle with the bolt groove in the spring pin.
- <FE84DHW>
Substitute an appropriate bolt or the like for .

Area 4 (Stoppers)



● Removal sequence

- 1 Helper rubber
- 2 Helper spring stopper

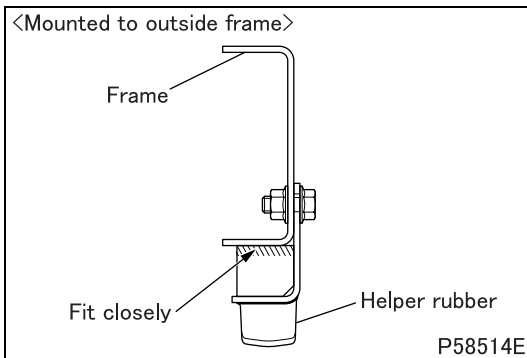
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Helper rubber mounting)	12 to 15 {8.9 to 11, 1.2 to 1.5}	—

◆ Installation procedure ◆



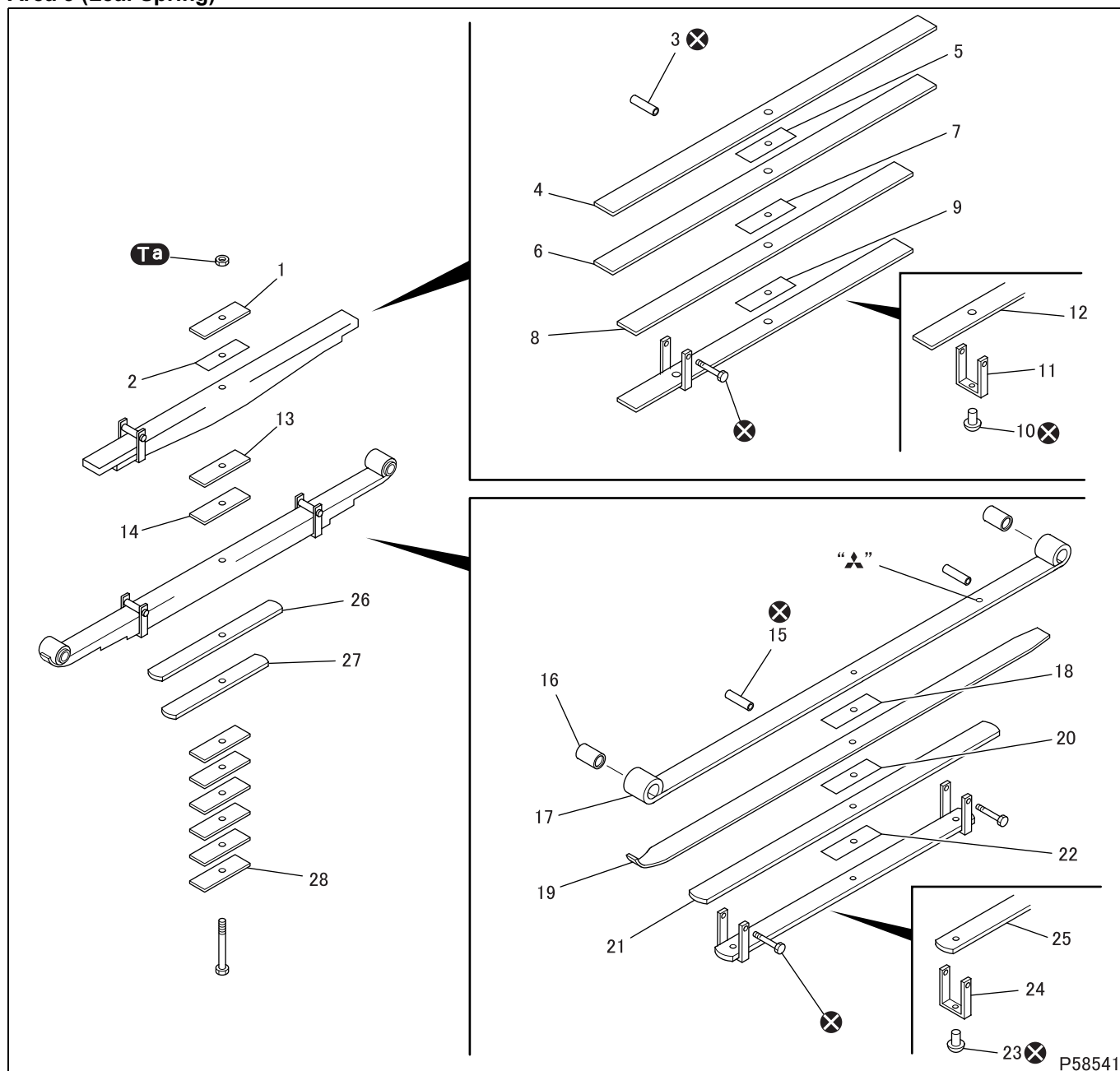
■ Installation: Helper rubber

<FE (Except FE84DHW)>

- Fit helper rubber to the lower face of frame closely as illustrated, then tighten installation bolt and nut.

LEAF SPRING

Area 5 (Leaf Spring)



● Disassembly sequence

- | | | |
|------------------------|----------------------------|-----------------------|
| 1 Spacer | 11 Clip | 21 Leaf spring (Main) |
| 2 Center spacer | 12 Leaf spring (Helper) | 22 Center spacer |
| 3 Pipe | 13 Spacer | 23 Rivet |
| 4 Leaf spring (Helper) | 14 Spacer | 24 Clip |
| 5 Center spacer | 15 Pipe | 25 Leaf spring (Main) |
| 6 Leaf spring (Helper) | 16 Metal bushing or collar | 26 Leaf spring (Main) |
| 7 Center spacer | 17 Leaf spring (Main) | 27 Leaf spring (Main) |
| 8 Leaf spring (Helper) | 18 Center spacer | 28 Spacer |
| 9 Center spacer | 19 Leaf spring (Main) | |
| 10 Rivet | 20 Center spacer | |

⊗: Non-reusable parts

NOTE

- The above schematic is only an example. Details may differ depending on vehicle models, such as the number of spring leaves, spacers, and the parts used.

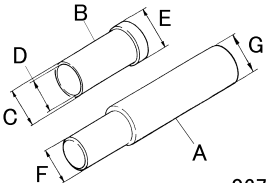
● **Assembly sequence**

Follow the disassembly sequence in reverse.

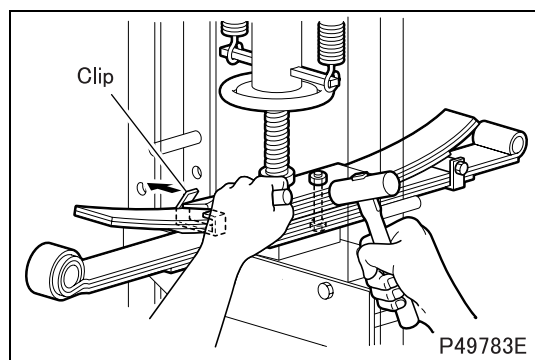
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Assembly of leaf spring)	69 to 93 {51 to 69, 7.0 to 9.5}	—

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application										
	Bushing installer A: Bushing installer A B: Bushing installer B  06790 <table><tr><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th></tr><tr><td>φ28 {1.10}</td><td>φ25 {0.98}</td><td>φ32.8 {1.29}</td><td>φ25 {0.98}</td><td>φ30 {1.18}</td></tr></table>	C	D	E	F	G	φ28 {1.10}	φ25 {0.98}	φ32.8 {1.29}	φ25 {0.98}	φ30 {1.18}	MB999066 A: MB999067 B: MB999068	Removal and installation of metal bushing
C	D	E	F	G									
φ28 {1.10}	φ25 {0.98}	φ32.8 {1.29}	φ25 {0.98}	φ30 {1.18}									

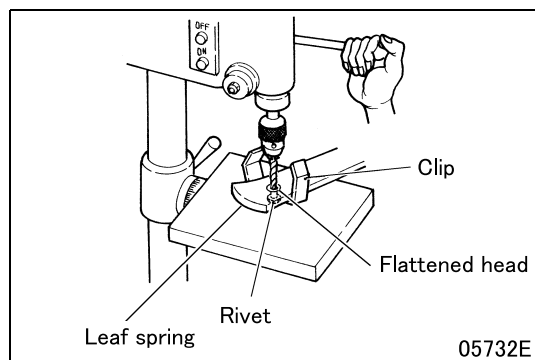
◆ **Work before removal** ◆



■ **Compression: Leaf spring**

- Using a press, compress the leaf spring as illustrated for subsequent operations.
- Using a chisel or the like, open the bent ends of the clip.

◆ **Removal procedure** ◆

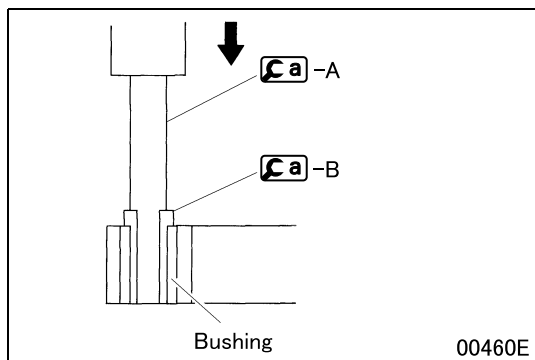


■ **Removal: Clip**

- Using a drill press, break the flattened head of the rivet and remove the clip from the leaf spring.

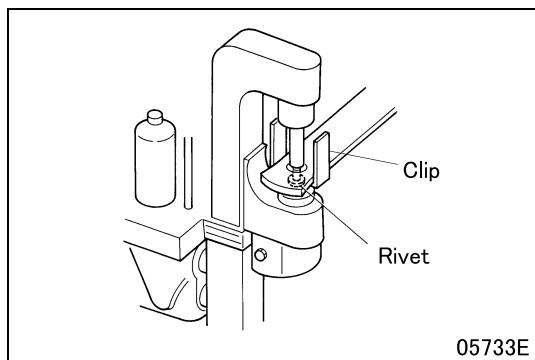
LEAF SPRING

◆ Installation procedure ◆



■ Removal: Metal bushing

◆ Installation procedure ◆



■ Installation: Clip

- Using a riveting machine, rivet a clip onto the leaf spring.

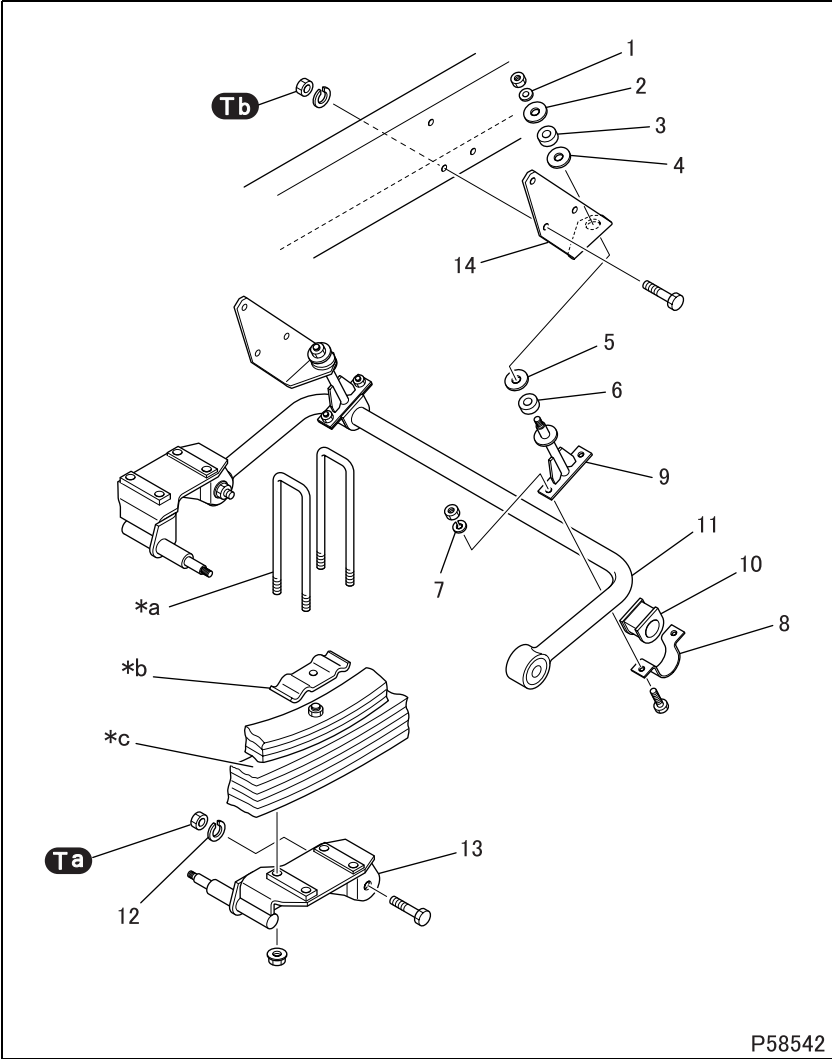
■ Installation: Metal bushing

- Install the metal bushing in a manner similar to that for removal.
(Refer to “■ Removal of metal bushing”.)

M E M O

STABILIZER

<FE84 (Except FE84DHW), FE85>



P58542

● Removal sequence

- 1 Washer
- 2 Seat
- 3 Bushing
- 4 Seat
- 5 Seat
- 6 Bushing
- 7 Washer
- 8 Clamp
- 9 Stabilizer hanger
- 10 Stabilizer bushing
- 11 Stabilizer bar
- 12 Washer
- 13 Stabilizer bracket tower
- 14 Stabilizer bracket upper

- *a:** U-bolt
***b:** Spring pad
***c:** Leaf spring

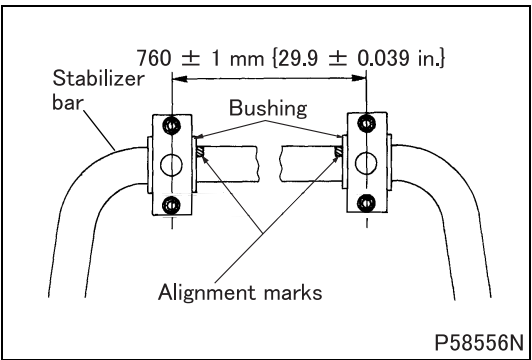
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

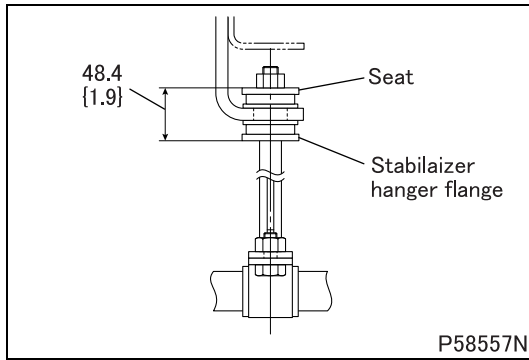
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Stabilizer bracket mounting)	410 to 550 {300 to 405, 41 to 56}	–
Tb	Nut (Stabilizer bracket mounting)	130 to 180 {96 to 130, 13 to 18}	–

◆ Installation procedure ◆



■ Installation: Stabilizer bushing

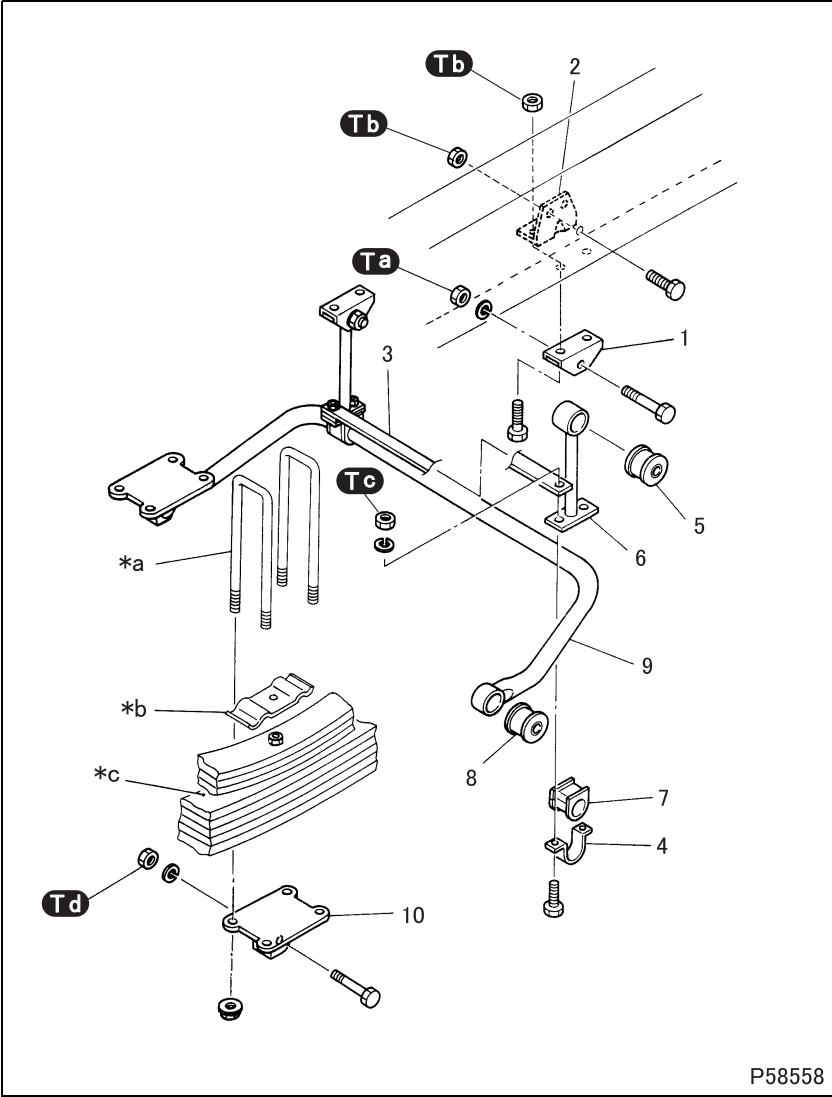
- Mount stabilizer bushings with their end surfaces aligned with marks on stabilizer bar.

**■ Installation: Stabilizer hanger**

- Tighten the mounting nut until the demension between the seat and stabilizer hanger flange becomes the amount as illustrated.

STABILIZER

<FE84DHW>



● Removal sequence

- 1 Stabilizer bracket
- 2 Stabilizer reinforcement
- 3 Plate
- 4 Clamp
- 5 Bushing
- 6 Stabilizer hanger
- 7 Stabilizer bushing
- 8 Bushing
- 9 Stabilizer bar
- 10 Stabilizer bracket

- *a: U-bolt
*b: Spring pad
*c: Leaf spring

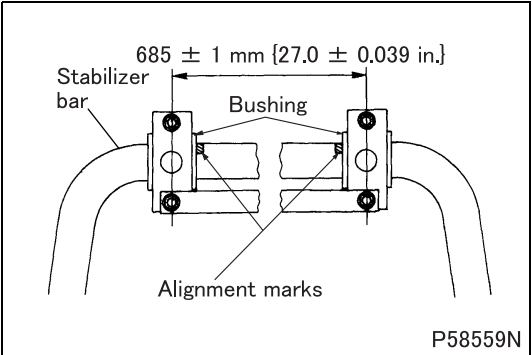
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Stabilizer bracket mounting)	78 to 95 {58 to 70, 8.0 to 9.7}	—
Tb	Nut (Stabilizer reinforcement mounting)	38 to 60 {28 to 44, 3.9 to 6.0}	—
Tc	Nut (Clamp and stabilizer hanger mounting)	12 to 15 {8.7 to 11, 1.2 to 1.5}	—
Td	Nut (Stabilizer bracket mounting)	70 to 95 {52 to 70, 7.0 to 9.5}	—

◆ Installation procedure ◆



■ Installation: Stabilizer bushing

- Mount stabilizer bushings with their end surfaces aligned with marks on stabilizer bar.



35A - Brake

35E - Anti-lock Brake System <ABS>

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 35A

Brake

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

GROUP 35A BRAKE

SPECIFICATIONS	35A-2
-----------------------------	--------------

STRUCTURE AND OPERATION

1. Brake System	35A-4
2. Vacuum Pump	35A-7
3. Vacuum Booster and Brake Master Cylinder	35A-8
4. Hydraulic Booster and Brake Master Cylinder	35A-14
5. Flow Priority Valve	35A-20
6. Front Disc Brake	35A-21
7. Front Drum Brake	35A-22
8. Rear Disc Brake	35A-25
9. Rear Drum Brake	35A-26
10.Exhaust Brake System	35A-27

TROUBLESHOOTING	35A-30
------------------------------	---------------

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Replacement of Brake Fluid	35A-34
2. Air Bleeding of Brake System	35A-36
3. Inspection and Adjustment of Brake Pedal Free Play	35A-40
4. Inspection and Adjustment of Brake Pedal Depressed Height from Floor	35A-40
5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal	35A-41
6. Inspection and Replacement of Disc Brake Pad	35A-42
7. Measurement of Disc Brake Drag Torque	35A-45
8. Inspection of Drum Brake Lining Thickness	35A-45
9. Initial Setting of Clearance between Brake Drum and Shoe ..	35A-46

10.Inspection of Check Valve in Vacuum Line Hose	35A-47
11.Inspection of Vacuum Pump	35A-47
12.Inspection of Vacuum Booster ..	35A-48
13.Inspection of Hydraulic Booster	35A-55

VACUUM PUMP.....	35A-58
-------------------------	---------------

BRAKE MASTER CYLINDER <WITH VACUUM BOOSTER>.....	35A-60
---	---------------

BRAKE MASTER CYLINDER <WITH HYDRAULIC BOOSTER>	35A-64
--	---------------

BRAKE PEDAL & VACUUM BOOSTER, HYDRAULIC BOOSTER.....	35A-66
---	---------------

FRONT DISC BRAKE <φ235 mm {9.25 in.} DISC>	35A-68
---	---------------

FRONT DISC BRAKE <φ252 mm {9.92 in.} DISC>	35A-72
---	---------------

FRONT DRUM BRAKE	35A-76
-------------------------------	---------------

REAR DISC BRAKE <φ235 mm {9.25 in.} DISC>	35A-82
--	---------------

REAR DISC BRAKE <φ252 mm {9.92 in.} DISC>	35A-84
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REAR DRUM BRAKE	35A-86
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EXHAUST BRAKE SYSTEM	35A-92
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SPECIFICATIONS

Vacuum Booster and Brake Master Cylinder

Item				Specifications		
				FG84		FE83
Vacuum booster	Boosting type			Vacuum tandem type		
	Diaphragm diameter inch			ϕ8 + ϕ9	ϕ9 + ϕ10	
	Manufacturer			BOSCH AUTOMOTIVE SYSTEMS		
Brake master cylinder	Inner diameter mm {in.}			ϕ30.16 {1.19}		ϕ31.75 {1.25}
	Stroke	Front	mm {in.}	17.4 {0.69}		16.0 {0.63}
		Rear	mm {in.}	14.6 {0.57}		16.0 {0.63}
	Manufacturer			NISSIN KOGYO		

Hydraulic Booster and Brake Master Cylinder

Item				Specifications		
				Hydraulic type		
Hydraulic booster	Boosting type			Hydraulic type		
	Manufacturer			BOSCH AUTOMOTIVE SYSTEMS		
Brake master cylinder	Inner diameter mm {in.}			$\phi 33.34 \{1.31\}$		
	Stroke	Front	mm {in.}	17.5 {0.69}		
		Rear	mm {in.}	16.0 {0.63}		
	Manufacturer			BOSCH AUTOMOTIVE SYSTEMS		

Front Disc Brake

Item				Specifications	
				FE83, FE84	FE85
Brake type				Twin caliper type	
Effective diameter for braking mm {in.}				$\phi 235 \{9.25\}$	$\phi 252 \{9.92\}$
Disc rotor outer diameter $\times$ thickness mm {in.}				$\phi 293 \times 40 \{11.5 \times 1.57\}$	$\phi 310 \times 40 \{12.2 \times 1.57\}$
Caliper piston inner diameter mm {in.}				$\phi 51.1 \{2.01\}$	$\phi 54 \{2.13\}$
Thickness of pad mm {in.}				14 {0.55}	14 {0.55}

Front Drum Brake

Item				Specifications	
				2-leading type (with auto adjuster)	
Brake type				2-leading type (with auto adjuster)	
Wheel cylinder inner diameter mm {in.}				$\phi 31.75 \{1.25\}$	
Brake drum inner diameter mm {in.}				$\phi 320 \{12.6\}$	
Brake lining width $\times$ thickness mm {in.}				$75 \times 8.8 \{2.95 \times 0.35\}$	

Rear Disc Brake

Item		Specifications	
		FE83, FE84	FE85
Brake type		Twin caliper type	
Effective diameter for braking	mm {in.}	φ235 {9.25}	φ252 {9.92}
Disc rotor outer diameter × thickness	mm {in.}	φ293 × 40 {11.5 × 1.57}	φ310 × 40 {12.2 × 1.57}
Caliper piston inner diameter	mm {in.}	φ51.1 {2.01}	φ54 {2.13}
Thickness of pad	mm {in.}	14 {0.55}	14 {0.55}

Rear Drum Brake

Item		Specifications
Brake type		Dual 2-leading type (with auto adjuster)
Wheel cylinder inner diameter	mm {in.}	φ28.57 {1.12}
Brake drum inner diameter	mm {in.}	φ320 {12.6}
Brake lining width × thickness	mm {in.}	75 × 8.8 {2.95 × 0.35}

Vacuum Pump

Item	Specifications
Type	Vane type
Output	cm ³ {cu.in.}
Manufacturer	Mitsubishi Electric Corporation

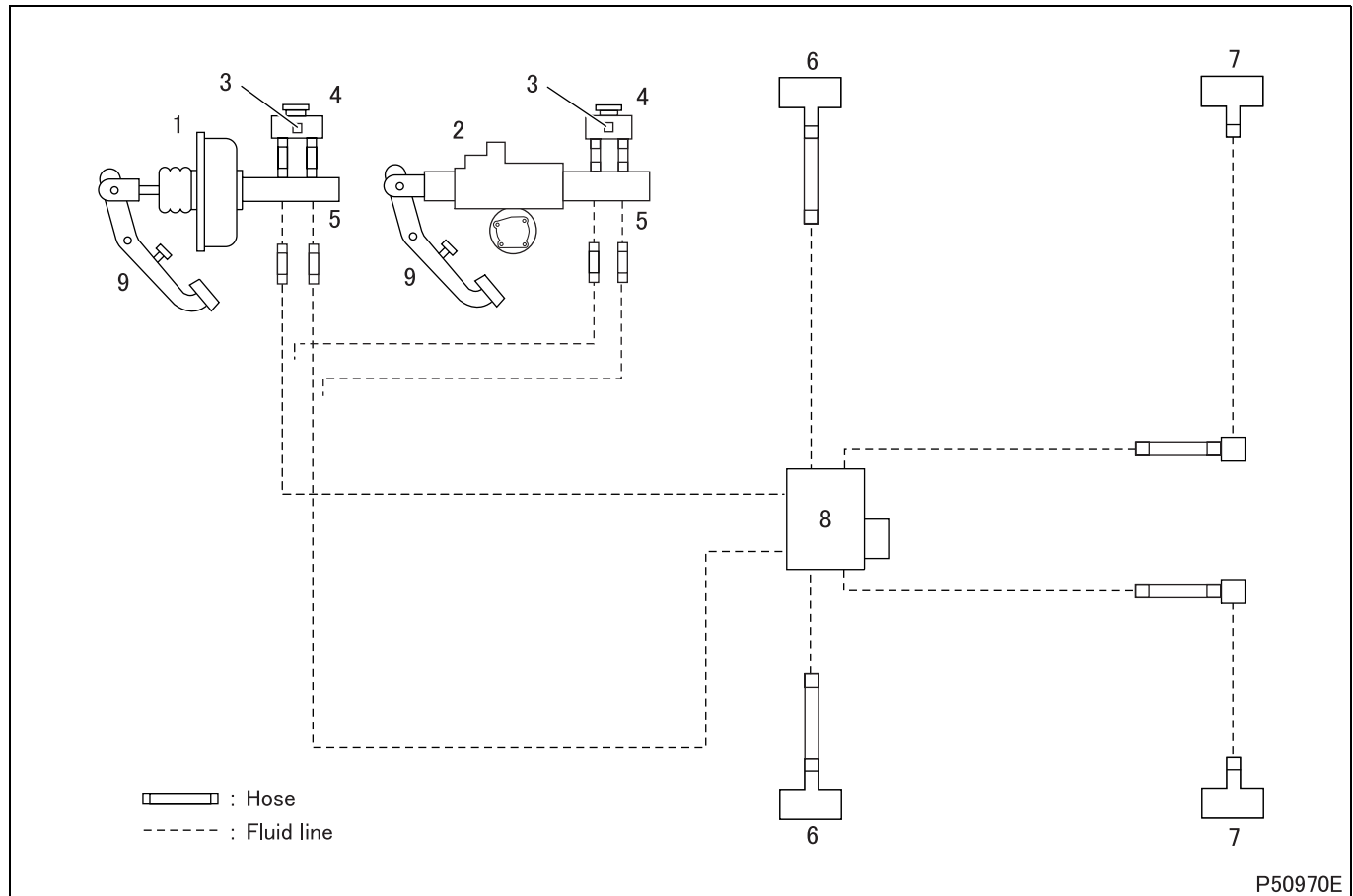
Exhaust Brake

Item	Specifications
Control type	Combined electric and vacuum control
Valve type	Butterfly valve type

STRUCTURE AND OPERATION

1. Brake System

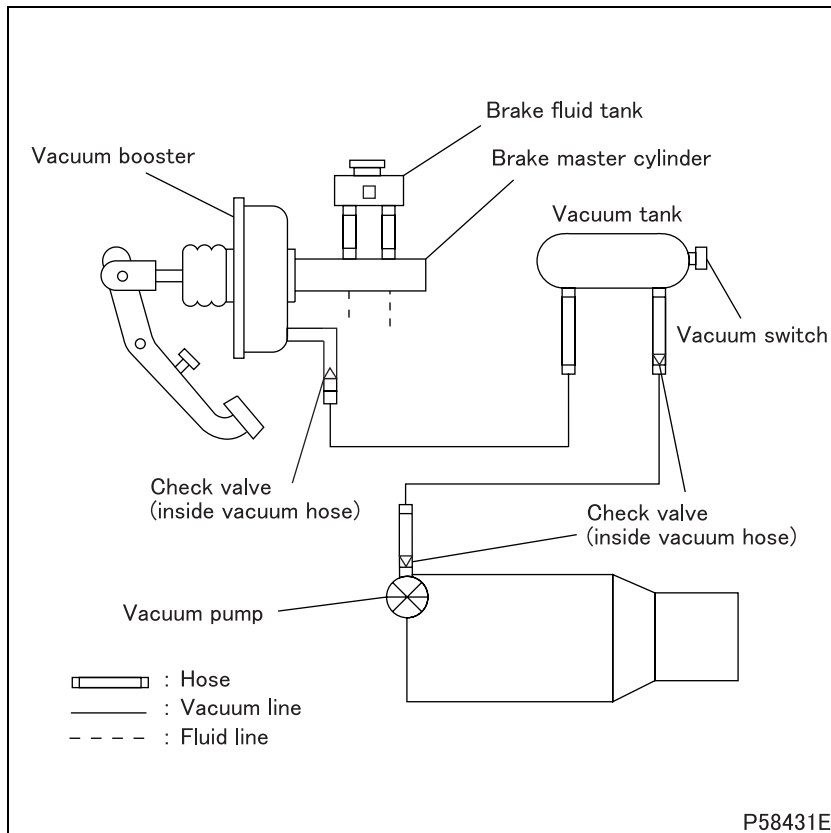
1.1 Brake fluid line



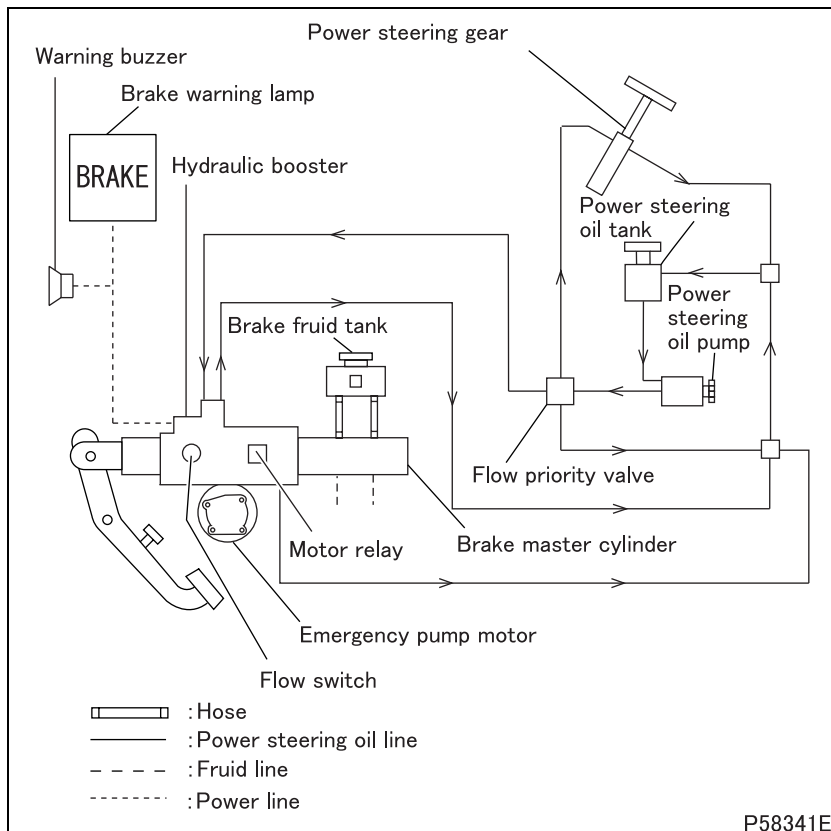
- | | |
|----------------------------|---|
| 1 Vacuum booster | 6 Front wheel brake |
| 2 Hydraulic booster | 7 Rear wheel brake |
| 3 Brake fluid level switch | 8 Hydraulic unit (anti-lock brake system) |
| 4 Brake fluid tank | 9 Stop lamp switch |
| 5 Brake master cylinder | |

- The brake system incorporating the vacuum booster uses vacuum to provide servo-assisted braking to all wheels of the vehicle onto which it is mounted.
- The brake system incorporating the hydraulic booster uses the power steering oil pump pressure to provide servo-assisted braking to all wheels of the vehicle onto which it is mounted.

1.2 Vacuum booster line



1.3 Hydraulic booster line



- The stepping force applied on the brake pedal is boosted by the hydraulic booster which operates on the pressure provided by the power steering oil pump.
- When brakes are applied hard while the steering wheel is turned, the associated steering shock is dampened by the flow priority valve in the system.
- When engine stall, power steering oil pump failure, or oil leakage from the power steering line causes oil pressure to drop, the flow switch detects this. This causes the motor relay to switch over, providing power to the emergency pump motor which then turns to generate emergency oil pressure.

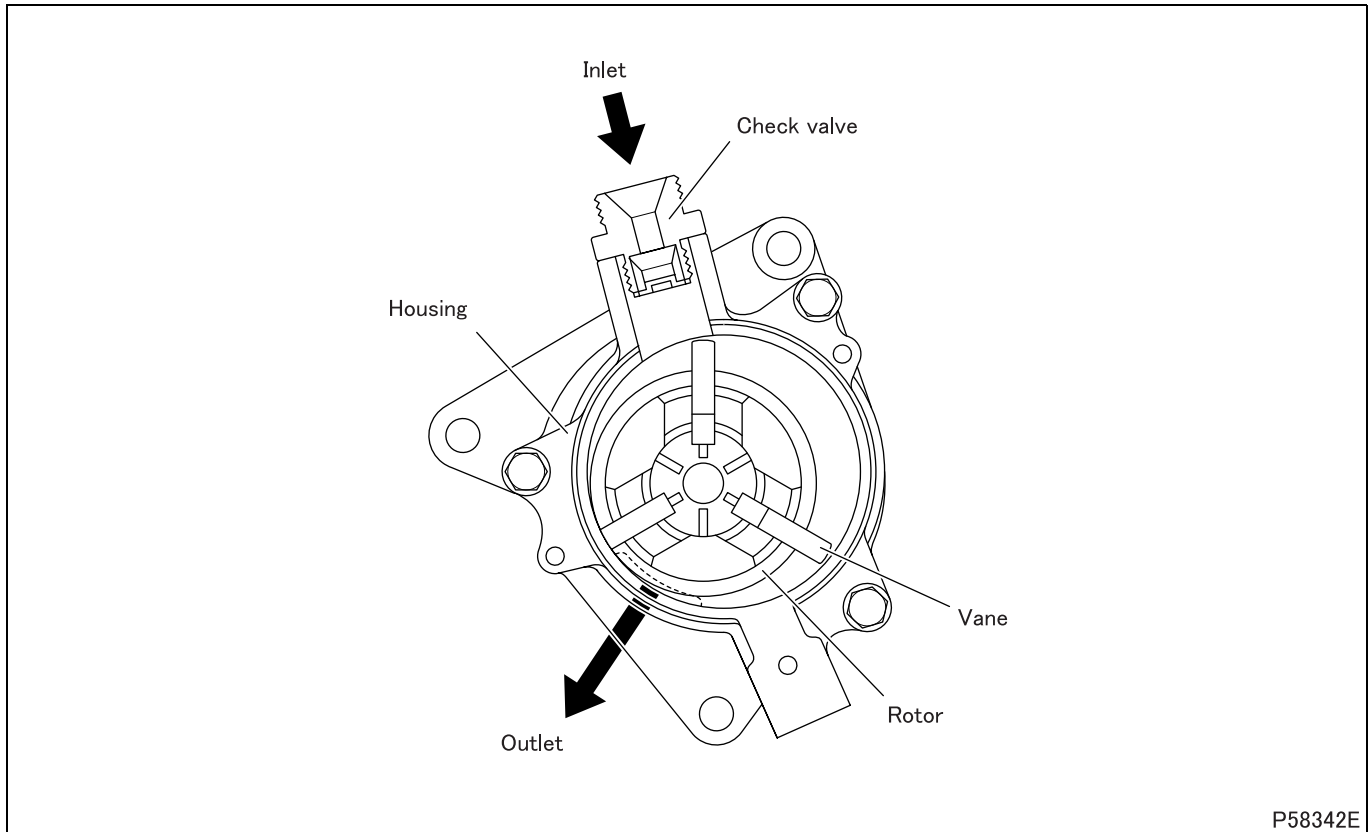
STRUCTURE AND OPERATION

- The emergency pump motor operates only when the brake pedal is depressed. The motor has various operating modes, as summarized below.

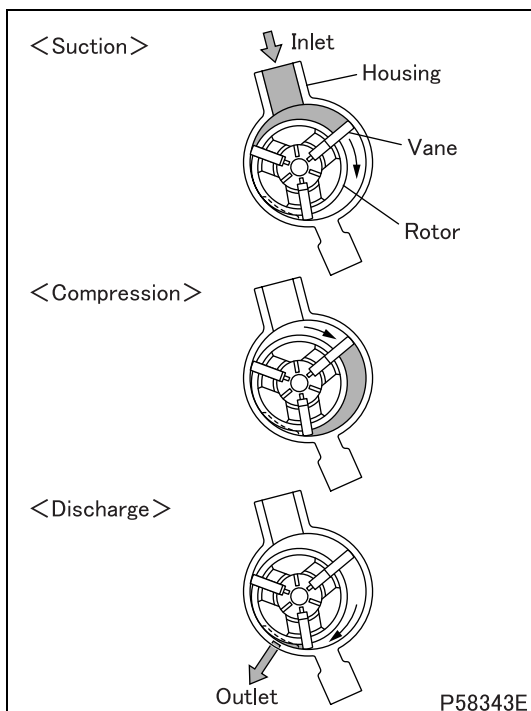
Starter switch	Engine	Parking switch	Warning		Power steering oil pressure	Emergency pump motor O: ON x: OFF	Vehicle state
			Brake warn- ing lamp O: ON x: OFF	Warning buzzer O: ON x: OFF			
ON	Run	ON (pulled)	O	×	Available	×	Normal
			O	×	Not available	O	* Oil leakage from power steering line
		OFF (released)	×	×	Available	×	Normal
			O	O	Not available	O	* Oil leakage from power steering line
	Stop	ON (pulled)	O	×		O	At engine start
						O	Engine stalled at uphill start
		OFF (released)	O	O		O	Engine stall
OFF	Stop	ON (pulled)	×	×		O	Vehicle moved after parked (parking brake lever pulled insufficiently)
		OFF (released)	×	×		O	Engine stopped before vehicle came to complete halt

*: The failsafe feature of the hydraulic booster cuts off oil supply to the power steering line to maintain oil pressure.

2. Vacuum Pump



- The vacuum pump is mounted onto the timing gear case, and is driven by the idler gear.
- The check valve is provided to ensure that no air or engine oil flow from the vacuum pump back to the vacuum tank when the engine is stationary.



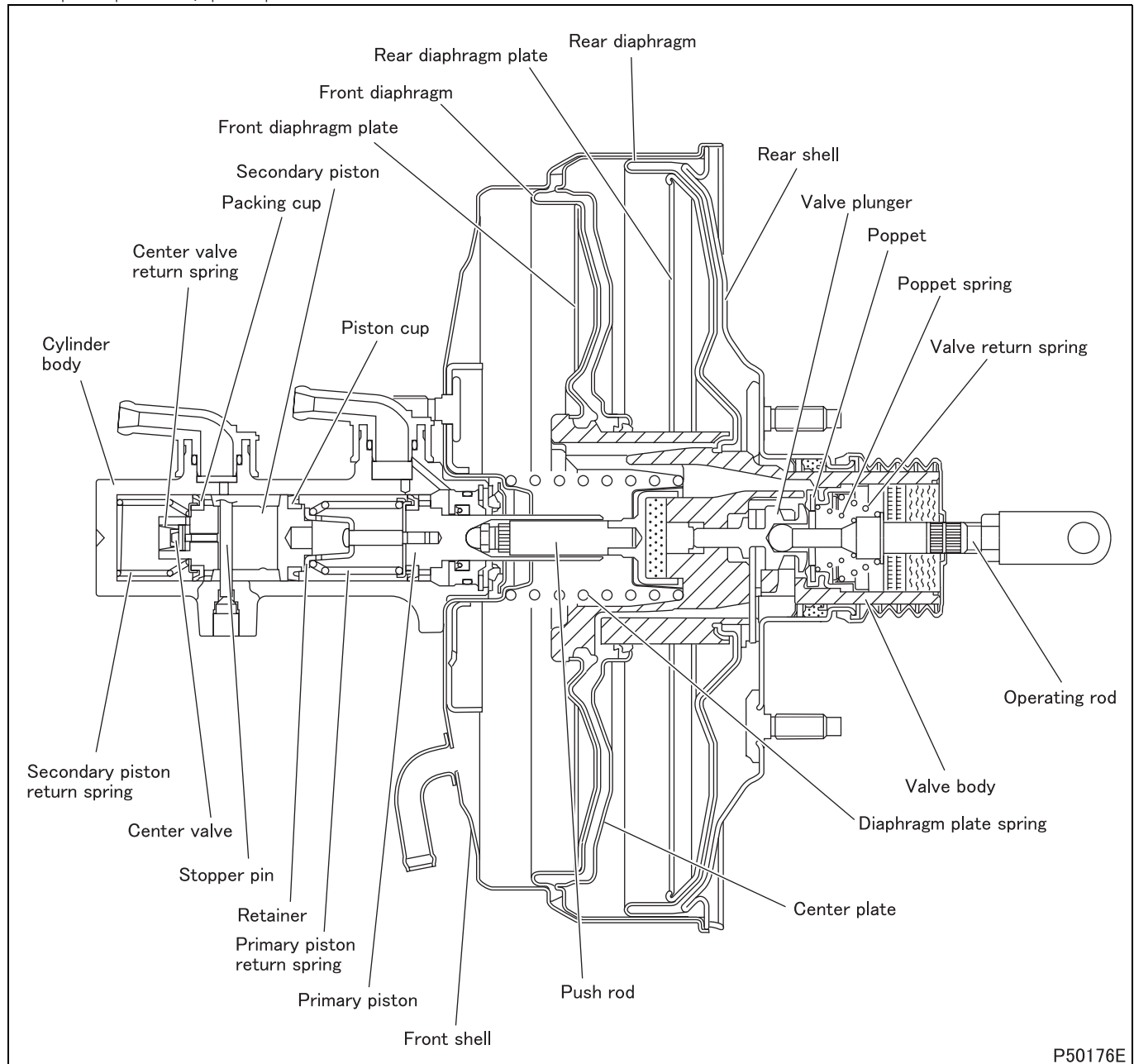
2.1 Operation

- A rotor with 3 movable vanes is housed in a cylindrical housing. As the rotor rotates, the vanes are pressed against the inner face of the housing by centrifugal force.
- The rotor is eccentrically mounted relative to the housing. As the rotor rotates, air in the vacuum tank is sucked through the pump inlet and then compressed before being discharged through the outlet. The suction-compression-discharge cycle is repeated to generate vacuum in the vacuum tank.
- The inside of the housing is lubricated and cooled by engine oil. After lubrication/cooling, the engine oil together with the compressed air is returned through the pump outlet and into the oil pan.

STRUCTURE AND OPERATION

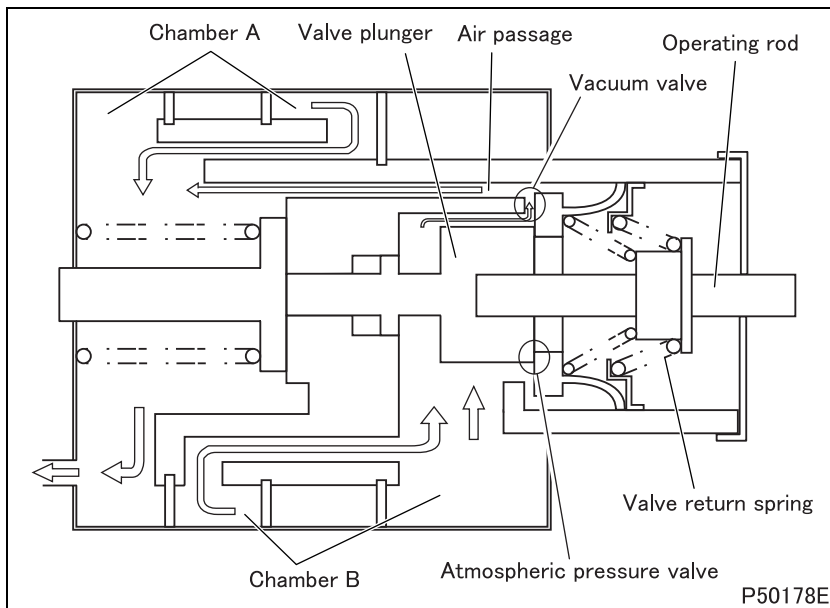
3. Vacuum Booster and Brake Master Cylinder

3.1 $\phi 8 + \phi 9$ inch, $\phi 9 + \phi 10$ inch vacuum booster



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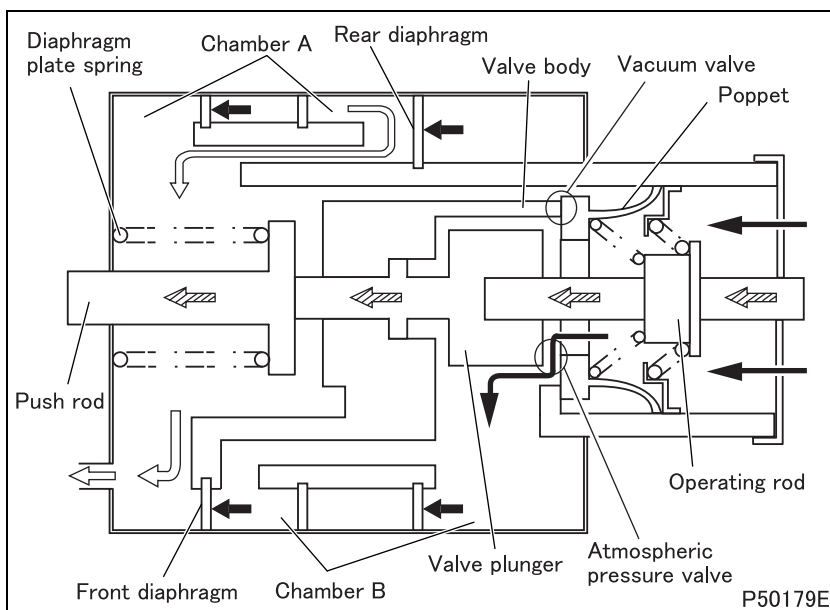
- The vacuum booster magnifies the stepping force applied onto the brake pedal (therefore reduces the operator's pedal effort) through the utilization of pressure difference between the vacuum it generates and the atmospheric pressure. The system is of a tandem type and has 2 vacuum chambers, achieving size reduction while offering a great capacity for highly efficient boosting performance.
- The brake master cylinder serves both the front and rear brake systems that are independent of each other. Should fluid leakage occur in either the front or rear brake system, stopping power can still be provided by which-ever system is intact.



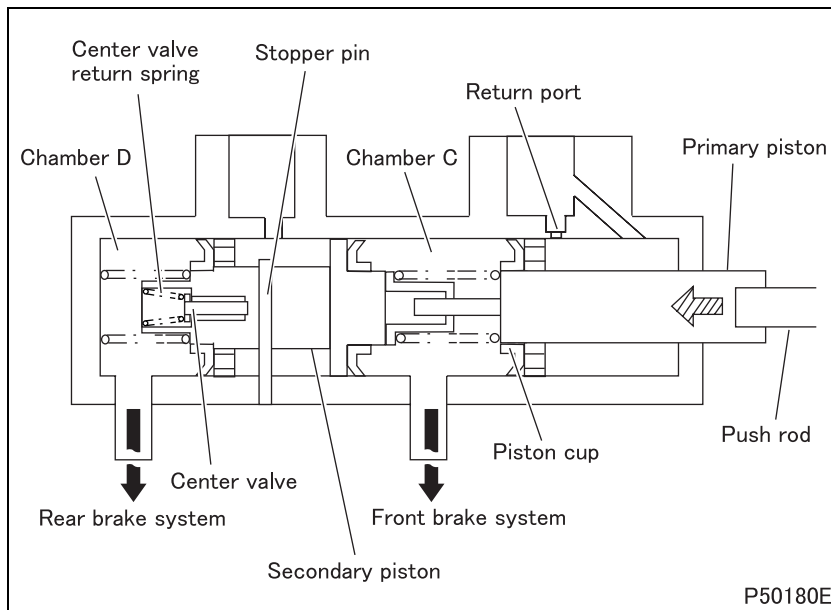
(1) When brake pedal is depressed

(1.1) Vacuum booster operation

- With the brake pedal released and no stepping force applied to the brake pedal, the operating rod and the valve plunger are held to the right by the force of the valve return spring. The atmospheric pressure valve remains closed while the vacuum valve remains open.
- The vacuum pump creates vacuum in chamber **A**. As the atmospheric pressure valve is closed, no outside air flows into chamber **B**. Instead, vacuum in chamber **A** flows through the air passage and into chamber **B**. Chambers **A** and **B** are both filled with vacuum, and there is no pressure difference between the chambers. No boosting occurs.
- As the brake pedal is depressed, the stepping force acts on the operating rod. This seats the poppet onto the valve body, closing the vacuum valve and cutting off vacuum supply into chamber **B**. As the brake pedal is depressed further, the valve plunger separates from the poppet. This opens the atmospheric pressure valve, allowing outside air into chamber **B**. There is now a pressure difference between chambers **A** and **B**.
- The stepping force, boosted as a result of the pressure difference between chambers **A** and **B**, overcomes the force of the diaphragm plate spring, pushing the front and rear diaphragms and the push rod to operate the brake master cylinder.

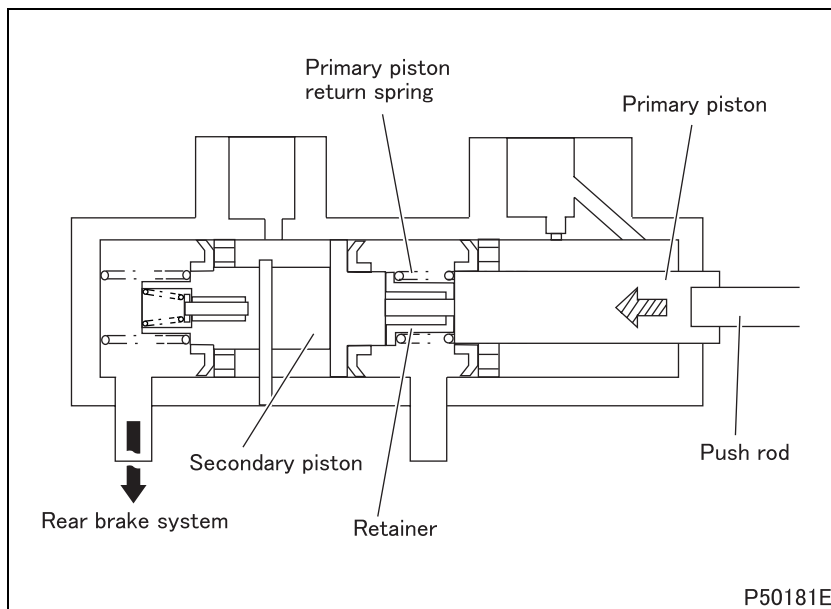


STRUCTURE AND OPERATION



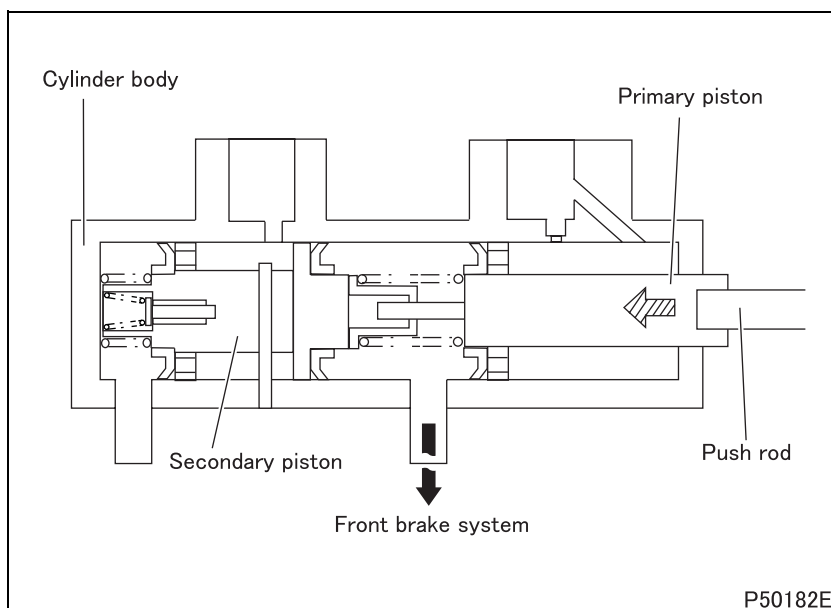
(1.2) Brake master cylinder operation

- As the push rod pushes the primary piston, the return port is closed by the piston cup. Fluid pressure now builds up in chamber C.
- The pressure buildup is sent to the front brake system and at the same time pushes the secondary piston.
- The center valve in front of the secondary piston separates from the stopper pin. The center valve return spring now closes the center valve, seating it onto the secondary piston.
- Fluid pressure now builds up in chamber D in front of the secondary piston, and the pressure is sent to the rear brake system.



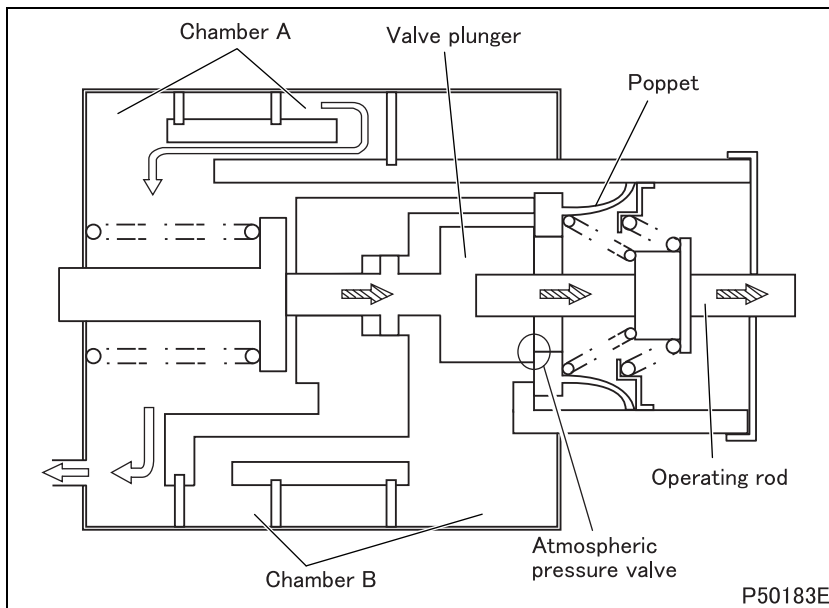
(2) Fluid leakage in front brake system

- As the brake pedal is depressed, the push rod moves to push the primary piston. As there is fluid leakage in the front brake system, no fluid pressure builds up in that system.
- As the brake pedal is depressed further, the primary piston overcomes the force of the primary piston return spring and, via the retainer, pushes the secondary piston. Fluid pressure is now sent to the rear brake system.



(3) Fluid leakage in rear brake system

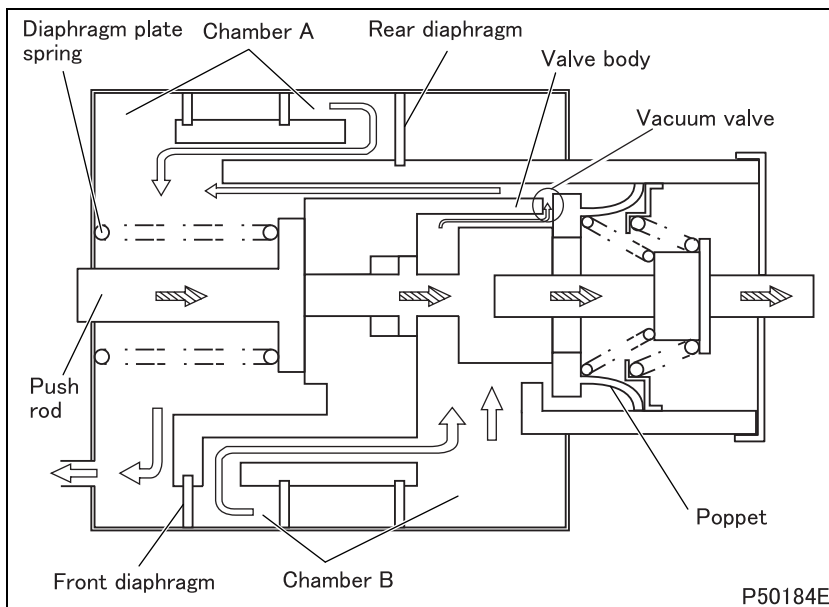
- As the brake pedal is depressed, the push rod moves to push the primary and secondary pistons. As there is fluid leakage in the rear brake system, no pressure builds up in that system.
- As the brake pedal is depressed further, the tip of the secondary piston contacts the cylinder body while the primary piston continues to be pushed. Fluid pressure builds up further in the front brake system.



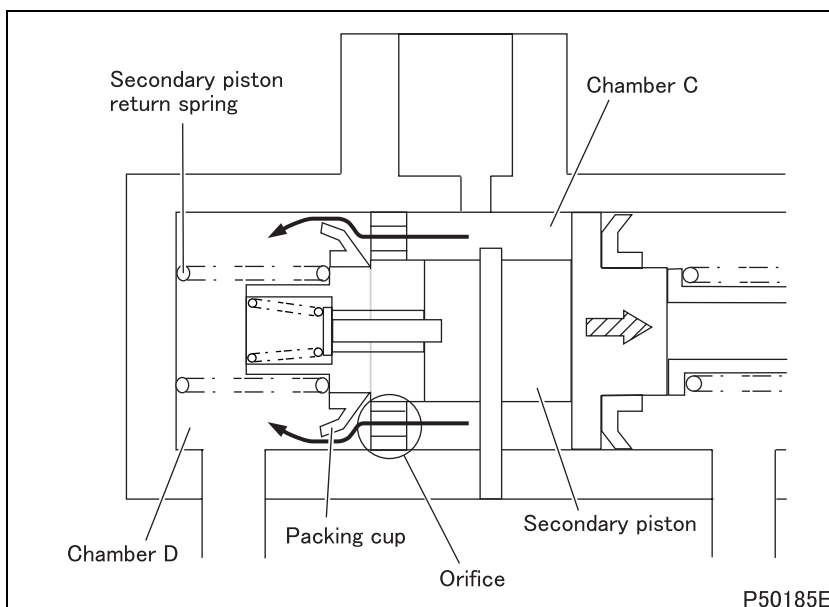
(4) When brake pedal is released

(4.1) Vacuum booster operation

- With the brake pedal depressed, chamber **A** is filled with vacuum generated by the vacuum pump while chamber **B** is open to the atmosphere. When the brake pedal is released, the stepping force no longer acts on the operating rod. This causes the valve plunger to seat on the poppet, closing the atmospheric pressure valve and cutting off air flow into chamber **B**.



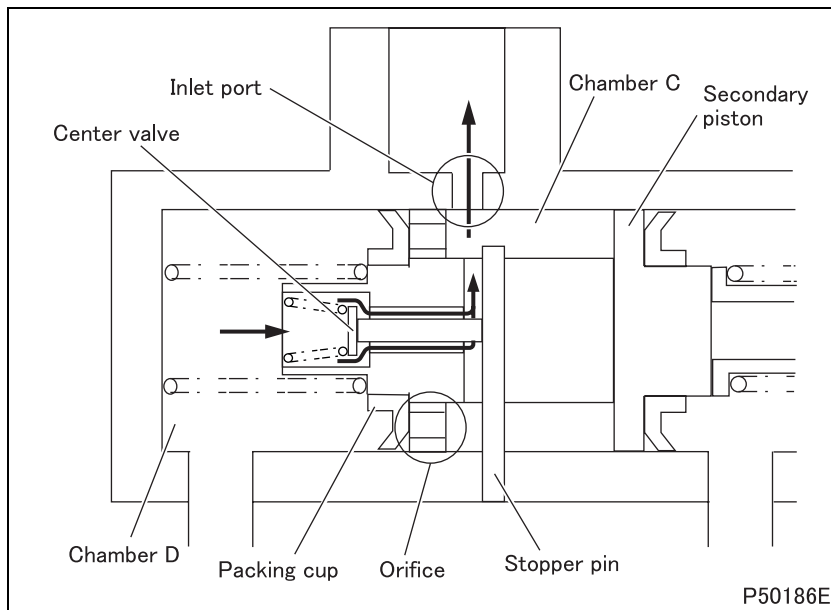
- In further progression, the poppet separates from the valve body. This opens the vacuum valve, allowing vacuum from the vacuum pump to flow into chamber **B**. As there is now no pressure difference between chambers **A** and **B**, the diaphragm plate spring pushes back the front and rear diaphragms and also the push rod to their original positions.



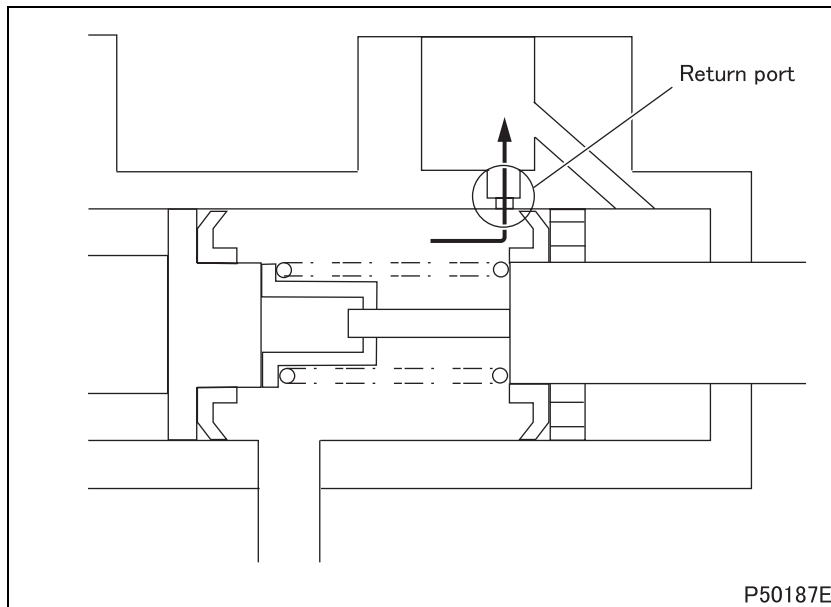
(4.2) Brake master cylinder operation

- As the push rod returns to its original position, the secondary piston immediately starts to be pushed back by the force of the secondary piston return spring. The speed of return is gradual as there is no difference between chambers **C** and **D** in fluid pressure supplied by the brake master cylinder.
- As the secondary piston starts to return to its original position, the pressure in chamber **D** becomes lower than the pressure in chamber **C**. The pressure difference causes the packing cup to buckle, allowing the fluid pressure in chamber **C** to flow through the orifices and into chamber **D**.

STRUCTURE AND OPERATION



- With the secondary piston back in its original position, there is no difference in fluid pressure between chambers **C** and **D**. The packing cup restores its original shape, blocking the orifices. The liquid pressure in the brake line now flows through the center valve, which has been open since hitting the stopper pin. The liquid pressure then returns through the inlet port to the brake fluid tank.

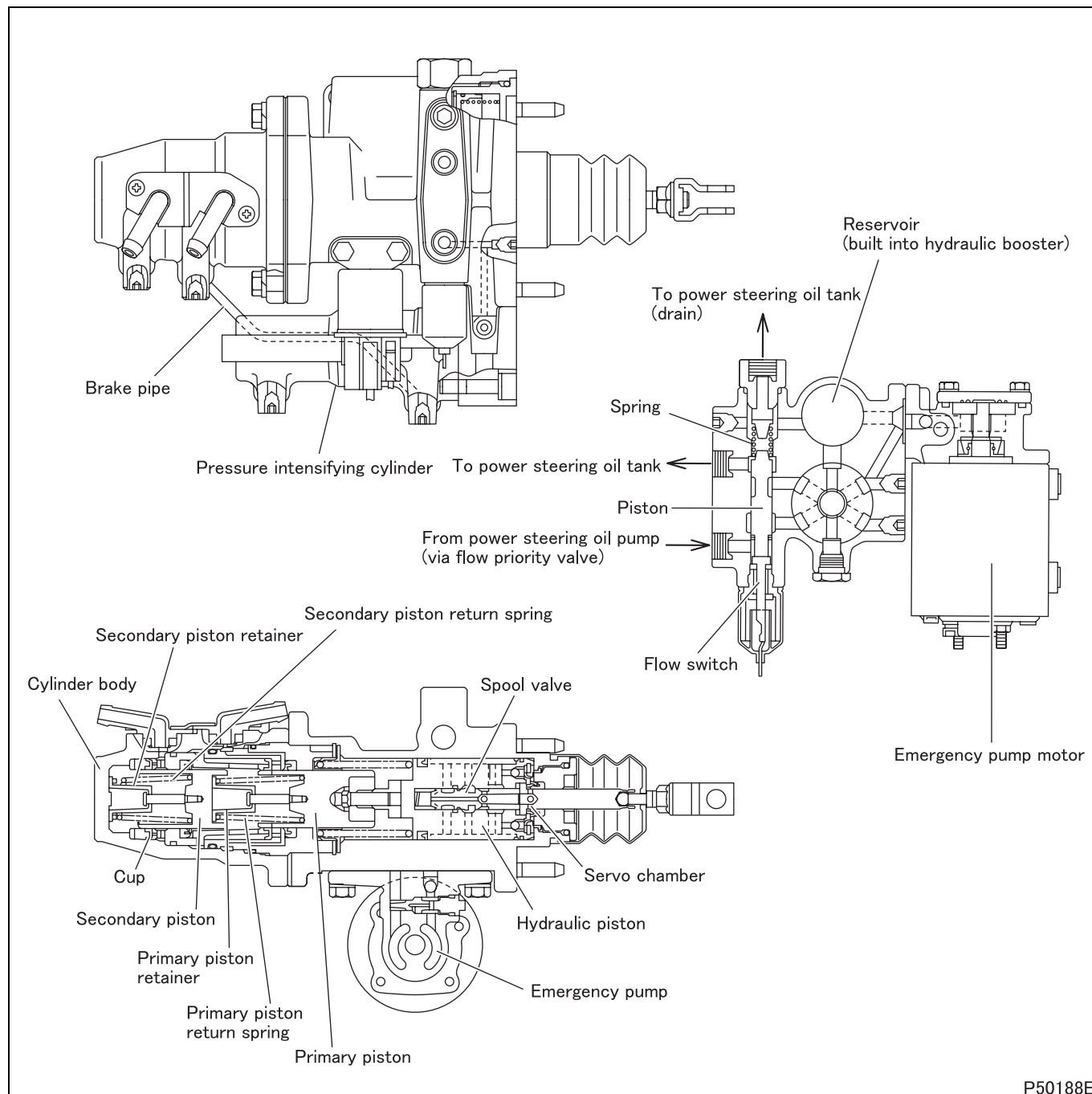


- The fluid pressure in the primary (front) brake line returns through the return port to the brake fluid tank.

M E M O

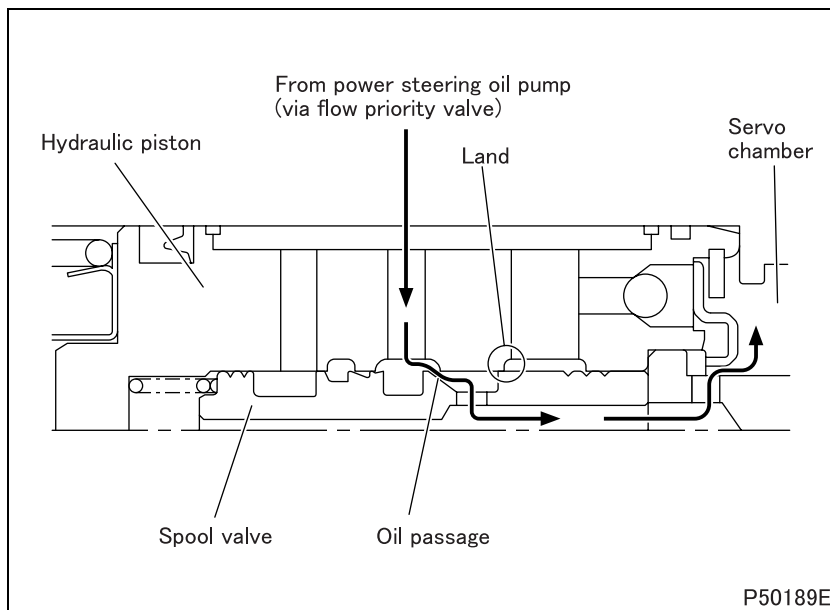
STRUCTURE AND OPERATION

4. Hydraulic Booster and Brake Master Cylinder



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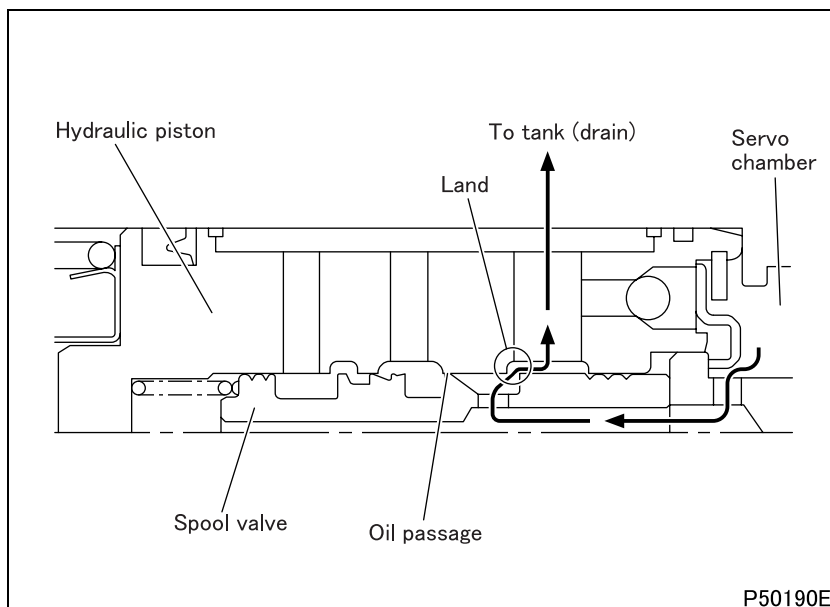
- The hydraulic booster magnifies the stepping force applied onto the brake pedal (therefore reduces the operator's pedal effort) through the utilization (via the flow priority valve) of the steering pump pressure.
- The brake master cylinder serves both the front and rear brake systems that are independent of each other. Should fluid leakage occur in either the front or rear brake system, stopping power can still be provided by whichever system is intact.
- The spool valve is connected to the brake pedal, and generates oil pressure proportional to the pedal stepping force.
- The hydraulic piston, which is connected to the brake master cylinder, operates to store oil supplied via the spool valve into the servo chamber for pressure boost.
- Should oil pressure is lost, the piston is pushed to the left by the force of the spring, blocking oil flow from the power steering oil pump and to the power steering oil tank. At the same time, the flow switch is turned ON, providing power to the emergency pump motor. The emergency pump generates oil pressure for the hydraulic booster to continue to operate.



4.1 Spool valve

(1) When brake pedal is depressed

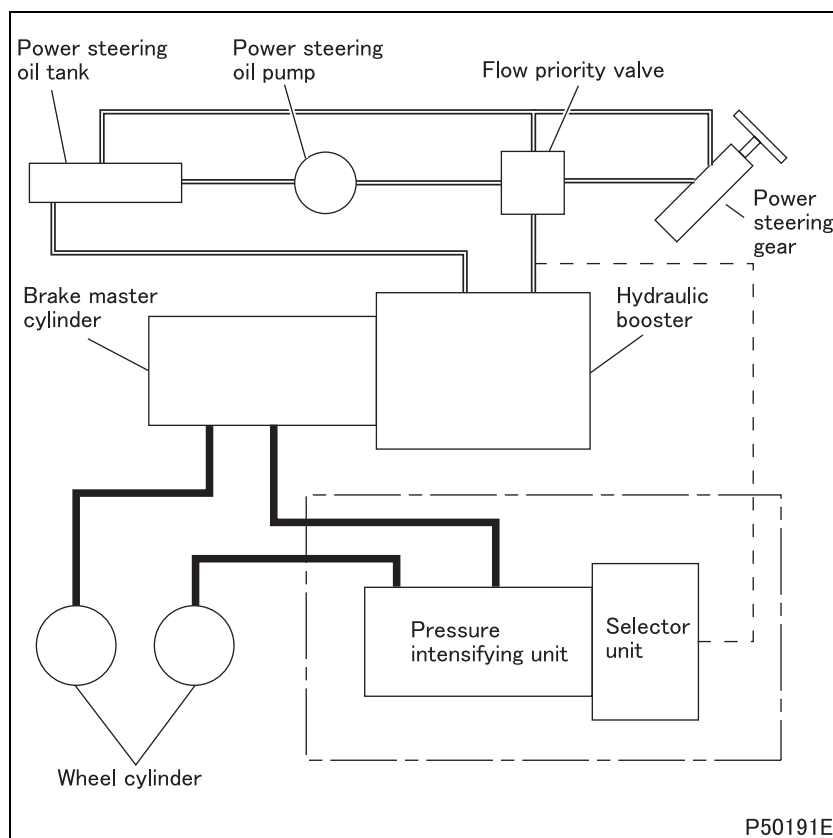
- As the brake pedal is depressed, the spool valve moves to the left, closing the land.
- Oil pressure from the flow priority valve builds up.
- The high pressure oil flows through the oil passage and into the servo chamber.
- The hydraulic piston is pushed to the left.
- The pistons in the brake master cylinder are moved, supplying pressure for brake application.



(2) When brake pedal is released

- As the brake pedal is released, the spool valve moves to the right. This opens the land while the oil passage is closed.
- Oil pressure from the flow priority valve drops.
- The oil in the servo chamber drains to the tank as well as to the reservoir.
- The hydraulic piston returns to its original position.
- Pressure acting on the pistons in the brake master cylinder is released.

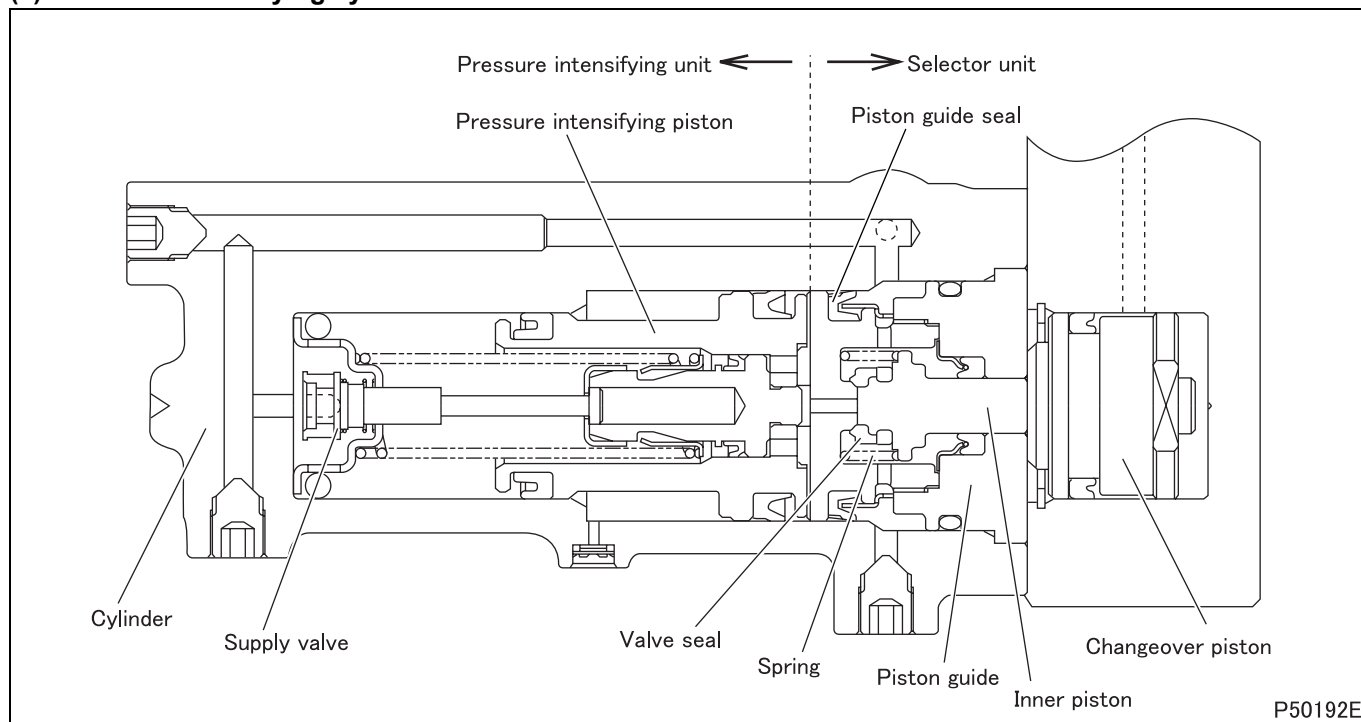
STRUCTURE AND OPERATION



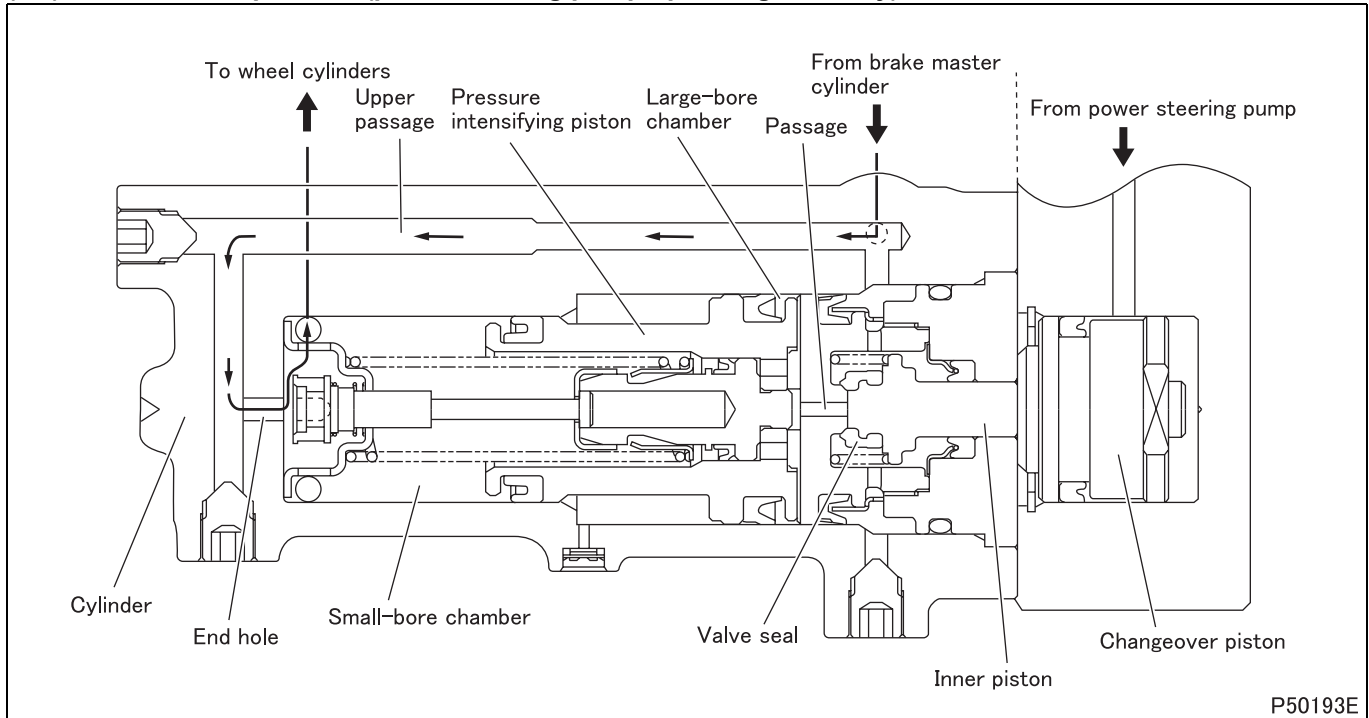
4.2 Pressure intensifying cylinder system

- The pressure intensifying cylinder system is attached onto the hydraulic booster which operates on the power steering oil pump pressure.
- Should the pump fail, depressing the brake pedal causes the system to boost the fluid pressure from the brake master cylinder and send it to the wheel cylinders.

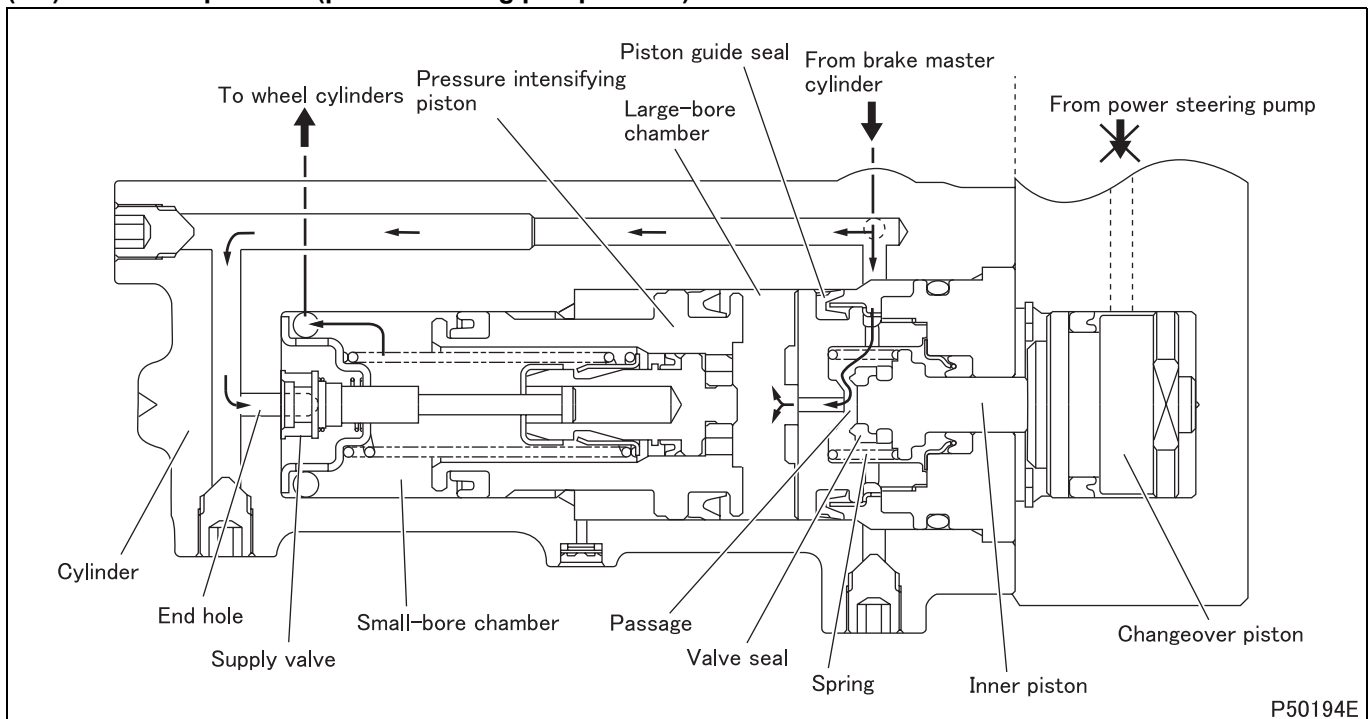
(1) Pressure intensifying cylinder



- Should the power steering pump fail to discharge oil, the selector unit detects this. The unit also ensures that pressure not be intensified when the power steering pump is functioning normally.
- Should the power steering pump fail, the pressure intensifying unit comes into action, boosting the fluid pressure from the brake master cylinder before sending it to the wheel cylinders.

(1.1) When not in operation (power steering pump operating normally)

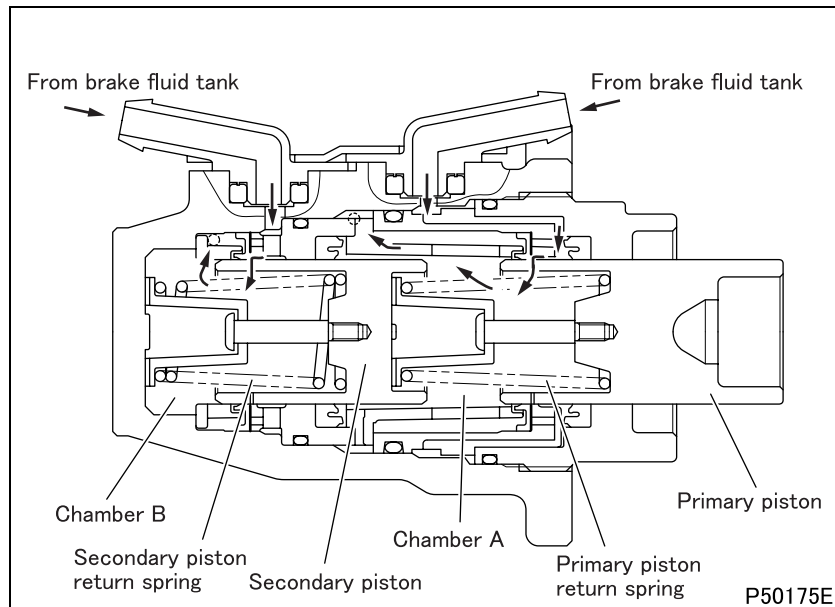
- Power steering oil pump pressure pushes the changeover piston, which then moves the inner piston. As a result, the passage to the large-bore chamber is blocked by the valve seal. Fluid pressure from the brake master cylinder flows through the upper passage, the end hole, the small-bore chamber, and into the wheel cylinders. As fluid pressure acts only on the small-bore end of the pressure intensifying piston, the piston remains in the same position.

(1.2) When in operation (power steering pump failure)

- When the power steering oil pump fails to discharge oil, the spring at the end of the inner piston pushes back the inner and changeover pistons. This opens up the passage through the valve seal into the large-bore chamber.
- Fluid pressure from the brake master cylinder flows into both the large- and small-bore chambers. As the large-bore end of the pressure intensifying piston has a larger area than the small-bore end, the piston moves to the left. As a result, the end hole is blocked by the supply valve.

STRUCTURE AND OPERATION

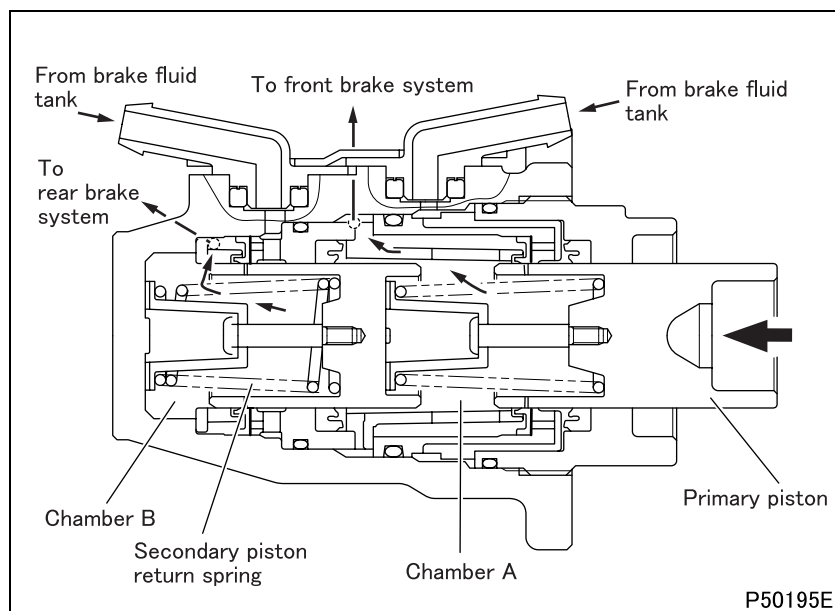
- The brake master cylinder continues to supply fluid into the pressure intensifying cylinder, which in turn sends the increasing pressure to the wheel cylinders.
- When the brake pedal is released, pressure fluid in the large-bore chamber flows through the valve seal, the back of the piston guide seal, and to the brake master cylinder.



4.3 Brake master cylinder

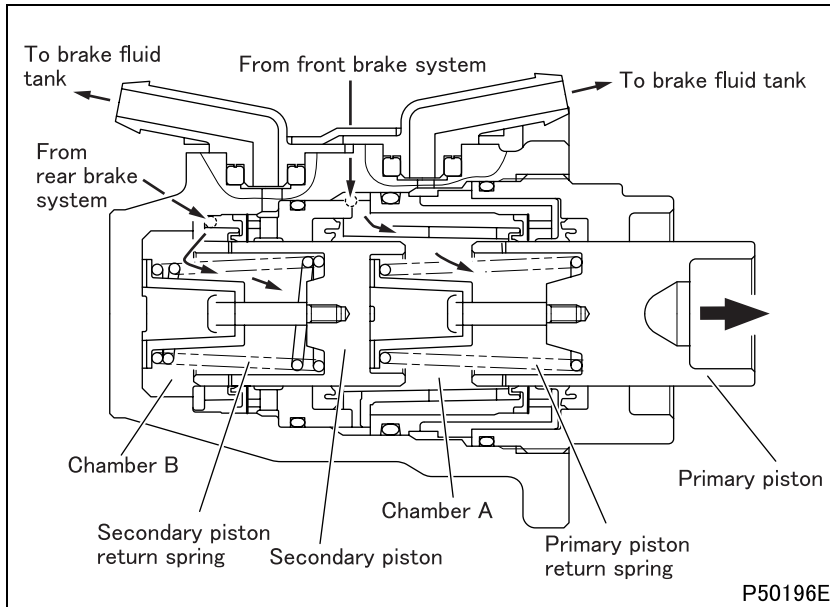
(1) When not in operation

- With the brake pedal released, the primary and secondary pistons are held to the right by the forces of the primary and secondary piston return springs respectively.
- Chambers **A** and **B** are open to the brake fluid tank.



(2) When brake pedal is depressed

- As the brake pedal is depressed, the primary piston is pushed via the push rod.
- The secondary piston return spring is compressed, and the passages from chambers **A** and **B** to the brake fluid tank are blocked.
- As the brake pedal is depressed further, the primary piston is pushed. Fluid pressure builds up in chambers **A** and **B**, and is sent to the front and rear brake systems respectively.
- When fluid leakage occurs in either the front or rear brake system, the master cylinder operates basically in the same manner as the master cylinder with the vacuum booster.

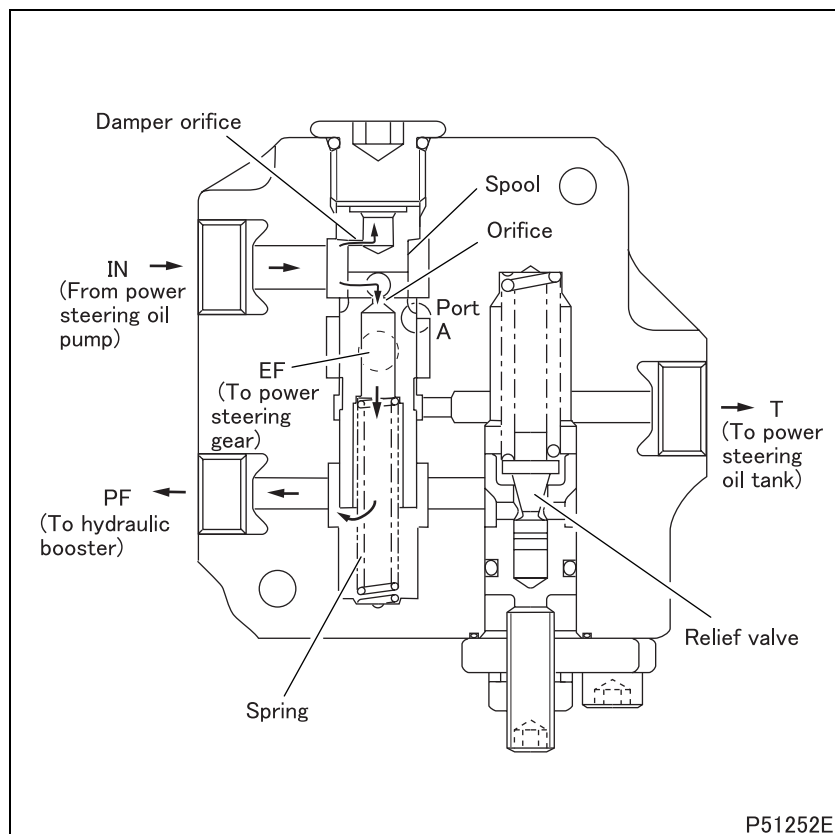


(3) When brake pedal is released

- As the brake pedal is released and the push rod returns to the original position, the primary piston return spring pushes back the primary piston. Chamber **A** restores the original volume and the pressure in the chamber drops accordingly.
- The secondary piston return spring pushes back the secondary piston. Chamber **B** restores the original volume and pressure.
- Chambers **A** and **B** open up to the brake fluid tank.
- Pressure fluid in the front and rear brake lines flows back into chambers **A** and **B**.

STRUCTURE AND OPERATION

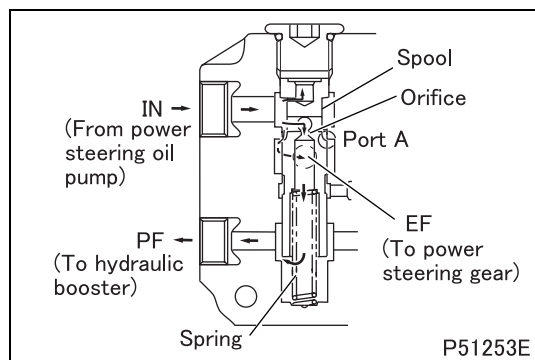
5. Flow Priority Valve



- When brakes are applied hard while the steering wheel is turned, the flow priority valve dampens the associated steering shock by appropriately distributing the flow from the power steering oil pump between the hydraulic booster and the power steering gear.

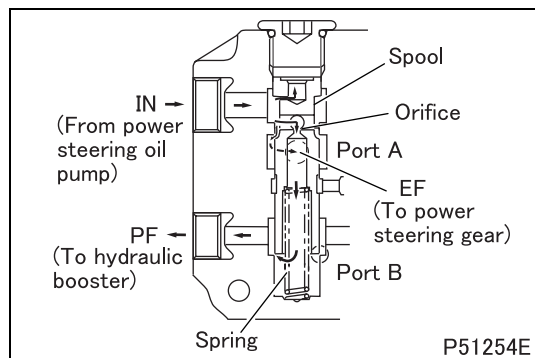
5.1 When pump output is at or below regulated flow rate

- The power steering oil pump output flows through the orifice and to the hydraulic booster.
- The pressure difference across the orifice acts on the spool which is then pushed down against the spring. However, port A remains blocked by the spool. As a result, the full flow from the pump is directed to PF.



5.2 When pump output exceeds regulated flow rate

- When the pump output exceeds the regulated flow rate, the pressure difference across the orifice becomes greater and acts on the spool such that the spool is pushed down against the spring until port A opens. Excess flow is directed through port A and into EF.
- In this state, if the hydraulic booster is operated and a greater flow is demanded by PF line (PF pressure > EF pressure), the spool moves to reduce the opening of port A so that the required pressure and the regulated flow rate are both achieved.



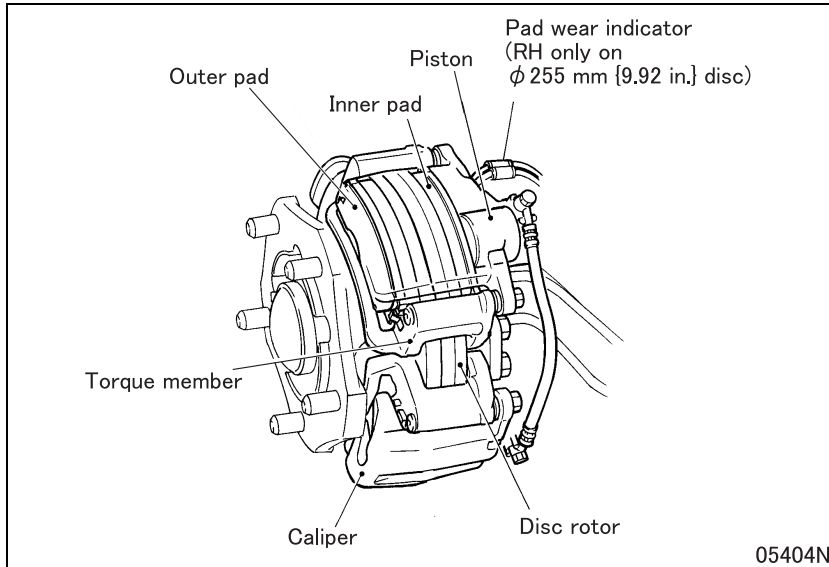
5.3 When power steering gear (EF line) is operated

- When power steering gear (EF line) is operated and a greater flow is demanded by EF line (PF pressure < EF pressure), the pressure difference across the orifice acts on the spool such that the spool is pushed down against the spring until the opening of port B is reduced. As a result, the required pressure and the regulated flow rate are both achieved.

5.4 When hydraulic booster (PF line) and power steering gear (EF line) are both operated

- When the hydraulic booster (PF line) and the power steering gear (EF line) are both operated and greater flows are demanded by these lines, the spool is moved against the spring such that the openings of ports A and B are appropriately balanced to achieve the regulated flow rate.

6. Front Disc Brake



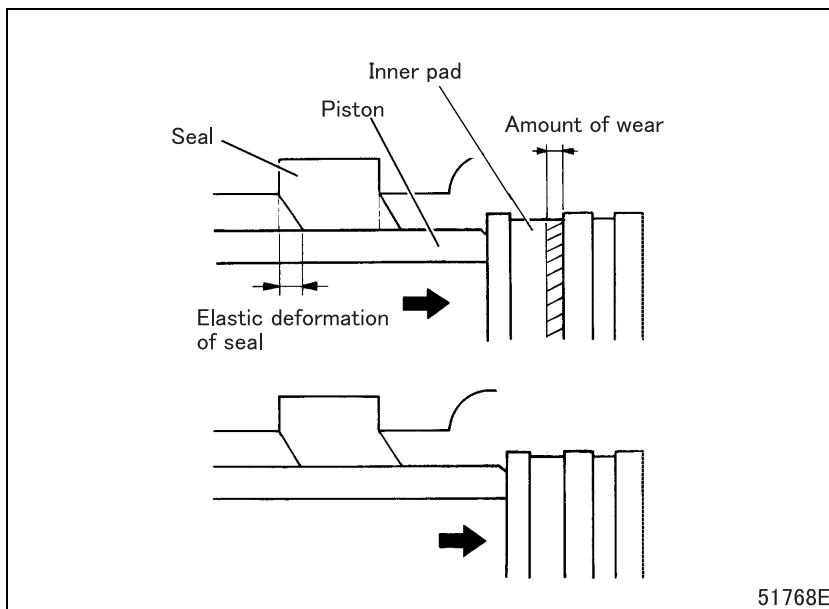
- The front disc brake uses a twin floating-type calipers.
- The caliper houses one each of cylinder and piston. Stopping power is generated by squeezing the disc rotor between the pads, with the outer pad pressed against the disc rotor by reaction.
- The inner pad is equipped with wear indicator which serves to indicate replacement timing for both the inner and outer pads.
- The front disc brake is equipped with a self-adjusting mechanism to compensate for pad wear and maintain the correct clearances between the disc rotor and the inner and outer pads. The adjustment is made each time braking is performed.

6.1 Self-adjusting mechanism

(1) Operation

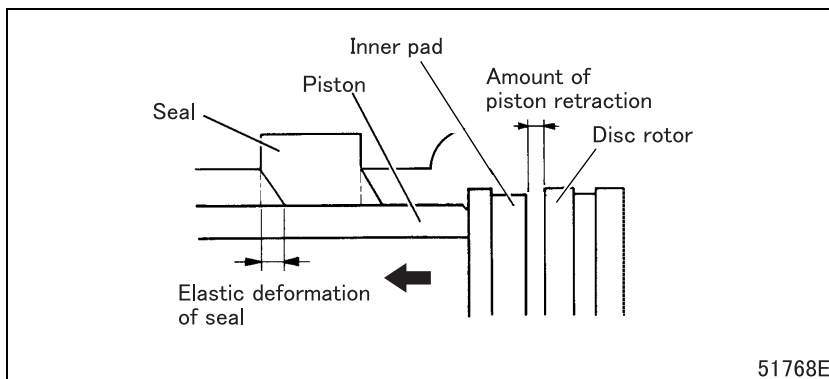
(1.1) When brake pedal is depressed

- The piston extends in excess of the seal's elastic deformation by the amount of inner pad wear (shown hatched).



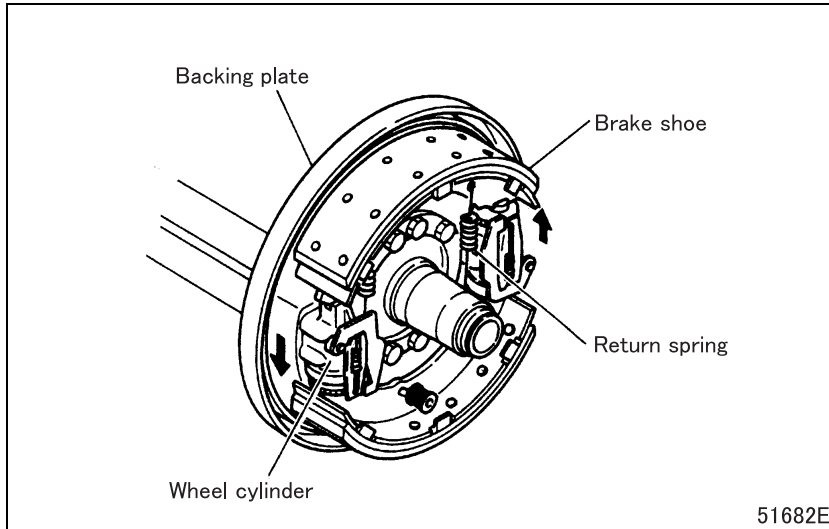
(1.2) When brake pedal is released

- The piston retracts as much as the amount of the seal's elastic deformation, thus maintaining the correct clearance between the disc rotor and the inner pad.

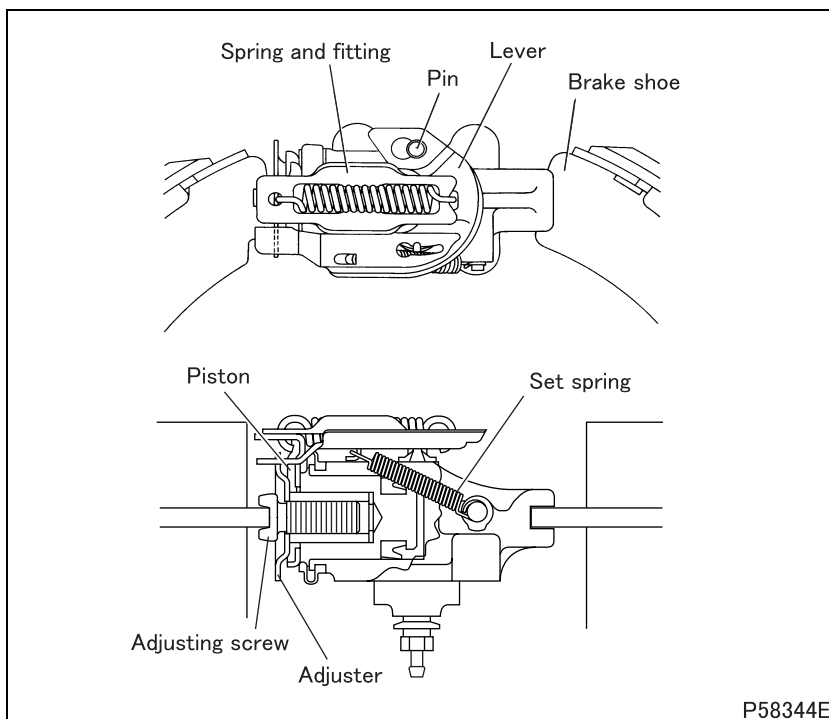


STRUCTURE AND OPERATION

7. Front Drum Brake

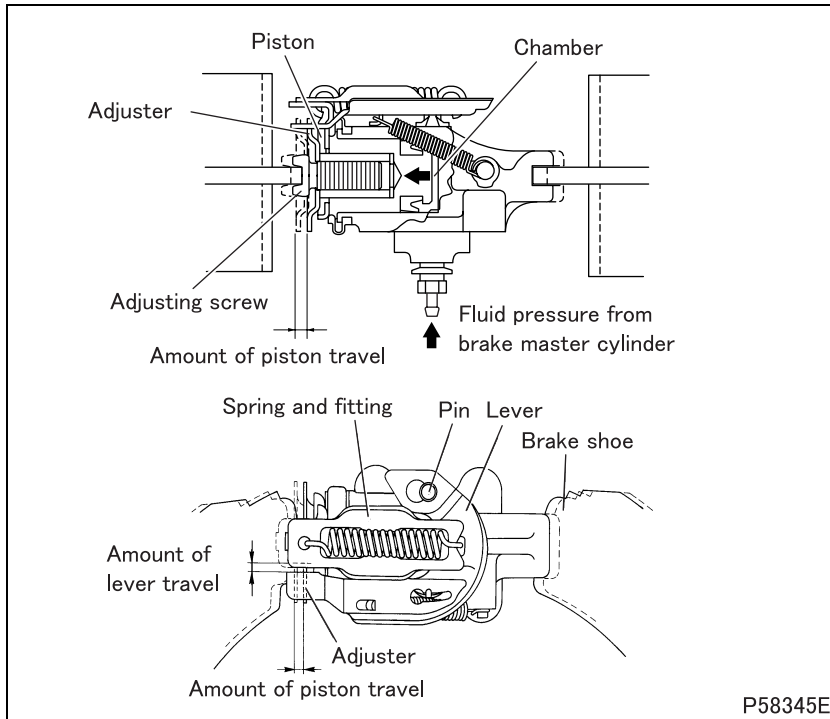


- The front drum brake is of a 2-leading type.
- Single-acting wheel cylinders activate brake shoes, both as a leading shoe, in forward-travel braking. By self-boosting effect, the 2-leading shoe brake generates a great stopping power.



7.1 Wheel cylinder

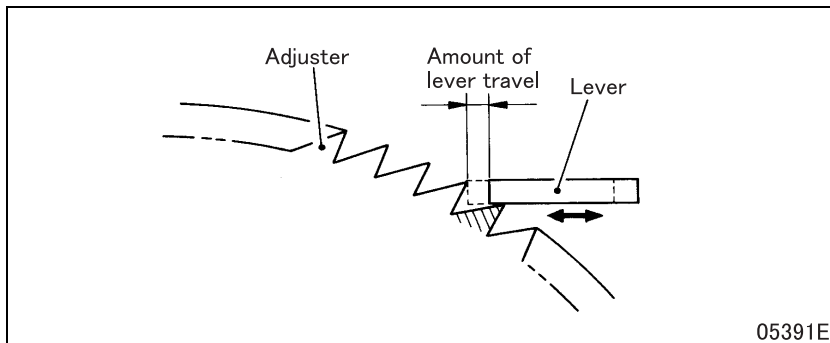
- The wheel cylinder is equipped with a self-adjusting mechanism to compensate for lining wear and maintain the correct clearance between the lining and the drum. The adjustment is made each time braking is performed.



7.2 Self-adjusting mechanism

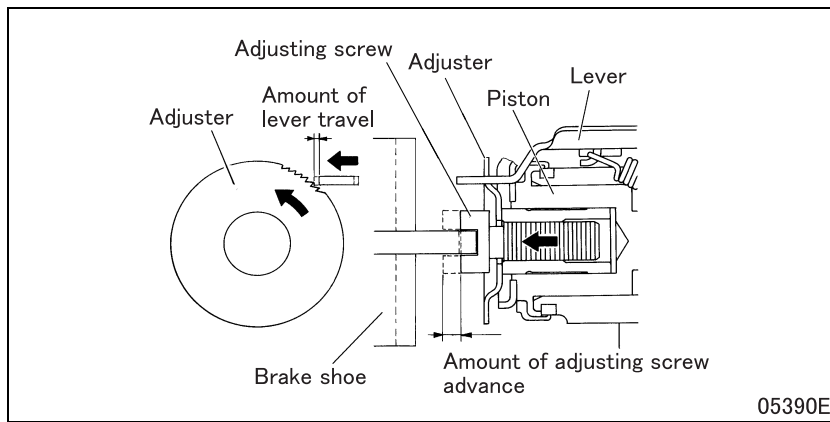
(1) Operation

- When the brake pedal is depressed, fluid pressure from the brake master cylinder enters into chamber and pushes the piston, which then extends the spring and fitting. The lever, which is connected to the spring and fitting, pivots about the pin.

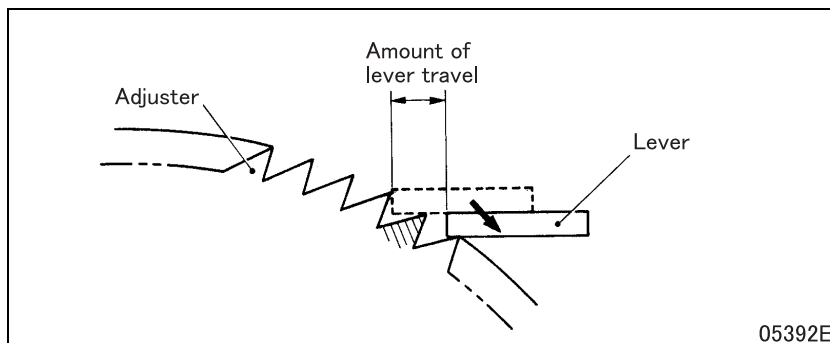
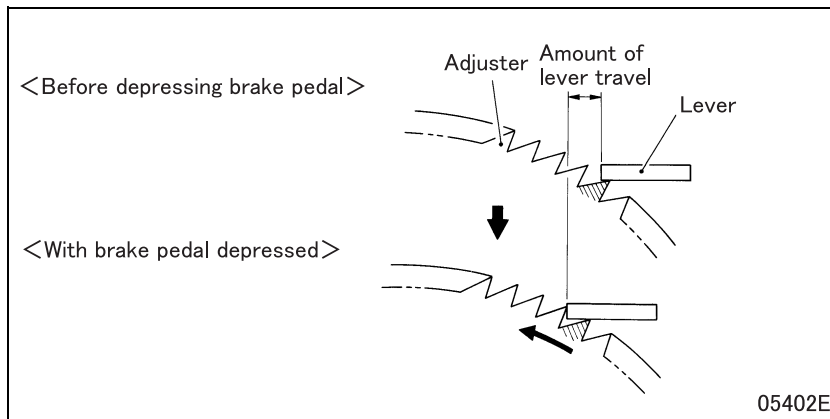


- When the brake drum-to-lining clearance is correct, the amount of lever travel when the brake pedal is depressed is not enough to turn the adjuster which therefore remains in the same place.

STRUCTURE AND OPERATION

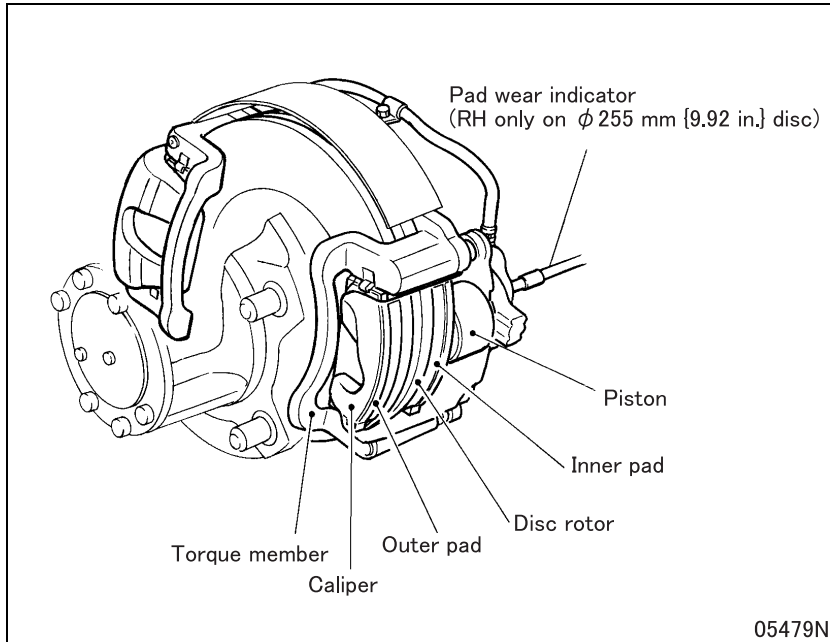


- As the brake drum-to-lining clearance grows, the amount of piston travel, and therefore the amount of lever travel, becomes greater.
- When the lever travels far enough to turn the adjuster, the threads on the adjuster causes the adjusting screw to advance. As a result, the brake shoe extends.



- As the brake pedal is released, the adjuster remains in the new position while the lever retracts by one tooth. The brake drum-to-lining clearance is now correctly adjusted.

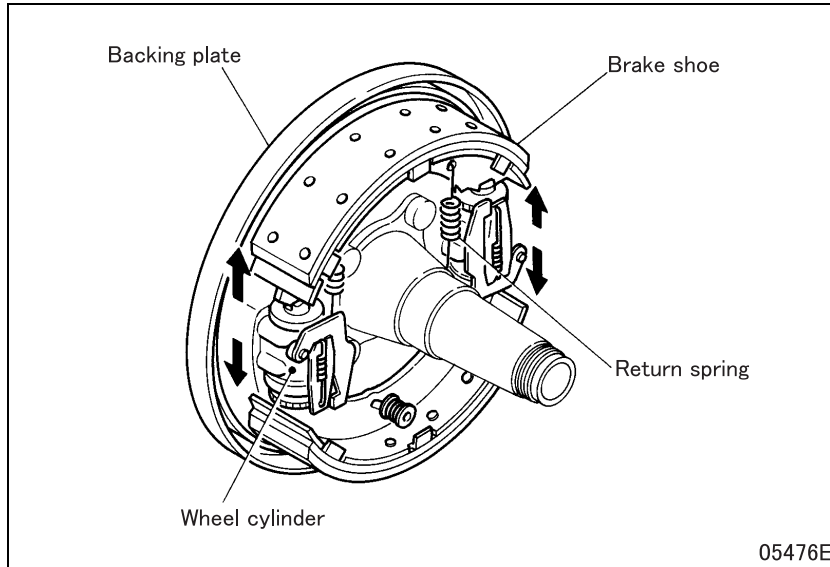
8. Rear Disc Brake



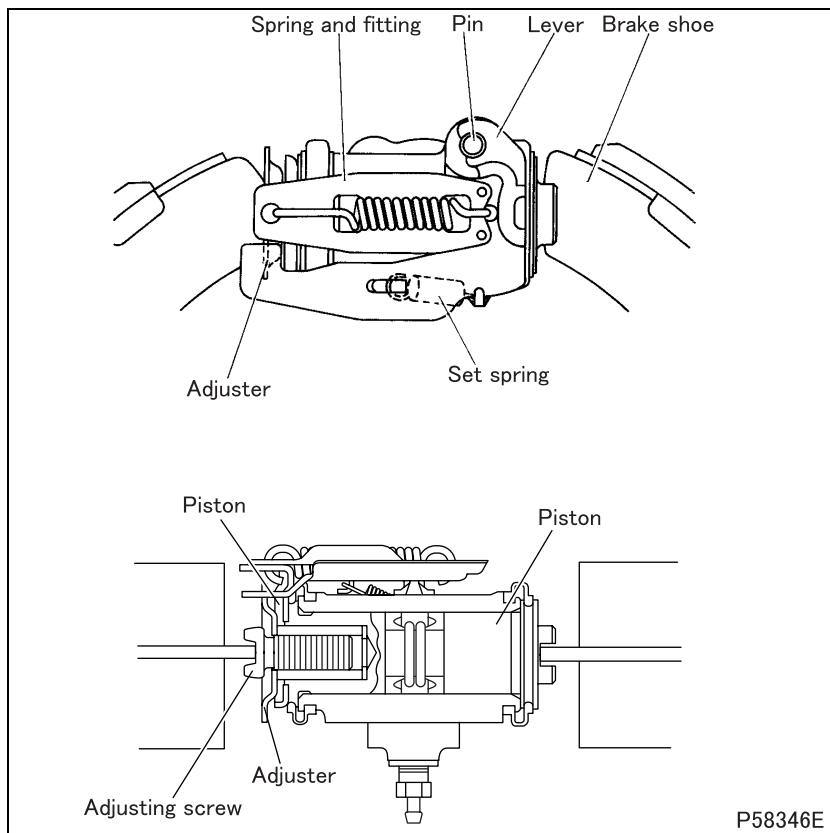
- The rear disc brake uses a twin floating-type calipers.
- The caliper houses one each of cylinder and piston. Stopping power is generated by squeezing the disc rotor between the pads, with the outer pad pressed against the disc rotor by reaction.
- The inner pad is equipped with wear indicator which serves to indicate replacement timing for both the inner and outer pads.
- The rear disc brake is equipped with a self-adjusting mechanism to compensate for pad wear and maintain the correct clearances between the disc rotor and the inner and outer pads. The adjustment is made each time braking is performed.
- The self-adjusting mechanism operates in the same manner as that of the front disc brake.

STRUCTURE AND OPERATION

9. Rear Drum Brake



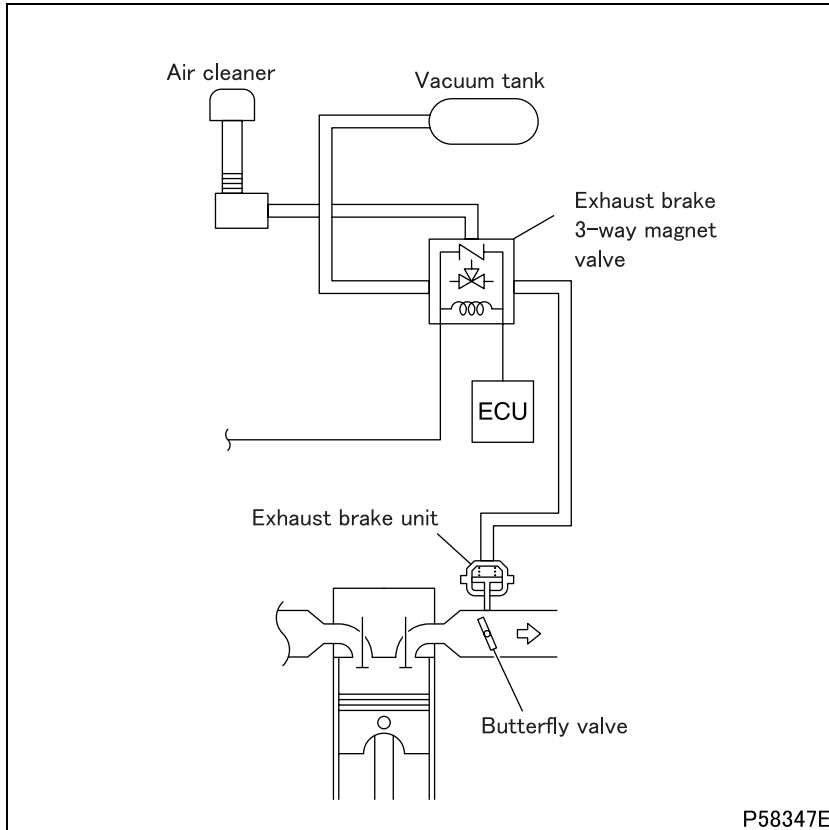
- The rear drum brake is of a dual 2-leading type.
- Double-acting wheel cylinders activate brake shoes, both as a leading shoe, in forward- and rearward-travel braking. By self-boosting effect, the dual 2-leading shoe brake generates a great stopping power.



9.1 Wheel cylinder

- The wheel cylinder is equipped with a self-adjusting mechanism to compensate for lining wear and maintain the correct clearance between the lining and the drum. The adjustment is made each time braking is performed.
- The self-adjusting mechanism operates in the same manner as that of the front drum brake.

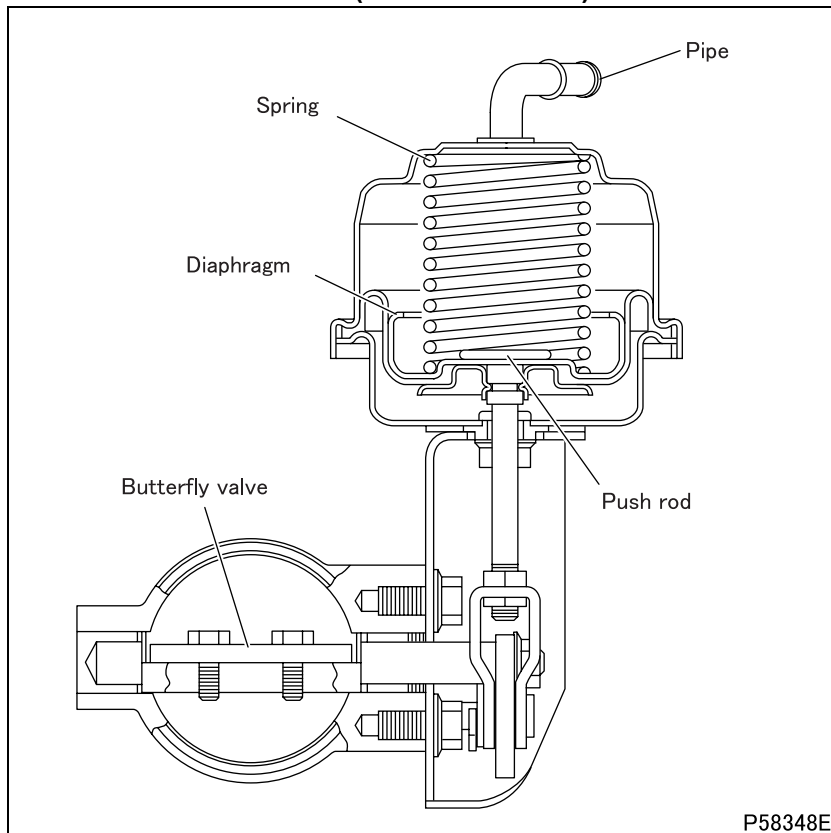
10. Exhaust Brake System



- The exhaust brake system provides stopping power by closing the exhaust piping. Specifically, pressure builds up in the blocked exhaust piping, which then is used to resist the pistons as they move to discharge exhaust in the exhaust stroke.
- The exhaust brake system supplements the foot brake. It is equipped with the exhaust brake unit incorporating a butterfly valve.
- When the exhaust brake switch is turned ON, the excitation winding within the exhaust brake 3-way magnet valve is magnetized. This closes the atmospheric pressure valve while opening the vacuum valve. Vacuum in the vacuum tank acts on the exhaust brake unit, closing the butterfly valve and bringing the exhaust braking in operation.

STRUCTURE AND OPERATION

10.1 Exhaust brake unit (Power chamber)



M E M O

TROUBLESHOOTING

Wheel Brake

Symptoms		Brake application one sided							Noise and shock when brake pedal depressed			Reference Gr
		Brake drag (slow disengagement after pedal release)	Stopping power different from right to left	Unstable stopping power	Locking point varies	Other			Insufficient stopping power	Reduced pedal travel	Noise generated when wheels are turned with jacked-up vehicle	
Possible causes												
Wheel brake	Backing plate surface rough	O		O								
	Backing plate deformed or incorrectly installed			O								
	Lubricant or moisture on brake pad/lining surface		O		O							
	Deterioration or incorrect material used for brake pad/lining		O									
	Brake pad/lining unevenly worn or with rough surface		O									
	Fade (pad/lining surface deterioration)				O							
	Brake pad/lining worn to limit									O		
	Incorrect contact of brake pad/lining		O		O		O					
	Brake lining worn radius uneven				O							
	Wheel cylinder malfunction	O	O					O	O			
	Shoe return spring fatigued or broken	O							O			
	Disc rotor/brake drum worn unevenly		O									
	Disc rotor/brake drum deformed			O								
	Disc rotor/brake drum worn				O							
	Disc rotor/brake drum surface rough						O					
	Disc rotor/brake drum inaccurately machined										O	
	Brake drum cracked										O	
	Foreign matter in brake drum							O				
	Brake shoe deformed or damaged							O				
	Shoe hold cup broken								O			
	Movable parts insufficiently lubricated										O	

Symptoms		Brake application one sided							Noise and shock when brake pedal depressed			Reference Gr
		Brake drag (slow disengagement after pedal release)	Stopping power different from right to left	Unstable stopping power	Locking point varies	Other			Insufficient stopping power	Reduced pedal travel	Noise generated when wheels are turned with jacked-up vehicle	
Possible causes												
Brake pedal	Incorrect pedal travel						O					
	Incorrectly adjusted, too much play							O				
Brake fluid	Fluid level low							O				
	Fluid leakage							O				
	Air ingress							O				
	Vapor lock							O				
Vacuum system	Vacuum drop						O					
Vacuum booster	Faulty						O	O				
Hydraulic booster	Faulty hydraulic booster						O	O				
	Faulty piston cup							O				
Tire	Tire pressure uneven between wheels					O						Gr31
	Different tire sizes from left to right					O						
Axle	Wheel hub bearing incorrectly adjusted					O				O		Gr26, 27
	Wheelbase different from left to right					O						
	Incorrect wheel alignment					O						Gr26

TROUBLESHOOTING

Symptoms		Brake drum overheating		Brake noise			Abnormal brake pedal return	Brake drag	Reference Gr
		Overheating on all wheels	Overheating on specific wheel(s)	Noisy when vehicle is new, or after brake lining/pad replacement	Brakes used under severe conditions	Other			
Possible causes									
Wheel brake	Backing plate surface rough							O	
	Shoe trapped on backing plate surface		O						
	Backing plate deformed or incorrectly installed				O				
	Lubricant or moisture on brake pad/lining surface				O				
	Wear powder attached on brake pad/lining					O			
	Brake pad/lining worn					O			
	Incorrect contact of brake pad/lining			O					
	Wheel cylinder malfunction		O					O	
	Faulty wheel cylinder piston cup		O					O	
	Shoe return spring fatigued or broken		O					O	
	Disc rotor/brake drum glazed				O				
	Brake drum deformed or center deviation					O			
	Disc rotor thickness uneven					O			
	Brake shoe deformed or damaged				O				
	Brake shoe twisted or sagged		O						
Brake pedal	Abnormal pedal return	O							
	Pedal play insufficient							O	
	Linkage rusted or deformed						O		
	Return spring fatigued or broken						O		
	Vacuum/hydraulic booster operating rod thrust						O		
Brake fluid	Brake pipe over-tightened, resulting in poor fluid return		O						
Vacuum booster	Faulty	O							
Hydraulic booster	Faulty hydraulic booster	O							
Brake master cylinder	Faulty piston cup							O	
	Clogged return port	O							
Axle	Wheel hub bearing incorrectly adjusted		O			O	O		Gr26, 27
	King pin bushing worn						O		Gr26A
	Trunnion bearing worn						O		Gr26B

Exhaust Brake

Symptoms		Exhaust brake not effective	Exhaust brake does not disengage	Reference Gr
Possible causes				
Vacuum system	Insufficient vacuum	O		
	Collapsed piping	O		
Faulty 3-way magnet valve		O	O	Gr54
Exhaust brake unit	Faulty valve	O	O	
	Stuck valve shaft	O	O	
	Faulty valve chamber	O		
Faulty electric system		O	O	Gr54

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Replacement of Brake Fluid

- Brake fluid is shared by the brake and clutch systems, and is divided in the brake fluid tank into the two systems. This section describes the replacement of the brake fluid for the brake system. In order to completely replace the brake fluid, the brake fluid in the clutch system should also be replaced.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
–	Air bleeder	Disc brake	5.8 to 8.8 {4.3 to 6.5, 0.6 to 0.9}	–
		Drum brake	6.86 to 8.83 {5.1 to 6.5, 0.7 to 0.9}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Brake fluid tank	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required

WARNING

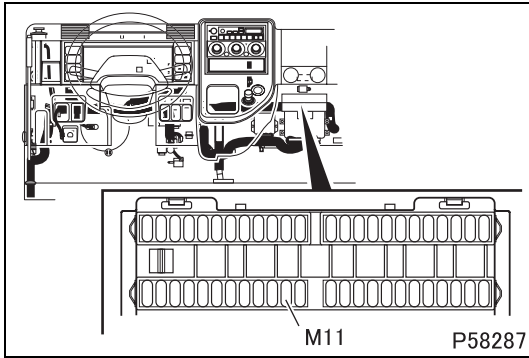
- Be sure to use new brake fluid. Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the brake rubber parts to swell. Faulty operation of the brake will result.
 - Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty brake operation.
 - Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.
-

CAUTION

- Brake fluid is corrosive on paintwork. Be careful not to spill it onto the paintwork. If brake fluid is spilled onto the paintwork, immediately wipe it off.
-

NOTE

- During brake fluid replacement operation, a change in color of the brake fluid being discharged indicates that the old brake fluid in the system has been replaced with new brake fluid.
- During the replacement, be sure to keep the brake fluid level at the “MAX” mark on the tank.

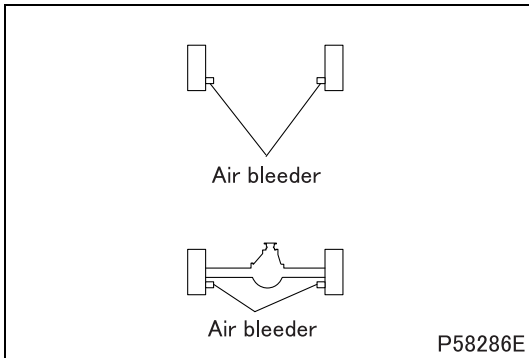


1.1 Work before replacement

- Remove the power fuse (M11) for the electronic control unit of anti-lock brake system.

WARNING ⚠

- Do not install the power fuse until after the brake fluid replacement is completed. Otherwise, the initial system check starts, possibly causing air to enter into the secondary system (anti-lock brake system operating circuit).



- On vehicles equipped with a vacuum booster, in order to ensure that the vacuum booster function properly, start the engine and keep it running at idle until the replacement is completed.
- On vehicles equipped with a hydraulic booster, the emergency pump is used for the replacement operation. Therefore, stop the engine and turn the starter switch ON.
- Install one end of a vinyl pipe onto each air bleeder. Place the loose end into a container.

1.2 Replacement of brake fluid

- Loosen each bleeder screw, and depress and release the brake pedal repetitively until brake fluid is no longer discharged from the pipes.
- While filling the brake fluid tank with new brake fluid up to the "MAX" mark, cycle the brake pedal repetitively until the old brake fluid being discharged is replaced with new brake fluid. Tighten each air bleeder to the specified torque.
- Proceed to Air Bleeding of Brake System.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Air Bleeding of Brake System

- Brake fluid is shared by the brake and clutch systems, and is divided in the brake fluid tank into the two systems. This section describes the air bleeding of the brake system.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
-	Air bleeder	Disc brake	5.8 to 8.8 {4.3 to 6.5, 0.6 to 0.9}	-
		Drum brake	6.86 to 8.83 {5.1 to 6.5, 0.7 to 0.9}	-

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
-	Brake fluid tank	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required

WARNING

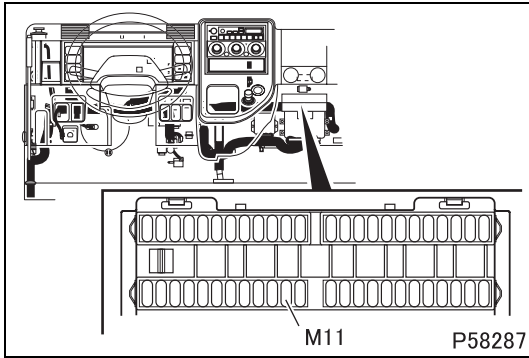
- Be sure to use new brake fluid. Do not mix it with brake fluid of different properties or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.). This will alter the original properties of FUSO Brake Fluid, causing the boiling point to drop as well as the brake rubber parts to swell. Faulty operation of the brake will result.
 - Ensure that no foreign matter or water enter into the brake fluid when refilling it, as they will cause faulty brake operation.
 - Use a mug exclusively kept for the specified brake fluid. This ensures that no brake fluid of different properties or mineral oil enter into the system.
-

CAUTION

- Brake fluid is corrosive on paintwork. Be careful not to spill it onto the paintwork. If brake fluid is spilled onto the paintwork, immediately wipe it off.
-

NOTE

- Brake fluid level drops during the air bleeding operation. Be sure to keep the brake fluid level at the "MAX" mark on the tank.

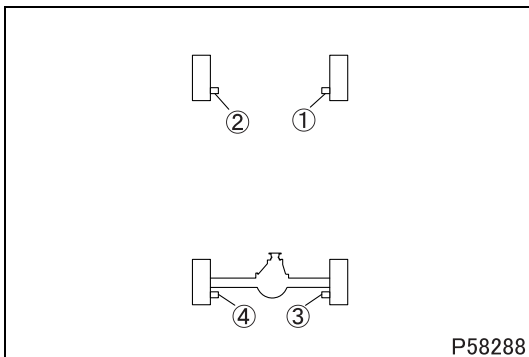
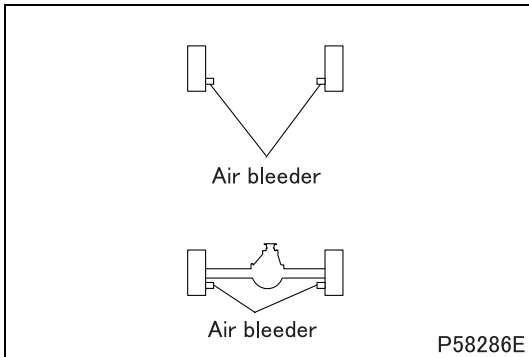


2.1 Work before replacement

- Remove the power fuse (M11) for the electronic control unit of anti-lock brake system.

WARNING ⚠

- Do not install the power fuse until after the air bleeding of the primary brake system (normal circuit) is completed. Otherwise, the initial system check starts, possibly causing air to enter into the secondary system (anti-lock brake system operating circuit).



- On vehicles equipped with a vacuum booster, in order to ensure that the vacuum booster function properly, start the engine and keep it running at idle until the replacement is completed.
- On vehicles equipped with a hydraulic booster, the emergency pump is used for the replacement operation. Therefore, stop the engine and turn the starter switch ON.
- Install one end of a vinyl pipe onto each air bleeder. Place the loose end into a container.

2.2 Air bleeding of brake system

(1) Air bleeding of primary brake system (normal circuit)

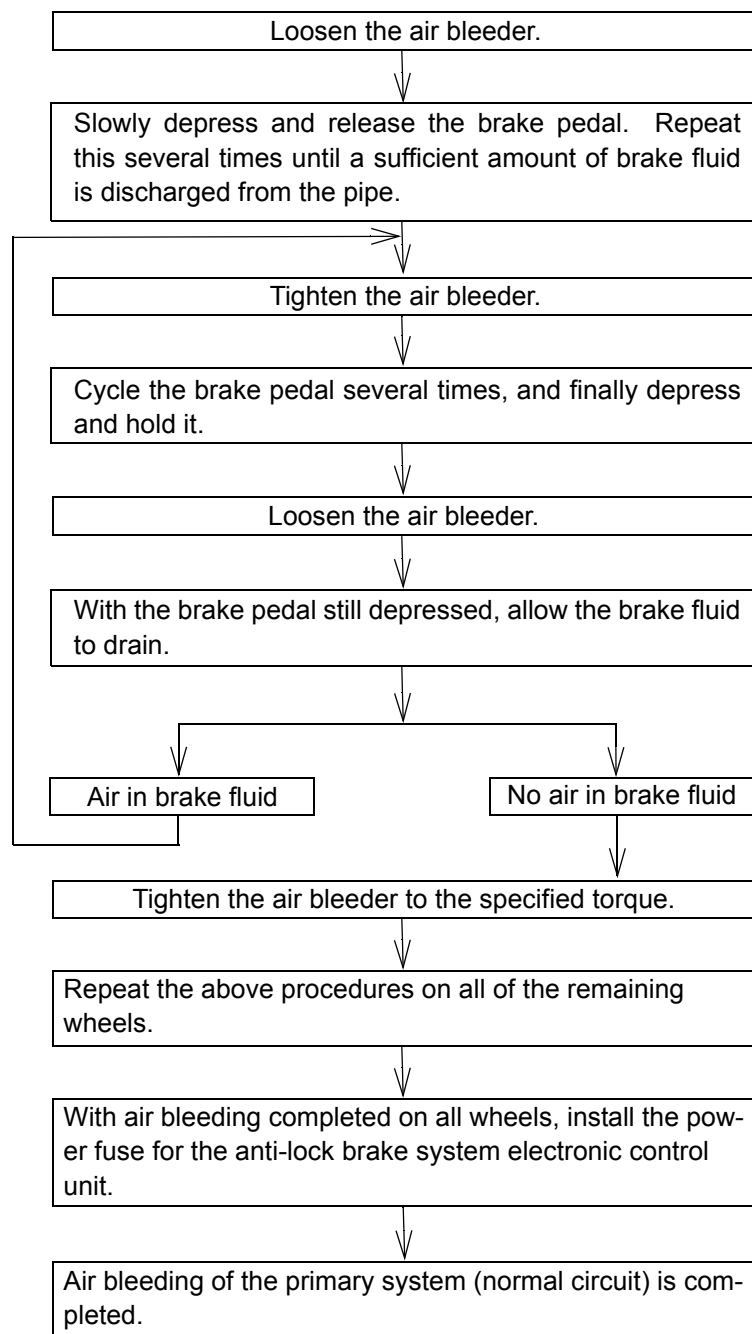
- Perform the air bleeding sequence described below on each of the 4 wheels in the order of the following table.

Order of air bleeding	Brake system	Wheel
(1)	Front	Front right
(2)		Front left
(3)	Rear	Rear right
(4)		Rear left

CAUTION ⚠

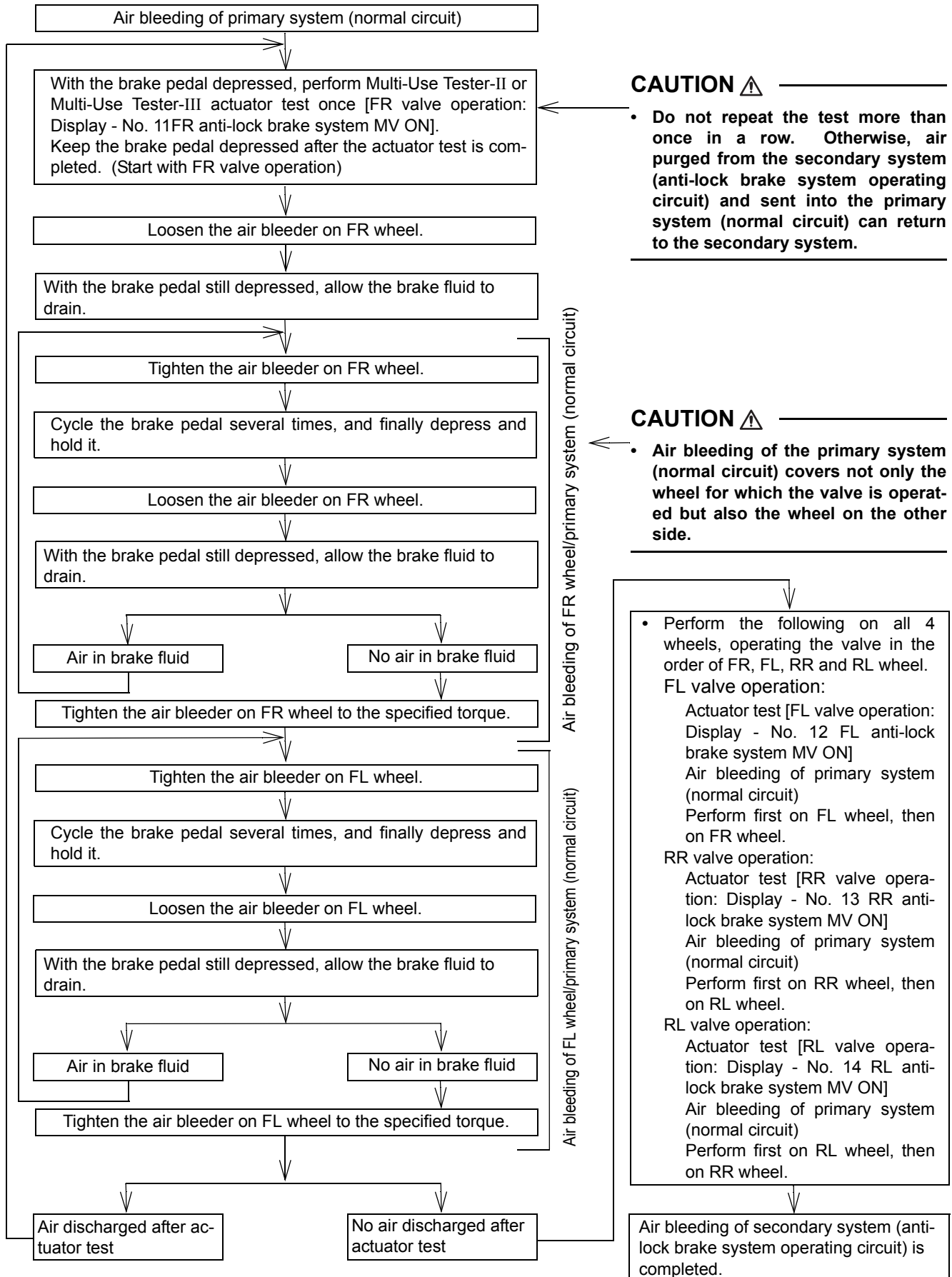
- If air has entered into the secondary brake system (anti-lock brake system operating circuit), bleed air from the secondary system after completing the air bleeding of the primary system (normal circuit).
- Normally, during air bleeding or hydraulic unit replacement operation, air cannot enter into the secondary system (anti-lock brake system operating circuit) which is filled with brake fluid and is closed off. Therefore, only the primary system (anti-lock brake system operating circuit) needs to be bled of air.

ON-VEHICLE INSPECTION AND ADJUSTMENT



(2) Air bleeding of secondary brake system (anti-lock brake system operating circuit)

- If the anti-lock brake system system is operated with air still remaining in the primary brake system (normal circuit), air can enter into the secondary brake system (anti-lock brake system operating circuit).
- If air has entered into the secondary system (anti-lock brake system operating circuit), that air can also flow into the primary system (normal circuit) when the anti-lock brake system system is operated, possibly causing the brake pedal stroke to extend.
- Multi-Use Tester-II or Multi-Use Tester-III actuator test (anti-lock brake system operating mode) is performed as part of the air bleeding procedures.

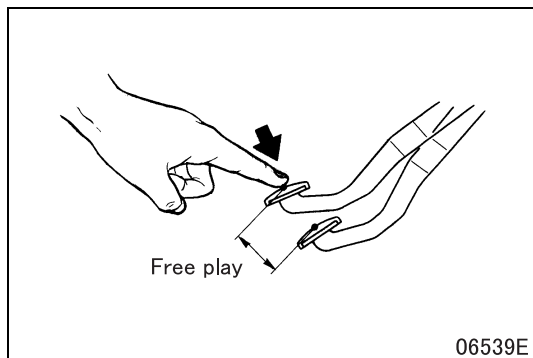


ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Inspection and Adjustment of Brake Pedal Free Play

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Pedal free play	0.1 to 3 {0.0034 to 0.12}	–	Adjust



[Inspection]

- With the engine stationary, ensure that the pedal play conforms to the standard value.
- If the measured value does not conform to the standard value, adjust the installed height of the brake pedal.

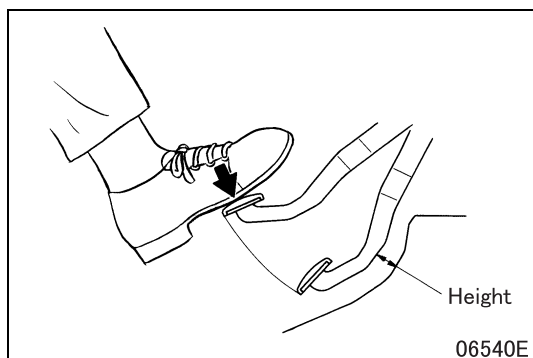
[Adjustment]

- For adjustment procedures, see “5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal.”

4. Inspection and Adjustment of Brake Pedal Depressed Height from Floor

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Brake pedal height from floor (when depressed with a force of 490 N {110 lbs, 50 kgf})	20 {0.79} or above	–	Adjust



[Inspection]

- With the engine running at idle, depress the brake pedal with a force of 490 N {110 lbs, 50 kgf} and measure the brake pedal height from the floor.
- If the measured value does not conform to the standard value, adjust the installed height of the brake pedal.

[Adjustment]

- For adjustment procedures, see “5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal.”

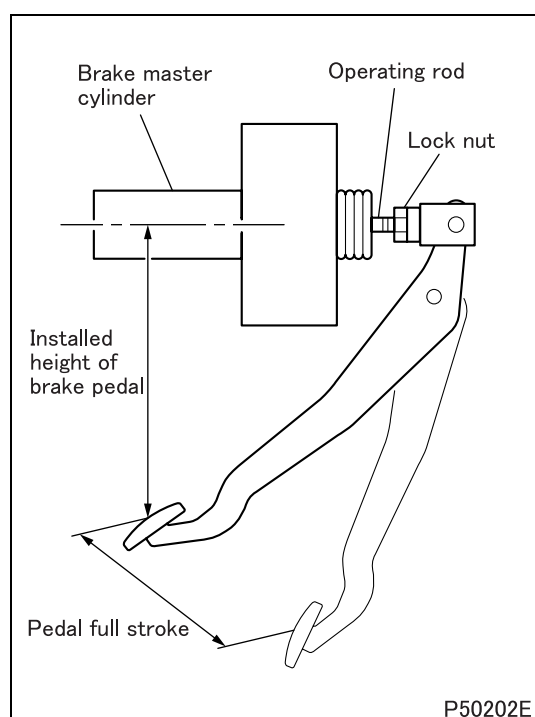
5. Inspection of Brake Pedal Full Stroke and Adjustment of Installed Height of Brake Pedal

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
-	Pedal full stroke	With $\phi 8 + \phi 9$, $\phi 9 + \phi 10$ inch vacuum booster	160 {6.30}	-	Adjust
		With hydraulic booster	152.7 {6.01}	-	
	Installed height of brake pedal (Pedal pad center to brake master cylinder center)	With $\phi 8 + \phi 9$, $\phi 9 + \phi 10$ inch vacuum booster	233 {9.17}	-	Adjust
		With hydraulic booster	230.2 {9.06}	-	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
-	Lock nut	With $\phi 8 + \phi 9$, $\phi 9 + \phi 10$ inch vacuum booster	21.6 ± 2.94 { 16 ± 2.2 , 2.2 ± 0.3 }	-
		With hydraulic booster	9.8 to 15.7 {7.2 to 12, 1.0 to 1.6}	-



5.1 Inspection of pedal full stroke

- Ensure that the pedal full stroke (the distance traveled by the pedal before it is fully depressed) conforms to the standard value.
- If the measured value does not conform to the standard value, adjust the installed height of the brake pedal.

5.2 Adjustment of installed height of brake pedal

- Set the distance from the center of the pedal pad to the center of the brake master cylinder by loosening the lock nut and turning in or out the operating rod of the vacuum or hydraulic booster.
- Tighten the lock nut to the specified torque.

NOTE

- When the brake pedal is fully depressed, the operating rod of the vacuum or hydraulic booster serves as a stop for the pedal.

CAUTION ⚠

- To prevent brake drag, ensure that the threaded end of the stop lamp switch does not interfere with the stop for the brake pedal.

ON-VEHICLE INSPECTION AND ADJUSTMENT

6. Inspection and Replacement of Disc Brake Pad

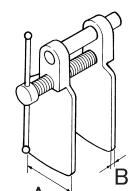
Service standards (Unit: mm {in.})

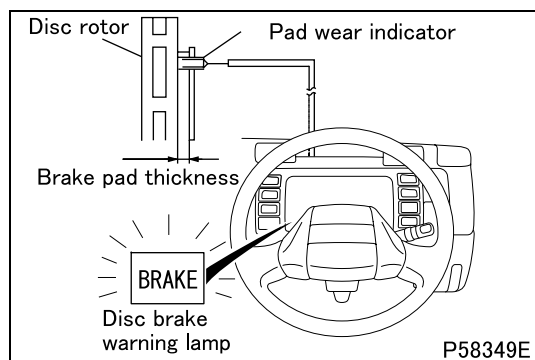
Location	Maintenance item	Standard value	Limit	Remedy
-	Thickness of outer/inner pad	φ235 {9.25} disc	14 {0.55}	Replace
		φ252 {9.92} disc	14 {0.55}	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
-	Pin bolt	40 to 50 {30 to 37, 4.0 to 5.0}	-

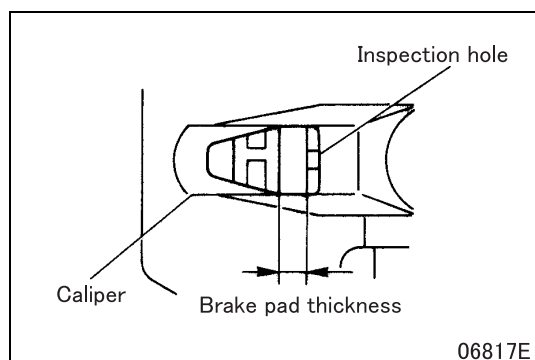
Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
 a	Piston expander  A 50 {1.97} B 5 {0.20} 06815	MB990520	Pressing piston during brake pad replacement

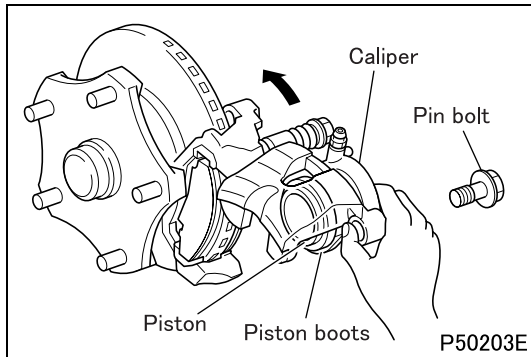


[Inspection]

- When a brake pad has worn down to a thickness of approximately 4 mm {0.16 in.}, the pad wear indicator contacts the disc rotor. This breaks the circuit, illuminating the disc brake warning lamp on the meter cluster to tell the operator that the brake pads need replacement.



- Through the inspection hole in the caliper, measure the brake pad thickness. If the measured value is less than the limit, replace all of the brake pads on that axle with a new kit.



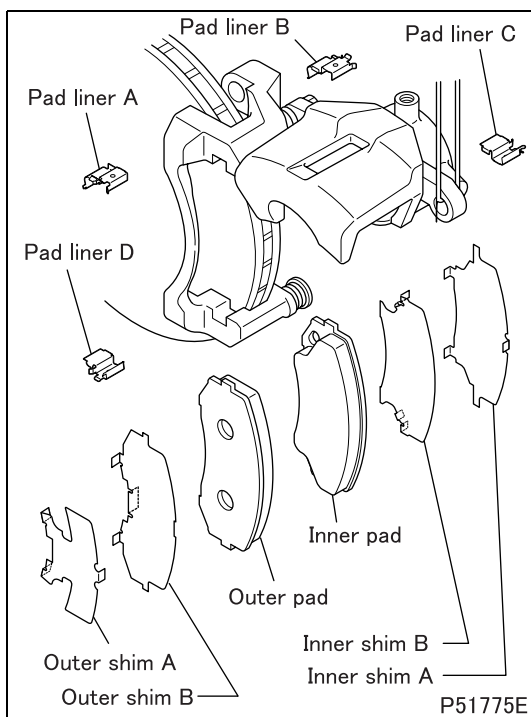
[Replacement]

- Remove the lower pin bolt. Flip the caliper upwards and suspend it in place using a wire or the like.

CAUTION

- The caliper needs to be suspended firmly in place so that it does not drop, without stretching, squeezing or otherwise forcing the brake hosing or harness.

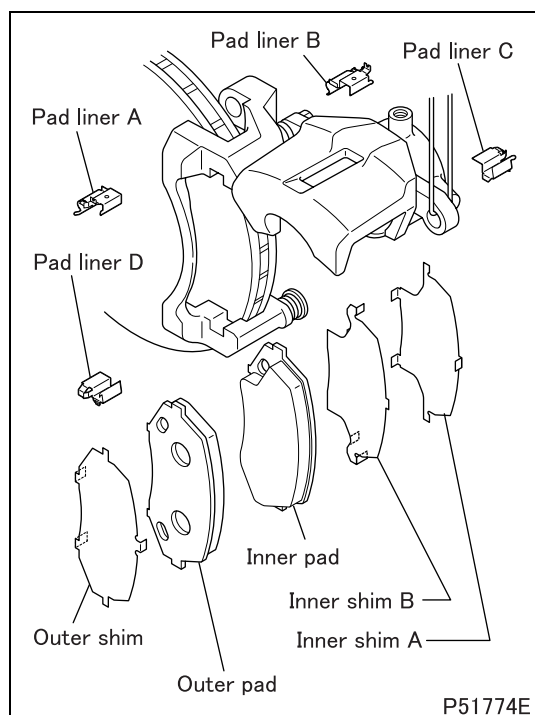
- Inspect the piston for fluid leakage. Inspect the piston boots for damage. Faulty parts must be replaced.
- Remove the following parts. Installation follows the removal procedure in reverse. When installing shims onto the pads, be sure to face them in the illustrated directions.



<φ235 mm {9.25 in.} disc>

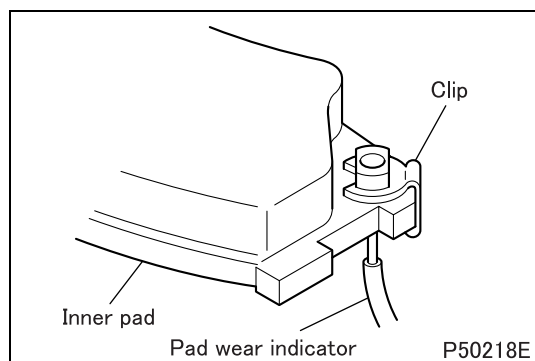
- The inner pad on RH wheel and the inner pad on LH wheel are both equipped with a pad wear indicator.

ON-VEHICLE INSPECTION AND ADJUSTMENT



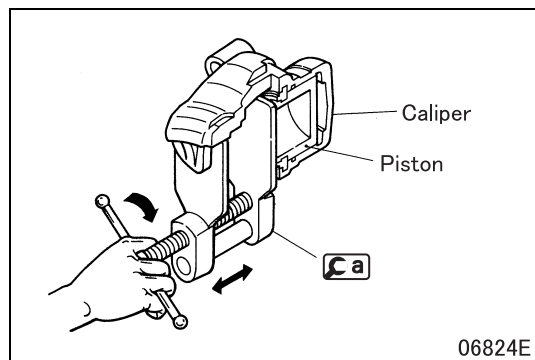
<φ252 mm {9.92 in.} disc>

- The inner pad on RH wheel and the inner pad on LH wheel are both equipped with a pad wear indicator.

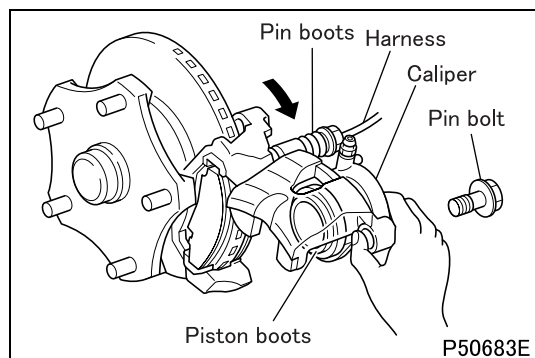


- Install a pad wear indicator onto the inner pad (included in the pad kit) using a clip (included in the pad wear indicator kit).

Pad wear indicator to be installed on	Inner pads on RH and LH wheels
---------------------------------------	--------------------------------



- Using **Ca**, screw in the piston of the caliper until it bottoms on the back of the caliper.



- Move the caliper back to the original place while taking care not to damage the piston boots.
- Bleed the pin boots of air.
- Ensure that the pin boots are firmly attached into the groove on the slide pin.
- Tighten the pin bolt to the specified torque.
- Correctly route the harness(es) for the pad wear indicator(s).
- Measure the drag torque of the disc brake.
- Cycle the brake pedal several times, and check the brake fluid level in the tank. The fluid level should be at the "MAX" mark on the tank. Add brake fluid as required.

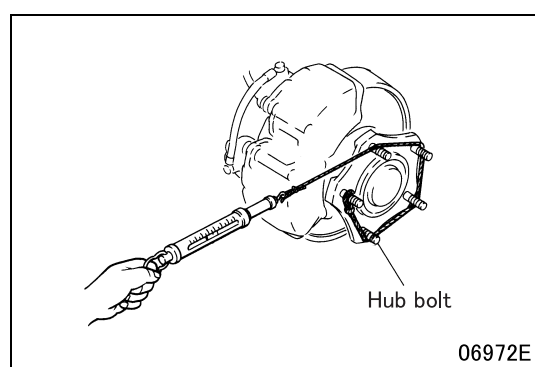
7. Measurement of Disc Brake Drag Torque

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
-	Drag torque of disc brake (tangential force at hub bolts)	Approx. 5 sec. after releasing brake pedal	9.8 N·m {7.2 ft.lbs, 1.0 kgf·m} or less	-	Inspect
		After turning disc rotor 10 revolutions	6.9 N·m {5.1 ft.lbs, 0.7 kgf·m} or less	-	

Table of tangential forces

		Approx. 5 sec. after releasing brake pedal	After turning disc rotor 10 revolutions
FE	Front	81 N {8.3 kgf}	57 N {5.8 kgf}
	Rear	83 N {8.5 kgf}	59 N {6 kgf}
FG	Front	85 N {8.7 kgf}	60 N {6.1 kgf}
	Rear	83 N {8.5 kgf}	59 N {6 kgf}



- Ensure that the starting torque of the wheel hub bearings conforms to the standard value.
- Using a spring balance, measure the tangential force at the hub bolts.
- The tangential force is calculated by the following formula.
Tangential force = Dragging torque / (Hub bolt P.C.D. / 2)
- If the measured tangential force conforms to the specified value, this means that the drag torque of the disc brake conforms to the standard value.
- If the measured value does not conform to the specified torque, check the sliding portions of the piston and piston seal.

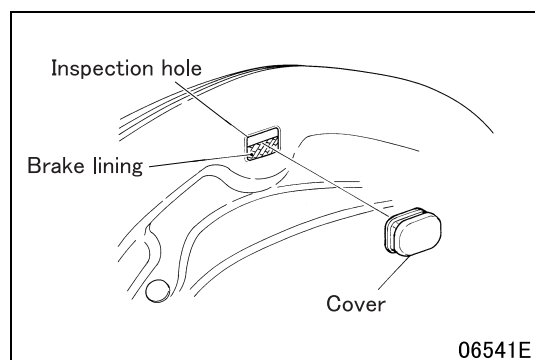
8. Inspection of Drum Brake Lining Thickness

CAUTION

- To ensure correct operation of the brakes, be sure to inspect both linings on each wheel.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
-	Brake lining thickness	φ320 {12.6} drum	-	4.0 {0.16}	Replace



- Remove the cover from the backing plate. Through the inspection hole, check the thickness of the brake lining.
- If the measured value is equal to or less than the limit, replace all of the brake linings or shoes on the same axle.
- After the inspection, be sure to install the cover.

ON-VEHICLE INSPECTION AND ADJUSTMENT

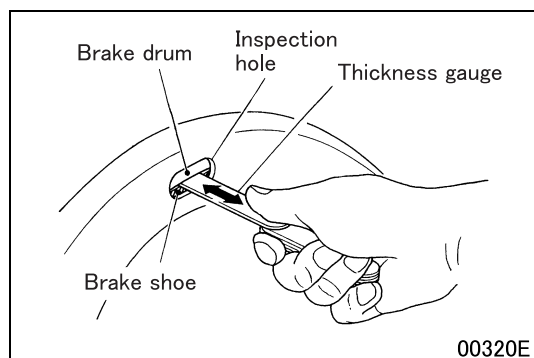
9. Initial Setting of Clearance between Brake Drum and Shoe

CAUTION

- To ensure correct operation of the brakes, be sure to inspect both shoes on each wheel.

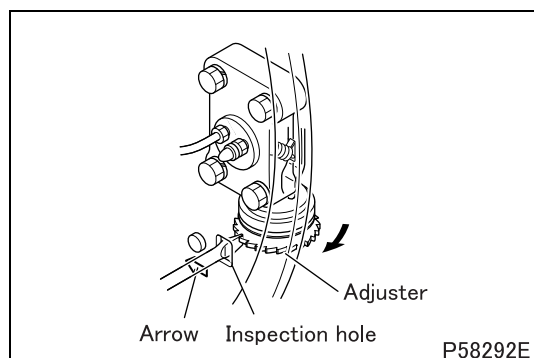
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Clearance between brake drum and shoe	0.2 {0.0079}	–	Inspect, and adjust as required



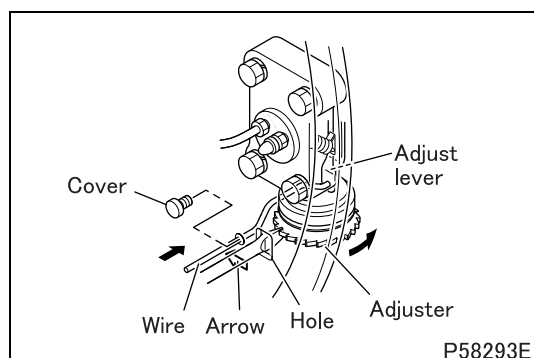
[Inspection]

- Cycle the brake pedal a couple of times to bring the brake shoes to conditions appropriate for the inspection.
- Through the inspection hole, insert a thickness gauge between the brake drum and lining. The gauge should be able to be inserted and out with slight resistance.
- If the clearance does not conform to the standard value, perform the following adjustment.



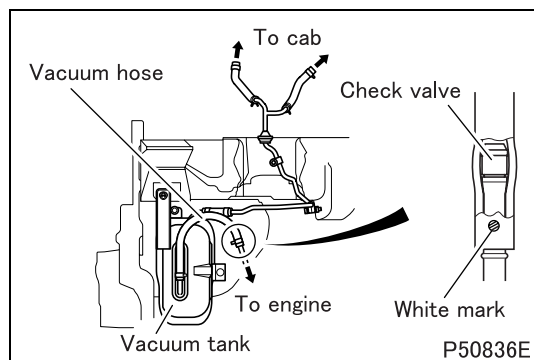
[Adjustment]

- Jack up the wheel being adjusted. Ensure that the wheel hub bearings are not loose.
- With a 0.3 mm {0.012 in.} thickness gauge inserted through the inspection hole, adjust the drum-to-lining clearance in the following manners such that the gauge can be inserted and out with slight resistance.
- If the thickness gauge can be inserted and out with no resistance, turn the adjuster through the inspection hole in the direction of the arrow on the backing plate.



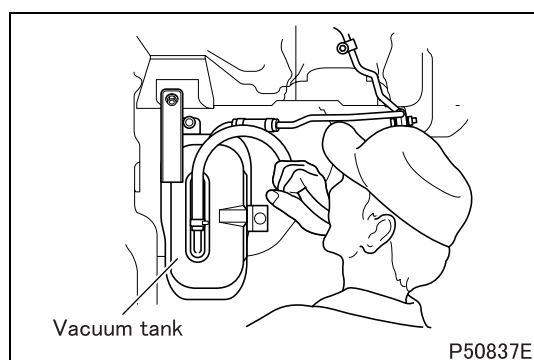
- If the clearance is too small to insert the thickness gauge or there is considerable resistance when inserting the gauge, remove the cover and insert a $\phi 2$ mm {0.079 in.} wire through the hole to lift the adjust lever for the wheel cylinder. Then, through the inspection hole turn the adjuster in the direction opposite to the arrow on the backing plate to increase the clearance between the brake drum and shoe.
- Then, cycle the brake pedal a couple of times. This will automatically bring the brake drum-to-shoe clearance to 0.2 mm {0.0079 in.}.
- Insert a 0.2 mm {0.0079 in.} thickness gauge between the brake drum and lining. It should be able to be inserted and out with slight resistance.
- Check the disc brake for normal operation. If faulty, disassemble and inspect the wheel cylinders.

10. Inspection of Check Valve in Vacuum Line Hose



CAUTION

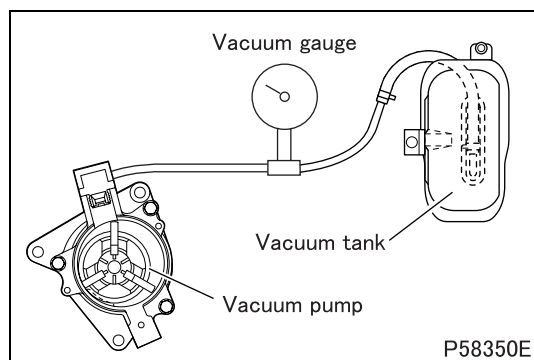
- Be careful not to allow moisture into the check valve.
 - During the inspection, ensure that the check valve opens as well as closes correctly.
 - Do not attempt to remove the check valve from the vacuum hose.
-
- Perform the following inspections. If the check valve does not pass both inspections, replace the check valve complete with the vacuum hose.
 - Blow into the hose. The check valve should close, preventing the breath from passing it.
 - Suck on the hose. The check valve should open, allowing air to pass.



11. Inspection of Vacuum Pump

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
-	Time to reach vacuum of 80 kPa {23.6 in.Hg, 600 mmHg}	At 1500 rpm	Within 20 sec.	Replace
		At 3000 rpm	Within 12 sec.	



- Install a vacuum gauge between the vacuum tank and the vacuum pump.
- Start the engine and measure the time taken to reach the specified degree of vacuum.
- If the measured time does not conform to the standard value, disassemble and service the vacuum pump.

ON-VEHICLE INSPECTION AND ADJUSTMENT

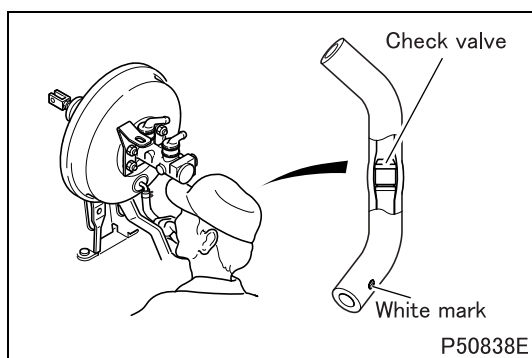
12. Inspection of Vacuum Booster

- The vacuum booster can be inspected in 2 ways: one without using any tester and the other using a simplified tester. In either way, ensure that the brake piping and hosing and their connections are free of leakage, damage, or other faults.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Precision inspection (vacuum loss) (vacuum of 67 kPa {19.8 in.Hg, 500 mmHg}, 15 sec. after engine stop)		3.3 kPa {25 mmHg} or less	–	Replace
–	Fluid pressure at vacuum of 67 kPa {19.8 in.Hg, 500 mmHg}	φ8 + φ9 inch vacuum booster, φ30.16 mm {1.19 in.} brake master cylinder	4830 kPa {700 psi, 49.3 kgf/cm ² } (Pedal depressed with a force of 98 N {22.0 lbs, 10 kgf})	–	Replace
			8230 kPa {1190 psi, 83.9 kgf/cm ² } (Pedal depressed with a force of 295 N {66.3 lbs, 30 kgf})	–	
		φ9 + φ10 inch vacuum booster, φ30.16 mm {1.19 in.} brake master cylinder	4830 kPa {700 psi, 49.3 kgf/cm ² } (Pedal depressed with a force of 98 N {22.0 lbs, 10 kgf})	–	
			9740 kPa {1410 psi, 99.3 kgf/cm ² } (Pedal depressed with a force of 295 N {66.3 lbs, 30 kgf})	–	
		φ9 + φ10 inch vacuum booster, φ31.75 mm {1.25 in.} brake master cylinder	4360 kPa {630 psi, 44.5 kgf/cm ² } (Pedal depressed with a force of 98 N {22.0 lbs, 10 kgf})	–	
			8800 kPa {1280 psi, 89.7 kgf/cm ² } (Pedal depressed with a force of 295 N {66.3 lbs, 30 kgf})	–	

Location	Maintenance item		Standard value	Limit	Remedy
-	Fluid pressure at vacuum of 0 kPa {0 in.Hg, 0 mmHg}	φ8 + φ9 inch vacuum booster, φ30.16 mm {1.19 in.} brake master cylinder	345 kPa {50 psi, 3.5 kgf/cm ² } (Pedal depressed with a force of 98 N {22.0 lbs, 10 kgf})	-	Replace
			1720 kPa {250 psi, 17.5 kgf/cm ² } (Pedal depressed with a force of 295 N {66.3 lbs, 30 kgf})	-	
		φ9 + φ10 inch vacuum booster, φ30.16 mm {1.19 in.} brake master cylinder	345 kPa {50 psi, 3.5 kgf/cm ² } (Pedal depressed with a force of 98 N {22.0 lbs, 10 kgf})	-	
			1720 kPa {250 psi, 17.5 kgf/cm ² } (Pedal depressed with a force of 295 N {66.3 lbs, 30 kgf})	-	
		φ9 + φ10 inch vacuum booster, φ31.75 mm {1.25 in.} brake master cylinder	315 kPa {46 psi, 3.2 kgf/cm ² } (Pedal depressed with a force of 98 N {22.0 lbs, 10 kgf})	-	
			1550 kPa {225 psi, 15.8 kgf/cm ² } (Pedal depressed with a force of 295 N {66.3 lbs, 30 kgf})	-	



12.1 Inspection of check valve in vacuum hose

CAUTION ⚠

- Be careful not to allow moisture into the check valve.
- During the inspection, ensure that the check valve opens as well as closes correctly.
- Do not attempt to remove the check valve from the vacuum hose.

- Start the engine and charge the vacuum tank with vacuum.
- Stop the engine, and immediately remove the clamp fixing the vacuum hose onto the vacuum pipe, and hold the hose in the mouth.
- Blow into the hose. The check valve should close, preventing the breath from passing it.
- Suck on the hose while depressing the brake pedal. The check valve should immediately open, allowing air to pass.
- If any fault is encountered during the above inspections, replace the check valve complete with the vacuum hose.

ON-VEHICLE INSPECTION AND ADJUSTMENT

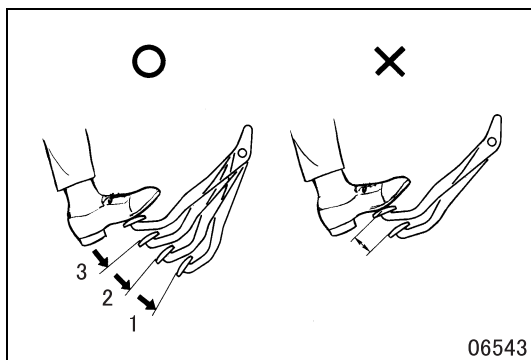
12.2 Operational check of vacuum booster

CAUTION

- The vacuum booster operational checks described below are only of summary nature. If the vacuum booster continues to malfunction, perform a bench test specified by a service station of the manufacturer on the vacuum booster after removing it from the vehicle.
- If the vacuum booster is found to be faulty during the specified testing, ask the service station of the manufacturer for repair.

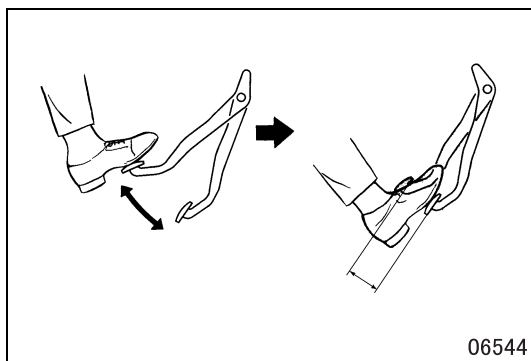
(1) Operational check without any tester

- Inspect the check valve in the vacuum hose for normal operation.
- Perform the checks described below. If any fault is found during these checks, inspect the following parts.
 - Vacuum booster
 - Vacuum pump



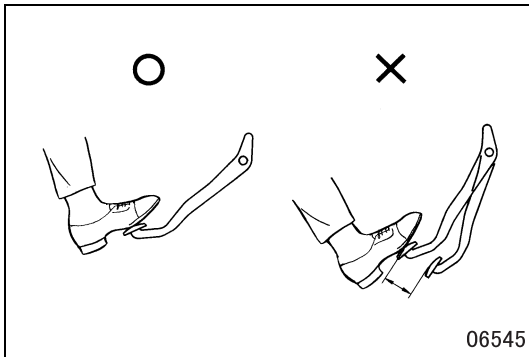
[Check 1]

- Start the engine and run it for 1 to 2 minutes. Stop the engine.
- Depress the brake pedal repetitively with the normal stepping force.
- The pedal stroke should become smaller each time the pedal is depressed.

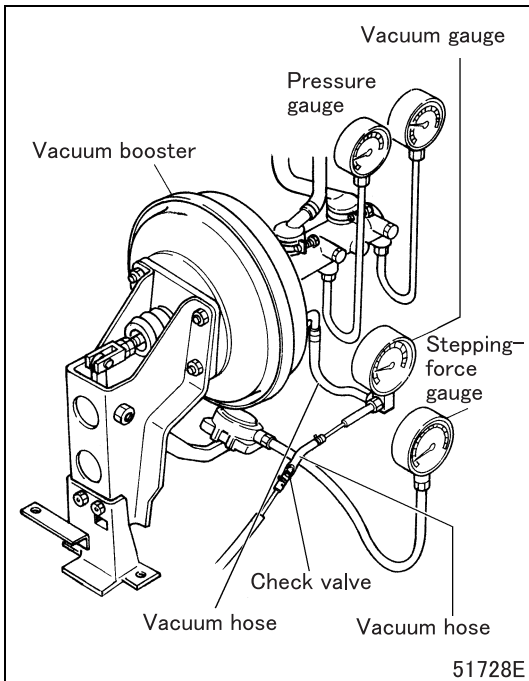


[Check 2]

- With the engine stationary, depress the brake pedal several times.
- With the brake pedal depressed, start the engine. The pedal should sink slightly.



06545



51728E

[Check 3]

- With the engine running and the brake pedal depressed, stop the engine.
- The brake pedal should maintain the same height for approximately 30 seconds.

(2) Operational check with a simplified tester**(2.1) Airtightness check**

- Inspect the check valve in the vacuum hose for normal operation.
- Remove the vacuum hose from the vacuum booster and connect it to the vacuum gauge.
- Connect another hose (not equipped with a check valve) onto the vacuum booster and the vacuum gauge.
- Install 2 pressure gauges and 1 stepping-force gauge as illustrated. Bleed the pressure gauges of air.
- Perform the following checks. If any fault is encountered during these checks, inspect the vacuum booster.

[Check 1]

- Start the engine. When the reading on the vacuum gauge has reached 67 kPa {19.8 in.Hg, 500 mmHg}, stop the engine.
- The vacuum lost in approximately 15 seconds of the engine stop should conform to the standard value.

[Check 2]

- Start the engine, and depress the brake pedal. When the reading on the vacuum gauge has reached 67 kPa {19.8 in.Hg, 500 mmHg}, stop the engine.
- The vacuum lost in approximately 15 seconds of the engine stop should conform to the standard value.

(2.2) System characteristics check

- Perform the following system characteristics checks after the airtightness check described above is completed.
- Perform the following checks. If any fault is encountered during these checks, inspect the vacuum booster.

[Check 1]

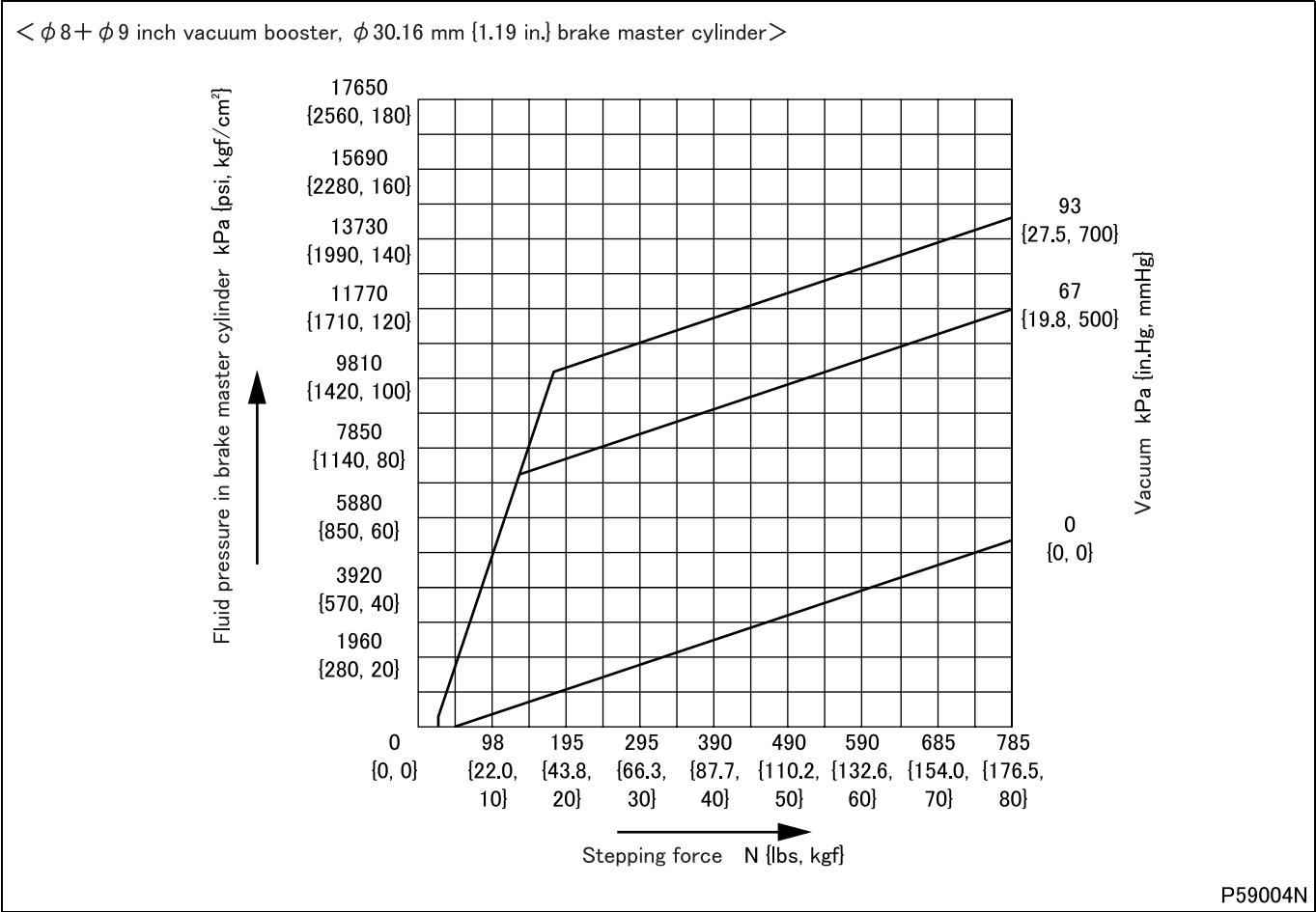
- Start the engine. When the reading on the vacuum gauge has reached 67 kPa {19.8 in.Hg, 500 mmHg}, depress the brake pedal with the specified stepping forces.
- The fluid pressures indicated on the pressure gauges should conform to the specified values.

[Check 2]

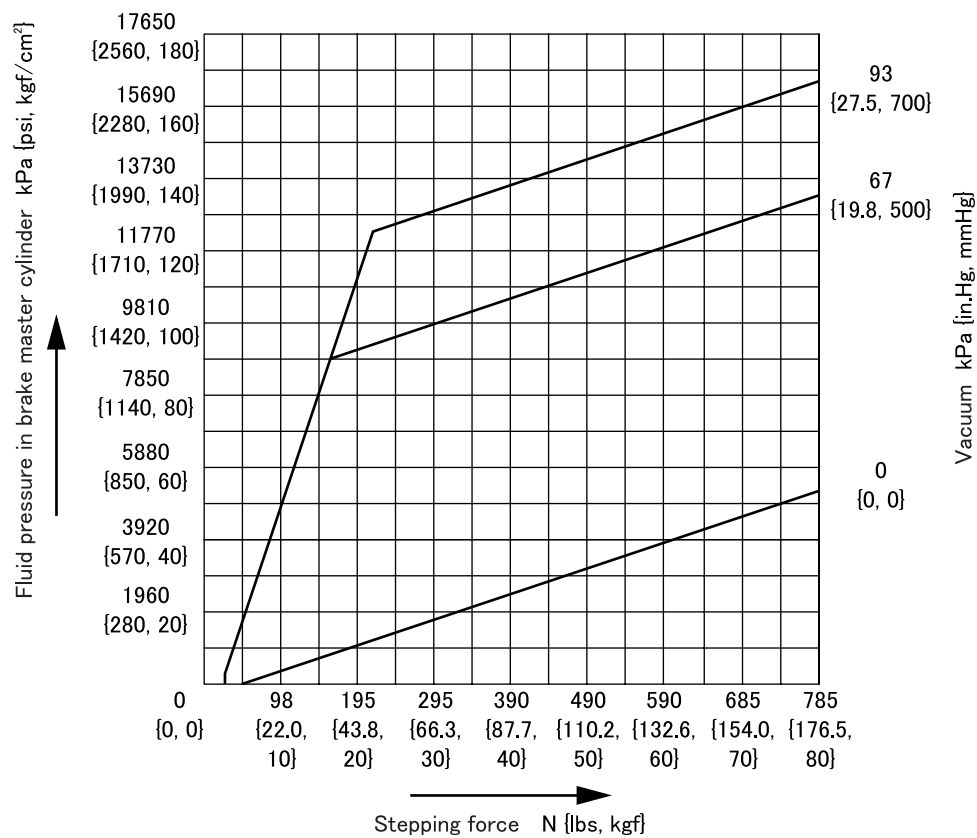
- Start the engine. When the reading on the vacuum gauge has reached 0 kPa {0 in.Hg, 0 mmHg}, depress the brake pedal with the specified stepping forces.
- The fluid pressures indicated on the pressure gauges should conform to the specified values.

ON-VEHICLE INSPECTION AND ADJUSTMENT

(2.3) Vacuum booster performance graph



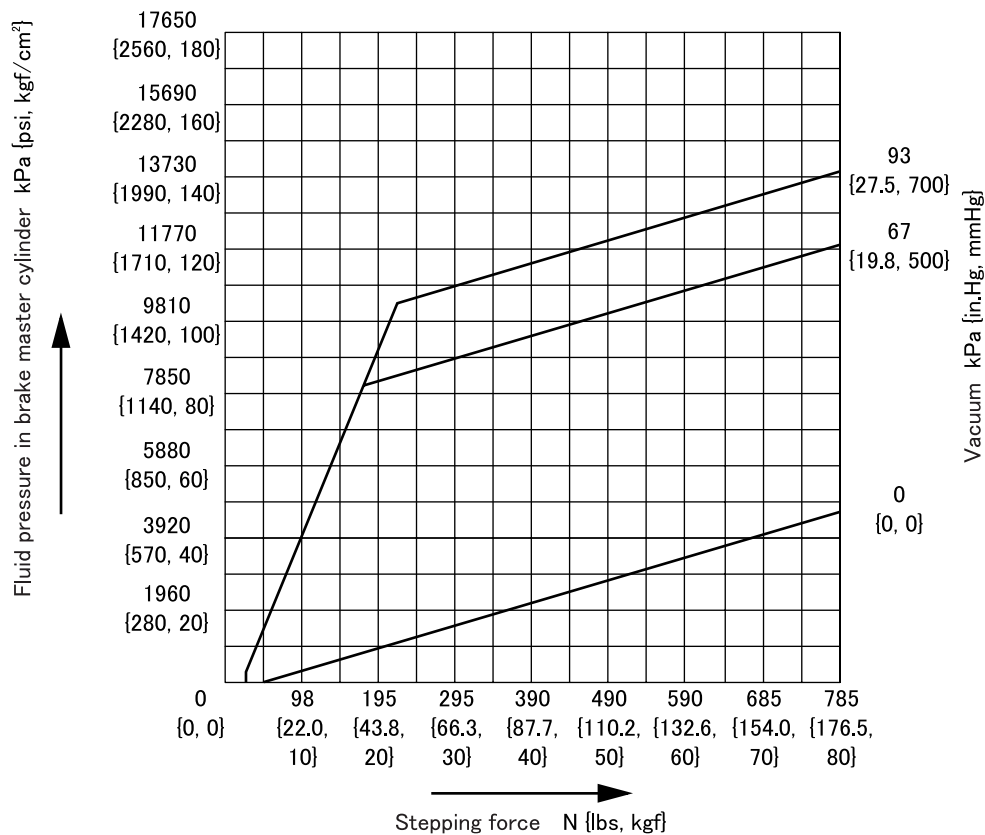
< $\phi 9 + \phi 10$ inch vacuum booster, $\phi 30.16$ mm [1.19 in.] brake master cylinder >



P59005N

ON-VEHICLE INSPECTION AND ADJUSTMENT

< $\phi 9 + \phi 10$ inch vacuum booster, $\phi 30.75$ mm {1.25 in.} brake master cylinder >



P59006N

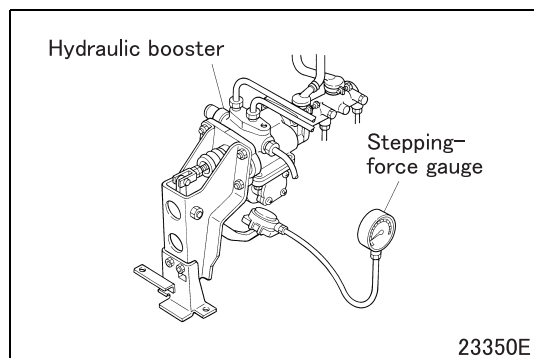
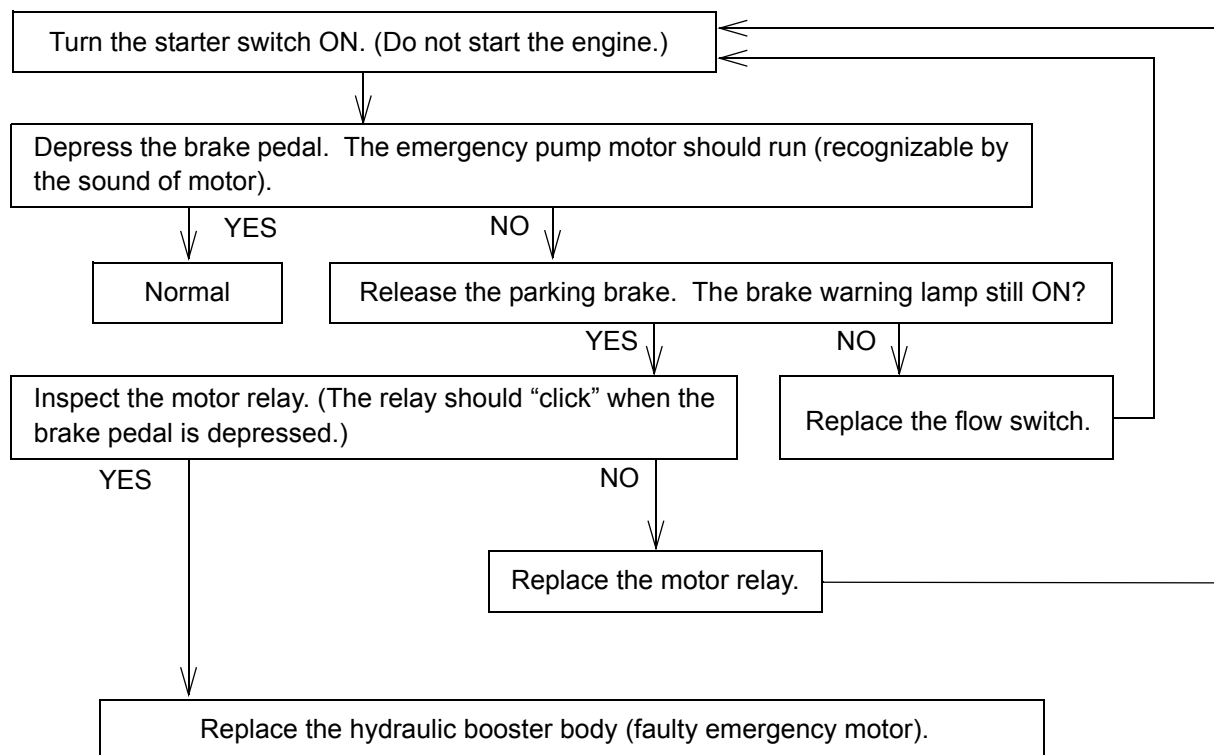
13. Inspection of Hydraulic Booster

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
-	Fluid pressure at power steering oil temperature of 60°C {140°F} or below	Pedal depressed with a force of 98 N {22.0 lbs, 10 kgf}	4620 kPa {670 psi, 47.1 kgf/cm ² }	Replace
		Pedal depressed with a force of 295 N {66.3 lbs, 30 kgf}	13600 kPa {1970 psi, 138.7 kgf/cm ² }	

13.1 Inspection of electric equipment

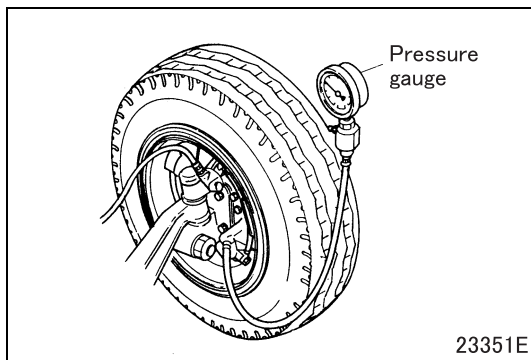
- Inspect in accordance with the following flow chart.
- Before inspection, park the vehicle on a flat surface, apply the parking brake firmly, and chock the wheels.



13.2 Functional check

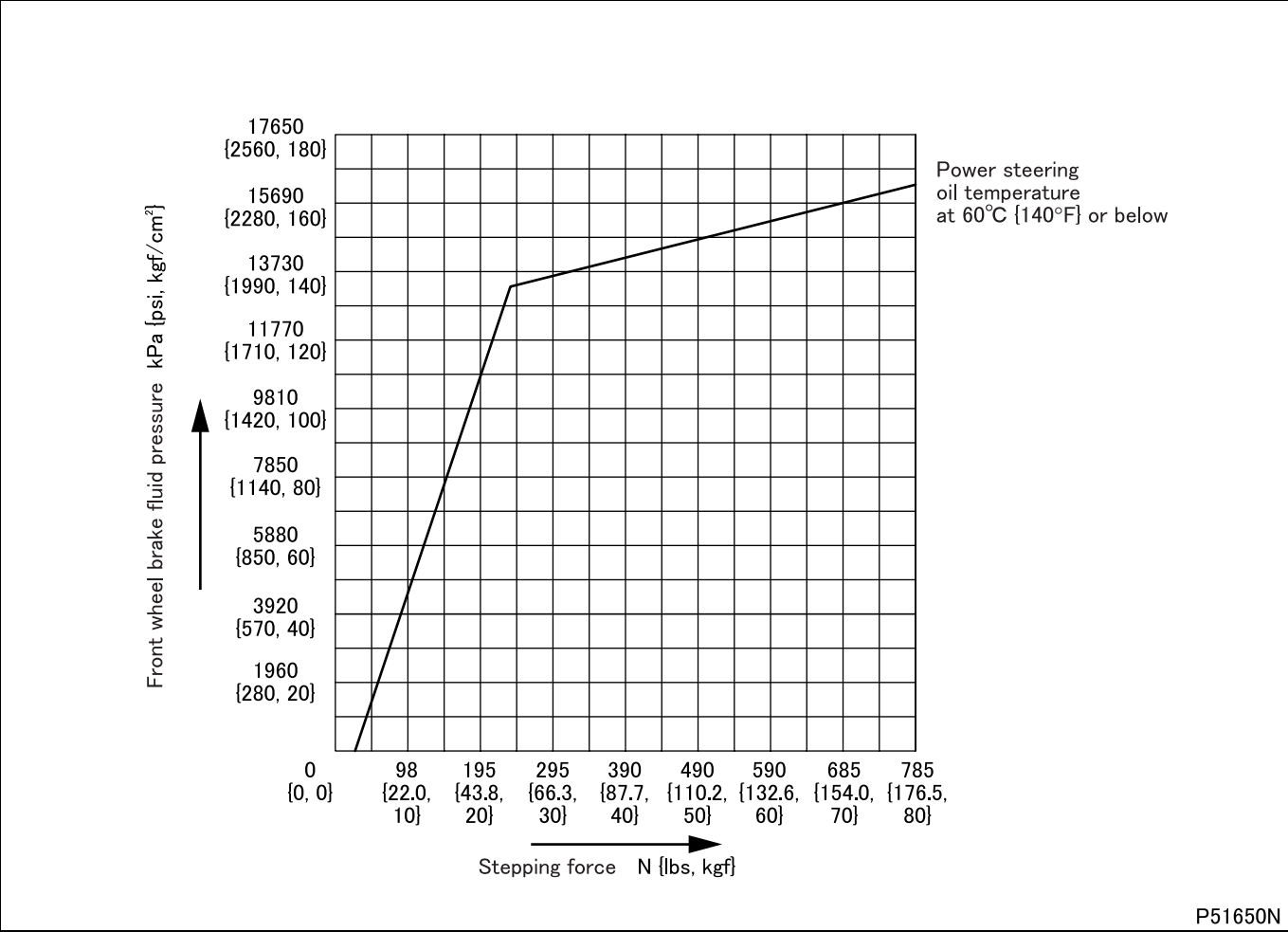
- Install a stepping-force gauge onto the brake pedal. Remove an air bleeder from the front wheel brake, and install a pressure gauge. Bleed the gauge of air.
- Carry out performance test on the power steering system. Ensure that the system pressure is to specification.
- After confirming that the electric equipment has passed the inspection described above, depress the brake pedal with varying forces. The reading of the front wheel brake fluid pressure should follow the pressure line of the graph.

ON-VEHICLE INSPECTION AND ADJUSTMENT

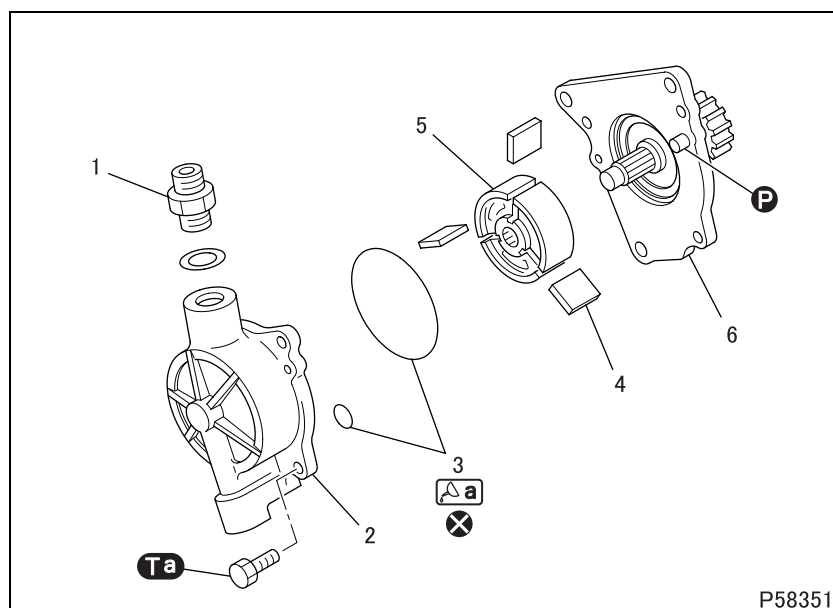


- If any fault is observed during these checks, replace the hydraulic booster.

13.3 Hydraulic booster performance graph



VACUUM PUMP



● Disassembly sequence

- 1 Check valve
- 2 Housing
- 3 O-ring
- 4 Vane
- 5 Rotor
- 6 Bracket

(P): Locating pin

(X): Non-reusable parts

NOTE

- For removal and installation procedures, see Gr11.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
-	Time to reach vacuum of 80 kPa {23.6 in.Hg, 600 mmHg} (Vacuum tank capacity: 10 dm ³ {2.6 gal, 10 L})	At 1500 rpm	Within 20 sec.	—	Replace
		At 3000 rpm	Within 12 sec.	—	

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

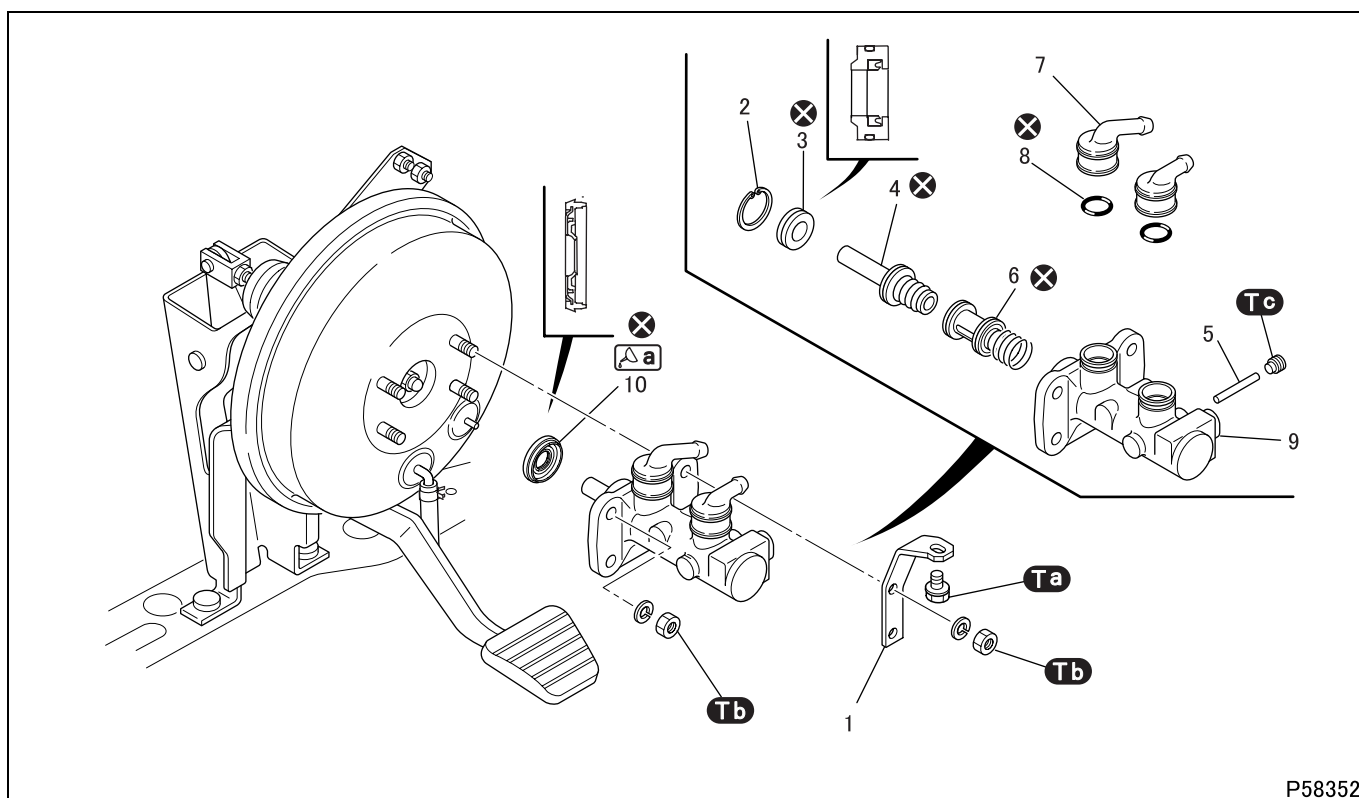
Mark	Parts to be tightened	Tightening torque	Remarks
(Ta)	Bolt (Housing and bracket assembling)	8.8 ± 2 {6.5 ± 1.5, 0.9 ± 0.2}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
(a)	O-ring	Engine oil	As required

M E M O

BRAKE MASTER CYLINDER <WITH VACUUM BOOSTER>



● Disassembly sequence

- 1 Bracket
- 2 Retaining ring
- 3 Piston guide
- 4 Primary piston
- 5 Set pin
- 6 Secondary piston

- 7 Connector
- 8 O-ring
- 9 Cylinder body
- 10 Seal

⊗: Non-reusable parts

CAUTION ⚠

- For cleaning, use brake fluid.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Master cylinder repair kit

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
4	Primary piston spring load	$\phi 30.16$ {1.19} (Installed length 33.4 {1.31})	103.9 to 115.6 N {23 to 26 lbs, 10.6 to 11.8 kgf}	100.9 N {23 lbs, 10.3 kgf}	Replace
		$\phi 31.75$ {1.25} (Installed length 32 {1.26})	113.7 to 125.4 N {26 to 28 lbs, 11.6 to 12.8 kgf}	110.7 N {25 lbs, 11.3 kgf}	
4, 6, 9	Clearance between primary and secondary pistons and cylinder body		0.02 to 0.10 {0.00079 to 0.0039}	0.2 {0.0079}	Replace
6	Secondary piston spring load	$\phi 30.16$ {1.19} (Installed length 25.7 {1.01})	87.2 to 98 N {20 to 22 lbs, 8.9 to 10.0 kgf}	85.3 N {19 lbs, 8.7 kgf}	Replace
		$\phi 31.75$ {1.25} (Installed length 27.1 {1.07})	81.3 to 91.1 N {18 to 20 lbs, 8.3 to 9.3 kgf}	79.4 N {18 lbs, 8.1 kgf}	

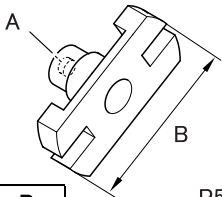
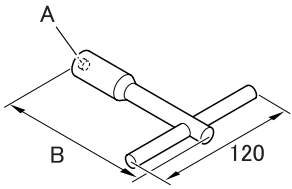
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Bracket mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	—
Tb	Nut (Brake master cylinder mounting)	9.8 to 15.7 {7.2 to 12, 1 to 1.6}	—
Tc	Screw (Set pin mounting)	8.8 to 11.8 {6.5 to 8.7, 0.9 to 1.2}	—

Lubricant and/or sealant

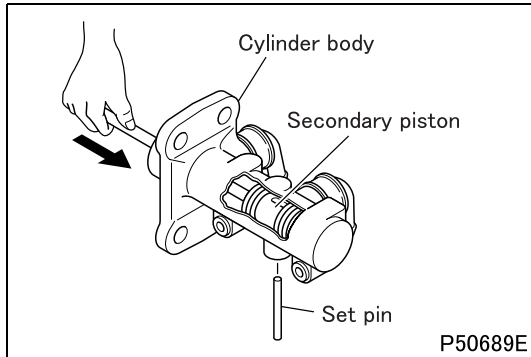
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Seal lips and outer periphery	Rubber grease	As required
	Seal ring groove		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application								
	Support tool  P51262 <table><tr><th></th><th>A</th><th>B</th></tr><tr><td>$\phi 8 + \phi 9$ inch</td><td>No. of splines: 20</td><td rowspan="2">$\phi 95$ {3.74}</td></tr><tr><td>$\phi 9 + \phi 10$ inch</td><td>No. of splines: 20</td></tr></table>		A	B	$\phi 8 + \phi 9$ inch	No. of splines: 20	$\phi 95$ {3.74}	$\phi 9 + \phi 10$ inch	No. of splines: 20	$<\phi 8 + \phi 9 \text{ inch}>$ MB999006 $<\phi 9 + \phi 10 \text{ inch}>$ MB999061	Adjustment of vacuum booster push rod
		A	B								
$\phi 8 + \phi 9$ inch	No. of splines: 20	$\phi 95$ {3.74}									
$\phi 9 + \phi 10$ inch	No. of splines: 20										
	Box spanner  P51263 <table><tr><th></th><th>A</th><th>B</th></tr><tr><td>$\phi 8 + \phi 9$ inch</td><td>Width across flats: 7</td><td rowspan="2">120 {4.72}</td></tr><tr><td>$\phi 9 + \phi 10$ inch</td><td>Width across flats: 8</td></tr></table>		A	B	$\phi 8 + \phi 9$ inch	Width across flats: 7	120 {4.72}	$\phi 9 + \phi 10$ inch	Width across flats: 8	$<\phi 8 + \phi 9 \text{ inch}>$ MB999007 $<\phi 9 + \phi 10 \text{ inch}>$ MB999062	
	A	B									
$\phi 8 + \phi 9$ inch	Width across flats: 7	120 {4.72}									
$\phi 9 + \phi 10$ inch	Width across flats: 8										

BRAKE MASTER CYLINDER <WITH VACUUM BOOSTER>

◆ Removal procedure ◆

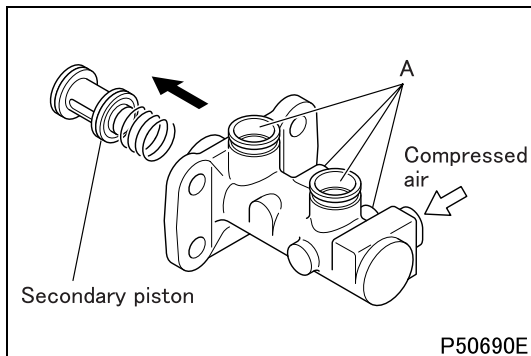


■ Removal: Secondary piston

- Position the cylinder body such that the set pin faces down. Using a rod or the like, compress the secondary piston to ease out the set pin.

CAUTION ⚠

- As the secondary piston is compressed, the set pin will fall out. Be sure to catch it with hand. Do not drop it on the floor.

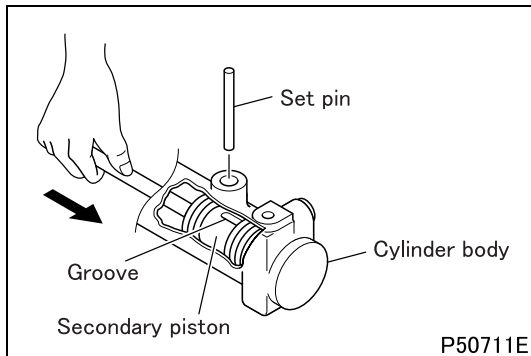


- With ports A blocked, feed compressed air in the direction of the arrow, gradually increasing pressure from 0 kPa {0 kgf/cm²}, to remove the secondary piston.

WARNING ⚠

- Do not apply compressed air suddenly and at high pressure. Otherwise, the secondary piston may fly out with full force.

◆ Installation procedure ◆

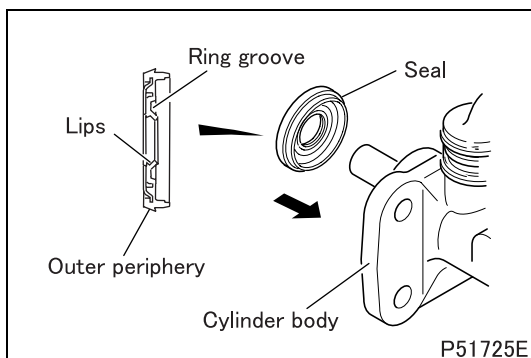


■ Installation: Secondary piston

- Position the cylinder body such that the set pin hole faces up. Using a rod or the like, insert the secondary piston into the cylinder body while at the same time trying to insert the set pin.

NOTE

- If necessary, rotate the secondary piston to align the groove on the piston with the set pin hole.



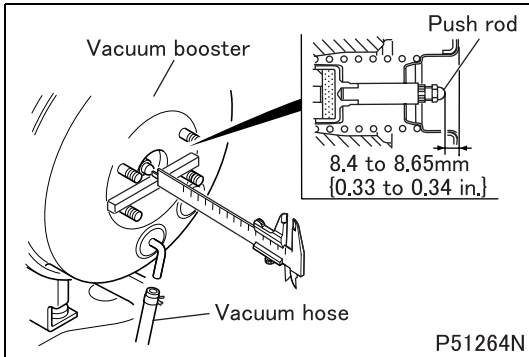
■ Installation: Seal

- Apply grease onto the lips and outer periphery of the seal. Also, pack grease into the seal's ring groove. Then, face the seal in the illustrated direction before installing it onto the cylinder body.

CAUTION ⚠

- Ensure that the seal has been assembled correctly onto the cylinder body, i.e. facing the illustrated direction and without roll-up or damage. Otherwise, vacuum may be lost through the seal.

◆ Work after installation ◆



CAUTION ⚠

- If the brake master cylinder or the primary piston is replaced, be sure to inspect and, if required, adjust the illustrated distance between the push rod and the end of the brake pedal & vacuum booster.

■ Inspection: Brake pedal & vacuum booster

[Inspection]

- Remove the vacuum hose from the brake pedal & vacuum booster to fill the vacuum booster with the atmospheric pressure.

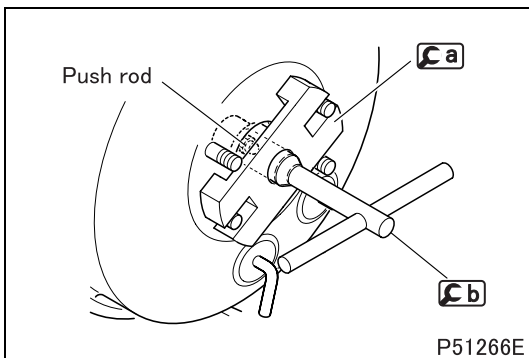
CAUTION ⚠

- The vacuum booster needs to be filled with the atmospheric pressure to obtain accurate results from the inspection.

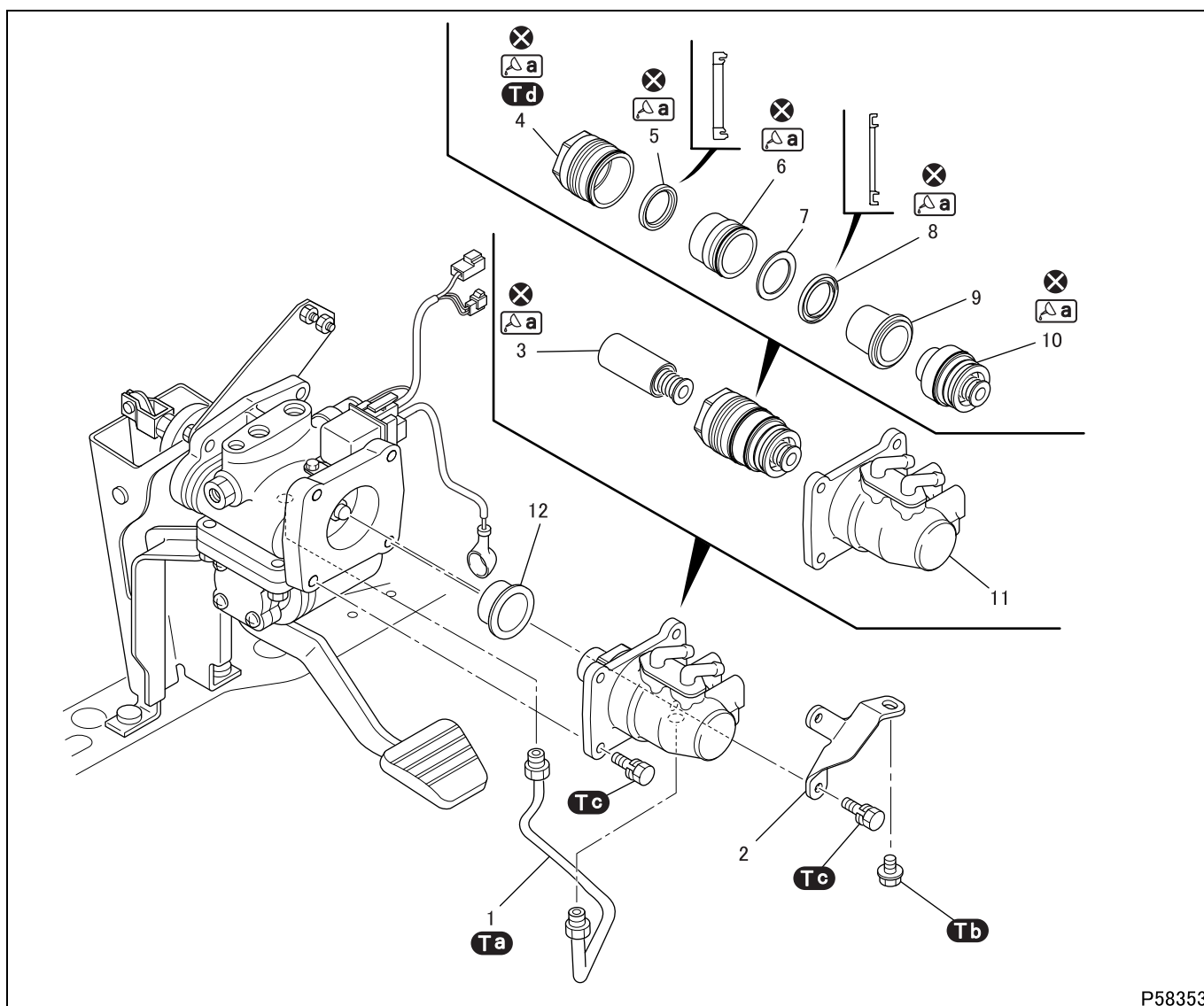
- Measure the distance (illustrated) between the push rod and the end of the brake pedal & vacuum booster.
- If the measured value does not conform to the specified value, adjust the distance as follows.

[Adjustment]

- Set the distance to the specified value by turning in or out the push rod.



BRAKE MASTER CYLINDER <WITH HYDRAULIC BOOSTER>



P58353

● Disassembly sequence

- | | |
|------------------|---------------------|
| 1 Brake pipe | 8 Primary cup |
| 2 Bracket | 9 Cup retainer |
| 3 Primary piston | 10 Secondary piston |
| 4 Cap | 11 Cylinder |
| 5 Secondary cup | 12 Piston protector |
| 6 Bushing | |
| 7 Cup spacer | |

⊗: Non-reusable parts

CAUTION

- For cleaning, use brake fluid.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Master cylinder repair kit, Cap kit

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3	Primary piston spring load (Installed length: 49.7 {1.96})	130 to 140 N {29 to 31 lbs, 13.3 to 14.3 kgf}	125 N {28 lbs, 12.7 kgf}	Replace
3, 10, 11	Clearance between primary and secondary pistons and cylinder	0.065 to 0.125 {0.0026 to 0.0049}	0.13 {0.0051}	Replace
10	Secondary piston spring load (Installed length: 44.5 {1.75})	102 to 118 N {23 to 27 lbs, 10.4 to 11.4 kgf}	96 N {22 lbs, 9.8 kgf}	Replace

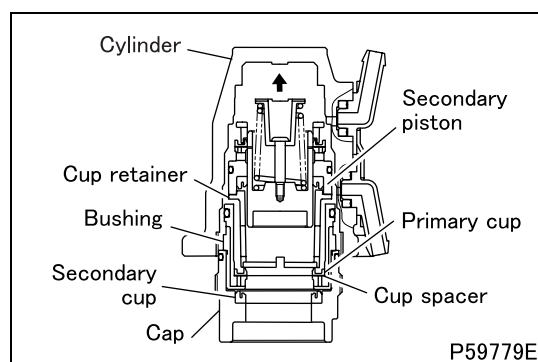
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Brake pipe	17.2 ± 2.5 {13 ± 1.8, 1.75 ± 0.25}	–
Tb	Bolt (Bracket mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–
Tc	Bolt (Brake master cylinder mounting)	17.6 to 27.4 {13 to 20, 1.8 to 2.8}	–
Td	Cap	68.6 to 78.4 {51 to 58, 7 to 8}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Sliding face of primary piston	Rubber grease	As required
	O-ring on cap		
	Secondary cup		
	O-ring on bushing		
	Primary cup		
	Sliding face of secondary piston		

◆ Installation procedure ◆

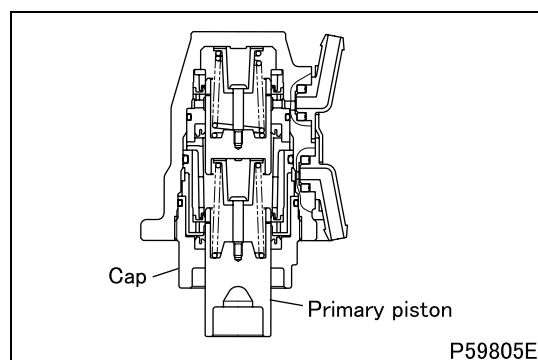


■ Installation: Cap, secondary cup, cup spacer, primary cup, bushing, cup retainer, secondary cup and primary piston

- With the end of the cylinder facing upward, insert each assembled part slowly.

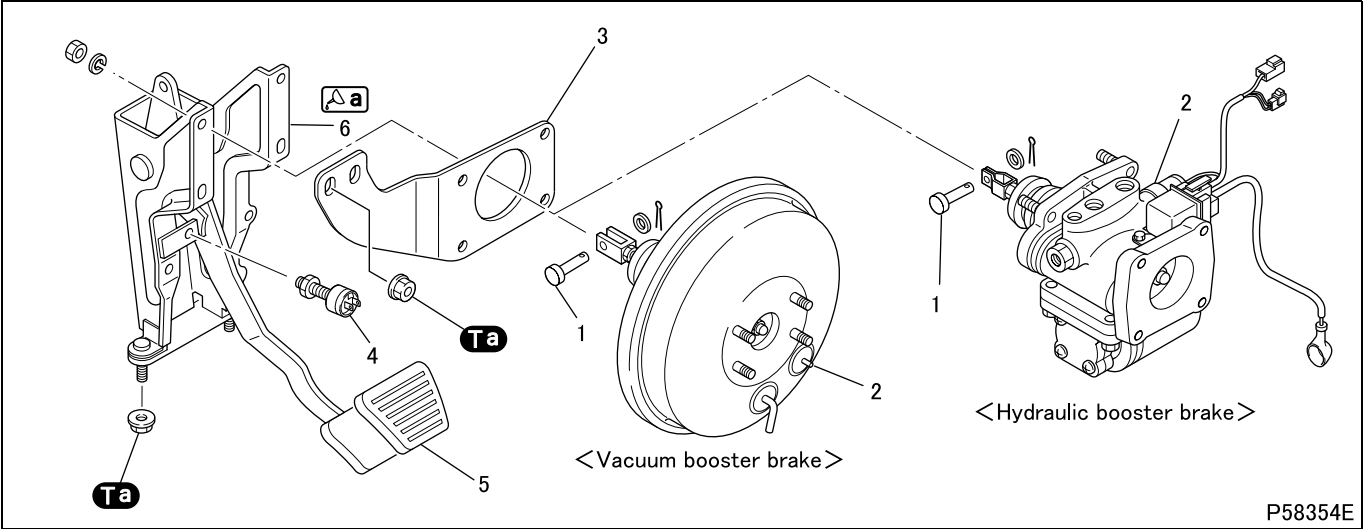
CAUTION

- To prevent the cup retainer from falling off, hold the cylinder with its end upward until the the cap is screwed into the cylinder.



- After screwing the cap into the cylinder, tighten it to the specified torque.
- Slowly insert the primary piston through the cap.

BRAKE PEDAL & VACUUM BOOSTER, HYDRAULIC BOOSTER



Disassembly sequence

- | | |
|--|----------------------------------|
| 1 Clevis pin | 3 Bracket <Vacuum booster brake> |
| 2 Vacuum booster
<Vacuum booster brake> | 4 Stop lamp switch |
| Hydraulic booster (See later section.) | 5 Pedal pad |
| <Hydraulic booster brake> | 6 Brake pedal & pedal support |

CAUTION

- Do not attempt to disassemble the vacuum booster.

Assembly sequence

Follow the disassembly sequence in reverse.

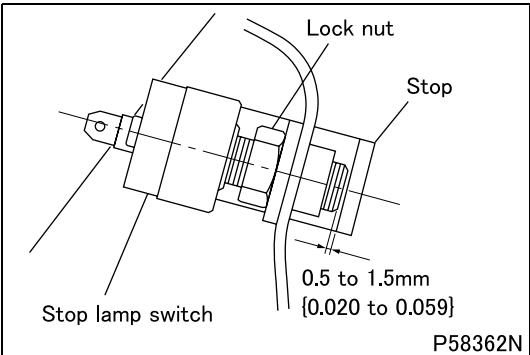
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
	Nut (Bracket mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	—
	Nut (Brake pedal & pedal support mounting)		

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Return spring of brake pedal & pedal support; Inner periphery of clevis pin hole	Chassis grease [NLGI No. 1 (Ca soap)]	As required

Installation procedure



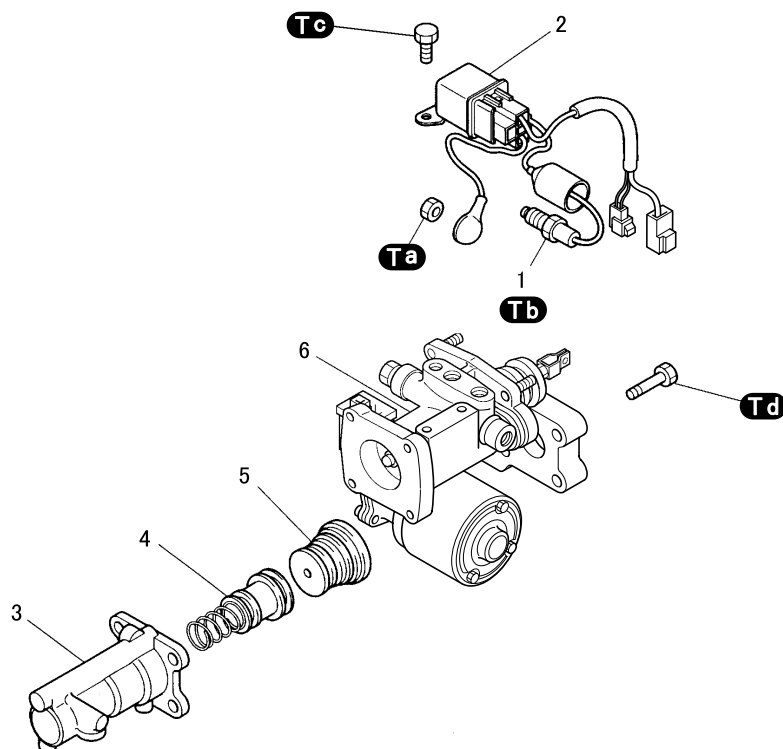
Installation: Stop lamp switch

- Set the distance between the threaded end of the stop lamp switch and the stop for the brake pedal & pedal support to the illustrated value. Then, fix the assembly with the lock nut.

CAUTION

- To prevent brake drag, ensure that the threaded end of the stop lamp switch does not interfere with the stop for the brake pedal.

Hydraulic Booster



P58355

● **Disassembly sequence**

- | | |
|----------------------------------|--------------------------------|
| 1 Flow switch | 4 Valve piston guide |
| 2 Motor relay | 5 Pressure intensifying piston |
| 3 Pressure intensifying cylinder | 6 Hydraulic booster body |

● **Assembly sequence**

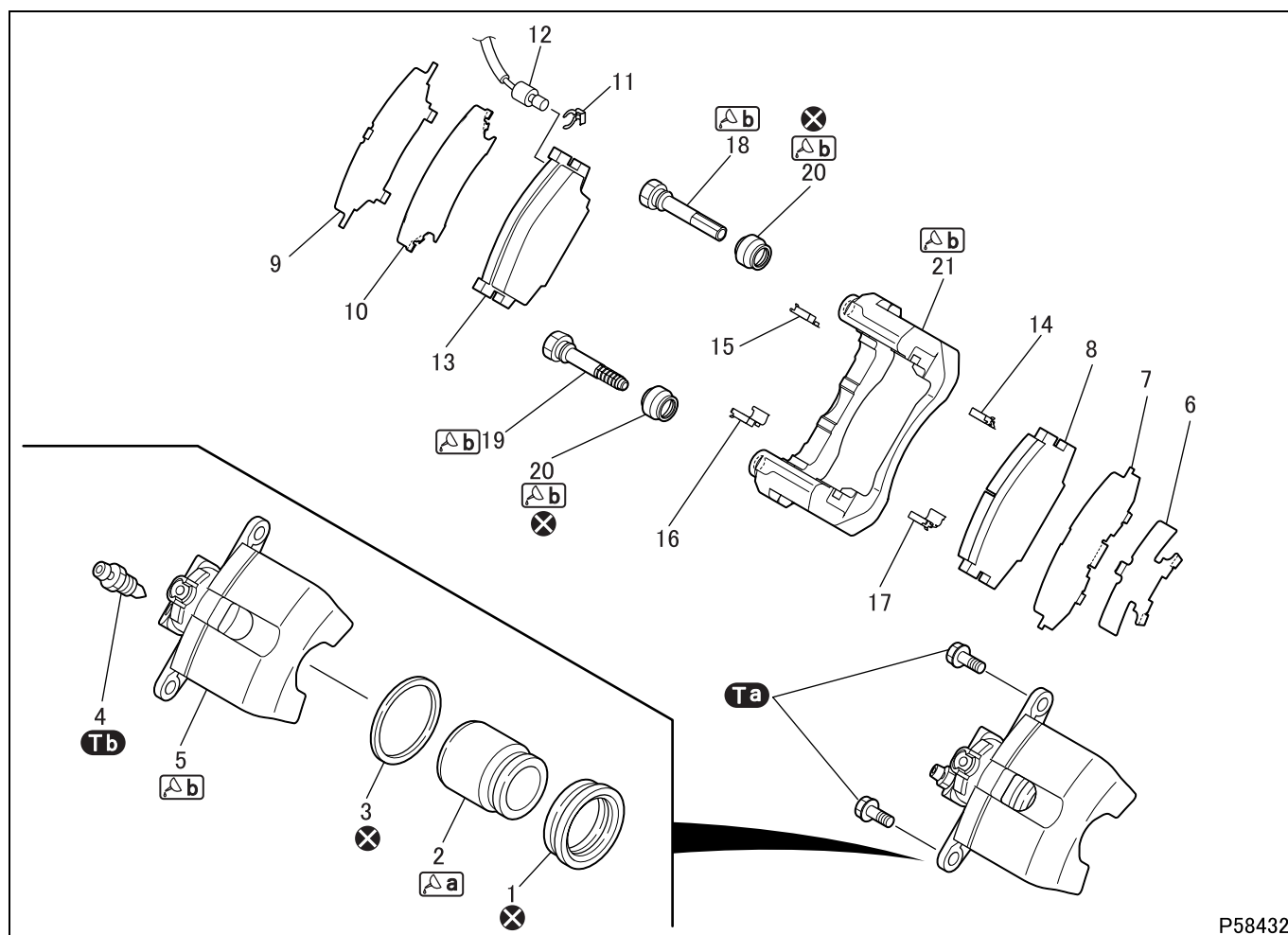
Follow the disassembly sequence in reverse.

Repair kit: Valve piston guide, Pressure intensifying piston

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Motor relay earth mounting)	2.45 to 4.41 {1.8 to 3.3, 0.25 to 0.45}	—
Tb	Flow switch	24.5 to 34.3 {18 to 25, 2.5 to 3.5}	—
Tc	Bolt (Motor relay mounting)	4.41 to 7.35 {3.3 to 5.4, 0.45 to 0.74}	—
Td	Bolt (Pressure intensifying cylinder mounting)	17.6 to 27.4 {13 to 20, 1.8 to 2.8}	—

FRONT DISC BRAKE <φ235 mm {9.25 in.} DISC>



● Disassembly sequence

- | | | | |
|----|---------------------|----|----------------|
| 1 | Piston boots | 13 | Inner pad |
| 2 | Piston | 14 | Pad liner A |
| 3 | Piston seal | 15 | Pad liner B |
| 4 | Air bleeder (lower) | 16 | Pad liner C |
| 5 | Caliper | 17 | Pad liner D |
| 6 | Outer shim A | 18 | Main slide pin |
| 7 | Outer shim B | 19 | Sub slide pin |
| 8 | Outer pad | 20 | Pin boots |
| 9 | Inner shim A | 21 | Torque member |
| 10 | Inner shim B | | |
| 11 | Clip | | |
| 12 | Pad wear indicator | | |

⊗: Non-reusable parts

NOTE

- For removal and installation of the front disc brake, see Gr26.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- Rubber parts that are disassembled must be replaced as a seal kit.
- Items included in a seal kit must be lubricated with grease supplied with the kit before installation.
- Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.
- Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Service standards (Unit: mm {in.})

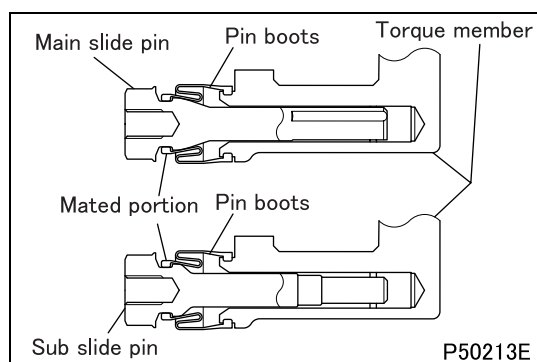
Location	Maintenance item	Standard value	Limit	Remedy
8, 13	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

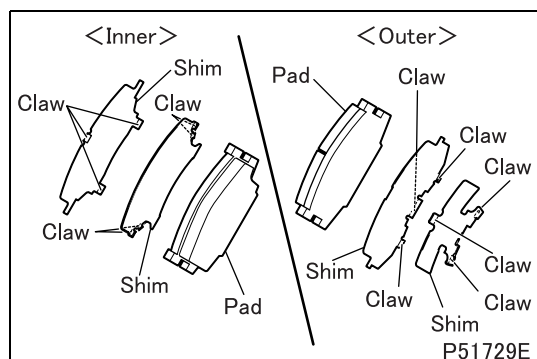
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Pin bolt	40 to 50 {30 to 37, 4.0 to 5.0}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5, 0.6 to 0.9}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

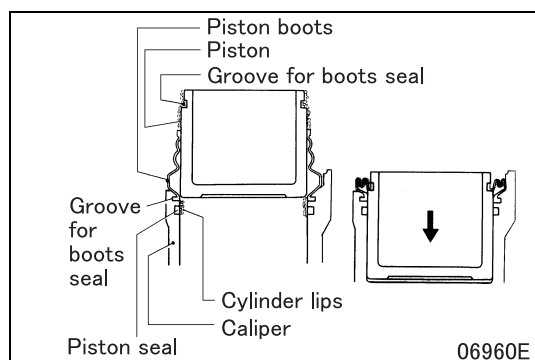
◆ Installation procedure ◆**■ Installation: Main slide pin, sub slide pin, pin boots, and torque member**

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.

**■ Installation: Shims**

- Position shims such that they face the illustrated directions before installing them onto the pads.

FRONT DISC BRAKE <Ø235 mm {9.25 in.} DISC>

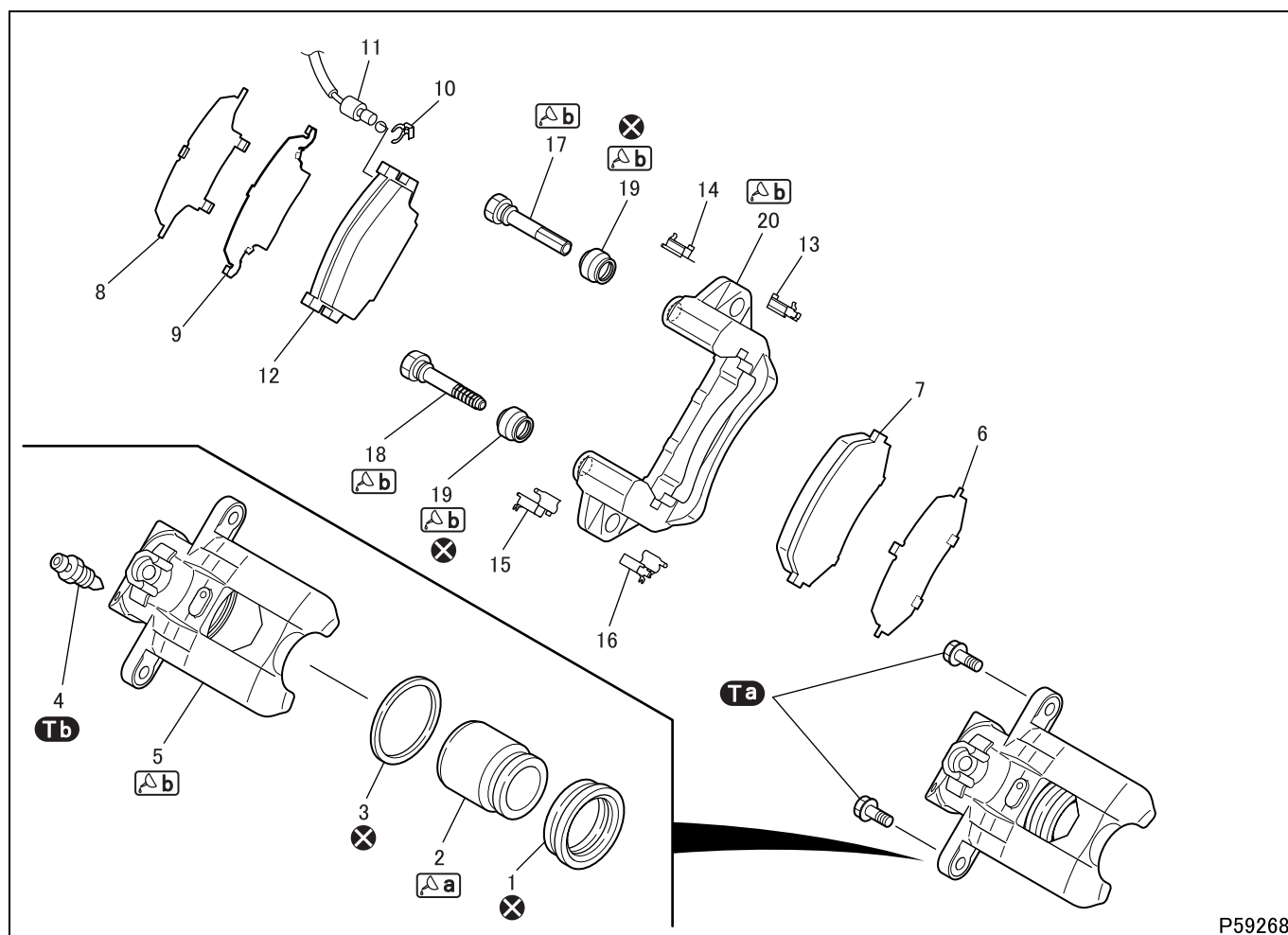


■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

M E M O

FRONT DISC BRAKE <φ252 mm {9.92 in.} DISC>



P59268

● Disassembly sequence

- | | |
|---------------------------------------|-------------------|
| 1 Piston boots | 12 Inner pad |
| 2 Piston | 13 Pad liner A |
| 3 Piston seal | 14 Pad liner B |
| 4 Air bleeder (lower) | 15 Pad liner C |
| 5 Caliper | 16 Pad liner D |
| 6 Outer shim | 17 Main slide pin |
| 7 Outer pad | 18 Sub slide pin |
| 8 Inner shim A | 19 Pin boots |
| 9 Inner shim B | 20 Torque member |
| 10 Clip (Upper RH only) | |
| 11 Pad wear indicator (Upper RH only) | |

⊗: Non-reusable parts

NOTE

- For removal and installation of the front disc brake, see Gr26.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- Rubber parts that are disassembled must be replaced as a seal kit.
- Items included in a seal kit must be lubricated with grease supplied with the kit before installation.
- Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.
- Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Service standards (Unit: mm {in.})

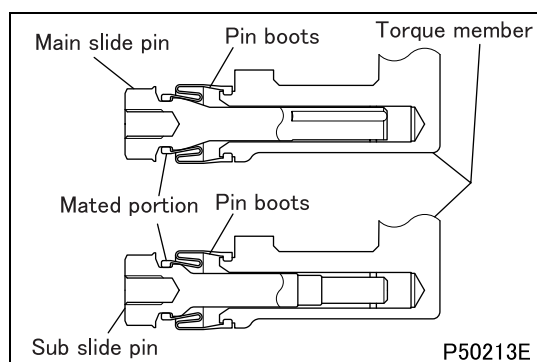
Location	Maintenance item	Standard value	Limit	Remedy
7, 10	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

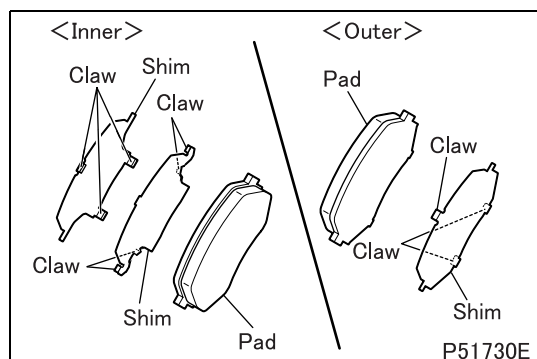
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Pin bolt	40 to 50 {30 to 37, 4.1 to 5.1}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5, 0.6 to 0.9}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

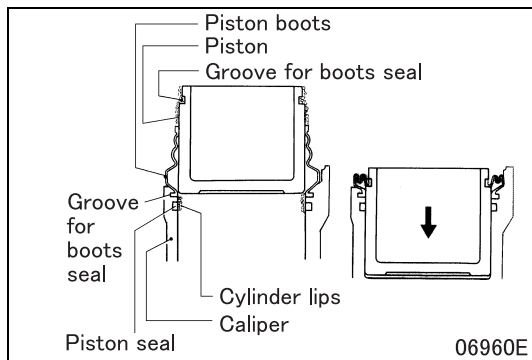
◆ Installation procedure ◆**■ Installation: Main slide pin, sub slide pin, pin boots, and torque member**

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.

**■ Installation: Shims**

- Position shims such that they face the illustrated directions before installing them onto the pads.

FRONT DISC BRAKE <Ø252 mm {9.92 in.} DISC>

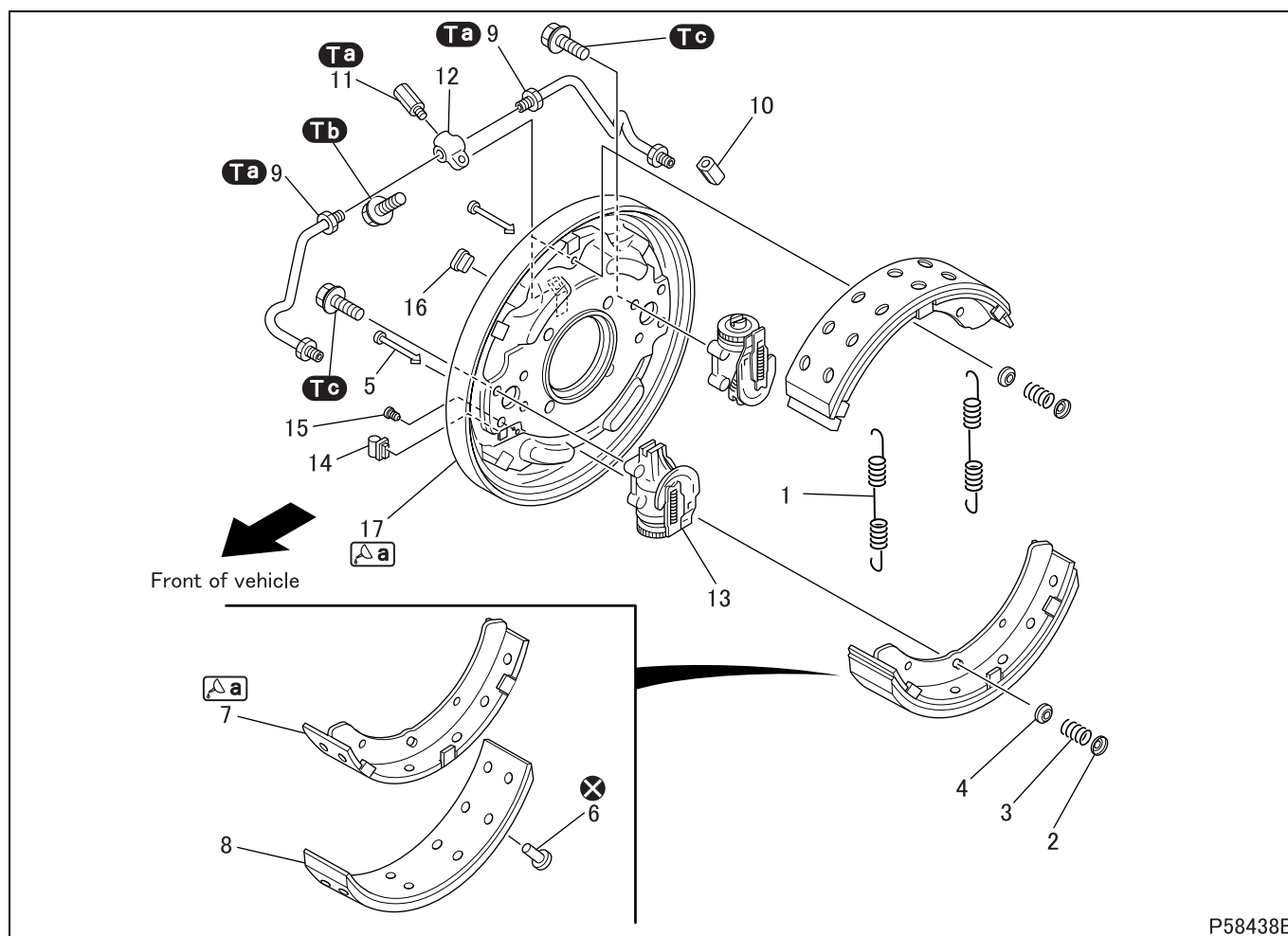


■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

M E M O

FRONT DRUM BRAKE



P58438E

● Disassembly sequence

- | | |
|-------------------------|--|
| 1 Return spring | 11 Extension |
| 2 Shoe hold-down cup | 12 Connector |
| 3 Shoe hold-down spring | 13 Wheel cylinder (See later section.) |
| 4 Shoe hold-down cup | 14 Cover |
| 5 Shoe hold-down pin | 15 Cover |
| 6 Rivet | 16 Cover |
| 7 Brake shoe | 17 Backing plate |
| 8 Brake lining | |
| 9 Brake pipe | |
| 10 Spacer | |
- ⊗: Non-reusable parts

NOTE

- For removal and installation procedures of the front drum brake, see Gr26.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Brake lining kit

CAUTION ⚠

- Do not smear the surface of the brake lining with lubricant. Otherwise, braking performance will be reduced.
- When replacing the brake lining, clean the threaded portions of the wheel cylinder adjuster and adjust screw and coat them with rubber grease.
- Adjust clearance between brake drum and shoe after installing the drum brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Service standards (Unit: mm {in.})

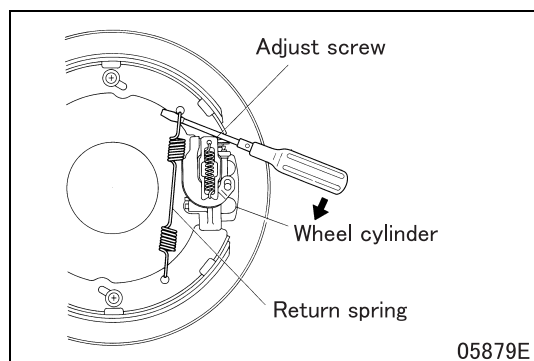
Location	Maintenance item	Standard value	Limit	Remedy
1	Return spring load (Installed length 190 {7.48})	195 to 235 N {44 to 53 lbs, 19.8 to 24.2 kgf}	175 N {39 lbs, 18.0 kgf}	Replace
8	Brake lining thickness	8.8 {0.35}	4.0 {0.16}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

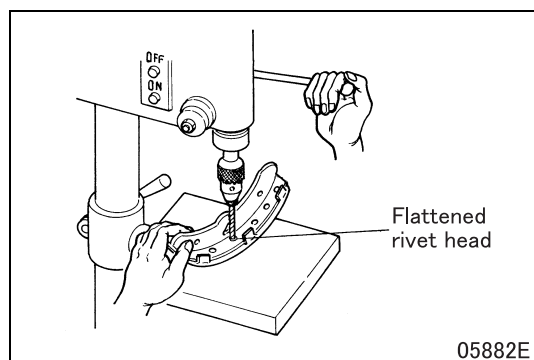
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Brake pipe	13 to 15 {9.6 to 11, 1.3 to 1.5}	—
	Extension		
Tb	Bolt (Connector mounting)	7.8 to 12 {5.8 to 8.9, 0.8 to 1.2}	—
Tc	Bolt (Wheel cylinder mounting)	37 to 49 {27 to 36, 3.8 to 5.0}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Contact areas between brake shoe and wheel cylinder	Brake grease	As required
	Contact areas between backing plate and brake shoe		

◆ Removal procedure ◆**■ Removal: Return spring**

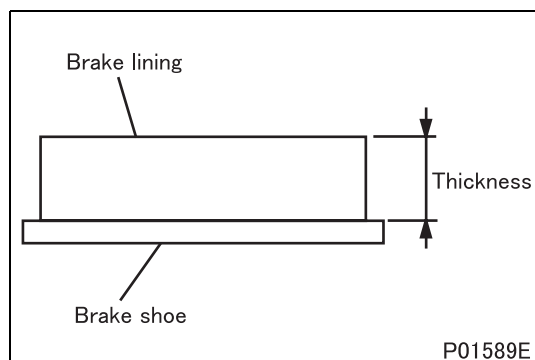
- Using a flat-head screwdriver, remove the return spring. To do this, rest the screwdriver on the wheel cylinder adjust screw. Then, with the adjust screw as a fulcrum, engage the screwdriver with the spring hook and pry away the spring.

**■ Removal: Brake lining**

- Using a drilling machine, break the flattened rivet heads on the brake shoe side to release the brake lining.

FRONT DRUM BRAKE

◆ Inspection procedure ◆



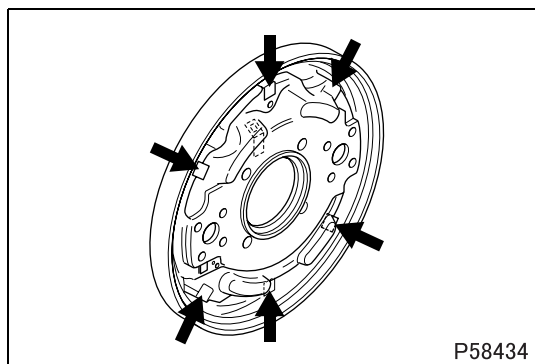
■ Inspection: Brake shoe

- Measure the thickness of the brake lining. If the measured value is less than the limit, replace all of the brake linings on the same axle.

CAUTION ⚠

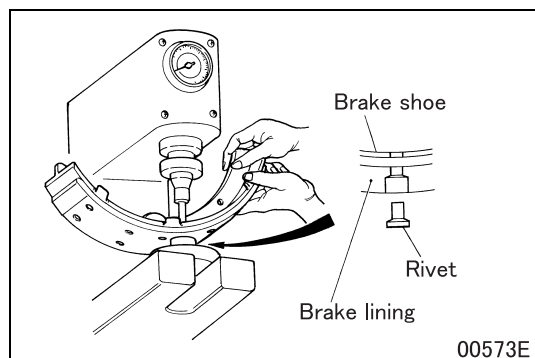
- Brake linings used on the same axle should be in the same size and have the same identification mark. Otherwise, braking performance can be different from left to right.

◆ Installation procedure ◆



■ Installation: Backing plate

- Grease the backing plate at the illustrated locations.



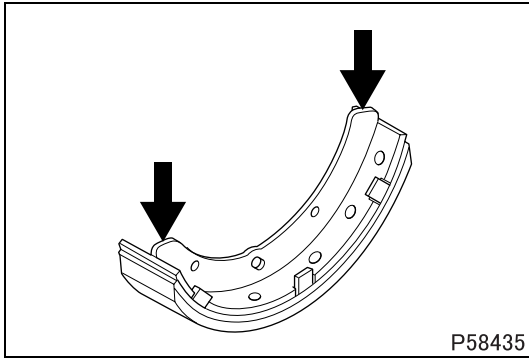
■ Installation: Brake lining

- Using cleaning fluid, clean the surface of the brake shoe to which the brake lining is to be mounted. Dry the brake shoe.
- Insert rivets from the lining to the shoe. Stake them, starting from the center of the shoe and moving towards the ends. Ensure that the shoe-to-lining clearances conform to the following specifications.
 - Around the rivets: 0.05 {0.0020 in.} mm or less
 - Along the shoe/lining sides: 0.4 mm {0.016 in.} or less
 - Along the shoe/lining ends: 0.2 mm {0.0078 in.} or less
- Stake the rivets with a force of 17650 ± 980 N {38920 ± 2160 lbs, 1800 ± 100 kgf}.

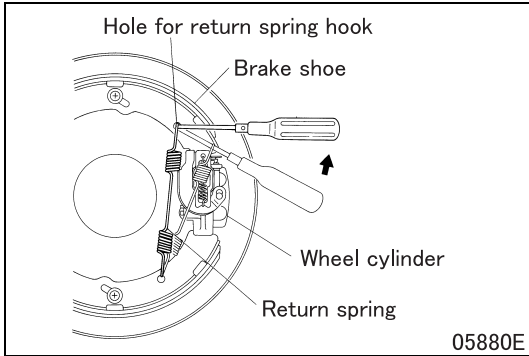
CAUTION ⚠

- Brake linings used on the same axle should be in the same size and have the same identification mark. Otherwise, braking performance can be different from left to right.

- After assembly, check the drum-to-lining contact. Correct as required.

**■ Installation: Brake shoe**

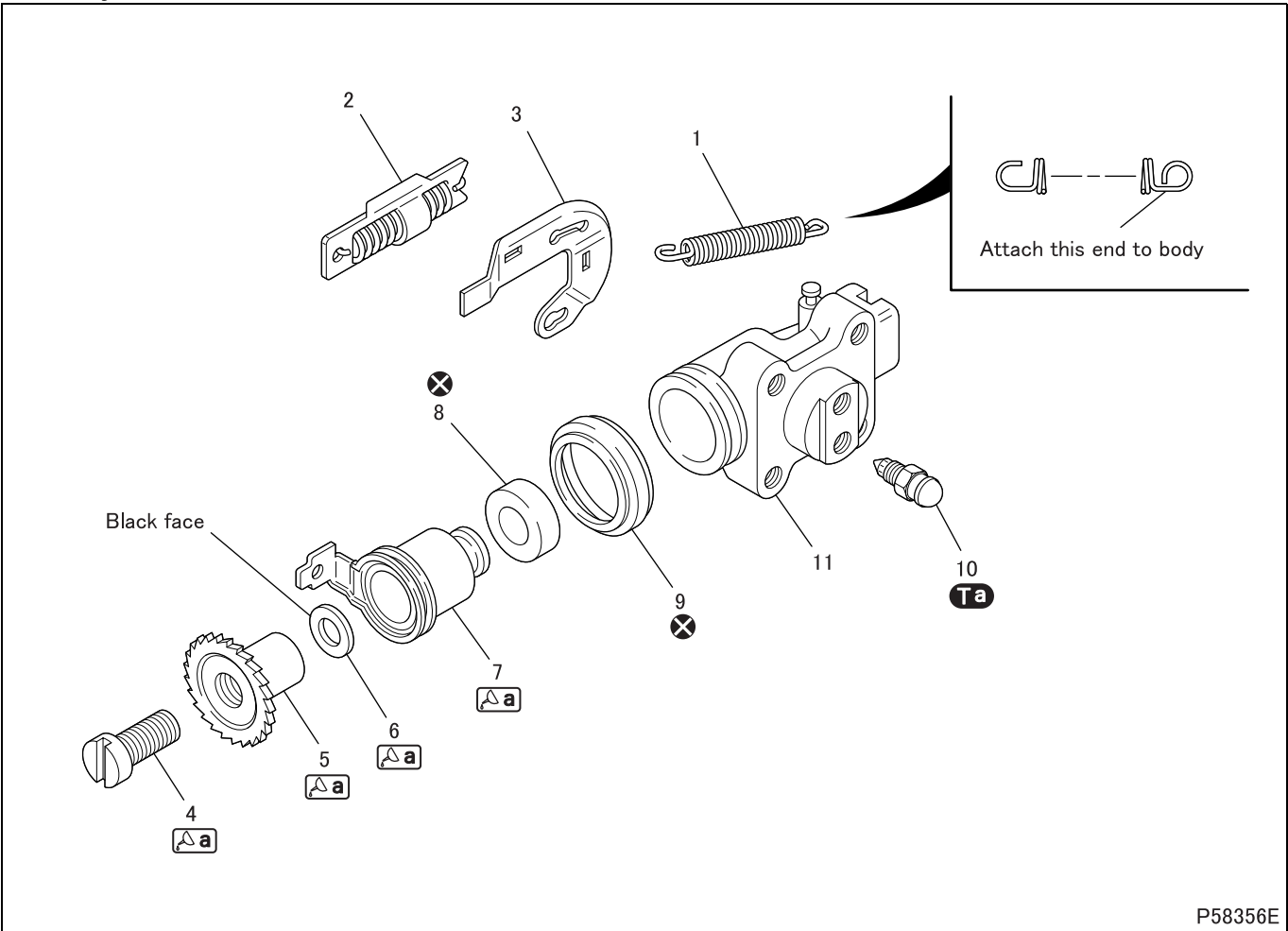
- Grease the brake shoe at the illustrated locations.

**■ Installation: Return spring**

- Hook the end of the return spring that has a smaller number of coils onto the brake shoe on the adjust screw side of the wheel cylinder.
- Engage a small Phillips screwdriver into the return spring hook. Then, using the screwdriver insert the spring hook into the hook hole in the brake shoe and attach the hook onto the shoe.

FRONT DRUM BRAKE

Wheel Cylinder



P58356E

● Disassembly sequence

- | | | |
|--------------------|----------------------|-----------------------|
| 1 Spring | 6 Washer | 11 Body |
| 2 Spring & fitting | 7 Piston | |
| 3 Lever | 8 Wheel cylinder cup | ⊗: Non-reusable parts |
| 4 Adjust screw | 9 Boots | |
| 5 Adjuster | 10 Air bleeder | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Wheel cylinder kit

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
8, 11	Piston-to-body clearance	0.02 to 0.08 {0.00079 to 0.031}	0.2 {0.0079}	Replace

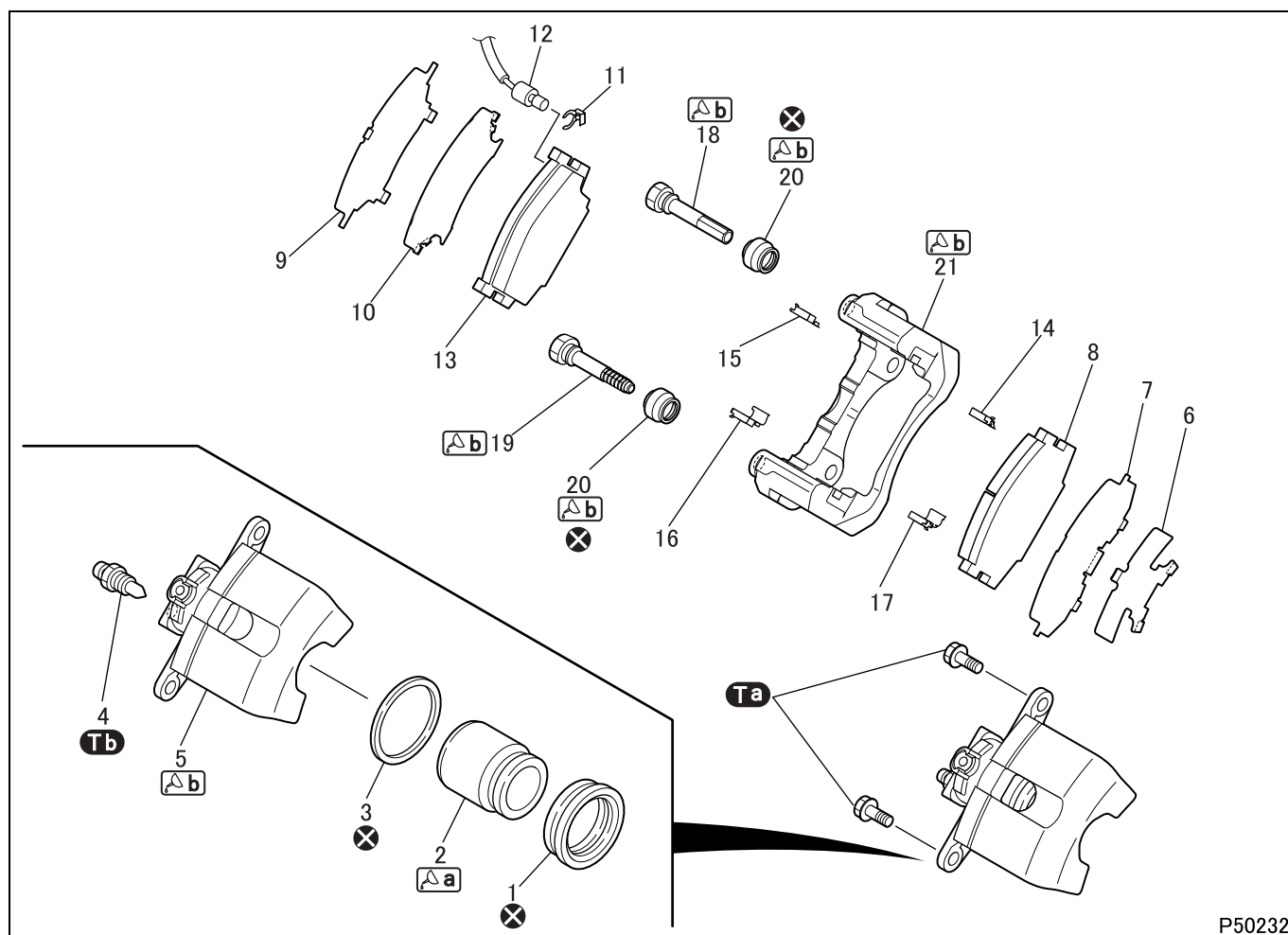
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Air bleeder	6.9 to 8.8 {5.1 to 6.5, 0.7 to 0.9}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Threaded portion of adjust screw	Rubber grease	As required
	Sliding face of adjuster		
	Both sides of washer		
	Sliding face of piston		

REAR DISC BRAKE <φ235 mm {9.25 in.} DISC>



● Disassembly sequence

- | | | |
|-----------------------|------------------------------|-----------------------|
| 1 Piston boots | 9 Inner shim A | 17 Pad liner D |
| 2 Piston | 10 Inner shim B | 18 Main slide pin |
| 3 Piston seal | 11 Clip (rear) | 19 Sub slide pin |
| 4 Air bleeder (front) | 12 Pad wear indicator (rear) | 20 Pin boots |
| 5 Caliper | 13 Inner pad | 21 Torque member |
| 6 Outer shim A | 14 Pad liner A | |
| 7 Outer shim B | 15 Pad liner B | ⊗: Non-reusable parts |
| 8 Outer pad | 16 Pad liner C | |

NOTE

- For removal and installation of the rear disc brake, see Gr27.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION ⚠

- Rubber parts that are disassembled must be replaced as a seal kit.
- Items included in a seal kit must be lubricated with grease supplied with the kit before installation.
- Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.
- Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
8, 13	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

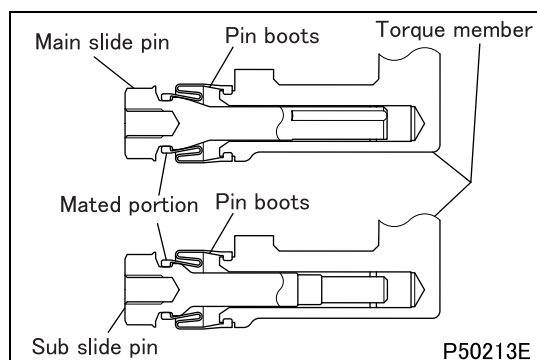
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Pin bolt	40 to 50 {30 to 37, 4.1 to 5.1}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5, 0.6 to 0.9}	–

Lubricant and/or sealant

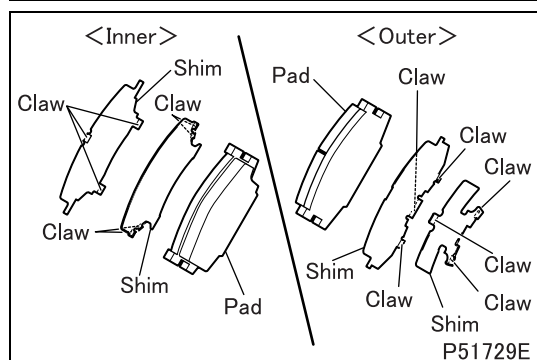
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆ Installation procedure ◆



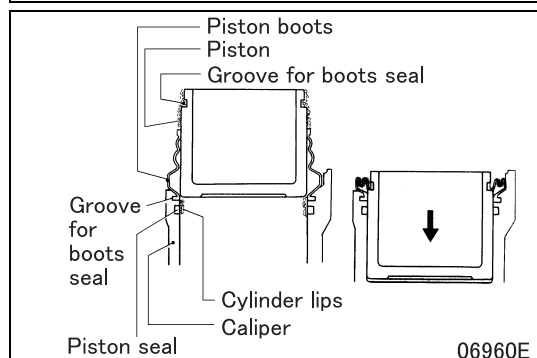
■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.



■ Installation: Shims

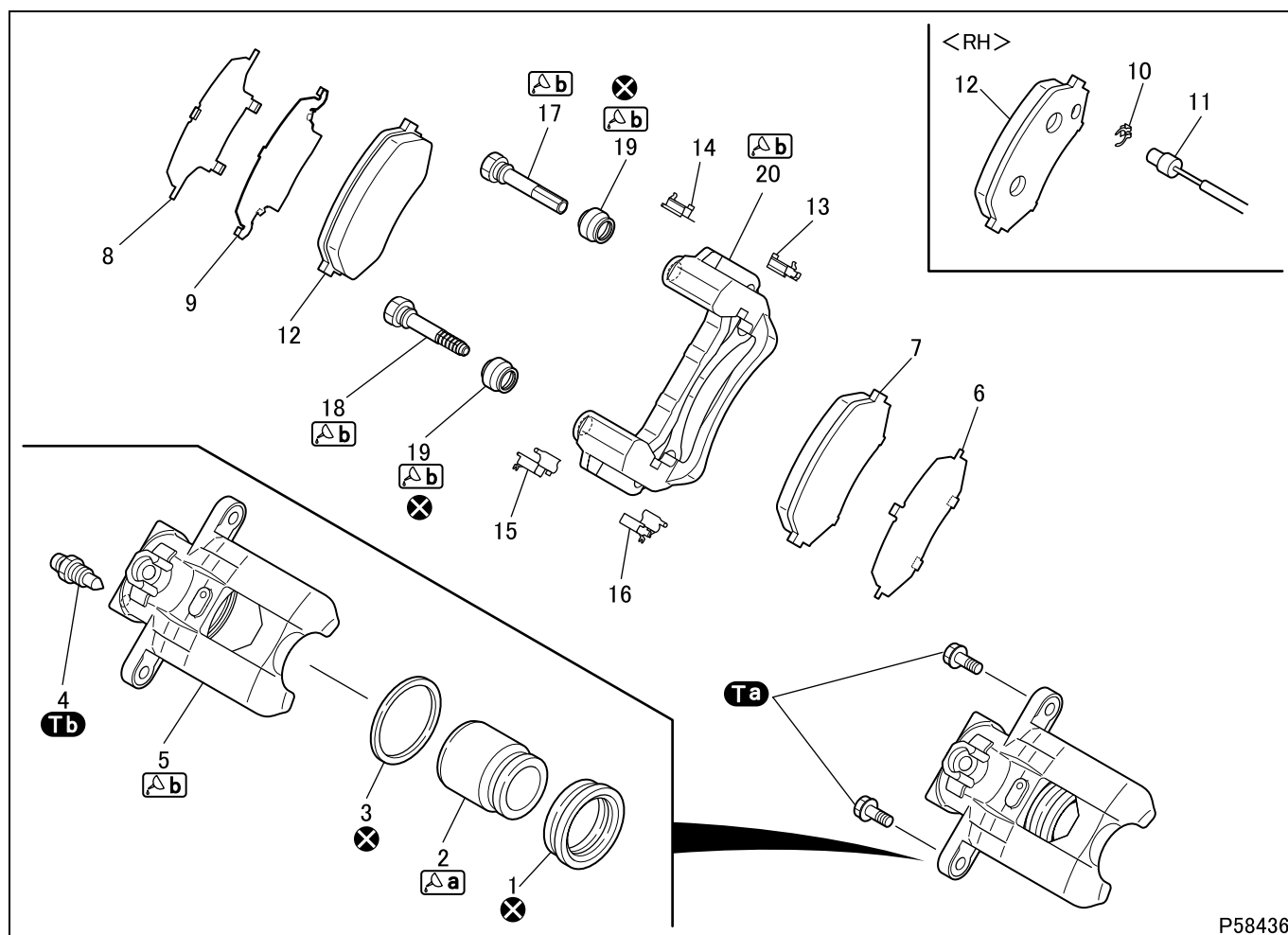
- Position shims such that they face the illustrated directions before installing them onto the pads.



■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

REAR DISC BRAKE <φ252 mm {9.92 in.} DISC>



● Disassembly sequence

- | | | |
|-----------------------|--------------------------------------|-------------------|
| 1 Piston boots | 9 Inner shim B | 16 Pad liner D |
| 2 Piston | 10 Clip (rear RH only) | 17 Main slide pin |
| 3 Piston seal | 11 Pad wear indicator (rear RH only) | 18 Sub slide pin |
| 4 Air bleeder (front) | 12 Inner pad | 19 Pin boots |
| 5 Caliper | 13 Pad liner A | 20 Torque member |
| 6 Outer shim | 14 Pad liner B | |
| 7 Outer pad | 15 Pad liner C | |
| 8 Inner shim A | | |
- ⊗: Non-reusable parts

NOTE

- For removal and installation of the rear disc brake, see Gr27.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Pad kit, Seal kit, Pad wear indicator kit, Sub pin kit

CAUTION

- Rubber parts that are disassembled must be replaced as a seal kit.
- Items included in a seal kit must be lubricated with grease supplied with the kit before installation.
- Do not smear the surface of the outer or inner pad with lubricant. Otherwise, braking performance will be reduced.
- Measure disc brake drag torque after installing the disc brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
7, 12	Thickness of outer/inner pad	14 {0.55}	4 {0.16}	Replace

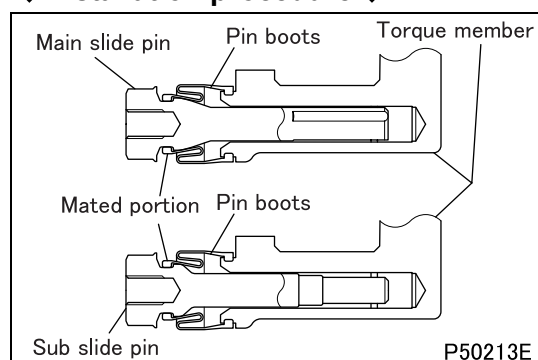
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Pin bolt	40 to 50 {30 to 37, 4.1 to 5.1}	–
Tb	Air bleeder	5.8 to 8.8 {4.3 to 6.5, 0.6 to 0.9}	–

Lubricant and/or sealant

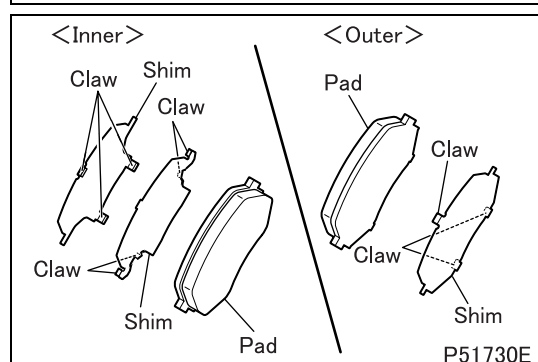
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston	Brake fluid (SAE J1703 or FMVSS No. 116 DOT3)	As required
b	Inner periphery of caliper cylinder lips	Rubber grease	As required
	Outer periphery of main and sub slide pins		
	Pin boots mating surfaces with slide pins		
	Torque member grooves and guide holes for pin boots		

◆ Installation procedure ◆



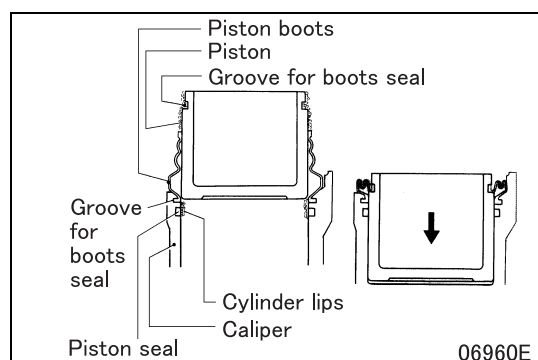
■ Installation: Main slide pin, sub slide pin, pin boots, and torque member

- On the torque member, apply grease onto the grooves and guide holes for the pin boots.
- Apply grease onto the outer peripheries of the main and sub slide pins. Apply grease onto the surfaces of the pin boots that are to be mated with the slide pins. Then, assemble these onto the torque member.
- Ensure that the seals on the pin boots are correctly attached onto the mated pin-boots portions.



■ Installation: Shims

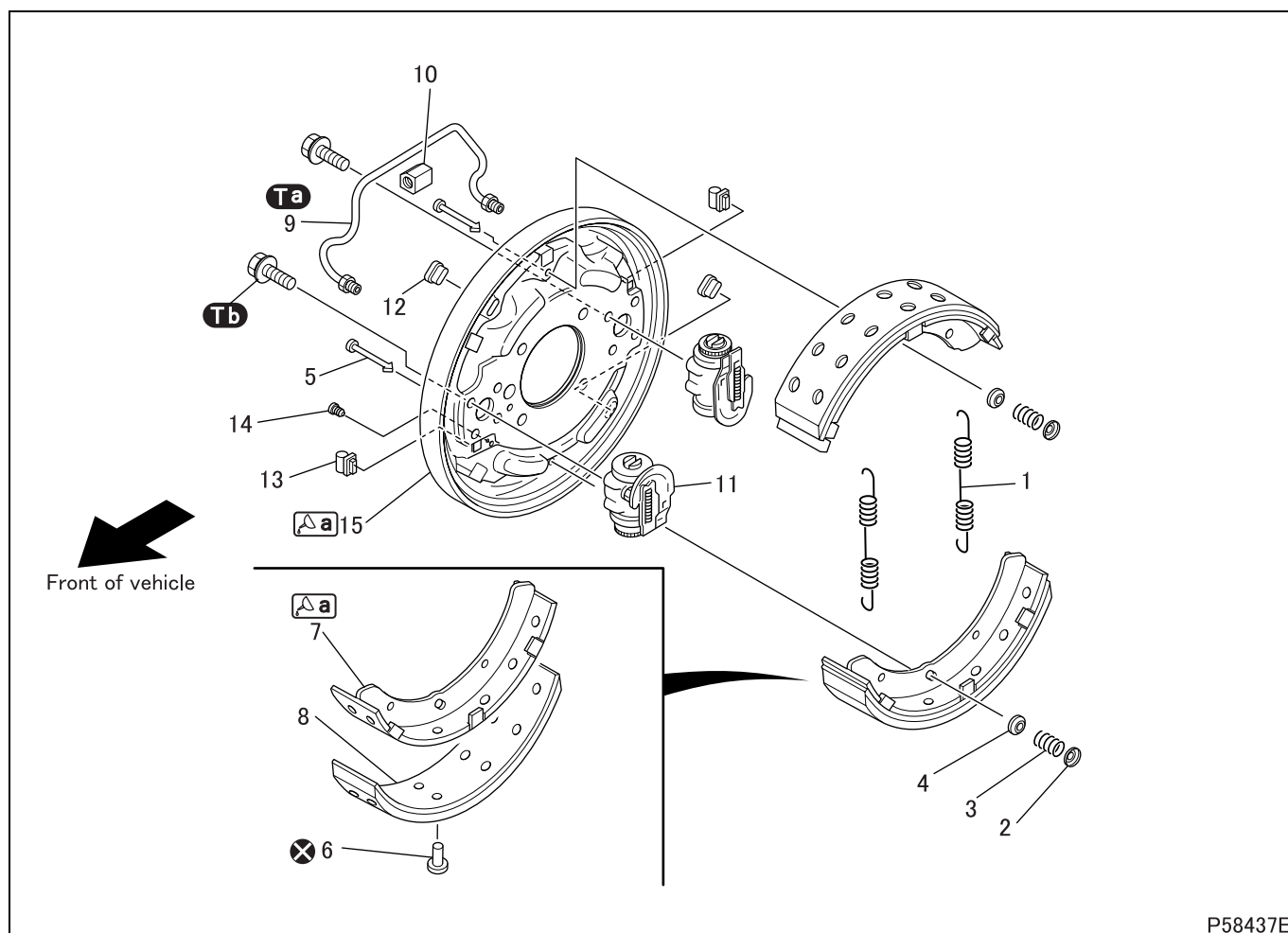
- Position shims such that they face the illustrated directions before installing them onto the pads.



■ Installation: Piston boots, piston, and piston seal

- Apply brake fluid onto the outer periphery of the piston. Then, insert the piston boots over the piston.
- On the piston seal, spread the grease, already applied on it, evenly over the seal. Then, install the seal into the groove on the caliper.
- Apply grease evenly along the inner periphery of the cylinder lips on the caliper.
- Install the caliper-end seal of the piston boots into the groove on the caliper.
- Press fit the piston further into the boots. Ensure that the piston-end seal of the piston boots is engaged in the groove on the piston.

REAR DRUM BRAKE



P58437E

● Disassembly sequence

- | | | |
|-------------------------|---|-----------------------|
| 1 Return spring | 7 Brake shoe | 12 Cover |
| 2 Shoe hold-down cup | 8 Brake lining | 13 Cover |
| 3 Shoe hold-down spring | 9 Brake pipe | 14 Cover |
| 4 Shoe hold-down cup | 10 Spacer | 15 Backing plate |
| 5 Shoe hold-down pin | 11 Wheel cylinder
(See later section.) | |
| 6 Rivet | | ⊗: Non-reusable parts |

CAUTION ⚠

- For removal and installation of the rear drum brake, see Gr27.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- Do not smear the surface of the brake lining with lubricant. Otherwise, braking performance will be reduced.
- When replacing the brake lining, clean the threaded portions of the wheel cylinder adjuster and adjust screw and coat them with rubber grease.
- Adjust clearance between brake drum and shoe after installing the drum brake. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1	Return spring load (Installed length 190 {7.48})	195 to 235 N {44 to 53 lbs, 19.8 to 24.2 kgf}	175 N {39 lbs, 18.0 kgf}	Replace
8	Brake lining thickness	8.8 {0.35}	4.0 {0.16}	Replace

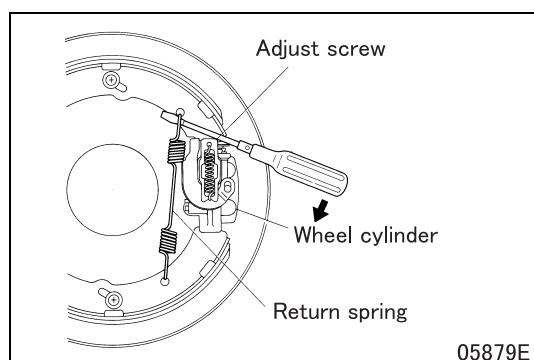
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Brake pipe	13 to 15 {9.6 to 11, 1.3 to 1.5}	—
Tb	Bolt (Wheel cylinder mounting)	37 to 49 {27 to 36, 3.8 to 5.0}	—

Lubricant and/or sealant

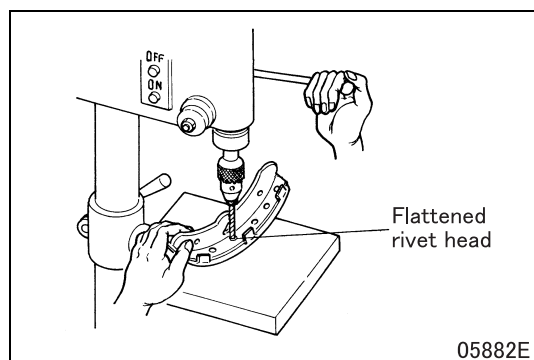
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Contact areas between brake shoe and wheel cylinder	Brake grease	As required
	Contact areas between backing plate and brake shoe		

◆ Removal procedure ◆



■ Removal: Return spring

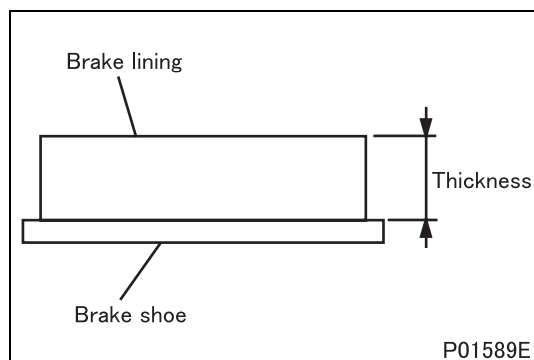
- Using a flat-head screwdriver, remove the return spring. To do this, rest the screwdriver on the wheel cylinder adjust screw. Then, with the adjust screw as a fulcrum, engage the screwdriver with the spring hook and pry away the spring.



■ Removal: Brake lining

- Using a drilling machine, break the flattened rivet heads on the brake shoe side to release the brake lining.

◆ Inspection procedure ◆



■ Inspection: Brake shoe

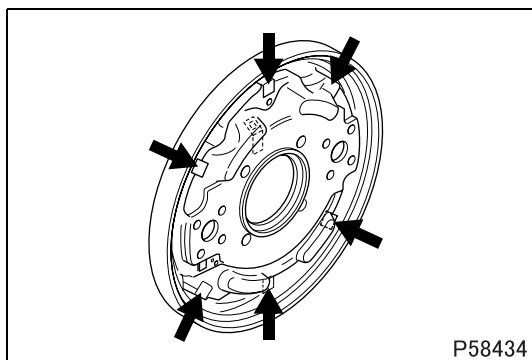
- Measure the thickness of the brake lining. If the measured value is less than the limit, replace all of the brake linings on the same axle.

CAUTION ⚠

- Brake linings used on the same axle should be in the same size and have the same identification mark. Otherwise, braking performance can be different from left to right.

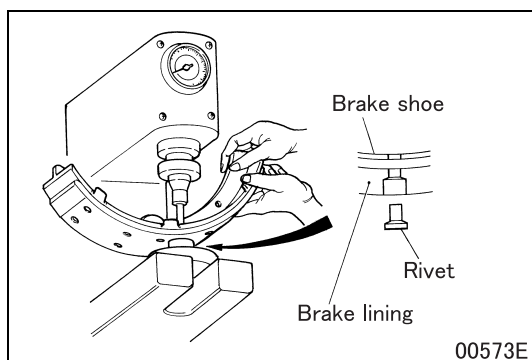
REAR DRUM BRAKE

◆ Installation procedure ◆



■ Installation: Backing plate

- Grease the backing plate at the illustrated locations.



■ Installation: Brake lining

- Using cleaning fluid, clean the surface of the brake shoe to which the brake lining is to be mounted. Dry the brake shoe.
- Insert rivets from the lining to the shoe. Stake them, starting from the center of the shoe and moving towards the ends. Ensure that the shoe-to-lining clearances conform to the following specifications.
 - Around the rivets: 0.05 mm or less
 - Along the shoe/lining sides: 0.4 mm {0.016 in.} or less
 - Along the shoe/lining ends: 0.5 mm {0.020 in.} or less
- Stake the rivets with a force of 21 ± 1.0 kN {2100 $\pm$ 100 kgf}.

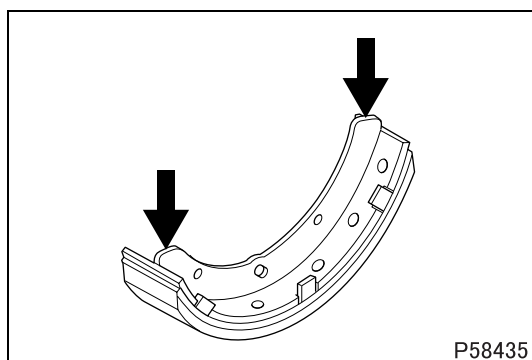
CAUTION ⚠

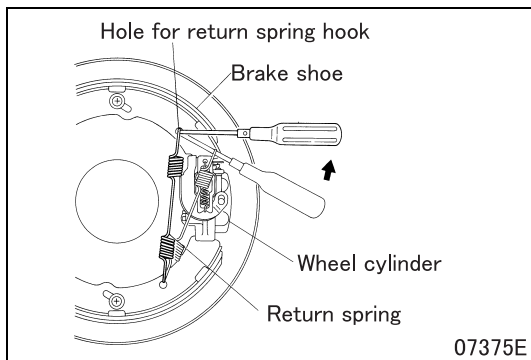
- Brake linings used on the same axle should be in the same size and have the same identification mark. Otherwise, braking performance can be different from left to right.

- After assembly, check the drum-to-lining contact. Correct as required.

■ Installation: Brake shoe

- Grease the brake shoe at the illustrated locations.



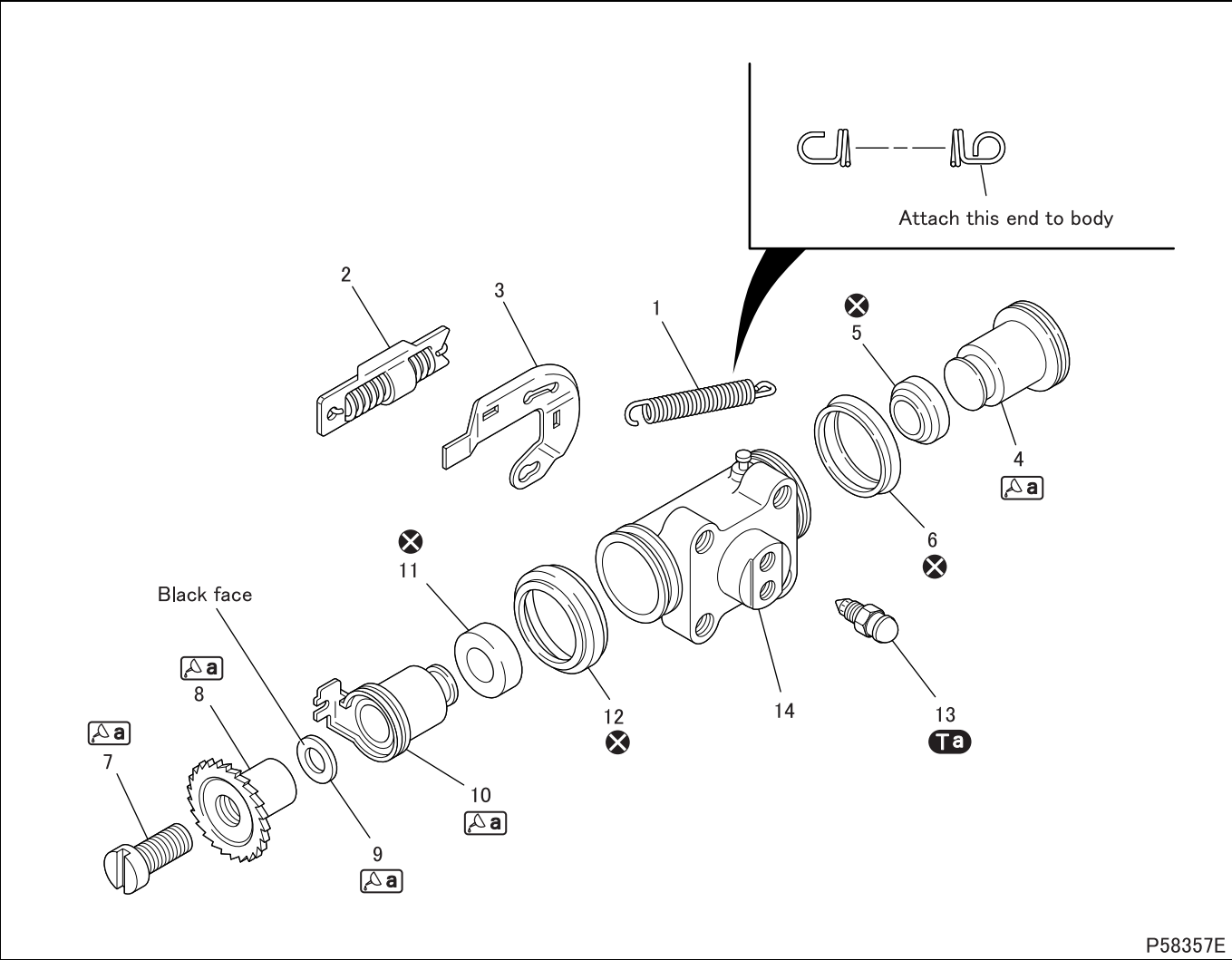


■ Installation: Return spring

- Hook the end of the return spring that has a smaller number of coils onto the brake shoe on the adjust screw side of the wheel cylinder.
- Engage a small Phillips screwdriver into the return spring hook. Then, using the screwdriver insert the spring hook into the hook hole in the brake shoe and attach the hook onto the shoe.

REAR DRUM BRAKE

Wheel Cylinder



P58357E

● Disassembly sequence

- | | |
|--------------------|----------------|
| 1 Spring | 9 Washer |
| 2 Spring & fitting | 10 Piston |
| 3 Lever | 11 Piston cup |
| 4 Piston | 12 Boots |
| 5 Piston cup | 13 Air bleeder |
| 6 Boots | 14 Body |
| 7 Adjust screw | |
| 8 Adjuster | |

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Wheel cylinder kit

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
4, 10, 14	Piston-to-body clearance	0.02 to 0.08 {0.00079 to 0.031}	0.2 {0.0079}	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

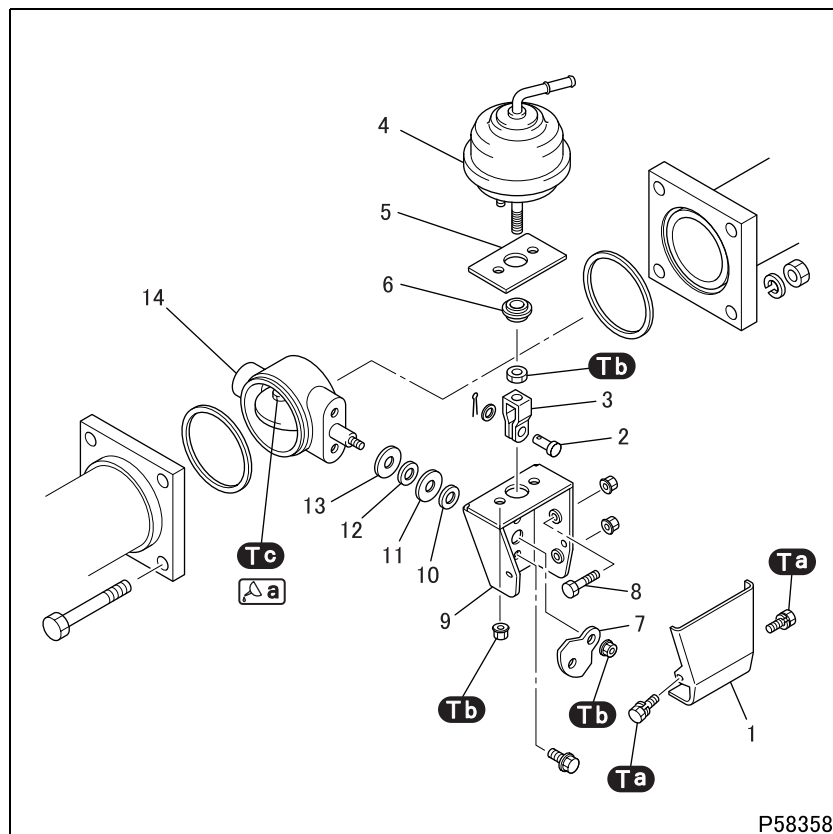
Mark	Parts to be tightened	Tightening torque	Remarks
 a	Air bleeder	6.9 to 8.8 {5.1 to 6.5, 0.7 to 0.9}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Sliding face of piston	Rubber grease	As required
	Threaded portion of adjust screw		
	Sliding face of adjuster		
	Both sides of washer		

EXHAUST BRAKE SYSTEM

Exhaust Brake Unit



● Disassembly sequence

- 1 Cover
- 2 Clevis pin
- 3 Clevis
- 4 Power chamber
- 5 Gasket
- 6 Bearing
- 7 Lever
- 8 Adjust bolt
- 9 Bracket
- 10 Seal ring A
- 11 Seal ring B
- 12 Seal ring A
- 13 Seal ring B
- 14 Valve

CAUTION

- Do not attempt to disassemble the power chamber.

NOTE

- For removal and installation procedures of the exhaust brake unit, see Gr15.

● Assembly sequence

Follow the disassembly sequence in reverse.

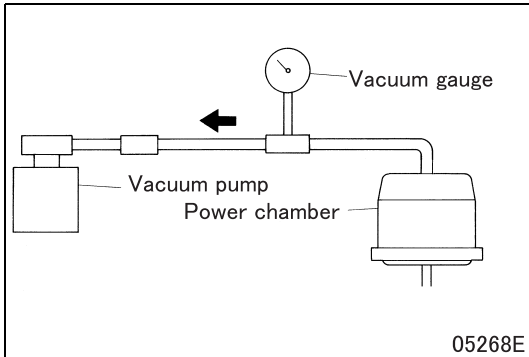
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
—	Average of top and bottom clearances between butterfly valve and body with valve fully closed (With power chamber vacuum of 87 to 93 kPa {25.7 to 27.5 in.Hg, 650 to 700 mmHg} or above)	0.10 to 0.25 {0.0039 to 0.0098}	—	Replace
4	Air-tightness of power chamber (At 15 sec. after vacuum of 67 kPa {19.8 in.Hg, 500 mmHg} is achieved in chamber)	63 kPa {18.6 in.Hg, 475 mmHg} or above	—	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Cover mounting)	4.9 to 6.9 {3.6 to 5.1, 0.5 to 0.7}	—
Tb	Nut (Power chamber mounting)	11 to 17 {8.0 to 12, 1.10 to 1.70}	—
	Lock nut (Clevis retention)	9.8 to 16 {7.2 to 12, 1.0 to 1.6}	—
	Nut (Lever mounting)	11 to 17 {8.0 to 12, 1.10 to 1.70}	—

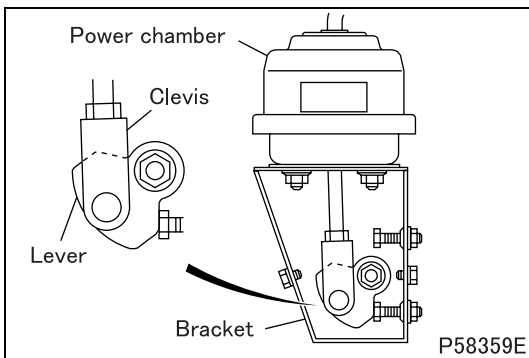
◆ Inspection procedure ◆



■ Inspection: Power chamber air-tightness

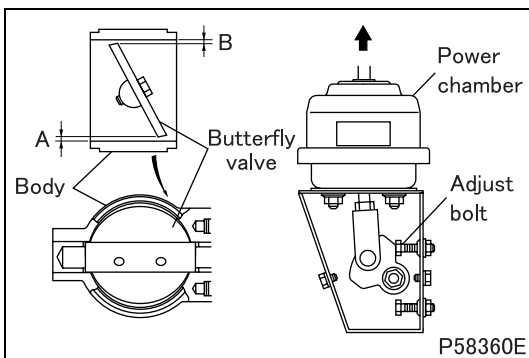
- Connect the components with piping as illustrated. When a vacuum of 67 kPa {19.8 in.Hg, 500 mmHg} or above is applied to the power chamber, stop the vacuum pump.
- Fifteen seconds later, the reading on the vacuum gauge should conform to the standard value.
- If not, replace the power chamber.

◆ Adjustment after installation ◆



■ Adjustment: Clevis

- Assemble the power chamber onto the bracket. Then, adjust the location of the clevis such that the hole in the clevis is aligned by half with the hole in the lever.



■ Adjustment: Valve

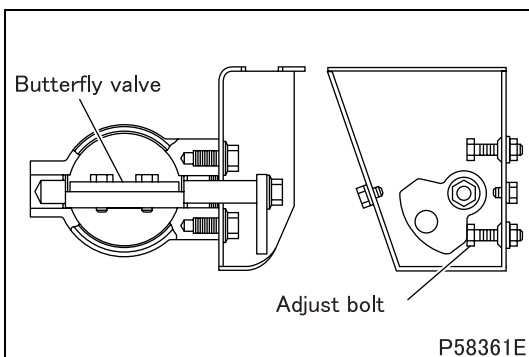
(1) Butterfly valve fully-closed position

- Apply a vacuum of 87 to 93 kPa {25.7 to 27.5 in.Hg, 650 to 700 mmHg} to the power chamber to fully close the butterfly valve. With the valve fully closed, measure the top and bottom clearances **B** and **A** between the valve and the body, and obtain the average of the two. The average value should conform to the standard value. Adjust with the adjust bolt as required.

$$\text{Average clearance} = \frac{(A + B)}{2}$$

(2) Valve fully-open position

- Adjust the butterfly valve to the full open position using the adjust bolt.





Group 35E

Anti-lock Brake System (ABS)

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	35E-2
STRUCTURE AND OPERATION	
1. Overview	35E-4
2. Electronic Control System	35E-14
3. Electronic Control Unit Schematic Diagram	35E-18
TROUBLESHOOTING	
1. Diagnosis Procedure	35E-20
2. Precautions when Carrying Out Diagnosis	35E-21
3. Diagnosis Based on Diagnosis Codes	35E-22
4. Multi-Use Tester Service Data	35E-28
5. Actuator Test Using Multi-Use Tester	35E-30
6. Inspection at Hydraulic Unit (Electronic Control Unit) Connector	35E-31
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Functional Check	35E-34
2. Inspection of Wheel Speed Sensor Signal Waveform Using Oscilloscope	35E-35
3. Inspection of Hydraulic Unit (Electronic Control Unit) Operation	35E-36
4. Inspection after Replacing or Removing/Installing Hydraulic Unit (Electronic Control Unit)	35E-37
HYDRAULIC UNIT CONNECTOR COUPLING AND UNCOUPLING	
	35E-38
INSPECTION OF ELECTRICAL COMPONENTS	35E-40
COMPONENTS LOCATION	35E-44
ELECTRICAL WIRING DIAGRAM	35E-48

SPECIFICATIONS

Item			Specifications
Hydraulic unit (electronic control unit)	Manufacturer		ADVICS
	Rated voltage	V	DC12
	Working voltage range	V	DC10 to 18
Wheel speed sensor	Rear disc brake Drum brake	Manufacturer	SUMITOMO ELECTRIC
	Front disc brake	Manufacturer	BOSCH AUTOMOTIVE SYSTEMS
G sensor <4WD>	Manufacturer		MITSUBISHI ELECTRIC
	Rated voltage	V	DC12
	Working voltage range	V	DC10 to 16

M E M O

STRUCTURE AND OPERATION

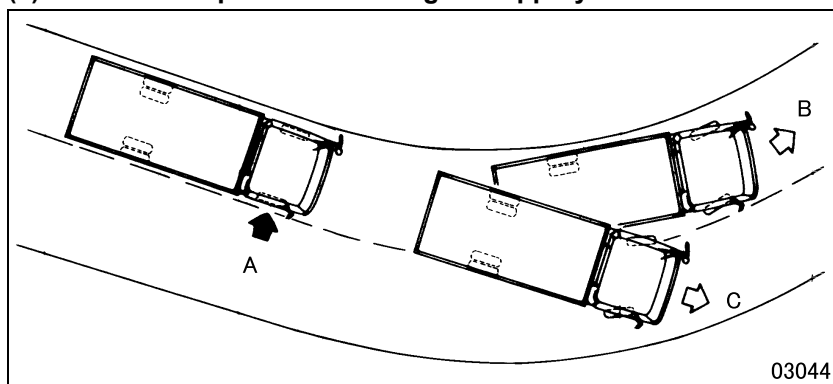
1. Overview

- The anti-lock brake system (ABS) prevents wheel lock-up and resultant skid when braking hard or on slippery roads, thus maintain vehicle stability and steerability.

1.1 Outline of anti-lock brake system

- Wheels will roll along on the road in the direction of their rotation. Therefore, the driver can steer the vehicle as he/she wishes by maneuvering the steering wheel.
However, on vehicles not equipped with anti-lock brake system, applying the brakes hard can cause wheel lock-up. Once tires are locked up, they are simply a piece of rubber in contact with the road surface and steering control will be lost. The vehicle will skid in the direction of inertia irrespective of the steering angle.
In other words, vehicle stability and steerability are lost and the vehicle is beyond the driver's control.
- On vehicles equipped with anti-lock brake system, the system prevents wheel lock-up by reducing the braking power to the wheel that is about to lock up and, thereby, maintain vehicle stability and steerability.

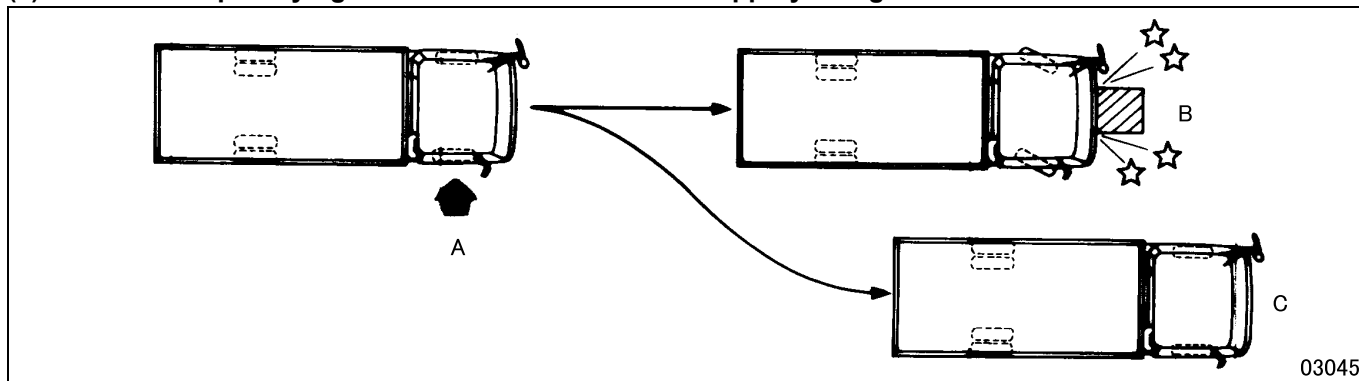
(1) Wheel lock-up when cornering on slippery road



- If wheel lock-up occurs during braking on a slippery curve, steering control will be lost. If this happens, the vehicle may deviate, while skidding, from the intended course no matter how the driver maneuvers the steering wheel.

A: Application of brakes (wheel lock-up)
B: Intended course
C: Go out of course

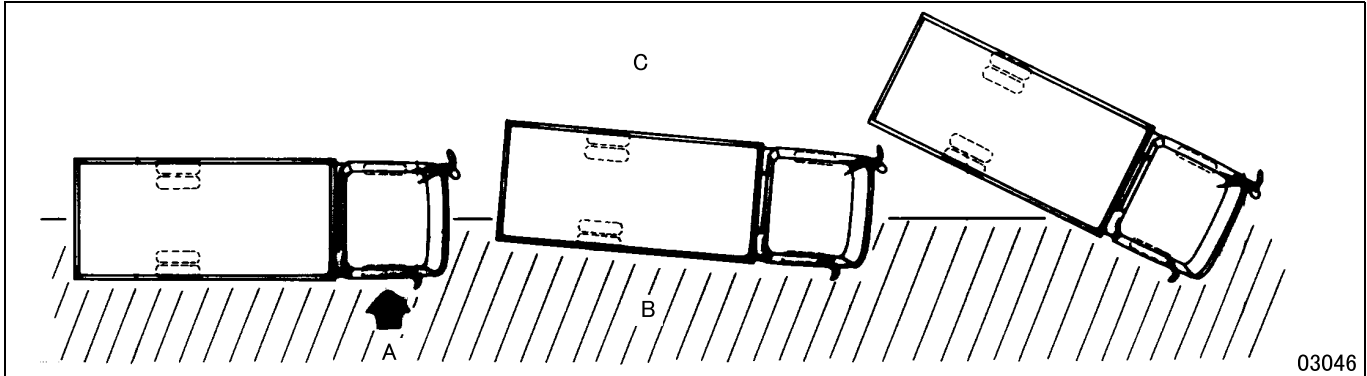
(2) Wheel lock-up in trying to avoid obstacle ahead on slippery straight road



- If wheel lock-up occurs during hard braking on a slippery straight road in trying to avoid an obstacle ahead, steering control will be lost. If this happens, the vehicle will not be able to avoid the obstacle no matter how the driver maneuvers the steering wheel.

A: Application of brakes (wheel lock-up)
B: Obstacle
C: Intended course

(3) Split μ (Wheel lock-up on asymmetrical road surface, with higher friction of coefficient on one side and lower friction of coefficient on the other side)



- If the front and rear wheels on one side of the vehicle are on the side of the road that has a lower friction of coefficient and therefore is more slippery than the other side of the road, these wheels are more likely to lock up and slip than the wheels on the other side of the vehicle. When the brakes are applied under such conditions, the braking efficiency will be different between the right and left sides of the vehicle and the vehicle will lose stability. Braking hard under such conditions can even cause the vehicle to spin.
A: Application of brakes (wheel lock-up)
B: Less slippery road surface
C: More slippery road surface
- On vehicles equipped with anti-lock brake system, the system prevents wheel lock-up by providing controlled braking force to each wheel. This prevents wheel slip and skid and ensures steering control and vehicle stability even during hard braking.

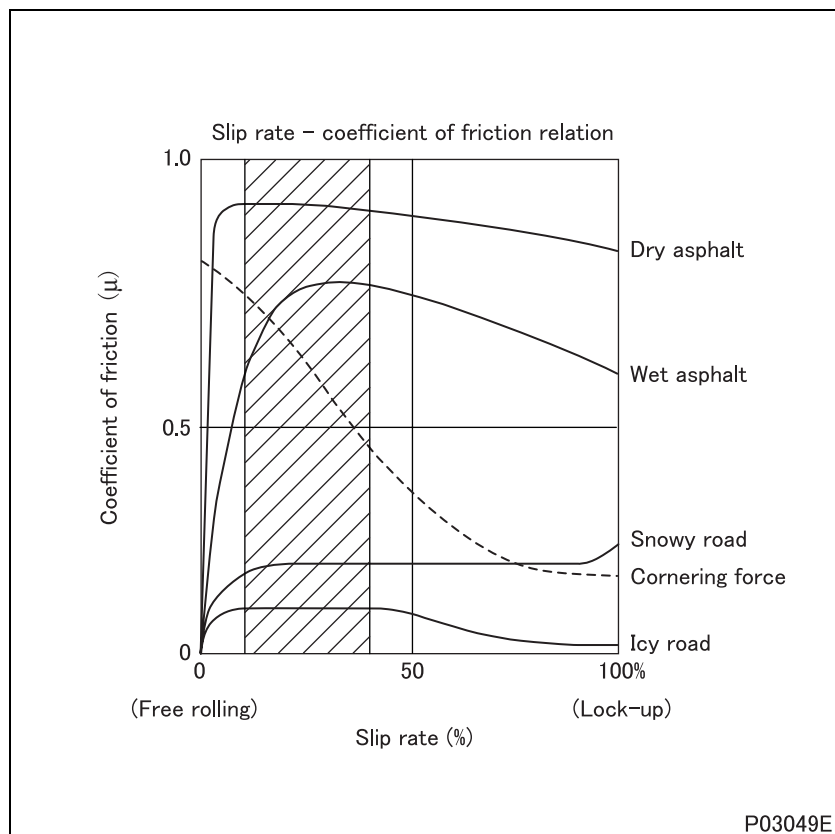
STRUCTURE AND OPERATION

1.2 Anti-lock brake system control process

- Anti-lock brake system ensures controlled yet optimum braking in a given road surface condition by placing the braking force within a certain range of slip rate determined by the wheel speed - vehicle speed relation.
- Stepping on the brake pedal causes the wheel speed to slow down and, as a result, the vehicle also slows down. However, the vehicle will still try to move on due to the inertia that has built up. This causes a difference between the wheel speed and the vehicle speed, or, in other words, slip. The amount of slip can be expressed as slip rate, as follows.

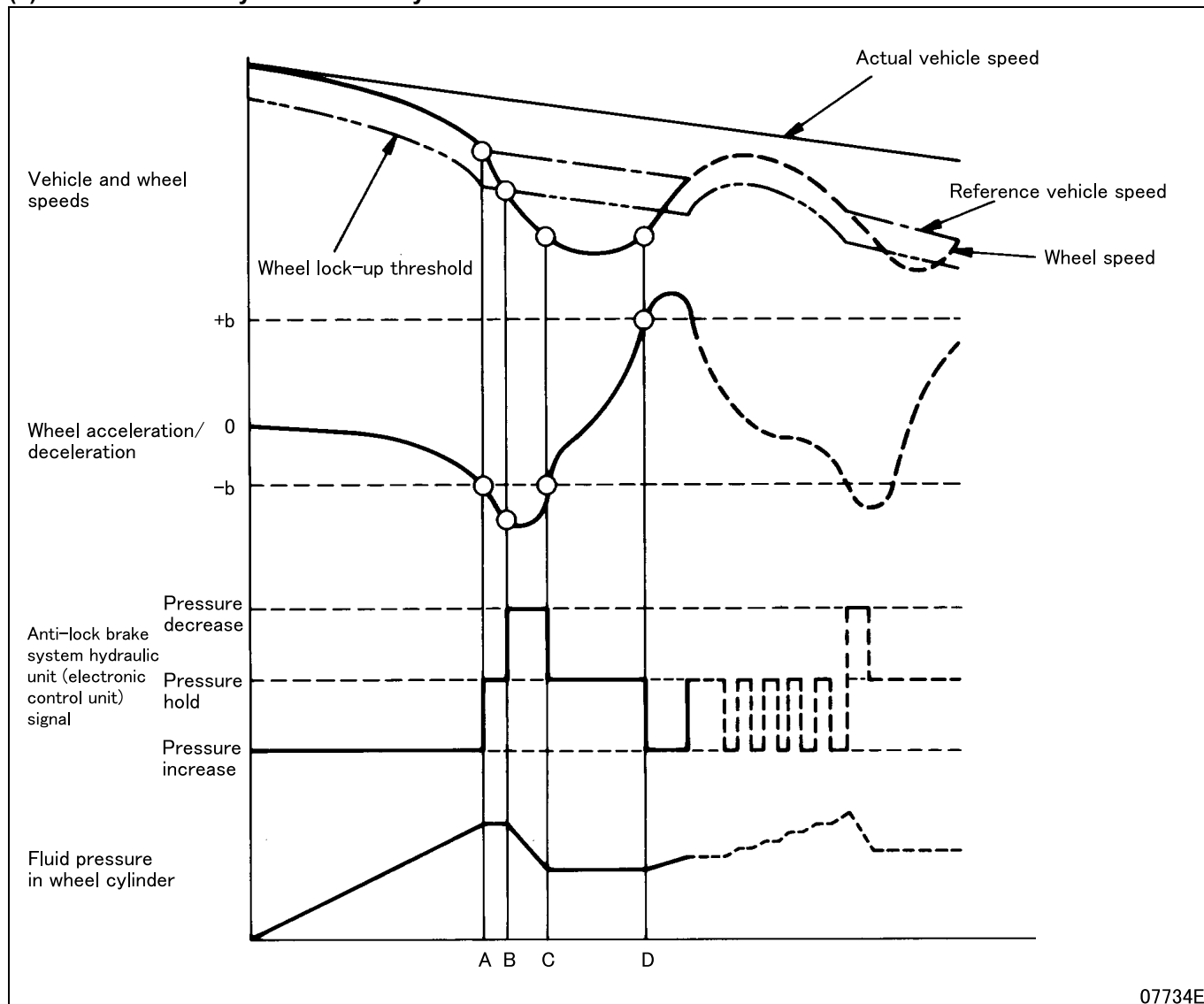
$$\text{Slip rate (\%)} = \frac{\text{Vehicle speed} - \text{Wheel speed}}{\text{Vehicle speed}} \times 100$$

- A slip ratio of 0% means that there is no slip between the wheel and the road surface. A slip rate of 100% means that the wheel is locked up.



- The graph shows the variation in the tire's coefficient of friction from free rolling to lock-up. As the brake pedal is slowly depressed, the tires continue to rotate but start slipping.
- As the stepping force on the brake pedal increases, the tires will stop rotating and the vehicle will just skid. This is wheel lock-up.
- As the graph shows, the coefficient of friction peaks within the hatched area.
- In other words, the maximum coefficient of friction can be achieved, not by stepping on the brake pedal with full force, but by doing so moderately to try to place the slip rate within the hatched area.
- On vehicles equipped with anti-lock brake system, the hydraulic control unit (electronic control unit) controls the braking force so that it falls within the hatched area. This will ensure that the tires do not lock up but have the maximum coefficient of friction, thus achieving efficient braking performance.

(1) Anti-lock brake system control cycle



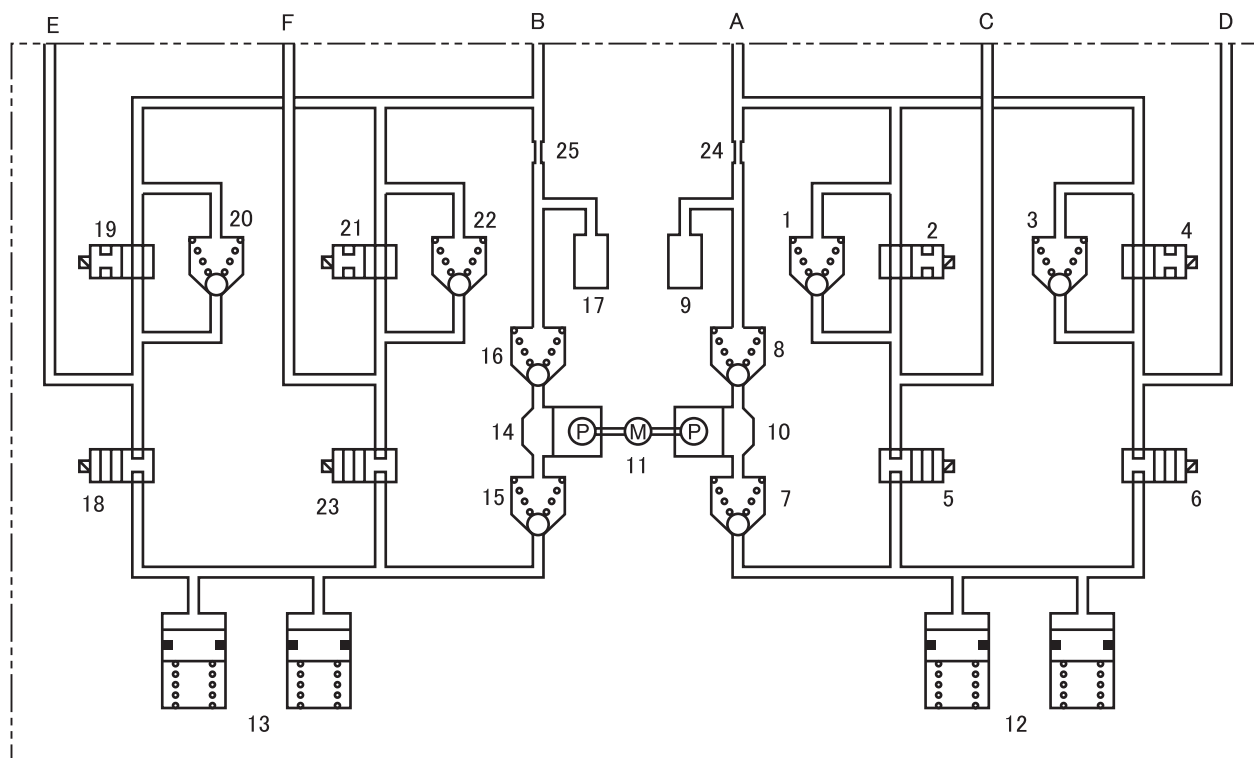
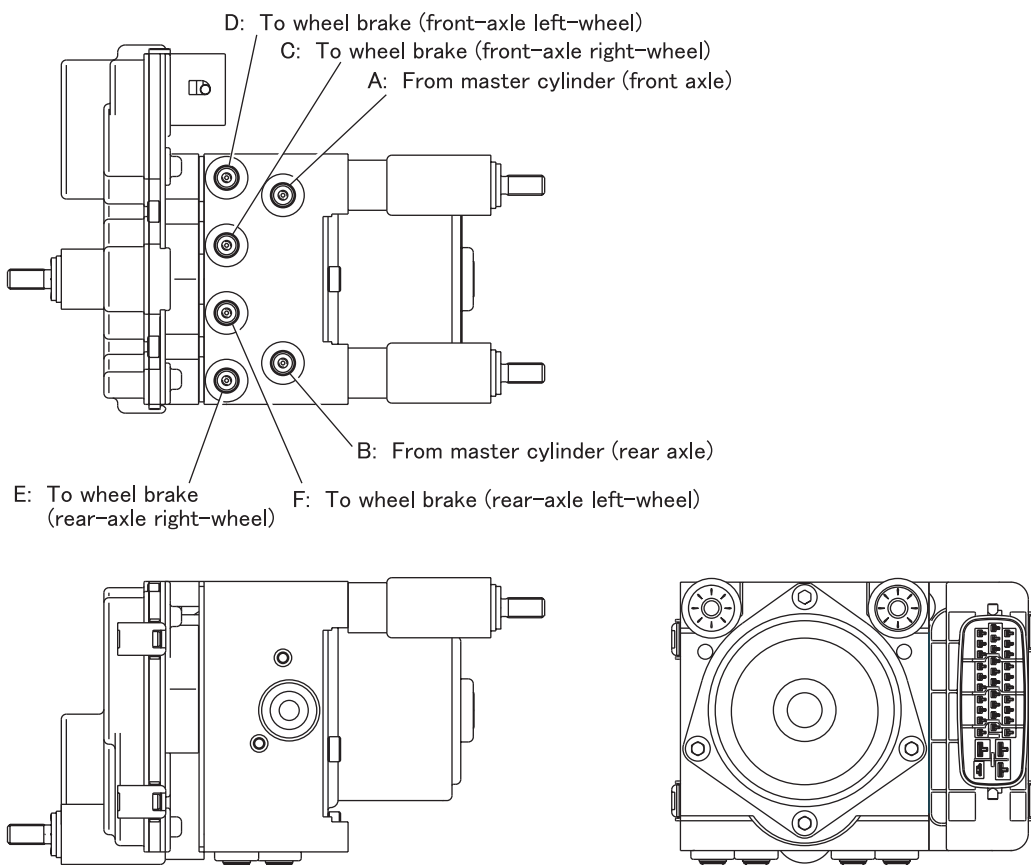
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- The above chart shows the typical control cycle of anti-lock brake system following the application of brakes, detailing in time series the variation in wheel speed, wheel speed acceleration/deceleration and fluid pressure in the wheel cylinder.
- When the wheel speed acceleration/deceleration drops to the “-b” threshold at A, the hydraulic unit (electronic control unit) sends “pressure hold” signal to maintain the fluid pressure in the wheel cylinder at the current level. At the same time, the hydraulic unit (electronic control unit) calculates the reference vehicle speed.
- When the vehicle decelerates to the wheel lock-up threshold at B, the hydraulic unit (electronic control unit) interprets this as imminent wheel lock-up and sends “pressure decrease” signal to reduce the fluid pressure in the wheel cylinder.
- When the wheel speed picks up and exceeds the “-b” threshold at C, the hydraulic unit (electronic control unit) sends “pressure hold” signal to maintain the fluid pressure in the wheel cylinder at the current level.
- When the wheel speed exceeds the “+b” threshold at D, the hydraulic unit (electronic control unit) determines that the imminent wheel lock-up has gone and sends “pressure increase” signal to increase the fluid pressure in the wheel cylinder.
- The pressure hold-decrease-increase cycle is repeated to keep the slip rate at optimum levels to prevent wheel lock-up.

STRUCTURE AND OPERATION

1.3 Hydraulic unit (electronic control unit)

(1) Schematic circuit diagram



P78478E

- | | | |
|--|--|---|
| 1 Check valve
(front-axle right-wheel) | 11 Motor | 23 Solenoid valve
(rear-axle left-wheel
DECREASE) |
| 2 Solenoid valve
(front-axle right-wheel HOLD) | 12 Reservoir (front axle) | 24 Orifice (front axle) |
| 3 Check valve
(front-axle left-wheel) | 13 Reservoir (rear axle) | 25 Orifice (rear axle) |
| 4 Solenoid valve
(front-axle left-wheel HOLD) | 14 Plunger pump (rear axle) | A: From master cylinder
(front axle) |
| 5 Solenoid valve
(front-axle right-wheel
DECREASE) | 15 Inlet valve (rear axle) | B: From master cylinder
(rear axle) |
| 6 Solenoid valve
(front-axle left-wheel
DECREASE) | 16 Outlet valve (rear axle) | C: To wheel brake
(front-axle right-wheel) |
| 7 Inlet valve
(front axle) | 17 Damper (rear axle) | D: To wheel brake
(front-axle left-wheel) |
| 8 Outlet valve
(front axle) | 18 Solenoid valve
(rear-axle right-wheel
DECREASE) | E: To wheel brake
(rear-axle right-wheel) |
| 9 Damper (front axle) | 19 Solenoid valve
(rear-axle left-wheel HOLD) | F: To wheel brake
(rear-axle left-wheel) |
| 10 Plunger pump (front axle) | 20 Check valve
(rear-axle right-wheel) | |
| | 21 Solenoid valve
(rear-axle left-wheel HOLD) | |
| | 22 Check valve
(rear-axle left-wheel) | |
- ⊗: Non-reusable parts

- The hydraulic unit (electronic control unit) is the heart of anti-lock brake system control, energizing/de-energizing the solenoid valves and turning ON/OFF the motor. The table below shows how each solenoid valve and the motor are controlled in each phase.

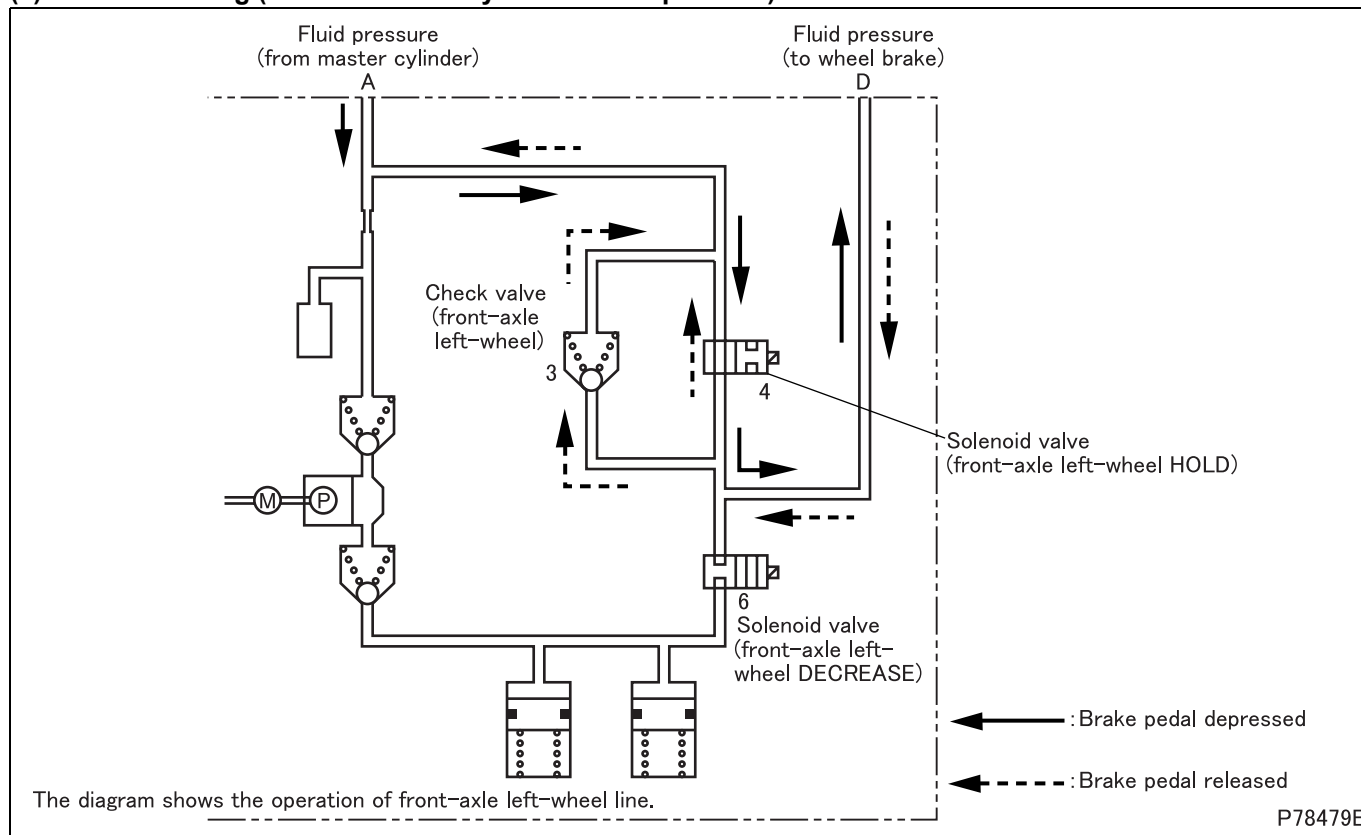
		Anti-lock brake system control											
		Front-axle right-wheel			Front-axle left-wheel			Rear-axle right-wheel			Rear-axle left-wheel		
		DECREASE	HOLD	INCREASE	DECREASE	HOLD	INCREASE	DECREASE	HOLD	INCREASE	DECREASE	HOLD	INCREASE
Solenoid valve	Front-axle right-wheel DECREASE	O	×	×	-	-	-	-	-	-	-	-	-
	Front-axle right-wheel HOLD	O	O	×	-	-	-	-	-	-	-	-	-
	Front-axle left-wheel DECREASE	-	-	-	O	×	×	-	-	-	-	-	-
	Front-axle left-wheel HOLD	-	-	-	O	O	×	-	-	-	-	-	-
	Rear-axle right-wheel DECREASE	-	-	-	-	-	-	O	×	×	-	-	-
	Rear-axle right-wheel HOLD	-	-	-	-	-	-	O	O	×	-	-	-
	Rear-axle left-wheel DECREASE	-	-	-	-	-	-	-	-	-	O	×	×
	Rear-axle left-wheel HOLD	-	-	-	-	-	-	-	-	-	O	O	×
Motor		O											

O: On

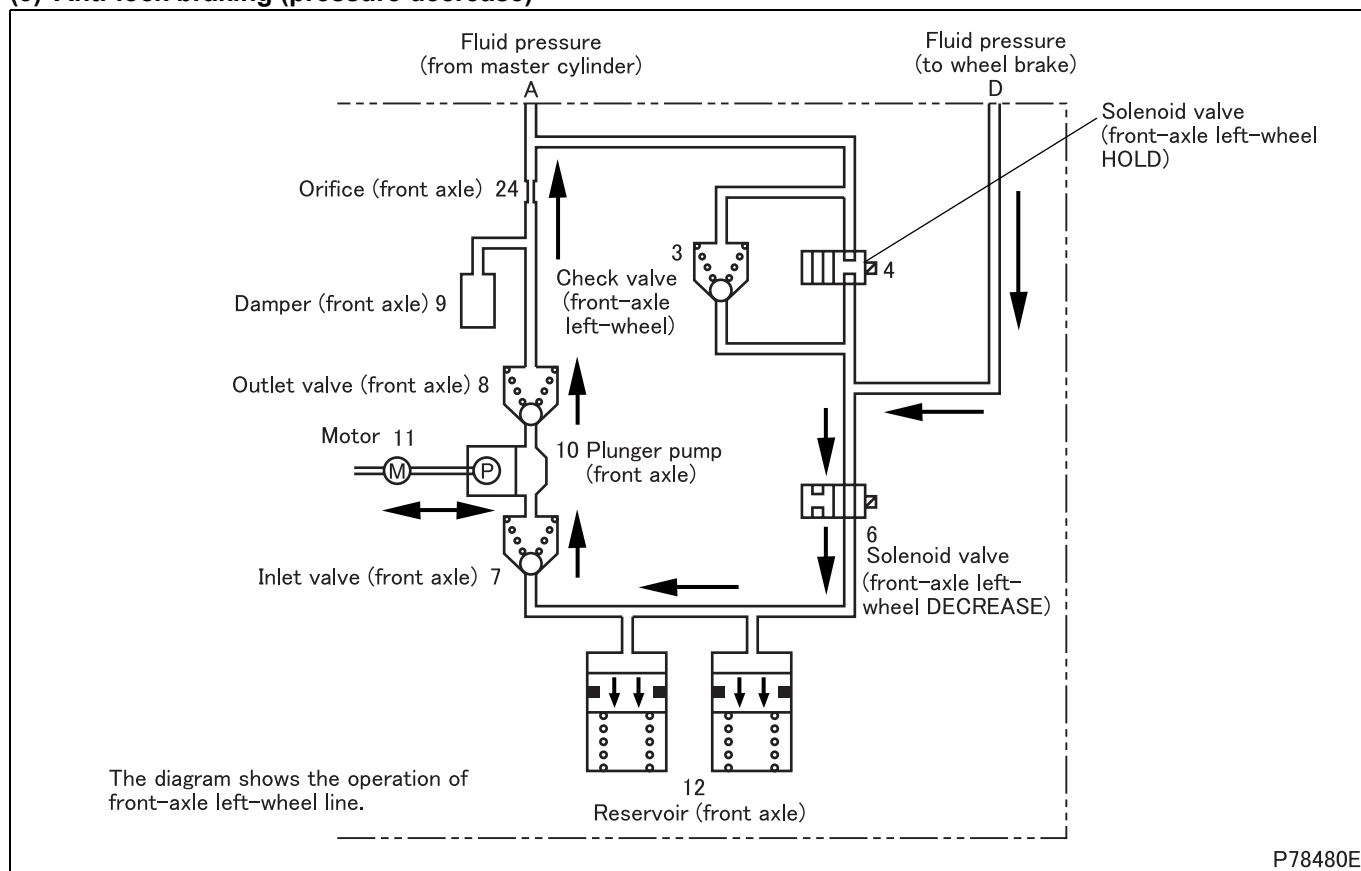
×: OFF

STRUCTURE AND OPERATION

(2) Normal braking (Anti-lock brake system not in operation)



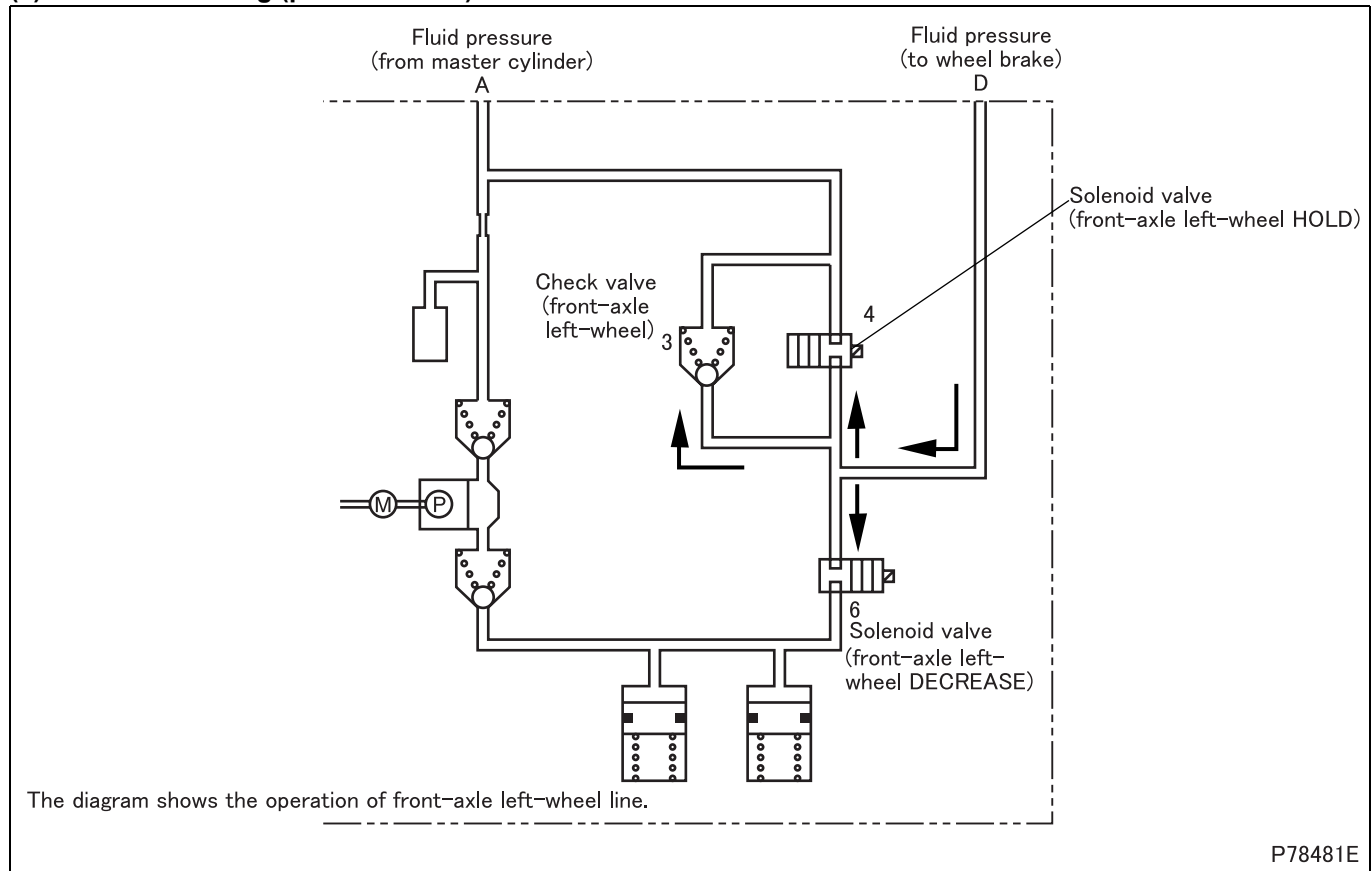
- When the brake pedal is depressed and there is no imminent wheel lock-up, the hydraulic unit (electronic control unit) will not send any control signal to the solenoid valve (front-axle left-wheel DECREASE) or to the solenoid valve (front-axle left-wheel HOLD). The former valve remains closed while the latter valve stays open.
- Pressure fluid **A** from the brake master cylinder flows past the solenoid valve (front-axle left-wheel HOLD) and to the wheel brake **D**.
- When the brake pedal is released, pressure fluid **A** from the brake master cylinder drops. Pressure fluid from the wheel brake **D** now flows past the solenoid valve (front-axle left-wheel HOLD) and the check valve (front-axle left-wheel) and returns to the brake master cylinder.

(3) Anti-lock braking (pressure decrease)

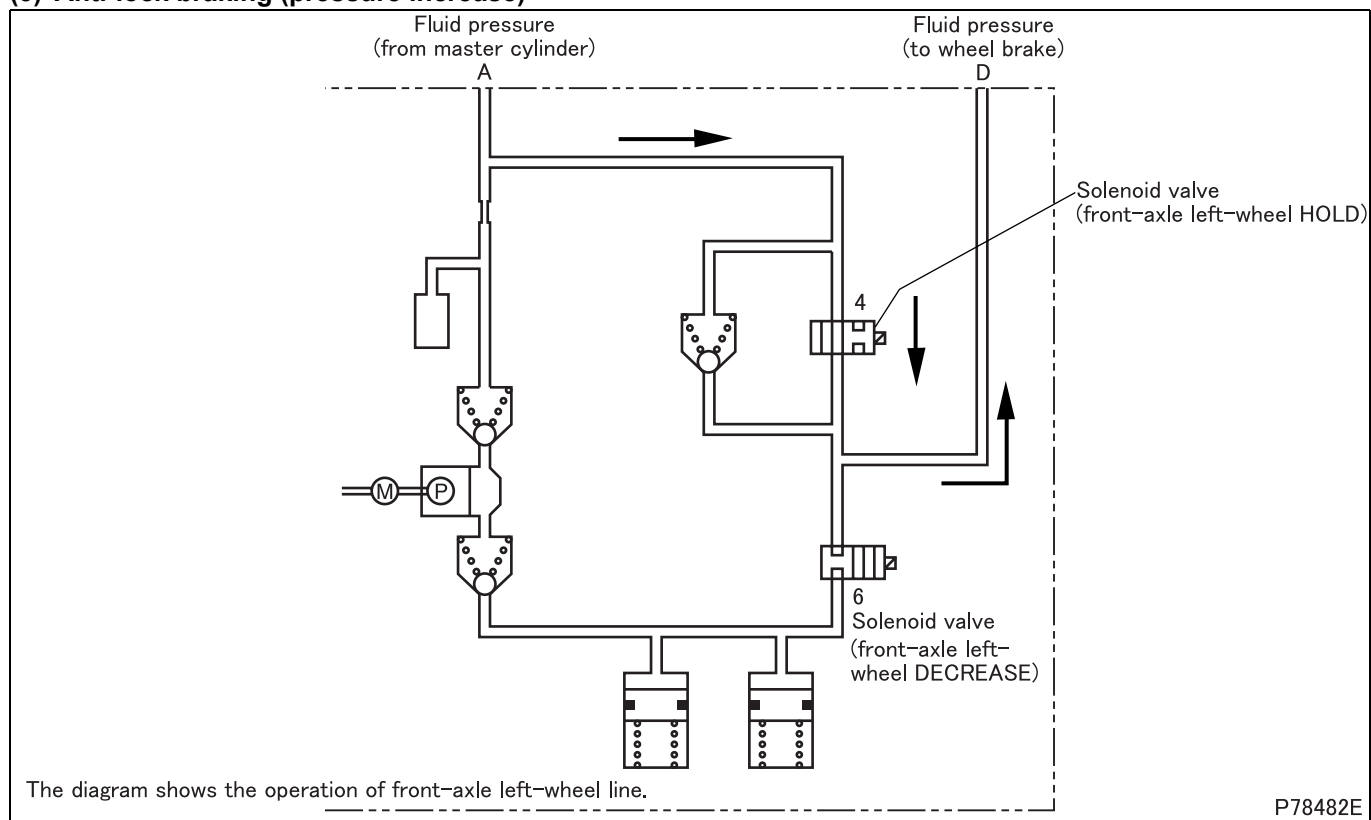
- When the brake pedal is depressed and there is imminent wheel lock-up, the hydraulic unit (electronic control unit) sends control signal to the solenoid valve (front-axle left-wheel DECREASE) and the solenoid valve (front-axle left-wheel HOLD). The former valve will open while the latter valve will close.
- Pressure fluid from the wheel brake **D** now flows past the solenoid valve (front-axle left-wheel DECREASE) and to the reservoirs. The line pressure will drop.
- When the hydraulic unit (electronic control unit) sends control signal to the solenoid valve (front-axle left-wheel DECREASE) and the solenoid valve (front-axle left-wheel HOLD), it also sends control signal to the motor at the same time, causing the plunger pump (front axle) to start pumping. Pressure fluid in the reservoirs now flows past the inlet valve (front axle), the outlet valve (front axle), the damper (front axle) and the orifice (front axle) and returns to the master cylinder.
- During this process, the check valve (front-axle left-wheel) remains closed by the fluid pressure **A** from the brake master cylinder. As a result, no pressure fluid from the master cylinder flows to the wheel brake.

STRUCTURE AND OPERATION

(4) Anti-lock braking (pressure hold)



- When it becomes necessary to hold the fluid pressure **D** in the wheel brake at the same level as part of anti-lock brake system control, the hydraulic unit (electronic control unit) sends "HOLD" signal to the solenoid valve (front-axle left-wheel HOLD). As a result, both of the solenoid valve (front-axle left-wheel HOLD) and the solenoid valve (front-axle left-wheel DECREASE) will be closed, which holds the fluid pressure in the wheel brake at the current level.
- The check valve (front-axle left-wheel) remains closed by the fluid pressure **A** from the brake master cylinder.

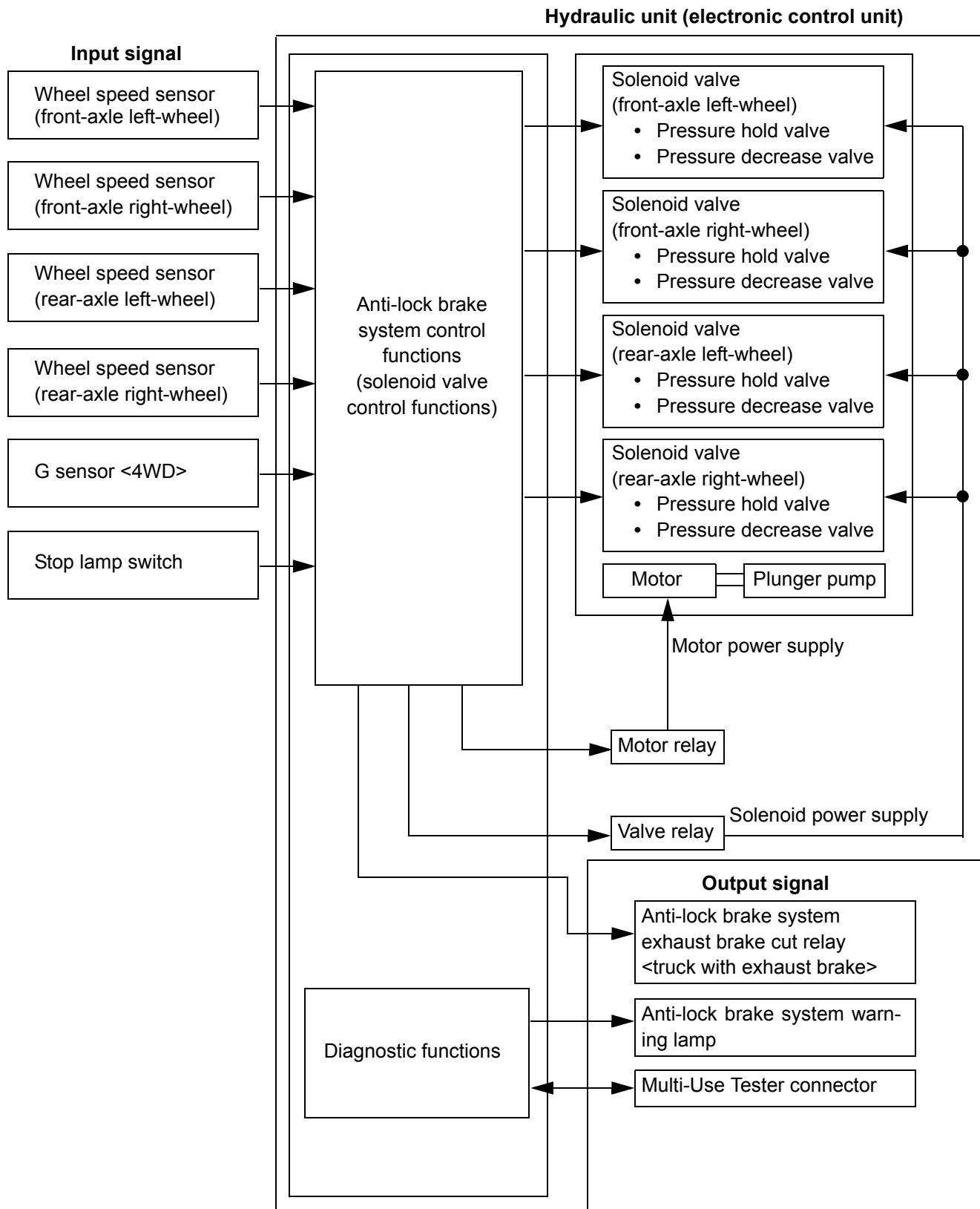
(5) Anti-lock braking (pressure increase)

- When it becomes necessary to increase the fluid pressure **D** in the wheel brake, control signal from the hydraulic unit (electronic control unit) to the solenoid valve (front-axle left-wheel HOLD) and to the solenoid valve (front-axle left-wheel DECREASE) will be cut off.
- As a result, the solenoid valve (front-axle left-wheel HOLD) will open while the solenoid valve (front-axle left-wheel DECREASE) will close. Both valves are now in their normal-braking positions. Fluid pressure **A** being generated by the depression of the brake pedal is now applied to the wheel brake to increase the braking force.

STRUCTURE AND OPERATION

2. Electronic Control System

2.1 Block diagram



Part	Primary function or operation
Wheel speed sensor	Senses wheel speed
G sensor <4WD>	Senses acceleration/deceleration
Stop lamp switch	Senses the depression of brake pedal
Anti-lock brake system exhaust brake cut relay	Cuts off exhaust brake in anti-lock braking mode
Anti-lock brake system warning lamp	Displays anti-lock brake system faults; Performs system check
Multi-Use Tester connector	Communicates with Multi-Use Tester; Displays/Clears diagnosis codes

STRUCTURE AND OPERATION

2.2 Anti-lock brake system control functions

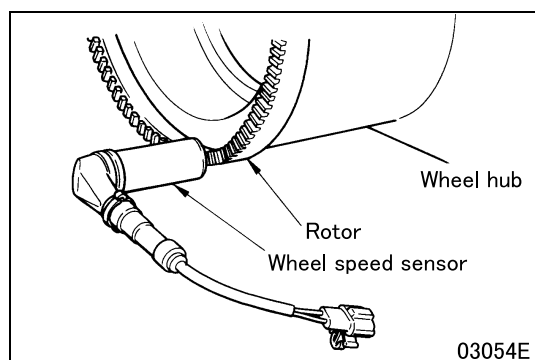
- The hydraulic unit (electronic control unit) continuously monitors signals from the wheel speed sensors. Upon detecting imminent wheel lock-up, the unit sends pressure HOLD, DECREASE or INCREASE signal to appropriate wheels.

(1) Anti-lock brake system fail-safe

- If any fault occurs in the anti-lock brake system, the warning lamp comes on to warn the driver of the fault and the normal braking will resume in place of the anti-lock braking which will be disabled.

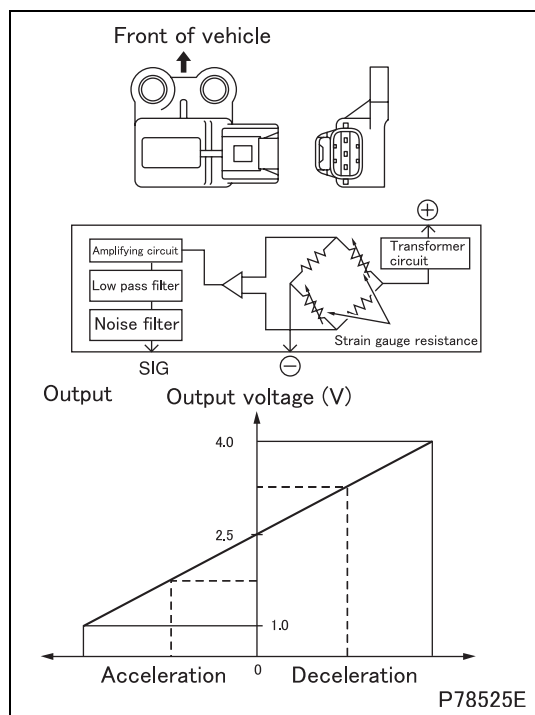
(2) Anti-lock brake system and exhaust brake

- On slippery roads, wheel lock-up can result even from application of the exhaust brake. In the anti-lock braking mode, activation of the exhaust brake makes it difficult for anti-lock brake system to perform controlled braking. To avoid this, the exhaust brake will be disabled upon activation of anti-lock brake system even when the exhaust brake switch is in the "ON" position.
The exhaust brake will automatically be enabled upon deactivation of anti-lock brake system.



(3) Wheel speed sensor

- Each wheel speed sensor detects wheel speed and sends this as a signal to the hydraulic unit (electronic control unit). The sensor is essentially a magnetic pickup unit, consisting of a permanent magnet core and a coil of wire wound around the core.
- A rotor is fitted onto the wheel hub. This rotor, like a ring gear, has a set of evenly-spaced teeth directly facing the sensor. As the wheel rotates, these teeth pass through the magnetic flux of the sensor, inducing potential difference in the coil which is then sent as a signal (alternating voltage proportional to the wheel speed) to the hydraulic unit (electronic control unit).



(4) G sensor <4WD>

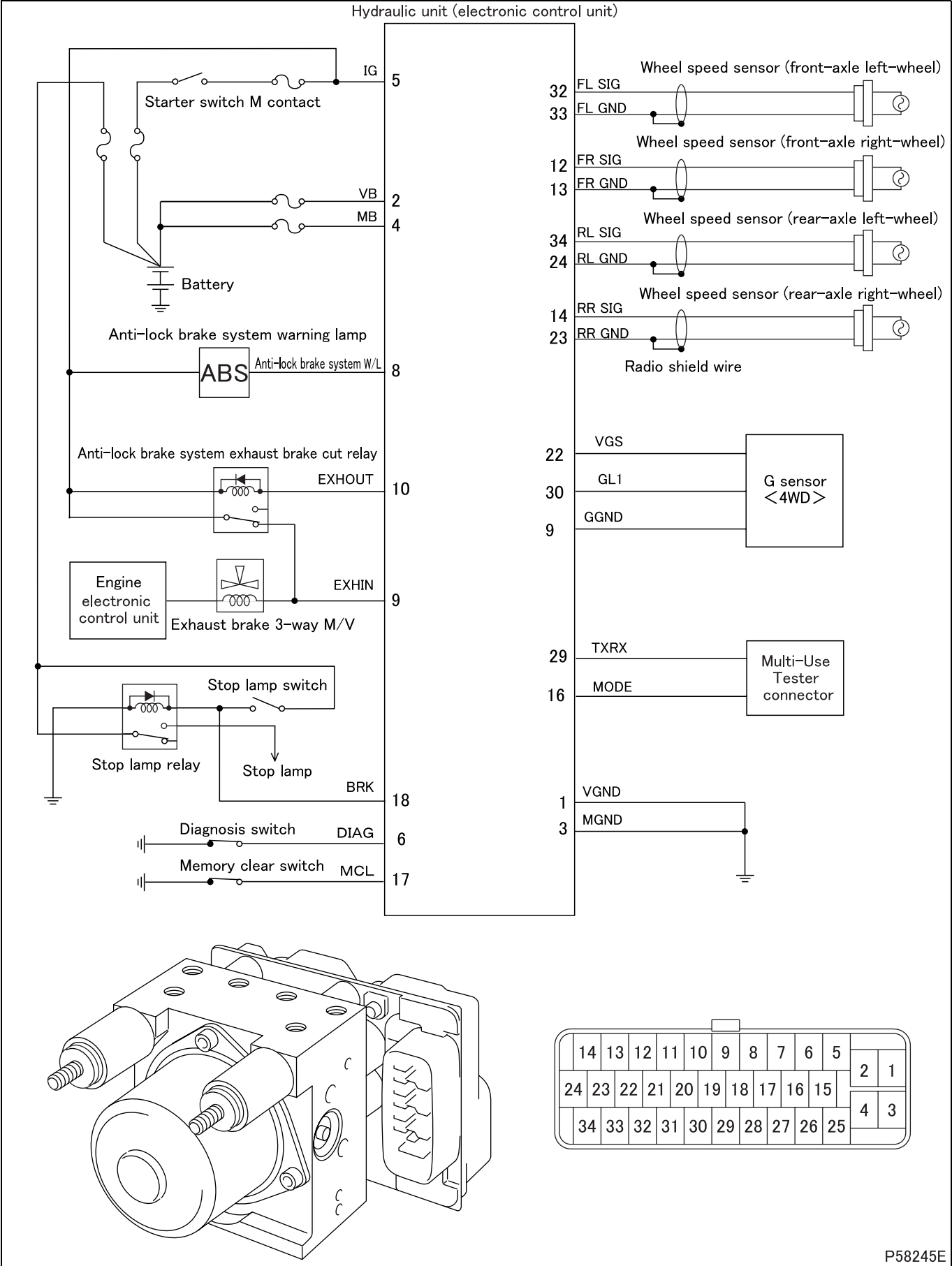
- On slippery roads, trucks with 4WD can experience wheel lock-up due to the inertia of the powertrain. This makes it difficult for anti-lock brake system to perform controlled braking.
- To avoid this, in addition to the wheel speed sensors, a G sensor is also used to detect acceleration/deceleration and assist anti-lock brake system control.
- The G sensor is a semiconductor-type strain gauge. It detects acceleration or deceleration by converting acceleration/deceleration inertia into resistance and further converting this into voltage.

2.3 Diagnostic functions

- When the starter switch is in the ON position, the system continuously monitors the sensors and other system components. If any fault is detected, the system warns the driver of this by displaying the relevant fault information on the meter cluster. At the same time, the system also stores a relevant diagnosis code in the memory and starts operation in the fault mode.
- In the fault-mode operation, the system functions are limited to ensure safety for the driver and the vehicle. Stored diagnosis codes can be accessed using Multi-Use Tester-II/III or can be read by observing the flashing of the warning lamp.

STRUCTURE AND OPERATION

3. Electronic Control Unit Schematic Diagram

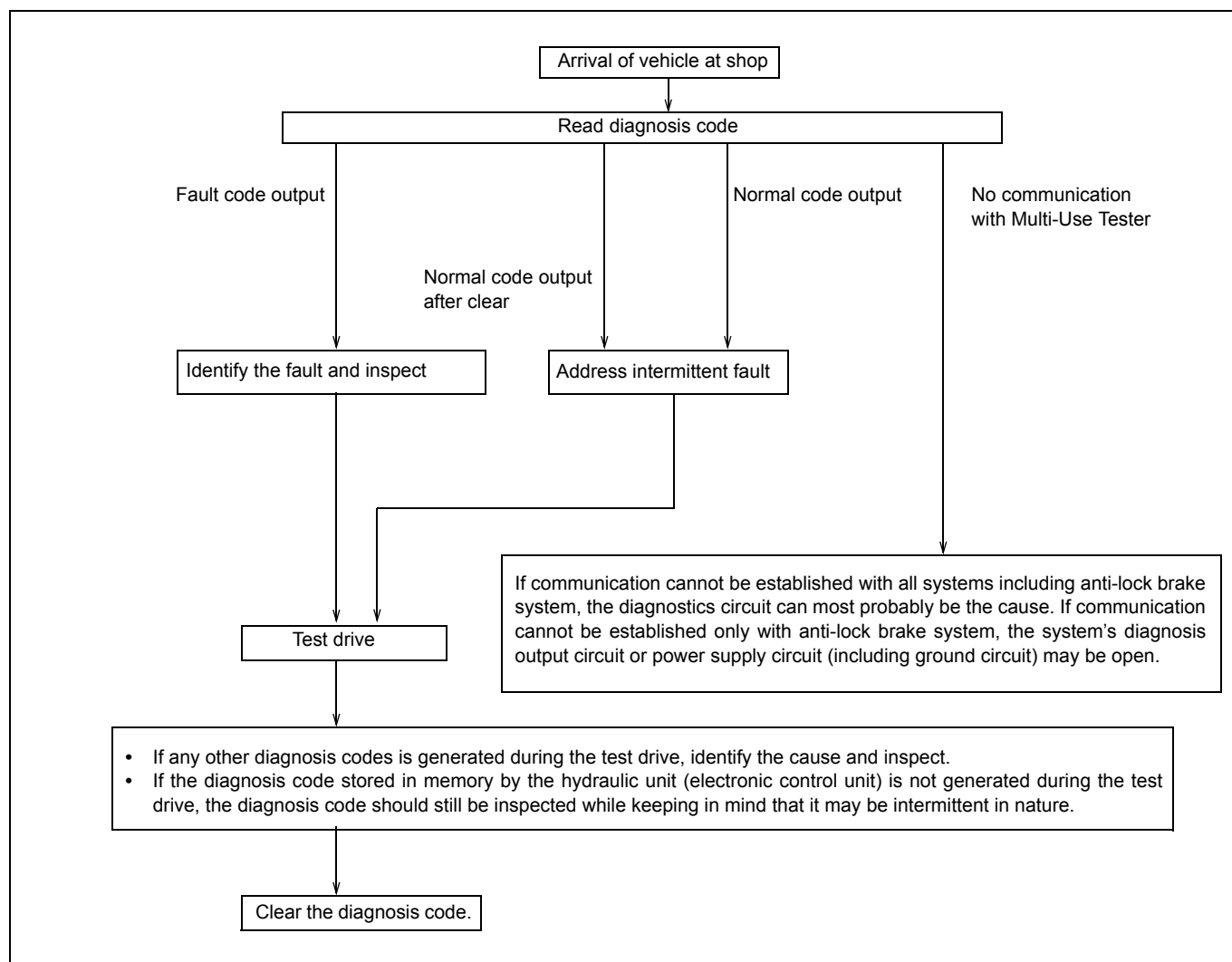


M E M O

TROUBLESHOOTING

1. Diagnosis Procedure

- The system can be efficiently diagnosed using Multi-Use Tester-II or Multi-Use Tester-III.
There are basically 2 different approaches to system diagnosis.
 - Diagnosis based on diagnosis codes stored in memory by the hydraulic unit (electronic control unit)
 - Addressing intermittent faults



2. Precautions when Carrying Out Diagnosis

CAUTION

- Ensure that the battery voltage is to specification.
 - Ensure that the connectors on the harness and system components are tight. When removing the connectors, first move the starter switch to LOCK and then wait for 20 sec.
 - After carrying out any repair, clear the diagnosis code using Multi-Use Tester or the memory clear switch.
 - Diagnosis should be performed with the starter switch in the LOCK position except for certain cases in which diagnosis should be performed with the switch in the ON position. When diagnosis is performed with the switch in the ON position, take extreme care not to cause short circuit between connector terminals or that to the vehicle body.
 - The system components may show out-of-range resistance depending on the temperature or tester accuracy. The figures listed in this manual are based on the temperature range of 10 to 35°C {50 to 95°F}.
 - Whether or not the system automatically resets from the fault mode to the normal mode upon the resolution of error depends on the fault (diagnosis code) in question. When the system resets to normal, the warning lamp will go out.
 - Even after the fault is resolved and the system has reset to normal, the hydraulic unit (electronic control unit) retains the diagnosis code in memory.
 - When a fault of non-automatic system reset is resolved, the diagnosis code needs to be manually cleared from memory to restore the system from the fault mode to the normal mode.
-

TROUBLESHOOTING

3. Diagnosis Based on Diagnosis Codes

3.1 List of diagnosis codes

Code	Message	Remarks
11	FR SENSOR	
12	FL SENSOR	
13	RR SENSOR	
14	RL SENSOR	
21	FR SENSOR SIG	
22	FL SENSOR SIG	
23	RR SENSOR SIG	
24	RL SENSOR SIG	
31	BATT VOLT ERR	
34	G SENSOR	<4WD>
35	EXB CUT RLY	
41	FR VALVE	
42	FL VALVE	
43	RR VALVE	
44	RL VALVE	
51	VALVE RLY	
52	MOTOR RLY	
53	MOTOR ERR	
61	ECU ID ERR	<4WD or Exhaust Brake>
63	ECU ERR	
64	ILLEGAL WHEEL	
65	LONG ABS	

3.2 Code generation criteria and inspection items

11: FR SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after starter switch OFF → ON.
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	11: FR SPEED
	Electronic control unit connector	01 : Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

12: FL SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after starter switch OFF → ON.
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	12: FL SPEED
	Electronic control unit connector	01 : Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

13: RR SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after starter switch OFF → ON.
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	13: RR SPEED
	Electronic control unit connector	01 : Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

14: RL SENSOR

Code generation criteria		Wheel speed sensor resistance out of range
Resettability		System resets when normal resistance is detected after starter switch OFF → ON.
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	14: RL SPEED
	Electronic control unit connector	01 : Wheel speed sensor
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

21: FR SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after starter switch OFF → ON
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	11: FR SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	- Inspect rotor (see Gr26) - Incorrectly installed wheel speed sensor

22: FL SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after starter switch OFF → ON
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	12: FL SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	- Inspect rotor (see Gr26) - Incorrectly installed wheel speed sensor

TROUBLESHOOTING

23: RR SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after starter switch OFF → ON
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	13: RR SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	- Inspect rotor (see Gr27) - Incorrectly installed wheel speed sensor

24: RL SENSOR SIG

Code generation criteria		When driving off, no wheel speed sensor output or abrupt change in wheel speed sensor output
Resettability		System resets upon normal signal input after starter switch OFF → ON
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	14: RL SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	- Inspect rotor (see Gr27) - Incorrectly installed wheel speed sensor

31: BATT VOLT ERR

Code generation criteria		Electronic control unit power-supply terminal voltage out of range
Resettability		Normal signal with starter switch in the ON position
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02 : Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power supply circuit

34: G SENSOR

Code generation criteria		G sensor terminal voltage out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	16: G-SNS VOLTAGE
	Electrical part	#327: G sensor
	Other	G sensor circuit

35: EXB CUT RLY

Code generation criteria		Anti-lock brake system exhaust brake cut relay monitor terminal voltage out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Exhaust brake control disabled (No exhaust brake cut during Anti-lock brake system operation)
Inspection item	Service data	22: EXB CUT RLY, 23: EXB MONITOR
	Actuator test	22: EXB RLY ON
	Electronic control unit connector	03 : Anti-lock brake system exhaust brake cut relay
	Electrical part	#201: Anti-lock brake system exhaust brake cut relay
	Wiring diagram	Anti-lock brake system exhaust brake cut relay circuit

41: FR VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02 : Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

42: FL VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02 : Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

43: RR VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02 : Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

44: RL VALVE

Code generation criteria		Solenoid valve terminal voltage out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02 : Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

TROUBLESHOOTING

51: VALVE RLY

Code generation criteria		Terminal voltage of valve relay in electronic control unit out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	15: BATT VOLTAGE
	Electronic control unit connector	02 : Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

52: MOTOR RLY

Code generation criteria		Terminal voltage of motor relay in electronic control unit out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Service data	32: MOTOR RLY
	Actuator test	21: ABS MOTOR ON
	Electronic control unit connector	02 : Electronic control unit power-supply voltage
	Wiring diagram	Electronic control unit power-supply circuit

53: MOTOR ERR

Code generation criteria		Motor terminal voltage out of range
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Wiring diagram	Electronic control unit power-supply circuit
	Other	Clear memory and re-energize. If system still does not reset when driving at 10km/h or above, replace hydraulic unit (electronic control unit).

61: ECU ID ERR

Code generation criteria		Wiring incorrect for vehicle system
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Inspection item	Electronic control unit connector	04 : Configuration check
	Wiring diagram	Anti-lock brake system EXB cut relay circuit

63: ECU ERR

Code generation criteria		Electronic control unit internal fault
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system enabled
Other		Clear memory and re-energize. If system still does not reset, replace hydraulic unit (electronic control unit).

64: ILLEGAL WHEEL

Code generation criteria		At 30 km/h or above, difference in output signal between wheel speed sensors exceeds the limit. (The difference should be less than 20% between front and rear wheel speed sensors and less than 10% between left and right wheel speed sensors.)
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	11: FR SPEED, 12: FL SPEED, 13: RR SPEED, 14: RL SPEED * Min. speed displayed = 2 km/h {1.2 mph}
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit

65: LONG ABS

Code generation criteria		Anti-lock brake system operates longer than the specified time duration.
Resettability		Normal signal after starter switch OFF → ON (Re-energize electronic control unit)
Electronic control unit control		Anti-lock brake system disabled
Inspection item	Service data	11: FR SPEED, 12: FL SPEED, 13: RR SPEED, 14: RL SPEED
	Electrical part	#329: Wheel speed sensor
	Wiring diagram	Wheel speed sensor circuit
	Other	- Inspect rotor (see Gr26, Gr27) - Incorrectly installed wheel speed sensor

TROUBLESHOOTING

4. Multi-Use Tester Service Data

NOTE

- Service data can be accessed while actuator test is being performed, and vice versa.

No.	Item	Data	Diagnosis condition	Pass criteria
11	FR SPEED	■■■■. ■km/h	Drive at a constant speed	Synchronized with speedometer
12	FL SPEED	■■■■. ■km/h		
13	RR SPEED	■■■■. ■km/h		
14	RL SPEED	■■■■. ■km/h		
15	BATT VOLTAGE	■■. ■■V	Starter switch ON	Correspond with battery voltage
16 <4WD>	G-SNS VOLTAGE	■. ■■■V	Vehicle parked horizontally; Starter switch ON	2.2 to 2.8 V
21	BRAKE SW	ON/OFF	Brake pedal depressed	ON
			Brake pedal released	OFF
22 <Exhaust Brake>	EXB CUT RLY	ON/OFF	When anti-lock brake system exhaust brake cut relay activated	ON
			When anti-lock brake system exhaust brake cut relay not activated	OFF
			[Actuator test] 22: EXB RLY ON	
23 <Exhaust Brake>	EXB MONITOR	ON/OFF	When anti-lock brake system exhaust brake cut relay activated	ON
			When anti-lock brake system exhaust brake cut relay not activated	OFF
			[Actuator test] 22: EXB RLY ON	
24	ABS LAMP	ON/OFF	Anti-lock brake system warning lamp ON	ON
			Anti-lock brake system warning lamp OFF	OFF
			[Actuator test] 23: ABS LAMP ON	
25	DIAGNOSIS SW	OPEN/CLOSE	Diagnosis switch fuse removed	OPEN
			Diagnosis switch fuse plugged in	CLOSE
26	DIAG.RESET SW	OPEN/CLOSE	Memory clear switch fuse removed	OPEN
			Memory clear switch fuse plugged in	CLOSE
27 <4WD>	4WD SW	4WD/2WD	4WD	4WD
			2WD	2WD
31	VALVE RLY	ON/OFF	When valve relay activated	ON
			When valve relay not activated	OFF
32	MOTOR RLY	ON/OFF	Motor in operation	ON
			Motor stationary	OFF
			[Actuator test] 11: FR ABS MV ON 12: FL ABS MV ON 13: RR ABS MV ON 14: RL ABS MV ON 21: ABS MOTOR ON	

No.	Item	Data	Diagnosis condition	Pass criteria
41	FR-DV	ON/OFF	Solenoid valve energized (front-axle right-wheel DECREASE)	ON
			Solenoid valve de-energized (front-axle right-wheel DECREASE)	OFF
			[Actuator test] 11: FR ABS MV ON	
42	FR-HV	ON/OFF	Solenoid valve energized (front-axle right-wheel HOLD)	ON
			Solenoid valve de-energized (front-axle right-wheel HOLD)	OFF
			[Actuator test] 11: FR ABS MV ON	
43	FL-DV	ON/OFF	Solenoid valve energized (front-axle left-wheel DECREASE)	ON
			Solenoid valve de-energized (front-axle left-wheel DECREASE)	OFF
			[Actuator test] 12: FL ABS MV ON	
44	FL-HV	ON/OFF	Solenoid valve energized (front-axle left-wheel HOLD)	ON
			Solenoid valve de-energized (front-axle left-wheel HOLD)	OFF
			[Actuator test] 12: FL ABS MV ON	
45	RR-DV	ON/OFF	Solenoid valve energized (rear-axle right-wheel DECREASE)	ON
			Solenoid valve de-energized (rear-axle right-wheel DECREASE)	OFF
			[Actuator test] 13: RR ABS MV ON	
46	RR-HV	ON/OFF	Solenoid valve energized (rear-axle right-wheel HOLD)	ON
			Solenoid valve de-energized (rear-axle right-wheel HOLD)	OFF
			[Actuator test] 13: RR ABS MV ON	
47	RL-DV	ON/OFF	Solenoid valve energized (rear-axle left-wheel DECREASE)	ON
			Solenoid valve de-energized (rear-axle left-wheel DECREASE)	OFF
			[Actuator test] 14: RL ABS MV ON	
48	RL-HV	ON/OFF	Solenoid valve energized (rear-axle left-wheel HOLD)	ON
			Solenoid valve de-energized (rear-axle left-wheel HOLD)	OFF
			[Actuator test] 14: RL ABS MV ON	

TROUBLESHOOTING

5. Actuator Test Using Multi-Use Tester

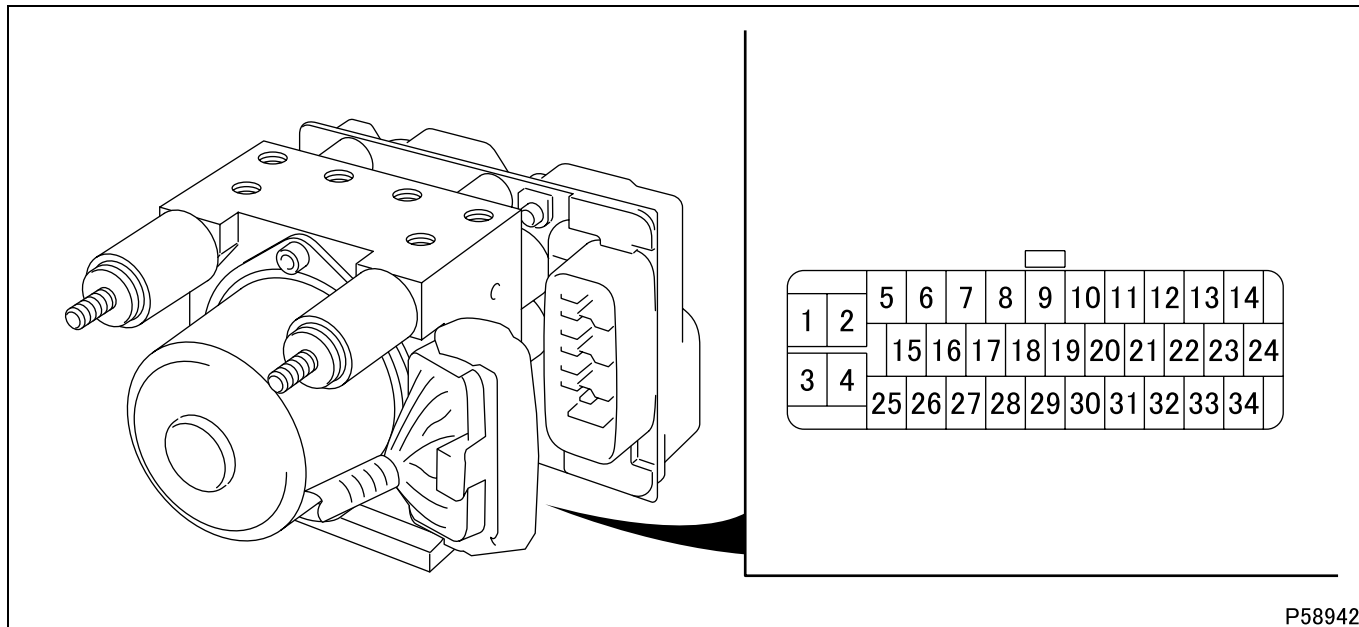
NOTE

- Service data can be accessed while actuator test is being performed, and vice versa.

No.	Item	Description	Verification method
11	FR ABS MV ON	P49621E	Hydraulic unit (electronic control unit) functional check [Service data] 32: MOTOR RLY 41: FR-DV 42: FR-HV 43: FL-DV 44: FL-HV 45: RR-DV 46: RR-HV 47: RL-DV 48: RL-HV
12	FL ABS MV ON		
13	RR ABS MV ON		
14	RL ABS MV ON		
21	ABS MOTOR ON	Motor P49620E	Motor noise [Service data] 32: MOTOR RLY
22	EXB RLY ON	Exhaust brake cut relay P49620E	Relay noise [Service data] 22: EXB CUT RLY 23: EXB MONITOR
23	ABS LAMP ON	Anti-lock brake system warning lamp P49620E	Anti-lock brake system warning lamp ON [Service data] 24: ABS LAMP

6. Inspection at Hydraulic Unit (Electronic Control Unit) Connector

- This inspection is intended to aid troubleshooting by verifying whether or not hydraulic unit (electronic control unit) signals are correctly transmitted via the vehicle harness and connector.
The **01** in the table below is a cross reference to the electronic control unit connector 01 inspection items listed in the table in “3. Diagnosis Based on Diagnosis Codes” of this manual.



P58942

CAUTION

- The inspection requires the connector with a locking feature to be uncoupled. Before carrying out the inspection, read the “Hydraulic Unit Connector Uncoupling and Coupling” in this manual.
- Do not touch terminals that are irrelevant to the inspection being performed. When using a tester, be careful not to cause short circuit across the terminals being measured.

Check item	Measurement
01 Wheel speed sensor resistance	[Condition] - Starter switch OFF - With the connector uncoupled, inspect at vehicle harness connector half [Pass criteria] - Between terminals: 12 and 13 (FR) - Between terminals: 32 and 33 (FL) - Between terminals: 14 and 23 (RR) - Between terminals: 34 and 24 (RL) - The resistance measured should be 1 to 2 Ω
02 Electronic control unit power-supply voltage	[Condition] - Starter switch ON - With the connector uncoupled, inspect at vehicle harness connector half [Pass criteria] - Between terminals (+) - (-): 2 - 1 (VB) 4 - 3 (MB) 5 - 1 (IG) 20 to 30 V

TROUBLESHOOTING

Check item	Measurement
03 Anti-lock brake system exhaust brake cut relay voltage	[Condition] • Starter switch ON • With the connector uncoupled, inspect at vehicle harness connector half [Pass criteria] Between terminals (+) - (-): 10 - 1 9 - 1 • 20 to 30 V
04 Configuration check	[Pass criteria] Terminals 11, 22 and 30 should be free (no wiring connected). CAUTION ⚠ _____ • If wires are connected to these terminals, disconnect the wires and insulate the exposed portions. _____

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Functional Check

1.1 Inspection with vehicle stationary

- While depressing the brake pedal, check the hydraulic unit (electronic control unit) and the brake pipes and connections for fluid leakage.
- If fluid is leaking from the hydraulic unit (electronic control unit), replace the unit. If fluid is leaking from the brake pipes or connections, retighten the hardware.

1.2 Inspection using brake tester

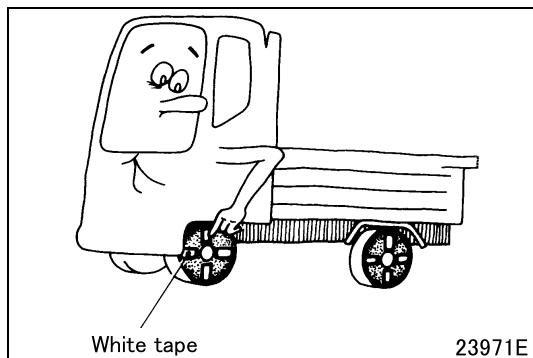
- Using the brake tester, check each wheel for braking force following the normal procedures.
- If faulty, check the wheel brake in question, the service brake system and the hydraulic unit (electronic control unit).

1.3 Inspection of anti-lock brake system operation while driving the vehicle

WARNING

- During this inspection, do not allow any other vehicle or anyone into the test course.
-

- The vehicle being tested should be in the unloaded state.
- Apply white tapes onto the walls of front and rear tires to aid the observation of wheel rotation.
- Turn the starter switch from LOCK to ON. The warning lamp should come on and, in several seconds, go out.
- Drive the vehicle at 20 to 30 km/h {12 to 19 mph} and apply the brakes hard. The wheels should not lock up.



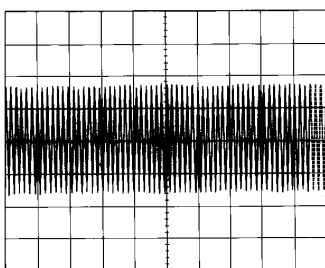
2. Inspection of Wheel Speed Sensor Signal Waveform Using Oscilloscope

- Inspect the rotor for dent or chipped tooth using an oscilloscope. These faults cannot be detected by a brake tester.

NOTE

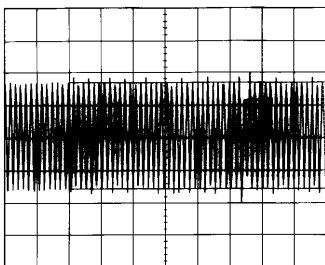
- **Use an oscilloscope that is equipped with waveform recording feature.**
- Jack up the wheel being tested, and uncouple the connector for the wheel speed sensor.
- Connect the terminal of the oscilloscope to the connector terminal that has been exposed. While rotating the wheel at a constant speed, observe the waveform displayed on the oscilloscope for indication of dent or chipped tooth on the rotor.
- Dent or chipped tooth on the rotor is, in most cases, formed when the rotor, which is press-fit onto the hub, hits the axle or other parts as the hub and brake drum (drum brake) or the hub and rotor (disc brake) are assembled onto the axle. Keep this in mind when assembling the hub onto the axle.
- If there are any waveforms that are evidently narrower than other waveforms, this may indicate dent or chipped tooth.
- If so, visually inspect the rotor.

Normal waveform
(No dent or chipped tooth on the rotor)



03122E

Abnormal waveform
(Dent or chipped tooth on the rotor)



51148E

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Inspection of Hydraulic Unit (Electronic Control Unit) Operation

3.1 Inspection using Multi-Use Tester

- Jack up the vehicle and support it on rigid racks, or place the vehicle on the rollers of a brake tester.

WARNING

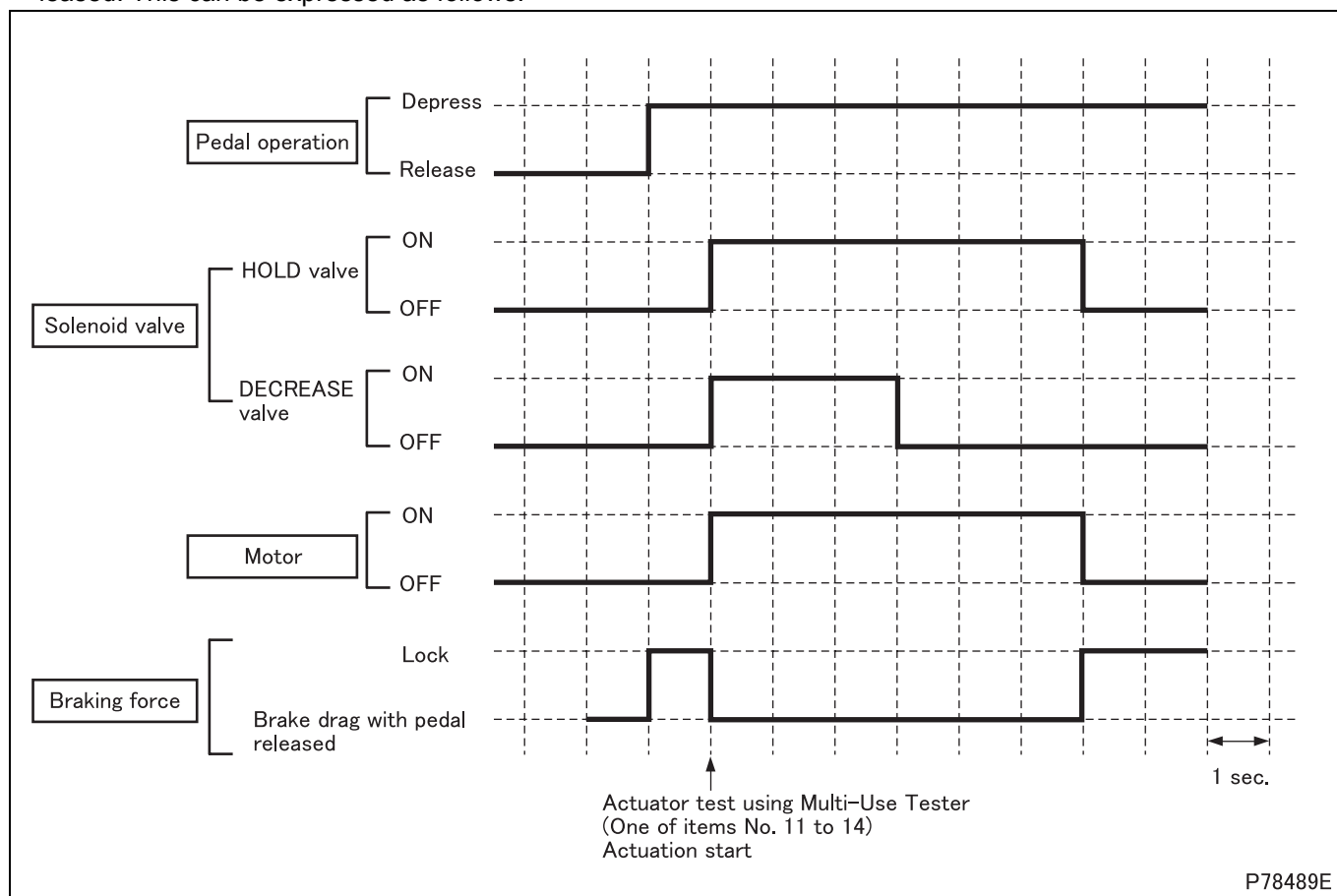
- Apply the parking brake when testing the front-axle brake. Chock the front wheels when testing the rear-axle brake.

NOTE

- During the inspection, keep the brake tester rollers and the tires dry.
- With the parking brake released, feel the brake drag of each wheel. When using a brake tester, note the brake drag reading.
- Turn the starter switch to LOCK, and connect the Multi-Use Tester.
- With the transmission in neutral, start the engine.
- Using the Multi-Use Tester, move the actuator.

NOTE

- Actuator test using the Multi-Use Tester is not possible when the hydraulic unit (electronic control unit) is inoperative in the fail-safe mode.
- While rotating the wheel by hand, feel the variation in brake drag/force as the brake pedal is depressed and released. This can be expressed as follows.



- Determine whether the system is faulty or not by referring to the diagnosis table on the next page. If faulty, take the actions indicated.

Diagnosis table (Actuator test using Multi-Use Tester)

No.	Multi-Use Tester display	Operation	Diagnosis		Cause	Remedial action
			Normal	Faulty		
11	FR ABS MV ON	(1) Depress the brake pedal to lock up the wheel. (2) Using Multi-Use Tester, select the wheel being tested and move the relevant actuator. (3) Rotate the wheel being tested using the brake tester or by hand, and check the variation in braking force.	Braking force drops for 6 seconds following wheel lock-up.	Wheel will not lock up when brake pedal is depressed.	Clogged brake line outside hydraulic unit (electronic control unit)	Inspect and clean brake line
12	FL ABS MV ON				Clogged line inside hydraulic unit (electronic control unit)	Replace hydraulic unit (electronic control unit)
13	FR ABS MV ON			Braking force will not drop.	Incorrectly connected hydraulic unit (electronic control unit) brake piping	Connect piping correctly
14	RL ABS MV ON				Faulty hydraulic unit (electronic control unit) magnetic valve	Replace hydraulic unit (electronic control unit)

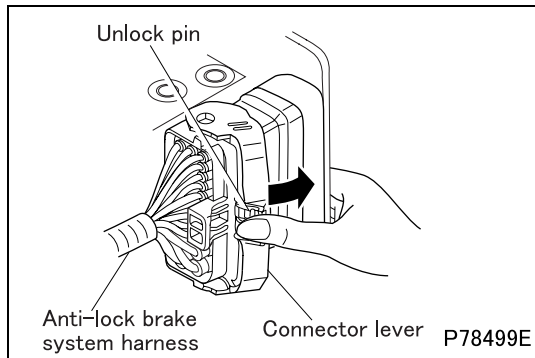
- With the inspection completed, turn the starter switch to LOCK before removing the Multi-Use Tester.

4. Inspection after Replacing or Removing/Installing Hydraulic Unit (Electronic Control Unit)

- Check the hydraulic unit (electronic control unit) for normal operation.
- After replacing or removing/installing the hydraulic unit (electronic control unit), always check the system for normal operation. Controlled braking will not be available if the piping is incorrect.
- The vehicle harness connector is equipped with a locking device. For correct use of the device, refer to “**HYDRAULIC UNIT CONNECTOR COUPLING AND UNCOUPLING**” in this manual.

HYDRAULIC UNIT CONNECTOR COUPLING AND UNCOUPLING

1. Uncoupling the Connector



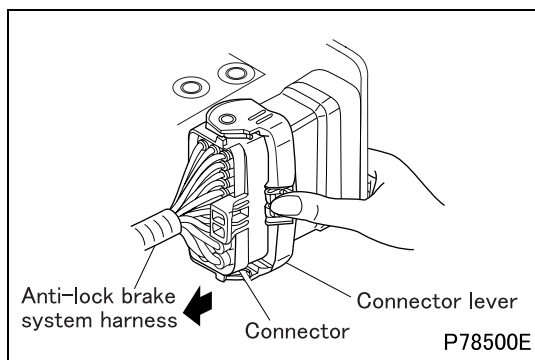
- While holding the connector, push the unlock pin on the connector lever with finger and unlock.
- With the connector unlocked, push the connector lever in the direction of the arrow.

CAUTION

- **Do not push the connector lever with strong force, or it may break.**

NOTE

- **If the connector lever is stiff and will not move, return the connector lever to the locked position and try again.**

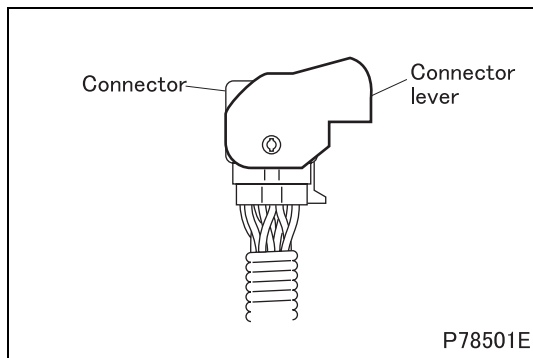


- With the connector lever fully pushed back, remove it together with the anti-lock brake system harness while holding the connector.

CAUTION

- **Do not attempt to remove the connector with strong force with the locking device still not completely unlocked. Doing so may break the connector. Push the connector lever fully back and try again.**

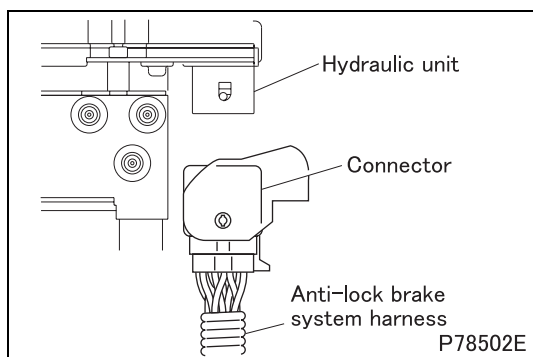
2. Coupling the Connector



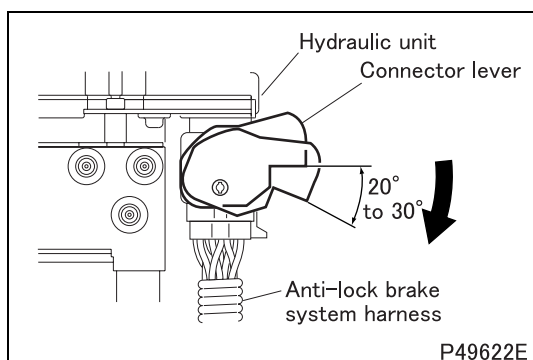
- Ensure that the connector terminals are clean and free from foreign matter.
- Set the connector lever to the illustrated position.

CAUTION

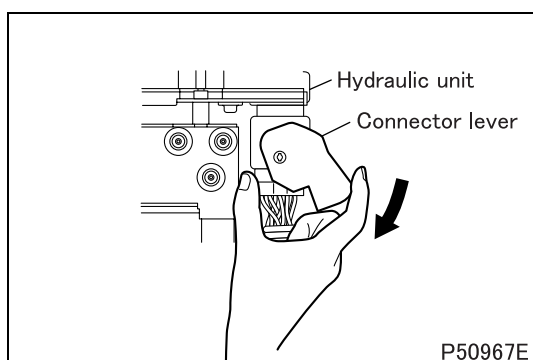
- Trying to plug in the connector with the connector lever not positioned as illustrated may break the connector lever.



- Insert the anti-lock brake system harness connector straight into the other connector half on the hydraulic unit.



- As the anti-lock brake system harness connector is plugged in, the connector lever will rotate approx. 20° to 30° in the direction of the arrow (until the lever and the casing are almost parallel with each other).



- While holding the connector, turn the connector lever in the direction of the arrow until it clicks into the locked position.

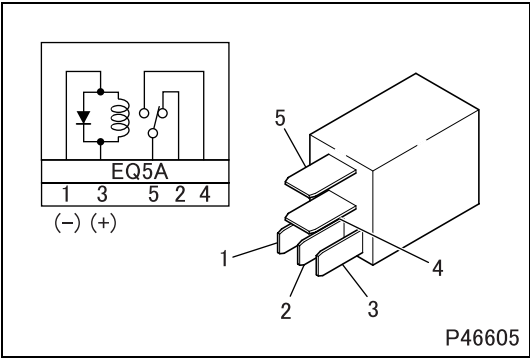
CAUTION

- When turning the connector lever, push in the center, not the end, of the lever to avoid breaking the lever.
- Before attempting to turn the connector lever to the locked position, ensure that the lever has turned approx. 20° to 30° in the direction of the arrow. If not, the lever may break when pushed with strong force.

NOTE

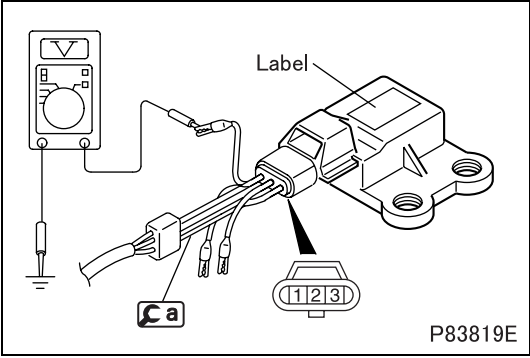
- If the connector is not correctly plugged in, the anti-lock brake system warning lamp may illuminate. If the lamp comes on, uncouple and plug in the connector again.

INSPECTION OF ELECTRICAL COMPONENTS



#210 Inspection of relay (normally open 5-pin relay)

- Check the relay for continuity and normal operation. If faulty, replace the relay.



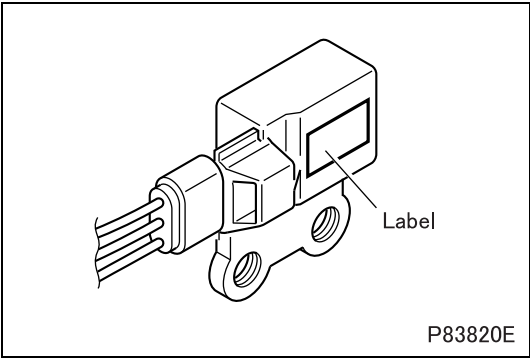
#327 Inspection of G sensor

Special tools

Mark	Tool name and shape	Part No.	Application
	Test Harness Set 35728	MB991348	Inspection of G sensor

- Remove the G sensor.
- Connect to the connector terminals, and place the G sensor on a horizontal plane as illustrated.
- Turn the starter switch ON. Measure the voltage between Terminal 2 and the ground on the vehicle body.

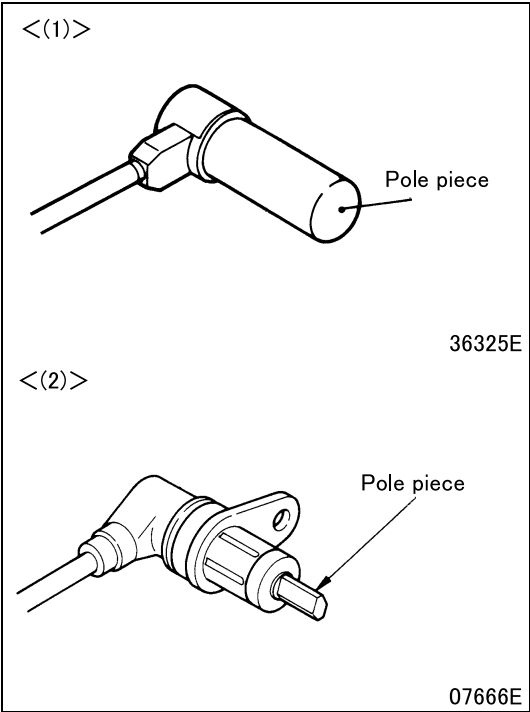
Standard value	2.4 to 2.6 V
----------------	--------------



- With still connected to the connector terminals, place the sensor vertically with the label facing the illustrated direction. Measure the voltage between Terminal 2 and the ground on the vehicle body.

Standard value	3.3 to 3.7 V
----------------	--------------

- If the measured voltage does not conform to the standard value, check the power supply and ground circuits. If they are normal, replace the G sensor.



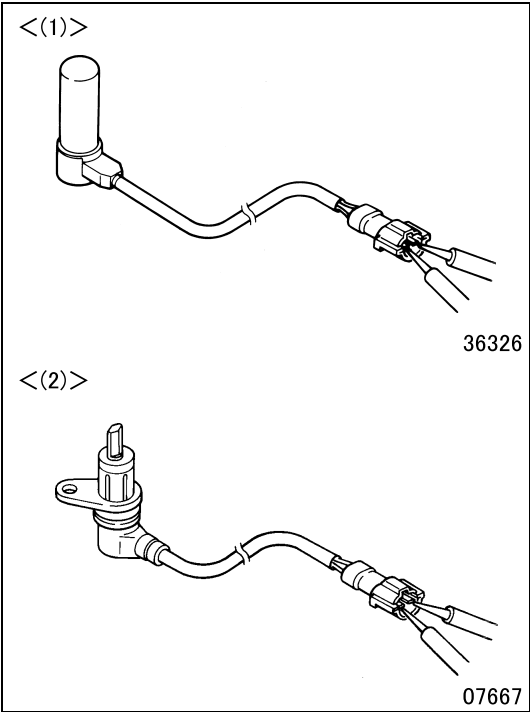
#329 Inspection of wheel speed sensor

- Types of wheel speed sensors used.

Type	Application
(1)	Rear disc brake Front drum brake
(2)	Front disc brake

CAUTION ⚠

- The pole piece is magnetized by the magnet housed in the wheel speed sensor. Be careful not to allow metal parts to stick onto the pole piece.

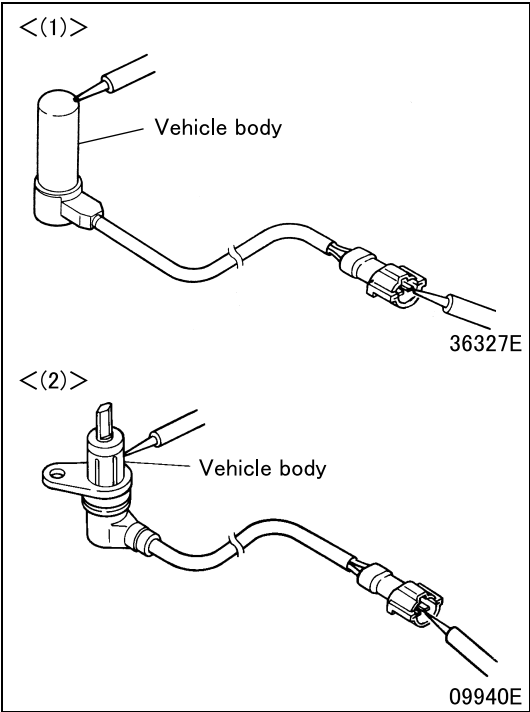


- Carry out the following checks. If faulty, replace the wheel speed sensor.

(1) Resistance between terminals

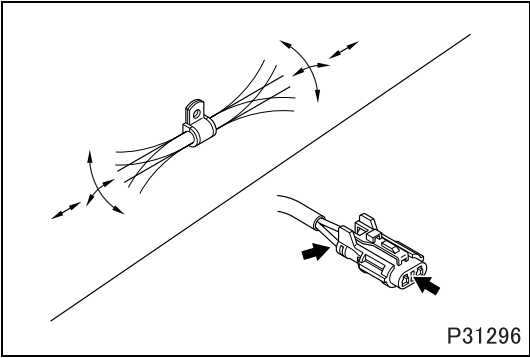
Standard value	Type (1)	$1.4 \pm 0.2 \text{ k}\Omega$
	Type (2)	$1.6 \pm 0.16 \text{ k}\Omega$

INSPECTION OF ELECTRICAL COMPONENTS



(2) Insulation resistance (between the vehicle body and each terminal)

Standard value	Type (1)	1000 kΩ or above
	Type (2)	100 kΩ or above



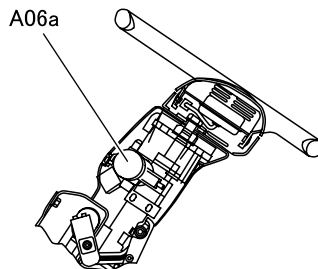
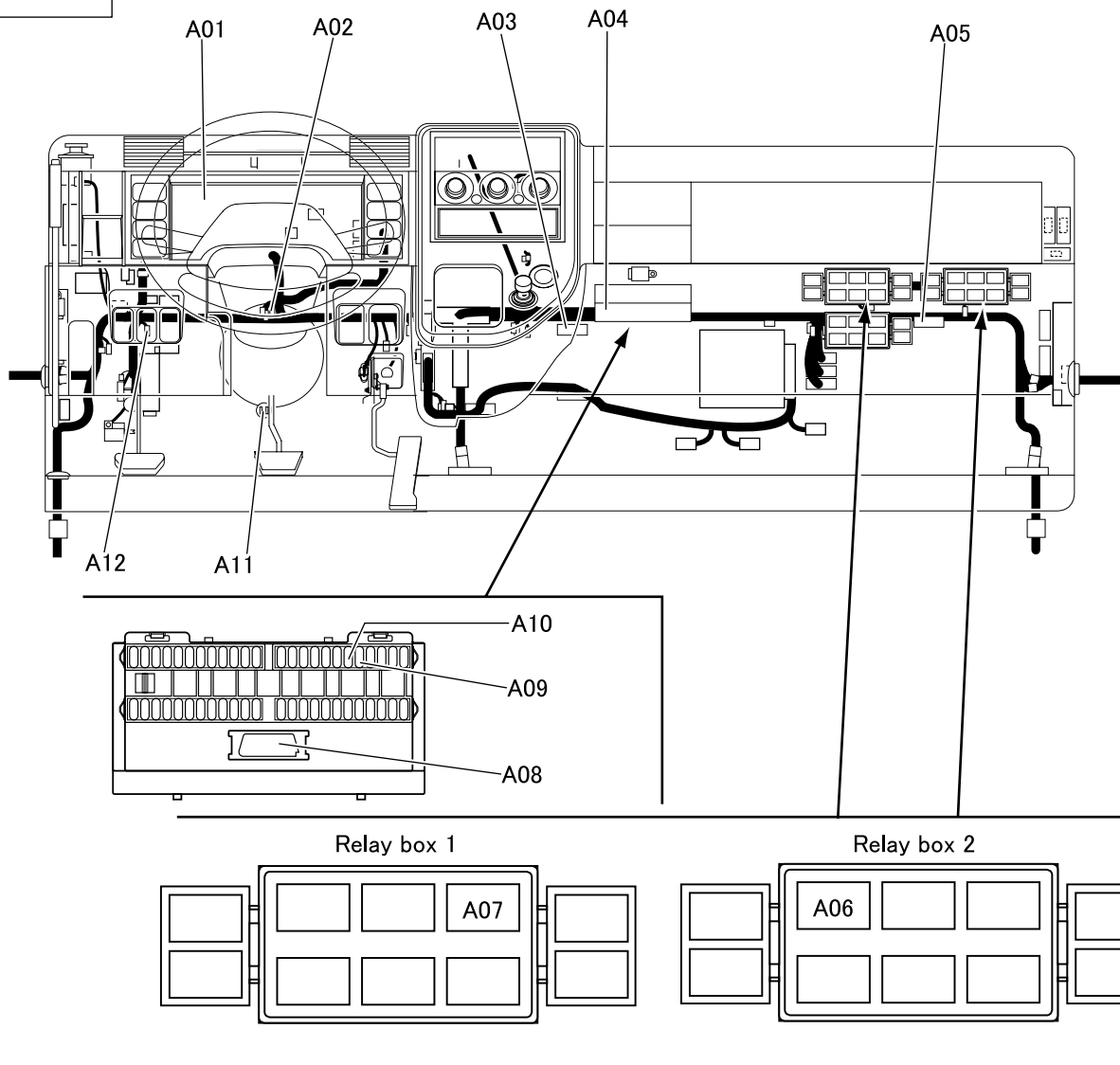
(3) Open circuit

- If open circuit is suspected, remove the harness clamps and wiggle the harness to determine whether it is an intermittent fault or not. Check also the connector terminals for proper connection.

M E M O

COMPONENTS LOCATION

A01 to 35



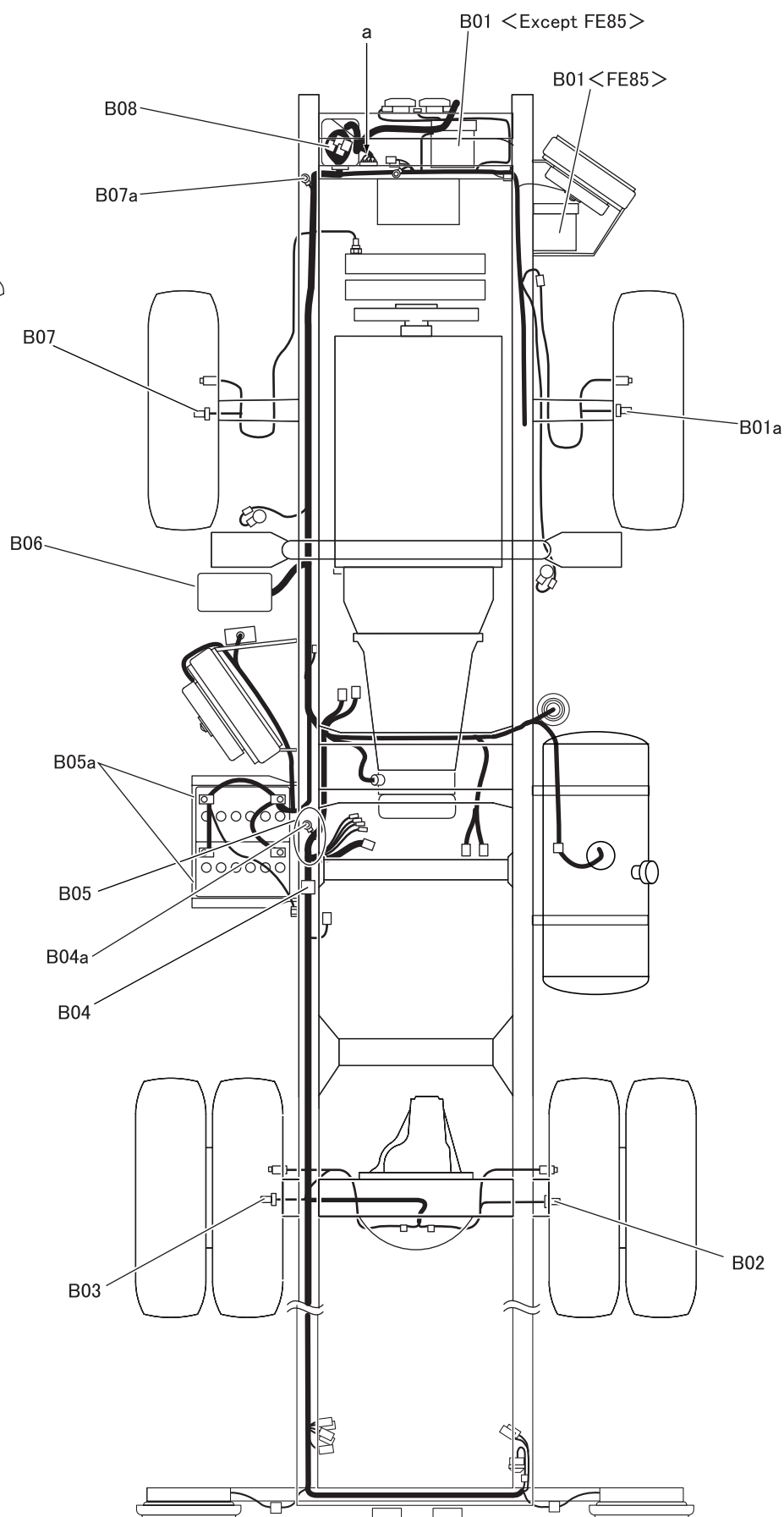
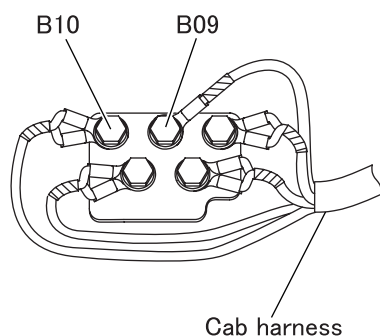
No relevant parts in a missing number

- A01 Meter cluster
- A02 Diode
- A03 Joint connector (J/C-1)
- A04 Fuse box
- A05 Joint connector (J/C-2,3)
- A06 ABS exhaust brake cut relay
- A06a Starter switch
- A07 Stop lamp relay
- A08 Multi-Use Tester connector
- A09 Memory clear switch
- A10 Diagnosis switch
- A11 Stop lamp switch
- A12 G-sensor
- ABS: Anti-lock brake system

L00179

B01 to 10

View a



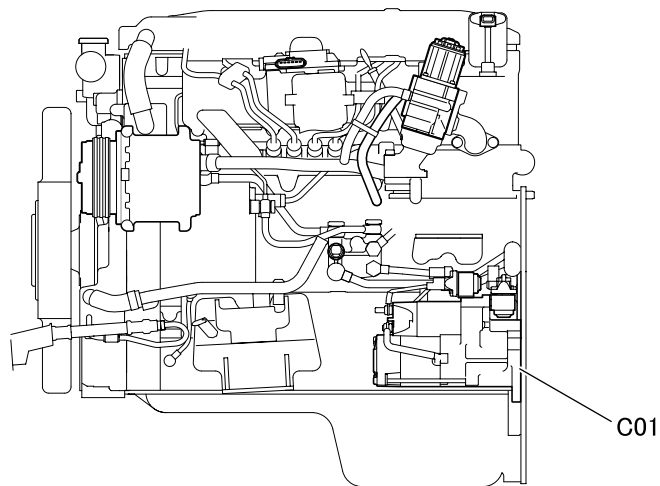
No relevant parts in a missing number

- B01 Hydraulic unit
- B01a Front wheel speed sensor,RH
- B02 Rear wheel speed sensor,RH
- B03 Rear wheel speed sensor,LH
- B04 Connection of chassis harness and rear chassis harness
- B04a Ground
- B05 JOINT4
- B05a Battery
- B06 High-current fuse box
- B07 Front wheel speed sensor,LH
- B07a Ground
- B08 Connection of chassis harness and cab harness
- B09 Ground
- B10 Ground

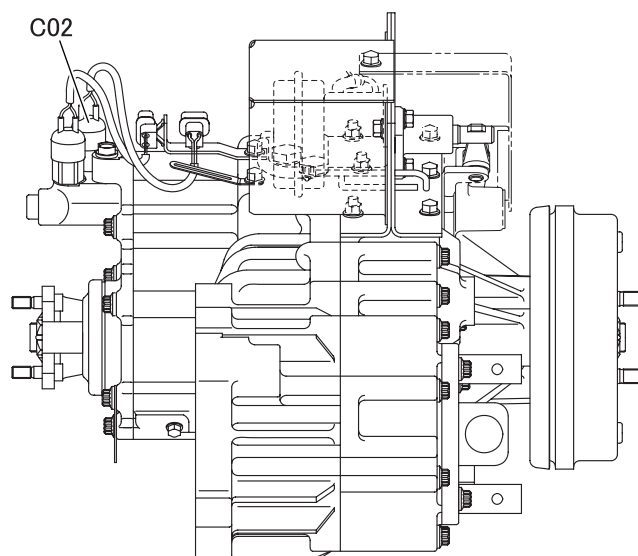
COMPONENTS LOCATION

C01 to 10

Engine Left side view



Transfer <FG>

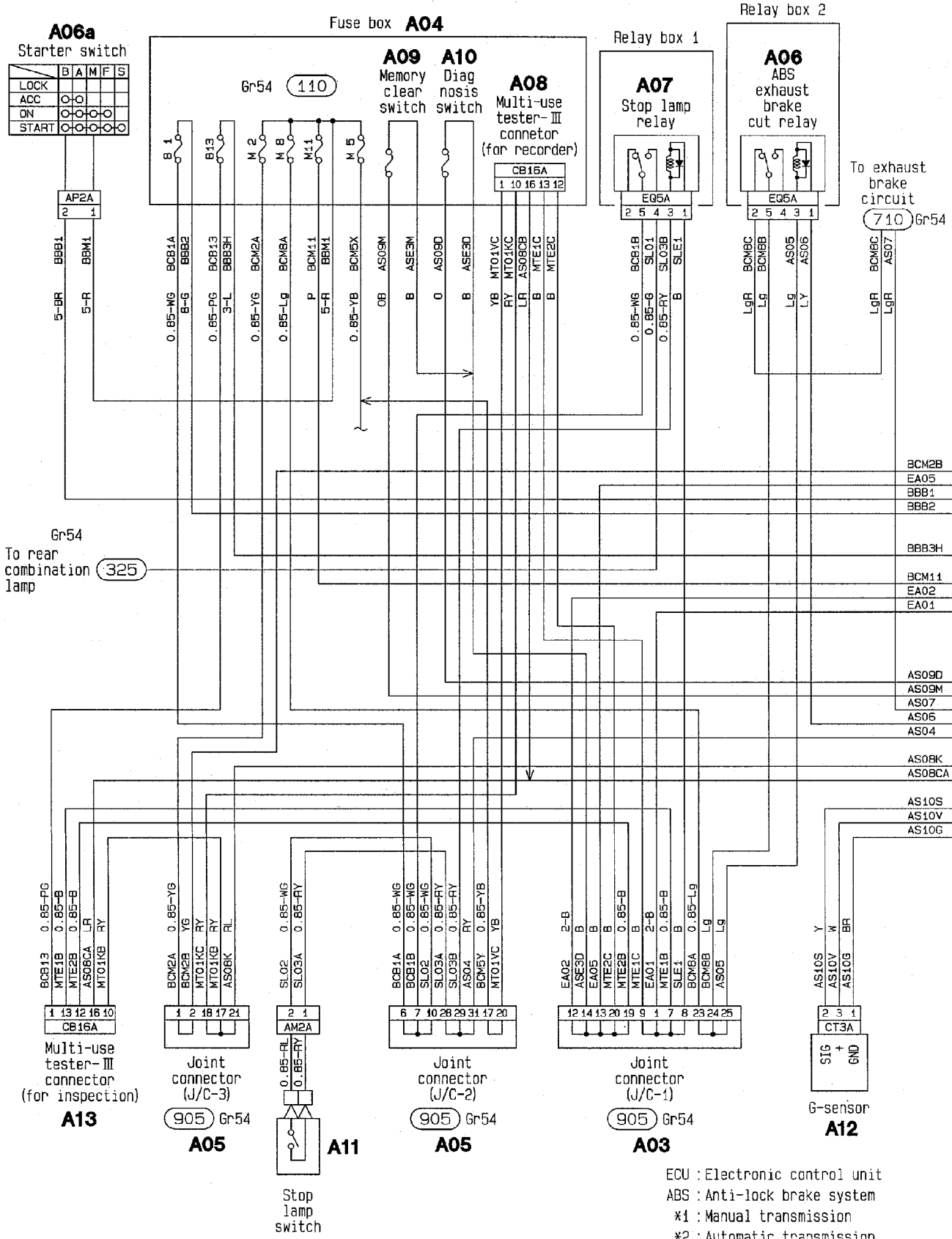


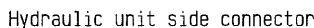
No relevant parts in a missing number

C01 Starter

C02 Transfer four-wheel drive switch <FG>

M E M O







Group 36

Parking Brake

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

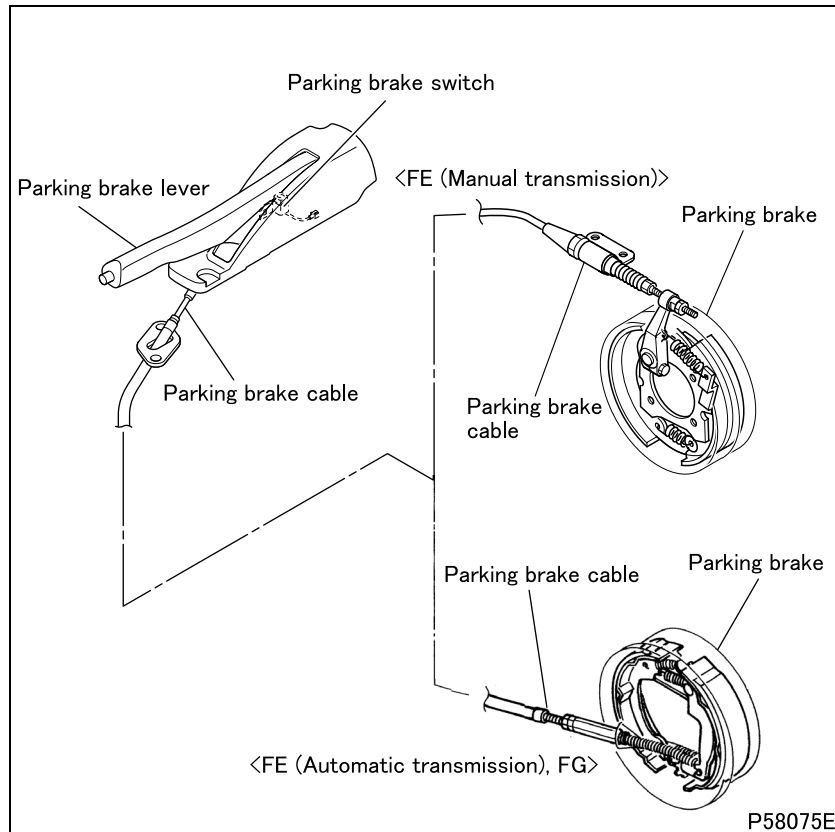
INDEX

SPECIFICATIONS	36-2
STRUCTURE AND OPERATION	
1. Components and Parts	36-3
2. Parking Brake Lever	36-3
3. Parking Brake	36-4
TROUBLESHOOTING	36-5
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Inspection and Adjustment of Parking Brake Shoe Clearance	36-6
2. Inspection and Adjustment of Parking Brake Lever	36-7
PARKING BRAKE CONTROL	36-10
PARKING BRAKE	
<FE (MANUAL TRANSMISSION)>	36-14
<FE (AUTOMATIC TRANSMISSION)>	36-16
<FG>	36-18

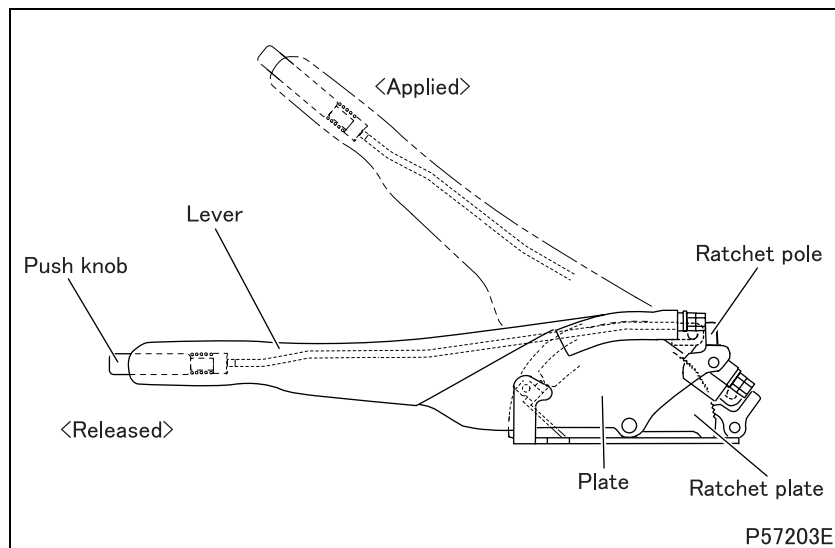
SPECIFICATIONS

Item		Specifications		
		FE		FG
Brake	Type	Internal expanding type acting on propeller shaft		
	Operation type	Mechanical cable type		
Parking brake	Type	Duo servo type		
	Brake drum I.D.	mm {in.}	$\phi 190 \{7.48\}$	$\phi 203.2 \{8.00\}$ $\phi 180 \{7.09\}$
	Lining width $\times$ thickness	mm {in.}	45×4.0 $\{1.77 \times 0.16\}$	50×4.0 $\{1.97 \times 0.16\}$ 35×5 $\{1.38 \times 0.20\}$

1. Components and Parts



2. Parking Brake Lever

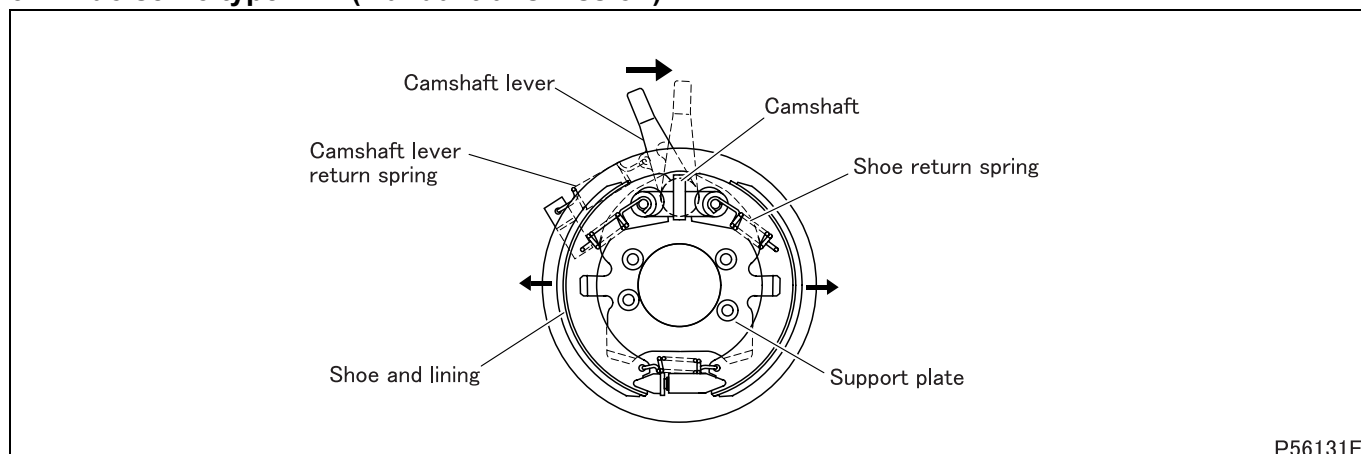


- Pulling the parking brake lever makes the parking brake work, at which point the ratchet pole engages with the ratchet plate and the lever is locked.
- To release the parking brake lever, slightly pull it up while pushing the release knob. This disengages the ratchet pole from the ratchet plate, allowing the parking brake lever to return to the released position.

STRUCTURE AND OPERATION

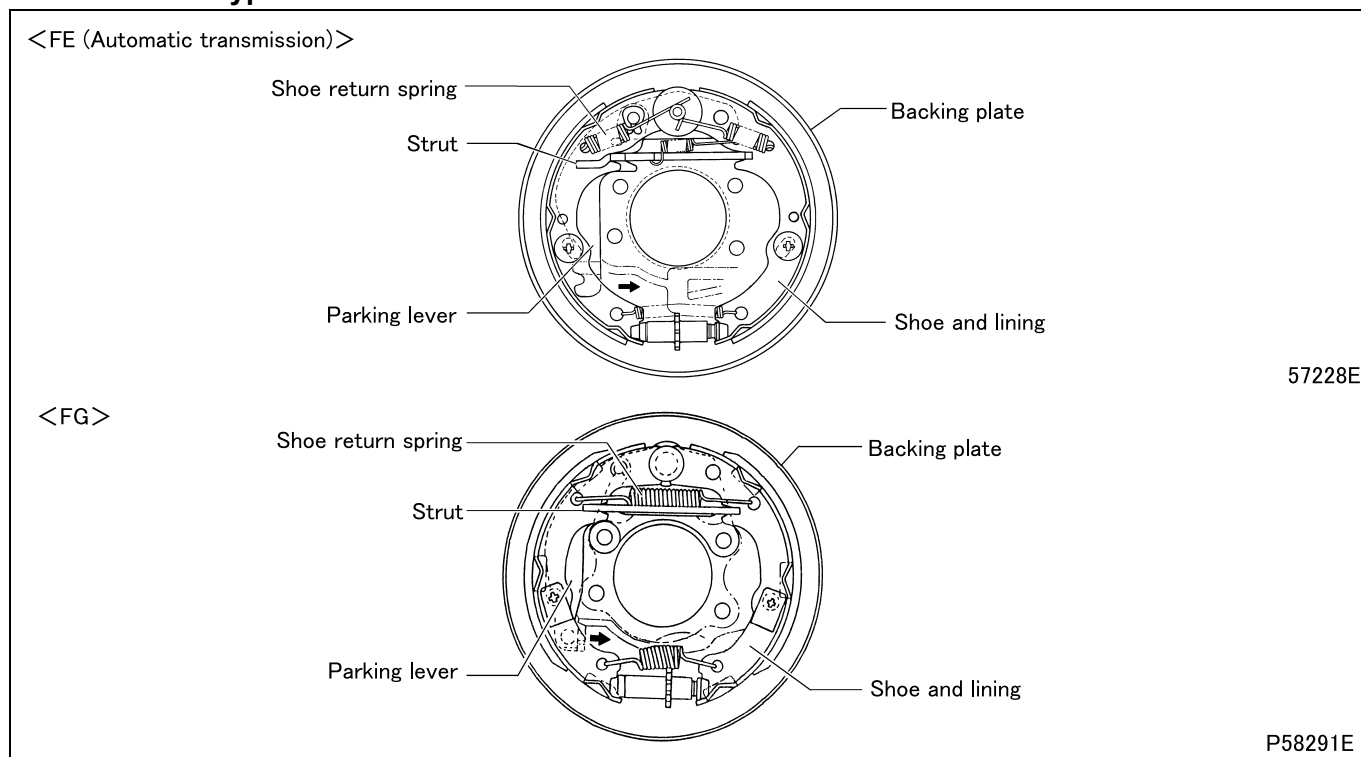
3. Parking Brake

3.1 Duo servo type <FE (Manual transmission)>



- The camshaft lever, which is used to actuate the shoes/linings, is built into the parking brake unit. Pulling the parking brake lever actuates the camshaft lever via the parking brake cable.
- Actuation of the camshaft lever causes the camshaft to rotate, which expands both shoes/linings onto the brake drum. In this case, both shoes/drums function as a leading shoe.
- As the parking brake lever (camshaft lever) is released, the forces of shoe and camshaft lever return springs restore the components to their home positions. This releases the parking brake.

3.2 Duo servo type



- The parking lever that actuates the shoe and lining is a built-in component of the parking brake body. Pulling the parking brake lever pulls the parking brake cable, which in turn pulls the parking lever.
- When the parking lever is pulled, one shoe and lining is forced to expand with the medium of strut. At the same time, the parking lever directly expands the other shoe and lining. Thus, each shoe and lining assembly works as a leading shoe.
- When the parking brake lever (parking lever) is returned to the released position, the repercussive force of the shoe return spring releases the brake.

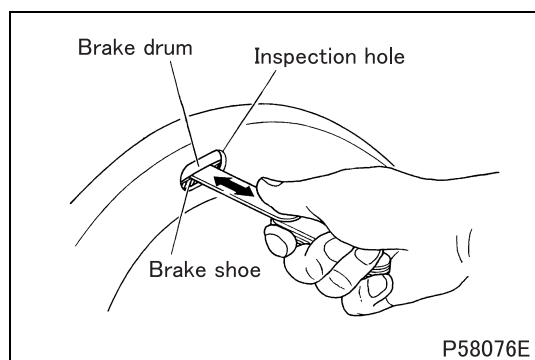
Symptoms						Reference Gr
		Parking brake does not work	Parking brake release not smooth (dragging)	Parking brake lever operating physical force insufficient	Parking brake lever operating physical force excessive	
Possible causes						
Parking brake cable	Inner cable stretched or damaged	O	O	O	O	
	Inner cable improperly adjusted	O	O	O	O	
	Front parking cable and rear parking cable improperly connected	O	O	O	O	
	Front parking cable and rear parking cable joints in poor contact	O	O	O	O	
Parking brake lever	Ratchet pole and ratchet plate pawl engaged improperly	O				
	Pulling stroke insufficient		O		O	
	Pulling stroke excessive	O		O		
Parking brake	Shoe clearance insufficient		O		O	
	Shoe clearance excessive	O		O		
	Parking brake drum inner surface deformed or warped	O		O		
	Lining worn unevenly	O		O		
	Brake drum inner surface greasy or oily	O				
	Lining surface greasy or oily	O				
	Camshaft lever return spring fatigued or fractured <FE (Manual transmission)>		O			
	Shoe return spring fatigued or fractured		O			

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Adjustment of Parking Brake Shoe Clearance

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
-	Brake shoe clearance	FE (Manual transmission)	0.1 to 0.25 {0.0039 to 0.0098}	Adjust or inspect
		FE (Automatic transmission)	0.2 to 0.25 {0.0079 to 0.0098}	
		FG	0.25 to 0.3 {0.0098 to 0.012}	

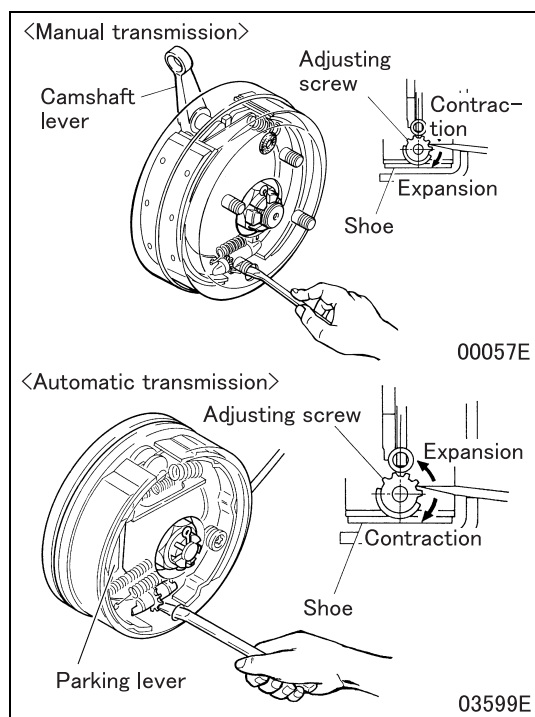


[Inspection]

- Move the parking brake lever 2 or 3 times to make the brake shoe smooth.
- Insert a thickness gauge from the wear inspection hole and measure the clearance between brake drum and brake shoe. The clearance is optimal if the thickness gauge can be taken out and pulled in with a feel of slight resistance.
- If the measurement deviates from the standard value, adjust the shoe clearance.

[Adjustment]

- Chock the front wheels and raise the rear wheels with a jack before adjusting the shoe clearance.
- Operate the parking brake lever to release the parking brake. (The parking lever or camshaft lever is released from locking.)
- Using a standard screwdriver inserted through the shoe adjusting hole in the parking brake drum, turn the adjusting screw in the C direction (expansion) shown to bring the shoe into close contact with the brake drum.
- Turn the adjusting screw 8 notches in the B direction (contraction) shown from the position where the shoe is in close contact with the drum. The shoe clearance should be adjusted to the standard value.



2. Inspection and Adjustment of Parking Brake Lever

Service standards

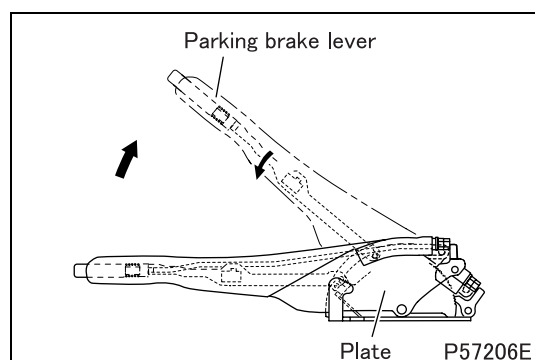
Location	Maintenance item	Standard value	Limit	Remedy
–	Parking brake lever pulling stroke (with operating physical operating of 300N {67 lbs, 31 kgf})	7 to 9 notches	–	Adjust or inspect

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Lock nut <FE (Automatic transmission), FG>	18.7 to 27.5 {14 to 20, 1.9 to 2.8}	–

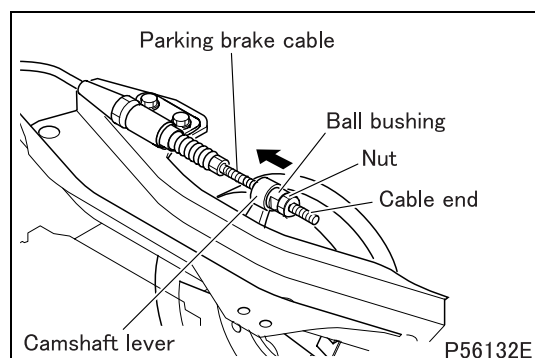
Lubricant and/or sealant

Mark	Point of application	Specified lubricant and/or sealant	Quantity
–	Camshaft lever (on sliding face with parking brake cable and on contact face with ball bushing) <FE (Manual transmission)>	Chassis grease [NLGI No. 1 (Ca soap)]	As required



[Inspection]

- Pull the parking brake lever from the released position with an operating physical force of 300N {67 lbs, 31 kgf} and count the number of cleared notches.
- If the count of notches deviates from the specified range of standard values, adjust the length of the parking brake cable.
- If the count of notches (pulling stroke) is still out of the specified range after cable length adjustment, check the parking brake shoe clearance.



[Adjustment]

<FE (Manual transmission)>

- Pull on the parking brake cable end with a force of 100 N {22 lbs, 10 kgf} to remove any slack from the cable.
- Apply grease onto the camshaft lever, on the sliding face with the parking brake cable and on the contact face with the ball bushing.
- While pulling the cable end of the camshaft lever in the direction of the arrow with a force of 45 to 50 N {10 to 11 lbs, 4.6 to 5.1 kgf}, rotate the ball bushing until it contacts the cable end of the camshaft lever.

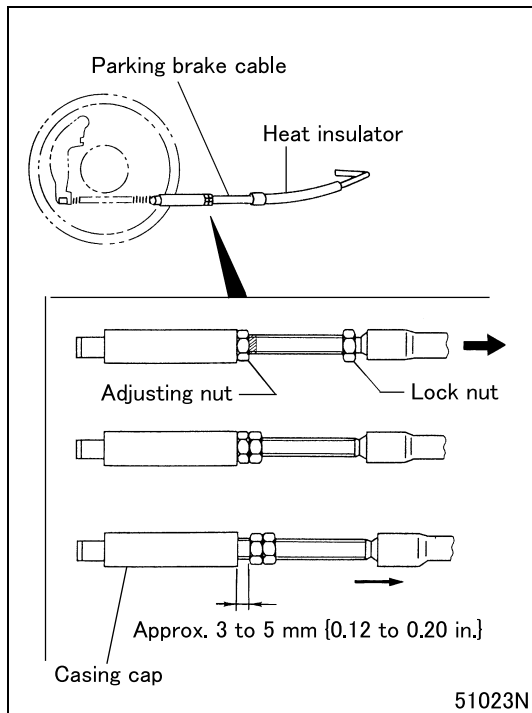
CAUTION ⚠

- Do not rotate the ball bushing so much as to cause the camshaft lever to move.

- Pull the parking brake lever 3 times with a force of 500 N {110 lbs, 51 kgf}.
- This operation causes the cable to extend. Rotate the ball bushing again until it contacts the camshaft lever. Then, pull the parking brake lever with a force of 45 to 50 N {10 to 11 lbs, 4.6 to 5.1 kgf}. The camshaft lever should not move more than 1mm {0.039 in.}.

ON-VEHICLE INSPECTION AND ADJUSTMENT

- Pull the parking brake lever from the released position with a force of 300 N {67 lbs, 31 kgf}. The lever should travel past the specified number of notches. Tighten the nut.



<FE (Automatic transmission), FG>

- Pull the outer cable of the parking brake cable with a force of 60 to 100 N {13 to 22 lbs, 6.1 to 10 kgf} to zero the parking brake shoe clearance.

CAUTION ⚠

- **When pulling the outer cable, take care not to move heat insulator on the parking brake cable out of place.**

- While pulling the parking brake cable, tighten the adjust nut until it seats the cable support end.
- Lock the adjust nut with the lock nut.
- Operate the parking brake lever several times with the force of 500 N {110 lbs, 51 kgf}.
- Pull the outer cable of the rear parking brake cable again with the force of 60 to 100 N {13 to 22 lbs, 6.1 to 10 kgf}.

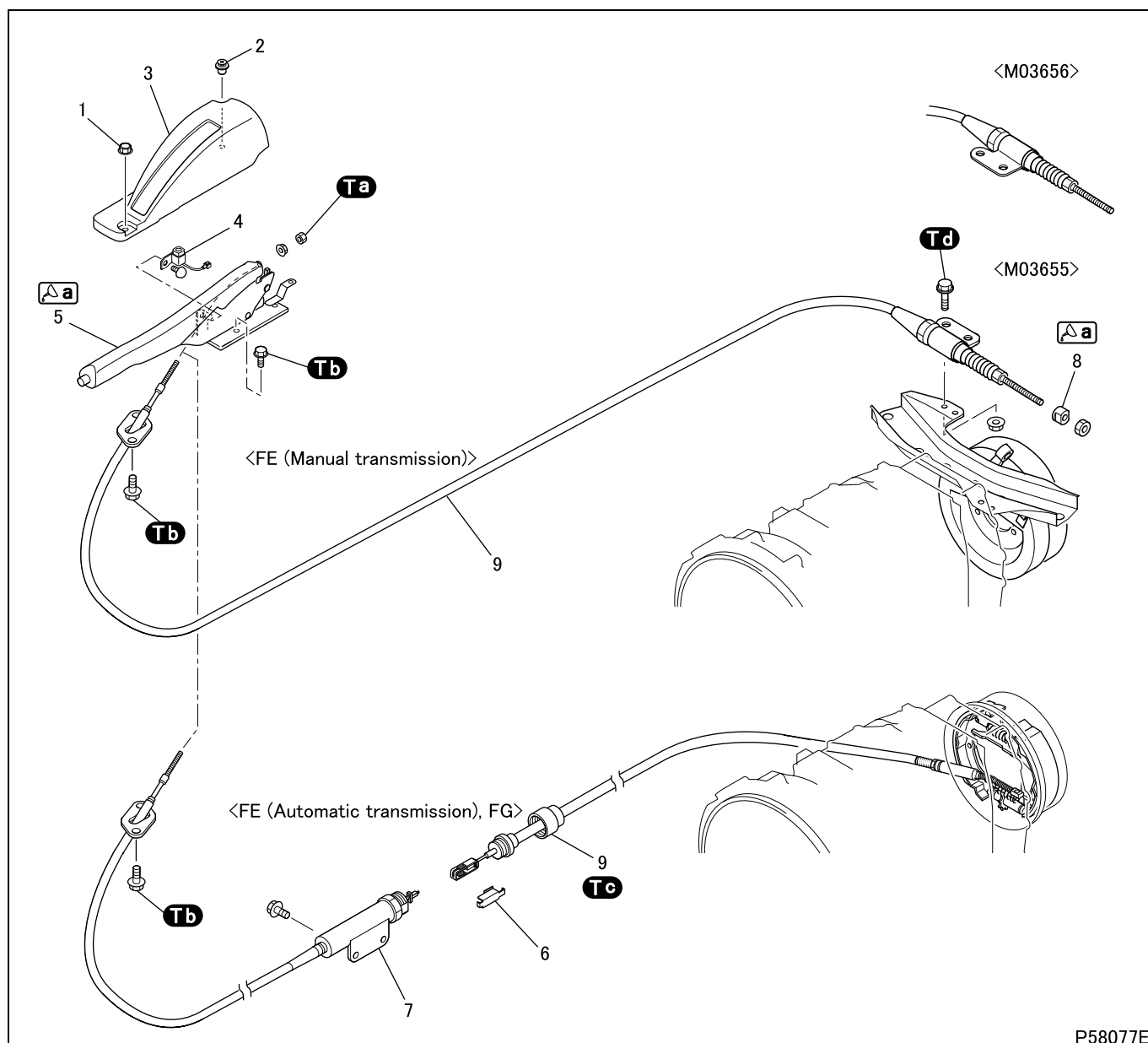
CAUTION ⚠

- **When pulling the outer cable, take care not to move heat insulator on the parking brake cable out of place.**

- Holding the parking brake cable in the pulled state, turn the adjusting nut until its distance from the casing cap becomes 3 to 5 mm {0.12 to 0.20 in.} as shown in the illustration.
- Return the parking brake cable to the original position.
- Tighten the lock nut to the specified torque.

M E M O

PARKING BRAKE CONTROL



P58077E

● Removal sequence

- 1 Push nut
- 2 Push turn rivet
- 3 Cover
- 4 Parking brake switch
- 5 Parking brake lever
- 6 Cap <FE (Automatic transmission), FG>

- 7 Front parking brake cable
<FE (Automatic transmission), FG>
- 8 Ball bushing <FE (Manual transmission)>
- 9 Parking brake cable <FE (Manual transmission)>
Rear parking brake cable
<FE (Automatic transmission), FG>

● Installation sequence

Follow the removal sequence in reverse.

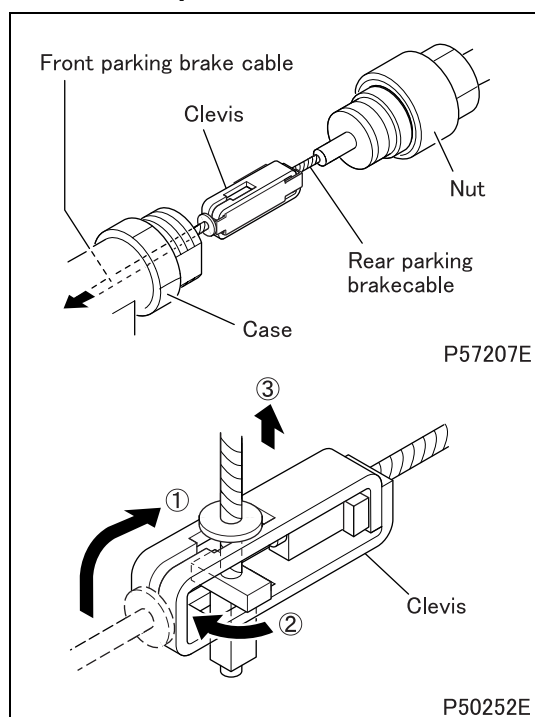
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Parking brake cable attaching)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
Tb	Bolt (Parking brake lever mounting)	12 to 15 {8.9 to 11, 1.2 to 1.5}	—
	Bolt (Parking brake cable attaching)		
Tc	Rear parking brake cable to front parking brake cable connection <FE (Automatic transmission), FG>	55 to 70 {41 to 52, 5.6 to 7.1}	—
Td	Bolt (Parking brake cable attaching) <FE (Manual transmission)>	19 to 28 {14 to 21, 1.9 to 2.9}	

Lubricant and/or sealant

Mark	Point of application	Specified lubricant and/or sealant	Quantity
 a	Contact surfaces of parking brake lever	Chassis grease [NLGI No. 1 (Li soap)]	As required
	Spherical face of ball bushing <FE (Manual transmission)>		

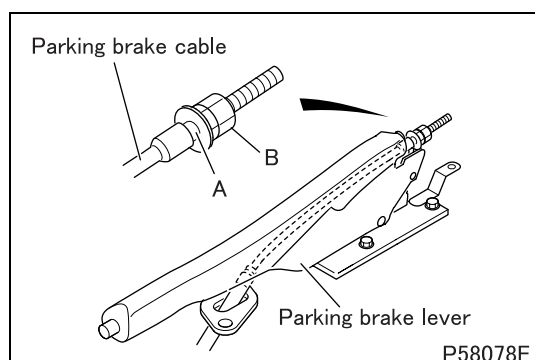
◆ Removal procedure ◆



■ Removal: Front parking brake cable <FE (Automatic transmission), FG>

- Loosen the nut connecting the front and rear parking brake cables, then separate the front parking brake cable case from the rear parking brake cable.
- Pull out the clevis from the front parking brake cable case and remove it at the steps of 1, 2 and 3 in that order as shown.

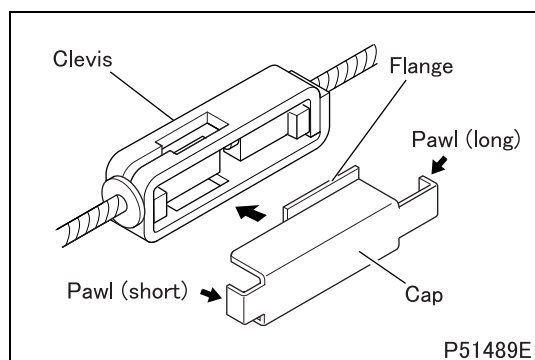
◆ Installation procedure ◆



■ Installation: Front parking brake cable or parking brake cable

- Connect the front parking brake cable to the rear parking brake cable by following the removal procedure in reverse. <FE (Automatic transmission), FG>
- Attach the parking brake cable to the parking brake lever by fully tightening nut **A**, then tightening nut **B** to the specified torque.

PARKING BRAKE CONTROL

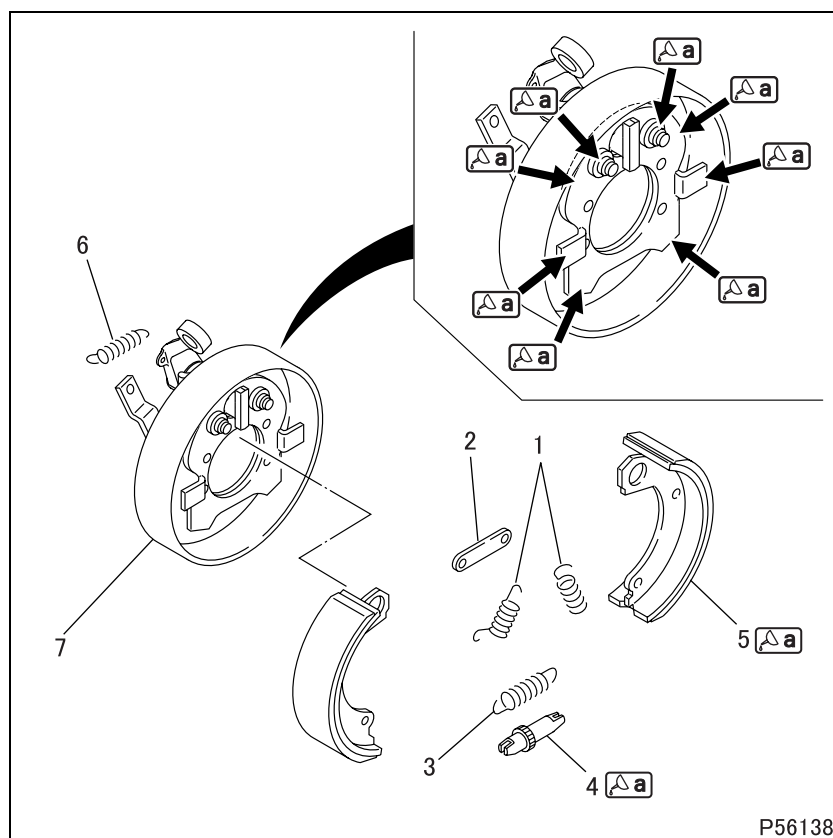


■ Installation: Cap <FE (Automatic transmission), FG>

- Attach the cap to the clevis of the rear parking brake cable from the direction shown in the illustration.
- Fit the cap into the clevis all the way so that the flange of the cap comes out at the other side of the clevis.

M E M O

PARKING BRAKE <FE (MANUAL TRANSMISSION)>



● Disassembly sequence

- 1 Shoe return spring
- 2 Anchor pin brace
- 3 Adjust wheel return spring
- 4 Adjust screw
- 5 Shoe & lining
- 6 Camshaft lever return spring
- 7 Support plate & dust cover

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

- To prevent poor working of the brake, do not smear the surface of shoe and lining with grease or oil.

NOTE

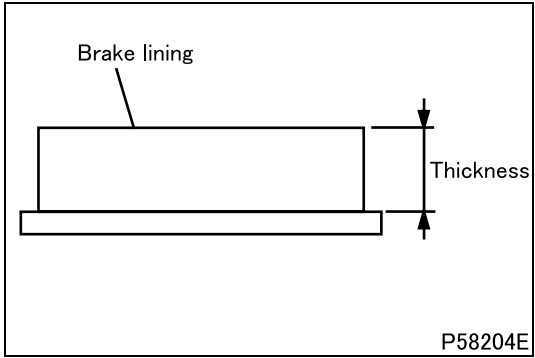
- Refer to Gr22 for parking brake removal and installation procedures.
- When the shoe and lining has been replaced with a new one, always check it for contact with the parking brake drum.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1	Shoe return spring installed load (installed length: 57.5 {2.26})	145 ± 15 N {33 ± 3.3 lbs, 15 ± 1.5 kgf}	115 N {26 lbs, 12 kgf}	Replace
3	Adjust wheel return spring installed load (installed length: 59 {2.32})	78 ± 7.8 N {18 ± 1.8 lbs, 8 ± 0.8 kgf}	63 N {14 lbs, 6.4 kgf}	Replace
5	Brake lining thickness	4.0 {0.16}	1.4 {0.055}	Replace
6	Cam shaft lever return spring installed load (installed length: 85 {3.35})	62 ± 5.9 N {14 ± 1.3 lbs, 6.3 ± 0.6 kgf}	49 N {11 lbs, 5.0 kgf}	Replace

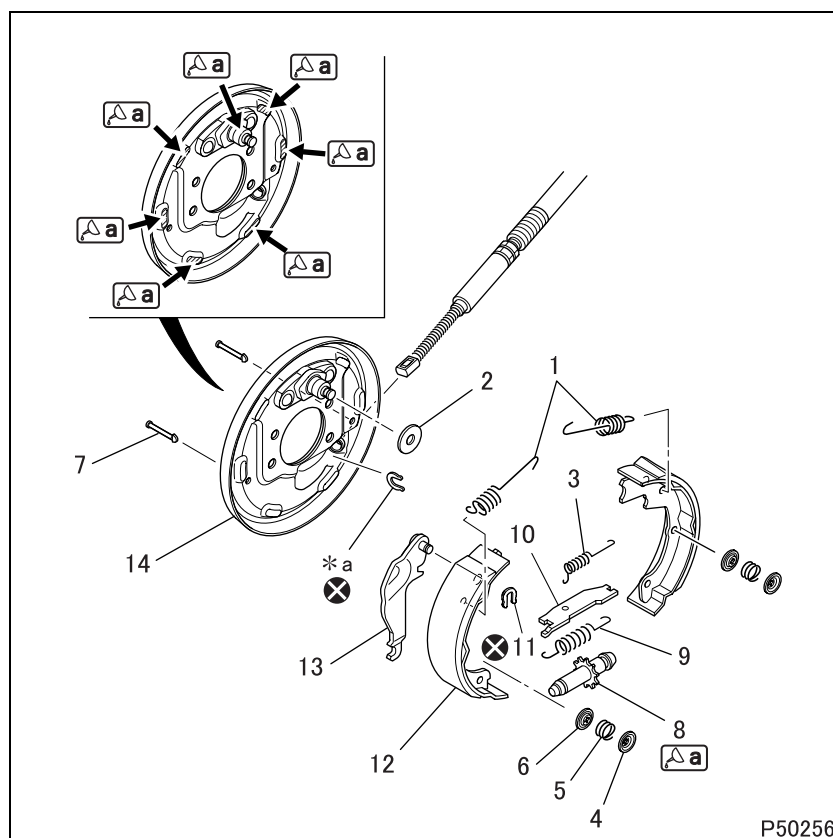
Lubricant and/or sealant

Mark	Point of application	Specified lubricant and/or sealant	Quantity
	Adjust screw ends' contact faces with shoe & lining	Brake grease (AKB100)	As required
	Contact faces between support plate, camshaft and shoe & lining		
	Contact faces between support plate, anchor pin and shoe & lining		

◆ Inspection procedure ◆**■ Inspection: Brake lining thickness of shoe and lining**

- If the measured value is lower than the limit, replace the shoe and lining.

PARKING BRAKE <FE (AUTOMATIC TRANSMISSION)>



● Disassembly sequence

- 1 Shoe return spring
- 2 Washer
- 3 Strut spring
- 4 Shoe holddown cup
- 5 Shoe holddown spring
- 6 Shoe holddown cup
- 7 Shoe holddown pin
- 8 Adjuster
- 9 Adjuster spring
- 10 Strut
- 11 Retainer
- 12 Shoe and lining
- 13 Parking lever
- 14 Backing plate

*a: Retainer

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

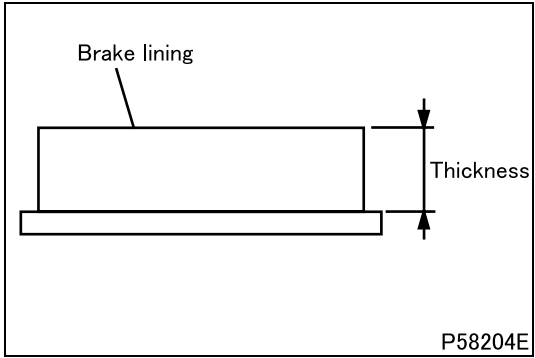
- Refer to Gr23 for parking brake removal and installation procedures.
- To prevent poor working of the brake, do not smear the surface of shoe and lining with grease or oil.
- When the shoe and lining has been replaced with a new one, always check it for contact with the parking brake drum.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1	Installed load of shoe return spring (installed length: 67.1 {2.64})	58.8 ± 5.9 N {13 ± 1.3 lbs, 6.0 ± 0.6 kgf}	49 N {11 lbs, 5.0 kgf}	Replace
3	Installed load of strut spring (installed length: 49 {1.93})	29.4 ± 2.9 N {6.6 ± 0.7 lbs, 3.0 ± 0.3 kgf}	26 N {5.8 lbs, 2.7 kgf}	Replace
5	Installed load of shoe holddown spring (installed length: 15.5 {0.61})	78.5 ± 7.9 N {18 ± 1.8 lbs, 8.0 ± 0.8 kgf}	71 N {16 lbs, 7.2 kgf}	Replace
9	Installed load of adjuster spring (installed length: 78.2 {3.08})	58.8 ± 5.9 N {13 ± 1.3 lbs, 6.0 ± 0.6 kgf}	49 N {11 lbs, 5.0 kgf}	Replace
12	Brake lining thickness of shoe and lining	4.0 {0.16}	1.4 {0.053}	Replace

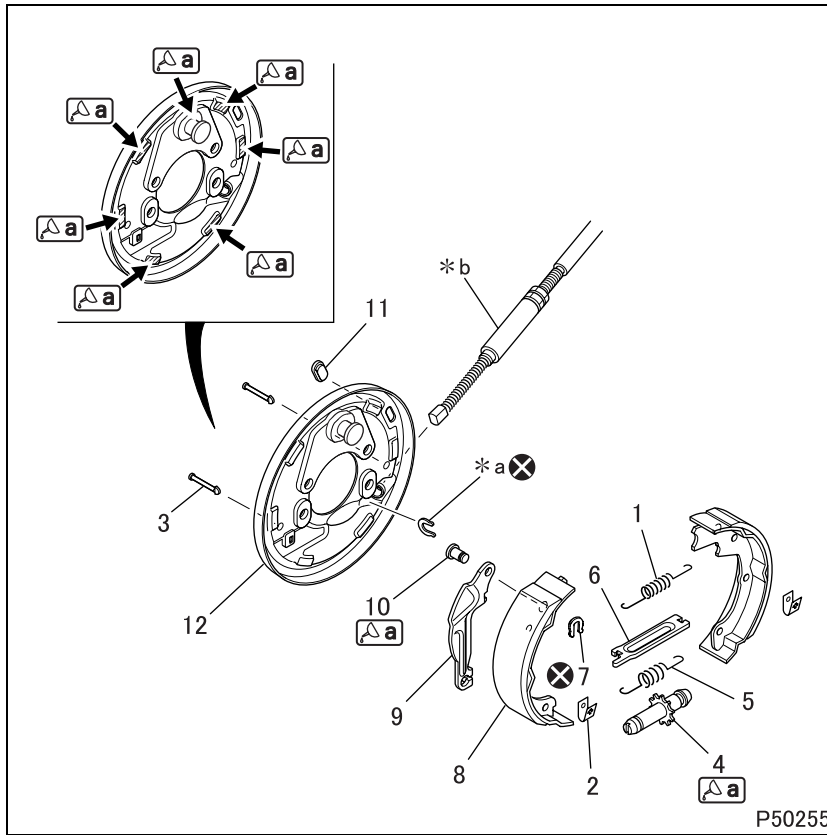
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Adjuster ends in contact with shoe and lining	Brake grease (AKB100)	As required
	Backing plate anchor pin and surface in contact with shoe and lining		

◆ Inspection procedure ◆**■ Inspection: Brake lining thickness of shoe and lining**

- If the measured value is lower than the limit, replace the shoe and lining.

PARKING BRAKE <FG>



● Disassembly sequence

- 1 Shoe return spring
- 2 Shoe holddown spring
- 3 Shoe holddown pin
- 4 Adjuster
- 5 Adjuster spring
- 6 Strut
- 7 Retainer
- 8 Shoe & lining
- 9 Parking lever
- 10 Brake lever pin
- 11 Plug
- 12 Backing plate

*a: Retainer

*b: Rear parking brake cable

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

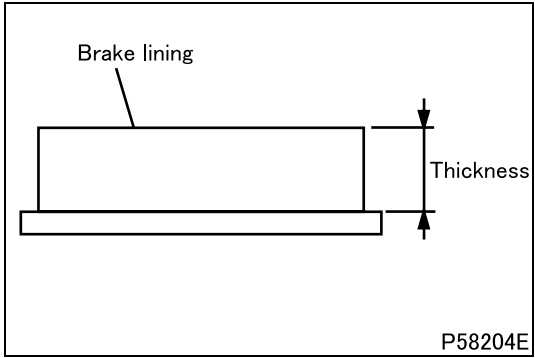
- Refer to Gr24 for parking brake removal and installation procedures.
- To ensure efficient braking performance, keep the shoe & lining faces free from lubricant.
- When a new shoe & lining is installed, check and adjust the clearance between the brake shoe and the brake drum.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
1	Shoe return spring installed load (installed length: 109.4 {4.31})	145 ± 15 N {32 ± 3.3 lbs, 14.6 ± 1.5 kgf}	115 N {26 lbs, 11.7 kgf}	Replace
5	Adjuster spring installed load (installed length: 72 {2.83})	50 ± 7.8 N {11 ± 1.8 lbs, 5.1 ± 0.8 kgf}	40 N {9.0 lbs, 4.1 kgf}	Replace
8	Brake lining thickness	5.3 {0.21}	3.0 {0.12}	Replace

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
⊗ a	Adjuster ends' contact faces with shoe & lining	Brake grease (AKB100)	As required
	Brake lever pin contact face		
	Backing plate contact faces with anchor pins and shoe & lining		

◆ Inspection procedure ◆**■ Inspection: Brake lining thickness of shoe and lining**

- If the measured value is lower than the limit, replace the shoe and lining.



Group 37

Steering

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	37-2
STRUCTURE AND OPERATION	
1. Steering System	37-4
2. Oil Flow	37-4
3. Power Steering Gear (Backlash Compensation Mechanism)	37-5
4. Power Steering Oil Pump <Kayaba Industry Product>	37-6
5. Power Steering Oil Pump <Unisia JKC Product>	37-8
TROUBLESHOOTING	37-10
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Change of Power Steering Fluid	37-12
2. Bleeding of Power Steering System	37-13
3. Performance Verification Test of Power Steering System	37-14
4. Steering Wheel Play	37-15
5. Steering Column Looseness	37-15
6. Drag Link Ball Joint Backlash	37-15
STEERING COLUMN	37-16
POWER STEERING GEAR AND DRAG LINK	37-26
POWER STEERING OIL PUMP <KAYABA INDUSTRY Product> ...	37-48
POWER STEERING OIL PUMP <UNISIA JKC Product>	37-52
POWER STEERING OIL TANK	37-56

SPECIFICATIONS

Steering wheel, steering shaft and power steering gear

Item		Specifications	
		FG	FE
Steering wheel	Type	2-spoke type	
	Outer diameter mm {in.}	400 {15.7}	
Steering shaft	Type	Universal joint type (Tilt and telescopic type)	
Power steering gear assembly	Manufacturer	Koyo Seiko	Unisia JKC Steering Systems
	Type	Ball nut type	
	Form	Integral form	
	Item number	2710-8AL0	448-00203
	Gear ratio	22.6	22.7
	Cylinder diameter mm {in.}	78 {3.07}	85 {3.35}

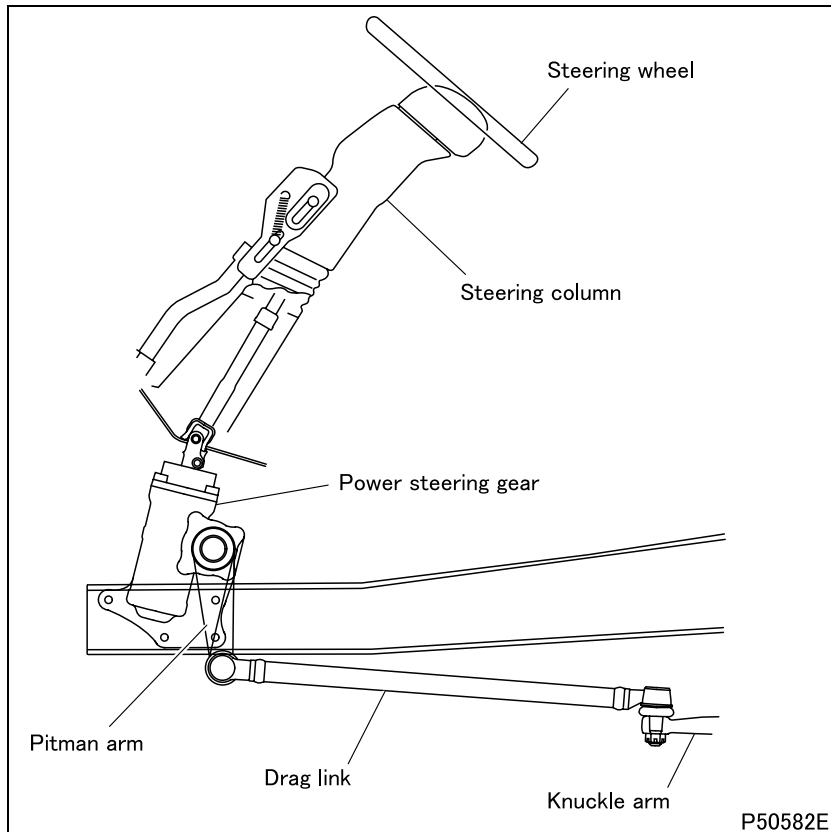
Power steering oil pump

Item		Specifications	
		FE <Except FE85>, FG	FE85
Manufacturer		Unisia JKC steering systems	Kayaba industry
Type		Vane type	
Manufacturer's item number		478-04302	B4220-13002
Delivery rate cm ³ {cu.in., mL}/rev.		9.6 {0.59, 9.6}	12.6 {0.77, 12.6}
Adjusted flow volume dm ³ {qts., L}/min.		6 to 8 {6.3 to 8.5, 6 to 8}	11 to 13 {12 to 14, 11 to 13}
Adjusted pressure (Relief valve) MPa {psi, kgf/cm ² }		10.8 ^{+0.20} _{-0.49} {1560 ⁺²⁹ ₋₇₁ , 110 ⁺² ₋₅ }	12.3 ⁰ _{-0.49} {1780 ⁰ ₋₇₁ , 125 ⁰ _{5.0} }
Permissible revolutions rpm		600 to 6500	

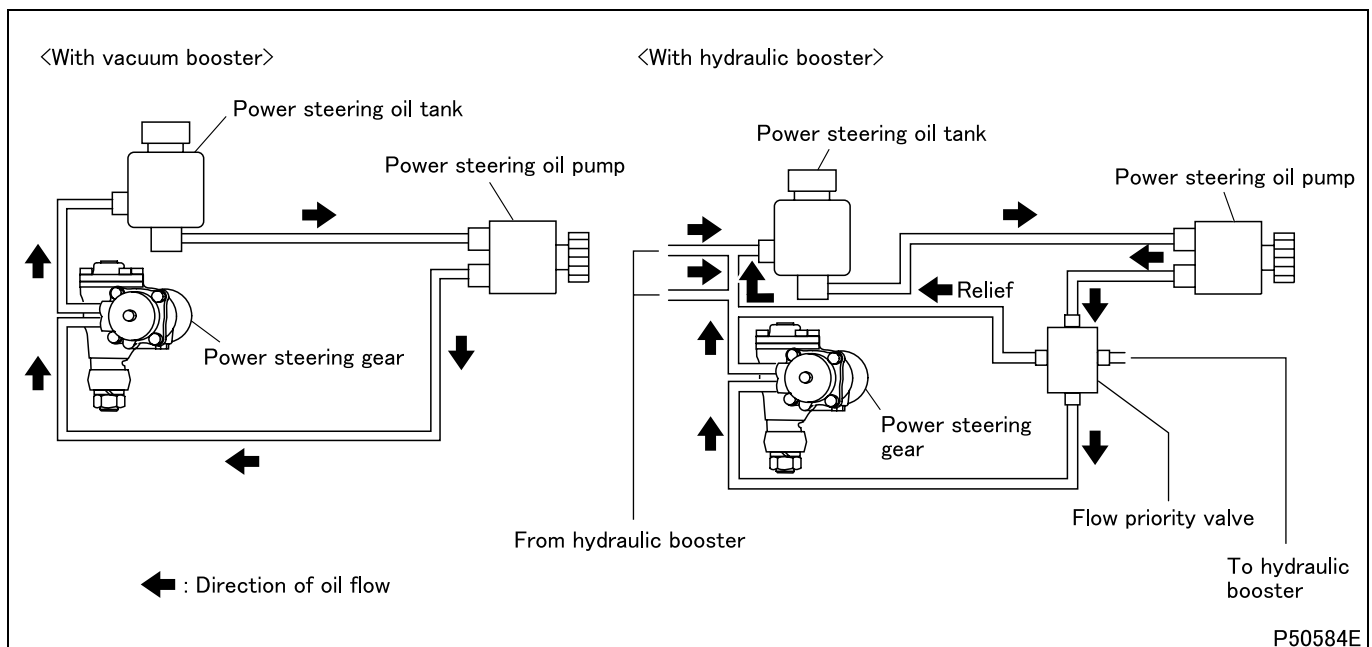
M E M O

STRUCTURE AND OPERATION

1. Steering System

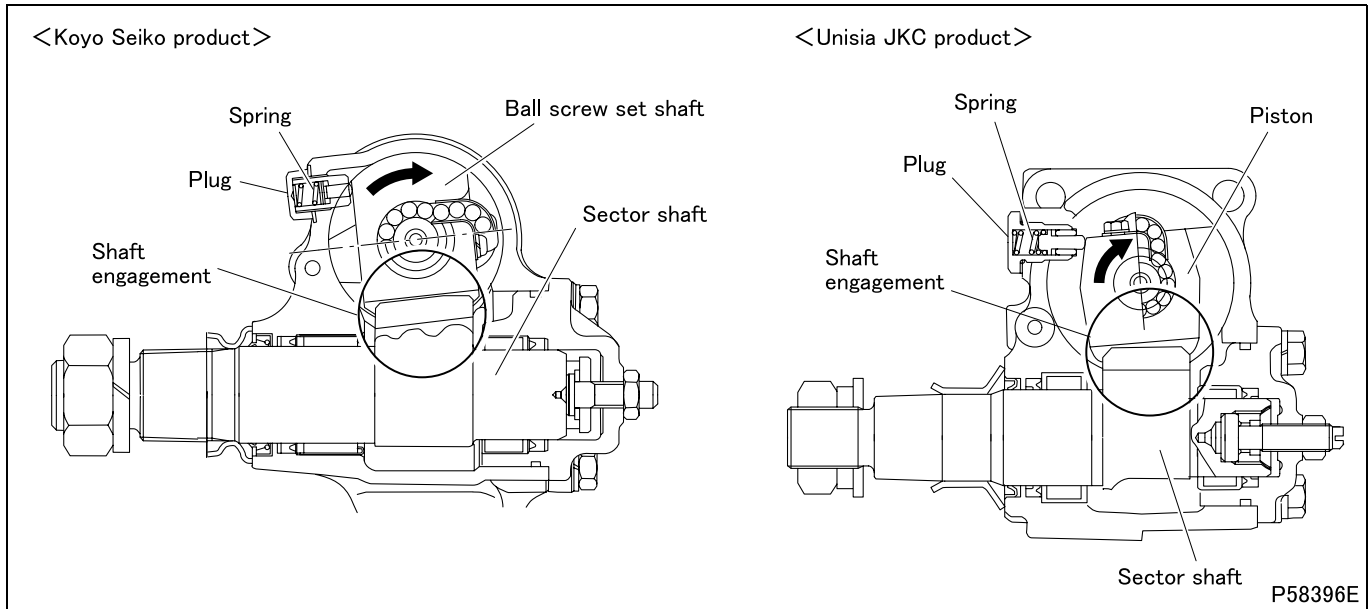


2. Oil Flow



- The power steering system with vacuum booster is provided with a flow priority valve to reduce steering shock that occurs when the brakes are suddenly applied during steering wheel manipulation.

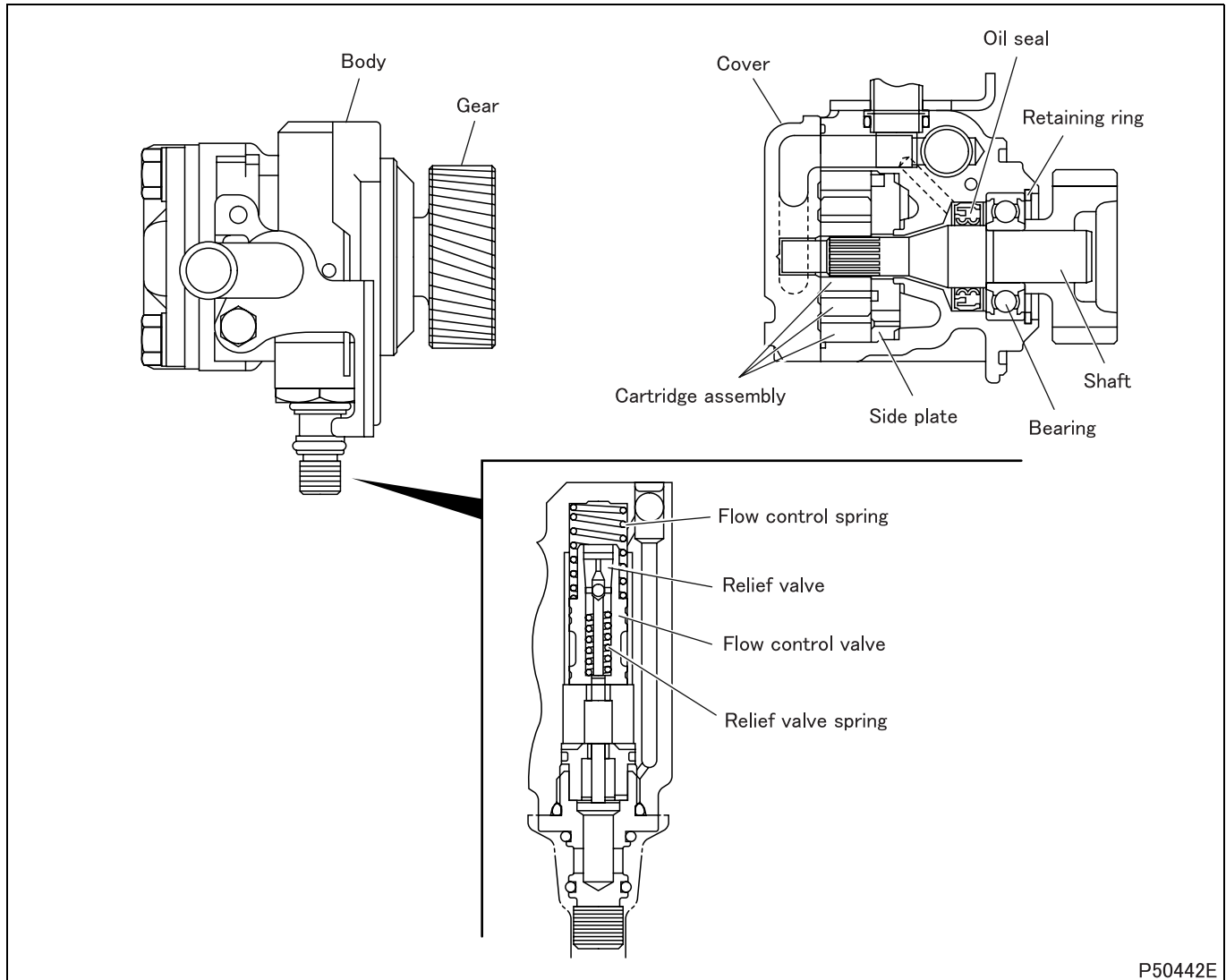
3. Power Steering Gear (Backlash Compensation Mechanism)



- The plug constantly presses the ball screw set shaft (piston in the case of Unisia JKC product) in the illustrated turning direction with the force of internal spring.
- This eliminates play between the ball screw set shaft and sector shaft where they are engaged to suppress backlash during straight travel, thus improving steerability.

STRUCTURE AND OPERATION

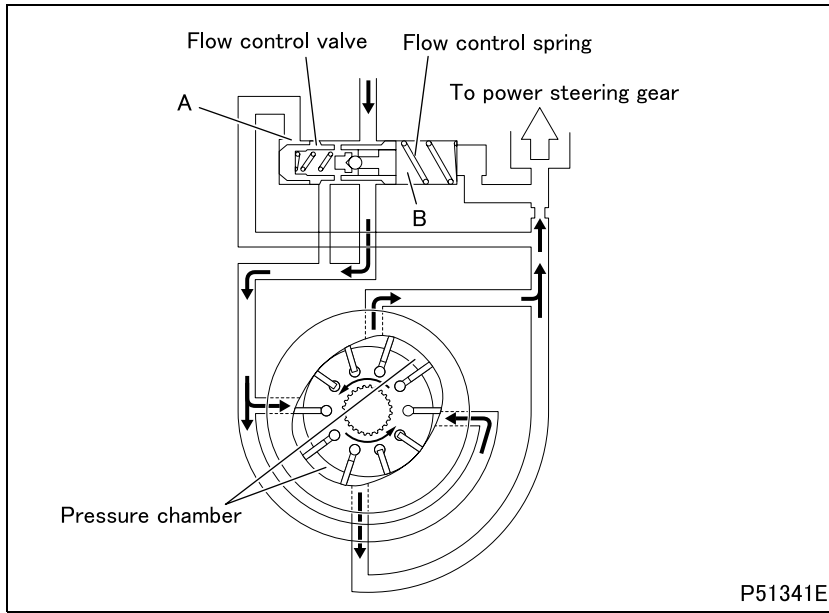
4. Power Steering Oil Pump <Kayaba Industry Product>



P50442E

- The power steering oil pump is a hydraulic source pump with the vane in the rotor groove and is geared to the engine.
 - The power steering oil pump consists of a cartridge assembly that discharges oil, a flow control valve that controls the oil flow rate and a relief valve that prevents free oil pressure rise.
 - The flow control valve maintains constant the quantity of oil to the power steering gear during steering wheel manipulation.
- The relief valve is provided in the flow control valve to prevent oil pump pressure from rising beyond necessary level during stationary swing operation.

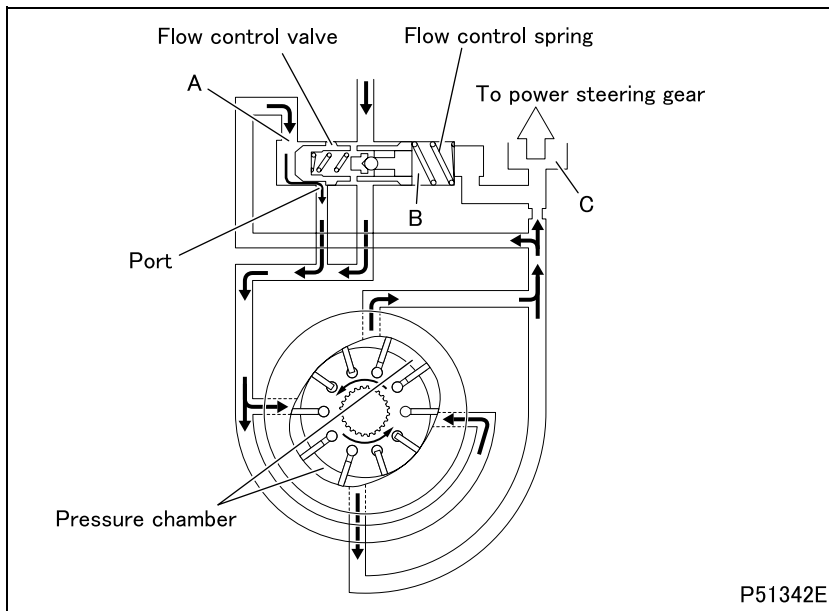
4.1 Flow control valve



(1) Operation of flow control valve

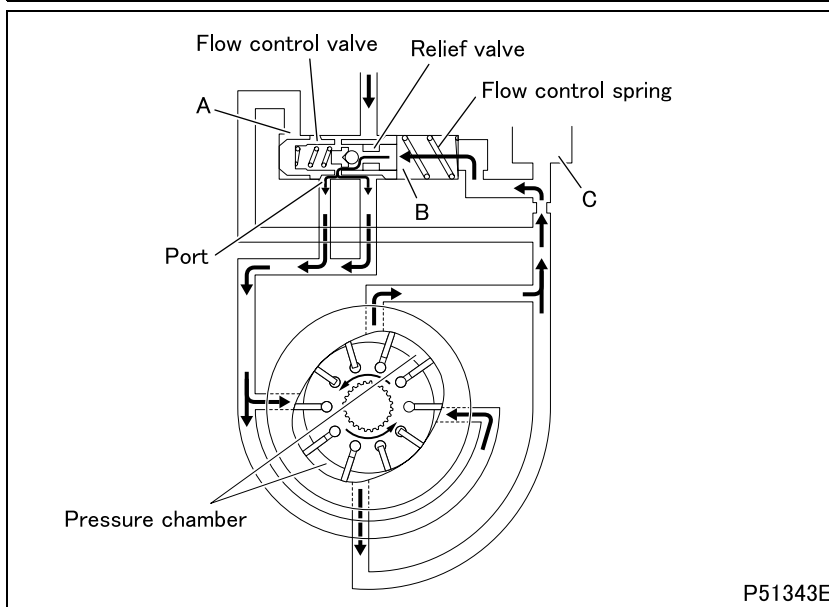
(1.1) When not functioning (oil pump in operation at low speed)

- Oil pressure in the chamber **A** is weaker than the combined force of oil pressure in the chamber **B** and tension of the flow control spring, and the flow control valve remains stationary.



(1.2) When functioning (oil pump in operation at middle to high speeds)

- Oil pressure in the chamber **A** overcomes the combined force of oil pressure in the chamber **B** and tension of the flow control spring, and the flow control valve is shifted.
- Port is made open to release oil pressure, and the flow rate from the chamber **C** is maintained constant.

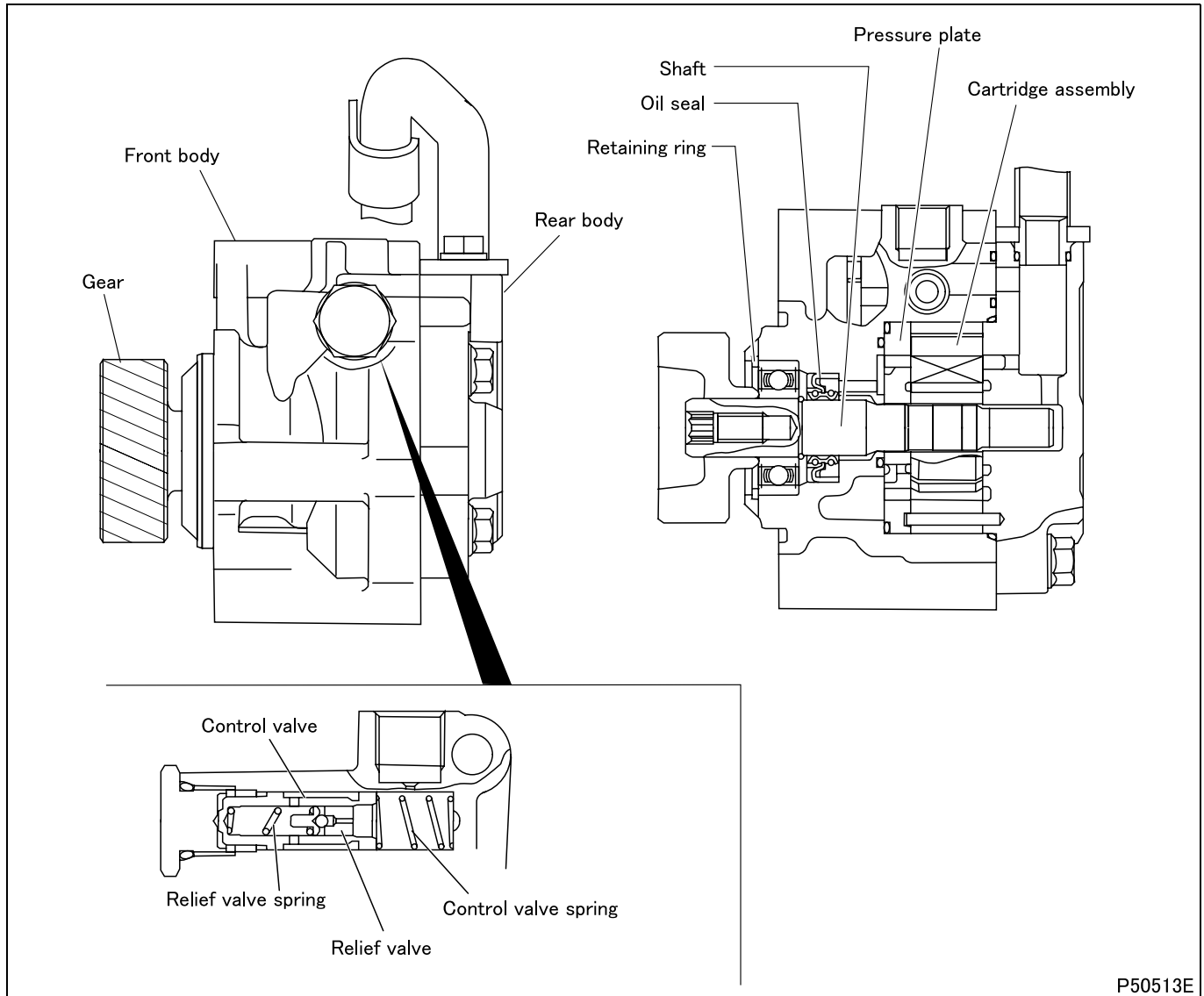


(2) Operation of relief valve

- When the combined force of oil pressure in the chamber **B** and tension of the flow control spring overcomes oil pressure in the chamber **A**, the flow control valve is shifted. Further increased oil pressure in the chamber **B** pushes the relief valve to open port, thus preventing excessive oil pressure from going to the chamber **C**.

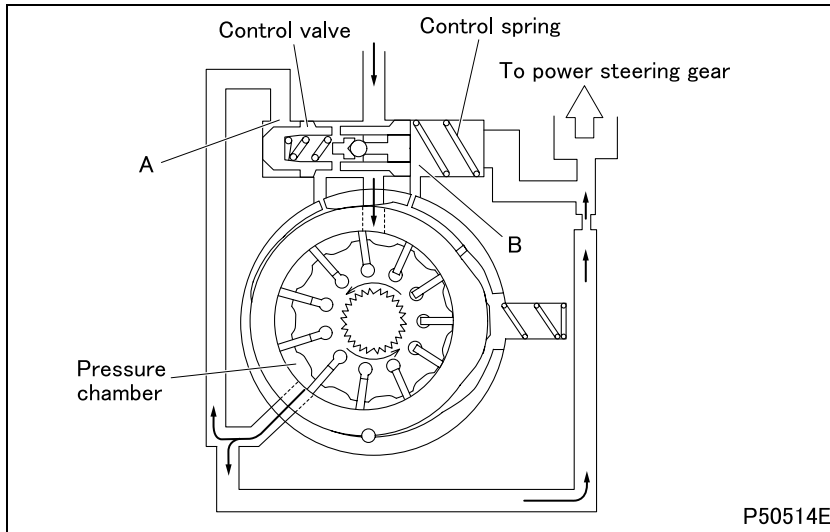
STRUCTURE AND OPERATION

5. Power Steering Oil Pump <Unisia JKC Product>



- The power steering oil pump is a hydraulic source pump with the vane in the rotor groove and is geared to the engine.
- The power steering oil pump consists of a cartridge assembly that discharges oil, a control valve that control the oil flow rate and a relief valve that prevents free oil pressure rise.
- The control valve maintains constant the quantity of oil to the power steering gear during steering wheel manipulation. The relief valve is provided in the control valve to prevent oil pump pressure from rising beyond necessary level during stationary swing operation.

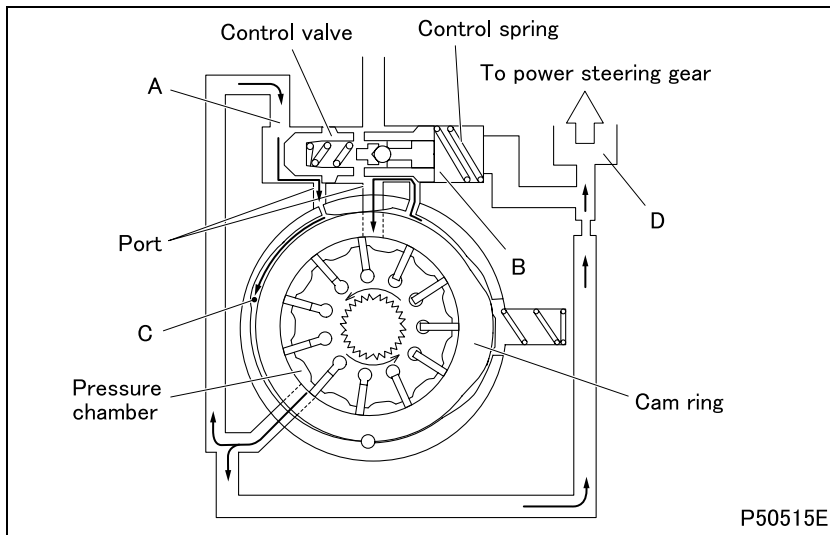
5.1 Control valve



(1) Operation of control valve

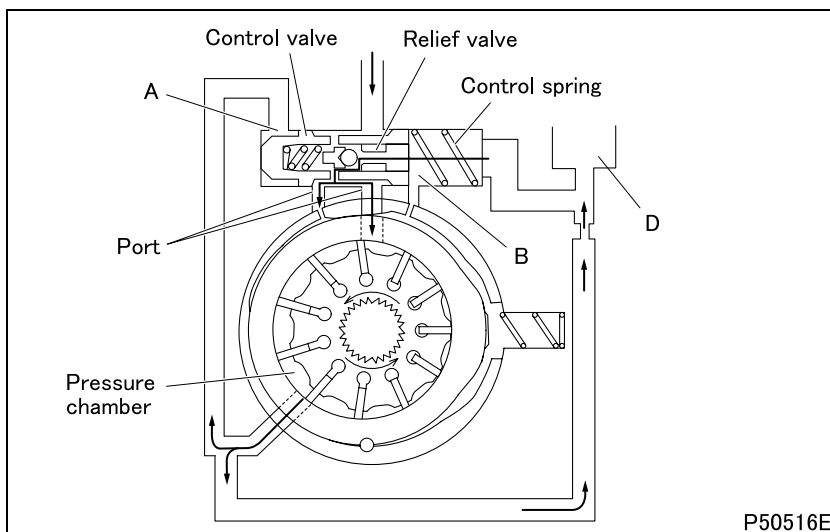
(1.1) When not functioning (oil pump in operation at low speed)

- Oil pressure in the chamber **A** is weaker than the combined force of oil pressure in the chamber **B** and tension of the control spring, and the control valve remains stationary.



(1.2) When functioning (oil pump in operation at medium to high speeds)

- Oil pressure in the chamber **A** overcomes the combined force of oil pressure in the chamber **B** and tension of the control spring, and shifts the control valve.
- Port is made open to release oil pressure in the chamber **A** into the chamber **C**, and the cam ring is shifted to right.
- This reduces the pressure chamber in capacity to decrease oil pump output per revolution, thus maintaining constant the flow rate from the chamber **D**.



(2) Operation of relief valve

- The combined force of oil pressure in the chamber **B** and tension of the control spring overcomes oil pressure in the chamber **A**, and the control valve is shifted.
- Increased oil pressure in the chamber **B** pushes the relief valve to open port, thus preventing excessive oil pressure from going to the chamber **D**.

TROUBLESHOOTING

Symptoms														Reference Gr
		Steering wheel heavy to operate	Steering wheel play excessive and unstable	Steering wheel pulled to one side	Steering wheel vibration	Steering wheel return not smooth	Steering wheel does not turn	Steering angle insufficient or different between right and left	Oil leakage	Oil pump oil pressure abnormal	Noise from oil pump (grinding)	Noise from oil pump (Squeaking)	Noise from oil pump (low whirring)	
Possible causes														
Faulty power steering mechanism	Oil quantity insufficient	O	O											
	Air bleeding insufficient	O	O											
	Oil viscosity unsuitable	O												
	Hydraulic circuit clogged	O												
	Power steering gear assembly faulty	O	O	O	O	O	O							
	Power steering gear assembly improperly installed	O	O			O								
	Gear engagement rotating torque incorrectly adjusted	O				O								
	Pitman mounting position incorrect							O						
Faulty steering column and link mechanism	Steering shaft universal joint abnormally worn, or damaged	O	O											
	Link deformed	O						O						
	Drag link ball joint abnormally worn or damaged	O	O											
	Tie rod ball joint abnormally worn or damaged	O	O											
	Steering angle off center between left and right			O										
	Tie rod bent						O							
Faulty front axle, etc.	King pin poorly greased	O				O								Gr26
	Front wheel alignment (toe-in, camber and caster) incorrect	O		O	O	O								
	Thrust bearing damaged	O												
	Wheel hub bearing worn out or damaged		O	O	O									
	King pin or bushing worn out or damaged		O	O	O									
	Front axle deformed			O										
	Knuckle arm, tie rod arm, knuckle, etc. improperly tightened				O									
	Front spring U bolt, nut, etc. loose				O									Gr33A
	Front tire radial and lateral runout; static and dynamic balance incorrect				O									Gr31
	Front axle parts overtightened					O								Gr26
	Steering angle incorrectly adjusted						O	O						
	Mounted parts, connections loose		O											
	Knuckle stopper bolt improperly adjusted							O						

Symptoms		Steering wheel heavy to operate	Steering wheel play excessive and unstable	Steering wheel pulled to one side	Steering wheel vibration	Steering wheel return not smooth	Steering wheel does not turn	Steering angle insufficient or different between right and left	Oil leakage	Oil pump oil pressure abnormal	Noise from oil pump (grinding)	Noise from oil pump (Squeaking)	Noise from oil pump (low whirring)	Reference Gr
Possible causes														
Faulty oil pump	Oil pump housing faulty								O					
	O-ring, oil seal faulty								O					
	Bolt improperly tightened								O					
	Maximum generated oil pressure insufficient									O				
	Oil line crushed or clogged									O				
	Air caught in oil pump										O			
	Oil pump interior seized									O	O	O		
	Mounting bolt and nut loose												O	
	Pump body faulty												O	
	Valve malfunctioning									O				
Faulty oil tank	Oil leakage from oil tank due to filling beyond capacity								O					
	Oil leakage from oil tank due to air caught inside								O					
Other abnormalities	Load excessive forward of load-carrying platform	O												
	Load excessive rearward of load-carrying platform		O											
	Load excessive on one side of loading bed			O										
	Difference excessive in wheelbase between left and right			O										
	Propeller shaft runout excessive				O									Gr25
	Rear axle housing bent			O										Gr27
	Final drive gear and final drive pinion damaged or improperly engaged				O									Gr26, 27
	Tire pressure insufficient	O												Gr31
	Tire pressure excessive		O											
	Difference excessive in degree of wear between left and right tires			O										
	Left and right tires different in outer diameter			O										
	Front tire radial and lateral runout, static and dynamic balance incorrect				O									
	Braking force unbalanced			O										Gr35

ON-VEHICLE INSPECTION AND ADJUSTMENT

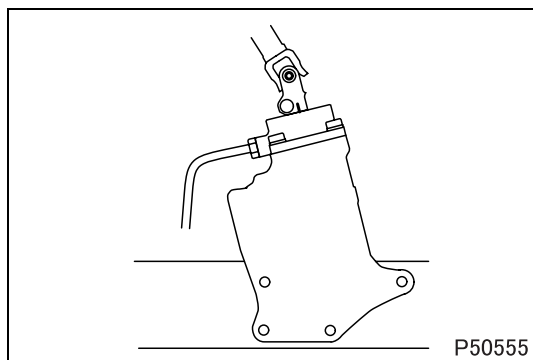
1. Change of Power Steering Fluid

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Feed pipe and return pipe	11.8 to 17.6 {8.7 to 13, 1.2 to 1.8}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Power steering oil tank	Automatic transmission fluid (DEXRON, DEXRON II or DEXRON III type)	Between MIN and MAX of power steering oil tank



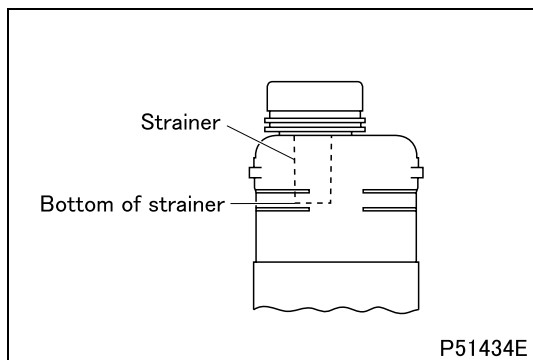
(1) Draining

- Jack up the front wheels.
- Loosen feed and return pipes connected to the power steering gear.

CAUTION ⚠

- **Clean the port area to prevent ingress of dirt, dust, and other foreign matters inside the power steering gear.**

- Repeatedly turn the steering wheel fully left and right to drain the fluid from the power steering gear.
- After draining the fluid, tighten the feed and return pipes to specified torque.



(2) Filling

- Pour fluid into the power steering oil tank up to the bottom of the strainer.

CAUTION ⚠

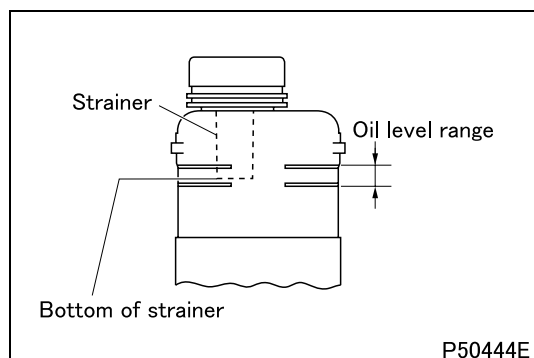
- **Power steering fluid is used for brake booster (hydraulic booster). Therefore, do not supply any other oil than power steering fluid such as brake fluid to the oil tank. <Hydraulic booster>**

- Bleed the power steering system of air.

2. Bleeding of Power Steering System

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
-	Power steering oil tank	Automatic transmission fluid (DEXRON, DEXRON II or DEXRON III type)	Between MIN and MAX of power steering oil tank



- Pour fluid to the power steering oil tank up to the bottom of the strainer.

CAUTION

- **Power steering fluid is used for brake booster (hydraulic booster). Therefore, do not supply any other oil than power steering fluid such as brake fluid to the oil tank. <Hydraulic booster>**

- With the engine stopped, jack up the front wheels.
- Repeatedly turn the steering wheel fully left and right. When the fluid level has dropped, add fluid enough to maintain the fluid level within the specified range.
- Start the engine to idle.
- When the fluid level has dropped, stop the engine and add fluid enough to maintain the fluid level within the specified range.
- Restart the engine. While checking for a drop in fluid level, turn the steering wheel fully left and right and add fluid as much as necessary. Repeat this practice until the fluid level is stabilized within the specified range.
- Fully depress the brake pedal (with a foot force of approximately 250 N {55 lbs., 25 kgf or more}) a few times. Repeat this until the fluid level is stabilized within the specified range. (In this case, there is no need to operate the steering wheel.) <Hydraulic booster>
- Turn the steering wheel fully left and right repeatedly.

CAUTION

- **To avoid seizure of the power steering oil pump, do not keep the steering wheel turned fully to left or right for more than 10 seconds when the engine is running.**

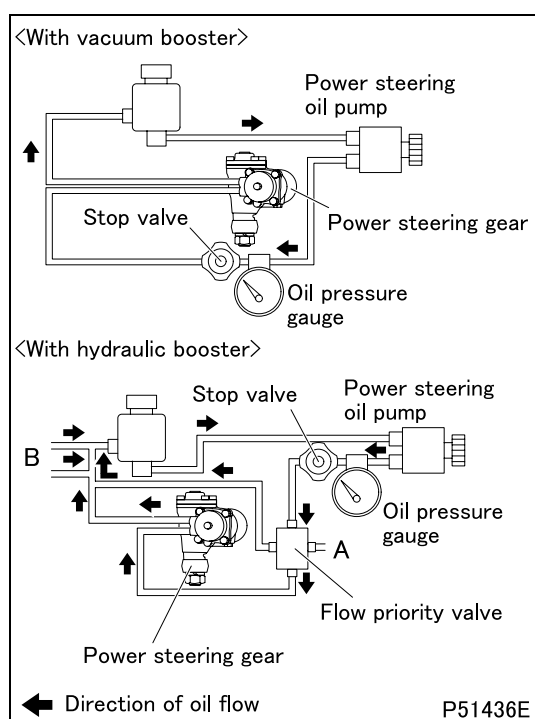
- If there is any abnormal noise or a fluid level fluctuation, air should be still trapped in the power steering system. Turn the steering wheel several times to raise the fluid temperature to approximately 60 to 80°C {140 to 175°F}.
- Stop the engine and wait for approximately five minutes.
- Lower the front wheels and turn the steering wheel several times. If there is no noise or fluid level fluctuation, the bleeding of the power steering system is completed.
- With the engine stopped, depress the brake pedal several times and bleed the brake booster (hydraulic booster) by means of emergency pump. <Hydraulic booster>
- Repeat starting and stopping the engine several times to remove small air bubbles left in the power steering oil tank.
- If air bubbles are not removed completely, drive the vehicle for a while, then check for abnormal noise and oil level fluctuation.
- When bleeding is finished, check that fluid in the power steering oil tank is within the specified level range. Also check pipe and hose connections for fluid leaks.
- After bleeding is finished, check the brake booster (hydraulic booster) for performance (input and output characteristics). <Hydraulic booster>

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Performance Verification Test of Power Steering System

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
-	Power steering system fluid pressure (with hands off steering wheel)	With vacuum booster 490 kPa {71 psi, 5.0 kgf/cm ² }	-	Repair
		With hydraulic booster 980 kPa {140 psi, 10.0 kgf/cm ² }	-	
-	Relief set pressure	With vacuum booster 10.8 ^{+0.20} _{-0.49} MPa {1560 ⁺²⁹ ₋₇₁ psi, 110 ⁺² ₋₅ kgf/cm ² }	-	Replace
		With hydraulic booster 12.3 ⁰ _{-0.49} MPa {1780 ^{0.0} ₋₇₁ psi, 125 ⁰ ₋₅ kgf/cm ² }	-	



- Perform the following tests to verify normal operation of the power steering gear assembly and power steering oil pump.

A: To hydraulic booster

B: From hydraulic booster

NOTE

- If fluid pressure in the power steering system is higher than the standard value with the engine idling, check the power steering gear and hydraulic circuit for clogging.

CAUTION

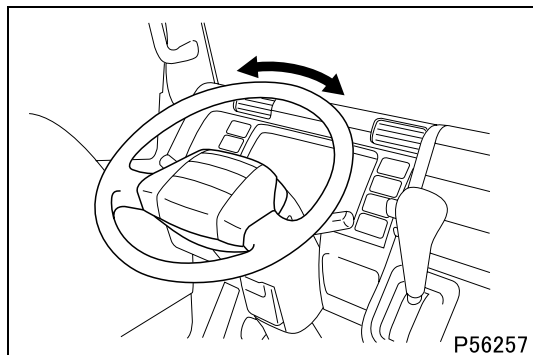
- To avoid seizure of the power steering oil pump, never close the stop valve for more than 10 seconds.

Test item	Test procedure	Assembly standard
Verification of smooth operation	• Jack up front wheels and turn steering wheel fully left and right.	Smooth operation throughout test
Measuring conditions	• Install oil pressure gauge capable of measuring upward of 13.2 MPa {1910 psi, 135 kgf/cm²} and stop valve between power steering oil pump and power steering gear <with vacuum booster> or flow priority valve <with hydraulic booster>, then bleed air. • Start engine to idle. • Turn steering wheel left and right several times to raise fluid temperature up to 50 to 60°C {122 to 140°F}. • With the engine idling, fully open stop valve.	-
Measurement of fluid pressure in power steering system	• Measure fluid pressure with hands off steering wheel.	Specified standard value
Measurement of relief set pressure	• Gradually increase engine speed to 1000 to 1500 rpm, then close stop valve and measure maximum fluid pressure. • Do not close stop valve for longer than 10 seconds.	Specified standard value

4. Steering Wheel Play

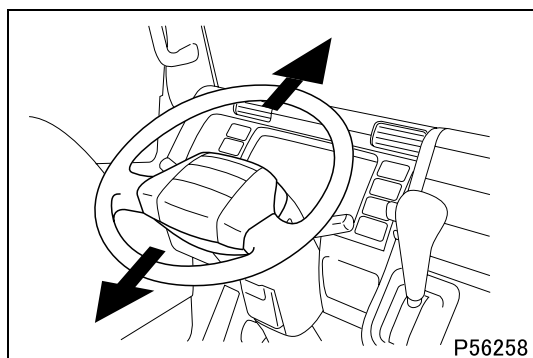
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Steering wheel play (Measure at the periphery of steering wheel)	5 to 50 {0.2 to 2.0}	–	Adjust



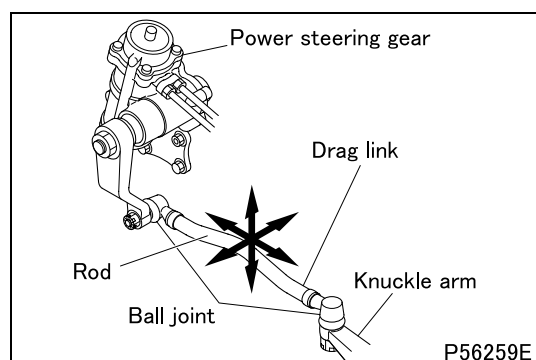
- With vehicle placed straight forward, start the engine and gently turn the steering wheel left and right to measure its peripheral play.
- If the play deviates from the standard value, check tightening points and the power steering gear.

5. Steering Column Looseness



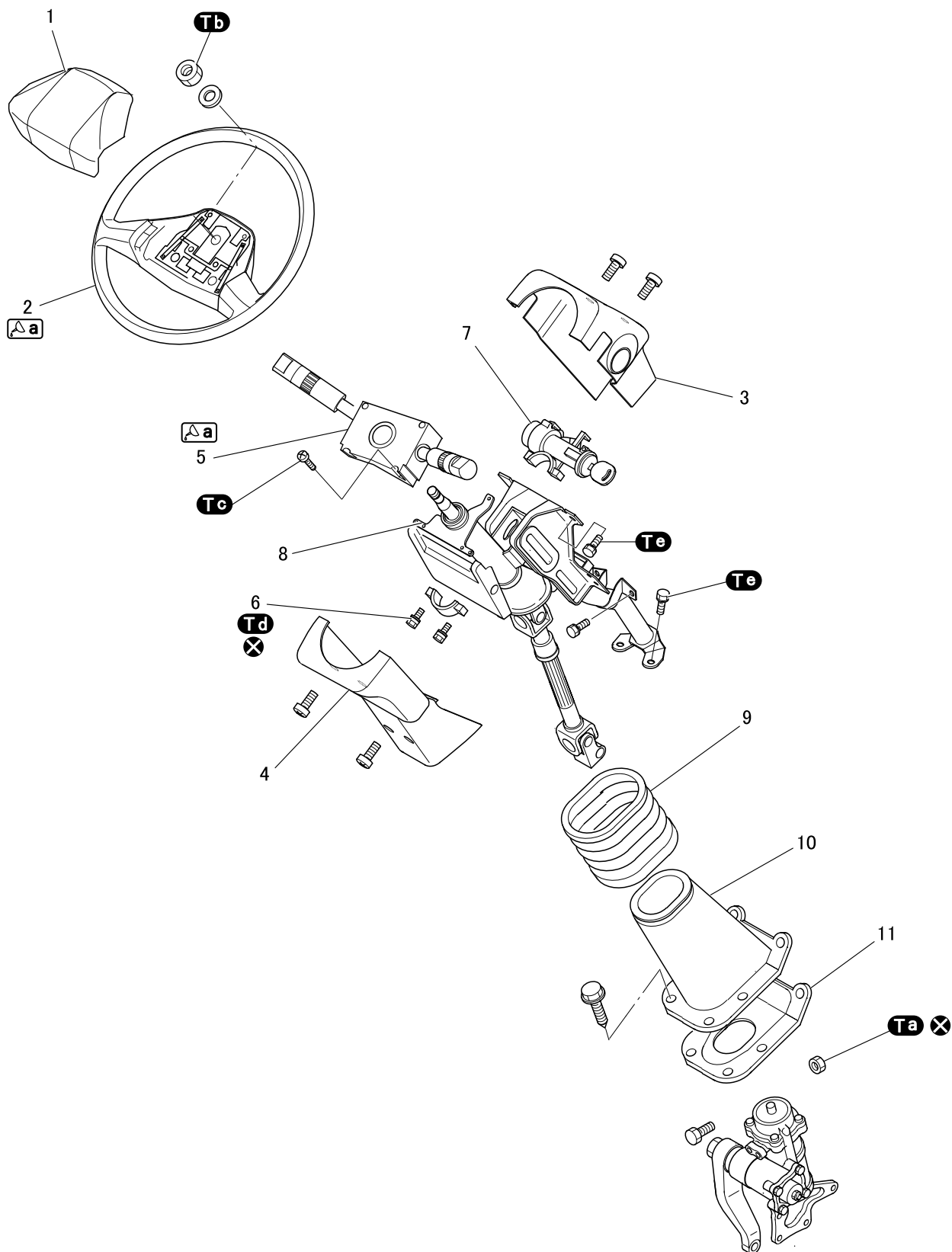
- Push and pull the steering wheel by hand to check the steering column for looseness.
- With the steering column tilted all the way forward, pull the steering wheel backward and check the steering column for looseness.
- If the steering column is loose, adjust the tilting and telescoping lever.

6. Drag Link Ball Joint Backlash



- With the vehicle in the stationary state, move the drag link by the rod in the forward, backward, vertical and lateral directions of the vehicle and check for play at the ball joints with the gear power steering gear and knuckle arm.
- If play is excessive, replace the drag link.

STEERING COLUMN



● Removal sequence

- | | | | |
|---|--------------------|----|--|
| 1 | Horn pad | 8 | Steering column
(For details, see later pages.) |
| 2 | Steering wheel | 9 | Dust cover |
| 3 | Front column cover | 10 | Dust cover |
| 4 | Rear column cover | 11 | Dust cover |
| 5 | Combination switch | | |
| 6 | Twist-off bolt | | |
| 7 | Starter switch | | |

⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

- After installation, check the steering column for looseness. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

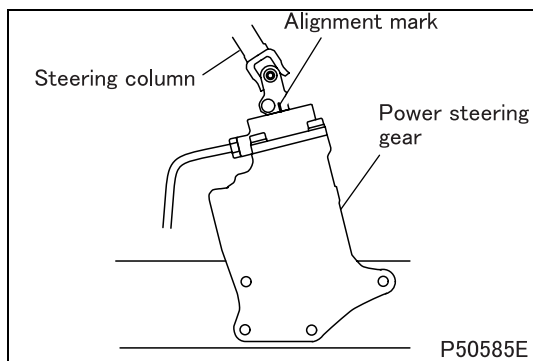
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Steering column and power steering gear mounting)	22 to 31 {16 to 23, 2.2 to 3.2}	–
Tb	Nut (Steering wheel mounting)	39 to 49 {29 to 36, 4.0 to 5.0}	–
Tc	Screw (Combination switch mounting)	2.5 ± 0.5 {1.8 ± 0.4, 0.3 ± 0.1}	–
Td	Twist-off bolt (Starter switch mounting)	14.2 ± 1.5 {10 ± 1.1, 1.4 ± 0.2}	–
Te	Bolt (Steering column assembly mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Contact ring under steering wheel	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Horn contact piece on combination switch side		

STEERING COLUMN

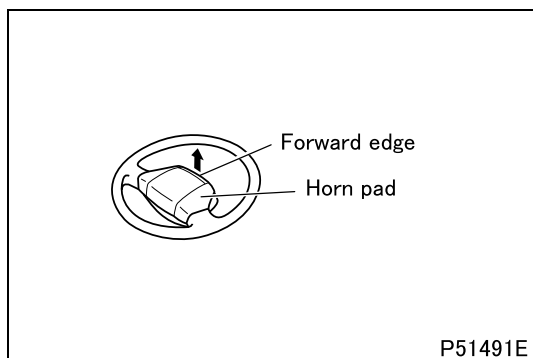
◆ Work before removal ◆



■ Alignment mark: Steering column and power steering gear

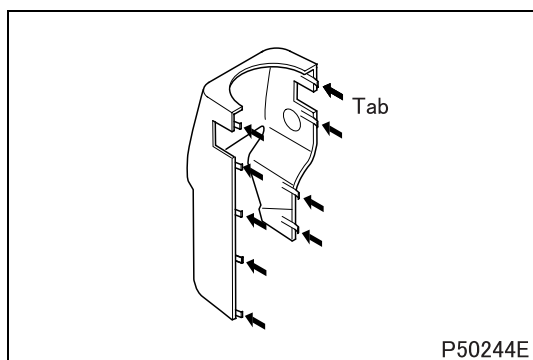
- Provide alignment marks on the steering column and power steering gear.

◆ Removal procedure ◆

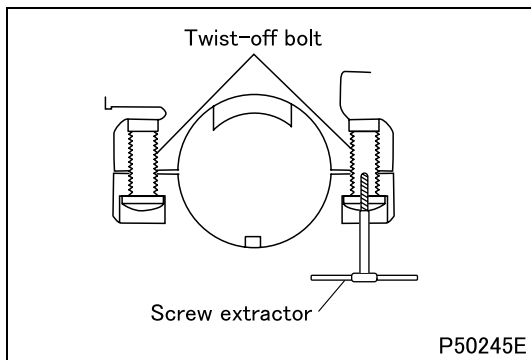


■ Removal: Horn pad

- Lift up the horn pad by the forward edge to remove from the steering wheel.

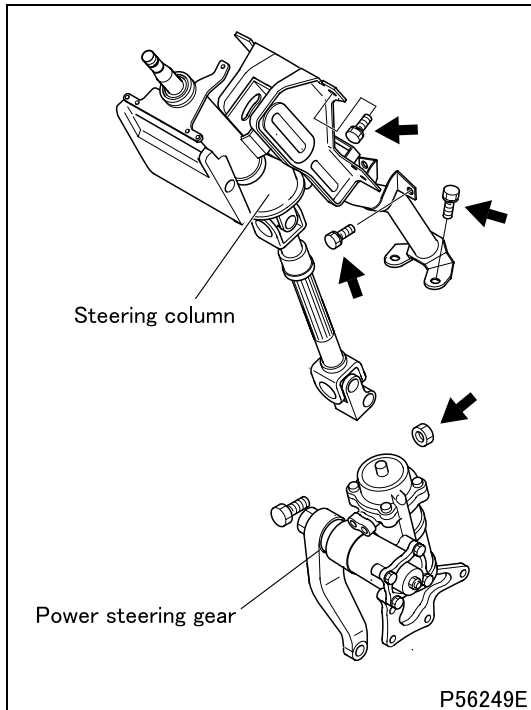


■ Removal: Front column cover



■ Removal: Starter switch

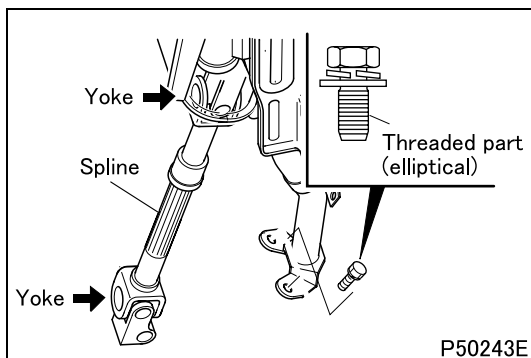
- Drill a hole of 5.5 to 6 mm {0.22 to 0.24 in.} in diameter to a depth of 10 to 15 mm {0.39 to 0.59 in.} in the twist-off bolt.
- Using the drilled hole, screw the screw extractor counterclockwise into the twist-off bolt and remove it.



■ Removal: Steering column

- To remove the steering column, remove the nut connecting it to the power steering gear, in addition to mounting bolts in the cab.

◆ Installation procedure ◆



■ Installation: Steering column

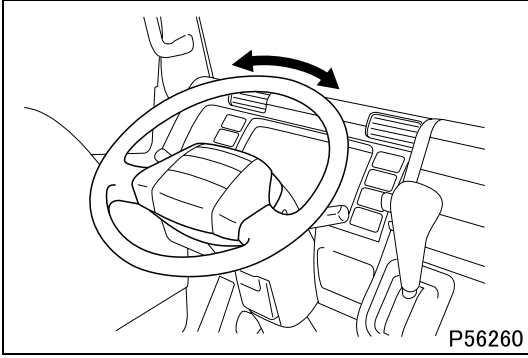
- If the spline is off the steering column, assemble them with the yokes facing in the same direction.
- Install the steering column using the illustrated bolts. The threaded portion of these bolts is elliptical for grounding the horn circuit properly.

■ Installation: Starter switch

- Install the starter switch using new twist-off bolts. Tighten the bolts to specified torque to snap off their heads.

STEERING COLUMN

◆ Inspection after installation ◆



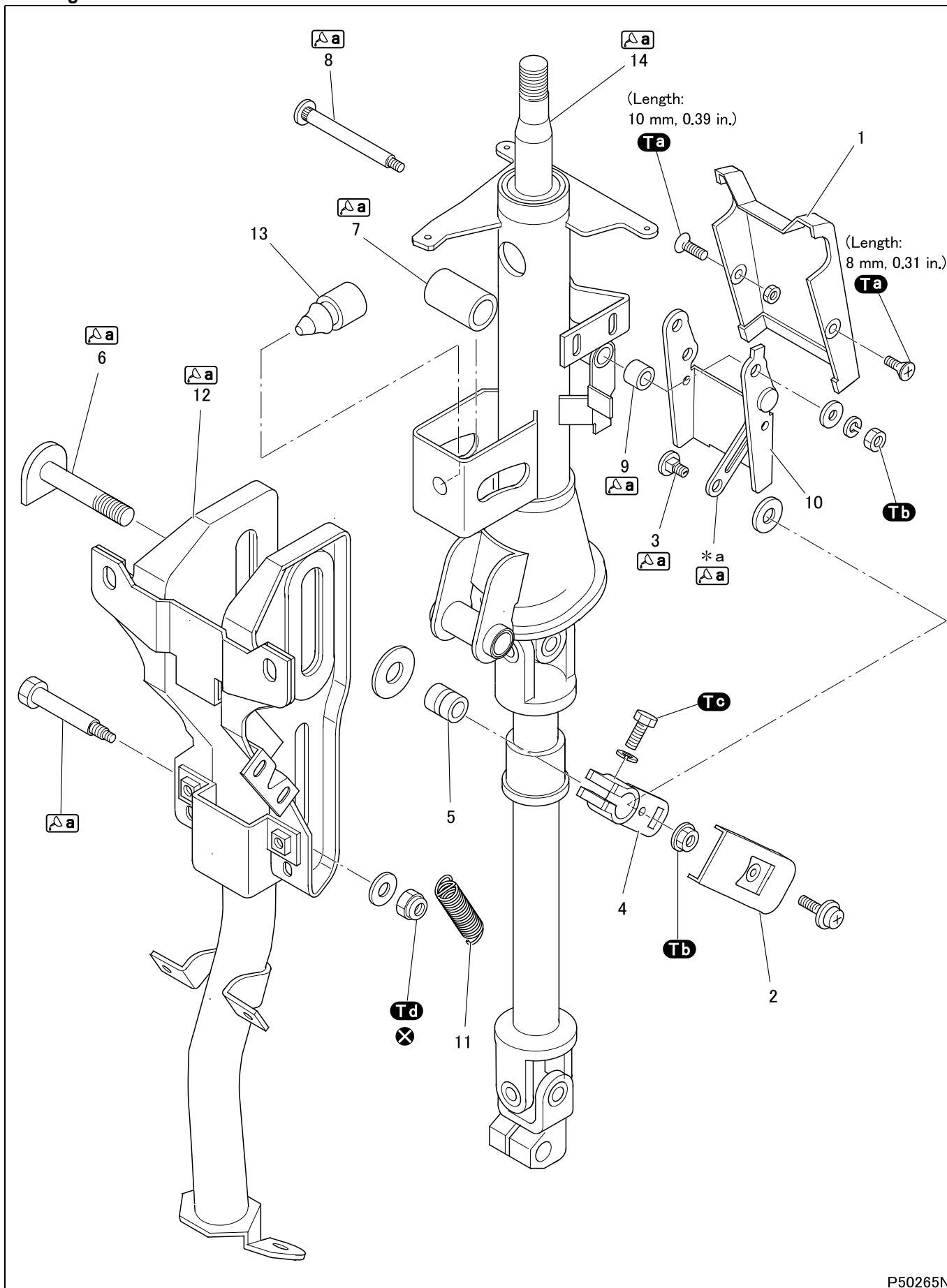
■ Inspection: Noise from steering wheel

- Lightly turn the steering wheel left and right and check for noise and other abnormalities.
- If any abnormality is found, disassemble the steering wheel, remove the cause and reinstall.

M E M O

STEERING COLUMN

Steering Column



● Disassembly sequence

- | | |
|-------------------|----------------------------------|
| 1 Lever cover | 10 Tilting and telescoping lever |
| 2 Lever protector | 11 Spring |
| 3 Pin | 12 Steering column support |
| 4 Lock lever | 13 Shock absorbing rubber |
| 5 Nut | 14 Steering column |
| 6 Bolt | |
| 7 Spacer | *a: Link plate |
| 8 Pin | ⊗: Non-reusable parts |
| 9 Collar | |

● Assembly sequence

Follow the disassembly sequence in reverse.

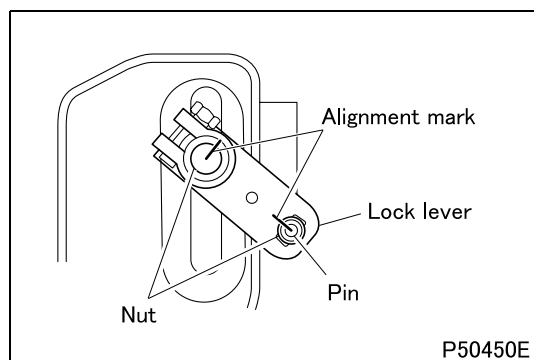
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (Lever cover mounting)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.2}	–
Tb	Nut (Lock lever mounting)	3.9 to 5.9 {2.9 to 4.4, 0.4 to 0.6}	–
	Nut (Tilting and telescoping lever mounting)		–
Tc	Bolt (Lock lever mounting)	16 to 20 {12 to 15, 1.6 to 2.0}	–
Td	Nut (Steering column support mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Friction surface of pin	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Friction surface of collar		
	Staked area of link plate		
	Friction surface and thread of bolt		
	Friction surface of spacer		
	Friction surfaces of steering column support and steering column		
	Friction surface of bolt		

◆ Work before removal ◆

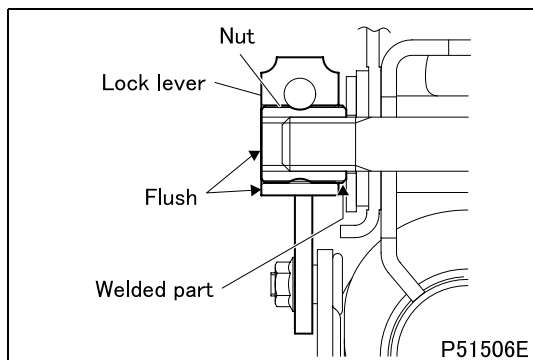


■ Alignment mark: Nut and lock lever

- Be sure to provide alignment marks on the lock lever and nuts before removal.

STEERING COLUMN

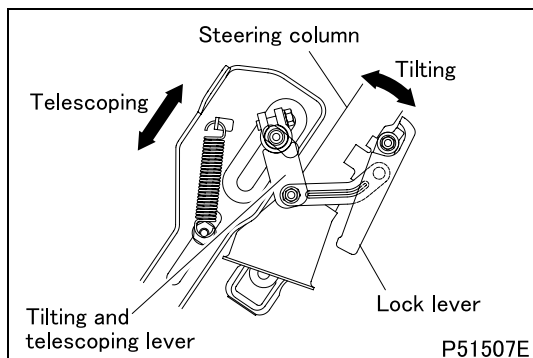
◆ Installation procedure ◆



■ Installation: Lock lever

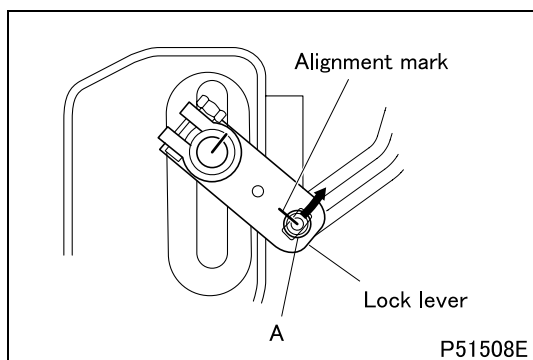
- Install the lock lever flush with the nut, with the welded part facing in the illustrated direction.

◆ Inspection after installation ◆



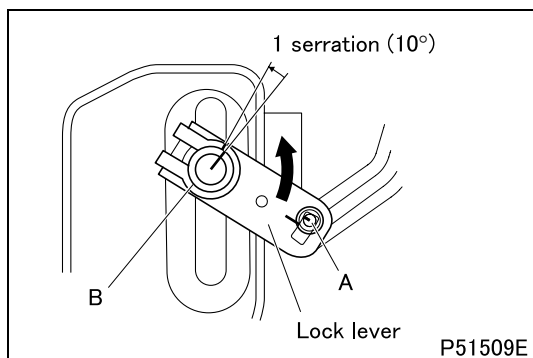
■ Inspection: Tilting and telescoping lever operating force

- Tilt the steering column all the way forward and telescope it to the mid-point of the movable range.
- Push the tilting and telescoping lever in and lock the steering column. In this state, check that the force required to operate the tilting and telescoping lever is 140 N {31 lbs, 14 kgf} or more.
- Push the steering column forward by hand to check that it is securely held.
- Adjust the installed position of the lock lever if necessary.



■ Adjustment: Lock lever

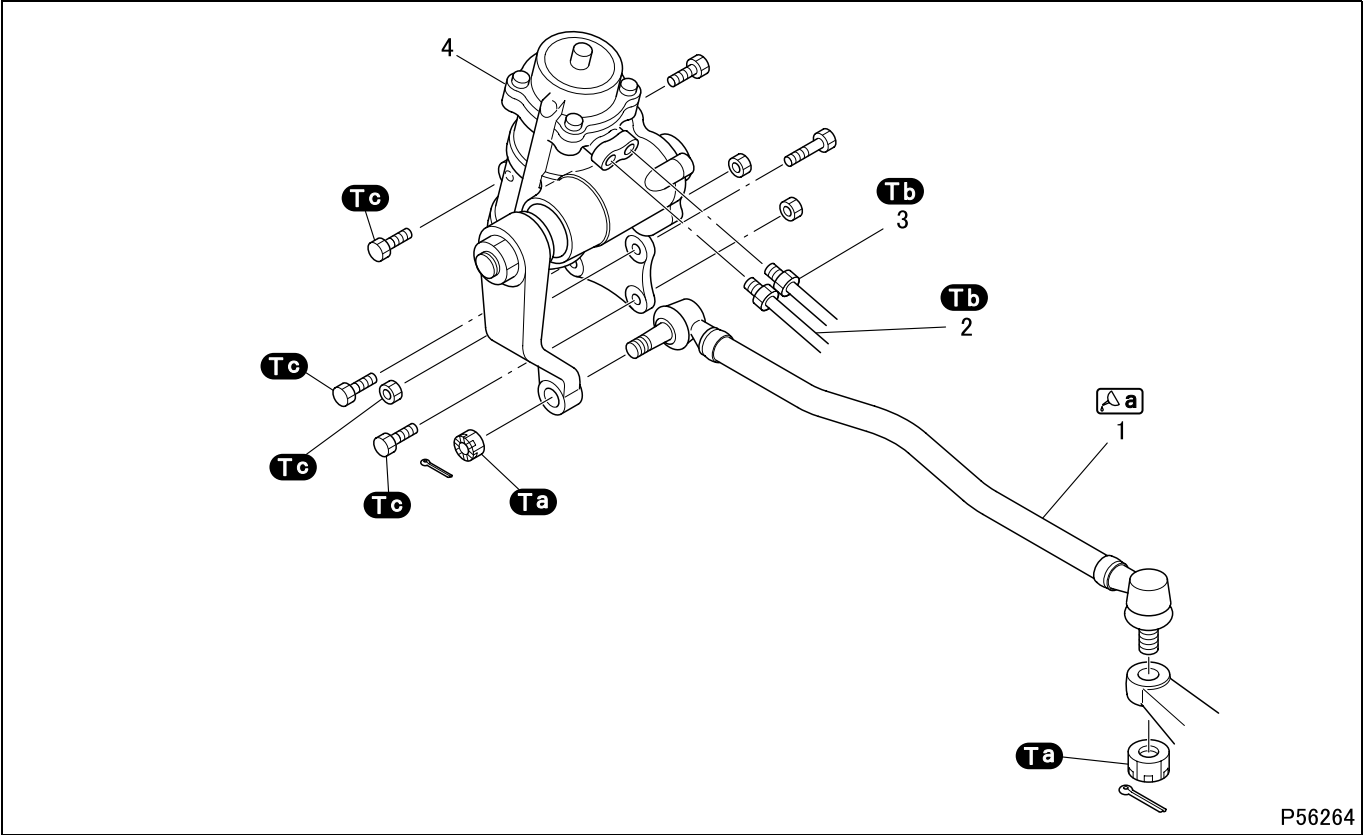
- Loosen nut **A**.
- Move the lock lever to relocate the nut **A** in the slot from the alignment mark in the arrow direction, then tighten the nut **A** in that position.



- If the nut **A** is already at the end of the slot in the lock lever and cannot be relocated, remove the lock lever and turn the nut **B** one serration (10°) from the alignment mark in the arrow direction, then reinstall the lock lever.
- Adjust the tightening position of the nut **A** so that the tilting and telescoping lever operating force becomes 140 N {31 lbs, 14 kgf} or more.

M E M O

POWER STEERING GEAR AND DRAG LINK



● Removal sequence

- | | |
|-------------|-----------------------|
| 1 Drag link | 3 Return pipe |
| 2 Feed pipe | 4 Power steering gear |

CAUTION

- When removing the drag link, use care not to deform or damage the dust cover.
- Do not attempt to disassemble the drag link because it is of a unit construction.

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Turning torque of drag link ball joint	0.1 to 5.9 N·m {0.1 to 4.4 ft.lbs, 0.01 to 0.6 kgf·m}	–	Replace

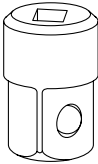
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Drag link mounting)	137 to 196 {100 to 145, 14 to 20}	–
Tb	Feed pipe and return pipe	11.8 to 17.6 {8.7 to 13, 1.2 to 1.8}	–
Tc	Bolt or nut (Power steering gear mounting)	83.5 to 108 {61 to 80, 8.5 to 11}	–

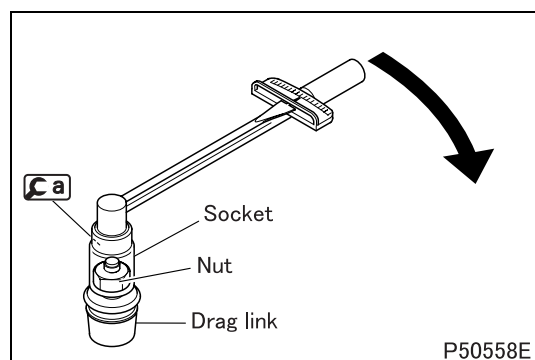
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Lip area of drag link ball joint dust cover	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

Mark	Tool name and shape	Part No.	Application
 a	 Preload socket P48876	MB990326	Measurement of drag link ball joint turning torque

◆ Inspection procedure ◆

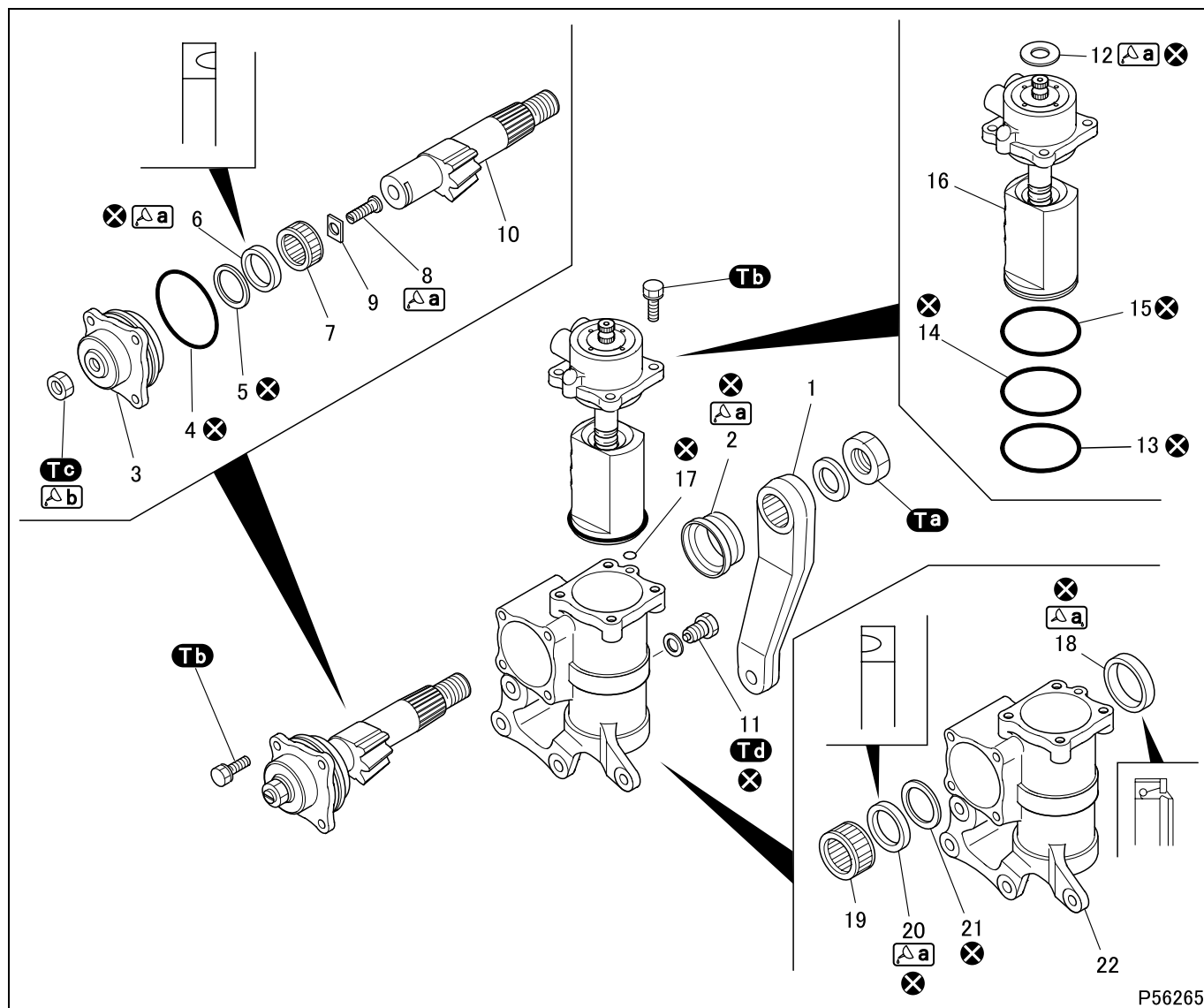


■ Inspection: Drag link

- Install nut onto the drag link ball joint.
- Using  a and a torque wrench set on the nut, measure the turning torque of the nut.
- If the measurement deviates from the standard value, replace the drag link.

POWER STEERING GEAR AND DRAG LINK

Power Steering Gear <Koyo Seiko Product>



● Disassembly sequence

- | | | |
|------------------|-------------------------|-------------------|
| 1 Pitman arm | 9 Adjusting plate | 17 O-ring |
| 2 Dust cover | 10 Sector shaft | 18 Oil seal |
| 3 Side cover | 11 Plug | 19 Needle bearing |
| 4 O-ring | 12 Dust cover | 20 Y-packing |
| 5 Backup ring | 13 O-ring | 21 Backup ring |
| 6 Y-packing | 14 Seal ring | 22 Gear box |
| 7 Needle bearing | 15 O-ring | |
| 8 Adjusting bolt | 16 Ball screw set shaft | |

⊗: Non-reusable parts

CAUTION ⚠

- Do not attempt to disassemble the ball screw set shaft because it is of a unit construction.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Seal kit
Repair kit

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Power steering gear	Starting torque	0.88 N·m {0.6 ft.lbs, 0.1 kgf·m} or less	Adjust
		Engaging torque	0 to 0.25 N·m {0 to 0.2 ft.lbs, 0 to 0.03 kgf·m}	
		Normal turning torque	0.15 to 0.78 N·m {0.1 to 0.6 ft.lbs, 0.01 to 0.1 kgf·m}	Replace
8, 10	End play between sector shaft and adjusting bolt	0.1 {0.0039} or less	–	Adjust
10	Stepped wear of gear box contact surface of sector shaft	–	0.003 {0.00012}	Replace
16, 22	Clearance between ball screw set shaft and gear box	0.022 to 0.069 {0.00087 to 0.0027}	–	Replace
22	Inner diameter of gear box	78.012 to 78.034 {3.071 to 3.072}	78.05 {3.07}	Replace

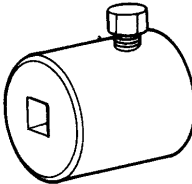
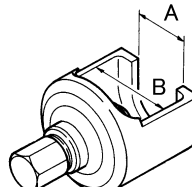
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Pitman arm fastening)	294 to 343 {215 to 255, 30 to 35}	–
Tb	Bolt (Sector shaft mounting)	98 to 118 {72 to 87, 10.0 to 12}	–
	Bolt (Ball screw set shaft mounting)		
Tc	Nut (Adjusting bolt fastening)	29 to 39 {21 to 29, 3.0 to 4.0}	Locking compound
Td	Plug	44 to 54 {32 to 40, 4.5 to 5.5}	–

Lubricant and/or sealant

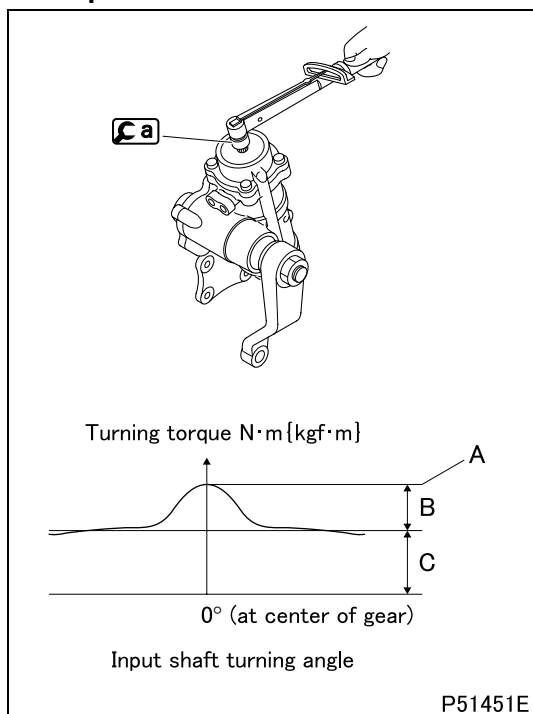
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Inner surface of dust cover	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
	Inner periphery of Y-packing		
	Contact surface of adjusting bolt to sector shaft		
	Oil seal lip		
	Thread of nut	ThreeBond 1141	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application				
	Preload socket  10028	MB991006	Measurement of power steering gear starting torque				
	Pitman arm puller <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>49 {1.93}</td><td>76 {2.99}</td></tr></tbody></table>  01355	A	B	49 {1.93}	76 {2.99}	MH062472	Removal of pitman arm
A	B						
49 {1.93}	76 {2.99}						

POWER STEERING GEAR AND DRAG LINK

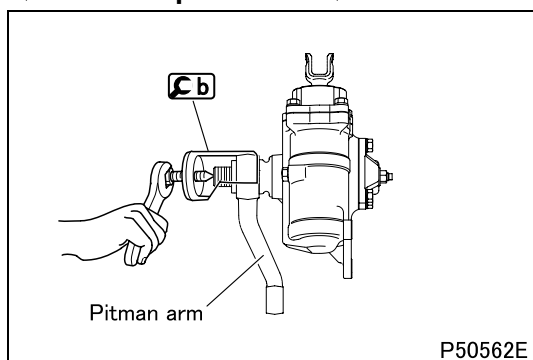
◆ Inspection before removal ◆



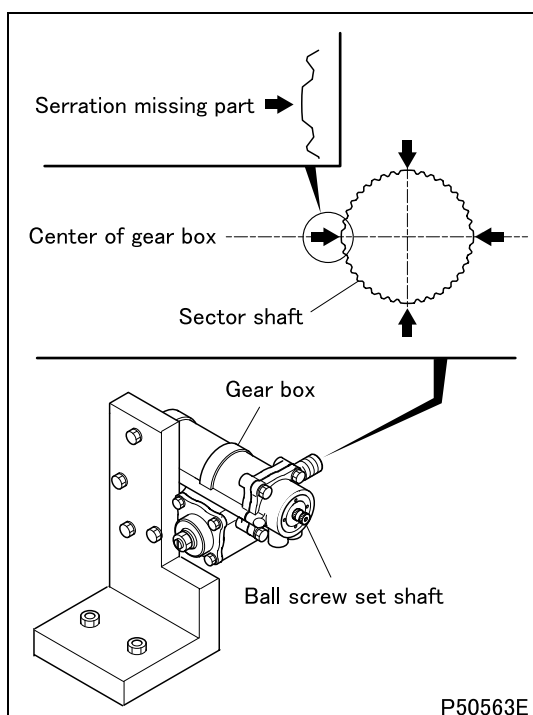
■ Inspection: Starting torque

- Using , measure the starting torque of the power steering gear for reference at the time of reassembly before removal.
A: Starting torque (= engaging torque + normal turning torque)
B: Engaging torque
C: Normal turning torque

◆ Removal procedure ◆

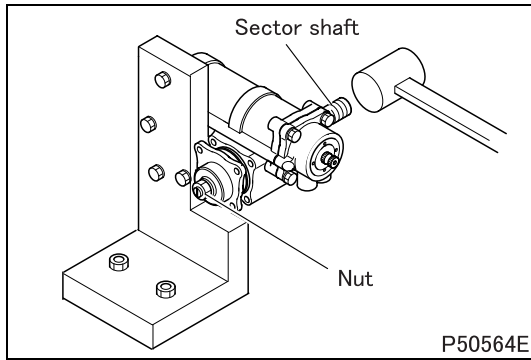


■ Removal: Pitman arm



■ Removal: Sector shaft

- Before removing, set the sector shaft in neutral position as follows.
- Turn the ball screw set shaft counterclockwise into the lock position, then back it up roughly 2.6 turns to bring the serration missing part of the serrated portion of the sector shaft into parallelism with the center of the gear box as shown.

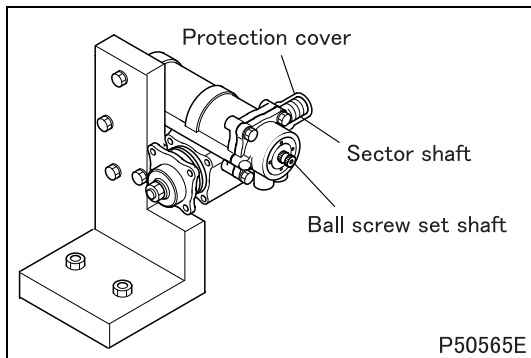


- Loosen nut, and remove the sector shaft by tapping the shaft end with a plastic hammer.

CAUTION

- If the sector shaft is stuck, it should be out of neutral position. In such a case, do not attempt to force it out by hammering but redo the neutral positioning procedure.

◆ Installation procedure ◆



■ Installation: Sector shaft

- Set the sector shaft in the neutral position and install it into the gear box.

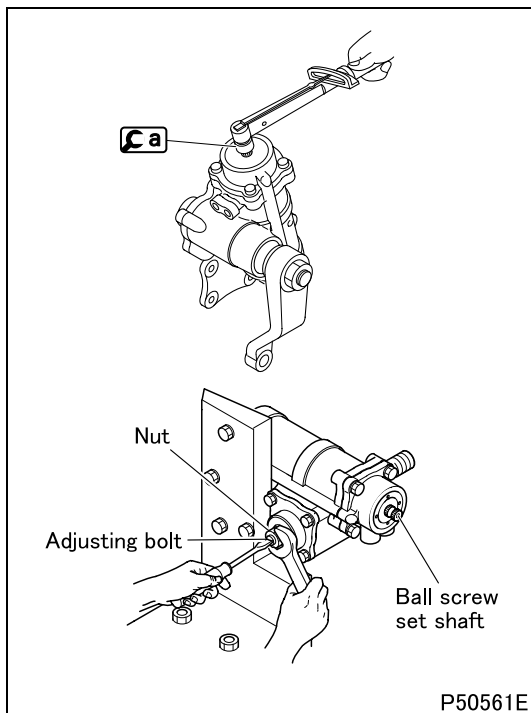
CAUTION

- When installing the sector shaft, cover up the threaded end and serrated portions of the shaft for protection.

NOTE

- Check that the ball screw set shaft rotates roughly 5 turns lock to lock.
- If the turns of the ball screw set shaft are less, check its engagement with the sector shaft and correct if necessary.

◆ Inspection after installation ◆



■ Inspection: Starting torque

[Inspection]

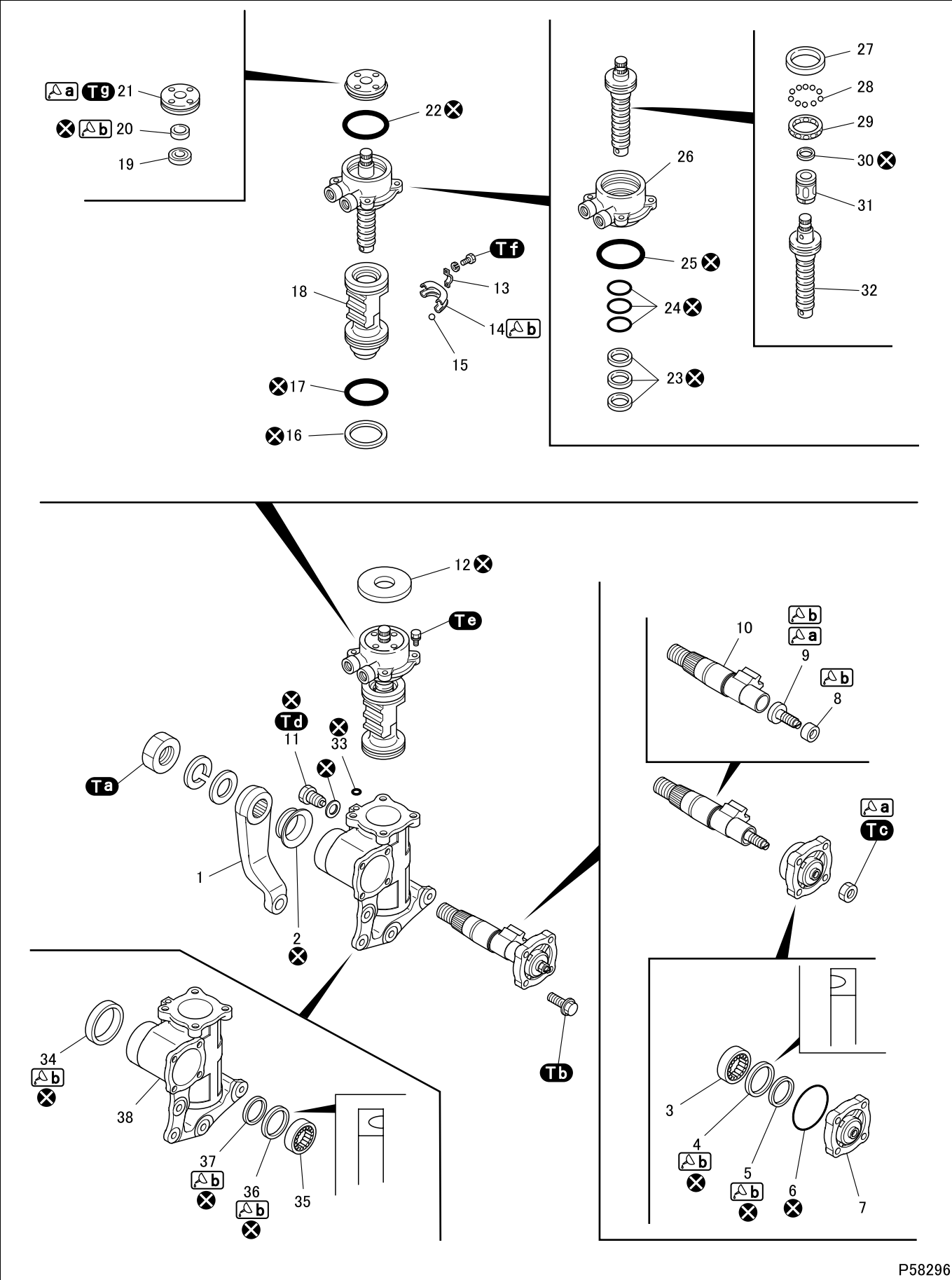
- Using  a, measure the starting torque of the power steering gear in the same manner as measurement before removal. If the measurement deviates from the standard value, adjust the power steering gear for proper starting torque or replace.

[Adjustment]

- Loosen nut.
- Rotating the ball screw set shaft roughly 1/4 turn to left and right, make adjustment for proper starting torque with the adjusting bolt.

POWER STEERING GEAR AND DRAG LINK

Power Steering Gear <Unisia JKC Product>



P58296

● Disassembly sequence

- | | | |
|--------------------|-------------------|------------------------|
| 1 Pitman arm | 15 Steel ball | 29 Bearing cage |
| 2 Dust cover | 16 Seal ring | 30 Seal ring |
| ★3 Needle bearing | 17 O-ring | 31 Rotor |
| 4 Y-packing | 18 Piston | 32 Worm and stub shaft |
| 5 Backup ring | 19 Ball bearing | 33 O-ring |
| 6 O-ring | 20 Oil seal | 34 Oil seal |
| 7 Side cover | 21 Adjusting plug | ★35 Needle bearing |
| ★8 Retainer | 22 O-ring | 36 Y-packing |
| ★9 Adjusting screw | 23 Seal ring | 37 Backup ring |
| 10 Sector shaft | 24 O-ring | 38 Body |
| 11 Plug | 25 O-ring | |
| 12 Dust cover | 26 Valve housing | ⊗: Non-reusable parts |
| 13 Ball tube clip | 27 Side race | |
| 14 Ball tube | 28 Steel ball | |

NOTE

- Do not remove parts marked ★ unless absolutely necessary.

CAUTION

- When holding the body with a vise, use care not to scratch the gasket seated surface of plug.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Repair kit

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Power steering gear	Starting torque	0.88 N·m {0.6 ft.lbs, 0.1 kgf·m} or less	–	Adjust
		Engaging torque	0 to 0.25 N·m {0 to 0.2 ft.lbs, 0 to 0.03 kgf·m}	–	
		Normal turning torque	0.15 to 0.78 N·m {0.1 to 0.6 ft.lbs, 0.02 to 0.1 kgf·m}	–	
9, 10	Play between adjusting screw and sector shaft		0.1 {0.0039} or less	–	Replace
10	Sector shaft outer diameter	Adjusting screw side	φ34.975 {1.38}	φ34.875 {1.37}	Replace
		Pitman side	φ44.975 {1.77}	φ44.875 {1.77}	
18, 32	Play in diametric direction between piston and worm and stub shaft		–	0.5 {0.020} or less	Replace
18, 38	Clearance between piston and body		0.11 {0.0043}	0.16 {0.0063}	Replace
31, 32	Clearance between rotor and worm and stub shaft		0.02 {0.00079}	0.03 {0.0012}	Replace

POWER STEERING GEAR AND DRAG LINK

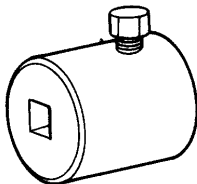
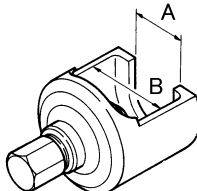
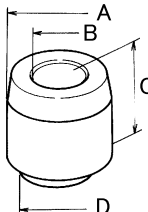
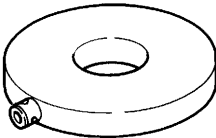
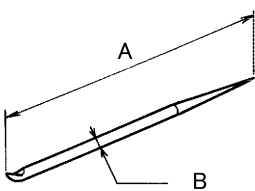
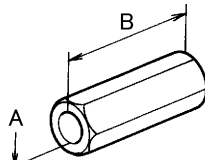
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (Pitman arm fastening)	294 to 343 {215 to 255, 30 to 35}	—
Tb	Bolt (Sector shaft mounting)	53.9 to 63.7 {40 to 47, 5.5 to 6.5}	—
Tc	Nut (Adjusting screw tightening)	63.7 to 73.5 {47 to 54, 6.5 to 7.5}	—
Td	Plug	73.6 to 83.4 {54 to 62, 7.5 to 8.5}	—
Te	Bolt (Valve housing attaching)	98.1 to 107.9 {72 to 80, 10 to 11}	—
Tf	Screw (Ball tube clip fitting)	4.41 to 5.39 {3.3 to 4.0, 0.4 to 0.5}	—
Tg	Adjusting plug	147 to 166 {110 to 120, 15 to 17}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Nut threads and contact surface of side cover	Hermetic seal 101Y or ThreeBond 1102	As required
	Adjusting screw threads		
	Periphery of adjusting plug		
 b	Inner periphery of backup ring	Multi-purpose type grease [NLGI No. 2 (Li soap)]	As required
	Inner periphery of Y-packing		
	Inner periphery of retainer		
	Adjusting screw threads and contact surface of sector shaft		
	Inner surface of ball tube		
	Inner periphery of oil seal		

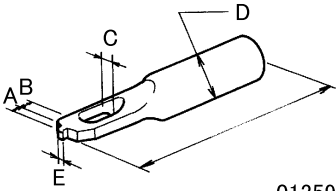
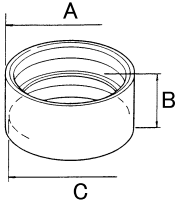
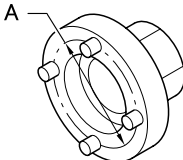
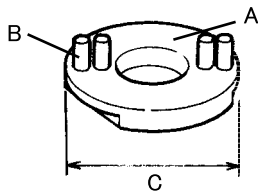
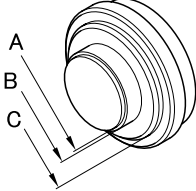
Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application								
	Preload socket  10028	MB991006	Measurement of power steering gear starting torque								
	Pitman arm puller <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>49 {1.93}</td><td>76 {2.99}</td></tr></tbody></table>  01355	A	B	49 {1.93}	76 {2.99}	MH062472	Removal of pitman arm				
A	B										
49 {1.93}	76 {2.99}										
	Insert tool assembly  01358 <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr></thead><tbody><tr><td>φ35 {1.38}</td><td>φ25 {0.98}</td><td>53.5 {2.11}</td><td>φ33 {1.30}</td></tr></tbody></table>	A	B	C	D	φ35 {1.38}	φ25 {0.98}	53.5 {2.11}	φ33 {1.30}	MH062881 *910-21719	Forming of backup ring
A	B	C	D								
φ35 {1.38}	φ25 {0.98}	53.5 {2.11}	φ33 {1.30}								
	Insert tool assembly  01356	MC811971 *910-11001	Forming of backup ring and installation of oil seal								
	Needle <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>120 {4.72}</td><td>φ3 {0.12}</td></tr></tbody></table>  02288	A	B	120 {4.72}	φ3 {0.12}	MC811948 *910-21200	Removal of O-ring and seal ring				
A	B										
120 {4.72}	φ3 {0.12}										
	Bar <table border="1"><thead><tr><th>A</th><th>B</th></tr></thead><tbody><tr><td>φ16.5 {0.65}</td><td>57 {2.24}</td></tr></tbody></table>  01360	A	B	φ16.5 {0.65}	57 {2.24}	MC811955 *910-22811	Turning of retainer				
A	B										
φ16.5 {0.65}	57 {2.24}										

*: Unisia JKC part numbers

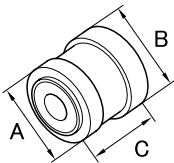
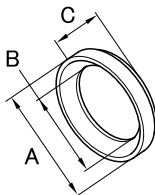
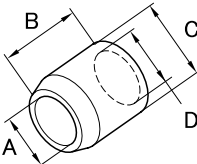
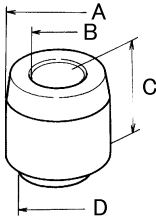
POWER STEERING GEAR AND DRAG LINK

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application										
	Squeeze tool  01359 <table><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th></tr><tr><td>5 {0.20}</td><td>8 {0.31}</td><td>18 {0.71}</td><td>φ30 {1.18}</td><td>6 {0.24}</td></tr></table>	A	B	C	D	E	5 {0.20}	8 {0.31}	18 {0.71}	φ30 {1.18}	6 {0.24}	MC811950 *910-21801	Crimping of retainer
A	B	C	D	E									
5 {0.20}	8 {0.31}	18 {0.71}	φ30 {1.18}	6 {0.24}									
	Insert tool  02289 <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ98 {3.86}</td><td>50 {1.97}</td><td>φ85.05 {3.35}</td></tr></table>	A	B	C	φ98 {3.86}	50 {1.97}	φ85.05 {3.35}	MC8131516 *910-21718	Forming of piston seal ring				
A	B	C											
φ98 {3.86}	50 {1.97}	φ85.05 {3.35}											
	Wrench assembly  P51270 <table><tr><th>A</th></tr><tr><td>φ52 {2.05}</td></tr></table>	A	φ52 {2.05}	MH062883 *910-10745	Removal and installation of adjusting plug								
A													
φ52 {2.05}													
	Attachment assembly (A: Adapter) (B: Bolt (pin))  02290 <table><tr><th>C</th></tr><tr><td>φ147 {5.79}</td></tr></table>	C	φ147 {5.79}	MC811969 *910-10671 (A: *910-23581) (B: *910-23194)	Fixing of valve housing								
C													
φ147 {5.79}													
	Press-fit tool  P51271 <table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>φ29.7 {1.17}</td><td>φ31.8 {1.25}</td><td>φ45 {1.77}</td></tr></table>	A	B	C	φ29.7 {1.17}	φ31.8 {1.25}	φ45 {1.77}	MH062884 *910-20405	Installation of oil seal				
A	B	C											
φ29.7 {1.17}	φ31.8 {1.25}	φ45 {1.77}											

*: Unisia JKC part numbers

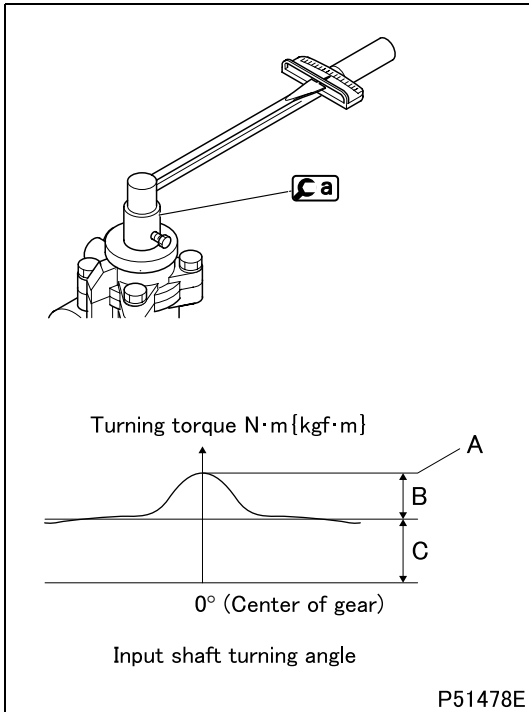
Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application								
	Adjusting tool <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ59.5 {2.34}</td><td>φ65.5 {2.58}</td><td>65 {2.56}</td></tr></tbody></table>  P51272	A	B	C	φ59.5 {2.34}	φ65.5 {2.58}	65 {2.56}	MH062885 *910-22997	Assembly of thrust bearing		
	A	B	C								
φ59.5 {2.34}	φ65.5 {2.58}	65 {2.56}									
	Guide assembly <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ76 {2.99}</td><td>φ56 {2.20}</td><td>13 {0.51}</td></tr></tbody></table>  P51273	A	B	C	φ76 {2.99}	φ56 {2.20}	13 {0.51}	MH062886 *910-23051			
A	B	C									
φ76 {2.99}	φ56 {2.20}	13 {0.51}									
	Insert tool <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr></thead><tbody><tr><td>φ28.1 {1.11}</td><td>45 {1.77}</td><td>φ40 {1.57}</td><td>φ30.3 {1.19}</td></tr></tbody></table>  P51274	A	B	C	D	φ28.1 {1.11}	45 {1.77}	φ40 {1.57}	φ30.3 {1.19}	MH062882 *910-22776	Forming of rotor seal ring and valve housing seal ring
A	B	C	D								
φ28.1 {1.11}	45 {1.77}	φ40 {1.57}	φ30.3 {1.19}								
	Insert tool <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr></thead><tbody><tr><td>φ45 {1.77}</td><td>φ20 {0.79}</td><td>φ45 {1.77}</td><td>φ33 {1.30}</td></tr></tbody></table>  55473	A	B	C	D	φ45 {1.77}	φ20 {0.79}	φ45 {1.77}	φ33 {1.30}	MH062880 *910-21716	Forming of backup ring
A	B	C	D								
φ45 {1.77}	φ20 {0.79}	φ45 {1.77}	φ33 {1.30}								

*: Unisia JKC part numbers

POWER STEERING GEAR AND DRAG LINK

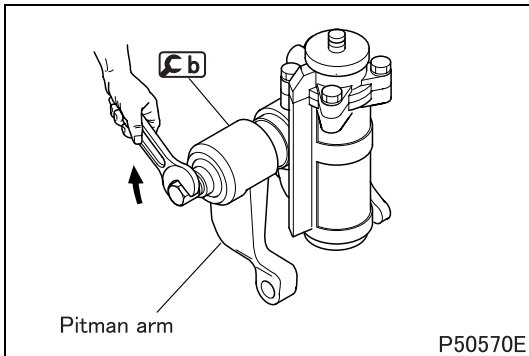
◆ Inspection before removal ◆



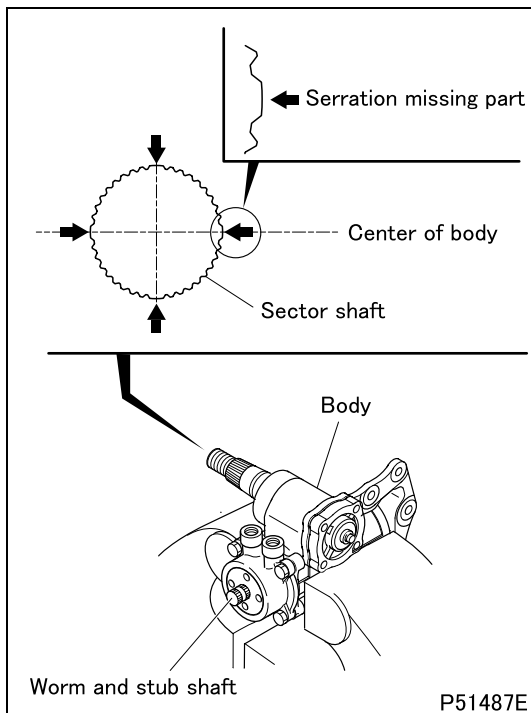
■ Inspection: Starting torque

- Using **a**, measure the starting torque of the power steering gear for reference at the time of reassembly before removal.
 - A**: Starting torque (= engaging torque + normal turning torque)
 - B**: Engaging torque
 - C**: Normal turning torque

◆ Removal procedure ◆

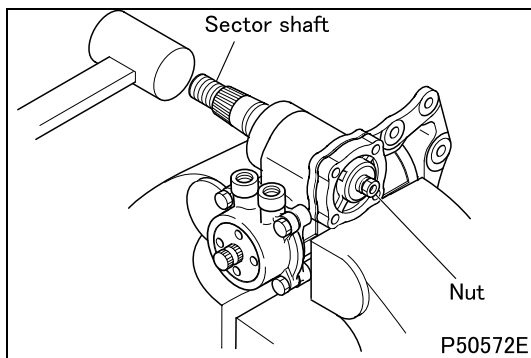


■ Removal: Pitman arm



■ Removal: Sector shaft

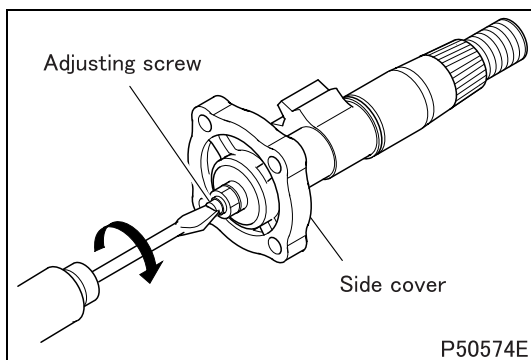
- Before removing, set the sector shaft in neutral position as follows.
- Turn the worm and stub shaft counterclockwise into the lock position, then back it up roughly 2.6 turns to bring the serration missing part of the serrated portion of the sector shaft into parallelism with the center of the body as shown.



- Loosen nut, and remove the sector shaft by tapping the shaft end with a plastic hammer.

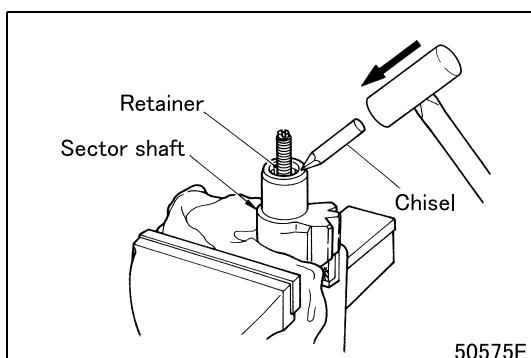
CAUTION ⚠

- If the sector shaft is stuck, it should be out of neutral position. In such a case, do not attempt to force it out by hammering but redo the neutral positioning procedure.



■ Removal: Side cover

- Remove the side cover by screwing in the adjusting screw.



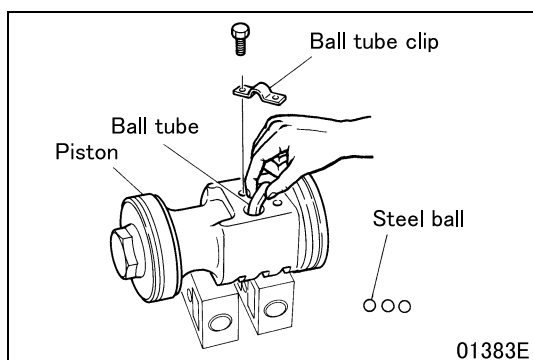
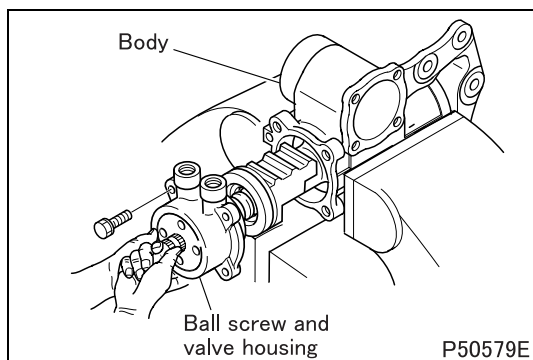
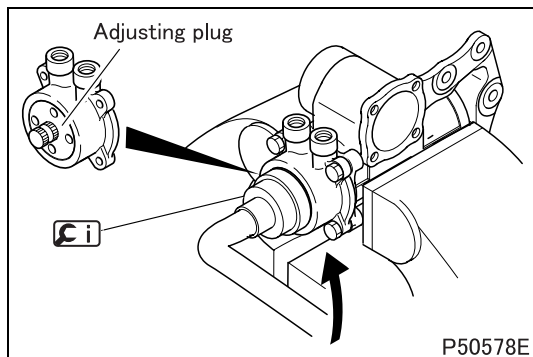
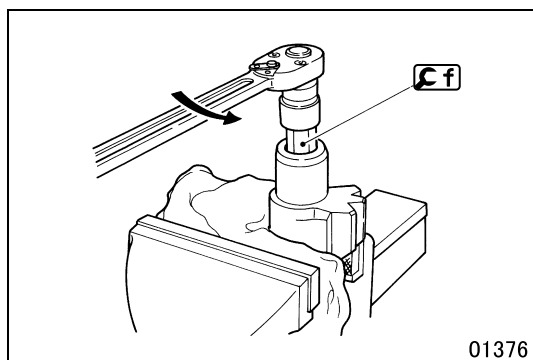
■ Removal: Retainer

- Undo the crimp of the retainer (at 2 points) using a chisel.

CAUTION ⚠

- When holding the sector shaft with a vise, be sure to cover it with a cloth or the like for protection.

POWER STEERING GEAR AND DRAG LINK



■ Removal: Ball screw and valve housing

- Before removing the ball screw and valve housing, back up the adjusting plug by roughly 180° with .

CAUTION

- Do not remove the adjusting plug. If it is removed, bearing in the valve housing may pop out.

- Remove the ball screw and valve housing from the body.

CAUTION

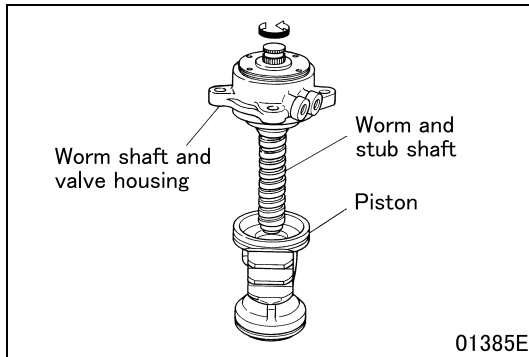
- Take care so that balls in the ball screw and valve housing do not pop out.
- Take care not to scratch or otherwise damage the inner surface of the body and piston.

■ Removal: Ball tube and steel ball

- First remove steel balls from the piston, then remove ball tube clip. Hold the ball tube between fingers and remove it from the piston moving it lightly.

CAUTION

- Be careful not to lose the steel balls (28 pieces in all).

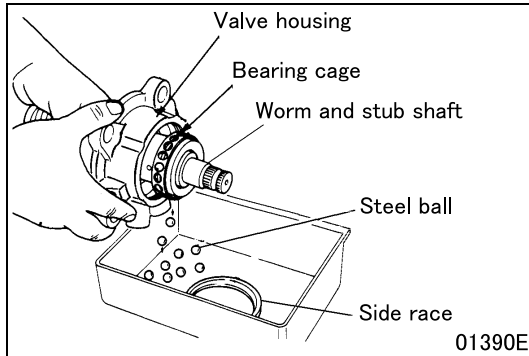


■ Removal: Piston

- Holding the worm shaft and valve housing with the piston downward, turn the worm and stub shaft and remove the piston.

CAUTION ⚠

- Be careful not to tilt the piston during removal. If it is tilted, steel balls will fall off the race of the piston and worm and stub shaft into the piston.



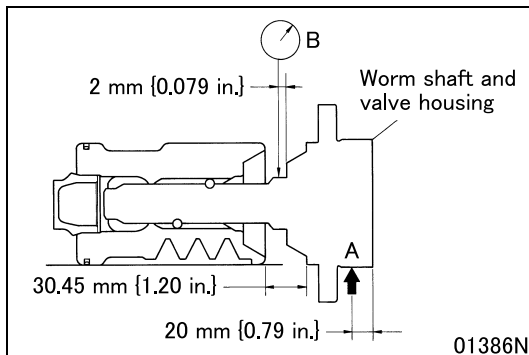
■ Removal: Worm and stub shaft

- Remove the worm and stub shaft by pushing its piston-side end out.

CAUTION ⚠

- Use a suitable receptacle not to lose the side race, steel balls and bearing cage that fall off in separated pieces.

◆ Inspection procedure ◆

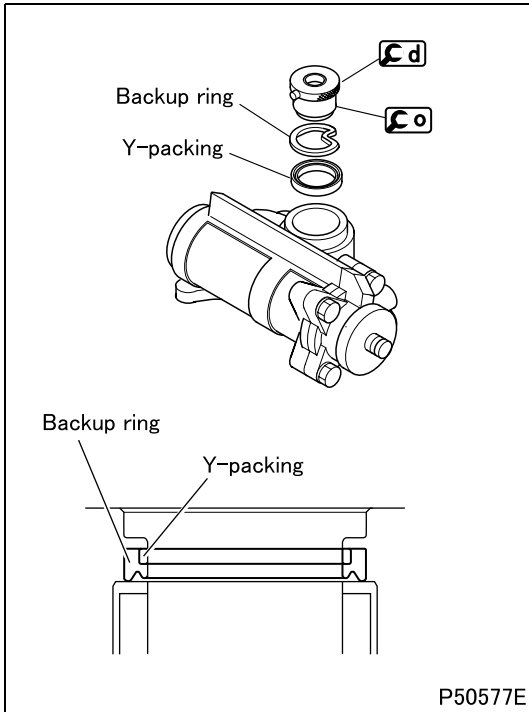


■ Inspection: Side play of piston and worm and stub shaft

- Apply a force of 49 N {11 lbs, 5.0 kgf} to the illustrated point A and measure play B (play in the diametric direction) of the worm shaft and valve housing.
- If the measurement exceeds the limit, replace the faulty parts.

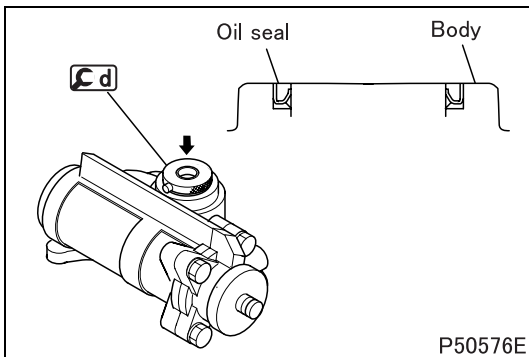
POWER STEERING GEAR AND DRAG LINK

◆ Installation procedure ◆



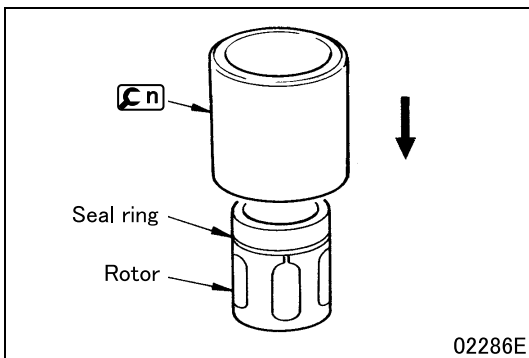
■ Installation: Backup ring and Y-packing

- Fill grease in the groove of Y-packing and install Y-packing in the illustrated direction.
- Install backup ring, formed as shown, using **C d** and **C o**.



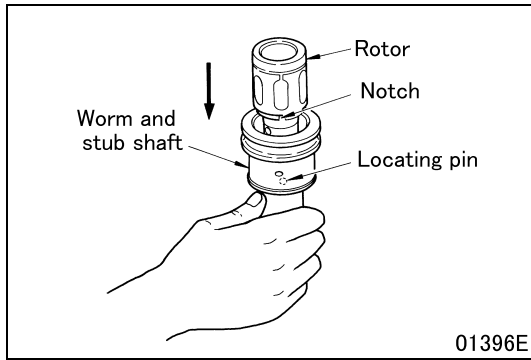
■ Installation: Oil seal

- Install the oil seal to the body in the illustrated direction.



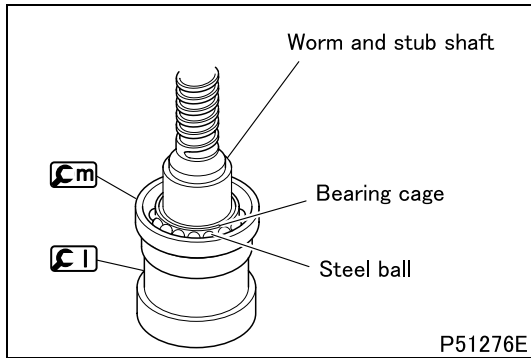
■ Installation: Seal ring

- Install the seal ring onto the rotor.
- Form the seal ring to fit the rotor using **C n**.



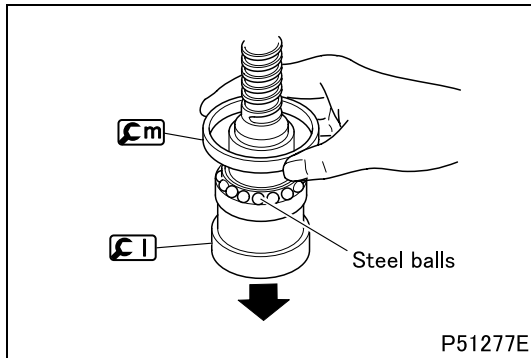
■ Installation: Rotor

- Install the rotor aligning its notch with the locating pin of the worm and stub shaft.

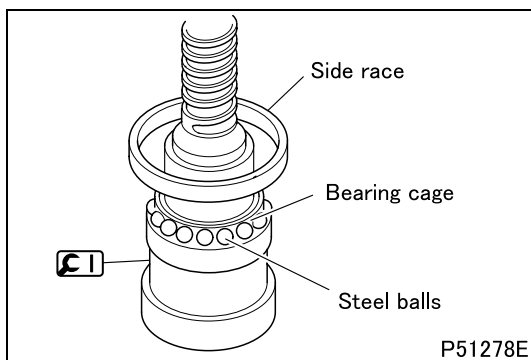


■ Installation: Side race, steel balls and bearing cage

- Using  and  assembled, install the worm and stub shaft in the illustrated direction.
- Install the bearing cage and steel balls onto the worm and stub shaft.

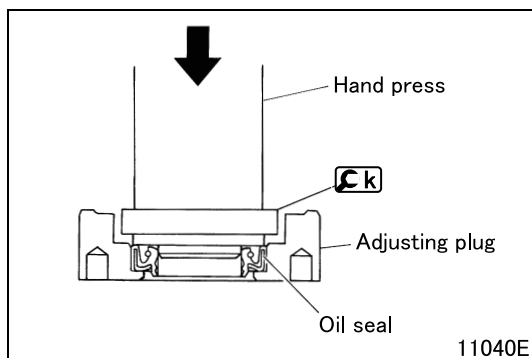


- Holding  with hand, slide  downward to have steel balls set in place.



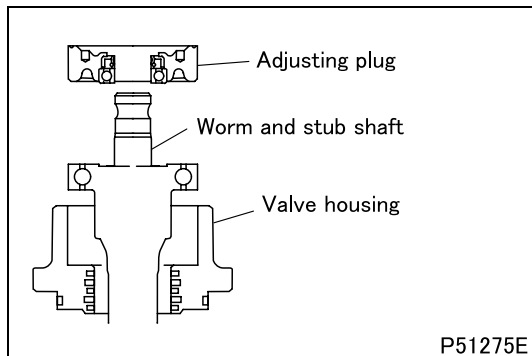
- Install the side race onto the steel balls and bearing cage.

POWER STEERING GEAR AND DRAG LINK



■ Installation: Oil seal

- Using **Ck**, press oil seal in the illustrated direction into the adjusting plug.

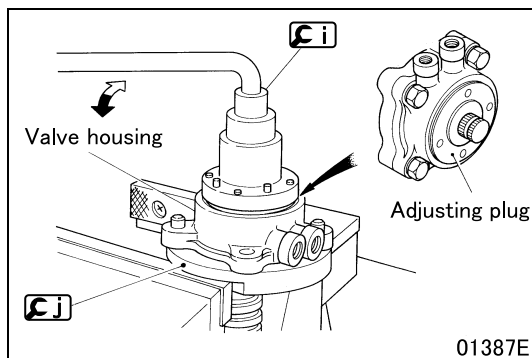


■ Installation: Worm and stub shaft

- Install the valve housing onto the worm and stub shaft and secure it in place with adjusting plug.

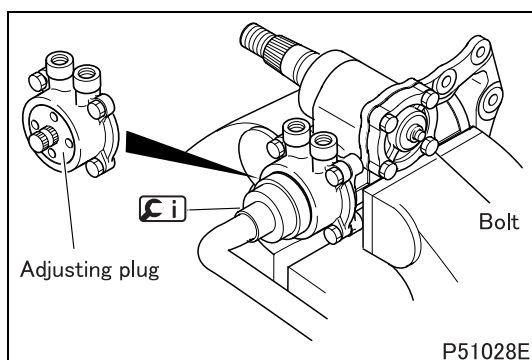
CAUTION ⚠

- Take care not to damage the seal rings with the ball race of the worm and stub shaft.

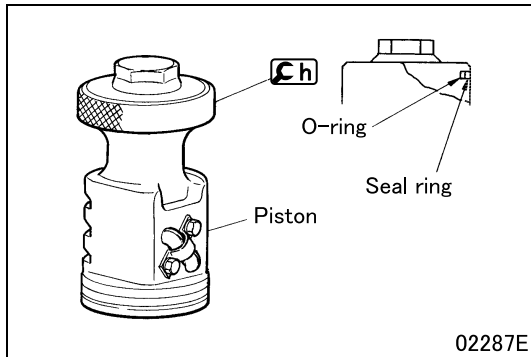


■ Installation: Adjusting plug

- Hold **Cj** with a vise and secure the valve housing to it.
- Tighten the adjusting plug to the specified torque using **Ci**, then back it up by approximately 180°.

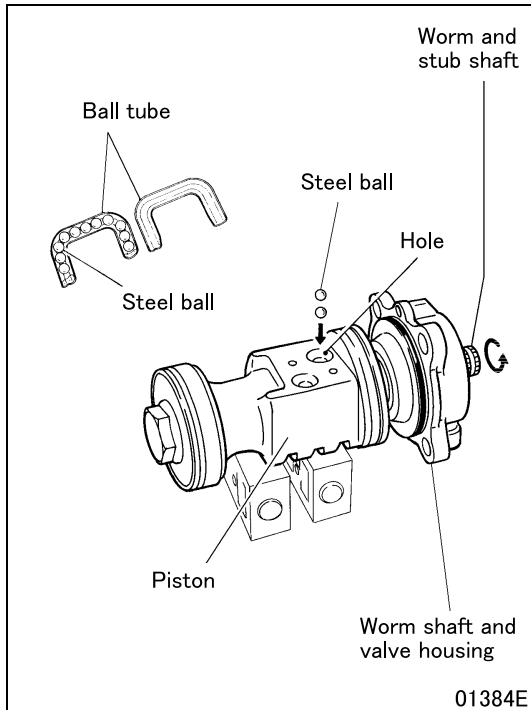


- Tighten bolt to the specified torque, then retighten the adjusting plug using **Ci**.



■ Installation: Seal ring and O-ring

- Install seal ring and O-ring in the outer surface grooves of the piston, and form the seal ring to fit in place using .

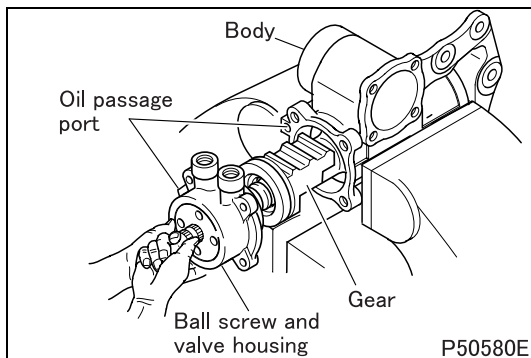


■ Installation: Ball tube

- Pack grease in one half of the ball tube, place 10 to 11 steel balls in it and put the other half upon it.
- Place the piston on a flat workbench, align the positions of the worm shaft and valve housing and piston ball race, then while turning the worm and stub shaft, let steel balls fall from the ball tube hole.

CAUTION

- Do not draw out the worm shaft and valve housing until its end passes over the ball tube hole during installation. Otherwise the steel balls will come out of the ball race.



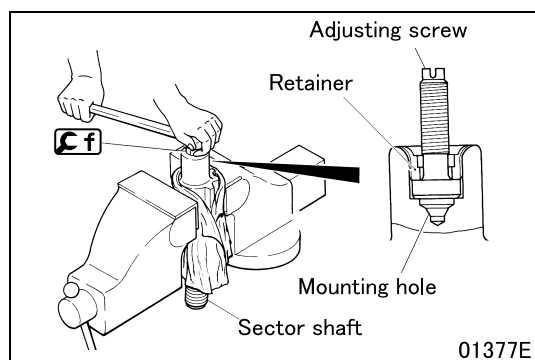
■ Installation: Ball screw and valve housing

- Position the gear toothed portion of the ball screw and valve housing in the illustrated direction so that it engages with the sector shaft.
- Install the ball screw and valve housing to the body, lightly holding it with hand so that its gear portion does not turn out of position. When installing, align the oil passage ports of the ball screw and valve housing and body.

CAUTION

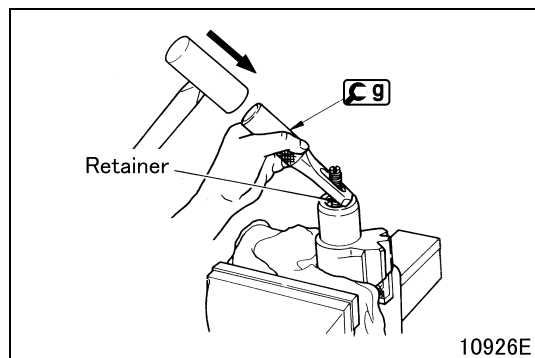
- Be careful not to damage the seal ring on the piston and the inner surface of the body.

POWER STEERING GEAR AND DRAG LINK

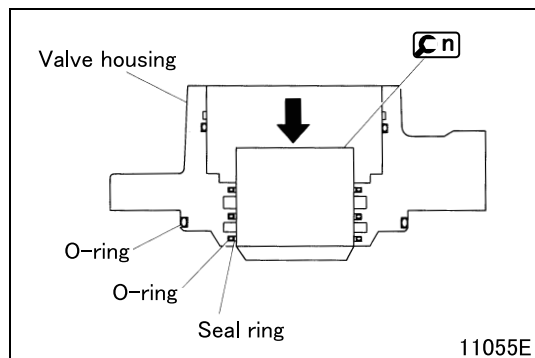


■ Installation: Retainer

- Pack grease in the adjusting screw mounting hole on the sector shaft.
- Install the adjusting screw into the sector shaft.
- Using **Cf**, tighten the retainer into place in the sector shaft.
- Back up the retainer by 180°, retighten it to a torque of 39 N·m {29 ft.lbs, 4 kgf·m}, then back it up again by 20°.
- Check that the adjusting screw turns smoothly.

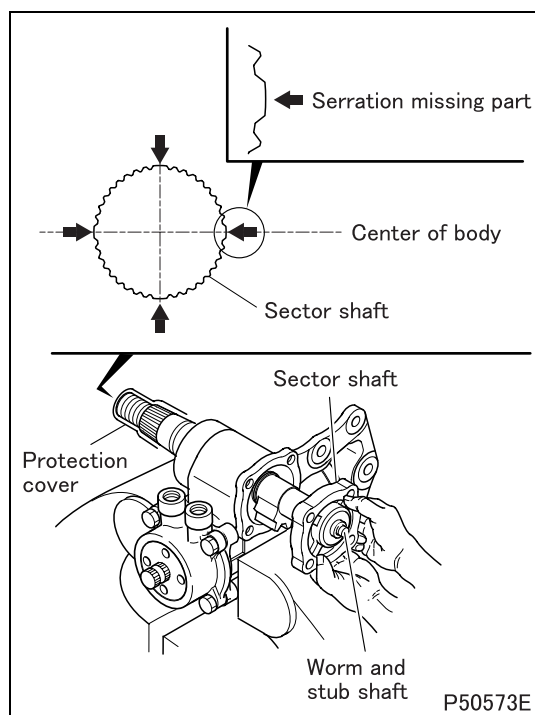


- Using **Cg**, crimp the retainer at two places.



■ Installation: Seal ring and O-rings

- Install seal ring and O-rings to the valve housing.
- Form seal ring to fit the valve housing using **Cn**.



■ Installation of sensor shaft

- Set the sector shaft in the neutral position and install it into the body.

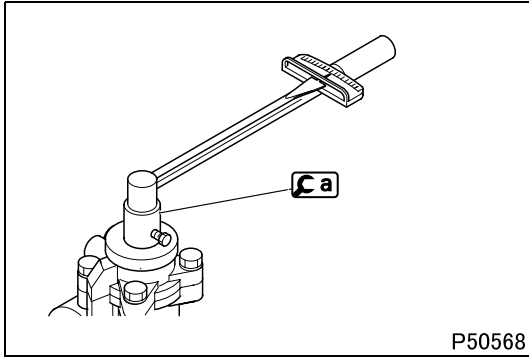
CAUTION ⚠

- When installing the sector shaft, cover up its threaded end and serration portions for protection.

NOTE

- Turn the worm and stub shaft to check that it makes roughly five turns lock to lock.
- If the number of turns is less, check engagement of the worm and stub shaft with the sector shaft, and correct if necessary.

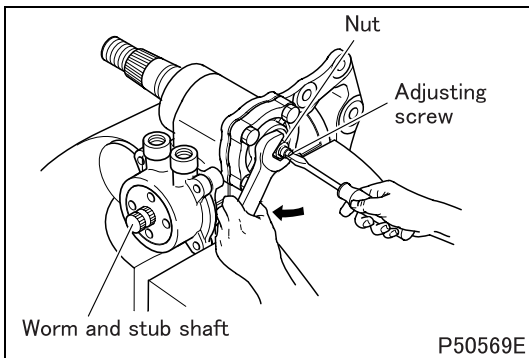
◆ Adjustment after installation ◆



■ Inspection: Starting torque

[Inspection]

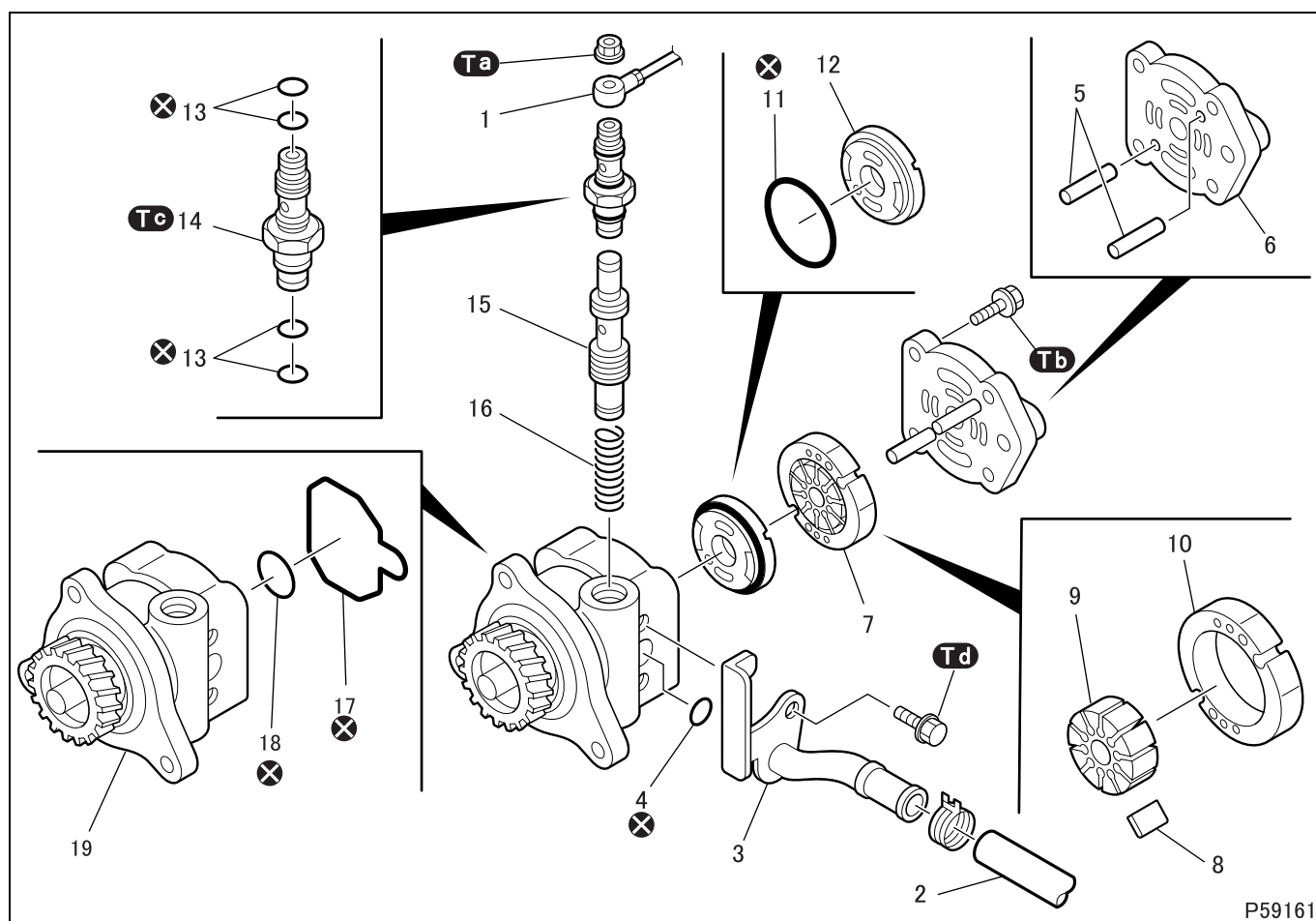
- Using **a**, measure the starting torque of the power steering gear in the same manner as the measurement before removal. If the measurement deviates from the standard value, adjust the power steering gear for proper starting torque or replace.



[Adjustment]

- Loosen nut.
- Rotating the worm and stub shaft approximately 1/4 turns left and right, make adjustment for proper starting torque with the adjusting screw.

POWER STEERING OIL PUMP <KAYABA INDUSTRY Product>



P59161

● Disassembly sequence

- | | | |
|----------------------|---------------|------------------------|
| 1 Pipe | 8 Vane | 15 Flow control valve |
| 2 Hose | 9 Rotor | 16 Flow control spring |
| 3 Suction connector | 10 Cam ring | 17 O-ring |
| 4 O-ring | 11 O-ring | 18 O-ring |
| 5 Pin | 12 Side plate | 19 Body |
| 6 Cover | 13 O-ring | |
| 7 Cartridge assembly | 14 Connector | |

⊗: Non-reusable parts

NOTE

- See Gr11 for removal and installation of the power steering oil pump.

CAUTION ⚠

- Do not disassemble the flow control valve and body.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Seal repair kit

Service standards (Unit: mm {in.})

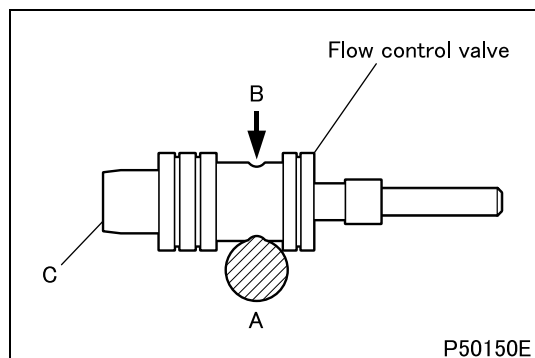
Location	Maintenance item	Standard value	Limit	Remedy
6	Stepped wear on rotor and vane contact surfaces of cover	–	0.05 {0.0020}	Replace*
8, 9	Clearance between vane and rotor	0.01 {0.00039}	0.06 {0.0024}	Replace
12	Stepped wear on rotor and vane contact surfaces of side plate	–	0.05 {0.0020}	Replace*
15, 19	Clearance between flow control valve and body	0.01 to 0.02 {0.00039 to 0.00079}	0.03 {0.0012}	Replace*
16	Free length of flow control spring	36.5 {1.44}	33.5 {1.32}	Replace

*: Replace the power steering oil pump.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Pipe mounting)	29.4 to 39.2 {22 to 29, 3 to 4}	–
Tb	Bolt (Cover mounting)	Except flange bolt	18 to 22 {13 to 16, 1.8 to 2.2}
Tc	Connector		49 to 69 {36 to 51, 5.0 to 7.0}
Td	Bolt (Suction connector mounting)		7.8 to 11.8 {5.8 to 8.7, 0.8 to 1.2}

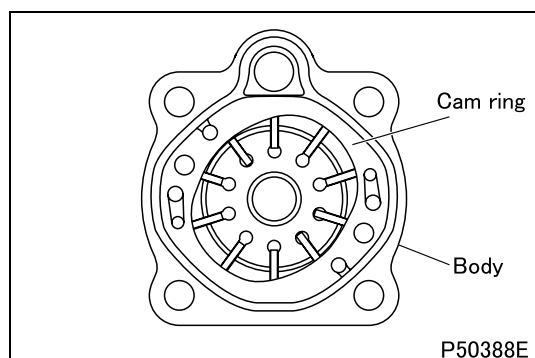
◆ Inspection procedure ◆



■ Inspection: Flow control valve

- Cover port **A** of the flow control valve with a finger.
- Apply air pressure (390 to 490 kPa {57 to 71 psi, 4.0 to 5.0 kgf/cm²}) to port **B**.
- Check for a leak of air from port **C**.
- If there is an air leakage, replace the power steering oil pump.

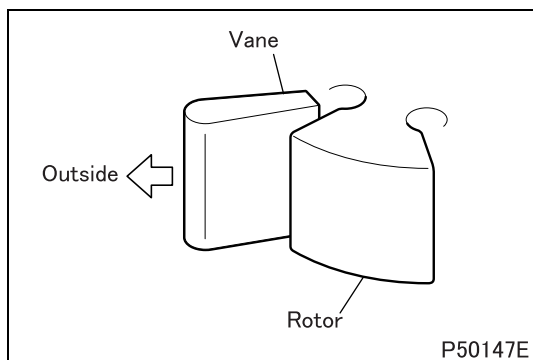
◆ Installation procedure ◆



■ Installation: Cam ring

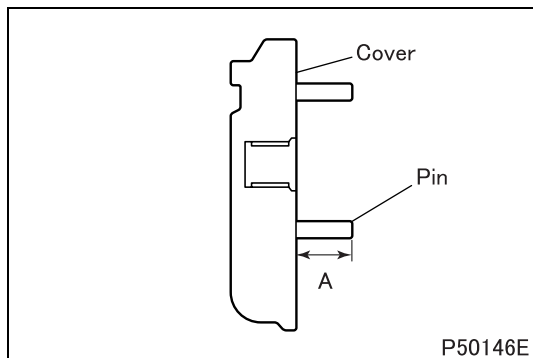
- Install the cam ring in the illustrated direction to the body.

POWER STEERING OIL PUMP <KAYABA INDUSTRY Product>



■ Installation: Vane

- Fit the vane into the rotor, with its round edge facing toward outside.

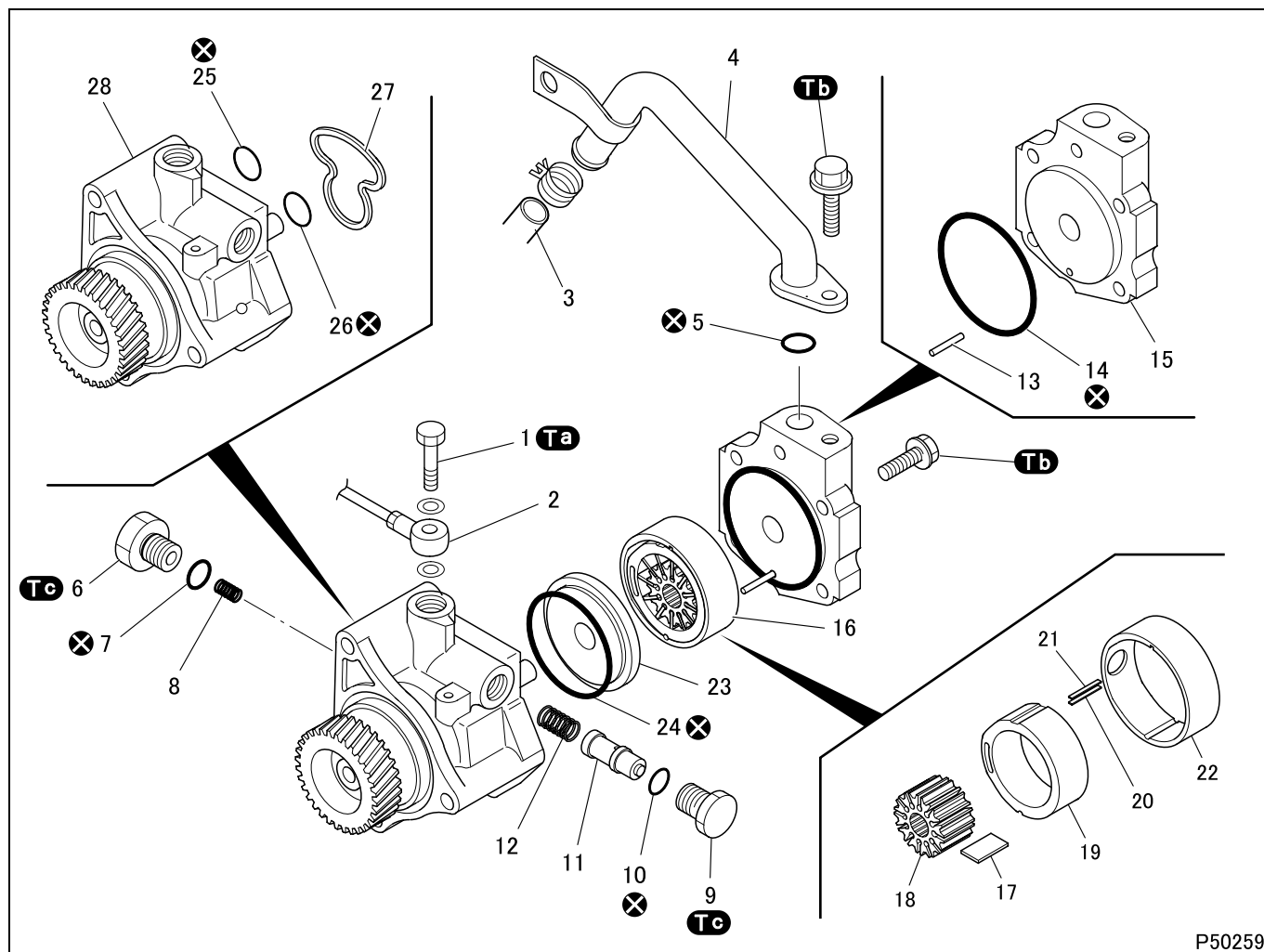


■ Installation: Pin

- Fit the pins into the cover so that they protrude to the illustrated length **A** from the cover.
A: 14.5 mm {0.57 in.}

M E M O

POWER STEERING OIL PUMP <UNISIA JKC Product>



P50259

● Disassembly sequence

- | | | |
|---------------------|-------------------------|-------------------|
| 1 Eye bolt | 11 Control valve | 21 Rubber spring |
| 2 Pipe | 12 Control valve spring | 22 Adapter |
| 3 Hose | 13 Straight pin | 23 Pressure plate |
| 4 Suction connector | 14 O-ring | 24 O-ring |
| 5 O-ring | 15 Rear body | 25 O-ring |
| 6 Plug | 16 Cartridge assembly | 26 O-ring |
| 7 O-ring | 17 Vane | 27 Seal ring |
| 8 Spring | 18 Rotor | 28 Front body |
| 9 Plug | 19 Cam ring | |
| 10 O-ring | 20 Seal | |
- ⊗: Non-reusable parts

NOTE

- See Gr11 for removal and installation of the power steering oil pump.

CAUTION ⚠

- Do not disassemble the control valve and front body.
- If the cartridge assembly is difficult to disassemble, not attempt to pry it out but heat the side surface of the front body with a dryer.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Repair kit

Service standards (Unit: mm {in.})

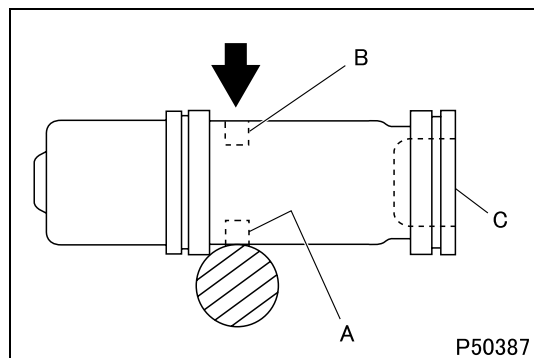
Location	Maintenance item	Standard value	Limit	Remedy
8	Free length of spring	24 {0.94}	23 {0.91}	Replace
11, 28	Clearance between control valve and front body	0.02 {0.00079}	0.03 {0.0012}	Replace*
12	Free length of control valve spring	26.2 {1.03}	23.6 {0.93}	Replace
15	Stepped wear on rotor and vane contact surfaces of rear body	–	0.01 {0.00039}	Replace*
17, 18	Clearance between vane and rotor	0.02 {0.00079}	0.03 {0.0012}	Replace
23	Stepped wear on rotor and vane contact surfaces of pressure plate	–	0.01 {0.00039}	Replace*

*: Replace the power steering oil pump.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eye bolt (Pipe mounting)	49.0 to 63.7 {36 to 47, 5.0 to 6.5}	–
Tb	Bolt (Suction connector mounting)	17.7 to 24.5 {13 to 18, 1.8 to 2.5}	–
	Bolt (Rear body mounting)		
Tc	Plug	29.4 to 39.2 {22 to 29, 3.0 to 4.0}	–

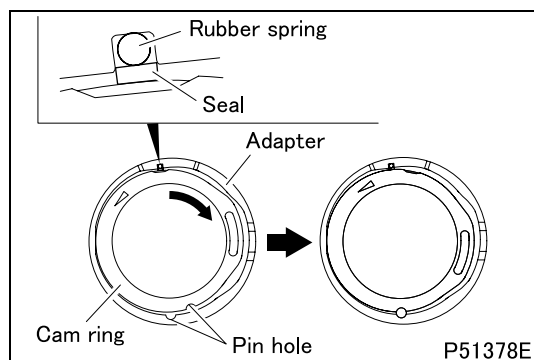
◆ Inspection procedure ◆



■ Inspection: Control valve

- Cover port **A** of the control valve with a finger.
- Apply air pressure (390 to 490 kPa {57 to 71 psi, 4.0 to 5.0 kgf/cm²}) to port **B**.
- Check for a leak of air from port **C**.
- If there is an air leakage, replace the control valve.

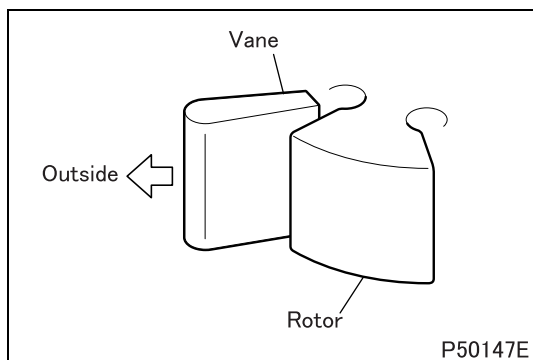
◆ Installation procedure ◆



■ Installation: Seal and rubber spring

- Align the peripheral groove of the cam ring to the inner groove of the adapter, then fit the rubber spring (black) into the adapter and the seal (white) into the cam ring.
- Turn the cam ring clockwise to align pin holes.

POWER STEERING OIL PUMP <UNISIA JKC Product>



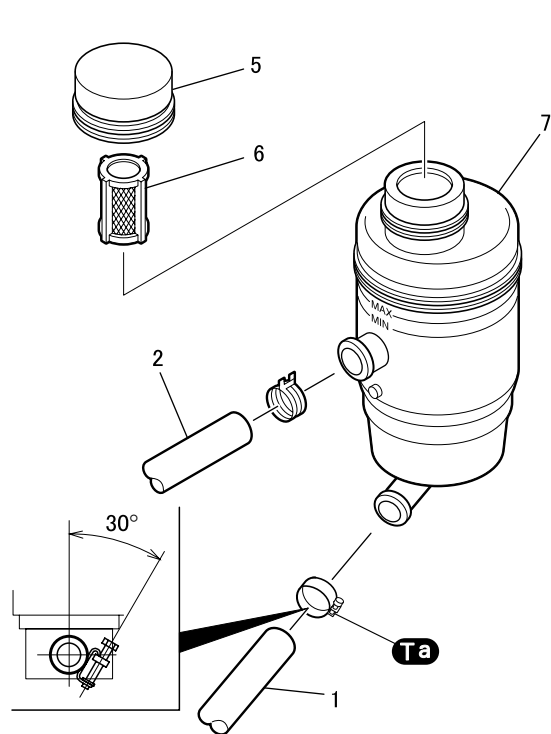
■ Installation: Vane

- Fit the vane into the rotor, with its round edge facing toward outside.

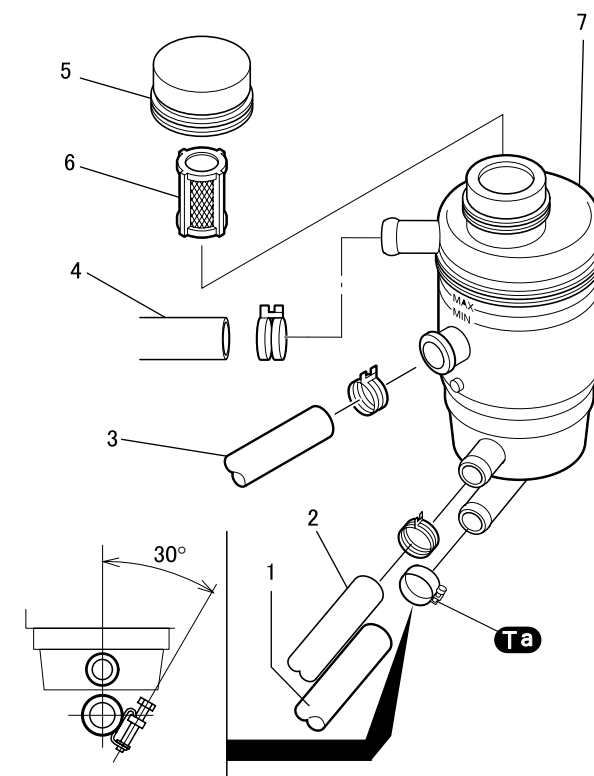
M E M O

POWER STEERING OIL TANK

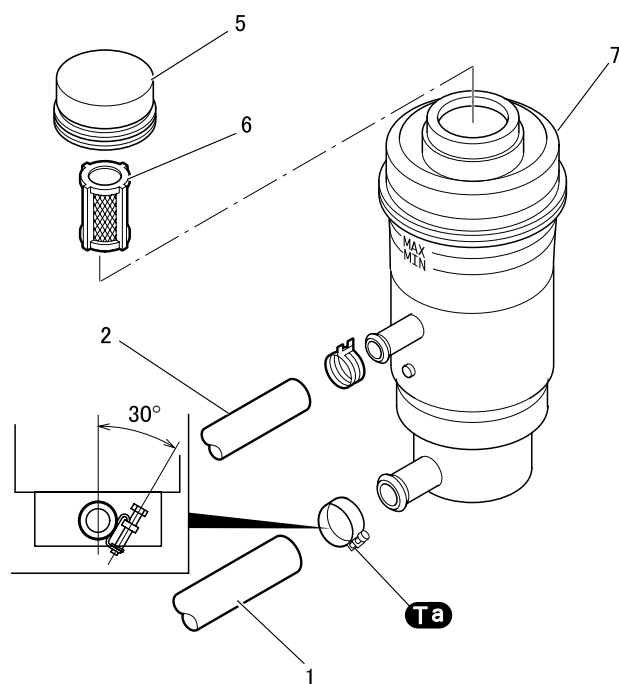
<FE (Except FE84DHWSL, FE85)>



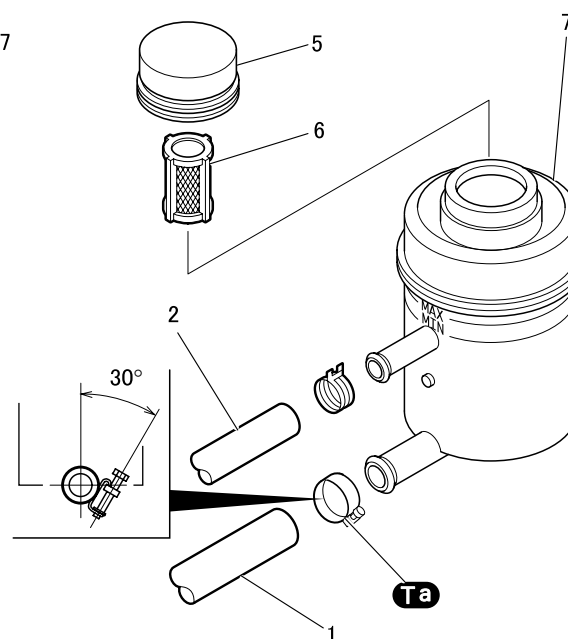
<FE84DHWSL>



<FE85>



<FG>



● Disassembly sequence

- | | |
|--------------------|------------|
| 1 Hose | 5 Cap |
| 2 Hose | 6 Strainer |
| 3 Hose <FE84DHWSL> | 7 Body |
| 4 Hose <FE84DHWSL> | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	2.9 to 3.4 {2.1 to 2.5, 0.30 to 0.35}	–



Group 41

Frame

Table of Contents

BACK

HOME

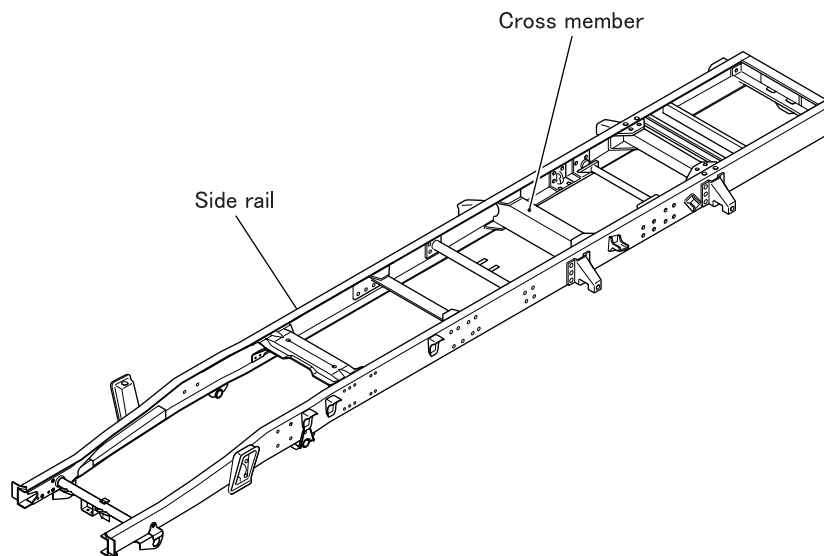
 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	41-2
STRUCTURE AND OPERATION	41-3
FRAME	41-4

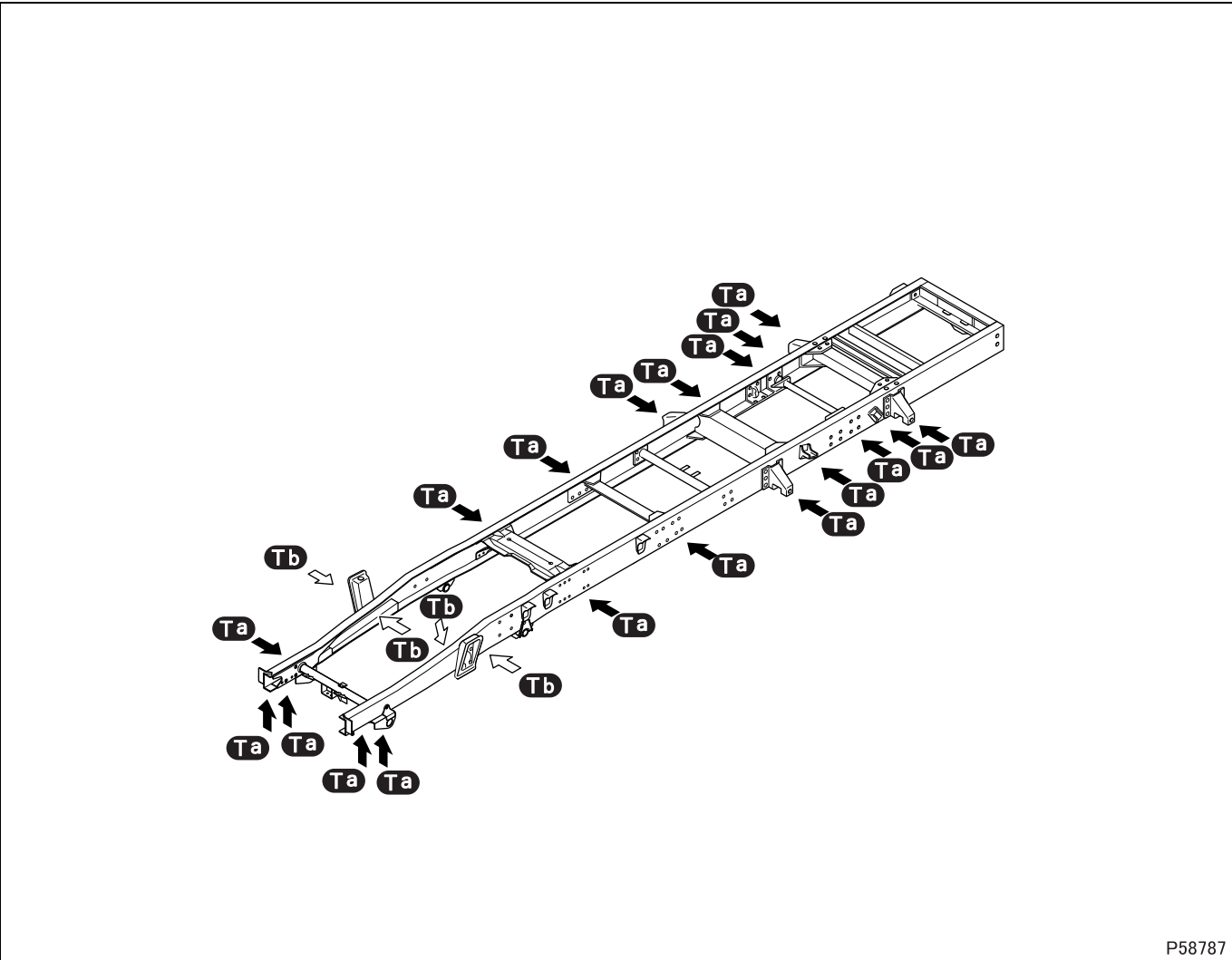
SPECIFICATIONS

Item	Specifications	
	Except 4WD	4WD
Frame type	Ladder type	
Cross section configuration of side rail	 shaped (open) channel section	 shaped (open) channel section



P58786E

- The frame has cross members fastened to the web of side rails (lateral linkage) so that stress on the joints is very small. This allows joint rivets to maintain tightness and ensures long-lasting high torsional stiffness.
- Unlike vertical linkage where cross members are fastened to the flange of side rails, no rivets appear on top of the frame, making the body mounting greatly easier.



P58787

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	M10 bolt or nut	60 to 80 {43 to 58, 6 to 8}	–
Tb	M12 bolt or nut	98 to 120 {72 to 87, 10 to 12}	–

◆ **Cleaning procedure** ◆

■ **Cleaning: Frame**

- Thoroughly remove mud, grease, rust etc. from the outer and inner surfaces of the frame.

◆ **Inspection procedure** ◆

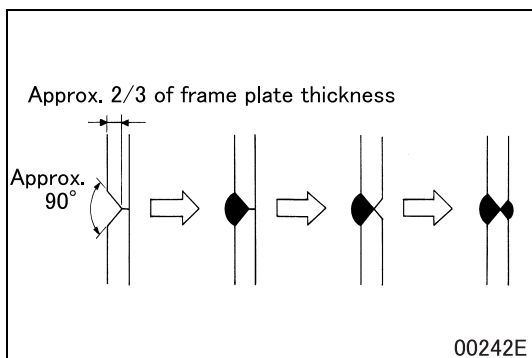
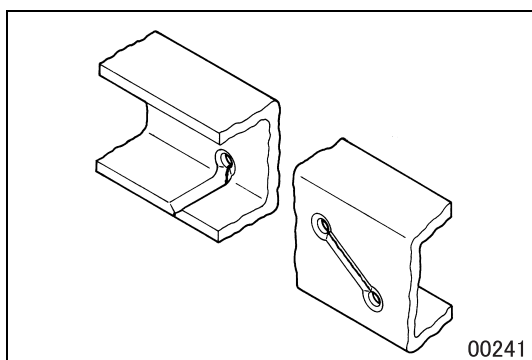
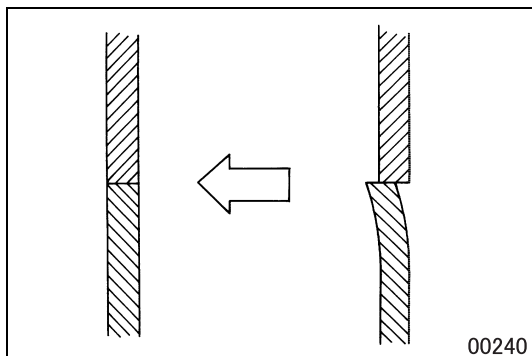
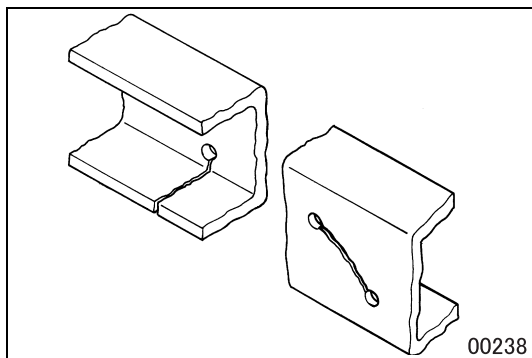
■ **Inspection: Frame**

(1) Inspection for deformation

- If deformation or any other defect is found, repair the frame.

(2) Inspection for cracks

- Remove paint from suspected areas and carefully inspect exposed surfaces for cracks.
 - If visual inspection is difficult, perform dye check or any other suitable examination.
- If a crack is found, repair as follows.



(3) Repair of crack in frame

- With the vehicle unloaded, level the frame.
- Drill a hole, roughly twice the thickness of frame plate in diameter, 10 mm {0.39 in.} from the inside end of crack.

NOTE

- If crack is within the frame plate, drill holes at both ends of the crack.

- If the edges of crack are uneven, make them even.

- Using a grinder, cut a 90° V-channel at the crack to a depth of approximately 2/3 of the frame plate thickness, then fill the channel with filler metal by welding.

CAUTION ⚠

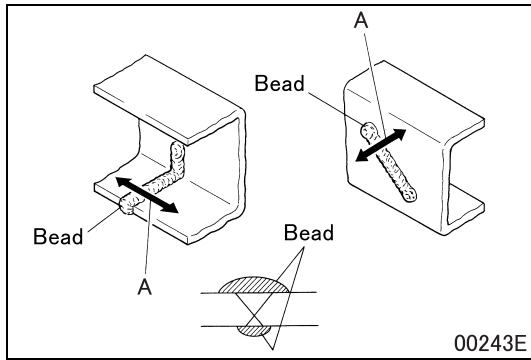
- Avoid gas welding because heat embrittles the material of welded area. Be sure to use electric welding.
- Electric welding could allow the welding current to reverse through ground circuit and burn electrical components. To prevent this, be sure to disconnect negative cable from the battery and ground the welding machine at a point near the weld zone before work.
- For electric welding, follow other precautions given elsewhere.
- If there are any combustibles, such as pipeline, wiring harness, rubber part and fuel tank, near the weld zone, be sure to cover them for protection.
- Use low-hydrogen type coated CO₂ and arc welding electrodes for welding and check that there are not harmful defects such as undercut and blow hole after welding.
- Preheat the area around weld zone to approximately 50 to 350°C {120 to 660°F} before welding when the workshop temperature is below 0°C {32°F}.
- Be sure to protect mountings that may be affected by heat, such as main sills, using heat insulators or the like.

- Then, make a similar V-channel on the opposite side of the weld and fill it with filler metal by electric welding as well. At the same time, deposit metal to cover up the hole or holes at both ends of the crack by welding.

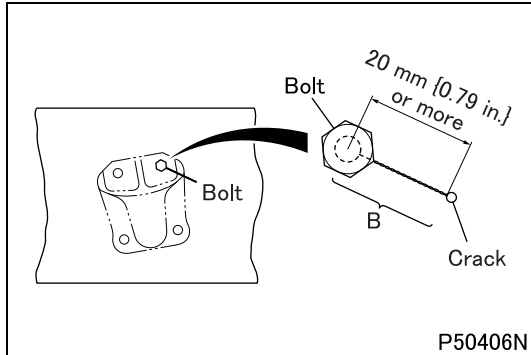
NOTE

- In cold districts, heat the weld zone to approximately 200°C {390°F} after welding.

FRAME

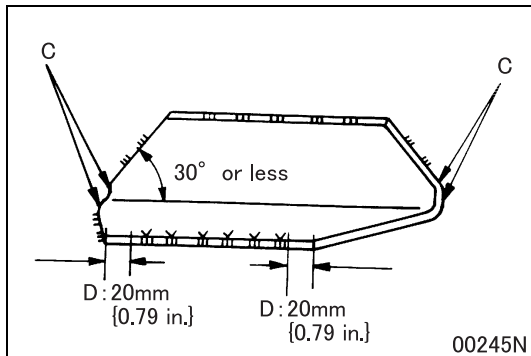


- After welding, run a grinder over the bead at right angles **A** to remove the hatched portion from the weld on each side of the plate.
- Finish the ground surfaces flat to a thickness equal to the original plate thickness.



[Repairing crack from rivet or bolt hole]

- To make the edges of cracked hole even, temporarily tighten bolt in the hole.
- First weld to close the crack at a point at least 20 mm {0.79 in.} apart from the center of the bolt.
For this welding, refer to the aforementioned welding procedures for crack repair.
- Remove the temporary bolt. After making hole edges even, weld to close the rest **B** of the crack. Fill the hole with weld metal at the same time.
- Drill a hole at the location of original hole, and install a rivet or bolt in it.



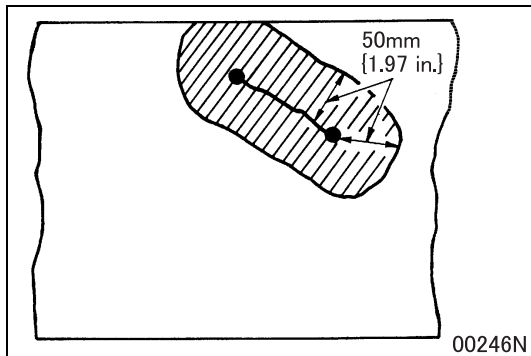
[Repairing using reinforcement plate]

- To prevent the concentration of welding stress at both ends **C** of the reinforcement plate, cut the ends at a bevel of 30° or less for welding. Do not weld at points **D**.
- The reinforcement plate must have enough to cover the cracked area.

NOTE

- **Reinforcement plate thickness:** Equal to frame plate thickness
- **Reinforcement plate material:** As specified below or equivalent

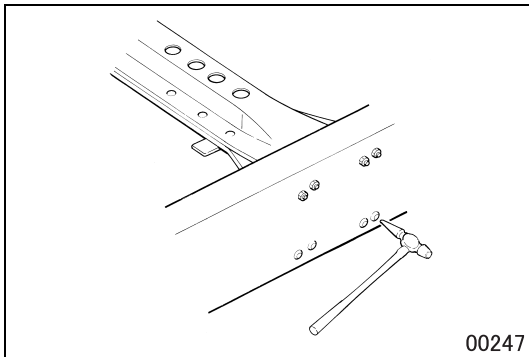
SAPH440 (Hot rolled steel for automobiles), or
SS400 (Rolled steel for general structures)



- After welding, heat the hatched area to 600 to 700°C {1110 to 1292°F}.

CAUTION ⚠

- Be sure to protect mountings that may be affected by heat, such as main sills, using heat insulators or the like.

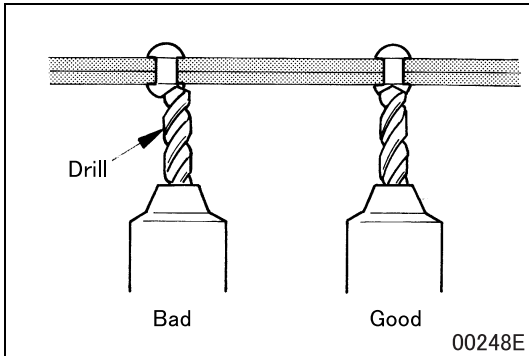


(4) Inspection of rivets for looseness

- Lightly tap the head of each rivet using an inspection hammer and feel or listen for the echo to determine if the rivet is loose.
- Rusting between rivet and frame plate is an indication of loosened rivet.

CAUTION

- **Be sure to replace loose rivets. They could break off or allow cracks to develop from the rivet holes, leading to an accident.**

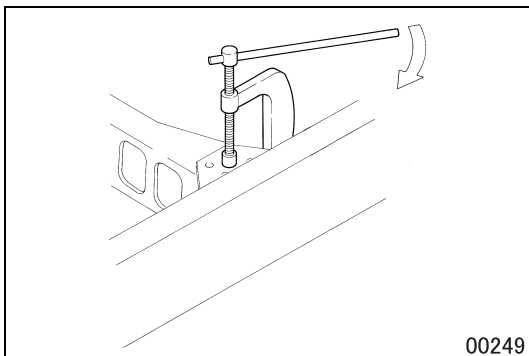


(5) Replacement of rivet

- To remove a loosened rivet, eliminate its head using a drill or grinder. When a drill is used, make a dent in the middle of the rivet's head and align the drill bit to the dent as shown.

NOTE

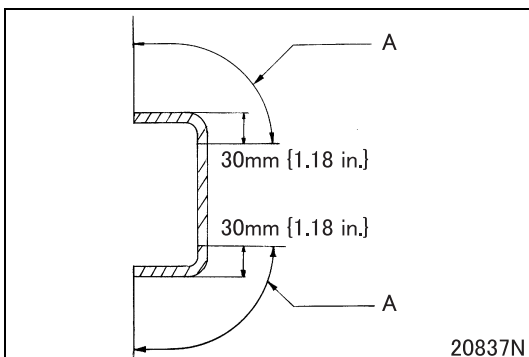
- **The rivet hole must be intact.**



- Before rivetting, clamp the two plates closely together near the rivet hole using a C vice.
- Using a rivetting machine, drive the rivet (cold rivet) into the rivet hole.
- If rivetting is impracticable, ream the rivet hole, drive a reamer bolt in the hole, fully tighten the nut, then weld it in place. As the reamer bolt and nut, use a flange bolt and a flange nut.

(6) Inspection of bolts and nuts for looseness

- Inspect the bolts attaching cross members to the side rails for looseness. If any loose bolt is found, retighten it to specified torque.



(7) Drilling hole in frame

- When drilling holes in the frame becomes necessary, perform it using care in the following respects.

CAUTION

- **When drilling holes in the side rail, avoid the illustrated ranges A to prevent cracking.**
- **Grind the edge of drilled hole smooth.**



Group 42

Cab

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	42-2
STRUCTURE AND OPERATION	
1. Front Cab Mounting.....	42-3
2. Rear Cab Mounting <Except Crew Cab>	42-4
3. Center and Rear Cab Mountings <Crew Cab>	42-4
4. Cab Tilt Link <Except Crew Cab>	42-5
TROUBLESHOOTING	42-6
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Adjustment of Cab Tilt System <Except Crew Cab>.....	42-8
REMOVAL AND INSTALLATION OF CAB	
<EXCEPT CREW CAB>	42-10
<CREW CAB>	42-14
FRONT CAB MOUNTING	
<EXCEPT CREW CAB>	42-18
<CREW CAB>	42-20
REAR CAB MOUNTING <EXCEPT CREW CAB>	42-22
CENTER AND REAR CAB MOUNTINGS <CREW CAB>	42-23
CAB TILT LINK <EXCEPT CREW CAB>	42-24
CAB STAY <EXCEPT CREW CAB>	42-26

SPECIFICATIONS

Cab

Item	Specifications	
	Except crew cab	Crew cab
Type	Cab-over type (forward control type)	Cab-over crew cab type (forward control type)
Mass kg {lb}	410 {905}	630 {1390}

Cab Mounting

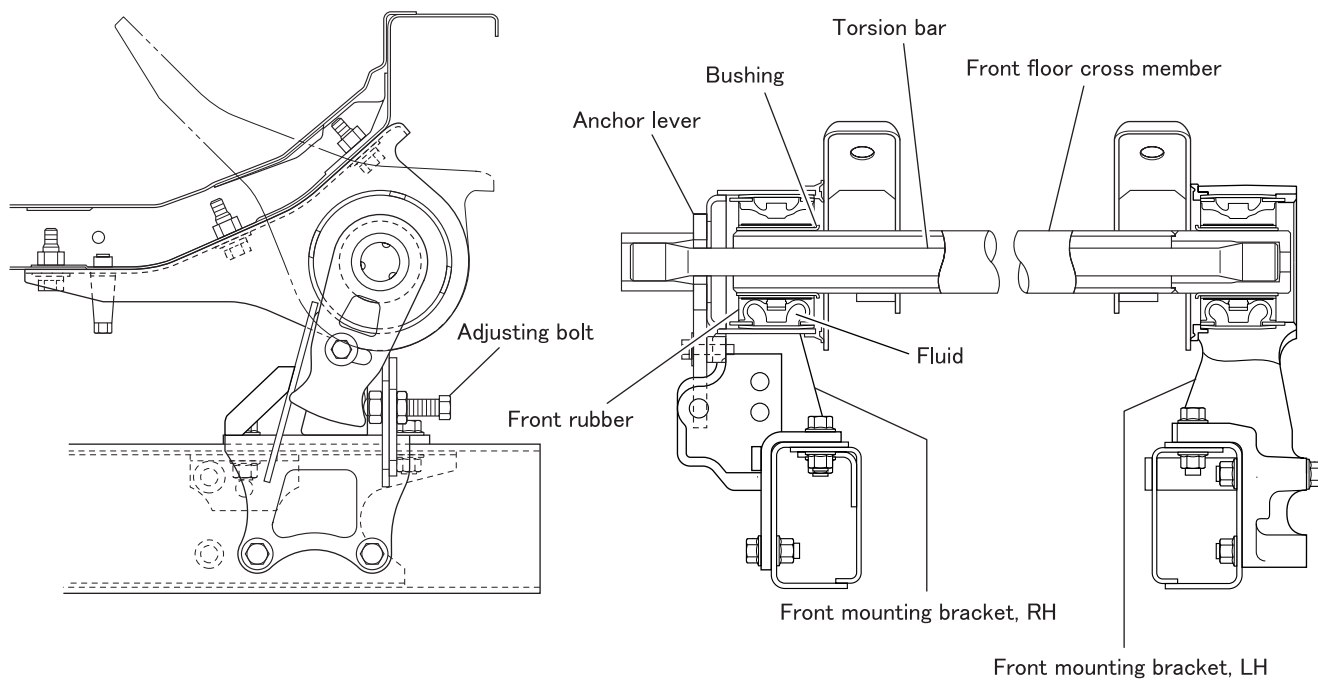
Item	Specifications		
	Except crew cab	Crew cab	
		Front cab mounting	Rear cab mounting
Type	Semi-floating type		Fixed type
Kind	Liquid-filled rubber cushioned mounting		Rubber cushioned mounting

Cab Tilt System <Except crew cab>

Item	Specifications
Type	Torsion bar type
Tilt angle	45°
Cab tilt lock	Manually operated hook type

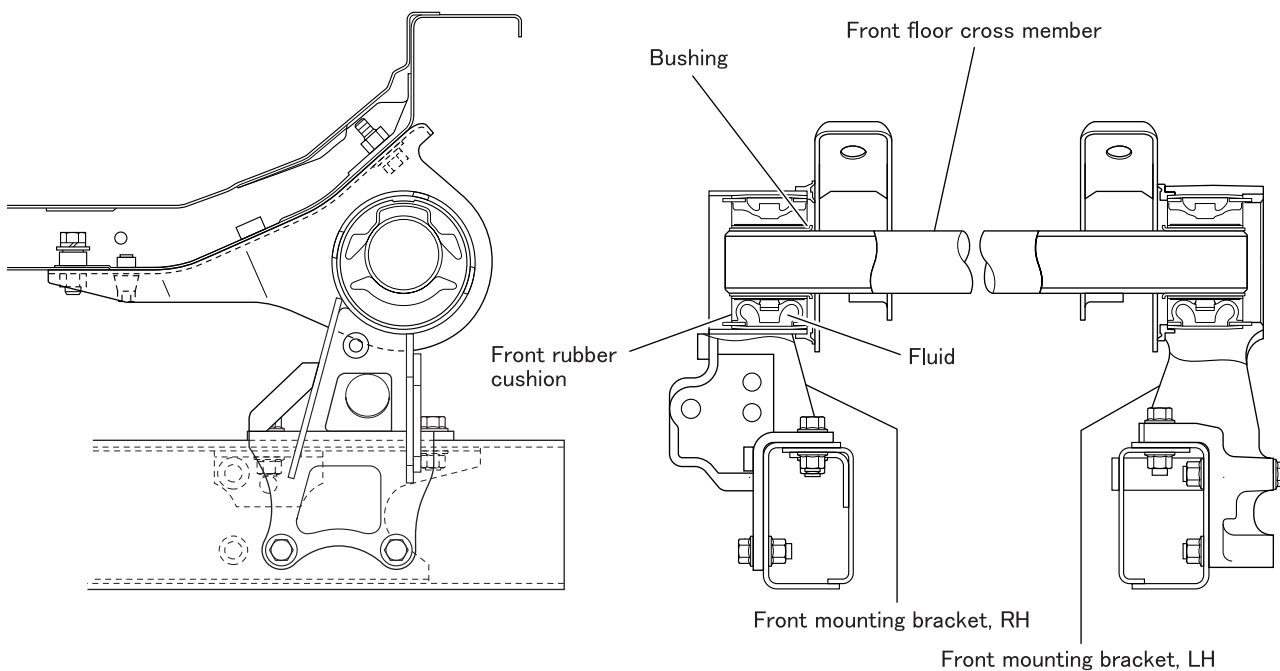
1. Front Cab Mounting

<Except crew cab>



P58035E

<Crew cab>

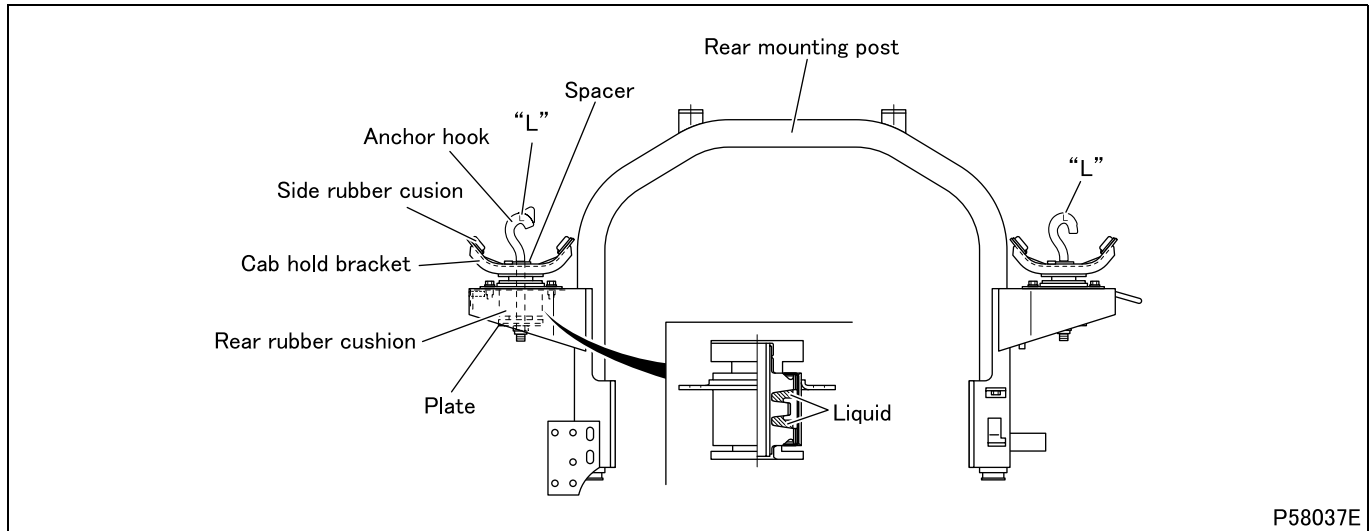


P58036E

- The operating physical force for the cab tilt system can be adjusted using the adjusting bolt of the front mounting bracket. <Except crew cab>
- The front rubber cushion reduces the vibration and noise of the cab.

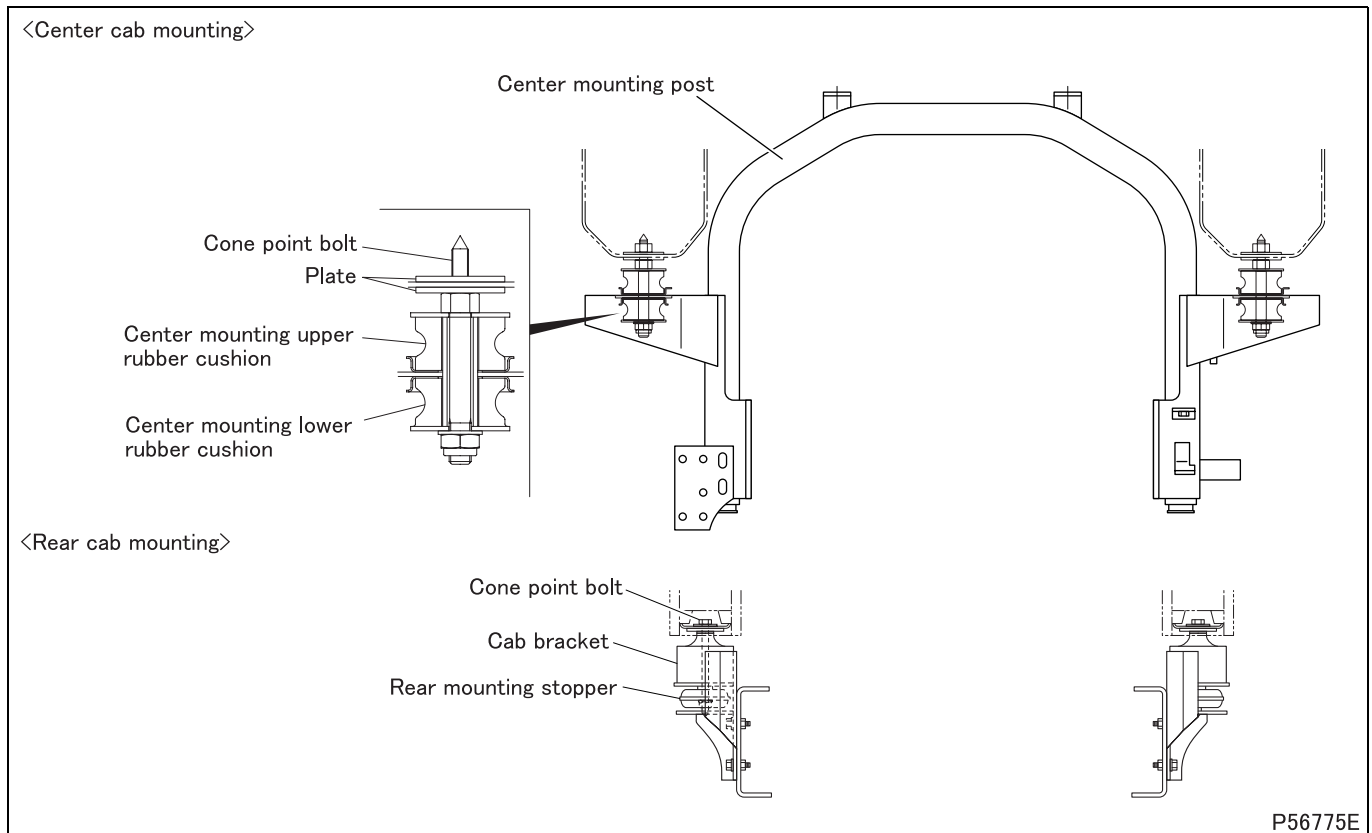
STRUCTURE AND OPERATION

2. Rear Cab Mounting <Except Crew Cab>



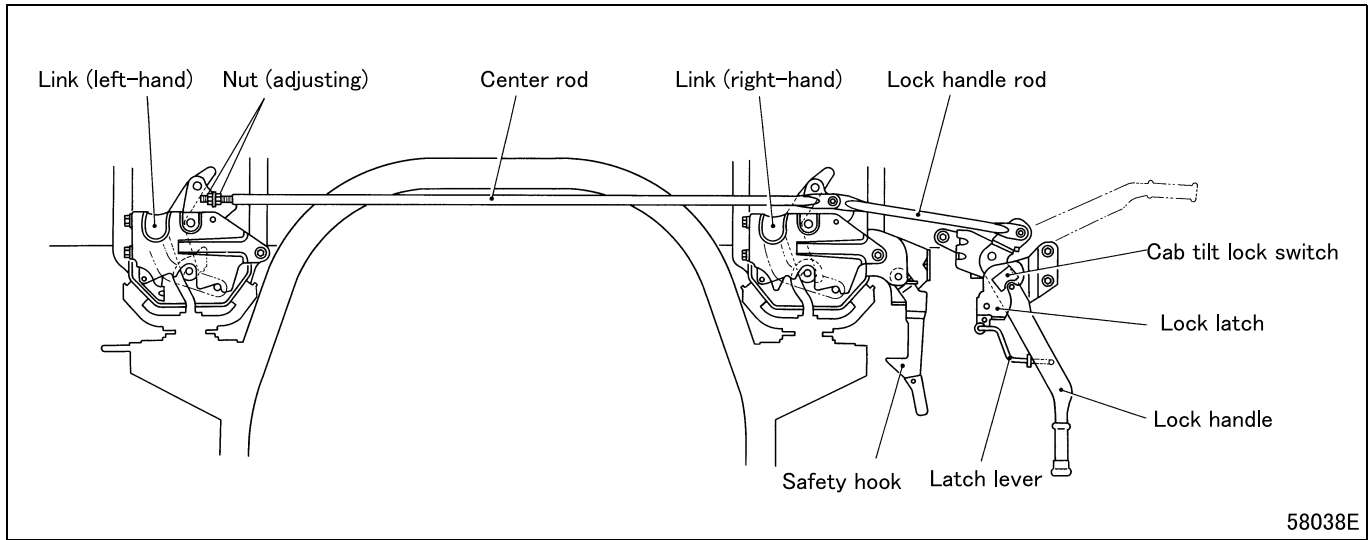
- The operating physical force for the lock handle can be adjusted by increasing and decreasing the number of spacers provided between anchor hook and cab hold bracket.
- Rear mounting upper and lower rubber cushions reduce the vibration and noise of the cab.

3. Center and Rear Cab Mountings <Crew Cab>



- Center mounting upper and lower rubber cushions reduce the vibration and noise of the cab.

4. Cab Tilt Link <Except Crew Cab>



- The length of center rod is adjustable with the adjusting nut.
- The cab tilt lock switch of the manual cab tilt system monitors the locking status of the lock handle.

TROUBLESHOOTING

Cabs in general

Symptoms			Cab shimmy (vibration with pitching and rolling)	High-frequency vibration (above 20Hz) and noise in cab and steering wheel	Reference Gr
Cab-related problems	Front cab mounting	Front mounting bracket loose, play	O		
		Sagging of front rubber cushion		O	
	Center or rear cab mounting	Sagging of mounting rubber cushion		O	
	Cab improperly mounted			O	
Engine-related problems		Propeller shaft inclination angle excessive due to increased tilt angle caused by deteriorated engine mounting		O	Gr11
		Engine improperly mounted		O	
		Intake and exhaust system components improperly installed		O	Gr15
Transmission-related problem		Transmission improperly mounted		O	Gr22
Propeller shaft-related problems		Propeller shaft runout excessive		O	Gr25
		Universal joint excessively worn		O	
		Backlash excessive at slip yoke joint		O	
		Center bearing play excessive		O	
		Angle at propeller shaft joint excessive due to deteriorated center bearing rubber cushions or other causes		O	
		Angle at propeller shaft joint excessive due to increased tilt of drive axle caused by overloading		O	
Front axle-related problem		Sympathetic vibrations from axle seat	O		Gr26
Rear axle-related problems		Reduction gears in poor mesh		O	Gr27
		Differential gears in poor mesh		O	
Wheel and tire-related problems		Wheel and tire runout excessive	O		Gr31
		Wheels and tires out of balance	O		
		Use of tires different in size or type	O		
		Wheel mounting surface deformed	O		
Front suspension-related problem		Friction excessive between spring leaves	O		Gr33
Brake-related problems		Brake drum out of balance <Drum brake>	O		Gr35A
		Brake drum eccentric <Drum brake>	O		
		Disc brake rotor runout <Disc brake>	O		

Manual cab tilt system

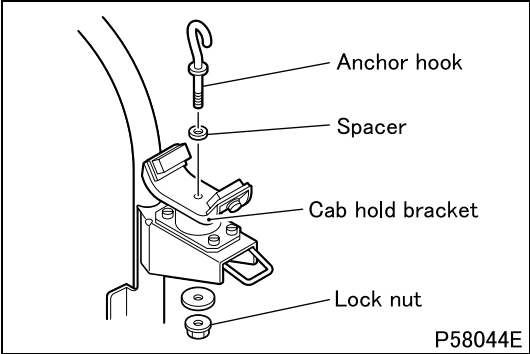
Symptoms					Reference Gr
	Cab fails to tilt up.	Cab cannot lock on rear mounting post.	Cab tilt warning lamp fails to come on.	Cab tilt warning lamp fails to go out.	
Probable causes					
Main hook not released	O				
Safety hook not released	O				
Torsion bar damaged or fatigued	O				
Main hook does not engage with hook pin bracket		O			
Cab tilt lock switch poorly adjusted			O	O	
Cab tilt lock switch faulty			O	O	
Cab tilt warning lamp faulty			O		
Fuse or high current fuse blown			O		
Wiring open-circuited or improperly connected			O		

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Adjustment of Cab Tilt System <Except Crew Cab>

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
—	Lock nut (Anchor hook fitting)	83 to 98 {61 to 72, 8.5 to 10}	—



(1) Adjustment of lock handle operating physical force

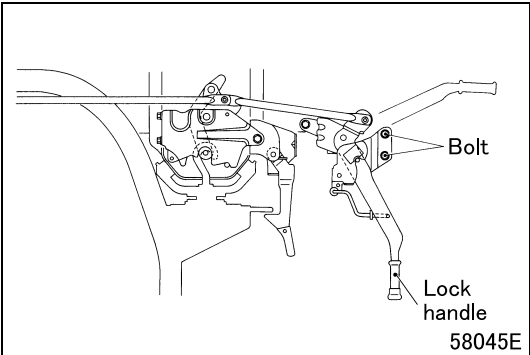
- Remove the lock nut, then remove the anchor hook.
- Adjust the operating physical force increasing or decreasing the number of spacers between anchor hook and cab hold bracket as follows.

	Number of spacers
If lock handle feels too heavy	Increase
If lock handle feels too light	Decrease

- After adjustment, tighten the lock nut to the specified torque.

CAUTION ⚠

- If the lock handle feels too light, it is an indication that the handle could be easily unlocked by the vibration of the running vehicle. In such a case, there is a possibility that the cab tilt lock switch does not respond and the tilt warning lamp is lit.

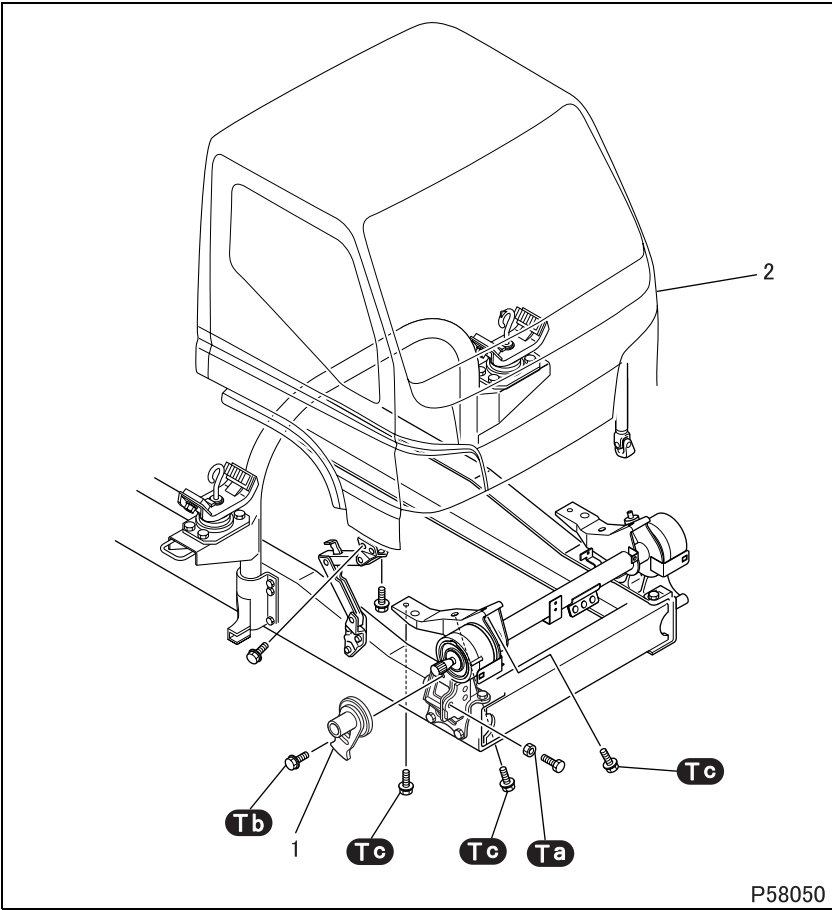


(2) Adjustment of latch

- If the latch resists, loosen bolts and adjust the installed position of the lock handle using bolt slot.
- After adjustment, retighten the bolts.

M E M O

REMOVAL AND INSTALLATION OF CAB <EXCEPT CREW CAB>



● Removal sequence

- 1 Anchor lever
- 2 Cab

CAUTION ⚠

- During removal and installation of the cab, the parking brake is not available for holding the vehicle at a standstill. Therefore, be sure to apply chocks to the tires to ensure that the vehicle does not move.
- Never remove the chocks until all the operations are completed.
- Disconnect all cables, hoses and wires before removal and installation of the cab.

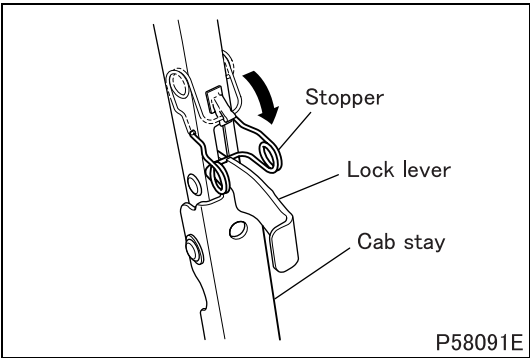
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (Anchor lever adjusting bolt locking)	59 to 83 {43 to 61, 6 to 8.5}	–
Tb	Bolt (Anchor lever attaching)	34 to 54 {25 to 40, 3.5 to 5.5}	–
Tc	Bolt (Cab mounting)	70 to 95 {51 to 70, 7.1 to 9.7}	–

◆ Removal procedure ◆

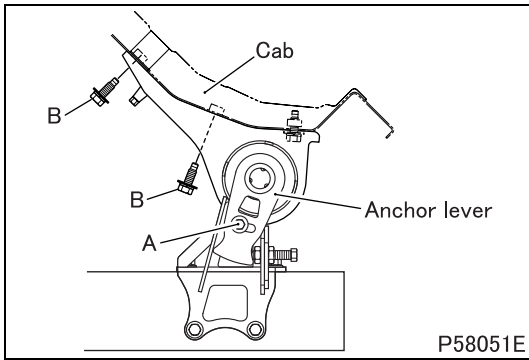


■ Removal: Cab

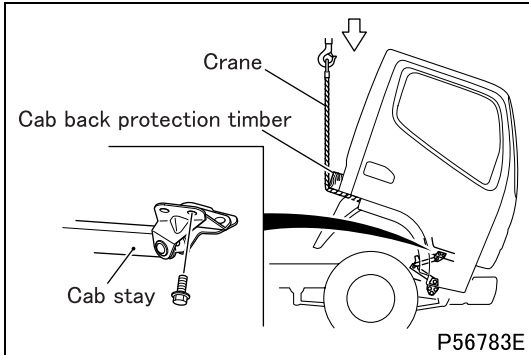
- Tilt the cab to securely lock the cab stay.

WARNING ⚠

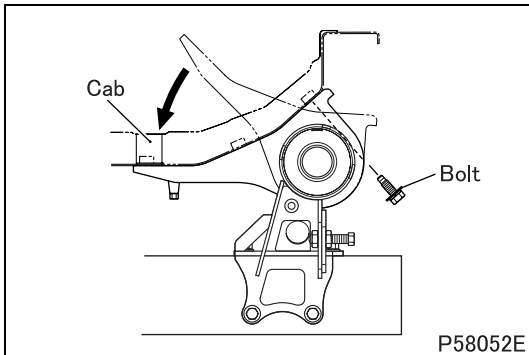
- Be sure to fit the stopper onto the lock lever to lock the cab stay.



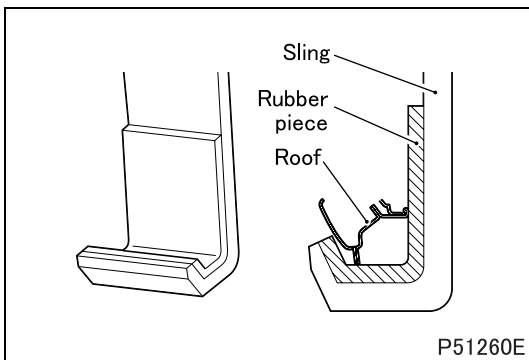
- Remove the bolt **A**, then detach the anchor lever.
- Remove the bolts **B** holding the cab in place.



- Supporting the tilted cab with the crane, remove the cab stay.

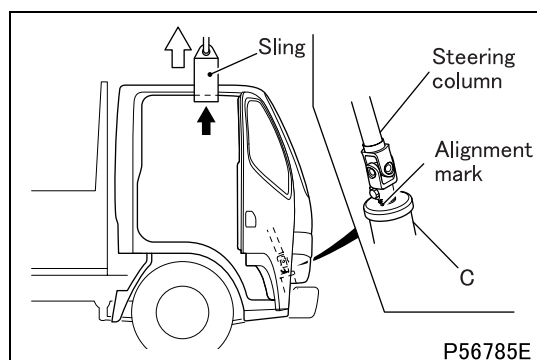


- Lower the cab all the way, then remove bolt.



- Make available a sling rigid enough to carry the weight of the cab.
- The hook portion of the sling must be lined with a rubber piece as shown to prevent deformation of the roof of the cab.

REMOVAL AND INSTALLATION OF CAB <EXCEPT CREW CAB>



- Hook the sling on the cab roof as shown, then hoist the cab a little to see if it maintains level (balanced at the center of gravity).
- Provide alignment marks on the power steering gear **C** and steering column, then separate the steering column.
- To prevent the steering column from falling off, tie it securely to the cab using a rigid cord.
- Lift off the cab straight.

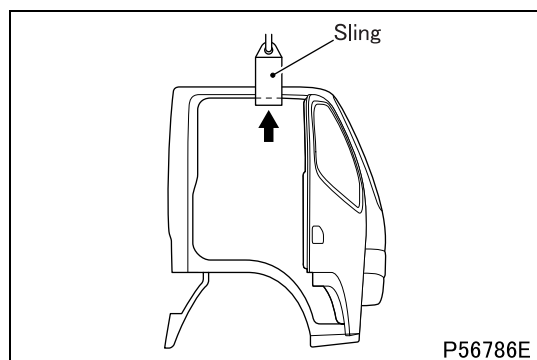
WARNING ⚠

- While the cab is up in the air, be sure to stay out from under it.

CAUTION ⚠

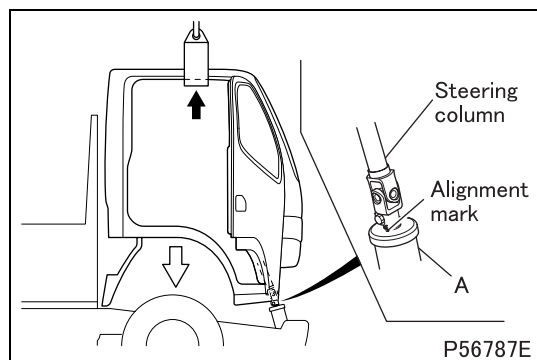
- Before lifting the cab, check to ensure that cables, hoses, wires, etc. have been all disconnected.

◆ Installation procedure ◆

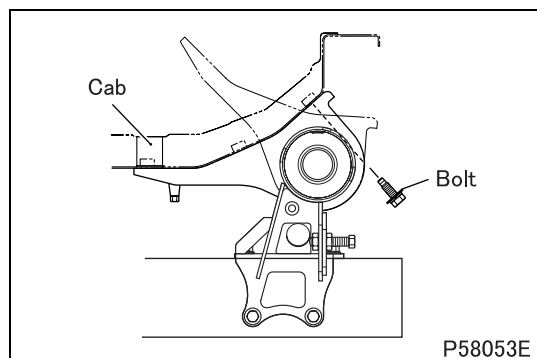


■ Installation: Cab

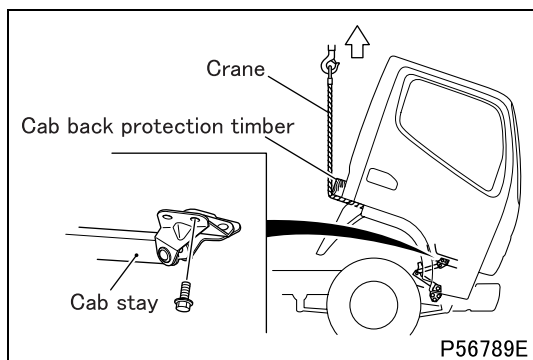
- Hook the sling at center-of-gravity points on both sides of the cab roof, and lift the cab.



- Slowly lower the cab halfway.
- Join the power steering gear **A** and steering column together in accordance with the alignment marks.



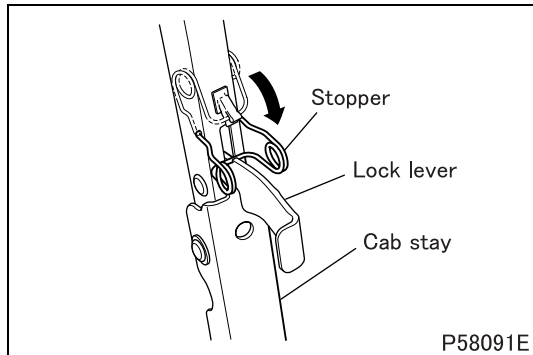
- Further lower the cab slowly to mount in position, then unhook the sling.
- Tighten mounting bolts to specified torque.



- Before tilting, support the cab using the crane.
- Tilt the cab with the crane, and install the cab stay.

WARNING ⚠

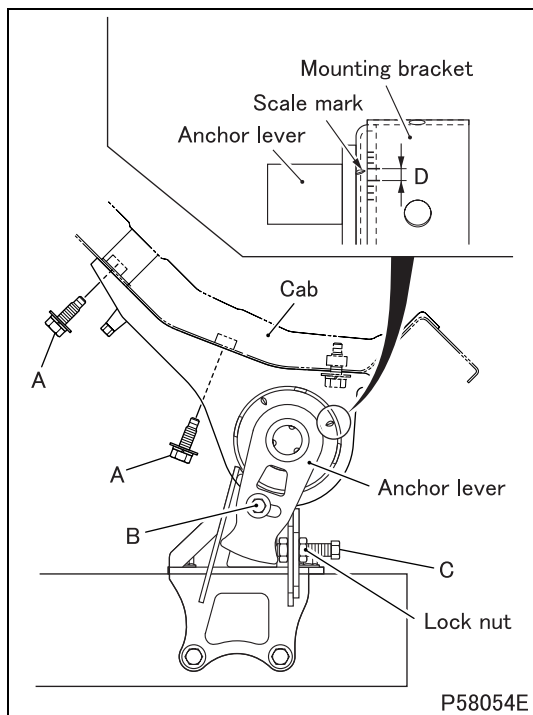
- **Be careful not to tilt the cab more than necessary. Doing so is extremely dangerous because it causes the cab to fall down forward.**



- After the cab stay is installed, tilt the cab to securely lock the cab stay. Then, remove the crane from the cab.

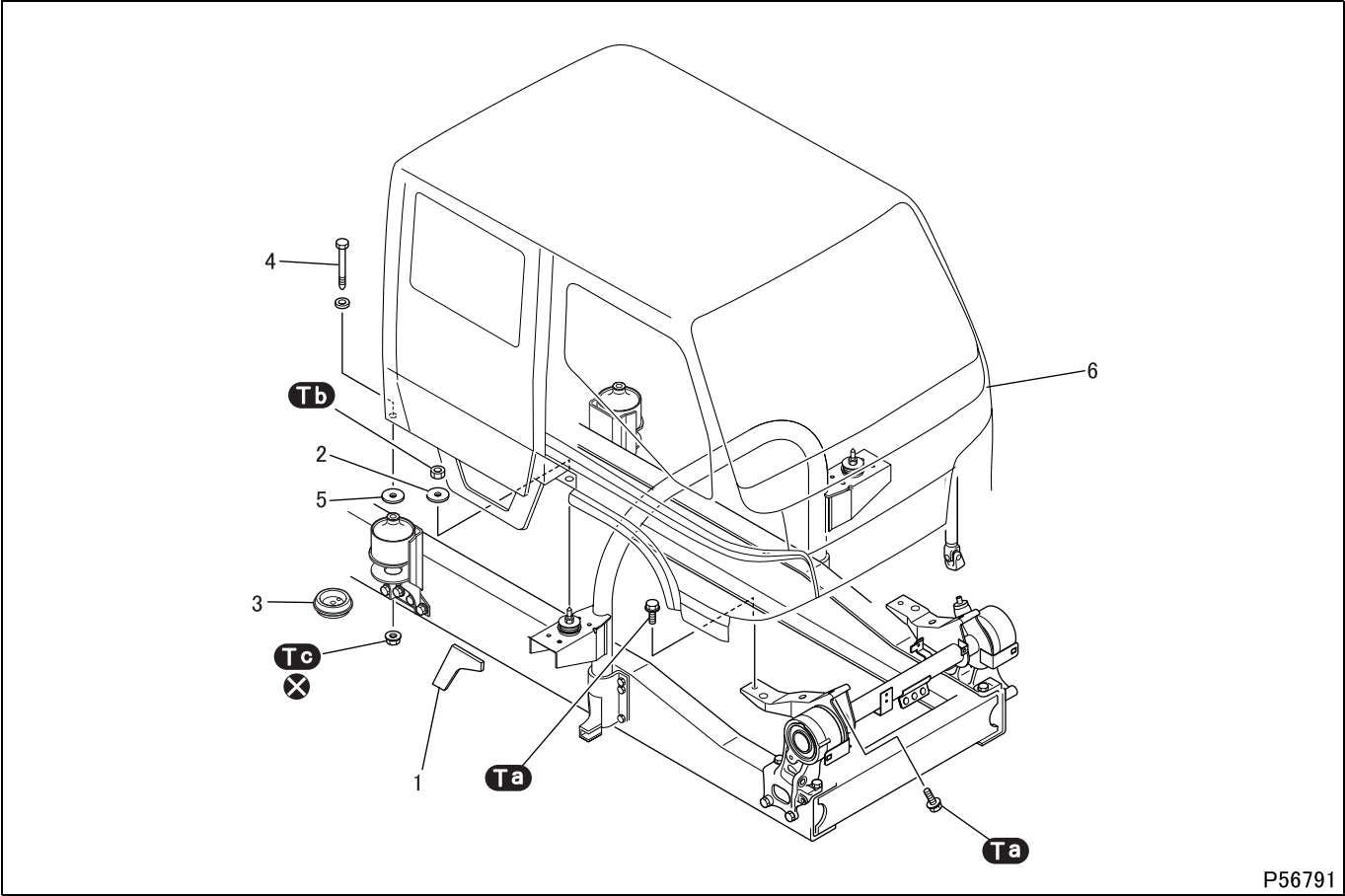
WARNING ⚠

- **Be sure to fit the stopper onto the lock lever to lock the cab stay.**



- Tighten the bolt **A** to specified torque.
- Align the graduated line of the anchor lever to the illustrated range of **D** (long division) of the scale graduated on the mounting bracket, then install the bolt **B** handtight.
- Tighten the bolt **C** to turn the anchor lever 5 degrees (one short division of the scale on the mounting bracket), then tighten the lock nut to specified torque.
- Tighten the handtight bolt **B** to specified torque.

REMOVAL AND INSTALLATION OF CAB <CREW CAB>



P56791

● Disassembly sequence

- 1 Garnish
- 2 Plate
- 3 Rear mounting stopper
- 4 Cone point bolt

- 5 Plate
- 6 Cab

$\otimes$: Non-reusable parts

CAUTION

- During removal and installation of the cab, the parking brake is not available to hold the vehicle at a standstill. Be sure to apply chocks to the tires to ensure that the vehicle does not move.
- Never remove the chocks until all the operations are completed.
- Before removal and installation, disconnect all cables, hoses and wires.

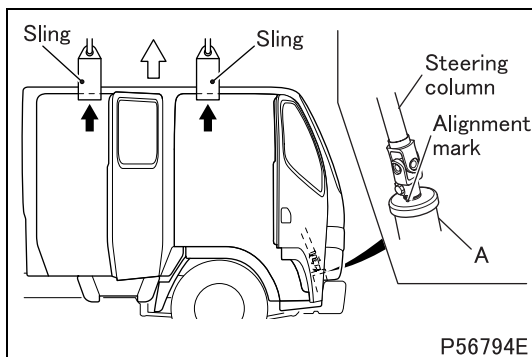
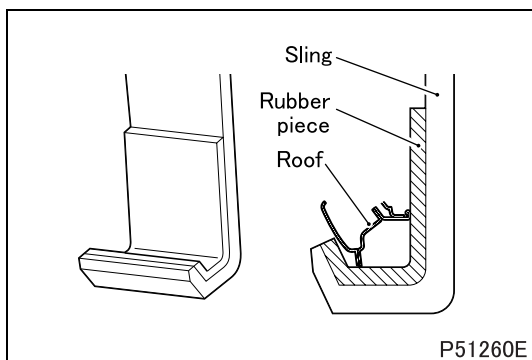
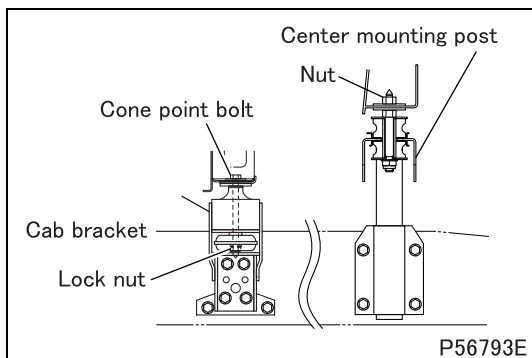
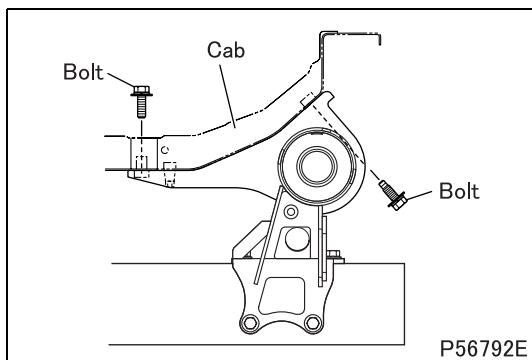
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Cab mounting)	70 to 95 {51 to 70, 7.1 to 9.7}	–
Tb	Nut (Cab mounting)	39 to 59 {30 to 43, 4 to 6}	–
Tc	Lock nut (Cab mounting)	59 to 69 {43 to 51, 6 to 7}	–

◆ Removal procedure ◆



■ Removal: Cab

- Remove bolts from inside and outside the cab.
- Remove nuts from the center mounting post, then remove lock nut and cone point bolt from the cab bracket.
- Make available slings rigid enough to support the weight of the cab.
- Line the hook portion of each sling with a rubber piece to prevent deformation of the roof of the cab.
- Hook the slings at appropriate points on the roof of the cab, and lift the cab a little to see if it maintains level (balanced at the center of gravity).
- Provide alignment marks on the power steering gear **A**, then separate the steering column.
- Tie the steering column securely to the cab with a rigid cord not to fall off.
- Slowly lift off the cab.

WARNING ⚠

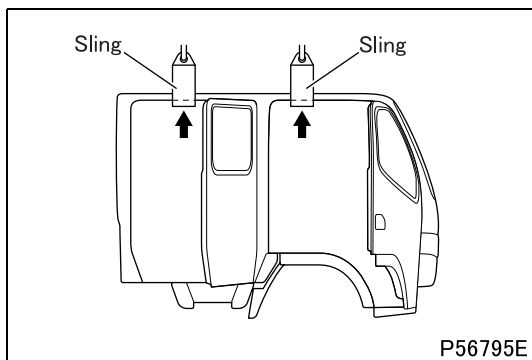
- When the cab is up in the air, be sure to stay out from under it.

CAUTION ⚠

- Before lifting the cab, make sure that cables, hoses and wires have been all disconnected.

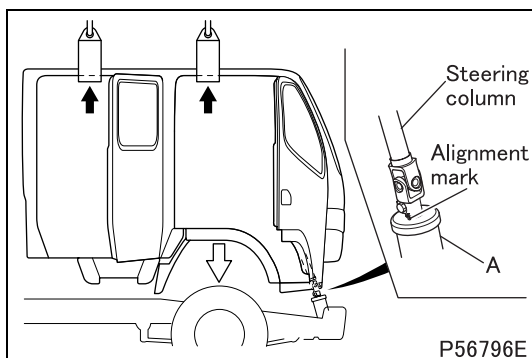
REMOVAL AND INSTALLATION OF CAB <CREW CAB>

◆ Installation procedure ◆

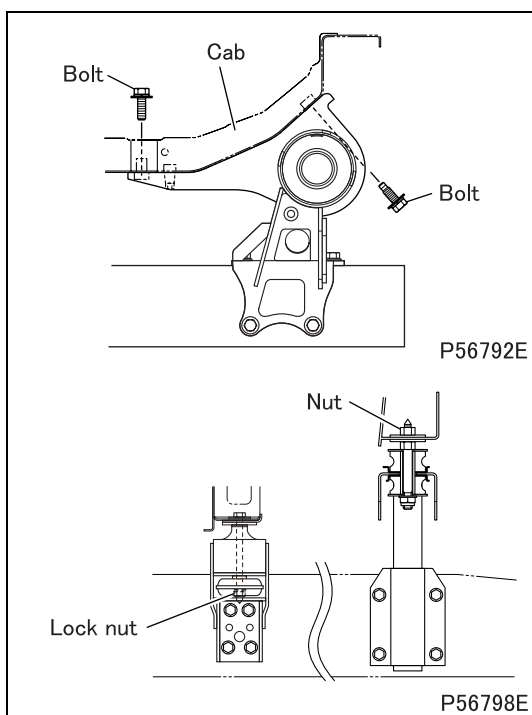


■ Installation: Cab

- Hook the sling at equilibrium center-of-gravity points on the roof of the cab.



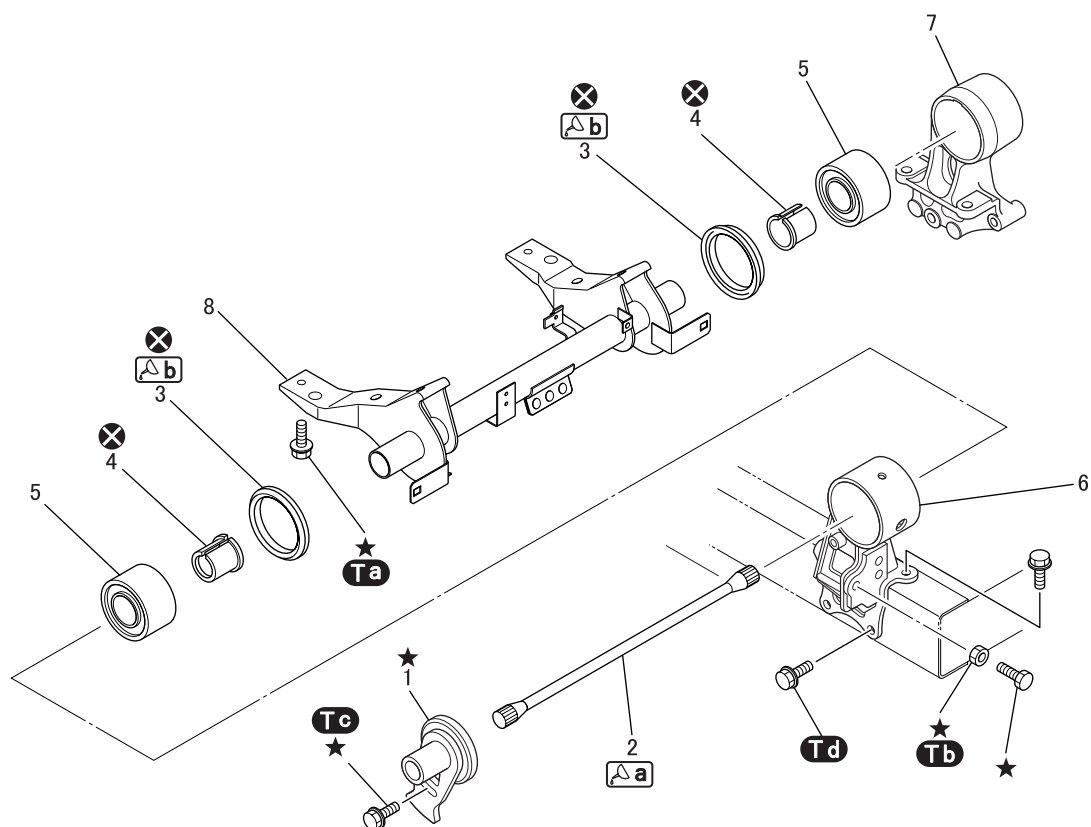
- Slowly lower the cab.
- Join the power steering gear **A** and steering column together in accordance with the alignment marks on them.



- Further lower the cab slowly into place. Then unhook the slings and tighten bolts, nuts and lock nuts to specified torques.

M E M O

FRONT CAB MOUNTING <EXCEPT CREW CAB>



Parts marked with ★ are to be installed while the cab assembly is mounted.
Assemble them by reference to the removal and installation procedures for cab.

P58055E

● Disassembly sequence

- | | |
|------------------------|--------------------------------------|
| 1 Anchor lever | 6 Front mounting bracket, right-hand |
| 2 Torsion bar | 7 Front mounting bracket, left-hand |
| 3 Side cushion | 8 Front floor cross member |
| 4 Bushing | |
| 5 Front rubber cushion | ⊗: Non-reusable parts |

● Assembly sequence

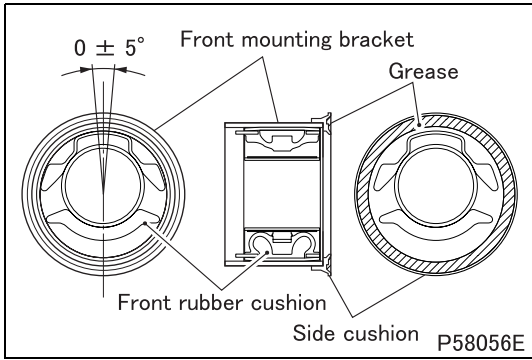
Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Cab mounting)	70 to 95 {51 to 70, 7.1 to 9.7}	—
Tb	Nut (Anchor lever adjusting bolt tightening)	59 to 83 {43 to 61, 6 to 8.5}	—
Tc	Bolt (Anchor lever attaching)	34 to 54 {25 to 40, 3.5 to 5.5}	—
Td	Bolt (Front mounting bracket attaching)	90 to 120 {67 to 87, 9.2 to 12}	—

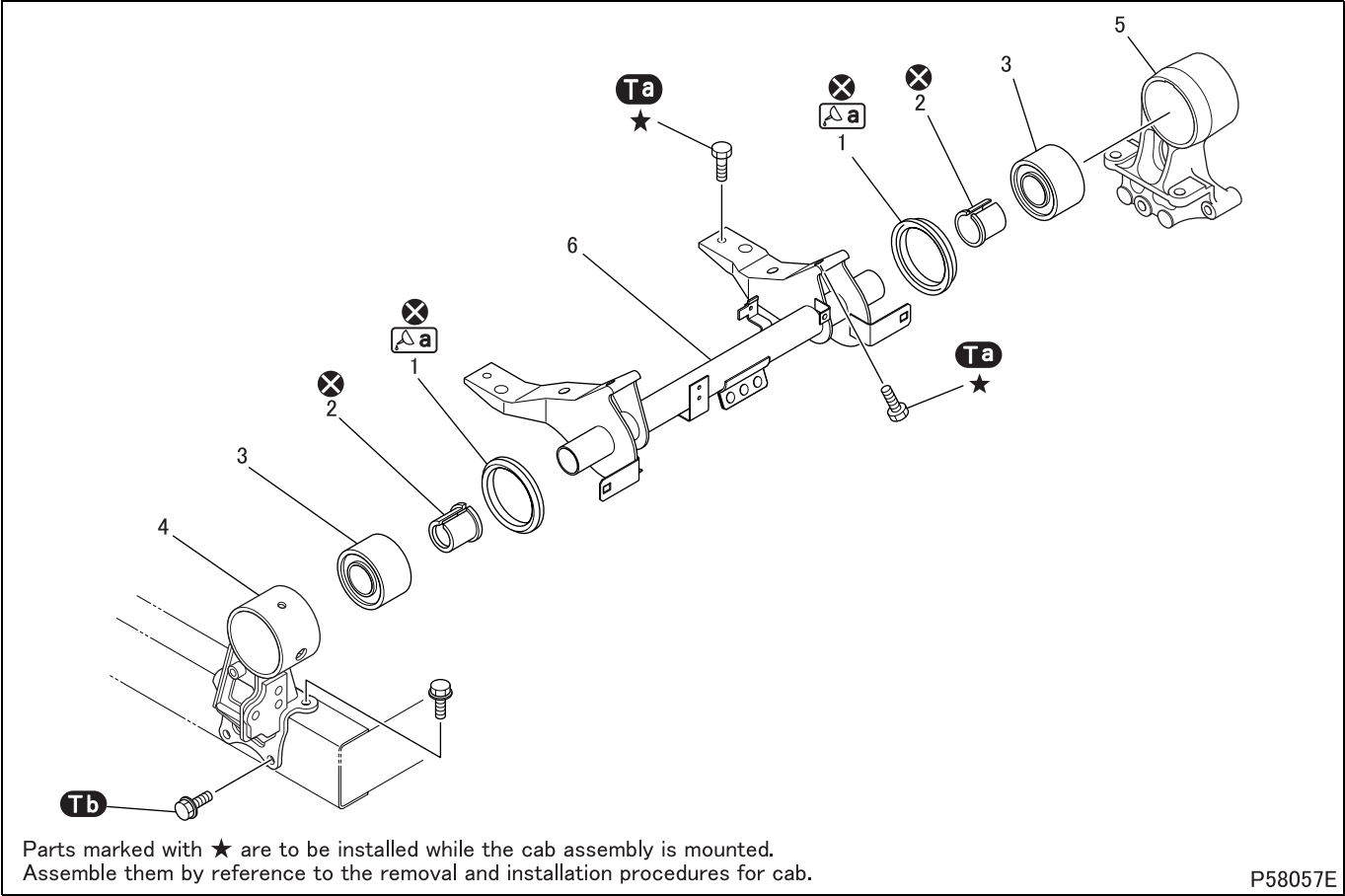
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Both serrated end portions of torsion bar	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
b	Front floor cross member contact surface of side cushion	Rubber Grease	As required

◆ Installation procedure ◆**■ Installation: Side rubber cushion and front rubber cushion**

- Fit the front rubber cushion to the front mounting bracket at an angle within the illustrated range.
- After installing the front rubber cushion, fit the side rubber cushion to it and fill grease in the side rubber cushion as shown.

FRONT CAB MOUNTING <CREW CAB>



P58057E

Disassembly sequence

- | | |
|--------------------------------------|-------------------------------------|
| 1 Side cushion | 5 Front mounting bracket, left-hand |
| 2 Bushing | 6 Front floor cross member |
| 3 Front rubber cushion | |
| 4 Front mounting bracket, right-hand | ⊗: Non-reusable parts |

Assembly sequence

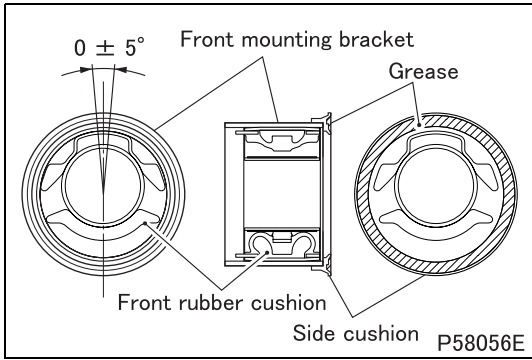
Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Cab mounting)	70 to 95 {50 to 70, 7.1 to 9.7}	–
Tb	Bolt (Front mounting bracket attaching)	90 to 120 {67 to 87, 9.2 to 12}	–

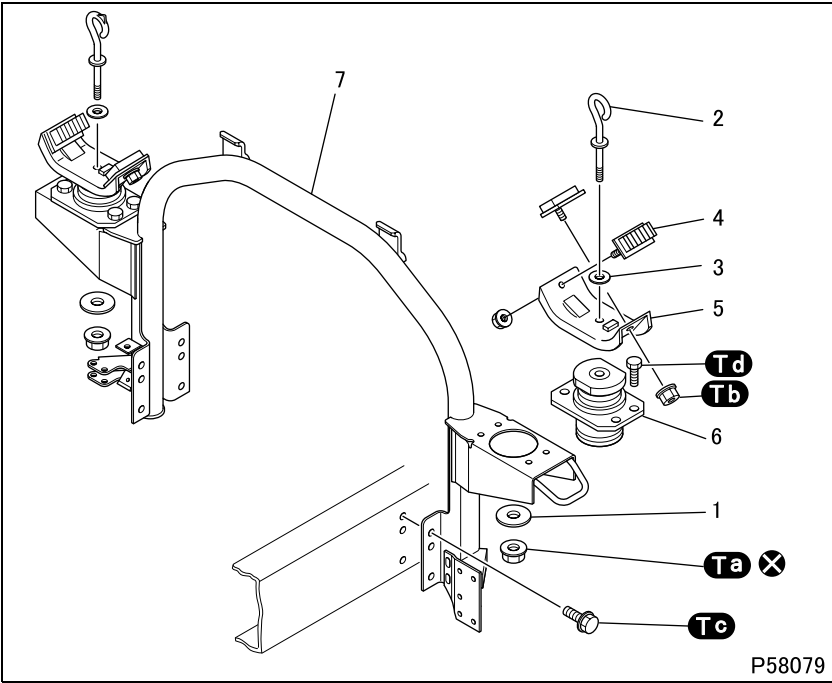
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Front floor cross member contact surface of side cushion	Rubber Grease	As required

◆ Installation procedure ◆**■ Installation: Side rubber cushion and front rubber cushion**

- Fit the front rubber cushion to the front mounting bracket at an angle within the illustrated range.
- After installing the front rubber cushion, fit the side rubber cushion to it and fill grease in the side rubber cushion as shown.

REAR CAB MOUNTING <EXCEPT CREW CAB>



Disassembly sequence

- 1 Plate
- 2 Anchor hook
- 3 Spacer
- 4 Side rubber cushion
- 5 Cab hold bracket
- 6 Rear lower rubber cushion
- 7 Rear mounting post

⊗: Non-reusable parts

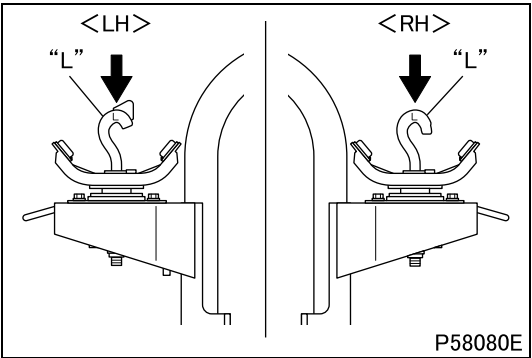
Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

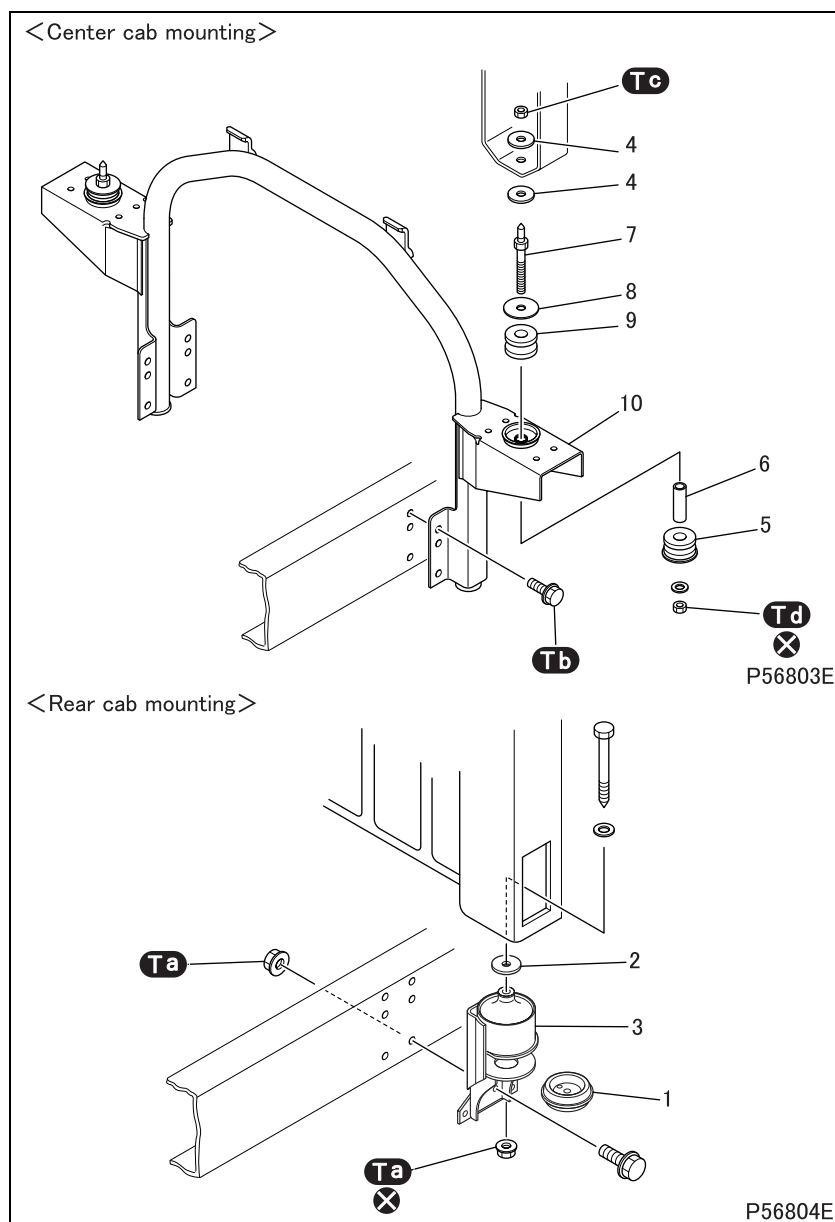
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (Anchor hook attaching)	83 to 98 {61 to 72, 8.5 to 10}	—
Tb	Nut (Side rubber cushion attaching)	10 to 15 {7.4 to 11, 1.0 to 1.5}	—
Tc	Bolt (Rear mounting post attaching)	78 to 108 {5.8 to 80, 8 to 11}	—
Td	Bolt (Rear rubber cushion attaching)	16 to 20 {12 to 14, 1.6 to 2}	—

Installation procedure



Installation: Anchor hook

- Fit the anchor hooks to the rear mounting post oriented as shown in the illustrations.



● Disassembly sequence

- 1 Rear mounting stopper
- 2 Plate
- 3 Cab bracket
- 4 Plate
- 5 Rear mounting lower rubber cushion
- 6 Pipe
- 7 Cone point bolt
- 8 Plate
- 9 Rear mounting upper rubber cushion
- 10 Rear mounting post

⊗: Non-reusable parts

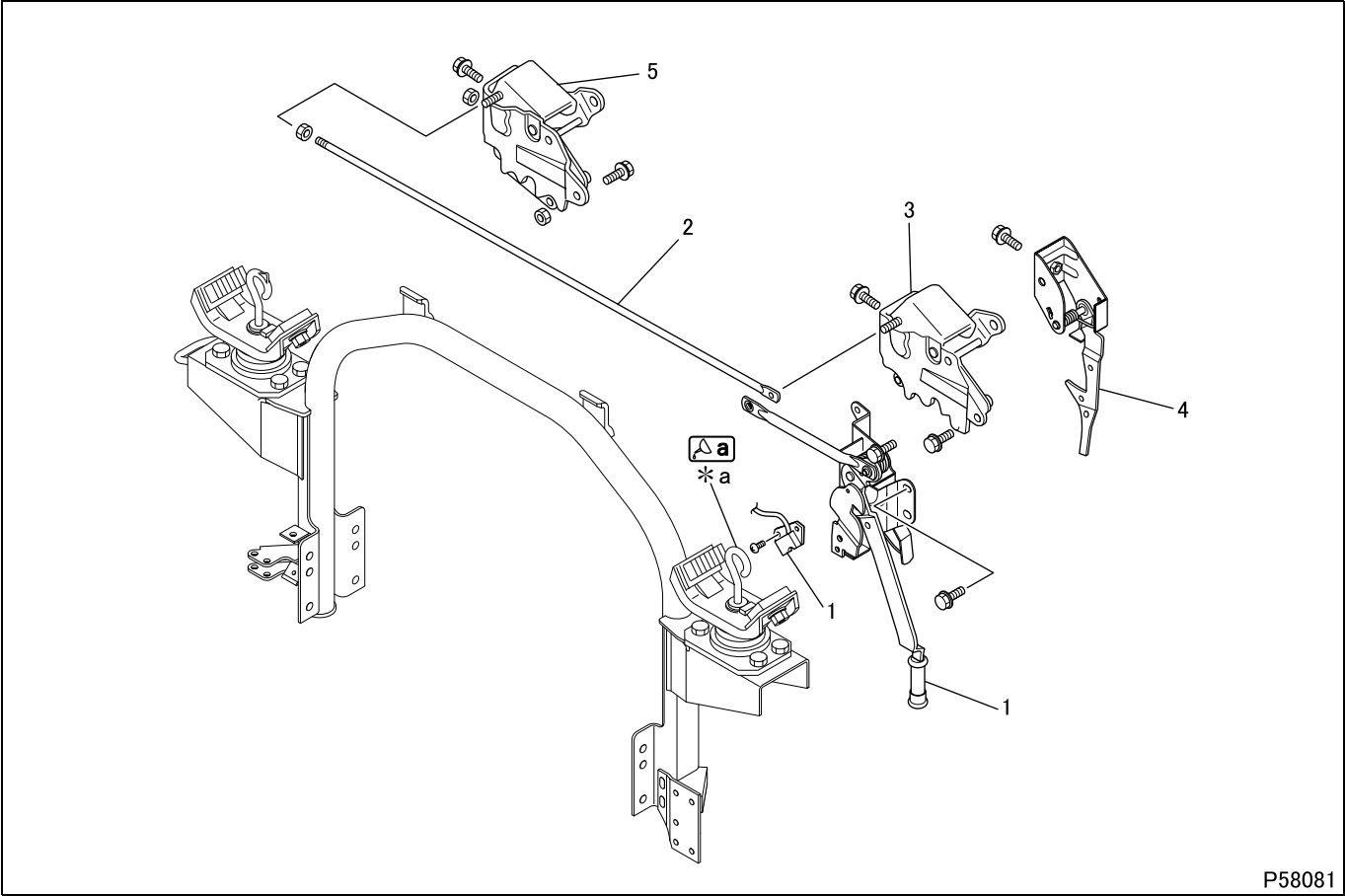
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (cab mounting)	59 to 69 {43 to 51, 6 to 7}	—
	Nut (Cab bracket attaching)		—
Tb	Bolt (Rear mounting post attaching)	78 to 108 {58 to 80, 8 to 11}	—
Tc	Nut (Cone point bolt installing)	39 to 59 {29 to 43, 4 to 6}	—
Td	Lock nut (Cab mounting)	83 to 98 {61 to 72, 8.5 to 10}	—

CAB TILT LINK <EXCEPT CREW CAB>



P58081

● Disassembly sequence

- | | |
|---|--------------------------|
| 1 Lock handle and safety hook
<Standard width cab>
Lock handle <Wide cab> | 4 Safety hook <Wide cab> |
| 2 Center rod | 5 Link (left-hand) |
| 3 Link (right-hand) | *a: Anchor hook |

● Assembly sequence

Follow the disassembly sequence in reverse.

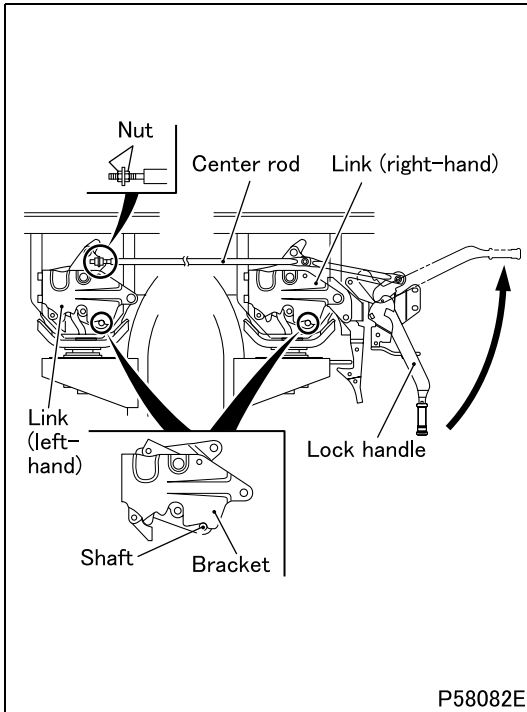
CAUTION

- After assembly, adjust the lock handle operating physical force. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Contact of link (right-hand) of anchor hook	Chassis grease [NLGI No. 1 (Li soap)]	As required

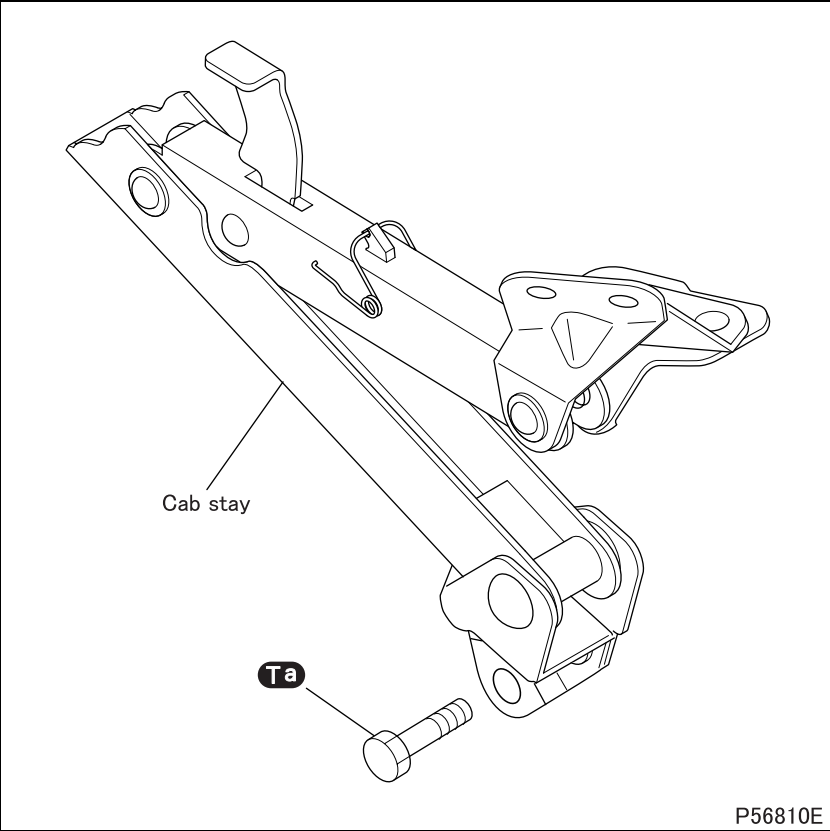
◆ Installation procedure ◆



■ Installation: Center rod

- Operate the lock handle in the illustrated direction to unlock the left-hand and right-hand links.
- Adjust the center rod nut to bring the shafts of left-hand and right-hand links into contact with brackets.

CAB STAY <EXCEPT CREW CAB>



WARNING ⚠

- Before removing the cab stay, be sure to support the cab with a crane or the like so that it does not fall during work.

Tightening torque (Unit: N·m {ft. lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (cab stay mounting)	59 to 78 {43 to 58, 6 to 8}	—



Group 43

Door

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

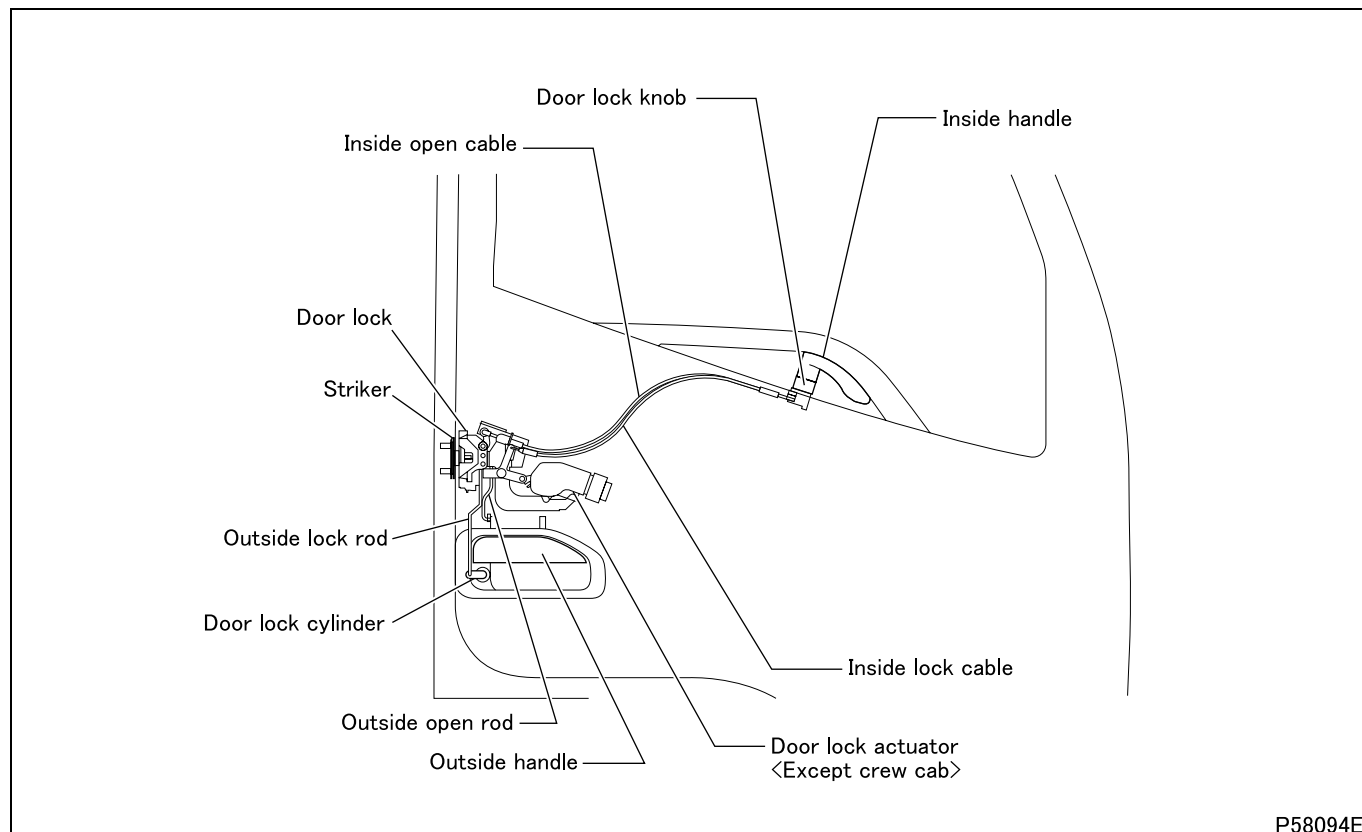
INDEX

SPECIFICATIONS	43-2
STRUCTURE AND OPERATION	
1. Front Door Lock System	43-3
2. Rear Door Lock System <Crew Cab>	43-3
3. Front Door Glass Opening and Closing Mechanism	43-4
4. Rear Door Glass Opening and Closing Mechanism <Crew Cab>	43-6
TROUBLESHOOTING	43-8
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Adjustment of Front Door Alignment	43-10
2. Adjustment of Rear Door Alignment <Crew Cab>	43-13
FRONT DOOR	43-16
REAR DOOR <CREW CAB>	43-24

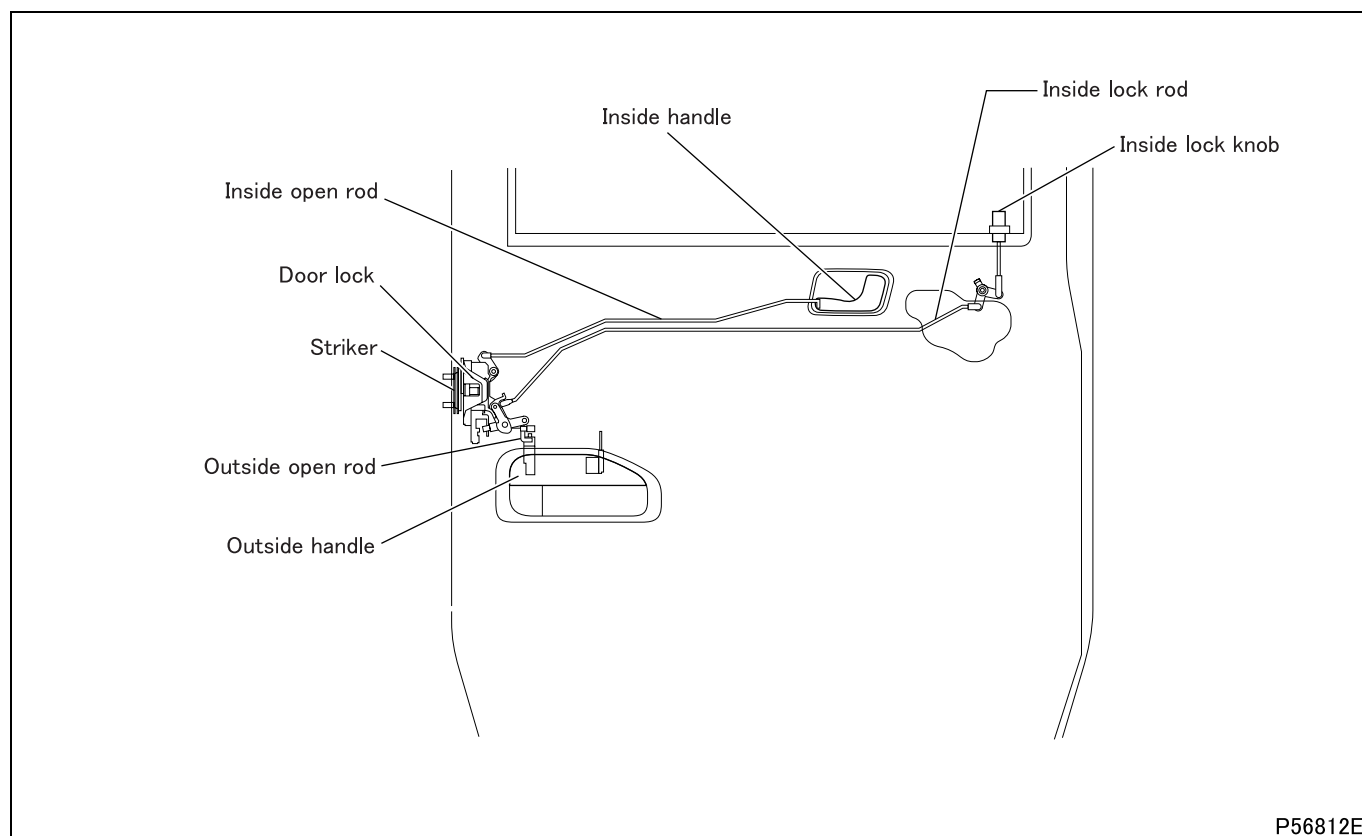
SPECIFICATIONS

Item		Specifications	
		Except crew cab	Crew cab
Front door	Door lock system	Auto door lock system (Centralized door lock)	Manual
	Door glass opening and closing mechanism	Electrical control type	Manual control type
Rear door	Door lock system	—	Manual
	Door glass opening and closing mechanism	—	Manual control type

1. Front Door Lock System

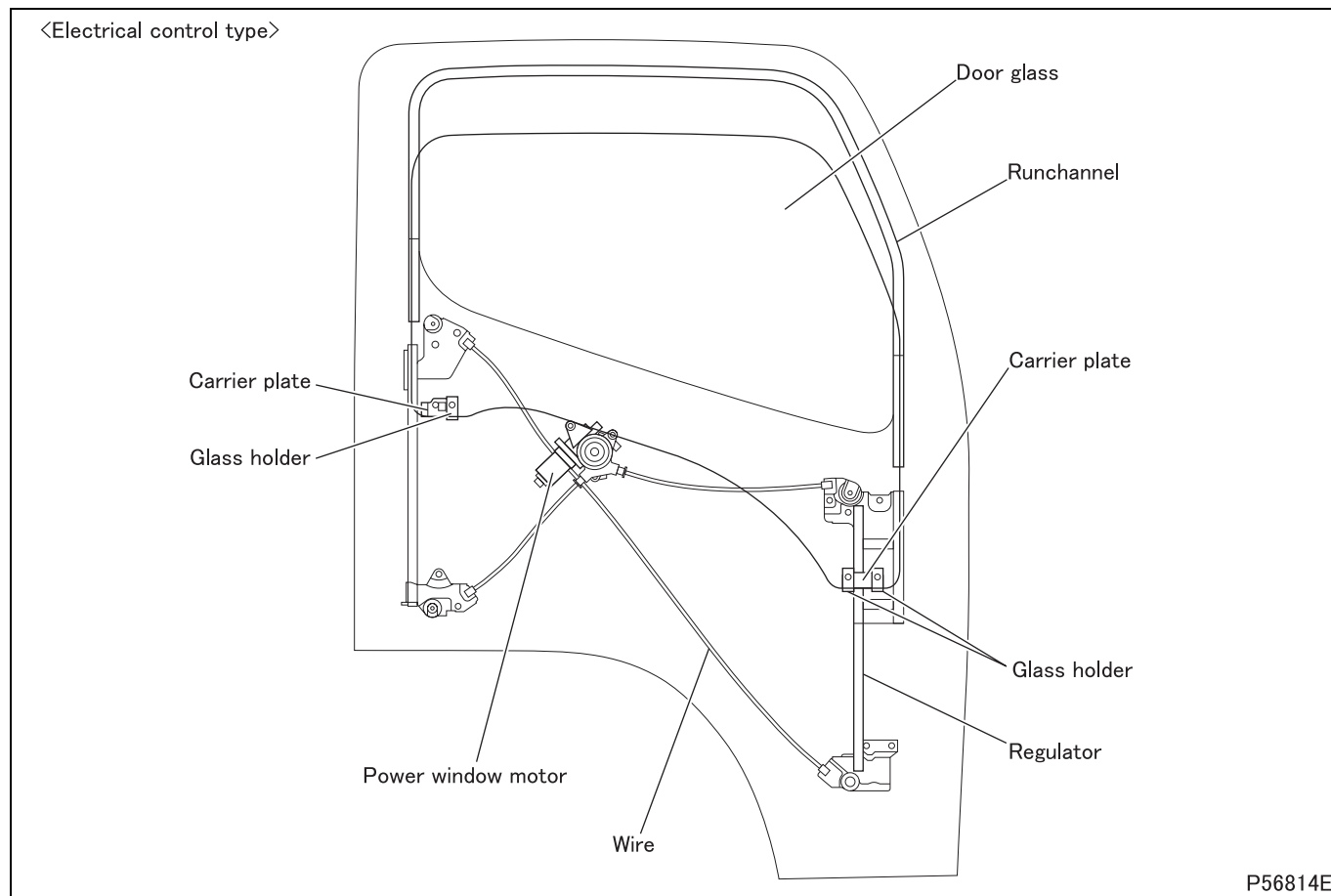


2. Rear Door Lock System <Crew Cab>

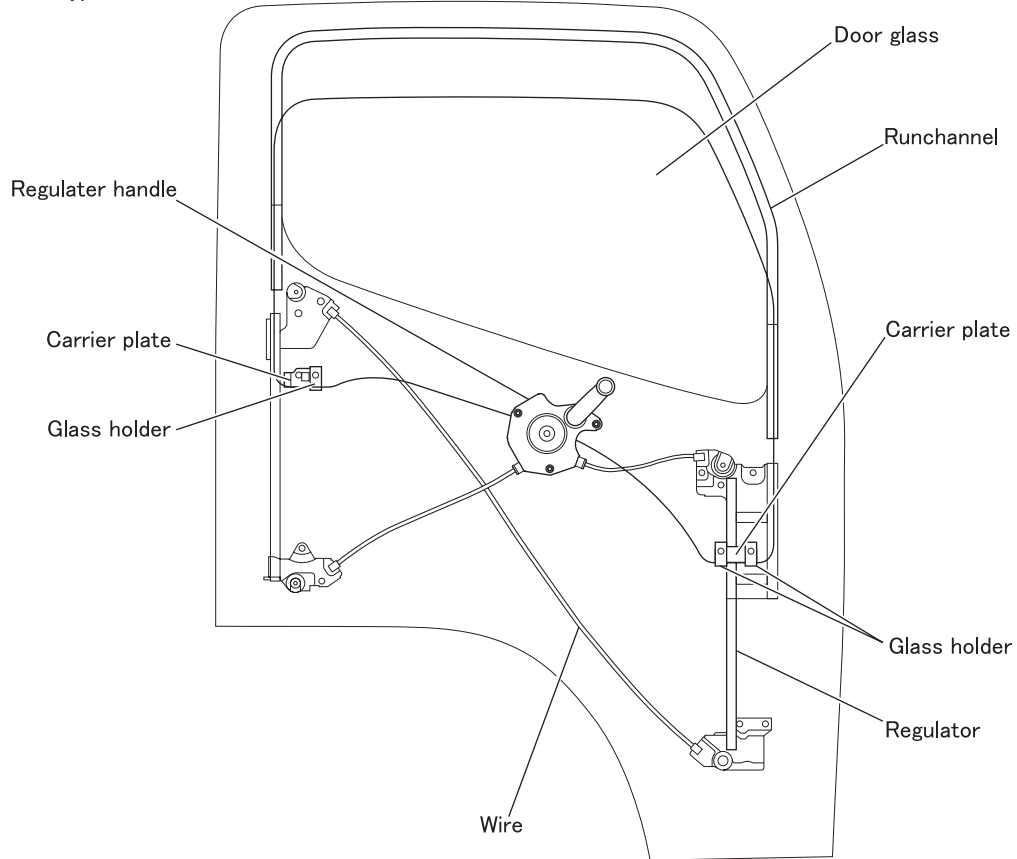


STRUCTURE AND OPERATION

3. Front Door Glass Opening and Closing Mechanism



<Manual control type>

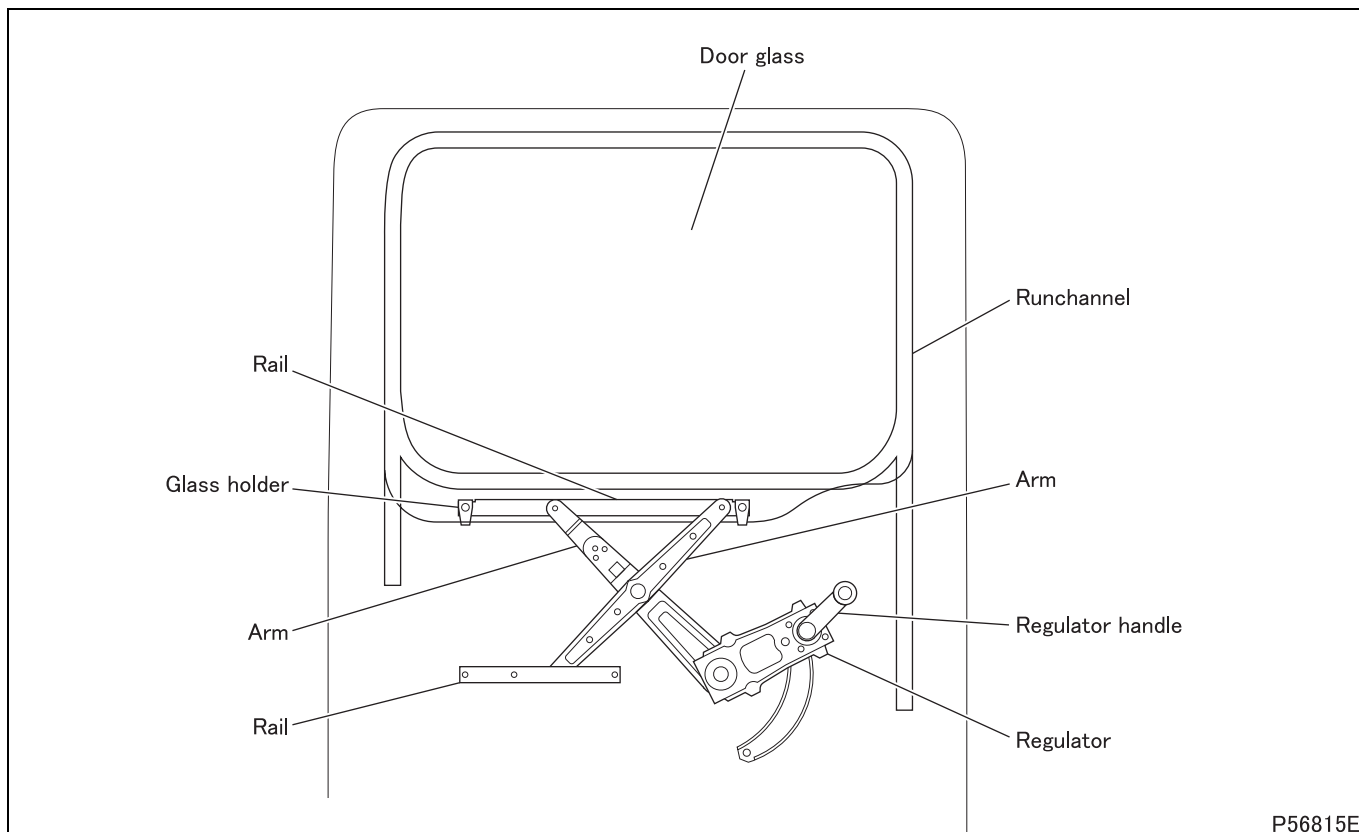


P56813E

- The door glass is secured to the carrier plate by the medium of glass holder.
- With the rotation of the power window motor <Electrical control type> or regulator handle <manual control type>, the carrier plate is moved up and down by means of the wire to open and close the door glass.

STRUCTURE AND OPERATION

4. Rear Door Glass Opening and Closing Mechanism <Crew Cab>



- The door glass is secured to the rail by the medium of glass holder.
- The rail is secured to the door panel, and the arms slide back and forth inside the rail.
- Turning the regulator handle moves the rail up and down by means of the regulator and arm to open and close the door glass.

M E M O

TROUBLESHOOTING

Door Glass Opening and Closing Mechanism

<Electrical control type>

Symptoms						Reference Gr
	Door glass falls by gravity when vehicle is running	Regulator or motor emits noise when vehicle is running	Power window fails to operate	Power window fails to stop	Power window emits noise when in motion	
Possible causes						
Power window switch faulty			O	O		Gr54
Regulator and motor assembly faulty	O		O	O	O	
Regulator and motor assembly improperly mounted					O	
Fuse or high current fuse blown			O			
Connector improperly connected, harness open-circuited or improperly grounded			O			
Door glass and door beltline molding unsteady		O				
Air temperature low						

<Manual control type>

Symptoms		Reference Gr				
		Regulator handle drags	Door glass unsteady when opening and closing	Regulator emits noise when door glass moves up and down	Regulator emits noise when vehicle is running	Door glass falls by gravity when vehicle is running
Probable causes						
Regulator	Regulator faulty	O				O
	Roller resistive	O		O		
	Improperly mounted		O		O	
Runchannel damaged			O			
Runchannel improperly mounted			O			
Door glass improperly installed		O				
Door glass and door beltline molding unsteady					O	

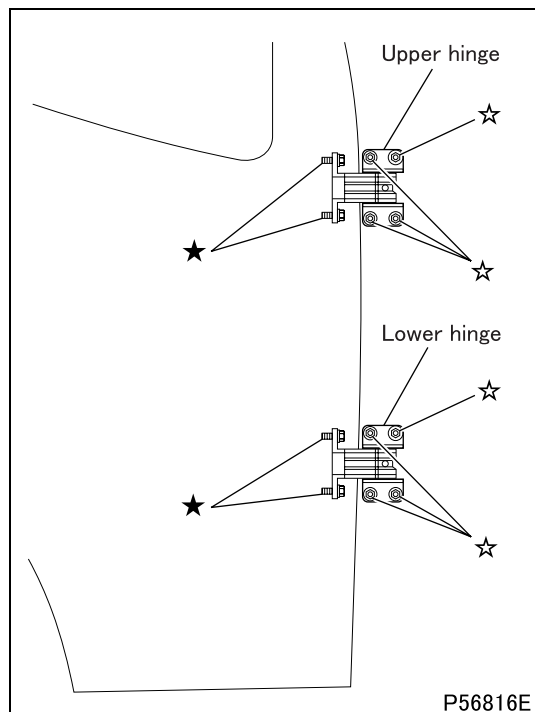
ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Adjustment of Front Door Alignment

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

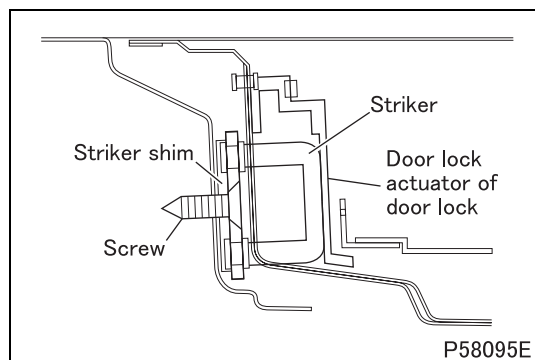
Mark	Parts to be tightened	Tightening torque	Remarks
-	Bolt (Door mounting; ★ marked)	17 to 26 {12 to 19, 1.7 to 2.6}	-
	Bolt (Upper and lower hinge mounting; ☆ marked)		
-	Screw (Striker mounting)	9 to 14 {6.5 to 10, 0.9 to 1.4}	-

- Door alignment is adjusted by changing the positions of the upper and lower hinges and striker.
- Door alignment dimensions: See 1.3.



1.1 Adjustment of hinge positions

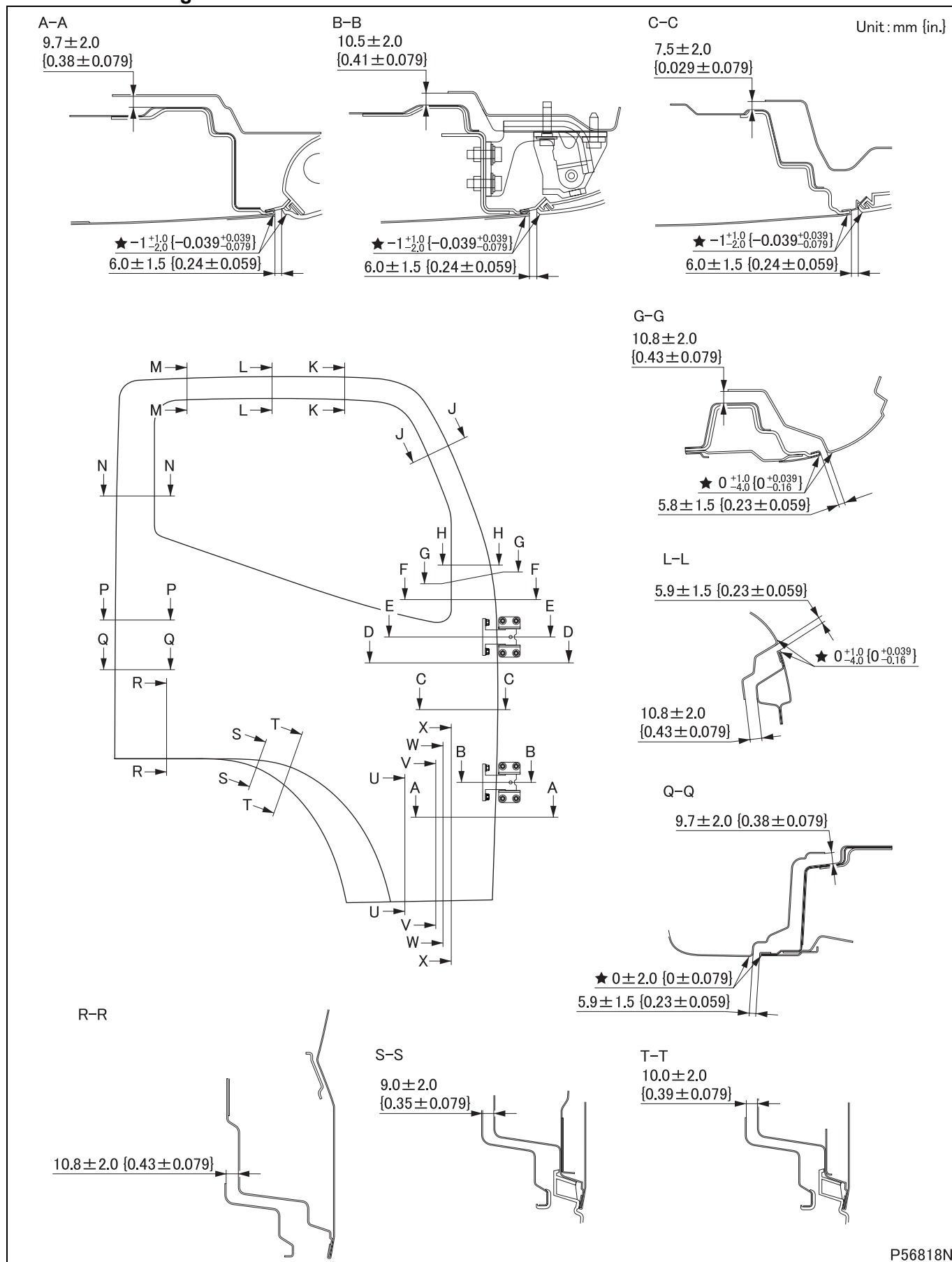
- Use ★ marked bolts to adjust gap.
- Use ☆ marked bolts to adjust flushness.



1.2 Adjustment of striker position

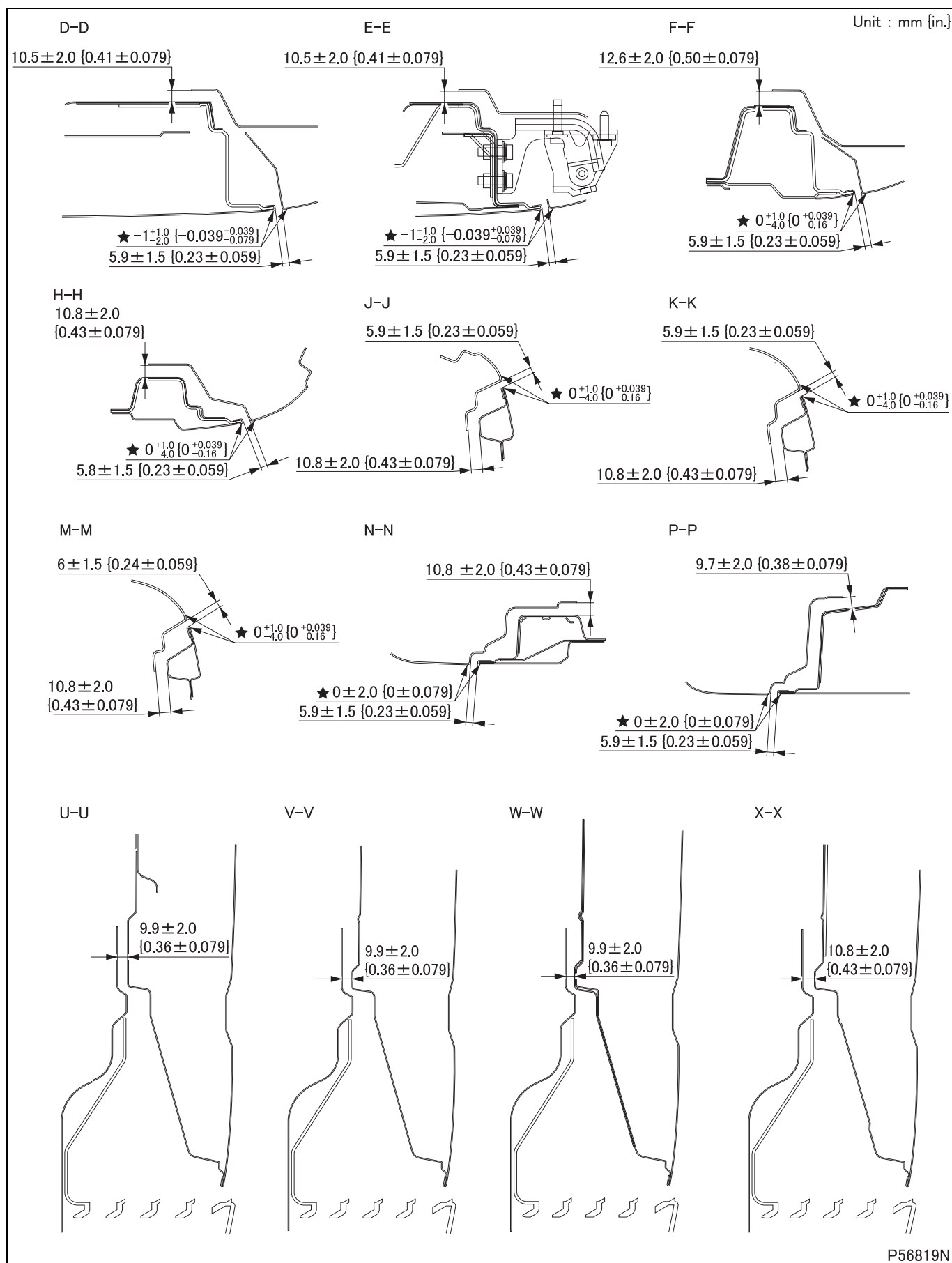
- Use mounting screw to make the adjustment.
- To adjust the engagement of the striker with the door lock actuator or door lock, change the number of striker shims as required.

1.3 Front door alignment dimensions



P56818N

ON-VEHICLE INSPECTION AND ADJUSTMENT



P56819N

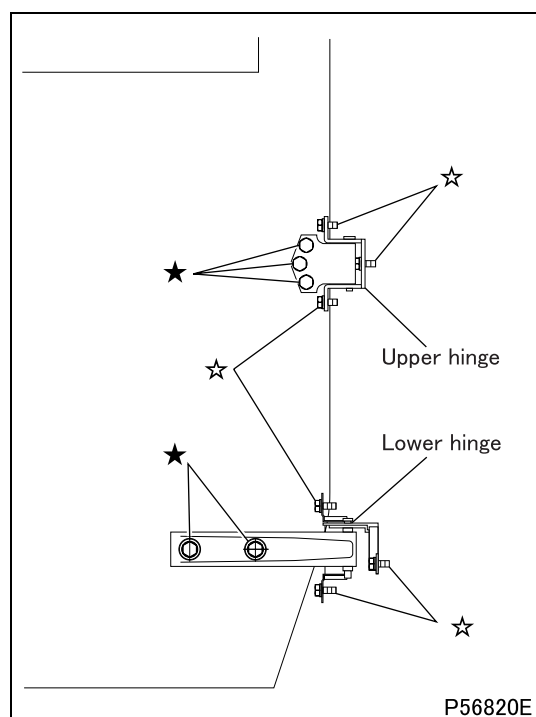
2. Adjustment of Rear Door Alignment <Crew Cab>

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Screw (Striker mounting)	9 to 14 {6.5 to 10, 0.9 to 1.4}	–

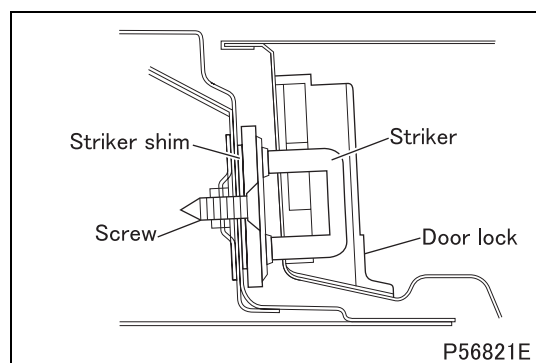
- Door alignment is adjusted by changing the positions of the upper and lower hinges and striker.

Rear door alignment dimensions: See 2.3.



2.1 Adjustment of hinge positions

- Use ★ marked bolts to adjust gap.
- Use ☆ marked bolts to adjust flushness.

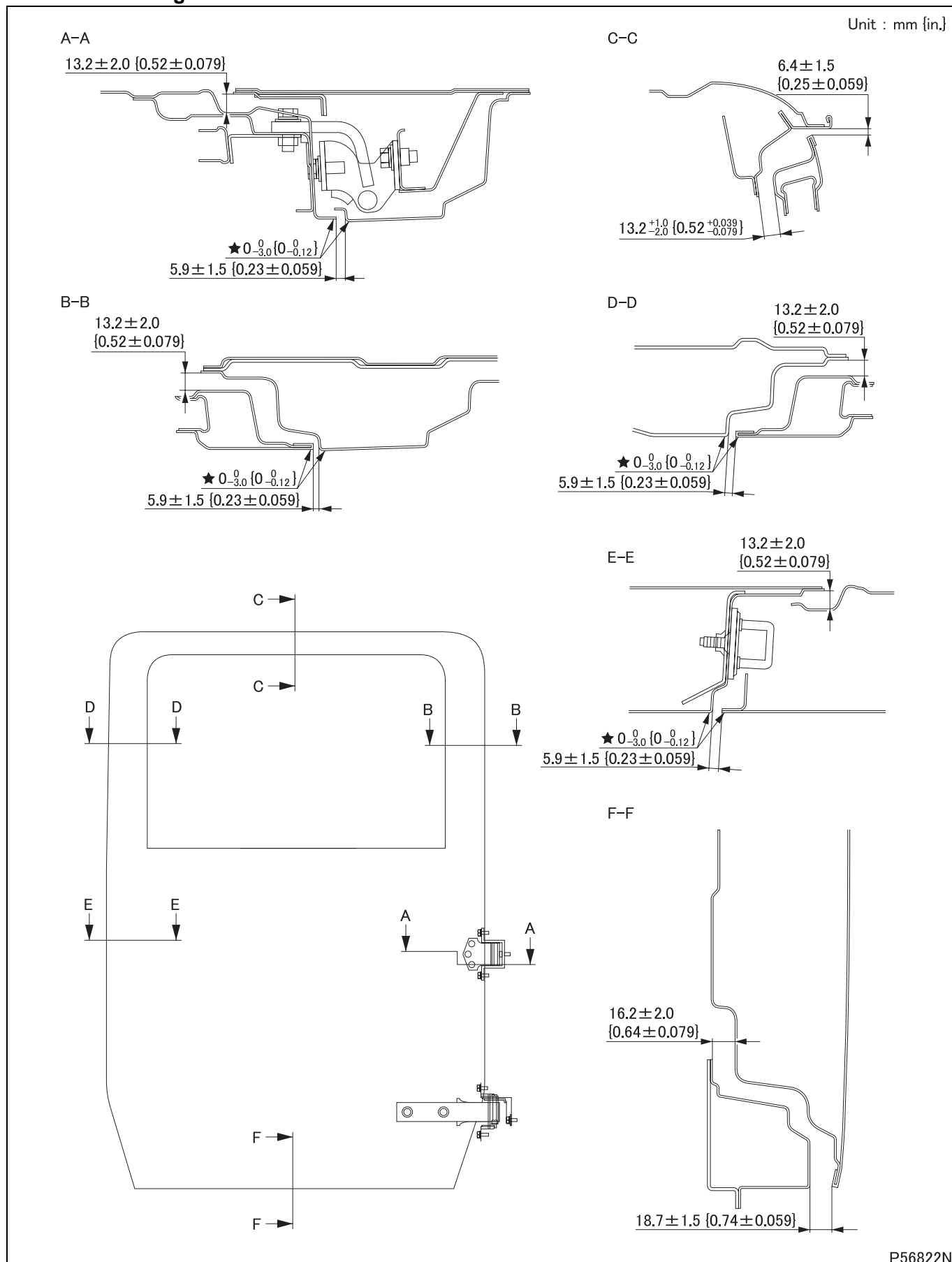


2.2 Adjustment of striker position

- Use mounting screw to make the adjustment.
- To adjust the engagement of the striker with the door lock, change the number of striker shims as required.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2.3 Rear door alignment dimensions

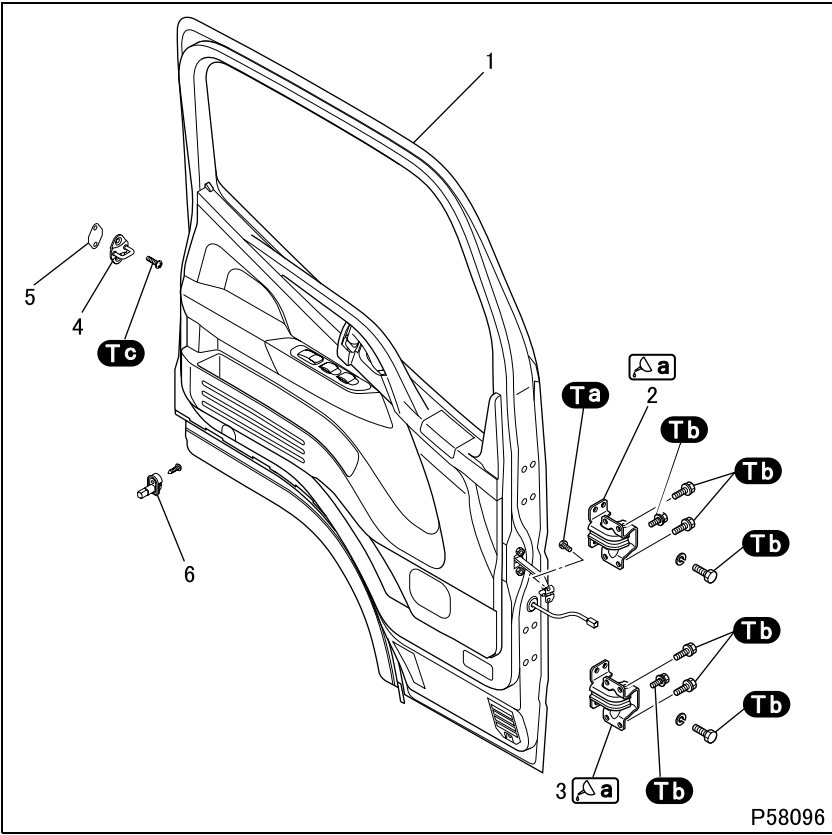


P56822N

★: Flushness dimension (+ for outside of cab; – for inside of cab)

M E M O

FRONT DOOR



●Removal sequence

- 1 Door (See later section.)
- 2 Upper hinge
- 3 Lower hinge
- 4 Striker
- 5 Striker shim
- 6 Door switch

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- Adjust front door alignment after installation. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

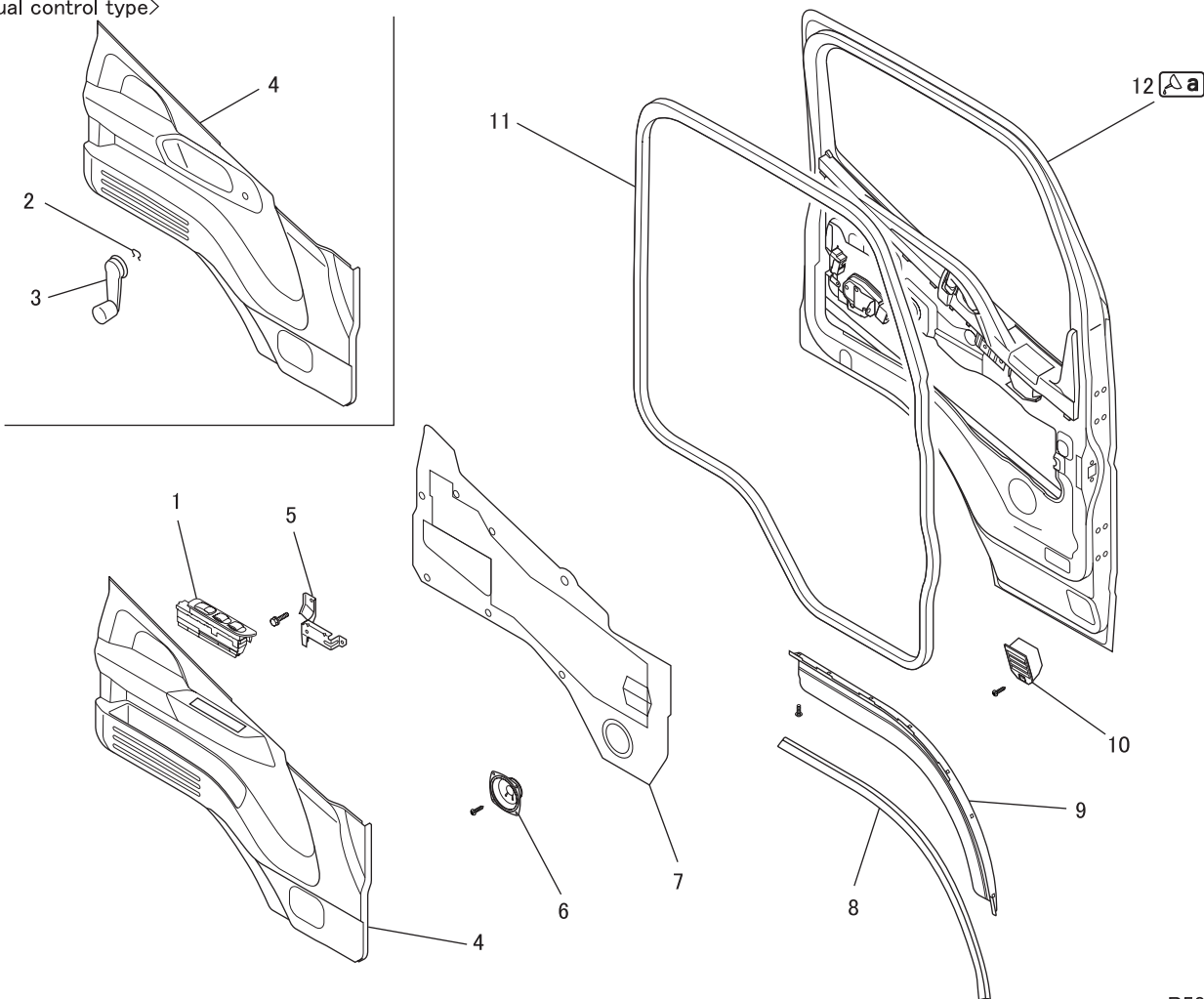
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Door mounting)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	–
Tb	Bolt (Door mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	–
	Bolt (Upper and lower hinge mounting)		
Tc	Screw (Striker mounting)	9 to 14 {6.5 to 10, 0.9 to 1.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Rotating contact parts of upper and lower hinges	Chassis grease [NLGI No. 1 (Li soap)]	As required

Door

<Manual control type>



P58097E

● Disassembly sequence

- | | |
|-----------------------|------------------------------------|
| 1 Power window switch | 7 Water-proof cover |
| 2 Clip | 8 Weatherstrip <FF> |
| 3 Regulator handle | 9 Door fender <FF> |
| 4 Lower door trim | 10 Air outlet garnish |
| 5 Trim bracket | 11 Weatherstrip |
| 6 Speaker | 12 Door panel (See later section.) |

● Assembly sequence

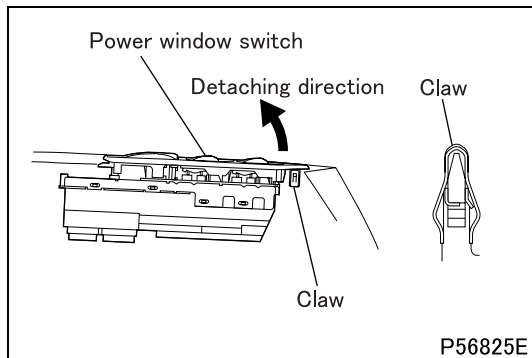
Follow the disassembly sequence in reverse.

Lubricant and/or sealant

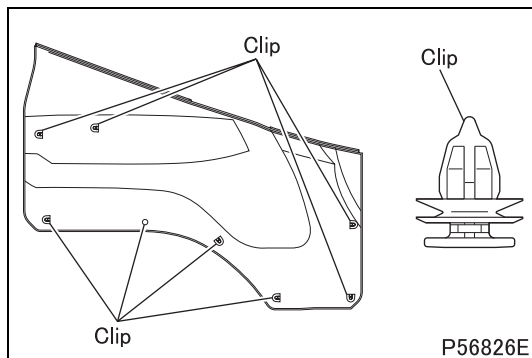
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Water-proof cover fitting surface of door panel	Butyl tape	As required

FRONT DOOR

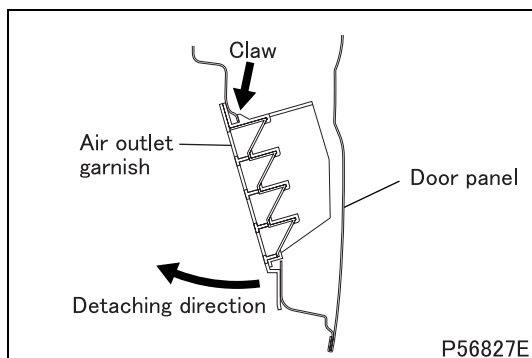
◆ Removal procedure ◆



■ Removal: Power window switch

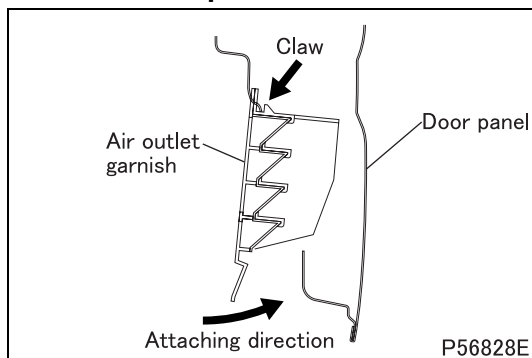


■ Removal: Lower door trim



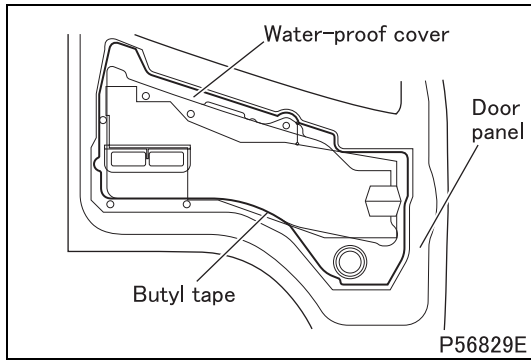
■ Removal: Air outlet garnish

◆ Installation procedure ◆

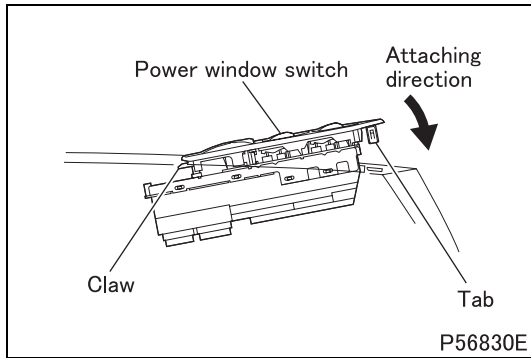


■ Installation: Air outlet garnish

- Attach the air outlet garnish to the door panel in the illustrated direction, with its claw fitted in the door panel.

**■ Installation: Water-proof cover**

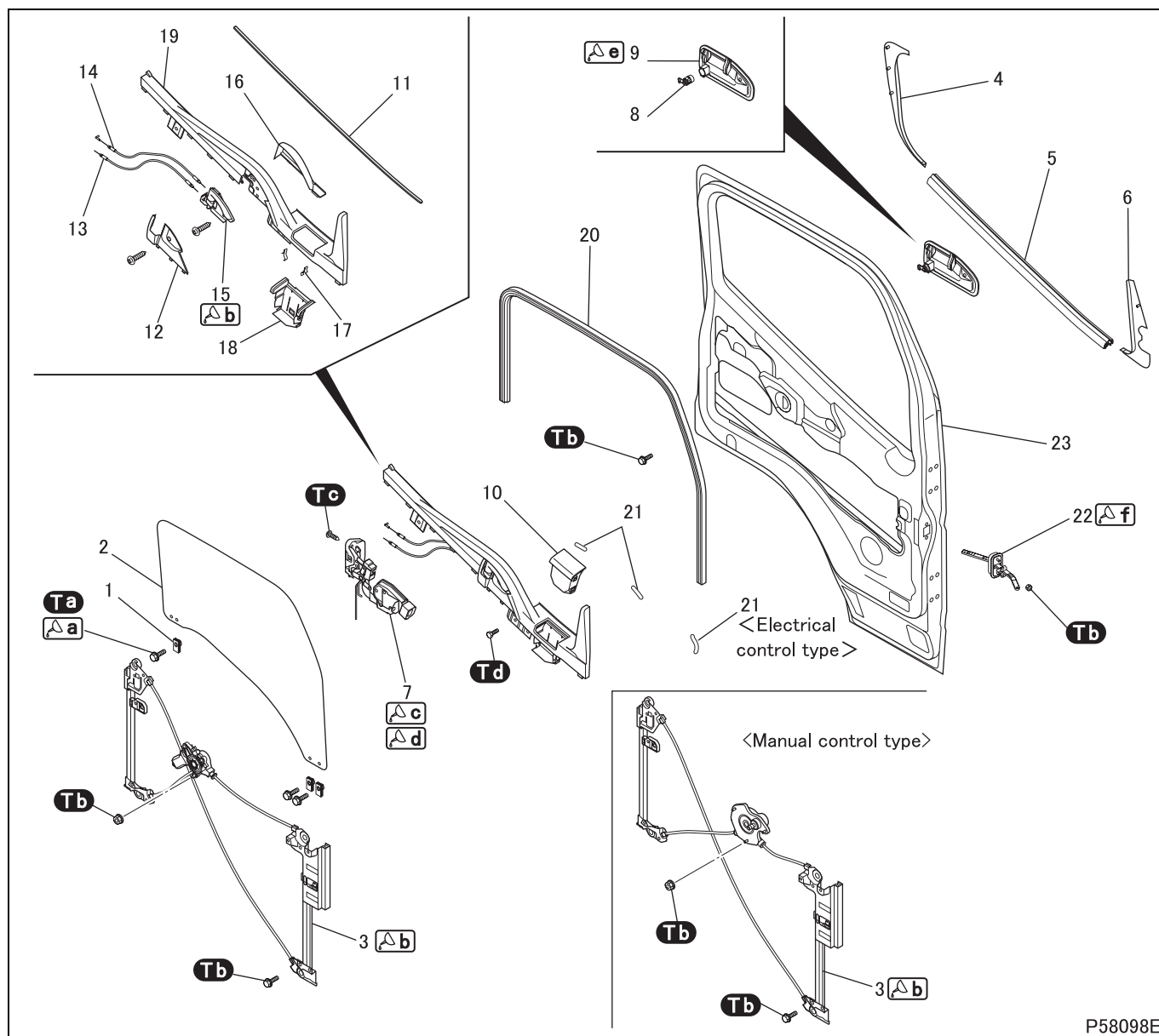
- Apply butyl tape to the door panel as shown, then attach the water-proof cover to the door panel.

**■ Installation: Power window switch <Option>**

- To install the power window switch in position, fit claw first, then tab, in the lower door trim.

FRONT DOOR

Door Panel Assembly



P58098E

● Disassembly sequence

- | | | |
|---|---------------------------------------|------------------------------|
| 1 Glass holder | Door lock
<without auto door lock> | 15 Inside handle |
| 2 Door glass | 8 Door lock cylinder | 16 Inside handle outer cover |
| 3 Regulator and motor
Manual regulator | 9 Outside handle | 17 Spring |
| 4 Sash garnish | 10 Ash tray | 18 Ash tray cover |
| 5 Beltline molding | 11 Weatherstrip | 19 Upper door trim |
| 6 Delta garnish | 12 Inside handle inner cover | 20 Runchannel |
| 7 Door lock actuator
<with auto door lock> | 13 Inside lock cable | 21 Protector |
| | 14 Inside open cable | 22 Door check |
| | | 23 Door panel |

● Assembly sequence

Follow the disassembly sequence in reverse.

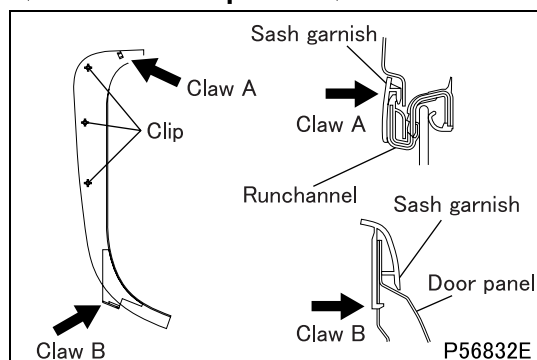
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Door glass attaching)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	sealant
Tb	Nut (Regulator and motor or manual regulator attaching)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	–
	Bolt (Regulator and motor or manual regulator attaching)		
	Bolt (Outside handle attaching)		
	Nut (Door check attaching)		
Tc	Screw (Door lock attaching)	4.9 to 8.2 {3.7 to 6.1, 0.51 to 0.84}	–
Td	Bolt (Upper door trim attaching)	10 to 15 {7.2 to 11, 1.0 to 1.5}	–

Lubricant and/or sealant

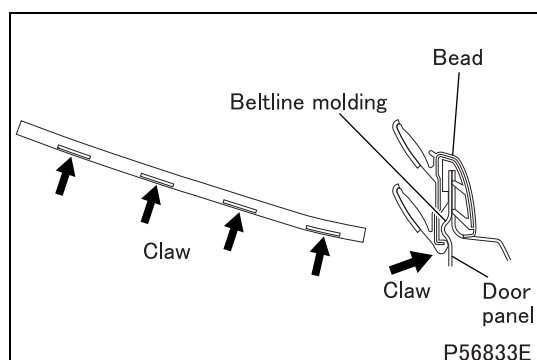
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Bolt threads	LOCTITE Dri-Loc 202	As required
 b	Sliding contact surface of regulator and motor assembly or regulator	Kyodo Yushi MULTEMP AC-D	As required As required
 c	Rotating contact surface of door lock	Kyodo Yushi MULTEMP TAS-2	As required
 d	Sliding contact surface of door lock	Kyodo Yushi MULTEMP SL-DII	As required
 e	Rotating contact surface of outside handle	Showa Shell Sekiyu SUNLITE GREASE LA2	As required
	Rotating contact surface of inside handle		
 f	Sliding contact surface of door check	Kyodo Yushi EMALUB M	1 g {0.035 oz}

◆ Removal sequence ◆



■ Removal: Sash garnish

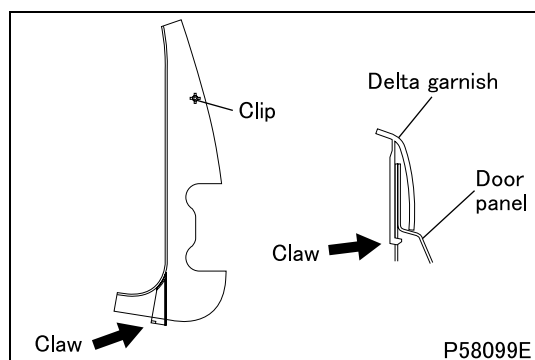
- Disengage claw A on upper part of the sash garnish from the runchannel, then remove clips (3 places).
- Disengage claw B on the lower part of the sash garnish from the door panel.



■ Removal: Beltline molding

- Disengage claws (4 places) and remove the beltline molding from the door panel bead.

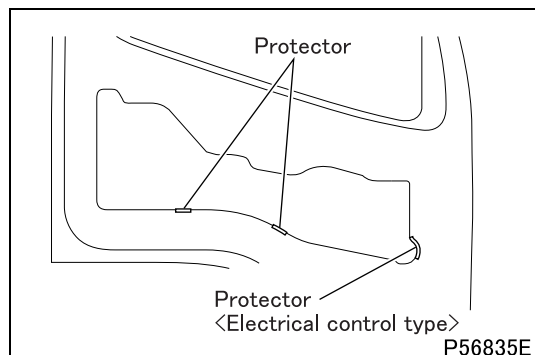
FRONT DOOR



■ Removal: Delta garnish

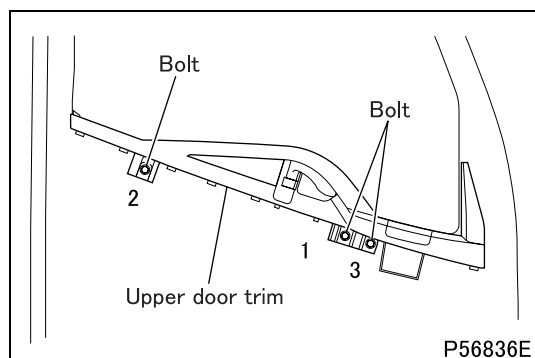
- Disengage clip (1 place) first and then claw to remove the delta garnish from the door panel.

◆ Installation procedure ◆



■ Installation: Protector

- Fit the protectors (three on electrical control type; two on manual control type) to the door panel in the illustrated positions.



■ Installation: Upper door trim

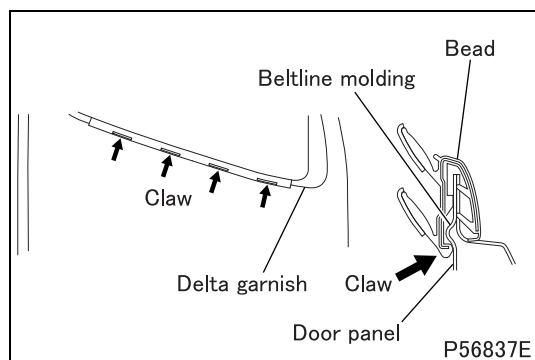
- Tighten bolts to specified torque in numerical order (1 to 3) as shown to secure the upper door trim.

■ Installation: Delta garnish

- To install the delta garnish, follow the removal procedure in reverse.
(See “■ Removal: Delta garnish”.)

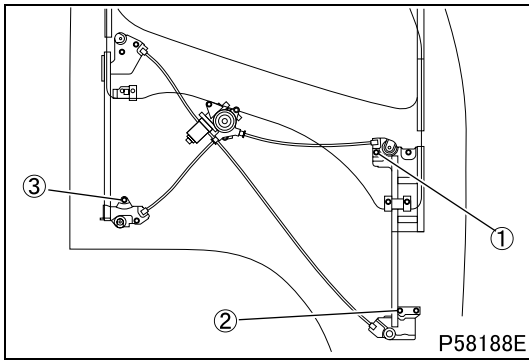
■ Installation: Beltline molding

- Position the beltline molding with its front side applied to the delta garnish, then engage claws (4 places) with the door panel bead to secure the beltline molding in place.



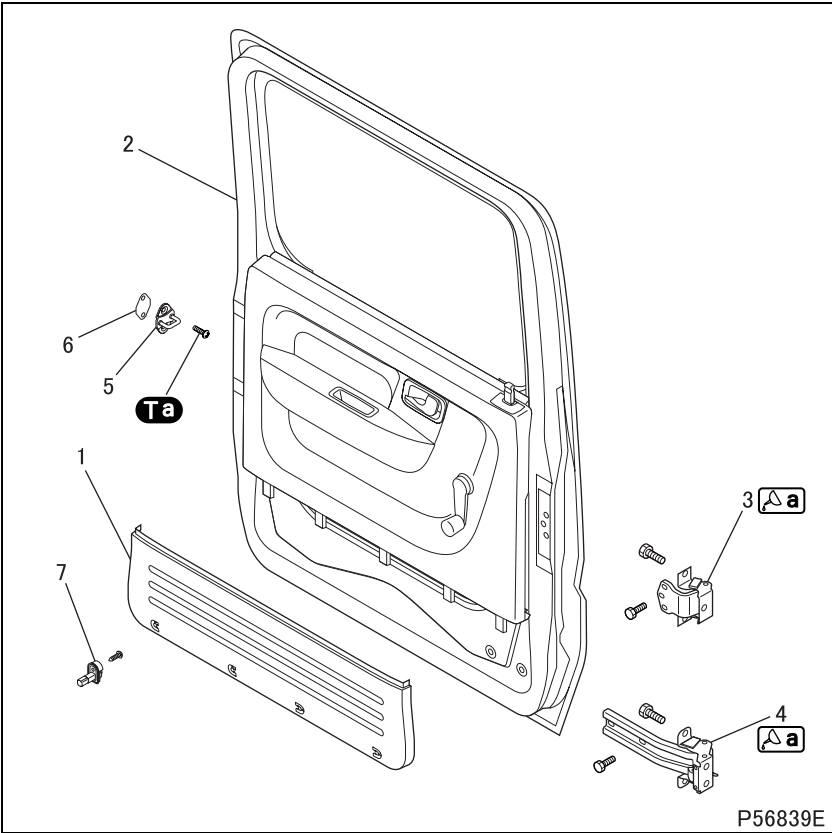
■ Installation: Sash garnish

- To install the sash garnish, follow the removal procedure in reverse.
(See “■ Removal: Sash garnish”.)

**■ Installation: Regulator and motor or manual regulator**

- Tighten bolts (3 places) to specified torque in numerical order (1 to 3) as shown, then tighten the remaining bolts and nuts to specified torque.

REAR DOOR <CREW CAB>



●Removal sequence

- 1 Lower door trim
- 2 Door
- 3 Upper hinge
- 4 Lower hinge
- 5 Striker
- 6 Strike shim
- 7 Door switch

●Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- Adjust rear door alignment after installation. (See ON-VEHICLE INSPECTION AND ADJUSTMENT.)

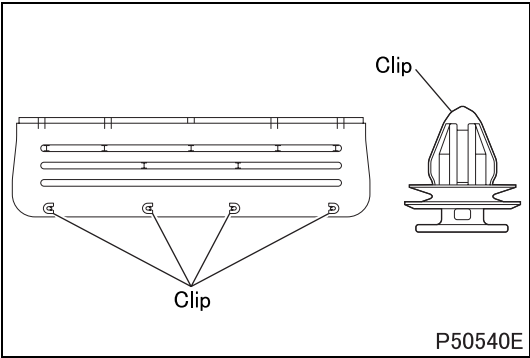
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (Striker attaching)	9 to 14 {6.5 to 10, 0.9 to 1.4}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Rotating contact surfaces of upper and lower hinges	Chassis grease [NLGI No. 1 (Li soap)]	As required

◆Removal procedure◆

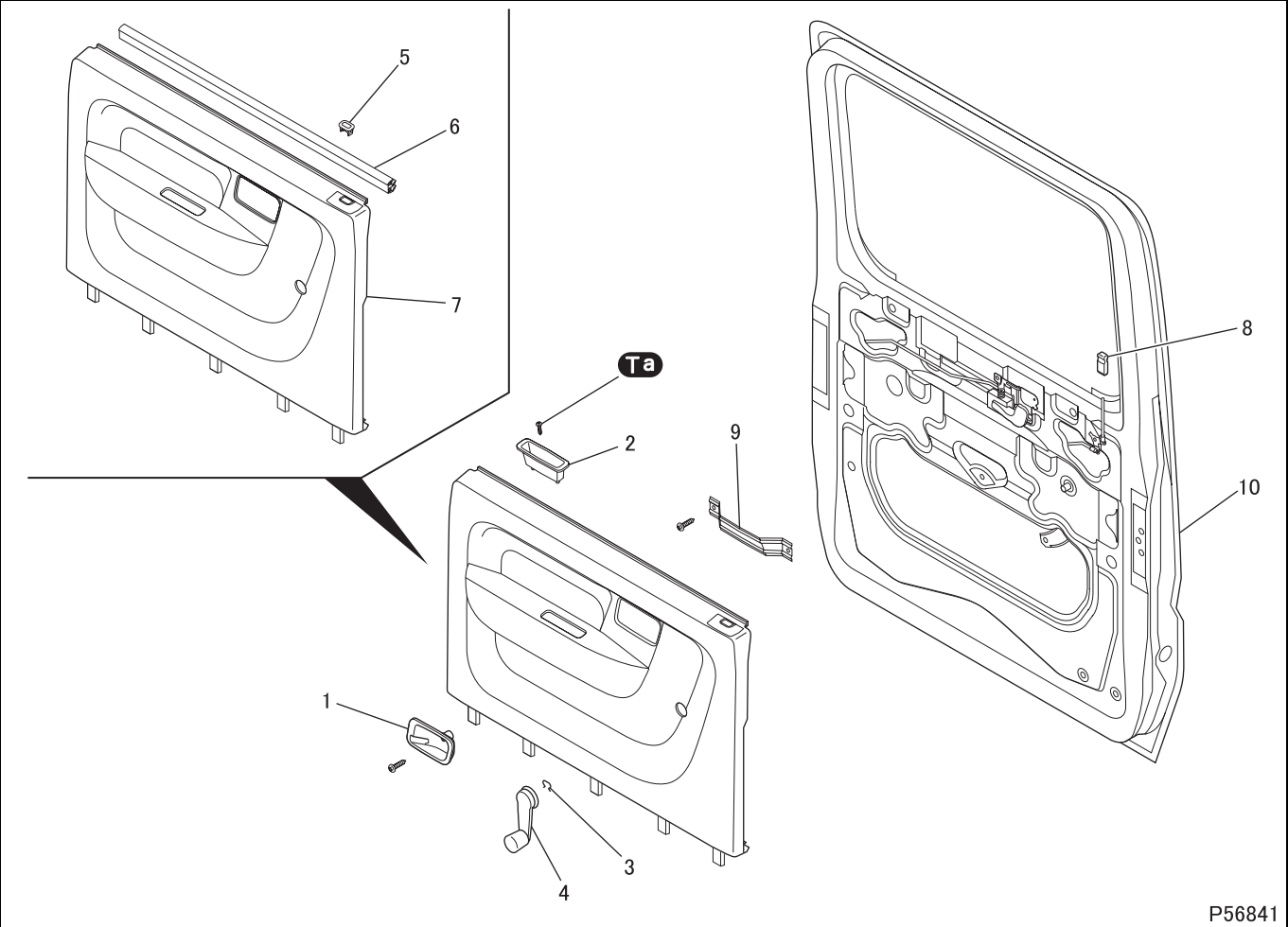


■Removal: Lower door trim

M E M O

REAR DOOR <CREW CAB>

Door Assembly



P56841

Disassembly sequence

- | | |
|-----------------------|-----------------------|
| 1 Inside handle cover | 7 Upper door trim |
| 2 Pull handle cover | 8 Inside lock knob |
| 3 Clip | 9 Pull handle bracket |
| 4 Regulator handle | 10 Door panel |
| 5 Bushing | |
| 6 Weatherstrip | |

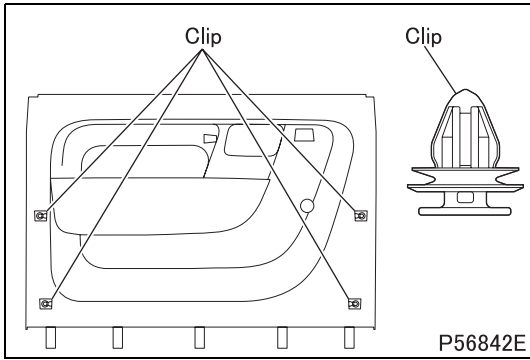
Assembly sequence

Follow the disassembly sequence in reverse.

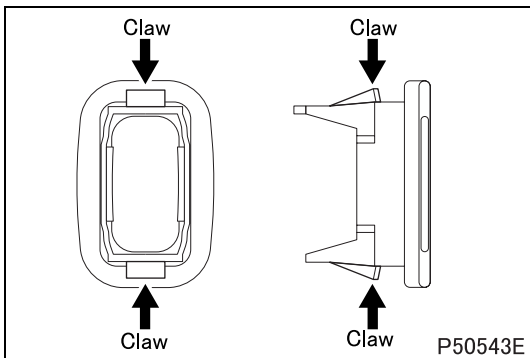
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (Pull handle cover attaching)	2 to 3 {1.4 to 2.1, 0.2 to 0.3}	—

◆ Removal procedure ◆

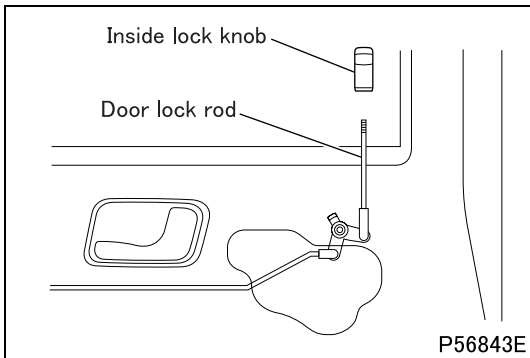


■ Removal: Upper door trim



■ Removal: Bushing

◆ Installation procedure ◆

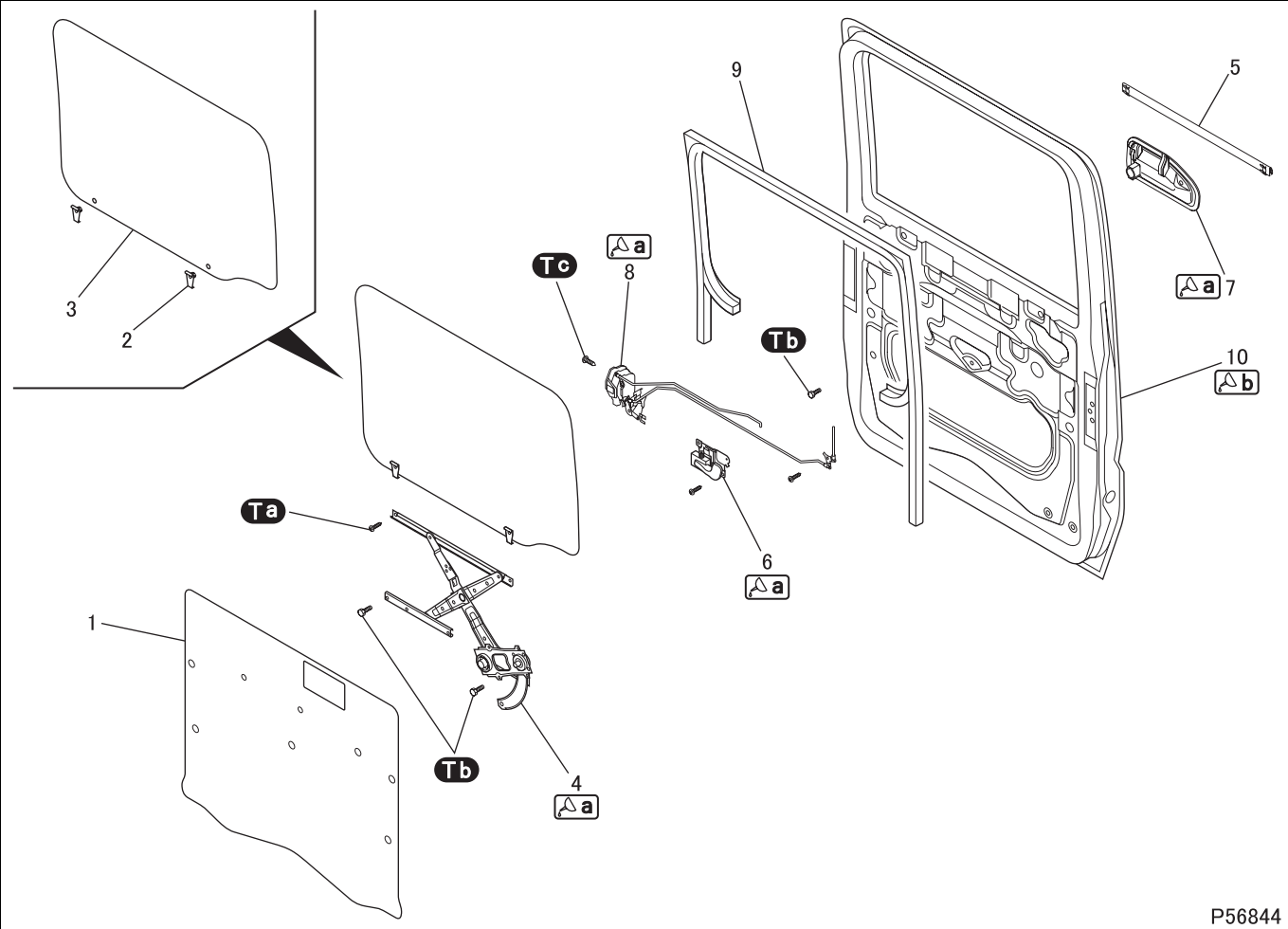


■ Installation: Inside lock knob

- Screw the inside lock knob all the way onto the door lock rod, then back it up 1 or 2 turns.

REAR DOOR <CREW CAB>

Door Panel Assembly



Disassembly sequence

- | | | | |
|---|-------------------|----|----------------|
| 1 | Water-proof cover | 6 | Inside handle |
| 2 | Glass holder | 7 | Outside handle |
| 3 | Door glass | 8 | Door lock |
| 4 | Regulator | 9 | Runchannel |
| 5 | Beltline molding | 10 | Door panel |

Assembly sequence

Follow the disassembly sequence in reverse.

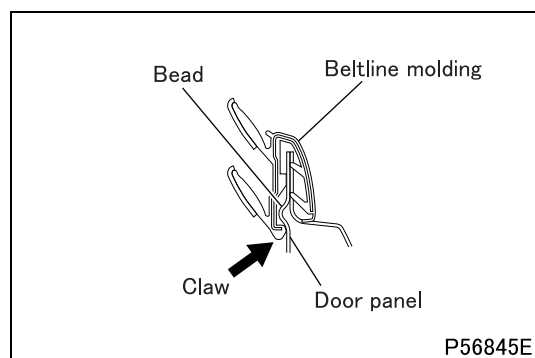
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (door glass attaching)	1.8 to 2.5 {1.3 to 1.8, 0.18 to 0.25}	—
Tb	Bolt (Regulator attaching)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—
	Bolt (Outside handle attaching)		
Tc	Screw (Door lock attaching)	4.9 to 8.2 {3.6 to 6.1, 0.5 to 0.84}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Sliding contact surface of regulator	DYNAMIC GB	As required
 b	Rotating contact surface of inside handle	Showa Shell Sekiyu SUNLITE GREASE LA2	As required
	Rotating contact surface of outside handle		
 c	Rotating and sliding contact surfaces of door lock	Kyodo Yushi MULTEMP TAS-2	As required
 d	Water-proof cover attaching surface of door panel	Butyl tape	As required

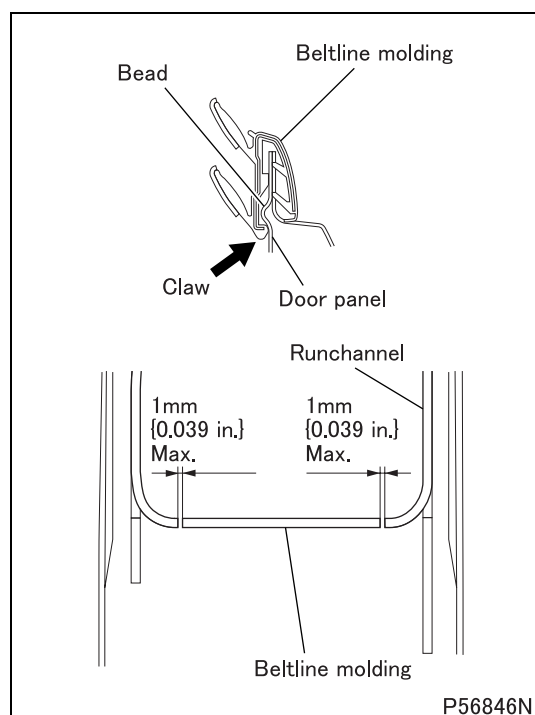
◆ Removal procedure ◆



■ Removal: Beltline molding

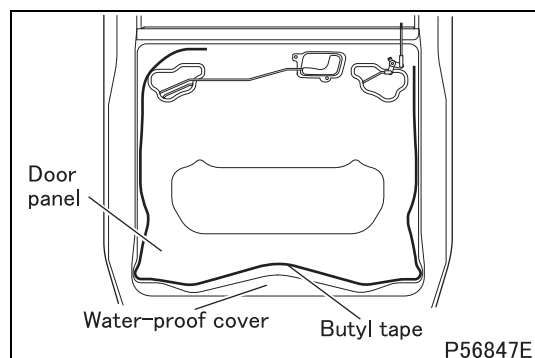
- Disengage claws (4 places) from the door panel bead to remove the beltline molding from the door panel.

◆ Installation procedure ◆



■ Installation: Beltline molding

- Engage hooks (4 places) with the door panel bead to install the beltline molding to the door panel. Gaps between beltline molding and runchannel should be as shown.
- Make sure that the cover is tight at both ends of the belt line molding.



■ Installation: Water-proof cover

- Apply butyl tape to the door panel as shown, and attach the water-proof cover to the door panel.



Group 51

Exterior

Table of Contents

BACK

HOME

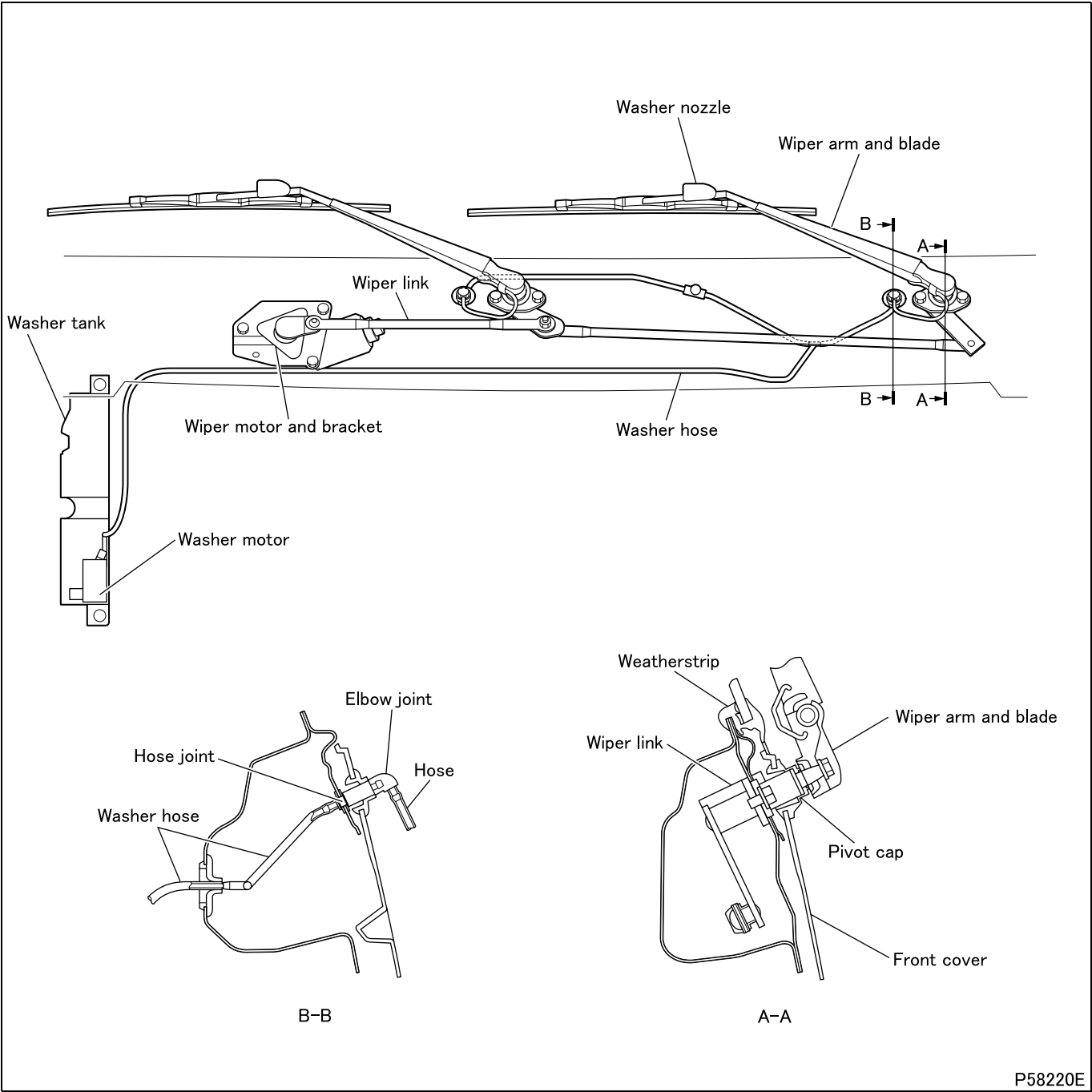
 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

STRUCTURE AND OPERATION	
1. Wiper and Washer System	51-2
TROUBLESHOOTING	51-3
MIRROR	51-4
WIPER AND WASHER.....	51-6
FRONT COVER	51-8
FRONT GRILLE, FRONT CORNER PANEL AND HEADLAMP	51-10
FENDER	51-14
STEP	51-16
GARNISH <CREW CAB>.....	51-18
WHEEL HOUSE	51-19
WINDOW GLASS	51-20

STRUCTURE AND OPERATION

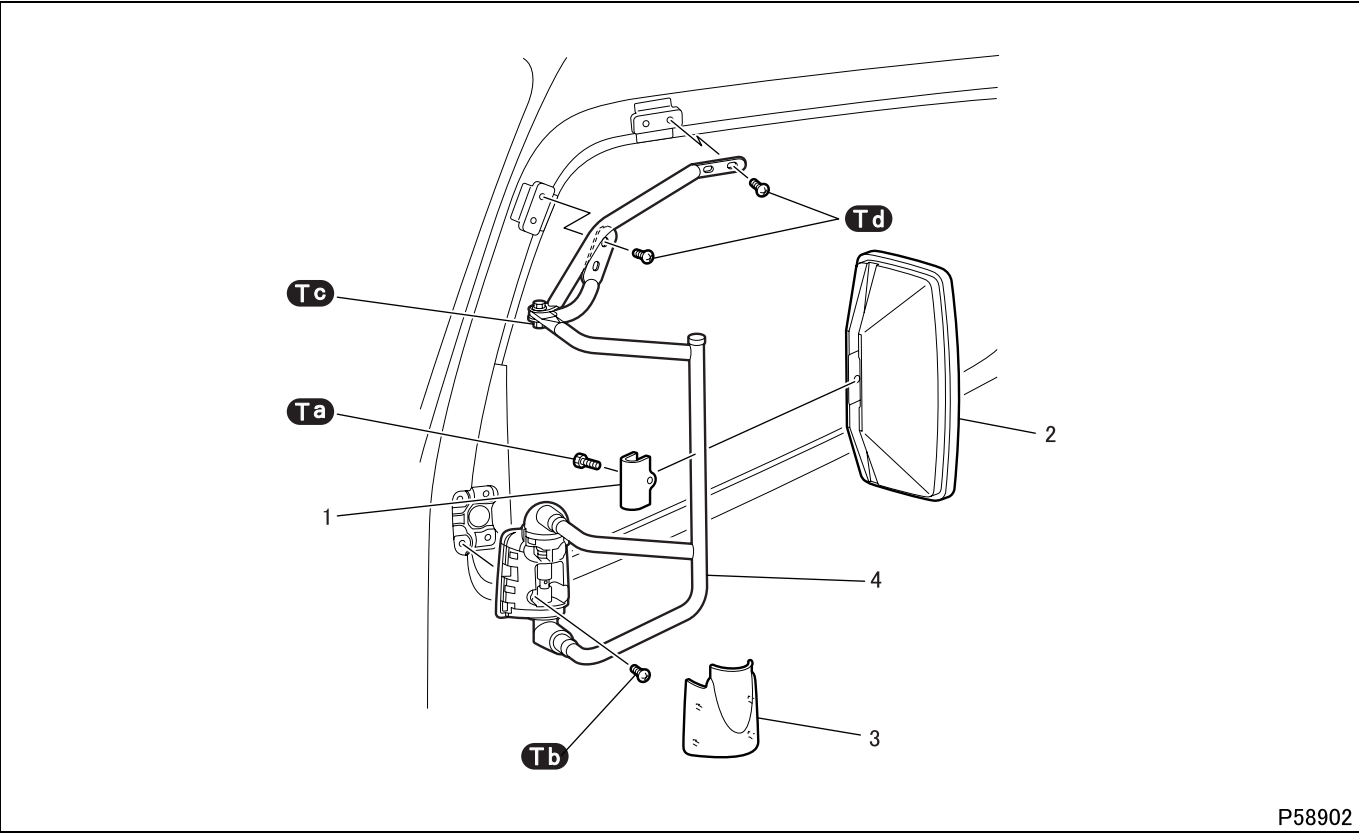
1. Wiper and Washer System



Wiper and washer

Symptoms											Reference Gr
	Wiper fails to operate	Wiper fails to stop	Wiper fails to operate intermittently	Wiper blade stops at improper position	Wiper does not wipe well	Wiper emits noise during operation	Washer motor fails to operate	Washer injects insufficient amount of fluid	Washer fails to inject washer fluid	Wiper fails to operate in unison with washer	
Possible causes											
Wiper motor faulty	O	O		O		O					Gr54
Washer motor faulty							O	O	O		
Wiper and washer switch faulty	O	O	O				O			O	
MUTIC (control unit) faulty			O							O	
Wiper relay faulty	O						O				
Fuse/high current fuse blown	O						O				
Connector improperly connected, harness open-circuited, grounding improper	O		O				O		O	O	
Wiper motor crank arm out of position				O							
Wiper link and wiper arm improperly connected						O					
Wipe blade defective					O	O					
Wiper arm defective					O						
Washer hose twisted								O	O		
Washer hose improperly connected								O	O		
Washer nozzle clogged								O	O		
Washer fluid insufficient									O		

MIRROR



● Disassembly sequence

- 1 Clamp
- 2 Mirror
- 3 Cover
- 4 Mirror stay

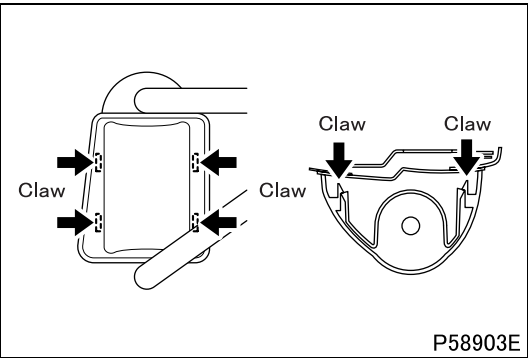
● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

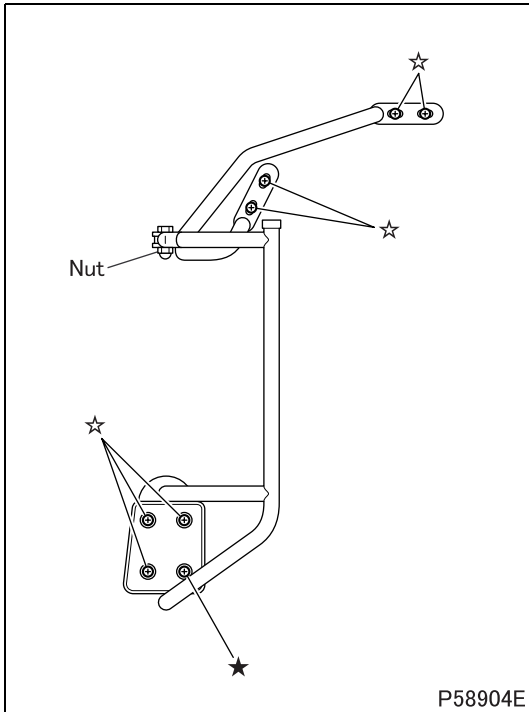
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (mirror mounting)	6.5 to 7.2 {4.8 to 5.3, 0.66 to 0.73}	—
Tb	Screw (mirror stay mounting)	9 to 14 {6.6 to 10, 0.9 to 14}	—
Tc	Nut (mirror stay fastening)	19 to 28 {14 to 21, 1.9 to 2.9}	—

◆ Removal procedure ◆



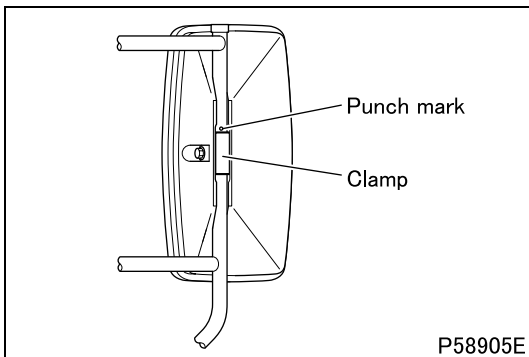
■ Removal: Cover

◆ Installation procedure ◆



■ Installation: Mirror stay

- Install the one screw marked ★ and adjust the position of the mirror stay.
- Install all the remaining seven screws marked ★ to secure the mirror stay.
- Fasten the mirror stay nut to the specified torque.



■ Installation: Mirror

- Adjust the height of the mirror by aligning the punch mark on the mirror stay with the clamp edge as shown in the illustration.



● Disassembly sequence

- | | |
|------------------------|-------------------------------|
| 1 Wiper blade | 10 Wiper motor bracket |
| 2 Blade rubber | 11 Wiper motor |
| 3 Washer nozzle | 12 Joint |
| 4 Elbow joint | 13 Washer hose |
| 5 Joint | 14 Washer hose |
| 6 Hose | 15 Joint |
| 7 Wiper arm | 16 Washer tank |
| 8 Pivot cap | 17 Washer motor |
| 9 Wiper link | 18 Washer hose |

NOTE

- **Before disconnecting the connector to remove the wiper motor, pull out cab side harness enough, otherwise it will fall in the cab side and cannot be taken out without removing the instrument panel.**

● Assembly sequence

Follow the disassembly sequence in reverse.

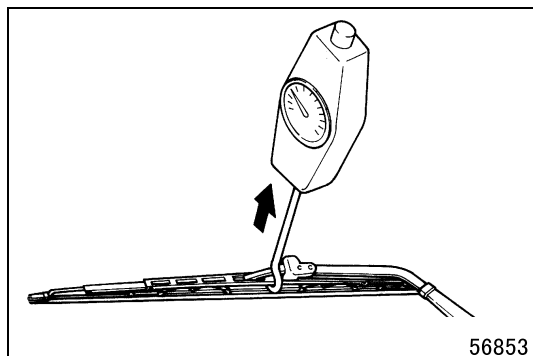
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
7	Wiper arm force to press blade against windshield	6.2 ± 0.5 N {1.4 ± 0.11 lbs, 0.63 ± 0.05 kgf}	—	Replace

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (Wiper arm and blade attaching)	11 to 16 {8.1 to 12, 1.1 to 1.6}	—

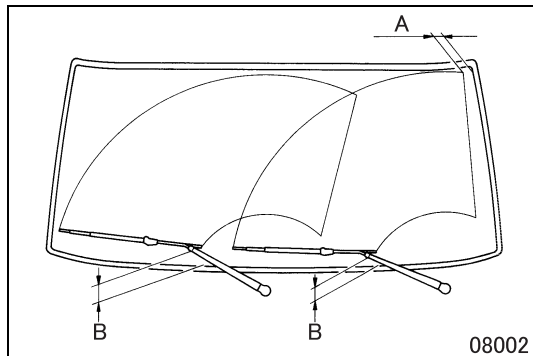
◆ Inspection procedure ◆



■ Inspection: Wiper arm

- Measure the wiper arm force to press the blade against the windshield.
- If the measurement deviates from the standard value, replace the wiper arm.

◆ Installation procedure ◆



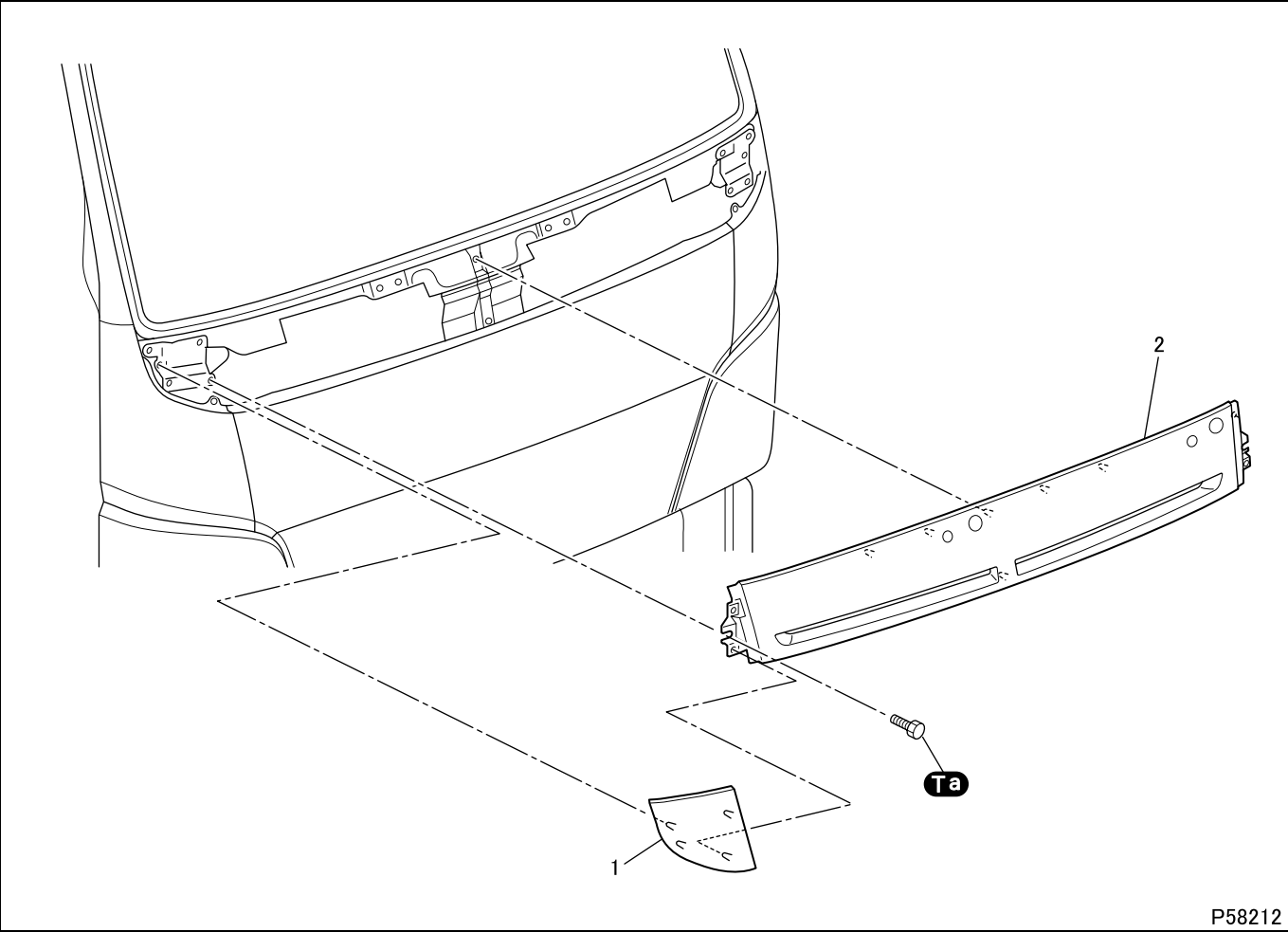
■ Installation: Wiper arm and blade

- Install the wiper arm and blade so that the blades come to the illustrated points as much as **A** and **B** apart from the edge of weatherstrip.

A: 50 mm {1.97 in.}

B: 59 ± 5 mm {2.3 ± 0.20 in.}

FRONT COVER



●Disassembly sequence

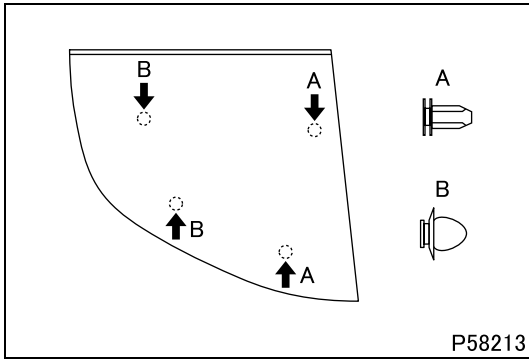
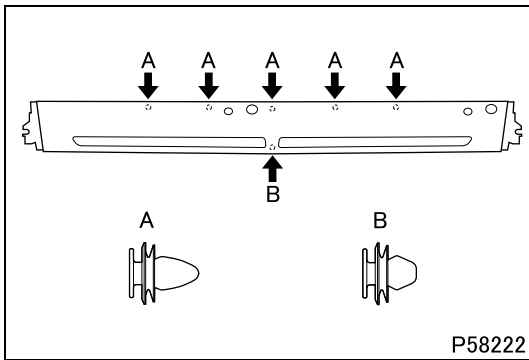
- 1 Front side cover
- 2 Front cover

●Assembly sequence

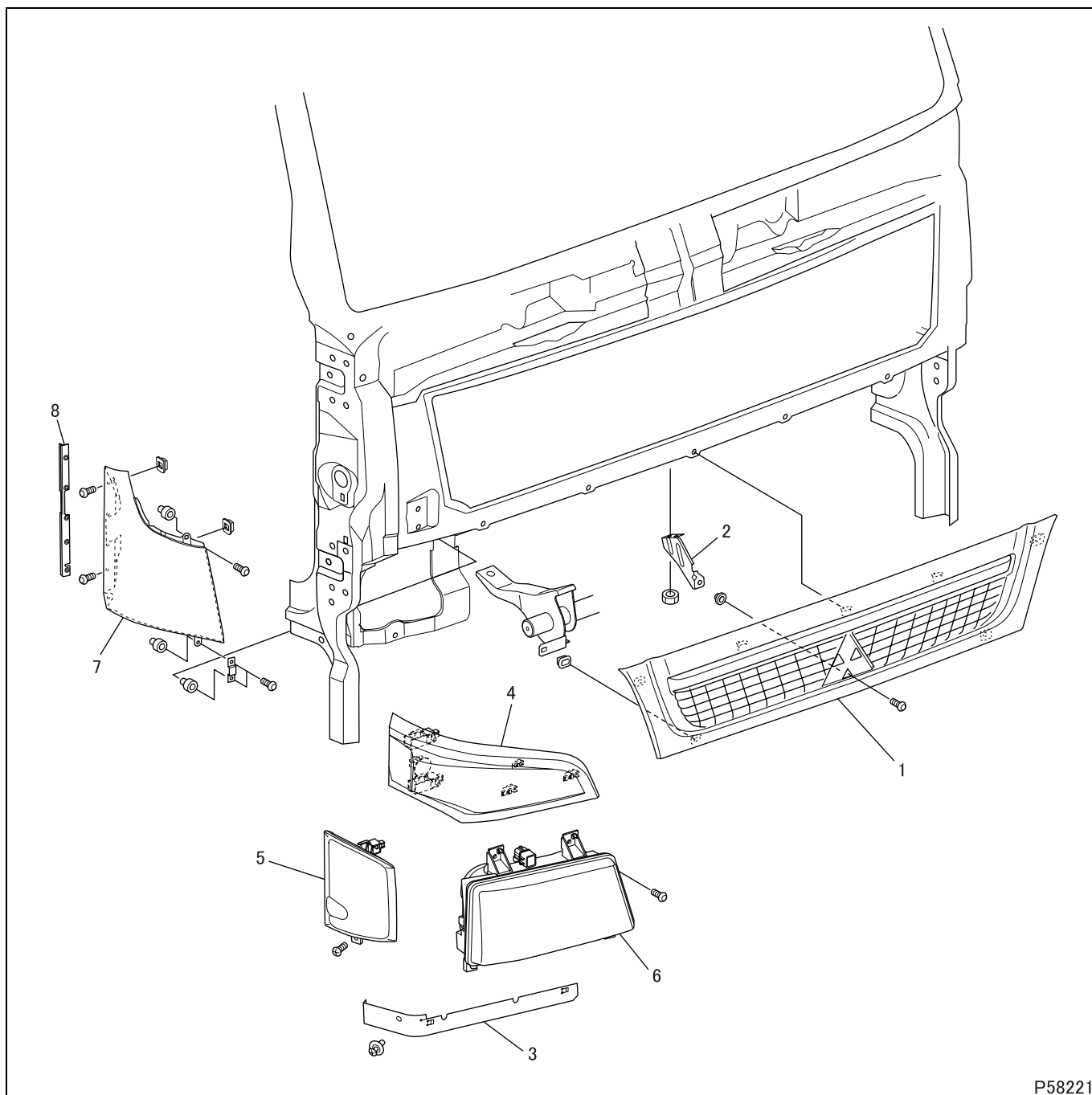
Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Front cover attaching)	9 to 14 {6.6 to 10, 0.9 to 1.4}	—

◆ Removal procedure ◆**■ Removal: Front side cover****■ Removal: Front cover**

FRONT GRILLE, FRONT CORNER PANEL AND HEADLAMP



● Disassembly sequence

- | | |
|--------------------|----------------------|
| 1 Front grille | 5 Dummy lamp |
| 2 Bracket | 6 Headlamp |
| 3 Lamp rubber | 7 Front corner panel |
| 4 Turn signal lamp | 8 Door opening seal |

CAUTION

- Do not attempt to forcibly remove lamp rubber, turn signal lamp, cornering lamp and headlamp. Their mounting claws could be damaged.

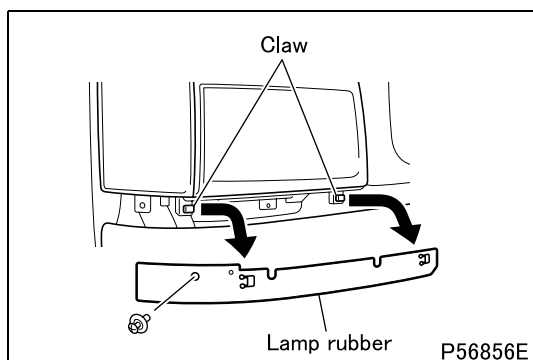
NOTE

- Do not remove door opening seal unless absolutely necessary.

● Assembly sequence

Follow the disassembly sequence in reverse.

◆ Removal procedure ◆

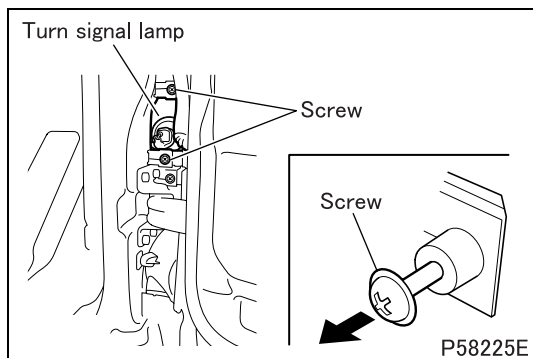


■ Removal: Lamp rubber

- Slide the lamp rubber sideways to disengage from the claws of the headlamp.

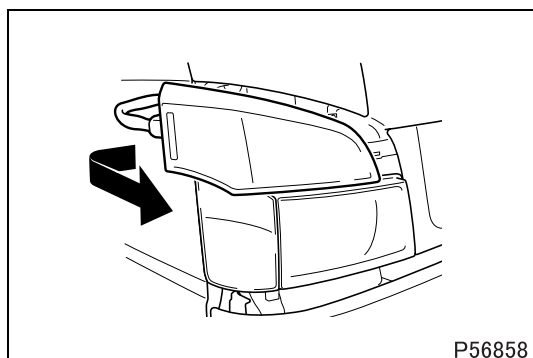
CAUTION ⚠

- Do not pull the lamp rubber to forcedly remove. It could be damaged.

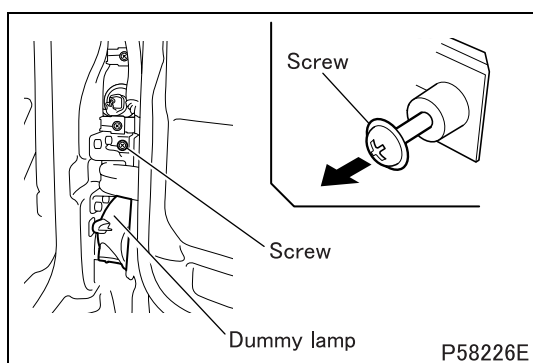


■ Removal: Turn signal lamp

- Open the door. Loosen screws securing the turn signal lamp from behind to such an extent that they freely turn.
- Draw out the loosened screws.

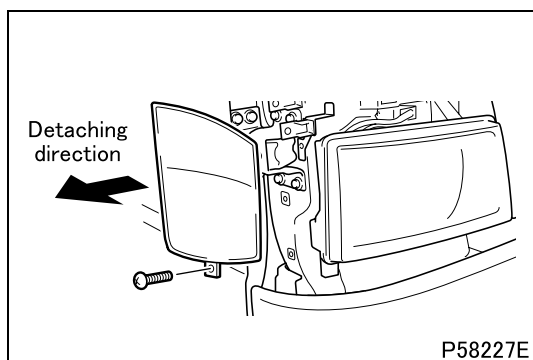


- Close the door. Move the turn signal lamp sideways to disengage its claws.
- Ascertain the disengagement of the claws, then pull out the turn signal lamp.



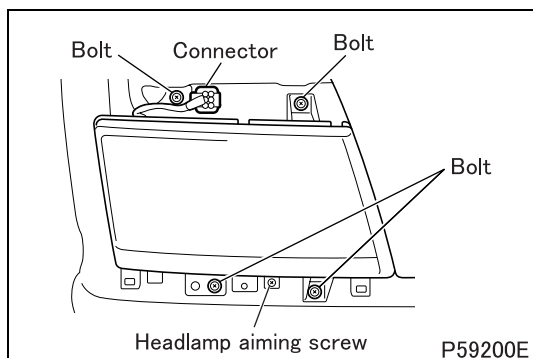
■ Removal: Dummy lamp

- Open the door. Loosen screw securing the dummy lens from behind to such an extent that it freely turn.
- Pull out the loosened screw.



- Close the door, and remove the dummy lamp.

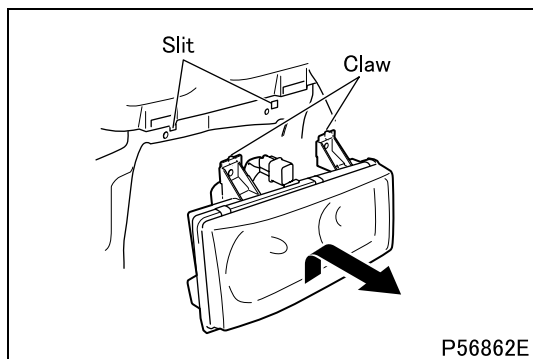
FRONT GRILLE, FRONT CORNER PANEL AND HEADLAMP



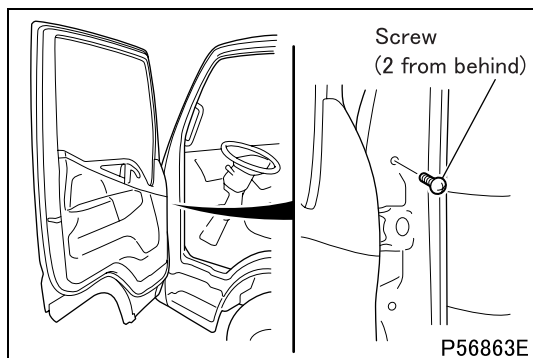
■ Removal: Headlamp

CAUTION ⚠

- The headlamp has aiming screw at the illustrated positions. Do not mistake them for mounting bolts.



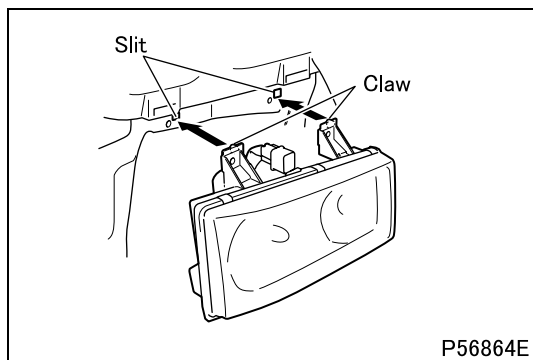
- Lift the headlamp a little to disengage its claws from the slits, then pull it out.



■ Removal: Front corner panel

- Open the door. Remove two screws securing the front corner panel from behind.
- Close the door. Remove three screws securing the front corner panel from front.
- Remove the front corner panel.

◆ Installation procedure ◆

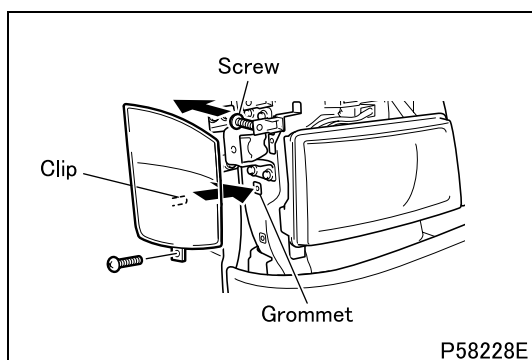


■ Installation: Front corner panel

- Perform the removal procedure in reverse.
(See ■ Removal: Front corner panel.)

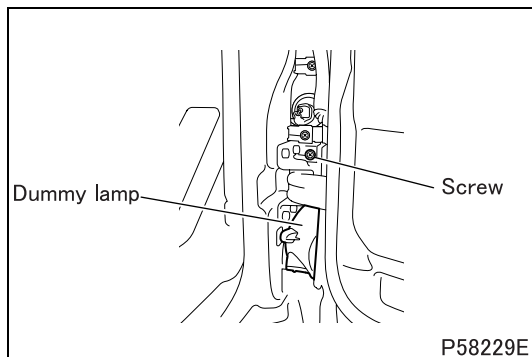
■ Installation: Headlamp

- Install the headlamp with its claws inserted in the slits.



■ Installation: Dummy lamp

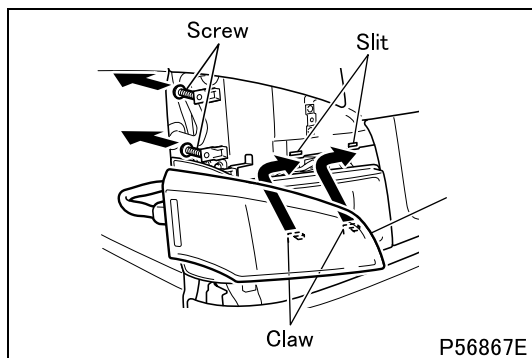
- Check to see if the threaded portion of cab-side screw protrudes. If it does, move it out of the way in the illustrated direction.
- Insert the clip of the dummy lamp into the grommet.



- Open the door. Tighten the screw securing the dummy lens from behind.

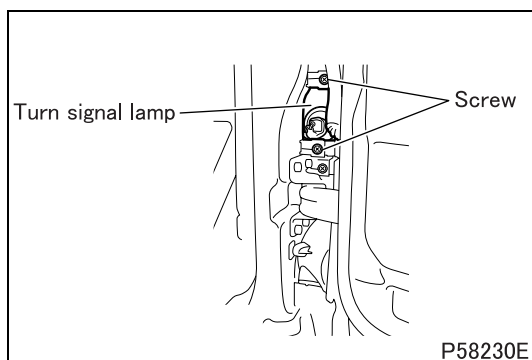
CAUTION

- Do not overtighten the screw.



■ Installation: Turn signal lamp

- Check to see if the threaded portions of screws protrude. If they protrude, move them out of the way in the illustrated direction.
- Put the claws of the turn signal lamp in the cab-side slits, then press-fit the lamp sideways into place.



- Open the door, and secure the turn signal lamp by tightening screws from behind.

CAUTION

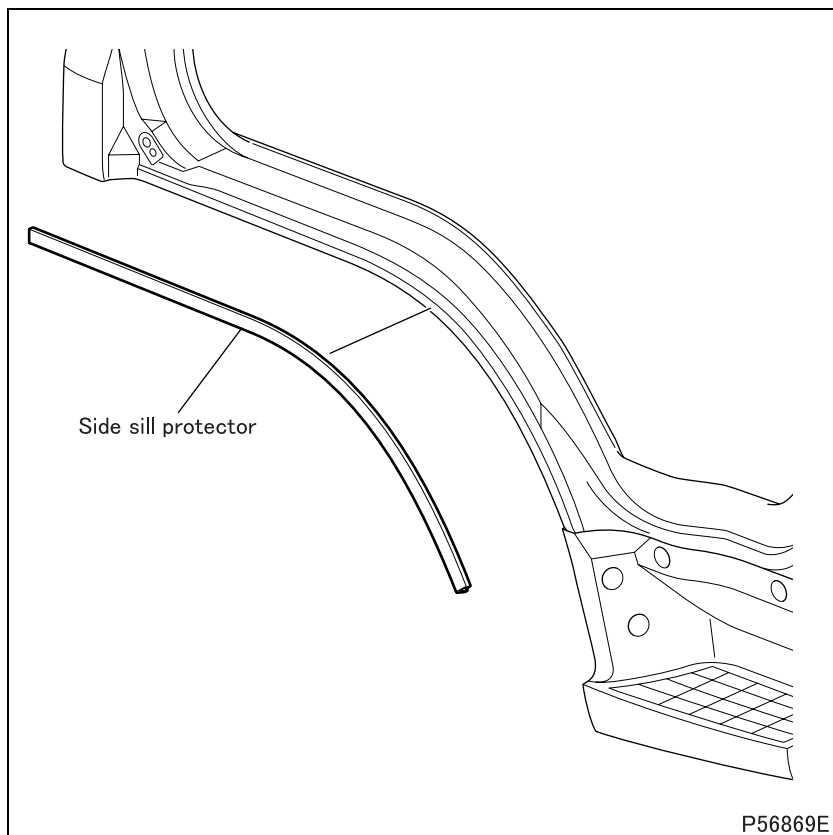
- If the door is opened without the turn signal lamp press-fitted all the way into place, the lamp will be damaged.
- Do not overtighten the screws.

■ Installation: Lamp rubber

- Perform the removal procedure in reverse.
(See ■ Removal: Lamp rubber.)

FENDER

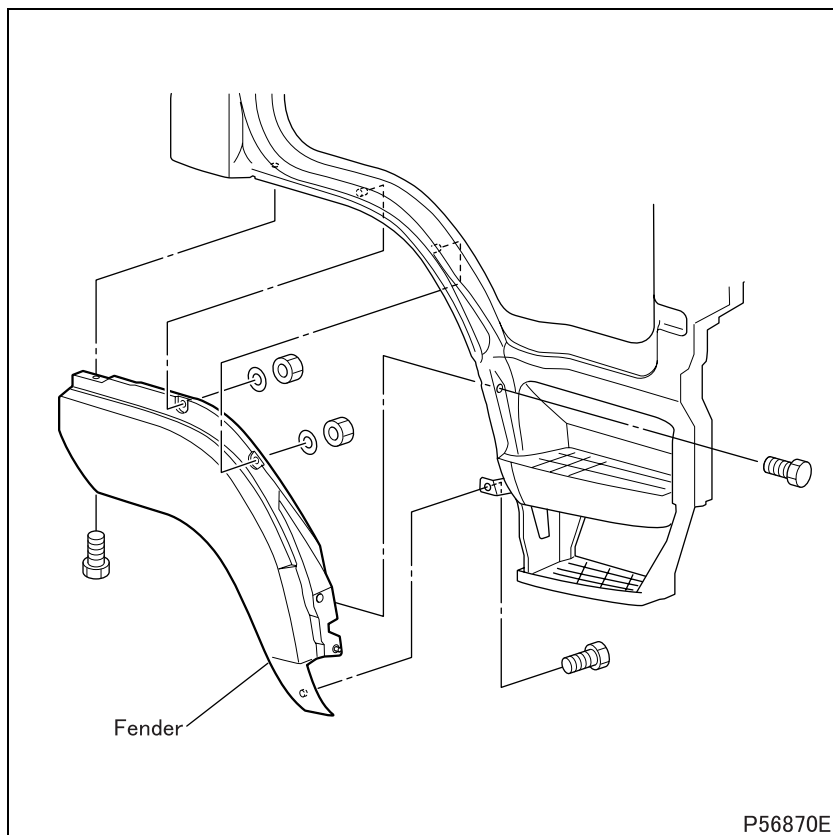
<FE>



NOTE

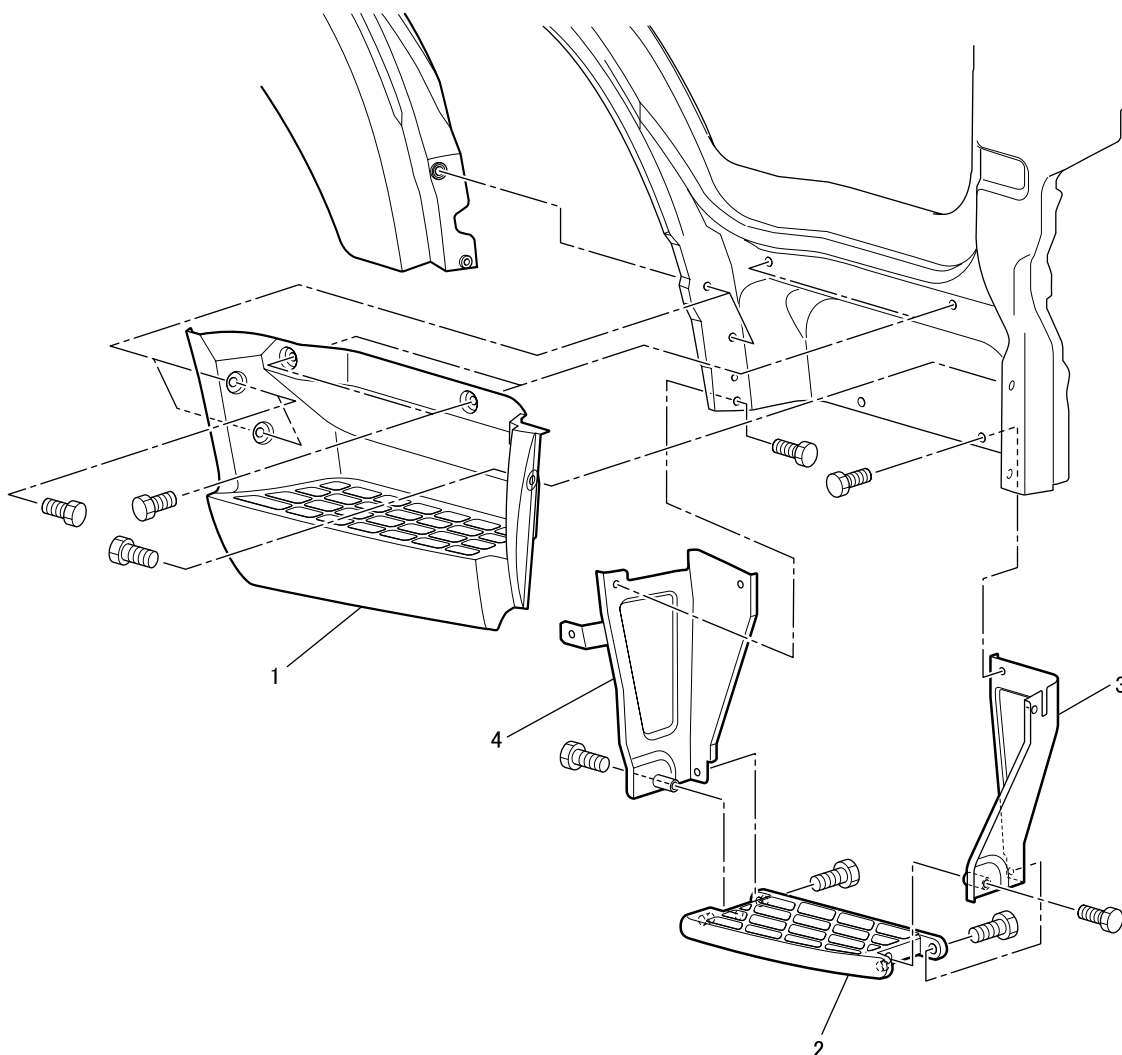
- For details on removal and installation of the fender, refer to Gr43.
- Attach the side sill protector using double-coated adhesive tape.

<FG>



M E M O

STEP



P56871

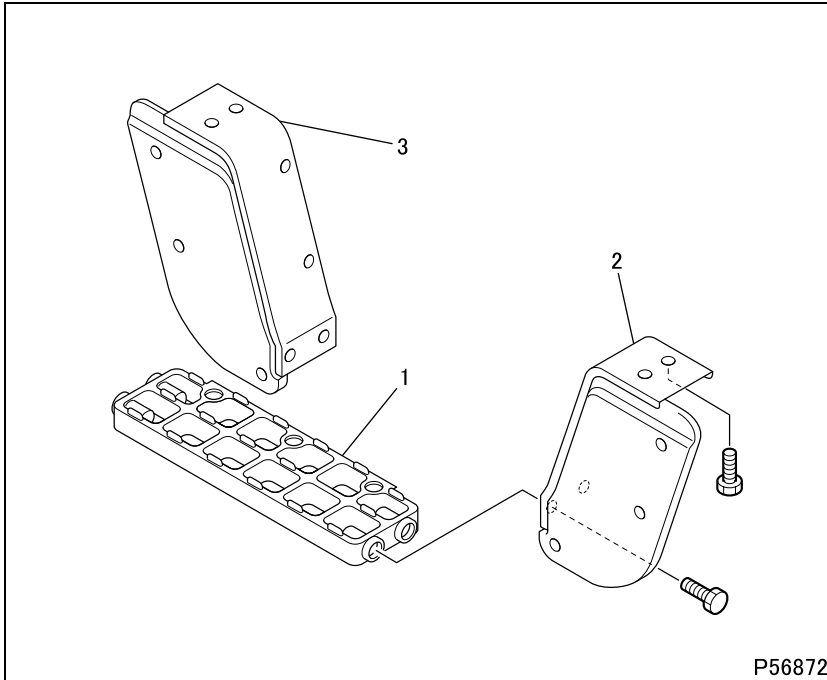
● Removal sequence

- 1 Step
- 2 No. 1 step <FG>
- 3 No. 1 step front bracket <FG>
- 4 No. 1 step rear bracket <FG>

● Installation sequence

Follow the removal sequence in reverse.

<Rear Step (Crew Cab)>



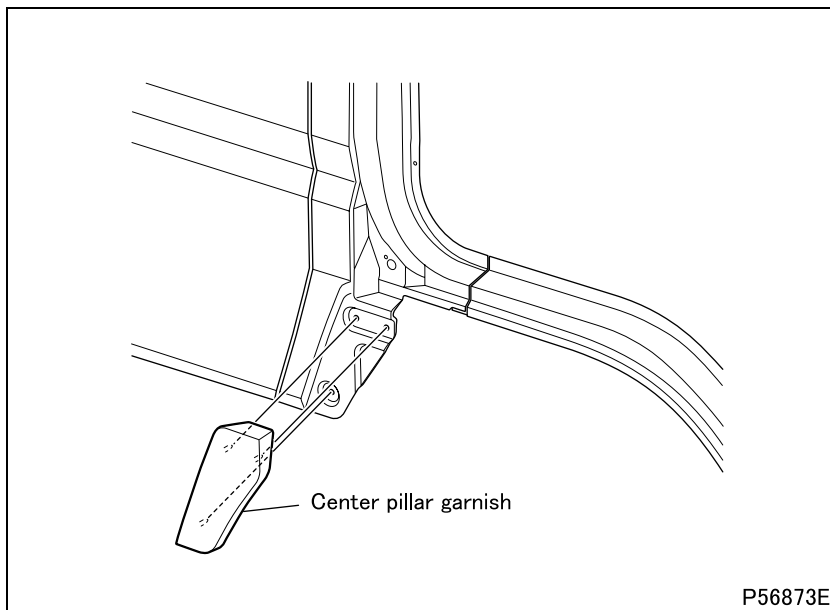
● Removal sequence

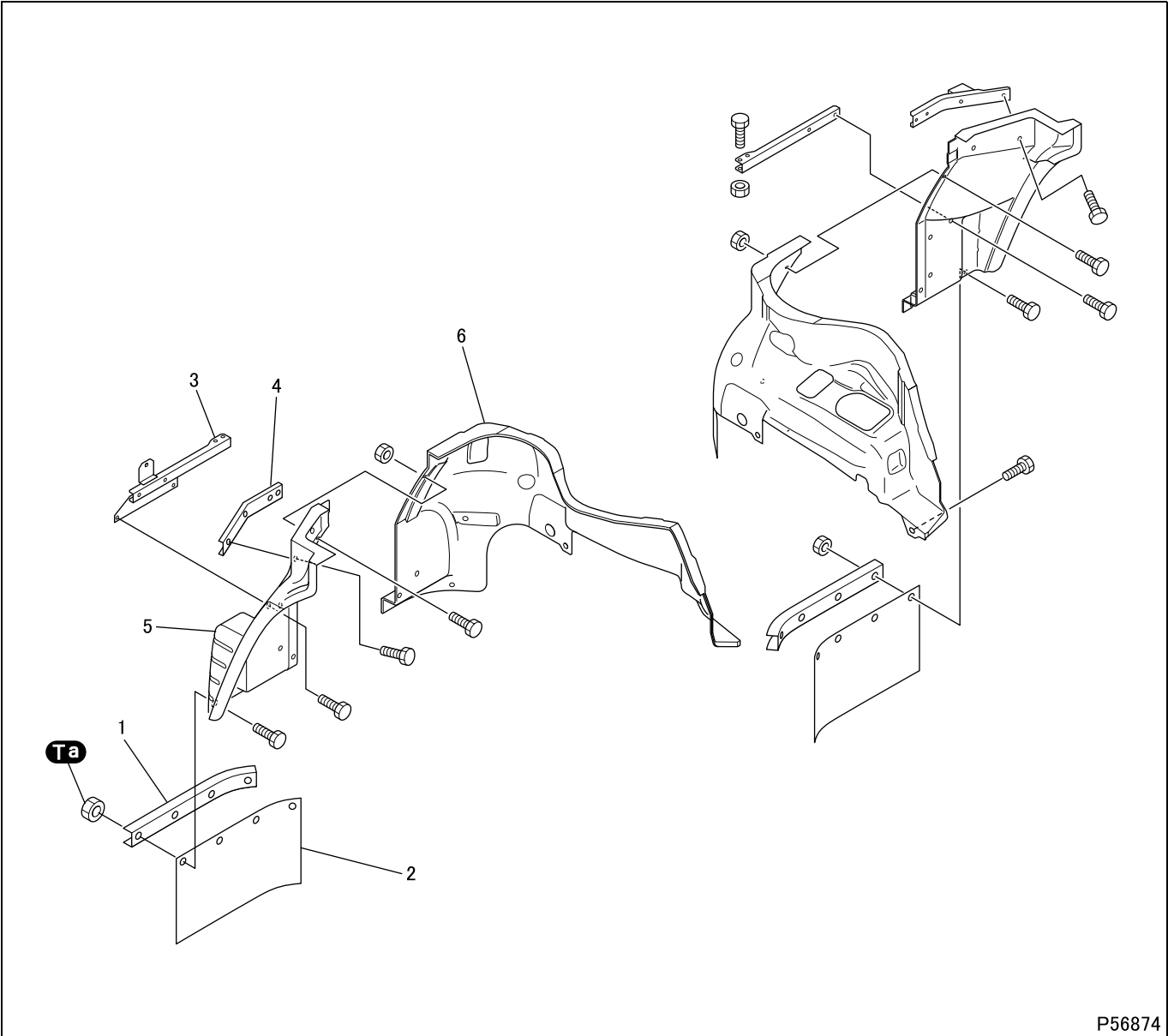
- 1 Step
- 2 Front bracket
- 3 Rear Bracket

● Installation sequence

Follow the removal sequence in reverse.

GARNISH <CREW CAB>





P56874

● Removal sequence

- 1 Apron support
- 2 Mud guard apron
- 3 Mud guard lower stay
- 4 Mud guard upper stay
- 5 Mud under guard
- 6 Lower shield panel

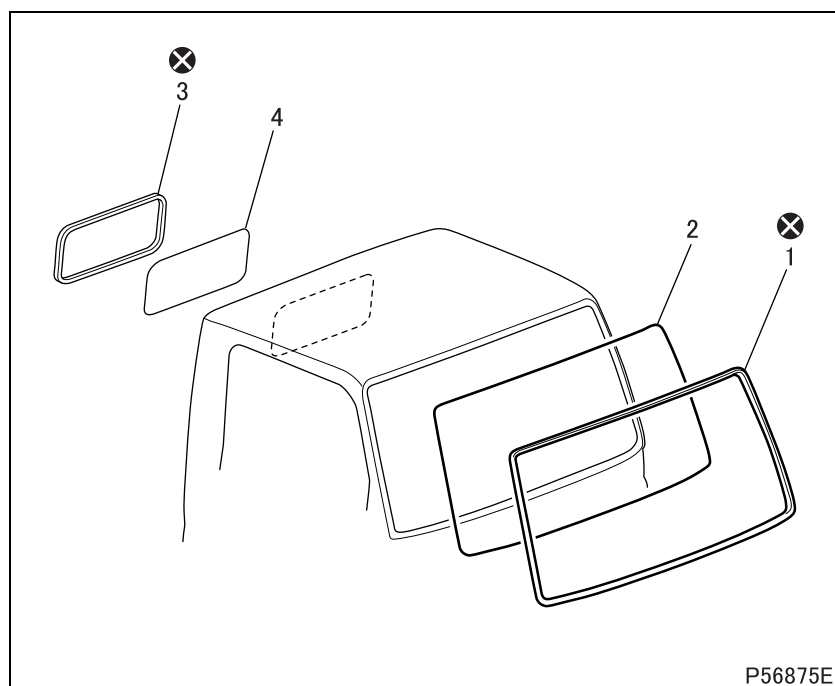
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (attaching apron support to mud guard apron)	3.9 to 5.9 {2.9 to 4.4, 0.4 to 0.6}	–

WINDOW GLASS



● Removal sequence

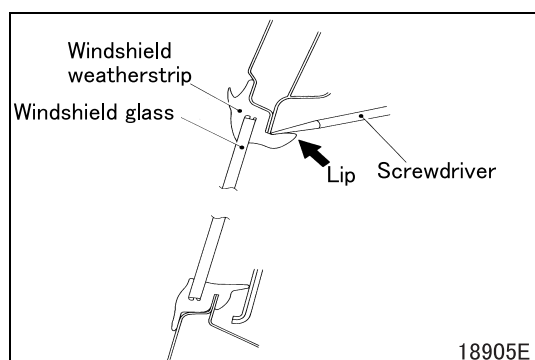
- 1 Windshield weatherstrip
- 2 Windshield glass
- 3 Rear window weatherstrip
- 4 Rear window glass

⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

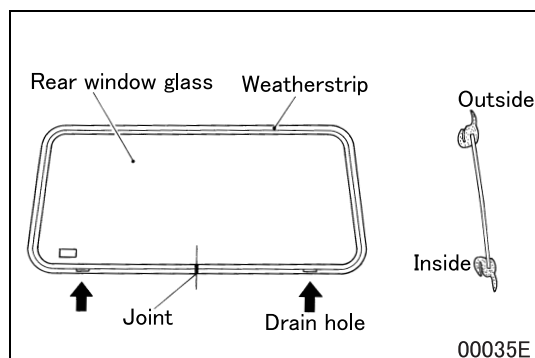
◆ Removal procedure ◆



■ Removal: Windshield weatherstrip and windshield glass

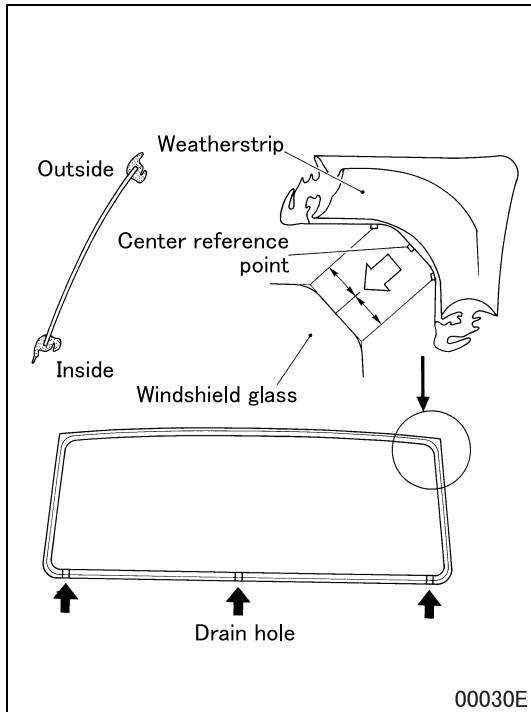
- While prying up the lip of the weatherstrip with the tip of a screwdriver, push the windshield glass out from inside the cab.

● Installation procedure



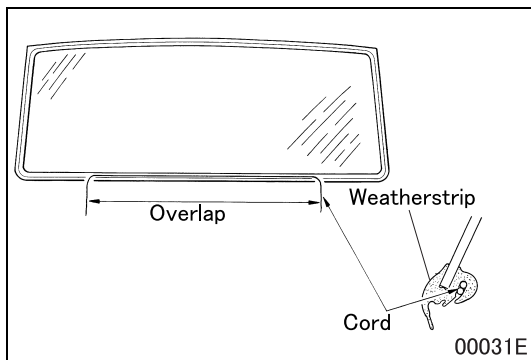
■ Installation: Rear window weatherstrip and rear window glass

- Fit the rear window weatherstrip round the rear window glass so that the joint of weatherstrip comes at the bottom center of the glass.
- Except for the point mentioned above, install the rear window glass in the same manner as the windshield glass.

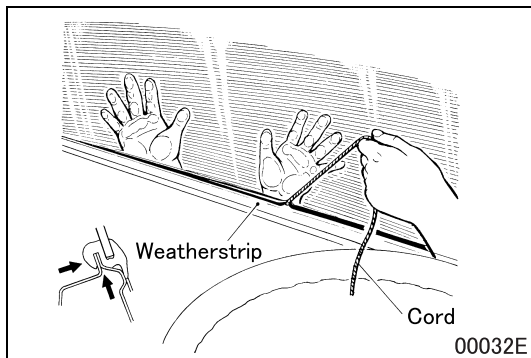


■ Installation: Windshield weatherstrip and windshield glass

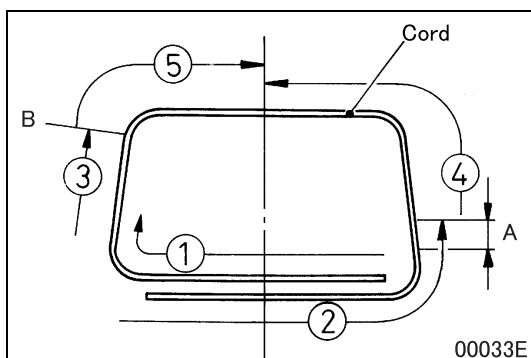
- Install the weatherstrip with its center reference point aligned with the center of the cut at each corner of the glass.



- Put a piece of strong cord in the cab flange fitting groove in the weatherstrip with its end portions overlapped.



- With the glass strongly pushed from outside, pull out the cord by its ends from inside the cab to gradually fit the flange of the cab in the inner groove of the weatherstrip.

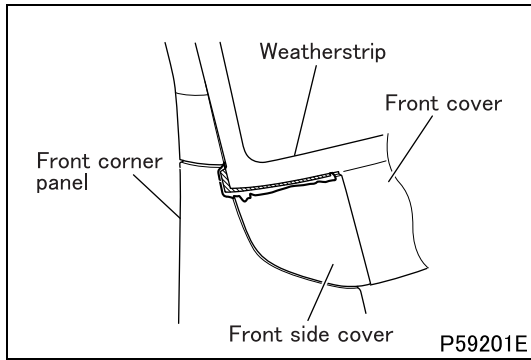


- Pull the cord in the numerical order of steps as shown. At the same time, while tapping with a rubber-headed mallet from outside the cab, settle the windshield glass in place in the weatherstrip.

A: Approx. 100 mm {3.9 in.} from the beginning of straight portion

B: Up to the end of straight portion

WINDOW GLASS



- To ensure watertightness, put the hatched part of the weatherstrip inside between the cab and the front cover, front side cover and front corner panel.



Group 52

Interior

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SEAT

<DRIVER>.....	52-2
<PASSENGER>.....	52-4
<REAR>	52-6

SEAT BELT	52-8
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INSTRUMENT PANEL	52-14
------------------------	-------

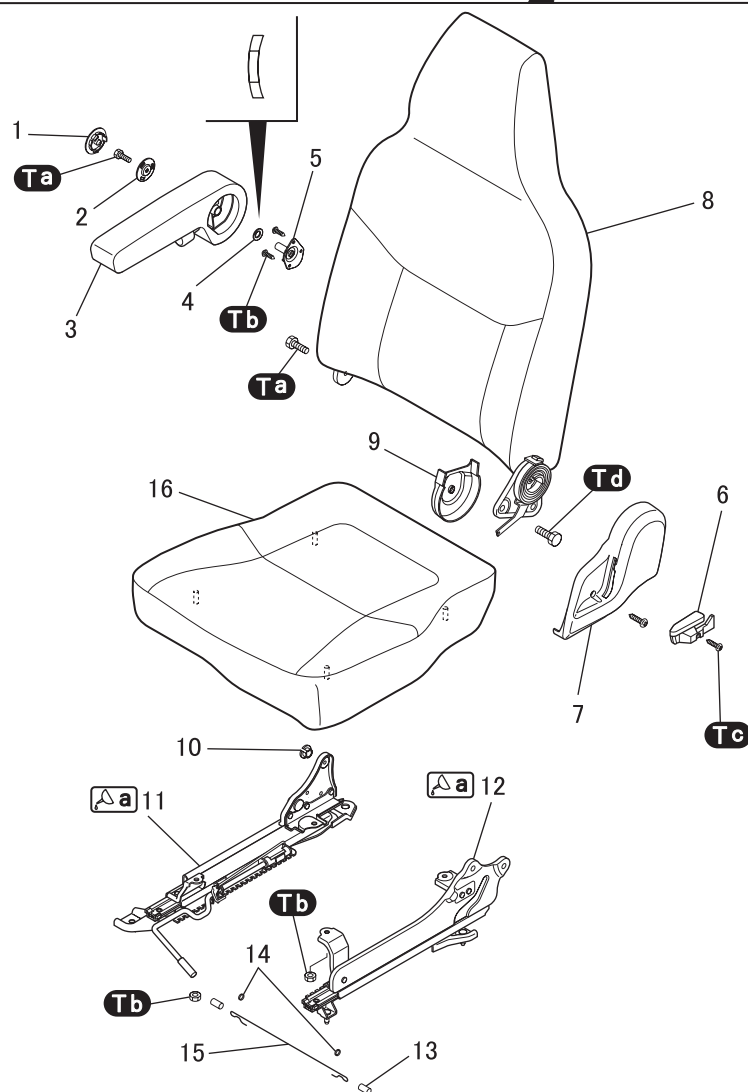
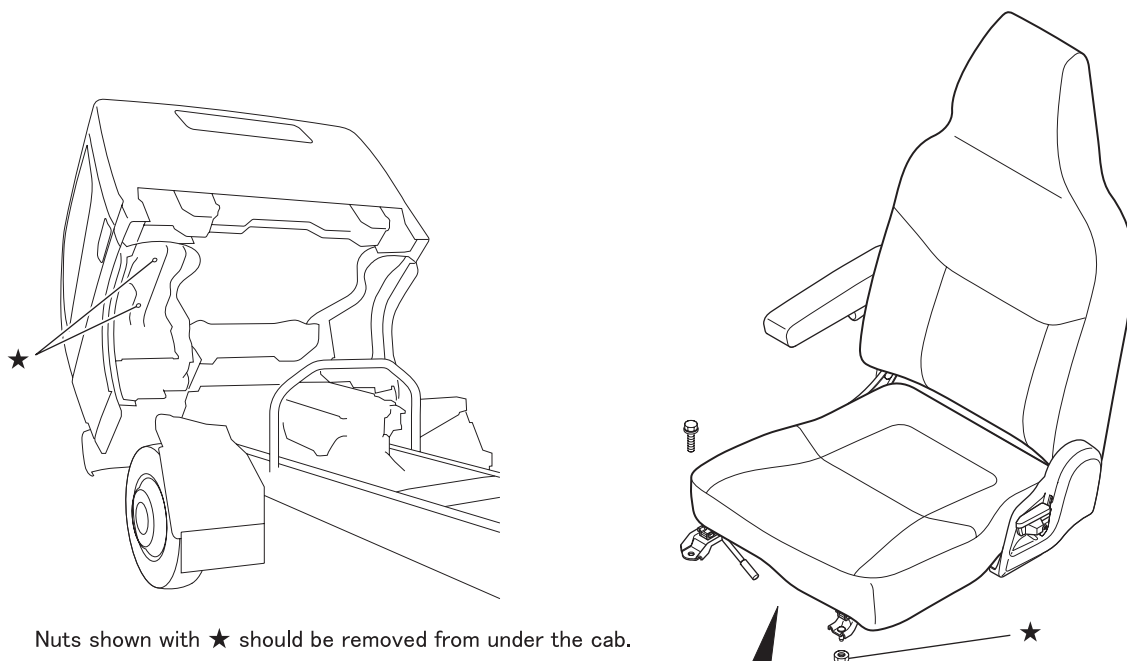
TRIM AND SCUFF PLATE

<EXCEPT CREW CAB>	52-34
<CREW CAB>	52-38

HEAD LINING

<EXCEPT CREW CAB>	52-40
<CREW CAB>	52-42

SEAT <DRIVER>



● Removal sequence

- | | | |
|-------------------|-------------------------------|-----------------|
| 1 Cover | 7 Reclining cover | 13 Tube |
| 2 Plate | 8 Back cushion | 14 Clip |
| 3 Armrest | 9 Inner cover | 15 Wire |
| 4 Washer | 10 Bushing | 16 Seat cushion |
| 5 Armrest bracket | 11 Seat adjuster (right-hand) | |
| 6 Knob | 12 Seat adjuster (left-hand) | |

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

- When installing the seat adjusters, be sure to engage the locking device before fitting them onto the seat cushion.

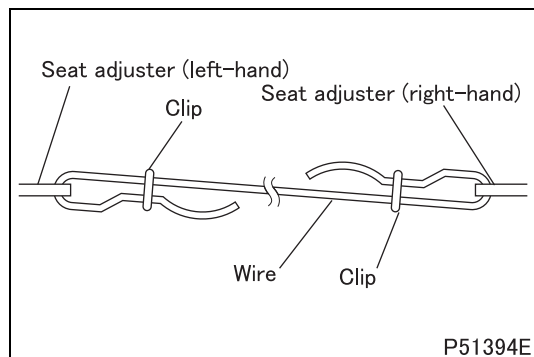
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
	Screw (Plate mounting)	10 to 15 {7.4 to 11, 1.0 to 1.5}	–
	Bolt (Back cushion mounting)		
	Screw (Armrest bracket mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–
	Bolt (Seat adjuster mounting)		
	Nut (Seat adjuster mounting)		
	Screw (Knob mounting)	1.4 {1.0, 0.14}	–
	Bolt (Back cushion mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Sliding surface of seat adjuster	Chassis grease [NLGI No. 1 (Li soap)]	As required

◆ Installation procedure ◆



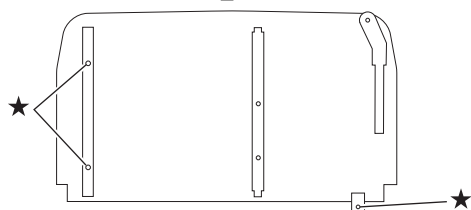
■ Installation: Wire

- Install one end of the wire onto the seat adjuster (left-hand). Then, twist the wire a half turn before fitting the other end onto the seat adjuster (right-hand).

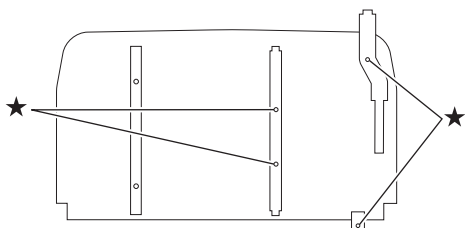
SEAT <PASSENGER>

Bottom view

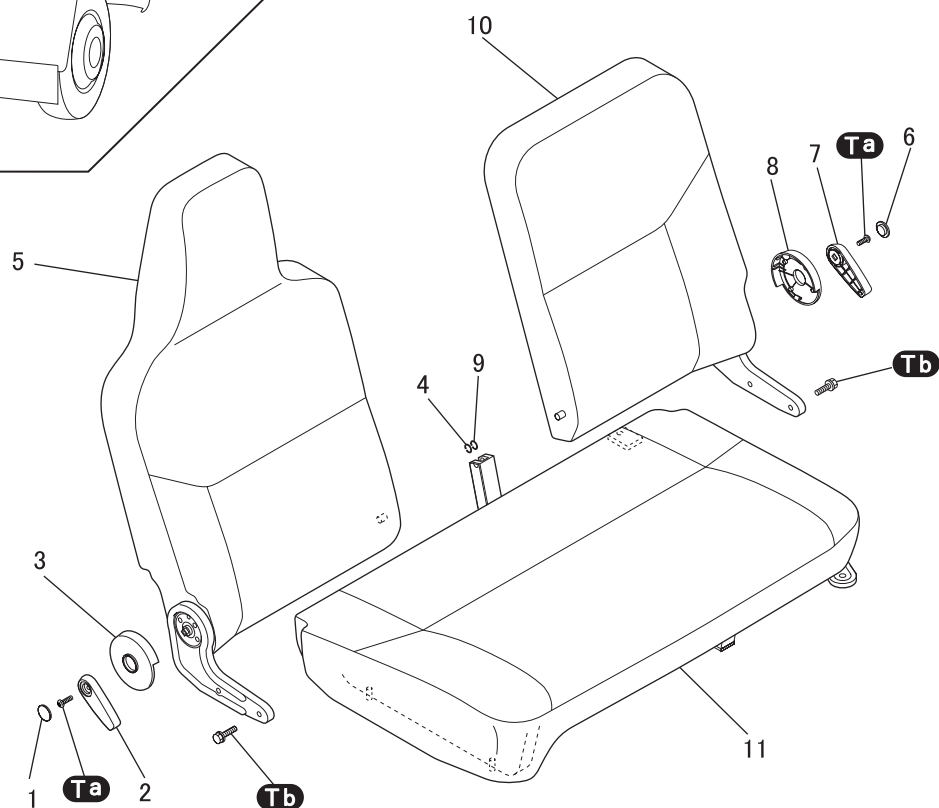
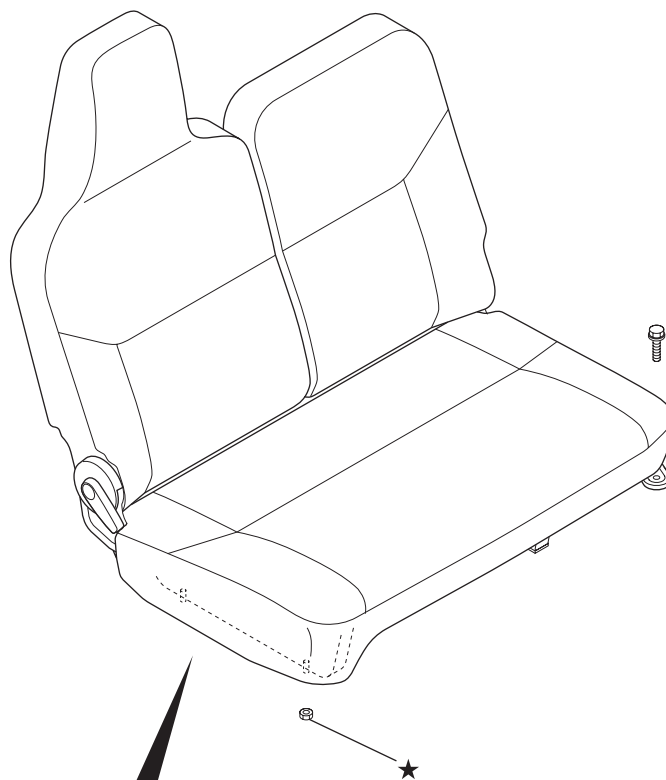
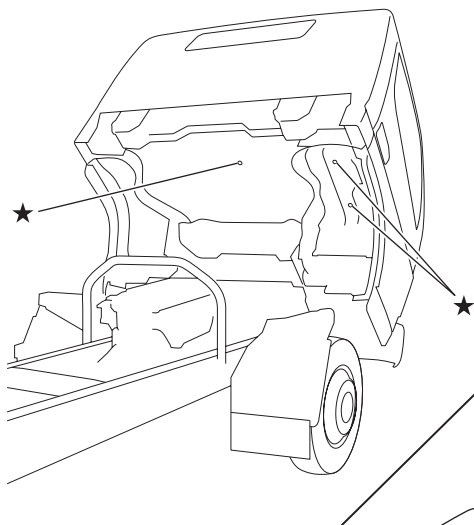
<Except crew cab> ↑ Front of vehicle



<Crew cab>



Nuts shown with ★ should be removed from under the cab.



P56179E

● Removal sequence

- | | |
|--------------------------------|-------------------------------|
| 1 Cap | 7 Knob |
| 2 Knob | 8 Reclining cover (left-hand) |
| 3 Reclining cover (right-hand) | 9 Snap ring |
| 4 Snap ring | 10 Center back cushion |
| 5 Side back cushion | 11 Seat cushion |
| 6 Cap | |

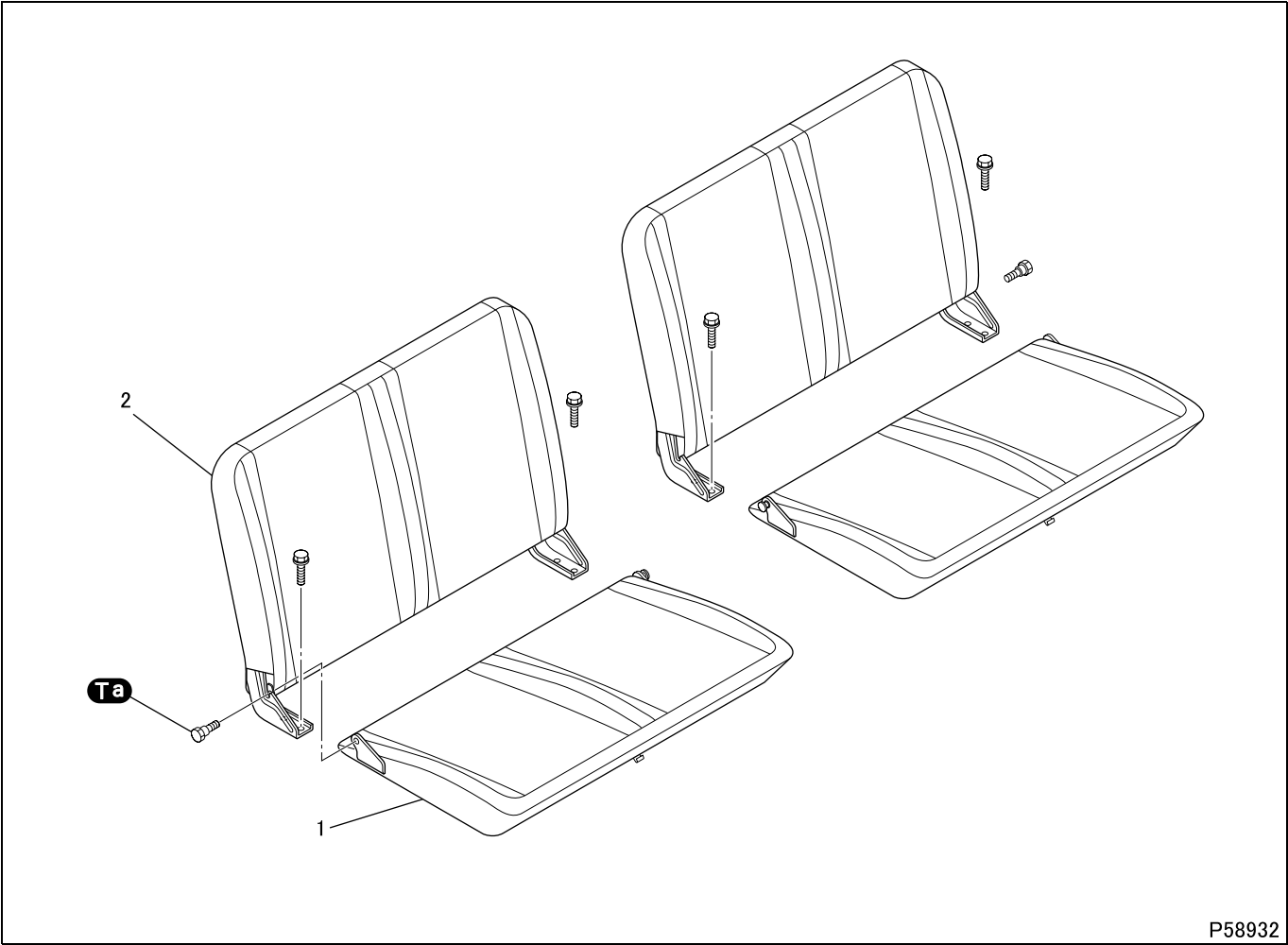
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (Knob mounting)	1.4 {1.0, 0.14}	–
Tb	Bolt (Back cushion mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	–

SEAT <REAR>



P58932

● Removal sequence

- 1 Seat cushion
- 2 Back cushion

● Installation sequence

Follow the removal sequence in reverse.

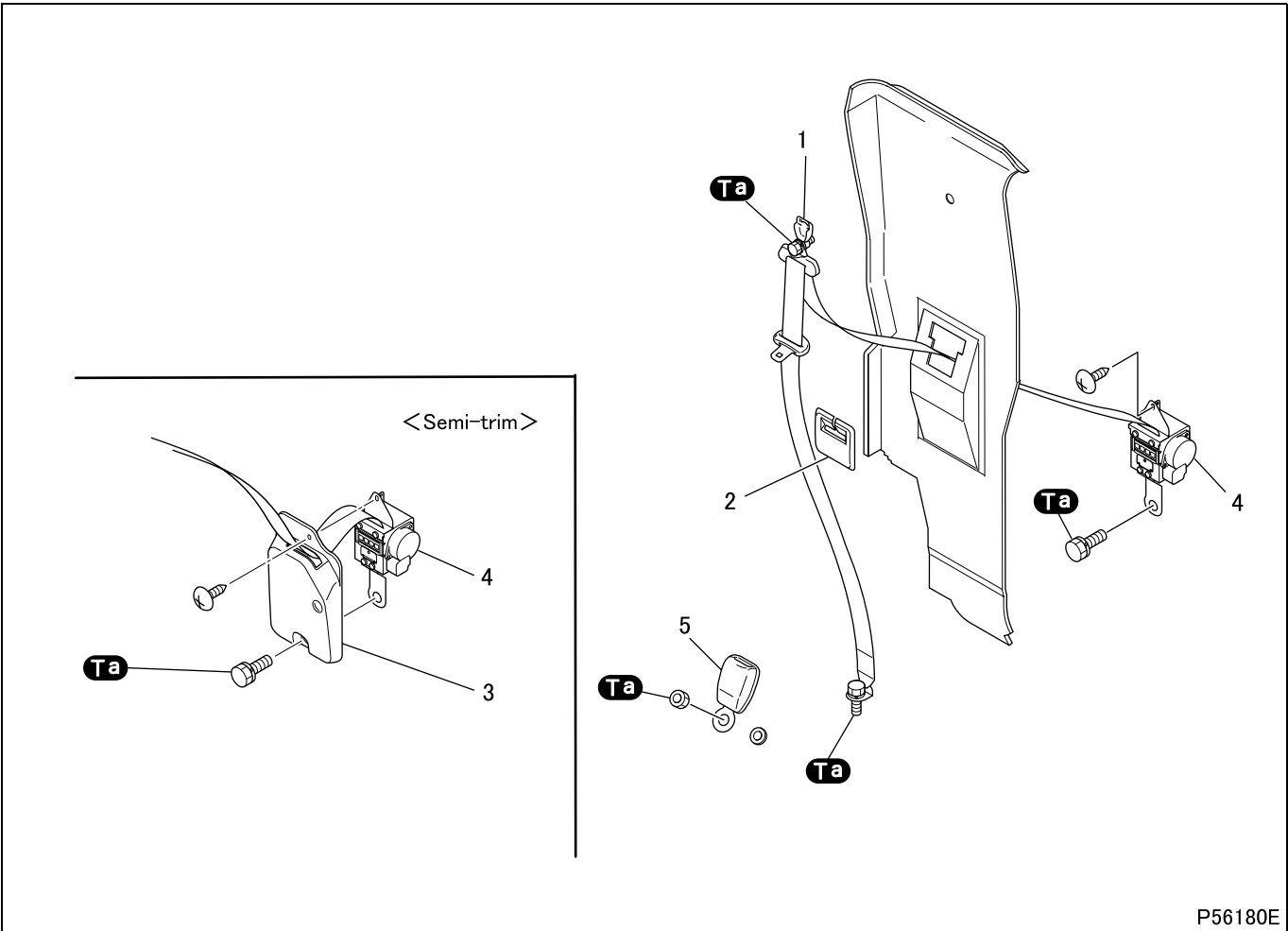
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Seat cushion mounting)	9 to 14 {6.6 to 10, 0.9 to 1.4}	—

M E M O

SEAT BELT

<Driver>



● Removal sequence

- | | |
|---|---|
| 1 Shoulder anchor cover | 3 Emergency locking retractor cover <semi-trim> |
| 2 Seat belt guide <Except semi-trim, except crew cab> | 4 Emergency locking retractor |
| | 5 Buckle |

● Installation sequence

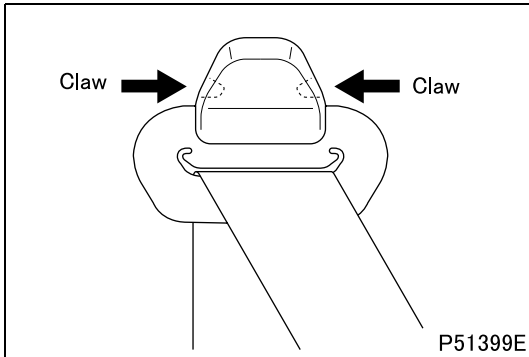
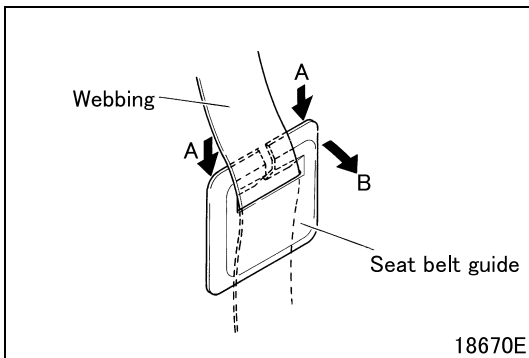
Follow the removal sequence in reverse.

CAUTION ⚠

- Never disassemble the emergency locking retractor, or buckle.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

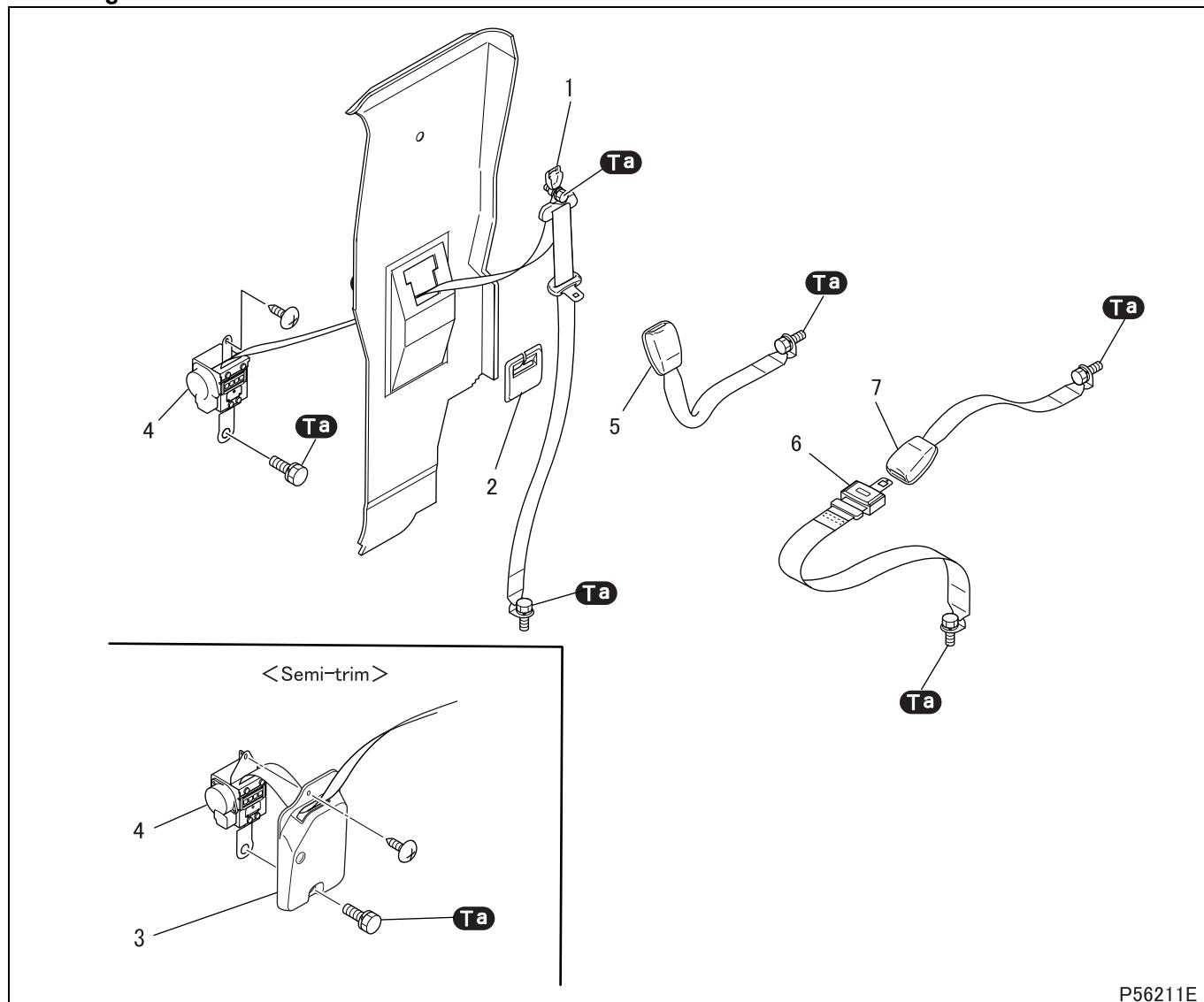
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Floor anchor mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—
	Bolt (Shoulder anchor mounting)		
	Bolt (Emergency locking retractor mounting)		
	Nut (Buckle mounting)		

◆ Removal procedure ◆**■ Removal: Shoulder anchor cover****■ Removal: Seat belt guide**

- To detach the seat belt guide, pull the top of the guide towards you in the direction of **B** while holding it down in the direction of **A**.

SEAT BELT

<Passenger>



P56211E

● Removal sequence

- 1 Shoulder anchor cover
- 2 Seat belt guide <Except semi-trim, except crew cab>
- 3 Emergency locking retractor cover <semi-trim>

- 4 Emergency locking retractor
- 5 Buckle
- 6 Tongue
- 7 Buckle

● Installation sequence

Follow the removal sequence in reverse.

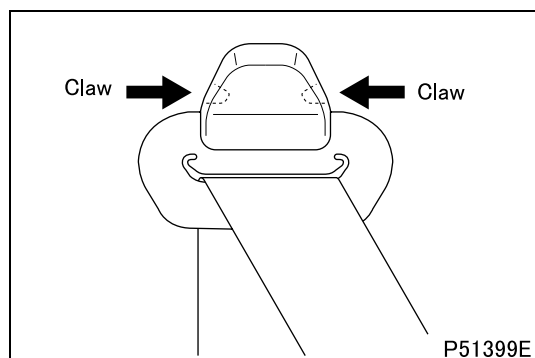
CAUTION ⚠

- Never disassemble the emergency locking retractor, or buckle.

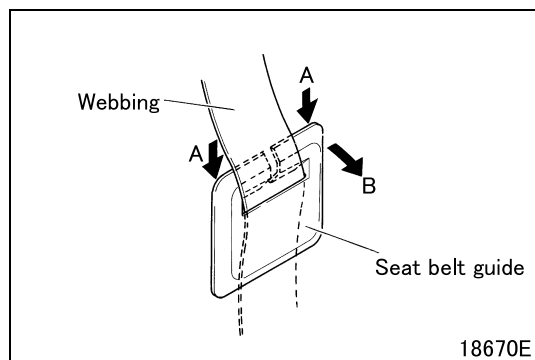
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Floor anchor mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—
	Bolt (Shoulder anchor mounting)		
	Bolt (Emergency locking retractor mounting)		
	Bolt (Buckle mounting)		
	Bolt (Tongue mounting)		

◆ Removal procedure ◆



■ Removal: Shoulder anchor cover

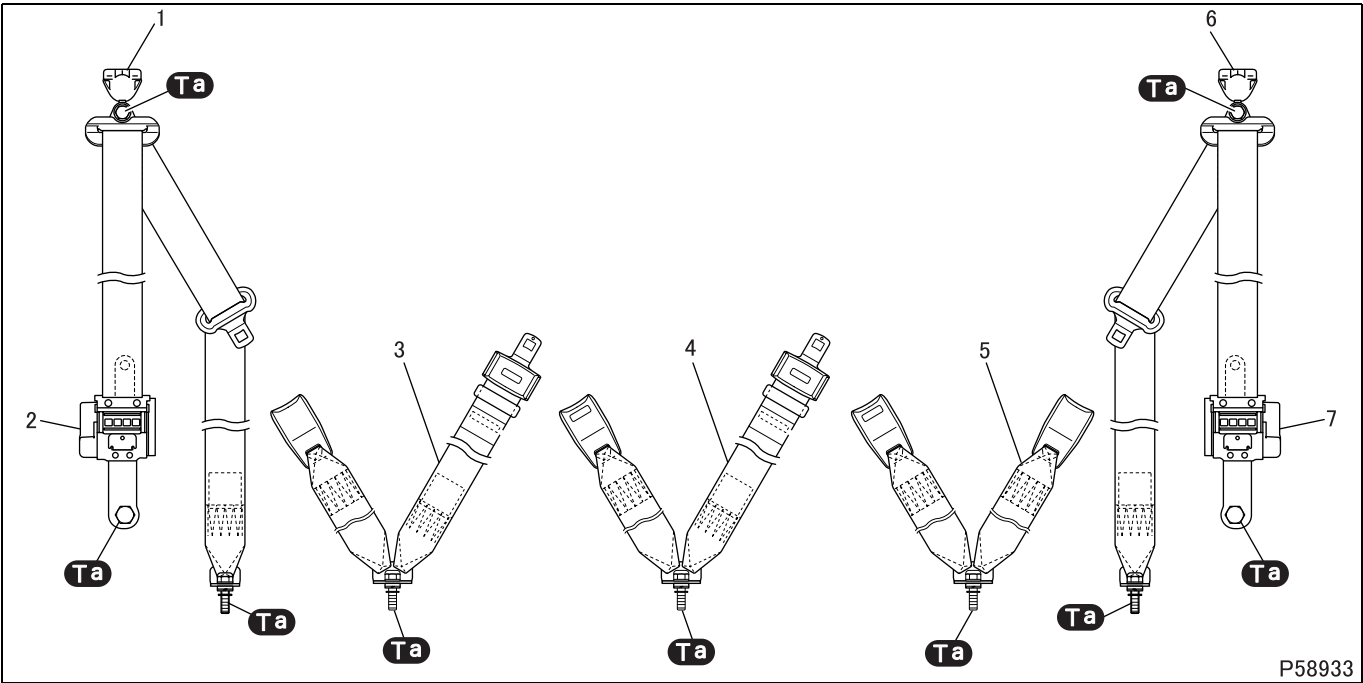


■ Removal: Seat belt guide

- To detach the seat belt guide, pull the top of the guide towards you in the direction of **B** while holding it down in the direction of **A**.

SEAT BELT

<Rear>



● Removal sequence

- | | |
|--|---|
| 1 Shoulder anchor cover | 5 Rear seat belt (left-hand) |
| 2 Emergency locking retractor (right-hand) | 6 Shoulder anchor cover |
| 3 Rear seat belt (right-hand) | 7 Emergency locking retractor <left-hand> |
| 4 Rear seat belt (center) | |

● Installation sequence

Follow the removal sequence in reverse.

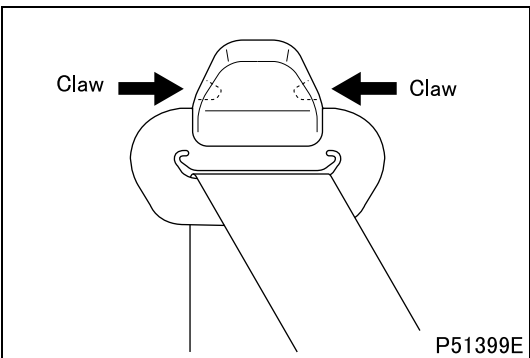
CAUTION ⚠

- Never disassemble the emergency locking retractor.

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (Floor anchor mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—
	Bolt (Shoulder anchor mounting)		
	Bolt (Emergency locking retractor mounting)		
	Bolt (Rear seat belt mounting)		

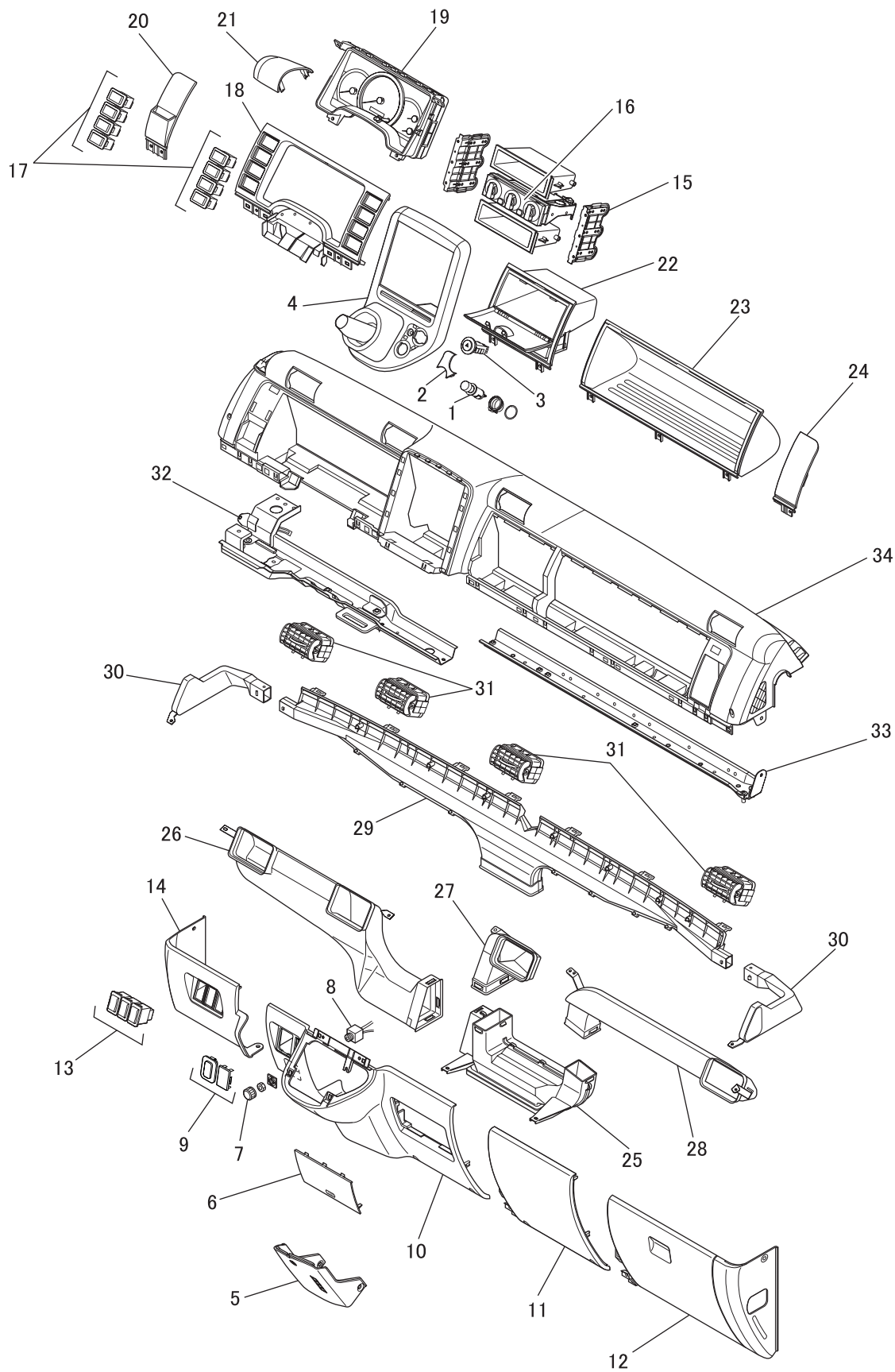
◆ Removal procedure ◆



■ Removal: Shoulder anchor cover

M E M O

INSTRUMENT PANEL



- This section divides the instrument panel in 4 areas and describes removal and installation procedures for each area. For information on specific components, refer to the corresponding area descriptions. Removal/installation of components with ★ require that components belonging to other areas (shown in brackets []) also need to be removed/installed. Components shown without ★ can be removed/installed without affecting other areas.

1 Cigar lighter		
2 Panel cover		
3 Hazard switch		
4 Upper center panel		
5 Gear shift lever cover		
6 Lid (for inspection of fuses)		
7 Knob		
8 Idle speed adjuster		
9 Plug		
10 Lower center panel		
11 Passenger panel B		
12 Passenger panel A		
13 Switch or plug		
14 Driver panel		
15 Radio bracket A		
16 Heater controls		
17 Switch or plug		
★ 18 Meter bezel [Area 1]		
19 Meter cluster		
★ 20 Lid (Accessories box) [Area 1]		
21 Lid (Brake fluid tank)		
★ 22 Glove box [Area 1]		
★ 23 Parcel tray [Area 1]		
★ 24 Lid (for inspection of relays) [Area 1]		
★ 25 Center duct [Areas 1 to 3]		
★ 26 Driver face duct [Areas 1 to 3]		
★ 27 Center face duct [Areas 1 to 3]		
★ 28 Passenger face duct [Areas 1 to 3]		
★ 29 Front defroster duct [Areas 1 to 3]		
★ 30 Side defroster duct [Areas 1 to 3]		
★ 31 Air outlet grille [Areas 1 to 3]		
★ 32 Driver instrument panel frame [Areas 1 to 3]		
★ 33 Passenger instrument panel frame [Areas 1 to 3]		
★ 34 Instrument panel [Areas 1 to 3]		

Area 1 (Lower panel)

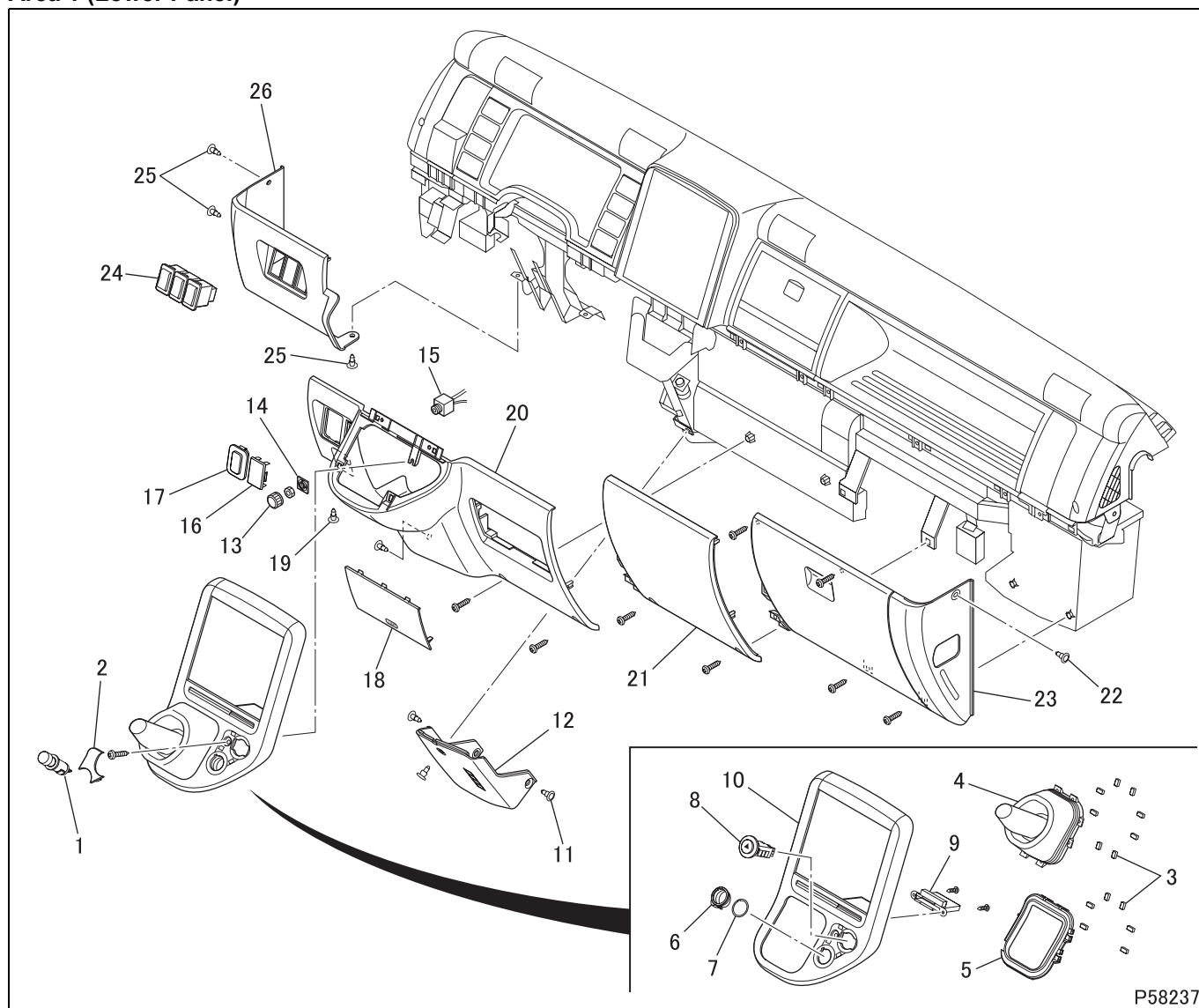
Area 2 (Driver upper panel)

Area 3 (Passenger upper panel)

Area 4 (Instrument panel)

INSTRUMENT PANEL

Area 1 (Lower Panel)



P58237

● Removal sequence

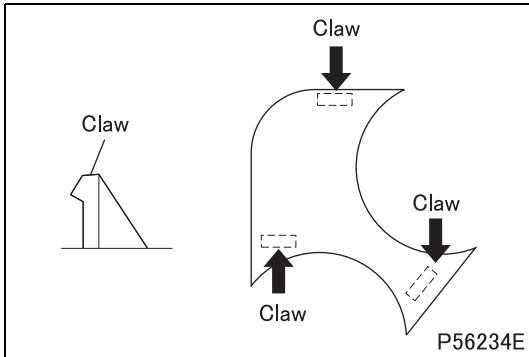
- | | |
|--------------------------------------|----------------------------------|
| 1 Cigar lighter | 16 Plug |
| 2 Panel cover | 17 Plug |
| 3 Push-on nut (× 8 <M/T>, × 6 <A/T>) | 18 Lid (for inspection of fuses) |
| 4 Shift lever boots <M/T> | 19 Clip |
| 5 A/T cover <A/T> | 20 Lower center panel |
| 6 Cigar lighter ring | 21 Passenger panel B |
| 7 Cigar lighter protector | 22 Clip |
| 8 Hazard switch | 23 Passenger panel A |
| 9 Card holder | 24 Switch or plug |
| 10 Upper center panel | 25 Clip (× 3) |
| 11 Clip | 26 Driver panel |
| 12 Gear shift lever cover | |
| 13 Knob | |
| 14 Plate | |
| 15 Idle speed adjuster | |

M/T: Manual transmission
A/T: Automatic transmission

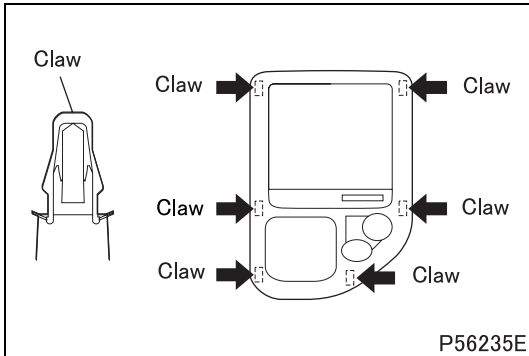
● Installation sequence

Follow the removal sequence in reverse.

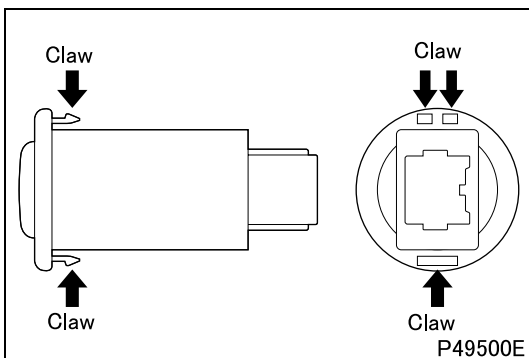
◆ Removal procedure ◆



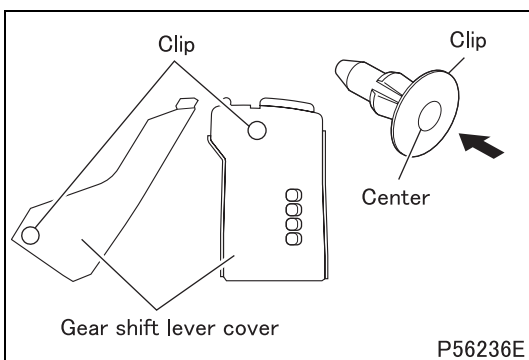
■ Removal: Panel cover



■ Removal: Upper center panel

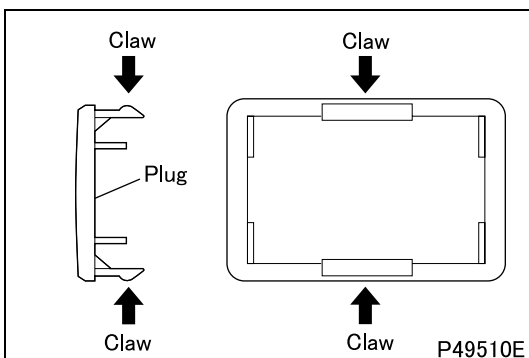


■ Removal: Hazard switch



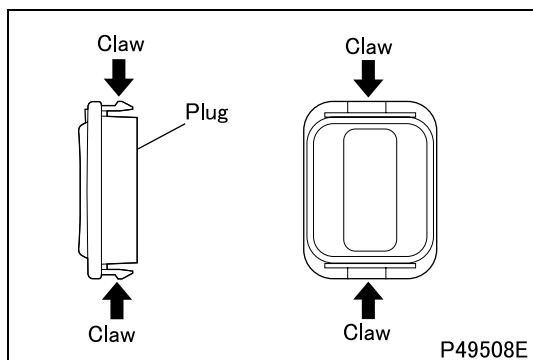
■ Removal: Gear shift lever cover

- Push the clips (× 3) in the center to disengage them from the gear shift lever cover.

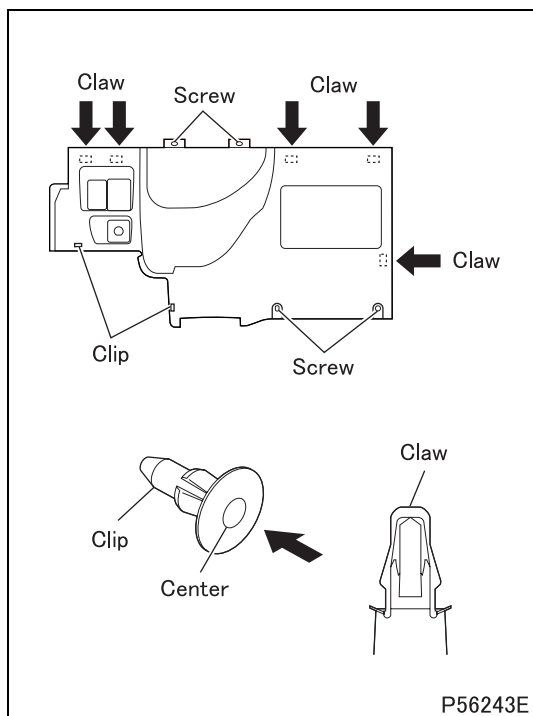


■ Removal: Plug

INSTRUMENT PANEL

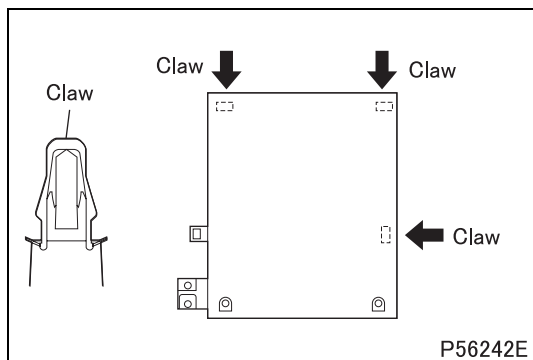


■ Removal: Plug

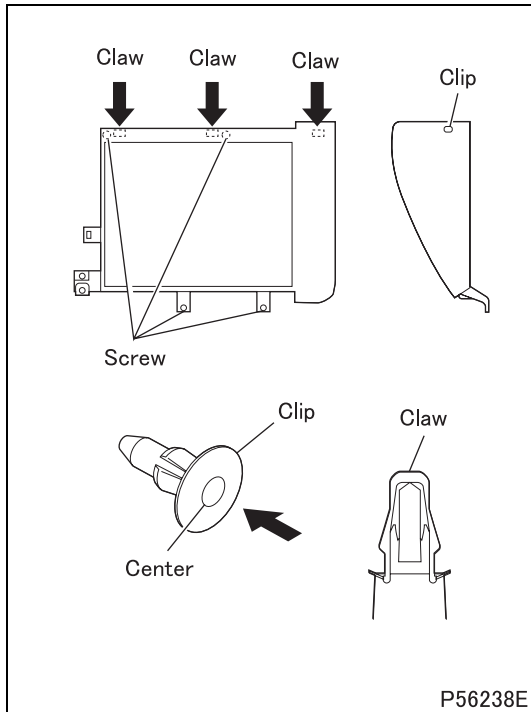


■ Removal: Lower center panel

- Remove the screws (× 4) from the lower center panel.
- Push the clips (× 2) in the center to disengage them from the lower center panel.

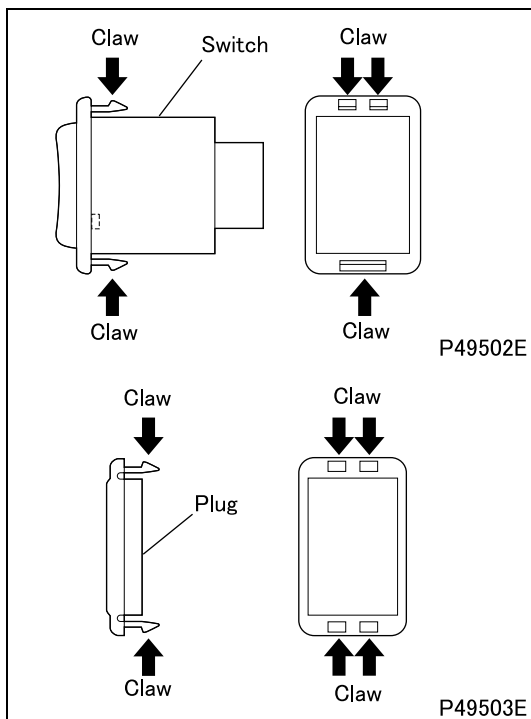


■ Removal: Passenger panel B



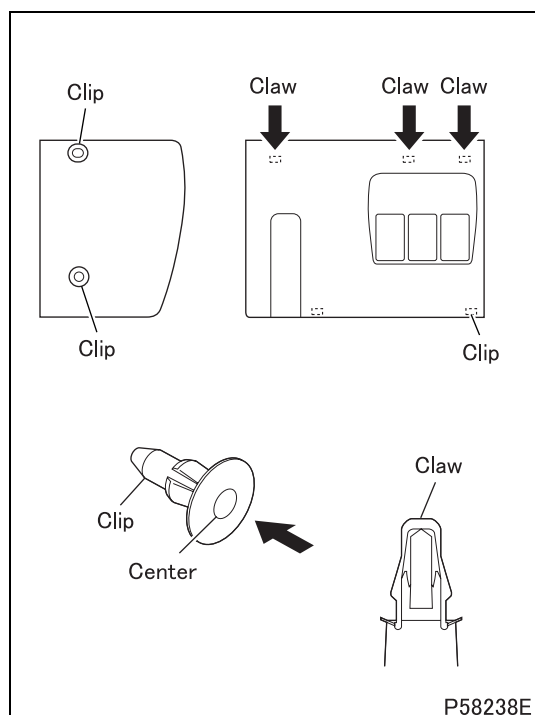
■ Removal: Passenger panel A

- Remove the screws (× 4) from the passenger panel.
- Push the clip (× 1) in the center to disengage it from the passenger panel.



■ Removal: Switch or plug

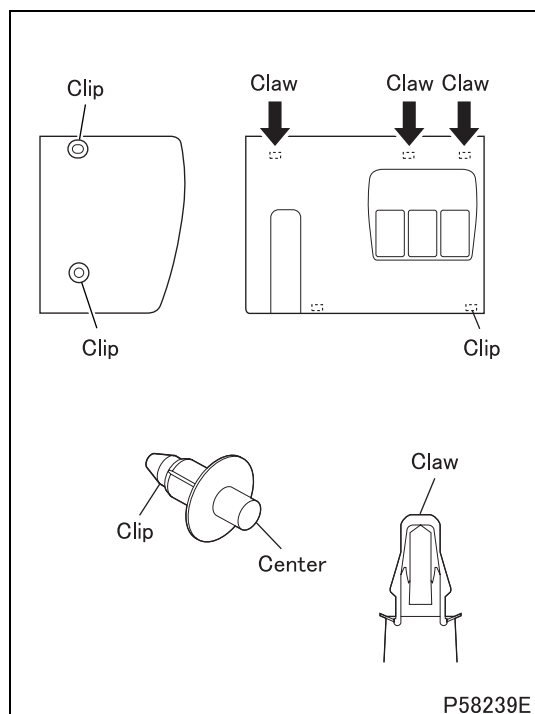
INSTRUMENT PANEL



■ Removal: Driver panel

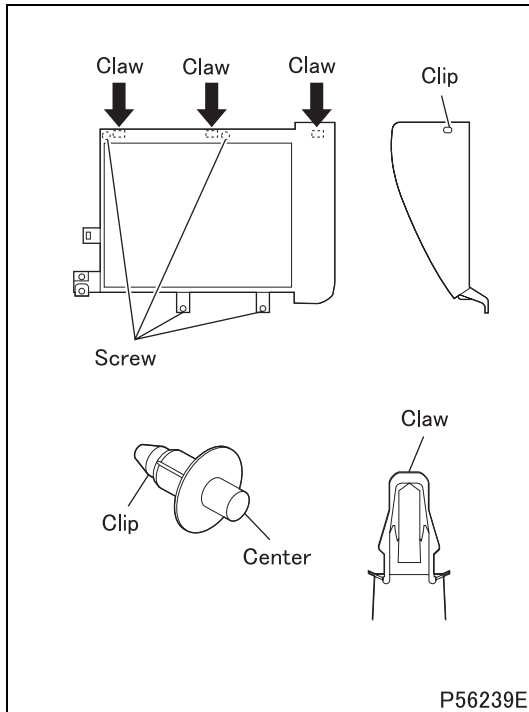
- Push the clips (× 3) in the center to disengage them from the driver panel.

◆ Installation procedure ◆



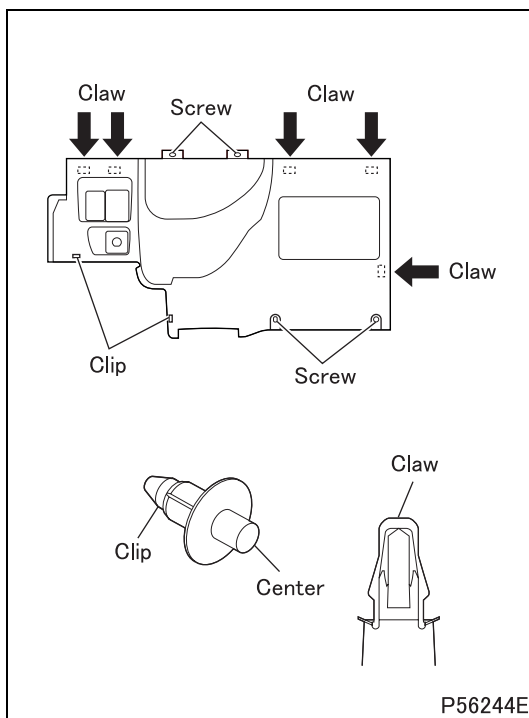
■ Installation: Driver panel

- Insert the clips (× 3) at the illustrated locations and push them in the center to engage into the driver panel.



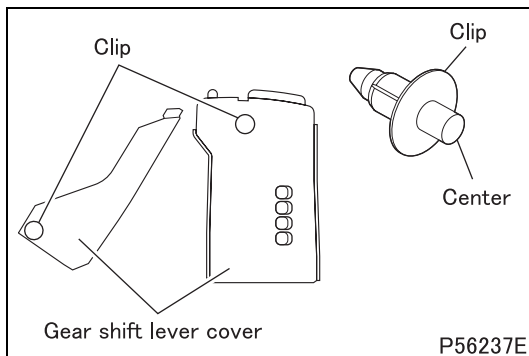
■ Installation: Passenger panel A

- Insert the clip (× 1) at the illustrated location and push it in the center to engage into the passenger panel.
- Install the screws (× 4) to the passenger panel.



■ Installation: Lower center panel

- Insert the clips (× 2) at the illustrated locations and push them in the center to engage into the lower center panel.
- Install the screws (× 4) to the lower center panel.

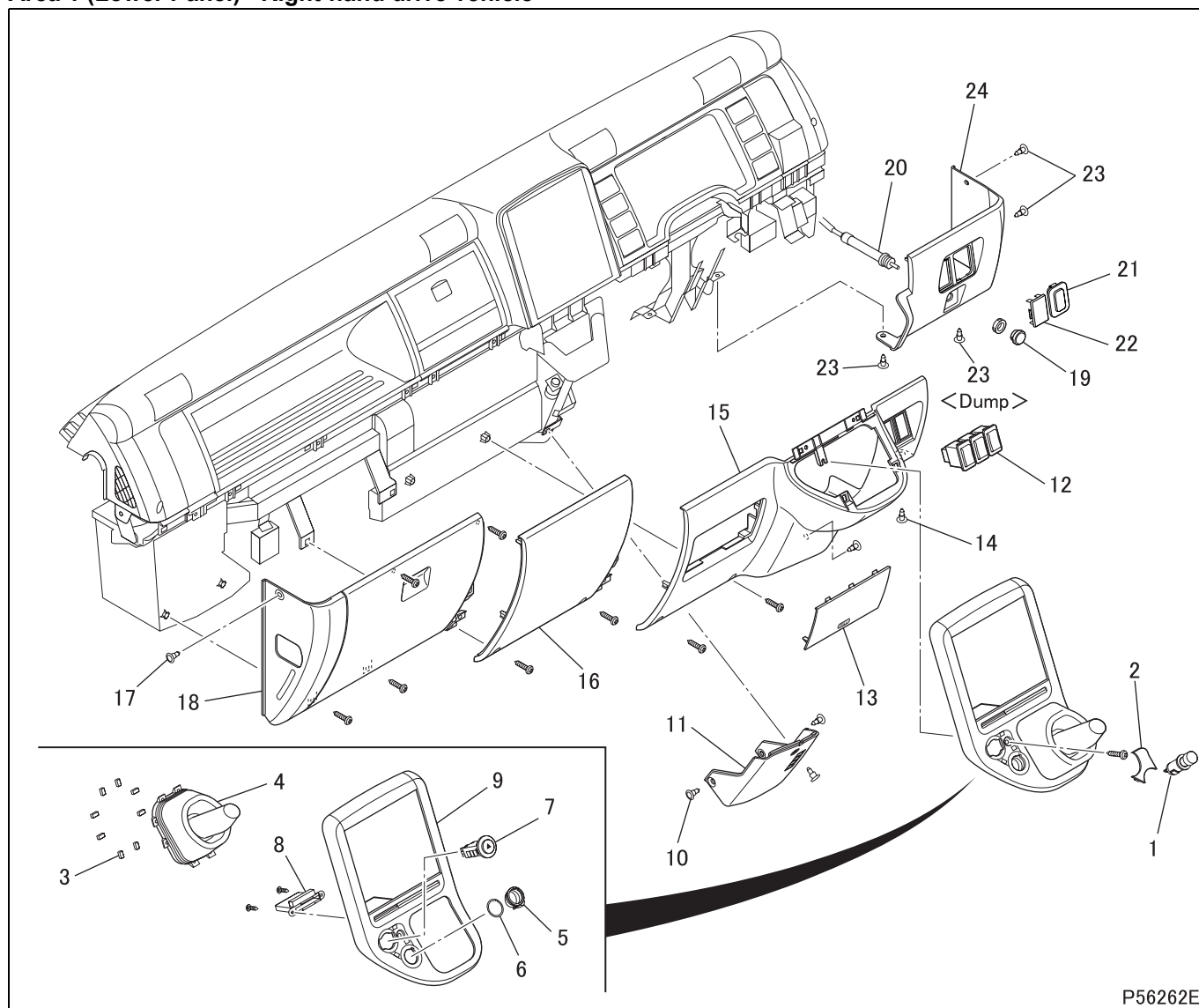


■ Installation: Gear shift lever cover

- Insert the clips (× 3) at the illustrated locations and push them in the center to engage into the gear shift lever cover.

INSTRUMENT PANEL

Area 1 (Lower Panel) <Right-hand drive vehicle>



P56262E

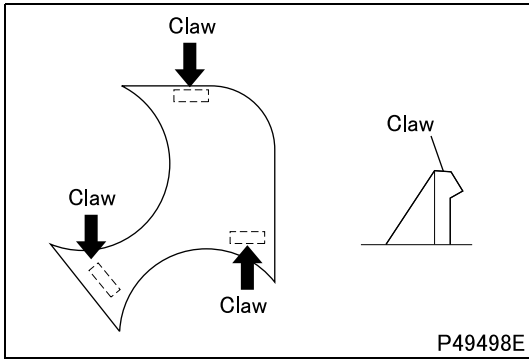
● Removal sequence

- | | |
|---------------------------|---|
| 1 Cigar lighter | 13 Lid (for inspection of fuses) |
| 2 Panel cover | 14 Clip |
| 3 Push-on nut (× 8) | 15 Lower center panel |
| 4 Shift lever boots | 16 Passenger panel B |
| 5 Cigar lighter ring | 17 Clip |
| 6 Cigar lighter protector | 18 Passenger panel A |
| 7 Hazard switch | 19 Knob |
| 8 Card holder | 20 Idle speed adjuster |
| 9 Upper center panel | 21 Plug |
| 10 Clip | 22 Plug |
| 11 Gear shift lever cover | 23 Clip (× 3 <Except dump>, × 4 <Dump>) |
| 12 Switch or plug | 24 Driver panel |

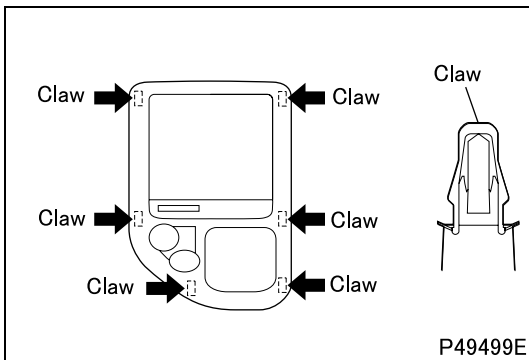
● Installation sequence

Follow the removal sequence in reverse.

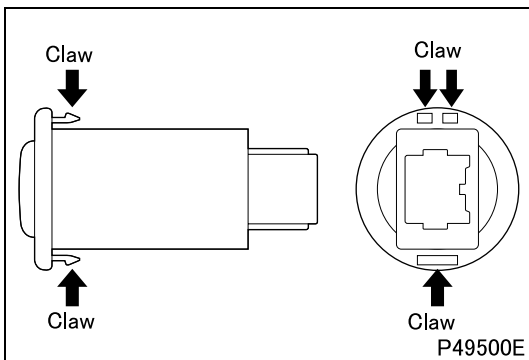
◆ Removal procedure ◆



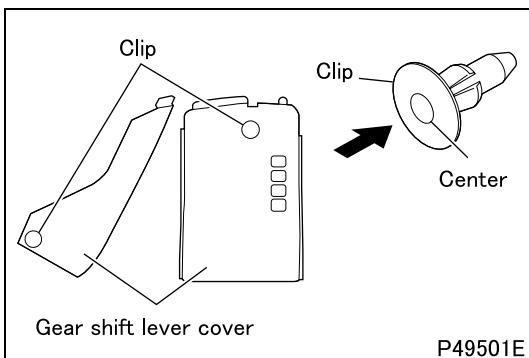
■ Removal: Panel cover



■ Removal: Upper center panel



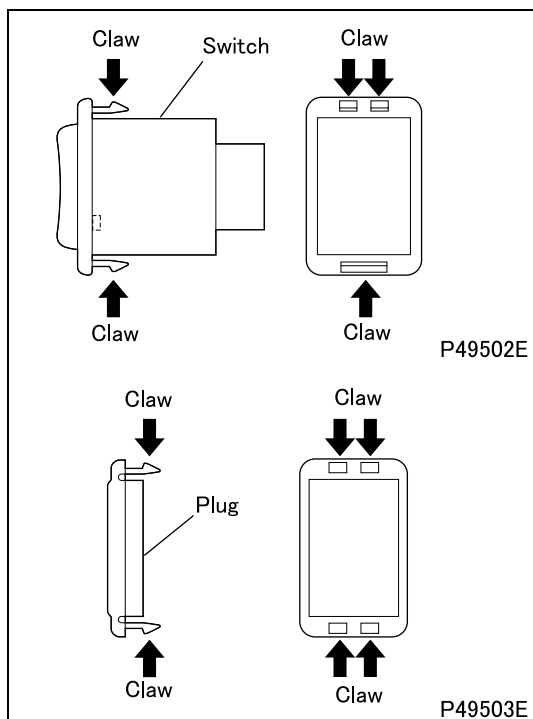
■ Removal: Hazard switch



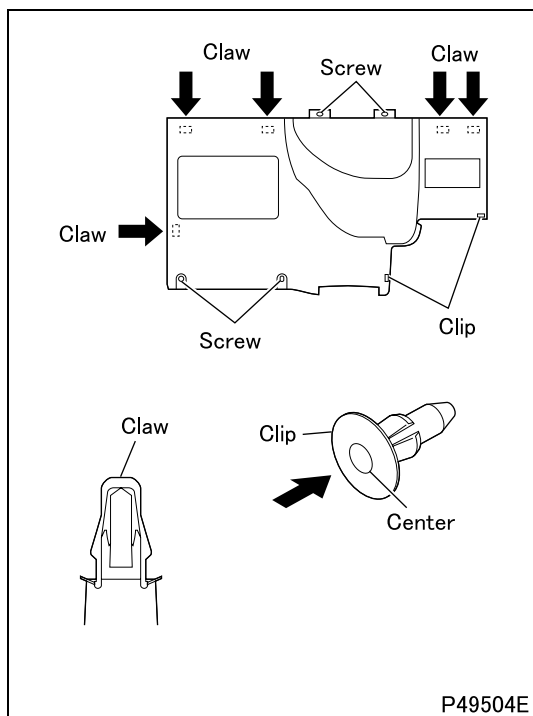
■ Removal: Gear shift lever cover

- Push the clips (× 3) in the center to disengage them from the gear shift lever cover.

INSTRUMENT PANEL

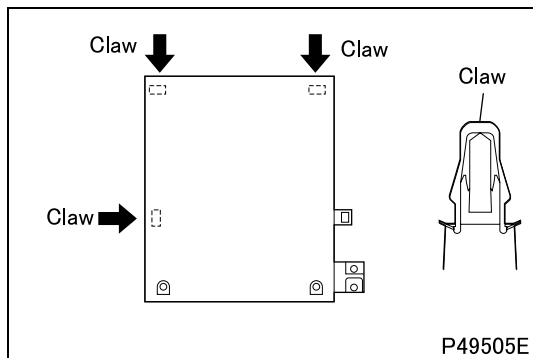


■ Removal: Switch or plug

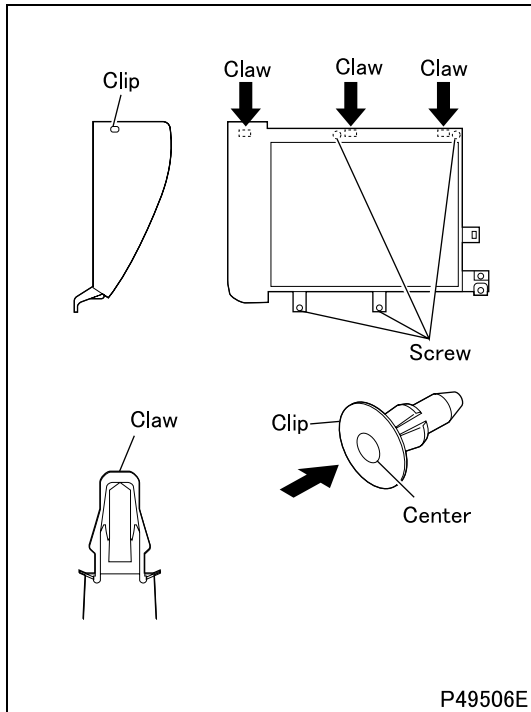


■ Removal: Lower center panel

- Remove the screws (× 4) from the lower center panel.
- Push the clips (× 2) in the center to disengage them from the lower center panel.

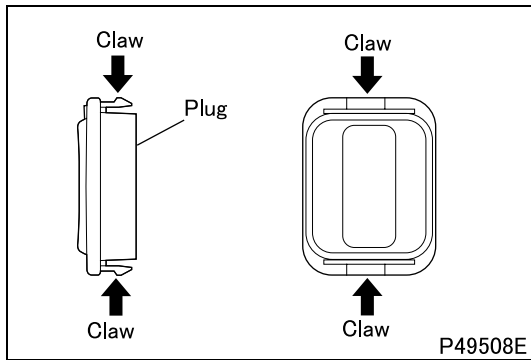


■ Removal: Passenger panel B

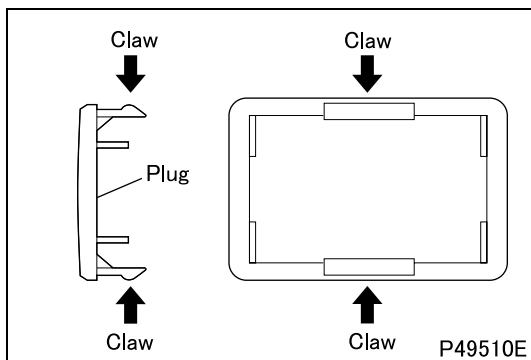


■ Removal: Passenger panel A

- Remove the screws (× 4) from the passenger panel.
- Push the clip (× 1) in the center to disengage it from the passenger panel.

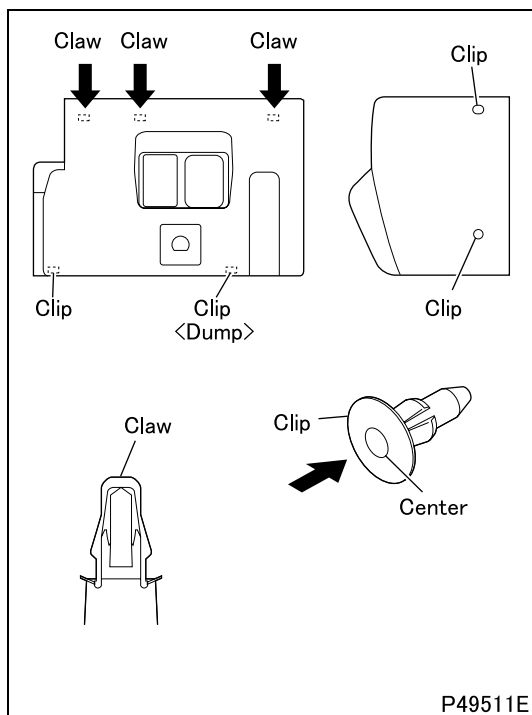


■ Removal: Plug



■ Removal: Plug

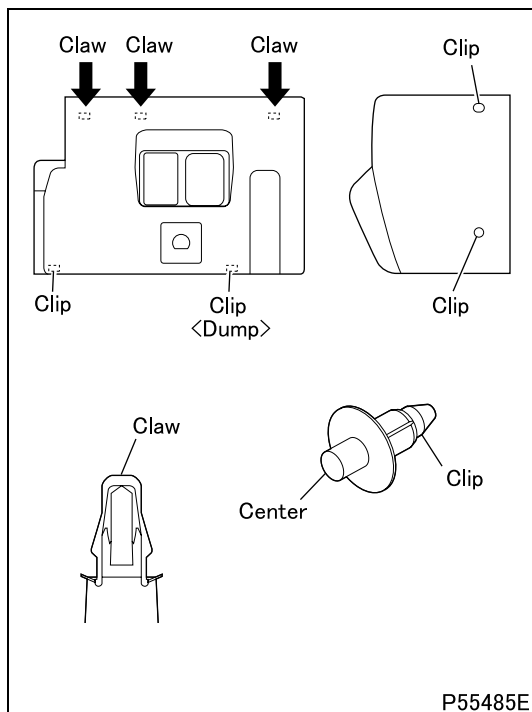
INSTRUMENT PANEL



■ Removal: Driver panel

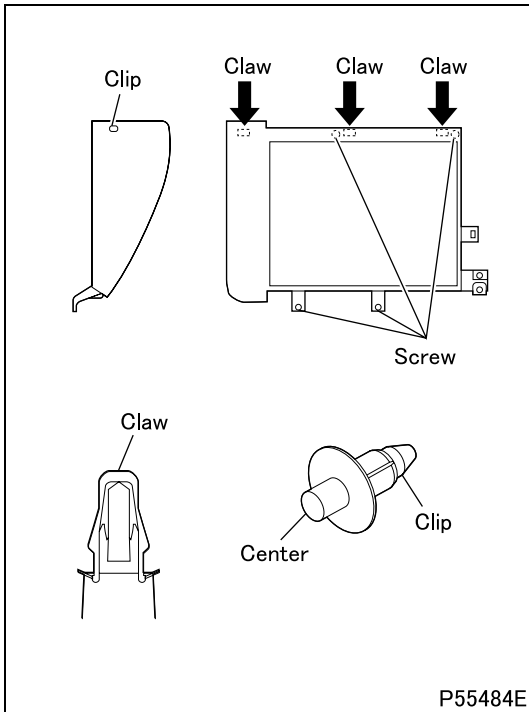
- Push the clips (× 3 <Except dump>, × 4 <Dump>) in the center to disengage them from the driver panel.

◆ Installation procedure ◆



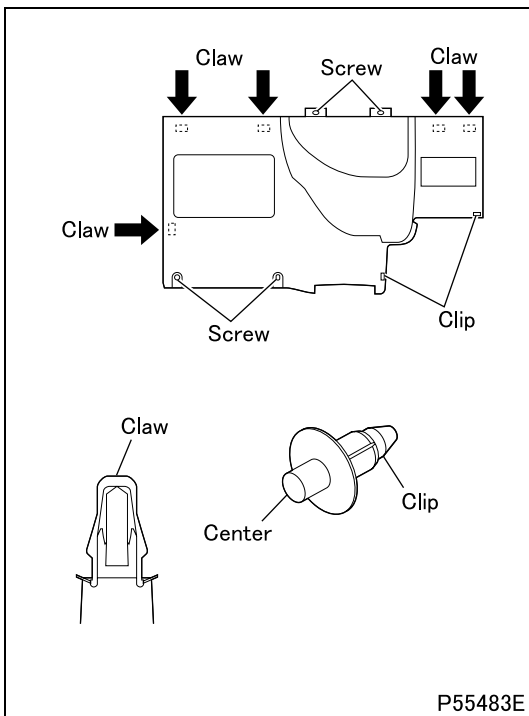
■ Installation: Driver panel

- Insert the clips (× 3 <Except dump>, × 4 <Dump>) at the illustrated locations and push them in the center to engage into the driver panel.



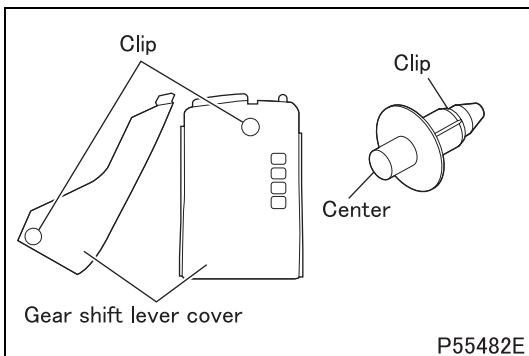
■ Installation: Passenger panel A

- Insert the clip (× 1) at the illustrated location and push it in the center to engage into the passenger panel.
- Install the screws (× 4) to the passenger panel.



■ Installation: Lower center panel

- Insert the clips (× 2) at the illustrated locations and push them in the center to engage into the lower center panel.
- Install the screws (× 4) to the lower center panel.

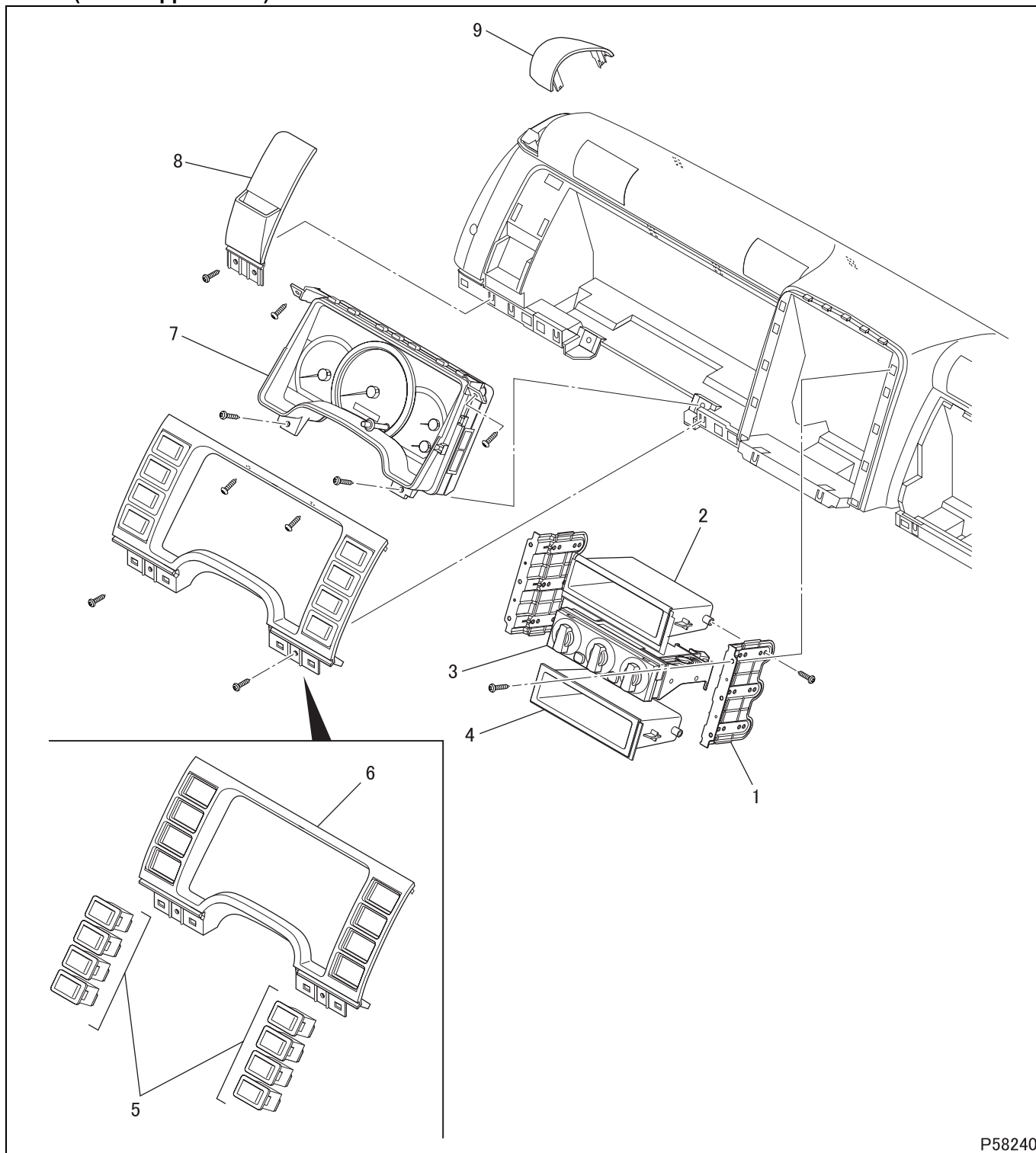


■ Installation: Gear shift lever cover

- Insert the clips (× 3) at the illustrated locations and push them in the center to engage into the gear shift lever cover.

INSTRUMENT PANEL

Area 2 (Driver Upper Panel)



P58240

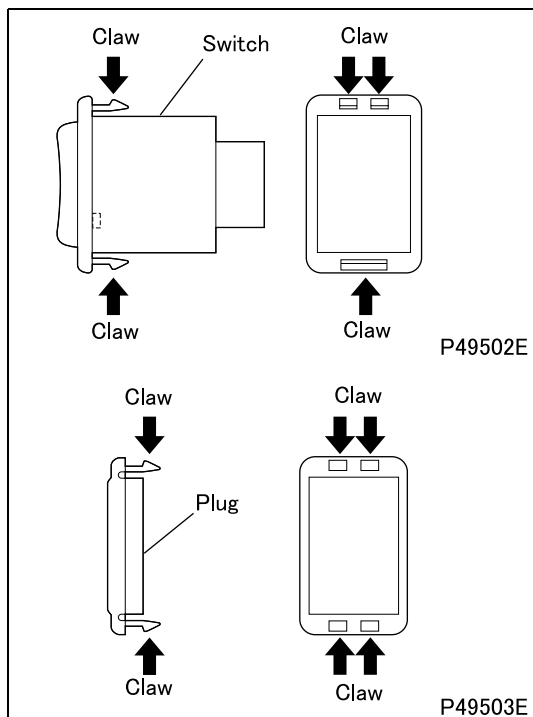
● Removal sequence

- | | |
|-------------------|--------------------------|
| 1 Radio bracket | 6 Meter bezel |
| 2 Box | 7 Meter cluster |
| 3 Heater controls | 8 Lid (Accessories box) |
| 4 Box | 9 Lid (Brake fluid tank) |
| 5 Switch or plug | |

● Installation sequence

Follow the removal sequence in reverse.

◆ Removal procedure ◆



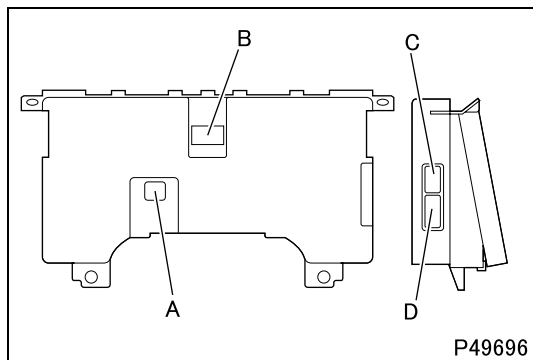
■ Removal: Meter cluster

■ Removal: Meter cluster

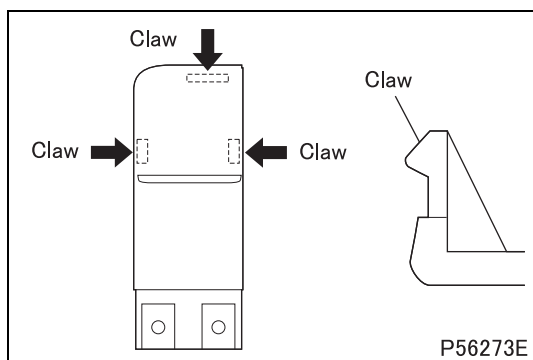
- Disconnect the cab harness connectors **A** to **D** from the meter cluster and remove the meter cluster from the instrument panel. (The illustration shows the rear face of the meter cluster.)

Connector poles

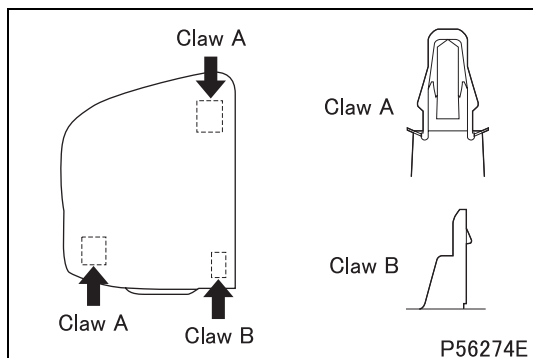
A	B	C	D
10	20	18	22



■ Removal: Lid (accessories box)

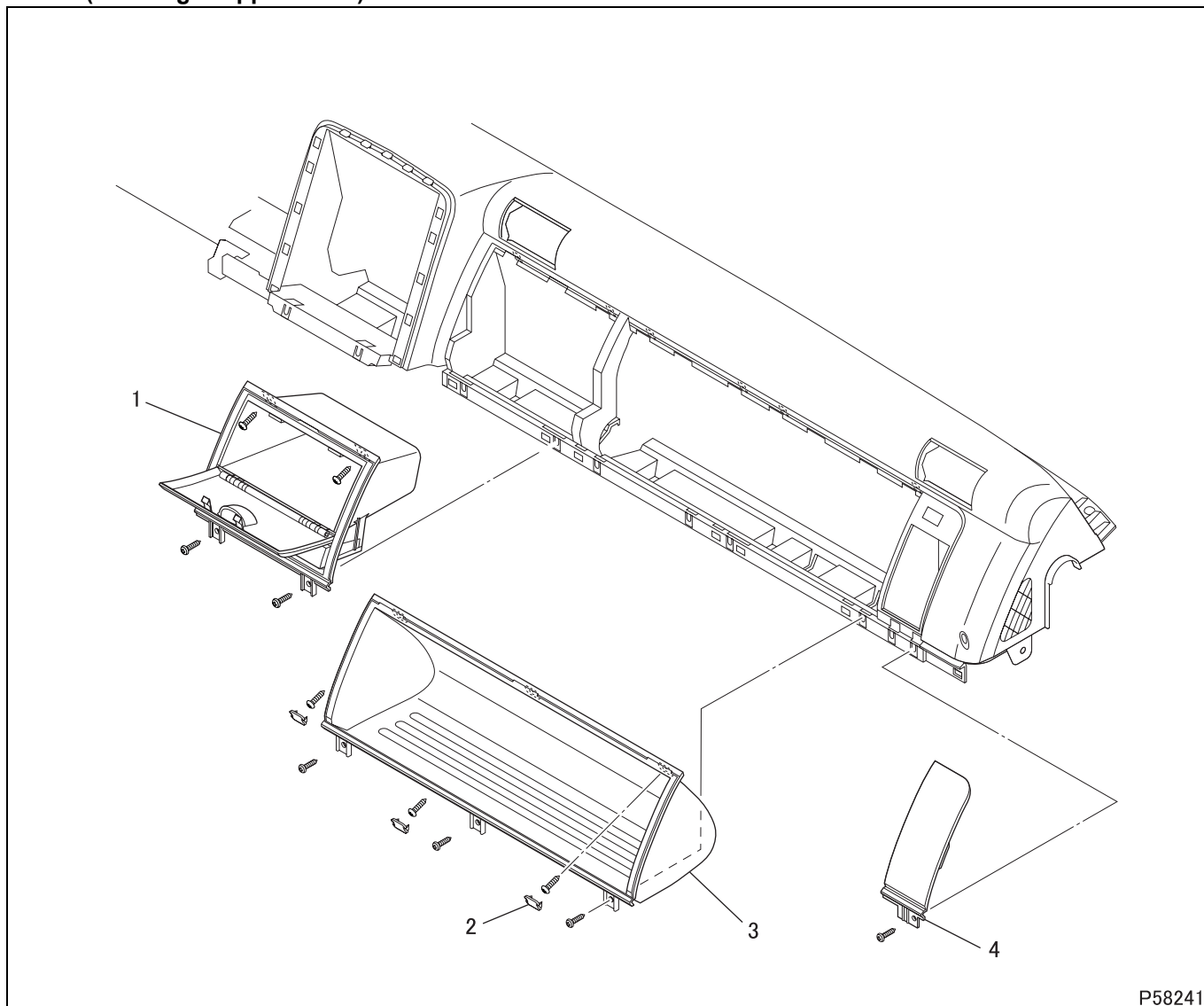


■ Removal: Lid (brake fluid tank)



INSTRUMENT PANEL

Area 3 (Passenger Upper Panel)



P58241

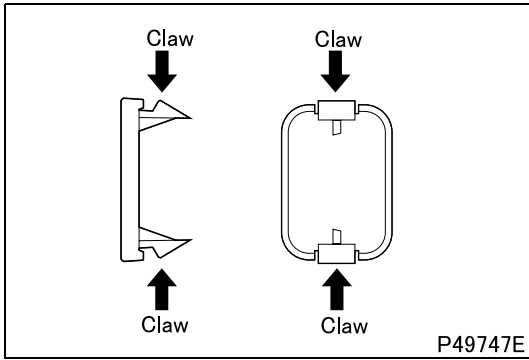
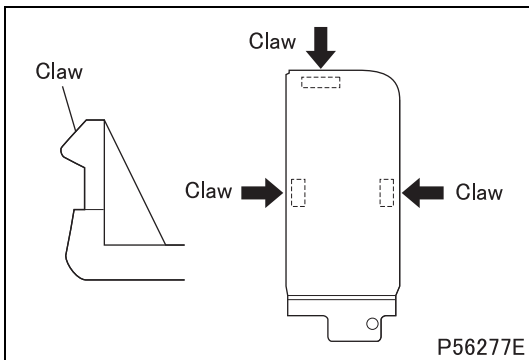
● Removal sequence

- 1 Glove box
- 2 Plug

- 3 Parcel tray
- 4 Lid (for inspection of relays)

● Installation sequence

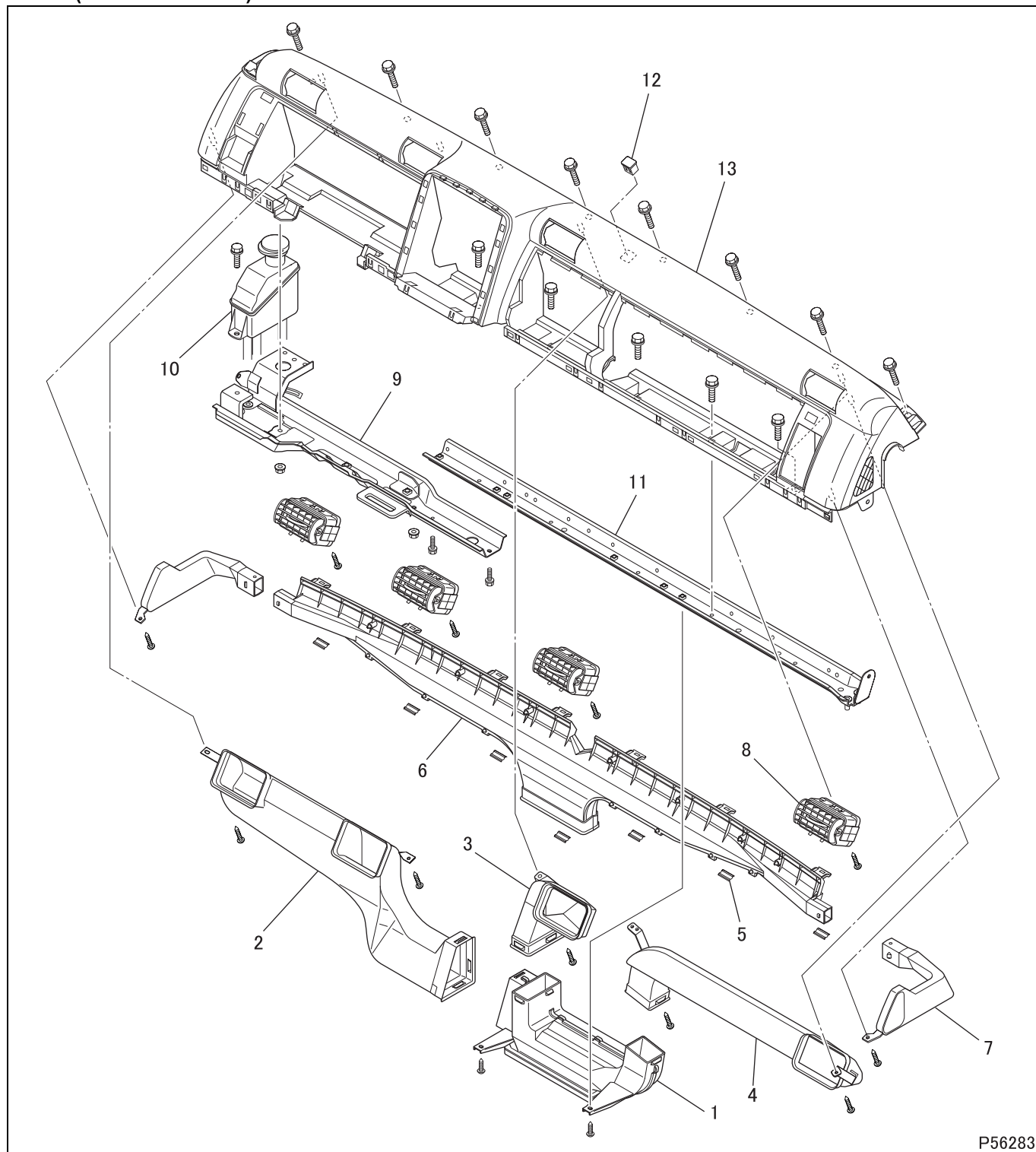
Follow the removal sequence in reverse.

◆ Removal procedure ◆**■ Removal: Plug****■ Removal: Lid (for inspection of relays)****◆ Installation procedure ◆****■ Installation: Facing**

- Install the facing in a manner similar to that for removal. (See “■ Removal: Facing”.)

INSTRUMENT PANEL

Area 4 (Instrument Panel)



P56283

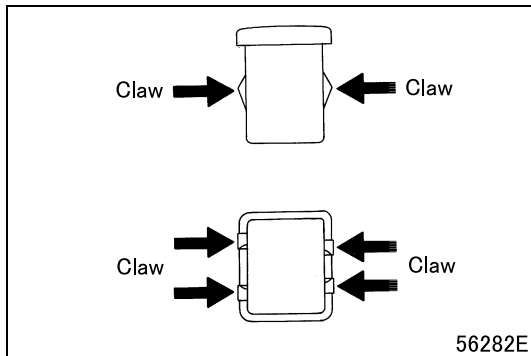
● Removal sequence

- | | |
|------------------------|-------------------------------------|
| 1 Center duct | 8 Air outlet grille |
| 2 Driver face duct | 9 Driver instrument panel frame |
| 3 Center face duct | 10 Brake fluid tank |
| 4 Passenger face duct | 11 Passenger instrument panel frame |
| 5 Clip (× 7) | 12 Plug |
| 6 Front defroster duct | 13 Instrument panel |
| 7 Side defroster duct | |

● Installation sequence

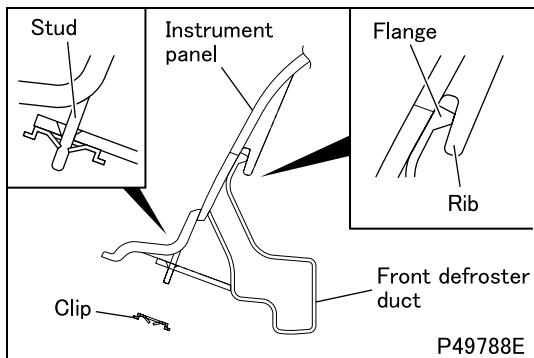
Follow the removal sequence in reverse.

◆ Removal procedure ◆



■ Removal: Plug

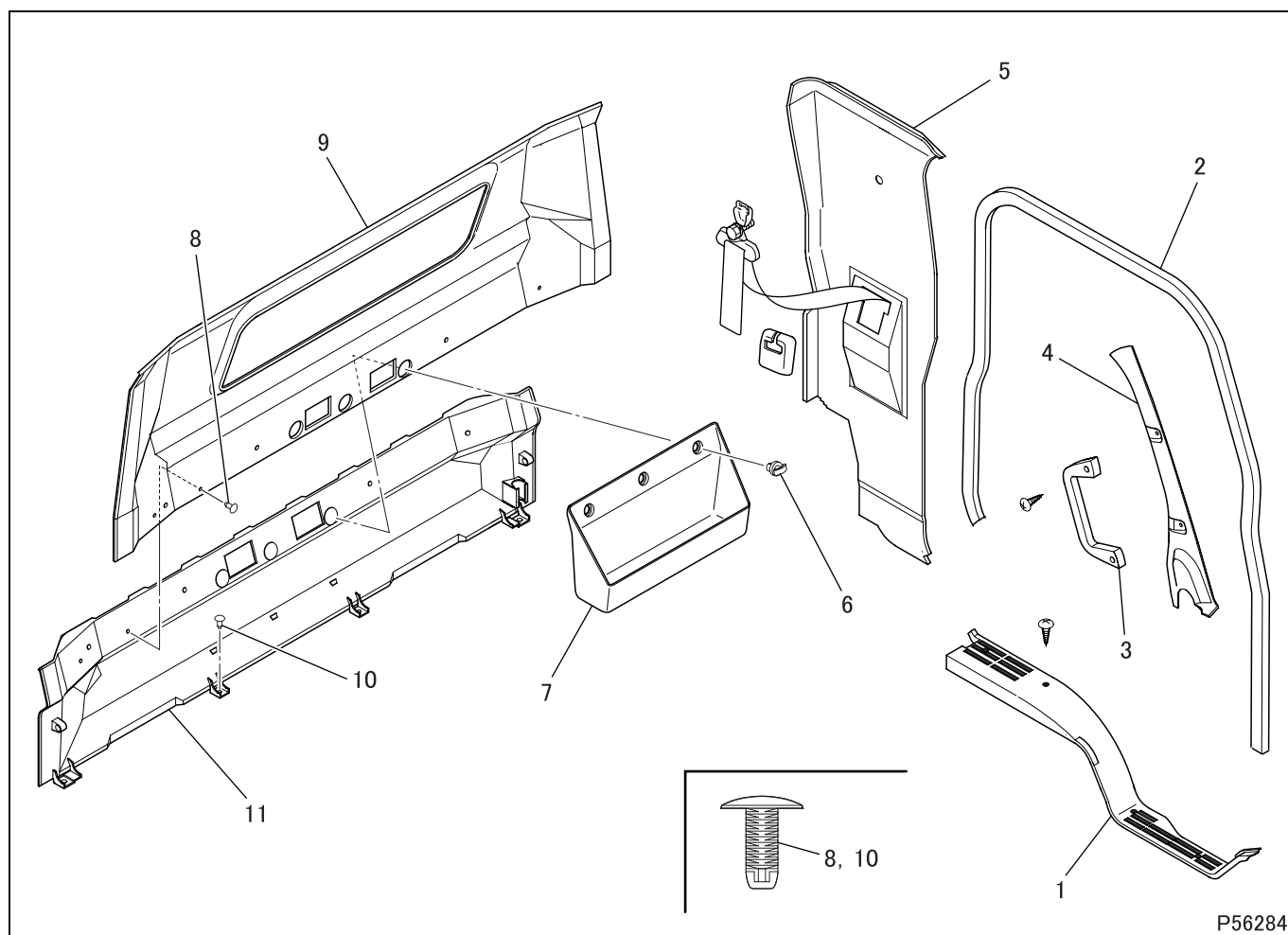
◆ Installation procedure ◆



■ Installation: Front defroster duct

- Insert the front defroster duct flanges into the instrument panel ribs.
- Insert the instrument panel studs into the front defroster duct holes and clip them together.

TRIM AND SCUFF PLATE <EXCEPT CREW CAB>



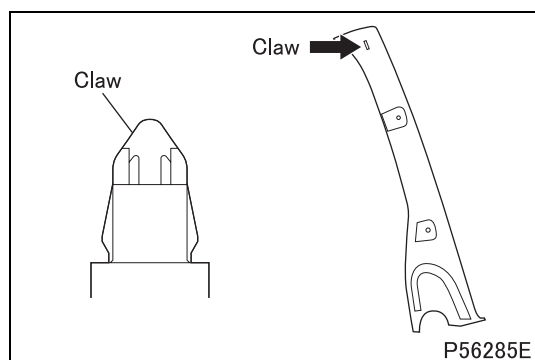
● Removal sequence

- | | |
|---------------------|--------------------|
| 1 Scuff plate | 7 Back panel tray |
| 2 Weather strip | 8 Clip |
| 3 Grip | 9 Upper rear trim |
| 4 Front pillar trim | 10 Clip |
| 5 Rear side trim | 11 Lower rear trim |
| 6 Hook (× 3) | |

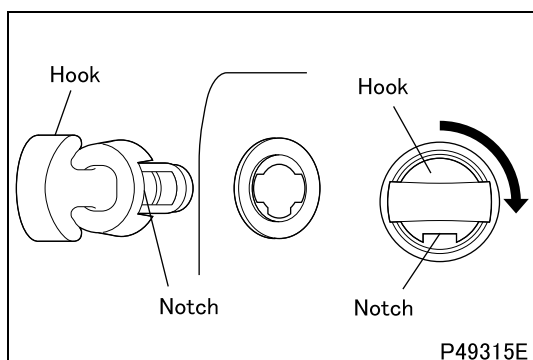
● Installation sequence

Follow the removal sequence in reverse.

◆ Removal procedure ◆



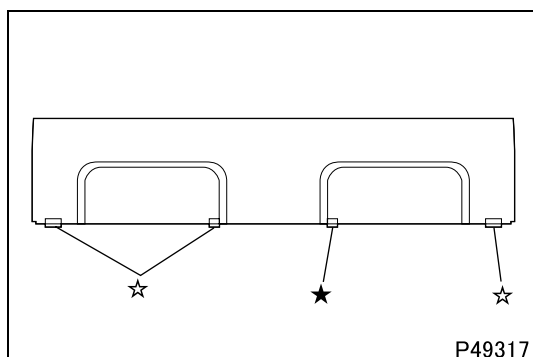
■ Removal: Front pillar trim



■ Removal: Hook

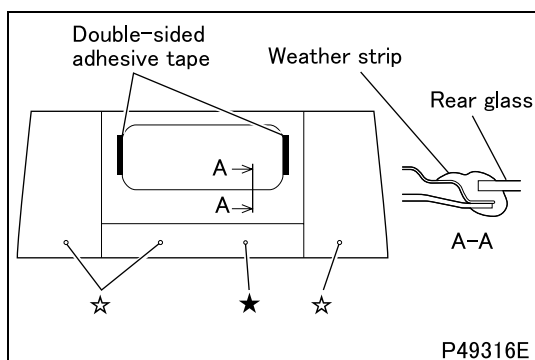
- Turn the hook 90° to disengage it.

◆ Installation procedure ◆



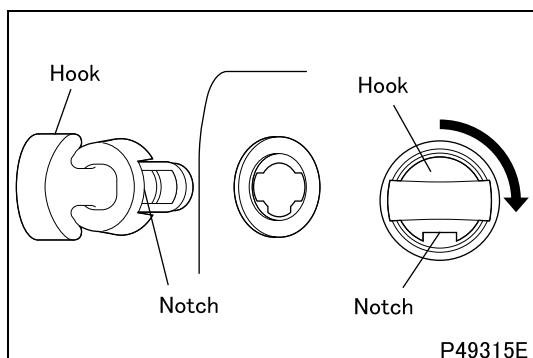
■ Installation: Lower rear trim

- Locate the lower rear trim correctly in position by installing a clip into the hole ☆.
- Install 3 clips into the holes ☆ to completely fix the lower rear trim in position.



■ Installation: Upper rear trim

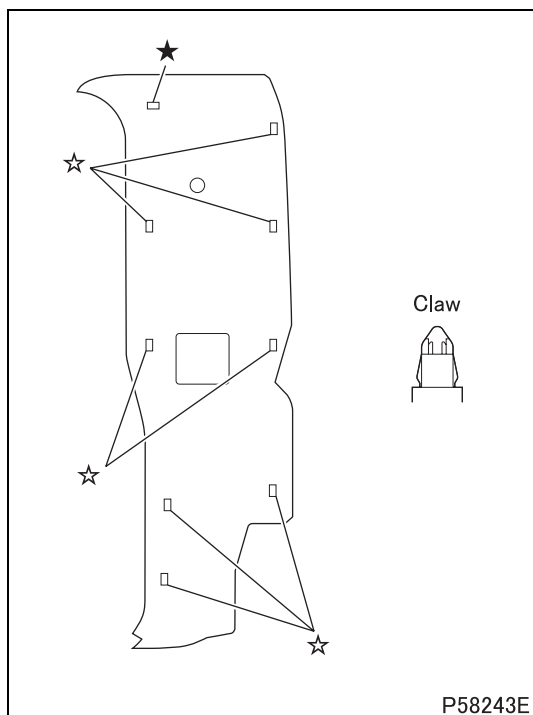
- Stick double-sided adhesive tapes onto the upper rear trim along the strips illustrated.
- Locate the upper rear trim correctly in position by installing a clip into the hole ☆.
- Remove the backing strips from the double-sided adhesive tapes. Press the trim firmly on where the adhesive tapes are applied on the back. Then, install 3 clips at the places ☆.
- Install the rear glass by inserting the rear glass weather strip over the upper rear trim.



■ Installation: Hook

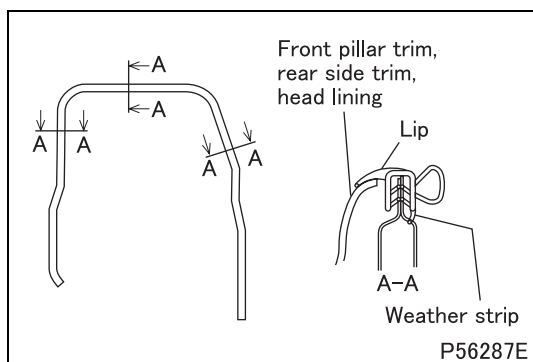
- With the notch facing in the illustrated direction, insert the hook into the lower rear trim.
- To engage the hook, turn it 90° until the notch faces downwards.

TRIM AND SCUFF PLATE <EXCEPT CREW CAB>



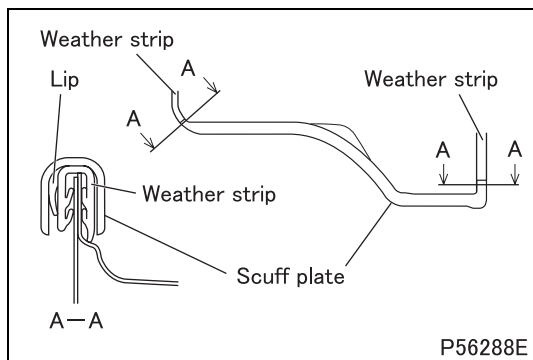
■ Installation: Rear side trim

- Locate the rear side trim correctly onto the cab by engaging the claw ★.
- Engage the claws ★ (× 8) onto the cab, from the front to the rear.



■ Installation: Weather strip

- Install the weather strip in such a manner that the lip of the strip holds down the front pillar trim, rear side trim, and head lining.

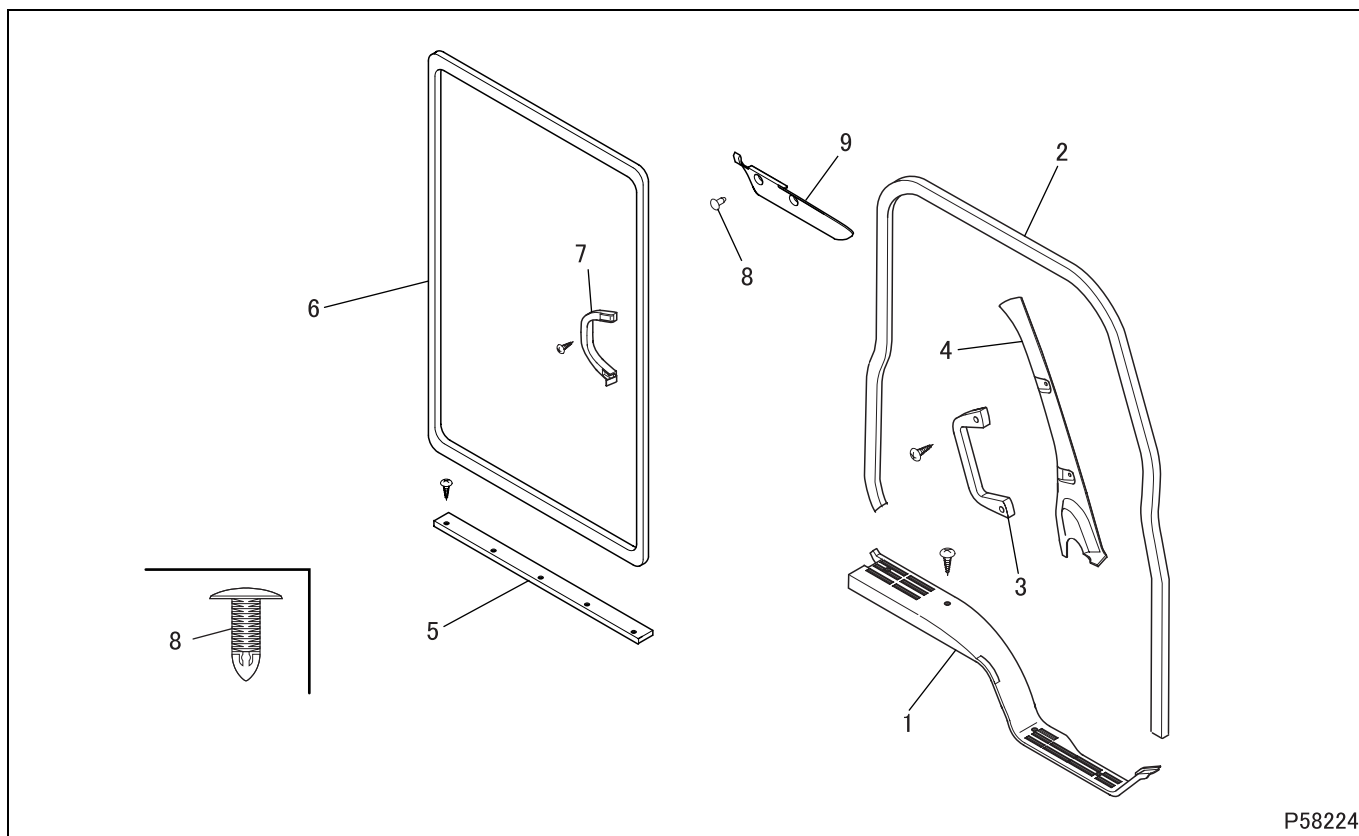


■ Installation: Scuff plate

- Install the scuff plate in such a manner that it holds down the lip of the weather strip.

M E M O

TRIM AND SCUFF PLATE <CREW CAB>



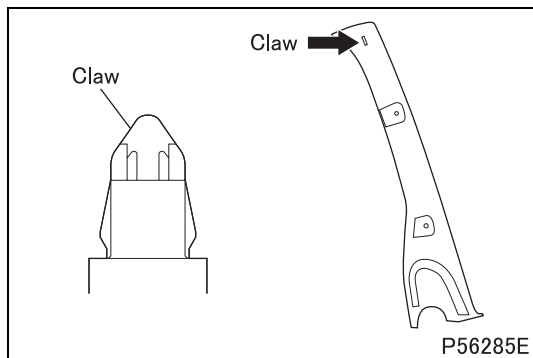
● Removal sequence

- | | |
|---------------------|----------------------|
| 1 Front scuff plate | 6 Weather strip |
| 2 Weather strip | 7 Rear grip |
| 3 Front grip | 8 Clip |
| 4 Front pillar trim | 9 Center pillar trim |
| 5 Rear scuff plate | |

● Installation sequence

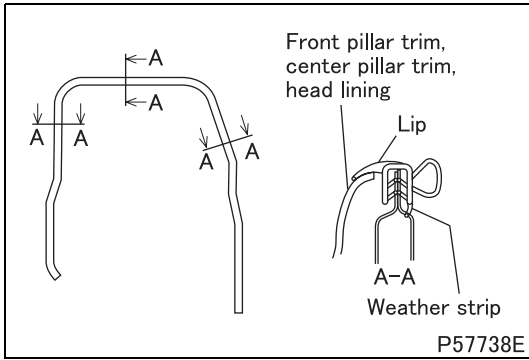
Follow the removal sequence in reverse.

◆ Removal procedure ◆



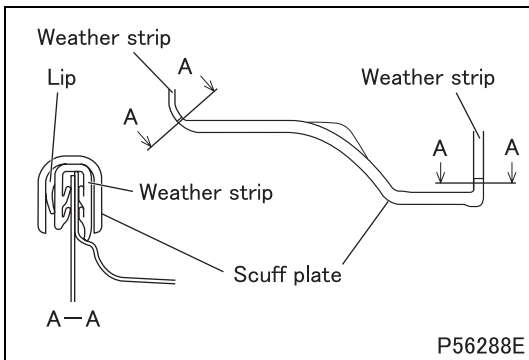
■ Removal: Front pillar trim

◆ Installation procedure ◆



■ Installation: Weather strip

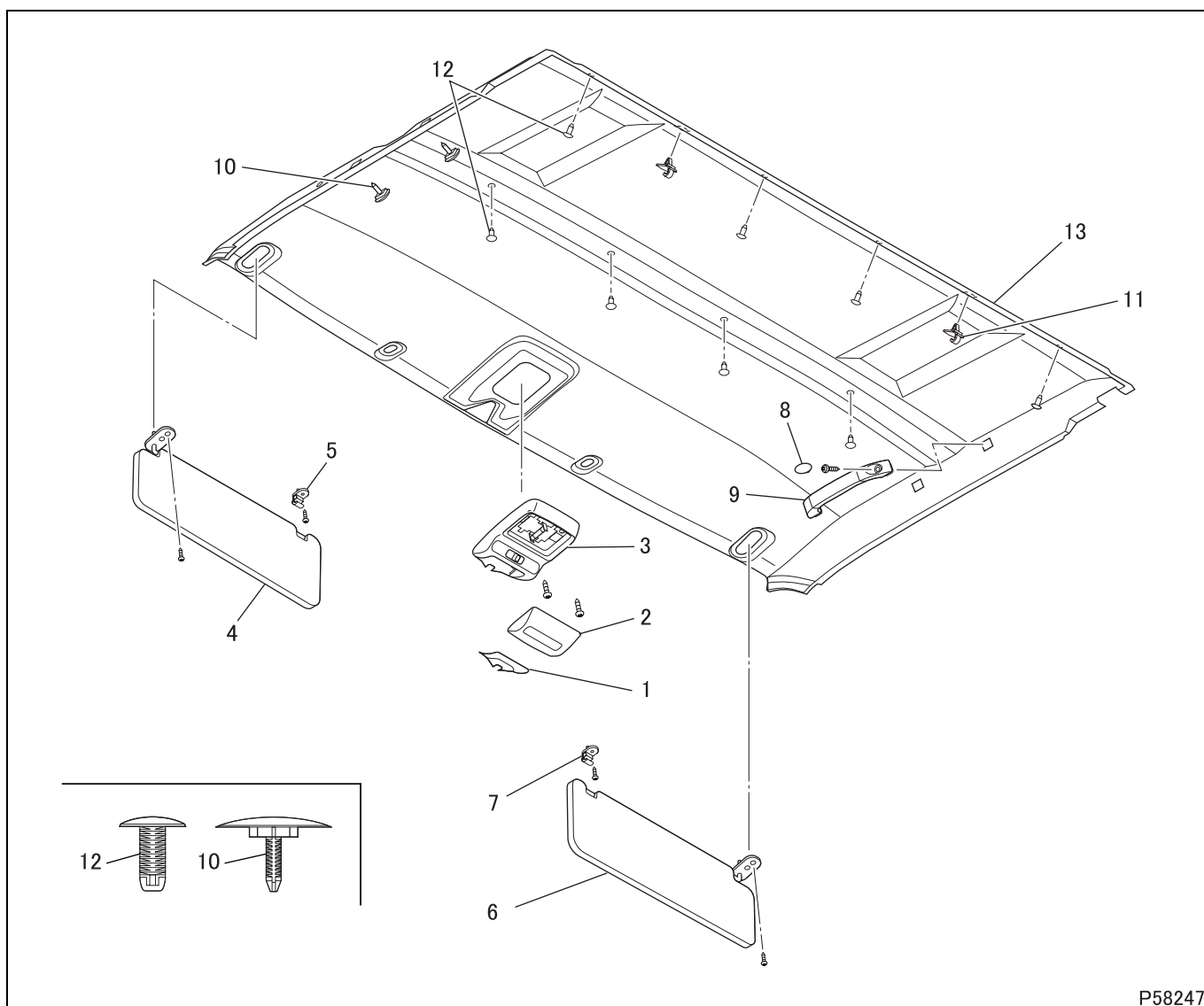
- Install the weather strip in such a manner that the lip of the strip holds down the front pillar trim, center pillar trim, and head lining.



■ Installation: Scuff plate

- Install the scuff plate in such a manner that it holds down the lip of the weather strip.

HEAD LINING <EXCEPT CREW CAB>



P58247

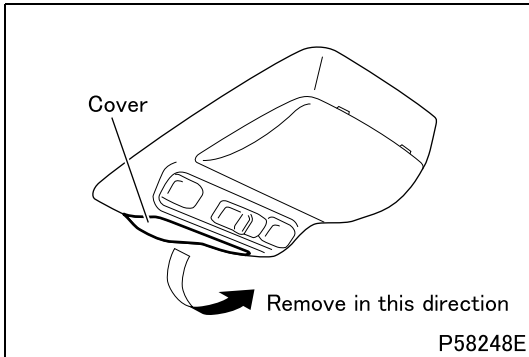
● Removal sequence

- | | |
|--------------------------|----------------|
| 1 Cover | 8 Cap |
| 2 Lens | 9 Grip |
| 3 Room lamp | 10 Plug |
| 4 Sun visor (left-hand) | 11 Coat hanger |
| 5 Sun visor hook | 12 Clip (× 8) |
| 6 Sun visor (right-hand) | 13 Head lining |
| 7 Sun visor hook | |

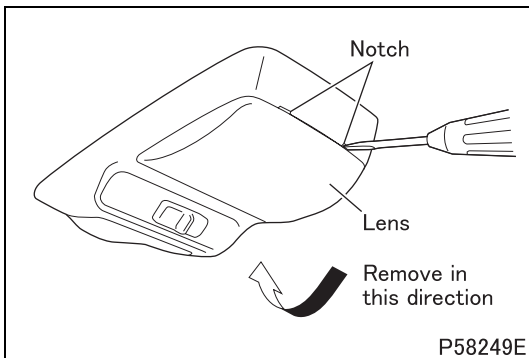
● Installation sequence

Follow the removal sequence in reverse.

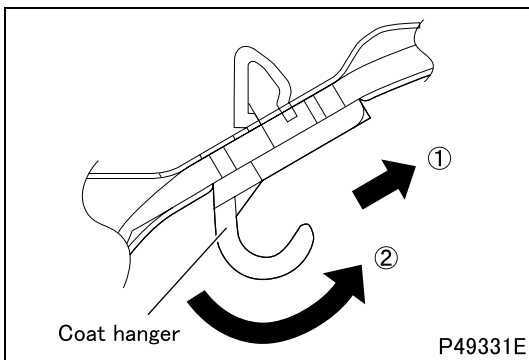
◆ Removal procedure ◆



■ Removal: Cover



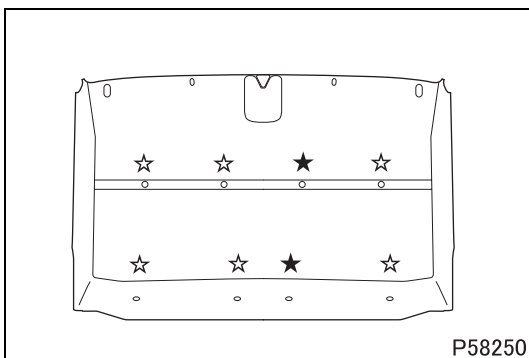
■ Removal: Lens



■ Removal: Coat hanger

- Remove the coat hanger from the head lining by pulling it in the direction of "2" while pressing it in the direction of "1".

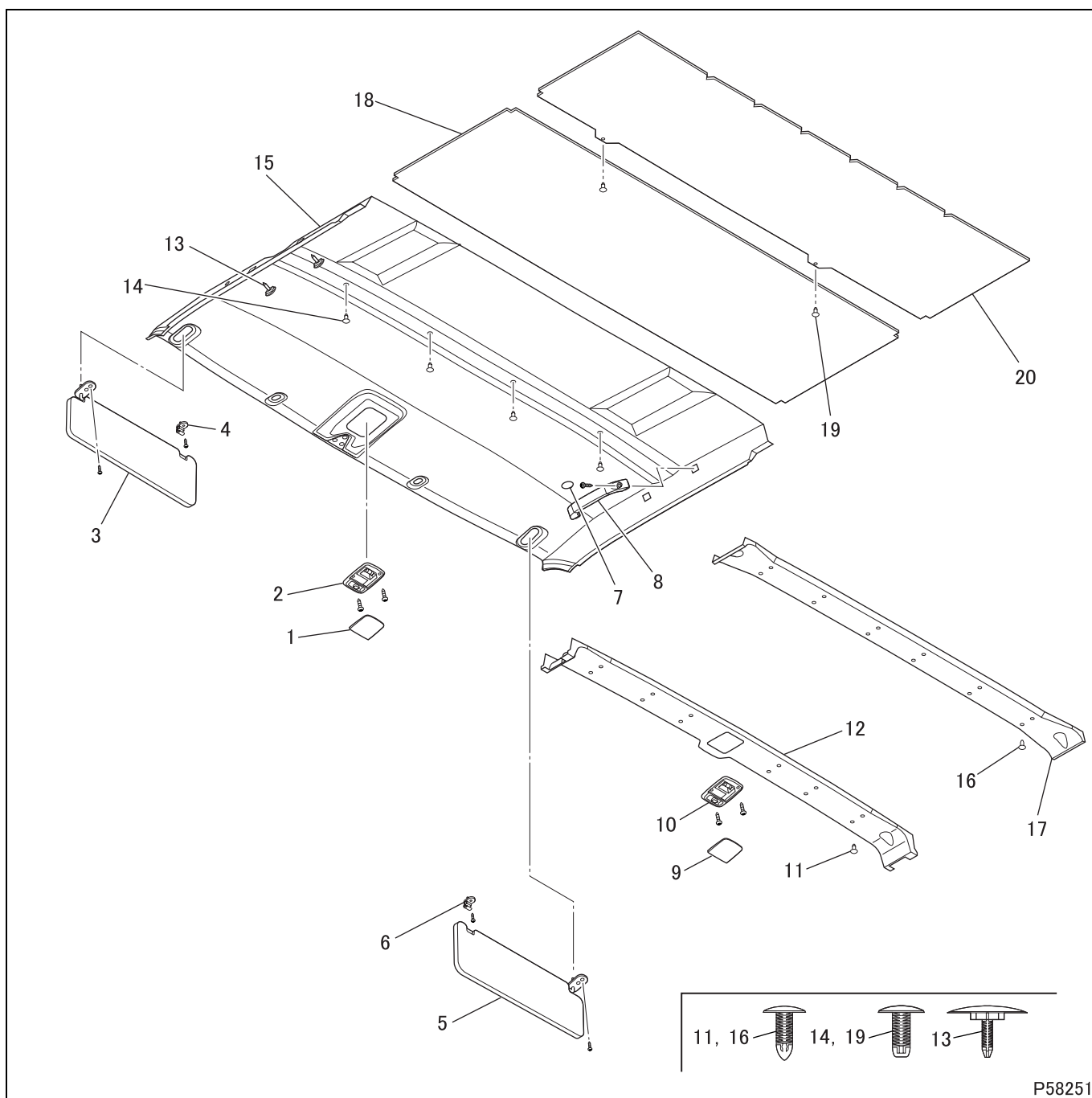
◆ Installation procedure ◆



■ Installation: Head lining

- Locate the head lining correctly onto the cab by installing clips at the locations ★ (× 2). Install clips at the locations ☆ (× 6).

HEAD LINING <CREW CAB>



P58251

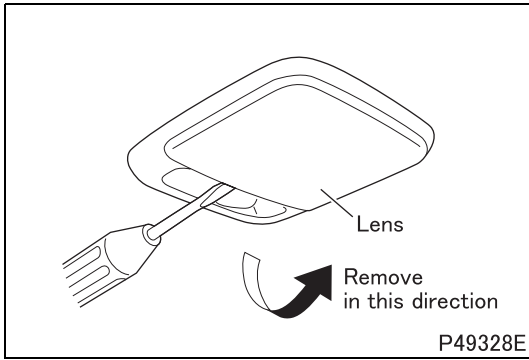
● Removal sequence

- | | |
|--------------------------|------------------------|
| 1 Lens | 11 Clip (× 14) |
| 2 Room lamp | 12 Center roof garnish |
| 3 Sun visor (left-hand) | 13 Plug |
| 4 Sun visor hook | 14 Clip (× 4) |
| 5 Sun visor (right-hand) | 15 Front head lining |
| 6 Sun visor hook | 16 Clip (× 14) |
| 7 Cap | 17 Rear roof garnish |
| 8 Grip | 18 Center head lining |
| 9 Lens | 19 Clip |
| 10 Rear room lamp | 20 Rear head lining |

● Installation sequence

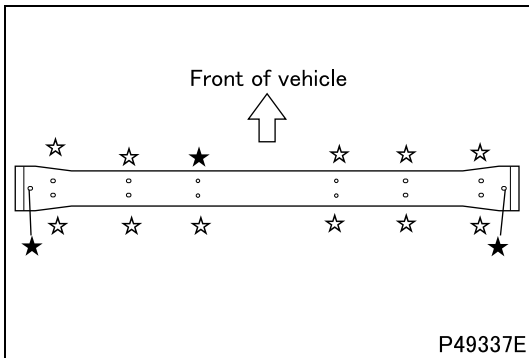
Follow the removal sequence in reverse.

◆ Removal procedure ◆



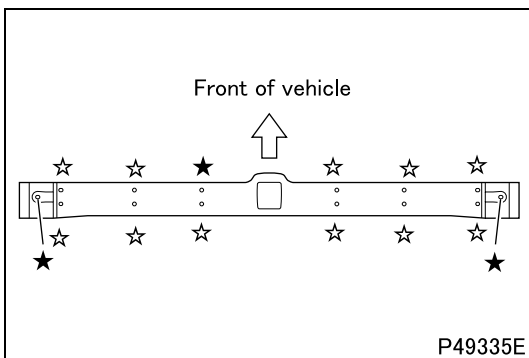
■ Removal: Lens

◆ Installation procedure ◆



■ Installation: Rear roof garnish

- Locate the rear roof garnish correctly onto the cab by installing clips at the locations ★ (× 3). Install clips at the locations ☆ (× 11).



■ Installation: Center roof garnish

- Locate the center roof garnish correctly onto the cab by installing clips at the locations ★ (× 3). Install clips at the locations ☆ (× 11).



Group 54

Electrical

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

HOW TO READ THIS GROUP 1

54-00 GENERAL

PRECAUTIONS FOR MAINTENANCE

OPERATION 54-00-2

SPECIFICATIONS 54-00-12

STRUCTURE AND OPERATION

1. Starter 54-00-15
2. Alternator 54-00-16
3. Headlamps 54-00-19
4. Meter Cluster 54-00-20
5. Daytime Running Light System 54-00-28
6. Wiper Control 54-00-30
7. Starter Continuous Energizing Preventing
Function and Preheating Function 54-00-32

TROUBLESHOOTING 54-00-36

54-01 POWER, CHARGE AND GROUND CIRCUIT

HIGH-CURRENT FUSE BOX 54-01-2

FUSE BOX 54-01-4

(110) POWER CIRCUIT 54-01-6

(115) RESERVE POWER CIRCUIT 54-01-16

(125) BATTERY CHARGING
CIRCUIT 54-01-17

(130) GROUND 54-01-18

54-02 STARTING CIRCUIT

(210) ENGINE STARTING CIRCUIT 54-02-2

(220) ENGINE PREHEATING CIRCUIT.. 54-02-4

54-03 LIGHTING CIRCUIT

(310) HEADLAMP CIRCUIT 54-03-2

(313) DAYTIME RUNNING LIGHT
CIRCUIT 54-03-4

(320) TAIL, CLEARANCE AND LICENSE
PLATE LAMPS CIRCUIT 54-03-6

(325) STOP LAMP CIRCUIT 54-03-7

(330) TURN SIGNAL AND HAZARD
LAMP CIRCUIT 54-03-8

(340) BACKUP LAMP CIRCUIT 54-03-10

(345) CAB LAMP CIRCUIT 54-03-12

(348) ILLUMINATION LAMP
CIRCUIT 54-03-14

(349) IDENTIFICATION LAMP AND SIDE
MARKER LAMP CIRCUIT 54-03-15

(352) VAN BODY DOME LIGHT
CIRCUIT 54-03-16

54-04 METER CIRCUIT

(401) METER CLUSTER INTERNAL
CIRCUIT 54-04-2

(412) SPEEDOMETER CIRCUIT 54-04-3

(420) FUEL GAUGE CIRCUIT 54-04-4

(425) WATER TEMPERATURE GAUGE
CIRCUIT 54-04-5

54-05 INDICATOR AND WARNING LAMP CIRCUIT

(510) PARKING BRAKE INDICATOR
CIRCUIT 54-05-2

(515) BRAKE WARNING CIRCUIT 54-05-4

(535) ENGINE OIL LEVEL WARNING
CIRCUIT 54-05-6

(536) ENGINE OIL PRESSURE
WARNING CIRCUIT 54-05-7

(537) OVERHEATING WARNING
CIRCUIT 54-05-8

(540)	BRAKE PAD WARNING	
	CIRCUIT	54-05-9
(550)	CAB TILT WARNING CIRCUIT ...	54-05-10
(566)	FUEL FILTER WARNING	
	CIRCUIT	54-05-11

54-06 CAB SIDE ELECTRICAL CIRCUIT

(610)	CIGARETTE LIGHTER CIRCUIT ..	54-06-2
(612)	AUDIO CIRCUIT	54-06-3
(614)	WIPER AND WASHER	
	CIRCUIT	54-06-4
(616)	HORN CIRCUIT	54-06-5
(620)	AIR-CONDITIONER CIRCUIT	54-06-6
(622)	POWER WINDOW AND AUTO	
	DOOR LOCK CIRCUIT	54-06-8
(629)	MIRROR HEATER CIRCUIT.....	54-06-9

54-07 CHASSIS SIDE ELECTRICAL CIRCUIT

(710)	EXHAUST BRAKE CIRCUIT	54-07-2
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54-08 ENGINE AND TRANSMISSION SIDE ELECTRICAL CIRCUIT

(810)	FOUR-WHEEL DRIVE	
	CIRCUIT <FG>.....	54-08-2
(850)	TRANSMISSION POWER	
	TAKE-OFF CIRCUIT.....	54-08-3

54-09 OTHER CIRCUIT

(905)	JOINT CONNECTOR (J/C).....	54-09-2
(907)	DIAGNOSIS SWITCH, MEMORY	
	CLEAR SWITCH	54-09-7

54-10 PARTS INSTALLATION POSITIONS

Cab side

A	SWITCH.....	54-10-2
B	RELAY AND ELECTRONIC	
	CONTROL UNIT	54-10-5
C	FUSE, METER, SENSOR, BUZZER,	
	MOTOR AND ACTUATOR.....	54-10-6
D	AIR-CONDITIONER <OPTION>.....	54-10-7
E	DOOR	54-10-8
F	ROOF.....	54-10-9
J	JOINT OF MAIN HARNESS	
	CONNECTORS.....	54-10-10

Engine and transmission

R	ENGINE	54-10-12
S	TRANSMISSION.....	54-10-13

Chassis side

T	SWITCH AND SENSOR.....	54-10-16
U	FUSE AND CONNECTOR.....	54-10-17
V	MAGNETIC VALVE AND MOTOR..	54-10-19
W	BUZZER AND CONNECTOR.....	54-10-19

54-11 INSPECTION OF PARTS

#001 to #179	SWITCH	54-11-2
#180 to #249	RELAY	54-11-8
#250 to #349	SENSOR	54-11-10
#350 to #409	CONTROL UNIT	54-11-11
#410 to #509	MOTOR.....	54-11-12
#510 to #539	ACTUATOR	54-11-13
#560 to #609	MAGNETIC VALVE	54-11-14
#610 to #649	BUZZER, HORN	54-11-15
#650 to #699	LAMP	54-11-17
#750 to #859	OTHER.....	54-11-18
#860	BATTERY.....	54-11-20

54-12 STARTER AND ALTERNATOR

#930 STARTER..... 54-12-2

#940 ALTERNATOR 54-12-16

54-13 ON-VEHICLE INSPECTION AND ADJUSTMENT

#950 INSPECTION OF ALTERNATOR.. 54-13-2

#951 INSPECTION OF REGULATOR.... 54-13-3

**#955 INSPECTION OF PREHEATING
SYSTEM..... 54-13-4**

**#956 INSPECTION OF STARTER
CONTINUOUS ENERGIZING
PREVENTING FUNCTION..... 54-13-8**

#960 HEADLAMP AIMING 54-13-12

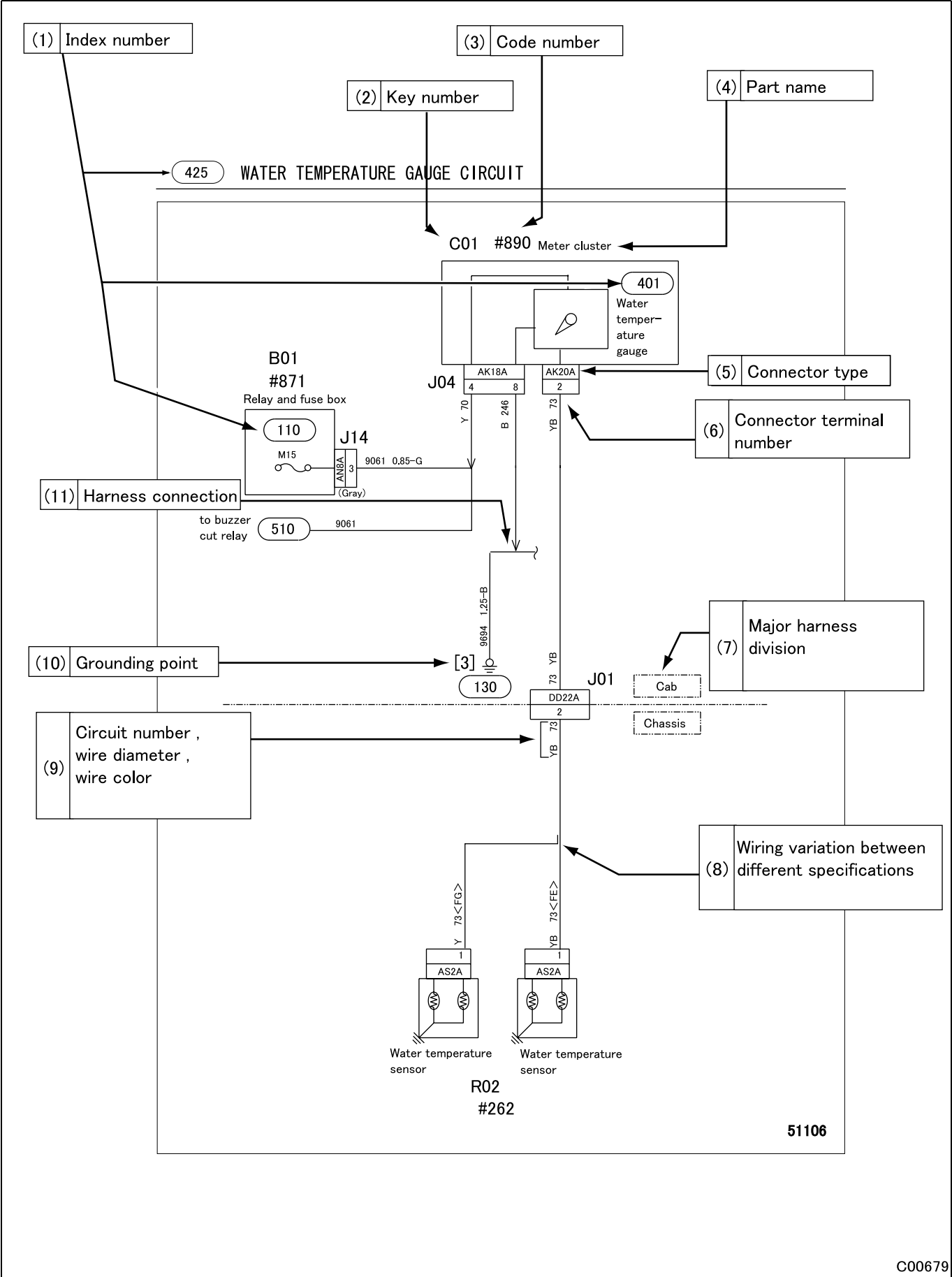
54-14 CONNECTOR CONFIGURATION CHART

**CONNECTOR CONFIGURATION
CHART 54-14-2**

HOW TO READ THIS GROUP

HOW TO READ THIS GROUP

HOW TO READ CIRCUITS (ELECTRICAL)



(1) Index number: (100) - (999)

- Index numbers are used as reference numbers for electrical circuits. Each electrical circuit has been assigned its own index number.

(2) Key number: A01 - Z99

- Key numbers indicate parts installation locations. The installation location of a part can be easily found using its key number shown in a circuit diagram.
All of the parts installation locations are listed in Gr54-10.

(3) Code number: #001 - #999

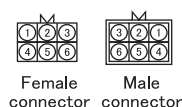
- Code numbers are reference numbers to find individual parts inspection procedures. The inspection procedure for a part can be found using its code number shown in a circuit diagram.

(4) Part name

(5) Connector type (type indication)

- A list of the connectors used is included in Gr54-14.

(6) Connector terminal number



Connector terminal numbering starts with the upper left corner for female connectors and with the upper right corner for male connectors.

P50678E

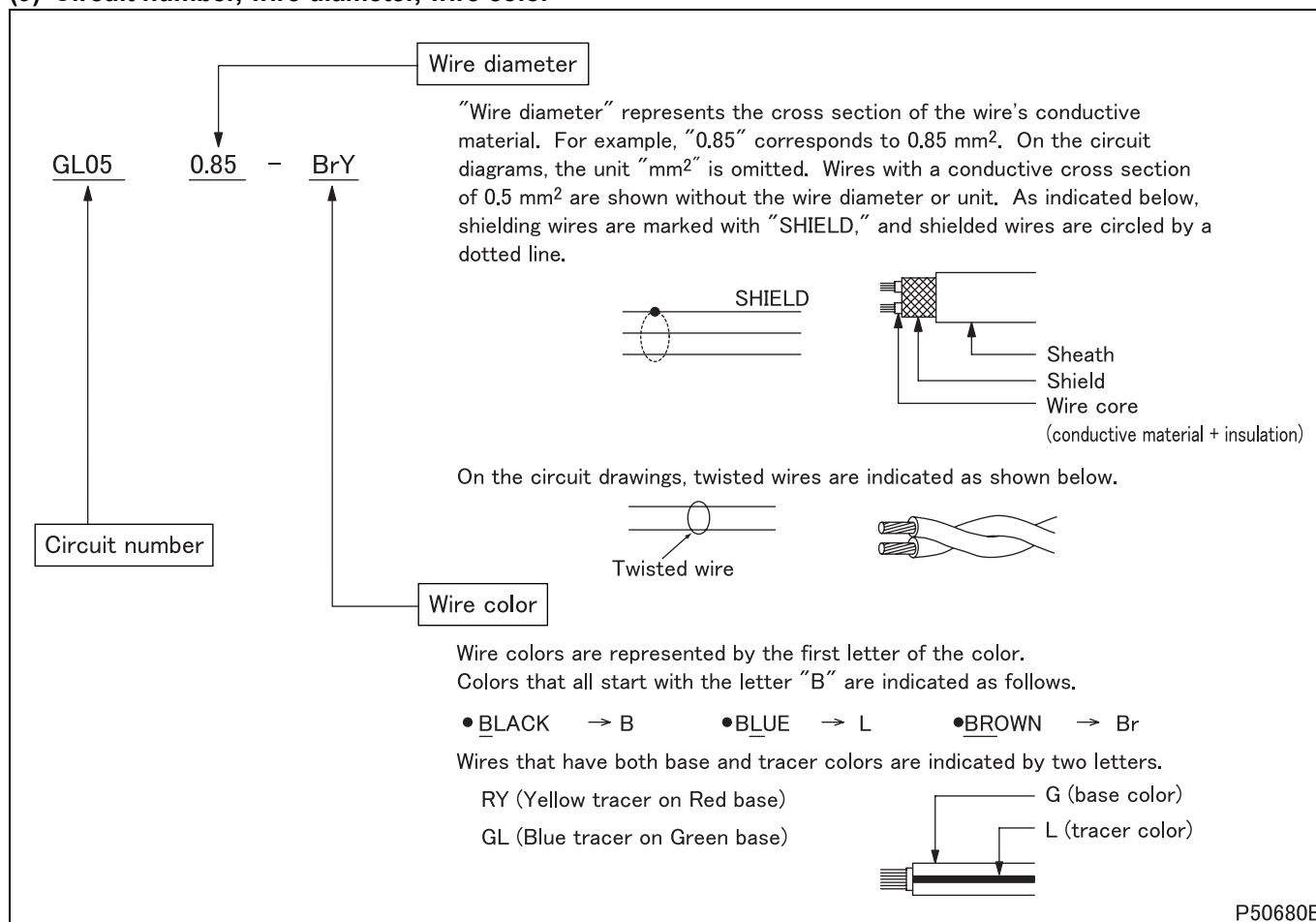
(7) Major harness division

- Major harness divisions are shown.

(8) Wiring variations between different specifications

- Variations in wiring/circuit between different vehicle specifications are clearly indicated as shown.

(9) Circuit number, wire diameter, wire color



HOW TO READ THIS GROUP

(10)Grounding point: [1] - [99]

- Locations where wires are grounded to the vehicle. All of the grounding points are listed in (130).

(11)Harness connection

- The arrow in the wiring diagram indicates where harnesses are connected, and NOT the flow of electricity.

Wire color

Wire color		Base color + tracer											
B	Black	BW	Black/ white	BY	Black/ yellow	BR	Black/red	BG	Black/ green	BL	Black/ blue		
Br	Brown	BrW	Brown/ white	BrB	Brown/ black	BrY	Brown/ yellow	BrR	Brown/ red	BrG	Brown/ green		
G	Green	GW	Green/ white	GR	Green/ red	GY	Green/ yellow	GB	Green/ black	GL	Green/ blue	GO	Green/ orange
Gr	Gray	GrL	Gray/ blue	GrR	Gray/ red								
L	Blue	LW	Blue/ white	LR	Blue/red	LY	Blue/ yellow	LB	Blue/ black	LO	Blue/ orange	LG	Blue/ green
Lg	Light green	LgR	Light green/ red	LgY	Light green/ yellow	LgB	Light green/ black	LgW	Light green/ white				
O	Orange	OL	Orange/ blue	OB	Orange/ black	OG	Orange/ green						
P	Pink	PB	Pink/ black	PG	Pink/ green	PL	Pink/ blue	PN	Pink/ white				
Pu	Purple												
R	Red	RW	Red/ white	RB	Red/ black	RY	Red/ yellow	RG	Red/ green	RL	Red/blue	RO	Red/ orange
Sb	Sky blue												
V	Violet	VY	Violet/ yellow	VW	Violet/ white	VR	Violet/red	VG	Violet/ green				
W	White	WR	White/ red	WB	White/ black	WL	White/ blue	WG	White/ green	WO	White/ orange		
Y	Yellow	YR	Yellow/ red	YB	Yellow/ black	YG	Yellow/ green	YL	Yellow/ blue	YW	Yellow/ white	YO	Yellow/ orange
		YP	Yellow/ pink	YV	Yellow/ violet								

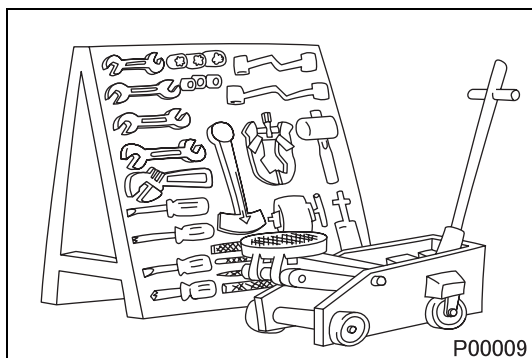
54-00 GENERAL

PRECAUTIONS FOR MAINTENANCE OPERATION

- Before performing service operations, inquire into the customer's complaints and ascertain the condition by checking the total distance traveled, the conditions under which the vehicle is operated, and other relevant factors on the vehicle. And note the necessary information. This information will help you to service the vehicle efficiently.
- Check the location of the fault, and identify its cause. Based on your findings, determine whether parts must be removed or disassembled. Then, follow the service procedure given in this manual.



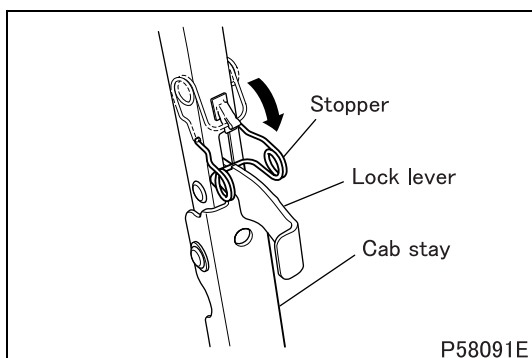
- Perform service operations on a level surface. Before starting, take the following preparatory steps:
 - To prevent soiling and damage, place covers over the seats, trim and floor in the cab and over the paintwork of the body.



- Prepare all the general and special tools necessary for the job.

WARNING ⚠

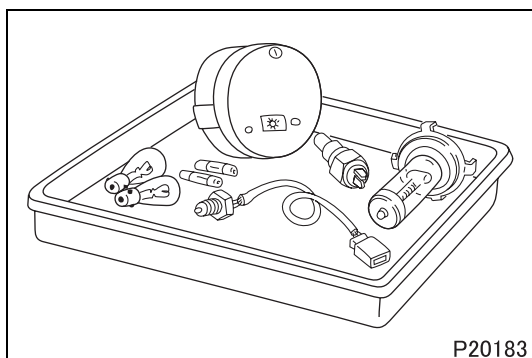
- **Special tools must be used wherever specified in this manual. Do not attempt to use other tools since they could cause injuries and/or vehicle damage.**



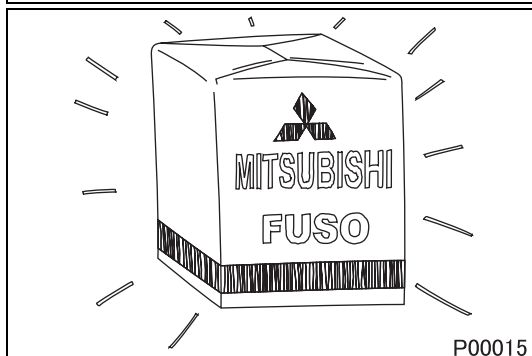
- After tilting the manual tilt type cab, be sure to engage the stopper with the lock lever to lock the cab stay securely.



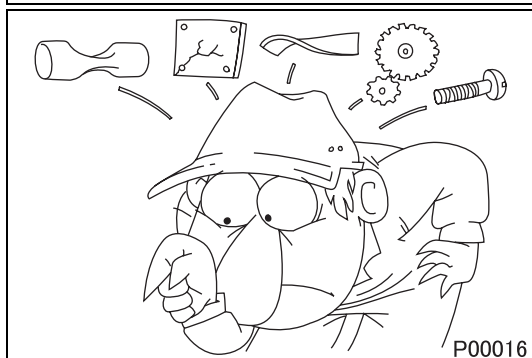
- Never work in shoes that have oily soles. When working with a partner or in a group, use pre-arranged signals and pay constant attention to safety. Be careful not to touch switches and levers unintentionally.



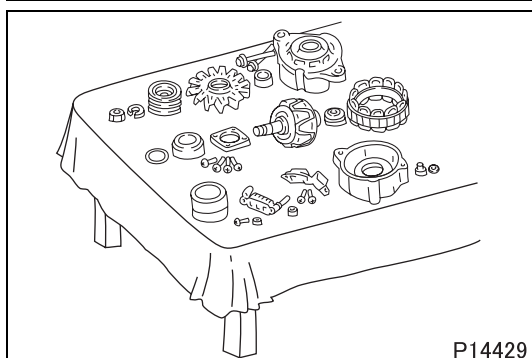
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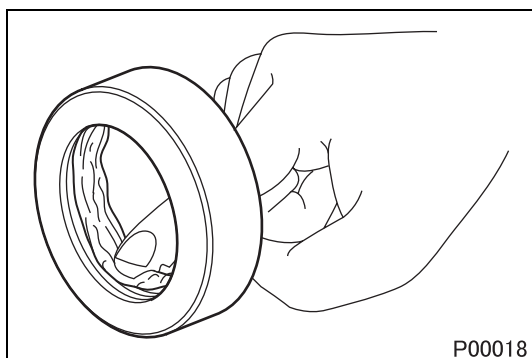
P00015



P00016



P14429



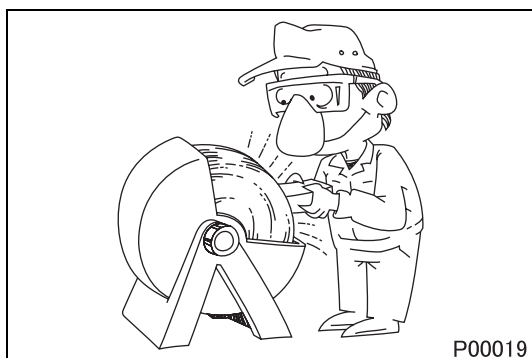
P00018

- Prepare replacement parts ready for installation.
- Oil seals, packings, O-rings and other rubber parts, gaskets, and split pins must be replaced with new ones after removal. Use only genuine MITSUBISHI replacement parts.
- When disassembling parts, visually check them for wear, cracks, damage, deformation, deterioration, rust, corrosion, defective rotation, fatigue, clogging and any other possible defect.
- To facilitate correct reassembly of parts, make alignment marks on them before disassembly and arrange disassembled parts neatly. Make punch marks and other alignment marks where they will not detract from parts' functionality and appearance.
- After removing parts from the vehicle, cover the area to keep it free of dust.

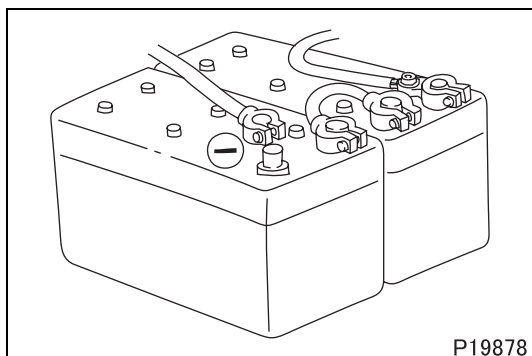
CAUTION

- **Be careful not to mix up identical parts, similar parts and parts that have left/right alignments.**
- **Keep new replacement parts and original (removed) parts separately.**
- Apply the specified oil or grease to U-seals, oil seals, dust seals and bearings before reassembly.
- Always use the specified oils and greases when performing inspection or replacement. Immediately wipe away any excess oil or grease with a rag.

PRECAUTIONS FOR MAINTENANCE OPERATION



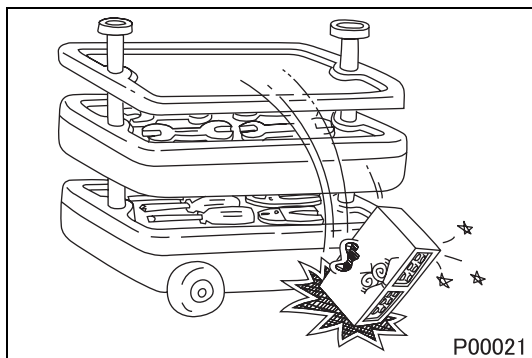
- Wear safety goggles when using a grinder or welder. Wear gloves when necessary, and watch out for sharp edges and other items that might wound your hands.



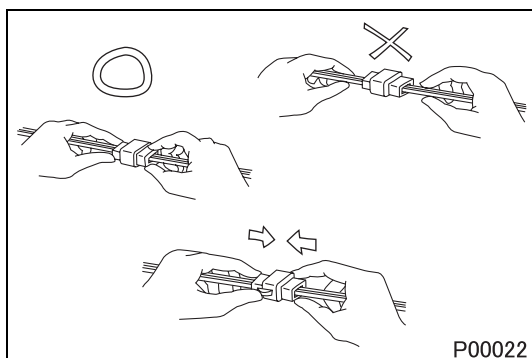
- Before working on the electrical system, disconnect the battery (–) terminal to prevent short circuits.

CAUTION

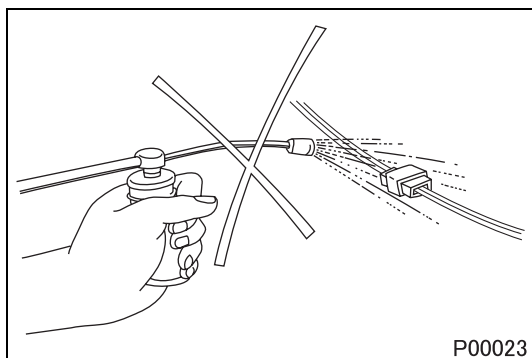
- **Make sure the starter switch and lighting switches are OFF before disconnecting or connecting battery terminals. Semiconductor components may otherwise be damaged.**



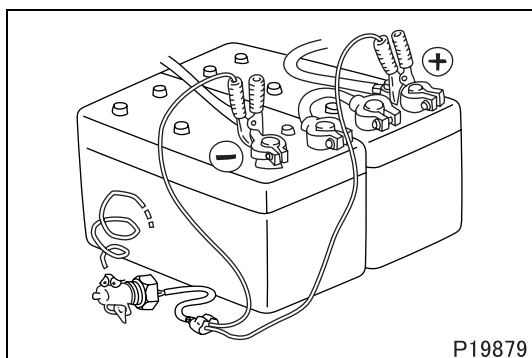
- Carefully handle sensors, relays, and other items that are sensitive to shock and heat. Do not remove or paint the cover of any control unit.



- When separating connectors, grasp the connectors themselves rather than the harnesses.
- To separate locking connectors, first push them in the direction of the arrows. To reconnect locking connectors, push them together until they click.



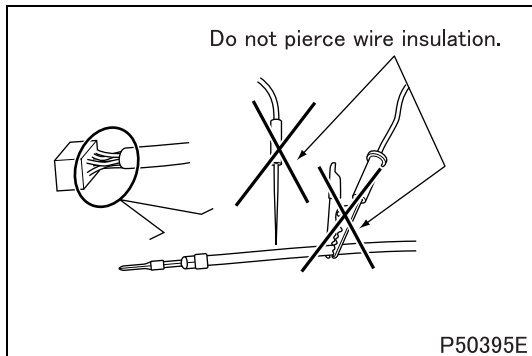
- Before washing the vehicle, cover electrical parts to keep them dry. (Use plastic sheets or the like.) Keep water away from harness connectors and sensors and immediately wipe off any water that gets on them.



- When applying a voltage to a part for inspection purposes, check that the (+) and (-) cables are connected properly then gradually increase the voltage from zero. Do not exceed the specified voltage.

Remember that control units and sensors do not necessarily operate on the battery voltage.

1. Handling Precautions for Electric Circuits



CAUTION

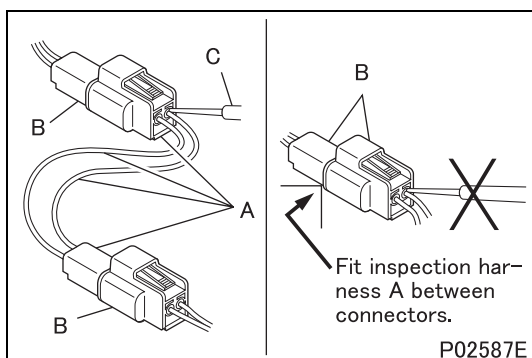
- Do not pierce wire insulation with test probes or alligator clips when performing electrical inspections. Doing so can, particularly with the chassis harness, hasten corrosion.

1.1 Inspection of harnesses

(1) Inspections with connectors fitted together

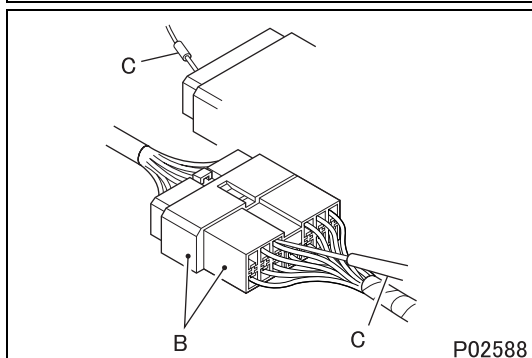
(1.1) Waterproof connectors

- Connect an inspection harness and connector **A** between the connectors **B** of the circuit to be inspected. Perform the inspection by applying a test probe **C** to the connectors of the inspection harness. Do not insert the test probe **C** into the wire-entry sides of the waterproof connectors since this would damage their waterproof seals and lead to rust.



(1.2) Non-waterproof connectors

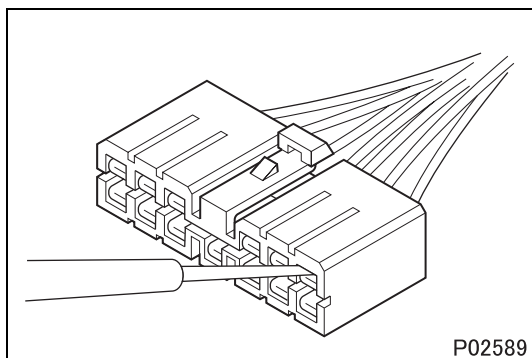
- Perform the inspection by inserting a test probe **C** into the wire-entry sides of the connectors. An extra-narrow probe is required for control unit connectors, which are smaller than other types of connector. Do not force a regular-size probe into control unit connectors since this would cause damage.



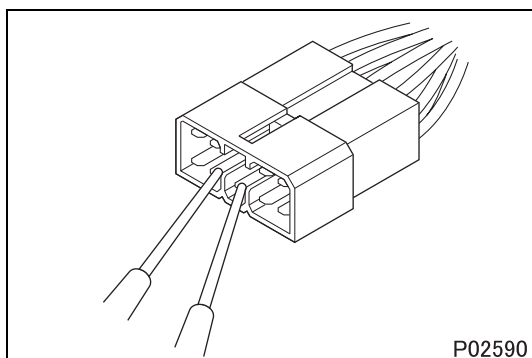
(2) Inspections with connectors separated

(2.1) Inspections on female terminals

- Perform the inspection by carefully inserting a test probe into the terminals. Do not force the test probe into the terminals since this could deform them and cause poor connections.



PRECAUTIONS FOR MAINTENANCE OPERATION

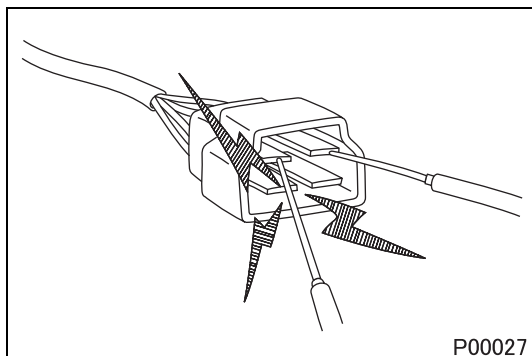


(2.2) Inspections on male terminals

- Perform the inspection by applying test probes directly to the pins.

CAUTION ⚠

- **Be careful not to short-circuit pins together with the test probes. With control unit connectors, short-circuiting of pins can cause damage to the control unit's internal circuitry.**

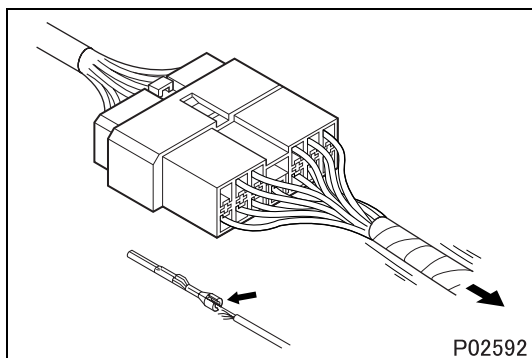
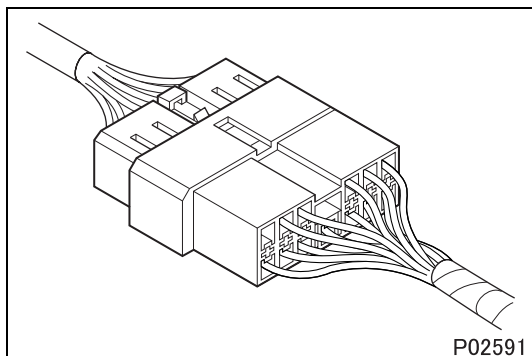


- When using a multimeter to check continuity, do not allow the test probes to touch the wrong terminals.

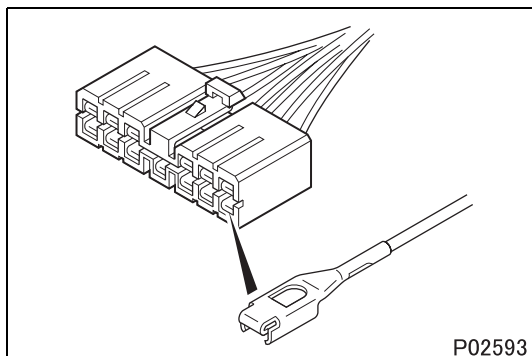
1.2 Inspection of connectors

(1) Visual inspection

- Check that the connectors are fitted together securely.

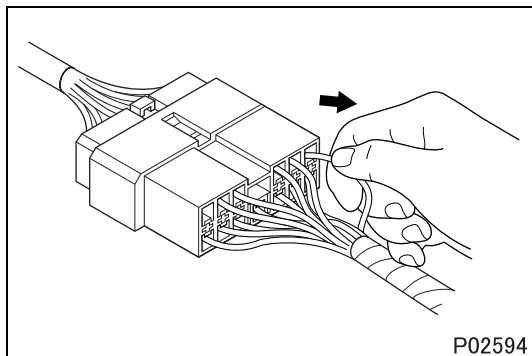


- Check whether wires have been separated from their terminals due to pulling of the harness.



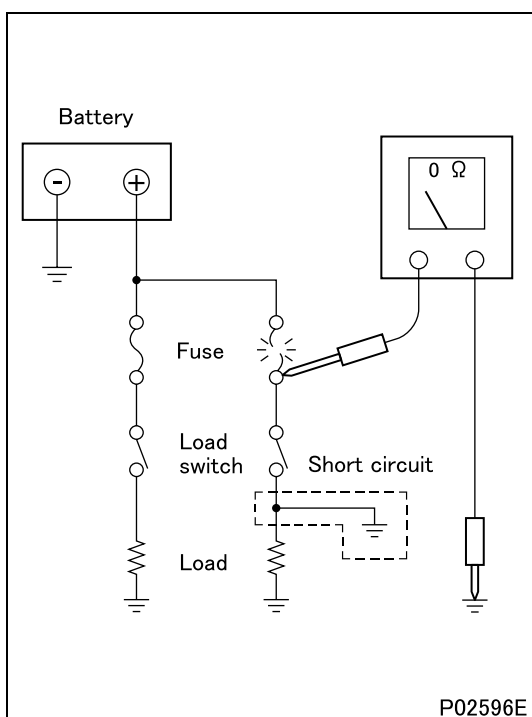
- Check that male and female terminals fit together tightly.

- Check for defective connections caused by loose terminals, by rust on terminals, or by contamination of terminals by foreign substances.



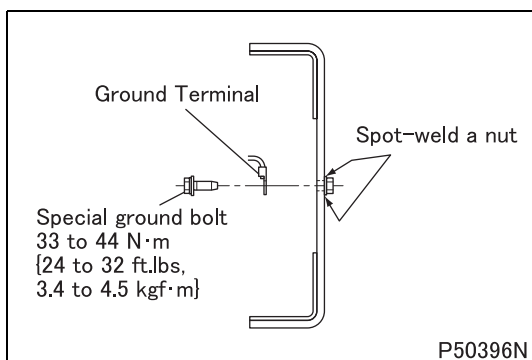
(2) Checking for loose terminals

- If connector terminal retainers become damaged, male and female terminals may not mate with each other when the connector bodies are fitted together. To check for such terminals, gently pull each wire and see whether any terminals slip out of their connector housings.



1.3 Inspections when a fuse blows

- Remove the fuse, then measure the resistance between ground and the fuse's load side.
Next, close the switch of each circuit connected to the fuse. If the resistance measurement between any switch and ground is zero, there is a short circuit between the switch and the load. If the resistance measurement is not zero, the circuit is not currently short-circuited; the fuse probably blew due to a momentary short circuit.
- The main causes of short circuits are as follows:
 - Harnesses trapped between chassis parts
 - Harness insulation damage due to friction or heat
 - Moisture in connectors or circuitry
 - Human error (accidental short-circuiting of components)

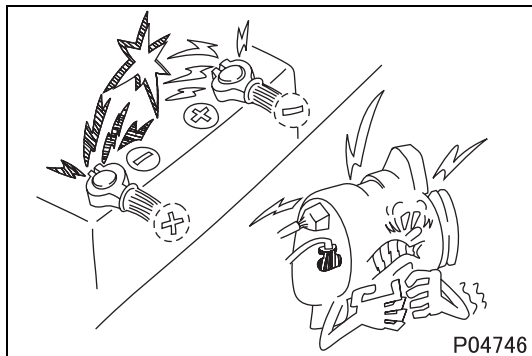


1.4 Inspection of chassis ground

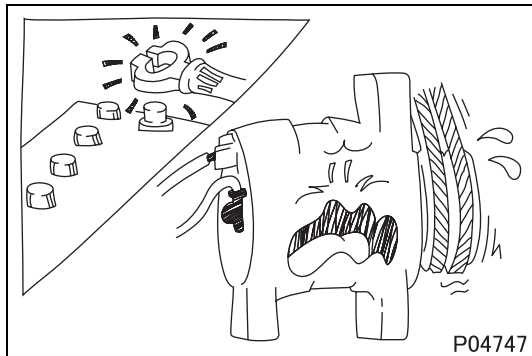
- A special ground bolt is used to tighten a ground terminal. When servicing the ground point, be sure to follow the procedures described below:
 - When reinstalling the ground bolt
Tighten the ground bolt to the specified torque.
 - When relocating the ground point
A special ground bolt must be used. Spot-weld a nut to a frame and tighten the ground bolt to the specified torque. Be sure to apply touch-up paint to the welded point.

PRECAUTIONS FOR MAINTENANCE OPERATION

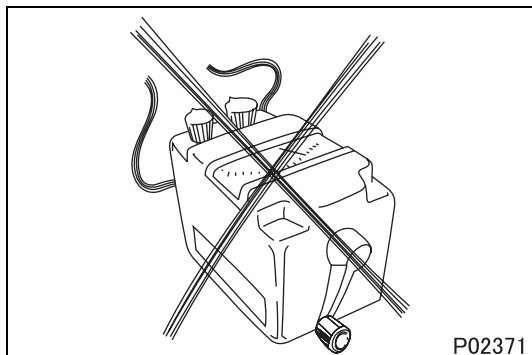
2. Service Precautions for Alternators



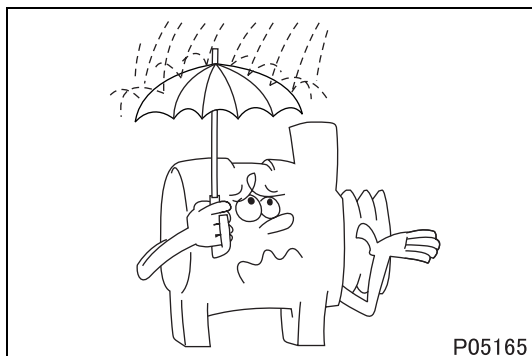
- When servicing alternators, observe the following precautions:
 - Never reverse the polarity of battery connections.
If the polarity of the battery connections was reversed, a large current would flow from the battery to the alternator, damaging the diodes and regulator.



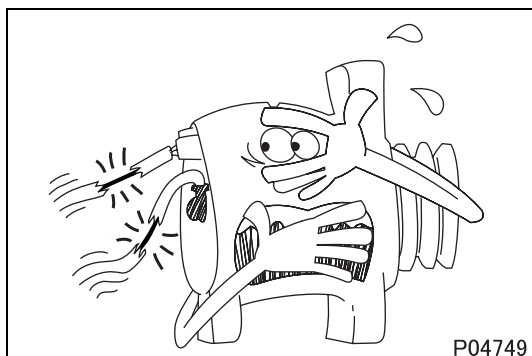
- Never disconnect the battery terminals with the engine running. Disconnection of the battery terminals during engine operation would cause a surge voltage, leading to deterioration of the diodes and regulator.



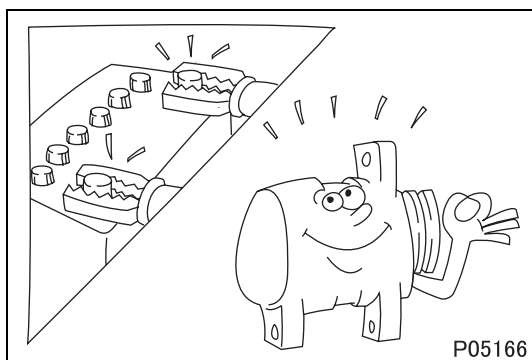
- Never perform inspections using a high-voltage multimeter. The use of a high-voltage multimeter could damage the diodes and regulator.



- Keep alternators dry. Water on alternators can cause internal short circuits and damage.

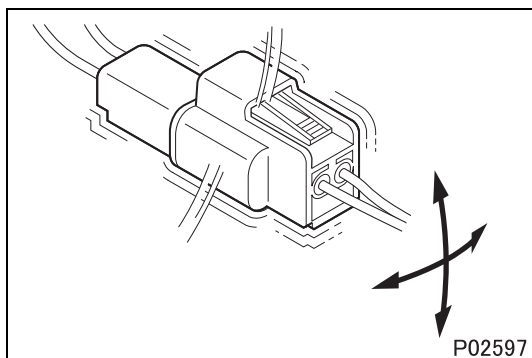


- Never operate an alternator with the **B** and **L** terminals short-circuited. Operation with the **B** and **L** terminals connected together would damage the diode trio.



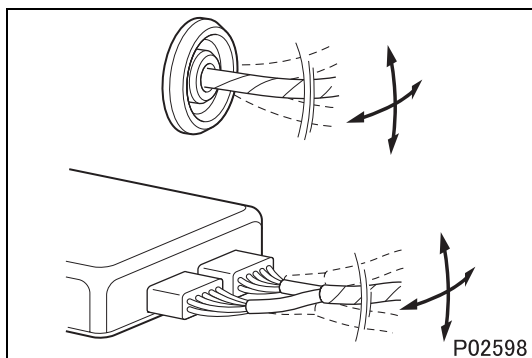
- Disconnect the battery terminals before quick-charging the battery with a quick charger. Unless the battery terminals are disconnected, quick-charging can damage the diodes and regulator.

3. Intermittent Faults

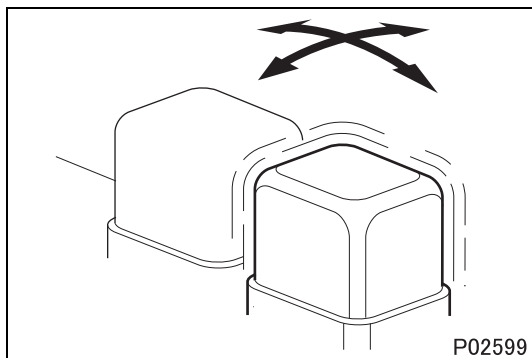


- An intermittent fault typically occurs only under certain operating conditions. Once these conditions have been identified, the cause of the intermittent fault can be ascertained easily. First, ask the customer about the vehicle operating conditions and weather conditions under which the fault occurs. Also ask about the frequency with which the fault occurs and about the fault symptoms. Then, reproduce the fault based on this information. In accordance with the conditions under which the fault occurs, determine whether the fault is caused by vibration, heat or other factors. If vibration is a possible factor, see if the fault can be reproduced by performing the following checks on individual connectors and other parts:

- Gently move connectors up and down and to left and right.
- Gently move wiring harnesses up and down and to left and right.
- Gently wiggle sensors and other devices by hand.
- Gently wiggle wiring harnesses on suspension systems and other moving parts.



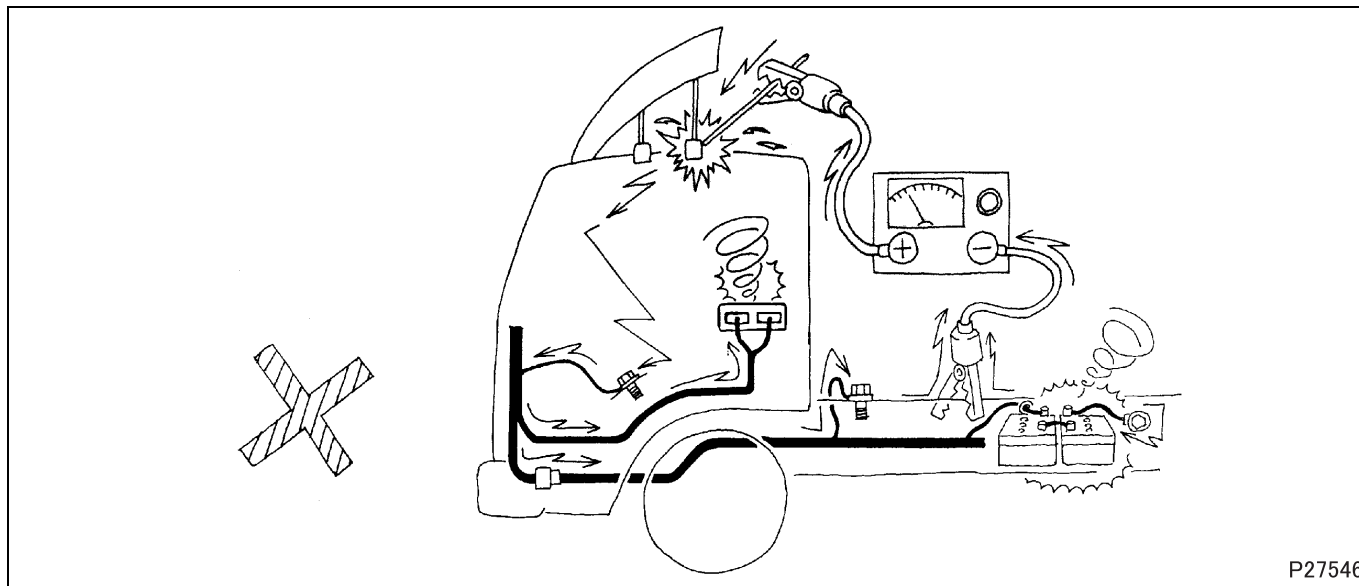
- Connectors and other parts to be checked are those included or given as likely fault locations in inspection procedures corresponding to diagnosis codes and/or fault symptoms.



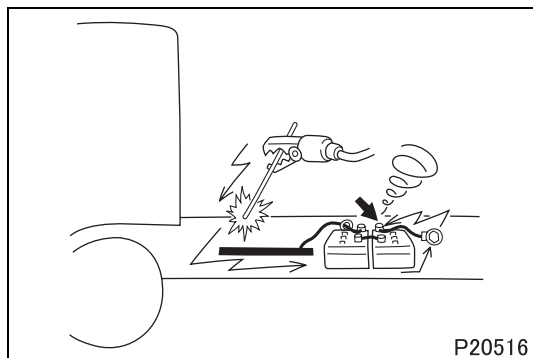
PRECAUTIONS FOR MAINTENANCE OPERATION

4. Precautions for Arc Welding

- When arc welding is performed, current from the welder flows to ground via the vehicle's metal parts. Unless appropriate steps are taken, this current can damage control units, other electrical devices and wiring harnesses. And, any electrical device near the point on vehicle, to which the negative cable of the welder is connected might be largely damaged.



- Current flows backward as shown below.



4.1 From battery (–) terminal

To prevent damage to the battery and to electrical devices that are connected directly to the battery, it is essential to disconnect the battery's (–) terminal.

4.2 Procedure

- Turn the starter switch to the LOCK position.
↓
- Disconnect the battery's (–) terminal.
↓
- Cover all parts of the vehicle that may be damaged by welding sparks.
↓
- Connect the welder's (–) cable to the vehicle as close as possible to the area being welded. Do not connect the welder's (–) cable to the cab if the frame is being welded, and vice versa.
↓
- Set the welding current in accordance with the part being welded.

M E M O

SPECIFICATIONS

Battery

Item		Specifications
Model		130E41L
Voltage × Quantity	V	12 × 2
Capacity (5-hour rating)	Ah	92

Alternator

Item		Specifications
Manufacturer		MITSUBISHI ELECTRIC
Type		Alternator with built-in regulator (without brush, external fan)
Model		A4TU1081B
Output	V-A	12–100

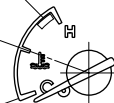
Starter

Item		Specifications
Starter	Manufacturer	MITSUBISHI ELECTRIC
	Model	M8T55371
	Output V-kW	12–3.0
	Reduction gear mechanism	Planetary gears
	Magnetic switch operating voltage V	8 or less
Starter relay	Model	U1X11773
	Excitation current V-A	12–4
	Closing voltage V	8 or less
	Opening voltage V	3.5 or less
	Allowable cutoff current A	200
Glow relay	Model	U1T11872
	Excitation current V-A	12–4
	Closing voltage V	8 or less
	Opening voltage V	3.5 or less
	Allowable cutoff current A	60
	Temperature fuse capacity A	127
Glow plug	Model	Seathed type
	Excitation current V-A	11–5

Lighting

Item		Specifications
Headlamp	Model	Unconventional, rectangular, 2-lamp-system, semi-sealed beam
	Type	Parabola reflector type
	Upper beam (HIGH) W	HB2 halogen 60/55 (HIGH/LOW)
	Lower beam (LOW) W	
	Parking lamp W	5
Front side turn signal lamp (serving also as hazard warning lamp) W		21
Clearance and side marker lamp W		7.5
Rear combination lamp	Stop and tail lamp (Stop/tail) W	21/5 (Double filament type)
	Rear turn signal lamp (serving also as hazard warning lamp) W	21
	Backup lamp W	21
License plate lamp W		7.5 <Except crew cab, FG>, 8 <Crew cab, FG>
Identification lamp W		7.5
Cab lamp W		10

Meter

Item			Specifications	
Meter cluster	Manufacturer		DENSO	
	Voltage V		12	
	Speedometer indicating range	km/h	Meter reading $\overset{+2}{0}$ to $\overset{+6.5}{0}$	
	Tachometer indicating range rpm		Meter reading ± 150	
	Water temperature gauge indicating range		<M/T> 103°C {217°F} 70 to 96°C {158 to 205°F} 50°C {122°F}  P58273N <A/T> 103°C {217°F} 70 to 96°C {158 to 205°F} 50°C {122°F}  P57939N	
	Meter warning buzzer	Rated current	mA	50 or less
		Sound pressure	dB	$60 \overset{+6}{0}$ (at 1 m {3.3 ft.})

A/T: Automatic transmission

M/T: Manual transmission

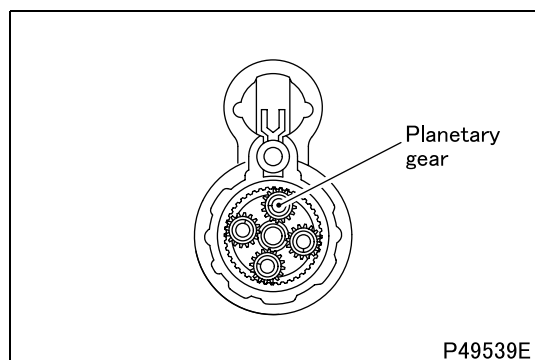
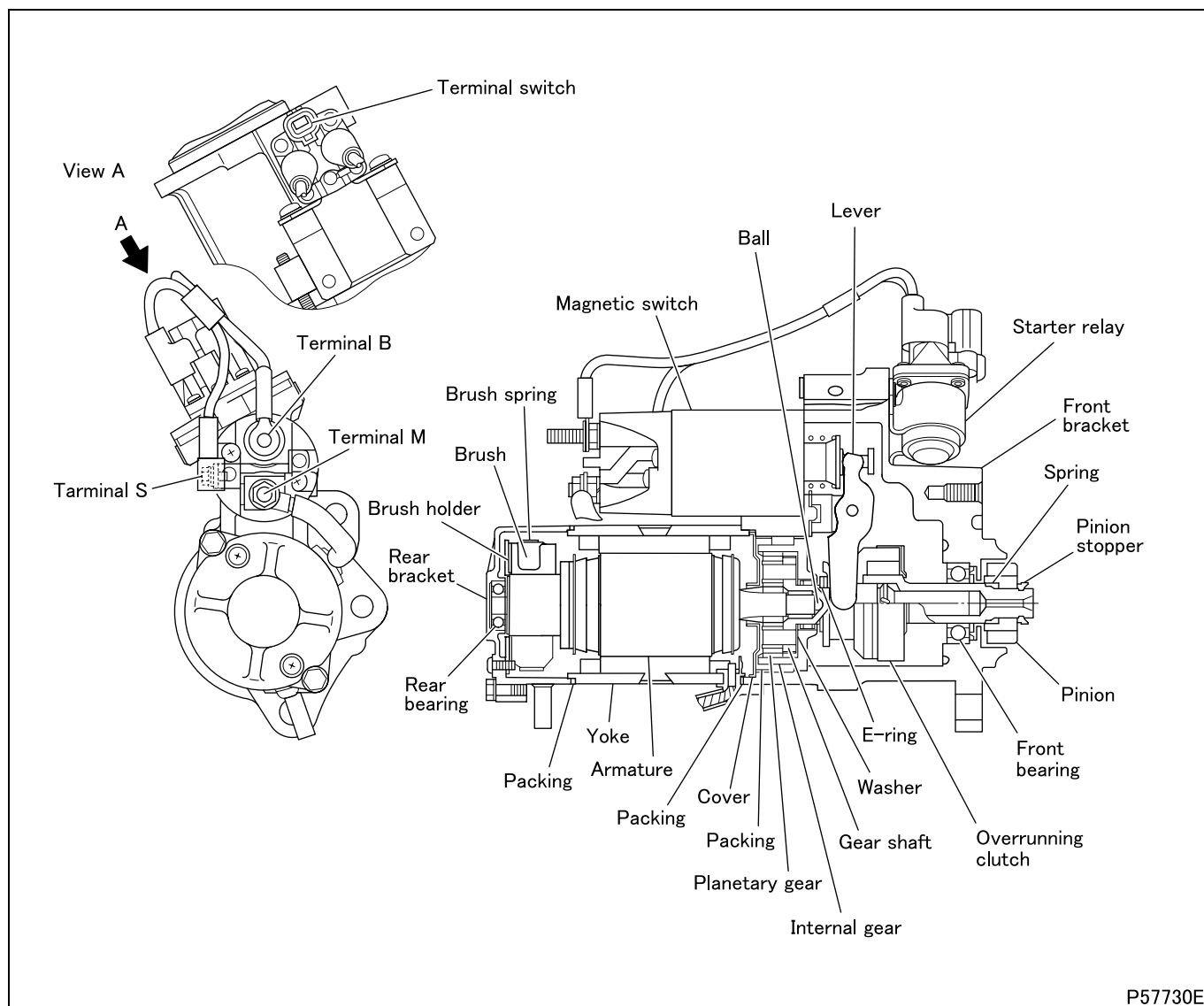
SPECIFICATIONS

Relay, Radio, Motor, Horn, Buzzer

Item		Specifications
Minimum operating voltage of relay		V
		8 or less
Loudspeaker	Rated input	W
		15
	Maximum input	W
		25
	Impedance	Ω
		4 ± 0.6
Wiper motor	Rated voltage	V
		12
	No-load current	A
		4 or less
	Bound current	A
		30 or less
Washer motor	Rated voltage	V
		12
	Rated current	A
		3.8 or less
Power window motor	Rated voltage	V
		12
	Rated current	A
		5 or less
Electric horn	Rated voltage	V
		12
	Current consumption	A
		3 or less
	Sound pressure	dB
		110 ± 5 (at 2 m {6.6 ft.})
Back buzzer	Rated voltage	V
		12
	Rated current	mA
		50 or less
	Sound pressure	dB
		85 ± 10 (at 1 m {3.3 ft.})
Cab tilt buzzer <Except crew cab>	Rated voltage	V
		12
	Rated current	mA
		66 or less
	Sound pressure	dB
		73 ± 10 (at 1 m {3.3 ft.})
Hydraulic warning buzzer (Only attached hydraulic brake)	Rated voltage	V
		12
	Rated current	mA
		100 or less
	Sound pressure	dB
		90 to 105 (at 1 m {3.3 ft.})

1. Starter

<M8T55371>

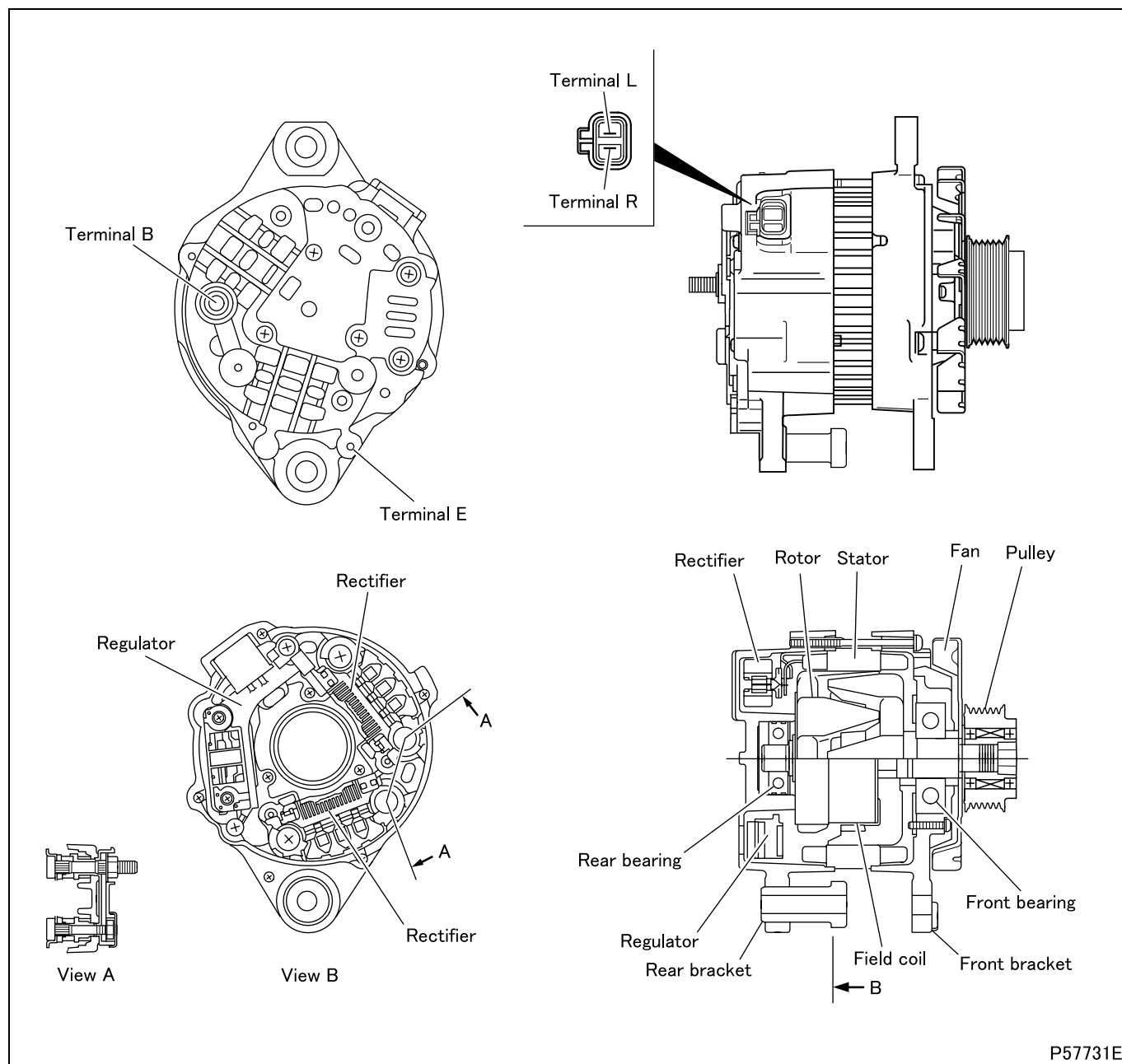


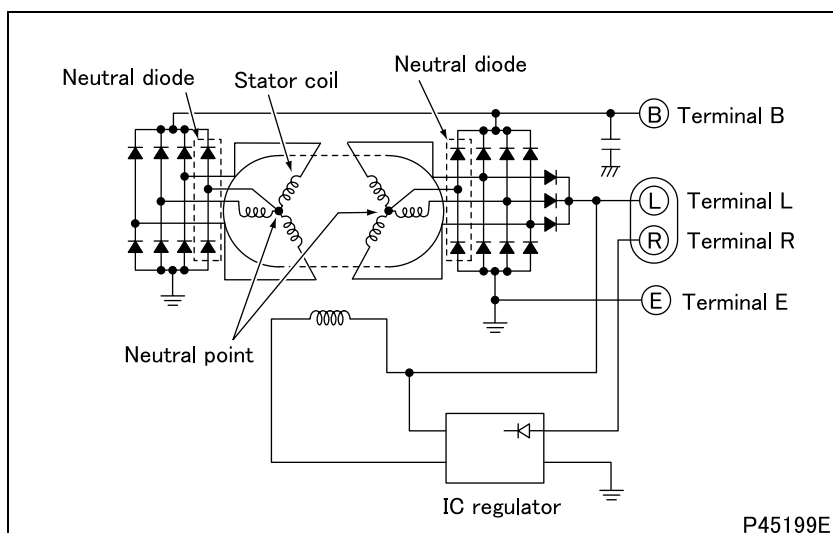
- This starter uses planetary gears as its reduction gearing mechanism.

STRUCTURE AND OPERATION

2. Alternator

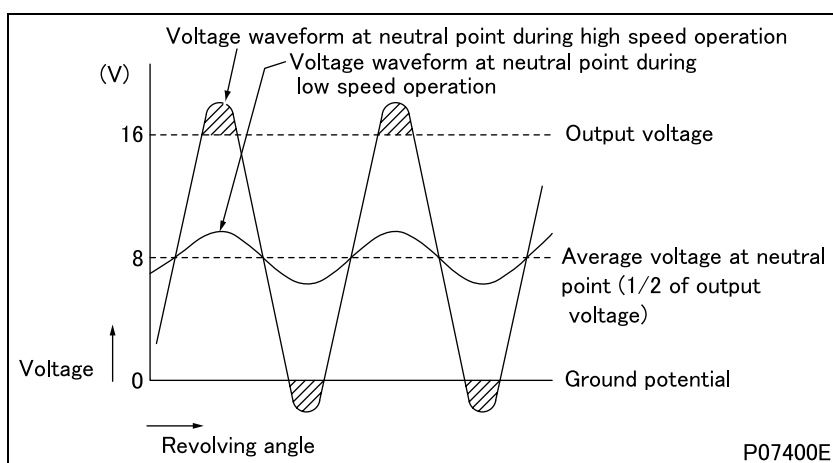
<12V-100A without brush (A4TU1081)>





2.1 Features of alternator with neutral diodes

- The alternator is the same as the current alternator except that neutral diodes have been added.
- These neutral diodes enable this alternator to provide higher DC output during operation at high speeds than the alternator without neutral diodes.



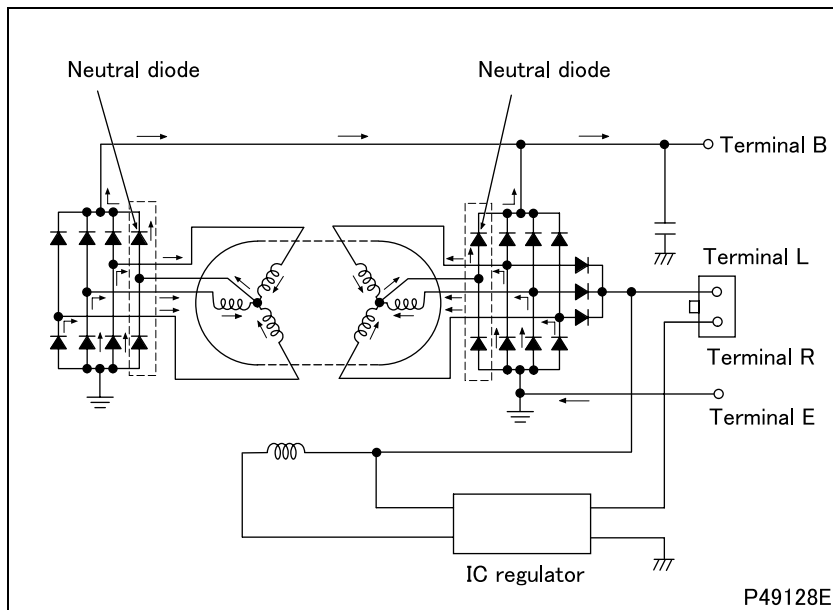
2.2 Variations of voltage at neutral point and operation of neutral diodes

- The potential at the neutral point varies up and down with the neutral point DC voltage ($1/2$ of output voltage) as a center as shown.
- When the alternator is operated at high speeds, the voltage at the neutral point can increase to exceed the output voltage (16V) and decrease to become lower than the ground voltage (0V). To adjust these over-voltage and under-voltage (shaded portions of diagram) the current from the excess voltages is taken by neutral diodes and added to the DC output.

The operation of neutral diodes for each voltage and potential is as follows.

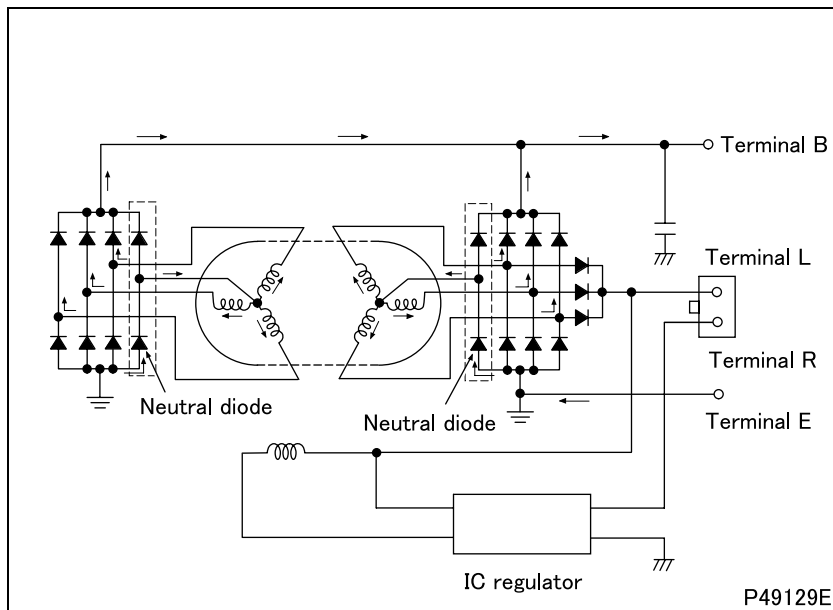
- When the voltage at neutral point is in the range from 0 to 16V, the other six diodes are operated. Neutral diodes are not operated.

STRUCTURE AND OPERATION



2.3 When the voltage at neutral point exceeds 16V

- The positive neutral diode adds extra output to the DC output for supply to each electric equipment.

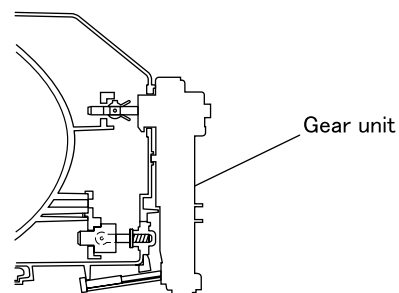
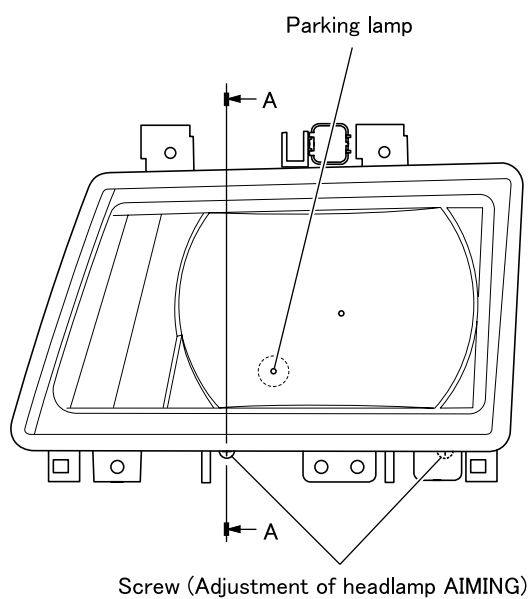


2.4 When the voltage at neutral point drops below 0V

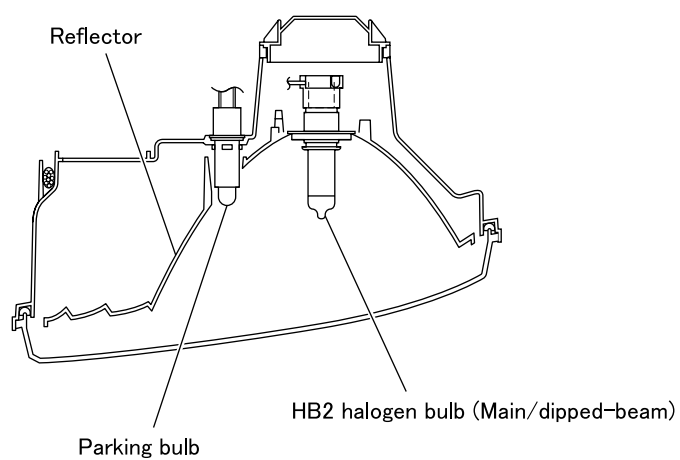
- The negative neutral diode supplies the output from neutral point through other three diodes.

3. Headlamps

<Unconventional, rectangular 2-lamp halogen headlamp>



View A



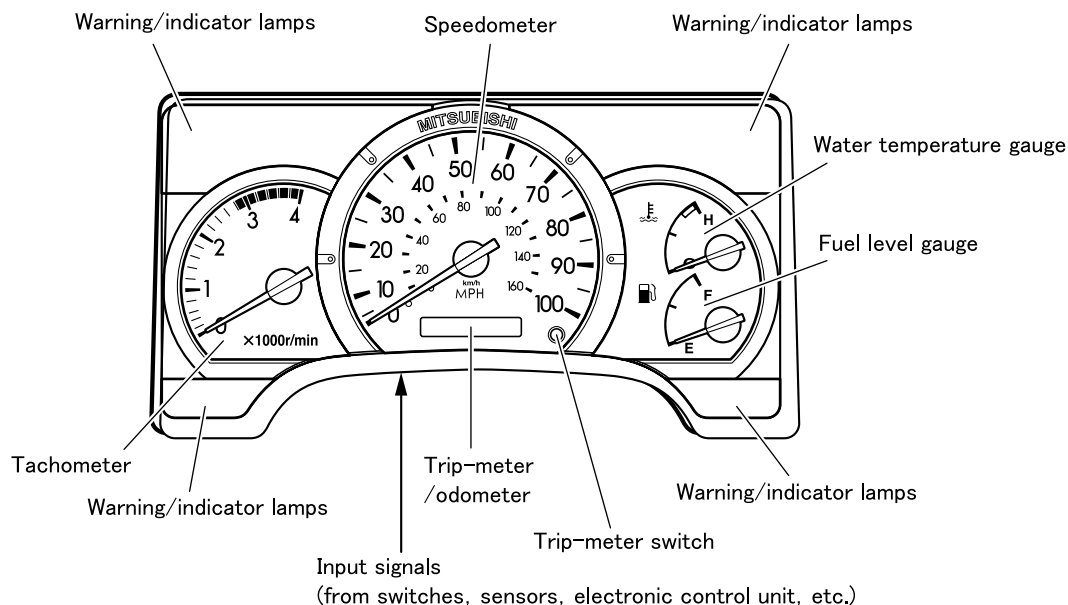
P57951E

(Left headlamps are shown in this illustration)

STRUCTURE AND OPERATION

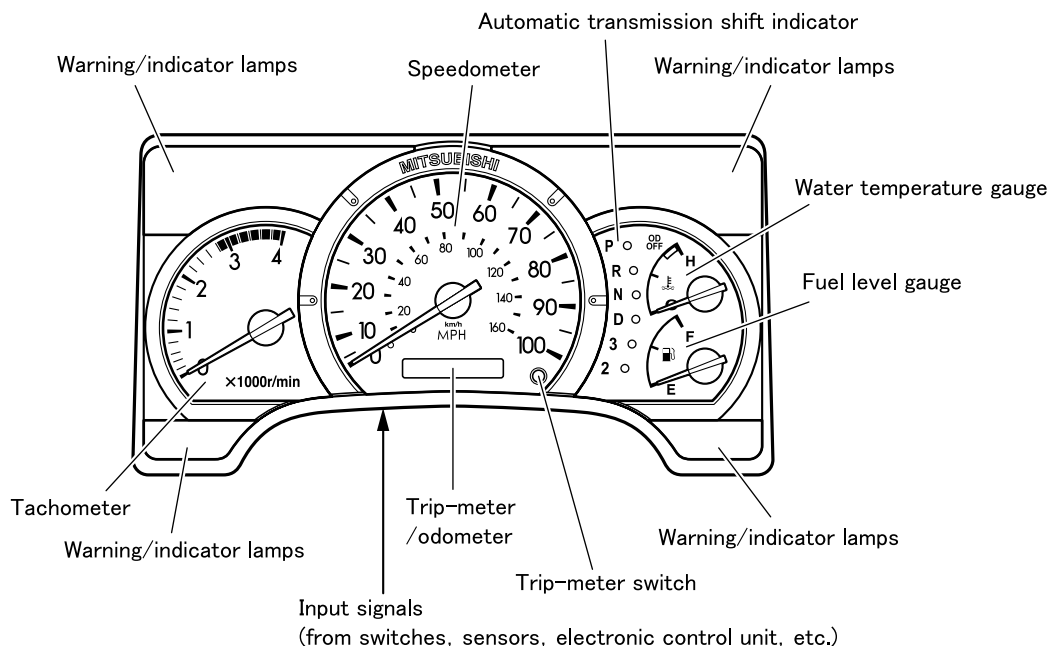
4. Meter Cluster

<Manual transmission>



P57966E

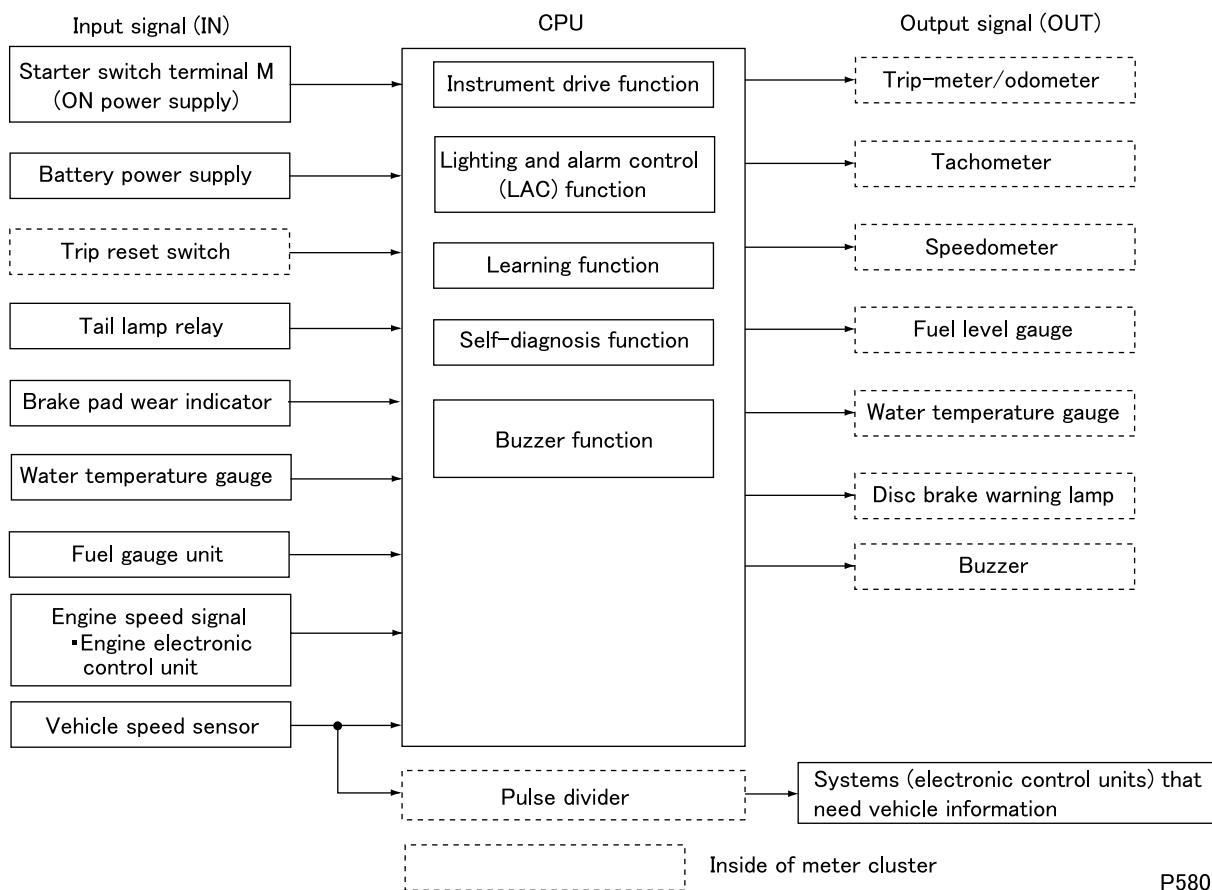
<Automatic transmission>



P57967E

- The meter cluster incorporates a CPU, which has the lighting and alarm control (LAC) function, learning function, and self-diagnosis function.

4.1 Electronic control unit in the meter cluster system block diagram

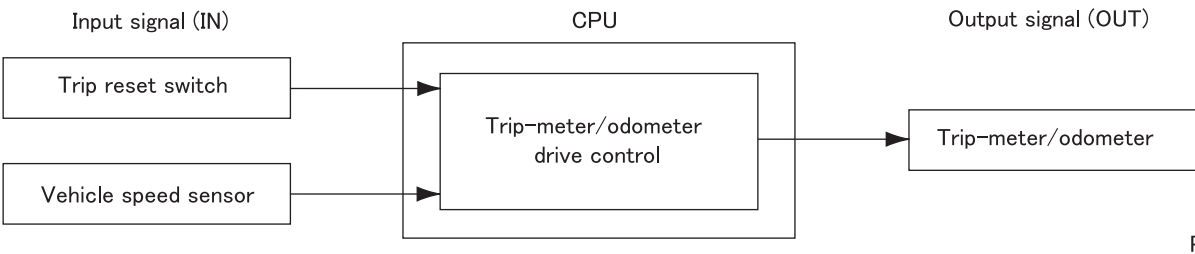


P58089E

STRUCTURE AND OPERATION

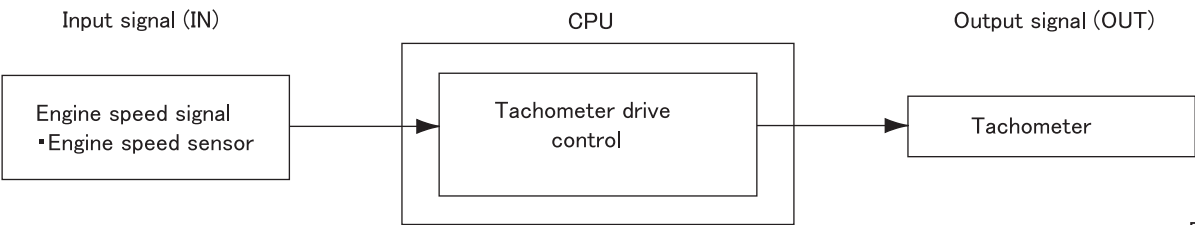
4.2 Instrument drive function

(1) Trip-meter/odometer



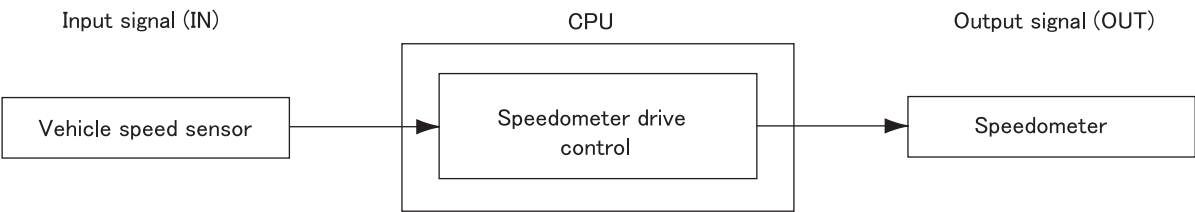
P57489E

(2) Tachometer



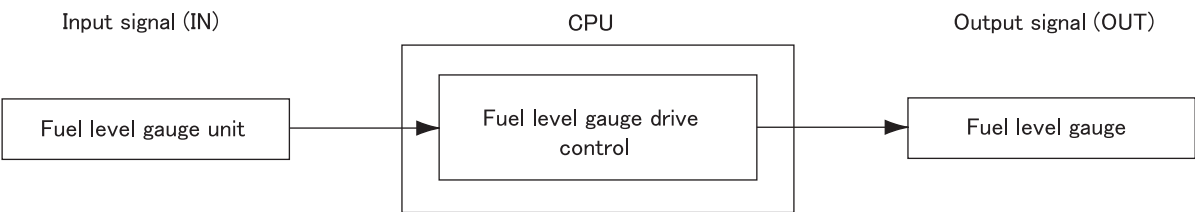
P57490E

(3) Speedometer



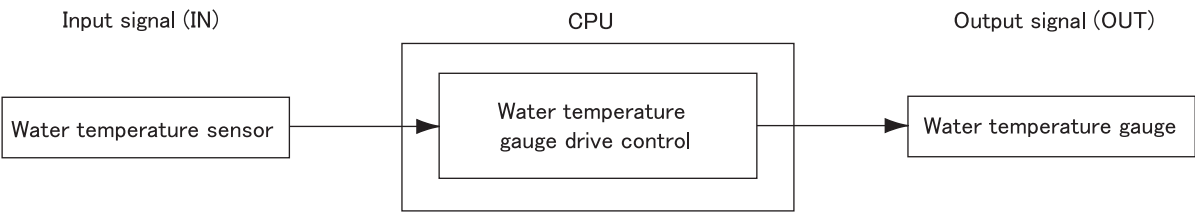
P57491E

(4) Fuel level gauge



P57492E

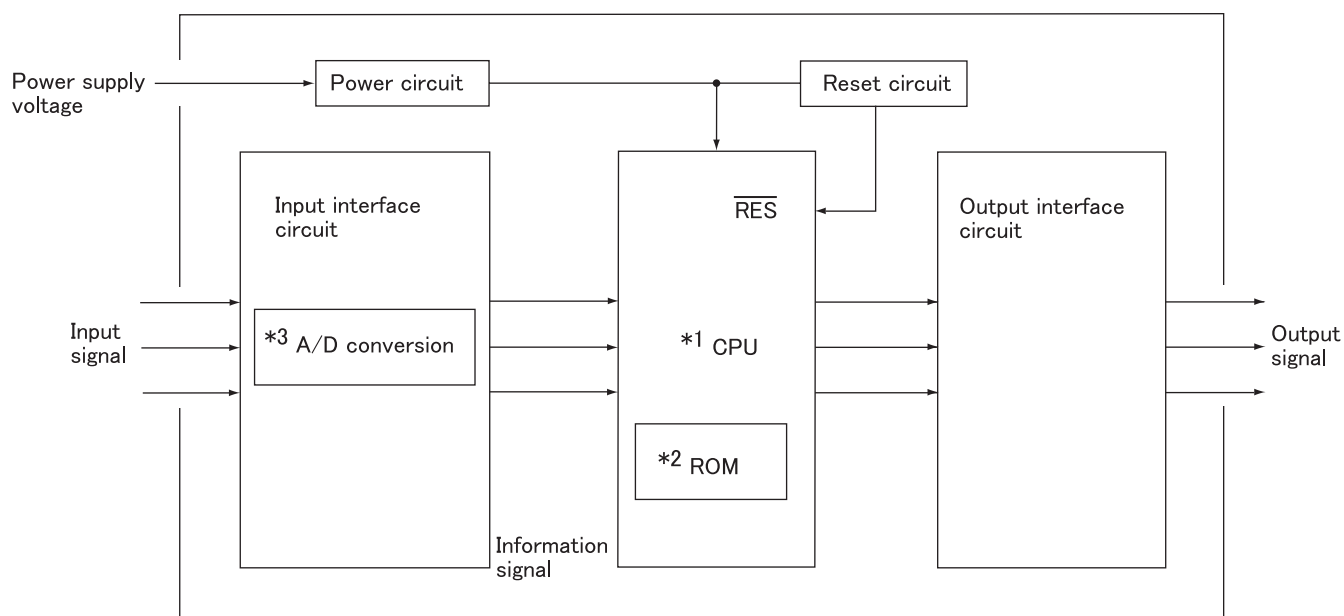
(5) Water temperature gauge



P57493E

4.3 Lighting and alarm control (LAC) function

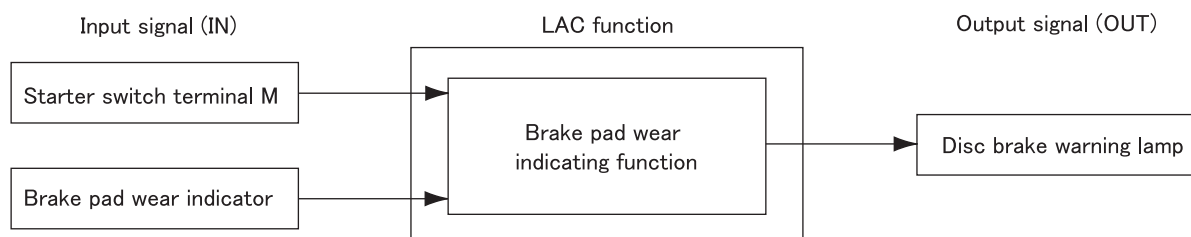
(1) Internal structure of LAC



P57494E

- The LAC is internally made up roughly of the input interface circuit, *1CPU, *2ROM, and output interface circuit.
 - *1CPU:
An abbreviation for Central Processing Unit. It compares the input information and the information stored in the ROM and makes a decision and sends commands to the outputs.
 - *2ROM:
An abbreviation for Read-Only Memory. It is an element used exclusively to have its contents read. It stores fixed data and program, and such retained information is not deleted even after power is cut off.
- Information sources such as sensor and switch send input signal to the input interface circuit.
- The input interface circuit performs *3A/D conversion of the input signals, and the converted signals are transmitted to the CPU as information signals.
 - *3A/D conversion:
An abbreviation for Analog/Digital conversion. It is a conversion from analog to digital signals. This conversion enables calculation to be made in the CPU.
- The CPU compares the received signals with the data in the ROM, makes a decision, and sends the results to the output interface circuit.
- The output interface circuit transmits these results to each system as output signals to instruct operations.
- Performing these series of operations continuously enables optimum control of each function.

(2) LAC function system block diagram



P57495E

STRUCTURE AND OPERATION

(3) Brake pad wear indicating function

- The LAC function determines ON or OFF state of the brake pad wear indicator, and causes the disc brake warning lamp to turn on if necessary.

4.4 Learning function

- The learning function makes the electronic control unit in the meter cluster recognize the specifications of the vehicle, without which the meter cluster cannot provide proper indications.
- There are the following two learning items:
 - “With” or “without” brake pad wear indicator.
 - “With” or “without” clutch disc wear indicator.

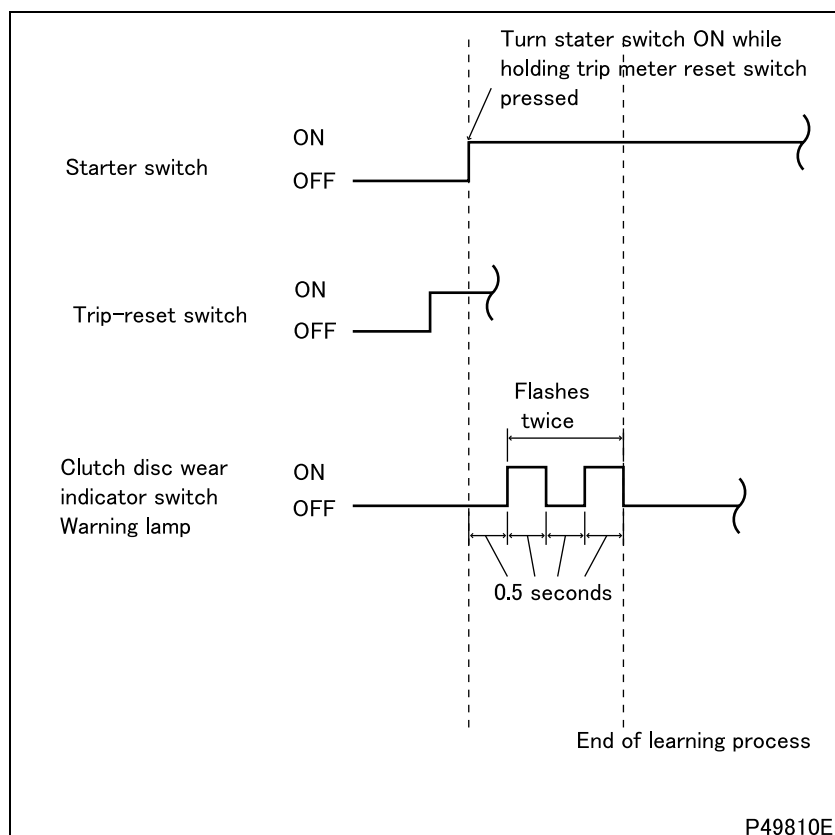
CAUTION

- **When making the electronic control unit recognize “with” for the clutch disc wear indicator, make sure that there is no open circuit in any of the relevant switch circuits. (If any circuit is found open, replace the corresponding switch.)**

(1) Learning operation

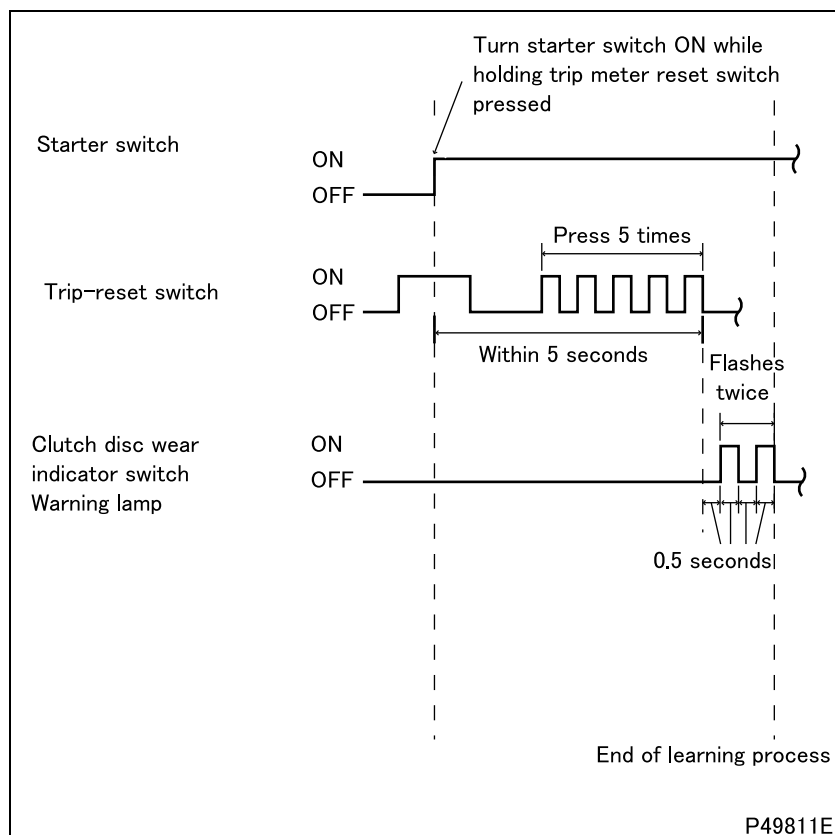
- The learning operation method differs depending on the odometer reading as follows:
 - Less than 3 km {1.86 mph} (for when the meter cluster is replaced with a new one).
 - 3 km {1.86 mph} or more (for when re-learning is required due to such a reason as wrong initial learning).

(2) Learning operation for odometer reading of less than 3 km {1.86 mph}



- Turn the starter switch to ON while holding the trip meter reset switch pressed, then release the reset switch.
- A half second later, the clutch disc wear indicator lamp will flash twice, indicating completion of the learning process.
- If “without” is learned for the clutch disc wear indicator, the indicator lamp neither flashes nor illuminates.

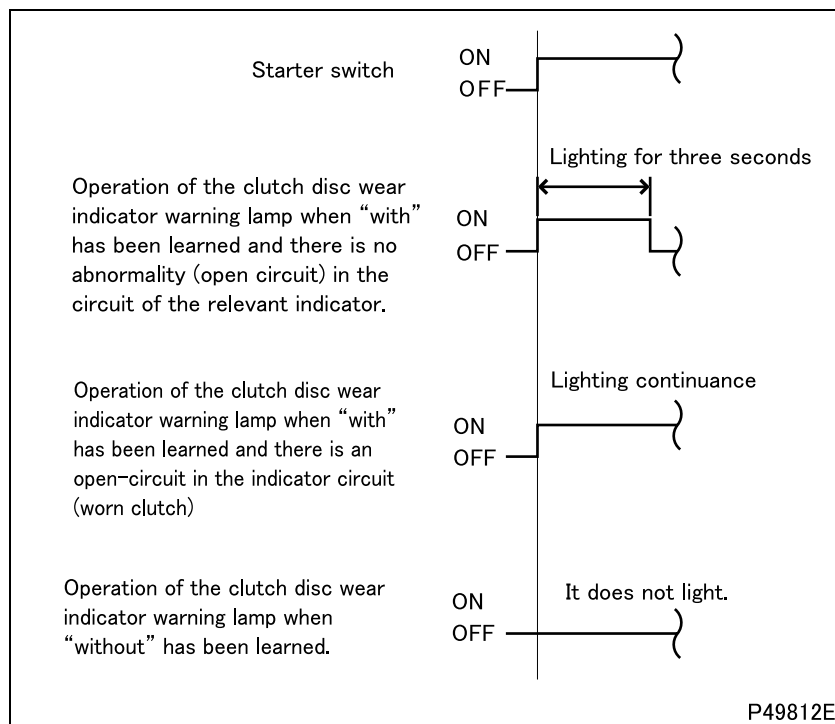
(3) Learning operation for odometer reading of 3 km {1.86 mph} or more



- Turn the starter switch to ON while holding the trip meter reset switch pressed, then release the reset switch.
- Within 0.5 seconds after turning the starter switch to ON, press again the trip meter reset switch 5 times.
- If “without” is learned for the clutch disc wear indicator, the indicator lamp neither flashes nor illuminates.

(4) Learning result confirmation and open-circuit checking

- After every learning operation, turn the starter switch to OFF and then to ON again to make sure that the indicator lamp for which “equipment” has been learnt illuminates.

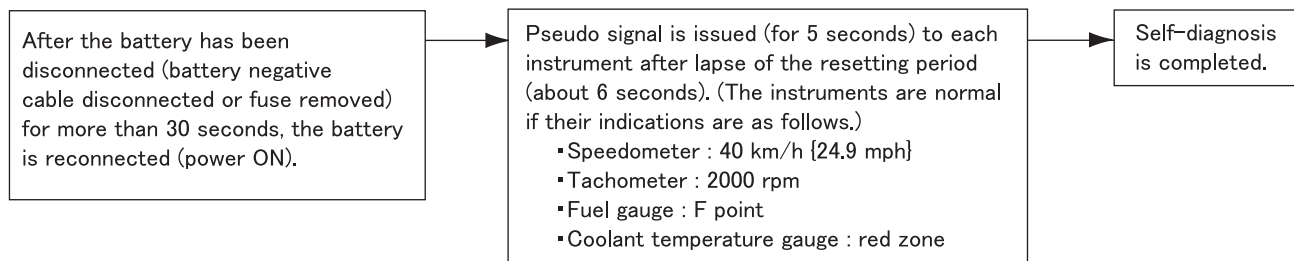


- The open-circuit checking function checks that the indicator lamp(s) for which “equipment” has been learned illuminates normally when the starter switch is turned to ON.

STRUCTURE AND OPERATION

4.5 Self-diagnosis function

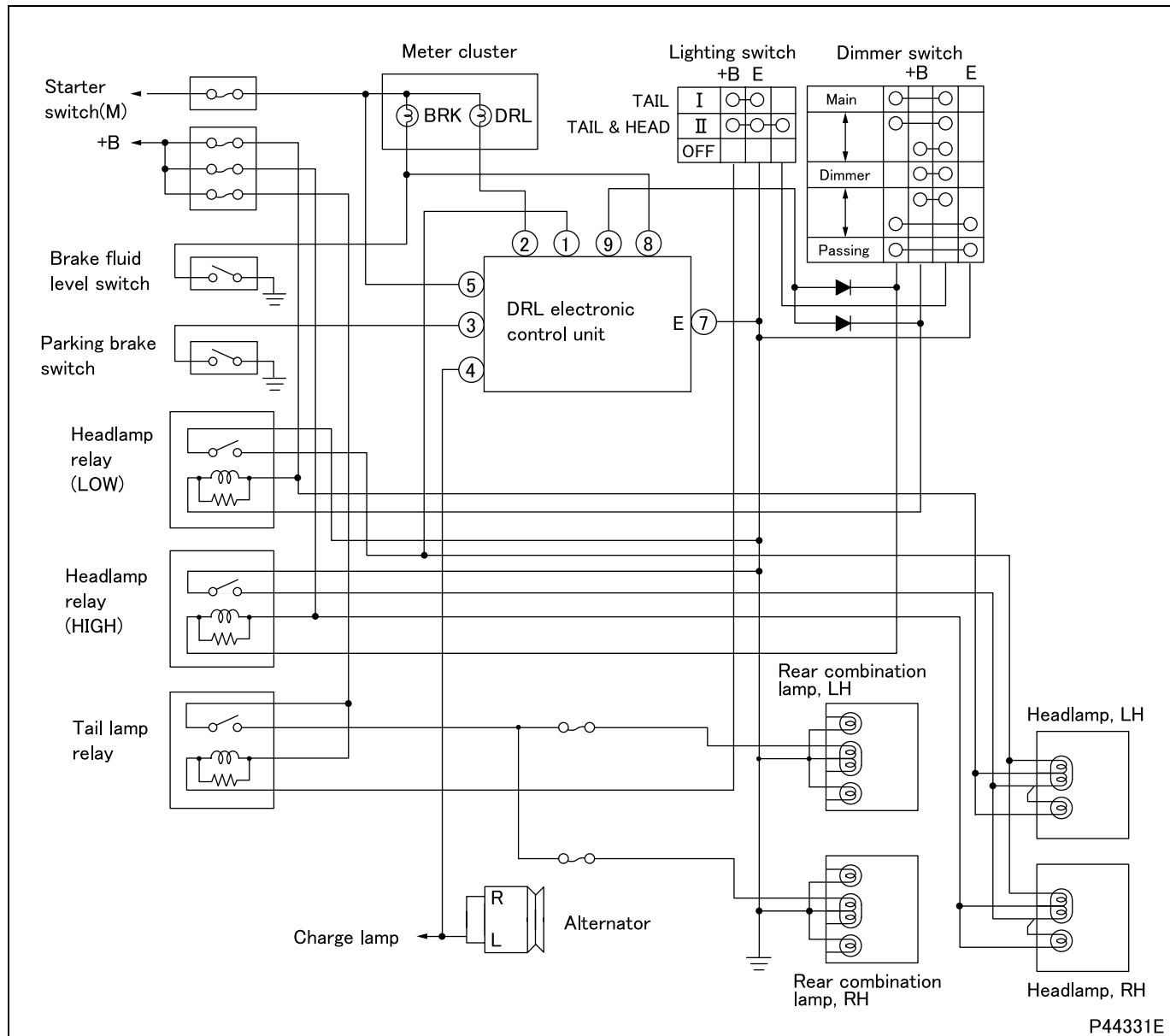
- The CPU performs the self-diagnosis function by sending a pseudo signal to each instrument and determining whether the instrument responds normally to the signal.



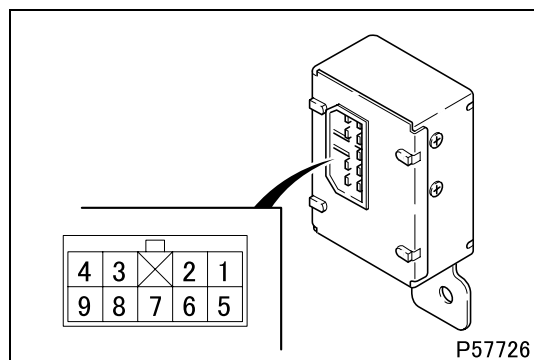
P57496N

M E M O

5.2 Daytime running light electronic control unit circuit diagram



5.3 DRL electronic control unit



Terminal No.	Connecting destinations	Terminal No.	Connecting destinations
1	Head lamp (Dipped)	6	—
2	DRL indicator lamp	7	Ground
3	Parking brake switch	8	Parking brake indicator lamp
4	Alternator L terminal	9	Lighting switch
5	Starter switch M terminal	—	—

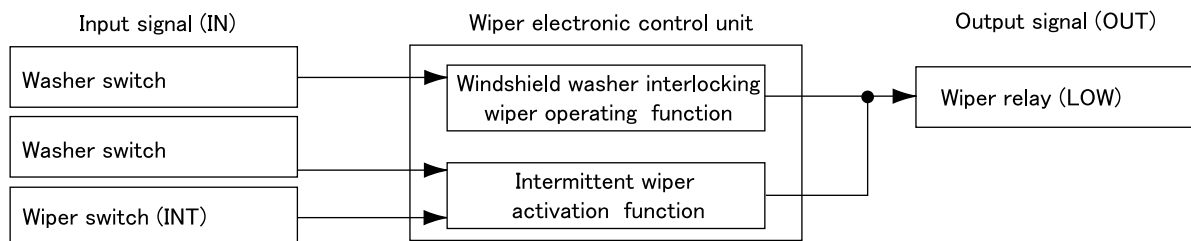
STRUCTURE AND OPERATION

6. Wiper Control

6.1 Outline

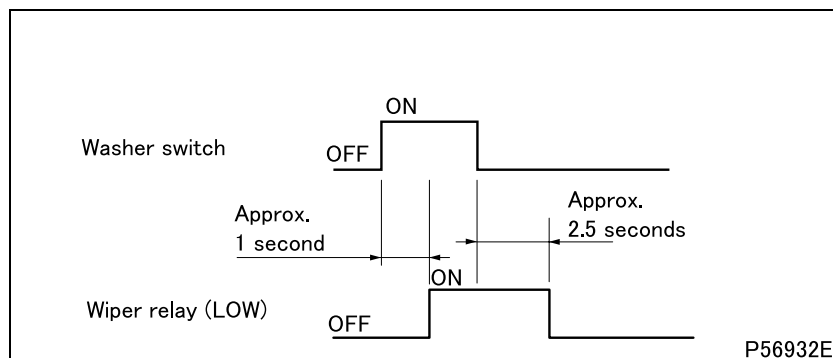
- This wiper electronic control unit is an integrated control unit controlling the following functions.
 - Windshield washer interlocking wiper-operating function.
 - Intermittent wiper activation function.

(1) System function schematic



P58030E

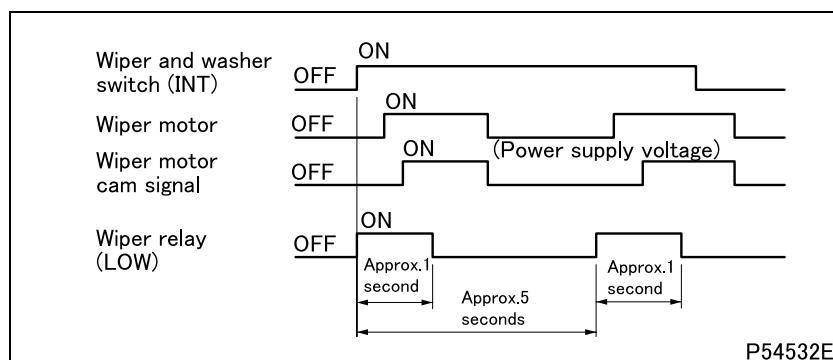
6.2 Windshield washer interlocking wiper-operating function



P56932E

- This function causes the windshield wipers to operate a few times at low speed when the windshield washer switch is turned ON.
- As shown in the drawing, the wiper electronic control unit introduces a short delay between detecting the ON condition of the wiper and washer switch (washer switch) and activating the wiper relay.

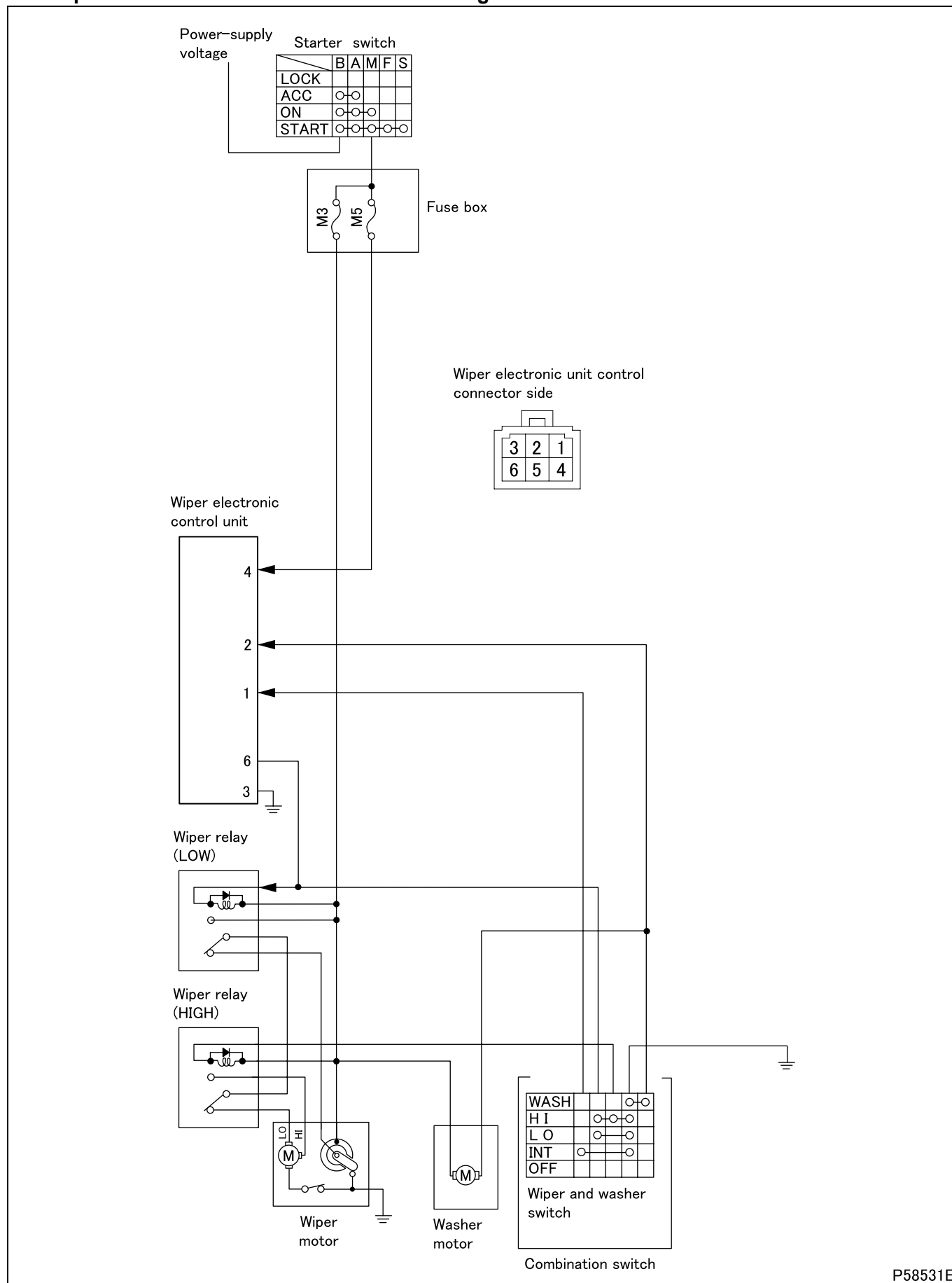
6.3 Intermittent wiper activation function



P54532E

- Wiper electronic control unit causes intermittent wiper operation to take place as shown in the drawing.

6.4 Wiper electronic control unit connection diagram



P58531E

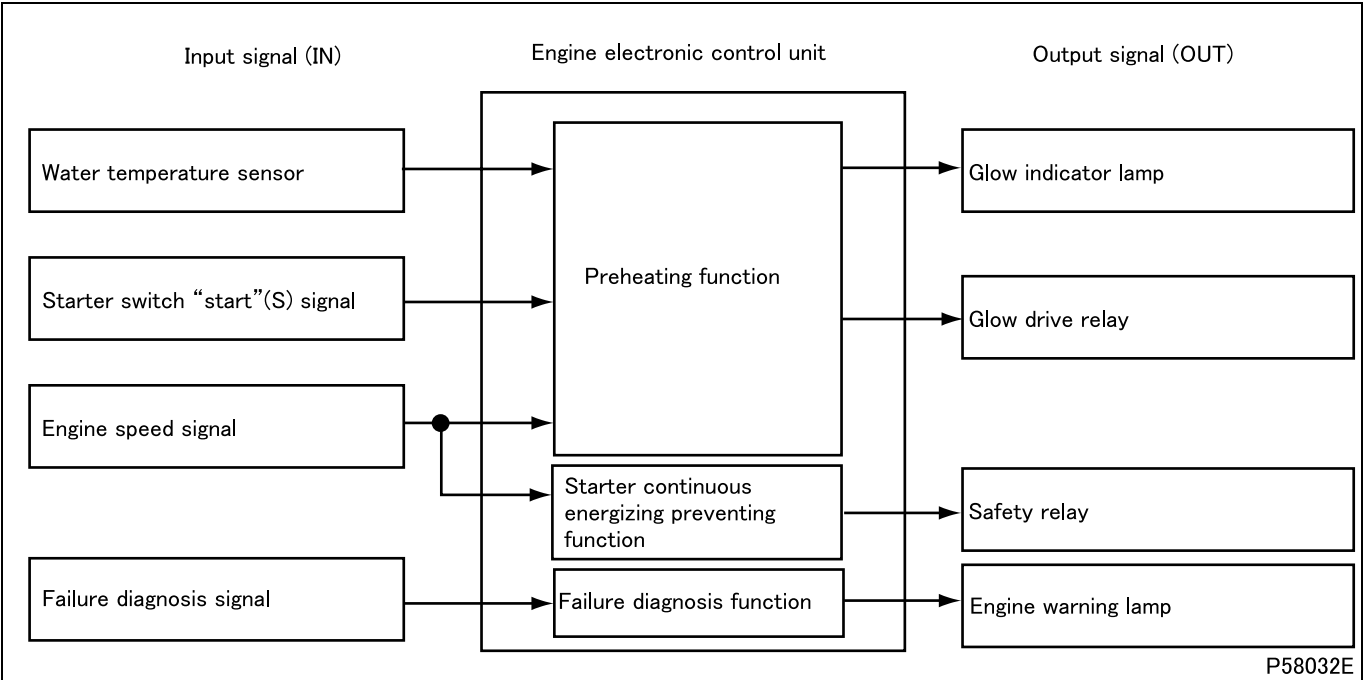
STRUCTURE AND OPERATION

7. Starter Continuous Energizing Preventing Function and Preheating Function

7.1 Outline

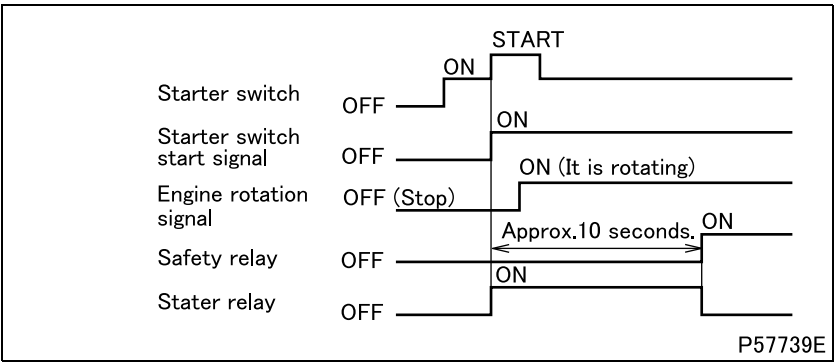
- These functions are controlled by the engine electronic control unit.

(1) System function schematic



Information signal	Parts name	Major function and operation
Engine water temperature signal	Water temperature sensor	Engine water temperature detection
Starter switch "start" (S) signal	Starter switch	Start position detection
Engine speed signal	Engine speed sensor	Engine speed detection
Failure diagnosis signal	Diagnosis switch	Output of diagnosis code
	Memory clear switch	Erasure of diagnosis code Transmission of past diagnostic code
Engine warning signal	Engine warning lamp	Abnormality of each function
Safety relay activation signal	Safety relay	Release of starter continuous energizing

7.2 Starter continuous energizing preventing function



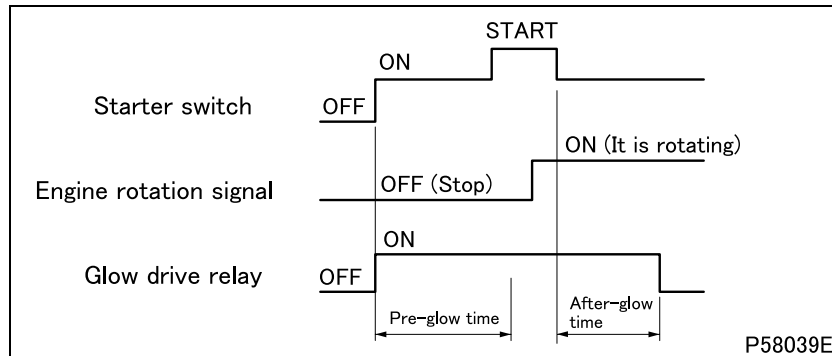
- This function is provided to prevent starter over-run.
- If the starter operates for longer than a predetermined period following engine startup, the Engine electronic control unit deems that it has been energized continuously for too long. The Engine electronic control unit then stops the flow of current to the starter and starter relay, thereby preventing the starter from seizing.

- If the engine electronic control unit determines, based on the engine speed signal it receives, that the engine has run at or above the specified speed for longer than the specified time period after start-up, the unit trips the safety relay open.

7.3 Preheating function

- This preheating function aims to enhance the engine start up when the engine coolant is low in cold weather or temperature.

Engine electronic control unit the entire function as follows:

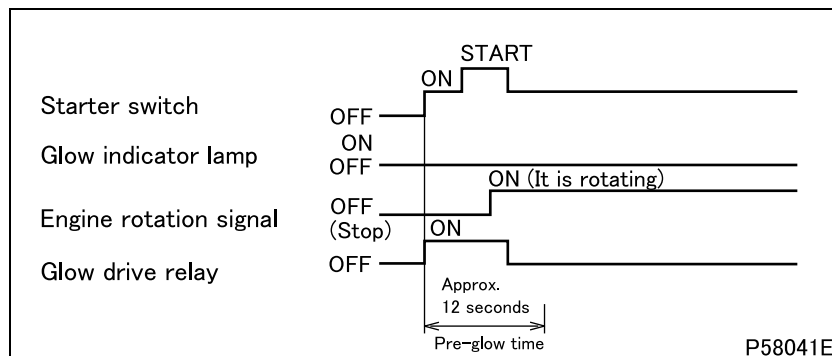
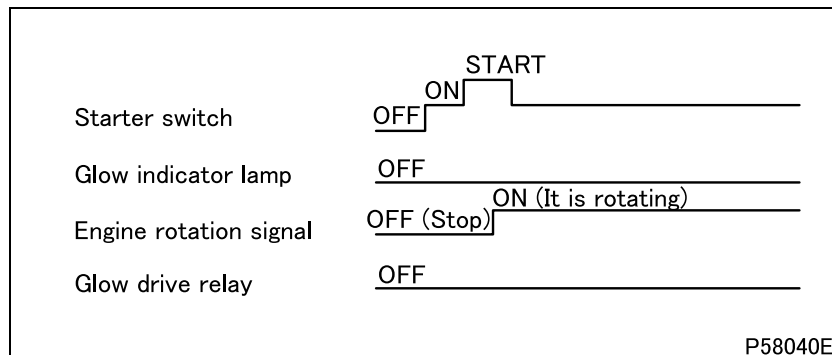


(1) Pre-glow and After-glow

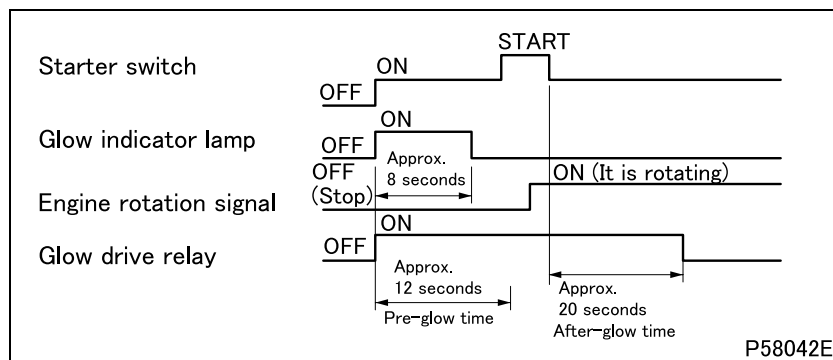
The preheating is operated with a pre-glow before the engine starting and an after-glow after the engine starting, which are controlled by the starter switch (S terminal) signal, engine water temperature signal and the engine rotation signal.

(2) Operation mode

- Where the engine coolant temperature is 60°C or more.
- Where the engine coolant temperature is 0 to 60°C.



STRUCTURE AND OPERATION



- Where the engine coolant temperature is 0°C or less.

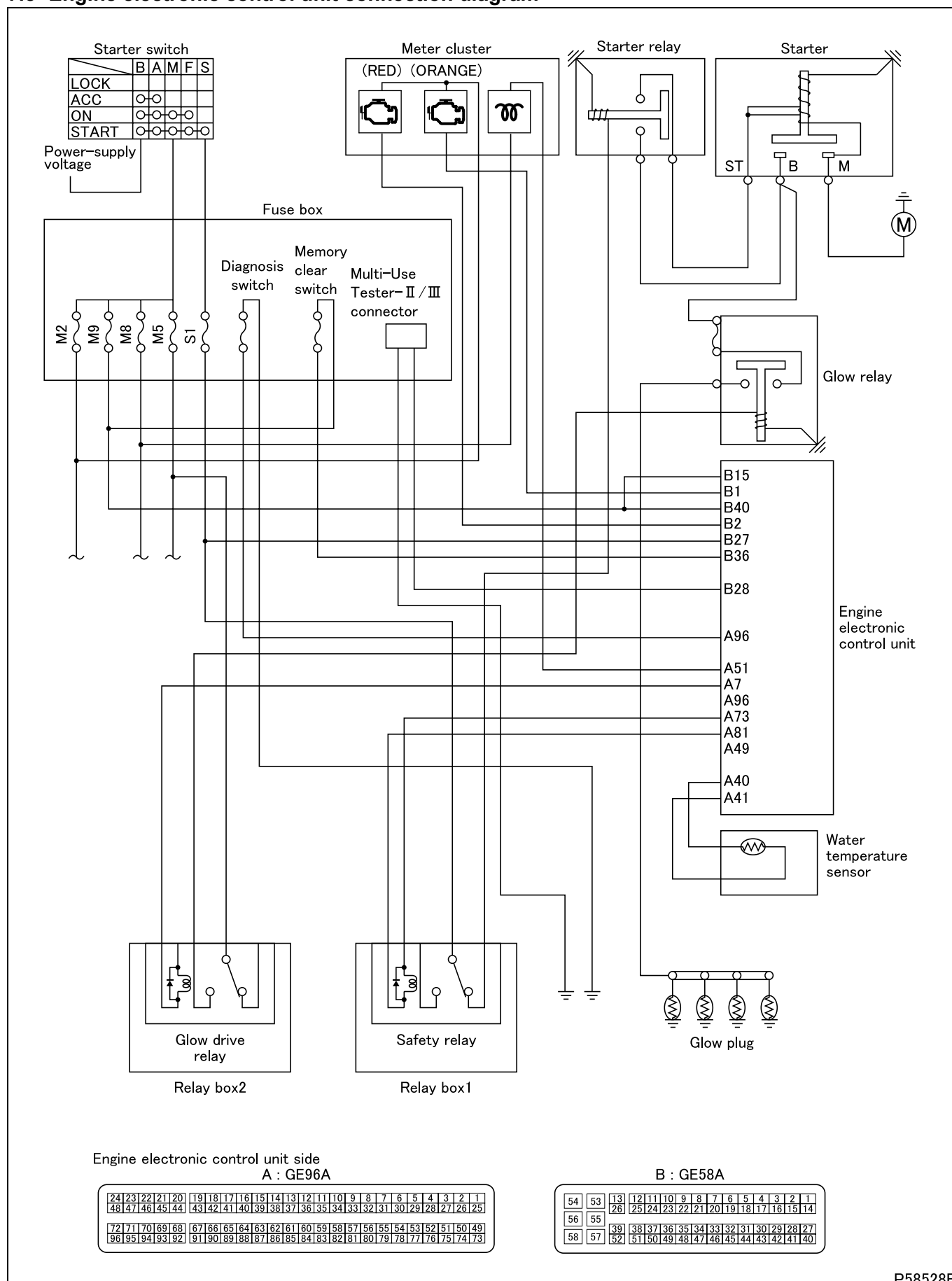
7.4 Fault diagnosis function

- While the starter switch is in the ON position, the sensors and other components are continuously monitored for faults. In the event that a component is found faulty, an indication is made in the meter cluster to alert the driver, the fault location is memorized in the form of a diagnosis code, and backup control necessitated by the fault is initiated.
- While the backup control is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

7.5 Engine electronic control unit connection diagram



TROUBLESHOOTING

1. Power and Charging

Symptoms		Possible causes					Reference Gr
		Battery electrolyte decreases too early.	Battery overheating.	Battery is normal but over-discharged.	Charge warning lamp does not light when starter switch is turned ON, with engine stopped.	Alternator is normal but battery over-discharged.	
Connector connection faulty, harness broken, grounding faulty				O		O	
Fuse blown				O	O	O	
V-belts loose				O		O	Gr14
V-belts damaged				O		O	Gr14
Battery faulty		O				O	
Alternator	Stator coil broken			O			
	Stator coil short-circuited with core			O			
	Field coil broken			O			
	Rectifier faulty			O			
	Regulator faulty		O	O	O		
	Wiring faulty			O			
Meter cluster faulty					O		

2. Engine Starting

Symptoms		Starter operates but engine does not start								Reference Gr
		Starter does not operate.	Pinion does not engage with ring gear.	Pinion engages with ring gear but does not rotate.	Flywheel rotates but engine does not start.	Engine does not stop.	Engine cannot be preheated.	Engine is hard to start.	Engine warm-up function does not operate.	
Possible causes										
Defective connector connection; harness open/short circuit; defective grounding		O			O	O	O		O	
High-current fuse blown		O								
Fuse blown		O				O	O		O	
Battery insufficiently charged		O		O						
Starter	Magnetic switch contacts stuck or fused together	O								
	Open circuit in magnetic switch coil	O								
	Overrunning clutch malfunctioning			O						
	Pinion worn or damaged		O							
Starter relay defective		O								
Starter switch defective		O				O				
Flywheel ring gear worn or damaged			O							Gr11
Glow plugs defective							O	O		
Glow relay defective							O	O		
Safety relay defective		O								
Water temperature sensor defective							O	O	O	
Engine electronic control unit defective		O					O	O	O	Gr13E
Exhaust brake system defective								O	O	Gr35
Faulty connection of connecting plate							O	O		
Transmission neutral switch defective									O	
Neutral start relay defective <A/T>		O								
Inhibitor switch defective <A/T>		O								
Warm-up switch defective									O	

A/T: Automatic transmission

TROUBLESHOOTING

3. Lighting

Symptoms Possible causes		Headlamp													Reference Gr
		Does not light.	Dim.	Does not switch to main beam.	Does not switch to dipped beam.										
Connector improperly connected, harness open-circuited, grounding faulty		O				O	O	O	O	O	O	O	O		
Fuse blown		O				O	O	O	O	O	O	O	O		
Battery capacity insufficient			O												
Alternator output insufficient			O												
Bulb burnt-out		O				O	O	O	O	O	O	O	O		
Power (wattage) of bulb is lower than specified value															
Power (wattage) of bulb is higher than specified value															
Combination switch	Lighting switch faulty	O				O		O	O	O		O			
	Turn signal lamp switch faulty														
	Dimmer switch faulty			O	O										
Relay box	Headlamp relay (HIGH, LOW) faulty	O		O	O										
	Tail lamp relay faulty					O		O	O	O		O			
	Stop lamp relay faulty						O								
Stop lamp switch faulty							O								
Flasher unit faulty															
Backup lamp switch faulty												O			
Back buzzer faulty															
Cab lamp switch faulty															
Cab lamp faulty															
Door switch faulty															
Hazard warning lamp switch faulty															
Rheostat switch faulty															

Symptoms		Turn signal lamp (serving also as hazard warning lamp)					Cab lamp does not light.	Interior illumination lamps for meters, radio system, etc. do not light.	Reference Gr
		Does not blink.	Stay ON.	Blinks too slowly.	Blinks too quickly.	Blinks irregularly.			
Possible causes									
Connector improperly connected, harness open-circuited, grounding faulty		O					O	O	
Fuse blown		O					O		
Battery capacity insufficient			O						
Alternator output insufficient			O						
Bulb burnt-out		O			O		O	O	
Power (wattage) of bulb is lower than specified value					O				
Power (wattage) of bulb is higher than specified value				O					
Combination switch	Lighting switch faulty							O	
	Turn signal lamp switch faulty								
	Dimmer switch faulty								
Relay box	Headlamp relay (HIGH, LOW) faulty								
	Tail lamp relay faulty							O	
	Stop lamp relay faulty								
	Turn signal lamp relay faulty	O							
Stop lamp switch faulty									
Flasher unit faulty		O	O	O	O	O			
Backup lamp switch faulty									
Back buzzer faulty									
Cab lamp switch faulty							O		
Cab lamp faulty							O		
Door switch faulty							O		
Hazard warning lamp switch faulty		O	O						
Rheostat switch faulty								O	

TROUBLESHOOTING

Possible causes		Symptoms			Reference Gr
			Van body dome light does not light.	Daytime running light system does not operate after engine starts, and headlamps do not light.	
Connector improperly connected, harness open-circuited, grounding faulty			O	O	
Fuse blown			O		
Battery capacity insufficient					
Alternator output insufficient					
Bulb burnt-out			O		
Power (wattage) of bulb is lower than specified value					
Power (wattage) of bulb is higher than specified value					
Combination switch	Lighting switch faulty		O		
	Turn signal lamp switch faulty				
	Dimmer switch faulty				
Relay box	Headlamp relay (HIGH, LOW) faulty			O	
	Tail lamp relay faulty			O	
	Stop lamp relay faulty				
	Turn signal lamp relay faulty				
	Daytime running light relay			O	
Stop lamp switch faulty					
Flasher unit faulty					
Backup lamp switch faulty					
Back buzzer faulty					
Cab lamp switch faulty					
Cab lamp faulty					
Door switch faulty					
Hazard warning lamp switch faulty					
Rheostat switch faulty					
Van body dome light relay faulty			O		
Van body dome light switch faulty			O		
Daytime running light electronic control unit faulty				O	

4. Meter

Symptoms		Pointer does not move.	Pointer movement unstable.	Indication error large.	Abnormal noise from meter.	Reference Gr
Possible causes						
Connector improperly connected, harness open-circuited, grounding faulty		O	O			
Fuse blown		O				
Internal circuits of meter cluster faulty		O	O	O		
Printed wiring board of meter cluster faulty		O				
Tachometer	Engine speed sensor coil open-circuited	O				
	Engine speed sensor improperly mounted	O	O			
	Tachometer faulty	O	O	O	O	
Speedometer or tachograph	Vehicle speed sensor faulty	O				
	Vehicle speed sensor improperly mounted		O			
	Specified tires not used			O		Gr31
	Tires worn or inflation pressure incorrect			O		Gr31
	Specified L-joint of transmission not used (Difference in gear ratio)			O		Gr22
	Specified speedometer gear of transmission not used (Difference in gear ratio)			O		Gr22
	Installation angle of speedometer gear bushing on transmission incorrect (Not set at correct gear ratio position)			O		Gr22
	Speedometer or tachograph faulty	O	O	O	O	
Water temperature gauge	Water temperature sensor faulty	O		O		
	Water temperature gauge faulty	O		O		
	Thermostat does not close	O				Gr14
Fuel gauge	Fuel level sensor faulty	O		O		
	Fuel gauge faulty	O		O		

TROUBLESHOOTING

5. Cigarette Lighter

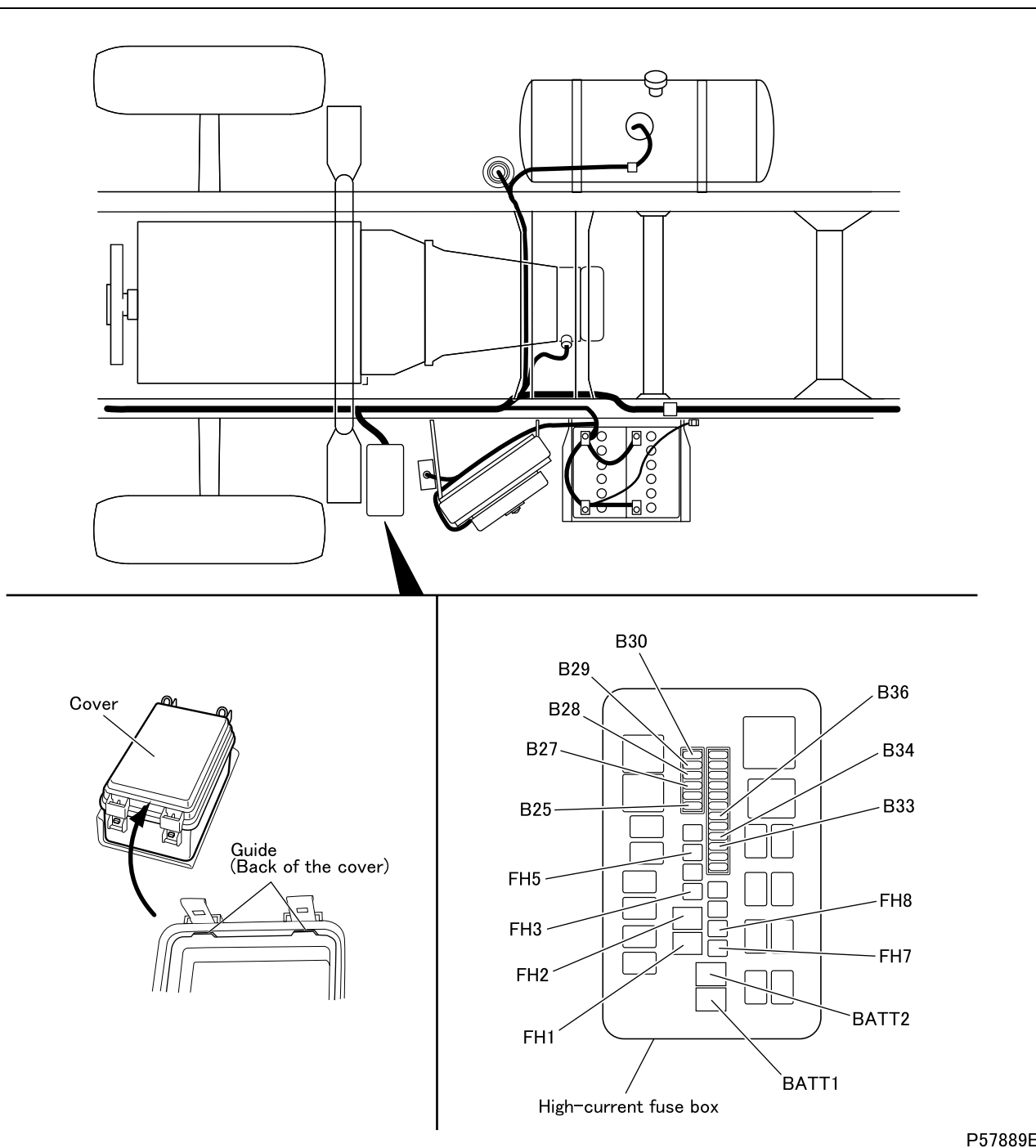
Symtoms	Cigarette lighter				Reference Gr
	Does not glow.	Does not return.	Night lamp does not light up.	Radio does not work.	
Possible causes					
Connector connection faulty, harness disconnection, grounding faulty	☐		☐	☐	
Fuse blown	☐		☐	☐	
Cigarette lighter faulty	☐	☐			
Tail lamp relay faulty			☐		
Antenna and antenna cable connection faulty				☐	
Radio amplifier faulty				☐	
Radio tuner faulty				☐	
Cassette deck head and pinch roller faulty					
Speaker faulty				☐	
Left and right speaker impedance different					

6. Accessory Noise Generation Source

Accessory	Noise	Symptoms
Alternator	Whistling	High pitch sound when accelerator pedal suddenly depressed (Stops soon after engine stopped)
Water temperature meter	Scratching	Occurs when engine running (Continues for a while after engine stops)
Engine oil pressure switch	Rattling	Depends on engine speed (Does not occur during idling)
Fuel level sensor	Scratching	Occurs when engine suddenly revved, while running on rough roads, or starter switch turned ON
Flasher unit	Banging	When turn signal blinks
Horn	Hissing	Occurs when horn button pressed or released
Wiper motor	Whining	Depends on windshield wiper speed
Washer motor	Whining	When windshield washer operates

54-01 POWER, CHARGE AND GROUND CIRCUIT

HIGH-CURRENT FUSE BOX



P57889E

WARNING ⚠

- To prevent possible injury, be sure to disconnect the negative terminal (–) of the battery and insulate it with tape before removing high-current fuses. (See #860.)
- With the negative terminal (–) of the battery connected, battery voltage is always applied to each fuse. The battery voltage is applied to the fuses under the following conditions: Always (directly connected to the battery)

CAUTION

- If a fuse blows out, identify and remedy the cause, then replace the fuse.
- Be sure to use the fuse of the specified ampere.
- When installing the cover on the high-current fuse box, lightly press the cover directly down until the guide on the cover securely fits in the guide on the fuse box. Do not push with force the cover inward, as doing so could easily damage the guides.

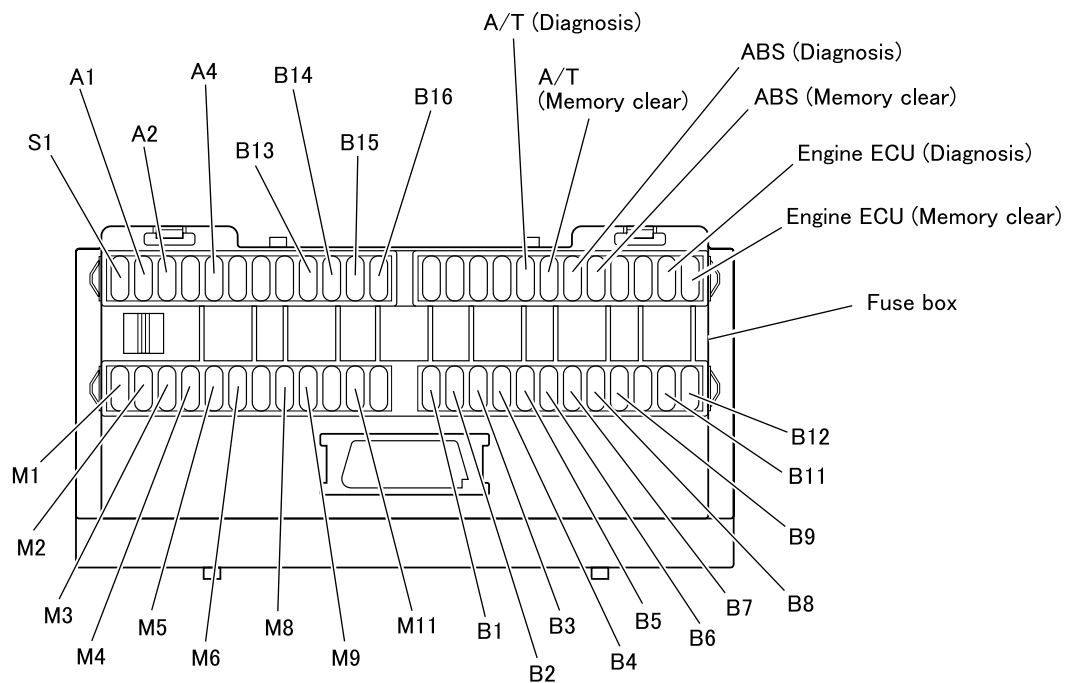
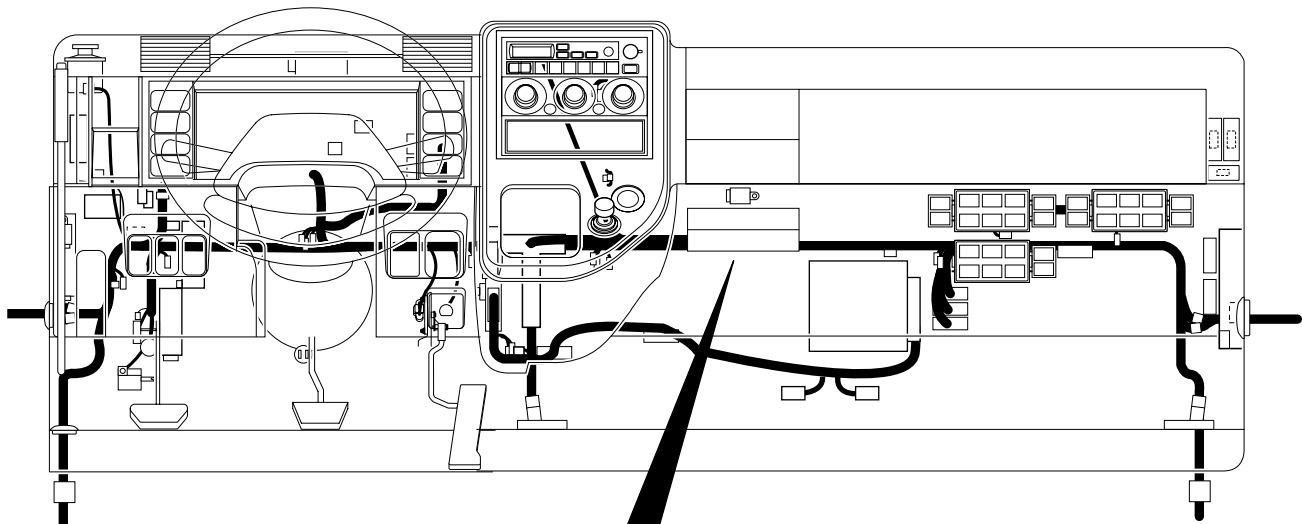
High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (S1, A1 to A5, M1 to M12)	60A
FH2	Fuse box (B1 to B12)	60A
FH3	Fuse box (B13 to B16)	40A
FH5	Hydraulic booster	60A
FH7	ABS motor	40A
FH8	ABS solenoid	40A
B25	Tail lamp	15A
B27	Horn	10A
B28	Air-conditioner	10A
B29	Condenser fan	25A
B30	Blower fan	30A
B33	Van body dome light	10A
B34	ATF cooler fan	20A
B36	Engine electronic drive unit	20A
BATT1	Alternator	120A
BATT2	Alternator	120A

ABS: Anti-lock brake system

ATF: Automatic transmission fluid

FUSE BOX



P57900E

CAUTION

- If a fuse blows out, identify and remedy the cause, then replace the fuse.
- Be sure to use the fuse of the specified ampere.

Fuse box

Fuse No.	Main load	Capacity
A1	Cigar lighter	15A
A2	Audio	10A
A4	Opt (ACC)	10A
B1	Stop lamp	15A
B2	Meter	10A
B3	Turn signal lamp	15A
B4	Opt (B)	10A
B5	Audio	10A
B6	Cab lamp	10A
B7	Power window (driver)	30A
B8	Power window (assistant)	30A
B9	Engine electronic control unit	20A
B11	Mirror heater	20A
B12	Automatic transmission	10A
B13	Tester	15A
B14	Headlamp (HI)	20A
B15	Headlamp (LH/LO)	20A
B16	Headlamp (RH/LO)	20A
M1	Backup lamp	10A
M2	Meter	10A
M3	Wiper	15A
M4	Opt (M)	10A
M5	Relay control	10A
M6	Automatic transmission	10A
M8	Exhaust brake	10A
M9	Engine electronic control unit	5A
M11	ABS	10A
S1	Starter	10A

Diagnosis fuse

Fuse No.	Main load	Capacity
A/T	Diagnosis	5A
A/T	Memory clear	10A
ABS	Diagnosis	5A
ABS	Memory clear	10A
Engin ECU	Diagnosis	5A
Engin ECU	Memory clear	10A

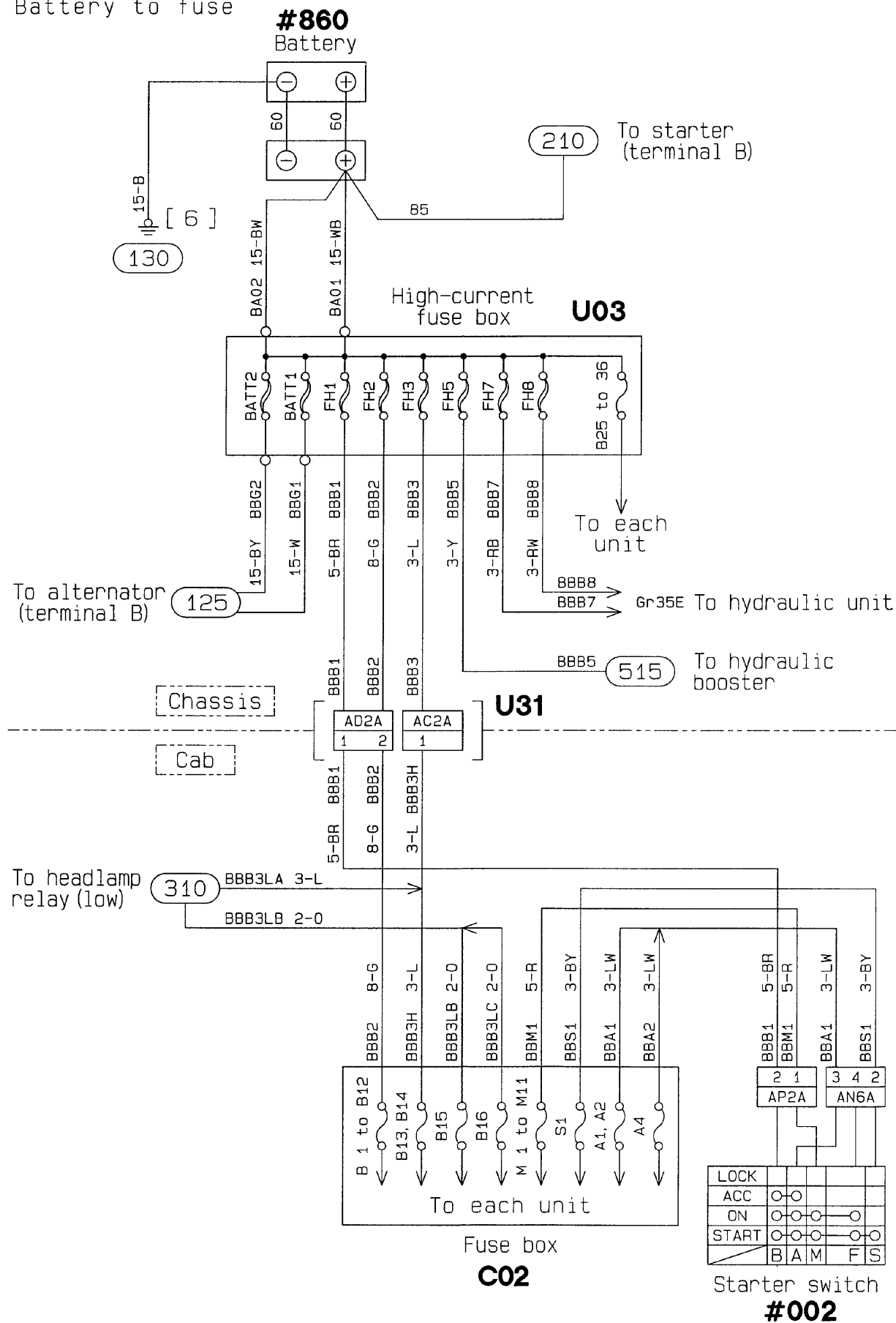
ABS: Anti-lock brake system

A/T: Automatic transmission

ECU: Electronic control unit

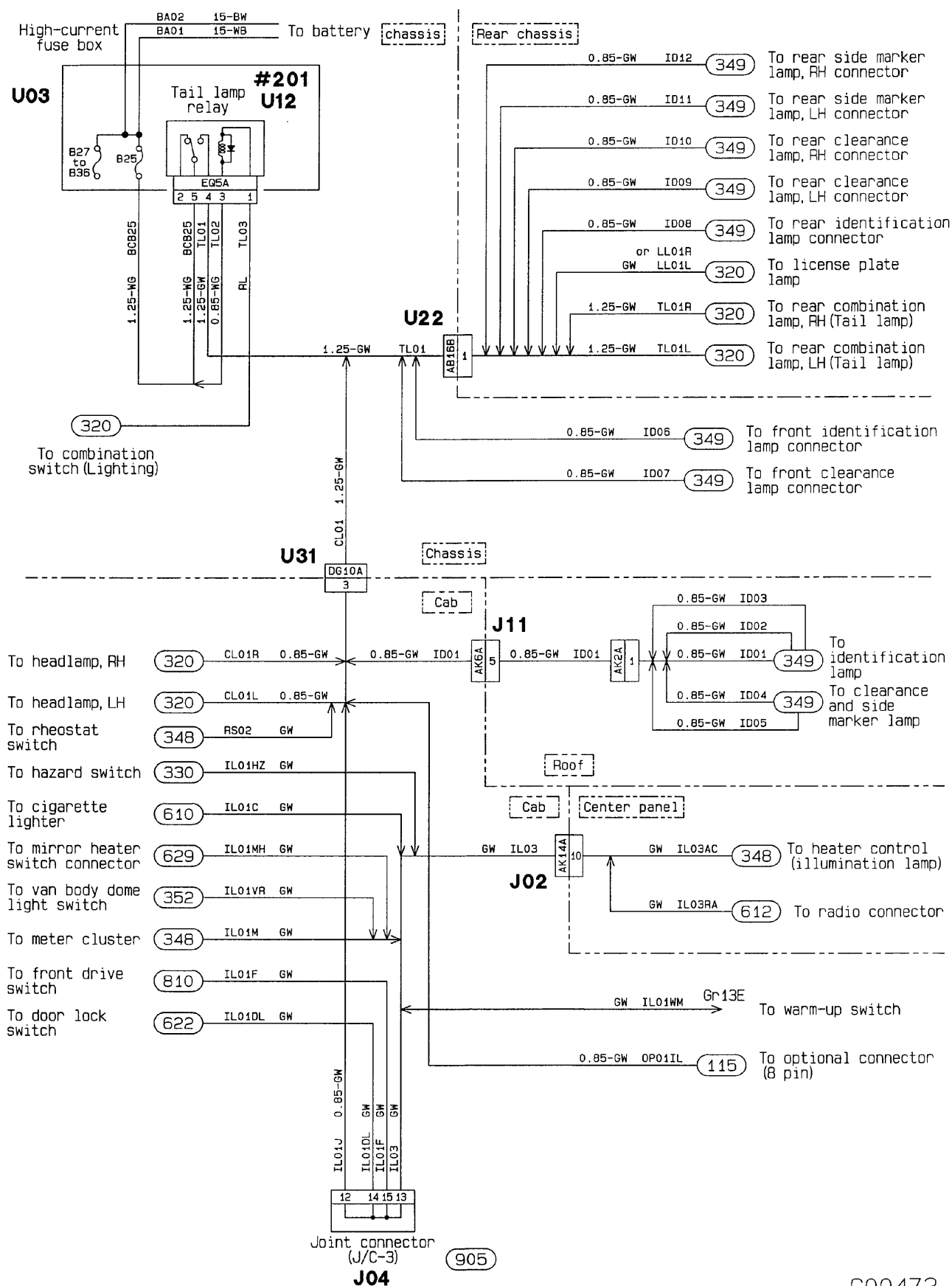
110 POWER CIRCUIT

Battery to fuse



C00467

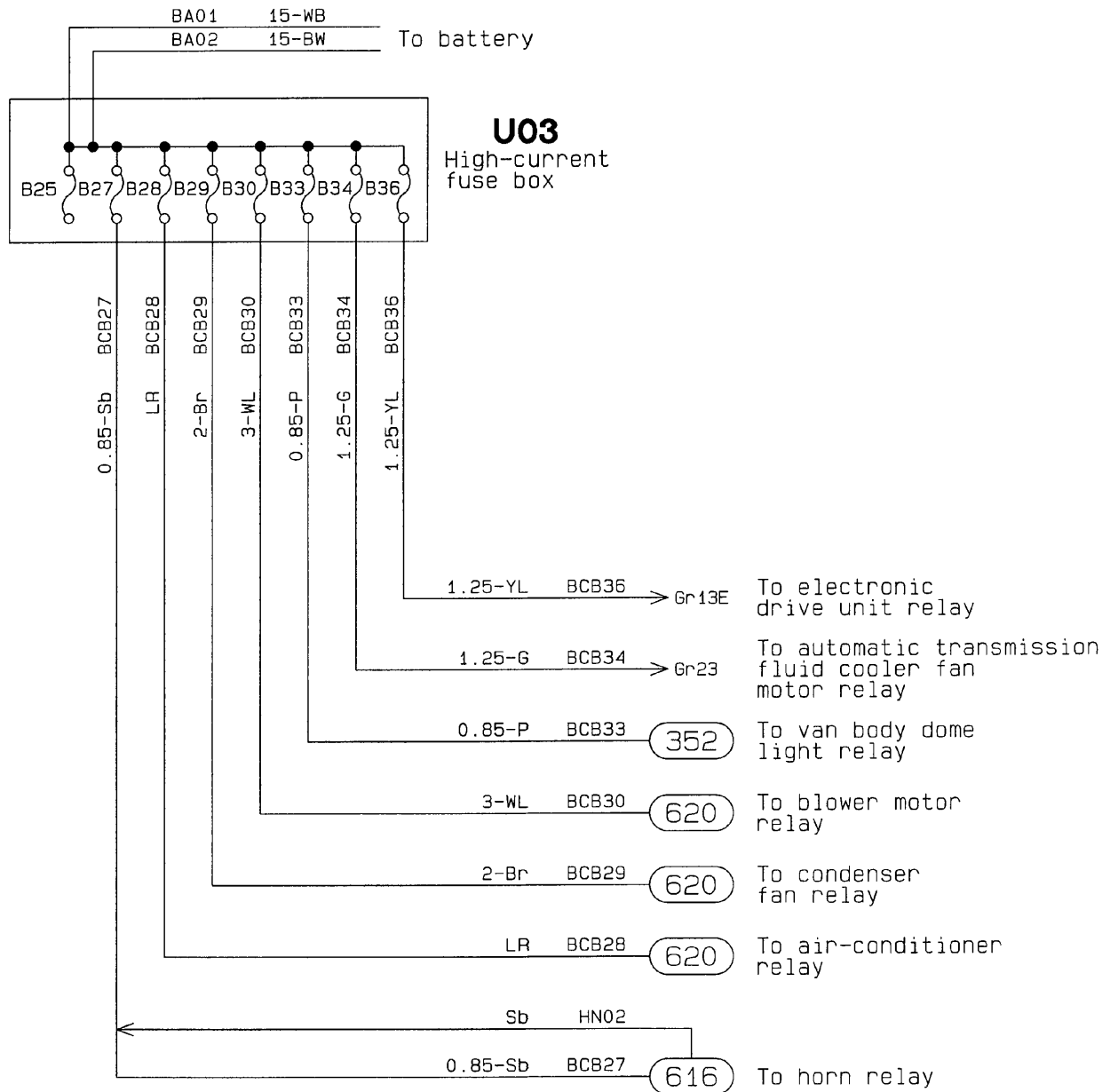
High-current fuse box (Fuse B25)



C00472

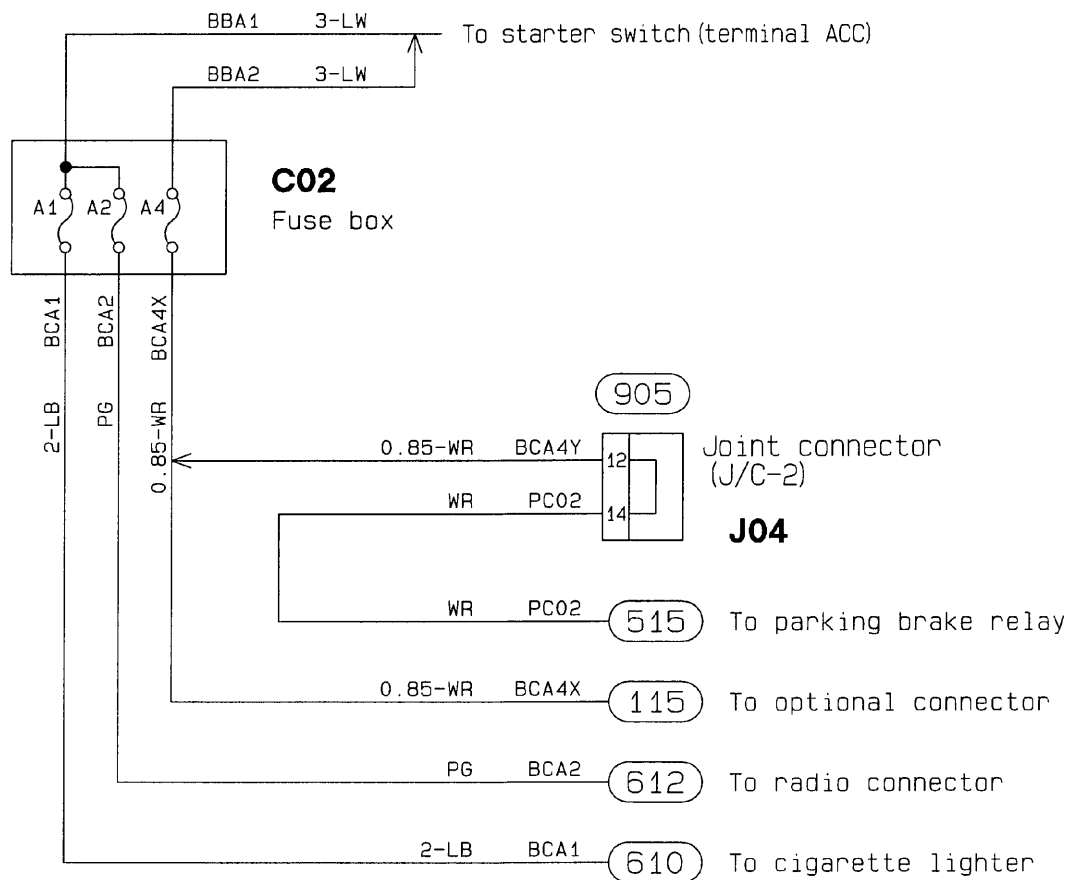
110 POWER CIRCUIT

High-current fuse box
(Fuse B27 to B36)



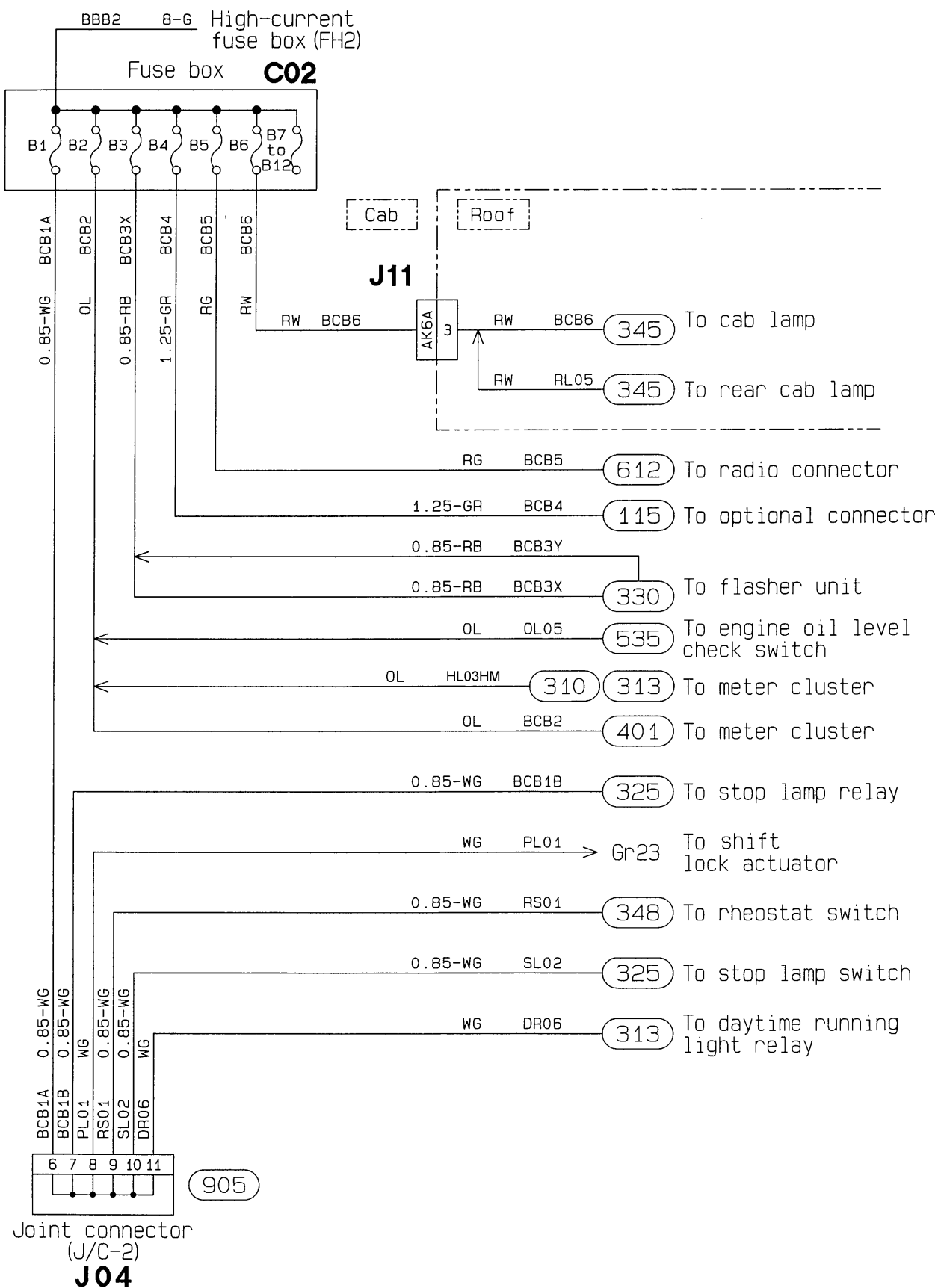
C00473

Fuse box
(Fuse A1 to A4)



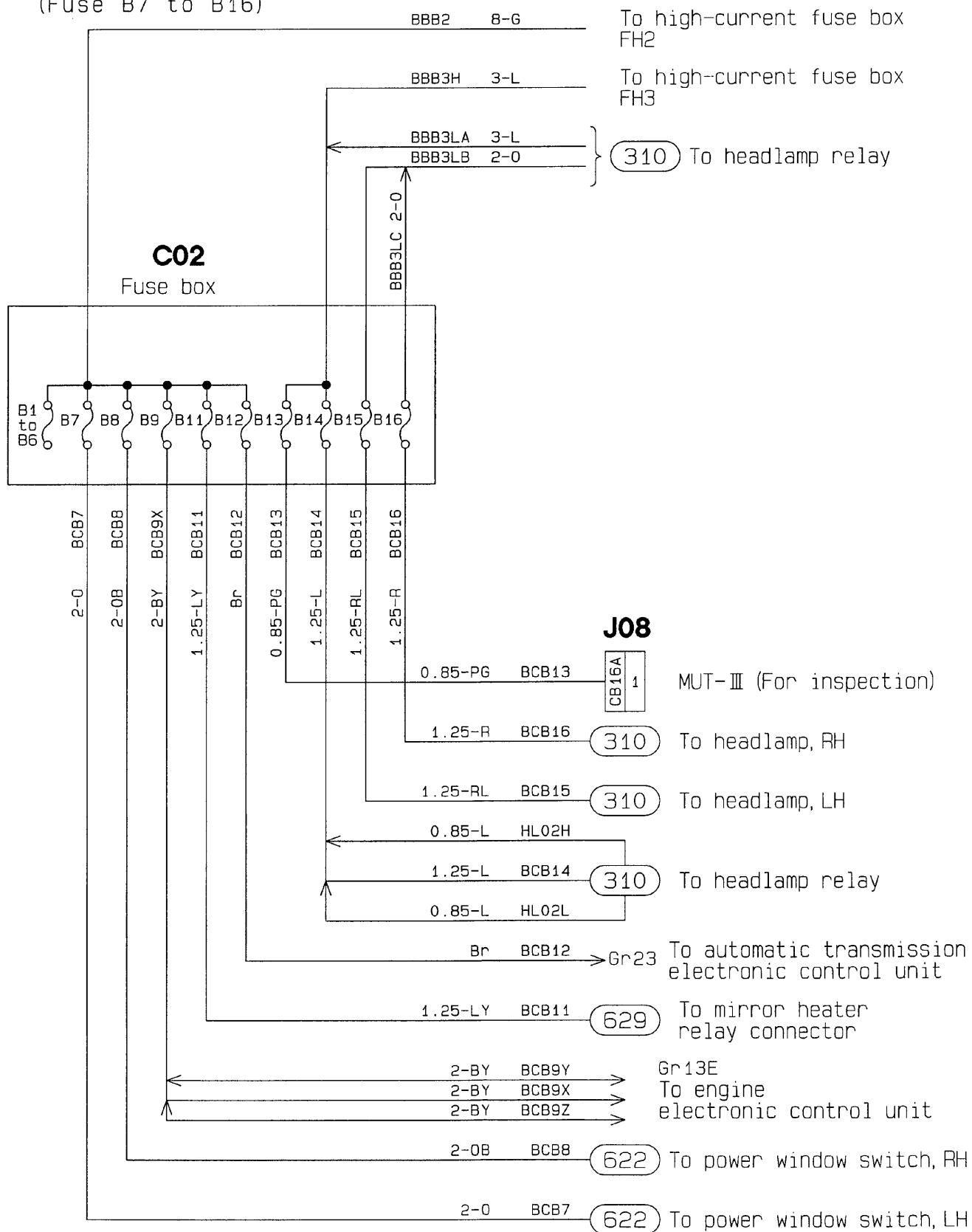
110 POWER CIRCUIT

Fuse box
(Fuse B1 to B6)



C00470

Fuse box
(Fuse B7 to B16)

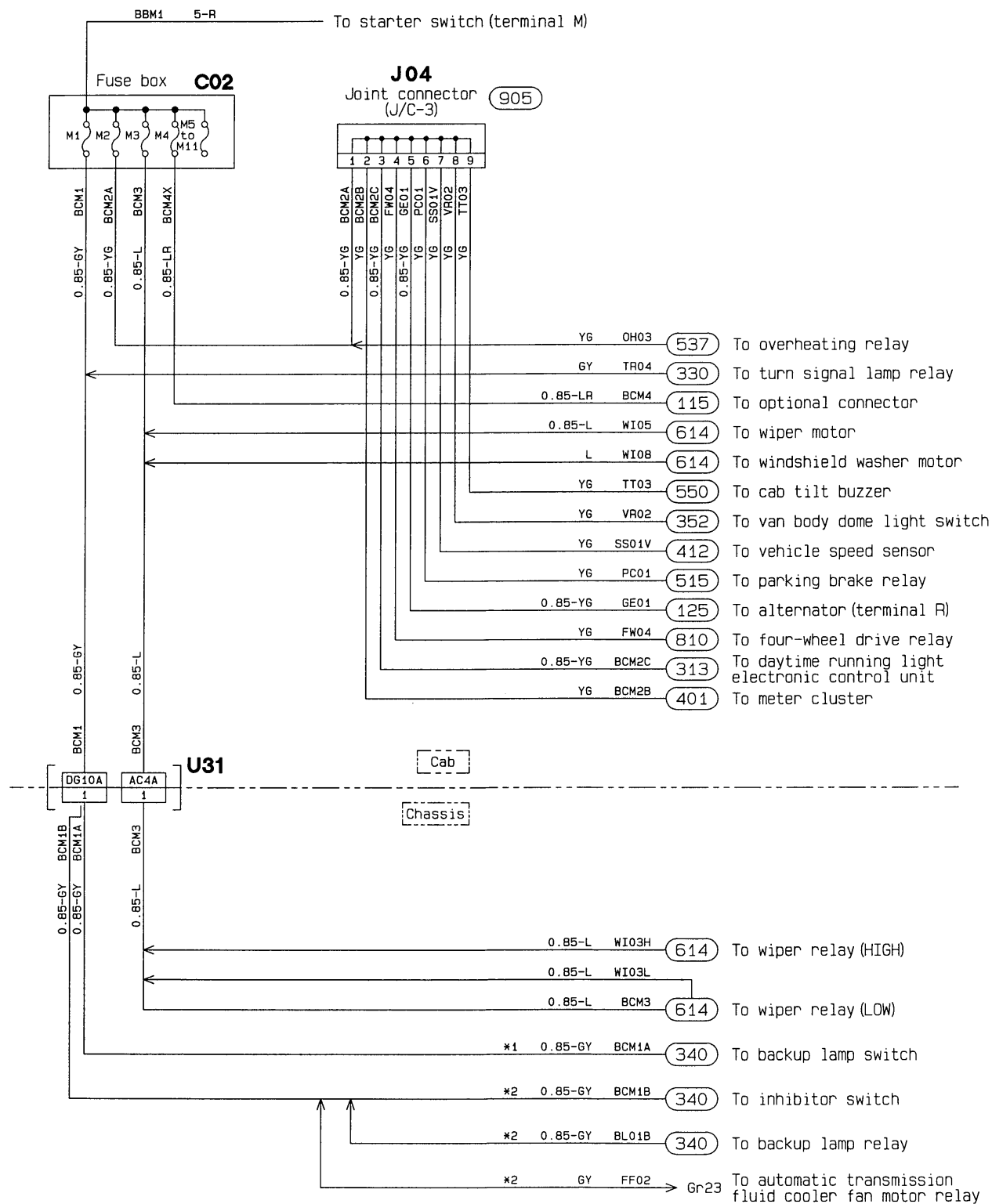


MUT : Multi-use tester

C00471

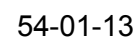
110 POWER CIRCUIT

Fuse box
(Fuse M1 to M4)



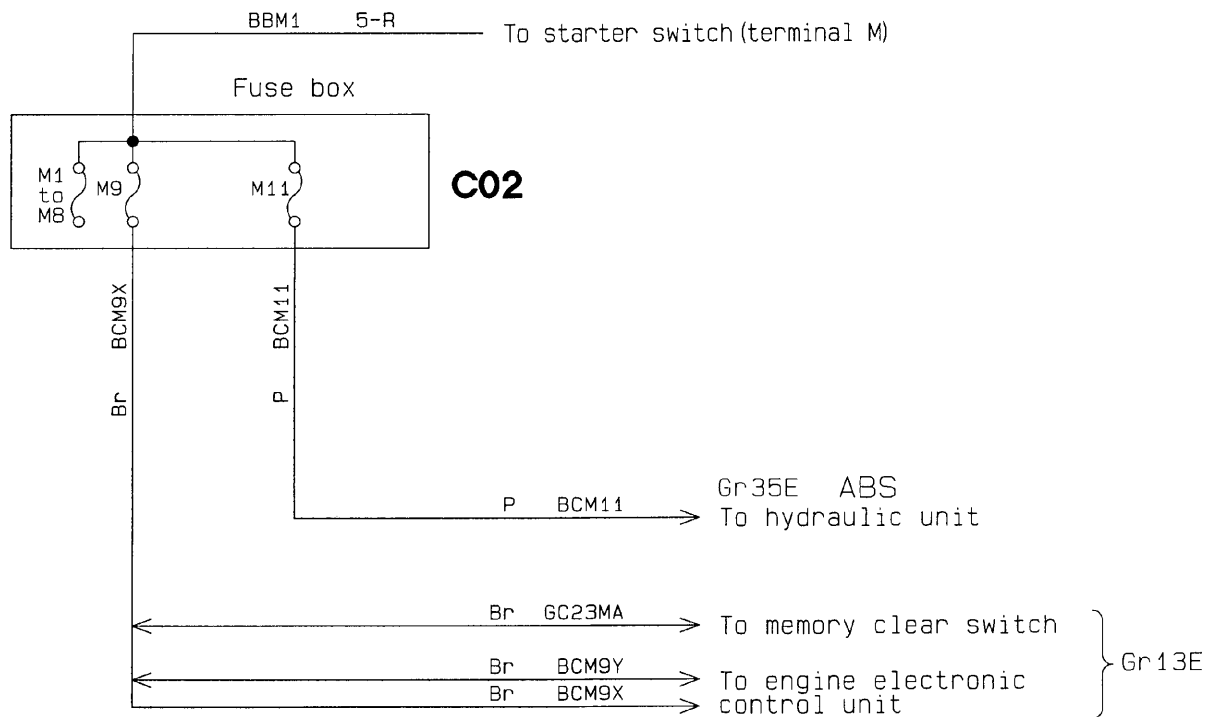
*1 : Manual transmission
*2 : Automatic transmission

C00474



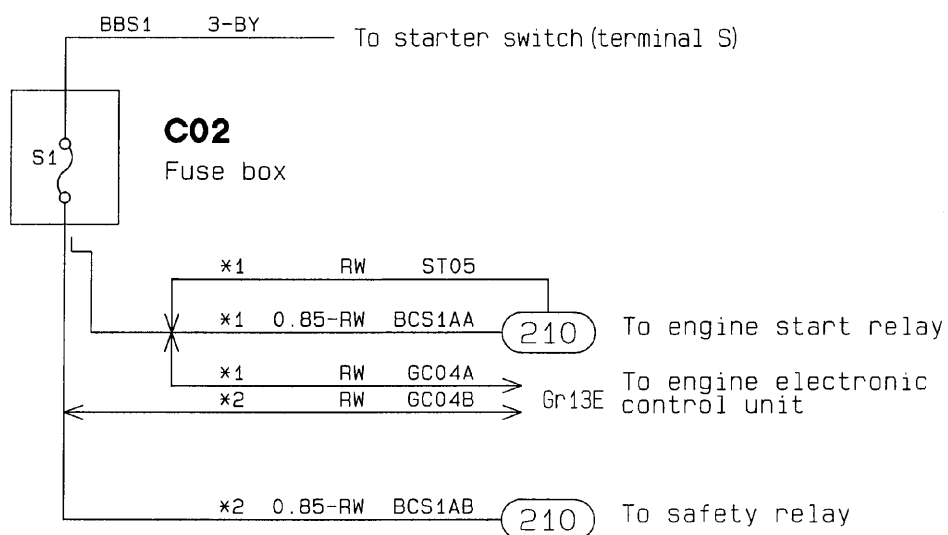
110 POWER CIRCUIT

Fuse box
(Fuse M9 to M11)



ABS: Anti-lock brake system

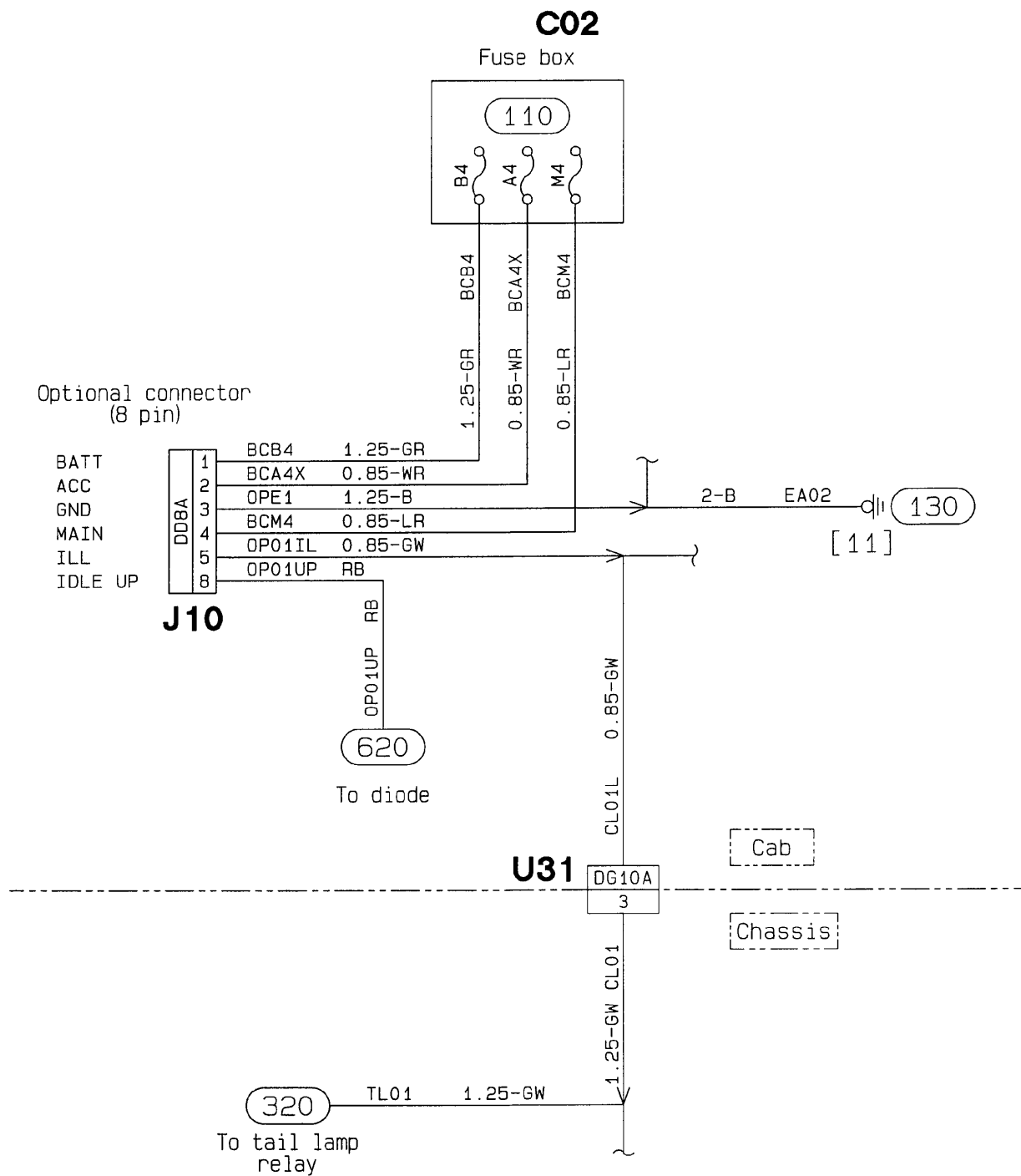
Fuse box (Fuses S1)



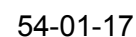
*1 : Manual transmission

*2 : Automatic transmission

115 RESERVE POWER CIRCUIT



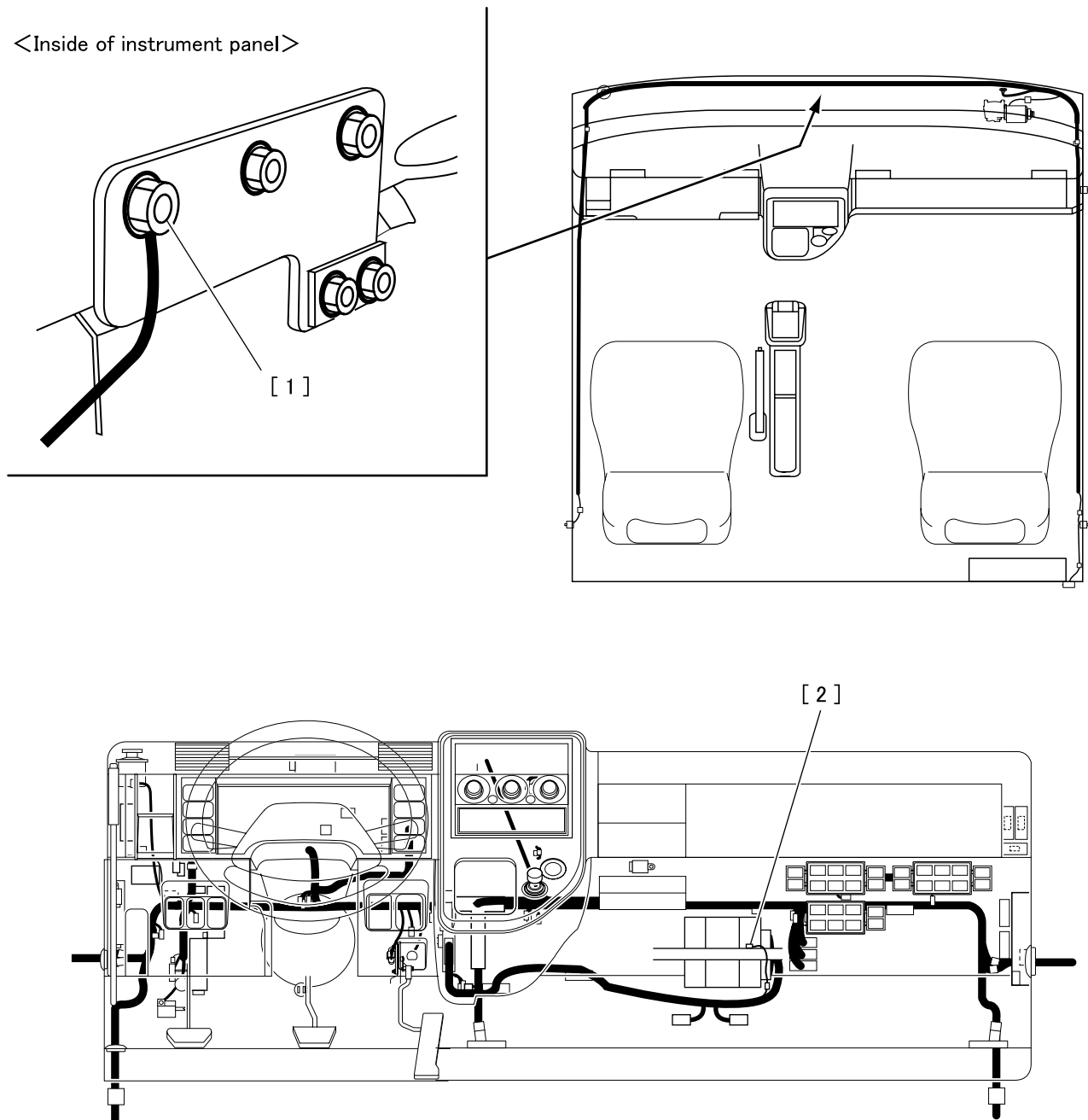
C00477



130 GROUND

[1] to [2] Cab ground

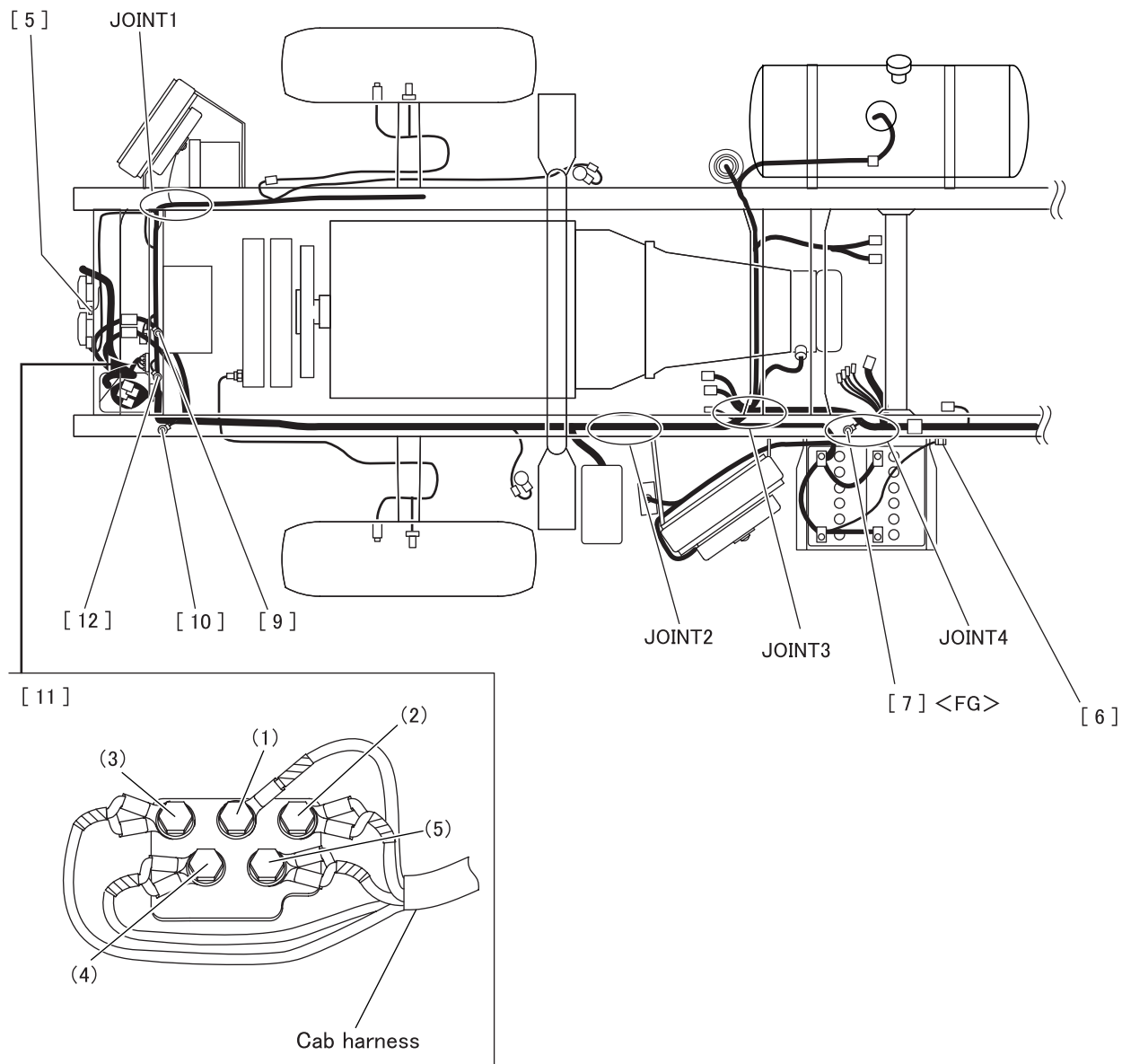
<Inside of instrument panel>



Location	Circuit No.	Wire diameter-wire color	Destination	Remarks
[1]	EA09	2-B	Joint connector (J/C-3)	—
	EA10	5-B	Frame ground	—
[2]	GCE5	1.25-B	Joint connector (J/C-3)	Engine electronic control unit case ground

130 GROUND

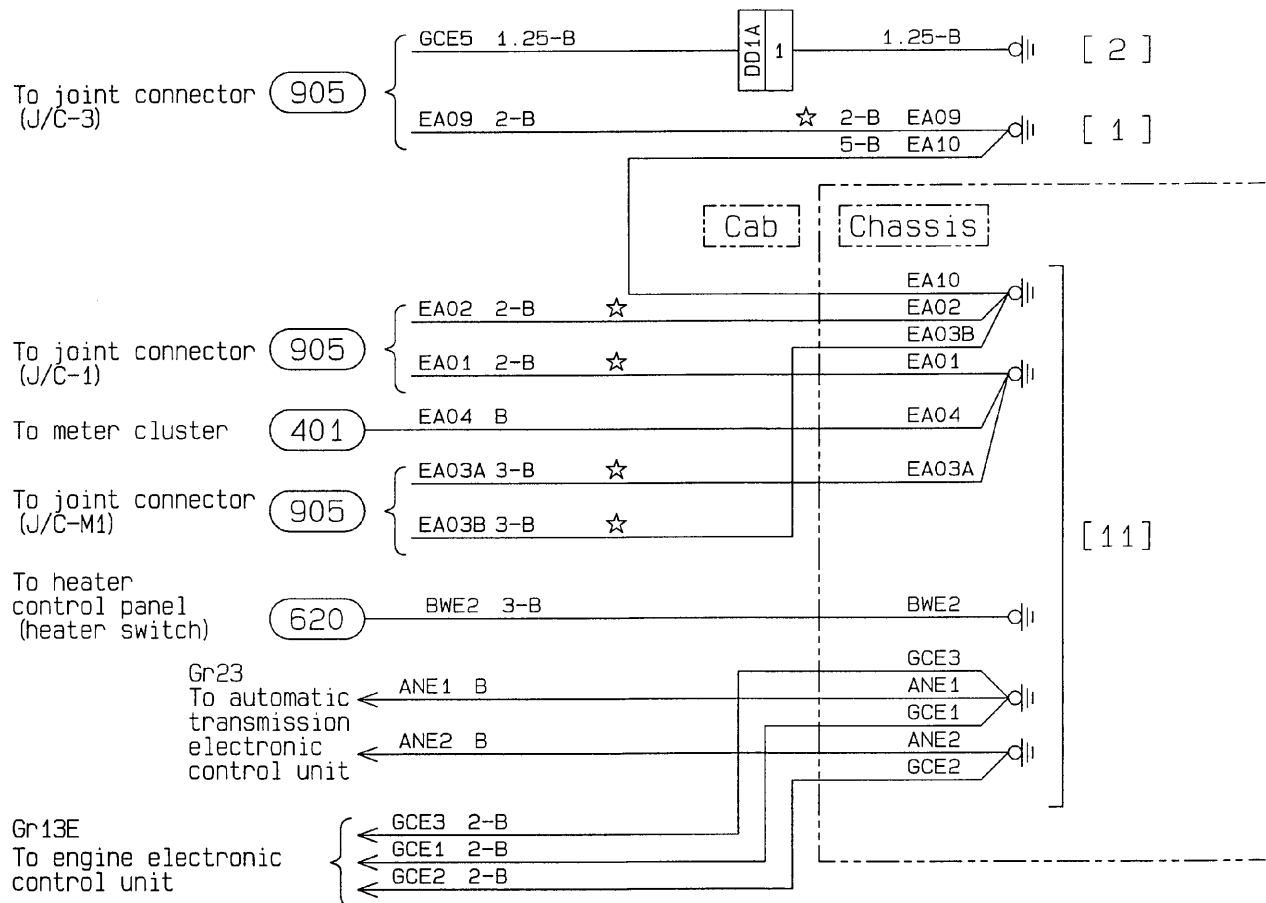
[5] to [12] Chassis ground



Location	Circuit No.	Wire diameter-wire color	Destination	Remarks
[5]	HNE1	2-B	Horn bracket	—
[6]	—	15-B	Battery	Battery ground (Frame ground)
[7]	FWE1	0.85-B	Joint4	—
[9]	EA11	2-B	Joint1	Frame ground
	EA12	1.25-B	Joint2	Frame ground
[10]	ASE1	3-B	Hydraulic unit	—
	ASE2	3-B	Hydraulic unit	—
[11](5)	ANE1	B	Automatic transmission electronic control unit	Automatic transmission
[11](4)	ANE2	B	Automatic transmission electronic control unit	Automatic transmission
[11](1)	BWE2	3-B	Center panel harness	—
[11](2)	EA01	2-B	Joint connector (J/C-1)	(Cab)
[11](3)	EA02	2-B	Joint connector (J/C-1)	(Cab)
[11](2)	EA03A	3-B	Joint connector (J/C-M1)	(Cab)
[11](3)	EA03B	3-B	Joint connector (J/C-M1)	(Cab)
[11](2)	EA04	B	Combination meter	(Cab)
[11](3)	EA10	5-B	Cab ground	—
[11](5)	GCE1	2-B	Engine electronic control unit	—
[11](4)	GCE2	2-B	Engine electronic control unit	—
[11](5)	GCE3	2-B	Engine electronic control unit	—
[12]	EA13	1.25-B	Joint3	Frame ground
	EA14	2-B	Rear chassis harness	Frame ground

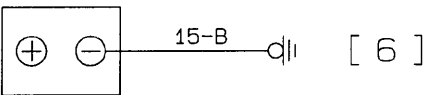
Entire ground

- This diagram indicates grounding points.
- See the following pages for branching of grounding (wiring for ☆).
(in circuit No.order)



#860

Battery



To horn circuit (616) HNE1 2-B HNE1 [5]

To hydraulic unit ABS Gr35E { ASE1 3-B ASE1 [10]
 ASE2 3-B ASE2

To JOINT 1 EA11 2-B ☆ EA11 [9]

To JOINT 2 EA12 1.25-B ☆ EA12

To JOINT 3 EA13 1.25-B ☆ EA13 [12]

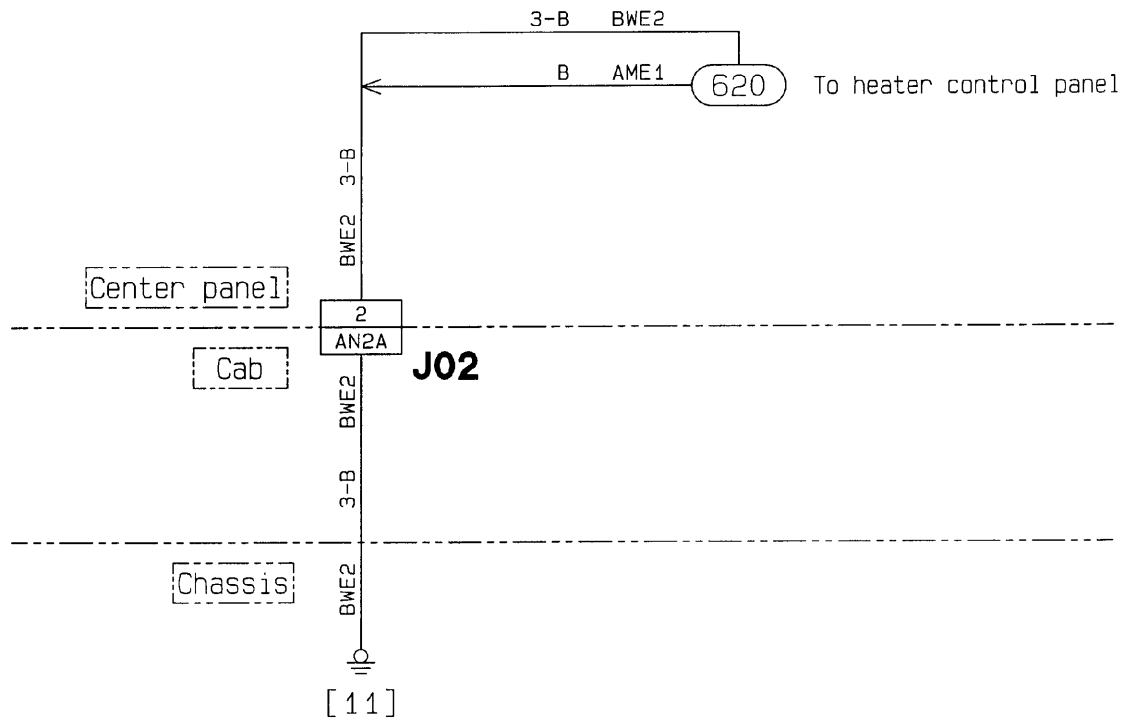
To rear combination lamp, LH (320) EA14 2-B ☆ EA14

To JOINT 4 FWE1 0.85-B ☆ FWE1 [7]

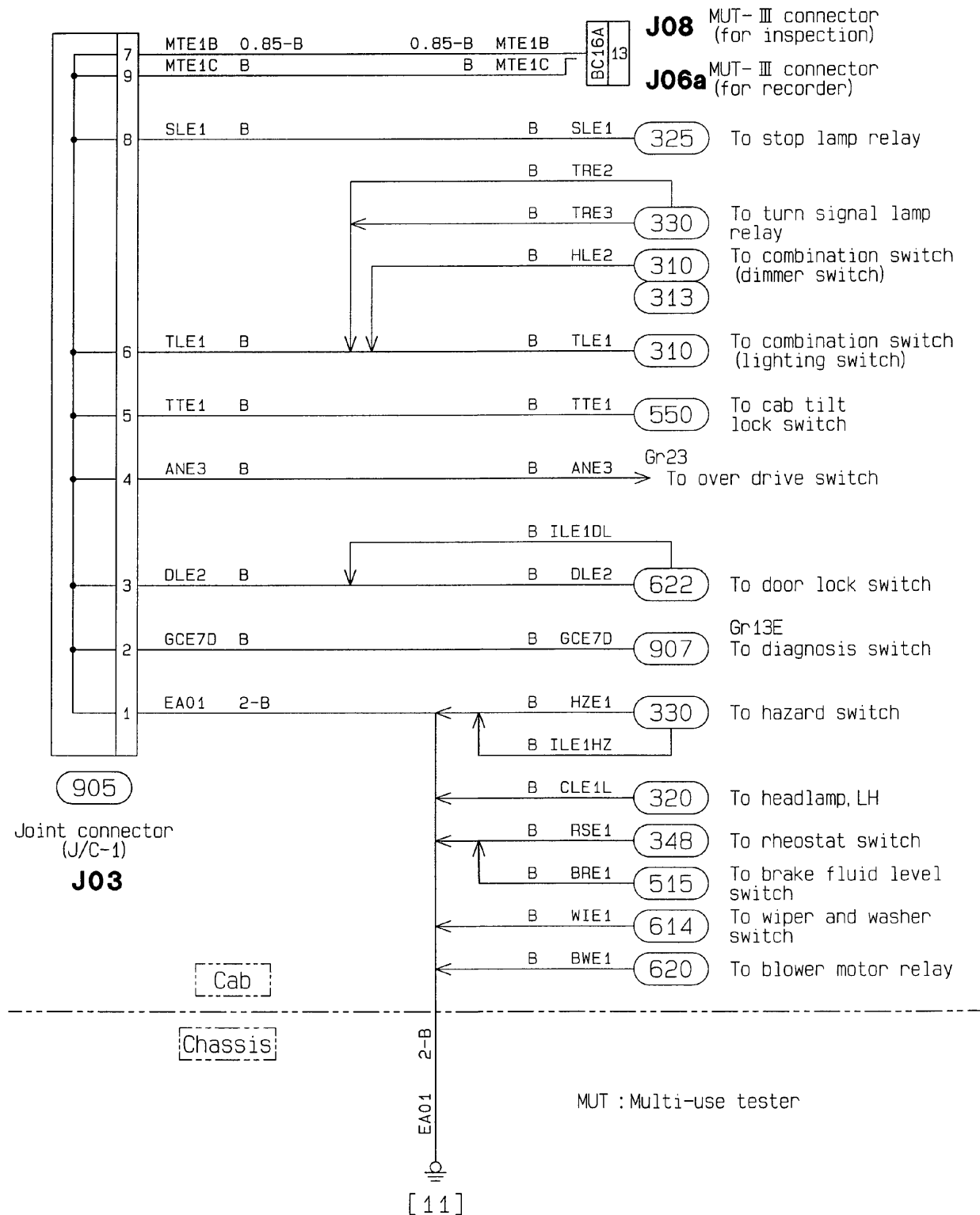
ABS : Anti-lock brake system

130 GROUND

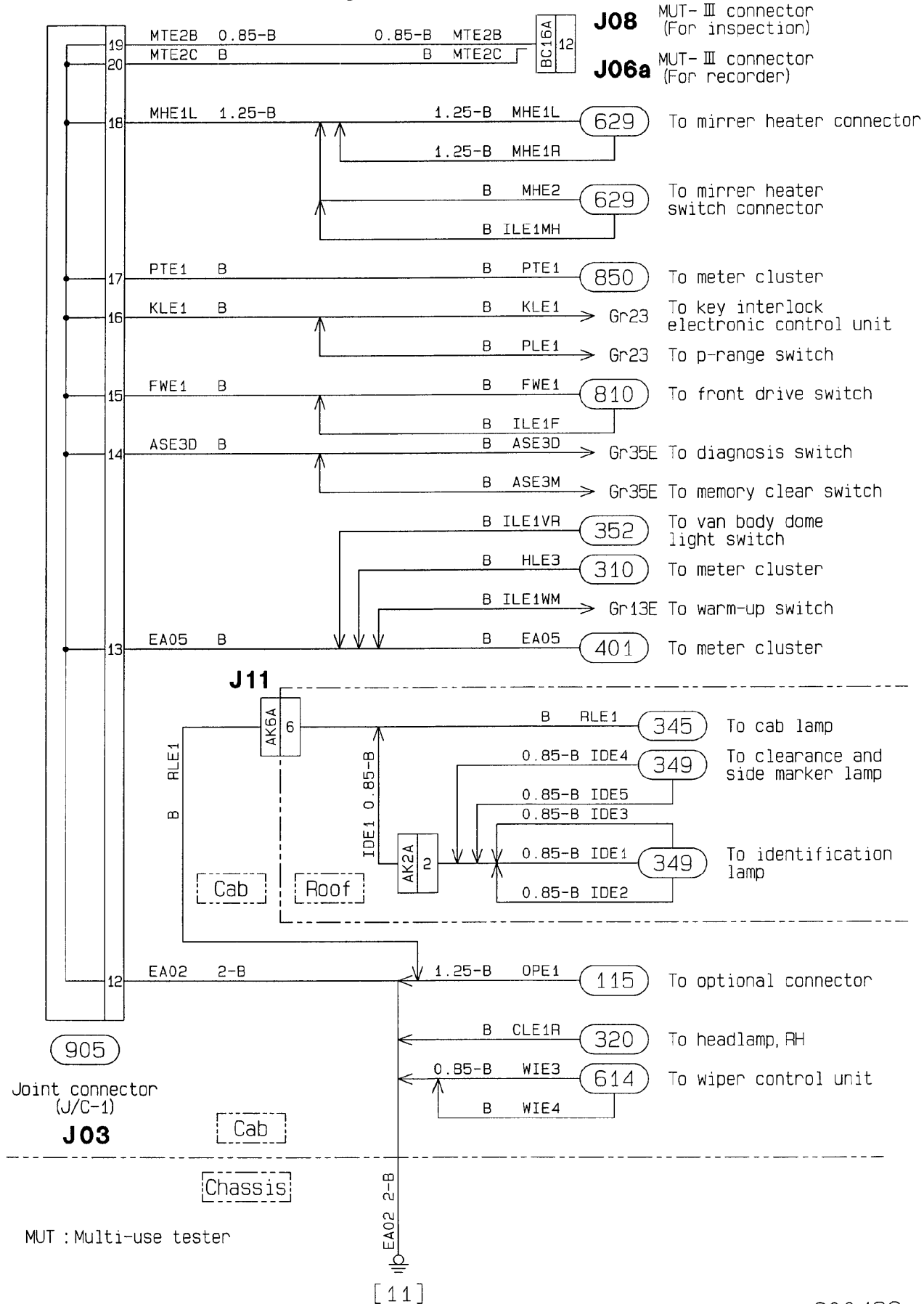
Circuit No.BWE2 chassis ground



Circuit No.EA01 chassis ground

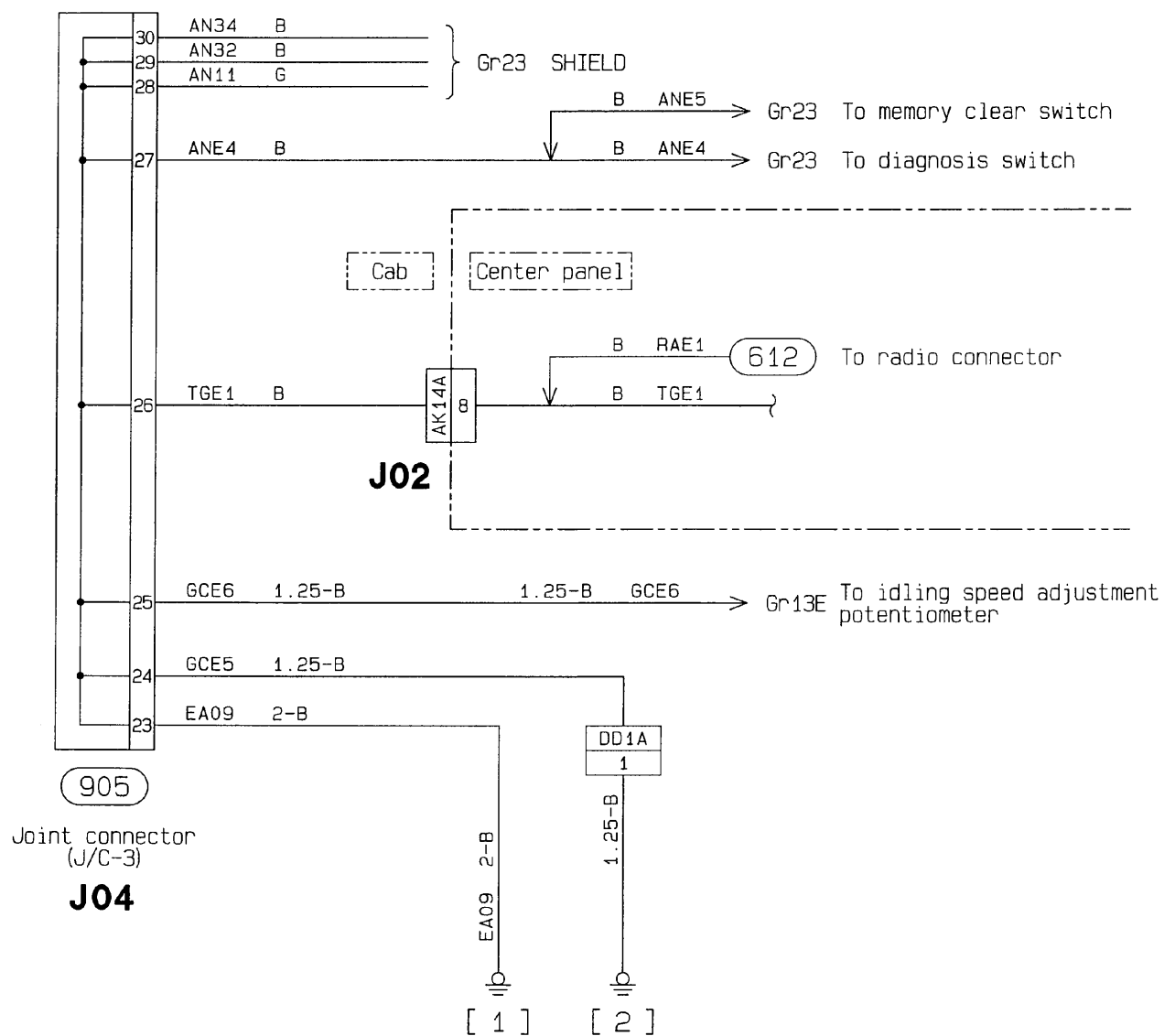


Circuit No.EA02 chassis ground



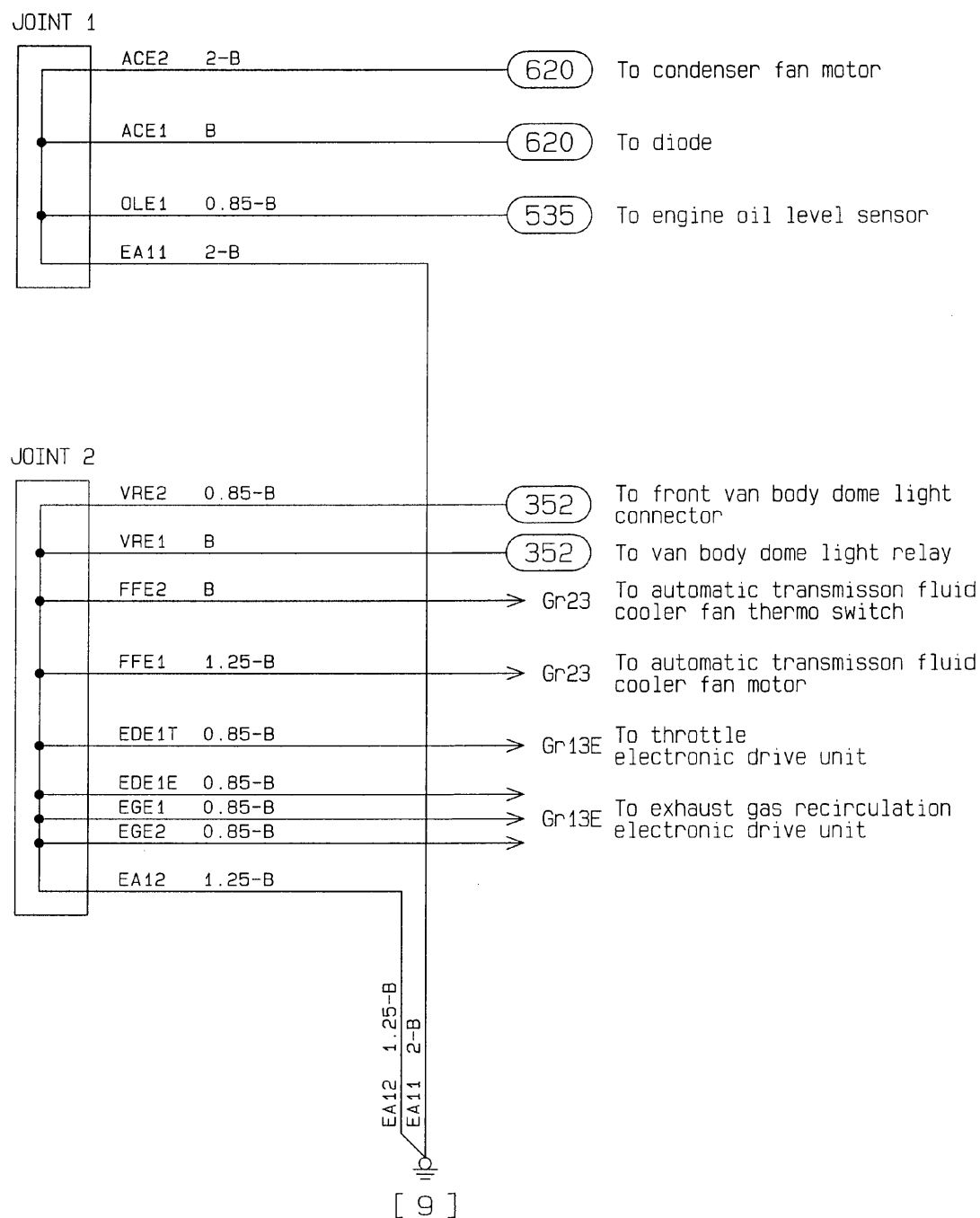
130 GROUND

Circuit No.EA09 cab ground



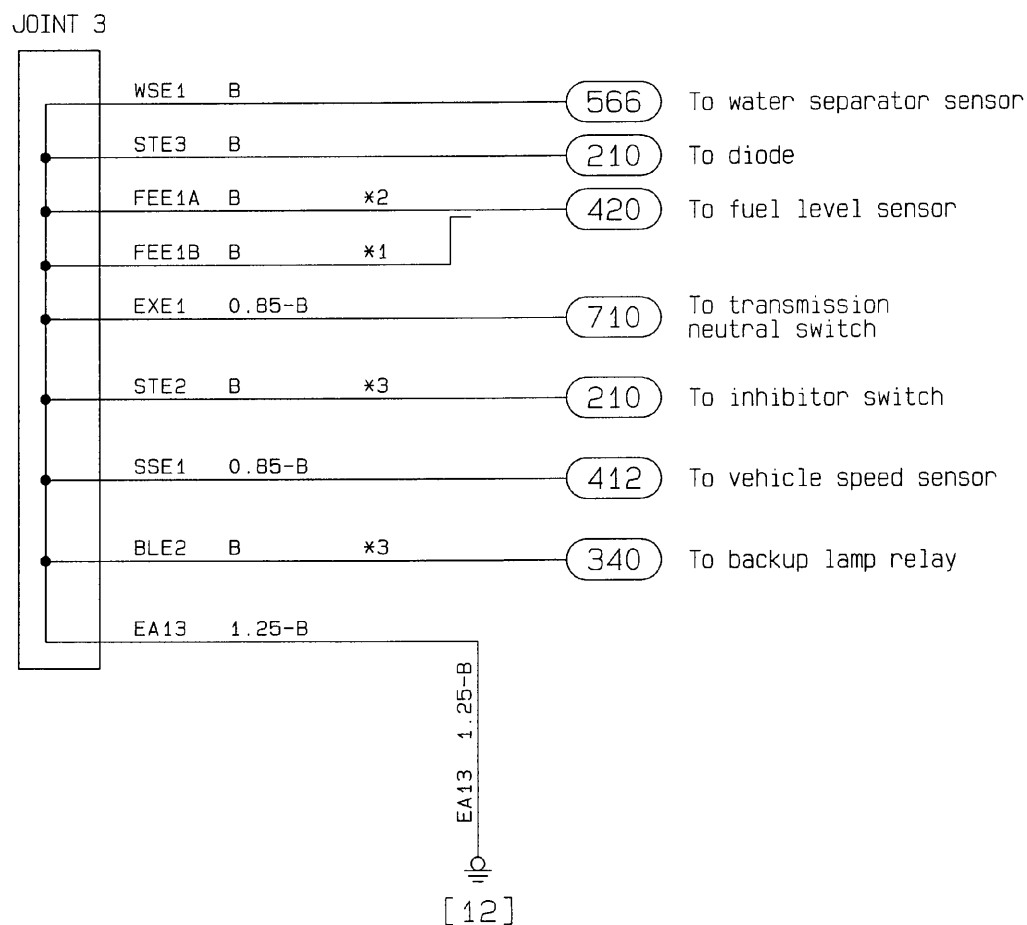
C00484

Circuit No.EA11, EA12 chassis ground



130 GROUND

Circuit No.EA13 chassis ground

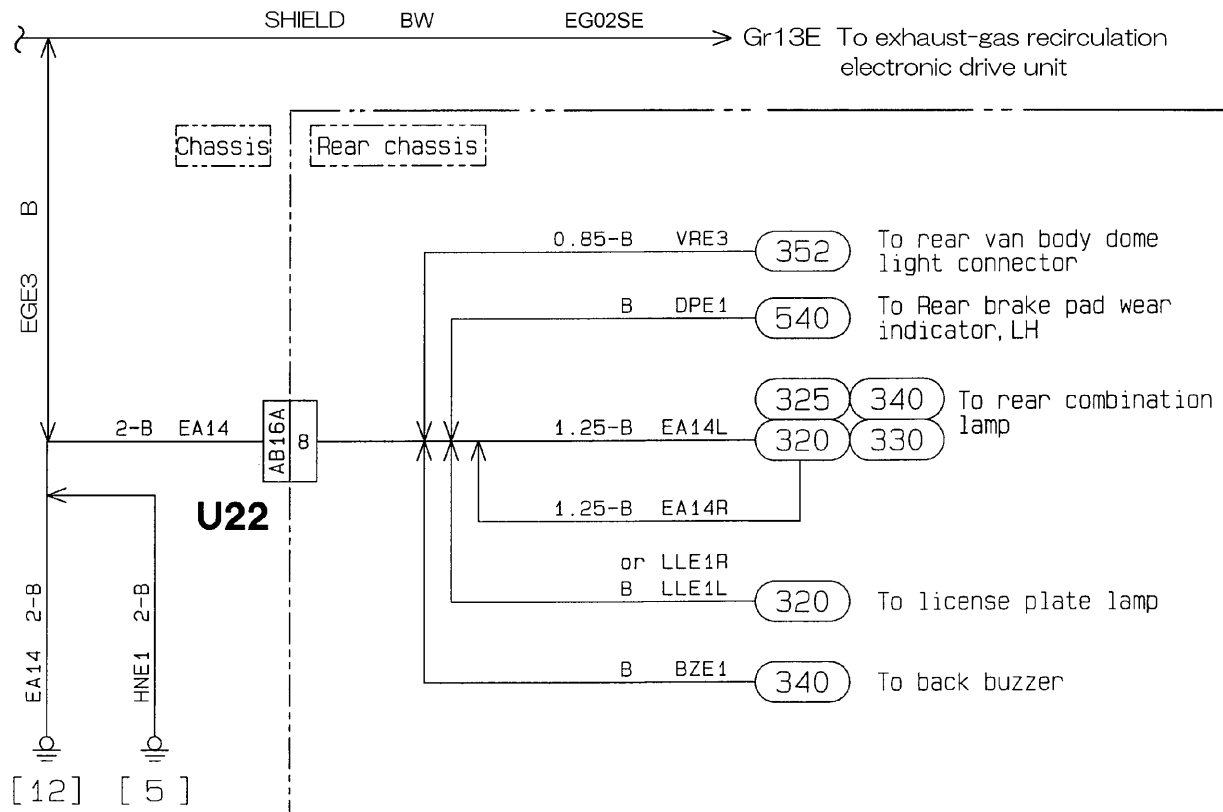


*1 : Fuel tank equipped rear overhang

*2 : Except *1

*3 : Automatic transmission

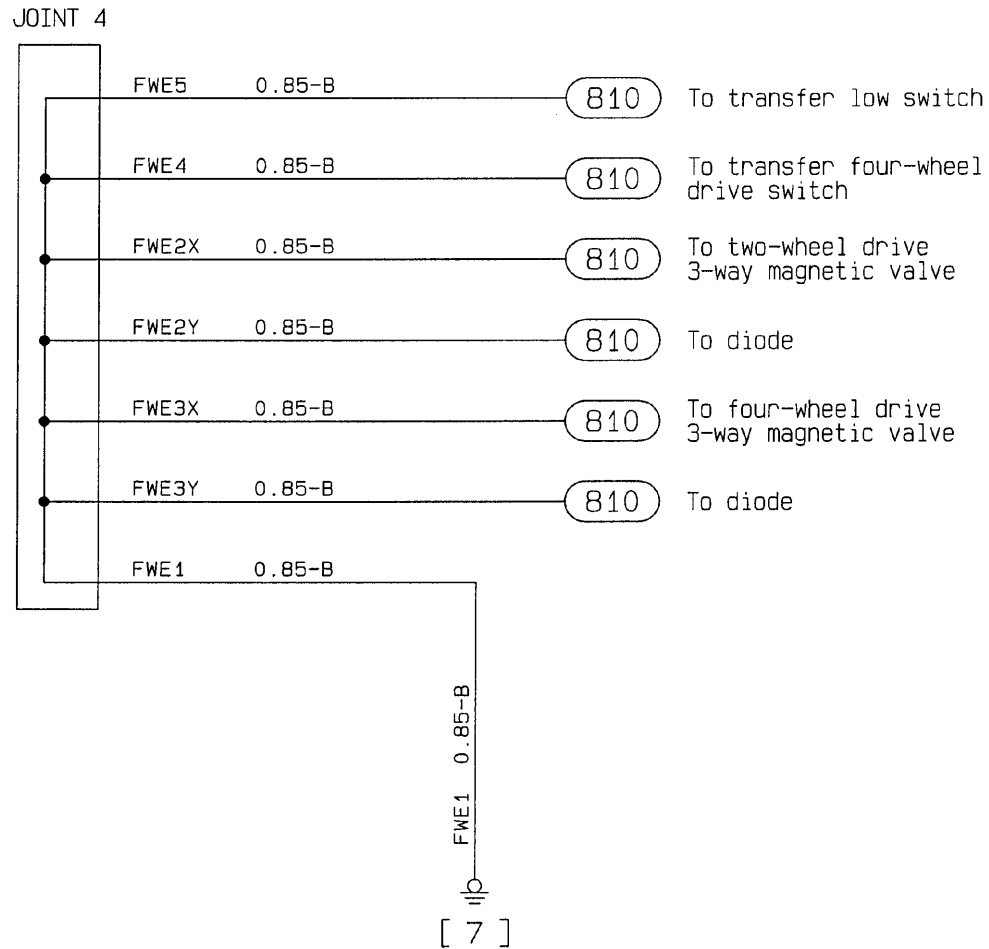
Circuit No.EA14 chassis ground



130 GROUND

Circuit No.FWE1 chassis ground

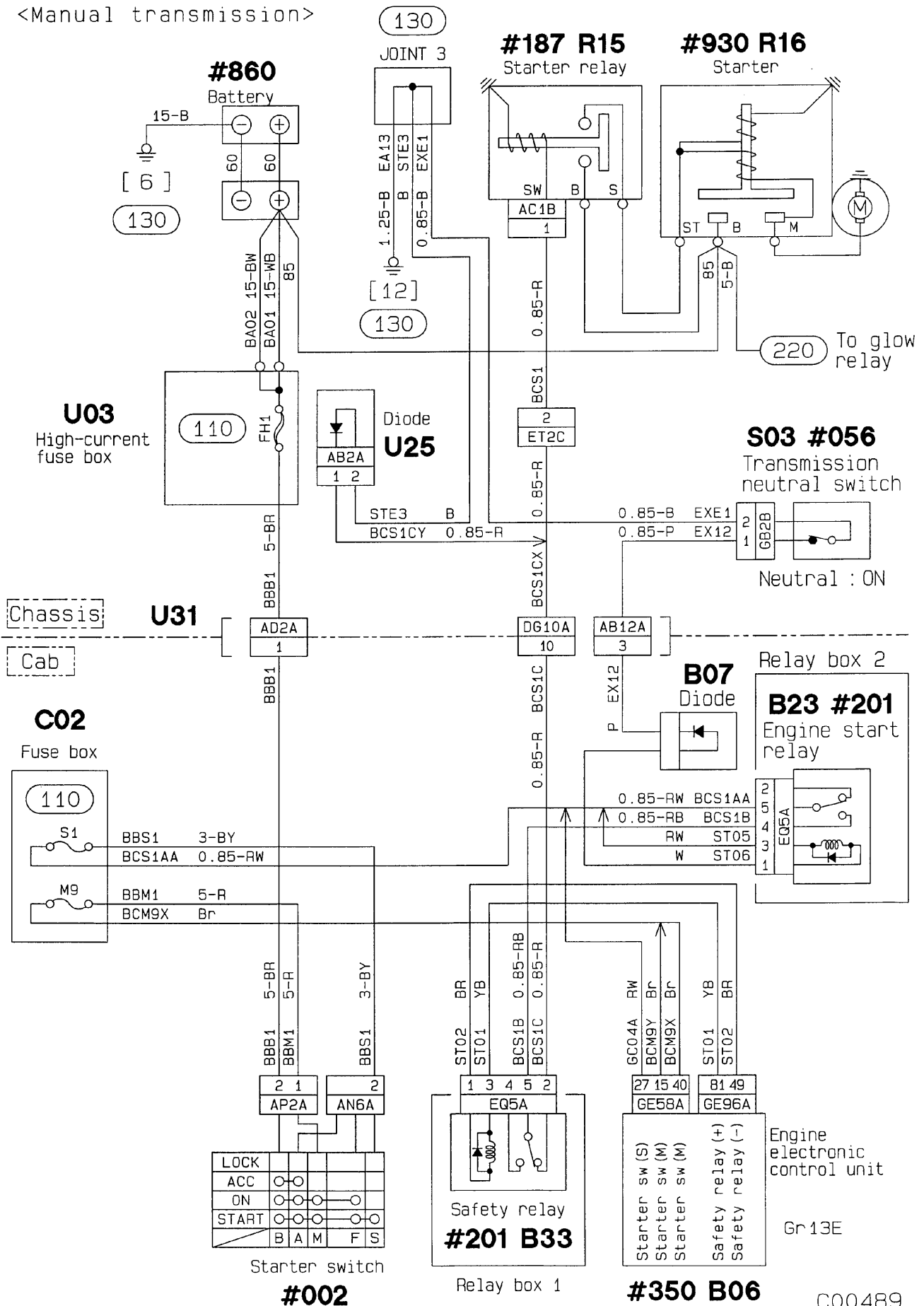
<FG>



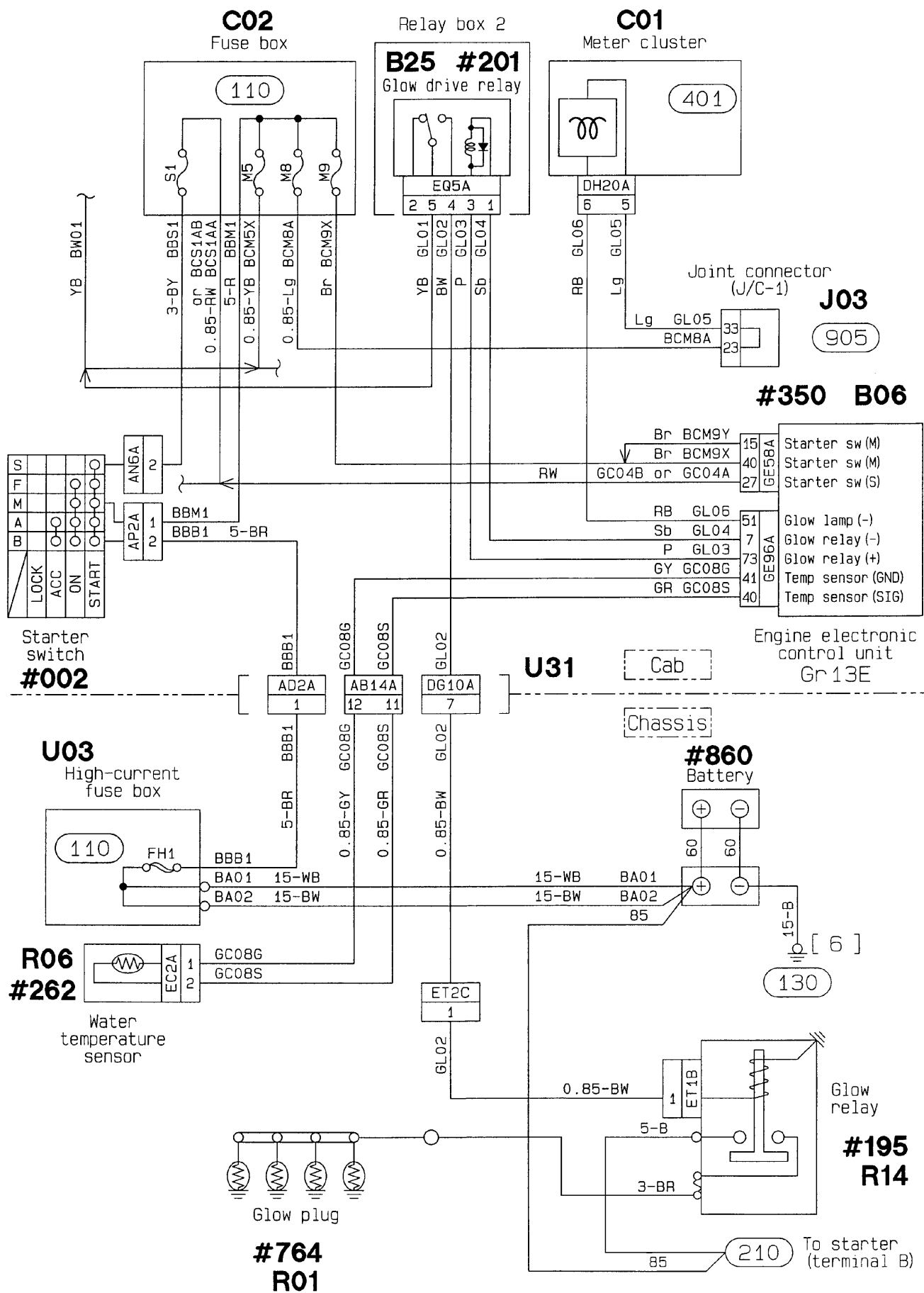
54-02 STARTING CIRCUIT

210 ENGINE STARTING CIRCUIT

<Manual transmission>



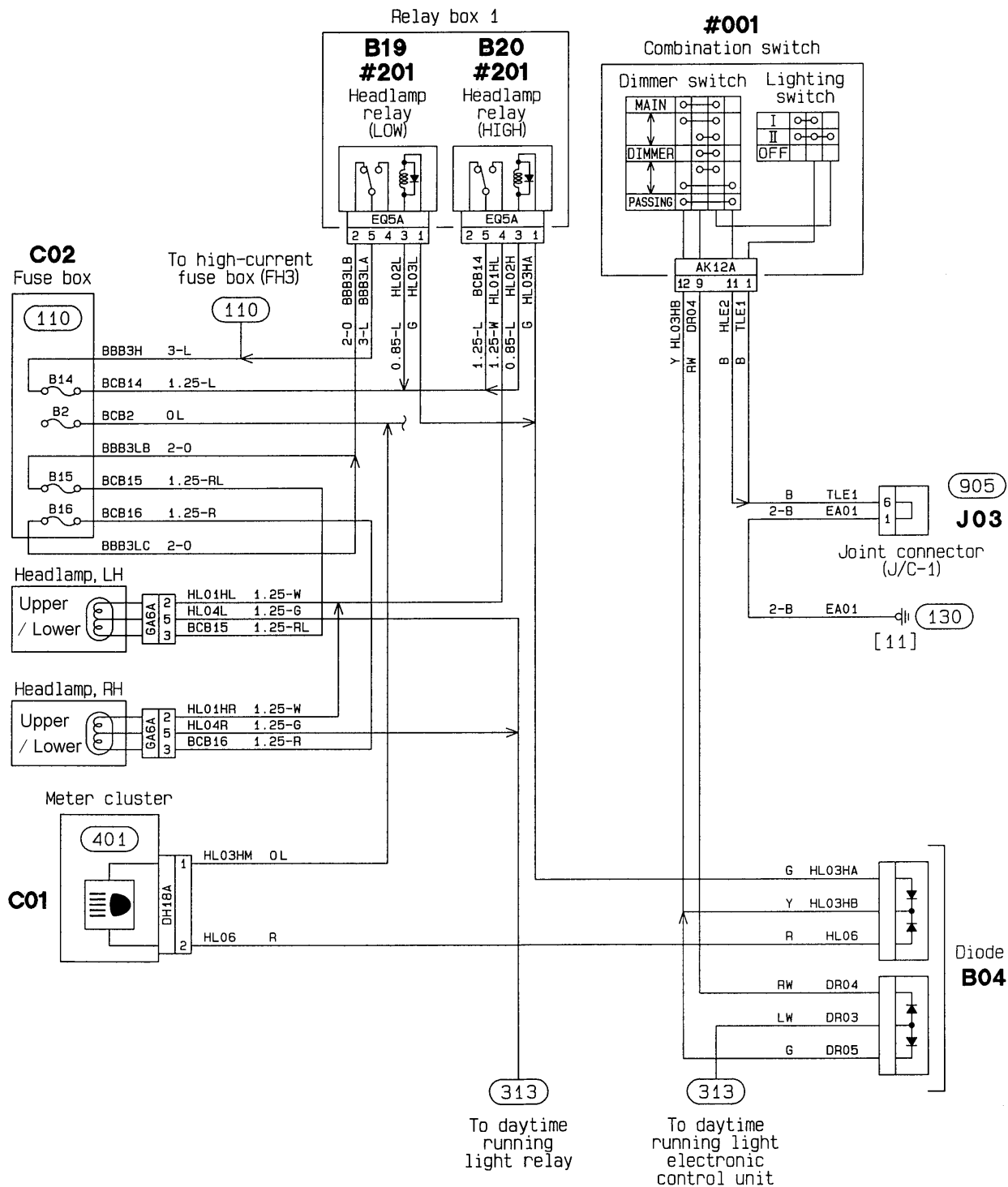
220 ENGINE PREHEATING CIRCUIT



C00491

54-03 LIGHTING CIRCUIT

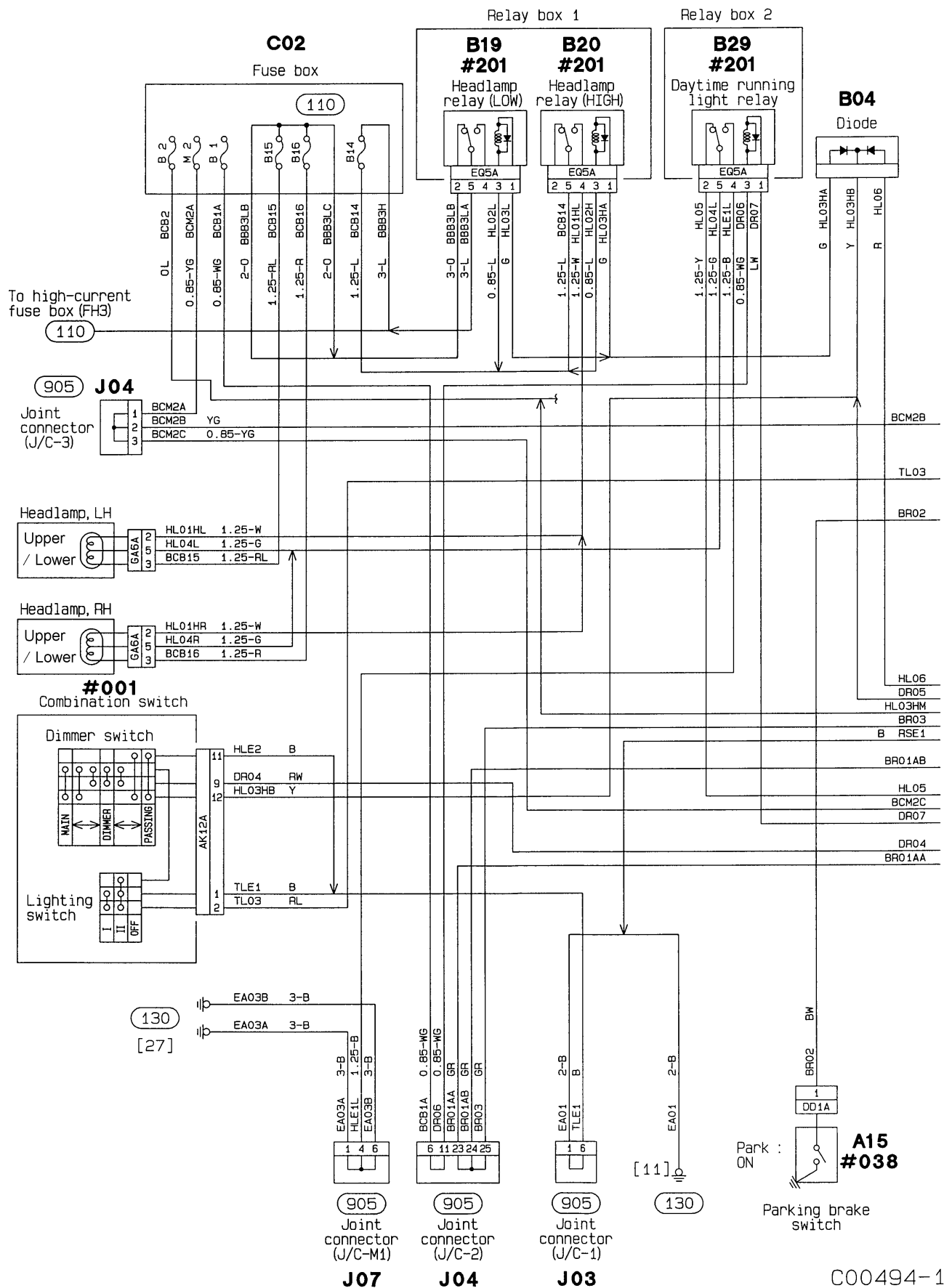
310 HEADLAMP CIRCUIT



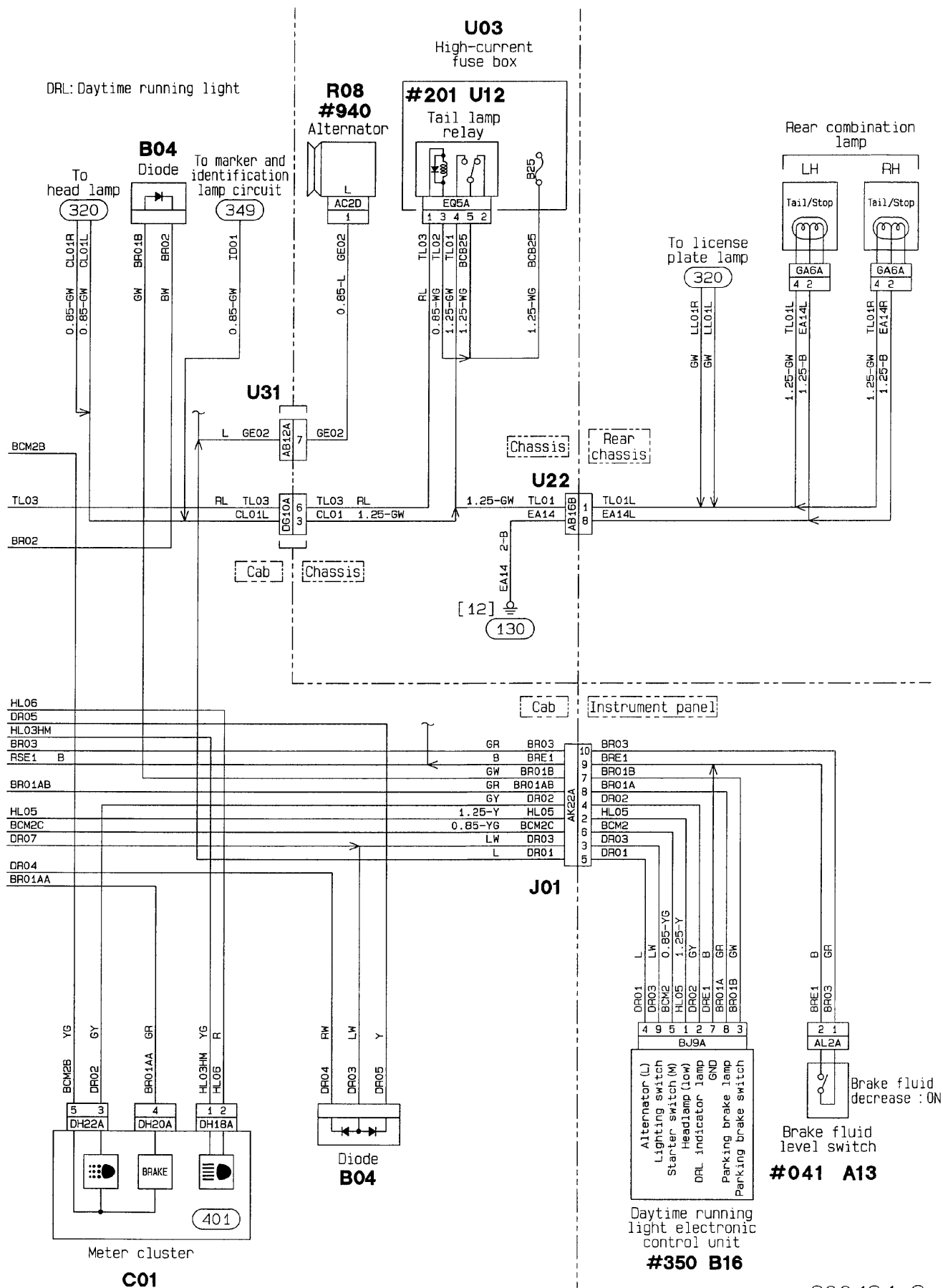
C00493

M E M O

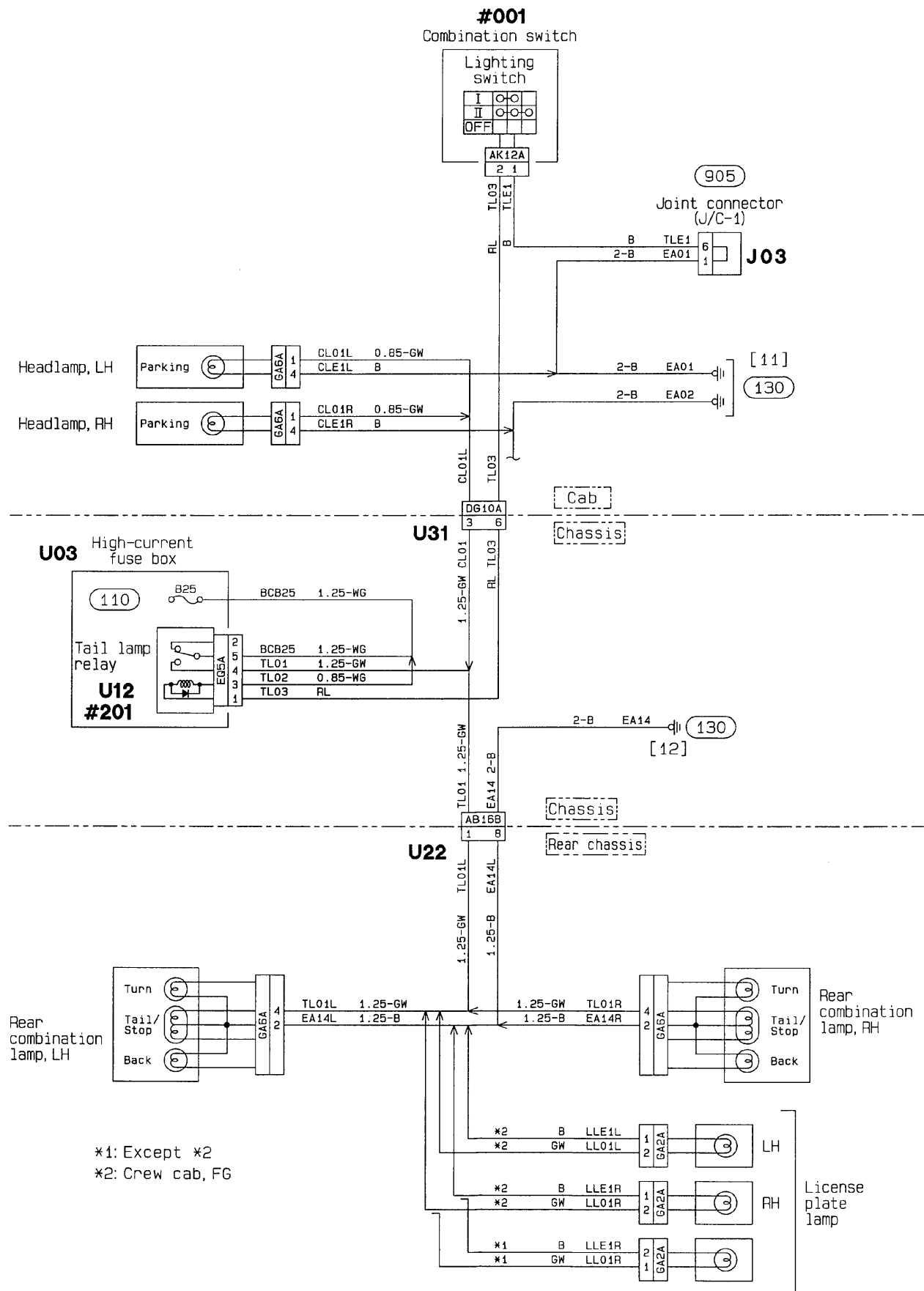
313 DAYTIME RUNNING LIGHT CIRCUIT



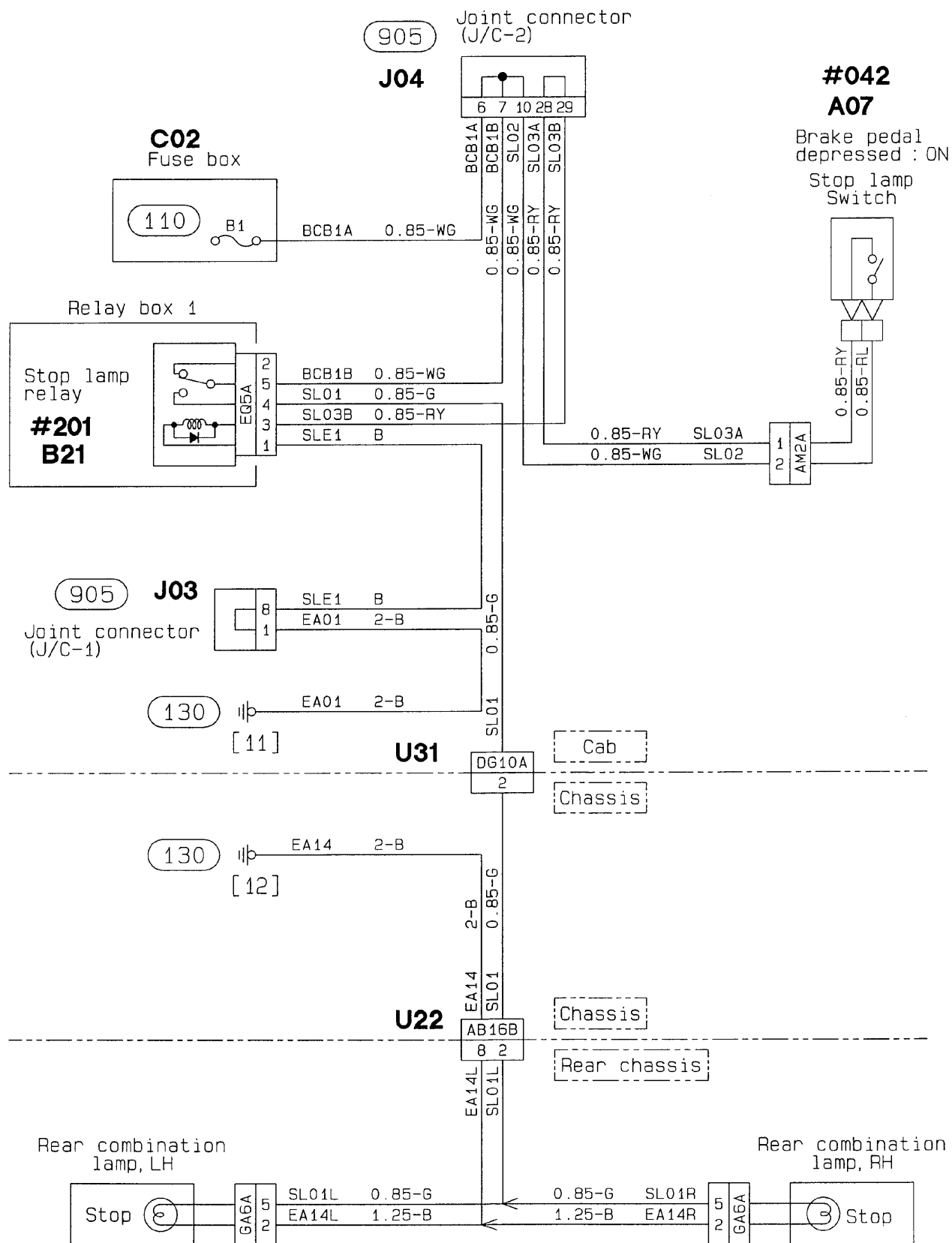
C00494-1



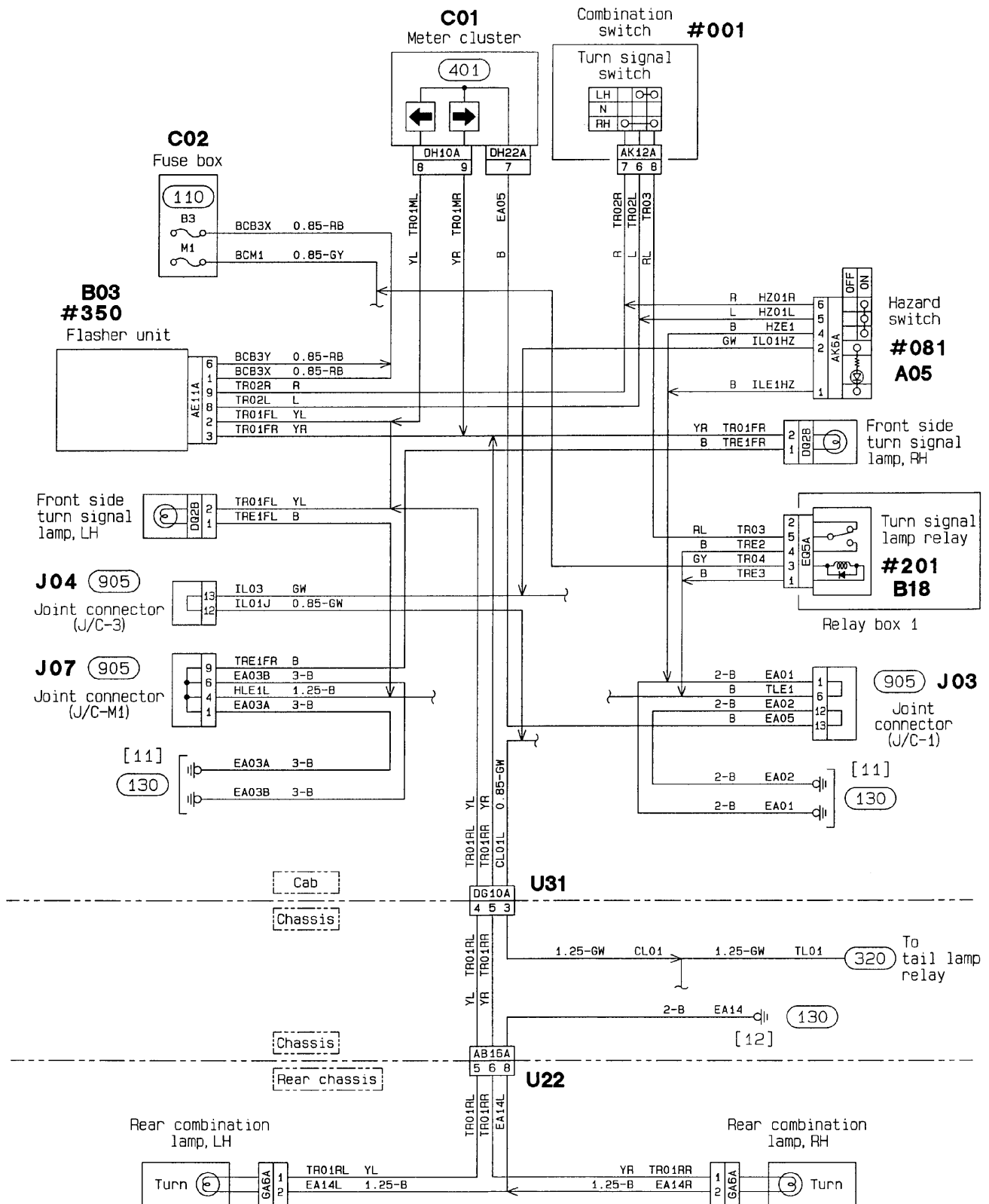
320 TAIL, CLEARANCE AND LICENCE PLATE LAMPS CIRCUIT



C00495



330 TURN SIGNAL AND HAZARD LAMP CIRCUIT

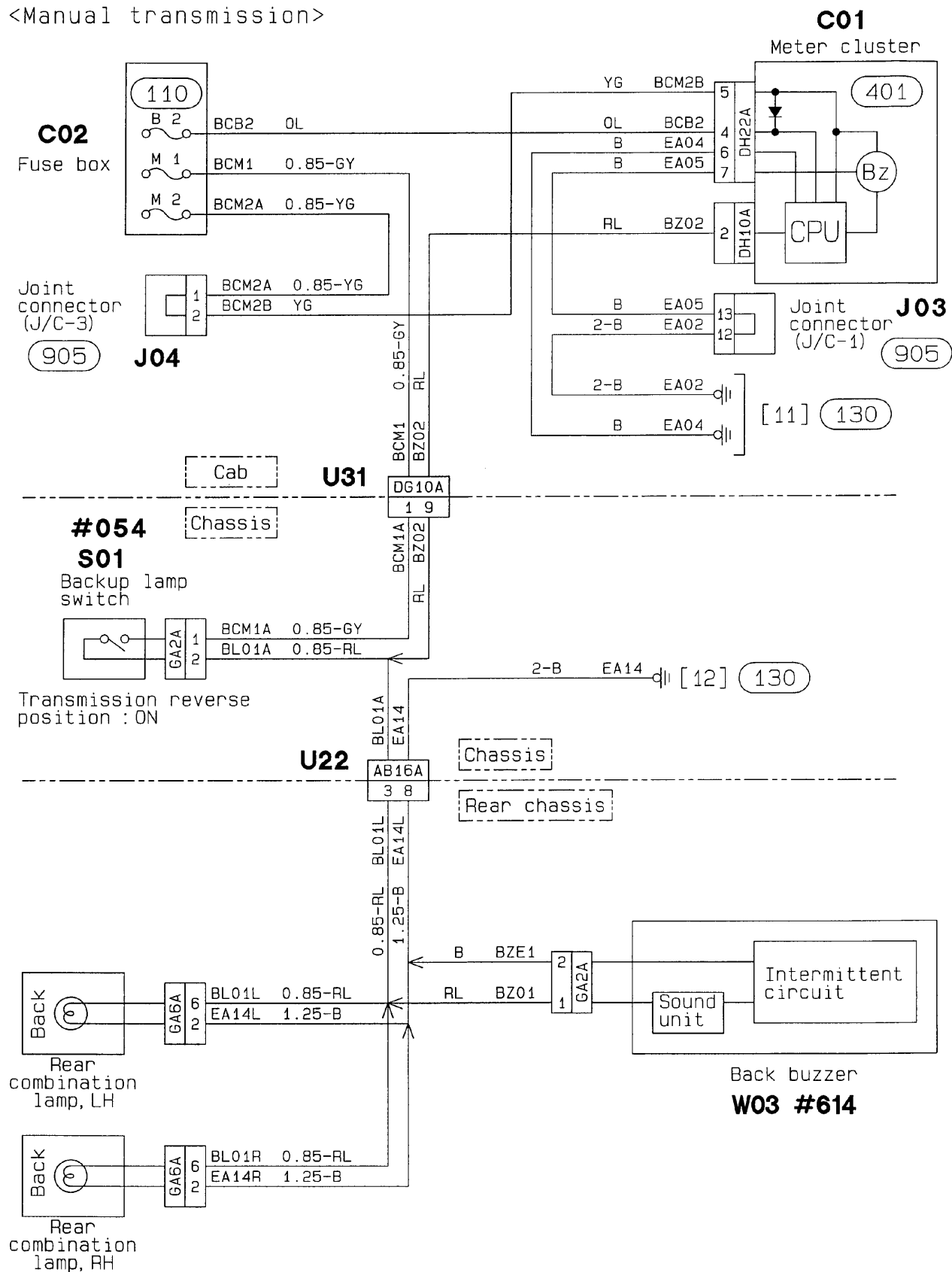


C00497

M E M O

340 BACKUP LAMP CIRCUIT

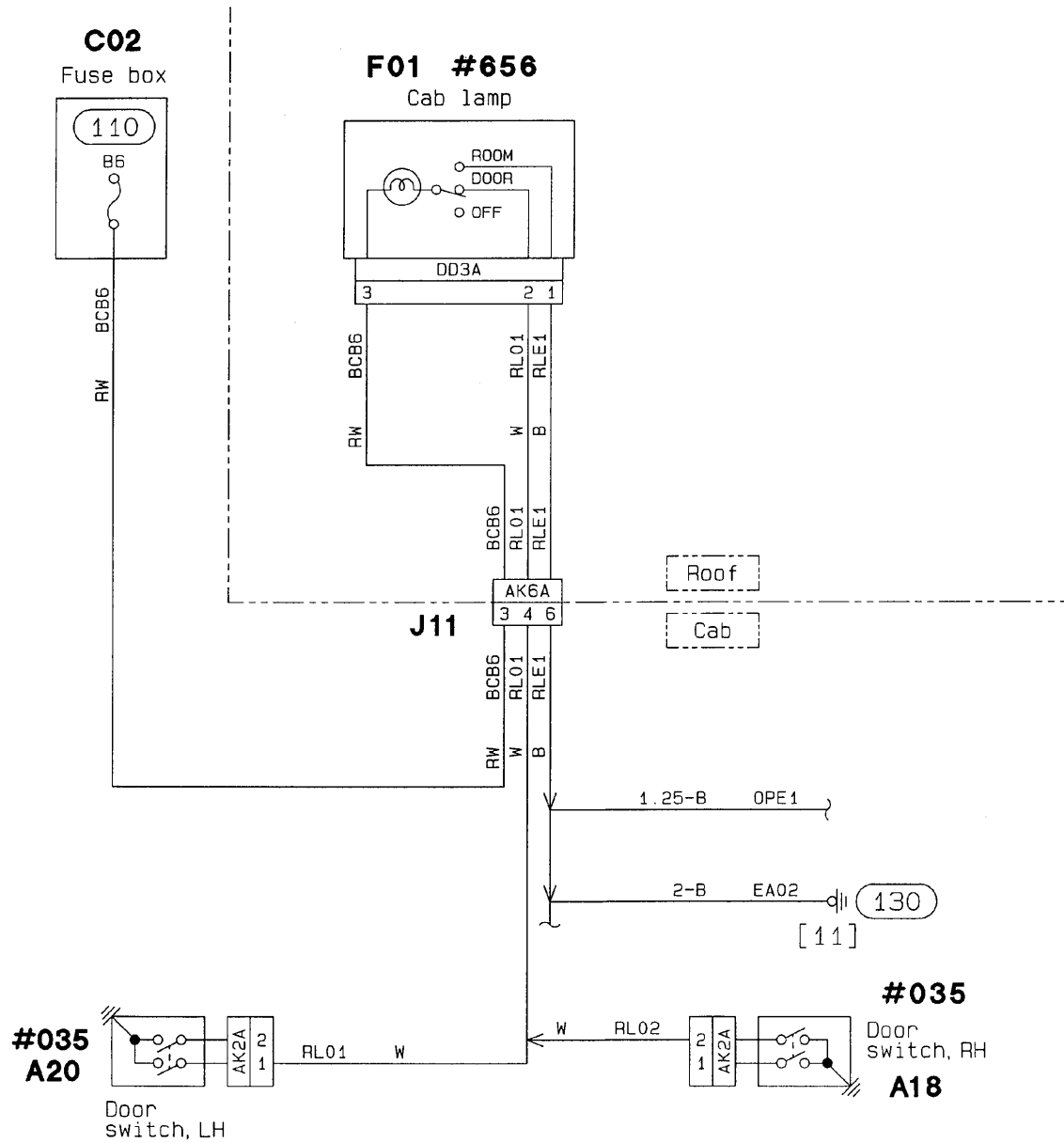
<Manual transmission>



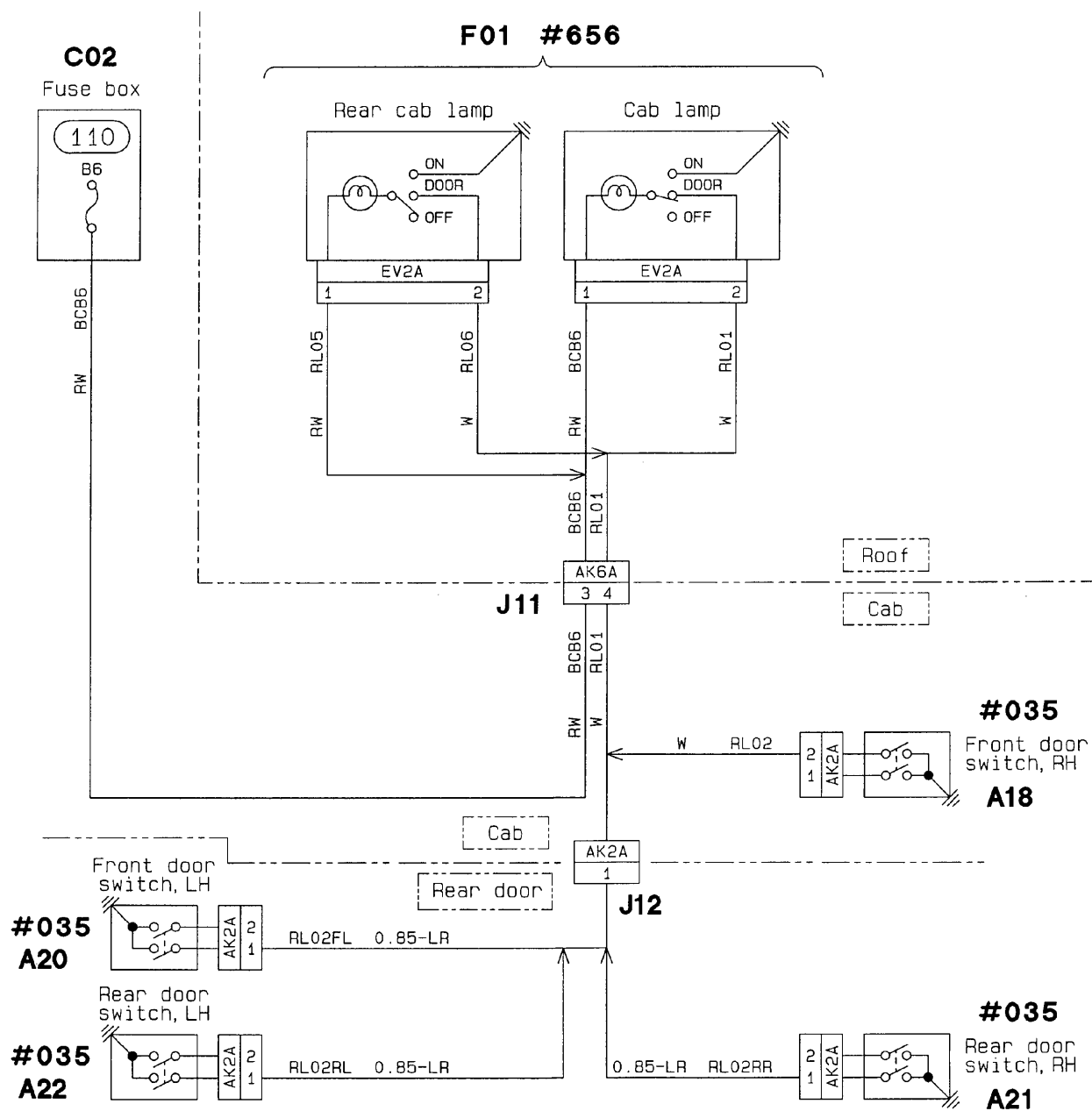
C00498

345 CAB LAMP CIRCUIT

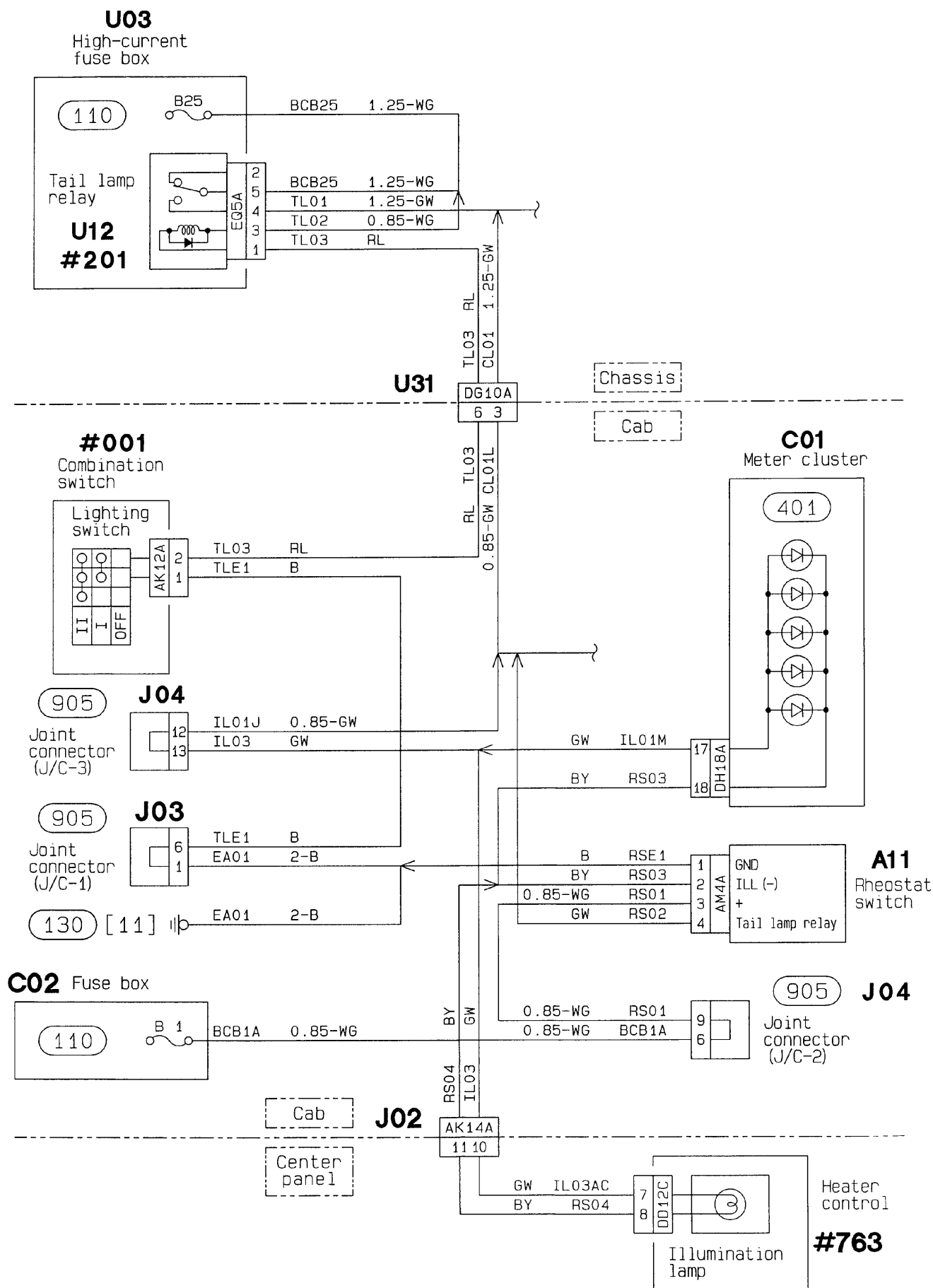
<Except crew cab>



<Crew cab>



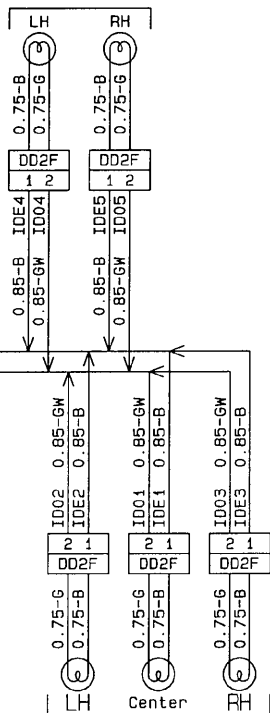
348 ILLUMINATION LAMP CIRCUIT



C00502

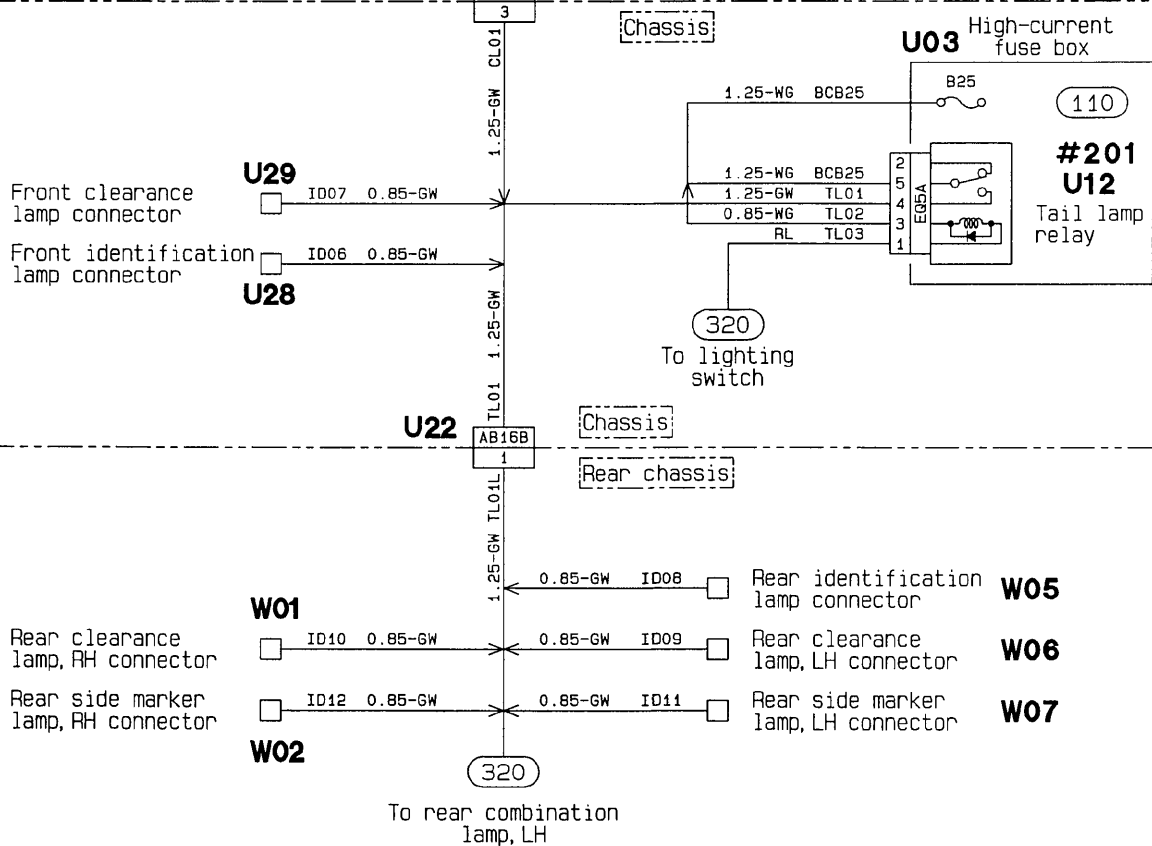


Clearance and side
marker lamp



Identification lamp
F03

F03



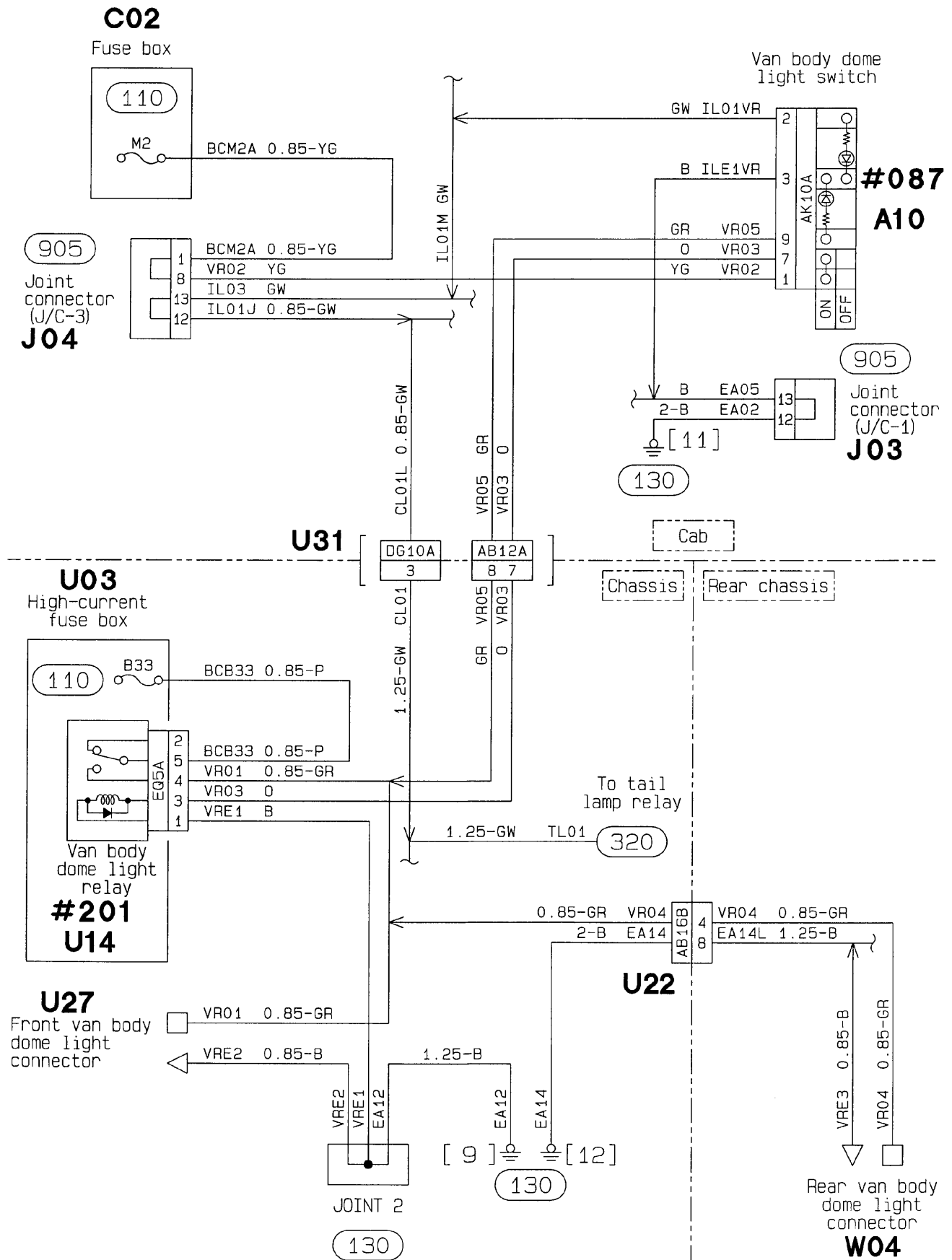
U03 High-current fuse box

#201
U12
Tail lamp
relay

To lighting
switch

To rear combination
lamp, LH

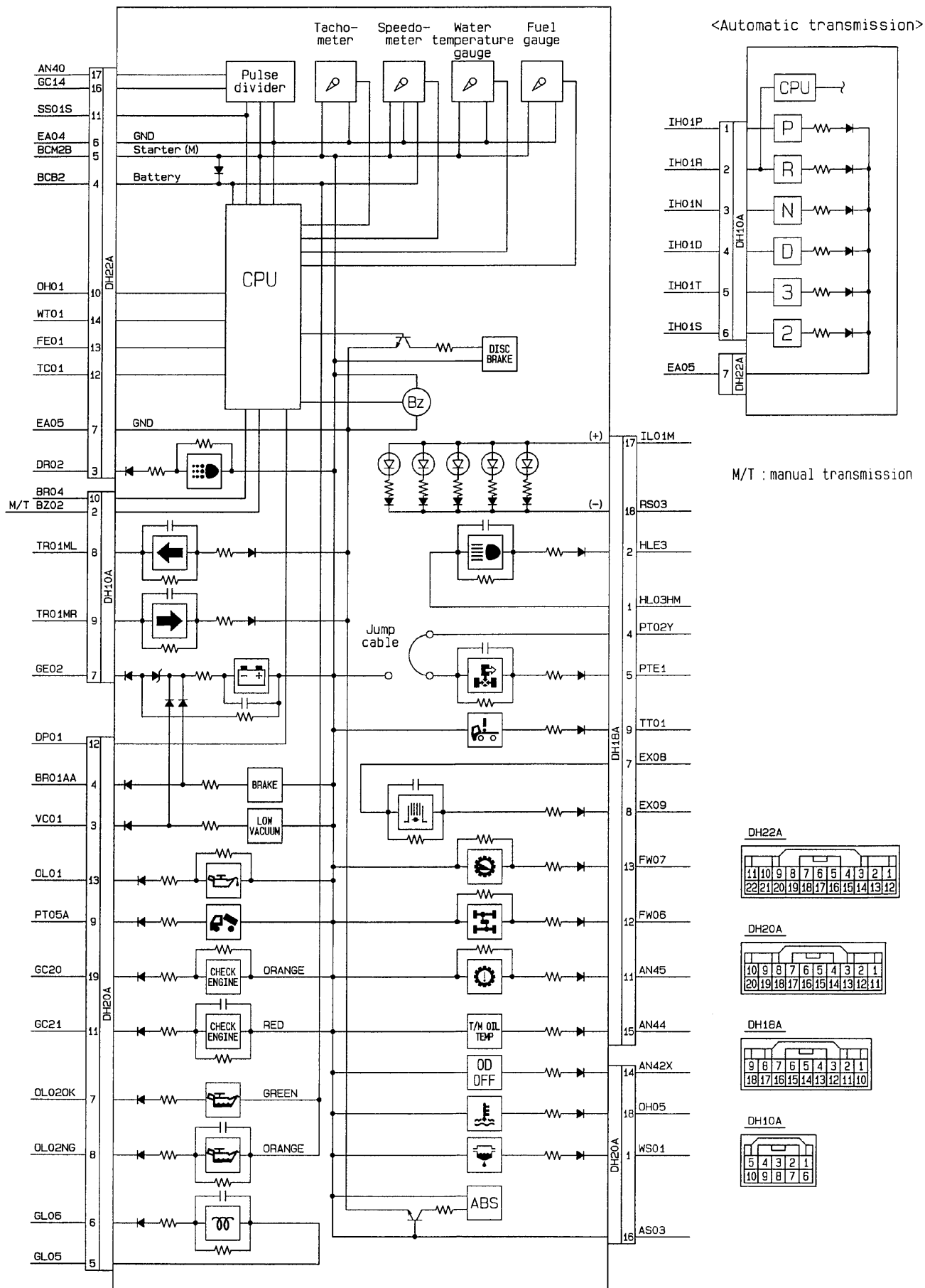
352 VAN BODY DOME LIGHT CIRCUIT



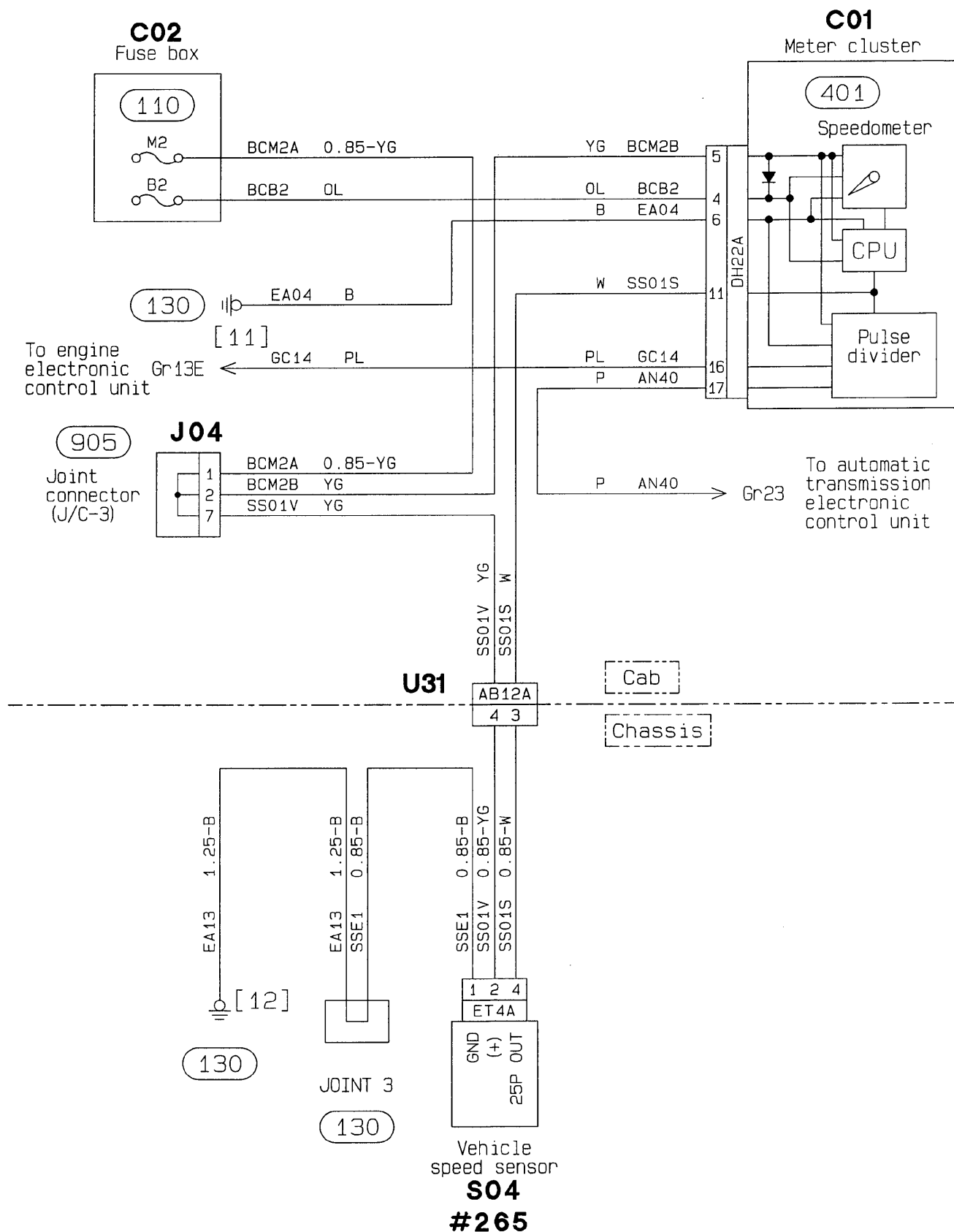
C00504

54-04 METER CIRCUIT

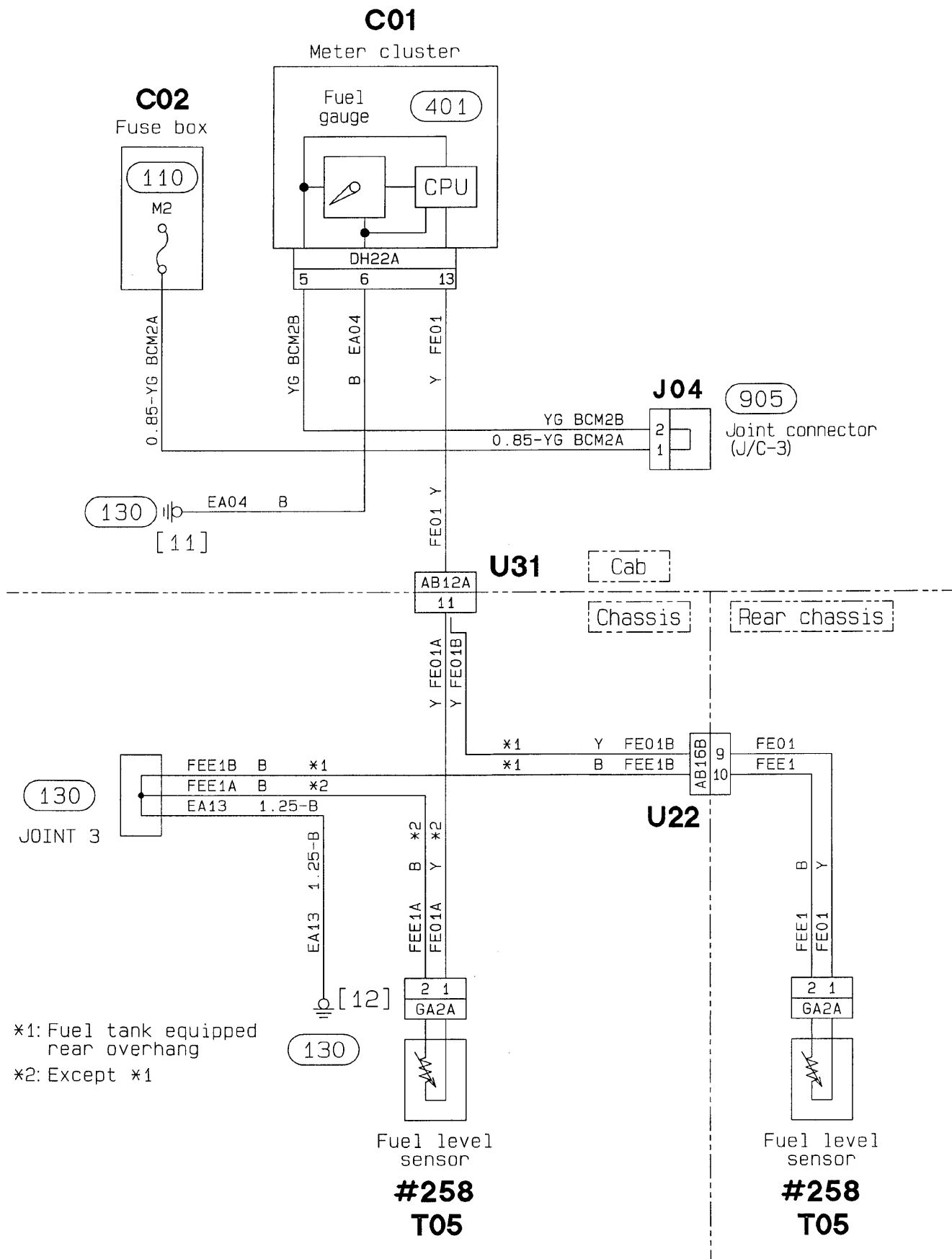
401 METER CLUSTER INTERNAL CIRCUIT



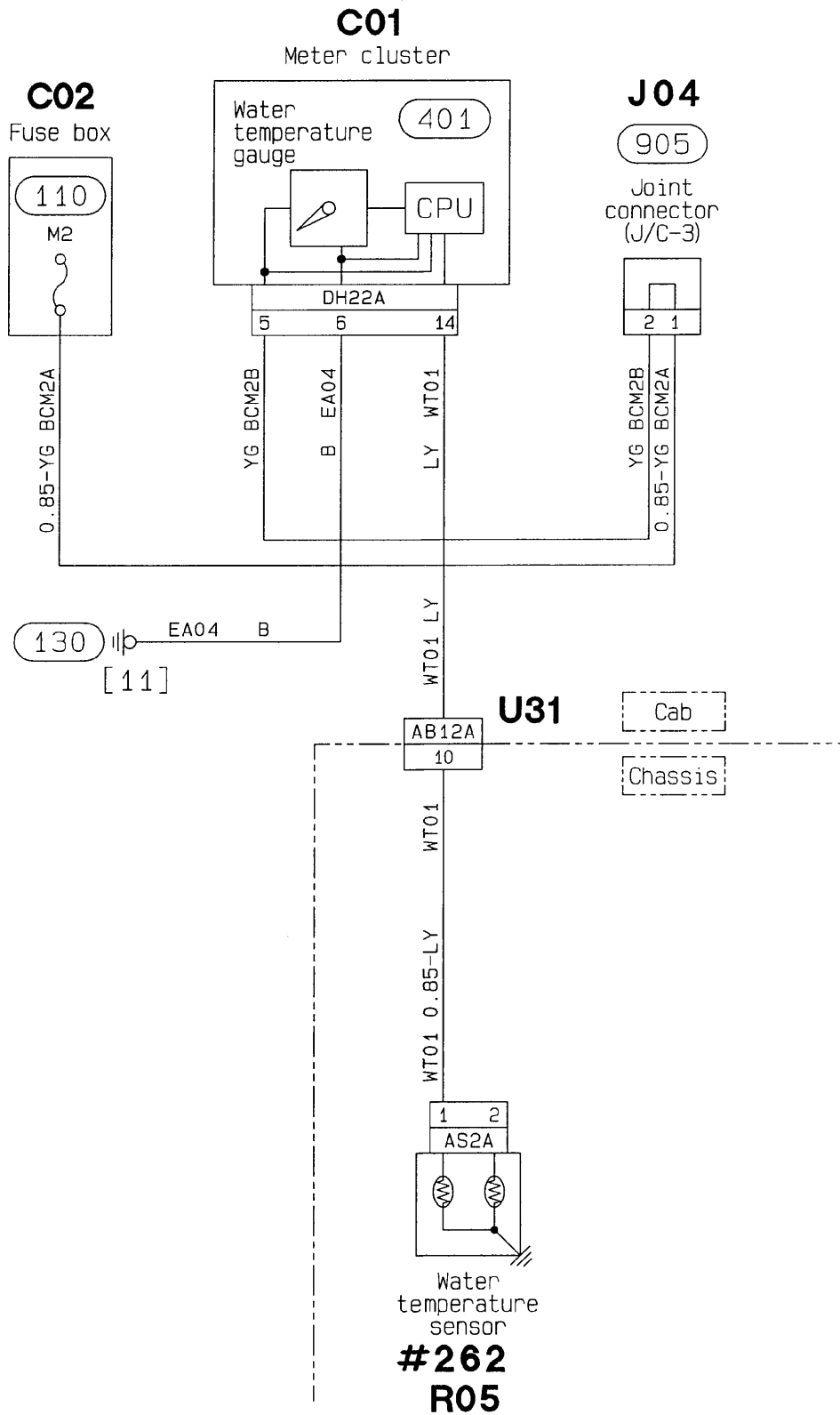
C00505



420 FUEL GAUGE CIRCUIT

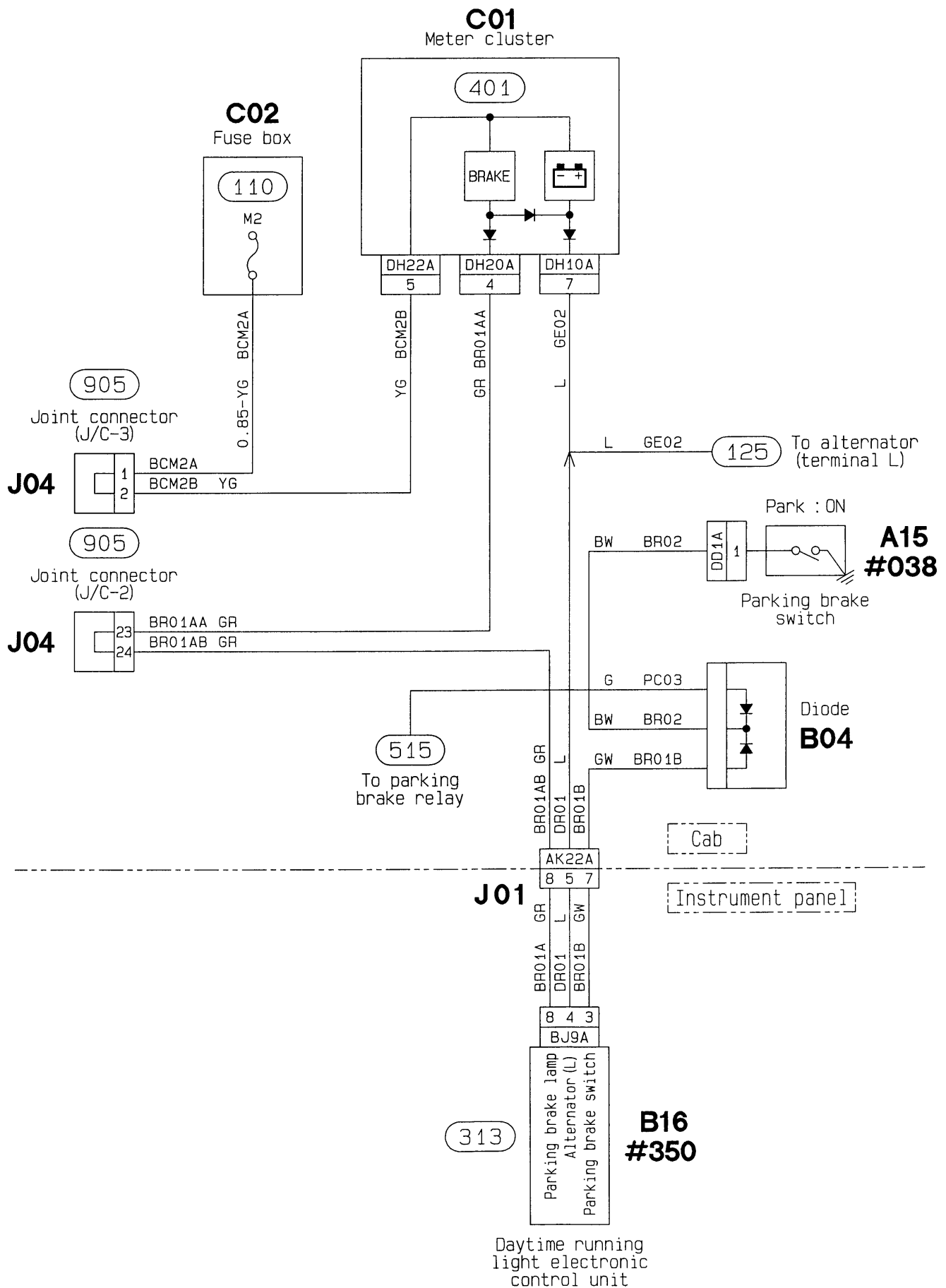


C00508



54-05 INDICATOR AND WARNING LAMP CIRCUIT

510 PARKING BRAKE INDICATOR CIRCUIT

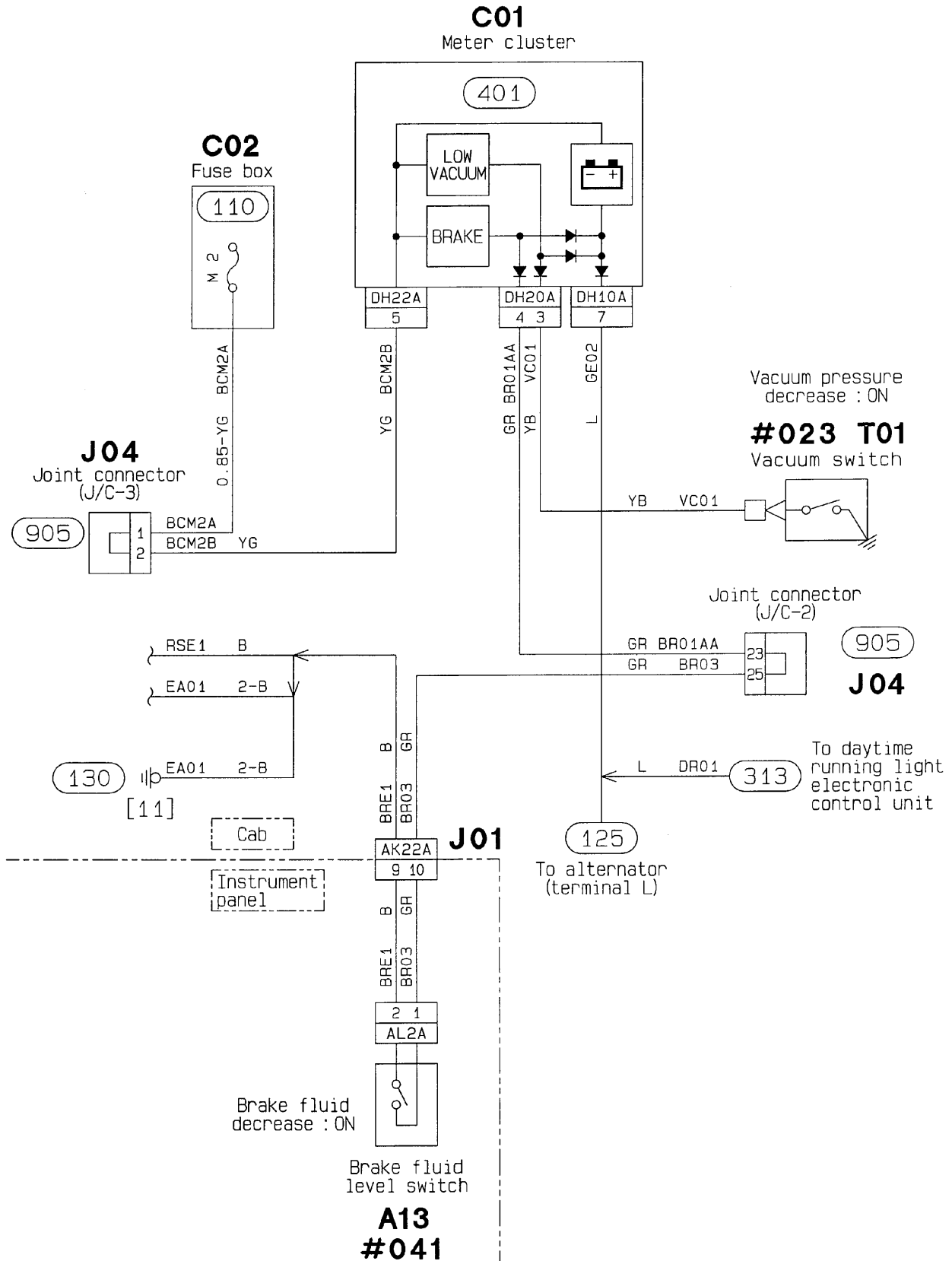


C00510

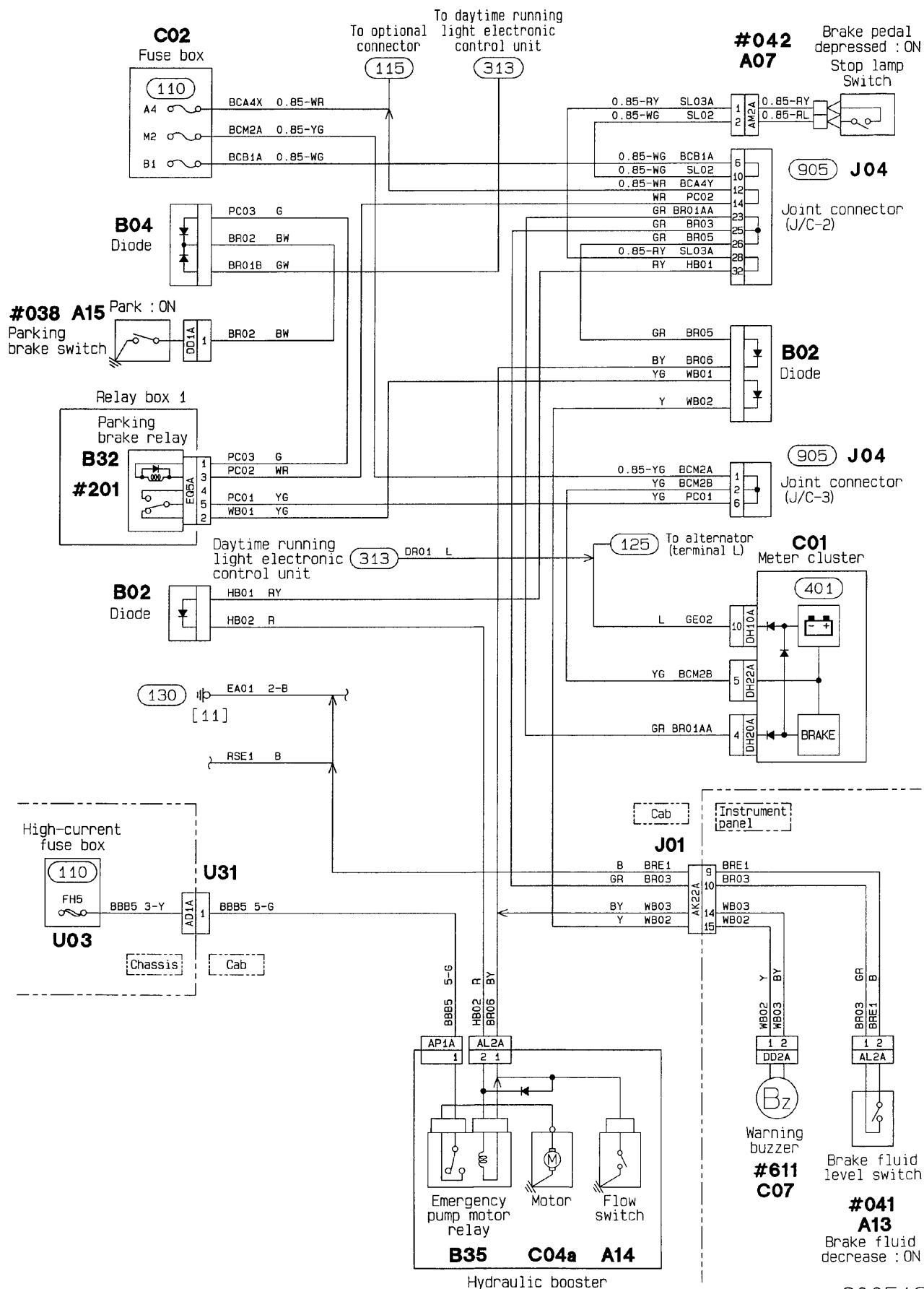
M E M O

515 BRAKE WARNING CIRCUIT

<Except hydraulic booster>

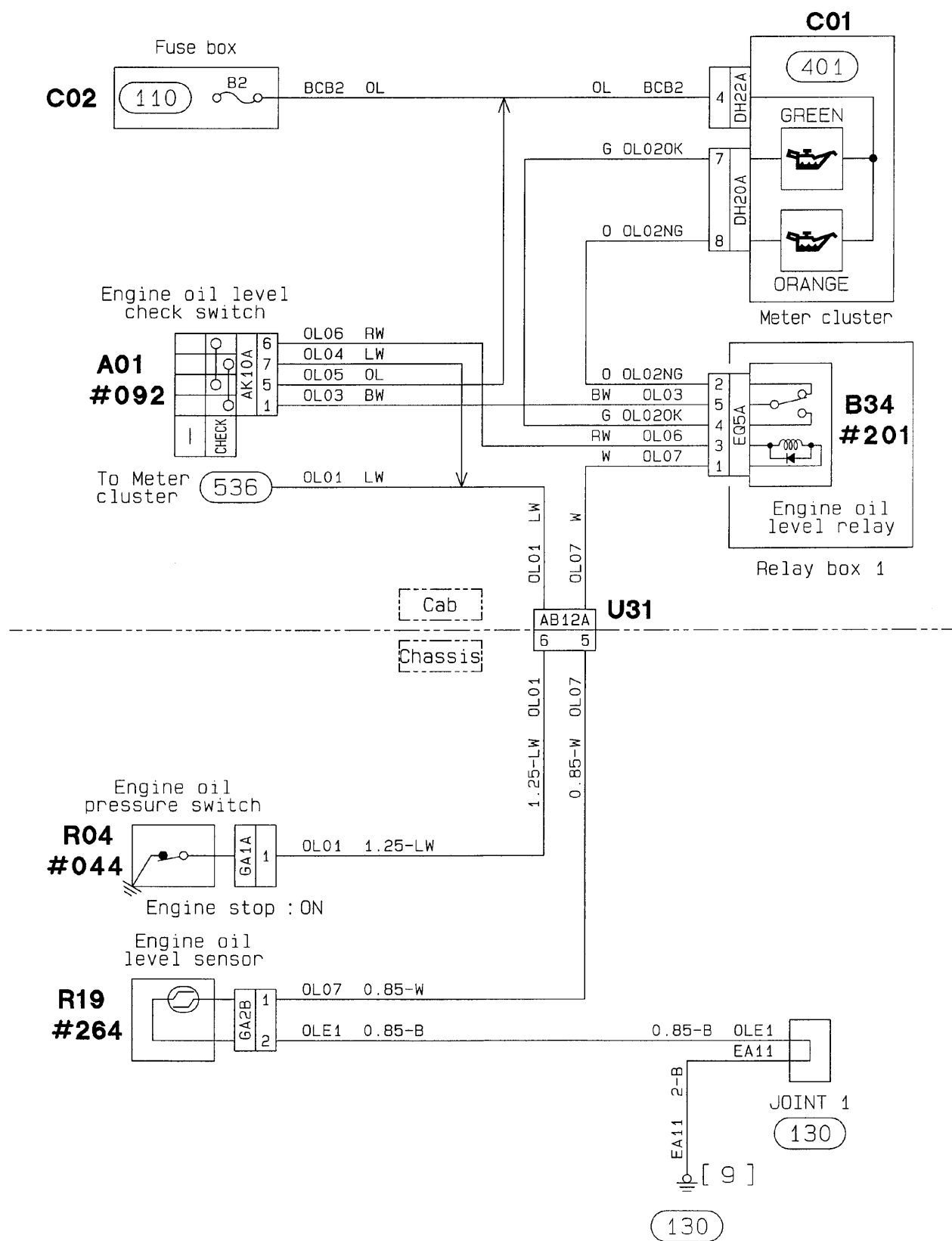


<Hydraulic booster>

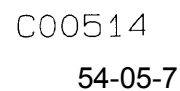


C00512

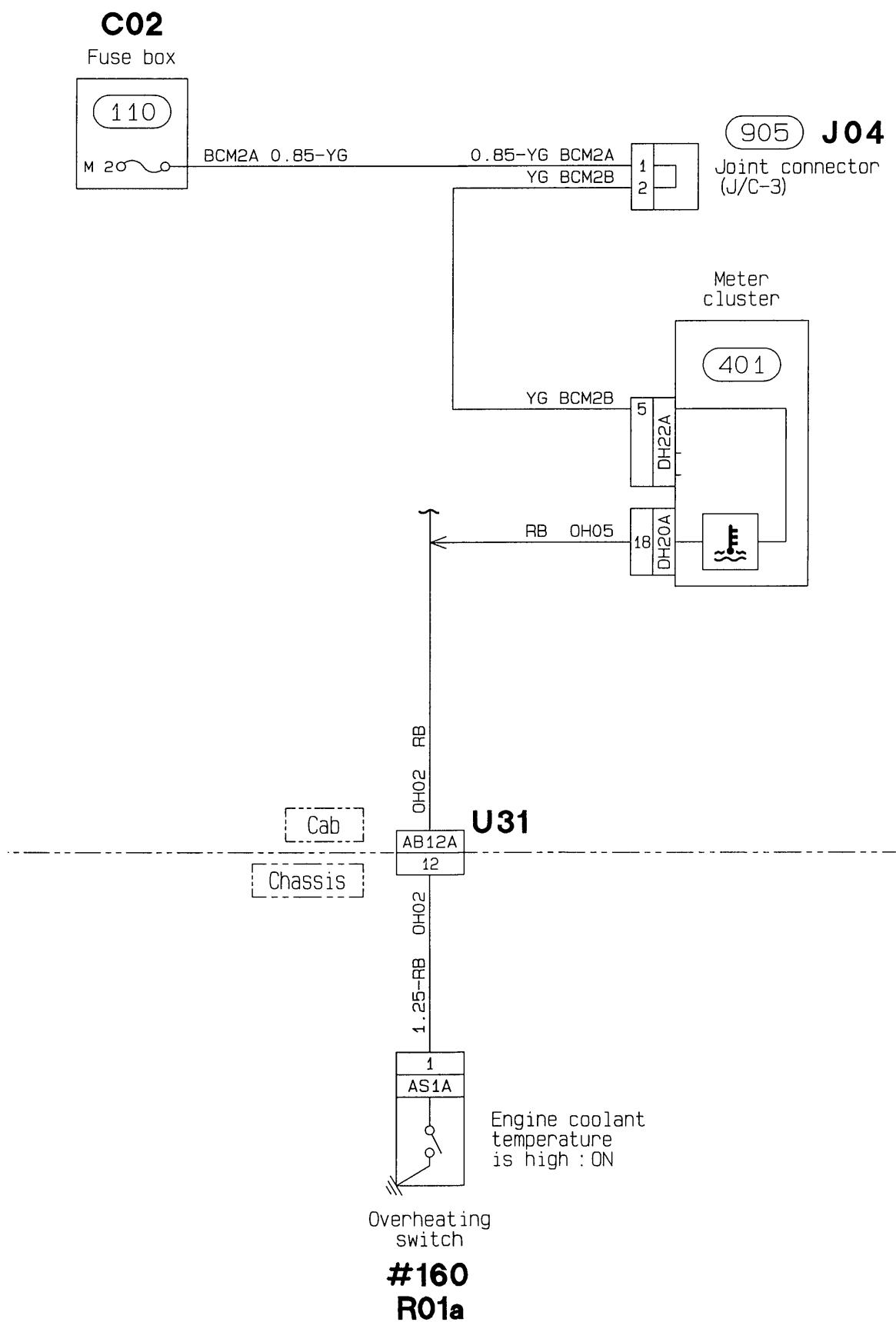
535 ENGINE OIL LEVEL WARNING CIRCUIT



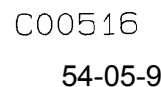
C00513



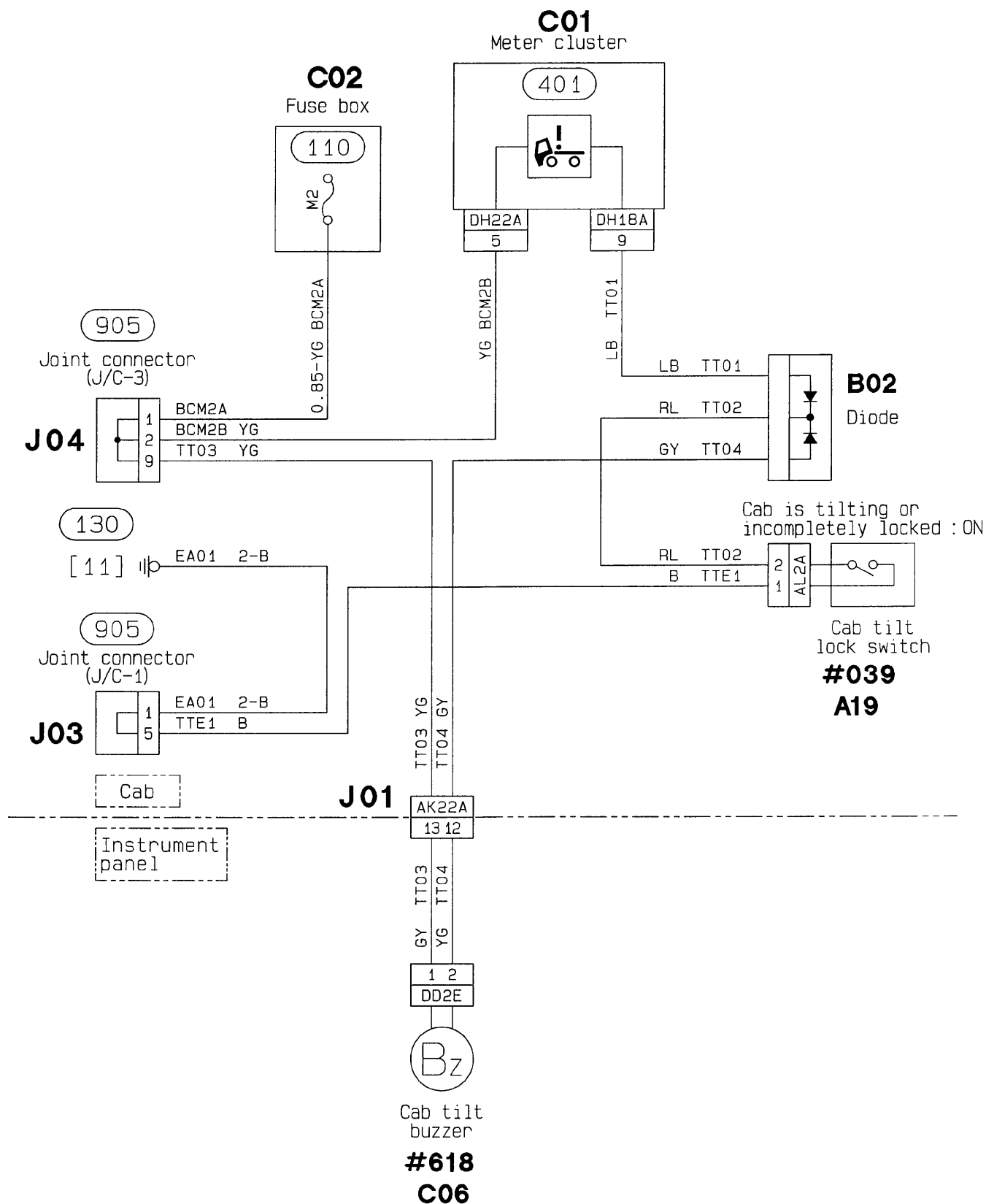
537 OVERHEATING WARNING CIRCUIT



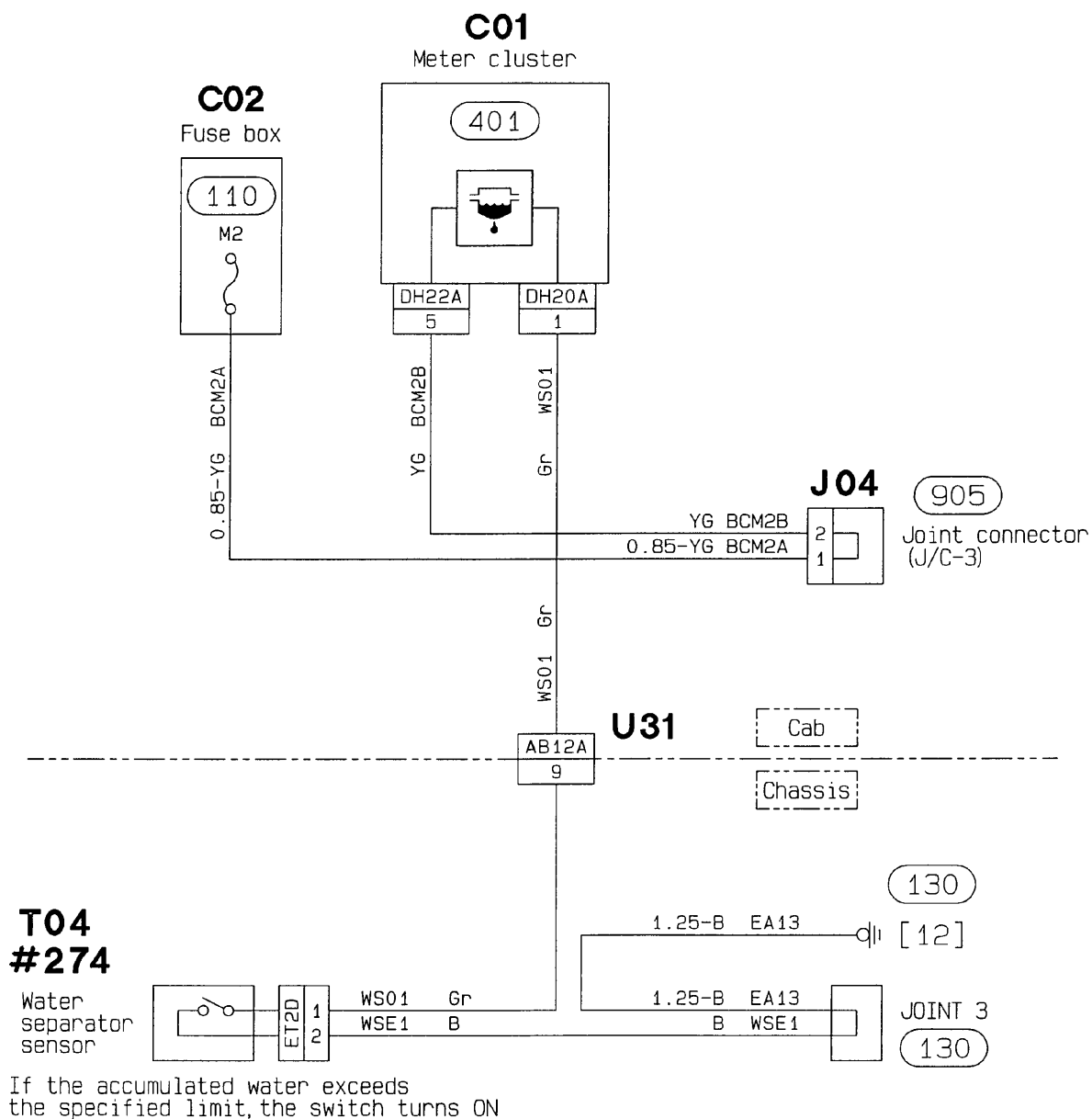
C00515



550 CAB TILT WARNING CIRCUIT

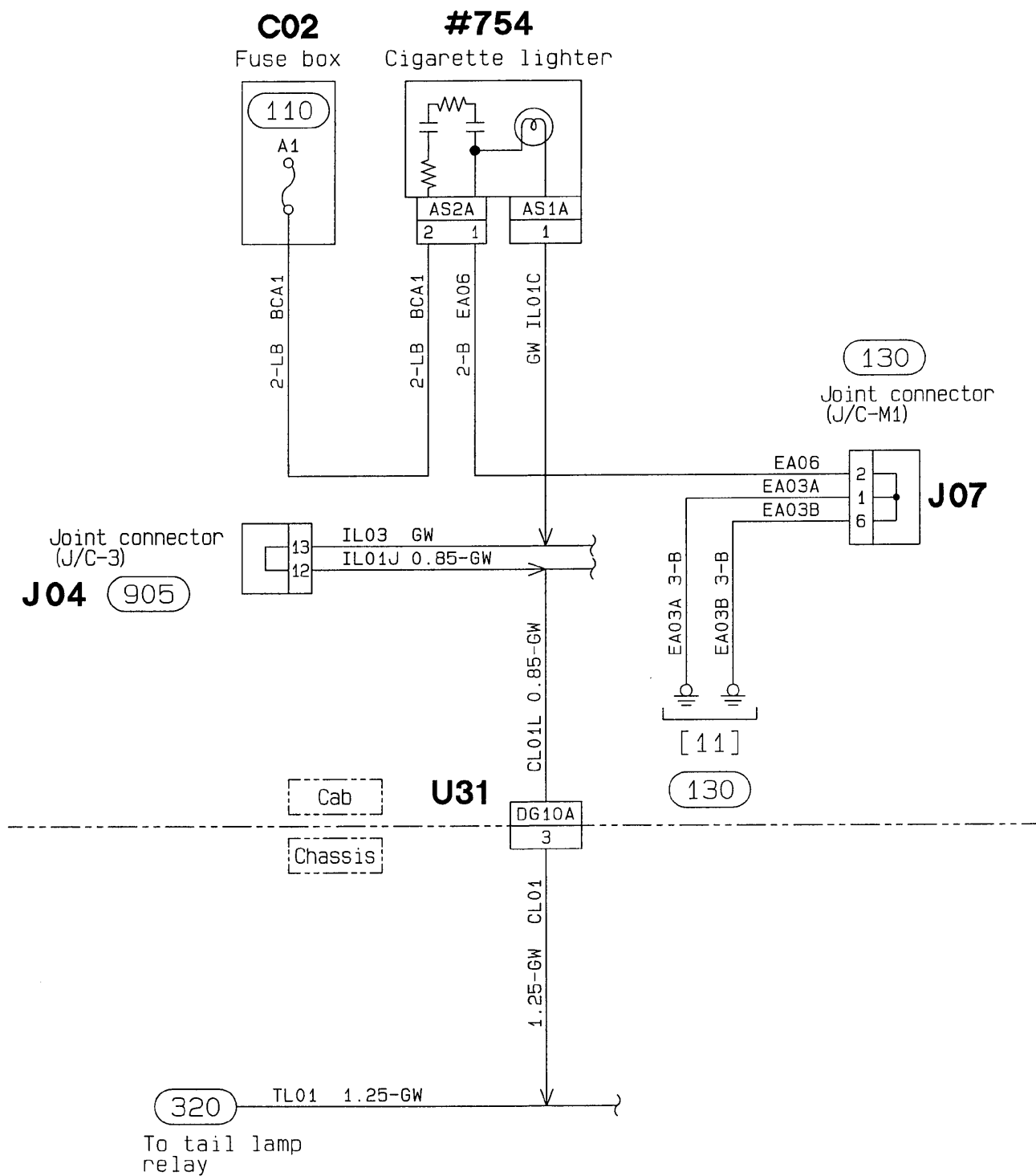


C00517

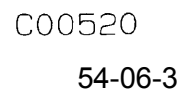


54-06 CAB SIDE ELECTRICAL CIRCUIT

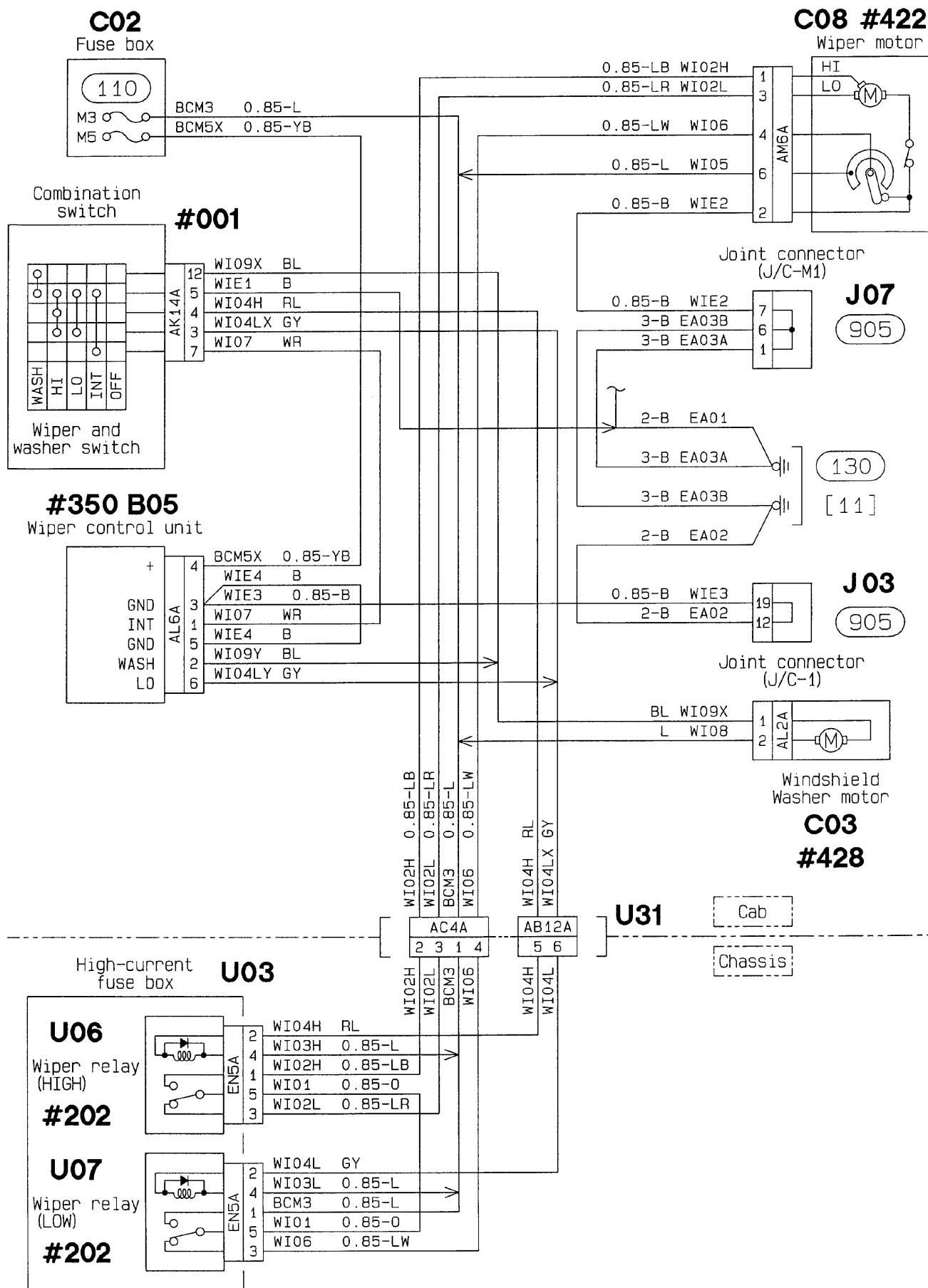
610 CIGARETTE LIGHTER CIRCUIT



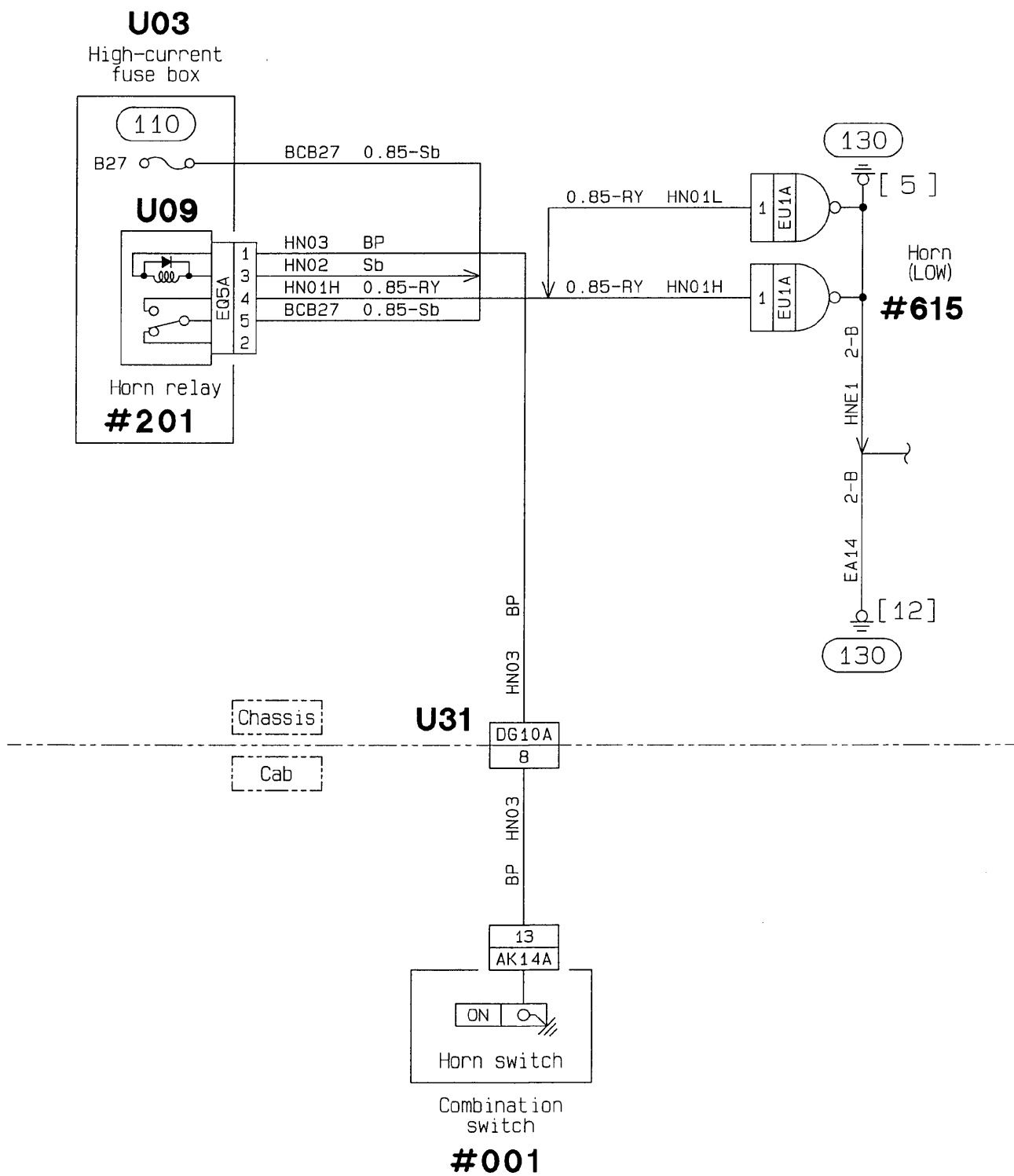
C00519



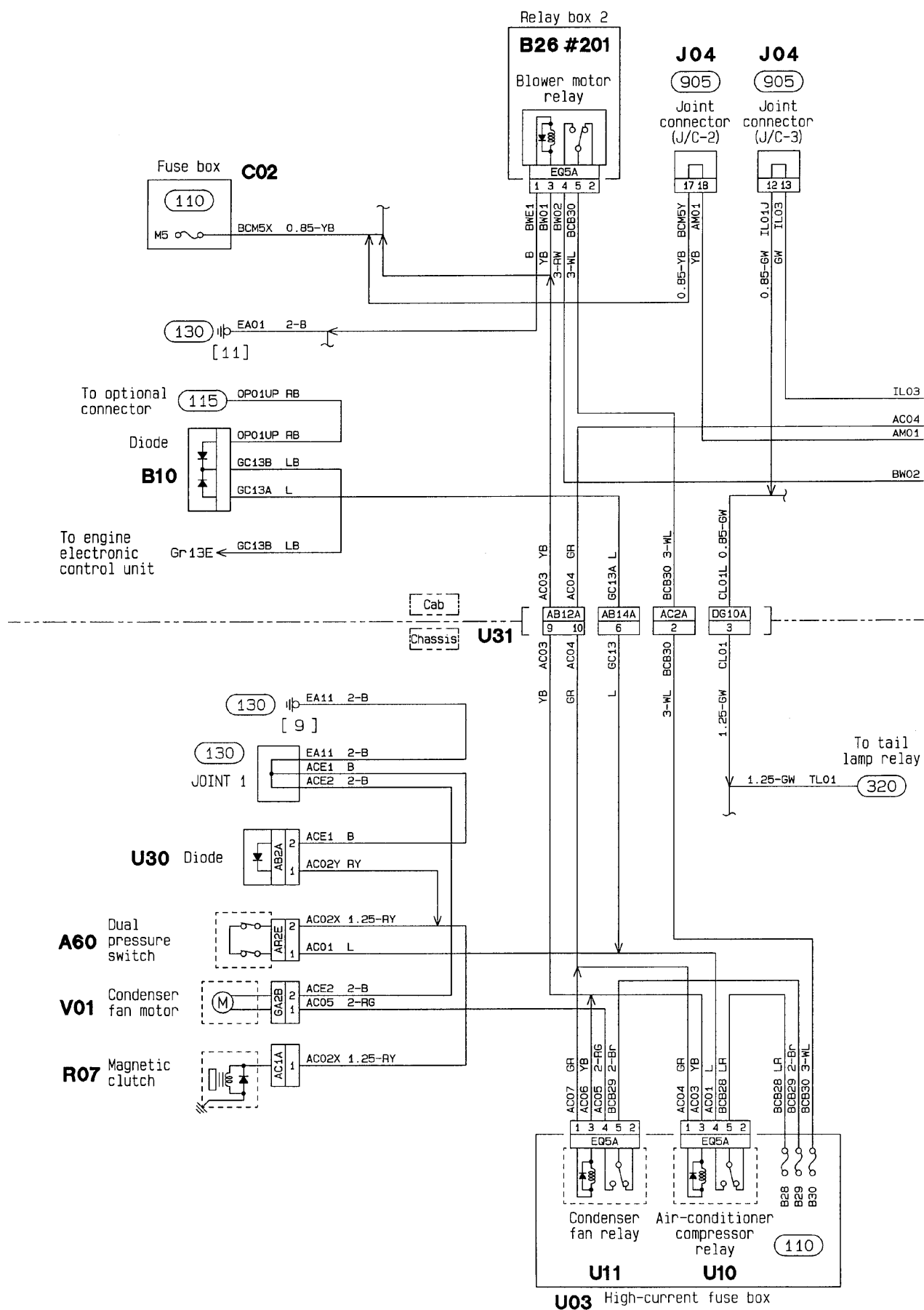
614 WIPER AND WASHER CIRCUIT



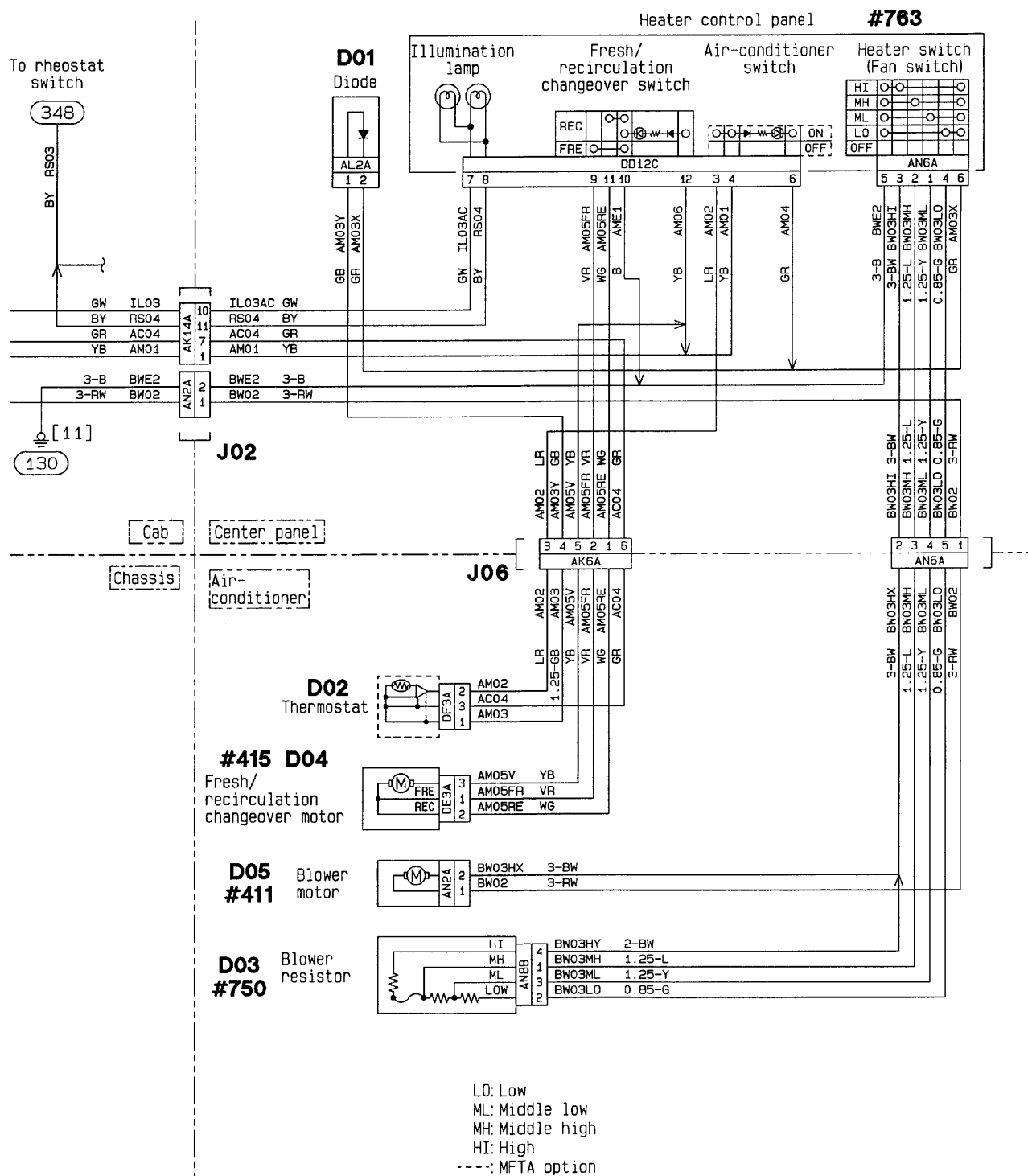
C00521



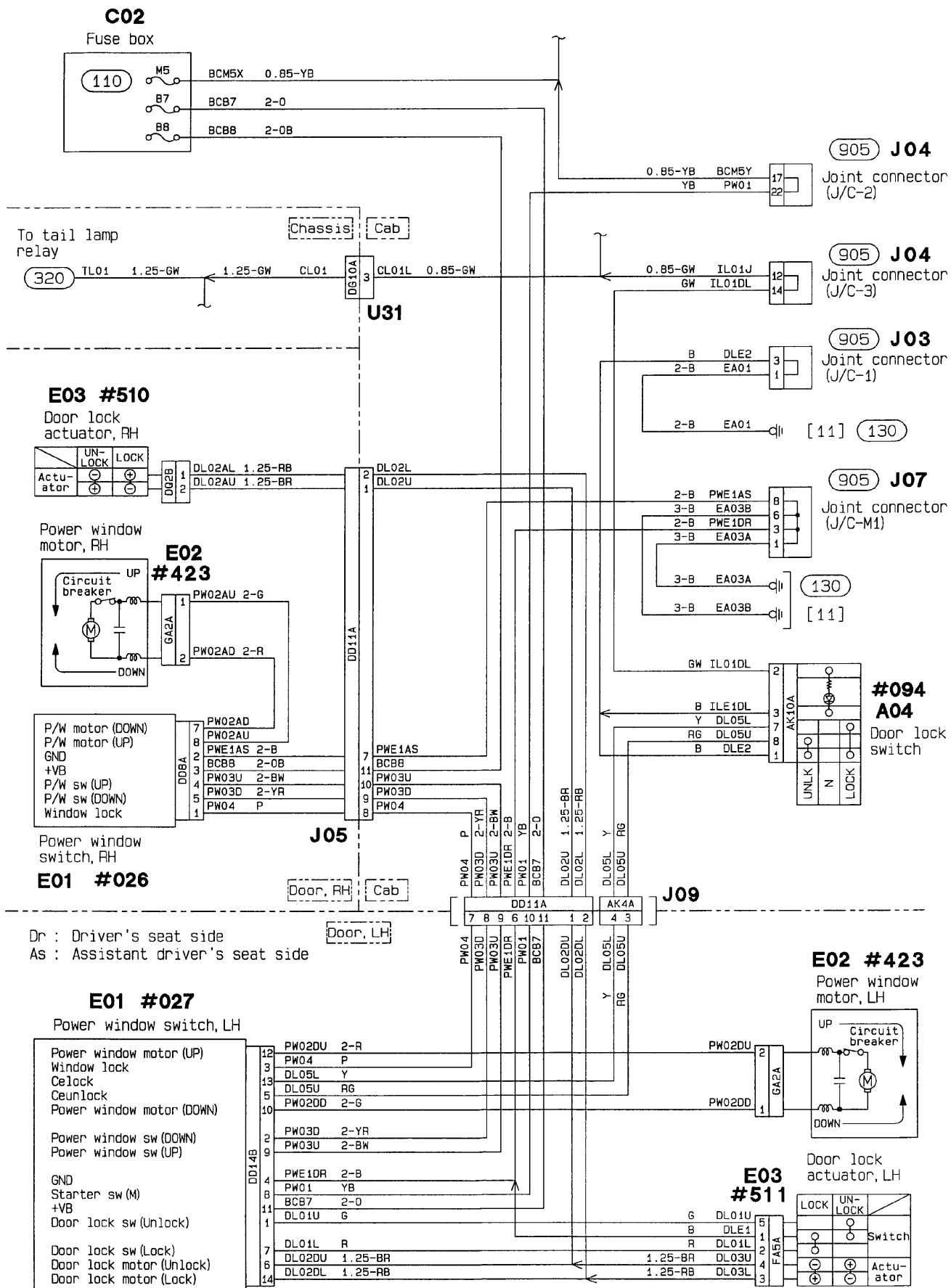
620 AIR-CONDITIONER CIRCUIT



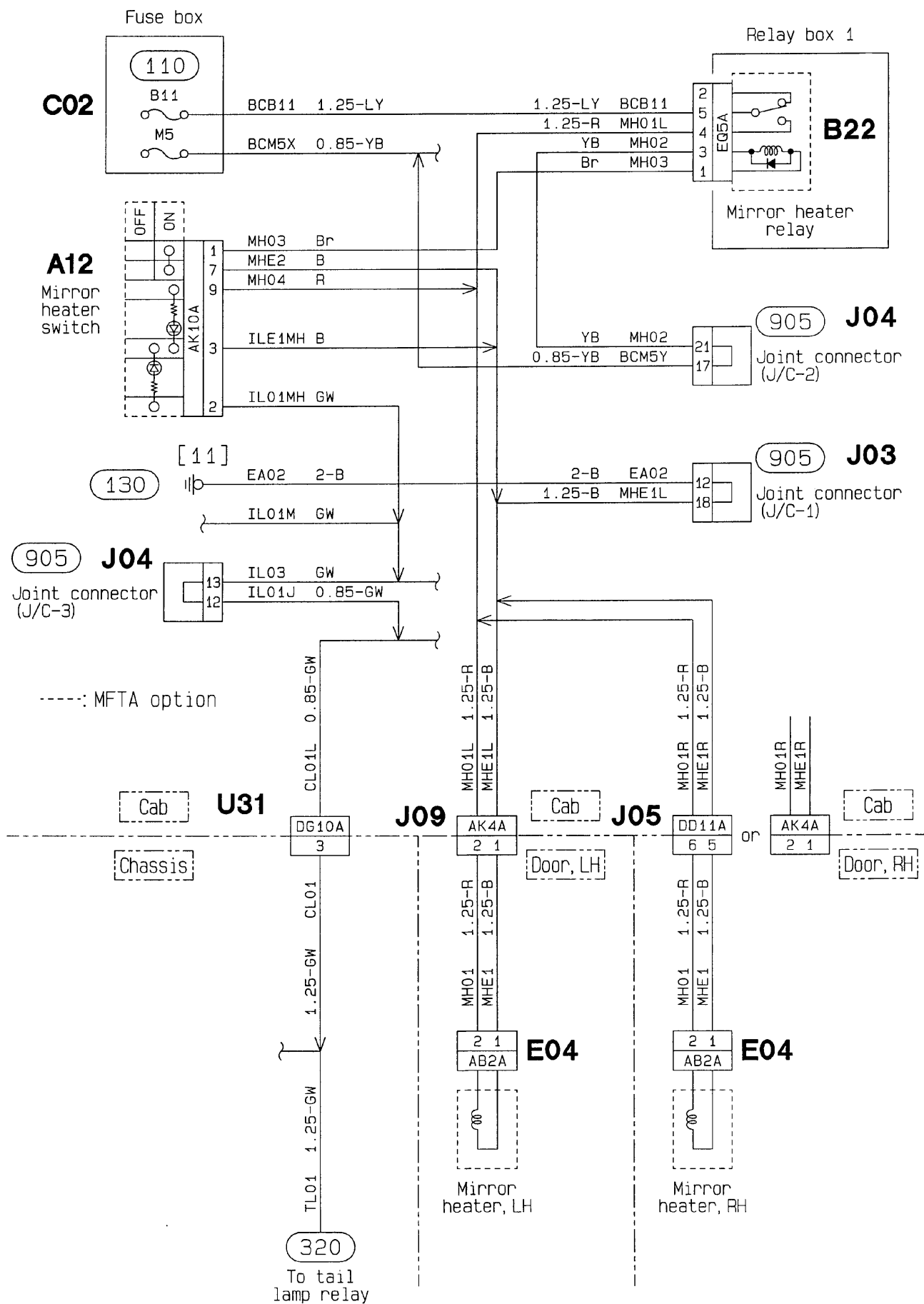
C00523-1



622 POWER WINDOW AND AUTO DOOR LOCK CIRCUIT



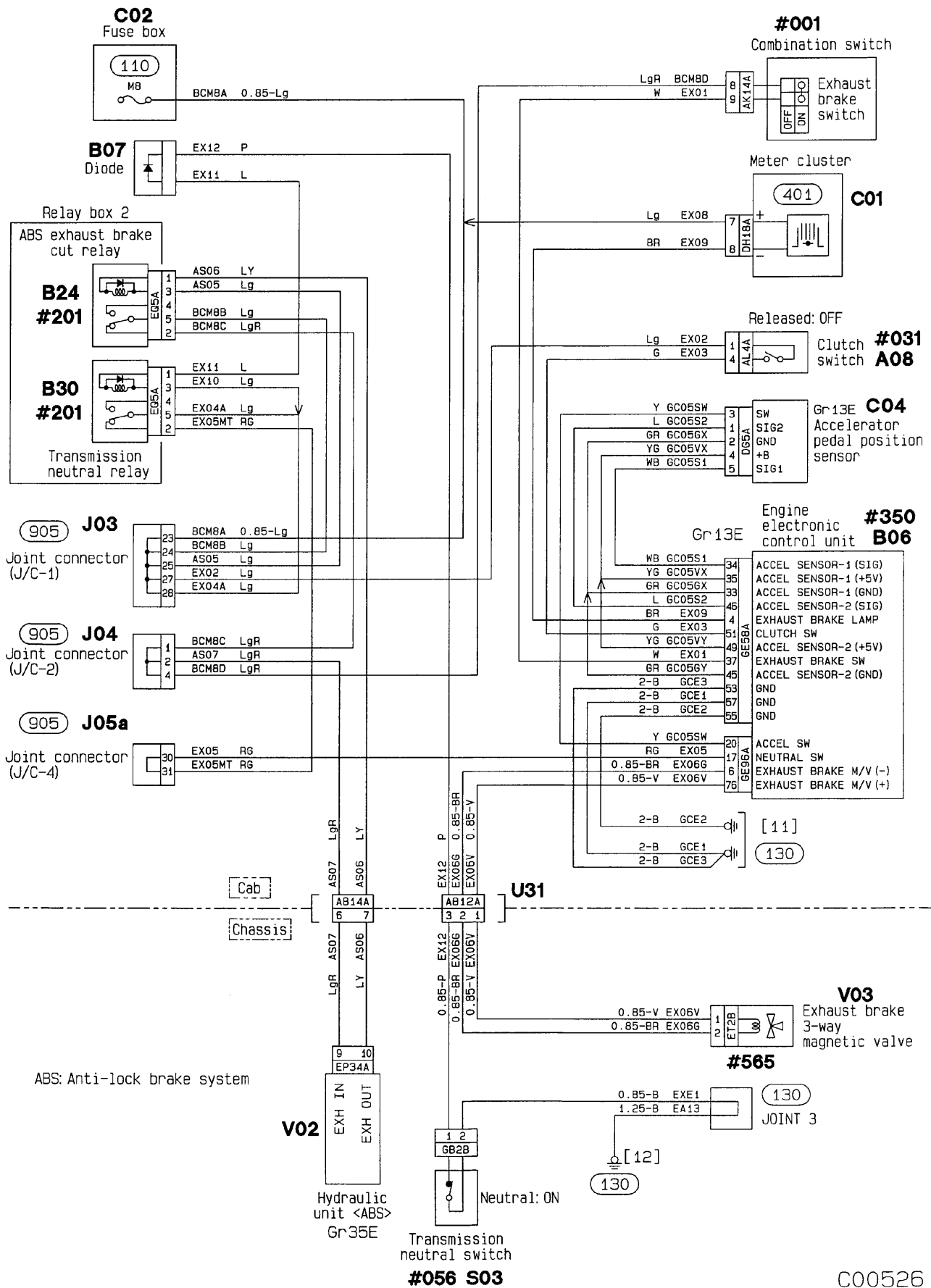
C00524



54-07 CHASSIS SIDE ELECTRICAL CIRCUIT

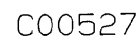
710 EXHAUST BRAKE CIRCUIT

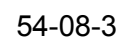
<Manual transmission>



54-08 ENGINE AND TRANSMISSION SIDE ELECTRICAL CIRCUIT

54-08-2



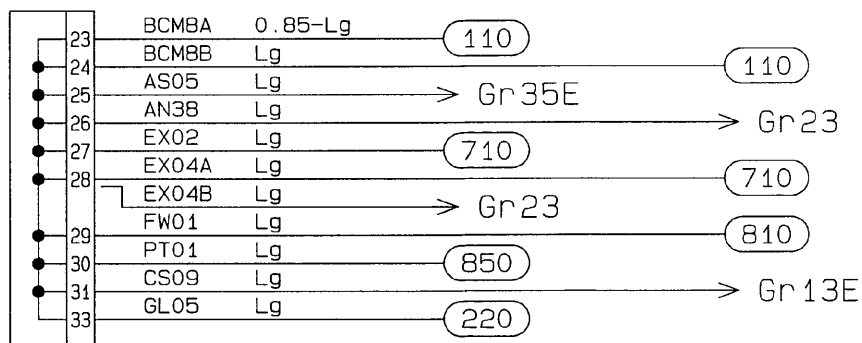
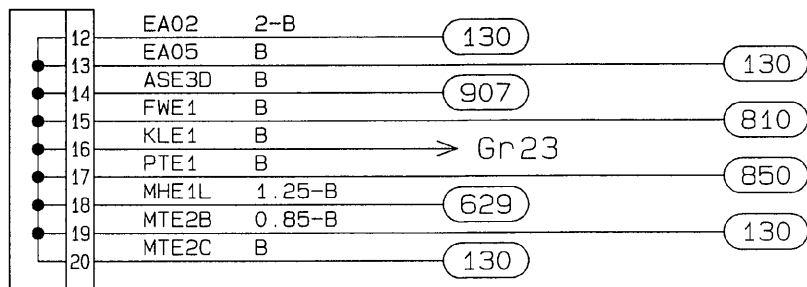
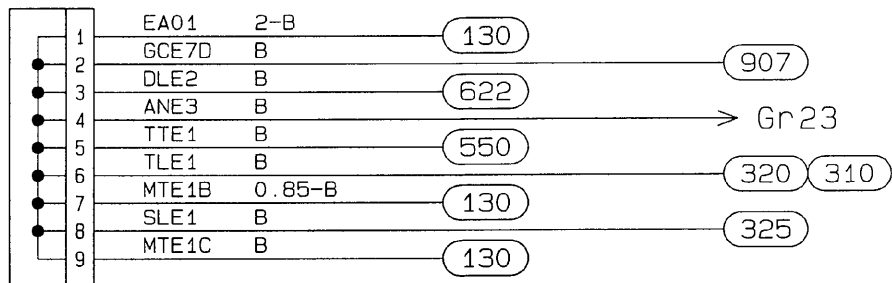


54-09 OTHER CIRCUIT

905 JOINT CONNECTOR (J/C)

(J/C-1)

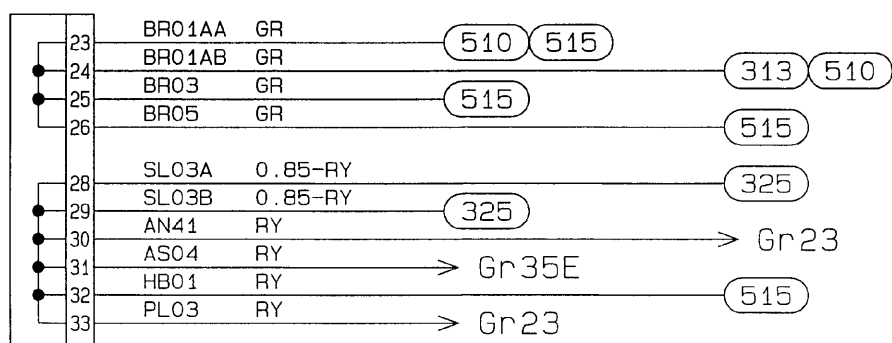
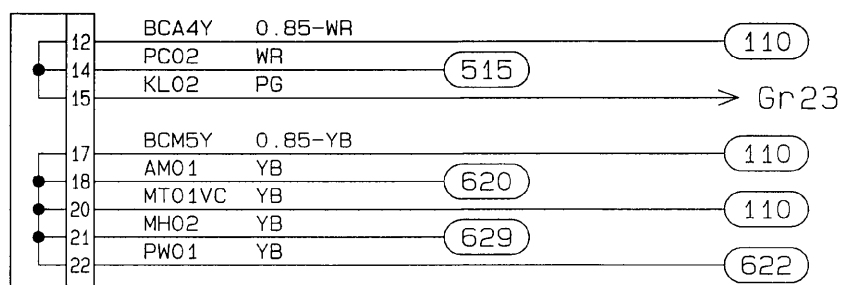
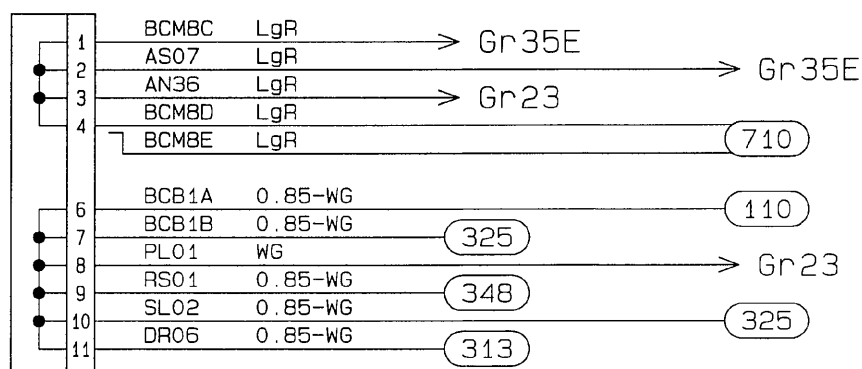
1	2	3	4	5	6	7	8	9	10	11
EA01	GCE7D	DLE2	ANE3	TTE1	TLE1	MTE1B	SLE1	MTE1C		—
12	13	14	15	16	17	18	19	20	21	22
EA02	EA05	ASE3D	FWE1	KLE1	PTE1	MHE1L	MTE2B	MTE2C		—
23	24	25	26	27	28	29	30	31	32	33
BCM8A	BCM8B	AS05	AN38	EX02	EX04A EX04B	FW01	PT01	CS09		GL05



C00529

(J/C-2)

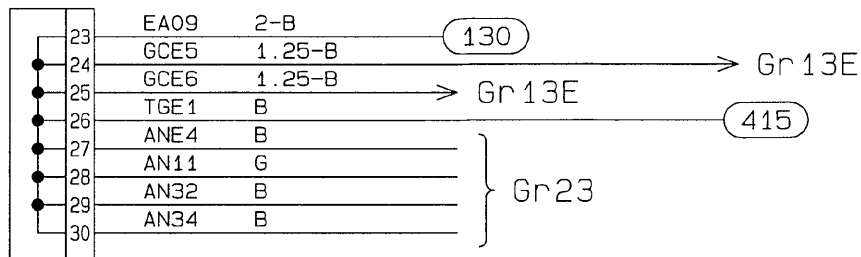
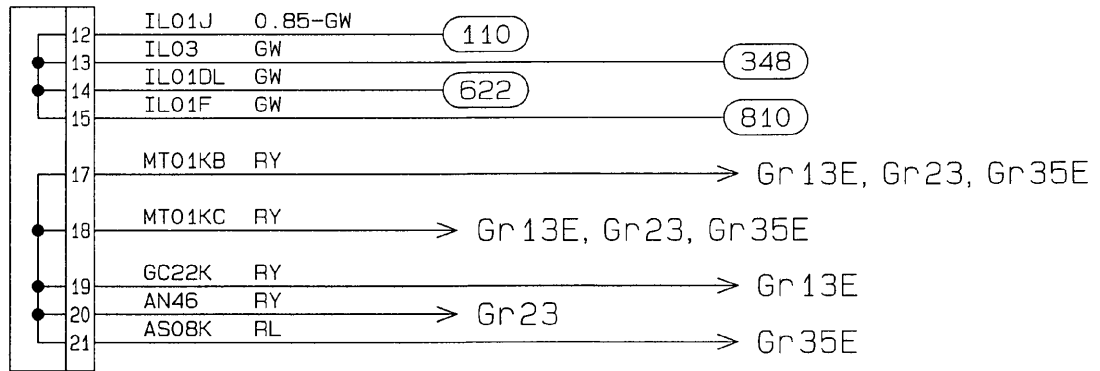
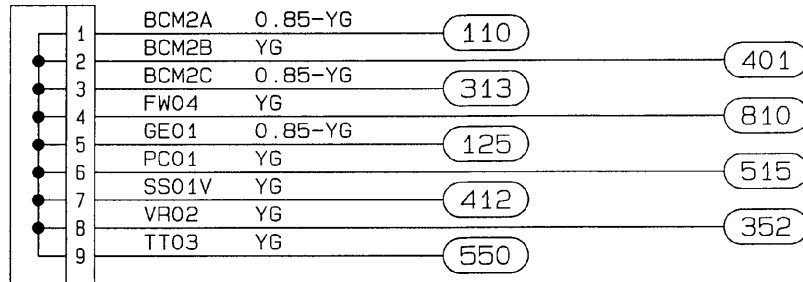
1	2	3	4	5	6	7	8	9	10	11
BCMBC	AS07	AN36	BCM8D BCM8E		BCB1A	BCB1B	PL01	RS01	SL02	DR06
12	13	14	15	16	17	18	19	20	21	22
BCA4Y	—	PC02	KL02		BCM5Y	AM01	—	MT01VC	MH02	PW01
23	24	25	26	27	28	29	30	31	32	33
BR01AA	BR01AB	BR03	BR05		SL03A	SL03B	AN41	AS04	HB01	PL03



905 JOINT CONNECTOR (J/C)

(J/C-3)

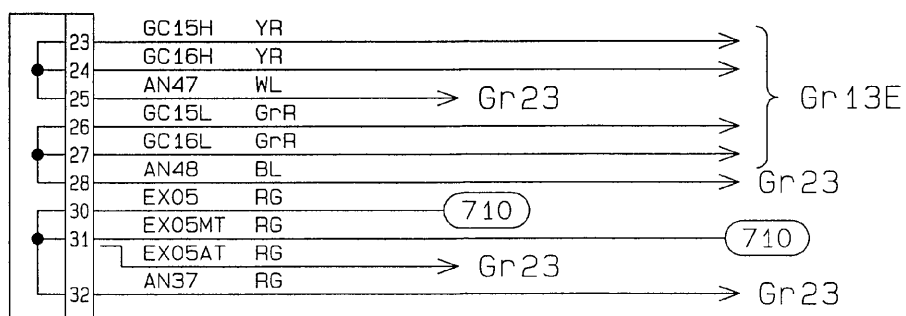
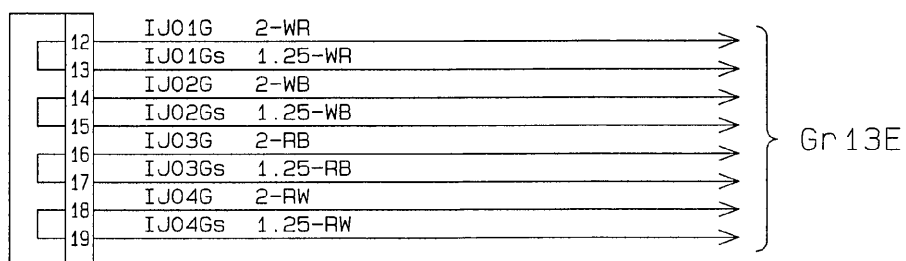
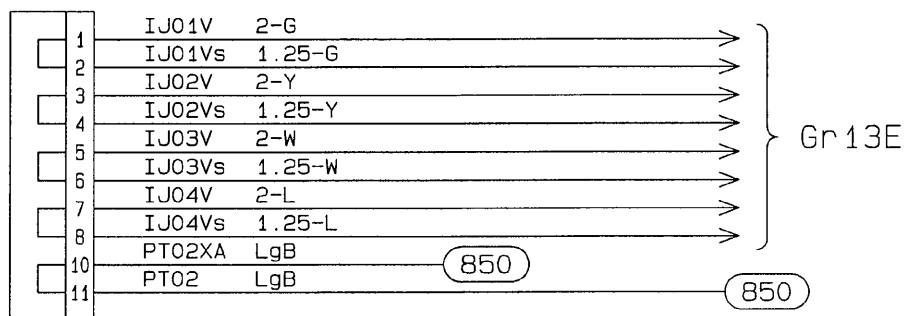
1	2	3	4	5	6	7	8	9	10	11
BCM2A	BCM2B	BCM2C	FW04	GE01	PC01	SS01V	VR02	TT03		—
12	13	14	15	16	17	18	19	20	21	22
IL01J	IL03	IL01DL	IL01F		MT01KB	MT01KC	GC22K	AN46	AS08K	—
23	24	25	26	27	28	29	30	31	32	33
EA09	GCE5	GCE6	TGE1	ANE4	AN11	AN32	AN34	—		—



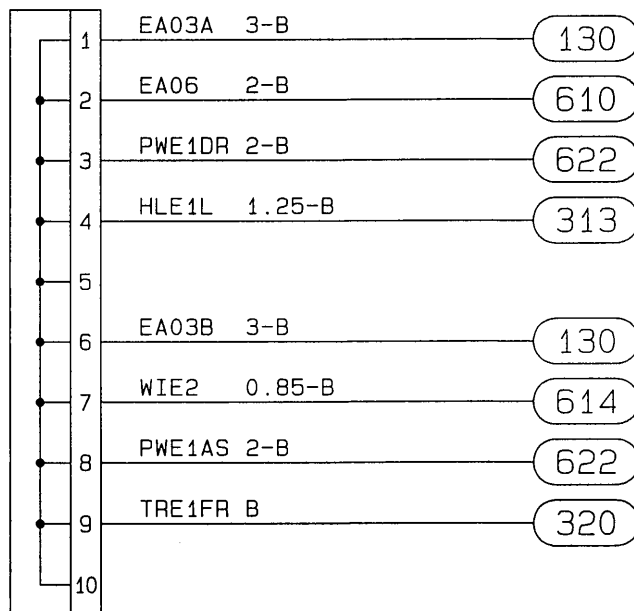
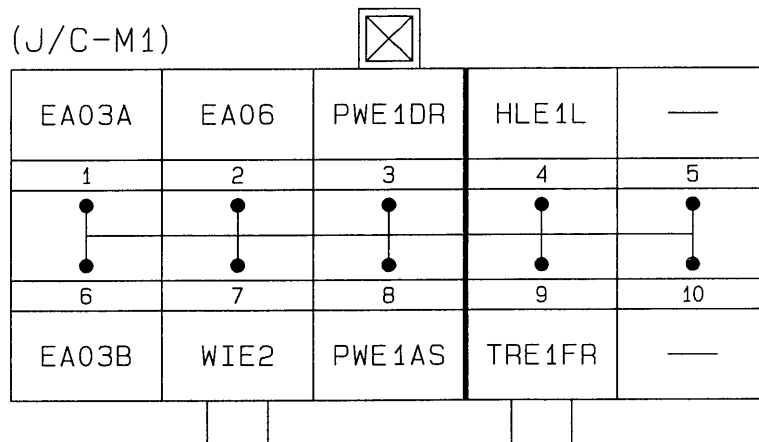
C00531

(J/C-4)

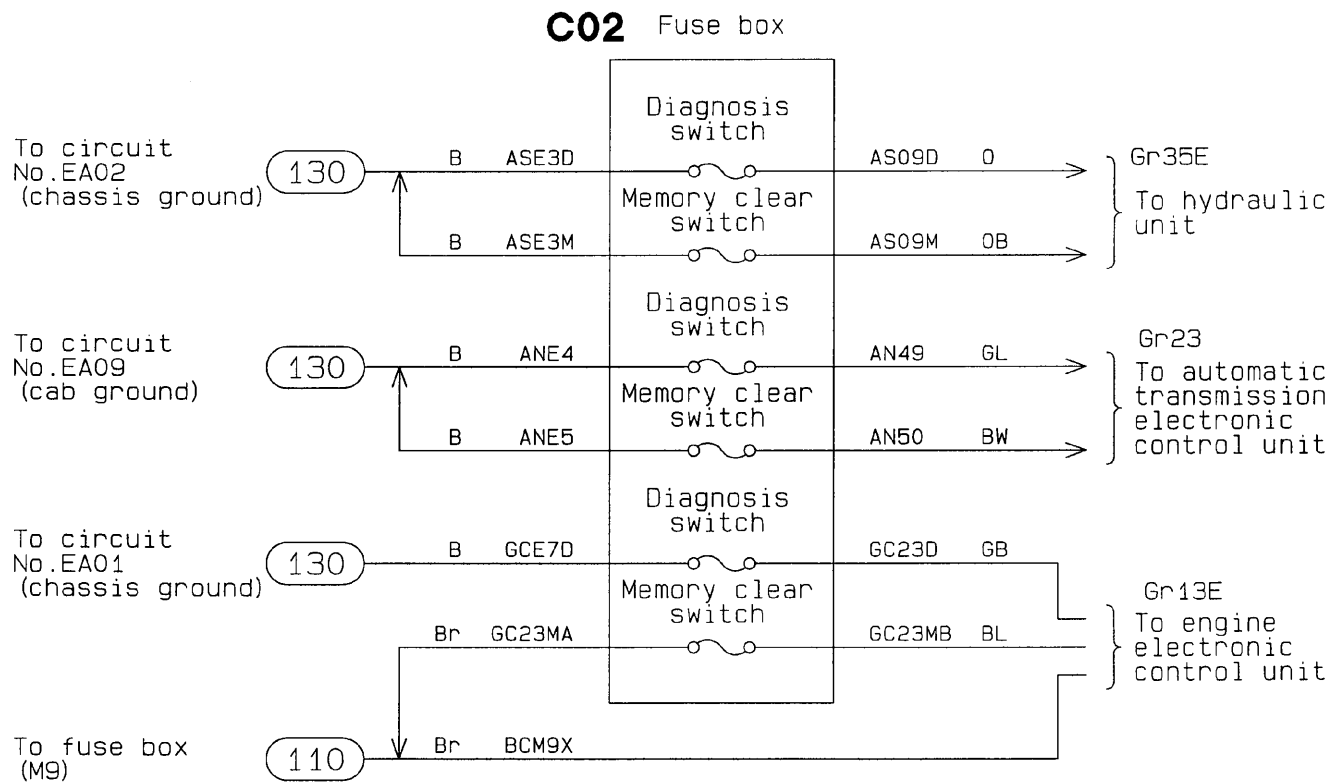
1	2	3	4	5	6	7	8	9	10	11
IJ01V	IJ01Vs	IJ02V	IJ02Vs	IJ03V	IJ03Vs	IJ04V	IJ04Vs		PT02XA	PT02
12	13	14	15	16	17	18	19	20	21	22
IJ01G	IJ01Gs	IJ02G	IJ02Gs	IJ03G	IJ03Gs	IJ04G	IJ04Gs		—	—
23	24	25	26	27	28	29	30	31	32	33
GC15H	GC16H	AN47	GC15L	GC16L	AN48		EX05	EX05AT EX05MT	AN37	—



905 JOINT CONNECTOR (J/C)



C00533



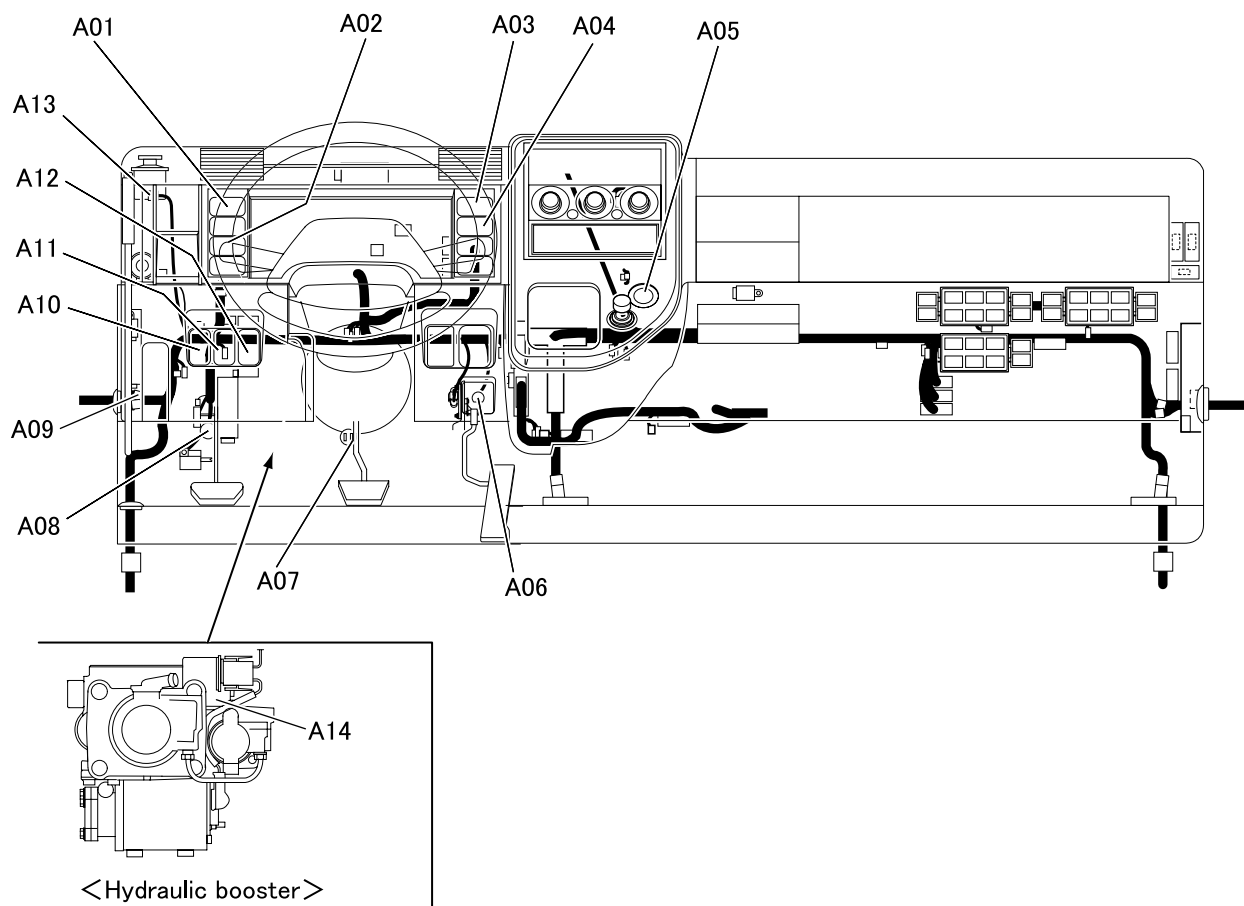
The fuse is substituted for
diagnosis switch and the memory clear switch.

C00534

54-10 PARTS INSTALLATION POSITIONS

A SWITCH

A01 to 14



No relevant parts in a missing number

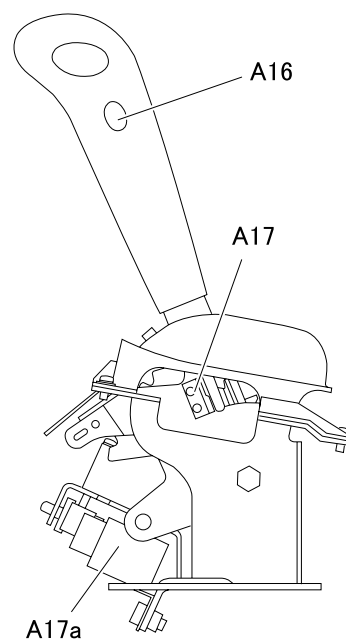
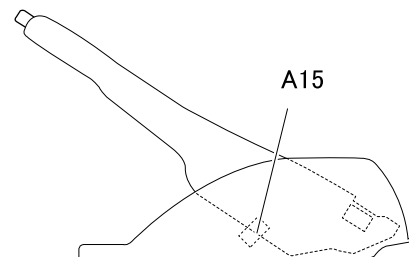
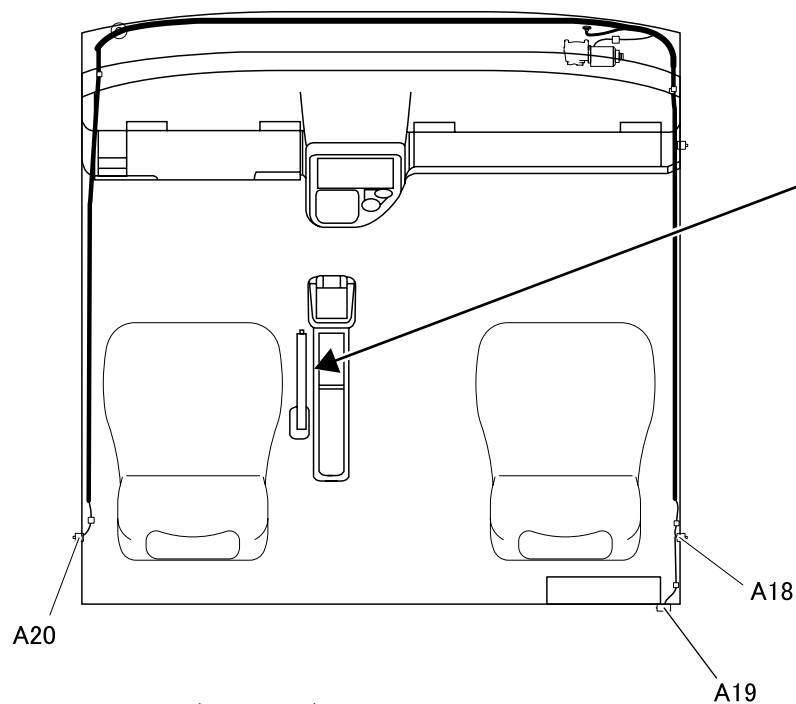
- | | |
|---|--|
| A01 Engine oil level check switch | A09 T/M PTO indicator lamp switch |
| A02 Front drive switch <FG> | A10 Van body dome light switch |
| A03 Warming switch | A11 Rheostat switch |
| A04 Door lock switch | A12 Mirror heater switch |
| A05 Hazard switch | A13 Brake fluid level switch |
| A06 Idling speed adjustment potentiometer | A14 Flow switch <With hydraulic booster> |
| A07 Stop lamp switch | |
| A08 Clutch switch | |

PTO : Power take-off

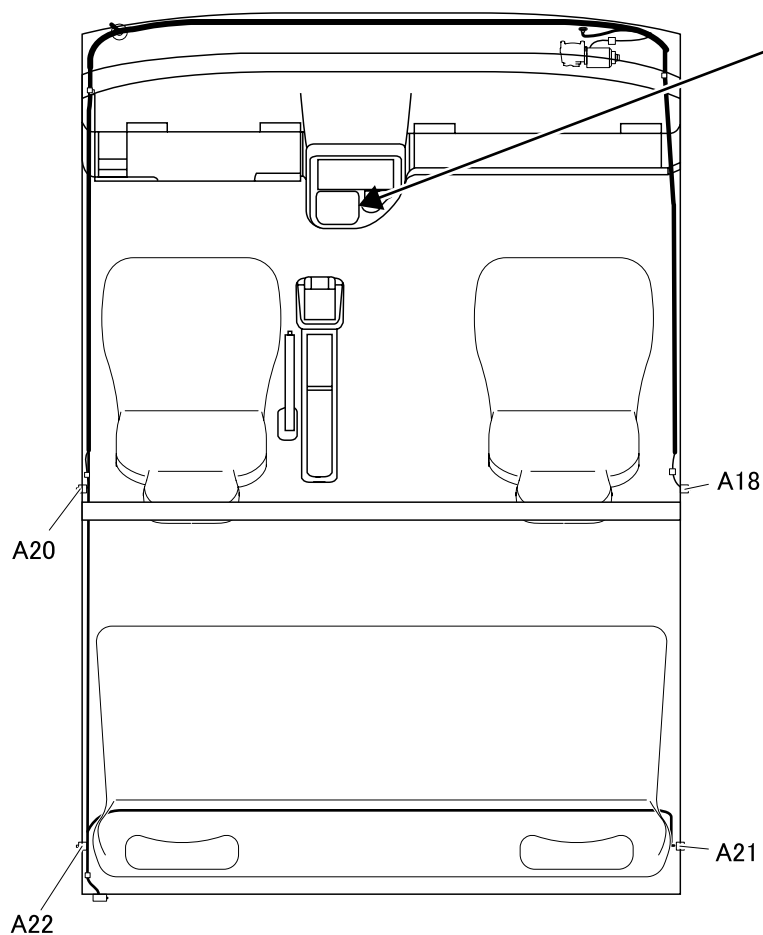
T/M : Transmission

A15 to 22

<Except crew cab>



<Crew cab>



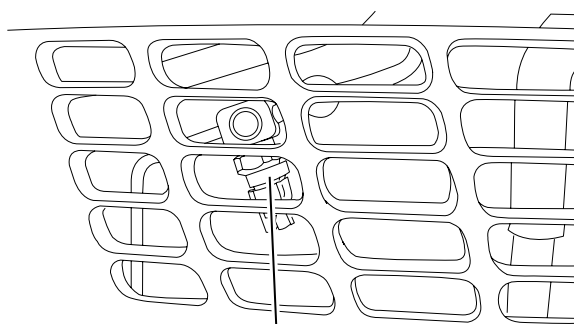
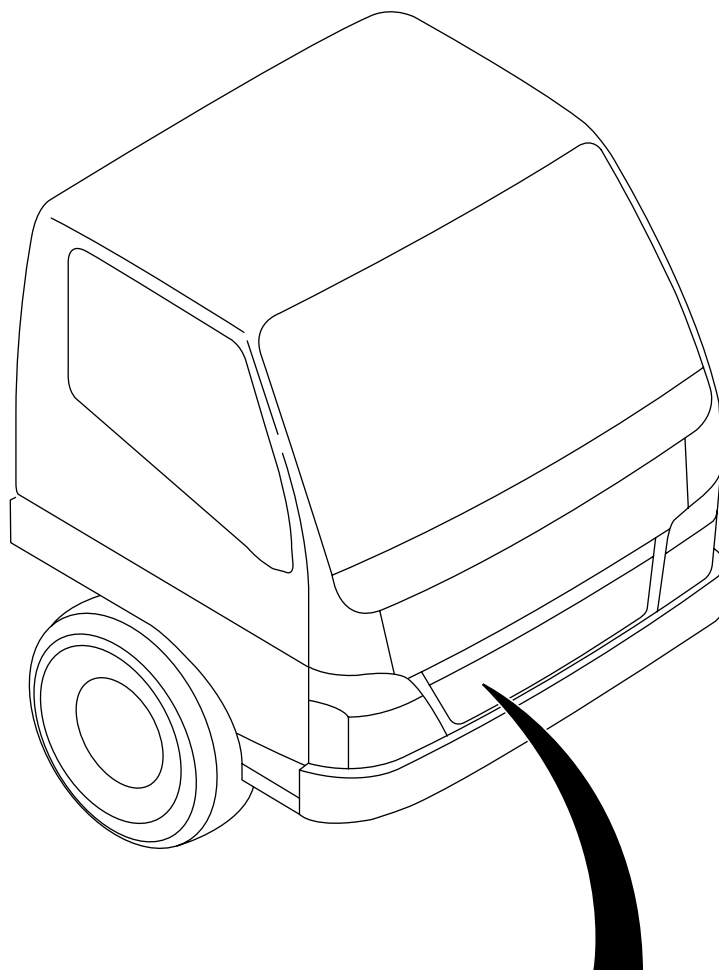
No relevant parts in a missing number

- A15 Parking brake switch
- A16 O/D switch <A/T>
- A17 P range switch <A/T>
- A17a Shift lock actuator <A/T>
- A18 Front door switch, RH
- A19 Cab tilt lock switch <Except crew cab>
- A20 Front door switch, LH
- A21 Rear door switch, RH <Crew cab>
- A22 Rear door switch, LH <Crew cab>

A/T : Automatic transmission
O/D : Over drive

A SWITCH

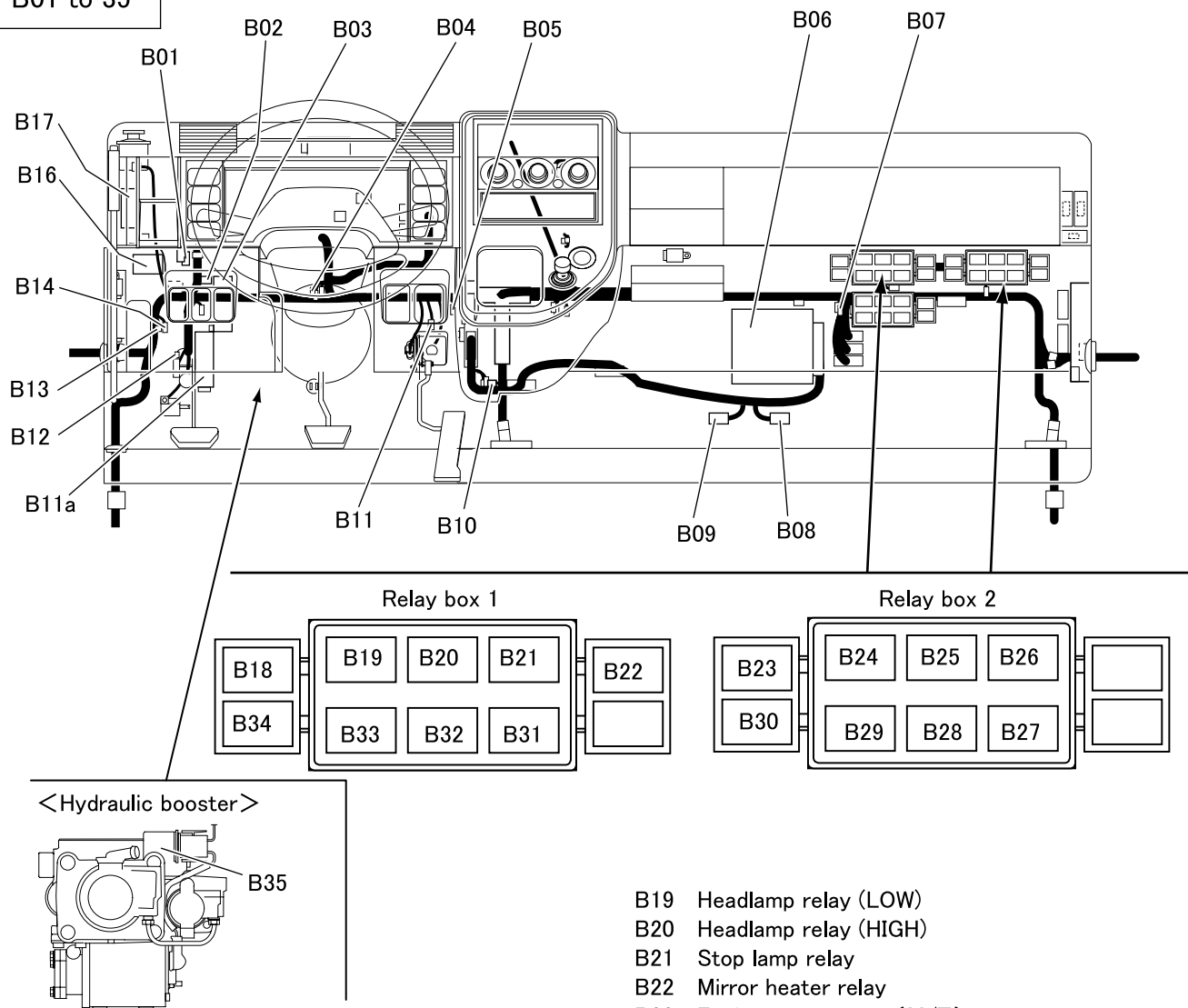
A60



A60

A60 Dual pressure switch <With air-conditioner>

B01 to 35



<Hydraulic booster>

No relevant parts in a missing number

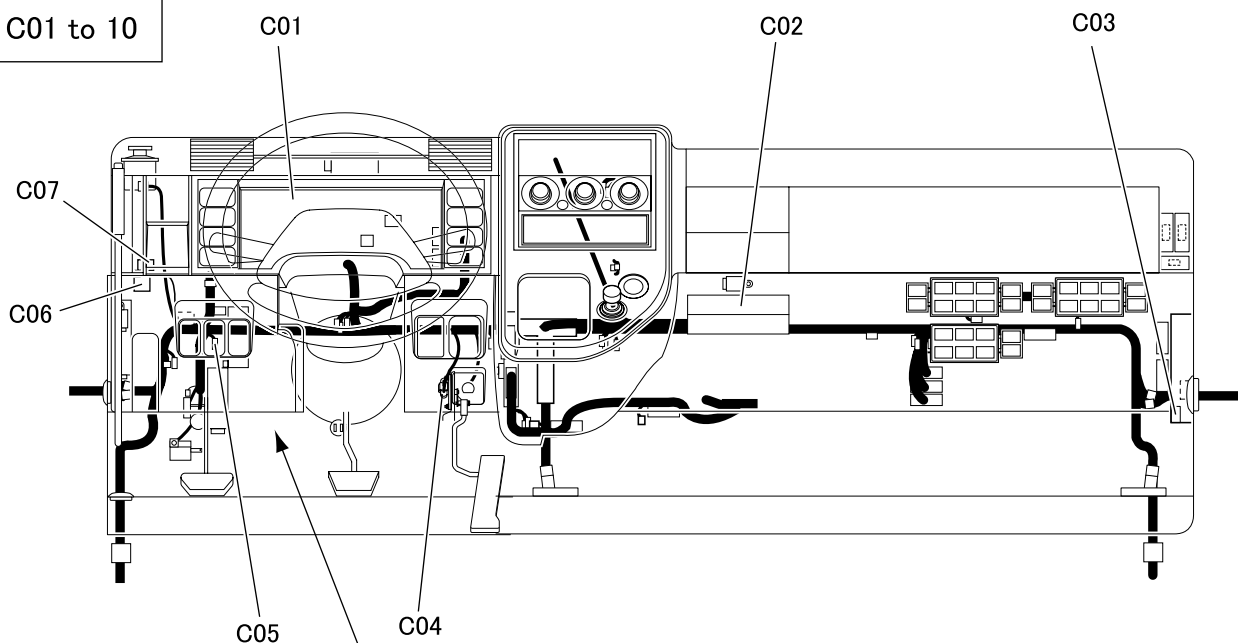
- B01 Diode
- B02 Diode
- B03 Flasher unit
- B04 Diode
- B05 Wiper control unit
- B06 Engine ECU
- B07 Diode
- B08 Resistor unit
- B09 Resistor unit
- B10 Diode
- B11 PTO resistor
- B11a A/T ECU
- B12 Diode
- B13 Fuel injection rate adjustment unit
- B14 Diode
- B16 Daytime running light ECU
- B17 Key interlock control unit
- B18 Turn signal lamp relay

- B19 Headlamp relay (LOW)
- B20 Headlamp relay (HIGH)
- B21 Stop lamp relay
- B22 Mirror heater relay
- B23 Engine start relay <M/T>
- B24 ABS exhaust brake cut relay
- B25 Glow drive relay
- B26 Blower motor relay
- B27 Four-wheel drive relay <FG>
- B28 Overheating relay
- B29 Daytime running light relay
- B30 T/M neutral relay <M/T>
- B31 Exhaust brake cut relay <A/T>
PTO relay <M/T>
- B32 Parking brake relay <With hydraulic booster>
- B33 Safety relay
- B34 Engine oil level relay
- B35 Emergency pump motor relay
<With hydraulic booster>

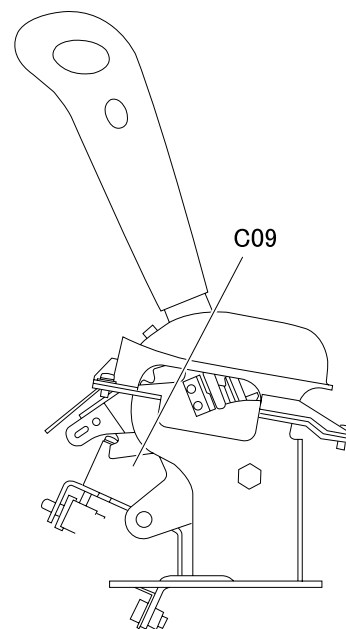
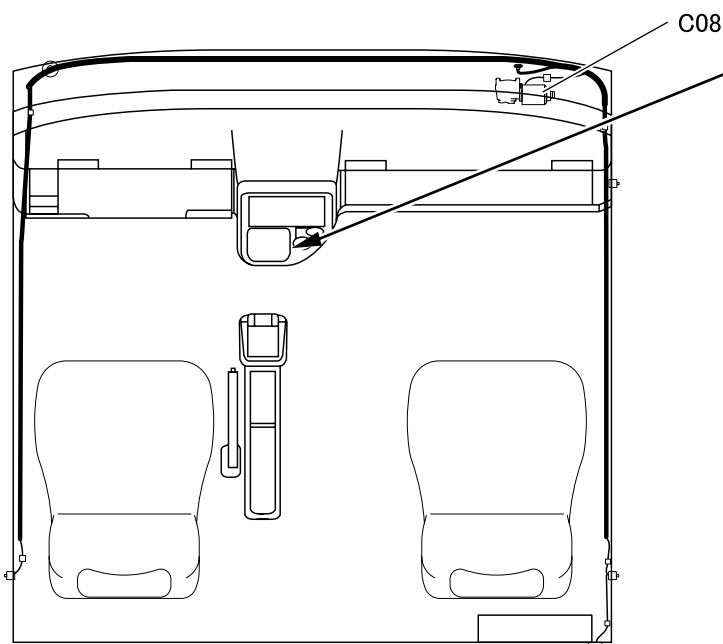
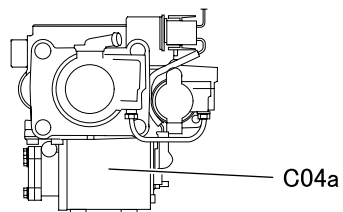
A/T : Automatic transmission
 ABS : Anti-lock brake system
 ECU : Electronic control unit
 M/T : Manual transmission
 PTO : Power take-off
 T/M : Transmission

C FUSE, METER, SENSOR, BUZZER, MOTOR AND ACTUATOR

C01 to 10



<Hydraulic booster>



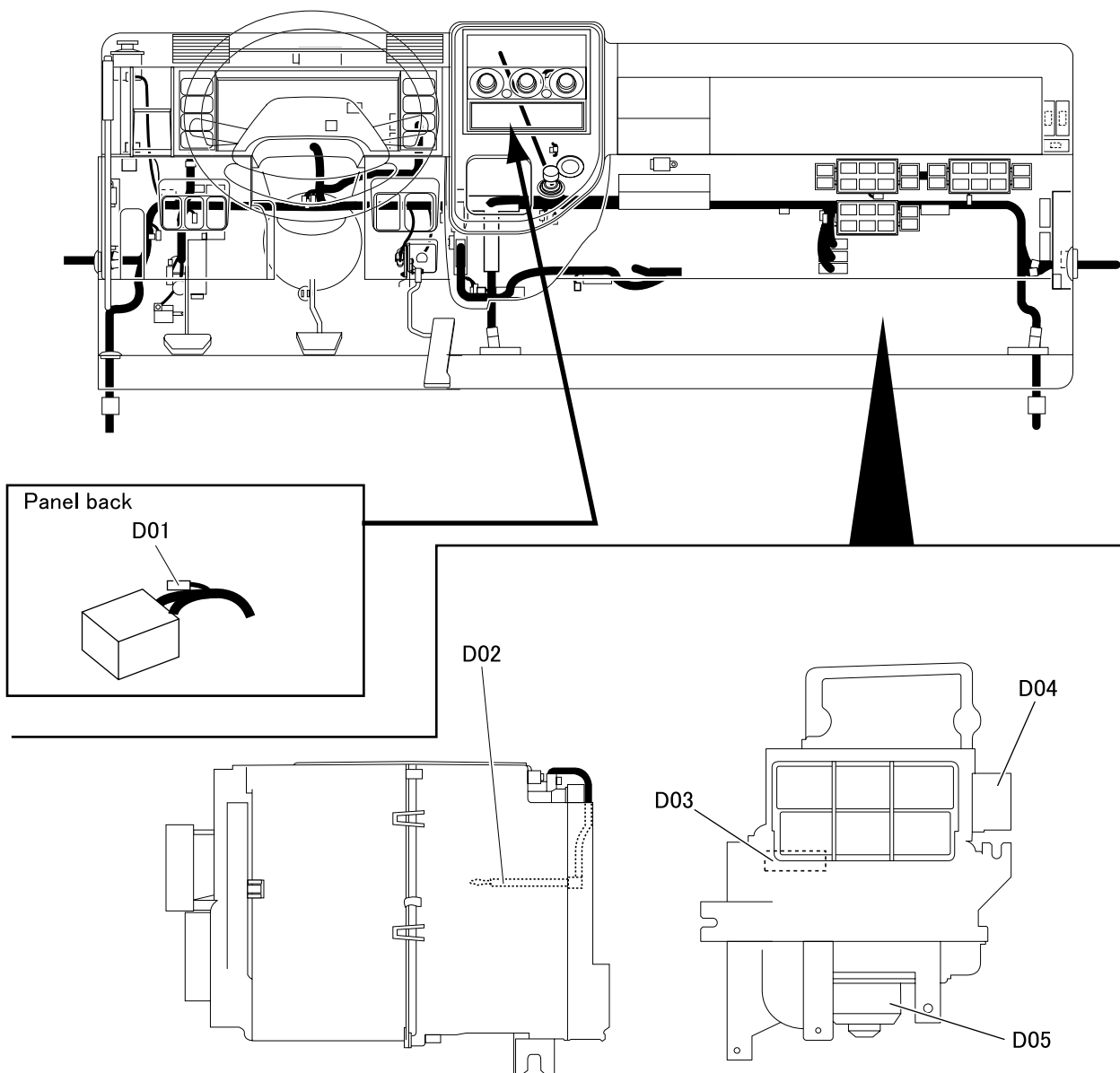
No relevant parts in a missing number

- C01 Meter cluster
- C02 Fuse box
- C03 Windshield washer motor
- C04 Accelerator pedal position sensor

- C04a Motor <With hydraulic booster>
- C05 G sensor <ABS>
- C06 Cab tilt buzzer
- C07 Warning buzzer
- C08 Wiper motor
- C09 Shift lock actuator <A/T>

ABS: Anti-lock brake system
A/T: Automatic transmission

D01 to 05

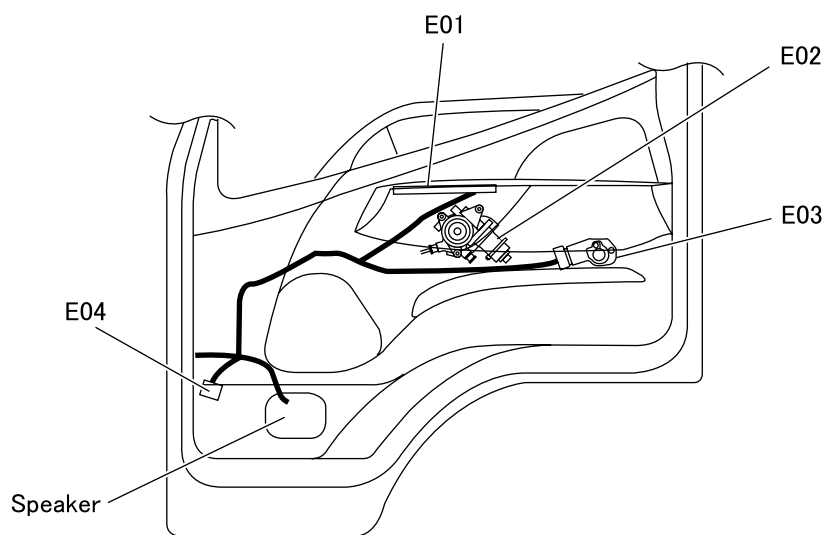


No relevant parts in a missing number

- D01 Diode
- D02 Thermostat
- D03 Blower resistor
- D04 Fresh/recirculation changeover motor
- D05 Blower motor

E DOOR

E01 to 04



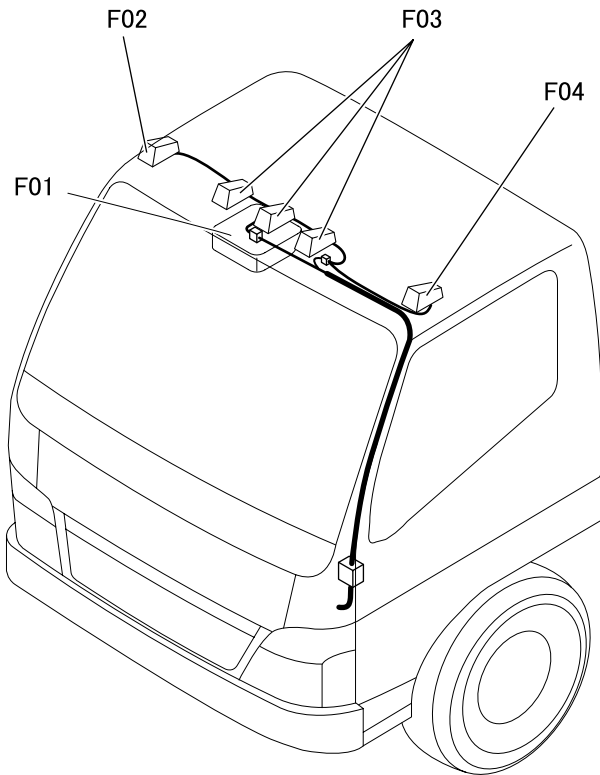
This illustrations show the right side door, the left side door is symmetrical.

No relevant parts in a missing number

- E01 Power window switch
- E02 Power window motor
- E03 Door lock actuator
- E04 Mirror heater connector

F01 to 05

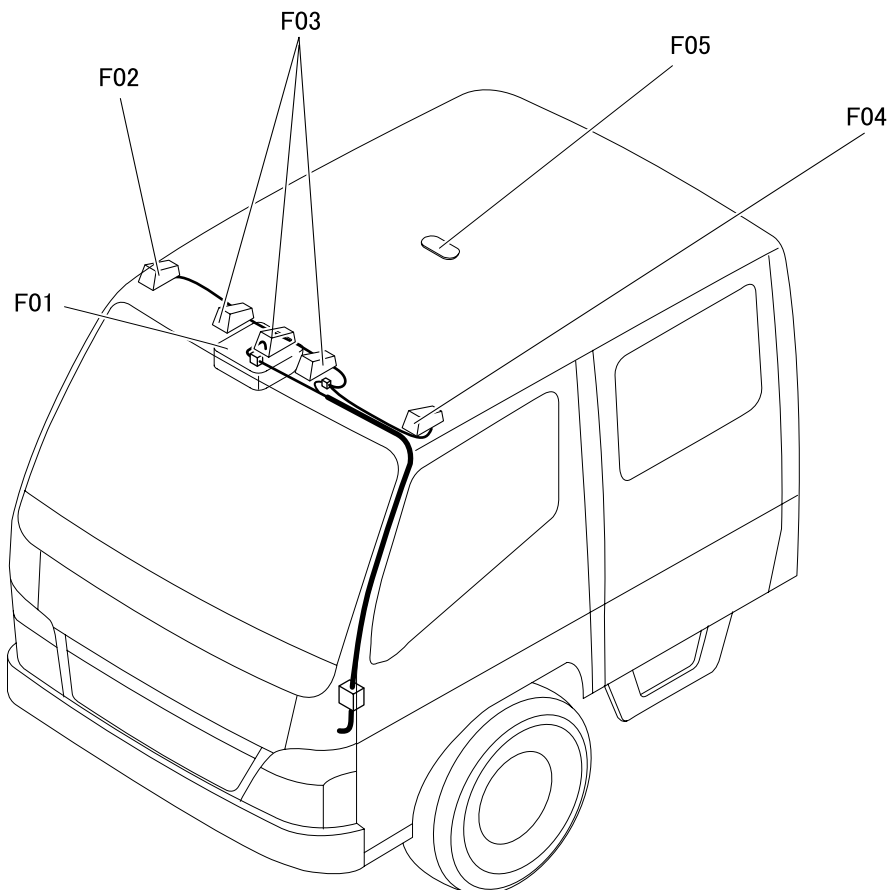
<Except crew cab>



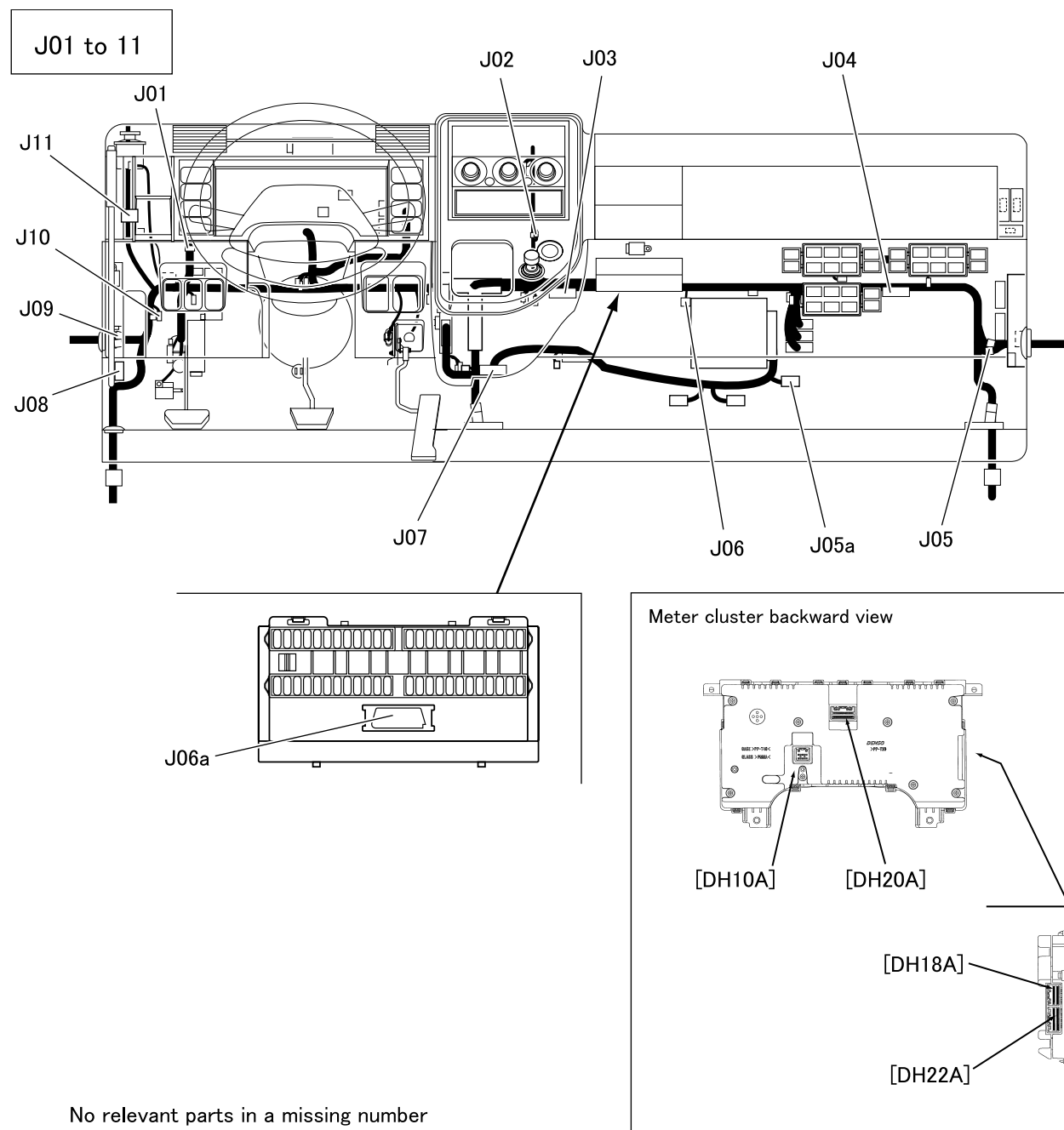
No relevant parts in a missing number

- F01 Cab lamp
- F02 Clearance and side marker lamp, RH
- F03 Identification lamp
- F04 Clearance and side marker lamp, LH
- F05 Rear cab lamp <Crew cab>

<Crew cab>



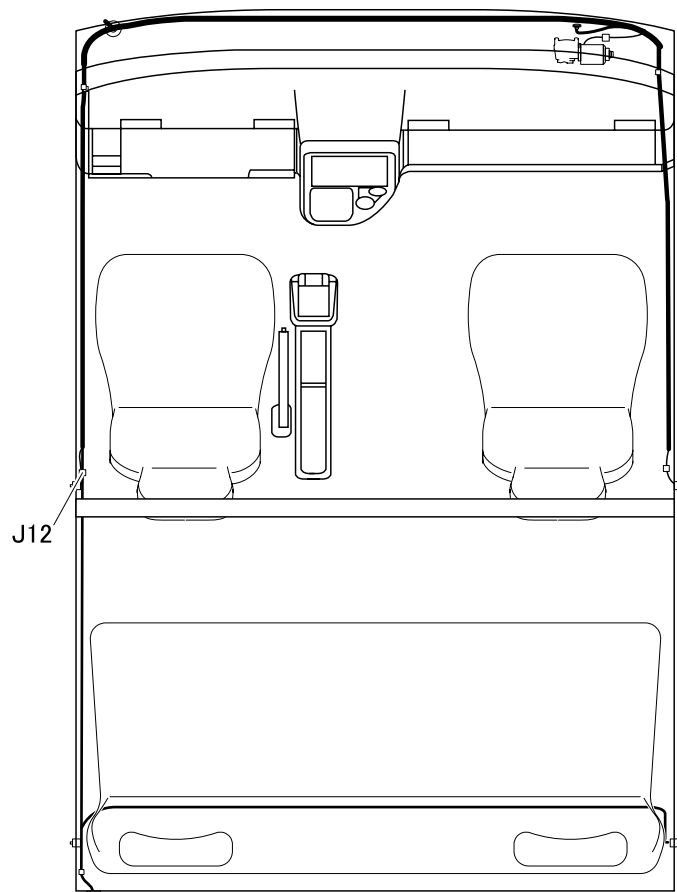
J JOINT OF MAIN HARNESS CONNECTORS



- J01 Connection of cab harness and instrument panel harness
- J02 Connection of cab harness and center panel harness
- J03 Joint connector (J/C-1)
- J04 Joint connector (J/C-2, 3)
- J05 Connection of cab harness and door harness, RH
- J05a Joint connector (J/C-4)
- J06 Connection of center panel harness and air-conditioner harness
- J06a Multi-Use Tester-III connector (for recorder)
- J07 Joint connector (J/C-M1)
- J08 Multi-Use Tester-III connector (for inspection)
- J09 Connection of cab harness and door harness, LH
- J10 Optional connector
- J11 Connection of cab harness and roof harness

Indicate by connector type []. [connector type]

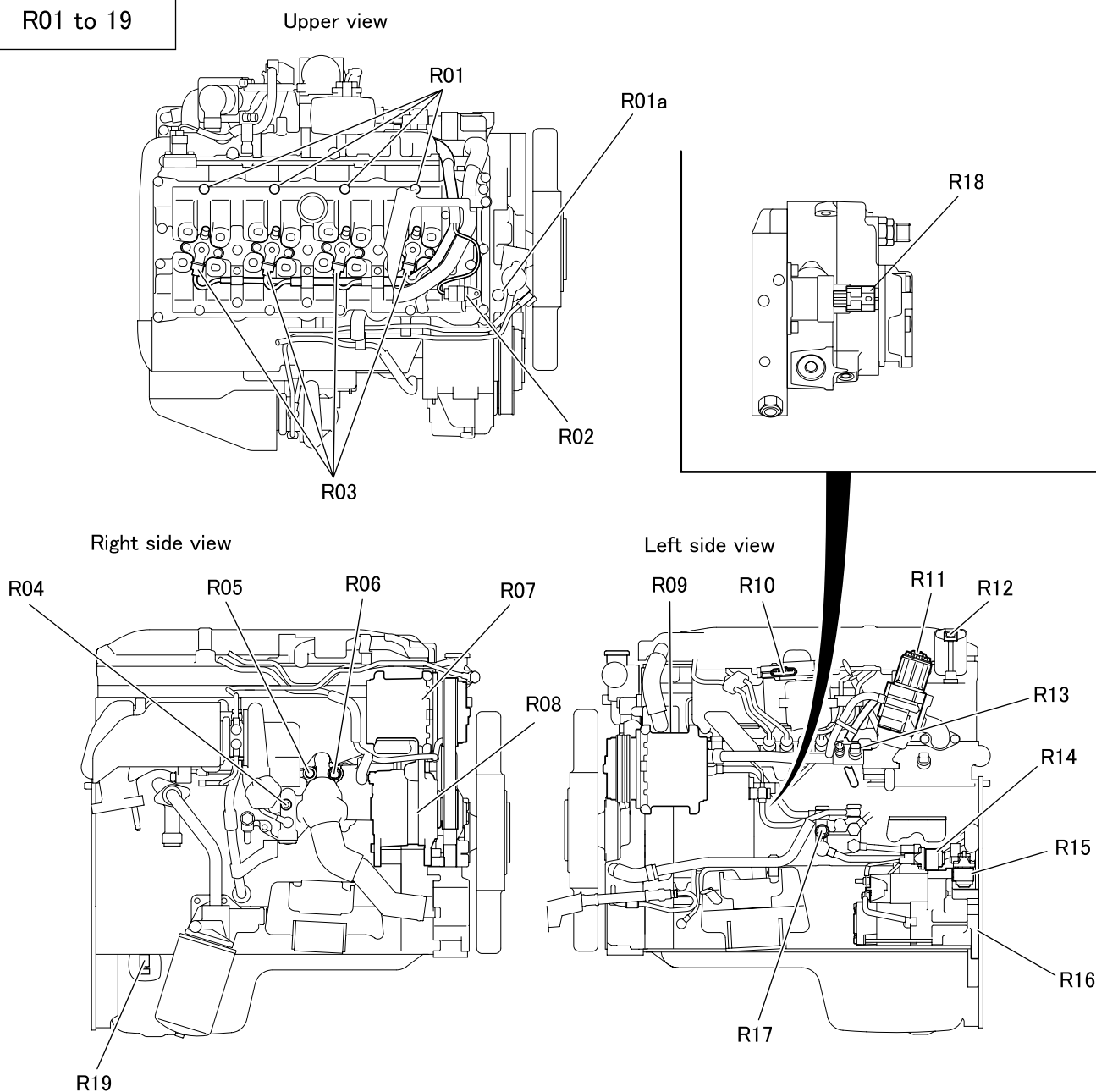
J12



No relevant parts in a missing number

J12 Connection of cab harness and rear door switch harness <Crew cab>

R01 to 19



No relevant parts in a missing number

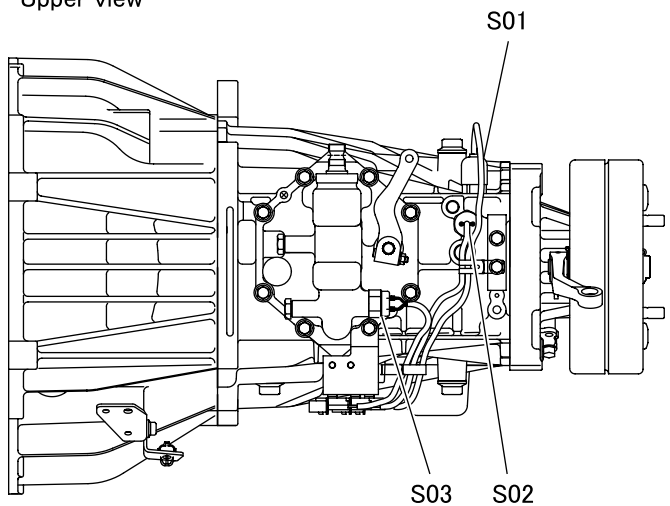
R01	Glow plug	R11	EGR valve
R01a	Overheating switch		(Building into motor, position sensor)
R02	Cylinder recognition sensor	R12	Boost pressure sensor
R03	Injector	R13	Common rail pressure sensor
R04	Engine oil pressure switch	R14	Glow relay
R05	Water temperature sensor (Connects to water temperature gauge)	R15	Starter relay
R06	Water temperature sensor (Connects to engine ECU)	R16	Starter
R07	Magnetic clutch	R17	Fuel temperature sensor
R08	Alternator	R18	MPROP (Injection quantity adjustment valve)
R09	Magnetic clutch <Freezer>	R19	Engine oil level sensor
R10	Throttle actuator (Building into motor, position sensor)		

ECU : Electronic control unit
EGR : Exhaust gas recirculation

S01 to 12

<Manual transmission>

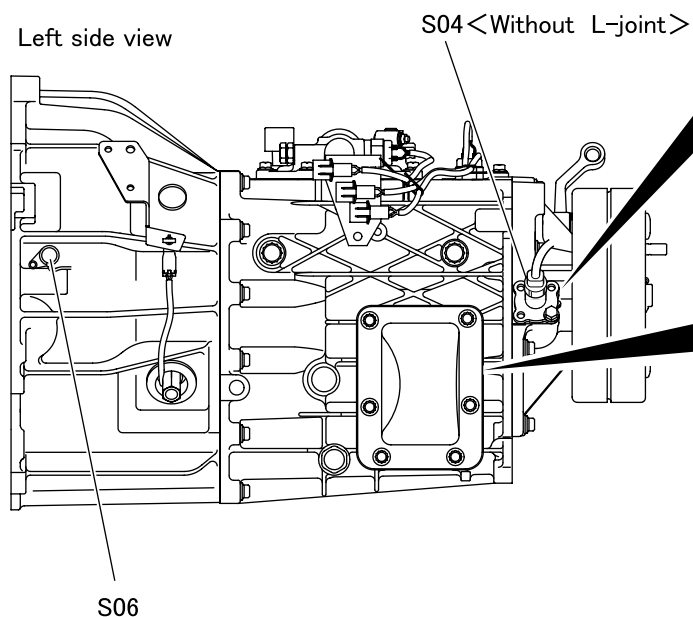
Upper view



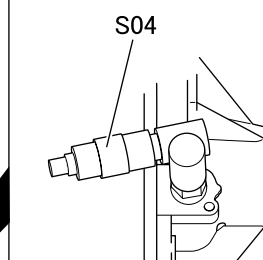
No relevant parts in a missing number

- S01 Backup lamp switch
- S02 Torque limit switch
- S03 Transmission neutral switch
- S04 Vehicle speed sensor
- S05 Transmission power take-off control switch
- S06 Engine speed sensor

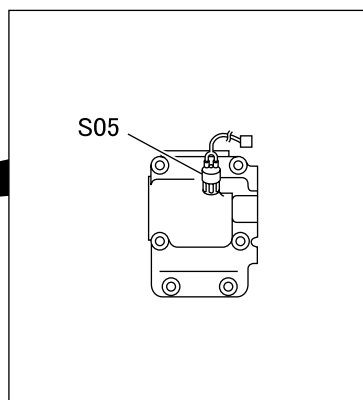
Left side view



<With L-joint>



S05

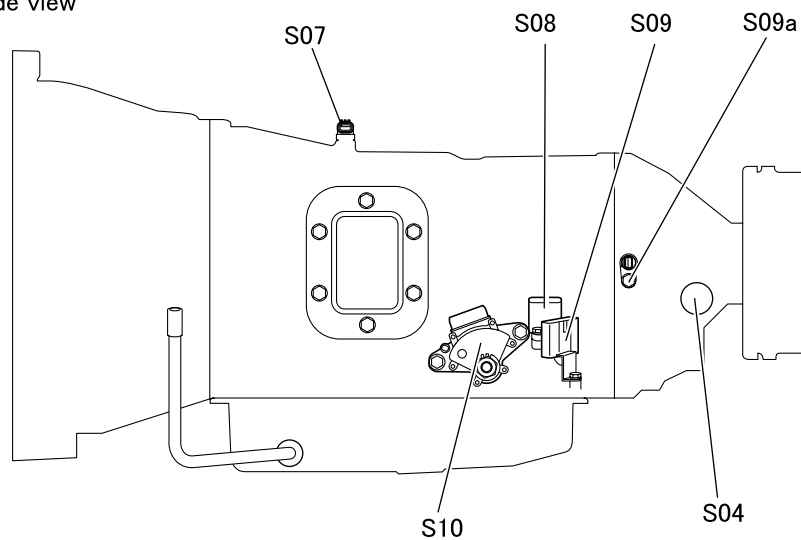


S TRANSMISSION

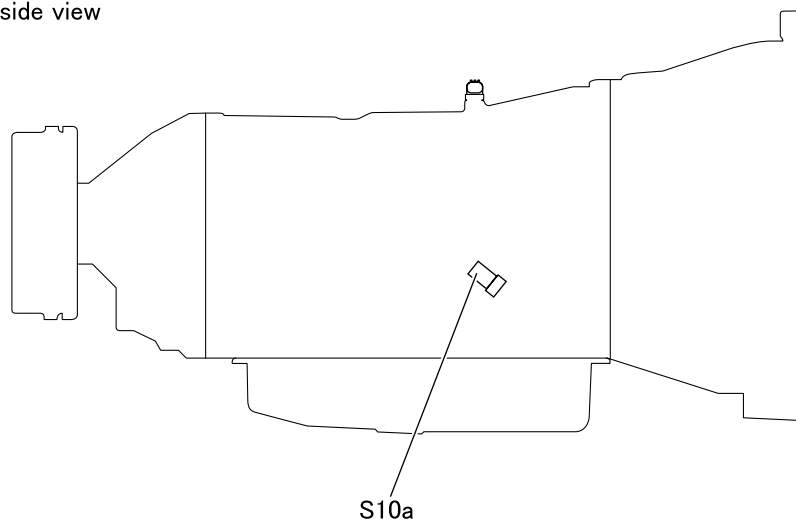
S01 to 12

<Automatic transmission>

Left side view



Right side view



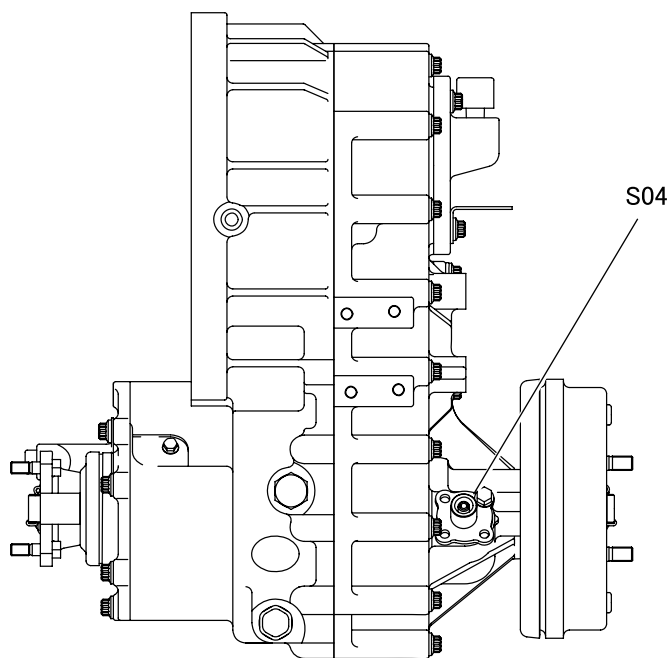
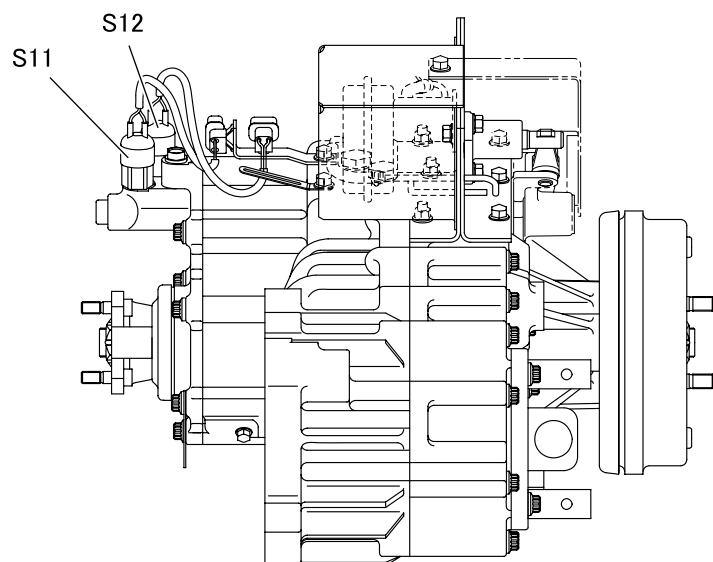
No relevant parts in a missing number

- S04 Vehicle speed sensor
- S07 Turbine revolution sensor
- S08 A/T solenoid connector
- S09 A/T solenoid connector
- S09a Output speed sensor
- S10 Inhibitor switch
- S10a A/T fluid temperature sensor

A/T : Automatic transmission

S01 to 12

<Transfer (FG)>

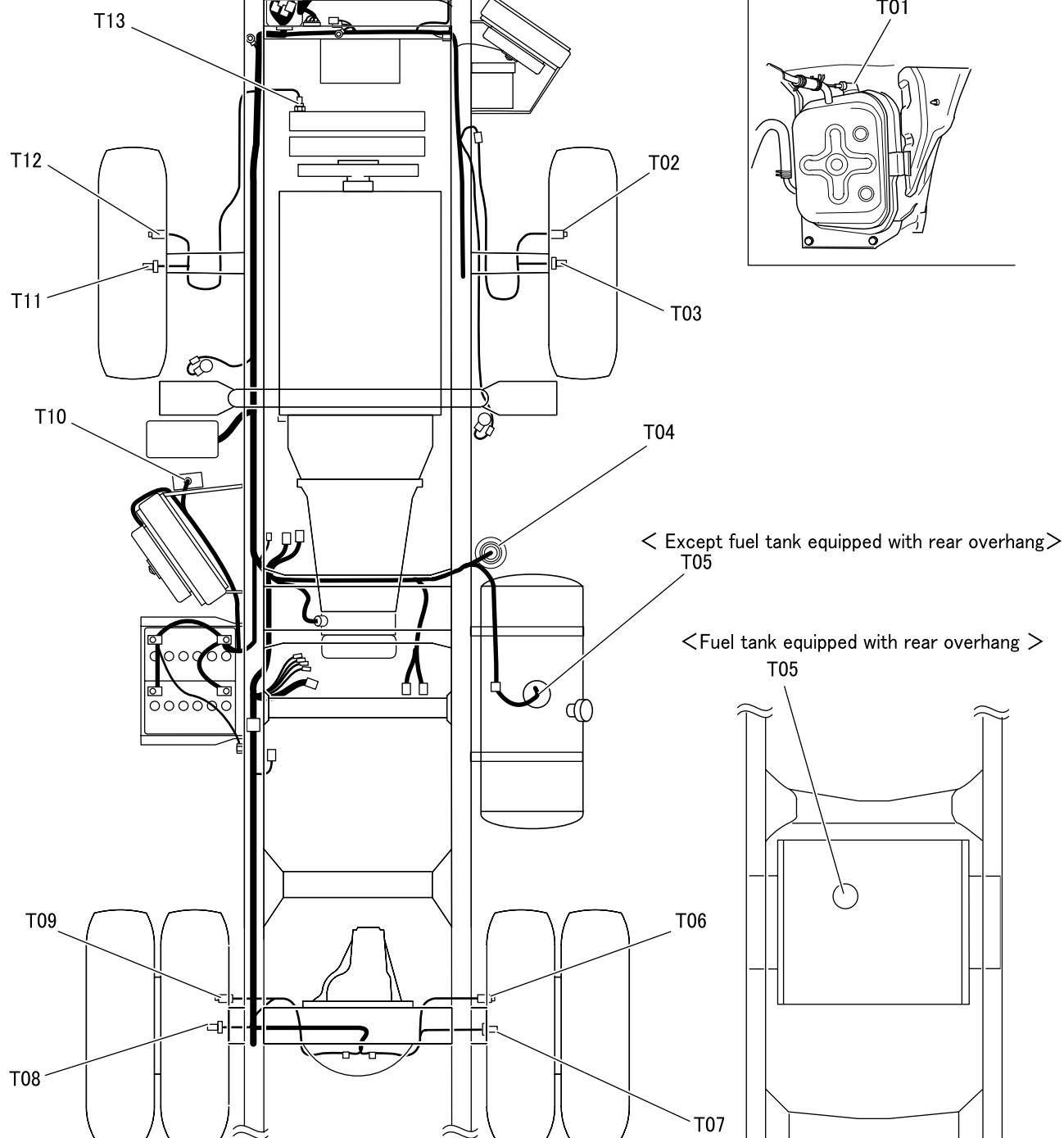


No relevant parts in a missing number

- S04 Vehicle speed sensor
- S11 Transfer low switch
- S12 Transfer four-wheel drive switch

T SWITCH AND SENSOR

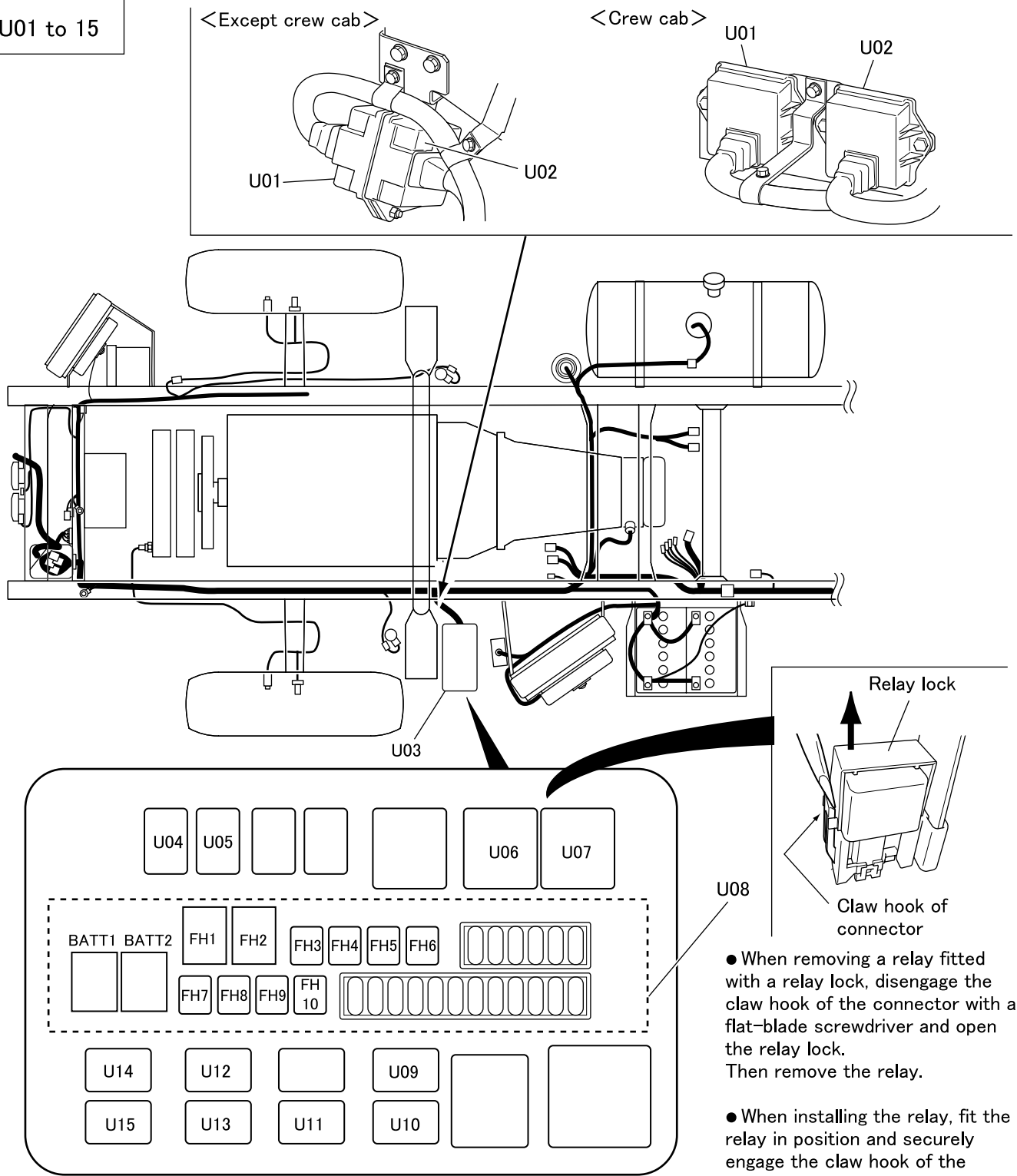
T01 to 13



No relevant parts in a missing number

T01	Vacuum switch	T08	Rear wheel speed sensor, LH
T02	Front brake pad wear indicator, RH	T09	Rear brake pad wear indicator, LH
T03	Front wheel speed sensor, RH	T10	Automatic transmission fluid cooler fan thermo switch
T04	Water separator sensor	T11	Front wheel speed sensor, LH
T05	Fuel level sensor	T12	Front brake pad wear indicator, LH
T06	Rear brake pad wear indicator, RH	T13	Boost air temperature sensor
T07	Rear wheel speed sensor, RH		

U01 to 15



No relevant parts in a missing number

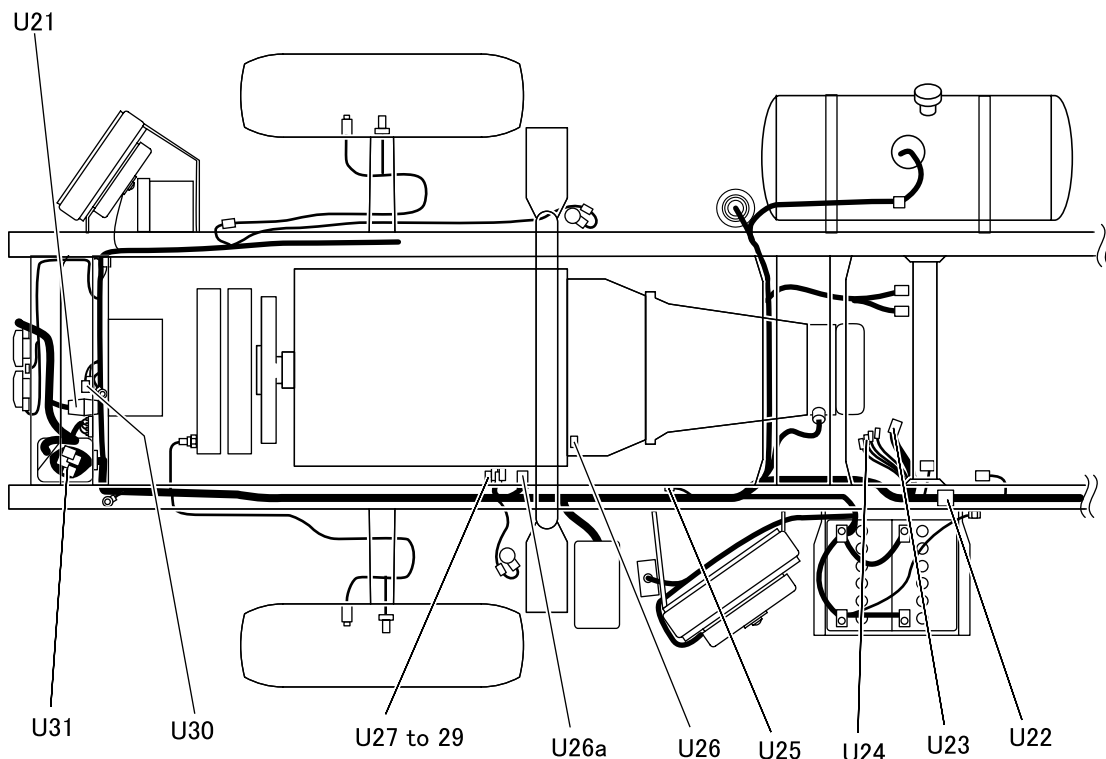
U01 Throttle EDU
 U02 EGR EDU
 U03 High-current fuse box
 U04 ATF cooler fan motor relay
 U05 Backup lamp relay <A/T>
 U06 Wiper relay (HIGH)
 U07 Wiper relay (LOW)

U08 High-current fuse
 U09 Horn relay
 U10 Air-conditioner compressor relay
 U11 Condenser fan relay
 U12 Tail lamp relay
 U13 EDU relay
 U14 Van body dome light relay
 U15 Neutral start relay <A/T>

ATF : Automatic transmission fluid
 A/T : Automatic transmission
 EDU : Electronic drive unit
 EGR : Exhaust gas recirculation

U FUSE AND CONNECTOR

U21 to 31

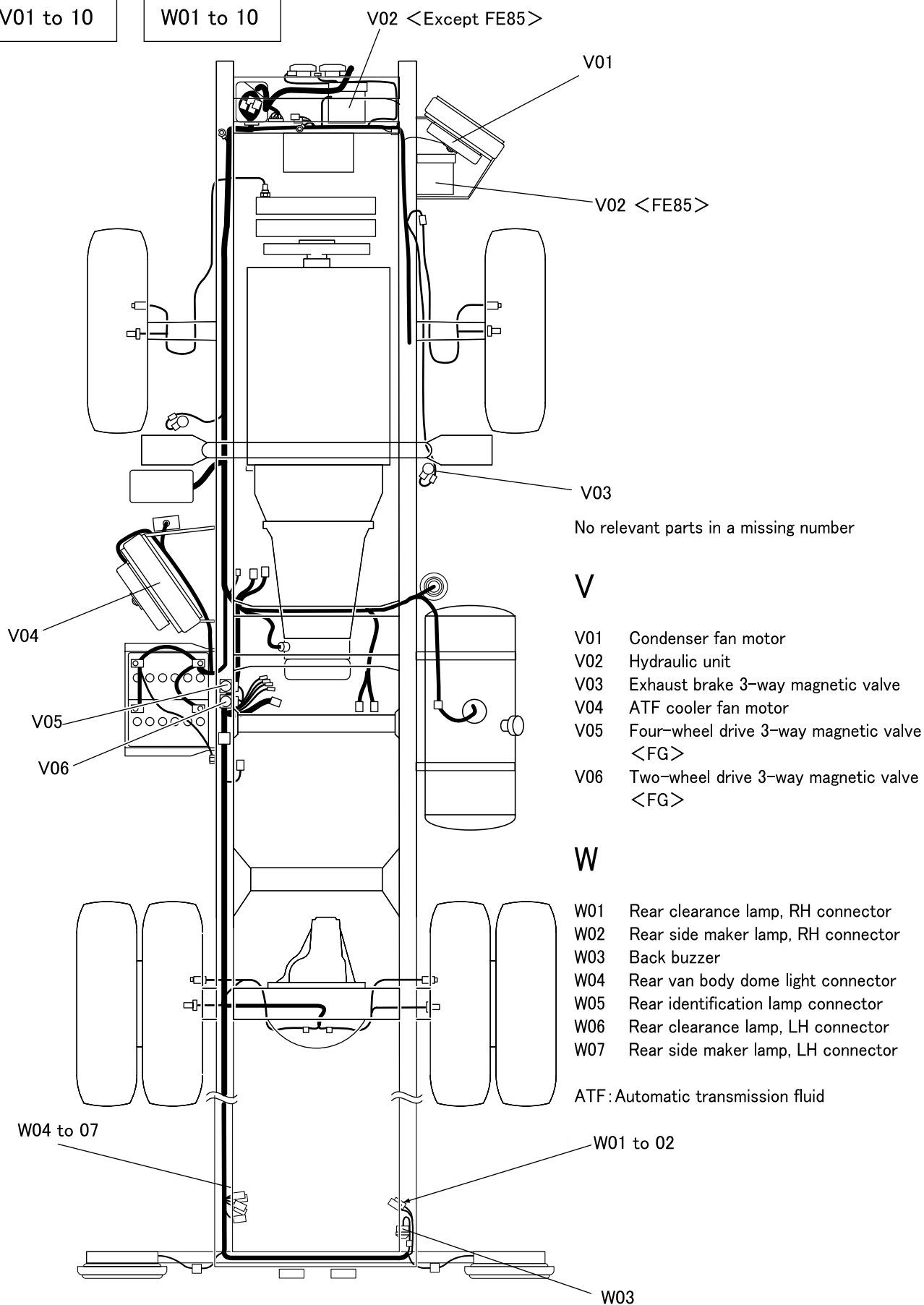


No relevant parts in a missing number

- U21 Connection of cab harness and engine harness
- U22 Connection of chassis harness and rear chassis harness
- U23 Connection of chassis harness and transfer control harness
- U24 Diode <FG>
- U25 Diode
- U26 Connection of chassis harness and starter harness
- U26a Joint connector
- U27 Front van body dome light connector
- U28 Front identification lamp connector
- U29 Front clearance lamp connector
- U30 Diode
- U31 Connection of chassis harness and cab harness or engine harness

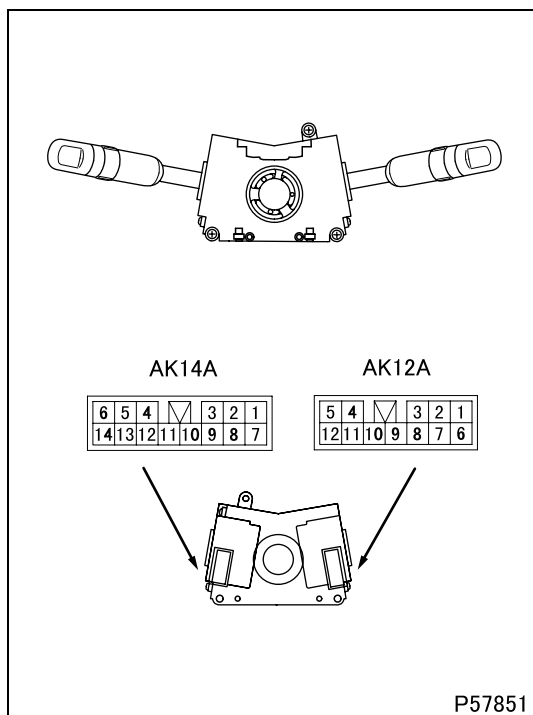
V01 to 10

W01 to 10



54-11 INSPECTION OF PARTS

#001 to #179 SWITCH



#001 Inspection of combination switch

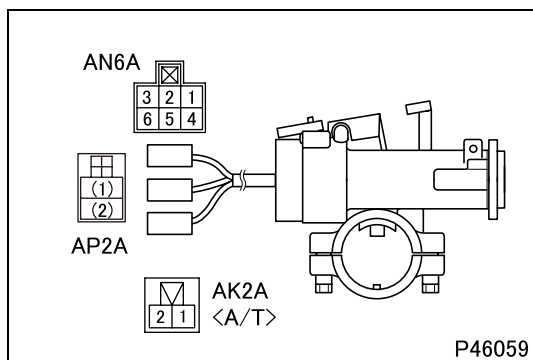
AK12A connector connection table

Switch position		Continuity terminal
Lighting switch	OFF	—
	I	1–2
	II	1–2–3
Dimmer switch	Main	3–12
	Dimmer	3–9
	Passing	11–12
Turn signal lamp switch	LH	6–8
	N (Neutral)	—
	RH	7–8

AK14A connector connection table

Switch position		Continuity terminal
Wiper and washer switch	OFF	—
	INT (Interval)	5–7
	LO (low)	3–5
	HI (high)	3–4–5
	WASH (Washer)	5–12
Horn switch	OFF	—
	ON	13-body ground
Exhaust brake switch	ON	8–9
	OFF	—

- If any fault is found, replace the switch. (See Gr37.)



#002 Inspection of starter switch

AP2A, AN6A connector connection table

Switch position	Continuity terminal
LOCK	—
ACC	(2)–3
ON	(1)–(2)–3–4
START	(1)–(2)–2–3–4

- Terminal numbers within parentheses () show terminals of AP2A.

AK2A connector connection table

<key interlock solenoid (A/T)>

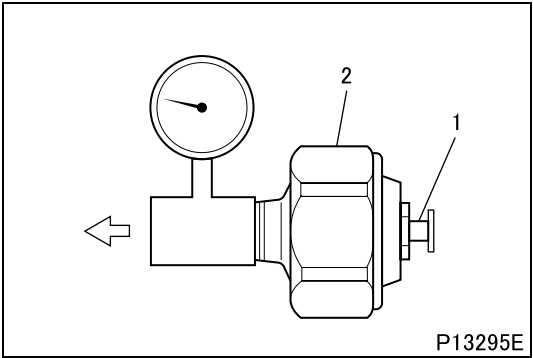
Shift position	Continuity terminal	Remarks
P range: OFF	—	The key must be turned to the lock direction
Without P range: ON	(+) 2–1 (–)	The key must not be turned to the lock direction

A/T: Automatic transmission

- If any fault is found, replace the switch. (See Gr37.)

#011 Inspection of rheostat switch

- Rheostat switch contains a control circuit, because of this it is difficult to inspect rheostat switch independently, therefore you should inspect the rheostat switch indirectly, by inspecting the system harness and the related parts.
- If no fault is found in the related parts but the system is faulty, replace the switch.



#023 Inspection of vacuum switch

- Perform the following checks, and if any fault is found, replace the switch. (See Gr35A.)

(1) Inspection by applying no negative pressure

- Make sure that there is no continuity between terminals 1 and 2 (body).

(2) Inspection by applying negative pressure

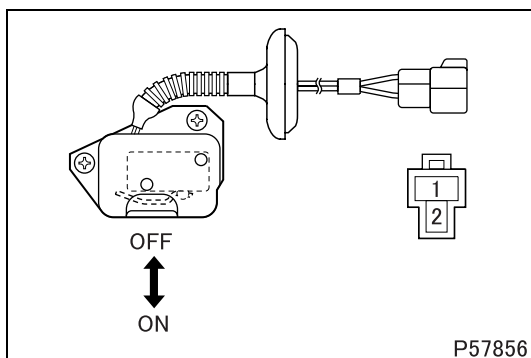
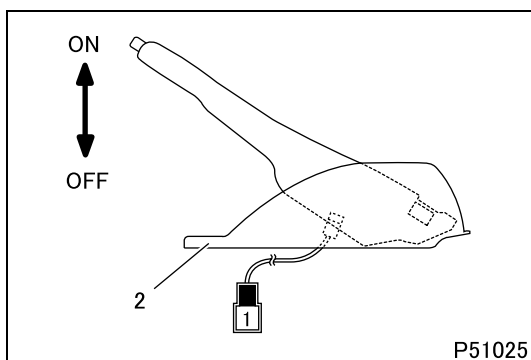
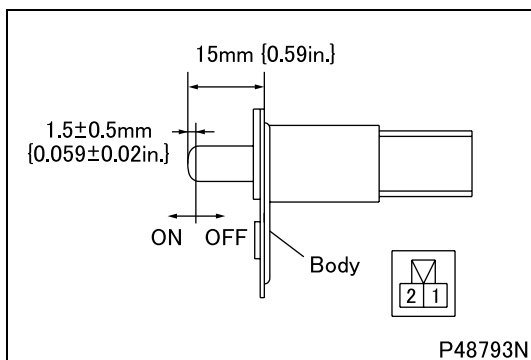
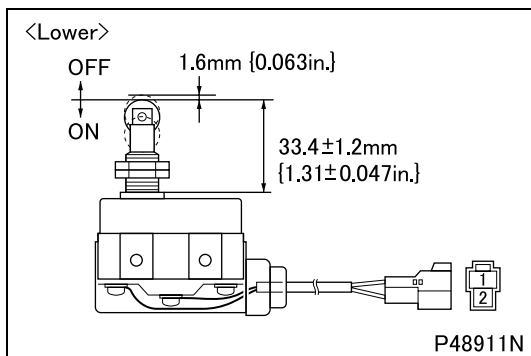
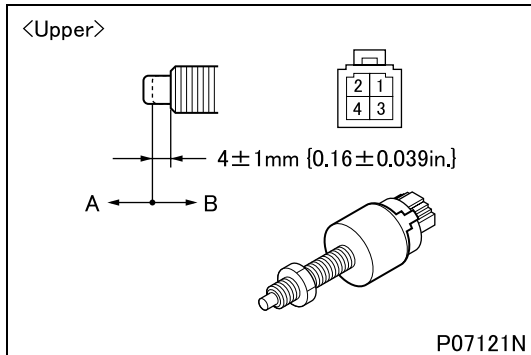
- Gradually apply negative pressure to the switch starting from 0 kPa {0 psi, 0 kgf/cm²}.
- Measure the degree of air pressure at the moment when continuity is detected between terminals 1 and 2 (body), and make sure to confirm if the value meets the standard.

Standard value	$-(47^{+3.3}_{-4.0})$ kPa { $-(13.8^{+0.98}_{-1.18})$ in.Hg, $-(350^{+25}_{-30})$ mmHg}
----------------	---

#026, #027 Inspection of power window switch

- Since it is not easily to check those switches by single part, determine quality of the switches indirectly by checking relative parts such as harnesses, power window motor, etc in the system.
- If there is nothing abnormal in relative parts, but still something wrong on the system, then replace the switches. (See Gr43.)

#001 to #179 SWITCH



#031 Inspection of clutch switch

Switch position	Continuity terminal
A	1-4
B	2-3

- If any fault is found, replace the switch. (See Gr21.)

#035 Inspection of door switch

Switch position	Continuity terminal	
OFF	-	-
ON	1-body, 2-body	1-body

- If any fault is found, replace the switch. (See Gr43.)

#038 Inspection of parking brake switch

- Measure continuity between terminal 1 and 2 (body) ground.

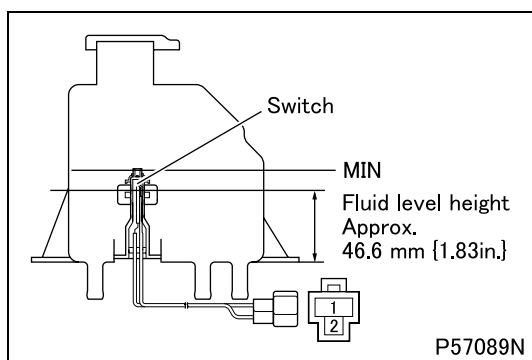
Pull the parking brake lever	Continuity exists
Release the parking brake lever	Continuity does not exist

- If any fault is found, replace the switch. (See Gr36.)

#039 Inspection of cab tilt lock switch

Switch position	Continuity terminal
OFF	-
ON	1-2

- If any fault is found, replace the switch. (See Gr42.)



#041 Inspection of brake fluid level switch

- Gradually drain brake fluid from the brake fluid tank.

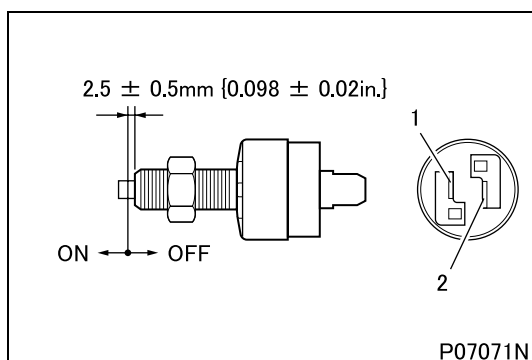
CAUTION

- Brake fluid contains ingredients that dissolve paint on the bodywork of a vehicle. Quickly wipe off brake fluid when it is spilled.**

- Measure height of the switch when continuity is detected between terminals 1 and 2.

Standard value	46.6 mm {1.83 in.}
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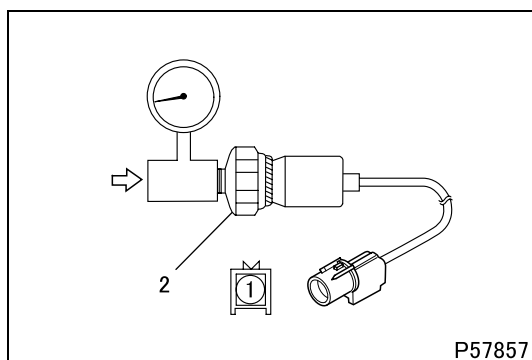
- If the measured value deviates from the standard value, replace the brake fluid tank. (See Gr52.)



#042 Inspection of stop lamp switch

Switch position	Continuity terminal
OFF	—
ON	1-2

- If any fault is found, replace the switch. (See Gr35A.)



#044 Inspection of engine oil pressure switch

- Perform the following checks, and if any fault is found, replace the switch. (See Gr12.)

(1) Inspection by applying no air pressure

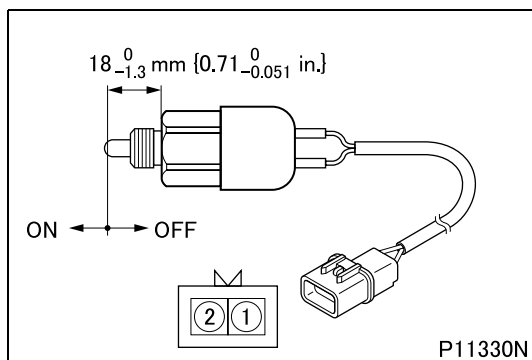
- Make sure that there is continuity between terminals 1 and 2 (body).

(2) Inspection by applying air pressure

- Gradually apply air pressure to the switch starting from 0 kPa {0 psi, 0 kgf/cm²}.

- Measure the degree of air pressure at the moment when continuity is not detected between terminals 1 and 2 (body), and make sure to confirm if the value meets the standard.

Standard value (Operating pressure)	50 ± 10 kPa {7.1 ± 1.4 psi, 0.5 ± 0.1 kgf/cm ² }
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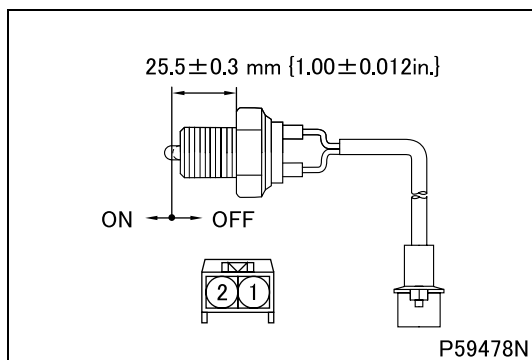


#054 Inspection of switch

Switch position	Continuity terminal
OFF	—
ON	1-2

- If any fault is found, replace the switch.
 - Backup lamp switch. (See Gr22.)
 - Transfer four-wheel drive switch. <FG> (See Gr24.)
 - Transfer low switch. <FG> (See Gr24.)

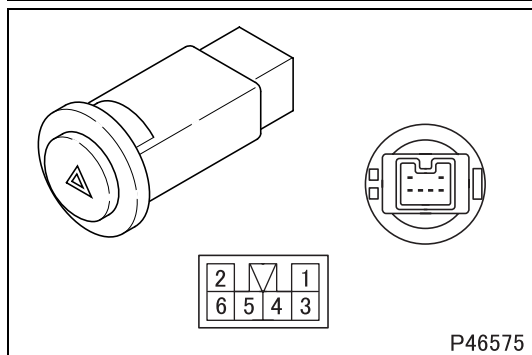
#001 to #179 SWITCH



#056 Inspection of transmission neutral switch

Switch position	Continuity terminal
OFF	—
ON	1-2

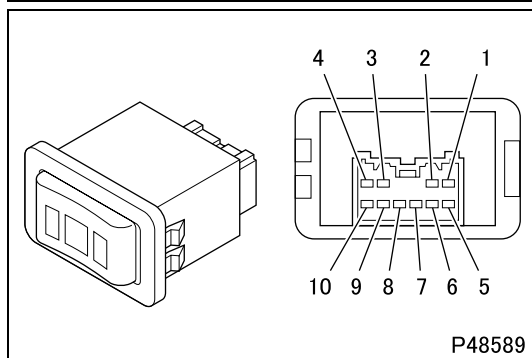
- If any fault is found, replace the switch. (See Gr22.)



#081 Inspection of hazard switch

Switch position	Continuity terminal	Night illumination
OFF	—	(+) 2-1 (-)
ON	4-5-6	

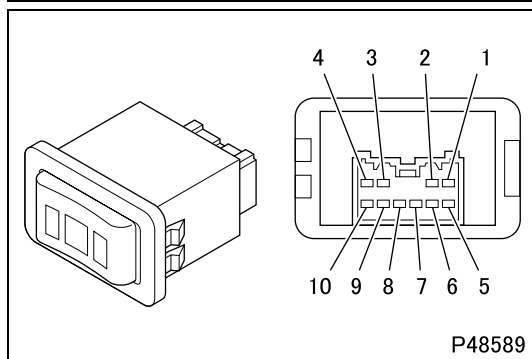
- If any fault is found, replace the switch. (See Gr52.)



#087 Inspection of van body dome light switch

Switch position	Continuity terminal	Operation illumination	Night illumination
OFF	1-8	—	(+) 2-3 (-)
ON	1-7	(-) 3-9 (+)	

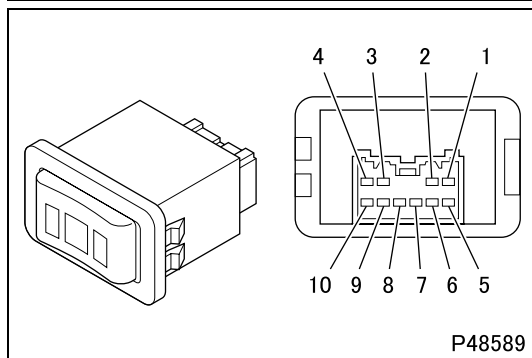
- If any fault is found, replace the switch.



#089 Inspection of switch

Switch position	Continuity terminal	Night illumination
OFF	1-8	(+) 2-3 (-)
ON	1-7	

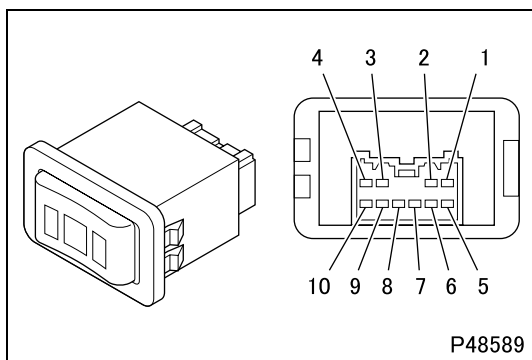
- If any fault is found, replace the switch. (See Gr52.)
- Front drive switch
- Warm-up switch



#092 Inspection of engine oil level check switch

Switch position	Continuity terminal
—	—
CHECK	1-7, 5-6

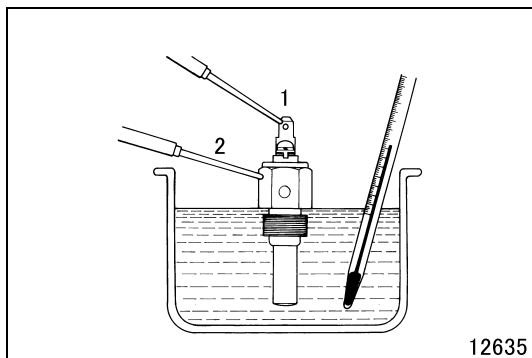
- If any fault is found, replace the switch. (See Gr52.)



#094 Inspection of door lock switch

Switch position	Continuity terminal	Night illumination
LOCK	1-7	(+) 2-3 (-)
Neutral	-	
UNLOCK	1-8	

- If any fault is found, replace the switch. (See Gr43.)



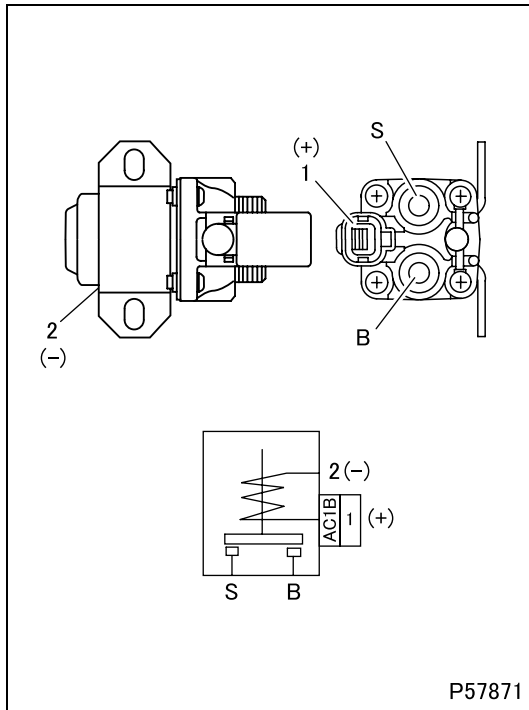
#160 Inspection of overheating switch

- Place the switch in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the operating temperature between terminals 1 and 2 (body) respectively.

Standard Value	When temperature increase (OFF→ON)	$110 \pm 2^{\circ}\text{C}$ { $230 \pm 36^{\circ}\text{F}$ }
	When temperature decrease (ON→OFF)	$110 \pm 4^{\circ}\text{C}$ { $230 \pm 39^{\circ}\text{F}$ }

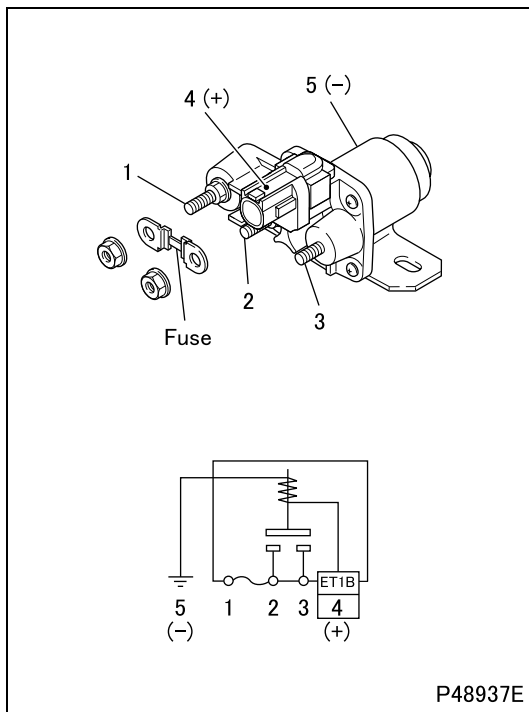
- If the measured value deviates from the standard value, replace the switch. (See Gr14.)

#180 to #249 RELAY



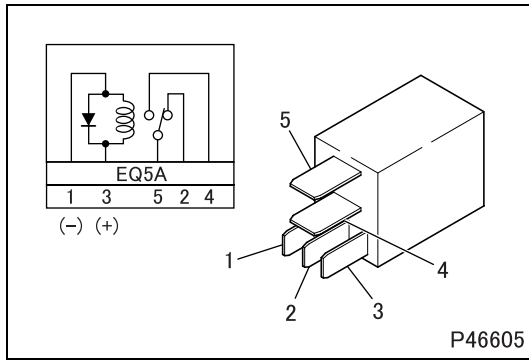
#187 Inspection of starter relay

- Perform continuity check and operation check, and if any fault is found, replace the relay.



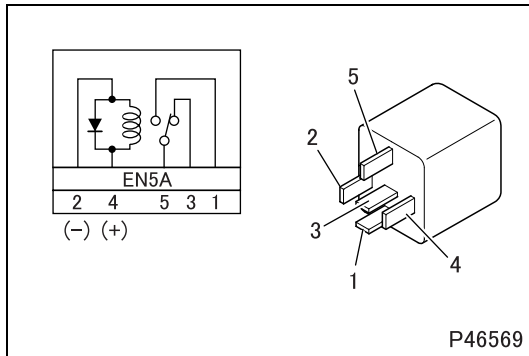
#195 Inspection of glow relay

- Perform continuity check and operation check, and if any fault is found, replace the relay.



#201 Inspection of relay (normally open type 5 pin)

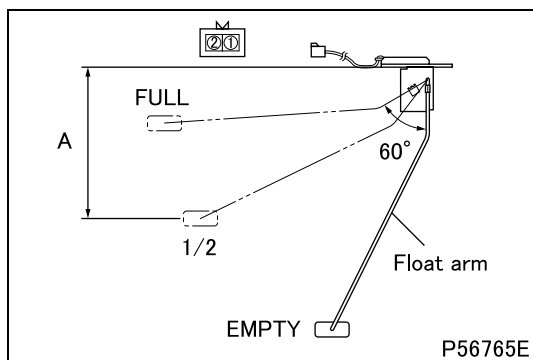
- Perform continuity check and operation check, and if any fault is found, replace the relay.



#202 Inspection of relay (normally open type 5 pin)

- Perform continuity check and operation check, and if any fault is found, replace the relay.

#250 to #349 SENSOR



#258 Inspection of fuel level sensor

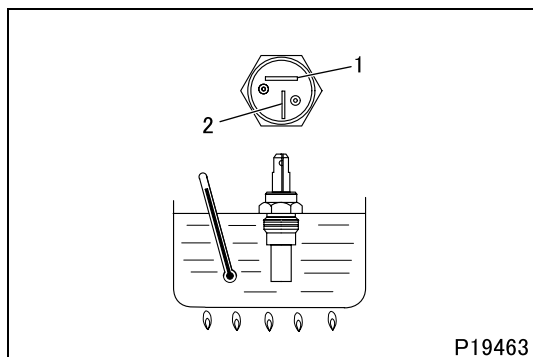
- Measure resistance values between terminals 1 and 2 when bringing the float arm into contact with stoppers (at EMPTY and FULL positions) and placing it at the midpoint position.

A: 220 mm <124.5L (32.9 gal)>

234 mm <131.4L (34.6 gal)>

Standard value	at FULL position	$0^{+2}_0 \Omega$
	at 1/2 position	$50 \pm 3 \Omega$
	at EMPTY position	$150 \pm 10 \Omega$

- If the measured value deviates from the standard value, replace the sensor. (See Gr13A.)



#262 Inspection of water temperature sensor

<For water temperature gauge>

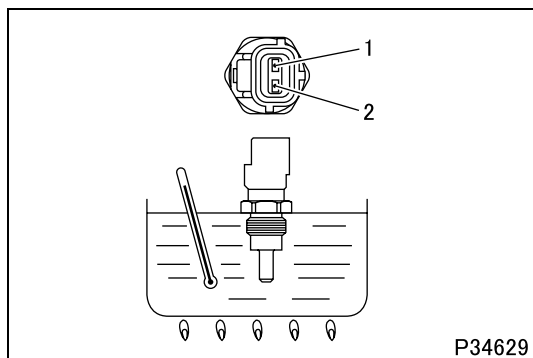
- Dip the sensor in a container filled with engine oil.
- Raise the oil temperature to the specified one while stirring oil.
- Measure resistance values between terminals 1 and 2 and body.

Terminal 1: water temperature gauge connected side

Terminal 2: Is not use

Standard value	1 and body (water temperature gauge connected side)	50°C {122°F}	153.9 Ω (reference value)
		80°C {176°F}	$51.9^{+4.9}_{-4.4} \Omega$
		100°C {212°F}	$27.4^{+1.9}_{-1.2} \Omega$

- If the measured value deviates from the standard value, replace the sensor. (See Gr14.)

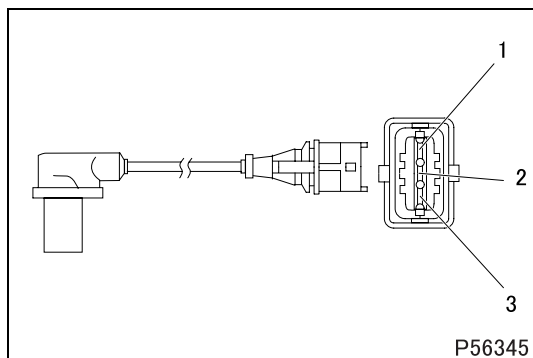


<For engine control>

- Place the sensor in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	$2.45 \pm 0.14 \text{ k}\Omega$
	80°C {176°F}	322.2 Ω (Reference value)
	110°C {230°F}	$147.1 \pm 2 \Omega$

- If the measured value deviates from the standard value, replace the sensor. (See Gr14.)

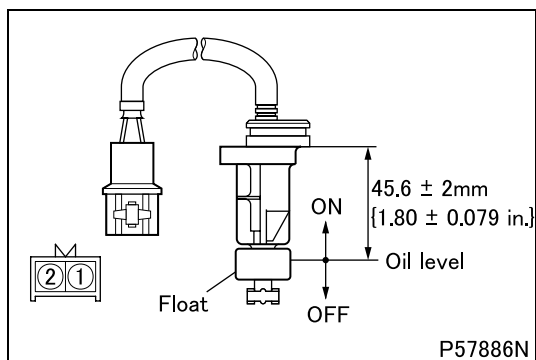


#263 Inspection of engine speed sensor

- Measure the resistance between terminals 1 and 2.

Standard value	$860 \pm 86 \Omega$
----------------	---------------------

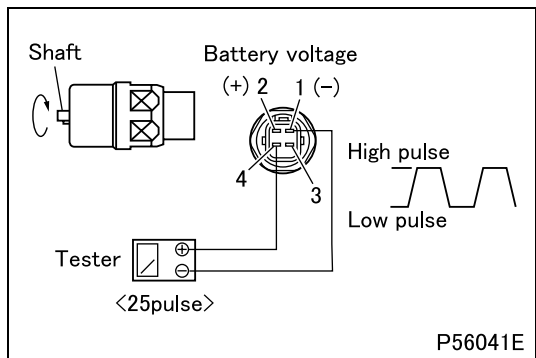
- If the measured value deviates from the standard value, replace the sensor. (See Gr13E.)



#264 Inspection of engine oil level sensor

Switch position	Continuity terminal
OFF	—
ON	1-2

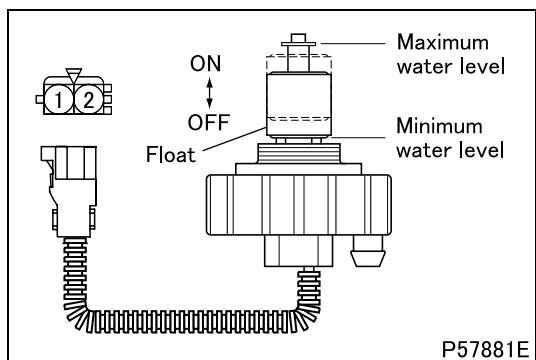
- If any fault is found, replace the sensor. (See Gr12.)



#265 Inspection of vehicle speed sensor

- Perform the following checks, and if any fault is found, replace the sensor. (See Gr22.)
- Rotate the sensor shaft with the battery voltage applied between terminals 1 and 2.
- Measure the maximum value (high pulse voltage) and the minimum value (low pulse voltage) of the voltage generated at each terminal.

Standard value	Between 25 pulse output terminals 1 and 4	Low pulse voltage	0.5 V or less
		High pulse voltage	8 ± 1 V



#274 Inspection of water separator sensor

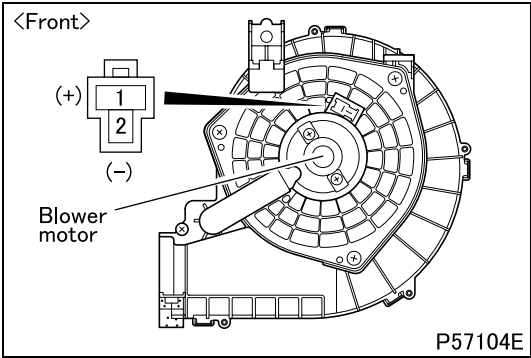
Condition	Continuity terminal
ON (when coolant quantity is approx. 100 cm ³ {6.10 cu.in.})	1-2
OFF	—

- If any fault is found, replace the sensor (See Gr13A.)

#350 Inspection of control unit and other units

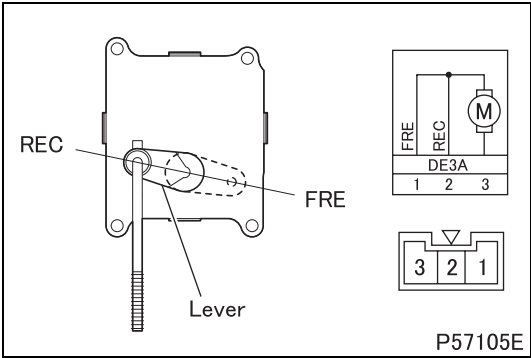
- Since the units alone cannot be readily checked in the off-vehicle state, check the harness, switch and other related parts in each system.
- If any fault is not found in the related parts, and the problem still remains in the system, replace the control units or other units.

#410 to #509 MOTOR



#411 Inspection of blower motor

- Make sure that the motor operates when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the motor. (See Gr55.)



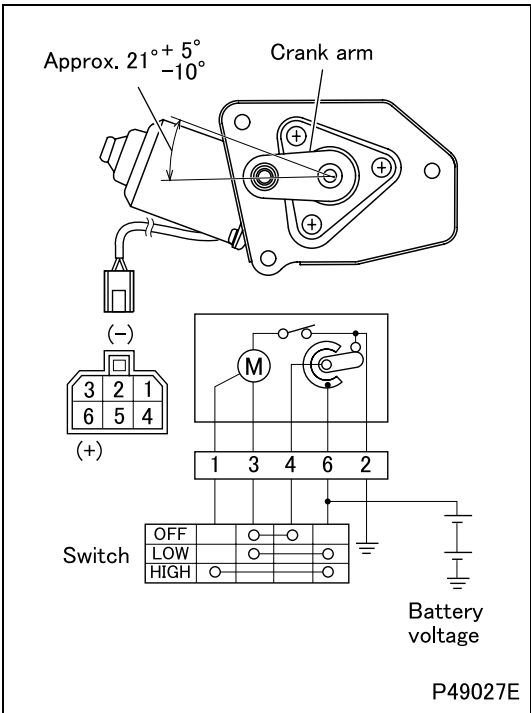
#415 Inspection of fresh/recirculation changeover motor

- Perform the following checks, and if any fault is found, replace the motor. (See Gr55.)
- Apply battery voltage to each pair of the terminals shown in the illustration.

Lever position	Terminal
REC (inside air)	(+) 3-2 (-)
FRE (outside air)	(+) 3-1 (-)

CAUTION

- Stop applying battery voltage if the lever stops spontaneously at the REC or FRE position.



#422 Inspection of wiper motor

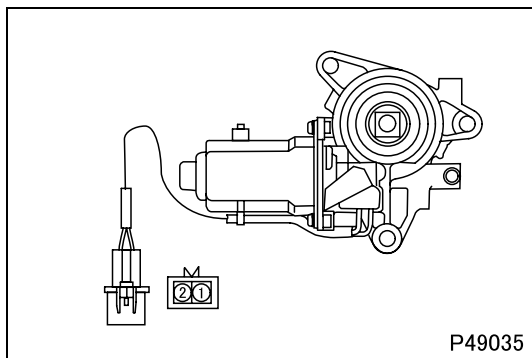
- Connect a switch to wiper motor as shown.
- Check the motor for correct operation as follows. If any fault is found, replace the motor. (See Gr51.)

(1) Inspection of motor operation

- Set switch in HIGH position to check that the motor rotates at high speed.
- Set switch in LOW position to check that the motor rotates at low speed.

(2) Inspection of automatic stop position

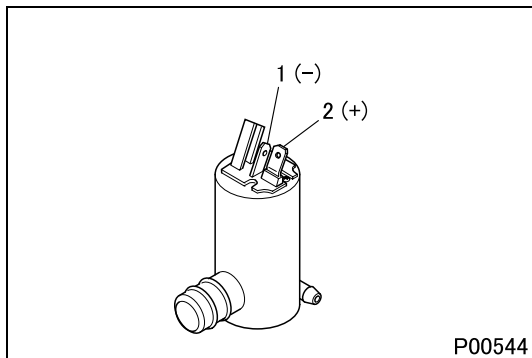
- Set switch in LOW position to let the motor rotates at low speed.
- When crank arm is a position other than the automatic stop position (outside the angles shown), set switch in OFF position.
- Check to see the crank arm stops at the automatic stop position (within the angles range shown).



#423 Inspection of power window motor

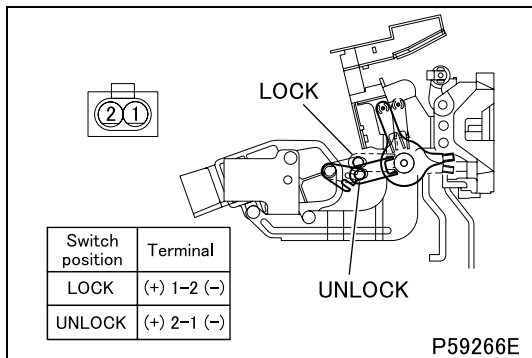
Rotation direction	Terminal
Left	(+) 2-1 (-)
Right	(+) 1-2 (-)

- If any fault is found, replace the motor. (See Gr43.)



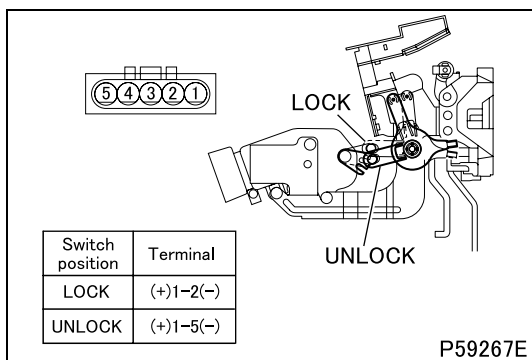
#428 Inspection of windshield washer motor

- Make sure that the motor operates when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the motor. (See Gr51.)



#510 Inspection of door lock actuator (for assistant driver's seat side)

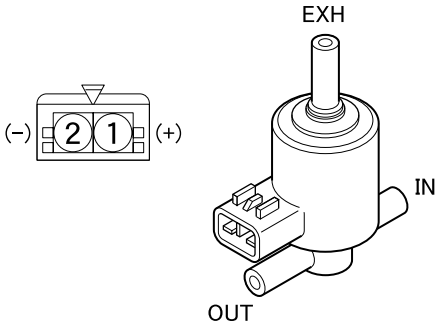
- By changing the polarity of the applied battery voltage, check if the actuator operates both in lock and unlock direction.



#511 Inspection of door lock actuator (for driver's seat side)

- By changing the polarity of the applied battery voltage, check if the actuator operates both in lock and unlock direction.

#560 to #609 MAGNETIC VALVE



	IN	OUT	EXH
ON	○	○	
OFF		○	○

○—○ : Air passage is open between ports.

P57888E

#565 Inspection of 3-way magnetic valve

- Perform the following checks, and if any fault is found, replace the 3-way magnetic valve.

(1) Operation check

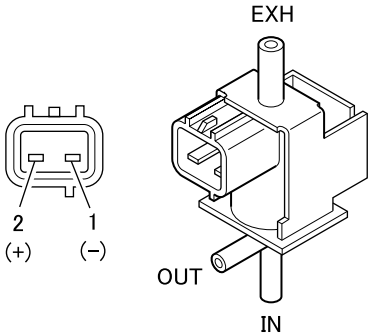
- Gradually apply DC current between terminals 1 and 2 starting from 0 V.

Measure the voltage at which the 3-way magnetic valve operates. (Determine ON/OFF of the magnetic valve by operating noises.)

Standard value (minimum operating voltage)	11 V
---	------

(2) Inspection of continuity and air tightness

- Negative pressure when inspected: −100 kPa {−29.5 in.Hg, −750 mmHg}



	IN	OUT	EXH
ON	○	○	
OFF		○	○

○—○ : Air passage is open between ports.

P49102E

#566 Inspection of 3-way magnetic valve

- Perform the following checks, and if any fault is found, replace the 3-way magnetic valve.

(1) Operation check

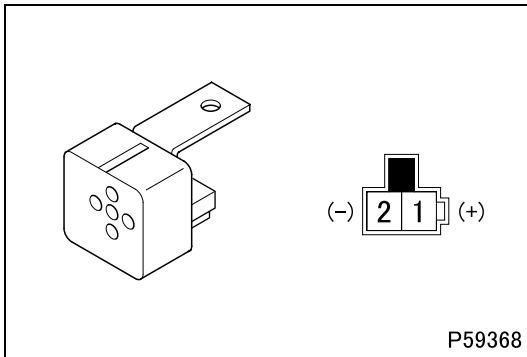
- Gradually apply DC current between terminals 1 and 2 starting from 0 V.

Measure the voltage at which the 3-way magnetic valve operates. (Determine ON/OFF of the magnetic valve by operating noises.)

Standard value (minimum operating voltage)	8 V
---	-----

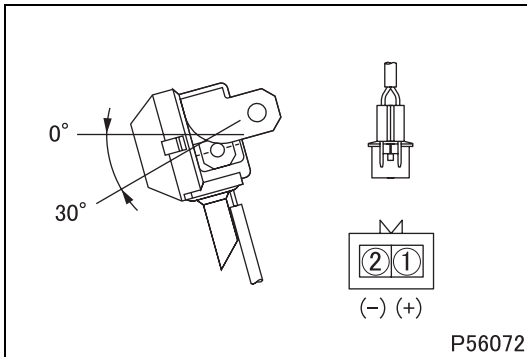
(2) Inspection of continuity and air tightness

- Negative pressure when inspected: −60 kPa {−17.7 in.Hg, −450 mmHg}



#611 Inspection of warning buzzer

- Make sure that the buzzer sounds when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the buzzer.



#614 Inspection of back buzzer

[Inspection]

- Make sure to confirm if the buzzer intermittently sounds by applying the battery voltage between terminals 1 and 2.
- If any fault is found, replace the buzzer.

[Installation]

- Install the back buzzer to the frame in the range of angles as illustrated.

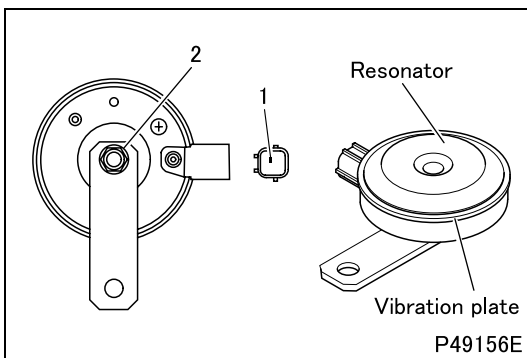
CAUTION ⚠

- Be careful that if the installed angle of the buzzer is out of the range as illustrated, water in the buzzer will not be drained normally.

#615 Inspection of electric horn

CAUTION ⚠

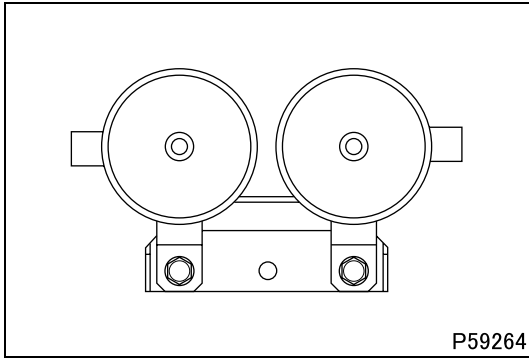
- Bending the stay changes the sound quality of the horn, degrading the horn performance.
- Never bend or damage the stay.



[Inspection]

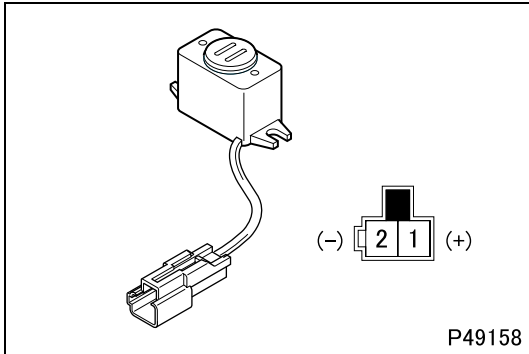
- Make sure to confirm if the horn sounds by applying the battery voltage between terminal 1 and 2 (body) <no polarity of (+) or (-)>.
- Remove foreign substances adhered to the resonator and diaphragm.
- If any fault is found, replace the horn.

#610 to #649 BUZZER, HORN



[Installation]

- Install in the direction as illustrated.

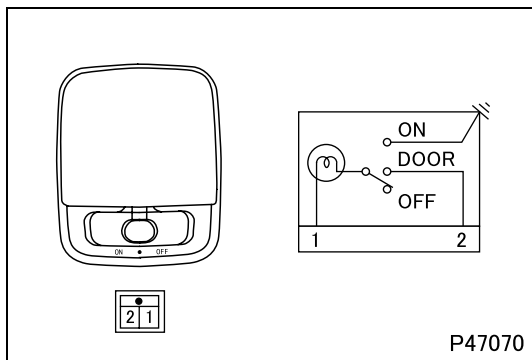
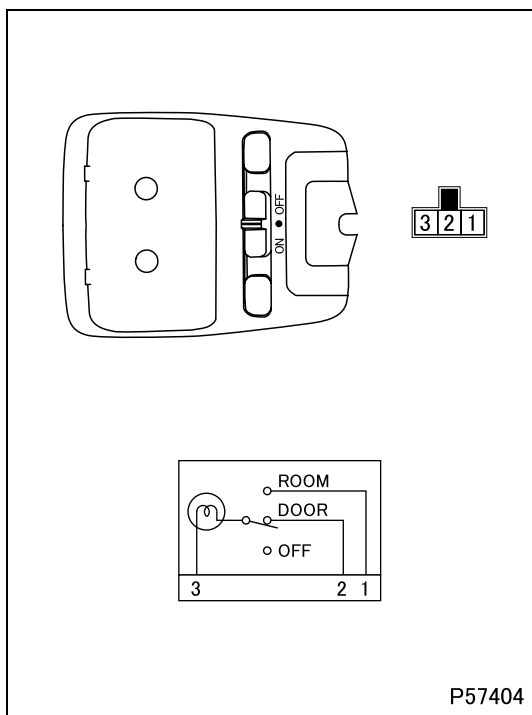


#618 Inspection of cab tilt buzzer

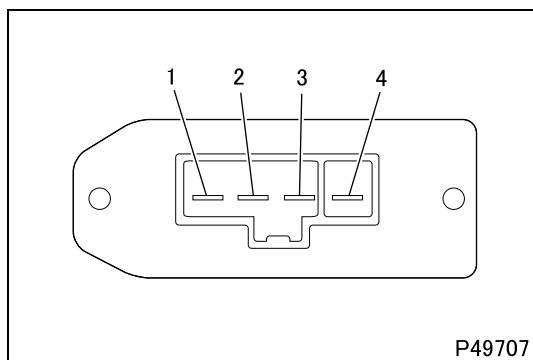
- Make sure that the buzzer sounds when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the buzzer.

#656 Inspection of cab lamp

- If any fault is found, replace the lamp.



#750 to #859 OTHER

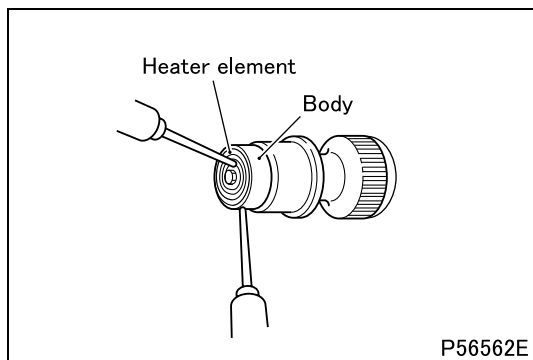


#750 Inspection of blower resistor

- Measure resistance values between each terminal.

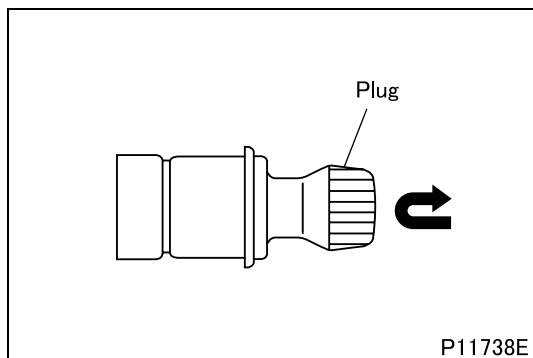
Position	Terminal	Standard value
MEDIUM HIGH	1-4	0.24 Ω
MEDIUM LOW	3-4	0.93 Ω
LOW	2-4	1.5 Ω

- If the measured value deviates from the standard value, replace the blower resistor. (See Gr55.)



#754 Inspection of cigarette lighter

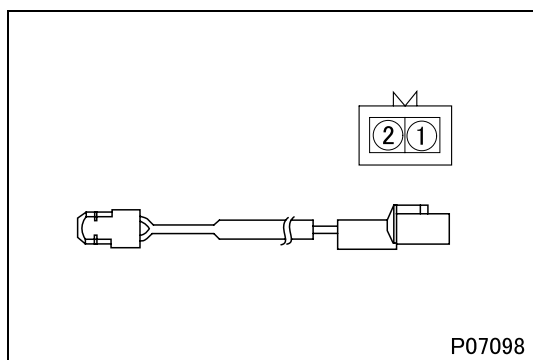
- Perform the following checks, and if any fault is found, replace the cigarette lighter. (See Gr52.)
- Make sure that there is continuity between heater element and body.



- Make sure that when plug is pushed in by hand, it immediately returns to its original position.
- Place the starter switch at ACC or ON position.
- Push plug into the socket in the cab.
- Measure the time required for plug automatically returns.

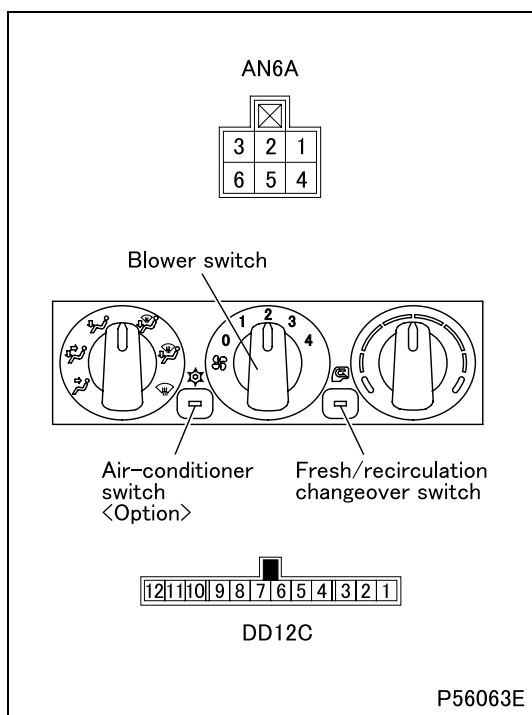
Standard value	15 $\pm$ 5 seconds
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- Check to see that heater element is red-hot.



#759 Inspection of brake pad wear indicator

- Make sure that there is continuity between terminals 1 and 2.
- If any fault is found, replace the brake pad wear indicator. (See Gr35A.)



#763 Inspection of heater control panel

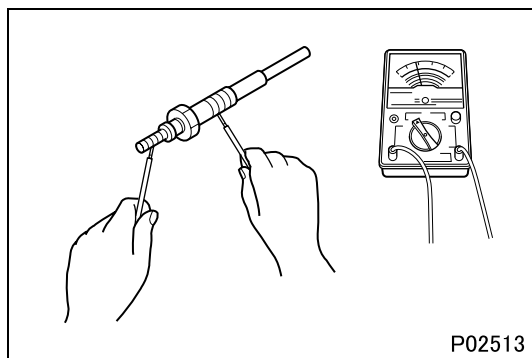
- Perform the following checks, and if any fault is found, replace the heater control panel. (See Gr52.)

Blower switch <AN6A connector>

Switch position	Continuity terminal
0 : OFF	—
1 : LO (LOW)	4-5-6
2 : ML (MEDIUM LOW)	1-5-6
3 : MH (MEDIUM HIGH)	2-5-6
4 : HI (HIGH)	3-5-6

Fresh/recirculation changeover switch <DD12C connector>

Switch position	Continuity terminal	Operation illumination	Night illumination
OFF : Fresh air	9-10	—	(+) 7-8 (-)
ON : recirculation air	10-11	(+) 12-10 (-)	



#764 Inspection of glow plug

- Measure resistance of glow plug as shown.

Standard value (Cold resistance of glow plug)	1.0 Ω (Reference value)
--	--------------------------------

- If the measured value deviates from the standard value, replace the glow plug. (See Gr11.)

#860 BATTERY

DANGER ⚠

- Since flammable hydrogen gas is generated by battery be sure to obey the following warnings:
 - Do not short-circuit the (+) and (–) terminals on the battery.
 - Keep sparks and lit cigarettes away from the battery.
 - Do not wear metal objects on your arms and lean over battery.
- Because the battery electrolyte is diluted sulfuric acid and is corrosive, when handling battery wear safety glasses and rubber gloves to protect the eyes and hands.

WARNING ⚠

- Make sure that you disconnect battery cable (–) first when you disconnect battery cables.

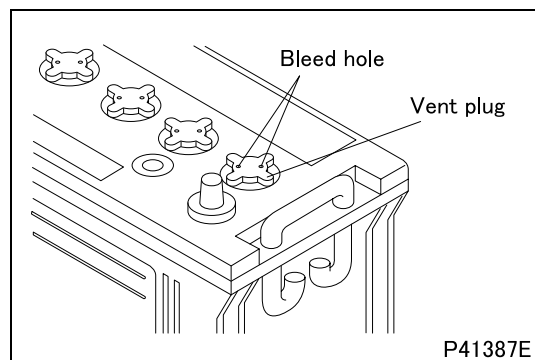
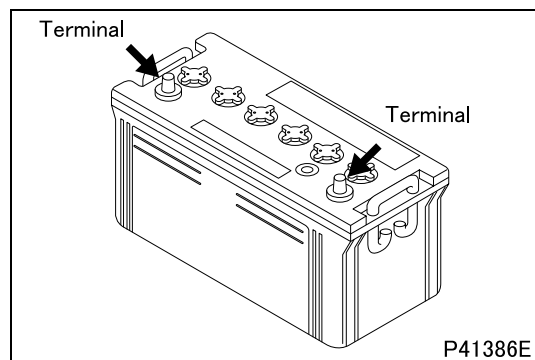
CAUTION ⚠

- Make sure that all electrical switches of the vehicle are OFF before connecting battery cables.
- Make sure that you connect battery cable (+) before you connect battery cable (–).
- To prevent a short-circuit be sure that disconnected battery cables do not accidentally touch the battery terminals.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Specific gravity of battery electrolyte (20°C {68°F})	1.280	1.220	Charge or replace

◆ Service procedure ◆



Inspection of battery

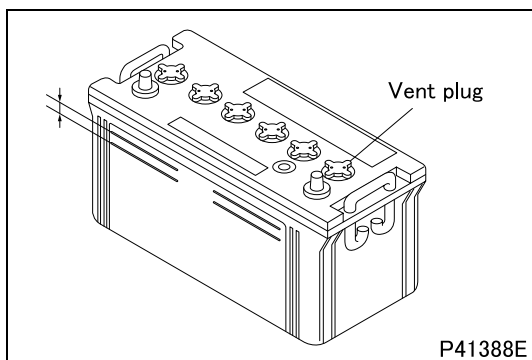
(1) Visual inspection

- If terminal is corroded, scrub off the corrosion from it using a wire brush.
- If cracks or defects are found on battery, replace it since the cracks or defects can cause liquid spills.

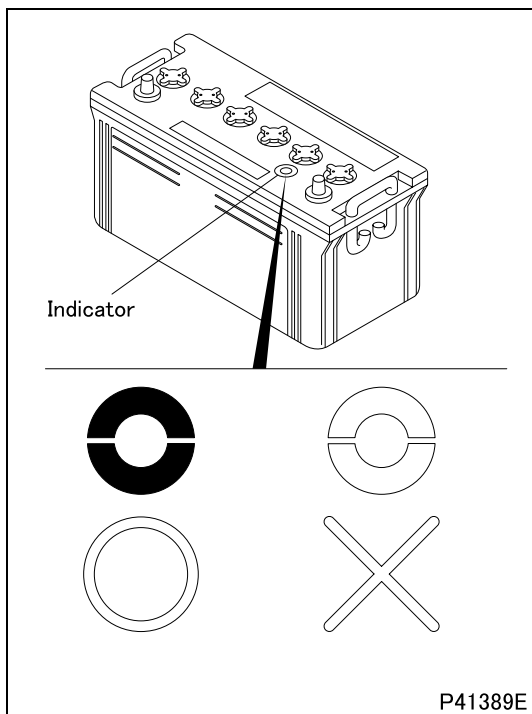
CAUTION ⚠

- Make sure you grease the (+) side of terminal because it is easily corroded.

- If bleed hole of vent plug is clogged, clean the hole.

**(2) Inspection of fluid level**

- Make sure that the battery electrolyte level is between UPPER and LOWER.
- If the level is below LOWER, remove vent plug and fill the battery with distilled water or battery replenisher to UPPER.

**(3) Measurement of specific gravity**

You can tell the specific gravity of the battery electrolyte by the color shown in indicator.

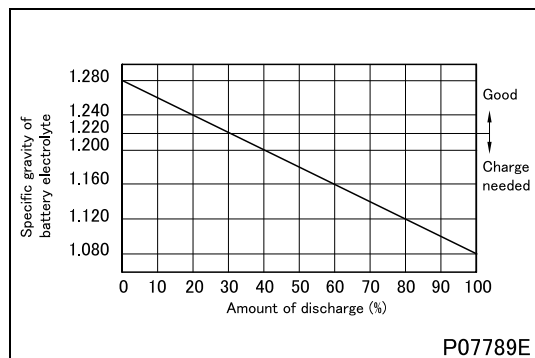
Blue : Good

White : Charge or replace

#860 BATTERY

(4) Charging

- Although, as a rule, battery charging should be done with the battery removed from the vehicle, if you have to charge the battery while it is on the vehicle, make sure that you stop the engine and disconnect battery cable (–).
- Remove vent plug before charging the battery.
- For the recommended charge time and current, see the following table to avoid overcharging.



	Charge current (A)	Charge time (H)	Upper limit of fluid temperature (°C {°F})
Normal charge	Value of 5-hour rating capacity 10	$\frac{\text{*Amount of discharge (Ah)}}{\text{Charge current (A)}} \times 1.2$ (to 1.5)	45 {113}
Quick charge	Value of 5-hour rating capacity 1.5	0.5	55 {131}

$$\text{* Amount of discharge (Ah)} = \frac{\text{5-hour rating capacity (Ah)} \times \text{Amount of discharge (\%)}}{100}$$

- Use the graph shown on the left to calculate the amount of discharge (%).
- Use diluted sulfuric acid, made up of sulfuric acid and refined or distilled water, as the battery electrolyte.

DANGER ⚠

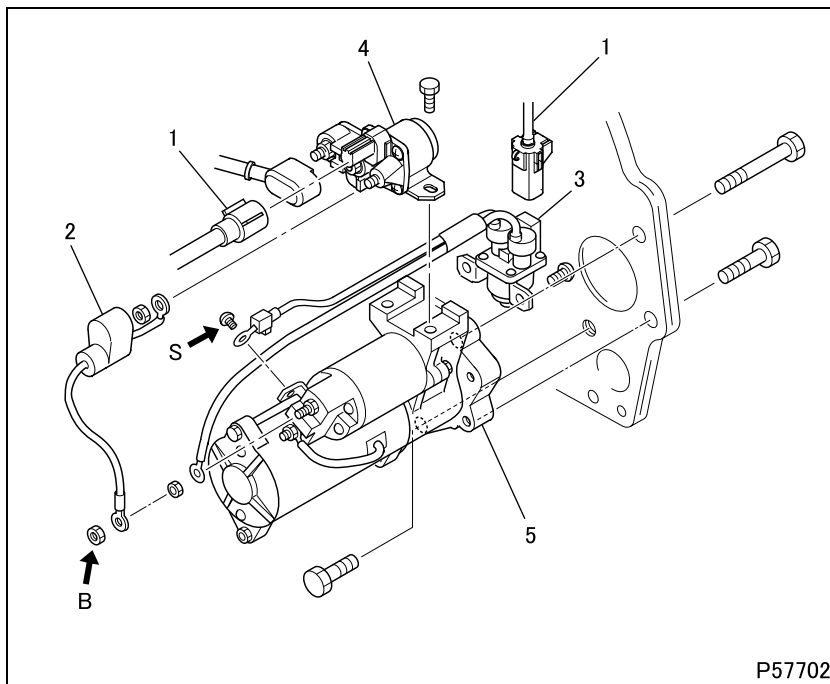
- Keep naked lights away from the battery while charging it or it might explode.
- Be careful not to generate sparks while charging the battery because it's dangerous.
- Do not charge battery if the electrolyte level is below LOWER LEVEL, since it can cause an earlier deterioration, heating, or explosion. Make sure to add the fluid to the specified level before charging.

WARNING ⚠

- Do not let the battery electrolyte level rise and overflow while charging the battery.
- After charging the battery, tighten vent plug, wash away sulfuric acid from the battery using water, and dry the surface.

54-12 STARTER AND ALTERNATOR

#930 STARTER



● Removal sequence

- 1 Chassis harness
- 2 Starter cable
- 3 Starter relay
- 4 Glow relay
- 5 Starter

B: Connected to terminal B

S: Connected to terminal S

WARNING ⚠

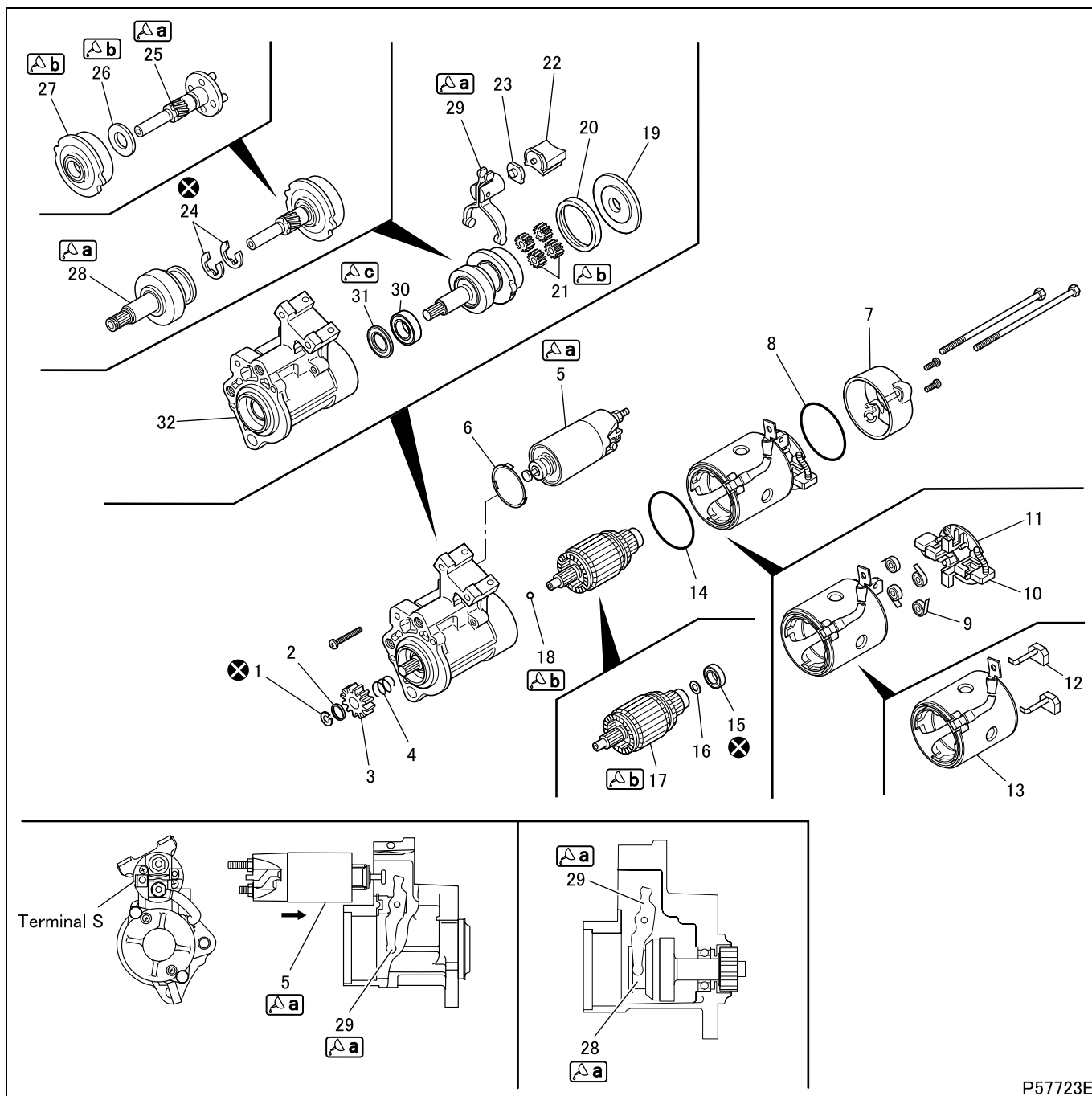
- Before removing the starter, disconnect the battery (–) terminal and insulate it with tape.
- It is dangerous to leave the battery (–) terminal connected since the battery voltage is always present at each terminal B.

● Installation sequence

Follow the removal sequence in reverse.

M E M O

#930 STARTER



P57723E

● Disassembly sequence

- | | | |
|-------------------|-------------------|-----------------------|
| 1 Stopper ring | 13 Yoke | 25 Gear shaft |
| 2 Pinion stopper | 14 Packing | 26 Washer |
| 3 Pinion | 15 Rear bearing | 27 Internal gear |
| 4 Spring | 16 Washer | 28 Overrunning clutch |
| 5 Magnetic switch | 17 Armature | 29 Lever |
| 6 Shim | 18 Ball | 30 Front bearing |
| 7 Rear bracket | 19 Cover | 31 Oil seal |
| 8 Packing | 20 Rubber packing | 32 Front bracket |
| 9 Brush spring | 21 Planetary gear | |
| 10 Brush (-) | 22 Rubber packing | |
| 11 Brush holder | 23 Plate | |
| 12 Brush (+) | 24 E-ring | |

⊗: Non-reusable parts

CAUTION ⚠

- Do not remove the rear bearing unless defects are evident.
- When the armature is removed, the ball might come out with it. Take care not to lose the ball.
- It is not necessary to remove the pinion when only the motor should be removed and inspected for inspection of the brushes and the related parts.
- Be sure to remove the pinion before disassembling any other parts.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- Whenever the magnetic switch is replaced, the pinion gap must be adjusted.

Service standards (Unit: mm {in.})

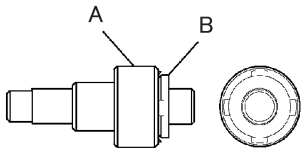
Location	Maintenance item			Standard value	Limit	Remedy
–	Pinion gap			0.5 to 2.0 {0.02 to 0.079}	–	Adjust
–	No-load characteristics	With 23 V applied	Current	180 A or less	–	Inspect
			Rotation speed	3800 rpm or higher	–	
9	Brush spring pressure			29.2 to 39.4 N {6.6 to 8.9 lbs, 3 to 4 kgf}	13.7 N {3.1 lbs, 1.4 kgf}	Replace
10, 12	Brush length			18 {0.71}	11 {0.43}	Replace
17	Commutator outside diameter			32 {1.26}	31.4 {1.24}	Replace
	Runout of commutator periphery			–	0.1 {0.0039} or higher	
	Mold depth between segments			–	0.2 {0.0079} or less	Correct or replace

Lubricant and/or sealant

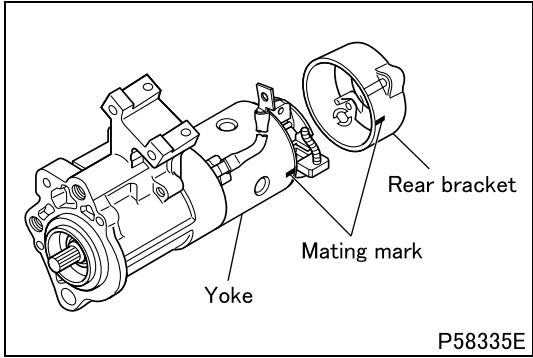
Mark	Points of application	Specified lubricant and/or sealant	Quantity
⚠ a	Lever contact surface of magnetic switch	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
	Sliding surfaces of gear shaft and overrunning clutch		
	Splines of overrunning clutch		
	Sliding surfaces of lever and overrunning clutch		
⚠ b	Sliding surfaces of armature and gear shaft	MOLYKOTE AG650	As required
	Ball		
	Teeth of planetary gear and internal gear		
	Washer		
⚠ c	Oil seal	Multipurpose grease [NLGI No.2 (Li soap)] or grease attached to oil seal	As required

#930 STARTER

Special tools

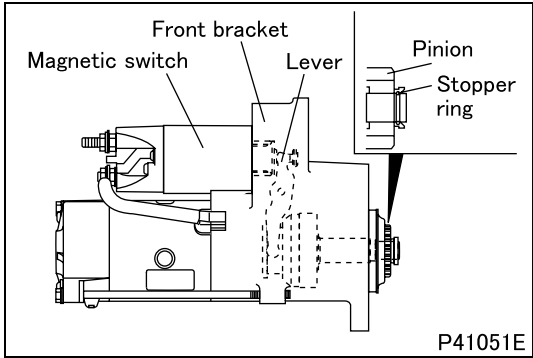
Mark	Tool name and shape	Part No.	Application
	Bearing remover and installer A: Bearing remover and installer B: Bearing installer  P50804	MH063596 A: MH063614 B: MH063618	Removal and installation of front bearing

◆ Work before disassembly ◆



■ Mating mark: Rear bracket and yoke

◆ Disassembly procedure ◆



■ Disassembly: Pinion

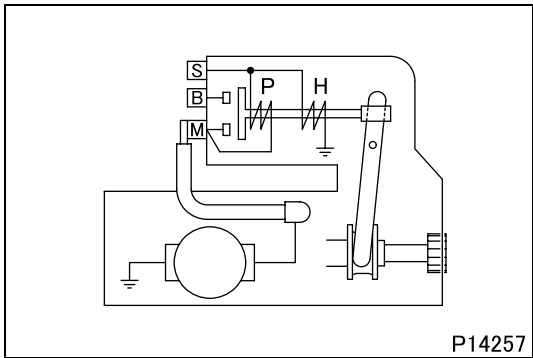
- For removal of the pinion, current must be supplied to the starter such that the pinion springs out.

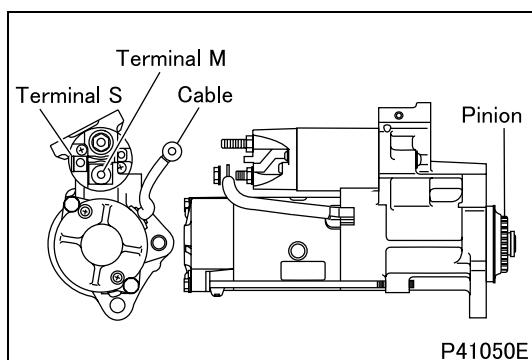
WARNING ⚠

- When the starter is energized, the pinion will spring out and rotate. Be careful not to touch it with your hands.
- The magnetic switch may become very hot during inspections. Be careful when touching it.

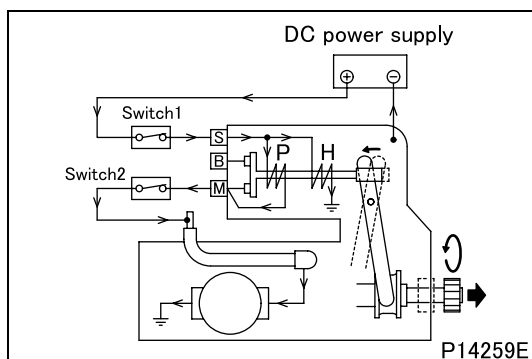
CAUTION ⚠

- Do not energize the pull-in coil P for longer than 10 seconds, and do not energize the holding coil H for longer than 30 seconds. If these periods are exceeded, the coils may overheat and burn out.
- To make the pinion spring out, be sure to energize the starter such that its parts are positioned correctly. If the starter is not energized and the lever is pulled to make the pinion come out, the front bracket and/or lever may be damaged by the shock inflicted upon them when the stopper ring is removed.
- When current is supplied to the starter, a large current (100 A or higher) will flow. For inspection purposes, use booster cables or similarly thick cables must therefore be used. Also, it is important to ensure that all connections are secure.

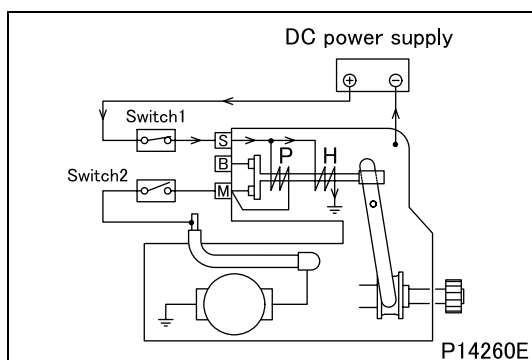




- Connect the starter as illustrated.



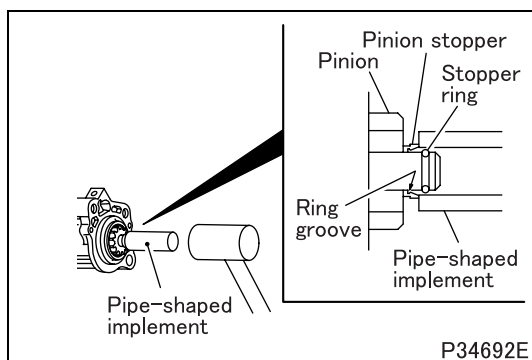
- The following operations are performed with current supplied to the starter. Thus, the entire procedure for removal of the pinion must be completed within 30 seconds.
- Turn ON switches 1 and 2 to supply current to the starter. The pinion will spring out and rotate.



- After the pinion starts to rotate, quickly (within five seconds) turn OFF switch 2 to stop the pinion's rotation.

CAUTION

- When switches 1 and 2 are turned ON, the pull-in coil P and holding coil H are both energized. The circuit is connected such that no voltage is applied to starter terminal B, so current flows to the pull-in coil while the pinion rotates. To prevent the pull-in coil from burning out, it is essential to turn OFF switch 2 quickly (within five seconds) after the pinion starts to rotate.

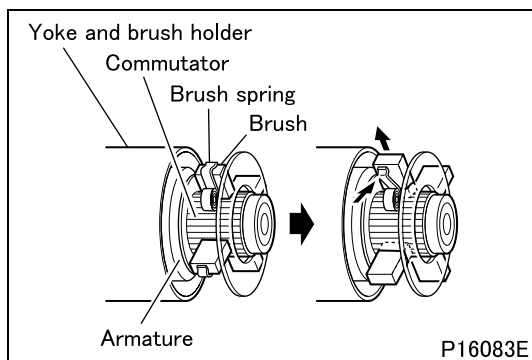


- Apply a pipe-shaped implement to the pinion stopper.
- Using a hammer, lightly tap the hit pipe-shaped implement to remove the stopper ring from the ring groove of the pinion stopper.
- Remove the stopper ring and pinion.
- Turn OFF switch 1 to de-energize the starter.

CAUTION

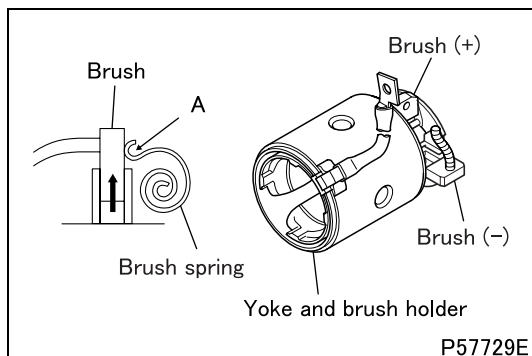
- When the starter is de-energized, the mechanism will attempt to pull in the pinion. Thus, the stopper ring may slip back into the ring groove of the pinion stopper. If this happens, energize the starter and go through the pinion removal procedure again.

#930 STARTER

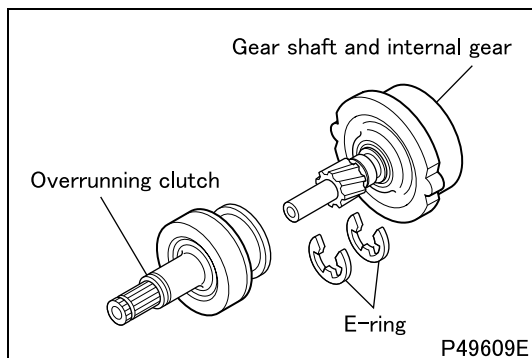


■ Disassembly: Yoke and brush holder

- Use the following method to remove the yoke and brush holder in order to prevent the commutator of the armature from being damaged by the brushes.
- Lift the brushes away from the commutator and hold them lifted by applying the brush springs against the sides of the brush springs.

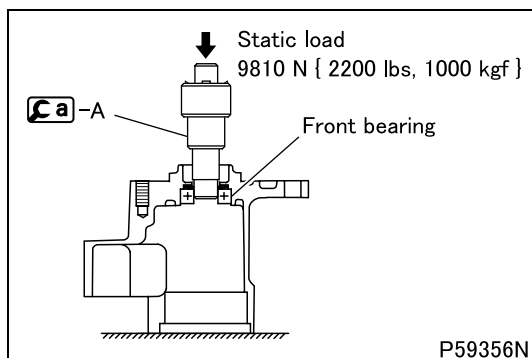
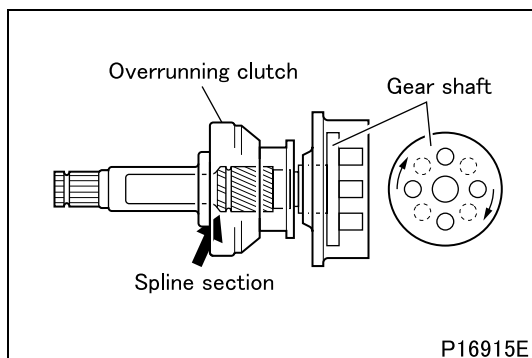


- Pull part A of each brush spring and pull up the brushes.
- Hold the brushes in position with the brush springs as illustrated.
- Remove the yoke and brush holder.



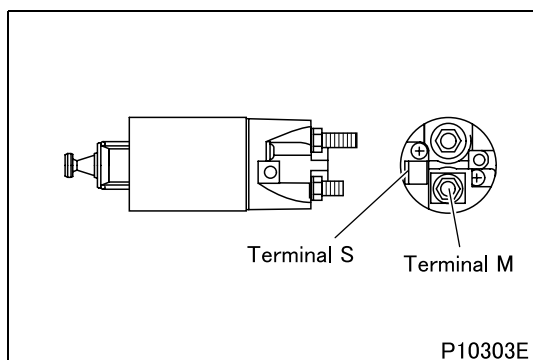
■ Disassembly: Gear shaft and internal gear

- Remove the E-rings and then the gear shaft and internal gear from the overrunning clutch. Proceed as follows if the gear shaft cannot be removed due to interference of the splined section of gear shaft with internal parts of the overrunning clutch.
- Press the gear shaft against the overrunning clutch.
- Turn the gear shaft approx. 1/8 of a turn to change the position of splined section.



■ Disassembly: Front bearing

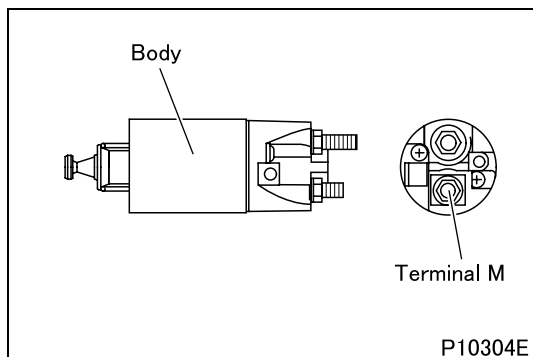
◆ Inspection procedure ◆



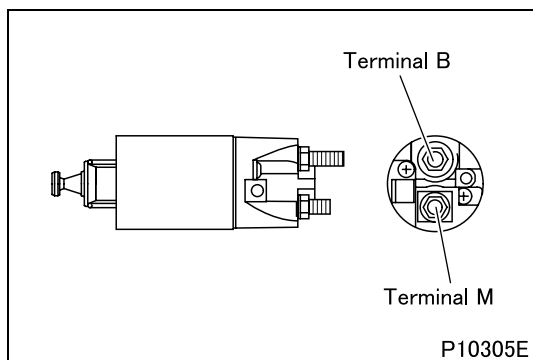
■ Inspection: Magnetic switch

(1) Test for coil open circuit

- Check that continuity exists between terminals S and M.
- If there is no continuity, replace the magnetic switch.

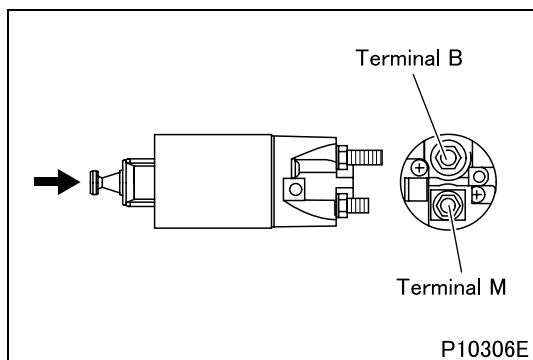


- Check that continuity exists between terminal M and the body.
- If there is no continuity, replace the magnetic switch.



(2) Test for fused-together contacts

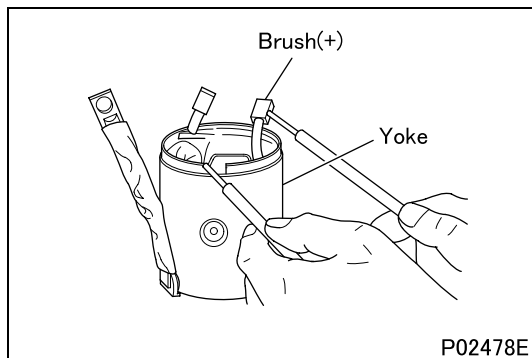
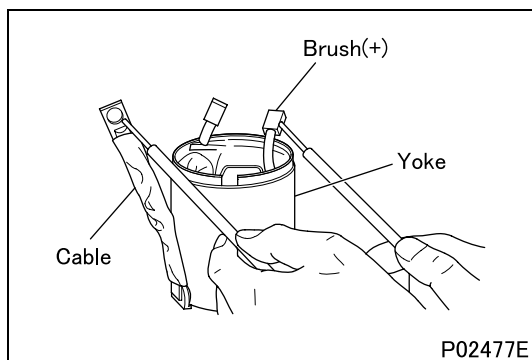
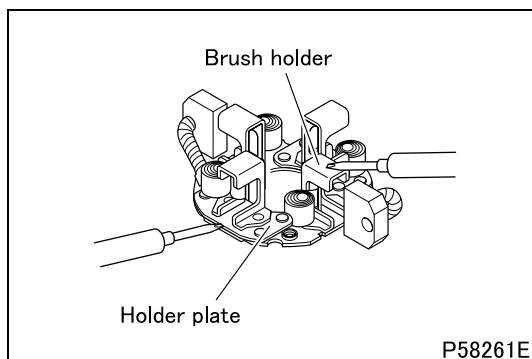
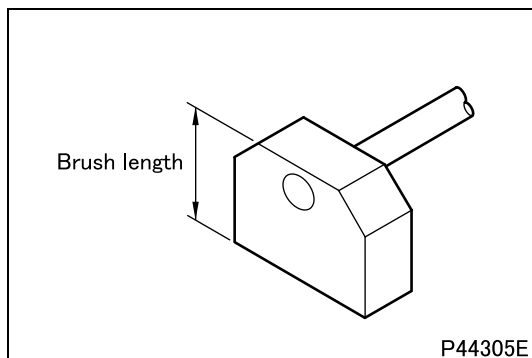
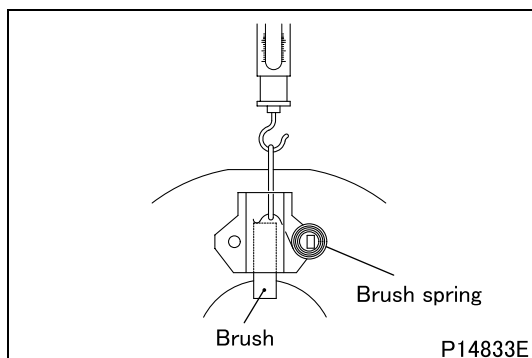
- Check that continuity does not exist between terminals B and M.
- If continuity exists, replace the magnetic switch.



(3) Test for contact-to-contact continuity

- Push in the end of the magnetic switch to close the internal contacts. Then, check that continuity exists between terminals B and M.
- If there is no continuity, replace the magnetic switch.

#930 STARTER



■ Inspection: Brush spring

- Using new brushes, measure the load required to separate each brush spring from its brush.
- If either measurement is lower than the specified limit, replace the brush springs.

■ Inspection: Brush (–)

(1) Brush length

- If either brush (–) is shorter than the limit, it must be replaced.

(2) Commutator contact surface of brush

- If the commutator contact surface of either brush is rough or unevenly worn, rectify it with emery paper (#300 to 500).

■ Inspection: Brush holder

- Thoroughly clean the (+) brush holder and the (–) holder plate, then, check that continuity does not exist between them.
- If continuity exists, there is a short circuit and the brush holder must be replaced.

■ Inspection: Yoke

(1) Test for coil open circuit

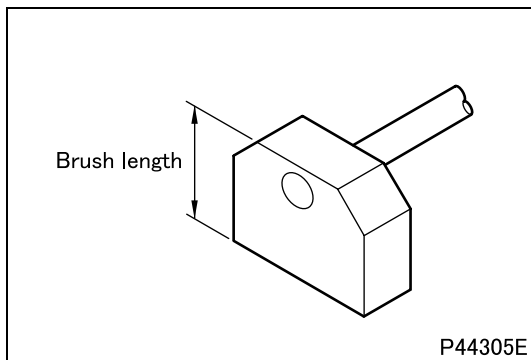
- Check that continuity exists between the cable and the (+) brush.
- If there is no continuity, there is an open circuit and the yoke or (+) brush must be replaced.

(2) Test for coil grounding

- Check that continuity does not exist between the yoke and the (+) brush.
- If continuity exists, the coil is grounded. Inspect the insulation, and replace the yoke and the (+) brush if the insulation cannot be rectified.

CAUTION ⚠

- The coil may be grounded to the yoke due to the accumulation of worn-off metal particles from the brushes and/or armature.



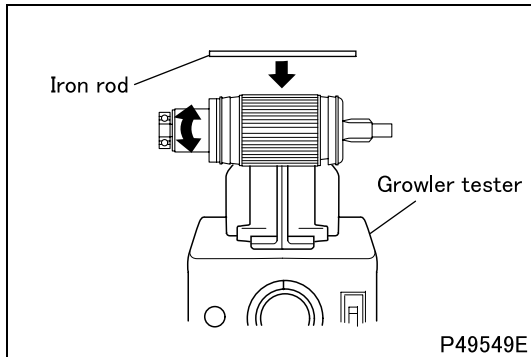
■ Inspection: Brush (+)

(1) Brush length

- If either brush (+) is shorter than the limit, it must be replaced.

(2) Commutator contact surface of brush

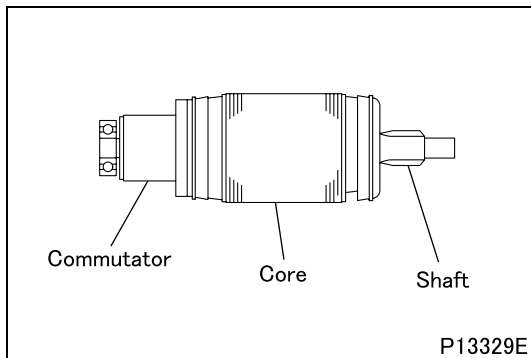
- If the commutator contact surface of either brush is rough or unevenly worn, rectify it with emery paper (#300 to 500).



■ Inspection: Armature

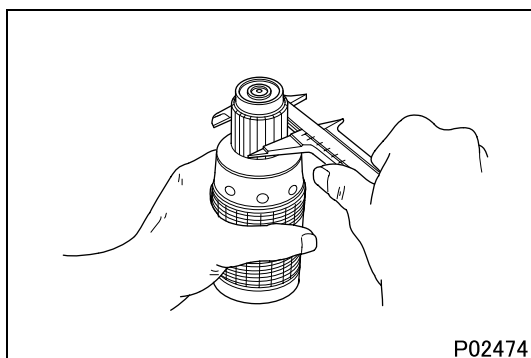
(1) Test for coil short circuit

- Hold an iron rod parallel with the armature.
- Slowly rotate the armature by hand.
- If the iron rod vibrates or is pulled toward the armature, the coil is short-circuited and the armature must be replaced.



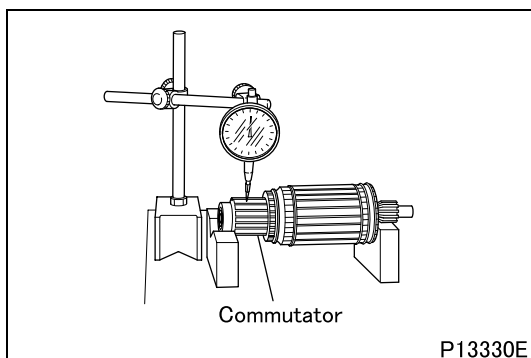
(2) Test for coil grounding

- Check that continuity does not exist between the commutator and the core (or shaft).
- If continuity exists, the coil is grounded and the armature must be replaced.



(3) Commutator outside diameter

- If the measurement is out of specification, replace the armature.



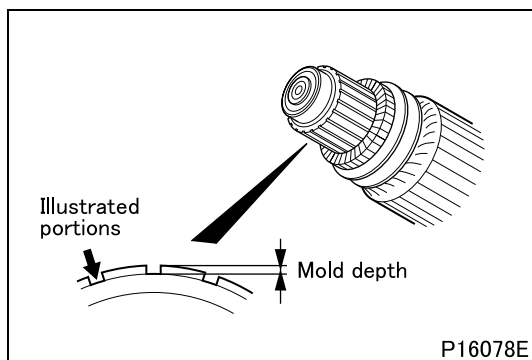
(4) Runout of commutator periphery

- If the reading exceeds the specified limit, rectify the commutator of the armature, making sure the outside diameter stays within specification.

(5) Condition of commutator surface

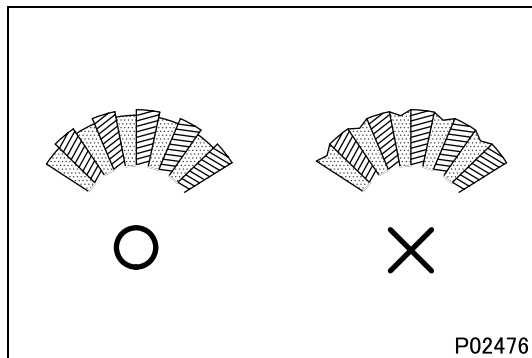
- If the surface is rough or has stepped wear, rectify it with emery paper (#300 to 500).
- After rectifying the surface, check the extent of commutator runout.

#930 STARTER



(6) Mold depth between segments

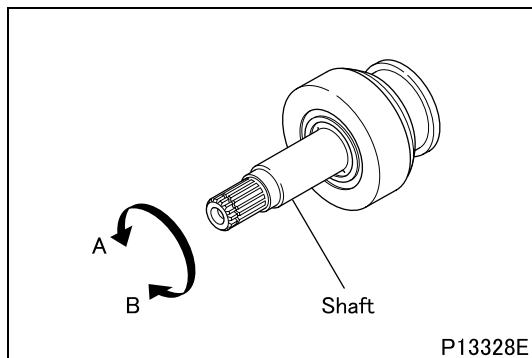
- If the measurement is lower than the specified limit, rectify or replace the armature.
- To rectify the armature, grind the illustrated portions.



- If the mold is worn as illustrated, rectify or replace the armature.

O : Acceptable

× : Unacceptable

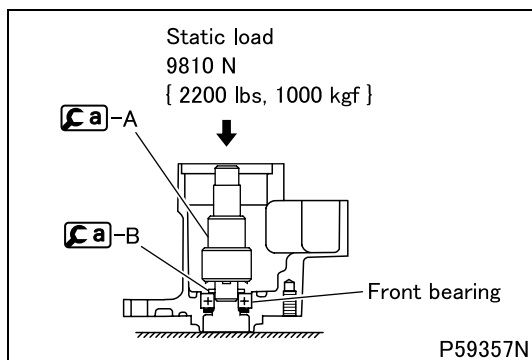


■ Inspection: Overrunning clutch

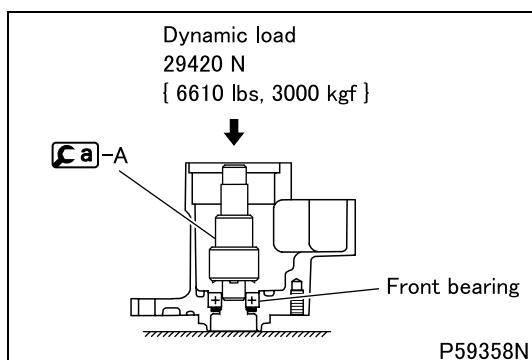
If the following inspections reveal any abnormality, replace the overrunning clutch.

- Turn the shaft in direction B and check that it rotates smoothly.
- Turn the shaft in direction A and check that it locks.

◆ Assembly procedure ◆



■ Assembly: Front bearing



- After the press fitting, caulk the front bearing.

CAUTION

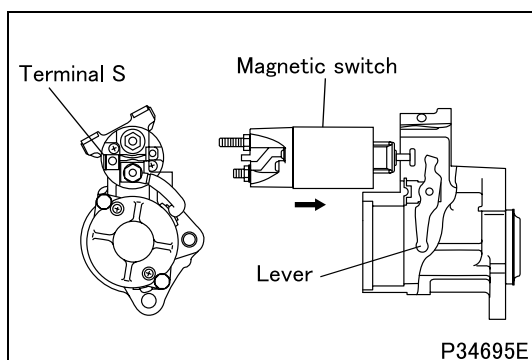
- Avoid re-caulking previously caulked points.

■ Assembly: Yoke and brush holder

- To install the yoke and brush holder, follow the removal sequence in reverse.
(See “■ Disassembly: Yoke and brush holder”)

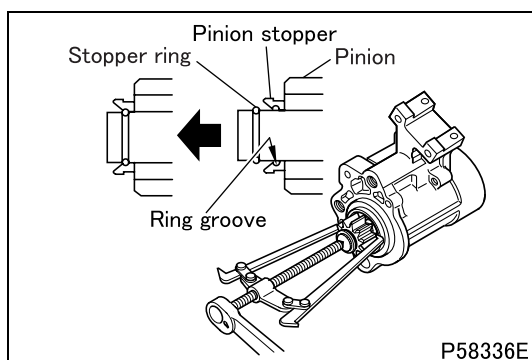
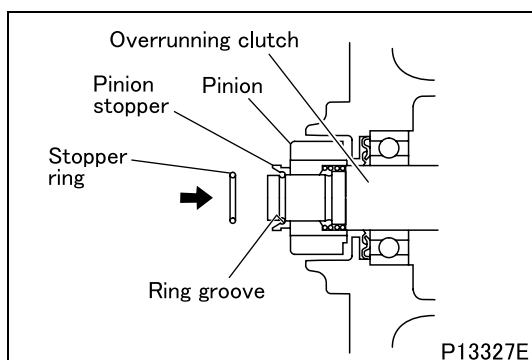
■ Assembly: Magnetic switch

- Fit the magnetic switch onto the lever with terminal S aligned as illustrated.



■ Assembly: Pinion

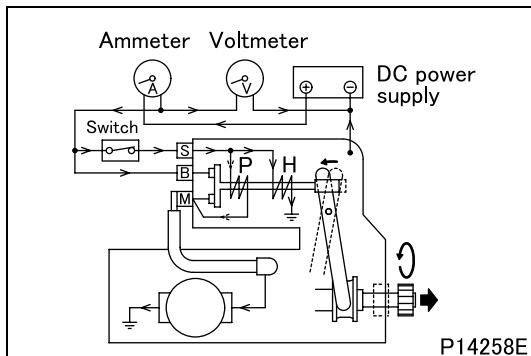
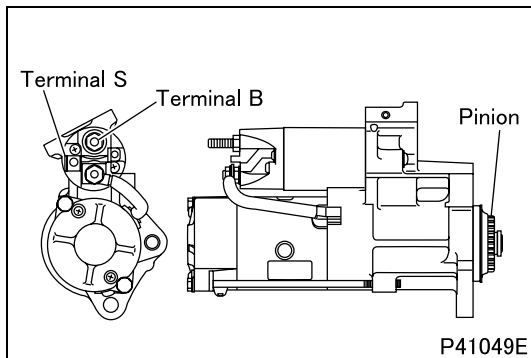
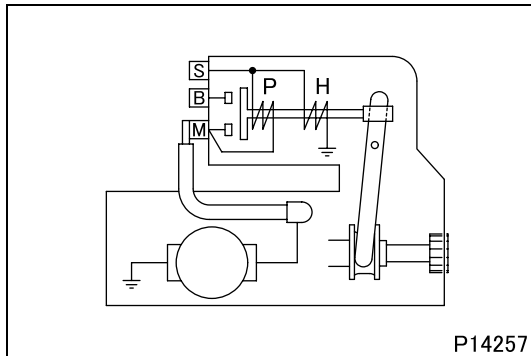
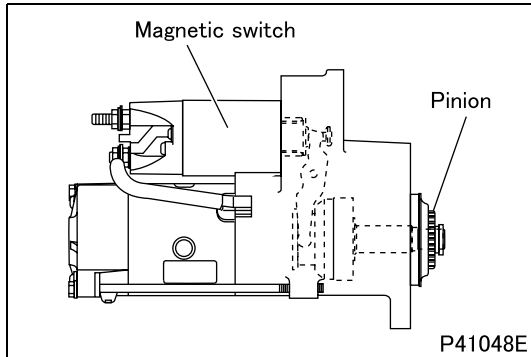
- For installation of the pinion, it is not necessary to supply current to the starter.
 - Fit the pinion stopper and pinion onto the overrunning clutch, making sure they are oriented as illustrated.
 - Fit the stopper ring into the ring groove of the overrunning clutch.



- Pull the pinion hard and securely fit the stopper ring into the ring groove of the pinion stopper.

#930 STARTER

◆ Inspection after assembly ◆



■ Inspection: Performance and pinion gap

- After assembling the starter, perform inspections with current supplied to it.

WARNING ⚠

- When the starter is energized, the pinion will spring out and rotate. Be careful not to touch it with your hands.
- The magnetic switch may become very hot during inspections. Be careful when touching it.

CAUTION ⚠

- Do not energize the pull-in coil P for longer than 10 seconds, and do not energize the holding coil H for longer than 30 seconds. If these periods are exceeded, the coils may overheat and burn out.
- When current is supplied to the starter, a large current (100 A or higher) will flow. For inspection purposes, booster cables or similarly thick cables must therefore be used. Also, it is important to ensure that all connections are secure.

(1) Performance test

- Connect the starter as illustrated.
- Set the voltage to 11 V DC.

CAUTION ⚠

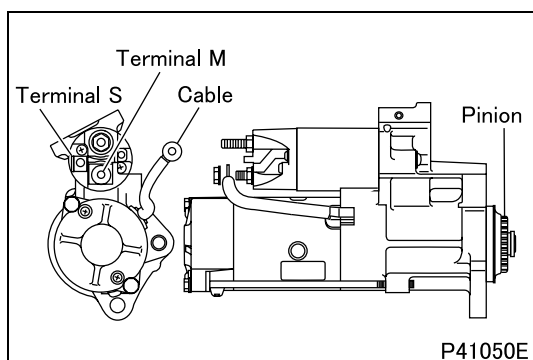
- The voltage applied must not exceed 12 V.

- The following operations are performed with current supplied to the starter. Thus, the entire test (consisting of measurement of the current flowing through the starter and measurement of the starter's rotational speed) must be completed within 30 seconds.
 - Turn ON the switch to supply current to the starter. The pinion will spring out and rotate.

CAUTION ⚠

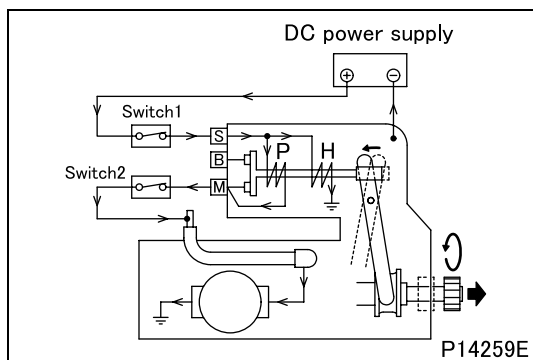
- When the switch is turned ON, the pull-in coil P and holding coil H are both energized. When the large current from the DC power supply flows from terminal B to terminal M, the supply of current to the pull-in coil P is cut; only the holding coil H remains energized. To prevent the holding coil from burning out, it is essential to complete all operations within 30 seconds.

- Measure the current and the starter's rotational speed. To measure the rotational speed, shine a stroboscope on the pinion.
- Turn OFF the switch to de-energize the starter.
- If either measurement is out of specification, disassemble and inspect the starter again.

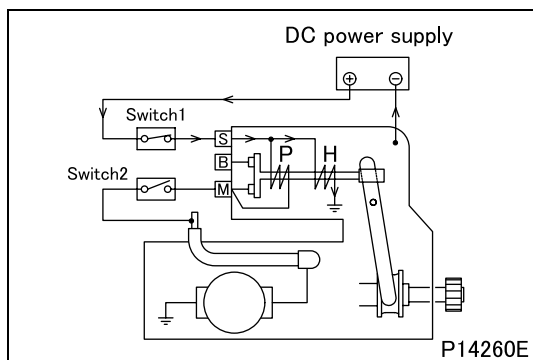


(2) Pinion gap

- Connect the starter as illustrated.



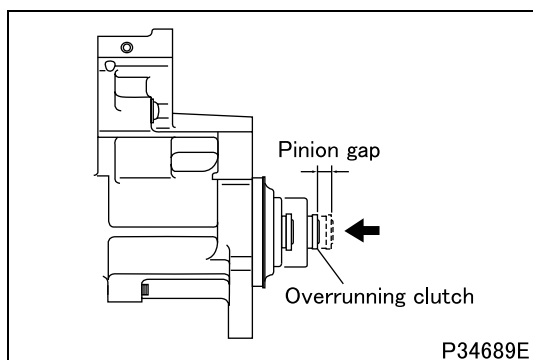
- The following operations are performed with current supplied to the starter. Thus, the entire procedure for measurement of the pinion gap must be completed within 30 seconds.
- Turn ON switches 1 and 2 to supply current to the starter. The pinion will spring out and rotate.



- After the pinion starts to rotate, quickly (within five seconds) turn OFF switch 2 to stop the pinion's rotation.

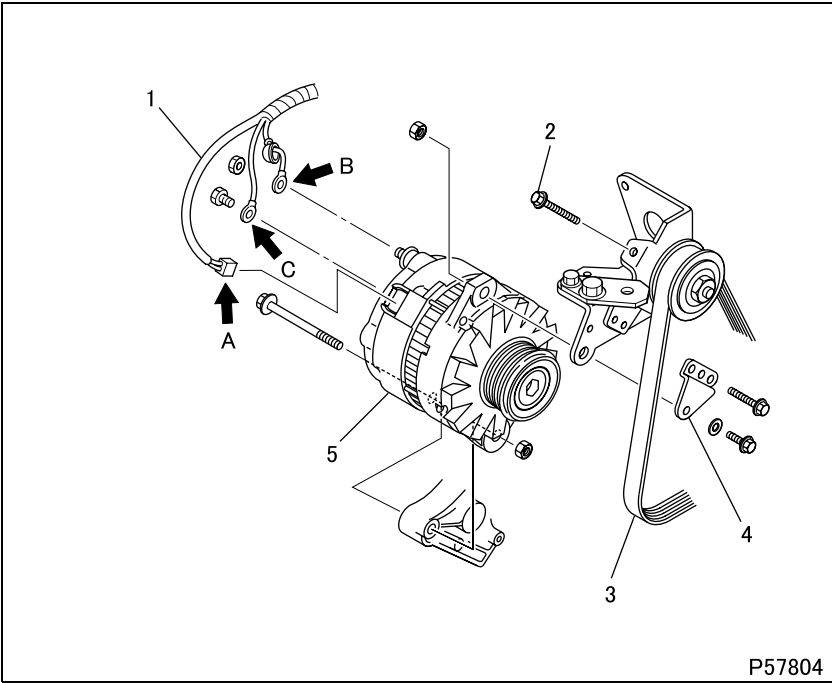
CAUTION ⚠

- When switches 1 and 2 are turned ON, the pull-in coil P and holding coil H are both energized. The circuit is connected such that no voltage is applied to starter terminal B, so current flows to the pull-in coil while the pinion rotates. To prevent the pull-in coil from burning out, it is essential to turn OFF switch 2 quickly (within five seconds) after the pinion starts to rotate.



- Pull out the end of the overrunning clutch and then lightly push in the end of the overrunning clutch and measure the amount of movement in the axial direction, i.e., the pinion gap.
- Turn OFF switch 1 to de-energize the starter.
- If the measurement is out of specification, replace the lever.

#940 ALTERNATOR



● Removal sequence

- 1 Chassis harness
- 2 Adjusting bolt
- 3 V-belts
- 4 Alternator stay
- 5 Alternator

A: Connect to terminal L, R
B: Connect to terminal B
C: Connect to terminal E

WARNING ⚠

- To prevent possible injury, be sure to disconnect the negative terminal (–) of the battery and insulate it with tape before removing alternator.
- With the negative terminal (–) of the battery connected, battery voltage is always applied to the terminal B.

● Installation sequence

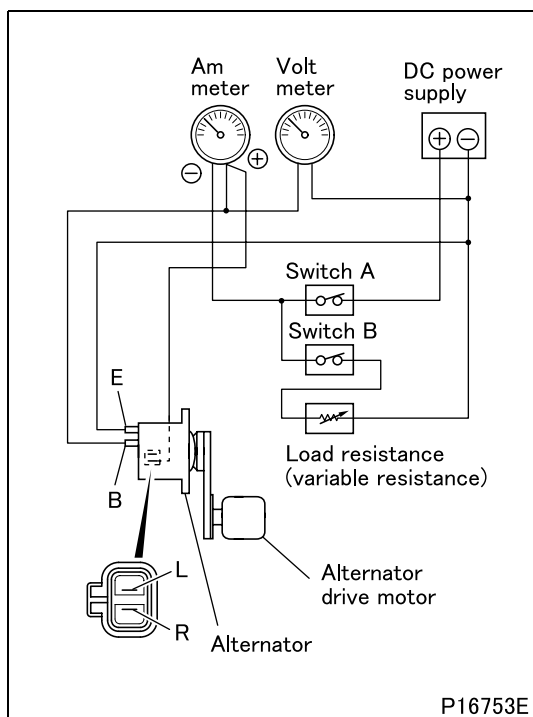
Follow the removal sequence in reverse.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
5	Alternator output current (*When alternator is hot and producing 13.5 V)	At 1500 rpm	53 A or more	–	Inspect
		At 2500 rpm	84 A or more	–	
		At 5000 rpm	102 A or more	–	
	Adjustment voltage of regulator (At 5000 rpm, 5A is loaded)		14.7 ± 0.3 V	–	Replace

* The hot condition is the one after the alternator has been run at normal ambient temperature with 5000 rpm and maximum output for 30 minutes.

◆ Inspection procedure ◆



■ Inspection: Alternator

(1) Alternator output current

- Connect the alternator as illustrated.

CAUTION ⚠

- Sufficiently thick wires should be used for wiring and each connection should be securely fastened.

B: Terminal B

E: Terminal E

L: Terminal L

R: Terminal R

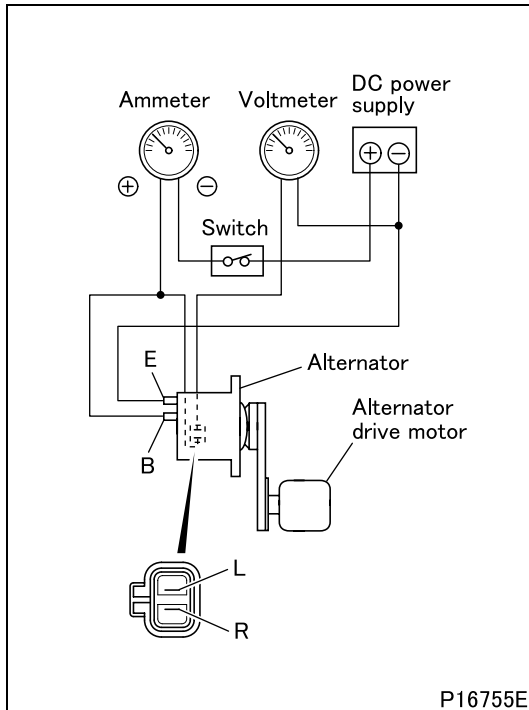
- Increase load resistance to the maximum (condition which the load current hardly flow).
- Turn switch A and B ON.
- Run alternator at 5000 rpm for 30 minutes by adjusting load resistance so that electric current can conform to the specified standard.

Alternator nominal current

Current
102 A or more

- Measure the current at each specified revolution of alternator.
- If the measured value deviates from the standard value, disassemble and check alternator.

#940 ALTERNATOR



(2) Adjustment voltage of regulator

- Connect the alternator as illustrated.

B: Terminal B

E: Terminal E

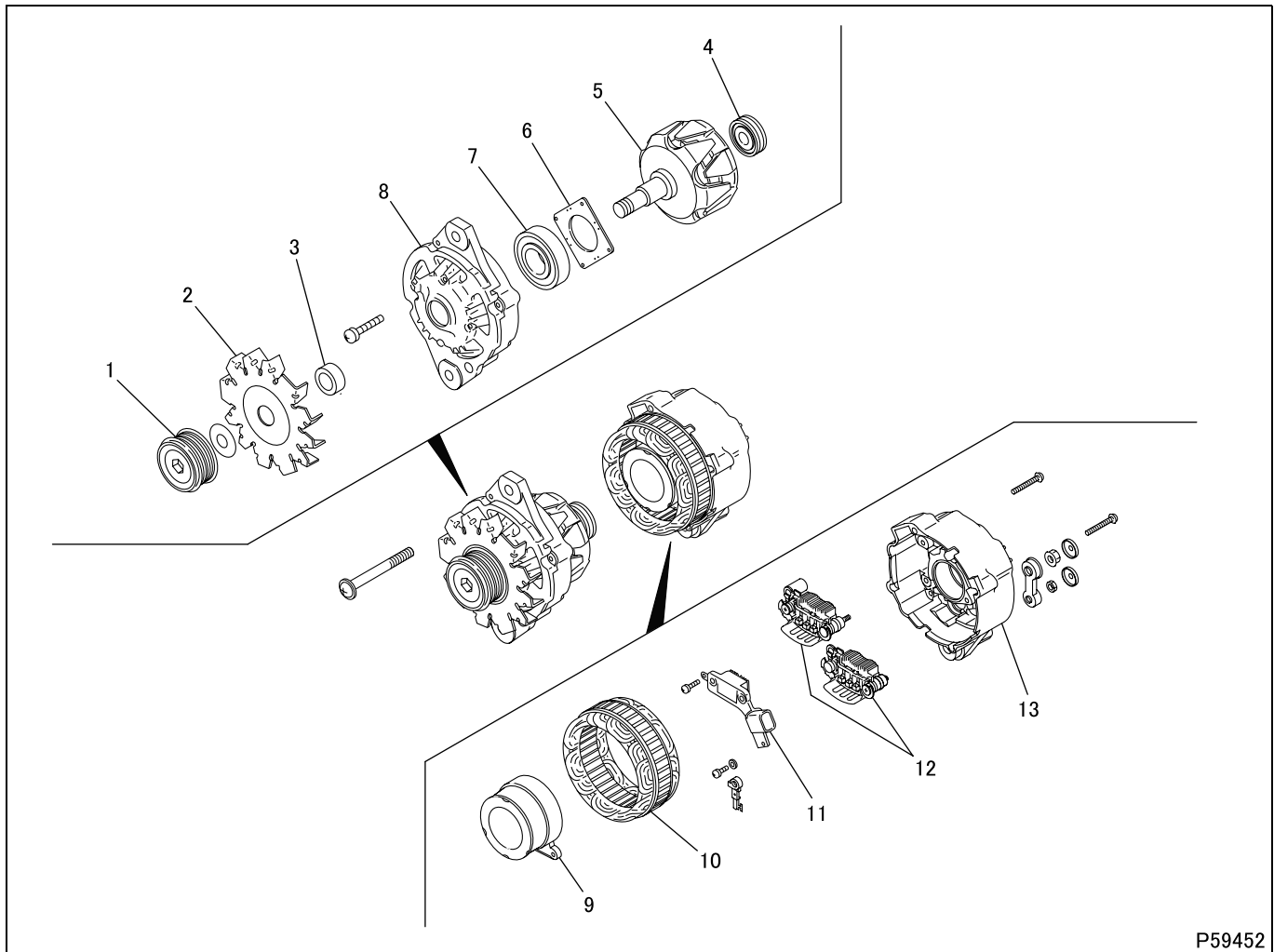
L: Terminal L

R: Terminal R

- Turn switch ON.
- Run alternator at low speeds.
- Increase the speed of alternator to 5000 rpm and measure the voltage (adjustment voltage) at this speed. At the same time, make sure that the current is 10 amperes or less at 5000 rpm.
- If the measured value deviates from the standard value, do as follows:
 - If higher than the standard value: Replace the regulator.
 - If lower than the standard value: Inspect the alternator related parts before replacing the regulator.

M E M O

#940 ALTERNATOR



P59452

● Disassembly sequence

- | | |
|-----------------|-----------------|
| 1 Pulley | 8 Front bracket |
| 2 Fan | 9 Field coil |
| 3 Spacer | 10 Stator |
| 4 Rear bearing | 11 Regulator |
| 5 Rotor | 12 Rectifier |
| 6 Cover | 13 Rear bracket |
| 7 Front bearing | |

NOTE

- Do not remove rear and front bearing, and stator unless they are faulty.

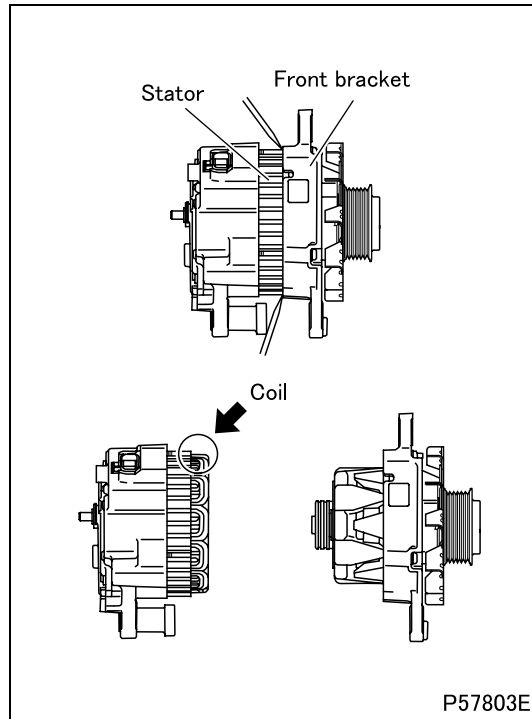
● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
9	Field coil resistance (at 20°C {68°F})	1.9 to 2.3 Ω	–	Replace

◆ Disassembly procedure ◆

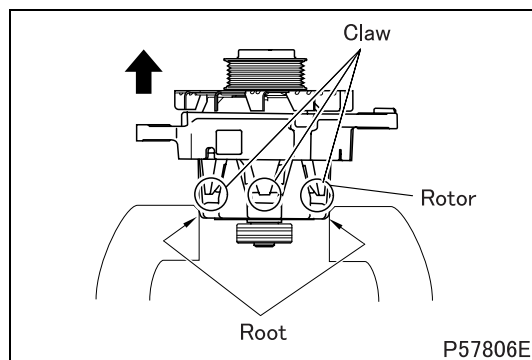


■ Disassembly: Rotor and front bracket

- Insert a screwdriver between front bracket and stator.
- Use the screwdriver to pry rotor and front bracket away from stator and rear bracket.

CAUTION ⚠

- Be careful not to insert the screwdriver too deep or it will damage coil of stator and might cause a short-circuit.

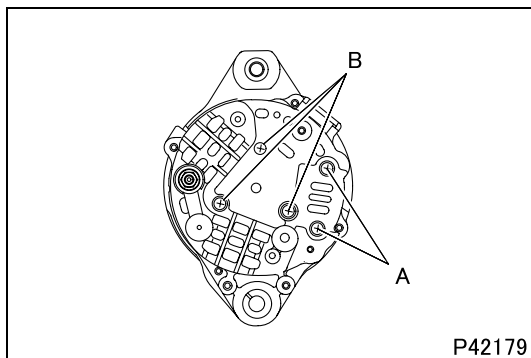


■ Disassembly: Pulley

CAUTION ⚠

- Make sure, when you hold rotor assembly in a vise, to grip root of the core claws. Gripping claws can damage them.

#940 ALTERNATOR

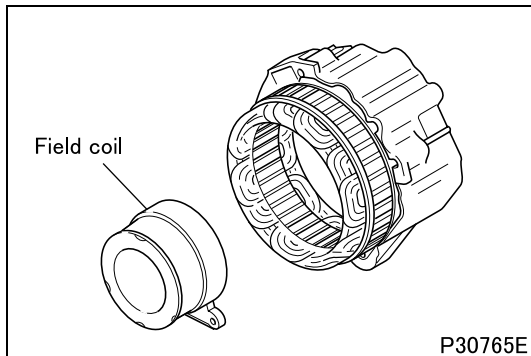


■ Disassembly: Field coil

- Remove screw **A** (2 places).

CAUTION ⚠

- If screw **B** are removed first, the weight of field coil may be placed on the joining portion with regulator which is fixed with screw **A**, causing break of the joining portion. To avoid this, remove screw **A** first.



- Remove screw **B** (3 places).

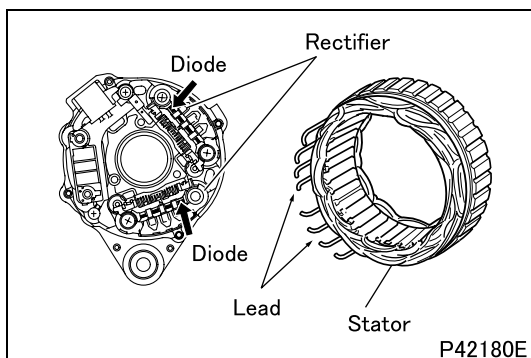
CAUTION ⚠

- If screw **B** are removed, field coil falls under its own weight. Keep the field coil supported by your hand.

- Remove field coil.

CAUTION ⚠

- Do not take out field coil forcibly. Otherwise the joining portion with regulator may be caught by the stator coil.



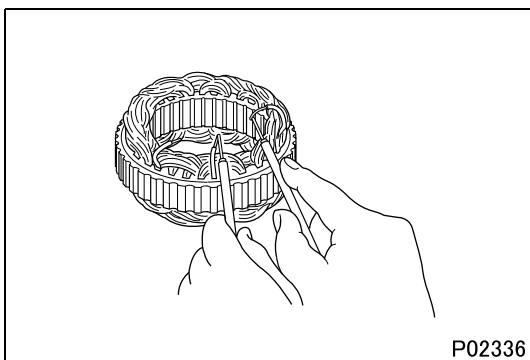
■ Disassembly: Stator

- Disconnect lead of stator from rectifier. The lead is soldered to diode of the rectifier at 8 places. (Each of the 2 rectifiers has 4 soldered sections.)

CAUTION ⚠

- Unsolder within as short a time as possible (within 5 seconds), or diode can be easily damaged by heat.

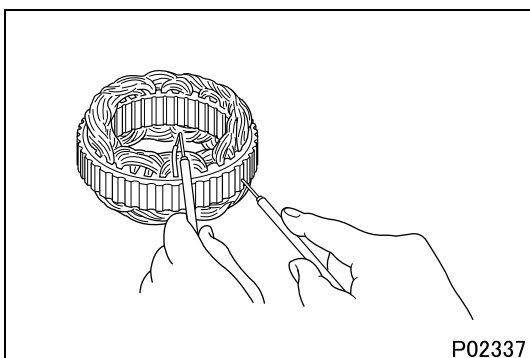
◆ Installation procedure ◆



■ Inspection: Stator

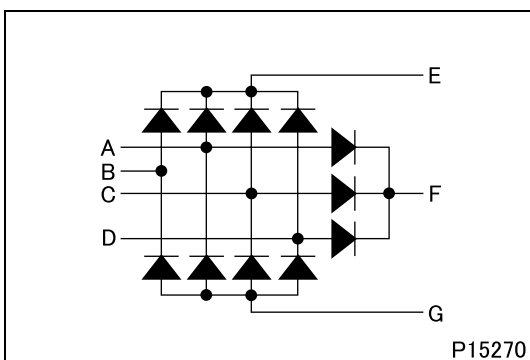
(1) Continuity between each lead wire

- Check that there is continuity between each stator lead.
- If there is no continuity, the lead is broken. Replace stator.



(2) Continuity between each lead wires and the core

- Check that there is no continuity between lead wires and the core.
- If there is continuity, the lead wire is short-circuited. Replace the stator.



■ Inspection: Rectifier

- Check the function of diodes within rectifier properly. If any fault is found, replace the rectifier.

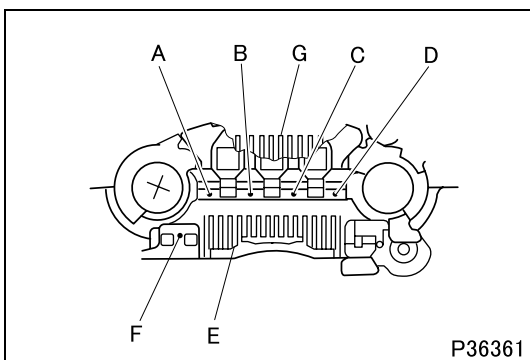
If resistance is infinite in both cases, the diode is open.

If resistance is close to 0 Ω in both cases, the diode is shorted.

A, B, C, D: Lead connecting area of stator coil

E, G: Heat sink area

F: Regulator connecting area



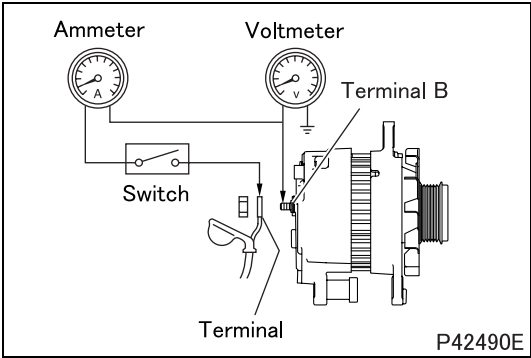
- Inspection should be repeated with the positive probe and the negative probe of the tester changed over.

CAUTION ⚠

- When inspecting using a tester, the current flowing through rectifier is smaller than usual. Therefore, an incorrect resistance value might be indicated on the tester. Also, incorrect indications become larger as the range of the tester gets smaller. Set the tester to a largest possible scale.

54-13 ON-VEHICLE INSPECTION AND ADJUSTMENT

#950 INSPECTION OF ALTERNATOR



Performance test

- Connect the meters to the alternator as shown.

WARNING ⚠

- To prevent possible injury, be sure to disconnect the negative terminal of the battery and insulate it with tape before working on the wiring. With the negative terminal (–) of the battery connected, battery voltage is always applied to the terminal B.
- To connect to switch, use a lead wire with the same or larger diameter than that of the chassis harness connected to terminal B.

- Turn on switch and make sure that voltmeter indicates battery voltage.
- Start the engine.
- Immediately turn on the switches for all lamps on the vehicle.
- Immediately accelerate the engine to the speed indicated below and measure the alternator's output current.
Approx. 2400 rpm
- The alternator is considered to be good if the measured value is 70% or more of the nominal output current.

Alternator nominal output

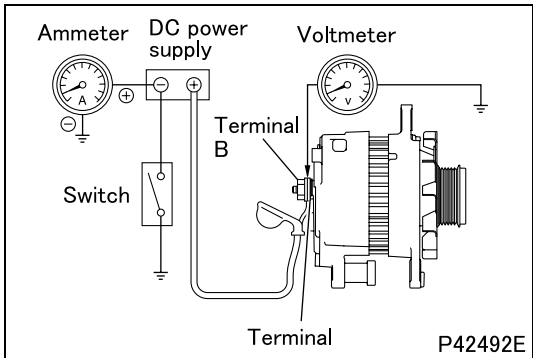
Alternator	Voltage	Output current
100 A	12 V	100 A

NOTE

- The on-vehicle inspection is only a simplified check. Use a test bench for accurate checking.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Adjusting voltage	14.7 ± 0.3 V	—	Replace



- Connect the meters to the alternator as shown.

WARNING

- To prevent possible injury, be sure to disconnect the negative terminal of the battery and insulate it with tape before working on the wiring. With the negative terminal (–) of the battery connected, battery voltage is always applied to the terminal B.
- To connect to switch, use a lead wire with the same or larger diameter than that of the chassis harness connected to terminal B.

- Turn off the switches for lamps, heater, etc. so that electric loads may not be applied during the inspection.
- Turn on switch and then start the engine.
- If the output current is 5 amperes or less when the engine speed is raised to the appropriate speed indicated below, then measure the voltage at terminal B.
Approx. 2400 rpm

CAUTION

- If the output current is in the range from 5 to 10 amperes, the measured value (regulated voltage) will be slightly lower.
14.4 V ± 0.3 V

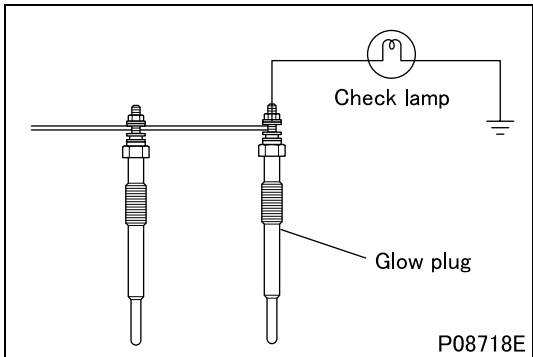
- If the output current is 5 amperes or more, do one of the following:
 - Run the engine for a while to charge the battery.
 - Replace the battery with a fully-charged one.
- If the measured value deviates from the standard value, conduct checking again on the test bench.

#955 INSPECTION OF PREHEATING SYSTEM

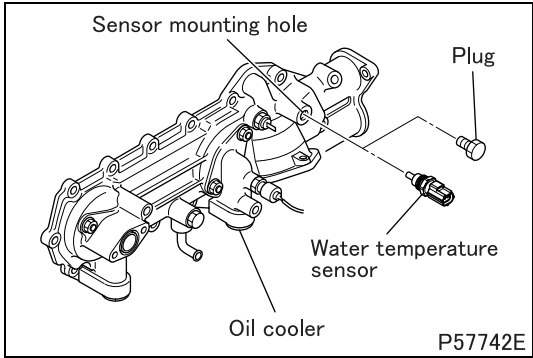
1. Preparation for inspection

Service standards

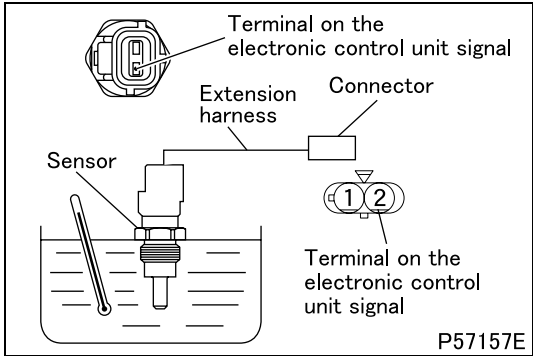
Location	Maintenance item			Standard value	Limit	Remedy
-	Pre-glow time	Coolant temperature	60°C {140°F} or higher	No pre-glow operation	-	Inspect
			0 to 60°C {32 to 140°F}	About 12 seconds	-	
			0°C {32°F} or below	About 12 seconds	-	
	After-glow time	Coolant temperature	60°C {140°F} or higher	No after-glow operation	-	
			0 to 60°C {32 to 140°F}	No after-glow operation	-	
			0°C {32°F} or below	About 20 seconds	-	
	Indicator lamp ON time	Coolant temperature	60°C {140°F} or higher	No illumination	-	
			0 to 60°C {32 to 140°F}	No illumination	-	
			0°C {32°F} or below	About 8 seconds	-	



- Turn the starter switch to OFF.
- Connect a check lamp to the glow plug.



- Remove the water temperature sensor from the engine, and close the sensor mounting hole with the plug (M16 × 1.5 mm).



- Connect the extension harness between the water temperature sensor and connector.

CAUTION ⚠

- **Connect the extension harness to the terminal on the engine electronic control unit.**

- Place the water temperature sensor in a container of water.
- Conduct the following test while changing the temperature of water in the container. If anything abnormal is found, check relevant components.

(1) Pre-glow time and indicator lamp ON time checking

- Turn the starter switch to ON (without starting the engine), and confirm that the pre-glow time and indicator lamp ON time at each water temperature conform with standard values.
- Measure the illuminating time of the check lamp to measure the pre-glow time.
- Measure the meter cluster glow lamp illuminating time to measure the indicator lamp ON time.

(2) After-glow time checking

- Start the engine, and measure how long the illumination of check lamp lasts after the glow lamp on the meter cluster goes out to ensure that the after-glow time conforms with the standard value.

2. Inspection Based on Diagnosis Codes**2.1 Diagnosis code list****NOTE**

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

Code	Message	Flashes
P0380	Relay for Glow Relay	26
P0381	Glow Lamp	89

2.2 Diagnosis code generation conditions and inspection items**P0380 : Relay for Glow Relay (Warning lamp flashes : 26)**

Generation conditions		Glow drive relay short or open circuit, or overload
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Suspend glow control
Inspection	Service data	8D : Glow Relay
	Actuator test	AF : Relay for Glow Relay
	Electronic control unit connector	01 : Glow drive relay
	Electrical equipment	#201 : Glow drive relay #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See (220))

P0381 : Glow Lamp (Warning lamp flashes : 89)

Generation conditions		Glow indicator lamp short or open circuit, or overload
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8E : Glow Relay Indicator Lamp
	Actuator test	B0 : Glow Indicator Lamp
	Electronic control unit connector	02 : Glow indicator lamp
	Electrical equipment	Meter cluster #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See (220))

#955 INSPECTION OF PREHEATING SYSTEM

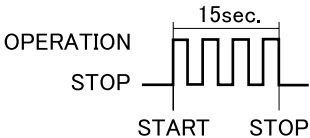
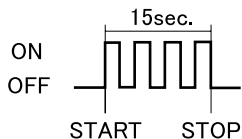
3. Multi-Use Tester Service Data

CAUTION

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
8D	Glow Relay	ON/OFF	With engine coolant temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect immediately after turning ON starter switch.	ON
			With engine coolant temperature at or above 60°C {140 °F} or water temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect 40 seconds after turning starter switch ON.	OFF
			[Actuator test] AF: Relay for glow relay	
8E	Glow Relay Indicator Lamp	ON/OFF	With engine coolant temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect immediately after turning ON starter switch.	ON
			With engine coolant temperature at or above 60°C {140 °F} or water temperature at or below 60°C {140 °F}, turn starter switch OFF and ON. Inspect 40 seconds after turning starter switch ON.	OFF
			[Actuator test] B0: Glow indicator lamp	

4. Actuator Tests Performed Using Multi-Use Tester

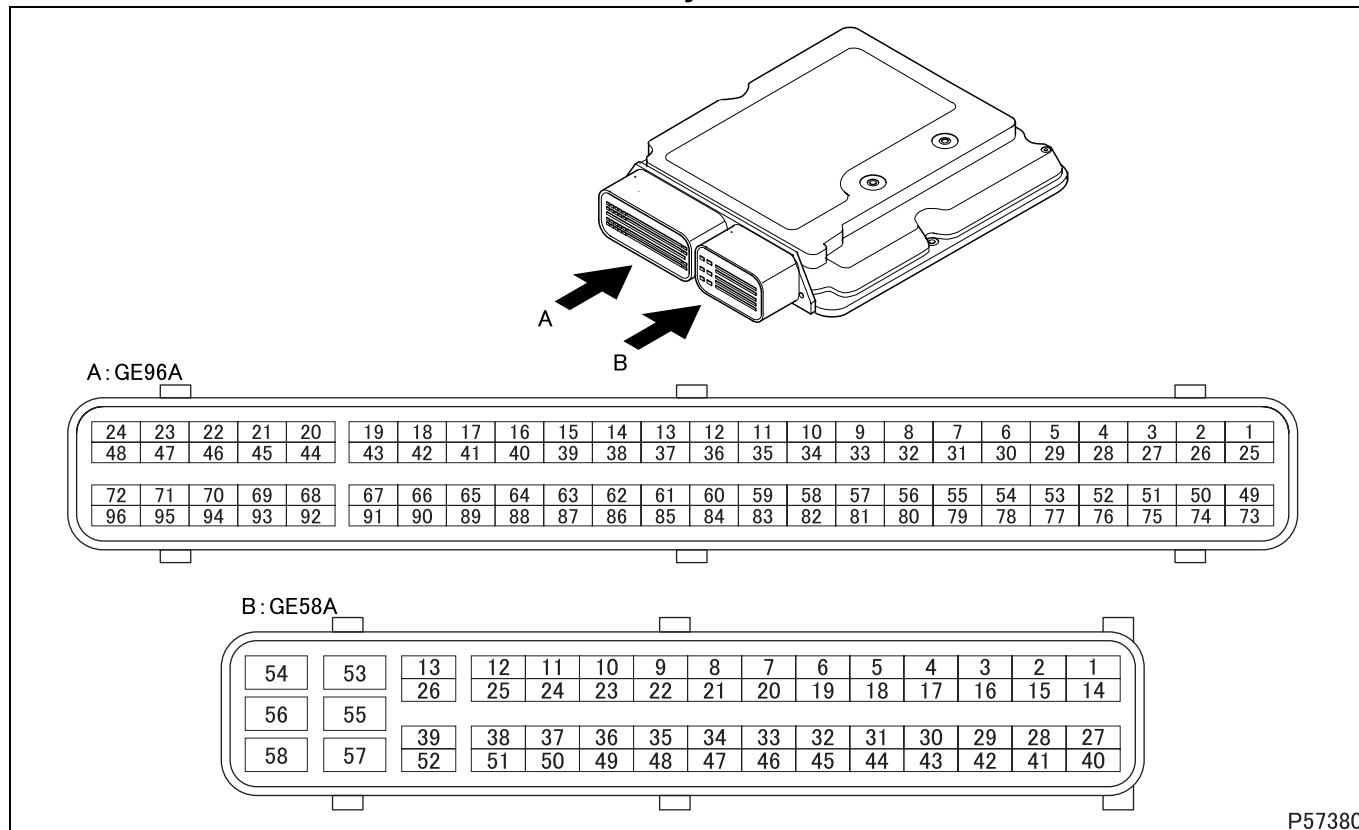
No.	Item	Explanation	Confirmation method
AF	Relay for Glow Relay	Glow drive relay drive signal  P57740E	Actuation noise should be heard. [Service data] 8D: Glow relay
B0	Glow Indicator Lamp	Glow indicator lamp illumination signal  P57725E	Actuation noise should be heard. [Service data] 8E: Glow indicator lamp

5. Inspection Performed at Electronic Control Unit Connectors

- The following inspection should assist troubleshooting by enabling you to verify whether or not electronic control unit signals are correctly transmitted via the vehicle harnesses and connectors.

The numbers in the table **01**, **02**, etc. cross-refers you to the corresponding numbers in the table in “2. Inspection Based on Diagnosis Codes”.

5.1 Electronic control unit connector terminal layout



5.2 Inspection instructions

CAUTION

- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:
- Do not touch any terminal other than those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.

Check item	Measurement method
01 Glow drive relay voltage	[Conditions] • Keep the vehicle harnesses connected to the electronic control unit connector halves. (Inspection is made at the back of the vehicle connectors.) • Carry out the actuator test “AF - Relay for Glow Relay” using Multi-Use Tester. [Normal status] Terminals (+) - (-) : A73 - A7 • Battery voltage
02 Glow indicator lamp illumination	[Conditions] • Keep the vehicle harnesses connected to the electronic control unit connector halves. (Inspection is made at the back of the vehicle connectors.) • Carry out the actuator test “B0 - Glow Indicator Lamp” using Multi-Use Tester. [Normal status] Short the terminal A51 to ground. • The glow indicator lamp should illuminate.

#956 INSPECTION OF STARTER CONTINUOUS ENERGIZING PREVENTING FUNCTION

1. Inspection Based on Diagnosis Codes

1.1 Diagnosis code list

NOTE

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Flashes
P0615	Starter Safety Relay	48
P0616		
P0617		

1.2 Diagnosis code generation conditions and inspection items

P0615 : Starter Safety Relay (Warning lamp flashes : 48)

Generation conditions		Safety relay overload
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8F : Starter safety relay
	Actuator test	B1 : Starter safety relay
	Electronic control unit connector	01 : Safety relay
	Electrical equipment	#201 : Safety relay #350 : Engine electronic control unit
	Electronic circuit diagram	Safety relay system (See (210))

P0616 : Starter Safety Relay (Warning lamp flashes : 48)

Generation conditions		Safety relay ground short or open circuit
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8F : Starter safety relay
	Actuator test	B1 : Starter safety relay
	Electronic control unit connector	01 : Safety relay
	Electrical equipment	#201 : Safety relay #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See (210))

P0617 : Starter Safety Relay (Warning lamp flashes : 48)

Generation conditions		Safety relay Battery short or open circuit
Recoverability		System recovers if signal becomes with starter switch ON position.
Control effected by electronic control unit		• Normal control
Inspection	Service data	8F : Starter safety relay
	Actuator test	B1 : Starter safety relay
	Electronic control unit connector	01 : Safety relay
	Electrical equipment	#201 : Safety relay #350 : Engine electronic control unit
	Electronic circuit diagram	Glow drive relay system (See (210))

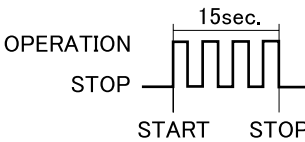
2. Multi-Use Tester Service Data

CAUTION

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
8F	Starter Safety Relay	ON/OFF	Carry out the actuator test "B1 - Starter safety relay" using Multi-Use Tester. The relay should be ON.	ON
			When not testing	OFF
			[Actuator test] B1: Starter safety relay	

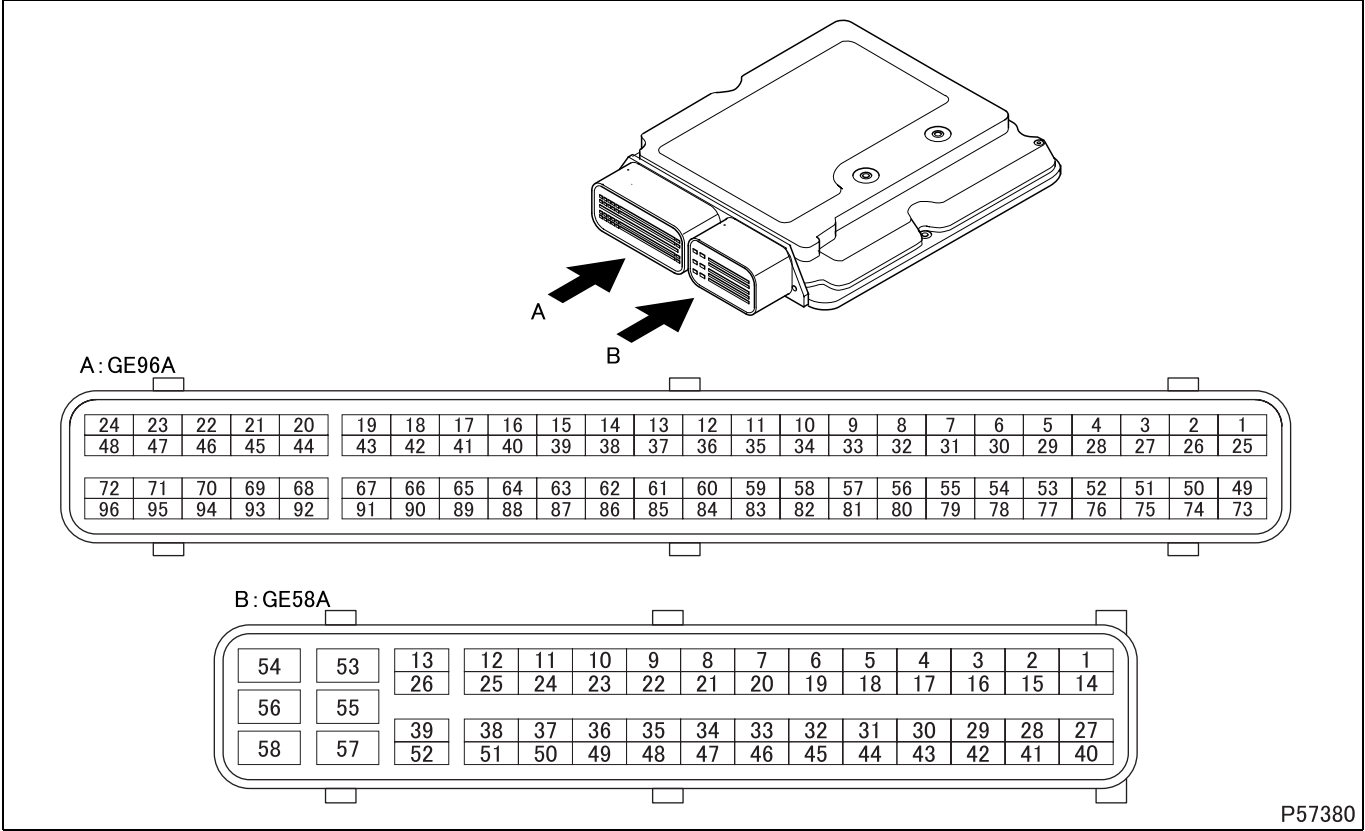
3. Actuator Tests Performed Using Multi-Use Tester

No.	Item	Explanation	Confirmation method
B1	Starter Safety Relay	Starter safety relay drive signal  P57740E	Actuation noise should be heard. [Service data] 8F: Starter safety relay

4. Inspection Performed at Electronic Control Unit Connectors

- The following inspection should assist troubleshooting by enabling you to verify whether or not electronic control unit signals are correctly transmitted via the vehicle harnesses and connectors.
The numbers in the table **01**, **02**, etc. cross-refers you to the corresponding numbers in the table in “1. Inspection Based on Diagnosis Codes”.

4.1 Electronic control unit connector terminal layout



4.2 Inspection instructions

CAUTION ⚠

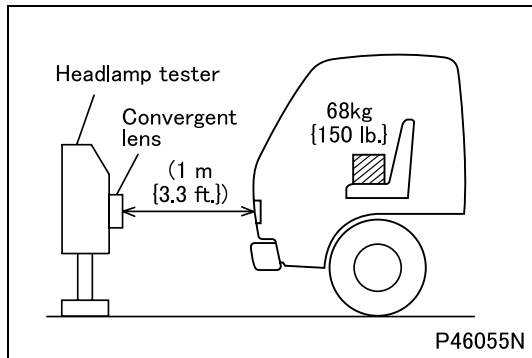
- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:
- Do not touch any terminal other than those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.

Inspection item	Procedures
01 Safety relay voltage	[Conditions] - Keep the vehicle harnesses connected to the electronic control unit connector halves. (Inspection is made at the back of the vehicle connectors.) [Normal status] Terminals (+) - (–) : A81 - A49 - Relay ON: 12 V - Relay OFF: 0 V

M E M O

#960 HEADLAMP AIMING

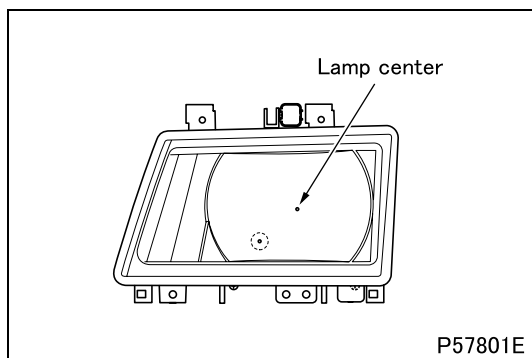
1. Preparation before Adjustment



- Park the vehicle on a level place.

WARNING

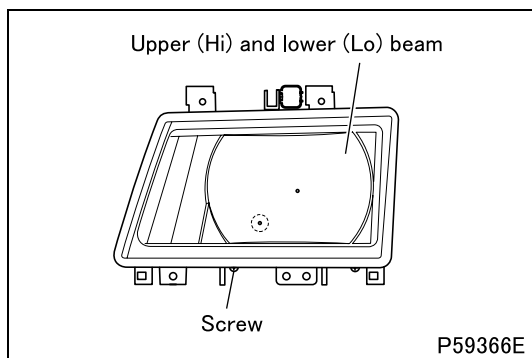
- Be sure to put tire chocks securely in place.
- Unload the vehicle and make sure no one is in it.
- Inflate the tires to the specified pressure. (See Gr31.)
- Seat one person of an equivalent mass (68 kg {150 lb.}) in the vehicle.
- Start the engine and check that the battery is being charged.
- Place convergent headlamp tester and the vehicle facing each other as shown in the drawing.
- Align the center of headlamp bulb and the center of convergent lens of convergent headlamp tester. (The drawing shows the left-hand headlamp.)



2. Adjustment

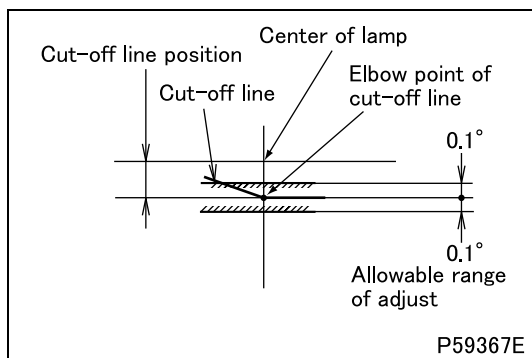
WARNING

- Do not mask a lit headlamp for more than 10 minutes or the heat generated might cause a fire.



2.1 Adjustment of Lower Beam

- Turn on Lower beam.
- Make adjustment by the following procedure so that the elbow point of dipped beam cut-off line is in the illustrated position.
- Vertical adjustment: Turn screw.



- Cut-off line position
0.4°

Adjusting direction for optical axis

<Left-hand headlamp>

	Upward	Downward
Screw	Counter-clockwise	Clockwise

<Right-hand headlamp>

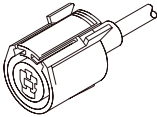
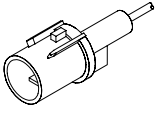
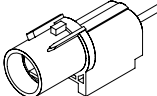
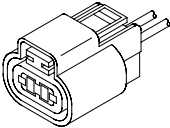
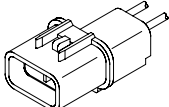
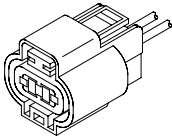
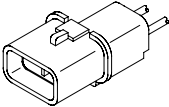
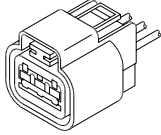
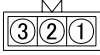
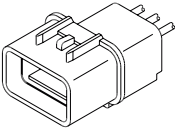
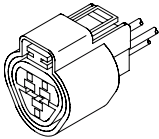
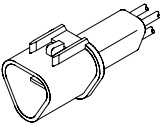
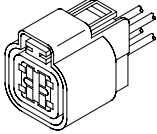
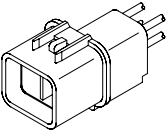
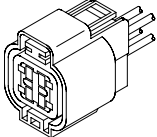
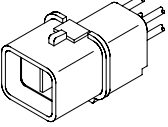
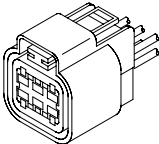
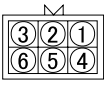
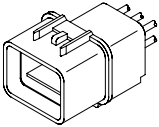
	Upward	Downward
Screw	Counter-clockwise	Clockwise

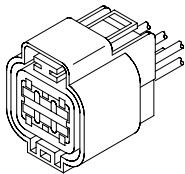
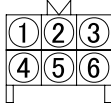
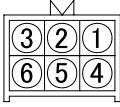
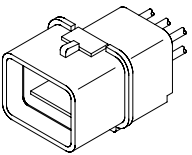
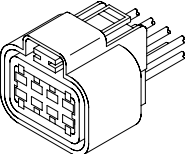
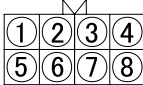
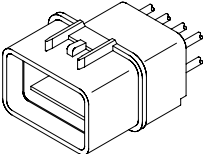
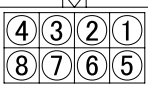
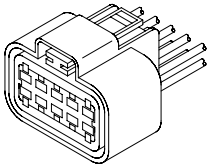
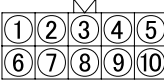
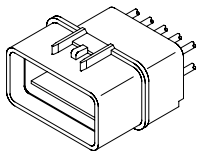
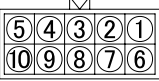
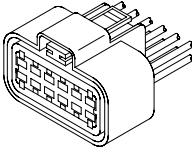
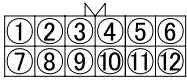
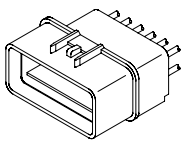
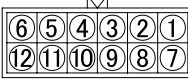
GROUP 54-14

CONNECTOR CONFIGURATION CHART

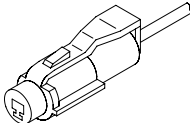
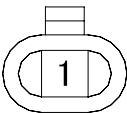
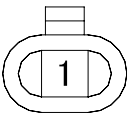
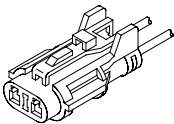
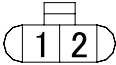
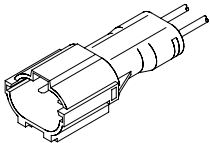
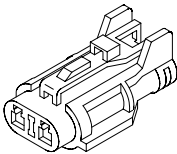
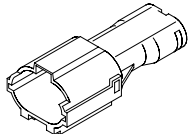
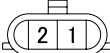
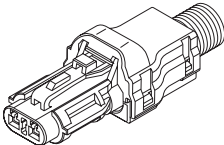
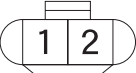
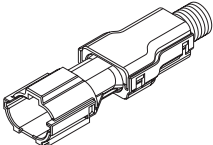
CONNECTOR CONFIGURATION CHART

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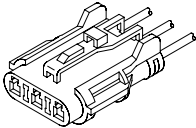
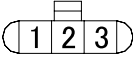
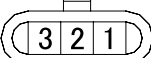
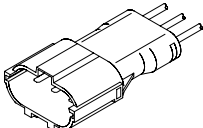
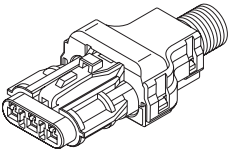
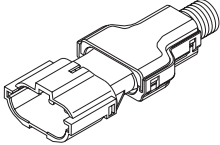
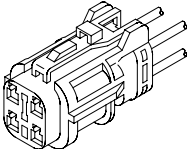
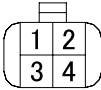
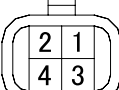
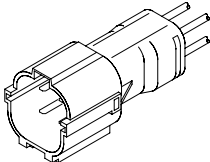
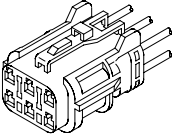
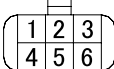
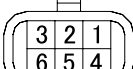
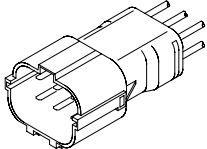
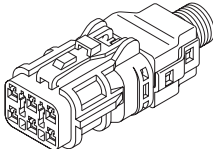
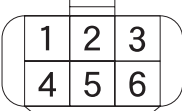
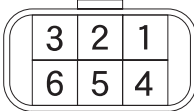
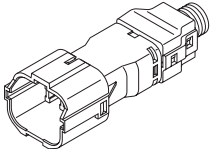
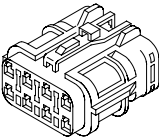
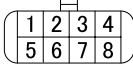
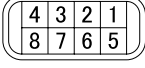
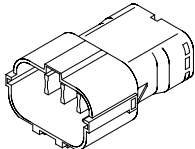
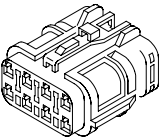
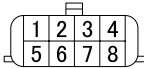
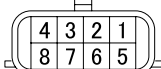
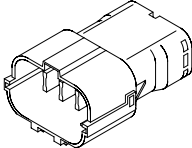
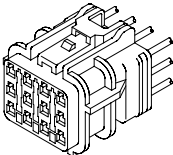
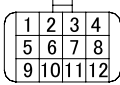
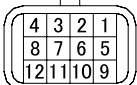
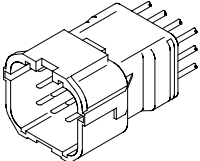
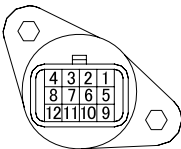
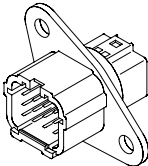
Number shows number of pins	Female connector	Male connector
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AA2A	 	 
AA2B	 	 
AA3A	 	 
AA3B	 	 
AA4A	 	 
AA4B	 	 
AA6A	 	 

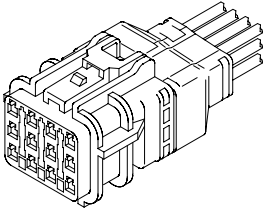
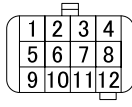
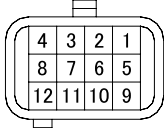
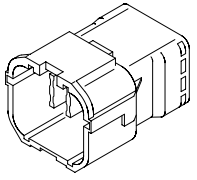
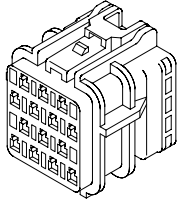
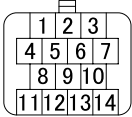
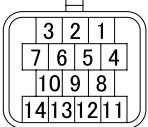
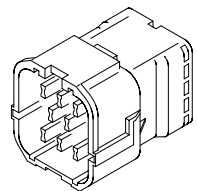
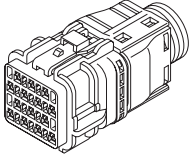
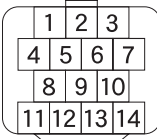
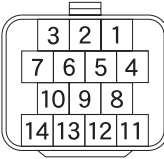
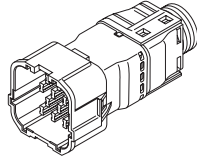
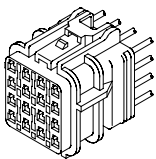
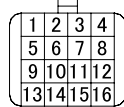
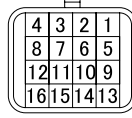
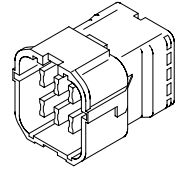
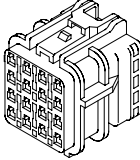
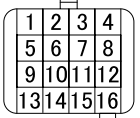
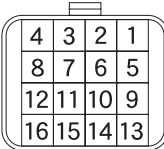
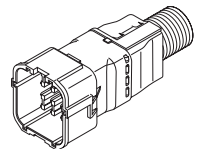
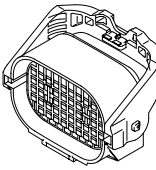
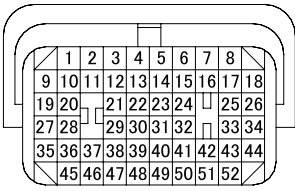
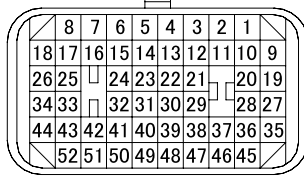
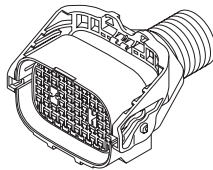
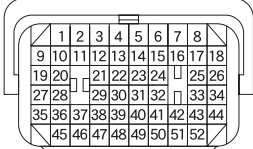
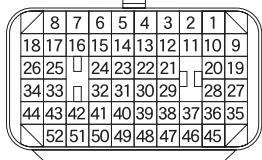
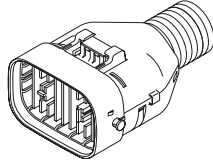
Number shows number of pins	Female connector	Male connector
AA6B	 	 
AA8A	 	 
AA10A	 	 
AA12A	 	 

AB type

Number shows number of pins	Female connector	Male connector
AB1A	 	 
AB2A	 	 
AB2B	 	 
AB2C	 	 

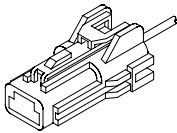
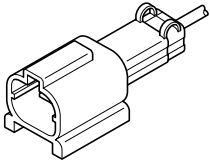
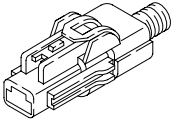
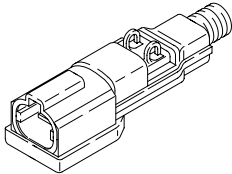
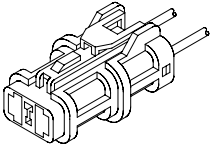
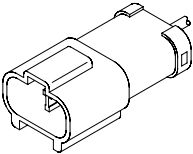
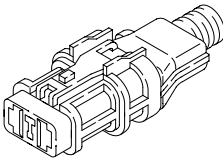
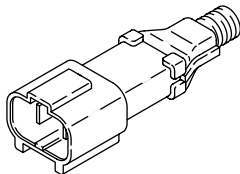
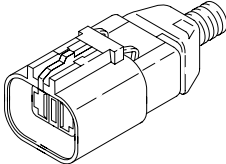
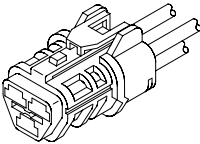
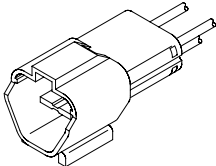
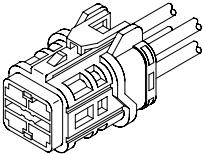
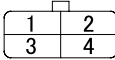
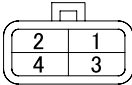
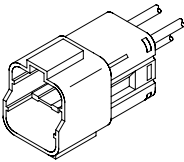
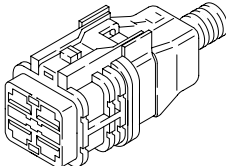
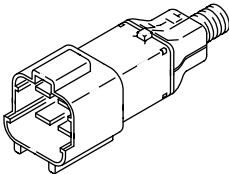
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
AB3A	 	 
AB3B	 	 
AB4A	 	 
AB6A	 	 
AB6B	 	 
AB8A	 	 
AB8B	 	 
AB12A	 	   

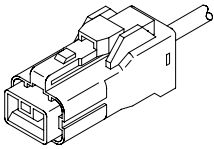
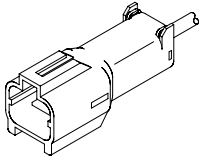
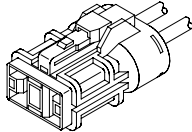
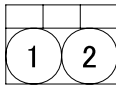
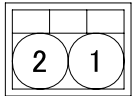
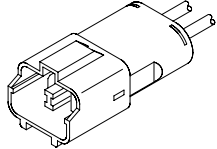
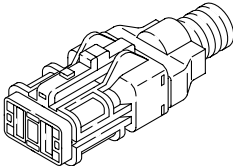
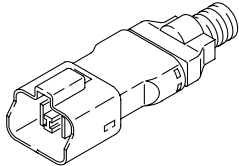
Number shows number of pins	Female connector	Male connector
AB12B	 	 
AB14A	 	 
AB14B	 	 
AB16A	 	 
AB16B	 	 
AB52A	 	
AB52B	 	 

CONNECTOR CONFIGURATION CHART

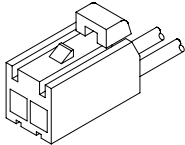
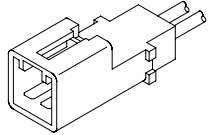
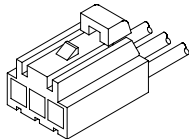
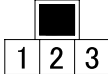
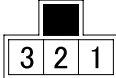
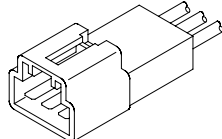
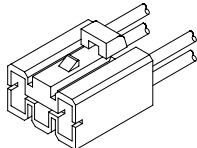
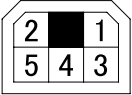
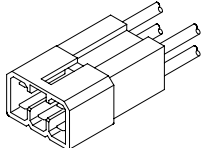
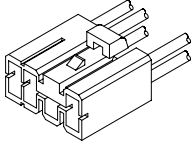
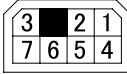
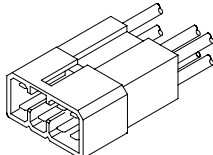
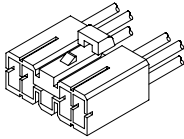
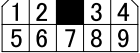
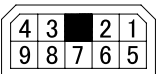
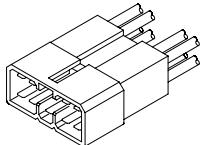
AC type

Number shows number of pins	Female connector		Male connector	
AC1A				
AC1B				
AC2A				
AC2B				
AC2C				
AC3A				
AC4A				
AC4B				

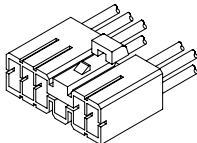
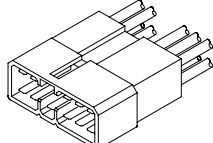
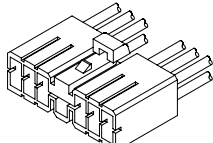
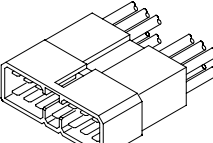
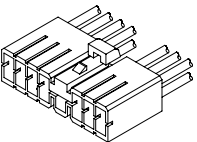
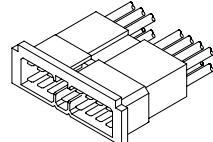
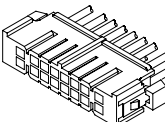
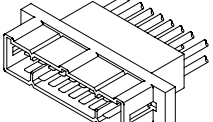
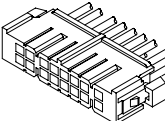
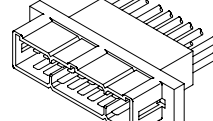
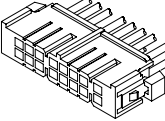
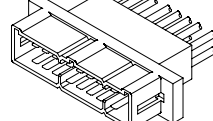
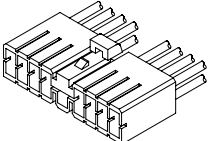
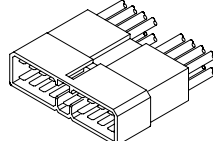
AD type

Number shows number of pins	Female connector	Male connector
AD1A	 	 
AD2A	 	 
AD2B	 	 

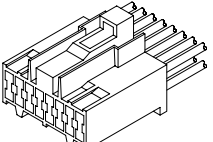
AE type

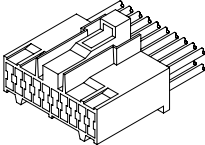
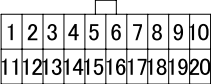
Number shows number of pins	Female connector	Male connector
AE2A	 	 
AE3A	 	 
AE5A	 	 
AE7A	 	 
AE9A	 	 

CONNECTOR CONFIGURATION CHART

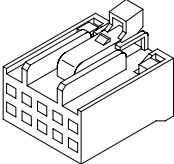
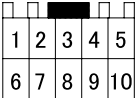
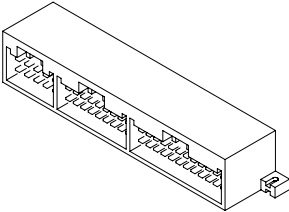
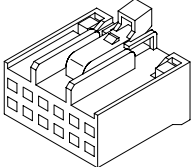
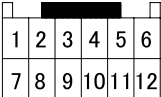
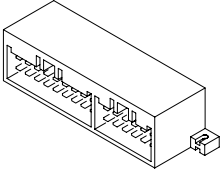
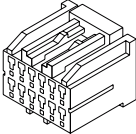
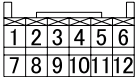
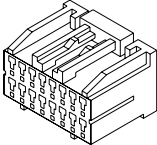
Number shows number of pins	Female connector	Male connector																																		
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AG type

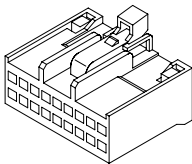
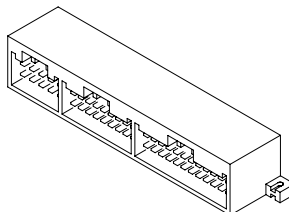
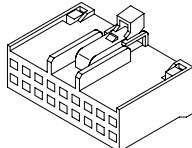
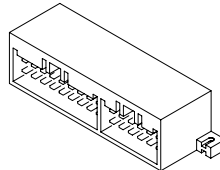
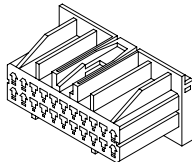
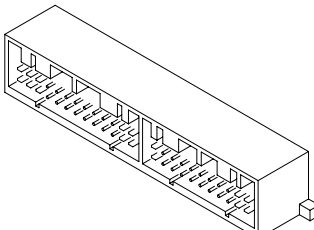
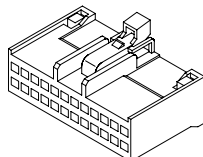
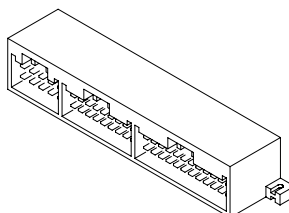
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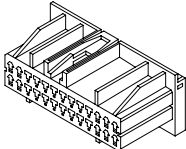
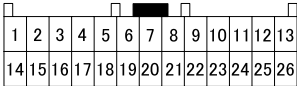
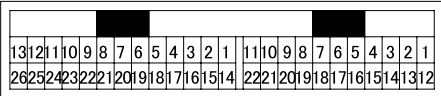
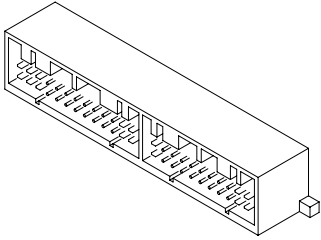
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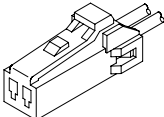
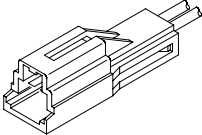
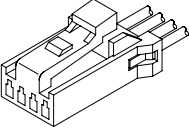
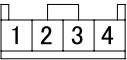
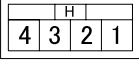
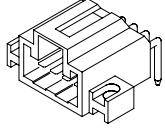
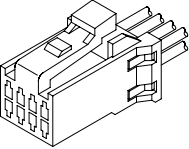
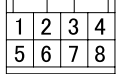
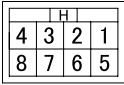
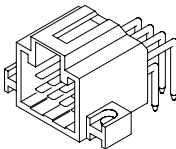
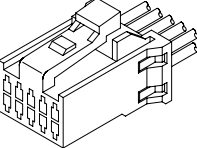
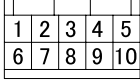
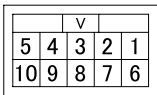
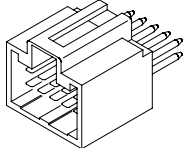
Number shows number of pins	Female connector	Male connector
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AH12A	 	(AH18B) AH12A 
AH12B	 	
AH16A	 	

CONNECTOR CONFIGURATION CHART

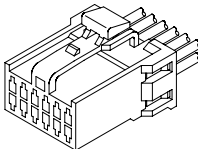
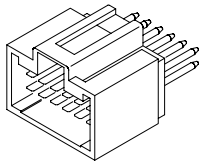
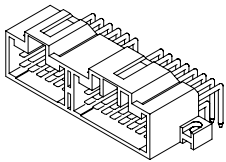
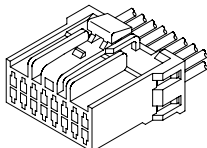
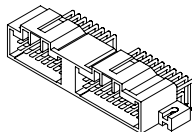
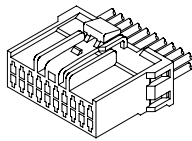
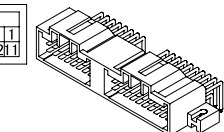
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AH22A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr><tr><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	<table><tr><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td></tr></table> (AH26A) AH22A 	13	12	11	10	9	8	7	6	5	4	3	2	1	11	10	9	8	7	6	5	4	3	2	1	26	25	24	23	22	21	20	19	18	17	16	15	14	22	21	20	19	18	17	16	15	14	13	12						
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Number shows number of pins	Female connector	Male connector
AH26A	 	 AH26A (AH22A) 

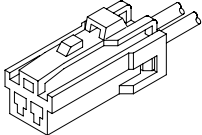
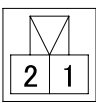
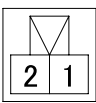
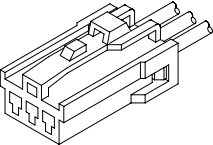
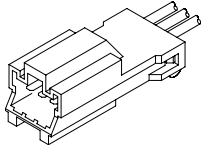
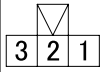
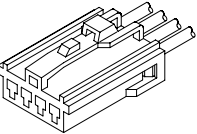
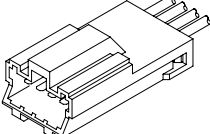
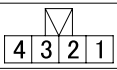
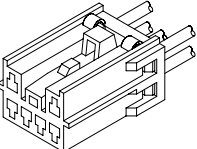
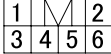
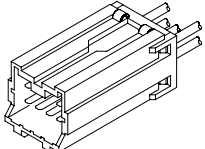
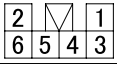
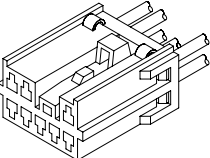
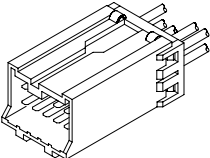
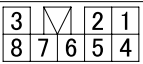
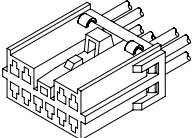
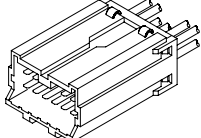
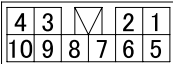
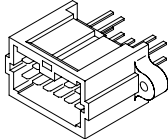
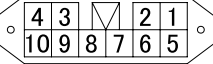
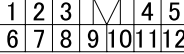
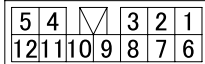
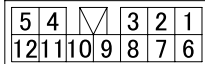
AJ type

Number shows number of pins	Female connector	Male connector
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AJ4A	 	 
AJ8A	 	 
AJ10A	 	 

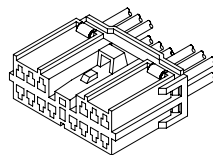
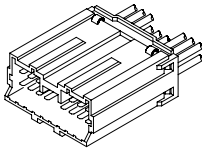
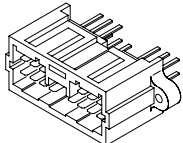
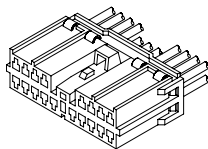
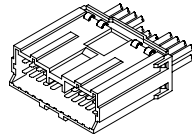
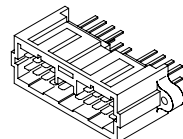
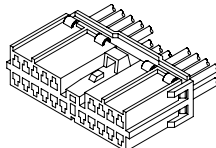
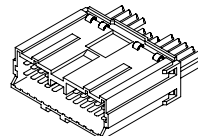
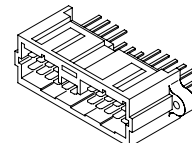
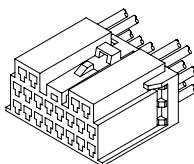
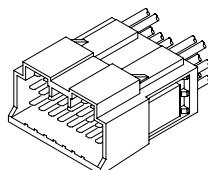
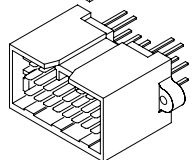
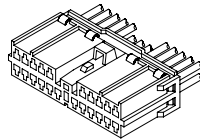
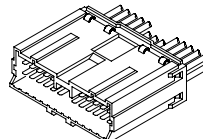
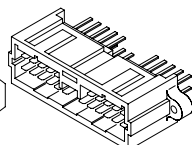
CONNECTOR CONFIGURATION CHART

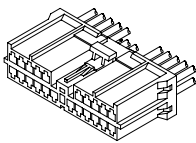
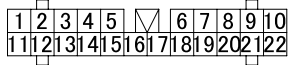
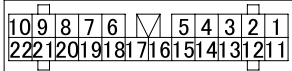
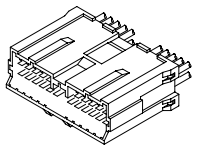
Number shows number of pins	Female connector	Male connector																																																																																																																																																																										
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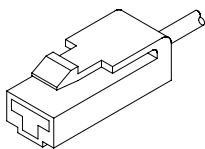
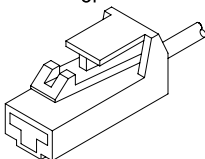
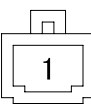
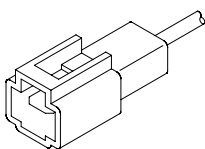
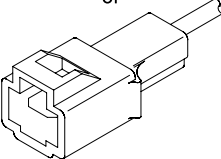
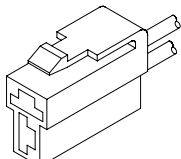
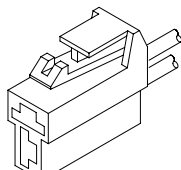
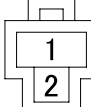
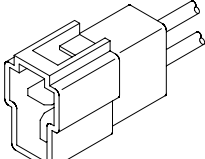
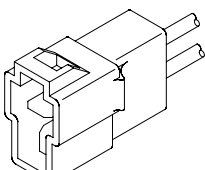
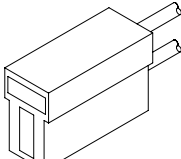
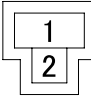
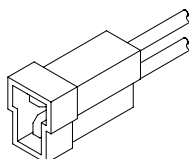
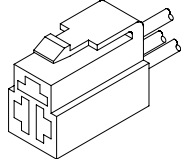
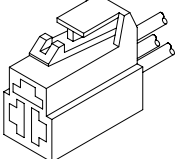
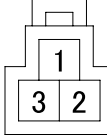
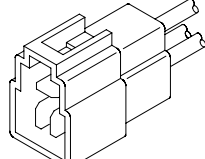
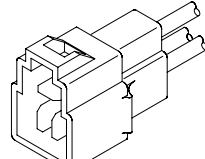
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AK3A	 	 
AK4A	 	 
AK6A	 	 
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CONNECTOR CONFIGURATION CHART

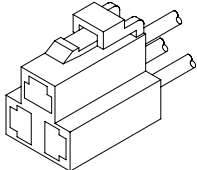
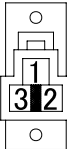
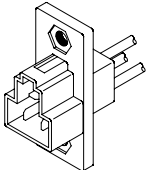
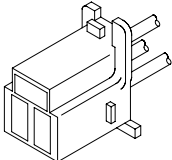
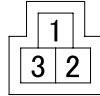
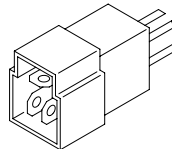
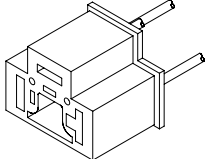
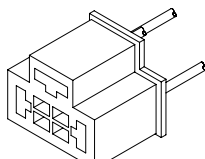
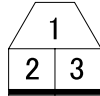
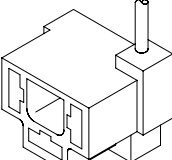
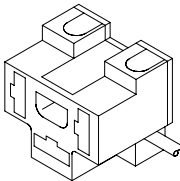
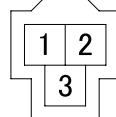
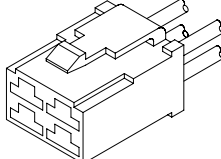
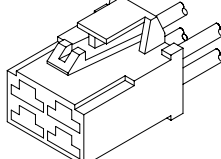
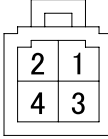
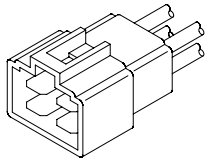
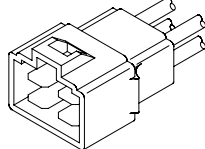
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AK22A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>▽</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td></tr></table>	1	2	3	4	5	▽	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	<table><tr><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>▽</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td></tr></table>  <table><tr><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>▽</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td></tr></table> 	10	9	8	7	6	▽	5	4	3	2	1	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	▽	5	4	3	2	1	22	21	20	19	18	17	16	15	14	13	12	11
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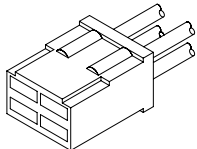
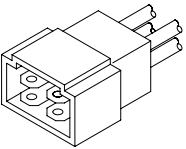
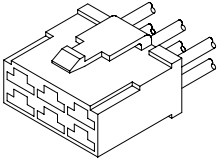
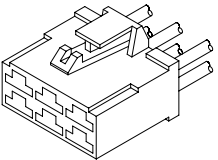
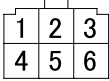
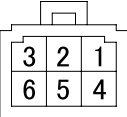
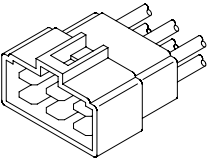
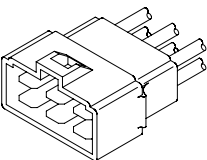
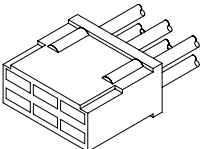
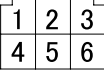
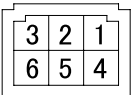
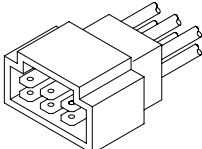
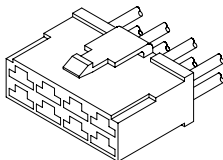
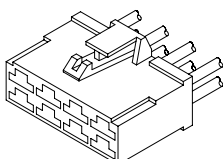
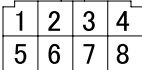
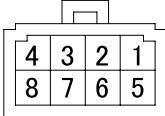
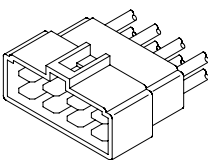
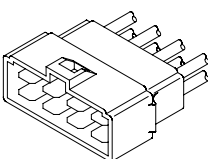
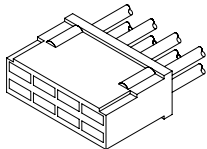
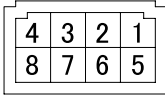
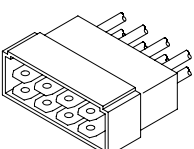
Number shows number of pins	Female connector	Male connector
AK22B	 	 

AL type

Number shows number of pins	Female connector	Male connector
AL1A	  	  
AL2A	  	  
AL2B	 	 
AL3A	  	  

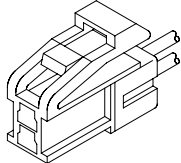
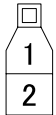
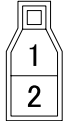
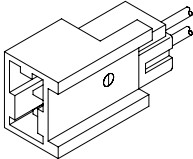
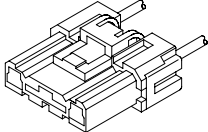
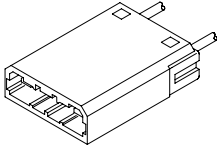
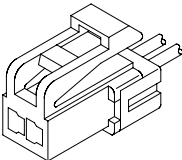
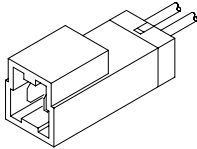
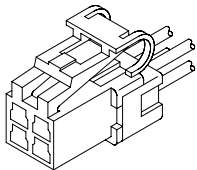
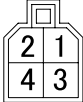
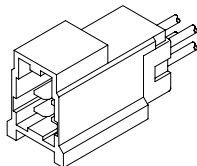
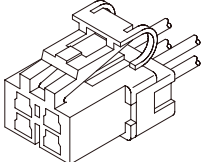
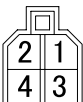
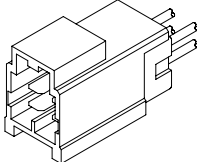
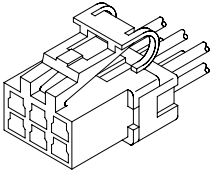
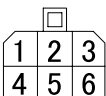
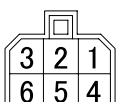
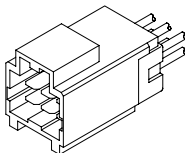
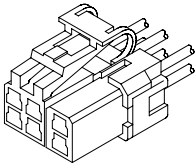
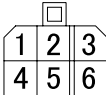
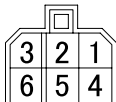
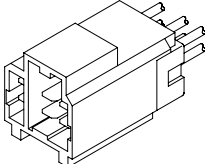
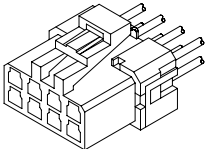
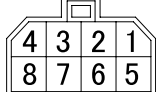
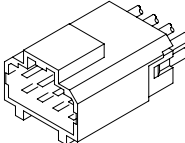
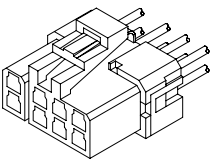
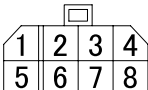
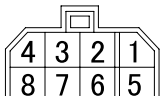
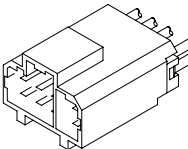
CONNECTOR CONFIGURATION CHART

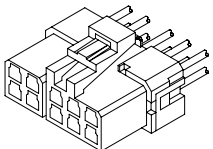
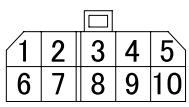
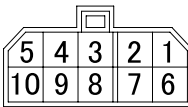
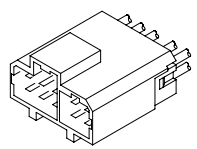
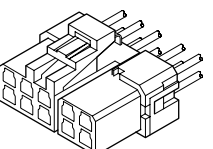
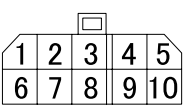
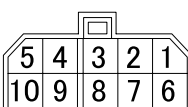
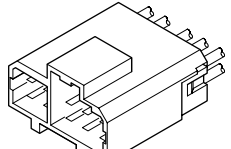
Number shows number of pins	Female connector	Male connector
AL3B	 	 
AL3C	 	 
AL3D	 or  	
AL3E	 or  	
AL4A	 or  	  or 

Number shows number of pins	Female connector	Male connector
AL4B	 	 
AL6A	  or 	  or 
AL6B	 	 
AL8A	  or 	  or 
AL8B	 	 

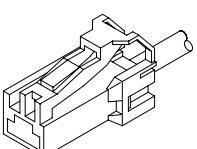
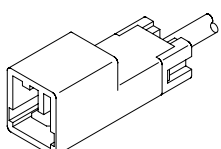
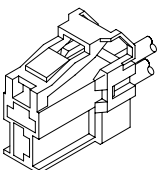
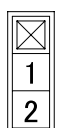
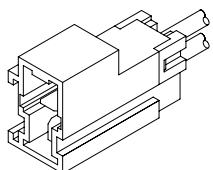
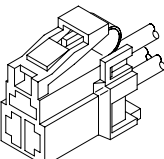
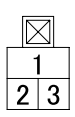
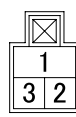
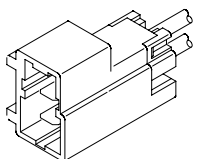
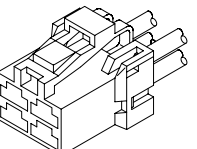
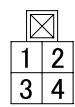
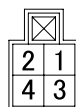
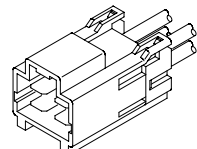
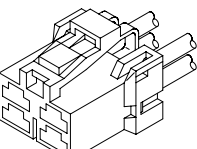
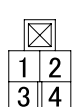
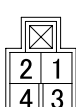
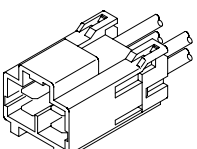
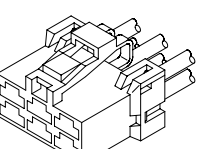
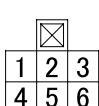
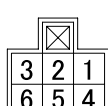
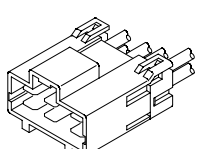
CONNECTOR CONFIGURATION CHART

AM type

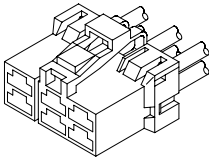
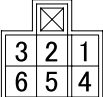
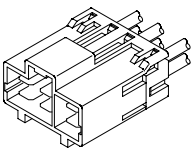
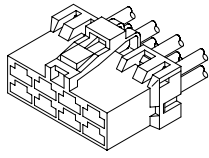
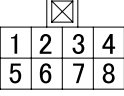
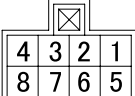
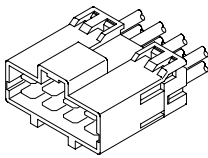
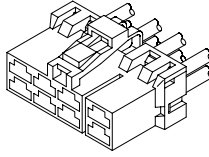
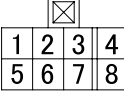
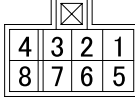
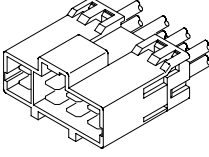
Number shows number of pins	Female connector		Male connector	
AM2A				
AM2B				
AM2C				
AM4A				
AM4B				
AM6A				
AM6B				
AM8A				
AM8B				

Number shows number of pins	Female connector	Male connector
AM10A	 	 
AM10B	 	 

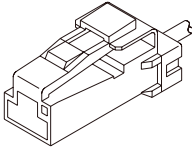
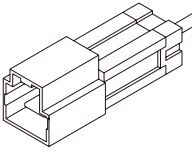
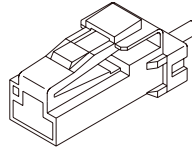
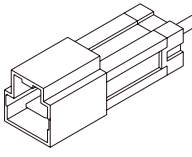
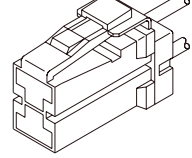
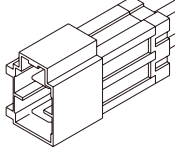
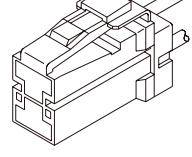
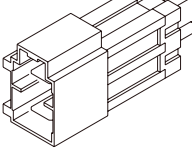
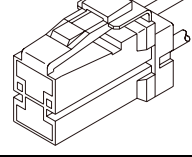
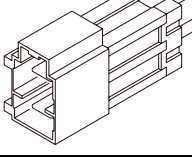
AN type

Number shows number of pins	Female connector	Male connector
AN1A	 	 
AN2A	 	 
AN3A	 	 
AN4A	 	 
AN4B	 	 
AN6A	 	 

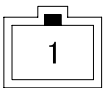
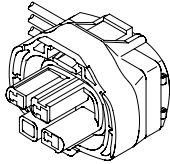
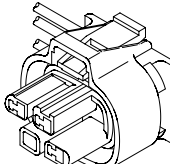
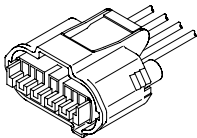
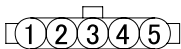
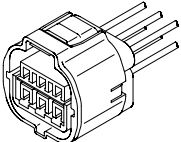
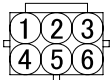
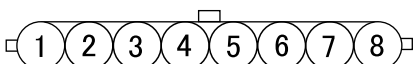
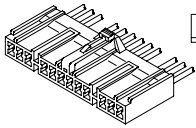
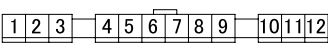
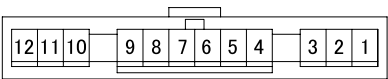
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
AN6B	 	 
AN8A	 	 
AN8B	 	 

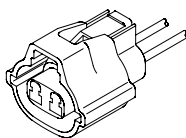
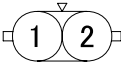
AP type

Number shows number of pins	Female connector	Male connector
AP1A	 	 
AP1B	 	 
AP2A	 	 
AP2B	 	 
AP2C	 	 

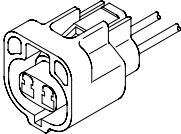
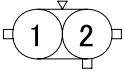
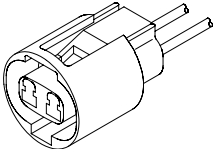
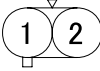
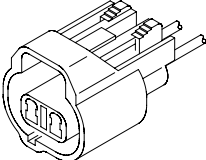
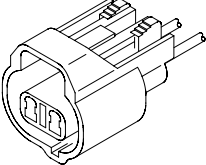
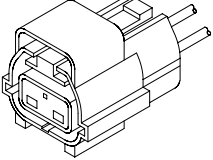
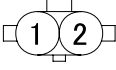
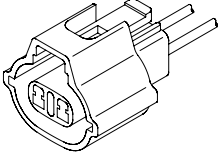
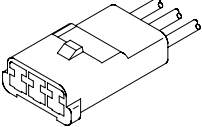
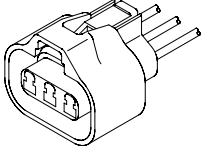
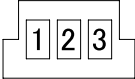
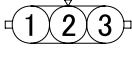
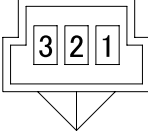
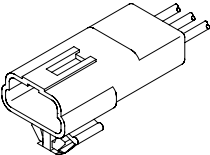
AQ type

Number shows number of pins	Female connector	Male connector
AQ1A		
AQ3A	 	
AQ3B	 	
AQ5A	 	
AQ6A	 	
AQ8A		
AQ12A	 	

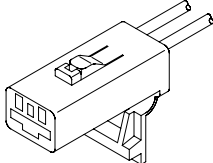
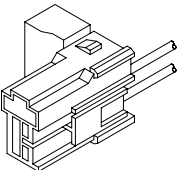
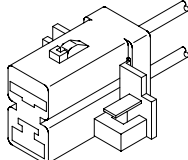
AR type

Number shows number of pins	Female connector	Male connector
AR2A	 	

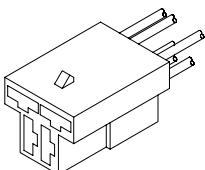
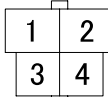
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector		Male connector	
AR2B				
AR2C				
AR2D				
AR2E				
AR2F				
AR2G				
AR2H				
AR3A	 	 		

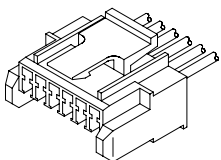
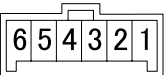
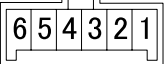
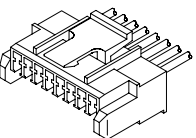
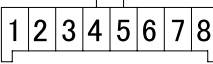
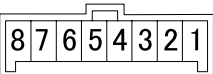
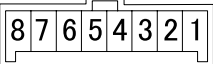
AS type

Number shows number of pins	Female connector	Male connector
AS1A	 	
AS2A	 	
AS2B	 	

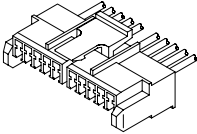
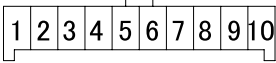
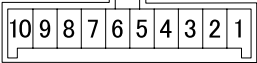
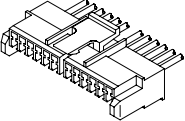
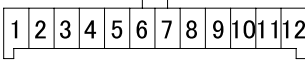
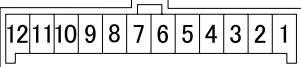
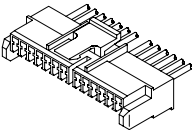
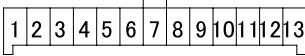
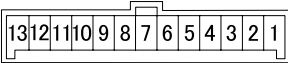
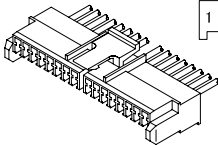
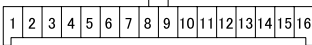
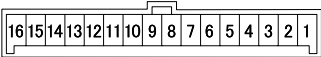
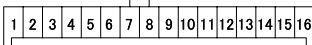
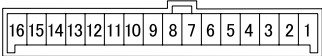
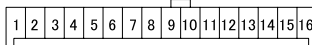
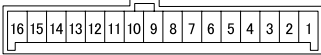
AT type

Number shows number of pins	Female connector	Male connector
AT4A	 	

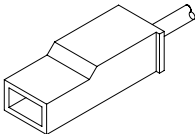
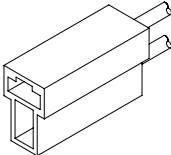
AU type

Number shows number of pins	Female connector	Male connector
AU2A	 	 
AU6A	 	 
AU8A	 	 

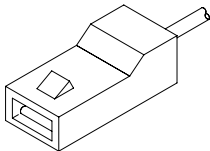
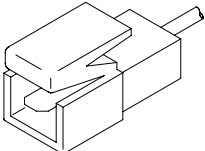
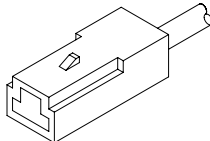
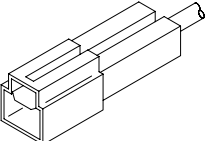
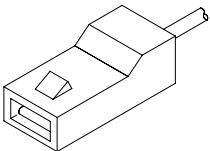
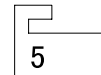
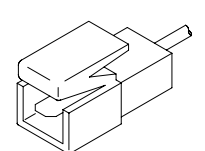
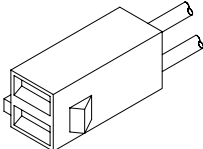
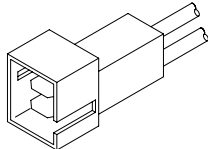
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
AU10A	 	
AU12A	 	
AU13A	 	
AU16A	 	
AU16B		
AU16C		

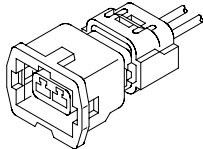
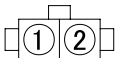
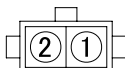
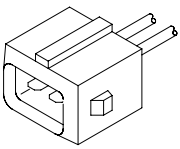
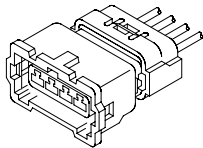
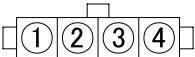
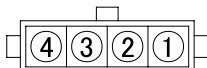
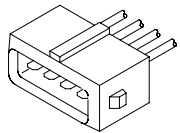
AV type

Number shows number of pins	Female connector	Male connector
AV1A	 	
AV2A	 	

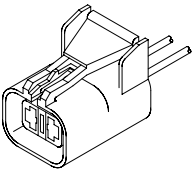
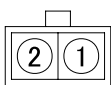
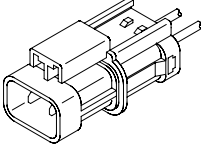
AW type

Number shows number of pins	Female connector	Male connector
AW1A	 	 
AW1B	 	 
AW1C	 	 
AW2A	 	 

AX type

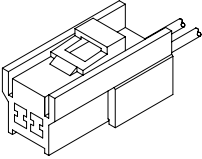
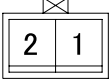
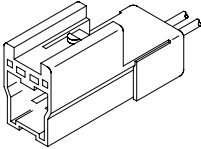
Number shows number of pins	Female connector	Male connector
AX2A	 	 
AX4A	 	 

AY type

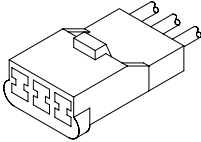
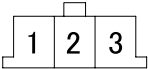
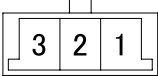
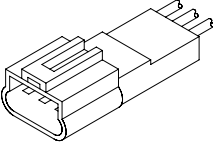
Number shows number of pins	Female connector	Male connector
AY2A	 	 

CONNECTOR CONFIGURATION CHART

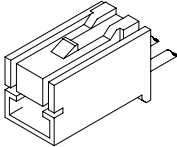
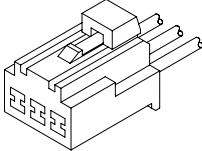
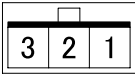
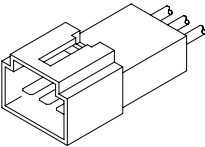
AZ type

Number shows number of pins	Female connector	Male connector
AZ2A	 	 

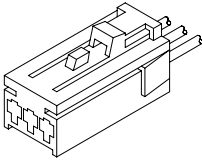
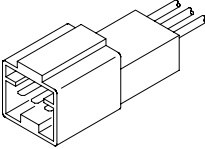
BA type

Number shows number of pins	Female connector	Male connector
BA3A	 	 

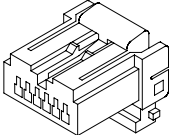
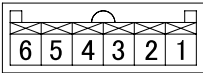
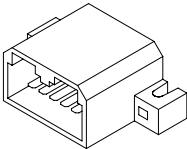
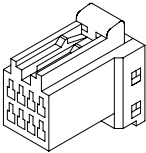
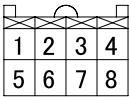
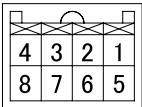
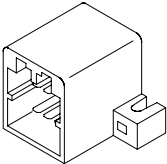
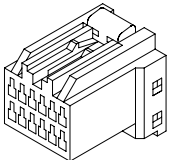
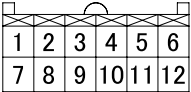
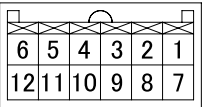
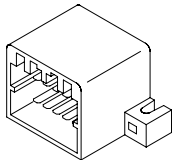
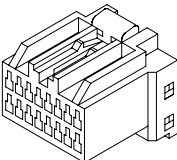
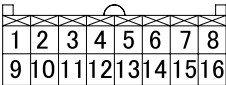
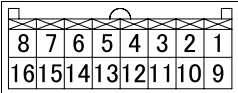
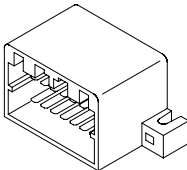
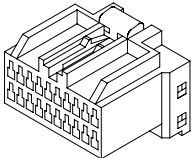
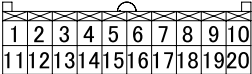
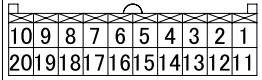
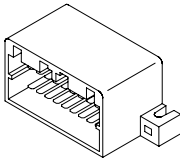
BB type

Number shows number of pins	Female connector	Male connector
BB2A	 	
BB3A	 	 

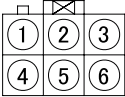
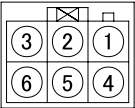
BC type

Number shows number of pins	Female connector	Male connector
BC3A	 	 

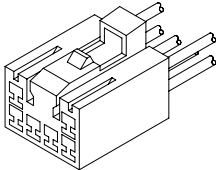
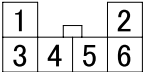
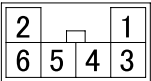
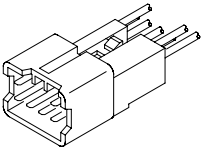
BD type

Number shows number of pins	Female connector	Male connector
BD6A	 	 
BD8A	 	 
BD12A	 	 
BD16A	 	 
BD20A	 	 

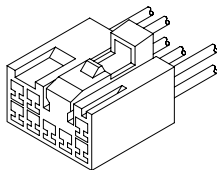
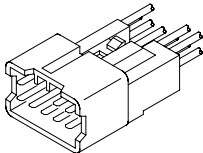
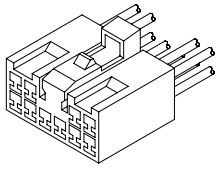
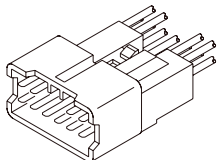
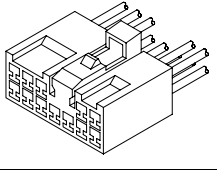
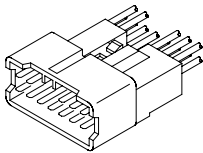
BE type

Number shows number of pins	Female connector	Male connector
BE6A		

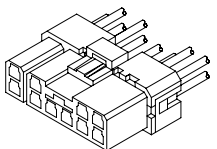
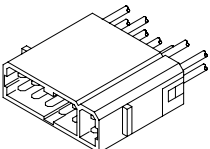
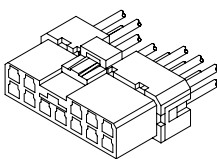
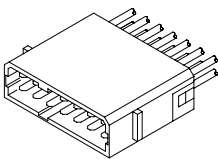
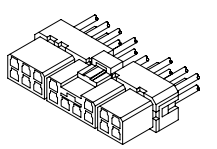
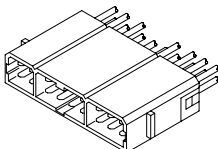
BF type

Number shows number of pins	Female connector	Male connector
BF6A	 	 

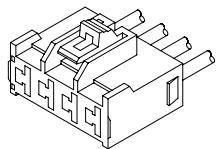
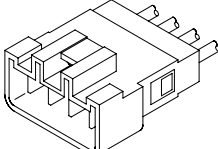
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector																										
BF8A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr></table>	1	2		3	4	5	6	7	8	<table><tr><td>3</td><td></td><td>2</td><td>1</td></tr><tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td></tr></table> 	3		2	1	8	7	6	5	4								
1	2		3																									
4	5	6	7	8																								
3		2	1																									
8	7	6	5	4																								
BF10A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr></table>	1	2		3	4	5	6	7	8	9	10	<table><tr><td>4</td><td>3</td><td></td><td>2</td><td>1</td></tr><tr><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td></tr></table> 	4	3		2	1	10	9	8	7	6	5				
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5	6	7	8	9	10																							
4	3		2	1																								
10	9	8	7	6	5																							
BF12A	 <table><tr><td>1</td><td>2</td><td>3</td><td></td><td>4</td><td>5</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3		4	5	6	7	8	9	10	11	12	<table><tr><td>5</td><td>4</td><td></td><td>3</td><td>2</td><td>1</td></tr><tr><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td></tr></table> 	5	4		3	2	1	12	11	10	9	8	7	6
1	2	3		4	5																							
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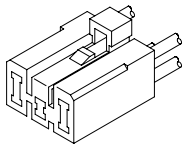
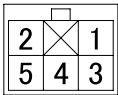
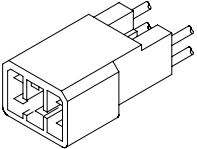
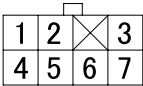
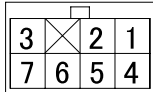
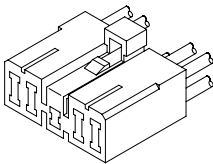
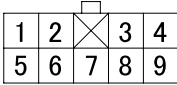
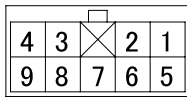
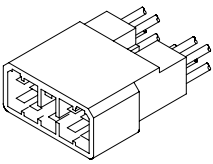
BG type

Number shows number of pins	Female connector	Male connector																																		
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1	2		3	4																																
5	6	7	8	9	10																															
4	3		2	1																																
10	9	8	7	6	5																															
BG12A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td><td>5</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2		3	4	5	6	7	8	9	10	11	12	<table><tr><td>5</td><td>4</td><td>3</td><td></td><td>2</td><td>1</td></tr><tr><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td></tr></table> 	5	4	3		2	1	12	11	10	9	8	7	6								
1	2		3	4	5																															
6	7	8	9	10	11	12																														
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12	11	10	9	8	7	6																														
BG16A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td></td><td>5</td><td>6</td><td>7</td></tr><tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr></table>	1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	<table><tr><td>7</td><td>6</td><td>5</td><td></td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr></table> 	7	6	5		4	3	2	1	16	15	14	13	12	11	10	9	8
1	2	3	4		5	6	7																													
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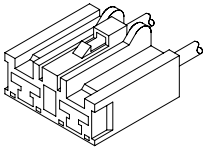
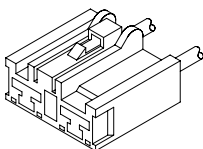
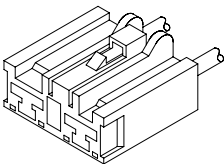
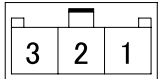
BH type

Number shows number of pins	Female connector	Male connector								
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BJ type

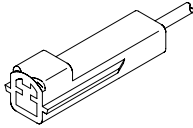
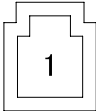
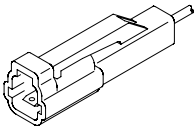
Number shows number of pins	Female connector	Male connector
BJ5A	 	 
BJ7A		
BJ9A	 	 

BM type

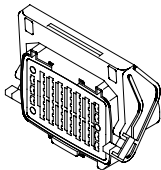
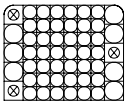
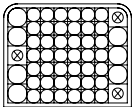
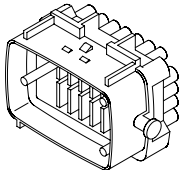
Number shows number of pins	Female connector	Male connector
BM2A	 	
BM2B	 	
BM2C	 	
BM3A		

CONNECTOR CONFIGURATION CHART

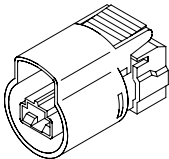
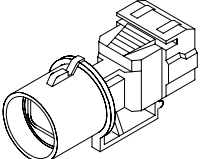
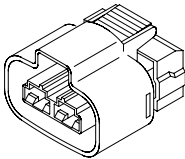
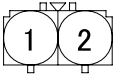
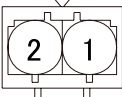
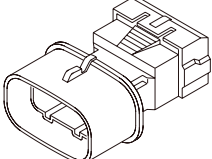
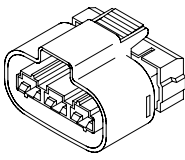
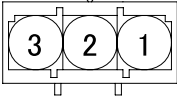
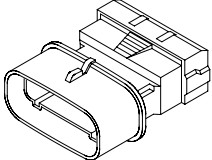
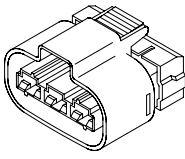
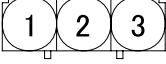
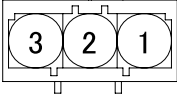
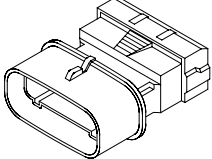
BN type

Number shows number of pins	Female connector	Male connector
BN1A	 	 

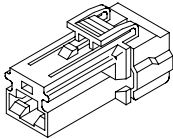
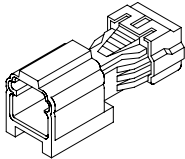
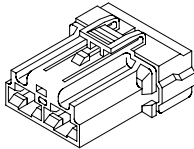
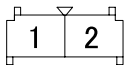
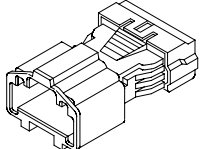
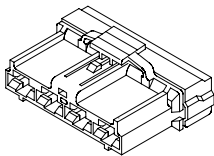
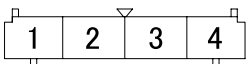
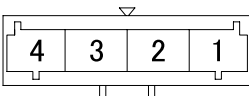
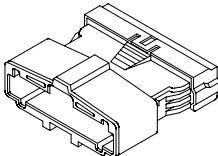
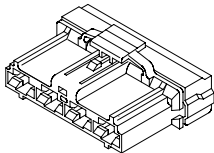
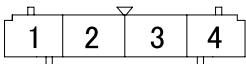
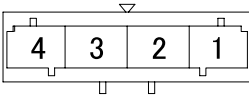
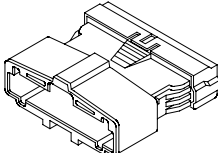
BP type

Number shows number of pins	Female connector	Male connector
BP49A	 	 

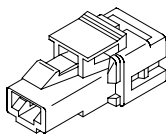
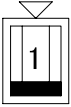
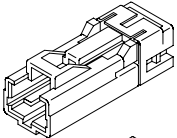
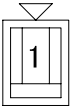
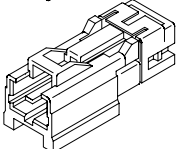
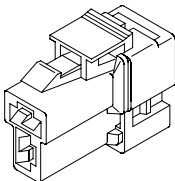
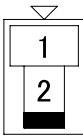
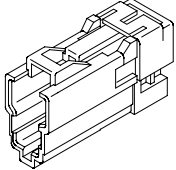
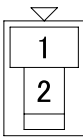
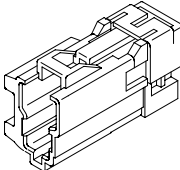
BQ type

Number shows number of pins	Female connector	Male connector
BQ1A	 	 
BQ2A	 	 
BQ3A	 	 
BQ3B	 	 

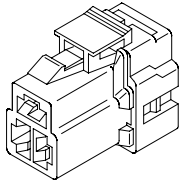
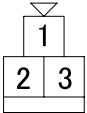
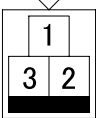
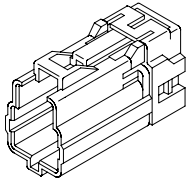
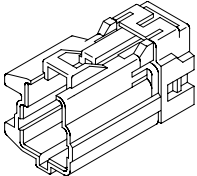
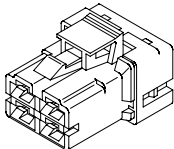
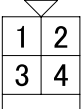
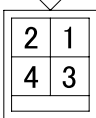
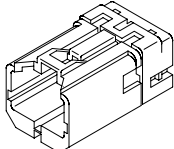
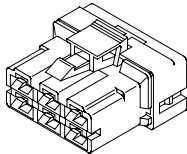
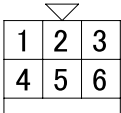
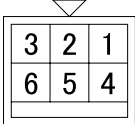
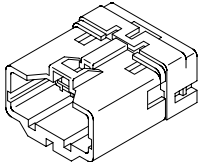
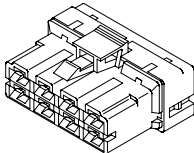
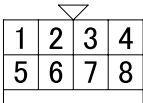
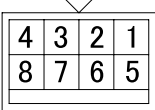
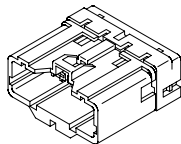
BR type

Number shows number of pins	Female connector	Male connector
BR1A	 	 
BR2A	 	 
BR4A	 	 
BR4B	 	 

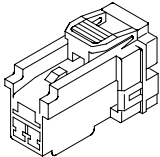
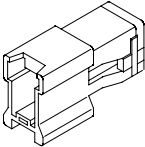
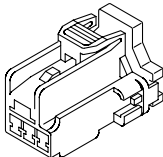
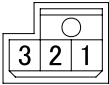
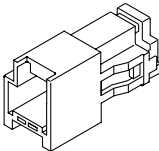
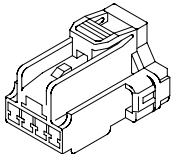
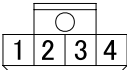
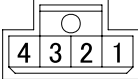
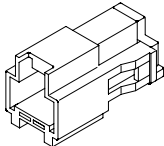
BS type

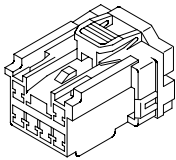
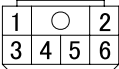
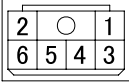
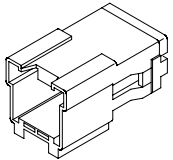
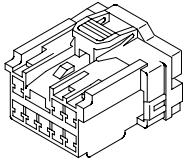
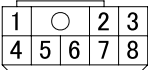
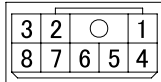
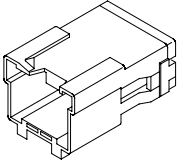
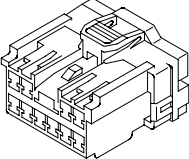
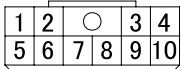
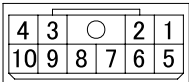
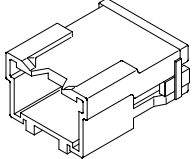
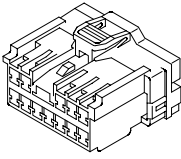
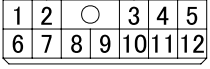
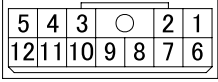
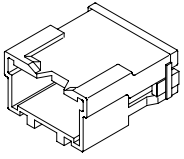
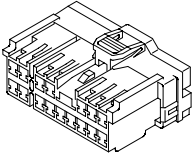
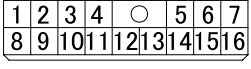
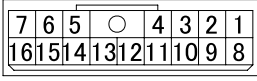
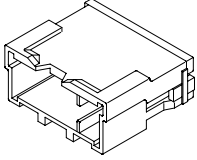
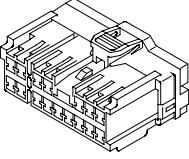
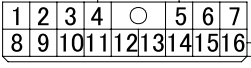
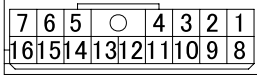
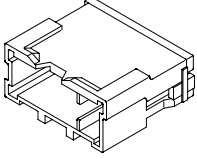
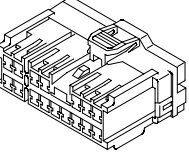
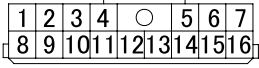
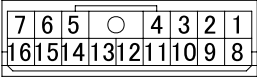
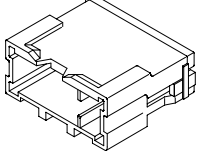
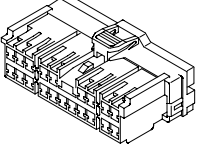
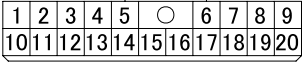
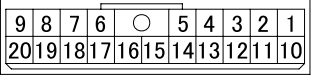
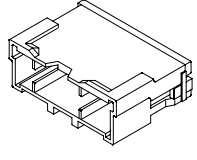
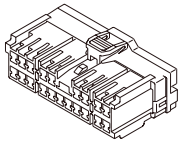
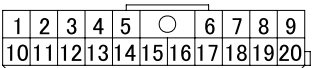
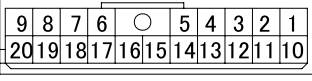
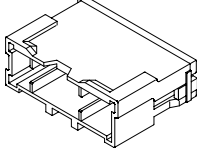
Number shows number of pins	Female connector	Male connector
BS1A	 	   
BS2A	 	   

CONNECTOR CONFIGURATION CHART

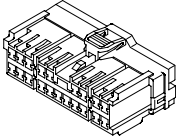
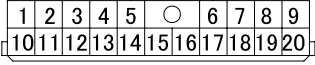
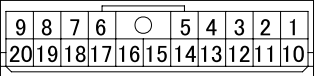
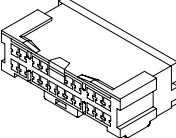
Number shows number of pins	Female connector	Male connector
BS3A	 	  
BS4A	 	 
BS6A	 	 
BS8A	 	 

BT type

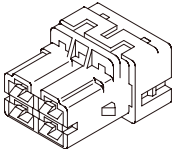
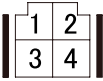
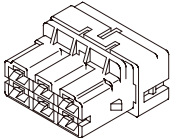
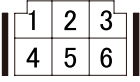
Number shows number of pins	Female connector	Male connector
BT2A	 	 
BT3A	 	 
BT4A	 	 

Number shows number of pins	Female connector	Male connector
BT6A	 	 
BT8A	 	 
BT10A	 	 
BT12A	 	 
BT16A	 	 
BT16B	 	 
BT16C	 	 
BT20A	 	 
BT20B	 	 

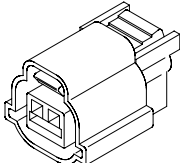
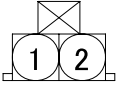
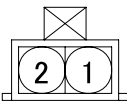
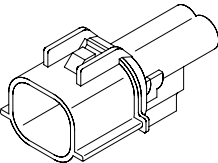
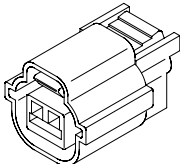
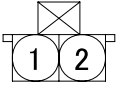
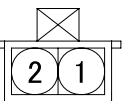
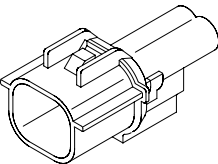
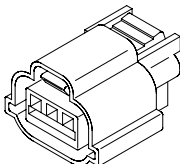
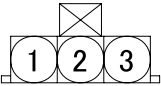
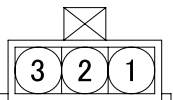
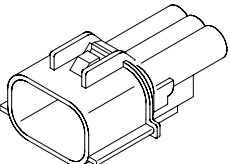
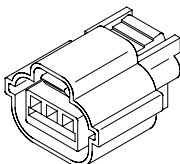
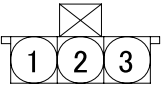
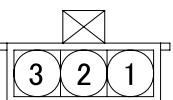
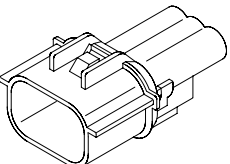
CONNECTOR CONFIGURATION CHART

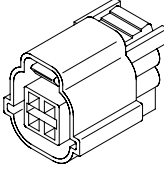
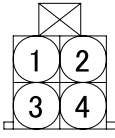
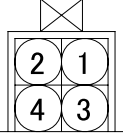
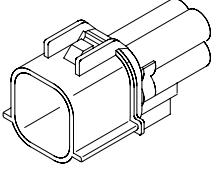
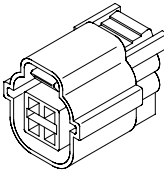
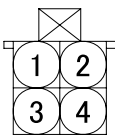
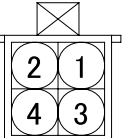
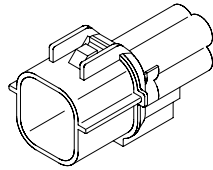
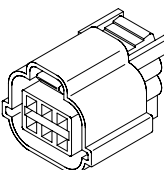
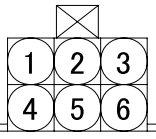
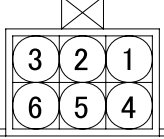
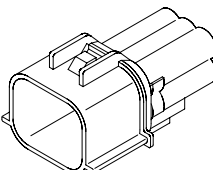
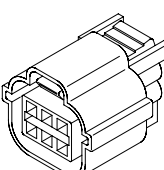
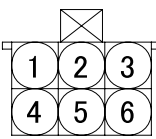
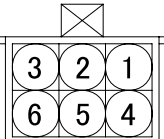
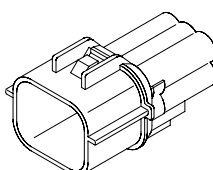
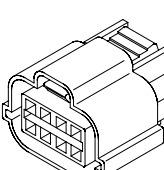
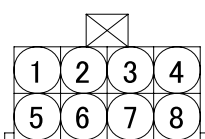
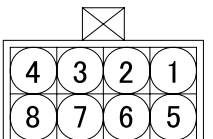
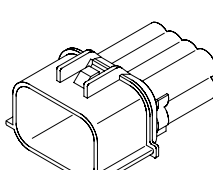
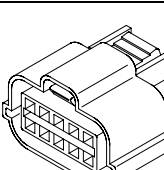
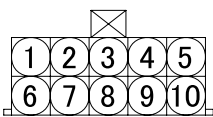
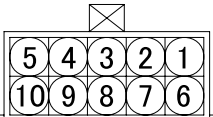
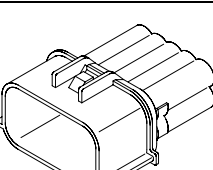
Number shows number of pins	Female connector	Male connector
BT20C	 	 

BU type

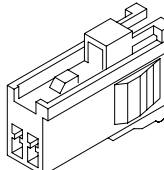
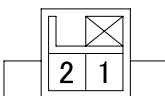
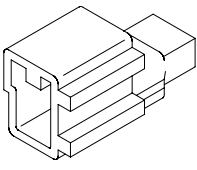
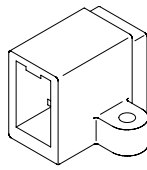
Number shows number of pins	Female connector	Male connector
BU4A	 	
BU6A	 	

BW type

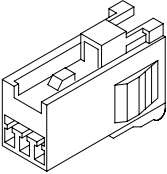
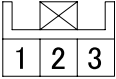
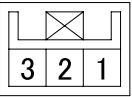
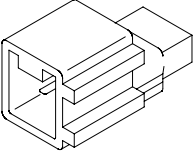
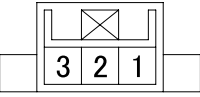
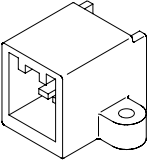
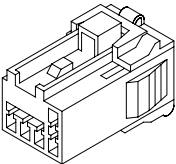
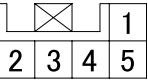
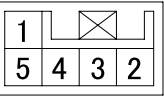
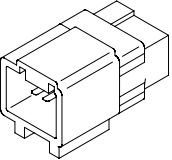
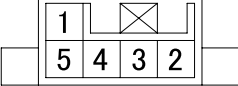
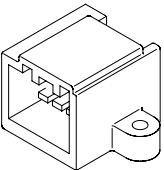
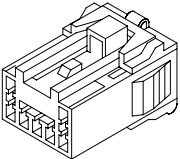
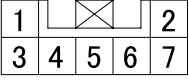
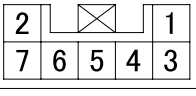
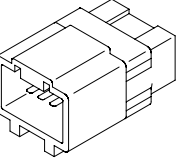
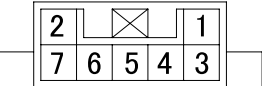
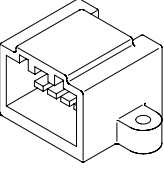
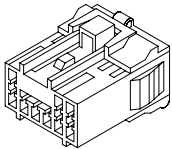
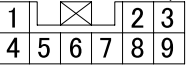
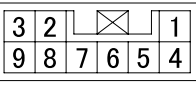
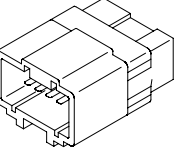
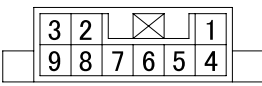
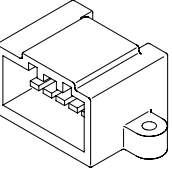
Number shows number of pins	Female connector	Male connector
BW2A	 	 
BW2B	 	 
BW3A	 	 
BW3B	 	 

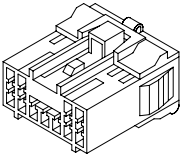
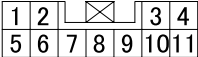
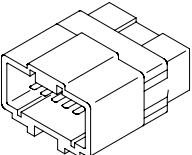
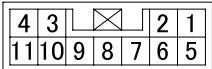
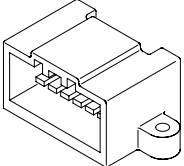
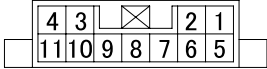
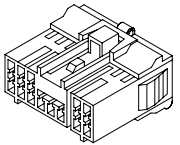
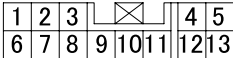
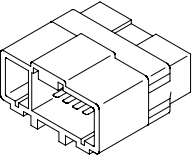
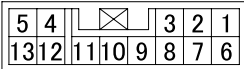
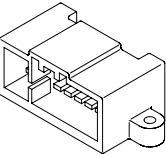
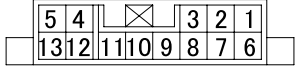
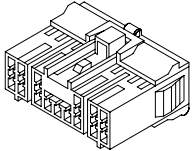
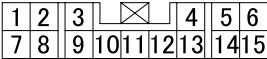
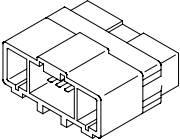
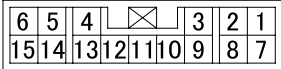
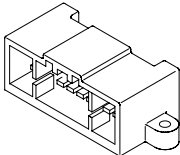
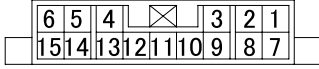
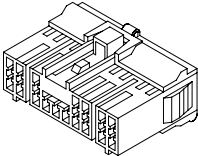
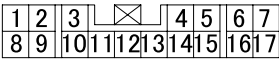
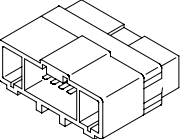
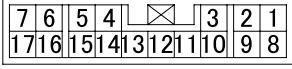
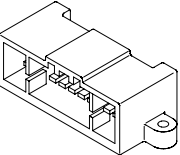
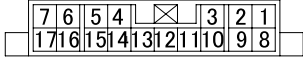
Number shows number of pins	Female connector		Male connector	
BW4A				
BW4B				
BW6A				
BW6B				
BW8A				
BW10A				

BX type

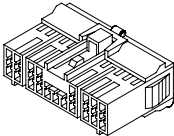
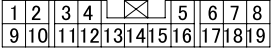
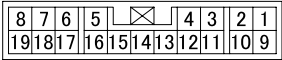
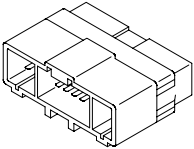
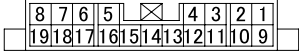
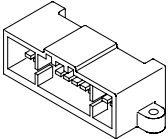
Number shows number of pins	Female connector		Male connector	
BX2A			 	 

CONNECTOR CONFIGURATION CHART

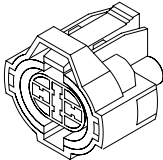
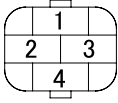
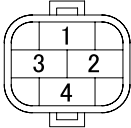
Number shows number of pins	Female connector		Male connector	
BX3A				
				
BX5A				
				
BX7A				
				
BX9A				
				

Number shows number of pins	Female connector	Male connector
BX11A	 	   
BX13A	 	   
BX15A	 	   
BX17A	 	   

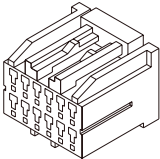
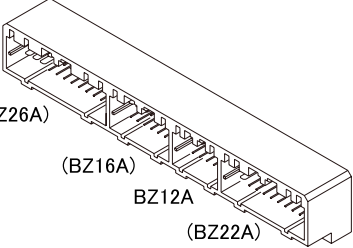
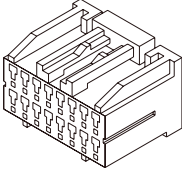
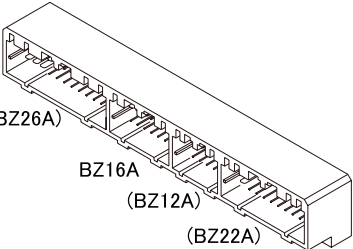
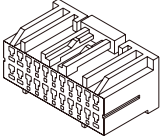
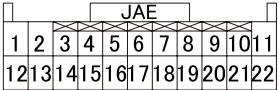
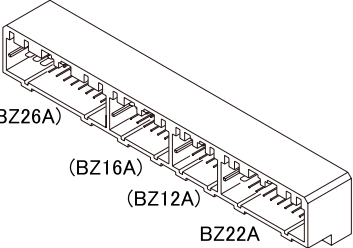
CONNECTOR CONFIGURATION CHART

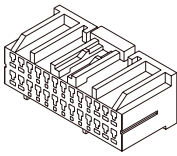
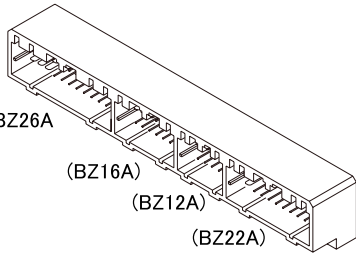
Number shows number of pins	Female connector	Male connector
BX19A	 	   

BY type

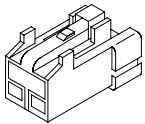
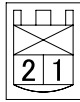
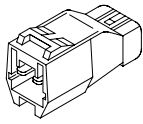
Number shows number of pins	Female connector	Male connector
BY4A	 	

BZ type

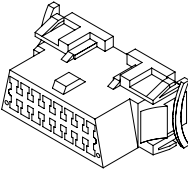
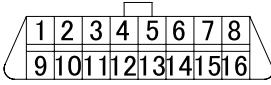
Number shows number of pins	Female connector	Male connector
BZ12A	 	 (BZ26A) (BZ16A) BZ12A (BZ22A)
BZ16A	 	 (BZ26A) BZ16A (BZ12A) (BZ22A)
BZ22A	 	 (BZ26A) (BZ16A) (BZ12A) BZ22A

Number shows number of pins	Female connector	Male connector
BZ26A	 	 BZ26A (BZ16A) (BZ12A) (BZ22A)

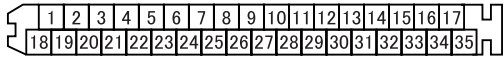
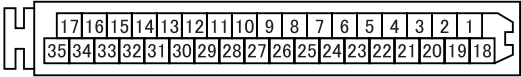
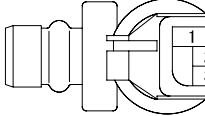
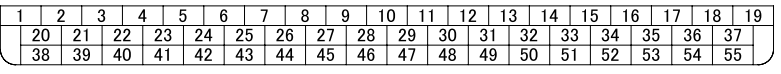
CA type

Number shows number of pins	Female connector	Male connector
CA2A	 	 

CB type

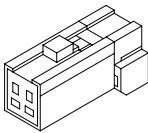
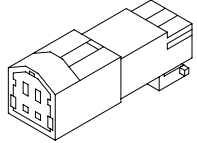
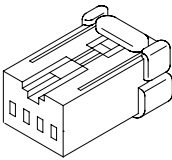
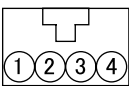
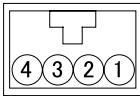
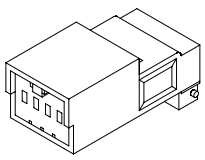
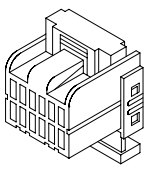
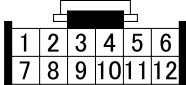
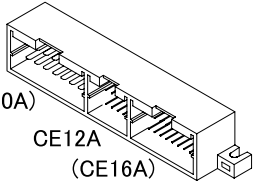
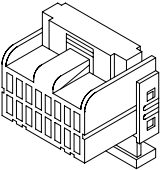
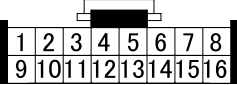
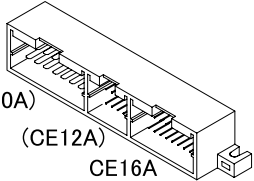
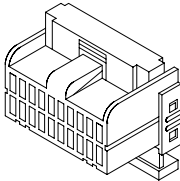
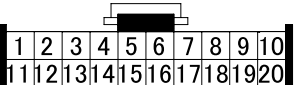
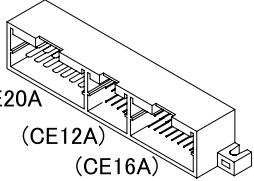
Number shows number of pins	Female connector	Male connector
CB16A	 	

CD type

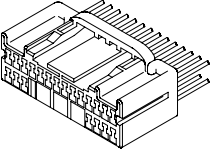
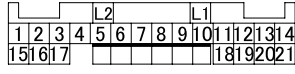
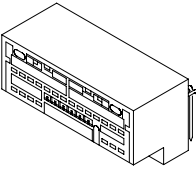
Number shows number of pins	Female connector	Male connector
CD35A		
CD55A	 	

CONNECTOR CONFIGURATION CHART

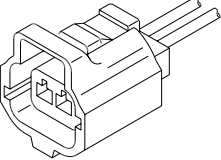
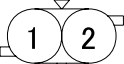
CE type

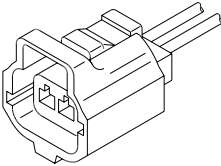
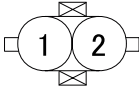
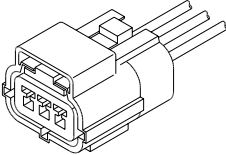
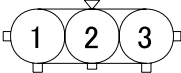
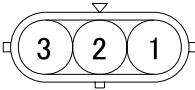
Number shows number of pins	Female connector	Male connector
CE2A	 	 
CE4A	 	 
CE12A	 	 (CE20A) CE12A (CE16A)
CE16A	 	 (CE20A) (CE12A) CE16A
CE20A	 	 CE20A (CE12A) (CE16A)

CF type

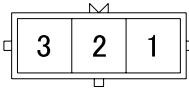
Number shows number of pins	Female connector	Male connector
CF21A	 	

CH type

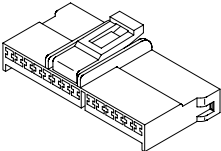
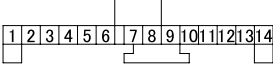
Number shows number of pins	Female connector	Male connector
CH2A	 	

Number shows number of pins	Female connector	Male connector
CH2B	 	
CH3A	 	

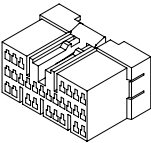
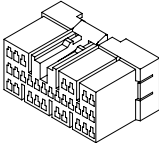
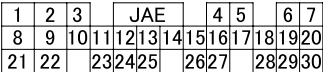
CK type

Number shows number of pins	Female connector	Male connector
CK3A		

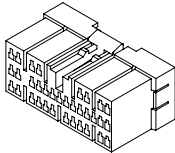
CL type

Number shows number of pins	Female connector	Male connector
CL14A	 	

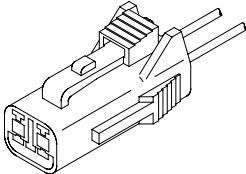
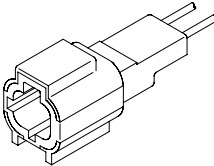
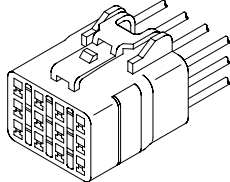
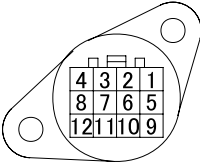
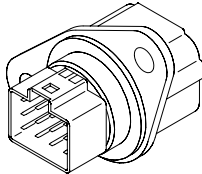
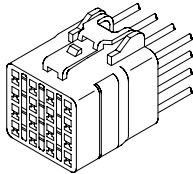
CM type

Number shows number of pins	Female connector	Male connector
CM28A	 	
CM30A	 	

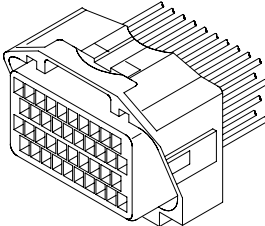
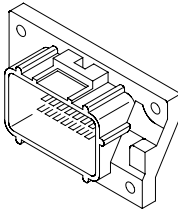
CONNECTOR CONFIGURATION CHART

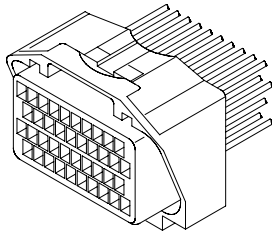
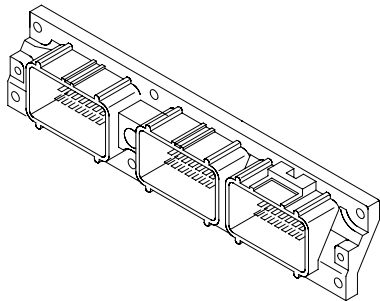
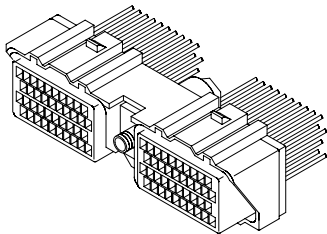
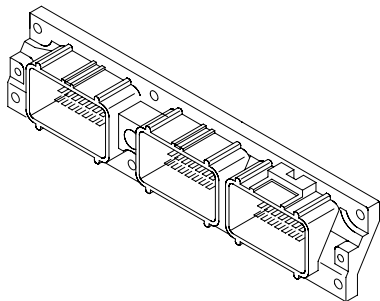
Number shows number of pins	Female connector	Male connector																																				
CM35A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>JAE</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr><tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td></tr><tr><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td></tr></table>	1	2	3	4	JAE	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
1	2	3	4	JAE	5	6	7	8																														
9	10	11	12	13	14	15	16	17																														
18	19	20	21	22	23	24	25	26																														
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CN type

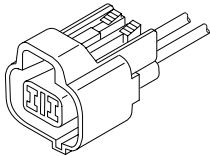
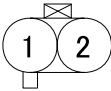
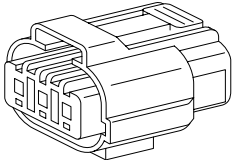
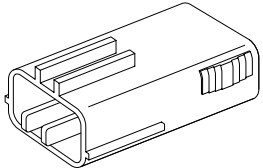
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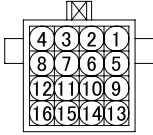
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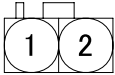
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CQ2B	 	
CQ3A		

CR type

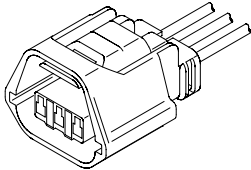
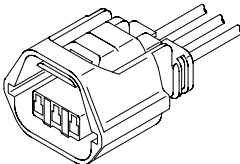
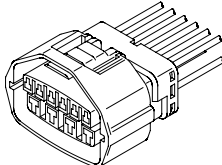
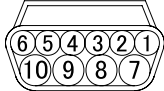
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CR16A		

CONNECTOR CONFIGURATION CHART

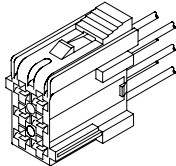
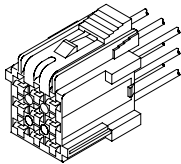
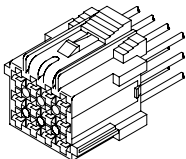
CS type

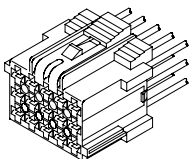
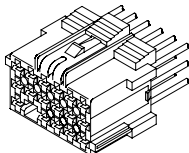
Number shows number of pins	Female connector	Male connector
CS2A		

CT type

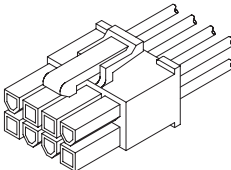
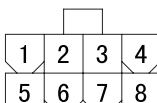
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CT3A		
CT3B		
CT10A		

CU type

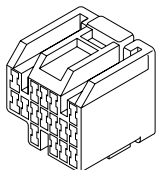
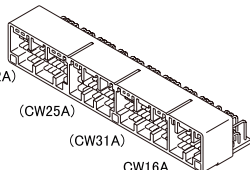
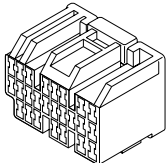
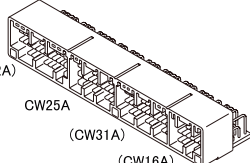
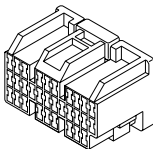
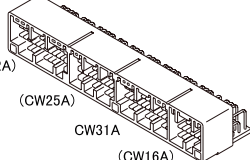
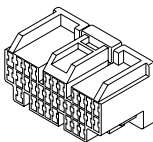
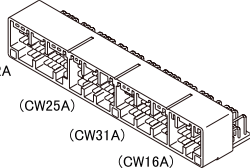
Number shows number of pins	Female connector	Male connector
CU6A		
CU9A		
CU12A		

Number shows number of pins	Female connector	Male connector																								
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CV type

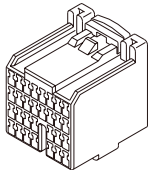
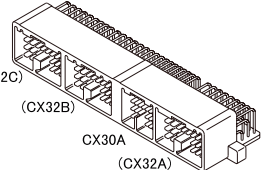
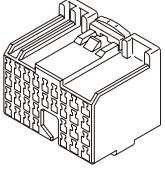
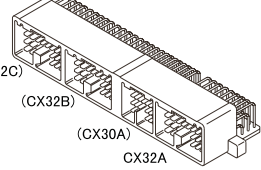
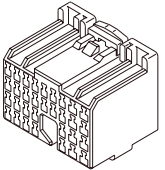
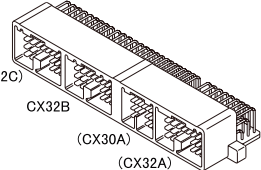
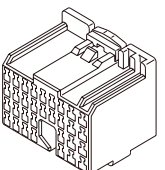
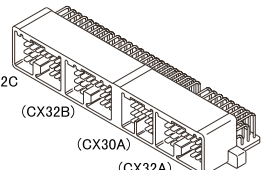
Number shows number of pins	Female connector	Male connector
CV8A	 	

CW type

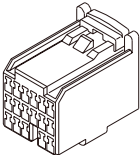
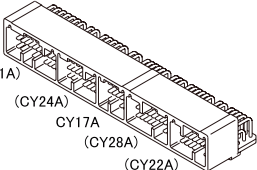
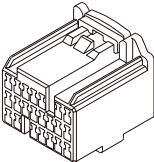
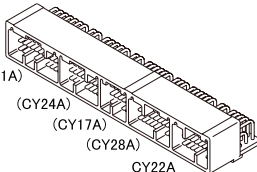
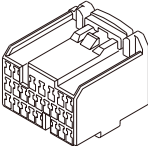
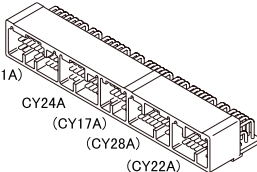
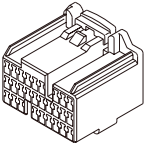
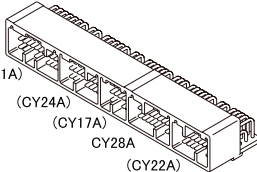
Number shows number of pins	Female connector	Male connector																																								
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CW25A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr><tr><td></td><td>19</td><td>20</td><td>21</td><td></td><td>22</td><td>23</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>24</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>25</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		19	20	21		22	23									24								25	 (CW32A) CW25A (CW31A) (CW16A)
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CW31A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr><tr><td>23</td><td>24</td><td>25</td><td></td><td>26</td><td>27</td><td>28</td><td></td><td>29</td><td>30</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>31</td><td></td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	23	24	25		26	27	28		29	30									31		 (CW32A) (CW25A) CW31A (CW16A)
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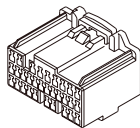
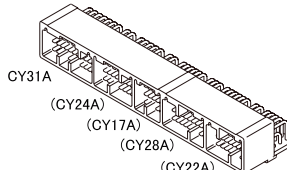
CONNECTOR CONFIGURATION CHART

CX type

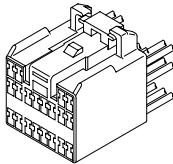
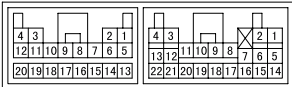
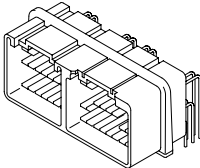
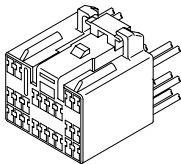
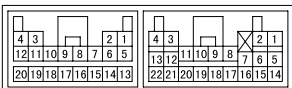
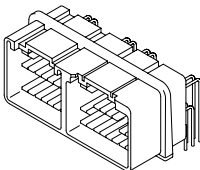
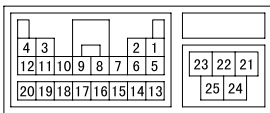
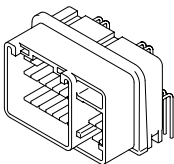
Number shows number of pins	Female connector	Male connector																																				
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CY type

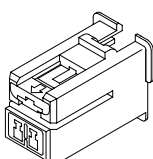
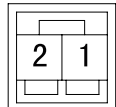
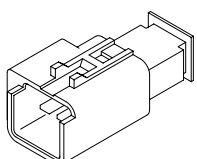
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Number shows number of pins	Female connector	Male connector																																				
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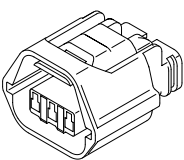
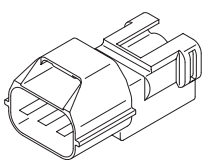
DA type

Number shows number of pins	Female connector	Male connector																																							
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1	2										3	4																													
5	6	7	8	9	10	11	12																																		
13	14	15	16	17	18	19	20																																		
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1	2										3	4																													
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DA25A		 																																							

DB type

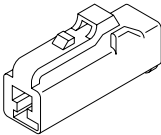
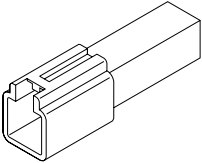
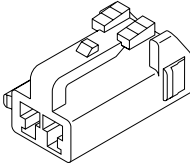
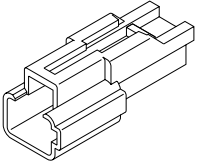
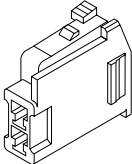
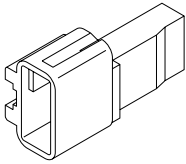
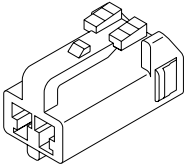
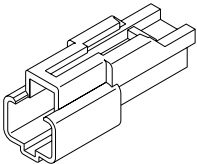
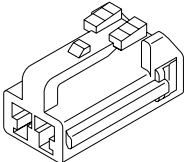
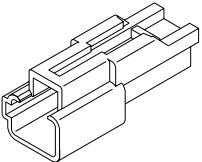
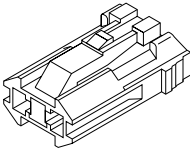
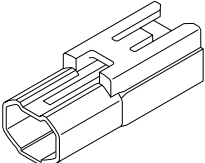
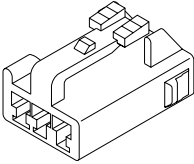
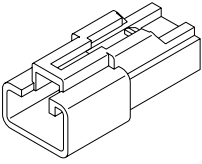
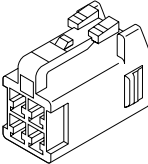
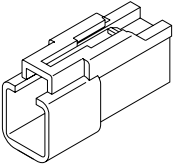
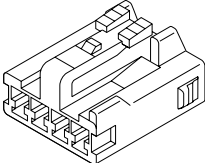
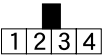
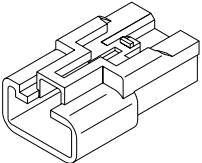
Number shows number of pins	Female connector	Male connector
DB2A	 	 

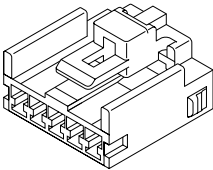
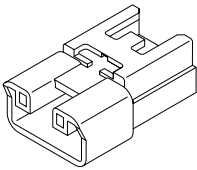
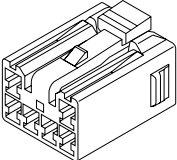
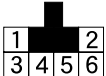
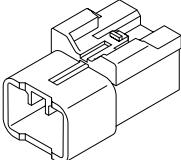
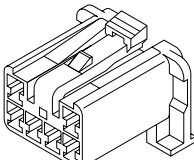
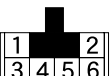
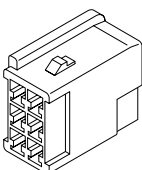
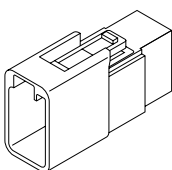
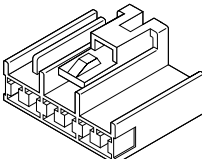
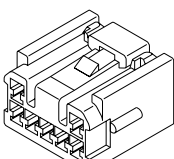
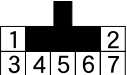
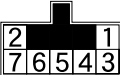
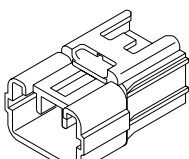
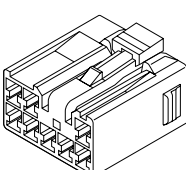
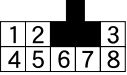
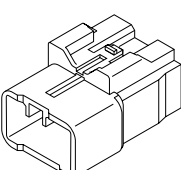
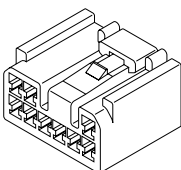
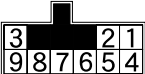
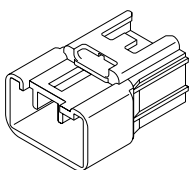
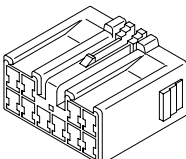
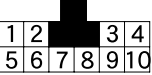
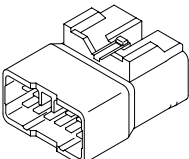
DC type

Number shows number of pins	Female connector	Male connector						
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3	2	1						

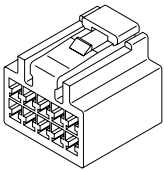
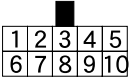
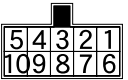
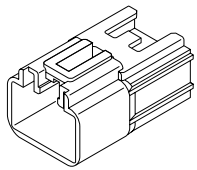
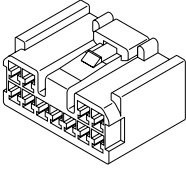
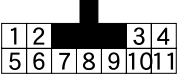
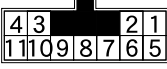
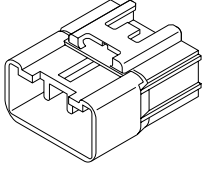
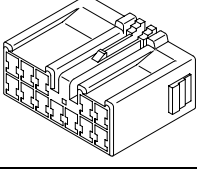
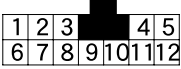
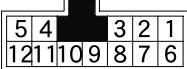
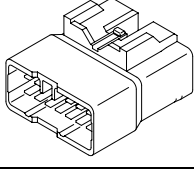
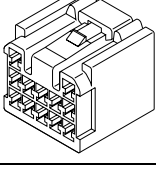
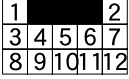
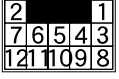
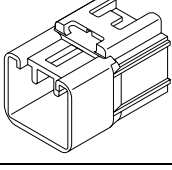
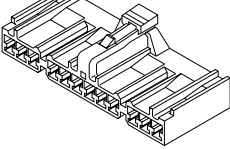
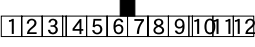
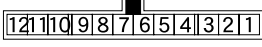
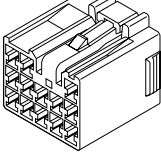
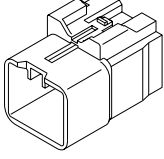
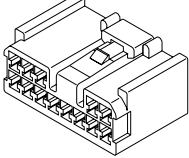
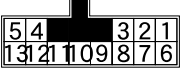
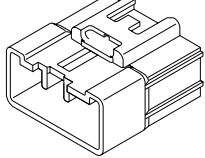
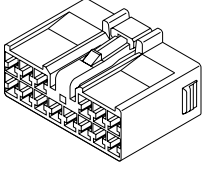
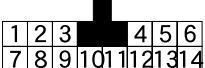
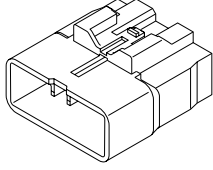
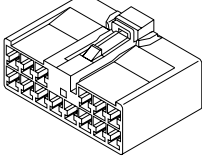
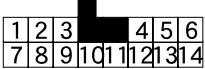
CONNECTOR CONFIGURATION CHART

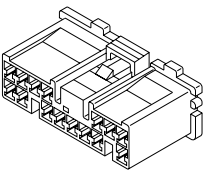
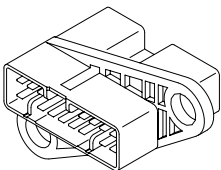
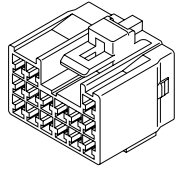
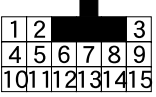
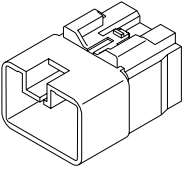
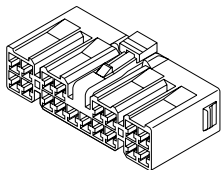
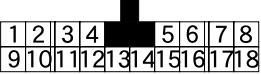
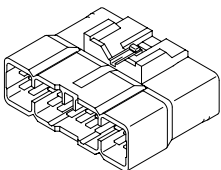
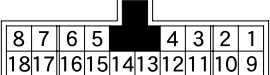
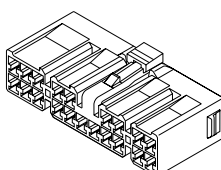
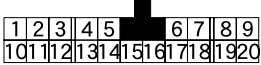
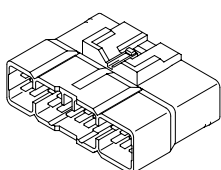
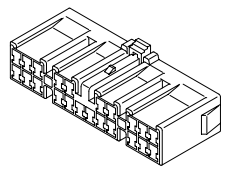
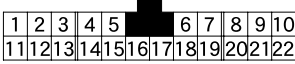
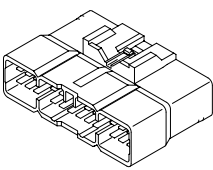
DD type

Number shows number of pins	Female connector	Male connector
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DD2A	 	 
DD2B	 	 
DD2C	 	 
DD2E	 	 
DD2F	 	 
DD3A	 	 
DD4A	 	 
DD4C	 	 

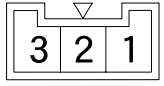
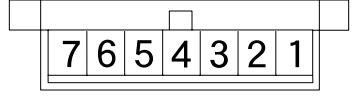
Number shows number of pins	Female connector	Male connector
DD5A	 	 
DD6A	 	 
DD6B	 	
DD6C	 	 
DD6E	 	
DD7A	 	 
DD8A	 	 
DD9A	 	 
DD10A	 	 

CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
DD10B	 	 
DD11A	 	 
DD12A	 	 
DD12B	 	 
DD12C	 	
DD13A	 	 
DD13B	 	 
DD14A	 	 
DD14B	 	

Number shows number of pins	Female connector	Male connector
DD15A	 	 
DD15B	 	 
DD18A	 	 
DD20A	 	 
DD22A	 	 

DE type

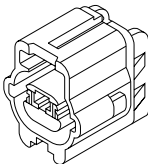
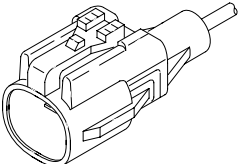
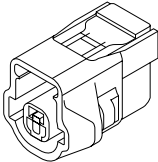
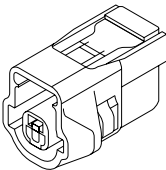
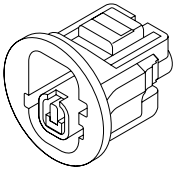
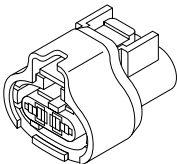
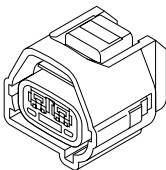
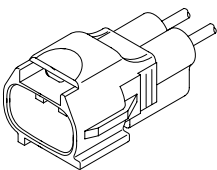
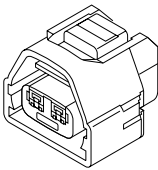
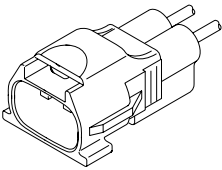
Number shows number of pins	Female connector	Male connector
DE3A		
DE7A		

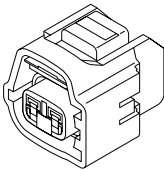
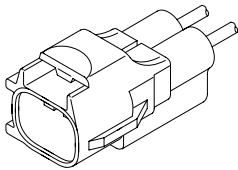
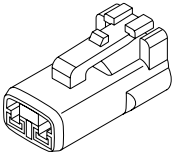
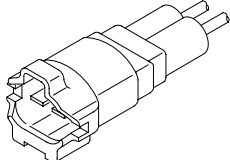
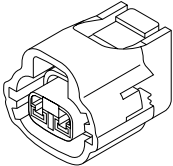
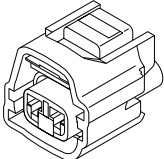
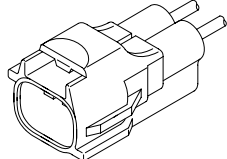
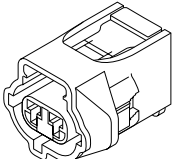
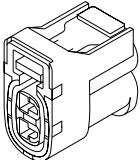
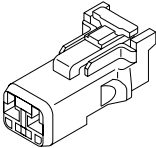
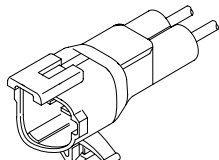
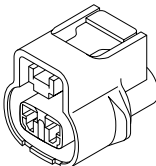
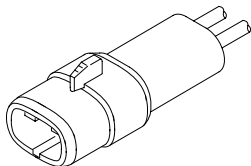
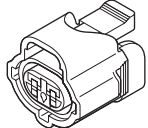
CONNECTOR CONFIGURATION CHART

DF type

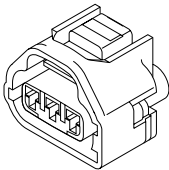
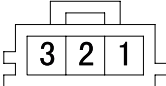
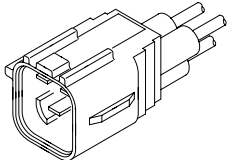
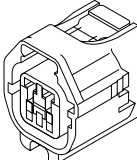
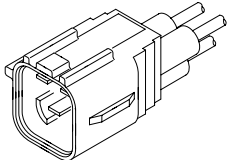
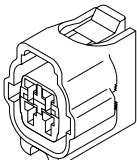
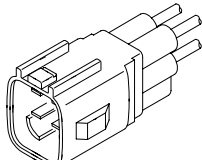
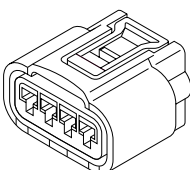
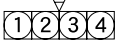
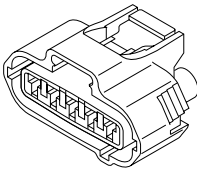
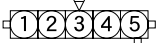
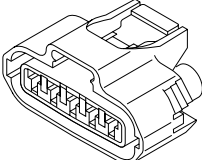
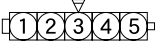
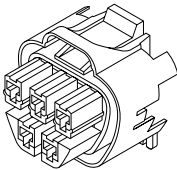
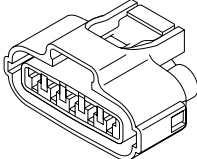
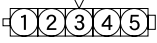
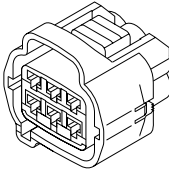
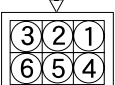
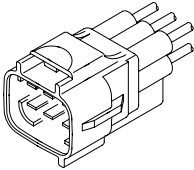
Number shows number of pins	Female connector	Male connector
DF3A		

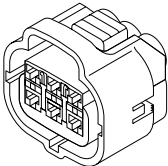
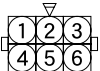
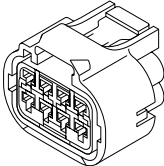
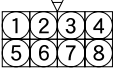
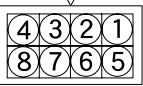
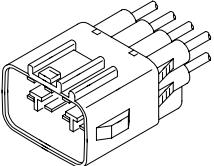
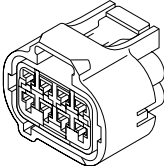
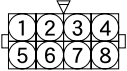
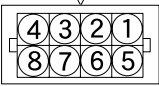
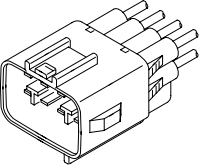
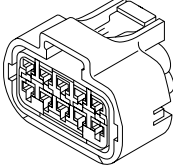
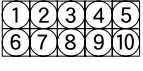
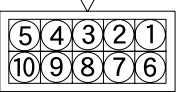
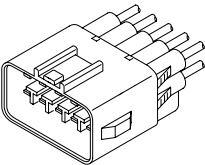
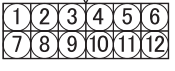
DG type

Number shows number of pins	Female connector	Male connector
DG1A	 	 
DG1B	 	
DG1C	 	
DG1D	 	
DG2A	 	
DG2B	 	 
DG2C	 	 

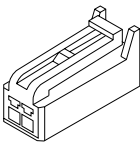
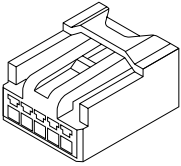
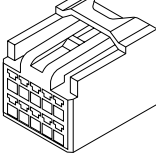
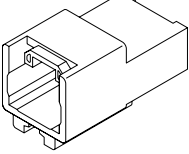
Number shows number of pins	Female connector	Male connector
DG2D	 	 
DG2E	 	 
DG2F	 	
DG2G	 	 
DG2H	 	
DG2J	 	
DG2K	 	 
DG2L	 	 
DG2M	 	

CONNECTOR CONFIGURATION CHART

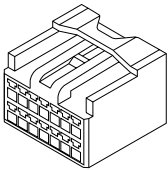
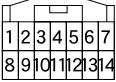
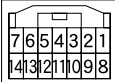
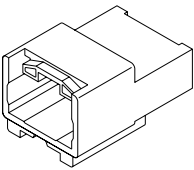
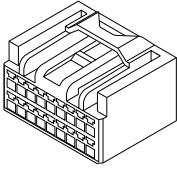
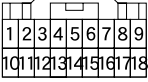
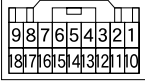
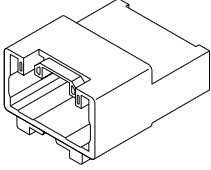
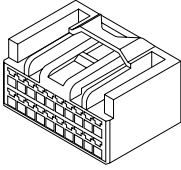
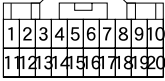
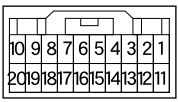
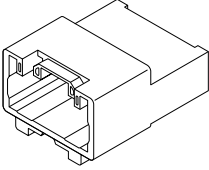
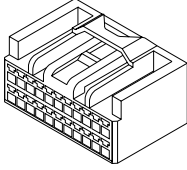
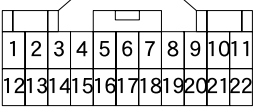
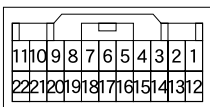
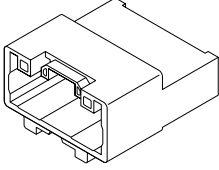
Number shows number of pins	Female connector	Male connector
DG3A	 	 
DG3B	 	 
DG4A	 	 
DG4B	 	
DG5A	 	
DG5B	 	
DG5C	 	
DG5D	 	
DG6A	 	 

Number shows number of pins	Female connector	Male connector
DG6B	 	
DG8A	 	 
DG8B	 	 
DG10A	 	 
DG12A	 	

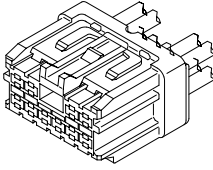
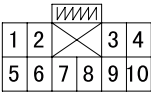
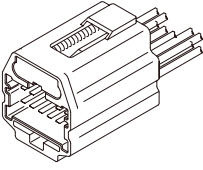
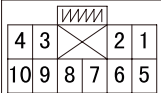
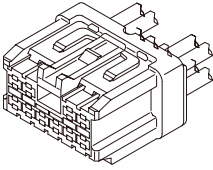
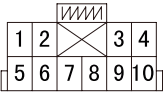
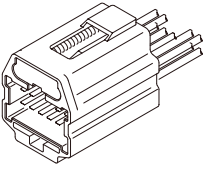
DH type

Number shows number of pins	Female connector	Male connector
DH2A	 	
DH5A	 	
DH10A	 	 

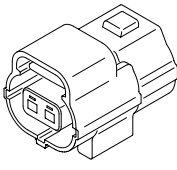
CONNECTOR CONFIGURATION CHART

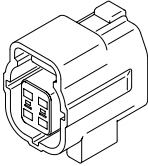
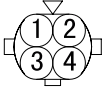
Number shows number of pins	Female connector	Male connector
DH14A	 	 
DH18A	 	 
DH20A	 	 
DH22A	 	 

DJ type

Number shows number of pins	Female connector	Male connector
DJ10A	 	 
DJ10B	 	 

DK type

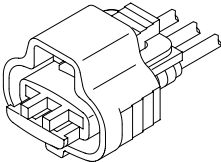
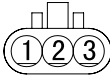
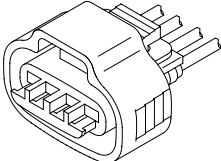
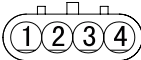
Number shows number of pins	Female connector	Male connector
DK2A	 	

Number shows number of pins	Female connector	Male connector
DK4A	 	

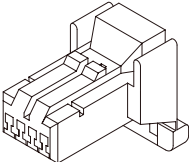
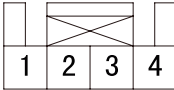
DL type

Number shows number of pins	Female connector	Male connector
DL4A		

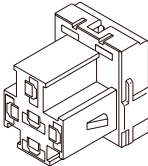
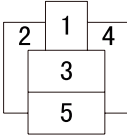
DM type

Number shows number of pins	Female connector	Male connector
DM3A	 	
DM4A	 	

DN type

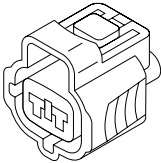
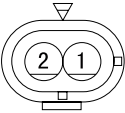
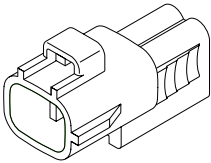
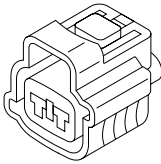
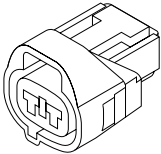
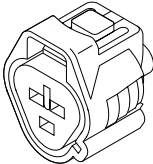
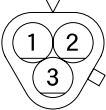
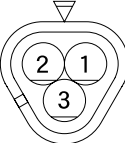
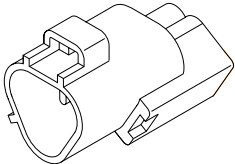
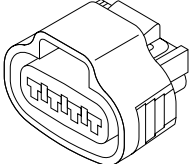
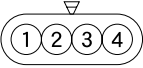
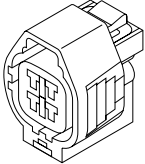
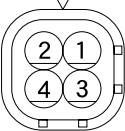
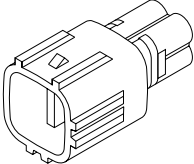
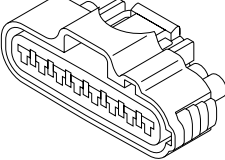
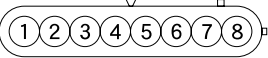
Number shows number of pins	Female connector	Male connector
DN4A	 	

DP type

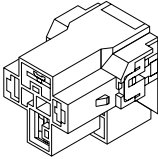
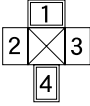
Number shows number of pins	Female connector	Male connector
DP5A	 	

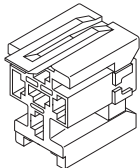
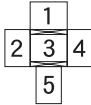
CONNECTOR CONFIGURATION CHART

DQ type

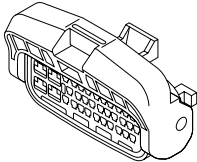
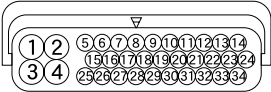
Number shows number of pins	Female connector	Male connector
DQ2A	 	 
DQ2B	 	
DQ2C	 	
DQ3A	 	 
DQ4A	 	
DQ4B	 	 
DQ8A	 	

EN type

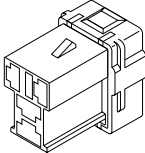
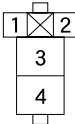
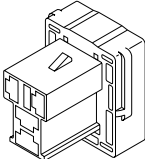
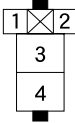
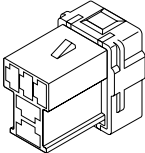
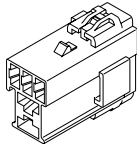
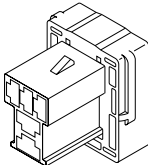
Number shows number of pins	Female connector	Male connector
EN4A	 	

Number shows number of pins	Female connector	Male connector
EN5A	 	

EP type

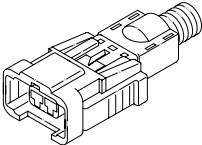
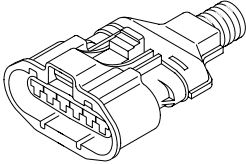
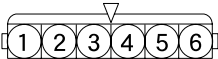
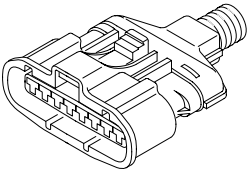
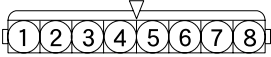
Number shows number of pins	Female connector	Male connector
EP34A	 	

EQ type

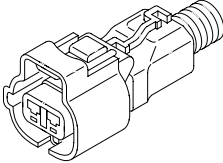
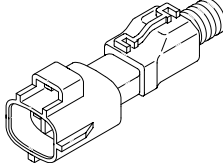
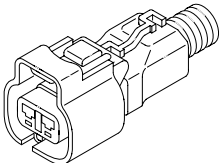
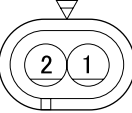
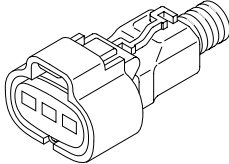
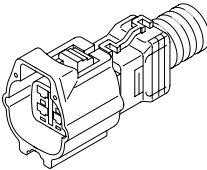
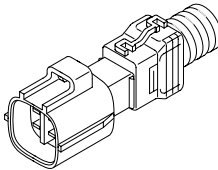
Number shows number of pins	Female connector	Male connector
EQ4A	 	
EQ4B	 	
EQ5A	   	
EQ5B	 	

CONNECTOR CONFIGURATION CHART

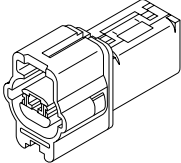
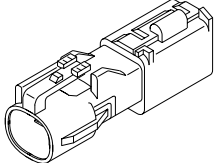
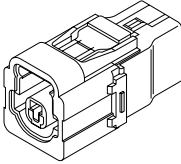
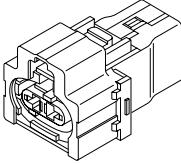
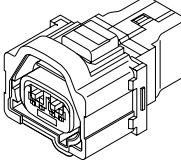
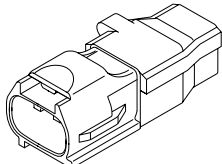
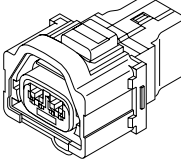
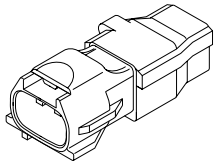
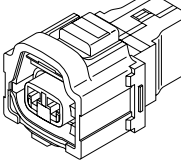
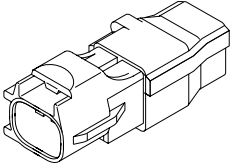
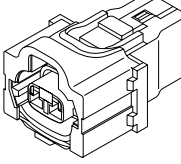
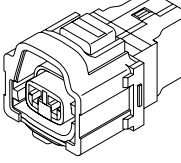
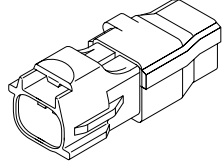
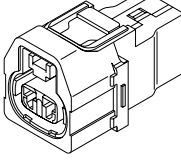
ER type

Number shows number of pins	Female connector	Male connector
ER2A	 	
ER6A	 	
ER8A	 	

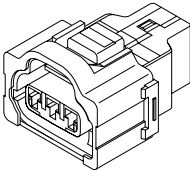
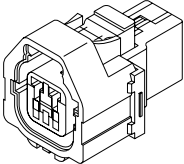
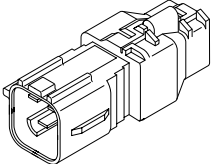
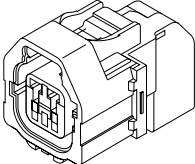
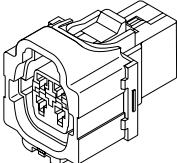
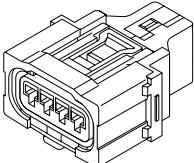
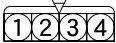
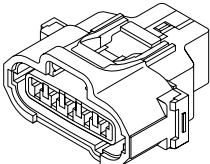
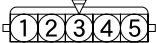
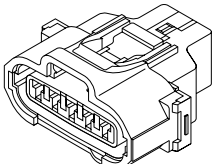
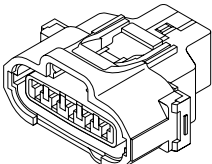
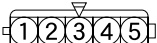
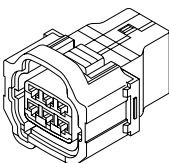
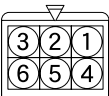
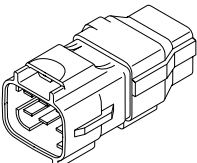
ES type

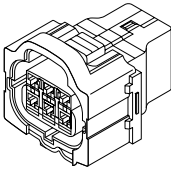
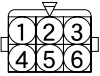
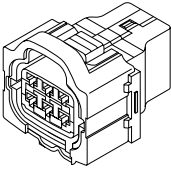
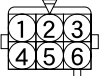
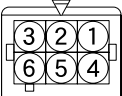
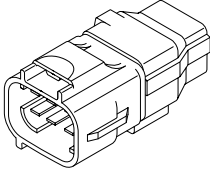
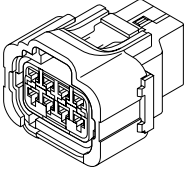
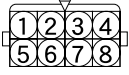
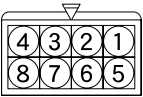
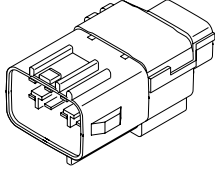
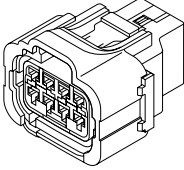
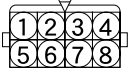
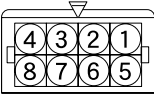
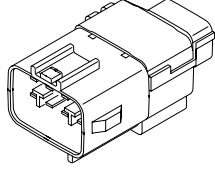
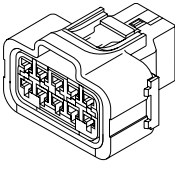
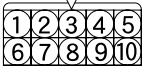
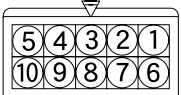
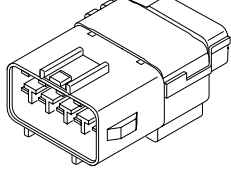
Number shows number of pins	Female connector	Male connector
ES2A	 	 
ES2B	 	
ES2C		
ES3A	 	
ES4A	 	 

ET type

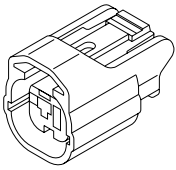
Number shows number of pins	Female connector	Male connector
ET1A	 	 
ET1B	 	
ET2A	 	
ET2B	 	 
ET2C	 	 
ET2D	 	 
ET2F	 	
ET2G	 	 
ET2L	 	

CONNECTOR CONFIGURATION CHART

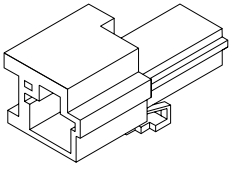
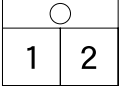
Number shows number of pins	Female connector	Male connector
ET3A	 	
ET3B	 	 
ET3C	 	
ET4A	 	
ET4B	 	
ET5A	 	
ET5B	 	
ET5D	 	
ET6A	 	 

Number shows number of pins	Female connector	Male connector
ET6B	 	
ET6C	 	 
ET8A	 	 
ET8B	 	 
ET10A	 	 

EU type

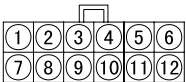
Number shows number of pins	Female connector	Male connector
EU1A	 	

EV type

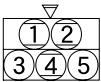
Number shows number of pins	Female connector	Male connector
EV2A	 	

CONNECTOR CONFIGURATION CHART

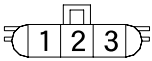
EW type

Number shows number of pins	Female connector	Male connector
EW12A		

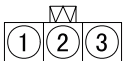
EX type

Number shows number of pins	Female connector	Male connector
EX5A		

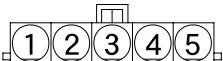
EY type

Number shows number of pins	Female connector	Male connector
EY3A		

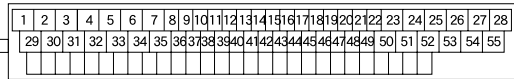
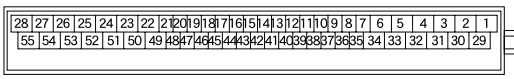
EZ type

Number shows number of pins	Female connector	Male connector
EZ3A		

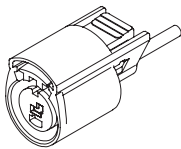
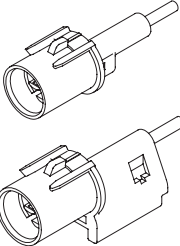
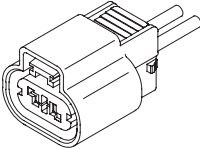
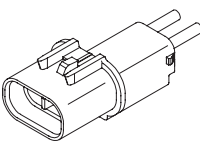
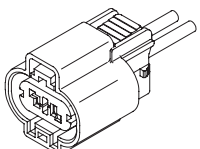
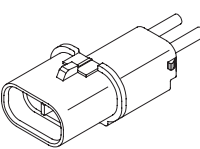
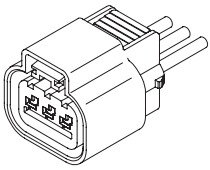
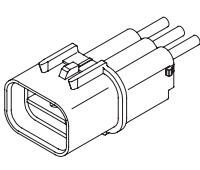
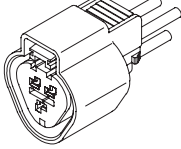
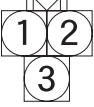
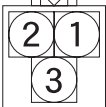
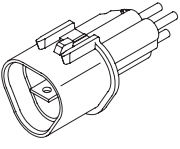
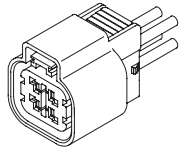
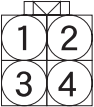
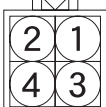
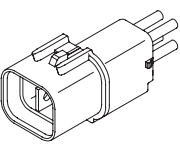
FA type

Number shows number of pins	Female connector	Male connector
FA5A		

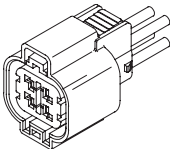
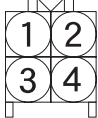
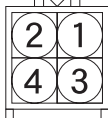
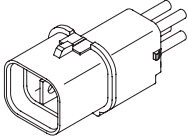
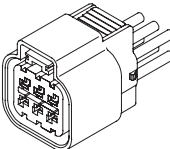
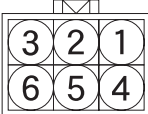
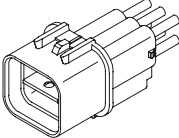
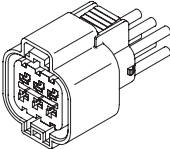
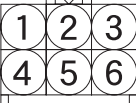
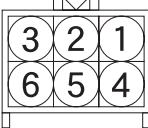
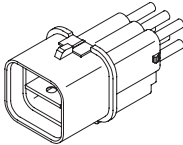
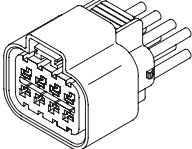
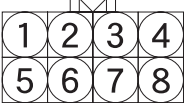
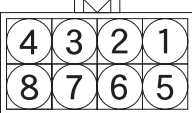
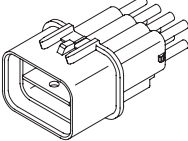
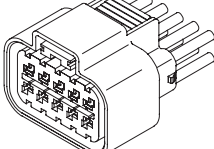
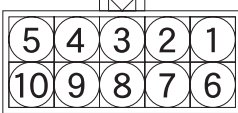
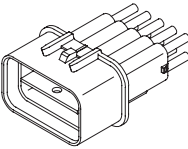
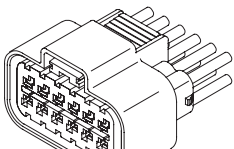
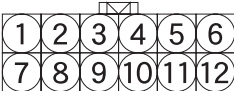
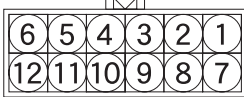
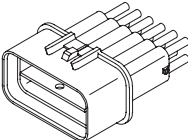
FB type

Number shows number of pins	Female connector	Male connector
FB55A		

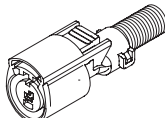
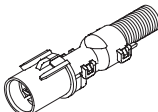
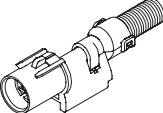
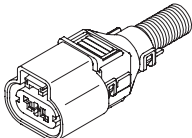
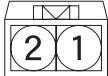
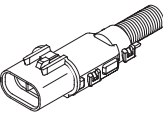
GA type

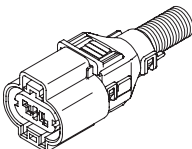
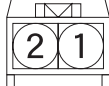
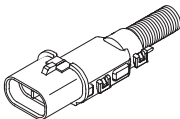
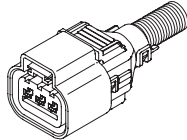
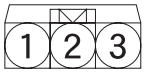
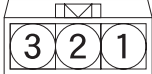
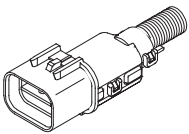
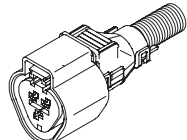
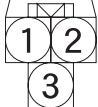
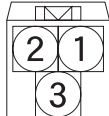
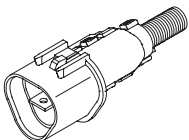
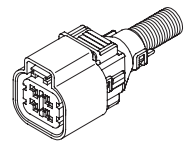
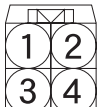
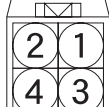
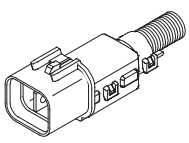
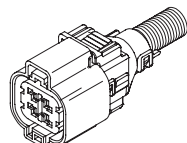
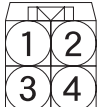
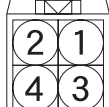
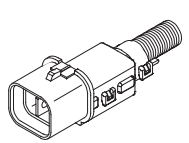
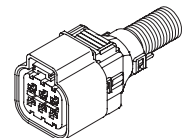
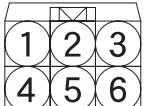
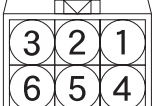
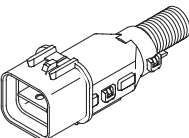
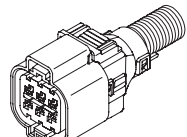
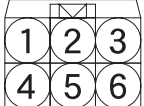
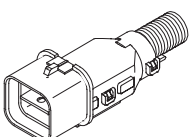
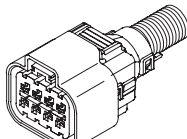
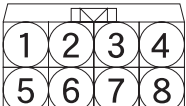
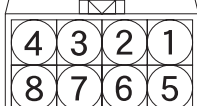
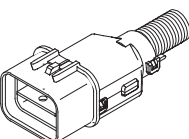
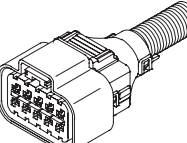
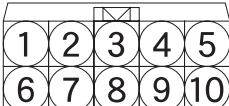
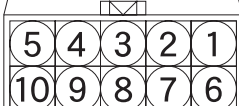
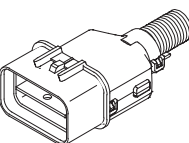
Number shows number of pins	Female connector	Male connector
GA1A	 	 
GA2A	 	 
GA2B	 	 
GA3A	 	 
GA3B	 	 
GA4A	 	 

CONNECTOR CONFIGURATION CHART

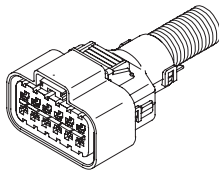
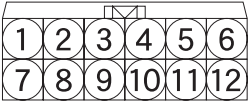
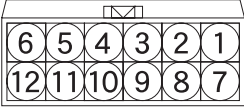
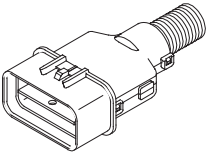
Number shows number of pins	Female connector		Male connector	
GA4B				
GA6A				
GA6B				
GA8A				
GA10A				
GA12A				

GB type

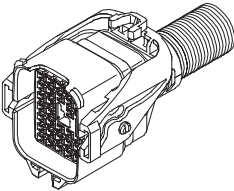
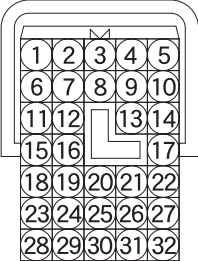
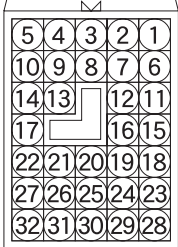
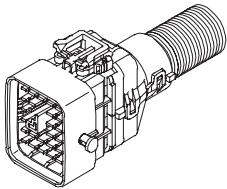
Number shows number of pins	Female connector		Male connector	
GB1A			 	 
GB2A				

Number shows number of pins	Female connector		Male connector	
GB2B				
GB3A				
GB3B				
GB4A				
GB4B				
GB6A				
GB6B				
GB8A				
GB10A				

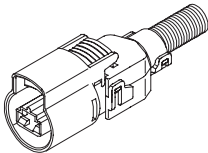
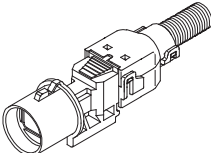
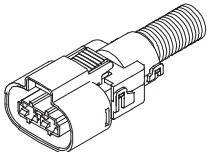
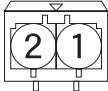
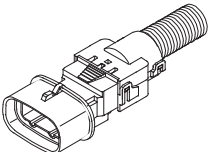
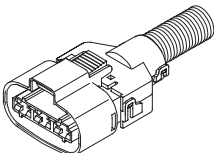
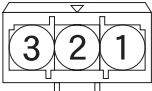
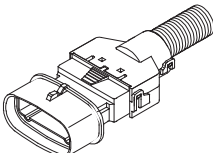
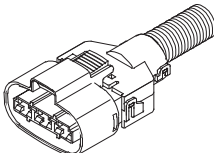
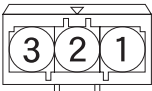
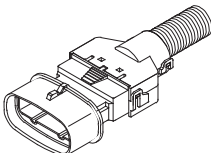
CONNECTOR CONFIGURATION CHART

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GB12A	 	 

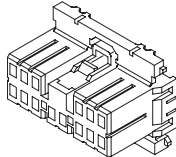
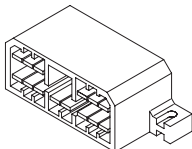
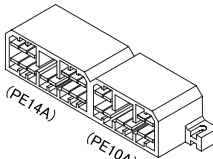
GC type

Number shows number of pins	Female connector	Male connector
GC32A	 	 

GD type

Number shows number of pins	Female connector	Male connector
GD1A	 	 
GD2A	 	 
GD3A	 	 
GD3B	 	 

PE type

Number shows number of pins	Female connector	Male connector																																													
PE14A	 <table><tr><td>1</td><td>2</td><td>3</td><td>A</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr></table>	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14	<table><tr><td>6</td><td>5</td><td>4</td><td>A</td><td>3</td><td>2</td><td>1</td></tr><tr><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td></tr></table>  <table><tr><td>6</td><td>5</td><td>4</td><td>A</td><td>3</td><td>2</td><td>1</td></tr><tr><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td></tr></table>  (PE14A) (PE10A) (PE14A) (PE10A)	6	5	4	A	3	2	1	14	13	12	11	10	9	8	7	6	5	4	A	3	2	1	14	13	12	11	10	9	8	7
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7	8	9	10	11	12	13	14																																								
6	5	4	A	3	2	1																																									
14	13	12	11	10	9	8	7																																								
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14	13	12	11	10	9	8	7																																								



55A - Air Conditioner

55B - Heater

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 55A

Air-conditioner

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	55A-2
-----------------------------	--------------

STRUCTURE AND OPERATION

1. Air Conditioner System	55A-4
2. Engine Room	55A-5
3. Cabin Room	55A-6
4. Compressor	55A-7
5. Magnetic Clutch	55A-8
6. Check Valve	55A-8
7. Side Condenser Assembly	55A-9
8. Relief Valve	55A-9
9. Receiver Assembly	55A-10
10. Evaporator Assembly	55A-10
11. Expansion Valve	55A-11
12. Dual Pressure Switch	55A-11
13. Power Relay	55A-12
14. Air Conditioner Switch	55A-12
15. Thermostat	55A-12
16. Control system	55A-14

TROUBLESHOOTING	55A-16
------------------------------	---------------

ON-VEHICLE INSPECTION

AND ADJUSTMENT

1. Recovery of Refrigerant	55A-18
2. Inspection and Adjustment of V-Belt	55A-18
3. Inspection of Magnetic clutch	55A-19
4. Recharging the System with Refrigerant	55A-20
5. Checking Refrigerant Charge Level	55A-22
6. Adding Refrigerant	55A-23
7. Inspection of Receiver Assembly	55A-24

8. Inspection of Dual Pressure Switch	55A-24
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CONNECTING AIR CONDITIONER

PIPING	55A-25
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COMPRESSOR	55A-26
-------------------------	---------------

CONDENSER, RECEIVER	55A-28
----------------------------------	---------------

COOLING UNIT	55A-30
---------------------------	---------------

AIR CONDITIONER CIRCUIT	55A-32
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※ This air-conditioner is dealer's option.

When installing the air-conditioner kit in your shop,
please refer to installation manual in the kit.

SPECIFICATIONS

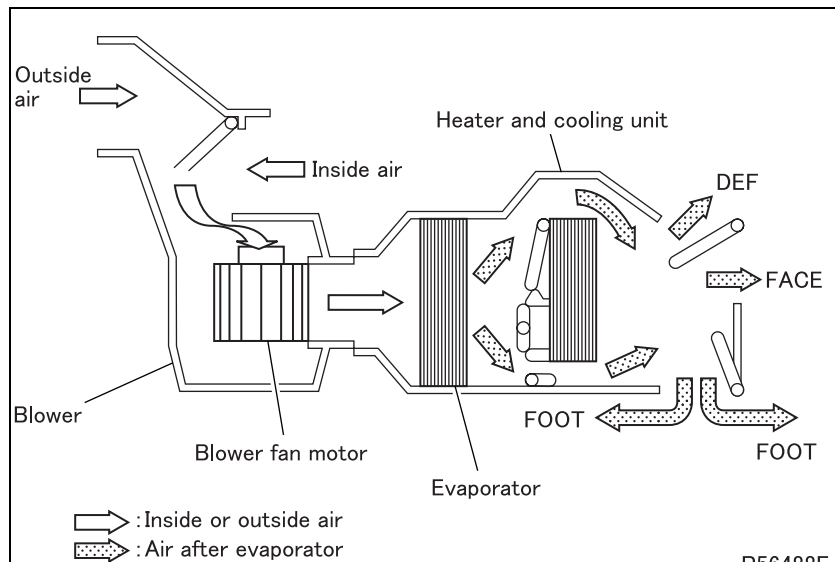
Item			Specification
Manufacturer			MITSUBISHI HEAVY INDUSTRIES, LTD.
*Cooling capacity (on JIS conditions)		W {BTU/h, kcal/h}	4,530 {15456, 3896}
Compressor	Model		MSC90TA
	Displacement cm ³ {cu.in, mL}		90 {5.49, 90}
	Maximum revolution min ⁻¹		MAX 9,000
	Compressor oil cm ³ {cu.in, mL}		SUN PAG 56, 120 {7.32, 120}
Magnetic clutch	Type		Dry single disc magnet
	Voltage & input V, W		DC12, 45
Cooling unit assembly	Type		Laminated fin type
Controls	Air flow control		Rotary switch, Five step type
	Temperature control		Air mix control
Condenser	Type		Corrugate fin type
Receiver assembly	cm ³ {cu.in, mL}		Cylinder type, approx 340. {20.7, 340}
Protective equipment	Frost prevention (Thermostat) °C {°F}		OFF : 4.2 {40} ON : 5.2 {41}
	Relief valve MPa {psi, kg/cm ² }		Open : 3.50 to 4.10 MPa {505 to 595, 36 to 42} Close : 2.94 {425, 30}
	Dual pressure switch	Low pressure switch MPa {psi, kg/cm ² }	OFF : 0.2 {29, 2.0} ON : 0.22 {33, 2.2}
		High pressure switch MPa {psi, kg/cm ² }	OFF : 2.94 {425, 30} ON : 2.35 {340, 24}
	Fuse (Fan equipment) Fuse (Magnetic clutch) A		15 10
Refrigerant and quantity g {oz}		HFC-134a, 540 {19}	

- The * marked cooling capacity is based on JIS conditions.
- Compressor speed : 1,800 min⁻¹
- Condensing temperature : 55°C {130°F}
- Cooling unit inlet air dry bulb temperature : 27°C {81°F}
- Cooling unit inlet air wet bulb temperature : 19.5°C {67°F}
- Terminal voltage : DC12 V

M E M O

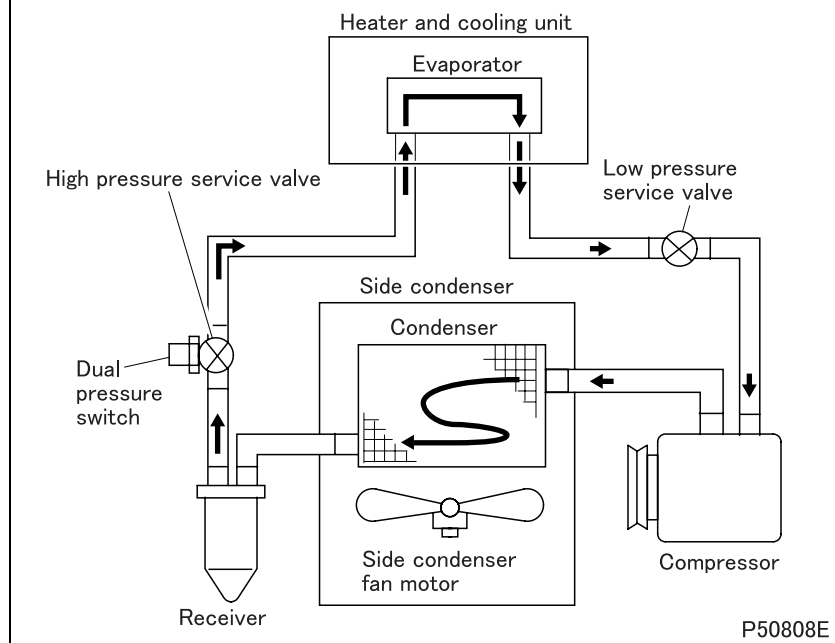
STRUCTURE AND OPERATION

1. Air Conditioner System



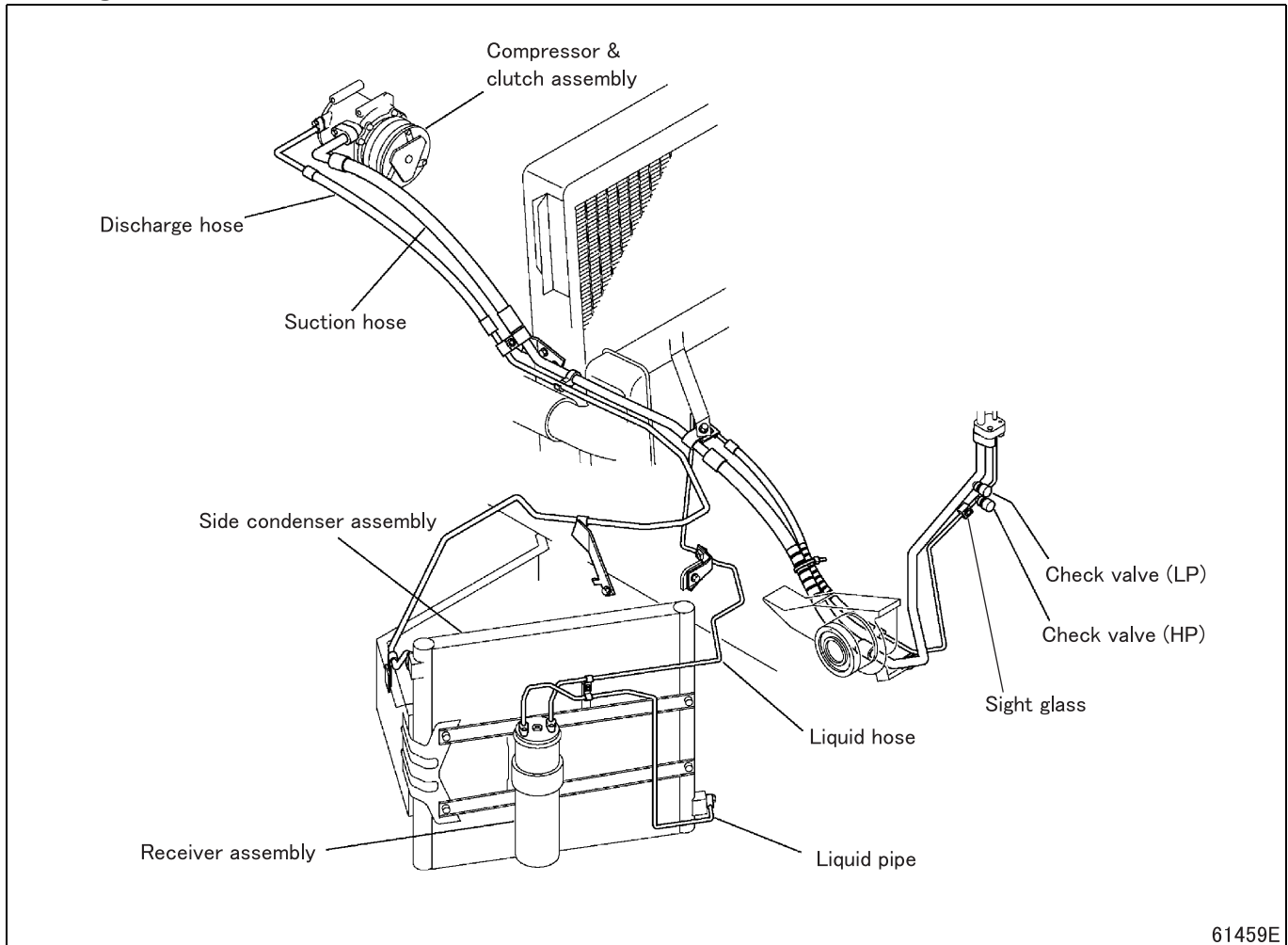
P56488E

- The blower sends air to the heater and cooling unit, where the air is cooled by the evaporator. The cooled air is then sent through the ducts into the cab.
- Refrigerant in gas form is compressed by the compressor. The compressed gas is then sent to the side condenser, where it is cooled by outside air and condenses into liquid form.
- The liquid refrigerant is sprayed into the evaporator, where it quickly evaporates into gas form while at the same time absorbing heat from the surrounding air.
- The refrigerant in gas form is again sent to the compressor and is compressed there.
- When the refrigerant pressure in the high pressure line reaches the specified limit, the dual pressure switch senses this and turns itself OFF. At the same time, the magnet clutch is turned OFF.



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2. Engine Room



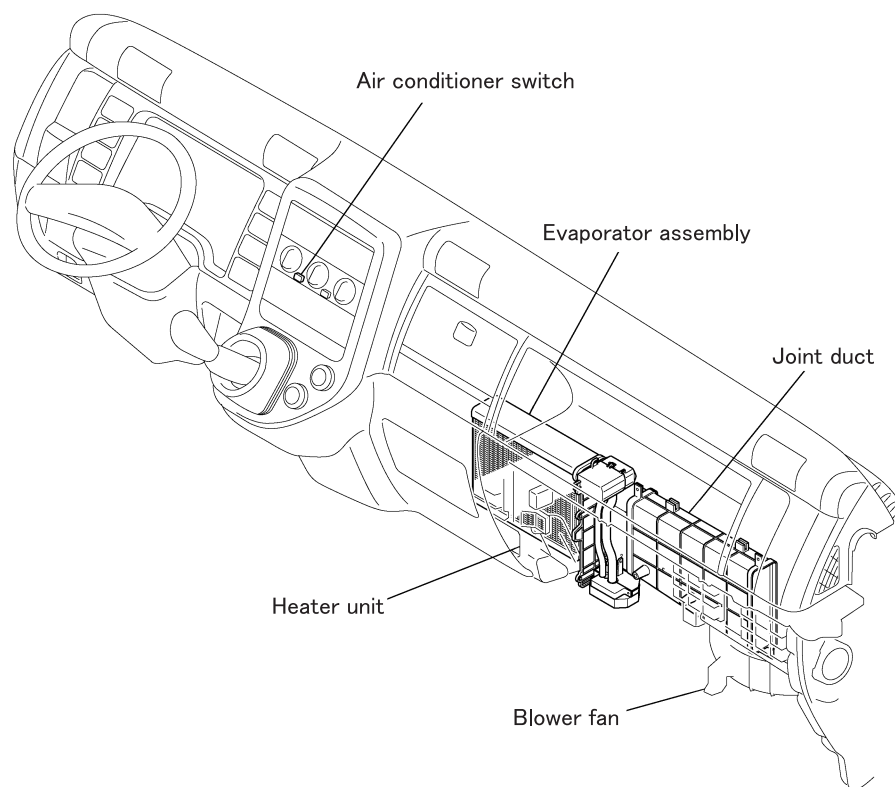
61459E

HP: High pressure

LP: Low pressure

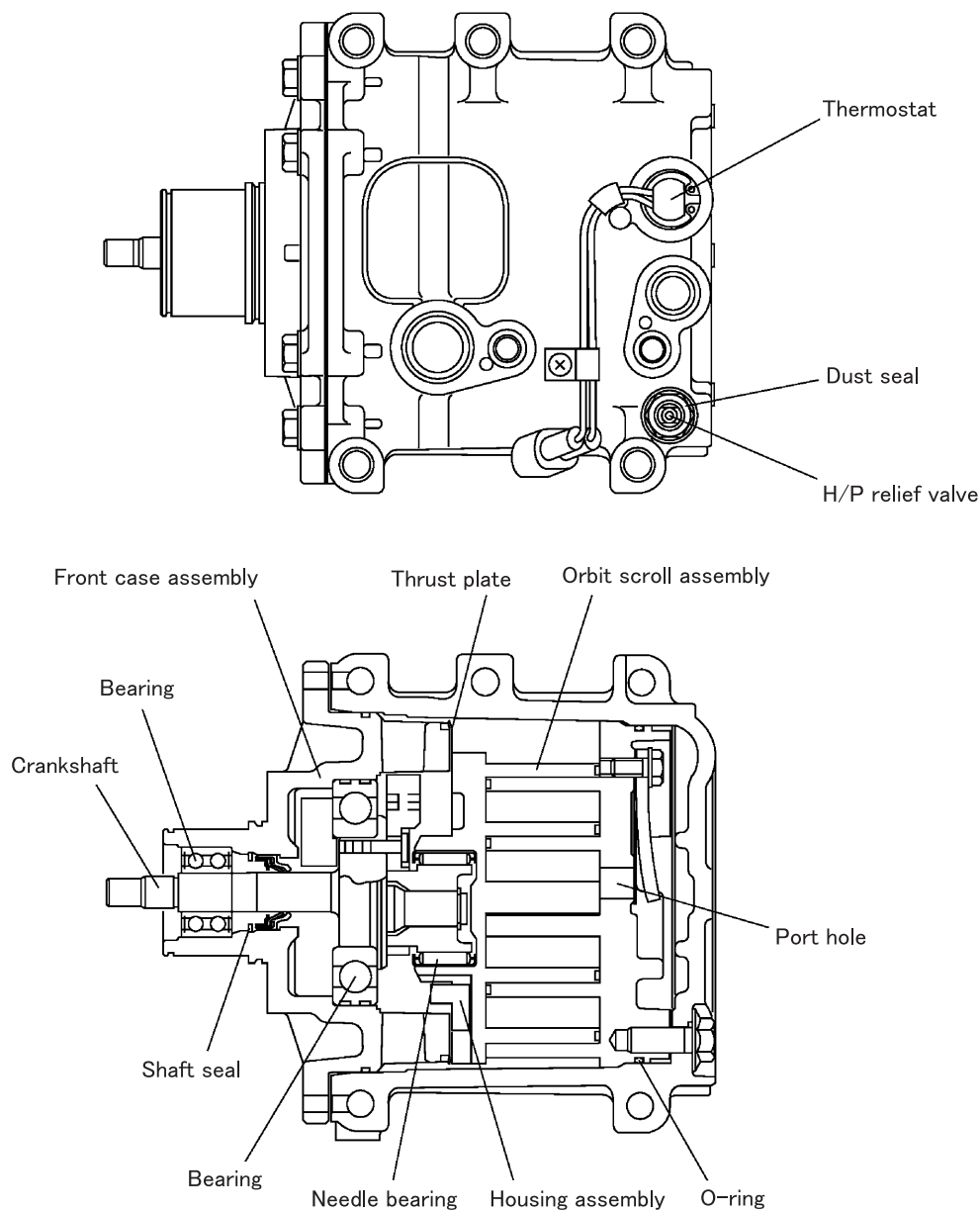
STRUCTURE AND OPERATION

3. Cabin Room



61460E

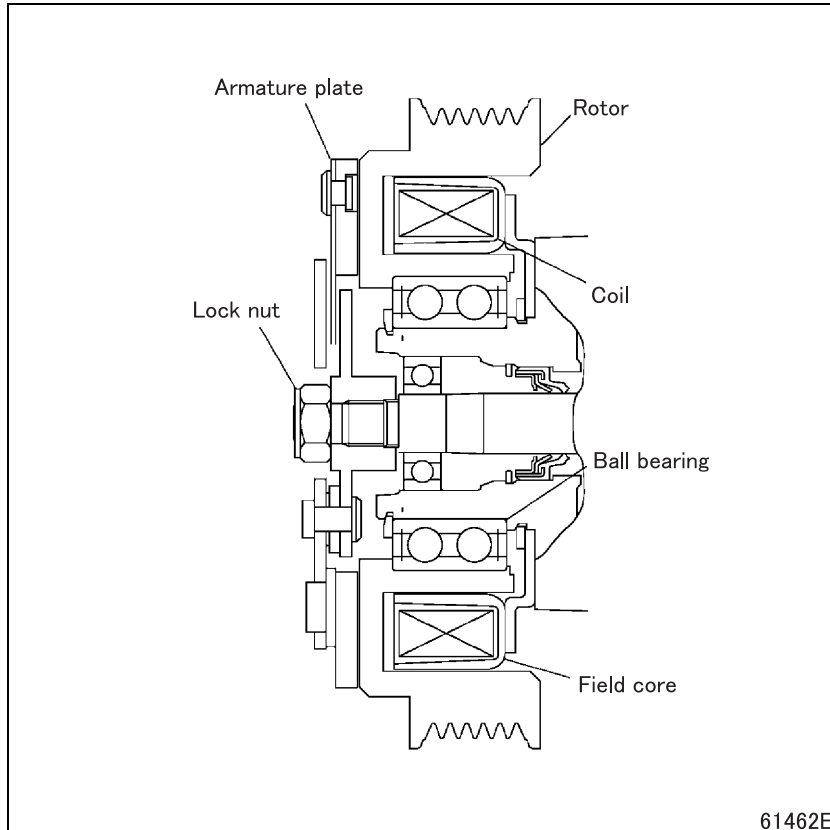
4. Compressor



61461E

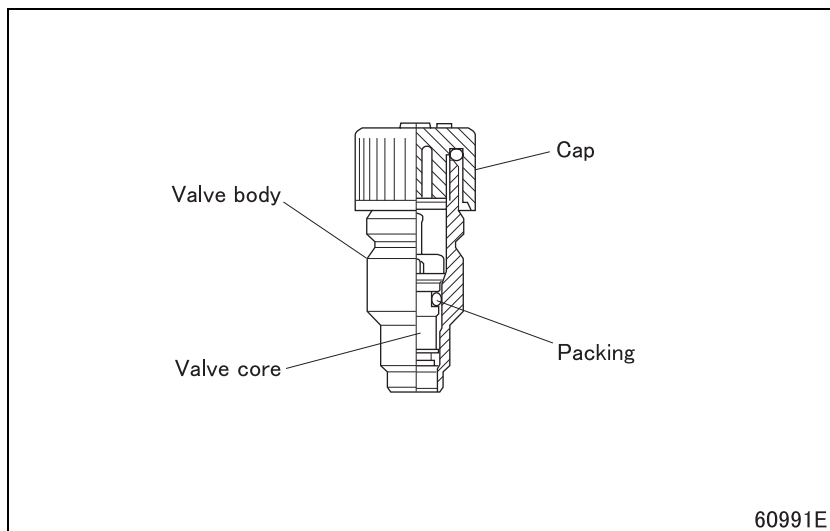
STRUCTURE AND OPERATION

5. Magnetic Clutch



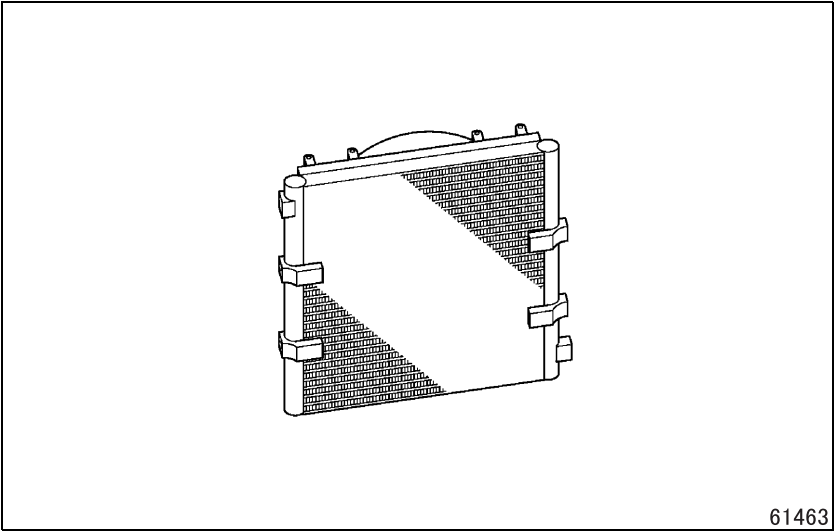
The magnetic clutch is mounted on the compressor crankshaft to start and stop the compressor. This means that the magnetic clutch is actuated to control the compressor operation electrically by the thermostat.

6. Check Valve



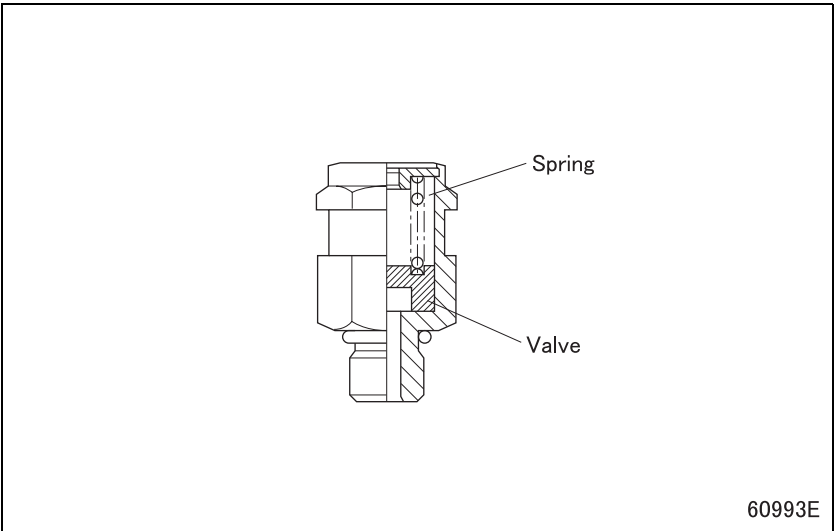
The suction hose and discharge hose are provided with check valve, and designed for gas evacuation and charging service. (shown left) In the valves, a valve rubber tube, as in automobile tire tubes, is provided as shown in the figure. Loosening the flare nut on the gauge manifold causes the passage to close automatically by the spring force, and tightening the flare nut causes the passage to open while pressing the compressed spring.

7. Side Condenser Assembly



The condenser is a means to liquefy the refrigerant gas. As the condenser is cooled by the air pulled in by the condenser fan, the refrigerant in the condenser is cooled into liquid. Therefore, when any obstacle prevents the air from flowing evenly to the condenser or the air flow is short circuited, the cooling effect is reduced, with a decrease in the performance of the condenser. When the vehicle is driven at a high speed, the air flow increases resulting in an increase of the cooling effect, and performance of the condenser.

8. Relief Valve

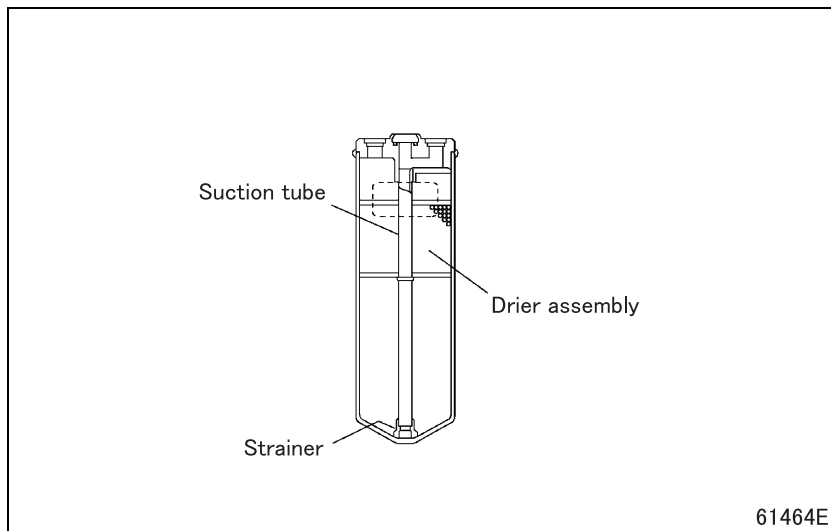


The relief valve is mounted to the compressor & clutch assembly. The relief valve is usually closed by spring. If pressure of refrigerant in air conditioner system is higher than spring pressure, refrigerant is discharged from relief valve. The pressure drop due to discharge refrigerant, and relief valve is closed again.

Unit: MPa {psi, kg/cm ² }	
Open	3.50 to 4.10 (505 to 595, 36 to 42}
Close	2.94 {425, 30}

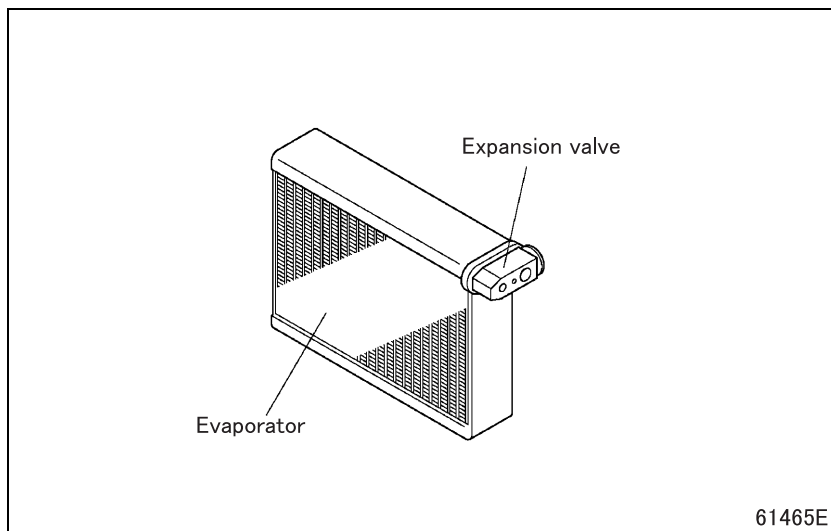
STRUCTURE AND OPERATION

9. Receiver Assembly



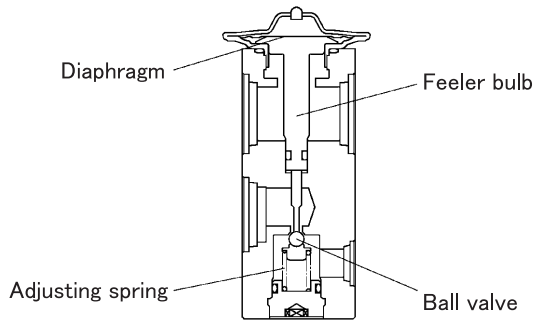
The receiver assembly is served as a refrigerant reservoir located between the condenser and expansion valve. The receiver assembly consists of a filter and a sight glass. The filter is used to remove dust, the drier is used to remove moisture from the refrigerant in the circuit. Any moisture in the refrigerant may not only corrode metal surfaces in the refrigerant circuit, but also cause the throttle of the expansion valve to be frosted, resulting in the interruption of refrigerant circulation. Therefore, the receiver assembly must be handled very carefully. When storing or installing it, care should be taken to protect it from the deterioration of drying performance due to exposure to the air. The retardation of heat exchange, or any fire around the refrigerant circuit will cause excessive pressurization or heating of the refrigerant. Should such an accident occur, the refrigerant in the circuit must be expelled to the outside to prevent the above hazards.

10. Evaporator Assembly



The evaporator core is a type of corrugated fin and tube. The tube is arranged in zigzag to achieve high efficiency, and to make the core system compact.

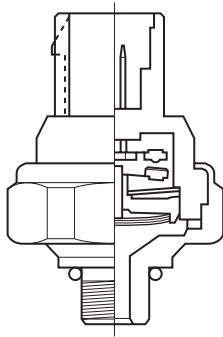
11. Expansion Valve



61466E

The refrigerant that it went out of the evaporator passes through the expansion valve again. It feels temperature, and feeler shaft transmits the heat to diaphragm at this time. Then, the refrigerant that it is sealed in diaphragm is in proportion, and pressure is made to change. It moves by feeler shaft due to the change, and control the ball valve. The amount of refrigerant to go into the evaporator by ball valve being controlled is adjusted.

12. Dual Pressure Switch

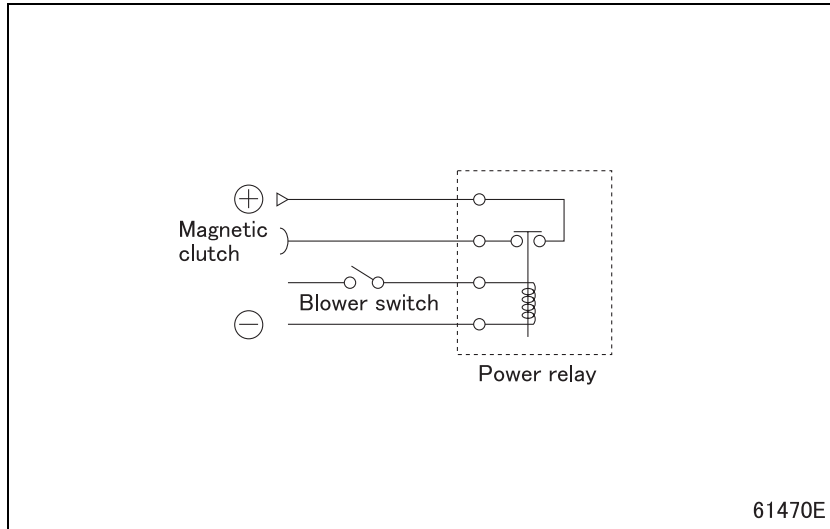


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The dual pressure switch, fixed to the receiver functions as a protector for stopping the compressor (OFF) at a preset value of pressure in the refrigerant circuit.

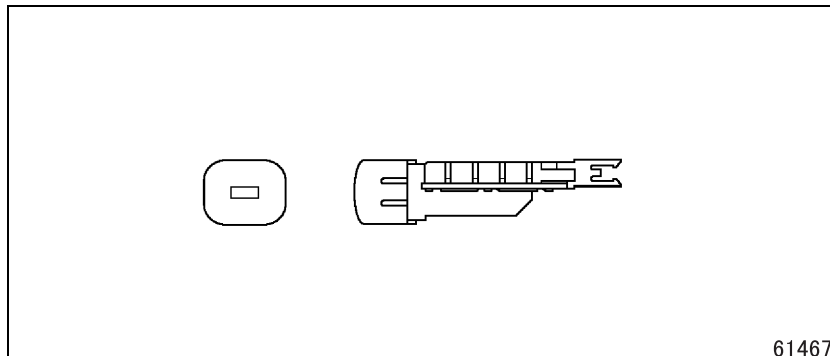
STRUCTURE AND OPERATION

13. Power Relay



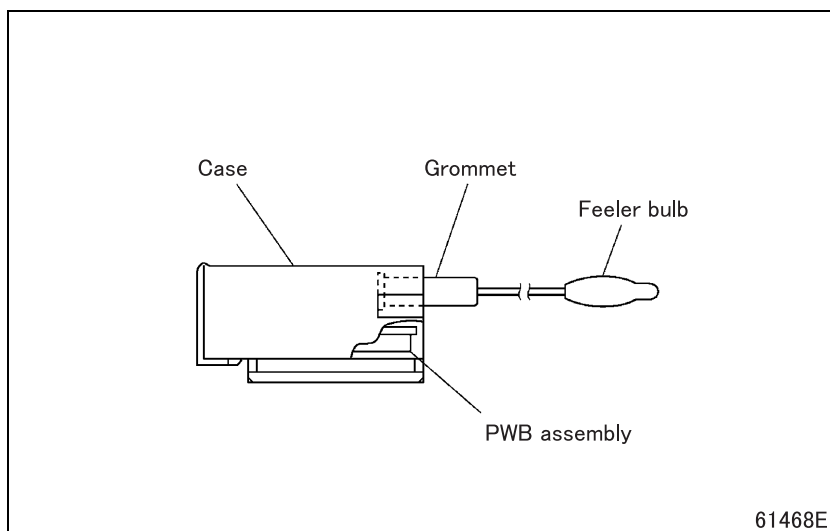
The power relay is excited at a closed position of the micro switch and enables the magnetic clutch to be ready for engaging electrically.

14. Air Conditioner Switch



The air conditioner switch functions as an operation controller for starting or stopping the compressor in cooling and dehumidifying. By initially depressing it, the magnetic clutch becomes engaged and the compressor starts with the indication lamp signing. By secondarily depressing it, the magnetic clutch becomes disengaged and the compressor stops with the indication lamp signing.

15. Thermostat



The thermostat is mounted on the heater unit case. It senses the temperature of evaporator fins, and controls the compressor operation for ON or OFF.

M E M O

STRUCTURE AND OPERATION

16. Control system

16.1 Control in panel

☐ Air outlet mode select switch

The air outlet is selected by positioning in cooling and heating operation.

-  The conditioned air is discharged at the center and both side outlets directed by the louvers as required.
-  The conditioned air is discharged at the center and both side and foot outlets directed by the louvers as required.
-  The conditioned air is discharged at the foot outlets directed by the louvers as required.
-  When a dial is moved to this position, ventilation has it in the windshield and the foot. The ventilation of the foot is abundant in this position.
-  When a dial is moved to this position, ventilation has it in the windshield and the foot. Both of the foot and the windshield do the ventilation of the same quantity in this position.
-  The conditioned air for dehumidifying is discharged to the front glass.

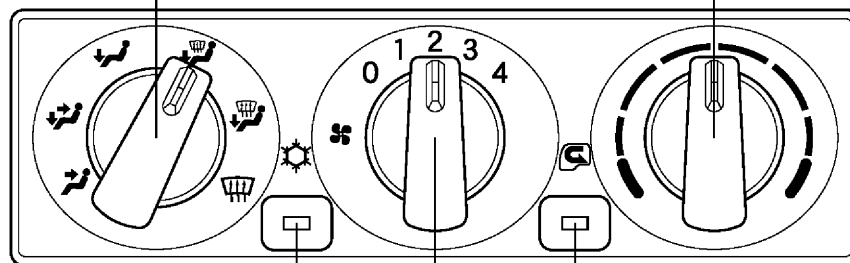
☐ Temperature control switch

The discharged air temperature is controllable by selecting the position of the control lever in cooling, heating or drying operation.

BLUE SIDE.....For cool air flow

RED SIDE.....For warm air flow

By turning the switch toward the BLUE and RED ZONE sides, the supply air temperature becomes more cooler and warmer respectively.



☐ Air conditioner switch

Push the air conditioner switch initially in cooling or drying operation, the compressor starts running.

☐ Fan switch

The air flow is selectable, out of the below four volume.

- 0 No air flow
- 1 Gentle
- 2 Low
- 3 Medium
- 4 High

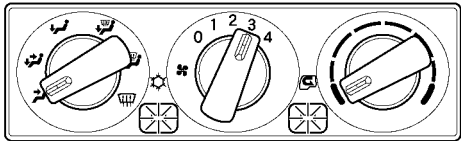
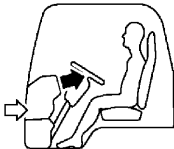
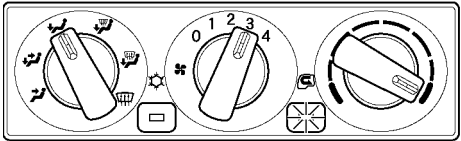
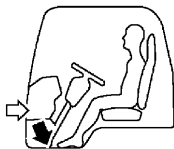
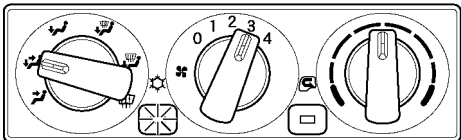
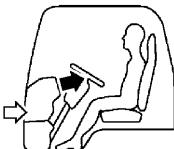
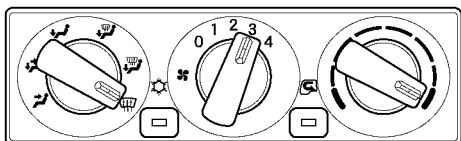
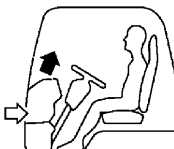
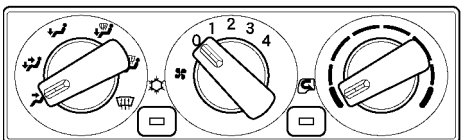
☐ Shift lever, air circulation

The recirculation air is selectable out of the below circulation modes.

-  Room circulation
-  Fresh air intake

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16.2 Operation control

Operation mode	Setting control lever	Air delivery	Remarks
COOL			Earlier cooling service, or conditioning at dusty, polluted air prevailing places : Fresh/Recirc switch : Recirc (ON) 
HEAT			Earlier cooling service, or conditioning at dusty, polluted air prevailing places : Fresh/Recirc switch : Recirc (ON) Air outlet mode select switch 
DEHUMIDIFY			Wetty conditioning in head cooled, and foot warmed : Fresh/Recirc switch : Fresh (OFF) Air outlet mode select switch 
DEFROST			
VENTILATION			

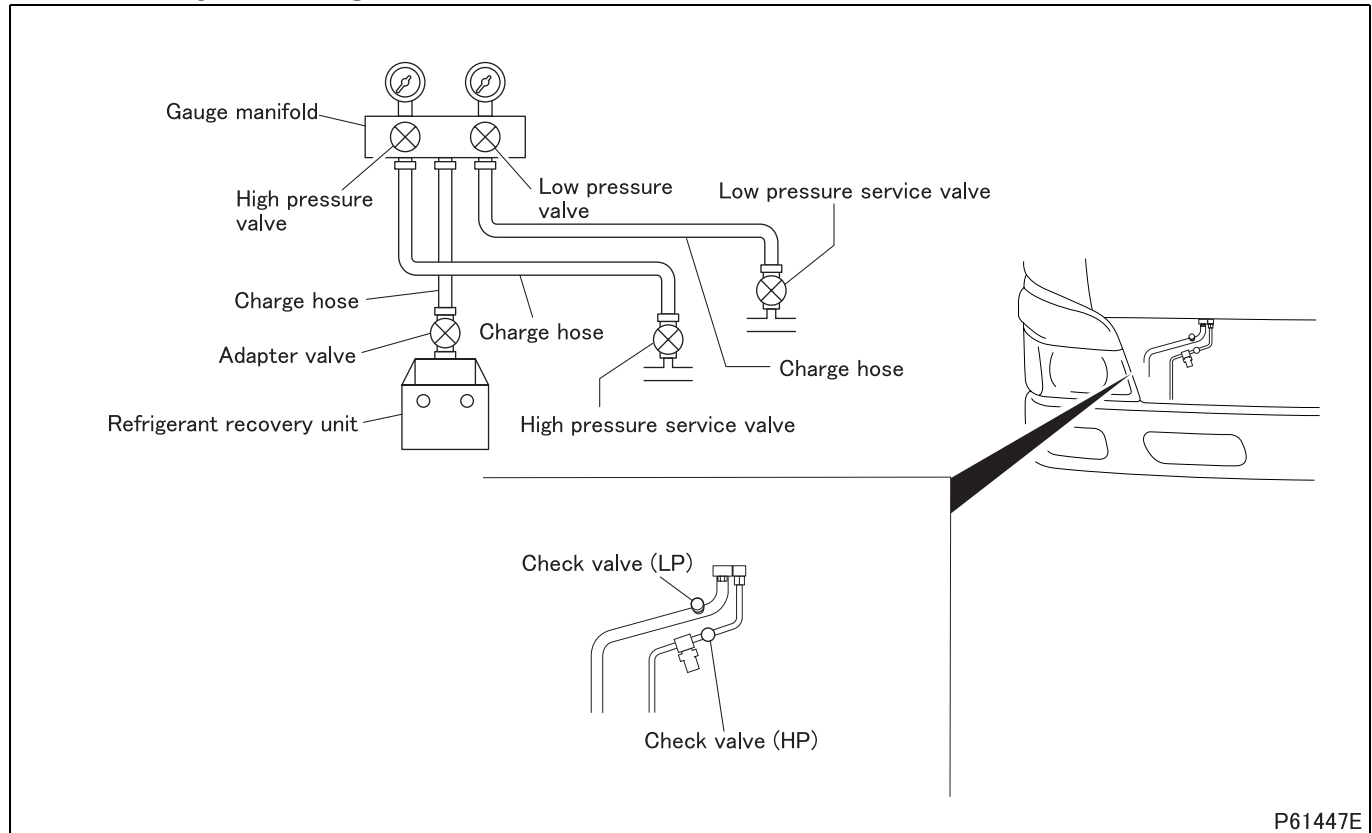
TROUBLESHOOTING

Symptoms		Reference Gr			
		Air is discharge but not cooled down	Cooling effect is insufficient	Air flow is short	Intermittent cooling down of discharge air
Possible causes					
Magnetic clutch fails to engage	Air conditioner fuse blown	O			
	Conditioner switch fault	O	O		
	Dual pressure switch fault	O	O		
	Thermostat fault	O	O		
	Power relay fault	O	O		
	Magnetic clutch seized or malfunctioning	O	O		
Insufficient refrigerant		O	O		
Receiver assembly clogged		O	O		
Improper compressor revolution due to losing V-belt		O	O		
Expansion valve clogged		O	O		
Ineffective compression		O			
Condenser fins portion clogged			O		
Refrigerant overcharged			O		
Air inclusion in refrigerant circuit			O		
Thermostat defect			O		
Evaporation frosting				O	
Blower motor defect				O	
Water inclusion in refrigerant circuit					O
Expansion valve malfunctioning					O

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

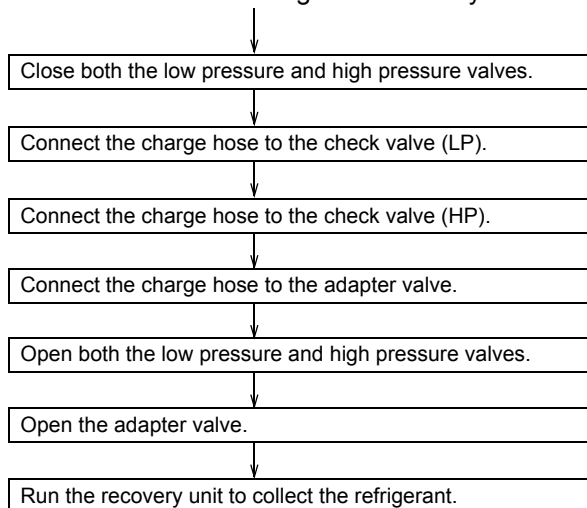
1. Recovery of Refrigerant



P61447E

HP: High pressure
LP: Low pressure

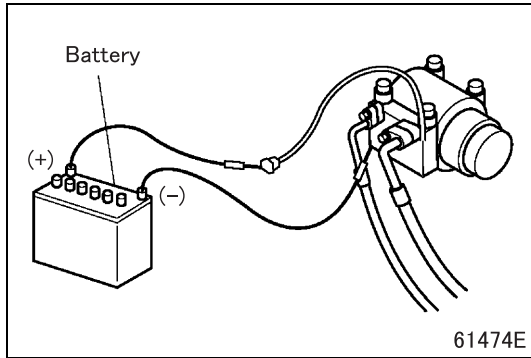
- Recover refrigerant from the air conditioning system in accordance with the following flow chart.
 - Installation of the refrigerant recovery unit



2. Inspection and Adjustment of V-Belt

See Gr14.

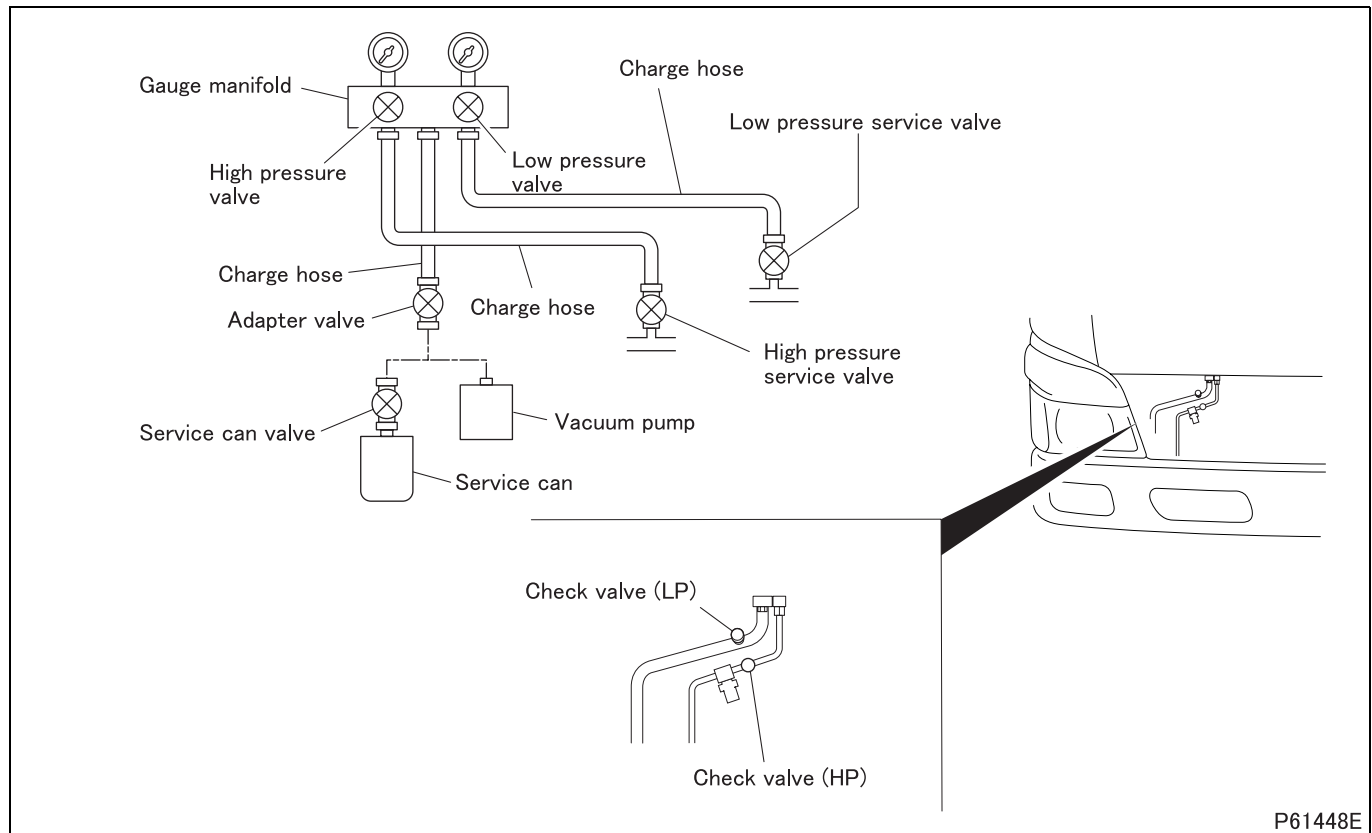
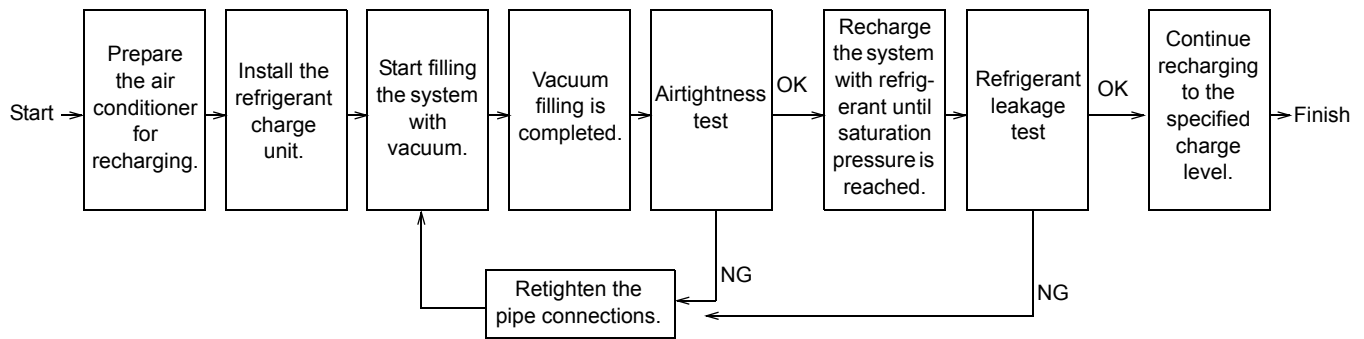
3. Inspection of Magnetic Clutch



- Disconnect the wiring to the magnetic clutch.
- Apply a positive side power voltage to the magnetic clutch through the wiring.
- In the case of regular functioning, the pulley and magnetic clutch are engaged with a clicking sound. The falling means any malfunction of the magnetic clutch.

ON-VEHICLE INSPECTION AND ADJUSTMENT

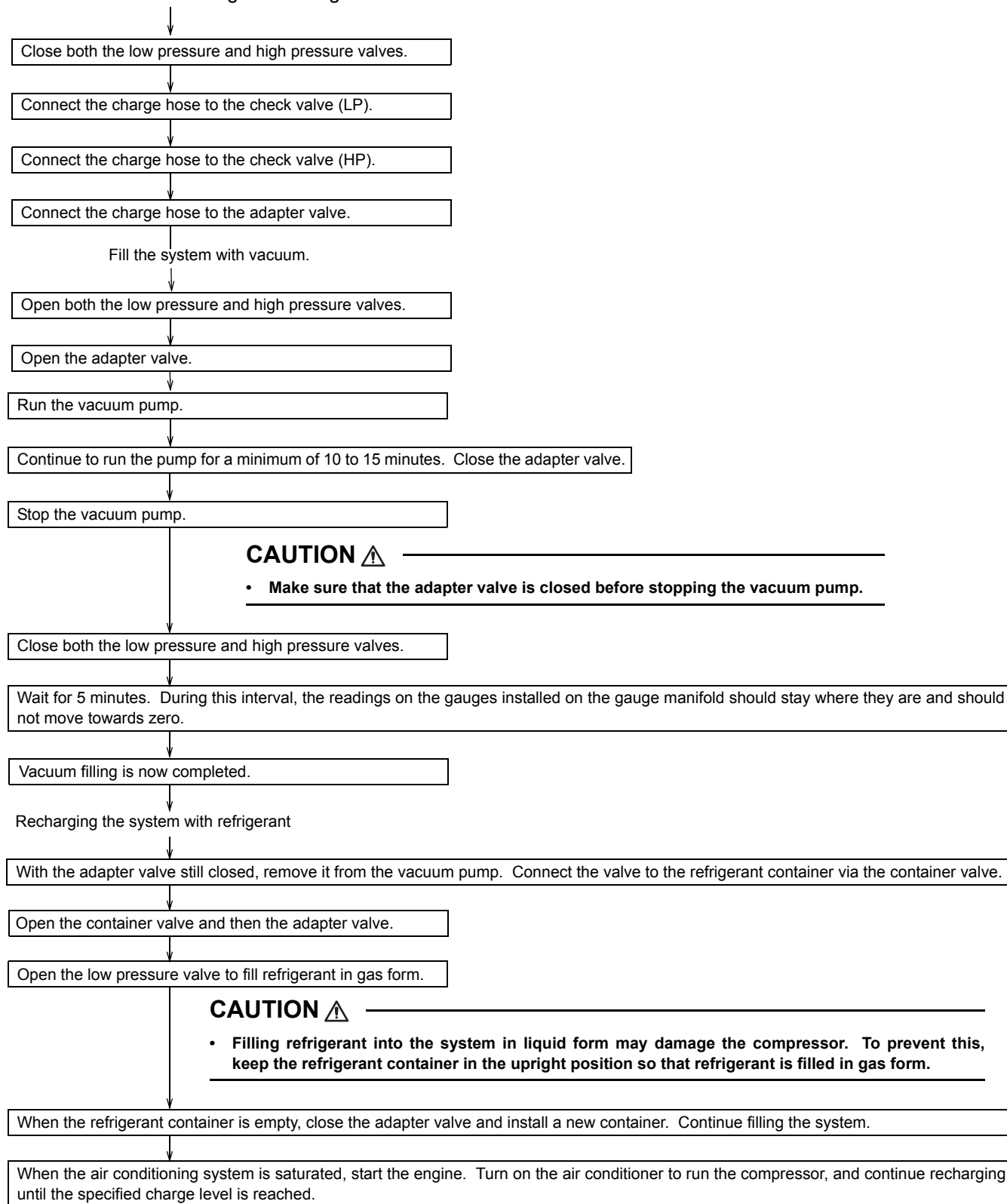
4. Recharging the System with Refrigerant



HP: High pressure
LP: Low pressure

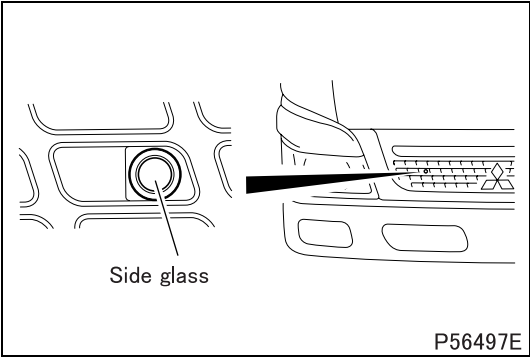
P61448E

- Recharge the system with refrigerant in accordance with the following flow chart.
- Installation of the refrigerant charge unit



ON-VEHICLE INSPECTION AND ADJUSTMENT

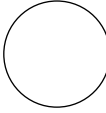
5. Checking Refrigerant Charge Level



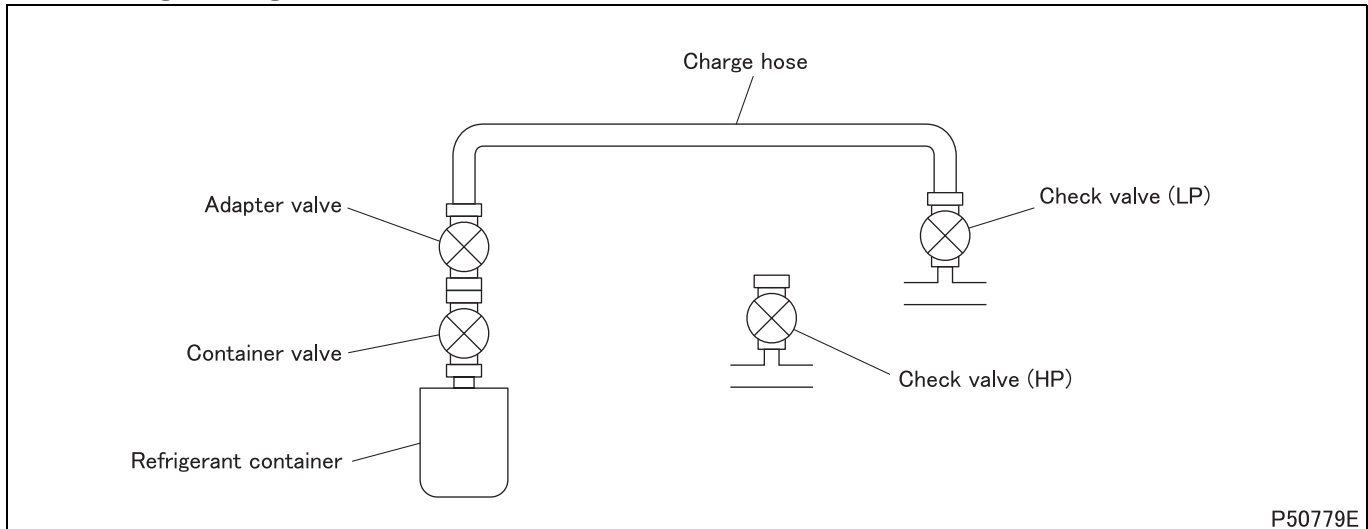
- To check the refrigerant charge level, observe the flow of refrigerant through the sight glass. If the visual inspection indicates a low charge level, add refrigerant.
- The visual check should be performed under the following conditions.
 - Engine speed: 1400 rpm
 - Air conditioner switch: ON
 - Fan speed control dial: 4 (MAX)
 - Temperature control dial: MAX COOL
 - Fresh/recirculation changeover switch: Indicator lamp in the switch (OFF Fresh)
 - Doors: Fully open

CAUTION ⚠

- **Never run the air conditioner with no or low level of refrigerant. Failure to observe this will damage the compressor.**

	Normal level	Low level	No refrigerant
Sight glass	 P06554 With a careful look, something like mist can be seen flowing.	 P06553 Air bubbles are seen flowing at all times. The refrigerant may be transparent or whitish.	 P06552 The refrigerant is almost transparent. Air bubbles may be seen flowing, but they disappear when the engine is revved up and down.
High/low pressure piping	The high pressure piping is hot while the low pressure piping is cold.	The high pressure piping is warm while the low pressure piping is slightly cold.	There is almost no difference in temperature between the high and low pressure piping.

6. Adding Refrigerant



HP: High pressure

LP: Low pressure

- Add refrigerant in accordance with the following flow chart.

With the adapter valve closed, connect the charge hose to the check valve (LP).

CAUTION ⚠

- If the charge hose is connected to the check valve (HP), refrigerant may flow back, possibly damaging the refrigerant container and charge hose.

Open and close the adapter valve to bleed air of the charge hose. After air bleeding is completed, close the adapter valve.

Take the refrigerant container and valve assembly. With the container valve closed, connect the assembly to the adapter valve.

CAUTION ⚠

- Filling refrigerant into the system in liquid form may damage the compressor. To prevent this, keep the refrigerant container in the upright position so that refrigerant is filled in gas form.

Open the container valve and then the adapter valve.

Start the engine.

Set the temperature control to MAX COOL. Turn on the air conditioner to run the compressor.

Continue adding refrigerant while observing the sight glass for charge level.

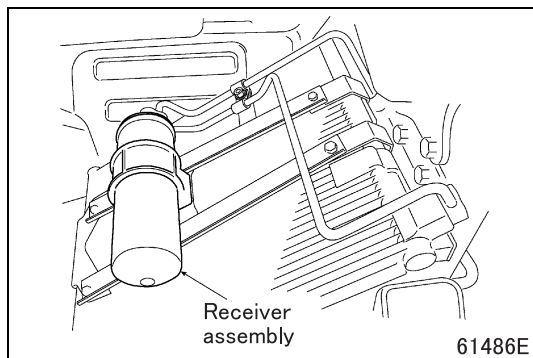
When "normal level" is confirmed through the sight glass, add refrigerant further 50g.

When charging is completed, close the adapter and container valves. Remove the charge hose and the refrigerant container from the low pressure service valve.

If there is still some refrigerant in the container, keep it for the next opportunity. Be sure to keep the container valve closed.

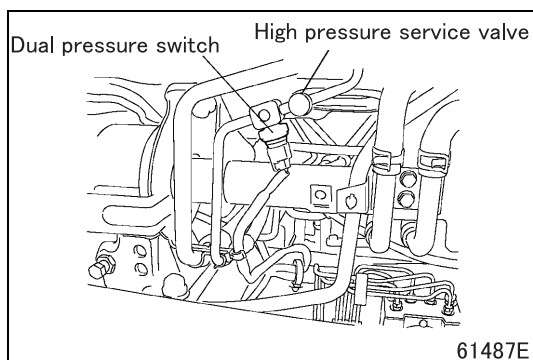
ON-VEHICLE INSPECTION AND ADJUSTMENT

7. Inspection of Receiver Assembly



- While operating the air conditioner, touch the refrigerant piping with a hand at the inlet and outlet portions.
- Sensed temperature difference:
It is possible that clogging is happening at the inside, liquid receiver assembly is to be replaced with a new one.

8. Inspection of Dual Pressure Switch



- The dual pressure switch is attached to the liquid hose for controlling the operation of the air conditioner by checking the inside pressure of the liquid hose.

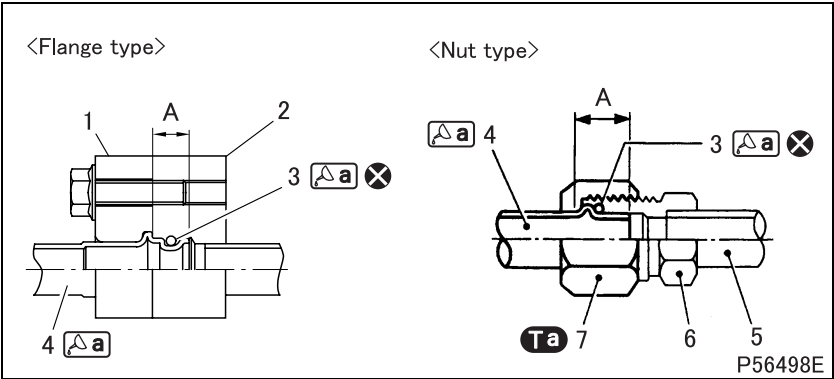
Switching point	Unit: MPa {psi, kg/cm ² }	
	LP side	HP side
OFF	0.2 {29, 2.0}	2.94 {425, 30}
ON	0.22 {33, 2.2}	2.35 {340, 24}

HP: High pressure

LP: Low pressure

- Unplug the connector at the liquid hose.
- Check the continuity between terminals of the connector with a tester.
- When electric continuity is found, connect the connector to the high pressure switch.
- Attach the high pressure gauge and low pressure gauge.
- Operate the air conditioner.
- Cover the surface of the condenser by using a piece of paper.
- When the high pressure exceeds 2.94 MPa {425 psi, 30 kg/cm²}, if the magnetic clutch is turned off, the switch is normal.
- If the magnetic clutch is not turned off, replace pressure switch with new one.
- Check the accuracy of the preset as below.
 - Stop the air conditioner.
 - Purge the air conditioner of refrigerant slowly starting at over 0.22 MPa {33 psi, 2.2 kg/cm²}.
 - At reading the pressure 0.2 MPa {29 psi, 2.0 kg/cm²}, the switch opens.
 - Here, stop the purging, then turn it to charging.
 - At reading the pressure 0.22 MPa {33 psi, 2.2 kg/cm²}, the switch closes.

If the dual pressure switch does not meet specifications, replace the switch.



- 1 Flange (pipe end) <Flange type>
 - 2 Flange (mating end) <Flange type>
 - 3 O-ring
 - 4 Pipe
 - 5 Pipe <Nut type>
 - 6 Union <Nut type>
 - 7 Nut <Nut type>
- A: Refrigerating machine oil application area
- ⊗: Non-reusable parts

Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut	11.8 to 14.7 {8.7 to 11, 1.2 to 1.5}	—

Lubricant and/or sealant

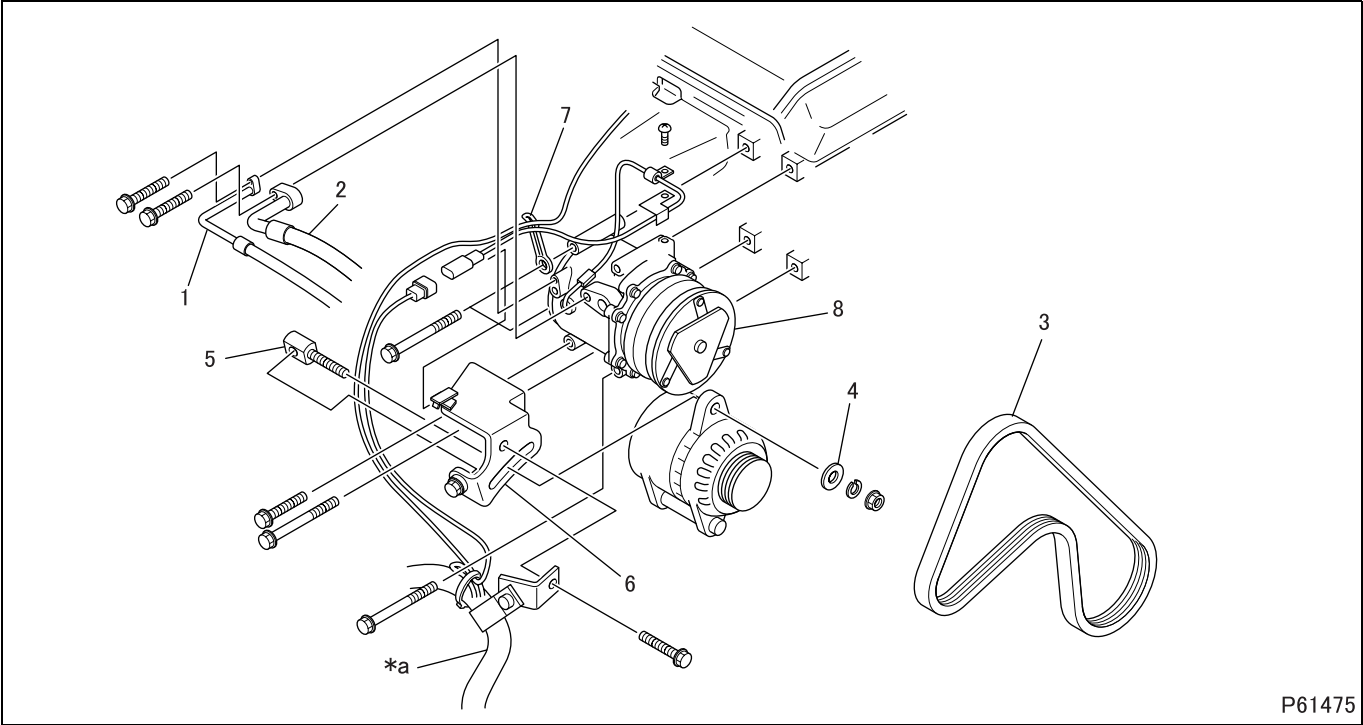
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Refrigerating machine oil SUN PAG56	As required
	Outer periphery of pipe end (area A)		

- There are 2 types of air conditioner pipe/hose connections: flange type and nut type. When connecting/tightening the connections, observe the following precautions.

CAUTION ⚠

- The connected parts are sealed by the O-ring. Be careful not to damage the O-ring, such as by twisting.
- The O-rings are exclusively designed for HFC-134a refrigerant and are not reusable. The O-rings are available at the MITSUBISHI HEAVY INDUSTRIES, LTD. service stations.
- Never tighten the nut-type connection by rotating the union. This will deform the piping, allowing refrigerant to leak out. Tighten by rotating the nut while holding the union in position.

COMPRESSOR



● Disassembly sequence

- | | |
|---|---------------------|
| 1 Discharge hose (high pressure side)
(See AIR CONDITIONER PIPE CONNECTION.) | 5 Shaft |
| 2 Suction hose (low pressure side)
(See AIR CONDITIONER PIPE CONNECTION.) | 6 Adjusting plate |
| 3 V-ribbed belt | 7 Clamp |
| 4 Spacer | 8 Compressor |
| | *a: Vehicle harness |

CAUTION

- Recover the refrigerant before removing the discharge hose and suction hose.
- Plug discharge hose, suction hose, and compressor after removal to keep them free from dust etc.

● Installation sequence

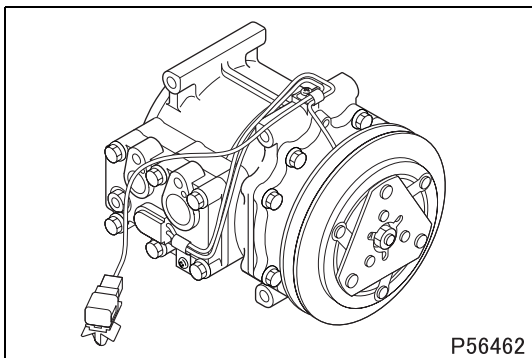
Follow the removal sequence in reverse.

CAUTION

- After installation, tension the V-belt to specification. (See Gr14.)

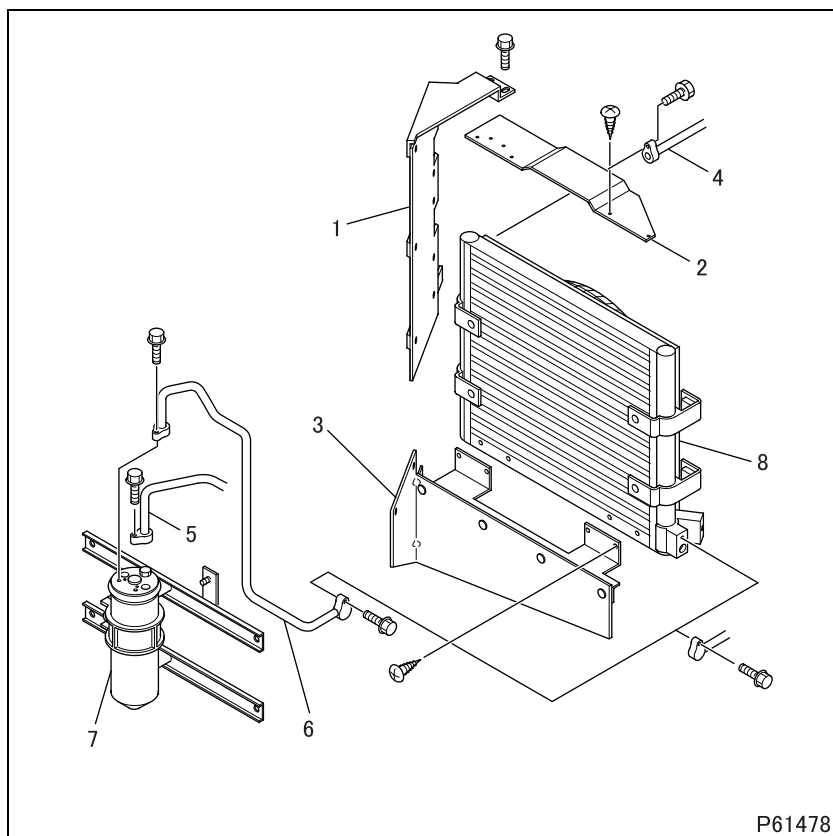
Tightening torque (Unit: N·m {ft.lbs, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
	Bolt (Tension pulley mounting)	44.5 {33, 4.54}	—

◆ Inspection procedure ◆**■ Inspection: Compressor**

- Check the compressor proper for malfunction and oil leakage.
- If there is anything wrong with the compressor, have it overhauled at a nearest MITSUBISHI HEAVY INDUSTRIES, LTD. service station.

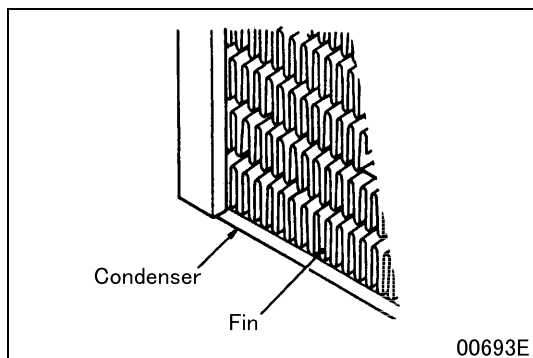
CONDENSER, RECEIVER



● Removal sequence

- 1 Baffle plate
- 2 Baffle plate (upper)
- 3 EVA plate
- 4 Discharge hose (compressor end)
(See the CONNECTING AIR CONDITIONER PIPING section.)
- 5 Liquid hose (heater and cooling unit end)
(See the CONNECTING AIR CONDITIONER PIPING section.)
- 6 Liquid pipe (See the CONNECTING AIR CONDITIONER PIPING section.)
- 7 Receiver
- 8 Condenser

◆ Inspection procedure ◆



■ Inspection: Condenser

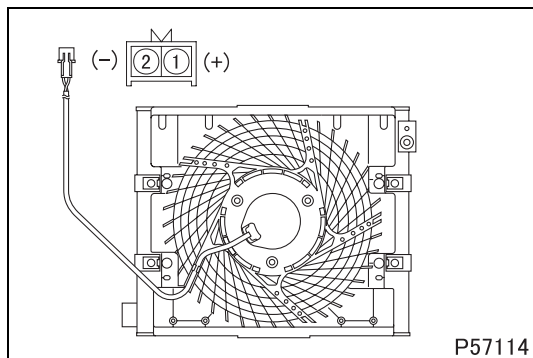
- If the condenser fins are clogged with dirt, dust or other foreign matter, wash it out. Any deformed fins should be straightened using a spatula or the like.

■ Inspection: Receiver

- If any need arise to inspect the receiver, contact the MITSUBISHI HEAVY INDUSTRIES, LTD. service station.

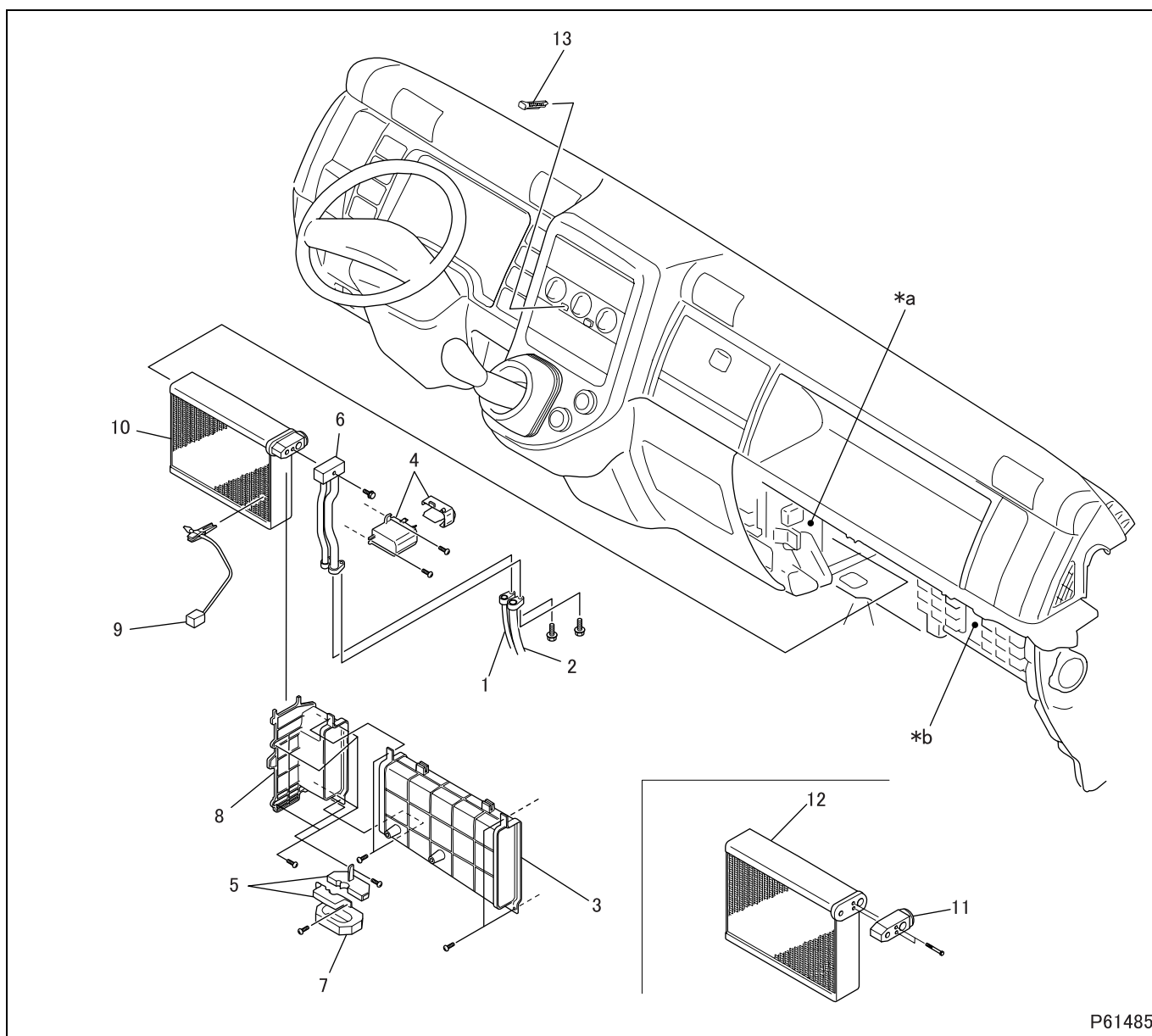
■ Inspection: Condenser fan motor

- Make sure that the motor operates when battery voltage is applied between terminals 1 and 2.
- If any fault is found, replace the motor.



M E M O

COOLING UNIT



P61485

● Removal sequence

- | | |
|---|-----------------------------|
| 1 Discharge pipe (high pressure)
(See the CONNECTING AIR CONDITIONER PIP-
ING section.) | 7 Rubber insulation |
| 2 Suction pipe (low pressure)
(See the CONNECTING AIR CONDITIONER PIP-
ING section.) | 8 Case cover |
| 3 Joint duct | 9 Thermostat assembly |
| 4 Cover | 10 Evaporator assembly |
| 5 Baffle cover | 11 Expansion valve |
| 6 Pipe assembly | 12 Evaporator |
| | 13 Air conditioner switch |
| | *a: Heater unit (See Gr55B) |
| | *b: Blower (See Gr55B) |

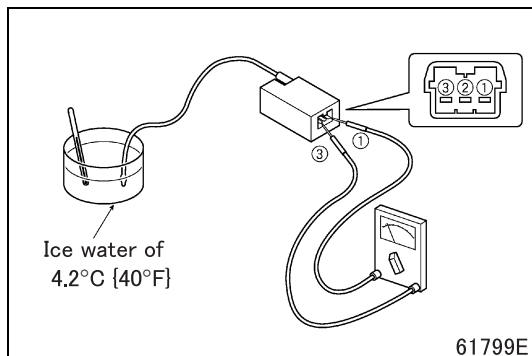
CAUTION

- Recover the refrigerant before removing the discharge pipe and suction pipe.
- Plug the discharge pipe, suction pipe, and evaporator assembly after removal to keep them free from dust etc.

● Installation sequence

Follow the removal sequence in reverse.

◆ Inspection procedure ◆



■ Inspection: Thermostat assembly

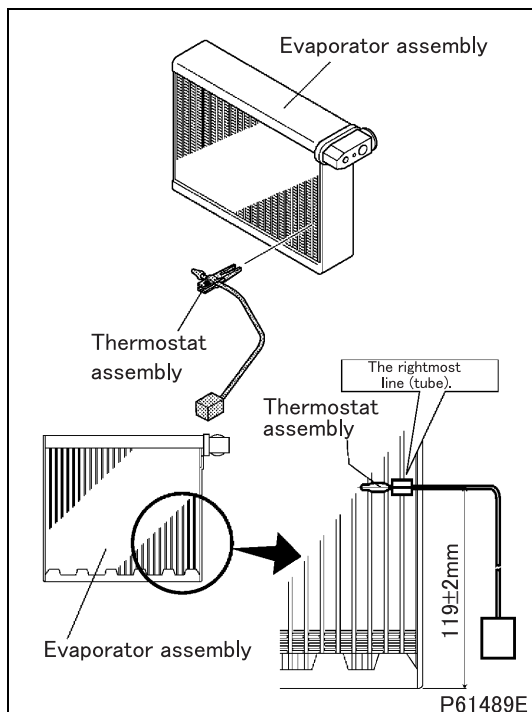
(1) Check the accuracy of the preset as below.

- Soak the sensor of the thermostat in ice-water of below 4.2°C {40°F}.
- Check the continuity between the switch terminals 1 and 3.
- Pull the sensor out of the ice-water, and check the continuity at over 5.2°C {41°F} of the sensor.

Switching point Unit: °C {°F}

OFF	4.2 {40}
ON	5.2 {41}

◆ Installation procedure ◆



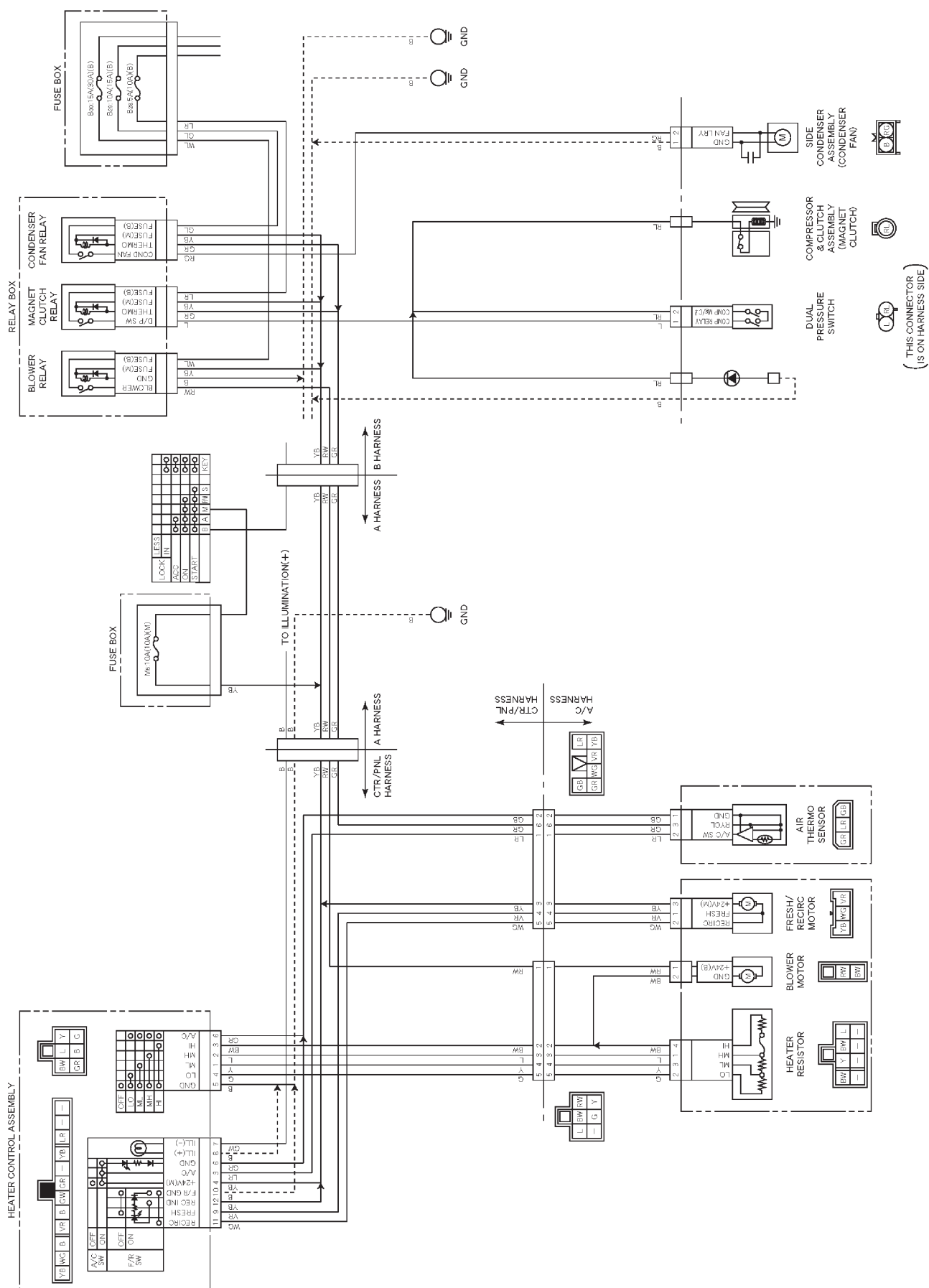
■ Inspection: Thermostat assembly

- Insert the clip of thermostat assembly to the evaporator assembly.

CAUTION ⚠

- The location of clip insertion is very crucial.
- Be sure to install it in the position of the figure.

55A-32





Group 55B

Heater

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	55B-2
STRUCTURE AND OPERATION	
1. Heater	55B-4
2. Air Duct	55B-5
3. Heater Control	55B-6
TROUBLESHOOTING	55B-10
HEATER CONTROL	55B-12
AIR DUCT	55B-16
HEATER UNIT, BLOWER.....	55B-18

SPECIFICATIONS

Item			Specifications
System	Type		Heater
	Damper change-over system	Mode selection	Manual cable type
		Air mixing	
		Fresh/recirculation changeover	Servomotor
	Servomotor rated voltage V		12
Heater unit	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Heating capacity W {BTU/h, kcal/h}		*4370 ± 437 {14910 ± 1491, 3758 ± 376}
	Temperature control system		Air mixing type
Blower	Manufacturer		MITSUBISHI HEAVY INDUSTRIES, LTD.
	Blower motor voltage V		12

*: Heating performance is shown under the following conditions.

Heater inlet air temp: 20°C {68°F}

Air flow rate: 270 m³/h {2.65 ft³/s}

Heater inlet water temp: 85°C {185°F}

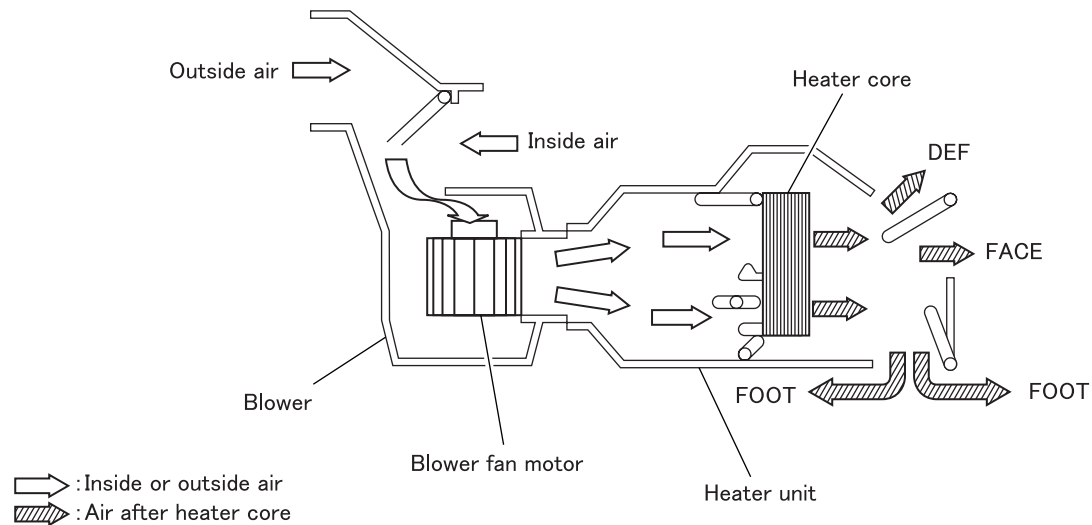
Water flow rate: 6 L/min {0.0035 ft³/s}

Air mix damper position: MAX HOT

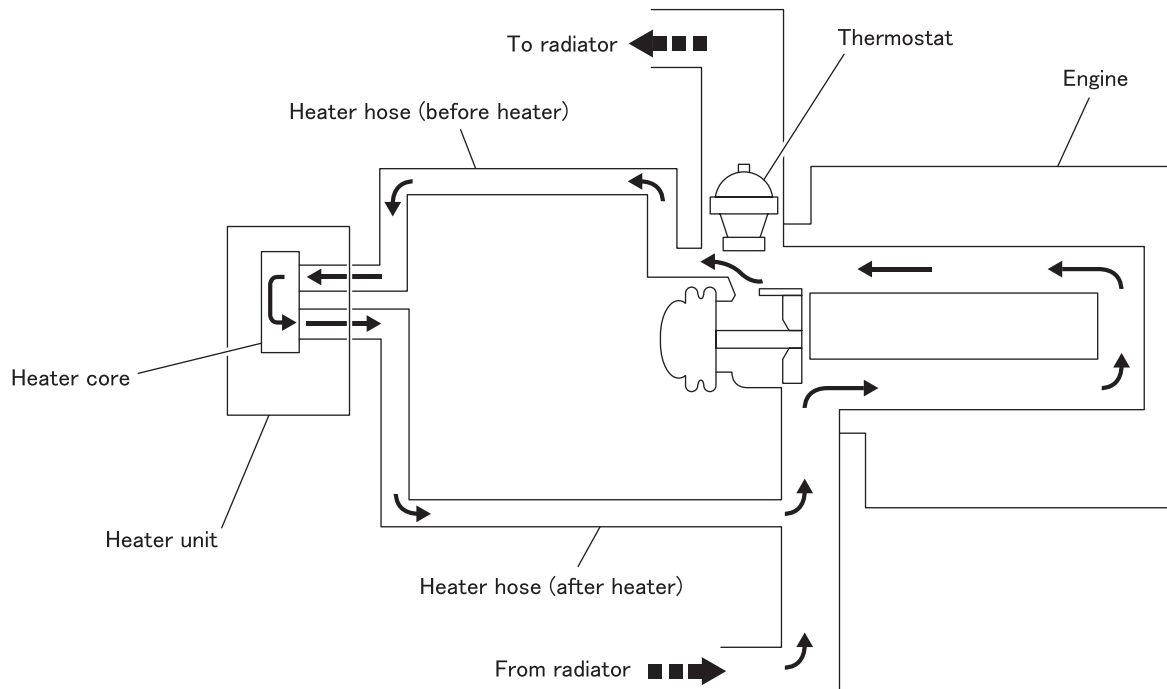
M E M O

STRUCTURE AND OPERATION

1. Heater



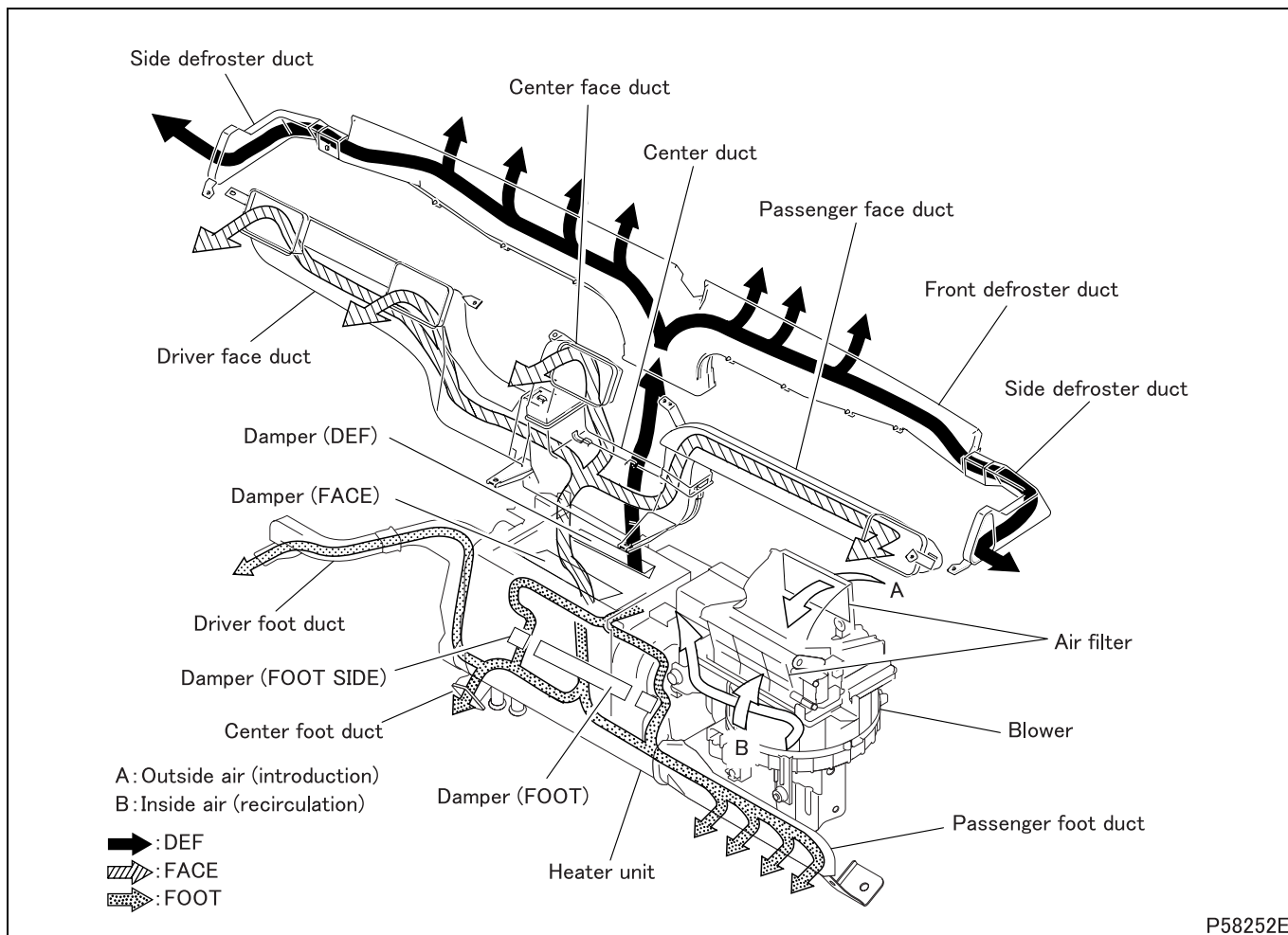
P56487E



P11955E

- The blower sends air to the heater unit, where the air is heated by the heater core (heat exchanger). The warmed-up air is then sent through the ducts into the cab.
- Water (engine coolant) warmed up by the heat from the engine circulates permanently through the heater core, irrespective of whether the thermostat is open or closed.

2. Air Duct

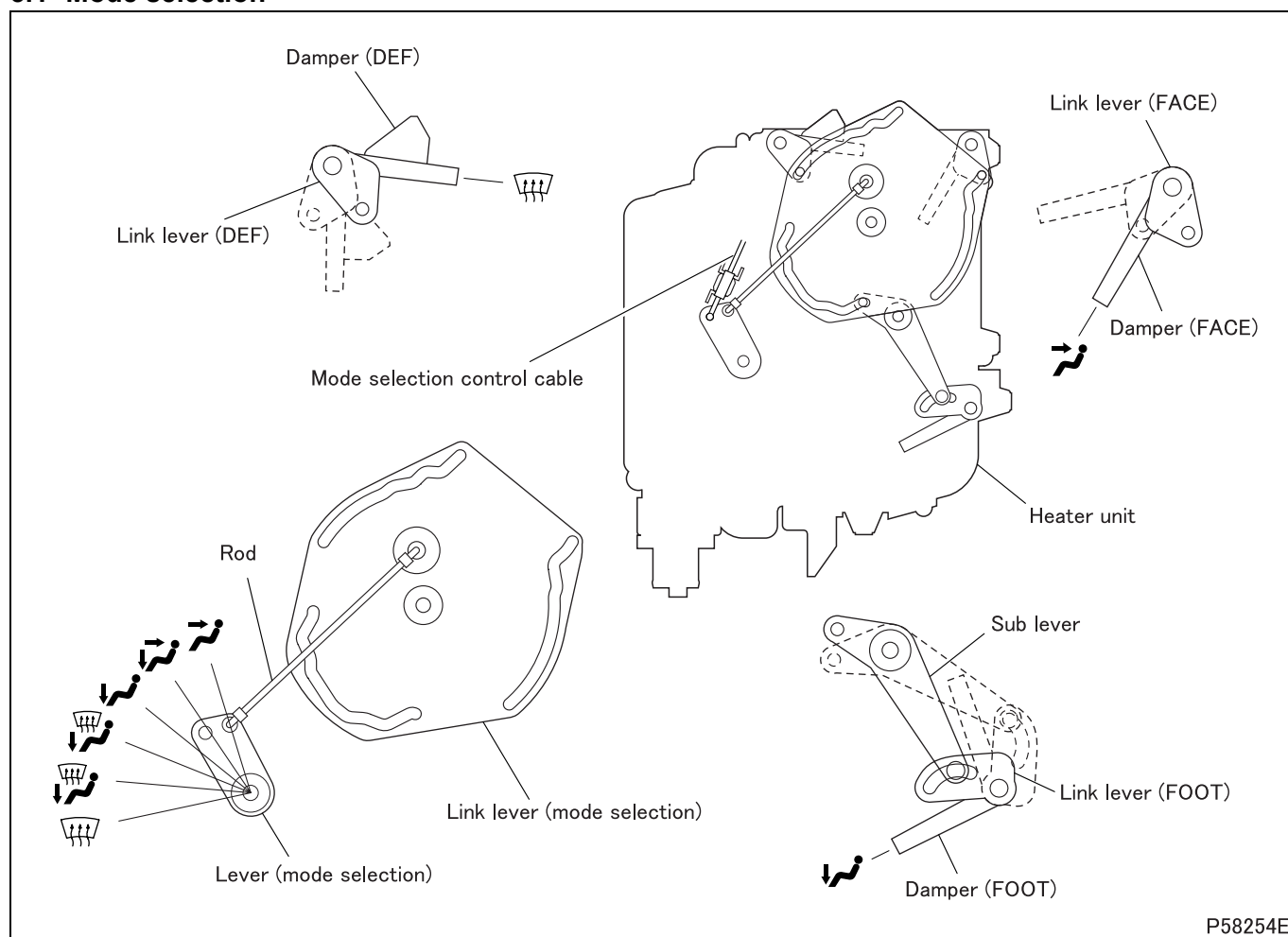


- The blower sends outside air **A** or inside air **B** through the heater unit to the ducts. The flow of air is dependent on the open/closed positions of the various dampers.

STRUCTURE AND OPERATION

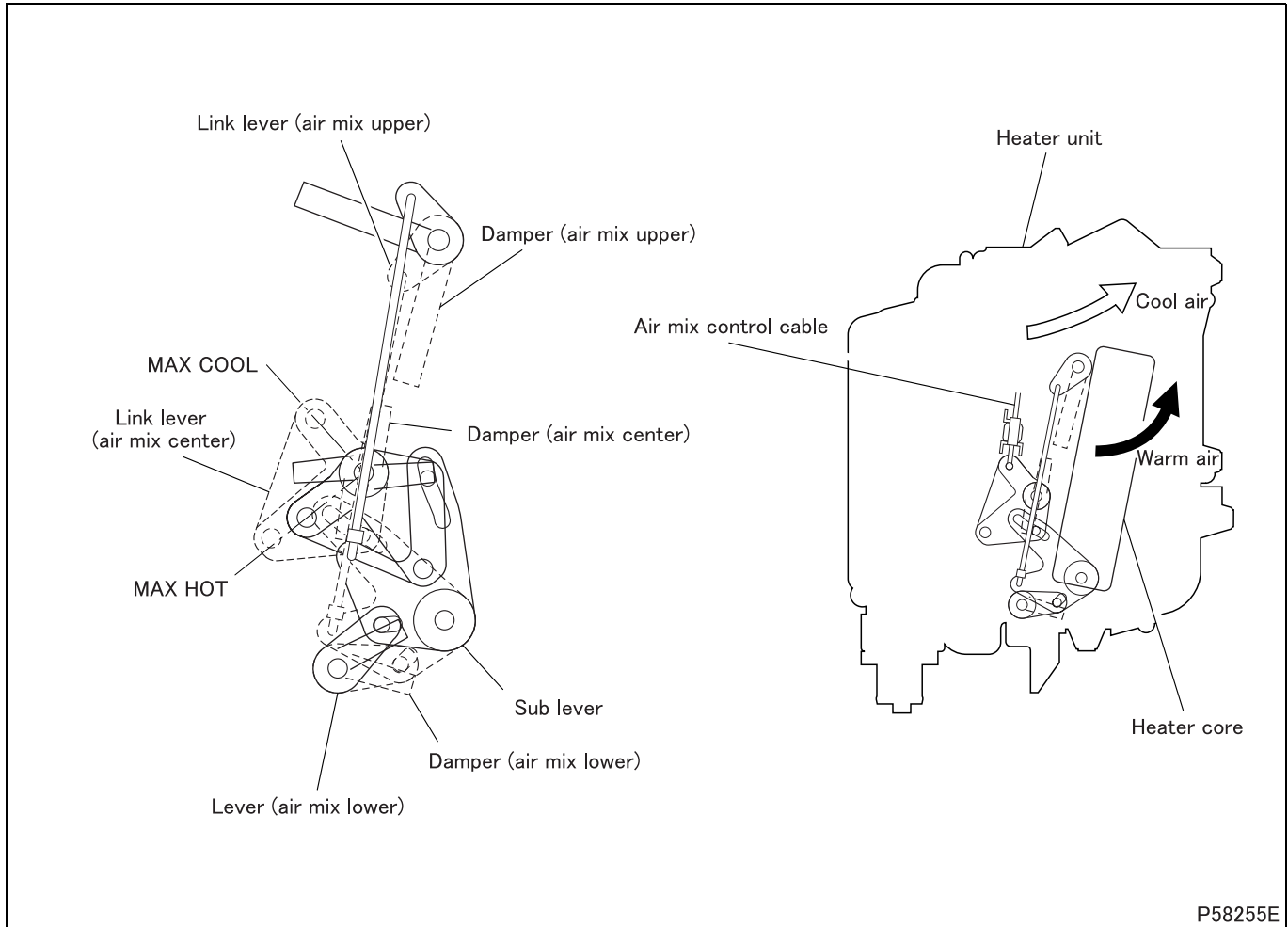
3. Heater Control

3.1 Mode selection



- Mode selection (opening/closing the dampers) is achieved by the operation of the mode selection control cables and the resultant movement of the related parts linked to the cables.

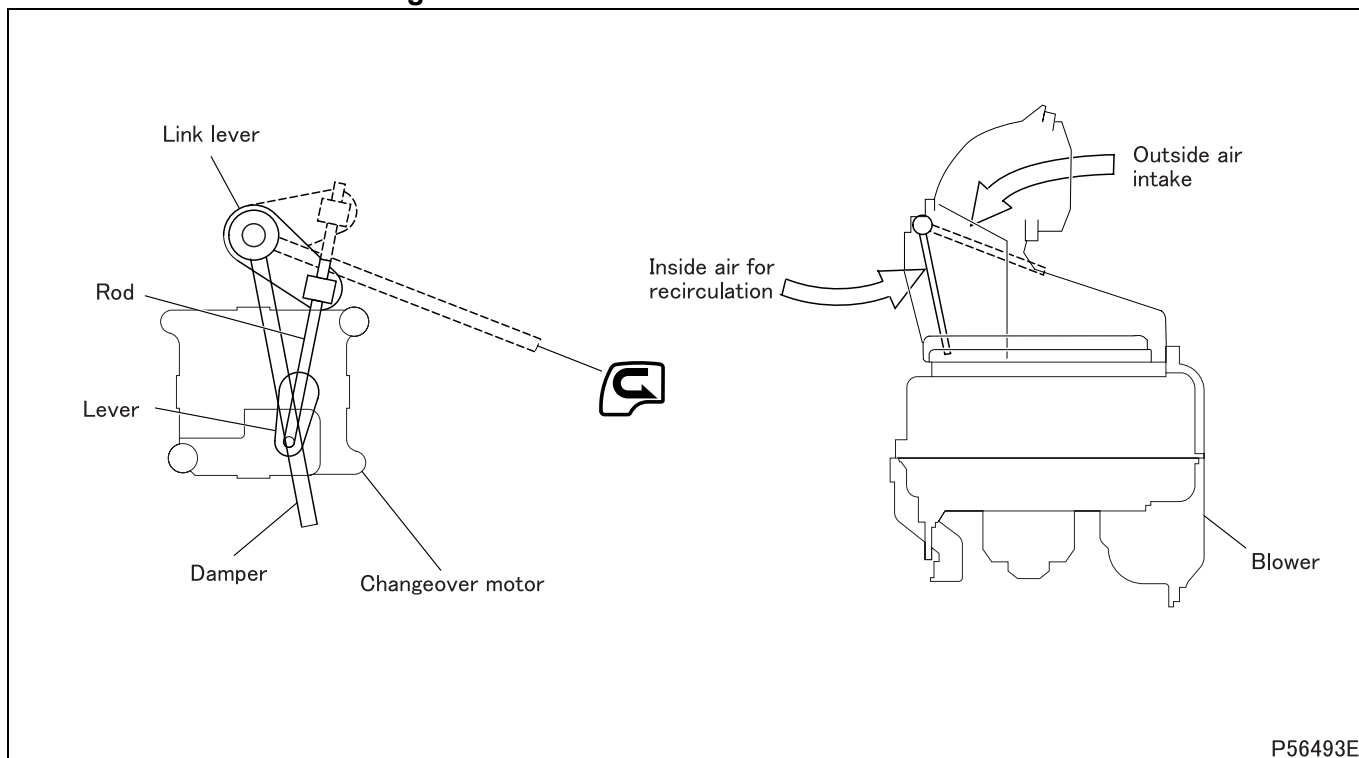
3.2 Air mix selection



- Air mix selection is achieved by controlling the positions of the dampers, thereby proportioning the volumes of warm and cool air that is and is not sent through the heater core.

STRUCTURE AND OPERATION

3.3 Fresh/recirculation changeover



- The fresh/recirculation changeover damper is operated by means of motor.

M E M O

TROUBLESHOOTING

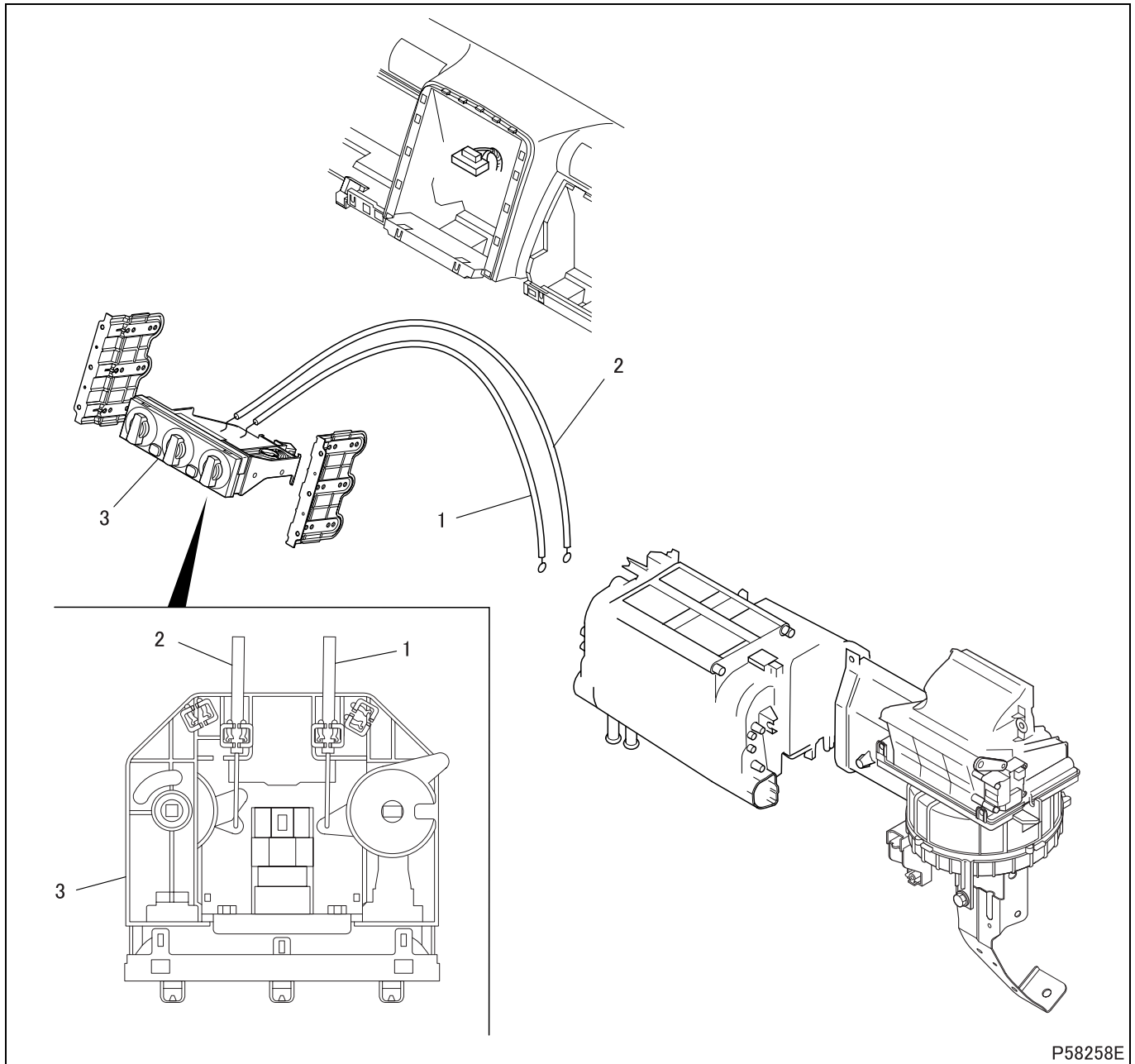
Heater

Symptoms									Reference Gr
	No air from vents	Poor heating	No mode selection	Draft from vents	No temperature setting	No ventilation/recirculation selection	Air volume from vents unstable	Controls require too much effort	
Possible causes									
Blower motor coil open, shorted	O								Gr54
Blower motor relay contacts stuck closed, coil open, shorted	O								
Mode damper malfunction, not fully closed			O	O				O	
Air mix damper malfunction, not fully closed				O	O			O	
Ventilation/recirculation selection damper malfunction, not fully closed				O		O		O	
Heater control malfunction	O	O	O	O	O	O			Gr54
Thermostat stays open		O							Gr14
Coolant level low		O							
Connector poor contact, harness open, faulty earth	O		O	O	O	O			Gr54
Fuse blown	O								
Heater piping clogged, loose, incorrectly connected		O							
Duct incorrectly connected				O					
Heater and cooling unit clogged		O							
Control wire jammed, incorrectly installed			O	O		O		O	
Lever bent			O	O		O		O	
Lever sliding section worn, out of grease			O	O		O		O	

Rear air conditioner

Symptoms							Reference Gr
	No air from vents	Poor cooling	Poor heating	No mode selection	No temperature setting	Air volume from vents unstable	
Possible causes							
Rear blower motor coil open, shorted	O						
Rear blower motor relay contacts stuck closed, coil open, shorted	O						
Rear blower resistor malfunction						O	
Rear mode motor coil open, shorted				O			
Rear temp motor coil open, shorted					O		
Rear side condenser relay contacts stuck closed, coil open, shorted		O					
Rear side condenser fan motor coil open, shorted		O					
Rear side condenser clogged		O					
Condenser clogging <Front>		O					
Rear air conditioner switch malfunction	O	O	O	O	O	O	
Connector poor contact, harness open, faulty earth	O	O		O	O	O	
Fuse blown	O	O					
Air conditioner piping clogged, loose, incorrectly connected		O					

HEATER CONTROL



P58258E

● Removal sequence

- 1 Air mix control cable (BLACK)
- 2 Mode selection control cable (NATURAL)
- 3 Heater control unit

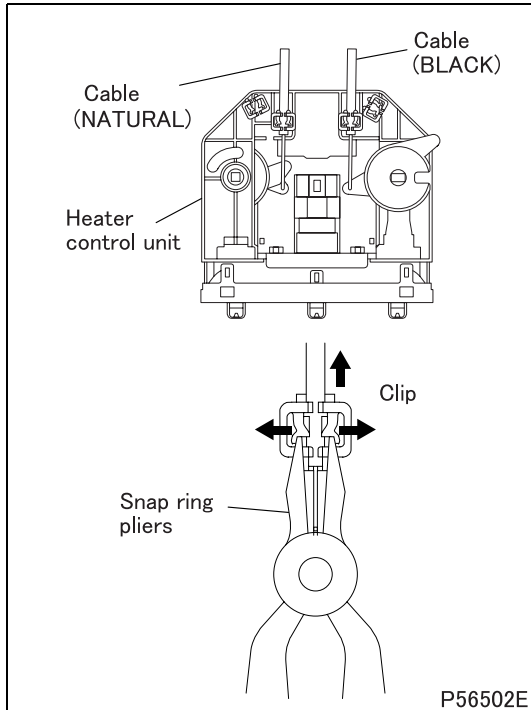
CAUTION

- Never remove the cable(s) from the heater control(s) except when the control cable(s) needs to be replaced. Failure to observe this may damage the claws of the cable clip.

● Installation sequence

Follow the removal sequence in reverse.

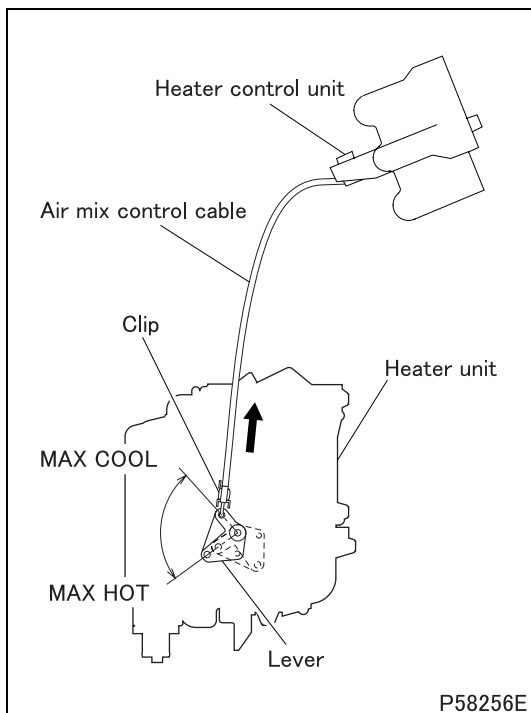
◆ Removal procedure ◆



■ Removal: Cable

- Use snap ring pliers to disconnect the cable(s) from the heater control(s).

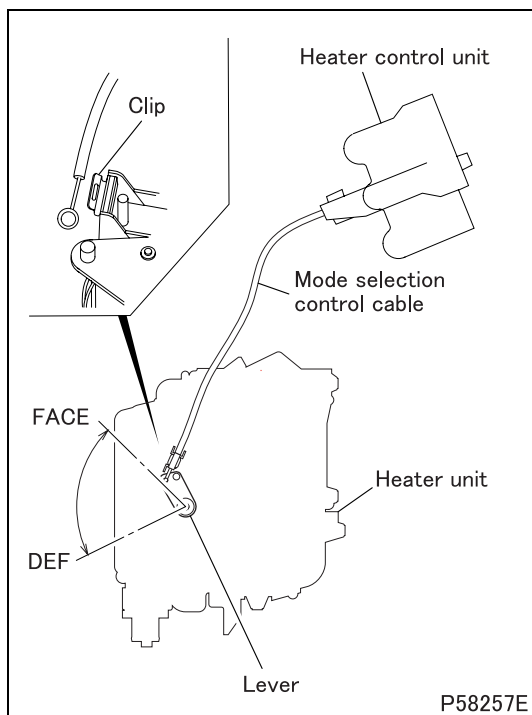
◆ Installation procedure ◆



■ Installation: Air mix control cable

- Install one end of the air mix control cable to the heater control unit.
- Set the unit's temperature control dial to MAX COOL.
- Install the other end of the air mix control cable to the lever on the heater unit.
- With the air mix control cable connected to the lever, pull the cable in the direction of the arrow to move the lever to MAX COOL (upper) position. Clip the cable into position.
- Move the temperature control dial to MAX COOL and MAX HOT. Make sure that the lever moves to the corresponding MAX COOL and MAX HOT positions. If not, repeat the above sequence to correctly install the cable. Also, make sure that the cable being installed is in the correct color.

HEATER CONTROL

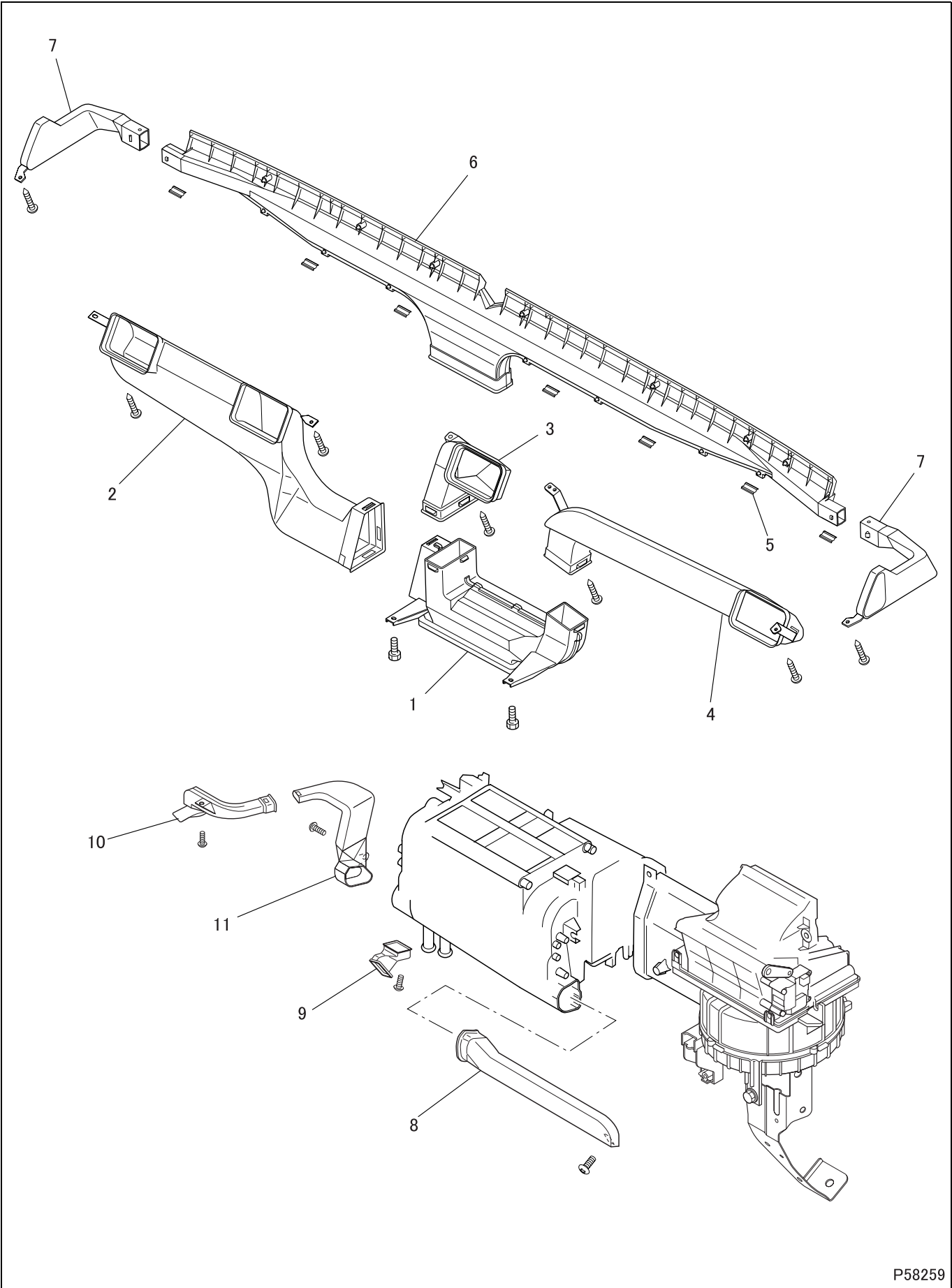


■ Installation: Mode selection control cable

- Install one end of the mode selection control cable to the heater control unit.
- Set the unit's mode control dial to FACE.
- Install the other end of the mode selection control cable to the lever on the heater unit.
- With the mode selection control cable connected to the lever, and push the cable into the clip.
- Move the mode control dial to FACE and DEF. Make sure that the lever moves to the corresponding FACE and DEF positions. If not, repeat the above sequence to correctly install the cable. Also, make sure that the cable being installed is in the correct color.

M E M O

AIR DUCT



P58259

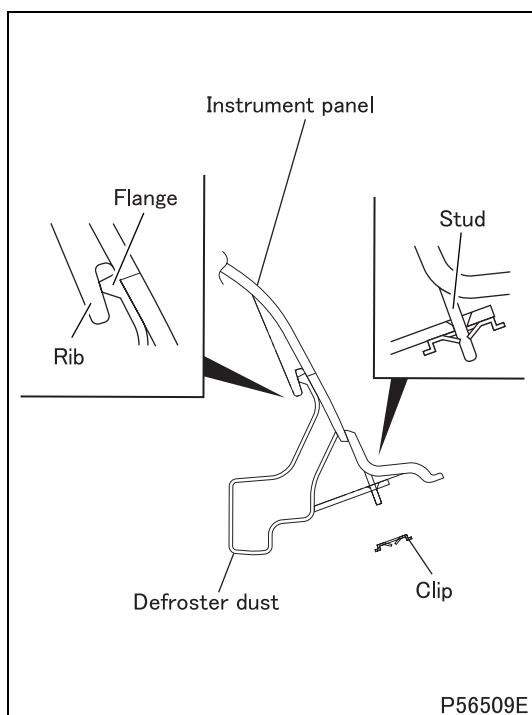
● Removal sequence

- | | |
|------------------------|-----------------------|
| 1 Center duct | 7 Side defroster duct |
| 2 Driver face duct | 8 Passenger foot duct |
| 3 Center face duct | 9 Center foot duct |
| 4 Passenger face duct | 10 Driver foot duct B |
| 5 Clip (× 7) | 11 Driver foot duct A |
| 6 Front defroster duct | |

● Installation sequence

Follow the removal sequence in reverse.

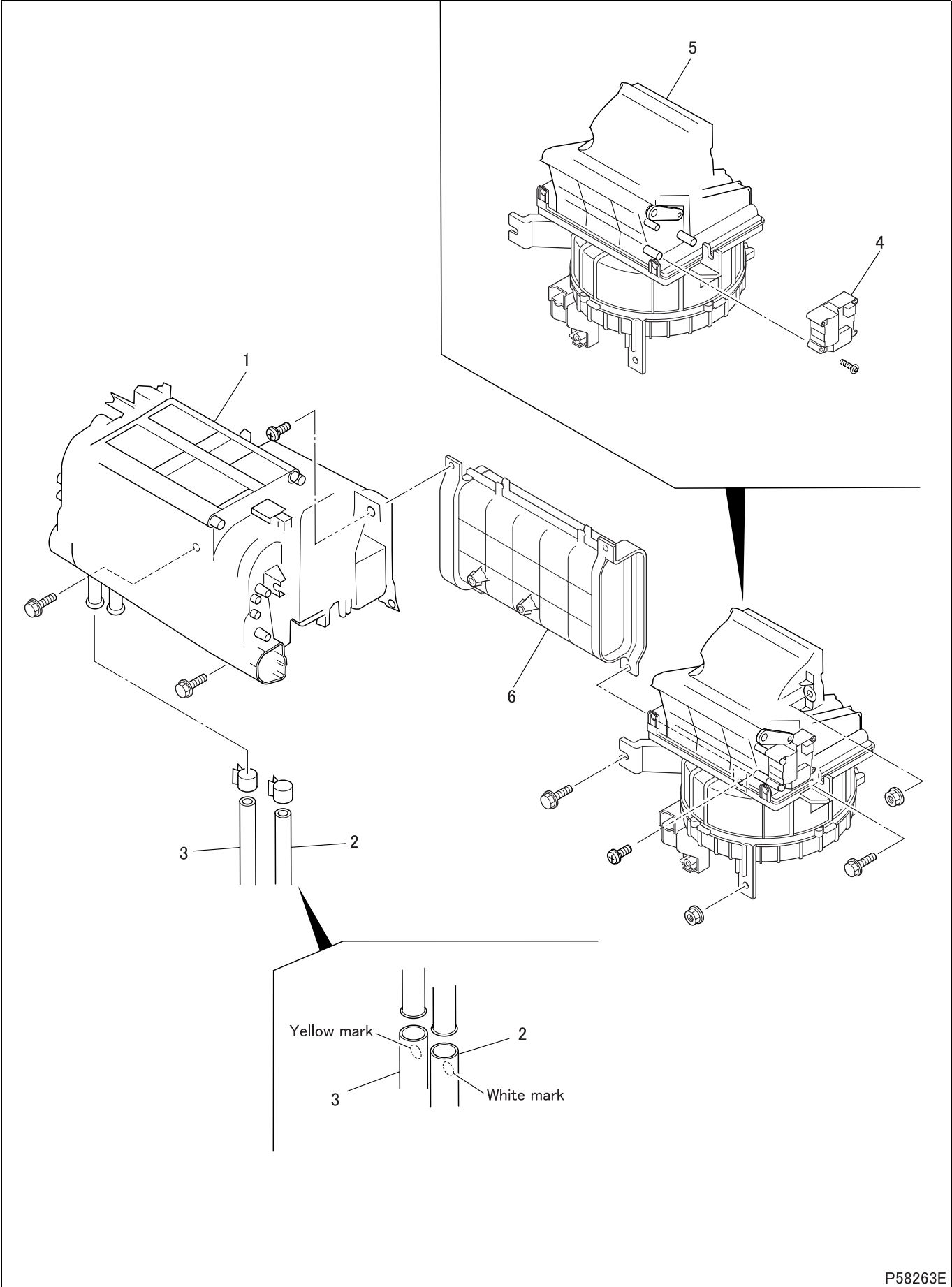
◆ Installation procedure ◆



■ Installation: Front defroster duct

- Insert the front defroster duct flanges into the instrument panel ribs.
- Insert the instrument panel studs into the front defroster duct holes and clip them together.

HEATER UNIT, BLOWER



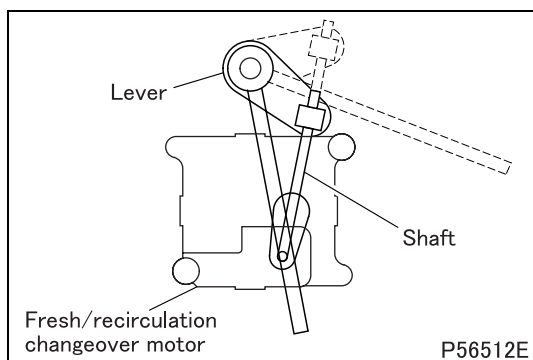
P58263E

● Removal sequence

- 1 Heater unit
- 2 Heater hose (outlet)
- 3 Heater hose (return)
- 4 Fresh/recirculation changeover motor
- 5 Blower
- 6 Joint duct

● Installation sequence

Follow the removal sequence in reverse.

◆ Installation procedure ◆**■ Installation: Fresh/recirculation changeover motor**

- With the lever set to the “Fresh” position, install the motor shaft through the lever.

FK.FM

SERVICE MANUAL

2005 Model

FOREWORD

This Service Manual contains maintenance and repair methods for the Mitsubishi Fuso Truck FK. FM Series. Read this manual carefully as an aid in providing correct, efficient maintenance. Please note that the information and specifications contained within this manual may change without notice. This is due to product modifications and continued vehicle improvements that are made throughout the model years. Should you encounter any discrepancy in the information provided, please do not hesitate to contact your nearest Mitsubishi Fuso Dealer or Mitsubishi Fuso Truck of America, Inc.

May 2004

HOME

GROUP INDEX

HOW TO READ THIS MANUAL

GENERAL	00
MAINTENANCE SCHEDULE	01
ENGINE.....	11
LUBRICATION	12
FUEL AND ENGINE CONTROL.....	13A
ELECTRONICALLY CONTROLLED FUEL SYSTEM	13E
COOLING.....	14
INTAKE AND EXHAUST.....	15
EMISSION CONTROL	17
CLUTCH.....	21
MANUAL TRANSMISSION	
<M060S6,M070S6>	22A
<M060S9(EATON FS-8209)>	22B
AUTOMATIC TRANSMISSION	
<M065A5(Allison LCT1000, LTC2400)>	23A
<M100A6(Allison MD3060P)>	23B
PROPELLER SHAFT.....	25
FRONT AXLE.....	26
REAR AXLE.....	27
WHEEL AND TIRE	31
FRONT SUSPENSION.....	33
REAR SUSPENSION	
<LEAF>	34A
<AIR>.....	34B
BRAKE	
<AIR OVER HYDRAULIC BRAKE>.....	35A
<FULL AIR BRAKE>	35B
ANTI-LOCK BRAKE SYSTEM	35E
PARKING BRAKE	
<CENTER PARKING BRAKE>	36A
<WHEEL PARKING BRAKE>.....	36B
STEERING	37
FRAME.....	41
CAB.....	42
ELECTRICAL.....	54
AIR-CONDITIONER	55A
HEATER	55B



Group 00

General

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

MODEL CODING SYSTEM	00-2
POWER TRAIN TABLE	00-4
CHASSIS NUMBER AND ENGINE NUMBER	00-6
POWER TRAIN LABEL	00-6
VEHICLE IDENTIFICATION NUMBER	00-7
PRECAUTIONS FOR MAINTENANCE OPERATION	00-8
DIAGNOSIS CODES	
1. Connecting Multi-Use Tester	00-20
2. ACCESSING / ERASING DIAGNOSIS CODES	
<Common Rail, Exhaust Gas Recirculation, Pre-heater>	00-24
3. ACCESSING / ERASING DIAGNOSIS CODES	
<Auto Cruise>	00-26
4. ACCESSING / ERASING DIAGNOSIS CODES	
<Anti-lock Brake System>	00-28
TABLE OF STANDARD TIGHTENING TORQUES	00-30
CONNECTOR CONFIGURATION CHART	00-34

MODEL CODING SYSTEM

Equipment Model Code

Equipment name	Model description	Code description
Engine	6 M 6 0 T1	With turbocharger Version number Series number Stands for diesel engine No. of cylinders (6 : Six cylinders)
Clutch	C 7 M 38	Disc outer diameter Facing material (M : Cera-metallic) Loading capacity of major type (tonnage) Stands for clutch
Transmission	M 060 S 6	No. of forward speeds Meshing (S : Synchromesh, A : Automatic) Loading capacity of major type (tonnage) Stands for transmission
Propeller shaft	P 8	Loading capacity of major type (tonnage) Stands for propeller shaft
Reduction and differential	D 8 H	Teeth shape (H: hypoid gear) Loading capacity of major type (tonnage) Stands for reduction and differential

MEMO

POWER TRAIN TABLE

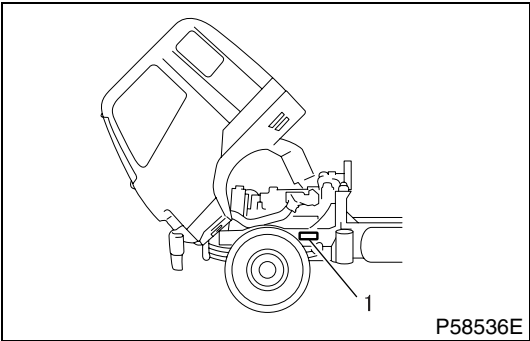
Vehicle model	Engine	Clutch	Transmission	Propeller shaft	Rear axle	Reduction and differential
FK61FH1LSUA	6M60-T1	C7M38	M060S6	P8	R050T	D050H
FK61FJ1LSUA	6M60-T1	C7M38	M060S6	P8	R050T	D050H
FK61FK1LSUA	6M60-T1	C7M38	M060S6	P8	R050T	D050H
FK61FL1LSUA	6M60-T1	C7M38	M060S6	P8	R050T	D050H
FK61FJ1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT1000]	P8	R050T	D050H
FK61FK1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT1000]	P8	R050T	D050H
FK61FL1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT1000]	P8	R050T	D050H
FM61FF1LSUA	6M60-T1	C7M38	M060S6	P8	R060T	D8H
FM61FJ1LSUA	6M60-T1	C7M38	M060S6	P8	R060T	D8H
FM61FL1LSUA	6M60-T1	C7M38	M060S6	P8	R060T	D8H
FM61FM1LSUA	6M60-T1	C7M38	M060S6	P8	R060T	D8H
FM61FP1LSUA	6M60-T1	C7M38	M060S6	P8	R060T	D8H
FM64FM1LSUA	6M60-T1	C7M38	M060S6	P8	R060T	D8H
FM64FP1LSUA	6M60-T1	C7M38	M060S6	P8	R060T	D8H
FM61FJ1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT2400]	P8	R060T	D8H
FM61FL1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT2400]	P8	R060T	D8H
FM61FM1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT2400]	P8	R060T	D8H
FM61FP1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT2400]	P8	R060T	D8H
FM64FM1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT2400]	P8	R060T	D8H
FM64FP1LSUB	6M60-T1	Torque converter	M065A5 [Allison LCT2400]	P8	R060T	D8H

Vehicle model	Engine	Clutch	Transmission	Propeller shaft	Rear axle	Reduction and differential
FM65FJ1LSUA	6M60-T1	C7M38	M070S6D	P10	R060T	D8H
FM65FL1LSUA	6M60-T1	C7M38	M070S6D	P10	R060T	D8H
FM65FM1LSUA	6M60-T1	C7M38	M070S6D	P10	R060T	D8H
FM65FP1LSUA	6M60-T1	C7M38	M070S6D	P10	R060T	D8H
FM65FJ1LSUB	6M60-T1	Torque converter	M100A6 [Allison MD3060P]	P10	R060T	D8H
FM65FL1LSUB	6M60-T1	Torque converter	M100A6 [Allison MD3060P]	P10	R060T	D8H
FM65FM1LSUB	6M60-T1	Torque converter	M100A6 [Allison MD3060P]	P10	R060T	D8H
FM65FP1LSUB	6M60-T1	Torque converter	M100A6 [Allison MD3060P]	P10	R060T	D8H
FM65FF2LSUC	6M60-T2	C7M38	M060S9 [EATON FS-8209]	P12	R080T	D10H
FM65FJ2LSUC	6M60-T2	C7M38	M060S9 [EATON FS-8209]	P12	R080T	D10H
FM65FL2LSUC	6M60-T2	C7M38	M060S9 [EATON FS-8209]	P12	R080T	D10H
FM65FM2LSUC	6M60-T2	C7M38	M060S9 [EATON FS-8209]	P12	R080T	D10H
FM65FP2LSUC	6M60-T2	C7M38	M060S9 [EATON FS-8209]	P12	R080T	D10H

CHASSIS NUMBER AND ENGINE NUMBER/POWER TRAIN LABEL

Chassis Number and Engine Number

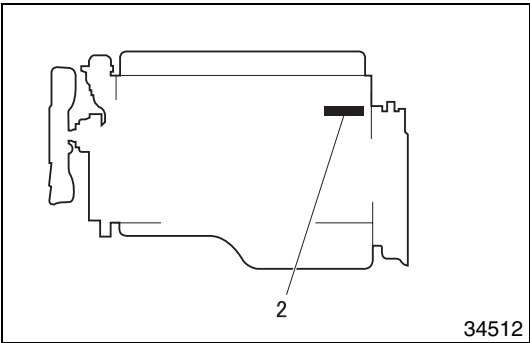
The serial numbers for chassis and engines are assigned to the respective vehicles and engines in manufacturing sequence: each vehicle and engine has its own number. These numbers are required for registration and incidental inspection of the vehicle. Please do not fail to mention these numbers to the dealers when ordering spare parts.



Chassis number
Chassis number 1 is punch-marked on the frame by the left-side front wheel.

Example : FK61FH-□□□□□□

Vehicle model	Chassis number
---------------	----------------

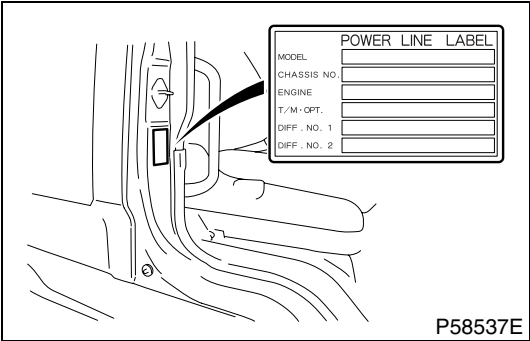


Engine number
Engine number 2 is punch-marked on the left of the crankcase.

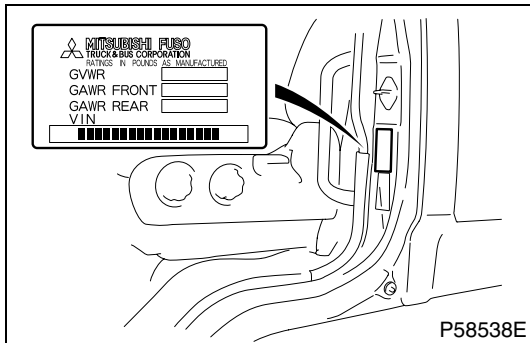
Example : 6M6-□□□□□□

Engine model	Engine number
--------------	---------------

Power Train Label



Power train label 1 located in the position illustrated indicates the vehicle model, chassis number and information relevant to the vehicle's power transmission components.



The vehicle identification number is punch-marked on the plate, which is attached in the position as illustrated.

The vehicle identification number consists of a 17-digit set of alphanumeric characters. Each digit represents the following specifications.

J	L	6	D	F	H	1	E	■	5	K	■ ■ ■ ■ ■ ■ ■ ■
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫

- | | |
|-------------------------------------|---|
| ① Country | J: Japan |
| ② Make | L: Mitsubishi Fuso |
| ③ Type | 6: Incomplete vehicle |
| ④ Gross vehicle weight/Brake system | D: 19,501 to 26,000 lbs./Air over hydraulic
F: 26,001 to 33,000 lbs./Full air |
| ⑤ Line | F: FK61F
G: FM61F
H: FM64F
J: FM65F |
| ⑥ Series (Wheel base) | F: 3.5 to 3.79 m (11.48 to 12.43 ft.)
H: 4.1 to 4.39 m (13.45 to 14.40 ft.)
J: 4.4 to 4.69 m (14.43 to 15.38 ft.)
K: 4.7 to 4.99 m (15.41 to 16.37 ft.)
L: 5.0 to 5.29 m (16.40 to 17.35 ft.)
M: 5.3 to 5.59 m (17.38 to 18.33 ft.)
P: 5.9 to 6.19 m (19.35 to 20.30 ft.) |
| ⑦ Cab/chassis type | 1: Chassis cab |
| ⑧ Engine | E: 7.545 L diesel turbo charged and charge air cooled |
| ⑨ Check digit | |
| ⑩ Model year | 5: 2005 |
| ⑪ Plant | K: Kawasaki |
| ⑫ Plant sequential No. | |

PRECAUTIONS FOR MAINTENANCE OPERATION

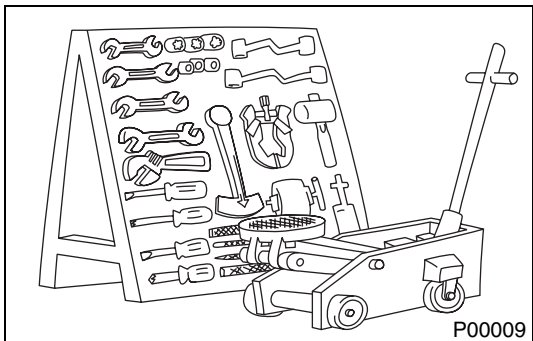
DANGER

This product contains or emits chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Before performing service operations, inquire into the customer's complaints and ascertain the condition by checking the total distance traveled, the conditions under which the vehicle is operated, and other relevant factors on the vehicle. And note the necessary information. This information will help you to service the vehicle efficiently.
- Check the location of the fault, and identify its cause. Based on your findings, determine whether parts must be removed or disassembled. Then, follow the service procedure given in this manual.



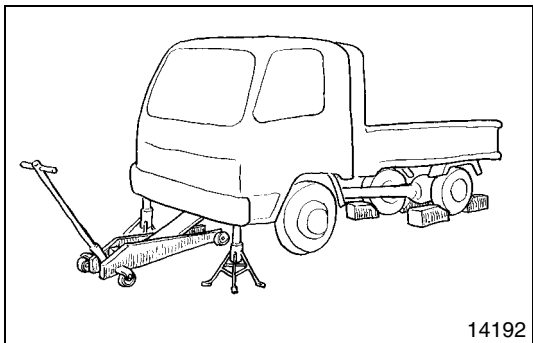
- Perform service operations on a level surface. Before starting, take the following preparatory steps:
- To prevent soiling and damage, place covers over the seats, trim and floor in the cab and over the paintwork of the body.



- Prepare all the general and special tools necessary for the job.

WARNING

- **Special tools must be used wherever specified in this manual. Do not attempt to use other tools since they could cause injuries and/or vehicle damage.**
-

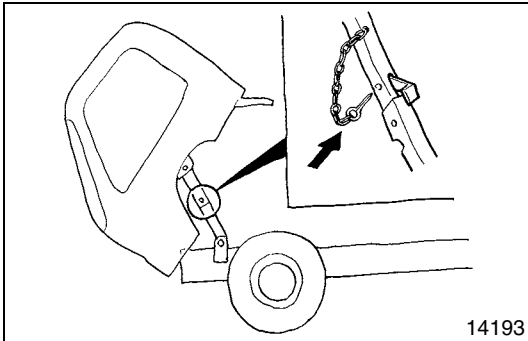


When jacking up the vehicle to work under the vehicle, carry out the following preparatory work:

- Chock the wheels on both sides.
- Jack up the vehicle using a garage jack.
- Support the frame on rigid racks.

WARNING

- **Chock the wheels securely so the vehicle does not move.**
 - **Do not remove the chocks until the entire operation is completed.**
 - **Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.**
 - **Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.**
-

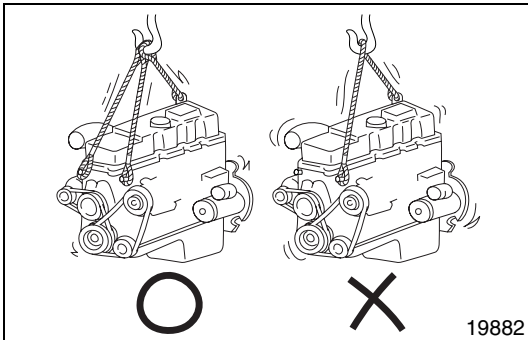


14193

When tilting the cab, be sure to insert the safety pin into the cab stay so that the cab stay remains locked and is not released when the cab is tilted.

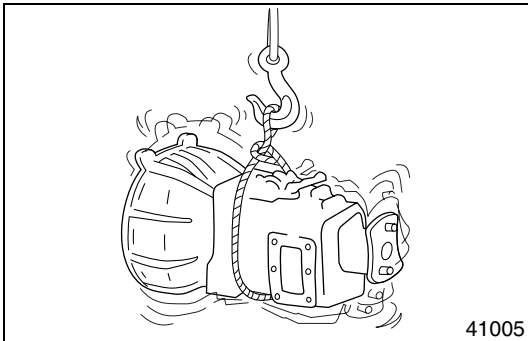
Pay special attention to safety when removing or installing heavy items such as engines, transmissions and axles.

When lifting up heavy items using cables, pay special attention to the following points:



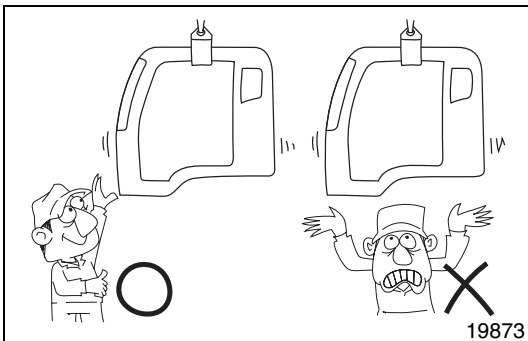
19882

- Pay extreme attention to safety when removing and installing heavy components such as the engine, transmission and axles. Especially, when lifting a heavy component using cables, be sure to respect the following instructions.
- Check the mass of the component to be lifted and use a cable that is strong enough to lift that mass.



41005

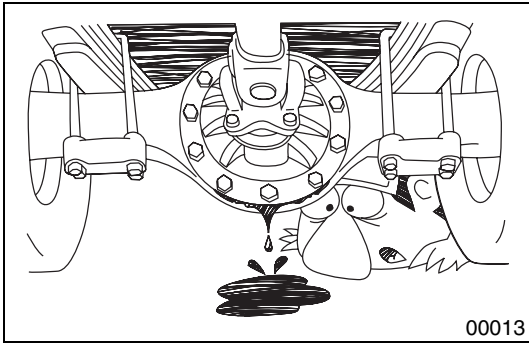
- If the component does not have dedicated hanging hooks, secure the cable round the component paying attention to the center of gravity when it is lifted.



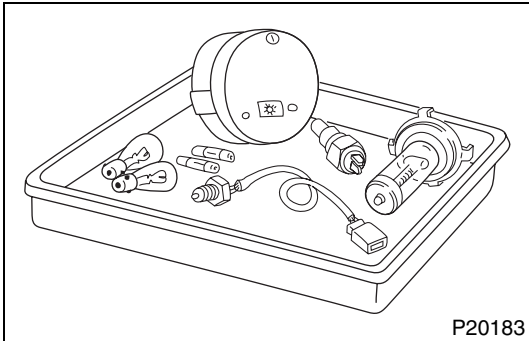
19873

- You must work in a position where you will not be injured even if the component slips off the cable and falls down.

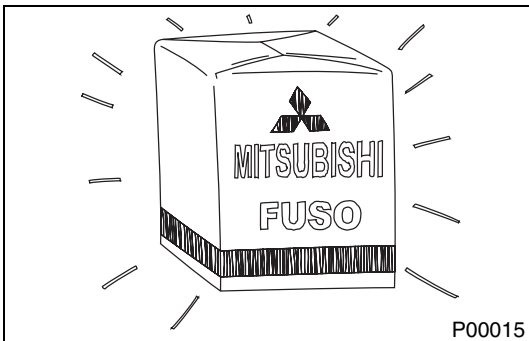
PRECAUTIONS FOR MAINTENANCE OPERATION



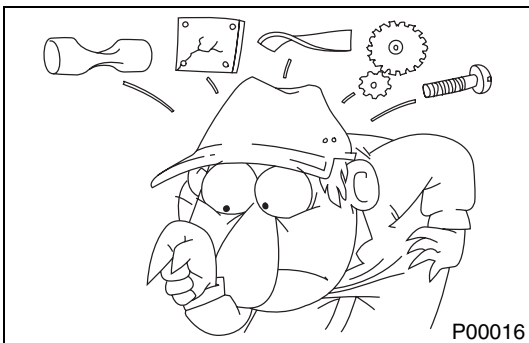
- Do not wash the vehicle before checking it for oil leakage. You might miss detecting the leakage after washing the vehicle.



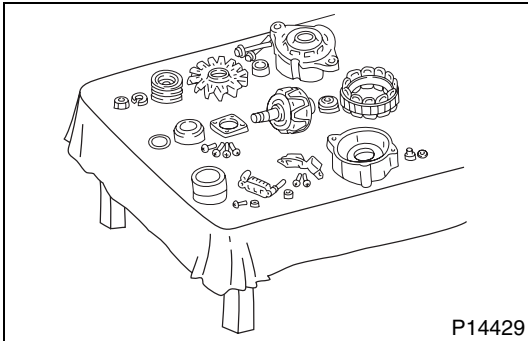
- Prepare replacement parts ready for installation.



- Oil seals, packings, O-rings and other rubber parts, gaskets, and split pins must be replaced with new ones after removal. Use only genuine MITSUBISHI replacement parts.



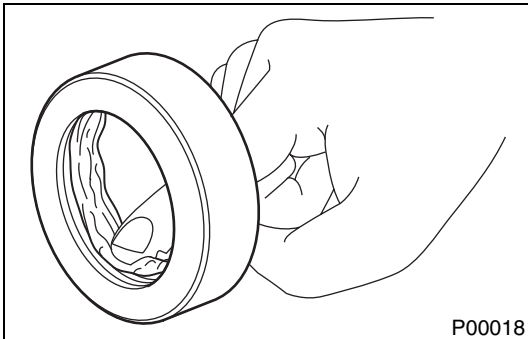
- When disassembling parts, visually check them for wear, cracks, damage, deformation, deterioration, rust, corrosion, defective rotation, fatigue, clogging and any other possible defect.



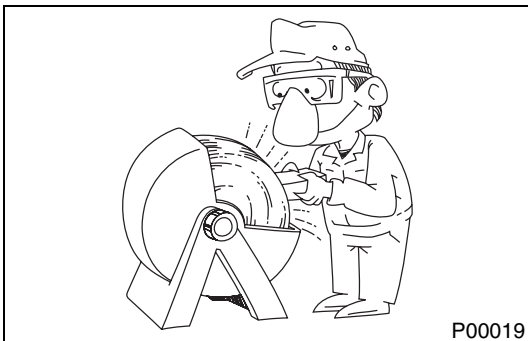
- To facilitate correct reassembly of parts, make alignment marks on them before disassembly and arrange disassembled parts neatly. Make punch marks and other alignment marks where they will not detract from parts' functionality and appearance.
- After removing parts from the vehicle, cover the area to keep it free of dust.

CAUTION

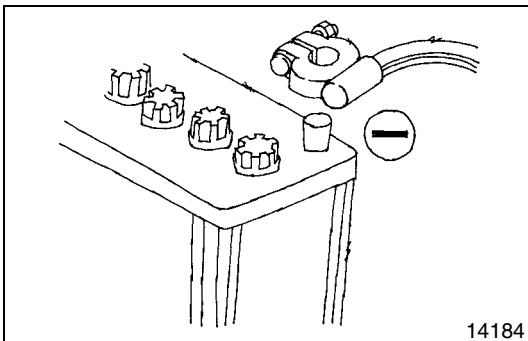
- **Be careful not to mix up identical parts, similar parts and parts that have left/right alignments.**
- **Keep new replacement parts and original (removed) parts separately.**



- Apply the specified oil or grease to U-seals, oil seals, dust seals and bearings before reassembly.
- Always use the specified oils and greases when performing inspection or replacement. Immediately wipe away any excess oil or grease with a rag.



- Wear safety goggles when using a grinder or welder. Wear gloves when necessary, and watch out for sharp edges and other items that might wound your hands.

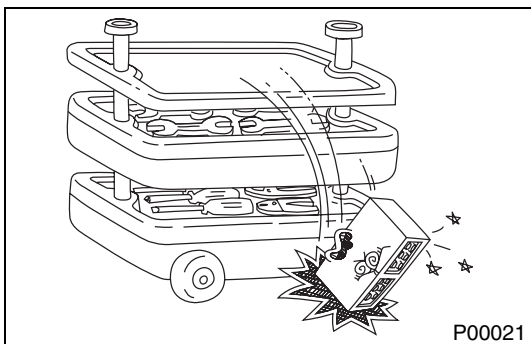


- Before working on the electrical system, disconnect the battery (–) terminal to prevent short circuits.

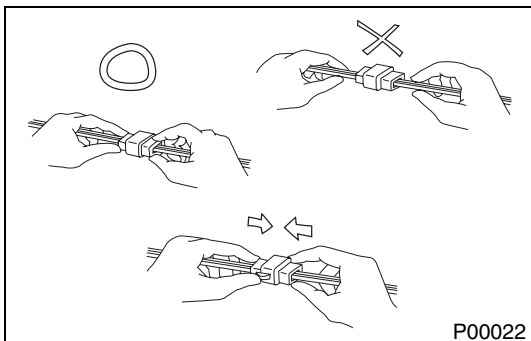
CAUTION

- **Make sure the starter switch and lighting switches are OFF before disconnecting or connecting battery terminals. Semiconductor components may otherwise be damaged.**

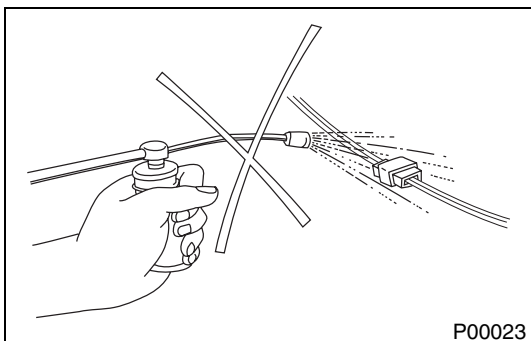
PRECAUTIONS FOR MAINTENANCE OPERATION



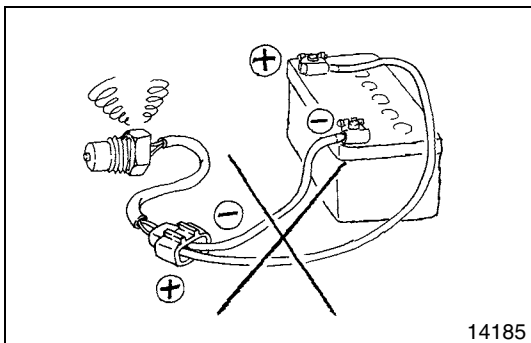
- Carefully handle sensors, relays, and other items that are sensitive to shock and heat. Do not remove or paint the cover of any control unit.



- When separating connectors, grasp the connectors themselves rather than the harnesses.
- To separate locking connectors, first push them in the direction of the arrows. To reconnect locking connectors, push them together until they click.

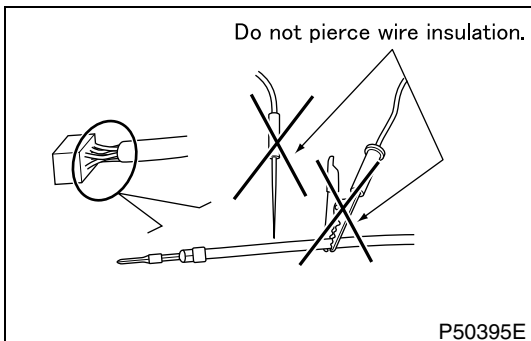


- Before washing the vehicle, cover electrical parts to keep them dry. (Use plastic sheets or the like.) Keep water away from harness connectors and sensors and immediately wipe off any water that gets on them.



- When applying a voltage to a part for inspection purposes, check that the (+) and (-) cables are connected properly then gradually increase the voltage from zero. Do not exceed the specified voltage. Remember that control units and sensors do not necessarily operate on the battery voltage.

1. Handling Precautions for Electric Circuits



CAUTION

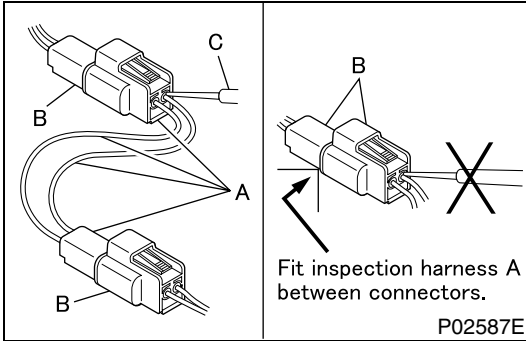
- Do not pierce wire insulation with test probes or alligator clips when performing electrical inspections. Doing so can, particularly with the chassis harness, hasten corrosion.

1.1 Inspection of Harnesses

(1) Inspections with connectors fitted together

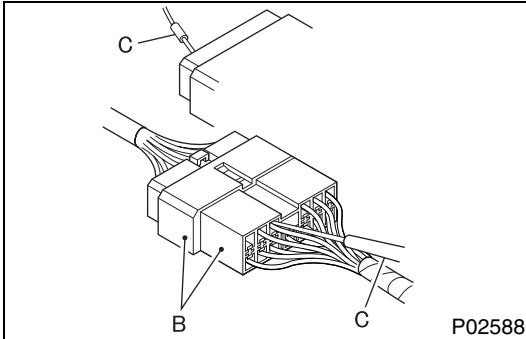
(1.1) Waterproof connectors

- Connect an inspection harness and connector **A** between the connectors **B** of the circuit to be inspected. Perform the inspection by applying a test probe **C** to the connectors of the inspection harness. Do not insert the test probe **C** into the wire-entry sides of the waterproof connectors since this would damage their waterproof seals and lead to rust.



(1.2) Non-waterproof connectors

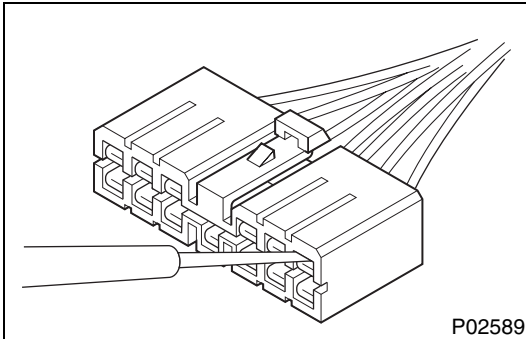
- Perform the inspection by inserting a test probe **C** into the wire-entry sides of the connectors. An extra-narrow probe is required for control unit connectors, which are smaller than other types of connector. Do not force a regular-size probe into control unit connectors since this would cause damage.



(2) Inspections with connectors separated

(2.1) Inspections on female terminals

- Perform the inspection by carefully inserting a test probe into the terminals. Do not force the test probe into the terminals since this could deform them and cause poor connections.

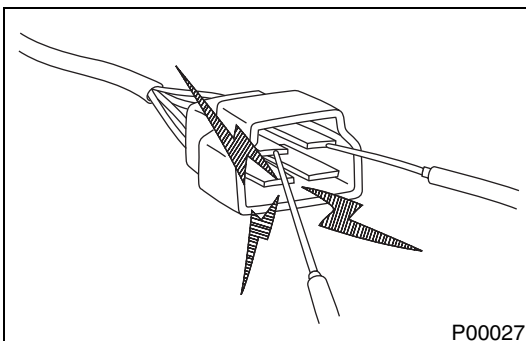
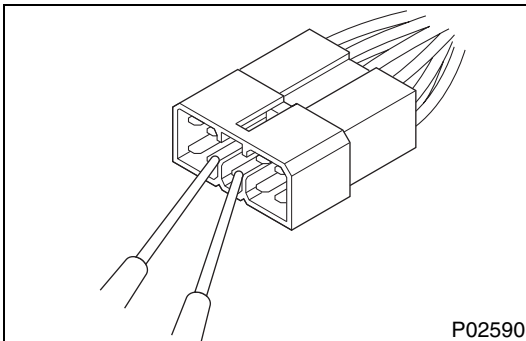


(2.2) Inspections on male terminals

- Perform the inspection by applying test probes directly to the pins.

CAUTION ⚠

- Be careful not to short-circuit pins together with the test probes. With control unit connectors, short-circuiting of pins can cause damage to the control unit's internal circuitry.



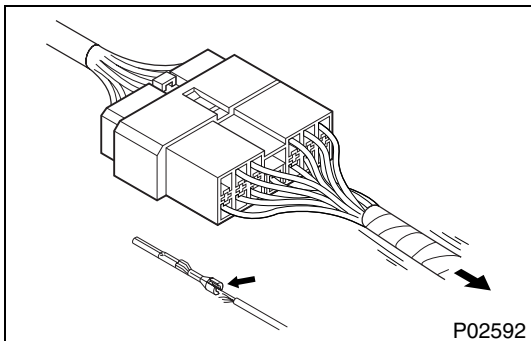
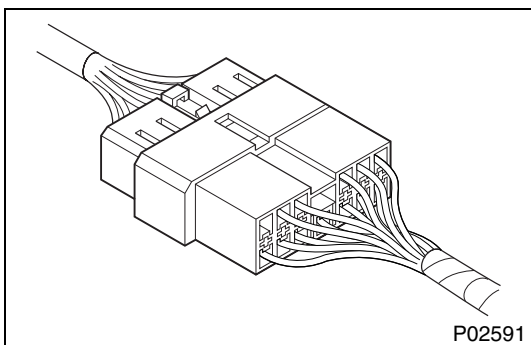
- When using a multimeter to check continuity, do not allow the test probes to touch the wrong terminals.

PRECAUTIONS FOR MAINTENANCE OPERATION

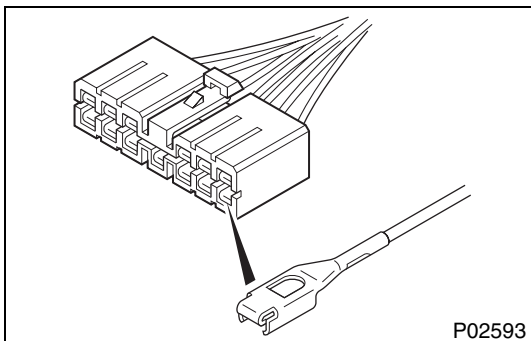
1.2 Inspection of Connectors

(1) Visual inspection

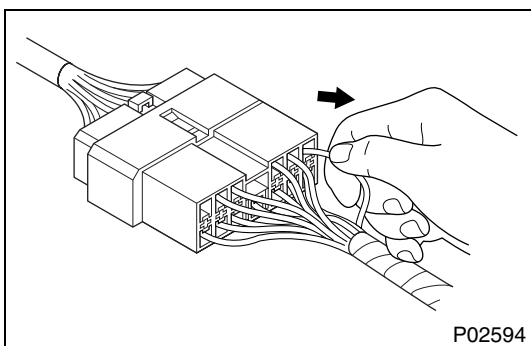
- Check that the connectors are fitted together securely.



- Check whether wires have been separated from their terminals due to pulling of the harness.



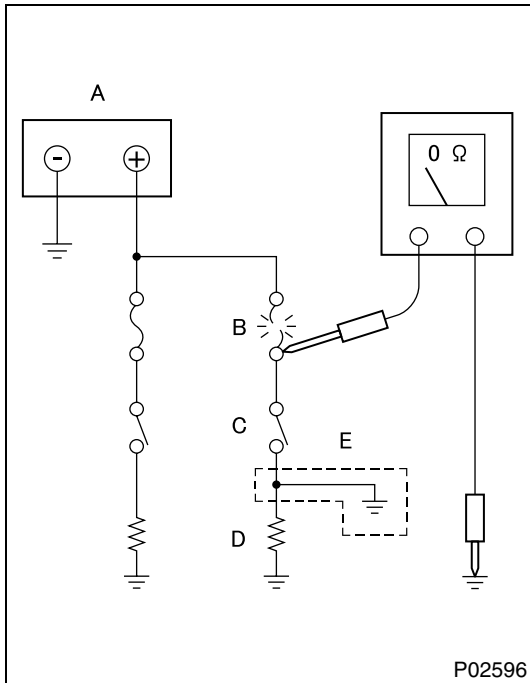
- Check that male and female terminals fit together tightly.



- Check for defective connections caused by loose terminals, by rust on terminals, or by contamination of terminals by foreign substances.

(2) Checking for loose terminals

- If connector terminal retainers become damaged, male and female terminals may not mate with each other when the connector bodies are fitted together. To check for such terminals, gently pull each wire and see whether any terminals slip out of their connector housings.



1.3 Inspections when a fuse blows

- Remove the fuse **B**, then measure the resistance between ground and the fuse's load side.

Next, close the switch of each circuit connected to the fuse. If the resistance measurement between any switch and ground is zero, there is a short circuit between the switch and the load. If the resistance measurement is not zero, the circuit is not currently short-circuited; the fuse probably blew due to a momentary short circuit.

- The main causes of short circuits are as follows:
 - Harnesses trapped between chassis parts
 - Harness insulation damage due to friction or heat
 - Moisture in connectors or circuitry
 - Human error (accidental short-circuiting of components)

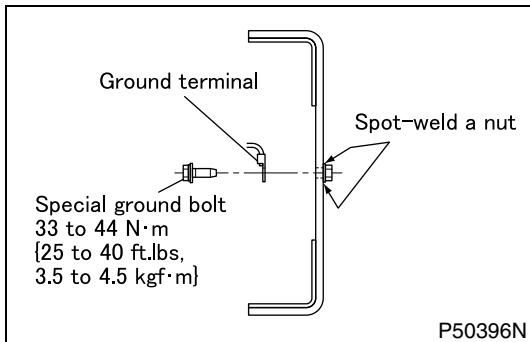
A: Battery

B: Fuse

C: Load switch

D: Load

E: Short circuit

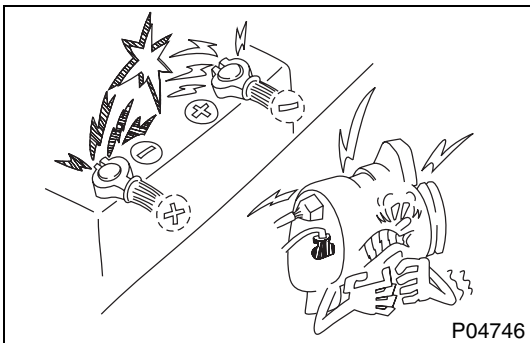


1.4 Inspection of Chassis Ground

- A special ground bolt is used to tighten a ground terminal. When servicing the ground point, be sure to follow the procedures described below:

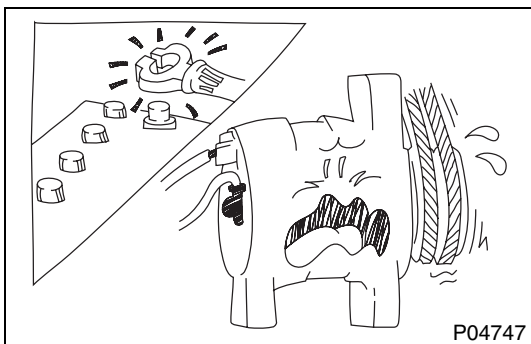
- When reinstalling the ground bolt
Tighten the ground bolt to the specified torque.
- When relocating the ground point
A special ground bolt must be used. Spot-weld a nut to a frame and tighten the ground bolt to the specified torque. Be sure to apply touch-up paint to the welded point.

2. Service Precautions for Alternators

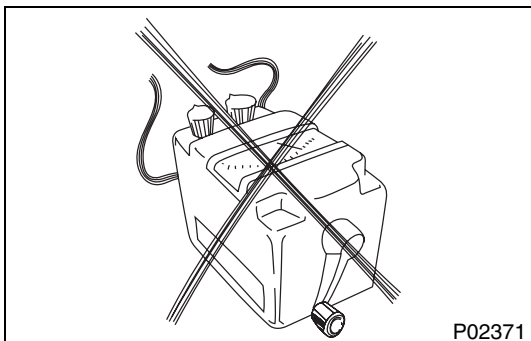


- When servicing alternators, observe the following precautions:
 - Never reverse the polarity of battery connections.
If the polarity of the battery connections was reversed, a large current would flow from the battery to the alternator, damaging the diodes and regulator.

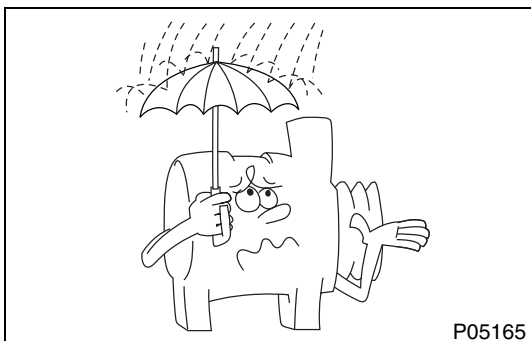
PRECAUTIONS FOR MAINTENANCE OPERATION



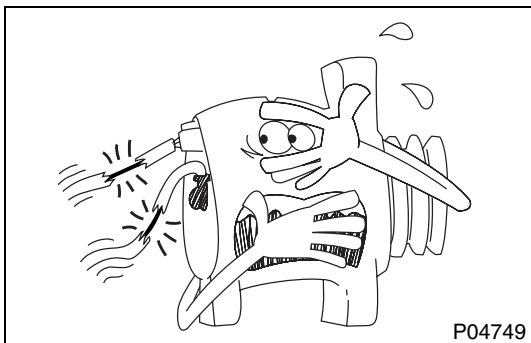
- Never disconnect the battery terminals with the engine running. Disconnection of the battery terminals during engine operation would cause a surge voltage, leading to deterioration of the diodes and regulator.



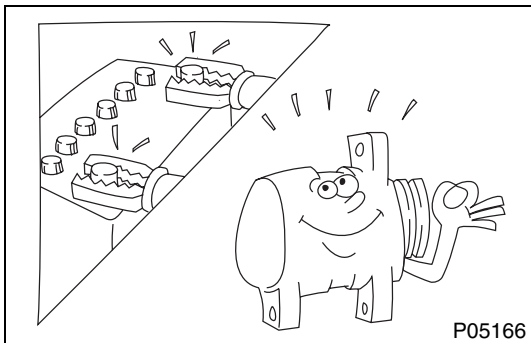
- Never perform inspections using a high-voltage multimeter. The use of a high-voltage multimeter could damage the diodes and regulator.



- Keep alternators dry. Water on alternators can cause internal short circuits and damage.

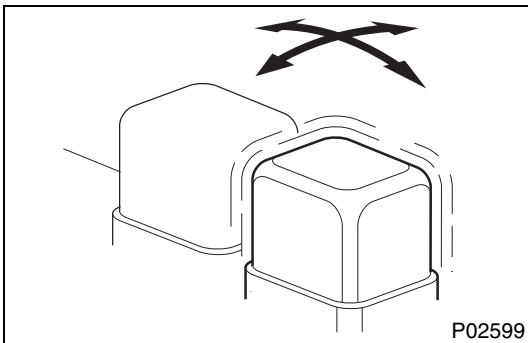
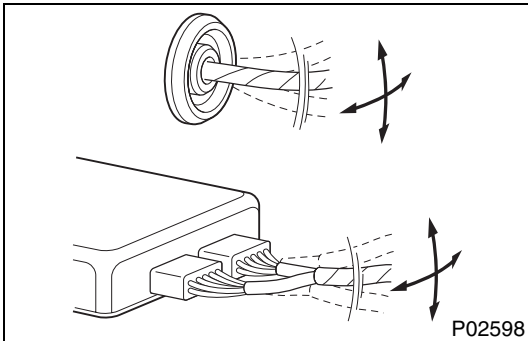
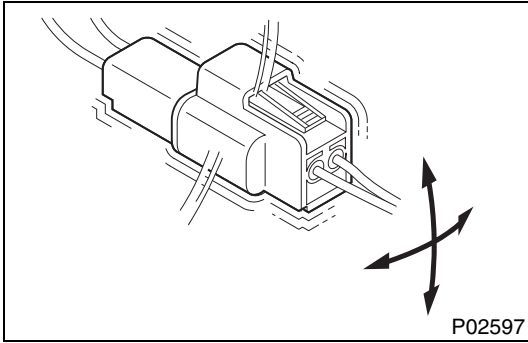


- Never operate an alternator with the **B** and **L** terminals short-circuited. Operation with the **B** and **L** terminals connected together would damage the diode trio.



- Disconnect the battery terminals before quick-charging the battery with a quick charger. Unless the battery terminals are disconnected, quick-charging can damage the diodes and regulator.

3. Intermittent Faults



- An intermittent fault typically occurs only under certain operating conditions. Once these conditions have been identified, the cause of the intermittent fault can be ascertained easily. First, ask the customer about the vehicle operating conditions and weather conditions under which the fault occurs. Also ask about the frequency with which the fault occurs and about the fault symptoms. Then, reproduce the fault based on this information.

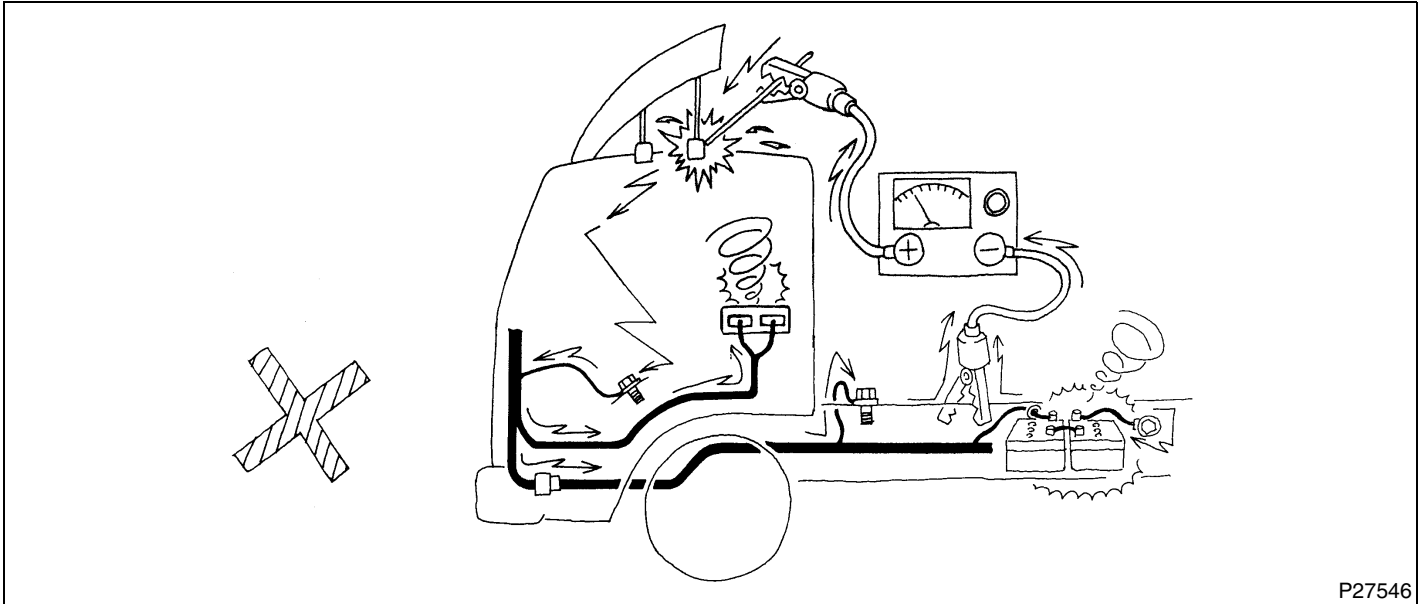
In accordance with the conditions under which the fault occurs, determine whether the fault is caused by vibration, heat or other factors. If vibration is a possible factor, see if the fault can be reproduced by performing the following checks on individual connectors and other parts:

- Gently move connectors up and down and to left and right.
 - Gently move wiring harnesses up and down and to left and right.
 - Gently wiggle sensors and other devices by hand.
 - Gently wiggle wiring harnesses on suspension systems and other moving parts.
- Connectors and other parts to be checked are those included or given as likely fault locations in inspection procedures corresponding to diagnosis codes and/or fault symptoms.

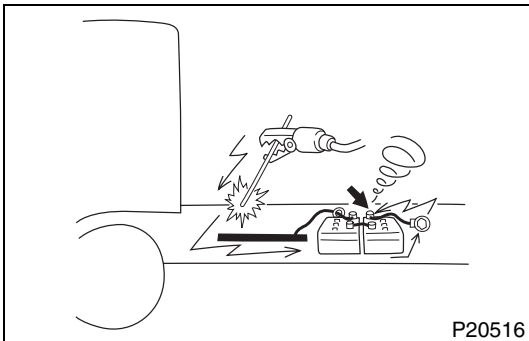
PRECAUTIONS FOR MAINTENANCE OPERATION

4. Precautions for Arc Welding

- When arc welding is performed, current from the welder flows to ground via the vehicle's metal parts. Unless appropriate steps are taken, this current can damage control units, other electrical devices and wiring harnesses. And, any electrical device near the point on vehicle, to which the negative cable of the welder is connected might be largely damaged.



- Current flows backward as shown below.



4.1 From battery (–) terminal

To prevent damage to the battery and to electrical devices that are connected directly to the battery, it is essential to disconnect the battery's (–) terminal.

4.2 Procedure

- Turn the starter switch to the LOCK position.
↓
- Disconnect the battery's (–) terminal.
↓
- Cover all parts of the vehicle that may be damaged by welding sparks.
↓
- Connect the welder's (–) cable to the vehicle as close as possible to the area being welded. Do not connect the welder's (–) cable to the cab if the frame is being welded, and vice versa.
↓
- Set the welding current in accordance with the part being welded.

MEMO

DIAGNOSIS CODES

1. Connecting Multi-Use Tester

- The type of Multi-Use Tester to be used varies depending on which system is being inspected. Select and connect the correct type of Multi-Use Tester to the system being inspected by referring to the following tables.

System compatible with Multi-Use Tester-III

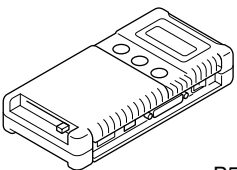
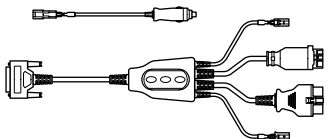
System	Reference Gr	Multi-Use Tester to be used
Common rail	13E	Multi-Use Tester-III only
Auto cruise	13E	
Exhaust gas recirculation	17	
Pre-heater	54	

System compatible with Multi-Use Tester-II

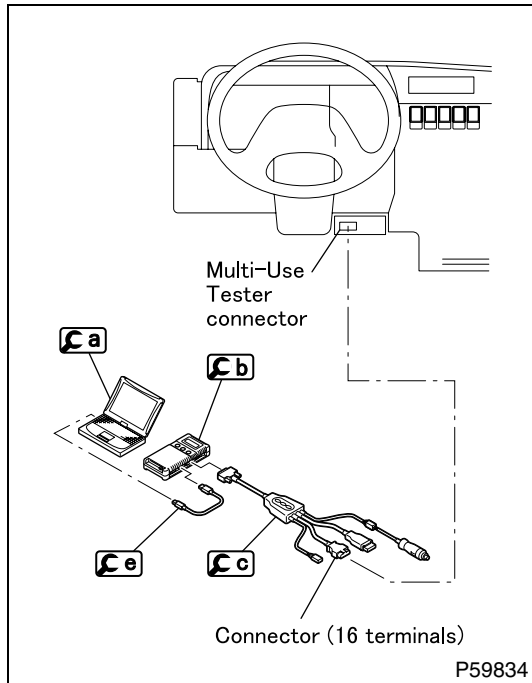
System	Reference Gr	Multi-Use Tester to be used
Anti-lock brake system	35E	Multi-Use Tester-II or Multi-Use Tester-III

1.1 Connecting Multi-Use Tester-III

Special tools

Mark	Tool name and shape	Part No.	Application
 a	PC  P57295	FMS-E04-1 (Multi-Use Tester-III version)	Data transmission to/from V.C.I.
 b	V.C.I.  P57296	MH062927	Data transmission between electronic control unit and PC
 c	Multi-Use Tester-III Test Harness B (used for communication)  P57298	MH062929	Power supply to V.C.I. and communication with electronic control unit
 d	Harness D (used for extension)  P57299	MH062951	Multi-Use Tester-III test harness B extension

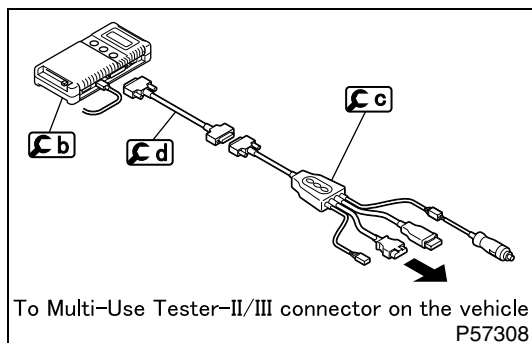
Mark	Tool name and shape	Part No.	Application
	USB cable  P57300	MB991827	Communication between V.C.I. and PC



- Move the starter switch to the LOCK position.
- Connect , ,  and  as illustrated.
- Connect the Multi-Use Tester-II/III connector with the connector (16 terminals) on the vehicle.

NOTE

For Multi-Use Tester operations, refer to the Multi-Use Tester instruction book.

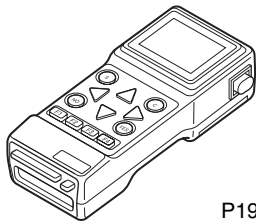
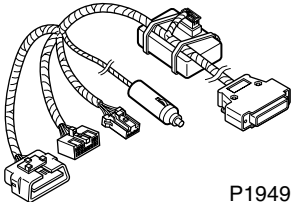
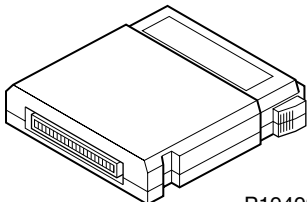


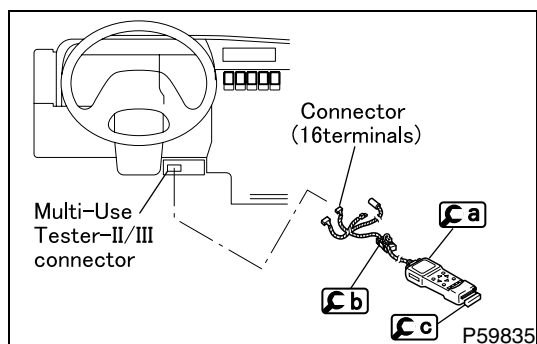
- Use  to extend the cable if  is not long enough such as when using Multi-Use Tester outside the vehicle.

DIAGNOSIS CODES

1.2 Conneting Multi-Use Tester-II

Special tools

Mark	Tool name and shape	Part No.	Application
	Multi-Use Tester  P19492	MB991946	System check
	Multi-Use Tester Harness (used for communica- tion)  P19491	MK327601	Power supply to Multi-Use Tester unit and communication with vehicle elec- trical equipment
	ROM Pack (MRT-E11)  P19493	MH062942	Electronic control unit inspection/con- trol data



- Move the starter switch to the LOCK position.
- Connect  with . Insert .
- Connect the connector (16 terminals) with the Multi-Use Tester II/III connector (16 terminals) in the fuse box.

NOTE

For Multi-Use Tester operations, refer to the Multi-Use Tester instruction book.

MEMO

DIAGNOSIS CODES

2. Accessing / Erasing Diagnosis Codes <Common Rail, Exhaust gas recirculation, Pre-heater>

2.1 Diagnosis codes

- There are two types of diagnosis codes: present codes and past codes.

(1) Present diagnosis codes

- When an error occurs after the starter switch has been turned on (when electronic control unit being energized), the relevant diagnosis code is generated and stored in electronic control unit. This is a present diagnosis code.

(2) Past diagnosis codes

- A present diagnosis code becomes a past diagnosis code and is stored in electronic control unit when it is reset, or when the starter switch is turned OFF and then ON.

2.2 Accessing and erasing diagnosis codes

- Diagnosis codes can be accessed or erased either by using Multi-Use Tester-III, or by using vehicle functions without using Multi-Use Tester-III.
- Removing/installing the dedicated fuses will turn the diagnosis and memory clear switches ON/OFF.

NOTE

- Be sure to restore the fuse to the original location after accessing and/or erasing diagnosis codes.

(1) Accessing/erasing diagnosis codes using Multi-Use Tester

(1.1) Present diagnosis codes

- Turn the starter switch ON.
- With the memory clear switch in the fuse box closed and using Multi-Use Tester, access present diagnosis codes and, if they exist, identify the faults.

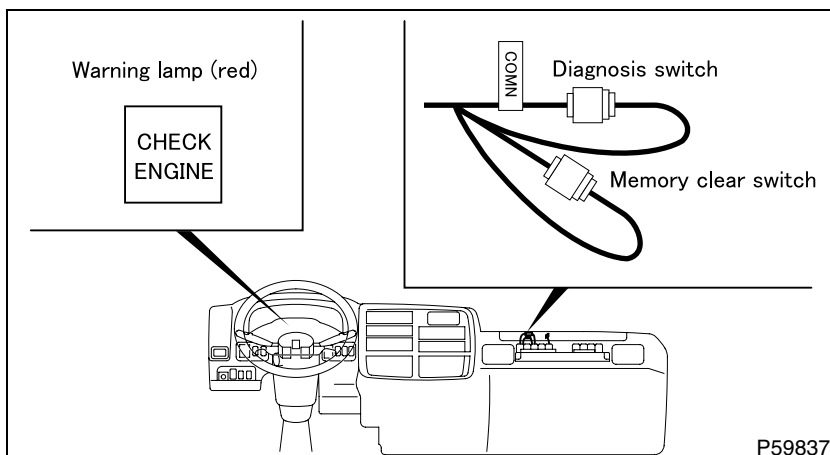
(1.2) Past diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, access past diagnosis codes and, if they exist, identify the faults.

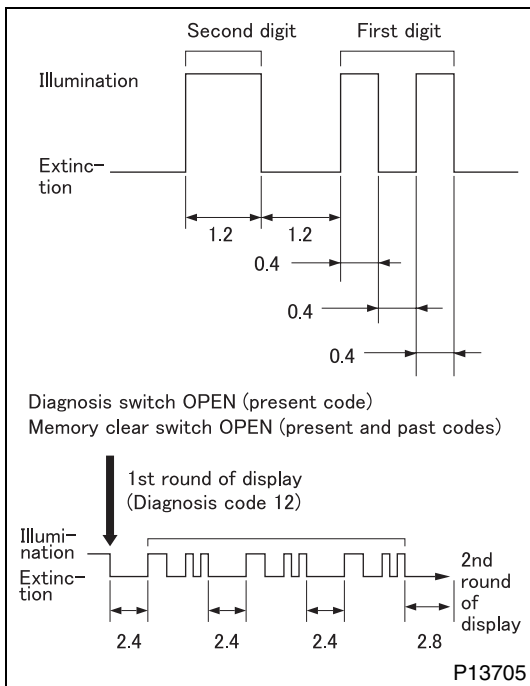
(1.3) Erasing diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, erase diagnosis codes that may have been stored in electronic control unit.

(2) Accessing/erasing diagnosis codes without using Multi-Use Tester

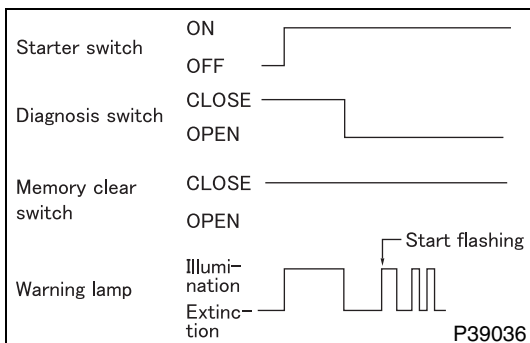


- Using the diagnosis and memory clear switches, display diagnosis codes that may have been stored in electronic control unit.



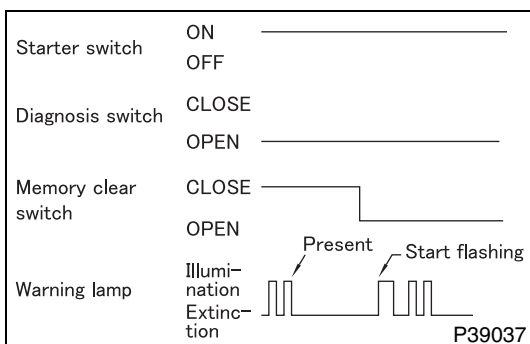
(2.1) Reading diagnosis codes

- To read a diagnosis code, observe how many times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.2 sec.
 - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.
- When the diagnosis switch is connected, electronic control unit will immediately stop (terminate) displaying diagnosis codes.



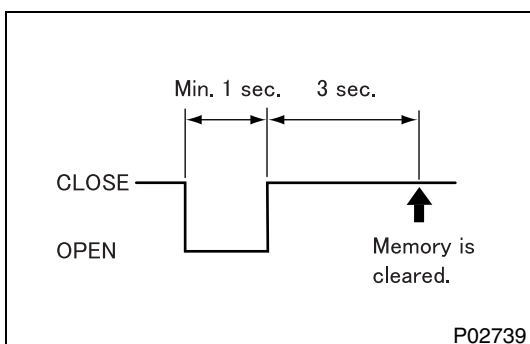
(2.2) Present diagnosis codes

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Diagnosis codes will be displayed (flashing of the warning lamp).



(2.3) Present and past diagnosis codes

- After present diagnosis codes are displayed, (with the diagnosis switch still removed) remove the memory clear switch.
- This will cause the warning lamp to start flashing again to indicate present and past diagnosis codes. Observe the codes that will be displayed, and identify the faults.



(2.4) Erasing diagnosis codes

- All diagnosis codes stored in Electronic control unit can be erased by removing the memory clear switch and then installing it again.

NOTE

- Be careful not to erase diagnosis codes by mistake. They can easily be erased simply by operating the memory clear switch only.
- If you do not wish to erase diagnosis codes after they have been displayed, turn the starter switch OFF with the memory clear switch still removed, and then connect the memory clear switch.

DIAGNOSIS CODES

3. Accessing / Erasing Diagnosis Codes <Auto Cruise>

3.1 Diagnosis codes

- There are two types of diagnosis codes: present codes and past codes.

(1) Present diagnosis codes

- When an error occurs after the starter switch has been turned on (when electronic control unit being energized), the relevant diagnosis code is generated and stored in electronic control unit. This is a present diagnosis code.

(2) Past diagnosis codes

- A present diagnosis code becomes a past diagnosis code and is stored in electronic control unit when it is reset, or when the starter switch is turned OFF and then ON.

3.2 Accessing and erasing diagnosis codes

- Diagnosis codes can be accessed or erased either by using Multi-Use Tester-III, or by using vehicle functions without using Multi-Use Tester-III.
- Removing/installing the dedicated fuses will turn the diagnosis and memory clear switches ON/OFF.

NOTE

- Be sure to restore the fuse to the original location after accessing and/or erasing diagnosis codes.

(1) Accessing/erasing diagnosis codes using Multi-Use Tester

(1.1) Present diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, access present diagnosis codes and, if they exist, identify the faults.

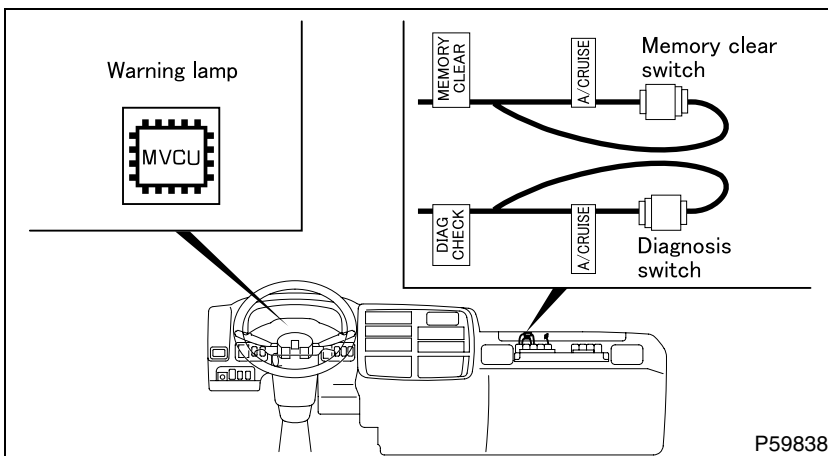
(1.2) Past diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, access past diagnosis codes and, if they exist, identify the faults.

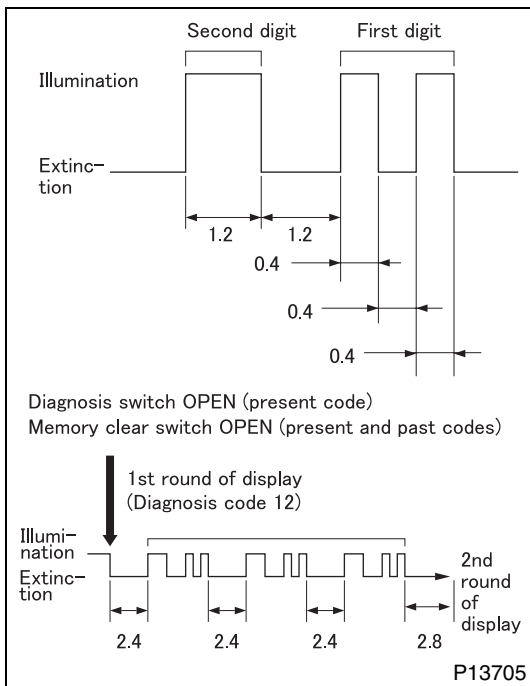
(1.3) Erasing diagnosis codes

- Turn the starter switch ON.
- Using Multi-Use Tester, erase diagnosis codes that may have been stored in electronic control unit.

(2) Accessing/erasing diagnosis codes without using Multi-Use Tester

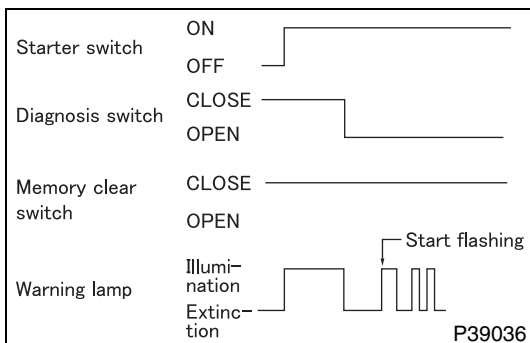


- Using the diagnosis and memory clear switches, display diagnosis codes that may have been stored in electronic control unit.



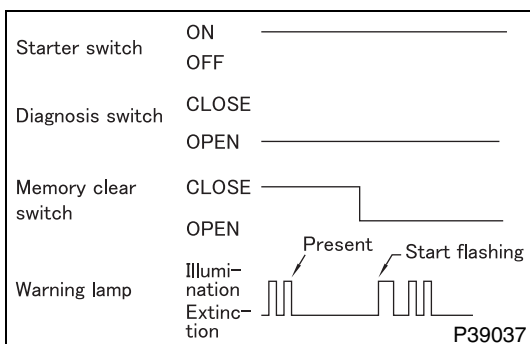
(2.1) Reading diagnosis codes

- To read a diagnosis code, observe how many times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.2 sec.
 - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.
- When the diagnosis switch is connected, electronic control unit will immediately stop (terminate) displaying diagnosis codes.



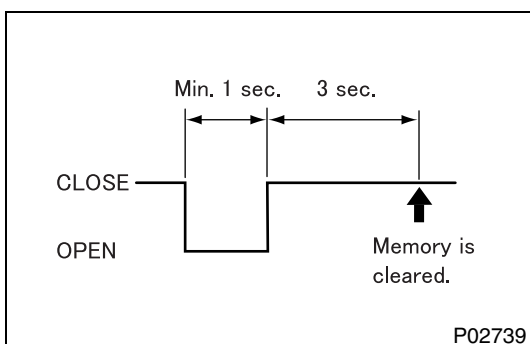
(2.2) Present diagnosis codes

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Diagnosis codes will be displayed (flashing of the warning lamp).



(2.3) Present and past diagnosis codes

- After present diagnosis codes are displayed, (with the diagnosis switch still removed) remove the memory clear switch.
- This will cause the warning lamp to start flashing again to indicate present and past diagnosis codes. Observe the codes that will be displayed, and identify the faults.



(2.4) Erasing diagnosis codes

- All diagnosis codes stored in Electronic control unit can be erased by removing the memory clear switch and then installing it again.

NOTE

- Be careful not to erase diagnosis codes by mistake. They can easily be erased simply by operating the memory clear switch only.
- If you do not wish to erase diagnosis codes after they have been displayed, turn the starter switch OFF with the memory clear switch still removed, and then connect the memory clear switch.

DIAGNOSIS CODES

4. Accessing / Erasing Diagnosis Codes <Anti-lock Brake System>

4.1 Diagnosis codes

- There are two types of diagnosis codes: present codes and past codes.

(1) Present diagnosis codes

- When an error occurs after the starter switch has been turned on (when electronic control unit being energized), the relevant diagnosis code is generated and stored in electronic control unit. This is a present diagnosis code.

(2) Past diagnosis codes

- A present diagnosis code becomes a past diagnosis code and is stored in electronic control unit when it is reset, or when the starter switch is turned OFF and then ON.

4.2 Accessing and erasing diagnosis codes

- Diagnosis codes can be accessed or erased either by using Multi-Use Tester-II or Multi-Use Tester-III, or by using vehicle functions without using Multi-Use Tester.
- Removing/installing the dedicated fuses will turn the diagnosis and memory clear switches ON/OFF.

NOTE

- Be sure to restore the fuse to the original location after accessing and/or erasing diagnosis codes.

(1) Accessing/erasing diagnosis codes using Multi-Use Tester

(1.1) Present diagnosis codes

- Turn the starter switch ON.
- With the memory clear switch connected in the fuse box, use Multi-Use Tester to access present diagnosis codes and, if they exist, identify the faults.

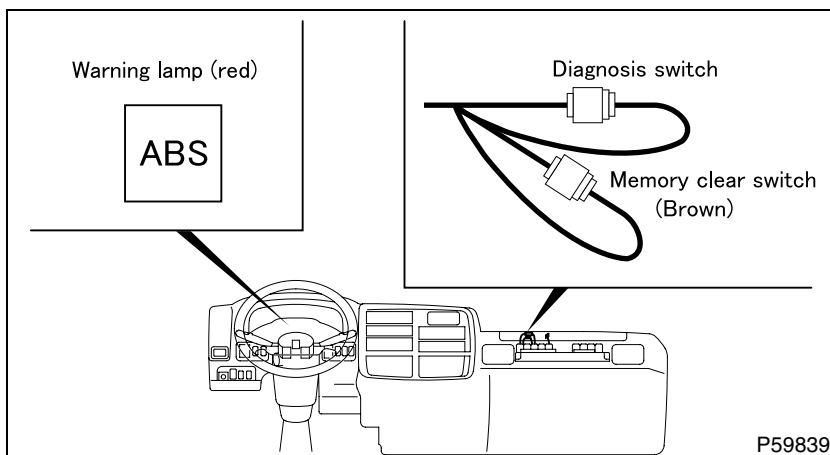
(1.2) Past diagnosis codes

- Turn the starter switch ON.
- With the memory clear switch removed, use Multi-Use Tester to access past diagnosis codes and, if they exist, identify the faults.

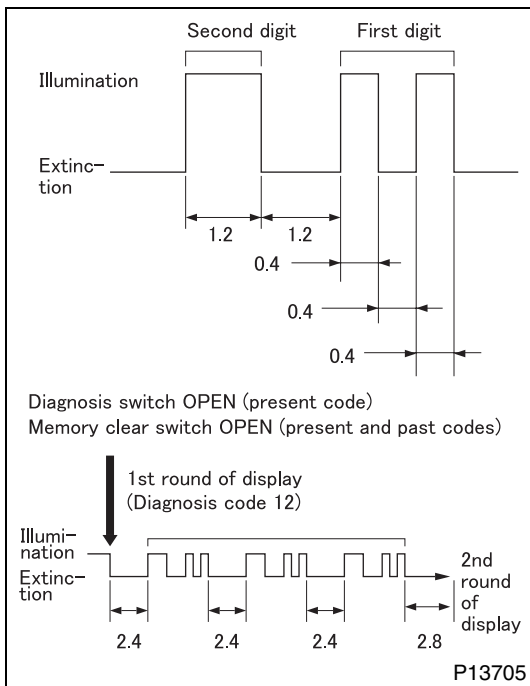
(1.3) Erasing diagnosis codes

- Turn the starter switch ON.
- Use Multi-Use Tester to erase diagnosis codes that may have been stored in electronic control unit.

(2) Accessing/erasing diagnosis codes without using Multi-Use Tester

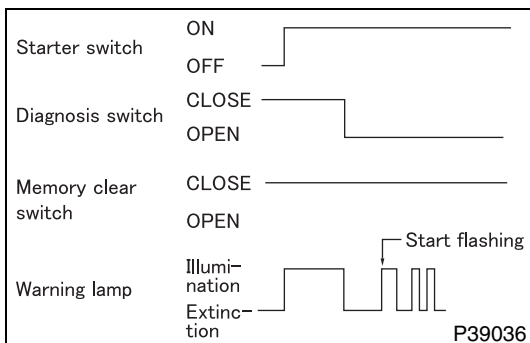


- Using the diagnosis and memory clear switches, display diagnosis codes that may have been stored in electronic control unit.



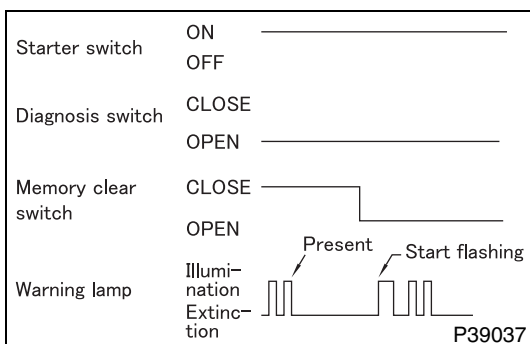
(2.1) Reading diagnosis codes

- To read a diagnosis code, observe how many times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.2 sec.
 - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.
- When the diagnosis switch is connected, electronic control unit will immediately stop (terminate) displaying diagnosis codes.



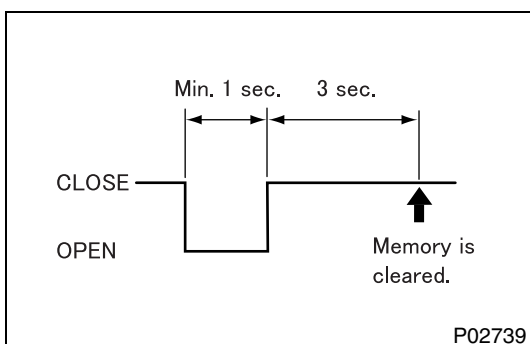
(2.2) Present diagnosis codes

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Diagnosis codes will be displayed (flashing of the warning lamp).



(2.3) Present and past diagnosis codes

- After present diagnosis codes are displayed, (with the diagnosis switch still removed) remove the memory clear switch.
- This will cause the warning lamp to start flashing again to indicate present and past diagnosis codes. Observe the codes that will be displayed, and identify the faults.



(2.4) Erasing diagnosis codes

- All diagnosis codes stored in Electronic control unit can be erased by removing the memory clear switch and then installing it again.

NOTE

- Be careful not to erase diagnosis codes by mistake. They can easily be erased simply by operating the memory clear switch only.
- If you do not wish to erase diagnosis codes after they have been displayed, turn the starter switch OFF with the memory clear switch still removed, and then connect the memory clear switch.

TABLE OF STANDARD TIGHTENING TORQUES

- Use specified bolts and nuts and tighten them at specified torques according to the following table, unless otherwise specified.
- Threads and contact seats shall be dry.
- Where there is a difference in strength classification between the nut and bolt (or stud bolt), the torque specified for the bolt shall apply.

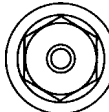
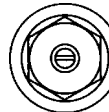
Hex-head Bolt and Stud Bolt

Unit : N·m {ft.lbs, kgf·m}

Strength classification	4 T		7 T		8 T	
Repre- sentation Diameter symbol	  (Stud)		  (Stud)		  (Stud)	
M 5	2 to 3 {1.5 to 2.2, 0.2 to 0.3}	–	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	5 to 7 {3.7 to 5.2, 0.5 to 0.7}	–
M 6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	7 to 10 {5.2 to 7.4, 0.7 to 1.0}	–	8 to 12 {5.9 to 8.9, 0.8 to 1.2}	–
M 8	9 to 13 {6.6 to 9.6, 0.9 to 1.3}	–	16 to 24 {12 to 18, 1.7 to 2.5}	–	19 to 28 {14 to 21, 2.0 to 2.9}	–
M 10	18 to 27 {13 to 20, 1.8 to 2.7}	17 to 25 {13 to 18, 1.8 to 2.6}	34 to 50 {25 to 37, 3.5 to 5.1}	32 to 48 {24 to 35, 3.3 to 4.9}	45 to 60 {33 to 44, 4.5 to 6.0}	37 to 55 {27 to 41, 3.8 to 5.7}
M 12	34 to 50 {25 to 37, 3.4 to 5.1}	31 to 45 {23 to 33, 3.1 to 4.6}	70 to 90 {52 to 66, 7.0 to 9.5}	65 to 85 {48 to 63, 6.5 to 8.5}	80 to 105 {59 to 77, 8.5 to 11}	75 to 95 {55 to 70, 7.5 to 10}
M 14	60 to 80 {44 to 59, 6.0 to 8.0}	55 to 75 {41 to 55, 5.5 to 7.5}	110 to 150 {81 to 110, 11 to 15}	100 to 140 {74 to 105, 11 to 14}	130 to 170 {96 to 125, 13 to 17}	120 to 160 {89 to 120, 12 to 16}
M 16	90 to 120 {66 to 89, 9 to 12}	90 to 110 {66 to 81, 9 to 11}	170 to 220 {125 to 160, 17 to 23}	160 to 210 {120 to 155, 16 to 21}	200 to 260 {145 to 190, 20 to 27}	190 to 240 {140 to 175, 19 to 25}
M 18	130 to 170 {96 to 125, 14 to 18}	120 to 150 {89 to 110, 12 to 16}	250 to 330 {185 to 245, 25 to 33}	220 to 290 {160 to 215, 23 to 30}	290 to 380 {215 to 280, 30 to 39}	250 to 340 {185 to 250, 26 to 35}
M 20	180 to 240 {130 to 175, 19 to 25}	170 to 220 {125 to 160, 17 to 22}	340 to 460 {250 to 340, 35 to 47}	310 to 410 {230 to 300, 32 to 42}	400 to 530 {295 to 390, 41 to 55}	360 to 480 {265 to 355, 37 to 49}
M 22	250 to 330 {185 to 245, 25 to 33}	230 to 300 {170 to 220, 23 to 30}	460 to 620 {340 to 455, 47 to 63}	420 to 560 {310 to 415, 43 to 57}	540 to 720 {400 to 530, 55 to 73}	490 to 650 {360 to 480, 50 to 67}
M 24	320 to 430 {235 to 315, 33 to 44}	290 to 380 {215 to 280, 29 to 39}	600 to 810 {440 to 595, 62 to 83}	540 to 720 {400 to 530, 55 to 73}	700 to 940 {515 to 695, 72 to 96}	620 to 830 {455 to 610, 63 to 85}

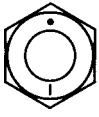
Hex-head Flange Bolt

Unit : N·m {ft.lbs, kgf·m}

Strength classification	4 T		7 T		8 T	
Repre- sentation Diameter symbol						
M 6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	–	8 to 12 {5.9 to 8.9, 0.8 to 1.2}	–	10 to 14 {7.4 to 10, 1.0 to 1.4}	–
M 8	10 to 15 {7.4 to 11, 1.0 to 1.5}	–	19 to 28 {14 to 21, 2.0 to 2.9}	–	22 to 33 {16 to 24, 2.3 to 3.3}	–
M 10	21 to 31 {15 to 23, 2.1 to 3.1}	20 to 29 {15 to 21, 2.0 to 3.0}	45 to 55 {33 to 41, 4.5 to 5.5}	37 to 54 {27 to 40, 3.8 to 5.6}	50 to 65 {37 to 48, 5.0 to 6.5}	50 to 60 {37 to 44, 5.0 to 6.5}
M 12	38 to 56 {28 to 41, 3.8 to 5.5}	35 to 51 {26 to 38, 3.5 to 5.2}	80 to 105 {59 to 77, 8.0 to 10.5}	70 to 95 {52 to 95, 7.5 to 9.5}	90 to 120 {66 to 89, 9 to 12}	85 to 110 {63 to 81, 8.5 to 11}

Hex-head Nut

Unit : N·m {ft.lbs, kgf·m}

Strength classification	4 T		6 T	
Repre- sentation			   	
Diameter symbol	Standard screw	Coarse screw	Standard screw	Coarse screw
M 5	2 to 3 {1.5 to 2.2, 0.2 to 0.3}	—	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
M 6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—	7 to 10 {5.2 to 7.4, 0.7 to 1.0}	—
M 8	9 to 13 {6.6 to 9.6, 0.9 to 1.3}	—	16 to 24 {12 to 18, 1.7 to 2.5}	—
M 10	18 to 27 {13 to 20, 1.8 to 2.7}	17 to 25 {13 to 18, 1.8 to 2.6}	34 to 50 {25 to 37, 3.5 to 5.1}	32 to 48 {24 to 35, 3.3 to 4.9}
M 12	34 to 50 {25 to 37, 3.4 to 5.1}	31 to 45 {23 to 33, 3.1 to 4.6}	70 to 90 {52 to 66, 7.0 to 9.5}	65 to 85 {48 to 63, 6.5 to 8.5}
M 14	60 to 80 {44 to 59, 6.0 to 8.0}	55 to 75 {41 to 55, 5.5 to 7.5}	110 to 150 {81 to 110, 11 to 15}	100 to 140 {74 to 105, 11 to 14}
M 16	90 to 120 {66 to 89, 9 to 12}	90 to 110 {66 to 81, 9 to 11}	170 to 220 {125 to 160, 17 to 23}	160 to 210 {120 to 155, 16 to 21}
M 18	130 to 170 {96 to 125, 14 to 18}	120 to 150 {89 to 110, 12 to 16}	250 to 330 {185 to 245, 25 to 33}	220 to 290 {160 to 215, 23 to 30}
M 20	180 to 240 {130 to 175, 19 to 25}	170 to 220 {125 to 160, 17 to 22}	340 to 460 {250 to 340, 35 to 47}	310 to 410 {230 to 300, 32 to 42}
M 22	250 to 330 {185 to 245, 25 to 33}	230 to 300 {170 to 220, 23 to 30}	460 to 620 {340 to 455, 47 to 63}	420 to 560 {310 to 415, 43 to 57}
M 24	320 to 430 {235 to 315, 33 to 44}	290 to 380 {215 to 280, 29 to 39}	600 to 810 {440 to 595, 62 to 83}	540 to 720 {400 to 530, 55 to 73}

Hex-head Flange Nut Unit : N·m {ft.lbs, kgf·m}

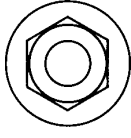
Strength classification	4 T	
Repre- sentation		
Diameter symbol	Standard screw	Coarse screw
M 6	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
M 8	10 to 15 {7.4 to 11, 1.0 to 1.5}	—
M 10	21 to 31 {15 to 23, 2.1 to 3.1}	20 to 29 {15 to 21, 2.0 to 3.0}
M 12	38 to 56 {28 to 41, 3.8 to 5.5}	35 to 51 {26 to 38, 3.5 to 5.2}

TABLE OF STANDARD TIGHTENING TORQUES

Tightening torque for flair nut for general purpose

Unit : N·m {ft.lbs, kgf·m}

Pipe diameter	φ4.76 mm {0.19 in.}	φ6.35 mm {0.25 in.}	φ8 mm {0.31 in.}	φ10 mm {0.39 in.}	φ12 mm {0.47 in.}	φ15 mm {0.59 in.}
Tightening torque	17 {13, 1.7}	25 {18, 2.6}	39 {29, 4.0}	59 {44, 6.0}	88 {65, 9.0}	98 {72, 10}

Tightening torque for air piping nylon tube for general purpose {DIN type} Unit : N·m {ft.lbs, kgf·m}

Standard diameter	6 × 1 mm {0.24 × 0.0039 in.}	10 × 1.25 mm {0.39 × 0.049 in.}	12 × 1.5 mm {0.47 × 0.059 in.}	15 × 1.5 mm {0.59 × 0.059 in.}
Tightening torque	20 ⁺⁶ ₀ {15 ^{+4.4} ₀ , 2.0 ^{+0.6} ₀ }	34 ⁺¹⁰ ₀ {25 ^{+7.4} ₀ , 3.5 ^{+1.0} ₀ }	49 ⁺¹⁰ ₀ {36 ^{+7.4} ₀ , 5.0 ^{+1.0} ₀ }	54 ⁺⁵ ₀ {40 ^{+3.7} ₀ , 5.5 ^{+0.5} ₀ }

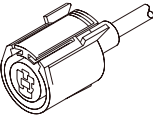
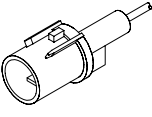
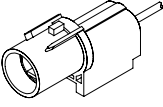
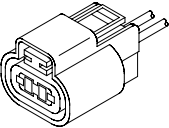
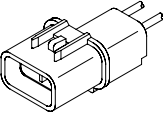
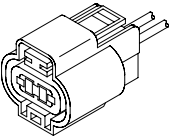
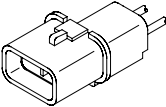
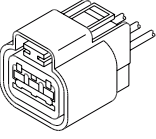
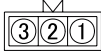
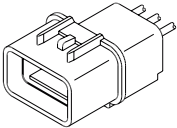
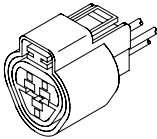
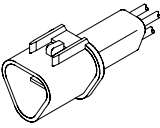
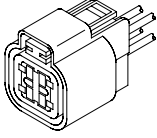
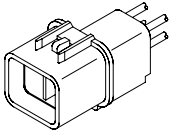
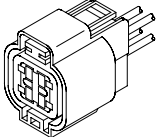
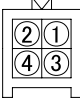
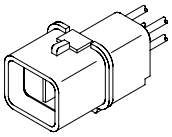
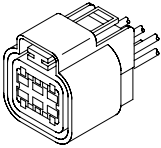
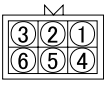
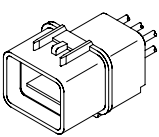
Tightening torque for air piping nylon tube for general purpose {SAE type} Unit : N·m {ft.lbs, kgf·m}

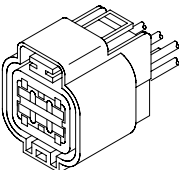
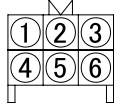
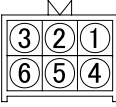
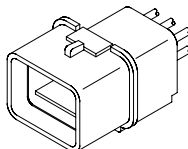
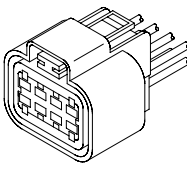
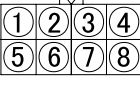
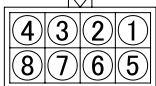
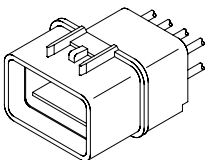
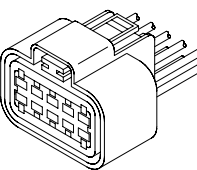
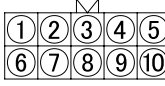
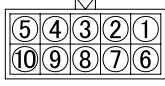
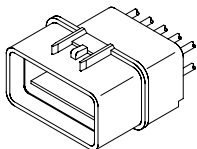
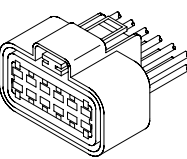
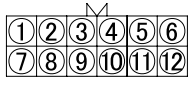
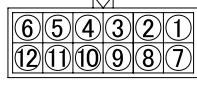
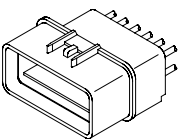
Standard diameter	1/4 in.	3/8 in.	1/2 in.	5/8 in.
Tightening torque	13 ⁺⁴ ₀ {9.6 ^{+3.0} ₀ , 1.3 ^{+0.4} ₀ }	29 ⁺⁵ ₀ {21 ^{+3.7} ₀ , 3.0 ^{+0.5} ₀ }	49 ⁺⁵ ₀ {36 ^{+3.7} ₀ , 5.0 ^{+0.5} ₀ }	64 ⁺⁵ ₀ {47 ^{+3.7} ₀ , 6.5 ^{+0.5} ₀ }

MEMO

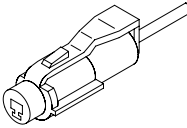
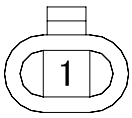
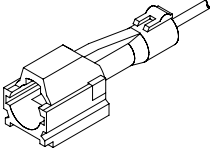
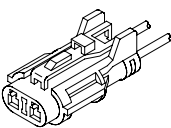
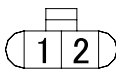
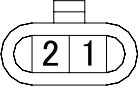
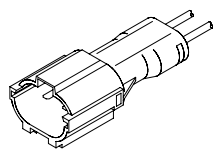
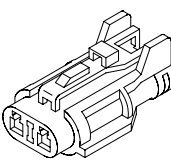
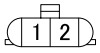
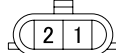
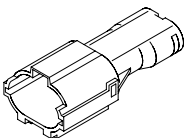
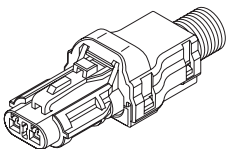
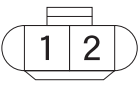
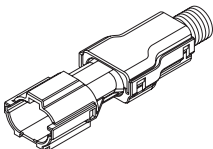
CONNECTOR CONFIGURATION CHART

AA type

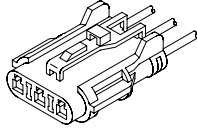
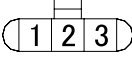
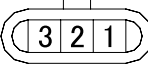
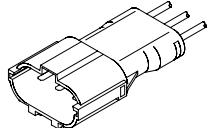
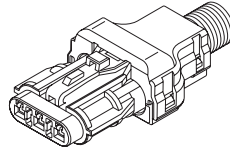
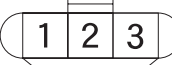
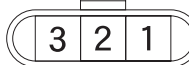
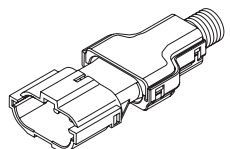
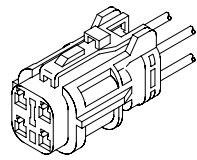
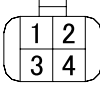
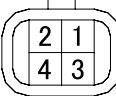
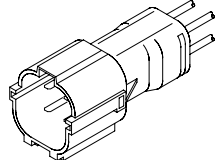
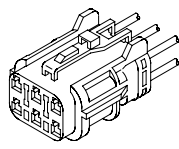
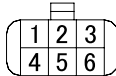
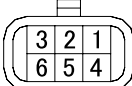
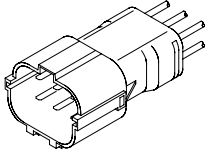
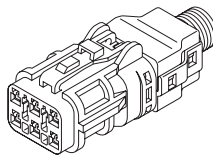
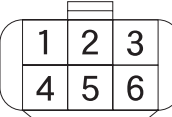
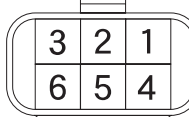
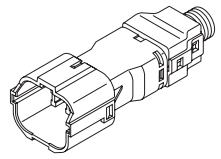
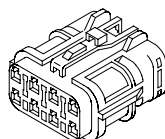
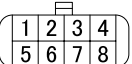
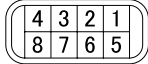
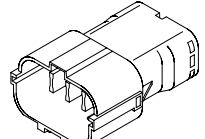
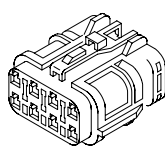
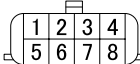
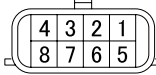
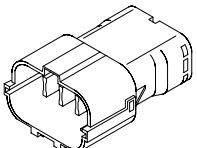
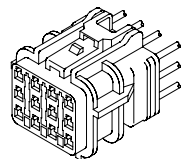
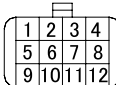
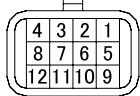
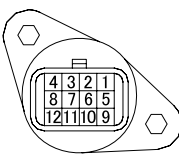
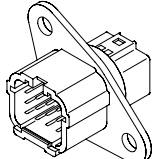
Number shows number of pins	Female connector	Male connector
AA1A	 	  
AA2A	 	 
AA2B	 	 
AA3A	 	 
AA3B	 	 
AA4A	 	 
AA4B	 	 
AA6A	 	 

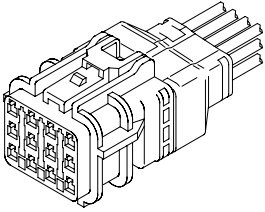
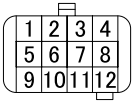
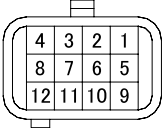
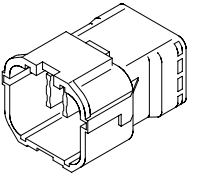
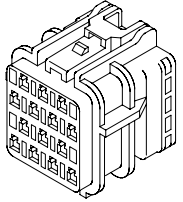
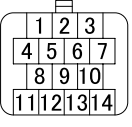
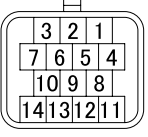
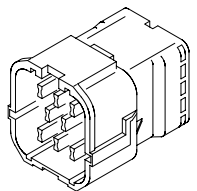
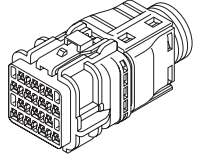
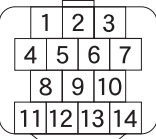
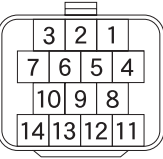
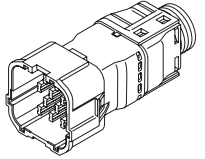
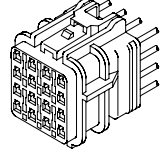
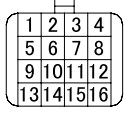
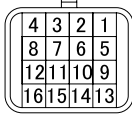
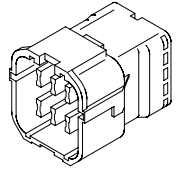
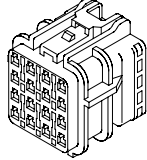
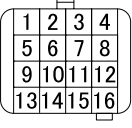
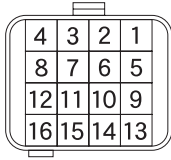
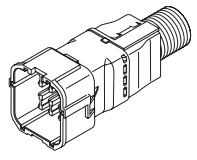
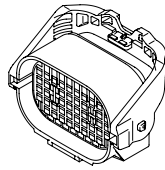
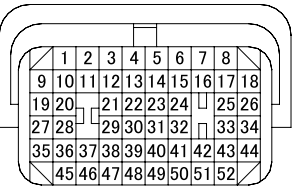
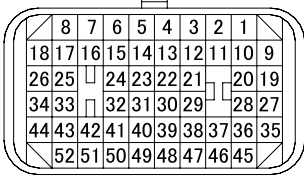
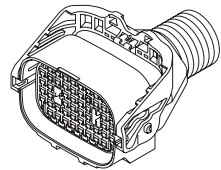
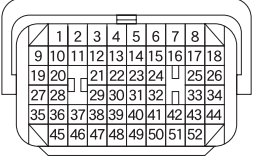
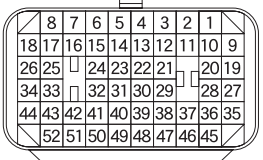
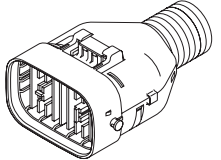
Number shows number of pins	Female connector	Male connector
AA6B	 	 
AA8A	 	 
AA10A	 	 
AA12A	 	 

AB type

Number shows number of pins	Female connector	Male connector
AB1A	 	 
AB2A	 	 
AB2B	 	 
AB2C	 	 

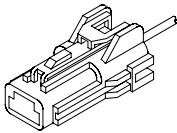
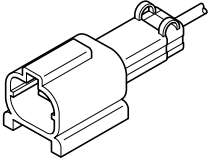
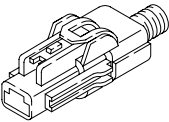
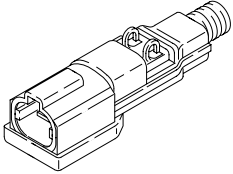
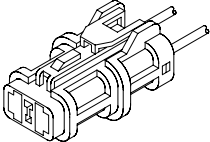
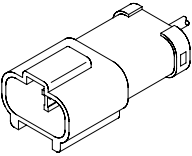
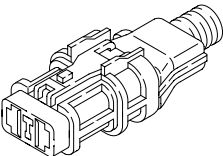
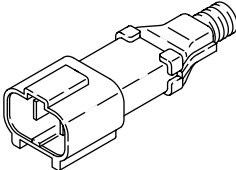
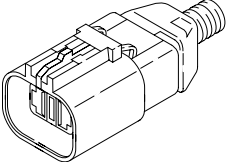
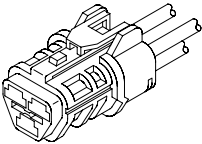
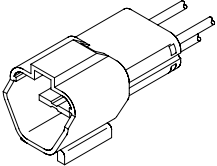
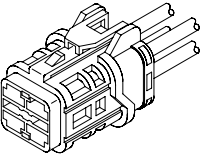
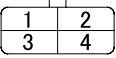
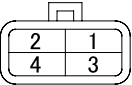
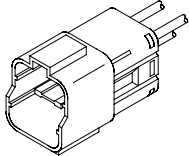
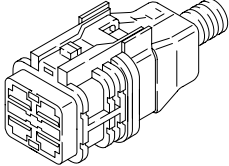
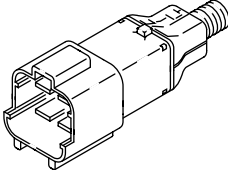
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector		Male connector	
AB3A			 	
AB3B			 	
AB4A			 	
AB6A			 	
AB6B			 	
AB8A			 	
AB8B			 	
AB12A			  	

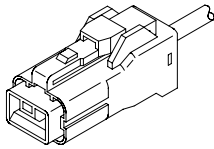
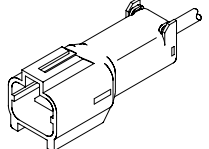
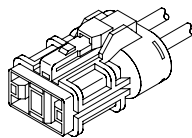
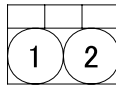
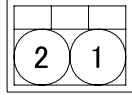
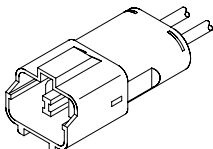
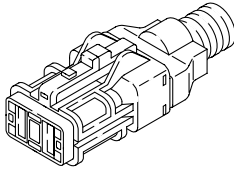
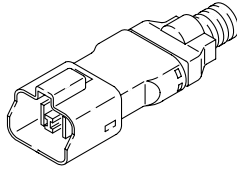
Number shows number of pins	Female connector	Male connector
AB12B	 	 
AB14A	 	 
AB14B	 	 
AB16A	 	 
AB16B	 	 
AB52A	 	
AB52B	 	 

CONNECTOR CONFIGURATION CHART

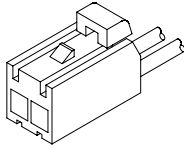
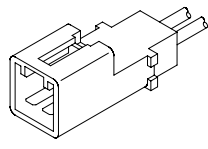
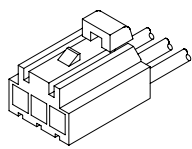
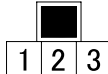
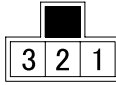
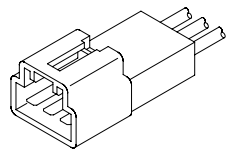
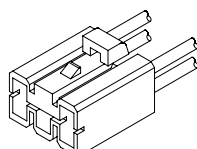
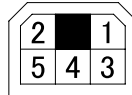
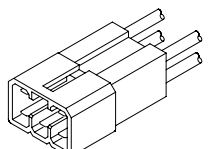
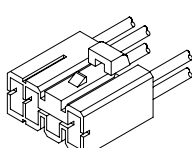
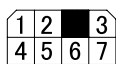
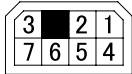
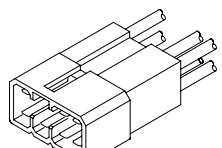
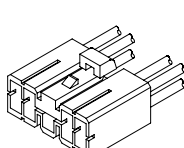
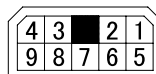
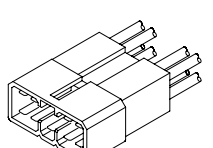
AC type

Number shows number of pins	Female connector		Male connector	
AC1A				
AC1B				
AC2A				
AC2B				
AC2C				
AC3A				
AC4A				
AC4B				

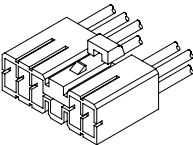
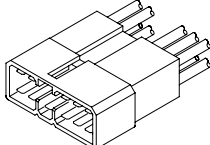
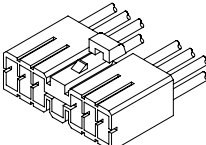
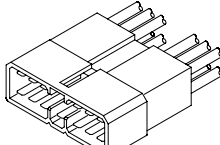
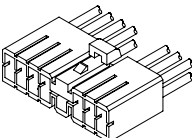
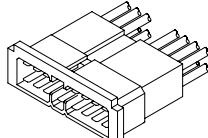
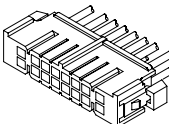
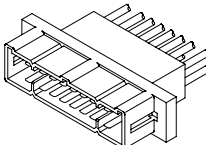
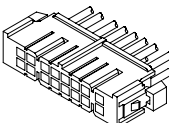
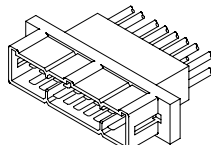
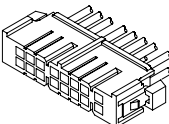
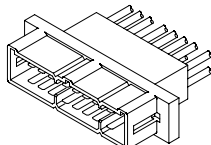
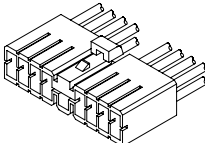
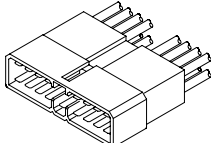
AD type

Number shows number of pins	Female connector	Male connector
AD1A	 	 
AD2A	 	 
AD2B	 	 

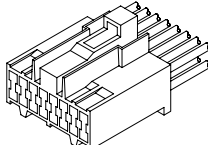
AE type

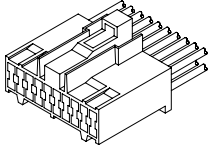
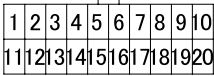
Number shows number of pins	Female connector	Male connector
AE2A	 	 
AE3A	 	 
AE5A	 	 
AE7A	 	 
AE9A	 	 

CONNECTOR CONFIGURATION CHART

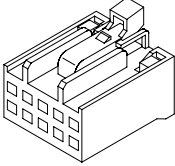
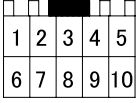
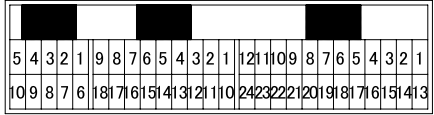
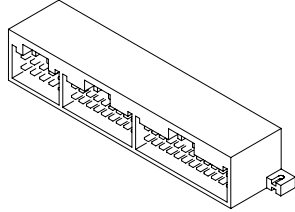
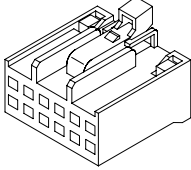
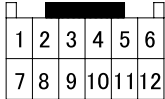
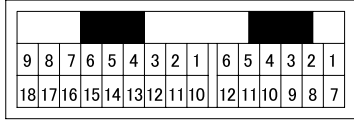
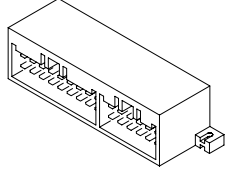
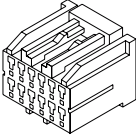
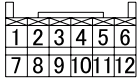
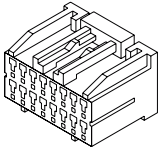
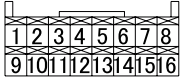
Number shows number of pins	Female connector		Male connector																																					
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AG type

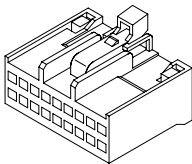
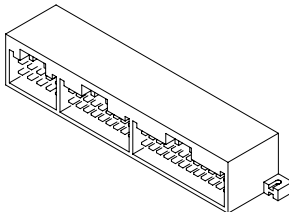
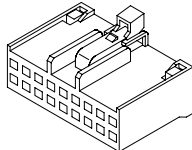
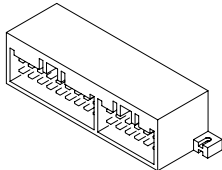
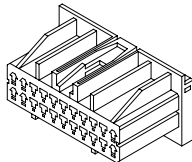
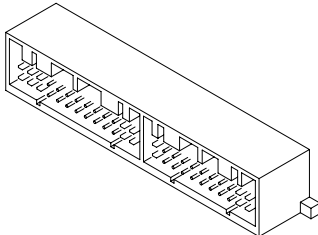
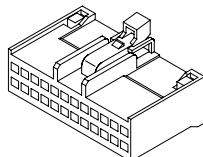
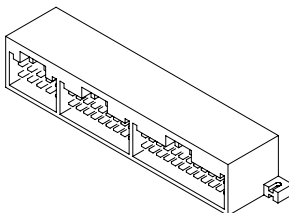
Number shows number of pins	Female connector	Male connector																
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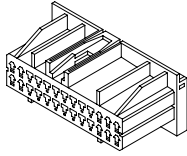
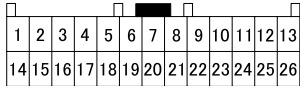
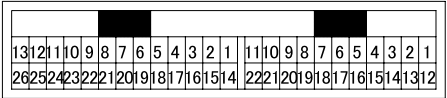
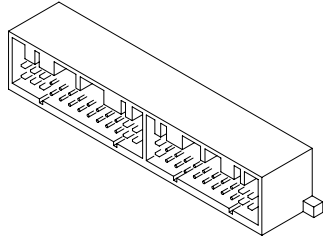
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AG20A	 	

AH type

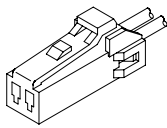
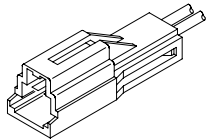
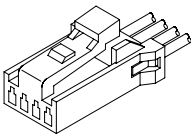
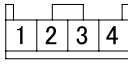
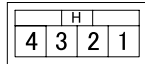
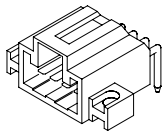
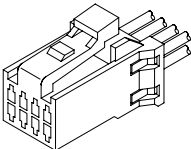
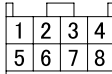
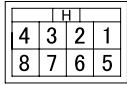
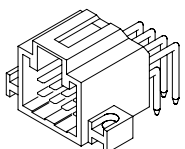
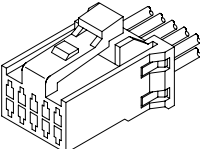
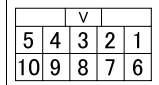
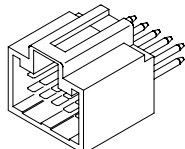
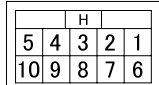
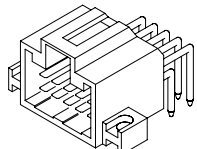
Number shows number of pins	Female connector	Male connector
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AH12A	 	 (AH18B) AH12A 
AH12B	 	
AH16A	 	

CONNECTOR CONFIGURATION CHART

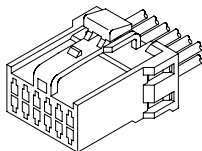
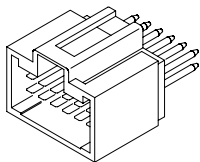
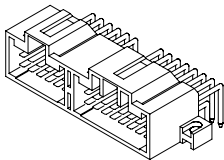
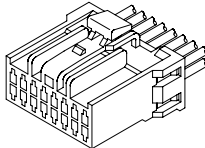
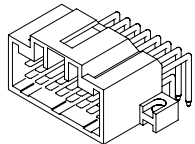
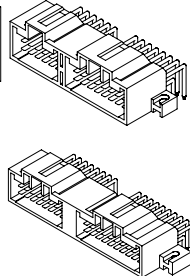
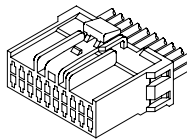
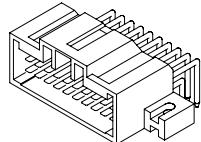
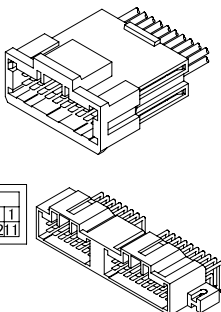
Number shows number of pins	Female connector	Male connector																																																																												
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Number shows number of pins	Female connector	Male connector
AH26A	 	 AH26A (AH22A) 

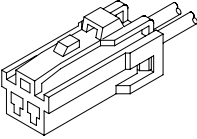
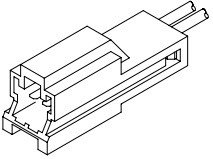
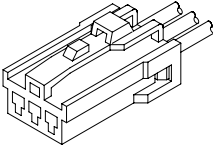
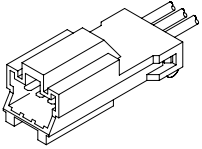
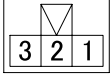
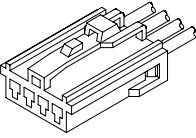
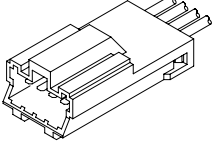
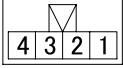
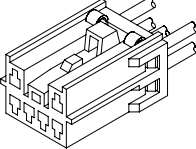
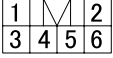
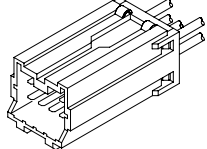
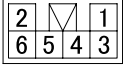
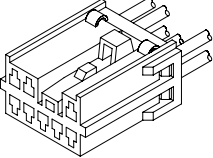
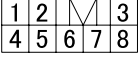
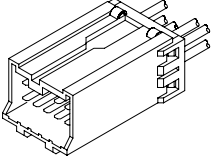
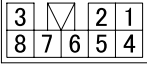
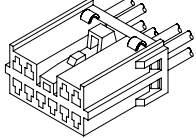
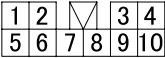
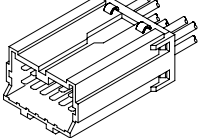
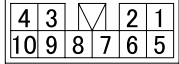
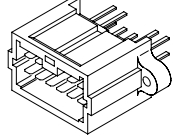
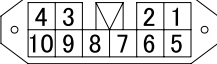
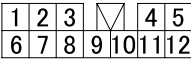
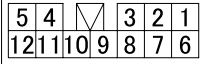
AJ type

Number shows number of pins	Female connector	Male connector
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AJ4A	 	 
AJ8A	 	 
AJ10A	 	   

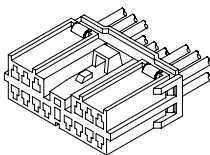
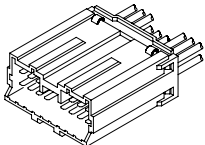
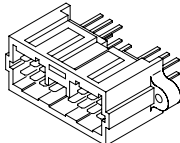
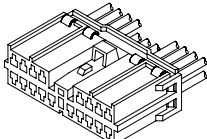
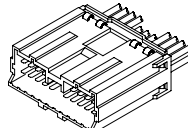
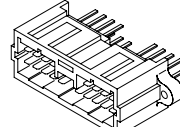
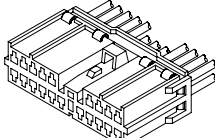
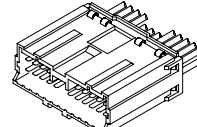
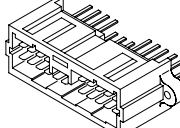
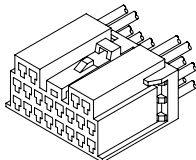
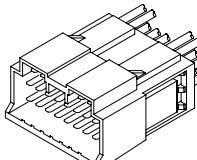
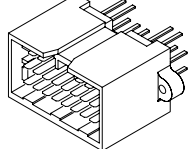
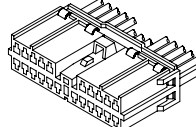
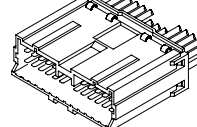
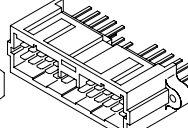
CONNECTOR CONFIGURATION CHART

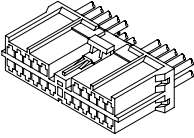
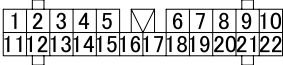
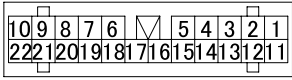
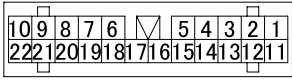
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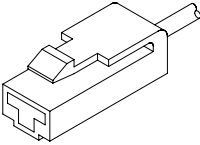
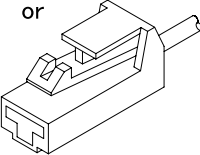
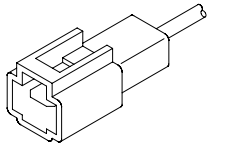
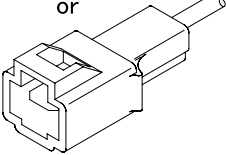
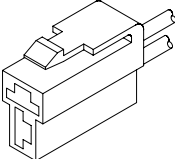
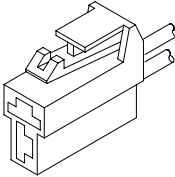
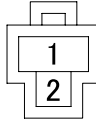
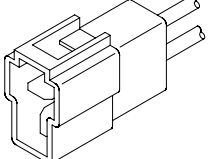
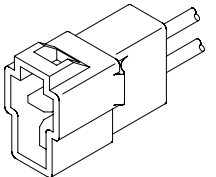
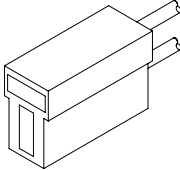
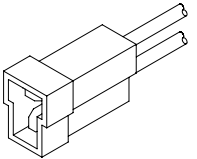
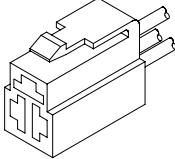
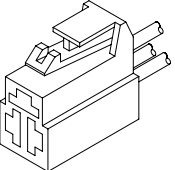
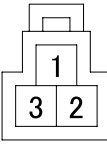
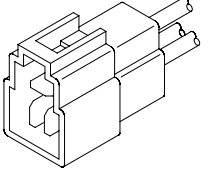
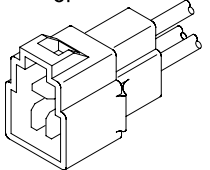
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AK3A	 	 
AK4A	 	 
AK6A	 	 
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CONNECTOR CONFIGURATION CHART

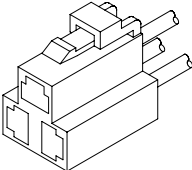
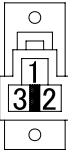
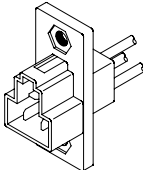
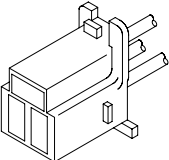
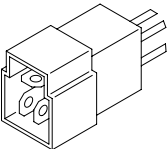
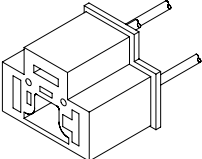
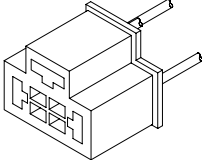
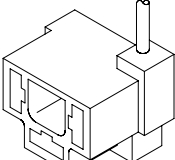
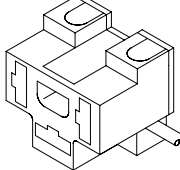
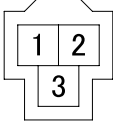
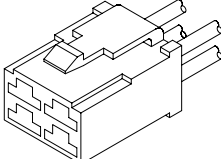
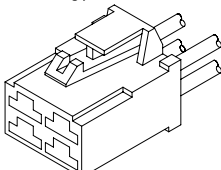
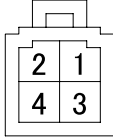
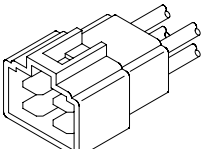
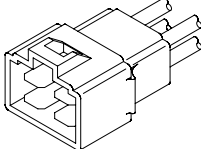
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10	9	8	7	6	▽	5	4	3	2	1																																																													
22	21	20	19	18	17	16	15	14	13	12	11																																																												

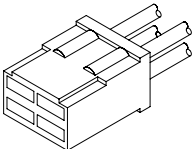
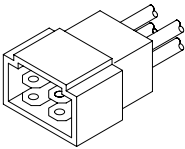
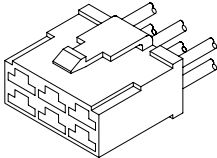
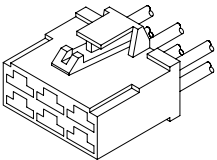
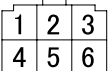
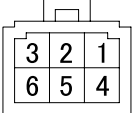
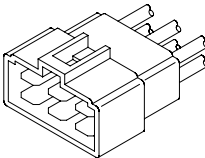
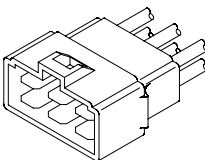
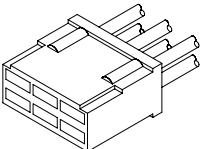
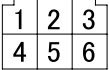
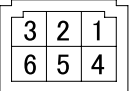
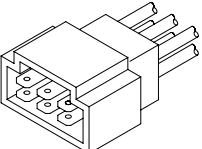
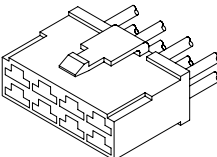
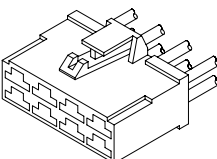
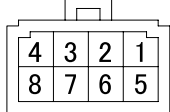
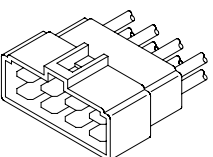
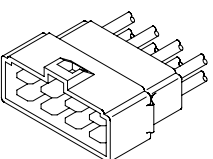
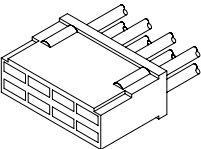
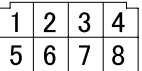
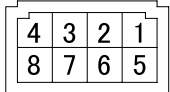
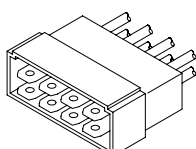
Number shows number of pins	Female connector	Male connector
AK22B	 	 

AL type

Number shows number of pins	Female connector	Male connector
AL1A	  	  
AL2A	  	  
AL2B	 	 
AL3A	  	  

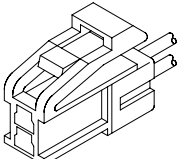
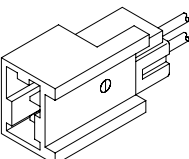
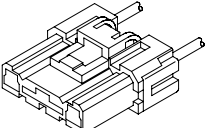
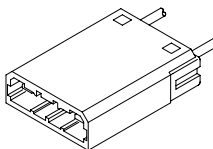
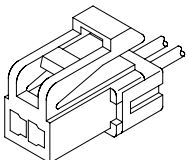
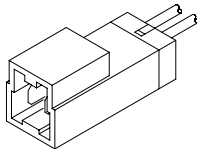
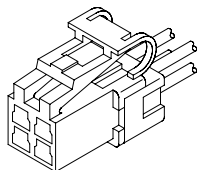
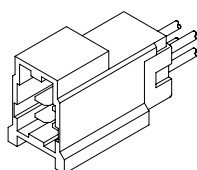
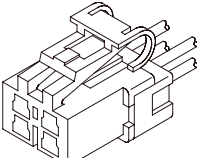
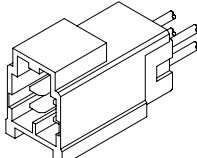
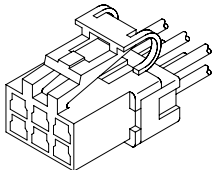
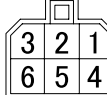
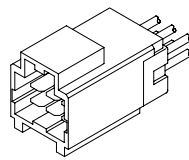
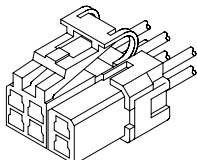
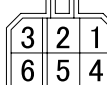
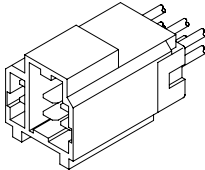
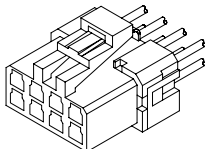
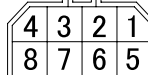
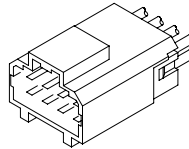
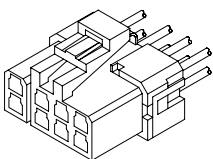
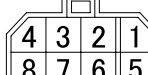
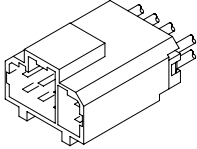
CONNECTOR CONFIGURATION CHART

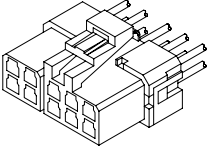
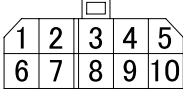
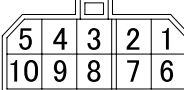
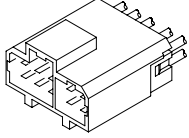
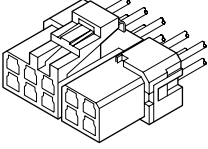
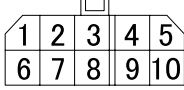
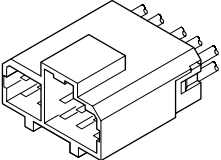
Number shows number of pins	Female connector	Male connector
AL3B	 	 
AL3C	 	 
AL3D	 or  	
AL3E	 or  	
AL4A	 or  	  or 

Number shows number of pins	Female connector	Male connector
AL4B	 	 
AL6A	 or  	  or 
AL6B	 	 
AL8A	 or  	  or 
AL8B	 	 

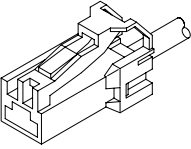
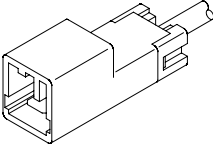
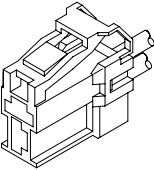
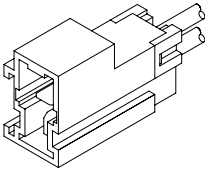
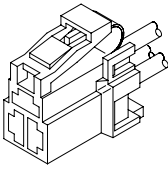
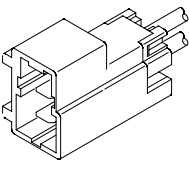
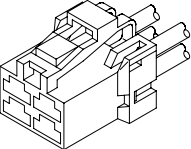
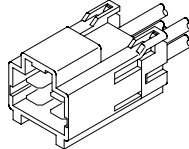
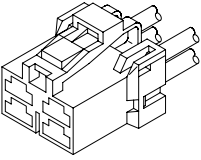
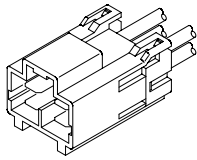
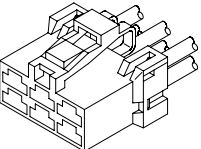
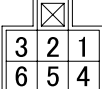
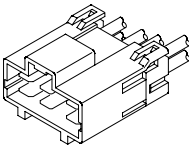
CONNECTOR CONFIGURATION CHART

AM type

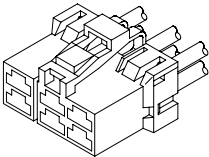
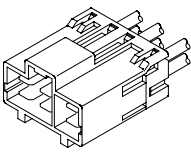
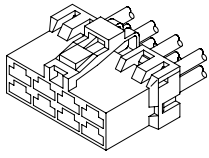
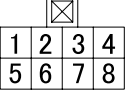
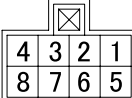
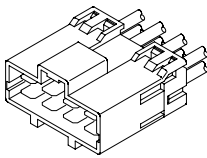
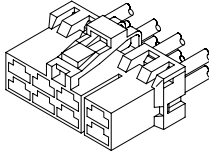
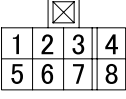
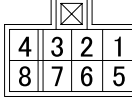
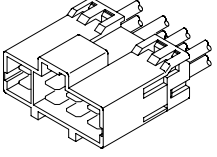
Number shows number of pins	Female connector		Male connector	
AM2A				
AM2B				
AM2C				
AM4A				
AM4B				
AM6A				
AM6B				
AM8A				
AM8B				

Number shows number of pins	Female connector	Male connector
AM10A	 	 
AM10B	 	 

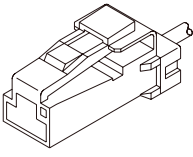
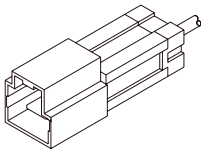
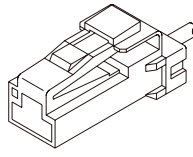
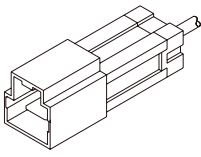
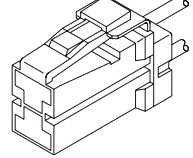
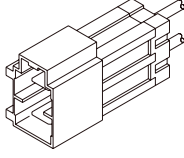
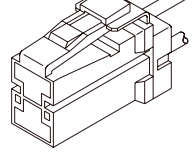
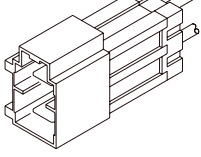
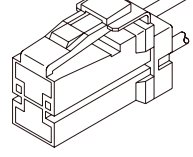
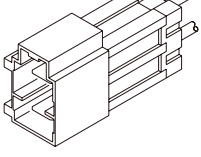
AN type

Number shows number of pins	Female connector	Male connector
AN1A	 	 
AN2A	 	 
AN3A	 	 
AN4A	 	 
AN4B	 	 
AN6A	 	 

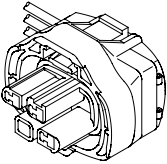
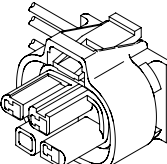
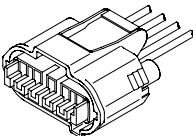
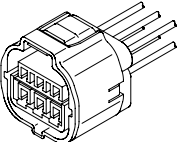
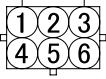
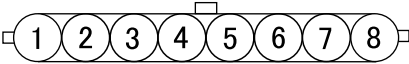
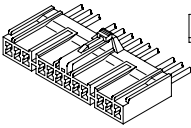
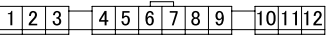
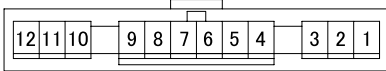
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector		Male connector	
AN6B				
AN8A				
AN8B				

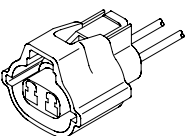
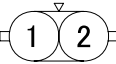
AP type

Number shows number of pins	Female connector		Male connector	
AP1A				
AP1B				
AP2A				
AP2B				
AP2C				

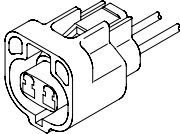
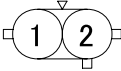
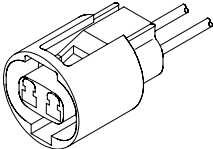
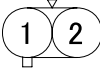
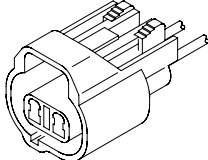
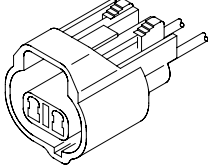
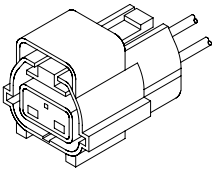
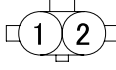
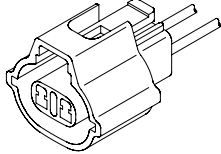
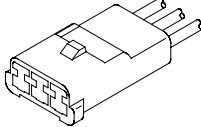
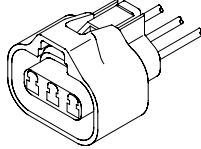
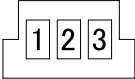
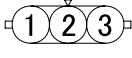
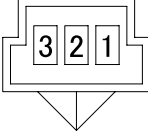
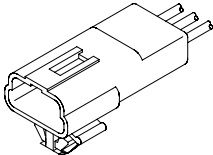
AQ type

Number shows number of pins	Female connector	Male connector
AQ1A		
AQ3A	 	
AQ3B	 	
AQ5A	 	
AQ6A	 	
AQ8A		
AQ12A	 	

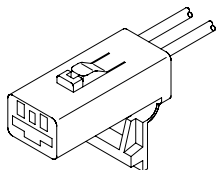
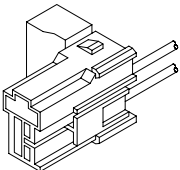
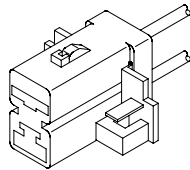
AR type

Number shows number of pins	Female connector	Male connector
AR2A	 	

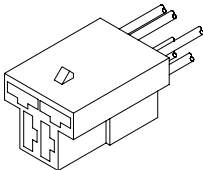
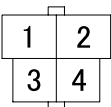
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector		Male connector	
AR2B				
AR2C				
AR2D				
AR2E				
AR2F				
AR2G				
AR2H				
AR3A	 	 		

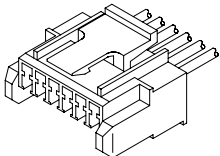
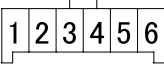
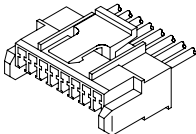
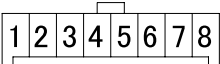
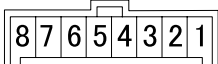
AS type

Number shows number of pins	Female connector	Male connector
AS1A	 	
AS2A	 	
AS2B	 	

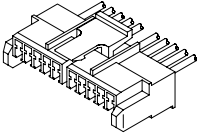
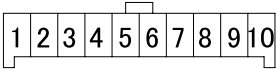
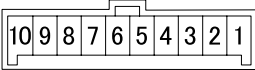
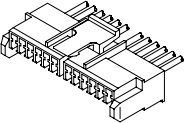
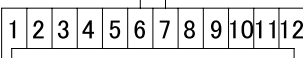
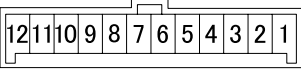
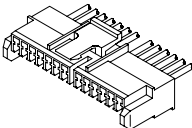
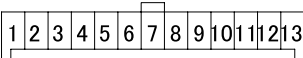
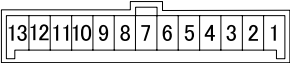
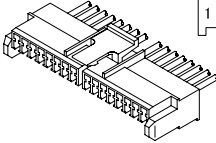
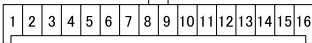
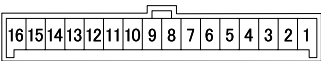
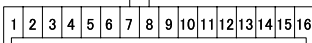
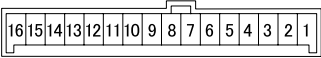
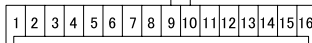
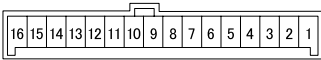
AT type

Number shows number of pins	Female connector	Male connector
AT4A	 	

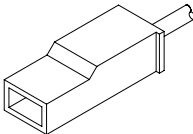
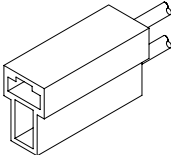
AU type

Number shows number of pins	Female connector	Male connector
AU2A	 	
AU6A	 	
AU8A	 	

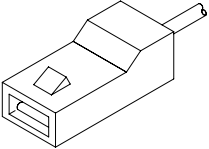
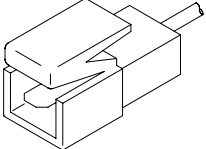
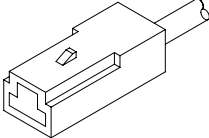
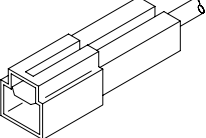
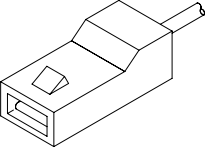
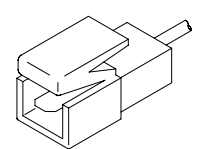
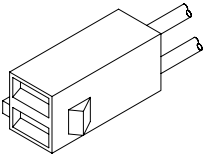
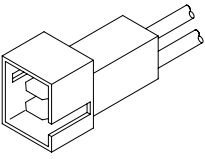
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
AU10A	 	
AU12A	 	
AU13A	 	
AU16A	 	
AU16B		
AU16C		

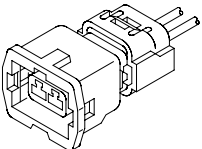
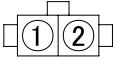
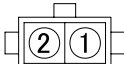
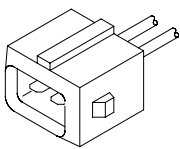
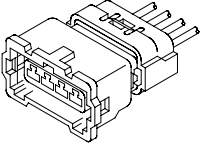
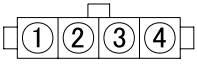
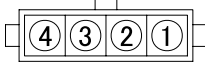
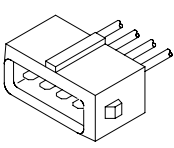
AV type

Number shows number of pins	Female connector	Male connector
AV1A	 	
AV2A	 	

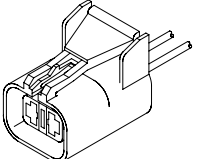
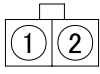
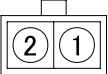
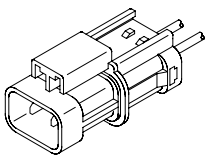
AW type

Number shows number of pins	Female connector		Male connector	
AW1A				
AW1B				
AW1C				
AW2A				

AX type

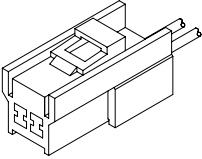
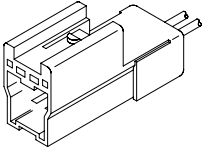
Number shows number of pins	Female connector		Male connector	
AX2A				
AX4A				

AY type

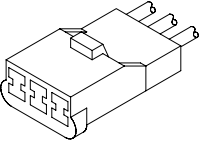
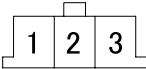
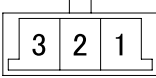
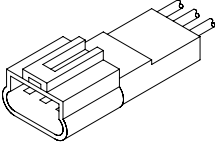
Number shows number of pins	Female connector		Male connector	
AY2A				

CONNECTOR CONFIGURATION CHART

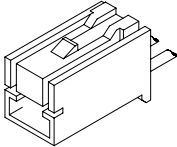
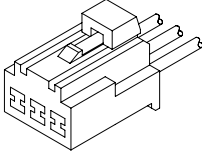
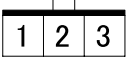
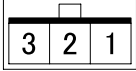
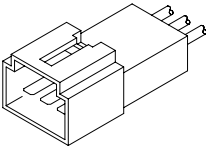
AZ type

Number shows number of pins	Female connector	Male connector
AZ2A	 	 

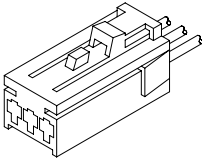
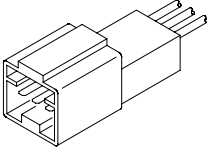
BA type

Number shows number of pins	Female connector	Male connector
BA3A	 	 

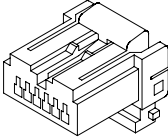
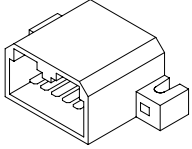
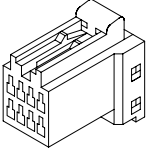
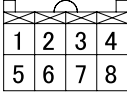
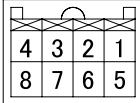
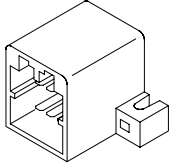
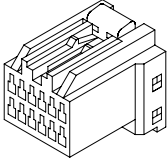
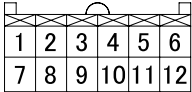
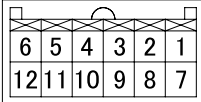
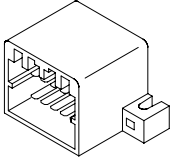
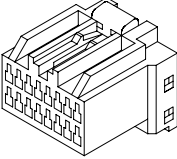
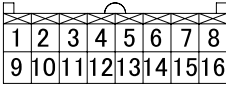
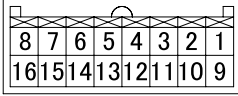
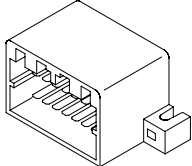
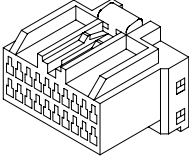
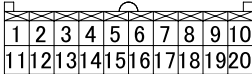
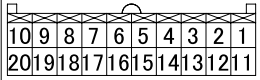
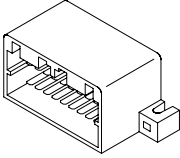
BB type

Number shows number of pins	Female connector	Male connector
BB2A	 	
BB3A	 	 

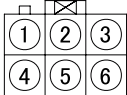
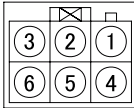
BC type

Number shows number of pins	Female connector	Male connector
BC3A	 	 

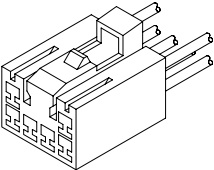
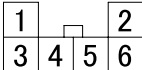
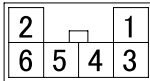
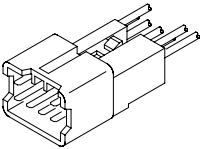
BD type

Number shows number of pins	Female connector	Male connector
BD6A	 	 
BD8A	 	 
BD12A	 	 
BD16A	 	 
BD20A	 	 

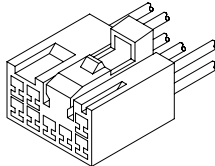
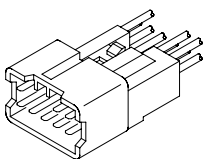
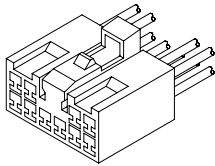
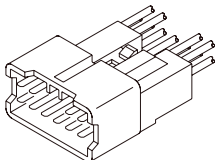
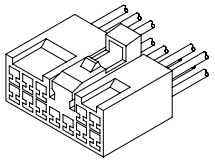
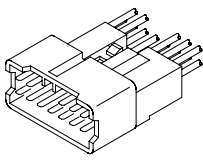
BE type

Number shows number of pins	Female connector	Male connector
BE6A		

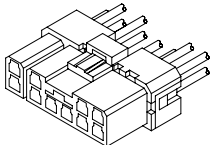
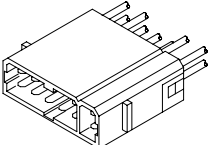
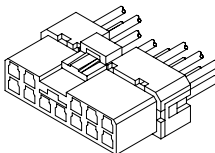
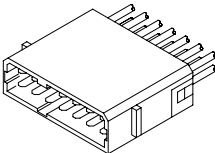
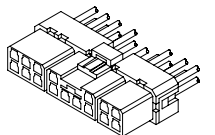
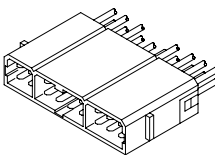
BF type

Number shows number of pins	Female connector	Male connector
BF6A	 	 

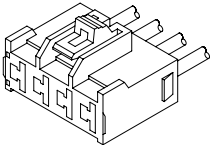
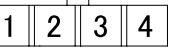
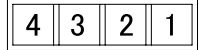
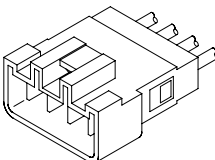
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector																										
BF8A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr></table>	1	2		3	4	5	6	7	8	<table><tr><td>3</td><td></td><td>2</td><td>1</td></tr><tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td></tr></table> 	3		2	1	8	7	6	5	4								
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4	5	6	7	8																								
3		2	1																									
8	7	6	5	4																								
BF10A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr></table>	1	2		3	4	5	6	7	8	9	10	<table><tr><td>4</td><td>3</td><td></td><td>2</td><td>1</td></tr><tr><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td></tr></table> 	4	3		2	1	10	9	8	7	6	5				
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4	3		2	1																								
10	9	8	7	6	5																							
BF12A	 <table><tr><td>1</td><td>2</td><td>3</td><td></td><td>4</td><td>5</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3		4	5	6	7	8	9	10	11	12	<table><tr><td>5</td><td>4</td><td></td><td>3</td><td>2</td><td>1</td></tr><tr><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td></tr></table> 	5	4		3	2	1	12	11	10	9	8	7	6
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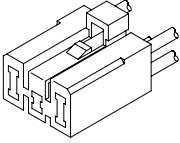
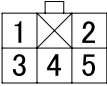
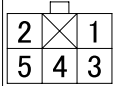
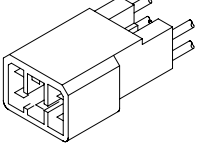
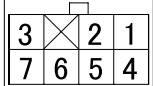
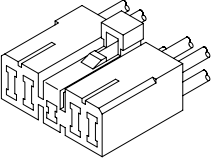
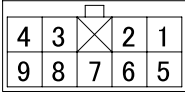
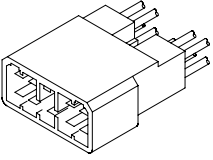
BG type

Number shows number of pins	Female connector	Male connector																																		
BG10A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr></table>	1	2		3	4	5	6	7	8	9	10	<table><tr><td>4</td><td>3</td><td></td><td>2</td><td>1</td></tr><tr><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td></tr></table> 	4	3		2	1	10	9	8	7	6	5												
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4	3		2	1																																
10	9	8	7	6	5																															
BG12A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td><td>5</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2		3	4	5	6	7	8	9	10	11	12	<table><tr><td>5</td><td>4</td><td>3</td><td></td><td>2</td><td>1</td></tr><tr><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td></tr></table> 	5	4	3		2	1	12	11	10	9	8	7	6								
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5	4	3		2	1																															
12	11	10	9	8	7	6																														
BG16A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td></td><td>5</td><td>6</td><td>7</td></tr><tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr></table>	1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	<table><tr><td>7</td><td>6</td><td>5</td><td></td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr></table> 	7	6	5		4	3	2	1	16	15	14	13	12	11	10	9	8
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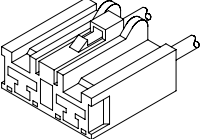
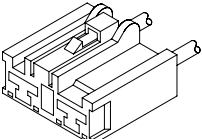
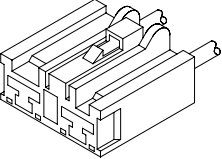
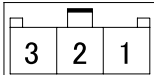
BH type

Number shows number of pins	Female connector	Male connector
BH4A	 	 

BJ type

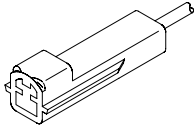
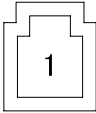
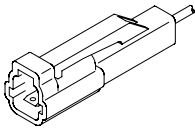
Number shows number of pins	Female connector	Male connector
BJ5A	 	 
BJ7A		
BJ9A	 	 

BM type

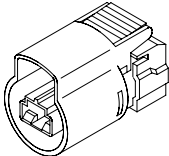
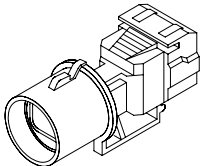
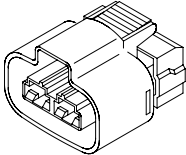
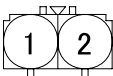
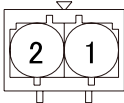
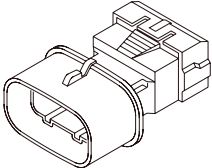
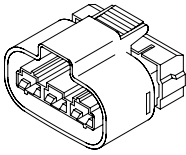
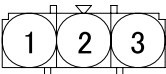
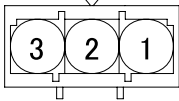
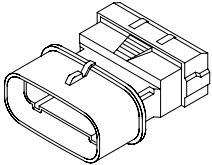
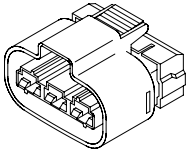
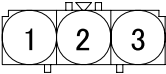
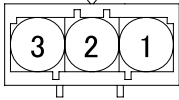
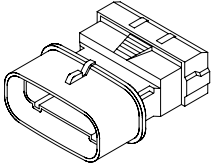
Number shows number of pins	Female connector	Male connector
BM2A	 	
BM2B	 	
BM2C	 	
BM3A		

CONNECTOR CONFIGURATION CHART

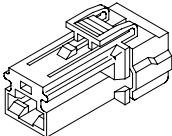
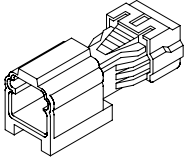
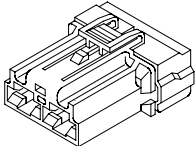
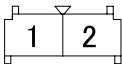
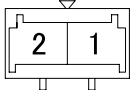
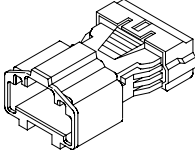
BN type

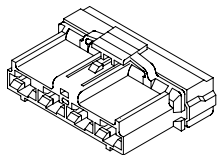
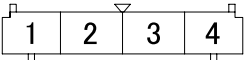
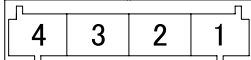
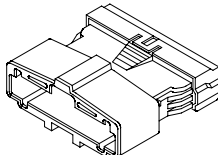
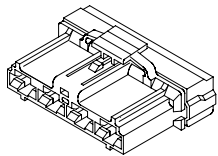
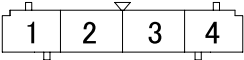
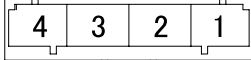
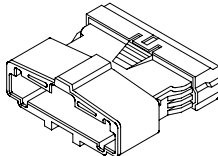
Number shows number of pins	Female connector	Male connector
BN1A	 	 

BQ type

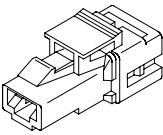
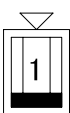
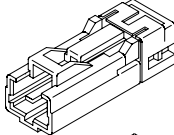
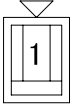
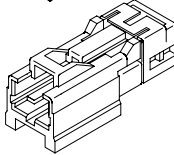
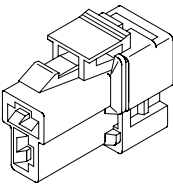
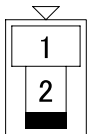
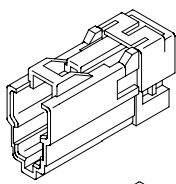
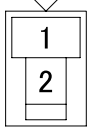
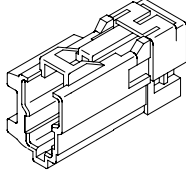
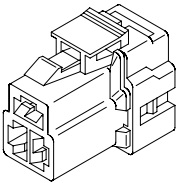
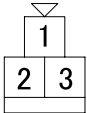
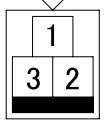
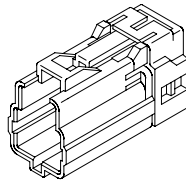
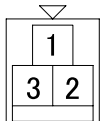
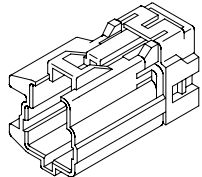
Number shows number of pins	Female connector	Male connector
BQ1A	 	 
BQ2A	 	 
BQ3A	 	 
BQ3B	 	 

BR type

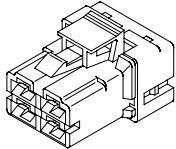
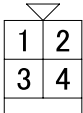
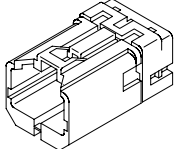
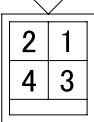
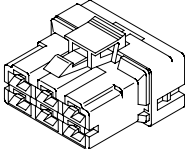
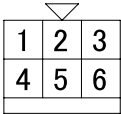
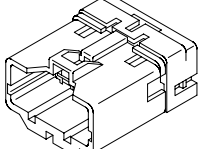
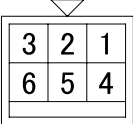
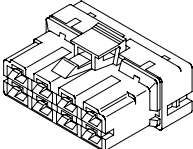
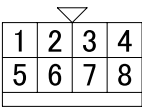
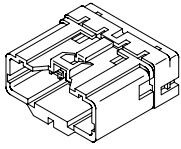
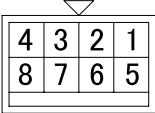
Number shows number of pins	Female connector	Male connector
BR1A	 	 
BR2A	 	 

Number shows number of pins	Female connector	Male connector
BR4A	 	 
BR4B	 	 

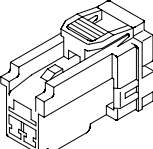
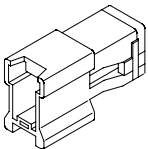
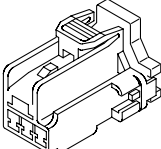
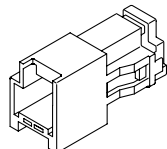
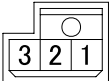
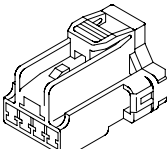
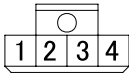
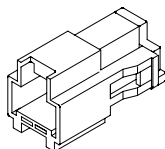
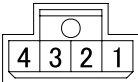
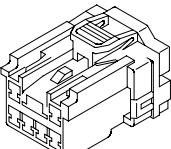
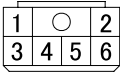
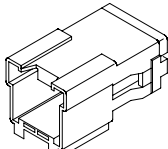
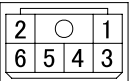
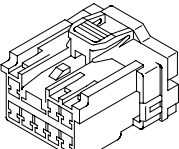
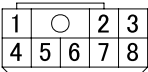
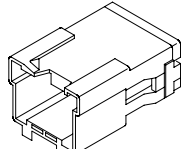
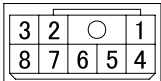
BS type

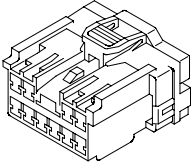
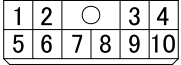
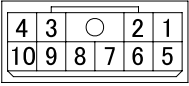
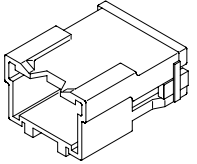
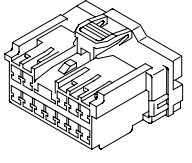
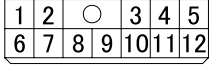
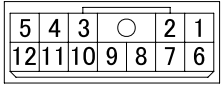
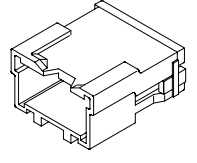
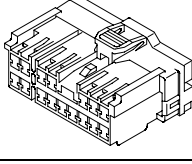
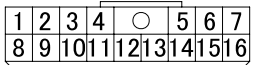
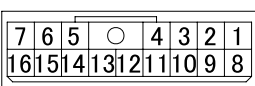
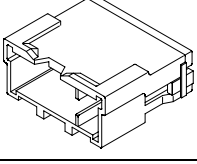
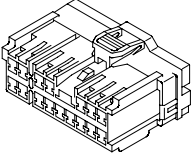
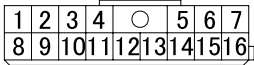
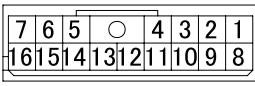
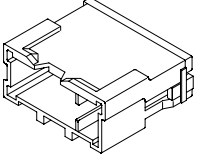
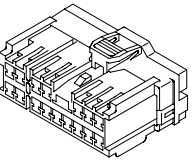
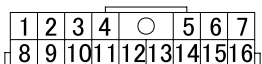
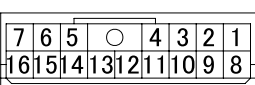
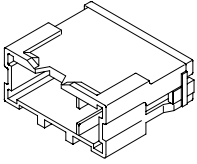
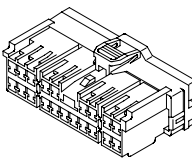
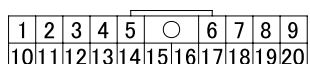
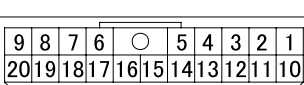
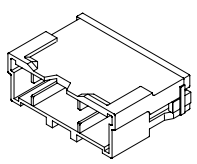
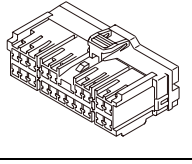
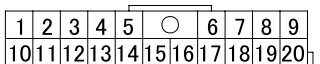
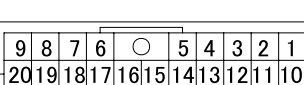
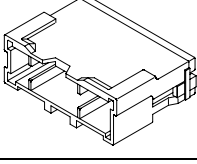
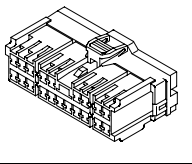
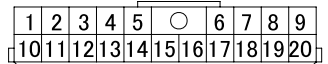
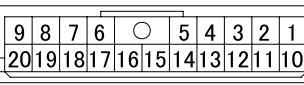
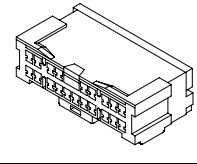
Number shows number of pins	Female connector	Male connector
BS1A	 	   
BS2A	 	   
BS3A	 	   

CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
BS4A	 	 
BS6A	 	 
BS8A	 	 

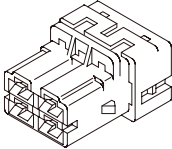
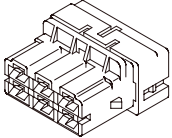
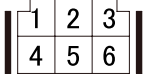
BT type

Number shows number of pins	Female connector	Male connector
BT2A	 	 
BT3A	 	 
BT4A	 	 
BT6A	 	 
BT8A	 	 

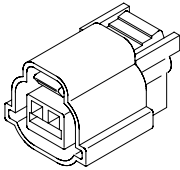
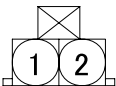
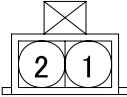
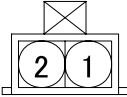
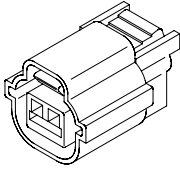
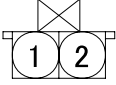
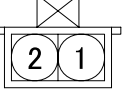
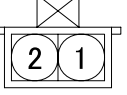
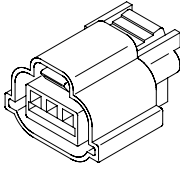
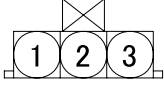
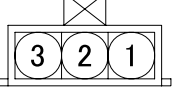
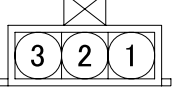
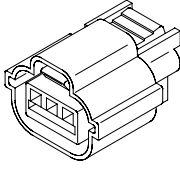
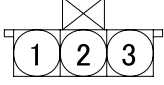
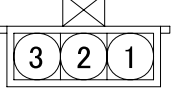
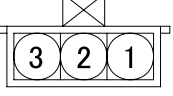
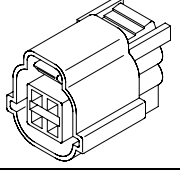
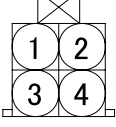
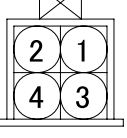
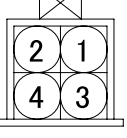
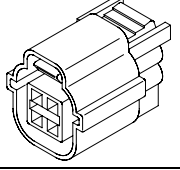
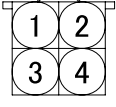
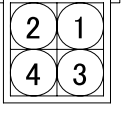
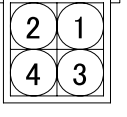
Number shows number of pins	Female connector	Male connector
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BT12A	 	 
BT16A	 	 
BT16B	 	 
BT16C	 	 
BT20A	 	 
BT20B	 	 
BT20C	 	 

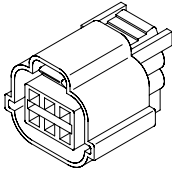
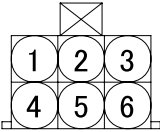
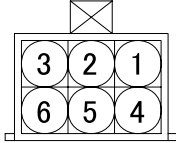
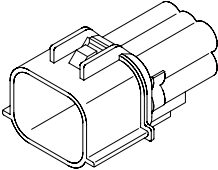
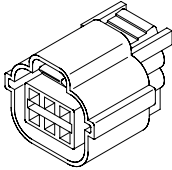
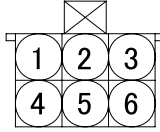
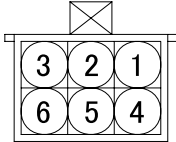
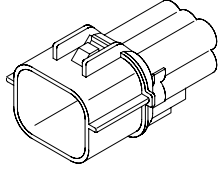
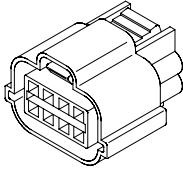
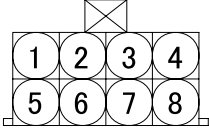
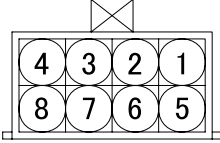
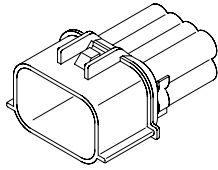
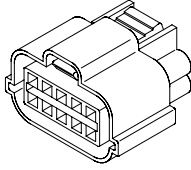
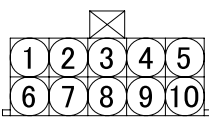
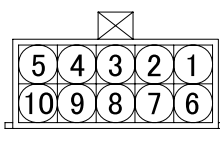
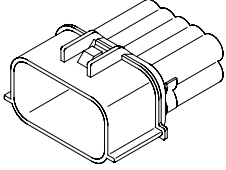
CONNECTOR CONFIGURATION CHART

BU type

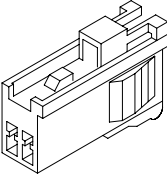
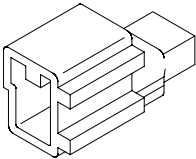
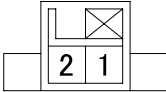
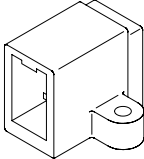
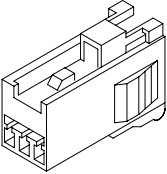
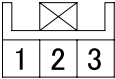
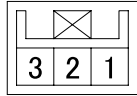
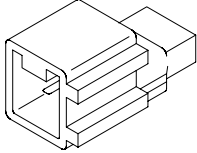
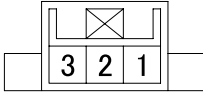
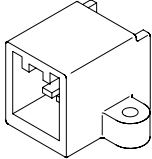
Number shows number of pins	Female connector	Male connector
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BU6A	 	

BW type

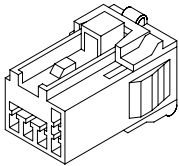
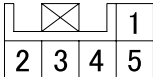
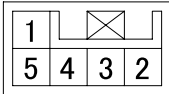
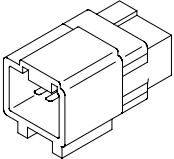
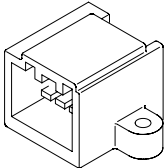
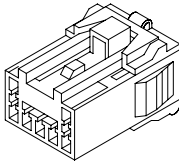
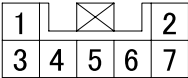
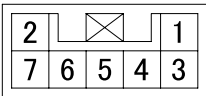
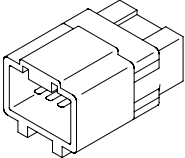
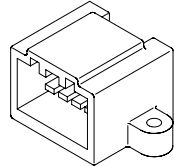
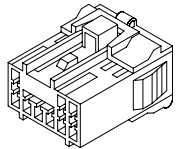
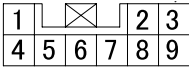
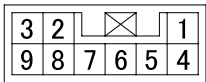
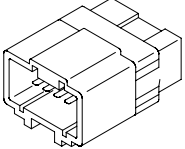
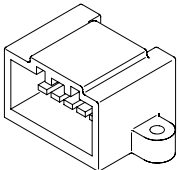
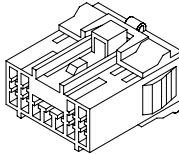
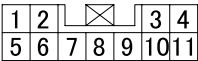
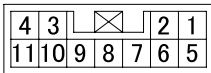
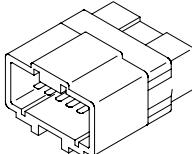
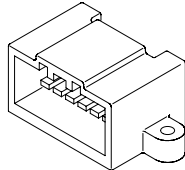
Number shows number of pins	Female connector	Male connector
BW2A	 	 
BW2B	 	 
BW3A	 	 
BW3B	 	 
BW4A	 	 
BW4B	 	 

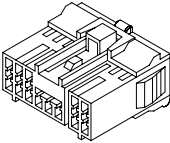
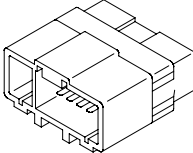
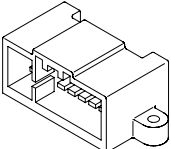
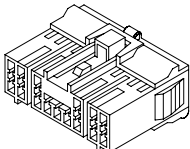
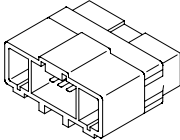
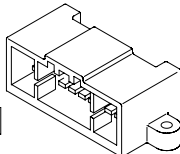
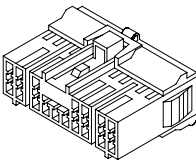
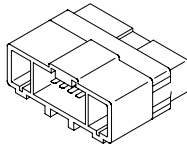
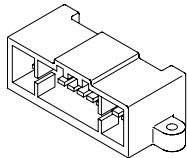
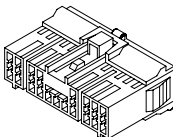
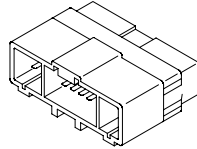
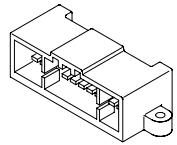
Number shows number of pins	Female connector	Male connector
BW6A	 	 
BW6B	 	 
BW8A	 	 
BW10A	 	 

BX type

Number shows number of pins	Female connector	Male connector
BX2A	 	   
BX3A	 	   

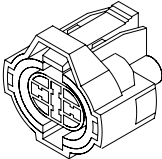
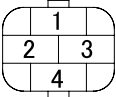
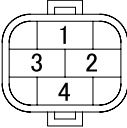
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
BX5A	 	  
BX7A	 	  
BX9A	 	  
BX11A	 	  

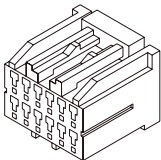
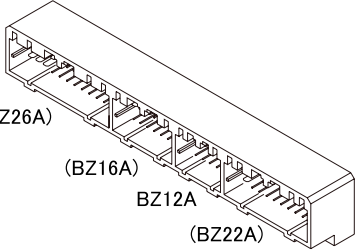
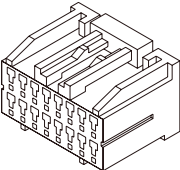
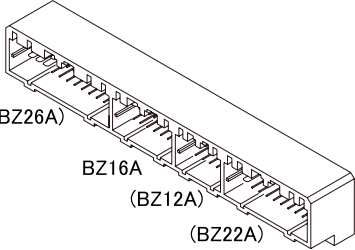
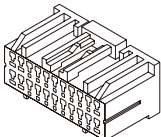
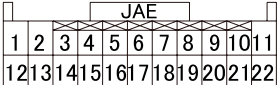
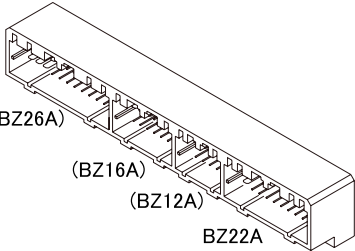
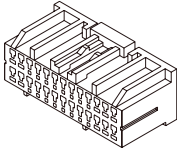
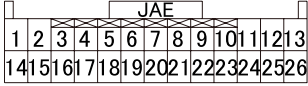
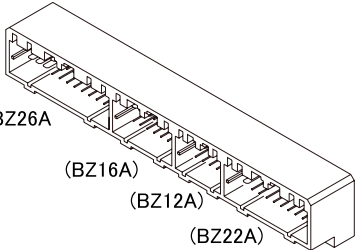
Number shows number of pins	Female connector	Male connector																																																																																	
BX13A	 <table><tr><td>1</td><td>2</td><td>3</td><td></td><td>4</td><td>5</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr><tr><td></td><td></td><td></td><td></td><td>12</td><td>13</td></tr></table>	1	2	3		4	5	6	7	8	9	10	11					12	13	<table><tr><td>5</td><td>4</td><td></td><td></td><td>3</td><td>2</td><td>1</td></tr><tr><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>6</td></tr></table>  <table><tr><td>5</td><td>4</td><td></td><td></td><td>3</td><td>2</td><td>1</td></tr><tr><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>6</td></tr></table> 	5	4			3	2	1	13	12	11	10	9	8	7							6	5	4			3	2	1	13	12	11	10	9	8	7							6																					
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CONNECTOR CONFIGURATION CHART

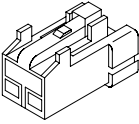
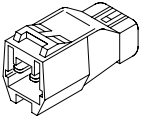
BY type

Number shows number of pins	Female connector	Male connector
BY4A	 	

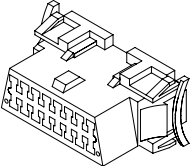
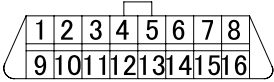
BZ type

Number shows number of pins	Female connector	Male connector
BZ12A	 	 (BZ26A) (BZ16A) BZ12A (BZ22A)
BZ16A	 	 (BZ26A) BZ16A (BZ12A) (BZ22A)
BZ22A	 	 (BZ26A) (BZ16A) (BZ12A) BZ22A
BZ26A	 	 BZ26A (BZ16A) (BZ12A) (BZ22A)

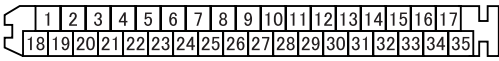
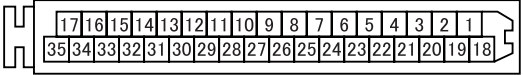
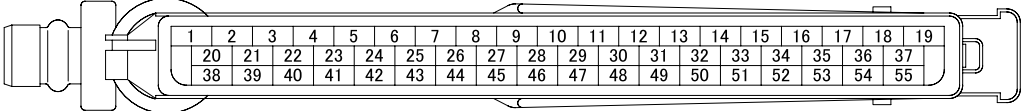
CA type

Number shows number of pins	Female connector	Male connector
CA2A	 	 

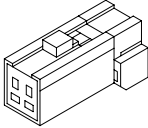
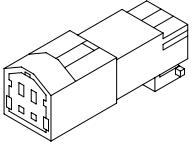
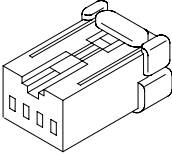
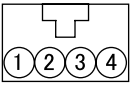
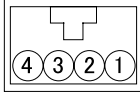
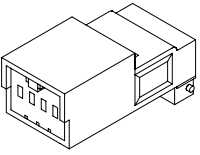
CB type

Number shows number of pins	Female connector	Male connector
CB16A	 	

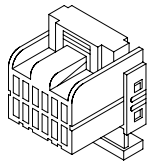
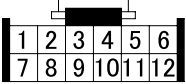
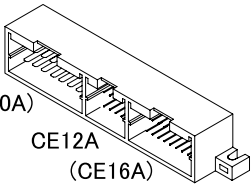
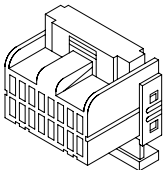
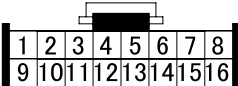
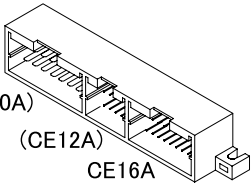
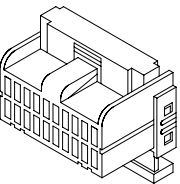
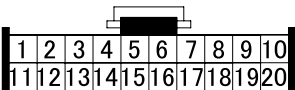
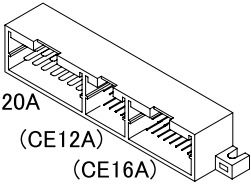
CD type

Number shows number of pins	Female connector	Male connector
CD35A		
CD55A		

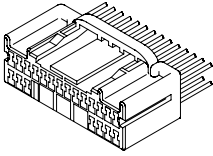
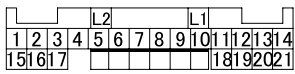
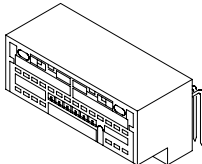
CE type

Number shows number of pins	Female connector	Male connector
CE2A	 	 
CE4A	 	 

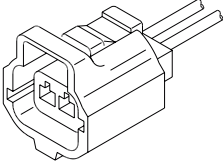
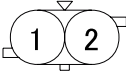
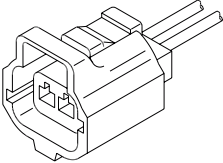
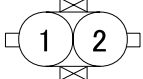
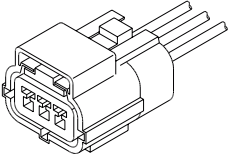
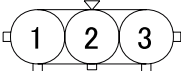
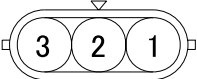
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
CE12A	 	 (CE20A) CE12A (CE16A)
CE16A	 	 (CE20A) (CE12A) CE16A
CE20A	 	 CE20A (CE12A) (CE16A)

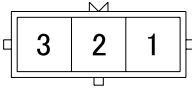
CF type

Number shows number of pins	Female connector	Male connector
CF21A	 	

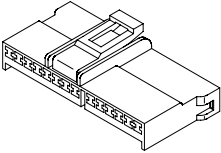
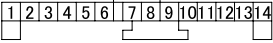
CH type

Number shows number of pins	Female connector	Male connector
CH2A	 	
CH2B	 	
CH3A	 	

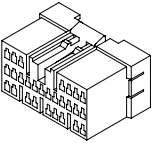
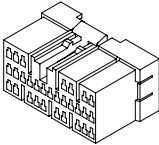
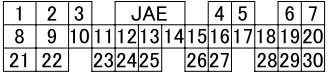
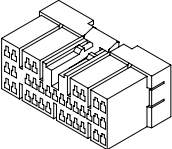
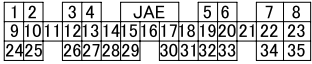
CK type

Number shows number of pins	Female connector	Male connector
CK3A		

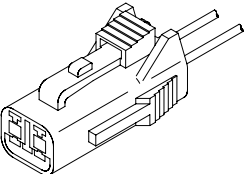
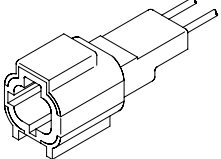
CL type

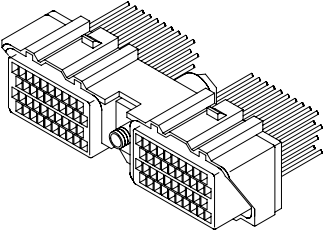
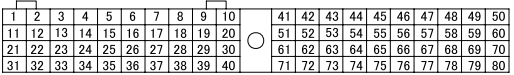
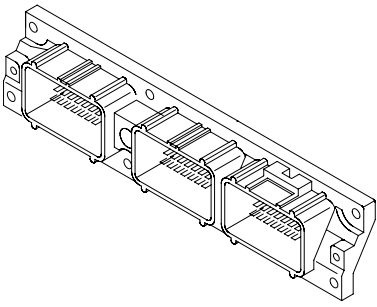
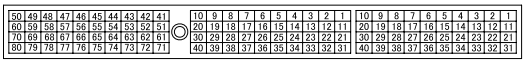
Number shows number of pins	Female connector	Male connector
CL14A	 	

CM type

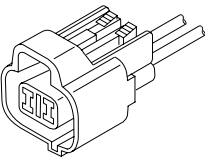
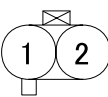
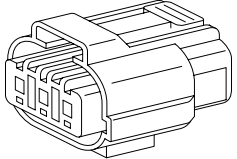
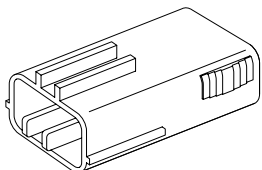
Number shows number of pins	Female connector	Male connector
CM28A	 	
CM30A	 	
CM35A	 	

CN type

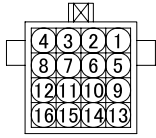
Number shows number of pins	Female connector	Male connector
CN2A	 	 

Number shows number of pins	Female connector	Male connector
CP80A	 	  CP80A (CP40B)

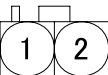
CQ type

Number shows number of pins	Female connector	Male connector
CQ2B	 	
CQ3A		

CR type

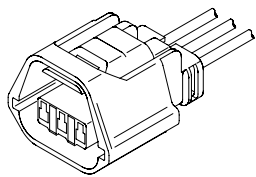
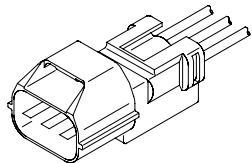
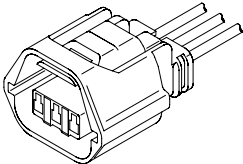
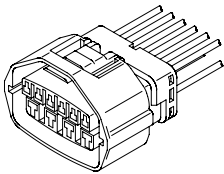
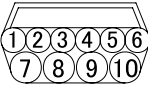
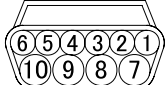
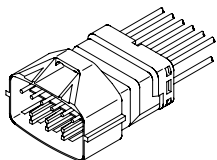
Number shows number of pins	Female connector	Male connector
CR16A		

CS type

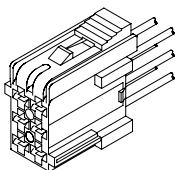
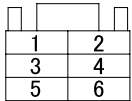
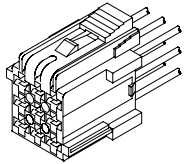
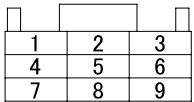
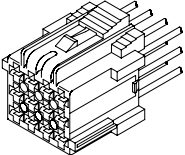
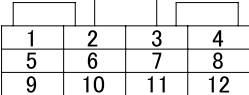
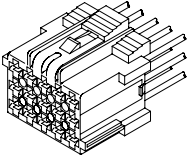
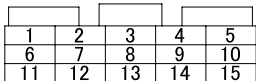
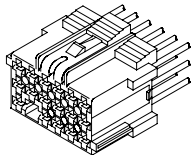
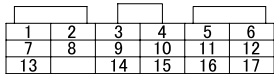
Number shows number of pins	Female connector	Male connector
CS2A		

CONNECTOR CONFIGURATION CHART

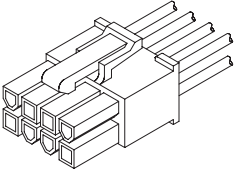
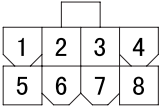
CT type

Number shows number of pins	Female connector		Male connector	
CT3A				
CT3B				
CT10A				

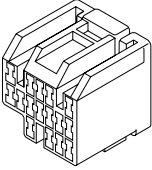
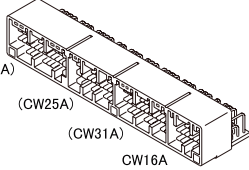
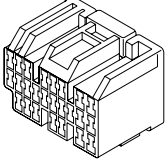
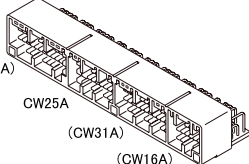
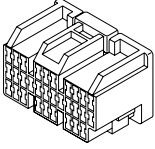
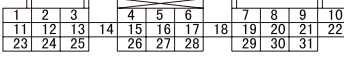
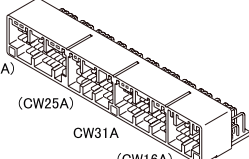
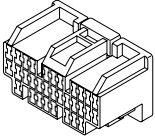
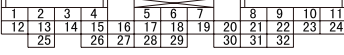
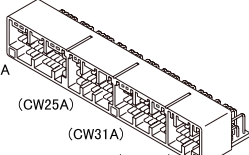
CU type

Number shows number of pins	Female connector		Male connector	
CU6A				
CU9A				
CU12A				
CU15A				
CU17A				

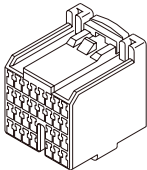
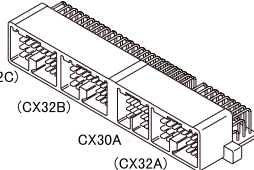
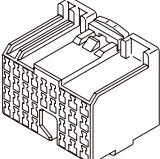
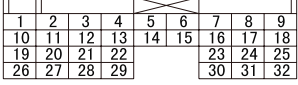
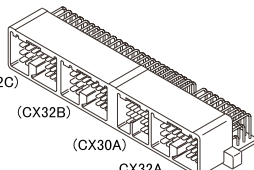
CV type

Number shows number of pins	Female connector	Male connector
CV8A	 	

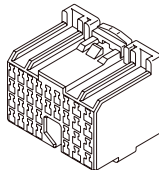
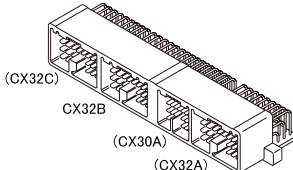
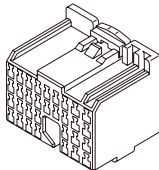
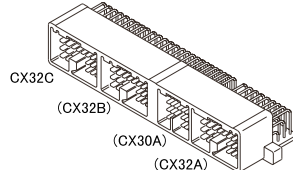
CW type

Number shows number of pins	Female connector	Male connector
CW16A	 	 (CW32A) (CW25A) (CW31A) CW16A
CW25A	 	 (CW32A) CW25A (CW31A) (CW16A)
CW31A	 	 (CW32A) (CW25A) CW31A (CW16A)
CW32A	 	 CW32A (CW25A) (CW31A) (CW16A)

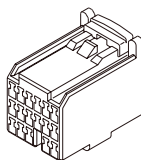
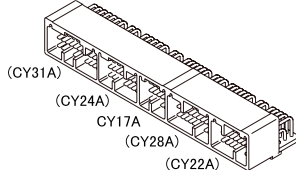
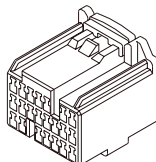
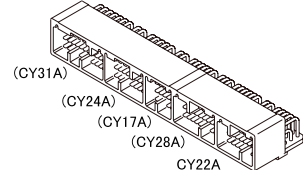
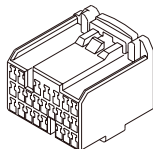
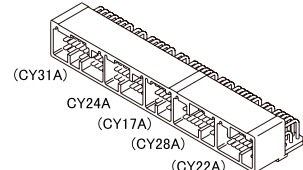
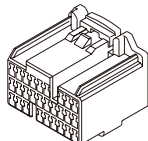
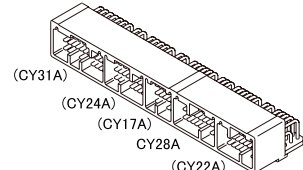
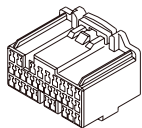
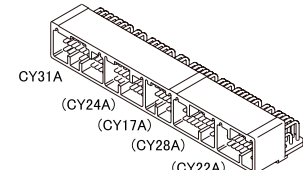
CX type

Number shows number of pins	Female connector	Male connector
CX30A	 	 (CX32C) (CX32B) CX30A (CX32A)
CX32A	 	 (CX32C) (CX32B) (CX30A) CX32A

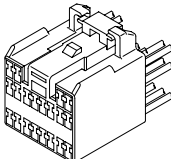
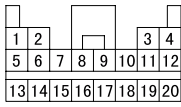
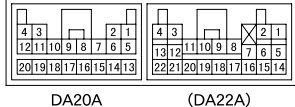
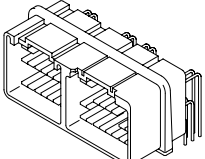
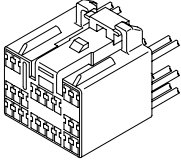
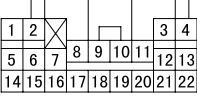
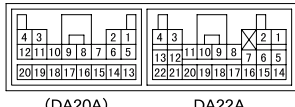
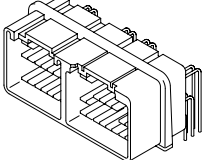
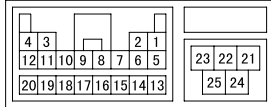
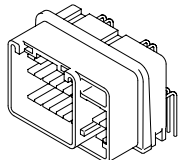
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector																																				
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CX32C	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr><tr><td>19</td><td>20</td><td>21</td><td>22</td><td></td><td></td><td>23</td><td>24</td><td>25</td></tr><tr><td>26</td><td>27</td><td>28</td><td>29</td><td></td><td></td><td>30</td><td>31</td><td>32</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			23	24	25	26	27	28	29			30	31	32	 CX32C (CX32B) (CX30A) (CX32A)
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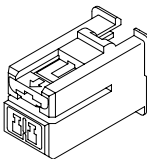
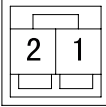
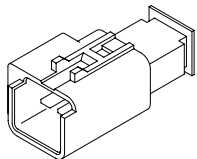
CY type

Number shows number of pins	Female connector	Male connector																																								
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13	14	15		16	17																																					
CY22A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td></td><td>6</td><td>7</td></tr><tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr><tr><td>16</td><td>17</td><td></td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td></tr></table>	1	2	3	4	5		6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22	 (CY31A) (CY24A) (CY17A) (CY28A) CY22A																
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CY24A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr><tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>24</td><td></td></tr></table>	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							24		 (CY31A) CY24A (CY17A) (CY28A) (CY22A)								
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CY28A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td></td><td>7</td><td>8</td><td>9</td></tr><tr><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr><tr><td>20</td><td>21</td><td>22</td><td></td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr></table>	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		23	24	25	26	27	28	 (CY31A) (CY24A) (CY17A) CY28A (CY22A)										
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CY31A	 <table><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr><tr><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>30</td><td>31</td></tr></table>	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29									30	31	 CY31A (CY24A) (CY17A) (CY28A) (CY22A)
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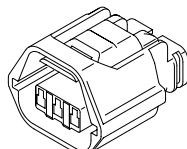
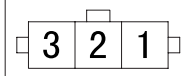
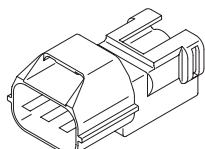
DA type

Number shows number of pins	Female connector	Male connector
DA20A	 	 
DA22A	 	 
DA25A		 

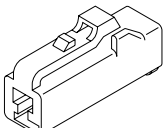
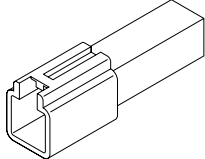
DB type

Number shows number of pins	Female connector	Male connector
DB2A	 	 

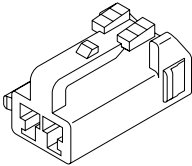
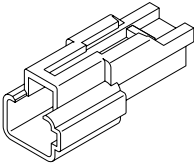
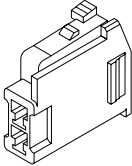
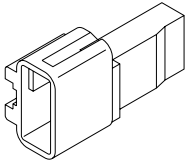
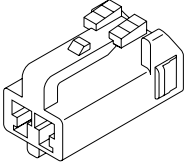
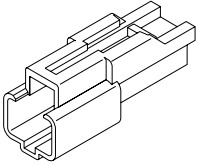
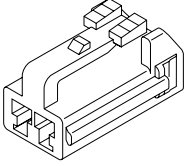
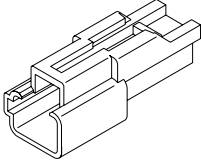
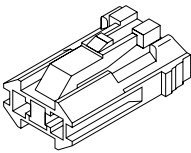
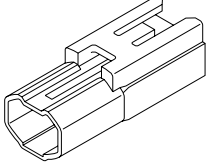
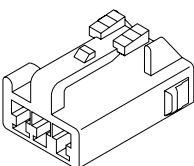
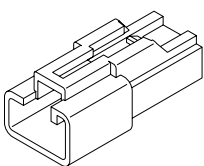
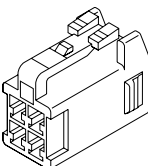
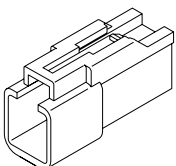
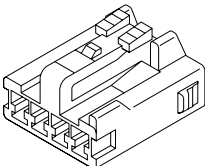
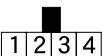
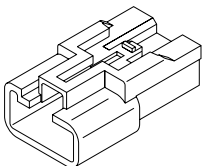
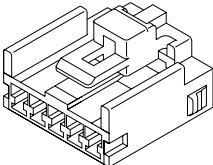
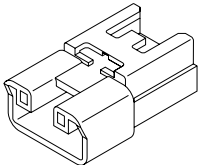
DC type

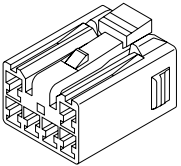
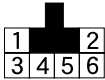
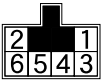
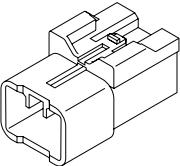
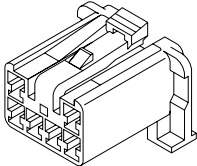
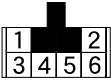
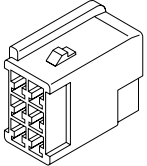
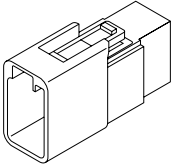
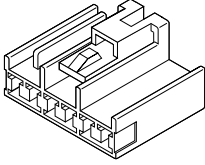
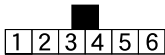
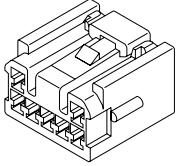
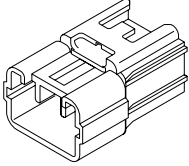
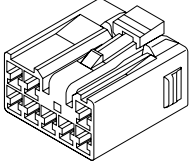
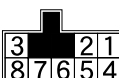
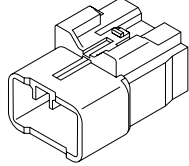
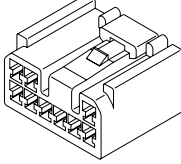
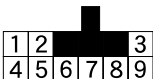
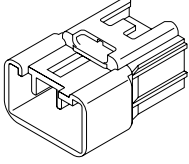
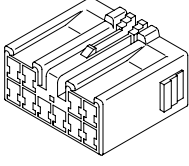
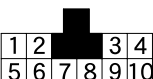
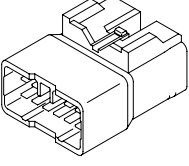
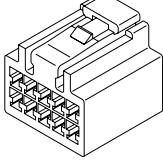
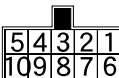
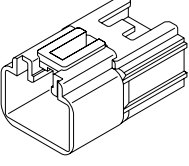
Number shows number of pins	Female connector	Male connector
DC3A	 	 

DD type

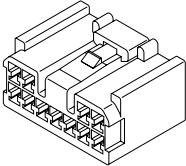
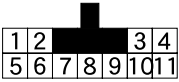
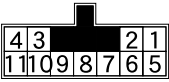
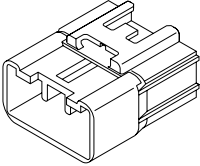
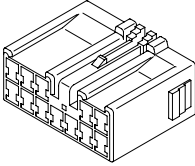
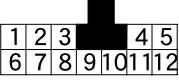
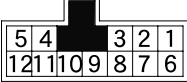
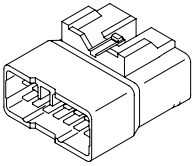
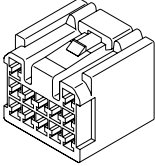
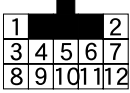
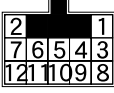
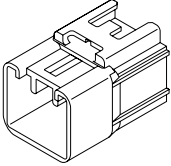
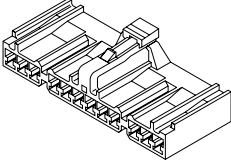
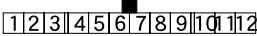
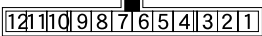
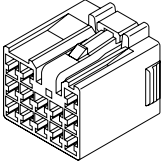
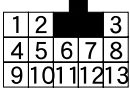
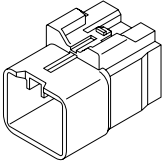
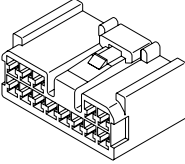
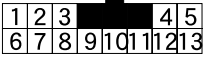
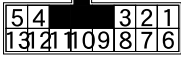
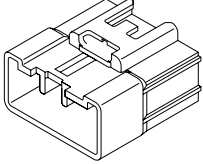
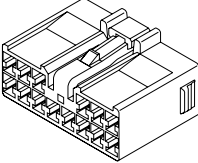
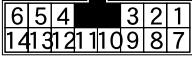
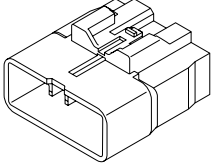
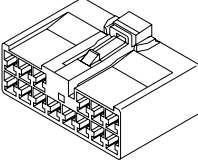
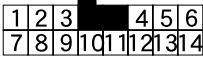
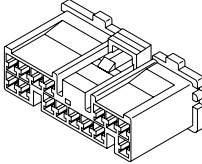
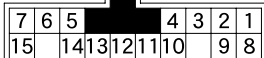
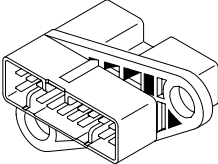
Number shows number of pins	Female connector	Male connector
DD1A	 	 

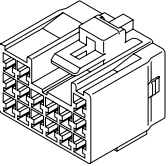
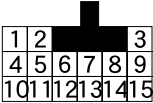
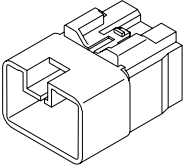
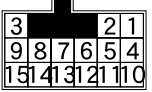
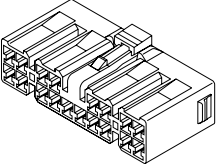
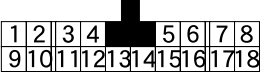
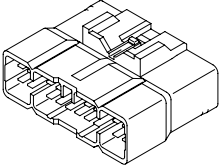
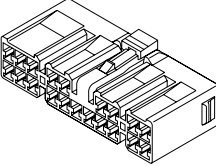
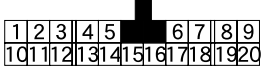
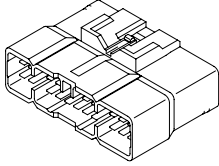
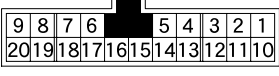
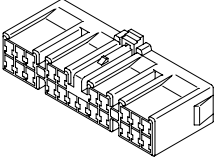
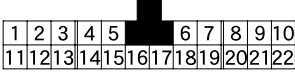
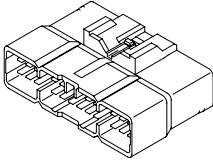
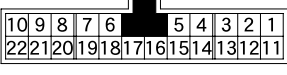
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
DD2A	 	 
DD2B	 	 
DD2C	 	 
DD2E	 	 
DD2F	 	 
DD3A	 	 
DD4A	 	 
DD4C	 	 
DD5A	 	 

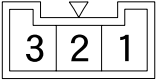
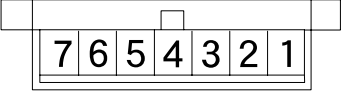
Number shows number of pins	Female connector	Male connector
DD6A	 	 
DD6B	 	
DD6C	 	 
DD6E	 	
DD7A	 	 
DD8A	 	 
DD9A	 	 
DD10A	 	 
DD10B	 	 

CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
DD11A	 	 
DD12A	 	 
DD12B	 	 
DD12C	 	
DD13A	 	 
DD13B	 	 
DD14A	 	 
DD14B	 	
DD15A	 	 

Number shows number of pins	Female connector	Male connector
DD15B	 	 
DD18A	 	 
DD20A	 	 
DD22A	 	 

DE type

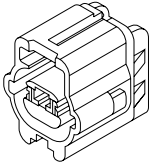
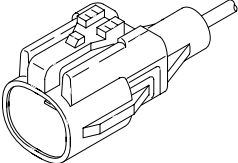
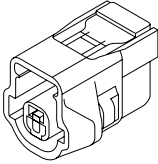
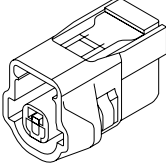
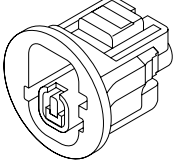
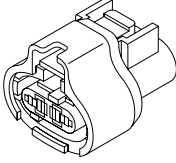
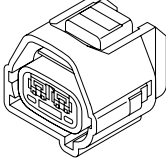
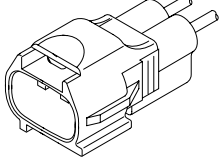
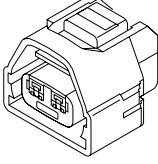
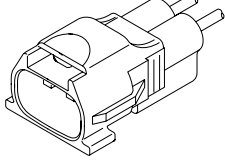
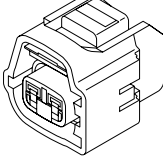
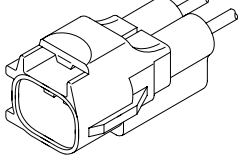
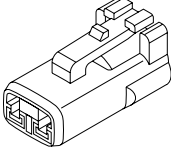
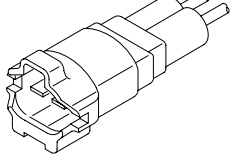
Number shows number of pins	Female connector	Male connector
DE3A		
DE7A		

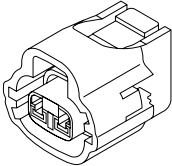
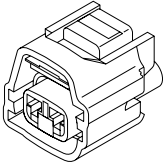
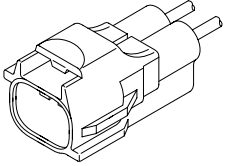
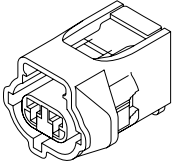
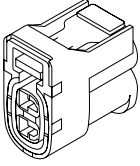
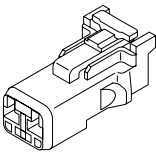
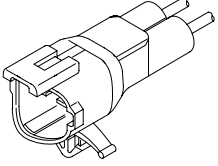
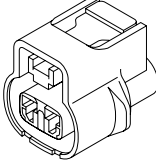
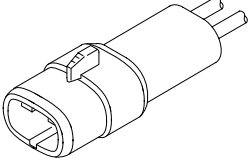
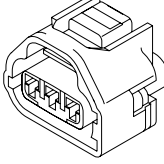
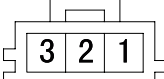
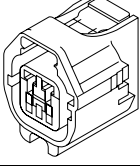
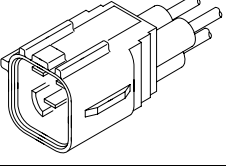
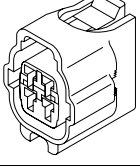
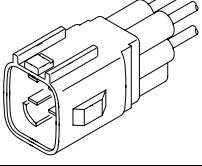
DF type

Number shows number of pins	Female connector	Male connector
DF3A		

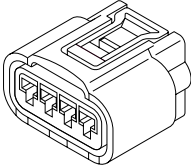
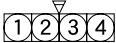
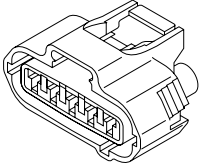
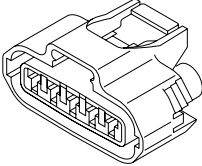
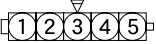
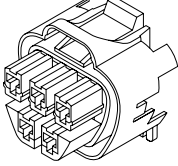
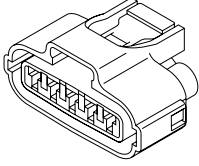
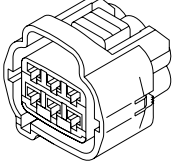
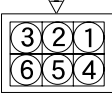
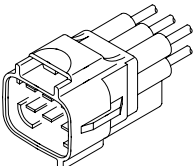
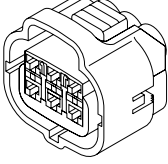
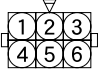
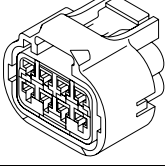
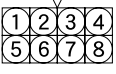
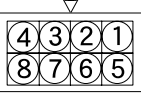
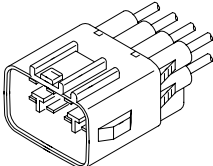
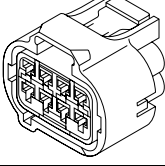
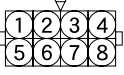
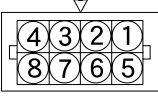
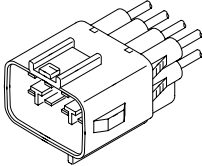
CONNECTOR CONFIGURATION CHART

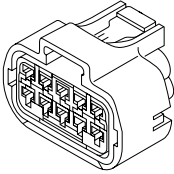
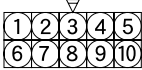
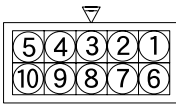
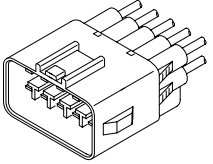
DG type

Number shows number of pins	Female connector	Male connector
DG1A	 	 
DG1B	 	
DG1C	 	
DG1D	 	
DG2A	 	
DG2B	 	 
DG2C	 	 
DG2D	 	 
DG2E	 	 

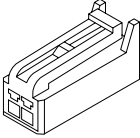
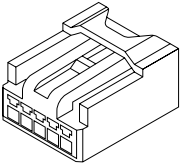
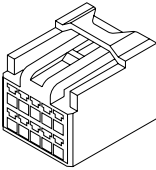
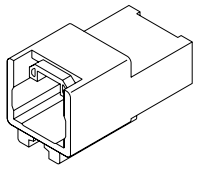
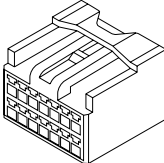
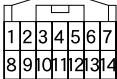
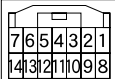
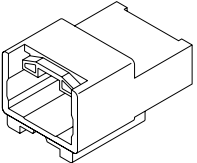
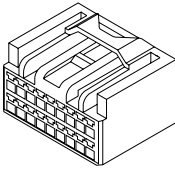
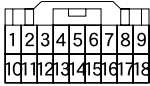
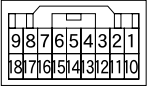
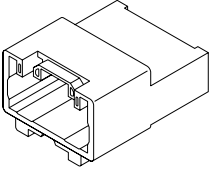
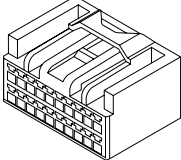
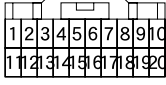
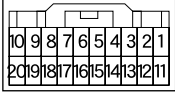
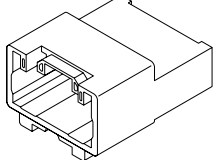
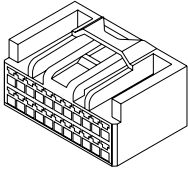
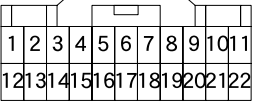
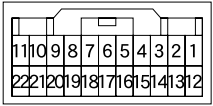
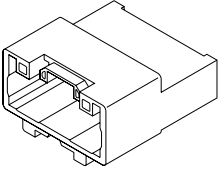
Number shows number of pins	Female connector	Male connector
DG2F	 	
DG2G	 	 
DG2H	 	
DG2J	 	
DG2K	 	 
DG2L	 	 
DG3A	 	
DG3B	 	 
DG4A	 	 

CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
DG4B	 	
DG5A	 	
DG5B	 	
DG5C	 	
DG5D	 	
DG6A	 	 
DG6B	 	
DG8A	 	 
DG8B	 	 

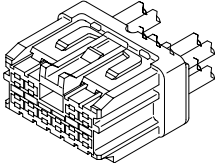
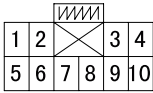
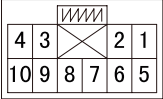
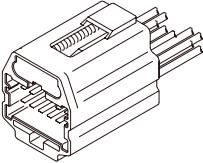
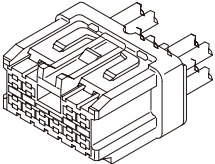
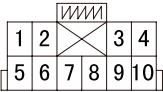
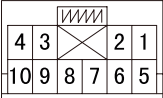
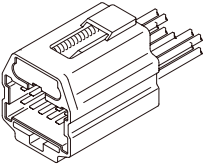
Number shows number of pins	Female connector	Male connector
DG10A	 	 

DH type

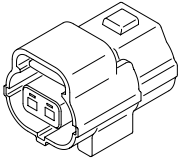
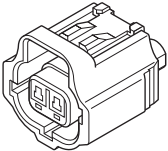
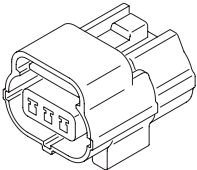
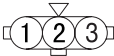
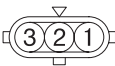
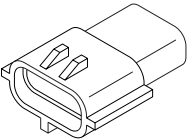
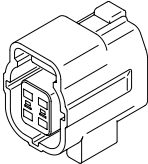
Number shows number of pins	Female connector	Male connector
DH2A	 	
DH5A	 	
DH10A	 	 
DH14A	 	 
DH18A	 	 
DH20A	 	 
DH22A	 	 

CONNECTOR CONFIGURATION CHART

DJ type

Number shows number of pins	Female connector	Male connector
DJ10A	 	 
DJ10B	 	 

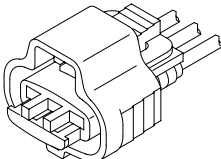
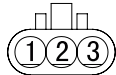
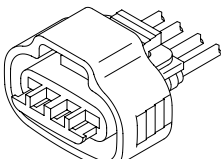
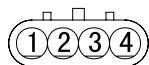
DK type

Number shows number of pins	Female connector	Male connector
DK2A	 	
DK2B	 	
DK3A	 	 
DK4A	 	

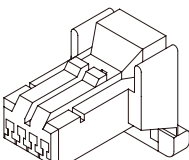
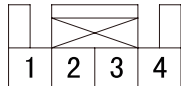
DL type

Number shows number of pins	Female connector	Male connector
DL4A		

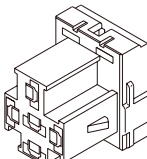
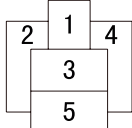
DM type

Number shows number of pins	Female connector	Male connector
DM3A	 	
DM4A	 	

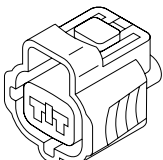
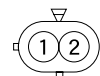
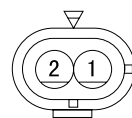
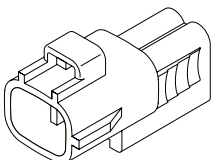
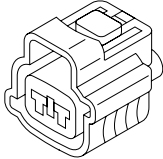
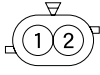
DN type

Number shows number of pins	Female connector	Male connector
DN4A	 	

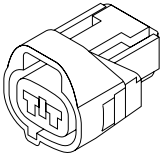
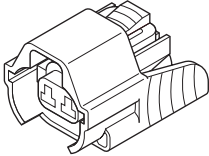
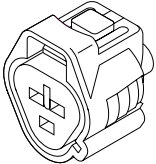
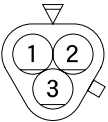
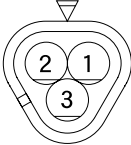
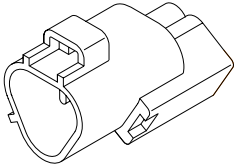
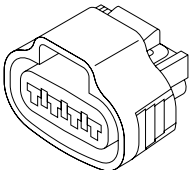
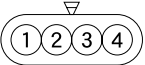
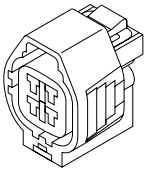
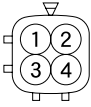
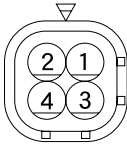
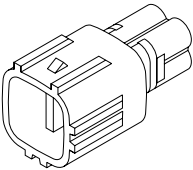
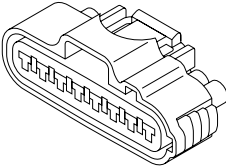
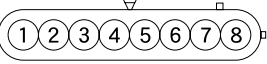
DP type

Number shows number of pins	Female connector	Male connector
DP5A	 	

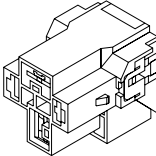
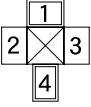
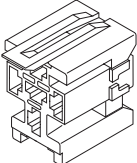
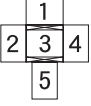
DQ type

Number shows number of pins	Female connector	Male connector
DQ2A	 	 
DQ2B	 	

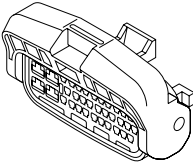
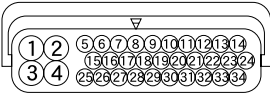
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
DQ2C	 	
DQ2E	 	
DQ3A	 	 
DQ4A	 	
DQ4B	 	 
DQ8A	 	

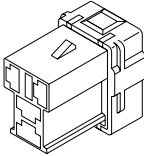
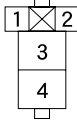
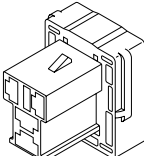
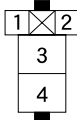
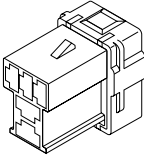
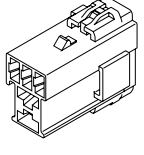
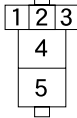
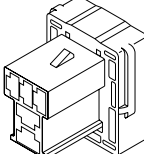
EN type

Number shows number of pins	Female connector	Male connector
EN4A	 	
EN5A	 	

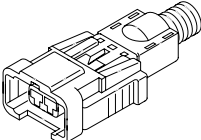
EP type

Number shows number of pins	Female connector	Male connector
EP34A	 	

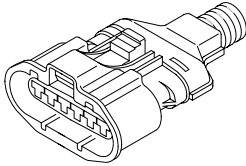
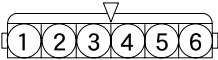
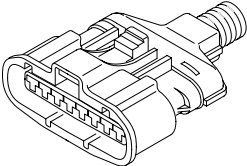
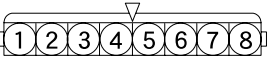
EQ type

Number shows number of pins	Female connector	Male connector
EQ4A		
EQ4B		
EQ5A	 	 
EQ5B		

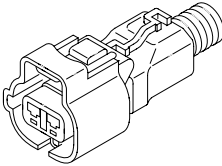
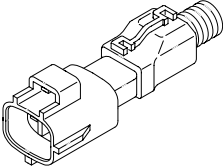
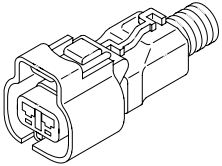
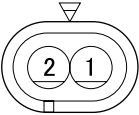
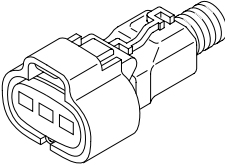
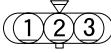
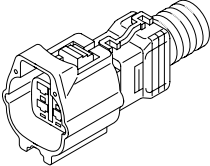
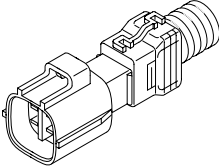
ER type

Number shows number of pins	Female connector	Male connector
ER2A		

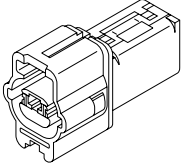
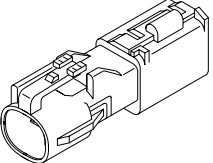
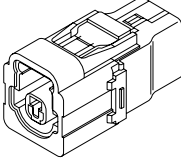
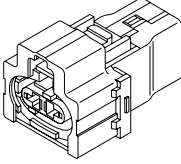
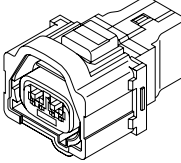
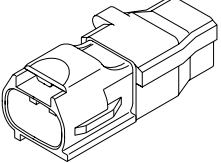
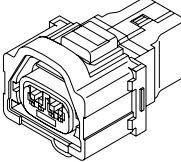
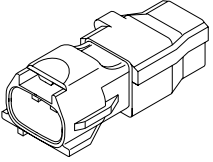
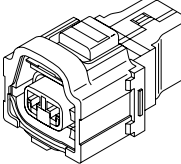
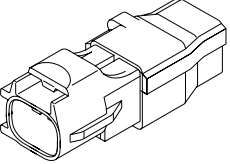
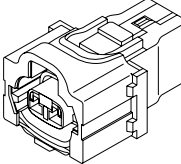
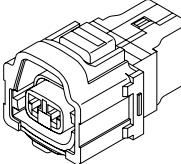
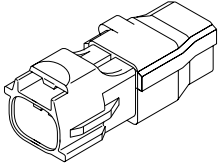
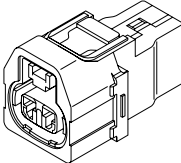
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
ER6A	 	
ER8A	 	

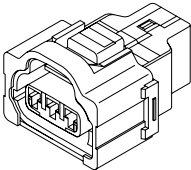
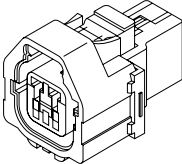
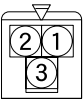
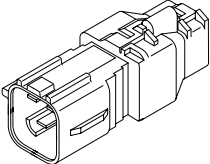
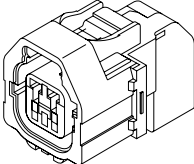
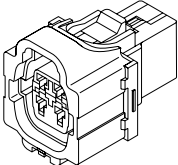
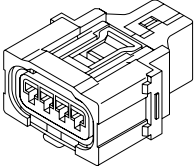
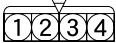
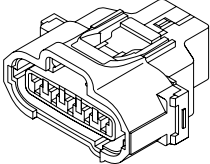
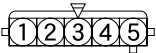
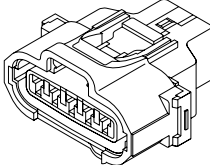
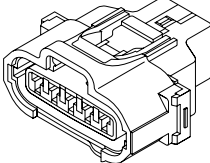
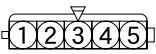
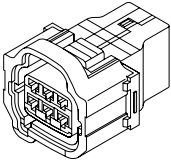
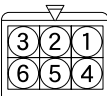
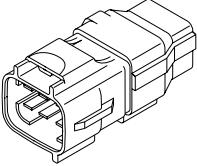
ES type

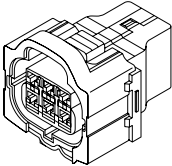
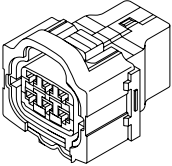
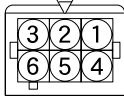
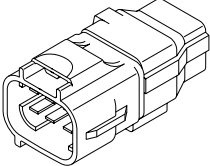
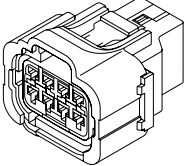
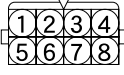
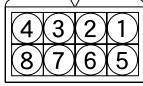
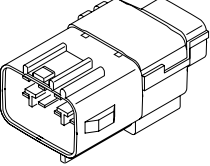
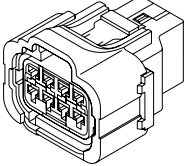
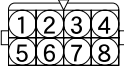
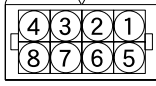
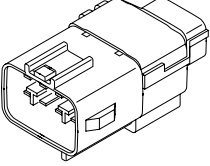
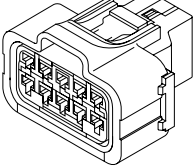
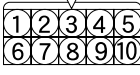
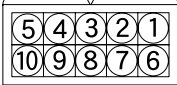
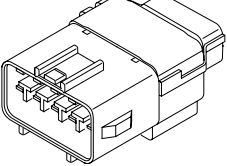
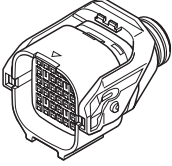
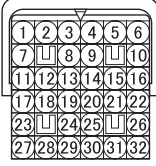
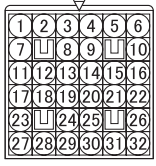
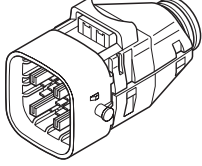
Number shows number of pins	Female connector	Male connector
ES2A	 	 
ES2B	 	
ES2C		
ES3A	 	
ES4A	 	 

ET type

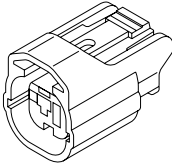
Number shows number of pins	Female connector	Male connector
ET1A	 	 
ET1B	 	
ET2A	 	
ET2B	 	 
ET2C	 	 
ET2D	 	 
ET2F	 	
ET2G	 	 
ET2L	 	

CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
ET3A	 	
ET3B	 	 
ET3C	 	
ET4A	 	
ET4B	 	
ET5A	 	
ET5B	 	
ET5D	 	
ET6A	 	 

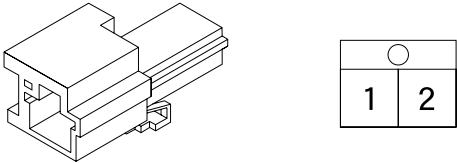
Number shows number of pins	Female connector	Male connector
ET6B	 	
ET6C	 	 
ET8A	 	 
ET8B	 	 
ET10A	 	 
ET32A	 	 

EU type

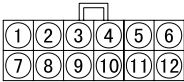
Number shows number of pins	Female connector	Male connector
EU1A	 	

CONNECTOR CONFIGURATION CHART

EV type

Number shows number of pins	Female connector	Male connector
EV2A		

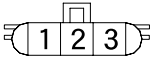
EW type

Number shows number of pins	Female connector	Male connector
EW12A		

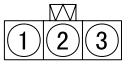
EX type

Number shows number of pins	Female connector	Male connector
EX5A		

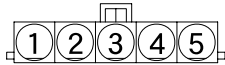
EY type

Number shows number of pins	Female connector	Male connector
EY3A		

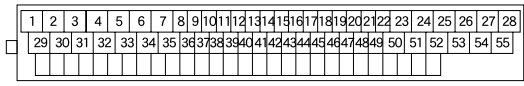
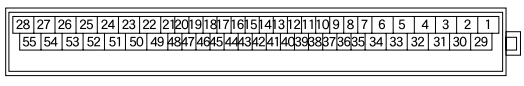
EZ type

Number shows number of pins	Female connector	Male connector
EZ3A		

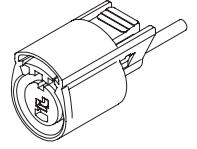
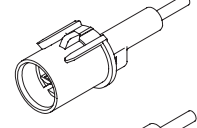
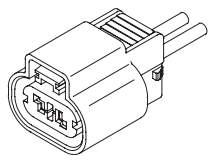
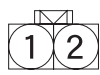
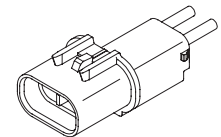
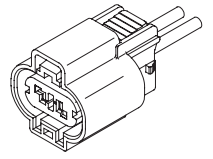
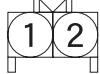
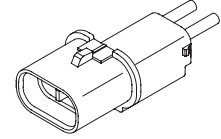
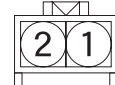
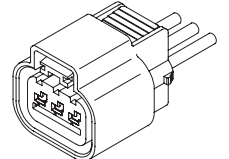
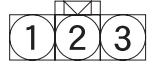
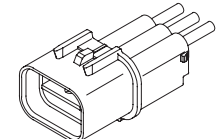
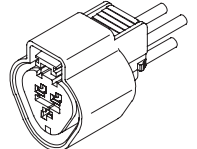
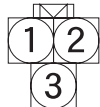
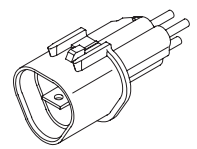
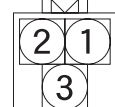
FA type

Number shows number of pins	Female connector	Male connector
FA5A		

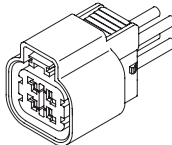
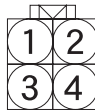
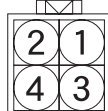
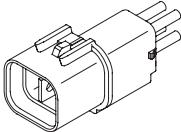
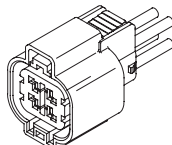
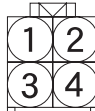
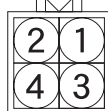
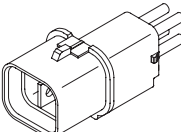
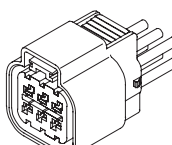
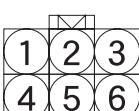
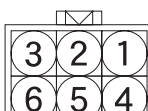
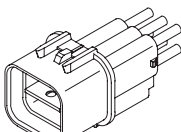
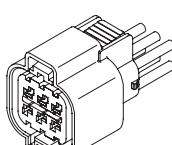
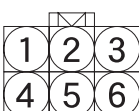
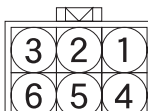
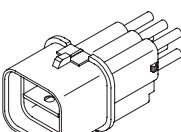
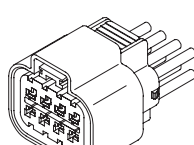
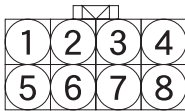
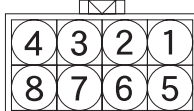
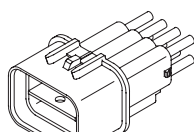
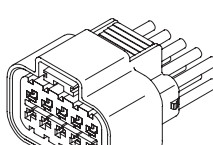
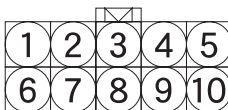
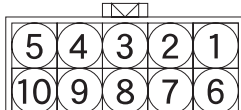
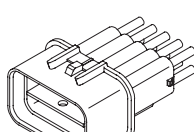
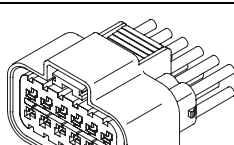
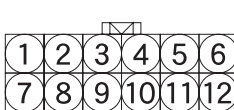
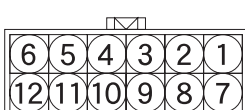
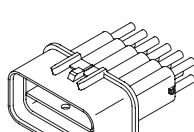
FB type

Number shows number of pins	Female connector	Male connector
FB55A		

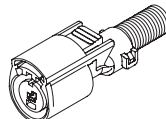
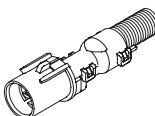
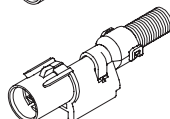
GA type

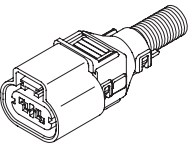
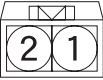
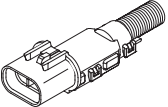
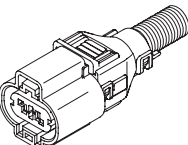
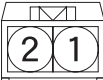
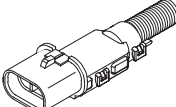
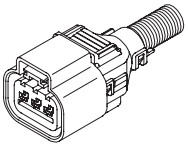
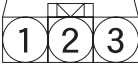
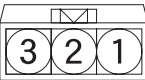
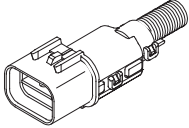
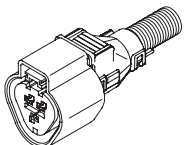
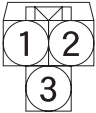
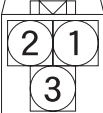
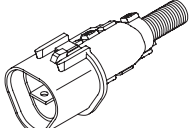
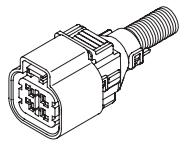
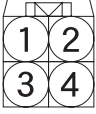
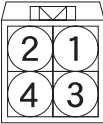
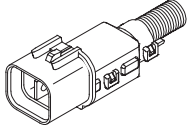
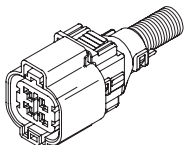
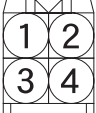
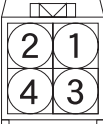
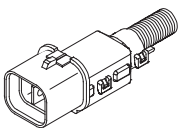
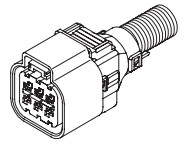
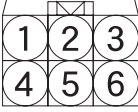
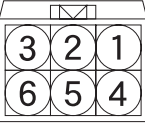
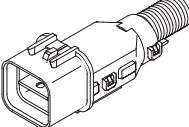
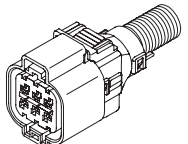
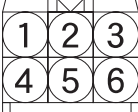
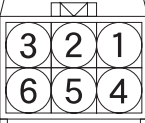
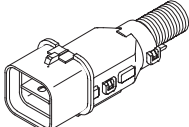
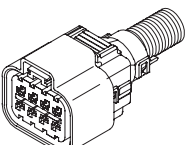
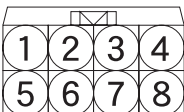
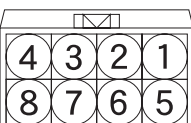
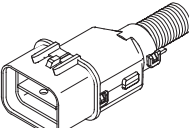
Number shows number of pins	Female connector	Male connector
GA1A	 	 
GA2A	 	 
GA2B	 	 
GA3A	 	 
GA3B	 	 

CONNECTOR CONFIGURATION CHART

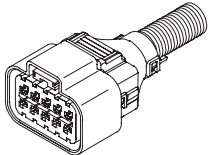
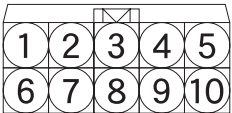
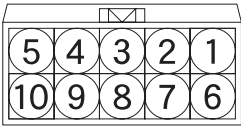
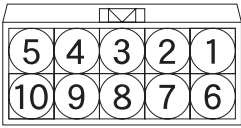
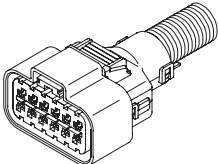
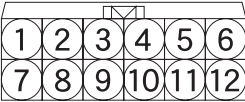
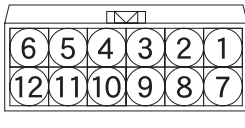
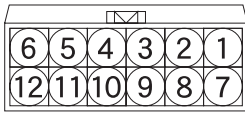
Number shows number of pins	Female connector		Male connector	
GA4A				
GA4B				
GA6A				
GA6B				
GA8A				
GA10A				
GA12A				

GB type

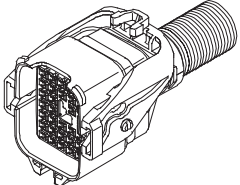
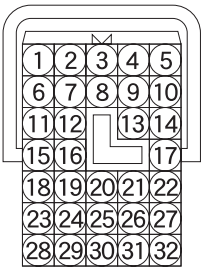
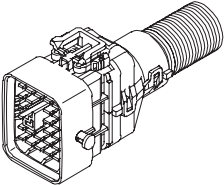
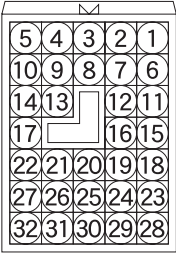
Number shows number of pins	Female connector	Male connector
GB1A	 	  

Number shows number of pins	Female connector	Male connector
GB2A	 	 
GB2B	 	 
GB3A	 	 
GB3B	 	 
GB4A	 	 
GB4B	 	 
GB6A	 	 
GB6B	 	 
GB8A	 	 

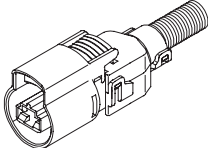
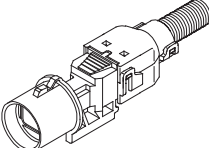
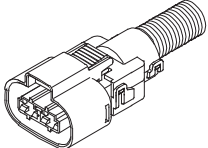
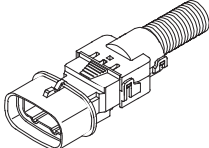
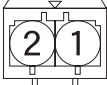
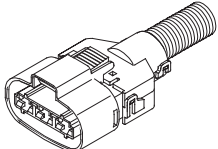
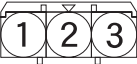
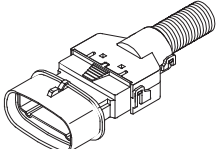
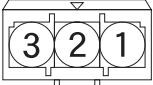
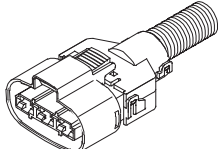
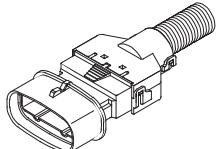
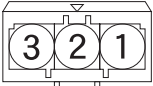
CONNECTOR CONFIGURATION CHART

Number shows number of pins	Female connector	Male connector
GB10A	 	 
GB12A	 	 

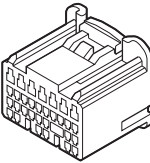
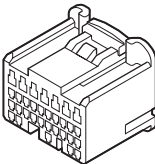
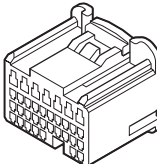
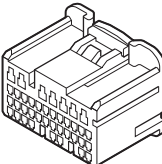
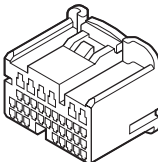
GC type

Number shows number of pins	Female connector	Male connector
GC32A	 	 

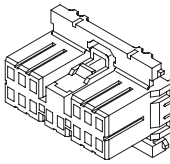
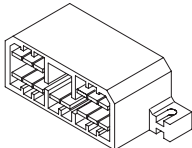
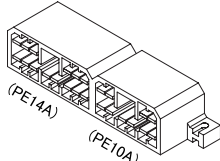
GD type

Number shows number of pins	Female connector	Male connector
GD1A	 	 
GD2A	 	 
GD3A	 	 
GD3B	 	 

GF type

Number shows number of pins	Female connector	Male connector																																				
GF31A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr><tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr><tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr><tr><td>29</td><td>30</td><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
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GF34A	 <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr><tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr><tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr><tr><td>29</td><td>30</td><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
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PE type

Number shows number of pins	Female connector	Male connector																																																								
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Group 01

Maintenance Schedule

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

GROUP 01 MAINTENANCE SCHEDULE

HOW TO READ THE MAINTENANCE SCHEDULE TABLES	01-2
MAINTENANCE SCHEDULE TABLES	01-3
MAINTENANCE OPERATIONS	01-9
LUBRICATION TABLES	01-15
LUBRICATION	01-16

HOW TO READ THE MAINTENANCE SCHEDULE TABLES

Example table:

- *1: 30,000 km/18,000 miles or 6 months, whichever occurs first
 *2: 60,000 km/36,000 miles or 12 months, whichever occurs first
 *3: FK61F, FM61F
 *4: FM65F
 *5: FM64F
 ⑥: Exhaust emission items
 ⑦: Noise control items

Item (1)	Time of inspection and maintenance (2)					Working procedures (3)	Remarks (4)
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
ENGINE							
Air, fuel, oil or coolant leaks from engine	×		×			Check engine for air, fuel, oil and coolant leaks.	 Gr11, 12, 13A, 14
ⒺⓃ Engine starting performance, speed, noise			×			Check for engine starting performance, idling speed, abnormal engine noise, black smoke or other abnormal exhaust and acceleration.	 Gr11,

- (1) This column contains the maintenance and inspection items.
- (2) The periods between inspection and service are based on the assumption that the vehicle will be driven approximately 60000 kilometers (36000 miles) per year.
Inspections which must be made are indicated by an “x” or by the appropriate period between servicing.
- (3) This column provides a simplified explanation of the operational procedures involved for each inspection or maintenance item.
- (4) The Gr. No. refers to the “group number” in this Service Manual. For visual checks and simple inspections, see the sections labelled “Working Procedures”.

MAINTENANCE SCHEDULE TABLES

01

- *1: 30,000 km/18,000 miles or 6 months, whichever occurs first
 *2: 60,000 km/36,000 miles or 12 months, whichever occurs first
 *3: FK61F, FM61F
 *4: FM65F
 *5: FM64F
 ⑤: Exhaust emission items
 ⑥: Noise control items

Item	Time of inspection and maintenance					Working procedures	Remarks
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
ENGINE							
Air, fuel, oil or coolant leaks from engine	×		×			Check engine for air, fuel, oil and coolant leaks.	Gr11, 12, 13A, 14
㊦㊮ Engine starting performance, speed, noise and exhaust gas conditions			×			Check for engine starting performance, idling speed, abnormal engine noise, black smoke or other abnormal exhaust gas during idling and acceleration. Check engine speed on tachometer.	Gr11, 13A, 15
Retightening, inlet and exhaust manifold bolts					×	Retighten. Checking of the tightening torque is unnecessary.	Gr15
㊦ Valve clearance		×			×	Check valve clearance with thickness gauge.	Gr11
㊦ Oil filter replacement			Every 20,000 km/ 12,000 miles On new vehicle, also replace at the first 10,000 km/ 6,000 miles.			Replace element.	Gr12
㊦ Fuel filter replacement				×		Replace element.	Gr13A
㊦ Draining water and sediment in fuel tank			Every 24 months			Remove fuel tank drain plug and remove water and sediment.	Gr13A
Retightening the fuel tank bracket bolts			×			Check the bolts for looseness and retighten to a torque of 69 to 93 N·m (51 to 68 ft.lbs, 7.0 to 9.5 kgf·m).	Gr13A
㊦ Check fuel line outside the engine compartment			Every 24 months			Check fuel line outside the engine compartment. Replace if necessary.	Gr13A
㊦㊮ Belt tension and damage	×		×			Press midpoint of belt firmly with finger to measure deflection and check for belt damage.	Gr14
Coolant level and leaks from cooling system	×					Check coolant level and if level is low, check for coolant leaks.	Gr14
Coolant replacement			Every 24 months			Replace with new coolant.	Gr14
Radiator cap condition			×			Check radiator cap for sealing and mounting condition.	Gr14
㊦ Cooling system hose clamp position and clamping condition.			×			Check clamp position and clamping condition of cooling system hose.	Gr14

MAINTENANCE SCHEDULE TABLES

Item	Time of inspection and maintenance					Working procedures	Remarks
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
㊦ Turbocharger rotor play			Every 250,000 km/ 150,000 miles			Check rotor for excessive end play by using a dial indicator.	📁Gr15
㊦㊮ Cleaning the air cleaner element	×		×			Clean air cleaner element. Also clean element whenever red signal appears on dust indicator regardless of specified inspection time.	📁Gr15
㊦㊮ Air cleaner element replacement			Every 50,000 km/ 30,000 miles			Replace element.	📁Gr15
㊦㊮ Damage of air intake system, looseness of clamp and loss of parts			×			Check air intake system for damage and inspect all parts for installation.	📁Gr15
㊦㊮ Exhaust system			×			Check the exhaust system for damage, corrosion and loose connection causing leakage.	📁Gr15
㊦ PCV (Positive Crankcase Ventilation) valve element replacement		×	×			Replace element.	📁Gr17
Starter function					×	Operate starter switch and check the switch for proper function.	📁Gr54
Alternator function					×	Check for function with a circuit tester.	📁Gr54
POWER TRAIN							
Air or oil leaks from power train			×			Check power train for air and oil leaks.	📁Gr21, 22, 23A, B, 25
Clutch pedal play			×			Press clutch pedal lightly and check that its play is adequate.	📁Gr21
Clutch function			×			- Press the clutch pedal to check for unusual noise or stiffness. Also check if gear engages quietly. - Check that clutch does not slip and engages smoothly.	📁Gr21
Manual transmission gearshift control looseness				×		In NEUTRAL position, check gearshift lever for looseness. With gearshift lever in each gear position, check all gears engage smoothly without excessive looseness. Also check that control cable is not damaged.	📁Gr22
Automatic transmission range selector linkage condition *3				×		Shifting to each position must be correct and secure.	📁Gr23A
Propeller shaft couplings and bearings looseness		×	×			- Check flange yoke bolts and center bearing bolts for looseness. - Turn propeller shaft manually to check for loose spline coupling. - Check for looseness between spider and needle roller bearing.	📁Gr25
		On new vehicle inspection at 4,000 km/ 2,500 miles, check only the looseness of bolts.					

Item	Time of inspection and maintenance					Working procedures	Remarks
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
FRONT AND REAR AXLES							
Axle shaft torsion and cracks					×	Remove axle shaft and check for torsion, bend, and cracks.	Gr27
Front wheel hub bearing looseness				×		With front axle jacked up, move wheel up and down by holding tire's top and bottom to check for bearing looseness.	Gr26
Rear wheel hub bearing damage					×	Disassemble rear wheel and check for hub bearing wear and damage.	Gr27
Retightening wheel nuts		×	×			Check wheel nuts for looseness.	P01-8
Disc wheel damage			×			Check disc wheel for corrosion, deformation and cracks.	Gr31
Tire inflation pressure, cracking, tread groove depth, abnormal wear, etc.	×		×			• Measure inflation pressure with a tire pressure gauge, and check that tire tread groove is deep enough. • Check tire tread and side walls for cracks, damage, uneven, ridgy, and other abnormal wear.	P01-8
Tire rotation			×			Rotate all tires.	P01-8
SUSPENSION SYSTEM							
Looseness, play and damage of suspension system				×		Check suspension system for looseness, play and damage.	Gr33, 34
Damage and looseness of leaf springs	×			×		Check leaf springs for damage and looseness.	Gr33, 34
Retightening U-bolts		×		×		Check U-bolts for looseness.	Gr33, 34
Air leak and damage of air spring *5		×	×			Check air springs for air leakage and damaged diaphragm. Check air spring height.	Gr33, 34
Air spring diaphragm replacement *5			Every 36 months			Check diaphragms. Replace them if necessary.	Gr34B
Oil leaks and damage of shock absorbers				×		Check for oil leaks from and damage of cylinders and other parts.	Gr33, 34
BRAKING SYSTEM							
Air pressure and its charging speed	×					After discharging air from air tank, start and run the engine at idle and measure time taken to charge air to specified pressure in air tank.	Gr35A, B
Air and fluid leaks from braking system			×			Check braking system for air and fluid leaks.	Gr35A, B
Looseness, play and damage of braking system parts			×			Check braking system parts for looseness, play and damage.	Gr35A, B
Condensation in air tank	×					Open drain cock, and check for presence of condensation in air tank.	Gr35A, B

MAINTENANCE SCHEDULE TABLES

Item	Time of inspection and maintenance					Working procedures	Remarks
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
Operation of brake pedal			×			Depress the brake pedal and release it, checking for the sound of air being released from the brake valve and to ensure that the pedal returns normally without catching. Press the brake pedal with a finger to the point where resistance is felt and measure the distance (play) over which the pedal has moved.	 Gr35A, B
Foot brake effectiveness	×		×			While driving the vehicle at low speed, check braking effect and check for uneven braking.	 Gr35A, B
Operation of exhaust brake	×		×			Check for exhaust brake operation.	 Gr35A, B
Exhaust brake control cylinder packing replacement			Every 12 months			Check exhaust brake control cylinder packing, replace if necessary.	 Gr35A, B
Operation of air drier			×			Open drain cock of air tank and make sure there is no drainage.	 Gr35A, B
Check drain from air drier exhaust port			×			Check to see that oil is not discharged abnormally from exhaust port of air drier.	 Gr35A, B
Air drier disassembly and check					×	Disassemble air drier and check every part of it. If more than 1/5 of the drying agent is discolored, replace drying agent.	 Gr35A, B
Replacement of drying agent in air drier			Every 24 months			Disassemble air drier and replace drying agent and rubber parts.	 Gr35A, B
Brake shoe clearance				×		Measure clearance with thickness gauge.	 Gr35A, B
Brake lining wear				×		Check for lining wear.	 Gr35A, B
Brake drum wear					×	Disassemble and check drum for wear, cracks and damage.	 Gr35A, B
Parking brake effectiveness			×			On a slope, check that vehicle can be held stationary.	 Gr36A, B
Parking brake operation *4	×		×			• Check for operation of parking brake control valve. • Check operation when brake line air pressure is reduced.	 Gr36B
Parking brake lever stroke *3	×		×			With lever full pulled, check that lever is locked completely and that there is allowance in pulling stroke.	 Gr36A
Parking brake drum and lining wear *3					×	Disassemble and check drum for wear, cracks and damage and lining for wear.	 Gr36A
Damage on boot of brake chamber expander *4					×	Check boot at expander for damage.	 Gr35B
Wheel cylinder piston cup and dust seal replacement *3			Every 12 months			Check wheel cylinder piston cup and dust seal; replace if necessary.	 Gr35A
Brake booster packing, cup and rubber parts replacement *3			Every 12 months			Check brake booster packing, cup and rubber parts; replace if necessary.	 Gr35A
Brake hose replacement			Every 12 months			Check brake hose; replace if necessary.	 Gr35A, B

Item	Time of inspection and maintenance					Working procedures	Remarks
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
Check valve packing and rubber parts replacement			Every 12 months			Check check valve packing and rubber parts; replace if necessary.	📁Gr35A, B
Brake valve packing and rubber parts replacement			Every 12 months			Check brake valve packing and rubber parts; replace if necessary.	📁Gr35A, B
Air compressor and pressure gauge hoses replacement			Every 24 months			Replace air compressor and pressure gauge hose.	📁Gr35A, B
Brake booster power cylinder packing replacement *3			Every 24 months			Replace brake booster power cylinder packing.	📁Gr35A
Brake fluid reservoir tank tube replacement *3			Every 24 months			Check and replace brake fluid reservoir tank tube.	📁Gr35A
Brake chamber packing and rubber parts replacement *4			Every 24 months			Replace brake chamber packing and rubber parts.	📁Gr35B
Replacement of rubber parts at brake chamber's wheel parking brake spring and expander *4			Every 36 months			Replace rubber parts at brake chamber's wheel parking brake spring and expander.	📁Gr35B
STEERING SYSTEM							
Fluid leaks from steering system			×			Check steering system for fluid leaks.	📁Gr37
Steering wheel play	×		×			Turn steering wheel right and left to measure play at steering wheel rim. Measure while engine is running.	📁Gr37
Steering operating condition	×		×			Check steering wheel to see if it vibrates, pulls to one side or requires unusual steering effort.	📁Gr37
Looseness and play of steering system (including hoses and pipes)			×			• Check steering system for looseness and play. • Check power steering hoses and pipes for looseness.	📁Gr37
Wheel alignment					×	Measure toe-in, camber, caster and kingpin inclination angles.	📁Gr26
Right and left turning angles and power steering function					×	• Check that stopper bolt is sufficiently tight without damage and that steering linkage operates smoothly until blocked by stopper bolt. • Check that steering wheel does not contact other parts.	📁Gr26
Power steering booster and oil pump internal rubber parts replacement			Every 48 month			Replace internal rubber parts.	📁Gr37
Power steering hose replacement			Every 48 month			Replace power steering hose.	📁Gr37
CAB AND FRAME							
Looseness and damage of chassis and body			×			• Check frame, crossmembers and other parts for cracks and damage and check for loose rivets. • Also, check for body damage and loose mounting bolts.	📁Gr41, 42

MAINTENANCE SCHEDULE TABLES

Item	Time of inspection and maintenance					Working procedures	Remarks
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
Heater and defroster operation			×			Check operation and installation of defroster.	Gr55B
Condition of rearview mirrors and reflectors	×					Check reflecting condition, stains and damage.	Gr42
Door lock function			×			Check door lock mechanism for proper functioning.	Gr42
Seat belt mounting condition			×			Check seat belt for damage, buckle and retracting function and mounting condition.	Gr42
ELECTRICAL SYSTEM							
Looseness and damage of electrical wiring and connections			×			Check wiring, connectors and battery terminals for looseness and corrosion.	Gr54
Battery electrolyte level and specific gravity			Every 20,000 km/12,000 miles			• Check electrolyte level. • Measure electrolyte specific gravity with hydrometer.	Gr54
Operation and damage of lighting system and turn signal lamps	×		×			Check operation, damage and installation of an lighting units. Also check turn signal lamps operated by turn signal switch.	Gr54
Operation of horn	×		×			Check operation, damage and mounting condition.	Gr54
Operation and fluid level of windshield wiper and washer	×		×			Check operation, damage and mounting condition. Check fluid level in washer tank.	Gr42
Gauge and warning/indicator lamp function	×		×			Check function of gauges and warning/indicator lamps.	Gr54
Switch function					×	Check operation, damage and installation of every switch.	Gr54
OTHERS							
Road test of vehicle			×			Drive the vehicle to check for vehicle general operating condition.	—

Tire

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Depth of tire tread grooves	—	1.6 {0.063}	Replace

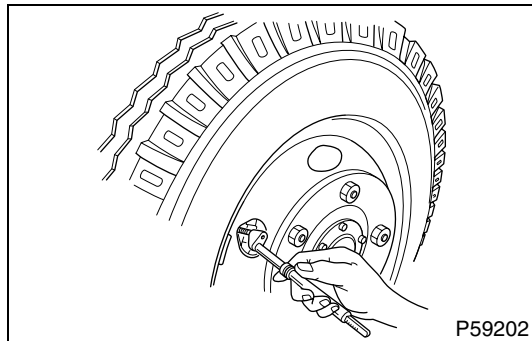
① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Wheel nut	400 to 440 {295 to 325, 41 to 45}	Wet

🔊 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Wheel nut spherical area	Chassis grease [NLGI No. 1 (Li soap)] or Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
4	Wheel nut (inner) at thread area and spherical area		
6	Thread area of hub bolt		



Air pressure

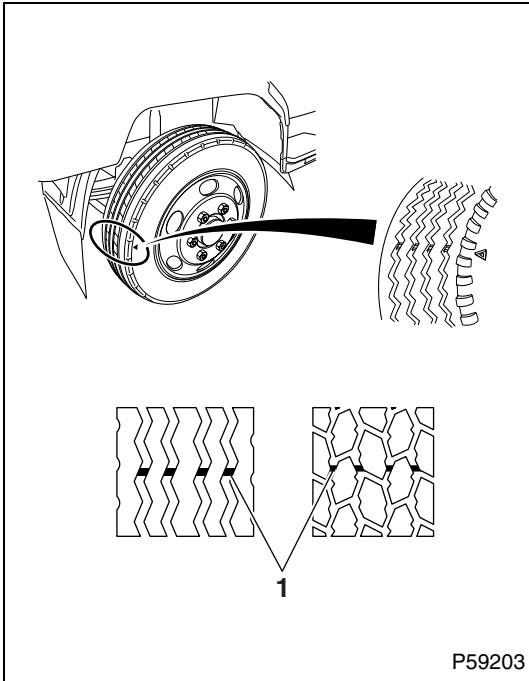
Tire air pressure should be checked before the vehicle is driven, while the tires are still cool.

Model	Tire size	Air pressure kPa {psi, kgf/cm ² }
FK	225/70R19.5	660 {95, 6.60}
FM	11R 22.5-14PR	720 {105, 7.20}

CAUTION ⚠

- Make certain that there is no difference in the air pressure between the inner and outer rear tires.
- Make certain you use valve caps on the air valves.
- It is not necessary to increase the air pressure for high-speed driving.

MAINTENANCE OPERATIONS

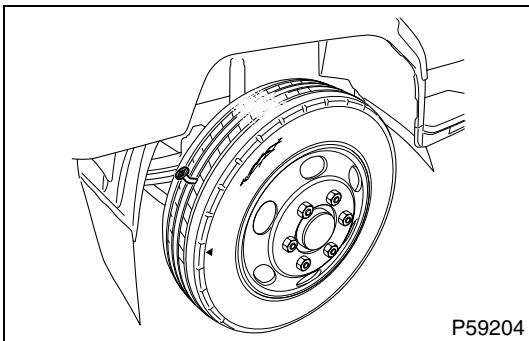


Checking tread depth

- Check all around the tire treads to make sure that the depth of the tread grooves is above the wear limit.
- If the tread grooves are not deep enough, slip sign appears at the position of the  mark, where the tread groove has worn away.

WARNING

If the depth of the tread grooves is not adequate, the tires will slip on wet roads and present a hazard. Such tires are also extremely dangerous because they are more susceptible to hydroplaning when the vehicle is running at high speeds in the rain. Such tires must be replaced with new ones as soon as possible.

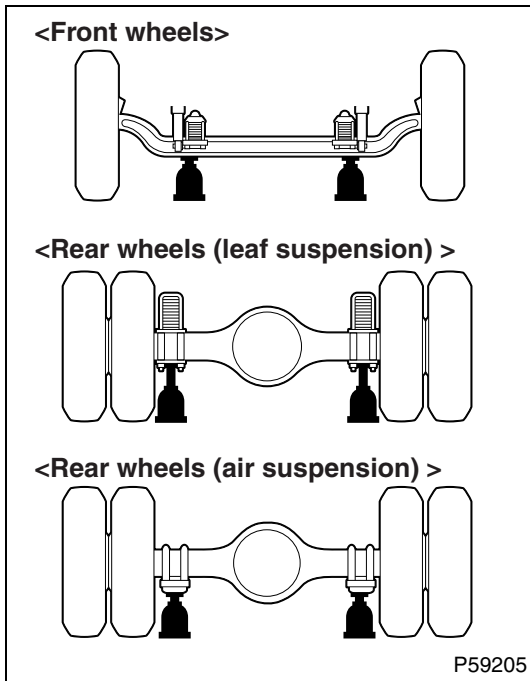


Checking for cracks, damage, and objects embedded in the treads

- Check the tire treads and walls for cracks and damage.
- Check tire treads for uneven wear or other abnormal wear.
- Check if metal objects or nails have penetrated the tires.
- Check for stones embedded between double tires.

WARNING

Badly damaged or worn tires are extremely dangerous, because they can be punctured more easily when the vehicle is running, they must be replaced with new ones as soon as possible.

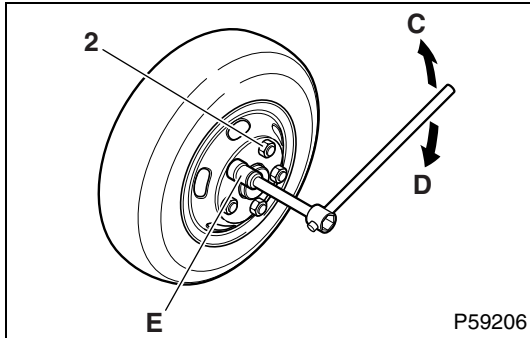


Removing tires

- Jacking up point.
 - For front wheels: Below the front axle
 - For rear wheels <leaf suspension>: Below the rear axle housing
 - For rear wheels <air suspension>: Below the rear leaf springs

WARNING

- The jack should be placed on flat, solid ground, and should not be used to raise the vehicle higher than necessary.
- Do not use the jack at vehicle locations other than those illustrated.
- Keep in mind the danger of a slipping jack. Never crawl under the vehicle while the jack is in use or rock the vehicle. Also, do not start the engine while the vehicle is jacked up.
- To increase safety, use supports for the vehicle when it is necessary to leave it jacked up for long periods.
- Chock both the tire to be removed and the tire diagonally opposite to it so that they will not rotate when you are removing the tire.



- Loosen wheel nuts **2** slightly. The wheel nuts for right tires **C** have right-hand threads “R”, and the wheel nuts for left tires **D** have left-hand threads “L”.

WARNING

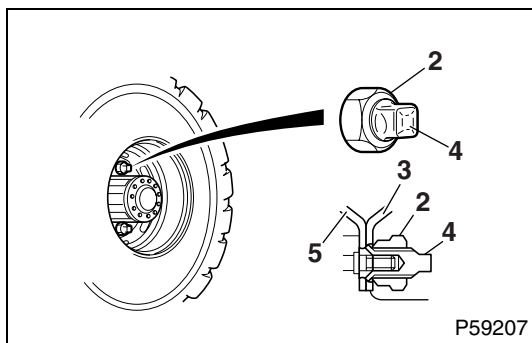
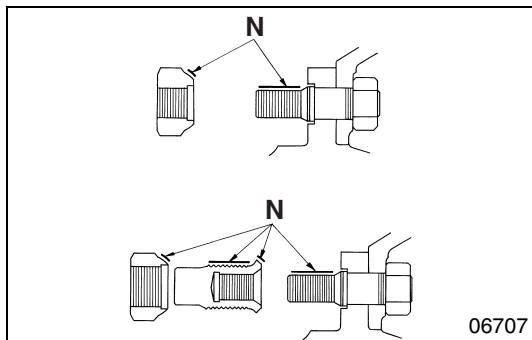
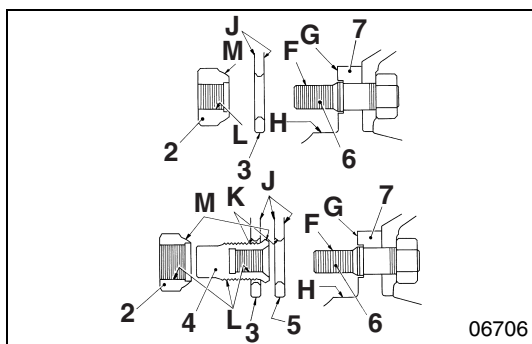
Make certain that wheel nut wrench **E** is fully engaged, all the way to the back of nuts **2**. If it is not, it could slip.

CAUTION

Only loosen wheel nuts **2** slightly. Do not remove them.

- Jack up the vehicle carefully, until the tire is slightly off the ground. Remove wheel nuts **2**, then remove the tire.
- When working on the double tires at the rear of the vehicle, first remove the outside tire, then lower the vehicle and loosen the nuts on the inside tire. After doing this, jack the vehicle back up and remove the tire.

MAINTENANCE OPERATIONS



Mounting tires

- To prevent wheel nuts **2, 4** and hub bolt **6** from becoming loose and to prevent mounted parts (tire assemblies **3, 5** and hub **7**) from being damaged, remove rust, dust, additional coatings of paint, and foreign particles from the following areas:

F : Hub bolt thread area

G : Wheel mounting surface of hub

H : Wheel alignment area of hub

J : Disc wheel mating surface

K : Disc wheel nut mounting surface

L : Wheel nut thread area

M : Wheel nut spherical area

N : Grease application area

WARNING

Never use grease containing molybdenum disulfide, because it would cause loosening of fitted screws.

- Put on the double rear tires as follows:

- After mounting inner tire **5** and fully tightening inner wheel nuts **4**, jack the vehicle up and mount on outer tire **3**, then tighten outer wheel nuts **2**.
- Even if only outside tire **3** is to be changed, do not mount it until inner wheel nuts **4** have been fastened at the specified torque.
- Slide the air valves on the inside and outside tires down when mounting the tires.

WARNING

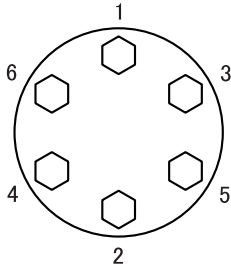
If the threads are scored, or the disc wheel is deformed or cracked, change bolts **6, nuts **2, 4** and disc. Driving the truck before correcting such problems can cause the tire in question to come loose, which could be the source of major accidents.**

CAUTION

Check hub bolt **6 threads carefully for damage before putting the tire on.**

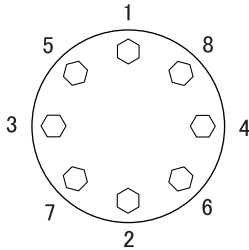
- Place the tapered end of wheel nuts **2, 4** towards the disc wheel and fasten temporarily. Center so that there is no eccentricity between bolts **6** and the disc wheel bolt holes.
- Lower the vehicle.

<6-stud>



P59209

<8-stud>



04904

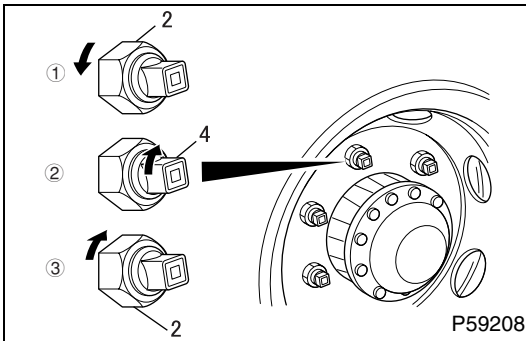
- Tighten the nuts in the order as illustrated, tightening each nut two or three times. To finish, tighten each nut at the specified torque.

WARNING ⚠

Always use the specified torque when tightening the wheel nuts. If the wheel nuts are not tightened properly, the wheels could come loose while the vehicle is being driven, which could result in life threatening accidents or the truck being disabled.

CAUTION ⚠

Over-tightening the wheel nuts can damage them.



P59208

Checking the wheel nuts for looseness

The wheel nuts should be checked for looseness every 10000 km (6000 miles). All nuts should be tightened at the specified torque.

- Check the double rear tires for looseness as follows:

- ① Loosen outer wheel nuts 2.
- ② Tighten inner wheel nuts 4 at specified torque.
- ③ Tighten outer wheel nuts 2 at specified torque.

CAUTION ⚠

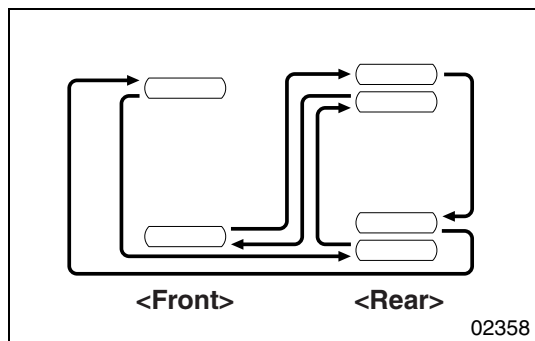
If outer wheel nuts 2 are tightened without first being loosened, it might not be possible to tighten them at the specified torque.

MAINTENANCE OPERATIONS

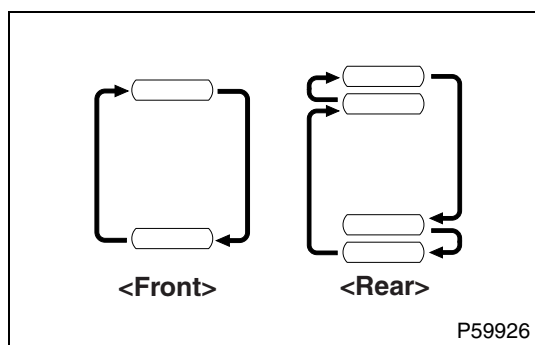
Tire rotation

Tires wear differently, according to the location where they are mounted. To make this wear uniform and prolong the life of your tires, they should be rotated every 10000 km (6000 miles) in the rotation order shown below:

- When the tread patterns for all tires are identical:



- When the tread patterns are different for the front and rear tires:



CAUTION

- Always adjust air pressure after running-in new tires.
 - When using tires of different tread patterns, use rib-type patterns for the front tires and traction type patterns for the rear tires.
 - Avoid using both radial and biased tires on the same vehicle.
-

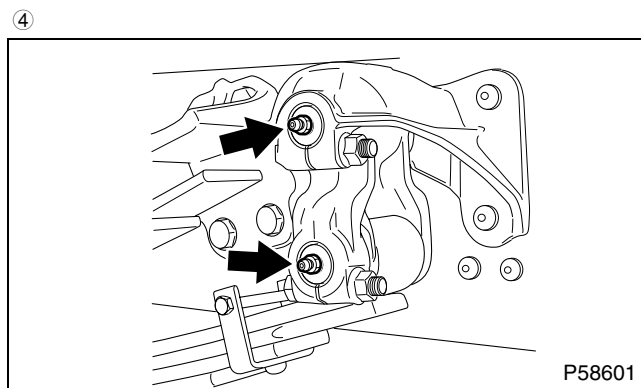
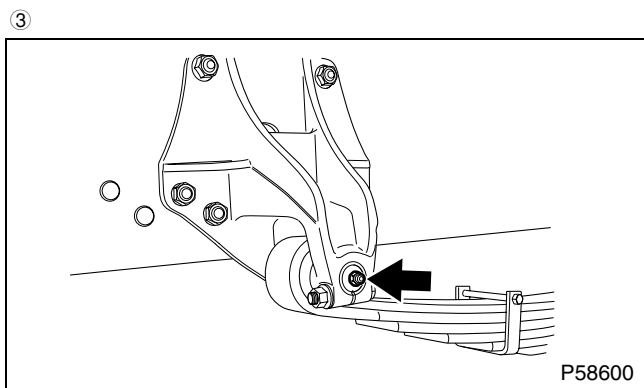
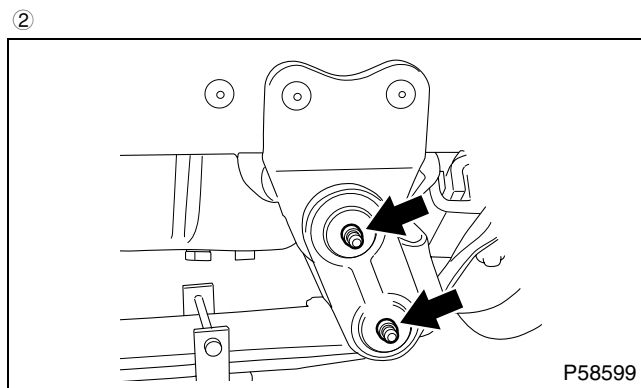
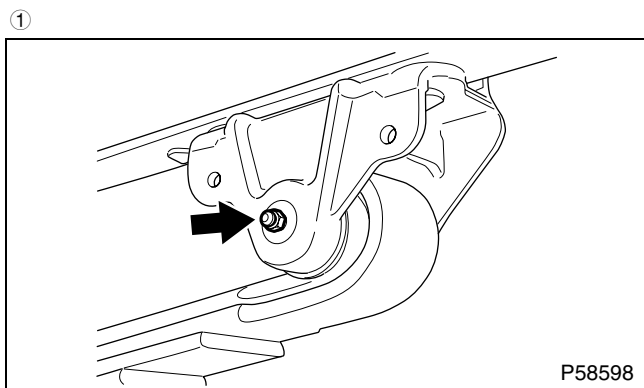
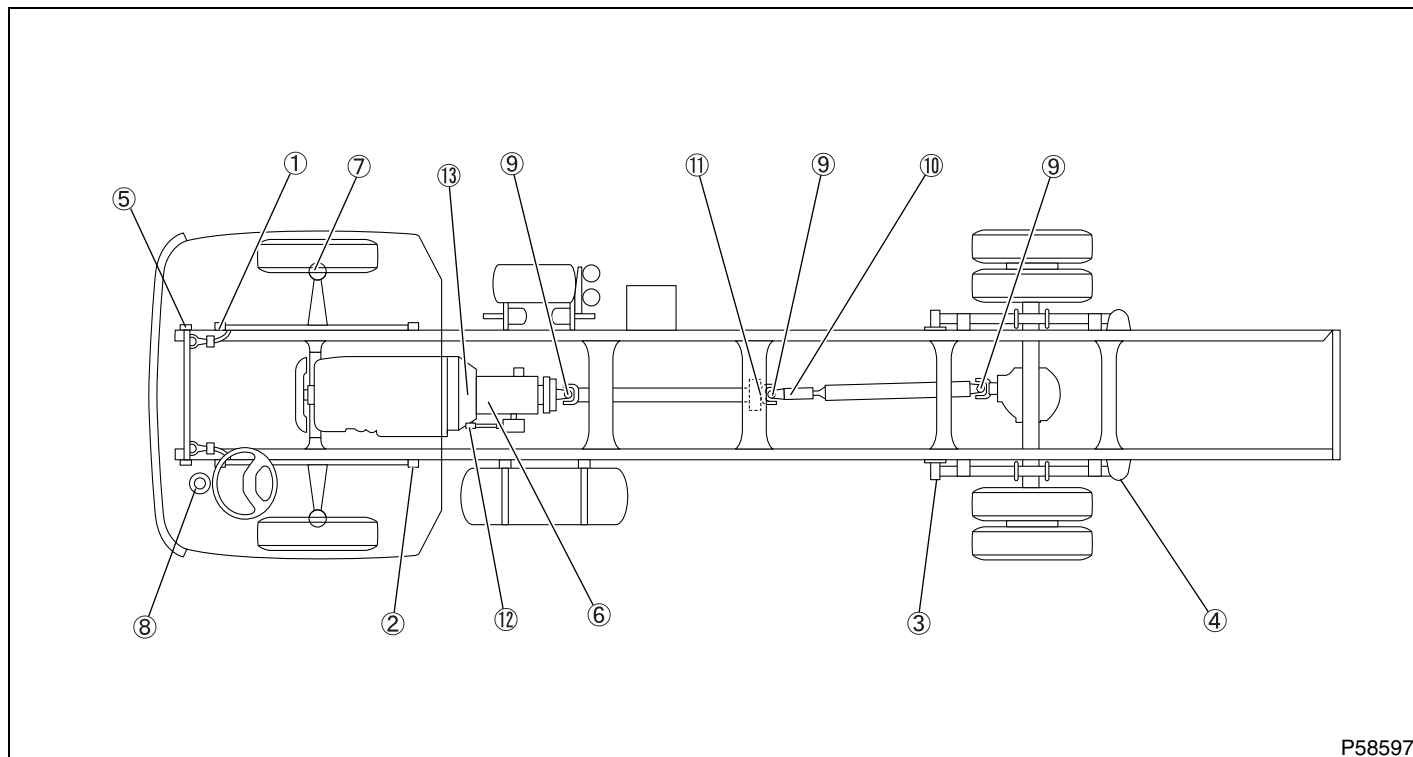
- *1: 30,000 km/18,000 miles or 6 months, whichever occurs first
 *2: 60,000 km/36,000 miles or 12 months, whichever occurs first
 *3: FK61F, FM61F, FM64F
 *4: 9-speed transmission vehicle
 ⑤: Exhaust emission items

Item	Time of inspection and maintenance					Lubrication procedures	Remarks
	Pre-operational checks	New vehicle at 4,000 km/ 2,500 miles	Inspection interval				
			Every 10,000 km/ 6,000 miles	Every 30,000 km/ 18,000 miles *1	Every 60,000 km/ 36,000 miles *2		
Ⓔ Engine oil contamination and oil level	×					Engine oil API classification DC, DC/SF, CE, CE/SF or CF-4 or JASO classification DH-1	📖Gr12
Ⓔ Engine oil replacement		×	×			Over 30°C {86°F} SAE 40 40 to -5°C {104 to 23°F} SAE 30 15 to -15°C {59 to 5°F} SAE 20W-20 Over -15°C {5°F} SAE 15W-40 Below 0°C {32°F} SAE 10W-30	
Clutch fluid tank fluid level	×		×			Brake fluid (SAE J1703f or FMVSS No. 116 DOT3)	📖Gr21
Clutch fluid tank fluid replacement					×		📖P01-15
Lubrication of clutch fork shaft				×		Wheel bearing grease [NLGI No. 2 (Li soap)]	
Lubrication of clutch shifter *4				×			
Manual transmission oil level			×			Gear oil, API classification GL-3 SAE 80 (General) GL-3 SAE 90 (Warm region) GL-4 SAE 90 (Tropical region) Engine oil Long period of high-speed driving API classification CC or CC/SF SAE 30 or SAE 40	📖Gr22
Manual transmission oil replacement		×	Every 50,000 km/ 30,000 miles				
Automatic transmission fluid level			×			Automatic transmission fluid (DEXRON III)	📖Gr23
Automatic transmission fluid and filter replacement			All models except FM65F: Every 80,000 km/48,000 miles FM65F: Every 40,000 km/24,000 miles				
		Replace only filter (not lubrication filter but main filter for FM65F) at first 8,000 km/ 5,000 miles.					
Axle housing gear oil level			×			Gear oil API classification GL-5 Below 40°C {104°F} SAE 90 Over 40°C {104°F} SAE 140 Use SAE 140 when operating vehicle under high load such as driving on continuous uphill roads and when the outside temperature is 10°C {50°F} or more	📖Gr27
Axle housing gear oil replacement		×			×		
Hub bearing grease and oil seal replacement					×	Wheel bearing grease [NLGI No. 2 (Li soap)]	📖Gr26, 27
Brake fluid tank fluid level *3	×		×			Brake fluid (SAE J1703 or FMVSS No. 116 DOT 3)	📖Gr35A, B
Brake fluid tank fluid replacement *3					×		
Power steering fluid level			×			Automatic transmission fluid (DEXRON, DEXRON II or DEXRON III type)	📖Gr37
Power steering fluid replacement					×		
Lubrication of propeller shaft (universal joint, slip joint, center bearing)			×			Wheel bearing grease [NLGI No. 2 (Li soap)]	📖P01-15
Lubrication of kingpins			×			Wheel bearing grease [NLGI No. 2 (Li soap)]	📖P01-15
Lubrication of all chassis parts			×			Chassis grease [NLGI No. 1 (Li soap)]	📖P01-15
Lubrication of cab rear mount side cushion				×		Chassis grease [NLGI No. 1 (Li soap)]	📖Gr42

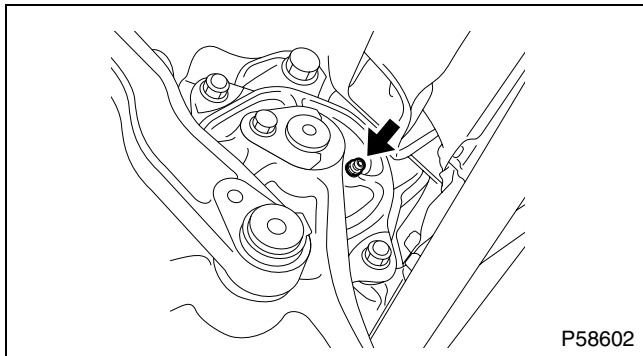
LUBRICATION

Greasing Various Areas of Chassis

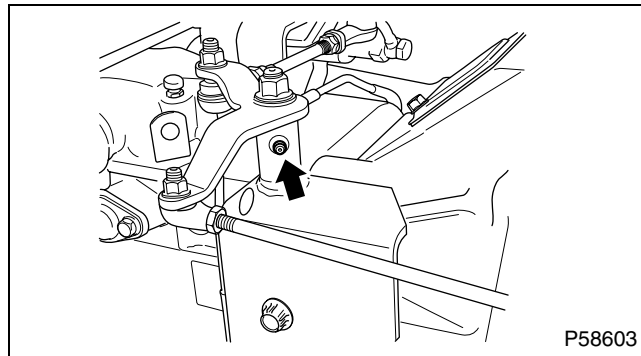
Carefully clean away all dust and dirt from the grease nipples, and use the specified type of grease. The areas to be greased are shown in the following illustration.



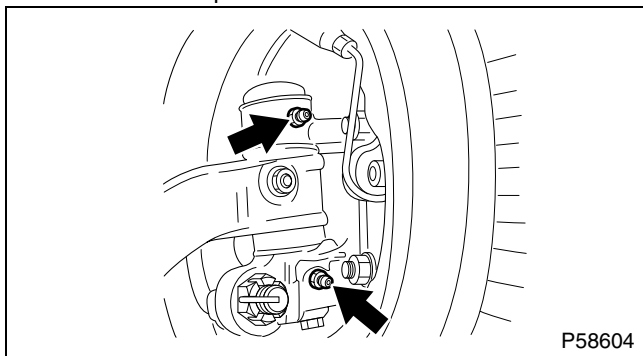
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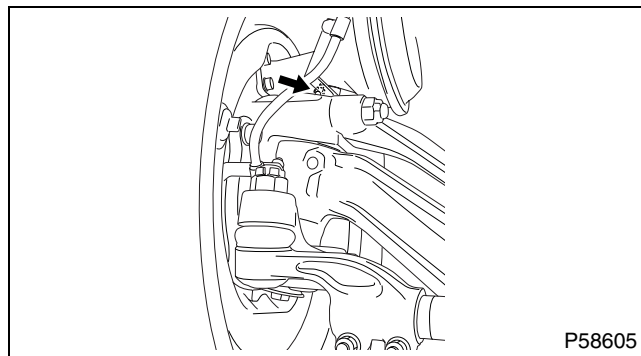
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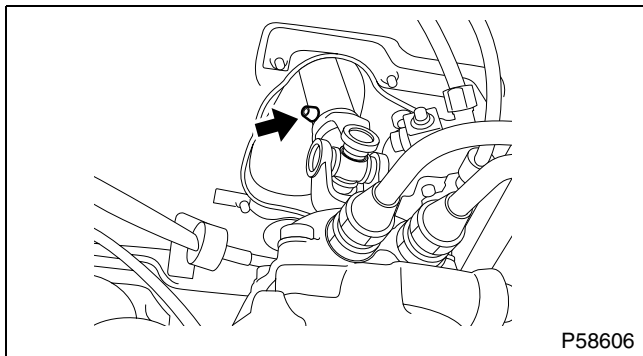
⑦ <All models except FM65F>



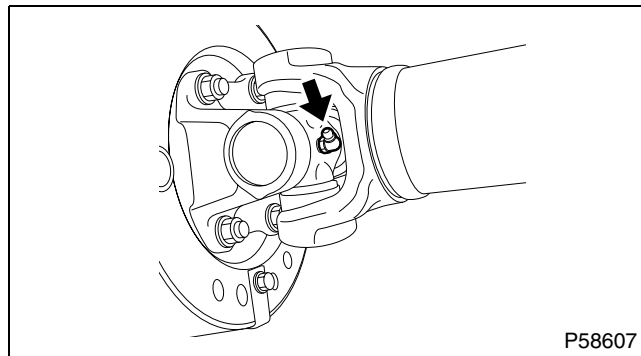
⑦ <FM65F>



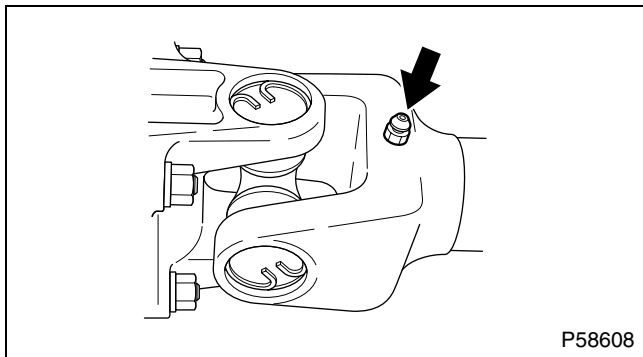
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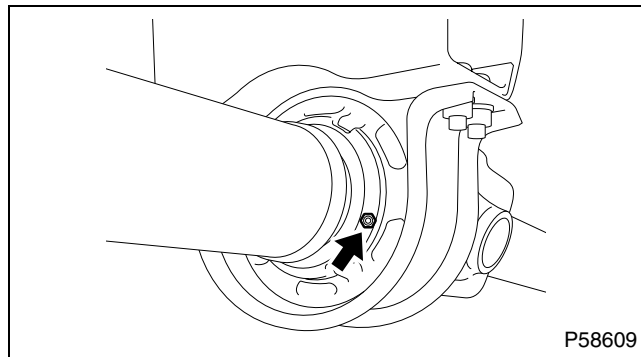
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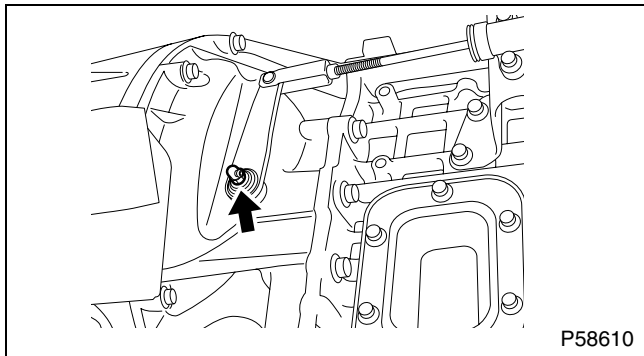


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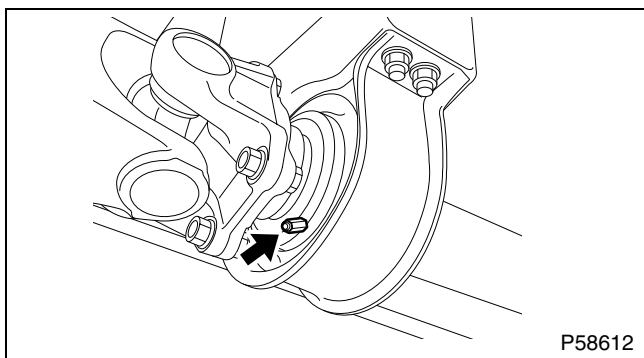
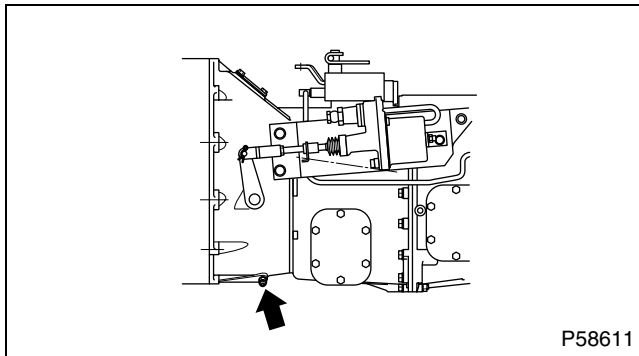


LUBRICATION

⑫



⑬



Supply grease to the center bearing until grease overflows from the escape valve at the back of the grease nipple.

- ① Front spring pin front (left and right, 2 points)
- ② Front spring pin front (left and right, 4 points)
- ③ Rear spring pin front (left and right, 2 points)
- ④ Rear spring pin front (left and right, 4 points)
- ⑤ Cab hinge (left and right, two points)
- ⑥ Transmission control select shaft <9-speed transmission vehicle>
- ⑦ Kingpin bearing (left and right, 4 points)
- ⑧ Steering shaft
- ⑨ Universal joint of propeller shaft
- ⑩ Slip joint of propeller shaft
- ⑪ Center bearing of propeller shaft
- ⑫ Clutch fork shaft (left and right, 2 points)
- ⑬ Clutch shifter <9-speed transmission vehicle>



Group 11

Engine

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

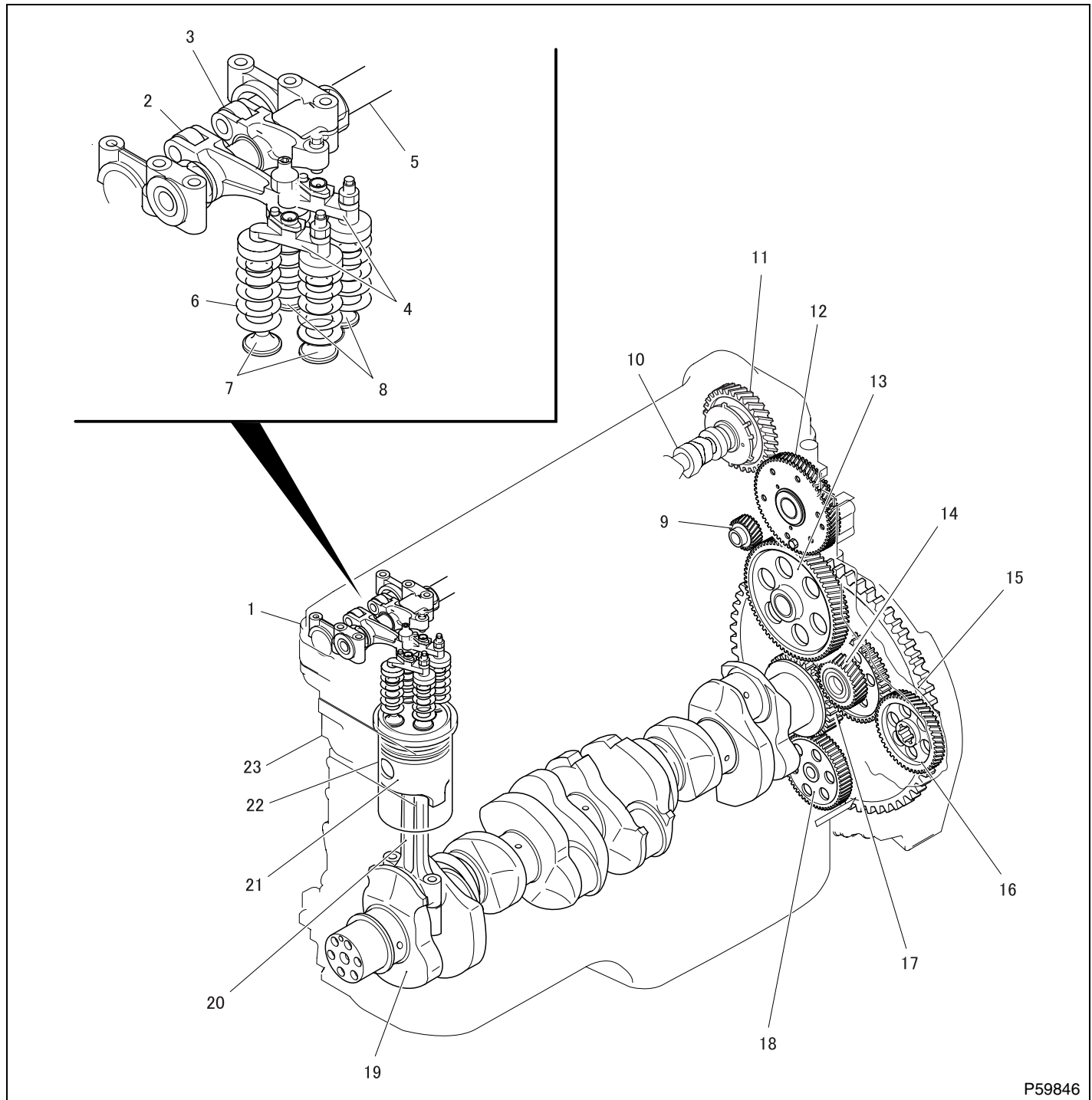
INDEX

SPECIFICATIONS	11-2
STRUCTURE AND OPERATION	
1. Engine Proper	11-3
2. Rocker and Bracket Assembly, Camshaft, Rocker Case and Cylinder Head Gasket	11-4
3. Valve Mechanism	11-5
4. Connecting Rods	11-5
5. Pistons	11-6
6. Timing Gears	11-6
7. Flywheel	11-8
TROUBLESHOOTING	11-9
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Measuring Compression Pressure	11-10
2. Inspecting and Adjusting Valve Clearances	11-14
ENGINE REMOVAL AND INSTALLATION	11-18
ROCKER COVER, ROCKER AND BRACKET ASSEMBLY, CAMSHAFT	11-20
CYLINDER HEAD, VALVE MECHANISM	11-30
PISTONS, CONNECTING RODS AND CYLINDER LINERS	11-48
FLYWHEEL	
<MANUAL TRANSMISSION>	11-62
<AUTOMATIC TRANSMISSION>	11-68
TIMING GEARS.....	11-72
CRANKSHAFT AND CRANKCASE	11-78

SPECIFICATIONS

Item		Specifications	
Engine model		6M60T1	6M60T2
Type		6-cylinder, in-line, water-cooled, 4-cycle diesel	
Combustion chamber type		Direct injection	
Valve mechanism		Overhead camshaft	
Max. power output	HP/rpm	243/2600	274/2600
Max. torque	ft.lbs/rpm	516/1400	589/1400
Cylinder bore × stroke	mm {in.}	φ118 × 115 {φ4.65 × 4.53}	
Total displacement	cm ³ {cu.in.}	7545 {460}	
Compression ratio		17.5	

1. Engine Proper



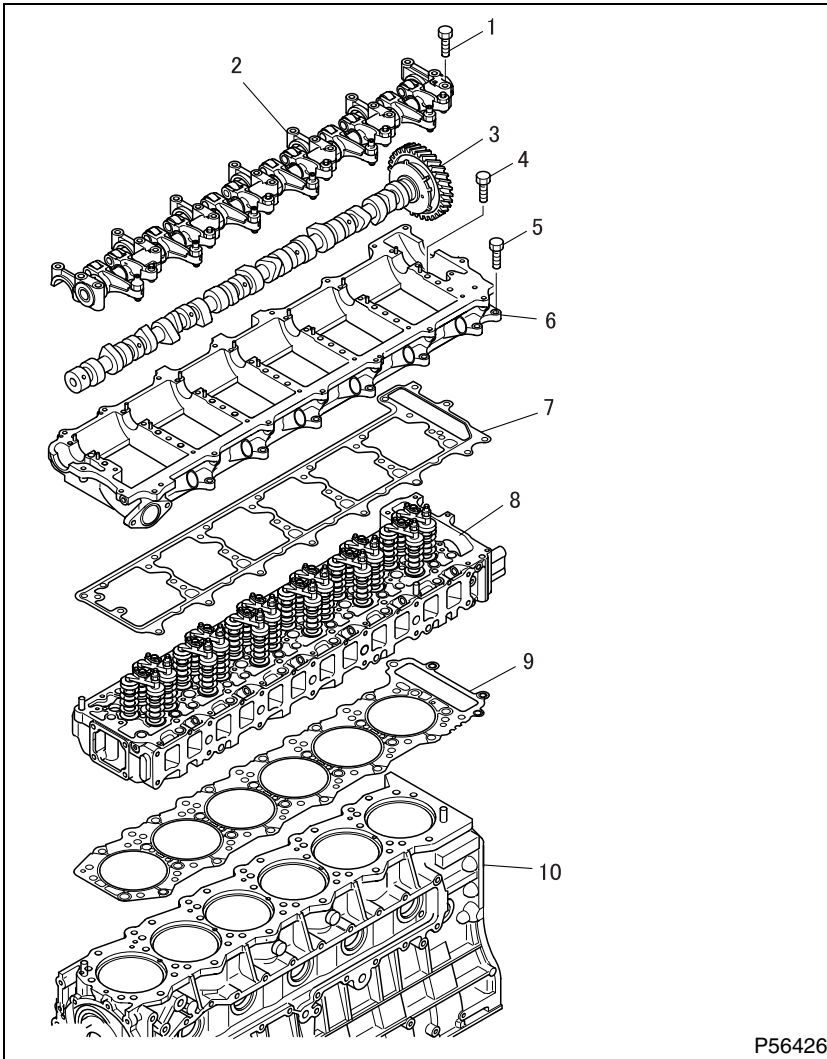
P59846

- | | | |
|------------------|--------------------------------|--------------------|
| 1 Rocker case | 9 Power steering oil pump gear | 17 Crankshaft gear |
| 2 Inlet rocker | 10 Camshaft | 18 Oil pump gear |
| 3 Exhaust rocker | 11 Camshaft gear | 19 Crankshaft |
| 4 Valve bridge | 12 No. 3 idler gear | 20 Connecting rod |
| 5 Rocker shaft | 13 No. 2 idler gear | 21 Piston |
| 6 Valve spring | 14 No. 1 idler gear | 22 Cylinder liner |
| 7 Inlet valve | 15 Flywheel | 23 Cylinder head |
| 8 Exhaust valve | 16 Air compressor gear | |

The 6M6 engine is an overhead camshaft (OHC) engine and has the valve mechanism and timing gears arranged as shown in the illustration above.

STRUCTURE AND OPERATION

2. Rocker and Bracket Assembly, Camshaft, Rocker Case and Cylinder Head Gasket



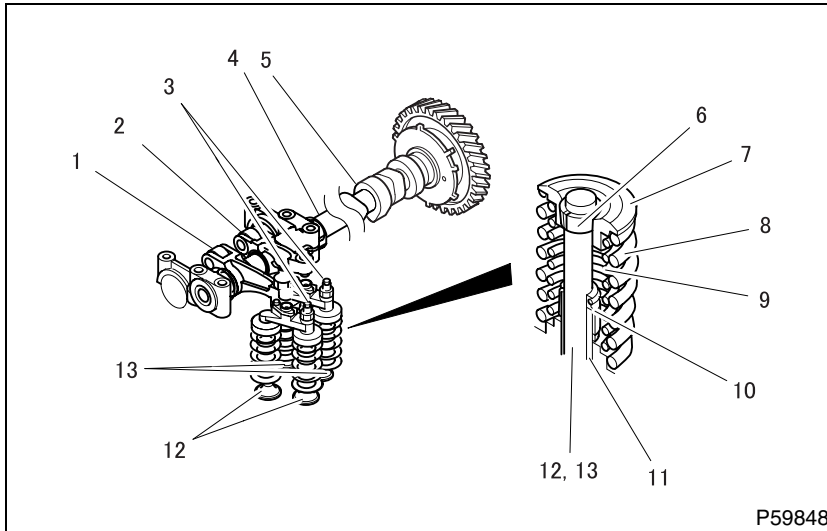
- 1 Bolt
- 2 Rocker and bracket assembly
- 3 Camshaft
- 4 Bolt
- 5 Bolt
- 6 Rocker case
- 7 Rocker case gasket
- 8 Cylinder head and valve assembly
- 9 Cylinder head gasket
- 10 Crankcase

P: Locating pin

P56426

- The camshaft **3** is supported at its journals by the rocker case **6**, and is retained from above by the bracket of the rocker and bracket assembly **2**.
- The camshaft **3** is supported at its journals, not through camshaft bearings but directly by the rocker case **6** and the bracket section of the rocker and bracket assembly **2**. Since the rocker case and bracket have been machined together, they must be replaced as a set when either of them becomes faulty.

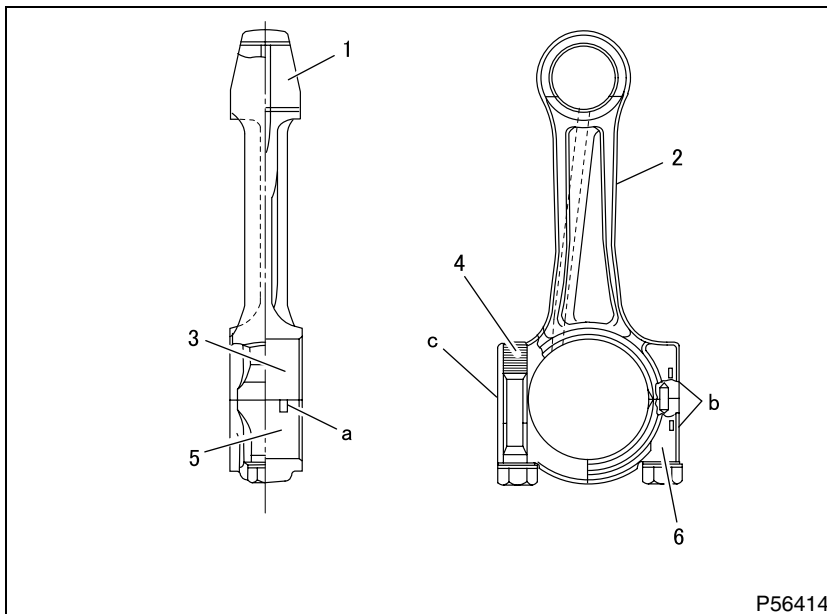
3. Valve Mechanism



- 1 Inlet rocker
- 2 Exhaust rocker
- 3 Valve bridge
- 4 Rocker shaft
- 5 Camshaft
- 6 Valve cotter
- 7 Upper retainer
- 8 Outer valve spring
- 9 Inner valve spring
- 10 Valve stem seal
- 11 Valve guide
- 12 Inlet valve
- 13 Exhaust valve

- The valves **12** and **13** are each fitted with a valve stem seal **10**, which controls the amount of lubrication oil feed to the sliding surfaces of the valves **12** and **13** and the valve guide **11**.
- The valve springs **8** and **9** are both a variable pitch type to prevent abnormal vibration at high engine speed. Only the exhaust valve uses a double spring system. The system's inner and outer springs are coiled in different directions to prevent them from jamming each other.

4. Connecting Rods

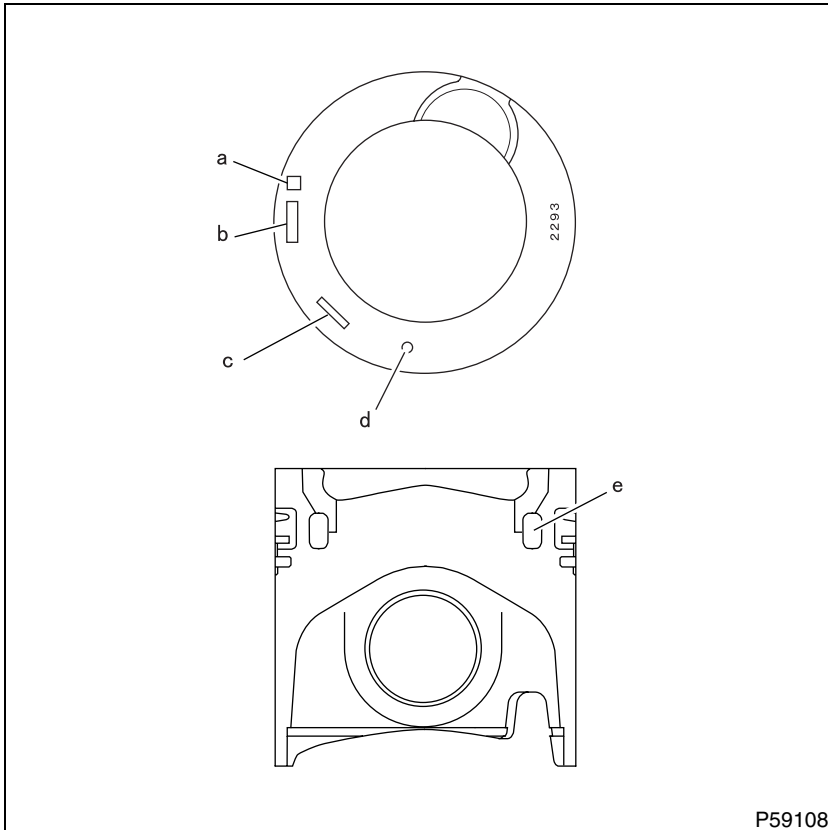


- 1 Connecting rod bushing
- 2 Connecting rod
- 3 Upper connecting rod bearing
- 4 Connecting rod bolt
- 5 Lower connecting rod bearing
- 6 Connecting rod cap

- a: Lug
- b: Alignment mark
- c: Mass mark
- "A to E"

STRUCTURE AND OPERATION

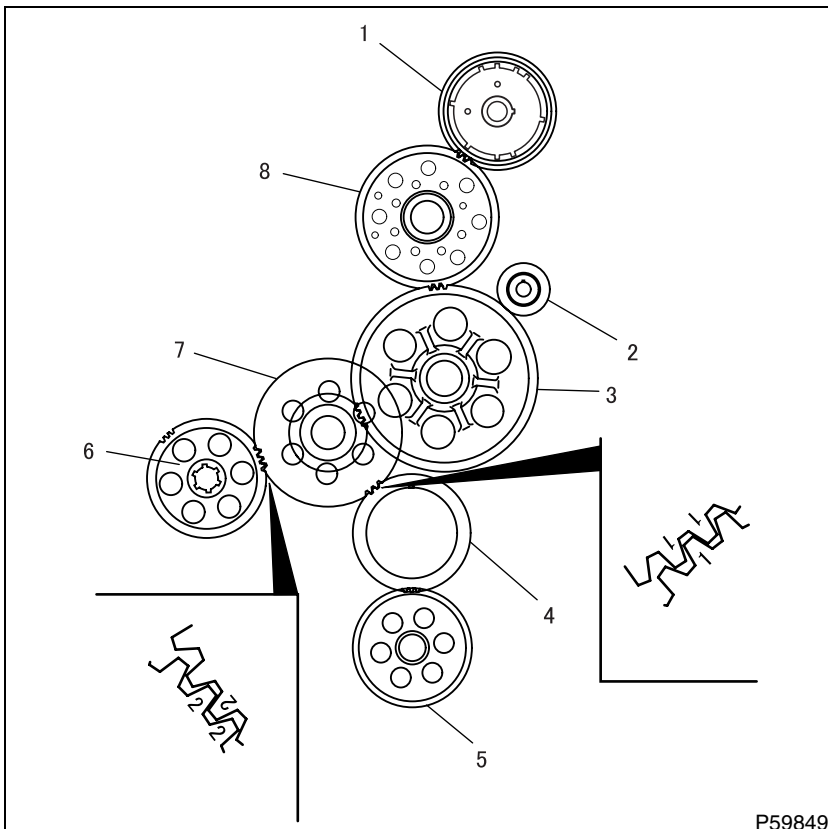
5. Pistons



- a: Size mark "A", "B"
- b: Mass
- c: Machining date No.
- d: Front mark "O"
- e: Cooling channel

- The pistons should be mated with the crankcase locations and cylinder liners that bear the same size marks as the pistons.
- The piston is made of special aluminum alloy.

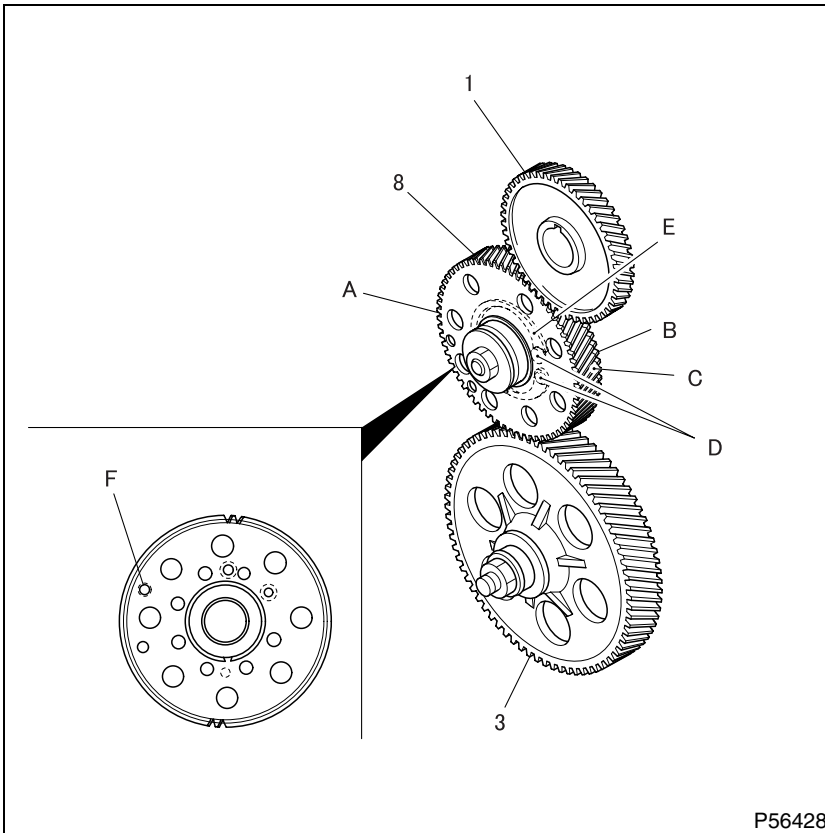
6. Timing Gears



- 1 Camshaft gear (53)
- 2 Power steering oil pump gear (20)
- 3 No. 2 idler gear (84)
- 4 Crankshaft gear (53)
- 5 Oil pump gear (58)
- 6 Air compressor gear (53)
- 7 No. 1 idler gear (66, 33)
- 8 No. 3 idler gear (64)

(): Number of teeth

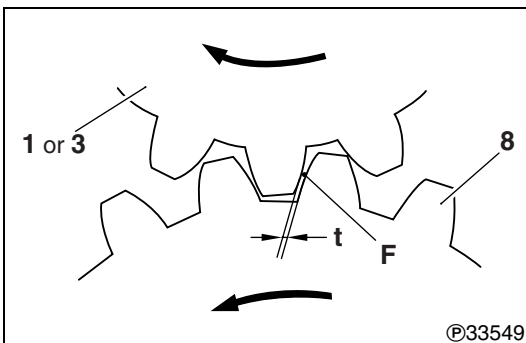
The crankshaft gear 4, air compressor gear 6 and No. 1 idler gear 7 all bear an alignment mark to enable these gears to be assembled such that the correct timing is obtained.



● No. 3 idler gear

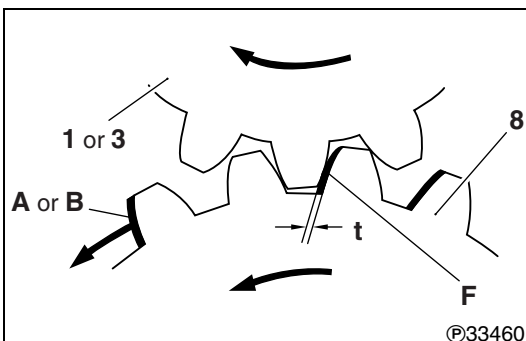
- The No. 3 idler gear **8** is composed of the sub-gears **A** and **B** and the main gear **C**, which is flanked by the sub-gears.
- Between the sub-gears **A** and **B** and the main gear **C**, the springs **E** are retained by the pins **D**.
- The sub-gear **A** is meshed with the camshaft gear **1** while the sub-gear **B** is meshed with the No. 2 idler gear **3**. Each sub-gear has been turned such that the force of the spring **E** acts on the sub-gear.

F: Sub-gear retaining bolt hole



Non-backlash mechanism

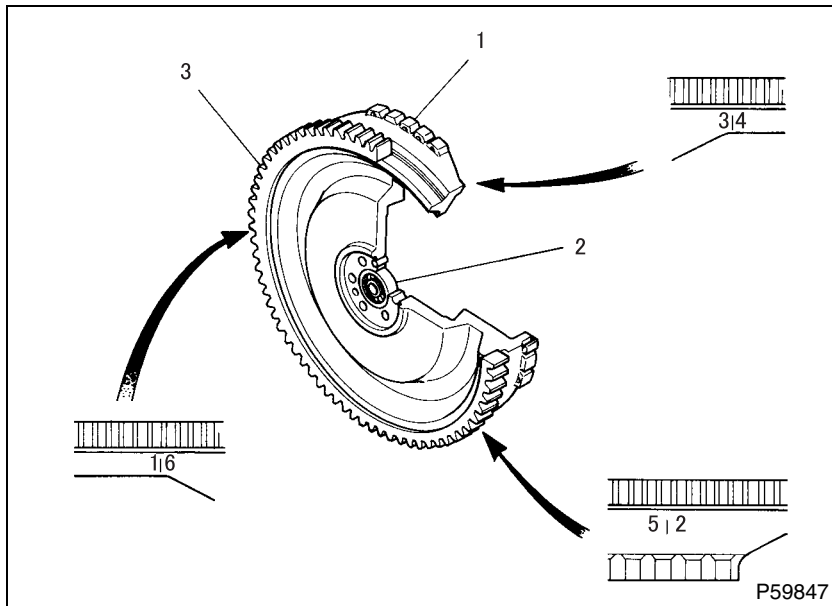
- When the engine is idling, fluctuation of the engine speed causes either the speed of the camshaft gear **1** or that of the No. 2 idler gear **3** to fluctuate.
- Without the non-backlash mechanism, the amount **t** of backlash at **F** changes between zero and the maximum, causing gear rattling.



- With the non-backlash mechanism provided, the sub-gear **A** or **B** ensures that the amount **t** of backlash at **F** is maintained at zero despite the engine speed fluctuation during idling. This eliminates gear rattling, which helps to reduce idling noise.

STRUCTURE AND OPERATION

7. Flywheel



- 1 Flywheel
- 2 Pilot bearing <Manual Transmission>
- 3 Ring gear

A: Cylinder number

Symptoms		Low power output	Abnormal engine noise	Remarks
Possible causes				
Cylinder head and valve mechanism	Incorrect valve clearance	☐	☐	
	Defective cylinder head gasket	☐	☐	
	Worn valve/valve seat, and carbon deposits	☐	☐	
	Weakened valve spring	☐	☐	
	Defective rocker shaft and bracket	☐	☐	
	Incorrect lubrication of rocker shaft bracket	☐	☐	
Timing gears	Incorrect backlash in timing gears	☐	☐	
	Incorrect lubrication of timing gear peripheries and idler shafts	☐	☐	
Camshaft	Excessive end play in camshaft	☐	☐	
	Worn camshaft	☐	☐	
Pistons and connecting rods	Worn/damaged piston ring groove(s)	☐	☐	
	Worn/damaged piston ring(s)	☐	☐	
	Worn piston pin and connecting rod small end bushing	☐	☐	
Crankshaft	Excessive end play in crankshaft	☐	☐	
	Incorrectly fitted fan pulley	☐	☐	
	Worn/damaged crankshaft pin and connecting rod big end bearing	☐	☐	
	Worn/damaged crankshaft journal and main bearing	☐	☐	
Fuel	Defective fuel injection system	☐	☐	 Gr13E
	Air trapped in fuel system	☐	☐	 Gr13A
Cooling	Defective cooling system	☐	☐	 Gr14
	Loose/damaged V-belt	☐	☐	
Intake and exhaust	Clogged air cleaner	☐	☐	 Gr15
	Clogged muffler	☐	☐	
	Defective turbocharger	☐	☐	
Incorrect oil viscosity		☐	☐	
Incorrect/defective fuel		☐	☐	
Incorrectly fitted pipe(s)/hose(s)		☐	☐	
Injection pump, alternator or other auxiliary device(s) defective/incorrectly fitted		☐	☐	

ON-VEHICLE INSPECTION AND ADJUSTMENT

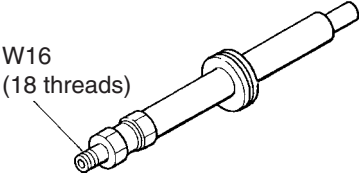
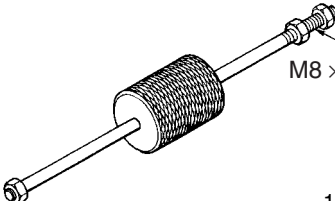
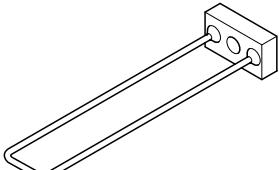
1. Measuring Compression Pressure

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Compression pressure	Each cylinder (at 200 rpm)	2940 kPa {426 psi, 30 kgf/cm ² }	1960 kPa {284 psi, 20 kgf/cm ² }	Inspect
		Cylinder-to-cylinder pressure difference	–	390 kPa or less {57 psi, 4.0 kgf/cm ² or less}	Inspect

Special tools

Unit: mm {in.}

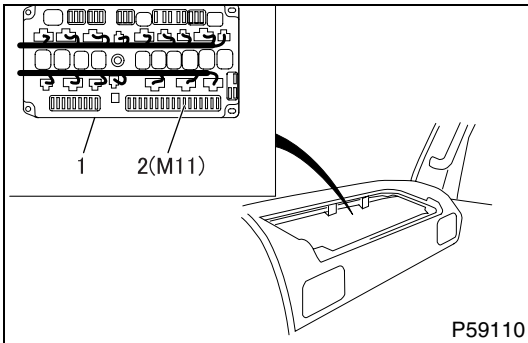
Location	Tool name and shape		Part No.	Application
6	Compression Gauge Adapter		MH063384	Measuring compression pressure
	Nozzle Extractor		MH061071	Removing injector and injection nozzle
	Injector Extractor Adaptor		MH062560	Removing injector (use with MH061071)

Reductions in compression pressure should be used as a guide in determining the timing of engine overhauls.

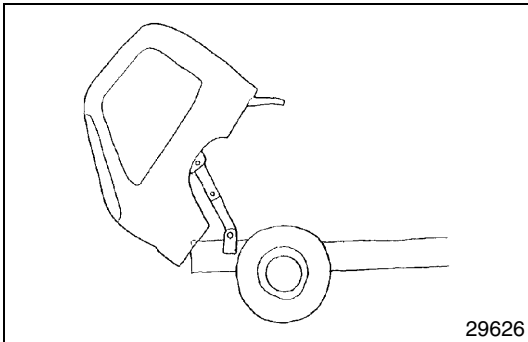
Take measurements regularly and keep track of changes; an overview of pressure variations can be useful in fault diagnosis.

During the engine's run-in period and after parts have been replaced, the compression pressure will increase slightly as piston rings, valve seats, and other parts fit snugly in position. The pressure will then normalize as parts wear.

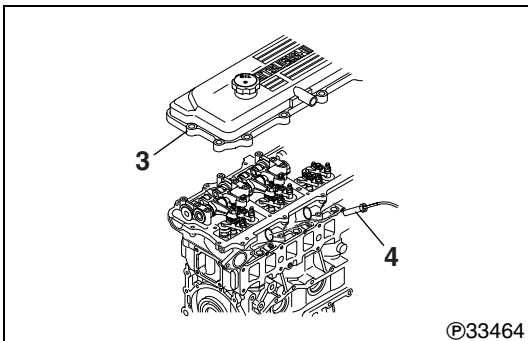
- Before inspections, check that the engine oil, starter and battery are normal.
- Take the following steps:
 - Warm up the engine until the coolant temperature reaches 75 to 85°C {167 to 185°F}.
 - Turn off all lights and auxiliary devices.
 - Place the transmission in neutral.
 - Place the steering wheel in the straight-ahead position.



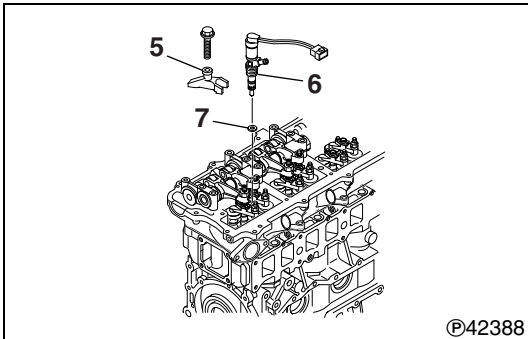
- Remove the fuse 2 from the relay and fuse box 1 in the cab to prevent fuel from being injected when the engine is cranked using the starter.



- Tilt the cab.

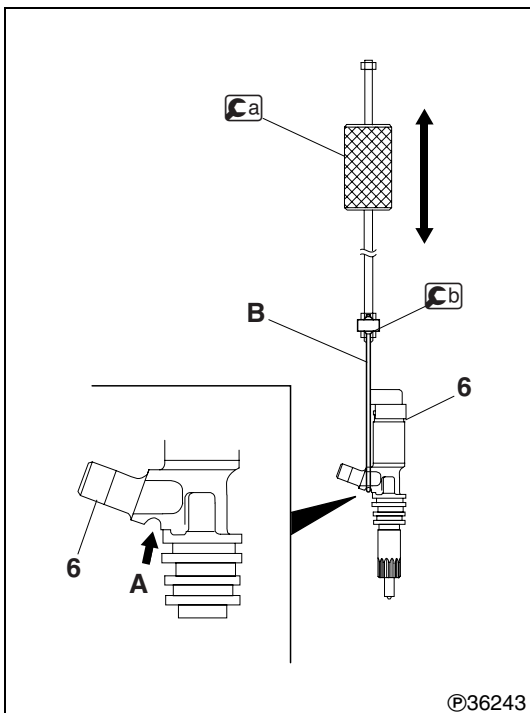


- Remove the EGR pipe and breather pipe. Gr17
- Remove the rocker cover 3 and injection pipe 4. P11-20, Gr13A

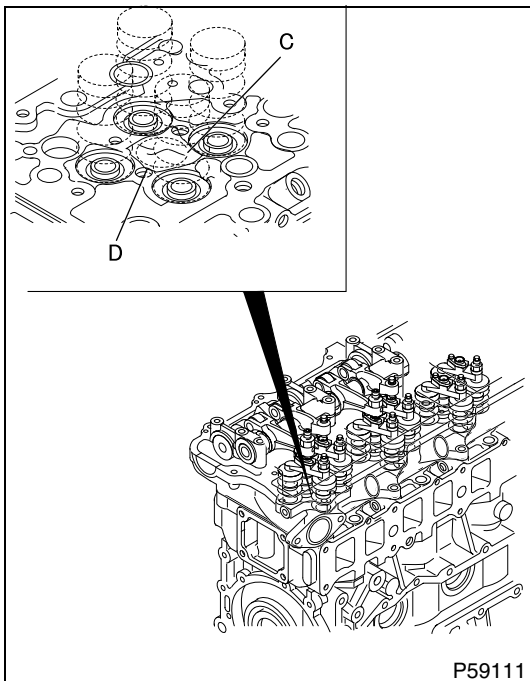


- Remove all nozzle bridges 5, injectors 6 and nozzle chip gaskets 7. Removal of the injectors can be accomplished by the following procedure.

ON-VEHICLE INSPECTION AND ADJUSTMENT



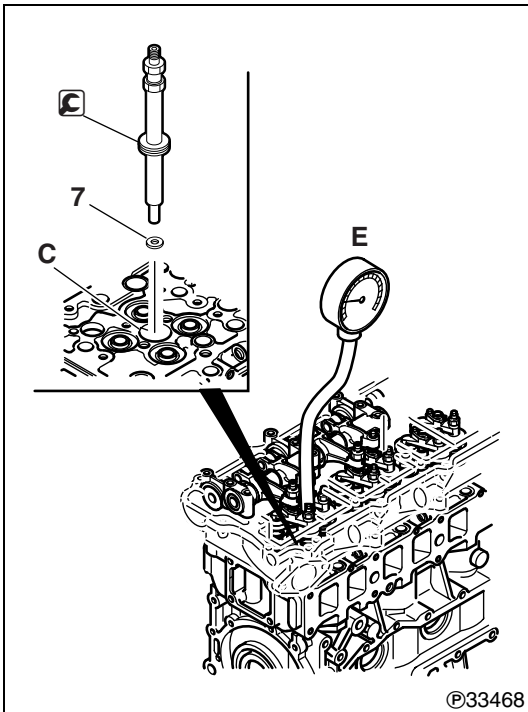
- Using the  **a** Nozzle Extractor and Injector Extractor Adapter, remove the injector **6** by hooking the wire **B** of the  **b** Injector Extractor Adapter in the groove **A** on the injector.



- Cover the injector or injection nozzle mounting holes **C** with a waste **D**. Then, cranking the engine with the starter and check that no foreign matter adheres to the waste.

WARNING

If any cylinder is cracked, coolant, engine oil or fuel will enter the cylinder through the crack. When the engine is cranking, these substances will spray out of the injector mounting hole **C** at a high temperature. For safety, move away from the injector mounting hole before cranking the engine.



- Fit the  Compression Gauge Adapter onto an injector mounting hole **C** together with a nozzle gasket **7**. Then, connect the compression gauge **E**.
- Cranking the engine, measure the compression pressure.
- Measure the compression pressure in every cylinder and determine the pressure differences between cylinders.
- If any compression pressure or cylinder-to-cylinder pressure difference exceeds the specified limit, pour a little engine oil into the cylinder via the injector mounting hole **C** then take the measurement again.
 - If the compression pressure increases, there may be wear or damage on piston rings and inner surfaces of cylinders.
 - If the compression pressure does not increase, valves may be seized or incorrectly seated, or the cylinder head gasket may be defective.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Inspecting and Adjusting Valve Clearances

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
–	Valve clearance (when cold)	0.6 {0.024}	–	Adjust

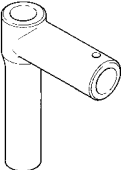
ⓘ Tightening torque

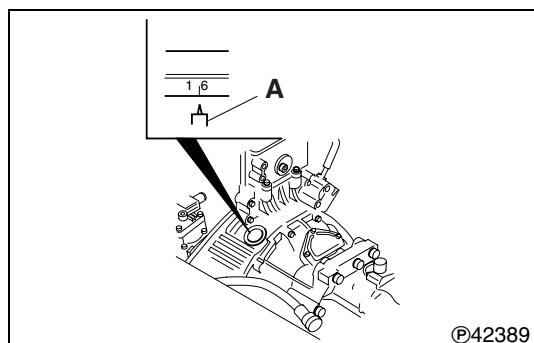
Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Lock nut (valve bridge adjusting screw tightening)	59 {44, 6.0}	–
6	Lock nut (rocker arm adjusting screw tightening)	34 {25, 3.5}	–

🔧 Special tool

Unit: mm {in.}

Location	Tool name and shape	Part No.	Application
4	Socket Wrench 	MH063003	Tightening lock nut



Valve clearances should be checked and adjusted as follows while the engine is cold.

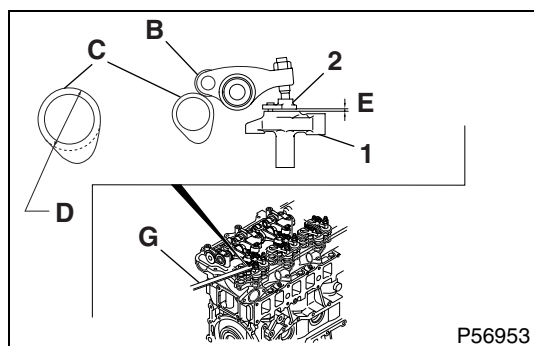
[Inspection]

- Tilt the cab.
- Remove the EGR pipe and breather pipe. 🗑 Gr17
- Remove the rocker cover.
- Bring piston No. 1 or piston No. 6 to the top-dead-center (TDC) position of its compression stroke. To do this, crank the engine until the “1”, “6” mark inscribed on the flywheel is aligned with the pointer A in the flywheel housing inspection window.

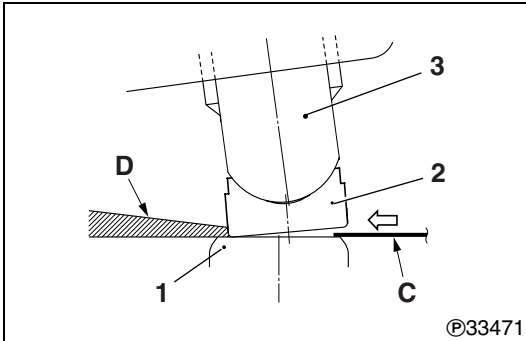
NOTE

Pistons whose rockers B for both inlet and exhaust valves are on the cam base circle D of camshaft C are at the top dead center of their compression strokes.

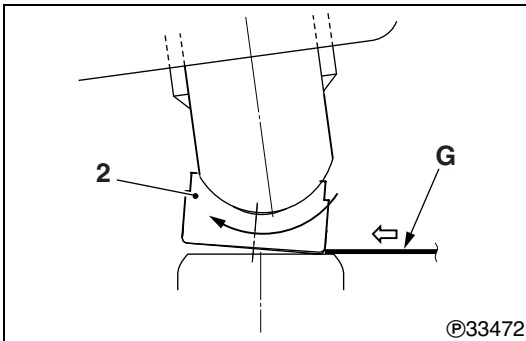
- When piston No. 1 or piston No. 6 is at the TDC position of its compression stroke, measure the clearance E (clearance between valve bridge 1 and pad 2) of every valve marked “○” in the following table.



Piston No.	1		2		3		4		5		6	
Valve arrangement	In.	Ex.	In.	Ex.	In.	Ex.	In.	Ex.	In.	Ex.	In.	Ex.
No. 1 piston at TDC of compression stroke	○	○	○	–	–	○	○	–	–	○	–	–
No. 6 piston at TDC of compression stroke	–	–	–	○	○	–	–	○	○	–	○	○



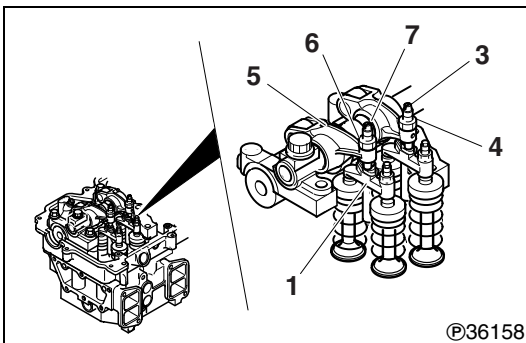
- When measuring the valve clearance, press the pad **2** between the valve bridge **1** and adjusting screw **3** with the tip of a standard screwdriver or the like **F** from opposite to the feeler gauge insertion side as shown in the illustration. This is necessary to make a space for inserting the feeler gauge **G**.



- An attempt to insert the feeler gauge **G** without making an insertion space will cause the pad **2** to incline in the illustrated direction, making the insertion impossible.

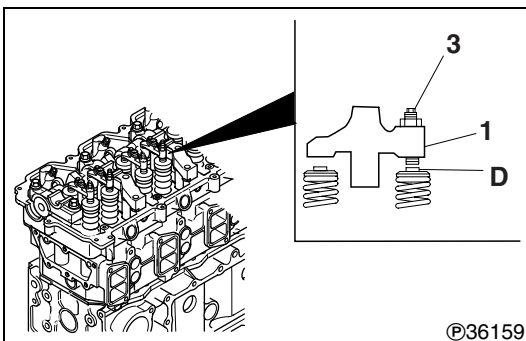
NOTE

- For proper measurement, some resistance must be felt when inserting the feeler gauge **G** in the clearance.
- Accurate measurements cannot be expected if the gauge loosely moves in the clearance.
- If any measurement is out of specification, make adjustments as follows:



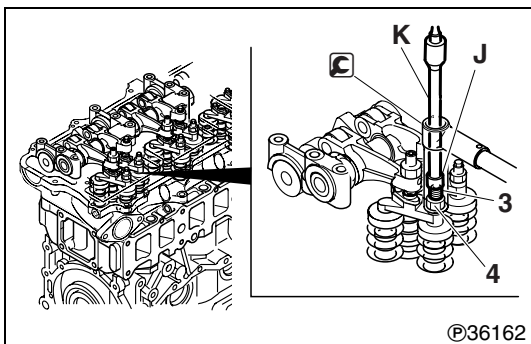
[Adjustment]

- Loosen lock nuts **4**, **6** and adjusting screw **3**, **7** on the valve bridge **1** and rocker arm **5**.



- Holding the valve bridge **1** by hand, tighten the adjusting screw **3** until it comes in light contact with the valve top **H**.
- From this point, tighten the adjusting screw **3** by 45 degrees further.

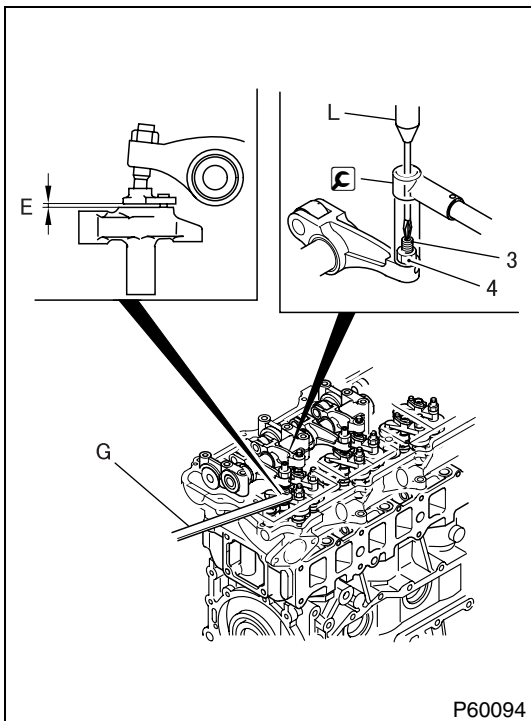
ON-VEHICLE INSPECTION AND ADJUSTMENT



- While holding the adjusting screw 3 with the socket wrench J and extension K to keep it from turning, tighten the lock nut 4 to the specified torque using the  Socket Wrench in order to lock the adjusting screw.

CAUTION

After tightening adjusting screw 3, be sure to tighten lock nut 4 to the specified torque. Insufficient torque will impair the parallelism of valve bridge, which will damage the valve mechanism.



- Tighten the adjusting screw 3 on the rocker arm 5 until the feeler gauge C moves somewhat stiffly in the gap.
- Holding the adjusting screw 3 in that position with a Phillips screwdriver L, tighten the lock nut 4 to the specified torque with  Socket Wrench to lock the adjusting screw.
- Recheck the valve clearance E using the feeler gauge G.

MEMO

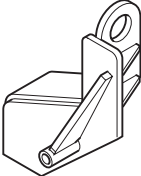
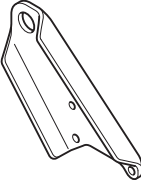
ENGINE REMOVAL AND INSTALLATION

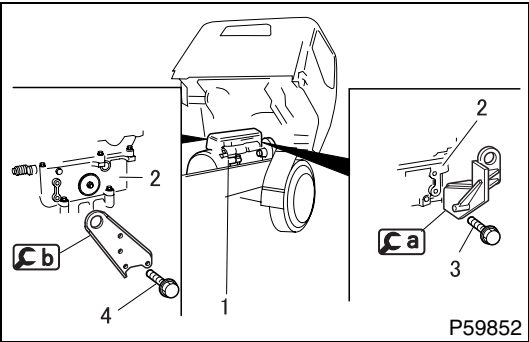
Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Bolt (front engine mounting installation)	50 to 65 {37 to 48, 5.1 to 6.6}	—
6	Nut (rear engine mounting installation)	60 to 85 {44 to 63, 6 to 8.5}	—

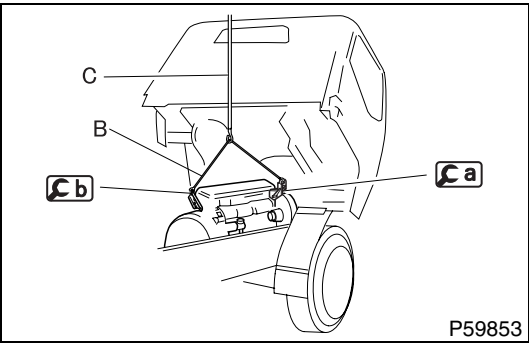
Special tools

Location	Tool name and shape	Part No.	Application
1	Front Hanger A  P59850	ME132633	Removing and installing engine
	Rear Hanger  P59851	ME132933	Removing and installing engine



[Removal]

- Using the flange bolt **3** (M10 × 1.5, 22 mm long), install the **a** Front Hanger A onto the cylinder head **2** on the engine assembly **1**.
- Using the flange bolt **4** (M10 × 1.5, 22 mm long), install the **b** Rear Hanger onto the cylinder head **2** on the engine assembly **1**.

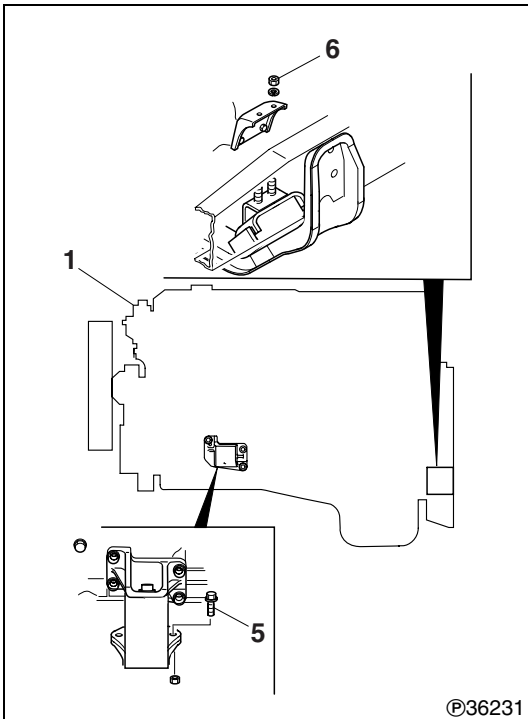


- Attach a sling **B** to the **a** Front Hanger A and **b** Rear Hanger. Strain the sling using a crane **C**.

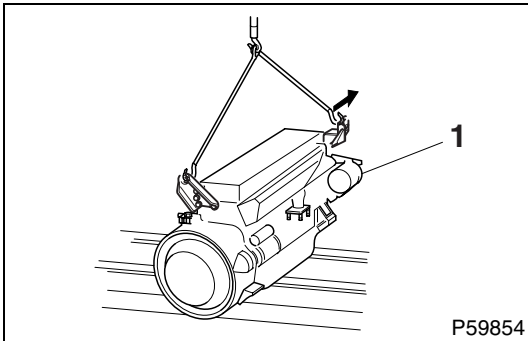
WARNING

The sling B should be strong enough to withstand the mass (approximately 700 kg {1540 lb.}) of the engine assembly 1.

- Make sure that the harnesses, piping and other ancillaries have been removed from the engine assembly.



- Remove the engine mounting bolt **5** and nut **6**.

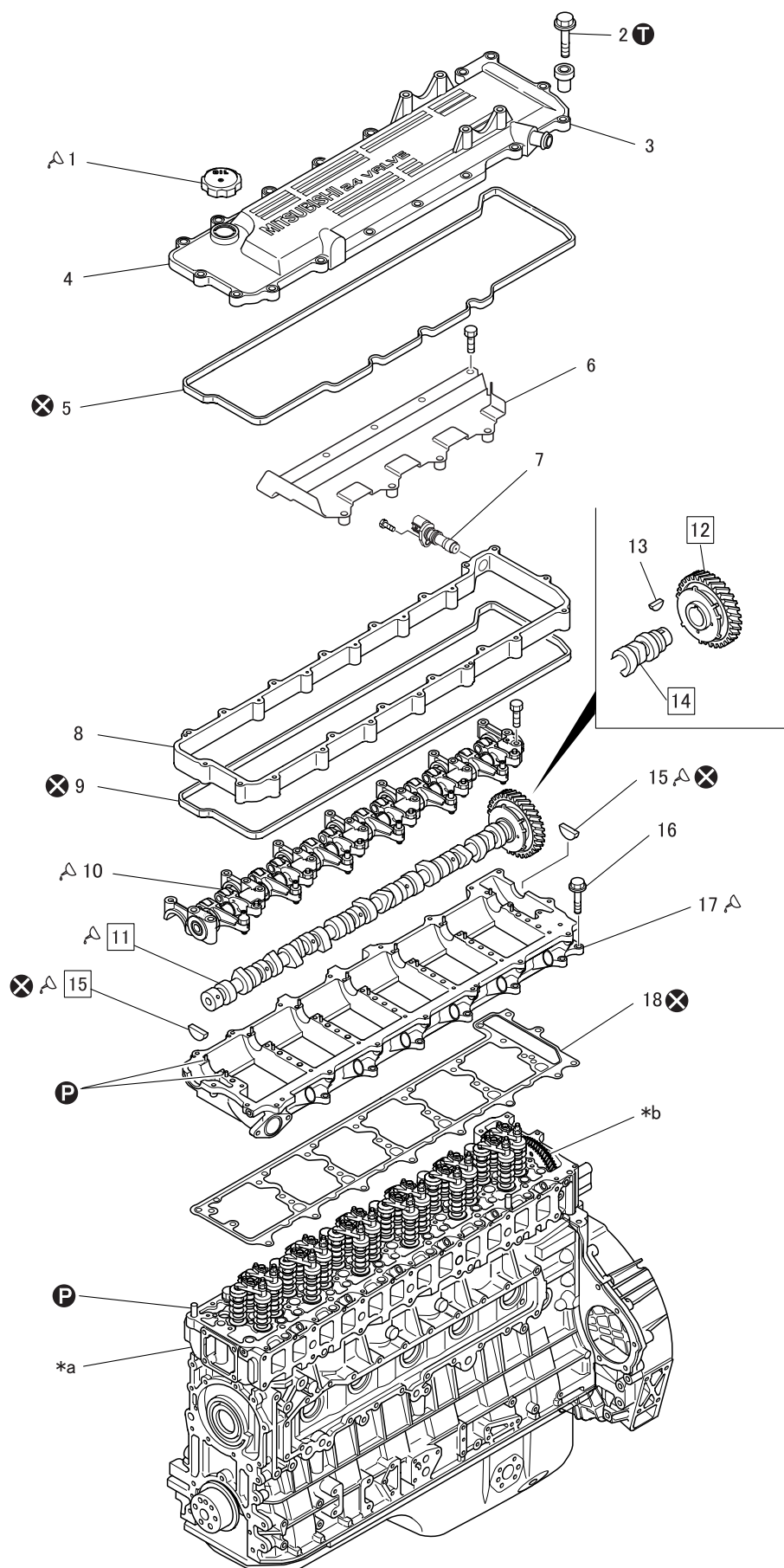


- Slowly lift the engine assembly **1** using care that it does not bump against the frame and cab.
- Turn the engine 90 degrees just when its bottom has come up out of the frame, and dismount it.

[Installation]

Follow the removal sequence in reverse.

ROCKER COVER, ROCKER AND BRACKET ASSEMBLY, CAMSHAFT



P59855

● Pre-disassembly operation

📖 P11-22

● Pre-disassembly inspection

📖 P11-23

● Disassembly sequence

- | | | |
|-------------------------|--------------------------------|------------------------------|
| 1 Oil filler cap | 9 Rocker case upper gasket | 16 Bolt |
| 2 Bolt | 10 Rocker and bracket assembly | 17 Rocker case |
| 3 Rubber assembly | 📖 P11-26 | 18 Rocker case gasket |
| 4 Rocker cover | 11 Camshaft assembly | |
| 5 Rocker cover gasket | 12 Camshaft gear | Ⓟ: Locating pin |
| 6 Baffle plate | 13 Key | ⓧ: Non-reusable part |
| 7 Cylinder sensor 📖 13E | 14 Camshaft | *a: Cylinder head 📖 P11-30 |
| 8 Rocker case (upper) | 15 Packing | *b: No.3 idler gear 📖 P11-30 |

NOTE

- Do not remove the camshaft gear 12 unless an abnormality is evident.
- Since the rocker case 17 and the bracket of the rocker and bracket assembly 10 have been machined together, replace them as a pair. Never change their original combinations.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item			Standard value	Limit	Remedy
11	Camshaft assembly end play			0.05 to 0.20 {0.0020 to 0.0079}	0.40 {0.016}	Inspect each part
12, *b	Backlash between camshaft gear and No. 3 idler gear			0.18 to 0.26 {0.0071 to 0.010}	0.35 {0.014}	Replace
12, 14	Camshaft gear to camshaft interference			0.017 to 0.062 {0.00067 to 0.0024}	—	Replace
14	Camshaft	Difference between long and short diameters	Inlet	5.023 {0.197}	4.973 {0.195}	Long diameter: 45.110 {1.775} Short diameter: 40.087 {1.578}
			Exhaust	7.084 {0.278}	7.034 {0.276}	Long diameter: 47.370 {1.864} Short diameter: 40.286 {1.586}
		Bend		0.02 {0.00079} or less	0.04 {0.0016}	Replace
		Oil clearance at journal		0.075 to 0.120 {0.0030 to 0.0047}	0.25 {0.0098}	Inspect each part

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (rocker cover mounting)	8.8 {6.5, 0.9}	—

ROCKER COVER, ROCKER AND BRACKET ASSEMBLY, CAMSHAFT

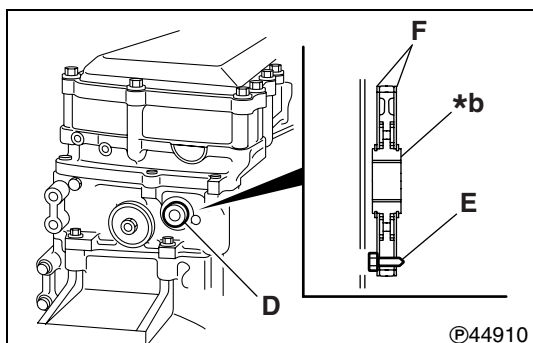
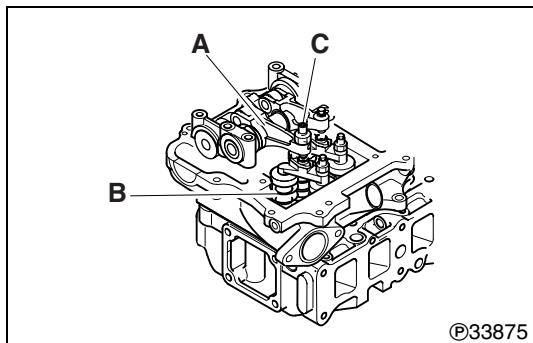
Lubricant and/or sealant

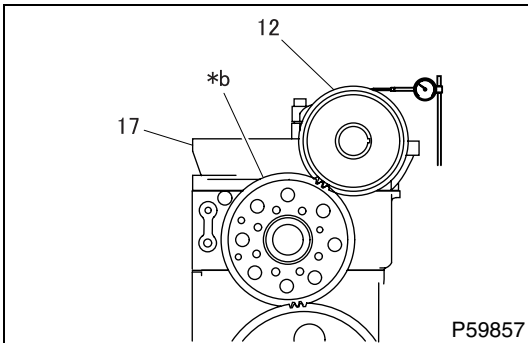
Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Rubber part of oil filter cap	Engine oil	As required
10	Camshaft journal brackets of rocker and bracket assembly	Engine oil	As required
11	Camshaft journals and cams	Engine oil	As required
15	Periphery and top surface of packing	THREEBOND 1211	As required
17	Camshaft journal supports of rocker case	Engine oil	As required

◆ Service procedure

● Pre-disassembly operation

- Set the No. 1 cylinder to the top dead center on the compression stroke.
- If the valve spring **B** is found compressed by the rocker **A**, as a result of being pushed up by the camshaft **11**, free the spring from the compression by loosening the adjusting screw **C** on the rocker.
- Before removing the camshaft assembly **11**, remove the plug **D** at the rear end of the cylinder head and lock the sub-gear **F** by inserting the bolt **E** (M8 × 1.25 mm) into the hole on the No. 3 idler gear assembly ***b**.

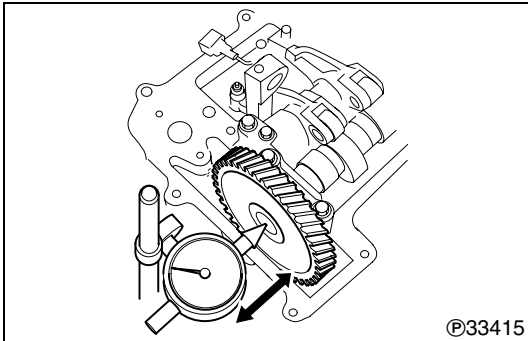




● Pre-disassembly inspection

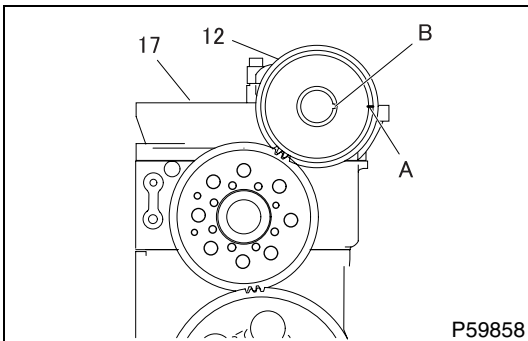
(1) Backlash between camshaft gear and No. 3 idler gear

Measure the backlash at three or more points. If any of the measurements exceeds the specified limit, replace the defective part(s).



(2) Camshaft assembly end play

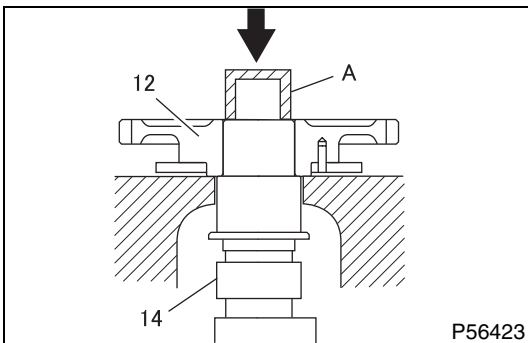
If the measurement exceeds the specified value, replace the defective part(s).



11 Installation of camshaft assembly

Make sure that the stamped line **A** on the camshaft gear **12** is level with the top surface of the rocker case **17**.

B: Key way



12 Camshaft gear

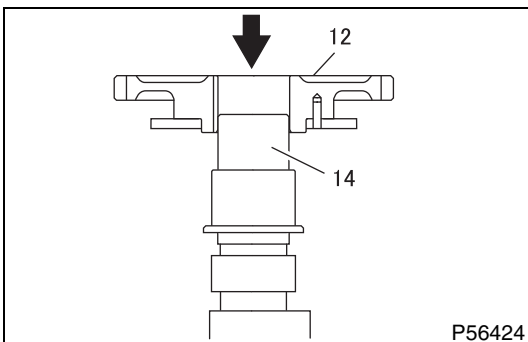
[Removal]

Remove the camshaft gear **12** by pushing on the camshaft **14** using a press.

A: Removing block

CAUTION ⚠

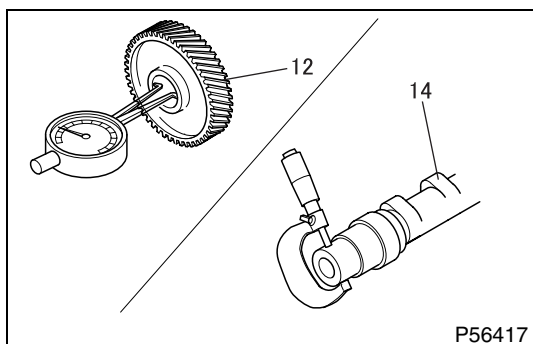
Do not use a hammer to remove the camshaft gear 12. Be sure to use a press to do this.



[Installation]

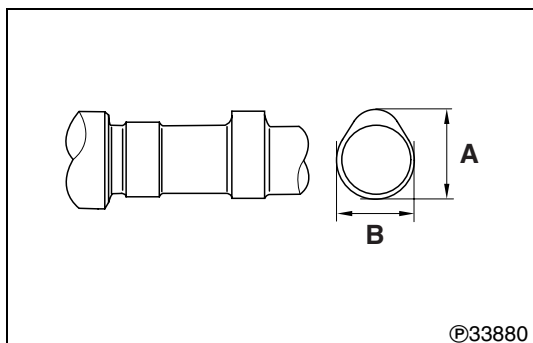
Heat the camshaft gear **12** to approximately 150°C {300°F} using a piston heater. Then, press the gear onto the camshaft **14**.

ROCKER COVER, ROCKER AND BRACKET ASSEMBLY, CAMSHAFT



12 14 Interference between camshaft gear and camshaft

If the measurement does not meet the standard value, replace the defective part(s).



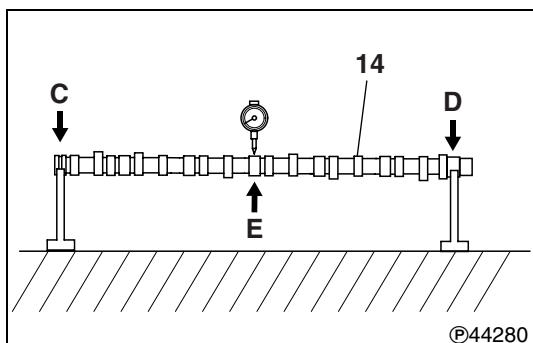
14 Inspecting camshaft

(1) Cam lift

If the measurement is less than the specified value, replace the camshaft 14.

A: Long diameter

B: Short diameter

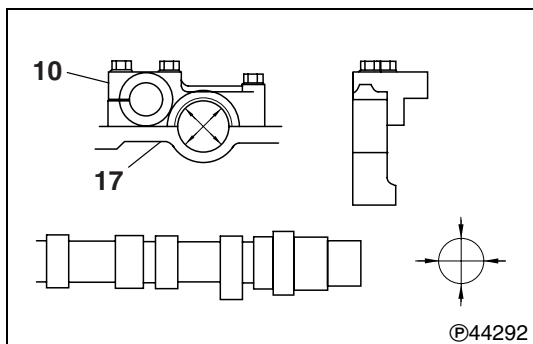


(2) Bend

While supporting the camshaft 14 at the No. 1 journal C and the No. 7 journal D, measure the bend at the No. 4 journal E. If the measurement exceeds the specified limit, replace the camshaft.

NOTE

Turn the camshaft 14 by one turn and read the dial gauge. Divide the reading by two to obtain the camshaft bend.

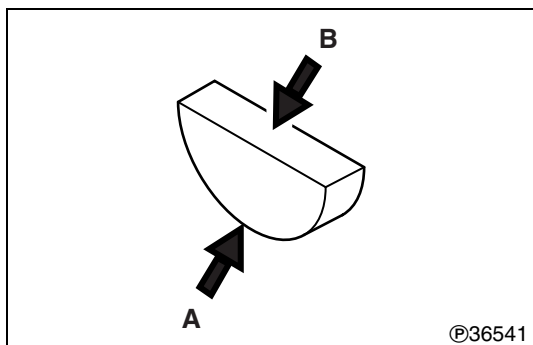


(3) Oil clearance at journal

Measure the oil clearances at the journals. If any of the measurements exceeds the specified limit, replace the defective part(s).

CAUTION ⚠

The brackets of the rocker and bracket assembly 10 and the rocker case 17 have been machined together. All of the brackets and the rocker case should be replaced as a set.



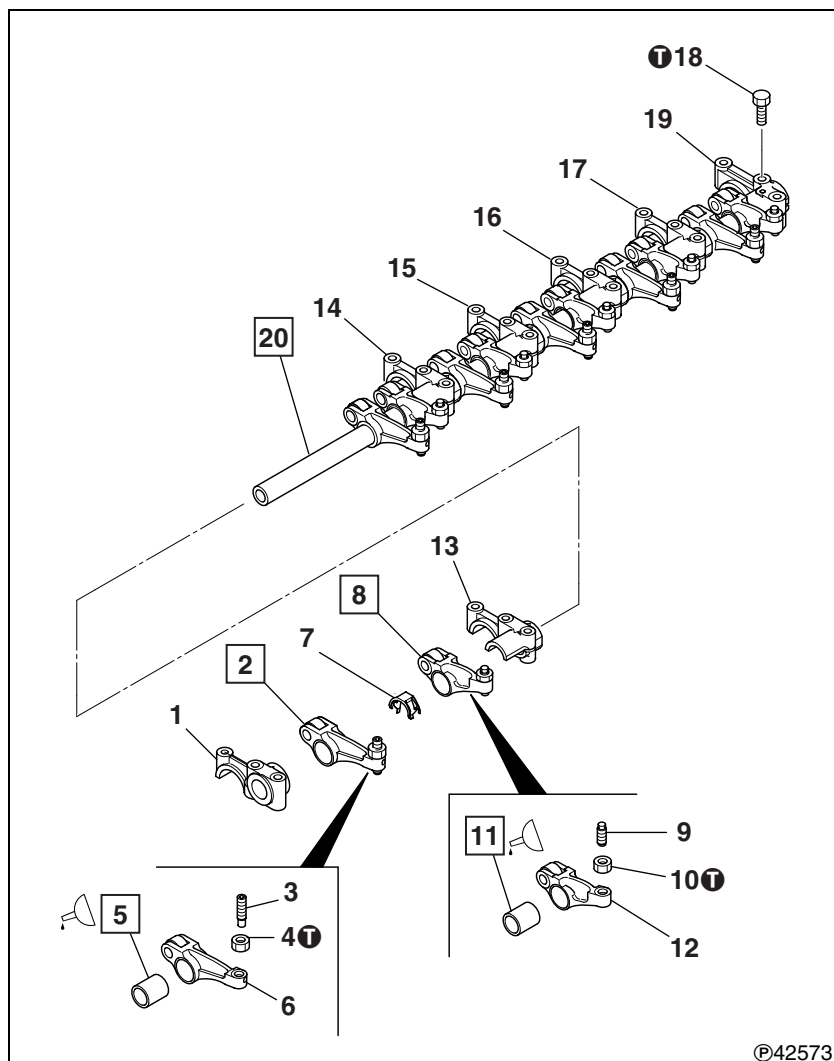
15 Fitting packing

Apply a coat of specified sealant to the periphery A and top surface B of the packing 15.

MEMO

ROCKER COVER, ROCKER AND BRACKET ASSEMBLY, CAMSHAFT

Rocker and Bracket Assembly



● Disassembly sequence

- 1 Front bracket
- 2 Intake rocker assembly
- 3 Adjusting screw
- 4 Lock nut
- 5 Rocker bushing
- 6 Intake rocker
- 7 Rocker shaft spring
- 8 Exhaust rocker assembly
- 9 Adjusting screw
- 10 Lock nut
- 11 Rocker bushing
- 12 Exhaust rocker
- 13 No. 1 center bracket
- 14 No. 2 center bracket
- 15 No. 3 center bracket
- 16 No. 4 center bracket
- 17 No. 5 center bracket
- 18 Set screw
- 19 Rear bracket
- 20 Rocker shaft

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value {Basic diameter in []}	Limit	Remedy
2, 8	Radial roller clearance of rocker assembly	0.022 to 0.039 {0.00087 to 0.0015}	—	Replace
5, 11, 20	Rocker bushing-to-rocker shaft clearance	[25 {0.98}] 0.006 to 0.076 {0.00024 to 0.0030}	0.114 {0.0045}	Replace

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

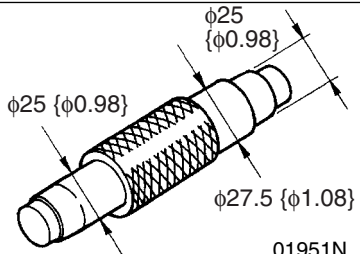
Location	Parts to be tightened	Tightening torque	Remarks
4, 10	Adjusting screw lock nut	34 {25, 3.5}	—
18	Rocker shaft set screw	3.9 {2.9, 0.4}	—

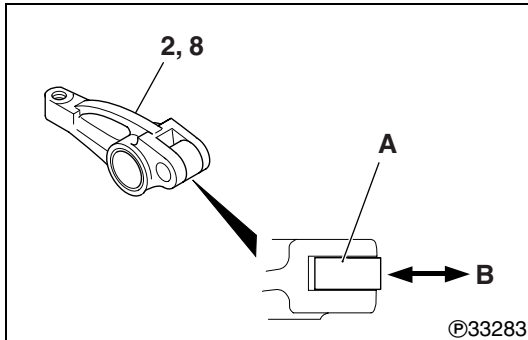
🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5, 11	Rocker bushing inner surface	Engine oil	As required

Special tools

Unit: mm {in.}

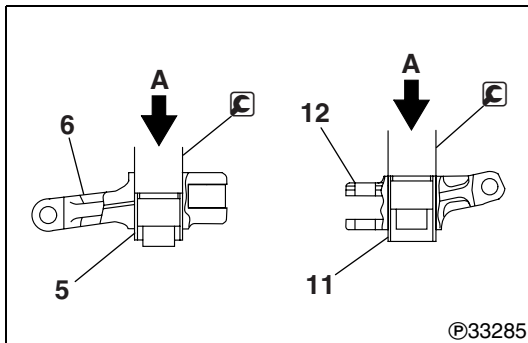
Location	Tool name and shape	Part No.	Application
5, 11	Rocker Bushing Puller 	MH062727	Removing and installing rocker bushing



Service procedure

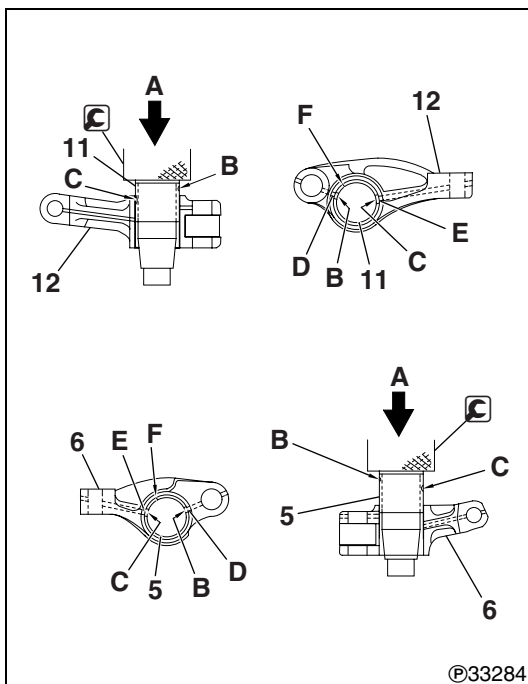
Inspection of rocker assembly

If the radial clearance **B** at the roller **A** of the rocker assembly **2, 8** exceeds the specified limit, replace the defective part(s).



Rocker bushing

[Removal]

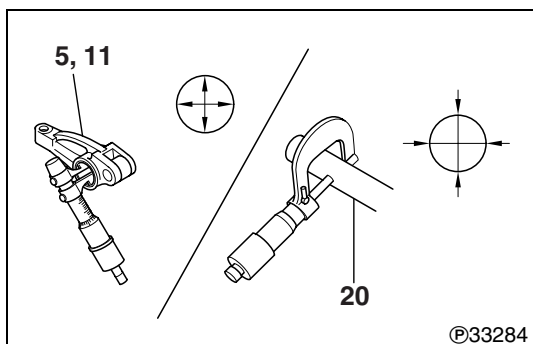
: Rocker Bushing Puller
A: Press

[Installation]

Using the  Rocker Bushing Puller, press-fit the rocker bushing **5, 11**, duly positioned as shown in the illustration, into the rocker **6, 12**.

B: Rocker bushing oil hole**C**: Rocker bushing oil hole**D**: Rocker oil hole**E**: Rocker oil hole**F**: Notch in rocker bushing

ROCKER COVER, ROCKER AND BRACKET ASSEMBLY, CAMSHAFT

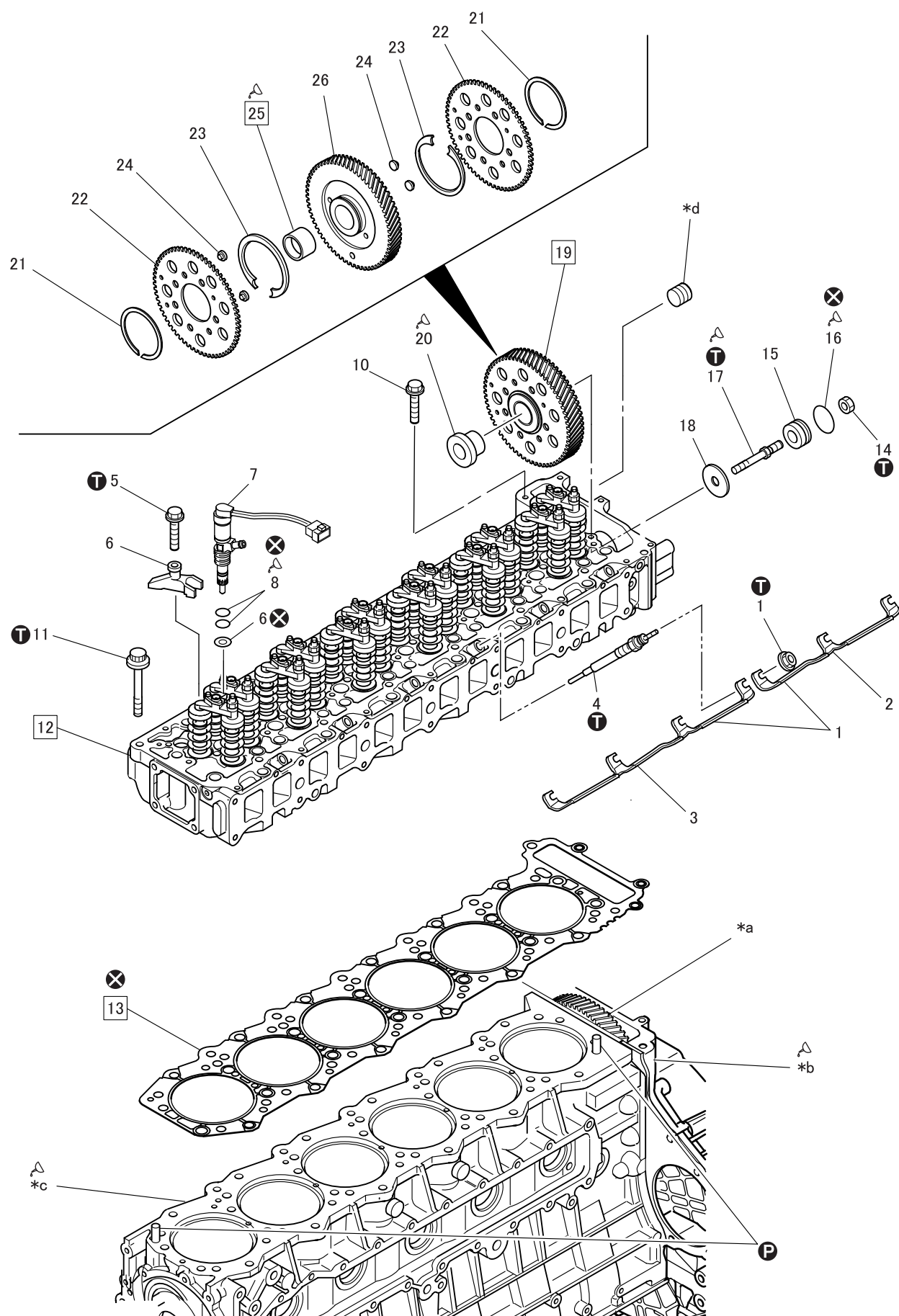


5 11 20 Clearance between rocker bushing and rocker shaft

If the measurement exceeds the specified limit, replace the defective part(s).

MEMO

CYLINDER HEAD, VALVE MECHANISM



● Pre-disassembly operation

📖 P11-32

● Pre-disassembly inspection

📖 P11-33

● Disassembly sequence

- | | | |
|--------------------------------|------------------------------|--|
| 1 Nut | 13 Cylinder head gasket | 26 No. 3 idler gear |
| 2 Connecting plate | 14 Nut | |
| 3 Connecting plate | 15 Collar | *a: No. 2 idler gear assembly |
| 4 Glow plug | 16 O-ring | 📖 P11-72 |
| 5 Bolt | 17 No. 3 idler bolt | *b: Flywheel housing 📖 P11-62, 68 |
| 6 Nozzle bridge | 18 Trust plate | *c: Crankcase assembly |
| 7 Injector assembly 📖 Gr13A, E | 19 No. 3 idler gear assembly | 📖 P11-78 |
| 8 O-ring | 20 No. 3 idler shaft | *d: Plug 📖 P11-20 |
| 9 Nozzle tip gasket | 21 Snap ring | |
| 10 Bolt | 22 Sub-gear | 🔧: Locating pin |
| 11 Cylinder head bolt | 23 Spring | ⚠️: Non-reusable part |
| 12 Cylinder head assembly | 24 Pin | |
| 📖 P11-38 | 25 No. 3 idler gear bushing | |

NOTE

Before installing the No. 3 idler gear assembly 19, lock the sub-gear 22 using a bolt (M8 x 1.25, 20 mm long) to prevent the sub-gear from moving out of place. 📖 P11-32

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
—	Backlash between No. 3 idler gear and No. 2 idler gear assembly	0.17 to 0.25 {0.0067 to 0.0098}	0.35 {0.014}	Replace
	No. 3 idler gear end play	0.05 to 0.15 {0.0020 to 0.0059}	0.30 {0.012}	Replace
20, 25	Clearance between No. 3 idler gear bushing and No. 3 idler shaft	[32 {1.26}] 0.01 to 0.05 {0.00039 to 0.0020}	0.20 {0.0079}	Replace

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (connecting plate installation)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.15}	—
4	Glow plug	15 to 25 {11 to 13, 1.5 to 2.5}	—
5	Bolt (nozzle bridge installation)	33 to 38 {24 to 28, 3.4 to 3.9}	—
11	Cylinder head bolt	78 {58, 8} + 90° ⁺⁵ ₀ + 90° ⁺⁵ ₀	- Wet - Can be reused up to three times
14	Nut (collar installation)	39 to 59 {29 to 44, 4.0 to 6.0}	—
17	No. 3 idler bolt	59 to 78 {44 to 58, 6.0 to 8.0}	—

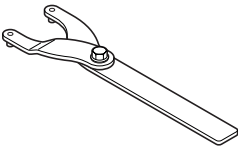
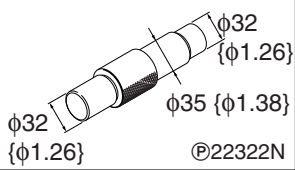
CYLINDER HEAD, VALVE MECHANISM

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
8	Entire periphery of O-ring	Engine oil	As required
16	Entire periphery of O-ring	Engine oil	As required
17	Threaded portion of No. 3 idler bolt	Engine oil	As required
20	Periphery of No. 3 idler shaft	Engine oil	As required
25	Inner surface of bushing	Engine oil	As required
*b, *c	Upper mating surfaces of flywheel housing and crankcase	THREEBOND 1207F	As required

Special tools

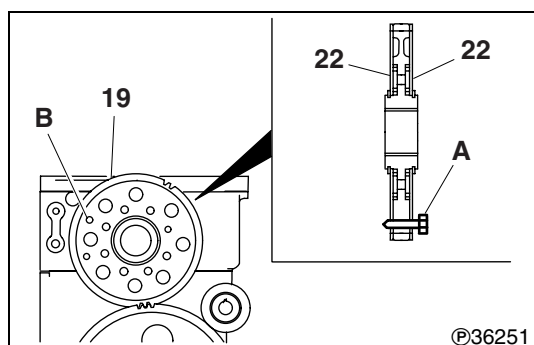
Unit: mm {in.}

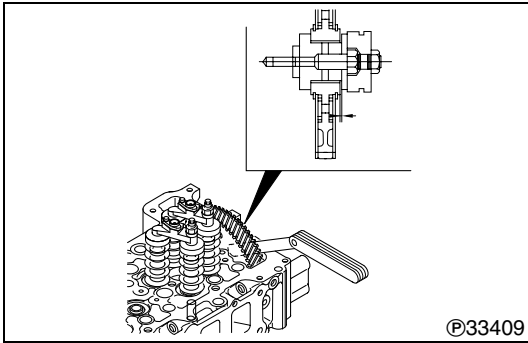
Location	Tool name and shape	Part No.	Application
12	Socket Wrench  ⑰01984	MH063388	Installation of cylinder head
19	Pin Wrench Arm  ⑰36247	MH063473	Assembly of No. 3 idler gear assembly
25	Idler Gear Bushing Puller  ⑰22322N	MH061779	Removal and installation of idler gear bushing

◆ Service procedure

● Pre-disassembly operation

Before removing the No. 3 idler gear assembly **19**, lock the sub-gear **22** by inserting the bolt **A** (M6 × 1, 20 mm long) into the hole **B**.

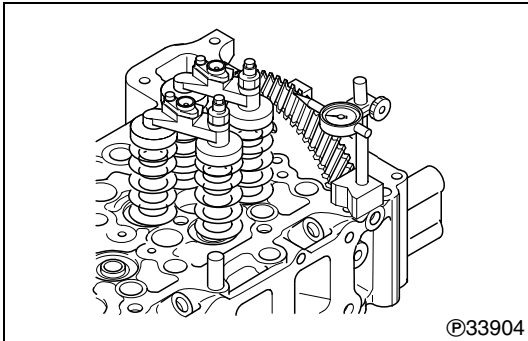




● Pre-disassembly inspection

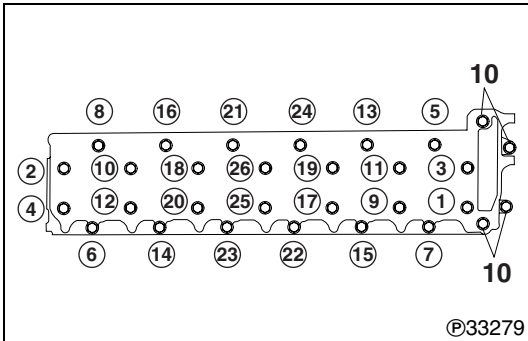
(1) No. 3 idler gear end play

If the measurement exceeds the specified limit, replace the defective part(s).



(2) No. 3 idler gear backlash

If the measurement exceeds the specified limit, replace the defective part(s).



12 Cylinder head assembly

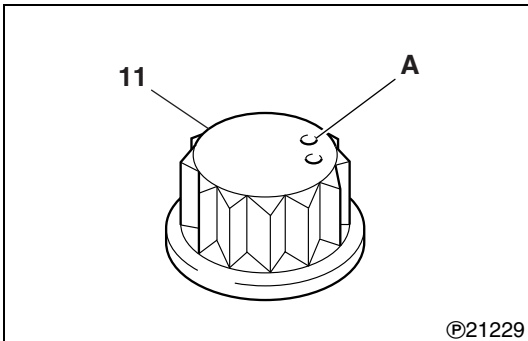
[Removal]

- Remove the bolts 10.
- Progressively loosen the cylinder head bolts 11 (items ① to ②⑥) in the sequence shown, each time loosening them a little, until they are completely removed.

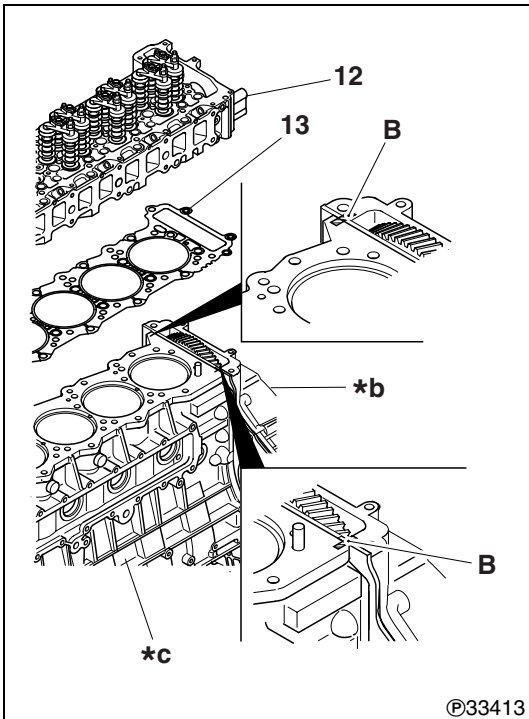
[Installation]

CAUTION ⚠

Before fitting any cylinder head bolt 11, check the bolt head for the number of punch marks A. Do not use the bolt on which there are more than two punch marks. Punch marks indicate how many times the bolt concerned has been refitted using the plastic area tightening method. Any bolt that already has three punch marks should be replaced.



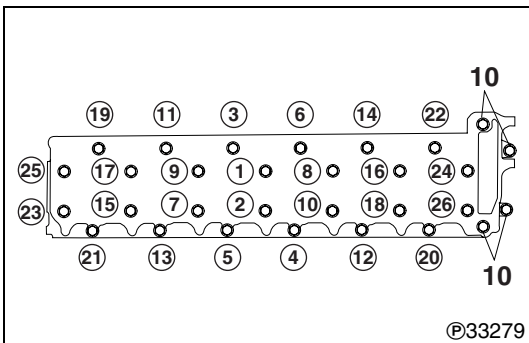
CYLINDER HEAD, VALVE MECHANISM



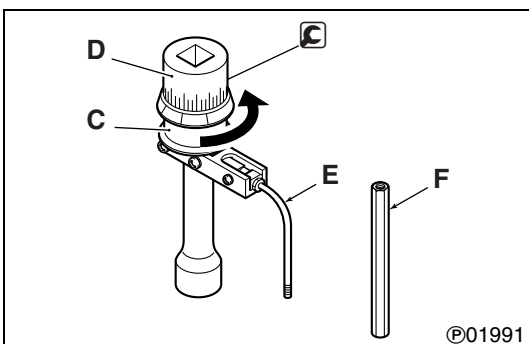
- Apply a coat of specified sealant to the upper mating surfaces **B** of the flywheel housing ***b** and the crankcase assembly ***c**.
- Within 3 minutes after the sealant application, install the cylinder head assembly **12** to the crankcase assembly ***c** together with the cylinder head gasket **13**.

CAUTION

- Check to ensure that the surfaces **B** are clean and free of oil and other foreign matters before sealant application.
- During installation, take care that the sealant is kept in place.
- Do not start the engine for at least 1 hour after the cylinder head assembly is installed.
- Whenever the cylinder head bolt **11** is loosened or removed after the cylinder head assembly is installed, always replace the cylinder head gasket **13** and apply a fresh coat of specified sealant.

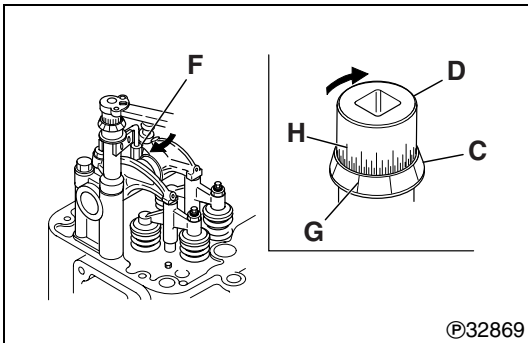


- Tighten the cylinder head bolts **11** (① through ②⑥) to the specified torque of 78 N·m {58 ft.lbs, 8.0 kgf·m} in the sequence shown. Then additionally tighten the bolts in the following procedure.
- Install the bolts **10**.



- Before fitting the Socket Wrench over a cylinder head bolt, turn the holder **C** in the direction shown to tension the built-in spring.

D: Socket
E: Rod
F: Rod (extension)



- Set the socket such that the built-in spring forces the rod **F** (extension) against the rocker shaft bracket.
- Align any inscribed line **G** on the holder **C** with any inscribed line **H** on the socket **D**. (Use this point as reference 0° position.)
- From the above reference position, tighten the cylinder head bolts (① to ②⑥) until the graduation of 90° **H** matches to the line **G** sequentially. Then, tighten further 90° in the same manner. (One gradation on the scale **H** represents 5°.)
- After tightening the cylinder head bolts **11** using the plastic region tightening method, make a punch mark on the head of each one to indicate the times of use.

CAUTION

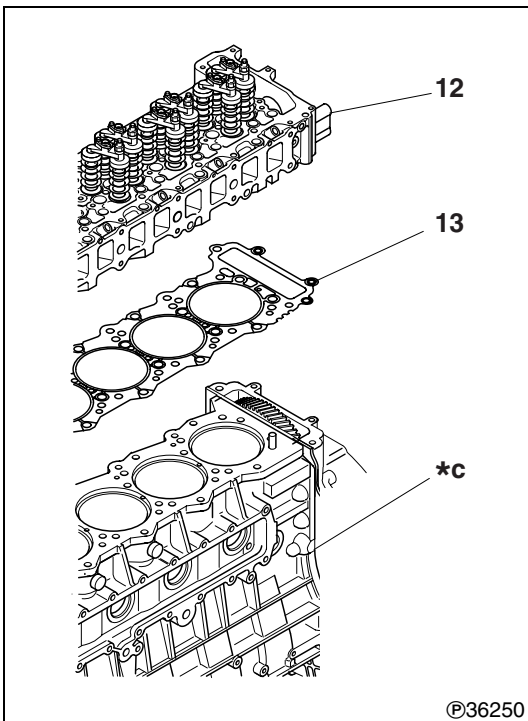
Since the cylinder head bolts utilize the plastic area tightening method, they must not be tightened further after the angular tightening procedure has been performed.

13 Cylinder head gasket

[Removal]

CAUTION

When removing cylinder head gasket **13**, take care not to scratch the cylinder head assembly **12** as well as the crankcase assembly ***c** and flywheel housing ***b**.



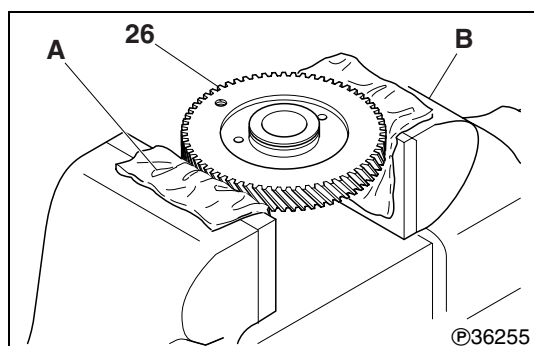
[Installation]

- With the cylinder head gasket **13** faced as shown, install it onto the crankcase assembly ***c**.

CAUTION

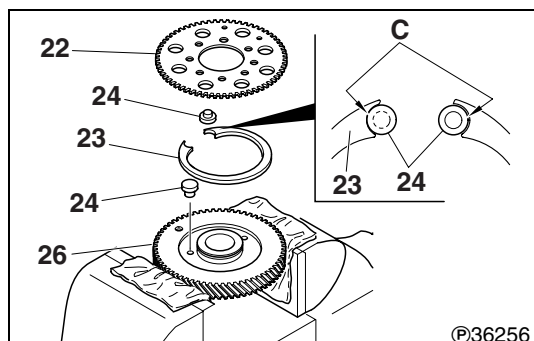
If any of the pistons, connecting rods, or related parts has been replaced, measure the protrusion of the new piston and take appropriate measures.

CYLINDER HEAD, VALVE MECHANISM

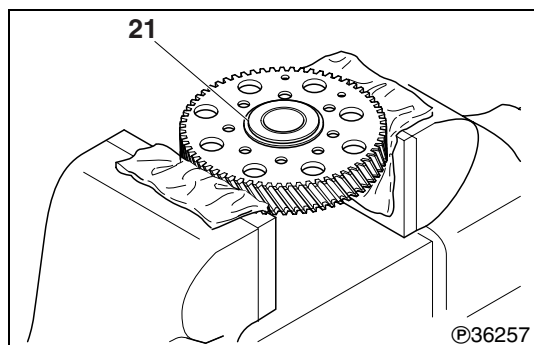


19 Assembling No. 3 idler gear assembly

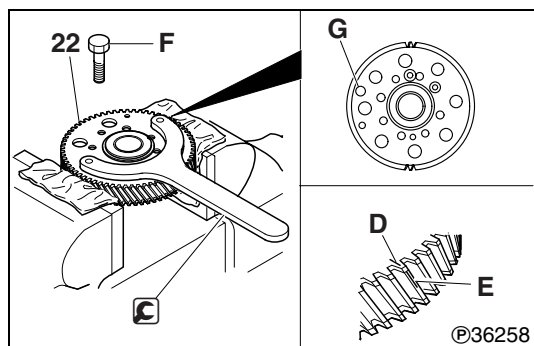
- Hold the No. 3 idler gear **26** by the vice **B**, taking care not to damage the gear teeth. Use cloth **A** as shown between the teeth and the vice.



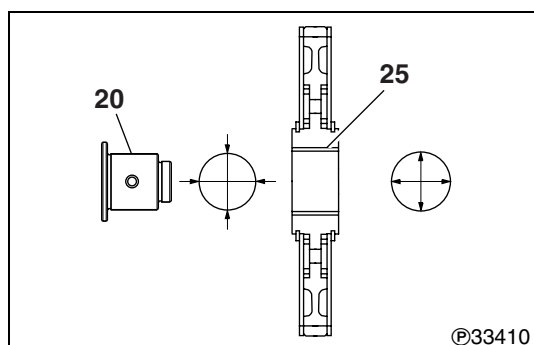
- Install the sub-gear **22**, spring **23** and pin **24** onto the No. 3 idler gear **26**.
- Hook the spring **23** on the pins **24** at **C**.



- Install the snap ring **21**.



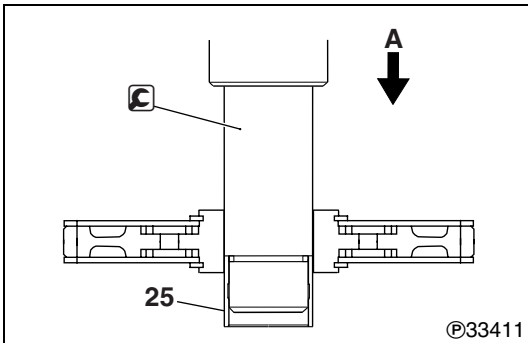
- Using the  Pin Wrench Arm Assembly, turn the sub-gear **22** clockwise until the alignment mark **D** on the sub-gear and the stamped line **E** on the No. 3 idler gear **26** are aligned. Install the bolt **F** (M8 × 1.25, 20 mm long) into the hole **G** and tighten the bolt.
- Turn the No. 3 idler gear **26** over. Using the same method as described above, install the spring **23**, pin **24**, sub-gear **22** and snap ring **21**.



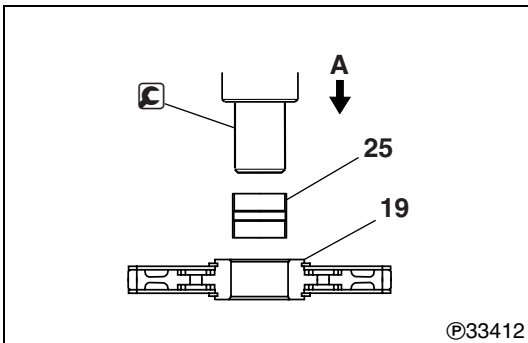
20 25 No. 3 idler shaft and bushing

[Inspection]

If the clearance exceeds the specified limit, replace the defective part(s).

**25 Bushing**

[Removal]

A: Press**C:** Idler Gear Bushing Puller

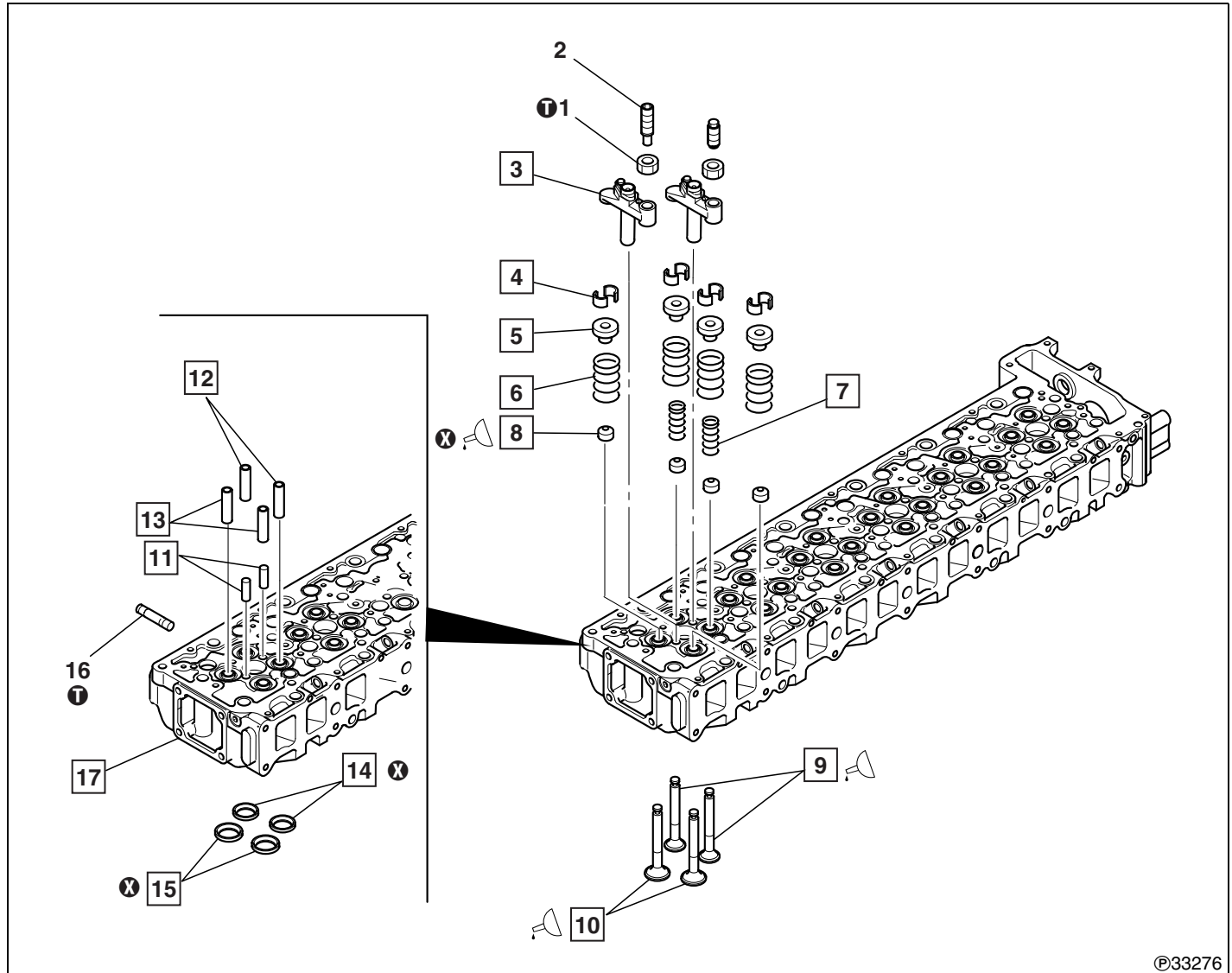
[Installation]

Using the **C** Idler Gear Bushing Puller, press the bushing into the No. 3 idler gear assembly **19** until the puller touches the end surface of the gear assembly.

A: Press

CYLINDER HEAD, VALVE MECHANISM

Cylinder Head Assembly



©33276

● Disassembly sequence

- | | | |
|------------------------------|--------------------------------|-----------------------|
| 1 Lock nut | 7 Inner valve spring <Exhaust> | 14 Exhaust valve seat |
| 2 Adjusting screw | 8 Valve stem seal | 15 Inlet valve seat |
| 3 Valve bridge | 9 Exhaust valve | 16 Stud bolt |
| 4 Valve cotter | 10 Inlet valve | 17 Cylinder head |
| 5 Upper retainer | 11 Valve bridge guide | |
| 6 Valve spring <Inlet> | 12 Exhaust valve guide | |
| Outer valve spring <Exhaust> | 13 Inlet valve guide | |

ⓧ: Non-reusable part

NOTE

Any valve stem seal 8 removed from an exhaust valve 9 or inlet valve 10 must be replaced.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
3, 11	Valve bridge-to-valve bridge guide clearance		[10 {0.39}] 0.01 to 0.04 {0.00039 to 0.0016}	0.1 {0.0039}	Replace
6	Valve spring <Inlet>	Free length	71.7 {2.82}	68.1 {2.68}	Replace
		Installed load (at 46.5 {1.83} installed length)	407 N {91 lbs, 41.5 kgf}	367 N {83 lbs, 37.4 kgf}	Replace
		Squareness	—	2° or less	Replace
	Outer valve spring <Exhaust>	Free length	66.47 {2.62}	63.1 {2.48}	Replace
		Installed load (at 46.5 {1.83} installed length)	280 N {63 lbs, 28.6 kgf}	252 N {37 lbs, 25.7 kgf}	Replace
		Squareness	—	2° or less	Replace
7	Inner valve spring	Free length	60.61 {2.39}	57.6 {2.27}	Replace
		Installed load (at 41.8 {1.65} installed length)	127 ± 6.3 N {29 ± 1.4 lbs, 13 ± 0.6 kgf}	121 N {27 lbs, 12.3 kgf}	Replace
		Squareness	—	2° or less	Replace
9	Exhaust valve	Stem outside diameter	$\phi 8 \begin{smallmatrix} -0.060 \\ -0.075 \end{smallmatrix} \{ \phi 0.31 \begin{smallmatrix} -0.0024 \\ -0.0030 \end{smallmatrix} \}$	$\phi 7.85$ { $\phi 0.31$ }	Replace
		Sinkage from cylinder head bottom surface	1.3 ± 0.2 {0.051 ± 0.0079}	1.55 {0.061}	Inspect
		Valve margin	1.5 {0.059}	1.2 {0.047}	Replace
		Seat angle	45° ± 15'	—	Correct
9, 12	Exhaust valve stem-to-valve guide clearance		[8 {0.31}] 0.07 to 0.10 {0.0028 to 0.0039}	0.2 {0.0079}	Replace
10	Inlet valve	Stem outside diameter	$\phi 8 \begin{smallmatrix} -0.025 \\ -0.040 \end{smallmatrix} \{ \phi 0.31 \begin{smallmatrix} -0.00098 \\ -0.0016 \end{smallmatrix} \}$	$\phi 7.85$ { $\phi 0.31$ }	Replace
		Sinkage from cylinder head bottom surface	1.3 ± 0.2 {0.051 ± 0.0079}	1.55 {0.061}	Inspect
		Valve margin	1.5 {0.059}	1.2 {0.047}	Replace
		Seat angle	45° ± 15'	—	Correct
10, 13	Inlet valve stem-to-valve guide clearance		[8 {0.31}] 0.06 to 0.09 {0.0024 to 0.0035}	0.2 {0.0079}	Replace
11	Valve bridge guide outside diameter		9.989 to 10 {0.393 to 0.394}	9.94 {0.391}	Replace
14	Exhaust valve seat width		2.3 to 2.7 {0.091 to 0.11}	3.3 {0.13}	Correct or replace
15	Inlet valve seat width		1.8 to 2.2 {0.071 to 0.087}	2.8 {0.11}	Correct or replace
17	Cylinder head	Bottom surface distortion	0.08 {0.0031} or less	0.2 {0.0079}	Correct or replace
		Height from top to bottom surface	94.9 to 95.1 {3.736 to 3.744}	94.5 {3.72}	Replace

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut (for locking valve bridge adjusting screw)	59 {44, 6.0}	—
16	Stud	29 {21, 3.0}	—

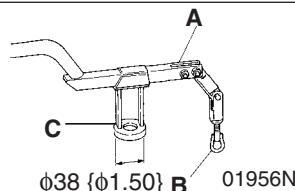
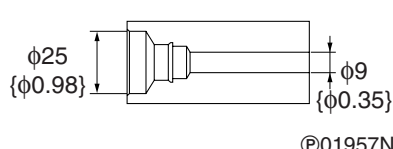
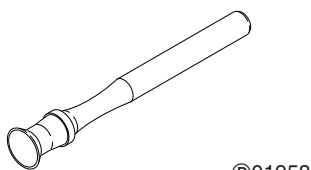
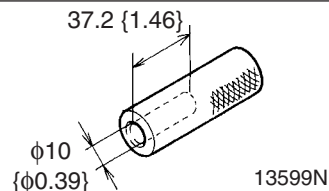
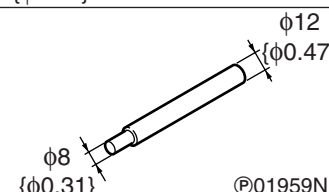
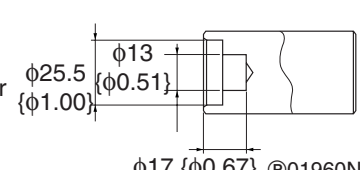
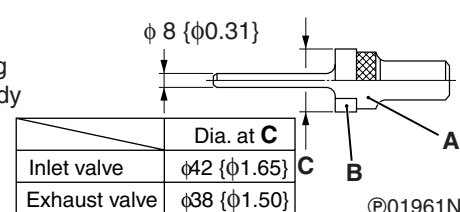
CYLINDER HEAD, VALVE MECHANISM

Lubricant and/or sealant

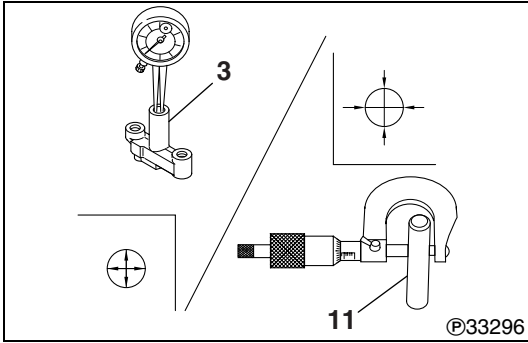
Location	Points of application	Specified lubricant and/or sealant	Quantity
8	Lip of valve stem seal	Engine oil	As required
9, 10	Valve stem and end	Engine oil	As required

Special tools

Unit: mm {in.}

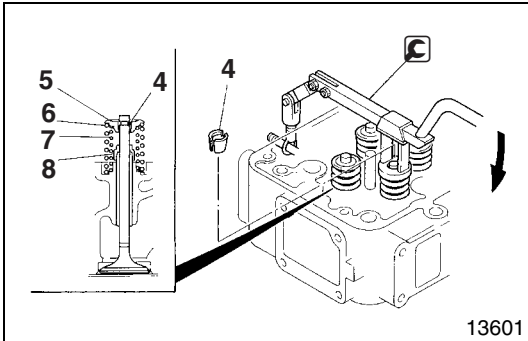
Location	Tool name and shape	Part No.	Application						
4	A: Valve Lifter B: Valve Lifter Hook C: Valve Lifter Seat  φ38 {φ1.50} B 01956N	A: MH061668 B: MH061679 C: MH061772	Removing and installing valve cotters						
8	Valve Stem Seal Installer  φ25 {φ0.98} φ9 {φ0.35} P01957N	MH062689	Installing valve stem seals						
9, 10	Valve Lapper  P01958	30091-07500	Lapping inlet and exhaust valves and valve seats						
11	Valve Bridge Guide Installer  37.2 {1.46} φ10 {φ0.39} 13599N	MH062724	Installing valve bridge guide						
12, 13	Valve Guide Remover  φ12 {φ0.47} φ8 {φ0.31} P01959N	31391-10500	Removing valve guides						
	Valve Guide Installer  φ25.5 {φ1.00} φ13 {φ0.51} φ17 {φ0.67} P01960N	MH062726	Installing valve guides						
14, 15	A: Caulking Tool Body B: Installer Ring  φ8 {φ0.31} φ42 {φ1.65} φ38 {φ1.50} P01961N <table><tr><th></th><th>Dia. at C</th></tr><tr><td>Inlet valve</td><td>φ42 {φ1.65}</td></tr><tr><td>Exhaust valve</td><td>φ38 {φ1.50}</td></tr></table>		Dia. at C	Inlet valve	φ42 {φ1.65}	Exhaust valve	φ38 {φ1.50}	A: 31391-13100 B: MH062725 <Inlet valve> : MH063605 <Exhaust valve>	Instaling inlet and exhaust valve seats
	Dia. at C								
Inlet valve	φ42 {φ1.65}								
Exhaust valve	φ38 {φ1.50}								

◆ Service procedure



3 11 Valve bridge-to-valve bridge guide clearance

If the measurement exceeds the specified limit, replace the defective part(s).



4 Valve cotters

[Removal]

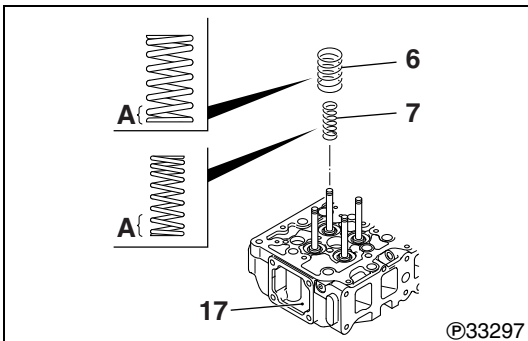
Remove the valve cotto 4 by compressing the valve spring 6, 7 evenly using the  Valve Lifter.

[Installation]

Follow the removal operation in reverse.

CAUTION

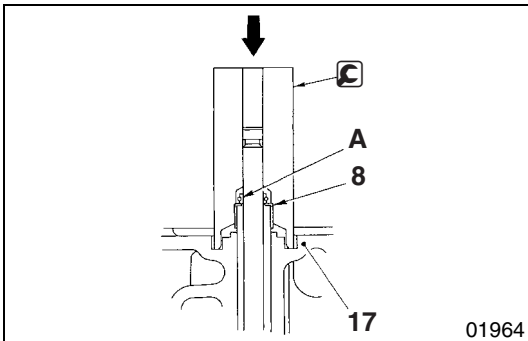
Do not compress the valve spring 6, 7 too much as this can allow the upper retainer 5 to contact and damage the valve stem seal 8.



6 7 Valve spring installation

With the outer valve spring 6 and inner valve spring 7 faced as shown, install them onto the cylinder head 17.

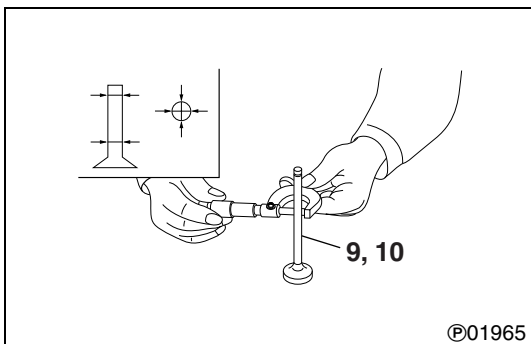
A: Painted end



8 Installing valve stem seals

- Apply engine oil to the lip A of the valve stem seal 8.
- Install the valve stem seal 8 using the  Valve Stem Seal Installer. Strike the  Valve Stem Seal Installer until it sits snugly on the cylinder head 17.

CYLINDER HEAD, VALVE MECHANISM



9 10 Inlet and exhaust valves

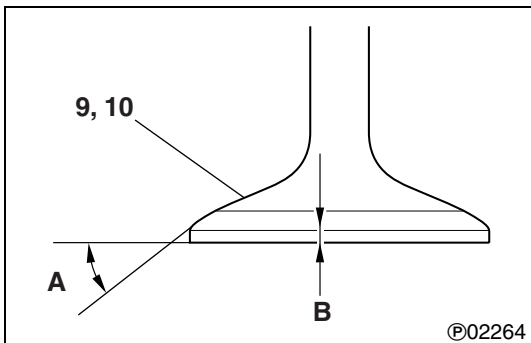
[Inspection]

(1) Valve stem outside diameter

Replace the valve 9, 10 if its stem's outside diameter is below specification or severely worn.

CAUTION ⚠

Whenever a valve 9, 10 is replaced, be sure to lap the valve and valve seat 14, 15. 📖 P11-43

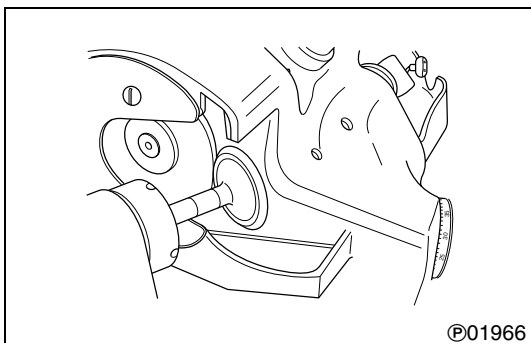


(2) Valve seat angle and valve margin

Reface or replace the valve 9, 10 if the valve seat angle or valve margin exceeds the specified limits.

A: Valve seat angle

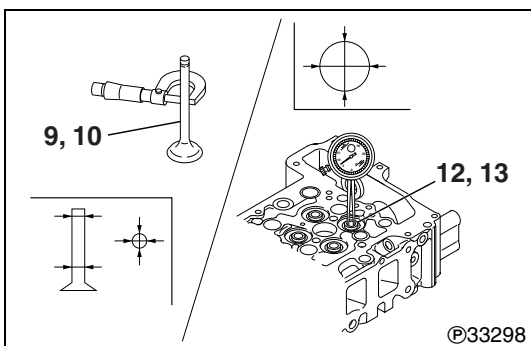
B: Valve margin



[Rectification]

NOTE

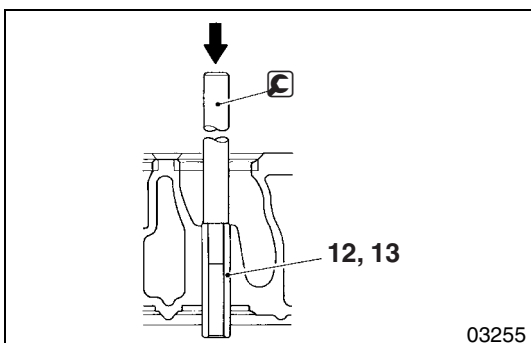
- Keep grinding to a minimum.
- If the valve margin is below specification after grinding, replace the valve 9, 10.
- After grinding, be sure to lap the valve 9, 10 and valve seat 14, 15. 📖 P11-43



9 10 12 13 Valves and valve guides

[Inspection]

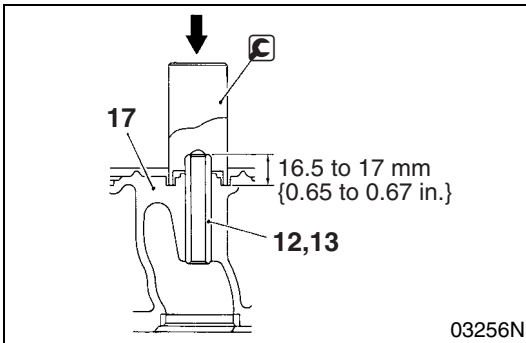
If any clearance exceeds the specified limit, replace the defective part(s).



Valve guides

[Removal]

🔧: Valve Guide Remover

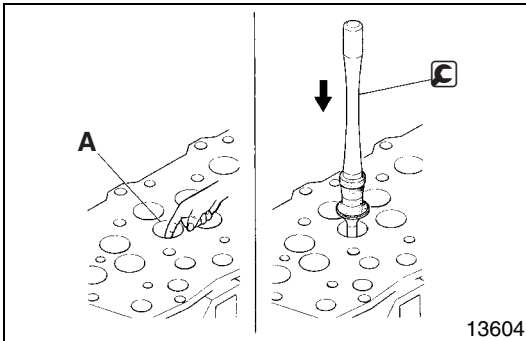


[Installation]

Using the Valve Guide Installer, install the valve guide 12, 13 until it sits snugly on the cylinder head 17.

CAUTION

- The valve guides 12, 13 must be pressed in to the specified depth. Be sure to use the Valve Guide Installer for this operation.
- Note that the exhaust valve guide 12 is longer than the inlet valve guide 13.



Valves and valve seats

[Inspection]

- Apply an even coat of minium to the valve seat 14, 15 surface A that makes contact with the valve 9, 10.
- Strike the valve 9, 10 against the valve seat 14, 15 once. Do not rotate the valve during this operation.

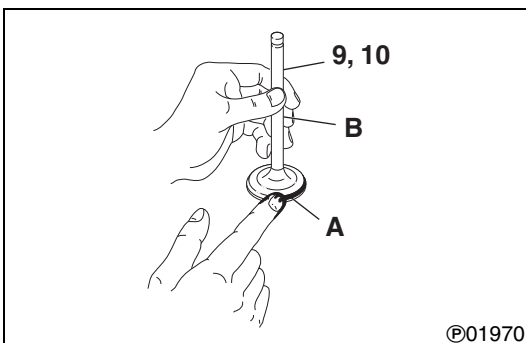
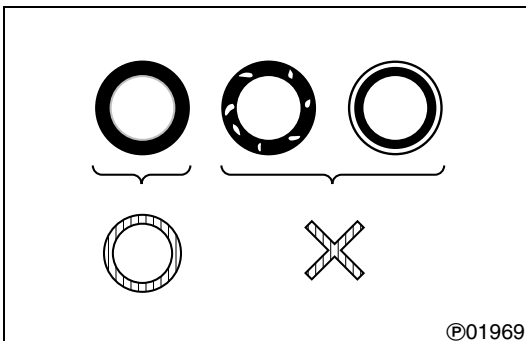
: Valve Lapper

NOTE

Carry out these inspections after inspecting the valves 9, 10 and valve guides 12, 13.

- If the minium deposited on the valve 9, 10 indicates a poor contact pattern, rectify the contact pattern as follows:

Contact	Corrective action
Minor defect	Lapping
Serious defect	Reface or replace valve and valve seat



[Refacing]

Lap the valve in accordance with the following procedure:

- Apply a thin, even coat of lapping compound to the surface A of the valve 9, 10 that makes contact with the valve seat 14, 15.

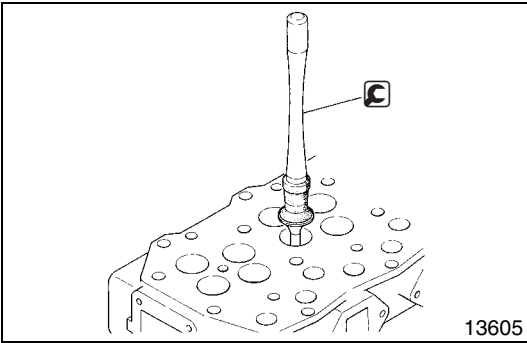
CAUTION

Ensure that no compound adheres to the stem B of the valve 9, 10.

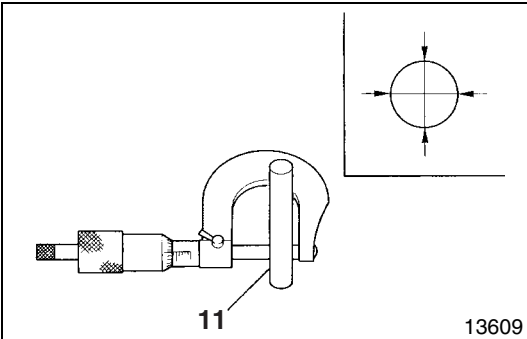
NOTE

- Start with intermediate-mesh compound (120 to 150 mesh) and finish with fine-mesh compound (200 mesh or more).
- The addition of a small amount of engine oil makes lapping compound easier to apply.

CYLINDER HEAD, VALVE MECHANISM



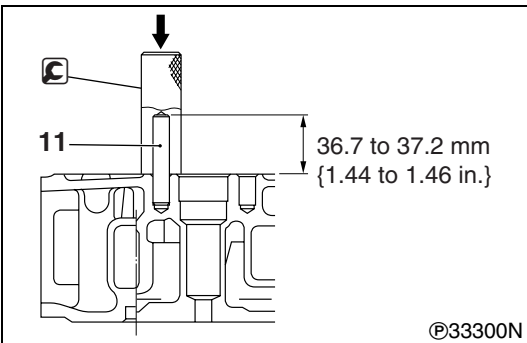
- Strike the valve **9, 10** against the valve seat **14, 15** while turning it little by little.
- Wash away the compound with gas oil or a similar fluid.
- Apply engine oil to the contact surfaces of the valve seat **14, 15** and rub it in so that the contact surfaces are lubricated and mate together snugly.
- Inspect the contact pattern of the valve **9, 10** and valve seat **14, 15** once more.
- If the contact pattern is still defective, replace the valve seat **14, 15**.



11 Valve bridge guide

[Inspection]

If the outer diameter of the valve bridge guide **11** is less than the specified limit or the valve bridge guide has worn excessively and unevenly, replace the guide.

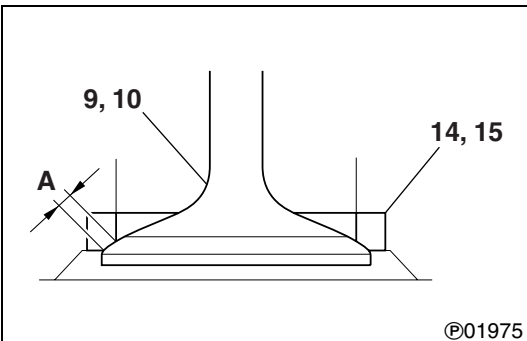


[Installation]

Using the  Valve Bridge Guide Installer, press the valve bridge guide **11** until the tool bottoms out on the cylinder head **17**.

CAUTION

- The valve bridge guide **11** should be press-fitted to the specified depth. This can only be achieved by using the  Valve Bridge Guide Installer.
- Before installing the valve bridge guide **11**, make sure that no water, oil or other fluid has collected in the hole on the cylinder head where the guide is to be installed.



14 15 Valve seats

[Inspection]

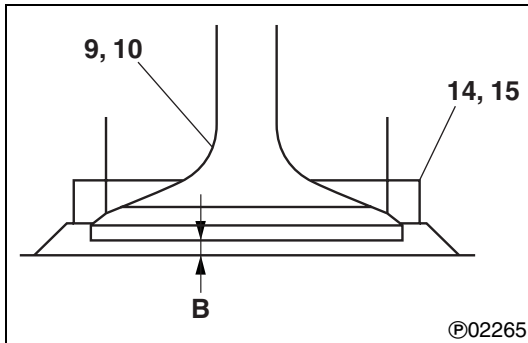
(1) Valve seat width

If the measurement exceeds the specified limit, rectify or replace the valve seat **14, 15**.

A: Valve seat width

NOTE

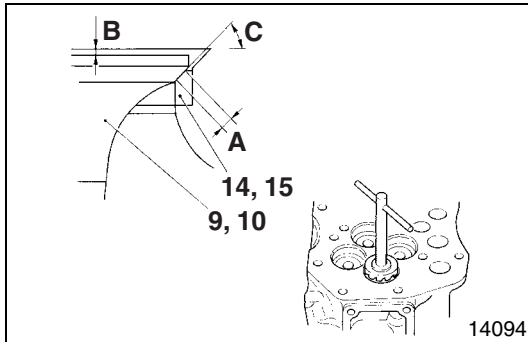
Whenever a valve seat **14, 15** is rectified or replaced, be sure to lap the valve seat and valve **9, 10**.  P11-43



(2) Valve sinkage from cylinder head bottom surface

If any measurement exceeds the specified limit, rectify or replace the defective part(s).

B: Valve sinkage



[Rectification]

- Grind the valve seat **14, 15** using a valve seat cutter or valve seat grinder.
- After grinding, put some sandpaper of around #400 grade between the cutter and valve seat and grind the valve seat lightly.
- Use a 15° or 75° cutter to achieve the specified valve seat width **A** of the valve seat **9, 10**.

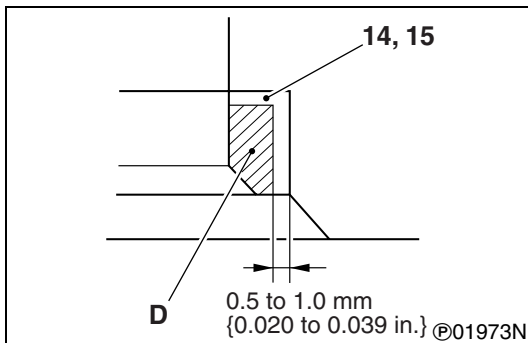
C: Valve seat angle

CAUTION

Ensure that grinding does not cause the sinkage B of the valve 9, 10 to exceed the specified limit.

- After rectification, lap the valve **9, 10** and valve seat **14, 15**.

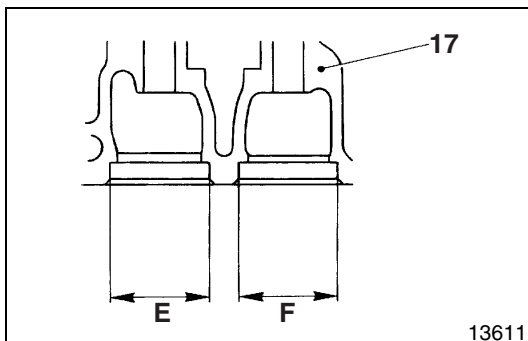
 P11-43



[Removal]

Valve seats **14, 15** are installed by expansion fitting. To remove a valve seat, grind the inside surface to reduce its thickness, then remove the valve seat at room temperature.

D: Material to be ground

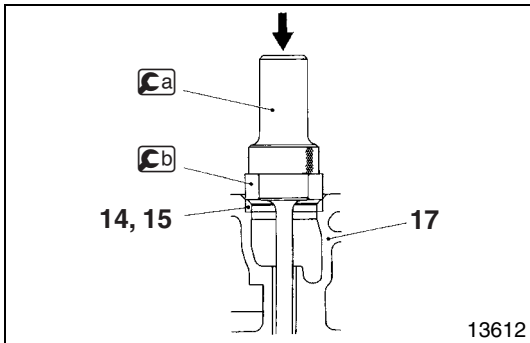


[Installation]

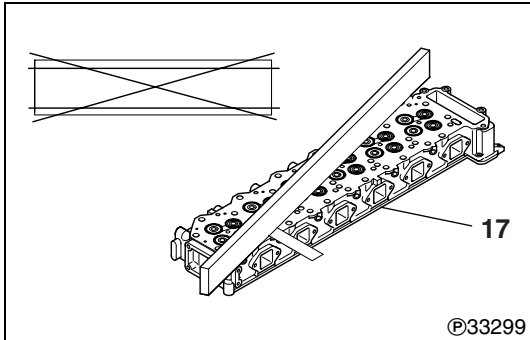
- Check that the valve seat hole diameters **E, F** in the cylinder head **17** conform with the values shown below.

Inlet valve seat hole: E	$\phi 42^{+0.025}_0 \text{ mm } \{ \phi 1.65^{+0.00098}_0 \}$
Exhaust valve seat hole: F	$\phi 38^{+0.025}_0 \text{ mm } \{ \phi 1.50^{+0.00098}_0 \}$

CYLINDER HEAD, VALVE MECHANISM



- Cool the valve seat **14**, **15** by immersing it in liquid nitrogen.
- Install the valve seat **14**, **15** in the cylinder head **17** using the **Ca** Caulking Tool Body and the **Cb** Installer Ring.
- After installing the valve seat **14**, **15**, lap the valve seat and valve **9**, **10**. P11-43



17 Inspecting cylinder head

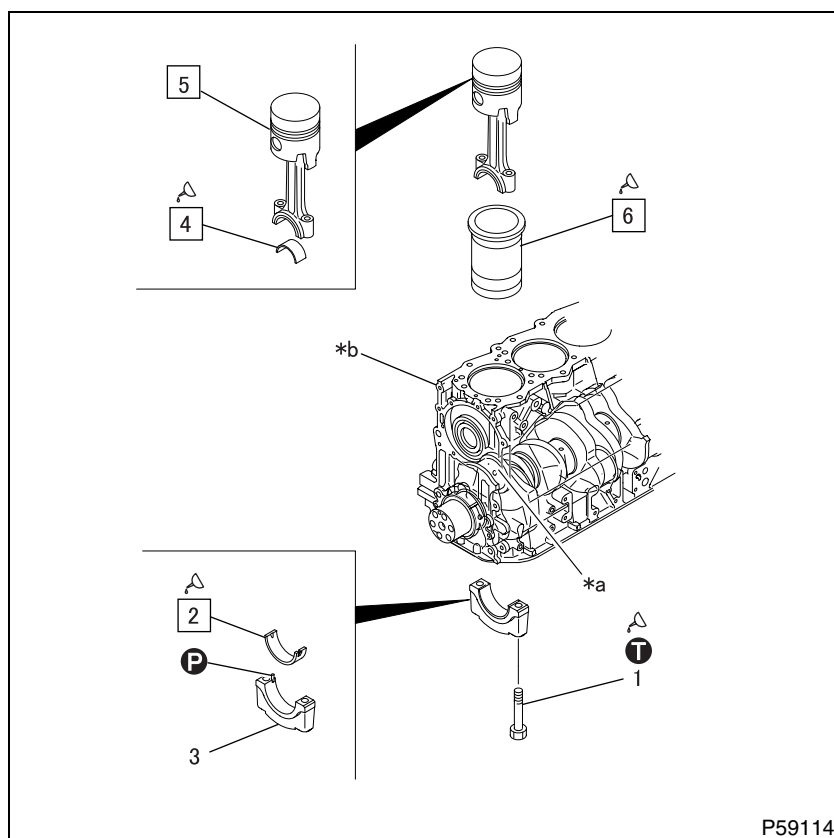
Measure the extent of distortion in the cylinder head **17** bottom surface. If the degree of distortion exceeds the specified limit, rectify the distortion with a surface grinder.

CAUTION

Ensure that grinding does not cause the cylinder head **17** top surface-to-bottom surface distance to fall below the specified limit.

MEMO

PISTONS, CONNECTING RODS AND CYLINDER LINERS



● Pre-disassembly inspection

📖 P11-49

● Removal sequence

- 1 Bolt
- 2 Lower connecting rod bearing
- 3 Connecting rod cap
- 4 Upper connecting rod bearing
- 5 Piston and connecting rod assembly
📖 P11-56
- 6 Cylinder liner

*a: Crankshaft 📖 P11-78

*b: Crankcase 📖 P11-78

Ⓟ: Locating pin

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
—	Piston projection		0.75 to 0.96 {0.030 to 0.038}	—	Inspect each location
	Connecting rod end play		0.15 to 0.45 {0.0059 to 0.018}	0.6 {0.024}	Replace
2, 4	Connecting rod bearing	Oil clearance	[70 {2.76}] 0.03 to 0.09 {0.0012 to 0.0035}	0.2 {0.0079}	Replace
		Span when free	—	Less than 74.5 {2.93}	
5, 6	Piston and connecting rod assembly-to-cylinder liner clearance		0.18 to 0.21 {0.0071 to 0.0083}	—	Replace
6	Cylinder liner	Flange projection	0.03 to 0.10 {0.0012 to 0.0039}	—	Replace
		Inside diameter	φ 118 to 118.03 {φ 4.646 to 4.647}	φ 118.25 {φ 4.66}	Replace
		Cylindricity	0.03 {0.0012} or less	—	Replace

ⓘ Tightening torque

Unit: N·m {ft.lbs, kgf·m}

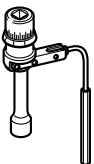
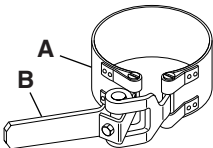
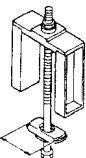
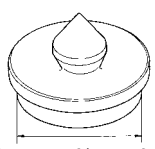
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt	29 {21, 3.0} +90° ± 5°	Wet

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Bolt threads	Engine oil	As required
2, 4	Connecting rod bearing inside surface	Engine oil	As required
6	Cylinder liner outer surface	Engine oil	As required

Special tools

Unit: mm {in.}

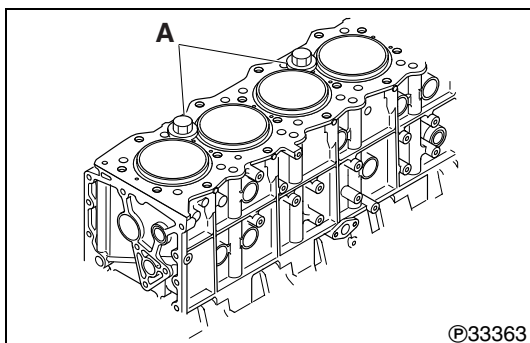
Location	Tool name and shape	Part No.	Application
5	Socket Wrench  P01984	MH061560	Installing piston and connecting rod assembly
	A: Piston Guide Clamp B: Piston Guide Lever  P01981	A: MH061760 B: MH061658	
6	Cylinder Liner Extractor  $\phi 117.5 \{ \phi 4.63 \}$ 13615N	MH061761	Removing cylinder liner
	Cylinder Liner Installer  $\phi 117.5 \{ \phi 4.63 \}$ 01983N	MH061771	Installing cylinder liner

◆ Service procedure

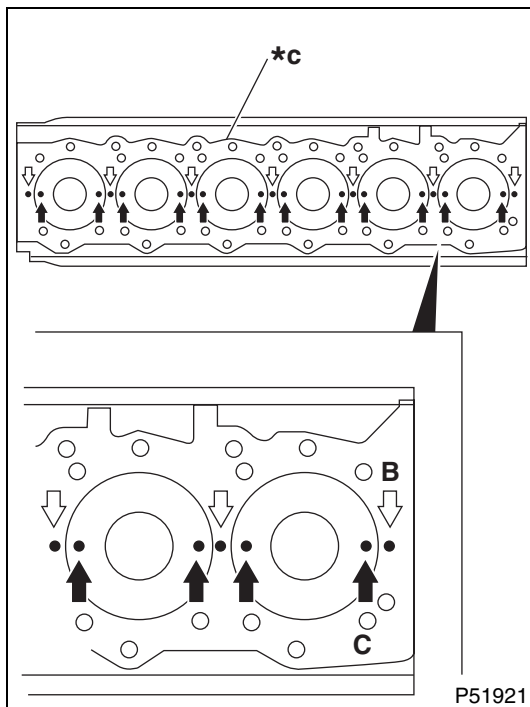
● Pre-disassembly inspection

CAUTION

Cylinder liner 6 may come up when the crankcase is turned upside down or when the crankshaft is rotated after the pistons are inserted. To prevent this, hold the cylinder liner flanges with washers A.



PISTONS, CONNECTING RODS AND CYLINDER LINERS

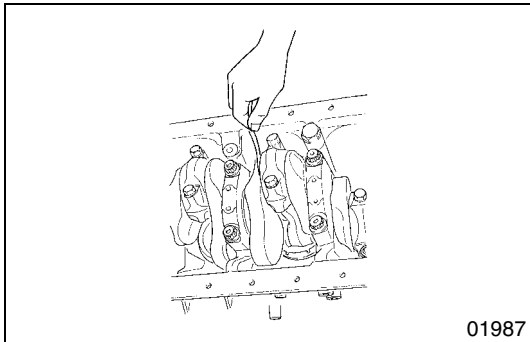


(1) Piston projection from crankcase top surface

NOTE

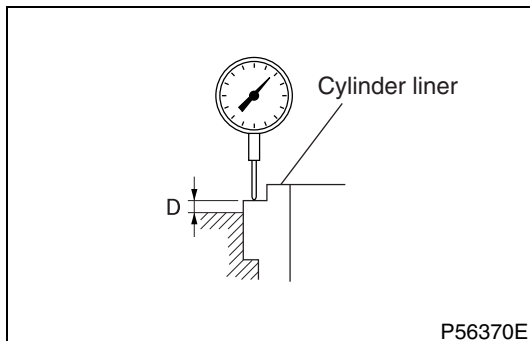
The piston projections affect engine performance and must therefore be checked.

- Move each piston, in turn, to the top-dead-center (TDC).
- With a piston at top-dead-center (TDC), measure the projection of the piston from the top surface of the crankcase *c, at two locations C. In each of the two measurements, choose one of the seven points B on the top surface of the crankcase as the reference point (zero) that is the nearest to the point being measured.
- Repeat this for the remaining pistons. When the piston projections have been measured at all of the 12 locations, calculate the average projection.
- If the average projection is not within the standard value range, check the clearances of relevant parts.
- Choose a cylinder head gasket with a thickness appropriate for the average projection. 📖 P11-30



(2) Connecting rod end play

- Measure the end play of every connecting rod.
- If any measurement exceeds the specified limit, replace the defective part(s).



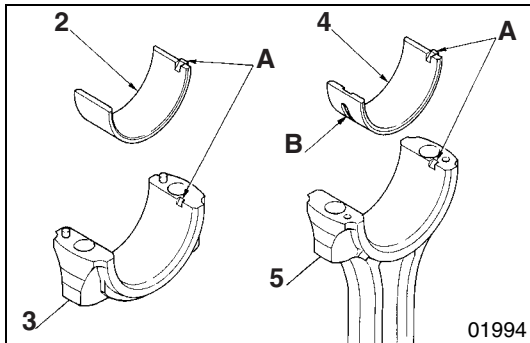
(3) Cylinder liner flange projection

If measurements exceed the standard values, replace the defective part(s).

D: Flange projection

CAUTION ⚠

If the cylinder liner flange projection is insufficient, bearing pressure on the cylinder head gasket will be too low in the region of the bore, possibly causing gas to leak.



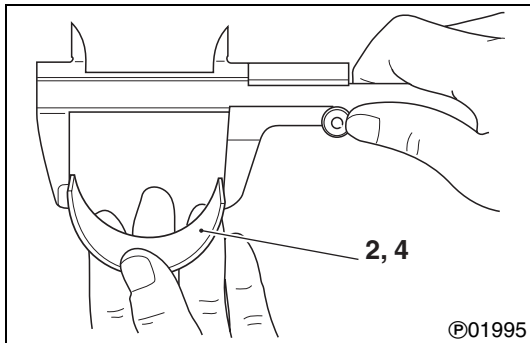
2 4 Connecting rod bearings

[Installation]

Install the lower connecting rod bearing **2** onto the connecting rod cap **3** and install the upper connecting rod bearing **4** onto the piston and connecting rod assembly **5**, making sure that the lugs **A** are fitted into the mating recesses.

CAUTION

An oil hole **B** is provided on the upper connecting rod bearing **4** while the lower connecting rod bearing **2** does not have an oil hole. Do not mix them up.



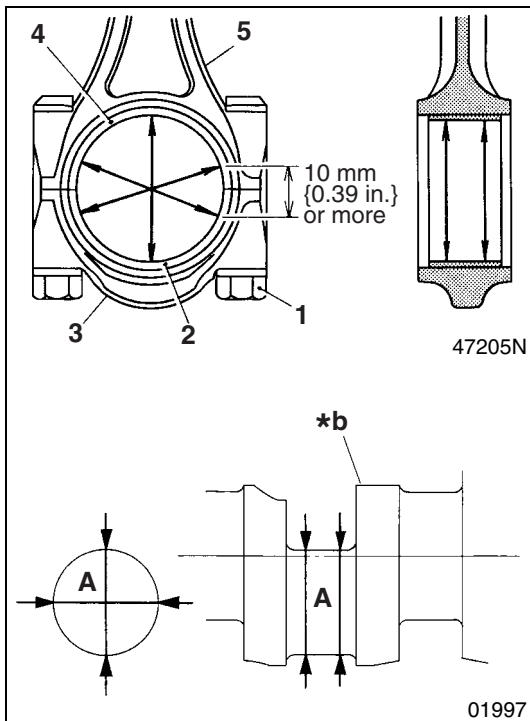
[Inspection]

CAUTION

- Do not attempt to manually expand a connecting rod bearing **2**, **4** if its span is insufficient.
- Upper and lower connecting rod bearings **2**, **4** must be replaced as a set.

(1) Span when free

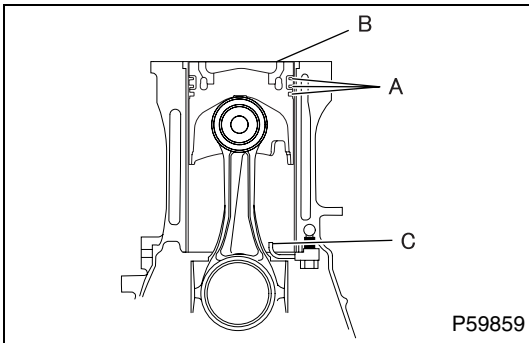
If the span is less than the specified requirement, replace the upper and lower connecting rod bearings **2**, **4** as a set.



(2) Connecting rod bearing-to-crankshaft pin clearance (oil clearance)

- Fit the lower connecting rod bearing **2** into the connecting rod cap **3**, and fit the upper connecting rod bearing **4** into the piston and connecting rod assembly **5**. Then, tighten the bolts **1** to the specified torque (29 N·m {21 ft.lbs, 3.0 kgf·m}).
- Measure the inside diameter of the connecting rod bearings **2**, **4** and the outside diameter of the crankshaft ***b** pin outside diameter **A**. If the clearance exceeds the specified limit, replace the defective part(s).
- When the connecting rod bearing **2**, **4** is replaced with an undersize bearing, adjust the pin outside diameter **A** of the crankshaft ***b** to the specified undersize dimension.  P11-78

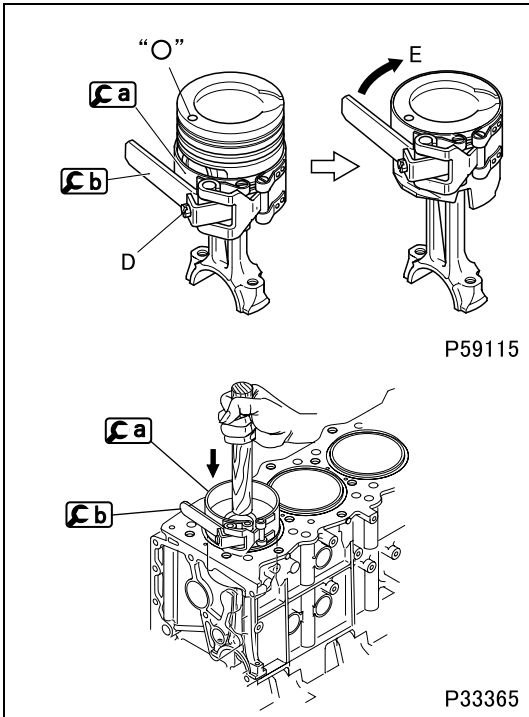
PISTONS, CONNECTING RODS AND CYLINDER LINERS



5 Installing piston and connecting rod assembly

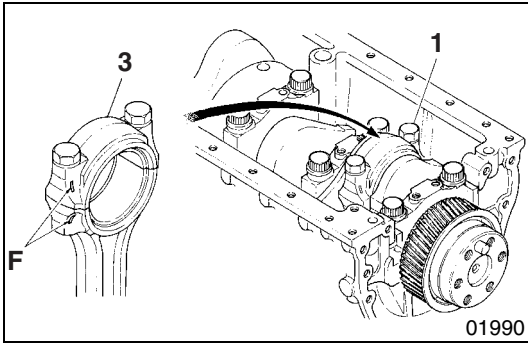
CAUTION

- Ensure that the gaps of the piston rings A remain in their correct positions. P11-56
- Take care not to scratch or otherwise damage the piston crown (recessed combustion chamber area) B.
- Use care not to hit the connecting rod against the oil jet C.

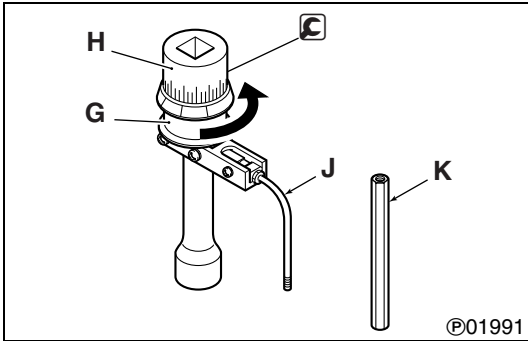


- With the piston's front mark "O" facing the front of the engine, install the piston and connecting rod assembly in the following manner.
- Fit the Piston Guide Clamp over the piston skirt. Using the bolt **D** of the Piston Guide Lever, adjust the clamp's inside diameter such that it matches the piston's outside diameter.
- Once the Piston Guide Clamp is adjusted properly, remove it from the piston and smear engine oil over the following items:
 - Outside of piston
 - Inside of the Piston Guide Clamp
 - Cylinder liner

E: Piston Guide Clamp tightening direction



- With the piston installed, align the mating marks **F** on the connecting rod and connecting rod cap **3** and tighten the bolts **1** to the specified torque (29 N·m {21 ft.lbs, 3.0 kgf·m}).

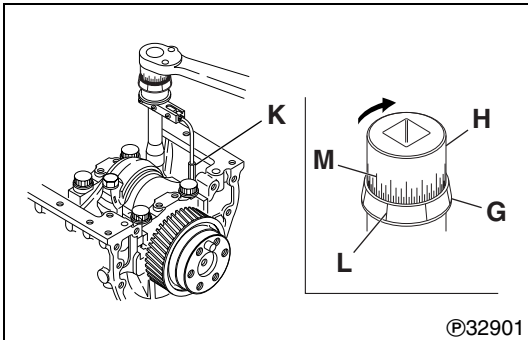


- Turn the holder **G** of the  Socket Wrench counterclockwise to compress the spring inside the wrench.

H: Socket

J: Rod

K: Rod (for extension)



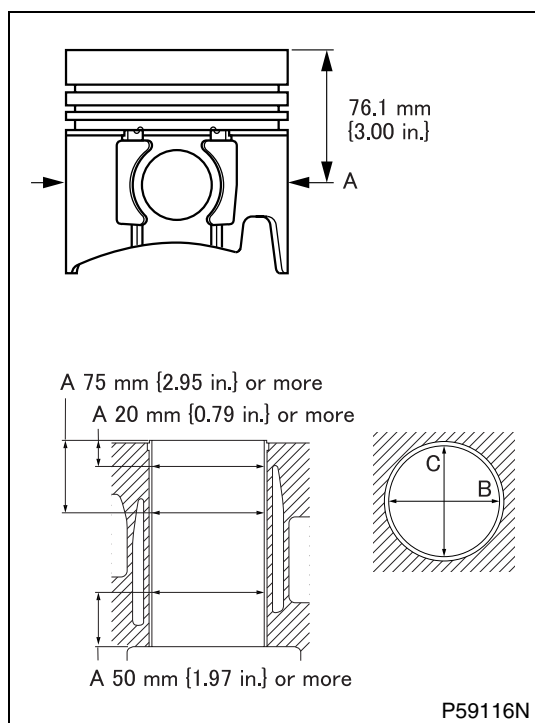
- Set the rod **K** (extension) such that it is pressed onto the crankshaft by the force of the compressed spring.
- Align one of the stamped lines **L** on the holder **G** with one of the stamped lines **M** on the scale of the socket **H** at any location. (The location at which the selected lines are aligned serves as the reference point "zero" for the next step.)
- Tighten the socket **H** in the direction shown until the selected line **M** on the scale forms a $95 \pm 5^\circ$ angle with the reference point "zero." One division (**M**) on the scale = 5°

NOTE

Inspect the following items after installing the connecting rod cap **3**.

- Connecting rod end play  P11-50
- Piston projection from crankcase top surface  P11-50

PISTONS, CONNECTING RODS AND CYLINDER LINERS



5 6 Piston-and-connecting rod assembly and cylinder liners

[Inspection]

If the clearance is out of specification, replace the defective part(s).

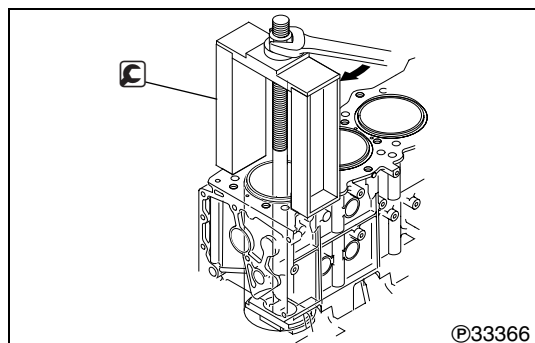
A: Diameter measurement position

B: Direction of crankshaft axis

C: Perpendicular to crankshaft axis

CAUTION

The cylinder liner is thin in wall thickness. Do not attempt to re-bore it to a larger diameter. Also, to prevent deformation, do not remove it except when it is replaced.



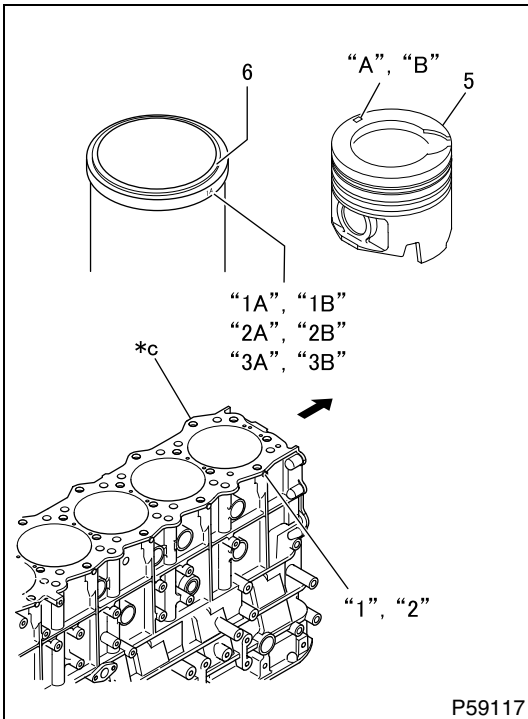
Cylinder liners

[Removal]

: Cylinder Liner Extractor

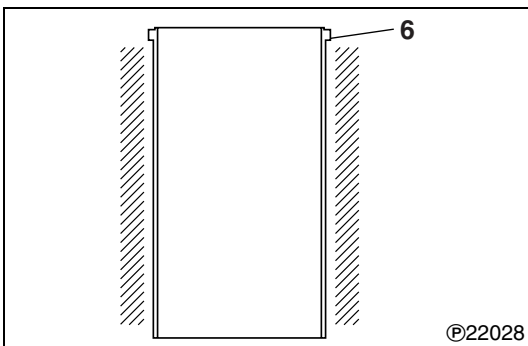
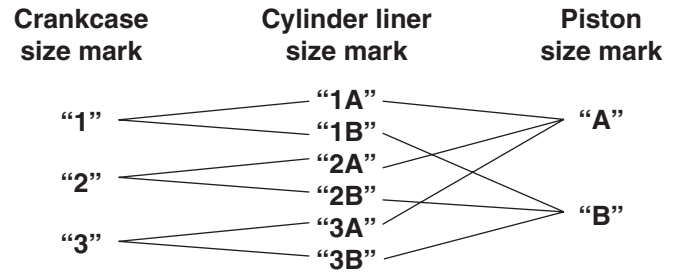
CAUTION

If the cylinder liner 6 is to be unavoidably reused, provide match marks showing its original location before removal, and install it at the same position as before.

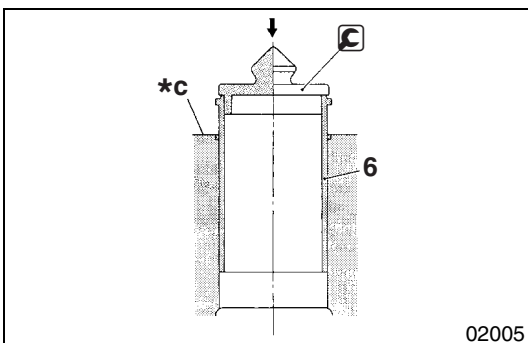


[Installation]

- Select cylinder liner **6** that has the same size mark as the crankcase ***c** and the piston and connecting rod assembly **5**.



- Apply a thin coat of engine oil to the periphery (shaded area) of cylinder liner **6**.



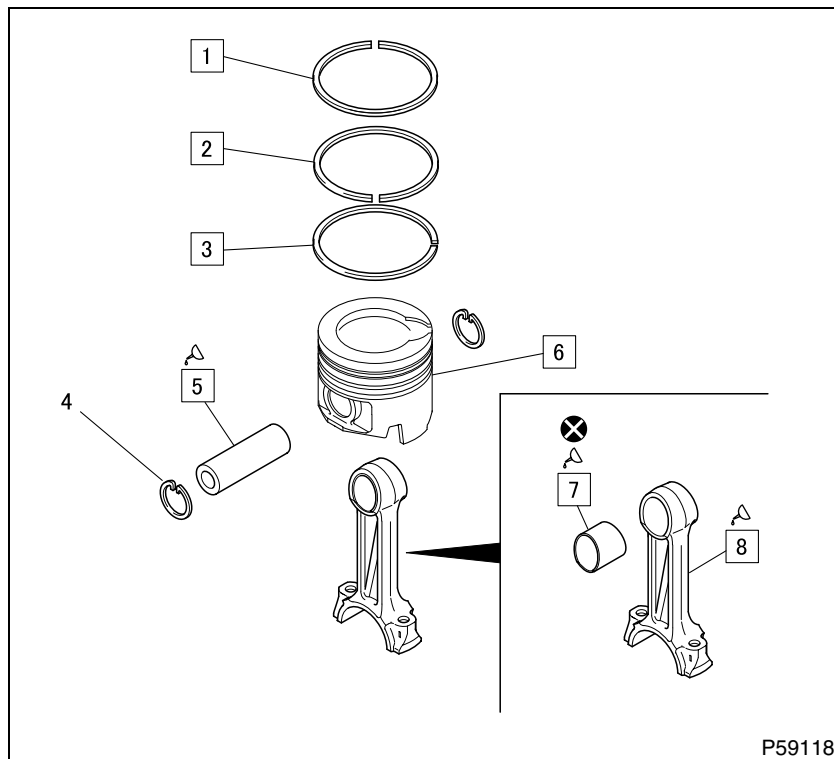
- Fit cylinder liner **6** into the crankcase ***c** gently while evenly pushing on the entire upper surface of the  Cylinder Liner Installer by hand.

CAUTION

Be extremely careful when handling cylinder liner **6** because its wall is thin.

PISTONS, CONNECTING RODS AND CYLINDER LINERS

Piston and Connecting Rod Assembly



● Disassembly sequence

- 1 1st compression ring
- 2 2nd compression ring
- 3 Oil ring
- 4 Snap ring
- 5 Piston pin
- 6 Piston
- 7 Connecting rod bushing
- 8 Connecting rod

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

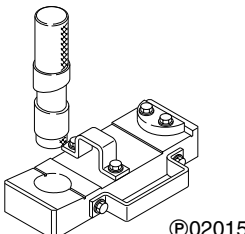
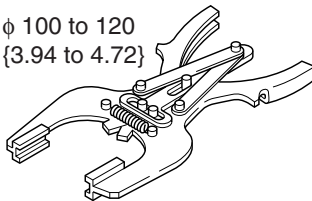
Location	Maintenance item		Standard value	Limit	Remedy
1 to 3	Piston ring end gap	1st compression ring	$0.45^{+0.05}_{-0.10}$ { $0.018^{+0.0020}_{-0.0039}$ }	1.5 {0.059}	Replace
		2nd compression ring	$0.45^{+0.05}_{-0.10}$ { $0.018^{+0.0020}_{-0.0039}$ }	1.5 {0.059}	
		Oil ring	0.30 to 0.55 {0.012 to 0.022}	1.5 {0.059}	
1 to 3, 6	Piston ring-to-piston ring groove clearance	1st compression ring	0.13 to 0.18 {0.0051 to 0.0071}	0.2 {0.0079}	Replace
		2nd compression ring	0.065 to 0.105 {0.0026 to 0.0041}	0.15 {0.059}	
		Oil ring	0.025 to 0.065 {0.00098 to 0.0026}	0.15 {0.059}	
5, 6	Piston pin-to-piston clearance		0.004 to 0.002 {0.00016 to 0.000079}	0.05 {0.0020}	Replace
5, 7	Piston pin-to-connecting rod small end bushing clearance		0.02 to 0.05 {0.00079 to 0.0020}	0.1 {0.0039}	Replace
8	Connecting rod	Bend	—	0.05 {0.0020}	Correct or replace
		Torsion	—	0.1 {0.0039}	

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5	Piston pin outer surface	Engine oil	As required
7	Connecting rod bushing outer surface	Engine oil	As required
8	Bushing installation surface of connecting rod	Engine oil	As required

Special tools

Unit: mm {in.}

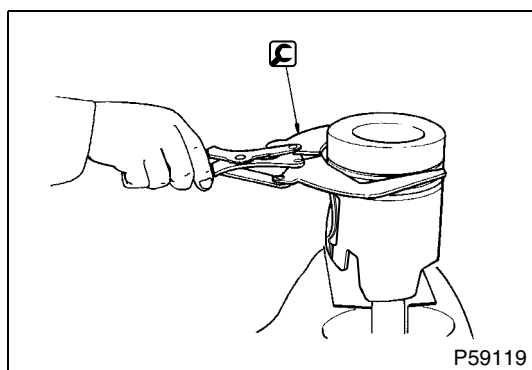
Location	Tool name and shape	Part No.	Application
7	Connecting Rod Bushing Puller Kit  ©02015	MH062556	Removing and installing connecting rod bushings
1 to 3	Piston Ring Tool  ©02013N	30091-07100	Removing and installing piston rings

◆ Service procedure

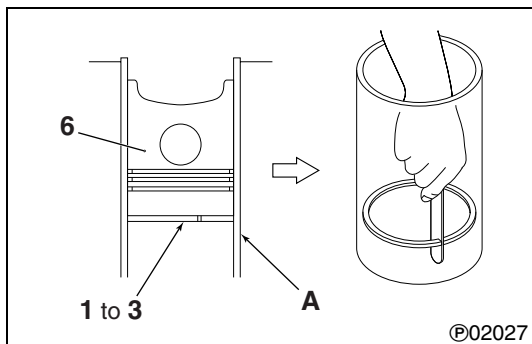
1 to 3 6 Piston rings and piston

Piston rings

[Removal]

: Piston Ring Tool

PISTONS, CONNECTING RODS AND CYLINDER LINERS



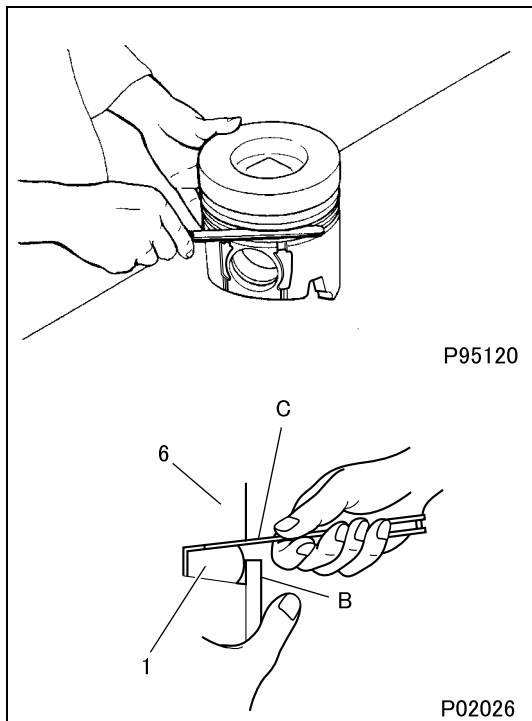
[Inspection]

(1) Piston ring end gap

- Using the crown of a piston **6**, push the piston ring **1 to 3** horizontally into a cylinder liner **A** for measurement.
- Taking care not to move the piston ring **1 to 3**, measure the end gap. Replace all the rings of a piston if any gap exceeds the specified limit.

NOTE

- To keep the piston ring **1 to 3** horizontal, be sure to insert them into the cylinder liner **A** using a piston **6**.
- Push the piston ring **1 to 3** down to the bottom of cylinder liner **A**; the bottom should be less worn than the top.
- Piston rings **1 to 3** must be replaced as a set. Never replace piston rings individually.

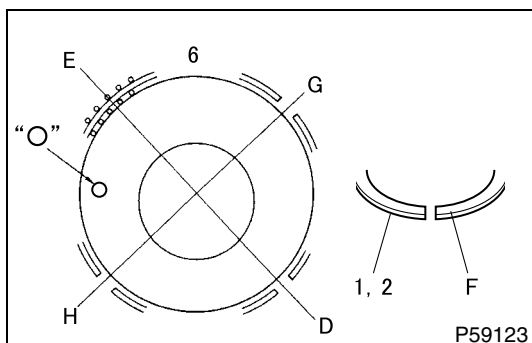


(2) Piston ring-to-piston ring groove clearance

- If any measurement exceeds the specified limit, replace the defective part(s).
- Measure the 1st compression ring **1** clearance with a feeler gauge **C** while pressing the ring against the piston **6** with a straight edge **B**.

NOTE

- Remove any carbon deposits from the ring groove of the piston **6** and measure the clearance around the piston's entire periphery.
- Piston rings **1 to 3** must be replaced as a set. Never replace piston rings individually.



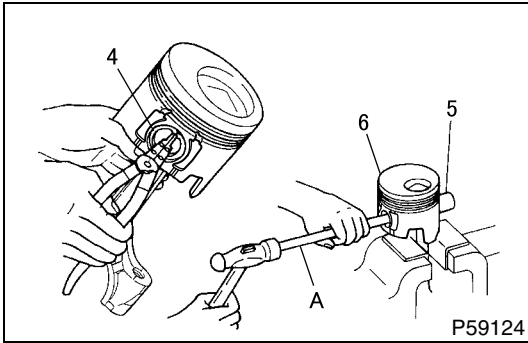
[Installation]

- Fit the oil ring **3** onto the piston **6** with its gap **D** and the expander spring gap **E** in the positions illustrated.
- Fit the compression rings **1, 2** onto the piston **6** such that the manufacturer's marks **F** near the gaps face upward.
- Fit the compression rings **1, 2** onto the piston **6** with their gaps **G, H** positioned as illustrated.

G: 1st compression ring gap

H: 2nd compression ring gap

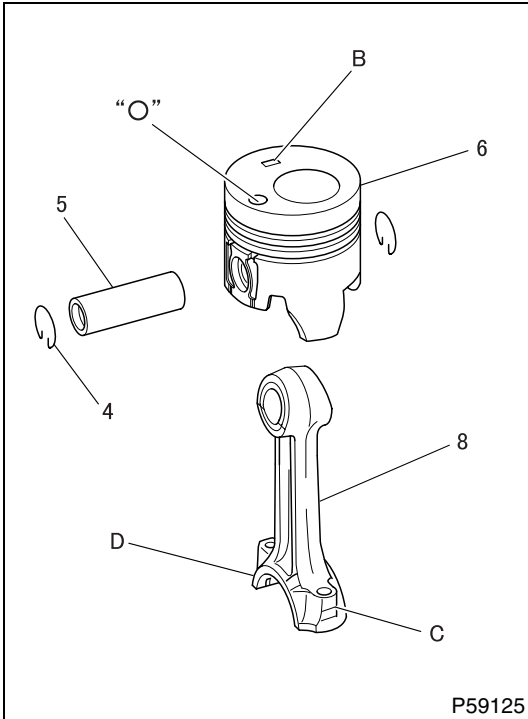
“O”: Front mark



5 6 8 Piston pin, piston, and connecting rod

[Removal]

- Tap out the piston pin **5** using a rod **A** and hammer.
- If the piston pin **5** is difficult to remove, heat the piston **6** using a piston heater or in hot water.



[Installation]

- Apply engine oil to the piston pin **5**. With the connecting rod **8** and piston **6** aligned as illustrated, insert the piston pin to hold these components together.

B: Size mark "A", "B"

C: Mass mark (A, B, C, D, E)

A: Maximum mass

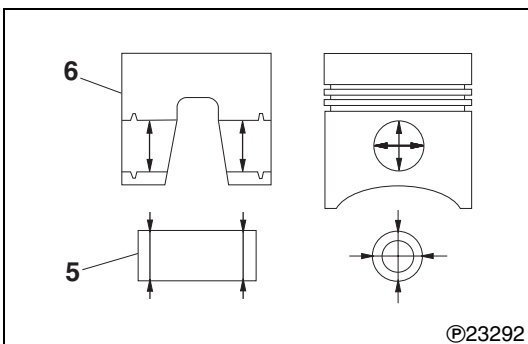
D: Alignment mark for connecting rod cap

"O": Front mark (on connecting rod)

- If the piston pin **5** is difficult to insert, heat the piston **6** using a piston heater or in hot water.

CAUTION ⚠

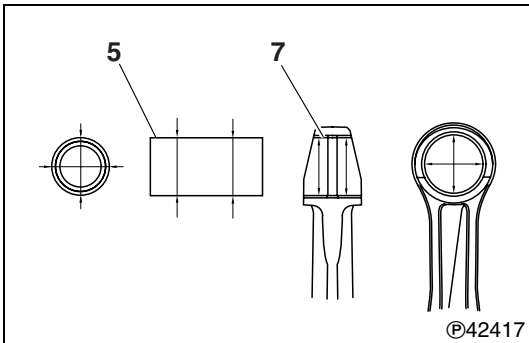
- No piston should differ from any other piston by a weight of more than 10 g {0.35 oz}.
- The connecting rods must all have the same mass mark.
- After inserting the piston pin **5**, check that it turns smoothly and without play.



5 6 Piston pin-to-piston clearance

If the clearance exceeds the specified limit, replace the defective part(s).

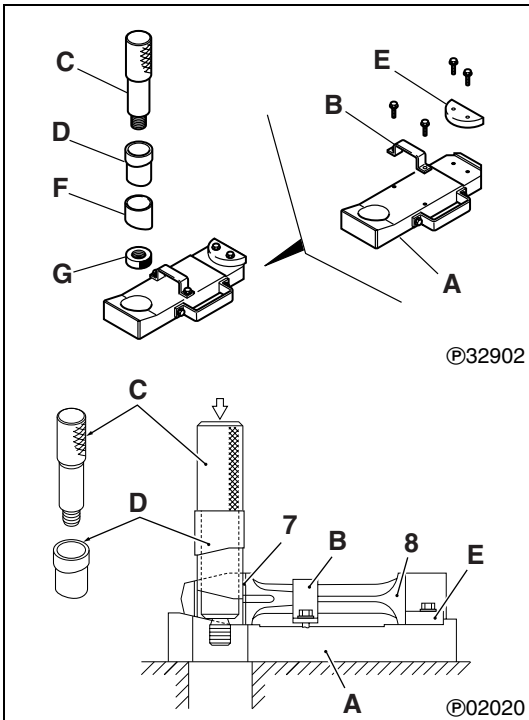
PISTONS, CONNECTING RODS AND CYLINDER LINERS



5 7 Piston pin and connecting rod bushing

[Inspection]

If the clearance exceeds the specified limit, replace the defective part(s).



Connecting rod bushing

Replace the connecting rod bushing **7** using the  Connecting Rod Bushing Puller Kit:

(Component parts of the  Connecting Rod Bushing Puller Kit)

- | | |
|-------------------|------------------|
| A: Base | E: Plate |
| B: Bracket | F: Collar |
| C: Puller | G: Nut |
| D: Collar | |

[Removal]

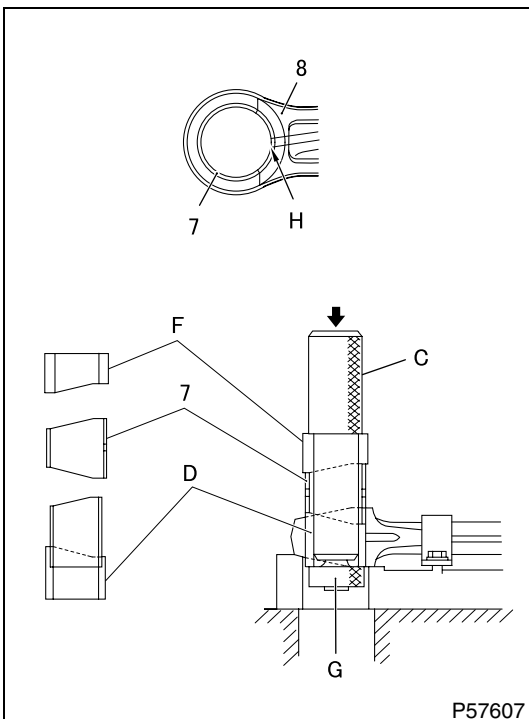
- Remove the upper connecting rod bearing (if fitted) from the big end of the connecting rod **8**.
- Mount the connecting rod **8** on the base **A** and lock it in position with the bracket **B** and plate **E**.
- Fit the collar **D** and the Puller **C** in the direction shown. Then, slowly apply pressure of approximately 49,000 N (11,020 lbs, 5,000 kgf) until the connecting rod bushing **7** is pressed out.

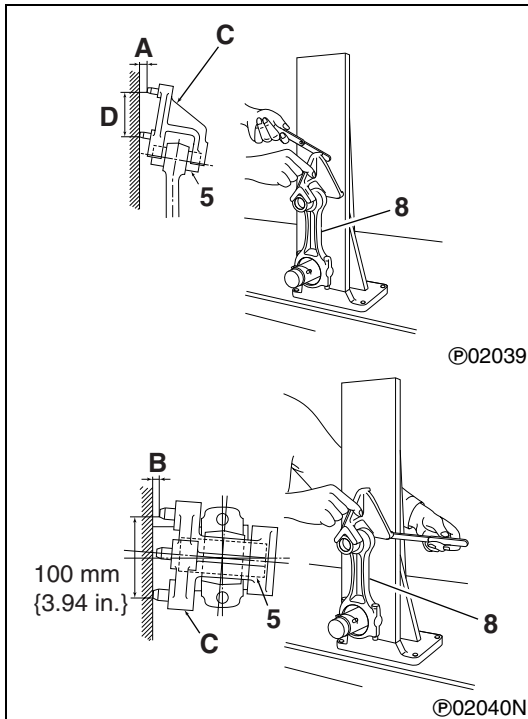
[Installation]

- Apply engine oil to the small end of the connecting rod **8** and to the outer surface of the connecting rod bushing **7**.
- Fit the collar **F** over the puller **C**, position the connecting rod bushing **7** and the collar **D**, and lock this arrangement together with the nut **G**.
- Align the oil holes **H** in the connecting rod bushing **7** and in the small end of the connecting rod **8**. Then, use a press to slowly apply pressure of approximately 49,000 N (11,020 lbs, 5,000 kgf) until the bushing is pressed into place.
- After press-fitting the connecting rod bushing **7**, ream it to achieve the specified nominal clearance between the bushing and piston pin **5**.

NOTE

After installing the connecting rod bushing **7**, insert the piston pin **5** and check that it turns smoothly and without play.





8 Connecting rod bend and twist

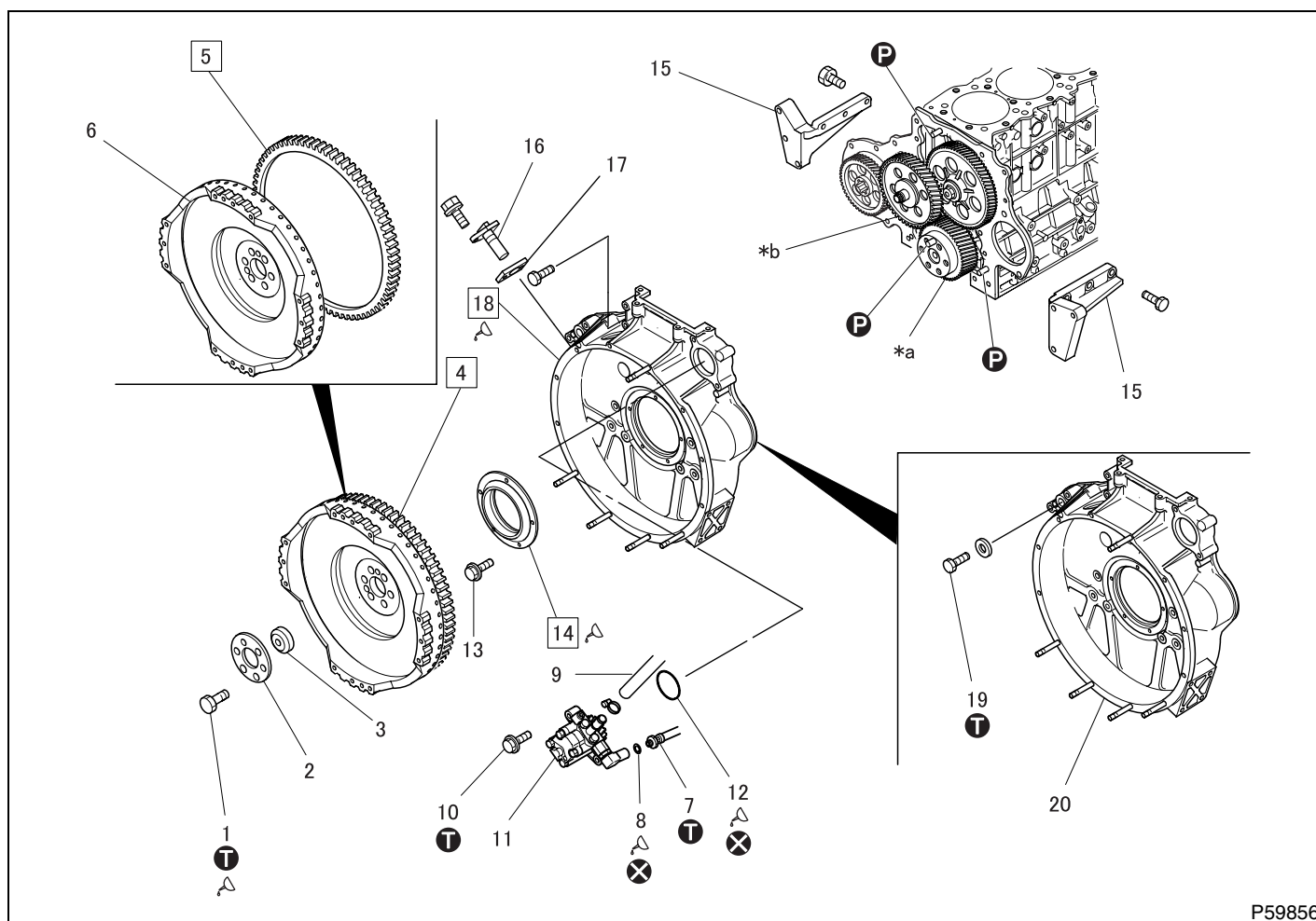
- Fit the connecting rod bushing 7 and piston pin 5 in their respective positions of the connecting rod 8.
- Measure the extent of bending **A** and twisting **B** in the connecting rod 8. If either measurement exceeds the specified limit, correct or replace the connecting rod.

C: Connecting rod aligner (measurement device)

NOTE

- **Before mounting the connecting rod 8 on the connecting rod aligner C, install the upper and lower connecting rod bearings in their respective positions.**
- **Measurements must be made with the connecting rod cap mounting bolts tightened to their specified torque.** P11-48

FLYWHEEL <MANUAL TRANSMISSION>



P59856

● Disassembly sequence

- | | |
|---------------------------|------------------------------|
| 1 Bolt | 11 Power steering oil pump |
| 2 Washer plate | 12 O-ring |
| 3 Pilot bearing | 13 Bolt |
| 4 Flywheel assembly | 14 Rear oil seal |
| 5 Ring gear | 15 Stiffener |
| 6 Flywheel | (Engine with stiffener) |
| 7 Power steering oil hose | 16 Engine speed sensor Gr54 |
| 8 O-ring | 17 Speed sensor adapter |
| 9 Suction hose | 18 Flywheel housing assembly |
| 10 Bolt | |

- 19 Plug
20 Flywheel housing

*a: Crankshaft gear P11-78
*b: No. 1 idler gear P11-72

P: Locating pin
X: Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
4	Flywheel assembly	Friction surface distortion	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Hight of friction surface	26.5 {1.04}	25.5 {1.00}	Replace
		Friction surface runout (when fitted)	–	0.2 {0.0079}	Correct or replace
18	Eccentricity of flywheel housing assembly measured at socket section as installed		–	0.2 {0.0079}	Inspect or replace

① Tightening torque

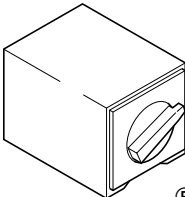
Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (flywheel installation)	98 {72, 10} + 50° ± $\begin{smallmatrix} +10^\circ \\ 0 \end{smallmatrix}$	- Wet - Can be used up to 3 times
7	Power steering oil hose	69 to 82 {51 to 60, 7.0 to 8.4}	–
10	Bolt (power steering oil pump installation)	44 ± 8.8 {32 ± 6.5, 4.5 ± 0.9}	–

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Threaded portion of bolt	Engine oil	As required
8	O-ring	Engine oil	As required
14	Rear oil seal lip	Engine oil	As required
	Flywheel housing mounting surface of rear oil seal	Threebond 1207C	As required
18	Engine mounting surface of flywheel housing assembly	Threebond 1207C	As required

🔧 Special tools

Location	Tool name and shape	Part No.	Application
4	Socket Wrench  ©01984	MH062354	Installing flywheel assembly
	Magnet Base  ©00471	MH062356	

FLYWHEEL <MANUAL TRANSMISSION>

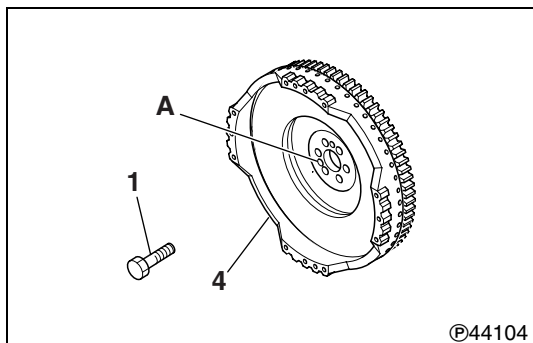
◆ Service procedure

● Pre-disassembly operation

4 Flywheel assembly

[Removal]

To remove the flywheel assembly **4**, screw the mounting bolts **1** into the removal holes **A**.



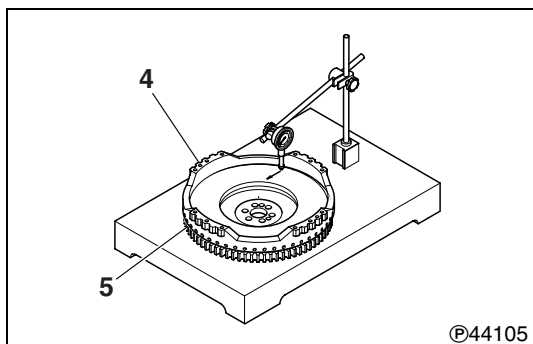
[Inspection]

(1) Distortion of friction surface

If distortion exceeds the specified limit, rectify or replace the flywheel assembly **4**.

NOTE

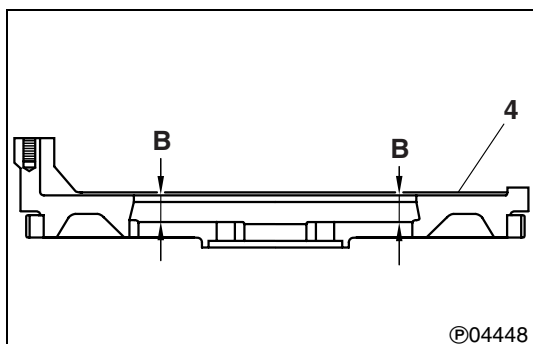
If any abnormality is evident on the ring gear **5**, replace the ring gear before making inspections.



(2) Height of friction surface

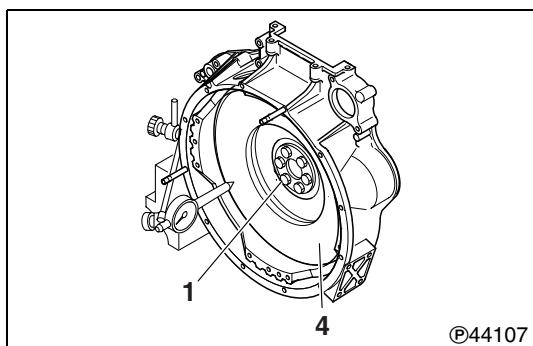
If the measurement is below the specified value, rectify or replace the flywheel assembly **4**.

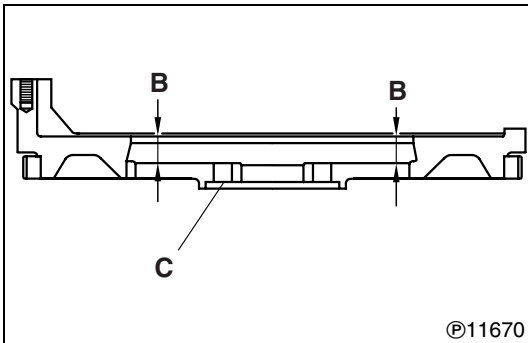
B: Height of friction surface



(3) Runout

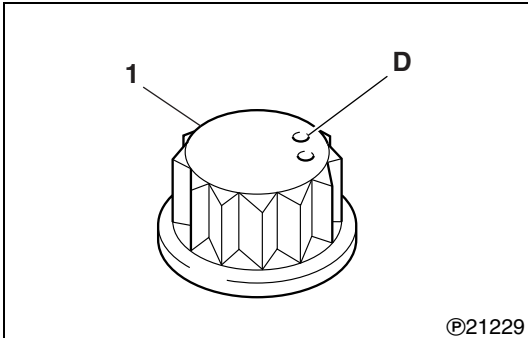
- Tighten the bolts **1** to a torque of 98 N·m {72 ft.lbs, 10 kgf·m}.
- If runout exceeds the specified limit, check that the bolts **1** are tightened correctly and inspect the crankshaft mounting surface. Then, rectify or replace the flywheel assembly **4** as required.





[Rectification]

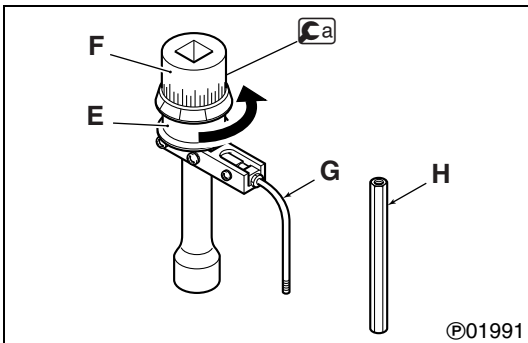
Grind the friction surface such that its height **B** remains greater than the specified minimum. The friction surface must remain parallel with surface **C** with a tolerance of 0.1 mm {0.0039 in.}.



[Installation]

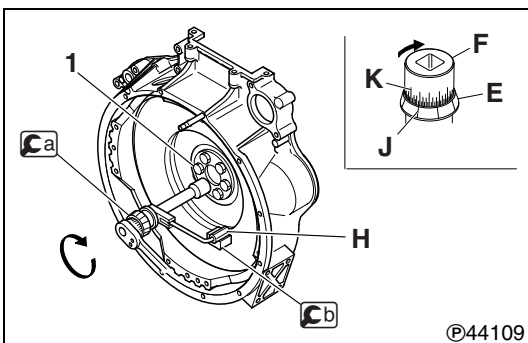
CAUTION

Before installing the bolt 1, check the number of punch marks (D) on its head. (If there are two or less, the bolt is reusable.) The number of punch marks corresponds with the number of times a bolt has been tightened by the plastic region tightening method. If there are three (which means that the bolt has been tightened 3 times), replace the bolt.



- Tighten the bolts **1** to a torque of 98 N·m {72 ft.lbs, 10 kgf·m}. Then, turn the bolts further in accordance with the following procedure.
- Turn the holder **E** of the  Socket Wrench counter-clockwise to tension the built-in spring.

F: Socket
G: Rod
H: Rod (extension)

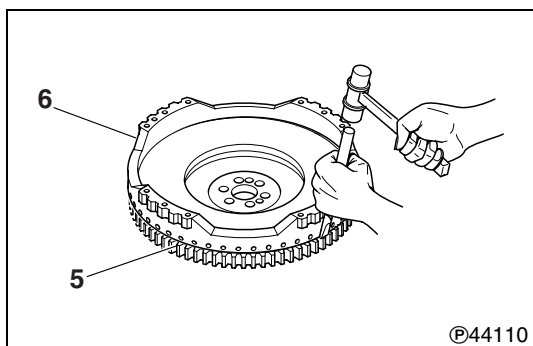


- Set the socket wrench so that the built-in spring forces the rod **H** (extension) against the  Magnetic Base.
- Align any inscribed line **J** on the holder **E** with any inscribed line **K** on the socket **F**. (Use this point as reference 0° position.)
- From this reference position, turn the socket **F** by $150^{\circ} +10^{\circ}_0$ in the illustrated direction. (One graduation on the scale **K** represents 5°.)
- After tightening the bolts **1** in the plastic area using the plastic region tightening method, make a punch mark on the head of each one to indicate the times of use.

CAUTION

Since the bolts 1 utilize the plastic region tightening method, they must not be tightened further after the angular tightening procedure has been performed.

FLYWHEEL <MANUAL TRANSMISSION>



5 Ring gear

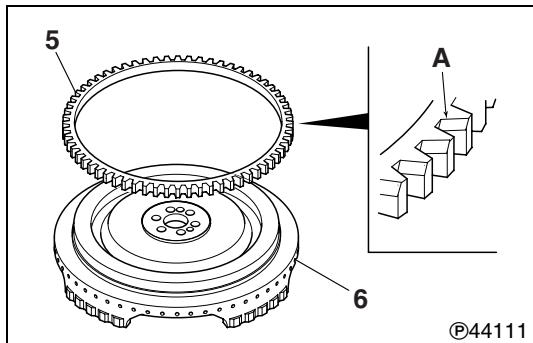
[Removal]

- Heat the ring gear 5 evenly with an acetylene torch or the like.

WARNING

Be careful not to get burned.

- Remove the ring gear 5 from the flywheel 6 by tapping around its entire periphery.



[Installation]

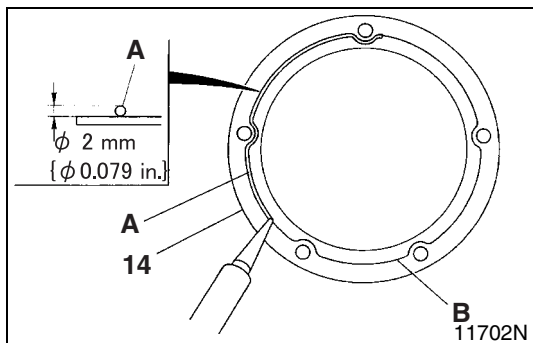
- Using a piston heater or the like, heat the ring gear 5 to approximately 200°C {390°F} for 3 minutes.

WARNING

Be careful not to get burned.

- Fit the ring gear 5 with the non-chamfered side of its teeth toward the flywheel 6.

A: Chamfered side of ring gear

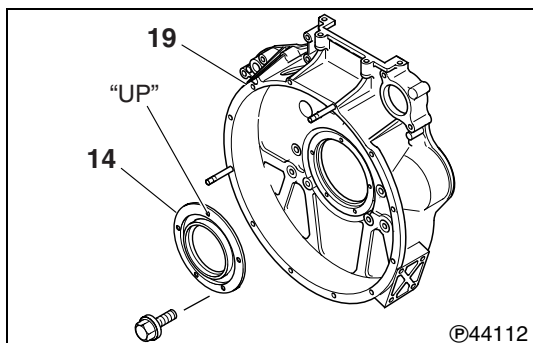


14 Installation of rear oil seal

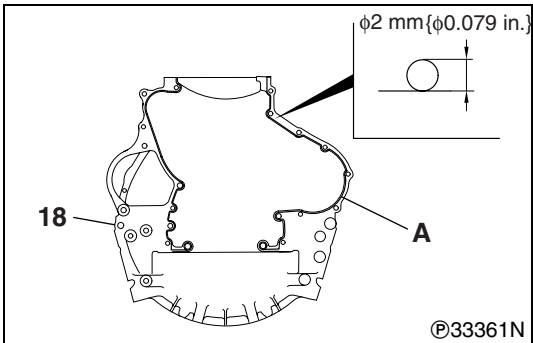
- Apply an even, unbroken bead of specified sealant A to the given sealant application area B of the rear oil seal 14.
- Within 3 minutes after the sealant application, fit the rear oil seal 14 to the flywheel housing assembly 18.

CAUTION

- Make sure that the sealant application area B of the rear oil seal 14 is clean.
- Take care that the sealant is kept in place during installation of the rear oil seal 14.
- Do not start the engine for at least 30 minutes after the rear oil seal 14 is installed.
- Whenever the bolts 13 fitting the rear oil seal 14 to the flywheel housing assembly are loosened, always apply a fresh coat of specified sealant A.



- Apply a coat of engine oil to the lip of the rear oil seal 14.
- With the rear oil seal 14 faced as shown, install the seal onto the flywheel housing assembly 18.



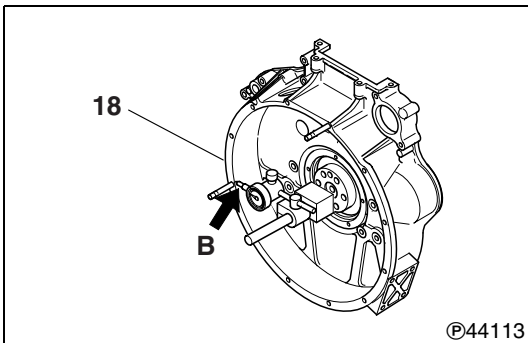
18 Flywheel housing assembly

[Installation]

- Apply an even, unbroken bead of the sealant **A** along the crankcase mounting surface of the flywheel housing assembly **18**.
- Within three minutes of the sealant **A** application, fit the flywheel housing assembly **18** onto the crankcase.

CAUTION

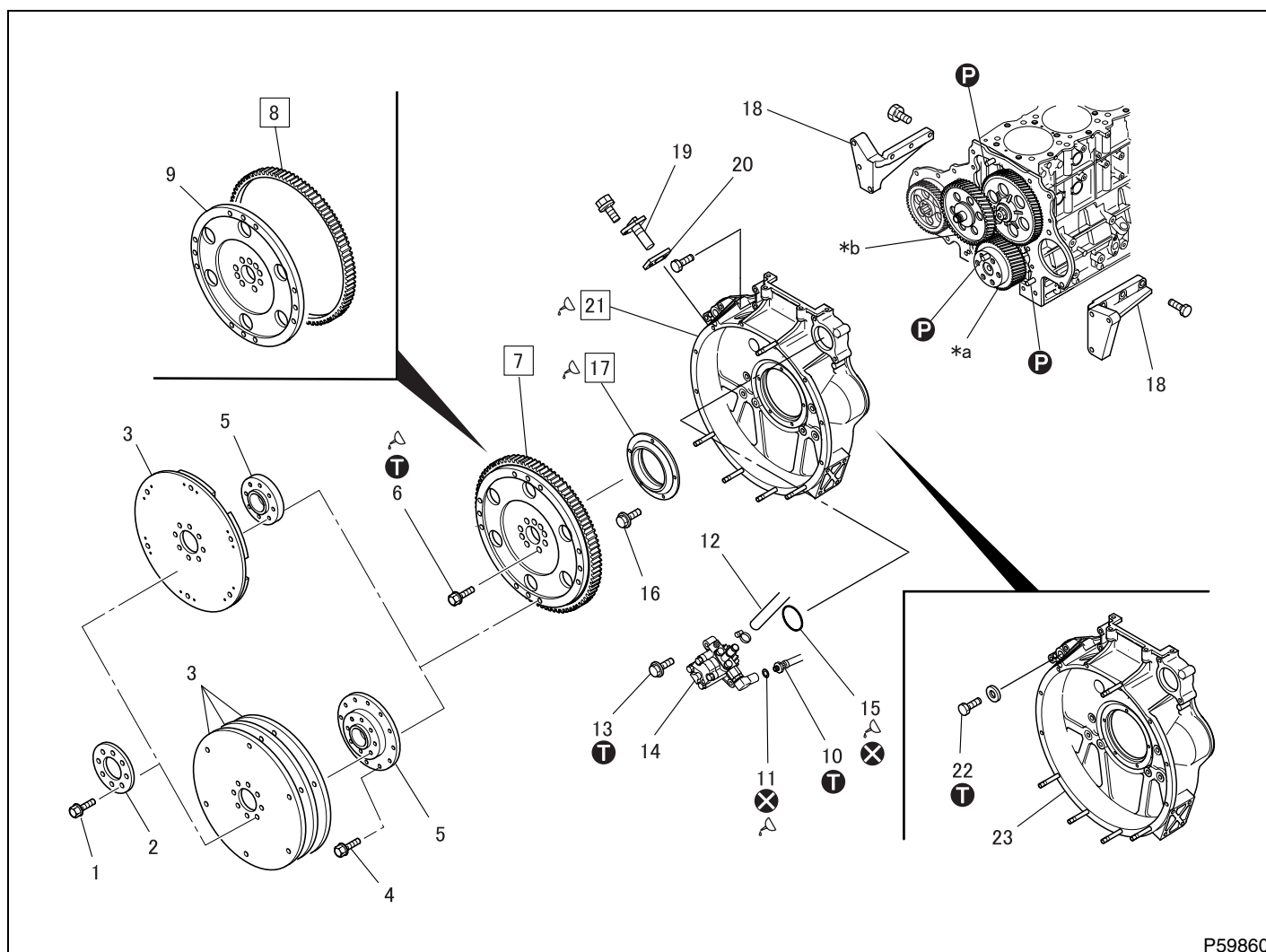
- Ensure that the surface of the flywheel housing assembly **18** onto which the sealant **A** is to be applied is clean.
- Fit the flywheel housing assembly **18** to the correct position on the crankcase, making sure that the assembly is not offset relative to the crankcase.
- After fitting the flywheel housing assembly **18**, wait for at least one hour before starting the engine.
- Apply a new bead of the sealant **A** whenever the mounting bolts of the flywheel housing assembly **18** have been loosened.



[Inspection]

- Rotate the crankshaft and check the eccentricity of the flywheel housing assembly **18** at its socket section **B**.
- If eccentricity exceeds the specified limit, carry out reassembly.
- If eccentricity still exceeds the specified limit after reassembly, replace the defective part(s).

FLYWHEEL <AUTOMATIC TRANSMISSION>



P59860

● Disassembly sequence

- | | | |
|---------------------------------|-----------------------------|------------------------------|
| 1 Bolt | 11 O-ring | 21 Flywheel housing assembly |
| 2 Wear plate | 12 Suction hose | 22 Plug |
| 3 Flex plate <FK61, FM61, FM64> | 13 Bolt | 23 Flywheel housing |
| Flex plate assembly <FM65> | 14 Power steering oil pump | |
| 4 Bolt | Gr37 | |
| 5 Flywheel adaptor | 15 O-ring | |
| 6 Bolt | 16 Bolt | |
| 7 Flywheel assembly | 17 Rear oil seal | |
| 8 Ring gear | 18 Stiffener | |
| 9 Flywheel | (Engine with stiffener) | |
| 10 Power steering oil hose | 19 Engine speed sensor Gr54 | |
| | 20 Speed sensor adaptor | |

*a: Crankshaft gear P11-78

*b: No. 1 idler gear P11-72

Locating pin

Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
21	Eccentricity of flywheel housing assembly measured at socket section as installed	—	0.2 {0.0079}	Inspect or replace

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Bolt (flywheel installation)	250 {185, 25}	Wet
10	Power steering oil hose	69 to 82 {51 to 60, 7.0 to 8.4}	—
13	Bolt (power steering oil pump installation)	44 ± 8.8 {32 ± 6.5, 4.5 ± 0.9}	—

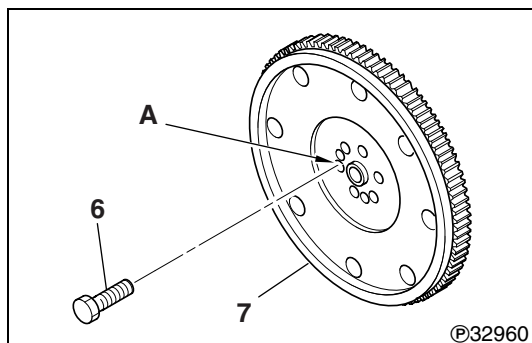
🔊 Lubricant and/or sealant

Location	Maintenance item	Specified lubricant and/or sealant	Quantity
6	Threaded portion of bolt	Engine oil	As required
11,15	O-ring	Engine oil	As required
17	Rear oil seal lip	Engine oil	As required
	Flywheel housing mounting surface of rear oil seal	Threebond 1207C	As required
21	Engine mounting surface of flywheel housing	Threebond 1207C	As required

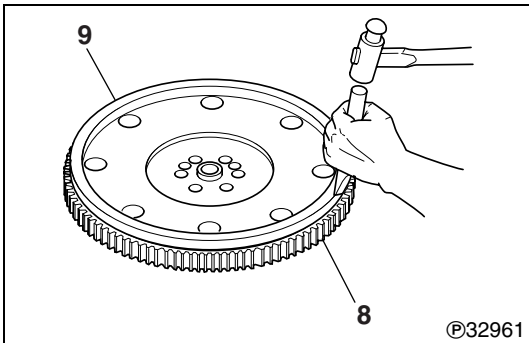
◆ Service procedure

7 Removal of flywheel assembly

To remove the flywheel assembly 7, screw the mounting bolts 6 into the removal holes A.



FLYWHEEL <AUTOMATIC TRANSMISSION>



9 Ring gear

[Removal]

- Heat the ring gear **8** evenly with an acetylene torch or the like.

WARNING

Be careful not to get burned.

- Remove the ring gear **8** from the flywheel **9** by tapping around its entire periphery.

[Installation]

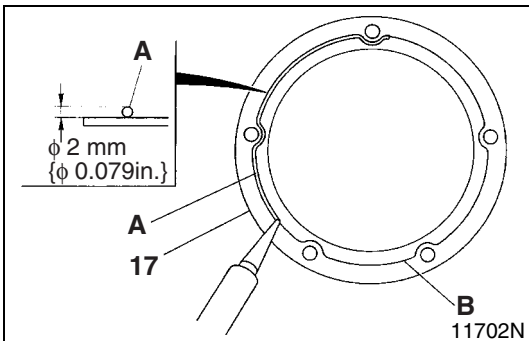
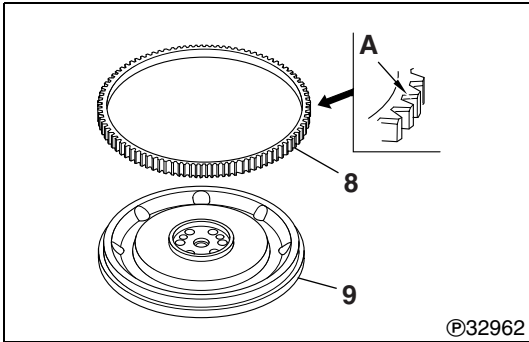
- Using a piston heater or the like, heat the ring gear **8** to approximately 200°C {390°F} for 3 minutes.

WARNING

Be careful not to get burned.

- Fit the ring gear **8** with the non-chamfered side of its teeth toward the flywheel **9**.

A: Chamfered side of ring gear

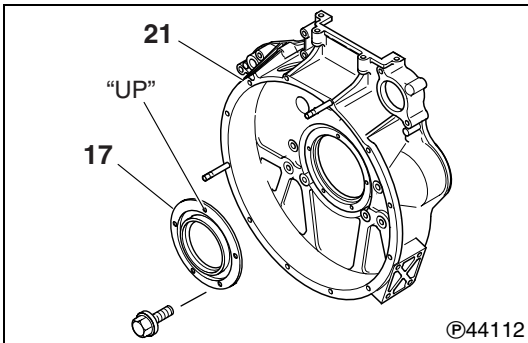


17 Installation of rear oil seal

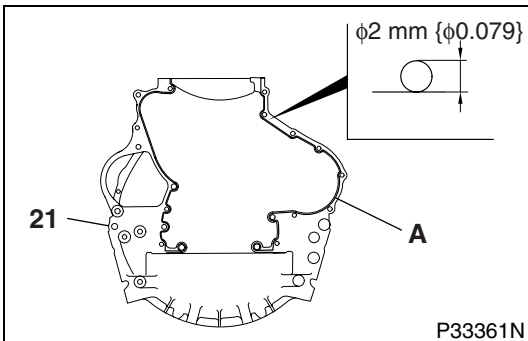
- Apply an even, unbroken bead of specified sealant **A** to the given sealant application area **B** of the rear oil seal **17**.
- Within 3 minutes after the sealant application, fit the rear oil seal **17** to the flywheel housing assembly **21**.

CAUTION

- Make sure that the sealant application area **B** of the rear oil seal **17** is clean.
- Take care that the sealant is kept in place during installation of the rear oil seal **17**.
- Do not start the engine for at least 30 minutes after the rear oil seal **17** is installed.
- Whenever the bolts **16** fitting the rear oil seal **17** to the flywheel housing assembly are loosened, always apply a fresh coat of specified sealant **A**.



- Apply a coat of engine oil to the lip of the rear oil seal 17.
- With the rear oil seal 17 faced as shown, install the seal onto the flywheel housing assembly 21.



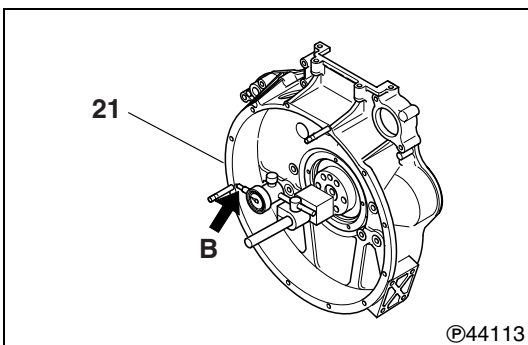
21 Flywheel housing assembly

[Installation]

- Apply an even, unbroken bead of the sealant A along the crankcase mounting surface of the flywheel housing assembly 21.
- Within three minutes of the sealant A application, fit the flywheel housing assembly 21 onto the crankcase.

CAUTION

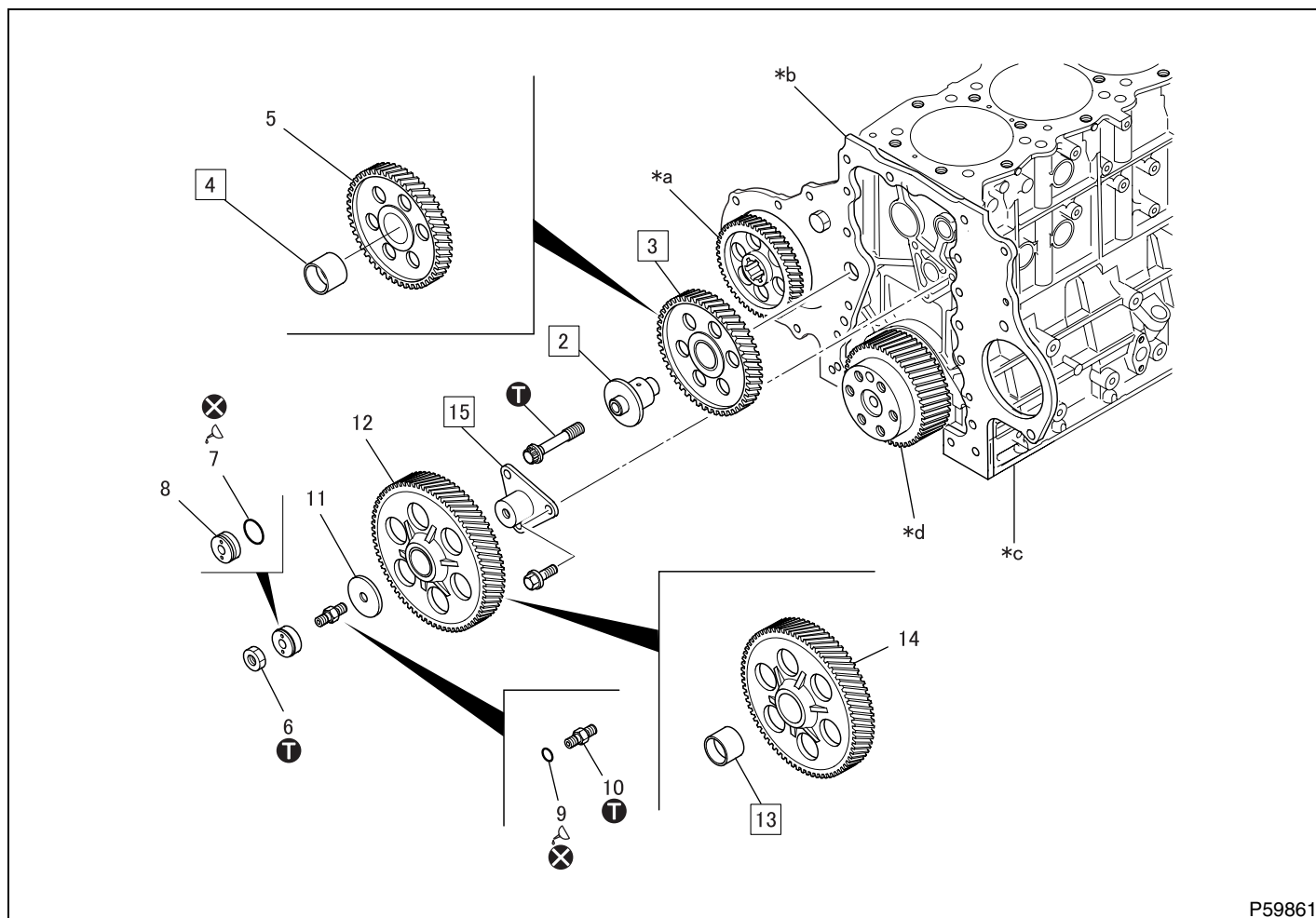
- Ensure that the surface of the flywheel housing assembly 21 onto which the sealant A is to be applied is clean.
- Fit the flywheel housing assembly 21 to the correct position on the crankcase, making sure that the assembly is not offset relative to the crankcase.
- After fitting the flywheel housing assembly 21, wait for at least one hour before starting the engine.
- Apply a new bead of the sealant A whenever the mounting bolts of the flywheel housing assembly 21 have been loosened.



[Inspection]

- Rotate the crankshaft and check the eccentricity of the flywheel housing assembly 21 at its socket section B.
- If eccentricity exceeds the specified limit, carry out reassembly.
- If eccentricity still exceeds the specified limit after reassembly, replace the defective part(s).

TIMING GEARS



P59861

● Pre-disassembly inspection

📖 P11-74

● Disassembly sequence

- | | |
|-----------------------------|------------------------------|
| 1 Bolt | 9 O-ring |
| 2 No. 1 idler shaft | 10 No. 2 idler bolt |
| 3 No. 1 idler gear assembly | 11 Washer |
| 4 No. 1 idler gear bushing | 12 No. 2 idler gear assembly |
| 5 No. 1 idler gear | 13 No. 2 idler gear bushing |
| 6 Nut | 14 No. 2 idler gear |
| 7 O-ring | 15 No. 2 idler shaft |
| 8 Collar | |

*a: Air compressor gear 📦 Gr35

*b: Rear plate 📖 P11-78

*c: Crankcase 📖 P11-78

*d: Crankshaft gear 📖 P11-78

⊗: Non-reusable part

NOTE

Since the No. 1 idler gear assembly 3 is supported by the idler shaft 2, remove them as a unit.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
–	Gear backlash	Between No. 1 idler gear and air compressor gear	0.07 to 0.15 {0.0028 to 0.0059}	0.35 {0.014}	Replace
		Between No. 1 idler gear and No. 2 idler gear	0.08 to 0.15 {0.0031 to 0.0059}	0.35 {0.014}	Replace
		Between No. 1 idler gear and crank-shaft gear	0.08 to 0.14 {0.0031 to 0.0055}	0.35 {0.014}	Replace
2, 4	Clearance between No. 1 idler shaft and No. 1 idler gear bushing		[37 {1.46}] 0.01 to 0.05 {0.00039 to 0.0020}	0.2 {0.0079}	Replace
3, 12	Idler gear end play		0.05 to 0.15 {0.0020 to 0.0059}	0.3 {0.012}	Replace
13, 15	Clearance between No. 2 idler gear bushing and No. 2 idler shaft		[32 {1.26}] 0.01 to 0.05 {0.00039 to 0.0020}	0.2 {0.0079}	Replace

Tightening torque

Unit: N·m {ft.lbs, kgf·m}

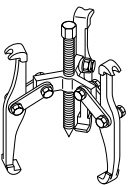
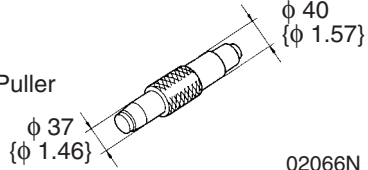
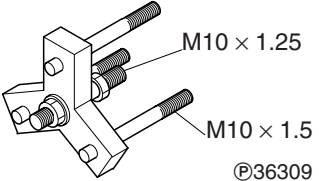
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (No. 1 idler gear assembly installation)	88 {65, 9.0}	–
6	Nut (collar installation)	82 {60, 8.4}	–
10	No. 2 idler bolt (No. 2 idler gear assembly installation)	95 {70, 9.7}	–

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7, 9	O-ring	Engine oil	As required

Special tools

Unit: mm {in.}

Location	Tool name and shape	Part No.	Application
2, 3	Gear Puller  ②02065	MH061326	Removing No. 1 idler shaft and gear assembly
4, 13	Idler Gear Bushing Puller  02066N	MH062601	Removing and installing No. 1, 2 idler gear bushing
15	No. 2 Idler Shaft Puller  ③36309	MH062562	Removing No. 2 idler shaft

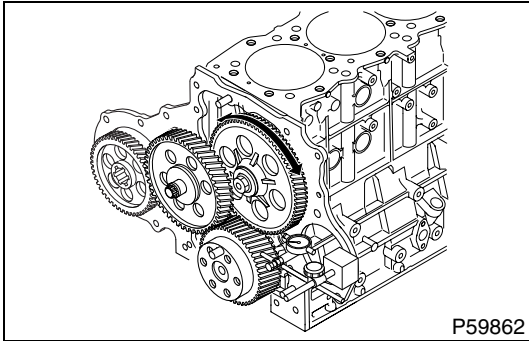
TIMING GEARS

◆ Service procedure

● Pre-disassembly inspection

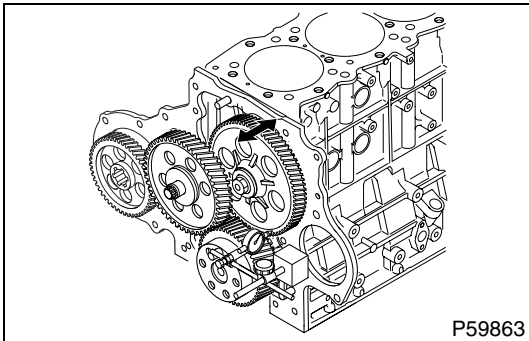
(1) Gear backlash

For each gear pair, measure backlash at three or more points. If any measurement exceeds the specified limit, replace the defective part(s).



(2) Idler gear end play

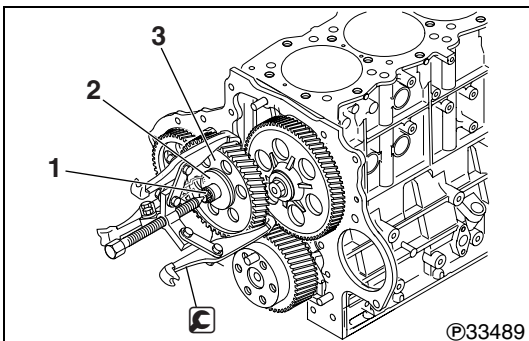
If the measurement exceeds the specified value, replace the defective part(s).



2 3 Removal of No. 1 idler shaft and No. 1 idler gear assembly

Loosen the bolt **1** approximately 15 mm {0.59 in.}. Remove the No. 1 idler shaft **2** and the No. 1 idler gear assembly **3** together as one piece.

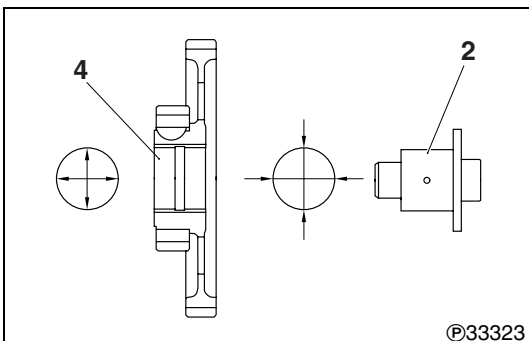
: Gear Puller

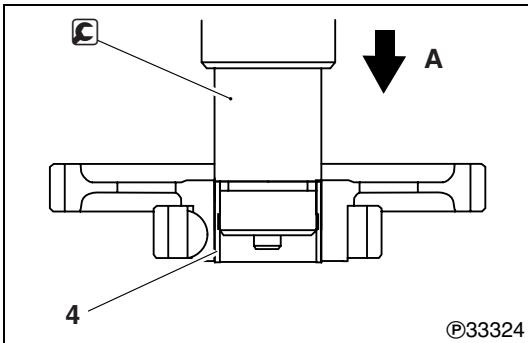


2 4 No. 1 idler shaft and No. 1 idler gear bushing

[Inspection]

If the clearance between the two parts exceeds the specified limit, replace the defective part(s).

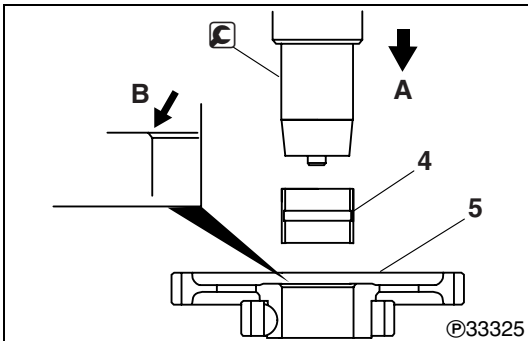




No. 1 idler gear bushing

[Removal]

- A: Press
- C: Idler Gear Bushing Puller

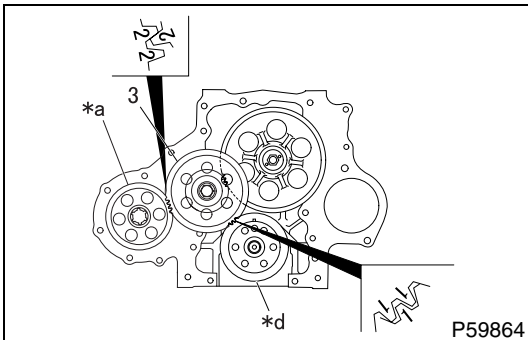


[Installation]

- With the No. 1 idler gear 5 faced as illustrated, press the bushing into the gear using the Idler Gear Bushing Puller until the tool touches the chamfered face B of the gear.

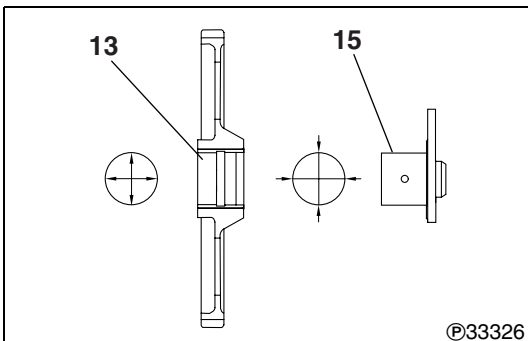
A: Press

- After installation, measure the clearance again. If the measurement is less than the standard value, ream the idler gear bushing 4 until the standard value is achieved.



3 Installation of No. 1 idler gear assembly

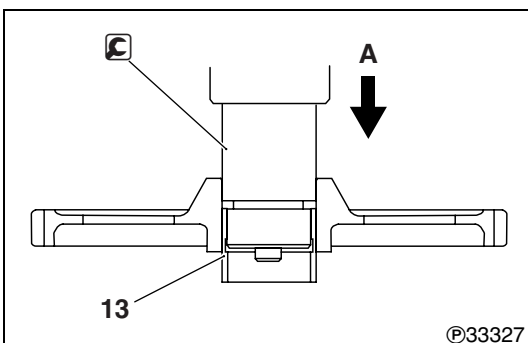
- Install the No. 1 idler gear assembly 3, making sure that the alignment mark "2" on the idler gear is aligned with the alignment mark "2" on the air compressor gear *a.
- Install the No. 1 idler gear assembly 3, making sure that the alignment mark "1" on the idler gear is aligned with the alignment mark "1" on the crankshaft gear *d.



13 15 No. 2 idler gear bushing and No. 2 idler shaft

[Inspection]

If the clearance between the two parts exceeds the specified limit, replace the defective part(s).

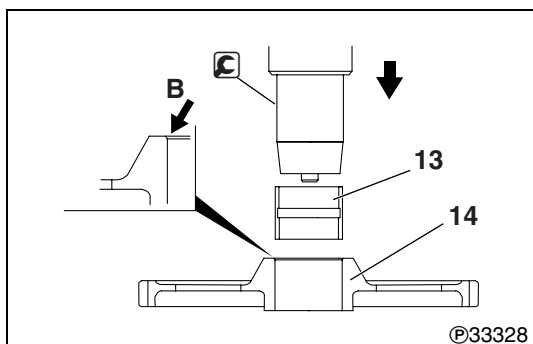


No. 2 idler gear bushing

[Removal]

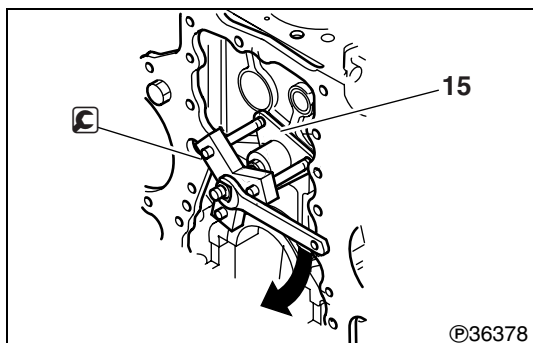
- A: Press
- C: Idler Gear Bushing Puller

TIMING GEARS



[Installation]

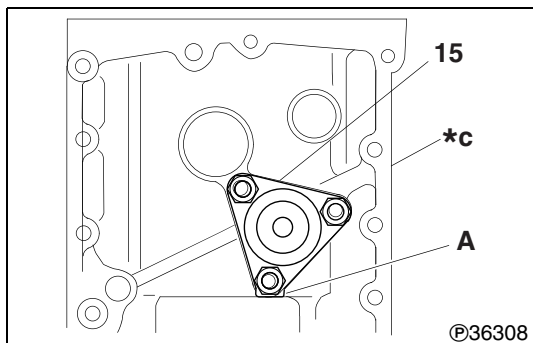
- With the No. 2 idler gear **14** faced as illustrated, press the bushing into the gear using the  Idler Gear Bushing Puller until the tool touches the chamfered face **B** of the gear.
- After installation, measure the clearance again. If the measurement is less than the standard value, ream the idler gear bushing **13** until the standard value is achieved.



15 Removal of No. 2 idler shaft

[Removal]

: No. 2 Idler Shaft Puller

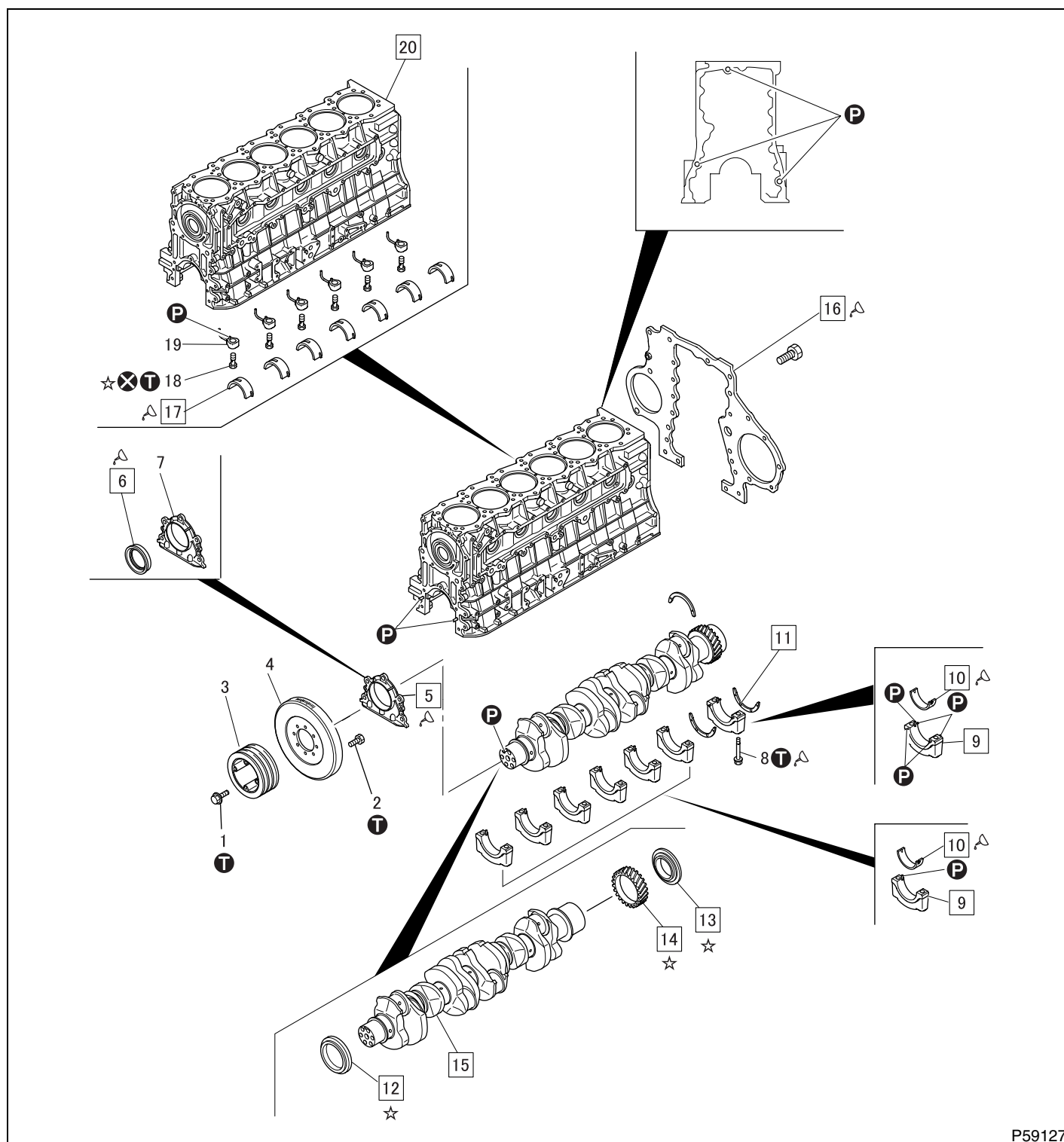


[Installation]

With a boss **A** on the No. 2 idler shaft **15** faced downwards, install the shaft onto the crankcase ***c**.

MEMO

CRANKSHAFT AND CRANKCASE



P59127

● Pre-disassembly inspection

📖 P11-81

● Disassembly sequence

- | | | |
|------------------------|---------------------------|-----------------------|
| 1 Bolt | 9 Main bearing cap | 17 Upper main bearing |
| 2 Bolt | 10 Lower main bearing | 18 Check valve |
| 3 Crankshaft pulley | 11 Thrust plate | 19 Oil jet |
| 4 Torsional damper | 12 Front oil seal slinger | 20 Crankcase |
| 5 Front cover assembly | 13 Rear oil seal slinger | |
| 6 Front oil seal | 14 Crankshaft gear | Ⓟ: Locating pin |
| 7 Front cover | 15 Crankshaft | ⓧ: Non-reusable part |
| 8 Bolt | 16 Rear plate | |

NOTE

The parts indicated with the mark ★ should never be removed unless they are defective.

CAUTION

The check valve 18 has been tightened using thread-locking compound and can be deformed as it is removed. Do not reuse the valve once it is removed.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item			Standard value (Basic diameter in [])	Limit	Remedy
10, 17	Main bearing	Oil clearance		[84 {3.31}] 0.04 to 0.10 {0.0016 to 0.0039}	0.15 {0.0059}	Replace
		Span when free		—	Less than 89.5 {3.52}	Replace
15	Crankshaft	End play		0.10 to 0.25 {0.0039 to 0.0098}	0.4 {0.016}	Replace
		Bend		0.025 {0.0098} or less	0.1 {0.0039}	Correct or replace
		Pin and journal	Roundness	0.01 {0.00039} or less	0.03 {0.0012}	Correct or replace
			Cylindricity	0.006 {0.00024} or less	—	Correct or replace
20	Distortion of crankcase top surface			0.07 {0.0028} or less	0.2 {0.0079}	Replace

ⓘ Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (crankshaft pulley installation)	190 {140, 19}	—
2	Bolt (torsional damper installation)	78 {58, 8.0}	—
8	Bolt (main bearing cap installation)	$78 + 90^{\circ} \begin{smallmatrix} +10 \\ 0 \end{smallmatrix}$ { $58 + 90^{\circ} \begin{smallmatrix} +10 \\ 0 \end{smallmatrix}$, $8.0 + 90^{\circ} \begin{smallmatrix} +10 \\ 0 \end{smallmatrix}$ }	- Wet - Can be reused up to 3 times
18	Check valve	34 {25, 3.5}	—

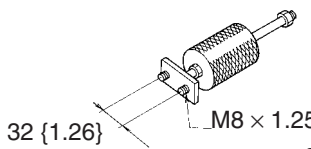
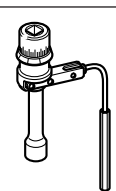
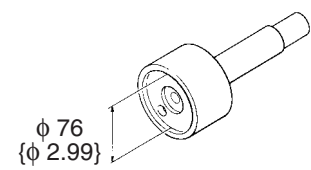
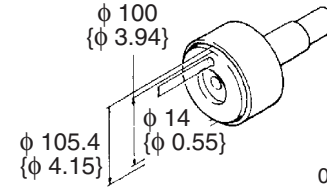
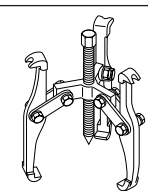
CRANKSHAFT AND CRANKCASE

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5	Front cover assembly surface where it joins the crankcase	THREEBOND 1207C	As required
6	Front oil seal lip	Engine oil	As required
8	Threaded portion of bolt	Engine oil	As required
10, 17	Main bearing inner surface	Engine oil	As required
16	Rear plate surface where it joins the crankcase	THREEBOND 1207C	As required

Special tools

Unit: mm {in.}

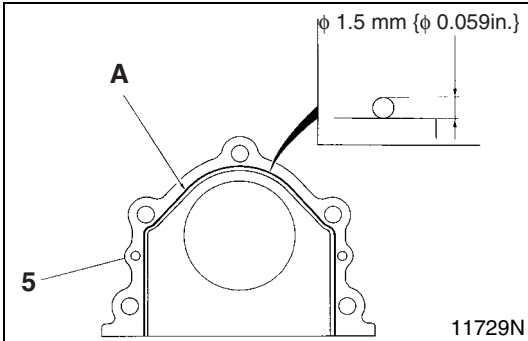
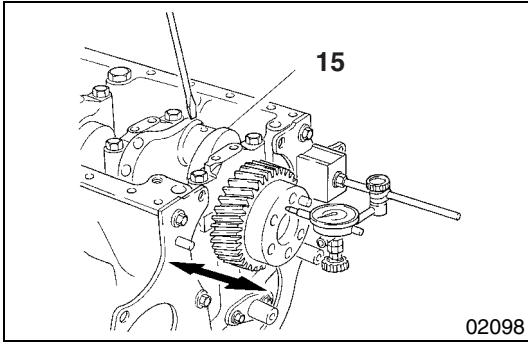
Location	Tool name and shape	Part No.	Application
9	Main Bearing Cap Extractor  02097N	MH061189	Removing main bearing caps
	Socket Wrench  P01984	MH061560	Fitting main bearing caps
12	Front Oil Seal Slinger Installer  13625N	MH062710	Installing front oil seal slinger
13	Rear Oil Seal Slinger Installer  02051N	MH061470	Installing rear oil seal slinger
14	Gear Puller  P02065	MH061326	Removing crankshaft gear

◆ Service procedure

● Pre-disassembly inspection

Crankshaft end play

- Before removing the main bearing caps, measure the extent of crankshaft end play.
- If the measurement exceeds the specified limit, replace the thrust plates with oversize ones. P11-84

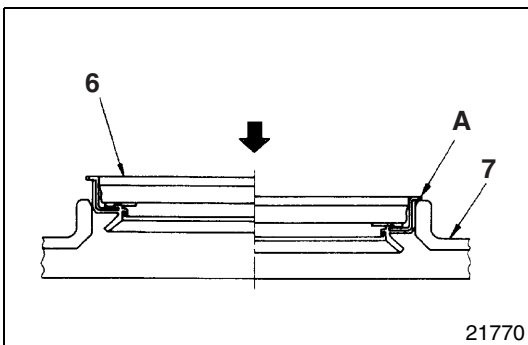


5 Installation of front cover assembly

- Apply an even, unbroken bead of the sealant **A** to the surface of the front cover assembly **5** where it joins the crankcase **20**.
- Within three minutes of the sealant application, fit the front cover assembly **5** onto the crankcase **20**.

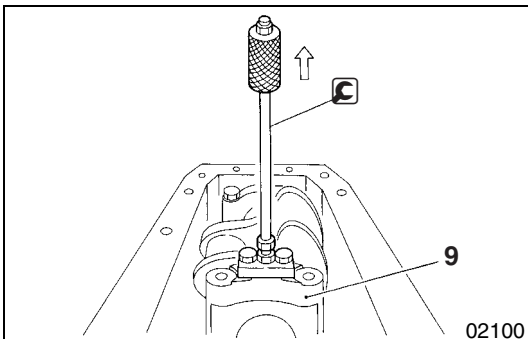
CAUTION

- Ensure that the surface of the front cover assembly **5** onto which the sealant **A** is to be applied is clean.
- Fit the front cover assembly **5** to the correct position on the crankcase, making sure that the assembly is not offset relative to the crankcase.
- After fitting the front cover assembly **5**, wait for at least one hour before starting the engine.
- Apply a new bead of the sealant **A** whenever the mounting bolts of the front cover assembly **5** have been loosened.



6 Installation of front oil seal

- Keeping the front oil seal **6** level, press evenly around its entire periphery to fit the oil seal in the front cover **7**.
- The flange **A** of the front oil seal **6** must fit tightly against the front cover **7**.

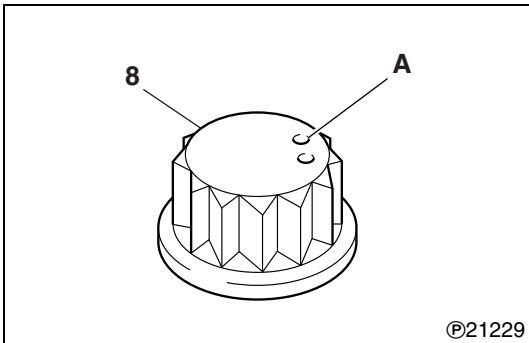


9 Main bearing caps

[Removal]

: Main Bearing Cap Extractor

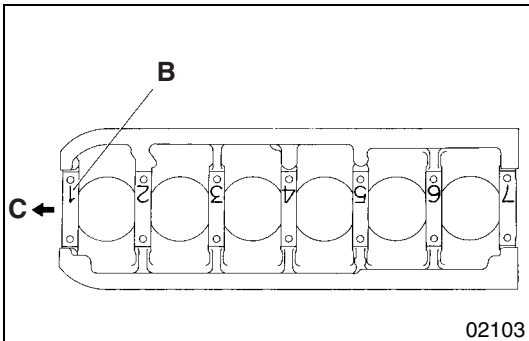
CRANKSHAFT AND CRANKCASE



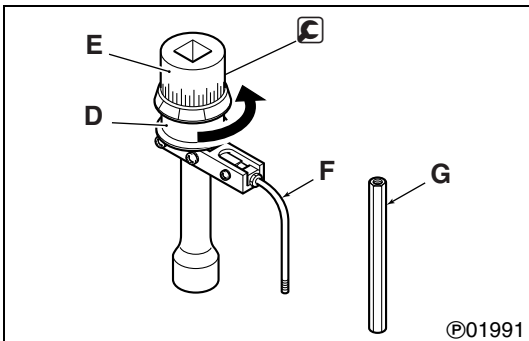
[Installation]

CAUTION

- Before installing the bolt 8, check the number of punch marks A on its head. (If there are two or less, the bolt is reusable.)
- The number of punch marks A corresponds with the number of times the bolt has been tightened to the plastic region. If there are three (which means that the bolt has been used 3 times), replace the bolt 8.

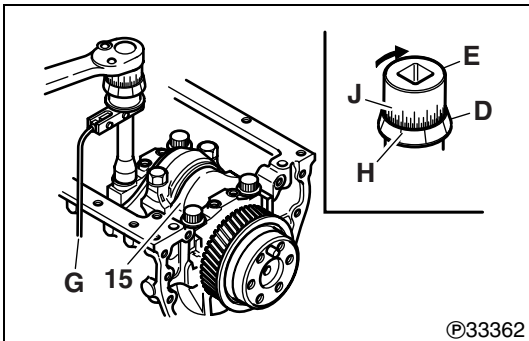


- Starting at the front of the engine C, fit the main bearing caps 9 in the order of the numbers B embossed on them.



- Tighten the bolts 8 to the specified torque (78 N·m {58 ft.lbs, 8.0 kgf·m}). Then, turn the bolts further in accordance with the following procedure:
- Turn the holder D of the  Socket Wrench counter-clockwise to tension the built-in spring.

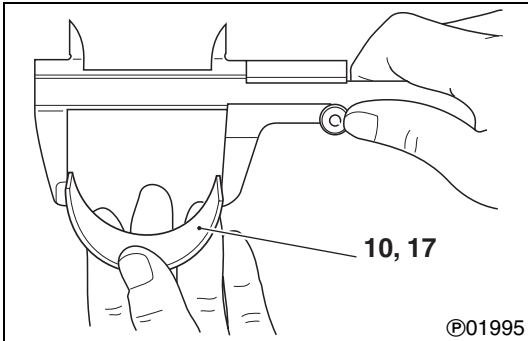
E: Socket
F: Rod
G: Rod (for extension)



- Set the socket wrench such that the built-in spring forces the rod G (for extension) against the crankshaft 15.
- Align any inscribed line H on the holder D with any inscribed line J on the socket E. (Use this point as reference 0° position.)
- From the above reference position, turn the socket E by 90° in the illustrated direction. (One gradation on the scale J represents 5°.)
- After tightening the bolts 8 using the plastic region tightening method, make a punch mark on the head of each one to indicate the times of use.
- Then, check:
 - Rotation of the crank shaft by hand
 - Crankshaft end play  P11-81

CAUTION

Since the bolts 8 utilize the plastic area tightening method, they must not be tightened further after the angular tightening procedure has been performed.



10 17 Main bearings

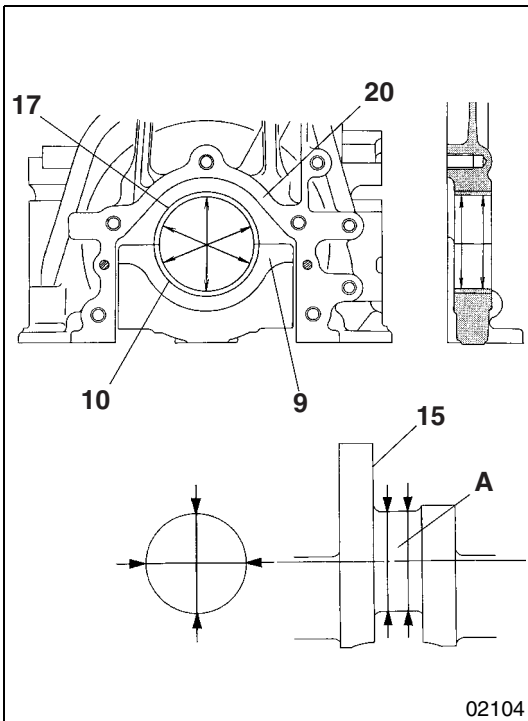
[Inspection]

(1) Span when free

If either bearing's span when free exceeds the specified limit, the bearings 10, 17 must be replaced.

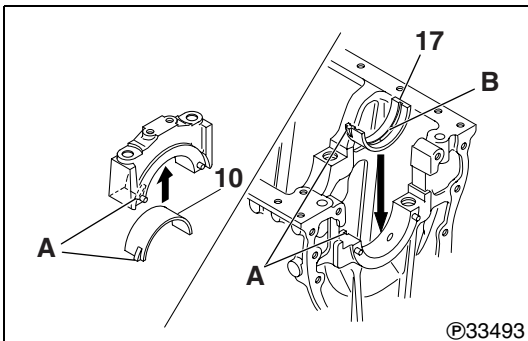
CAUTION

- Do not attempt to manually expand either bearing 10, 17 if its span is insufficient.
- Upper and lower bearings 10, 17 must be replaced as a set.



(2) Main bearing-to-crankshaft clearance

- Fit the upper main bearing 17 into the crankcase 20 and the lower main bearing 10 into the main bearing cap 9. Then, tighten the bolts 8 to their specified torque (78 N·m {58 ft.lbs, 8.0 kgf·m}).
- Measure the internal diameters of the main bearings 10, 17 and the journal outside diameter A of the crankshaft 15. If the clearance exceeds the specified limit, replace the defective part(s).



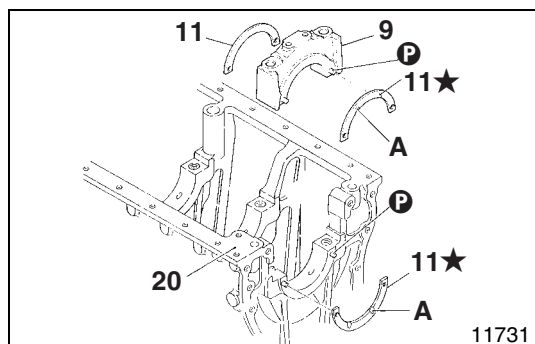
[Installation]

Install the main bearing 10, 17 such that their lugs A fit into the corresponding grooves.

CAUTION

Upper main bearing 17 has an oil hole B. The lower main bearing 10 has no oil hole. Take care not to confuse the upper and lower parts.

CRANKSHAFT AND CRANKCASE



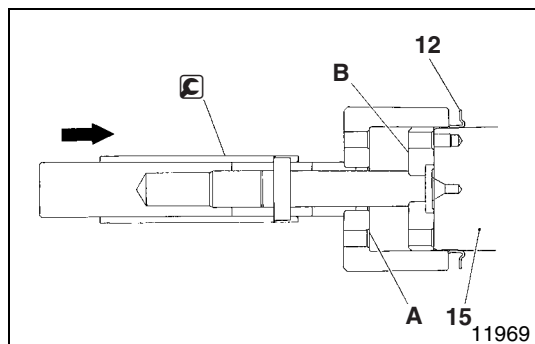
11 Installing thrust plates

Fit a thrust plate 11 on each side of the main bearing cap 9 and at the rear end of the crankcase 20 such that the oil grooves A are on the outside.

P: Location pin

NOTE

If oversize thrust plates 11 are used, make sure the parts marked ★ are of the same size.



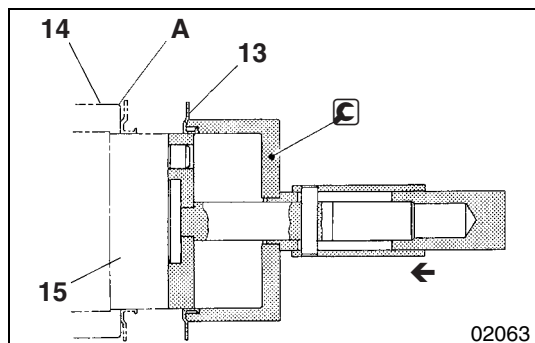
12 Front oil seal slinger

[Removal]

Taking care not to damage the crankshaft 15, split the oil seal slinger using a chisel or the like.

[Installation]

Using the **C** Front Oil Seal Slinger Installer, drive the front oil seal slinger 12 onto the crankshaft 15 until the tool's end face A is pressed firmly against the guide B.



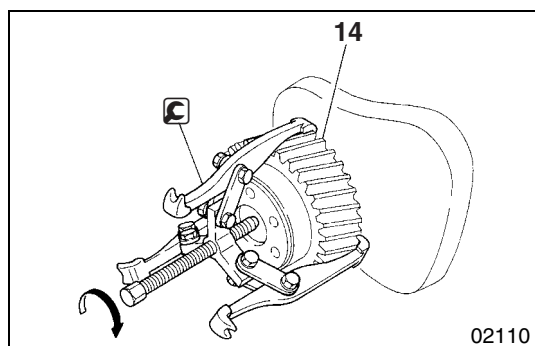
13 Rear oil seal slinger

[Removal]

Taking care not to damage the crankshaft 15, split the oil seal slinger using a chisel or the like.

[Installation]

Using the **C** Rear Oil Seal Slinger Installer, drive the rear oil seal slinger 13 onto the crankshaft 15 until it touches the end face A of the crankshaft gear 14.



14 Crankshaft gear

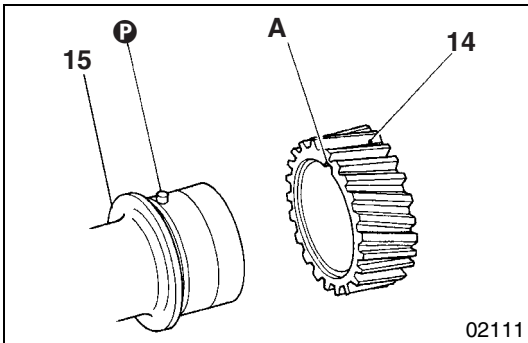
<Without flywheel power take-off>

[Removal]

C: Gear Puller

CAUTION

Do not tap off the crankshaft gear 14 since this could damage it.



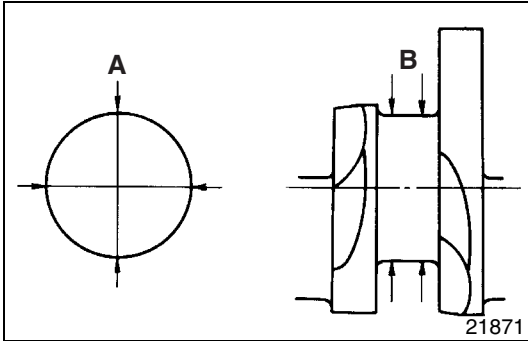
[Installation]

- Using a piston heater or the like, heat the crankshaft gear **14** to a temperature of approximately 100°C {212°F}.

WARNING ⚠

Be careful not to get burned.

- Align the locating pin **P** on the crankshaft **15** with the notch **A** in the crankshaft gear **14**. Then, drive the gear into position by striking its end face with a plastic hammer.

**15 Crankshaft**

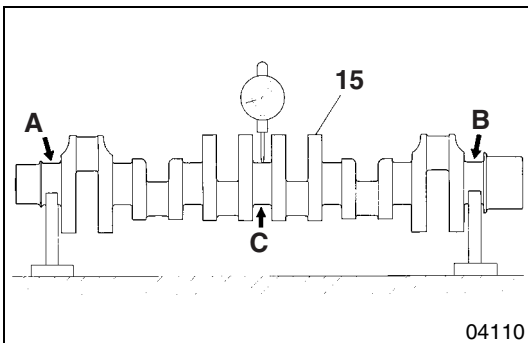
[Inspection]

(1) Roundness and cylindricity of crankshaft journal and pin

If either measurement exceeds the specified limit, grind the crankshaft **15** to undersize or replace the crankshaft.

A: Roundness

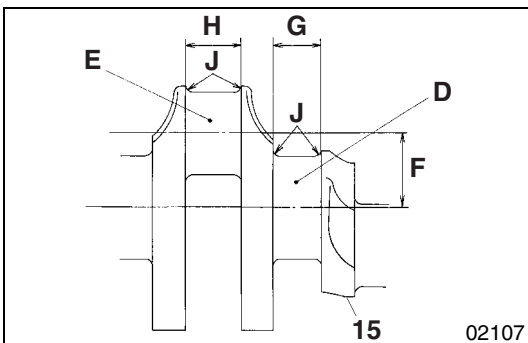
B: Cylindricity

**(2) Bend**

- Support the crankshaft **15** at its No. 1 journal **A** and No. 7 journal **B**. Measure the extent of bending in the crankshaft at the center of the No. 4 journal **C**.
- If the measurement exceeds the specified limit, replace the crankshaft **15**.

NOTE

Turn the crankshaft **15** through one revolution. One-half of the dial indicator reading represents the extent of bending.



[Rectification]

NOTE

If the crankshaft **15** is rectified by grinding, the lower bearings **10**, **17** must be replaced with undersized ones.

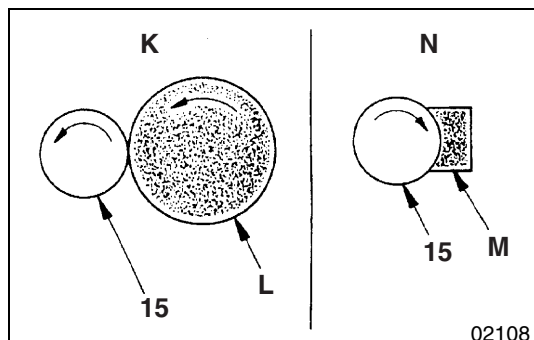
- Grind such that the center-to-center distance **F** between the journal **D** and pin **E** will never be changed.
F: 57.5 $^{+0.025}_{-0.075}$ mm {2.26 $^{+0.00098}_{-0.0030}$ in.}
- Grind such that the journal width **G** and pin width **H** do not change.
G: 37.0 mm {1.46 in.}
H: 42 $^{+0.2}_{0}$ mm {1.65 $^{+0.0079}_{0}$ in.}
- Finish the corner fillet smoothly and to the specified radius **J**.
J: 4 ± 0.2 mm {0.16 ± 0.0079 in.}
- Carry out a magnetic inspection to check for cracks caused by grinding. Also, check that the Shore hardness of the surface has not dropped below Hs 75.

CRANKSHAFT AND CRANKCASE

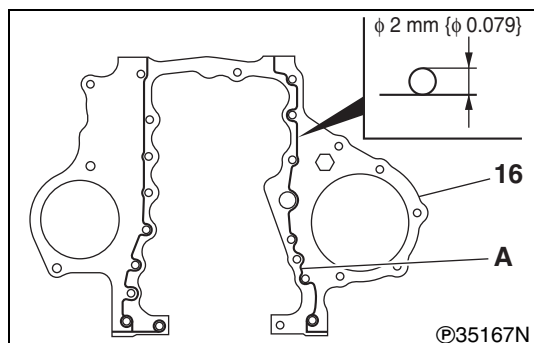
Crankshaft undersize dimensions

Unit: mm {in.}

	Degree of undersize			
	0.25 {0.0098}	0.50 {0.020}	0.75 {0.030}	1.00 {0.039}
Finished journal diameter	83.685 to 83.705 {3.294 to 3.295}	83.435 to 83.455 {3.284 to 3.285}	83.185 to 83.205 {3.274 to 3.275}	82.935 to 82.955 {3.2651 to 3.2659}
Finished pin diameter	69.67 to 69.69 {2.742 to 2.743}	69.42 to 69.44 {2.7330 to 2.7338}	69.17 to 69.19 {2.723 to 2.724}	68.92 to 68.94 {2.713 to 2.714}
Roundness	0.01 {0.00039} or less			
Cylindricity	0.006 {0.00024} or less			



- When grinding **K**, turn the crankshaft **15** counter-clockwise as viewed from its front end. The grinder **L** should rotate in the same direction.
- When finishing **N** the crankshaft **15** with whetstone or sandpaper **M**, rotate the crankshaft clockwise.

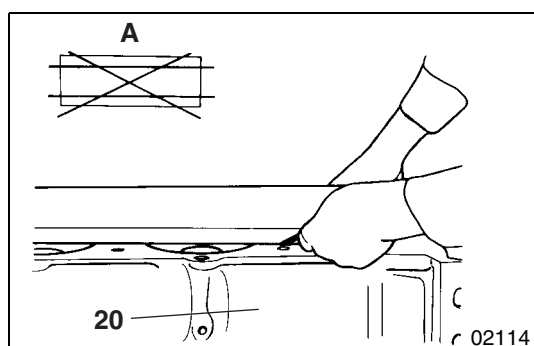


16 Installation of rear plate

- Apply an even, unbroken bead of the sealant **A** to the surface of the rear plate **16** where it joins the crankcase.
- Within three minutes of the sealant **A** application, fit the rear plate **16** onto the crankcase.

CAUTION ⚠

- Ensure that the surface of the rear plate **16** onto which the sealant **A** is to be applied is clean.
- Fit the rear plate **16** to the correct position on the crankcase, making sure that the plate is not offset relative to the crankcase.
- After fitting the rear plate **16**, wait for at least one hour before starting the engine.
- Apply a new bead of the sealant **A** whenever the mounting bolts of the rear plate **16** have been loosened.



20 Distortion of crankcase top surface

If the measurement exceeds the specified limit, grind the top surface with a surface grinder to bring the distortion to specification.

A: Measurement positions

CAUTION ⚠

Do not grind the top surface of the crankcase **20** too much. Remember that the piston protrusion should stay within the standard value.



Group 12

Lubrication

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

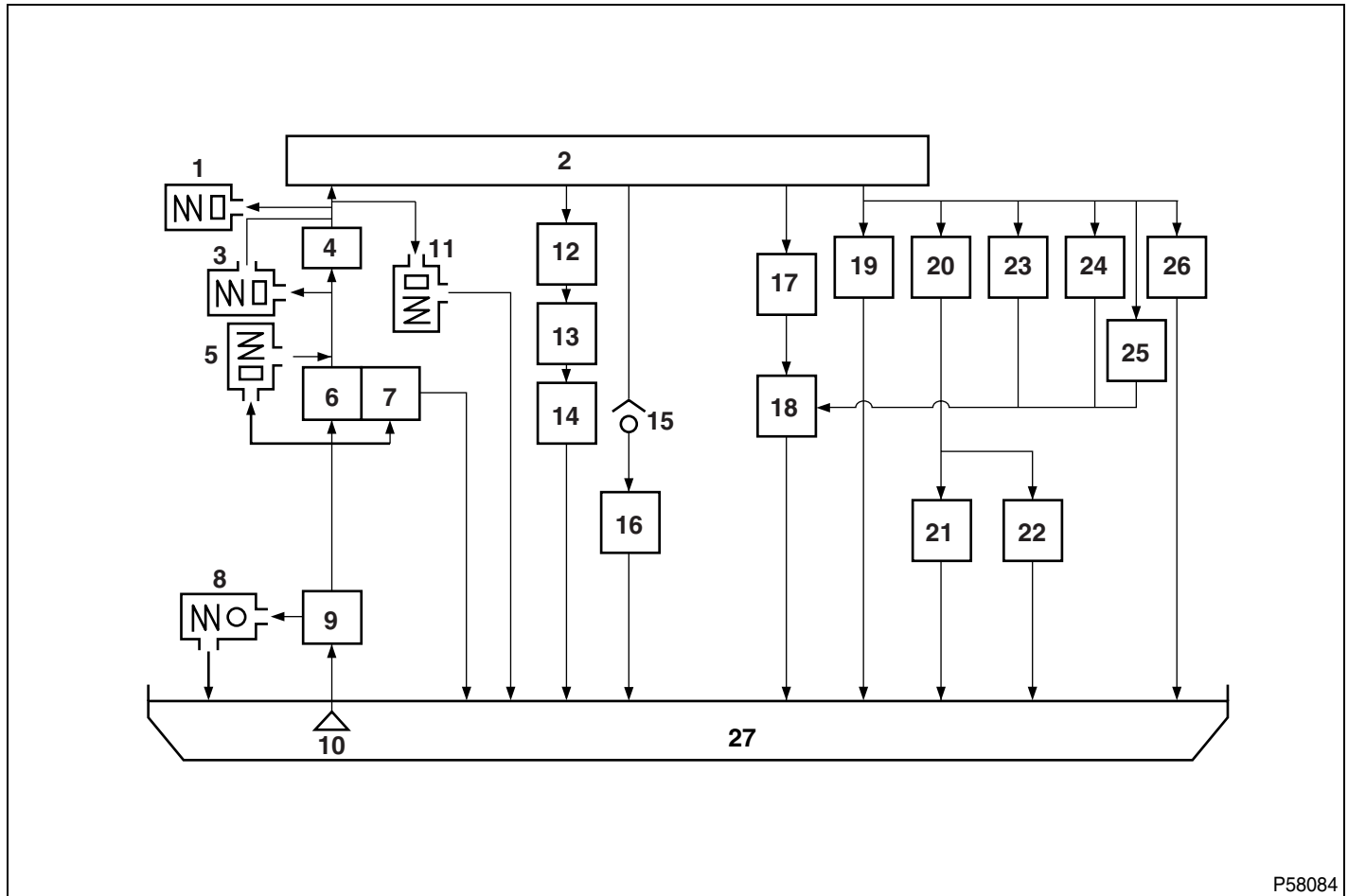
INDEX

SPECIFICATIONS	12-2
STRUCTURE AND OPERATION	
1. Lubrication System	12-3
2. Oil Pump	12-4
3. Oil Filter	12-4
4. Oil Cooler	12-5
5. Engine Oil Pressure Switch and Regulator Valve	12-5
6. Lubrication of Related Parts	12-6
TROUBLESHOOTING	12-9
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Oil Filter Replacement	12-10
2. Engine Oil Replacement	12-12
3. Oil Pressure Measurement	12-13
OIL PAN AND OIL JET	12-14
OIL PUMP AND OIL STRAINER	12-16
OIL FILTER	12-19
OIL COOLER	12-20
REGULATOR VALVE	12-22

SPECIFICATIONS

Item			Specifications
Model of lubrication			Oil pump type
Oil filter type			Paper-filter, spin-on type
Oil cooler type			Shell and plate type (multi-plate type)
Engine oil			API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1
Oil quantity	L {qts}	Oil pan	Approx. 11 {12}
		Oil filter	2.3 {2.4}

1. Lubrication System

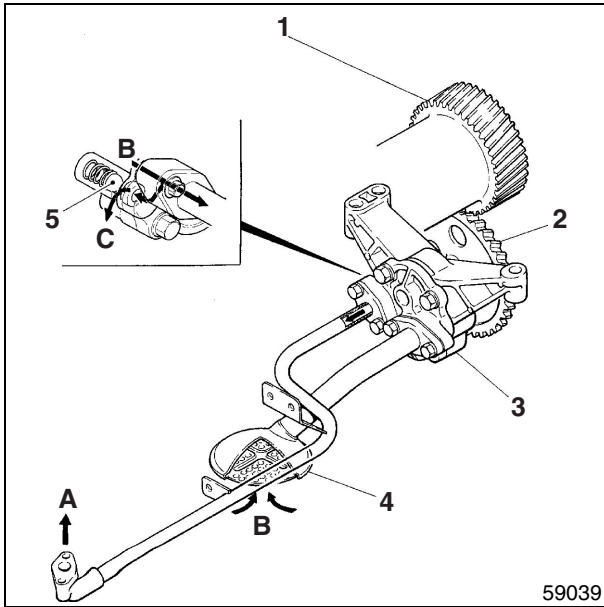


P58084

- | | |
|------------------------------------|------------------------|
| 1 Engine oil pressure switch | 15 Oil jet check valve |
| 2 Main oil gallery | 16 Piston |
| 3 Bypass valve | 17 Air compressor |
| 4 Oil cooler | 18 Timing gear |
| 5 Engine oil bypass alarm switch | 19 Camshaft bushing |
| 6 Full-flow filter element | 20 Rocker bushing |
| 7 Bypass filter element | 21 Roller |
| 8 Relief valve (built in oil pump) | 22 Valve bridge |
| 9 Oil pump | 23 No. 1 idler shaft |
| 10 Oil strainer | 24 No. 2 idler shaft |
| 11 Regulator valve | 25 No. 3 idler shaft |
| 12 Crankshaft main bearing | 26 Turbocharger |
| 13 Connecting rod bearing | 27 Oil pan |
| 14 Connecting rod bushing | |

STRUCTURE AND OPERATION

2. Oil Pump



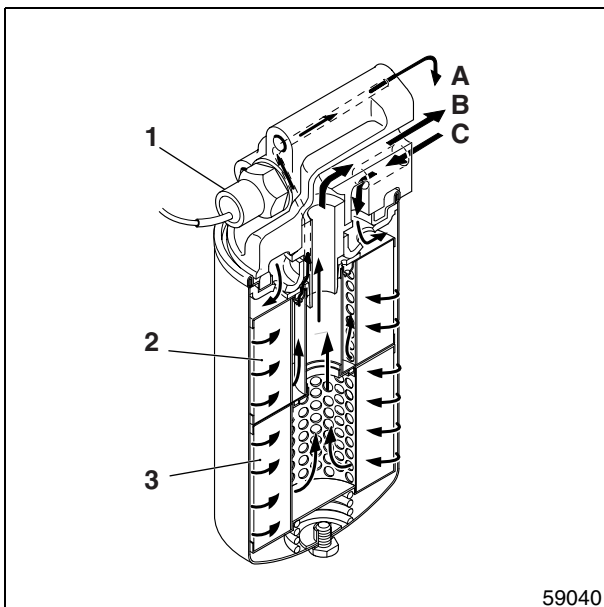
- 1 Crankshaft gear
- 2 Oil pump gear
- 3 Oil pump
- 4 Oil strainer
- 5 Relief valve

- A: To oil filter
B: From oil pan
C: To oil pan

Oil pump 3 is a gear type. It is driven by rotation of the crankshaft via crankshaft gear 1 and oil pump gear 2.

Relief valve 5 is fitted to the oil pump. When the oil pump discharge pressure exceeds a specified level, the relief valve returns some of the engine oil to the oil pan, thus protecting the lubrication system from excessive oil pressure.

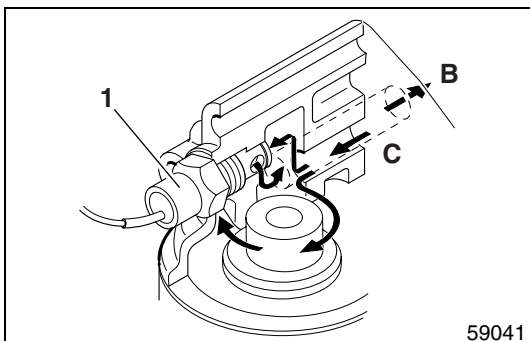
3. Oil Filter



- 1 Engine oil bypass alarm switch
- 2 Bypass filter element
- 3 Full-flow filter element

- A: To oil pan
B: To oil cooler
C: From oil pump

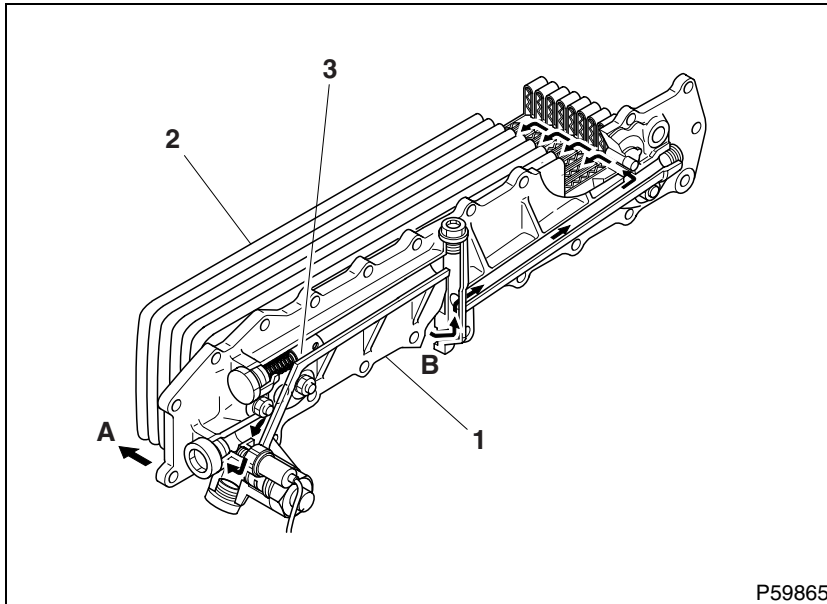
The oil filter consists of a full-flow filter element 3 and a bypass filter element 2 which are both of paper type and form one united body.



Engine oil bypass alarm switch operation

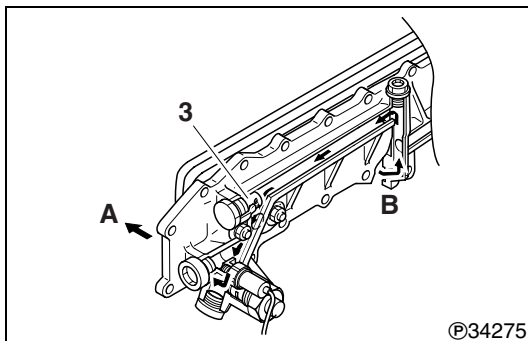
- If the oil filter is clogged, the engine oil flow is reduced, which causes various engine parts to seize. To prevent it, the oil filter is fitted with an engine oil bypass alarm switch 1.
- The engine oil bypass alarm switch 1 is activated to allow engine oil to flow directly to the oil cooler without passing through the full-flow filter element 3 when the oil filter is clogged. Simultaneously, the warning lamp is lit to warn the driver of the clogged oil filter element.

4. Oil Cooler



- 1 Oil cooler cover
- 2 Oil cooler element
- 3 Bypass valve

A: To main oil gallery
B: From oil filter

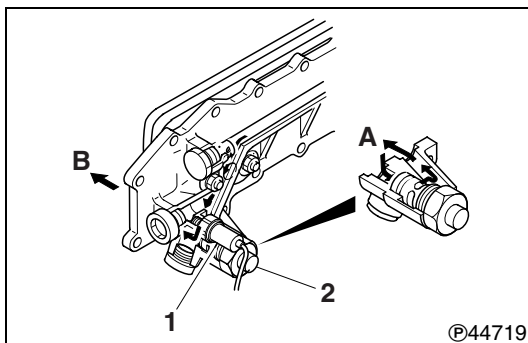


● Oil cooler bypass valve

When oil viscosity is high at low temperatures or the oil cooler element **1** is clogged, flow resistance increases. When this happens, bypass valve **3** installed on the oil cooler opens to allow engine oil to return to the main oil gallery without passing through the cooler.

A: To main oil gallery
B: From oil filter

5. Engine Oil Pressure Switch and Regulator Valve



- 1 Engine oil pressure switch
- 2 Regulator valve

A: To main oil gallery
B: To oil pan

● Engine oil pressure switch

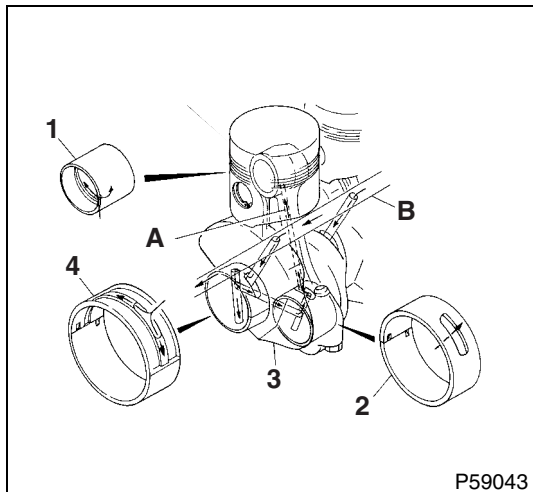
When the engine oil pressure supplied to the main oil gallery lowers below a specified level, the electrical contacts in the engine oil pressure switch **1** closes. When this happens, the warning lamp in the meter cluster illuminates, warning the driver of the oil pressure drop.

● Regulator valve

The regulator valve **2** opens when the oil pressure in the main gallery exceeds a specified level. If it is opened, the oil is allowed to escape to the oil pan, thereby the lubrication system being protected from excessive pressure.

STRUCTURE AND OPERATION

6. Lubrication of Related Parts



Engine oil fed to the main oil gallery lubricates the following related parts.

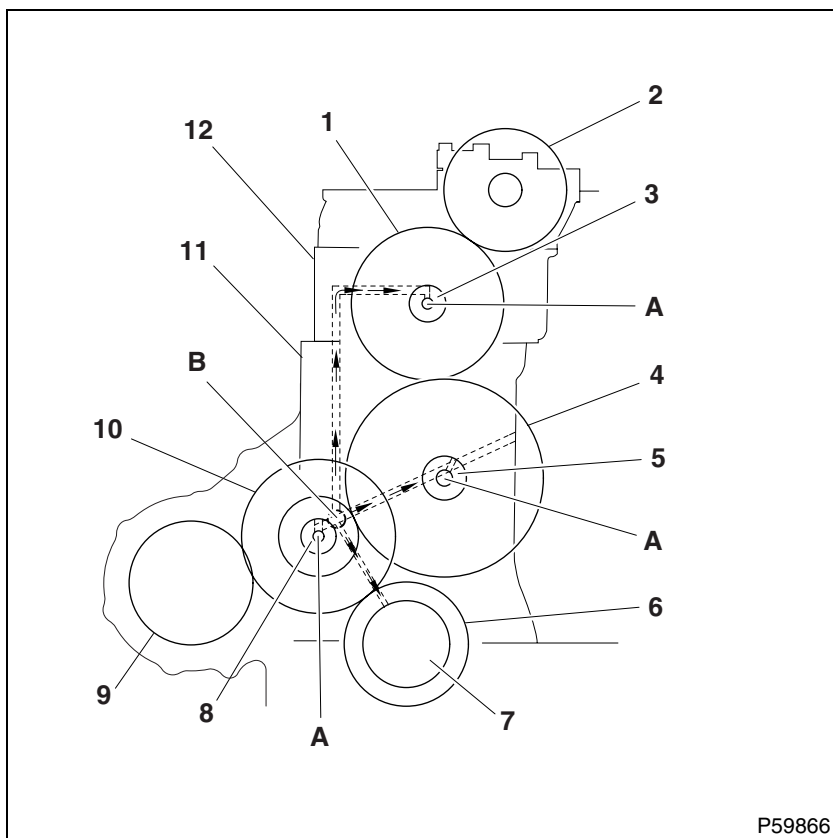
● Main Bearing and Connecting Rod Bearing

- 1 Connecting rod bushing
- 2 Connecting rod bearing
- 3 Crankshaft
- 4 Crankshaft main bearing

A: Oil passage

B: Main oil gallery

Oil supplied via oil passage in the crankshaft 3 flows through the connecting rod oil passage A to lubricate the connecting rod's small end.



● Timing gear

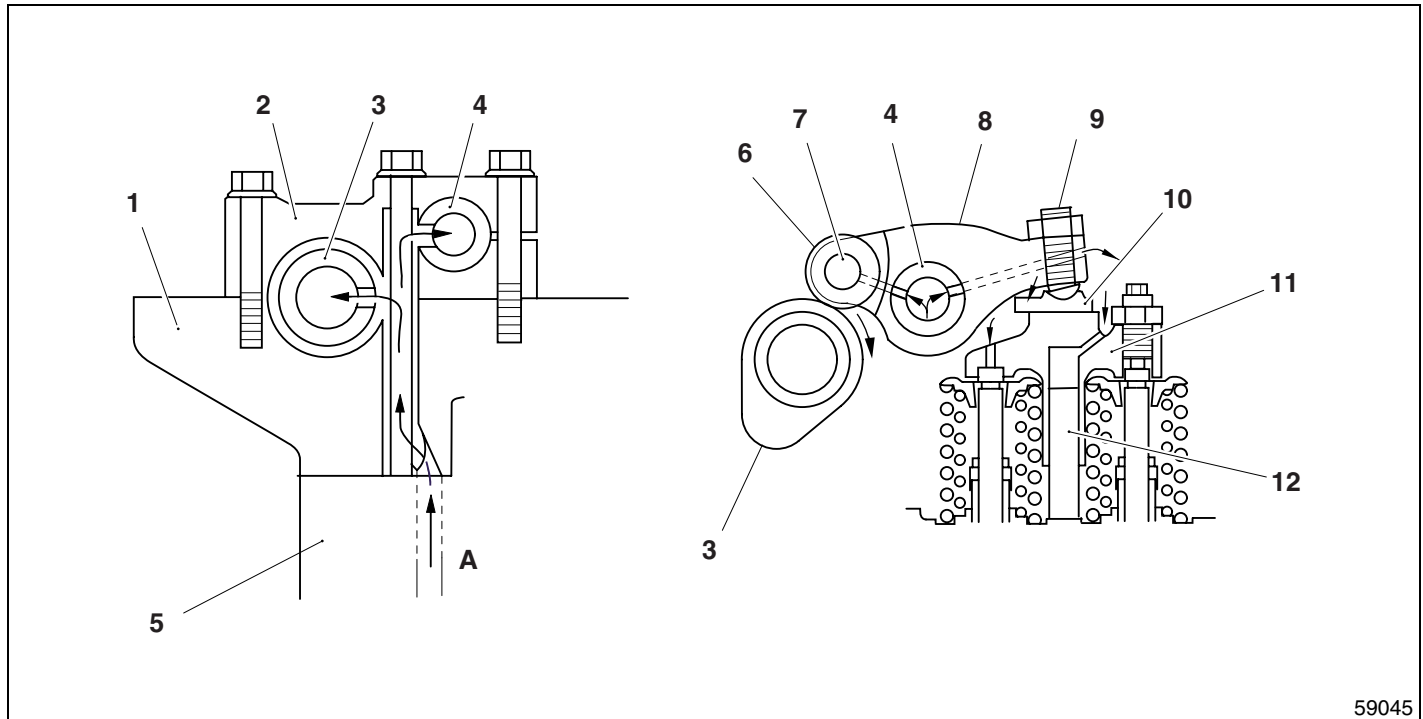
- 1 No. 3 idler gear
- 2 Camshaft gear
- 3 No. 3 idler shaft
- 4 No. 2 idler gear
- 5 No. 2 idler shaft
- 6 Crankshaft gear
- 7 Crankshaft
- 8 No. 1 idler shaft
- 9 Air compressor gear
- 10 No. 1 idler gear
- 11 Crankcase
- 12 Cylinder head

A: Oil passage

B: Main oil gallery

Engine oil from the main oil gallery B flows through oil passage in the crankcase 11 and cylinder head 12 to lubricate the gear shaft bushings. The oil that has lubricated the gear shaft bushings returns to the oil pan while lubricating the gears on the way.

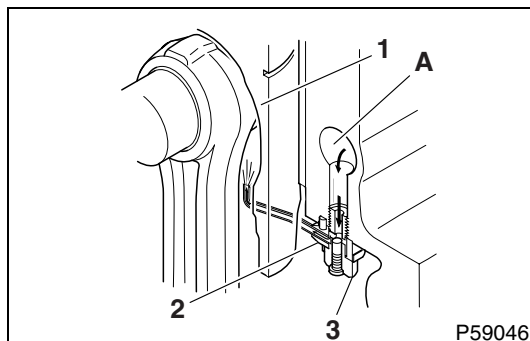
● Valve mechanism



- | | |
|------------------------|-----------------------|
| 1 Rocker case | 8 Rocker |
| 2 Front rocker bracket | 9 Adjusting screw |
| 3 Camshaft | 10 Pad |
| 4 Rocker shaft | 11 Valve bridge |
| 5 Cylinder head | 12 Valve bridge guide |
| 6 Roller | |
| 7 Pin | |

A: From main oil gallery

Engine oil from the main oil gallery flows through the oil passages in the cylinder head 5, rocker case 1 and front rocker bracket 2 and is sent to the camshaft 3 and the rocker shaft 4. The oil sent to the camshaft lubricates the camshaft journals while the oil sent to the rocker shaft lubricates the rockers 8. The oil flowing toward the rocker adjusting screw 9 lubricates the valve bridge 11. After lubricating various parts, the oil returns to the oil pan.



● Check valve and oil jet

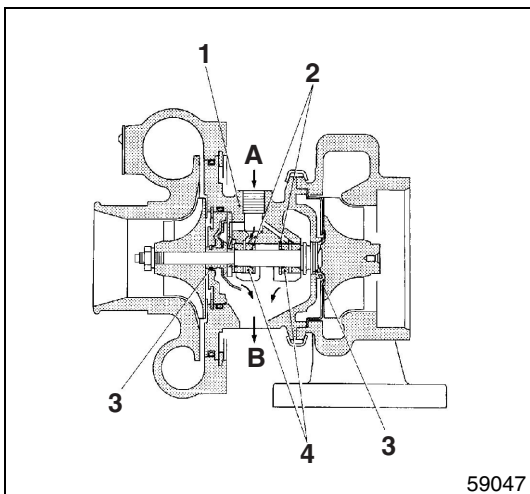
- | |
|---------------|
| 1 Piston |
| 2 Oil jet |
| 3 Check valve |

A: Main oil gallery

An oil jet 2 is fitted in the lower part of the main oil gallery A for each piston. These oil jets cool the pistons 1 by injecting oil into their cooling cavity.

Each oil jet is fitted with check valve 3 that opens and closes at specified oil pressure levels. At low engine speeds, these check valves close to maintain the required volume of oil in the lubrication system and prevent reductions in oil pressure.

STRUCTURE AND OPERATION



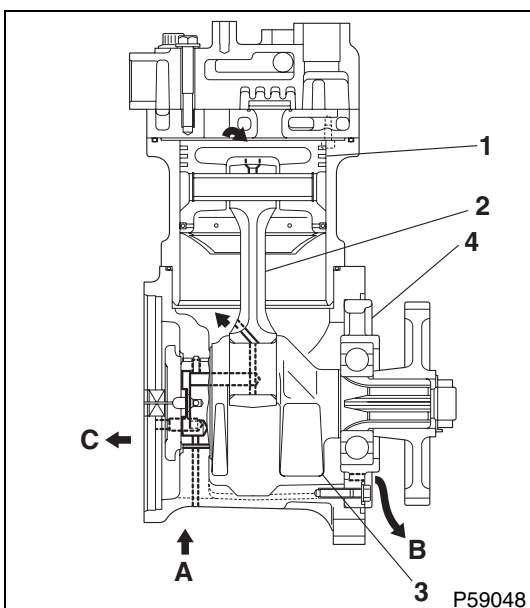
● Turbocharger

- 1 Bearing housing
- 2 Snap ring
- 3 Piston ring
- 4 Bearing

A: From main oil gallery

B: To oil pan

Via an oil pipe, engine oil is delivered from the main oil gallery to the bearing housing 1 to lubricate the inside of the bearing housing. At each end of the turbine wheel shaft, piston ring 3 acts as an oil seal.



● Air compressor

- 1 Piston
- 2 Connecting rod
- 3 Crankshaft
- 4 Crankcase

A: From main oil gallery

B: To oil pan

C: To supply pump coupling

Engine oil from main gallery passes through the oil hole in the crankshaft 3 and then flows in two ways, one lubricates the supply pump coupling and the other lubricates the big end of the connecting rod 2.

The engine oil is then splashed by the rotation of crankshaft 3, lubricating piston 1 and connecting rod small end.

Symptoms		Engine hard to start	Overheating	Low oil pressure	Excessive oil consumption (oil leakage)	Remarks
Oil cooler	Oil cooler element installed poorly		☐	☐	☐	
	Gasket defective		☐	☐	☐	
	O-ring defective		☐	☐	☐	
	Oil cooler element clogged		☐	☐		
	Oil cooler element damaged		☐	☐	☐	
	Fatigue in bypass valve spring		☐			
Oil pump	Oil pump malfunctioning		☐	☐		
	Interference between oil pump gear and oil pump case or cover	☐		☐		
	Oil pipe poorly fitted		☐	☐		
	Oil strainer clogged		☐	☐		
	Fatigue in relief valve spring			☐		
Oil filter	Oil filter fitted poorly				☐	
	Element clogged		☐	☐		
	O-ring defective			☐		
Front cover assembly timing gear case	Front oil seal defective				☐	 Gr11
	Front cover assembly installed poorly				☐	 Gr11
Flywheel housing	Rear oil seal defective				☐	 Gr11
	Gasket fitted poorly				☐	 Gr11
Fatigue in regulator valve spring				☐		
Piston cooling oil jet(s) defective			☐			
Oil working its way up into combustion chamber(s)					☐	 Gr11
Oil working its way down into combustion chamber(s)					☐	 Gr11
Oil viscosity too high		☐				
Unsuitable oil quality			☐			
Deterioration in oil			☐			
Fuel mixed with oil			☐			

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Oil Filter Replacement

ⓘ Tightening torque

Unit: N·m {ft.lbs, kgf·m}

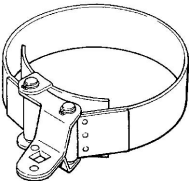
Location	Parts to be tightened	Tightening torque	Remarks
1	Oil filter drain plug	7.8 ± 2 { 5.8 ± 1.5 , 0.8 ± 0.2 }	—

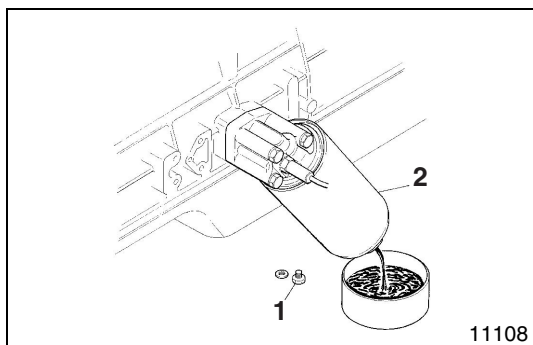
🔊 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	Oil filter	Engine oil (API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1)	Approx. 2.3 L {2.4 qts}

🔧 Special tool

Unit: mm {in}

Location	Tool name and shape	Part No.	Application
2	$\phi 120$ to 130 { $\phi 4.72$ to 5.12 } Oil Filter Wrench  01503N	MH061537	Removing oil filter

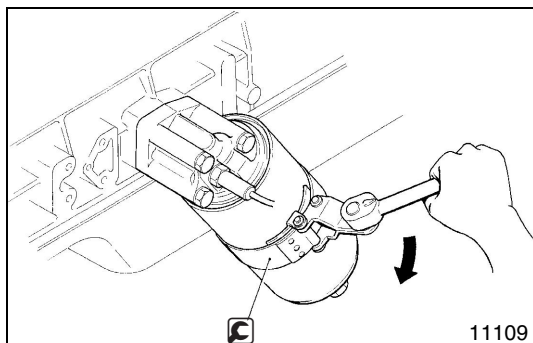


WARNING ⚠

- Wipe up any spilled engine oil since it may cause a fire.
- Do not touch oil when the engine is hot since it can inflict severe burns.

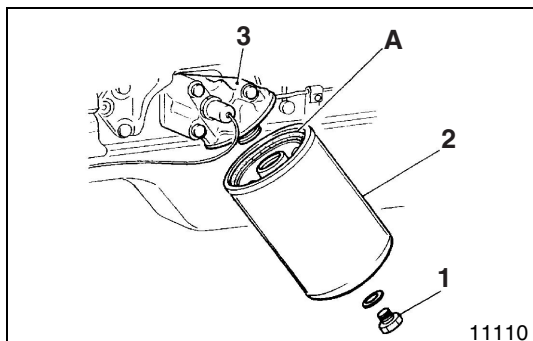
CAUTION ⚠

- When pouring oil into the engine, take care not to spill any on the V-belts. Contact with oil could make the V-belts slip, rendering the cooling system less effective.



[Removal]

🔧: Oil Filter Wrench



[Installation]

- Clean the surface of oil filter head 3 onto which oil filter 2 is attached.
- Apply thin coat of engine oil to gasket A of oil filter 2.
- Screw the oil filter onto oil filter head 3 by hand until gasket A is brought into contact with the filter head.
- Hand-tighten the oil filter further 1-1/8 to 1-3/8 turns from the point where gasket A comes in contact with oil filter head 3.
- Install oil filter drain plug 1.

-
- After installing the oil filter, start the engine to make sure that there is no oil leakage from the section sealed by gasket **A**.
 - Check the engine oil level and replenish if it is insufficient.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Engine Oil Replacement

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

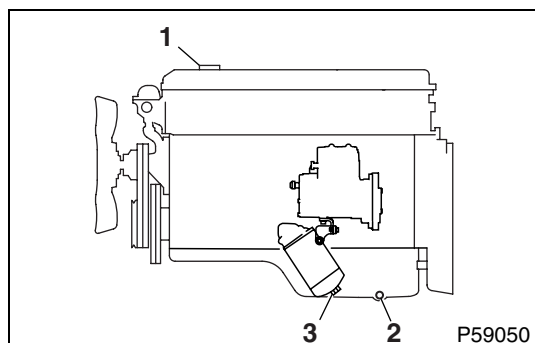
Location	Parts to be tightened	Tightening torque	Remarks
1	Oil filter drain plug	7.8 ± 2 { 5.8 ± 1.5 , 0.8 ± 0.2 }	—
2, 3	Oil pan drain plug	69 {51, 7}	—

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	Oil filter	Engine oil (API classification CD, CD/SF, CE, CE/ SF, CF-4 or JASO classification DH-1)	Approx. 2.3 L {2.4 qts}
—	Oil pan	Engine oil (API classification CD, CD/SF, CE, CE/ SF, CF-4 or JASO classification DH-1)	Approx. 11 L {12 qts}

WARNING ⚠

- Wipe up any spilled engine oil since it can cause a fire.
- Do not touch oil when the engine is hot since it can inflict severe burns.



CAUTION ⚠

When pouring oil into the engine, take care not to spill any on the V-belts. Contact with oil could make the V-belts slip, rendering the cooling system less effective.

[Draining]

- Warm up the engine, then remove oil filler cap 1.
- Remove oil pan drain plug 2 and oil filter drain plug 3. Then, drain the engine oil.

[Filling]

- Tighten oil pan drain plug 2 and oil filter drain plug 3 to their specified torques. Add new engine oil to the specified level.

3. Oil Pressure Measurement

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
-	Oil pressure (at oil temperature of 70 to 90°C {158 to 194°F})	At no-load minimum speed	145 to 295 kPa {21 to 43 psi, 1.5 to 3 kgf/cm ² }	49 kPa (7.1 psi, 0.5 kgf/cm ²)	Adjust
		At no-load maximum speed	295 to 490 kPa {43 to 71 psi, 3 to 5 kgf/cm ² }	195 kPa (28 psi, 2 kgf/cm ²)	

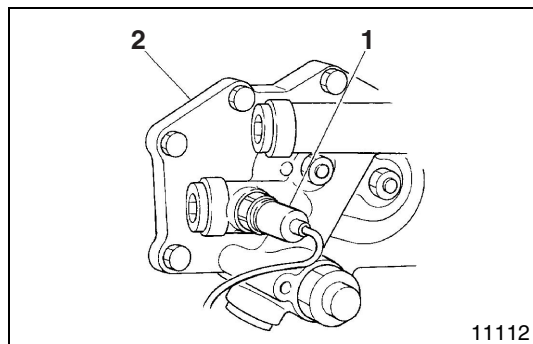
① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Engine oil pressure switch	15 to 22 {11 to 16, 1.5 to 2.2}	Check with engine cold

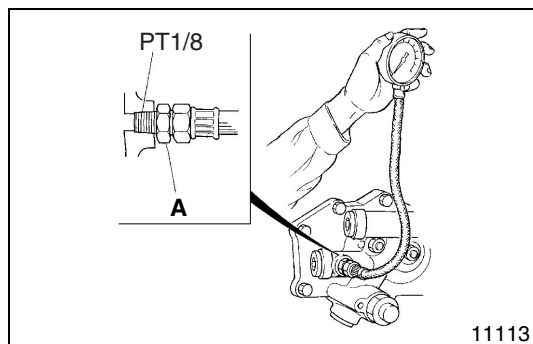
🔊 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Thread of engine oil pressure switch	Teflon tape	Wrap around 3 1/2 turns



- Remove engine oil pressure switch 1.

2: Oil cooler



- Fit adapter **A** onto the engine oil pressure switch mounting, then fit the oil pressure gauge onto the adapter.
- Warm up the engine until the oil temperature reaches 70 to 90°C {158 to 194°F}.
- Measure the oil pressure at no-load minimum speed and at no-load maximum speed. If the measured values are below the specified standard values, overhaul the lubrication system.
- After taking measurements, fit engine oil pressure switch 1 and tighten it to the specified torque.

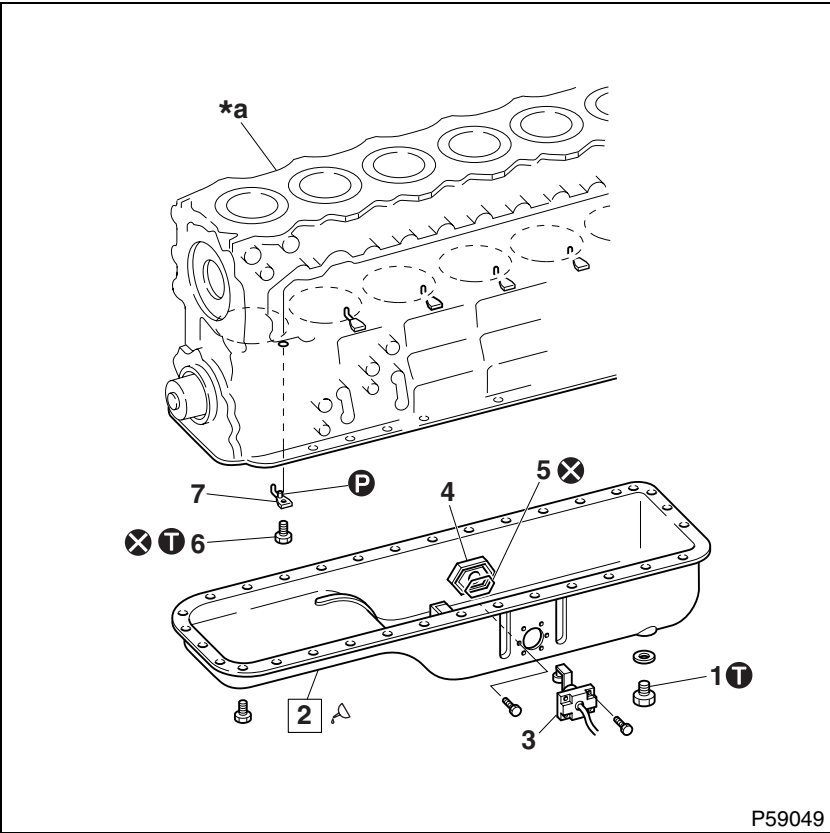
CAUTION ⚠

Engine oil pressure switch 1 must be fitted when the engine is cold.

Inspection of engine oil pressure switch

📦 Gr54

OIL PAN AND OIL JET



● Disassembly sequence

- 1 Drain plug
- 2 Oil pan
- 3 Engine oil level sensor <'05 FK, '06 FK/FM>
- 4 Retainer <'05 FK, '06 FK/FM>
- 5 O-ring <'05 FK, '06 FK/FM>
- 6 Check valve
- 7 Oil jet

*a: Crankcase Gr11
P: Locating pin
X: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION Do not tighten check valve 6 in excess of the specified torque. Excessive tightness can cause defective operation, resulting in scorching of the engine.

Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Drain plug	69 {51, 7}	—
6	Check valve	34 {25, 3.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Crankcase mounting surface of oil pan	THREEBOND 1207C	As required

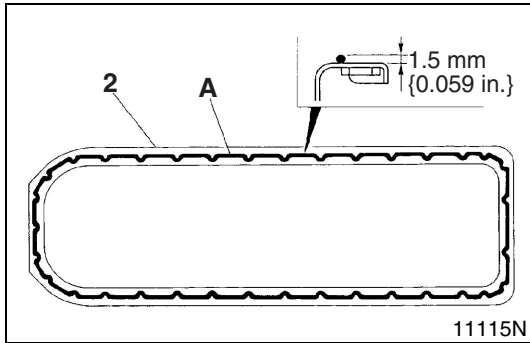
◆ Service procedure

2 Fitting oil pan

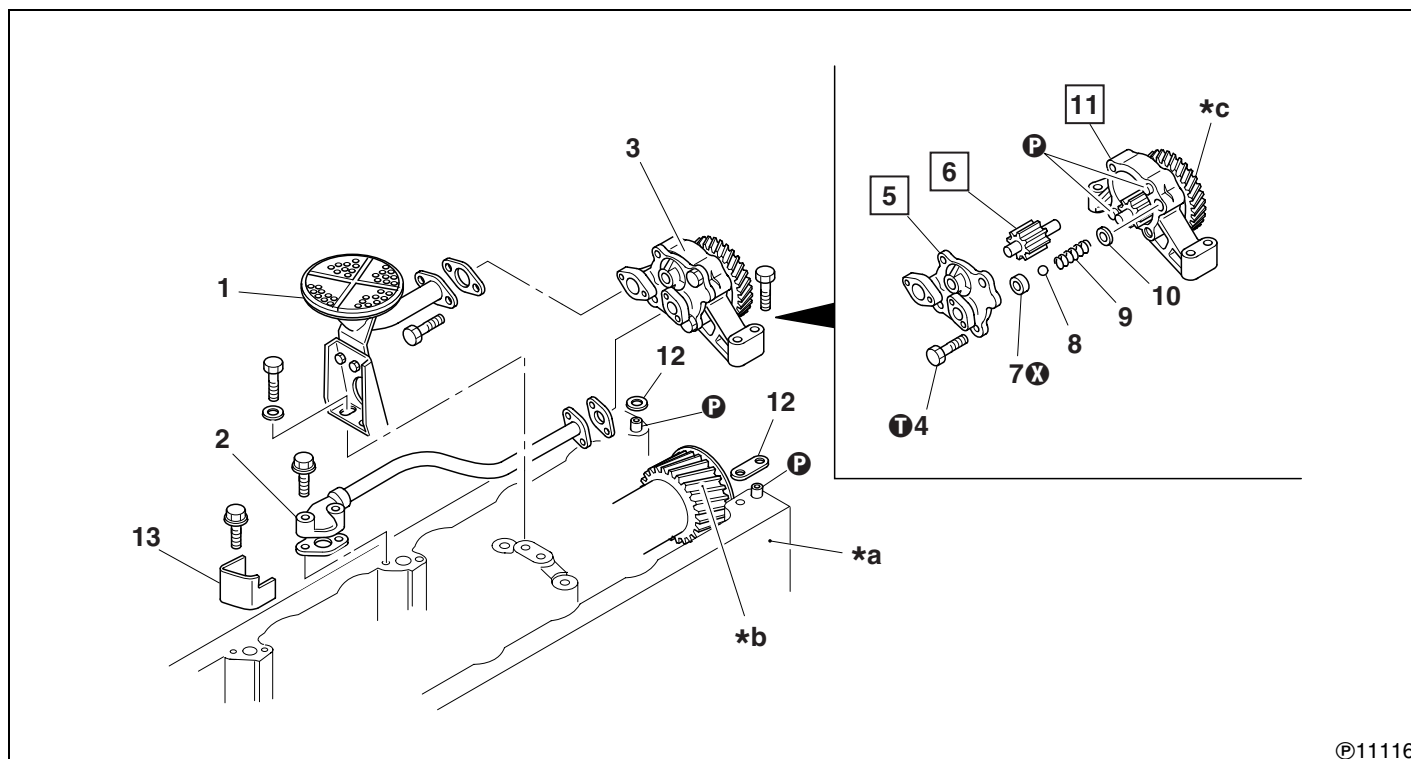
- Apply sealant **A** to the mounting surface of oil pan **2** as illustrated. Apply the sealant evenly and without breaks.
- Within three minutes of applying sealant **A**, fit oil pan **2** onto the crankcase ★a.

CAUTION ⚠

- Clean the oil pan mounting surface and ensure it is free of oily substances before applying sealant.
- Ensure that sealant **A** does not spread to other areas.
- After fitting oil pan **2**, wait at least one hour before starting the engine.
- Reapply sealant **A** to the oil pan mounting surface whenever the mounting bolts of oil pan **2** have been loosened.



OIL PUMP AND OIL STRAINER



©11116

● Inspection before assembly

📖 P12-17

● Disassembly sequence

- | | |
|------------------------|---------------------------|
| 1 Oil strainer | 8 Relief valve |
| 2 Oil pipe | 9 Relief valve spring |
| 3 Oil pump assembly | 10 Washer |
| 4 Bolt | 11 Gear and case assembly |
| 5 Cover | 12 Shim |
| 6 Driven gear assembly | 13 Oil deflector |
| 7 Ring | |

- *a: Crankcase Gr11
 *b: Crankshaft gear Gr11
 *c: Oil pump gear
 P: Locating pin
 X: Non-reusable part

NOTE

- Do not remove parts 7 to 10 unless they are defective.
- Gear and case assembly 11 is an integrated unit and cannot be disassembled. If any defect is apparent, replace the whole unit.
- Do not remove oil strainer 1 and oil pipe 2 from oil pump assembly 3 unless they are defective. Remove those three as a unit.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

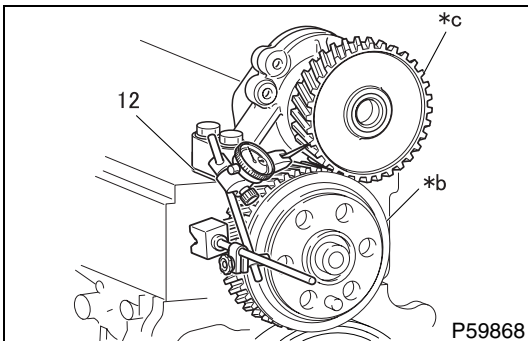
Unit: mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
5, 11	Clearance between drive gear shaft and inner diameter of cover	[20 {0.79}] 0.04 to 0.07 {0.0016 to 0.0028}	0.15 {0.0059}	Replace
5, 6, 11	Clearance between drive gear shaft and inner diameter of case and cover	[20 {0.79}] 0.04 to 0.07 {0.0016 to 0.0028}	0.15 {0.0059}	Replace
6, 11	Clearance between case and tooth tips of each gear	0.10 to 0.19 {0.0039 to 0.0075}	0.2 {0.0079}	Replace
	Difference between height of each gear and depth of case	0.06 to 0.11 {0.0024 to 0.0043}	0.15 {0.0059}	
8	Relief valve opening pressure	1.1 ± 0.1 MPa {160 ± 15 psi, 11 ± 1 kgf/cm ² }	—	Replace
9	Relief valve spring load (installed length = 30 mm {1.18 in.})	84 N {19 lbs, 8.6 kgf}	—	Replace
*b, *c	Backlash between oil pump gear and crankshaft gear	0.08 to 0.15 {0.0031 to 0.0059}	0.35 {0.0014}	Adjust with shim

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Bolt (oil pump cover mounting)	25 ± 4.9 {18 ± 3.6, 2.5 ± 0.5}	—



◆ Service procedure

● Inspection before disassembly

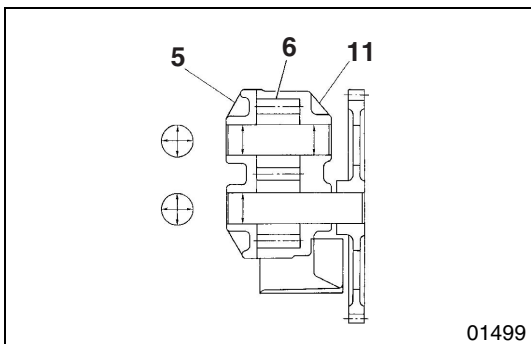
Measure the backlash between oil pump gear *c and crankshaft gear *b. Adjust the backlash using a shim 12 if the measurement exceeds the limit.

Thickness of shims available	Variation of backlash
0.1 mm {0.0039 in.}	0.073 mm {0.0029 in.}
0.2 mm {0.0079 in.}	0.146 mm {0.0057 in.}

CAUTION ⚠

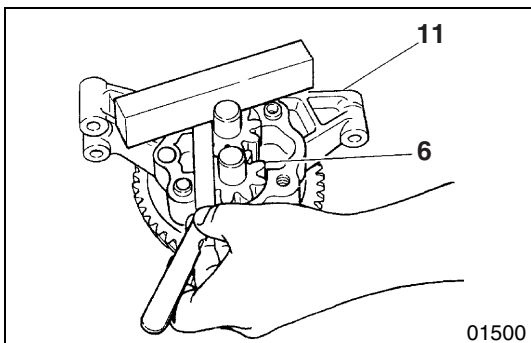
Use the same thickness of shim 12 for both left and right sides.

OIL PUMP AND OIL STRAINER



5 6 11 Inspection of cover, driven gear assembly and gear and case assembly

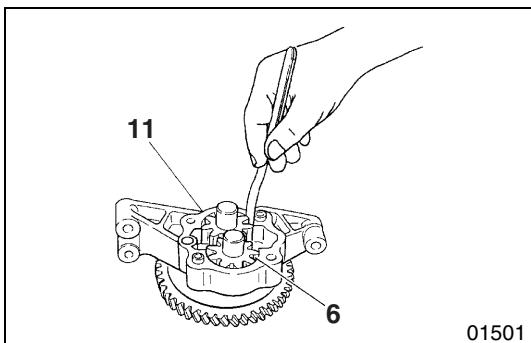
Measure the clearance between each gear shaft and the internal diameters of the cover and gear and case assembly. Replace any component whose measurement is out of specification.



6 11 Inspection of driven gear assembly and gear and case assembly

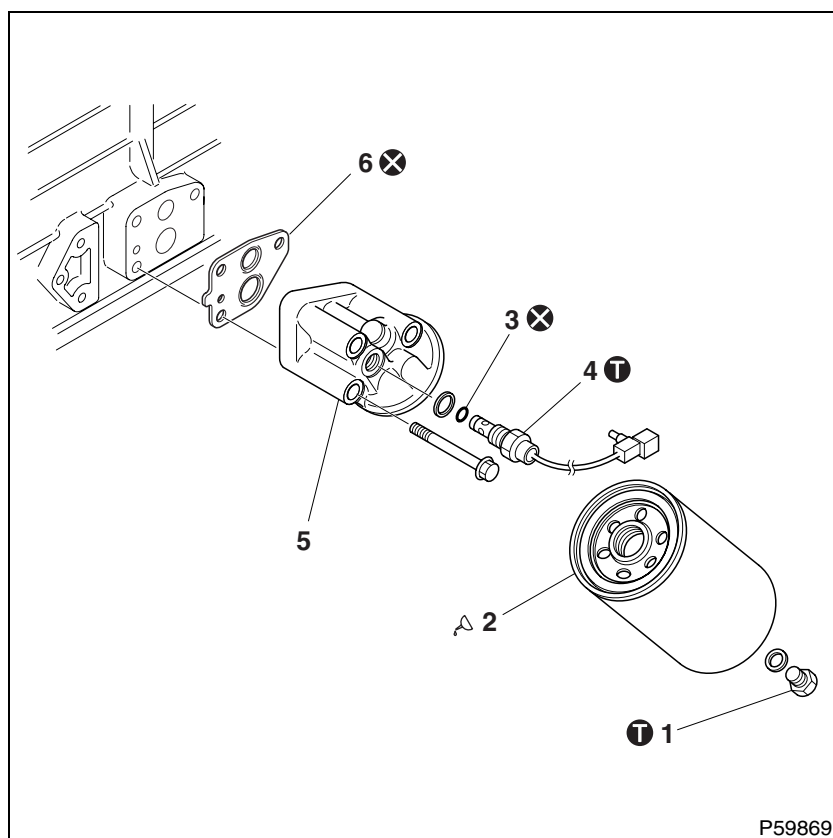
(1) Differences between gear heights and case depth

Replace any component whose measurement is out of specification.



(2) Clearance between gear teeth tip and case

Replace any component whose measurement is out of specification.



● Disassembly sequence

- 1 Oil filter drain plug
- 2 Oil filter P12-10
- 3 O-ring
- 4 Engine oil bypass alarm switch
 Electrical
- 5 Oil filter head
- 6 Gasket

X: Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

- Wipe up any spilled engine oil since it may cause a fire.
- Do not touch oil when the engine is hot since it can inflict severe burns.

CAUTION

- When pouring oil into the engine, take care not to spill any on the V-belts. Contact with oil could make the V-belts slip, rendering the cooling system less effective.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
4	Engine oil bypass alarm switch valve opening pressure	190^{+50}_0 kPa { $28^{+7.3}_0$ psi, $1.9^{+0.5}_0$ kgf/cm ² }	—	Replace

Tightening torque

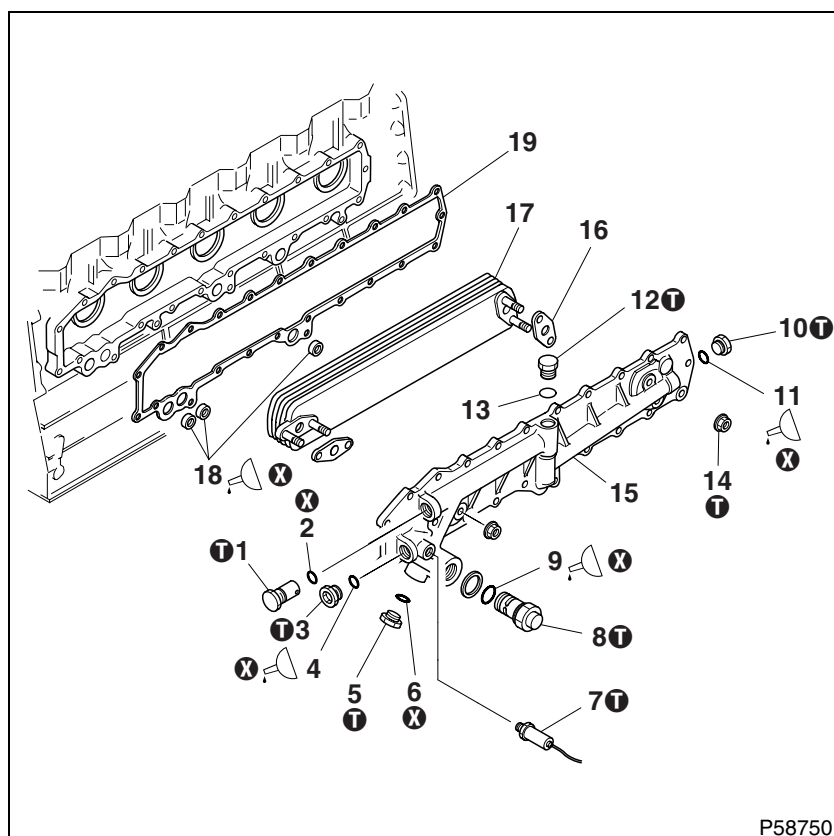
Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Oil filter drain plug	7.8 ± 2 { 5.8 ± 1.5 , 0.8 ± 0.2 }	—
4	Engine oil bypass alarm switch	49 ± 4.9 { 36 ± 3.6 , 5.0 ± 0.5 }	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Oil filter gasket P12-10	Engine oil	As required

OIL COOLER



● Disassembly sequence

- 1 Bypass valve
- 2 O-ring
- 3 Plug
- 4 O-ring
- 5 Plug
- 6 O-ring
- 7 Engine oil pressure switch
- 8 Regulator valve
- 9 O-ring
- 10 Plug
- 11 O-ring
- 12 Plug
- 13 O-ring
- 14 Nut
- 15 Oil cooler cover
- 16 Gasket
- 17 Oil cooler element
- 18 O-ring
- 19 Gasket

ⓧ: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
14	Air leakage from oil cooler element	0 L {0 qts}	—	Replace

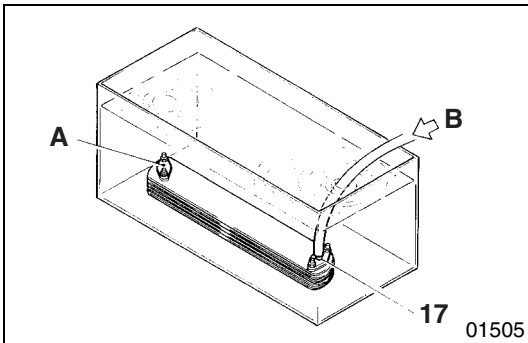
ⓧ Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bypass valve	15 to 20 {11 to 15, 1.5 to 2.0}	—
3	Plug (Key No. 3 in illustration)	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	—
5	Plug (Key No. 5 in illustration)	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	—
7	Engine oil pressure switch	15 to 22 {11 to 16, 1.5 to 2.2}	—
8	Regulator valve	98 to 118 {72 to 87, 10 to 12}	—
10	Plug (Key No. 10 in illustration)	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	—
12	Plug (Key No. 12 in illustration)	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	—
14	Nut (Oil cooler element mounting)	24.5 to 32.3 {18 to 24, 2.5 to 3.3}	—

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4, 9, 18	O-ring	Engine oil	As required
11	Winding around thread of engine oil pressure switch	Seal tape	Three and a half winding

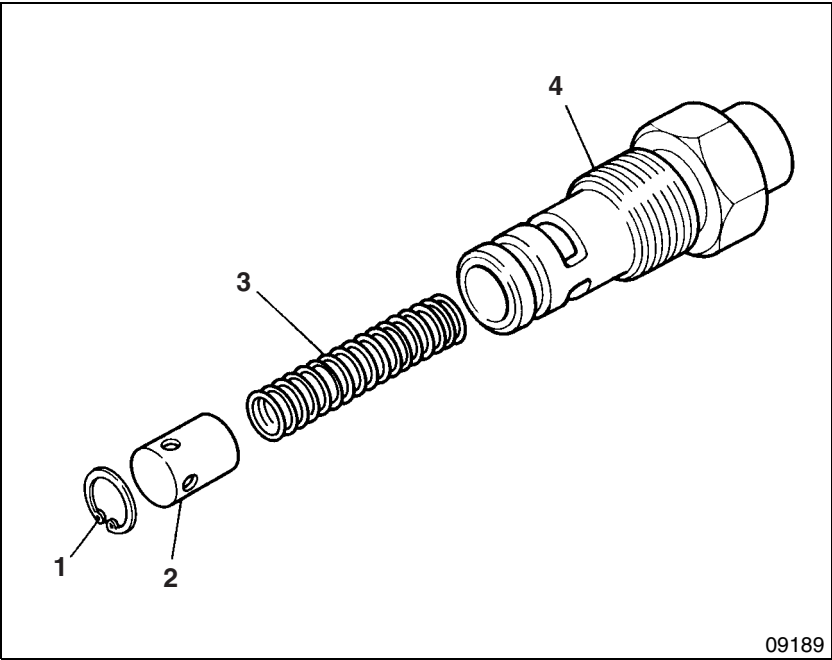


◆ Service procedure

● Inspection after assembly check for air leakage

- Close the outlet port of element **17** with plug **A**, connect a hose to the inlet port for engine oil, and then sink element **17** into a water tank.
- Apply air pressure **B** of 1470 kPa {215 psi, 15 kgf/cm²} from the hose side for 15 seconds to check all parts of element **17** for air leakage.
- If there is air leakage, replace element **17**.

REGULATOR VALVE



● **Disassembly sequence**

- 1 Snap ring
- 2 Valve
- 3 Spring
- 4 Body

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
–	Regulator valve opening pressure	392 ± 29 kPa {57 ± 4.2 psi, 4.0 ± 0.3 kgf/cm ² }	–	Replace
3	Installed load of regulator valve spring (Installed length 48.3 {1, 90})	78.5 ± 1.96 N {18 ± 0.4 lbs, 8.0 ± 0.2 kgf}	–	Replace



13A - Fuel and Engine Control

13E - Electronically Controlled Fuel System

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**



Group 13A

Fuel and Engine Control

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	13A-2
STRUCTURE AND OPERATION	
1. Fuel System	13A-3
2. Engine Control	13A-4
3. Fuel Filter	13A-5
TROUBLESHOOTING	13A-6
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Checking No-load Minimum and Maximum Speeds	13A-8
2. Air Bleeding of Fuel System	13A-9
3. Replacement of Fuel Filter	13A-10
ENGINE CONTROL	13A-12
FUEL TANK	13A-15
FUEL FILTER	13A-16
COMMON RAIL ASSY	13A-18
SUPPLY PUMP	13A-20
INJECTOR, FUEL TEMPERATURE SENSOR	13A-24

SPECIFICATIONS

Supply pump assembly

Item	Specifications
Model	HP-4
Feed pump type	Trochoid type
Fuel temperature sensor	Equipped
SCV (Suction control valve)	Equipped
Manufacturer	DENSO

Common rail

Item	Specifications
Common rail volume $\text{cm}^3 \{\text{cu.in}\}$	26 {1.56}
Pressure limiting valve opening pressure $\text{MPa} \{\text{psi, kgf/cm}^2\}$	221 ± 9 {32050 $\pm$ 1310 psi, 2250 $\pm$ 92}
Supply voltage to rail pressure sensor V	5
Manufacturer	DENSO

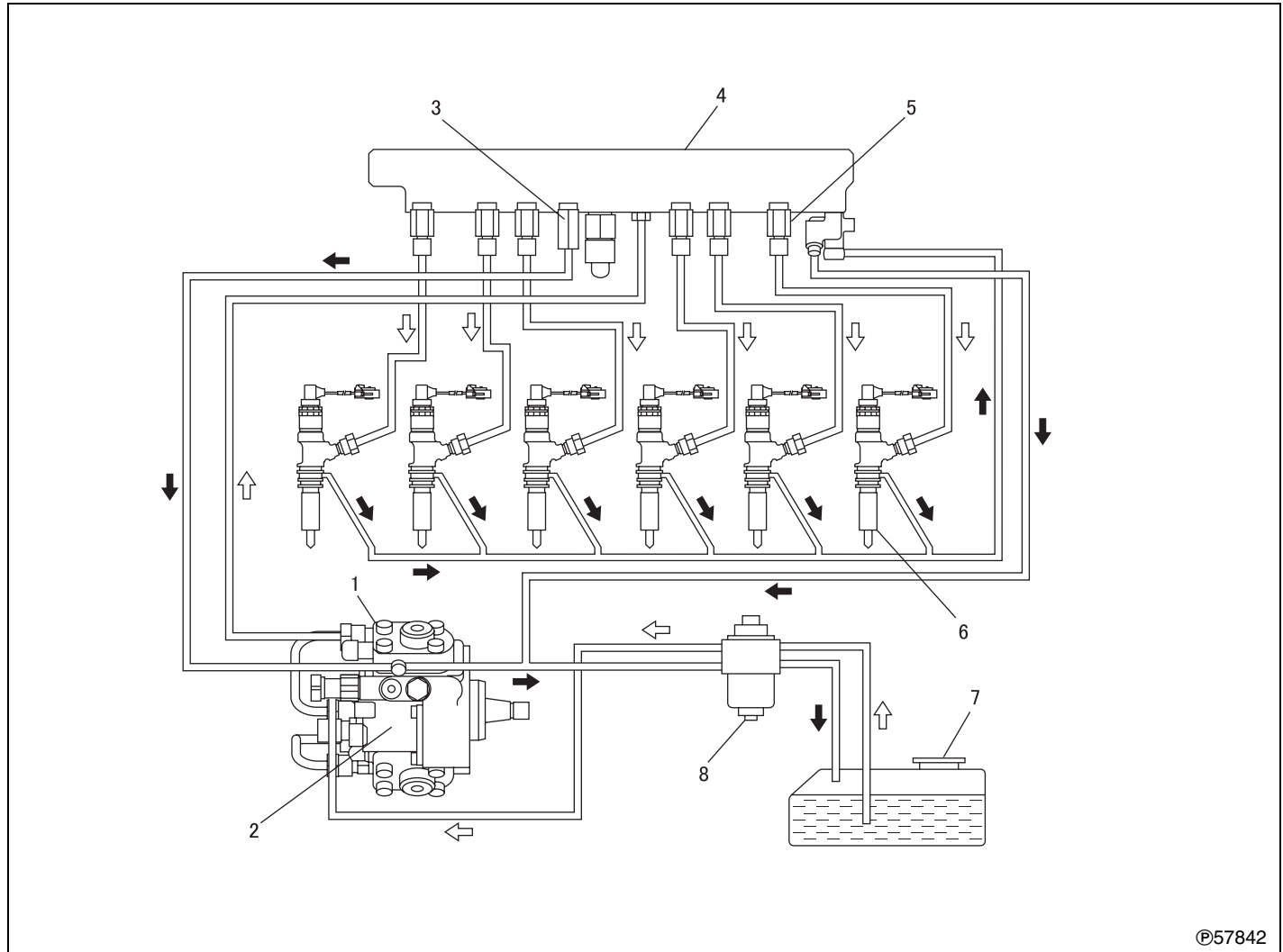
Injectors

Item	Specifications
Model	Electronically controlled
Type	Hole type
Two-way electromagnetic valve (TWV)	Equipped
No. of nozzle holes	6
Nozzle hole diameter $\text{mm} \{\text{in.}\}$	$\phi 0.15$ { $\phi 0.0059$ }
Manufacturer	DENSO

Fuel System

Item	Specifications
Type	Spin-on, paper-filter type

1. Fuel System



©57842

- 1 Supply pump assembly Gr13E
- 2 Feed pump Gr13E
- 3 Pressure limiter Gr13E
- 4 Common rail assembly Gr13E
- 5 Flow damper Gr13E
- 6 Injector assembly Gr13E

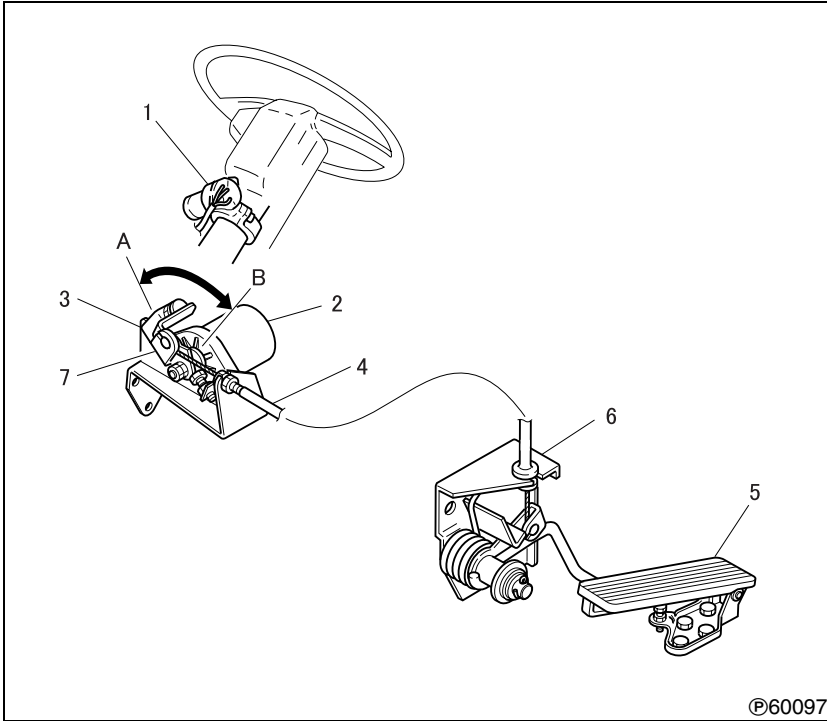
- 7 Fuel tank
- 8 Fuel filter P13A-5

⇐: Supplied fuel
 ⇐: Excess fuel

- Fuel in the fuel tank 7 is drawn up by the feed pump 2, which is driven by the pump camshaft in the supply pump assembly 1, and the fuel filter 8 to remove debris.
- Fuel, after having dirt and other foreign matters removed, is fed to the supply pump assembly 1 and pressurized there. It is then supplied under high pressure to the common rail assembly 4 and is accumulated there for a short time before it is sprayed into the combustion chamber through the injector assembly 6.
- If a fuel leakage occurs at the injection pipe joint between the common rail assembly 4 and the injector assembly 6, the flow damper 5 closes to shut off the fuel passage, preventing external outflow of fuel.
- If the fuel pressure in the common rail assembly 4 exceeds a specified level, the pressure limiter 3 opens to allow fuel to return to the fuel tank 7.
- If the fuel flow rate in the supply pump assembly 1 exceeds a specified level, to allow fuel to return to the fuel tank 7.

STRUCTURE AND OPERATION

2. Engine Control



- 1 Starter switch
- 2 Accelerator pedal position sensor assembly
- 3 Accelerator switch
- 4 Accelerator control cable
- 5 Accelerator pedal
- 6 Accelerator link assembly
- 7 Lever

A: Idling position

B: Full-load position

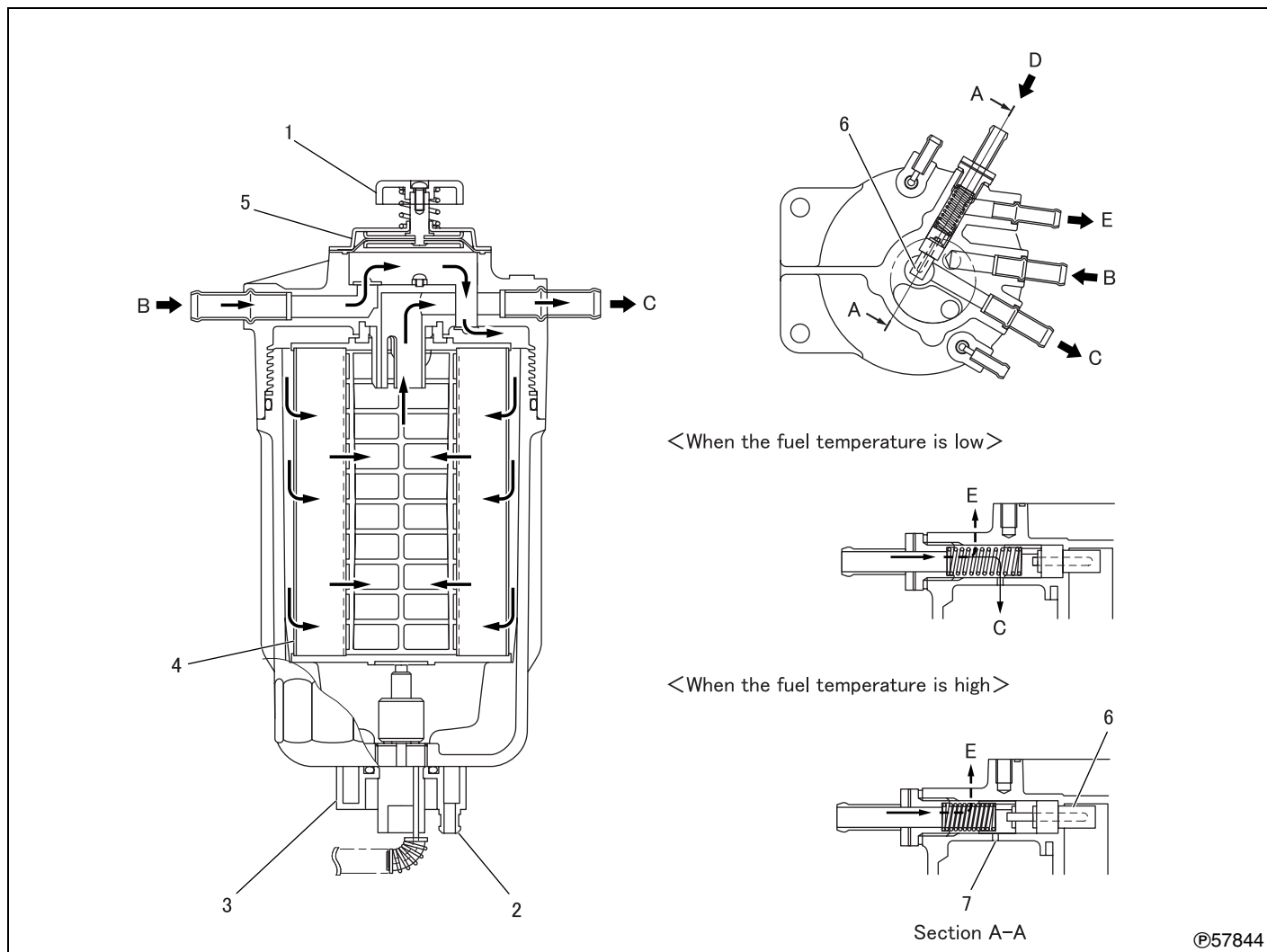
● Accelerator pedal switch

The accelerator switch 3 senses whether the accelerator pedal 5 is depressed.

● Accelerator pedal position sensor

The accelerator pedal position sensor assembly 2 sends electric signals to the common rail electronic control unit in accordance with movement of the accelerator pedal 5. The lever 7 of the position sensor is constantly pulled toward the idling position A by a return spring.

3. Fuel Filter



1 Hand pump

2 Drain hole

3 Water separator sensor

4 Element

5 Fuel filter head

6 Thermostat

7 Valve

B: From fuel tank

C: To supply pump

D: From fuel return pipe

E: To fuel tank

- The fuel filter, which also serves as a water separator, eliminates impurities in fuel with the element 4 and separates water from fuel.
- Separated water accumulates at the bottom of the filter. A water separator sensor 3 is installed to illuminate a warning lamp in the meter cluster when water accumulates to a certain level.
- Accumulated water can be drained from a drain hole 2 by loosening the water separator sensor 3.
- A hand pump 1 is provided on the fuel filter head for air bleeding of the fuel system.
- When the fuel temperature is high, the thermostat 6 expands to close the valve 7 of the fuel filter head 5. All of high-temperature fuel returning from the fuel return pipe D returns to the fuel tank E.
- When the fuel temperature is low, the valve 7 of the fuel filter head is open as the thermostat 6 does not expand. High-temperature fuel returning from the fuel return pipe D passes through the valve 7 and mixes with fuel on the periphery of the element. This warms fuel on the periphery of the element, which melts a wax component in fuel that deposits when the fuel temperature is low, thus preventing clogging of the element.

TROUBLESHOOTING

Symptoms		Engine does not start	Engine hard to start	Too much black exhaust smoke	Insufficient engine power	Too high engine maximum speed	Unstable idling	Engine stalls soon after start	Engine does not reach to maximum speed	Insufficient fuel supply	Warning lamp illuminates	Reference Gr
Possible causes												
Faulty common rail system											O	 Gr13E
Supply pump	Defective feed pump	O	O		O			O	O	O		*
	Poor pump discharge	O	O		O			O	O			*
	Defective pressure feed system	O	O		O			O	O			*
	Defective SCV, defective supply pump proper	O	O		O			O	O			*
	Open or short circuit failure, poor contact of SCV	O	O		O			O	O		O	 Gr13E or *
	Poor sealing		O		O				O			*
Common rail	Pressure limiter opening valve pressure too low		O	O	O				O			
	Flow damper activated		O		O							
	Open or short circuit failure, poor contact of common rail pressure sensor	O	O		O			O	O		O	 Gr13E
	Poor sealing		O	O	O				O			
Injectors	Open or short circuit failure, poor contact of injector M/V		O	O	O	O	O				O	 Gr13E or *
	Defective injector, defective injector M/V, defective nozzle		O	O	O	O	O		O			*
	Foreign matter caught in orifice			O		O	O					
Clogged fuel filter		O	O		O		O	O	O	O		
No fuel in fuel tank		O	O		O			O	O	O		
High pressure piping	Poor sealing, defective sealing surface		O		O			O	O			
	Cracked pipe		O		O			O	O			
	Crushed pipe		O		O			O	O			
	Foreign matter caught in pipe		O		O			O	O			
Low pressure piping	Poor sealing, defective sealing surface	O	O		O			O	O	O		
	Cracked or clogged pipe	O	O		O			O	O	O		
Air or water in fuel system			O		O		O	O	O	O		
Use of low quality fuel			O	O	O	O		O	O			
Engine control	Poorly adjusted accelerator pedal stopper bolt				O				O			
	Defective accelerator pedal position sensor										O	 Gr13E

SCV: Suction control valve

*: Contact a Denso service station for repair.

Symptoms		Engine does not start	Engine hard to start	Too much black exhaust smoke	Insufficient engine power	Too high engine maximum speed	Unstable idling	Engine stalls soon after start	Engine does not reach to maximum speed	Insufficient fuel supply	Warning lamp illuminates	Reference Gr
Possible causes												
Inappropriate oil viscosity			O		O							Gr12
Poorly adjusted valve clearance			O		O							Gr11
Defective cylinder head gasket			O		O							
Wear of and/or carbon deposits on valve and valve seat			O		O							
Distorted valve springs			O		O							
Worn or damaged piston rings			O		O							
Worn or damaged piston ring groove			O									
Worn piston and/or cylinder liner			O		O							
Inappropriate crankshaft dimensions			O	O	O			O				
Poorly functioning cooling system			O		O							Gr14
Defective starter switch		O	O		O			O				Gr54
Defective glow relay		O	O									
Engine speed sensor and cylinder sensor	Faulty sensor, open-circuit, short-circuit or poor contact		O	O	O			O	O		O	Gr13E
	Faulty installation		O	O	O			O	O			Gr11
Open-circuit, short-circuit, poorly connected or faulty boost pressure sensor				O	O						O	Gr13E
Open-circuit, short-circuit, poorly connected or faulty coolant temperature sensor		O	O								O	
Open-circuit, short-circuit, poorly connected or faulty injection rate adjusting resistor				O	O						O	
Open-circuit, short-circuit, poorly connected or faulty idling adjustment control							O				O	
Open-circuit, short-circuit, poorly connected or faulty ECU main power relay		O	O					O				
Engine ECU	Faulty ECU	O	O	O	O	O		O	O		O	
	Learning value of supply pump unit difference not initialized		O		O			O	O			
Dead battery		O	O		O			O				Gr54
Poor operation of alternator			O		O			O				
Blown fuse		O	O					O				

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Checking No-load Minimum and Maximum Speeds

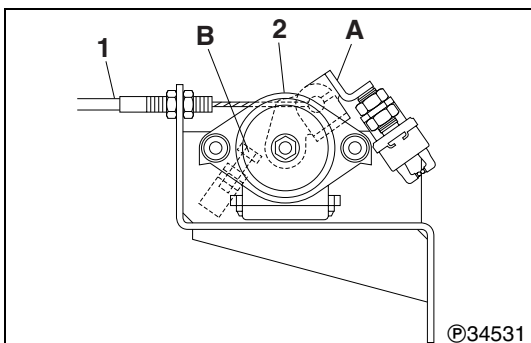
Service standards

Location	Maintenance item	Standard value	Limit	Remarks
–	No-load minimum speed (idling speed)	600 ± 25 rpm	–	Check
–	No-load maximum speed	3210 ± 30 rpm	–	Check

Start the engine and run it for a while to warm up, then carry out the following inspections.

No-load minimum speed

- Check that when the accelerator pedal is not depressed the idling speed is within the range of specified standard values.
- If the speed is out of specification, check the installed condition of the accelerator control cable **1**. Also, check the accelerator pedal position sensor **2** for function.  P13A-12,  Gr13E
- If the above parts are in order, then check the supply pump and common rail electronic control unit for function.



No-load maximum speed

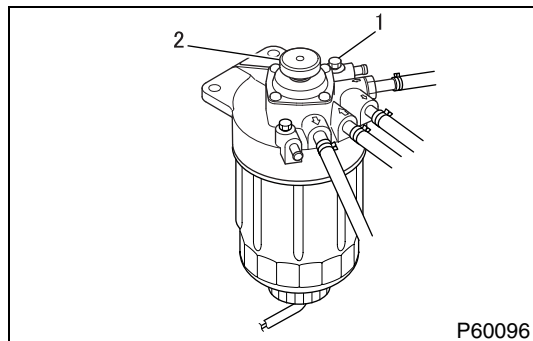
- Check that the engine speed is within the range of specified standard values when the lever **A** of the accelerator pedal position sensor **2** touches the full-load stopper bolt **B**.
- If the speed is out of specification, check the installed condition of the accelerator control cable **1**. Also, check the accelerator pedal position sensor **2** for function.  P13A-12,  Gr13E
- If the above parts are in order, then check the supply pump and common rail electronic control unit for function.

2. Air Bleeding of Fuel System

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Plug	10 ± 2 { 7.4 ± 1.5 , 1 ± 0.2 }	—



- Loosen either plug **1** of the fuel filter.
- Move hand pump **2** up and down to feed fuel.
- Continue to feed fuel until fuel coming out of plug **1** contains no air bubbles.
- When air bubbles are completely gone, tighten plug **1** to the specified torque.
- Feed the fuel some more by operating the priming pump further until a strong resistance is felt.

NOTE

- **When the fuel temperature is low, you may not feel the resistance. Be sure to operate the priming pump several times even in such a case.**
- Wipe off spilled fuel, and then start the engine.
- Make sure that there is no fuel leakage.

WARNING

- **Keep flames and heat away from fuel since it is flammable.**
- **Wipe off spilled fuel to avoid the danger of fire.**

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Replacement of Fuel Filter

① Tightening torque

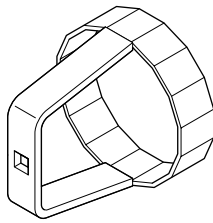
Unit: N·m {ft.lbs, kgf·m}

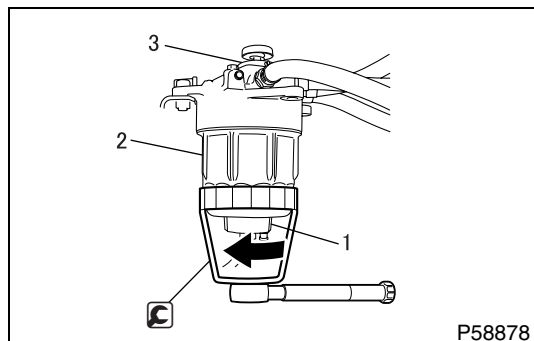
Location	Parts to be tightened	Tightening torque	Remarks
1	Water separator sensor	5 ± 1 { 3.7 ± 0.7 , 0.5 ± 0.1 }	—
2	Case	30 ± 2 { 22 ± 1.5 , 3.1 ± 0.2 }	—

🔊 Lubricant and/or sealant

Location	Maintenance item	Specified lubricant and/or sealant	Quantity
5, 6	O-ring	Engine oil	As required

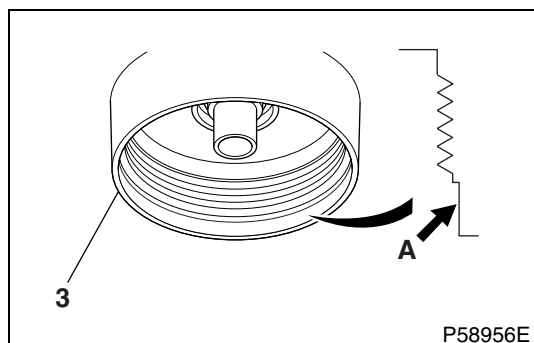
🔧 Special tools

Location	Tool name and shape	Part No.	Application
🔧	Filter wrench  P57179	MH063203	Removal and installation of case



[Removal]

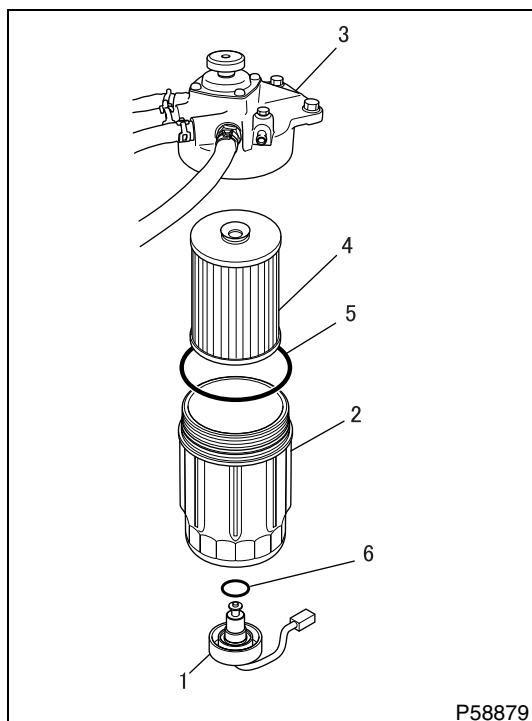
- Loosen water separator sensor 1 to discharge fuel in case 2.
- Remove the case with 🔧 filter wrench.



[Installation]

- Clean fuel filter head 3 contact surface with the O-ring.

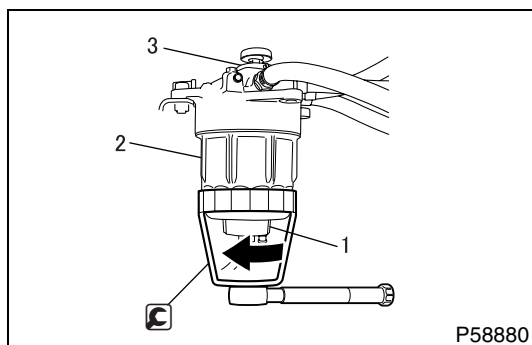
A: O-ring contact surface



- Replace element **4** and O-ring **5,6** with new ones.
- Apply a thin coat of engine oil to O-rings **5** and **6**, and install them on case **2** and water separator sensor **1**.

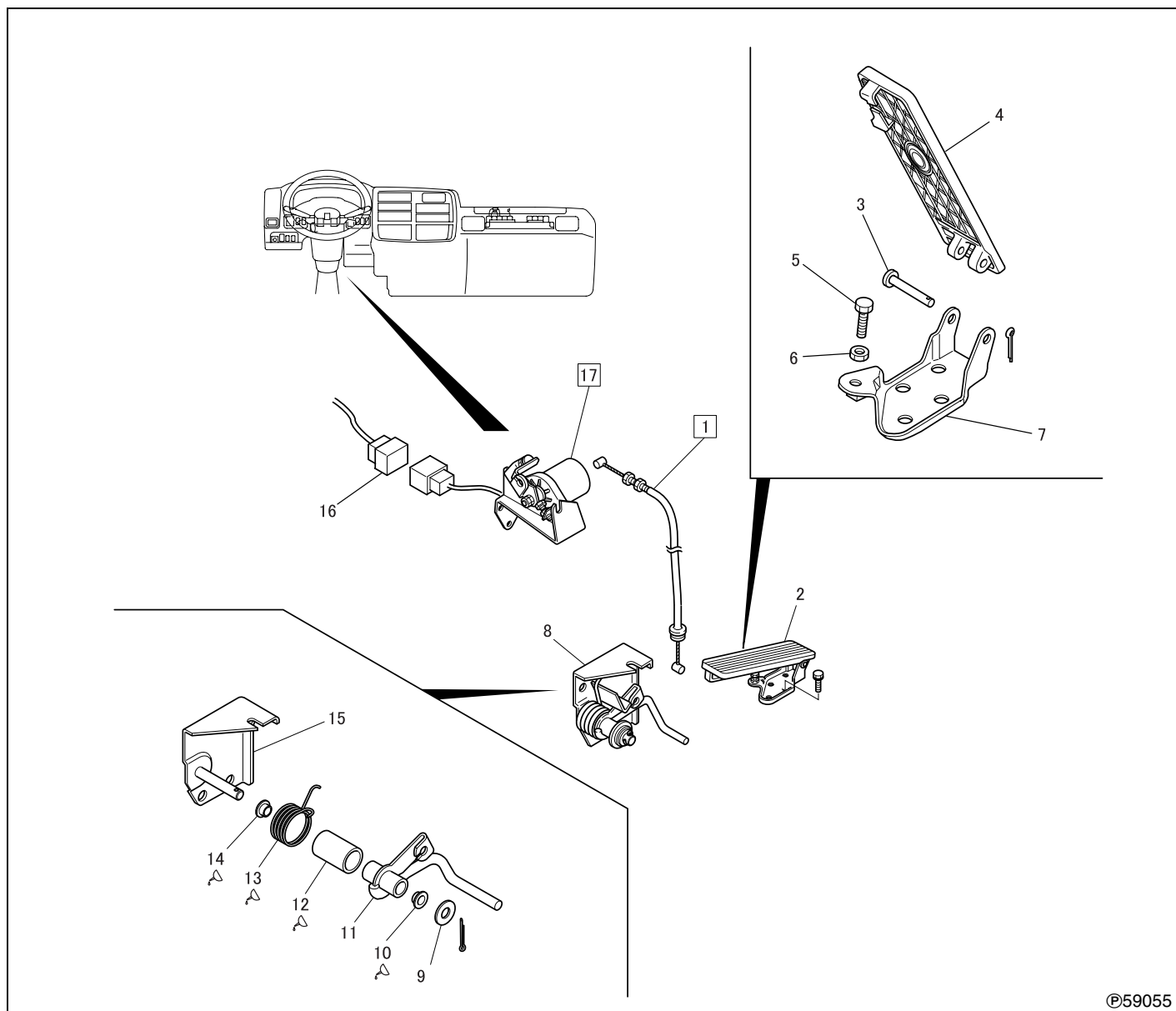
CAUTION

- **Be sure to use the genuine part since use of an inadequate element causes an engine trouble.**
- **Take sufficient care not to allow small dust to enter the fuel filter and fuel hose to prevent troubles such as abnormal injection.**



- Tighten case **2** with  filter wrench to the specified torque.
- Tighten water separator sensor **1** to the specified torque. After installation, bleed air from the fuel system.
- Start the engine to make sure that there is no fuel leakage.
- If any abnormality is found, replace the fuel filter assembly.

ENGINE CONTROL



©59055

- | | | |
|------------------------------|-----------------------------|--------------------------------------|
| 1 Accelerator control cable | 7 Accelerator pedal bracket | 13 Return spring |
| 2 Accelerator pedal assembly | 8 Accelerator link assembly | 14 Bushing |
| 3 Accelerator pin | 9 Washer | 15 Accelerator link bracket |
| 4 Accelerator pedal | 10 Bushing | 16 Harness connector |
| 5 Stop bolt | 11 Accelerator link | 17 Accelerator pedal position sensor |
| 6 Nut | 12 Collar | |

● Assembly sequence

Follow the disassembly sequence in reverse.

● Adjustment after assembly

📖 P13A-13

● Work after assembly

Inspection and adjustment of accelerator position sensor 📖 Gr13E

Lubricant and/or sealant

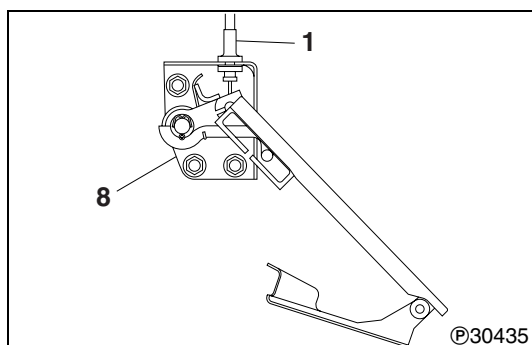
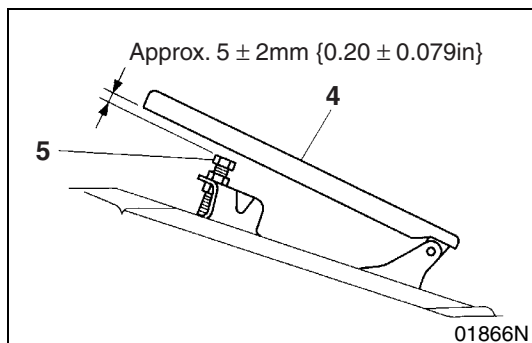
Location	Points of application	Specified lubricant and/or sealant	Quantity
10, 14	Bushing-to-accelerator link bracket sliding surfaces	Chassis Grease [NLGI No. 1 (Li soap)]	As required
12, 13	Collar-to-return spring sliding surfaces	Chassis Grease [NLGI No. 1 (Li soap)]	As required

◆ Service procedure

● Adjustment after reassembly

Adjustment of stop bolt

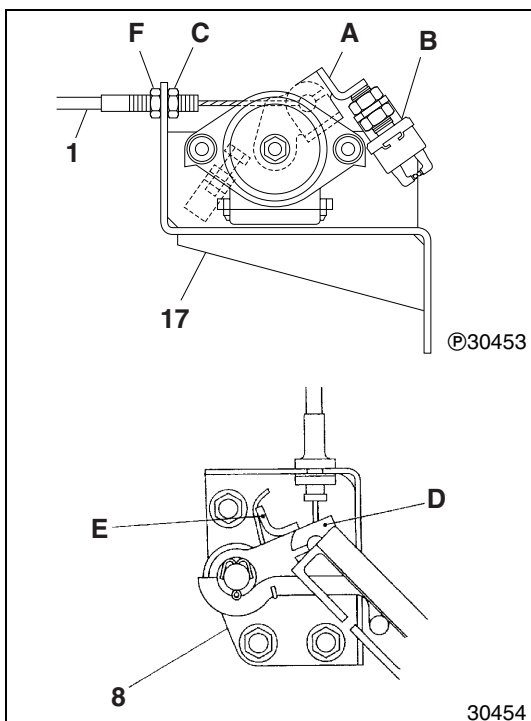
With the accelerator pedal **4** depressed, adjust the stop bolt **5** such that the clearance between the bolt and the pedal corresponds to the distance illustrated.



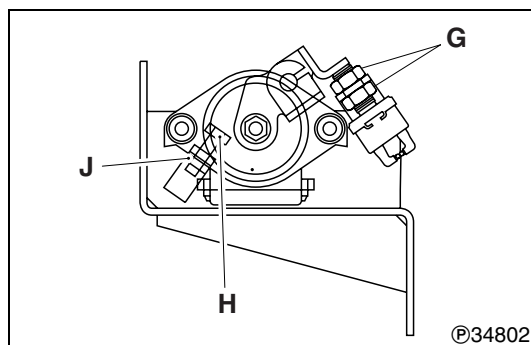
1 Installation of accelerator control cable

- Fit the accelerator control cable **1** onto the accelerator link assembly **8**.

ENGINE CONTROL

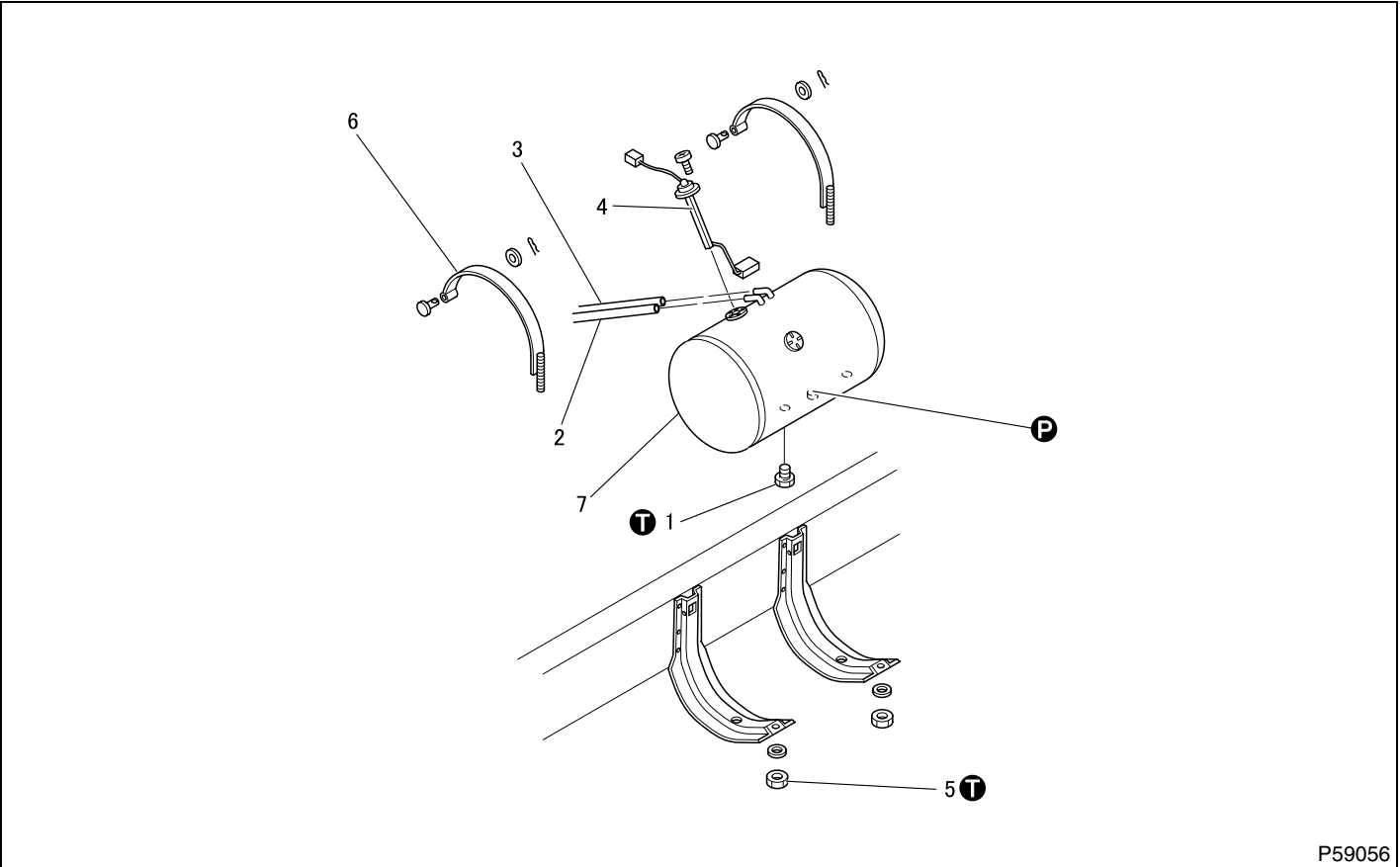


- Fit the other end of the accelerator control cable **1** onto the control lever **A** of the accelerator pedal position sensor **17**.
- Ensure that the accelerator switch **B** is fully depressed by the lever **A** of the accelerator pedal position sensor **17**.
- Using the nut **C**, adjust the length of the accelerator control cable **1** such that the lever **D** of the accelerator link assembly **8** rests against the stop **E**. Tighten the nut **F** to complete the adjustment.



[Adjustment]

- The output voltage for the accelerator switch contact position **D** can be adjusted using the nut **G**.
- The output voltage for the full-load position **E** can be adjusted using the stop bolt **H** after loosening the nut **J**. After the adjustment, tighten the nut **J**.



P59056

● Work before removal

WARNING ⚠

- Keep drop lights away because of the risk of explosion.
- Wipe up any spilled fuel because it can cause a fire.

NOTE

Drain fuel before working on the job.

● Removal sequences

- | | |
|--|-------------------|
| 1 Drain plug | 6 Fuel tank strap |
| 2 Suction hose | 7 Fuel tank |
| 3 Return hose | |
| 4 Fuel level sensor  Gr54 | Ⓟ: Locating pin |
| 5 Nut | |

● Installation sequence

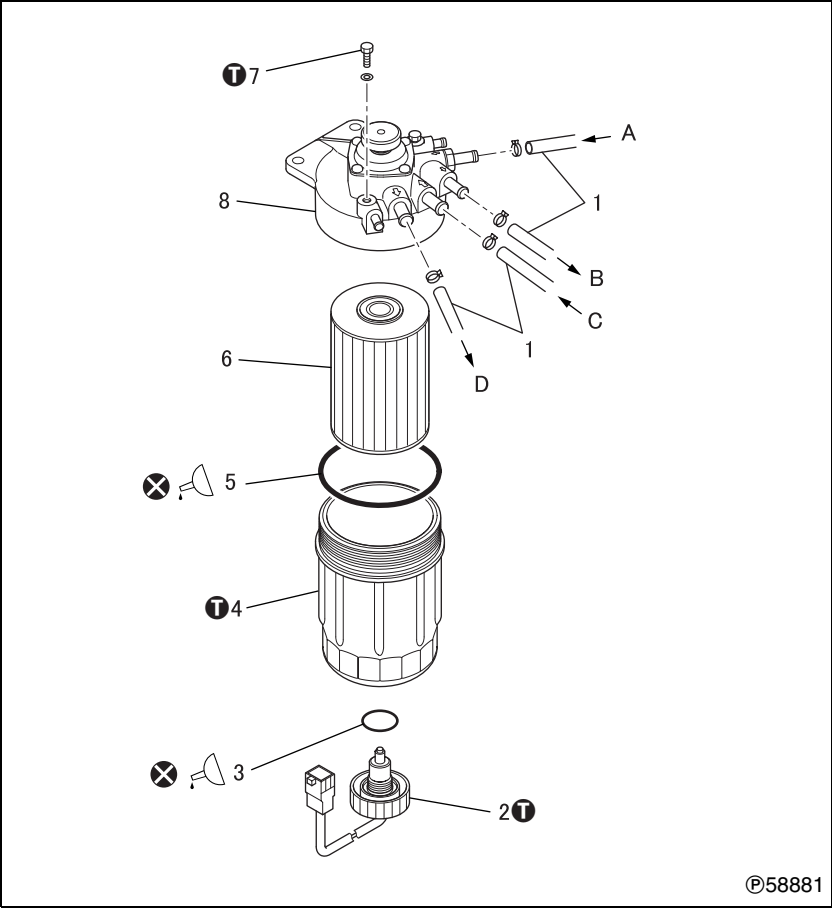
Follow the removal sequence in reverse.

T Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Drain plug	78 ± 19 {58 ± 14, 8.0 ± 1.9}	–
7	Nut (Fuel tank strap mounting)	12 to 15 {8.7 to 11, 1.2 to 1.5}	–

FUEL FILTER



● **Disassembly sequence**

- 1 Fuel hose
- 2 Water separator sensor
- 3 O-ring
- 4 Case
- 5 O-ring
- 6 Element P13A-10
- 7 Plug
- 8 Fuel filter head

- A: From fuel return pipe
B: To fuel tank
C: From fuel tank
D: To supply pump
X: Non-reusable part

WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Spilled fuel can catch fire. Wipe off any fuel spill.

CAUTION

After installation, verify that there is no fuel leakage from the installed part to prevent fire.

● **Assembly sequence**

Follow the disassembly sequence in reverse.

T Tightening torque

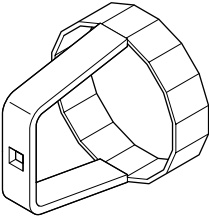
Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Water separator sensor	5 ± 1 {3.7 ± 0.7, 0.5 ± 0.1}	–
4	Case	30 ± 2 {22 ± 1.5, 3.1 ± 0.2}	–
7	Plug	10 ± 2 {7.4 ± 1.5, 1 ± 0.2}	–

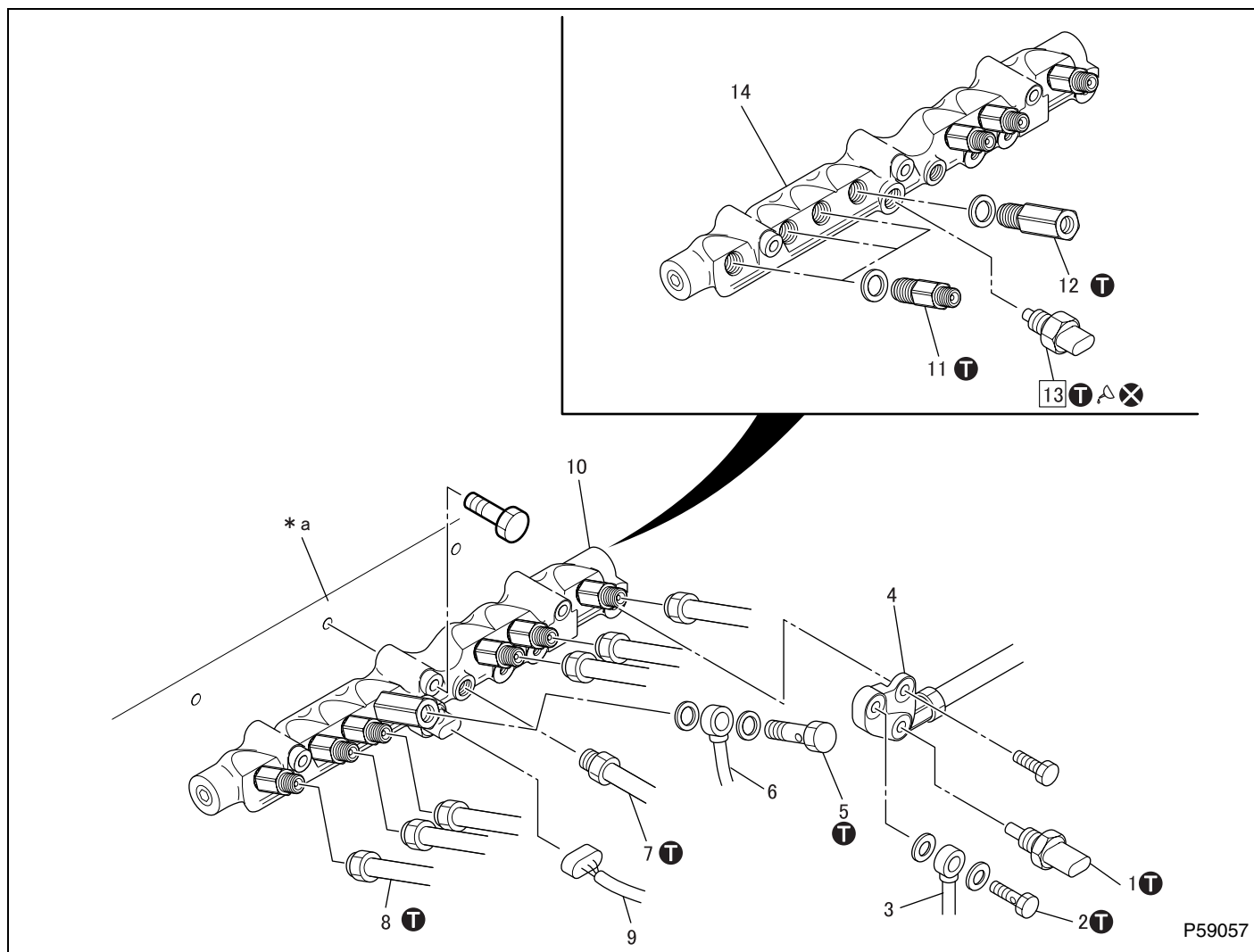
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3, 5	O-ring	Engine oil	As required

Special tools

Location	Tool name and shape	Part No.	Application
	Filter wrench  P57179	MH063203	Removal and installation of case

COMMON RAIL ASSY



● Removal sequence

- | | |
|---------------------------------|--------------------------------|
| 1 Fuel temperature sensor (out) | 10 Common rail Assy |
| 2 Eye bolt | 11 Flow damper |
| 3 Fuel return pipe | 12 Pressure limiter |
| 4 Connector | 13 Common rail pressure sensor |
| 5 Eye bolt | 14 Common rail |
| 6 Fuel over flow pipe | |
| 7 Fuel pipe | |
| 8 Injection pipe | |
| 9 Harness | |
- *a: Crank case
 X: Non-reusable part

WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Spilled fuel can catch fire. Wipe off any fuel spill.

CAUTION

- Dirt and dust in the common rail assembly 10 can seriously detract from engine performance. To prevent ingress of dirt, fully cover open pipe joints after removal of pipes. Also, clean the common rail assembly in kerosene and protect them properly from dirt.
- Do not disassemble the common rail assembly 10 without replacing the parts. When carrying the common rail assembly, hold its body.

Installation sequence

Follow the disassembly sequence in reverse.

CAUTION

- Install them with checking that the seat surface of fuel pipe 7 and injection pipe 8 is not damaged and bumped.

Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Fuel temperature sensor	17.6 to 21.5 {13 to 16, 1.8 to 2.2}	
2	Eye bolt (Fuel return pipe mounting)	25 {18, 2.5}	
5	Eye bolt (Fuel return pipe mounting)	17.7 to 22.6 {13 to 17, 1.8 to 2.3}	—
7	Fuel pipe (Union nut mounting)	49 to 58.8 {36 to 43, 5.0 to 6.0}	—
8	Injection pipe (Union nut mounting)	39.2 to 49 {29 to 36, 4.0 to 5.0}	—
11	Flow damper mounting	39.2 to 49 {29 to 36, 4.0 to 5.0}	—
12	Pressure limiter mounting	160 to 190 {120 to 140, 16 to 19}	—
13	Common rail pressure sensor mounting	98 {72, 10}	Wet

Lubricant and/or sealant

Location	Parts	Specified lubricant and/or sealant	Quantity
13	Apply to the edge and thread of common rail pressure sensor	DENSO 5th GREASE	As required

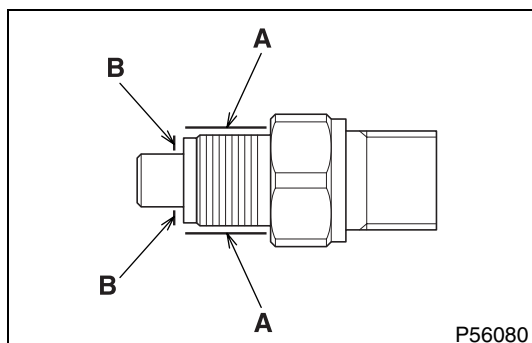
◆ Service procedure

13 Installation of common rail pressure sensor

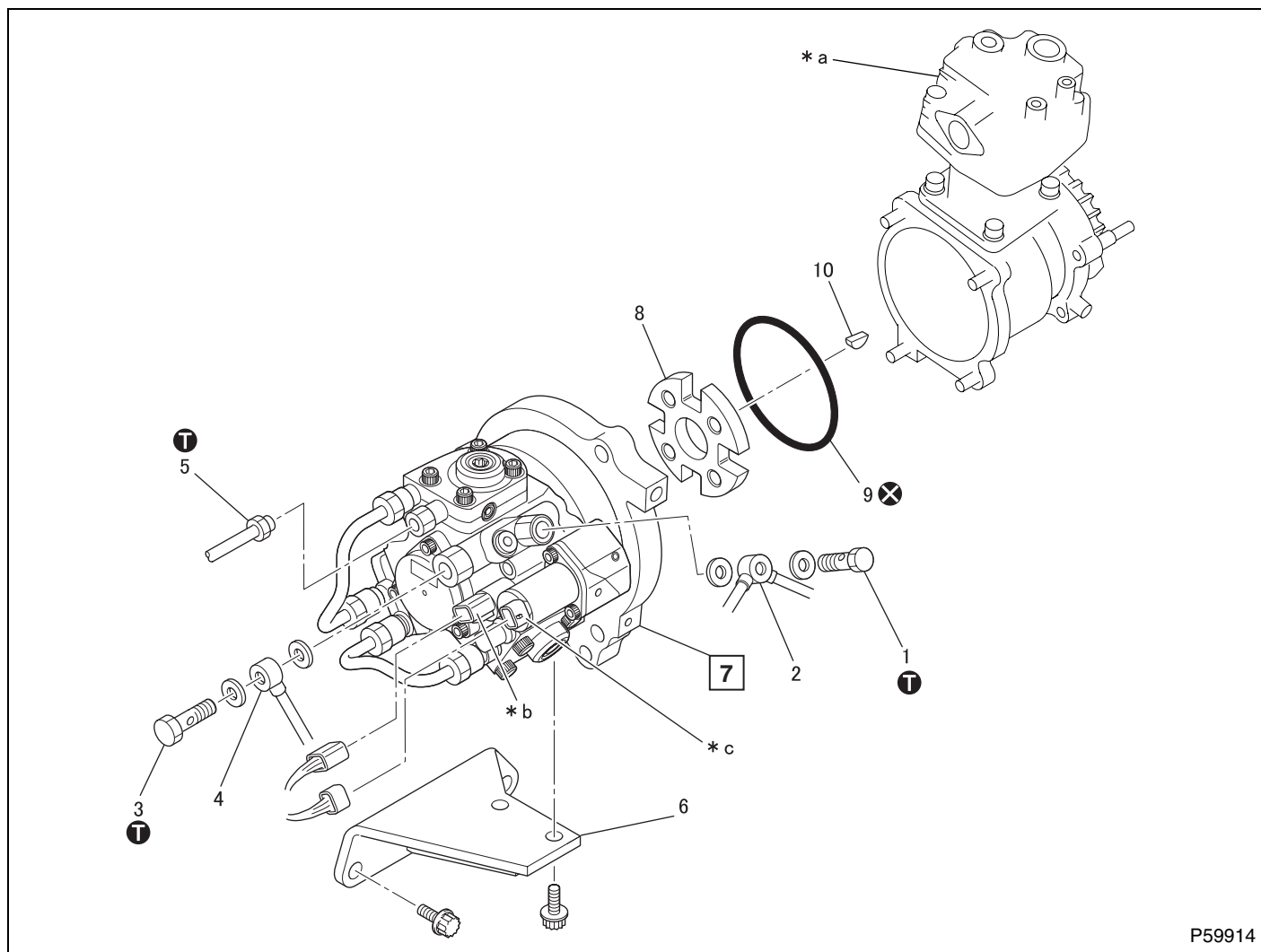
- Apply the grease to the thread **A** and edge **B** on common rail pressure sensor 13, and install it.

CAUTION

- Do not touch the connector terminal of common rail sensor 13.



SUPPLY PUMP



● Removal sequence

- 1 Eyebolt
- 2 Fuel return pipe
- 3 Eyebolt
- 4 Fuel suction pipe
- 5 Fuel pipe

- 6 Supply pump bracket
- 7 Supply pump
- 8 Driving disk
- 9 O-ring
- 10 Key

- *a: Air compressor
 *b: Fuel temperature sensor
 *c: Suction control valve
 X: Non-reusable parts

WARNING

- Keep flames and heat away from fuel since it is flammable.
- Wipe off spilled fuel to avoid the danger of fire.

CAUTION

- Cover all mounts after parts such as the pipe and hose are removed since small dust entering the inside of the supply pump produces big adverse effect on the engine performance. Clean the eyebolt and gasket with light oil, and take sufficient care not to allow dust to enter.
- Make sure that there are no flaw and step on the seat surface of the fuel pipe before installation.
- When the supply pump has been replaced, perform the “Initialization of supply pump unit difference learning value” using the MUT and erase the compensation information (pump learning condition) in the ECU.  Gr13E)

NOTE

- Ask a Denso service station for the maintenance of the supply pump.

● **Installation sequence**

Follow the removal sequence in reverse.

① **Tightening torque**

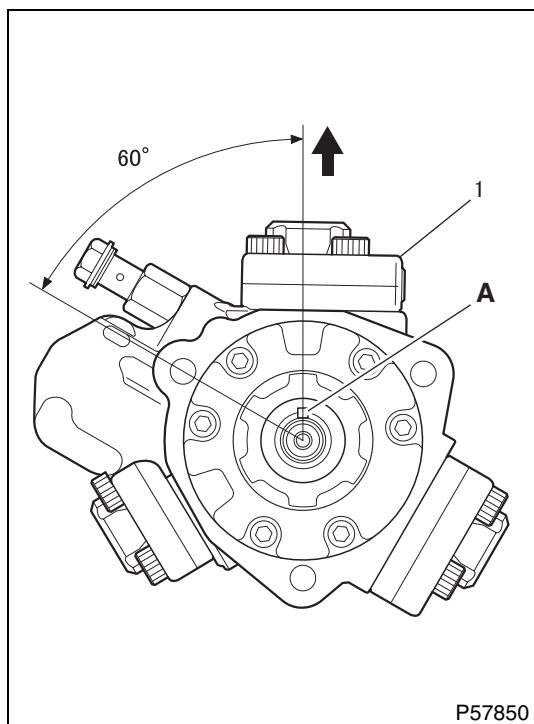
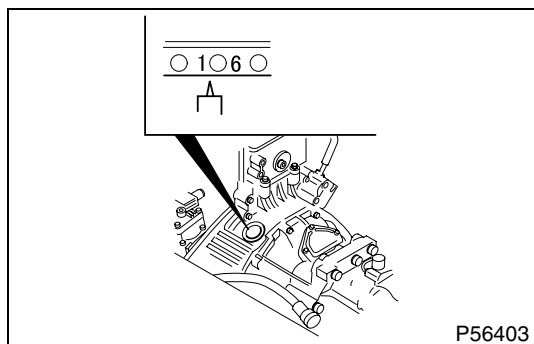
Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Eyebolt (Fuel return pipe mounting)	7.9 to 12.7 {5.8 to 9.4, 0.8 to 1.3}	—
3	Eyebolt (Fuel suction pipe mounting)	14.8 to 19.6 {11 to 14, 1.5 to 2.0}	—
5	Fuel pipe (Union nut mounting)	39.2 to 49 {29 to 36, 4.0 to 5.0}	—

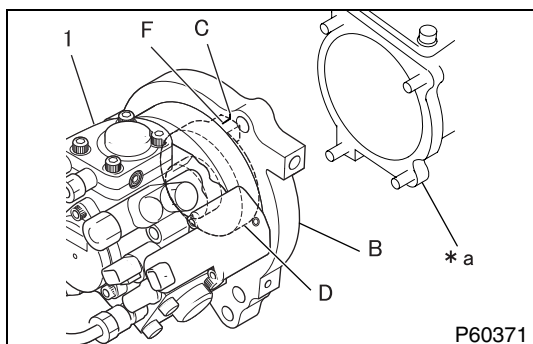
◆ **Service procedure**

7 Installation of supply pump assembly

- Set No. 1 cylinder of the engine at top dead center on the compression stroke in the following procedure.
 - Crank the engine and align the pointer with the position where “1 6” is stamped on the flywheel.
 - Either of No. 1 piston or No. 6 piston is at top dead center on the compression stroke. The piston whose rockers on the intake and exhaust sides can be moved by an amount of valve clearance by hand is at top dead center on the compression stroke. When the engine is rotated by one turn from here, the top dead center position of No. 1 piston and that of No. 6 piston change places.
- Stant the supply pump assembly 1 to position the key **A** as shown in illustration.



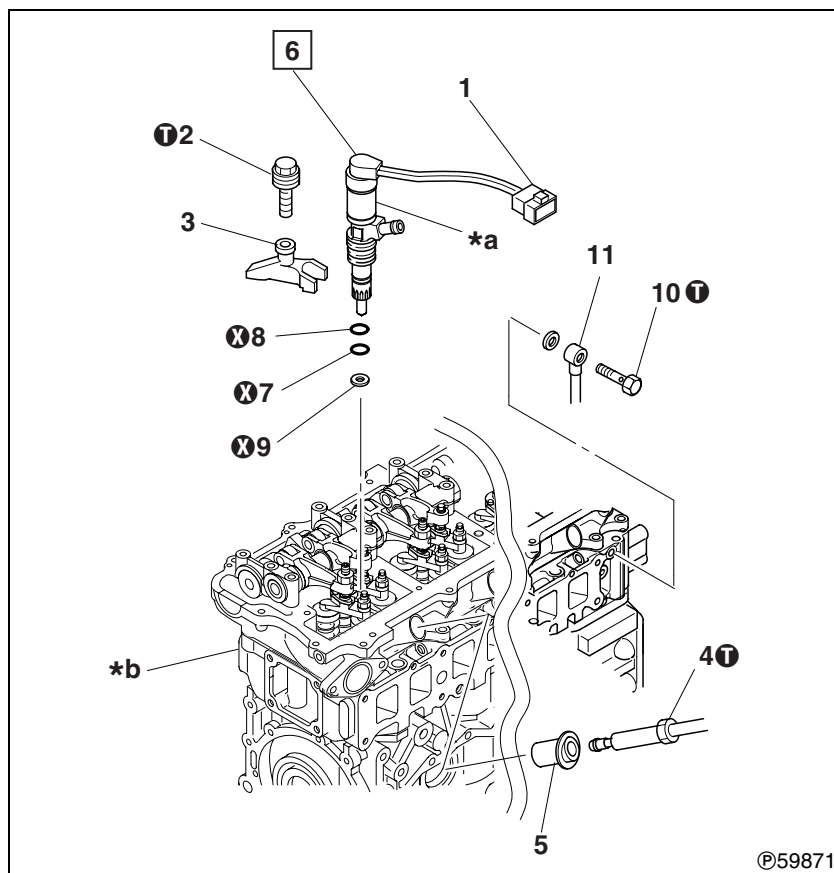
SUPPLY PUMP



- Align the scribed line **C** on the timing cover **B** of the supply pump assembly 1 and the scribed line **F** on the coupling block, then install them to the air compressor.

MEMO

INJECTOR, FUEL TEMPERATURE SENSOR



● Disassembly sequence

- 1 Harness connector
- 2 Bolt
- 3 Nozzle bridge
- 4 Injection pipe
- 5 Injection pipe seal
- 6 Injector assembly Gr13E
- 7 O-ring
- 8 O-ring
- 9 Nozzle tip gasket
- 10 Eyebolt
- 11 Fuel return pipe

*a: TWV (two-way electromagnetic valve)

*b: Cylinder head assembly

ⓧ: Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- The harness between the injector assembly 6 and common rail electronic control unit and the related connectors are under high voltage. Be careful not to receive an electric shock. Before attempting to remove the injector assembly, set the starter switch to the LOCK position.
- Spilled fuel can catch fire. Wipe off any fuel spill.

CAUTION ⚠

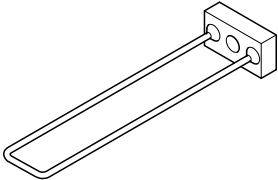
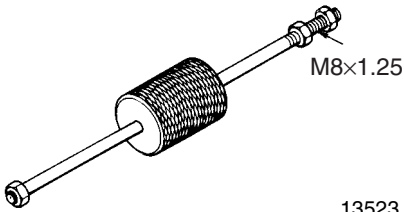
- When removing the injector assembly 6, take care not to hit TWV *a with tools or other objects.
- Take great care not to allow small foreign matter to enter the injector assembly 6 or injection pipe 4. This helps prevent faulty fuel injection or other problems.
- Make sure that the seating surface of the injection pipe 4 is flat and free of damage.

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (nozzle bridge mounting)	33 to 38 {24 to 28, 3.4 to 3.9}	—
4	Injection pipe (union nut)	39.2 to 49 {29 to 36, 4.0 to 5.0}	—
10	Eyebolt (fuel return pipe installation)	25 {18, 2.5}	—

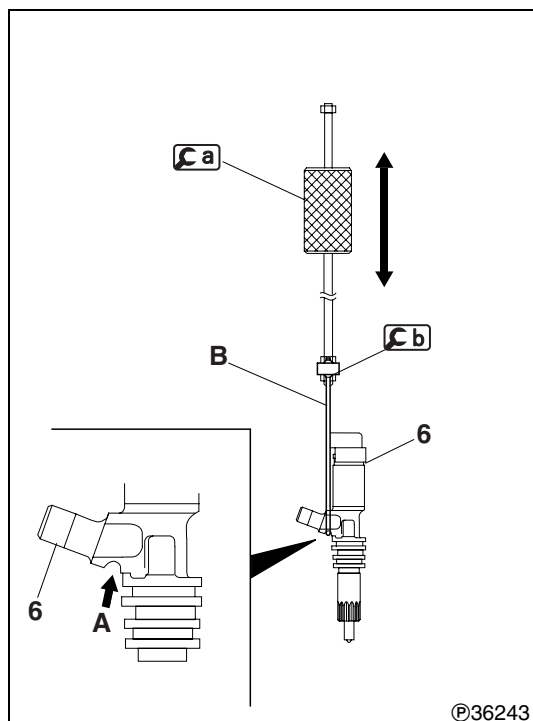
㊦ Special tools

Location	Tool name and shape	Part No.	Application
6	Injector Extractor Adaptor 	MH062560	Removing injector
	Nozzle Extractor 	MH061071	

◆ Service procedure

⑥ Removal of injector assembly

Using the ㊦a Nozzle Extractor and ㊦b Injector Extractor Adaptor, remove the injector 6 by hooking the wire B of the Injector Extractor Adaptor in the groove A on the injector.





Group 13E

Electronically Controlled Fuel System

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

<Common Rail System>

SPECIFICATIONS..... 13E-2

STRUCTURE AND OPERATION

- 1. Overview13E-4
- 2. Electronic Control System 13E-12
- 3. Electronic Control Unit Connection
Diagram 13E-18

TROUBLESHOOTING

- 1. Inspection Procedure 13E-20
- 2. Cautions to Observe When
Performing Inspections 13E-21
- 3. Inspections Based
on Diagnosis Codes 13E-22
- 4. Multi-Use Tester Service Data 13E-39
- 5. Actuator Tests Performed
Using Multi-Use Tester 13E-42
- 6. Initialization of Supply Pump Unit
Difference Learning Value in Engine
Electronic Control Unit 13E-44
- 7. Inspections Performed at Electronic
Control Unit Connectors13E-45

**INSPECTION OF ELECTRICAL
EQUIPMENT 13E-48**

**INSTALLED LOCATIONS OF
PARTS 13E-56**

ELECTRIC CIRCUIT DIAGRAM 13E-62

<Auto Cruise System>

STRUCTURE AND OPERATION

- 1. General Description 13E-70
- 2. Electronic Control System 13E-70
- 3. Electronic Control Unit
Connection Diagram 13E-74

TROUBLESHOOTING

- 1. Inspection Procedure 13E-76
- 2. Cautions to Observe When
Performing Inspections..... 13E-77
- 3. Inspection Based on Diagnosis
Codes..... 13E-78
- 4. Multi-Use Tester Service Data 13E-81
- 5. Actuator Tests Performed using
Multi-Use Tester 13E-82
- 6. Inspections Performed at Electronic
Control Unit Connector 13E-83

**INSPECTION OF ELECTRICAL
EQUIPMENT 13E-84**

**INSTALLED LOCATIONS OF
PARTS 13E-86**

ELECTRIC CIRCUIT DIAGRAM 13E-92

SPECIFICATIONS

<Common Rail System>

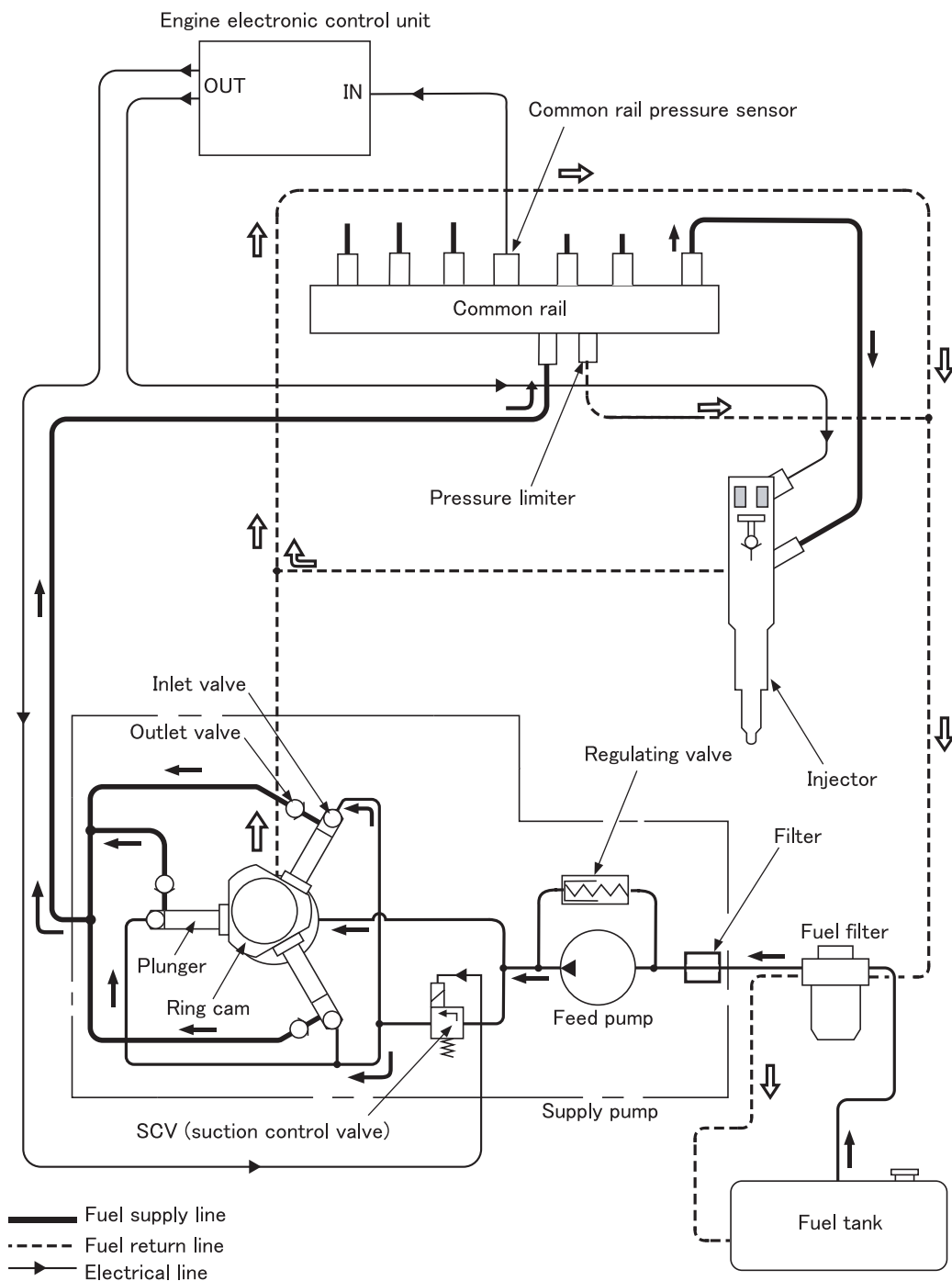
Item		Specification
Supply pump	Manufacturer	DENSO
	Model	HP-4
	Control method	Electronic
	Feed pump type	Trochoid pump
	SCV (suction control valve) Rated voltage V	12
	Max. common rail pressure MPa {psi, kgf/cm ² }	170 {24890, 1750}
Common rail	Manufacturer	DENSO
	Common rail volume cm ³ {cu. in.}	26 {1.56}
	Pressure limiter opening pressure MPa {psi, kgf/cm ² }	221 ± 9 {32050 ± 1310, 2250 ± 92}
	Common rail pressure sensor supply voltage V	5
Injectors	Manufacturer	DENSO
	Control method	Electrical
	Max. operating pressure MPa {psi, kgf/cm ² }	170 {24890, 1750}
	Min. operating pressure MPa {psi, kgf/cm ² }	24 {3480, 245}
Common rail electronic control unit	Manufacturer	DENSO
	Rated voltage V	12

MEMO

STRUCTURE AND OPERATION

1. Overview

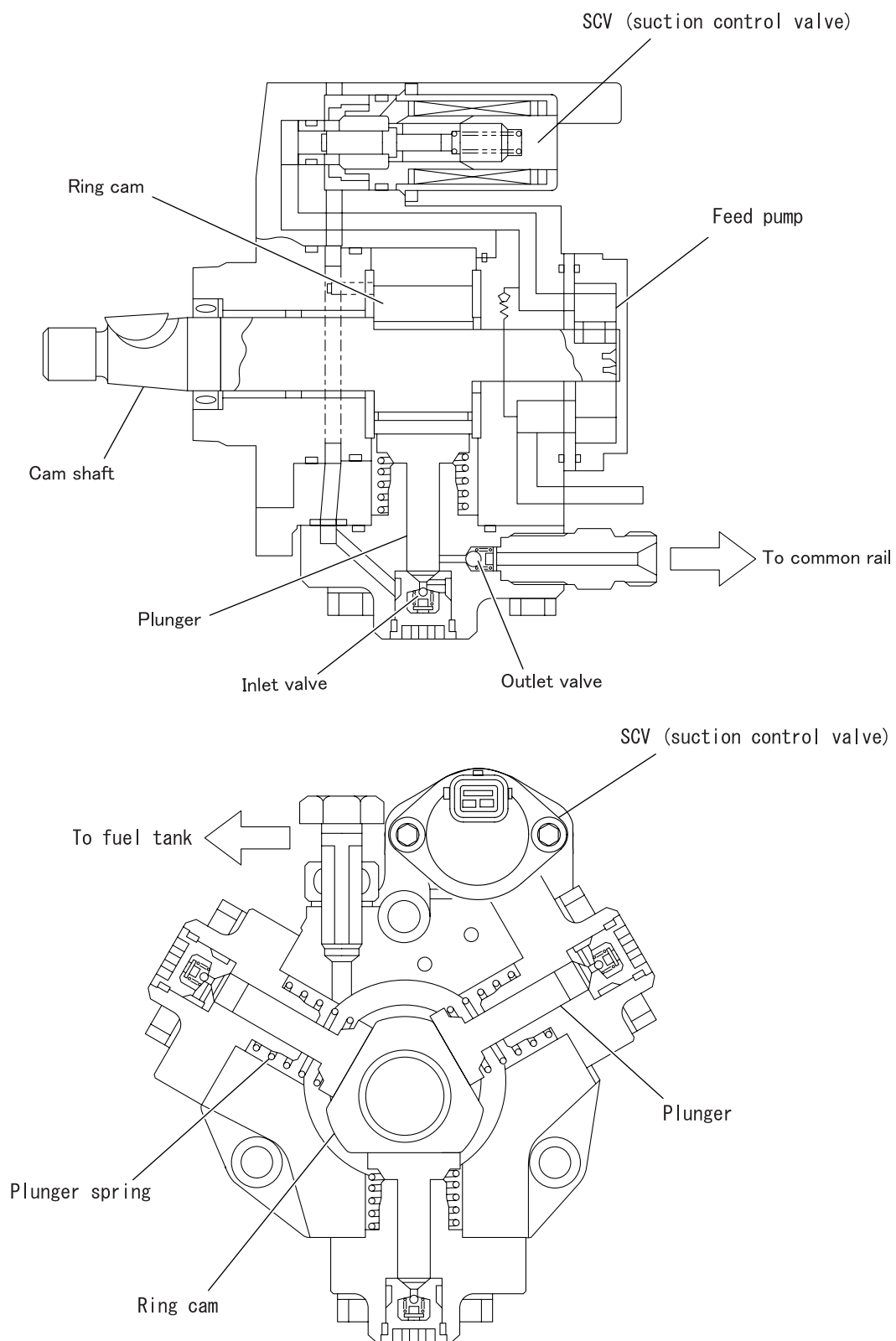
- In the common rail system, an electronic control unit monitors various aspects of the engine (engine speed, throttle opening, coolant temperature, etc.) using information from sensors. In accordance with these data, the electronic control unit effects control over the fuel injection quantity, fuel injection timing, and fuel injection pressure in order to optimize the engine's operation.
- The electronic control unit has a diagnosis function that enables it to recognize abnormalities in the common rail system's major components and alert the driver to them.
- The common rail system consists mainly of an electronically controlled supply pump; injectors; a common rail; and the electronic control unit and sensors that are used to control the other components.

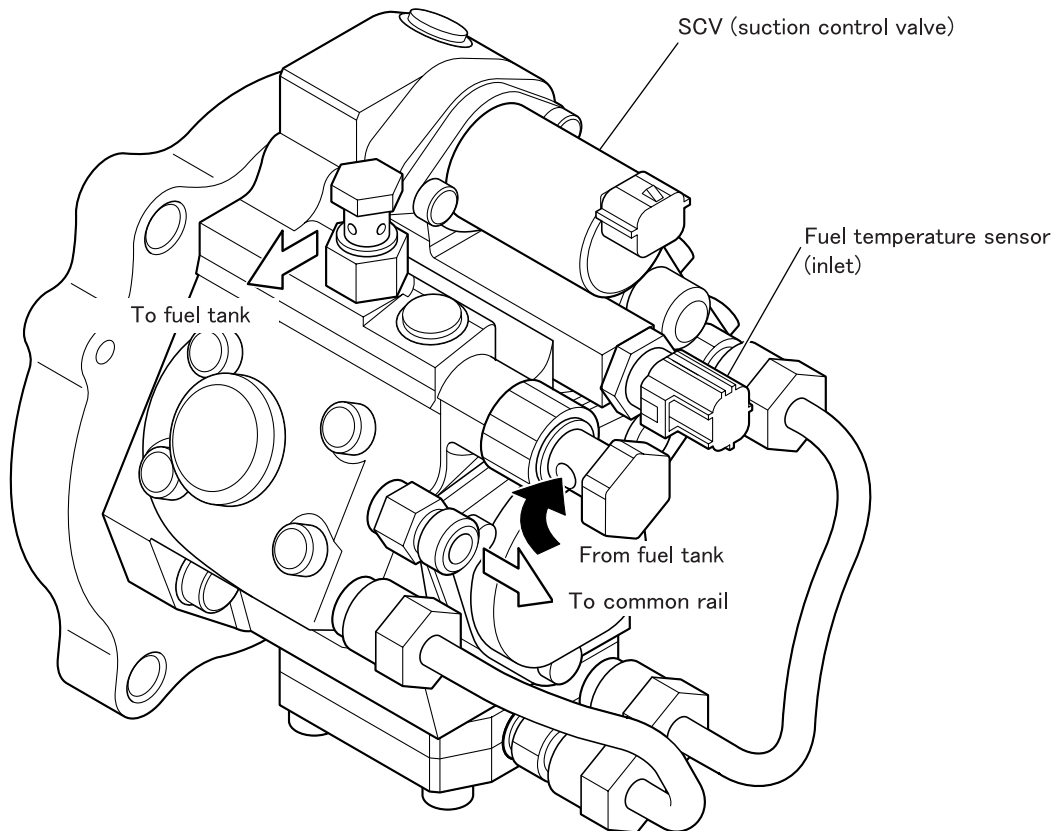


- When the engine is cranked by means of the starter switch, the feed pump (this is located inside the supply pump) simultaneously draws fuel from the fuel tank and feeds it via the fuel filter to the SCV (suction control valve). A quantity of fuel metered by the SCV (suction control valve) is supplied via the inlet valves to the plunger chambers.
- The fuel in the plunger chambers is pressurized. The outlet valves are then opened, and the fuel is fed under pressure to the common rail.
- The pressurized fuel is held in the common rail and then uniformly fed to the injectors.
- In response to signals from the engine electronic control unit, a solenoid valve in each injector causes the injector to inject fuel into the relevant combustion chamber at the optimal timing and in the optimal quantity.

STRUCTURE AND OPERATION

1.1 Supply pump



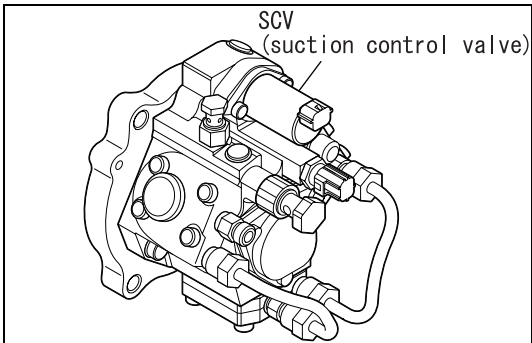


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CAUTION ⚠

- **Be sure to connect the SCV (suction control valve) connector to the engine harness before starting the engine. If the engine were started with the SCV (suction control valve) connector not connected, control of the supply pump by the engine electronic control unit would not be possible and a fault would ensue.**
- The supply pump pressurizes fuel and supplies it in a highly pressurized state.
- Fuel drawn from the fuel tank by the feed pump is not supplied directly to the plungers. It is supplied first to the common rail pressure solenoid valve, which controls the amount of fuel reaching the plungers.
- If the fuel pressure exceeds a certain level, the regulating valve returns fuel to the inlet side of the feed pump. This operation keeps the fuel pressure constant.
- Rotation of the camshaft causes (via the ring cam) up-down movement of the plungers. Fuel in the plunger chambers is thus highly pressurized.

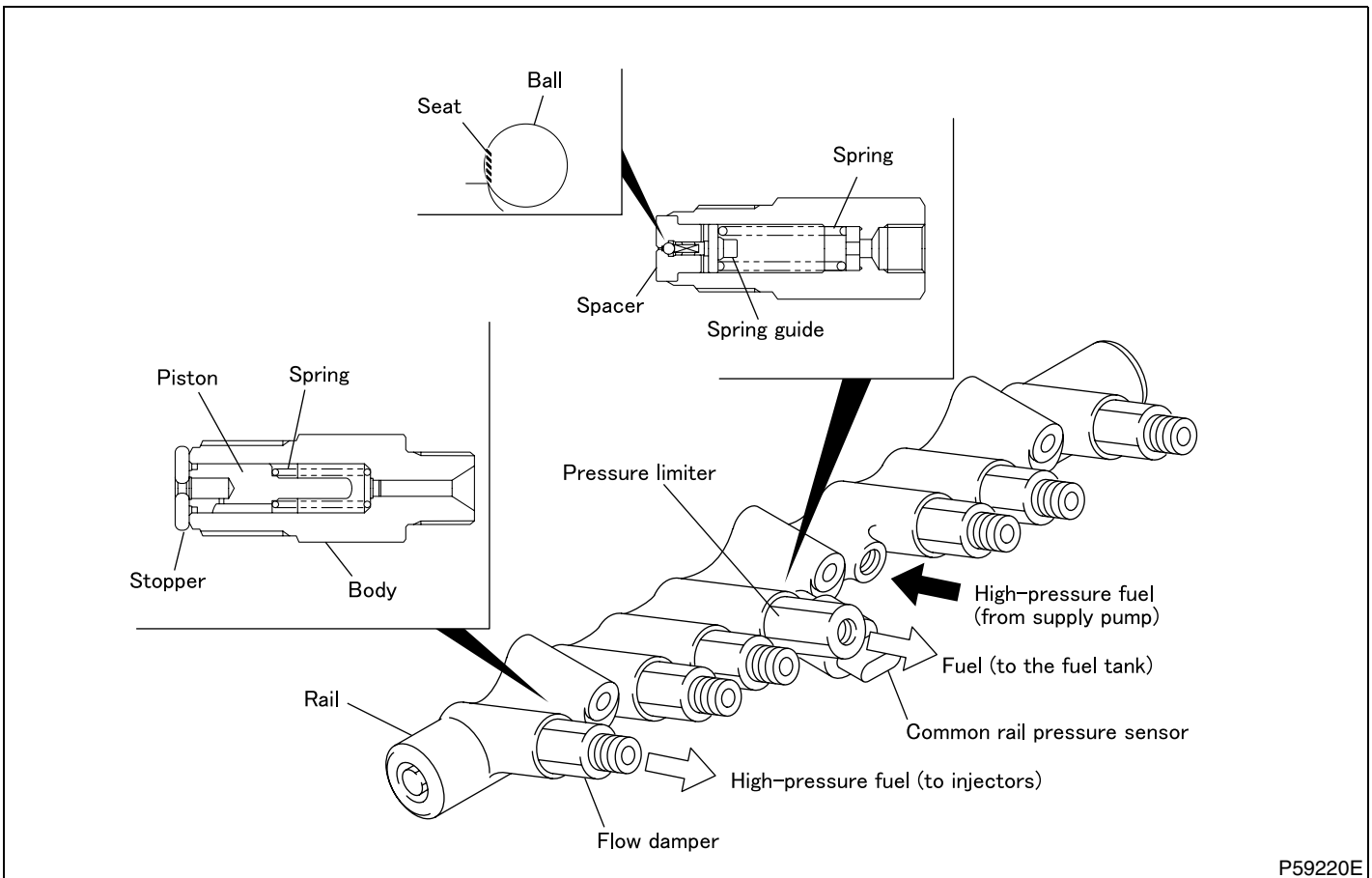
STRUCTURE AND OPERATION



(1) SCV (suction control valve)

- The SCV (suction control valve) receives fuel from the feed pump and feeds fuel toward the plungers of the supply pump in such a quantity that the fuel pressure corresponds to that required by the engine electronic control unit.
- When the SCV (suction control valve) is not operating, i.e., when current is not flowing, fuel flows at its maximum rate. When current flows, the piston in the common rail pressure solenoid valve is pressed down such that fuel is not fed toward the plungers.

1.2 Common rail



P59220E

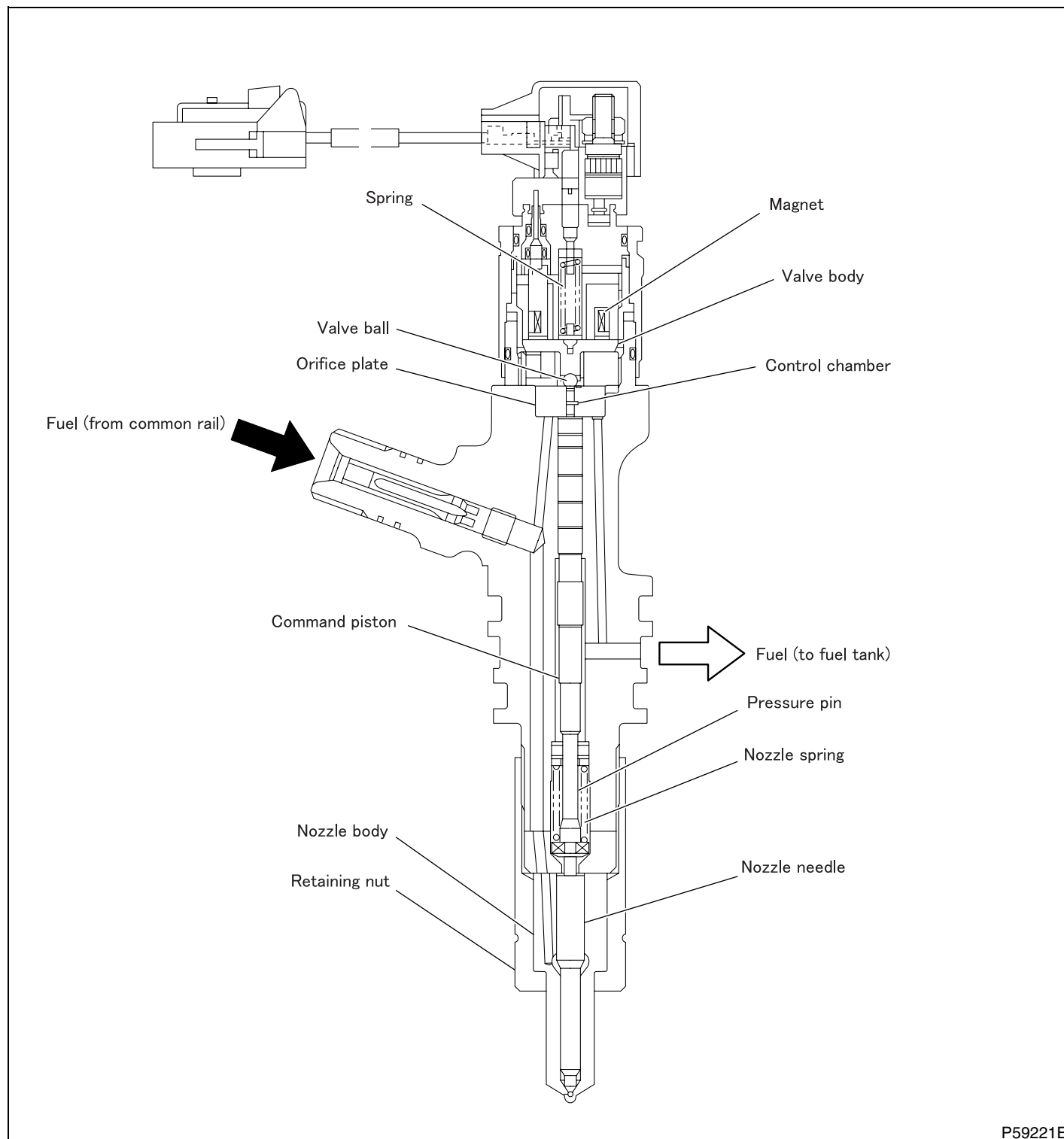
- The common rail distributes to the injectors high-pressure fuel that has been fed from the supply pump.
- Each flow damper prevents an abnormal outflow of fuel. It does so by blocking the fuel passage in the event of fuel leakage from the injection pipe or excessive injection of fuel from the injector.
- The common rail pressure sensor is used in feedback control. It senses the fuel pressure inside the common rail and feeds a corresponding signal to the electronic control unit.
- If the fuel pressure in the common rail exceeds a certain, set level, the piston in the pressure limiter pushes and compresses the spring such that fuel is able to escape. The pressure limiting valve thus prevents the fuel pressure from becoming higher than the set pressure.

Flow damper

- During normal operation, the piston moves (thus pushing and compressing the spring) to the extent necessary for one injection quantity to pass through. The piston does not make contact with the seat at this time. When injection is complete, the piston is returned to its initial position by the spring.

- If the amount of fuel passing through the flow damper becomes excessively great, the piston presses against the seat, thereby closing the fuel passage and preventing an abnormal outflow of fuel.
When the piston has pressed against the seat, it does not return to its original position until the engine has been stopped and the pressure in the common rail has come down.

1.3 Injector



P59221E

- In accordance with electrical signals from the engine electronic control unit, each injector supplies high-pressure fuel from the common rail to the relevant combustion chamber of the engine at the optimal timing and in the optimal quantity.

STRUCTURE AND OPERATION

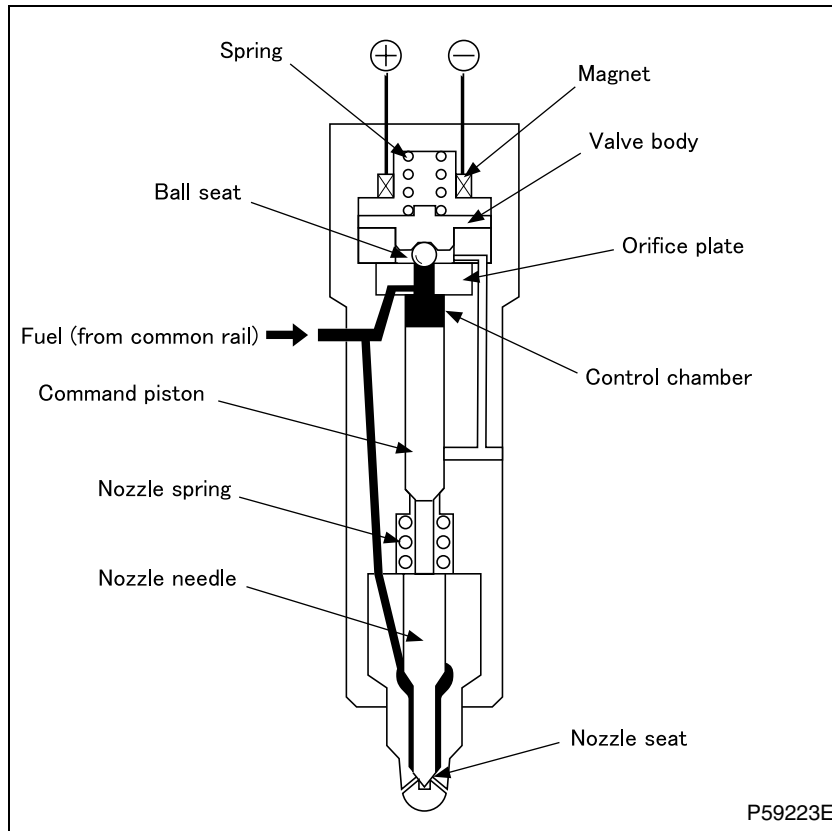
- The functional units of each injector can be broadly defined as follows:

(1) Control section

- The control section consists of the control chamber, magnet, spring, valve body, valve ball, pressure pin, command piston, and orifice plate. The pressure pin is located between the control section and the injection section.

(2) Injection section

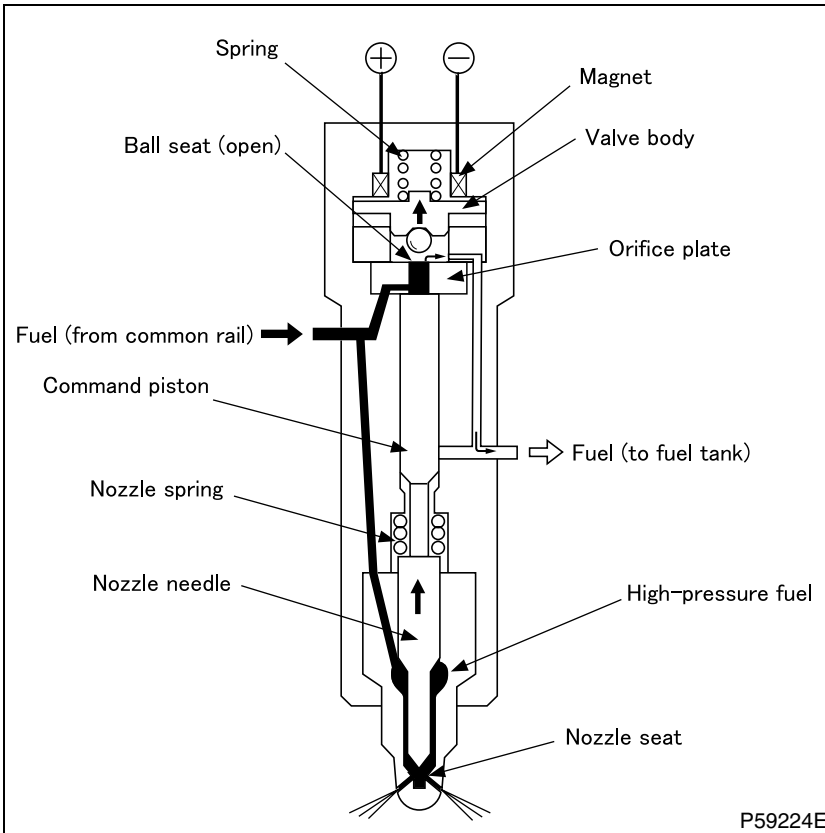
- The injection section consists of the nozzle body, nozzle needle, nozzle spring, and retaining nut.



(3) Operation

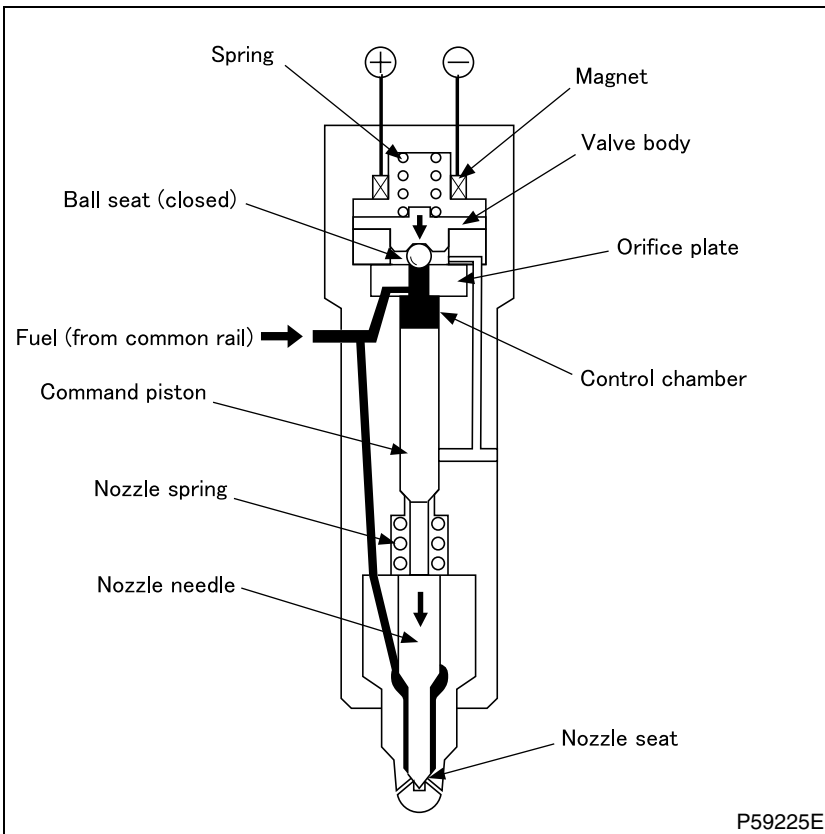
(3.1) Injection not taking place

- With the magnet not energized, the valve body, is pushed up by the spring in the magnet such that the ball seat is closed.
- The high-pressure fuel acts upon the control chamber via orifice plate. The same pressure acts upon the nozzle needle.
- The fuel pressure acting on the nozzle needle cannot overcome the command piston and nozzle spring, so the nozzle needle stays in its downward-pushed position and injection does not take place.



(3.2) Start of injection

- When the magnet is energized, the resulting electromagnetic force draws the valve body upward, causing the ball seat to open.
- Fuel in the control chamber passes through the ball seat and orifice plate and flows to the fuel tank.
- With the pressure in the control chamber reduced, the fuel acting on the nozzle needle overcomes the command piston and nozzle spring, pushing up the nozzle needle such that injection starts.
- If the magnet remains energized, the injection rate reaches its maximum level.



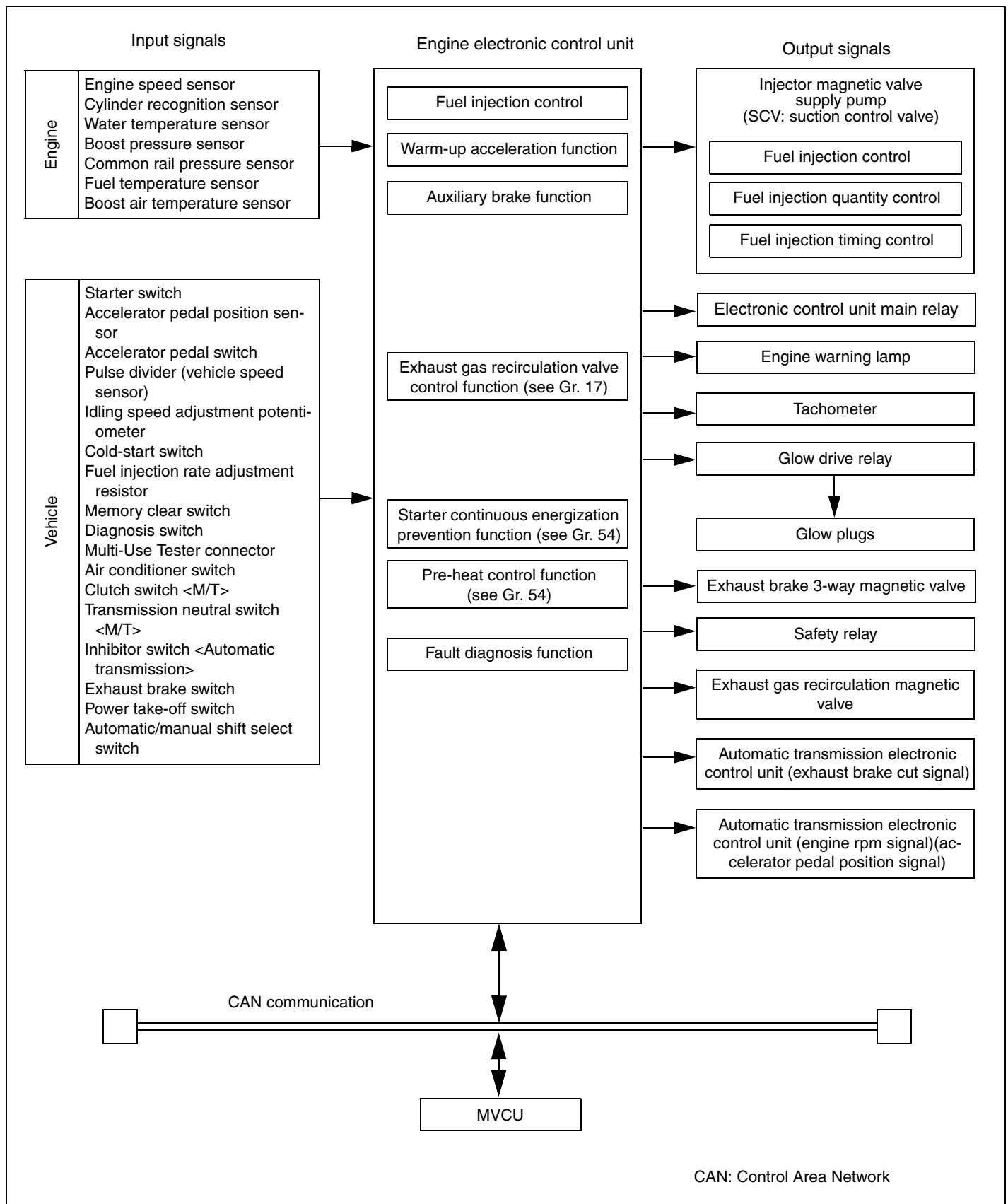
(3.3) End of injection

- When energization of the magnet is stopped, the valve body is pushed downward by the spring in the magnet such that the ball seat closes. At this time, fuel flows into the control chamber via orifice plate, pushing down the command piston and nozzle needle such that injection finishes.

STRUCTURE AND OPERATION

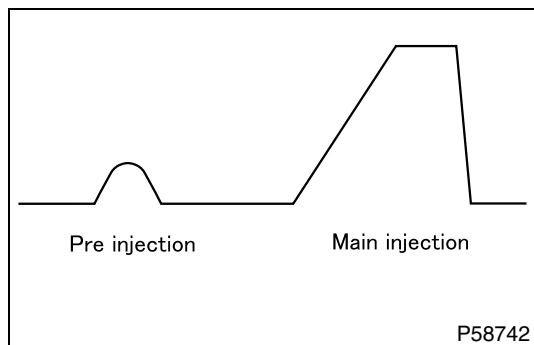
2. Electronic Control System

2.1 System block diagram



Part	Main function/operation
Engine speed sensor	Sensing of engine speed
Cylinder recognition sensor	Cylinder recognition
Starter switch	Senses that the engine is in starting condition with the starter switch in START position.
Water temperature sensor	Sensing of coolant temperature
Accelerator pedal position sensor	Sensing of extent of accelerator pedal depression
Accelerator pedal switch	Sensing of released/depressed condition of accelerator pedal (ON with pedal depressed)
Clutch switch	Sensing of released/depressed condition of clutch pedal (OFF with pedal released)
Transmission neutral switch <M/T>	Detection of transmission neutral condition (OFF with transmission in neutral)
Inhibitor switch <Automatic transmission>	Detection of transmission 'N' range
Pulse divider (vehicle speed sensor)	Sensing of vehicle speed
Fuel temperature sensor	Sensing of fuel temperature
Idling speed adjustment potentiometer	Acceleration of warm-up
Cold-start switch	
Exhaust brake switch	Operation of auxiliary brake
Diagnosis switch	Output of diagnosis codes
Memory clear switch	Deletion of diagnosis codes; output of past diagnosis codes
Fuel injection rate adjustment resistor	Correction of fuel injection rate
Air conditioner switch	ON when air conditioner is operating
Boost pressure sensor	Sensing of boost pressure
Boost air temperature sensor	Sensing of boost air temperature
Multi-Use Tester connector	Communication between Multi-Use Tester and common rail system
Common rail pressure sensor	Sensing of common rail pressure
Power take-off switch	Operation of power take-off
Automatic/manual shift select switch	On automatic transmission vehicles, wire connection is made (no wire connection on M/T vehicles)
Injectors	Control of fuel injection rate, fuel injection quantity, and fuel injection timing
SCV (suction control valve)	Control of fuel injection pressure
Electronic control unit main relay	Power on/off of electronic control unit
Engine control warning lamp	Indication of system abnormalities
Exhaust brake 3-way magnetic valve	ON/OFF control of exhaust brake valve
Glow drive relay	ON/OFF control of glow plugs
Tachometer	Indication of engine speed (in meter cluster)
Exhaust gas recirculation solenoid valve	Exhaust gas recirculation switching control
Safety relay	Control of starter continuous energization prevention function
Automatic transmission electronic control unit (exhaust brake cut signal)	Auxiliary brake function disabled at vehicle speeds below 10 km/h {6.21 mph}
Automatic transmission electronic control unit (engine speed signal)	Output of signals corresponding to engine speed for automatic transmission control
Automatic transmission electronic control unit (accelerator pedal position signal)	Output of signals corresponding to extent of accelerator pedal depression for automatic transmission control
CAN communication (MVCU)	Engine data recognized by the engine electronic control unit are outputted to the CAN bus to enable MVCU system to obtain data needed for control. MVCU system issues signals to the engine electronic control unit via the CAN bus to enable it to effect engine control appropriate for each type of system control.

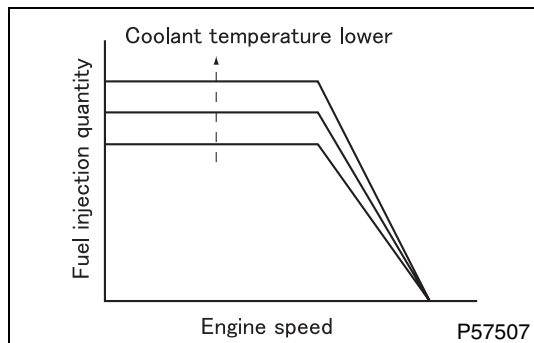
STRUCTURE AND OPERATION



2.2 Fuel injection rate control

(1) Pre injection

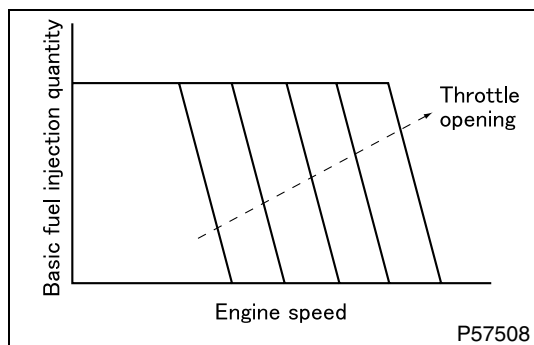
- Pre injection entails the injection of an extremely small amount of fuel ahead of the main injection.
- Pre injection suppresses heat generation early in the injection cycle and thus suppresses NOx generation and noise at the start of combustion.



2.3 Fuel injection quantity control

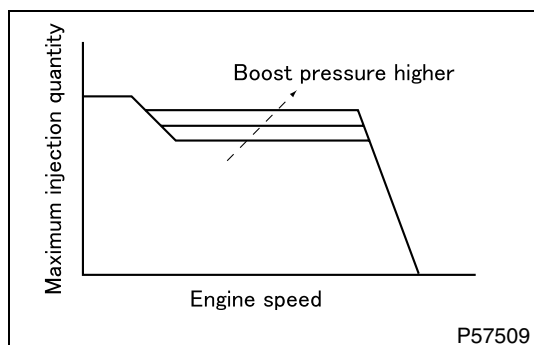
(1) Fuel injection quantity during engine startup

- During engine startup, the fuel injection quantity is determined in accordance with the engine speed and coolant temperature.



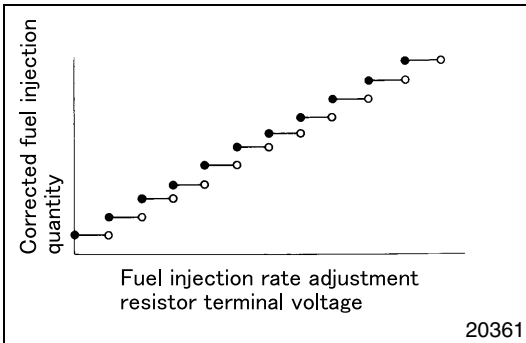
(2) Basic fuel injection quantity

- The basic fuel injection quantity is determined in accordance with the engine speed and throttle opening.



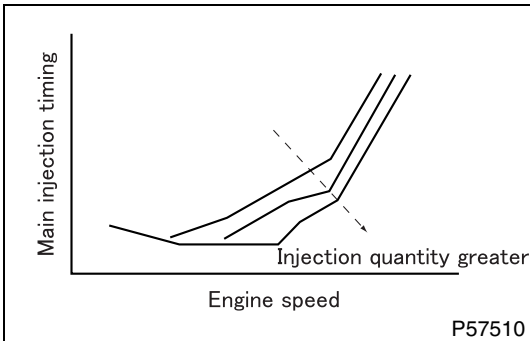
(3) Maximum injection quantity

- The maximum injection quantity is calculated from the engine speed and boost pressure.



(4) Fuel injection rate adjustment resistor correction amount

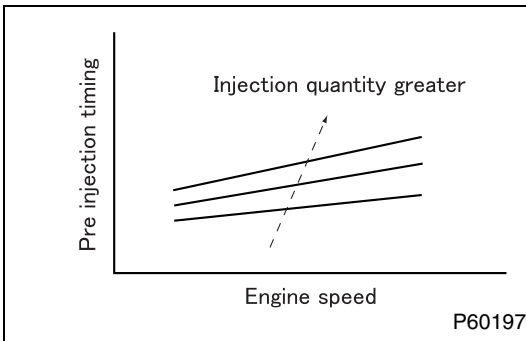
- To limit inconsistency in the injection quantity, the injection quantity is corrected by the fuel injection rate adjustment resistor.



2.4 Fuel injection timing control

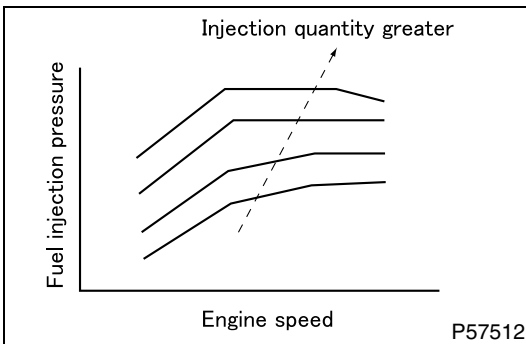
(1) Main injection timing

- The main injection timing is calculated from the fuel injection quantity and engine speed.



(2) Pre injection timing

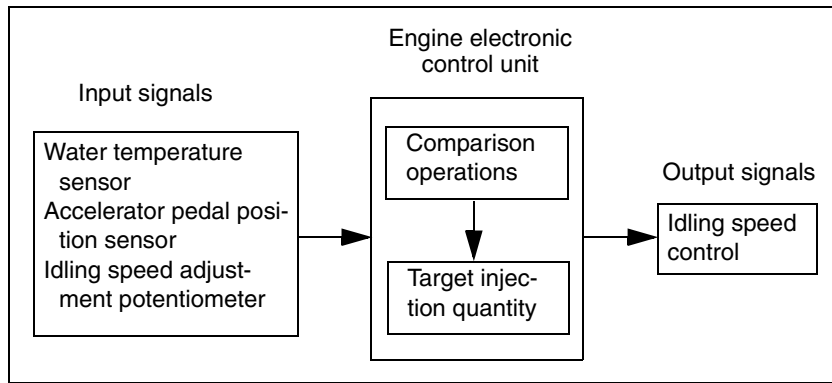
- The pre injection timing is calculated from the fuel injection quantity and engine speed.



2.5 Fuel injection pressure control

- The fuel injection pressure is calculated from the fuel injection quantity and engine speed.

STRUCTURE AND OPERATION



2.6 Warm-up acceleration function

- The warm-up acceleration function increases engine warm-up by varying the engine's idling speed in accordance with the engine's coolant temperature. It can operate either automatically or manually. Selection is made using the idling speed adjustment potentiometer.

2.7 Fault diagnosis function

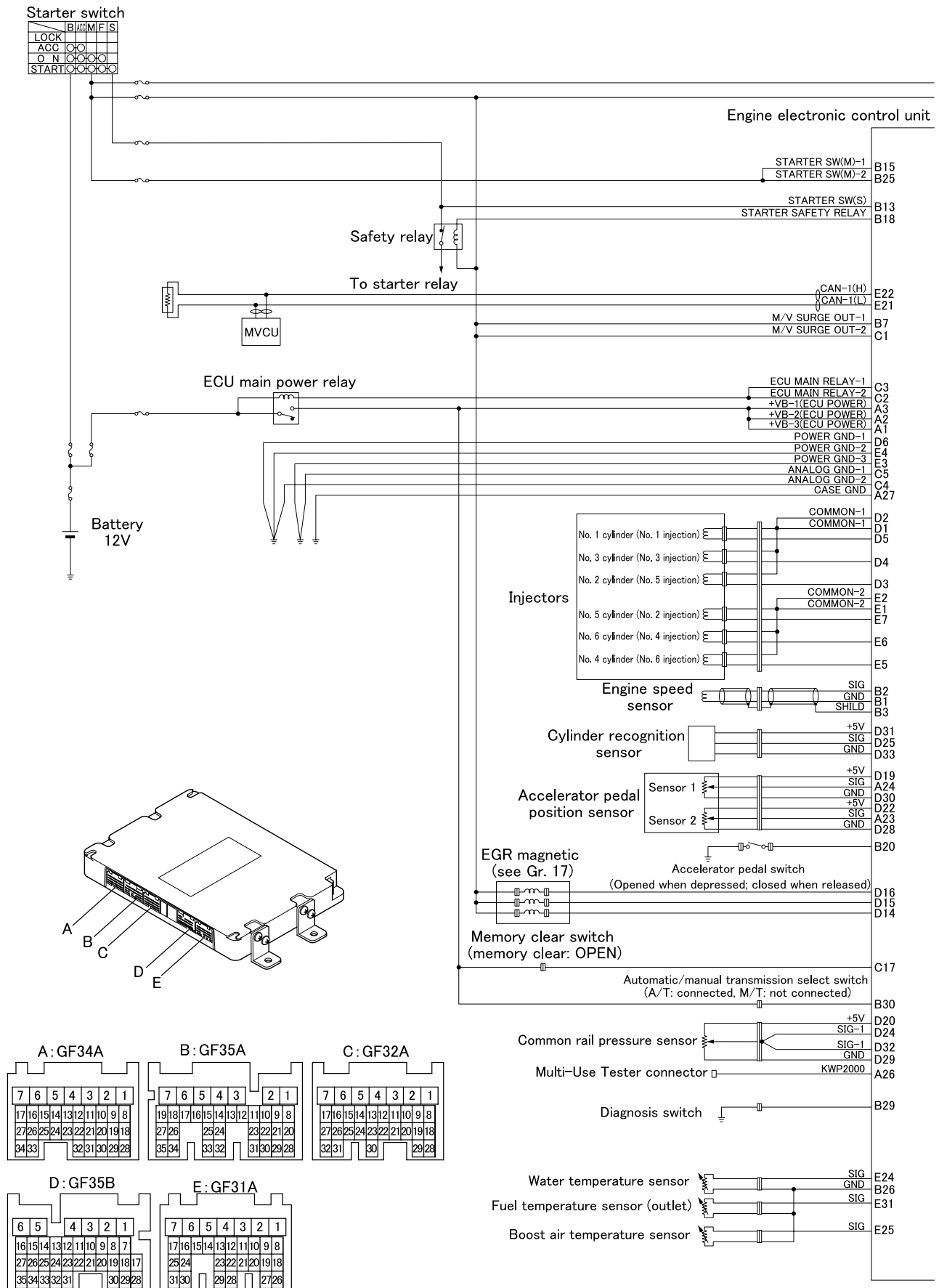
- While the starter switch is in the ON position, the sensors and other components are continuously monitored for faults. In the event that a component is found faulty, an indication is made in the meter cluster to alert the driver, the fault location is memorized in the form of a diagnosis code, and backup control necessitated by the fault is initiated.
- While the backup control is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

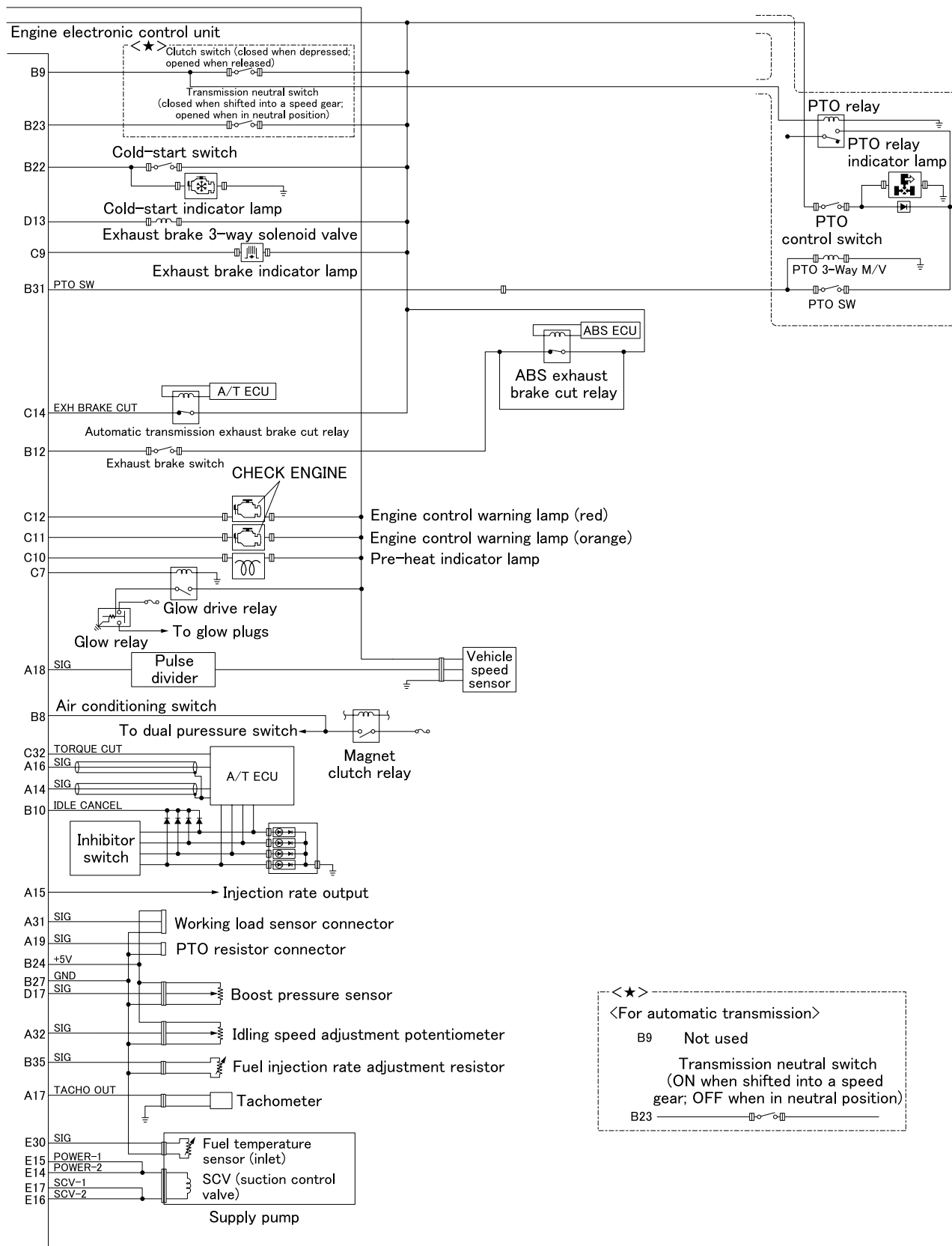
NOTE

- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

MEMO

3. Electronic Control Unit Connection Diagram

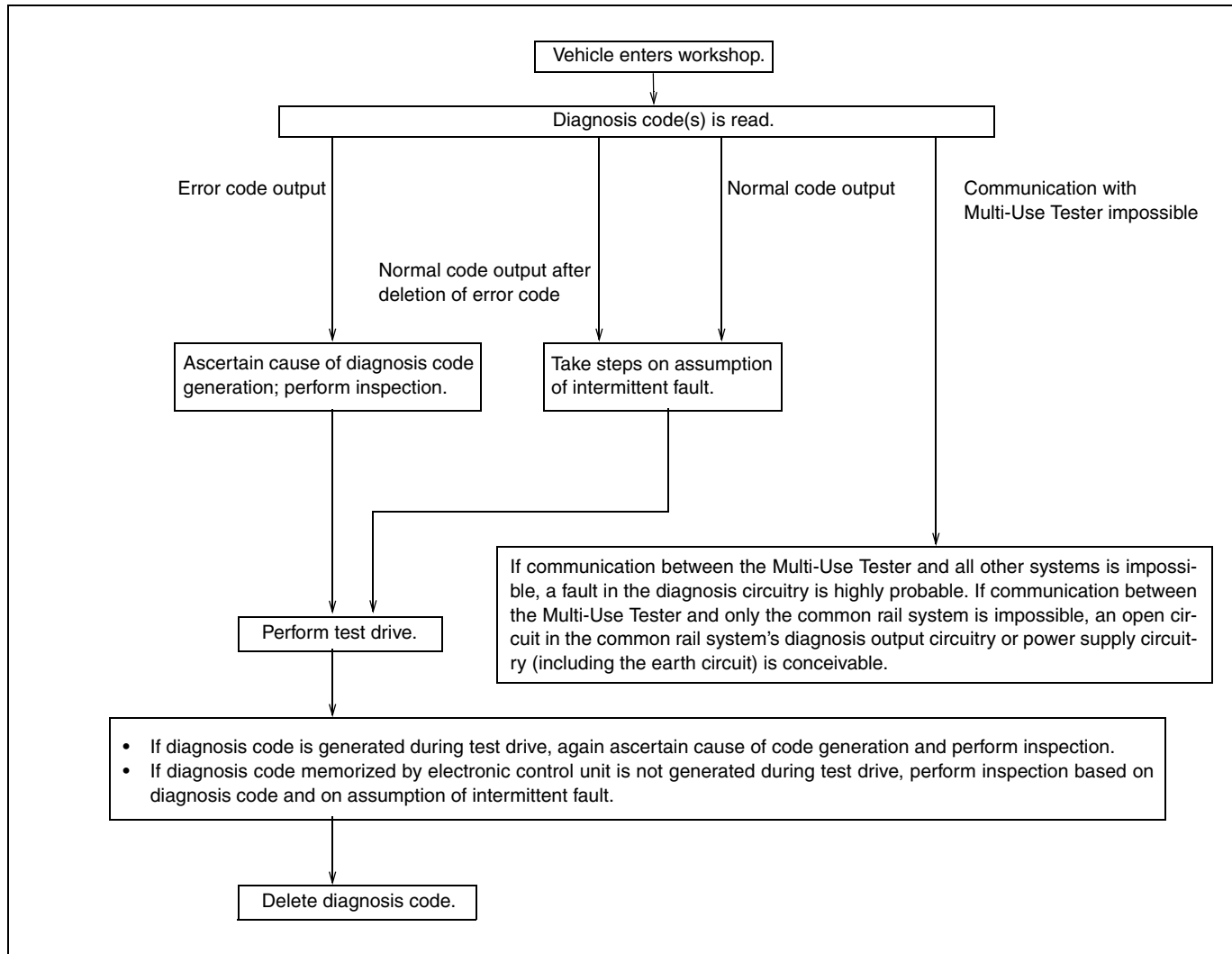




TROUBLESHOOTING

1. Inspection Procedure

- System inspection can be performed most effectively using a Multi-Use Tester III. Types of system inspection are broadly classified in accordance with fault symptoms and diagnosis codes as follows:
 - Inspection based on diagnosis code memorized by electronic control unit
 - Inspection performed on assumption of intermittent fault



2. Cautions to Observe When Performing Inspections

CAUTION

- The battery voltage must be the standard voltage.
- Make sure no harness connector or component connector is loose. Before disconnecting any connector, place the starter switch in the LOCK position and wait 20 seconds.
- After making a repair, delete the diagnosis code using the Multi-Use Tester or memory clear switch.
- As a general rule, inspection work should be performed with the starter switch in the LOCK position. However, it may be necessary to perform certain tasks with the starter switch in the ON position. At these times, be careful not to cause short circuits between connector terminals and between terminals and the vehicle body.
- Indicated component resistances may not fall within the standard ranges if they are unduly affected by the temperature and/or by the accuracy of the tester. Standard values in the text are given on the assumption of room temperature (10 to 35°C {50 to 95°F}).
- After rectification of an abnormality, the system's ability or inability to automatically return to normal control from the backup control that begins when a fault occurs depends upon the diagnosis code, i.e., the fault location. When the system resumes normal control, the warning lamp goes off.
- Even when an abnormality has been rectified and the system has automatically returned to normal control, the diagnosis code corresponding to the fault location remains in the memory of the electronic control unit as a past diagnosis code.
- Following a fault that does not permit an automatic return to normal control from the backup control that begins when a fault occurs, it is necessary to turn the starter switch to the OFF position in order for the system to recover.

TROUBLESHOOTING

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

NOTE

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Flash-es	Re-marks
P0107	Atmospheric Pressure Sensor	19	
P0108	Atmospheric Pressure Sensor	19	
P0112	INT Air Temp. SNSR (Upstream)	44	
P0113	INT Air Temp. SNSR (Upstream)	44	
P0117	Water Temperature Sensor	21	
P0118	Water Temperature Sensor	21	
P0121	Accel Pedal Check (Plausibility)	58	
P0122	Accel Pedal Sensor 1	24	
P0123	Accel Pedal Sensor 1	24	
P0182	Fuel Temp. Sensor (inlet)	41	
P0183	Fuel Temp. Sensor (inlet)	41	
P0187	Fuel Temp. Sensor (outlet)	56	
P0188	Fuel Temp. Sensor (outlet)	56	
P0191	Common Rail Pressure Sensor	11	
P0192	Common Rail Pressure Sensor	11	
P0193	Common Rail Pressure Sensor	11	
P0200	Injector Circuit 1	82	
P0201	Injector M/V-Cylinder1	37	
P0202	Injector M/V-Cylinder2	38	
P0203	Injector M/V-Cylinder3	39	
P0204	Injector M/V-Cylinder4	08	
P0205	Injector M/V-Cylinder5	46	
P0206	Injector M/V-Cylinder6	47	
P0219	Engine Overrunning	07	
P0222	Accel Pedal Sensor 2	16	
P0223	Accel Pedal Sensor 2	16	
P0234	Over Boost Error	54	
P0237	Boost Pressure Sensor	32	
P0238	Boost Pressure Sensor	32	
P0251	Common Rail Pressure Defect	36	
P0252	Common Rail Pressure Defect	36	
P0253	Common Rail Pressure Defect	22	
P0254	Common Rail Pressure Defect	23	
P0255	Common Rail Pressure M/V 1	23	
P0256	Common Rail Pressure M/V 1	23	
P0257	Common Rail Pressure M/V 1	23	
P0355	Engine Revolution Sensor	15	
P0340	Camshaft Position Sensor	12	

Code	Message	Flash-es	Re-marks
P0380	Relay for Glow Relay	26	Gr54
P0500	Vehicle Speed Sensor	25	
P0506	Idle Volume	31	
P0507	Idle Volume	31	
P0510	Accel SW	65	
P0600	CAN (SLD)	—	
P0605	ECU System (Hardware)	33	
P0616	Starter Safety Relay	48	Gr54
P0617	Starter Safety Relay	48	Gr54
P1171	Q Adjustment Resistor	34	
P1172	Q Adjustment Resistor	34	
P1200	Injector Circuit 2	82	
P1210	Injector Circuit 3	82	
P1240	Flow Limiter -Cylinder1	71	
P1241	Flow Limiter -Cylinder2	72	
P1242	Flow Limiter -Cylinder3	73	
P1243	Flow Limiter -Cylinder4	74	
P1244	Flow Limiter -Cylinder5	75	
P1245	Flow Limiter -Cylinder6	76	
P1255	Common Rail Pressure M/V 1	63	
P1256	Common Rail Pressure M/V 1	63	
P1257	Common Rail Pressure M/V 1	63	
P1267	EGR 1	67	Gr17
P1268	EGR 1	67	Gr17
P1272	EGR 2	68	Gr17
P1273	EGR 2	68	Gr17
P1277	EGR 3	69	Gr17
P1278	EGR 3	69	Gr17
P1462	Exhaust Brake M/V 1	93	
P1463	Exhaust Brake M/V 1	93	
P1605	ECU System (EEPROM)	33	

3.2 Diagnosis code generation conditions and inspection items

P0107: Atmospheric Pressure Sensor (warning lamp flashes: 19)

Generation condition		Atmospheric pressure sensor (incorporated into engine electronic control unit) voltage is below standard value (1.9 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected with atmospheric pressure assumed as constant 101 kPa {15 psi, 1.03 kgf/cm²}. (Exhaust emissions worsen.) - Exhaust gas recirculation control is stopped.
Inspection	Service data	38: Atmospheric Pressure
	Electrical equipment	Engine electronic control unit

P0108: Atmospheric Pressure Sensor (warning lamp flashes: 19)

Generation condition		Atmospheric pressure sensor (incorporated into engine electronic control unit) voltage is above standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected with atmospheric pressure assumed as constant 101 kPa {15 psi, 1.03 kgf/cm²}. (Exhaust emissions worsen.) - Exhaust gas recirculation control is stopped.
Inspection	Service data	38: Atmospheric Pressure
	Electrical equipment	Engine electronic control unit

P0112: INT Air Temp. SNSR (Upstream) (warning lamp flashes: 44)

Generation condition		Boost air temperature sensor (upstream) voltage is below standard value (0.1 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Boost air temperature is assumed as constant -20°C {-4°F} during engine startup and as constant 25°C {77°F} while vehicle is being driven.
Inspection	Service data	27: Intake Air Temperature
	Electronic control unit connector	01 : Boost air temperature sensor
	Electrical equipment	#305: Boost air temperature sensor
	Electric circuit diagram	Boost air temperature sensor system

P0113: INT Air Temp. SNSR (Upstream) (warning lamp flashes: 44)

Generation condition		Boost air temperature sensor (upstream) voltage is above standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Boost air temperature is assumed as constant -20°C {-4°F} during engine startup and as constant 25°C {77°F} while vehicle is being driven.
Inspection	Service data	27: Intake Air Temperature
	Electronic control unit connector	01 : Boost air temperature sensor
	Electrical equipment	#305: Boost air temperature sensor
	Electric circuit diagram	Boost air temperature sensor system

TROUBLESHOOTING

P0117: Water Temperature Sensor (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage is below standard value (0.1 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Water temperature is assumed as constant -20°C {-4°F} during engine startup and as constant 80°C {175°F} while vehicle is being driven. (Exhaust emissions worsen.) - Exhaust gas recirculation control is stopped.
Inspection	Service data	35: Water Temperature
	Electronic control unit connector	02 : Boost air temperature sensor
	Electrical equipment	#262: Water temperature sensor
	Electric circuit diagram	Water temperature sensor system

P0118: Water Temperature Sensor (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage is above standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Water temperature is assumed as constant -20°C {-4°F} during engine startup and as constant 80°C {175°F} while vehicle is being driven. (Exhaust emissions worsen.) - Exhaust gas recirculation control is stopped.
Inspection	Service data	35: Water Temperature
	Electronic control unit connector	02 : Water temperature sensor
	Electrical equipment	#262: Water temperature sensor
	Electric circuit diagram	Water temperature sensor system

P0121: Accel Pedal Check (Plausibility) (warning lamp flashes: 58)

Generation condition		Output voltage difference of accelerator pedal position sensors 1 and 2 is outside standard range.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using value of 30% with accelerator pedal depressed and using value of 0% with accelerator pedal not depressed. (Output is reduced.)
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered), 24: Accel Pedal Sensor Voltage 1, 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor system

P0122: Accel Pedal Sensor 1 (warning lamp flashes: 24)

Generation condition		Accelerator pedal position sensor 1 voltage is below standard value (0.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using accelerator pedal position sensor 2. - If both sensors 1 and 2 are faulty, control is effected on assumption that accelerator pedal is depressed 30% when accelerator switch is on and the pedal is not depressed when the switch is off.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered), 24: Accel Pedal Sensor Voltage 1
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor system

P0123: Accel Pedal Sensor 1 (warning lamp flashes: 24)

Generation condition		Accelerator pedal position sensor 1 voltage is above standard value (4.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using accelerator pedal position sensor 2. - If both sensors 1 and 2 are faulty, control is effected on assumption that accelerator pedal is depressed 30% when accelerator switch is on and the pedal is not depressed when the switch is off.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered), 24: Accel Pedal Sensor Voltage 1
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor system

P0182: Fuel Temp. Sensor (inlet) (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor (inlet) voltage is below standard value (0.1 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Fuel temperature is assumed to be constant 40°C {105°F}.
Inspection	Service data	36: Fuel Temperature (inlet)
	Electronic control unit connector	04 : Fuel temperature sensor (inlet)
	Electrical equipment	#323: Fuel temperature sensor (inlet)
	Electric circuit diagram	Fuel temperature sensor (inlet) system

P0183: Fuel Temp. Sensor (inlet) (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor voltage is above standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Fuel temperature is assumed to be constant 40°C {105°F}.
Inspection	Service data	36: Fuel Temperature (inlet)
	Electronic control unit connector	04 : Fuel temperature sensor (inlet)
	Electrical equipment	#323: Fuel temperature sensor (inlet)
	Electric circuit diagram	Fuel temperature sensor (inlet) system

TROUBLESHOOTING

P0187: Fuel Temp. Sensor (outlet) (warning lamp flashes: 56)

Generation condition		Fuel temperature sensor (outlet) voltage is below standard value (0.1 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Fuel temperature is assumed as constant 40°C {105°F} during engine startup and as constant 80°C {175°F} while vehicle is being driven.
Inspection	Service data	37: Fuel Temperature
	Electronic control unit connector	05 : Fuel temperature sensor (outlet)
	Electrical equipment	#323: Fuel temperature sensor (outlet)
	Electric circuit diagram	Fuel temperature sensor (outlet) system

P0188: Fuel Temp. Sensor (outlet) (warning lamp flashes: 56)

Generation condition		Fuel temperature sensor (outlet) voltage is above standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Fuel temperature is assumed as constant 40°C {105°F} during engine startup and as constant 80°C {175°F} while vehicle is being driven.
Inspection	Service data	37: Fuel Temperature
	Electronic control unit connector	05 : Fuel temperature sensor (outlet)
	Electrical equipment	#323: Fuel temperature sensor (outlet)
	Electric circuit diagram	Fuel temperature sensor (outlet) system

P0191: Common Rail Pressure Sensor (warning lamp flashes: 11)

Generation condition		All three conditions listed below are satisfied simultaneously while engine is being cranked or while vehicle is being driven. ① Engine speed, injection amount, common rail pressure and fuel type are within specification. ② Difference between actual common rail pressure and target common rail pressure is greater than standard value. ③ Extent of changes in actual common rail pressure is smaller than standard value.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Common rail pressure open loop control is effected. - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Service data	07: Reference Common Rail Pressure, 09: Actual Common Rail Pressure, 0B: Difference Common Rail Pressure, 0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P0192: Common Rail Pressure Sensor (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage is below standard value (0.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Common rail pressure open loop control is effected. - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Service data	07: Reference Common Rail Pressure, 09: Actual Common Rail Pressure, 0B: Difference Common Rail Pressure, 0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P0193: Common Rail Pressure Sensor (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage is above standard value (4.95 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Common rail pressure open loop control is effected. - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Service data	07: Reference Common Rail Pressure, 09: Actual Common Rail Pressure, 0B: Difference Common Rail Pressure, 0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P0200: Injector Circuit 1 (warning lamp flashes: 82)

Generation condition		Either one of injector magnetic valves (No. 1, 2 or 3 cylinder) is short-circuited, or open-circuited.
Recoverability		- When short-circuited: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. - When open-circuited: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		<When short-circuited> - Main injections only enabled. - Common rail pressure upper limit provided. - Injection rate limited to predetermined value. - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled. <When open-circuited> - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator test	BB: Injector Test 1, BD: Injector Test 3, BF: Injector Test 5
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 1, 2 and 3 cylinder) system

P0201: Injector M/V - Cylinder1 (warning lamp flashes: 37)

Generation condition		Injector magnetic valve (No. 1 cylinder) is short-circuited or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Fuel injection stopped for faulty cylinder - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator test	BB: Injector Test 1
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 1 cylinder) system

TROUBLESHOOTING

P0202: Injector M/V - Cylinder2 (warning lamp flashes: 38)

Generation condition		Injector magnetic valve (No. 2 cylinder) is short-circuited or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Fuel injection stopped for faulty cylinder - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator test	BB: Injector Test 2
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 2 cylinder) system

P0203: Injector M/V - Cylinder3 (warning lamp flashes: 39)

Generation condition		Injector magnetic valve (No. 3 cylinder) is short-circuited or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Fuel injection stopped for faulty cylinder - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator test	BB: Injector Test 3
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 3 cylinder) system

P0204: Injector M/V - Cylinder4 (warning lamp flashes: 08)

Generation condition		Injector magnetic valve (No. 4 cylinder) is short-circuited or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Fuel injection stopped for faulty cylinder - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator test	BB: Injector Test 4
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 4 cylinder) system

P0205: Injector M/V - Cylinder5 (warning lamp flashes: 46)

Generation condition		Injector magnetic valve (No. 5 cylinder) is short-circuited or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Fuel injection stopped for faulty cylinder - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator test	BB: Injector Test 5
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 5 cylinder) system

P0206: Injector M/V - Cylinder6 (warning lamp flashes: 47)

Generation condition		Injector magnetic valve (No. 6 cylinder) is short-circuited or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Fuel injection stopped for faulty cylinder - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator test	BB: Injector Test 6
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 6 cylinder) system

P0219: Engine Overrunning (warning lamp flashes: 07)

Generation condition		Engine speed is higher than specified level.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Common rail system is deactivated (engine stopped immediately).
Inspection	Electric circuit diagram	Engine electronic control unit

P0222: Accel Pedal Sensor 2 (warning lamp flashes: 16)

Generation condition		Accelerator pedal position sensor 2 voltage is below standard value (0.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using accelerator pedal position sensor 1. - If both sensors 1 and 2 are faulty, control is effected on assumption that accelerator pedal is depressed 30% when accelerator switch is on and the pedal is not depressed when the switch is off.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered), 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor system

P0223: Accel Pedal Sensor 2 (warning lamp flashes: 16)

Generation condition		Accelerator pedal position sensor 2 voltage is above standard value (4.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using accelerator pedal position sensor 1. - If both sensors 1 and 2 are faulty, control is effected on assumption that accelerator pedal is depressed 30% when accelerator switch is on and the pedal is not depressed when the switch is off.
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered), 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor system

TROUBLESHOOTING

P0234: Over Boost Error (warning lamp flashes: 54)

Generation condition		Boost pressure is beyond limit value
Recoverability		- Lower limit: System recovers if signal becomes normal with starter switch in ON position. - Upper limit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Injection amount is limited.
Inspection	Other	Turbocharger (See Gr 15.)

P0237: Boost Pressure Sensor (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage is below standard value (0.3 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected with boost pressure assumed as constant 101 kPa {15 psi, 1.03 kgf/cm ² }.
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

P0238: Boost Pressure Sensor (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage is above standard value (4.7V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected with boost pressure assumed as constant 101 kPa {15 psi, 1.03 kgf/cm ² }.
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

P0251: Common Rail Pressure Defect (warning lamp flashes: 36)

Generation condition		Fuel is leaking from high-pressure part of system (calculated value).
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		–
Inspection	Actuator test	B9: Fuel Leak Check
	Other	- Air-bleeding of fuel system (See Gr 13.) - Inspection of fuel piping (from supply pump to common rail) (See Gr 13.) - Fuel filter (See Gr 13.) - Supply pump (Have work performed by DENSO Service Station.), main body of common rail - Pressure limiter (Have work performed by DENSO Service Station.) - Injectors (Have work performed by DENSO Service Station.)

P0252: Common Rail Pressure Defect (warning lamp flashes: 36)

Generation condition		Common rail pressure is too high and fuel leakage (calculated value) exceeds standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		—
Inspection	Actuator test	B9: Fuel Leak Check
	Other	• Air-bleeding of fuel system (See Gr 13.) • Inspection of fuel piping (See Gr 13.) • Fuel filter (See Gr 13.) • Supply pump (Have work performed by DENSO Service Station.) • Pressure limiter (Have work performed by DENSO Service Station.) • Injectors (Have work performed by DENSO Service Station.)

P0253: Common Rail Pressure Defect (warning lamp flashes: 22)

Generation condition		Common rail pressure is abnormally high (above 245MPa (higher than operating pressure of pressure limiter))
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Common rail system is deactivated (engine stopped immediately).
Inspection	Other	• Inspection of fuel piping (See Gr 13.) • Inspection or replacement of supply pump. (Have work performed by DENSO Service Station.) • Pressure limiter (Have work performed by DENSO Service Station.), main body of common rail • Injectors (Have work performed by DENSO Service Station.)

P0254: Common Rail Pressure Defect (warning lamp flashes: 23)

Generation condition		Common rail pressure is slightly too high (lower than operating pressure of pressure limiter)
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Main injections only enabled. • Common rail pressure upper limit provided. • Injection rate limited to predetermined value. • Auto cruise control stopped. • Exhaust gas recirculation control stopped. (Common rail pressure and injection quantity are limited.)
Inspection	Actuator test	B9: Fuel Leak Check
	Other	• Inspection of fuel piping (See Gr 13.) • Inspection or replacement of supply pump. (Have work performed by DENSO Service Station.) • Pressure limiter (Have work performed by DENSO Service Station.), main body of common rail • Injectors (Have work performed by DENSO Service Station.)

TROUBLESHOOTING

P0255: Common Rail Pressure M/V 1 (warning lamp flashes: 23)

Generation condition		Common rail pressure exceeds standard value for longer than standard period during low-speed use of supply pump.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Normal control
Inspection	Actuator test	B9: Fuel Leak Check
	Other	• Inspection or replacement of supply pump (Have work performed by DENSO Service Station.) • Pressure limiter (Have work performed by DENSO Service Station.) , main body of common rail • Injectors (Have work performed by DENSO Service Station.)

P0256: Common Rail Pressure M/V 1 (warning lamp flashes: 23)

Generation condition		Common rail pressure exceeds standard value for longer than standard period during mid-range-speed or high-speed use of supply pump.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Main injections only enabled. • Common rail pressure upper limit provided. • Injection rate limited to predetermined value. (Common rail pressure and injection quantity are limited.)
Inspection	Other	• Inspection of fuel piping (See Gr 13.) • Inspection or replacement of supply pump. (Have work performed by DENSO Service Station.) • Pressure limiter (Have work performed by DENSO Service Station.), main body of common rail • Injectors (Have work performed by DENSO Service Station.)

P0257: Common Rail Pressure M/V 1 (warning lamp flashes: 23)

Generation condition		Pressure-feed malfunction occurs because of fault in supply pump assembly (fault in one cylinder).
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Main injections only enabled. • Common rail pressure upper limit provided. • Injection rate limited to predetermined value. (Common rail pressure and injection quantity are limited.)
Inspection	Other	• Inspection or replacement of supply pump (Have work performed by DENSO Service Station.)

P0335: Engine Revolution Sensor (warning lamp flashes: 15)

Generation condition		Engine speed sensor emits no pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Control is effected using cylinder recognition sensor. (If cylinder recognition sensor also becomes faulty, engine is stopped.) • Auto cruise control is disabled.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Engine speed sensor
	Electrical equipment	#263: Engine speed sensor
	Electric circuit diagram	Engine speed sensor system

P0340: Camshaft Position Sensor (warning lamp flashes: 12)

Generation condition		Cylinder recognition sensor emits no pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Control is effected using engine speed sensor. (If engine speed sensor also becomes faulty, engine is stopped.) - Auto cruise control is disabled. (Normal driving possible (If engine speed sensor is also faulty, engine is stopped.) (Engine startability worsens.)
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	08 : Cylinder recognition sensor
	Electrical equipment	#320: Cylinder recognition sensor
	Electric circuit diagram	Cylinder recognition sensor system

P0500: Vehicle Speed Sensor (warning lamp flashes: 25)

Generation condition		Vehicle speed sensor signal is missing even when engine speed exceeds predetermined level with a speed gear engaged and clutch pedal released.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- SLD control is disabled. - Auto cruise control is disabled.
Inspection	Service data	3C: Vehicle Speed
	Electronic control unit connector	09 : Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Vehicle speed sensor system

P0506: Idle Volume (warning lamp flashes: 31)

Generation condition		Idling speed adjustment potentiometer voltage is below standard value (0.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected on assumption that voltage is constantly 0 V.
Inspection	Service data	3B: Idle Volume Voltage
	Electronic control unit connector	10 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer
	Electric circuit diagram	Idling speed adjustment potentiometer system

P0507: Idle Volume (warning lamp flashes: 31)

Generation condition		Idling speed adjustment potentiometer voltage is above standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected on assumption that voltage is constantly 0 V.
Inspection	Service data	3B: Idle Volume Voltage
	Electronic control unit connector	10 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer
	Electric circuit diagram	Idling speed adjustment potentiometer system

TROUBLESHOOTING

P0510: Accel SW (warning lamp flashes: 65)

Generation condition		Accelerator pedal switch signal is abnormal when compared with accelerator pedal position sensor outputs 1 and 2.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Normal control is effected using accelerator pedal position sensor signals.
Inspection	Service data	73: Accel SW
	Electronic control unit connector	11 : Accelerator pedal switch
	Electrical equipment	#029: Accelerator pedal switch
	Electric circuit diagram	Accelerator pedal switch system

P0600: CAN (SLD) (warning lamp flashes: -)

Generation condition		Error occurs in CAN communication with MVCU.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Engine speed is limited.
Inspection	Service data	4A: Speed Limiter Reference Speed
	Electric circuit diagram	CAN communication system

P0605: ECU System (Hardware) (warning lamp flashes: 33)

Generation condition		Main CPU in electronic control unit is abnormal.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Common rail system control is disabled (engine is stopped immediately) if mutual diagnoses of main CPU and sub CPU become impossible.
Inspection	Other	Engine electronic control unit

P1171: Q Adjustment Resistor (warning lamp flashes: 34)

Generation condition		Fuel injection rate adjustment resistor voltage is below standard value (0.6 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using fuel injection rate adjustment resistor No. 1. (Output is slightly reduced.)
Inspection	Service data	3E: Q Adjustment Resistor No.
	Electronic control unit connector	12 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor system

P1172: Q Adjustment Resistor (warning lamp flashes: 34)

Generation condition		Fuel injection rate adjustment resistor voltage is above standard value (4.36 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using fuel injection rate adjustment resistor No. 1. (Output is slightly reduced.)
Inspection	Service data	3E: Q Adjustment Resistor No.
	Electronic control unit connector	12 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor system

P1200: Injector Circuit 2 (warning lamp flashes: 82)

Generation condition		Injector magnetic valve (for cylinder No. 4, 5 or 6) is short-circuited or open-circuited.
Recoverability		- When short-circuited: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. - When open-circuited: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		<When short-circuited> - Main injections only enabled. - Common rail pressure upper limit provided. - Injection rate limited to predetermined value. - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled. <When open-circuited> - Auto cruise control stopped. - Exhaust gas recirculation control stopped. - FCCB learning disabled.
Inspection	Actuator tests	BC: Injector Test 2, BE: Injector Test 4, C0: Injector Test 6
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 4, 5 and 6 cylinders) system

P1210: Injector Circuit 3 (warning lamp flashes: 82)

Generation condition		Injector drive circuit voltage in engine electronic control unit is too low or too high.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		<Too low voltage> - Common rail pressure lower limit provided. - Idling speed is increased. - FCCB learning disabled. <Too high voltage> - Engine is stopped immediately. - FCCB learning disabled. (Too low voltage: Injection rate is reduced in all cylinders.) (Too high voltage: Common rail system is deactivated.)
Inspection	Actuator tests	BB: Injector Test 1, BD: Injector Test 2, BD: Injector Test 3, BE: Injector Test 4, BF: Injector Test 5, C0: Injector Test 6
	Electronic control unit connector	06 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve system
	Other	Engine electronic control unit

P1240: Flow Limiter - Cylinder1 (warning lamp flashes: 71)

Generation condition		Inter-cylinder injection amount correction value (FCCB) is higher than standard value and fluctuation in engine speed is greater than standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		FCCB learning is disabled. (Engine rotation becomes unstable because of incorrect operation of injectors or function of flow damper.)
Inspection	Service data	43: Flow Limiter (#1)
	Other	Flow damper (Have work performed by DENSO Service Station.)

TROUBLESHOOTING

P1241: Flow Limiter - Cylinder2 (warning lamp flashes: 72)

Generation condition		Inter-cylinder injection amount correction value (FCCB) is higher than standard value and fluctuation in engine speed is greater than standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		FCCB learning is disabled. (Engine rotation becomes unstable because of incorrect operation of injectors or function of flow damper.)
Inspection	Service data	44: Flow Limiter (#2)
	Other	• Flow damper (Have work performed by DENSO Service Station.)

P1242: Flow Limiter - Cylinder3 (warning lamp flashes: 73)

Generation condition		Inter-cylinder injection amount correction value (FCCB) is higher than standard value and fluctuation in engine speed is greater than standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		FCCB learning is disabled. (Engine rotation becomes unstable because of incorrect operation of injectors or function of flow damper.)
Inspection	Service data	45: Flow Limiter (#3)
	Other	• Flow damper (Have work performed by DENSO Service Station.)

P1243: Flow Limiter - Cylinder4 (warning lamp flashes: 74)

Generation condition		Inter-cylinder injection amount correction value (FCCB) is higher than standard value and fluctuation in engine speed is greater than standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		FCCB learning is disabled. (Engine rotation becomes unstable because of incorrect operation of injectors or function of flow damper.)
Inspection	Service data	46: Flow Limiter (#4)
	Other	• Flow damper (Have work performed by DENSO Service Station.)

P1244: Flow Limiter - Cylinder5 (warning lamp flashes: 75)

Generation condition		Inter-cylinder injection amount correction value (FCCB) is higher than standard value and fluctuation in engine speed is greater than standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		FCCB learning is disabled. (Engine rotation becomes unstable because of incorrect operation of injectors or function of flow damper.)
Inspection	Service data	47: Flow Limiter (#5)
	Other	• Flow damper (Have work performed by DENSO Service Station.)

P1245: Flow Limiter - Cylinder6 (warning lamp flashes: 76)

Generation condition		Inter-cylinder injection amount correction value (FCCB) is higher than standard value and fluctuation in engine speed is greater than standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		FCCB learning is disabled. (Engine rotation becomes unstable because of incorrect operation of injectors or function of flow damper.)
Inspection	Service data	48: Flow Limiter (#6)
	Other	• Flow damper (Have work performed by DENSO Service Station.)

P1255: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		SCV (suction control valve) circuit is shorted to ground or open, or coil is broken.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Main injections only enabled. • Common rail pressure upper limit provided. • Injection rate limited to predetermined value. • Auto cruise control stopped. • Exhaust gas recirculation control stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	13 : SCV (suction control valve)
	Electrical equipment	#574: SCV (suction control valve)
	Electric circuit diagram	SCV (suction control valve) system

P1256: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		SCV (suction control valve) system is shorted to power supply circuit.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Main injections only enabled. • Common rail pressure upper limit provided. • Injection rate limited to predetermined value. • Auto cruise control stopped. • Exhaust gas recirculation control stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	13 : SCV (suction control valve) system
	Electrical equipment	#574: SCV (suction control valve) system
	Electric circuit diagram	SCV (suction control valve) system system

P1257: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		SCV (suction control valve) binds and fails to operate.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Main injections only enabled. • Common rail pressure upper limit provided. • Injection rate limited to predetermined value. • Auto cruise control stopped. • Exhaust gas recirculation control stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	13 : SCV (suction control valve)
	Electrical equipment	#574: SCV (suction control valve)
	Electric circuit diagram	SCV (suction control valve) system

TROUBLESHOOTING

P1462: Exhaust Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Short-circuit or open-circuit occurs in exhaust brake 3-way magnetic valve ground-ing circuit.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust brake lamp control is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Exhaust Brake 1
	Electronic control unit connector	14 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

P1463: Exhaust Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Exhaust brake 3-way magnetic valve (output side) is shorted to power supply circuit.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust brake control is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Exhaust Brake 1
	Electronic control unit connector	14 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

P1605: ECU System (EEPROM) (warning lamp flashes: 33)

Generation condition		CPU in engine electronic control unit is faulty.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Common rail system control is disabled (engine is stopped immediately) if mutual di-agnoses of main CPU and sub CPU become impossible.
Inspection	Other	Engine electronic control unit

4. Multi-Use Tester Service Data

NOTE

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
01	Engine Revolution	■■■■.rpm	Racing (engine running)	Value corresponds to tachometer indication.
02	Reference Injection Quantity	■■■■.■%	Starter switch ON	0%
07	Reference Common Rail Pressure	■■■■.■%	Starter switch ON	20 to 30%
09	Actual Common Rail Pressure	■■■■.■%	Starter switch ON	0%
0B	Difference Common Rail Pressure	■■■■.■MPa	Engine idling	0 MPa or lower
0C	Difference Common Rail Pressure	■■■■.■%	Engine idling	0% or lower
1F	EGR Position	■■■■.■STEP	Engine idling	0%
22	Accel Pedal Position (unfiltered)	■■■■.■%	Accelerator pedal not depressed	0%
			Accelerator pedal gradually depressed	Value gradually increases.
			Accelerator pedal fully depressed	100%
23	Accel Pedal Position (filtered)	■■■■.■%	Accelerator pedal not depressed	0%
			Accelerator pedal gradually depressed	Value gradually increases.
			Accelerator pedal fully depressed	100%
24	Accel Pedal Sensor Voltage 1	■.■■■■V	Accelerator pedal gradually depressed from released position	0.85 to 4.15 V
25	Accel Pedal Sensor Voltage 2	■.■■■■V	Accelerator pedal gradually depressed from released position	0.85 to 4.15 V
26	Boost Pressure	■■■■.■inHg	High idle	10.3 in.Hg
27	Intake Air Temperature	■■■■.■°F	Engine cold	Value corresponds to ambient temperature.
35	Water Temperature	■■■■.■°F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
36	Fuel Temperature (inlet)	■■■■.■°F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
37	Fuel Temperature	■■■■.■°F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
38	Atmospheric Pressure	■■■■.■inHg	Altitude: 0 m {0 ft.}	29.8 in.Hg
			Altitude: 600 m {1,970 ft.}	28.1 in.Hg
3B	Idle Volume Voltage	■.■■■■V	SLOW to FAST	2.6 to 1.2 V
3C	Vehicle Speed	■■■■.MPH	Vehicle in motion	Value corresponds to speedometer indication.
3E	Q Adjustment Resistor No.	1/2/3/4/5/6/7/8/9/10/11/NON	—	Number matches number marked on fuel injection rate adjustment resistor.
42	Power Supply Voltage	■■.■■■■V	Starter switch ON	Value matches battery voltage.

TROUBLESHOOTING

No.	Item	Data	Inspection condition	Requirement
43	Flow Limiter (#1)	■■■■■.	Starter switch ON	0
44	Flow Limiter (#2)	■■■■■.	Starter switch ON	0
45	Flow Limiter (#3)	■■■■■.	Starter switch ON	0
46	Flow Limiter (#4)	■■■■■.	Starter switch ON	0
47	Flow Limiter (#5)	■■■■■.	Starter switch ON	0
48	Flow Limiter (#6)	■■■■■.	Starter switch ON	0
49	Auto Cruise Reference Speed	■■■■■.MPH	During driving with auto cruise control ON	Value corresponds to auto cruise set speed.
4A	Speed Limiter Reference Speed	■■■■■.MPH	Vehicle speed limited	Value is same as vehicle speed during vehicle speed restriction.
4D	Pump Adjustment State	■■■■■.	Engine idling	It is adjusting or Temporary end or Complete end.
52	Pump Adjustment Value (Last Time)	■■■■■.■mA	Engine idling	−200 to + 200 mA
53	Pump Adjustment Value (This Time)	■■■■■.■mA	Engine idling	−200 to + 200 mA
71	Starter SW (S)	ON/OFF	Engine cranked by means of starter switch	ON
			Starter switch in position except START	OFF
72	Starter SW (M)	ON/OFF	Starter Switch in ON position	ON
			Starter switch in position except ON	OFF
73	Accel SW	ON/OFF	Accelerator pedal depressed	ON
			Accelerator pedal not depressed	OFF
76	Auxiliary Brake SW 1	ON/OFF	Exhaust brake switch ON	ON
			Exhaust brake switch OFF	OFF
78	Clutch SW	ON/OFF	Clutch pedal depressed	ON
			Clutch pedal not depressed	OFF
7A	Neutral SW	ON/OFF	Transmission in neutral	ON
			Transmission not in neutral	OFF
7B	Idle Up Cancel SW	ON/OFF	24V applied (On Automatic transmission vehicles, shift lever in R, D, 2 or L position)	ON
			24V not applied (On Automatic transmission vehicles, shift lever in N position)	OFF (On M/T vehicles, no connection is made to idle up cancel terminal.)
7C	Air Conditioner SW 1	ON/OFF	Air conditioner compressor running	ON
			Air conditioner compressor not running	OFF
			[Actuator test] B6: Air Conditioner SW 1	
7E	Cold Start SW	ON/OFF	Warm-up switch ON	ON
			Warm-up switch OFF	OFF
7F	Torque Cut SW	ON/OFF	Transmission in 1st or reverse	ON
			Transmission not in 1st or reverse	OFF
82	PTO SW	ON/OFF	Switch ON	ON
			Switch OFF	OFF

No.	Item	Data	Inspection condition	Requirement
83	Diagnosis SW	ON/OFF	Diagnosis switch OFF (fuse fitted)	ON
			Diagnosis switch ON (fuse removed)	OFF
84	Memory Clear SW	ON/OFF	Memory clear switch OFF (fuse fitted)	ON
			Memory clear switch ON (fuse removed)	OFF
86	Auxiliary Brake Cut SW	ON/OFF	Anytime	ON
87	Exhaust Brake M/V 1	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
			[Actuator test] AC: Exhaust Brake 1	
8C	Auxiliary Brake Indicator Lamp	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
8D	Glow Relay	ON/OFF	See Gr. 54.	—
8E	Glow Relay Indicator Lamp	ON/OFF	See Gr. 54.	—
8F	Starter Safety Relay	ON/OFF	Engine starting is not inhibited.	ON
			Engine starting is inhibited.	OFF
			[Actuator test] B1: Starter Safety Relay	
91	MIL Lamp	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B3: MIL Lamp	
92	Diagnosis Lamp	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B4: Diagnosis Lamp	

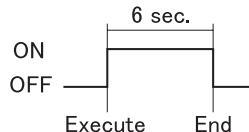
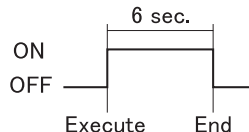
TROUBLESHOOTING

5. Actuator Tests Performed Using Multi-Use Tester

NOTE

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Explanation	Confirmation method
A1	EGR 1	See Gr 17.	—
A2	EGR 2	See Gr 17.	—
A3	EGR 3	See Gr 17.	—
AC	Exhaust Brake 1	Exhaust brake 3-way magnetic valve drive signal (Can be executed with engine not running.) 6 sec. Operate Stop Execute End P60193E	Operating sound of exhaust brake 3-way magnetic valve [Service data] 87: Exhaust brake M/V 1
AE	Auxiliary Brake Indicator Lamp	Exhaust brake indicator lamp drive signal (Can be executed with engine not running.) 6 sec. Operate Stop Execute End P60193E	ON/OFF condition of indicator lamp [Service data] 8C: Auxiliary Brake Indicator Lamp
AF	Relay for Glow Relay	See Gr 54.	
B0	Glow Indicator Lamp	See Gr 54.	
B1	Starter Safety Relay	See Gr 54.	
B3	MIL Lamp	Warning lamp (orange) drive signal 6 sec. Operate Stop Execute End P60193E	ON/OFF condition of warning lamp (orange) [Service data] 91: MIL Lamp
B4	Diagnosis Lamp	Warning lamp (red) drive signal 6 sec. Operate Stop Execute End P60193E	ON/OFF condition of warning lamp (red) [Service data] 92: Diagnosis Lamp

No.	Item	Explanation	Confirmation method
B6	Air Conditioner SW1	Idle up control reproduced by means of dummy signal (air conditioner operation). (Can be executed with vehicle speed of zero and with transmission in neutral.)  P59148E	Increase in idling speed [Service data] 7C: Air conditioner SW1
B8	Idle Up Cancel SW	Idle up cancel condition reproduced by means of dummy signal (idle up cancel). (Can be executed with vehicle speed of zero and with transmission in neutral.)  P59148E	Idling speed low idle [Service data] 7B: Idle Up Cancel SW
B9	Fuel Leak Check	Rail pressure increased on constant slope (Can be executed with vehicle speed of zero and transmission in neutral and diagnosis switch open.)	Check that no fuel leaks from fuel system.
BB	Injector Test 1	Injector 1 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease.
BC	Injector Test 2	Injector 2 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease.
BD	Injector Test 3	Injector 3 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease.
BE	Injector Test 4	Injector 4 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease.
BF	Injector Test 5	Injector 5 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease.
C0	Injector Test 6	Injector 6 not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease.
C2	Pump Adjustment Value Clear	Delete the compensation information (pump learning condition) in engine electronic control unit.	The service data "4D: Pump Adjustment State" displays "Unadjustment"

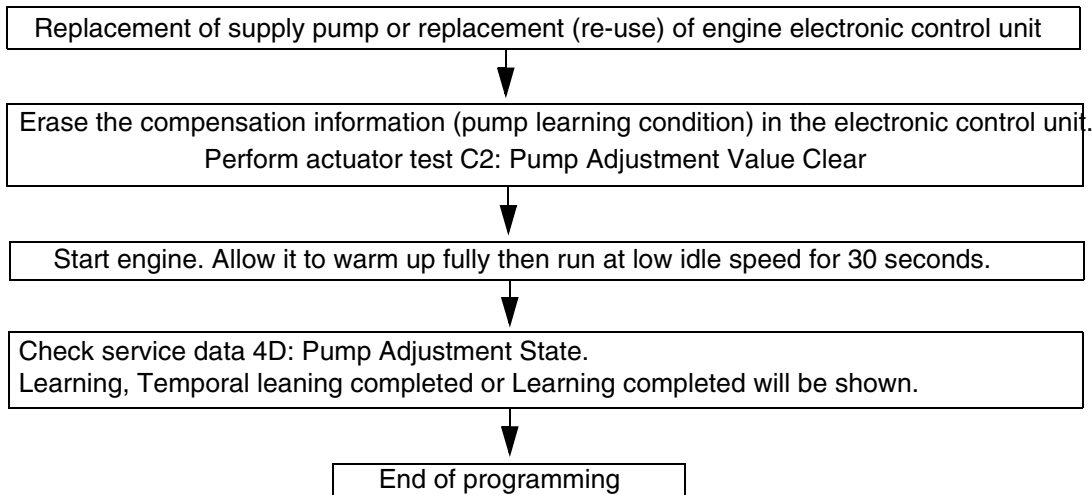
TROUBLESHOOTING

6. Initialization of supply pump unit difference learning value in engine electronic control unit

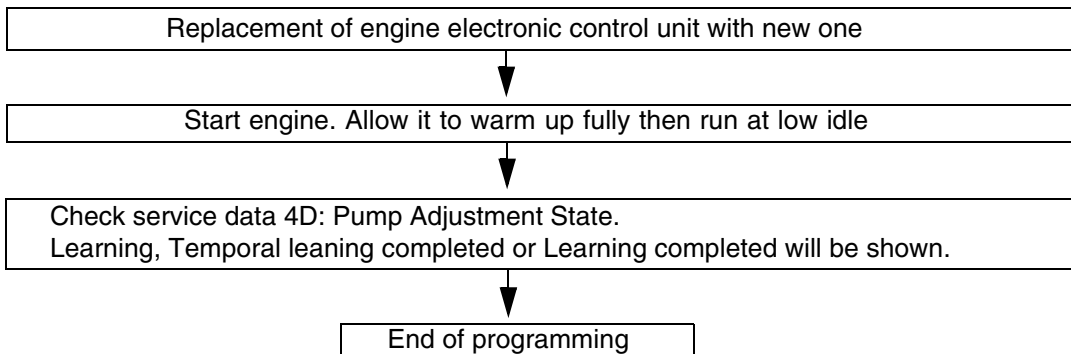
Following replacement of the supply pump, this item is used to erase the adjustment value (learning value) in the engine electronic control unit and program the current supply pump data into the engine electronic control unit.

Also following replacement of the engine electronic control unit with a new one, it is necessary to program in the current supply pump data.

6.1 After replacement of supply pump or replacement (re-use) of engine electronic control unit



6.2 After replacement of engine electronic unit with new one



6.3 Check after engine electronic control unit programming

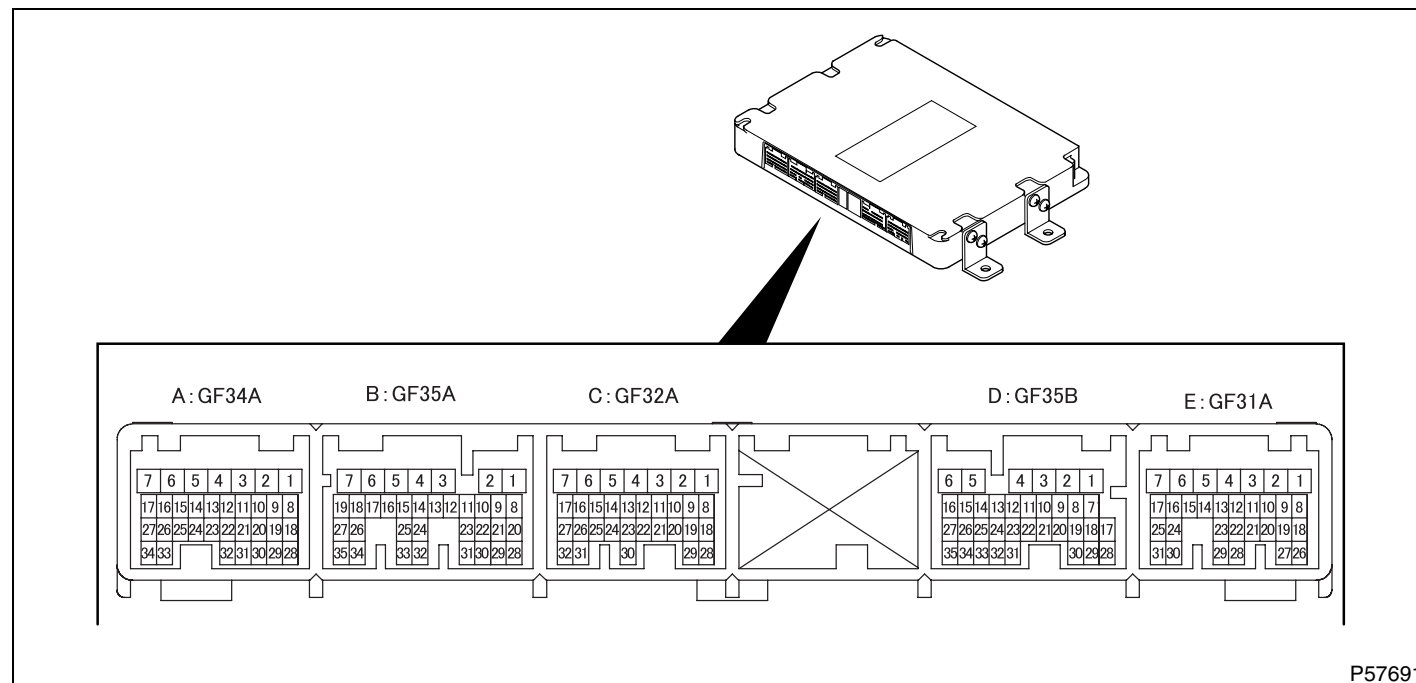
If the measurement values (which show the learning values) shown by service data 52: Pump Adjustment Value (Last Time) and 53: Pump Adjustment Value (This Time) are out of specification, a defect in the supply pump or in the engine electronic control unit is conceivable so you must replace the supply pump or engine electronic control unit. (Initialize the engine electronic control unit again after replacing the supply pump or engine electronic control unit.)

7. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.

The white-on-black numbers (**01** , **02** , and so on) correspond to the similarly printed reference numbers in section '3. Inspections based on diagnosis codes'.

7.1 Electronic control unit connector terminal layout



7.2 Inspection instructions

CAUTION

- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:
- Do not touch any terminal except those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.
- When the supply pump has been replaced, perform the “Initialization of supply pump unit difference learning value” using the MUT and erase the compensation information (pump learning condition) in the ECU.

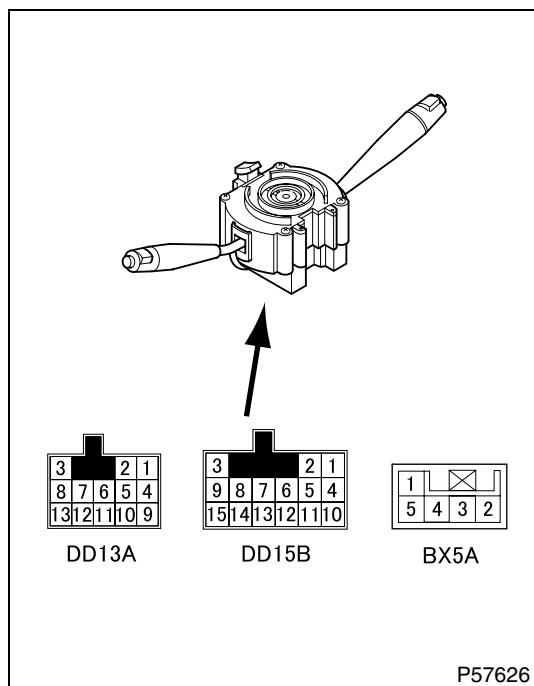
Check item	Measurement method
01 Resistance of boost air temperature sensor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: E25-B26 0°C {0°F}: $5.88 \pm 0.588 \text{ k}\Omega$ 20°C {68°F}: $2.45 \pm 0.245 \text{ k}\Omega$ 80°C {175°F}: $0.322 \pm 0.0483 \text{ k}\Omega$
02 Resistance of water temperature sensor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: E24-B26 20°C {68°F}: 2.3 to 2.6 kΩ 80°C {175°F}: 0.30 to 0.34 kΩ

TROUBLESHOOTING

Check item	Measurement method
03 Output voltage of accelerator pedal position sensor	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-) A24-D30 and B45 (accelerator pedal position sensor 1) A23-D28 and B45 (accelerator pedal position sensor 2) • With accelerator pedal not depressed: 0.85 ± 0.1 V • With accelerator pedal depressed: 4.15 ± 0.1 V
04 Resistance of fuel temperature sensor (inlet)	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: E30-B27 • -20°C $\{-4^{\circ}\text{F}\}$: 15.0 ± 1.5 k Ω • 20°C $\{68^{\circ}\text{F}\}$: 2.45 ± 0.24 k Ω • 80°C $\{175^{\circ}\text{F}\}$: 0.318 ± 0.008 k Ω
05 Resistance of fuel temperature sensor (outlet)	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: E31-B26 • 20°C $\{68^{\circ}\text{F}\}$: $2.45^{+0.14}_{-0.13}$ k Ω • 80°C $\{175^{\circ}\text{F}\}$: 0.318 ± 0.01 k Ω • 110°C $\{230^{\circ}\text{F}\}$: 0.1417 ± 0.01 k Ω
06 Resistance of injector magnetic valve	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: D1 or D2-D5 (injector magnetic valve: No. 1 cylinder) D1 or D2-D3 (injector magnetic valve: No. 2 cylinder) D1 or D2-D4 (injector magnetic valve: No. 3 cylinder) E1 or E2-E5 (injector magnetic valve: No. 4 cylinder) E1 or E2-E7 (injector magnetic valve: No. 5 cylinder) E1 or E2-E6 (injector magnetic valve: No. 6 cylinder) • 0.45 ± 0.1 Ω (20°C $\{68^{\circ}\text{F}\}$)
07 Resistance of engine speed sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: B2-B1 • 125.5 ± 17 Ω (20°C $\{68^{\circ}\text{F}\}$)
08 Output of cylinder recognition sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: D31-D33 (+5V to GND) • 200 to 1800 Ω (Resistance serves as rough indication only. Pulse output monitor is needed for confirmation of functionality.)
09 Output voltage of vehicle speed sensor	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) • Turn wheels slowly using chassis dynamometer. [Requirements] Terminals (+)-(-): A18-chassis earth • Hi: Approx. 8 ± 1 V • Lo: 0.5 V or lower

Check item	Measurement method
10 Output voltage of idling speed adjustment potentiometer	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A32-B27 - AUTO position: 4.0 ± 0.1 V - SLOW position: 3.0 ± 0.2 V - FAST position: 1.0 ± 0.1 V
11 Continuity of accelerator pedal switch	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] - Terminals : B20 and chassis earth - With accelerator pedal depressed: no continuity is found. - With accelerator pedal not depressed: continuity is found.
12 Resistance of fuel injection rate adjustment resistor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: B35-B27 - No. 1 resistor: 270 ± 13.5 Ω - No. 2 resistor: 510 ± 25.5 Ω - No. 3 resistor: 820 ± 41 Ω - No. 4 resistor: 1300 ± 65 Ω - No. 5 resistor: 2000 ± 100 Ω - No. 6 resistor: 3300 ± 165 Ω - No. 7 resistor: 5600 ± 280 Ω - No. 8 resistor: 15000 ± 750 Ω - No. 9 resistor: 390 ± 19.5 Ω - No. 10 resistor: 4300 ± 215 Ω - No. 11 resistor: 9100 ± 455 Ω
13 Resistance of SCV (suction control valve)	[Conditions] Starter switch OFF Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: E14-E16, E14-E17, E15-E16, E15-E17 2.1 ± 0.2 Ω
14 Voltage of exhaust brake 3-way magnetic valve	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A76-A6 - With exhaust brake operating: Corresponding to battery voltage - With exhaust brake not operating: 0 V

INSPECTION OF ELECTRICAL EQUIPMENT

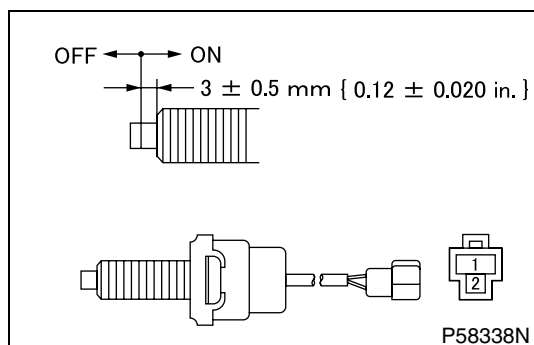


#001 Inspection of combination switch

DD15A connector connection table

Switch position		Terminals with continuity
Exhaust brake switch	OFF	—
	ON	5 to 6

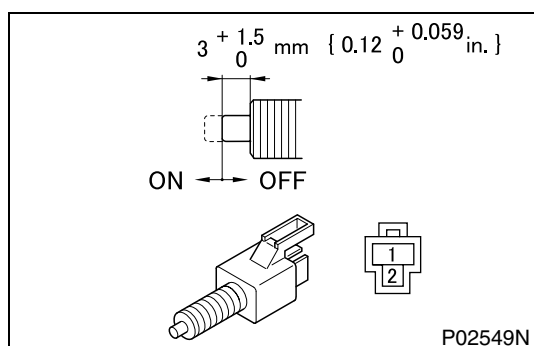
- If there is any abnormality, replace the switch.



#029 Inspection of accelerator pedal switch

Switch position	Terminals with continuity
OFF	—
ON	1 to 2

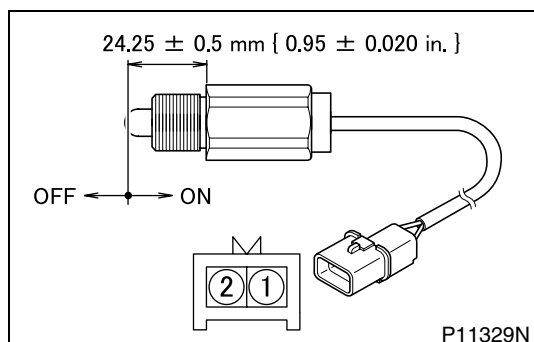
- If there is any abnormality, replace the switch.



#031 Inspection of clutch switch

Switch position	Terminals with continuity
OFF	—
ON	1 to 2

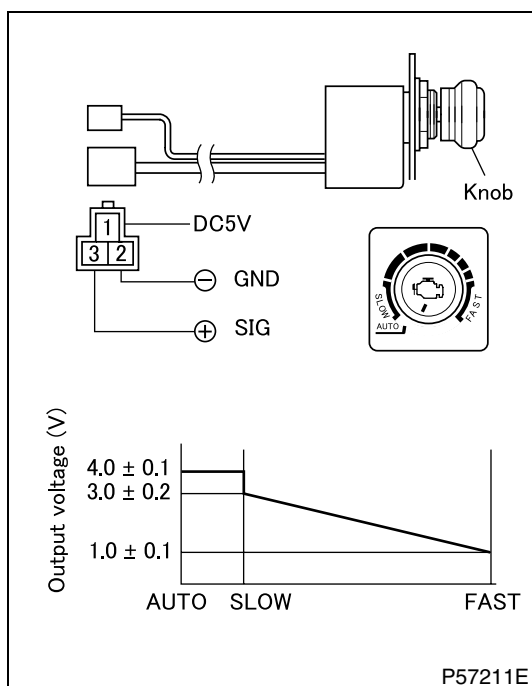
- If there is any abnormality, replace the switch.



#056 Inspection of transmission neutral switch

Switch position	Terminals with continuity
OFF	—
ON	1 to 2

- If there is any abnormality, replace the switch.

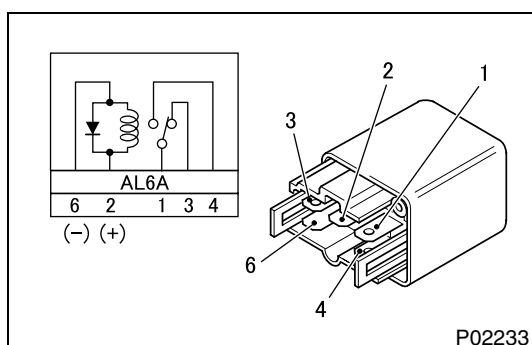


#157 Inspection of idling speed adjustment potentiometer

- Apply 5V DC to terminals 1 and 2 of the idling speed adjustment potentiometer.
- Turn the knob fully counterclockwise. Then, measure the output voltage across terminals 2 and 3 (see the diagrams on the left) while slowly turning the knob clockwise.

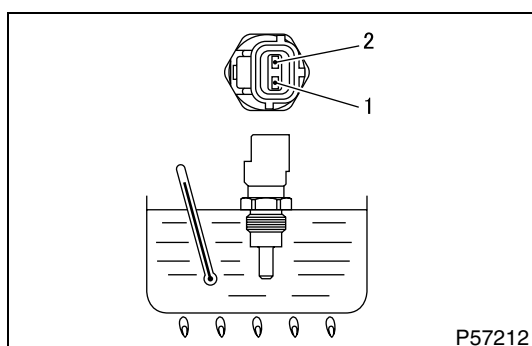
Standard value	Knob position	Output voltage
	AUTO (0°)	4.0 ± 0.1 V
	SLOW (30°)	3.0 ± 0.2 V
	FAST (300°)	1.0 ± 0.1 V

- If any measurement is out of specification, replace the idling speed adjustment potentiometer.



#182 Inspection of relay (Normally open type with 6 pins)

- Test for continuity and proper operation. If there is any abnormality, replace the relay.



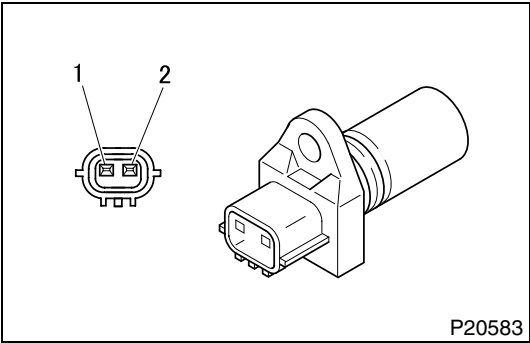
#262 Inspection of water temperature sensor

- Place the water temperature sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	2.3 to 2.6 kΩ
	80°C {175°F}	0.30 to 0.34 kΩ

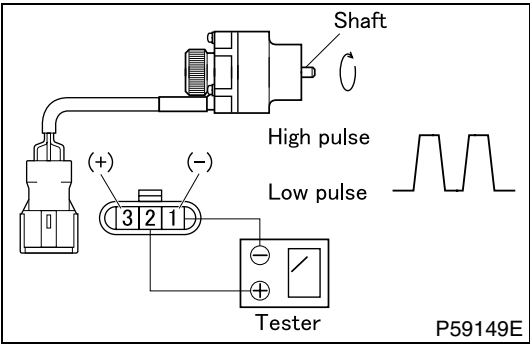
- If either measurement is out of specification, replace the sensor.

INSPECTION OF ELECTRICAL EQUIPMENT



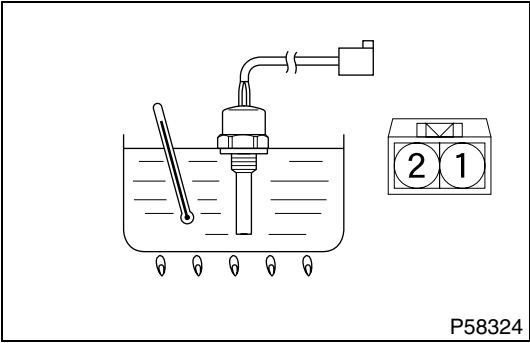
#263 Inspection of engine speed sensor

- Measure the resistance between terminals 1 and 2.
- | | |
|---------------------------------|--------------|
| Standard value (at 20°C {68°F}) | 125.5 ± 17 Ω |
|---------------------------------|--------------|
- If the measurement is out of specification, replace the sensor.



#265 Inspection of vehicle speed sensor

- With the battery voltage applied to terminals 3 and 1, slowly turn the shaft of the sensor.
 - Measure the maximum voltage (high pulse voltage) and minimum voltage (low pulse voltage) between terminals 1 and 2.
- | | | |
|----------------|--------------------|----------------|
| Standard value | Low pulse voltage | 0.5 V or lower |
| | High pulse voltage | 8 ± 1 V |
- If any measurement is out of specification, replace the sensor.

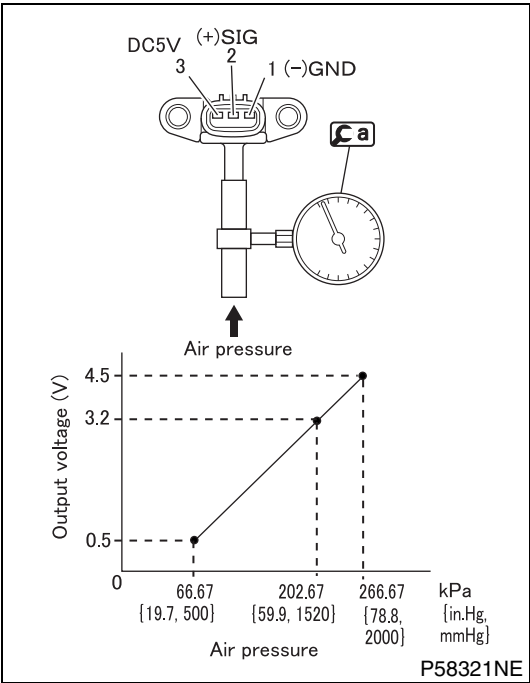


#305 Inspection of boost air temperature sensor

- Place the boost air temperature sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	0°C {0°F}	5.88 ± 0.588 kΩ
	20°C {68°F}	2.45 ± 0.245 kΩ
	80°C {175°F}	0.322 ± 0.0483 kΩ

- If either measurement is out of specification, replace the sensor.



#318 Inspection of boost pressure sensor

- Apply 5V DC to terminals 3 and 1.
- Apply air pressure **A**. Gradually increase it and, while doing so, measure the output voltage occurring at terminals 2 and 1 (see the diagram on the left).

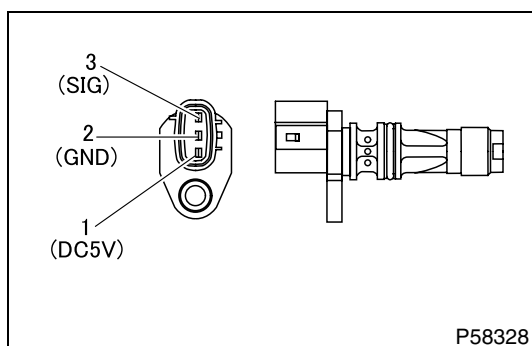
Part	Name and shape of tool	Part No.
	Pressure gauge  P01524	MH061366

Standard value	Air pressure	Voltage
	66.67 kPa {19.7 in.Hg, 500 mmHg}	Approx. 0.5 V
	202.67 kPa {59.9 in.Hg, 1520 mmHg}	Approx. 3.2 V
	266.67 kPa {78.8 in.Hg, 2000 mmHg}	Approx. 4.5 V

- If any measurement is out of specification, replace the sensor.

#319 Inspection of common rail pressure sensor

- The sensor cannot easily be inspected in isolation, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the common rail pressure sensor.

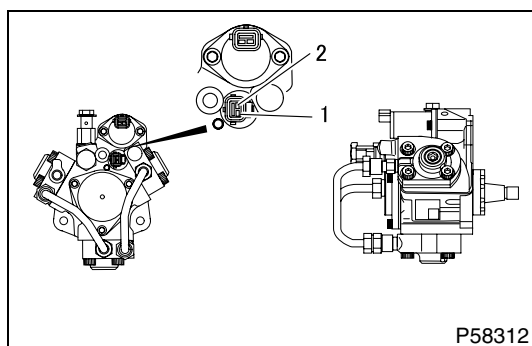


#320 Inspection of cylinder recognition sensor

- Measure the resistance between terminals 1 and 2. (The resistance serves as a rough indication only. A pulse output monitor is needed for confirmation of functionality.)

Standard value	200 to 1800 Ω
----------------	----------------------

- If the measurement is out of specification, replace the sensor.



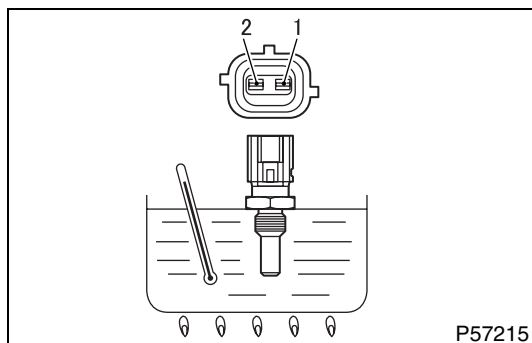
#323 Inspection of fuel temperature sensor

<Fuel temperature sensor (inlet)>

- Measure the resistance between terminals 1 and 2.

Standard value	-20°C {-4°F}	15.0 $\pm$ 1.5 k Ω
	20°C {68°F}	2.45 $\pm$ 0.24 k Ω
	80°C {175°F}	0.318 $\pm$ 0.008 k Ω

- If any measurement is out of specification, replace the supply pump.



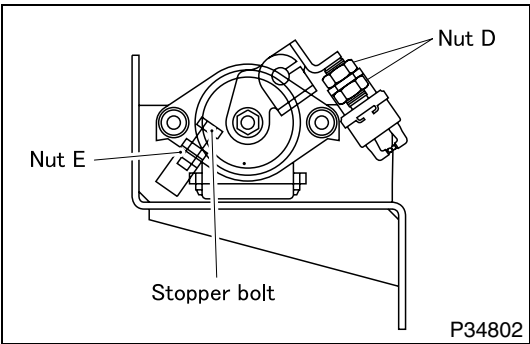
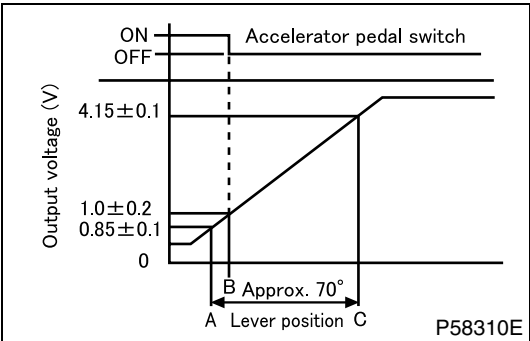
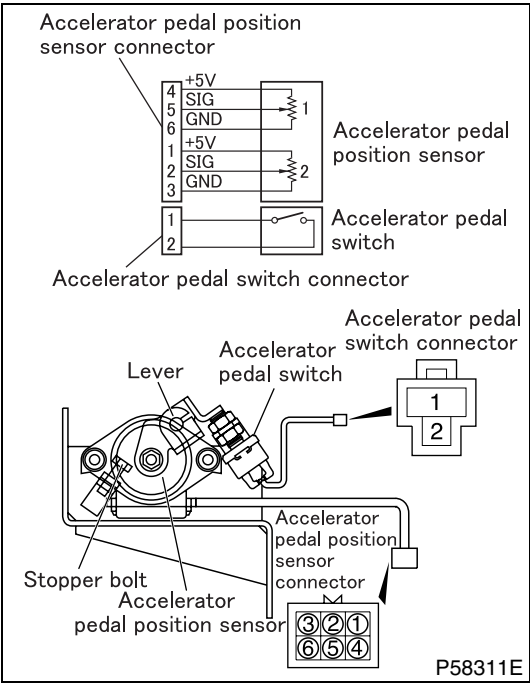
<Fuel temperature sensor (outlet)>

- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	2.45 $^{+0.14}_{-0.13}$ k Ω
	80°C {175°F}	0.318 $\pm$ 0.01 k Ω
	110°C {230°F}	0.1417 $\pm$ 0.01 k Ω

- If any measurement is out of specification, replace the sensor.

INSPECTION OF ELECTRICAL EQUIPMENT



#324 Inspection of accelerator pedal position sensor

[Inspection]

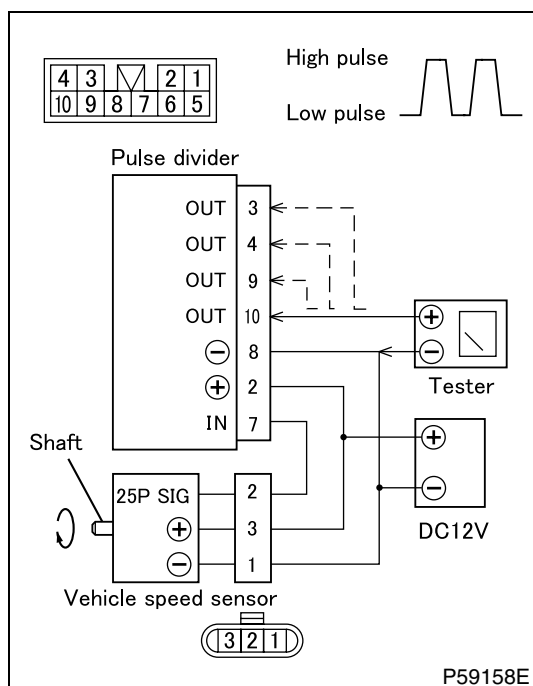
- Apply 5V DC to terminals 4 and 6 and terminals 1 and 3 of the accelerator pedal position sensor connector.
- Measure the output voltage at terminals 5 and 6 (sensor 1) and the output voltage at terminals 2 and 3 (sensor 2) with the lever in each specified position.

Standard value	Lever position	Output voltage
	Idling position A	0.85 ± 0.1 V
	Accelerator pedal switch operating position B	1.0 ± 0.2 V
	Full load position C	4.15 ± 0.1 V

- A:** Position in which accelerator pedal switch is fully pushed in by lever
- B:** Position at which continuity between terminals 1 and 2 of accelerator pedal switch connector disappears as accelerator pedal is pushed downward
- C:** Position in which lever is touching stopper bolt
- If any output voltage is out of specification, make an adjustment.
- If any output voltage is still out of specification when you have made an adjustment, replace the sensor.

[Adjustment]

- To adjust the output voltage for the accelerator pedal switch operating position **A**, use nut **D**.
- To adjust the output voltage for the full load position **C**, loosen nut **E** and make the adjustment using the stopper bolt.
- After making the adjustment, lock the stopper bolt in position with the nut.

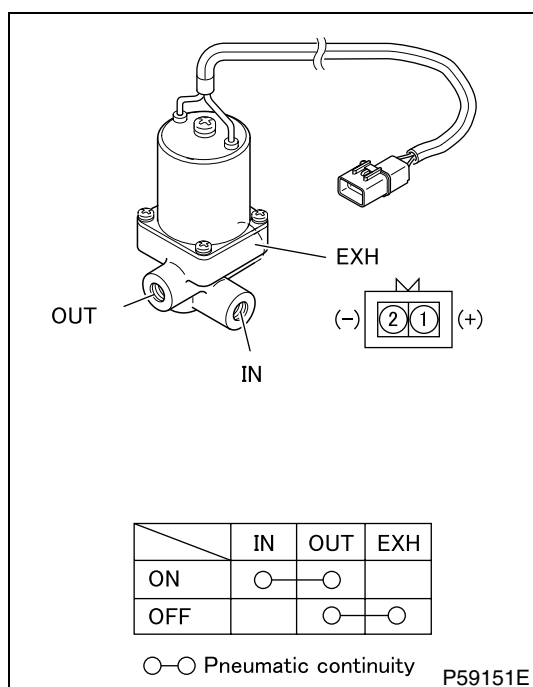


#351 Inspection of pulse divider

- Make a test circuit of pulse divider as shown.
- Measure the maximum voltage (high pulse voltage) and minimum voltage (low pulse voltage) between each of terminals 3, 4, 9 and 10 and terminal 8 of pulse divider while slowly turning the shaft of the vehicle speed sensor.

Standard value	High pulse voltage	$8 \pm 1 \text{ V}$
	Low pulse voltage	0.5 V or lower

- If any measurement is out of specification, replace the pulse divider.



#565 Inspection of 3-way magnetic valve

- Perform the following checks. If there is any abnormality, replace the 3-way magnetic valve.

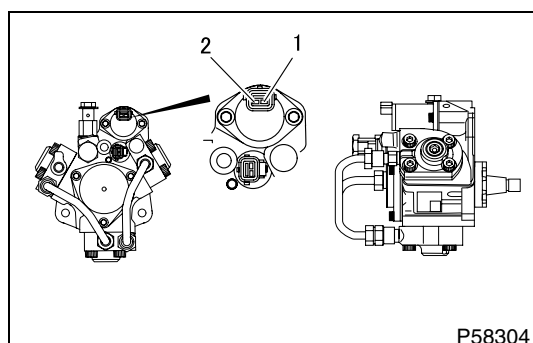
(1) Check of operation

- Gradually increase from zero the voltage applied to terminals 1 and 2.
- Observe the voltage when the 3-way magnetic valve operates. (Determine the magnetic valve's OFF-ON operation from the operating sound.)

Standard value (min. operating voltage)	10 V or lower
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(2) Check of continuity and airtightness

- Air pressure applied during check: 981kPa {140psi, 10kgf/cm²}



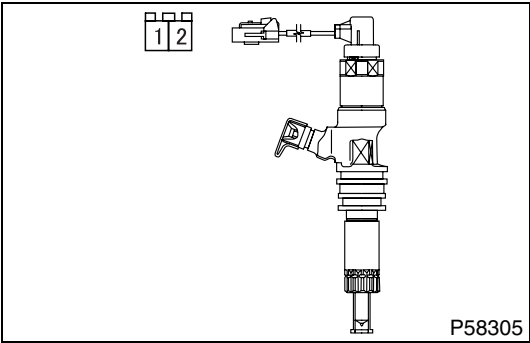
#574 Inspection of SCV (suction control valve)

- Measure the resistance between terminals 1 and 2.

Standard value	$2.1 \pm 0.2 \Omega$
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- If the measurement is out of specification, replace the supply pump.

INSPECTION OF ELECTRICAL EQUIPMENT

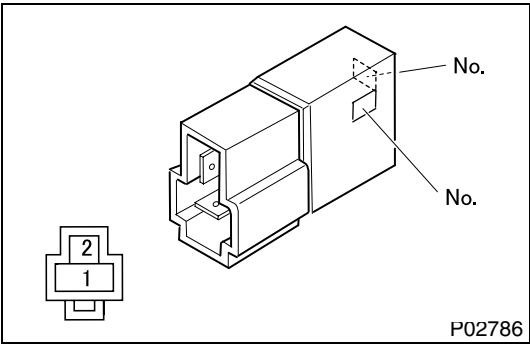


#582 Inspection of injector

- Measure the resistance between terminals 1 and 2.

Standard value (at 20°C {68°F})	0.45 ± 0.1 Ω
---------------------------------	--------------

- If the measurement is out of specification, replace the injector.



#828 Inspection of fuel injection rate adjustment resistor

- Measure the resistance of the resistor number marked on the fuel injection rate adjustment resistor.

Standard value (at 20°C {68°F})	Resistor No.	1	270 ± 13.5 Ω
		2	510 ± 25.5 Ω
		3	820 ± 41 Ω
		4	1300 ± 65 Ω
		5	2000 ± 100 Ω
		6	3300 ± 165 Ω
		7	5600 ± 280 Ω
		8	15000 ± 750 Ω
		9	390 ± 19.5 Ω
		10	4300 ± 215 Ω
		11	9100 ± 455 Ω

- If the measurement is out of specification, replace the fuel injection rate adjustment resistor with one that has the same resistor number and same specified resistance.

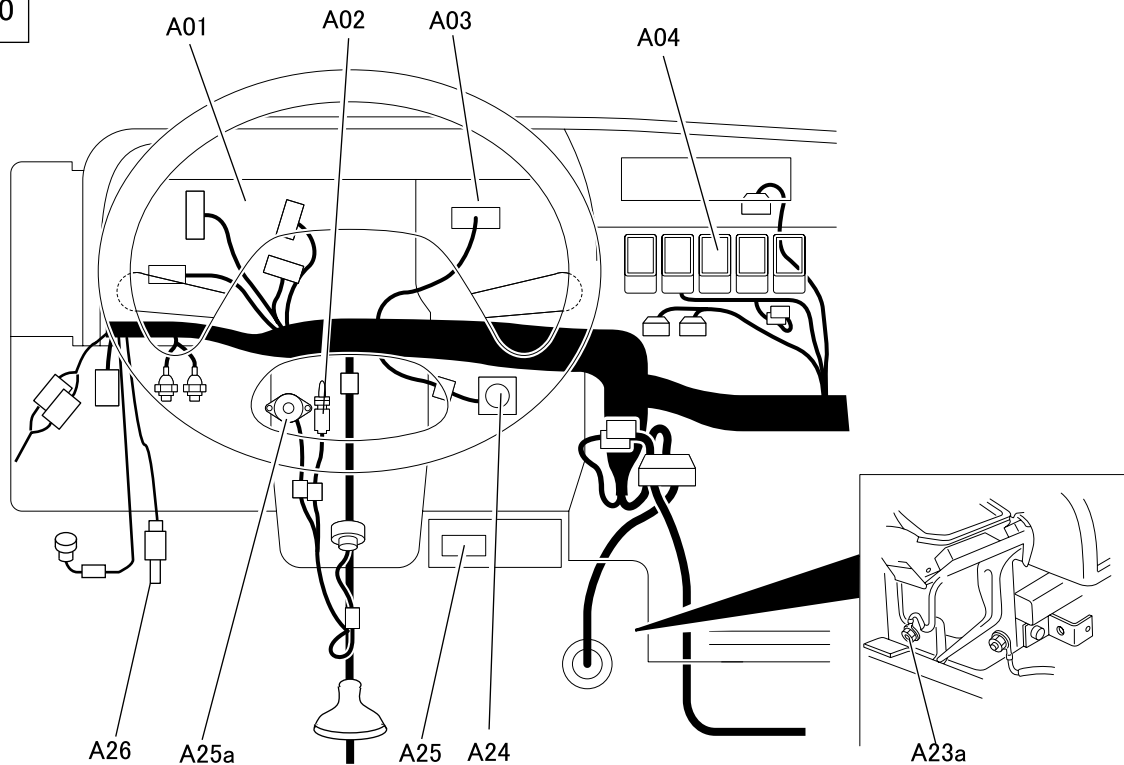
CAUTION ⚠

- The fuel injection rate adjustment resistor is matched to the engine. If you replace it, be sure to replace it with one that has the same resistor number.

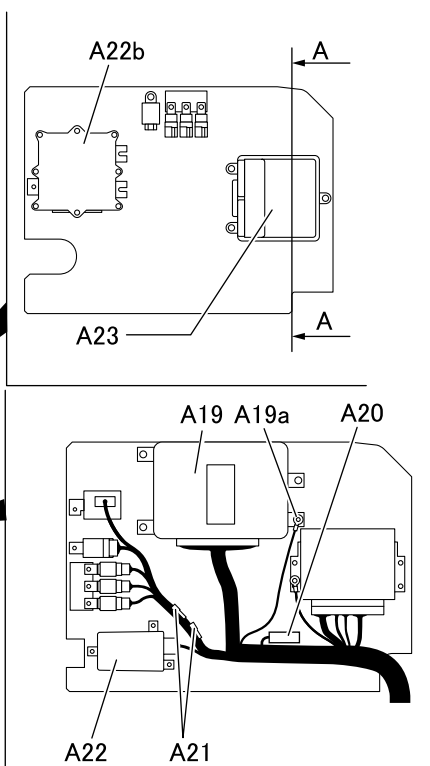
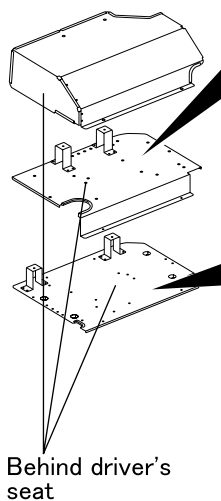
MEMO

INSTALLED LOCATIONS OF PARTS

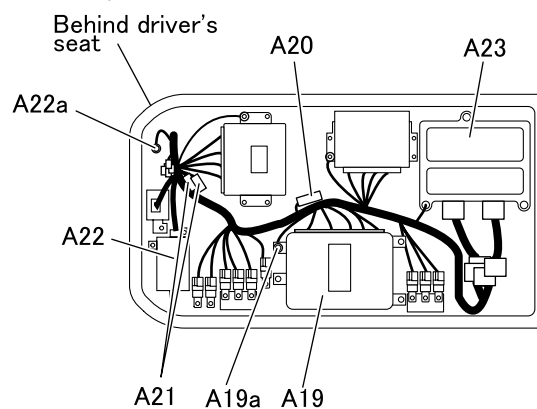
A 01 to 30



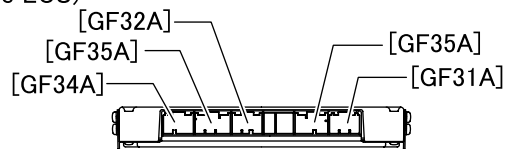
<FM65(A/T)>

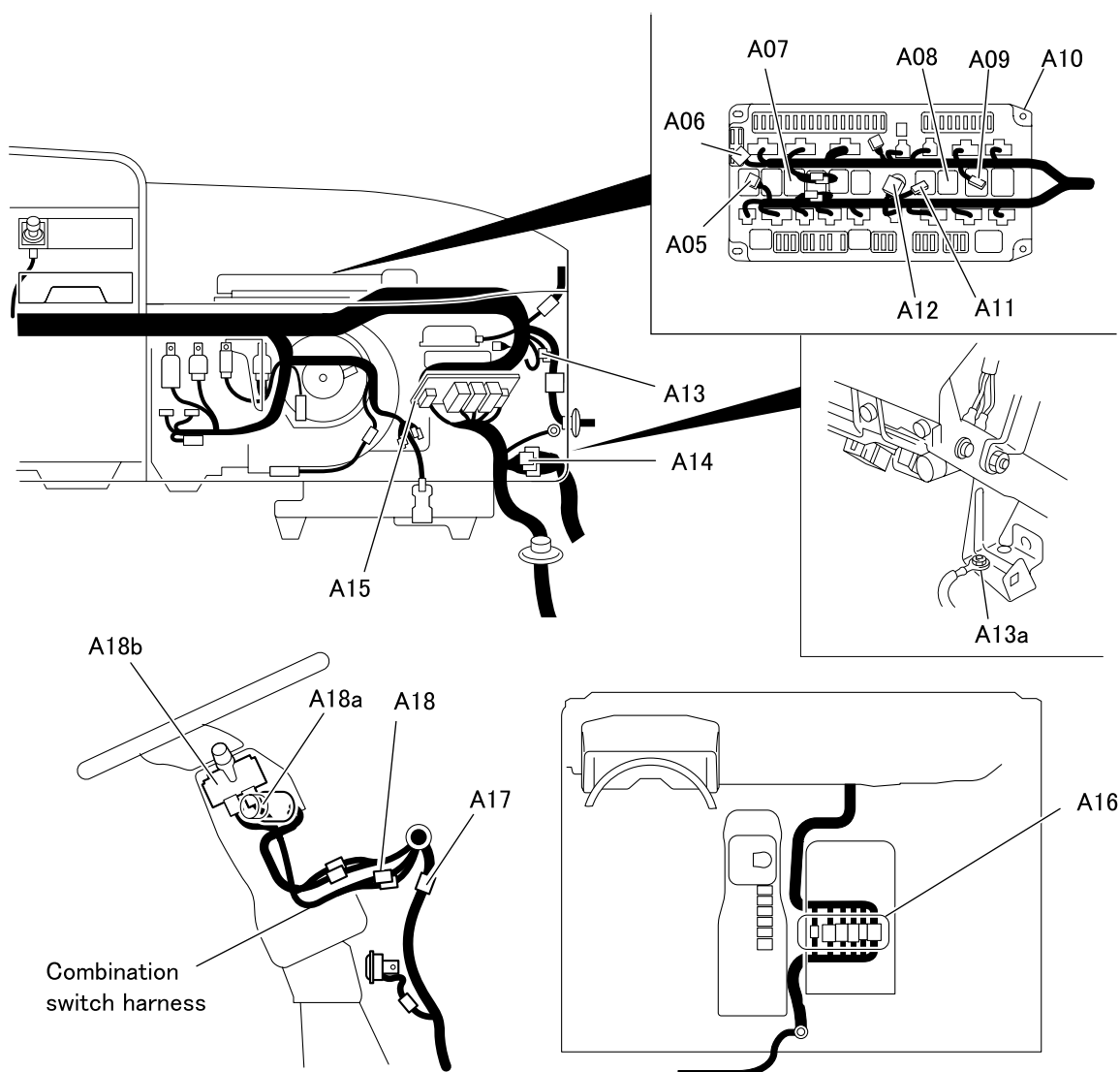


<Except FM65(A/T)>



(Engine ECU)





No relevant parts in a missing number

- | | |
|--|---|
| A01 Meter cluster | A18a Starter switch |
| A02 Accelerator switch | A18b Combination switch |
| A03 Speedometer | A19 Engine ECU |
| A04 Cold start switch | A19a Ground |
| A05 Fuel injection rate adjustment resistor | A20 Joint connector (J/C M1) |
| A06 Power take-off resistor <M/T> | A21 Resistor unit |
| A07 ECU main relay | A22 Pulse converter <A/T> |
| A08 Short connector | Pulse divider <M/T> |
| A09 Diagnosis switch and memory clear switch (Engine ECU) | A22a Ground <Except FM65(A/T)> |
| A10 Relay and fuse box | A22b Vehicle interface module |
| A11 Dummy connector | A23 A/T ECU |
| A12 Multi-use tester-III connector (For recorder) | A23a Ground |
| A13 Diode unit | A24 Idling speed adjustment potentiometer |
| A13a Ground <FM65(A/T)> | A25 Multi-use tester-III connector (For inspection) |
| A14 Connection of bed harness and chassis harness | A25a Accelerator pedal position sensor |
| A15 Connection of cab harness and chassis harness | A26 Clutch switch |
| A16 Connection of cab harness and bed harness | |
| A17 Connection of cab harness and headlamp harness | |
| A18 Connection of cab harness and combination switch harness | |

ECU : Electronic control unit

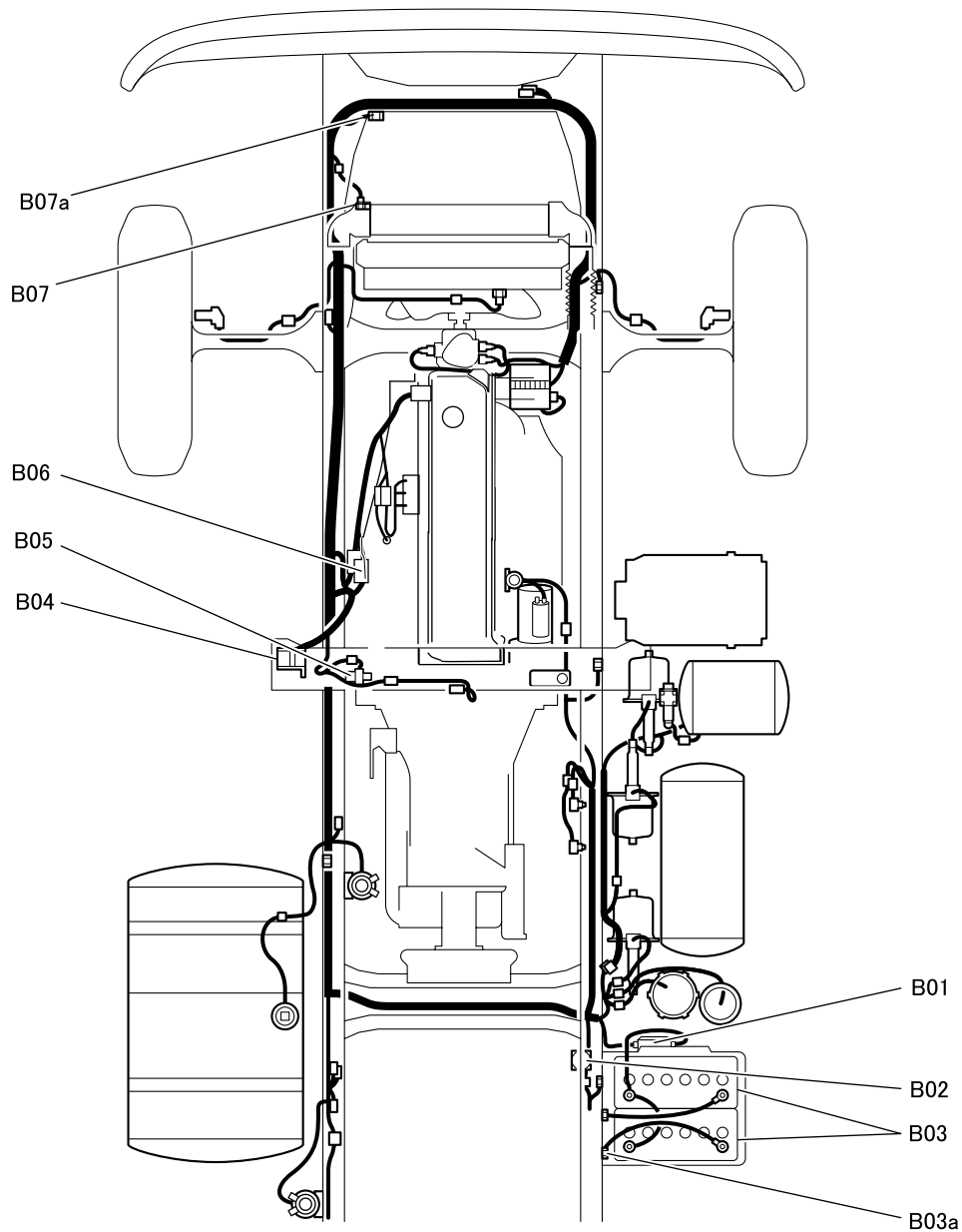
A/T:Automatic transmission

M/T:Manual transmission

INSTALLED LOCATIONS OF PARTS

B 01 to 20

<FK,FM61,FM64>

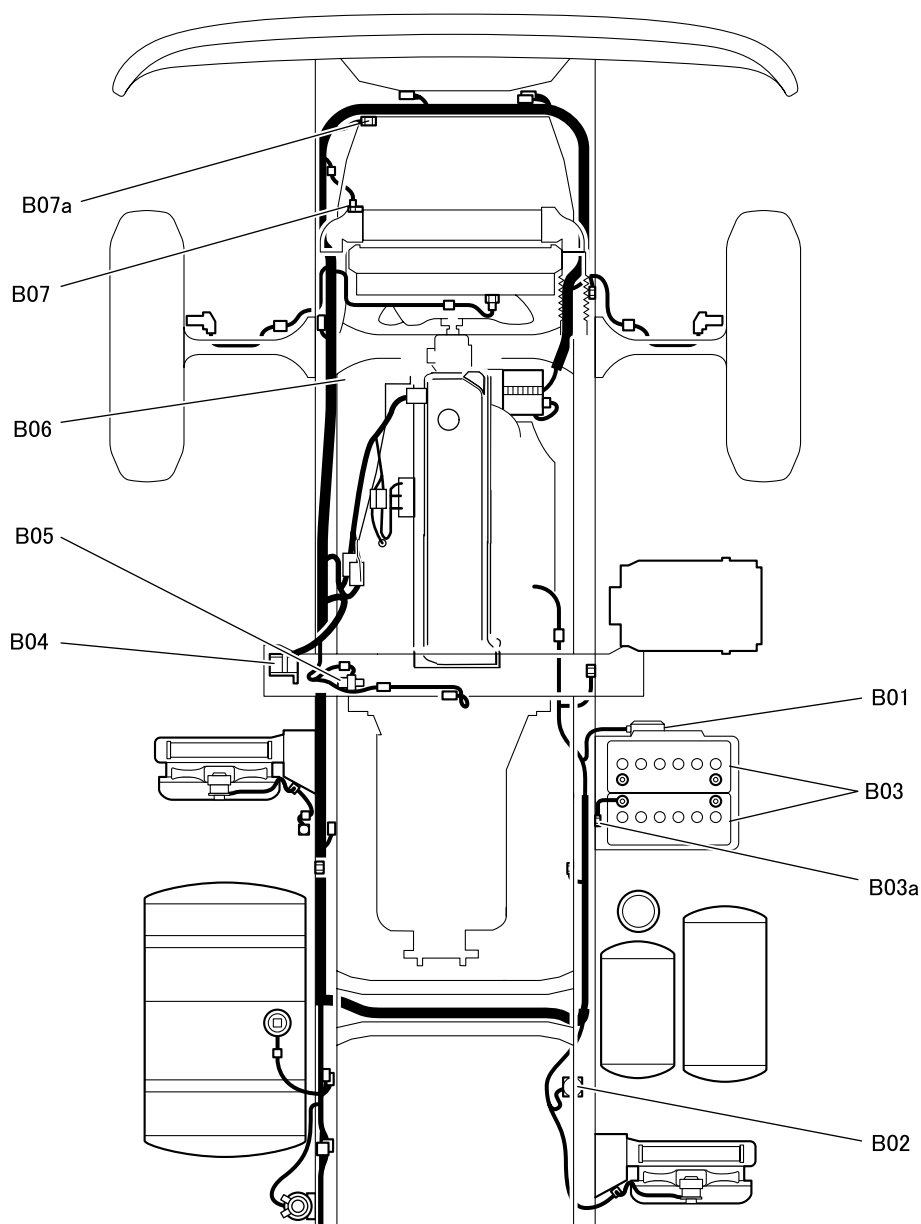


No relevant parts in a missing number

- B01 Main high-current fuse box
- B02 Exhaust brake 3-way magnetic valve
- B03 Battery
- B03a Battery ground
- B04 High-current fuse box
- B05 Transmission power take-off load sensor
- B06 Connection of chassis harness and engine harness
- B07 Boost air temperature sensor
- B07a Ground

B 01 to 20

<FM65>



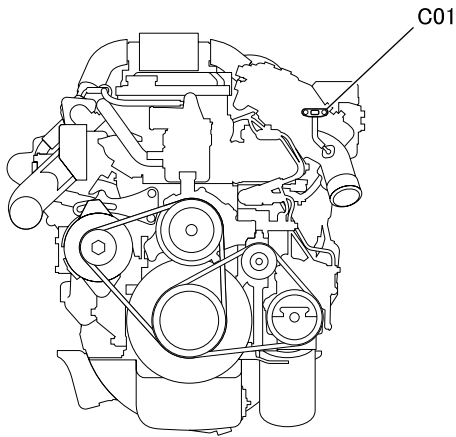
No relevant parts in a missing number

- B01 Main high-current fuse box
- B02 Exhaust brake 3-way magnetic valve
- B03 Battery
- B03a Battery ground
- B04 High-current fuse box
- B05 Transmission power take-off load sensor
- B06 Connection of chassis harness and engine harness
- B07 Boost air temperature sensor
- B07a Ground

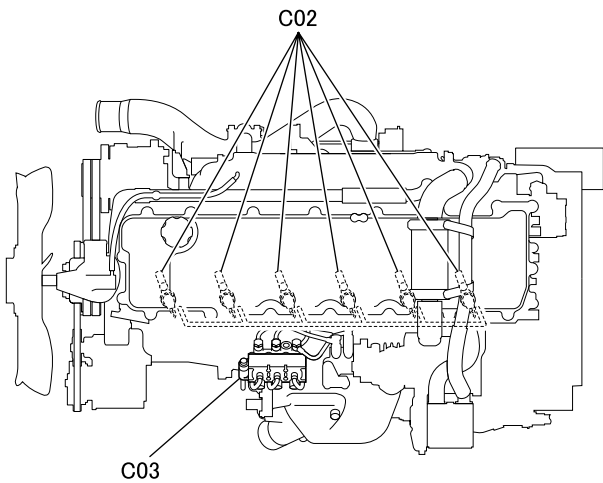
INSTALLED LOCATIONS OF PARTS

C 01 to 30

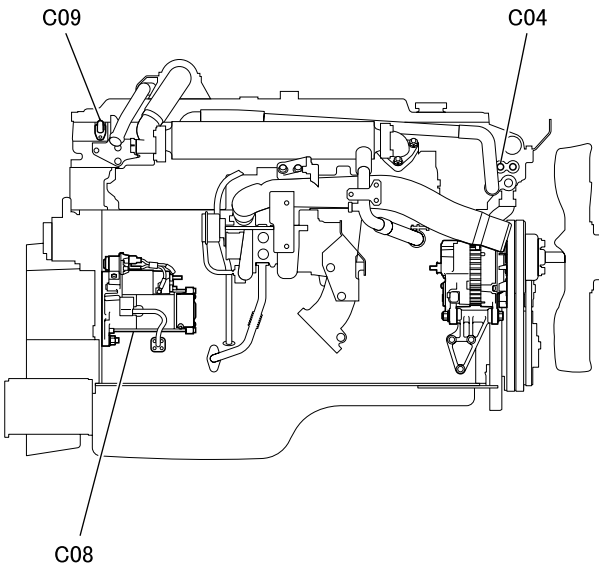
Front side view



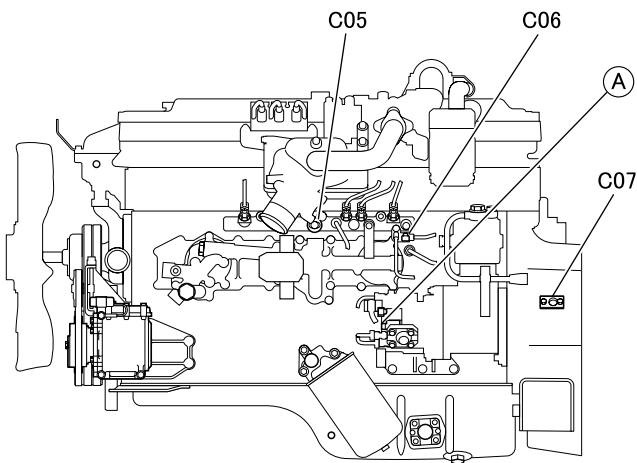
Upper view

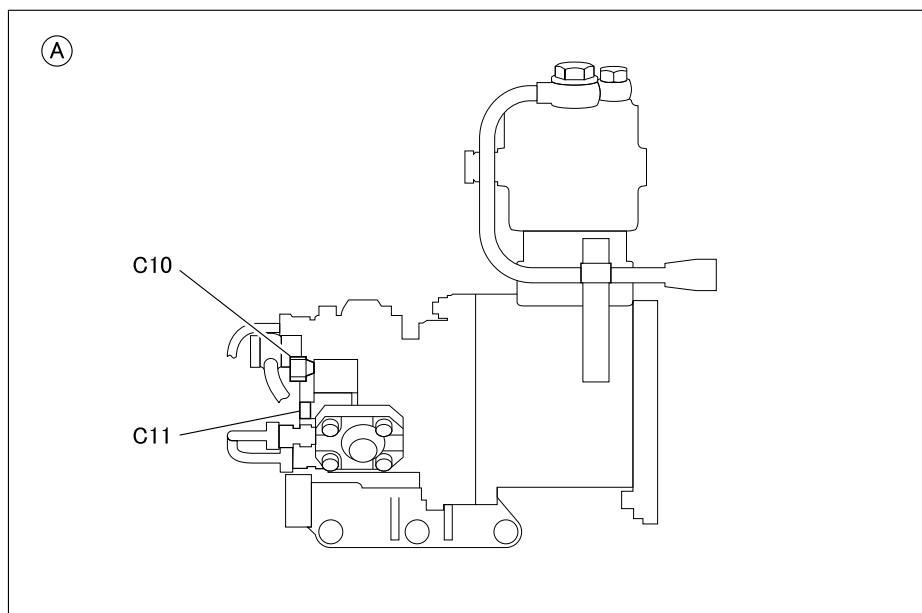


Right side view

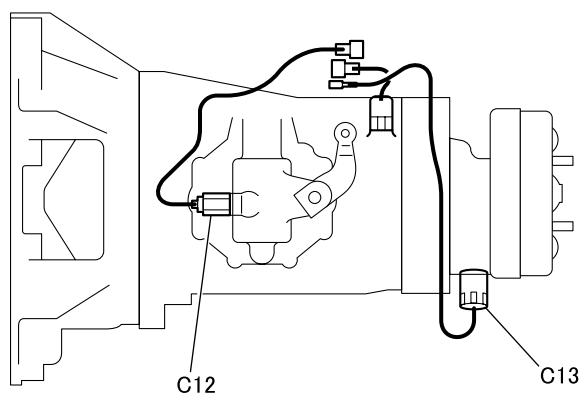


Left side view

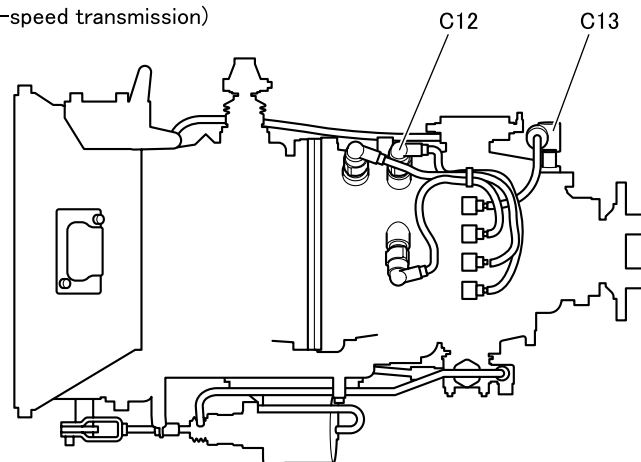




(6-speed transmission)



(9-speed transmission)



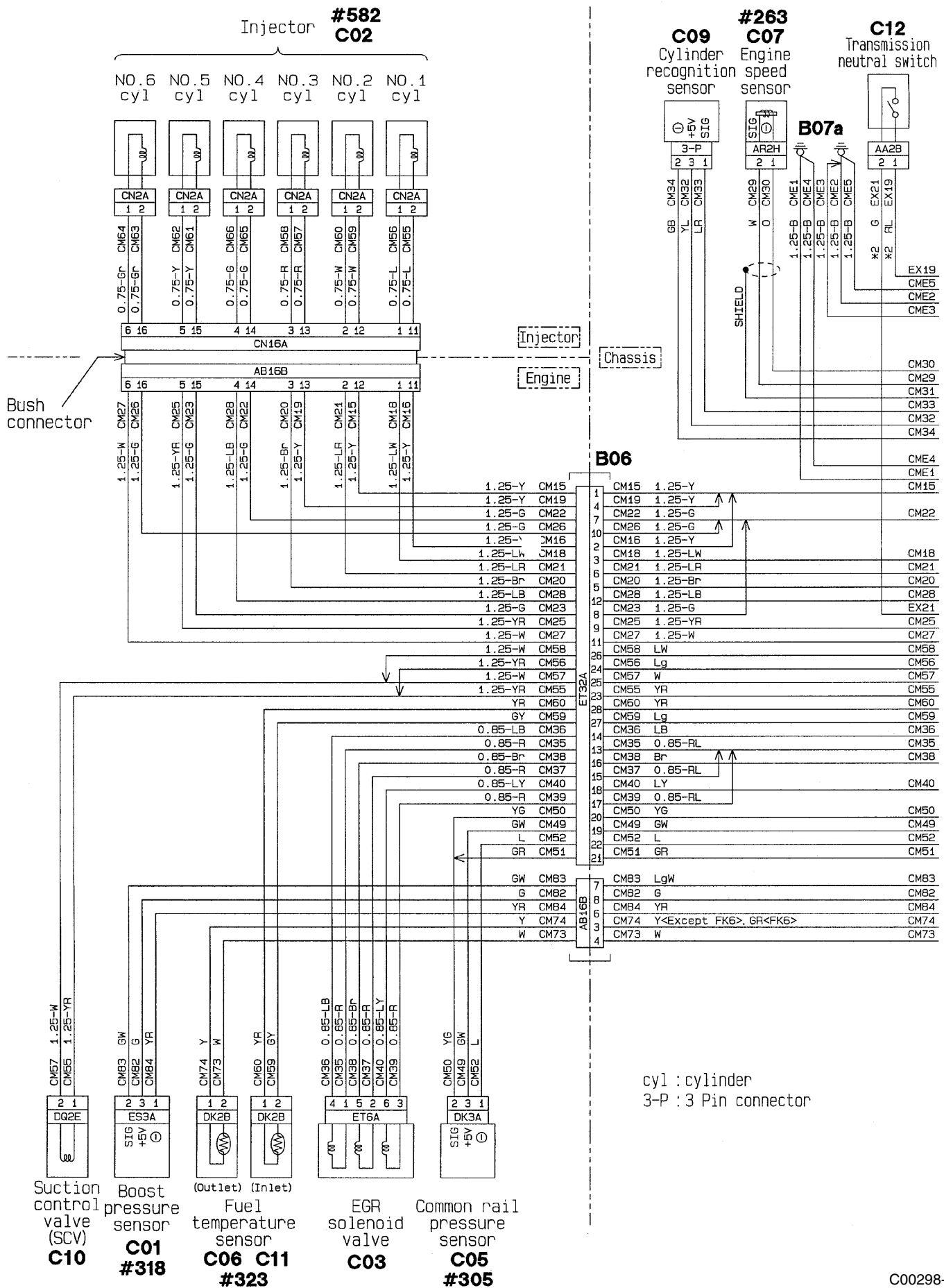
No relevant parts in a missing number

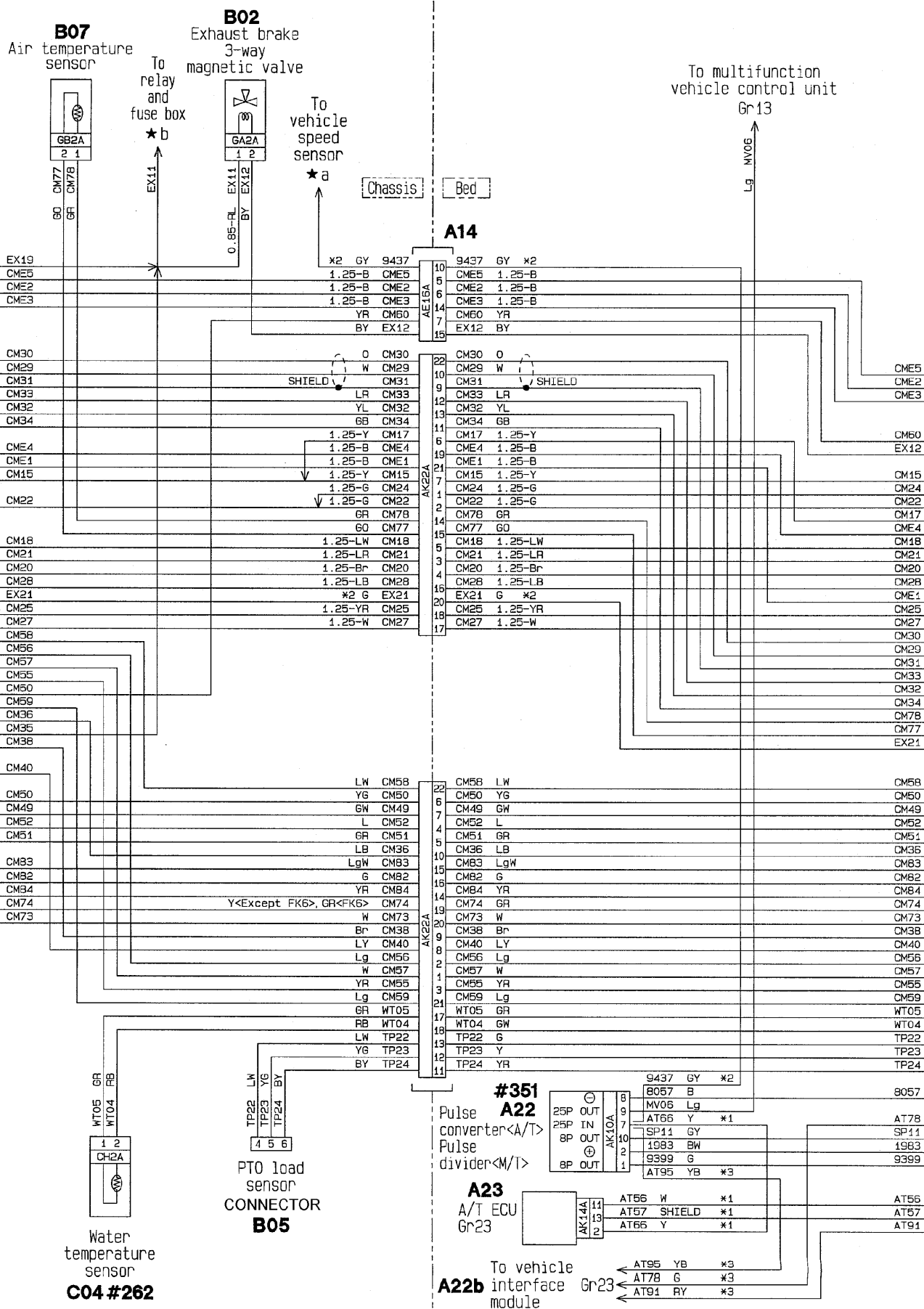
- C01 Boost pressure sensor
- C02 Injector
- C03 EGR solenoid valve
- C04 Water temperature sensor
(Connects to engine electronic control unit)
- C05 Common rail pressure sensor
- C06 Fuel temperature sensor (OUT)
- C07 Engine speed sensor
- C08 Starter

- C09 Cylinder recognition sensor
- C10 SCV (Suction control valve)
- C11 Fuel temperature sensor (IN)
- C12 Transmission neutral switch
- C13 Vehicle speed sensor

EGR : Exhaust gas recirculation

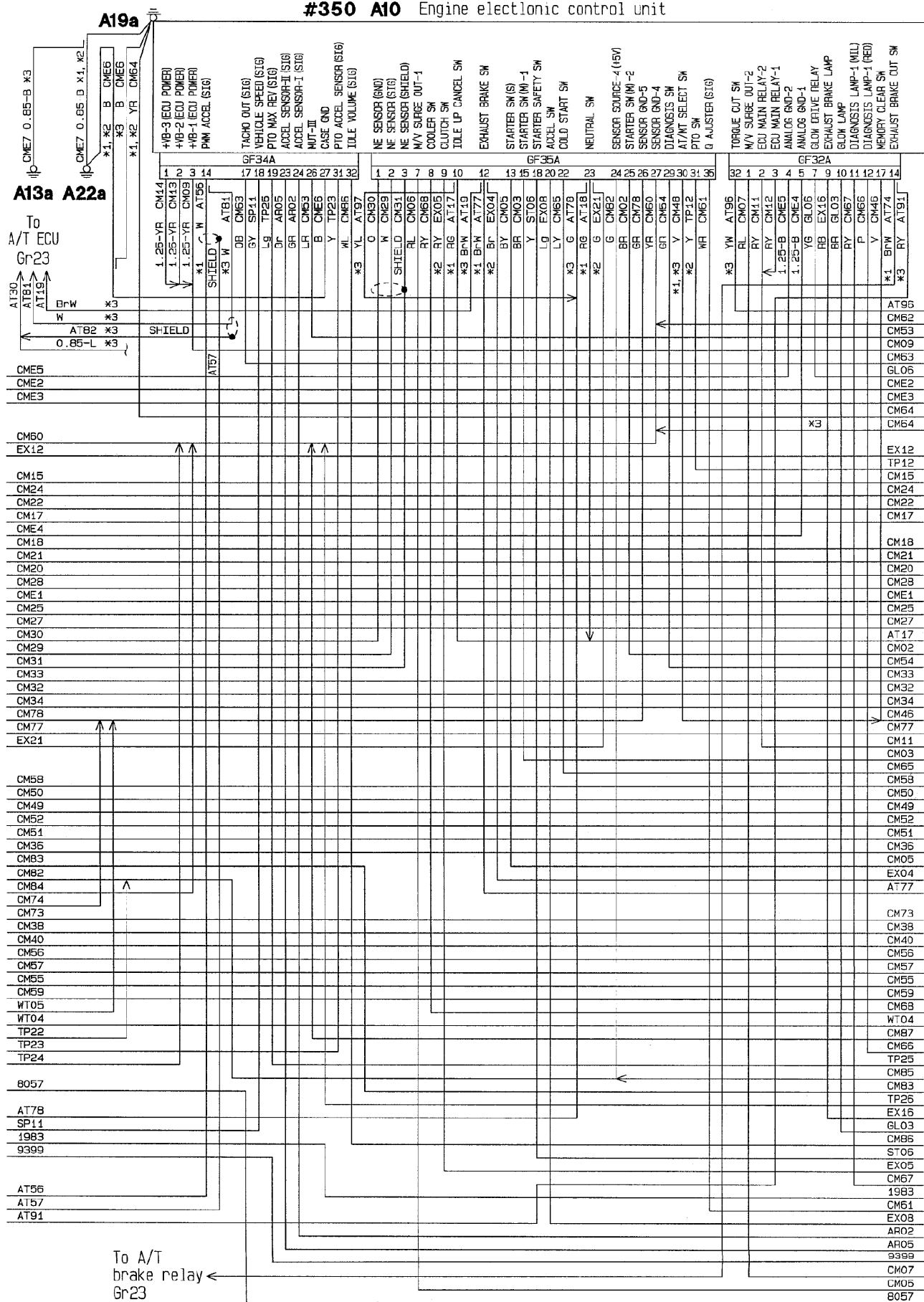
ELECTRIC CIRCUIT DIAGRAM



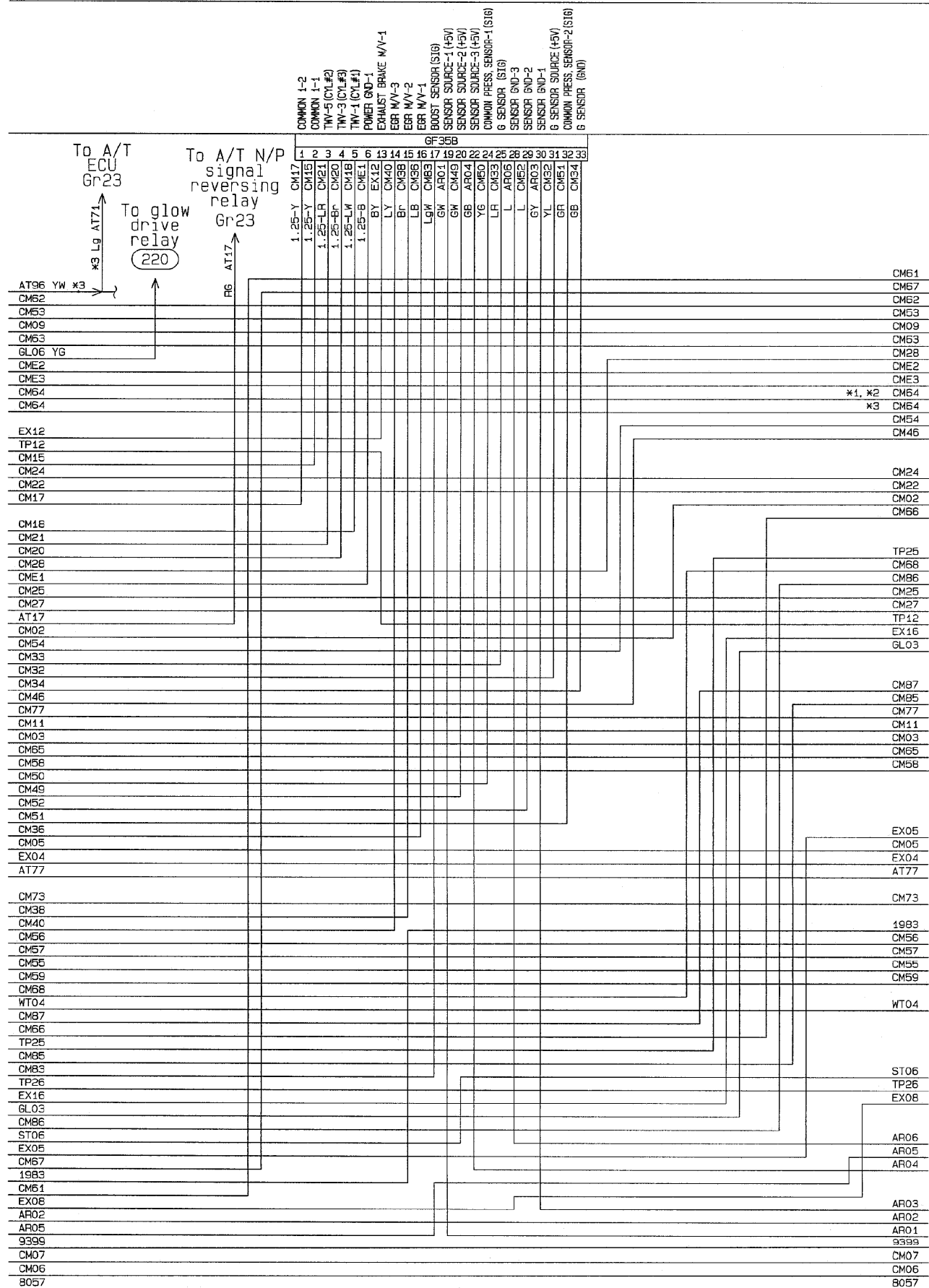


ELECTRIC CIRCUIT DIAGRAM

#350 A10 Engine electronic control unit



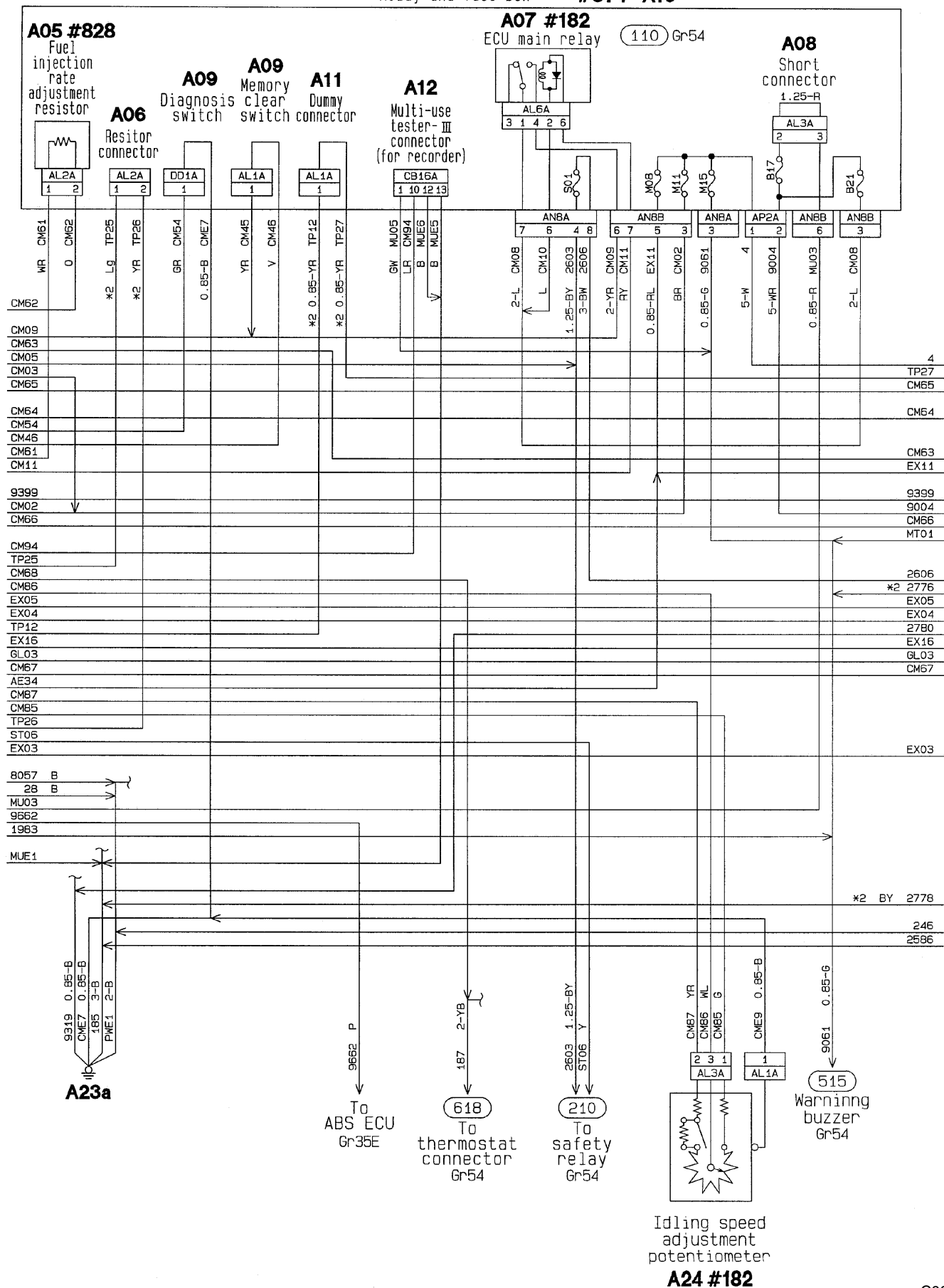
#350 A10 Engine electronic control unit



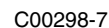
13E-66

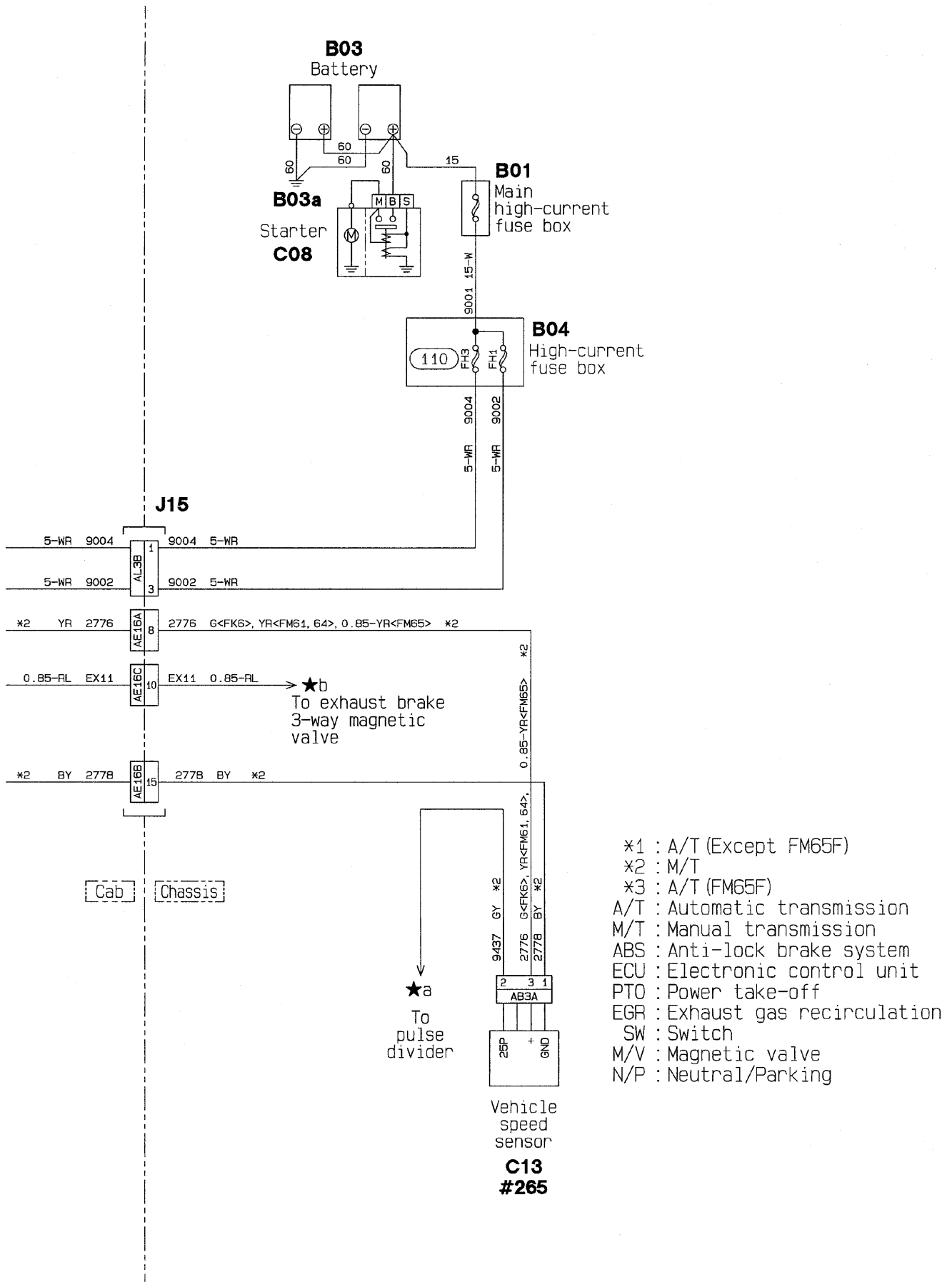
-66



Relay and fuse box **#871 A10**

13E-68





STRUCTURE AND OPERATION

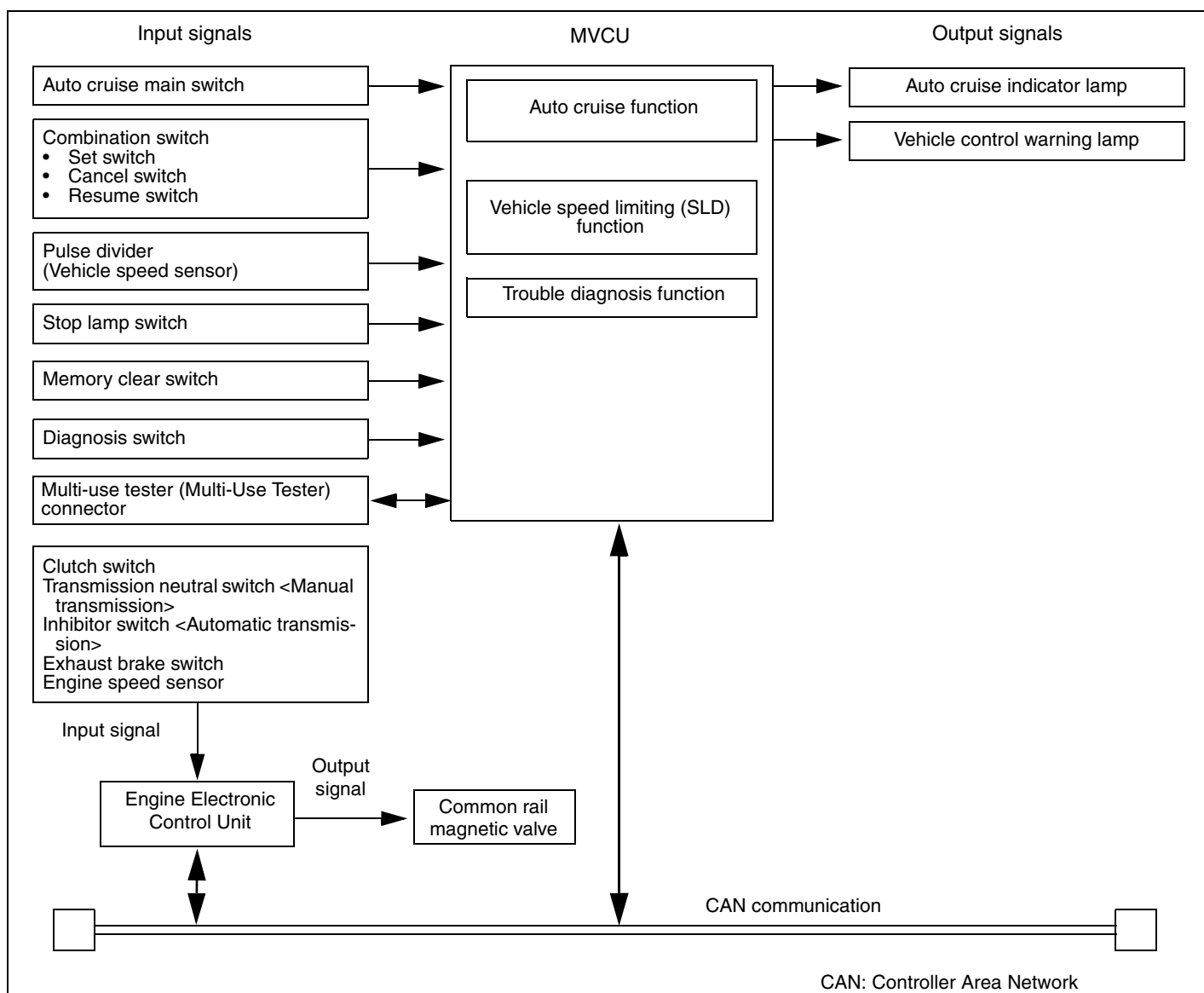
<Auto Cruise System>

1. General Description

- The auto cruise system automatically effects engine control according to actual vehicle speeds to keep the vehicle cruising at a desired speed. There is an auto cruise main switch to establish the auto cruise mode. Desired cruising speed is selected, changed, canceled and resumed by means of an auto cruise set switch, cancel switch and resume switch.
- Control over the system's behavior is effected by the Multifunction Vehicle Control Unit (MVCU), which issues engine control instructions to the engine electronic control unit by means of CAN communication.
- The auto cruise system is controlled by means of the malfunction vehicle control unit (MVCU). The MVCU automatically selects the way of control from various output data from auxiliaries and other systems.
- The MVCU is an integrated electronic control unit having the following control functions.
 - Auto cruise control function
 - Vehicle speed limiting (SLD) control function
- To effect the respective controls, sensor, switch and MVCU system data are provided by CAN communication.
- The auto cruise system contains a diagnosis function that performs self-diagnosis of troubles with main components by means of the electronic control unit and makes any trouble detected known to the driver.

2. Electronic Control System

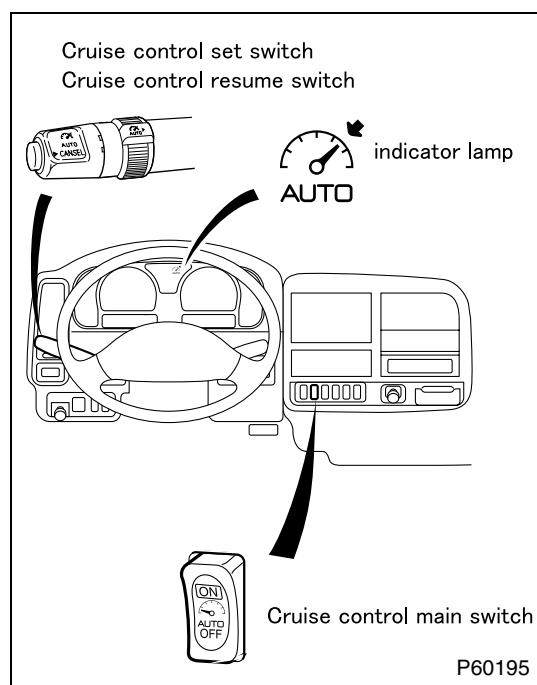
2.1 System block diagram



Part name	Function/operation
Auto cruise main switch	ON-OFF control of auto cruise system
Set switch	Selection and change of desired cruising speed
Cancel switch	Cancellation of current cruising speed
Resume switch	Resumption and change of canceled cruising speed
Pulse divider (vehicle speed sensor)	Detection of vehicle speed
Stop lamp switch	Detection of brake pedal depression (lamp lit on pedal being depressed)
Memory clear switch	Clearing of existing diagnosis code, output of earlier diagnosis codes
Diagnosis switch	Output of diagnosis codes
Multi-Use Tester connector	Communication between Multi-Use Tester and MVCU
Auto cruise indicator lamp	Indication of system in operation
Vehicle control warning lamp	Indication of system failure
CAN communication (engine electronic control unit)	MVCU outputs recognized vehicle data on CAN so that engine electronic control unit receives necessary data for control. Engine electronic control unit outputs necessary signals to MVCU for appropriate control of individual systems.

2.2 Auto cruise control function

(1) Setting cruise control



The cruise control should be operated using the cruise control set switch and the resume switch as follows.

CAUTION ⚠

The following conditions must be satisfied for cruise control to operate.

- The vehicle speed must be between 40 to 90 km/h {25 to 55.9 MPH} and the gear shift lever must be in the 4th position or higher.
- The cruise control main switch must be ON.
- The exhaust brake must be OFF
- The clutch and the brake pedal must be in released.

(1.1) Cruise control set resume switch

SET side

The switch is used to set and change the cruise vehicle speed.

- Setting the cruise speed
Set the vehicle speed at your discretion by operating the accelerator pedal.
Turn cruise control set/resume switch to SET, and the cruise speed will be set to the current vehicle speed when it is released. The indicator lamp will light up at the same time.
- Reducing the cruise speed
With cruise control in activation, vehicle speed decreases while cruise control set/resume switch is turned to SET.
Release the switch when the vehicle reaches a desired speed to set cruise control at that speed.

STRUCTURE AND OPERATION

- Increasing the cruise speed
Press the accelerator pedal. When the vehicle reaches a desired speed, turn cruise control set/resume switch to SET and release it immediately. The vehicle continues traveling at the set speed.

(1.2) RESUME side

To restore or change vehicle speed setting.

- Restoring previous vehicle speed setting when cruise control is deactivated by deceleration, turning and releasing cruise control set/resume switch will restore the previous vehicle speed setting.
- Increasing the set vehicle speed setting with cruise control in activation, turning cruise control set/resume switch to RESUME will increase vehicle speed. When the switch is released, vehicle speed at that time is set as cruise control speed.

2.3 Trouble diagnosis function

- The system constantly performs trouble diagnosis to determine if various sensors, etc. malfunction when the starter switch is ON. When a failure is detected, trouble information is indicated on the meter cluster to inform the driver to that effect. At the same time, the location of the trouble is stored in memory as a diagnosis code to start restricted in-trouble control.
- While in trouble, the system's control functions are restricted to ensure safety of the vehicle and its driver. Diagnosis codes stored in memory can be retrieved on the multi-use tester or through blinking warning lamp.

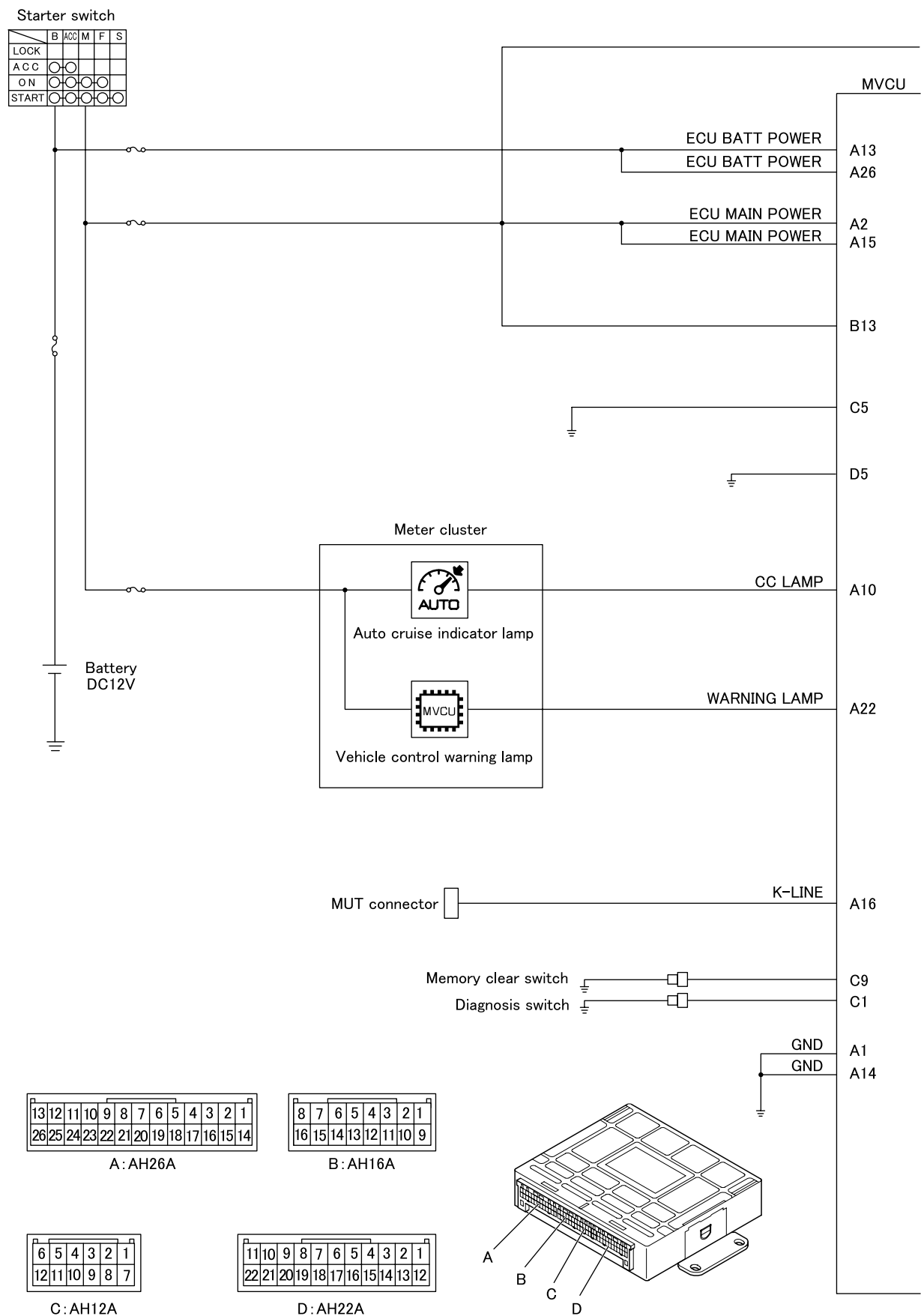
NOTE

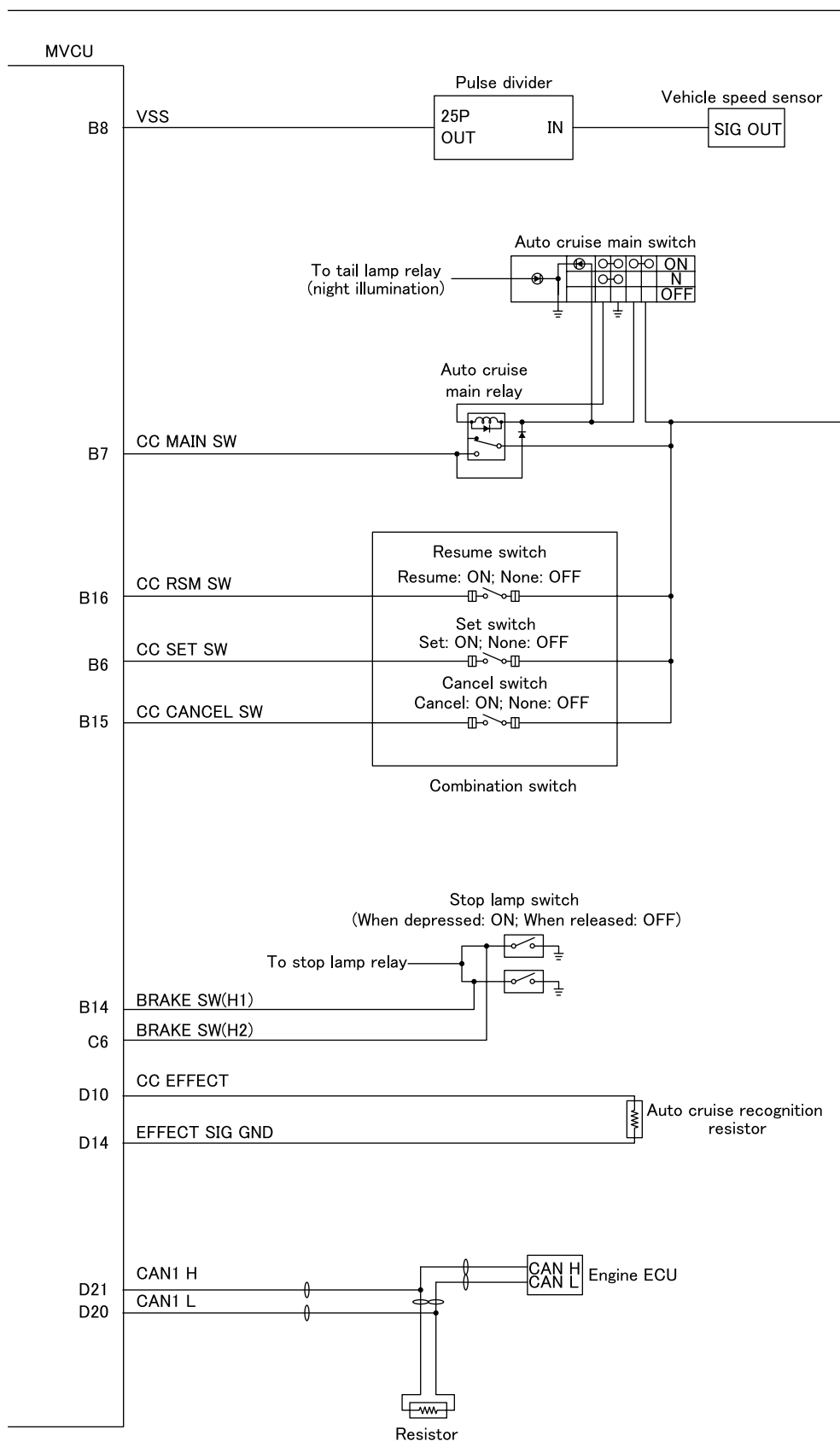
- **Diagnosis codes are different in kind between the Multi-Use Tester and blinking warning lamp.**
- **The Multi-Use Tester gives diagnosis codes that tell more in detail.**

MEMO

STRUCTURE AND OPERATION

3. Electronic Control Unit Connection Diagram





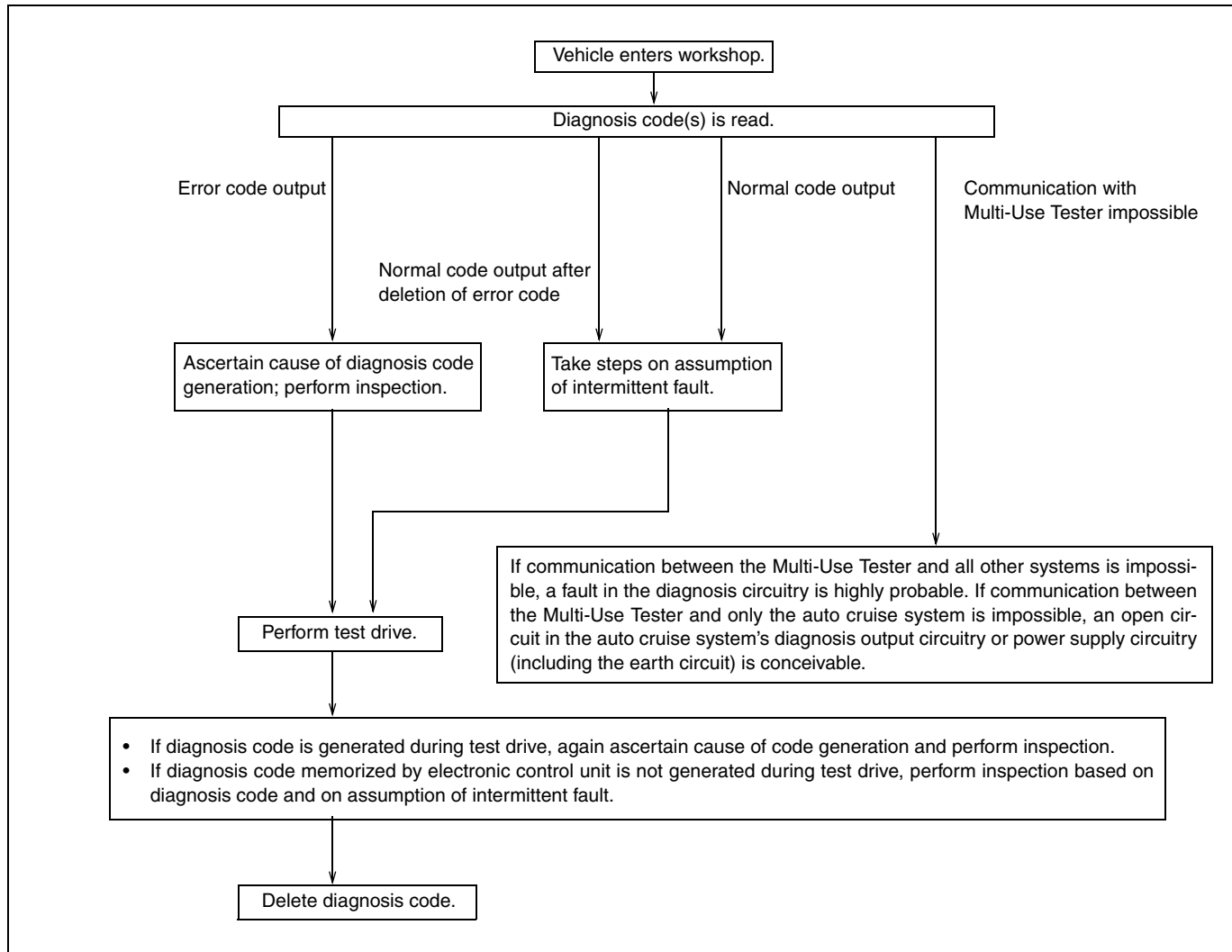
TROUBLESHOOTING

1. Inspection Procedure

- Use of Multi-use Tester-III facilitates system inspection.

System inspection is roughly divided into two types described below according to trouble symptom and diagnosis code.

- Inspection on individual diagnosis code (trouble diagnosis code) stored in the electronic control unit.
- Inspection for cause of transient trouble



2. Cautions to Observe When Performing Inspections

CAUTION

- The battery voltage must be the standard voltage.
- Make sure no harness connector or component connector is loose. Before disconnecting any connector, place the starter switch in the LOCK position and wait 20 seconds.
- After making a repair, delete the diagnosis code using the Multi-Use Tester or memory clear switch.
- As a general rule, inspection work should be performed with the starter switch in the LOCK position. However, it may be necessary to perform certain tasks with the starter switch in the ON position. At these times, be careful not to cause short circuits between connector terminals and between terminals and the vehicle body.
- Indicated component resistances may not fall within the standard ranges if they are unduly affected by the temperature and/or by the accuracy of the tester. Standard values in the text are given on the assumption of room temperature (10 to 35°C {50 to 95°F}).
- After rectification of an abnormality, the system's ability or inability to automatically return to normal control from the backup control that begins when a fault occurs depends upon the diagnosis code, i.e., the fault location. When the system resumes normal control, the warning lamp goes off.
- Even when an abnormality has been rectified and the system has automatically returned to normal control, the diagnosis code corresponding to the fault location remains in the memory of the electronic control unit as a past diagnosis code.
- If a trouble occurs where automatic system recovery is not effected, clear the diagnosis code from the memory to release the system from its restricted control status.

TROUBLESHOOTING

3. Inspection Based on Diagnosis Codes

3.1 List of diagnosis codes

NOTE

- Diagnosis codes are different in kind between the Multi-Use Tester and blinking warning lamp.
- The Multi-Use Tester issues diagnosis codes that tell more in detail.

Code	Message	Warning lamp blinking
–	OK	01
P0500	Vehicle Speed Sensor	06
P0504	Brake SW	11
P1002	Battery Voltage	–
P1003	Battery Terminal	03
P1004	Main Voltage	–
P1007	MVCU	07
P1008	Vehicle Identification	08
U0100	CAN Communication	05
U1013	Engine ECU Cruise Control	13
U1031	Engine ECU Speed Limiting	31

3.2 Diagnosis code generation conditions and Inspection Items

P0500: Vehicle Speed Sensor (Warning lamp: 06)

Generation condition		No vehicle speed sensor signal is output with vehicle in gear and clutch pedal free of foot pressure at engine speed higher than specified.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		• Auto cruise control and vehicle speed limiting (SLD) control interrupted. • Occurrence of trouble with vehicle speed limiting function sent through CAN.
Inspection	Service data	03: Vehicle Speed
	Electronic control unit connector	01 : Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Vehicle sensor system

P0504: Brake SW (Warning lamp: 11)

Generation condition		Stop lamp switch (H1, H2) signals are not identical.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Auto cruise control and vehicle speed limiting (SLD) control interrupted. - Occurrence of trouble with vehicle speed limiting function sent through CAN.
Inspection	Service data	74: Brake SW 1, 75: Brake SW 2
	Electronic control unit connector	02 : Stop lamp switch
	Electrical equipment	#042: Stop lamp switch
	Electric circuit diagram	Stop lamp system

P1002: Battery Voltage (Warning lamp: 02)

Generation condition		Electronic control unit power terminal (directly connected to battery) voltage remains below specified level (20 V) for predetermined time.
Control effected by electronic control unit		Auto cruise control and vehicle speed limiting (SLD) control interrupted.
Inspection	Service data	01: Power Supply Voltage (BATTERY)
	Electric circuit diagram	Power supply system
	Other	- Battery (See Gr54.) - Alternator (See Gr54.)

P1003: Battery Terminal (Warning lamp: 03)

Generation condition		No voltage appears at electronic control unit power terminal for predetermined time.
Control effected by electronic control unit		Auto cruise control and vehicle speed limiting (SLD) control interrupted.
Inspection	Service data	01: Power Supply Voltage (BATTERY)
	Electric circuit diagram	MVCU connector (AH26A) terminal No. 13 and No. 26 system

P1004: Main Voltage (Warning lamp: 04)

Generation condition		Electronic control unit power terminal (starter switch M terminal) voltage remains below specified level (20 V) for predetermined time.
Control effected by electronic control unit		Auto cruise control and vehicle speed limiting (SLD) control interrupted.
Inspection	Service data	02: Power Supply Voltage (MAIN)
	Electric circuit diagram	Starter switch (M terminal) system
	Other	- Battery (See Gr54.) - Alternator (See Gr54.)

P1007: MVCU (Warning lamp: 07)

Generation condition		CPU in electronic control unit malfunctions.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Auto cruise control and vehicle speed limiting (SLD) control interrupted. - Occurrence of trouble with vehicle speed limiting function sent through CAN.
Inspection	Other	Malfunction vehicle control unit proper

TROUBLESHOOTING

P1008: Vehicle Identification (Warning lamp: 08)

Generation condition		Identification start condition continues for predetermined time after start of vehicle identification but vehicle remains unidentified.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Auto cruise control and vehicle speed limiting (SLD) control interrupted. - Occurrence of trouble with vehicle speed limiting function sent through CAN.
Inspection	Service data	2A: Cruise Variation Number
	Electronic control unit connector	03 : Auto cruise recognition resistor
	Electric circuit diagram	Auto cruise recognition resistor system

U0100: CAN Communication (Warning lamp: 05)

Generation condition		No CAN data is received from engine electronic control unit after engine is started.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		- Auto cruise control and vehicle speed limiting (SLD) control interrupted. - Occurrence of trouble with vehicle speed limiting function sent through CAN.
Inspection	Electrical equipment	CAN communication system

U1013: Engine ECU Cruise Control (Warning lamp: 13)

Generation condition		Abnormality occurs in cruise function on engine electronic control unit side.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Auto cruise control interrupted.
Inspection	Other	10: Engine Electronic Control Unit

U1031: Engine ECU SPEED Limiting (Warning lamp: 31)

Generation condition		Abnormality occurs in SLD function on engine electronic control unit side.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		Vehicle speed limiting (SLD) control is stopped.
Inspection	Other	Engine Electronic Control Unit

4. Multi-Use Tester Service Data

NOTE

- Both service data and actuator test results are indicated at the same time.

No.	Item	Data	Inspection condition	Criterion for normality
01	Power Supply Voltage (BATTERY)	■■■.■■■V	Constantly	Consistent with battery voltage
02	Power Supply Voltage (MAIN)	■■■.■■■V	Starter switch in ON position	Consistent with battery voltage
03	Vehicle Speed	■■■■■.MPH	When driving	Synchronous with speedometer
04	Vehicle Speed (Engine Electronic Control Unit)	■■■■■.MPH	When driving	Synchronous with speedometer
05	Accel Pedal Position	■■■■.■%	Released	0%
			Gradually depressed	Gradually rising
			Fully depressed	100%
08	Engine Speed	■■■■■.rpm	Racing (with engine running)	Synchronous with tachometer
10	Cruise Control Set Speed	■■■■■.MPH	Auto cruise mode	Equal to vehicle speed in auto cruise mode
15	Limit Vehicle Speed	■■■■■.MPH	Vehicle speed limiting	—
2A	Cruise Variation Number	1/2/3/4/5/6/7/8/9/ 10/11/12/NON	Constantly	Recognized as "2" (with auxiliary brake non-linked cruise function) according to auto cruise recognition resistance value
71	Neutral SW	Neutral/shift	Transmission in neutral	Neutral
			Transmission in other gear than neutral	Shift
72	Clutch SW	ON/OFF	Clutch pedal depressed	ON
			Clutch pedal released	OFF
74	Brake SW 1	ON/OFF	Brake pedal depressed	ON
			Brake pedal released	OFF
75	Brake SW 2	ON/OFF	Brake pedal depressed	ON
			Brake pedal released	OFF
79	Cruise Main SW	ON/OFF	Auto cruise main switch ON	ON
			Auto cruise main switch OFF	OFF
7A	Cruise Set SW	ON/OFF	Auto cruise set switch ON	ON
			Auto cruise set switch OFF	OFF
7B	Cruise Resume SW	ON/OFF	Auto cruise resume switch ON	ON
			Auto cruise resume switch OFF	OFF
7C	Cruise Cancel SW	ON/OFF	Auto cruise cancel switch ON	ON
			Auto cruise cancel switch OFF	OFF

TROUBLESHOOTING

No.	Item	Data	Inspection condition	Criterion for normality
7E	Diag SW	ON/OFF	Diagnosis switch ON (connector connected)	ON
			Diagnosis switch OFF (connector disconnected)	OFF
7F	Memory Clear SW	ON/OFF	Memory clear switch ON (connector disconnected)	ON
			Memory clear switch OFF (connector connected)	OFF
81	Cruise Lamp	ON/OFF	Auto cruise mode	ON
			Normal driving	OFF
			[Actuator test] A1: Cruise lamp ON A2: Cruise Lamp OFF	
83	System Warning Lamp	ON/OFF	Starter switch in ON position (engine not started)	ON
			No error after engine started	OFF
			[Actuator test] A5: System Warning Lamp ON A6: System Warning Lamp OFF	

5. Actuator Tests Performed using Multi-Use Tester

NOTE

- Both service data and actuator test results are indicated at the same time.

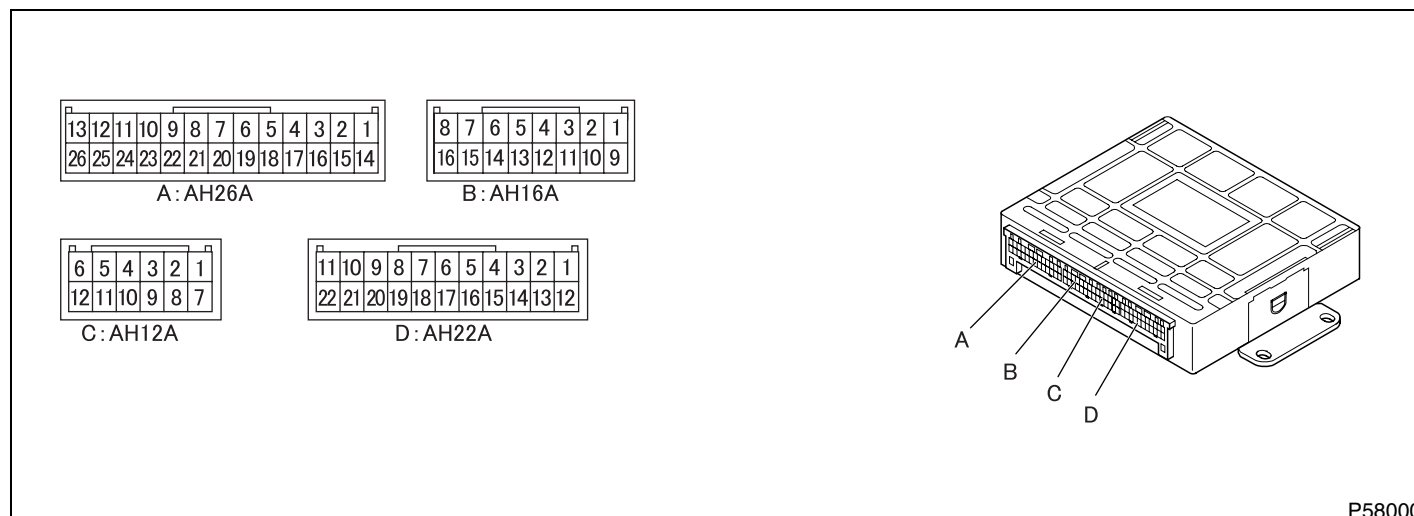
No.	Item	Description	Check method
A1	Cruise Lamp ON	Auto cruise indicator lamp drive signal	Lighting status of auto cruise indicator lamp [Service data] 81: Cruise Lamp
A2	Cruise Lamp OFF		
A5	System Warning Lamp ON	Vehicle control warning lamp drive signal	Lighting status of vehicle control warning lamp [Service data] 83: System Warning Lamp
A6	System Warning Lamp OFF		

6. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.

The white-on-black numbers (**01** , **02** , and so on) correspond to the similarly printed reference numbers in section '3. Inspections based on diagnosis codes'.

6.1 Electronic control unit connector terminal arrangement



P58000

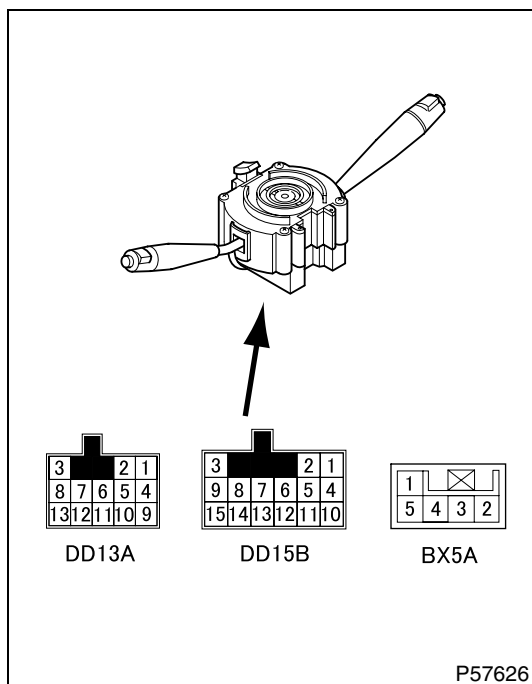
6.2 Inspection procedure

CAUTION

- Depending on check items, checking is performed with connector disconnected or left connected.
- Be sure to not touch any other connector terminal than involved in the check. Use extra care so that connector terminals are not shorted by the tester.

Check item	Check method
01 Vehicle speed sensor signal voltage	[Conditions] - Starter switch is in ON position. - Vehicle side harness is left connected (checked from behind the connector). - Wheels are slowly rotated using chassis dynamo or the like. [Criteria] Between terminals (+) - (-): B8-chassis grounding - High pulse voltage: Approx. 8 ± 1 V - Low pulse voltage: 0.5 V or less
02 Stop lamp switch continuity	[Conditions] - Starter switch in OFF position - Connector disconnected; check at vehicle-side connector [Criteria] Between terminals: B14 or C6-chassis grounding - When brake pedal depressed: Continuity established - When brake pedal released: No continuity
03 Auto cruise recognition resistance	[Conditions] - Starter switch in OFF position - Connector disconnected; check at vehicle-side connector. [Criteria] Between terminals: D10-D14 510 Ω

INSPECTION OF ELECTRICAL EQUIPMENT

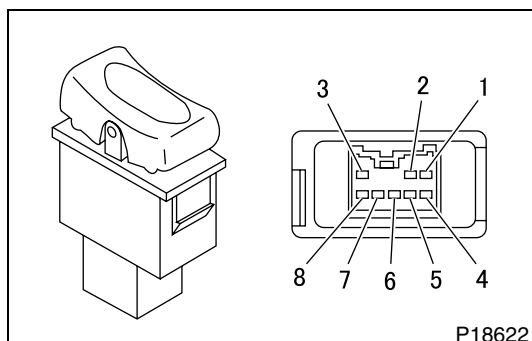


#001 Combination switch inspection

BX5A connector connection table

Switch position		Terminal continuity
Set & resume switch and cancel switch	SET	2 to 3
	CANCEL	3 to 5
	OFF	—
	RESUME	3 to 4

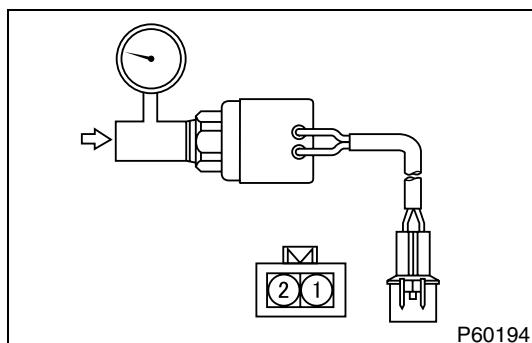
- Replace the switch if found abnormal.



#007 Auto cruise main switch inspection

Switch position	Terminal continuity	Operational illumination	Night illumination
ON	3 to 5, 7 to 8	(+) 4 to 1 (—)	(+) 6 to 1 (—)
N (Neutral)	3 to 5	—	
ON	—	—	

- Replace the switch if found abnormal.



#042 Stop lamp switch

- Inspect the switch as follows, and replace it if found abnormal.

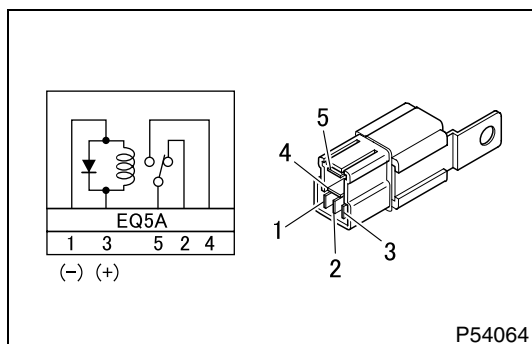
(1) Inspection without air pressure applied

- Check that there is no continuity between terminals 1 and 2.

(2) Inspection with air pressure applied

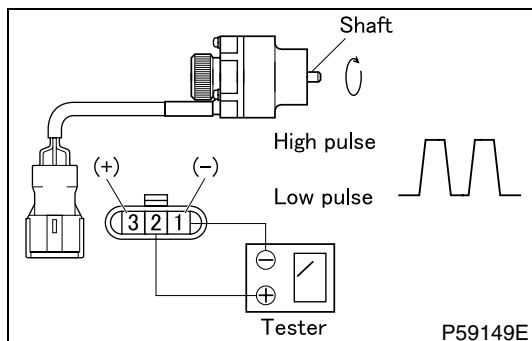
- Apply air pressure slowly increasing from 0 kPa {0 psi, 0 kgf/cm²}.
- Measure air pressure at the point of continuity being established between terminals 1 and 2, to see if it is within the specified limit of standard value.

Standard value (operating pressure)	29 ± 9.8 kPa {4.3 ± 1.4 psi, 0.3 ± 0.1 kgf/cm ² }
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#201 Relay inspection (normally open 5-pin)

- Check the relay for continuity and function. Replace the relay if found abnormal.

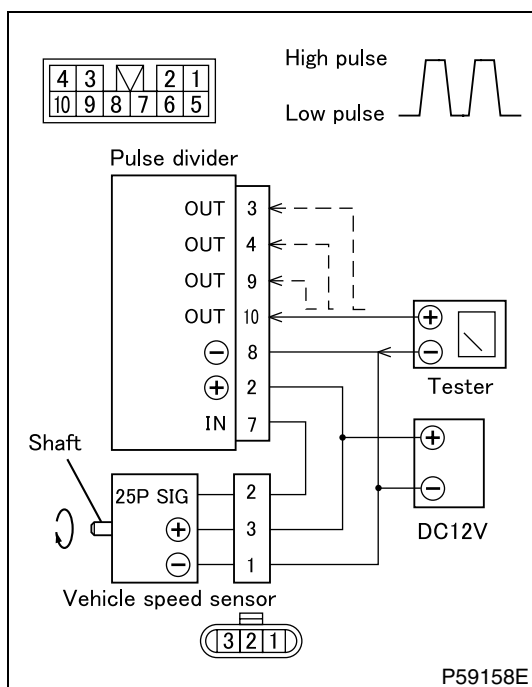


#265 Vehicle speed sensor inspection

- Slowly rotate the shaft of the vehicle speed sensor with battery voltage applied between terminals 3 and 1 of the sensor.
- Measure maximum voltage (high pulse voltage) and minimum voltage (low pulse voltage) appearing between terminals 2 and 1 of the sensor.

Standard value	Low pulse voltage	0.5 V or less
	High pulse voltage	8 ± 1 V

- If measurements deviate from the specified standard values, replace the sensor.



#351 Pulse divider inspection

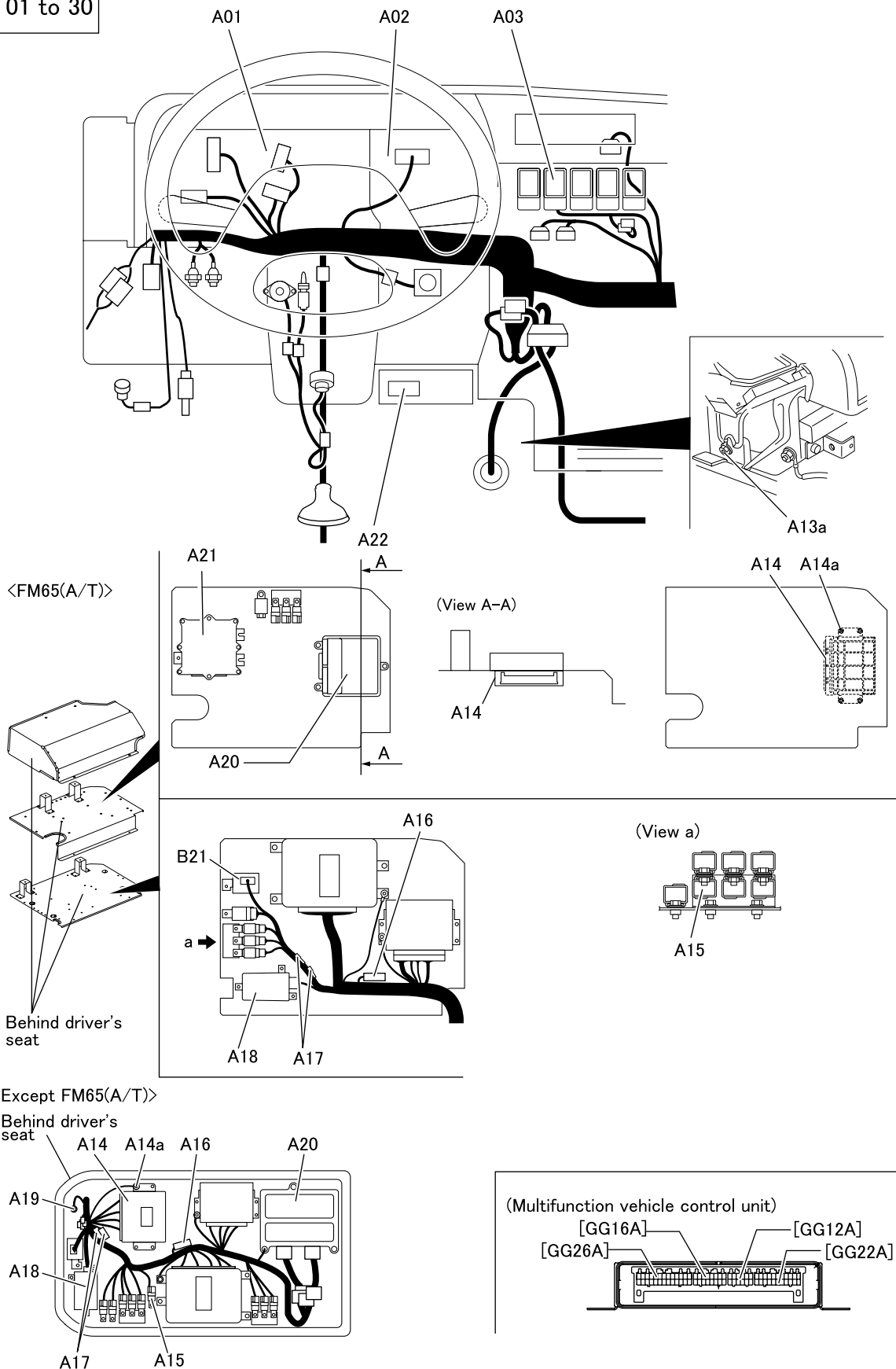
- Connect the pulse divider to the tester as shown.
- Slowly rotate the shaft of the vehicle speed sensor by hand, and measure maximum voltage (high pulse voltage) and minimum voltage (low pulse voltage) appearing between each of OUT terminals (3, 4, 9 and 10) and terminal 8 of the pulse divider.

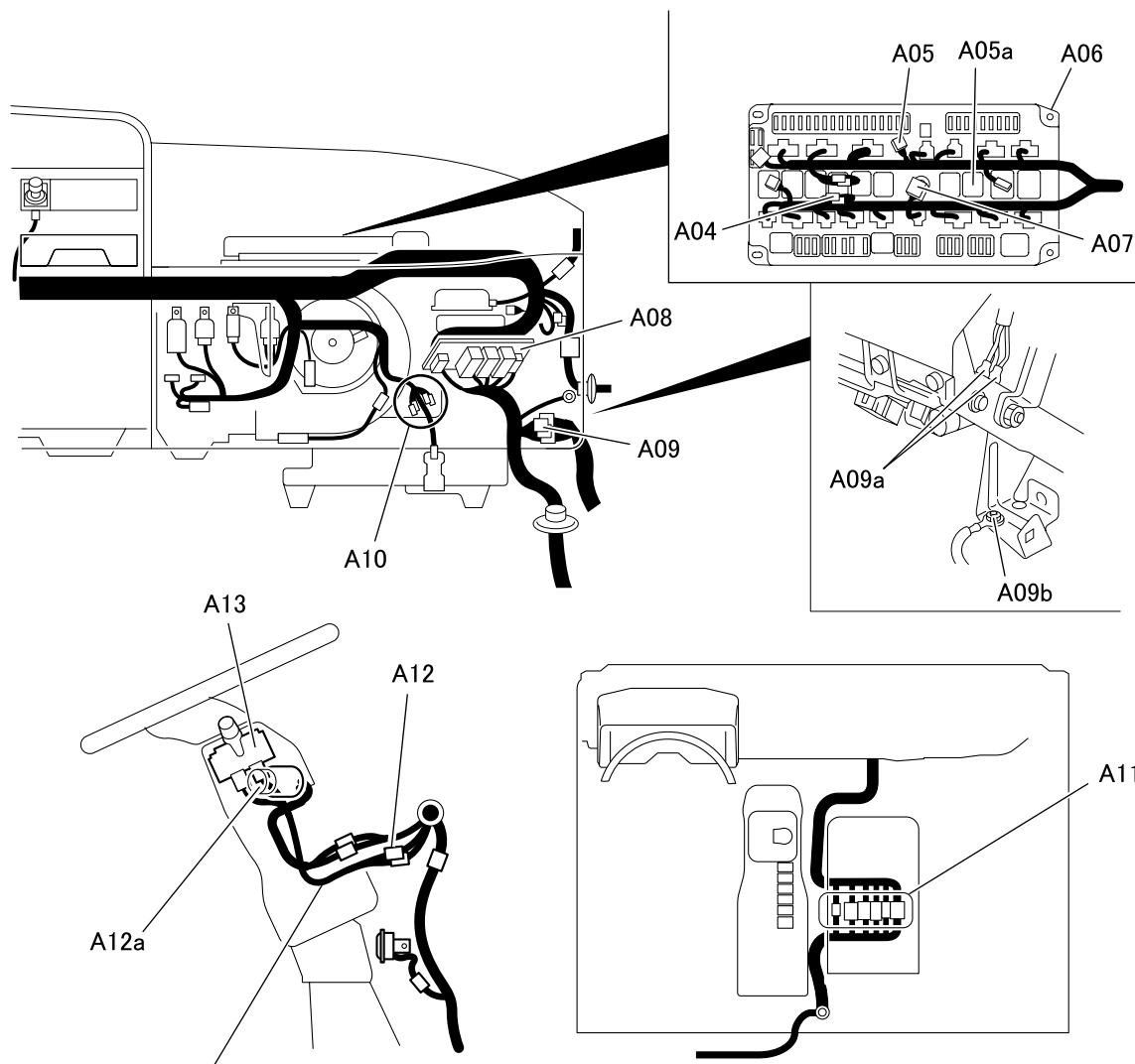
Standard value	High pulse voltage	8 ± 1 V
	Low pulse voltage	0.5 V or less

- If measurements deviate from the specified standard values, replace the pulse divider.

INSTALLED LOCATIONS OF PARTS

A 01 to 30





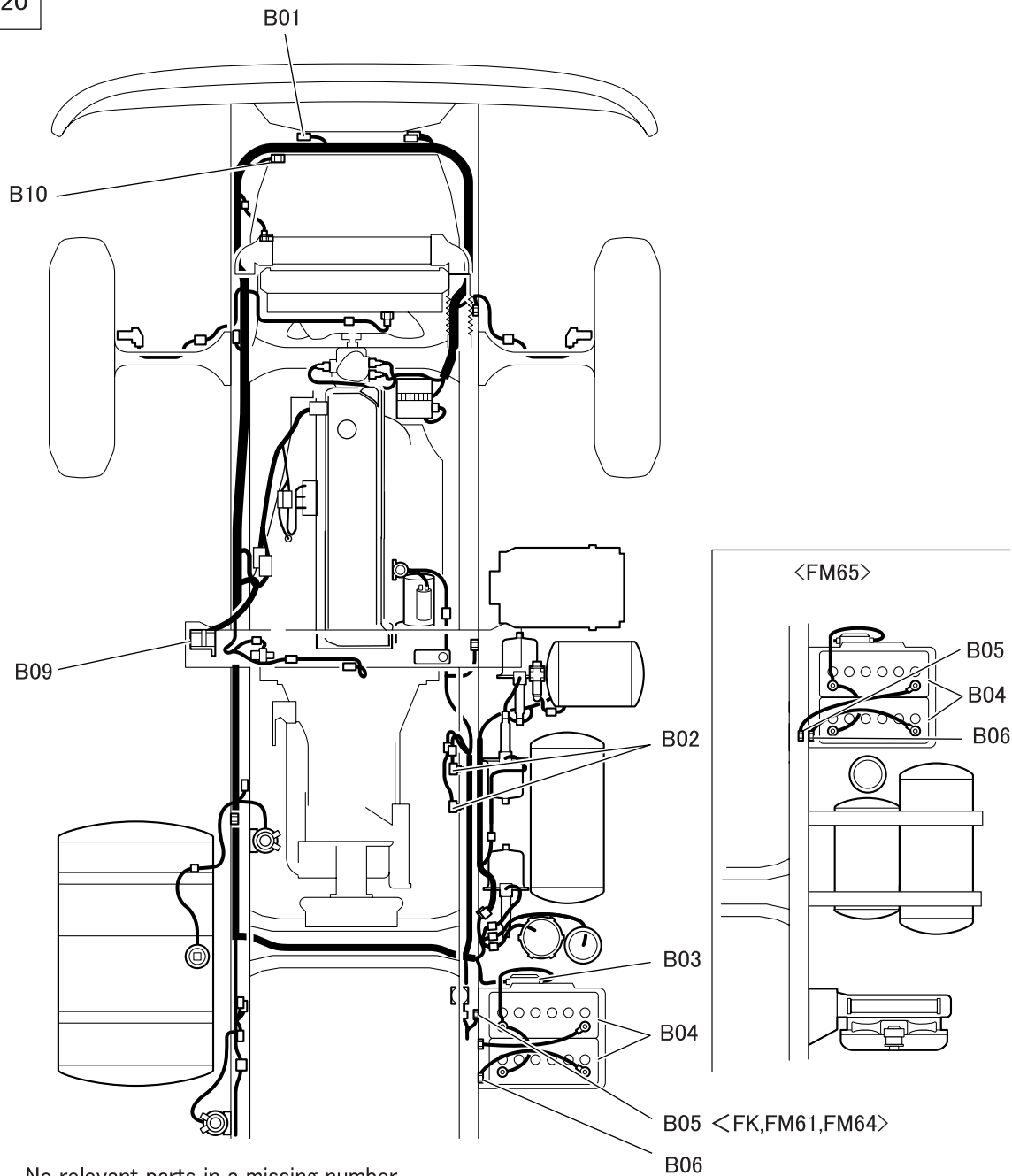
Combination switch harness

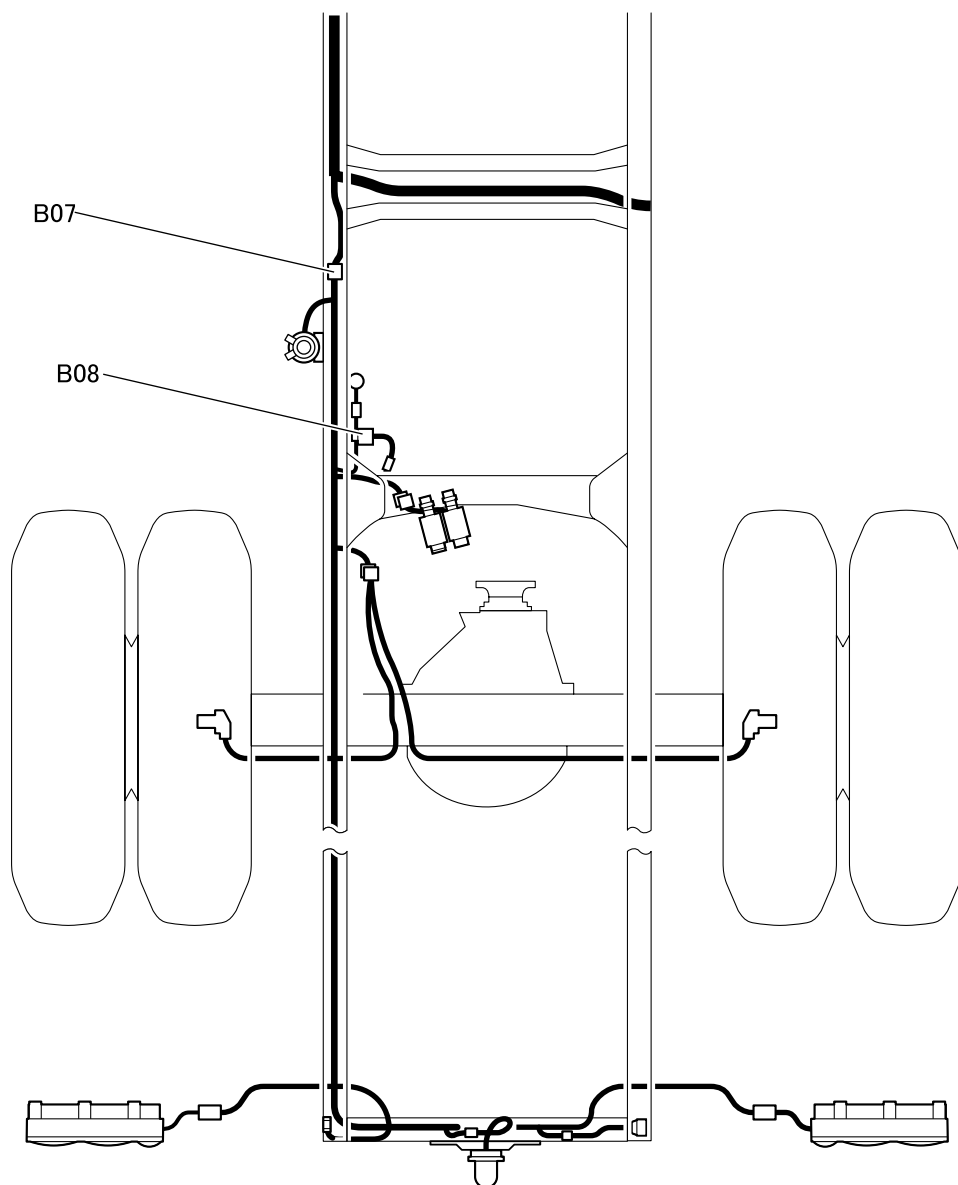
No relevant parts in a missing number

- | | |
|--|---|
| A01 Meter cluster | A13 Combination switch |
| A02 Speedometer | A13a Ground |
| A03 Cruise control main switch | A14 Multifunction vehicle control unit |
| A04 Diagnosis switch and memory clear switch (MVCU) | A14a Ground |
| A05 Resistor | A15 Cruise control main relay |
| A05a Short connector | A16 Joint connector(J/C M1) |
| A06 Relay and fuse box | A17 Resistor unit |
| A07 Multi-use tester-III connector (For recorder) | A18 Pulse converter <A/T>
Pulse divider <M/T> |
| A08 Connection of cab harness and chassis harness | A19 Ground |
| A09 Connection of bed harness and chassis harness | A20 A/T ECU |
| A09a Ground | A21 Vehicle interface module |
| to b | A22 Multi-use tester-III connector (For inspection) |
| A10 Diode | |
| A11 Connection of cab harness and bed harness | ABS : Anti-lock brake system |
| A12 Connection of cab harness and combination switch harness | ECU : Electronic control unit |
| A12a Starter switch | MVCU : Multifunction vehicle control unit |
| | A/T: Automatic transmission |

INSTALLED LOCATIONS OF PARTS

B 01 to 20



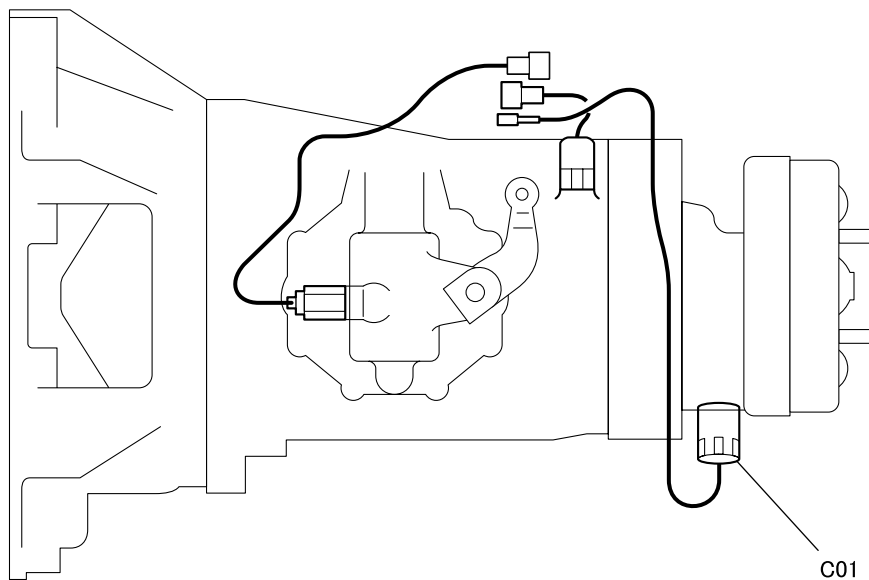


INSTALLED LOCATIONS OF PARTS

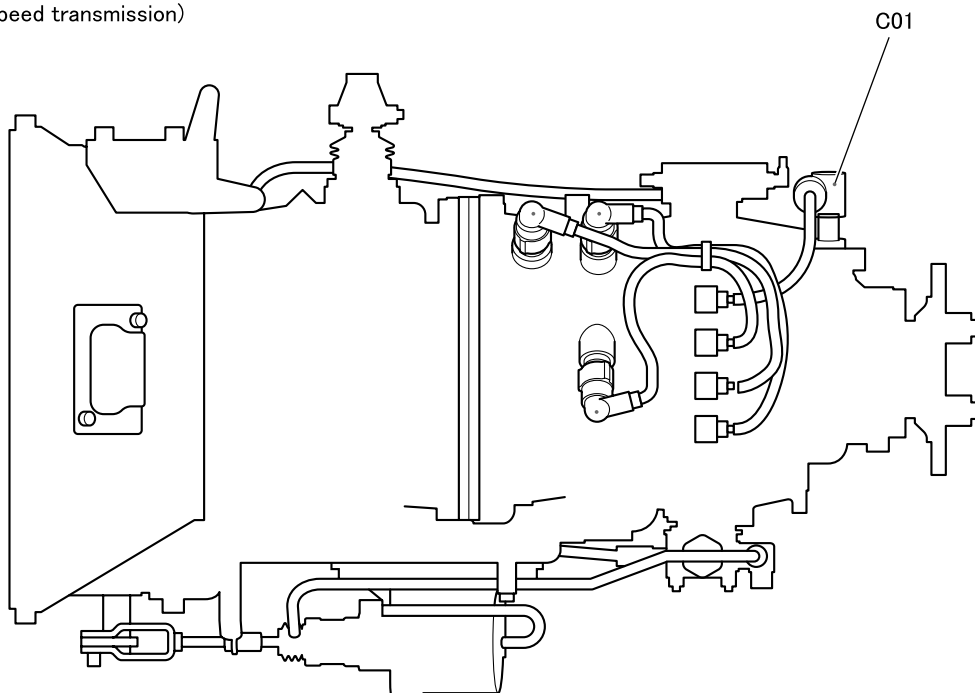
C 01 to 04

<Manual transmission>

(6-speed transmission)



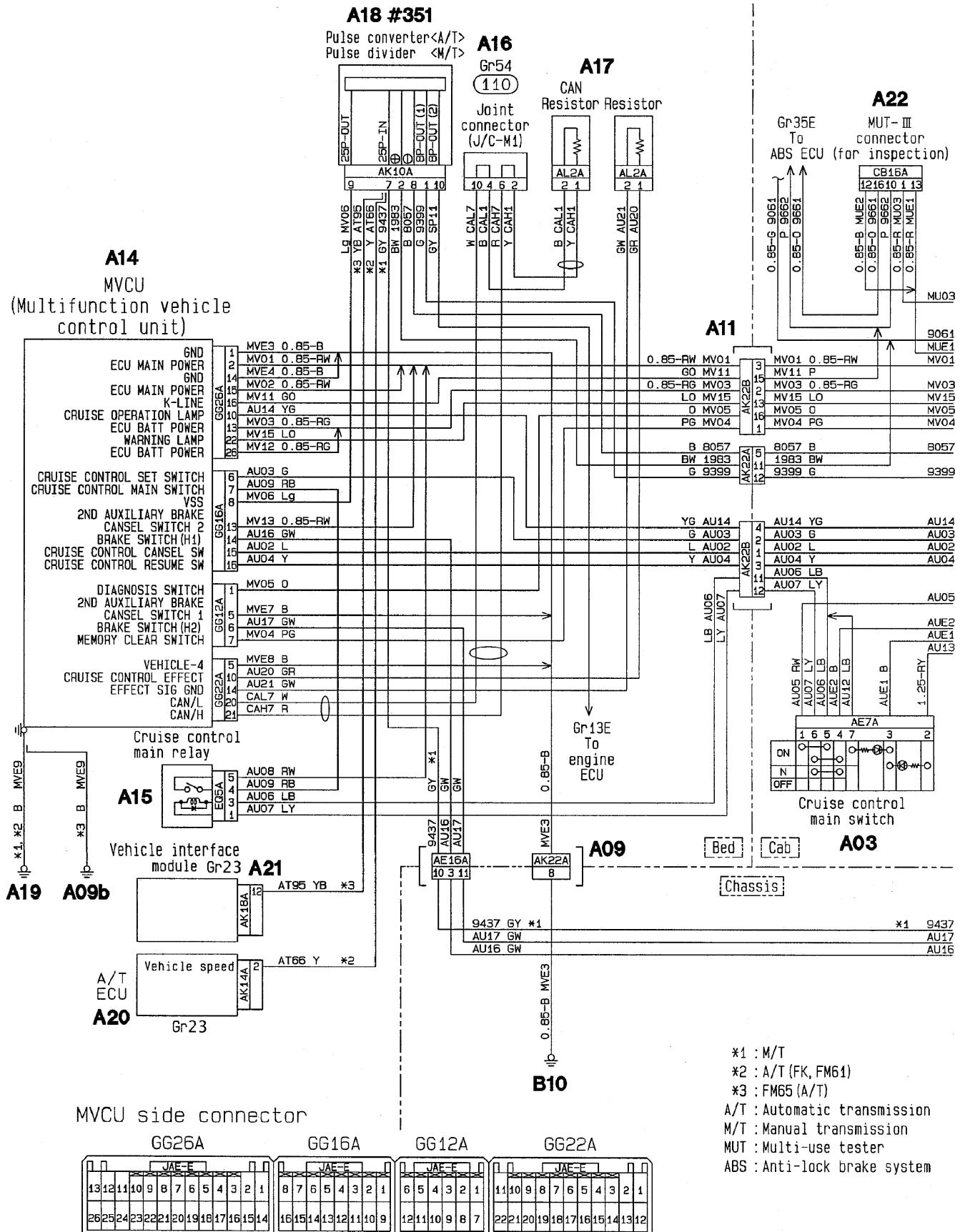
(9-speed transmission)



C01 Vehicle speed sensor

MEMO

ELECTRIC CIRCUIT DIAGRAM





Group 14

Cooling

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	14-2
STRUCTURE AND OPERATION	
1. Cooling System (Coolant Flow)	14-2
2. Water Pump	14-3
3. Thermostat	14-3
TROUBLESHOOTING	14-4
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Replacing Coolant and Cleaning Cooling System	14-6
2. Air Bleeding of Cooling System	14-8
3. Gas Leak Testing	14-8
RADIATOR AND FAN SHROUD	14-10
COOLING FAN AND V-BELT	14-18
WATER PUMP	14-22
THERMOSTAT	14-30

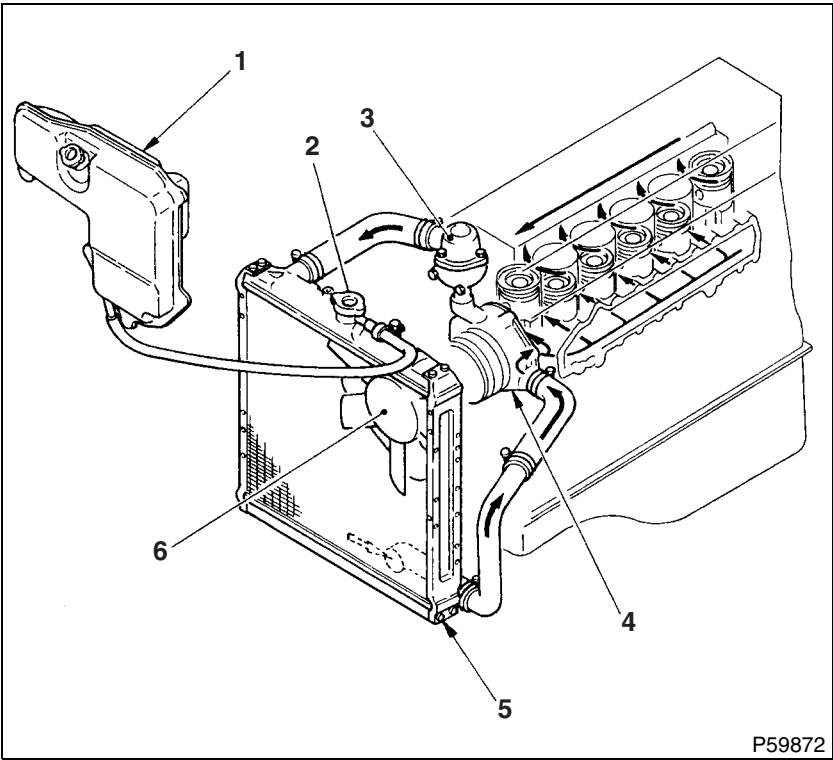
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item	Specifications
Cooling system	Forced water circulation type
Water pump type	Belt-driven volute pump
Thermostat type	Wax pellet/bottom bypass type (with jiggle valve)
Automatic cooling fan coupling type	Constant control type
Radiator type	Tube and corrugated fin type
Coolant capacity	L {qts}
	25 {26}

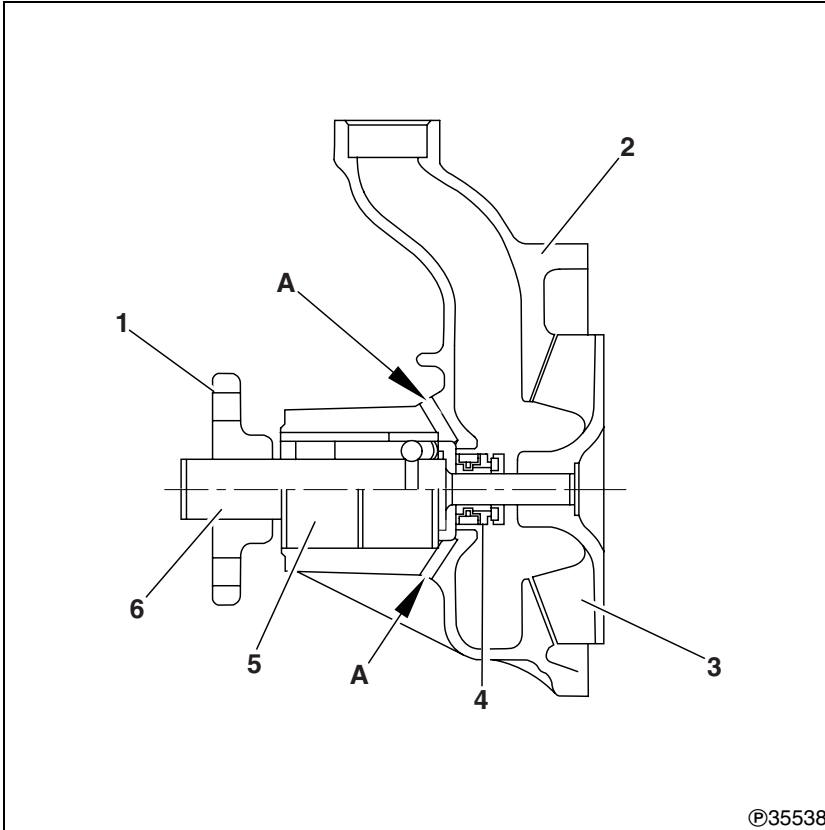
STRUCTURE AND OPERATION

1. Cooling System (Coolant Flow)



- 1 Reservoir tank
- 2 Pressure cap
- 3 Thermostat
- 4 Water pump
- 5 Radiator
- 6 Cooling fan

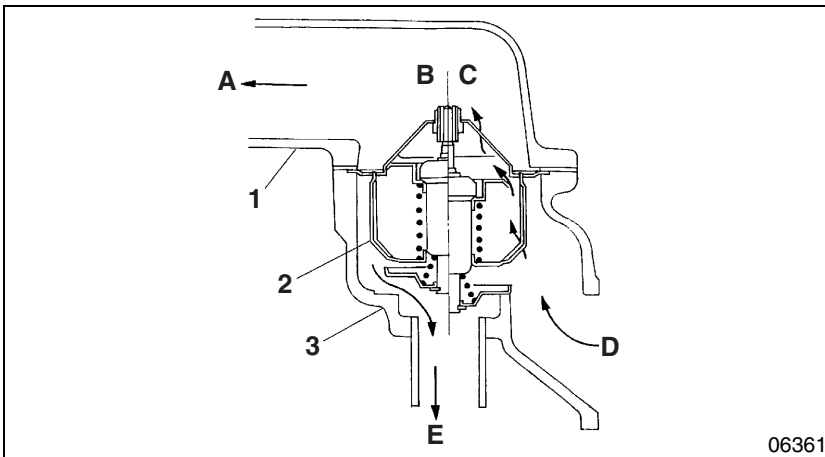
2. Water Pump



- 1 Flange
- 2 Water pump case
- 3 Impeller
- 4 Unit seal
- 5 Bearing
- 6 Water pump shaft

A: Drain hole

3. Thermostat



- 1 Thermostat cover
- 2 Thermostat
- 3 Thermostat case

A: To radiator

B: With low coolant temperature

C: With high coolant temperature

D: From cylinder head

E: To water pump

The thermostat is a bottom-bypass type that utilizes wax-charged pellets as the regulating element. As the wax changes from solid to liquid in line with temperature increases, the total wax volume changes. Thus, the position of the valve varies in accordance with the coolant temperature. This movement of the valve regulates the flow of coolant to the radiator and water pump (bypass side) and controls the coolant temperature.

TROUBLESHOOTING

Symptoms		Overheating (insufficient cooling)	Overcooling	Abnormal noise	Excessive coolant loss	Remarks
Possible causes						
V-belt	Loose or damaged	☐		☐		
	Excessive tension			☐		
	Oil on belt	☐				
Water pump	Water pump fitted poorly	☐			☐	
	Gasket defective	☐			☐	
	Bearing defective	☐		☐		
	Impeller defective	☐				
	Unit seal defective	☐			☐	
	Loose fit between shaft and flange and/or impeller	☐		☐		
Thermostat	Case fitted poorly	☐			☐	
	Gasket defective	☐			☐	
	Valve opening temperature too high; valve remains closed	☐				
	Valve opening temperature too low; valve remains open		☐			
	Water leaking from water temperature sensor	☐			☐	
Radiator	Core clogged	☐				
	Core cracked and/or soldered joints separated	☐			☐	
	Pressure cap not sufficiently airtight	☐				
	Water leaking from water level sensor	☐			☐	
Cooling fan	Fan shroud fitted poorly	☐		☐		
Automatic cooling fan coupling	Bearing defective	☐		☐		
	Bimetal damaged	☐				
	Bimetal contaminated with foreign particles	☐	☐			
	Silicone oil leaking	☐		☐		
Oil cooler	Oil cooler fitted poorly	☐			☐	 Gr12
	Gasket defective	☐			☐	
Cylinder head	Cylinder head fitted poorly	☐			☐	 Gr11
	Gasket defective	☐			☐	
Coolant quantity insufficient and/or coolant dirty		☐				
Coolant passages dirty and/or clogged		☐				
Hoses fitted poorly		☐			☐	
Ambient temperature extremely low			☐			

MEMO

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Replacing Coolant and Cleaning Cooling System

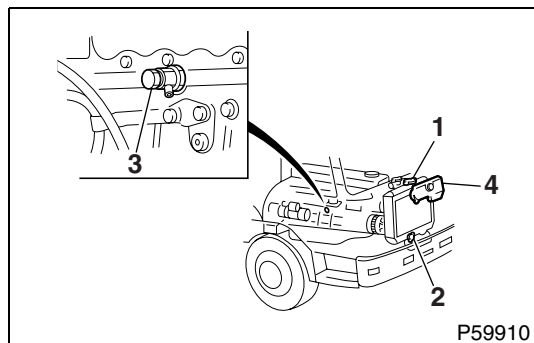
① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Radiator drain plug	2.0 {1.4, 0.2}	—
3	Water drain cock	7 {5.2, 0.7}	—

Using the radiator for extended periods without cleaning, the cooling system will cause overheating since rust and scale will accumulate. The cooling system must be cleaned periodically.

● Draining the coolant



WARNING ⚠

- To avoid being scalded, make sure the coolant has cooled sufficiently before draining it out.
- Unless care is taken, opening the pressure cap 1 when the coolant is hot can cause the coolant to spray out. Cover the pressure cap with a cloth, and loosen the cap slowly to bleed off the pressure before opening it fully.

- Loosen the pressure cap 1.
- Remove the radiator drain plug 2 and drain the coolant in the radiator.
- Remove the water drain cock 3 and drain the coolant in the crank-case.
- Drain the coolant in the reservoir tank 4 as well.

CAUTION ⚠

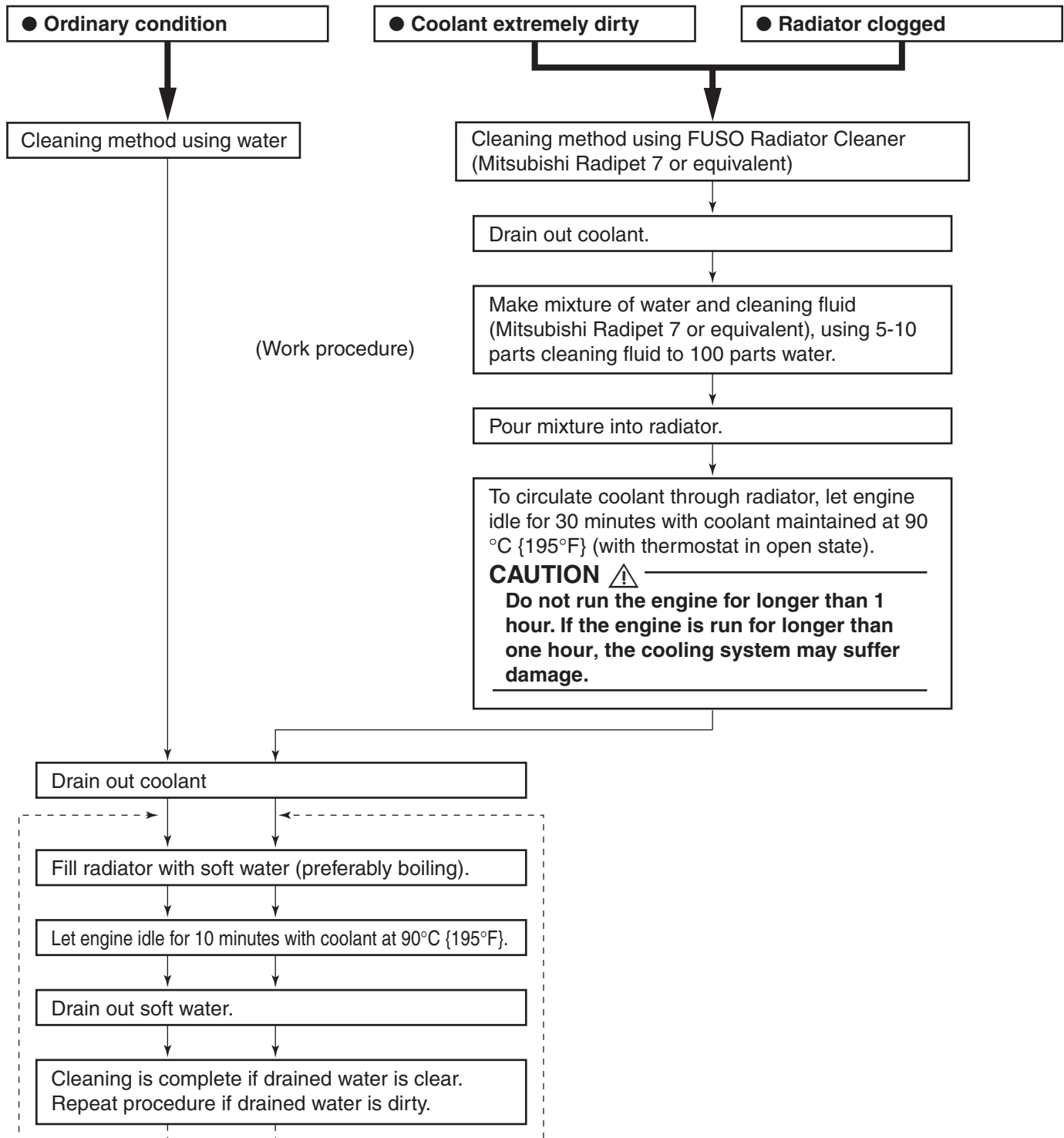
Hard water causes scaling and rusting. Use soft water as the coolant.

Required properties of soft water

Total hardness	300 ppm or less
Sulfate SO_4^-	100 ppm or less
Chloride Cl^-	100 ppm or less
Total dissolved solids	500 ppm or less
pH	6 to 8

● Cleaning the cooling system

As shown below, the cleaning method for the cooling system depends on the system's condition.



● Injecting the coolant

To prevent freezing of the coolant and corrosion of the cooling system, add to the coolant the specified proportion of FUSO Diesel Long Life Coolant, FUSO Antifreeze or Radiator Antirust (Radipet 9). (See the Owner's Handbook for instructions on the use of these products.)

ON-VEHICLE INSPECTION AND ADJUSTMENT

WARNING

FUSO Diesel Long Life Coolant is flammable. Keep it away from heat and naked flames.

DANGER

If you accidentally splash FUSO Diesel Long Life Coolant, FUSO Antifreeze or Radiator Antirust (Radipet 9) in your eyes, wash it off immediately with water and seek medical attention.

NOTE

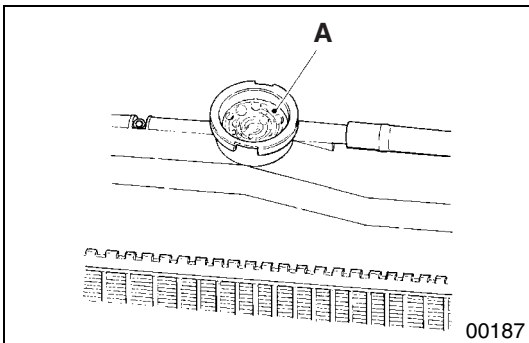
- After cleaning the cooling system with cleaning fluid, fill it with the coolant as soon as possible.
- After cleaning, check the radiator with extra care for water leakage.

2. Air Bleeding of Cooling System

- Let the engine idle with the pressure cap removed and the coolant at a temperature of 90°C {195°F} until the cooling system is completely bled of air.
- After bleeding the cooling system of air, add coolant to the reservoir tank as required.

3. Gas Leak Testing

The presence of air or exhaust gas in the coolant increases corrosion in the cooling system. Check for air or exhaust gas in the coolant using the following procedure.



- Remove the pressure cap.

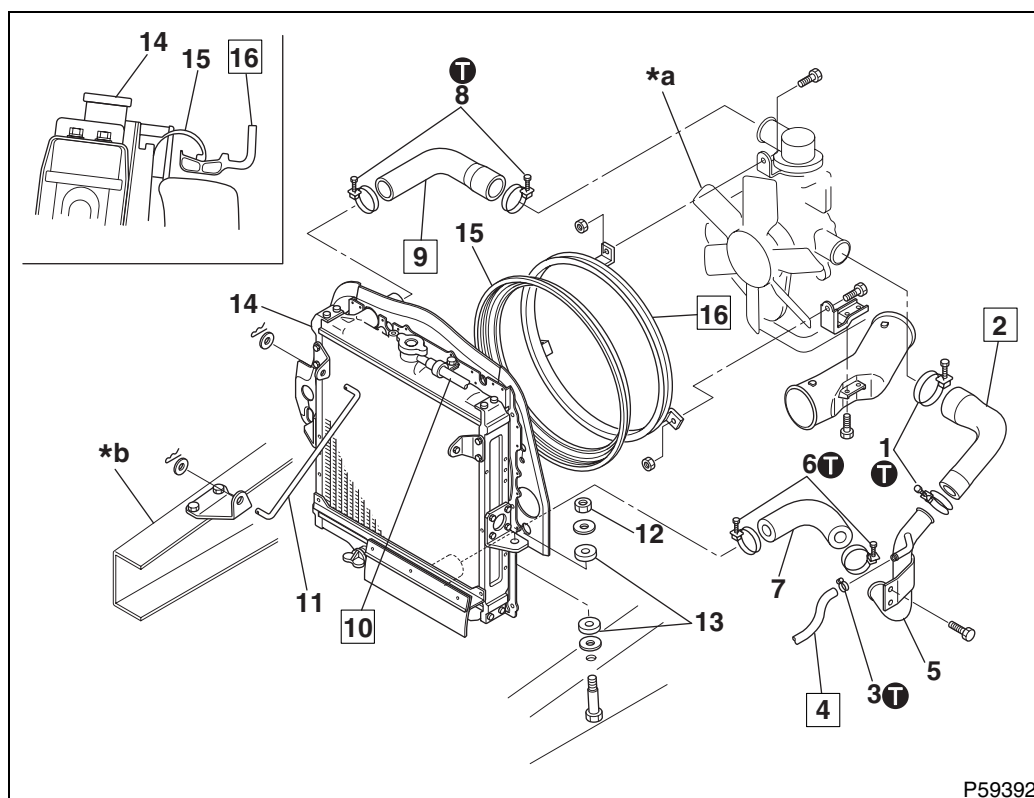
WARNING

When the coolant is hot, open the pressure cap 1 with extra care to avoid being scalded. Put a piece of cloth over the cap and loosen it slowly to release pressure before opening.

- Run the engine and let the coolant temperature reach approximately 90°C {195°F}.
- If bubbles **A** appear continuously in the coolant, air or exhaust gas is leaking into the cooling system.
- If the coolant contains air, the cylinder head bolts, water pump mounting bolts, or hose connections may be loose. Alternatively, the hoses may be damaged.
- If the coolant contains exhaust gas, it is possible that the cylinder head gasket is damaged or that the cylinder head is cracked.

MEMO

RADIATOR AND FAN SHROUD



● Disassembly sequence

- 1 Hose clamp
- 2 Inlet hose
- 3 Hose clamp
- 4 Heater hose
- 5 Inlet pipe
- 6 Hose clamp
- 7 Outlet hose
- 8 Hose clamp
- 9 Inlet hose
- 10 Reservoir hose
- 11 Support rod
- 12 Nut
- 13 Rubber seat
- 14 Radiator assembly
P14-12
- 15 Shroud seal
- 16 Fan shroud

***a:** Cooling fan
P14-18

***b:** Frame
Gr41

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
16, *a	Tip clearance between fan shroud and cooling fan	$5.0^{+3.5}_{-0.5}$ { $0.20^{+0.14}_{-0.020}$ }	—	Adjust

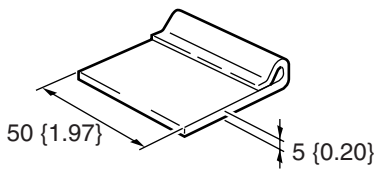
① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1, 3, 6, 8	Hose clamp	3.9 ± 0.6 { 2.9 ± 0.4 , 0.4 ± 0.06 }	—

🔧 Special tools

Unit: mm {in.}

Location	Tool name and shape	Part No.	Application
16	Tip Clearance Spacer  ©00189N	MC019470	Adjusting clearance between fan shroud and cooling fan

◆ Service procedure

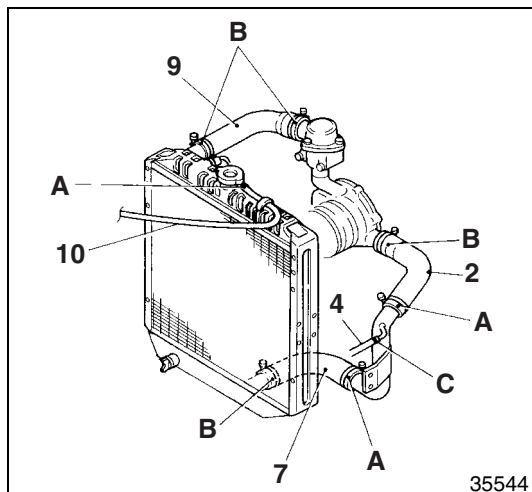
2 4 7 9 10 Installation of hoses

Hose insertion depths at connections are as follows.

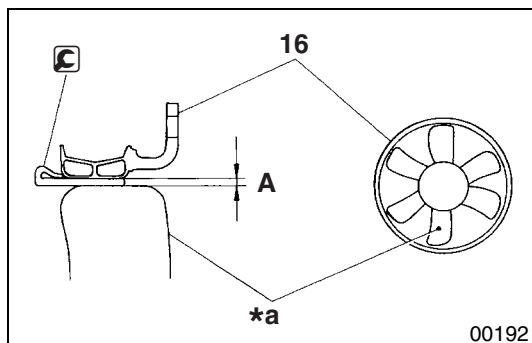
A: 30 mm {1.18 in.}

B: 35 mm {1.38 in.}

C: Insert until bottoming out on the connector of the inlet pipe 5.



35544



00192

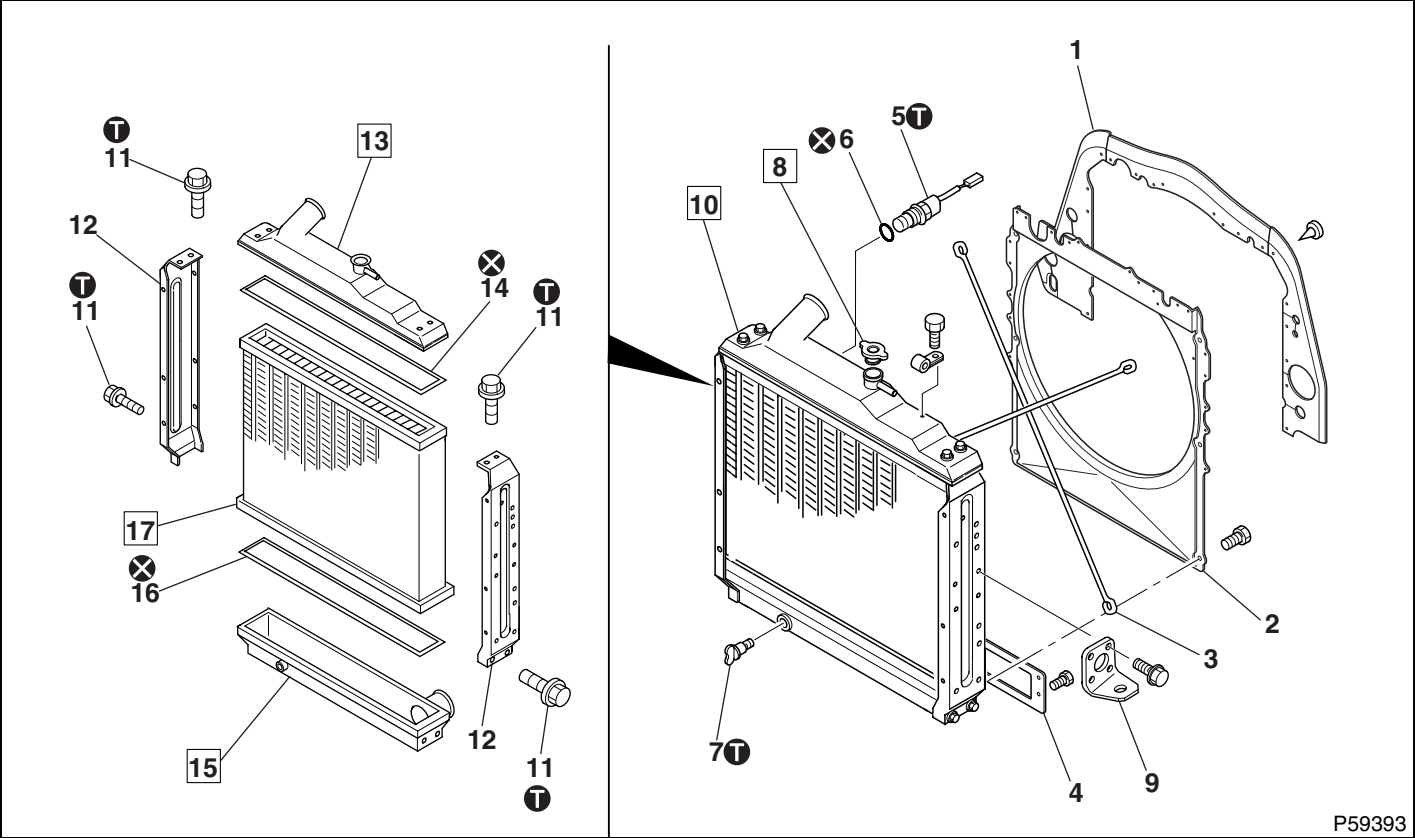
16 Installation of fan shroud

Using the  Tip Clearance Spacer, adjust such that the specified tip clearance **A** is obtained around the fan shroud **16**.

***a:** Cooling fan

RADIATOR AND FAN SHROUD

Radiator Assembly



P59393

Disassembly sequence

- 1 Baffle plate
- 2 Radiator shroud
- 3 Cross stay
- 4 Air scoop
- 5 Water level sensor Gr54
- 6 O-ring
- 7 Drain cock
- 8 Pressure cap
- 9 Bracket
- 10 Radiator assembly

- 11 Bolt
- 12 Side member
- 13 Upper tank
- 14 O-ring
- 15 Lower tank
- 16 O-ring
- 17 Core

: Non-reusable part

CAUTION

- Do not disassemble radiator assembly 10 unless there is an abnormality.
- Gently handle upper tank 13 and lower tank 15, since they are made of a resin that can break on impact.

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
8	Pressure cap opening pressure	69 ± 15kPa {10 ± 2.2 psi, 0.7 ± 0.15 kgf/cm ² }	—	Replace
10	Air leakage from radiator (Air pressure : 150 kPa {21 psi, 1.5 kgf/cm ² })	0 L {0 qts}	—	Repair or replace

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Water level sensor	2.9 to 3.9 {2.1 to 2.9, 0.3 to 0.4}	—
7	Drain cock	2 {1.5, 0.2}	—
11	Bolt (Side member mounting)	12.7 ± 2 {9.4 ± 1.5, 1.3 ± 0.2}	—

🔧 Special tools

Location	Tool name and shape	Part No.	Application
13, 15	Lock-and-break tool	J94-Z013 -10000	Removal of upper and lower tanks

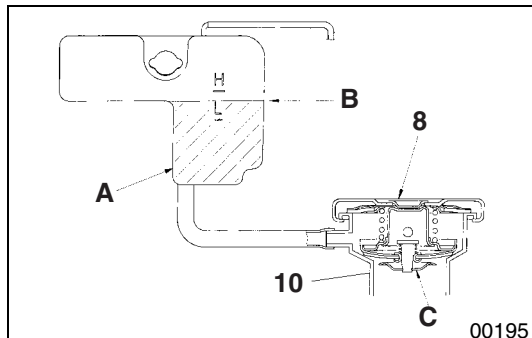
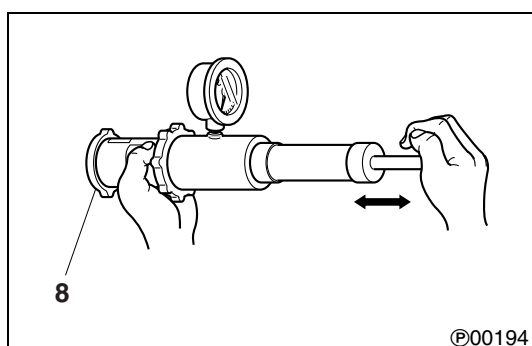
The indicated part number is Toyo Radiator's part number.

◆ Service procedure

8 Inspection of pressure cap

(1) Pressure valve opening pressure

Measure the pressure required to open the pressure valve. If the measurement does not conform to the standard value, replace the pressure cap 8.



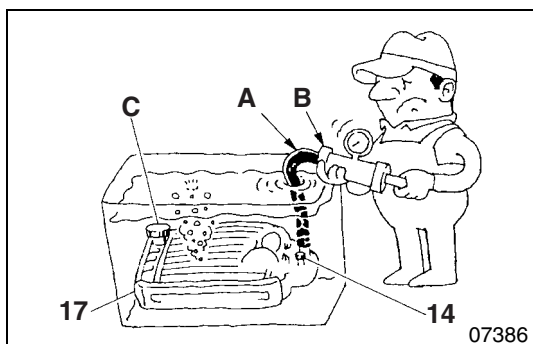
(2) Inspection of vent valve

- Note the coolant level **B** in the reservoir tank **A**.
- Start the engine and run it at high speed until the coolant level rises somewhere above the H mark on the reservoir tank **A**. Stop the engine.
- Allow the system to cool down. When the coolant temperature has dropped to the atmospheric temperature, check if the coolant level **B** in the reservoir tank **A** has subsided to the original level noted earlier.
- If not, the vent valve **C** is deemed faulty. Replace the pressure cap 8.

CAUTION ⚠

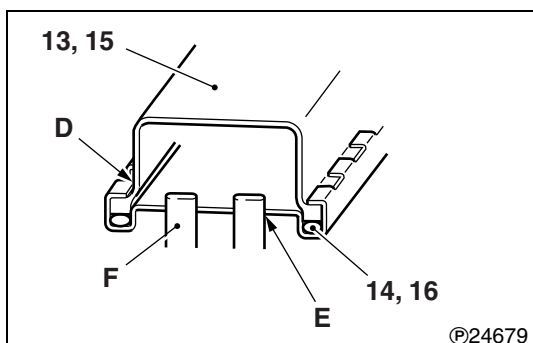
If the pressure cap 8 is opened before the coolant temperature drops to the atmospheric temperature, the negative pressure in the radiator 10 is canceled out. As a result, it is no longer possible for coolant to flow into the reservoir tank A. Ensure that this does not happen.

RADIATOR AND FAN SHROUD



10 Inspection of radiator assembly

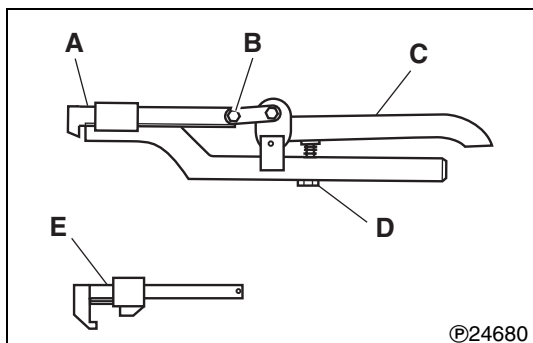
- Install hose **A** and radiator cap tester **B** to upper tank **13**.
- Insert plug **C** in lower tank **15**, and immerse the entire body of the radiator in water.
- Apply an air pressure of 150 kPa {21 psi, 1.5 kgf/cm²} using radiator cap tester **B**, and check for any air leakage.
- If any leakage is found, repair or replace radiator assembly **10**.



- Replace the following parts according to the leakage location.

Leakage location	Parts to be replaced
Tank joint D	O-ring 14 or 16
Tank 13	Tank 13 and O-ring 14
Tank 15	Tank 15 and O-ring 16
Tube joint E	Core 17 and O-ring 14, 16
Tube F	*Tube F (solder) and O-ring 14, 16
	*Tube F (solder) and O-ring 14, 16

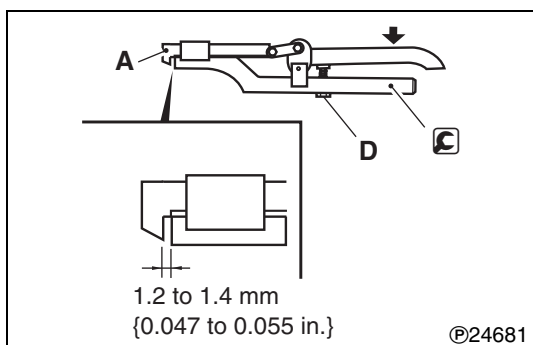
* : For repairing



13 15 Upper tank and lower tank

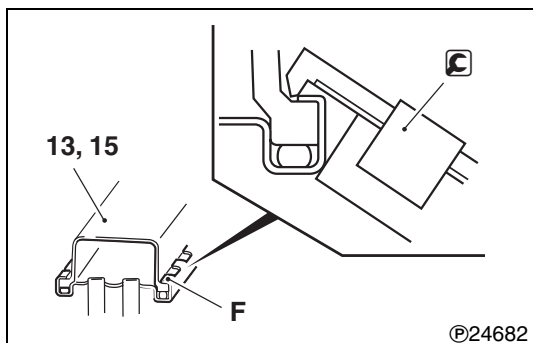
Use  lock-and-break tool for removal and reinstallation of the tanks.

- A**: Attachment (for tank removal)
- B**: Attachment stopper bolt
- C**: Slide handle
- D**: Stopper-and-adjuster bolt
- E**: Attachment (for tank reinstallation)

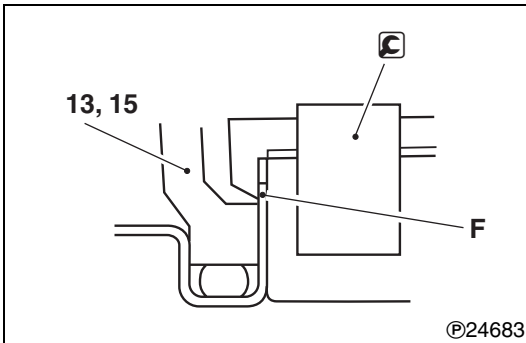


[Removal]

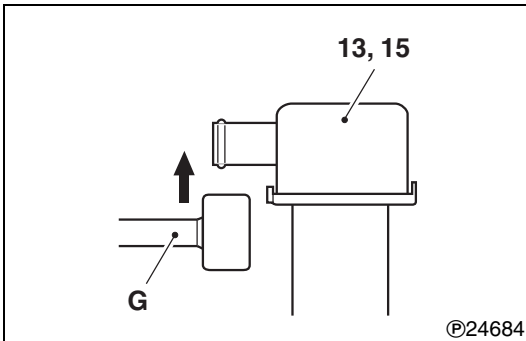
- Mount attachment **A** to  lock-and-break tool and set the tool tip to the dimension indicated in the diagram. Tighten stopper-and-adjuster bolt **D** to secure it in position.



- Use  lock-and-break tool to bend open tabs **F** of retain tank **13, 15** in place.



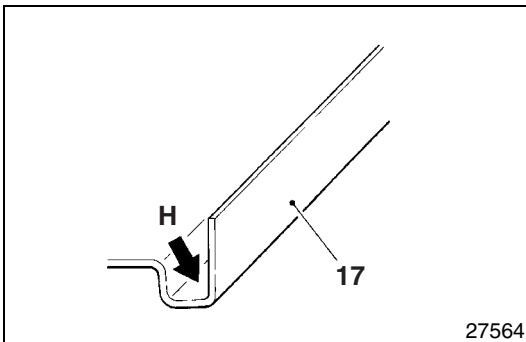
- After tabs **F** are bent open, squeeze the handle of **C** lock-and-break tool to straighten tabs **F** as illustrated.
- After straightening all tabs **F** in the perimeter, hold the pipes connected to the inlet/outlet, and remove tank **13, 15**.



- If it is difficult to remove tank **13, 15** lightly hit with rubber hammer (or plastic hammer) **G** to remove.

CAUTION

Gently handle tanks **13** and **15**, since they are made of a resin that can break on impact.

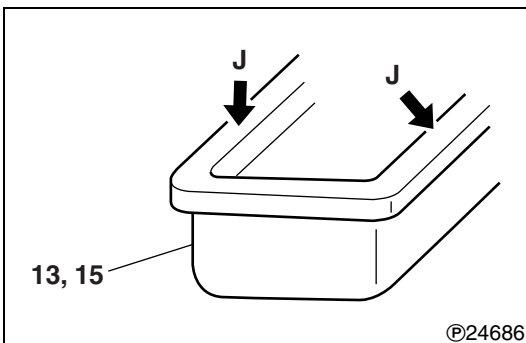


[Inspection]

- Inspect tank mounting groove **H** of core **17** and make sure there is no adhesion of foreign substance.
- If foreign substances are found, rub the area with #1000 sandpaper or a like gently so as to avoid scratching the surface, or use compressed air to remove them.

CAUTION

Be sure to inspect and clean tank mounting groove **H** on the entire perimeter. If O-ring **14, 16** and tank **13, 15** are installed on foreign substances, leakage can result. (Even a piece of hair can sometimes cause a leakage.)

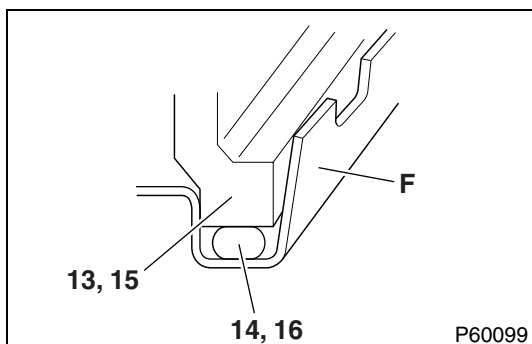


- Inspect for dirtiness and scratches on mounting surface **J** of tank **13, 15** which contacts the core, and clean the surface. If an abnormality is found on the surface, replace the tank.

CAUTION

To prevent adhesion of foreign substances on mounting surface **J**, conduct work with bare hands.

RADIATOR AND FAN SHROUD

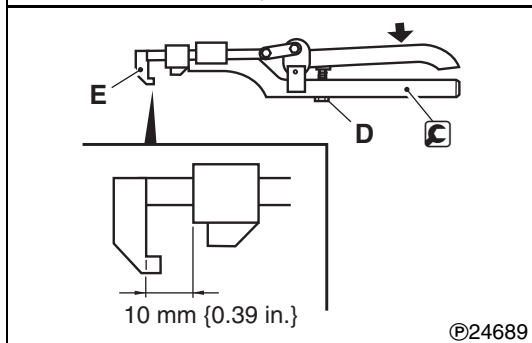


[Installation]

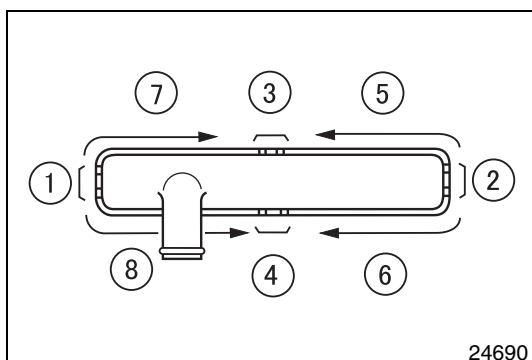
- After installing tank **13**, **15** one each on the left and right sides (total of four sub-plates for one radiator).

CAUTION

When installing O-ring **14, **16**, tank, **13**, **15**, conduct work with bare hands to prevent adhesion of foreign substances.**



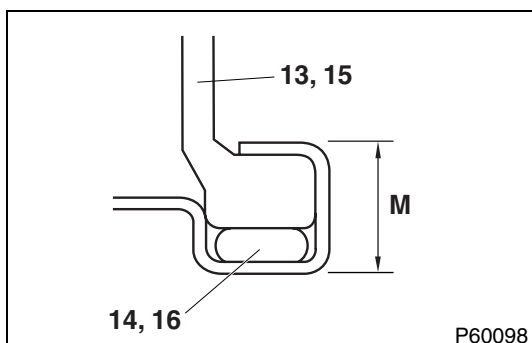
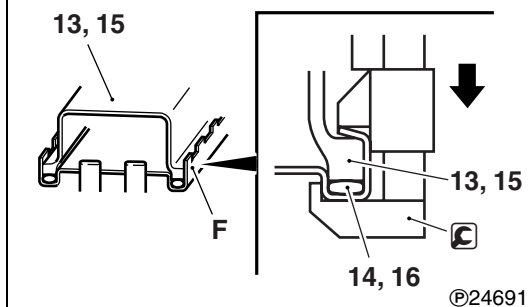
- Mount attachment **E** to  lock-and-break tool and set the tool tip to the dimension indicated in the diagram. Tighten stopper-and-adjuster bolt **D** to secure it in position.



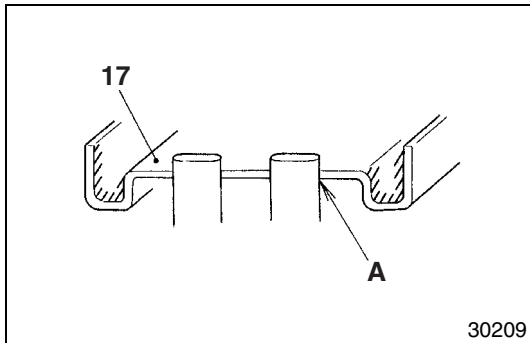
- Following the sequence shown in the diagram, bend tabs **F** for caulking tank **13**, **15**.
 - ① to ④: Bend two tabs at the center.
 - ⑤ to ⑧: Bend other tabs following the direction of the arrow.
 - : Lock-and-break tool (with attachment **E**)

NOTE

Since  lock-and-break tool cannot be used to caulk sides ① and ②, use pliers with the tips wrapped in vinyl tape.



- After caulking, inspect and make sure that the caulked section has the following dimension.
M : 8.95 to 9.35 mm {0.35 to 0.37 in.}
- Check for leakage.  P14-14
- After repair, apply paint on an easily visible location, so that when the radiator is brought in for another repair, a mechanic will know that it has been repaired before.

**17 Core****[Inspection]**

Inspect tube joint **A** for water leaks.

If water leaks from tube joint **A**, replace core **17** or repair the leak in the following method.

[Correction]

- To repair a leakage in the core **17** or tube joint, solder the leaking location in the same method used for conventional radiators (made of 100% brass).

CAUTION ⚠

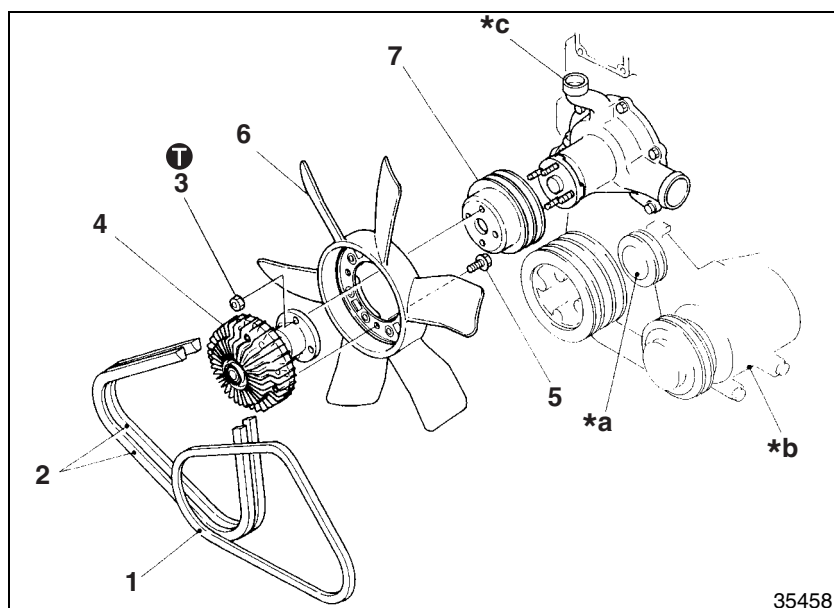
Do not let solder drip and form into a ball on the O-ring seat (shaded area in the diagram).

- As soon as soldering is completed, wash the repaired section repeatedly in hot water (as hot as possible) to remove flux.

WARNING ⚠

Be careful not to burn yourself with hot water during washing.

COOLING FAN AND V-BELT



● Disassembly sequence

- 1 V-belt <for air conditioner>
- 2 V-belt <for fan>
- 3 Nut
- 4 Automatic cooling fan coupling
- 5 Bolt
- 6 Cooling fan
- 7 Water pump pulley

*a: Tension pulley Gr55

*b: Compressor (for air conditioner)
 Gr55

*c: Water pump P14-22

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- The automatic cooling fan coupling 4 cannot be disassembled. If it is found faulty, replace the whole assembly.
- When replacing the V-belts 2, replace them as a set to prevent differences in tension between the two belts.

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	V-belt tension (for air conditioner)	7 to 10 {0.28 to 0.39}	—	Adjust
2	V-belt tension (for fan)	10 to 15 {0.39 to 0.59}	—	Adjust

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Nut (for automatic cooling fan coupling)	34 {25, 3.5}	—
5	Bolt (for cooling fan installation)	34 {25, 3.5}	—

Special tools

Location	Tool name and shape	Part No.	Application
1, 2	 Belt Tension Gauge 03612	MH062345	V-belt tension measurement

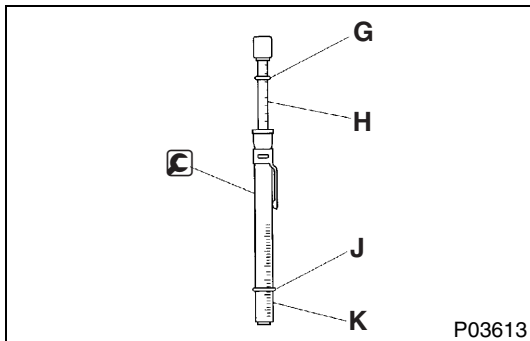
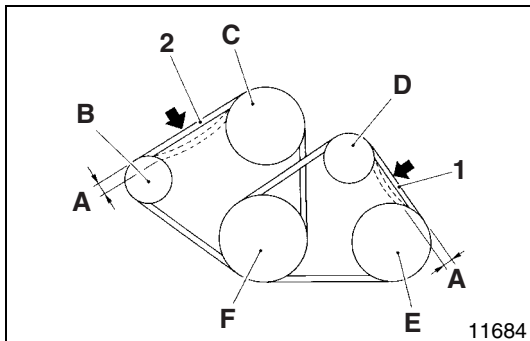
Service procedure

1 2 V-belt

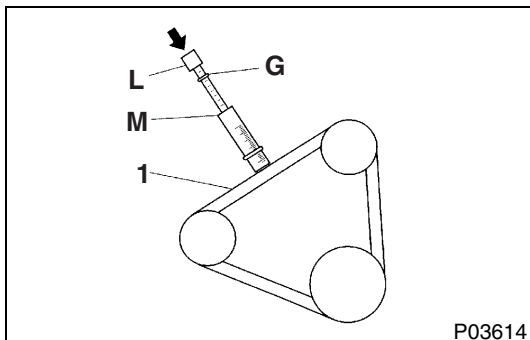
[Inspection]

- Apply force of approximately 98 N {22 lbs, 10 kgf} to the centers of V-belts **1, 2** as shown and measure the extent of V-belt deflection **A** between the illustrated pulleys.

- B:** Alternator pulley
C: Water pump pulley
D: Tension pulley
E: Air conditioner compressor pulley
F: Crankshaft pulley

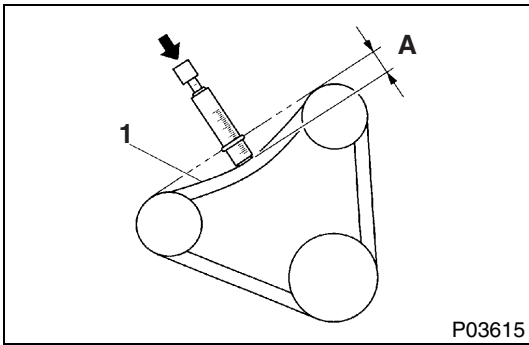


- Set the upper O-ring **G** of the  Belt Tension Gauge to a push load of 98 N {22 lbs, 10 kgf} on scale **H**.
- Set the lower O-ring **J** of the  Belt Tension Gauge to the V-belt's specified maximum deflection value on scale **K**.

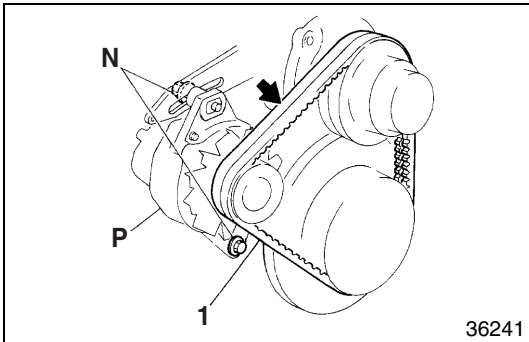


- Apply the  Belt Tension Gauge to the center of the V-belt **2** and push the part **L** until the upper O-ring **G** reaches the flange **M**.

COOLING FAN AND V-BELT



- Measure the deflection **A** of the V-belt **2**. If the measurement does not comply with the standard value, adjust the tension in accordance with the following procedure.



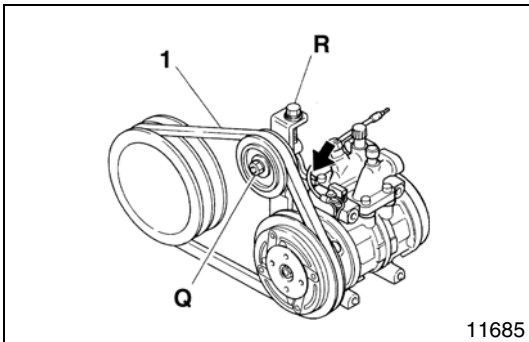
[Adjustment]

(1) Tention adjustment of V-belts for cooling fan

- Loosen two alternator mounting bolts **N**, then adjust the tension of V-belts **2** by moving the alternator **P** from side to side.
- When the adjustment is completed, tighten the bolts and nuts securely.

CAUTION

- **Excessive tension in V-belts 2 may damage the belts and related bearings.**
- **When replacing the V-belts 2, replace them as a set to prevent differences in tension between the two belts.**
- **Keep the V-belts 2 free of oil. If the belts become oily, they may slip, resulting in overheating of the engine and insufficient charging of the battery.**

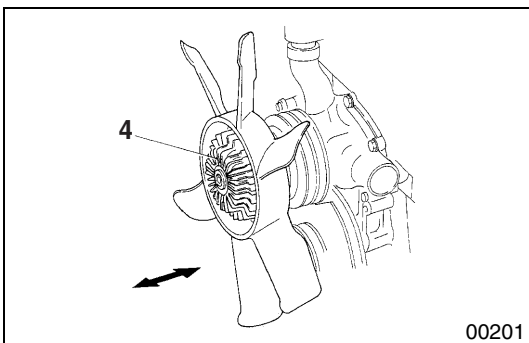


(2) Tention adjustment of V-belts for air conditioner

- Loosen the tension pulley mounting nut **Q** and adjust the tension of the V-belt **1** with the adjusting bolt **R**.
- After adjustment, be sure to tighten the bolt and nut.

CAUTION

- **Excessive tension in V-belts 1 may damage the belts and related bearings.**
- **Keep the V-belt 1 free of oil. If the belts become oily, it may slip, resulting in insufficient cooling effects.**

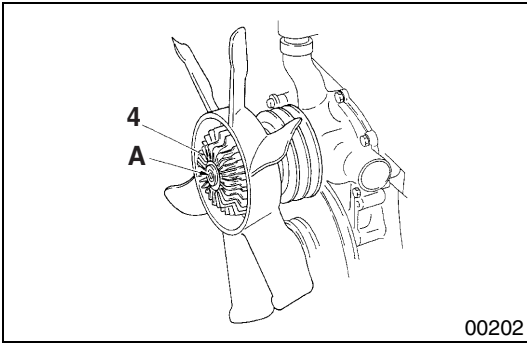


4 Automatic cooling fan coupling

[Inspection]

Inspect the automatic cooling fan coupling **4** in accordance with the following procedure. If any defect is apparent, replace the unit.

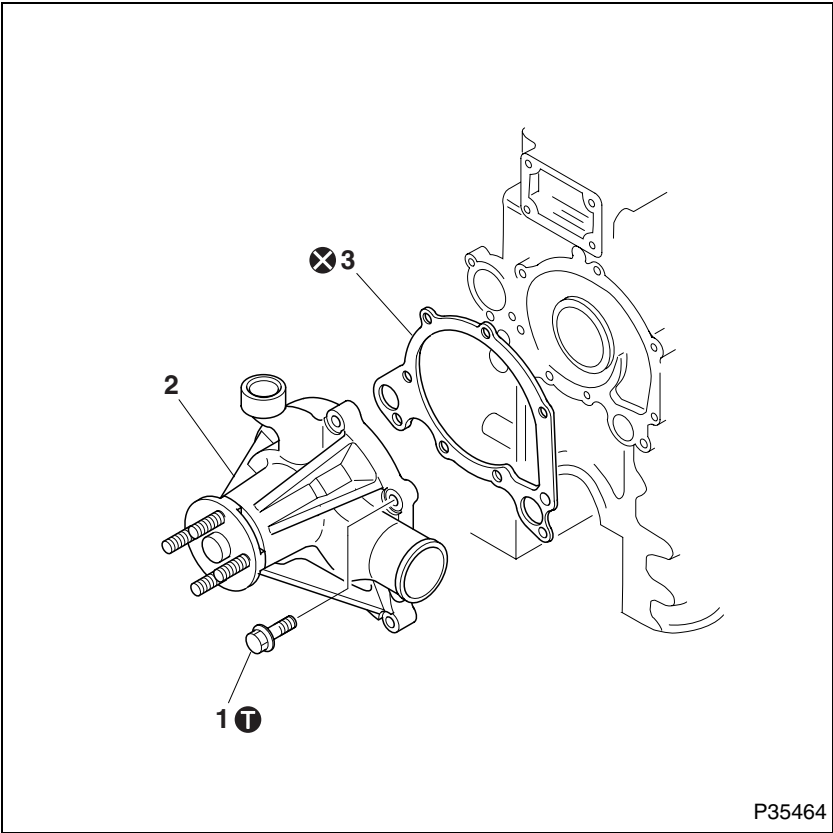
- Check for leakage of oil from the coupling body.
- Rotate the automatic cooling fan coupling **4** by hand and check for irregular movement or abnormal noise caused by a defect in the bearing.
- Check for excessive axial play in the automatic cooling fan coupling **4** when the engine is cool.



[Cleaning]

If any foreign particles have adhered to the bimetal **A**, remove them carefully without applying excessive force.

WATER PUMP



● **Disassembly sequence**

- 1 Bolt
- 2 Water pump assembly P14-24
- 3 Gasket

ⓧ: Non-reusable part

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Tightening torque

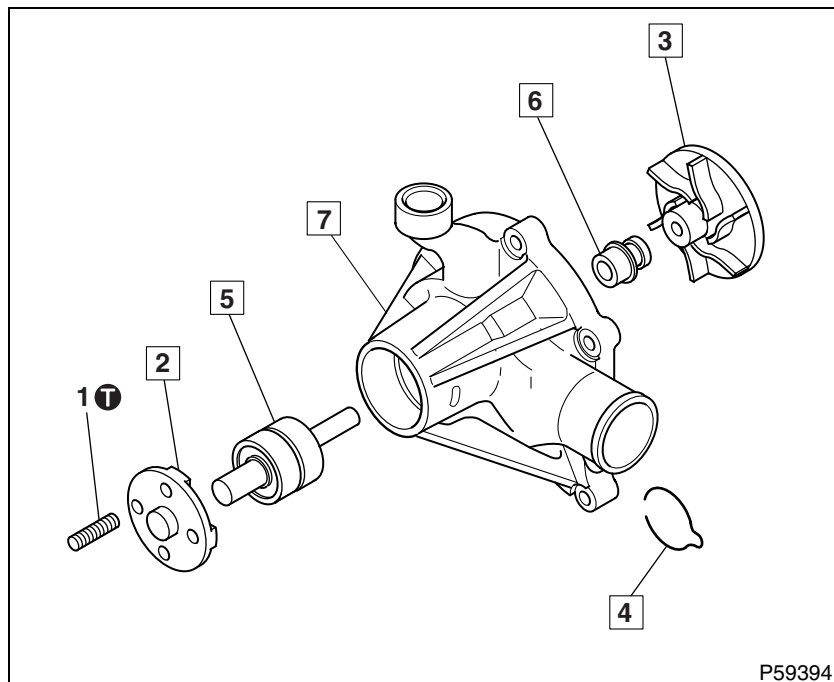
Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (for installation of water pump assembly)	24 {18, 2.4}	—

MEMO

WATER PUMP

Water Pump Assembly



● Disassembly sequence

- 1 Stud bolt
- 2 Flange
- 3 Impeller
- 4 Wire
- 5 Bearing unit
- 6 Unit seal
- 7 Water pump case

● Assembly sequence

6 → 4 → 3 → 5 → 2 → 1

● Inspection after assembly

📖 P14-25

P59394

Service standards

Unit: mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
2, 5	Flange-to-bearing unit interference	[22 {0.87}] 0.03 to 0.06 {0.0012 to 0.0024}	—	Reassembly allowed only twice
3, 5	Impeller-to-bearing unit interference	[12 {0.47}] 0.03 to 0.06 {0.0012 to 0.0024}	—	Reassembly allowed only twice

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

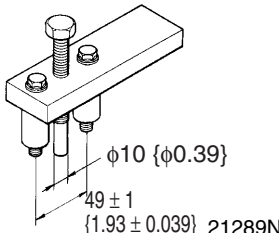
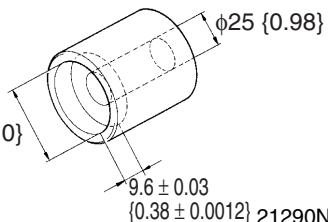
Location	Parts to be tightened	Tightening torque	Remarks
1	Stud bolt	9.8 {7.2, 1.0}	—

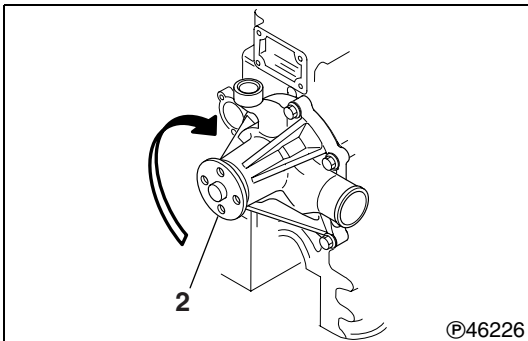
🔧 Special tools

Unit: mm {in.}

Location	Tool name and shape	Part No.	Application
2	Water Pump Pulley Puller	MH062411	Flange removal
	Bolt	MH000715	

Unit: mm {in.}

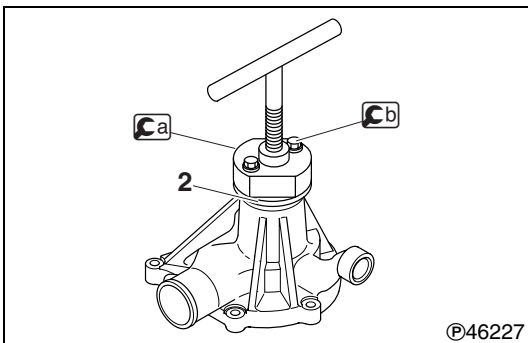
Location	Tool name and shape	Part No.	Application
3	Impeller Puller 	MH062192	Impeller puller removal
6	Unit Seal Installer 	MH062195	Unit seal installation



◆ Service procedure

● Inspection after assembly

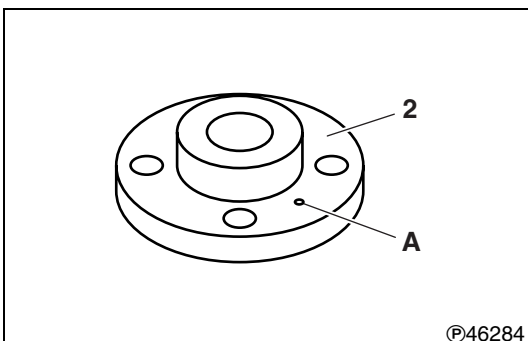
- After assembly, rotate the flange 2 by hand and check that it turns smoothly without hindrance.
- If the flange does not turn smoothly, disassemble and inspect the water pump again.



2 Flange

[Removal]

-  a: Water Pump Pulley Puller
 b: Bolt

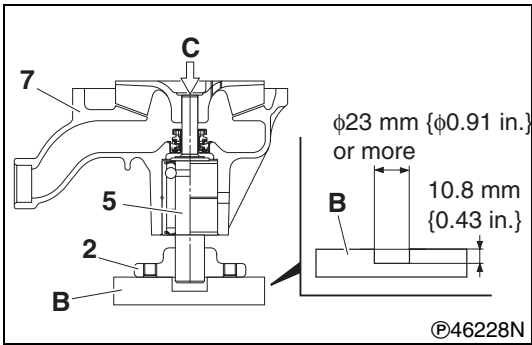


[Installation]

CAUTION

- Before installing flange 2, make sure that there is no or only one punch mark A in the shown location on the flange. Make an additional punch mark on the flange to indicate that it undergoes the disassembly and reassembly process you are doing now.
- Punch mark(s) A indicate the number of times the flange 2 was disassembled and reassembled in the past. If there are two marks, the flange must be replaced.

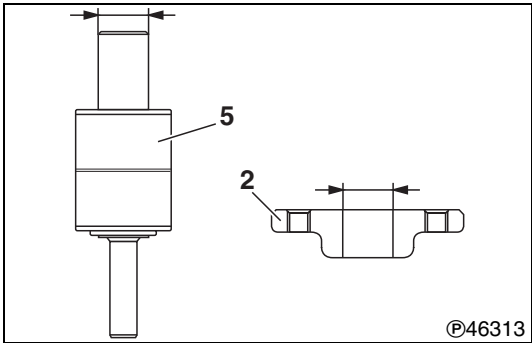
WATER PUMP



- Place a fixture **B** under the flange **2** and apply the ram load of a press **C** to the shaft of the bearing unit **5**.
- Ram the shaft of the bearing unit **5** down into the flange **2** until it contacts the fixture **B**.

CAUTION

If the flange **2** is installed without the block **B**, the water pump case **6** will be damaged.

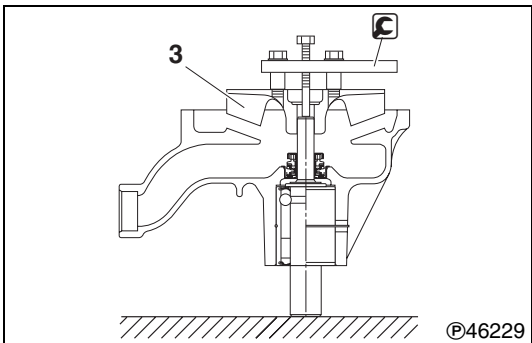


2 **5** Flange-to-bearing unit interference

If the measurement does not comply with the standard value, replace the defective part(s).

CAUTION

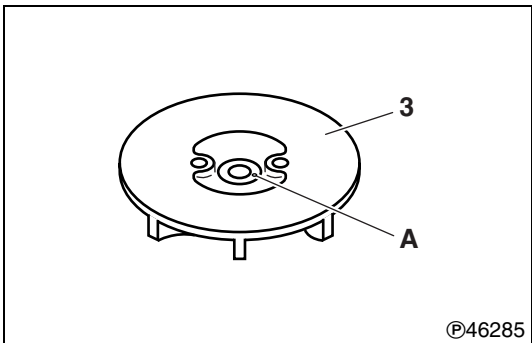
Even if the measurement complies with the standard value, re-assembly must not be carried out more than twice.



3 Impeller

[Removal]

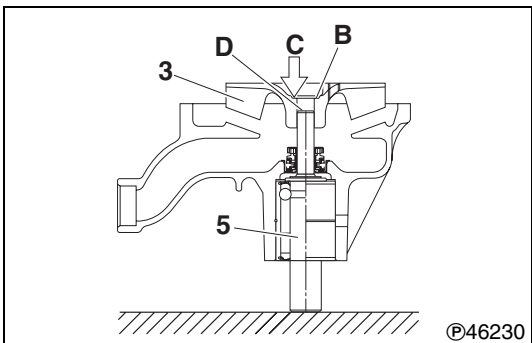
: Impeller Puller



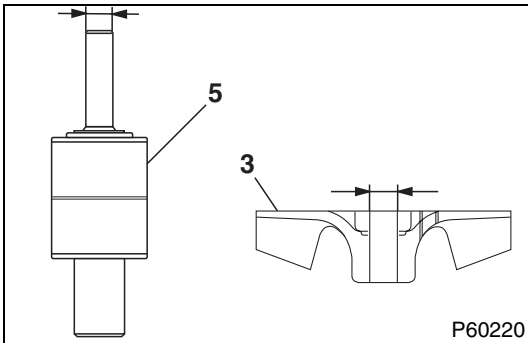
[Installation]

CAUTION

- Before installing impeller **3**, make sure that there is no or only one punch mark **A** in the shown location on the impeller. Make an additional punch mark on the impeller to indicate that it undergoes the disassembly and reassembly process you are doing now.
- Punch mark(s) **A** indicate the number of times the impeller **3** was disassembled and reassembled in the past. If there are two marks, the impeller must be replaced.



Install the impeller **3** in such a way that its end face **B** is rammed with a press **C** to be flush with the shaft end **D** of the bearing unit **5**.

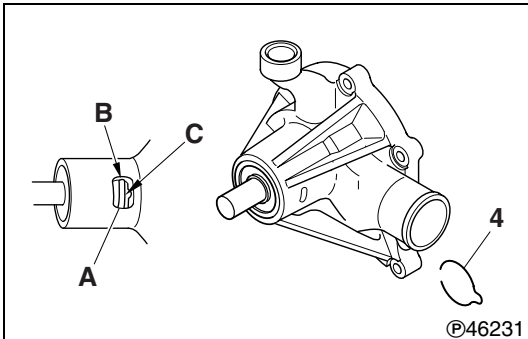


3 5 Impeller-to-water pump shaft interference

If the measurement does not comply with the standard value, replace the defective part(s).

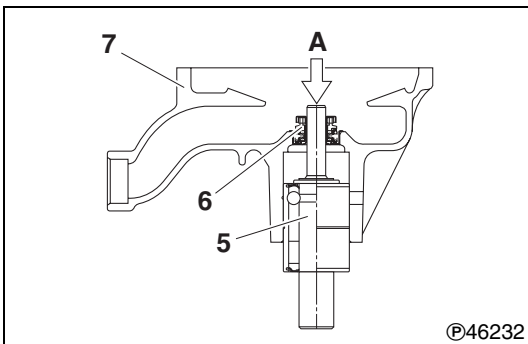
CAUTION

Even if the measurement complies with the standard value, re-assembly must not be carried out more than twice.



4 Wire insertion

Align the groove **B** on the water pump case side with the groove **C** on the bearing side at the wire inlet **A** before inserting the wire **4** into the water pump case.



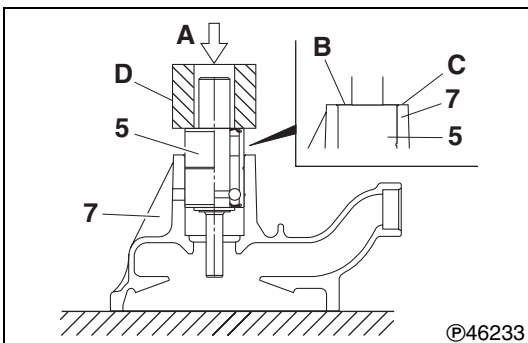
5 Bearing unit

[Removal]

Remove the bearing unit **5** using a press **A**. Heating the water pump case **7** to approximately 80°C {176°F} will facilitate the removal.

CAUTION

- The ram load applied to remove the bearing unit **5** should not exceed 9810 N {2200 lbs, 1000 kg}.
- When the bearing unit **5** is replaced, always replace the unit seal **6**.



[Installation]

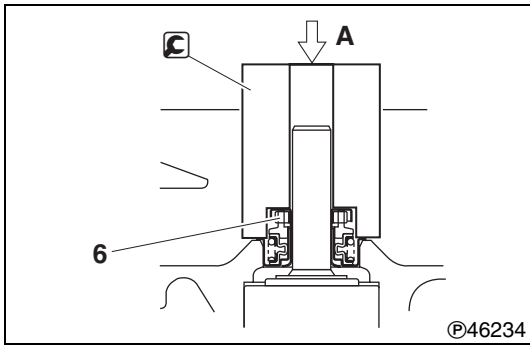
Install the bearing unit **5** by ramming down its outer race with the press **A** until the end faces **B** of the outer race and the end face **C** of water pump case **7** meet flush.

D: Pipe fixture

CAUTION

- Before installing, check the rotating condition of the bearing unit **5**.
- When installing, do not press the shaft end of the bearing unit **5**.

WATER PUMP



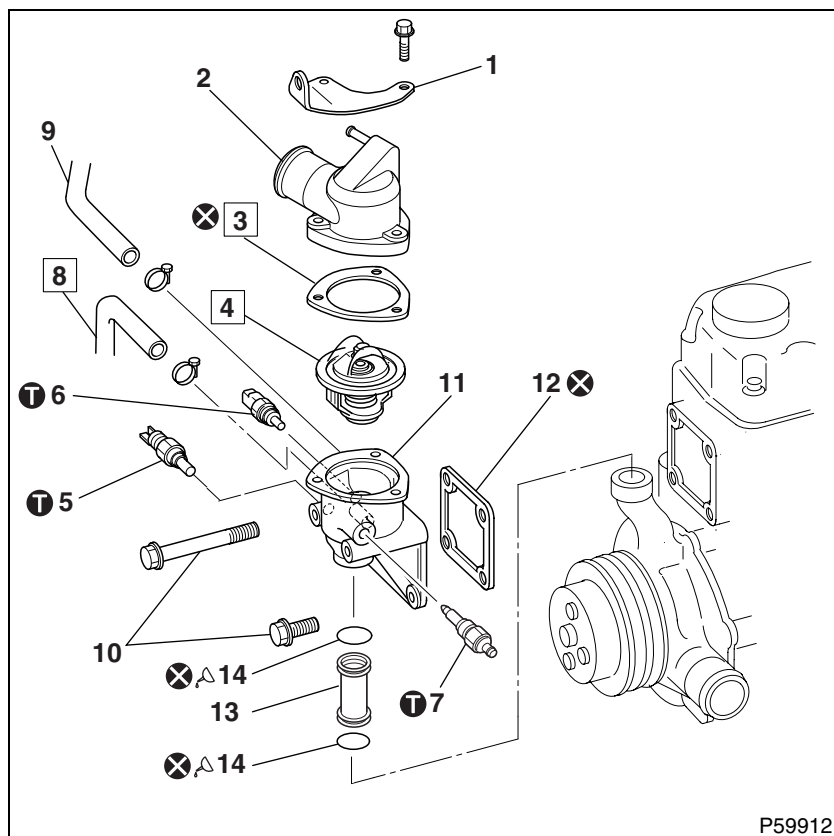
6 Unit seal installation

A: Press

C: Unit Seal Installer

MEMO

THERMOSTAT



● Disassembly sequence

- 1 Fan shroud stay
- 2 Thermostat cover
- 3 Thermostat cover gasket
- 4 Thermostat
- 5 Water temperature sensor (for multi-purpose timing control unit) Gr54
- 6 Water temperature sensor (for engine control) Gr54
- 7 Overheat alarm switch Gr54
- 8 Heater hose
- 9 EGR cooler water hose
- 10 Bolt
- 11 Thermostat case
- 12 Gasket
- 13 Joint
- 14 O-ring

⊗: Non-reusable parts

CAUTION

Do not remove the thermostat case 11 unless it has a water leak or any other defect.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
4	Thermostat	Valve opening temperature	82 ± 2°C {180 ± 3.6°F}	—	Replace
		Valve lift/temperature	10 {0.39} or more/95°C {205°F}	—	Replace

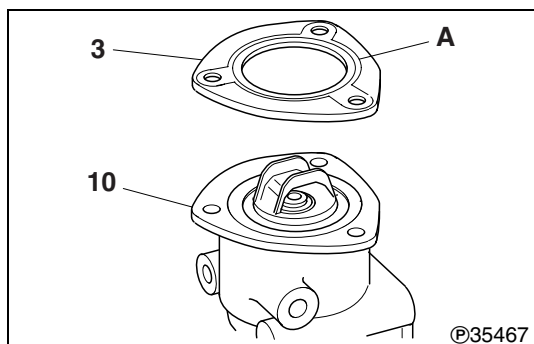
① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Water temperature sensor (for multipurpose timing control unit)	39 {29, 4}	—
6	Water temperature sensor (for engine control)	35 ± 7 {26 ± 5.2, 3.6 ± 0.7}	—
7	Overheat alarm switch	39 to 59 {29 to 44, 4 to 6}	—

Lubricant and/or sealant

Location	Point of application	Specified lubricant and/or sealant	Quantity
14	Entire periphery of O-ring	Soapy water	As required

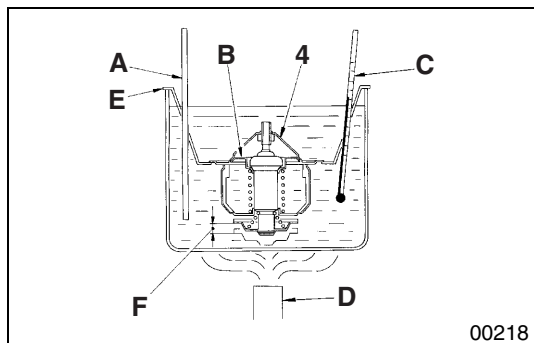


◆ Service procedure

3 Thermostat cover gasket installation

Fit the thermostat cover gasket **3** onto the thermostat case **10** in the illustrated direction.

A: Raised side



4 Thermostat

[Inspection]

- Carry out the following inspection procedure while stirring the water in the container with a rod **A** to ensure that it is heated evenly.
- If the measurement does not comply with the standard value, replace the thermostat **4**.

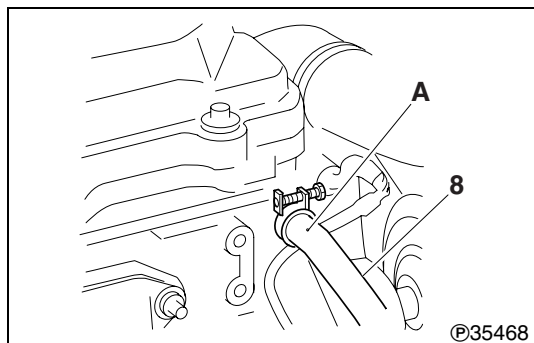
(1) Valve opening temperature

- Support the thermostat **4** with wire **E** to keep it away from the heat source **D**.
- Gradually heat the water until it reaches the valve opening temperature.
- Maintain this temperature for five minutes and check that the valve **B** is open.
- When the water temperature drops below 65°C {150°F}, check that the valve **B** is completely closed.

C: Thermometer

(2) Valve lift

Heat the water to slightly higher temperature than the valve full open temperature. With the valve **B** fully open for five minutes, measure the extent of valve lift **F**.



8 Heater hose installation

The hose must be pressed into position to the following depth:

A: 25 mm {0.98 in.}



Group 15

Intake and Exhaust

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	15-2
STRUCTURE AND OPERATION	
1. Air Cleaner	15-3
2. Turbocharger Assembly	15-3
TROUBLESHOOTING	15-5
ON-VEHICLE INSPECTION AND ADJUSTMENT	
Measurement of Turbocharger Boost Pressure	15-6
AIR DUCT	15-8
AIR CLEANER	15-10
TURBOCHARGER	15-12
INTERCOOLER	15-17
INTAKE MANIFOLD	15-18
EXHAUST MANIFOLD	15-19
EXHAUST PIPE AND MUFFLER	15-20

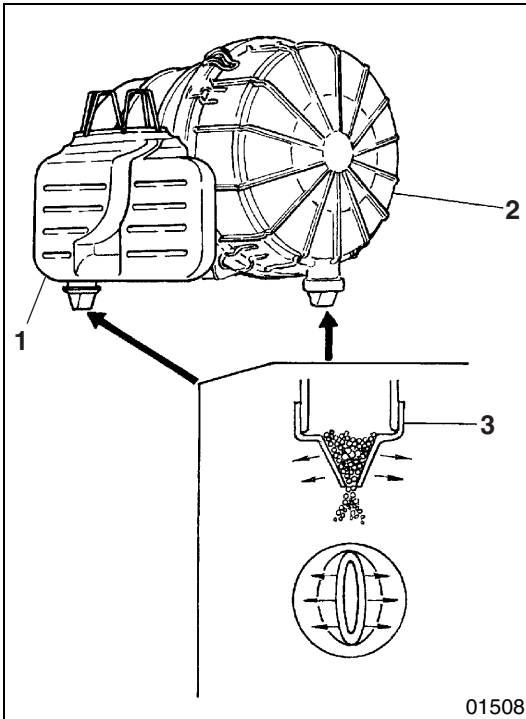
SPECIFICATIONS

SPECIFICATIONS

Item		Specifications
Air cleaner element		Cyclone filter paper type
Dust indicator type		Mechanical
Turbocharger	Model	TD06
	Manufacturer	Mitsubishi Heavy Industries
Intercooler type		Tube and corrugated fin (air cooled)

STRUCTURE AND OPERATION

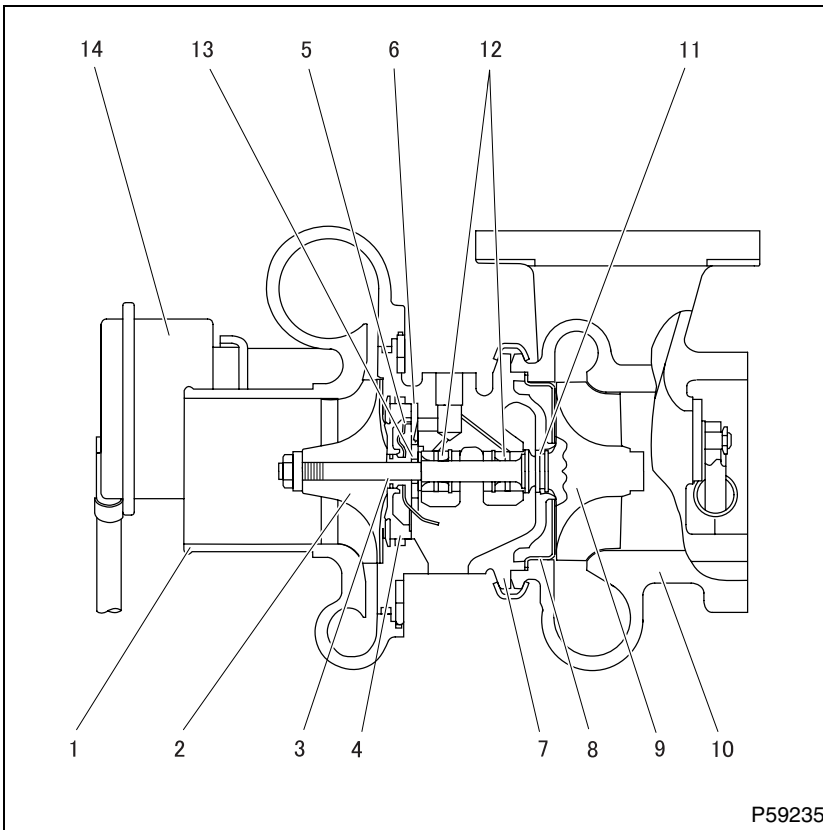
1. Air Cleaner



- 1 Lower air duct
- 2 Air cleaner assembly
- 3 Vacuator valve

- The air cleaner assembly 2 utilizes double element.
- The lower air duct 1 and air cleaner assembly 2 incorporate a vacuator valve 3 each.
- The vacuator valve 3 automatically works in such a way that when the engine speed drops below a specified level, the valve's rubber boot which is usually subdued by internal vacuum is allowed to spring back and accumulated dust and dirt are discharged as a result.

2. Turbocharger Assembly



- 1 Compressor cover
- 2 Compressor wheel
- 3 Thrust sleeve
- 4 Insert
- 5 Oil deflector
- 6 Thrust bearing
- 7 Bearing housing
- 8 Turbine back plate
- 9 Shaft and turbine wheel
- 10 Turbine housing
- 11 Piston ring
- 12 Bearing
- 13 Thrust ring
- 14 Actuator

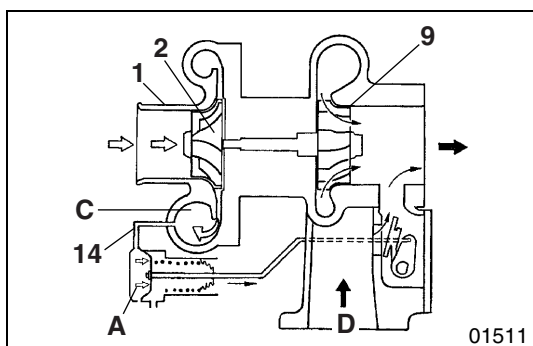
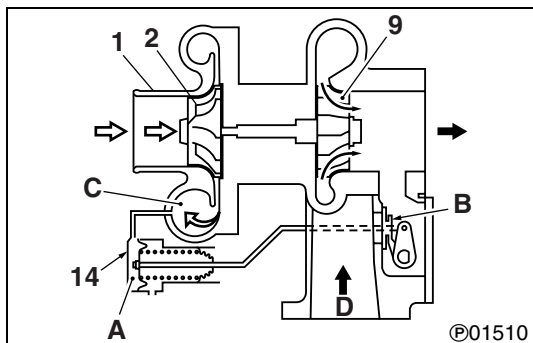
2-13: Cartridge assembly

P59235

STRUCTURE AND OPERATION

● Waste Gate Mechanism

- The waste gate mechanism, a device to release excess exhaust gas by means of an actuator **14**, keeps the boost pressure optimal and prevents overrunning of the turbocharger and excessive pressure increase in the intake manifold.
- The boost pressure is led from the compressor cover **1** into the actuator's chamber **A** through rubber hose. When the boost pressure **C** working on the chamber **A** is lower than the preset level, the actuator remains inactive, allowing exhaust gas **D** to be blown against the turbine wheel **9** with the waste gate valve **B** closed.
- When the boost pressure **C** in the chamber **A** becomes higher than the preset level, it causes the waste gate valve **B** to be opened, and the exhaust gas **D** being blown against the shaft and turbine wheel **9** is decreased. This reduces the revolution of the compressor wheel **2** and the boost pressure returns below the preset level as a result.



Possible causes		Symptoms	Engine hard to start	Black exhaust gas	White exhaust gas	Poor engine power	Excess oil consumption	Abnormal noise or vibration in intake/exhaust system	Remarks
Air cleaner	Clogged air cleaner element		○	○		○			
Turbocharger	Cartridge assembly	Defective bearing		○		○		○	
		Carbon deposits on shaft and turbine wheel unit		○		○			
		Interference between shaft and turbine wheel unit and turbine back plate		○		○		○	
		Interference between shaft and turbine wheel unit and turbine housing		○		○		○	
		Bent shaft and turbine wheel unit		○		○		○	
		Damaged shaft and turbine wheel unit		○		○		○	
		Interference between compressor wheel and compressor cover		○		○		○	
		Seized thrust sleeve and/or thrust bearing		○		○		○	
		Damaged compressor wheel		○		○		○	
		Oil leakage due to worn piston ring and/or insert		○	○		○		
		Piston ring fitted poorly					○		
		Defective sliding action between parts due to clogged lubrication oil pipe and eyebolt		○		○			
		Oil seals damaged due to clogged oil return pipe			○		○		
		Compressor cover fitted poorly		○		○	○	○	
		Turbine housing fitted poorly				○		○	
Intercooler	Foreign substances deposited on intercooler front core					○			
Actuator	Defective butterfly valve			○	○	○			Gr35
	Butterfly valve adjusted incorrectly			○	○	○			Gr35
Front pipe/muffler/tail pipe deformed								○	
Front pipe/muffler/tail pipe fitted poorly								○	
Incorrect valve clearances				○					Gr11
Head gasket defective				○					Gr11
Wear/carbon deposits on valves and valve seats				○					Gr11
Valve spring weakened				○					Gr11
Piston rings worn/damaged					○		○		Gr11
Piston ring grooves worn/damaged					○		○		Gr11
Cooling system malfunctioning				○					Gr14
Engine oil quantity excessive					○				Gr12
Major moving parts seized				○					Gr11
Uneven or excessive fuel injection				○					Gr13E

ON-VEHICLE INSPECTION AND ADJUSTMENT

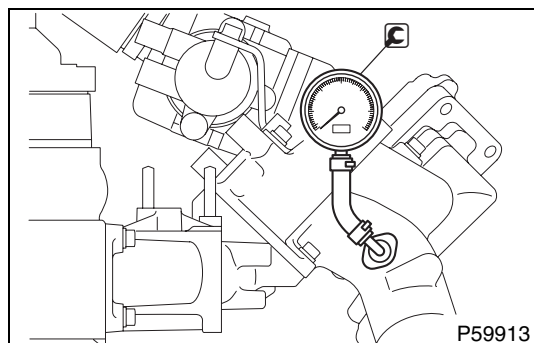
Measurement of Turbocharger Boost Pressure

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	Boost pressure (at ambient temperature of 20°C {68°F} and atmospheric pressure of 100 kPa (29.9 in.Hg, 760 mm-Hg))	–	73 kPa {21.6 in.Hg, 545 mmHg} /3180 rpm	Inspect/ adjust
–	Maximum idling speed	3210 ± 30 rpm	–	–

Special tools

Location	Tool name and shape	Part No.	Application
–	Boost Pressure Gauge  01524	MH061366	Measurement of boost pressure

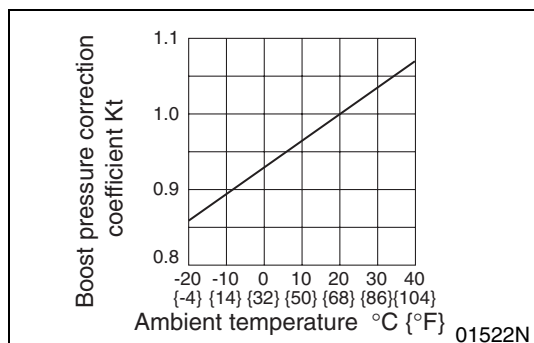


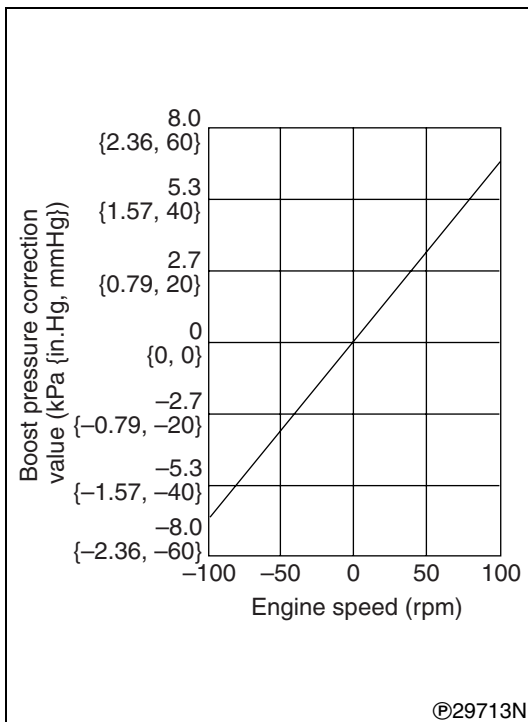
- Before measuring the boost pressure, clean or replace the air cleaner element.
- Remove the boost hose, then fit the  Boost Pressure Gauge.
- Warm up the engine, then measure the boost pressure at the engine's maximum idling speed. At the same time, measure the engine speed and ambient temperature.

- Correct the measurement to determine the boost pressure under standard conditions.

[Correction for ambient temperature]

From the graph, determine the boost pressure correction coefficient Kt for the ambient temperature.





[Correction for engine speed]

From the engine speed during boost pressure measurement, subtract the median of the maximum idling speed. From the result, determine the boost pressure correction value P_a in accordance with the graph.

Median: 3210 rpm

[Calculation of corrected boost pressure]

- If the measured boost pressure is P , the corrected boost pressure P_b is determined as follows:

$$P_b = K_t P + P_a$$

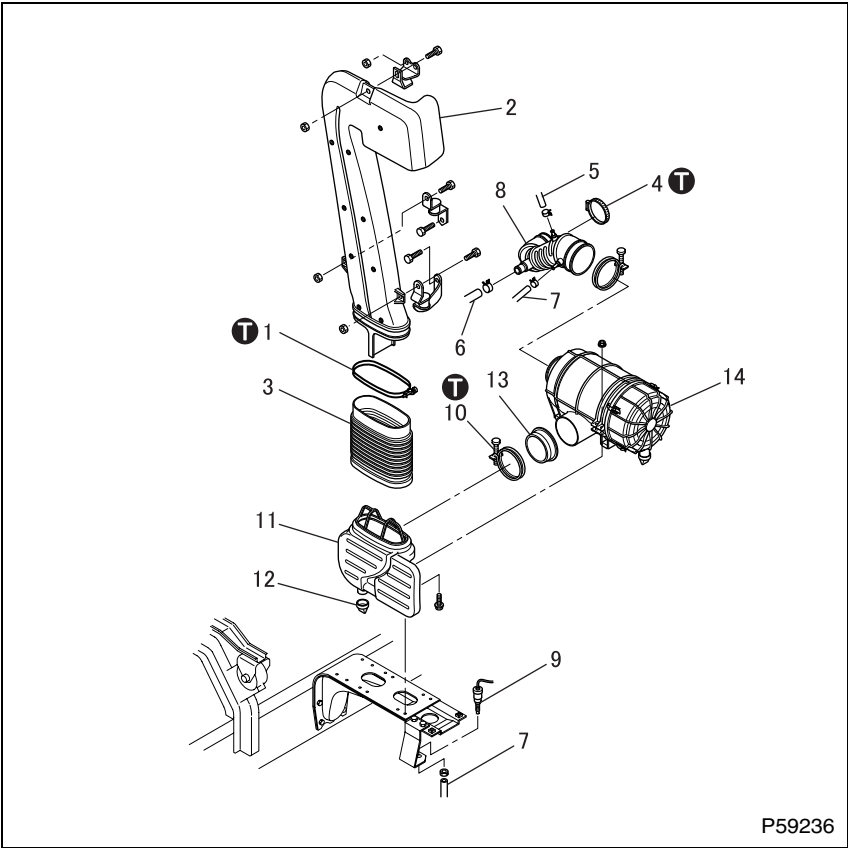
K_t : Boost pressure correction coefficient for ambient temperature

P : Measured boost pressure

P_a : Boost pressure correction value

- If P_b is out of specification, the turbocharger must be inspected and adjusted.

AIR DUCT



Disassembly sequence

- 1 Clamp
- 2 Upper air duct
- 3 Rubber boot
- 4 Clamp
- 5 Air hose
- 6 Breather hose
- 7 Air tube
- 8 Air intake hose
- 9 Dust indicator  Gr54
- 10 Clamp
- 11 Lower duct
- 12 Vacuator valve
- 13 Adaptor
- 14 Air cleaner assembly  P15-10

Assembly sequence

Follow the disassembly sequence in reverse.

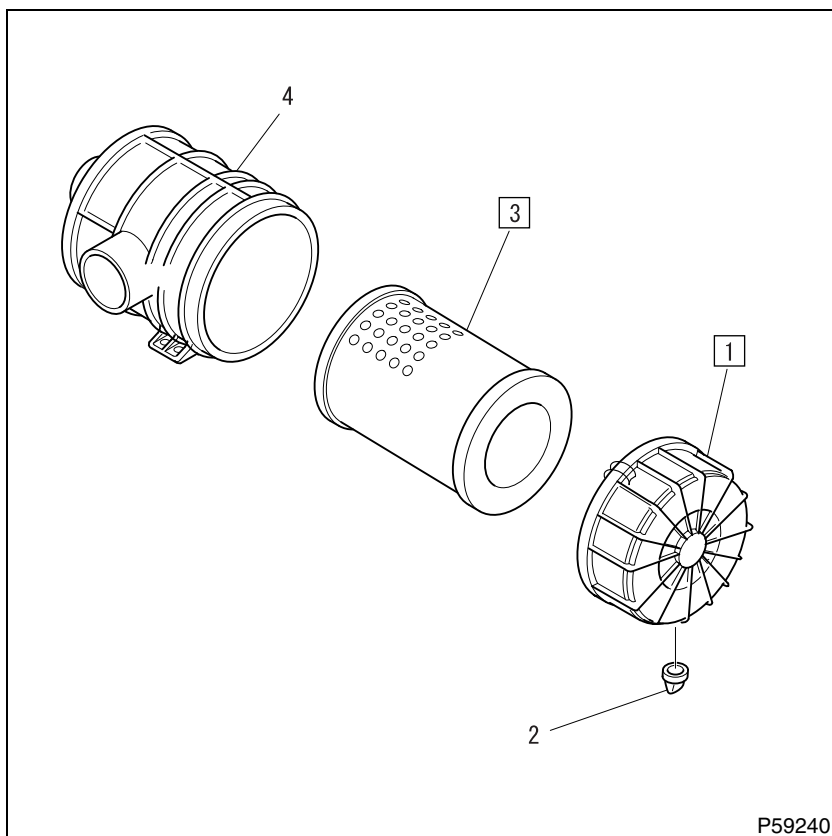
Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Clamp	3.0 to 3.5 {2.2 to 2.6, 0.3 to 0.36}	—
4	Clamp	4.0 to 5.0 {3.0 to 3.7, 0.4 to 0.5}	—
10	Clamp	4.0 to 5.0 {3.0 to 3.7, 0.4 to 0.5}	—

MEMO

AIR CLEANER



● Disassembly sequence

- 1 Cover
- 2 Vacuator valve
- 3 Element
- 4 Body

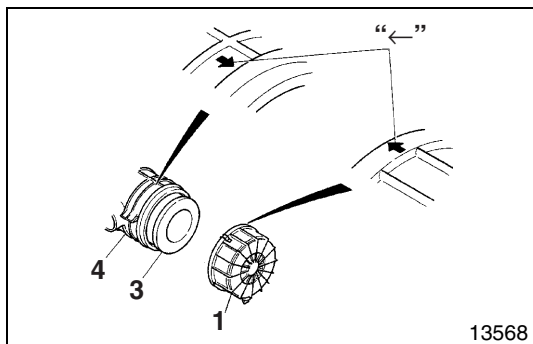
● Assembly sequence

Follow the disassembly sequence in reverse.

◆ Service procedure

1 Installation of cover

“←”: Alignment mark



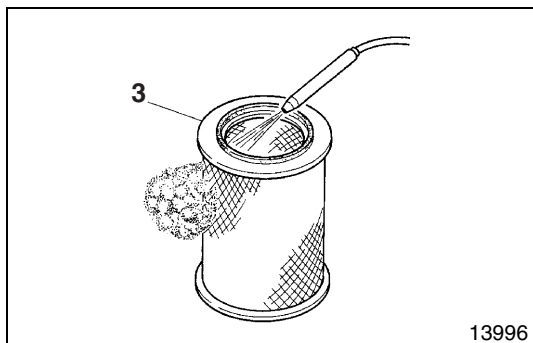
3 Outer element

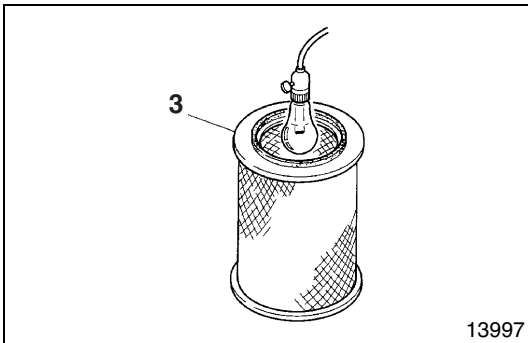
[Cleaning]

- Blow compressed air (at a pressure of 685 kPa {100 psi, 7 kgf/cm²} or less) through the outer element **3** from the inside.
- Blow compressed air up and down along the pleats of the filter paper until the entire element is clean.

CAUTION ⚠

- Do not remove dust by striking the element **3** or knocking it against another object.
- Do not blow compressed air through the element **3** from the outside.



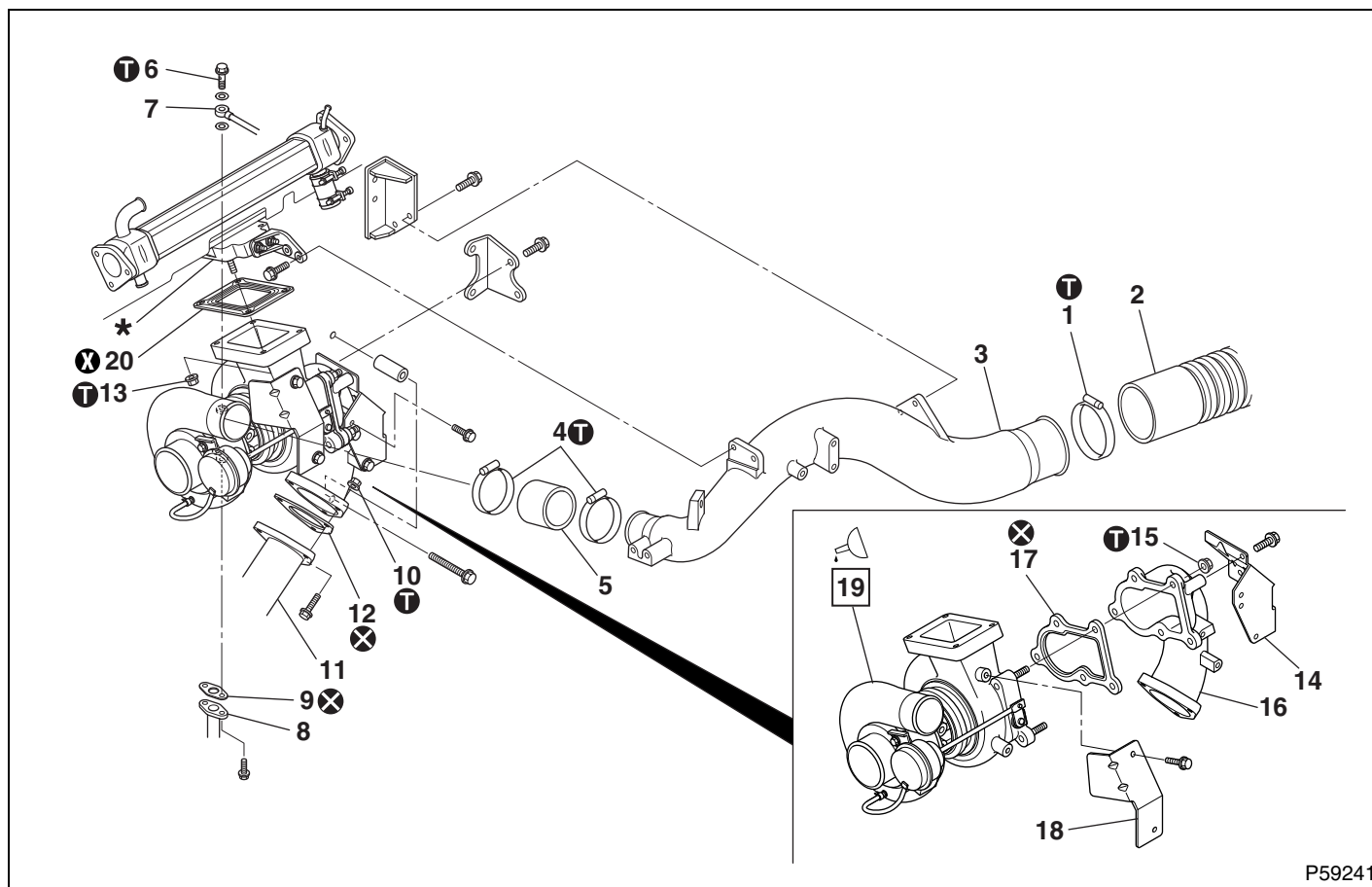


[Inspection]

- Place a lamp inside the element **3**.
- Replace the element **3** if the filter paper appears damaged or frayed or if the seal on the top of the element is damaged.

If dust on the element is wet with oil smoke or soot, replace the element irrespective of the specified replacement interval.

TURBOCHARGER



P59241

● Disassembly sequence

- | | | |
|-------------------|--------------------------------|----------------------------------|
| 1 Clamp | 9 Gasket | 17 Gasket |
| 2 Air inlet hose | 10 Nut | 18 Turbocharger cover |
| 3 Air inlet pipe | 11 Front pipe assembly P15-20 | 19 Turbocharger assembly P15-14 |
| 4 Clamp | 12 Gasket | 20 Gasket |
| 5 Rubber hose | 13 Nut | |
| 6 Eyebolt | 14 Exhaust pipe insulator | *: Exhaust manifold P15-19 |
| 7 Oil feed pipe | 15 Nut | ⊗: Non-reusable parts |
| 8 Oil return pipe | 16 Exhaust pipe | |

● Assembly sequence

Follow the disassembly sequence in reverse.

ⓘ Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Clamp (air inlet hose installation)	7 to 8 {5.2 to 5.9, 0.7 to 0.8}	—
4	Clamp (rubber hose installation)	4.9 {3.6, 0.5}	—
6	Eyebolt	21 {15, 2.1}	—
10	Nut (exhaust pipe-to-front pipe installation)	90 to 120 {67 to 89, 9.2 to 12}	—
13	Nut (turbocharger assembly installation)	41 {30, 4.2}	—
15	Nut (exhaust pipe installation)	41 {30, 4.2}	—

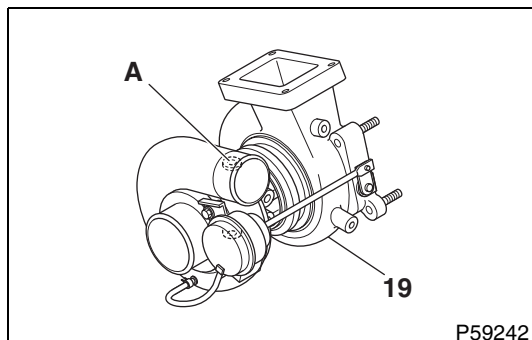
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
19	Turbocharger assembly oil hole (supply at time of installation)	Engine oil	As required

◆ Service procedure

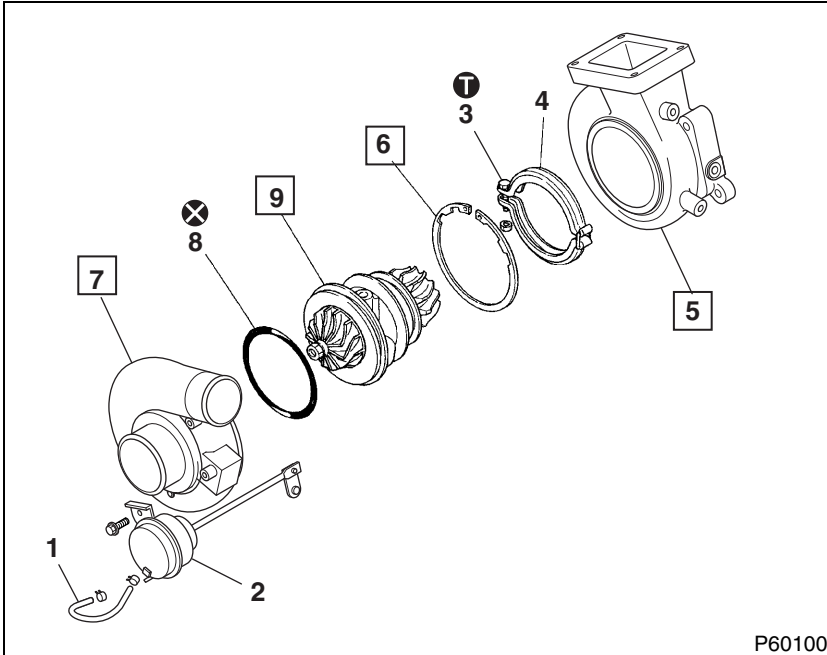
19 Installation of turbocharger assembly

Before installing the turbocharger assembly **19**, pour engine oil into the oil hole **A** to ensure smooth operation of the internal parts.



TURBOCHARGER

Turbocharger Assembly



● Operation before disassembly

📖 P15-15

● Disassembly sequence

- 1 Hose
- 2 Actuator
- 3 Bolt
- 4 Coupling
- 5 Turbine housing
- 6 Snap ring
- 7 Compressor cover
- 8 O-ring
- 9 Cartridge assembly

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection after assembly

📖 P15-15

CAUTION ⚠

The cartridge assembly 9 cannot be taken to pieces. Replace the whole assembly if the turbine wheel or compressor wheel is damaged and when the cartridge does not rotate smoothly or is found faulty in the assembled state.

Service standards

Unit: mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
9	Cartridge assembly	Play in axial direction of shaft & turbine wheel assembly	0.05 to 0.09 {0.0020 to 0.0035}	0.1 {0.0039}	Replace
		Play perpendicular to axis of shaft & turbine wheel assembly	Turbine wheel side	0.40 to 0.53 {0.016 to 0.021}	
			Compressor wheel side	0.55 to 0.66 {0.022 to 0.026}	

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Bolt (for tightening coupling)	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	—

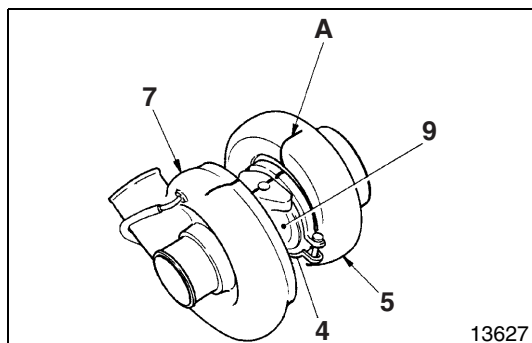
🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3	Bolt threads	Molybdenum disulfide grease NLGI No.2 (Li-soap)	As required
8	Entire periphery of O-ring	Engine oil	As required

◆ Service procedure

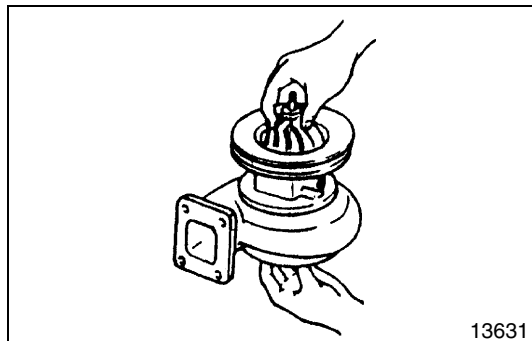
● Operation before disassembly

Put alignment marks **A** on the coupling **4**, turbine housing **5**, compressor cover **7** and cartridge assembly **9**.



● Inspection after reassembly

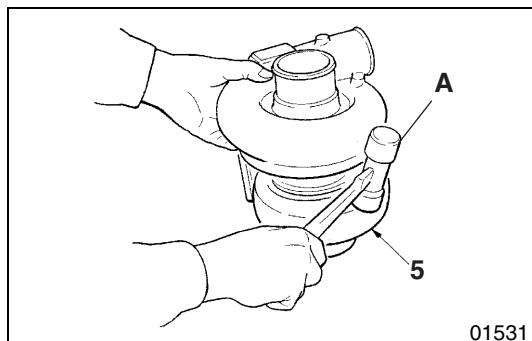
After the turbocharger assembly is completed, manually rotate each wheel to check that it turns smoothly.



5 Removal of turbine housing

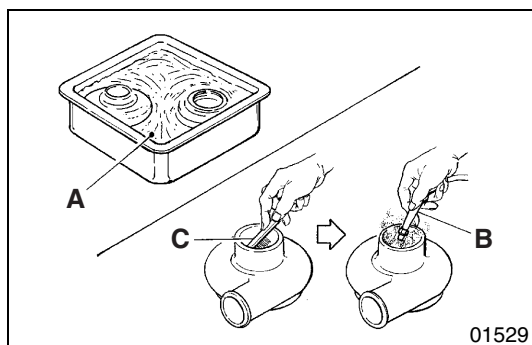
CAUTION ⚠

- Lightly tap around the entire periphery of the turbine housing **5** with a rubber-faced hammer **A**, taking care not to cause damage.
- The blades on the turbine wheel are easily bent. Make sure that they do not strike the turbine housing **5**.



5 7 Cleaning of turbine housing and compressor cover

- Before cleaning, visually check the disassembled parts for scorching, abrasion and other marks that may be difficult to see after cleaning. Replace any part that appears defective.
- Immerse the disassembled parts in a non-flammable solvent **A** (Daido Chemical Industry's Dai Cleaner T-40 or equivalent). Remove the parts from the solvent and blow them dry with compressed air **B**. Remove any hard deposits with a stiff brush or plastic scraper **C**.



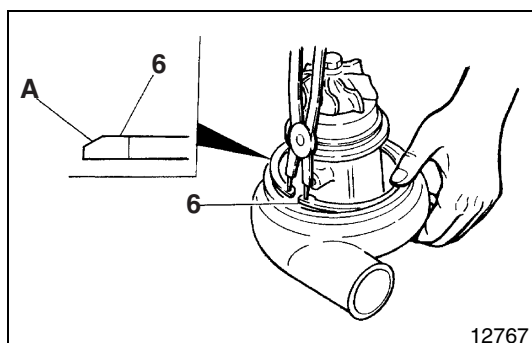
6 Installation of snap ring

Install the snap ring **6** as shown in the illustration.

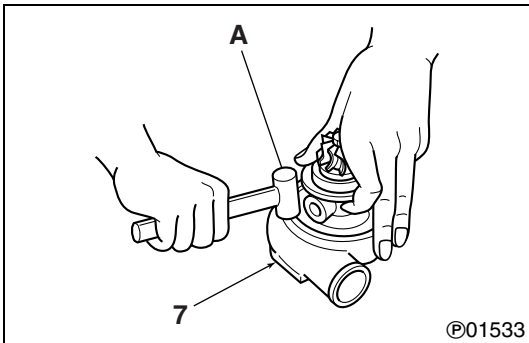
A: Tapered surface

CAUTION ⚠

Fit the snap ring **6** into place using hands not to let it spring away.



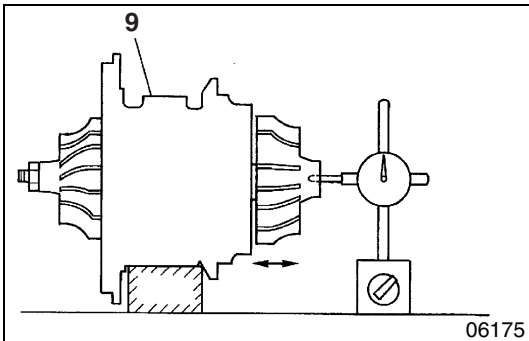
TURBOCHARGER



7 Removal of compressor cover

CAUTION ⚠

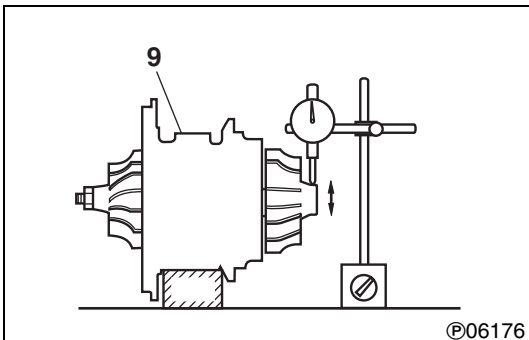
- Lightly tap around the entire periphery of the compressor cover 7 with a rubber-faced hammer A, taking care not to cause damage.
- The blades on the compressor wheel are easily bent. Make sure that they do not strike the compressor cover 7.



9 Inspection of cartridge assembly

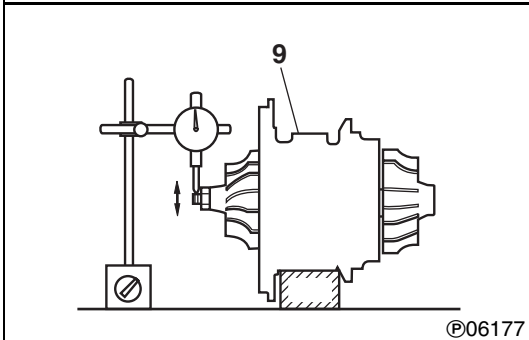
(1) Play in axial direction of shaft and turbine wheel assembly

If the measurement exceeds the specified limit, replace the cartridge assembly 9.

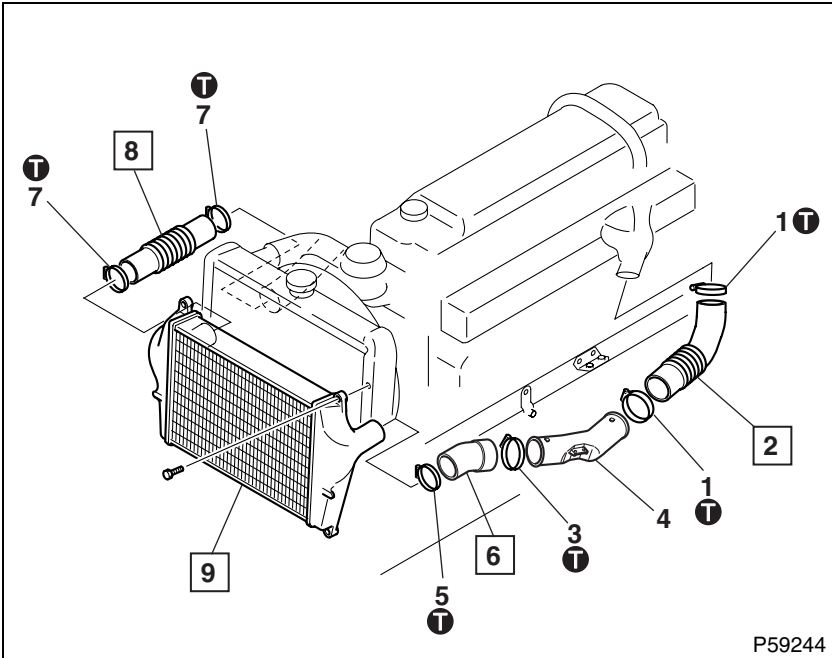


(2) Play perpendicular to axis of shaft and turbine wheel assembly

- Play at the turbine wheel side
If the measurement exceeds the specified limit, replace the cartridge assembly 9.



- Play at the compressor wheel side
If the measurement exceeds the specified limit, replace the cartridge assembly 9.



● Disassembly sequence

- 1 Clamp
- 2 Air outlet hose
- 3 Clamp
- 4 Air outlet pipe
- 5 Clamp
- 6 Air outlet duct
- 7 Clamp
- 8 Air inlet hose
- 9 Intercooler

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

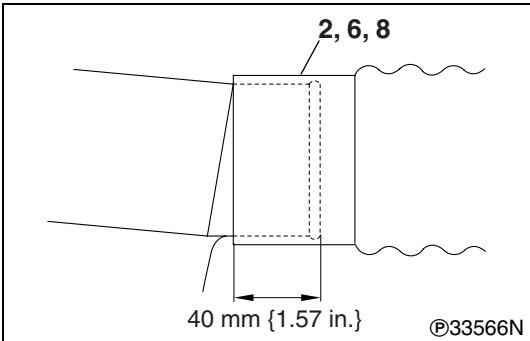
Unit: mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
9	Intercooler air leakage (at air pressure of 150 kPa {22 psi, 1.5 kgf/cm ² })	0 L {0 qts}	—	Replace

ⓘ Tightening torque

Unit: N·m {ft.lbs, kgf·m}

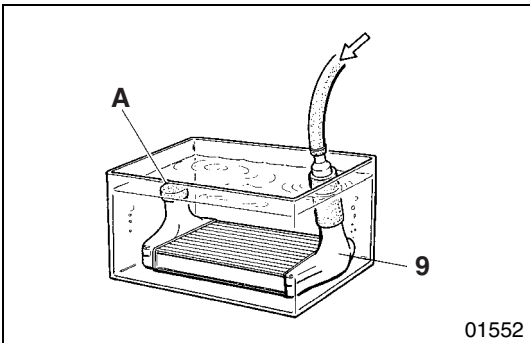
Location	Parts to be tightened	Tightening torque	Remarks
1, 3, 5, 7	Clamp (installation of air inlet hose, air outlet hose, air outlet pipe and air outlet duct)	7 to 8 {5.2 to 5.9, 0.7 to 0.8}	—



◆ Service procedure

2 6 8 Installation of air outlet hose and air inlet hose

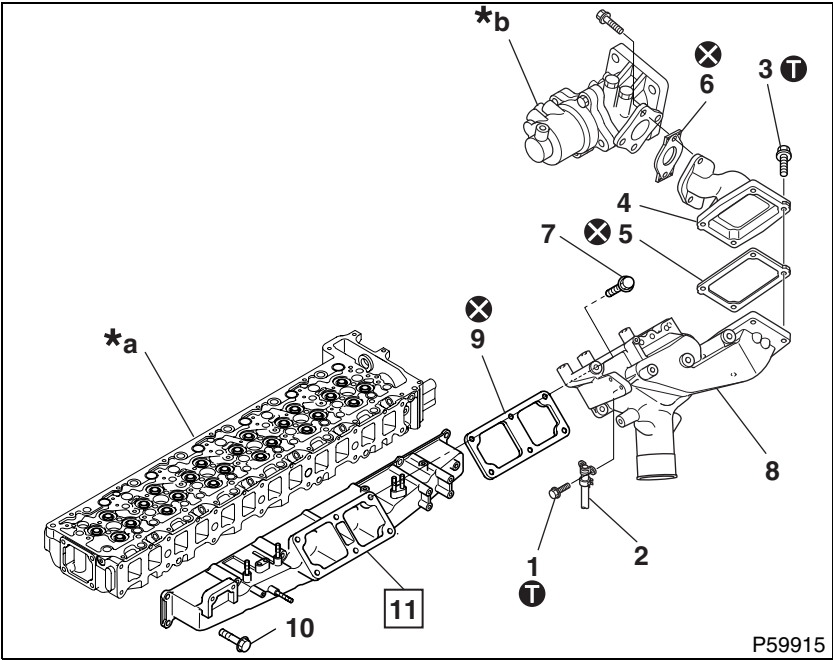
Fit the air hose 2, 6, 8 onto the hose joint as deep as illustrated.



9 Inspection of intercooler

- Fit a cap over one of the air ports **A** on the intercooler **9**, connect a hose to the other port, and immerse the intercooler in a tank of water. Then, apply the specified air pressure (150 kPa {22 psi, 1.5 kgf/cm²}) via the hose and check for air leakage.
- If leakage is apparent, replace the intercooler **9**.

INTAKE MANIFOLD



● Disassembly sequence

- 1 Bolt
- 2 Boost pressure sensor
- 3 Bolt
- 4 Exhaust gas recirculation adapter
- 5 Gasket
- 6 Gasket
- 7 Bolt
- 8 Intake manifold fitting
- 9 Gasket
- 10 Bolt
- 11 Intake manifold

*a: Cylinder head Gr11

*b: Exhaust gas recirculation valve Gr17

⊗: Non-reusable parts

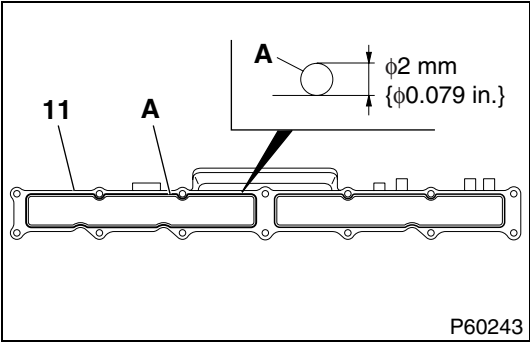
● Assembly sequence

Follow the disassembly sequence in reverse.

ⓘ Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (boost pressure sensor mounting)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
3	Bolt (exhaust gas recirculation adapter mounting)	46 to 54 {34 to 40, 4.7 to 5.5}	—



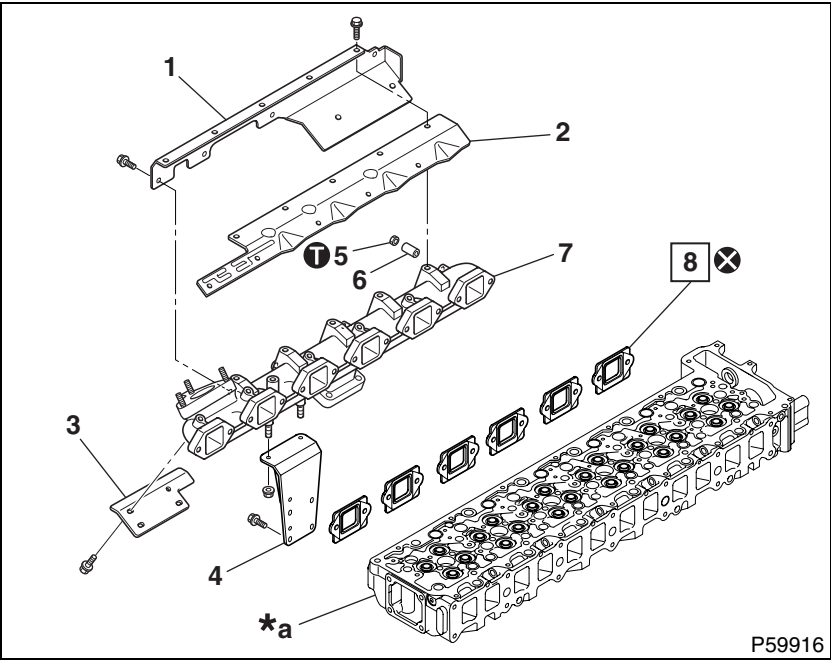
◆ Service procedure

11 Installation of intake manifold

- Apply an even, unbroken bead of the sealant **A** to the surface of the intake manifold **11** where it joins the cylinder head.
- Within three minutes of the sealant **A** application, fit the intake manifold **11** onto the cylinder head.

CAUTION

- Ensure that the surface of the intake manifold **11** onto which the sealant **A** is to be applied is clean.
- Fit the intake manifold **11** to the correct position on the cylinder head, making sure that the plate is not offset relative to the cylinderhead.
- After fitting the intake manifold **11**, wait for at least one hour before starting the engine.
- Apply a new bead of the sealant **A** whenever the mounting bolts of the intake manifold **11** have been loosened.



● Disassembly sequence

- 1 Exhaust manifold insulator A
- 2 Exhaust manifold insulator B
- 3 Front exhaust manifold insulator
- 4 Exhaust manifold bracket
- 5 Nut
- 6 Distance piece
- 7 Exhaust manifold
- 8 Gasket

*a: Cylinder heat  Gr11
X: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

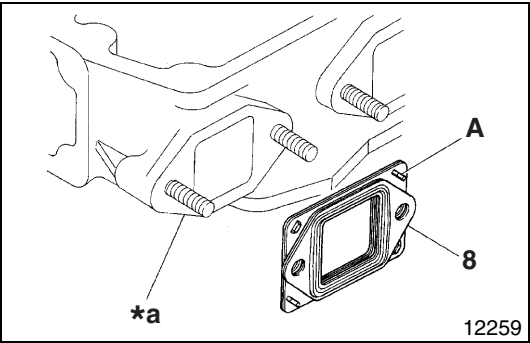
Location	Parts to be tightened	Tightening torque	Remarks
5	Nut (exhaust manifold installation)	58 {43, 5.9}	—

◆ Service procedure

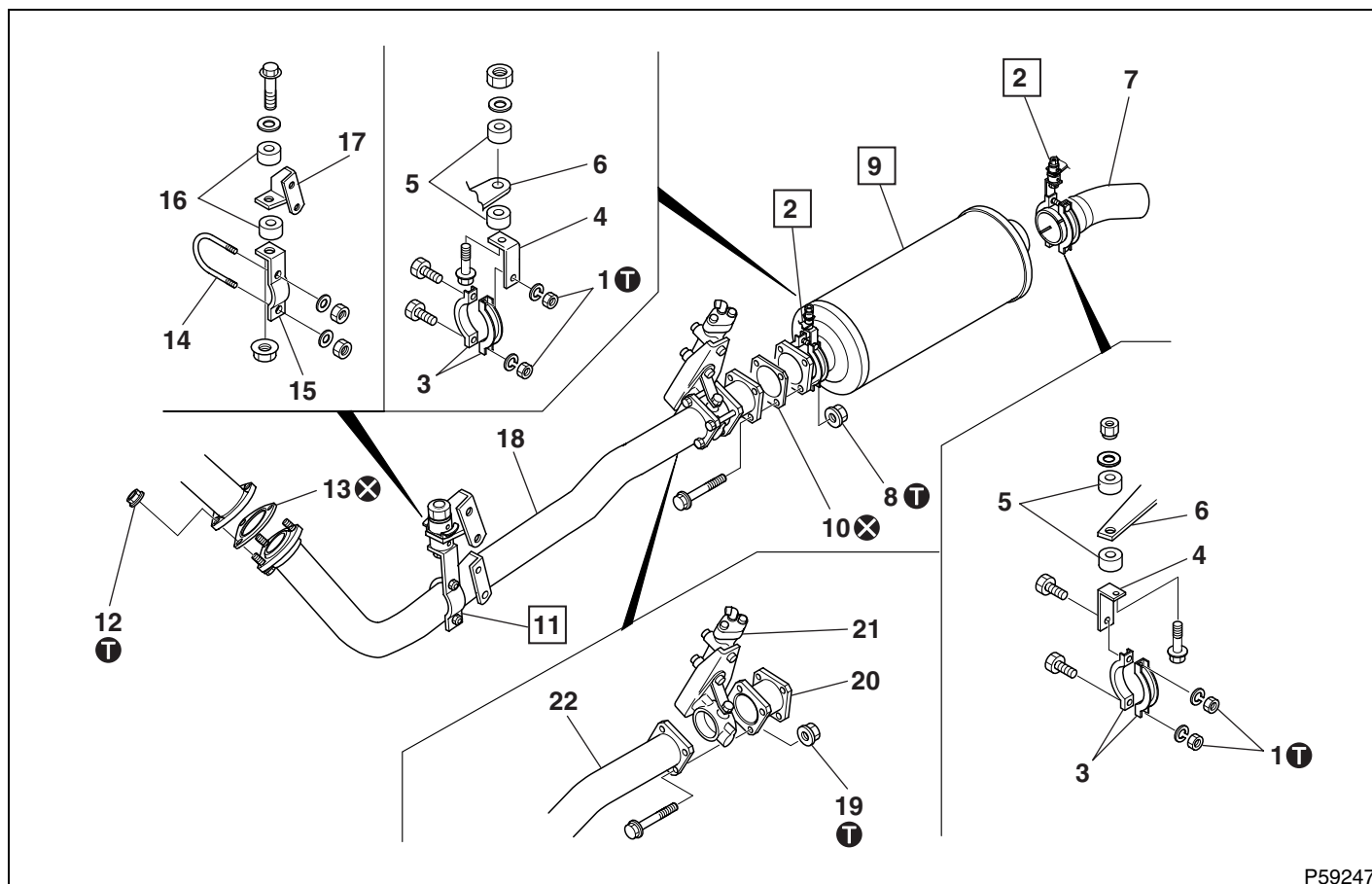
8 Installation of gasket

Fit the gasket 8 to the cylinder head *a in the illustrated direction.

A: Projection



EXHAUST PIPE AND MUFFLER



P59247

● Disassembly sequence

- | | | |
|-----------------------|---------------------------|--|
| 1 Nut | 9 Muffler (with catalyst) | 17 Exhaust pipe hanger |
| 2 Clamp assembly | 10 Gasket | 18 Front pipe assembly |
| 3 Clamp | 11 Clamp assembly | 19 Nut |
| 4 Pipe clamp stay | 12 Nut | 20 Center pipe |
| 5 Cushion rubber | 13 Gasket | 21 Exhaust brake unit  Gr35 |
| 6 Exhaust pipe hanger | 14 U-bolt | 22 Front pipe |
| 7 Tail pipe | 15 Pipe clamp stay | |
| 8 Nut | 16 Cushion rubber | |

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

A small quantity of water may be collected in the muffler 9. Be careful not to contact the water that comes out from the muffler. Should it contact the skin, wash it off in running water immediately.

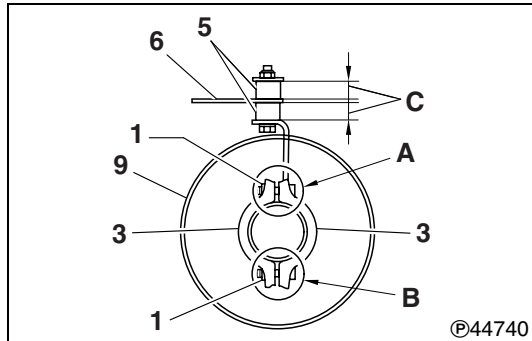
CAUTION

Do not kick or strike the muffler 9. The impact could damage the catalyst in the muffler.

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (clamp installation)	20 {15, 2.0}	—
8	Nut (muffler installation)	49 to 68 {36 to 50, 5.0 to 6.9}	—
12	Nut (front pipe assembly installation)	90 to 120 {66 to 89, 9.2 to 12}	—
19	Nut (exhaust brake unit installation)	41 {30, 4.2}	—



◆ Service procedure

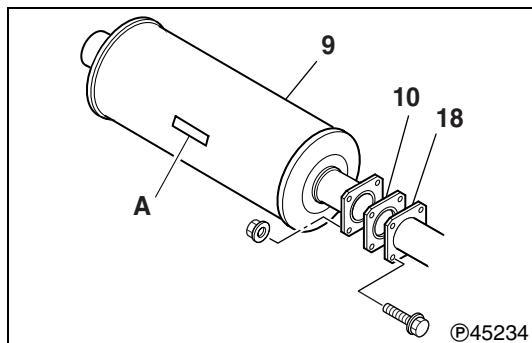
② Installation of clamp assembly

- Tighten nuts **1** to such an extent that clamp **3** can still move loosely.
- Tighten the nut **1** on the side **A** of clamp **3** until the ends of the clamp halves contact each other.
- Then, tighten the nut **1** on the side **B** to close the clamp **3** tight on that side.
- Tighten cushion rubbers **5** to achieve the specified compression **C**.

C: 25 mm {0.98 in.} before tightened
23 mm {0.91 in.} after tightened

CAUTION ⚠

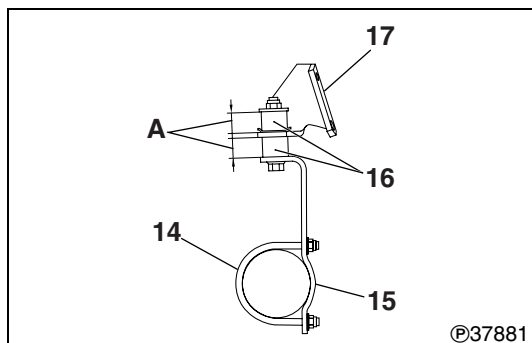
Do not overtighten nut 1 on the side B since clamp 3 and muffler 9 may be damaged.



⑨ Installation of muffler

Fit the muffler **9** to the front pipe assembly **18** in the illustrated direction.

A: Stamped part number



⑪ Installation of clamp assembly

Tighten cushion rubbers **16** to achieve the specified compression **A**.

A: 25 mm {0.98 in.} before tightened
23 mm {0.91 in.} after tightened



Group 17

Emission Control

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

STRUCTURE AND OPERATION

- 1. Exhaust Gas Recirculation System 17-2
- 2. Crankcase Emission Control System 17-6

ON-VEHICLE INSPECTION AND ADJUSTMENT

- 1. Replacement of PCV Valve Element 17-7

EXHAUST GAS RECIRCULATION SYSTEM

- 1. Inspection Procedure 17-8
- 2. Cautions to Observe when Performing Inspections 17-9
- 3. Inspections Based on Diagnosis Codes 17-10
- 4. Multi-Use Tester Service Data 17-12
- 5. Actuator Tests Performed Using Multi-Use Tester 17-12
- 6. Inspection of Electrical Equipment 17-12

INSTALLED LOCATIONS OF PARTS 17-14

ELECTRIC CIRCUIT DIAGRAM 17-20

EXHAUST GAS RECIRCULATION VALVE, EXHAUST GAS RECIRCULATION SOLENOID VALVE, EXHAUST GAS RECIRCULATION PIPE, EXHAUST GAS RECIRCULATION COOLER 17-24

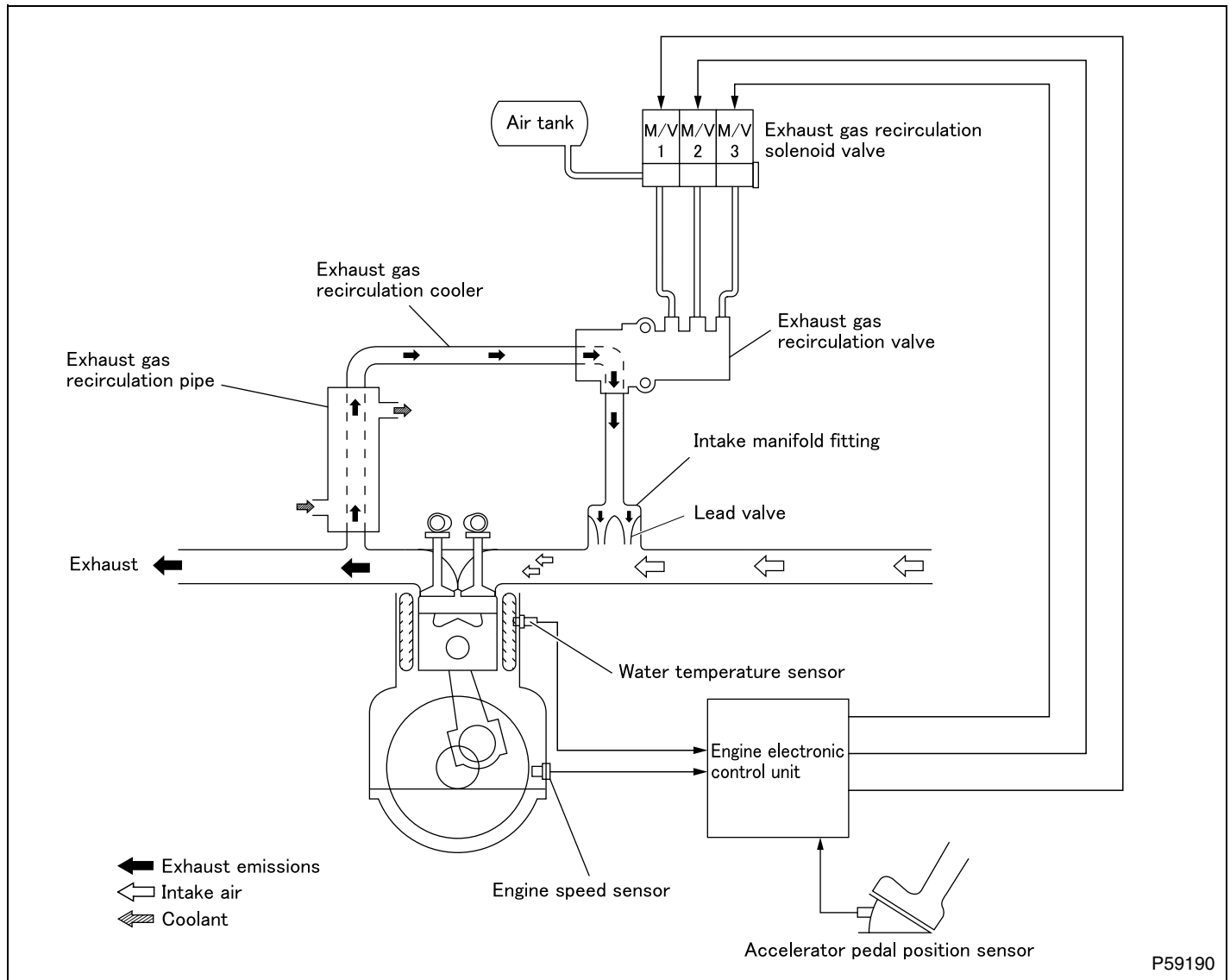
CRANKCASE EMISSION CONTROL SYSTEM 17-28

STRUCTURE AND OPERATION

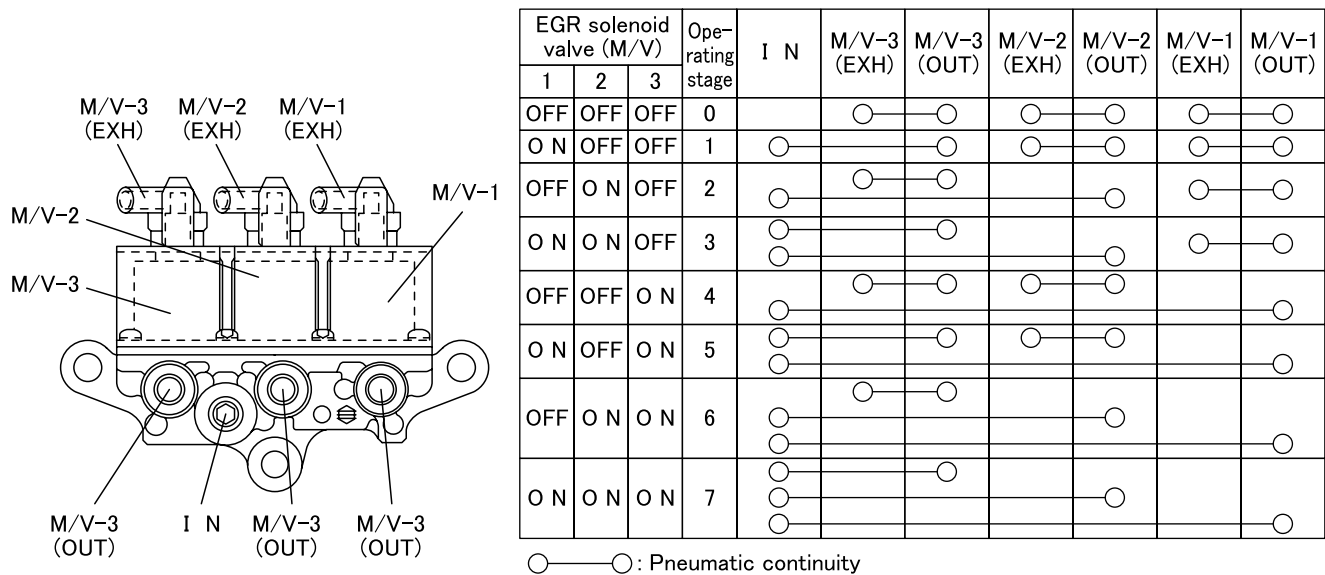
1. Exhaust Gas Recirculation System

1.1 Overview

- In the exhaust gas recirculation system, the engine electronic control unit controls the exhaust gas recirculation solenoid valve in accordance with information from sensors on various aspects of the engine (engine speed, coolant temperature, throttle opening, etc.).
- Exhaust gas recirculation involves the introduction of inert gases in the post-combustion exhaust emissions into the intake manifold. By reducing the combustion temperature, it reduces the amount of nitrogen oxides (NOx), which are harmful, in the exhaust emissions. Further, an exhaust gas recirculation cooler cools the recirculated exhaust emissions, thereby reducing the peak combustion temperature.



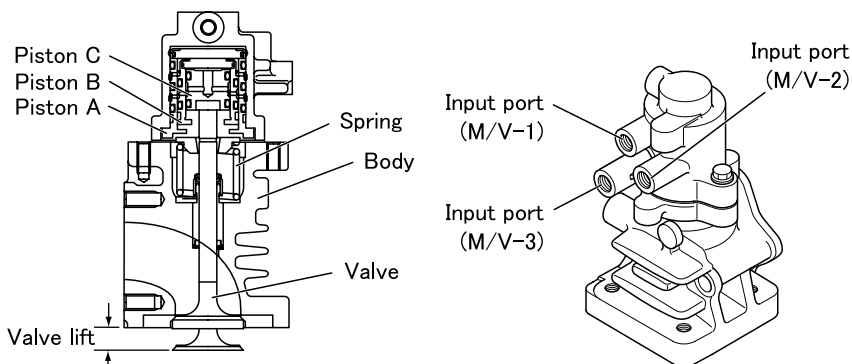
(1) Exhaust gas recirculation solenoid valves



P57892

- The exhaust gas recirculation solenoid valves are each turned ON/OFF by drive signals from the engine electronic control unit to realize a 7- stage supply of air to the exhaust gas recirculation valve.

(2) Exhaust gas recirculation valve



Operating step	Input port (M/V)			Valve lift (mm [in.])
	1	2	3	
0	OFF	OFF	OFF	0 {0}
1	O N	OFF	OFF	1.3±0.3 {0.051±0.012}
2	OFF	O N	OFF	2.6±0.3 {0.10±0.012}
3	O N	O N	OFF	4.6±0.3 {0.18±0.012}
4	OFF	OFF	O N	5.7±0.4 {0.22±0.016}
5	O N	OFF	O N	7.7±0.4 {0.30±0.016}
6	OFF	O N	O N	9.0±0.3 {0.35±0.012}
7	O N	O N	O N	11.0±0.3 {0.43±0.012}

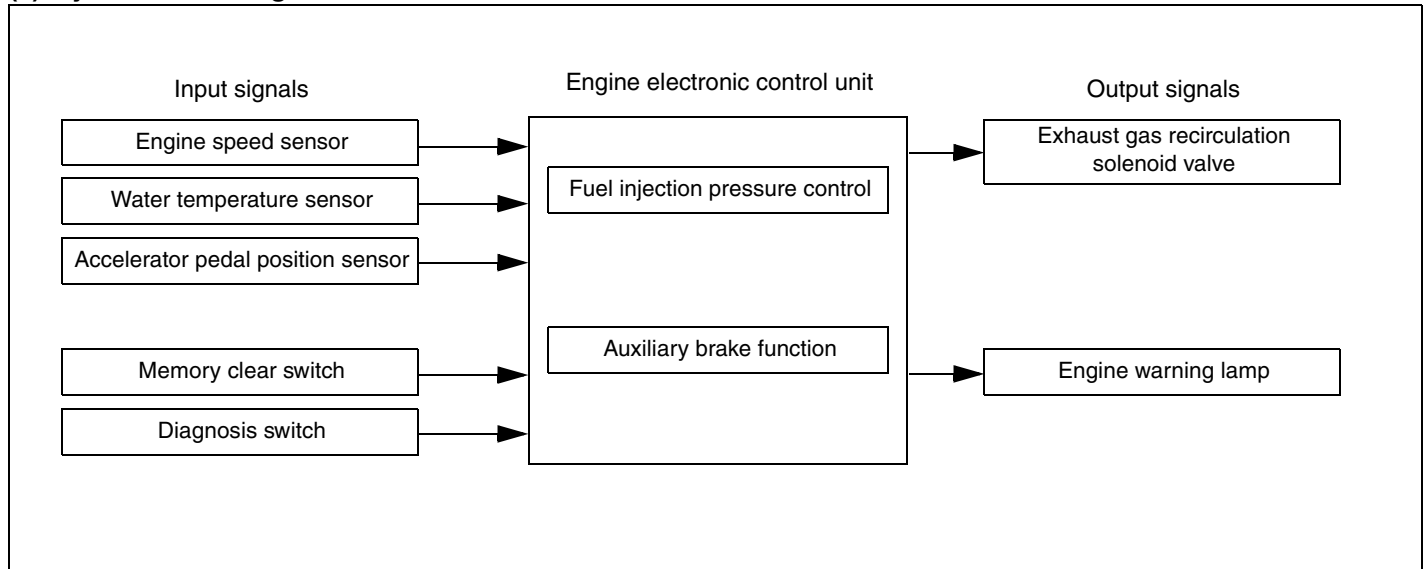
P57893

- The exhaust gas recirculation valve realizes 7 stages of valve lift in accordance with the supply of air to its input ports from the exhaust gas recirculation solenoid valves.

STRUCTURE AND OPERATION

1.2 Electronic control system

(1) System block diagram



(2) Exhaust gas recirculation valve control function

- In accordance with data from sensors, the engine electronic control unit determines the exhaust gas recirculation valve opening that suits the operating condition and sends a driving signal to the exhaust gas recirculation solenoid valve. This control is suspended when the coolant temperature is low.

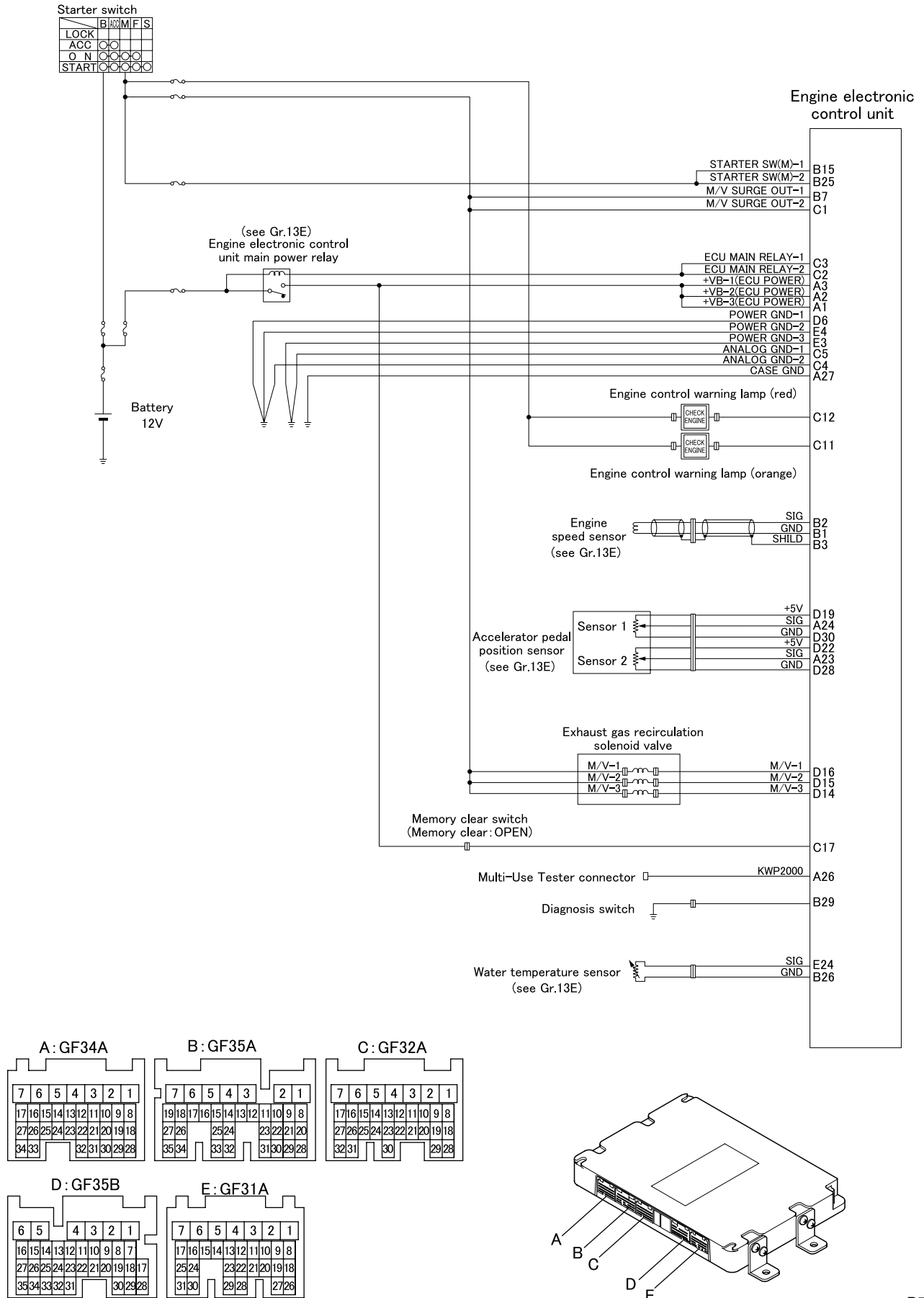
(3) Fault diagnosis function

- While the starter switch is in the ON position, the engine electronic control unit continuously monitors the sensors and other control elements for faults. In the event that the engine electronic control unit finds a component faulty, it causes an indication to be made in the meter cluster to alert the driver. At the same time, it memorizes the fault location in the form of a diagnosis code.
- While control necessitated by a fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.

NOTE

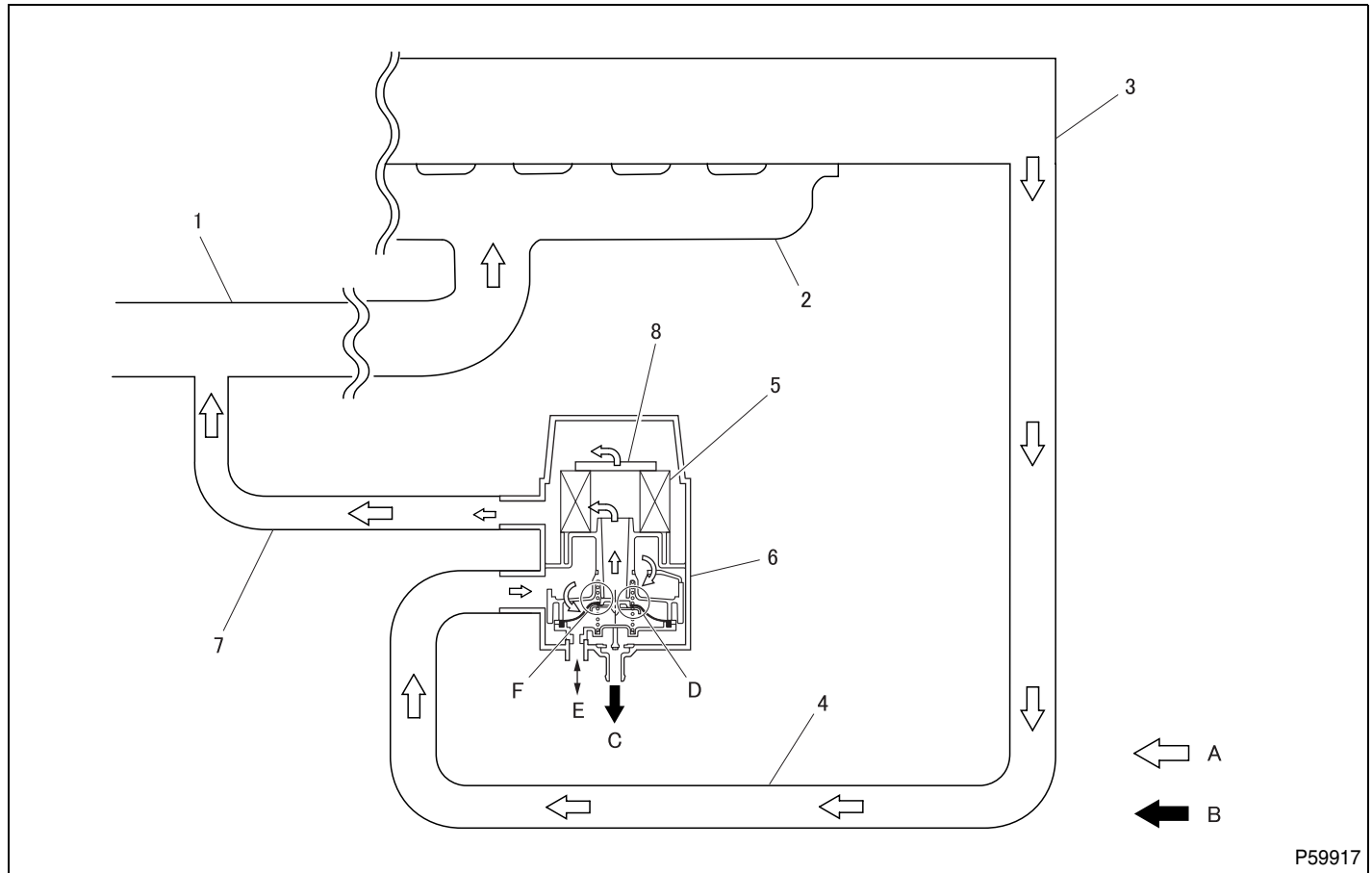
- **Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.**
- **The Multi-Use Tester is capable of showing more detailed diagnosis codes.**

1.3 Electronic control unit connection diagram



STRUCTURE AND OPERATION

2. Crankcase Emission Control System



P59917

- 1 Air duct
- 2 Intake manifold
- 3 Rocker cover
- 4 Breather hose
- 5 Element
- 6 PCV valve
- 7 Breather hose
- 8 Regulator valve

- A: Blowby gases
- B: Engine oil
- C: To oil pan
- D: PCV valve open
- E: Atmospheric pressure
- F: PCV valve closed

PCV: Positive Crankcase Ventilation

- The crankcase emission control system returns blowby gases to an air duct to prevent them from being released to the outside air.
- The positive crankcase ventilation valve keeps constant the pressure inside the crankcase.
- The oil in the blowby gas is separated by the wire mesh and the element 5 in the PCV valve 6 and is returned to the oil pan.
- When the element 5 is clogged, the regulator valve 8 opens and the blowby gas is returned to the breather hose 7.

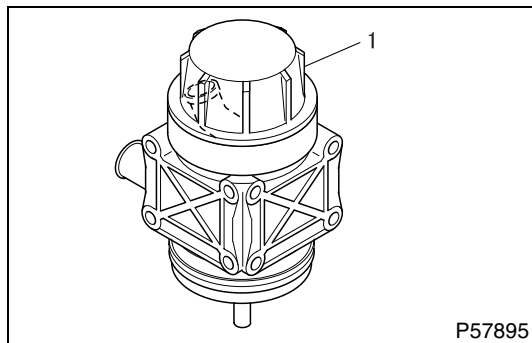
1. Replacement of PCV Valve Element

Lubricant and/or sealant

Mark	Point of application	Specified lubricant and/or sealant	Quantity
2	O-ring (entire periphery)	Engine oil	As required

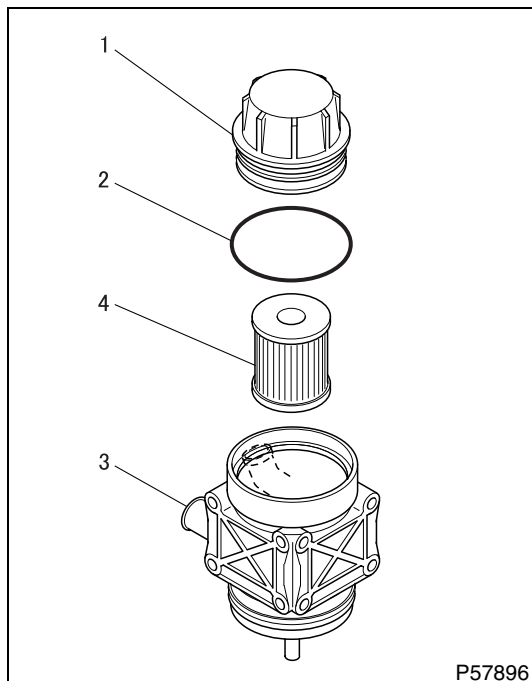
CAUTION

- For information on the element 4 replacement interval, refer to the element instruction manual. If the element is used beyond its replacement interval, it may become clogged, causing the pressure inside the engine to increase such that oil leakage occurs.
- Be sure to remove and install the cap 1 by hand. Using tools could result in damage.



[Removal]

- Loosen the cap 1 by hand.



[Installation]

- Clean the thread on the cap 1.
- Lightly smear the O-ring 2 with engine oil and fit it on the cap 1.
- Securely tighten the cap 1 until it stops slightly above the PCV body 3.

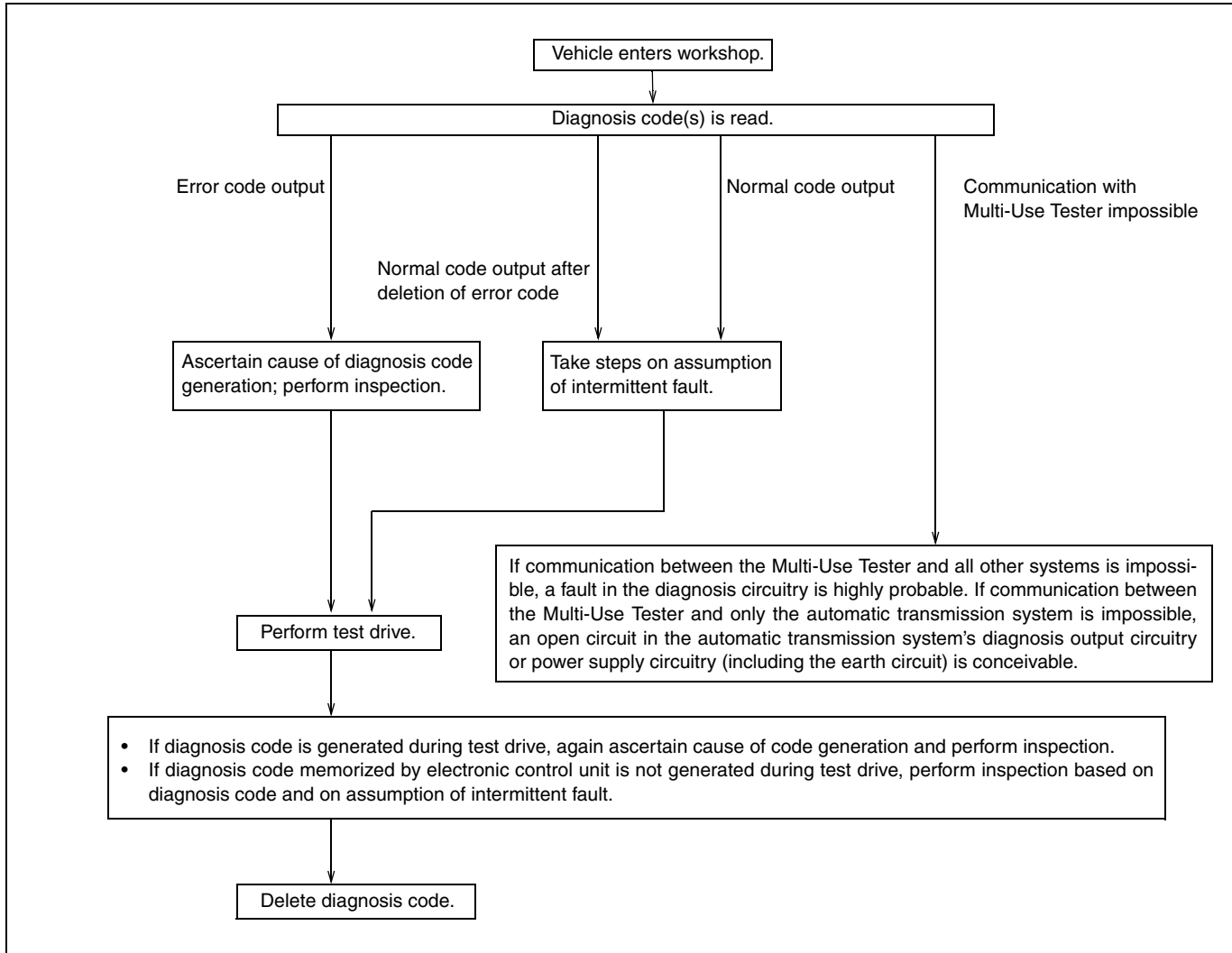
CAUTION

- Be sure to use a genuine Mitsubishi Fuso element. Using an inappropriate element 4 could result in engine trouble.
- When replacing the element 4, be sure to replace the O-ring 2 also.

EXHAUST GAS RECIRCULATION SYSTEM

1. Inspection Procedure

- System inspection can be performed most effectively using a Multi-Use Tester III. Types of system inspection are broadly classified in accordance with fault symptoms and diagnosis codes as follows:
- Inspection based on diagnosis code memorized by electronic control unit
- Inspection performed on assumption of intermittent fault



2. Cautions to Observe when Performing Inspections

CAUTION

- The battery voltage must be the standard voltage.
- Make sure no harness connector or component connector is loose. Before disconnecting any connector, place the starter switch in the LOCK position and wait 20 seconds.
- After effecting a repair, delete the diagnosis code using the Multi-Use Tester or memory clear switch.
- As a general rule, inspection work should be performed with the starter switch in the LOCK position. However, it may be necessary to perform certain tasks with the starter switch in the ON position. At these times, be careful not to cause short circuits between connector terminals and between terminals and the vehicle body.
- Indicated component resistances may not fall within the standard ranges if they are unduly affected by the temperature and/or by the accuracy of the tester. Standard values in the text are given on the assumption of room temperature (10 to 35°C {50 to 95°F}).
- After rectification of an abnormality, the system's ability or inability to automatically return to normal control from the backup control that begins when a fault occurs depends upon the diagnosis code, i.e., the fault location. When the system resumes normal control, the warning lamp goes off.
- Even when an abnormality has been rectified and the system has automatically returned to normal control, the diagnosis code corresponding to the fault location remains in the memory of the electronic control unit as a past diagnosis code.
- Following a fault that does not permit an automatic return to normal control from the backup control that begins when a fault occurs, it is necessary to clear the diagnosis code from memory in order for the system to recover.

EXHAUST GAS RECIRCULATION SYSTEM

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

NOTE

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Flashes
P1267	EGR 1	67
P1268	EGR 1	67
P1272	EGR 2	68
P1273	EGR 2	68
P1277	EGR 3	69
P1278	EGR 3	69

3.2 Diagnosis code generation conditions and inspection items

P1267: EGR 1 (warning lamp flashes: 67)

Generation condition		Exhaust gas recirculation solenoid valve (M/V-1) is short-circuited to earth, or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	1F: EGR Position
	Actuator test	A1: EGR 1
	Electrical equipment	#530: Exhaust gas recirculation solenoid valve
	Electric circuit diagram	Exhaust gas recirculation solenoid valve system

P1268: EGR 1 (warning lamp flashes: 67)

Generation condition		Exhaust gas recirculation solenoid valve (M/V-1) is short-circuited to earth.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	1F: EGR Position
	Actuator test	A1: EGR 1
	Electrical equipment	#530: Exhaust gas recirculation solenoid valve
	Electric circuit diagram	Exhaust gas recirculation solenoid valve system

P1272: EGR 2 (warning lamp flashes: 68)

Generation condition		Exhaust gas recirculation solenoid valve (M/V-2) is short-circuited to earth, or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	1F: EGR Position
	Actuator test	A2: EGR 2
	Electrical equipment	#530: Exhaust gas recirculation solenoid valve
	Electric circuit diagram	Exhaust gas recirculation solenoid valve system

P1273: EGR 2 (warning lamp flashes: 68)

Generation condition		Exhaust gas recirculation solenoid valve (M/V-2) is short-circuited to earth.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	1F: EGR Position
	Actuator test	A2: EGR 2
	Electrical equipment	#530: Exhaust gas recirculation solenoid valve
	Electric circuit diagram	Exhaust gas recirculation solenoid valve system

P1277: EGR 3 (warning lamp flashes: 69)

Generation condition		Exhaust gas recirculation solenoid valve (M/V-3) is short-circuited to earth, or open-circuited.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	1F: EGR Position
	Actuator test	A3: EGR 3
	Electrical equipment	#530: Exhaust gas recirculation solenoid valve
	Electric circuit diagram	Exhaust gas recirculation solenoid valve system

P1278: EGR 3 (warning lamp flashes: 69)

Generation condition		Exhaust gas recirculation solenoid valve (M/V-3) is short-circuited to earth.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	1F: EGR Position
	Actuator test	A3: EGR 3
	Electrical equipment	#530: Exhaust gas recirculation solenoid valve
	Electric circuit diagram	Exhaust gas recirculation solenoid valve system

EXHAUST GAS RECIRCULATION SYSTEM

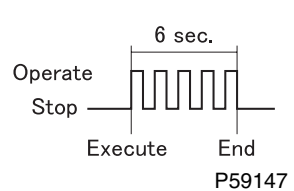
4. Multi-Use Tester Service Data

NOTE

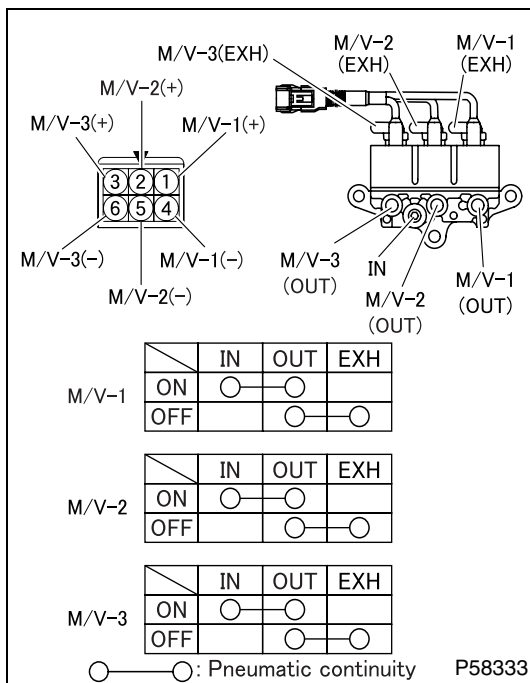
- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
1F	EGR Position	■■■■.■STEP	Idling [Actuator test] A1: EGR 1, A2: EGR 2, A3: EGR 3	0%

5. Actuator Tests Performed Using Multi-Use Tester

No.	Item	Explanation	Confirmation method
A1	EGR 1	Exhaust gas recirculation solenoid valve driving signal 	Exhaust gas recirculation solenoid valve operating sound [Service data] 1F: EGR Position
A2	EGR 2		
A3	EGR 3		

6. Inspection of Electrical Equipment



#530 Inspection of exhaust gas recirculation solenoid valve

- Perform the following checks. If there is any abnormality, replace the exhaust gas recirculation solenoid valve.

(1) Check of operation

- Gradually increase from zero the voltage applied to terminals 1 and 4 (M/V-1), 2 and 5 (M/V-2), or 3 and 6 (M/V-3).
- Observe the voltage when the exhaust gas recirculation solenoid valve operates. (Determine the solenoid valve's OFF-ON operation from the operating sound.)

Standard value (min. operating voltage)	9 V or lower
--	--------------

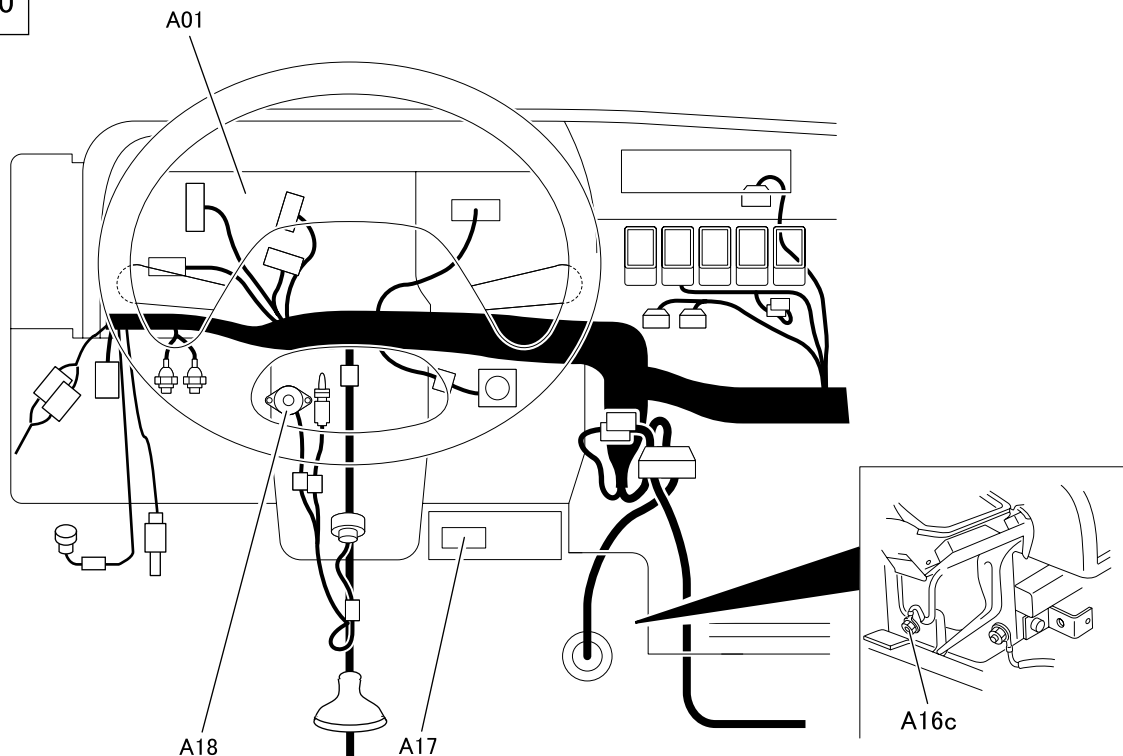
(2) Check of continuity and airtightness

- Air pressure applied during check: 930 kPa {135 psi, 9.5 kgf/cm²}

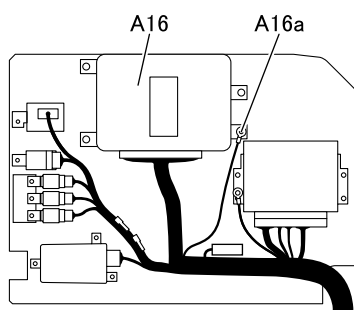
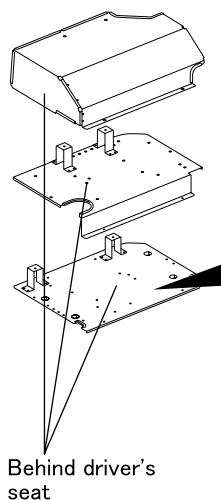
MEMO

INSTALLED LOCATIONS OF PARTS

A 01 to 20

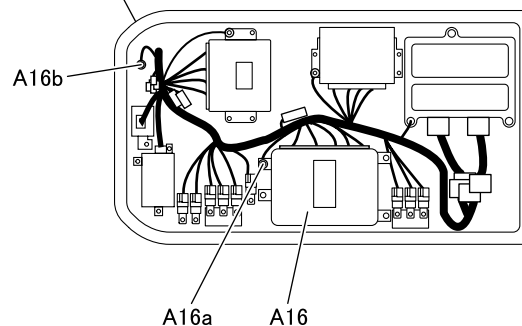


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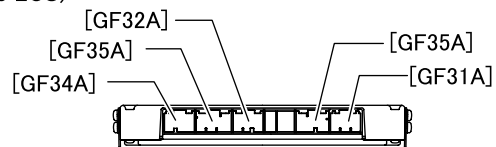


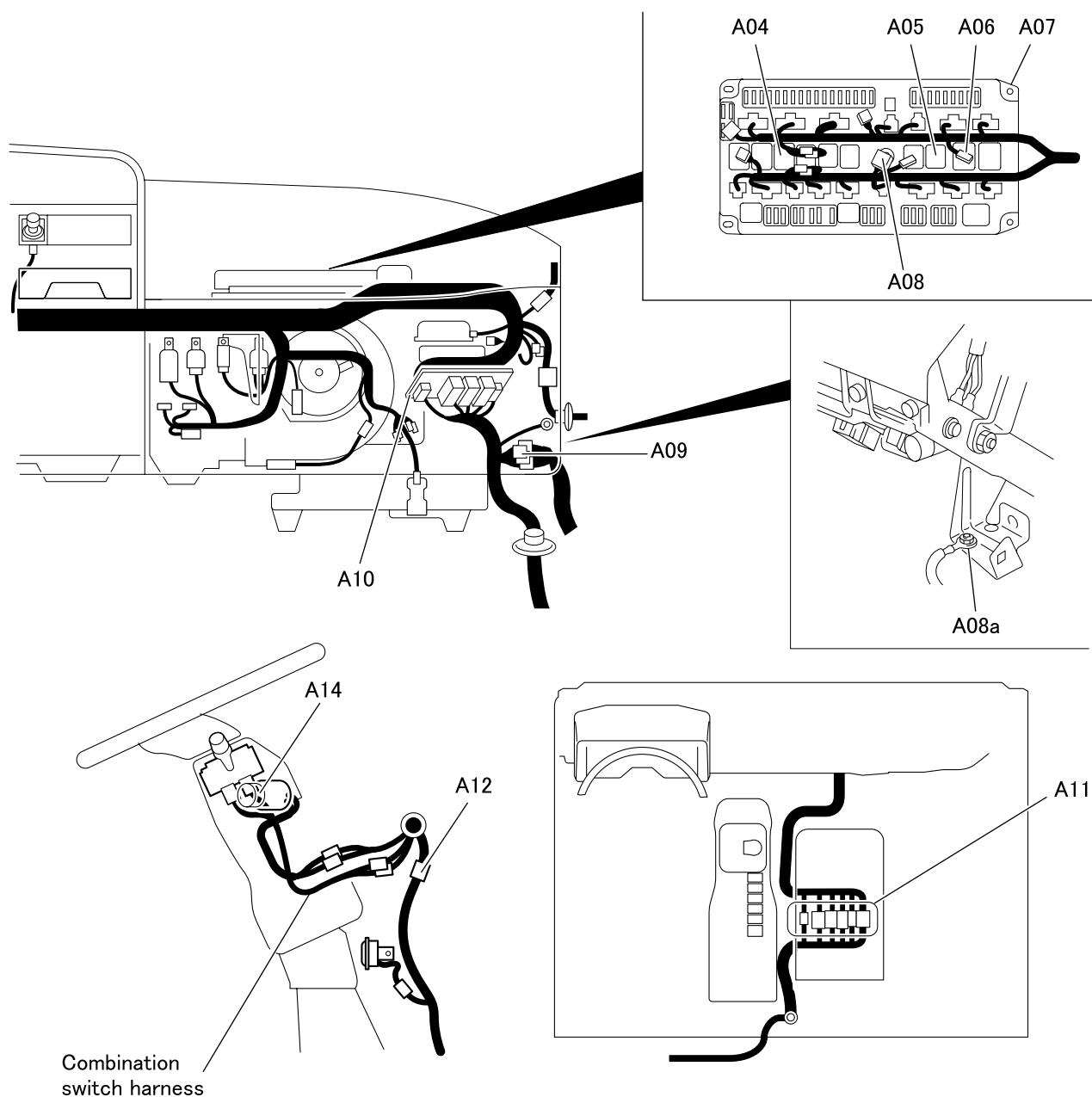
<Except FM65(A/T)>

Behind driver's seat



(Engine ECU)





No relevant parts in a missing number

- A01 Meter cluster
- A04 ECU main relay
- A05 Short connector
- A06 Diagnosis switch and memory clear switch (Engine ECU)
- A07 Relay and fuse box
- A08 Multi-use tester-III connector (For recorder)
- A09 Connection of bed harness and chassis harness
- A10 Connection of cab harness and chassis harness
- A11 Connection of cab harness and bed harness
- A12 Connection of cab harness and headlamp harness

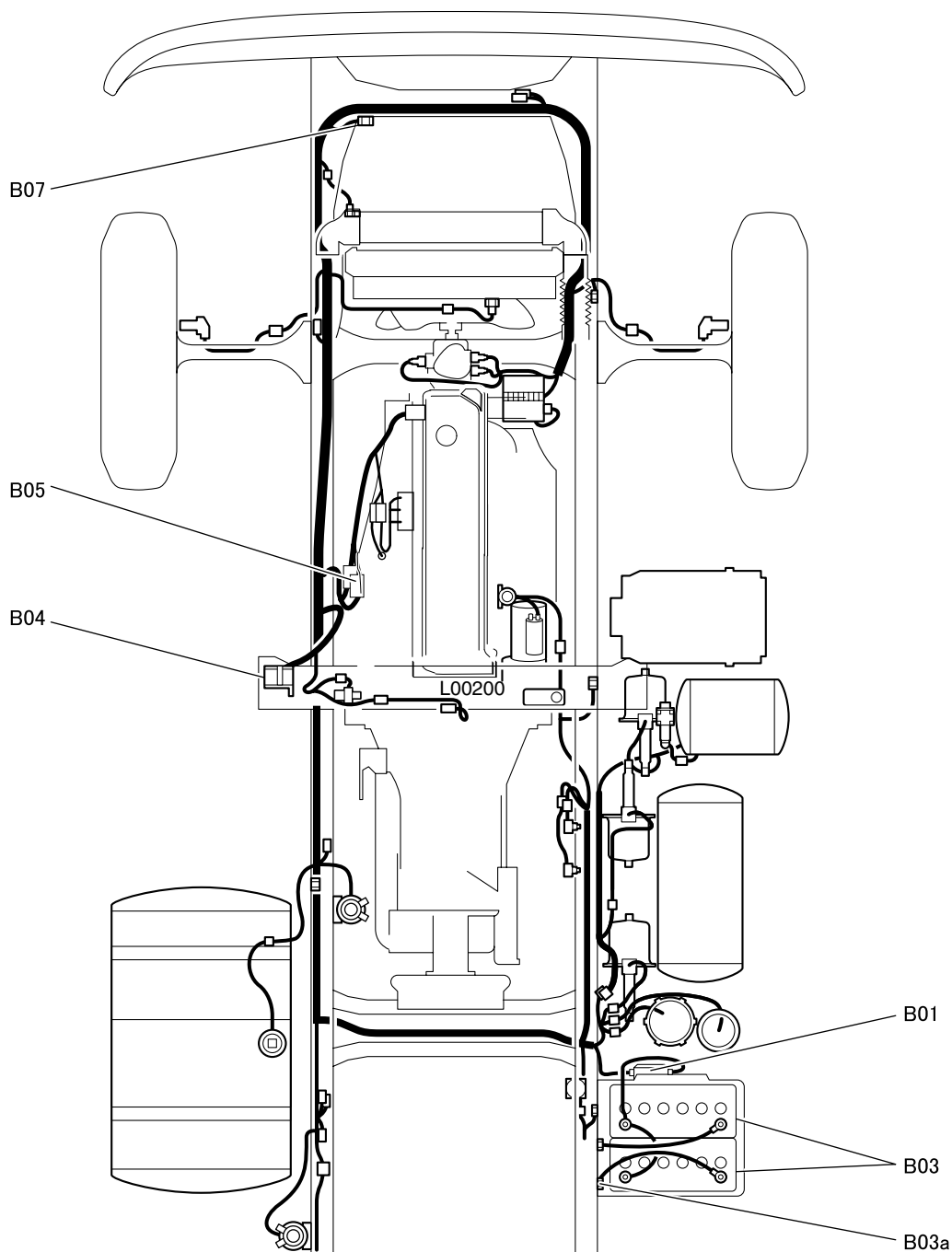
- A14 Starter switch
- A16 Engine ECU
- A16a Ground to c
- A17 Multi-use tester-III connector (For inspection)
- A18 Accelerator pedal position sensor

ECU : Electronic control unit
A/T : Automatic transmission

INSTALLED LOCATIONS OF PARTS

B 01 to 20

<FK,FM61,FM64>

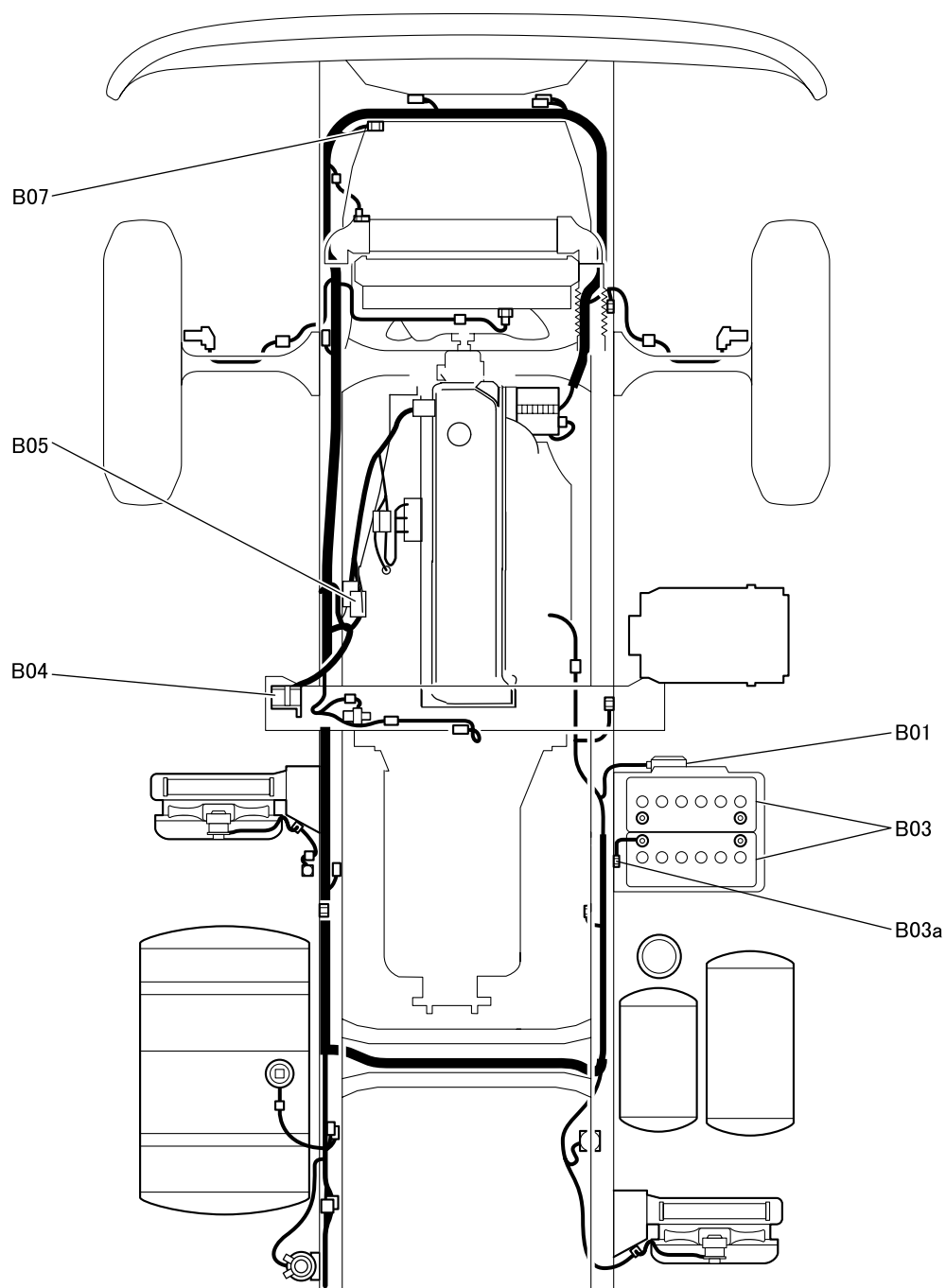


No relevant parts in a missing number

- B01 Main high-current fuse box
- B03 Battery
- B03a Battery ground
- B04 High-current fuse box
- B05 Connection of chassis harness and engine harness
- B07 Ground

B 01 to 20

<FM65>



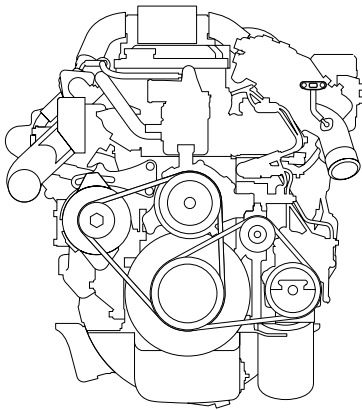
No relevant parts in a missing number

- B01 Main high-current fuse box
- B03 Battery
- B03a Battery ground
- B04 High-current fuse box
- B05 Connection of chassis harness and engine harness
- B07 Ground

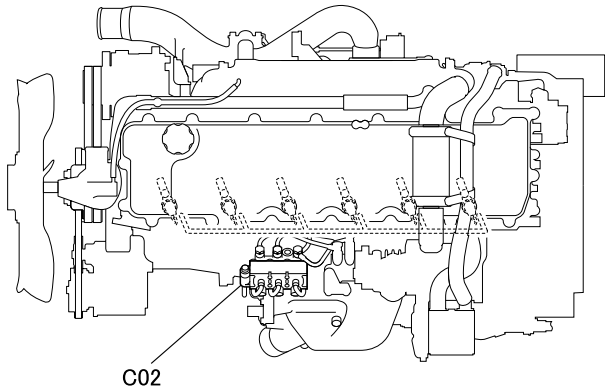
INSTALLED LOCATIONS OF PARTS

C 01 to 30

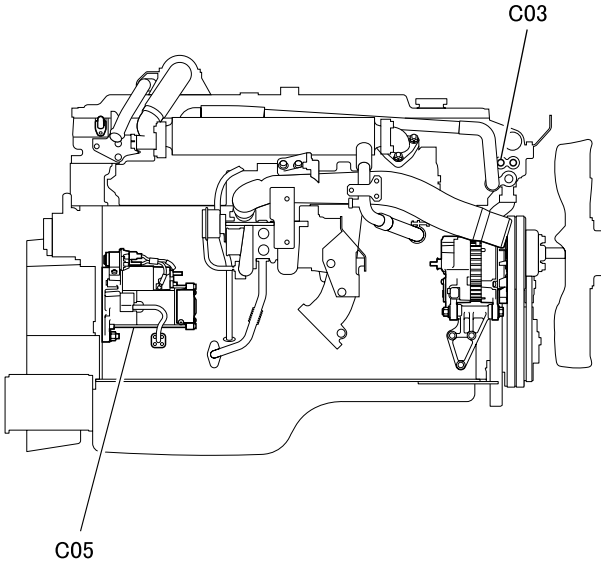
Front side view



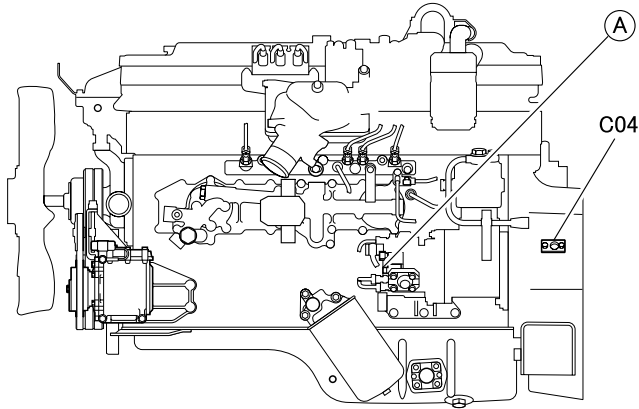
Upper view

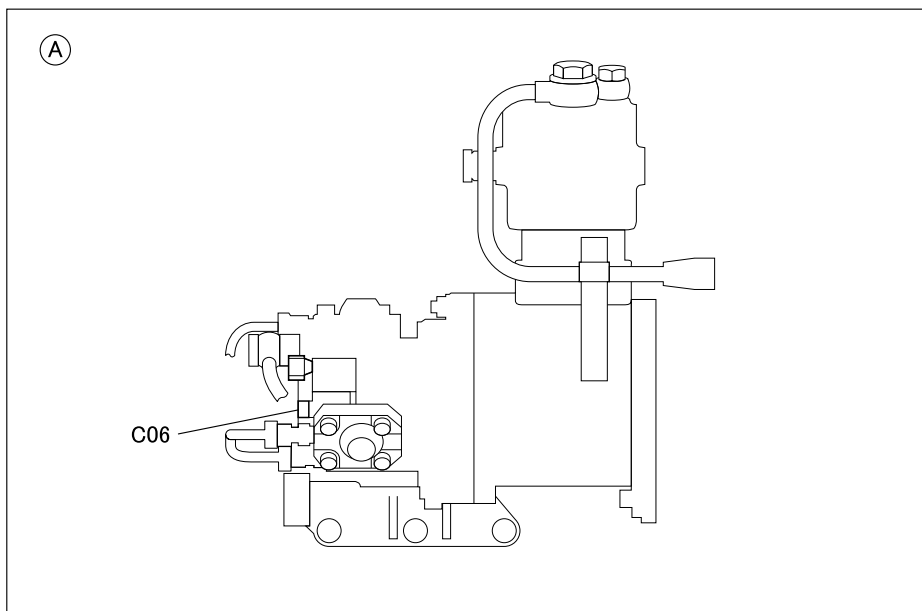


Right side view

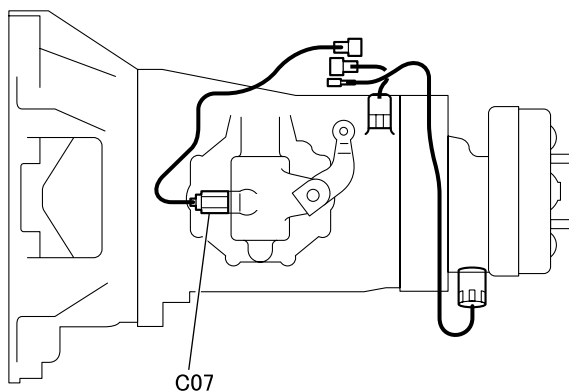


Left side view

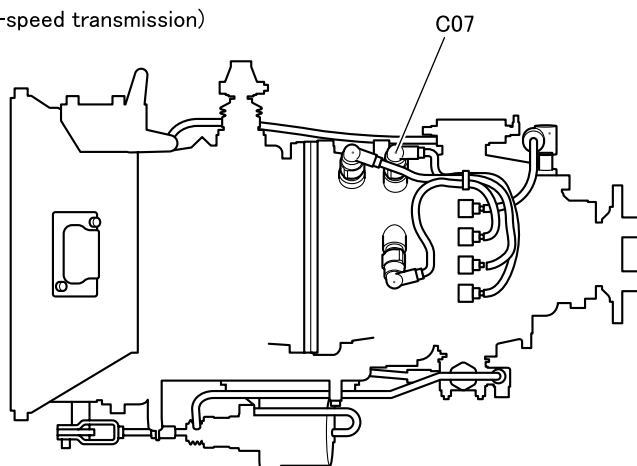




(6-speed transmission)



(9-speed transmission)



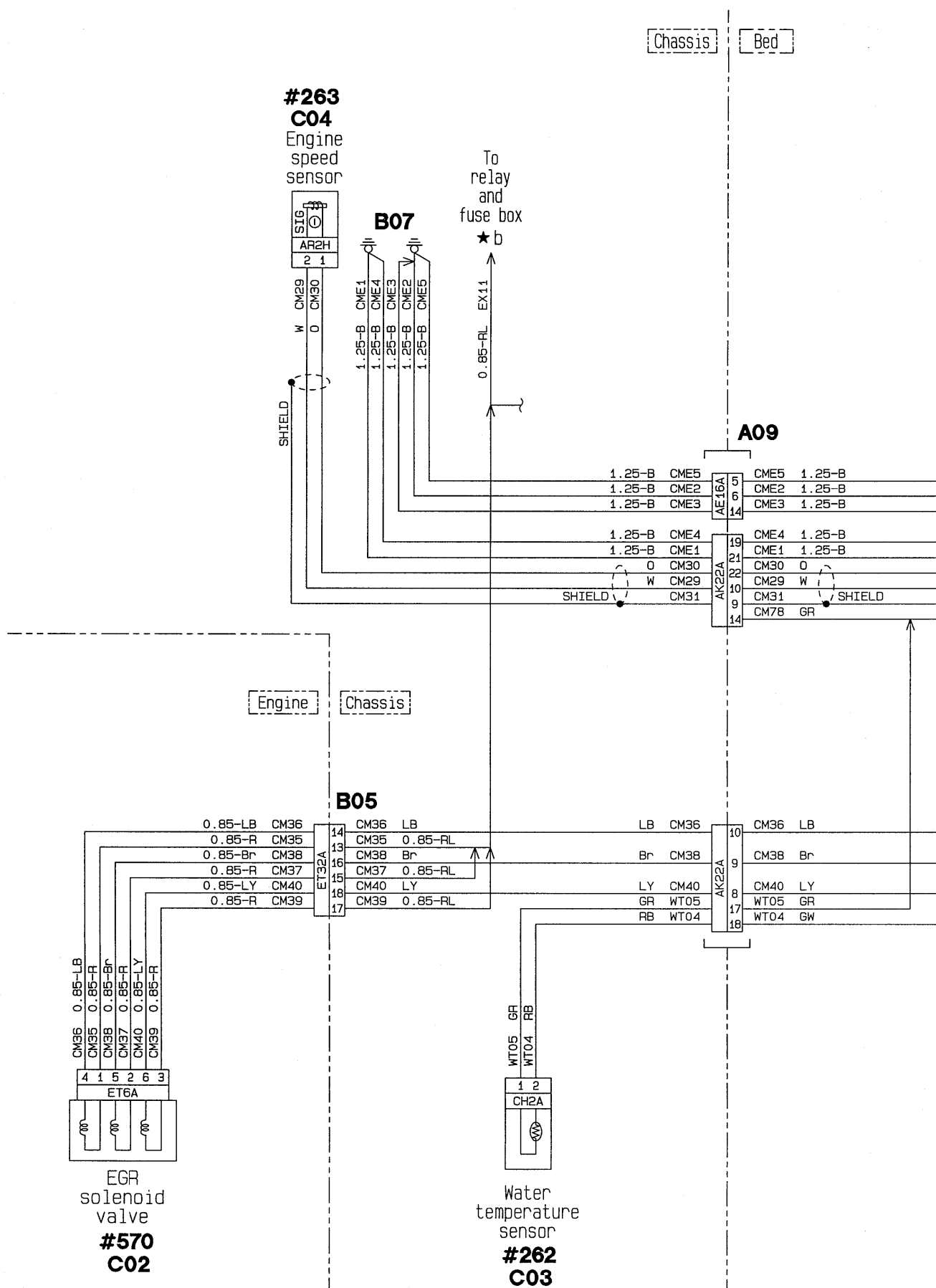
No relevant parts in a missing number

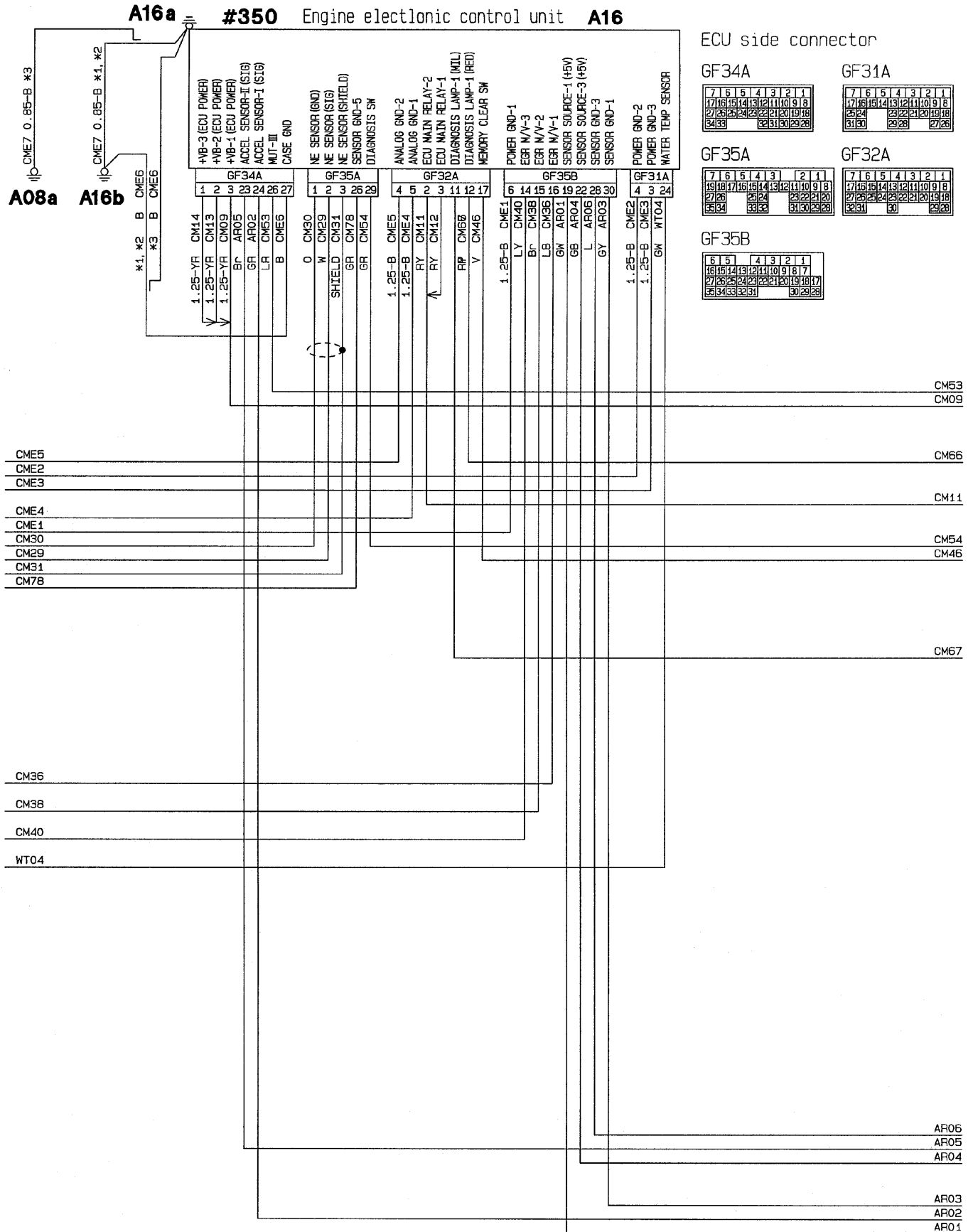
C01 Boost pressure sensor
 C02 EGR solenoid valve
 C03 Water temperature sensor
 (Connects to engine electronic control unit)
 C04 Engine speed sensor
 C05 Starter

C06 Fuel temperature sensor (IN)
 C07 Transmission neutral switch

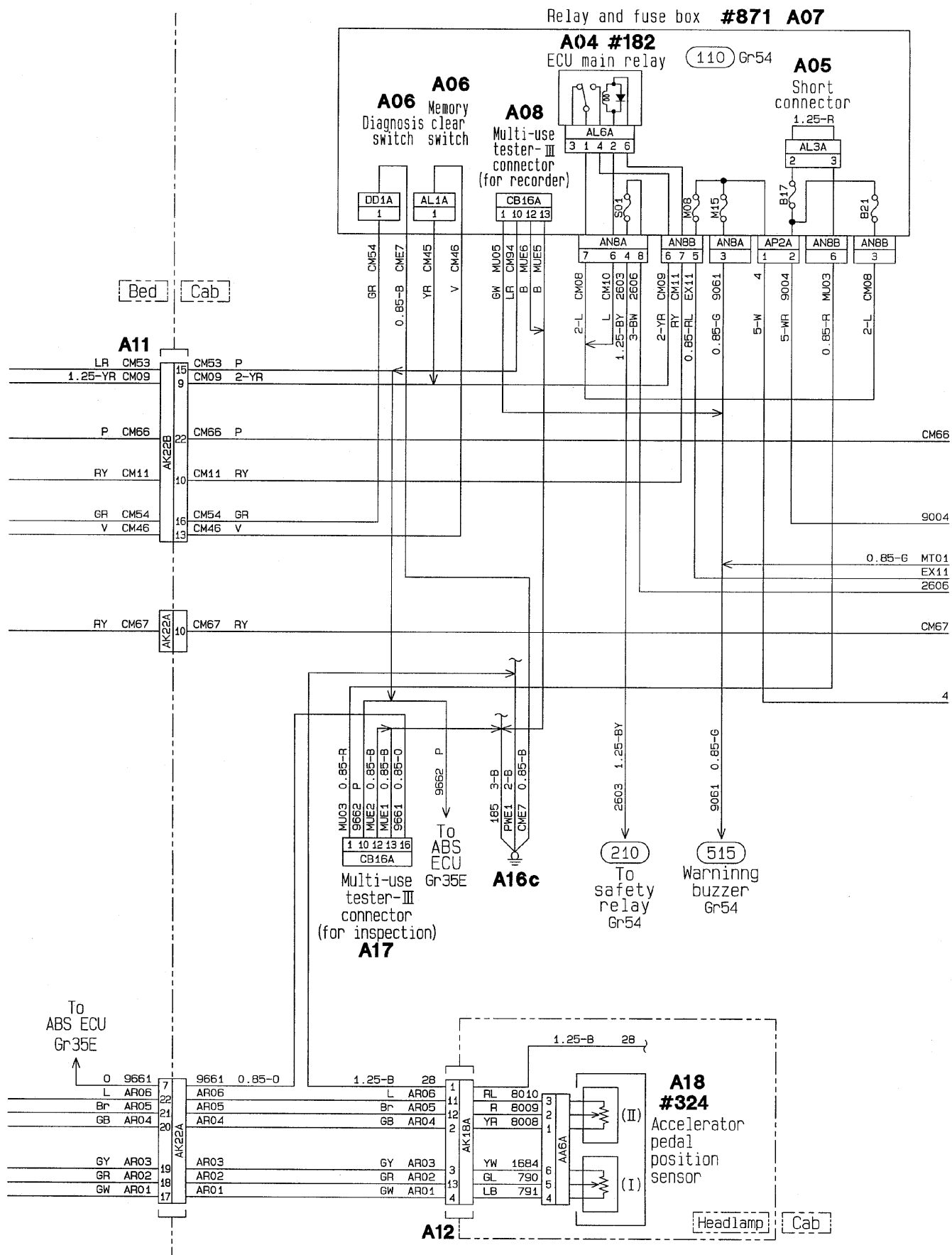
EGR : Exhaust gas recirculation

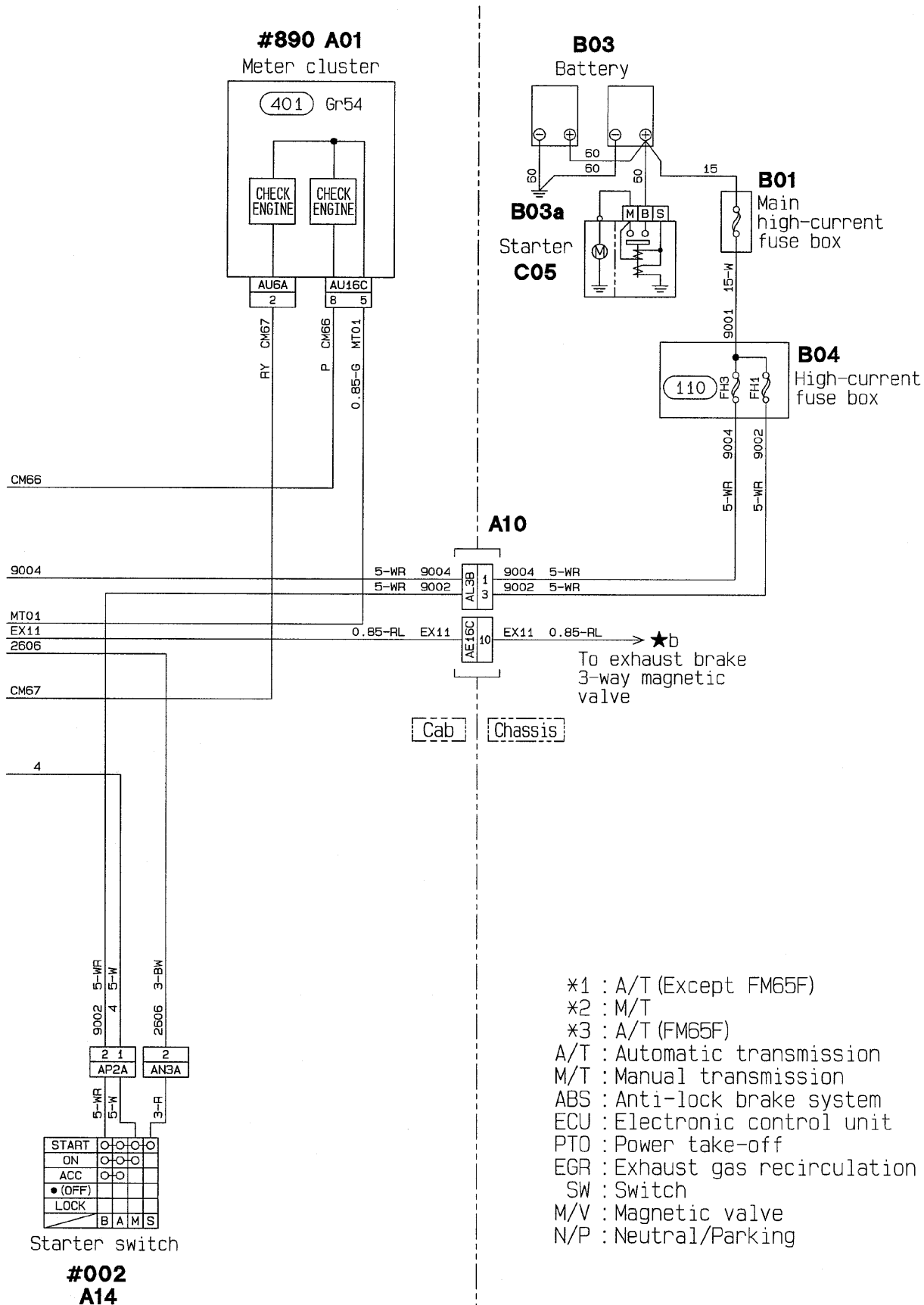
ELECTRIC CIRCUIT DIAGRAM



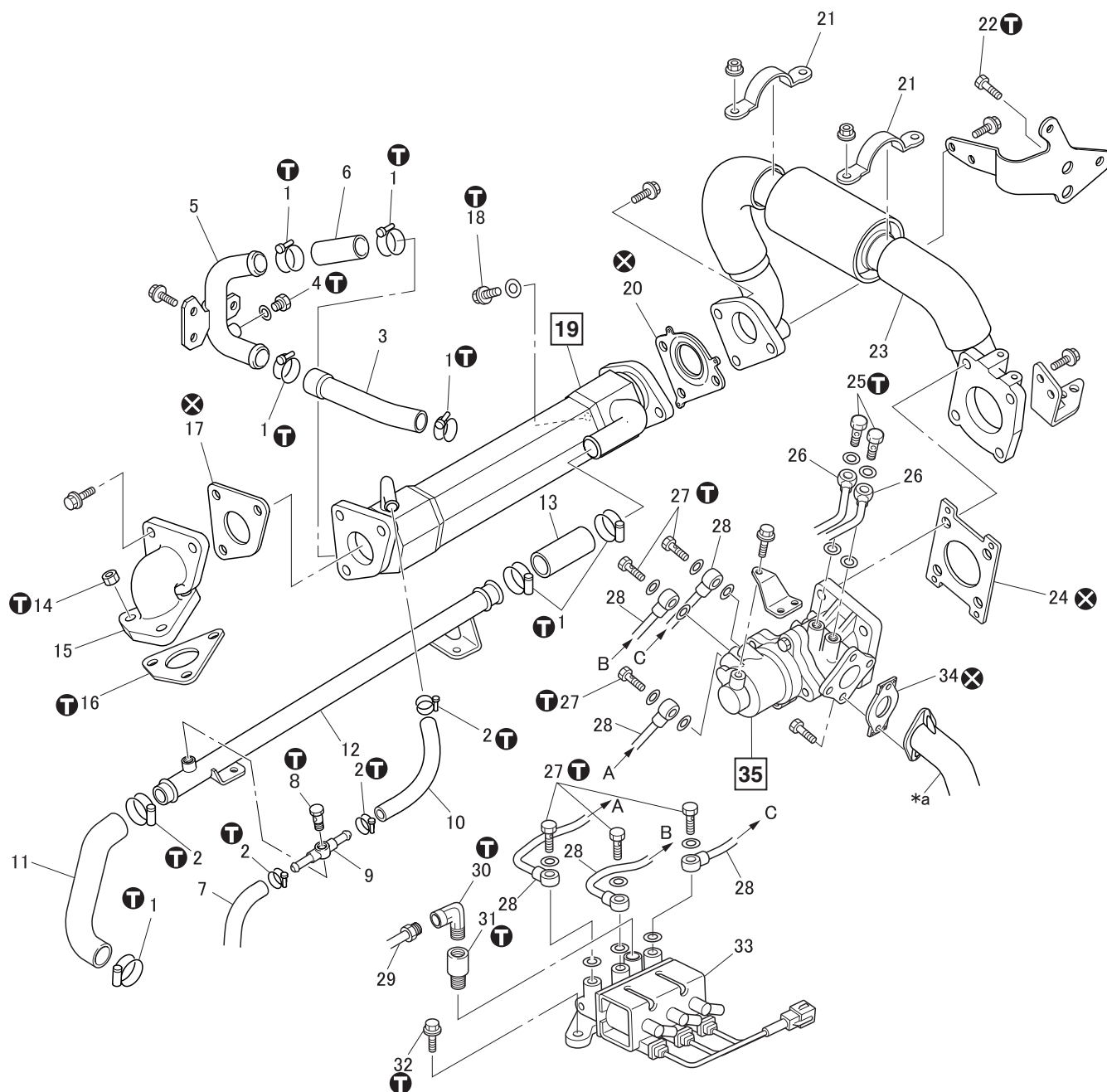


ELECTRIC CIRCUIT DIAGRAM





**EXHAUST GAS RECIRCULATION VALVE, EXHAUST GAS RECIRCULATION SOLENOID VALVE,
EXHAUST GAS RECIRCULATION PIPE, EXHAUST GAS RECIRCULATION COOLER**



● Removal sequence

1	Clamp	16	Gasket	31	Connector
2	Clamp	17	Gasket	32	Bolt
3	Water hose	18	Dram plug	33	Exhaust gas recirculation solenoid valve
4	Drain plug	19	Exhaust gas recirculation cooler	34	Gascket
5	Exhaust gas recirculation cooler water pipe	20	Gasket	35	Exhaust gas recirculation valve
6	Water hose	21	Exhaust gas recirculation upper pipe clamp	*a:	Exhaust gas recirculation adapter
7	Water hose	22	Bolt	ⓧ:	Non-reusable parts
8	Eye bolt	23	Exhaust gas recirculation pipe	Arrows A, B and C indicate points to or from which pipes are connected.	
9	Joint pipe	24	Gascket		
10	Water hose	25	Eye bolt		
11	Water hose	26	Exhaust gas recirculation valve water outlet pipe		
12	Exhaust gas recirculation cooler water pipe	27	Eye bolt		
13	Water hose	28	Exhaust gas recirculation air pipe		
14	Nut	29	Air pipe		
15	Exhaust gas recirculation adapter	30	Connector		

● Installation sequence

Follow the removal sequence in reverse.

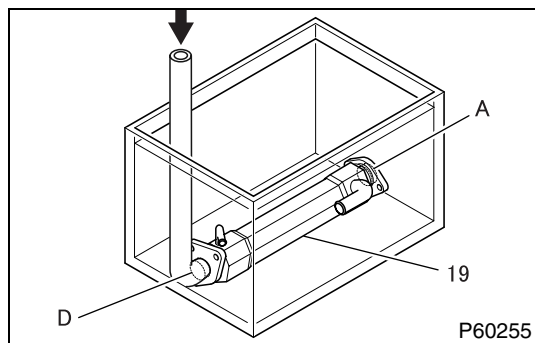
① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Part to be tightened	Tightening torque	Remarks
1	Clamp (mounting of water hose)	5.9 to 6.9 {4.3 to 5.1, 0.6 to 0.7}	—
2	Clamp (mounting of water hose)	3.9 {2.9, 0.4}	—
4	Drain plug	29 {22, 3.0}	—
8	Eye bolt (mounting of joint pipe)	25 {18, 2.5}	—
14	Nut (mounting of exhaust gas recirculation adapter)	58 {43, 5.9}	—
18	Drain plug	29 {22, 3.0}	—
22	Bolt (mounting of exhaust gas recirculation pipe)	46 to 54 {34 to 40, 4.7 to 5.5}	—
25	Eye bolt (mounting of exhaust gas recirculation valve water outlet pipe)	39 {29, 4.0}	—
27	Eye bolt (mounting of exhaust gas recirculation air pipe)	25 {18, 2.5}	—
30	Connector (mounting of air pipe)	15 to 29 {11 to 22, 1.5 to 3.0}	—
31	Connector (mounting of air pipe)	15 to 29 {11 to 22, 1.5 to 3.0}	—
32	Bolt (mounting of exhaust gas recirculation solenoid valve)	15 to 29 {11 to 22, 1.5 to 3.0}	—

EXHAUST GAS RECIRCULATION VALVE, EXHAUST GAS RECIRCULATION SOLENOID VALVE, EXHAUST GAS RECIRCULATION PIPE, EXHAUST GAS RECIRCULATION COOLER

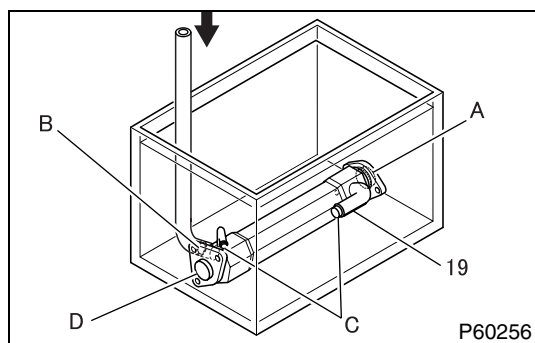
◆ Service procedure



19 Inspection of exhaust gas recirculation cooler

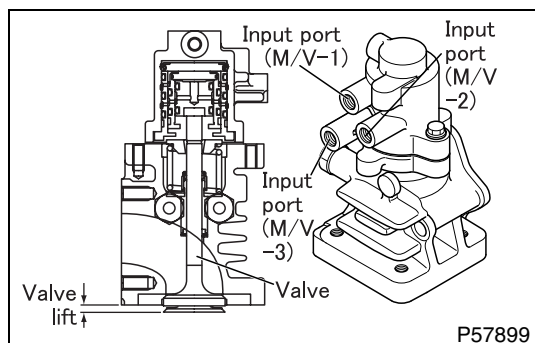
Exhaust gas passage side

- Fit a cover over the exhaust gas outlet A of the exhaust gas recirculation cooler 19, and connect a hose to the exhaust gas inlet D. Then, submerge the exhaust gas recirculation cooler in a container of water. Make sure the coolant passage is full of water.
- Apply air pressure of 390 kPa {57 psi, 4 kgf/cm²} through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler 19.
- If there is any abnormality, replace the exhaust gas recirculation cooler 19.



Coolant passage side

- Fit covers over the exhaust gas recirculation cooler A's exhaust gas inlet D, exhaust gas outlet A, and coolant outlet C, and connect a hose to the coolant inlet B. Then, submerge the exhaust gas recirculation cooler 19 in a container of water.
- Apply air pressure of 294 kPa {43 psi, 3 kgf/cm²} through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler 19.
- If there is any abnormality, replace the exhaust gas recirculation cooler 19.



35 Inspection of exhaust gas recirculation valve

Perform the following inspection. If there is any abnormality, replace the exhaust gas recirculation valve.

- Apply pressure of 637 to 932 kPa {92 to 135 psi, 6.5 to 9.5 kgf/cm²} to the ports in accordance with the table below and measure the valve lift E.

Operating stage	Input port (M/V)			Valve lift (mm {in.})
	1	2	3	
0	OFF	OFF	OFF	0 {0}
1	ON	OFF	OFF	1.3 ± 0.3 {0.05 ± 0.012}
2	OFF	ON	OFF	2.6 ± 0.3 {0.10 ± 0.012}
3	ON	ON	OFF	4.6 ± 0.3 {0.18 ± 0.012}
4	OFF	OFF	ON	5.7 ± 0.4 {0.22 ± 0.016}
5	ON	OFF	ON	7.7 ± 0.4 {0.30 ± 0.016}
6	OFF	ON	ON	9.0 ± 0.3 {0.35 ± 0.012}
7	ON	ON	ON	11.0 ± 0.3 {0.43 ± 0.012}

MEMO



● Removal sequence

- | | |
|---------------------|----------------------|
| 1 Clamp | 7 Oil hose stay |
| 2 Pipe | 8 PCV valve assembly |
| 3 Breather hose | 9 Cap |
| 4 Breather hose | 10 O-ring |
| 5 Oil hose | 11 Element |
| 6 PCV valve bracket | 12 PCV body |

- *a:** Rocker cover
***b:** Breather hose
⊗: Non-reusable parts
 PCV: Positive Crankcase Ventilation

● Installation sequence

Follow the removal sequence in reverse.

① Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Part to be tightened	Tightening torque	Remarks
1	Clamp	4.9 {3.6, 0.5}	—

** Lubricant and/or sealant**

Location	Point of application	Specified lubricant and/or sealant	Quantity
10	O-ring	Engine oil	As required



Group 21

Clutch

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	21- 2
STRUCTURE AND OPERATION	21- 2
TROUBLESHOOTING	21- 7
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Clutch Fluid (Brake Fluid) Replacement and Air Bleeding < Clutch Power Cylinder >	21- 8
• Clutch Fluid (Brake Fluid) Replacement and Air Bleeding < Clutch Booster >	21-10
• Inspection of Function < Clutch Booster >	21-12
• Clutch Pedal Free Play < Clutch Power Cylinder >	21-13
• Clutch Pedal Free Play < Clutch Booster >	21-14
CLUTCH PEDAL < M060S6, M070S6 >	21-16
CLUTCH PEDAL < EATON FS-8209 >	21-20
CLUTCH MASTER CYLINDER	21-24
CLUTCH POWER CYLINDER < M060S6, M070S6 >	21-26
CLUTCH BOOSTER < EATON FS-8209 >	21-28
WORK BEFORE REMOVAL AND INSTALLATION OF CLUTCH BODY	
CLUTCH BODY	21-38
CLUTCH CONTROL < M060S6, M070S6 >	21-54
CLUTCH CONTROL < EATON FS-8209 >	21-56

SPECIFICATIONS/STRUCTURE AND OPERATION

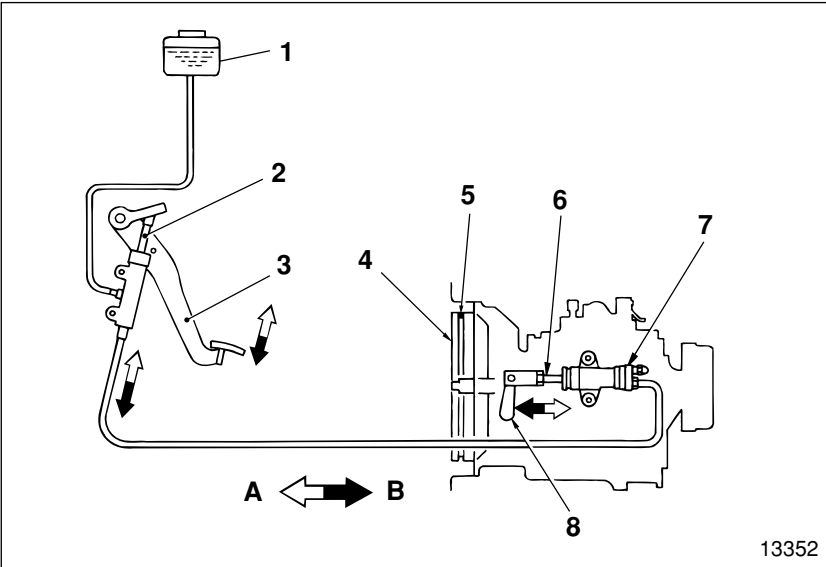
SPECIFICATIONS

Item		Specifications	
Clutch	Model	C7M38 < M060S6, M070S6 >	C7M38 < EATON FS-8209 >
Drive type		Strap drive	
Clutch disc	Type	Dry, single plate type	
Pressure plate	Type	Coil spring type	
Control system		Hydraulic pressure type	
Clutch master cylinder	Manufacturer	NABCO	
Clutch power cylinder	Manufacturer	NABCO	—
Clutch booster	Manufacturer	—	BOSCH BRAKING SYSTEMS

STRUCTURE AND OPERATION

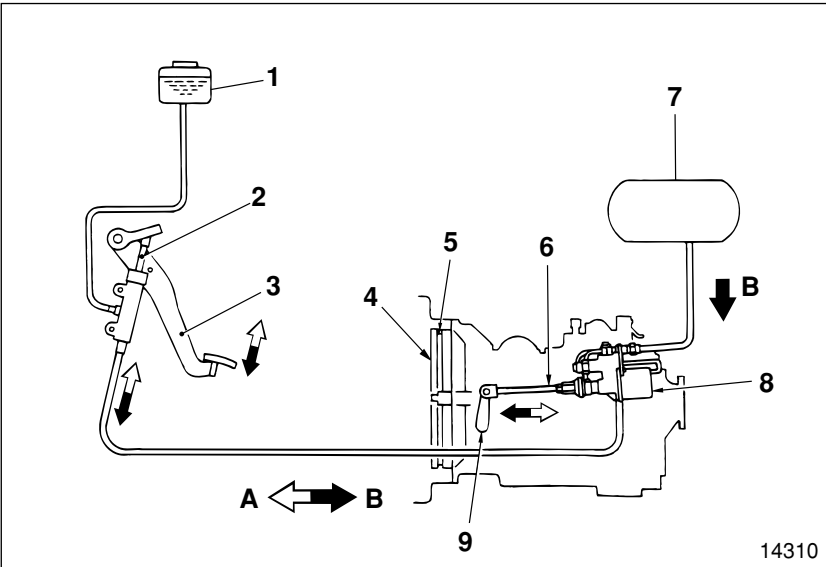
Clutch Control

< M060S6, M070S6 >



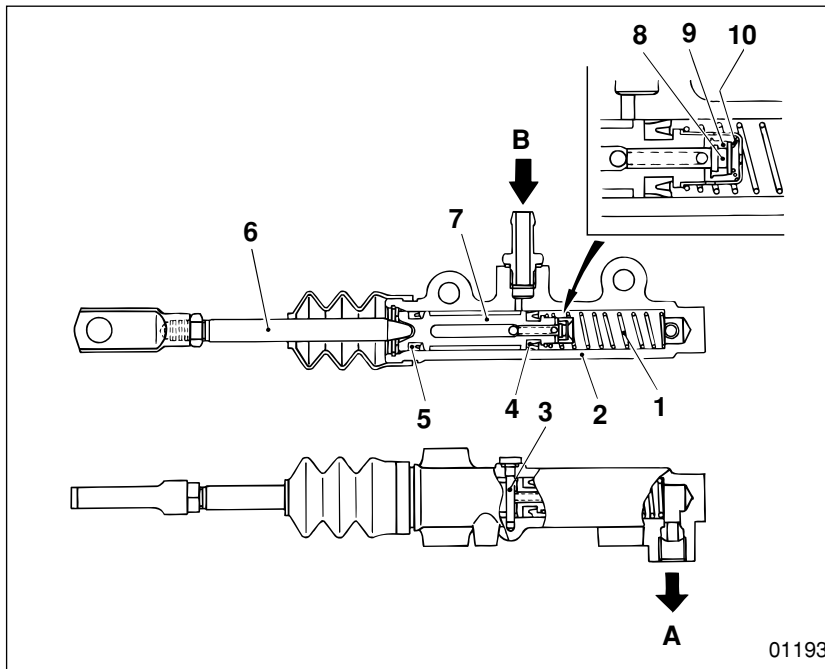
- 1 Fluid tank
 - 2 Clutch master cylinder
 - 3 Clutch pedal
 - 4 Flywheel
 - 5 Clutch disc
 - 6 Push rod
 - 7 Clutch power cylinder
 - 8 Release fork shaft
- A : Power transmission
B : Cutting off power transmission

< EATON FS-8209 >



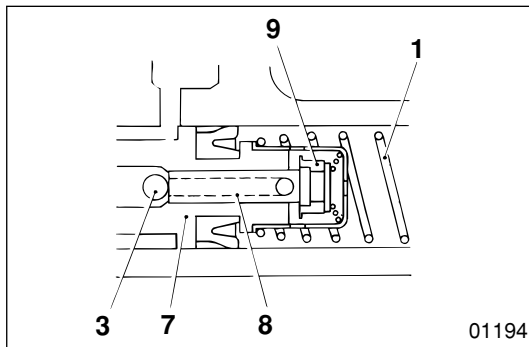
- 1 Fluid tank
 - 2 Clutch master cylinder
 - 3 Clutch pedal
 - 4 Flywheel
 - 5 Clutch disc
 - 6 Push rod
 - 7 Air tank
 - 8 Clutch booster
 - 9 Release fork shaft
- A : Power transmission
B : Cutting off power transmission

Clutch Master Cylinder



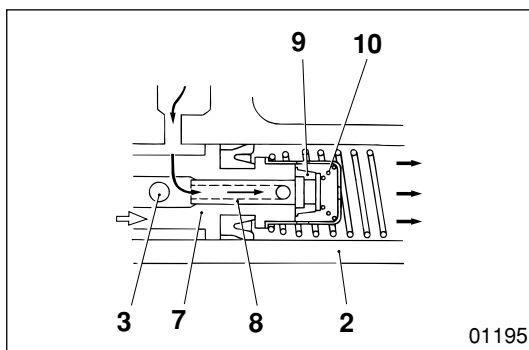
- 1 Return spring
- 2 Cylinder
- 3 Supply valve stopper
- 4 Primary cup
- 5 Secondary cup
- 6 Push rod
- 7 Piston
- 8 Supply valve rod
- 9 Supply valve
- 10 Supply valve spring

A : To clutch power cylinder
B : From fluid tank



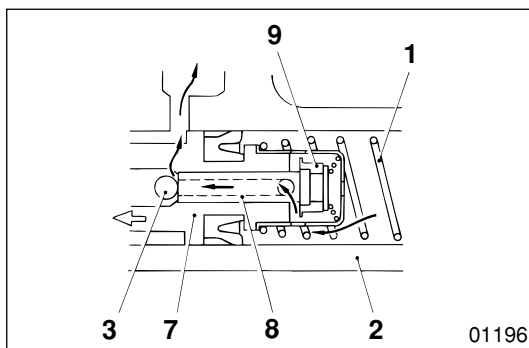
Before clutch pedal is depressed

- As piston 7 is pressed in the direction of push rod 6 by return spring 1, supply valve rod 8 rests at supply valve stopper 3, and supply valve 9 remains open.
- This opens the passage between the fluid tank and the clutch.



When clutch pedal is depressed

- As push rod 6 pushes piston 7, supply valve rod 8 separates from supply valve stopper 3. At the same time, supply valve spring 10 closes supply valve 9.
- As piston 7 is pressed further, hydraulic pressure is generated inside cylinder 2 to actuate the clutch power cylinder.
- Fluid is supplied in proportion to the amount of movement of piston 7.

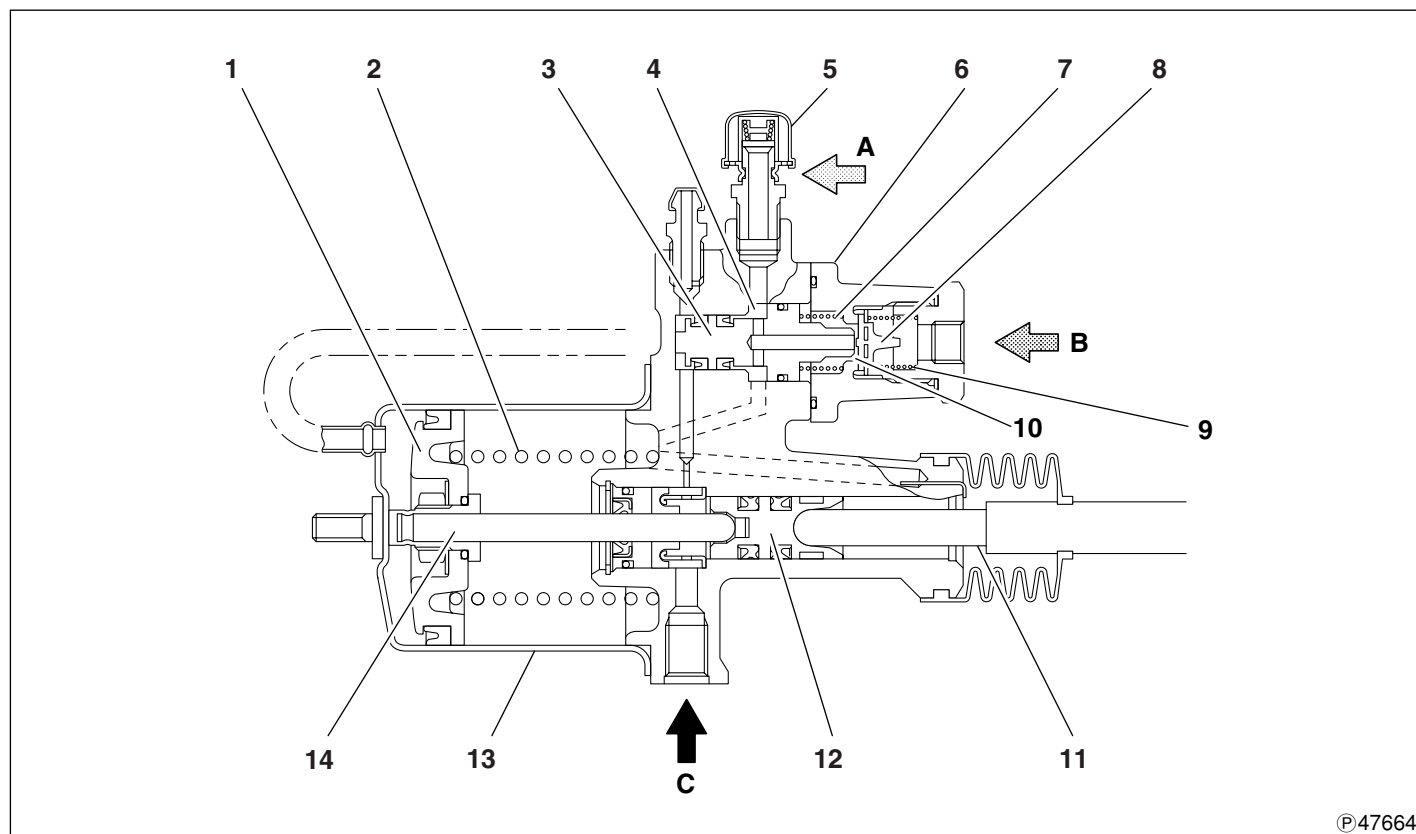


When clutch pedal is released

- The combined repercussive forces of the hydraulic pressure inside cylinder 2 and return spring 1 push piston 7 back, causing supply valve rod 8 to hit supply valve stopper 3, opening supply valve 9.
- Fluid from the clutch power cylinder returns to the fluid tank, and hydraulic pressure ceases to exist.

STRUCTURE AND OPERATION

< EATON FS-8209 >

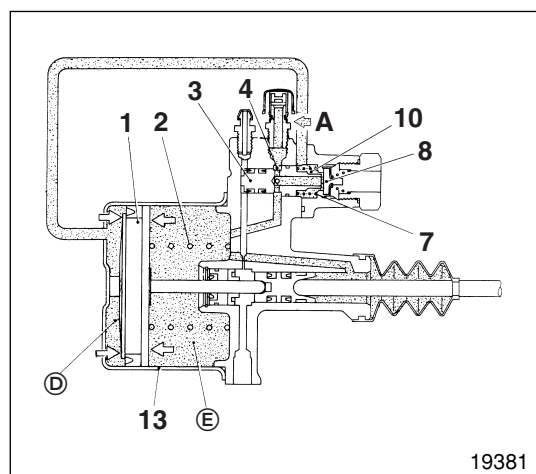


©47664

- 1 Piston plate
- 2 Spring
- 3 Relay piston
- 4 Air chamber
- 5 Exhaust cover
- 6 Upper valve body
- 7 Spring

- 8 Poppet valve
- 9 Spring
- 10 Control chamber
- 11 Push rod
- 12 Hydraulic piston
- 13 Cylinder shell
- 14 Push rod

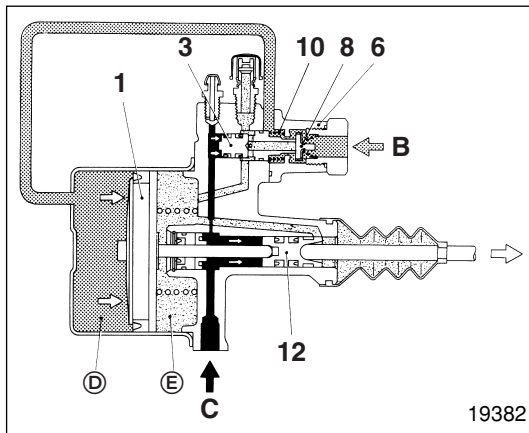
- A : Atmospheric pressure
- B : Pressure air from air tank
- C : Pressure fluid from clutch master cylinder



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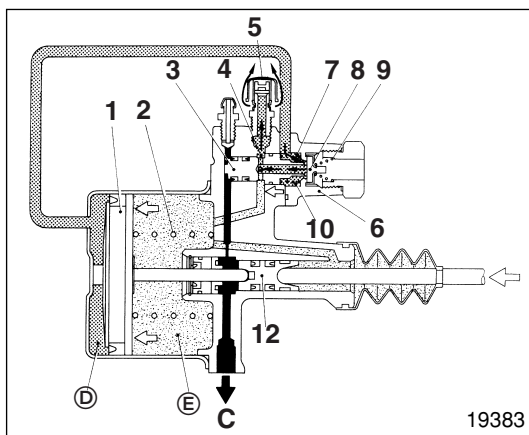
When not in operation

- Air chamber 4 and control chamber 10 are both at atmospheric pressure A.
- Relay piston 3 is pressed to the left by the force of spring 7, leaving a clearance between the relay piston and poppet valve 8.
- Through the clearance, control chamber 10 is open to chamber ① of cylinder shell 13. This means that chamber ① is also at atmospheric pressure A.
- Also, chamber ② of cylinder shell 13 is open to air chamber 4 and thus is also at atmospheric pressure A. This means that there is no pressure difference between chambers ① and ② of the cylinder shell.
- As a result, piston plate 1 remains pressed to the left by the combined force of spring 2 and the clutch pressure spring.



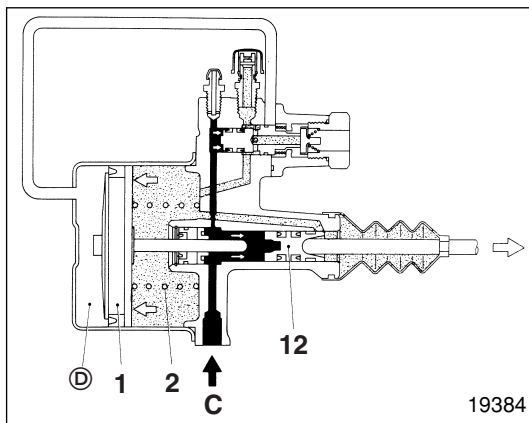
When clutch pedal is depressed

- Pressure fluid **C** from the clutch master cylinder is applied onto hydraulic piston **12** and relay piston **3**.
- Pressure fluid **C** pushes relay piston **3** to the right, causing it to come into contact with poppet valve **8**.
- As the clearance between the relay piston and poppet valve is now closed, the passage from control chamber **10** to chamber **D** is also closed.
- Relay piston **3** pushes poppet valve **8** further to the right, creating a clearance between the valve and upper valve body **6**.
- This allows pressure air **B** to flow through the clearance and into chamber **D** creating a pressure difference between chambers **D** and **E**.
- The higher pressure in chamber **D** pushes piston plate **1** to the right. Also, pressure fluid **C** is acting on hydraulic piston **12**. These forces combine to help the operator to depress the clutch pedal. As a result, smaller force is required by the operator to depress the clutch pedal.



When clutch pedal is released

- Pressure fluid **C** no longer acts on hydraulic piston **12** or relay piston **3**.
- As a result, relay piston **3** and poppet valve **8** are pushed back to the left by the forces of springs **7** and **9**.
- Poppet valve **8** comes into contact with upper valve body **6**, closing the air passage to chamber **D**. At the same time, clearance is created between the poppet valve and relay piston **3**.
- Through the clearance, air chamber **4** is now connected with control chamber **10** and chamber **D**, allowing pressure air in chamber **D** to be vented through exhaust cover **5** into the atmosphere. This equalizes pressure in chambers **D** and **E**. As a result, piston plate **1** is pushed back to the non-active position by spring **2** and the clutch pressure spring.

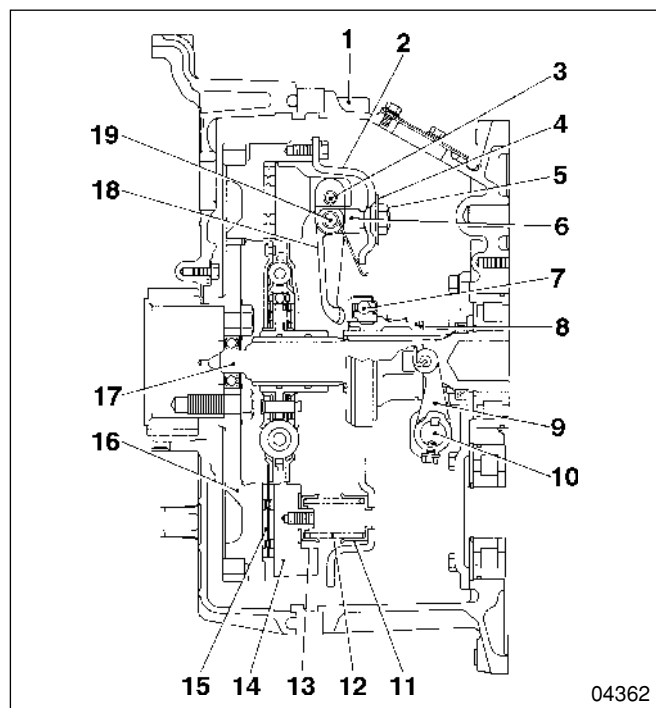


When air system is faulty

- When air tank pressure is not available due to a faulty air system, pressure air is no longer supplied to chamber **D**.
- Piston plate **1** is pushed back to the left by the force of spring **2**.
- The operator is now only aided by pressure fluid **C** acting on hydraulic piston **12** when depressing the clutch pedal.

STRUCTURE AND OPERATION

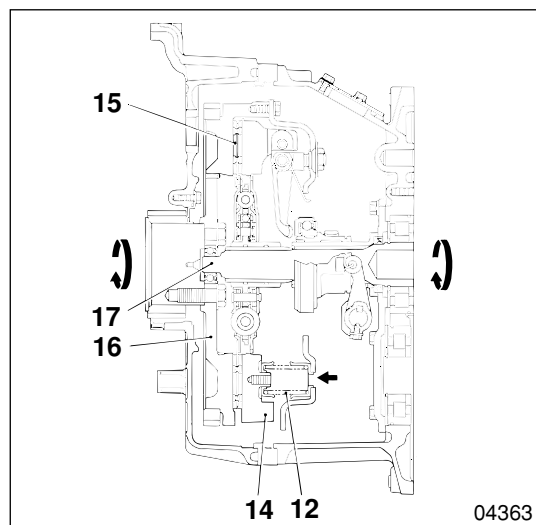
Clutch



- 1 Clutch housing
- 2 Clutch cover
- 3 Release lever pin
- 4 Lock plate
- 5 Support nut
- 6 Lever support
- 7 Release bearing
- 8 Clutch shifter
- 9 Release fork
- 10 Release fork shaft
- 11 Pressure spring seat
- 12 Pressure spring
- 13 Pressure spring seat
- 14 Pressure plate
- 15 Clutch disc
- 16 Flywheel
- 17 Drive pinion
- 18 Release lever
- 19 Lever support pin

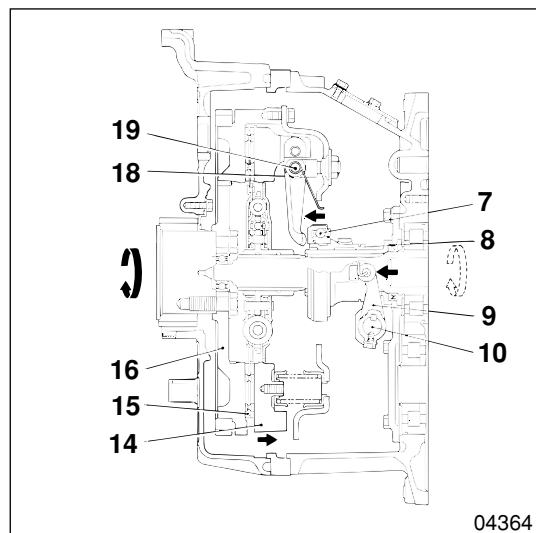
When clutch pedal is released

- Pressure plate **14**, activated by pressure spring **12**, forces clutch disc **15** against flywheel **16**.
- Clutch disc **15** forced against flywheel **16** runs together with the flywheel and transmits power from the engine to transmission drive pinion **17**.



When clutch pedal is depressed

- Hydraulic pressure generated within the clutch master cylinder activates the clutch power cylinder, or clutch booster. Release fork shaft **10** actuates release fork **9** and pushes release bearing **7** forward together with clutch shifter **8**, pushing release lever **18**.
- Release lever **18**, with lever support pin **19** acting as the fulcrum, retracts pressure plate **14**, which opens a clearance between clutch disc **15** and flywheel **16**, cutting off power transmission from the engine.



Symptoms								Remarks
		Clutch disengaged but drags	Clutch slips	Clutch does not engage smoothly	Clutch makes noise on disengagement	Clutch makes noise on engagement	Judder when vehicle starting	
Possible causes								
Pressure plate and lever assembly	Release bearing faulty	☐	☐	☐	☐			
	Release lever heights uneven	☐		☐			☐	
	Pressure plate warped or faulty	☐	☐	☐			☐	
	Pressure spring fatigued		☐	☐				
	Loose strap bolts		☐	☐			☐	
	Strap plate bent				☐			
Clutch disc	Disc deformed	☐		☐		☐	☐	
	Disc rivets loose		☐	☐			☐	
	Disc torsion spring fatigued or damaged					☐		
	Spline worn	☐		☐	☐			
	Spline area rusted	☐		☐				
	Facing worn		☐					
	Facing surface hardened		☐	☐			☐	
	Facing oily or greasy		☐	☐			☐	
Clutch pedal	Pedal free play insufficient		☐					
	Pedal free play excessive	☐						
	Pedal stroke insufficient	☐						
	Return spring fatigued			☐				
	Pedal friction surfaces faulty			☐				
Clutch master cylinder	Piston and piston cup sliding movement faulty	☐	☐	☐				
	Spring fatigued	☐	☐	☐				
	Brake fluid passage port clogged	☐	☐	☐				
Clutch power cylinder	Return spring fatigued	☐	☐	☐				
	Piston and piston cup sliding movement faulty	☐	☐	☐				
	Brake fluid passage port clogged	☐	☐	☐				
Clutch booster	Piston and piston cup sliding movement faulty	☐	☐	☐				
	Spring fatigued	☐	☐	☐				
	Brake fluid port clogged	☐	☐	☐				
Clutch control	Release bearing faulty	☐	☐	☐	☐			
	Clutch shifter sliding movement faulty	☐	☐	☐				
	Clutch shifter lubrication insufficient	☐	☐	☐				
	Clutch release fork deformed	☐	☐	☐				
Transmission drive pinion spline worn		☐		☐		☐		 Gr 22
Engine idling speed too slow						☐		 Gr 13
Engine mounting fatigued				☐			☐	 Gr 11
Flywheel warped, deformed or worn forming steps		☐	☐	☐				 Gr 11
Flywheel pilot bearing faulty		☐						
Air mixed in clutch hydraulic system		☐						
Clutch hydraulic system leaking		☐						

ON-VEHICLE INSPECTION AND ADJUSTMENT

Clutch Fluid (Brake Fluid) Replacement and Air Bleeding < Clutch Power Cylinder >

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

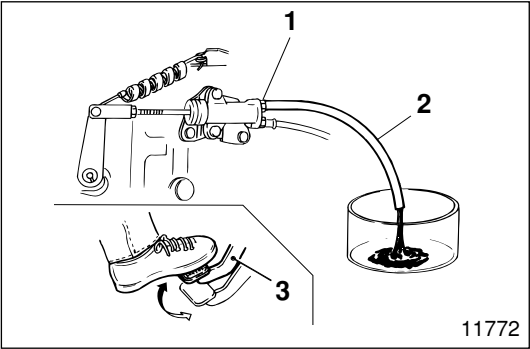
Location	Parts to be tightened	Tightening torque	Remarks
1	Air bleeder	25 to 34 {18 to 25, 2.5 to 3.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Fluid tank	Brake fluid (SAE J1703 or FMVSS No.116 DOT3)	As required

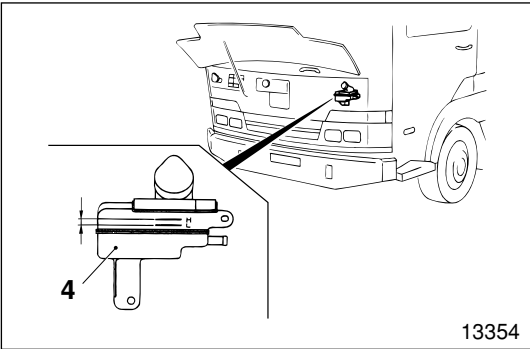
CAUTION

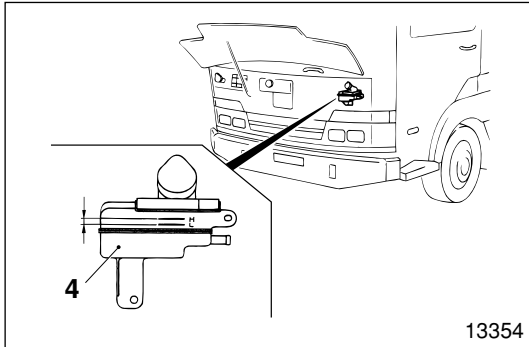
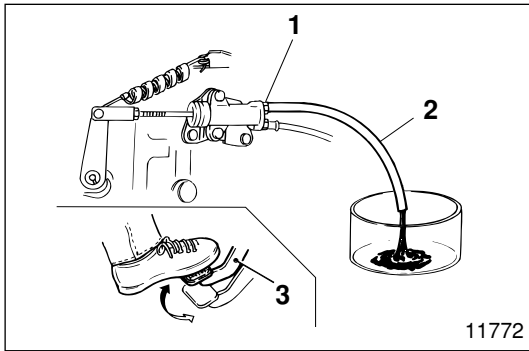
- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.
- You must use new brake fluid (SAE J1703 or FMVSS No. 116 DOT3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system to swell, resulting in faulty clutch operation.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will cause faulty clutch operation.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oils.



(1) Replacement of brake fluid

- Attach vinyl pipe 2 to air bleeder 1 of the clutch power cylinder.
- Loosen air bleeder 1 and depress clutch pedal 3 several times to drain brake fluid completely.
- Supply new brake fluid to the “H” level of fluid tank 4. Depress clutch pedal 3 repeatedly until the old brake fluid discharged from vinyl pipe 2 is replaced by the new brake fluid.





(2) Air bleeding of clutch system

NOTE

Carry out this operation maintaining the brake fluid level in fluid tank 4 between “H” and “L”.

- Attach vinyl pipe 2 to air bleeder 1 of the clutch power cylinder as in the replacement procedure.
- Fill fluid tank 4 with brake fluid, and loosen air bleeder 1 of the clutch power cylinder, then depress clutch pedal 3 continuously.
- Keep depressing clutch pedal 3, and tighten air bleeder 1 when air is bled completely.
- Depress clutch pedal 3 several times again, then keep it depressed at its fullest extent.
- With clutch pedal 3 depressed, loosen air bleeder 1 to drain brake fluid containing air. Release the pedal after tightening the air bleeder.
- Repeat this operation until air is no longer present in the fluid being drained.
- When this operation is completed, tighten air bleeder 1 at specified torque.
- Check that brake fluid is at the “H” level of fluid tank 4, and supply new brake fluid if necessary.
- Check for brake fluid leakage from each of the parts with clutch pedal 3 depressed.

ON-VEHICLE INSPECTION AND ADJUSTMENT

Clutch Fluid (Brake Fluid) Replacement and Air Bleeding < Clutch Booster >

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

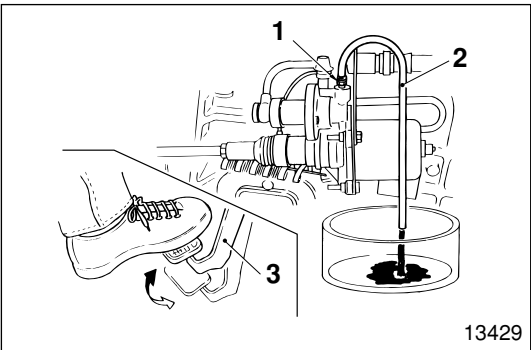
Location	Parts to be tightened	Tightening torque	Remarks
1	Air bleeder	6.9 to 13 {5.1 to 9.4, 0.7 to 1.3}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Fluid tank	Brake fluid (SAE J1703 or FMVSS No.116 DOT3)	As required

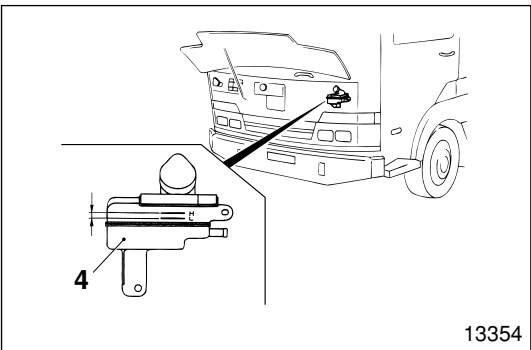
CAUTION

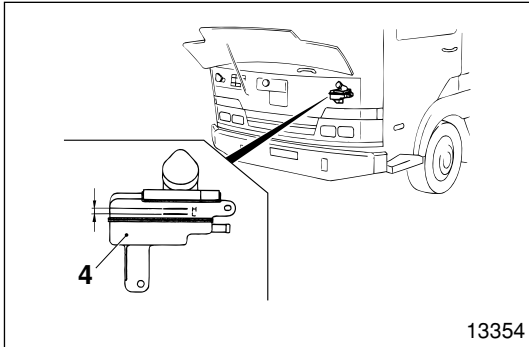
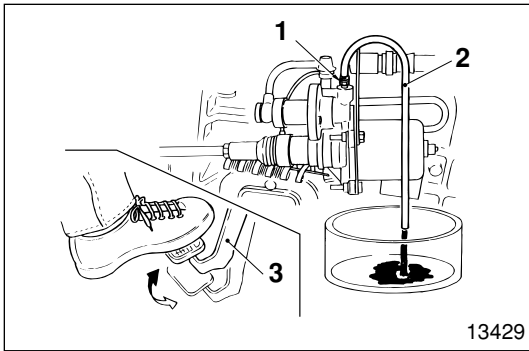
- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.
- You must use new brake fluid (SAE J1703 or FMVSS No. 116 DOT3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system to swell, resulting in faulty clutch operation.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will cause faulty clutch operation.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oils.



(1) Replacement of brake fluid

- Attach vinyl pipe 2 to air bleeder 1 of the clutch booster.
- Loosen air bleeder 1 and depress clutch pedal 3 several times to drain brake fluid completely.
- Supply new brake fluid to the “H” level of fluid tank 4. Depress clutch pedal 3 repeatedly until the old brake fluid discharged from vinyl pipe 2 is replaced by the new brake fluid.





(2) Air bleeding of clutch system

NOTE

Carry out this operation maintaining the brake fluid level in fluid tank 4 between “H” and “L”.

- Attach vinyl pipe 2 to air bleeder 1 of the clutch booster as in the replacement procedure.
- Fill fluid tank 4 with brake fluid, and loosen air bleeder 1 of the clutch booster, then depress clutch pedal 3 continuously.
- Keep depressing clutch pedal 3, and tighten air bleeder 1 when air is bled completely.
- Depress clutch pedal 3 several times again, then keep it depressed at its fullest extent.
- With clutch pedal 3 depressed, loosen air bleeder 1 to drain brake fluid containing air. Release the pedal after tightening the air bleeder.
- Repeat this operation until air is no longer present in the fluid being drained.
- When this operation is completed, tighten air bleeder 1 at specified torque.
- Check that brake fluid is at the “H” level of fluid tank 4, and supply new brake fluid if necessary.
- Check for brake fluid leakage from each of the parts with clutch pedal 3 depressed.

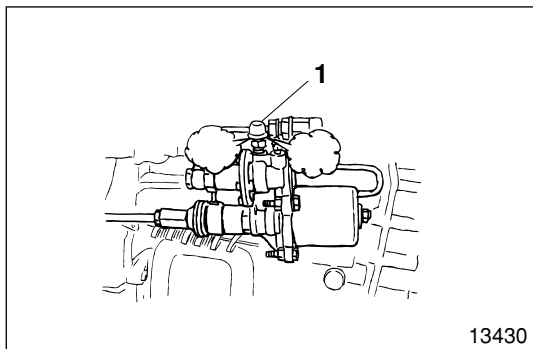
ON-VEHICLE INSPECTION AND ADJUSTMENT

Inspection of Function < Clutch Booster >

- If any abnormality is found in the following inspections, disassemble and service the clutch booster.  P21-28

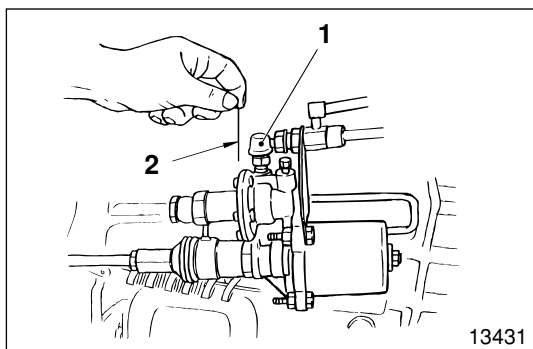
(1) Clutch pedal operating force

- Make sure that the clutch pedal operating force is large when the air pressure is 0 kPa {0 psi, 0 kgf/cm²} and it is small when the air pressure is 590 kPa {85 psi, 6 kgf/cm²} to 785 kPa {85 to 115 psi, 8 kgf/cm²}.



(2) Air discharge

- Depress and then release the clutch pedal. Make sure that air is discharged momentarily when the pedal is released.



(3) Air leakage

- Apply air pressure of 590 to 785 kPa {85 to 115 psi, 6 to 8 kgf/cm²} and hang thread 2 in front of exhaust cover 1. Make sure that the thread is not blown upward when depressing and releasing the clutch pedal. If the thread is blown upward, it indicates that air is leaking from the poppet valve.

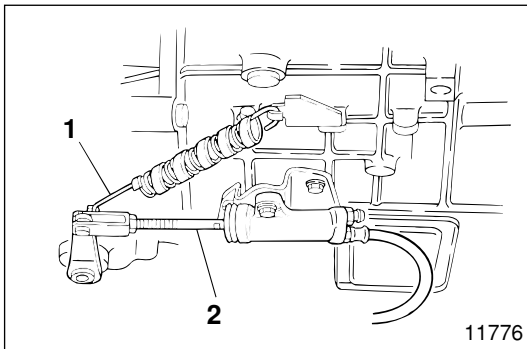
Clutch Pedal Free Play < Clutch Power Cylinder >

Service standards

Unit : mm {in.}

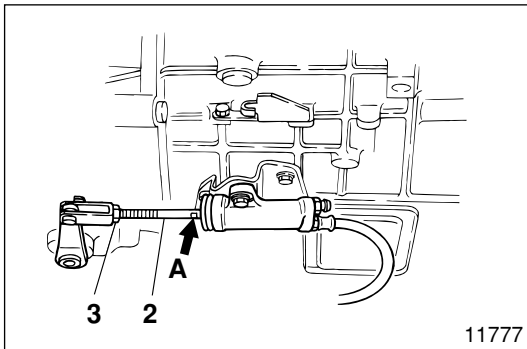
Location	Maintenance item	Standard value	Limit	Remedy
2	Push rod stroke	3.8 {0.15}	—	Adjust or replace
4	Clutch pedal free play	32 to 44 {1.25 to 1.73}	—	Adjust or replace

Inspect and adjust the free play of the clutch pedal, by noting the stroke of the clutch power cylinder push rod, after the clutch pedal has been correctly adjusted.



[Inspection]

- Bleed air from the clutch system. P21-9
- Adjust the clutch pedal. P21-18
- Remove return spring **1** and measure the free travel of push rod **2** by moving it with your hand. If the measured value deviates from the standard value, adjust as follows:

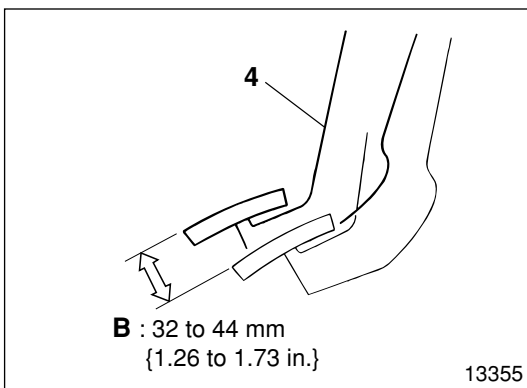


[Adjustment]

- Loosen nut **3** and turn head **A** of push rod **2** to extend the push rod until it stops.
- Then, slacken off head **A** of push rod **2** by the following value and retighten nut **3**.

Amount of slackening off: Approximately three turns

- If push rod **2** does not return by the above amount, replace the clutch disc because it is worn beyond the limit.



[Confirmation]

Push clutch pedal **4** with your hand until you feel a resistance and measure free play **B**.

If the measured value deviates from the standard value, readjust or replace the clutch disc.

ON-VEHICLE INSPECTION AND ADJUSTMENT

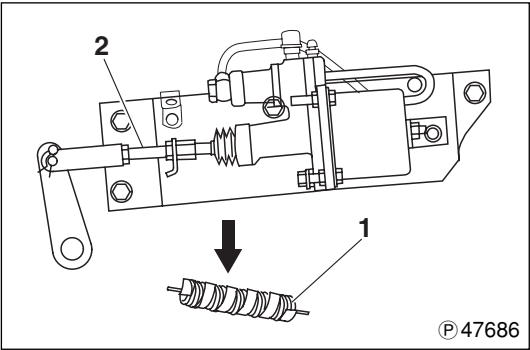
Clutch Pedal Free Play < Clutch Booster >

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Push rod stroke	3.2 {0.13}	—	Adjust or replace
5	Clutch pedal free play	35 to 47 {1.38 to 1.85}	—	Adjust or replace
5	Clutch pedal height from floor with clutch fully dis-engaged	40 or more {1.57 or more}	—	Adjust or replace

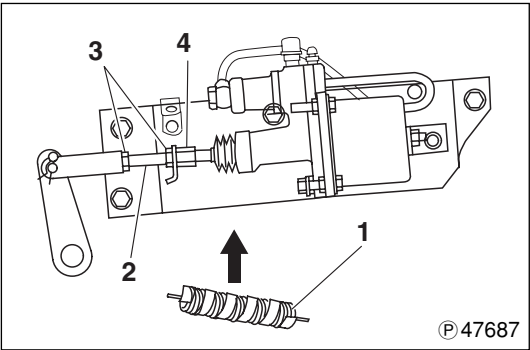
Inspect and adjust the free play of the clutch pedal, by noting the stroke of the clutch booster push rod, after the clutch pedal has been correctly adjusted.



(1) Clutch pedal free play

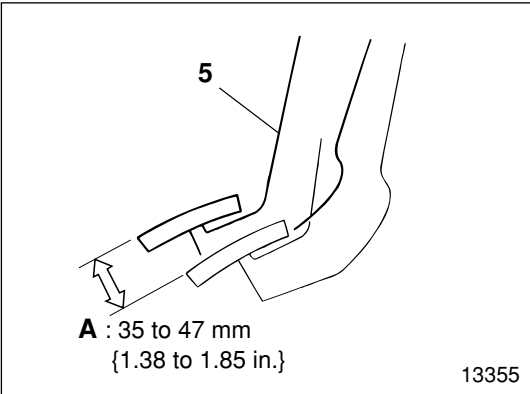
[Inspection]

- Bleed air from the clutch system. [P21-11](#)
- Adjust the clutch pedal. [P21-22](#)
- Remove return spring 1 and measure the free travel of push rod 2 by moving it with your hand. If the measured value deviates from the standard value, adjust as follows:



[Adjustment]

- Loosen nut 3 and turn head 4 of push rod 2 to extend the push rod until it stops.
- Then, slacken off head 4 of push rod 2 by the following value and retighten nut 3.
Amount of slackening off: Approximately two and three-fifth turns
- If push rod 2 does not return by the above amount, replace the clutch disc because it is worn beyond the limit.

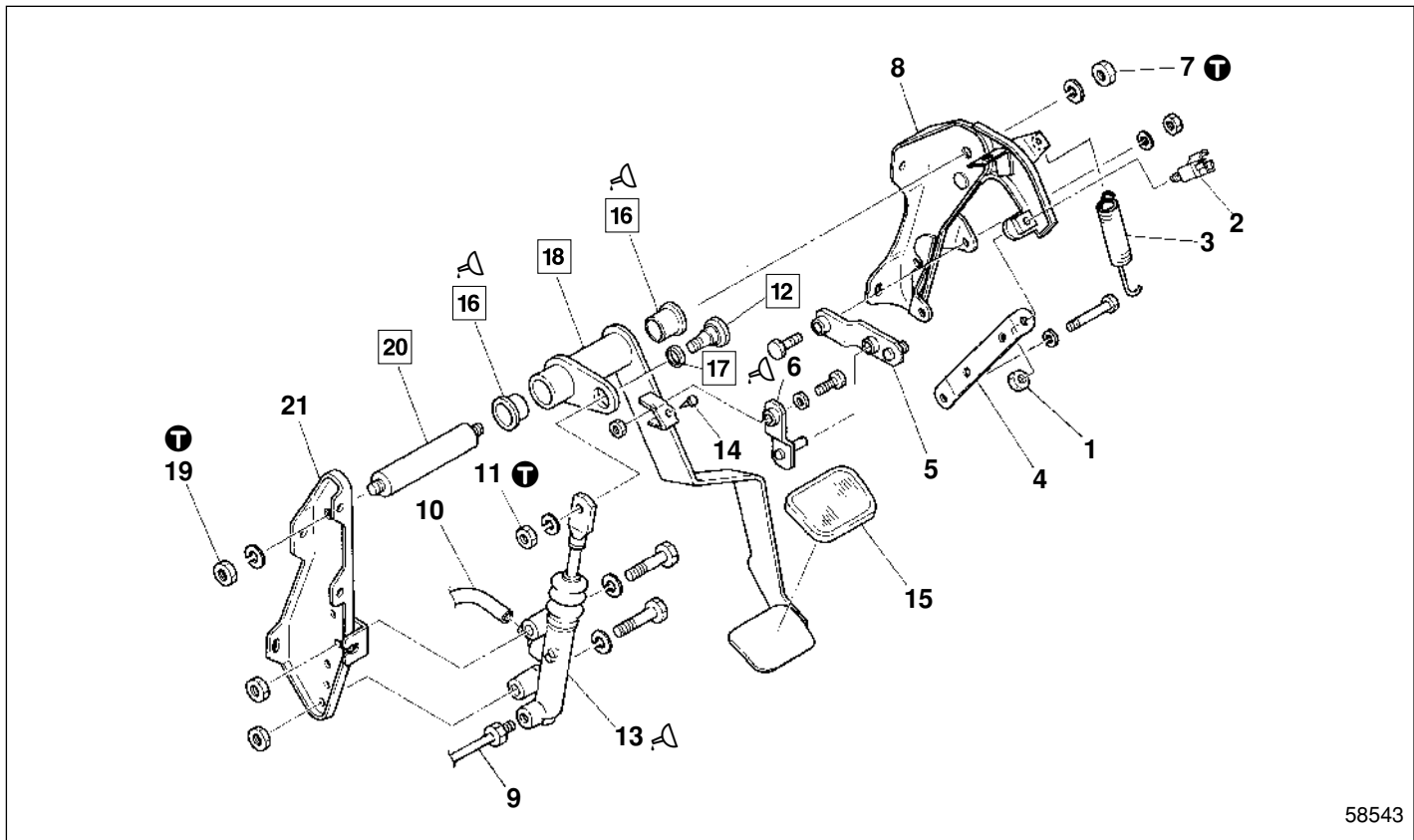


[Confirmation]

Push clutch pedal 5 with your hand until you feel a resistance and measure free play A.
If the measured value deviates from the standard value, readjust or replace the clutch disc.

MEMO

CLUTCH PEDAL < M060S6, M070S6 >



Disassembly sequence

- | | | |
|---|--|-----------------------------|
| 1 Nut | 9 Clutch pipe | 15 Pedal pad |
| 2 Clutch switch  Gr 54 | 10 Clutch hose | 16 Bushing |
| 3 Return spring | 11 Nut | 17 Bushing |
| 4 Clutch switch stay | 12 Offset bolt | 18 Clutch pedal arm |
| 5 Lever assembly B | 13 Clutch master cylinder | 19 Nut |
| 6 Lever assembly A |  P21-24 | 20 Pedal arm shaft |
| 7 Nut | 14 Clutch switch stopper | 21 Clutch pedal bracket, LH |
| 8 Clutch pedal bracket, RH | | |

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3	Installed load of return spring (Installed length 129.1 {5.08})	91 N {21 lbf, 9.3 kgf}	—	—
12, 17	Clearance between offset bolt and bushing	[18] 0.07 to 0.20 {[0.71] 0.0028 to 0.0079}	—	Replace
16, 20	Clearance between bushing and pedal arm shaft	[20] 0.07 to 0.22 {[0.79] 0.0026 to 0.0085}	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
7, 19	Nut (Pedal arm shaft mounting)	48.1±9.8 {35±7.2, 4.9±1}	—
11	Nut (Offset bolt mounting)	48.1±9.8 {35±7.2, 4.9±1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
13	Offset bolt installation area	Chassis grease [NLGI No.1 (Li soap)]	As required
16	Interior of bushing	Chassis grease [NLGI No.1 (Li soap)]	As required
17	Interior of bushing	Chassis grease [NLGI No.1 (Li soap)]	As required

◆ Service procedure

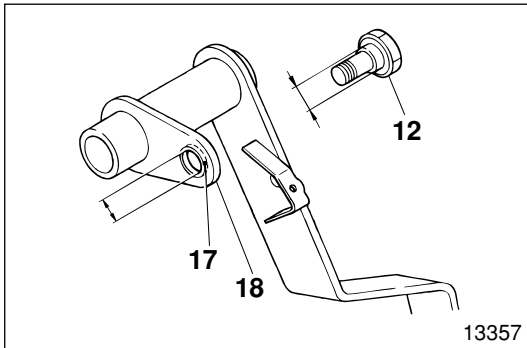
12 17 Offset bolt and bushing

[Inspection]

Replace faulty parts if clearance is higher than the standard value.

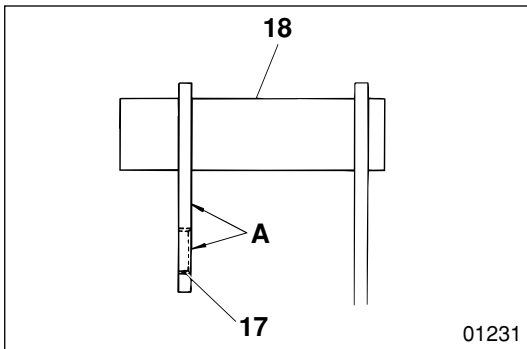
NOTE

Inspect bushing 17 when it is press-fitted in clutch pedal arm 18.



[Press-fitting]

Make ends **A** of bushing 17 and clutch pedal arm 18 flush.

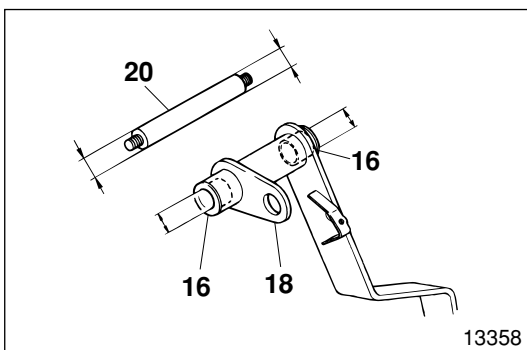


16 20 Clearance between bushing and pedal arm shaft

If clearance is higher than the standard value, replace the faulty parts.

NOTE

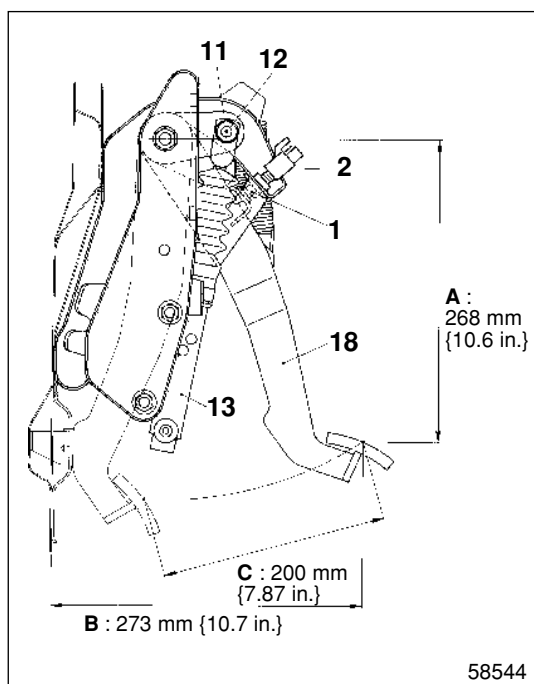
Inspect bushing 16 when it is press-fitted in clutch pedal arm 18.



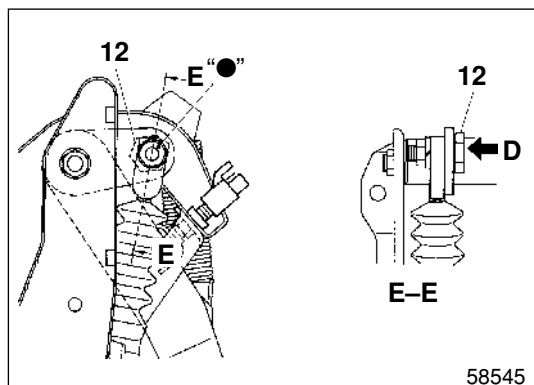
CLUTCH PEDAL < M060S6, M070S6 >

18 Adjustment of clutch pedal

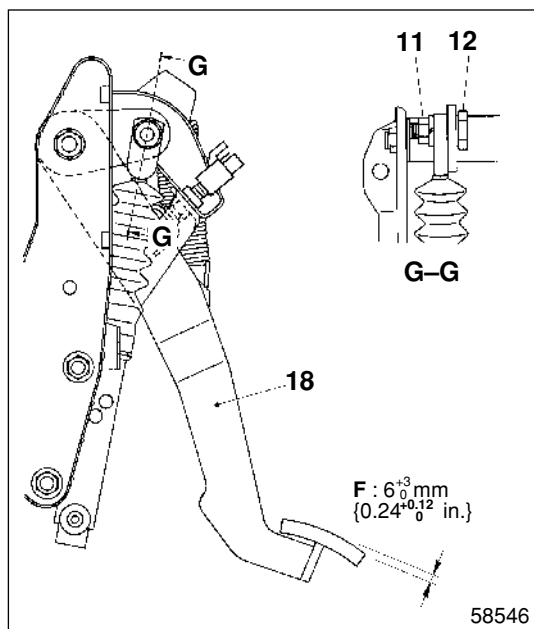
- Loosen offset bolt **12** and nut **11** of clutch master cylinder **13**.
- Turn clutch switch **2** so that clutch pedal arm **18** is installed keeping dimensions **A**, **B**, **C** as illustrated, then tighten nut **1**.



- At this time, temporarily tighten offset bolt **12** in the direction as illustrated.
D : "●" mark side

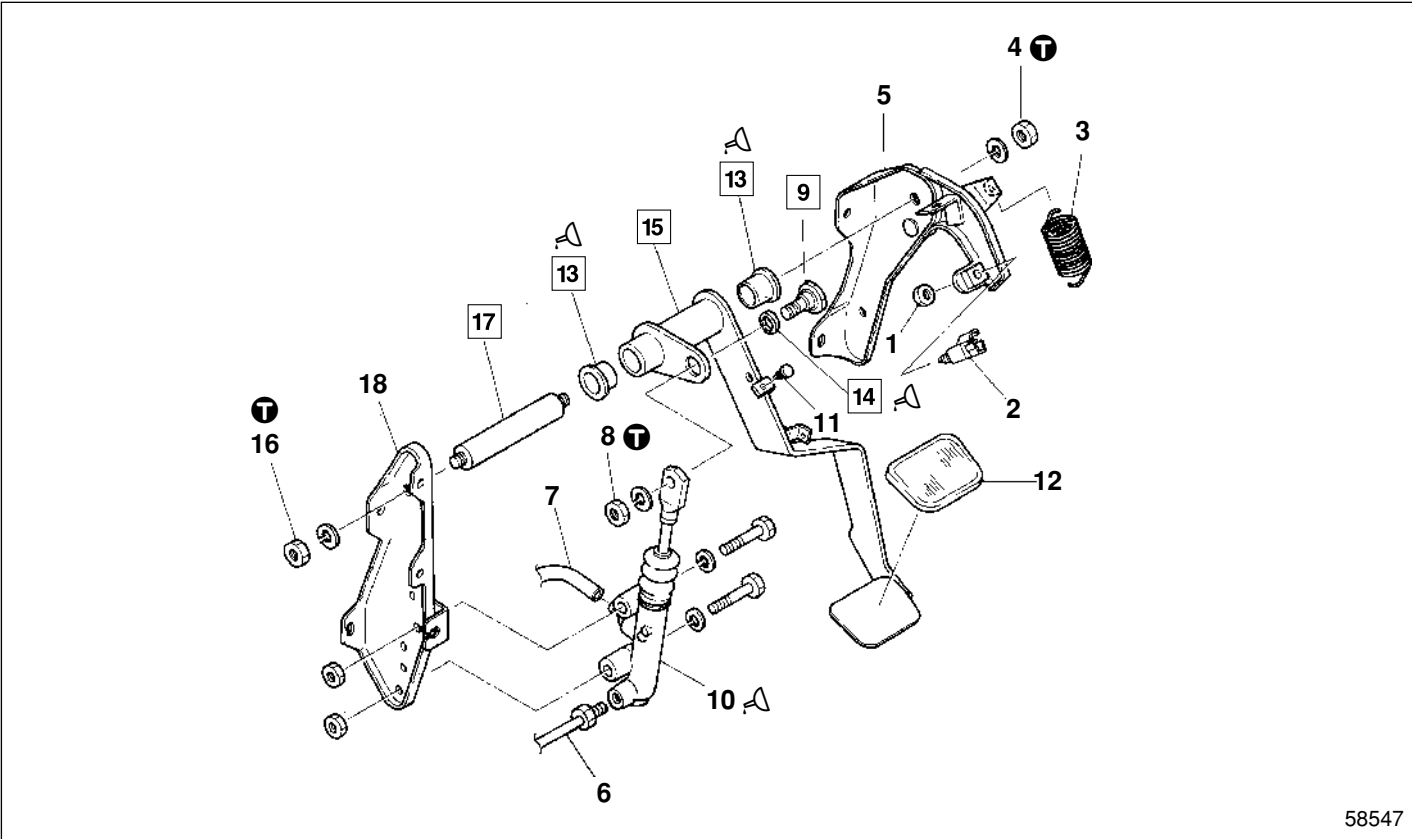


- Then, turn offset bolt **12** to adjust free play **F** at the top of clutch pedal arm **18** to the dimensions as illustrated, then tighten nut **11**.



MEMO

CLUTCH PEDAL < EATON FS-8209 >



58547

Disassembly sequence

- | | |
|----------------------------|-----------------------------------|
| 1 Nut | 10 Clutch master cylinder P21-24 |
| 2 Clutch switch Gr 54 | 11 Clutch switch stopper |
| 3 Return spring | 12 Pedal pad |
| 4 Nut | 13 Bushing |
| 5 Clutch pedal bracket, RH | 14 Bushing |
| 6 Clutch pipe | 15 Clutch pedal arm |
| 7 Clutch hose | 16 Nut |
| 8 Nut | 17 Pedal arm shaft |
| 9 Offset bolt | 18 Clutch pedal bracket, LH |

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3	Installed load of return spring (Installed length 129.1 {5.08})	91 N {21 lbf, 9.3 kgf}	—	—
9, 14	Clearance between offset bolt and bushing	[18] 0.06 to 0.36 {[0.71] 0.0024 to 0.014}	—	Replace
13, 17	Clearance between bushing and pedal arm shaft	[20] 0.07 to 0.22 {[0.79] 0.0026 to 0.0085}	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4, 16	Nut (Pedal arm shaft mounting)	48.1±9.8 {35±7.2, 4.9±1}	—
8	Nut (Offset bolt mounting)	48.1±9.8 {35±7.2, 4.9±1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
10	Offset bolt installation area	Chassis grease [NLGI No.1 (Li soap)]	As required
13	Interior of bushing	Chassis grease [NLGI No.1 (Li soap)]	As required
14	Interior of bushing	Chassis grease [NLGI No.1 (Li soap)]	As required

◆ Service procedure

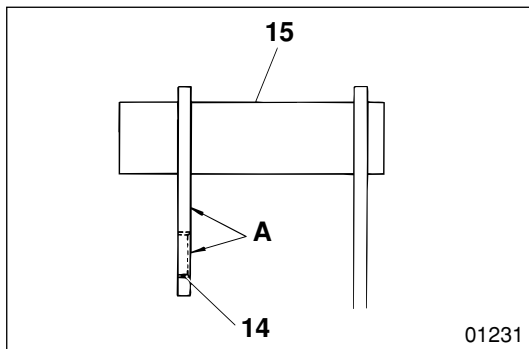
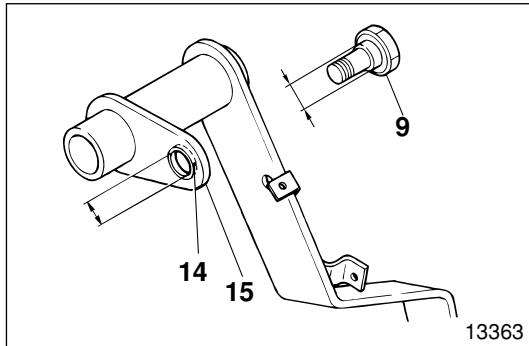
9 14 Offset bolt and bushing

[Inspection]

Replace faulty parts if clearance is higher than the standard value.

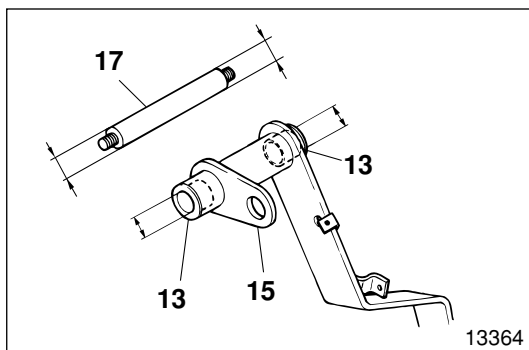
NOTE

Inspect bushing 14 when it is press-fitted in clutch pedal arm 15.



[Press-fitting]

Make ends **A** of bushing **14** and clutch pedal arm **15** flush.



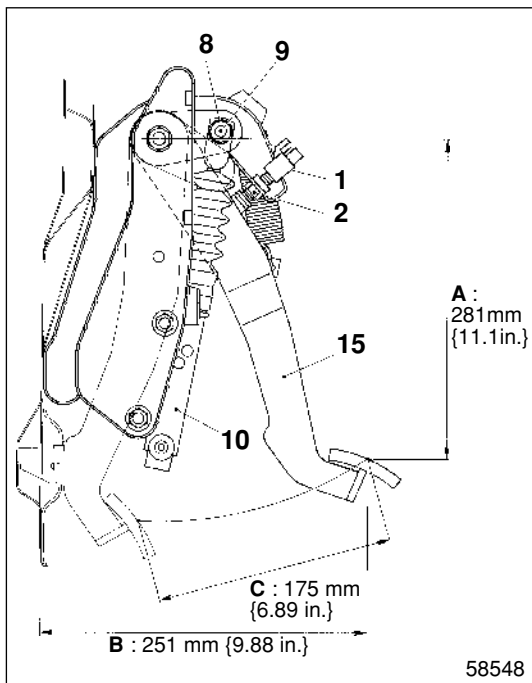
13 17 Clearance between bushing and pedal arm shaft

If clearance is higher than the standard value, replace the faulty parts.

NOTE

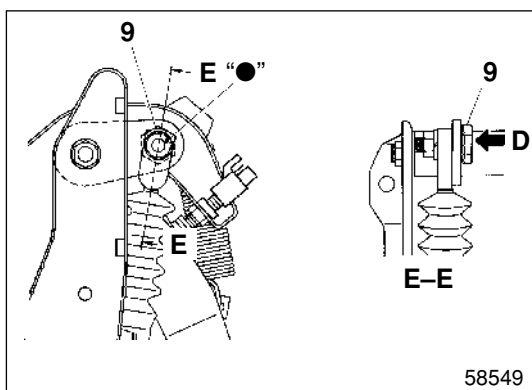
Inspect bushing 13 when it is press-fitted in clutch pedal arm 15.

CLUTCH PEDAL < EATON FS-8209 >

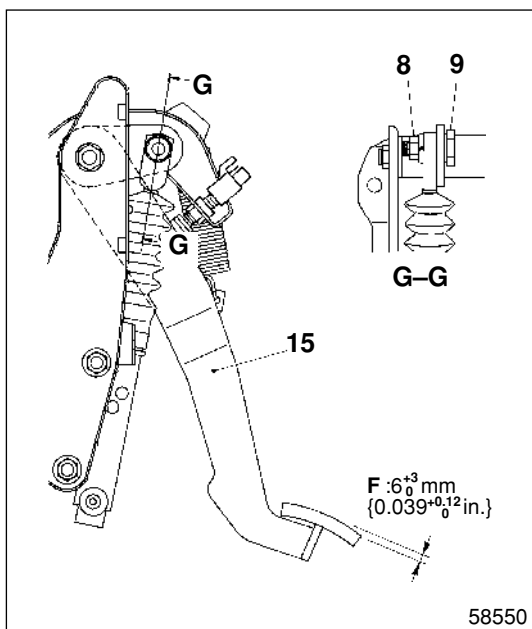


15 Adjustment of clutch pedal

- Loosen offset bolt **9** and nut **8** of clutch master cylinder **10**.
- Turn clutch switch **2** so that clutch pedal arm **15** is installed keeping dimensions **A**, **B**, **C** as illustrated, then tighten nut **1**.



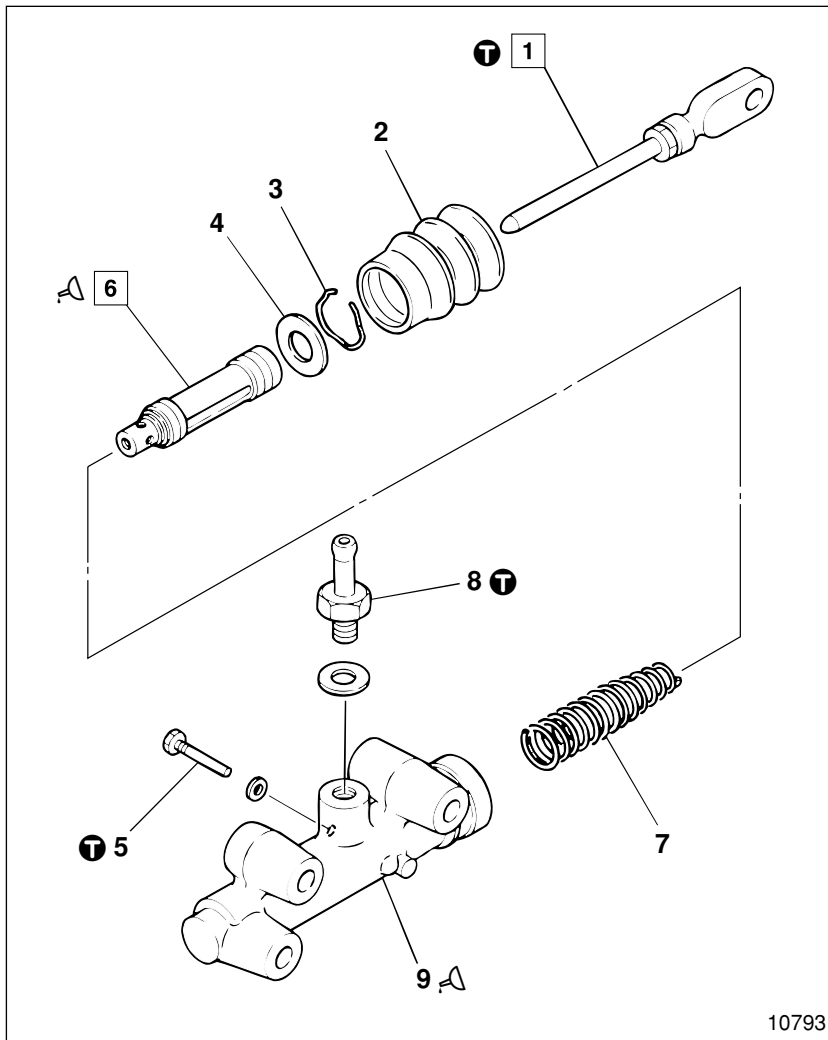
- At this time, temporarily tighten offset bolt **9** in the direction as illustrated.
- **D** : "●" mark side



- Then, turn offset bolt **9** to adjust free play **F** at the top of clutch pedal arm **15** to the dimensions as illustrated, then tighten nut **8**.

MEMO

CLUTCH MASTER CYLINDER



● Disassembly sequence

- 1 Push rod
- 2 Boot
- 3 Piston stop ring
- 4 Piston stop plate
- 5 Supply valve stopper
- 6 Piston assembly
- 7 Return spring
- 8 Nipple
- 9 Cylinder

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Piston and boot kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
6, 9	Clearance between piston assembly and cylinder	[19.05] 0.020 to 0.105 {[0.75] 0.00079 to 0.0041}	0.2 {0.0079}	Replace
7	Free length of return spring	97 {3.82}	92 {3.62}	Replace

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Push rod (Lock nut mounting)	9.8 to 14.7 {7.2 to 11, 1.0 to 1.5}	—
5	Supply valve stopper	1.47 to 2.94 {1.1 to 2.2, 0.15 to 0.3}	—
8	Nipple	24.5 to 34.3 {18 to 25, 2.5 to 3.5}	—

🔧 Lubricant and/or sealant

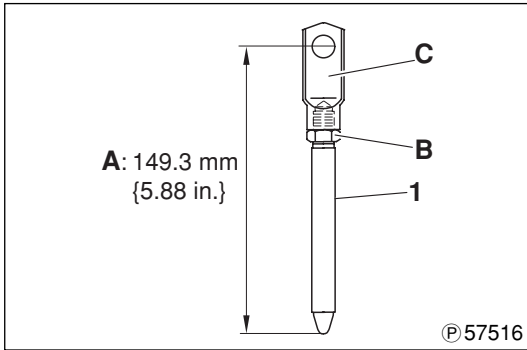
Location	Points of application	Specified lubricant and/or sealant	Quantity
6, 9	Friction surfaces between piston assembly and cylinder	Rubber grease	As required

◆ Service procedure

1 Adjustment of push rod length

If illustrated dimension **A** does not conform to the standard value, loosen lock nut **B** of push rod **1** and turn head **C** to adjust.

After adjustment, tighten lock nut at specified torque.



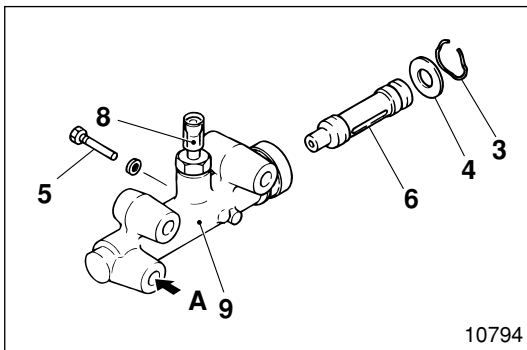
6 Piston assembly

[Removal]

- Remove piston stop ring **3**, piston stop plate **4** and supply valve stopper **5**.
- Block nipple **8** of cylinder **9**, and apply compressed air from **A** as illustrated to remove piston assembly **6**.

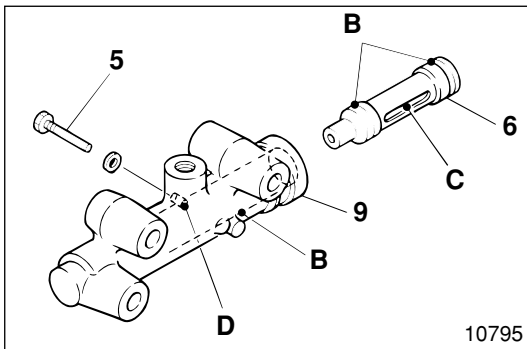
WARNING ⚠

You must apply compressed air gradually when you remove piston assembly **6. If you applied compressed air strongly at one time, the piston assembly would be violently ejected.**

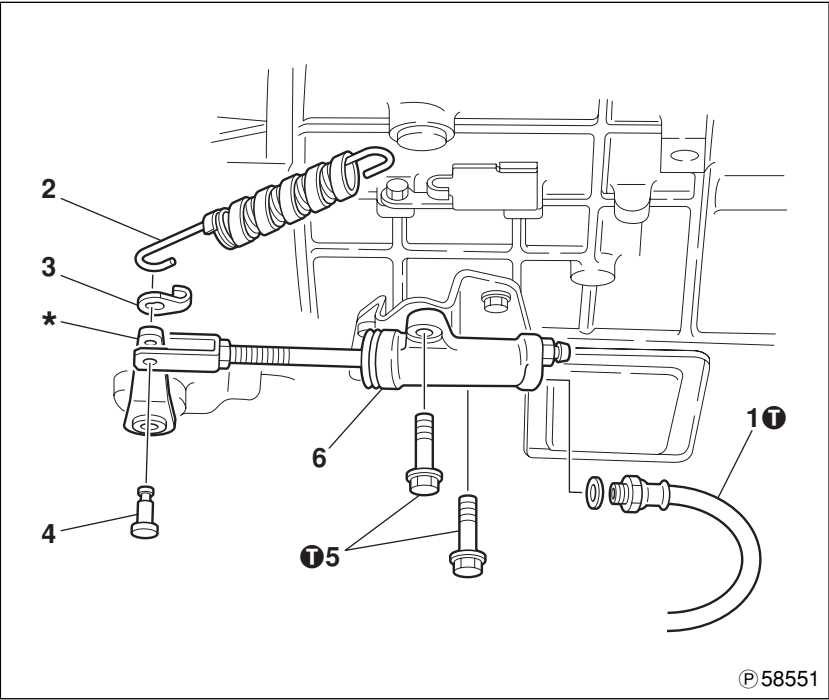


[Installation]

- Apply grease to friction surfaces **B** of piston assembly **6** and cylinder **9**.
- Fit piston by aligning piston assembly **6** groove **C** to cylinder **9** hole **D**, then insert valve stopper **5** to hold the piston in place.



CLUTCH POWER CYLINDER < M060S6, M070S6 >



● Removal sequence

- 1 Fluid hose
 - 2 Return spring
 - 3 Return spring claw
 - 4 Clevis pin
 - 5 Bolt
 - 6 Clutch power cylinder assembly
- 📖 P21-27

* : Clutch release fork shaft

CAUTION ⚠ After removing fluid hose 1, fit blanking plugs into its openings to prevent fluid from flowing out.

● Installation sequence

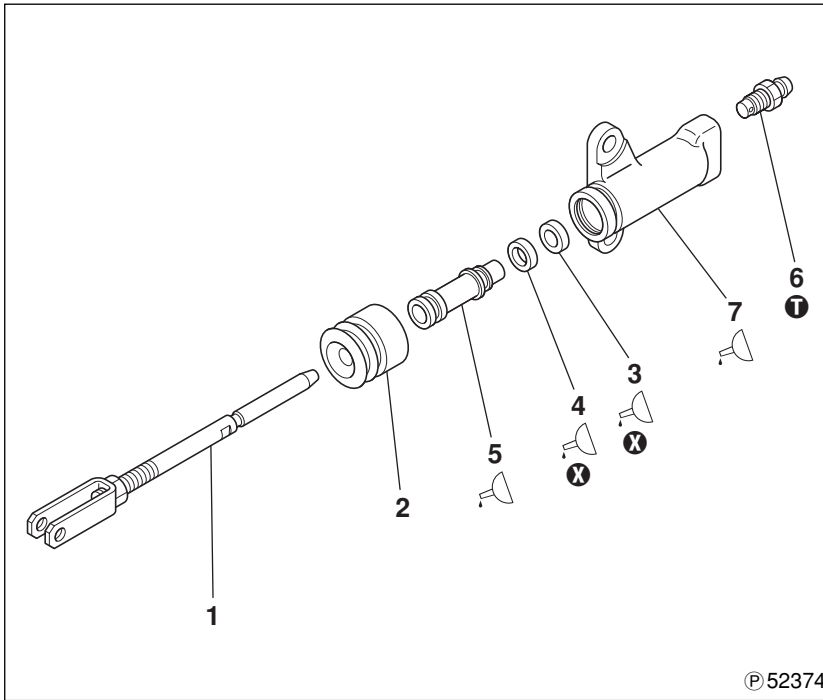
Follow the removal sequence in reverse.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Fluid hose connection	21 to 31 {15 to 23, 2.1 to 3.2}	—
5	Bolt (Clutch power cylinder assembly mounting)	47 {35, 4.8}	—

Clutch Power Cylinder Assembly



● Disassembly sequence

- 1 Push rod
- 2 Boot
- 3 Piston cup A
- 4 Piston cup B
- 5 Piston
- 6 Air bleeder plug
- 7 Cylinder

✕ : Non-reusable parts

● Assembly sequence

5→4→3
7→6→2→1

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
5, 7	Clearance between cylinder and piston	[20.64] 0.04 to 0.125 [[0.81] 0.0016 to 0.0049]	0.24 {0.0094}	Replace

Tightening torque

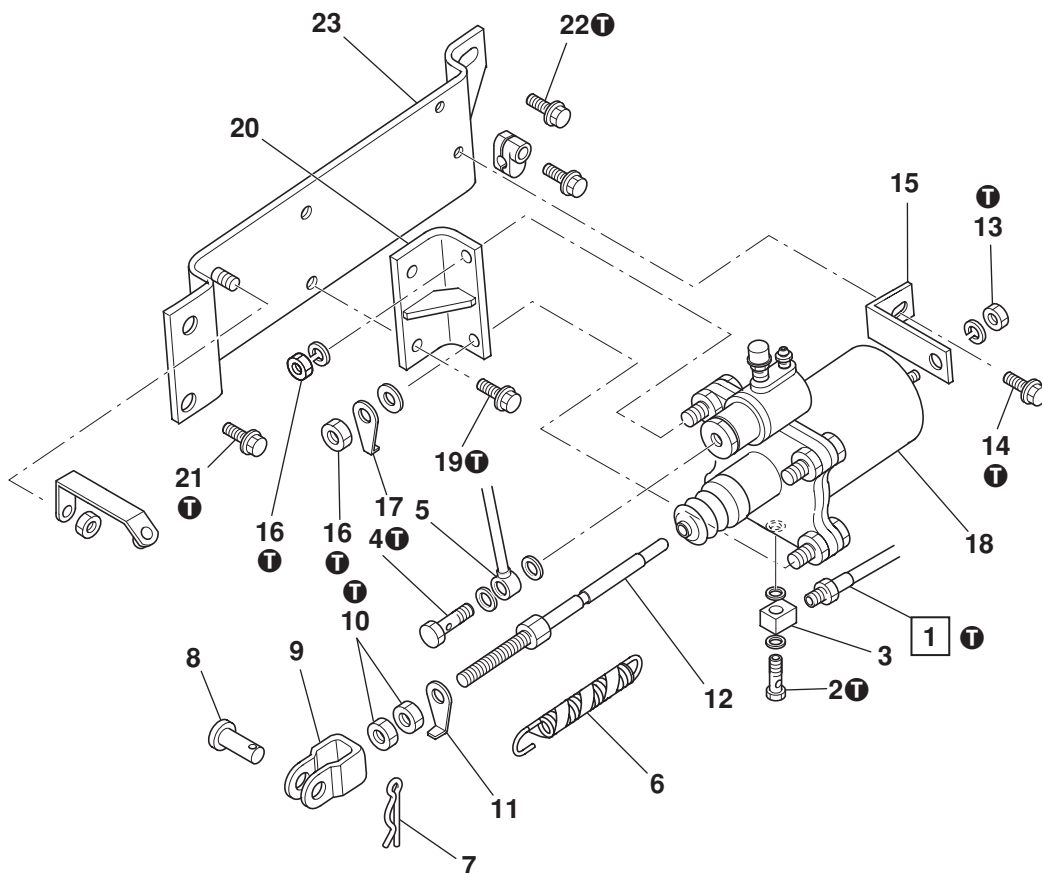
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Air bleeder	25 to 34 {18 to 25, 2.5 to 3.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3, 4	Piston cup circumference	Rubber grease	As required
5	Friction surface of piston	Rubber grease	As required
7	Cylinder bore	Rubber grease	As required

CLUTCH BOOSTER < EATON FS-8209 >



©58552

● Disassembly sequence

- | | |
|-----------------------|------------------------------------|
| 1 Fluid hose | 13 Nut |
| 2 Eye bolt | 14 Bolt |
| 3 Connector | 15 Clutch booster bracket C |
| 4 Eye bolt | 16 Nut |
| 5 Air pipe | 17 Return spring claw |
| 6 Return spring | 18 Clutch booster assembly P21-30 |
| 7 Snap pin | 19 Bolt |
| 8 Clevis pin | 20 Clutch booster bracket B |
| 9 Clevis | 21 Bolt |
| 10 Nut | 22 Bolt |
| 11 Return spring claw | 23 Clutch booster bracket A |
| 12 Push rod | |

● Installation sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Fluid hose	34 ± 7.8 { 25 ± 5.8 , 3.5 ± 0.8 }	—
2	Eye bolt (Connector mounting)	31 to 47 {23 to 35, 3.2 to 4.8}	—
4	Eye bolt (Air pipe mounting)	35.3 {26, 3.6}	—
10	Nut (Clevis and return spring claw mounting)	82.4 {61, 8.4}	—
13	Nut (Clutch booster assembly mounting)	17.2 {13, 1.75}	—
14	Bolt (Clutch booster bracket C mounting)	40.2 {30, 4.1}	—
16	Nut (Clutch booster assembly mounting)	17.2 {13, 1.75}	—
19	Bolt (Clutch booster bracket B mounting)	40.2 {30, 4.1}	—
21	Bolt (Clutch booster bracket A mounting)	85 to 110 {63 to 81, 8.5 to 11}	—
22	Bolt (Clutch booster bracket A mounting)	40.2 {30, 4.1}	—

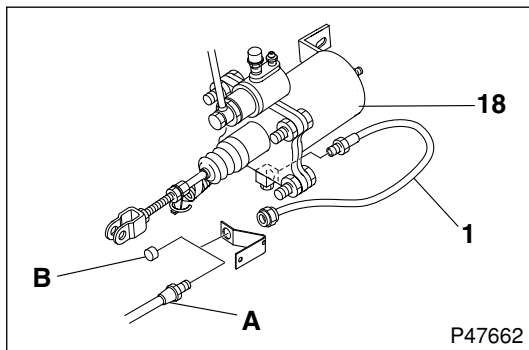
◆ Service procedure

1 Removal and installation of fluid hose

- When removing fluid hose **1**, first disconnect from pipe **A** on the frame side, then disconnect from clutch booster assembly **18**.
- For installation, follow the removal sequence in reverse.
- After installing fluid hose **1**, bleed the system.

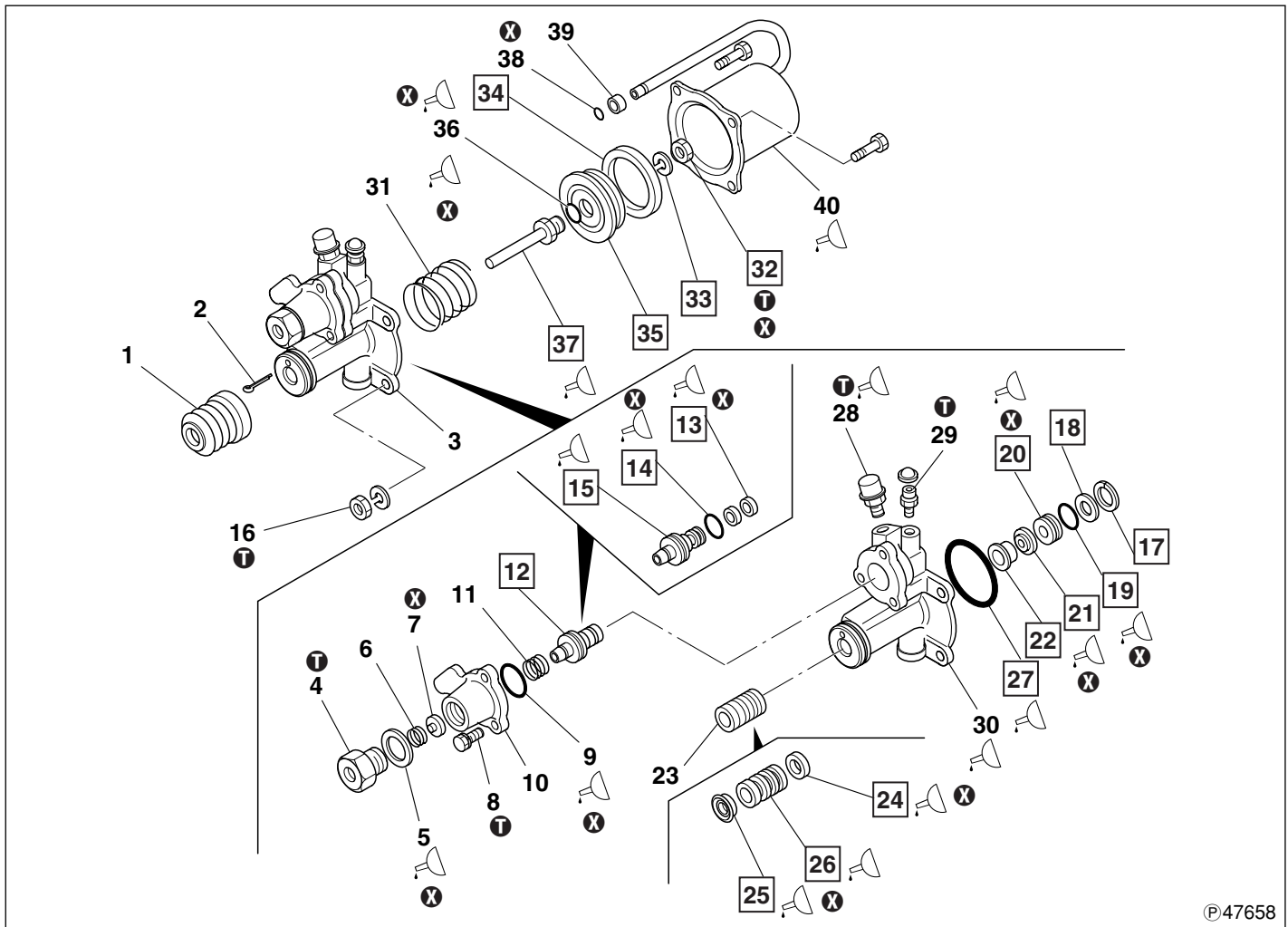
CAUTION

After removing fluid hose **1**, fit blanking plug **B** into pipe **A** to prevent fluid from flowing out.



CLUTCH BOOSTER < EATON FS-8209 >

Clutch Booster Assembly



©47658

● Work before disassembly

📖 P21-32

● Disassembly sequence

- | | | |
|--------------------------|--------------------------------|-------------------|
| 1 Guard | 16 Nut | 28 Exhaust cover |
| 2 Spring pin | 17 Retaining ring | 29 Air bleeder |
| 3 Body assembly | 18 Washer | 30 Body |
| 4 Connector | 19 O-ring | 31 Spring |
| 5 Gasket | 20 Retainer assembly | 32 Nut |
| 6 Spring | 21 Cup packing | 33 Spring |
| 7 Poppet valve | 22 Retainer | 34 Cup packing |
| 8 Bolt | 23 Hydraulic piston assembly | 35 Piston plate |
| 9 O-ring | 24 Cup packing | 36 O-ring |
| 10 Upper valve body | (on pressure fluid side) | 37 Push rod |
| 11 Spring | 25 Cup packing | 38 O-ring |
| 12 Relay piston assembly | (on atmospheric pressure side) | 39 Collar |
| 13 Cup packing | 26 Hydraulic piston | 40 Cylinder shell |
| 14 O-ring | 27 O-ring | |
| 15 Relay piston | | |
- ⊗ : Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Piston and boot kit

CAUTION

- Be careful not to damage relay piston 15 or hydraulic piston 26 on their periphery.
- Use metal cleaner to clean metal parts.
- Minor rusting, scratches, or dents on metal parts can be removed using emery paper (#800 or finer). If not successful, replace the metal part. Excessive sanding or use of emery paper coarser than #800 will cause air or fluid leakage.
- To clean rubber parts, wipe them clean using alcohol.
- Correct type of lubricants should be used at correct locations. Failure to observe this can cause rubber parts to degrade or expand.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
6	Spring load (Installed length 13 {0.51})		2.6 N {0.6 lbs, 0.27 kgf}	2.3 N {0.5 lbs, 0.23 kgf}	Replace
11	Spring load (Installed length 13.1 {0.52})		12.3 N {2.8 lbs, 1.25 kgf}	10.4 N {2.3 lbs, 1.06 kgf}	Replace
15, 30	Clearance between relay piston and body	To valve piston	[16] 0.04 to 0.10 [[0.63] 0.0016 to 0.0039]	0.11 {0.0043}	Replace
		To valve piston	[23.5] 0.1 to 0.25 [[0.93] 0.0039 to 0.0098]	0.3 {0.012}	Replace
26, 30	Clearance between hydraulic piston and body		[19.05] 0.01 to 0.06 [[0.75] 0.00039 to 0.0024]	0.08 {0.0031}	Replace
31	Spring load (Installed length 55 {2.17})		69 N {16 lbs, 7 kgf}	58 N {13 lbs, 5.9 kgf}	Replace
35, 40	Clearance between piston plate and cylinder shell		0.20 to 0.75 {0.0079 to 0.030}	—	Replace
37	Push rod bend		—	0.1 {0.0039}	Replace

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Connector	19.6 to 29.4 {14 to 22, 2 to 3}	—
8	Bolt (Upper valve body mounting)	3.9 to 5.9 {2.9 to 4.4, 0.4 to 0.6}	—
16	Nut (Body assembly and cylinder shell mating)	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	—
28	Exhaust cover	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	—
29	Air bleeder	6.9 to 12.7 {5.1 to 9.4, 0.7 to 1.3}	—
32	Nut (Piston plate mounting)	19.6 to 29.4 {14 to 22, 2 to 3}	—

CLUTCH BOOSTER < EATON FS-8209 >

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5	Entire surface of gasket	Air master paste	As required
9, 27, 36	Entire surface of O-ring	Air master paste	As required
13, 21, 24, 25	Entire surface of cup packing	Rubber grease	As required
14	Entire surface of O-ring	Shin-Etsu Chemical Silicon Grease FG721	As required
15	Periphery of relay piston $\phi 16$ mm {0.63 in.}	Rubber grease	As required
	Periphery of relay piston $\phi 23.5$ mm {0.93 in.} and O-ring groove	Shin-Etsu Chemical Silicon Grease FG721	As required
19	Entire surface of O-ring	Rubber grease	As required
20	Push rod sliding surface of retainer assembly	Rubber grease	As required
26	Periphery of hydraulic piston and grease groove	Rubber grease	As required
28	Threads on exhaust cover	THREEBOND 1105	As required
30	Inner surfaces of body $\phi 16$ mm {0.63 in.} and $\phi 19.05$ mm {0.75 in.}	Rubber grease	As required
	Inner surface of body $\phi 23.5$ mm {0.93 in.}	Shin-Etsu Chemical Silicon Grease FG721	As required
34	Entire surface of cup packing	Air master paste	As required
37	Push rod end	Rubber grease	As required
40	Inner surface of cylinder shell	Air master paste	As required

Special tools

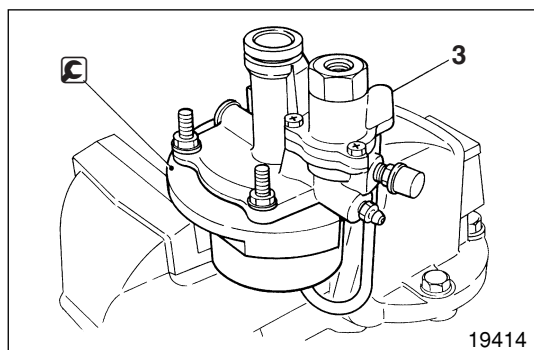
Location	Tool name and shape		Part No.	Application
–	Stand plate		*910-10691	Fixing of clutch booster
12	Pliers		*910-21471	Removal of relay piston assembly
13	Cup insert guide	On atmospheric pressure	*910-24905	Installation of cup packing
		On pressure fluid	*910-24902	
13, 14, 19, 24, 25	Needle		*910-21200	Removal of cup packing and O-ring
24	Cup insert guide		*910-23284	Installation of cup packing
25	Cup insert guide		*910-23285	Installation of cup packing

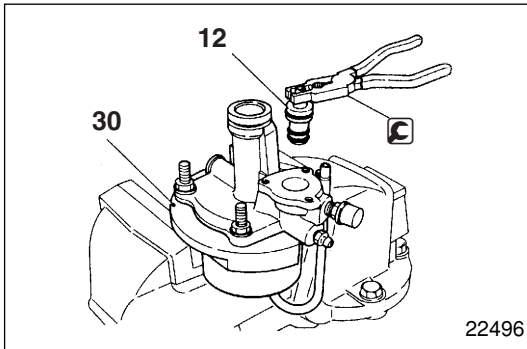
* : BOSCH BRAKING SYSTEMS part No.

◆ Service procedure

● Work before disassembly

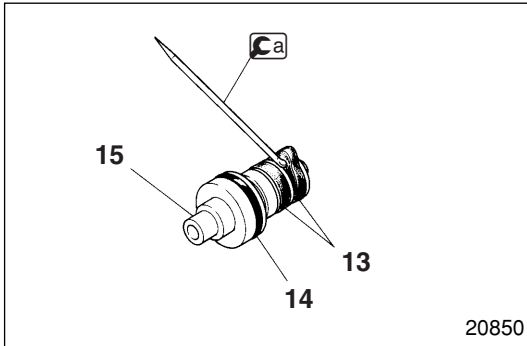
- To aid reassembly, mark the parts at mating locations before disassembly.
- Install the flange of clutch booster body assembly **3** onto  stand plate, and then set the assembly in a vice.





12 Removal of relay piston assembly

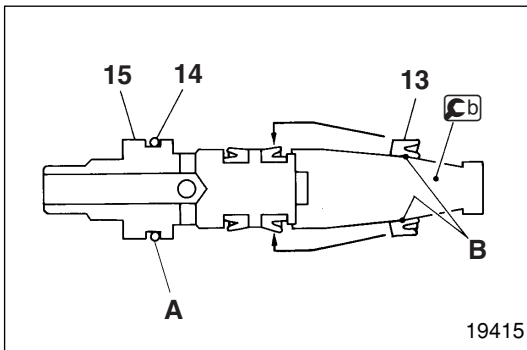
Using  pliers, remove relay piston assembly 12 from body 30.



13 to 15 Cup packing, O-ring, relay piston

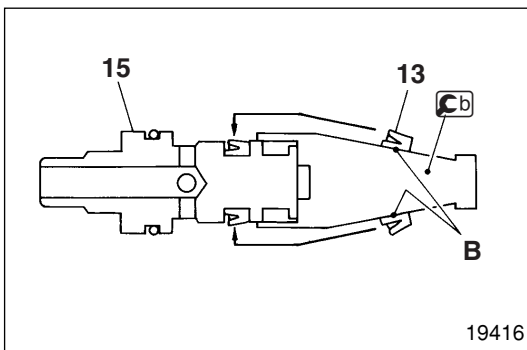
[Removal]

Using  needle, remove cup packing 13 and O-ring 14 from relay piston 15.



[Installation]

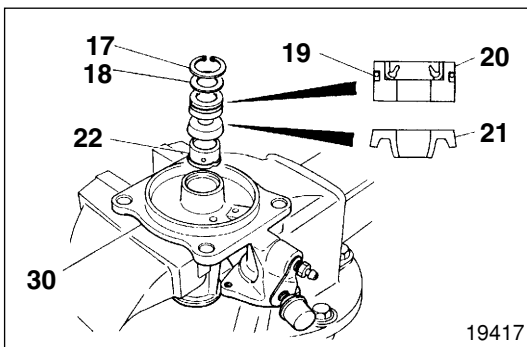
- Coat O-ring 14 with grease, and install it onto relay piston 15.
- Pack grease into O-ring groove A on relay piston 15.
- Apply grease on inner circumference B of cup packing 13. Face the packing as shown in the drawing and, using  cup insert guide, install it onto relay piston 15 on the atmospheric pressure side.



- Apply grease on inner circumference B of cup packing 13. Face the packing as shown in the drawing and, using  cup insert guide, install it onto relay piston 15 on the fluid pressure side.

CAUTION

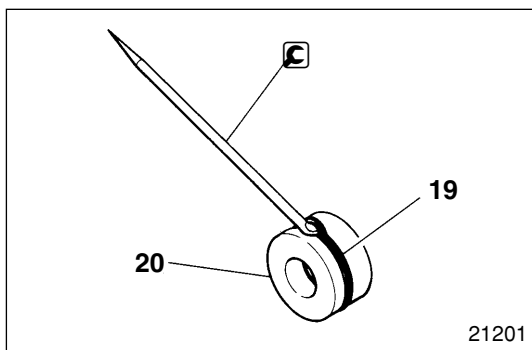
O-ring 14 and cup packing 13 use different types of grease from each other. Do not mix them up.



17 to 22 Installation of retaining ring, washer, O-ring, retainer assembly, cup packing and retainer

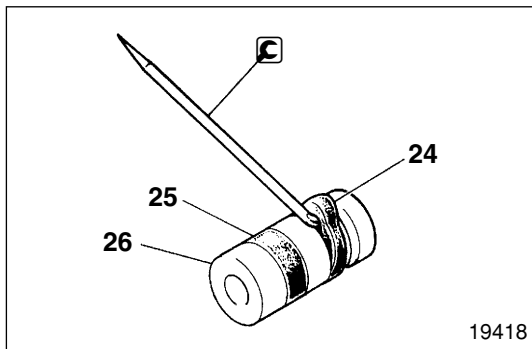
Install retainer 22, cup packing 21, retainer assembly 20, O-ring 19, washer 18 and retaining ring 17 onto body 30 while making sure to face them as indicated in the drawing.

CLUTCH BOOSTER < EATON FS-8209 >



19 20 O-ring and retainer assembly

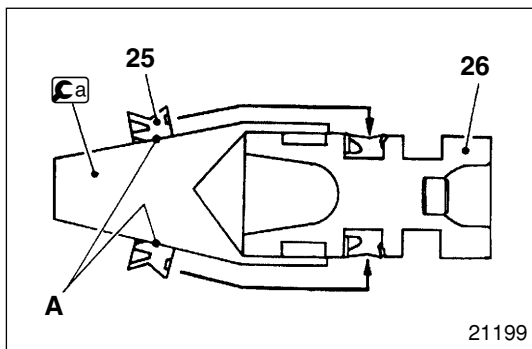
Using  needle, remove O-ring 19 from retainer assembly 20.



24 to 26 Cup packing and hydraulic piston

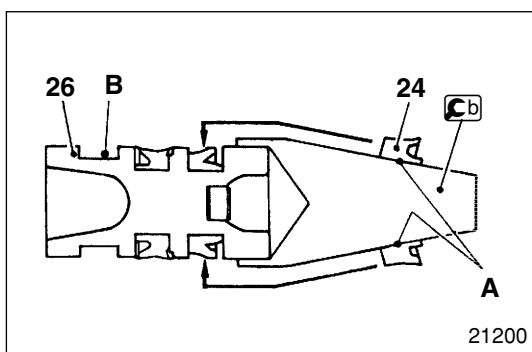
[Removal]

Using  needle, remove cup packing 24, 25 from hydraulic piston 26.

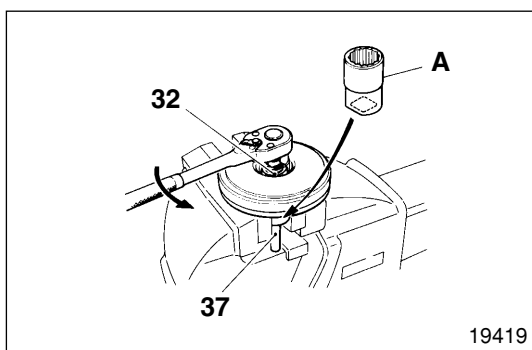


[Installation]

- Apply grease on inner circumference **A** of cup packing 25. Face the packing as shown in the drawing and, using  cup insert guide, install it onto hydraulic piston 26.



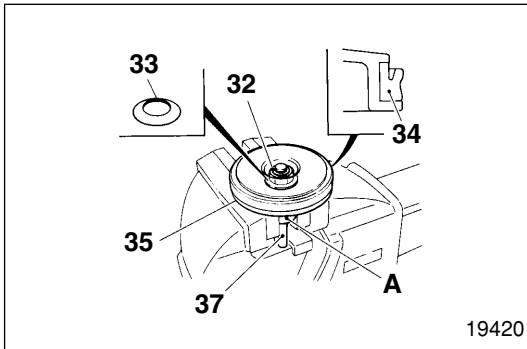
- Apply grease on inner circumference **A** of cup packing 24. Face the packing as shown in the drawing and, using  cup insert guide, install it onto hydraulic piston 26.
- Pack grease into groove **B** on hydraulic piston 26.



32 to 35 37 Nut, spring, cup packing, piston plate and push rod

[Removal]

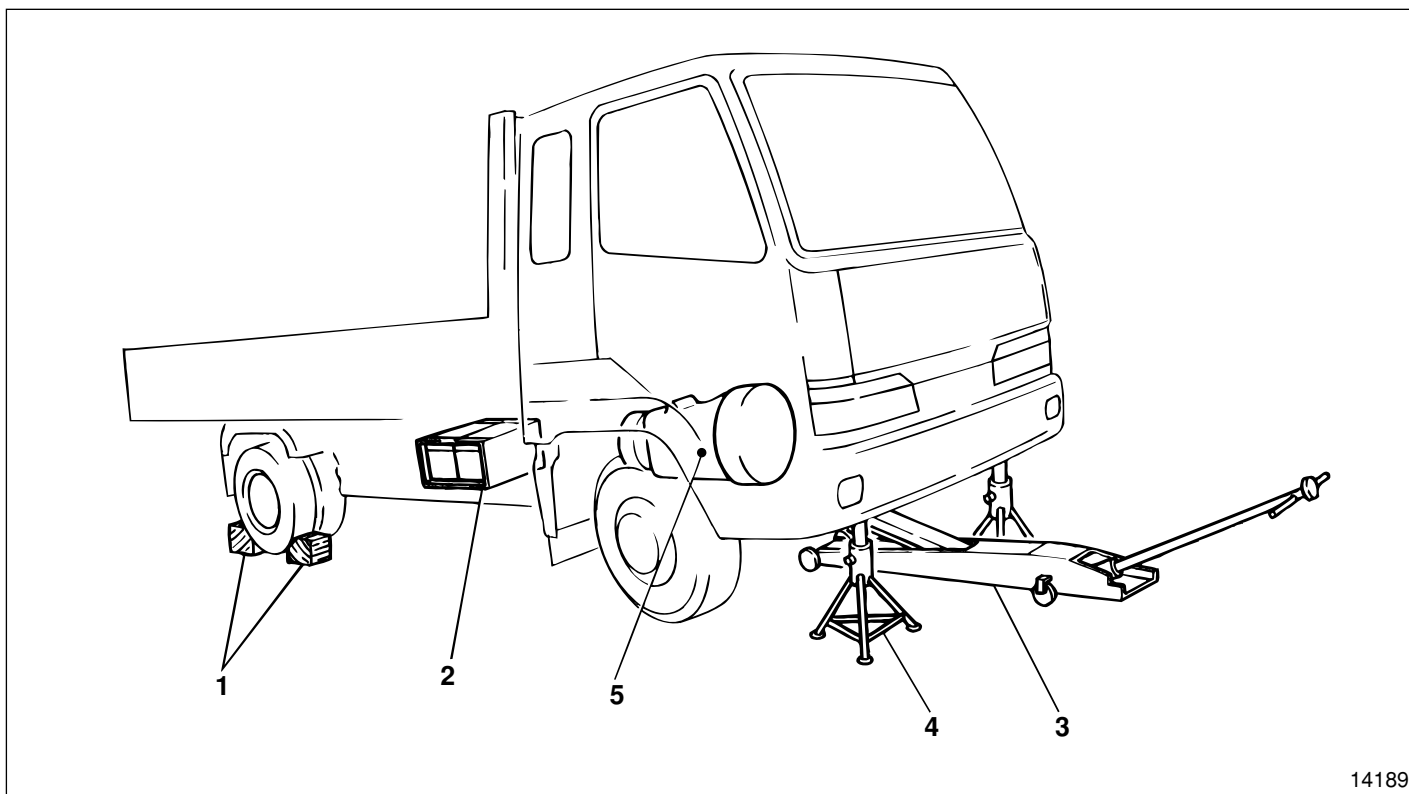
- Set socket (21 mm {0.83 in.}) **A** in a vice.
- Insert the hexagonal part of push rod 37 into the socket, and remove nut 32.



[Installation]

- Install spring **33** such that the convex side faces upwards.
- Tighten nut **32** and stake it in two locations.
- Install cup packing **34**.

WORK BEFORE REMOVAL AND INSTALLATION OF CLUTCH BODY



● Work sequence before removal

- 1 Place wheel chocks.
- 2 Disconnect the negative battery cable.  Gr 54
- 3 Jack up the front axle using a garage jack.
- 4 Support the front frame on rigid racks.
- 5 Remove the transmission.  Gr 22

WARNING

- Since the parking brake (center parking) will be removed, naturally it cannot be used. Therefore, you must chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Keep the transmission in neutral throughout the operation.

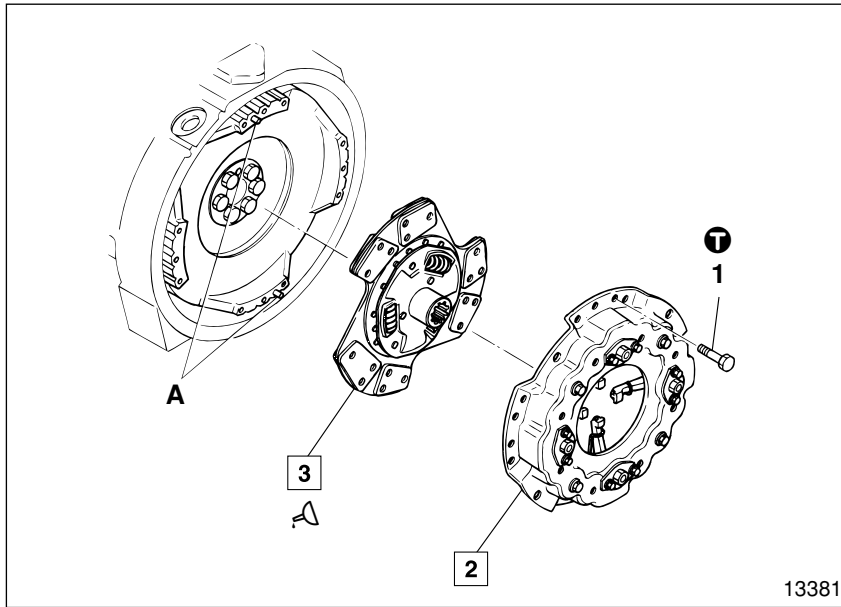
● Work sequence after installation

Follow the work sequence before removal in reverse.

MEMO

CLUTCH BODY

Clutch Disc



● Removal sequence

- 1 Bolt
- 2 Pressure plate and lever assembly
P21-42, 48
- 3 Clutch disc

A : Positioning pins

WARNING ⚠

Be careful when you handle pressure plate and lever assembly 2 because it is rather heavy.

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

Be careful not to get oily substances on clutch disc 3 surfaces because this will cause the clutch to slip.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
3	Clutch disc	Lateral runout	1.2 {0.047} or less	—	Replace
		Vertical runout	1.2 {0.047} or less	—	Replace
		Play to revolving direction at spline	0.07 to 0.23 {0.0028 to 0.0091}	0.5 {0.020}	Replace
		Depth from facing surface to cup	1.88 to 2.62 {0.074 to 0.103}	0.2 {0.0079}	Replace

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

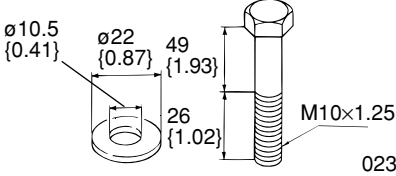
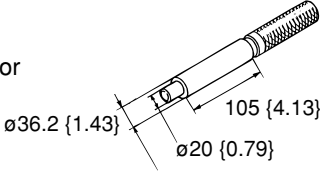
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Pressure plate and lever assembly mounting)	33 to 49 { 24 to 36, 3.3 to 5.0}	—

🛢 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3	Entire surface of splines	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	1.1 to 1.6 g {0.039 to 0.056 oz}
	Fill in the grease grooves of splines		4.2 to 5.9 g {0.15 to 0.21 oz}

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Stopper bolt Washer 	43402-09200 < Stopper bolt > MH005024 < Washer >	Removal and installation of pressure plate and lever assembly
2, 3	Clutch alignment arbor 	MH061987	Holds clutch disc

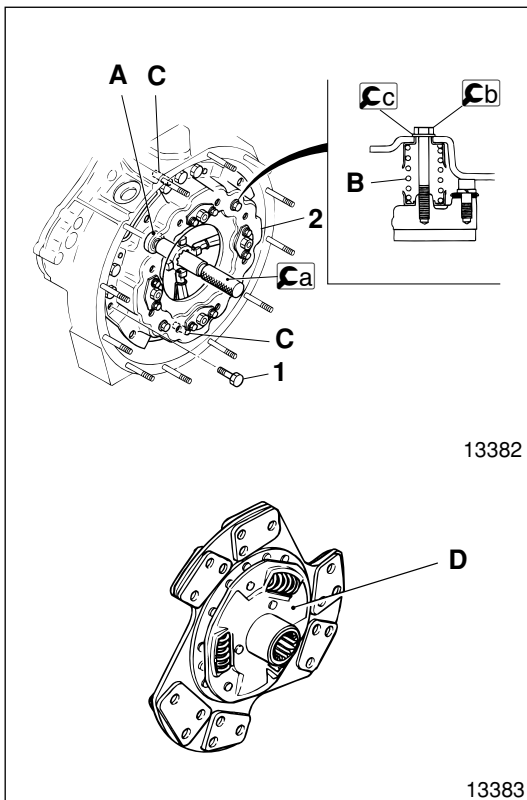
◆ Service procedure

2 Removal and installation of pressure plate and lever assembly

- Insert  clutch alignment arbor in flywheel pilot bearing **A** to hold clutch disc **3**.
- Compress springs **B** using  stopper bolt and  washer, then remove bolt **1**.
- For installation, follow the removal sequence in reverse.
- Install clutch disc **3** so that part No. **D** is visible.
- Tighten bolts **1** gradually, in diagonal order, to specified torque.

CAUTION

- Beware, if you do not use  stopper bolts and  washers (four points) to remove bolt **1**, the force of springs **B** might push out pressure plate and lever assembly **2**, damaging the strap plate. It might even come apart from knock pin **C** and drop off.
- Remember to remove stopper bolts and washers after installation (four points). If the stopper bolts and washers are left on, the clutch will not engage.

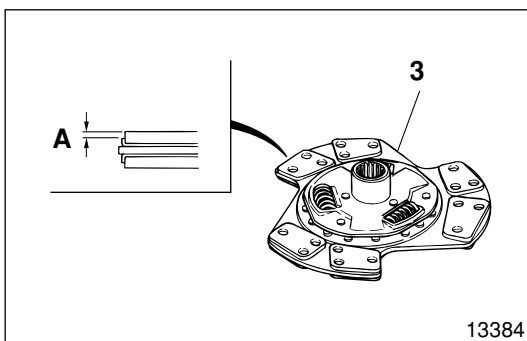


3 Clutch disc

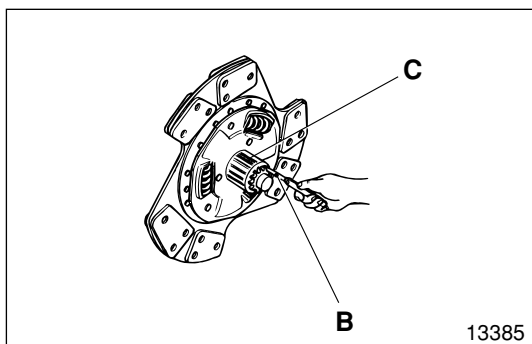
(1) Depth from facing surface to cup

Measure dimension **A** as illustrated.

If the measured value does not conform to the standard value, replace clutch disc **3**.



CLUTCH BODY



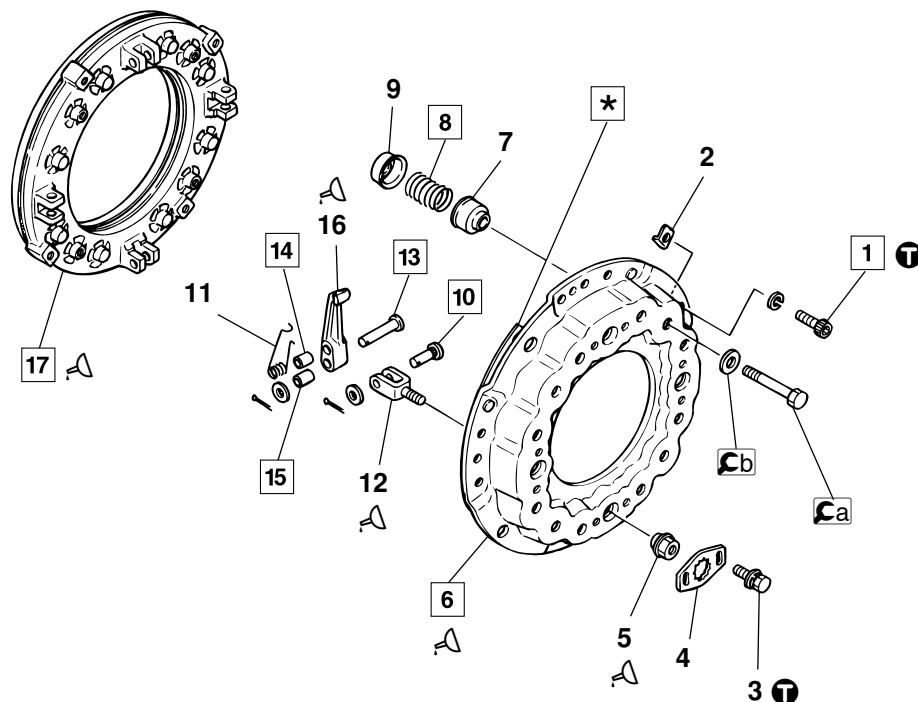
(2) Play to revolving direction at spline

- Reshape feeler gauge **B** for insertion into drive pinion spline **C**, and measure play there.
- If the measured value is higher than the limit, replace clutch disc **3** or the drive pinion.
- Carry out the same measurement on new clutch disc **3**. If the measured value is higher than the limit, replace the drive pinion.

MEMO

CLUTCH BODY

Pressure Plate and Lever Assembly < M060S6, M070S6 >



13375

● Work before disassembly

📖 P21-44

● Disassembly sequence

- | | | |
|------------------------|------------------------|-------------------|
| 1 Strap bolt | 8 Pressure spring | 15 Bushing |
| 2 Washer | 9 Pressure spring seat | 16 Release lever |
| 3 Lock bolt | 10 Lever support pin | 17 Pressure plate |
| 4 Lock plate | 11 Return spring | |
| 5 Support nut | 12 Lever support | * : Strap plate |
| 6 Clutch cover | 13 Release lever pin | a : Stopper bolt |
| 7 Pressure spring seat | 14 Bushing | b : Washer |

NOTE

Do not remove bushings 14, 15 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Clutch release lever kit

● Inspection and adjustment after assembly

📖 P21-44

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
1, *	Clearance between strap plate and bolt		0 to 0.16 {0 to 0.0063}	0.3 {0.012}	Replace
8	Pressure spring	Load (Installed length 56.05 {2.21})	1081 N {240 lbf, 110.2 kgf}	919 N {205 lbf, 93.7 kgf}	Replace
		Tilt	3.6 {0.14} or less	5.0 {0.20}	
10, 14	Clearance between lever support pin and bushing		[10] 0.017 to 0.126 {[0.39] 0.00067 to 0.0050}	0.4 {0.016}	Replace
14 to 16	Clearance between release lever pin and bushing		[10] 0.016 to 0.118 {[0.39] 0.00063 to 0.0046}	0.4 {0.016}	Replace
16	Release lever height		62.1±0.8 {2.44±0.031}	Difference between any two: 0.5 {0.020} or less	Adjust
17	Pressure plate	Thickness	30.8±0.1 {1.21±0.0039}	28 {1.10}	Replace
		Flatness	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Inner diameter of strap bolt fitting hole	10.2 to 10.25 {0.402 to 0.404}	10.5 {0.41}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

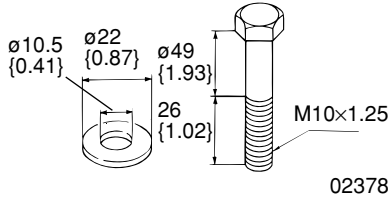
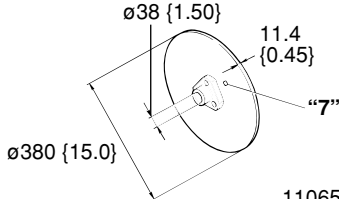
Location	Parts to be tightened	Tightening torque	Remarks
1	Strap bolt (Strap plate mounting)	39.2 to 49.0 {29 to 36, 4.0 to 5.0}	—
3	Lock bolt (Lock plate mounting)	9.8 to 14.7 {7.2 to 11, 1.0 to 1.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5	Threads of support nut and spherical surfaces	Anti-seizure compound	As required
5, 6	Contact areas of support nut and clutch cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
12, 16	Release lever to lever support friction surfaces	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
16, 17	Release lever and pressure plate sliding section	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

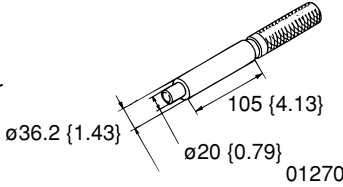
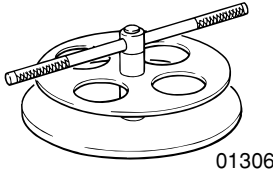
Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
—	Stopper bolt Washer 	43402-09200 < Stopper bolt > MH005024 < Washer > 02378	Disassembly and assembly of pressure plate and lever assembly
—	Clutch master plate 	MH062353 11065	Adjustment of release lever heights

CLUTCH BODY

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
—	Clutch alignment arbor 	MH061987	Holding clutch master plate
6	Clutch installer 	MH061331	Removal and installation of clutch cover

◆ Service procedure

● Work before disassembly

Put alignment marks on all parts before disassembly.

● Inspection and adjustment after assembly

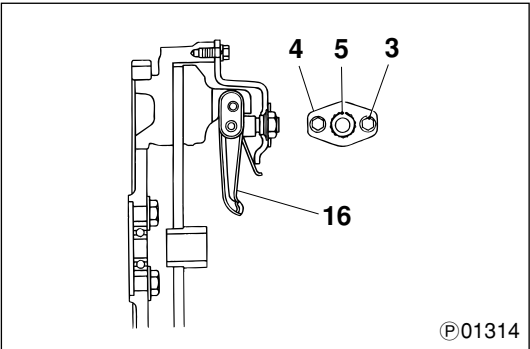
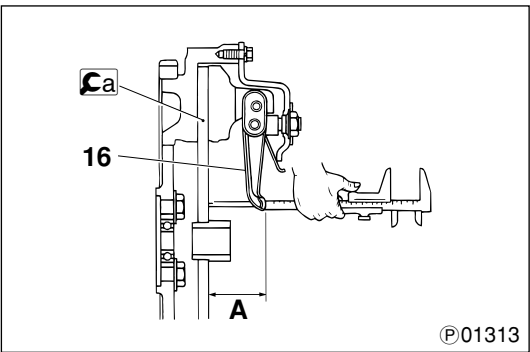
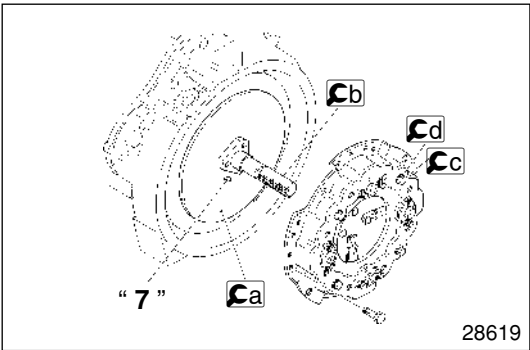
(1) Measurement of release lever height

- Install the pressure plate and lever assembly using **Ca** clutch master plate and **Cb** clutch alignment arbor instead of clutch disc.
- Install **Ca** clutch master plate so that identification mark “7” can be seen.

NOTE

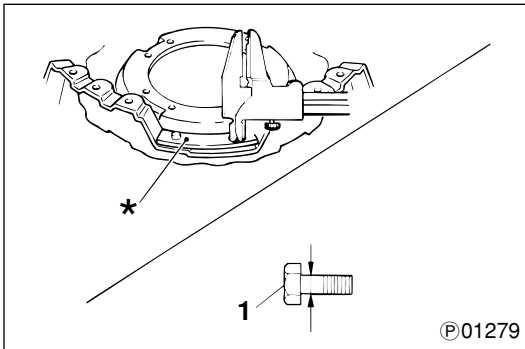
Be sure to remove **Cc** stopper bolt and **Cd** washer and make the inspection and adjustment after the pressure plate and lever assembly has installed.

- Measure dimension **A** between **Ca** clutch master plate and each upper surface of release levers **16** (four points).
- If the measured values deviate from the standard value, adjust as follows. Even if the measured values are within the standard value, if the relative difference among each measured value is 0.5 mm {0.020 in.} or more, adjust the heights, too.



(2) Adjustment of release lever height

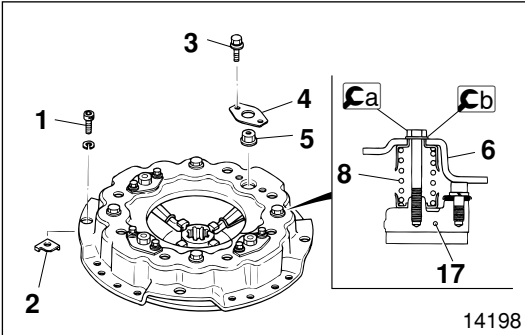
- Remove lock bolt **3** and lock plate **4**, and adjust the height by turning support nut **5**.
- After adjustment, install lock plate **4**, fasten support nut **5** and check the height of release lever **16**.



1 * Clearance between strap bolt and strap plate

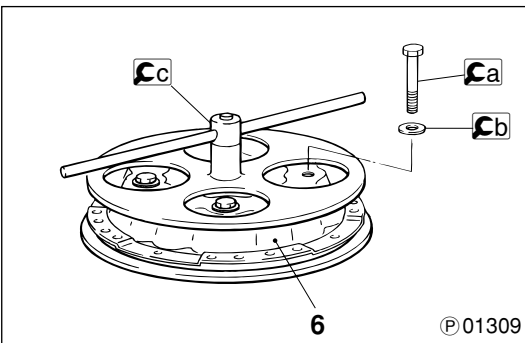
If the measured value is higher than the limit, replace the faulty parts.

* : Strap plate

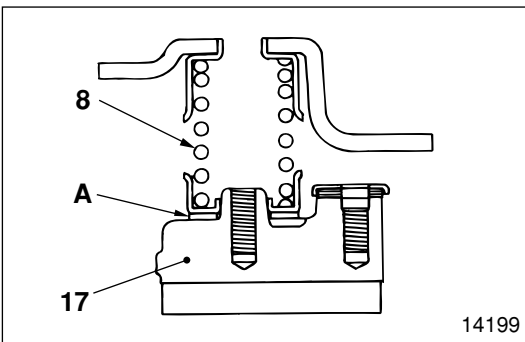


6 Removal and installation of clutch cover

- After fixing clutch cover 6 and pressure plate 17 using stopper bolt and washer, remove strap bolt 1, washer 2, lock bolt 3, lock plate 4 and support nut 5.



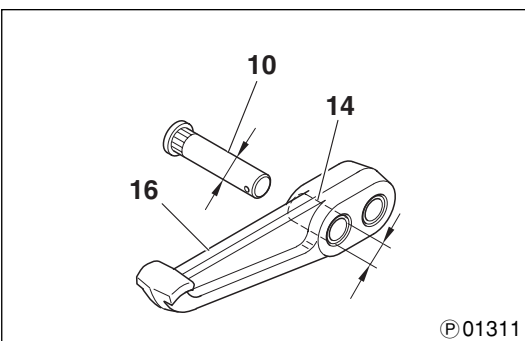
- Compress pressure spring 8 using clutch installer, and remove stopper bolt and washer.
- Gradually loosen clutch installer until pressure spring 8 is released, and remove clutch cover 6.
- For installation, follow the removal sequence in reverse.



8 Installation of pressure spring

When grinding pressure plate 17 to correct it, insert adjusting washer A, equivalent to the amount of correction made by grinding, between the pressure plate and pressure spring 8.

Amount of correction made by grinding	Thickness of adjusting washer
Less than 1 mm {0.039 in.}	Not required
1 to 2 mm {0.039 to 0.079 in.}	1.2 mm {0.047 in.}×1
2 to 3 mm {0.079 to 0.12 in.}	1.2 mm {0.047 in.}×2 or, 2.3 mm {0.091 in.}×1



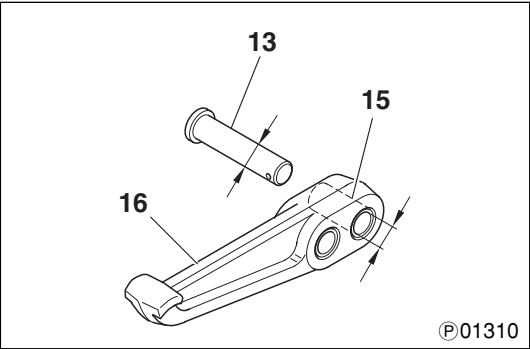
10 14 Clearance between lever support pin and bushing

If the measured value is higher than the limit, replace the faulty parts.

NOTE

This inspection must be made with bushing 14 press-fitted in release lever 16.

CLUTCH BODY

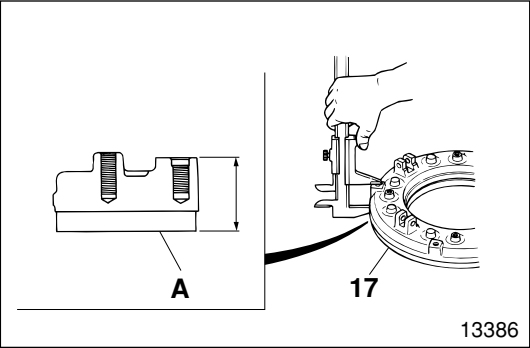


13 15 Clearance between release lever pin and bushing

If the measured value is higher than the limit, replace the faulty parts.

NOTE

This inspection must be made with bushing 15 press-fitted in release lever 16.

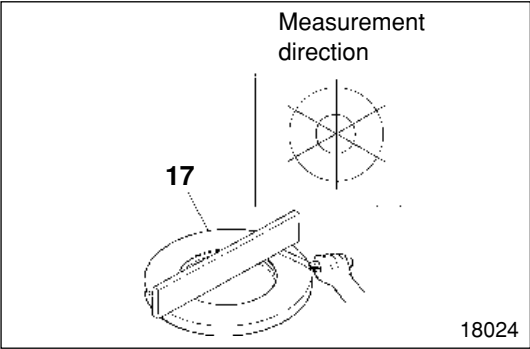


17 Inspection of pressure plate

(1) Thickness

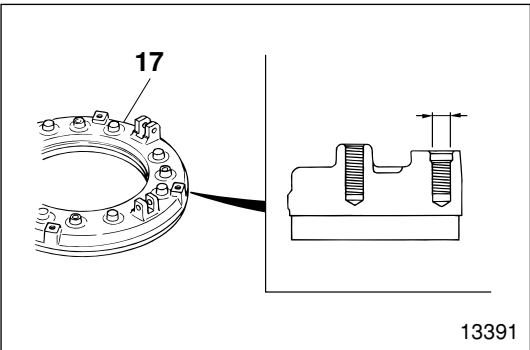
- Measure friction surface A of pressure plate 17 (measuring position must be within the maximum and minimum diameters), and if the measured value is lower than the limit, replace the pressure plate.

Maximum diameter	370 mm {14.6 in.}
Minimum diameter	240 mm {9.45 in.}



(2) Flatness

If the measured value is lower than the limit, replace pressure plate 17.



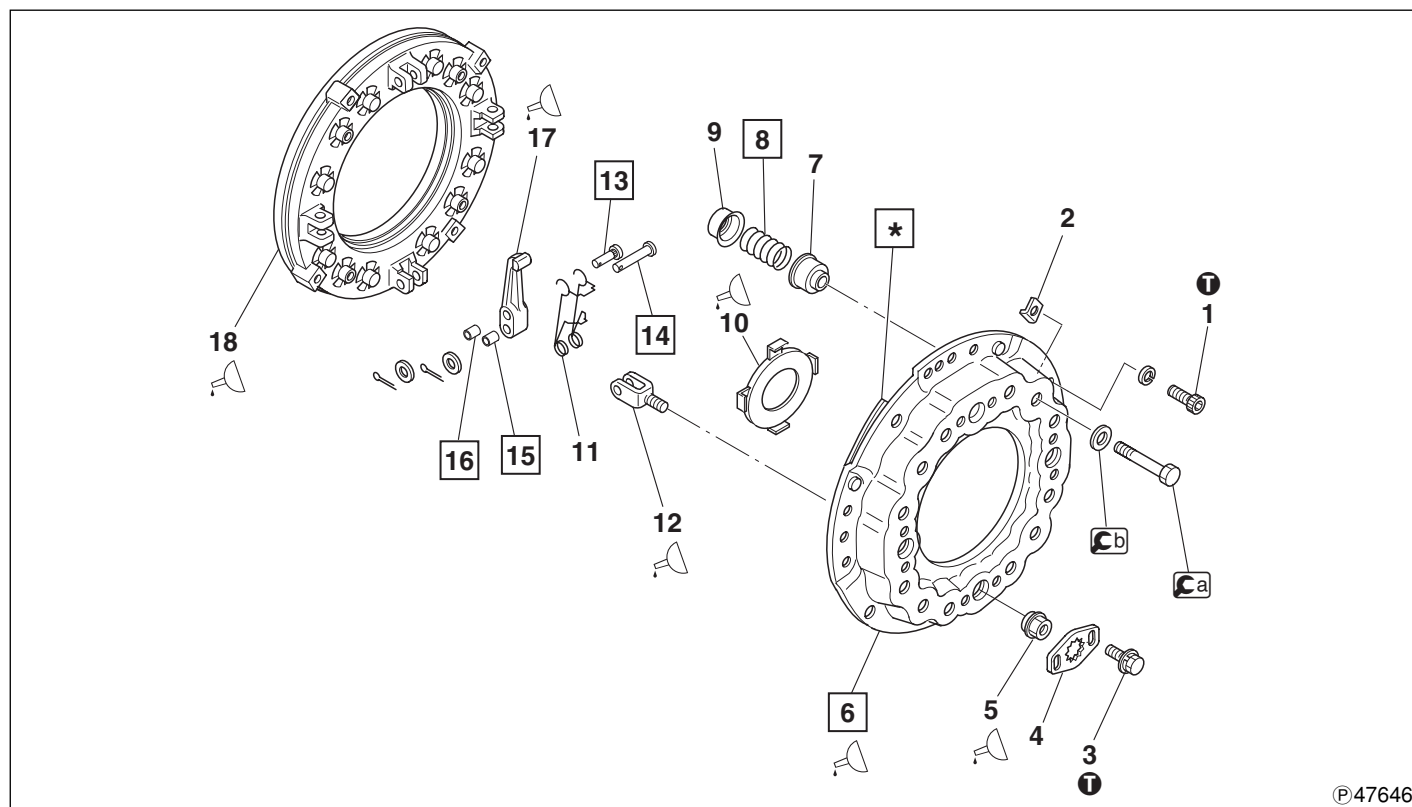
(3) Inner diameter of strap bolt fitting hole

If the measured value is higher than the limit, replace pressure plate 17.

MEMO

CLUTCH BODY

Pressure Plate and Lever Assembly < EATON FS-8209 >



● Work before disassembly

📖 P21-44

● Disassembly sequence

- | | | |
|------------------------|------------------------|-------------------|
| 1 Strap bolt | 9 Pressure spring seat | 16 Bushing |
| 2 Washer | 10 Release lever plate | 17 Release lever |
| 3 Lock bolt | 11 Return spring | 18 Pressure plate |
| 4 Lock plate | 12 Lever support | |
| 5 Support nut | 13 Lever support pin | * : Strap plate |
| 6 Clutch cover | 14 Release lever pin | Ⓐ : Stopper bolt |
| 7 Pressure spring seat | 15 Bushing | Ⓑ : Washer |
| 8 Pressure spring | | |

NOTE

Do not remove bushings 15, 16 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Clutch release lever kit

● Inspection and adjustment after assembly

📖 P21-50

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
1, *	Clearance between strap plate and bolt		0 to 0.16 {0 to 0.0063}	0.3 {0.012}	Replace
8	Pressure spring	Load (Installed length 56.05 {2.21})	1160 N {260 lbf, 118.2 kgf}	985 N {220 lbf, 100.5 kgf}	Replace
		Tilt	3.6 {0.14} or less	5.0 {0.20}	
10	Release lever plate height		68.1±0.8 {2.68±0.031}	Difference between any two: 0.5 {0.020} or less	Adjust
13, 16	Clearance between lever support pin and bushing		[10] 0.017 to 0.126 {[0.39] 0.00067 to 0.0050}	0.4 {0.016}	Replace
14, 15	Clearance between release lever pin and bushing		[10] 0.016 to 0.118 {[0.39] 0.00063 to 0.0046}	0.4 {0.016}	Replace
18	Pressure plate	Thickness	30.8±0.1 {1.21±0.0039}	28 {1.10}	Replace
		Flatness	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Inner diameter of strap bolt fitting hole	10.2 to 10.25 {0.402 to 0.404}	10.5 {0.41}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

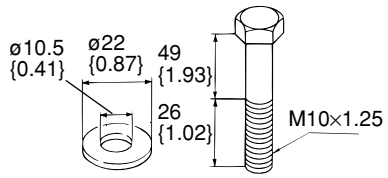
Location	Parts to be tightened	Tightening torque	Remarks
1	Strap bolt (Strap plate mounting)	39.2 to 49.0 {29 to 36, 4.0 to 5.0}	—
3	Lock bolt (Lock plate mounting)	9.8 to 14.7 {7.2 to 11, 1.0 to 1.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5	Threads of support nut and spherical surfaces	Anti-seizure compound	As required
5, 6	Contact areas of support nut and clutch cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
10, 17	Release lever plate and release lever friction surfaces	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
12, 17	Release lever to lever support friction surfaces	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
17, 18	Release lever and pressure plate sliding section	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

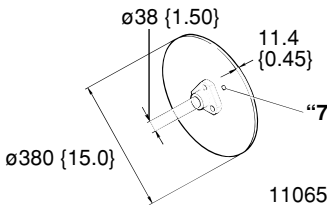
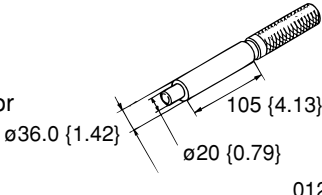
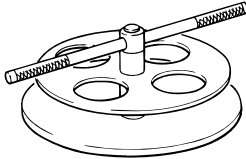
Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
—	Stopper bolt Washer 	43402-09200 < Stopper bolt > MH005024 < Washer >	Disassembly and assembly of pressure plate and lever assembly

CLUTCH BODY

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
—	 Clutch master plate 11065	MH062353	Adjustment of release lever heights
—	 Clutch alignment arbor 01270	MH062862	Holding clutch master plate
6	 Clutch installer 01306	MH061331	Removal and installation of clutch cover

◆ Service procedure

● Work before disassembly

Put alignment marks on all parts before disassembly.

● Inspection and adjustment after assembly

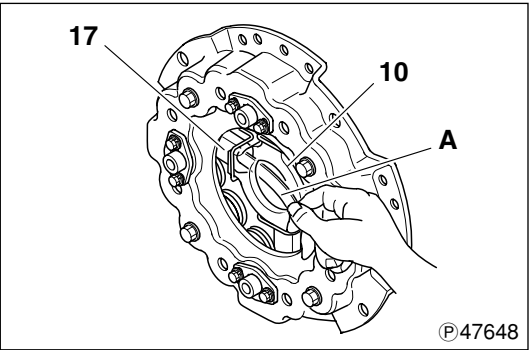
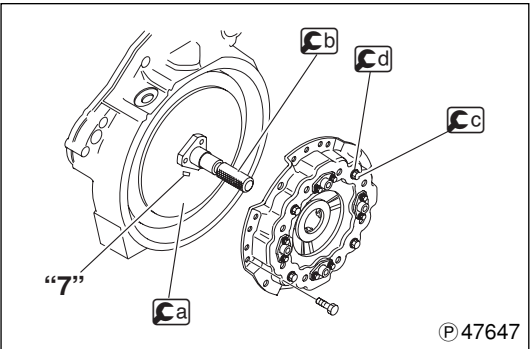
(1) Measurement of release lever plate height

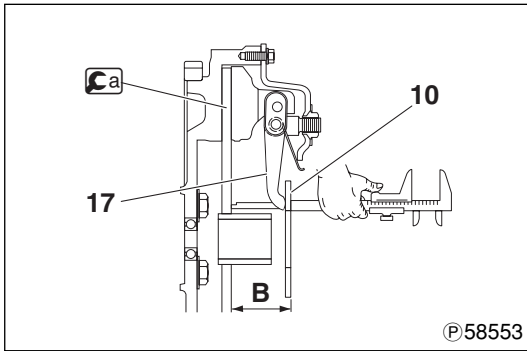
- Install the pressure plate and lever assembly using  clutch master plate and  clutch alignment arbor instead of clutch disc.
- Install  clutch master plate so that identification mark “7” can be seen.

NOTE

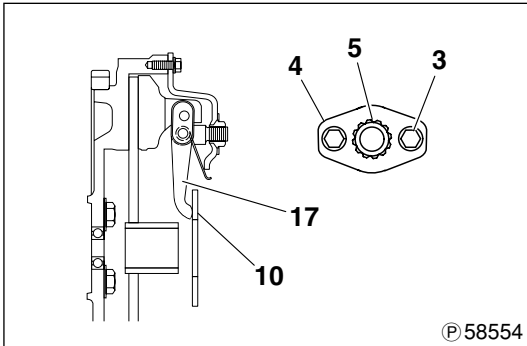
Be sure to remove  stopper bolt and  washer and make the inspection and adjustment after the pressure plate and lever assembly has installed.

- Make certain that the clearance between release lever **17** and release lever plate **10** is such that a 0.05 mm feeler gauge **A** cannot be inserted between them.
If there is excessive clearance, press in strongly using your fingers, and return slowly to lessen the clearance.



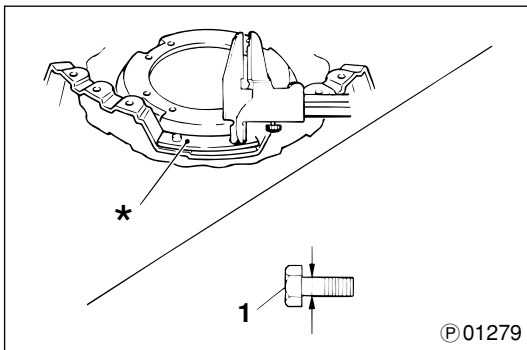


- Measure dimension **B** between **Ca** clutch master plate and each upper surface of release lever plate **10** (four points).
- If the measured values deviate from the standard value, adjust as follows. Even if the measured values are within the standard value, if the relative difference among each measured value is 0.5 mm {0.020 in.} or more, adjust the heights, too.



(2) Adjustment of release lever plate height

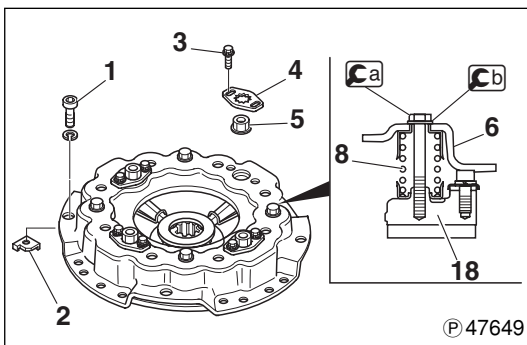
- Remove lock bolt **3** and lock plate **4**, and adjust the height by turning support nut **5**.
- After adjustment, install lock plate **4**, fasten support nut **5** and check the height of release lever plate **10**.



1 * Clearance between strap bolt and strap plate

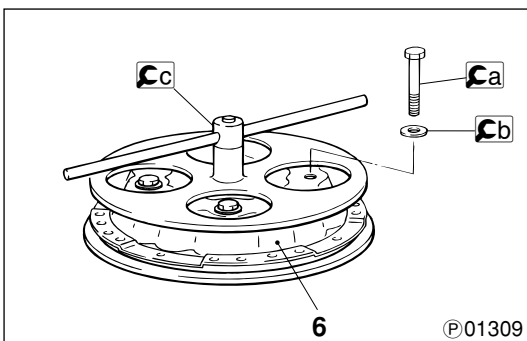
If the measured value is higher than the limit, replace the faulty parts.

* : Strap plate



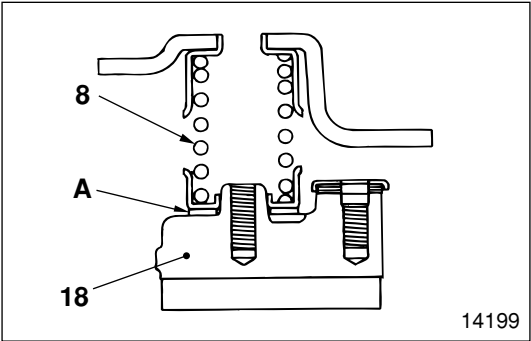
6 Removal and installation of clutch cover

- After fixing clutch cover **6** and pressure plate **18** using **Ca** stopper bolt and **Cb** washer, remove strap bolt **1**, washer **2**, lock bolt **3**, lock plate **4** and support nut **5**.



- Compress pressure spring **8** using **Cc** clutch installer, and remove **Ca** stopper bolt and **Cb** washer.
- Gradually loosen **Cc** clutch installer until pressure spring **8** is released, and remove clutch cover **6**.
- For installation, follow the removal sequence in reverse.

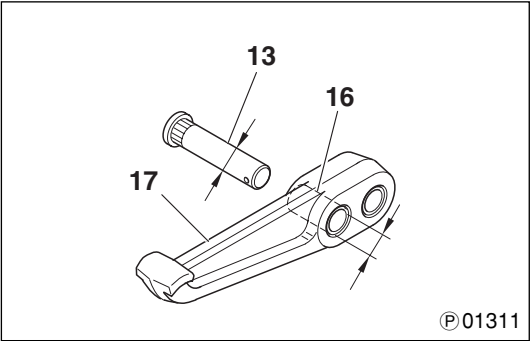
CLUTCH BODY



8 Installation of pressure spring

When grinding pressure plate **18** to correct it, insert adjusting washer **A**, equivalent to the amount of correction made by grinding, between the pressure plate and pressure spring **8**.

Amount of correction made by grinding	Thickness of adjusting washer
Less than 1 mm {0.039 in.}	Not required
1 to 2 mm {0.039 to 0.079 in.}	1.2 mm {0.047 in.}×1
2 to 3 mm {0.079 to 0.12 in.}	1.2 mm {0.047 in.}×2 or, 2.3 mm {0.091 in.}×1

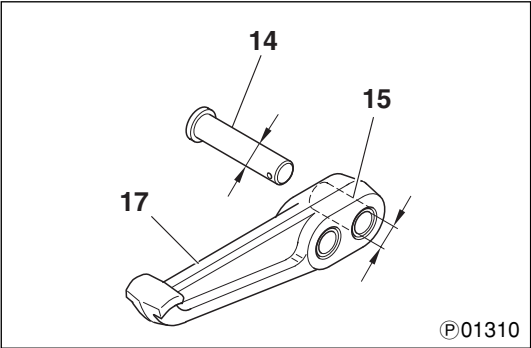


13 16 Clearance between lever support pin and bushing

If the measured value is higher than the limit, replace the faulty parts.

NOTE

This inspection must be made with bushing **16** press-fitted in release lever **17**.

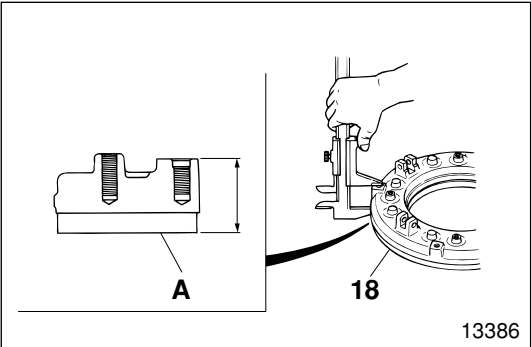


14 15 Clearance between release lever pin and bushing

If the measured value is higher than the limit, replace the faulty parts.

NOTE

This inspection must be made with bushing **15** press-fitted in release lever **17**.

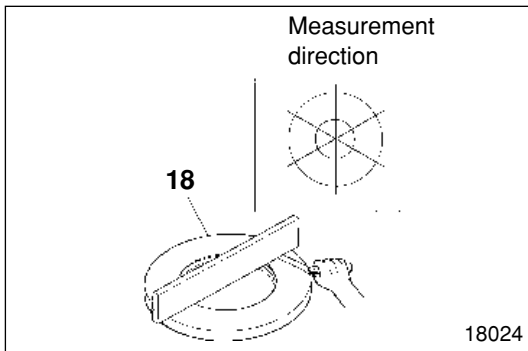


18 Inspection of pressure plate

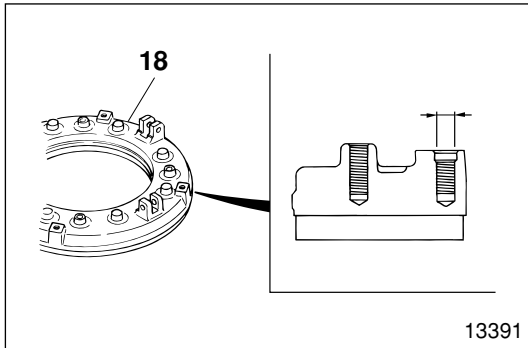
(1) Thickness

- Measure friction surface **A** of pressure plate **18** (measuring position must be within the maximum and minimum diameters), and if the measured value is lower than the limit, replace the pressure plate.

Maximum diameter	370 mm {14.6 in.}
Minimum diameter	240 mm {9.45 in.}

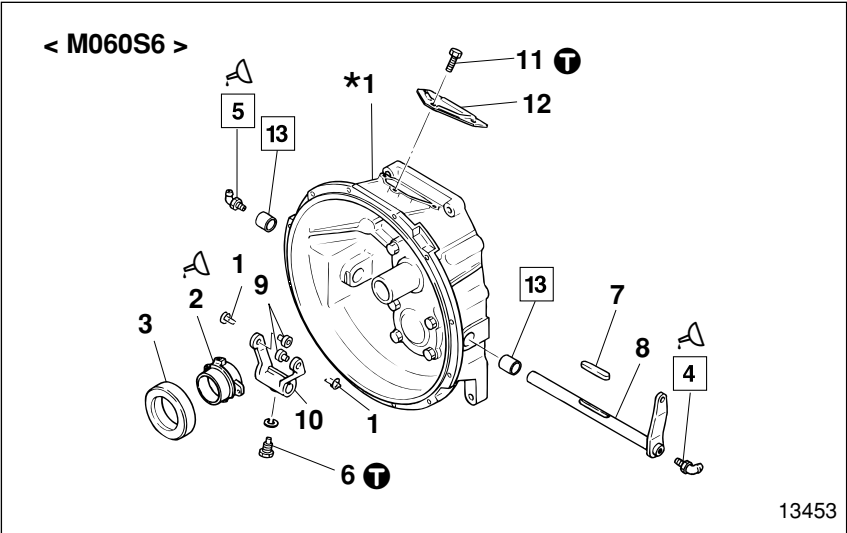
**(2) Flatness**

If the measured value is lower than the limit, replace pressure plate **18**.

**(3) Inner diameter of strap bolt fitting hole**

If the measured value is higher than the limit, replace pressure plate **18**.

CLUTCH CONTROL < M060S6, M070S6 >



● Disassembly sequence

- 1 Return spring
- 2 Clutch shifter
- 3 Release bearing
- 4 Grease nipple
- 5 Grease nipple
- 6 Set screw
- 7 Key
- 8 Release fork shaft
- 9 Cam follower
- 10 Release fork
- 11 Bolt
- 12 Cover
- 13 Needle roller bearing

* : Clutch housing  Gr 22A

NOTE

Do not remove release bearing 3 and needle roller bearing 13 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

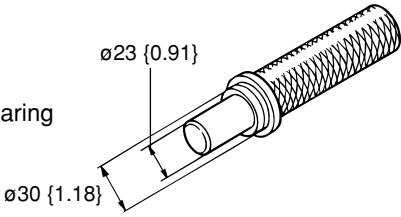
Location	Parts to be tightened	Tightening torque	Remarks
6	Set screw	21 {15, 2.1}	—
11	Bolt (Clutch housing cover mounting)	9.8 to 15 {7.2 to 11, 1.0 to 1.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Pack into clutch shifter	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
4, 5	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

Special tools

Unit : mm {in.}

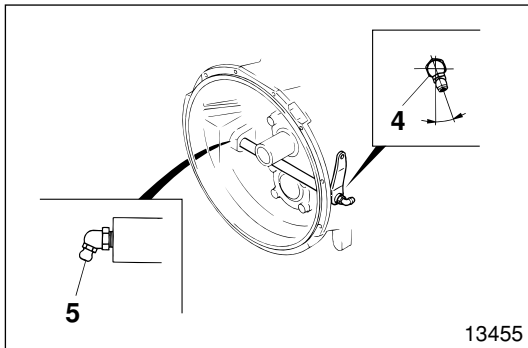
Location	Tool name and shape	Part No.	Application
13	Needle roller bearing installer 	03726-83000	Press-fitting of needle roller bearing

◆ Service procedure

4 5 Installation of grease nipple

NOTE

Install grease nipple 4, 5 so that it faces the direction as illustrated.

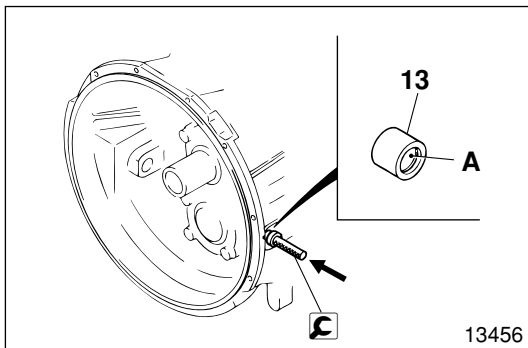


13 Installation of needle roller bearing

 Needle roller bearing installer

CAUTION

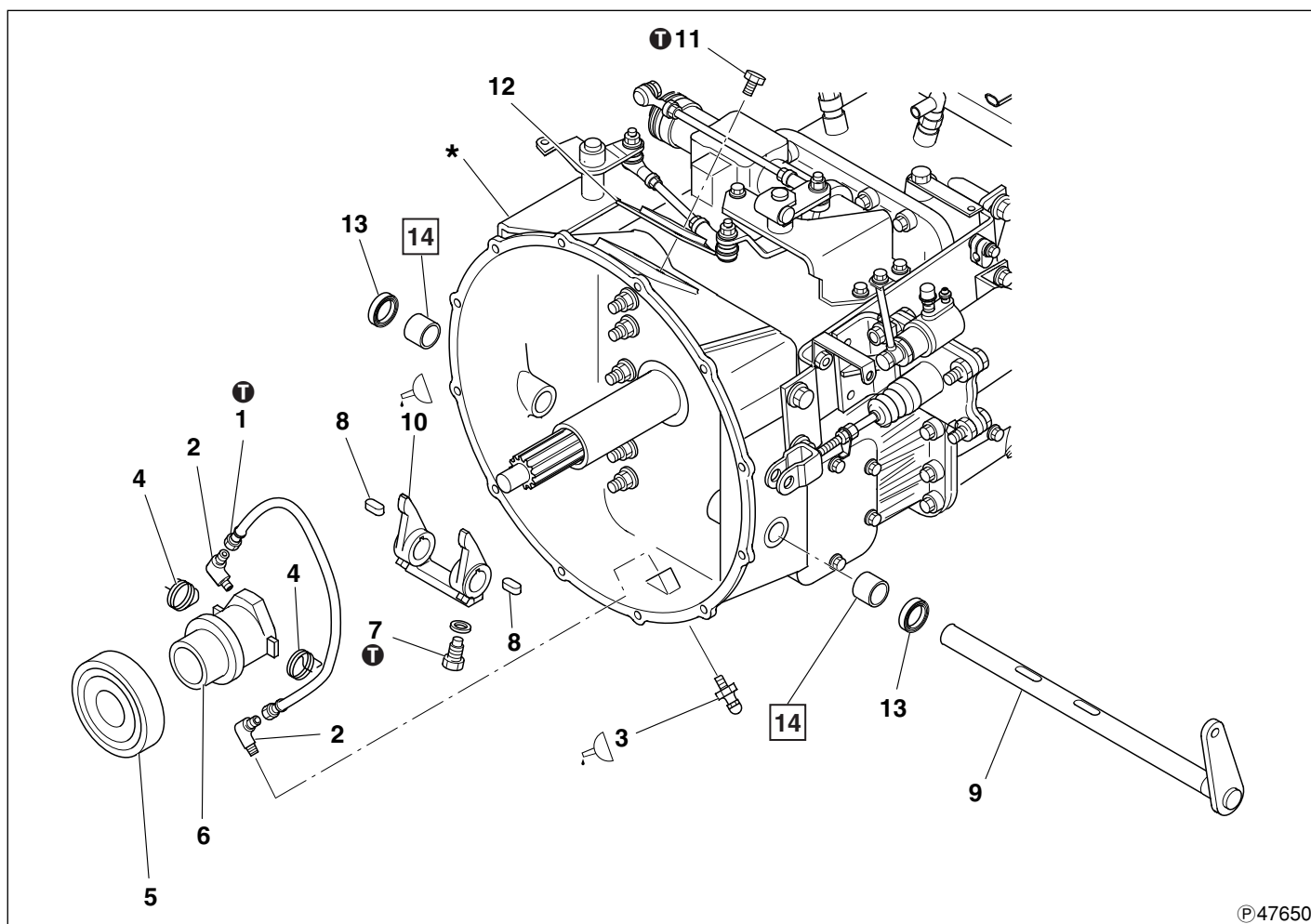
Do not damage the bearing by hitting it directly with a hammer during installation.



NOTE

Install needle roller bearing 13 so that the side with yellow sticker A faces outside.

CLUTCH CONTROL < EATON FS-8209 >



● Disassembly sequence

- | | |
|----------------------|-----------------------------|
| 1 Flexible hose | 10 Release fork |
| 2 Elbow connector | 11 Bolt |
| 3 Grease nipple | 12 Cover |
| 4 Return spring | 13 Clutch housing dust seal |
| 5 Release bearing | 14 Needle roller bearing |
| 6 Clutch shifter | |
| 7 Set screw | |
| 8 Key | |
| 9 Release fork shaft | |

* :  Gr22B

NOTE

Do not remove release bearing 5 and needle roller bearing 14 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

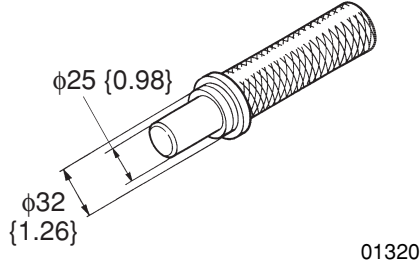
Location	Parts to be tightened	Tightening torque	Remarks
1	Flexible hose	5.9 to 10.8 {4.4 to 8.0, 0.6 to 1.1}	—
7	Set screw	20.6 {15, 2.1}	—
11	Bolt (Clutch housing cover mounting)	9.8 to 14.7 {7.2 to 11, 1.0 to 1.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3	Supply via grease nipple	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
10	Pack into clutch shifter	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
14	Needle roller bearing installer 	MH062861	Press-fitting of needle roller bearing

Service procedure

14 Installation of needle roller bearing

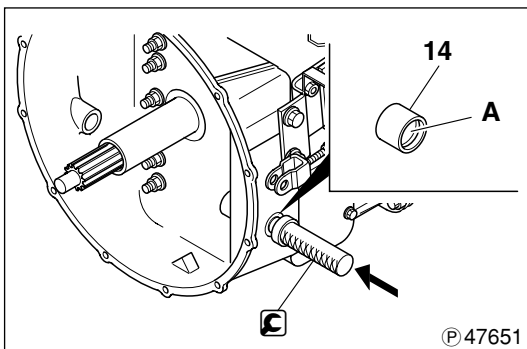
 Needle roller bearing installer

CAUTION

Do not damage the bearing by hitting it directly with a hammer during installation.

NOTE

Install needle roller bearing 14 so that the side with stamp mark A will face outside.





22A - Manual Transmission <M060S6, M070S6>

22B - Manual Transmission <M060S9 (Eaton FS-8209)>

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 22A

Manual Transmission

<M060S6, M070S6>

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	22A- 2
STRUCTURE AND OPERATION	22A- 2
TROUBLESHOOTING	22A-11
WORK BEFORE REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY	22A-12
REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY	22A-14
GEAR SHIFTER UPPER AND INTERLOCK PLATE	22A-17
POWER SHIFT ASSEMBLY	22A-22
EXTENSION HOUSING AND PARKING BRAKE ASSEMBLY	22A-28
6TH GEAR AND REVERSE IDLER GEAR < M060 >	22A-32
REVERSE GEAR AND REVERSE IDLER GEAR < M070 >	22A-40
TRANSMISSION BODY	22A-46
DRIVE PINION ASSEMBLY	22A-62
MAINSHAFT ASSEMBLY < M060 >	22A-64
MAINSHAFT ASSEMBLY < M070 >	22A-72
COUNTERSHAFT ASSEMBLY	22A-84
TRANSMISSION CONTROL	22A-88
PULLER AND INSTALLER KIT	22A-92

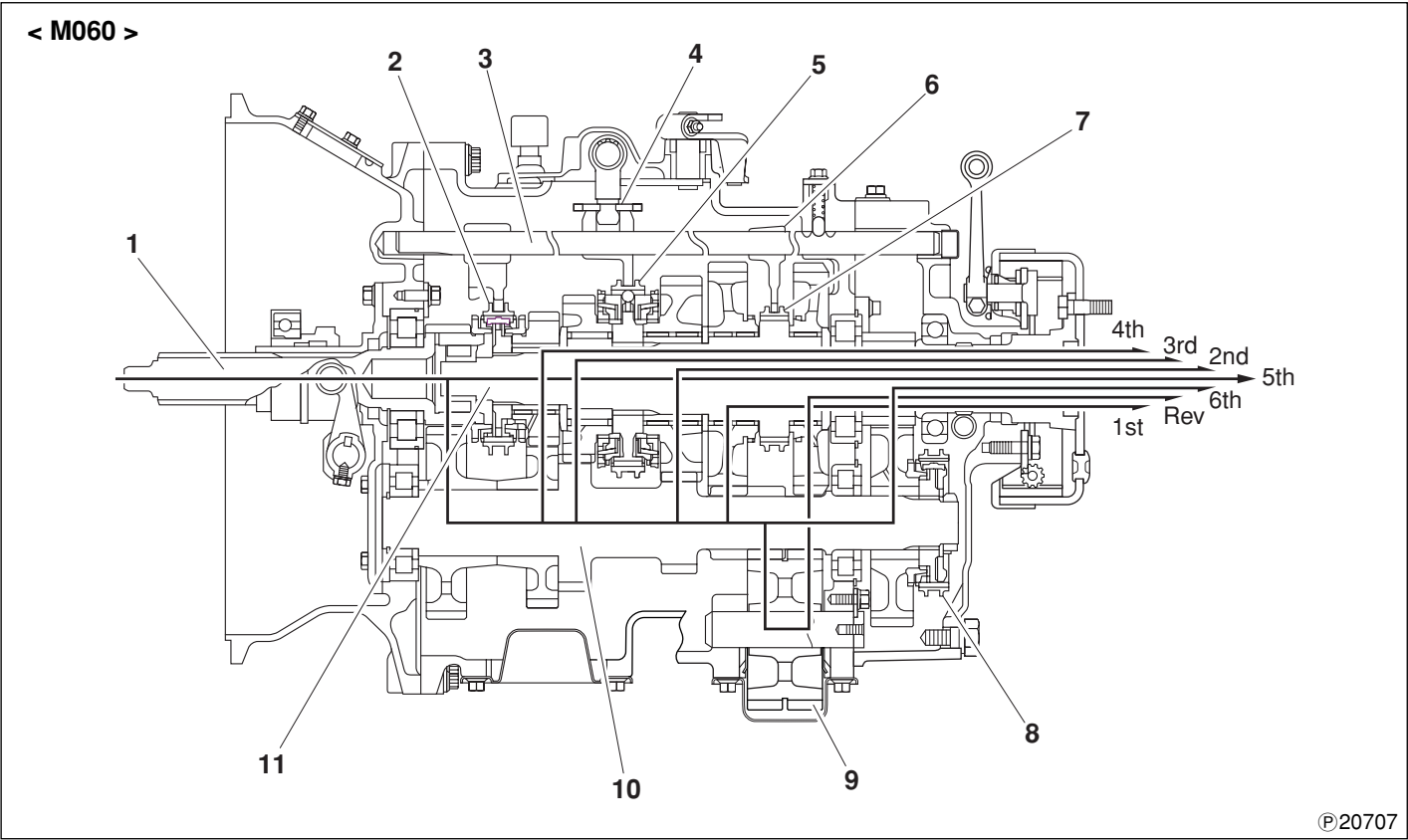
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

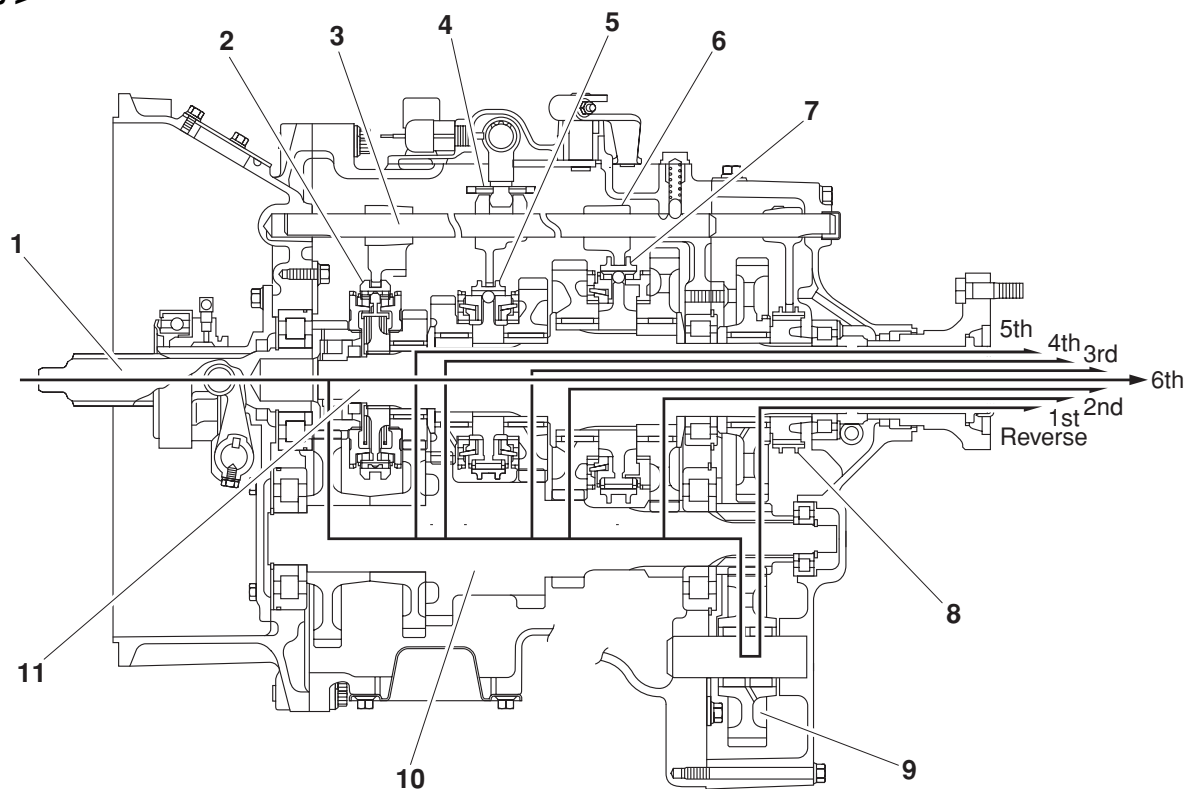
Item		Specifications	
Mode of control		Floor shift remote control	
Transmission model		M060S6	M070S6-D
Power shift	Manufacturer	Bosch Automotive Systems	
Gear ratio	1st	6.748	8.064
	2nd	4.112	5.443
	3rd	2.415	3.064
	4th	1.514	1.824
	5th	1.000	1.321
	6th	0.731	1.000
	Reverse	6.748	7.354
Oil capacity	Gear Oil	General : API GL-3 SAE 80 Warm region : API GL-3 SAE 90 Tropical region : API GL-4 SAE 90	
	Engine Oil	Long period of high-speed driving : API CC SAE 30 or SAE 40 : API CC/SF SAE 30 or SAE 40	
Quantity L {qts}		6.7 {7.1}	8.1 {8.6}
Mass	kg {lb}	156 {344}	174 {383}

STRUCTURE AND OPERATION

Transmission



< M070 >



P57797

- | | |
|--|--|
| 1 Drive pinion | 8 6th synchronizer assembly < M060 >
Reverse constant mesh < M070 > |
| 2 4th and 5th synchronizer assembly < M060 >
5th and 6th synchronizer assembly < M070 > | 9 Reverse idler gear |
| 3 Shift rail | 10 Countershaft |
| 4 Interlock mechanism | 11 Mainshaft |
| 5 2nd and 3rd synchronizer assembly < M060 >
3rd and 4th synchronizer assembly < M070 > | |
| 6 Shift fork | |
| 7 1st and reverse constant mesh assembly < M060 >
1st constant mesh and 2nd synchronizer assembly
< M070 > | |

The transmission changes revolution and torque generated by the engine into those that match the vehicle's power requirement (driving force). Revolution and torque are increased or decreased by making a selection from several sets of engaged gears. The transmission uses an interlock mechanism to avoid double engagement.

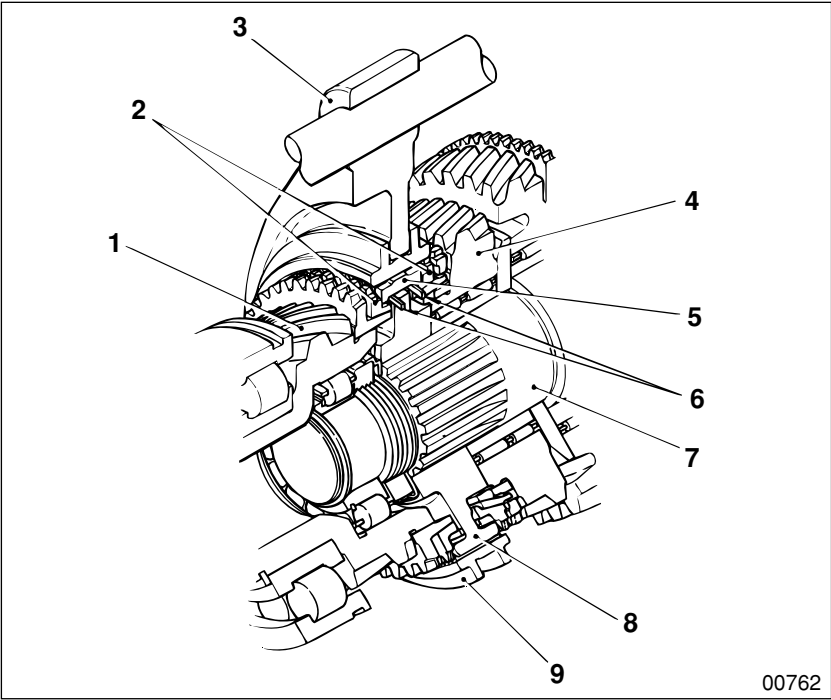
STRUCTURE AND OPERATION

Synchromesh Mechanism

This vehicle has two synchromesh mechanisms, a single cone type, and a double cone type, and uses the key system. The single or double cone type is used depending on the gear positions as shown below:

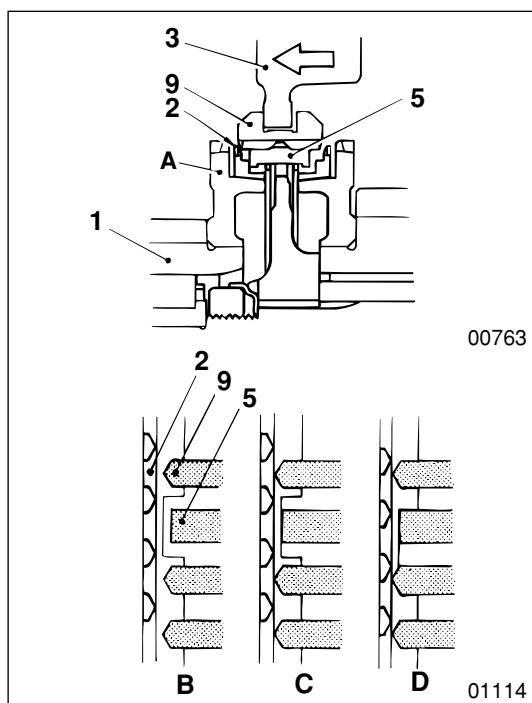
Transmission model	M060	M070
Synchromesh type		
Single cone type	4th, 5th and 6th	5th, 6th
Double cone type	2nd, 3rd	2nd, 3rd and 4th

Single Cone Type

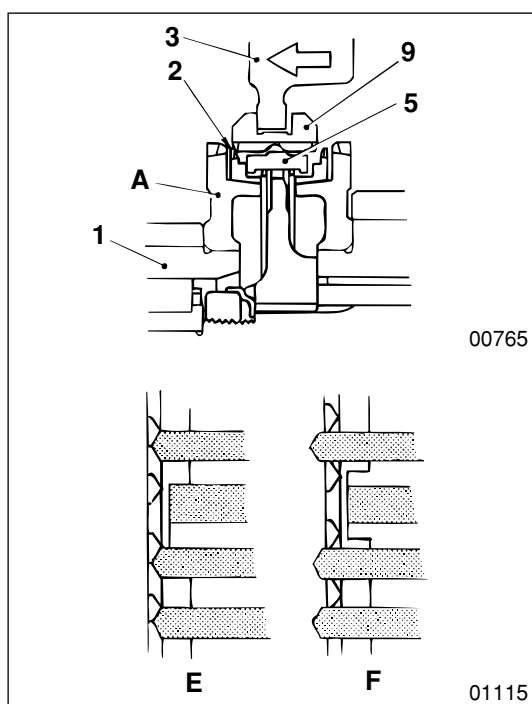


- 1 Drive pinion (Single cone type)
- 2 Synchronizer ring
- 3 4th and 5th shift fork
- 4 4th gear (Double cone type)
- 5 Shifting key
- 6 Shifting key spring
- 7 Mainshaft
- 8 Synchronizer hub
- 9 Synchronizer sleeve

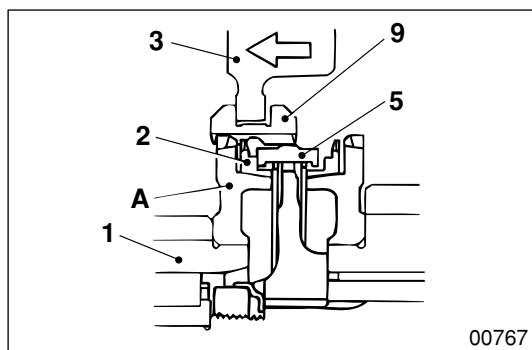
- The following descriptions are for 4th and 5th gear < M060 >
The inside of synchronizer hub **8** engages the spline of mainshaft **7** and rotates with it. The outside of the synchronizer hub has a spline that engages synchronizer sleeve **9** and three keyways.
- Shifting keys **5** are inserted into these keyways. When the gear shift is in neutral, a protrusion in the center of each shifting key engages a groove inside the synchronizer sleeve and the shifting keys are pressed against the inside of the synchronizer sleeve by shifting key springs **6**.
- Synchronizer rings **2** are inserted into drive pinions **1** in the front and rear of synchronizer hub **8**, and the taper cone of 4th gear **4**.
- The internal tapers of synchronizer rings **2** have fine threads, and the outer splines engage synchronizer sleeve **9**. On the hub side of the synchronizer rings are three keyways in which the ends of shifting keys **5** are inserted. These keyways are wider than the width of the shifting keys.
- Synchronizer rings **2** rotate relative to synchronizer sleeve **9** by the amount of play of the keyways.



- When the gear shift is in neutral (Figure B), moving shift fork 3 in the direction of the arrow as illustrated, moves synchronizer sleeve 9 slightly to the left. At the same time, shifting key 5, the central protrusion of which engages the synchronizer sleeve, moves to the left and presses synchronizer rings 2 against taper cone A of drive pinion 1. (Figure C)
- When the taper surfaces of synchronizer rings 2 make contact with the taper cone of the drive pinion, the taper surfaces of the synchronizer rings act as cone clutches. This frictional torque rotates the synchronizer rings in the rotating direction of the drive pinion by the amount of play between shifting key 5 and the synchronizer rings. The spline chamfers of the synchronizer rings and the spline chamfer of synchronizer sleeve 9 are offset from each other. (Figure D)
- The disengagement direction of synchronizer rings 2 is defined by the speed of rotation of the synchronizer—sleeve 9, and the synchronized—drive pinion 1. When increasing the vehicle speed by shifting up, disengagement is made in the opposite direction to rotation, and when decreasing the vehicle speed by shifting down, disengagement is made in the rotating direction.



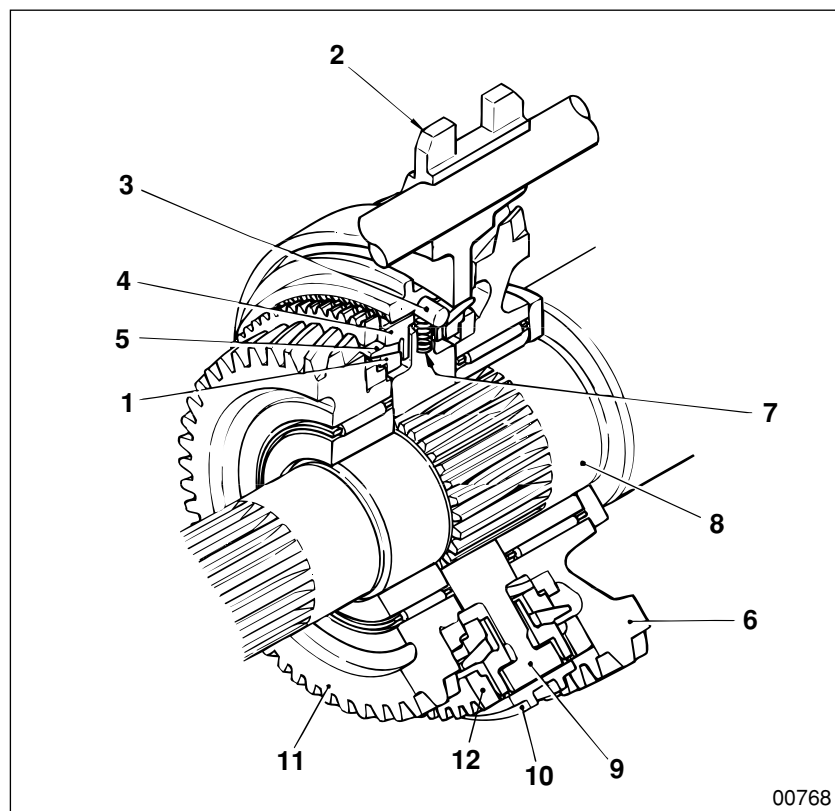
- When synchronizer sleeve 9 moves further to the left, synchronizer rings 2 prevent shifting key 5 from moving, and the synchronizer sleeve disengages from the protrusion of the shifting key.
 - Since synchronizer rings 2 remain disengaged, the spline chamfer of synchronizer sleeve 9 presses the spline chamfers of the synchronizer rings, which in turn press the synchronizer rings against taper cone A of drive pinion 1.
 - As the frictional torque increases on the taper surfaces, the relative speed of the synchronizer and the synchronized gradually decreases.
- E** : In synchronization
F : After synchronization



- When synchronizer sleeve 9 and drive pinion 1 rotate at the same speed, synchronizer rings 2 no longer prevent the synchronizer sleeve from moving, and the synchronizer sleeve moves further to the left and smoothly engages the spline of taper cone A of drive pinion 1, transmitting the driving force.

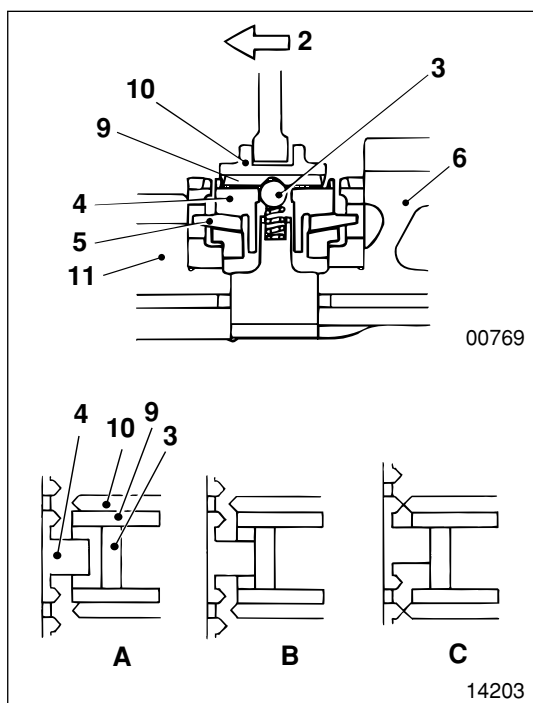
STRUCTURE AND OPERATION

Double Cone Type

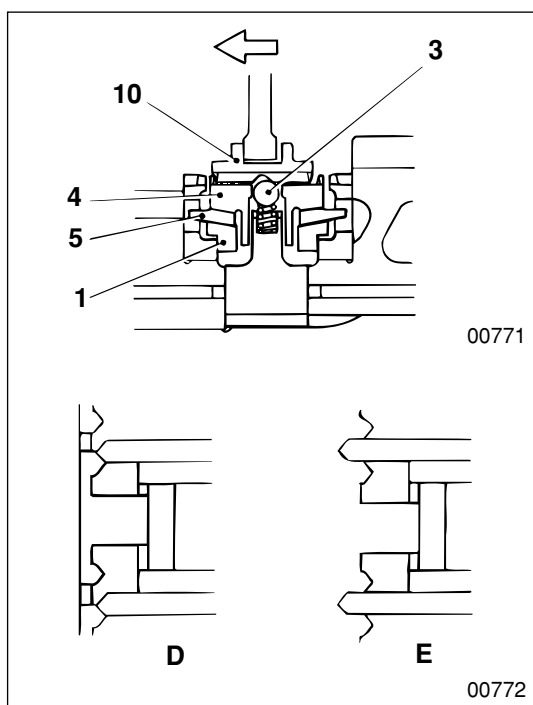


- 1 Synchronizer inner ring
- 2 2nd and 3rd shift fork
- 3 Shifting key
- 4 Synchronizer outer ring
- 5 Synchronizer center cone
- 6 2nd gear
- 7 Shifting key spring
- 8 Mainshaft
- 9 Synchronizer hub
- 10 Synchronizer sleeve
- 11 3rd gear
- 12 Dog clutch

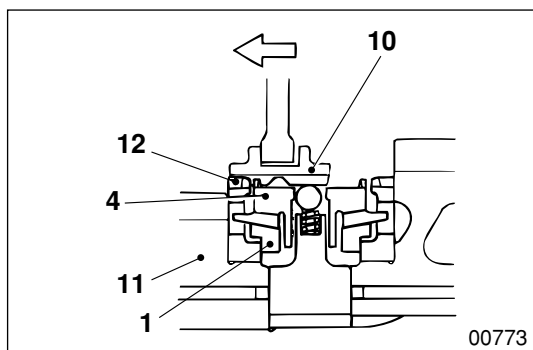
- The following descriptions are for 2nd and 3rd gear < M060 >
The synchromesh structure and operation of the double cone type are basically the same as for the single cone type.
- Synchronizer center cone **5** is a taper cone independent of 2nd gear **6** and 3rd gear **11**, (both the inside and outside surfaces are tapered). The synchronizer center cone is between synchronizer inner ring **1** and synchronizer outer ring **4** to increase the synchronization capacity.
- Six protrusions on the outside of center cone **5** fit into corresponding gear holes, in the same manner as the taper cone of the single cone type. The center cone and the gear are installed as if integrated.
Shifting key **3** is a cylinder installed so that the lengthwise direction of the cylinder is at right angles to the diameter direction of synchronizer hub **9**. Shifting key spring **7** is a coil spring inserted in a hole in the synchronizer hub, this spring presses the shifting key against the inside of synchronizer sleeve **10**.
- The 4th gear of the < M060 > model uses the double cone type; however, the structure of shifting key **3** and shifting key spring **7** is the same as for the single cone type.



- When the gear shift is in neutral (Figure **A**), moving shift fork **2** in the direction of the arrow as illustrated, moves synchronizer sleeve **10** slightly to the left. At the same time, shifting key **3**, the central protrusion of which engages the synchronizer sleeve, moves to the left and presses synchronizer outer ring **4** against synchronizer center cone **5**. (Figure **B**)
- When the taper surface of synchronizer outer ring **4** makes contact with the taper cone of synchronizer center cone **5**, the taper surface of the synchronizer outer ring acts as a cone clutch. This frictional torque rotates the synchronizer outer ring in the rotating direction of 3rd gear **11** by the amount of play between the synchronizer outer ring and synchronizer hub **9**. The spline chamfer of the synchronizer outer ring and the spline chamfer of synchronizer sleeve **10** are offset from each other. (Figure **C**)
- The disengagement direction of synchronizer outer ring **4** is defined by the speed of rotation of the synchronizer—the sleeve, and the synchronized—3rd gear **11**. When increasing the vehicle speed by shifting up, disengagement is made in the opposite direction to rotation, and when decreasing the vehicle speed by shifting down, disengagement is made in the rotating direction.



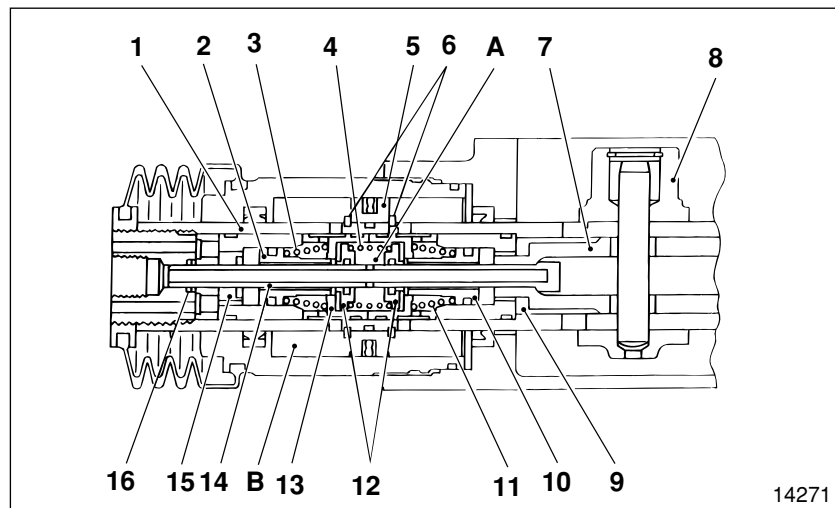
- When synchronizer sleeve **10** moves further to the left, synchronizer outer ring **4** prevents shifting key **3** from moving, and the synchronizer sleeve disengages from the protrusion of the shifting key.
 - Since synchronizer outer ring **4** remains disengaged, the spline chamfer of synchronizer sleeve **10** presses the spline chamfer of the synchronizer outer ring, which in turn presses the synchronizer outer ring against the taper cone of synchronizer center cone **5**, and the frictional torque acts on the taper surface.
 - As the frictional torque increases on the taper surface of synchronizer inner ring **1**, the relative speed of the synchronizer and the synchronized gradually decreases. The frictional torque acts on both sides of the synchronizer center cone. The double cone type has greater capacity for synchronization than the single cone type.
- D** : In synchronization
E : After synchronization



- When synchronizer sleeve **10** and 3rd gear **11** rotate at the same speed, synchronizer outer ring **4** no longer prevents the synchronizer sleeve from moving and the synchronizer sleeve moves further to the left and smoothly engages the spline of dog clutch **12** of the 3rd gear, transmitting the driving force.

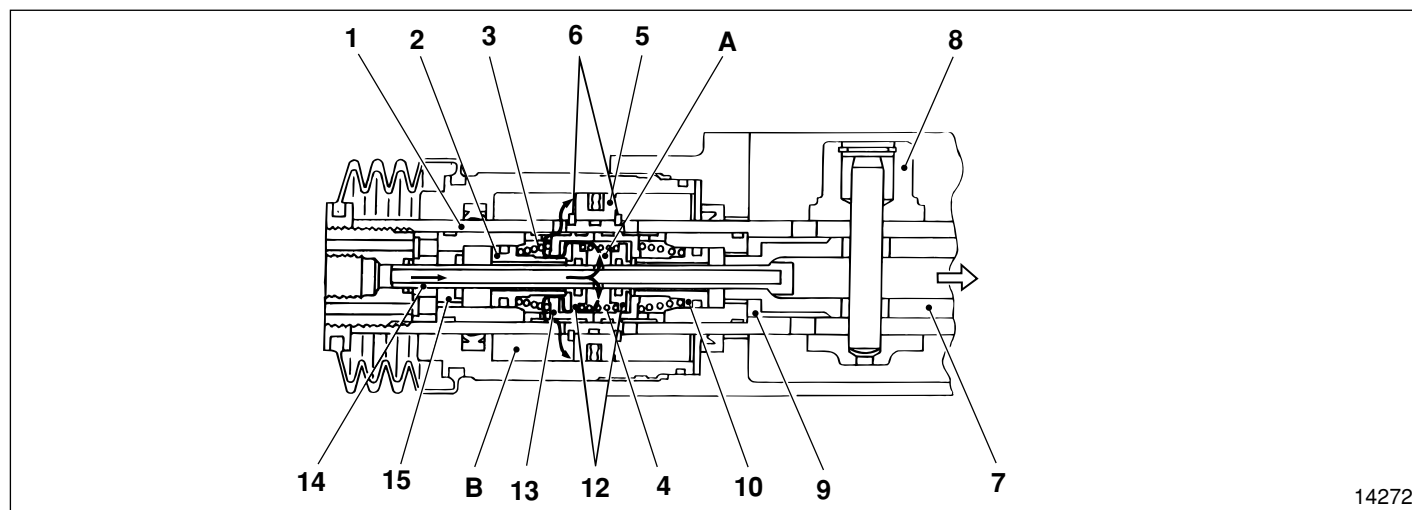
STRUCTURE AND OPERATION

Power Shift



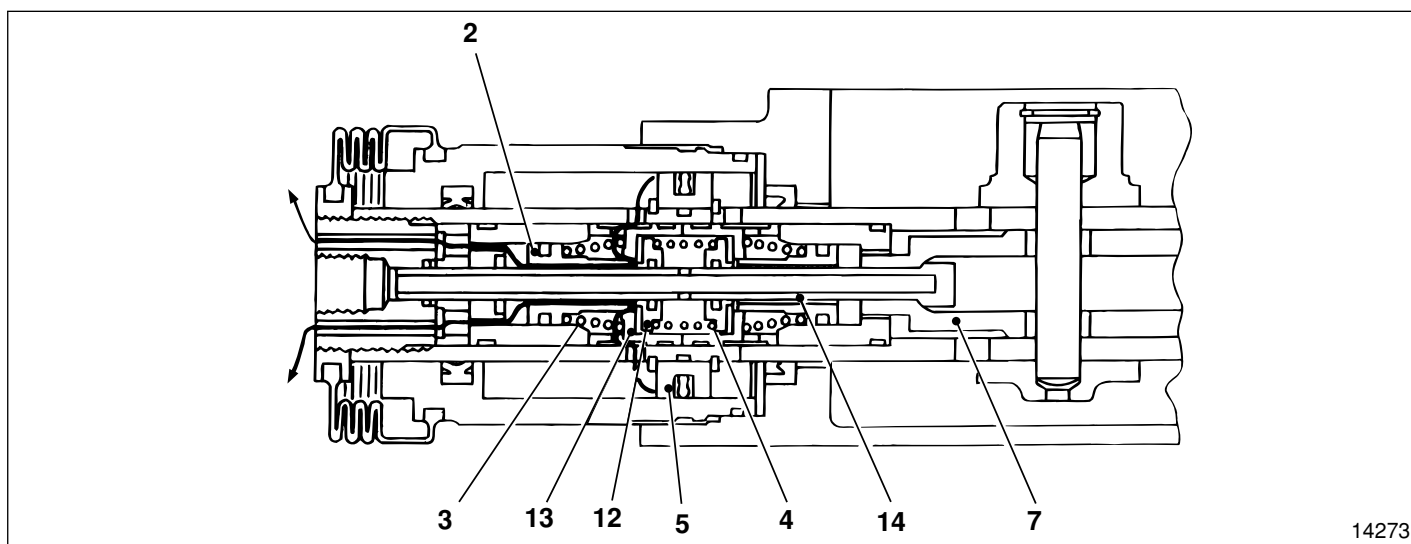
- 1 Shifter rod
- 2 Valve lifter
- 3 No.3 spring
- 4 No.2 spring
- 5 Piston
- 6 Retaining ring
- 7 Actuating rod
- 8 Striker
- 9 Cap
- 10 Valve lifter
- 11 No.1 spring
- 12 Valve seal
- 13 Valve seat
- 14 Pipe
- 15 Retainer
- 16 Retaining ring

A : Primary side chamber
B : Secondary side chamber



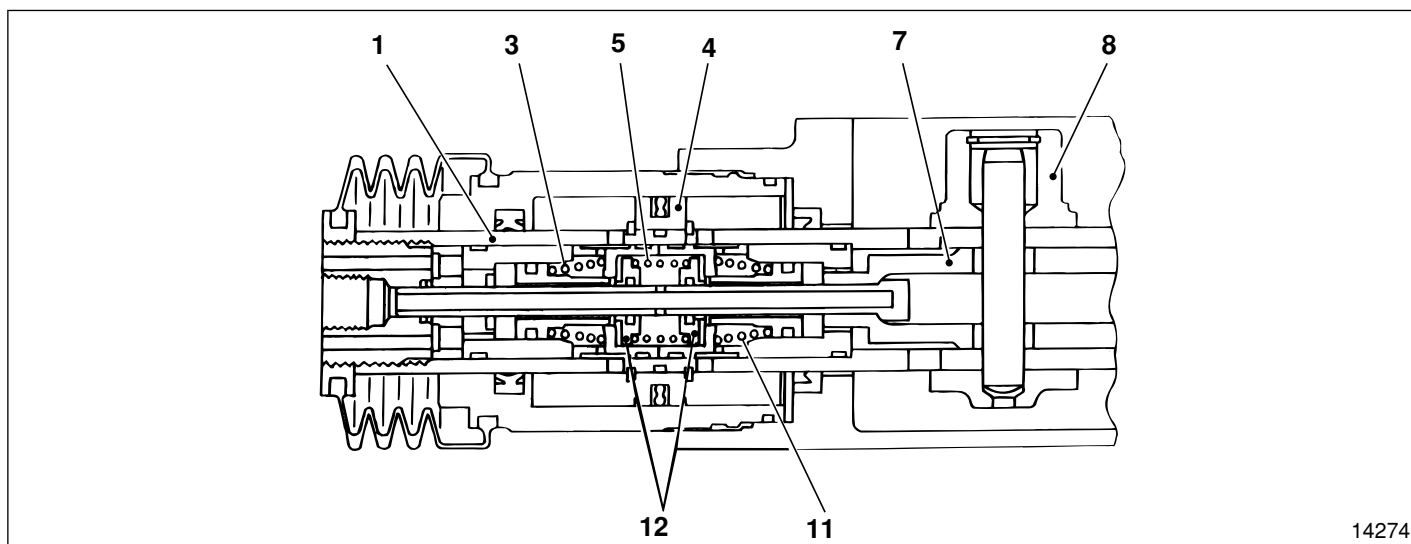
When activated

- When actuating rod 7 is moved in the direction of the arrow as illustrated, shifter rod 1 and the actuating rod move relative to this movement.
Valve lifter 2 presses No.3 spring 3 against valve seal 12 to overcome the combined percussive forces of the compressed air acting on the valve seal and No.2 spring 4. The valve seal separates from valve seat 13, and the compressed air supplied to primary side chamber A is let into secondary side chamber B via the opening between the valve seat and the valve seal. The compressed air flows into the cylinder through the hole and groove of the valve seal and the vent hole of shifter rod 1 to put pressure on piston 5, generating output.
- The output given to piston 5 is transmitted to shifter rod 1 via retaining ring 6 to assist striker 8 which is fixed on the shifter rod. This operates the shift fork on the transmission side, shifting the gears. Thus, gear shifting is completed.
- When the power shift operates in the direction of the arrow as illustrated, the input from the gear shift lever is transmitted by actuating rod 7 via cap 9, pipe 14, and retainer 15 fixed on retaining ring 16. For operation in the opposite direction, all operations are the same in principle as in the direction of the arrow as illustrated, except that the end of the cap, fixed on the end of the actuating rod, presses valve lifter 10 directly.



When releasing

- When gear shifting is completed and the input is released, actuating rod **7** is returned to the valve center position (the condition before operation) by the combined percussive forces of the compressed air of valve lifter **2**, the steel ball, and valve springs **3**, **4**.
As the valve lifter returns, valve seal **12** seats against valve seat **13**, cutting off the flow of compressed air from primary side chamber **A** to secondary side chamber **B**. As the input rod returns, clearance is generated between the valve lifter and the valve seal.
- The compressed air in the cylinder of secondary side chamber **B** is discharged into the atmosphere through the clearance between valve lifter **2** and pipe **14**. This eliminates the pressure difference between the chambers on both sides of piston **5**, so output is lost.

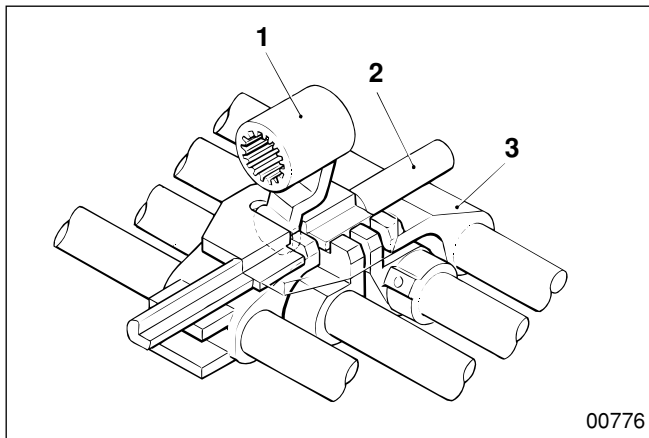


When not operating (non-boosting)

- To operate the power shift, that is, to open the valve and let the compressed air into the output chamber, actuating rod **7** on the input side and shifter rod **1** on the output side must generate relative disengagement.
- When the operating force is transmitted from the gear shift lever to actuating rod **7**, and the resistance on the transmission side is less than the combined percussive forces working on the relative disengagement of the input side and output side (percussive forces of No.1 to 3 springs, **3**, **4**, **11**; pressure on valve seal **12**; and sliding resistance on various parts), the mechanism, from the actuating rod to striker **8**, is integrated and does not generate relative disengagement. Therefore, the valve does not open, and without boosting operation, piston **5** moves in the cylinder to shift gears.

STRUCTURE AND OPERATION

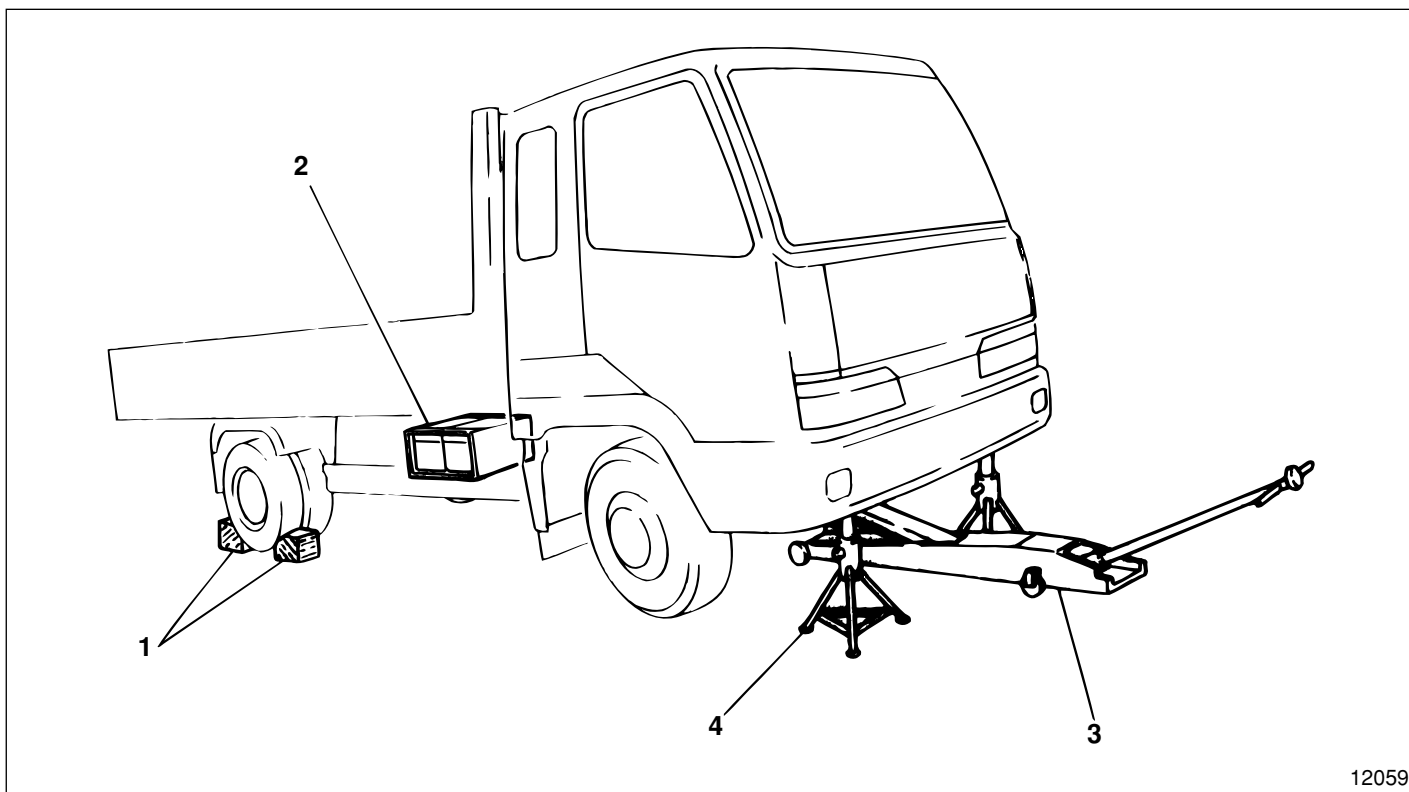
Interlock Mechanism



In the interlock mechanism, the rail beneath interlock plate **2** locks jaws **3**, (apart from the jaws shifted by gear shift slide lever **1**), preventing double engagement of gears.

Possible causes		Symptoms				
		Gears slip out of engagement	Gears hard to engage	Noise when engine is idling	Noise while cruising	Noise when changing gear
Transmission body faulty	Mainshaft rear lock nut loose	☐	☐			
	Mainshaft thrust washer worn	☐	☐			
	Mainshaft bearing worn or damaged	☐	☐			
	Synchronizer ring and synchronizer sleeve spline worn	☐				
	Synchronizer ring and gears taper cone area worn		☐			
	Mainshaft pilot bearing worn or damaged			☐	☐	
	Drive pinion bearing worn or damaged			☐		
	Countershaft bearing worn or damaged			☐		
	Needle bearings of gears worn or damaged			☐	☐	
	Mainshaft and countershaft bearings worn or damaged				☐	
	Mainshaft and countershaft gears backlash excessive				☐	
	Spline of gears worn					☐
	Gears damaged				☐	
	Gear oil insufficient				☐	
Control mechanisms faulty	Control cable joint play	☐	☐			
	Set board assembly bushings worn	☐				
	Shift rail steel ball and groove worn	☐				
	Shift rail poppet spring fatigued or damaged	☐				
	Shift rail sliding movement faulty		☐			
	Shift fork jaws worn		☐			
	Shift fork bent		☐			
Power shift malfunctioning	Air compressor faulty	 Gr 35A, B		☐		
	Air leakage			☐		
	Power shift assembly faulty			☐		
Clutch faulty	Clutch disengagement faulty	 Gr 21		☐		☐
	Clutch pedal play faulty			☐		
Synchronizer faulty	Contacting surfaces of synchronizer ring and gear taper cone worn					☐
	Shifting key worn					☐
	Shifting key spring deteriorated or damaged					☐
	Synchronizer sleeve worn or damaged				☐	☐

WORK BEFORE REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY



● Work sequence before removal

- 1 Place wheel chocks.
- 2 Disconnect negative battery cable.  Gr 54
- 3 Jack up the front axle on a garage jack.
- 4 Support the front frame on rigid racks.

WARNING

- Since the parking brake will be removed, naturally it cannot be used. Therefore, you must chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Keep the transmission in neutral throughout the operation.

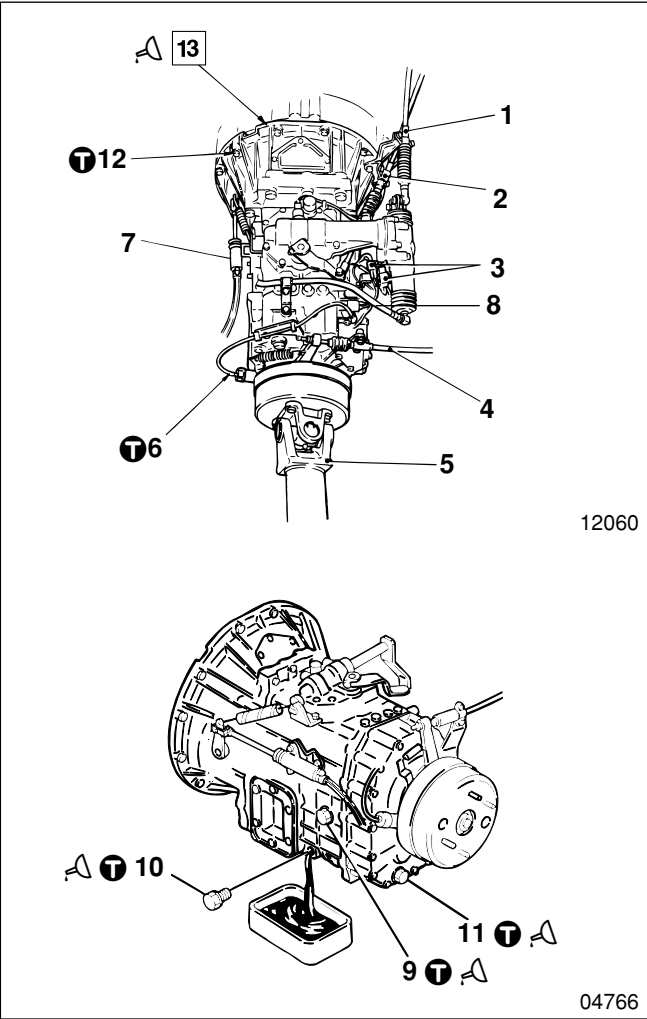
● Work sequence after installation

Follow the work sequence before removal in reverse.

MEMO

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY

Removal and Installation



● Disassembly sequence

- 1 Shift cable P22A-88
- 2 Selector cable P22A-88
- 3 Harness connector
- 4 Parking brake cable < M060 > Gr 36A
- 5 Propeller shaft Gr 25
- 6 Vehicle speed sensor Gr 54
- 7 Clutch power cylinder Gr 21
- 8 Air tube
- 9 Inspection plug
- 10 Drain plug
- 11 Drain plug
- 12 Nut or bolt
- 13 Transmission assembly

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Vehicle speed sensor	24.5±4.9 {18±3.6, 2.5±0.5}	—
8	Air tube	20 to 28 {15 to 21, 2.0 to 2.9}	—
9	Inspection plug	69±15 {50.9±11, 7±1.5}	—
10, 11	Drain plug	69±15 {50.9±11, 7±1.5}	—
12	Nut or bolt (Transmission mounting)	40.2 {30, 4.1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
9	Thread area of inspection plug	THREEBOND 1105	As required
10, 11	Thread area of drain plug	THREEBOND 1105	As required
13	Spline of drive pinion	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure

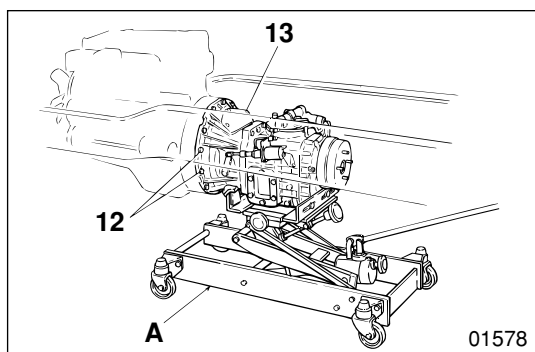
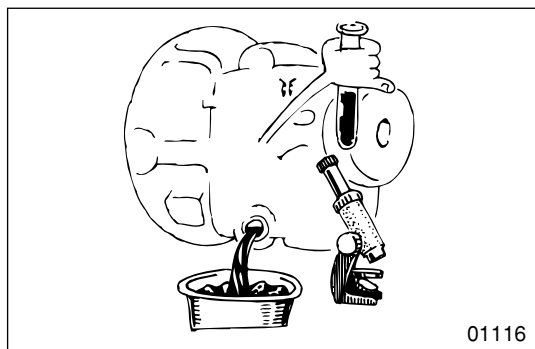
● Oil change

[Draining]

- When draining oil, check the quantity and quality of oil, especially for small pieces of metal and metal dust.
- Clean drain plug **9** before reinstalling it because it is magnetic.

[Filling]

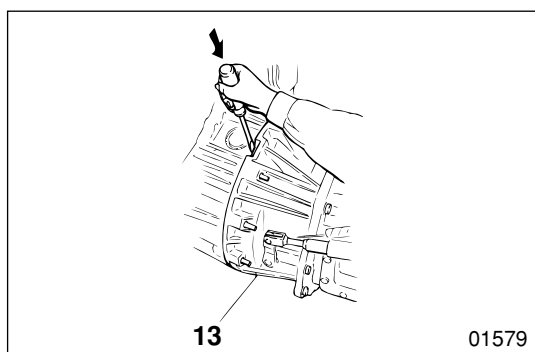
- Check that drain plugs **10, 11** are tightened at specified torque.
- Pour in gear oil until the oil overflows from the inspection hole. (For oil quantity, see specifications.)



13 Removal of transmission assembly

[Removal]

- Support transmission assembly **13** on transmission jack **A**.
- Tighten transmission mounting nuts or bolts **12**.

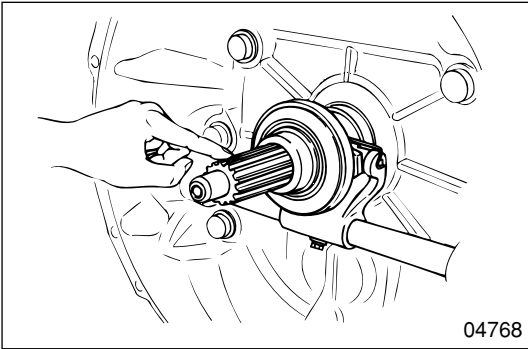


- Insert a screwdriver into the three removal grooves and pry transmission assembly **13** from the engine.
- Move transmission assembly **13** backward until the spline of the drive pinion is detached from the clutch.

CAUTION ⚠

- Make sure that you remove hoses and cables before starting service operations.
- Make sure that you pull transmission assembly **13** out in a straight line. If you seesaw the transmission assembly violently, you will damage the spline that connects the drive pinion and the clutch.

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY

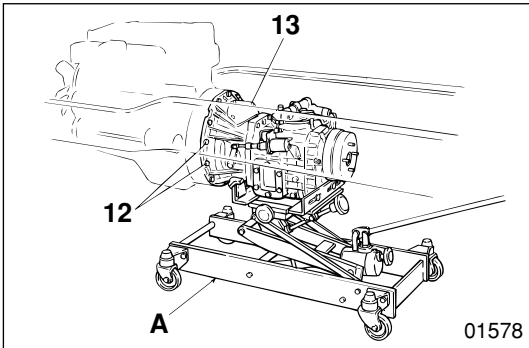


[Installation]

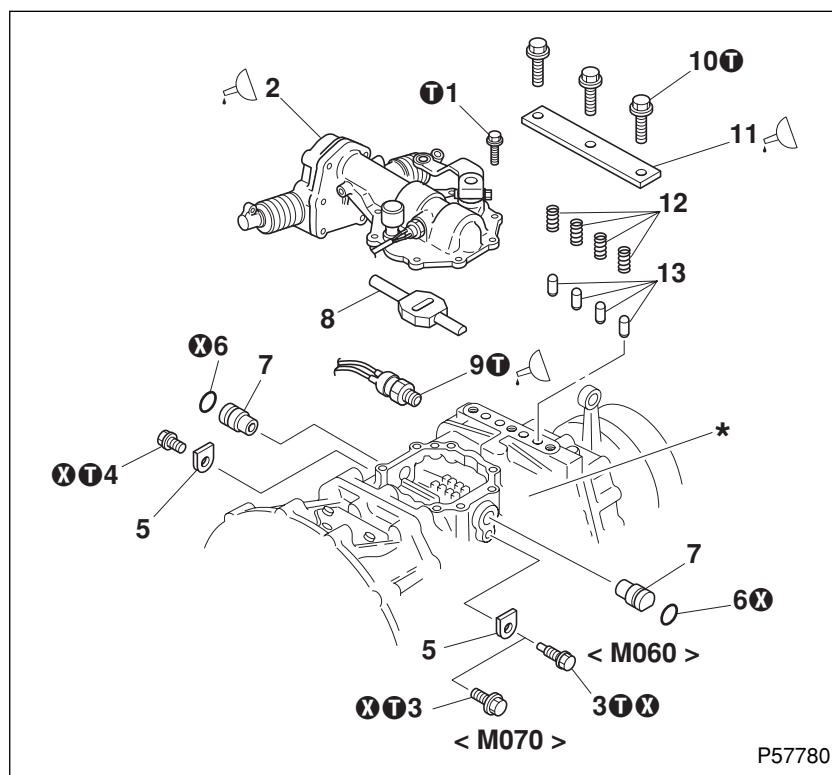
- Check the spline of the drive pinion for rust.
- If rust is found, remove it using a wire brush.
- Rub grease onto the clutch disc sliding surfaces of the drive pinion using your hand.

CAUTION ⚠

Make sure that you apply only the necessary amount of grease because too much grease would drip and cause clutch slip.



- Support transmission assembly **13** on transmission jack **A**, and insert the transmission assembly into the pilot bearing of the flywheel paying attention to the drive pinion spline.
- Tighten transmission mounting nuts or bolts **12** at specified torque.



● Disassembly sequence

- 1 Bolt
- 2 Gear shifter upper assembly
P22A-18
- 3 Jaw set bolt < M060 >
Bolt < M070 >
- 4 Bolt
- 5 Lock plate
- 6 O-ring
- 7 Bushing
- 8 Interlock plate
- 9 Backup lamp switch Gr 54
- 10 Bolt
- 11 Poppet spring plate
- 12 Poppet spring
- 13 Interlock pin

* : Transmission body

X : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
7, 8	Clearance between interlock plate axis and bushing	[12 {0.47}] 0.07 to 0.15 {0.0028 to 0.0059}	0.3 {0.012}	Replace
12	Poppet spring load (Installed length 30.2 {1.19})	115 N {26 lbs, 12 kgf}	92 N {21 lbs, 9.6 kgf}	Replace

T Tightening torque

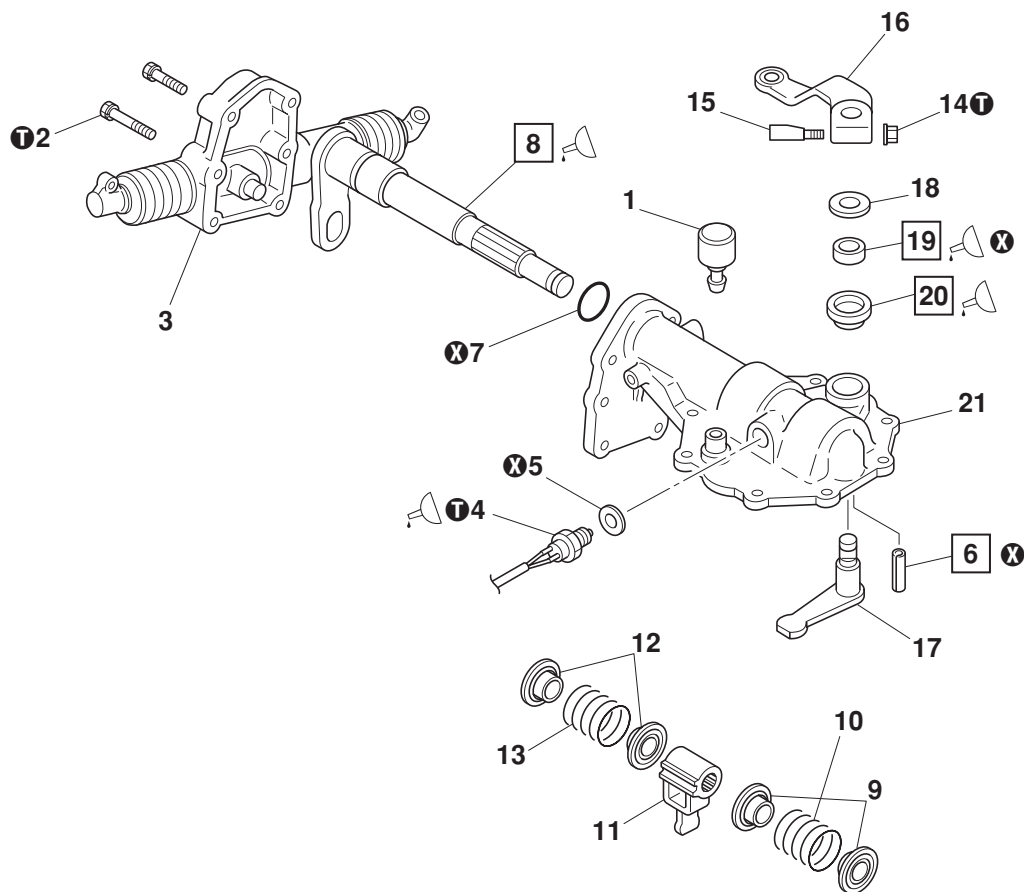
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Gear shifter upper mounting)	22.6 {17, 2.3}	—
3	Jaw set bolt	133 {98, 13.6}	—
	Bolt (Lock plate mounting)	133 {98, 13.6}	—
4	Bolt (Lock plate mounting)	40.2 {30, 4.1}	—
9	Backup lamp switch	49 {36, 5.0}	—
10	Bolt (Poppet spring plate mounting)	22.6 {17, 2.3}	—

L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Contact surface with transmission case	THREEBOND 1104J	As required
9	Thread area of backup lamp switch	THREEBOND 1104J	As required
11	Contact surface with transmission case	THREEBOND 1215	As required

GEAR SHIFTER UPPER AND INTERLOCK PLATE



P52438

● Disassembly sequence

- | | | |
|--|-----------------------------|------------------------|
| 1 Air breather | 8 Gear shift lever | 17 Gear selector lever |
| 2 Bolt | 9 Return spring retainer | 18 Washer |
| 3 Power shift assembly
P22A-22 | 10 Return spring | 19 Oil seal |
| 4 Transmission neutral switch
Gr 54 | 11 Gear shift sliding lever | 20 Bushing |
| 5 Gasket | 12 Return spring retainer | 21 Selector lever case |
| 6 Spring pin | 13 Return spring | |
| 7 O-ring | 14 Nut | |
| | 15 Lock pin | |
| | 16 Gear selector lever | |

✕ : Non-reusable parts

NOTE

Do not remove bushing 12 except for replacement.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
10	Return spring B load (Installed length 23.6 {0.93})	92 N {21 lbf, 9.4 kgf}	78 N {18 lbf, 8.0 kgf}	Replace
13	Return spring A load (Installed length 27.6 {1.09})	94 N {21 lbf, 9.6 kgf}	80 N {18 lbf, 8.2 kgf}	Replace
17	Play in axial direction of gear selector lever A	0.3 to 0.6 {0.012 to 0.024}	—	Replace

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

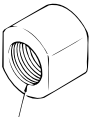
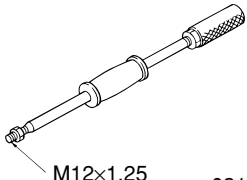
Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Power shift assembly mounting)	40.2 {30, 4.1}	—
4	Neutral switch	34.3 to 39.2 {25 to 29, 3.5 to 4.0}	—
14	Nut (Lock pin mounting)	16.7 {12, 1.7}	—

L Lubricant and/or sealant

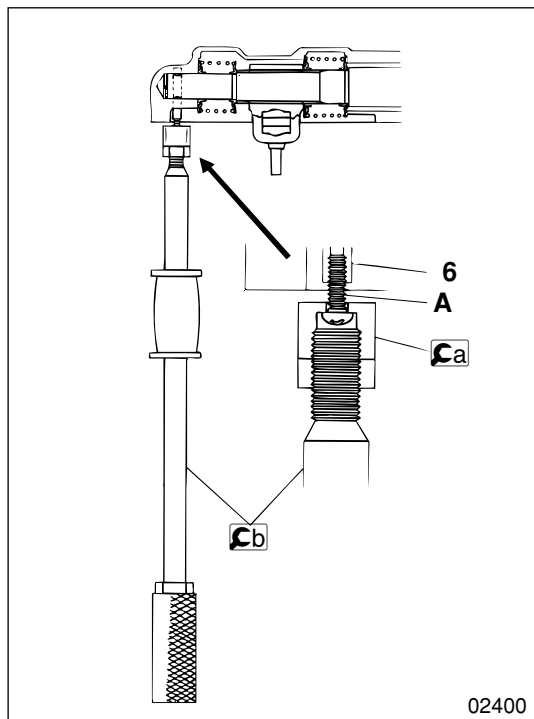
Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Thread area of neutral switch	THREEBOND 1104	As required
8	Gear shift lever O-ring groove	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
19	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
20	Inner surface of gear selector lever A axis bushing and its friction surface	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
	Contact surfaces between bushing outer surface and case	THREEBOND 1215	As required

C Special tools

Unit : mm {in.}

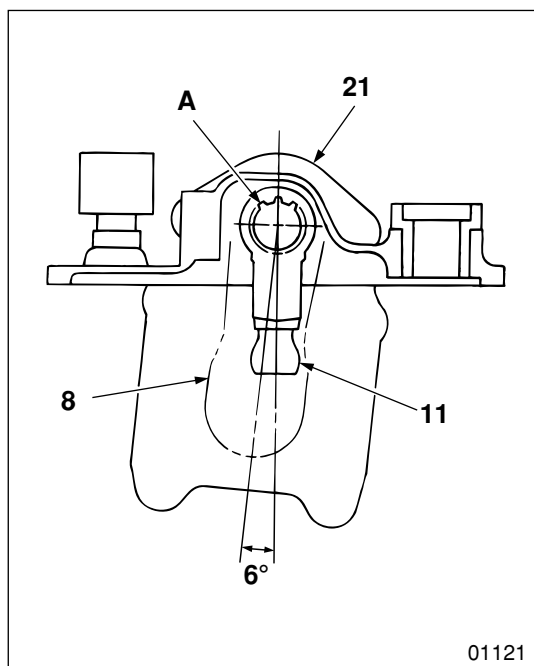
Location	Tool name and shape	Part No.	Application
6	Spring pin puller  M12×1.25 02399	MH062445	Removal of spring pin
	Reverse shaft puller  M12×1.25 02118	03726-82000	

GEAR SHIFTER UPPER AND INTERLOCK PLATE



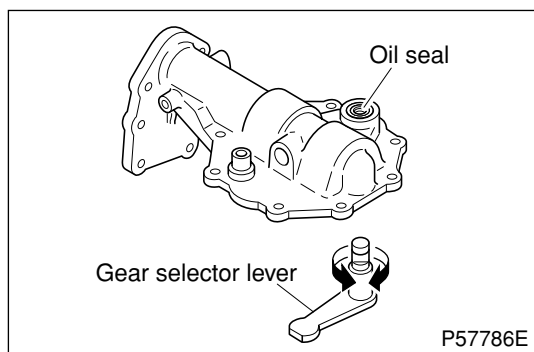
6 Removal of spring pin

- Tap spring pin 6 using an M4 tap.
- Insert **Ca** spring pin puller with an M4 thread **A** of appropriate length into spring pin 6.
- Position **Cb** reverse shaft puller on **Ca** spring pin puller.
- Remove spring pin 6 from selector lever case 21 using **Ca** spring pin puller and **Cb** reverse shaft puller.



8 11 Installation of gear shift slide lever and gear shift lever

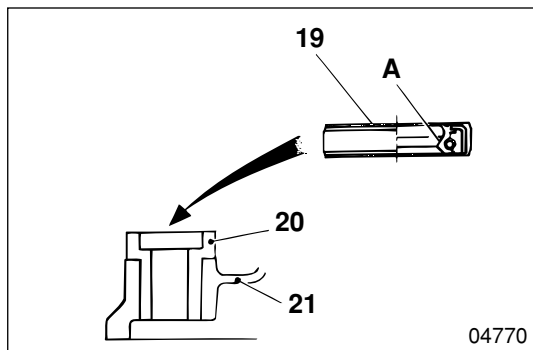
When you install gear shift sliding lever 11 in gear shift lever 8, position spline **A** so that the angle between the slide lever and the shift lever is as illustrated.



17 Installation of gear selector lever

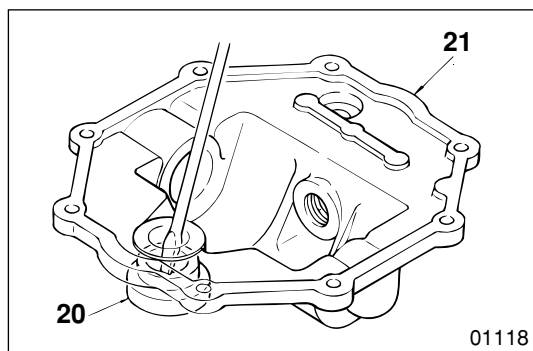
Turn the gear selector lever when installing it in order to prevent damage to the oil seal lip.

◆ Service procedure



19 Installation of oil seal

- Apply grease to lip area **A** of oil seal **19**.
- Press-fit oil seal **19** into bushing **20** in the direction as illustrated.



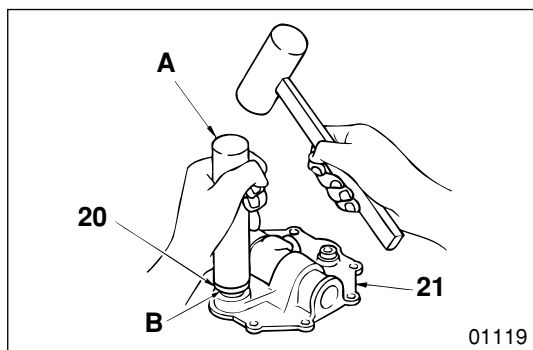
20 Bushing

[Removal]

Remove bushing **20** from selector lever case **21** using a screwdriver.

CAUTION ⚠

Be careful not to damage selector lever case **21**.



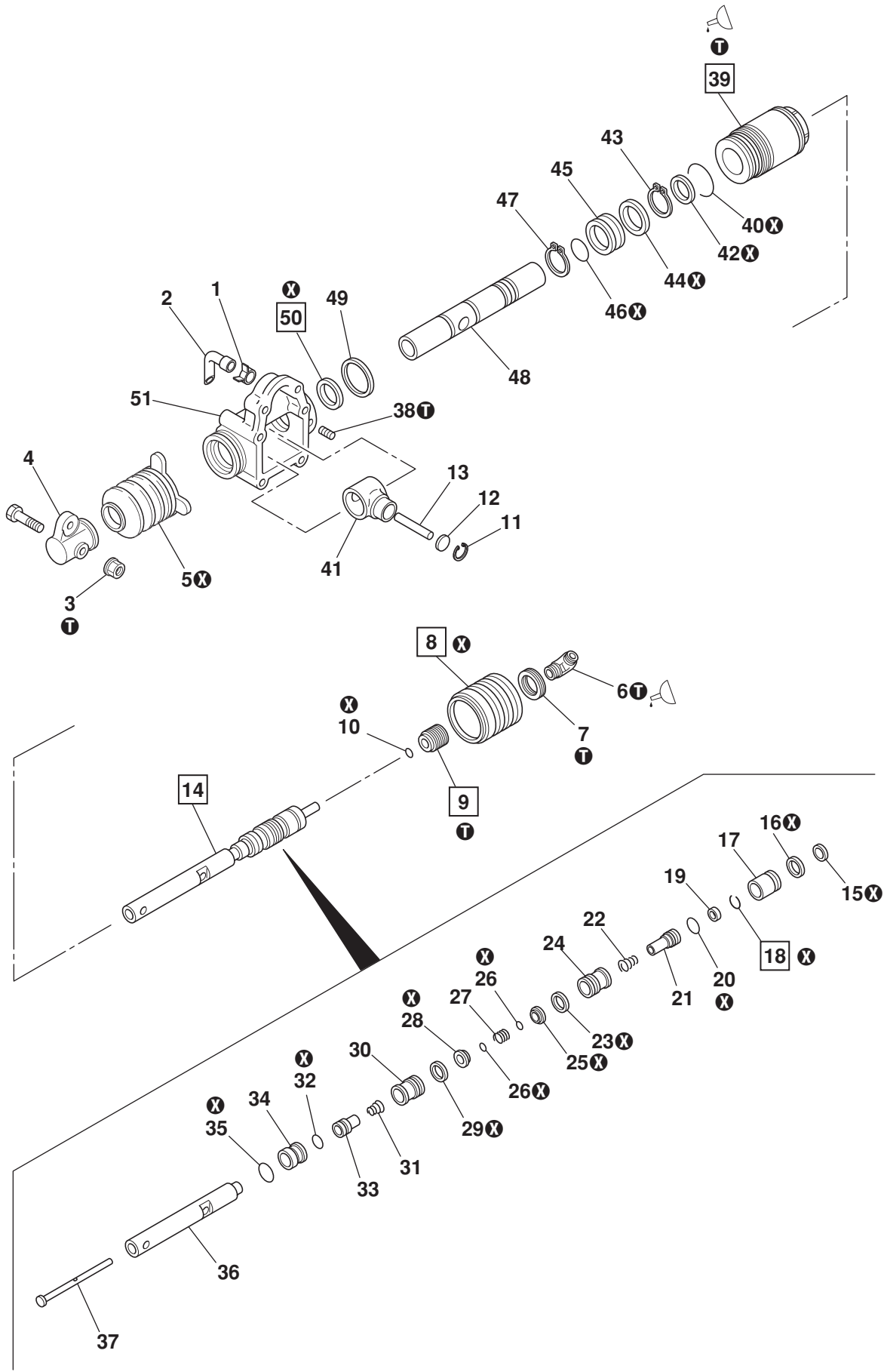
[Installation]

- Clean the inner surface of selector lever case **21**.
- Press-fit bushing **20** into selector lever case **21** using bar **A** (approximately $\varnothing 40$ mm {1.57 in.}).
- When press-fitting bushing **20**, take care not to damage selector lever case **21**.
- After press-fitting, apply sealant to press-fitted side **B** of bushing **20**.

CAUTION ⚠

Prevent sealant from sticking to the inner surface of bushing **20**.

POWER SHIFT ASSEMBLY



● Inspection before disassembly

📖 P22A-24

● Disassembly sequence

1 Clamp	19 Retainer	37 Pipe
2 Hose	20 O-ring	38 Set screw
3 Nut	21 Lifter	39 Cylinder
4 Lever	22 Spring	40 O-ring
5 Boot	23 Square ring	41 Striker
6 Connector	24 Seat	42 Packing
7 Nut	25 Seal assembly	43 Retaining ring
8 Boot	26 O-ring	44 Piston packing
9 Connector	27 Spring	45 Piston
10 O-ring	28 Seal assembly	46 O-ring
11 Retaining ring	29 Square ring	47 Retaining ring
12 Plate	30 Seat	48 Shifter rod
13 Straight pin	31 Spring	49 Plate
14 Valve assembly	32 O-ring	50 Cup packing
15 Filter	33 Lifter	51 Housing
16 Square ring	34 Bushing	
17 Tube	35 O-ring	
18 Retaining ring	36 Rod	

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
22	Spring load (Installed length 12.35 {0.49})	82 N {18 lbf, 8.4 kgf}	67 N {15 lbf, 6.8 kgf}	Replace
27	Spring load (Installed length 10 {0.39})	13 N {2.9 lbf, 1.3 kgf}	9.8 N {2.2 lbf, 1.0 kgf}	Replace
31	Spring load (Installed length 12.2 {0.48})	50 N {11 lbf, 5.06 kgf}	40 N {9.0 lbf, 4.1 kgf}	Replace

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Nut	23.5 to 26.6 {17 to 20, 2.4 to 2.7}	—
6	Connector (Air hose side)	13.7 to 49 {10 to 36, 1.4 to 5.0}	—
7	Nut (Cylinder side connector)	59 to 69 {44 to 51, 6 to 7}	—
9	Connector (Cylinder side)	7.8 to 11.8 {5.8 to 8.7, 0.8 to 1.2}	—
38	Set screw	2 to 3.4 {1.5 to 2.5, 0.2 to 0.35}	—
39	Cylinder	78.4 to 98 {58 to 72, 8 to 10}	—

POWER SHIFT ASSEMBLY

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	All friction surfaces	Multipurpose grease [NLGI No.2 (Li soap)]	As required
6	Thread area of connector	THREEBOND 1110B	As required
39	Thread area of cylinder	LOCTITE 242 or THREEBOND 1401B	As required

Special tools

Location	Tool name and shape	Part No.	Application
9	Connector	*910-25790	Removal and installation of connector
14	Guide	*910-24800	Inserting valve assembly
18	Insert tool	*910-22011	Inserting retaining valve
		*910-26500	
39	Socket	*910-21982	Removal and installation of cylinder

* Bosch Automotive Systems part No.

◆ Service Procedure

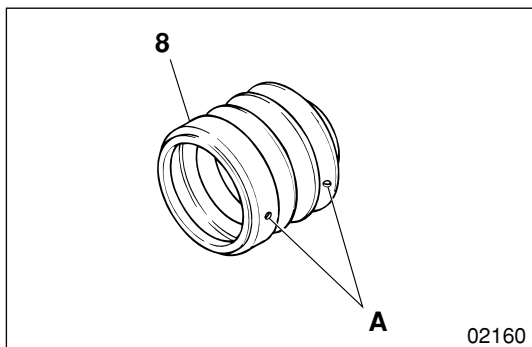
● Inspection before disassembly

- (1) Apply 735 kPa {105 psi, 7.5 kgf/cm²} of pressure to the power shift assembly from the connector, check the airtightness when not operating (valve in neutral), and when operating valve is pressed and pulled. If the measured value deviates from the standard value, replace the faulty parts.

Maintenance item	Standard value	
Airtightness when not operating	Decrease of pressure after 15 seconds	9.8 kPa {1.4 psi, 0.1 kgf/cm ² }
Airtightness when operating		49 kPa {7.1 psi, 0.5 kgf/cm ² }

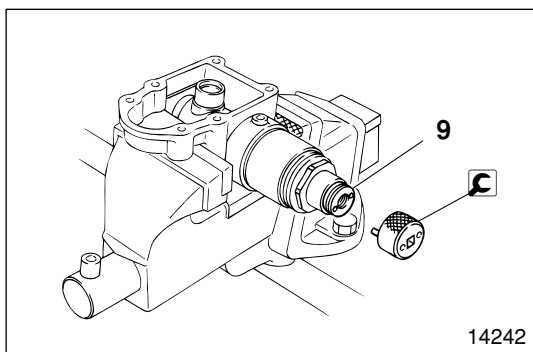
- (2) Measure the sliding resistance in the disengagement direction. If the measured value deviates from the standard value, replace the faulty parts, or grease them.

Maintenance item	Standard value
Resistance in shifting direction	39 N {8.8 lbf, 4 kgf}

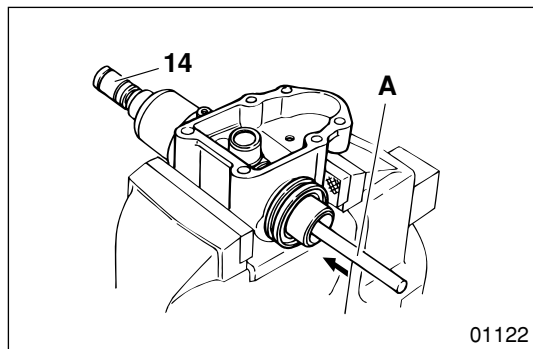


8 Installation of boot

When you install boot **8** on housing **51**, point drain holes **A** downward.



9 Removal and installation of connector



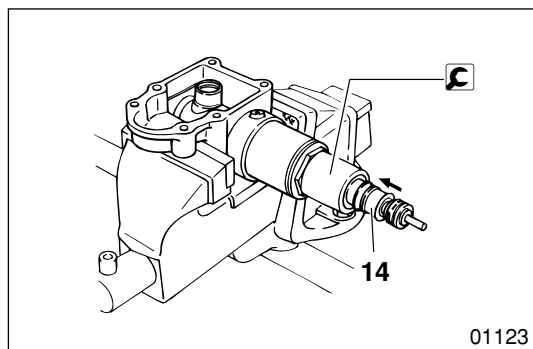
14 Valve assembly

[Removal]

Gently drive valve assembly **14** out from the shifter rod from the lever side using bar **A**.

CAUTION ⚠

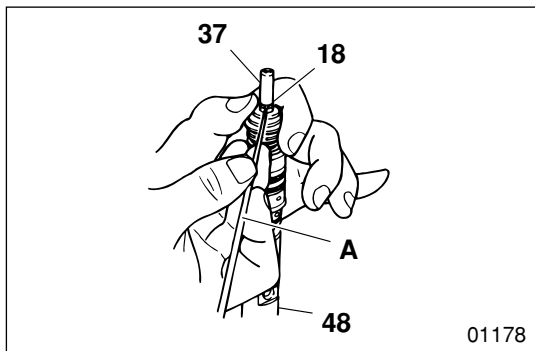
Do not drive valve assembly **14** too hard or you will damage the valve parts.



[Installation]

- Apply grease to valve assembly **14**.
- Install valve assembly **14** into the shifter rod using  guide, taking care not to damage the seals.

POWER SHIFT ASSEMBLY



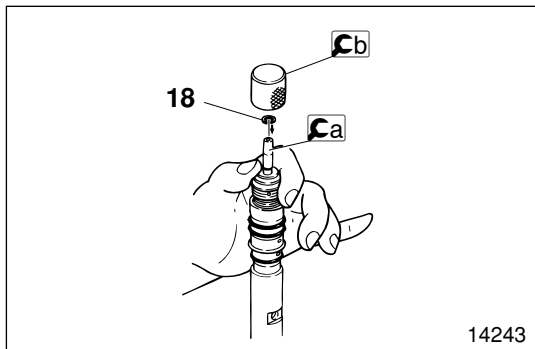
18 Retaining ring

[Removal]

- Hold shifter rod 48 in a vise, taking care not to damage the shifter rod.
- Remove retaining ring 18 from pipe 37 using bar A as illustrated.

CAUTION ⚠

- After removing retaining ring 18, you can remove all the valve parts.
- Keep the valve parts in order to avoid mix ups when installing.

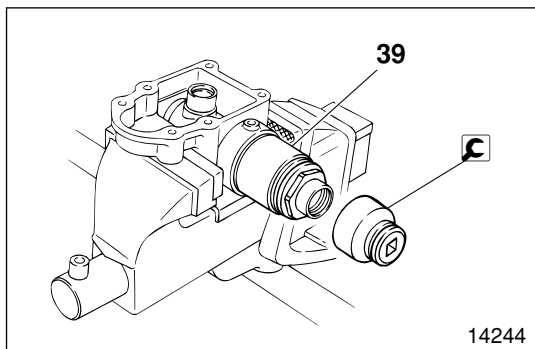


[Installation]

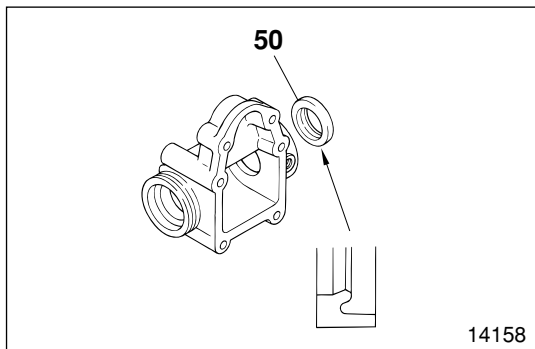
- Install the valve parts on pipe 37.
- Install 'a' insert tool on pipe 37 end.
- Insert retaining ring 18 into pipe 37 groove using 'b' insert tool.

CAUTION ⚠

Be careful not to apply excessive force to retaining ring 18 when you insert it.



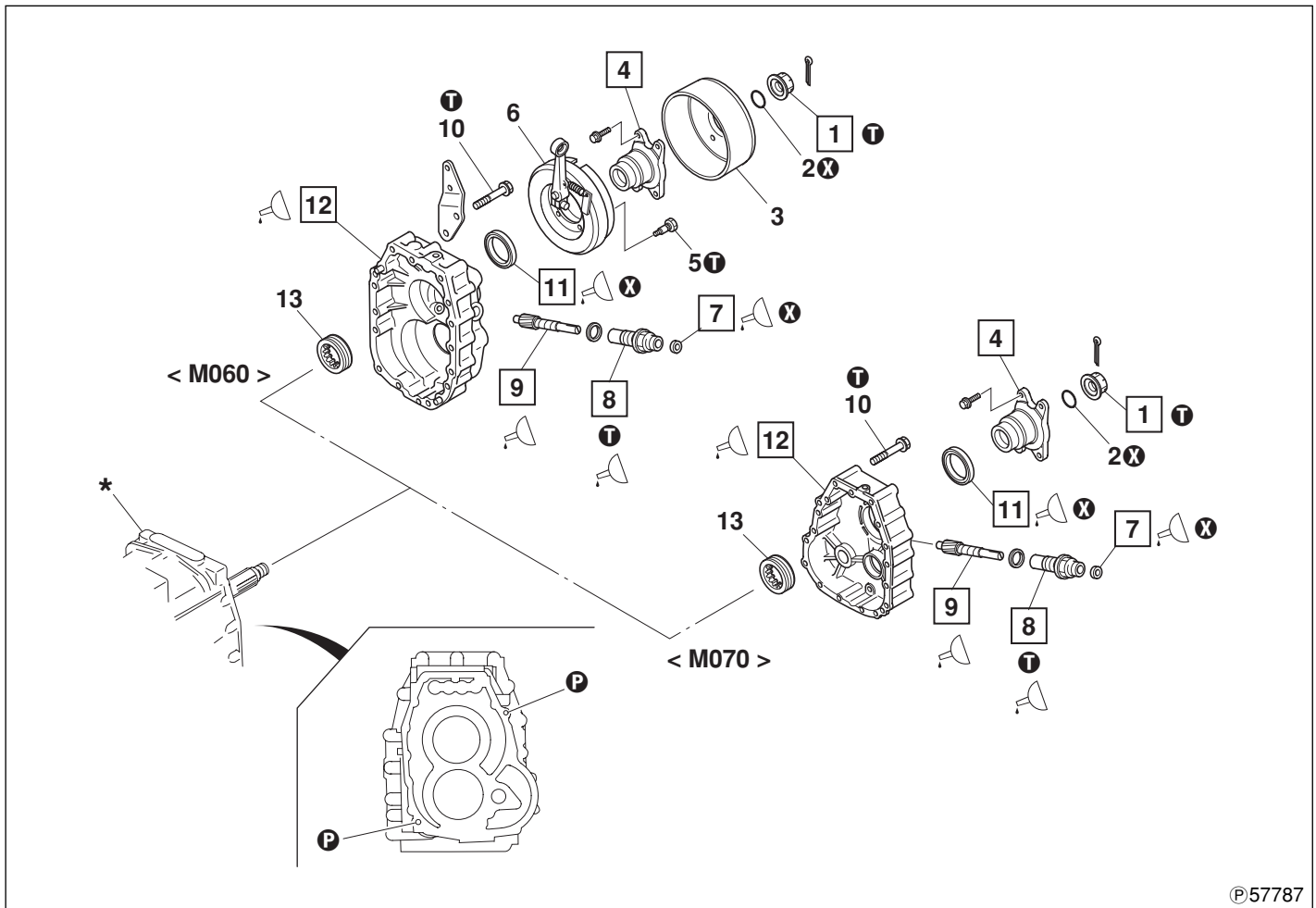
39 Removal and installation of cylinder



50 Installation of cup packing and retainer

MEMO

EXTENSION HOUSING AND PARKING BRAKE ASSEMBLY



©57787

● Inspection before disassembly

📖 P22A-30

● Disassembly sequence

- 1 Lock nut
- 2 O-ring
- 3 Parking brake drum assembly < M060 >
📦 Gr 36
- 4 Companion flange
- 5 Bolt
- 6 Support plate shoe assembly < M060 >
📦 Gr 36
- 7 Oil seal

- 8 Speedometer gear bushing
- 9 Speedometer gear
- 10 Bolt
- 11 Oil seal
- 12 Extension housing
- 13 Speedometer worm

★ : Transmission body

Ⓟ : Positioning pins

✕ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Inspect play of speedometer gear 9 before disassembly.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
4	Runout at socket portion of companion flange	0.15 {0.0059} or less	0.5 {0.02}	Replace
8, 9	Clearance between speedometer gear bushing and speedometer gear	0.02 to 0.07 {0.00079 to 0.0028}	0.15 {0.0059}	Replace
9, 13	Play between speedometer gear and speedometer worm	0.13 to 0.29 {0.0051 to 0.011}	0.36 {0.014}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

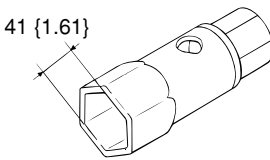
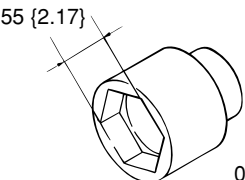
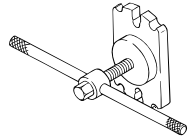
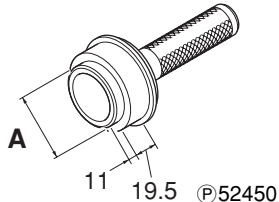
Location	Parts to be tightened		Tightening torque	Remarks
1	Lock nut	M060	245 to 343 {180 to 255, 25 to 35}	—
		M070	588 to 1080 {435 to 795, 60 to 110}	—
5	Bolt (Support plate and shoe assembly mounting)		40.2 {30, 4.1}	—
8	Speedometer gear bushing		74 {55, 7.5}	—
10	Bolt (Extension housing or mounting)		40.2 {30, 4.1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7, 11	Interior and lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
9	Friction surface with speedometer gear bushing	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
12	Contact surfaces between extension housing and transmission case	THREEBOND 1215	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape		Part No.	Application
1	Socket wrench	 41 {1.61} 00069	< M060 > MH061532	Removal and installation of mainshaft rear lock nut
	Socket wrench	 55 {2.17} 02030	< M070 > MH061519	
4	Flange puller	 02153	MH061393	Removal of flange at rear of mainshaft
12	Oil seal installer	 11 19.5 P52450	< M060 > ME624242 < M070 > MH062640	Installation of oil seal in extension housing

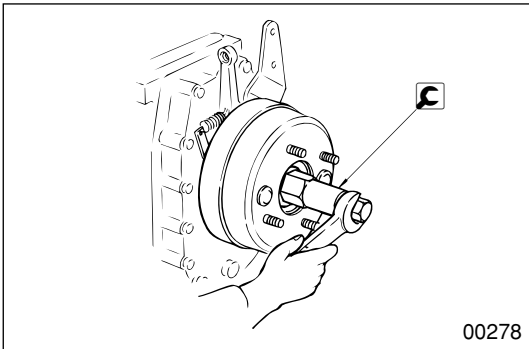
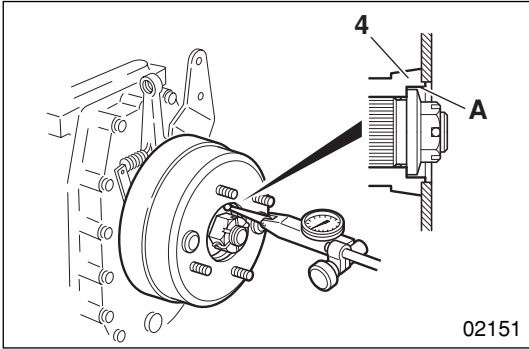
EXTENSION HOUSING AND PARKING BRAKE ASSEMBLY

◆ Service procedure

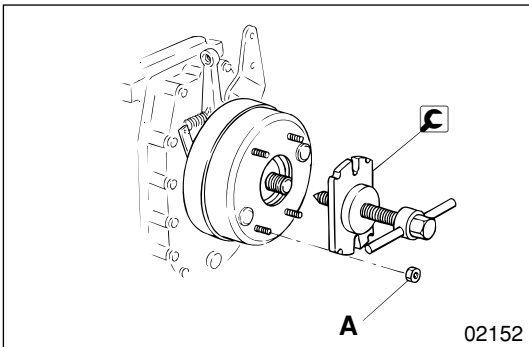
● Inspection before disassembly

Runout at socket portion of companion flange

- Measure the runout at socket portion **A** of companion flange **4**.
- If the measurement exceeds the limit, replace companion flange **4**.

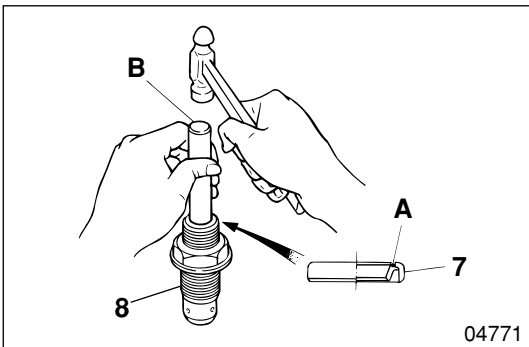


1 Removal and installation of lock nut



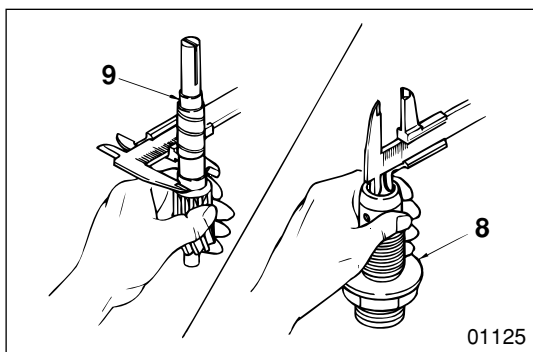
4 Removal of companion flange

A : Propeller shaft mounting nut



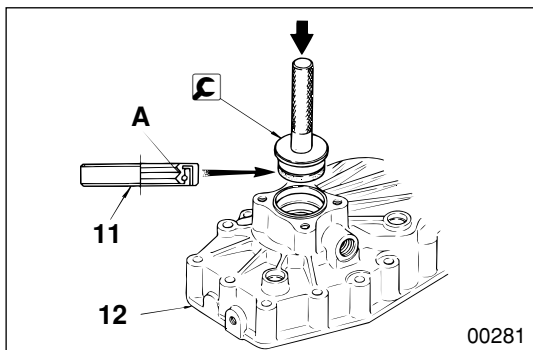
7 Press-fitting of oil seal

- Apply grease to inside of oil seal **7** packing **A**.
- Press-fit oil seal **7** into speedometer gear bushing **8** in the direction as illustrated using bar **B** (approximately $\varnothing 15$ mm {0.59 in.}).



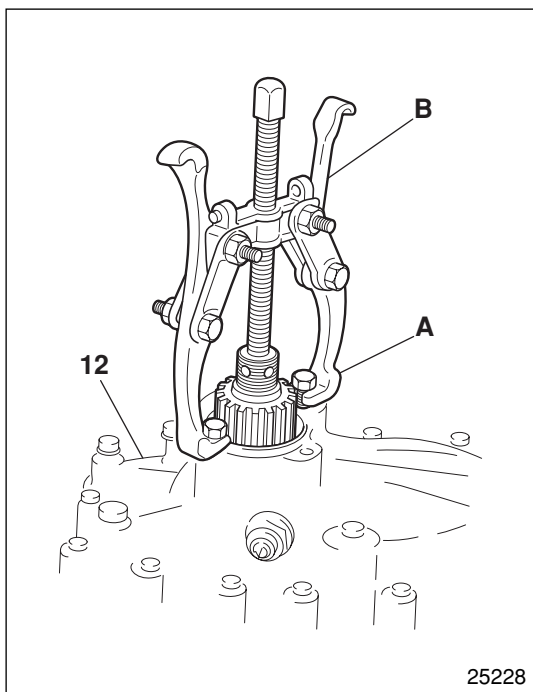
8 9 Clearance between speedometer gear bushing and speedometer gear

If the clearance is higher than the limit, replace the faulty parts.



11 Installation of oil seal

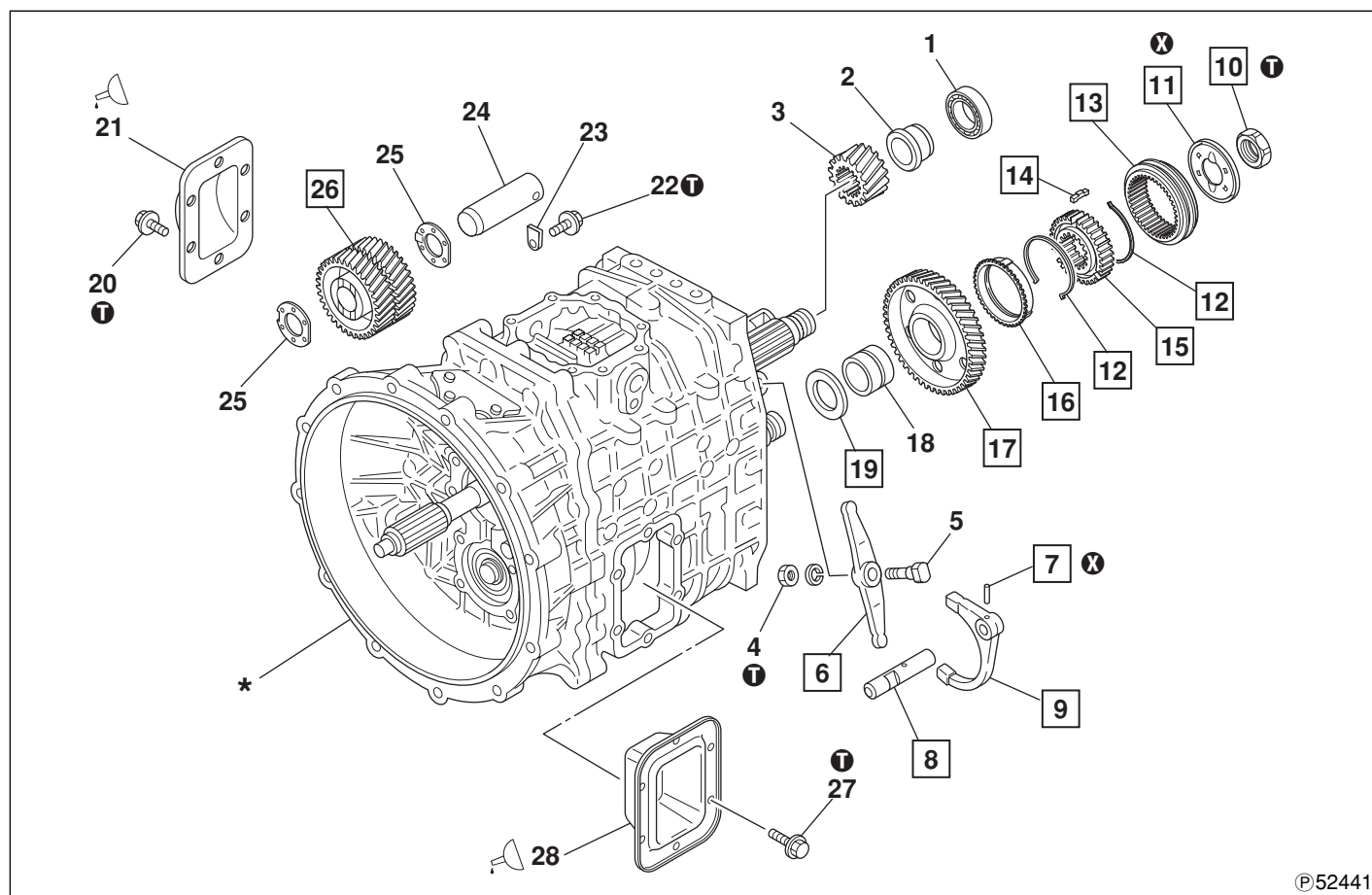
- Apply grease to lip area **A** of oil seal **11**.
- Press-fit oil seal **11** into extension housing **12** in the direction as illustrated using **C** oil seal installer.



12 Removal of extension housing

Remove extension housing **12** using the support plate and shoe assembly mounting bolts (or M10 x 1.5 bolts for M060 transmission/ M12 x 1.75 bolts for M070 transmission) **A** and a commercially available gear puller **B**.

6TH GEAR AND REVERSE IDLER GEAR < M060 >



©52441

● Inspection before disassembly

☞ P22A-34

● Disassembly sequence

- | | |
|------------------------------|--|
| 1 Mainshaft rear bearing | 16 Synchronizer ring |
| 2 Bearing sleeve | 17 Countershaft over drive gear assembly |
| 3 Mainshaft over drive gear | 18 Over drive gear sleeve |
| 4 Nut | 19 Thrust washer |
| 5 Over drive shift shaft | 20 Bolt |
| 6 Over drive shift lever | 21 Reverse idler gear cover |
| 7 Spring pin | 22 Bolt |
| 8 Over drive shift rail C | 23 Reverse shaft lock piece |
| 9 Over drive gear shift fork | 24 Reverse idler shaft |
| 10 Lock nut | 25 Reverse shaft gear side washer |
| 11 Shifting Key retainer | 26 Reverse idler gear |
| 12 Shifting key spring | 27 Bolt |
| 13 Synchronizer sleeve | 28 PTO cover |
| 14 Shifting key | |
| 15 Synchronizer hub | |
- * : Transmission body
 X : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
5, 6	Clearance between over drive shift and over drive shift lever	[16 {0.63}] 0.02 to 0.07 {0.00079 to 0.0028}	0.15 {0.0059}	Replace
6	Bend of over drive shift lever	0.05 {0.0020} or less	0.1 {0.0039}	Replace
8	Bend of over drive shift rail C	0.02 {0.00079} or less	0.04 {0.0016}	Replace
9	Tilt of over drive gear shift fork claw	0.1 {0.0039} or less	0.2 {0.0079}	Replace
9, 13	Clearance between gear shift fork and synchronizer sleeve	0.3 to 0.5 {0.012 to 0.020}	1.0 {0.039}	Replace
13, 15	Play to rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
14, 15	Clearance between shifting key and synchronizer hub	0.05 to 0.20 {0.0020 to 0.0079}	0.5 {0.020}	Replace
14, 16	Clearance between shifting key and synchronizer ring	4.75 to 4.95 {0.187 to 0.195}	5.8 {0.228}	Replace
15, *	Fitness to revolving direction of synchronizer hub and countershaft	-0.006 to 0.088 {-0.00024 to 0.0035}	0.2 {0.0079}	Replace
16, 17	Clearance between synchronizer ring and countershaft over drive gear assembly	1.45 to 1.85 {0.057 to 0.073}	0.2 {0.0079}	Replace
17	End play of countershaft over drive gear	0.25 to 0.40 {0.0098 to 0.016}	0.5 {0.020}	Replace
17, 18	Diameter direction after assembling countershaft over drive gear	0.105 to 0.150 {0.0041 to 0.0059}	0.3 {0.012}	Replace
24, 26	Diameter direction after assembling reverse idler gear	—	0.12 {0.0047}	Replace
26	End play of reverse idler gear	0.2 to 0.9 {0.0079 to 0.035}	1.2 {0.047}	Replace side washer

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

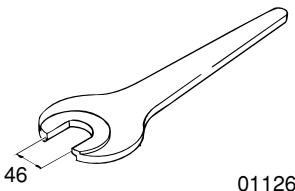
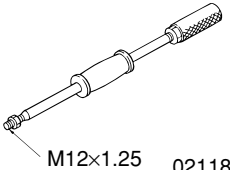
Location	Parts to be tightened	Tightening torque	Remarks
4	Nut (over drive shift shaft and over drive shift lever mounting)	42.2 {31, 4.3}	—
10	Lock nut	343±49 {250±36, 35±5}	—
20	Bolt (Reverse idler gear cover mounting)	18.7 {14, 1.9}	—
22	Bolt (Reverse shaft lock piece mounting)	40.2 {30, 4.1}	—
27	Bolt (PTO cover mounting)	18.7 {14, 1.9}	—

L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
21	Reverse idler gear cover installation surface	THREEBOND 1105	As required
28	PTO cover installation surface	LOCTITE 5999	As required

6TH GEAR AND REVERSE IDLER GEAR < M060 >

 Special tools

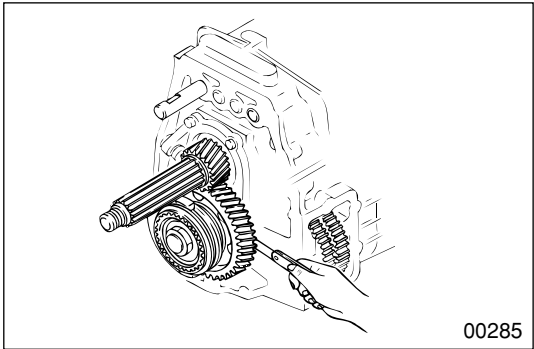
Location	Tool name and shape	Part No.	Application
10	Single spanner 	MH061555	Removal and istallation of countershaft rear lock nut
24	Reverse shaft puller 	03726-82000	Removal of reverse ilder shaft

◆ Service procedure

● Inspection before disassembly

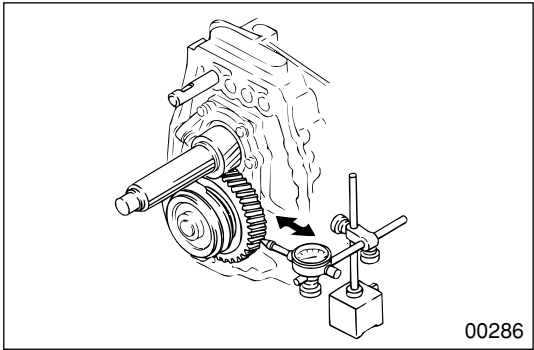
(1) End play of various gears

- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.



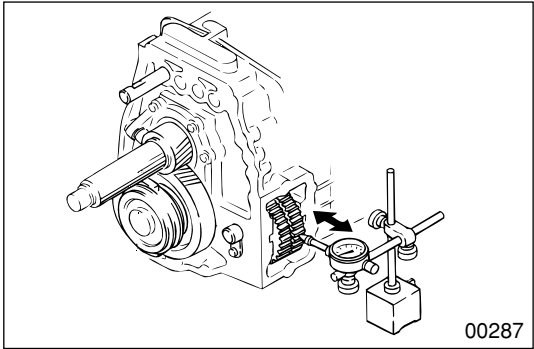
(2) Play of countershaft over drive gear in the diameter direction

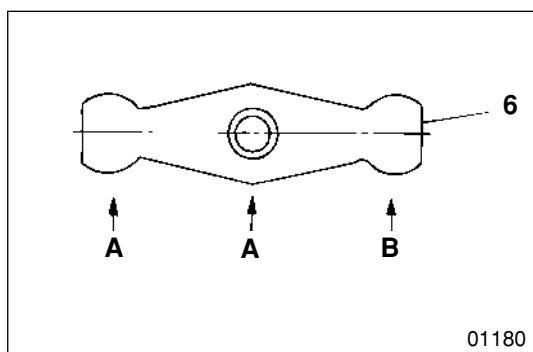
- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.



(3) Play of reverse ilder gear in the diameter direction

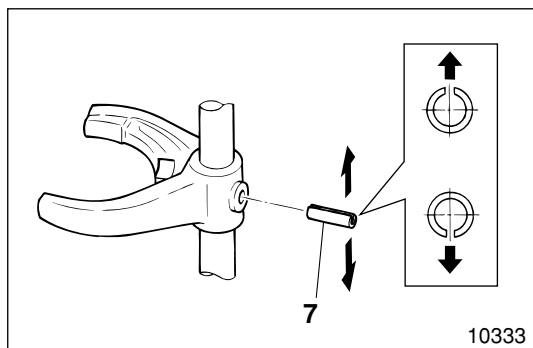
- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.





6 Bend of over drive shift lever

If bend **B** exceeds the limit on the basis of illustrated **A - A**, replace over drive shift lever **6**.

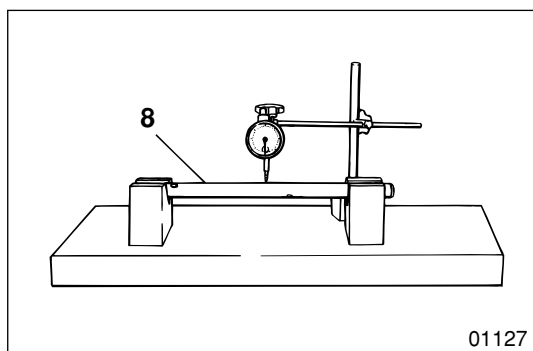


7 Installation of spring pin

Install spring pin **7** in over drive gear shift fork **9** in the direction as illustrated.

CAUTION

Make sure you do not drive in spring pin **7** fully, leave 0 to 0.5 mm {0 to 0.020 in.} outside to prevent them from slipping out.

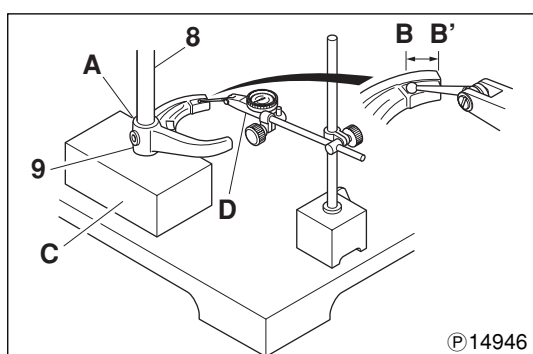


8 Bend of over drive shift rail C

If the measured value is higher than the limit, correct or replace over drive shift rail **C 8**.

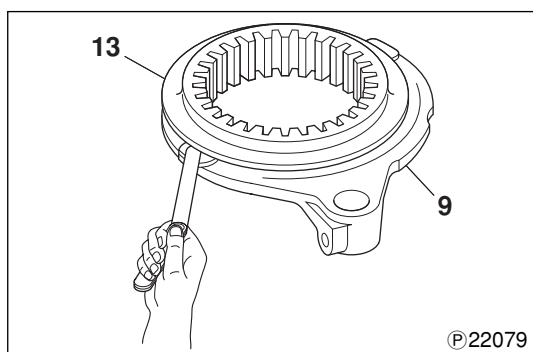
NOTE

Read the dial gauge after turning over drive shift rail **C 8** one full revolution. The bend is one half of the indicated value.



9 Tilt of over drive gear shift fork claw

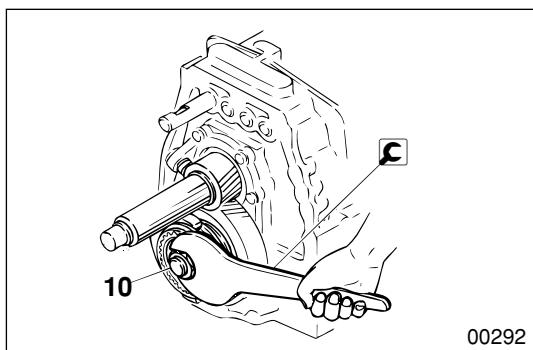
- Measure the tilt (difference between **B** and **B'**) of claw **B-B'** against hole **A** of over drive shift rail **C 8** of over drive gear shift fork **9** with the shift rail upright.
- If the measured value is higher than the limit, replace gear shift fork **9**.
C : V-block
D : Dial gauge



9 13 Clearance between over drive gear shift fork and synchronizer sleeve

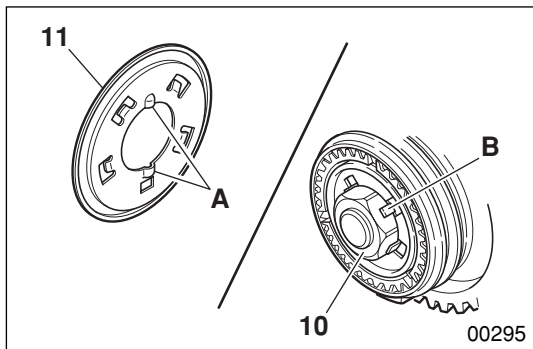
- Measure clearance **A** between over drive gear shift fork **9** and synchronizer sleeve **13**.
- If the measured value is higher than the limit, replace the faulty parts.

6TH GEAR AND REVERSE IDLER GEAR < M060 >



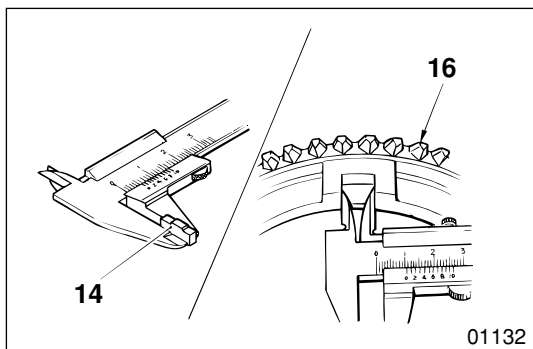
10 Removal and installation of countershaft rear lock nut

Have transmissions engaged in double to lock countershaft for this work.



11 Installation of shifting key retainer

- Install so that shifting key retainer 11 protrusions **A** (at 2 places) rest in recessions provided on synchronizer hub.
- After tightening of lock nut, caulk the areas with slits **B** at 4 places of shifting retainer, toward lock nut 10.

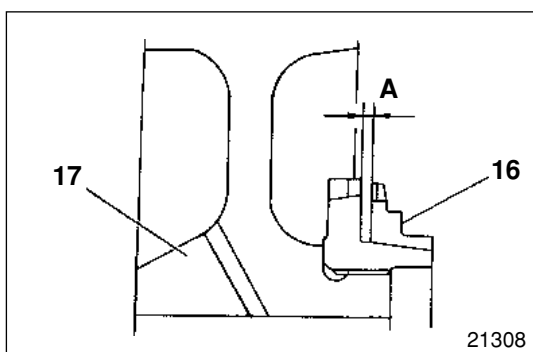


12 to 17 Synchromesh mechanism and countershaft over drive gear assembly

[Inspection]

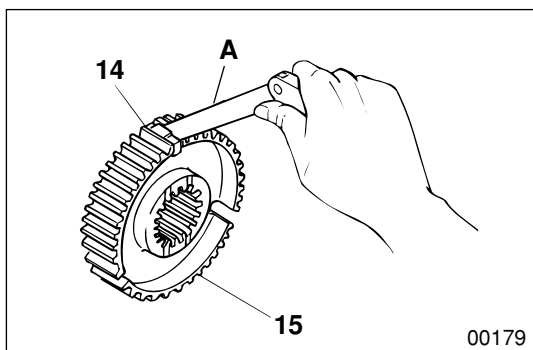
(1) Clearance between synchronizer ring 16 and shifting key 14.

If the measured value is higher than the limit, replace the faulty parts.



(2) Clearance between synchronizer ring 16 and countershaft over drive gear assembly 17

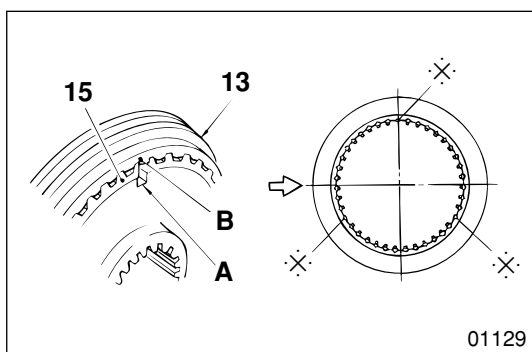
- Measure clearance **A** between synchronizer ring 16 and the gear cone of countershaft over drive gear assembly 17.
- When measuring this value, press synchronizer ring 16 evenly, and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.



(3) Clearance between shifting key 14 and synchronizer hub 15

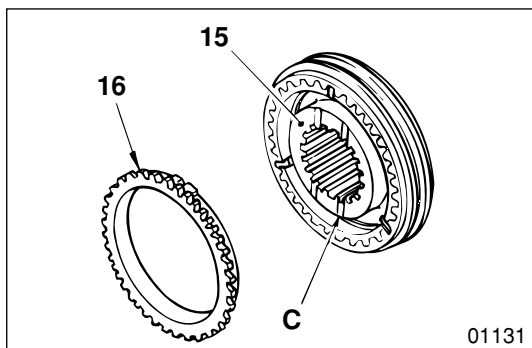
If the measured value is higher than the limit, replace the faulty parts.

A : Feeler gauge

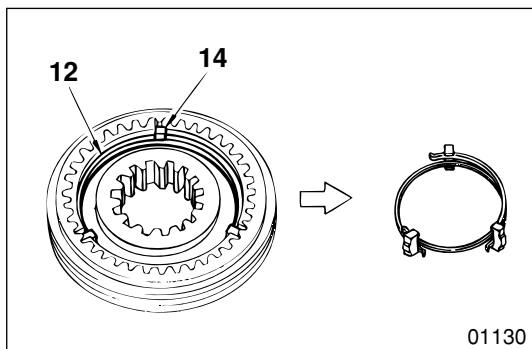


[Installation]

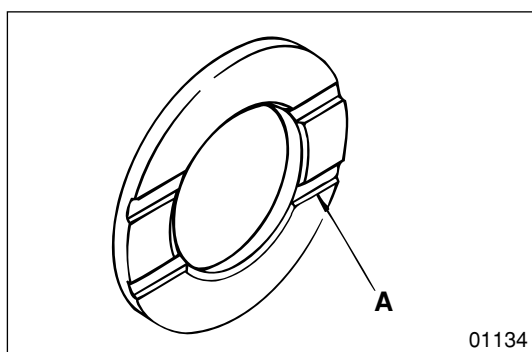
- Align the three keyways **A** of synchronizer hub **15** with the three stub teeth **B** (illustrated by ✕ mark) of synchronizer sleeve **13** to install the synchronizer hub.
- To reassemble synchronizer hub **15** and synchronizer sleeve **13**, align the alignment marks made during disassembly.



- Assemble synchronizer ring **16** on synchronizer hub **15** with the keyway aligned to the side where oil groove **C** is located.

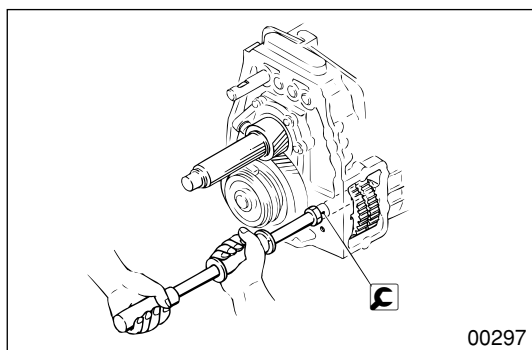


- Insert shifting **14** into the keyway.
- Install shifting key spring **12** so that its opening is offset from the one of the shifting key.
- Make sure that the openings of shifting key springs do not align with each other.



19 Installation of thrust washer

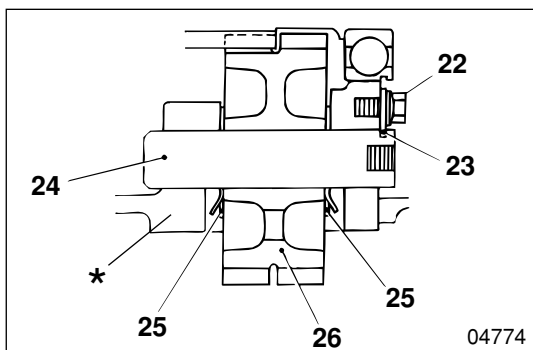
Install with the side having oil grooves **A** facing the side of gear.



24 Removal of reverse idler shaft.

: Reverse shaft puller

6TH GEAR AND REVERSE IDLER GEAR < M060 >

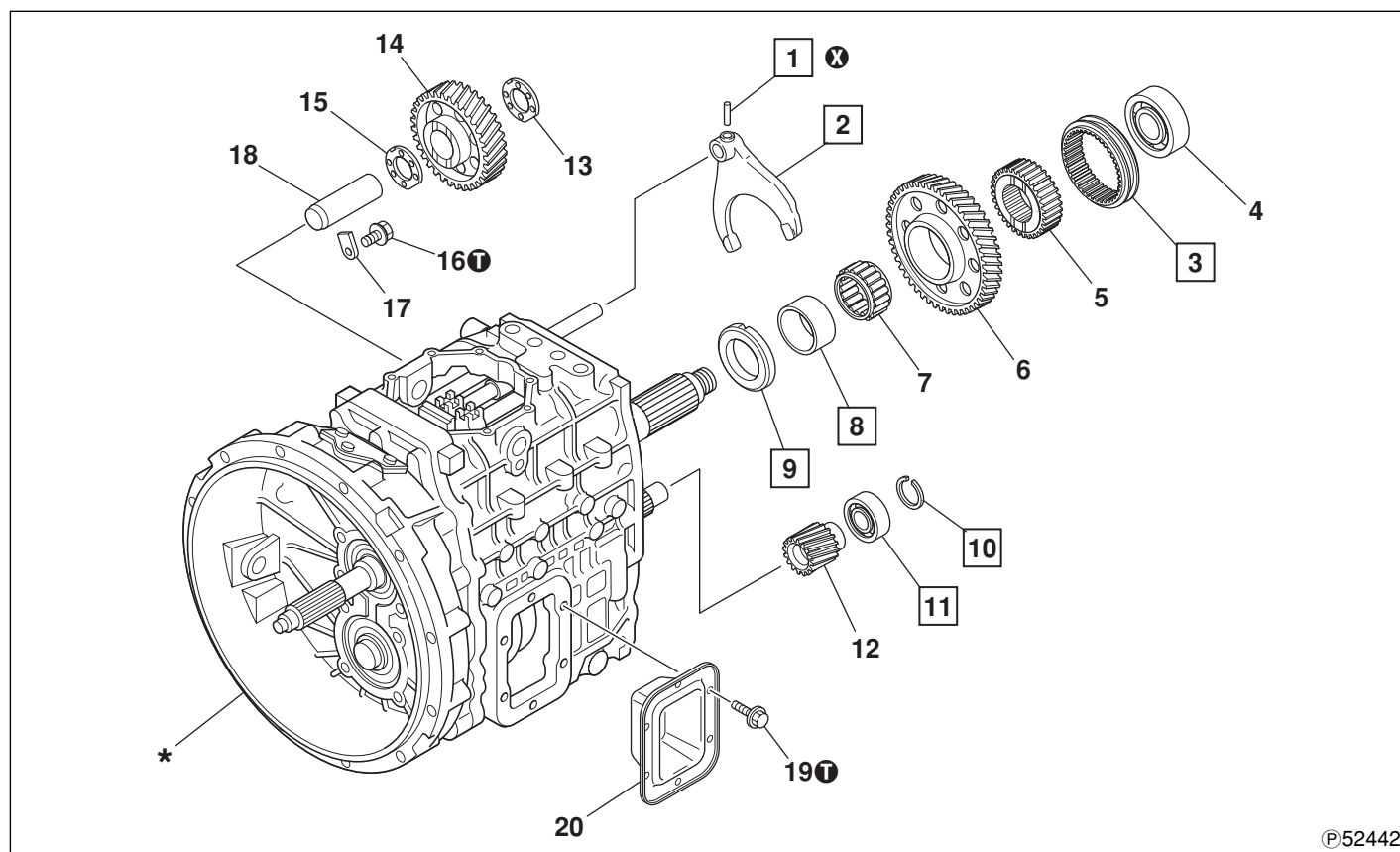


26 Assembly of reverse idler gear

- Install reverse shaft gear side washer **25** and reverse idler gear **26** in trasmission body *****.
- Install reverse idler shaft **24** in transmission body ***** using a plastic-headed mallet.
- Install reverse shaft lock piece **23** in transmission body ***** with mounting bolt **22**.

MEMO

REVERSE GEAR AND REVERSE IDLER GEAR < M070 >



© 52442

● Inspection before disassembly

📖 P22A-42

● Disassembly sequence

- 1 Spring pin
- 2 Reverse gear shift fork
- 3 Reverse gear shift sleeve
- 4 Mainshaft rear bearing
- 5 Hub
- 6 Mainshaft reverse gear
- 7 Needle bearing
- 8 Mainshaft reverse gear bearing sleeve
- 9 Thrust washer
- 10 Snap ring
- 11 Countershaft rear bearing

- 12 Countershaft reverse gear
- 13 Reverse idler gear side washer
- 14 Reverse idler gear
- 15 Reverse idler gear side washer
- 16 Bolt
- 17 Reverse idler shaft lock piece
- 18 Reverse idler shaft
- 19 Bolt
- 20 PTO cover

★ : Transmission body

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
2	Tilt of reverse gear shift fork claw	0.1 {0.0039} or less	0.2 {0.079}	Replace
2, 3	Clearance between reverse gear shift fork and reverse gear shift sleeve	0.3 to 0.5 {0.012 to 0.020}	—	Replace
3, 5	Play in the rotating direction of reverse gear shift sleeve and hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
5, *	Engagement in the rotating direction of hub and mainshaft	-0.006 to 0.094 {-0.00024 to -0.0037}	0.2 {0.0079}	Replace
6	End play of mainshaft reverse gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace side washer
6, 7, 8, *	Play in the diameter direction after assembling mainshaft reverse gear	—	0.1 {0.0039}	Replace
8	Outer diameter of reverse gear bearing sleeve	[71] $\begin{smallmatrix} -0.030 \\ -0.040 \end{smallmatrix}$ { [2.80] $\begin{smallmatrix} -0.0012 \\ -0.0016 \end{smallmatrix}$ }	0.1 { - 0.0039}	Replace
14	End play of reverse idler gear	0.2 to 0.9 {0.0079 to 0.035}	1.2 {0.047}	Replace
14, 18	Play in the diameter direction after assembling reverse idler gear	—	0.15 {0.0059}	Replace

Tightening torque

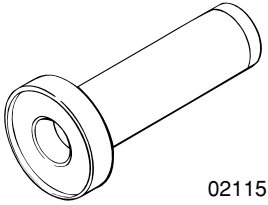
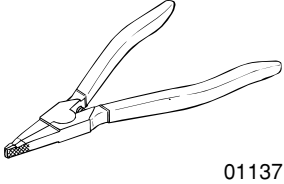
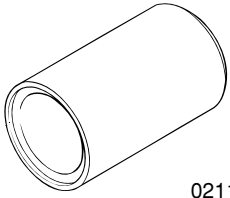
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
16	Bolt (Reverse idler shaft lock piece mounting)	40.2 {30, 4.1}	—
19	Bolt (PTO cover mounting)	18.7 {14, 1.9}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
20	Transmission mounting surface of PTO cover	LOCTITE 5999	As required

Special tools

Location	Tool name and shape	Part No.	Application
8	Mainshaft bearing installer  02115	*MH062634	Installation of mainshaft reverse gear bearing sleeve
10	Snap ring expander  01137	MH061268	Removal of countershaft rear bearing snap ring
11	Countershaft bearing installer  02117	*MH062642	Installation of countershaft rear bearing

* components of puller and installer kit  P22A-92

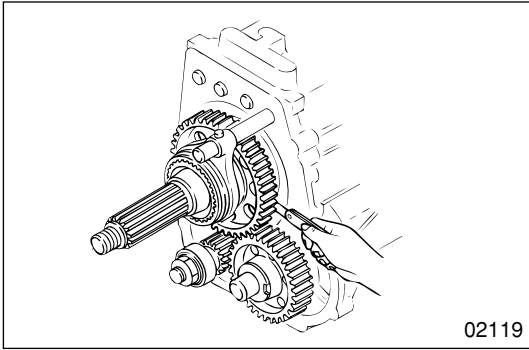
REVERSE GEAR AND REVERSE IDLER GEAR < M070 >

◆ Service procedure

● Inspection before disassembly

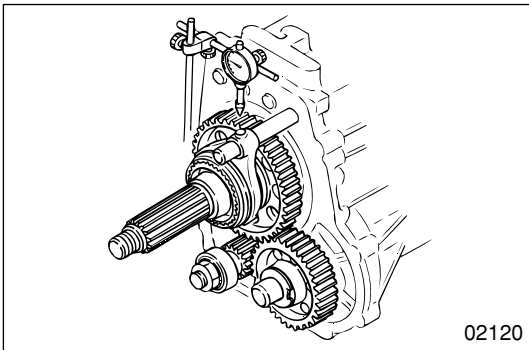
(1) End play of mainshaft reverse gear

- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.



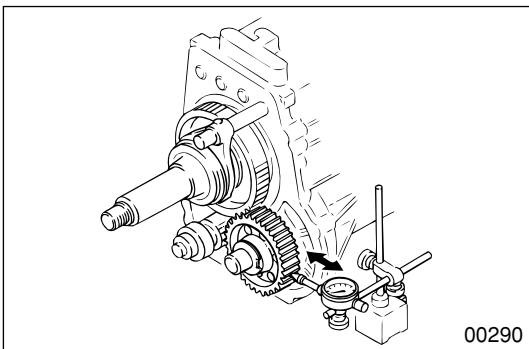
(2) Play of mainshaft reverse gear in diameter direction

- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.



(3) Play of reverse idler gear in diameter direction

- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.

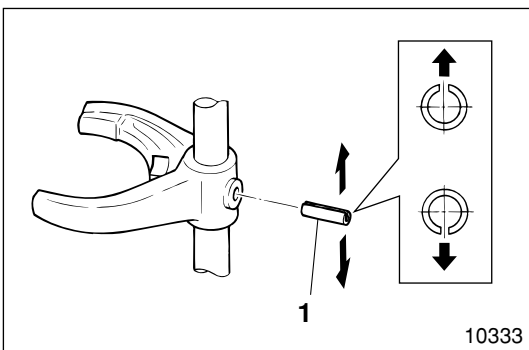


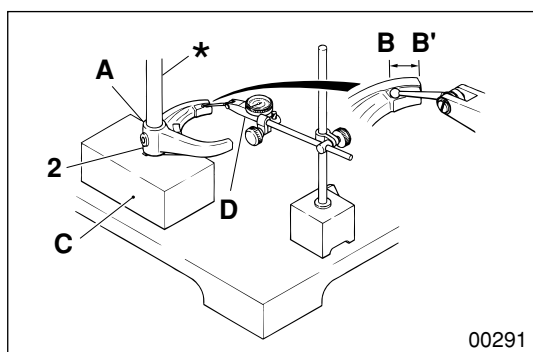
1 Installation of spring pin

Install spring pin 1 in reverse gear shift fork 2 in the direction as illustrated.

CAUTION ⚠

Make sure you do not drive in spring pin 1 fully, leave 0 to 0.5 mm {0 to 0.020 in.} outside to prevent them from slipping out.



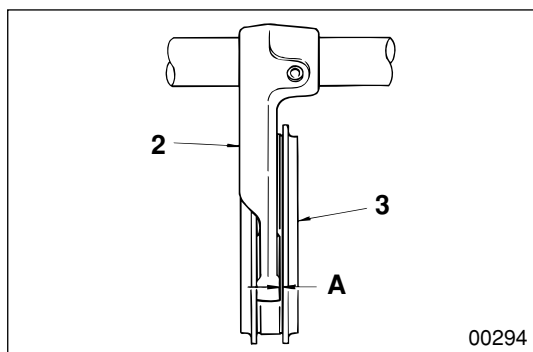


2 Tilt of reverse gear shift fork claw

- Measure the tilt (difference between **B** and **B'**) of claw **B-B'** against hole **A** of shift rail ***** of shift fork **2** with the shift rail upright.
- If the measured value is higher than the limit, replace reverse gear shift fork **2**.

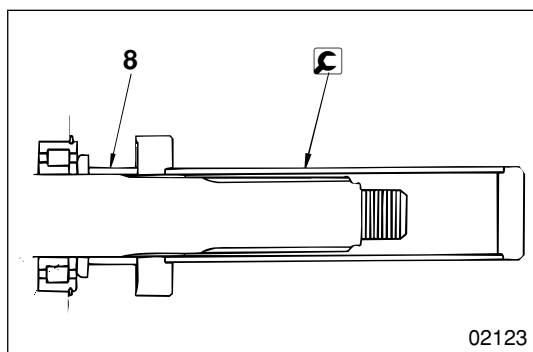
C : V-block

D : Dial gauge



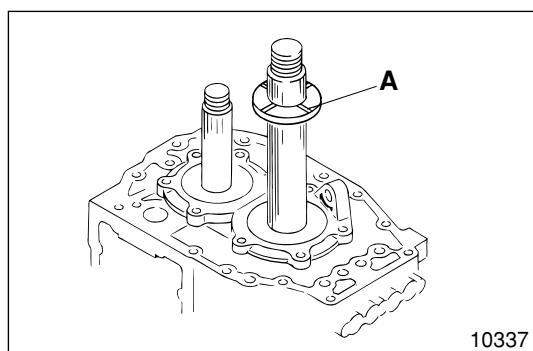
2 3 Clearance between reverse gear shift fork and reverse gear shift sleeve

- Measure clearance **A** between reverse gear shift fork **2** and reverse gear shift sleeve **3**.
- If the measured value is higher than the limit, replace the faulty parts.



8 Installation of mainshaft reverse gear bearing sleeve

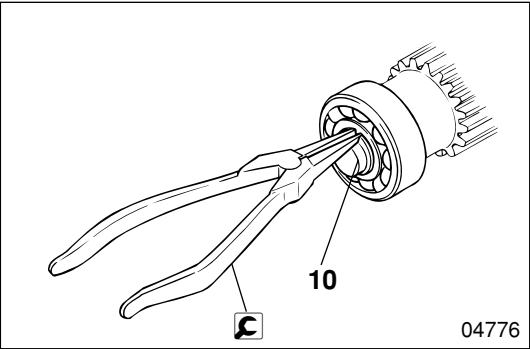
C: Mainshaft bearing installer



9 Installation of thrust washer

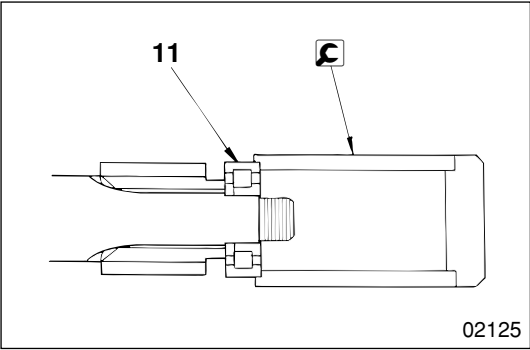
A : Oil groove

REVERSE GEAR AND REVERSE IDLER GEAR < M070 >



10 Removal and installation of snap ring

: Snap ring expander

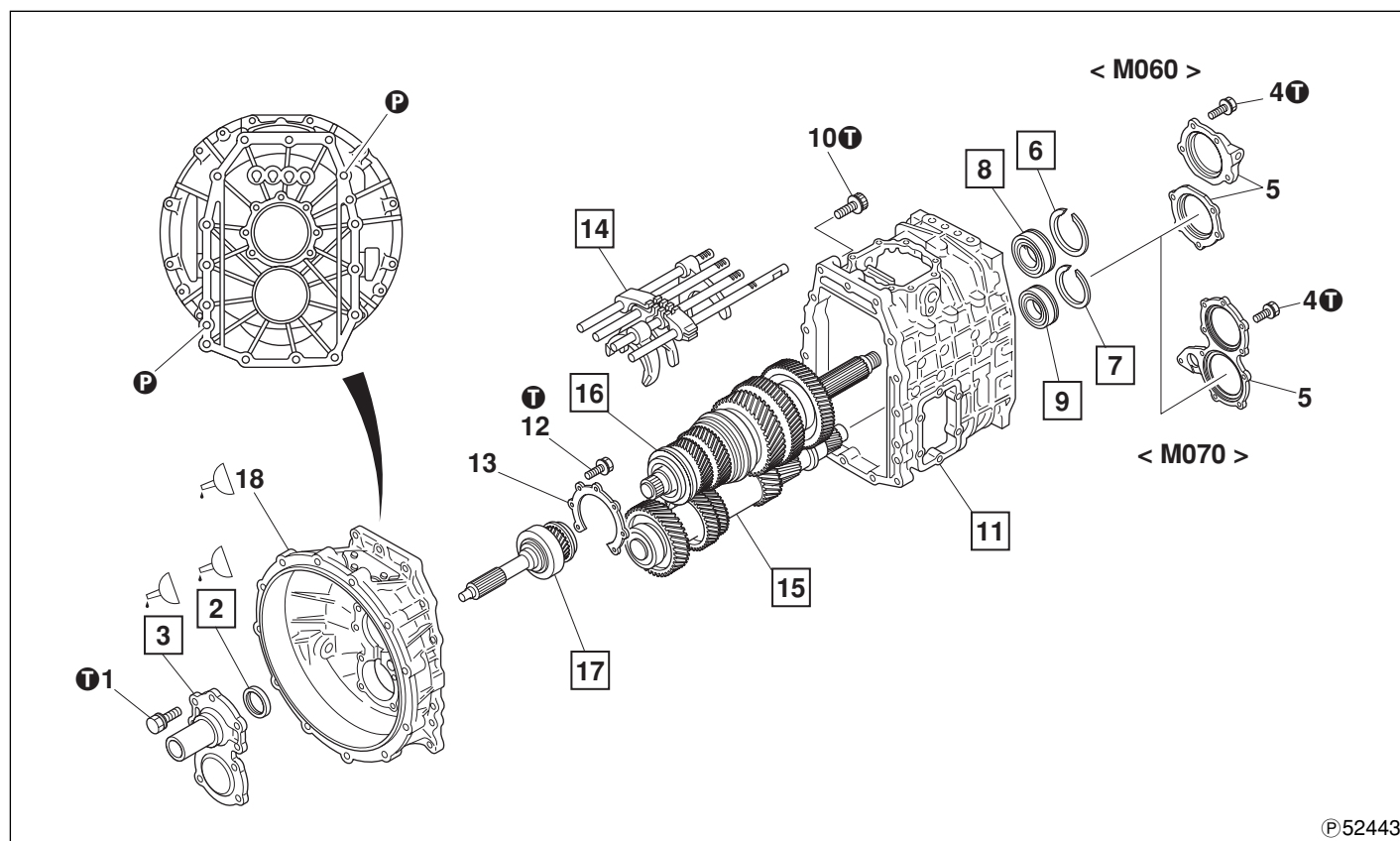


11 Installation of countershaft rear bearing

: Countershaft bearing installer

MEMO

TRANSMISSION BODY



⒫52443

● Disassembly sequence

- | | |
|-----------------------------|---|
| 1 Bolt | 12 Bolt |
| 2 Oil seal | 13 Drive pinion bearing retainer |
| 3 Front bearing retainer | 14 Shift rail and shift fork ⒫ P22A-56 or P22A-60 |
| 4 Bolt | 15 Countershaft assembly ⒫ P22A-84 |
| 5 Rear bearing retainer | 16 Mainshaft assembly ⒫ P22A-64 or P22A-72 |
| 6 Snap ring | 17 Drive pinion assembly ⒫ P22A-62 |
| 7 Snap ring | 18 Clutch housing assembly |
| 8 Mainshaft rear bearing | |
| 9 Countershaft rear bearing | |
| 10 Bolt | |
| 11 Transmission case | |
- ⒫ : Locating pin
 ✕ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

- After removing parts 1 to 3, disassemble the transmission assembly with the body laid vertically on its clutch housing side.
- Remove parts and 14 to 17 as a group. However, shift rail and shift fork 14 can be disassembled on its own if you are not going to disassemble parts 15 to 17. ⒫ P22A-56 or P22A-60

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

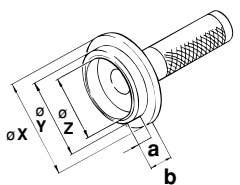
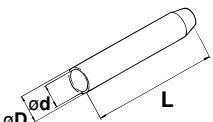
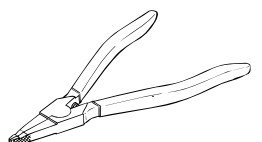
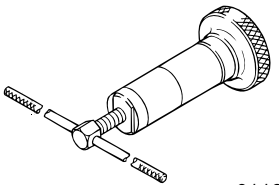
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Front bearing retainer mounting)	40.2 {30, 4.1}	—
4	Bolt (Rear bearing retainer mounting)	40.2 {30, 4.1}	—
10	Bolt (Transmission case mounting)	122 {90, 12}	—
13	Bolt (Drive pinion retainer mounting)	40.2 {30, 4.1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
3	Contact surface between front bearing retainer and clutch housing assembly	THREEBOND 1215	As required
18	Contact surface between clutch housing assembly and transmission case	THREEBOND 1215	As required

Special tools

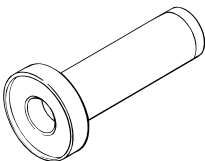
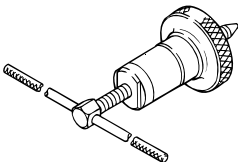
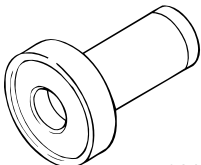
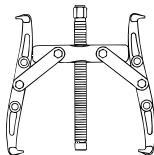
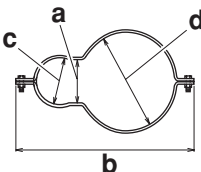
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application										
2	Oil seal installer <table><tr><td>X</td><td>72 {2.83}</td></tr><tr><td>Y</td><td>50 {1.97}</td></tr><tr><td>Z</td><td>40 {1.57}</td></tr><tr><td>a</td><td>10 {0.39}</td></tr><tr><td>b</td><td>10 {0.39}</td></tr></table> 	X	72 {2.83}	Y	50 {1.97}	Z	40 {1.57}	a	10 {0.39}	b	10 {0.39}	MH061992	Installation of front bearing retainer oil seal
	X	72 {2.83}											
Y	50 {1.97}												
Z	40 {1.57}												
a	10 {0.39}												
b	10 {0.39}												
	01135												
3	Oil seal front guide <table><tr><td>d</td><td>D</td><td>L</td></tr><tr><td>44 {1.73}</td><td>46 {1.81}</td><td>217 {8.54}</td></tr></table> 	d	D	L	44 {1.73}	46 {1.81}	217 {8.54}	MH061991	Installation of front bearing retainer				
	d	D	L										
44 {1.73}	46 {1.81}	217 {8.54}											
	01136												
6, 7	Snap ring expander 	MH061268	Removal of snap rings from mainshaft rear bearing and countershaft front and rear bearings										
8	Mainshaft bearing puller 	< M060 > *MH061732 < M070 > *MH062433	Removal of mainshaft rear bearing										
	01138												

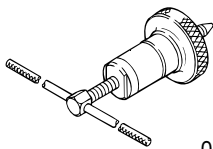
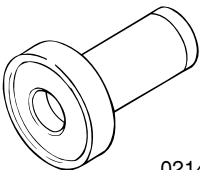
* components of puller and installer kit  P22A-92

TRANSMISSION BODY

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application															
8	Mainshaft bearing installer  02115	< M060 > *MH624234 < M070 > *MH062634	Installation of mainshaft rear bearing															
9	Countershaft bearing puller  01139	< M060 > *ME061731 < M070 > *MH062432	Removal of countershaft rear bearing															
	Countershaft bearing installer  02141	< M060 > *ME624233 < M070 > *MH062630	Installation of countershaft bearing															
11	Eye bolt  M10×1.5 01140	MH062340	Lifting of transmission case															
	Gear puller  01148	< M060 > MH062308 < M070 > MH062250	Removal of transmission case															
15 to 17	Steel lifting band <table border="1"><thead><tr><th></th><th>M060</th><th>M070</th></tr></thead><tbody><tr><td>a</td><td>80 {3.15}</td><td>100 {3.94}</td></tr><tr><td>b</td><td>336 {13.2}</td><td>360 {14.2}</td></tr><tr><td>c</td><td>Ø87 {3.43}</td><td>Ø116 {4.57}</td></tr><tr><td>d</td><td>Ø175 {6.8}</td><td>Ø173 {6.81}</td></tr></tbody></table>  P 55698		M060	M070	a	80 {3.15}	100 {3.94}	b	336 {13.2}	360 {14.2}	c	Ø87 {3.43}	Ø116 {4.57}	d	Ø175 {6.8}	Ø173 {6.81}	< M060 > MH062343 < M070 > MH062344	Removal and installation of mainshaft assembly, countershaft assembly and drive pinion assembly
		M060	M070															
a	80 {3.15}	100 {3.94}																
b	336 {13.2}	360 {14.2}																
c	Ø87 {3.43}	Ø116 {4.57}																
d	Ø175 {6.8}	Ø173 {6.81}																
Eye nut <table border="1"><thead><tr><th></th><th>A</th></tr></thead><tbody><tr><td>M060</td><td>M27×1.5</td></tr><tr><td>M070</td><td>M36×1.5</td></tr></tbody></table>  A 01142		A	M060	M27×1.5	M070	M36×1.5	< M060 > MH062341 < M070 > MH062342											
	A																	
M060	M27×1.5																	
M070	M36×1.5																	

* components of puller and installer kit.  P22A-92

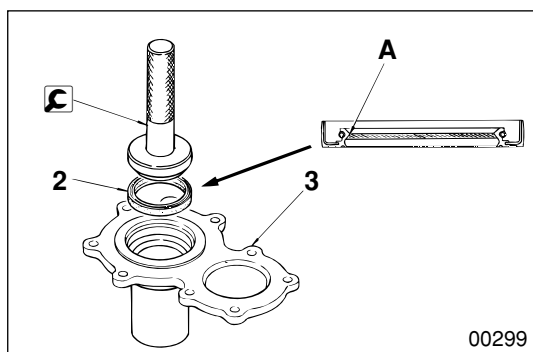
Location	Tool name and shape	Part No.	Application
15	Countershaft bearing puller  01139	< M060 > *MH062426 < M070 > *MH062429	Removal of countershaft front bearing
	Countershaft bearing installer  02141	< M060 > *ME624233 < M070 > *MH062630	Installation of countershaft front bearing

* components of puller and installer kit.  P22A-92

◆ Service procedure

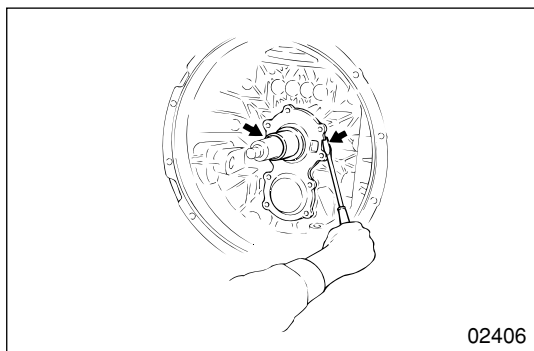
2 Installation of oil seal

- Apply grease to lip area **A** of oil seal **2**.
- Press-fit oil seal **2** into front bearing retainer **3** in the direction as illustrated using  oil seal installer.

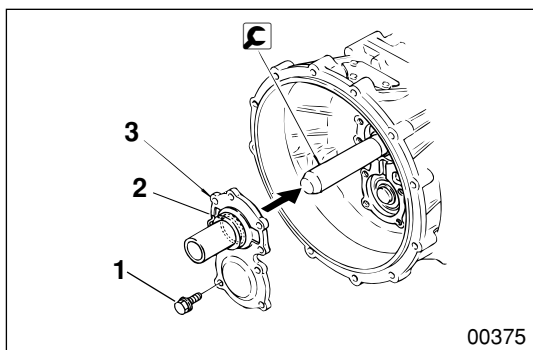


3 Front bearing retainer

[Removal]



TRANSMISSION BODY

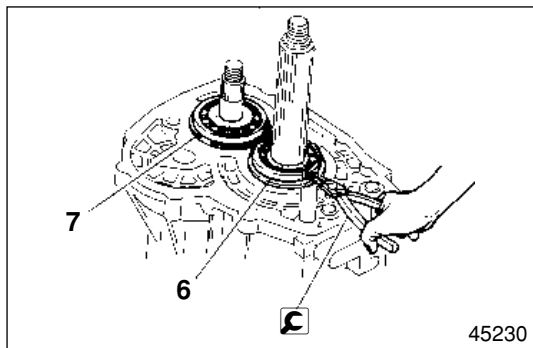


[Installation]

Press-fit front bearing retainer **3** into clutch housing assembly **18** using  oil seal front guide.

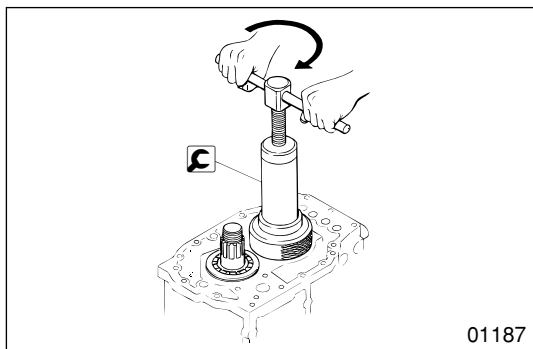
CAUTION

Be careful when installing front bearing retainer **3**, that you do not damage oil seal **2** installed on the front bearing retainer.



6 7 Removal and installation of snap ring

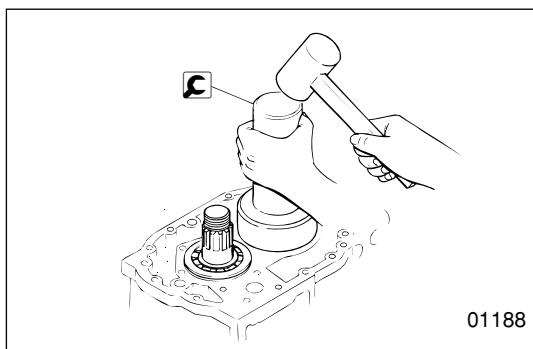
: Snap ring expander



8 Mainshaft rear bearing

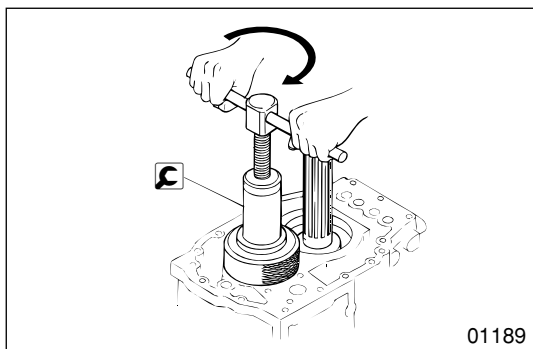
[Removal]

: Mainshaft bearing puller



[Installation]

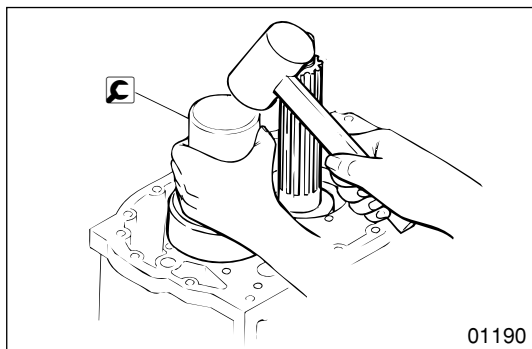
: Mainshaft bearing installer



9 Countershaft rear bearing

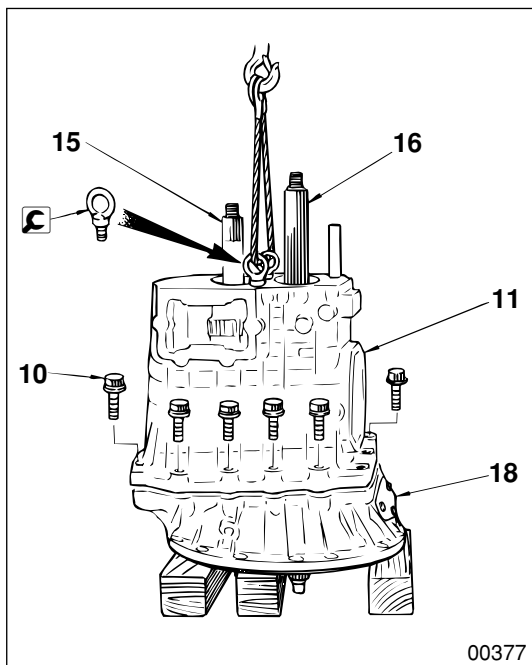
[Removal]

: Countershaft bearing puller



[Installation]

: Countershaft bearing installer



11 Removal and installation of transmission case

[Removal]

● Remove transmission case 11.

Method 1

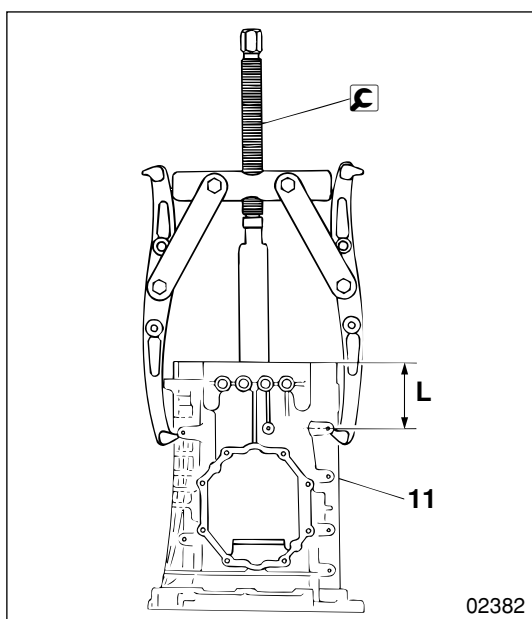
- When lifting up with a crane, install  eye bolts on transmission case 11 and pass a steel sling through them.
- After removing bolts 10, lift transmission case 11 up with a crane and keep hitting the rear ends of clutch housing assembly 18, mainshaft assembly 16 and countershaft assembly 15. Use a plastic-headed or copper-headed mallet to remove the transmission case.

Method 2

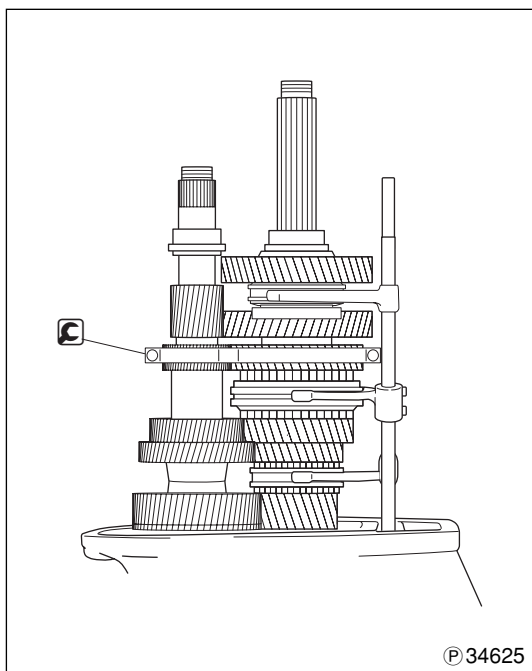
- A  gear puller can be used instead of a crane.

Puller installation position

Model	Dimension of L mm {in.}
M060	97 {3.82}
M070	273.5 {10.8}



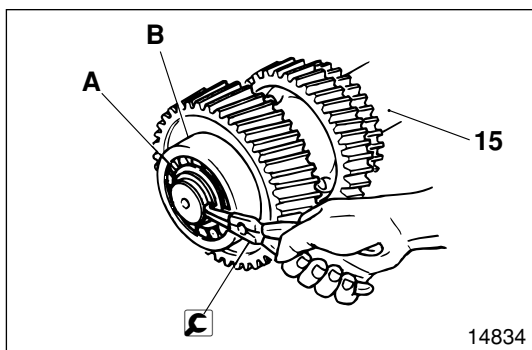
TRANSMISSION BODY



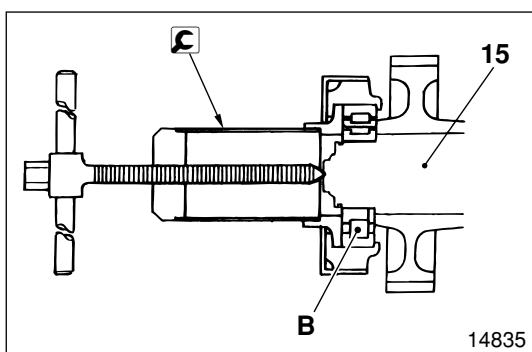
- After removing transmission case **11**, fit the 2nd gear unit < M060 > or 3rd gear unit < M070 > using  steel lifting band to ensure safety.

CAUTION

Be sure to tighten  steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.



- Remove snap ring **A** from countershaft assembly **15**.
B : Countershaft front bearing



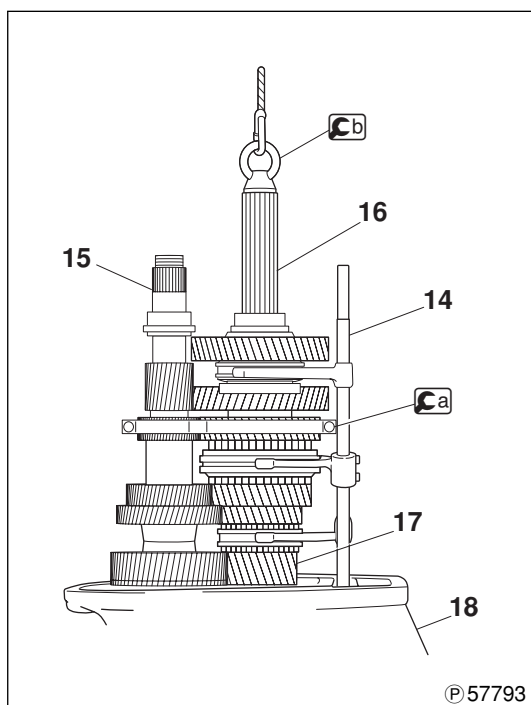
- Remove countershaft bearing **B** from countershaft assembly **15**.

[Installation]

Follow the removal sequence in reverse.

CAUTION

Be careful not to damage mainshaft assembly **16**, or rear bearings **8, 9** of countershaft assembly **15** during installation.



14 to 17

Shift rail and shift fork, countershaft assembly, drive pinion assembly, and mainshaft assembly

[Removal]

Remove or install shift rail and shift fork 14, countershaft assembly 15, drive pinion assembly 17, and mainshaft assembly 16 as a group.

- Before lifting, after removing the case, install eye nut at the end of mainshaft assembly 16, fitted with steel lifting band.
- Fix shift rail and shift fork 14 to mainshaft assembly 16 with a rubber band.
- Fix a piece of wood to clutch housing assembly 18, and use a crane to lift the clutch housing together with drive pinion assembly 17 up, at the same time hitting them with a plastic-headed mallet to remove them.

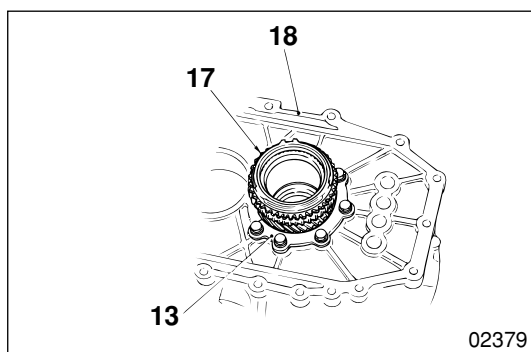
CAUTION

- Be sure to tighten steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.
- Make sure, when lifting mainshaft assembly 16 or other parts, that you support drive pinion assembly 17 with your hand in order to prevent it from falling when the mainshaft assembly and countershaft assembly 15 come apart.

[Installation]

Method 1

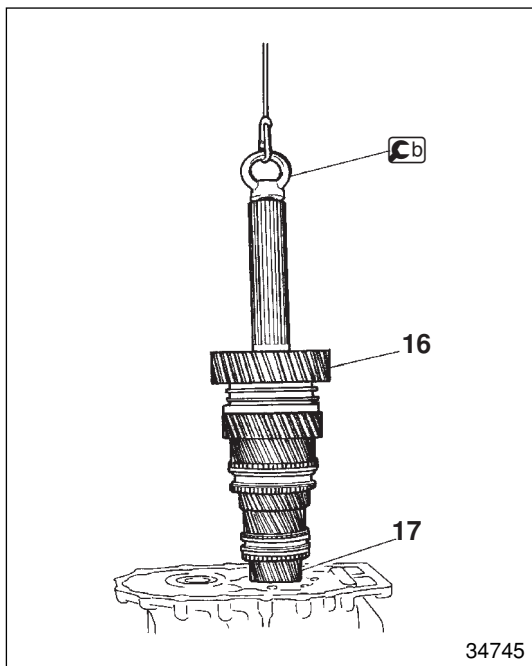
- Follow the removal sequence in reverse.



Method 2

- After installing drive pinion assembly 17 in clutch housing assembly 18, install drive pinion bearing retainer 13.

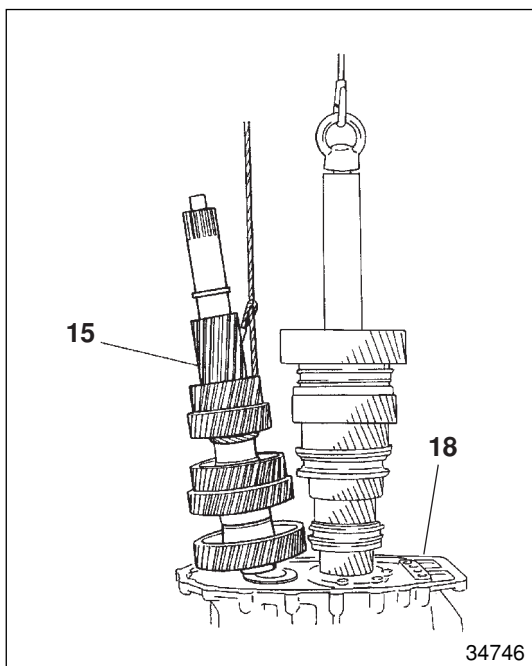
TRANSMISSION BODY



- Install **Cb** eye nut at the end of mainshaft assembly 16.
- Lift mainshaft assembly 16 up using a crane and install the mainshaft assembly on drive pinion assembly 17.

CAUTION

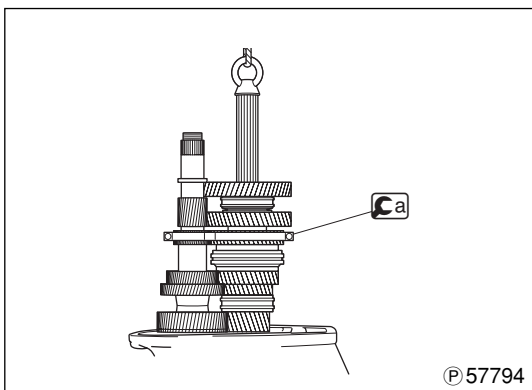
To prevent mainshaft assembly 16 from falling, support it using a crane.



- Install countershaft assembly 15 in clutch housing assembly 18.

CAUTION

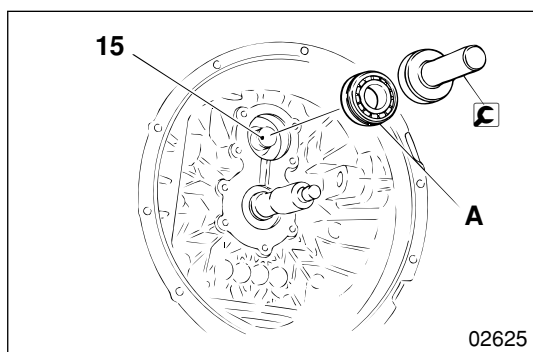
If you use this method of installation, first remove the countershaft front bearing. P22A-84



- Fit the 2nd gear unit using **Ca** steel lifting band to ensure safety.

CAUTION

Be sure to tighten **Ca** steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.



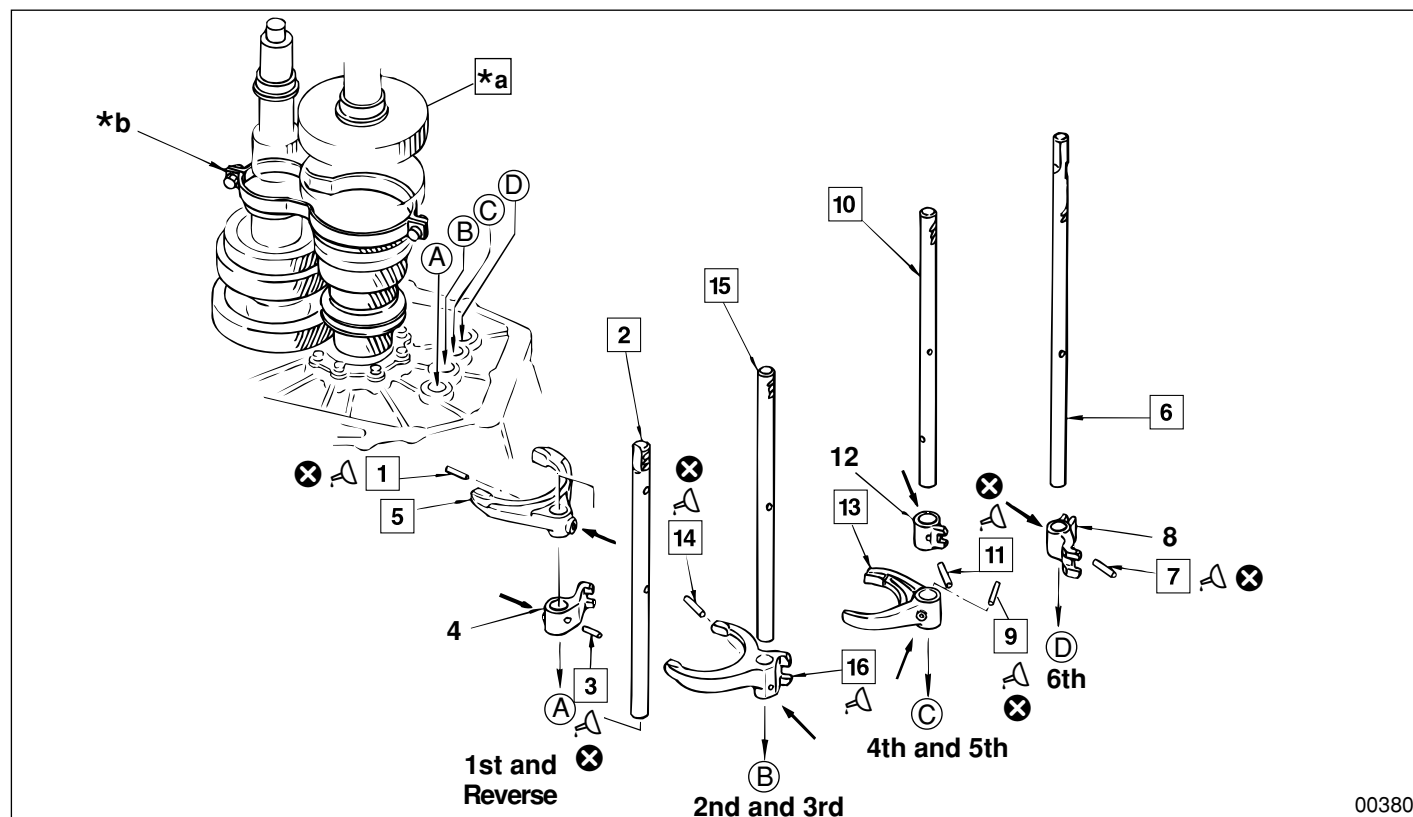
- Install shift rail and shift fork **14** and transmission case **11** in clutch housing assembly **18**.
- Place clutch housing assembly **18** horizontally so that countershaft assembly **15** is uppermost.
- Install the countershaft front bearing **A** into clutch housing assembly **18** using  countershaft bearing installer.

CAUTION

Be sure to install the snap ring of the countershaft front bearing.

TRANSMISSION BODY

Shift Rail and Shift Fork < M060 >



Arrow mark : Removal and installation direction for spring pin

● Disassembly sequence (When the mainshaft assembly is not removed or installed and only the shift rail and shift fork is disassembled)

- | | |
|----------------------------------|-------------------------------|
| 1 Spring pin | 11 Spring pin |
| 2 1st and reverse shift rail | 12 4th and 5th shift rail jaw |
| 3 Spring pin | 13 4th and 5th shift fork |
| 4 1st and reverse shift rail jaw | 14 Spring pin |
| 5 1st and reverse shift fork | 15 2nd and 3rd shift rail |
| 6 6th shift rail | 16 2nd and 3rd shift fork |
| 7 Spring pin | |
| 8 6th shift rail jaw | |
| 9 Spring pin | |
| 10 4th and 5th shift rail | |

*a : Mainshaft assembly

*b : steel lifting band

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse. Remove steel lifting band after installing the shift rail and shift fork.

Service standards

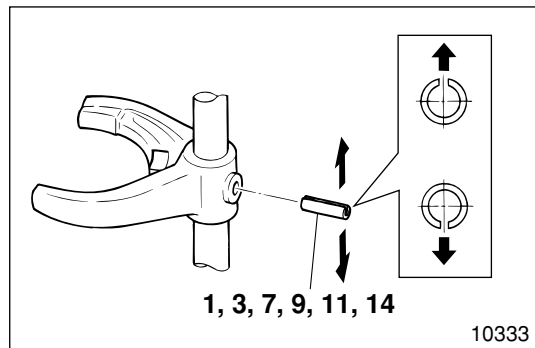
Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2, 10, 15	Bend of shift rail	0.039 {0.0015} or less	0.08 {0.0031}	Correct or replace
5, 13, 16	Tilt of shift fork claw	0.1 {0.0039} or less	0.2 {0.0079}	Replace
5, *a	Clearance between 1st and reverse shift fork and synchronizer sleeve	0.3 to 0.5 {0.012 to 0.020}	1.0 {0.039}	Replace
6	Bend of 6th shift rail	0.047 {0.0019} or less	0.09 {0.0035}	Correct or replace
13, *a	Clearance between 4th and 5th shift fork and synchronizer sleeve	0.3 to 0.6 {0.012 to 0.024}	1.0 {0.039}	Replace
16, *a	Clearance between 2nd and 3rd shift fork and synchronizer sleeve	0.2 to 0.4 {0.0079 to 0.016}	1.0 {0.039}	Replace

 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1, 3, 7, 9, 11, 14	Spring pin	LOCTITE 601	As required
16	Shift fork fingers	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure



1

3

7

9

11

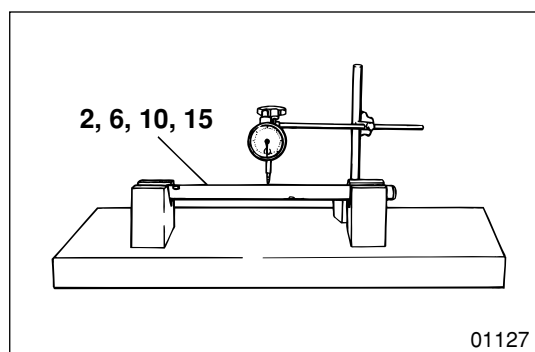
14

Installation of spring pin

Install spring pins 1, 3, 7, 9, 11, 14 in the direction as illustrated.

CAUTION

- Make sure you do not drive in spring pins 1, 3, 7, 9, 11, 14 fully, leave 0 to 0.5 mm {0 to 0.020 in.} outside to prevent them from slipping out.
- Do not remove spring pin 9 for 4th and 5th shift fork 13 (made of aluminum), except when replacing shift fork 13 or shift rail 10.
- Note that the length of spring pin 9 differs from that of spring pins 1, 3, 7, 11, 14.
- Be careful when driving in spring pins 1, 3, 7, 9, 11, 14 that you do not subject shift rails 2, 6, 10, 15 to excessive strain, because this would cause faults such as bent shift rails.



2

6

10

15

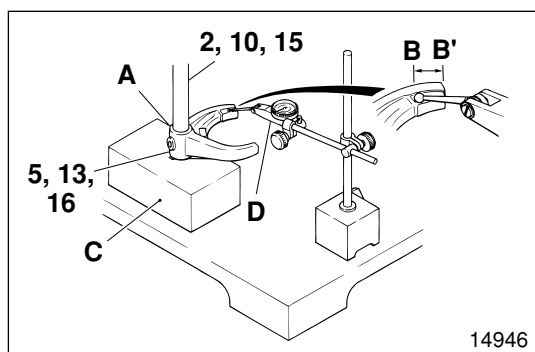
Bend of shift rail

If the measured value is higher than the limit, correct or replace shift rail 2, 6, 10 or 15.

NOTE

Read the dial gauge after turning shift rails 2, 6, 10, 15 one full revolution. The bend is one half of the indicated value.

TRANSMISSION BODY

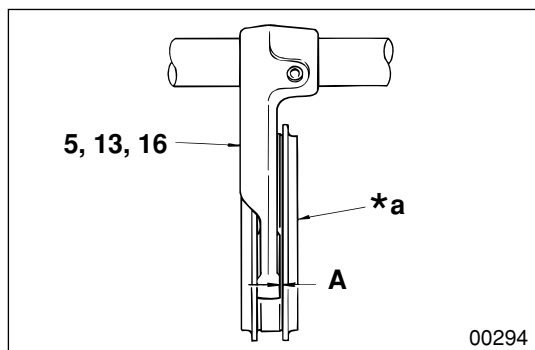


5 13 16 Tilt of shift fork claws

- Measure the tilt (difference between **B** and **B'**) of claw **B–B'** against hole **A** of shift rails **2, 10, 15** of shift forks **5, 13, 16** with the shift rails upright.
- If the measured value is higher than the limit, replace shift fork **5, 13, or 16**.

C : V-block

D : Dial gauge



5 13 16 *a Clearance between gear shift fork and synchronizer sleeve of mainshaft

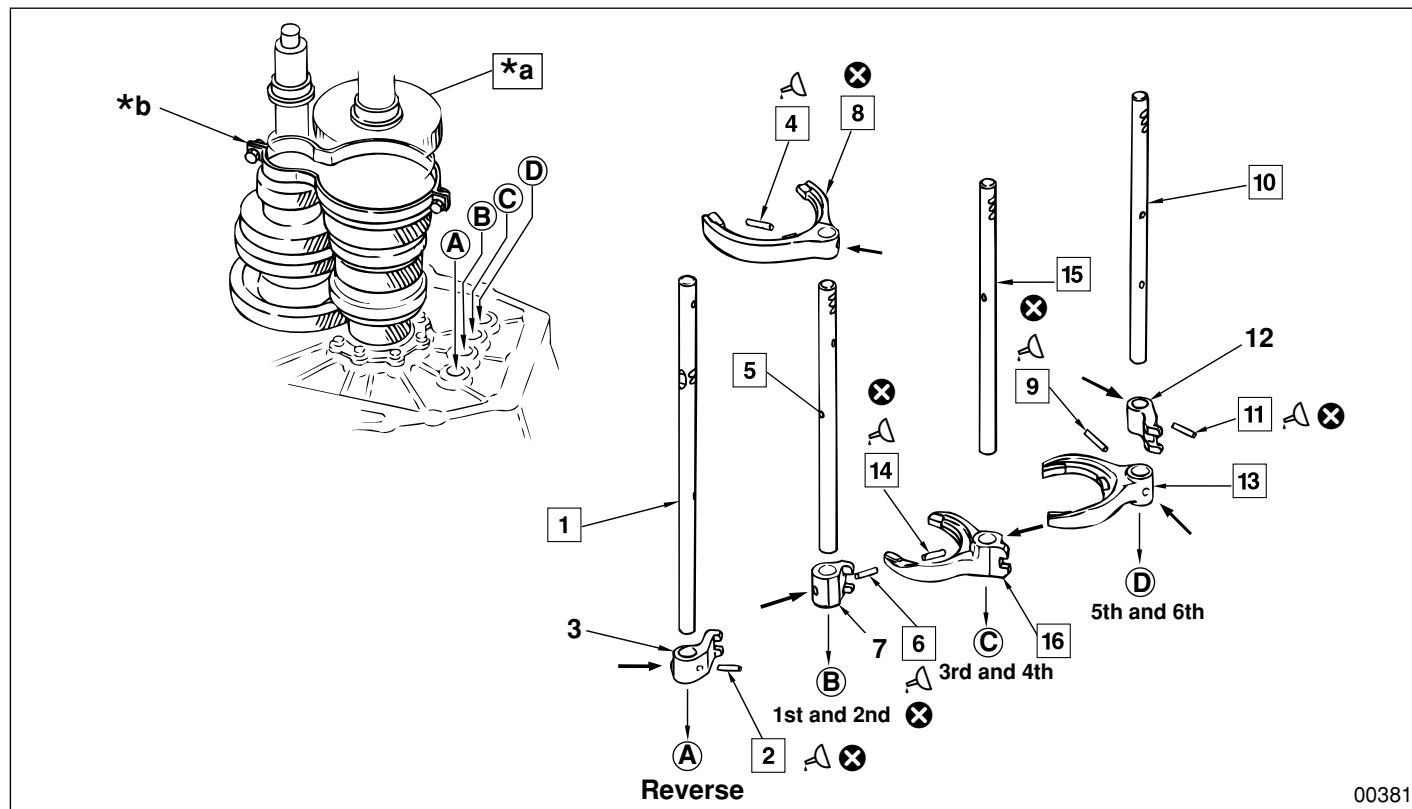
If clearance **A** is higher than the limit, replace the faulty parts.

***a** : Synchronizer ring of mainshaft assembly

MEMO

TRANSMISSION BODY

Shift Rail and Shift Fork < M070 >



Arrow mark: Removal and installation direction for spring pin

● Disassembly sequence (Where the mainshaft assembly is not removed or installed and only the shift rail and shift fork is disassembled)

- | | | |
|------------------------------|-------------------------------|---------------------------|
| 1 Reverse shift rail | 8 1st and 2nd shift fork | 15 3rd and 4th shift rail |
| 2 Spring pin | 9 Spring pin | 16 3rd and 4th shift fork |
| 3 Reverse shift rail jaw | 10 5th and 6th shift rail | |
| 4 Spring pin | 11 Spring pin | |
| 5 1st and 2nd shift rail | 12 5th and 6th shift rail jaw | |
| 6 Spring pin | 13 5th and 6th shift fork | |
| 7 1st and 2nd shift rail jaw | 14 Spring pin | |

*a : Mainshaft assembly

*b : steel lifting band

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse. Remove steel lifting band after installing the shift rail and shift fork.

Service standards

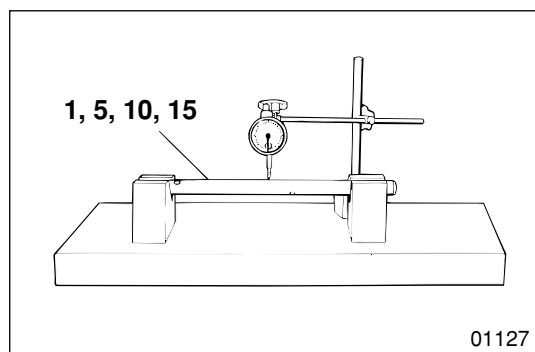
Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Bend of reverse shift rail	0.047 {0.0019} or less	0.09 {0.0035}	Correct or replace
5, 10, 15	Bend of shift rails	0.037 {0.0015} or less	0.07 {0.0028}	Correct or replace
8, 13, 16	Tilt of shift fork claw	0.1 {0.0039} or less	0.2 {0.0079}	Replace shift fork
8, *a	Clearance between 1st and 2nd shift fork and synchronizer sleeve	0.3 to 0.5 {0.012 to 0.002}	1.0 {0.039}	Replace
13, *a	Clearance between 5th and 6th shift fork and synchronizer sleeve	0.3 to 0.6 {0.012 to 0.024}	1.0 {0.039}	Replace
16, *a	Clearance between 3rd and 4th shift fork and synchronizer sleeve	0.2 to 0.4 {0.0079 to 0.016}	1.0 {0.039}	Replace

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2, 4, 6, 9, 11, 14	Spring pin	LOCTITE 601	As required

◆ Service procedure

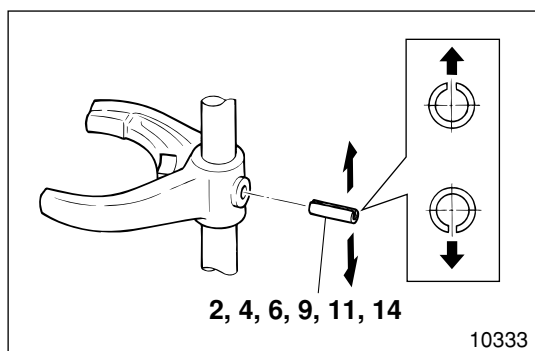


1 5 10 15 Bend of shift rail

If the measured value is higher than the limit, correct or replace shift rail 1, 5, 10, or 15.

NOTE

Read the dial gauge after turning shift rails 1, 5, 10, 15 one full revolution. The bend is one half of the indicated value.

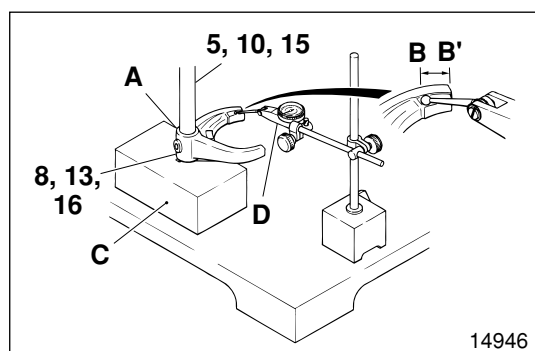


2 4 6 9 11 14 Installation of spring pin

Install spring pins 2, 4, 6, 9, 11, 14 in the direction as illustrated.

CAUTION

- Make sure you do not drive in spring pins 2, 4, 6, 9, 11, 14 fully, leave 0 to 0.5 mm {0 to 0.02 in.} outside to prevent them from slipping out.
- Do not remove spring pin 6 for 4th and 5th shift fork 10 (made of aluminum), except when replacing shift forks 8, 13 or shift rails 5, 10.
- The lengths of spring pins 4, 9 differ from those of other spring pins 2, 6, 11, 14.
- Be careful when driving in spring pins 2, 4, 6, 9, 11, 14 that you do not subject shift rails 1, 5, 10, 15 to excessive strain, because this would cause faults such as bent shift rails.

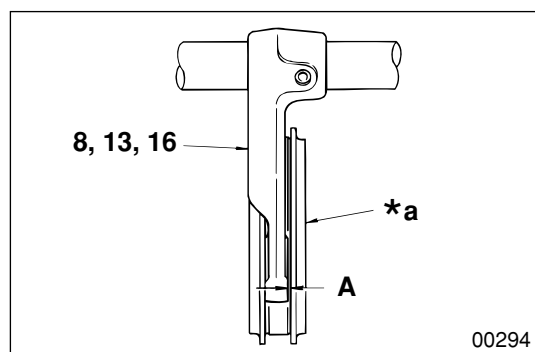


8 13 16 Tilt of shift fork claw

- Measure the tilt (difference between B and B') of claw B-B' against hole A of shift rails 5, 10, 15 of shift forks 8, 13, 16 with the shift rails upright.
- If the measured value is higher than the limit, replace shift fork 8, 13, or 16.

C : V-block

D : Dial gauge

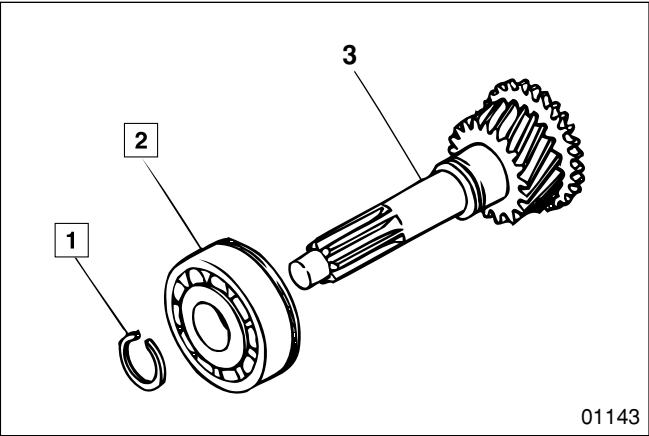


8 13 16 *a Clearance between shift fork and synchronizer sleeve of mainshaft

If clearance A is higher than the limit, replace the faulty parts.

*a : Synchronizer ring of mainshaft assembly

DRIVE PINION ASSEMBLY



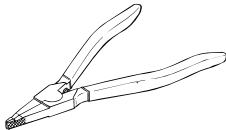
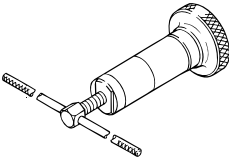
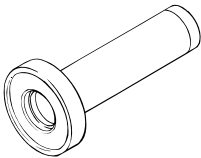
● **Disassembly sequence**

- 1 Snap ring
- 2 Drive pinion bearing
- 3 Drive pinion

● **Assembly sequence**

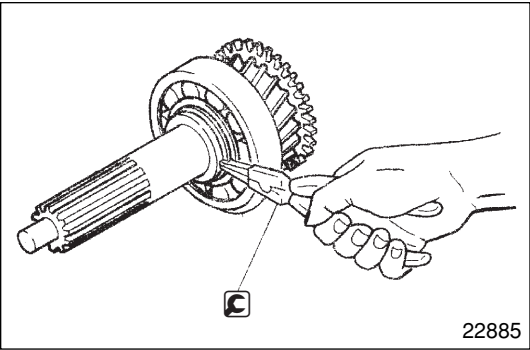
Follow the disassembly sequence in reverse.

Special tools

Location	Tool name and shape	Part No.	Application
1	Snap ring expander  01137	MH061268	Removal and installation of snap ring of drive pinion bearing
2	Drive pinion bearing puller  01138	*MH062440	Removal of drive pinion bearing
	Drive pinion bearing installer  02142	*ME624235	Installation of drive pinon bearing

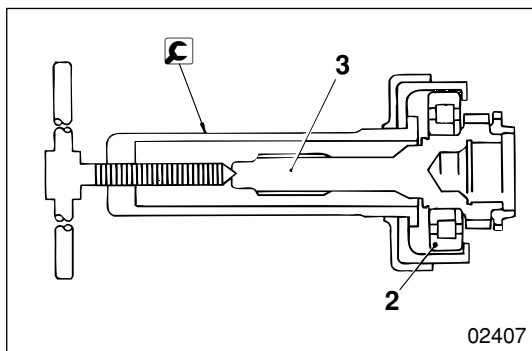
* components of puller and installer kit P22A-92

◆ **Service procedure**



1 Removal and installation of snap ring

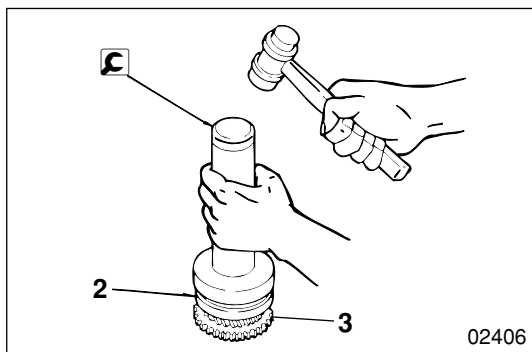
: Snap ring expander



2 Drive pinion bearing

[Removal]

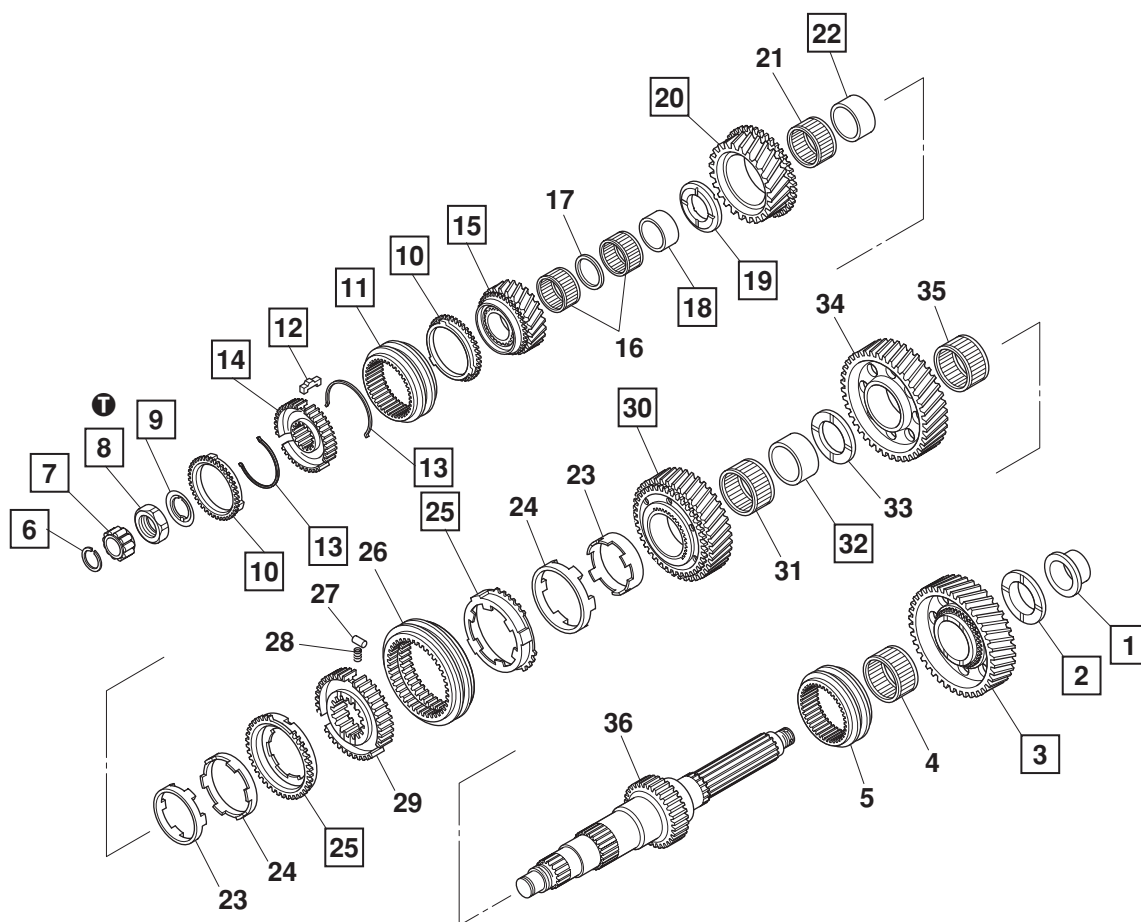
: Drive pinion bearing puller



[Installation]

: Drive pinion bearing installer

MAINSHAFT ASSEMBLY < OVER-DRIVE (M060) >



©34650

● Work before disassembly

📖 P22A-67

● Disassembly sequence

- | | | |
|-------------------------------------|-----------------------------------|-----------------------------------|
| 1 Mainshaft rear bearing inner race | 13 Shifting key | 25 Synchronizer outer ring |
| 2 Reverse gear thrust washer | 14 Synchronizer hub | 26 Synchronizer sleeve |
| 3 Reverse gear | 15 4th gear assembly | 27 Shifting pin |
| 4 Needle bearing | 16 Needle bearing | 28 Synchronizer spring |
| 5 Sleeve | 17 Bearing spacer | 29 Synchronizer hub |
| 6 Snap ring | 18 4th gear bearing sleeve | 30 2nd gear assembly |
| 7 Pilot bearing | 19 3rd and 4th gear thrust washer | 31 Needle bearing |
| 8 Lock nut | 20 3rd gear assembly | 32 2nd gear bearing sleeve |
| 9 Lock washer | 21 Needle bearing | 33 1st and 2nd gear thrust washer |
| 10 Synchronizer ring | 22 3rd gear bearing sleeve | 34 1st gear |
| 11 Synchronizer sleeve | 23 Synchronizer inner ring | 35 Needle bearing |
| 12 Shifting key spring | 24 Synchronizer center cone | 36 Mainshaft |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3	End play of reverse gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
3, 4, 36	Play in the diameter direction after assembling reverse gear	—	0.12 {0.0047}	Replace
5, 36	Play in the rotating direction of sleeve and spline of mainshaft	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
7, 36	Play in the diameter direction after assembling pilot bearing	—	0.12 {0.0047}	Replace
10	Clearance between synchronizer ring and cone of drive pinion assembly	1.48 to 1.77 {0.058 to 0.070}	0.2 {0.0079}	Replace
10, 13	Clearance between synchronizer ring keyway and shifting key	4.7 to 5 {0.19 to 0.20}	5.8 {0.23}	Replace
10, 15	Clearance between synchronizer ring and cone area of 4th gear assembly	1.48 to 1.77 {0.058 to 0.070}	0.2 {0.0079}	Replace
11, 14	Play in the rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
13, 14	Clearance between shifting key and synchronizer hub keyway	0.05 to 0.2 {0.0020 to 0.0079}	0.5 {0.020}	Replace
15	End play of 4th gear assembly	0.25 to 0.4 {0.0098 to 0.016}	0.5 {0.020}	Replace gear or thrust washer
15, 16, 18, 36	Play in the diameter direction after assembling 4th gear assembly	—	0.12 {0.0047}	Replace
18	Outer diameter of 4th gear bearing sleeve	$[54] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [2.13] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	— 0.1 {— 0.0039}	Replace
20	End play of 3rd gear assembly	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
20, 21, 22, 36	Play in the diameter direction after assembling 3rd gear assembly	—	0.12 {0.0047}	Replace
20, 28	Clearance between cone area of 3rd gear assembly and synchronizer outer ring	1.21 to 1.79 {0.048 to 0.070}	0.2 {0.0079}	Replace
22	Outer diameter of 3rd gear bearing sleeve	$[68] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [2.68] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	— 0.1 {— 0.0039}	Replace
25, 30	Clearance between synchronizer outer ring and cone area of 2nd gear assembly	1.21 to 1.79 {0.048 to 0.070}	0.5 {0.020}	Replace
26, 29	Play in the rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
30	End play of 2nd gear assembly	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
30, 31, 32, 36	Play in the diameter direction after assembling 2nd gear assembly	—	0.12 {0.0047}	Replace
32	Outer diameter of 2nd gear bearing sleeve	$[71] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [2.8] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	— 0.1 {— 0.0039}	Replace
34	End play of 1st gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
34 to 36	Play in the diameter direction after assembling 1st gear	—	0.12 {0.0047}	Replace

MAINSHAFT ASSEMBLY < OVER-DRIVE (M060) >

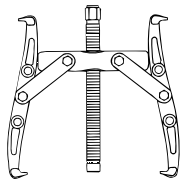
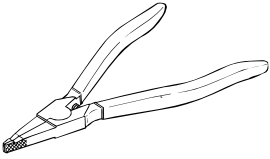
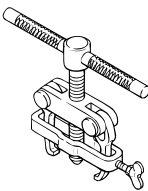
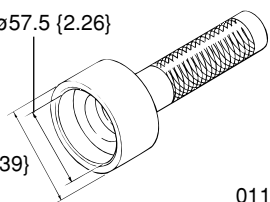
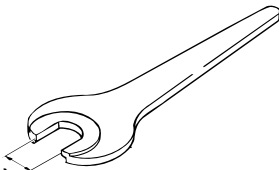
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8	Lock nut	245 {180, 25}	—

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1, 18, 22, 32	 01148	MH062308	Removal of bearing sleeve
6	 01137	MH061268	Removal and installation of snap ring
7	 01146	MH061043	Removal of pilot bearing
	 01147	*ME624236	Installation of pilot bearing
8	 01126	MH061555	Removal and installation of lock nut

* Components of puller and installer kit  P22A-92

◆ Service procedure

● Work before disassembly

[Inspection]

(1) End play of gears

- If the measured value is higher than the limit, replace the faulty parts.
- Check the play again after assembly and make sure it does not exceed the limit.

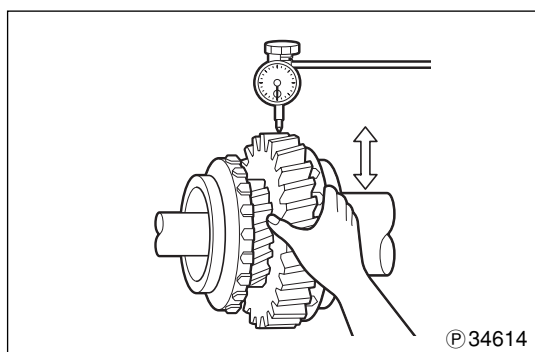
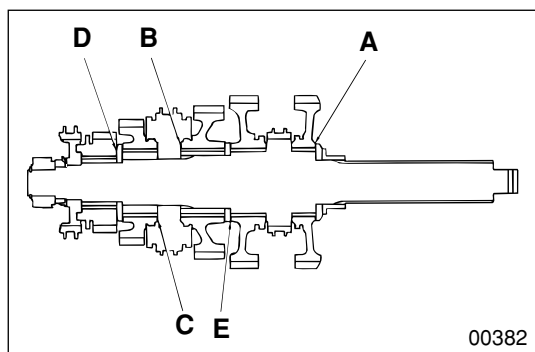
A : Reverse gear

B : 2nd gear

C : 3rd gear

D : 4th gear

E : 1st gear

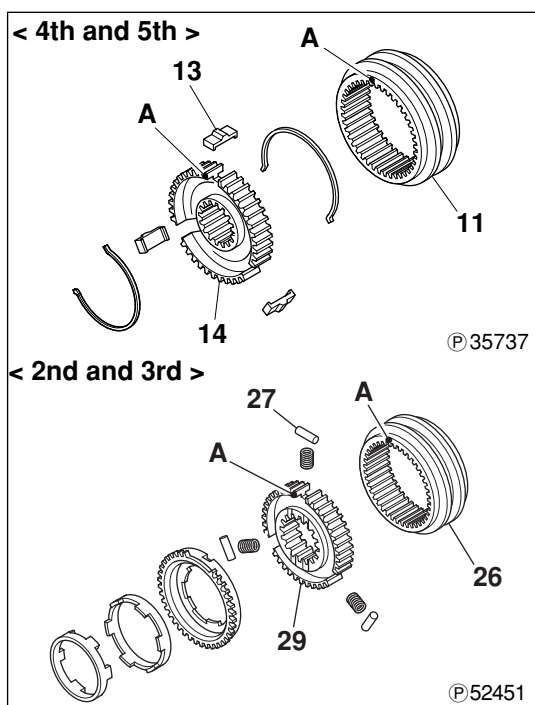


(2) Play of gears in diameter direction

- If the measured value is higher than the limit, replace the faulty parts.
- Check the play again after assembly and make sure it does not exceed the limit.

CAUTION ⚠

When either of the needle bearings of a gear needs to be replaced, replace both of them at the same time. Make sure the new needle bearings have the same package color.

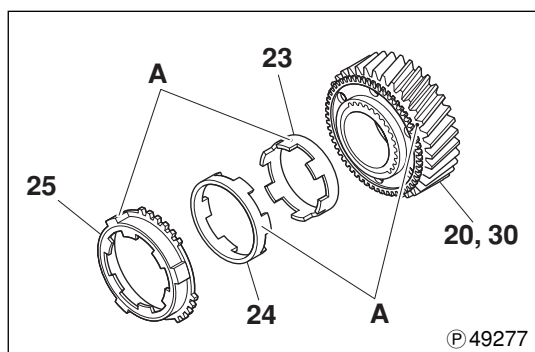


[Alignment marks]

(1) Synchronizer sleeve and synchronizer hub

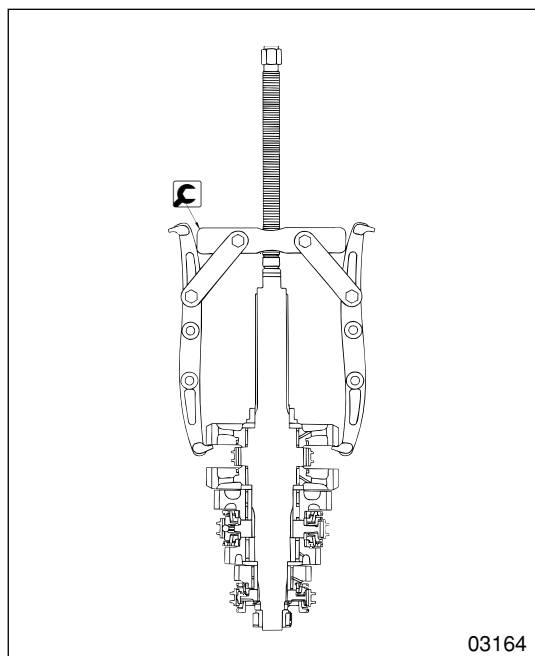
Before disassembling the synchronizer sleeves **11**, **26** and the synchronizer hubs **14**, **29**, put alignment marks **A** on the places where the shifting keys **12** or shifting pin **27** are installed. When reusing parts, align the alignment marks to assemble.

MAINSHAFT ASSEMBLY < OVER-DRIVE (M060) >



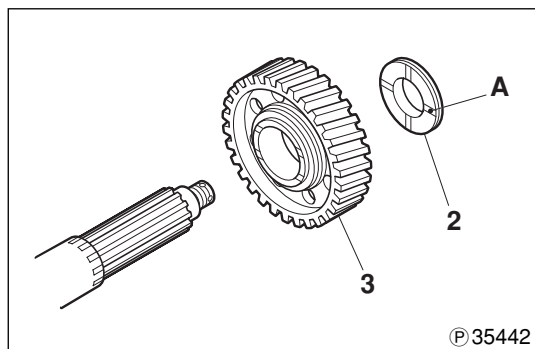
(2) Double cone synchronizer and 3rd and 2nd gear assemblies

- Make alignment marks **A** on synchronizer inner ring **23** and synchronizer outer ring **25** and on synchronizer center cone **24** and the 3rd gear assembly **20** or 2nd gear assembly **30**, each at one place before removing them.
- When the above-mentioned parts are reused, reassemble them with the alignment marks **A** in line.



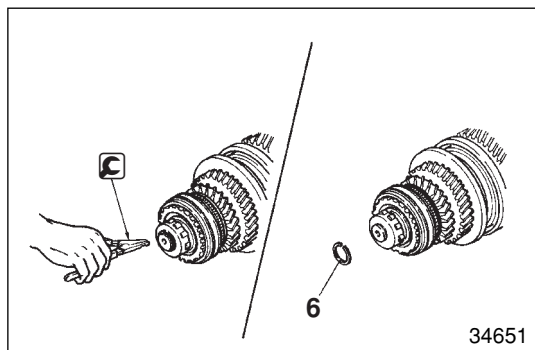
1 Removal of mainshaft rear bearing inner race, reverse gear thrust washer and reverse gear

: Gear puller



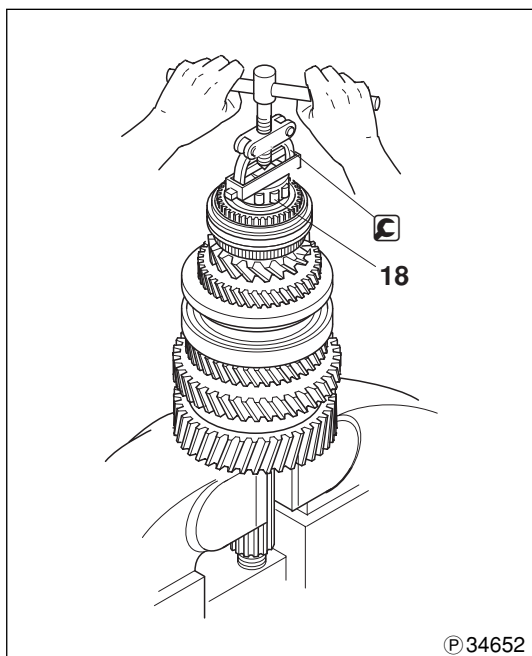
2 Installation of reverse gear thrust washer

Install reverse gear thrust washer **2** with grooves **A** facing in the shown direction.



6 Removal and installation of snap ring

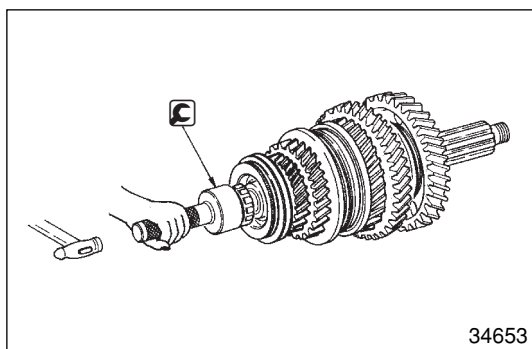
: Snap ring expander



7 Pilot bearing

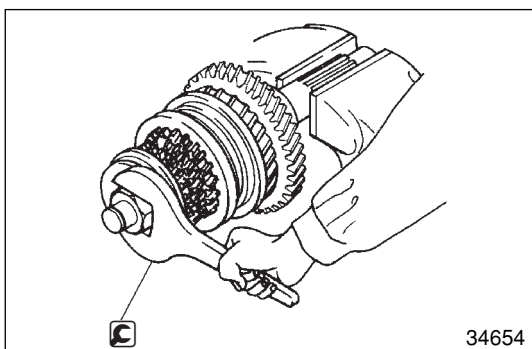
[Removal]

: Pilot bearing puller



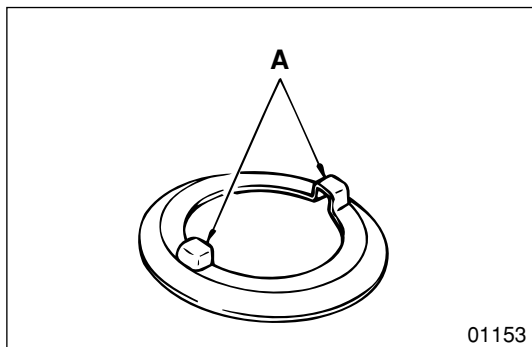
[Installation]

: Pilot bearing installer



8 Removal and installation of lock nut

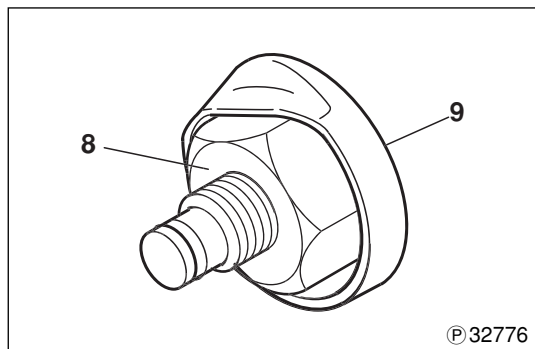
: Single spanner



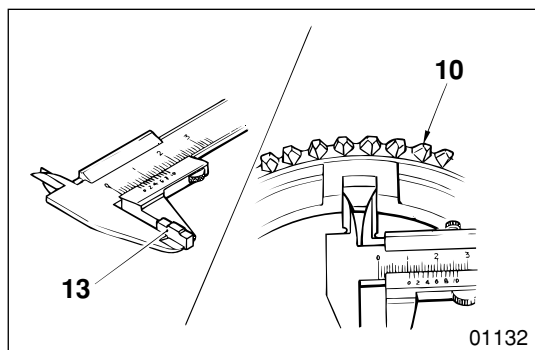
9 Installation of lock washer

Install so that protrusions **A** (two points as illustrated) fit into the grooves of synchronizer hub **15**.

MAINSHAFT ASSEMBLY < OVER-DRIVE (M060) >



- Tighten lock nut **8** to the specified torque, then bend lock washer **9** to prevent the lock nut from turning.

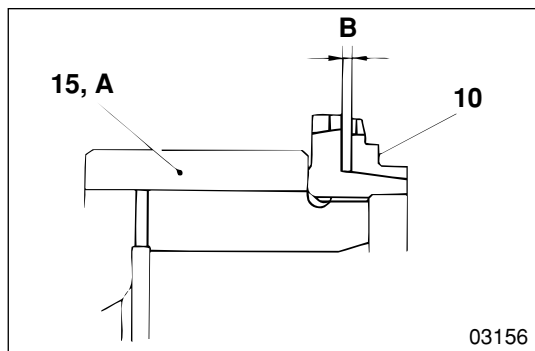


10 to 15 Synchromesh mechanism and 4th gear assembly

[Inspection]

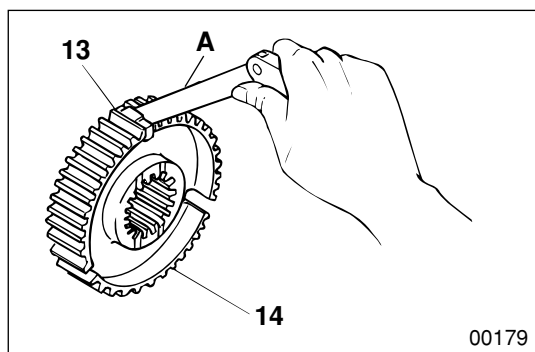
(1) Clearance between synchronizer ring 10 and shifting key 13

If the measured value is higher than the limit, replace the faulty parts.



(2) Clearance between synchronizer ring 10 and drive pinion or 4th gear assembly 15.

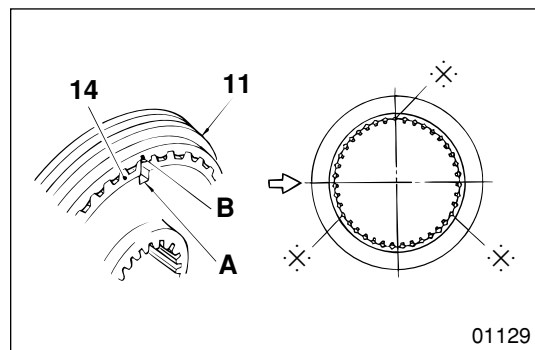
- Measure clearance **B** between synchronizer ring **10** and the gear cone of drive pinion **A** or 4th gear assembly **15**.
- When measuring this value, press synchronizer ring **10** evenly, and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.



(3) Clearance between shifting key 13 and synchronizer hub 14

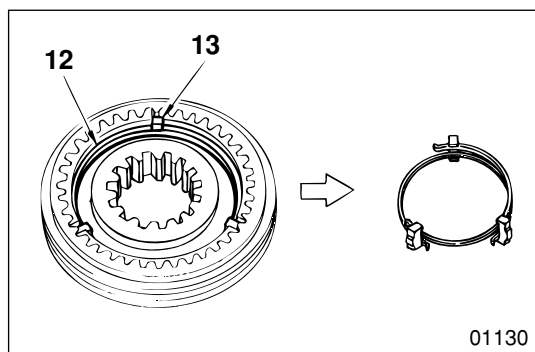
If the measured value is higher than the limit, replace the faulty parts.

A : Feeler gauge

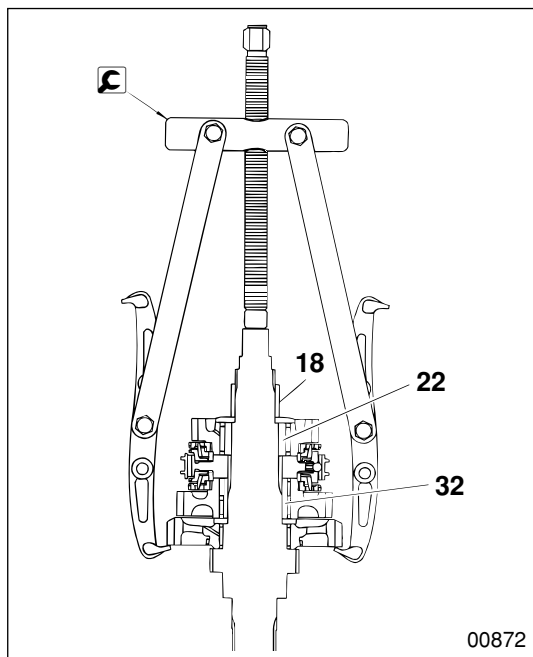


[Installation]

- Align the three keyways **A** of synchronizer hub **14** with the three stub teeth **B** (illustrated by $\times$ mark) of synchronizer sleeve **11** to install the synchronizer hub.
- To reassemble synchronizer hub **14** and synchronizer sleeve **11**, align the alignment marks made during disassembly.

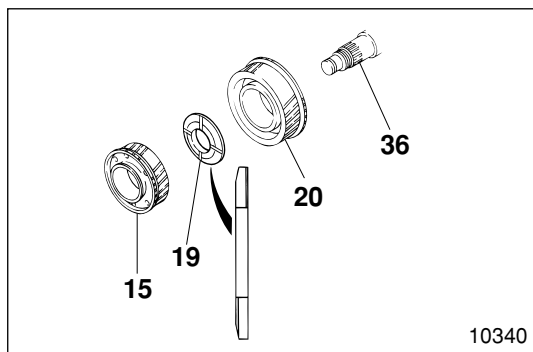


- Insert shifting key **13** into the keyway.
- Install shifting key spring **12** so that its opening is offset from the one of the shifting key.
- Make sure that the openings of shifting key springs do not align with each other.



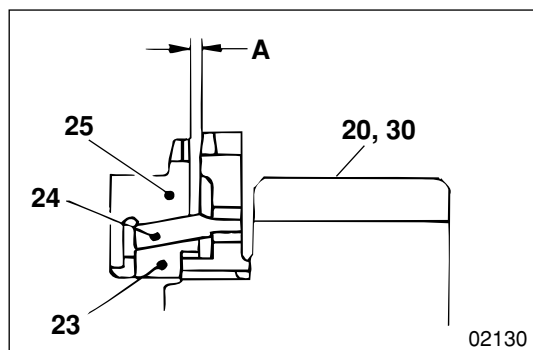
18 22 32 Removal of 4th, 3rd, 2nd gear bearing sleeves

: Gear puller



20 Installation of 3rd and 4th gear thrust washer

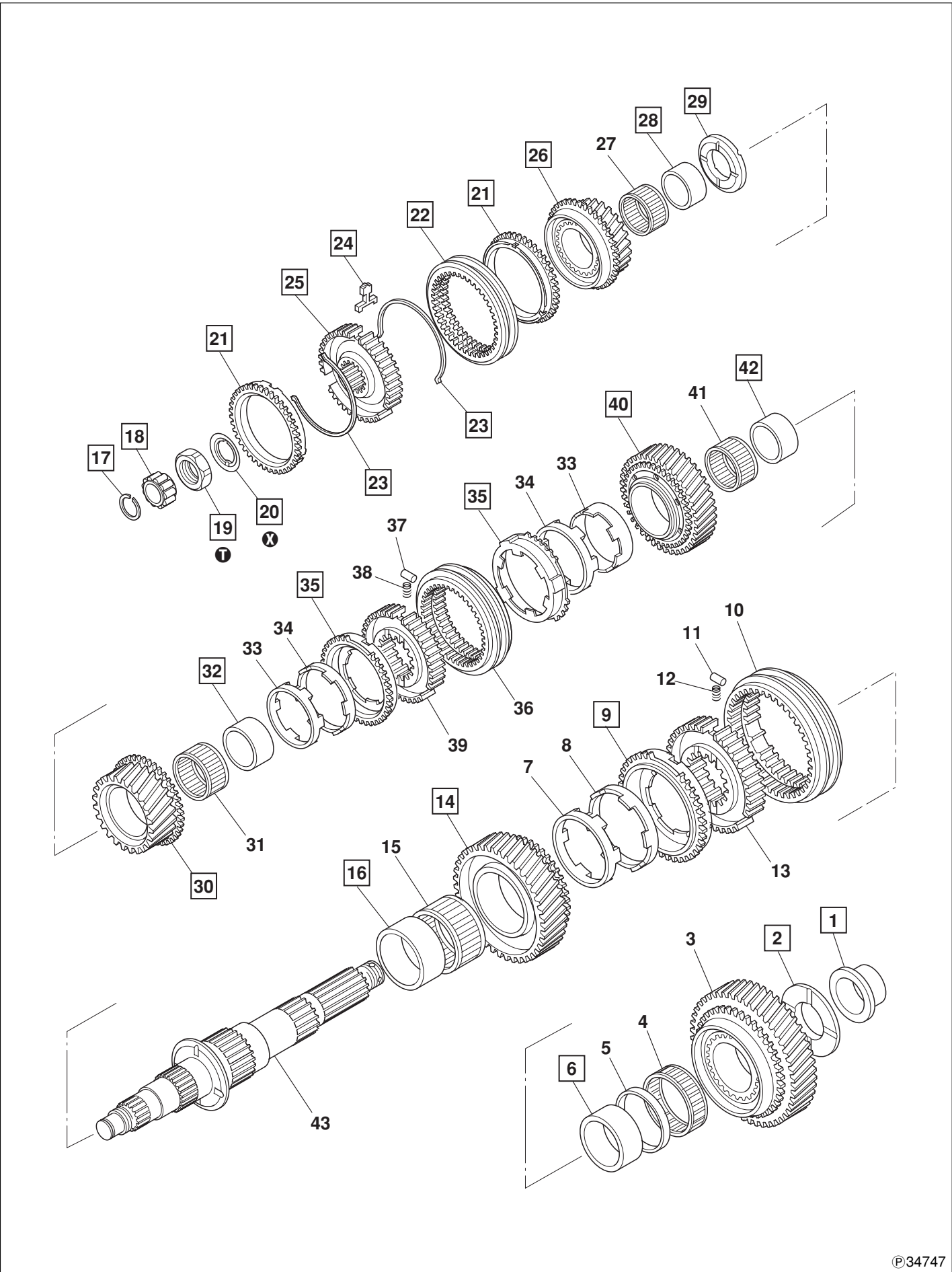
Install thrust washer **19** with the surface having larger contact area facing in the shown direction.



20 25 30 Clearance between synchronizer outer ring and 3rd gear assembly or 2nd gear assembly

- Measure clearance **A** between synchronizer outer ring **25** and the cone of 3rd gear assembly **20** or 2nd gear assembly **30**.
- When measuring this value, press synchronizer inner ring **23**, synchronizer outer ring **25** and synchronizer center ring **24** evenly and measure all around the circumference.
- If the measured value is higher than the limit, replace the faulty parts.

MAINSHAFT ASSEMBLY < DIRECT-DRIVE (M070) >



● Work before disassembly

📖 P22A-76

● Disassembly sequence

- | | |
|-------------------------------------|-----------------------------------|
| 1 Mainshaft rear bearing inner race | 24 Shifting key |
| 2 1st gear thrust washer | 25 Synchronizer hub |
| 3 1st gear assembly | 26 5th gear assembly |
| 4 Needle bearing | 27 Needle bearing |
| 5 Bearing spacer | 28 5th gear bearing sleeve |
| 6 1st gear bearing sleeve | 29 4th and 5th gear thrust washer |
| 7 Synchronizer inner ring | 30 4th gear assembly |
| 8 Synchronizer center cone | 31 Needle bearing |
| 9 Synchronizer outer ring | 32 4th gear bearing sleeve |
| 10 Synchronizer sleeve | 33 Synchronizer inner ring |
| 11 Shifting pin | 34 Synchronizer center cone |
| 12 Synchronizer spring | 35 Synchronizer outer ring |
| 13 Synchronizer hub | 36 Synchronizer sleeve |
| 14 2nd gear assembly | 37 Shifting pin |
| 15 Needle bearing | 38 Synchronizer spring |
| 16 2nd gear bearing sleeve | 39 Synchronizer hub |
| 17 Snap ring | 40 3rd gear assembly |
| 18 Pilot bearing | 41 Needle bearing |
| 19 Lock nut | 42 3rd gear bearing sleeve |
| 20 Lock washer | 43 Mainshaft |
| 21 Synchronizer ring | |
| 22 Synchronizer sleeve | |
| 23 Shifting key spring | |
- ⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

MAINSHAFT ASSEMBLY < DIRECT-DRIVE (D/D) >

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3	End play of 1st gear assembly	0.35 to 0.55 {0.014 to 0.022}	0.75 {0.030}	Replace gear or thrust washer
3, 4, 5, 6, 43	Play in the diameter direction after assembling 1st gear assembly	—	0.1 {0.0039}	Replace
6	Outer diameter of 1st gear bearing sleeve	$[96] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [3.78] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	— 0.1 {— 0.0039}	Replace
9, 14	Clearance between cone area of 2nd gear assembly and synchronizer outer ring	1.21 to 1.79 {0.048 to 0.070}	0.2 {0.0079}	Replace
10, 13	Play in the rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
13, 43	Engagement in the rotating direction of synchronizer hub and mainshaft	—0.005 to 0.114 {—0.00020 to 0.0045}	0.2 {0.0079}	Replace
14	End play of 2nd gear assembly	0.35 to 0.55 {0.014 to 0.022}	0.75 {0.030}	Replace gear or thrust washer
14, 15, 16, 43	Play in the diameter direction after assembling 2nd gear assembly	—	0.1 {0.0039}	Replace
16	Outer diameter of 2nd gear bearing sleeve	$[95] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [3.74] \begin{smallmatrix} -0.012 \\ -0.017 \end{smallmatrix} \}$	— 0.1 {— 0.0039}	Replace
18, 43	Play in the diameter direction after assembling pilot bearing	—	0.12 {0.0047}	Replace
21	Clearance between synchronizer ring and cone area of drive pinion	1.49 to 1.86 {0.059 to 0.073}	0.2 {0.0079}	Replace
21, 25	Clearance between synchronizer ring and synchronizer hub groove	4.7 to 5.3 {0.19 to 0.21}	6.5 {0.26}	Replace
21, 26	Clearance between cone area of 5th gear assembly and synchronizer ring	1.49 to 1.86 {0.059 to 0.073}	0.2 {0.0079}	Replace
22, 25	Play in the rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
24, 25	Clearance between shifting key and synchronizer hub keyway	0.05 to 0.20 {0.0020 to 0.0079}	0.5 {0.020}	Replace
25, 43	Engagement in the rotating direction of synchronizer hub and mainshaft	—0.006 to 0.094 {—0.00024 to 0.0037}	0.2 {0.0079}	Replace
26	End play of 5th gear assembly	0.25 to 0.40 {0.0098 to 0.016}	0.6 {0.024}	Replace gear or thrust washer
26, 27, 28, 43	Play in the diameter direction after assembling 5th gear assembly	—	0.1 {0.0039}	Replace
28	Outer diameter of 5th gear bearing sleeve	$[60] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [2.36] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	— 0.1 {— 0.0039}	Replace
30	End play of 4th gear assembly	0.15 to 0.35 {0.0059 to 0.014}	0.55 {0.022}	Replace gear or thrust washer
30, 31, 32, 43	Play in the diameter direction after assembling 4th gear assembly	—	0.1 {0.0039}	Replace

Unit : mm {in.}

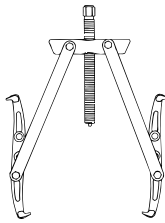
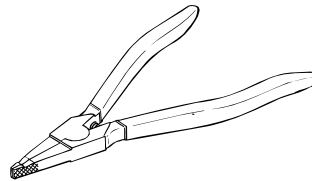
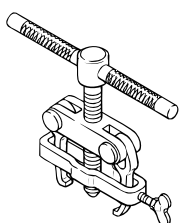
Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
30, 35	Clearance between cone area of 4th gear assembly and synchronizer outer ring	1.21 to 1.79 {0.048 to 0.070}	0.2 {0.0079}	Replace
32	Outer diameter of 4th gear bearing sleeve	$[71]_{-0.043}^{-0.030}$ {[2.80] $_{-0.0017}^{-0.0012}$ }	-0.1 {-0.0039}	Replace
35, 40	Clearance between cone area of 3rd gear assembly and synchronizer outer ring	1.21 to 1.79 {0.048 to 0.070}	0.2 {0.0079}	Replace
36, 39	Play in the rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
39, 43	Engagement in the rotating direction of synchronizer hub and mainshaft	-0.005 to 0.114 {-0.00020 to 0.0045}	0.2 {0.0079}	Replace
40	End play of 3rd gear assembly	0.15 to 0.35 {0.0059 to 0.014}	0.55 {0.022}	Replace gear or thrust washer
40, 41, 42, 43	Play in the diameter direction after assembling 3rd gear assembly	—	0.1 {0.0039}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

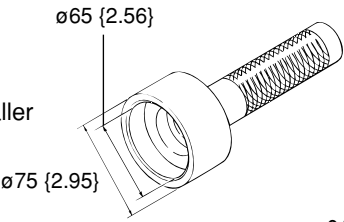
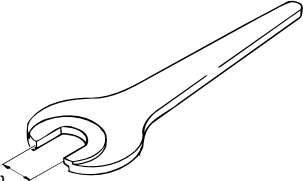
Location	Parts to be tightened	Tightening torque	Remarks
19	Lock nut	314 {230, 32}	—

Special tools

Location	Tool name and shape	Part No.	Application
1, 6, 28, 32	Gear puller  03160	MH062250	Removal of mainshaft rear bearing inner race and bearing sleeves
17	Snap ring expander  01137	MH061268	Removal and installation of snap ring
18	Pilot bearing puller  01146	MH061043	Removal of pilot bearing

MAINSHAFT ASSEMBLY < DIRECT-DRIVE (D/D) >

Unit : mm {in.}

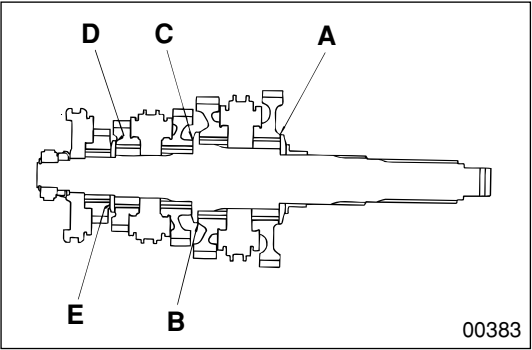
Location	Tool name and shape	Part No.	Application
18	 Pilot bearing installer 01147	*MH062628	Installation of pilot bearing
19	 Single spanner 01126	MH063101	Removal and installation of lock nut

* Components of puller and installer kit  P22A-92

◆ Service procedure

● Work before disassembly

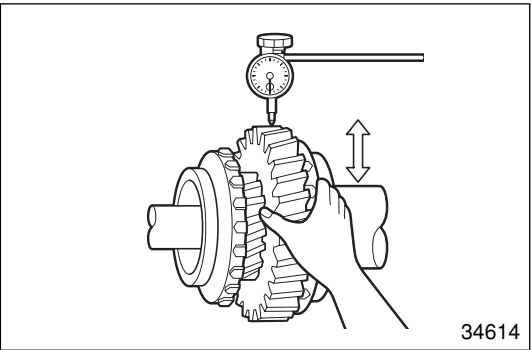
[Inspection]



(1) End play of gears

- If the measured value is higher than the limit, replace the faulty parts.
- Check the play again after assembly and make sure it does not exceed the limit.

A : 1st gear
B : 2nd gear
C : 3rd gear
D : 4th gear
E : 5th gear

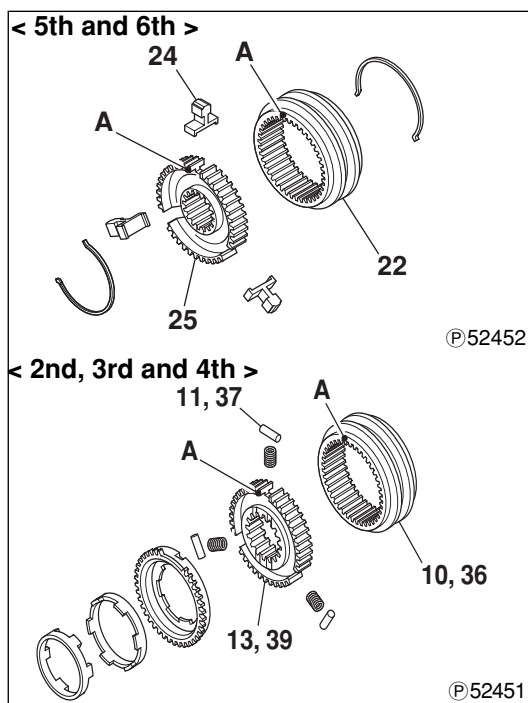


(2) Play of gears in diameter direction

- If the measured value is higher than the limit, replace the faulty parts.
- Check the play again after assembly and make sure it does not exceed the limit.

CAUTION

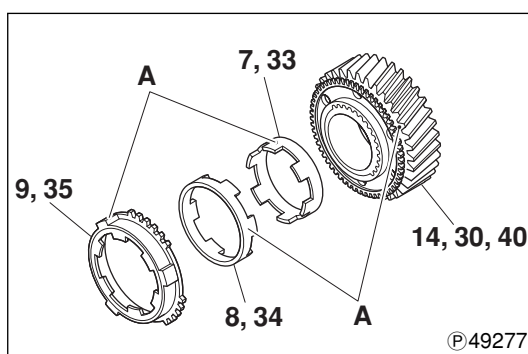
When either of the needle bearings of a gear needs to be replaced, replace both of them at the same time. Make sure the new needle bearings have the same package color.



[Alignment marks]

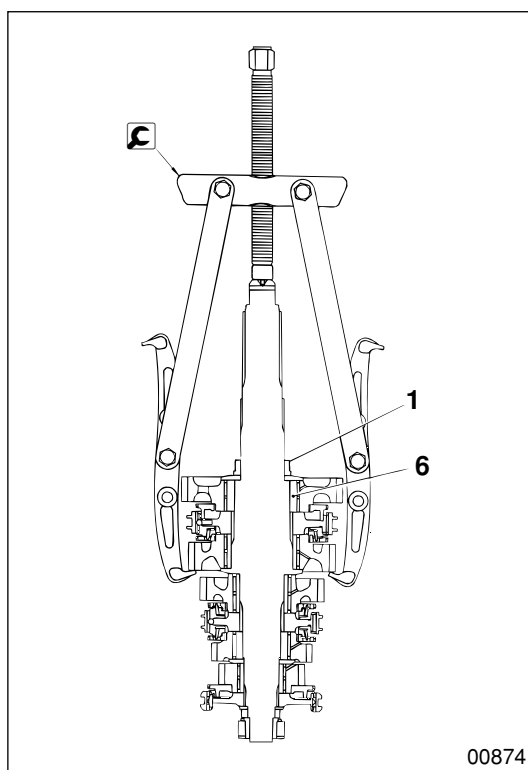
(1) Synchronizer sleeve and synchronizer hub

Before separating synchronizer sleeve **10**, **22**, or **36** and synchronizer hubs **13**, **25**, or **39**, put alignment marks **A** on them at the places where shifting keys **23** or shifting pins **11** or **37** are installed. When reusing these parts, align the marks during reassembly.



(2) Double cone synchronizer and each gear assembly

- Make alignment marks **A** on synchronizer inner ring **7** or **33** and synchronizer outer ring **9** or **35** and on synchronizer center cone **8** or **34** and each gear assembly **14**, **30**, or **40**, each at one place before removing them.
- When the above-mentioned parts are reused, reassemble them with the alignment marks **A** in line.



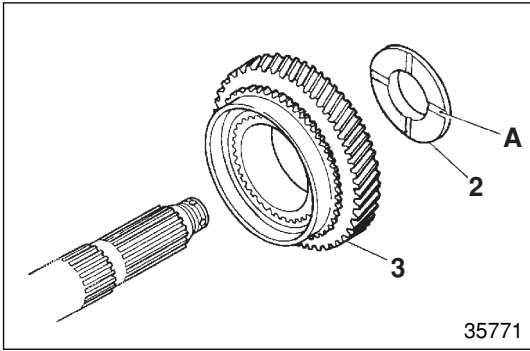
1

6

Removal of mainshaft rear bearing inner race and 1st gear bearing sleeve

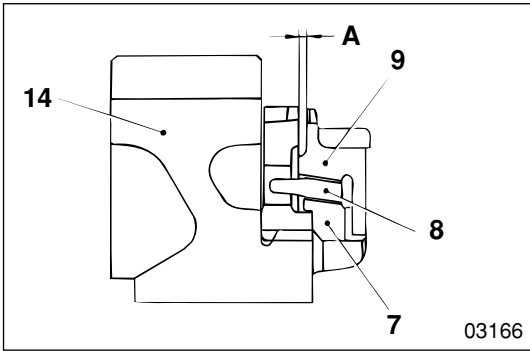
: Gear puller

MAINSHAFT ASSEMBLY < DIRECT-DRIVE (D/D) >



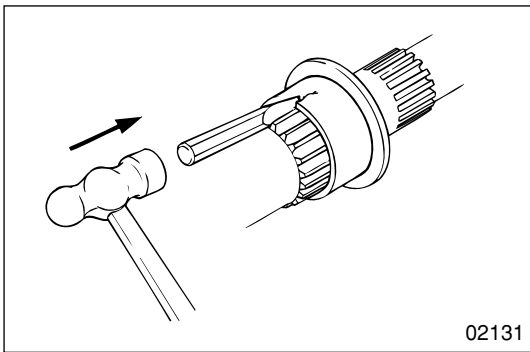
2 Installation of 1st gear thrust washer

Install reverse gear thrust washer 2 with grooves **A** facing in the shown direction.

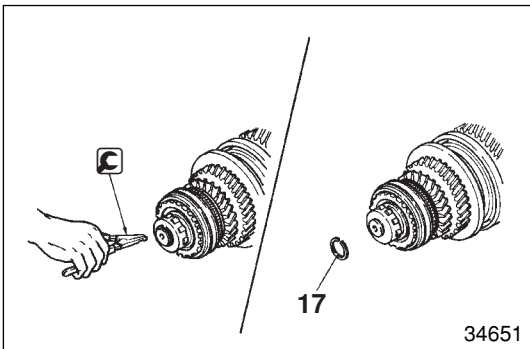


9 14 Clearance between synchronizer outer ring and 2nd gear assembly

- Measure clearance **A** between synchronizer outer ring 9 and the cone of 2nd gear assembly 14.
- When measuring this value, press synchronizer inner ring 7, center cone 8 and outer ring 9 evenly and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.

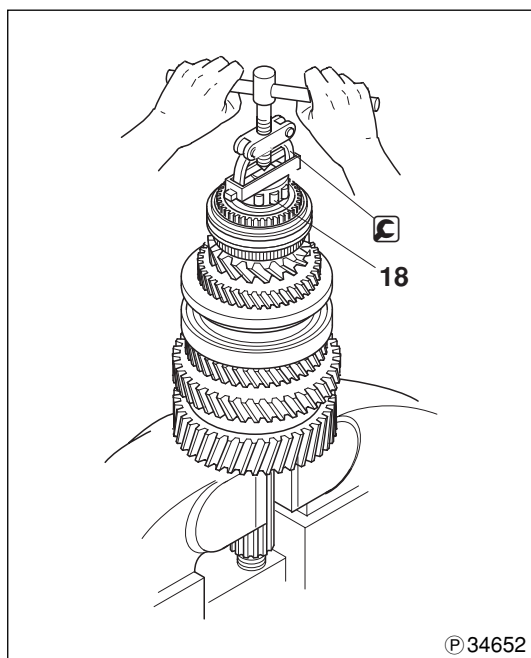


16 Removal of 2nd gear bearing sleeve



17 Removal and installation of snap ring

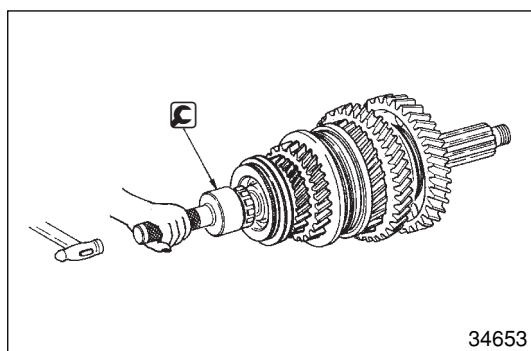
: Snap ring expander



18 Pilot bearing

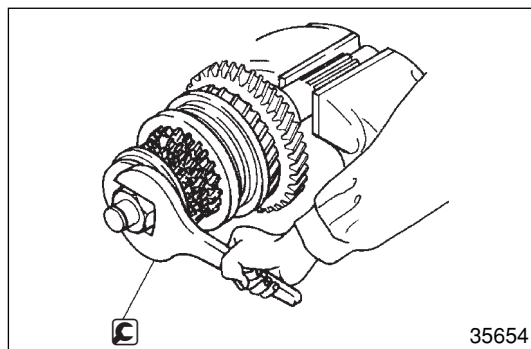
[Removal]

: Pilot bearing puller



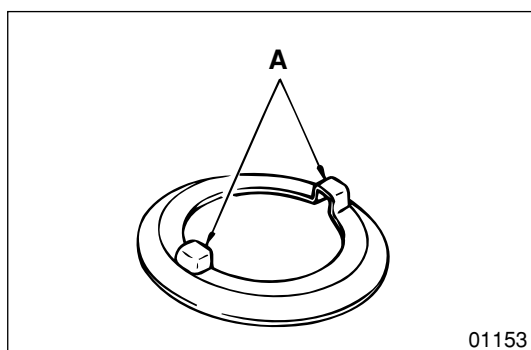
[Installation]

: Pilot bearing installer



19 Removal and installation of lock nut

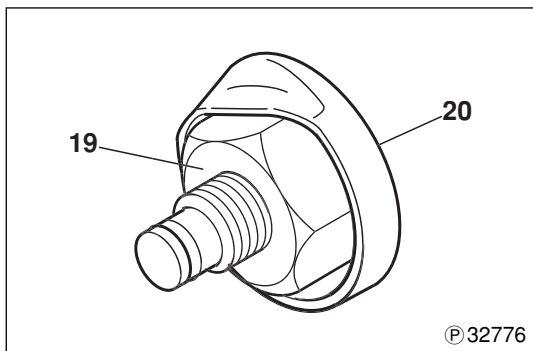
: Single spanner



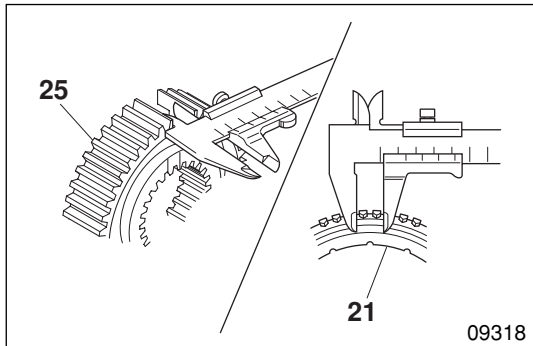
20 Installation of lock washer

Install so that protrusions **A** (two points as illustrated) fit into the grooves of synchronizer hub **25**.

MAINSHAFT ASSEMBLY < DIRECT-DRIVE (D/D) >



- Tighten lock nut **19** to the specified torque, then bend lock washer **20** to prevent the lock nut from turning.

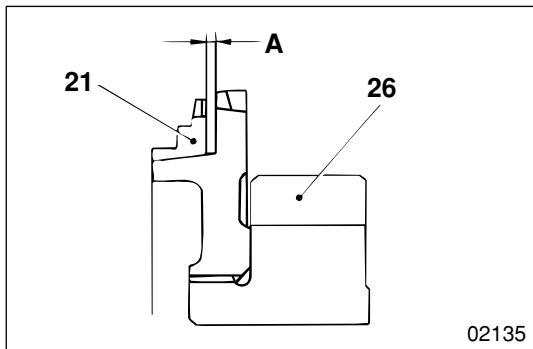


21 to 26 Synchronmesh mechanism and 5th gear assmblly

[Inspection]

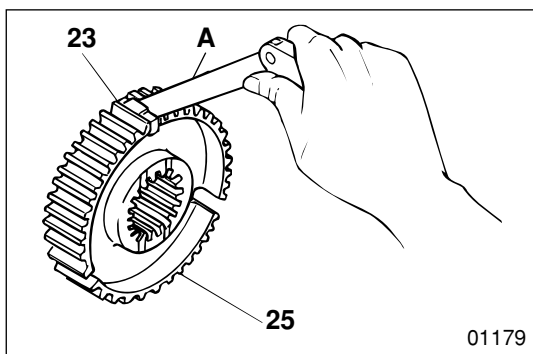
(1) Clearance between the protrusion of synchronizer ring 21 and the groove of synchronizer hub 25

If the measured value is higher than the limit, replace the faulty parts.



(2) Clearance between synchronizer ring 21 and 5th gear assembly 26 or drive pinion

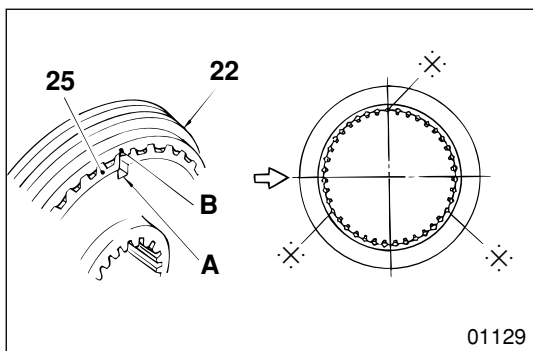
- Measure the clearance between synchronizer ring **21** and the gear cone of 5th gear assembly **26** or drive pinion
- When measuring this value, press synchronizer ring **21** evenly **1** and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.



(3) Clearance between shifting key 23 and synchronizer hub 25.

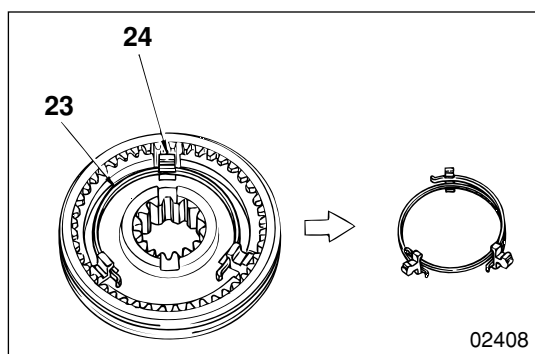
if the measured value is higher than the limit, replace the faulty parts.

A : Feeler gauge

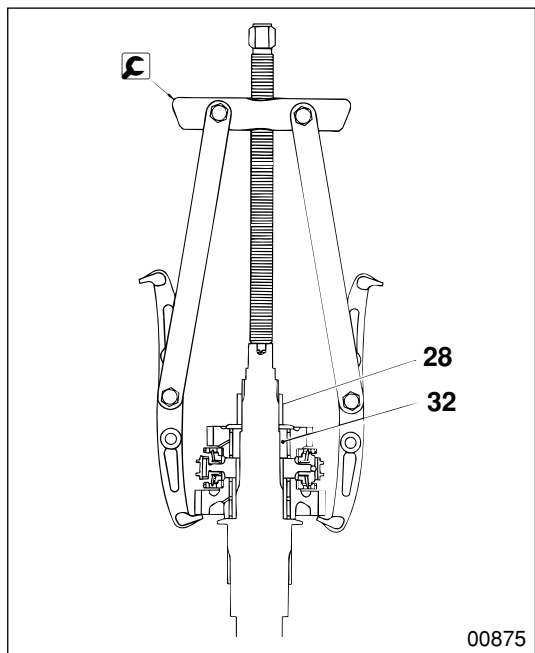


[Installation]

- Align the three keyways **A** of synchronizer hub **25** with the three stub teeth **B** (illustrated by ·×· mark) of synchronizer sleeve **22** to install the synchronizer hub.
- To reassemble synchronizer hub **25** and synchronizer sleeve **22**, align the alignment marks made during disassembly.

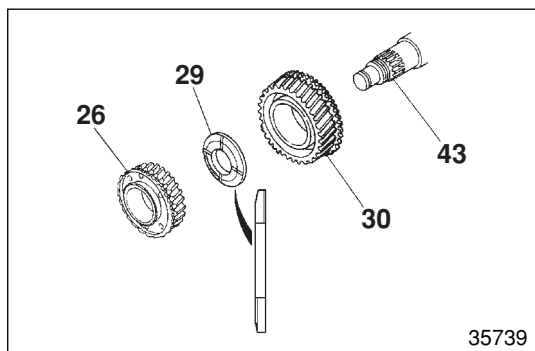


- Insert shifting key **24** into the keyway.
- Install shifting key spring **23** so that its opening is offset from the one on the shifting key.
- Make sure that the openings of shifting key springs do not align with each other.



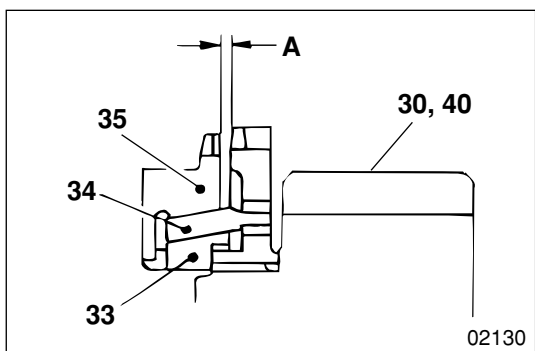
28 32 Removal of 5th gear bearing 4 th sleeves

: Gear puller



29 Installation of 4th and 5th gear thrust washer

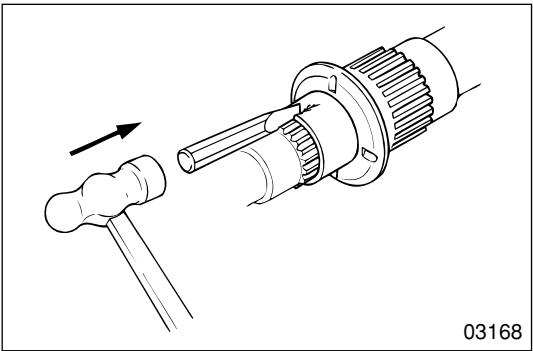
Install 4th and 5th gear thrust washer **29** with the surface having larger contact area facing in the shown direction.



30 35 40 Clearance between synchronizer outer ring and 3rd gear assembly or 4th gear assembly

- Measure clearance **A** between synchronizer outer ring **35** and the cone of 3rd gear assembly **40** or 4th gear assembly **30**.
- When measuring this value, press synchronizer inner ring **33**, synchronizer center cone **34** and synchronizer outer ring **35** evenly and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.

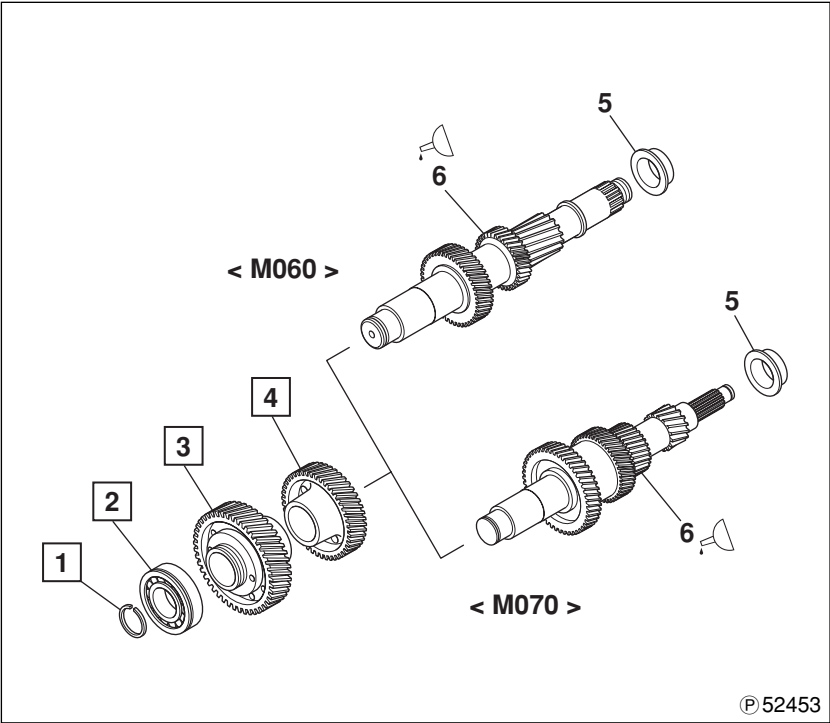
MAINSHAFT ASSEMBLY < DIRECT-DRIVE (D/D) >



42 Removal of 3rd gear bearing sleeve

MEMO

COUNTERSHAFT ASSEMBLY



● Disassembly sequence

- 1 Snap ring
- 2 Countershaft front bearing
- 3 Countershaft constant mesh gear
- 4 Countershaft 4th gear < M060 >
Countershaft 5th gear < M070 >
- 5 Countershaft rear bearing inner race
- 6 Countershaft

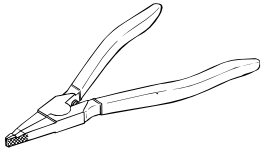
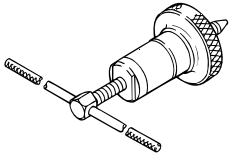
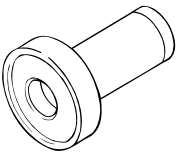
● Assembly sequence

Follow the disassembly sequence in reverse.

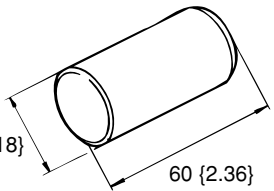
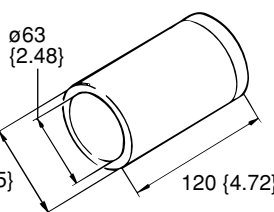
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
6	Gear installation area of countershaft	THREEBOND 1375B	As required

Special tools

Location	Tool name and shape	Part No.	Application
1	Snap ring expander 	MH061268 01137	Removal and installation of snap rings of countershaft bearing
2	Countershaft bearing puller 	< M060 > *MH062426 < M070 > *MH062429 01139	Removal of countershaft front bearing
	Countershaft bearing installer 	< M060 > *ME624233 < M070 > *MH062630 02141	Installation of countershaft front bearing

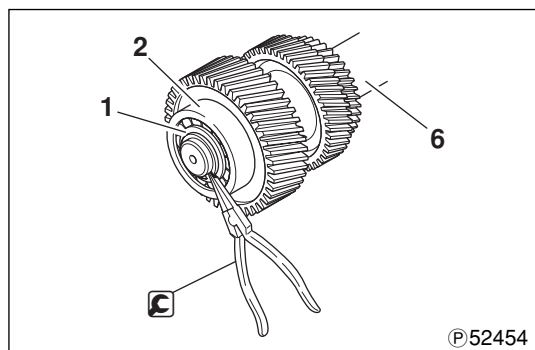
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
3, 4	Countershaft gear puller  01155	ME624243	Removal of countershaft gear
	Countershaft gear installer  01156	MH061740	Press-fitting of countershaft gear

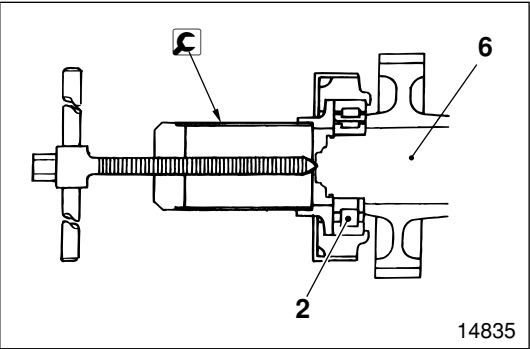
* Components of puller and installer kit  P22A-92

◆ Service procedure

1 Removal and installation of snap ring



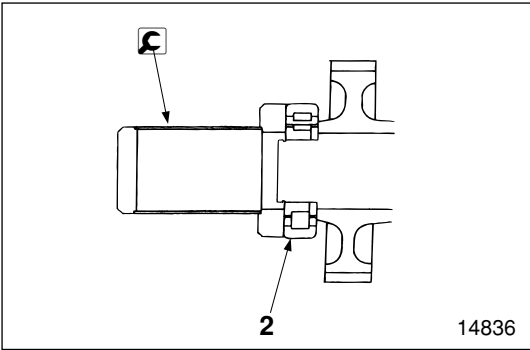
COUNTERSHAFT ASSEMBLY



2 Countershaft front bearing

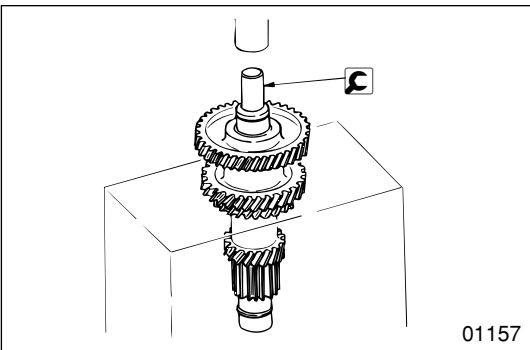
[Removal]

: Countershaft bearing puller



[Installation]

: Countershaft bearing installer

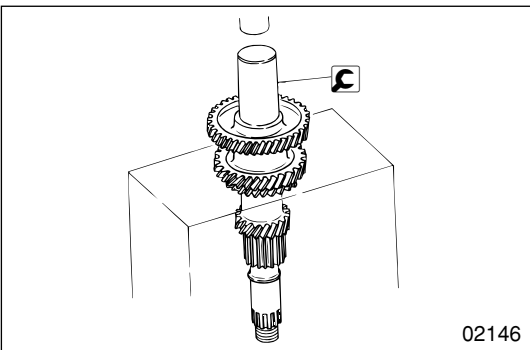


3 4 Countershaft constant mesh gear and countershaft 4th gear

[Removal]

Use a press.

: Countershaft gear puller



[Installation]

Use a press.

: Countershaft gear installer

MEMO



● Disassembly sequence

- | | | | |
|---|----------------|---|---|
| 1 | Nut | 7 | Transmission control lever assembly |
| 2 | Nut | |  P22A-91 |
| 3 | Nut | *a | Power shift |
| 4 | Nut | *b | Shift lever |
| 5 | Shift cable | *c | Select lever |
| 6 | Selector cable |  | Non-reusable parts |

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

All the nuts used for securing each cable are coated with thread locking product. These nuts must be replaced with new ones whenever they are loosened or removed.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

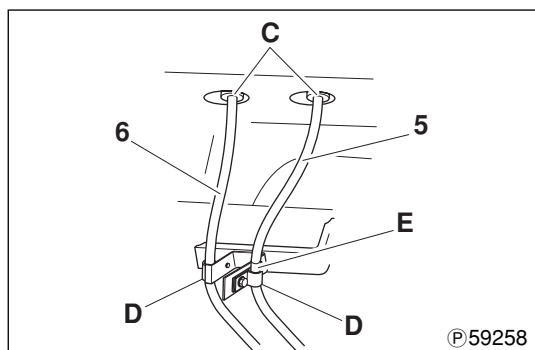
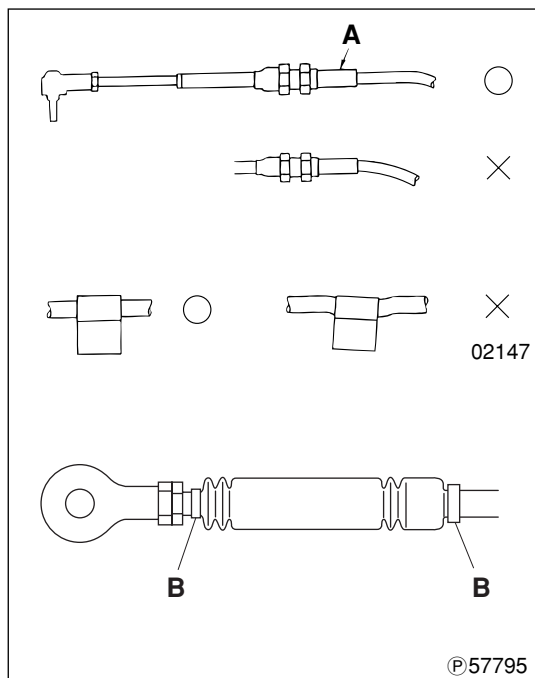
Location	Parts to be tightened	Tightening torque	Remarks
1 to 4	Nut (Ball joint or rubber damper mounting)	18.6 to 23.5 {14 to 17, 1.9 to 2.4}	—
5, 6	Cable lock nut tightening	58.8 to 83.4 {43 to 62, 6.0 to 8.5}	—

◆ Service procedure

5 6 Installation of shift cable and selector cable

CAUTION

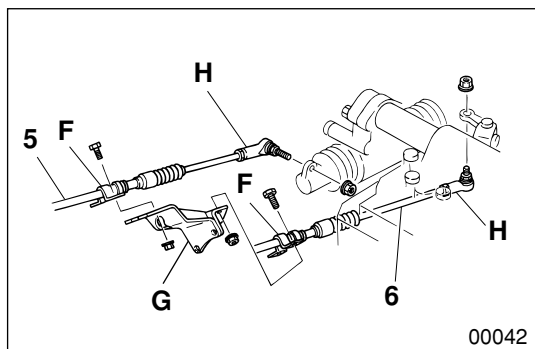
- Install casing cap A lengthwise.
- Make sure the radius of the bend is 200 mm {7.87 in.} or more.
- Make sure the cable operates smoothly.
- Install the clamp vertically against the cable.
- Do not twist clamps C at both ends of the boot.
- Make sure the identification marks on the cable, ball joint L, and rubber damper M point in the right direction when you install the cables. Installing the cables with the identification marks in the wrong direction can remarkably reduce the durability of the cables.



- Insert shift cable 5 and selector cable 6 under the cab floor and clamp them in the correct place by identifying identification mark E on the shift cable. (The selector cable has no identification mark.)

C : Grommet

D : Clip

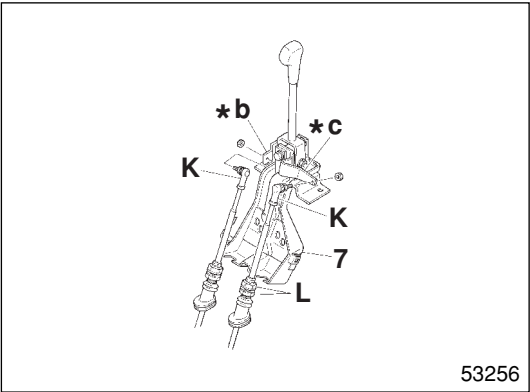


- Install cable clip F to bracket G temporarily and connect ball joint H to the shift lever or selector lever.
- Arrange the cable so that it not twisted, then tighten clip F permanently.

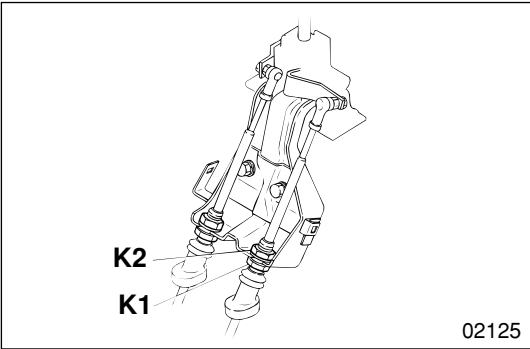
CAUTION

Make sure that ball joint H face the correct direction.

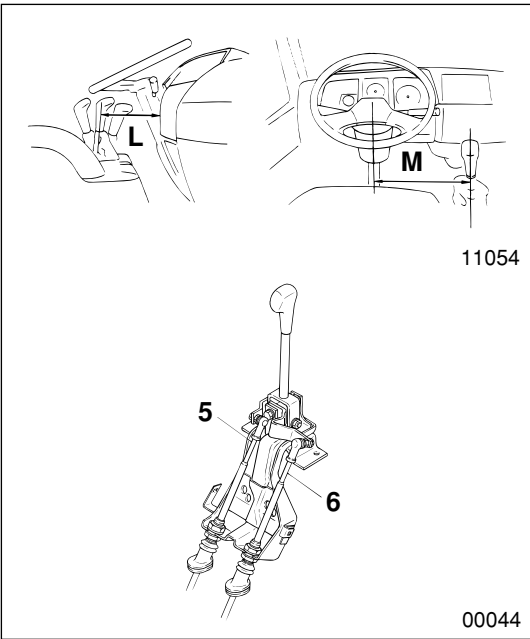
TRANSMISSION CONTROL



- Tilt the cab down.
- Install the cable on set board assembly **7** temporarily and connect ball joint **J** to shift lever ***b** and selector lever ***c**.
- Arrange the cable so that it is not twisted, then tighten lock nuts **K** permanently.



- CAUTION** ⚠
- **Make sure that ball joint L faces the correct direction.**
 - **When installing the lock nut, tighten lower nut K1. Do not move nut K2.**



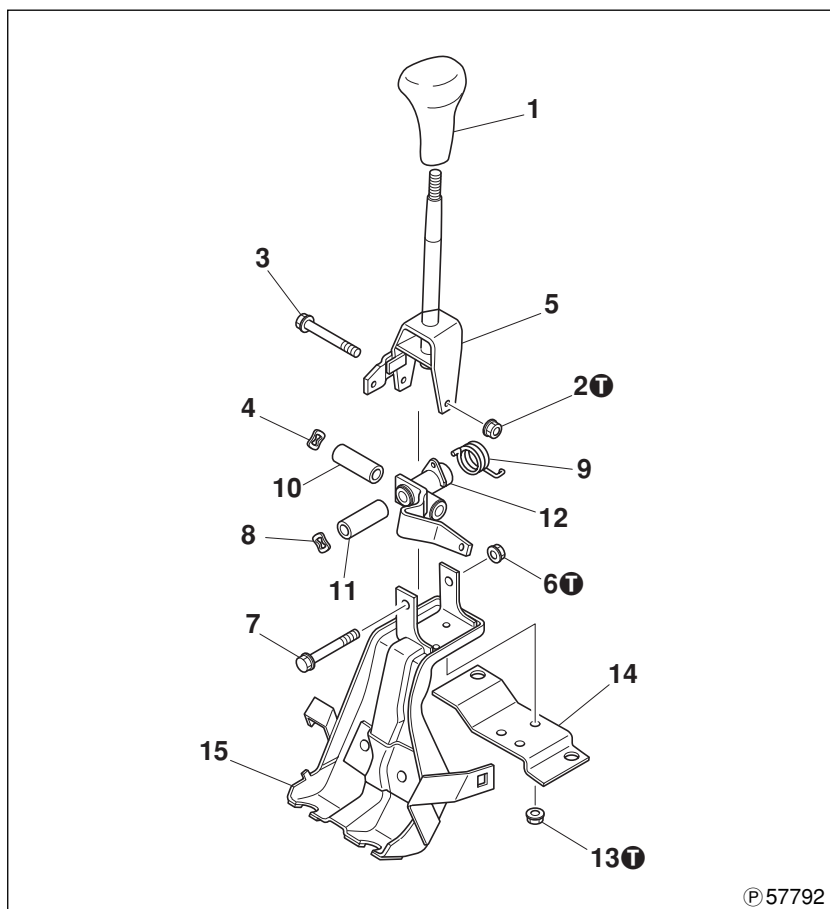
- Make sure when you operate the gear shift lever that it shifts smoothly and selects each position.
- If the gear shift lever leans to the front or rear, or to the left or right, excessively, adjust the length of the cable.
- When positioning the gear shift lever, use the distance from the center of the steering wheel or from the instrument panel as the reference distance.

Unit : mm {in.}

Front and rear direction L (Distance from the instrument panel)	Left and right direction M	
	M060 (Distance from steering wheel center on 4th-5th line)	M070 (Distance from steering wheel center on 3rd-4th line)
214 {8.43}	410 {16.1}	

	Shift cable 5	Selector cable 6
To front	Shorten	—
To rear	Lengthen	—
To left	—	Shorten
To right	—	Lengthen

Transmission Control Lever Assembly



● Disassembly sequence

- 1 Shift knob
- 2 Nut
- 3 Bolt
- 4 Washer
- 5 Shift lever
- 6 Nut
- 7 Bolt
- 8 Washer
- 9 Return spring
- 10 Collar
- 11 Collar
- 12 Select lever
- 13 Nut
- 14 Bracket
- 15 Set board

● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (Shift lever mounting)	19 to 28 {14 to 21, 1.9 to 2.9}	—
6	Nut (Selector lever mounting)	19 to 28 {14 to 21, 1.9 to 2.9}	—
13	Nut (Bracket mounting)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	All sliding areas	Chassis grease [NLGI No.1 (Li soap)]	As required

PULLER AND INSTALLER KIT

The puller and installer kit consists of principal bearing pullers and installers selected from the special tools used in this work group. For an installer use a component of this kit independently, and for a puller use the components of this kit in combination.

Name Part No.		Puller and installer kit		Bearing puller for M060						
		< M060 >	< M070>				Bearing puller for M070			
Component		MH062425	MH062444	MH061731	MH061732	MH062426	MH062440	MH062429	MH062432	NH062433
MH062427	Claw	○				○				
ME624235	Installer	○	○							
ME624234	Installer	○								
ME624233	Installer	○								
ME624236	Installer	○								
MH061162	Handle	○	○	○	○	○	○	○	○	○
ME624232	Bolt	○	○	○	○	○	○	○	○	○
MH061735	Body	○	○		○		○			
MH061734	Body	○	○	○		○		○	○	
ME624229	Protector	○	○	○	○	○	○	○	○	
MH062430	Claw	○	○				○	○		
ME624227	Claw	○			○					
ME624226	Claw	○		○						
MH062436	Body		○							○
MH062435	Protector		○							○
MH062642	Installer		○							
MH062634	Installer		○							
MH062630	Installer		○							
MH062628	Installer		○							
MH062434	Claw		○							○
ME624228	Claw		○						○	



Group 22B

Manual Transmission

<M060S9 (EATON FS-8209)>

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	22B- 2
REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY	22B- 4
TRANSMISSION CONTROL	22B- 8
HIGH-LOW CONTROL	22B-12

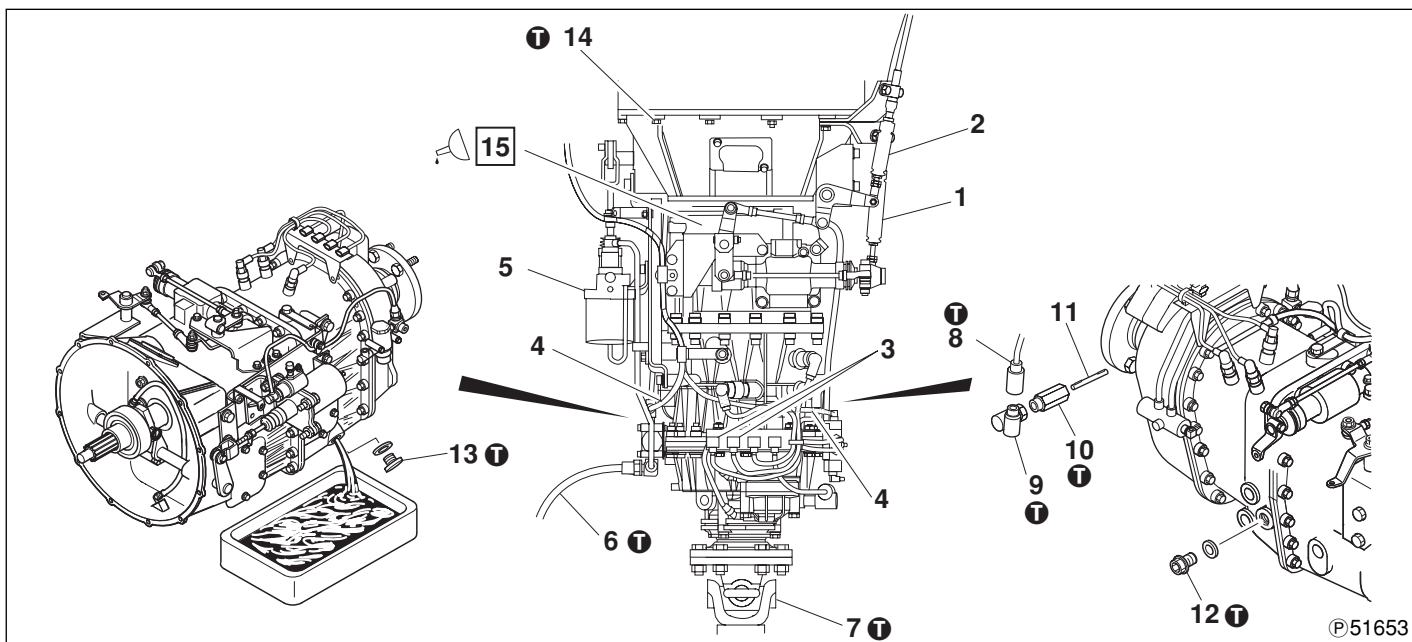
SPECIFICATIONS

SPECIFICATIONS

Item		Specifications
Mode of control		Floor shift remote control
Transmission model		M060S9
Gear ratio	Low	12.64
	1st (Low range)	8.81
	2nd (Low range)	6.55
	3rd (Low range)	4.77
	4th (Low range)	3.55
	5th (Low range)	2.48
	6th (Low range)	1.85
	7th (Low range)	1.34
	8th (Low range)	1.00
	Rev	13.21
Transmission oil	Gear oil	API GL-4 SAE90
	Engine oil	API CD SAE 30, 40 or 50
	Quantity L {qts}	8.5 {9}
Mass (without oil) kg {lb.}		230 {505}

MEMO

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY



● Removal sequence

- | | |
|------------------------------------|--------------------------|
| 1 Shift cable P22B-8 | 9 L-joint |
| 2 Select cable P22B-8 | 10 Speedometer joint |
| 3 Harness connector Electrical | 11 Speeddrive shaft |
| 4 Air tube P22B-12 | 12 Inspection plug |
| 5 Clutch booster Gr21 | 13 Drain plug |
| 6 Air hose | 14 Nut or bolt |
| 7 Propeller shaft | 15 Transmission assembly |
| 8 Vehicle speed sensor Electrical | |

NOTE

After removing propeller shaft 7, tie it to the frame temporarily at the height of installation assembly using a piece of rope.

● Installation sequence

Follow the removal sequence in reverse.

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Air hose	182 {135, 18.6}	—
7	Propeller shaft (Propeller shaft mounting nut)	180 to 250 {130 to 185, 18 to 25}	—
8	Vehicle speed sensor	10 to 30 {7.4 to 22, 1.0 to 3.1}	—
9	L-joint	34 to 39 {25 to 29, 3.5 to 4.0}	—
10	Speedometer joint	54 to 74 {40 to 55, 5.5 to 7.6}	—
12	Inspection plug	32 to 37 {24 to 27, 3.3 to 3.8}	—
13	Drain plug	40 to 47 {30 to 35, 4.1 to 4.8}	—
14	Nut or bolt (Transmission assembly mounting)	40.2 {30, 4.1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
15	Drive pinion spline	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure

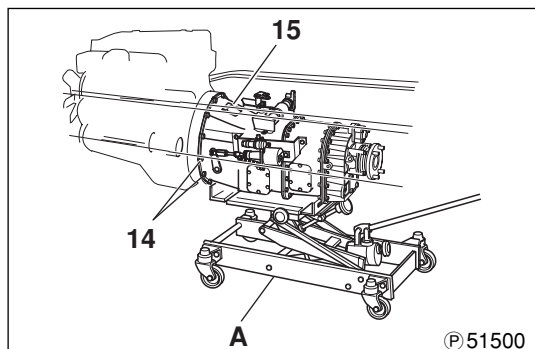
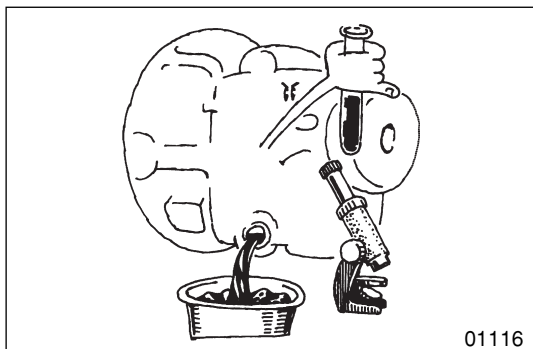
● Oil change

[Draining]

When draining oil, check the quantity and quality of oil, especially for small pieces of metal and metal dust.

[Filling]

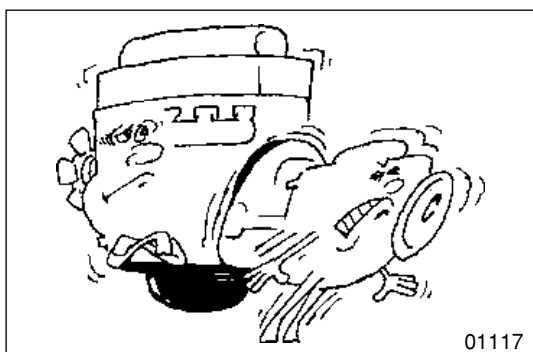
- Check that drain plug **13** is tightened at specified torque.
- Pour in gear oil until the oil overflows from the inspection hole.



15 Transmission assembly

[Removal]

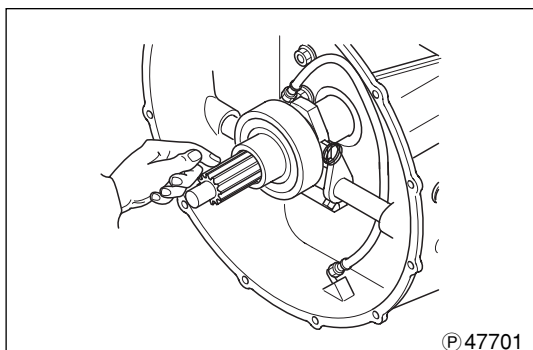
- Support transmission assembly **15** on transmission jack **A**.
- Remove transmission assembly mounting nuts or bolts **14**.



- Move transmission assembly **15** backward until the spline of the drive pinion is detached from the clutch.

CAUTION ⚠

Make sure that you pull transmission assembly 15 out in a straight line. If you seesaw the transmission assembly violently, you will damage the spline that connects the drive pinion and the clutch.



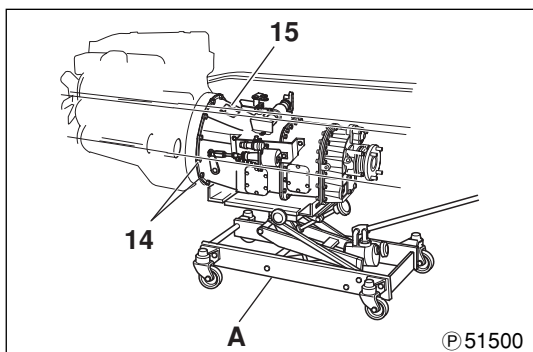
[Installation]

- Check the spline of the drive pinion for rust.
- If rust is found, remove it using a wire brush.
- Rub grease thinly and evenly onto the clutch sliding surfaces of the drive pinion using your hand.

CAUTION ⚠

Make sure that you apply only the necessary amount of grease because too much grease would drip and cause clutch slip.

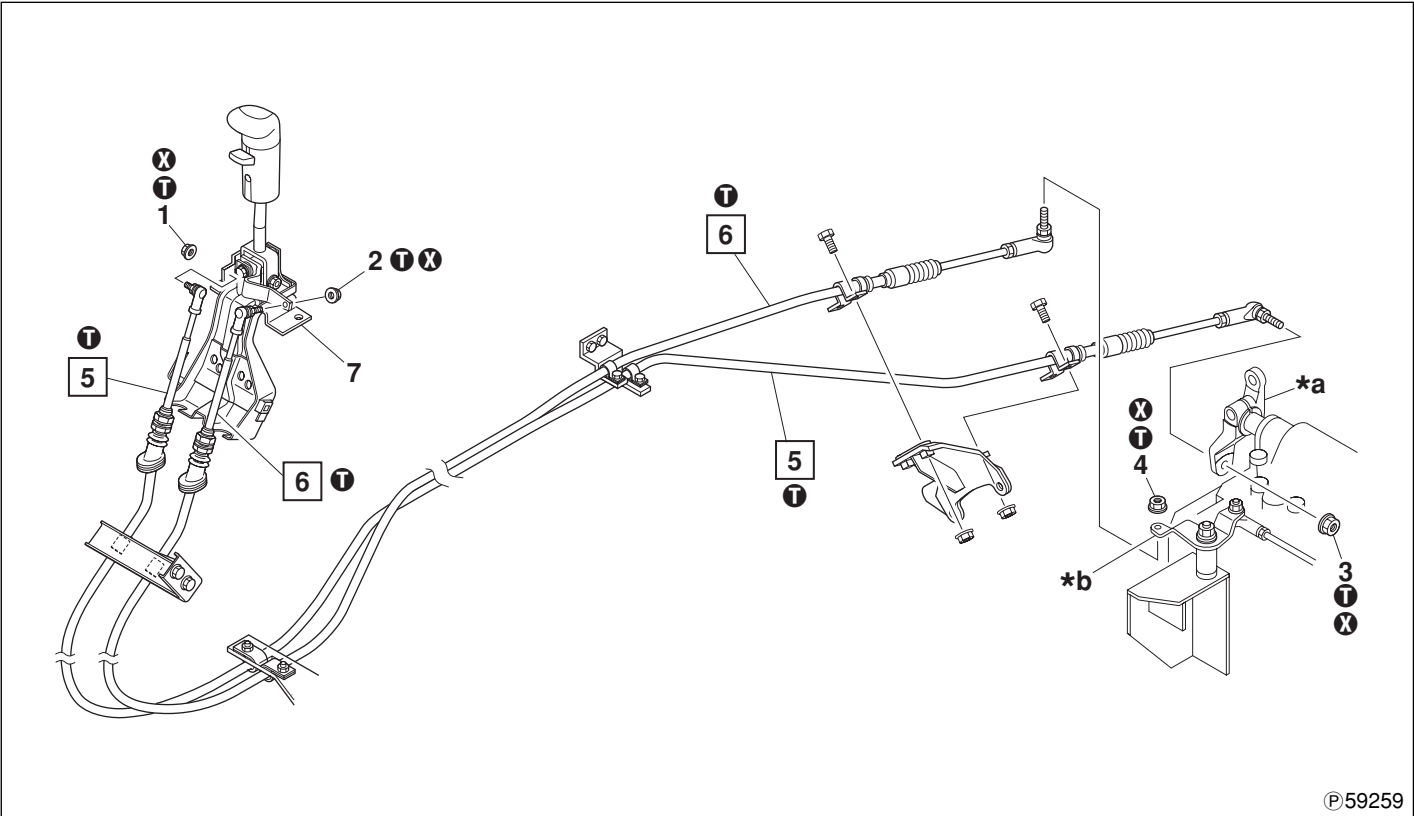
REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY



- Support transmission assembly **15** on transmission jack **A**.
- Insert transmission assembly **15** into the pilot bearing of the flywheel paying attention to the drive pinion spline.
- Tighten transmission mounting nuts or bolts **14** at specified torque.

MEMO

TRANSMISSION CONTROL



For removal and installation of the shift lever console and the floor console, refer to Gr42.

● **Disassembly sequence**

- 1 Nut

2 Nut

3 Nut

4 Nut

5 Shift cable
- 6 Select cable

7 Transmission control lever assembly

P22B-11
- *a: Shift lever

*b: Select lever

: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

T **Tightening torque**

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1 to 4	Nut (Ball joint mounting)	18.6 to 23.5 {14 to 17, 1.9 to 2.4}	—
5, 6	Tightening of cable lock nut	58.8 to 83.4 {43 to 62, 6.0 to 8.5}	—

◆ Service procedure

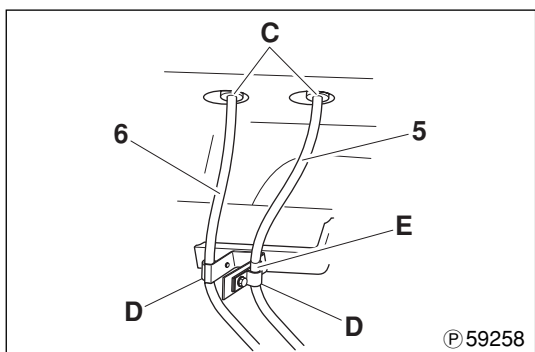
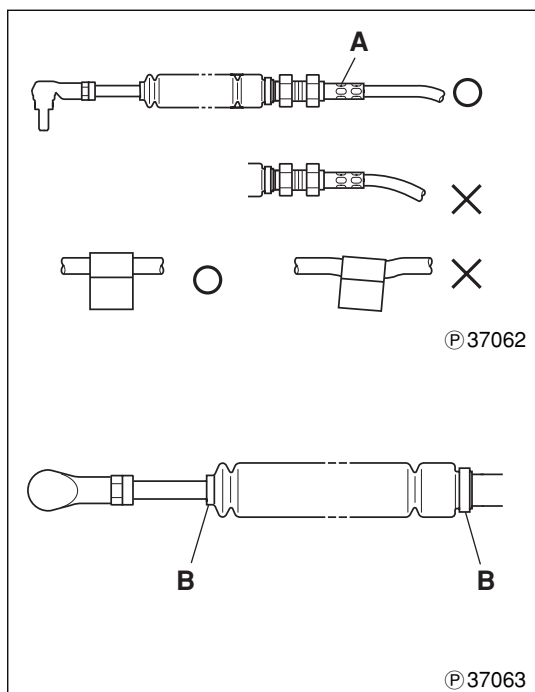
5 6 Installation of shift cable and select cable

CAUTION

In order to avoid installing them wrongly, examine cable identification mark and directions of ball joint. If installed with wrong direction, durability of cable will be remarkably reduced.

NOTE

- Install casing cap area A as a straight line.
- Radius of curved section of cable shall be more than 20 cm.
- Be sure that there is no obstruction in movement of cable.
- Install clamp square to cable.
- Do not twist at the area with clamp B at either end.

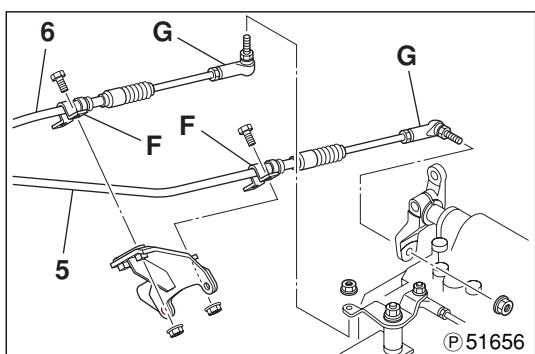


- Deliver the ends of shift cable 5 and select cable 6 from underneath cabin floor into cabin compartment, and clamp them paying attention to identification mark E.

(Select cable bears no marks.)

C: Grommet

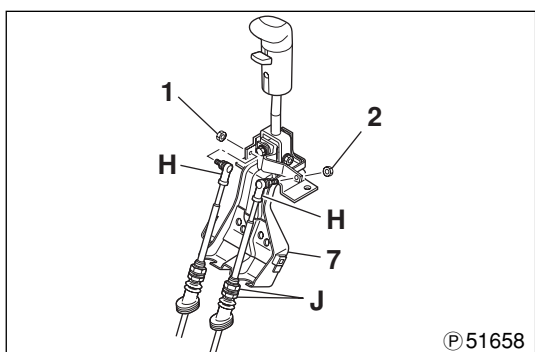
D: Clip



- Fasten cable clip F temporarily, connect ball-joint G with shift and select lever. Tighten clip F securely after slackening cables to avoid sharp bends.

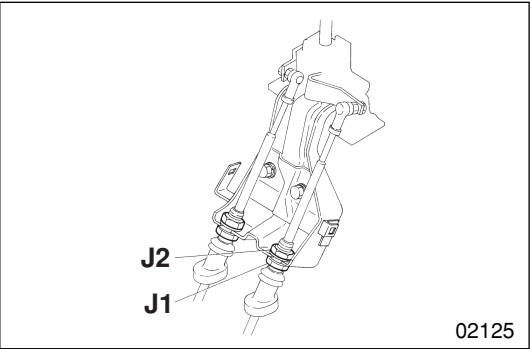
NOTE

Pay attention to the directions of ball-joint.



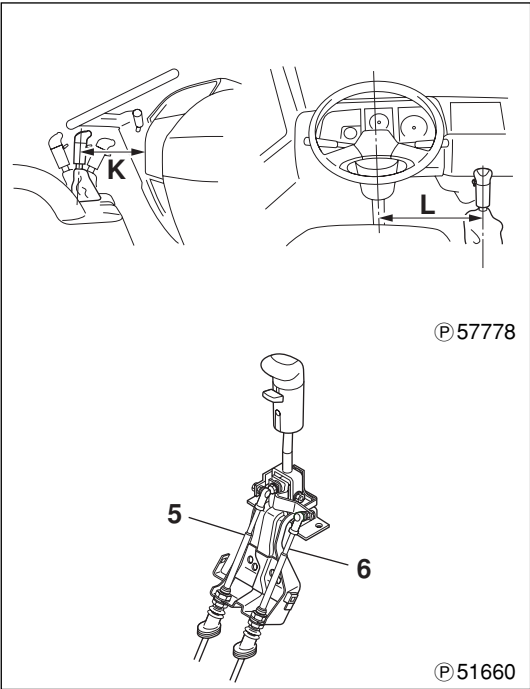
- Return the cabin from tilted position.
- Install transmission control lever assembly 7.
- Fasten cable to setting board assembly temporarily, and connect ball-joints H with shift and select lever. Tighten lock nut J securely after slackening cables to avoid sharp bends.

TRANSMISSION CONTROL



NOTE

- Pay attention to the direction of ball-joint.
- Upon tightening lock nut, tighten lower side nut J1, but do not move J2.
- Examine movement of gear shift lever to make sure that shifting and selecting can be made smoothly.

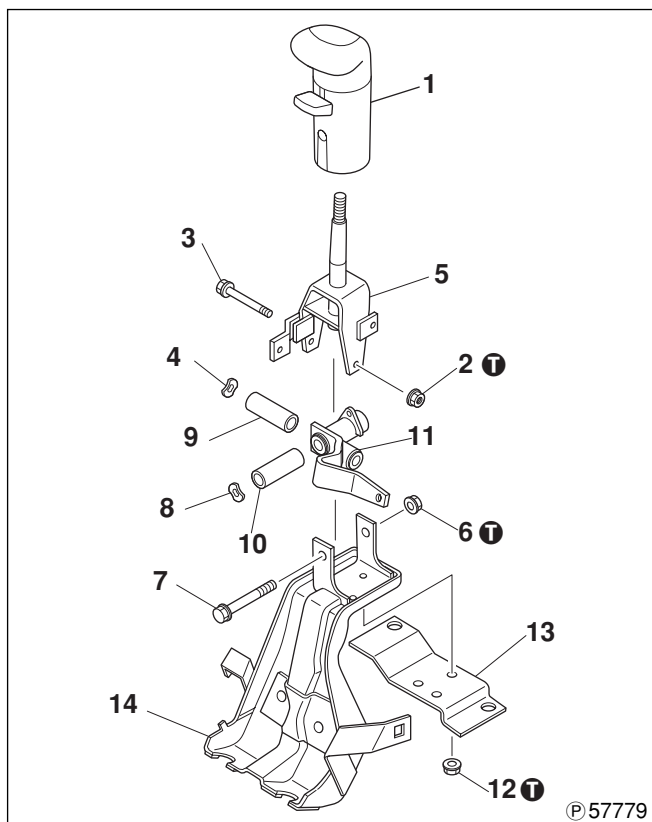


Unit : mm {in.}

Fore and aft direction K (Distance from instrument panel)	Left and right direction L	
	Low range (Distance from steering wheel center to 1st-2nd shift position indication line)	High rangee (Distance from steering wheel center to 5th-6th shift position indication line)
214 {8.43}	410 {16.1}	

	Shift cable 5	Select cable 6
To incline forward	Shorten	—
To incline rearward	Lengthen	—
To incline to the right	—	Lengthen
To incline to the left	—	Shorten

Transmission Control Lever Assembly



● Disassembly sequence

- 1 Shift knob P22B-12
- 2 Nut
- 3 Bolt
- 4 Washer
- 5 Shift lever
- 6 Nut
- 7 Bolt
- 8 Washer
- 9 Collar
- 10 Collar
- 11 Select lever
- 12 Nut
- 13 Bracket
- 14 Set board

● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (Shift lever mounting)	19 to 28 {14 to 21, 1.9 to 2.9}	—
6	Nut (Selector lever mounting)	19 to 28 {14 to 21, 1.9 to 2.9}	—
12	Nut (Bracket mounting)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	All sliding areas	Chassis grease [NLGI No. 1 (Li soap)]	As required



● Removal sequence

- *a:** Shift lever
***b:** Transmission
A: Red tube
B: Black tube

CAUTION _____

● Installation sequence

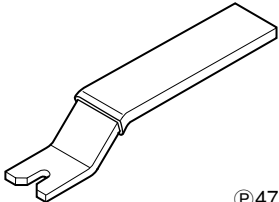
T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

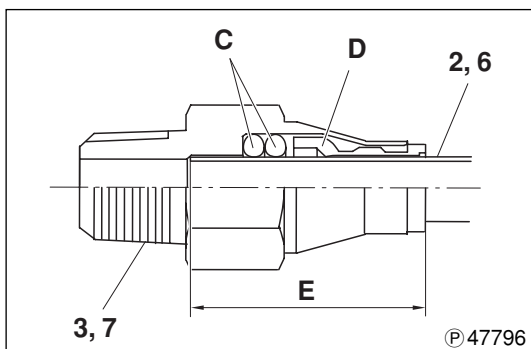
Location	Parts to be tightened	Tightening torque	Remarks
5	Nut (Shift knob mounting)	48 to 61 {35 to 45, 4.9 to 6.2}	—

C Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2, 6	Release tool 	MH063499	Removal of air tube

P47791

◆ Service procedure**2 3 6 7 Air tube and connector**

P47796

- Air tube **2, 6** can be correctly installed onto connector **3, 7** by simply inserting them into the connectors.
 - O-rings **C** are used to seal in pressure air. Scoring or dirt on the O-rings will cause air leakage.
 - Air tube **2, 6** can be removed by pressing collet **D**.
- E:** Air tube insertion depth (17.5 to 19 mm {0.69 to 0.75 in.})

[Special care for handling air tube]

Air tube **2, 6** can become damaged due to exposure to heat or acid, or can break from scoring. Therefore, observe the following instructions. If any abnormality is found on the air tubes, replace them with new ones.

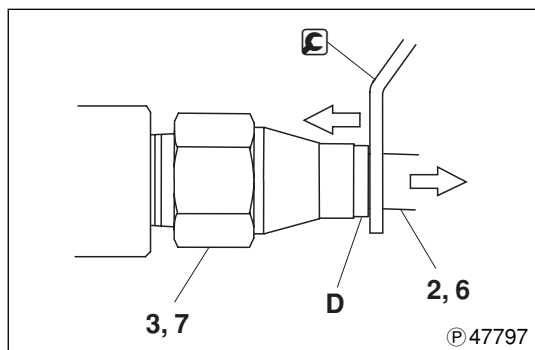
- Do not expose air tube **2, 6**, or connector **3, 7**, to a temperature of 100°C or above.
- Protect air tube **2, 6** from heat or flames when carrying out welding operations.
- Do not allow air tube **2, 6** to come into contact with battery fluid.
- Do not stamp on, bend, or place sharp edges on air tube **2, 6**.
- When pressure washing the vehicle, do not direct the nozzle at or near air tube **2, 6**.

[Removal and installation of air tubes]

CAUTION ⚠

- Air tube **2, 6** can become damaged during removal or installation. These operations should be carried out only when necessary.
- Replace connector **3, 7** with a new one if it becomes internally contaminated.
- Replace air tube **2, 6** with a new one if it becomes damaged.

HIGH-LOW CONTROL

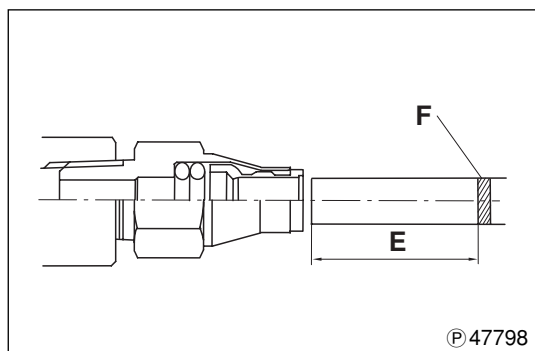


[Removal]

- Completely release air pressure from air tube 2, 6.
- Internally contaminated connector 3, 7 should not be used. Before removing air tube 2, 6, clean the external surfaces of the air tube and connector.
- Using (C) release tool, pull out air tube 2, 6 by hand while pressing collet D.

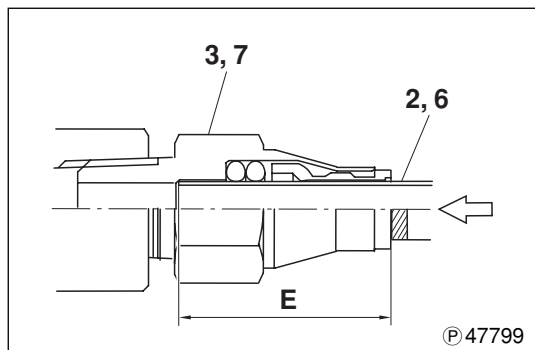
CAUTION ⚠

Do not attempt to pull out air tube 2, 6 forcefully or use tools except (C) release tool, as doing these can damage air tube 2, 6, and/or collet D.



[Installation]

- Make reference mark F on the air tube at specified insertion depth E (17.5 to 19 mm) from the tube end.



- Insert air tube 2, 6 straight into connector 3, 7 until it comes against a stop.
- Take care not to insert air tube 2, 6 at an angle into the connector, as this can damage the tube.
E: Air tube insertion depth
- After installation, pull air tube 2, 6 by hand to confirm that the tube is firmly in place.
- After installation, check connector 3, 7 for air leakage.



23A - Automatic Transmission
<M065A5 (Allison LCT1000, LCT2400)>

23B - Automatic Transmission
<M100A6 (Allison MD3060P)>

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**



Group 23A

Automatic Transmission

<M065A5

(Allison LCT1000, LCT2400)>

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	23A- 2
STRUCTURE AND OPERATION	
1. Outline	23A- 6
2. Electronic Control System	23A-10
3. Electronic control unit Connection Diagram	23A-14
TROUBLESHOOTING	
1. Failure by Equipment	23A-16
2. Measures for Transitory Failure	23A-22
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Stall Test	23A-24
2. Line Pressure Test	23A-25
3. Inspection of Automatic Transmission Fluid	23A-26
4. Replacement of Automatic Transmission Fluid	23A-27
5. Replacement of Oil Filter	23A-28
PREPARATORY WORK FOR REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION ASSEMBLY	
	23A-29
REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION ASSEMBLY	
	23A-30
PARKING BRAKE ASSEMBLY	
	23A-32
OIL PAN, SUCTION FILTER AND LEVEL GAUGE	
	23A-34
AUTOMATIC TRANSMISSION CONTROL	
	23A-36
OIL COOLER	
	23A-44
INSPECTION OF ELECTRICAL EQUIPMENT	
	23A-46
INSTALLED LOCATIONS OF PARTS	
	23A-50
ELECTRIC CIRCUIT DIAGRAM	
	23A-54

As repair and parts replacement for the automatic transmission body and the inside of transmission power take-off cannot be performed in general, you should only determine the quality of the above components when servicing them, and ask Aisin GM Allison to perform such repair and parts replacement. For detailed information such as a contact address of Aisin GM Allison, ask your nearest Mitsubishi Fuso dealership.

SPECIFICATIONS

Major Specifications

Vehicle Type			FK	FM
Item				
Transmission type			M065A5	
Manufacturer			Aisin GM Allison	
Torque converter	Model type		TC222	
	Type		3-element, 1-stage, 2-phase	
	Stall torque ratio		1.58	
Transmission	Model type		LCT1000	LCT2400
	Type		Planetary gear type 5 forward speeds and 1 reverse speed	
	Gear ratio	1st	3.102	3.512
		2nd	1.811	1.896
		3rd	1.406	1.439
		4th	1.000	1.000
		5th	0.712	0.737
		Rev	4.492	5.086
	Lock-up mechanism		Yes	
	Control system		Electrical and hydraulic system	
	Fail-safe function		Yes	
Foolproof function		Yes		
Range selector pattern			Ⓔ—R—Ⓔ—D—3—2—L Engine can be started in Ⓔ or Ⓔ position only.	
Parking brake			Yes	
Automatic transmission fluid	Specified fluid		DEXRON III	
	Fluid quantity for overall system	L {qts}	12 {13}	14 {15}
	Fluid quantity for replacement	L {qts}	Approx. 7 {7.4}	10 {11}
Mass of automatic transmission assembly kg			165	
Transmission control			Floor shift remote-controlled wire type	

Shifting Point (D range)

Unit: km/h {mph}

Throttle opening	Power mode switch position		Economy mode	Power mode
	Model	Gearshift		
At half throttle Accelerator opening: 4/8	FM	1st gear → 2nd gear	9.1 to 12.4 {5.65 to 7.71}	11.3 to 14.6 {7.02 to 9.07}
		2nd gear → 3rd gear	24.7 to 28.0 {15.3 to 17.4}	27.1 to 30.4 {16.8 to 18.9}
		3rd gear → 4th gear	36.3 to 39.6 {22.6 to 24.6}	36.7 to 40.0 {22.8 to 24.9}
		4th gear → 5th gear	49.9 to 53.1 {31.0 to 33.0}	50.4 to 53.7 {31.3 to 33.4}
	FK	1st gear → 2nd gear	10.8 to 14.1 {6.71 to 8.76}	13.4 to 16.7 {8.33 to 10.4}
		2nd gear → 3rd gear	26.0 to 29.3 {16.2 to 18.2}	28.5 to 31.8 {17.7 to 19.8}
		3rd gear → 4th gear	37.2 to 40.5 {23.1 to 25.2}	37.6 to 40.9 {23.4 to 25.4}
		4th gear → 5th gear	52.9 to 56.3 {32.9 to 35.0}	53.5 to 56.8 {33.2 to 35.3}
At full throttle Accelerator opening: 8/8	FM	1st gear → 2nd gear	15.1 to 18.4 {9.38 to 11.4}	19.8 to 23.1 {12.3 to 14.4}
		2nd gear → 3rd gear	38.5 to 41.7 {23.9 to 25.9}	47.1 to 50.4 {29.3 to 31.3}
		3rd gear → 4th gear	51.2 to 54.5 {31.8 to 33.9}	62.6 to 65.9 {38.9 to 41.0}
		4th gear → 5th gear	74.4 to 77.7 {46.2 to 48.3}	90.7 to 94.0 {56.4 to 58.4}
	FK	1st gear → 2nd gear	17.8 to 21.1 {11.1 to 13.1}	23.2 to 26.5 {14.4 to 16.5}
		2nd gear → 3rd gear	41.3 to 44.7 {25.7 to 27.8}	50.6 to 53.9 {31.4 to 33.5}
		3rd gear → 4th gear	53.7 to 57.1 {33.4 to 35.5}	65.6 to 69.0 {40.8 to 42.9}
		4th gear → 5th gear	76.2 to 79.6 {47.4 to 49.5}	93.0 to 96.3 {57.8 to 59.8}
At closed throttle Accelerator opening: 0/8	FM	5th gear → 4th gear	47.2 to 50.5 {29.3 to 31.4}	47.2 to 50.5 {29.3 to 31.4}
		4th gear → 3rd gear	34.3 to 37.6 {21.3 to 23.4}	34.3 to 37.6 {21.3 to 23.4}
		3rd gear → 2nd gear	23.3 to 26.6 {14.5 to 16.5}	23.3 to 26.6 {14.5 to 16.5}
		2nd gear → 1st gear	4.9 to 8.1 {3.04 to 5.03}	4.9 to 8.1 {3.04 to 5.03}
	FK	5th gear → 4th gear	50.1 to 53.5 {31.1 to 33.2}	50.1 to 53.5 {31.1 to 33.2}
		4th gear → 3rd gear	35.2 to 38.5 {21.9 to 23.9}	35.2 to 38.5 {21.9 to 23.9}
		3rd gear → 2nd gear	24.5 to 27.9 {15.2 to 17.3}	24.5 to 27.9 {15.2 to 17.3}
		2nd gear → 1st gear	5.9 to 9.2 {3.67 to 5.72}	5.9 to 9.2 {3.67 to 5.72}

- The value shown in the table is calculated under the following condition.
For the vehicle with different differential ratio or tire size, the vehicle speed varies from the value in the table. In such case, the value should be converted based on such deviation.

Model	Differential ratio	Tire size (radius)
FM	5.857	11R22.5 (0.508)
FK	4.444	225/70R19.5 (0.395)

SPECIFICATIONS

Lock-up Point

Unit: km/h {mph} (gear)

Power mode switch position		Economy mode	Power mode
Throttle opening	Model		
At half throttle Accelerator opening: 4/8 (ON)	FM	17.9 to 21.2 {11.1 to 13.2} (2nd gear)	20.3 to 23.6 {12.6 to 14.7} (2nd gear)
	FK	19.4 to 22.8 {12.1 to 14.2} (2nd gear)	22.1 to 25.5 {13.7 to 15.8} (2nd gear)
At full throttle Accelerator opening: 8/8 (ON)	FM	31.9 to 35.2 {19.8 to 21.9} (2nd gear)	38.9 to 42.1 {24.2 to 26.2} (2nd gear)
	FK	34.3 to 37.7 {21.3 to 23.4} (2nd gear)	41.8 to 45.1 {26.0 to 28.0} (2nd gear)
At closed throttle Accelerator opening: 0/8 (OFF)	FM	16.5 to 19.7 {10.3 to 12.2} (2nd gear)	16.5 to 19.7 {10.3 to 12.2} (2nd gear)
	FK	17.8 to 21.1 {11.1 to 13.1} (2nd gear)	17.8 to 21.1 {11.1 to 13.1} (2nd gear)

- Shown in brackets is the gear speed where ON and OFF point of lock-up exists.
- The value shown in the table is calculated under the following condition.
For the vehicle with different differential ratio or tire size, the vehicle speed varies from the value in the table. In such case, the value should be converted based on such deviation.

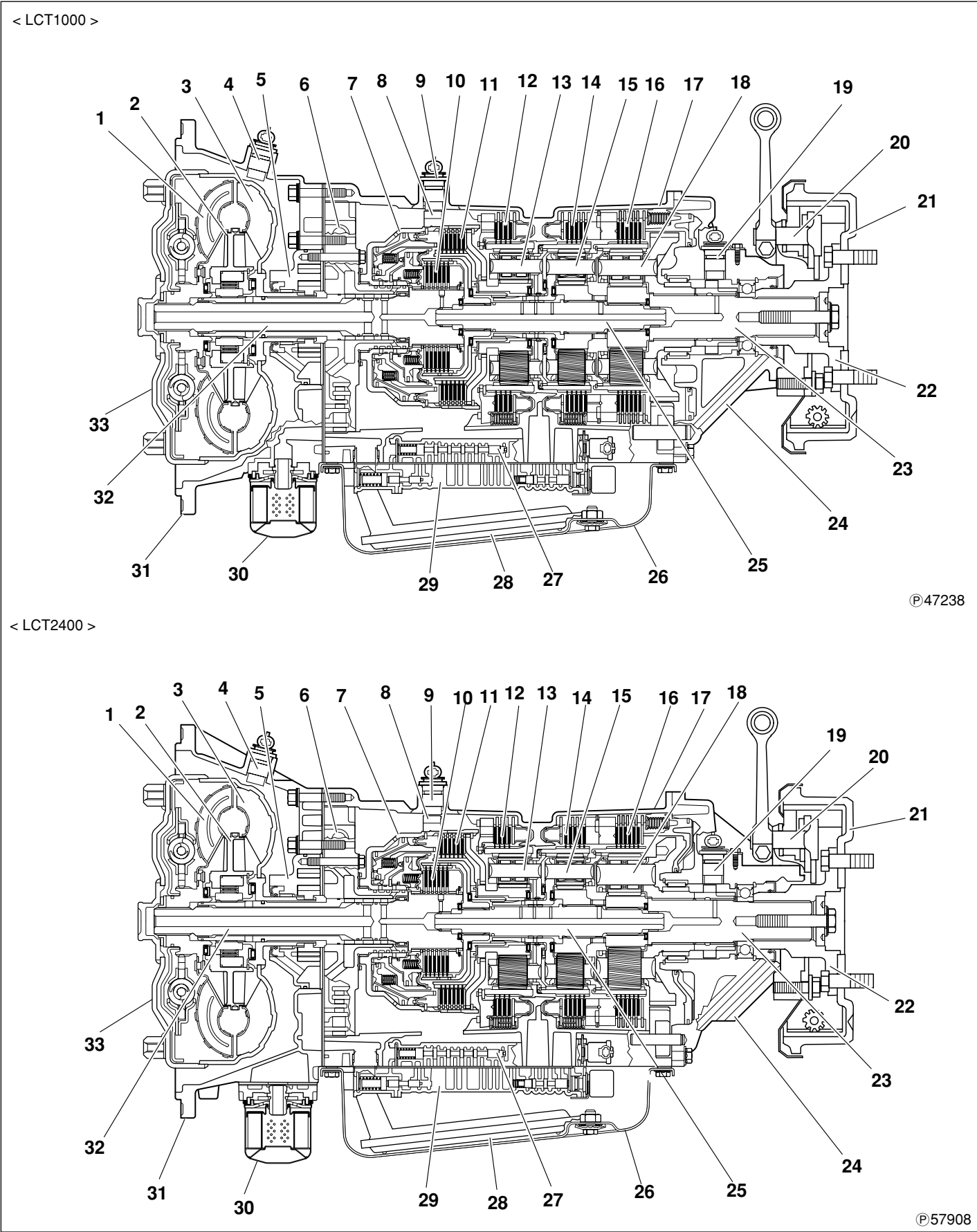
Model	Differential ratio	Tire size (radius)
FM	5.857	11R22.5 (0.508)
FK	4.444	225/70R19.5 (0.395)

MEMO

STRUCTURE AND OPERATION

1. Outline

1.1 Automatic transmission assembly



1 Turbine liner	12 C3 clutch	23 Output shaft
2 Stator	13 P1 planetary gear	24 Rear cover
3 Pump impeller	14 C4 clutch	25 Main shaft
4 Input speed sensor	15 P2 planetary gear	26 Oil pan
5 Main pump assembly	16 C5 clutch	27 Shift valve body assembly
6 Front support assembly	17 Main housing	28 Suction filter
7 Rotating clutch assembly	18 P3 planetary gear	29 Main control valve assembly
8 PTO gear	19 Output speed sensor	30 Oil filter
9 Turbine speed sensor	20 Support plate and shoe assembly	31 Converter housing
10 C1 clutch	21 Parking brake drum	32 Turbine shaft
11 C2 clutch	22 Companion flange	33 Torque converter assembly

This automatic transmission is a combination of a torque converter with lock-up mechanism and full automatic 5-speed gear system.

- **Torque converter**

The torque converter, an input device of the transmission, increases the torque transmitted from the engine as well as acts as a fluid coupling to absorb shocks when starting or shifting. It also improves transmission efficiency by eliminating slippage by the lock-up mechanism over a certain vehicle speed.

- **Transmission**

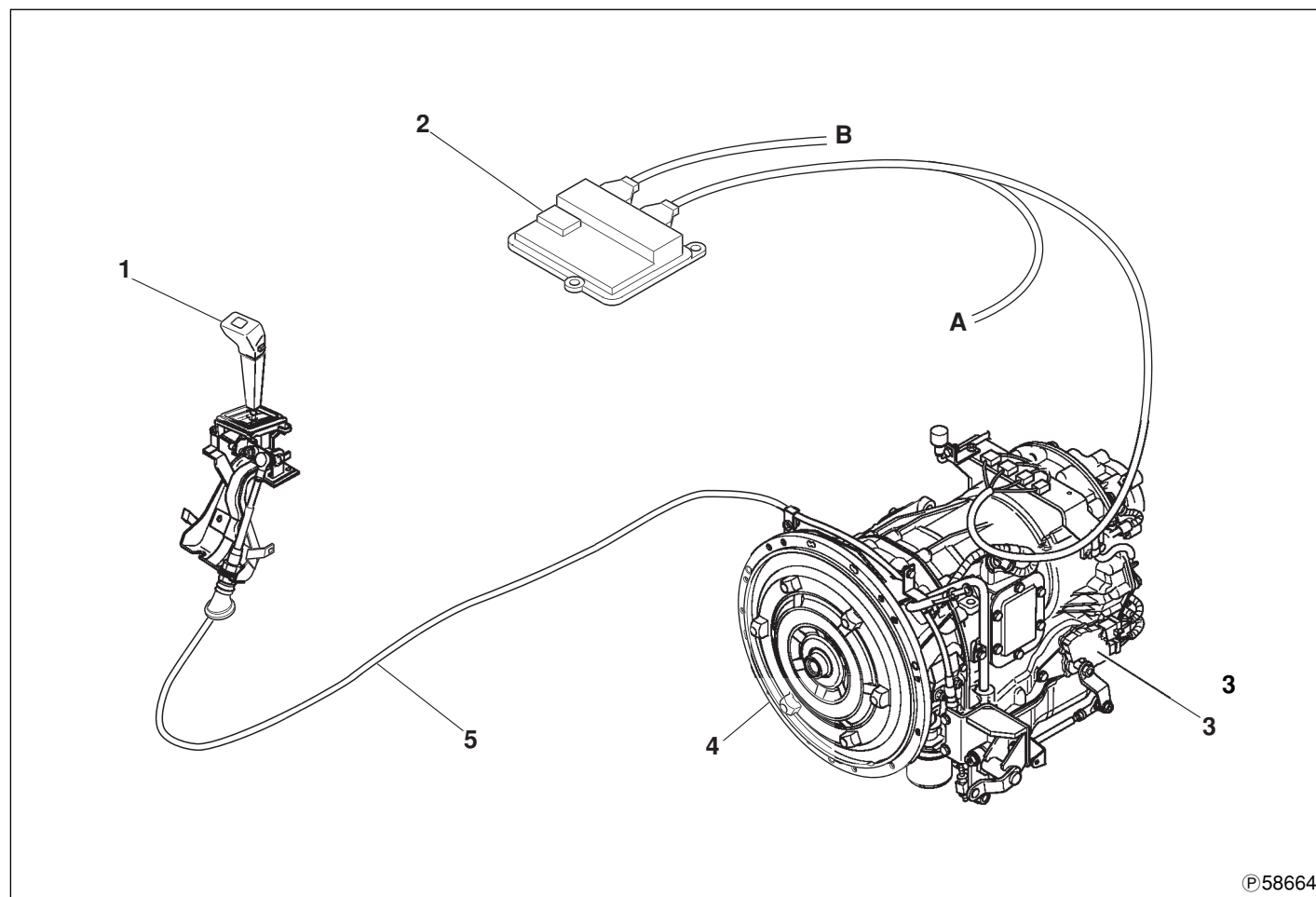
The transmission consists of a gear system of five forward gears and one reverse gear. Gears are shifted by three sets of planetary gear **13**, **15** and **18**. and hydraulically-operated five sets of wet-type multiple disc clutch **10**, **11**, **12**, **14** and **16**.

- **Hydraulic control**

Heavy use of electronic control using a microcomputer for the hydraulic control enables fine shifting control.

STRUCTURE AND OPERATION

1.2 Automatic transmission control

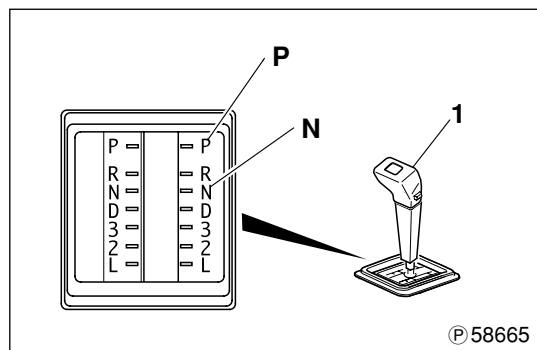


- 1 Range selector lever
- 2 Automatic transmission electronic control unit
- 3 Inhibitor switch

- 4 Automatic transmission assembly
- 5 Selector cable

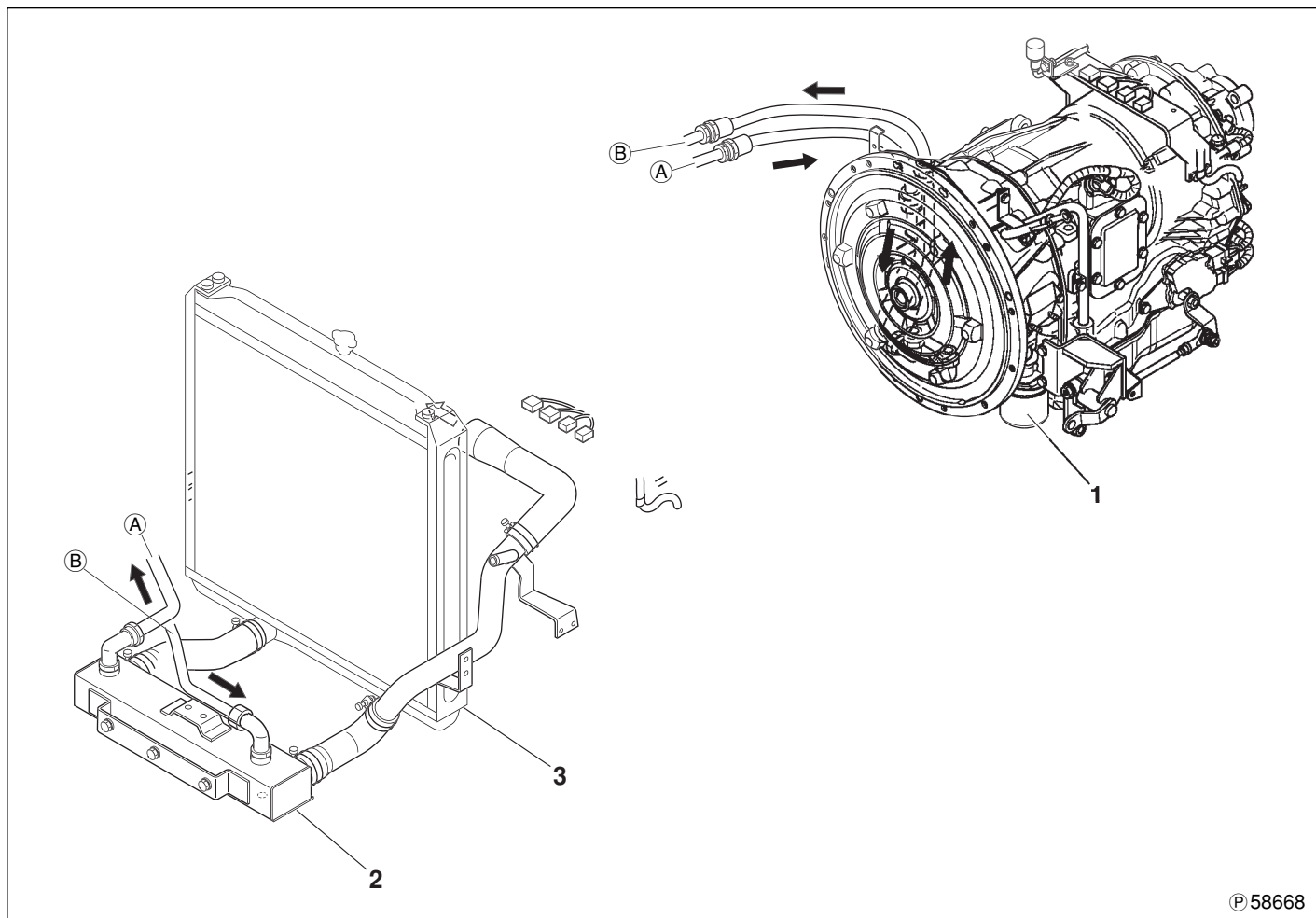
A : To engine electronic control unit
B : To related parts on vehicle side

1.3 Range selector lever



- Range selector lever 1 selects the appropriate range according to a driving condition and exploits the function of an automatic transmission.
- A safety device is provided so that the engine cannot be started when range selector lever 1 is placed in positions except in N or P range.

1.4 Oil cooler



P 58668

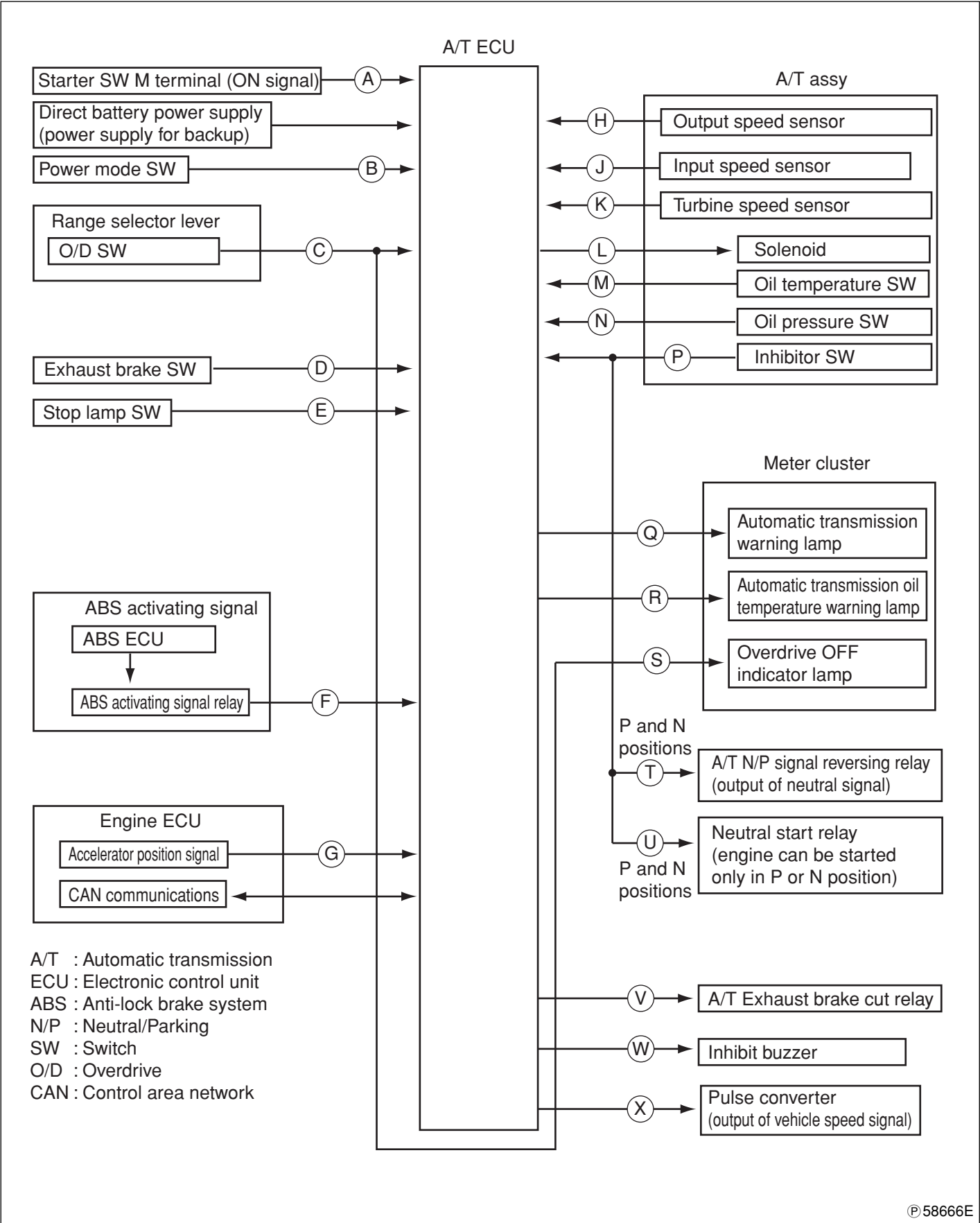
- 1 Oil filter
- 2 Oil cooler
- 3 Radiator

- Oil cooler **2** cools automatic transmission fluid.
- Cooling is performed using the engine coolant.

STRUCTURE AND OPERATION

2. Electronic Control System

2.1 System block diagram



Parts name	Main function or working of switch and sensor	Information signal
Starter switch	Power supply to control unit, etc. (ON position)	Ⓐ : Power supply to control unit, etc.
Power mode switch	Detection of driving mode switch	Ⓑ : Power mode signal
Range selector lever	Designation of driving range	—
Overdrive switch	Detection of overdrive OFF signal	Ⓒ : Detection of overdrive OFF signal (from range selector lever)
Exhaust brake switch	Detection of exhaust brake operating	Ⓓ : Exhaust brake operating signal
Stop lamp switch	Transmission of brake signal	Ⓔ : Brake signal
Anti-lock brake system activating signal relay	Detection of anti-lock brake system activating signal	Ⓕ : Anti-lock brake system activating signal
Engine electronic control unit (accelerator position sensor)	Detection of accelerator opening signal (used for shifting control and lock-up control)	Ⓖ : Accelerator opening signal
Output speed sensor	Detection of vehicle speed (used for shifting control)	Ⓗ : Vehicle speed pulse signal (from automatic transmission body)
Input speed sensor	Detection of engine speed (used for lockup control)	Ⓙ : Engine speed pulse signal (from automatic transmission body)
Turbine speed sensor	Detection of turbine revolution (used for shifting control)	Ⓚ : Turbine revolution pulse signal (from automatic transmission body)
Solenoid	Actuation of each solenoid	Ⓛ : Solenoid actuation signal
Oil temperature switch	Detection of automatic transmission fluid temperature (used for oil temperature control)	Ⓜ : Automatic transmission fluid temperature signal (from automatic transmission body)
Oil pressure switch	Operation of shifting clutch	Ⓝ : Shifting clutch oil pressure signal (from automatic transmission body)
Inhibitor switch	Detection of range selector lever position signal	Ⓟ : Range selector lever position signal
Automatic transmission warning lamp	Indication of system failure	Ⓠ : Lamp illumination signal
Oil temperature warning lamp	Warning indication of abnormal rise of oil temperature	Ⓡ : Lamp illumination signal
Overdrive OFF indicator lamp	Indication of overdrive OFF	Ⓢ : Lamp illumination signal
N/P signal reversing relay	Detection of P and N signal	Ⓣ : Inhibitor switch N and P signal
Neutral start relay	Approval of engine start	Ⓤ : Inhibitor switch N and P signal
Automatic transmission exhaust brake cut relay	Output of exhaust brake cut	Ⓥ : Exhaust brake cut output signal
Inhibit buzzer	Warning for shifting limit	Ⓦ : Buzzer signal
Pulse converter	Distribution of vehicle speed pulse signal	Ⓧ : Vehicle speed pulse output signal

STRUCTURE AND OPERATION

2.2 Fail-safe function

Main faulty content	Reaction and operation of transmission				
Battery voltage too low (faulty power supply)	- Automatic transmission warning lamp illuminates. - Shifting only to R, N and D (third gear fixed) is possible.				
- Turbine speed sensor faulty - Output speed sensor faulty	- Automatic transmission warning lamp illuminates. - Lock-up is released and the current gear is fixed when moving forward. - The gear is fixed to neutral when in reverse gear.				
Input speed sensor faulty	- Automatic transmission fluid warning lamp illuminates. - Lock-up is released. - Normal shifting is possible using turbine speed sensor signal.				
Drop in voltage during running (faulty power supply)	Lockup is released and the gear is fixed to the following.				
	Immediately preceding gear	R, N	1	2, 3	4, 5
	Gear to be changed to	N	1	3	5
Solenoid and oil pressure switch faulty	- Automatic transmission fluid warning lamp illuminates. - Lock-up is released and the gear is fixed to the specified gear.				
Wheels lock by sudden braking	Lock-up is released. The immediately preceding gear stays on and does not shift.				
Inhibitor switch faulty	The gear shifts regarding the range as the immediately preceding range.				
Throttle signal faulty	The gear shifts regarding the throttle opening as the specified value.				
Control by oil temperature inside oil pan	−35 °C {−31 °F} or below: Only 2nd gear and reverse gear can be operated. −25 °C {−13 °F} or below: Only 2nd gear, 3rd gear and reverse gear can be operated. 0 °C {32 °F} or below: Actuation of lockup is halted. 121 °C {250 °F} or above: Inspection of automatic transmission fluid temperature warning lamp. 128 °C {260 °F} or above: 5th gear cannot be engaged.				

2.3 Foolproof function

Function	Content of malfunction	Reaction and operation of transmission
Neutral safety	The starter is turned ON except in P or N position.	The starter does not turn in positions except P or N.
Protection from misshifting	The gear is shifted in the opposite direction while moving forward or backward	- When the vehicle speed is above the specified value, the gear becomes a neutral state and the inhibit buzzer sounds. - When the gear is shifted to the previous position, the gear is engaged according to the speed.
Range shift inhibit	Faulty return of engine revolution (exceeding 1000 rpm) or accelerator signal (exceeding 40%)	- The inhibit buzzer sounds and the gear stays in N and does not shift. - When the gear does not shift even if the limiting condition is cancelled, reselection of the gear is necessary.
Downshift inhibit	The gear is lowered excessively during high speed driving	The gear does not shift until the speed drops to a safety speed to prevent engine overrun.
Hold	The speed rises excessively on a downhill while driving in the hold mode.	The gear shifts up by one gear (up to the highest gear in D range) at approx. 120% of the engine max. speed.

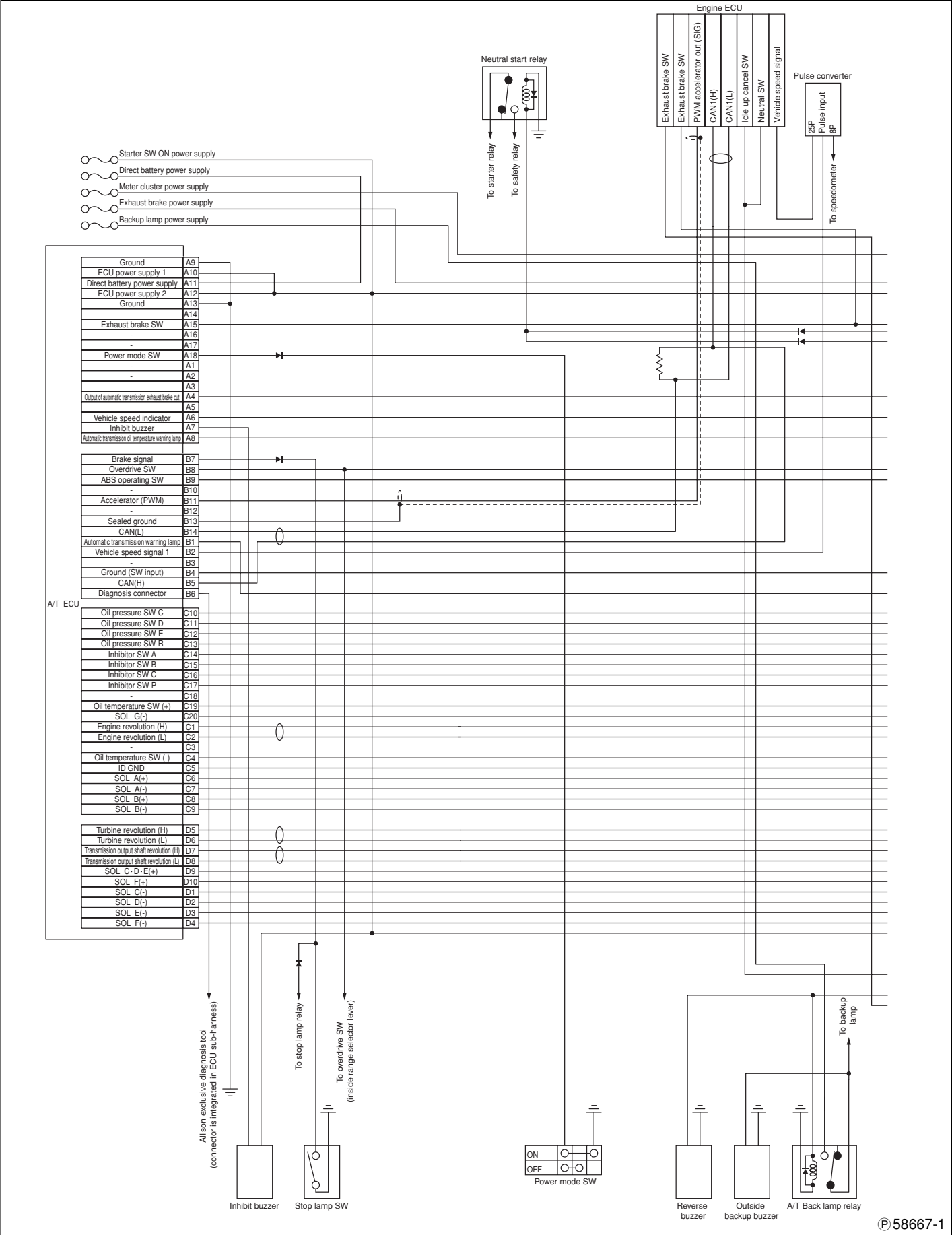
2.4 Operation of transmission when power is lost

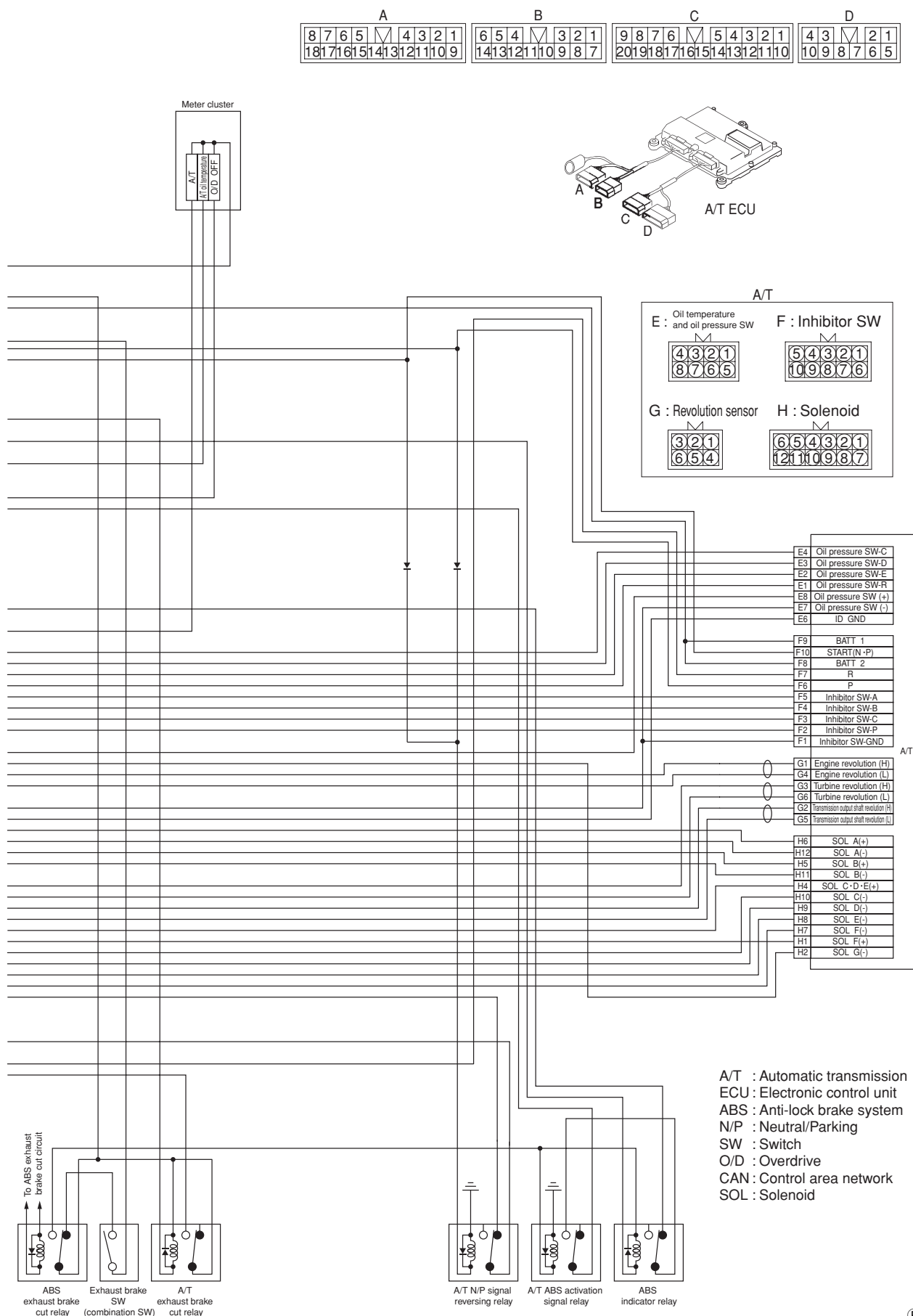
Gear engaged during	When failure occurs driving	When shifting gear		After restarting engine	
		N → R	N → D	N → R	N → D
R	Neutral	Neutral	5th gear	Reverse gear	3rd gear
N	Neutral	Neutral	Neutral	Reverse gear	3rd gear
1st gear	1st gear	Reverse gear	3rd gear	Reverse gear	3rd gear
2nd gear	3rd gear	Reverse gear	3rd gear	Reverse gear	3rd gear
3rd gear	3rd gear	Reverse gear	3rd gear	Reverse gear	3rd gear
4th gear	5th gear	Neutral	5th gear	Reverse gear	3rd gear
5th gear	5th gear	Neutral	5th gear	Reverse gear	3rd gear

MEMO

STRUCTURE AND OPERATION

3. Electronic control unit Connection Diagram





TROUBLESHOOTING

1. Failure by Equipment

NOTE

- If the automatic transmission warning lamp would not turn off, contact to GM Allison service.
- Allison exclusive diagnosis tool is required to read out the diagnosis code.

Symptoms		Engine does not start (engine does not run)	Automatic transmission warning lamp does not go out after engine start	Automatic transmission warning lamp sometimes flashes	Automatic transmission warning lamp does not illuminate when starter switch is turned ON	Forward gears and reverse gears do not engage (kept in N)	Gear stays in a forward or reverse gear	Specific shifting is not made	No correct shifting (shock, timing too high or too low)	Excessive creep in 1st and reverse gears	Moves forward in neutral	Moves backward in neutral	Overrun at full throttle acceleration	Clutch slippage, judder	Clutch slippage and judder in 1st, 2nd, 3rd and 4th gears
Probable causes															
Engine failure	Idling too high									○					
	Idling too high (shifting from N to R or D)								○						
	Engine speed too high					○									
	Engine output high														
	Engine output low							○							
	Engine is overheating														
Accelerator signal failure from engine electronic control unit						○			○				○	○	
Lever and cable failure	Range selector lever not engaged in N or R	○													
	Range selector lever failure					○		○							
	Poor adjustment of range selector lever					○		○							
	Control lever failure					○		○							
	Poor adjustment of control lever					○		○							
	Poor adjustment of selector cable					○		○							
Electrical system failure on chassis side	Battery voltage low	○													
	Broken wire, poor connection	○	○	○	○	○		○	○						
	N start circuit failure	○													
	Automatic transmission warning lamp failure		○	○	○										
Electrical system failure on automatic transmission body side	Broken wire, poor connection	○	○	○	○	○		○	○						
	Inhibitor switch failure	○													
	Poor adjustment of inhibitor switch	○													
	Speed sensor failure					○		○	○				○	○	
	Oil temperature sensor failure							○							
Automatic transmission electronic control unit failure	Automatic transmission electronic control unit failure		○		○			○							
	Code recorded in automatic transmission electronic control unit		○												

Symptoms		Probable causes													
		Engine does not start (engine does not run)	Automatic transmission warning lamp does not go out after engine start	Automatic transmission warning lamp sometimes flashes	Automatic transmission warning lamp does not illuminate when starter switch is turned ON	Forward gears and reverse gears do not engage (kept in N)	Gear stays in a forward or reverse gear	Specific shifting is not made	No correct shifting (shock, timing too high or too low)	Excessive creep in 1st and reverse gears	Moves forward in neutral	Moves backward in neutral	Overrun at full throttle acceleration	Clutch slippage, judder	Clutch slippage and judder in 1st, 2nd, 3rd and 4th gears
ATF failure	ATF level poor								○				○	○	
	ATF level too low					○	○								
	ATF level too high														
	ATF deteriorated							○							
	ATF is overheating							○							
	ATF overheated														
	ATF bubbles														
	ATF not replaced														
Oil cooler failure	Oil cooler piping clogged, leaking														
	Oil cooler clogged														
	Ventilation to oil cooler hindered														
	Mixing of coolant														
Mechanical failures of automatic transmission body	Torque converter failure														
	Mechanical troubles of torque converter, shaft and planetary					○									
	Operation failure of lock-up clutch												○		
	C1 clutch failure							○							
	C1 clutch slippage														○
	C1 clutch plate worn														○
	C1 clutch not disengaged									○					
	C2 clutch slippage														
	C2 clutch plate worn														
	C3 clutch slippage														
	C3 clutch plate worn														
	C3 clutch not disengaged										○				
	C4 clutch slippage														
	C4 clutch plate worn														

TROUBLESHOOTING

Symptoms		Engine does not start (engine does not run)	Automatic transmission warning lamp does not go out after engine start	Automatic transmission warning lamp sometimes flashes	Automatic transmission warning lamp does not illuminate when starter switch is turned ON	Forward gears and reverse gears do not engage (kept in N)	Gear stays in a forward or reverse gear	Specific shifting is not made	No correct shifting (shock, timing too high or too low)	Excessive creep in 1st and reverse gears	Moves forward in neutral	Moves backward in neutral	Overrun at full throttle acceleration	Clutch slippage, judder	Clutch slippage and judder in 1st, 2nd, 3rd and 4th gears
Probable causes															
Mechanical failures of automatic transmission body	C5 clutch slippage														
	C5 clutch plate worn														
	Mechanical trouble of C5 clutch					○									
	Clutch clearance excessive								○						
	Slippage of related clutch and piston seal leaks											○			
	Clutch pressure low												○		
Oil pressure failure of automatic transmission body	Oil pressure lowered					○	○		○				○	○	
	Oil pump failure														
	Inside leaks excessive														
	Control valve failure								○				○		
	Solenoid assembly leaks						○		○				○		
Other failures of automatic transmission body	Filter element clogged														
	Filter element seal failure														
	Filter element not replaced														
	Suction filter clogged														
	Air suction by suction filter														
	Level gauge seal failure														
	Breather clogged														
	Oil seal failure														
	Seal surface of companion flange damaged														
	Companion flange mounting area loosened														
	Rear cover failure														
	Front support bolt seal failure														
	Manifold seal failure														
	Main oil pressure plug seal failure														

Symptoms		Probable causes													
		Clutch slippage and judder in 4th and 5th gears	Clutch slippage and judder in 3rd, 5th and reverse gears	Clutch slippage and judder in 2nd gear only	Clutch slippage and judder in 1st and reverse gears	Main oil pressure decline in all ranges	Lubricant pressure decline	Stall revolution high	Stall revolution low	Overheat in all ranges	Blowoff of ATF from breather and level gauge guide	Occasional noise like a buzzer	ATF leaks from output side	ATF leaks from input side	Contamination of ATF
Engine failure	Idling too high														
	Idling too high (shifting from N to R or D)														
	Engine speed too high														
	Engine output high							○							
	Engine output low								○						
	Engine is overheating									○					
Accelerator signal failure from engine electronic control unit															
Lever and cable failure	Range selector lever not engaged in N or P														
	Range selector lever failure														
	Poor adjustment of range selector lever														
	Control lever failure														
	Poor adjustment of control lever														
	Poor adjustment of selector cable														
Electrical system failure on chassis side	Battery voltage low														
	Broken wire, poor connection														
	N start circuit failure														
	Automatic transmission warning lamp failure														
Electrical system failure on automatic transmission body side	Broken wire, poor connection														
	Inhibitor switch failure														
	Poor adjustment of inhibitor switch														
	Speed sensor failure														
	Oil temperature sensor failure									○					
Automatic transmission electronic control unit failure	Automatic transmission electronic control unit failure														
	Code recorded in automatic transmission Electronic control unit														

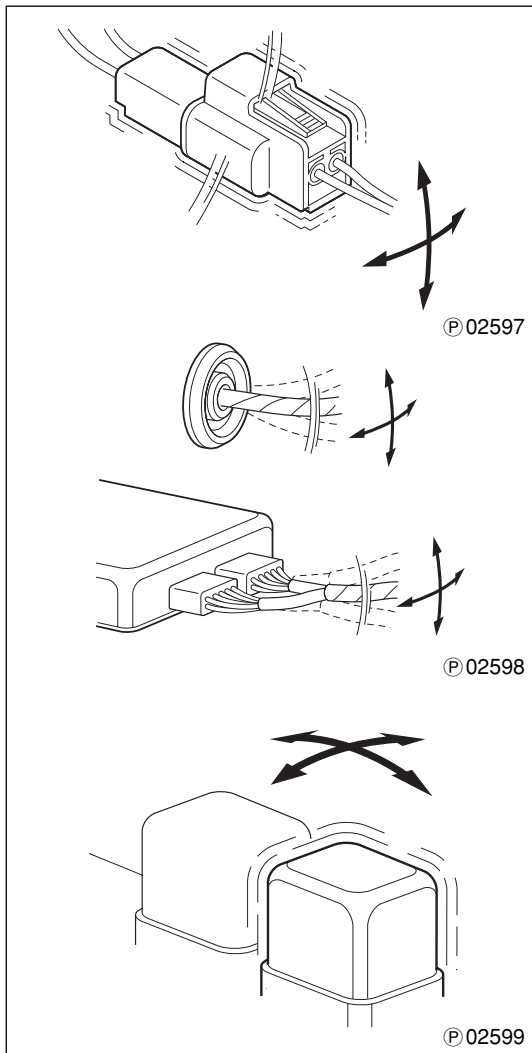
TROUBLESHOOTING

Symptoms		Probable causes													
		Clutch slippage and judder in 4th and 5th gears	Clutch slippage and judder in 3rd, 5th and reverse gears	Clutch slippage and judder in 2nd gear only	Clutch slippage and judder in 1st and reverse gears	Main oil pressure declines in all ranges	Lubricant pressure decline	Stall revolution high	Stall revolution low	Overheat in all ranges	Blowoff of ATF from breather and level gauge guide	Occasional noise like a buzzer	ATF leaks from output side	ATF leaks from input side	Contamination of ATF
ATF failure	ATF level poor					○	○								
	ATF level too low							○			○	○			
	ATF level too high									○	○				
	ATF deteriorated														
	ATF is overheating														
	ATF overheated														○
	ATF bubbles							○		○		○			
	ATF not replaced														○
Oil cooler failure	Oil cooler piping clogged, leaking						○			○					
	Oil cooler clogged						○								
	Ventilation to oil cooler hindered									○					
	Mixing of coolant										○				
Mechanical failures of automatic transmission body	Torque converter failure							○	○	○				○	
	Mechanical troubles of torque converter, shaft and planetary														
	Operation failure of lock-up clutch														
	C1 clutch failure														
	C1 clutch slippage							○							
	C1 clutch plate worn														
	C1 clutch not disengaged														
	C2 clutch slippage	○													
	C2 clutch plate worn	○													
	C3 clutch slippage		○												
	C3 clutch plate worn		○												
	C3 clutch not disengaged														
	C4 clutch slippage			○											
	C4 clutch plate worn			○											

Symptoms		Probable causes													
		Clutch slippage and judder in 4th and 5th gears	Clutch slippage and judder in 3rd, 5th and reverse gears	Clutch slippage and judder in 2nd gear only	Clutch slippage and judder in 1st and reverse gears	Main oil pressure declines in all ranges	Lubricant pressure decline	Stall revolution high	Stall revolution low	Overheat in all ranges	Blowoff of ATF from breather and level gauge guide	Occasional noise like a buzzer	ATF leaks from output side	ATF leaks from input side	Contamination of ATF
Mechanical failures of automatic transmission body	C5 clutch slippage				○			○							
	C5 clutch plate worn				○										
	Mechanical trouble of C5 clutch														
	Clutch clearance excessive														
	Slippage of related clutch and piston seal leaks														
	Clutch pressure low							○							
Oil pressure failure of automatic transmission body	Oil pressure lowered											○			
	Oil pump failure					○								○	
	Inside leaks excessive						○			○					
	Control valve failure					○	○								
	Solenoid assembly leaks					○									
Other failures of automatic transmission body	Filter element clogged					○									
	Filter element seal failure													○	
	Filter element not replaced														○
	Suction filter clogged					○	○					○			
	Air suction by suction filter											○			
	Level gauge seal failure										○				
	Breather clogged										○				
	Oil seal failure												○	○	
	Seal surface of companion flange damaged												○		
	Companion flange mounting area loosened												○		
	Rear cover failure												○		
	Front support bolt seal failure													○	
	Manifold seal failure													○	
	Main oil pressure plug seal failure													○	

TROUBLESHOOTING

2. Measures for Transitory Failure



As a transitory failure often occurs under a certain condition, it is easy to estimate its cause if the condition is determined. In order to determine the condition in which a transitory failure occurred, you must first ask the customer about the driving condition, weather, frequency of occurrence and failure phenomenon when the failure occurred, and have the customer replicate the failure phenomenon.

Next, you must determine, from the condition of failure occurrence, whether the failure was caused by vibration, temperature or other factors.

If the cause is considered to be vibration, inspect a single-unit connector, etc. in the following manner to make sure that the failure phenomenon will be replicated.

- Lightly shake a connector up and down, and right and left.
- Lightly shake a wiring harness up and down, and right and left.
- Lightly swing various sensors and equipment by hand.
- Lightly shake a wiring harness in moving parts such as suspension.

Subjects of inspection here are a connector and single-unit component described in probable causes for failure in troubleshooting.

MEMO

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Stall Test

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Stall revolution	1836±150 rpm	—	Inspect

● Purpose

- A stall test is conducted to determine whether power failure is caused by engine troubles or malfunction of the transmission.
- The stall speed is the maximum engine speed when the engine is at full throttle and the torque converter turbine does not rotate, namely in a state of stall.

CAUTION

Conduct a stall test only as a troubleshooting procedure. Do not conduct a stall test as general inspection or maintenance.

● Measurement procedure

Before starting the test, check the coolant and oil of the engine, and automatic transmission fluid level of the automatic transmission. Also sufficiently warm up the engine and transmission.

- Place chocks at both front and rear wheels and engage the parking brake to prevent the vehicle from moving. In addition, when pushing the accelerator pedal down, depress the foot brake strongly.
- Start the engine and engage the range selector lever into D range.
- Push the accelerator pedal down slowly to the full throttle; when the engine becomes stable at a constant speed, read the revolution (stall revolution) quickly, and then take off the foot from the accelerator pedal.

CAUTION

- **Be sure to set a full stall acceleration time as less than 30 seconds, and complete the measurement during that time.**
- **Be careful of overheating of the engine and transmission.**

- Put the range selector lever in N range, and run the engine for two minutes between 1200 and 1500 rpm to cool automatic transmission fluid.

● Result of diagnosis

1. In case the stall revolution is lower by 150 rpm or more than the standard value, engine failure may be the cause.
2. In case the stall revolution is abnormally low (approximately 1/3 of the specified value) even though there is no engine failure such as emitting black smoke, failure inside the torque converter (one-way clutch failure) may be the cause.
3. In case the stall revolution is higher by 150 rpm or more than the standard value, slippage inside the transmission, cavitation, bubbling of automatic transmission fluid, or damage to the torque converter may be the cause.

2. Line Pressure Test

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Plug	10 to 13 {7.4 to 9.6, 1.0 to 1.3}	—

● Purpose

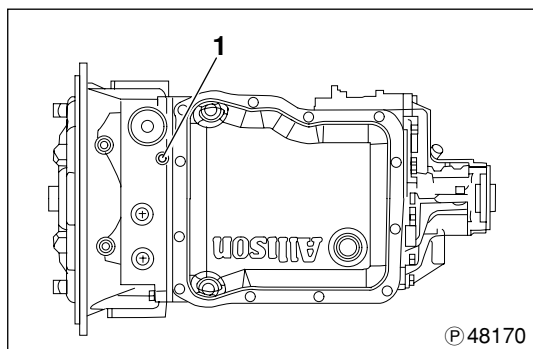
“Line pressure test” checks the performance of oil pump, function of control valve, and the oil leaking of each component.

● Measurement procedure

- Remove main oil pressure plug 1 (7/16 UNF-2A) on the lower part of the transmission case, and install the pressure gauge.
- Conduct a sufficient warm-up operation, and raise oil temperature to 60 to 80 °C {140 to 175 °F}.
- Measure the oil pressure in each range when the engine runs at 600 rpm and 2100 rpm, and make sure whether the result is within the standard value.
- When having finished the measurement, tighten plug 1 to the specified torque.

CAUTION

- Be sure to prevent foreign particles from entering the pressure detecting port.
- Remove foreign particles in the pressure detecting port before installing plug 1.



Range	Engine speed 600 rpm	Engine speed 2100 rpm
Forward movement (torque converter)	800 to 1380 kPa {115 to 200 psi, 8.2 to 14.1 kgf/cm ² }	1515 to 1795 kPa {220 to 260 psi, 15.4 to 18.3 kgf/cm ² }
Forward movement (lock-up)	—	1000 to 1170 kPa {145 to 170 psi, 10.2 to 11.9 kgf/cm ² }
R (reverse movement)	800 to 1380 kPa {115 to 200 psi, 8.2 to 14.1 kgf/cm ² }	1515 to 1795 kPa {220 to 260 psi, 15.4 to 18.3 kgf/cm ² }
N (neutral) P (park)	900 to 1653 kPa {130 to 240 psi, 9.2 to 16.9 kgf/cm ² }	1515 to 1795 kPa {220 to 260 psi, 15.4 to 18.3 kgf/cm ² }

● Diagnosis of result

The main oil pressure is low in all ranges.

- Too low automatic transmission fluid level
- Clogged filter element
- Clogged suction filter
- Faulty control valve (leaking or sticking inside)
- Worn or damaged oil pump

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Inspection of Automatic Transmission Fluid

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	Automatic transmission	DEXRON III	As required

(1) Inspection of properties

If having a burnt smell of automatic transmission fluid or finding out some worn particles of metal or friction materials, it is necessary to overhaul the transmission completely. Check automatic transmission fluid adhering to level gauge **1** carefully. If there are some doubts in a state of automatic transmission fluid, check the automatic transmission fluid again by extracting its sample.

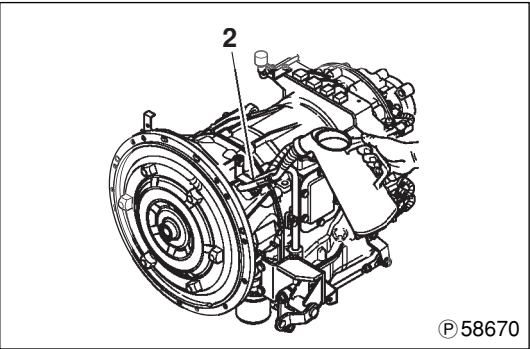
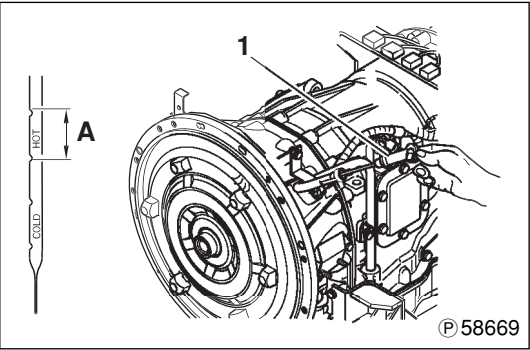
(2) Inspection of quantity of automatic transmission fluid

- Run the vehicle until automatic transmission fluid gets sufficiently warm (71 to 93 °C {160 to 200 °F}).
- Place the vehicle on a flat place, engage the parking brake surely, and place chokes securely at the wheels.
- To fill automatic transmission fluid in a hydraulic circuit with the engine at idle, return the range selector lever to P or N range after putting it in D range and R range.
- Pull out level gauge **1** with the engine at idle; insert it again after wiping off automatic transmission fluid adhered; and after pulling it out, check the quantity of automatic transmission fluid.
- If automatic transmission fluid is within the HOT range **A** of level gauge **1**, it shows that the quantity of automatic transmission fluid is as specified.

CAUTION

- Make sure to inspect the quantity of automatic transmission fluid at the horizontal level.
- Make sure to inspect the quantity of automatic transmission fluid with the engine at idle in P or N range since the apparent quantity of automatic transmission fluid increases in a state of the engine stop.
- Remove any dirt of the protection cap and the upper part of level gauge guide **2** completely before pulling level gauge **1** out.
- Since the inspection is conducted with the engine running, be careful of being caught in components, burn hazard, or safety.
- Do not raise the engine speed while keeping the engine at idle until the adjustment of quantity of automatic transmission fluid is completed.
- The COLD level indicated on the level gauge **1** is just for reference when the fluid temperature is low. Inspection should be performed at high fluid temperature after driving.

- In case the quantity of automatic transmission fluid is insufficient, replenish DEXRON III to the specified level of the level gauge from level gauge guide **2**.



4. Replacement of Automatic Transmission Fluid

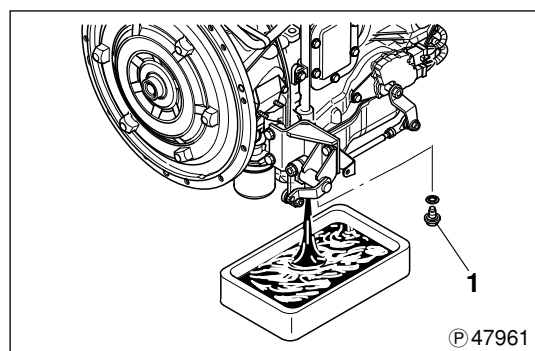
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Drain plug	30 to 40 {22 to 30, 3.1 to 4.1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	Automatic transmission	FK	7L {7.4 qts}
		FM	10L {11 qts}



(1) Discharge

- Place chokes at wheels on a flat place, and put the range selector lever in P range.
- Put an automatic transmission fluid receptacle under the transmission oil pan; then remove drain plug 1 of the oil pan to discharge automatic transmission fluid.

CAUTION

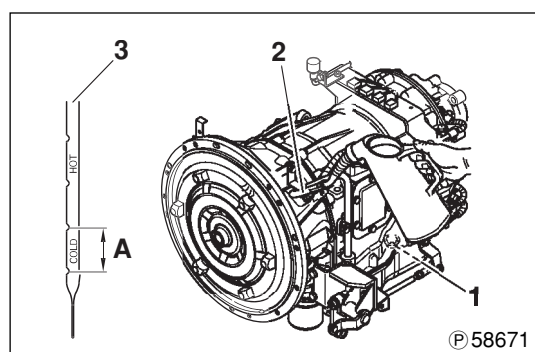
- Do not start any work for engine immediately after the engine is shut down. Wait until the engine cools to a safe temperature since a hot engine can cause burns.
- The discharge can be made more quickly by warming automatic transmission fluid with the warm-up operation of the engine.
- It is impossible to discharge automatic transmission fluid which is located around the hydraulic circuit, the converter, or the oil cooler.
- Check any dirt of automatic transmission fluid discharged, and any existence of metallic powder or metal pieces.

(2) Pouring in

- Install oil pan drain plug 1.
- Pour in the specified quantity of DEXRON III from level gauge guide 2.

CAUTION

Be careful not to allow any dust or foreign particles to enter.



- Put the range selector lever in P range, start the engine, and run the engine at idle for approximately one minute.
- After putting the range selector lever in each range, engage it to P range again.

CAUTION

In this process, run the engine at idle only; make sure to avoid just revving the engine.

ON-VEHICLE INSPECTION AND ADJUSTMENT

- Replenish automatic transmission fluid until it reaches the low position of the specified range of level gauge **3**. Then, check the level of automatic transmission fluid. The level of automatic transmission fluid is acceptable if it is within the specified range of the level gauge.

CAUTION

- Immediately after pouring in automatic transmission fluid, it may be difficult to clearly see the level of automatic transmission fluid due to the automatic transmission fluid adhering to the inner wall of level gauge guide **2**; therefore, check the level again after a while.
- As the temperature rises, the level of automatic transmission fluid rises. Therefore, do not pour in automatic transmission fluid above the COLD level (A range) of level gauge **3** while the temperature is low.
- Keep the engine at idle, and pour in automatic transmission fluid gradually while paying attention to the level of automatic transmission fluid.

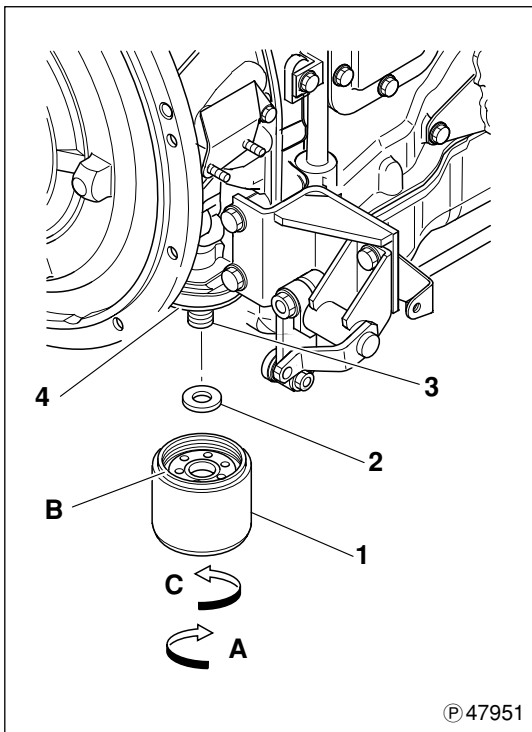
5. Replacement of Oil Filter

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Gasket of oil filter	DEXRON III	As required

CAUTION

Do not start any work for engine immediately after the engine is shut down. Wait until the engine cools to a safe temperature since a hot engine can cause burns.



[Removal]

- Remove oil filter **1** using a commercially available filter wrench.
- **A** : Removal
- Remove magnet **2** from filter mounting tube **3**.

CAUTION

Check for any existence of metallic powder or metal pieces.

[Installation]

- Clean magnet **2** before installation.

CAUTION

Clean magnet **2** with wash oil.

- Clean the oil filter **1** mounting surface of converter housing **4**.
- Apply a thin coat of “DEXRON III” to gasket **B** of oil filter **1**.
- Screw in the filter by hand until gasket **B** contacts converter housing **4**. In addition, tighten it one turn by hand.

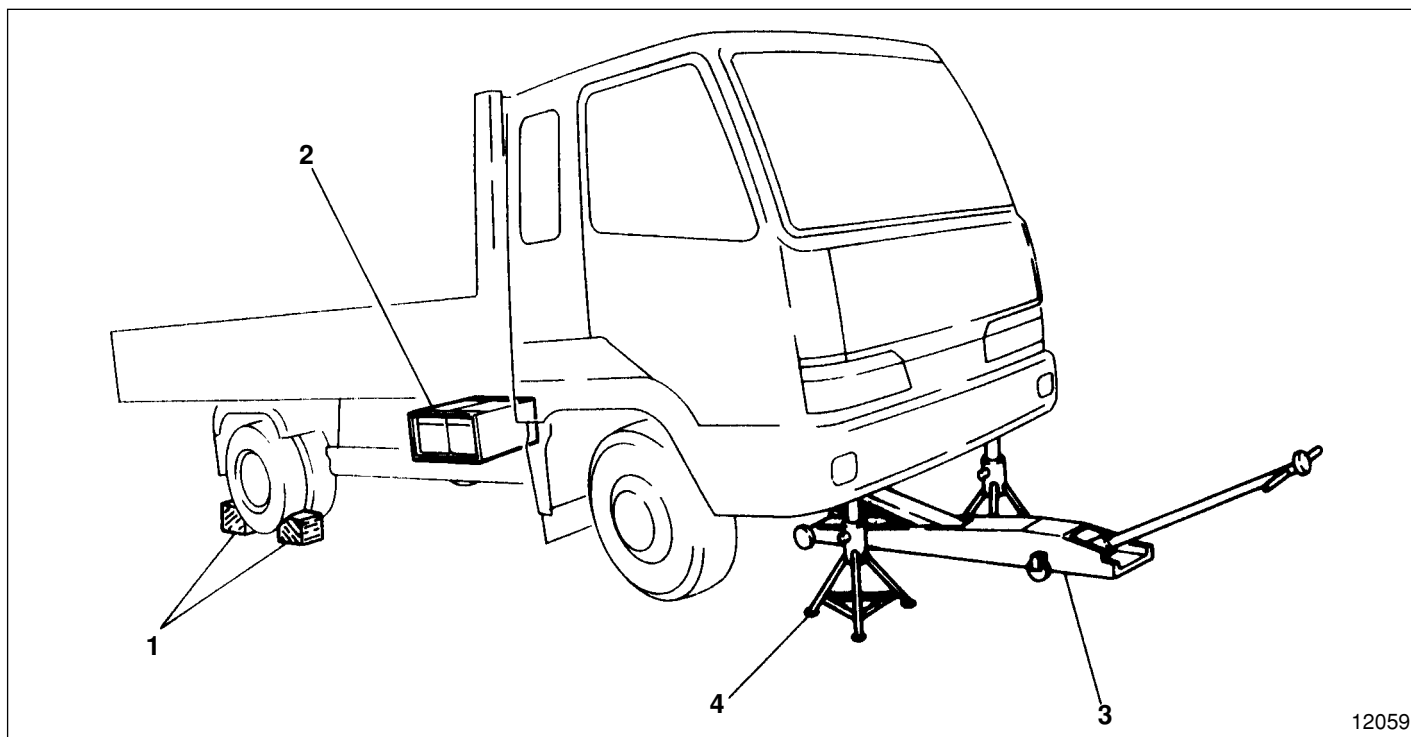
C : Installation

CAUTION

Do not overtighten oil filter **1** using a wrench. Overtightening can damage the oil filter, causing leaks of automatic transmission fluid.

- After installing oil filter **1**, start the engine to make sure that no automatic transmission fluid leaks from gasket **B**.
- Check the quantity of automatic transmission fluid. If the quantity is insufficient, replenish.

 P23A-26



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● Preparatory work

- 1 Place wheel chocks.
- 2 Disconnect the negative terminal of the battery.
- 3 Apply a garage jack to the center of the front axle and jack it up.
- 4 Support the frame with rigid racks.

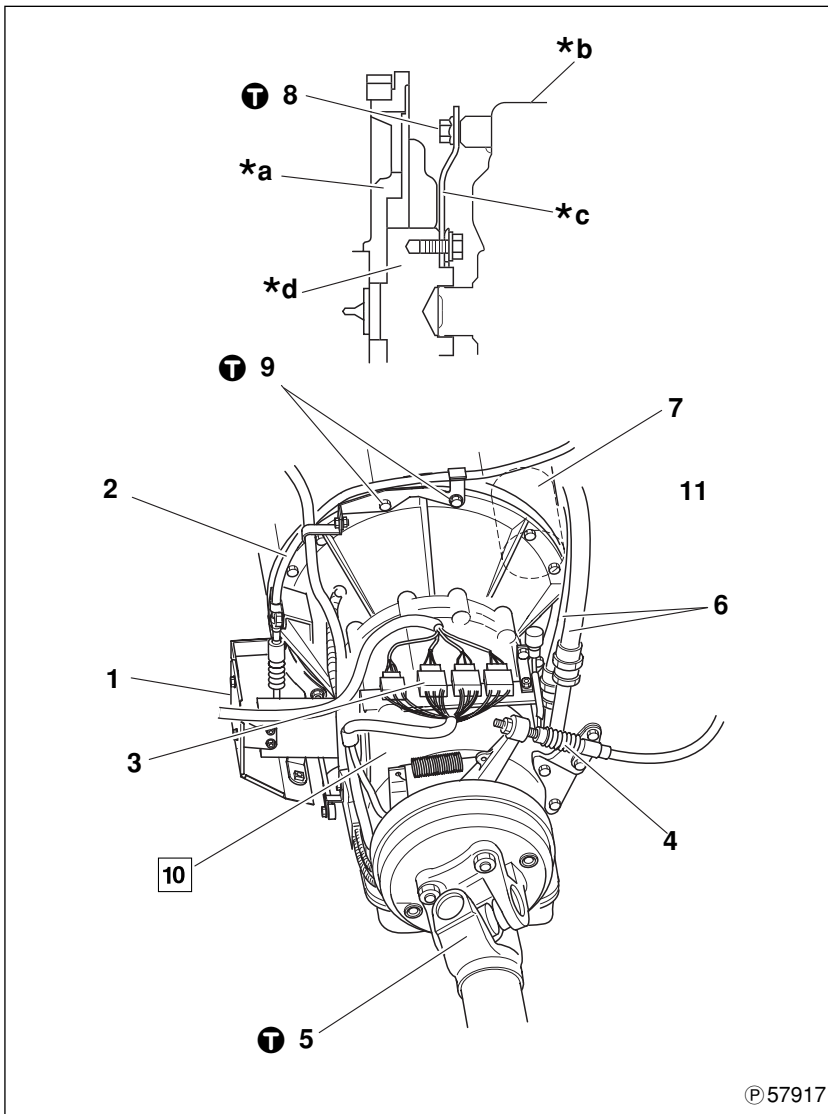
CAUTION

- Since the parking brake is removed, naturally, it cannot be used. Therefore, chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Be sure to support the bottom of the frame on the right and left with rigid racks since supporting the vehicle with a garage jack alone is very dangerous.
- Leave the rigid racks in place until the entire operation is completed. Never remove them during the operation.
- Keep the automatic transmission in N range throughout the operation.

● Work after removal and installation

Follow the preparatory work in reverse.

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION ASSEMBLY



● Removal sequence

- Control cover
- Selector cable P23A-36
- Harness connector
- Parking brake cable Gr 36A
- Propeller shaft Gr 25
- Oil hose P23A-44
- Starter Gr 54
- Flex bolt
- Bolt or nut
- Automatic transmission assembly

- *a** Flywheel
***b** Torque converter
***c** Flex plate
***d** Flywheel adapter

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

- After installation, be sure to adjust the automatic transmission fluid level.
 P23A-26
- Be sure to adjust the automatic transmission fluid level since starting the engine with insufficient automatic transmission fluid can damage the automatic transmission.

Tightening torque

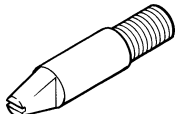
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8	Flex bolt (connection of flywheel and torque converter)	56±5 {41±3.7, 5.7±0.5}	—
9	Bolt or nut (automatic transmission assembly mounting)	37 to 53 {27 to 39, 3.8 to 5.4}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
10	Torque converter pilot area	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required

Special tools

Location	Tool name and shape	Part No.	Application
10	Converter installer 	MH633437	Automatic transmission assembly mounting

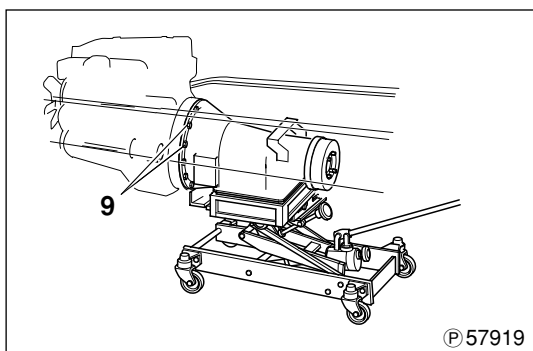
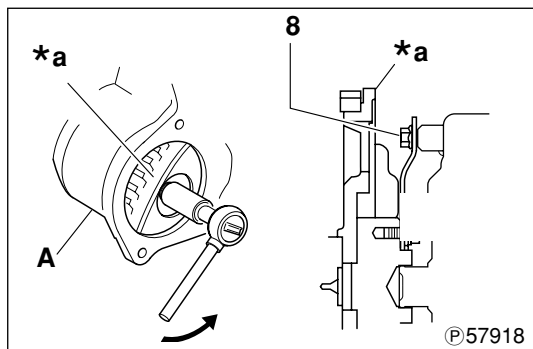
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◆ Service procedure

10 Automatic transmission assembly

[Removal]

- Turn flywheel ***a** to remove flex bolts **8** in succession.
A : Flywheel housing



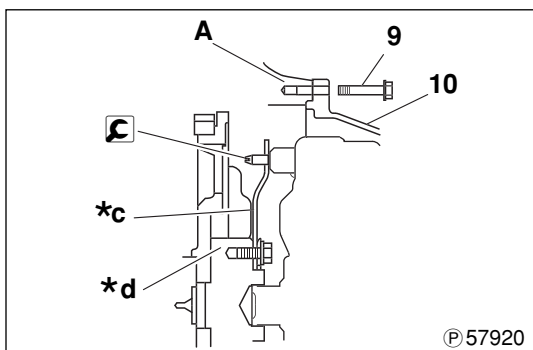
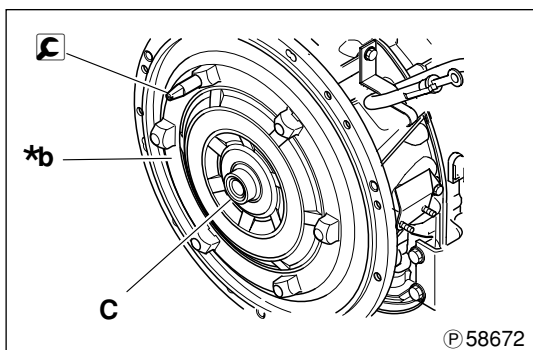
- Pinch the oil pan of automatic transmission assembly **10** with blocks of wood, and support it with jack **B** to remove automatic transmission assembly mounting bolt or nut **9**.
- Remove automatic transmission assembly **10** by pulling it out backward.

CAUTION ⚠

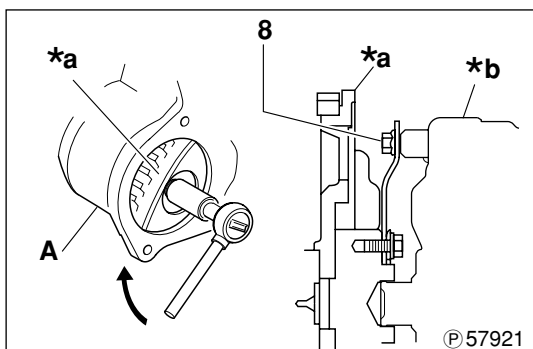
- Be careful not to allow local force to be applied to the oil pan.
- Secure torque converter ***b** with wire to prevent it from falling off.

[Installation]

- Apply grease to pilot area **C** of torque converter ***b**.
- Install  converter installer in the tapped hole on the periphery of torque converter ***b**.



- Install automatic transmission assembly **10** on flywheel housing **A**.
- Tighten automatic transmission assembly mounting bolt or nut **9** to the specified torque.

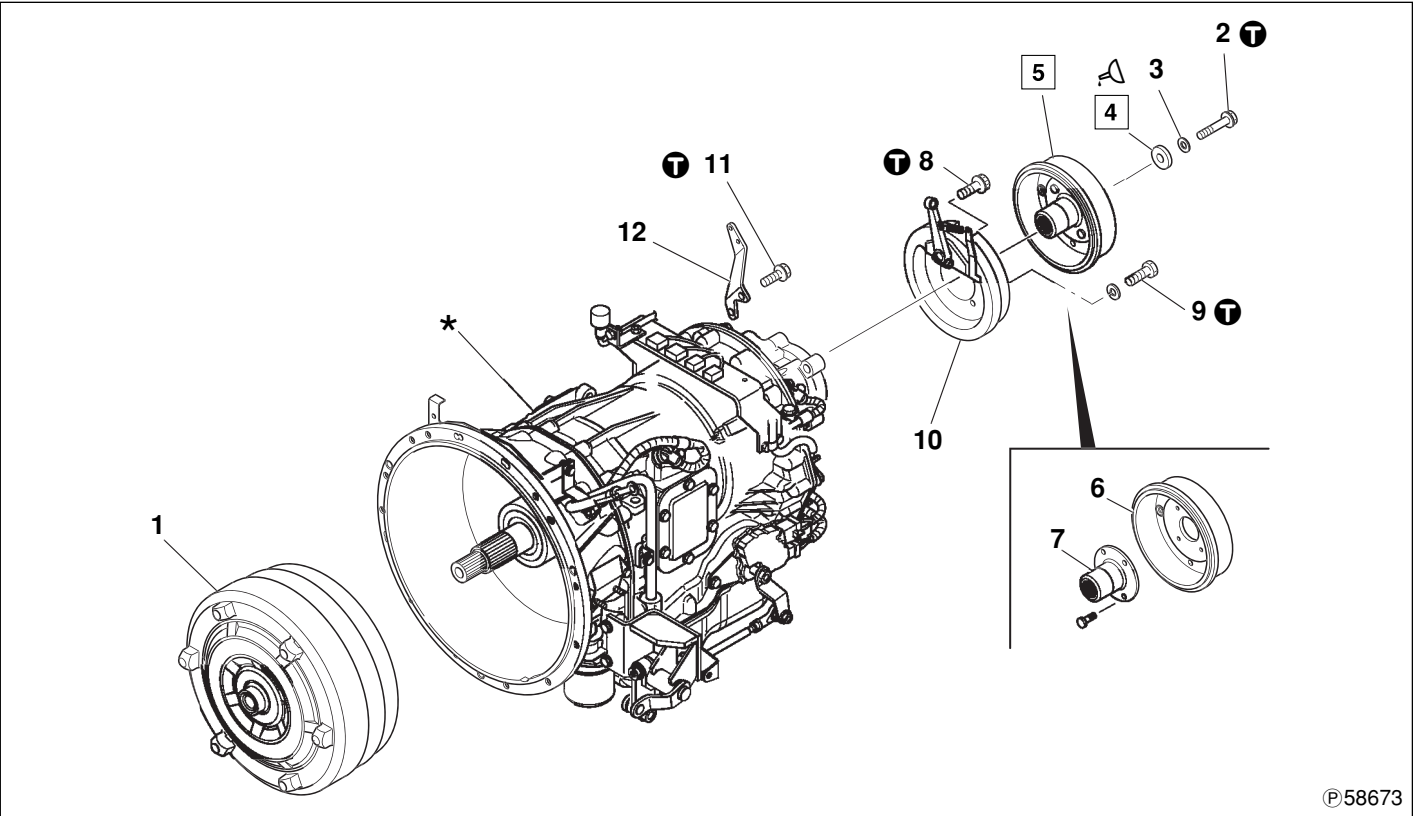


- Turn flywheel ***a**, and temporarily tighten flex bolts **8** in succession from the starter window (six locations).
- Where  converter installer is installed, remove  converter installer to install flex bolts **8**.
- Finally, fully tighten flex bolts **8** to the specified torque.

CAUTION ⚠

Be careful not to drop flex bolts **8** in the clearance between flywheel ***a** and torque converter ***b** during operation.

PARKING BRAKE ASSEMBLY



©58673

Disassembly sequence

- | | | |
|-------------------------------|--|--------------------------------|
| 1 Torque converter | 7 Companion flange | 12 Wire bracket |
| 2 Bolt | 8 Bolt | |
| 3 Sealing washer | 9 Bolt | *: Automatic transmission body |
| 4 Retainer washer | 10 Support plate and shoe assembly Gr 36A | ⊗: Non-reusable parts |
| 5 Parking brake drum assembly | 11 Bolt | |
| 6 Parking brake drum Gr 36A | | |

CAUTION

Do not disassemble parking brake drum 6 and companion flange 7 unless necessary since they are balanced. When disassembling them, put mating marks and align them to assemble. In addition, do not replace the parking brake drum or companion flange as a single unit.

Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

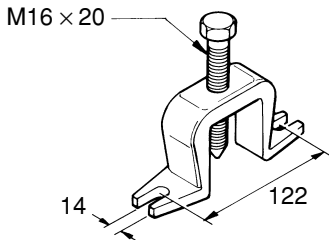
Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (companion flange mounting)	108 to 136 {80 to 100, 11 to 14}	—
8, 9	Bolt (support plate and shoe assembly mounting)	228 to 266 {170 to 195, 23.3 to 27.1}	—
11	Bolt (wire bracket mounting)	51 to 61 {38 to 45, 5.2 to 6.2}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Periphery of retainer washer	THREEBOND 1215	As required

Special tools

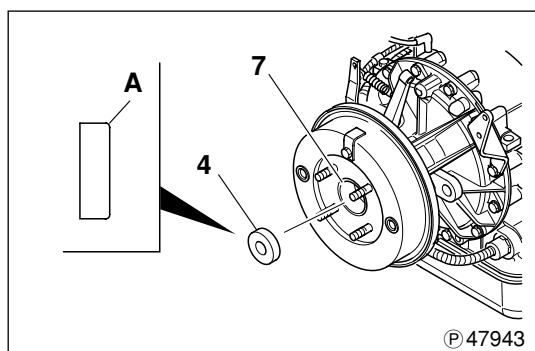
Unit : mm {in}

Location	Tool name and shape	Part No.	Application
5	Flange puller 	MC881524	Removal of parking brake drum assembly

◆ Service procedure

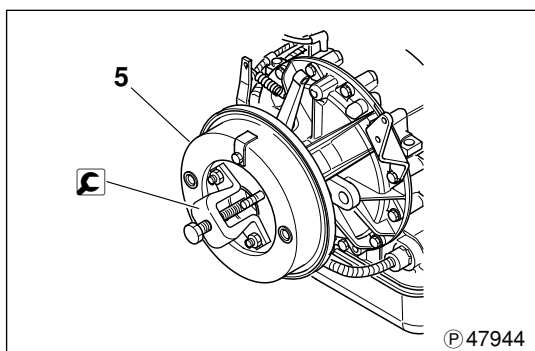
4 Installation of retainer washer

Install retainer washer 4 with chamfer **A** facing companion flange 7.

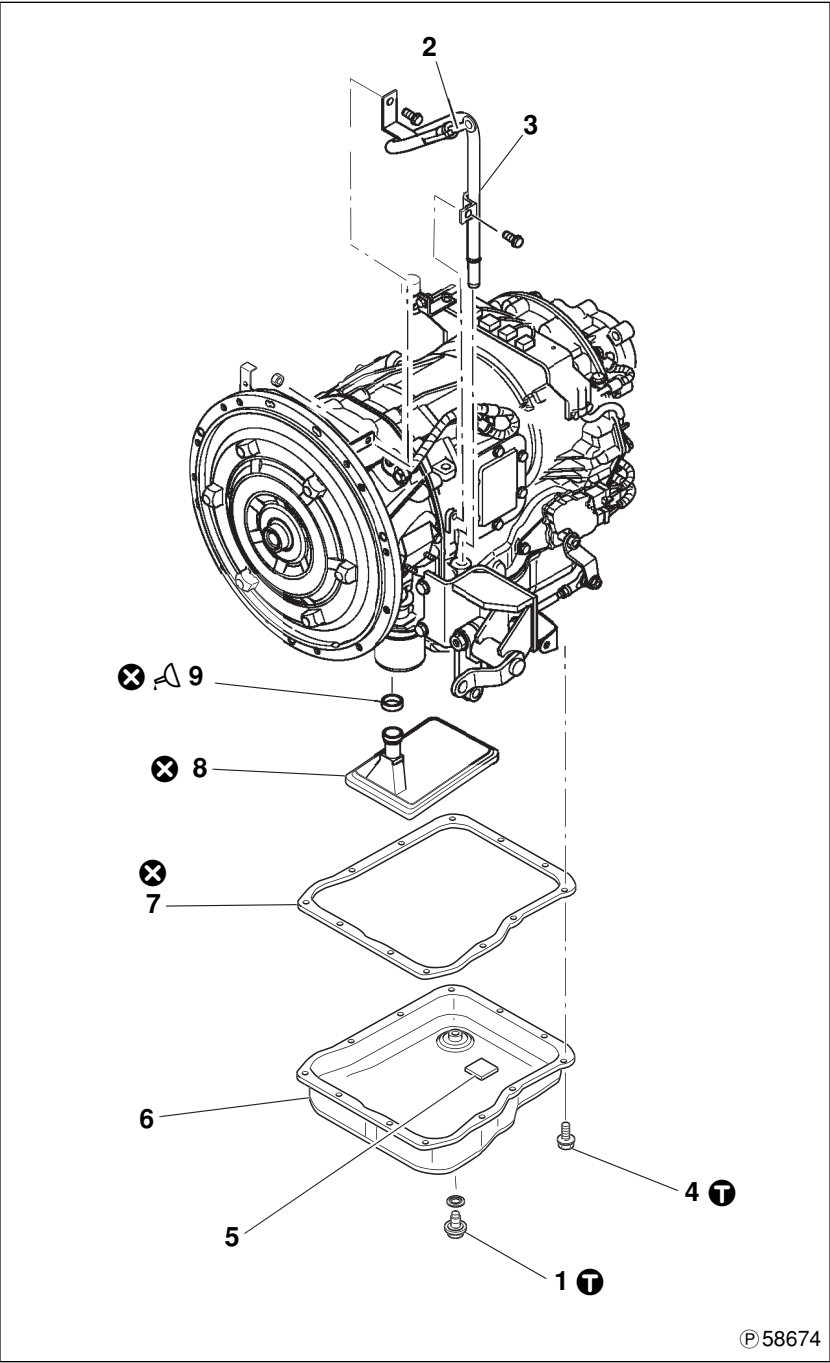


5 Removal of parking brake drum assembly

: Flange puller



OIL PAN, SUCTION FILTER AND LEVEL GAUGE



● Disassembly sequence

- 1 Drain plug
- 2 Level gauge
- 3 Level gauge guide
- 4 Bolt
- 5 Magnet
- 6 Oil pan
- 7 Gasket
- 8 Suction filter
- 9 Seal ring

⊗: Non-reusable parts

CAUTION ⚠

- Check any dirt of automatic transmission fluid discharged, and any existence of metallic powder or metal pieces.
- Replace suction filter 8 when overhauling the automatic transmission body.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- Clean drain plug 1, magnet 5 and oil pan 6 with wash oil.
- Fill in the specified quantity of automatic transmission fluid after assembling each component. 📖 P23A-26

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Drain plug	30 to 40 {22 to 30, 3.1 to 4.1}	—
4	Bolt (oil pan mounting)	24 to 29 {17 to 22, 2.4 to 3.0}	—

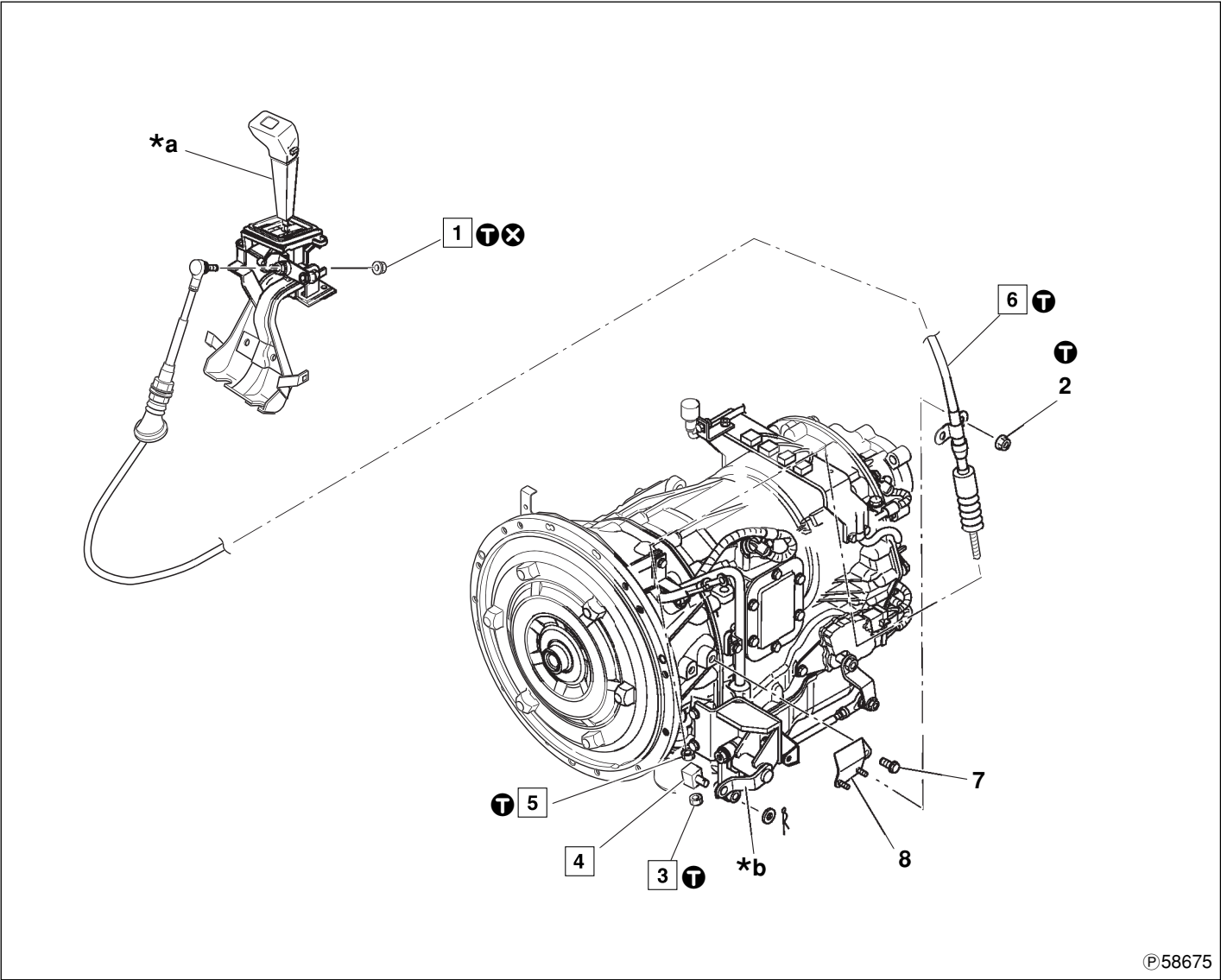
🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Seal ring	DEXRON III	As required

MEMO

AUTOMATIC TRANSMISSION CONTROL

Selector Cable



Removal sequence

- 1 Nut
 - 2 Nut
 - 3 Nut
 - 4 Adjuster
 - 5 Nut
 - 6 Selector cable
 - 7 Bolt
 - 8 Cable bracket
- *a: Range selector lever P23A-40
*b: Control lever P23A-42
X: Non-reusable parts

Installation sequence

Follow the removal sequence in reverse.

Tightening torque

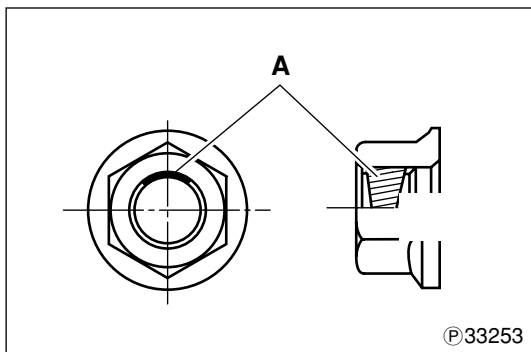
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (selector cable mounting)	18.6 to 23.5 {14 to 17, 1.9 to 2.4}	—
2	Nut (selector cable mounting)	21 to 30 {15 to 22, 2.1 to 3.1}	—
3, 5	Nut (selector cable mounting)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
6	Tightening of selector cable locknut	59 to 83 {44 to 61, 6.0 to 8.5}	—

◆ Service procedure

1 Installation of nut

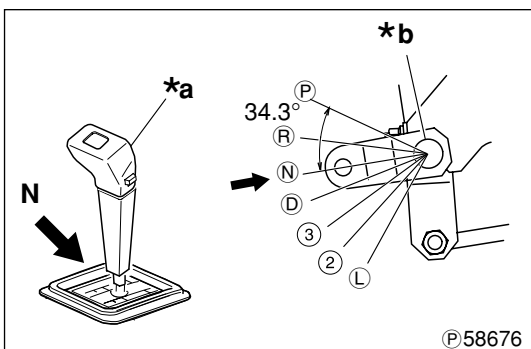
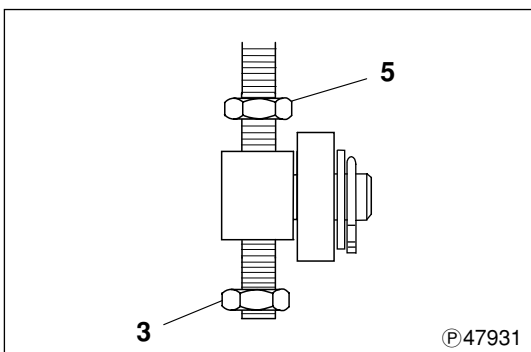
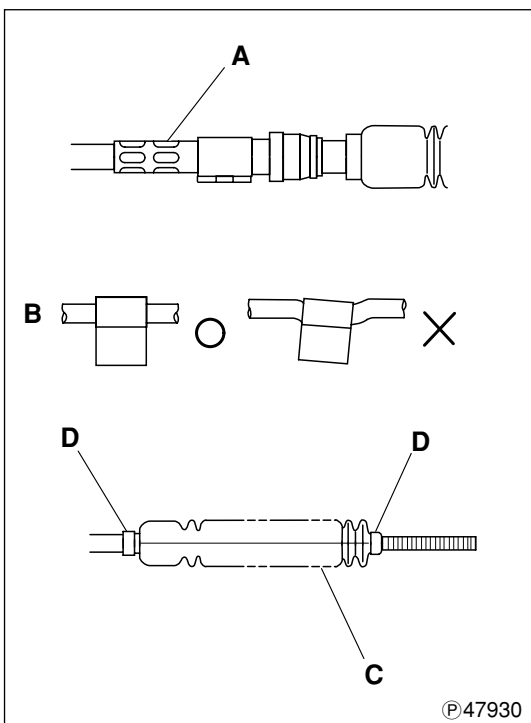
As coating agent adheres to thread **A** of nut **1** for prevention of looseness, check the nut surface treatment (galvanization: black chromating) before installation.



3 to 6 Installation of nut, adjuster and selector cable

CAUTION ⚠

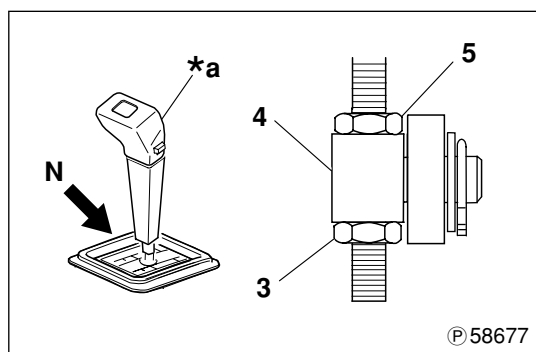
- Install casing cap **A** in a straight line.
- The bend radius must be 20 cm or more.
- Make sure that cable 6 has no stiffness.
- Install clamps at right angles to cable 6 (as shown in Fig. B).
- Do not twist clamps **D** on both ends of boot **C** of cable 6.



- Temporarily install nuts **5** and **3**.

- Align range selector lever ***a** and control lever ***b** with the N range position, respectively.

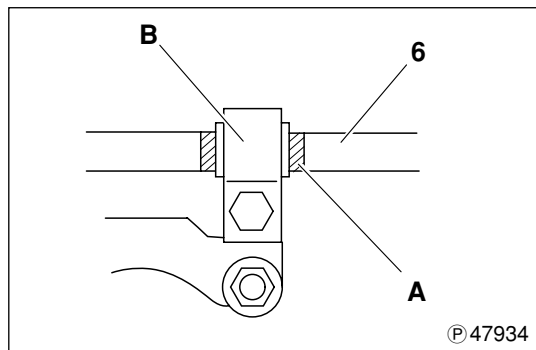
AUTOMATIC TRANSMISSION CONTROL



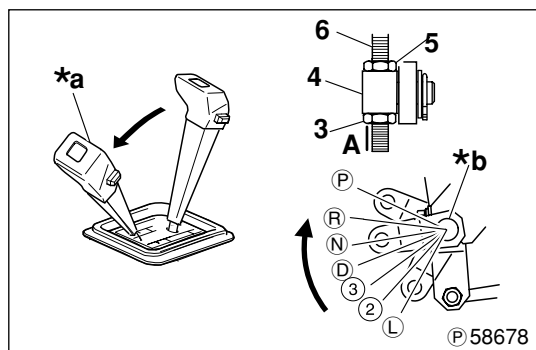
- Make sure that range selector lever ***a** is placed in the N range position, and then, tighten nuts **5** and **3** to the specified torque.

CAUTION

Do not move the position of adjuster 4, when tightening nuts 5 and 3, to prevent displacement of the N position.



- Install clip **B** on marking area **A** of selector cable **6** as shown in the figure, and install other clips in succession.

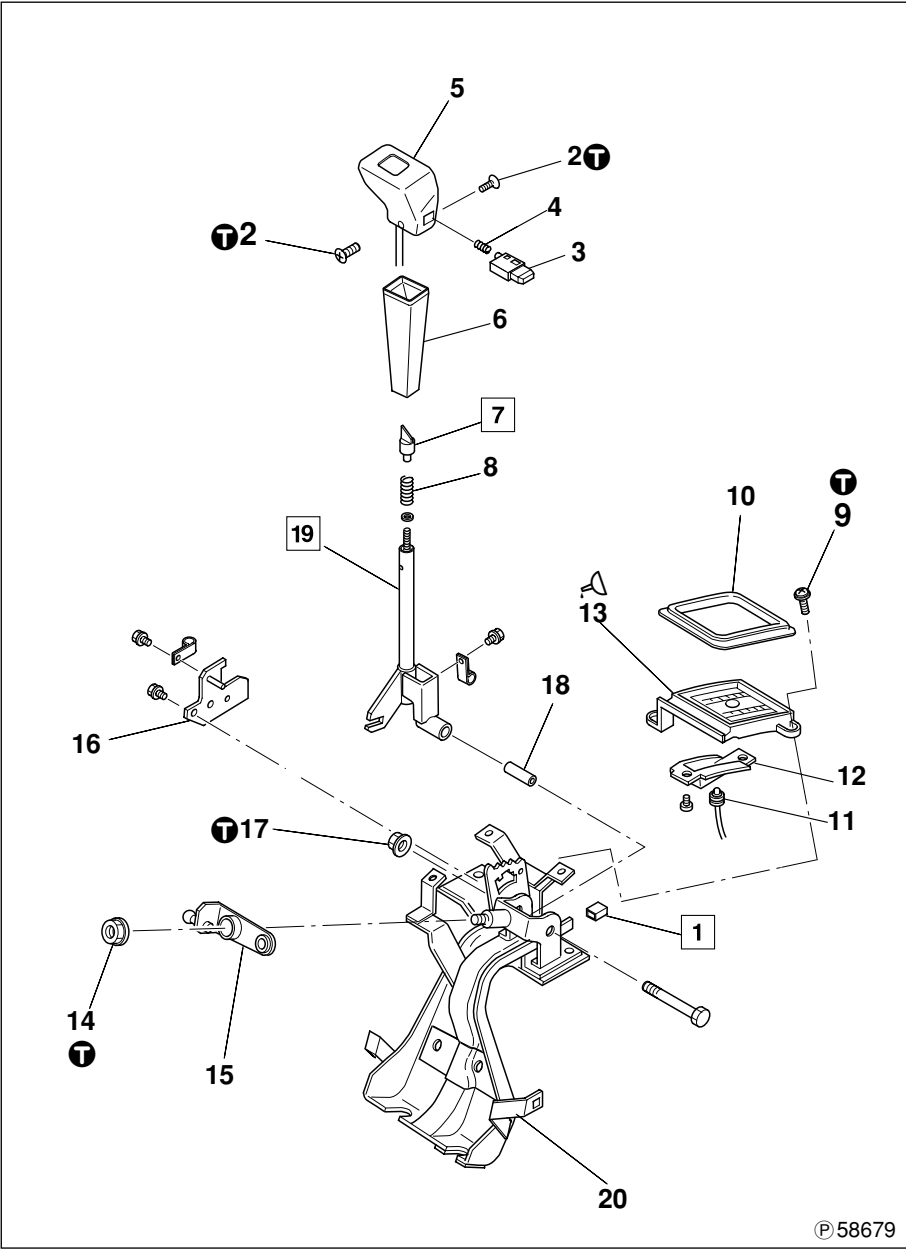


- Perform the following adjustment with nuts **5** and **3** so that shift feel between the N range and 3rd gear range will be the same when fully stroking range selector lever ***a** from the L range position to the P range position.
 - (1) In case there is no click stop feeling when shifting from N position to 3rd gear range position:
Shorten rod **A** of selector cable **6** jutting out from adjuster **4**.
 - (2) In case there is no click stop feeling when shifting from 3rd gear range position to N position:
Lengthen rod **A** of selector cable **6** jutting out from adjuster **4**.
- After adjustment, make sure that control lever ***b** moves smoothly from the L range to the P range position.
- Make sure that control lever ***b** is in N range and D range when range selector lever ***a** is in N range and D range, respectively.

MEMO

AUTOMATIC TRANSMISSION CONTROL

Range Selector Lever



Disassembly sequence

- 1 Connector
- 2 Screw
- 3 Push button
- 4 Spring
- 5 Knob and overdrive switch
- 6 Cover
- 7 Sleeve
- 8 Spring
- 9 Screw
- 10 Indicator rubber
- 11 Indicator lamp
- 12 Holder
- 13 Panel assembly
- 14 Nut
- 15 Range selector lever B
- 16 Lever bracket
- 17 Nut
- 18 Pipe
- 19 Range selector lever A
- 20 Set board assembly

Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Screw (knob and overdrive switch mounting)	2 {1.5, 0.2}	—
9	Screw (panel assembly mounting)	2 {1.5, 0.2}	—
14	Nut (range selector lever B mounting)	10 to 15 {7.4 to 11, 1.0 to 1.5}	—
17	Nut (range selector lever A mounting)	16 to 27 {12 to 20, 1.6 to 2.8}	—

Lubricant and/or sealant

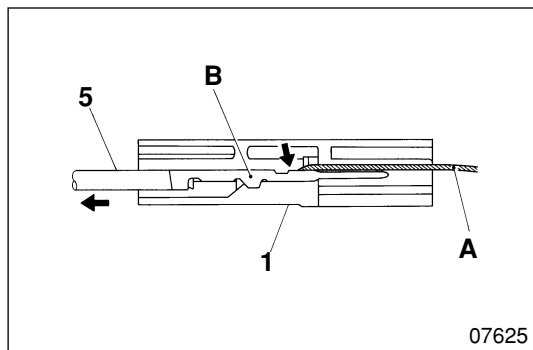
Location	Points of application	Specified lubricant and/or sealant	Quantity
13	Panel assembly mounting surface	Aronalfa type 241	As required
—	Each sliding area	Mitsubishi Chassis Grease [NLGI No. 1 (Ca Soap)]	As required

◆ Service procedure

1 Removal and installation of connector

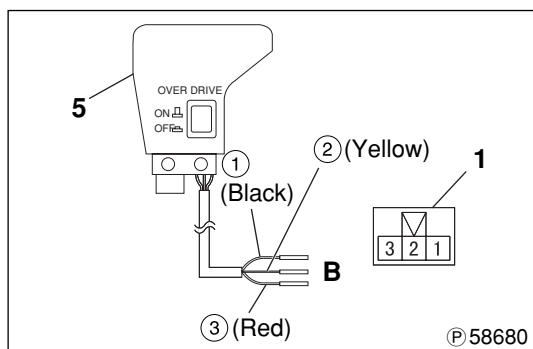
[Removal]

Pull out terminal **B** of knob and overdrive switch **5** inside connector **1** using flat blade screwdriver **A**, and remove the connector.



[Installation]

After checking wiring colors of knob and overdrive switch **5**, install terminal **B** in connector **1**.

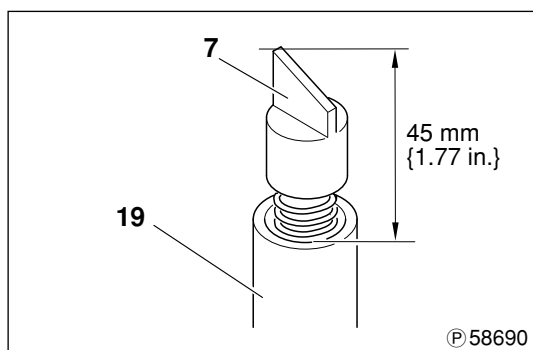


7 Installation of sleeve

Turn sleeve **7** to install so that the tip of sleeve **7** and range selector lever **A 19** will be to the dimension as shown in the figure.

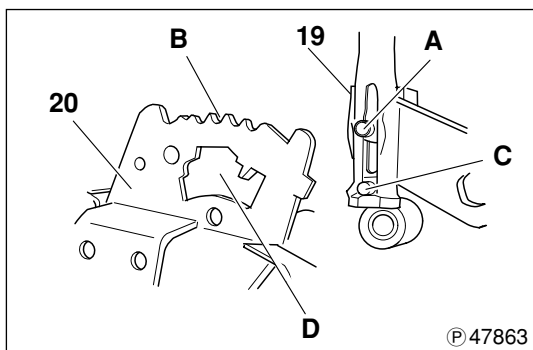
CAUTION ⚠

Install sleeve **7** with its tapered area on the push button side.



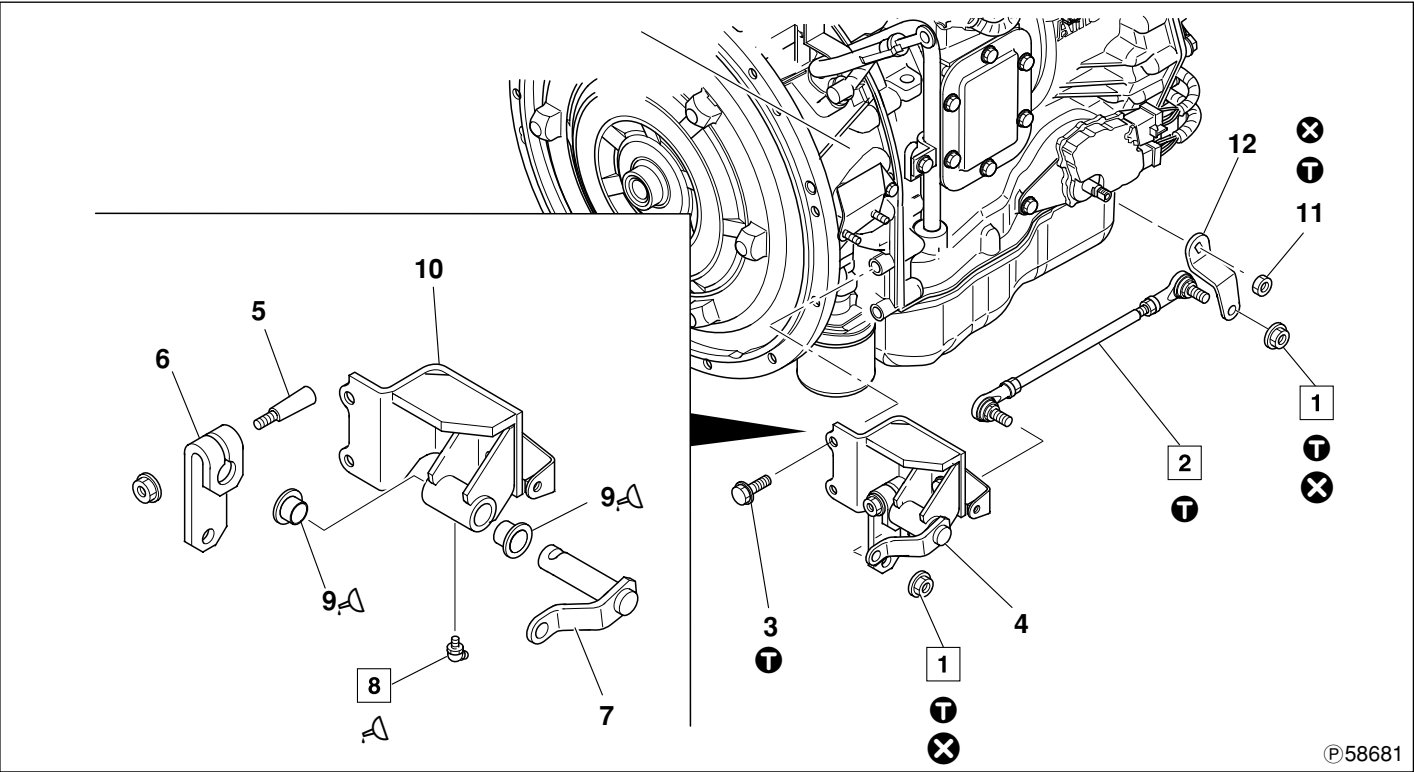
19 Installation of range selector lever A

- Hang roller pin **A** on range selector lever **A 19** diagonally on detent plate groove **B** of set board assembly **20**.
- Push down range selector lever **A 19** while hanging roller pin **A** diagonally, and insert detent pin **C** below in detent plate window **D**.



AUTOMATIC TRANSMISSION CONTROL

Control Lever



Disassembly sequence

- | | |
|--------------------------|--------------------|
| 1 Nut | 6 Control lever |
| 2 Shift rod | 7 Control shaft |
| 3 Bolt | 8 Grease nipple |
| 4 Control lever assembly | 9 Bushing |
| 5 Lock pin | 10 Control bracket |

- 11 Nut
12 Lever

*: Automatic transmission body
X: Non-reusable parts

CAUTION

Do not disassemble lever 12 except for replacement.

Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (shift rod mounting)	39 to 50 {28 to 36, 3.9 to 5.0}	—
2	Tightening of shift rod nut	23 to 28 {17 to 20, 2.3 to 2.8}	—
3	Bolt (control lever assembly mounting)	51 to 61 {38 to 45, 5.2 to 6.2}	—
11	Nut (lever mounting)	20 to 27 {15 to 20, 2.0 to 2.7}	—

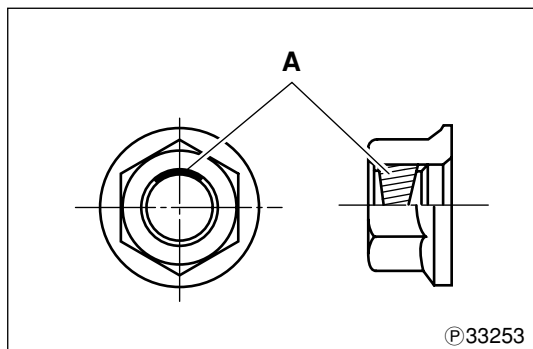
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
8	Greasing from grease nipple	Dow Corning's Molycoat BR2 Plus	As required
9	Inside surface of bushing	Dow Corning's Molycoat BR2 Plus	As required

◆ Service procedure

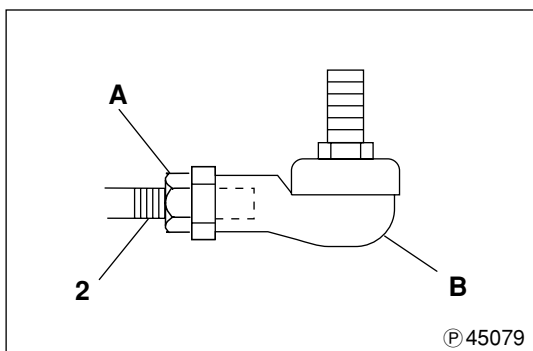
1 Installation of nut

As coating agent adheres to thread **A** of nut **1** for prevention of looseness, check the nut surface treatment (galvanization: black chromating) before installation.



2 Installation of shift rod

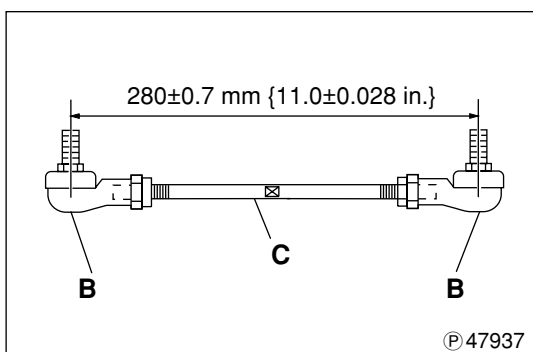
- For nut **A** of shift rod **2**, a plane that is not chamfered must be on ball joint **B** side.



- Turn rod **C** to adjust length of shift rod **2**.

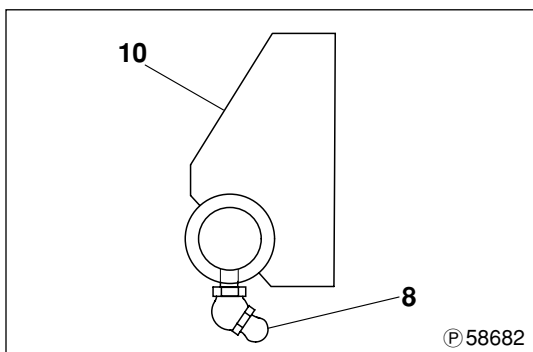
CAUTION ⚠

Screw ball joints **B** into rod **C** evenly on the right and left.

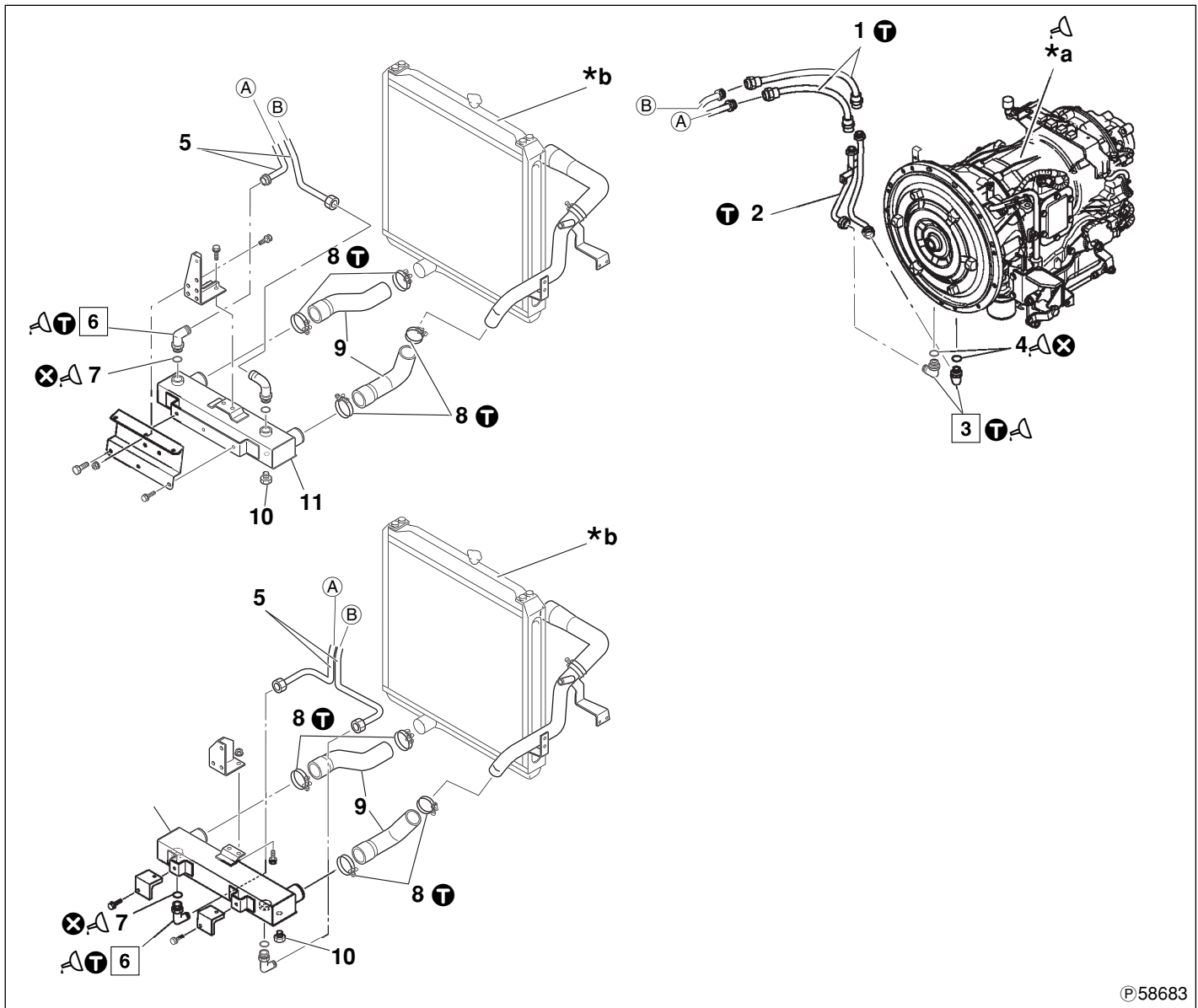


8 Installation of grease nipple

Screw in grease nipple **8** 2 to 4 mm (approx. 3 to 5 turns) to install it in control bracket **10**.



OIL COOLER



● Removal sequence

- | | |
|-------------|--|
| 1 Oil hose | 9 Water hose |
| 2 Oil pipe | 10 Drain plug |
| 3 Connector | 11 Oil cooler |
| 4 O-ring | |
| 5 Oil pipe | *a: Automatic transmission body |
| 6 Connector | *b: Radiator  Gr 14 |
| 7 O-ring | ⊗: Non-reusable parts |
| 8 Clamp | |

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

Be sure to check the quantity of automatic transmission fluid when removing the oil line.  P23-26

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Oil hose	118±10 {87±7.4, 12.0±1.0}	—
2	Oil pipe	51 to 61 {38 to 45, 5.2 to 6.2}	—
3	Tightening of connector locknut	41±6 {30±4.4, 4.2±0.6}	—
6	Tightening of connector locknut	80 {59, 8.2} or less	—
8	Clamp	3.9±0.6 {2.9±0.4, 0.4±0.06}	—

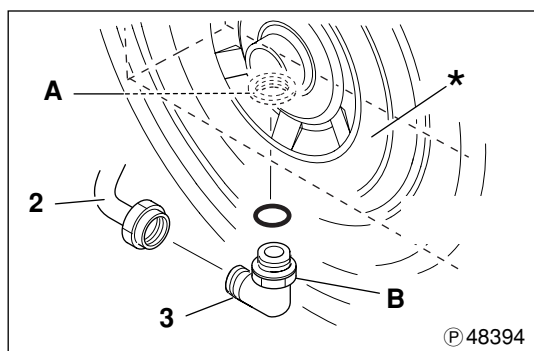
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3, 6	O-ring contact surface of connector	DEXRON III	As required
4, 7	O-ring	DEXRON III	As required
11	O-ring contact surface of oil cooler	DEXRON III	As required
*a	O-ring contact surface of automatic transmission body	DEXRON III	As required

Service procedure

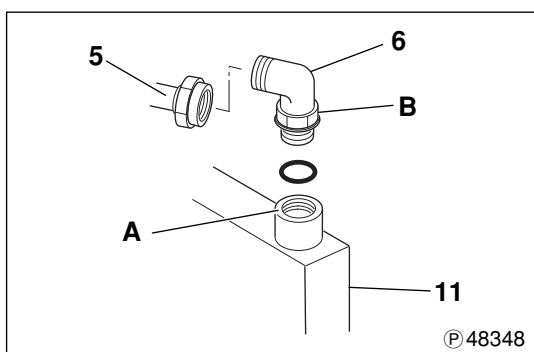
3 Installation of connector

- Screw in connector **3** until it contacts boss surface **A** of automatic transmission body *****.
- Turn connector **3** within one turn in a loosening direction to match with the connection angle with oil pipe **2**.
- Tighten locknut **B** to the specified torque to install.

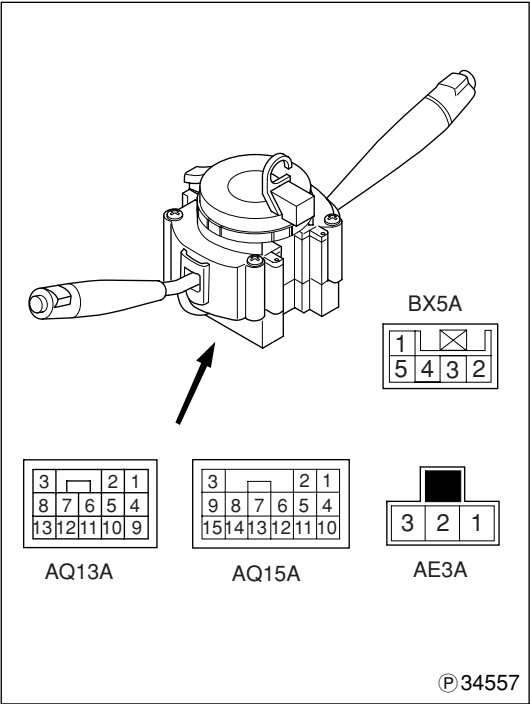


6 Installation of connector

- Screw in connector **6** until it contacts boss surface **A** of oil cooler **11**.
- Turn connector **6** within one turn in a loosening direction to match with the connection angle with oil pipe **5**.
- Tighten locknut **B** to the specified torque to install.



INSPECTION OF ELECTRICAL EQUIPMENT

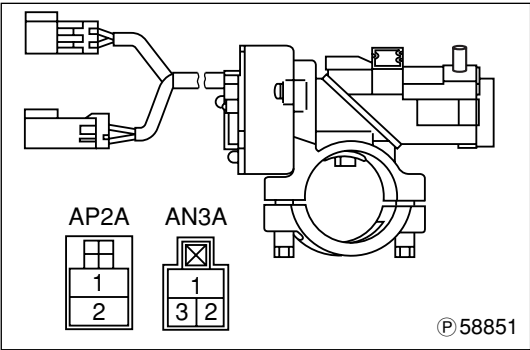


001 Inspection of combination switch

- Check for continuity according to the following table.
There is continuity between ○ and ○ terminals in the table.
- If any abnormality is found, replace the combination switch.

AQ13A connector connection table

		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬
Exhaust brake switch and Powertard switch	Exhaust brake ON	○			○									



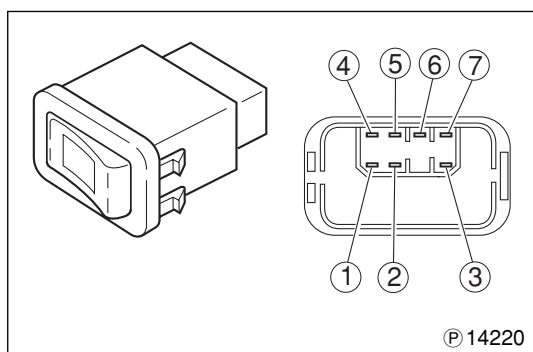
002 Inspection of starter switch

- Check for continuity according to the following table.

		AP2A		AN3A		
		②	①	①	③	②
LOCK	Without key					
	With key					
● (OFF)						
ACC		○		○		
ON		○	○	○	○	
START		○	○	○	○	○
		B	M	A	F/M	S

There is continuity between ○ and ○ terminals.

- If any abnormality is found, replace the starter switch. Gr 37



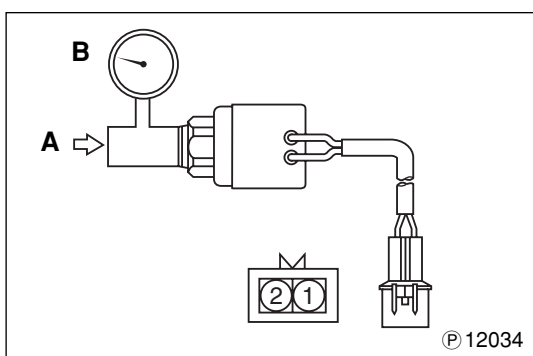
019 Inspection of power mode switch

- Check for continuity according to the following table.

	①	⑥	⑤	⑦	LED (operating illumination)	③	④	LED (night illumination)	②
ON	○	—	○	○	—	○	○	—	○
OFF	○	○					○	○	○

There is continuity between ○ and ○ terminals.

- If any abnormality is found, replace the power mode switch.



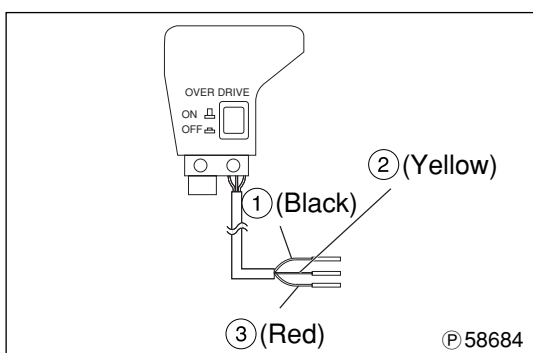
042 Inspection of stop lamp switch

Perform the following inspection. If any abnormality is found, replace the switch.

- Make sure that there is no continuity between terminals ① and ② without air pressure **A** applied to the switch.
- Apply air pressure **A** to the switch gradually from 0 kPa {0 kgf/cm²}. Measure the air pressure when continuity is established across terminals ① and ②, and make sure that the air pressure is within the standard value.

B: Air pressure gauge

Standard value (operating pressure)	29±9.8 kPa {4.2±1.4 psi, 0.3±0.1 kgf/cm ² }
--	--



150 Inspection of overdrive switch

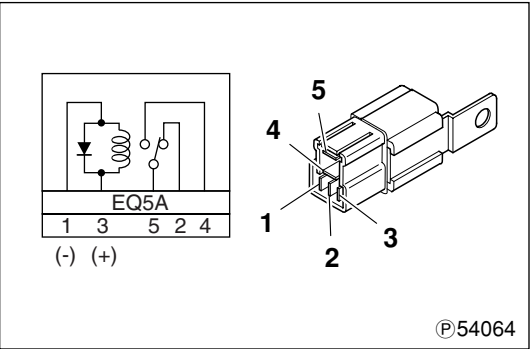
- Check for continuity according to the following table.

	① (Black)	② (Yellow)	③ (Red)
OFF		○	○
ON	○	○	○

There is continuity between ○ and ○ terminals.

- If any abnormality is found, replace the knob and overdrive switch.

INSPECTION OF ELECTRICAL EQUIPMENT



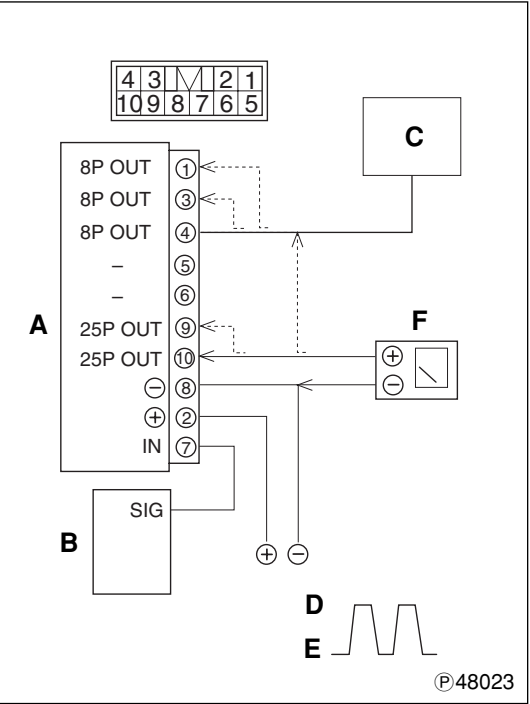
201 Inspection of relay (constantly open type, 5-pin)

- Check for continuity and operation according to the following table.

	①	②	③	④	⑤
No continuity	○		○		○
Continuity exists	⊖		⊕	○	○

There is continuity between ○ and ○ terminals.
12VDC is applied across terminals ⊕ and ⊖.

- If any abnormality is found, replace the relay.



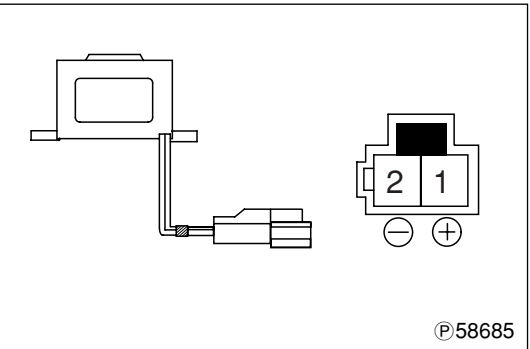
352 Inspection of pulse converter

- Inspect pulse converter A, automatic transmission electronic control unit B and speedometer C while they are installed on the vehicle.
- Turn the starter switch ON, turn the wheel slowly, and measure the maximum value (high pulse voltage D) and the minimum value (low pulse voltage E) of voltage developed between each output terminal (④, ⑨, ⑩) and terminal ⑧ of pulse converter A.

F: Tester

Standard value	8 pulse output	Low pulse voltage	1.0V or below
		High pulse voltage	12V-(0.5V or below)
	25 pulse output	Low pulse voltage	0.5V or below
		High pulse voltage	8±1V

- If the measured value is out of the standard value, replace pulse converter A.

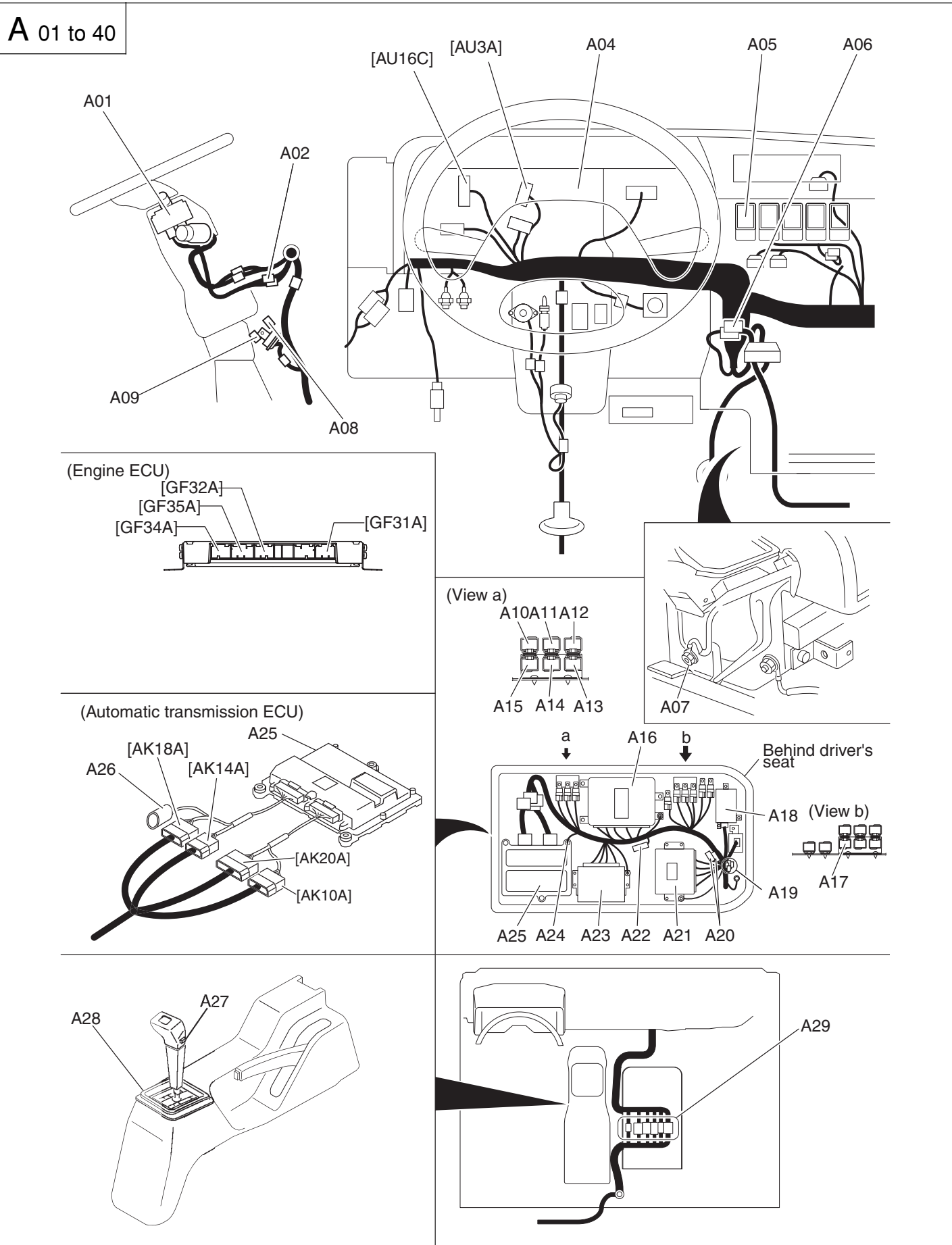


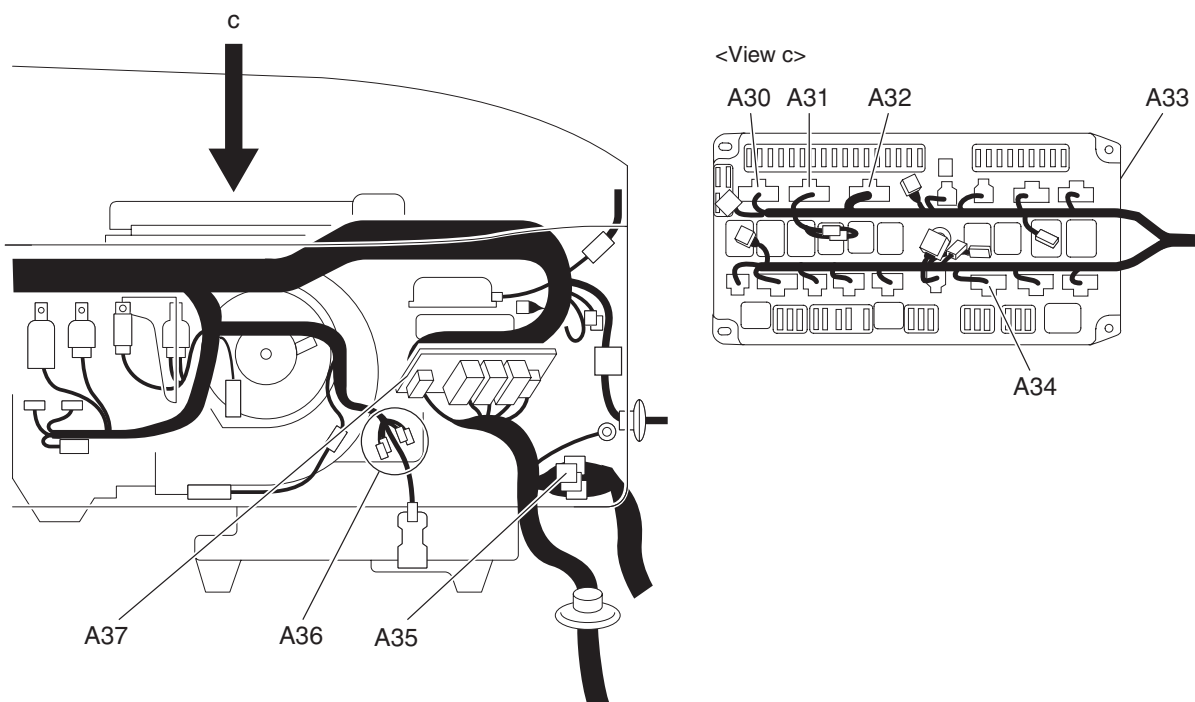
649 Inspection of inhibit buzzer

- Make sure that the inhibit buzzer sounds when a voltage of DC 12V is applied across terminals ① and ②.
- If any abnormality is found, replace the inhibit buzzer.

MEMO

INSTALLED LOCATIONS OF PARTS





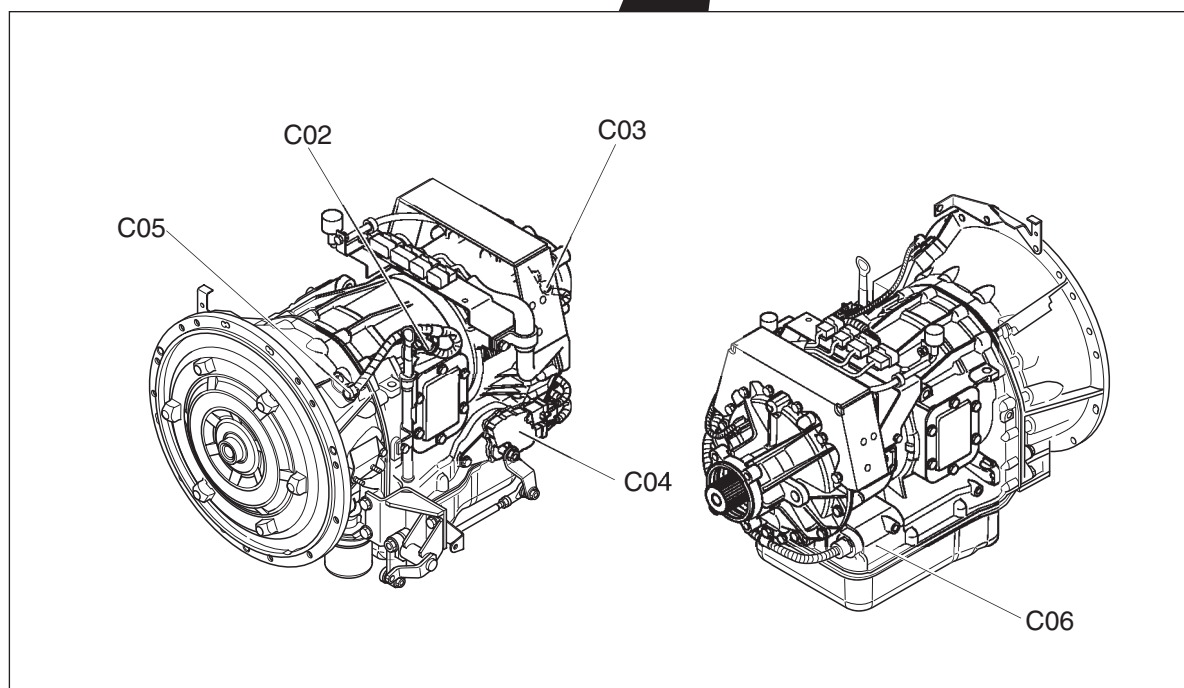
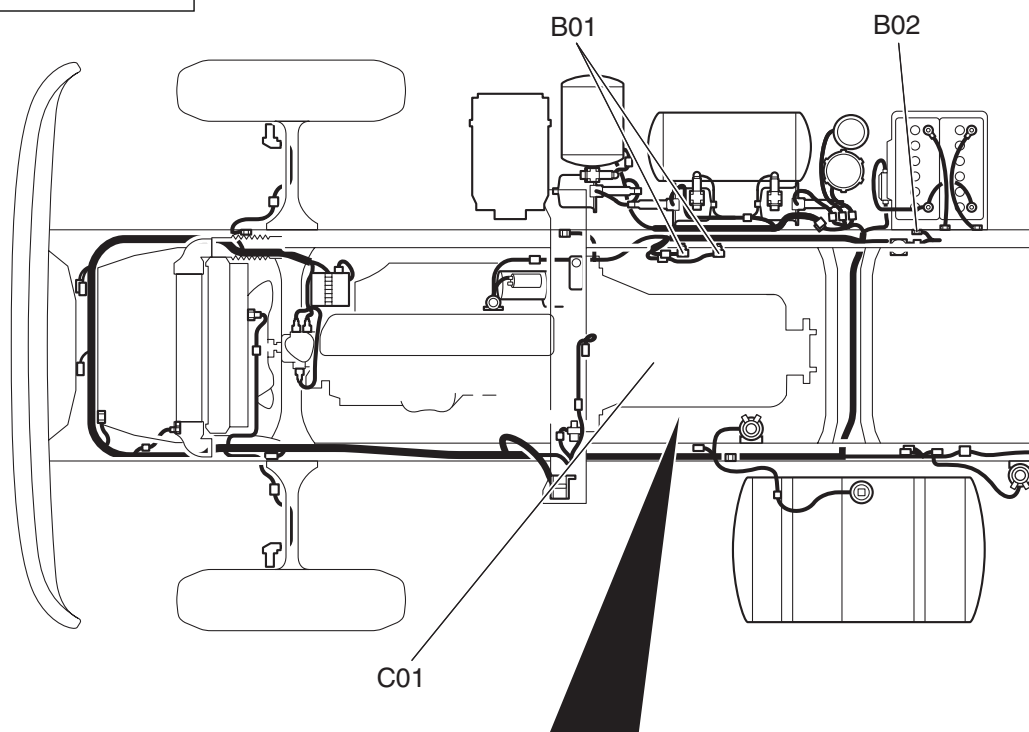
No relevant parts in a missing number

A01 Combination switch
 A02 Connection of cab harness and combination switch harness
 A04 Meter cluster
 A05 Power mode switch
 A06 Connection of cab harness and center floor harness
 A07 Ground
 A08 Inhibit buzzer
 A09 Reverse buzzer
 A10 ABS indicator relay
 A11 A/T ABS activation signal relay
 A12 A/T exhaust brake cut relay
 A13 A/T back lamp relay
 A14 A/T N/P signal reversing relay
 A15 Neutral start relay
 A16 Engine ECU
 A17 Exhaust brake cut relay
 A18 Pulse converter
 A19 Diode unit
 A20 Resistor unit
 A22 Joint connector (J/C-M1)
 A23 ABS ECU
 A24 ECU case ground
 A25 A/T ECU

A26 Diagnosis connector
 A27 Overdrive switch
 A28 Range selector lever
 A29 Connection of cab harness and bed harness
 A30 Connector
 A31 Connector
 A32 Connector
 A33 Relay and fuse box
 A34 Connector
 A35 Connection of bed harness and chassis harness
 A36 Diode unit
 A37 Connecton of cab harness and chassis harness

ABS : Anti-lock brake system
 A/T : Automatic transmission
 ECU : Electronic control unit
 N/P : Neutral/Parking
 Indicate by connector type and color [].
 [connector type : connector color]

B 01 to 03, **C** 01 to 06



No relevant parts in a missing number



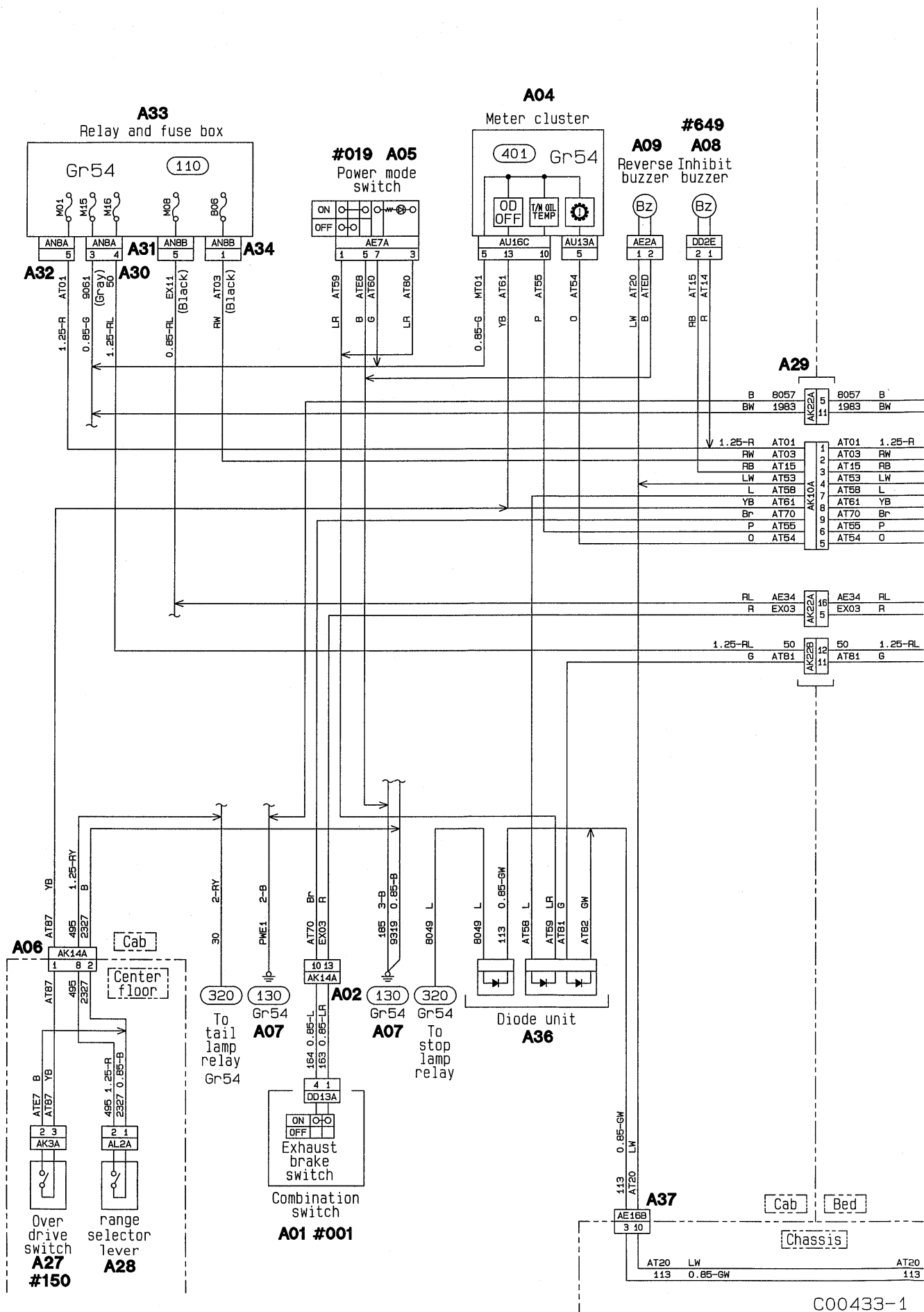
B01 Stop lamp switch
B02 Ground

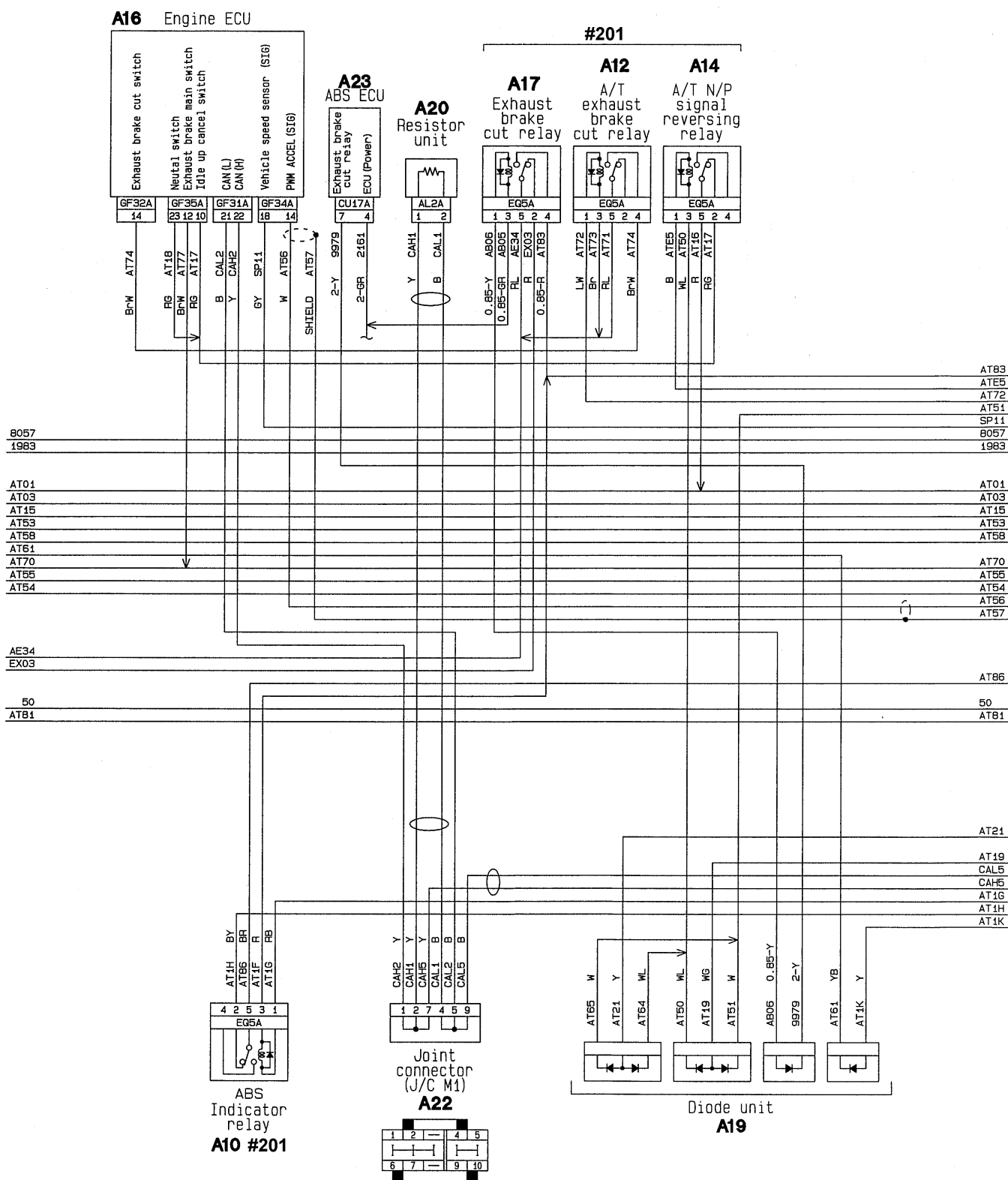


C01 Automatic transmission assembly
C02 Turbine speed sensor
C03 Output speed sensor
C04 Inhibitor switch
C05 Input speed sensor
C06 Solenoid

MEMO

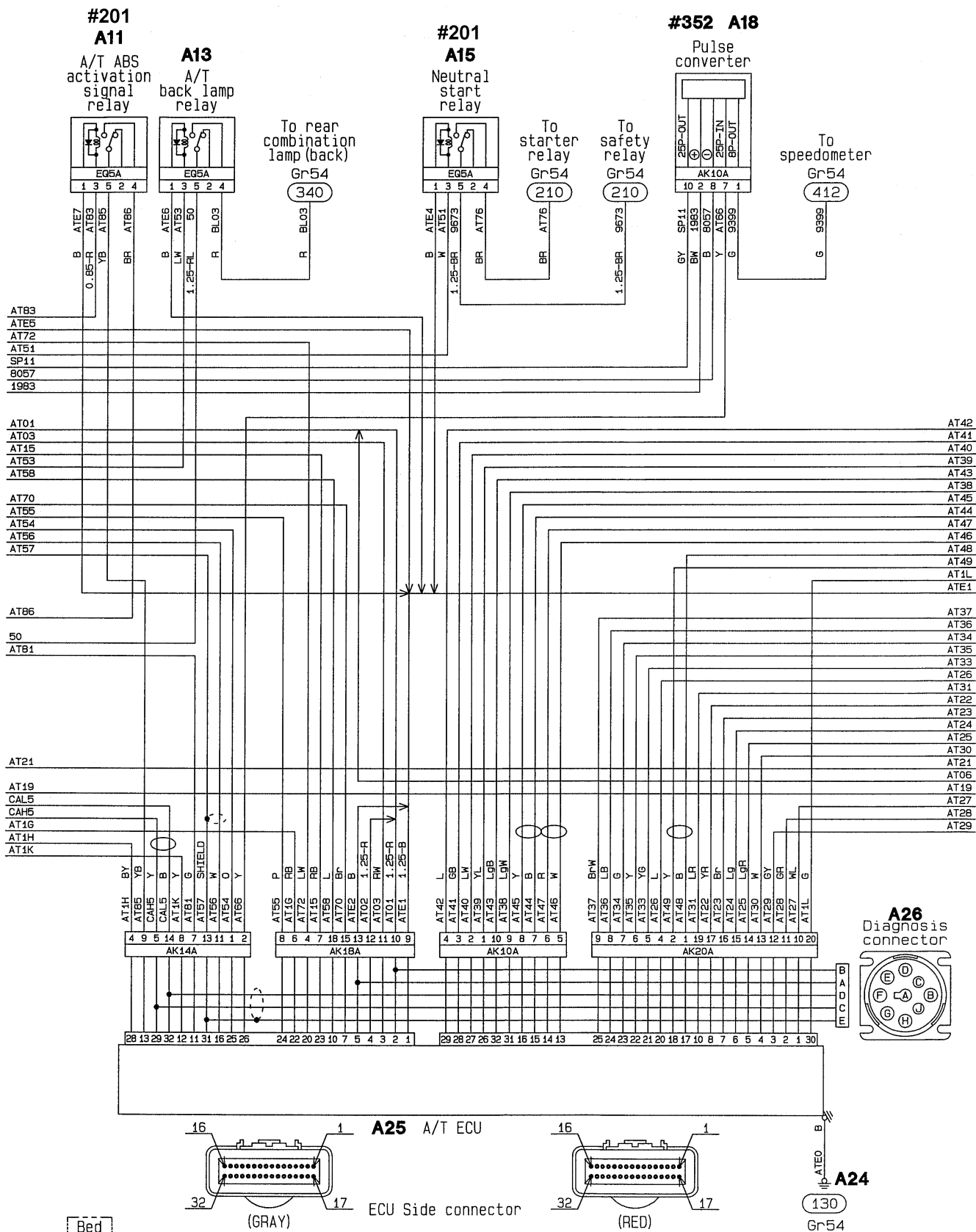
ELECTRIC CIRCUIT DIAGRAM



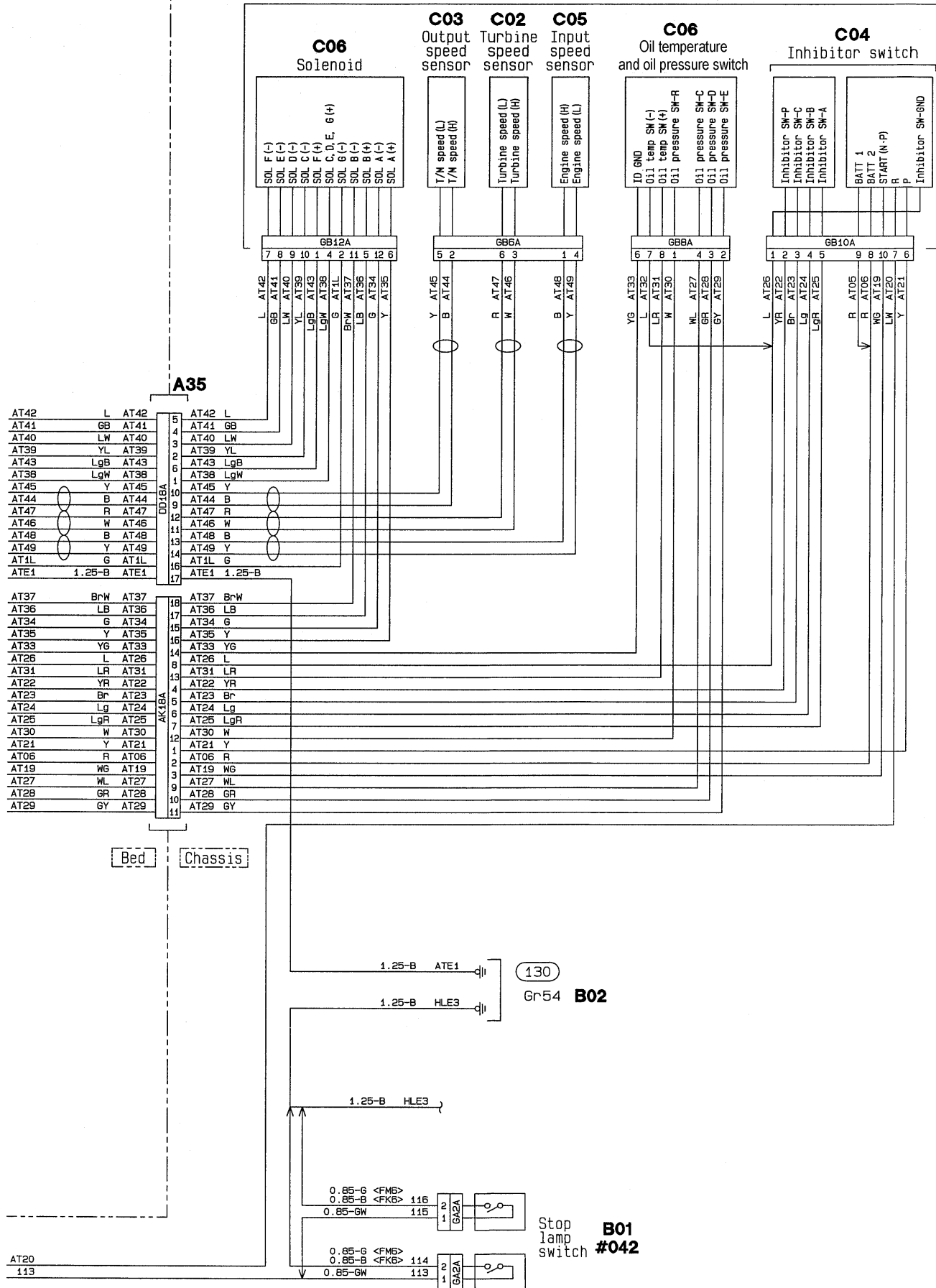


A/T : Automatic transmission
ECU : Electronic control unit
ABS : Anti-lock brake system
N/P : Neutral/Parking
CAN : Control area network

Bed
Chassis



C01 Automatic transmission assembly





Group 23B

Automatic Transmission <M100A6 (Allison MD3060P)>

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	23B- 2
STRUCTURE AND OPERATION	
1. Automatic Transmission Assembly	23B- 4
2. Automatic Transmission Control System	23B- 5
3. Oil Cooler System.....	23B- 6
TROUBLESHOOTING	23B- 7
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Stall Test.....	23B-12
2. Line Pressure Test	23B-13
3. Inspection of Automatic Transmission Fluid	23B-15
4. Replacement of Automatic Transmission Fluid	23B-16
5. Level Check of Automatic Transmission Fluid.....	23B-18
6. Replacement of Oil Filter	23B-19
OIL COOLER	23B-20
INSTALLED LOCATIONS OF PARTS	23B-22
ELECTRIC CIRCUIT DIAGRAM.....	23B-26

SPECIFICATIONS

AUTOMATIC TRANSMISSION MAJOR SPECIFICATIONS

Item			M100A6
Torque cinverter	Type		3-element, 1-stage, 2-phase
	Stall torque ratio		2.35
Transmission	Type		Planetary gear type 6 forward speeds and 1 reverse speed
	Gear ratio	1st	3.487
		2nd	1.846
		3rd	1.409
		4th	1.000
		5th	0.750
		6th	0.652
		Rev	5.027
Range selector pattern			R – “N” – D – 5 – 4 – 3 – 2 – 1 Engine can be started in N position only.
Automatic transmission fluid	Specified lubricant and/or sealant		DEXRON III
	Fluid quantity	Main unit dm ³ {L}	27 {27}
		Overall system dm ³ {L}	31 {31}
Mass of automatic transmission assembly kg			310

VEHICLE SPEED AT GEAR SHIFT (D RANGE) Unit: km/h {mph} (rpm)

Unit: km/h {mph} (rpm)

Operating of accelerator	Mode switch position Gearshift	Normal	Power
8/8	1 → 2	15 {10} (540)	17 {11} (600)
	2 → 3	37 {23} (1270)	41 {26} (1440)
	3 → 4	49 {30} (1700)	55 {34} (1920)
	4 → 5	70 {43} (2430)	78 {49} (2730)
	5 → 6	94 {58} (3270)	105 {65} (3670)
4/8	1 → 2	15 {10} (540)	17 {11} (600)
	2 → 3	29 {18} (990)	32 {20} (1120)
	3 → 4	37 {23} (1300)	43 {26} (1480)
	4 → 5	50 {31} (1730)	57 {35} (1970)
	5 → 6	71 {44} (2460)	79 {49} (2760)
0/8	6 → 5	68 {42} (2380)	77 {48} (2680)
	5 → 4	40 {25} (1400)	42 {26} (1450)
	4 → 3	30 {19} (1050)	31 {19} (1090)
	3 → 2	21 {13} (750)	22 {14} (770)
	2 → 1	9 {5} (300)	9 {5} (300)

LOCK-UP POINT

Unit: km/h {mph} (rpm)

Operating of accelerator	Mode switch position Gearshift	Normal	Power
8/8	2C – L	26 {16} (900)	29 {18} (1010)
4/8	2C – L	22 {13} (750)	24 {15} (850)
0/8	L → 2C	15 {10} (540)	15 {10} (540)

Note: Lock-up point is always set for the gear exceeding the 3rd.

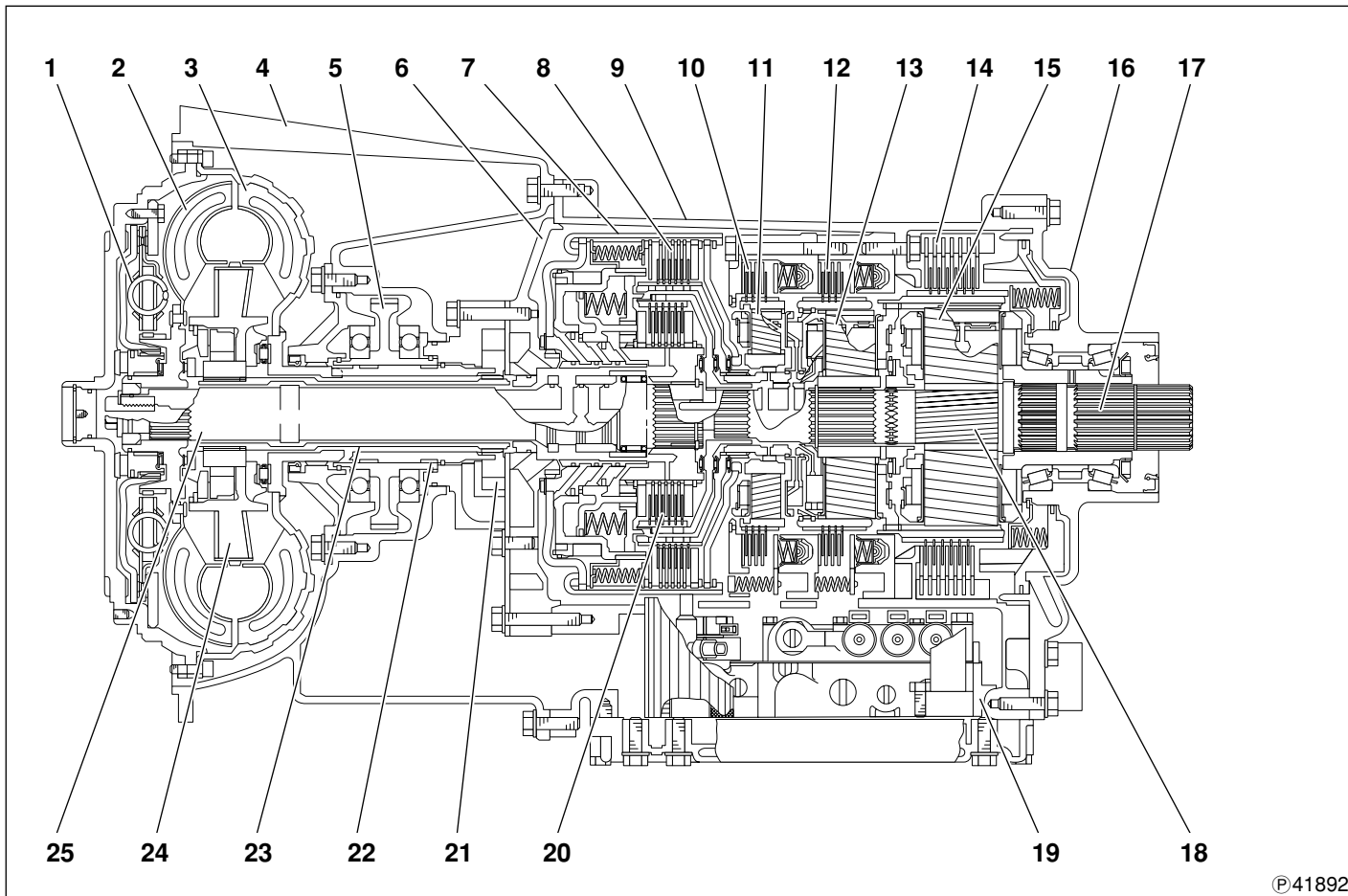
- Revolutions shown in brackets indicates revolutions of transmission.
- The numerical value indicated in Table is calculated for vehicles set with the diff ratio of 6.666 and fitted with 11R22.5 tires. When the diff ratio or the tire size for vehicles is different, the speed of the vehicles varies based on such deviation. So, convert the numerical value in Table based on the applied specifications.

REPLACEMENT INTERVALS OF AUTOMATIC TRANSMISSION FLUID AND OIL FILTER ELEMENT

Location	Replacement intervals	Specified lubricant and/or sealant
Automatic transmission fluid	40000km or 1.5 years	DEXRON III
Oil filter element	8000km for new vehicle, 40000km or 1.5 years	—

STRUCTURE AND OPERATION

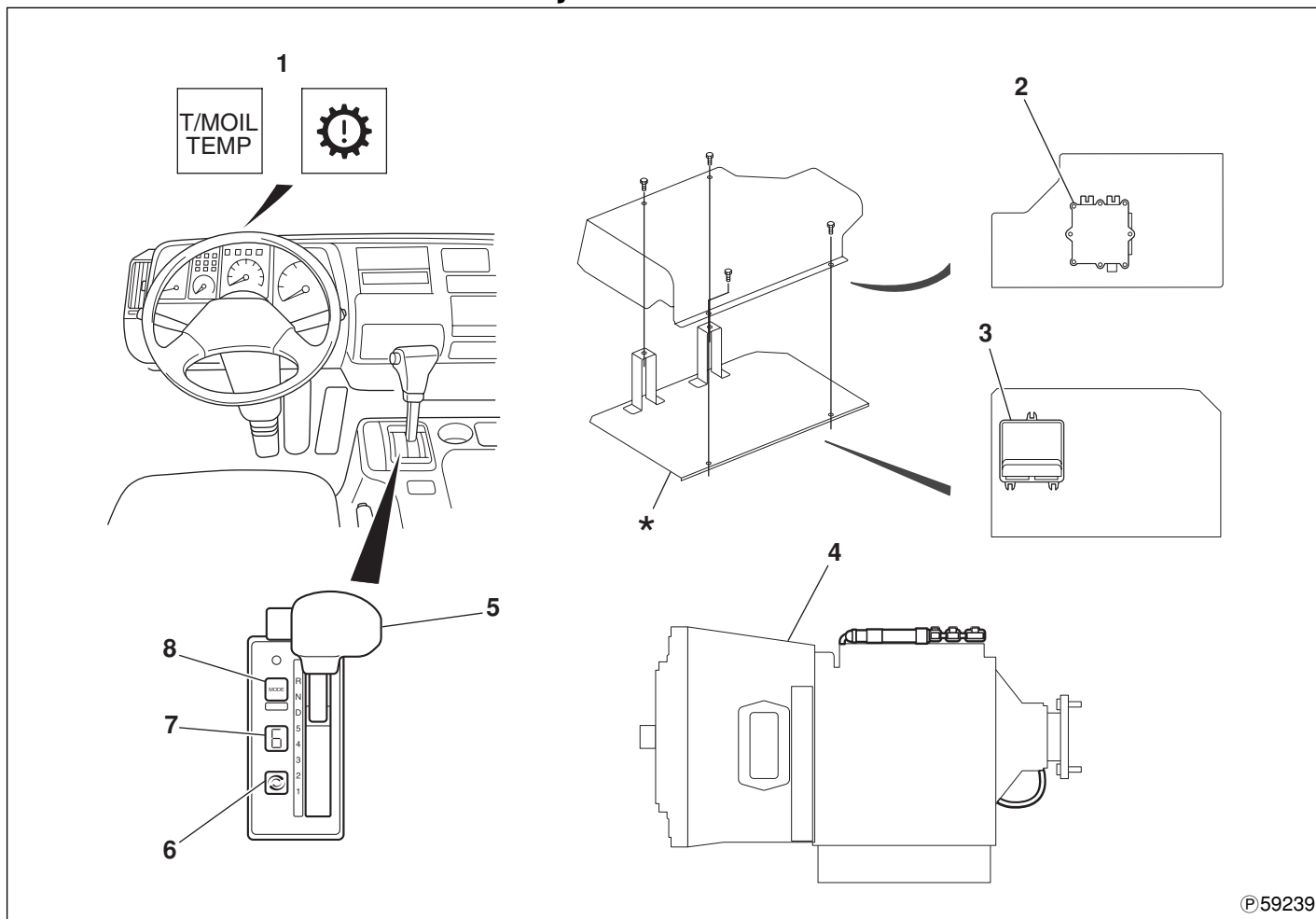
1. Automatic transmission assembly



©41892

- | | |
|--------------------------------------|----------------------------------|
| 1 Lock-up clutch/dumper | 14 C5 clutch |
| 2 Torque converter turbine | 15 P3 planetary module |
| 3 Torque converter pump | 16 Rear cover module |
| 4 Torque converter housing | 17 Output shaft |
| 5 Power take-off (PTO) gear assembly | 18 Main shaft |
| 6 Front support | 19 Control valve module |
| 7 Rotation clutch module | 20 C1 clutch |
| 8 C2 clutch | 21 Hydraulic fluid charging pump |
| 9 Main housing | 22 Charging pump drive hub |
| 10 C3 clutch | 23 Ground sleeve |
| 11 P1 planetary module | 24 Torque converter stator |
| 12 C4 clutch | 25 Turbine shaft |
| 13 P2 planetary module | |

2. Automatic transmission control system



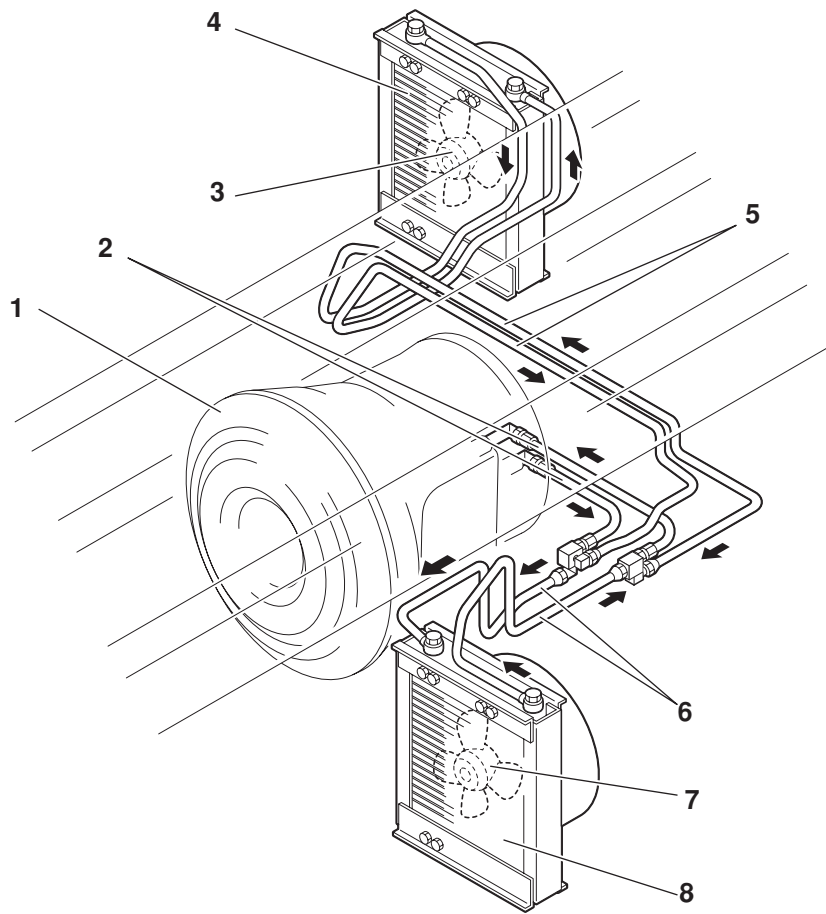
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- | | |
|--|---------------------------|
| 1 Warning lamp | 6 Display switch button |
| 2 Vehicle interface schedule | 7 Select position display |
| 3 Automatic transmission electronic control unit | 8 Mode button |
| 4 Automatic transmission assembly | |
| 5 Range selector | * Back of driver's seat |

Electronic control (ATEC: Allison Transmission Electronic Control) system is composed of vehicle interface module **2**, automatic transmission electronic control unit **3**, range selector **5**, throttle position sensor, electronic hydraulic valve body, and harnesses connecting these units. The automatic transmission electronic control unit receives electric signals, which are sent by each sensor and shift selector, processes them, transmits the signals to an appropriate solenoid, and thereby controls the transmission.

STRUCTURE AND OPERATION

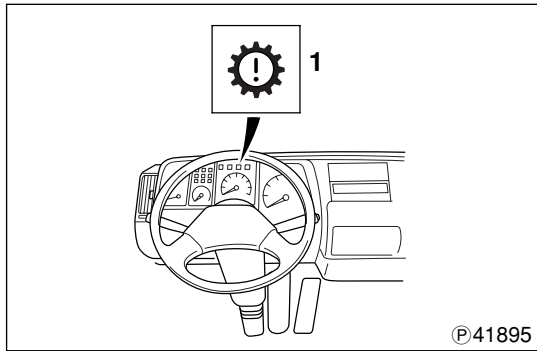
3. Oil cooler system



© 58794

- 1 Automatic transmission assembly
- 2 Oil hose
- 3 Blower assembly (RH)
- 4 Oil cooler (RH)

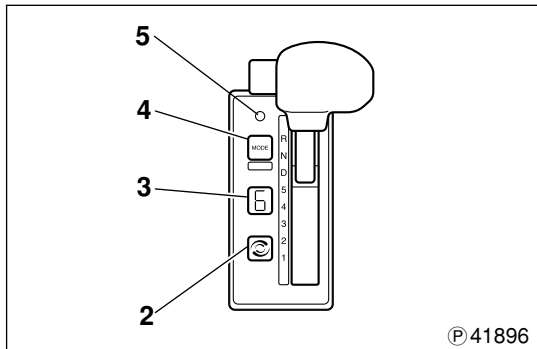
- 5 Oil pipe
- 6 Oil pipe
- 7 Blower assembly (LH)
- 8 Oil cooler (LH)



This automatic transmission is equipped with trouble self-diagnosis function. When detecting abnormality, the function displays occurrence of troubles on warning lamp **1**, as well as memorizes the trouble code No. in the memory. Trouble code No. is memorized to the maximum five (5).

Start of trouble mode (reading trouble code No.)

- Push display switch button **2** of range selector twice.
- Trouble code No. is indicated in select position display **3**. If "OL" is indicated, push the display switch button **2** again.
- Record the trouble code No. that is indicated.
For instance, if indicated in order of "d1", "25", and "11", it shows that main code No. 25 and sub code No. 11 are memorized in the 1st memory. When nothing is recorded, "--" "--" is repeatedly displayed in sequence.
- There are five (5) memories that memorize the code No. When pushing mode button **4**, the 2nd memory code is displayed following "d2".
- Whenever pushing mode button **4**, "d3", "d4", and "d5" are displayed in sequence, and finally "d1" is indicated back.



Clearing of diagnosis trouble code No.

After the repair is completed and mode button **4** is pushed for about 10 seconds, mode lamp **5** will flash for the first 5 seconds and the current malfunction code is cleared. After waiting another 5 seconds, the mode lamp will flash again and the past malfunction codes are cleared.

NOTE

The code No. is cleared only after if the trouble is repaired.

Release of diagnosis mode (returning to normal operation mode)

There are the following three (3) methods to return it to normal operation mode.

- Push the display switch button **2** of range selector.
- Switch it to either range of either range, "Reverse", "Neutral", or "Drive".
- Leave things as they are without doing anything (being automatically released in approximately ten (10) minutes).

TROUBLESHOOTING

Trouble self-diagnosis Table

CAUTION

If finding out code No. that is not indicated in the trouble self-diagnosis Table; contact to GM Allison.

Code No.		Symptoms	Inspection and adjustment
Main	Sub		
13	12 13 23	Automatic transmission electronic control unit voltage: too low Automatic transmission electronic control unit voltage: low Automatic transmission electronic control unit voltage: high	1. Looseness or dirtiness of power supply and earth cable connections 2. Decrease of battery capacity 3. Abnormal charge system of vehicle 4. Blowout of vehicle interface module fuse 5. Connections of vehicle interface module connector 6. Abnormal vehicle-side wirings 7. Connections of automatic transmission electronic control unit connector 8. If corresponding items not available, contact to GM Allison Service.
14	12, 13	Oil level sensor	1. Operation of speed sensor (engine/output), temperature sensor, and level sensor 2. Disconnection or short-circuit of harnesses 3. If corresponding items not available, contact to GM Allison Service.
21	12, 13	Throttle position sensor	1. Connections of throttle position sensor connector 2. Method installing throttle position sensor cables 3. Idling return of control rod of electronic governor 4. Stroke of throttle position sensor cable 5. Disconnection or short-circuit of throttle position sensor harnesses 6. Replace throttle position sensor assembly 7. If corresponding items not available, contact to GM Allison Service.
22	14, 15, 16	Speed sensor	1. Connections of sensor connector 2. Installation looseness of sensor assembly 3. Disconnection or short-circuit of harnesses 4. If corresponding items not available, contact to GM Allison Service.
23	12, 13, 14, 15	Range selector	1. Connections of automatic transmission electronic control unit connector 2. Remedy of range selector connections or jump wires 3. Disconnection or short-circuit of range selector harnesses 4. Replacement of range selector assembly 5. If corresponding items not available, contact to GM Allison Service.
24	12	Temperature of automatic transmission fluid: too low	1. Outside air temperature: -32°C {-0.9°F} or less 1) Really low: if temperature rises, it is repaired. 2) Not low: connections of automatic transmission electronic connector 2. Connections of automatic transmission electronic control unit connector 3. If corresponding items not available, contact to GM Allison Service.

Code No.		Symptoms	Inspection and adjustment
Main	Sub		
13	23	Temperature of automatic transmission fluid: too high	1. Check oil level after operating the cooled unit 2. Result of automatic transmission fluid level check 1) Abnormal level; Adjust excess and deficiency 2) Normal level; Inspect the cooling system of engine 3. Inspect connections of automatic transmission electronic control unit and automatic transmission connector 4. If corresponding items not available, contact to GM Allison Service.
25	00, 11, 22, 33, 44, 55, 66, 77	Output speed sensor	1. Connections of sensor connector 2. Connections of automatic transmission electronic control unit connector 3. Check automatic transmission fluid level 4. Installation looseness of sensor 5. Disconnection or short-circuit of sensor harnesses 6. If corresponding items not available, contact to GM Allison Service.
32	00, 33, 55, 77	Disconnection of C3 pressure switch	1. Inspect automatic transmission level 2. Connections of automatic transmission connector 3. Connections of automatic transmission electronic control unit connector 4. Disconnection or short-circuit of automatic transmission harnesses 5. If corresponding items not available, contact to GM Allison Service.
33	12, 13	Faulty automatic transmission fluid temperature sensor	1. Connections of automatic transmission connector 2. Connections of automatic transmission electronic control unit connector 3. Disconnection or short-circuit of harnesses 4. If corresponding items not available, contact to GM Allison Service.
34	12, 13, 14, 15, 16	Faulty EEPROM (memory chip)	Contact to GM Allison Service.
35	00, 16	Temporary interruption of power supply EEPROM writing error	1. Connections of automatic transmission electronic control unit connector 2. Connections of vehicle interface module connector 3. Vehicle-side interface wirings 4. Do power supply and ground connect the battery directly? 5. Wiring and connection from ignition switch 6. If corresponding items not available, contact to GM Allison Service.
36	00	Unmatched hardware/software	Contact to GM Allison Service.
41	12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26	Disconnection or short-circuit of solenoid line	1. Connections of automatic transmission connector 2. Connections of automatic transmission electronic control unit connector 3. Damaged or broken harnesses 4. Disconnection or short-circuit of harnesses 5. Replace wiring harnesses 6. If corresponding items not available, contact to GM Allison Service.

TROUBLESHOOTING

Code No.		Symptoms	Inspection and adjustment
Main	Sub		
42	12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26	Short-circuit of solenoid-circuit battery	1. Connections of automatic transmission connector 2. Connections of automatic transmission connector 3. Damaged or broken harnesses 4. Disconnection or short-circuit of harnesses 5. Wrong remodeling 6. Replace harnesses 7. If corresponding items not available, contact to GM Allison Service.
43	21, 25, 26	Solenoid Lo side circuit Disconnection or short-circuit	1. Connections of automatic transmission connector 2. Connections of electronic control unit connector 3. Disconnection or short-circuit of harnesses 4. Replace electronic control unit 5. If corresponding items not available, contact to GM Allison Service.
42	12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26	Short-circuit of solenoid circuit ground	1. Connections of automatic transmission connector 2. Connections of electronic control unit connector 3. Disconnection or short-circuit of harnesses 4. If corresponding items not available, contact to GM Allison Service.
42	12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26	Disconnection of solenoid circuit	1. Connections of automatic transmission connector 2. Connections of electronic control unit connector 3. Disconnection of harnesses 4. If corresponding items not available, contact to GM Allison Service.
51	01, 10, 12, 21, 23, 24, 35, 42, 43, 45, 46, 53, 64, 65	Off going ratio test	1. Connections of speed sensor (output/turbine) 2. Disconnection or short-circuit of sensor harnesses 3. Inspect automatic transmission fluid level 4. If corresponding items not available, contact to GM Allison Service.
52	01, 08, 32, 34, 54, 56, 71, 72, 78, 79, 99	C3 switch off test	1. Connections of speed sensor (output/turbine) 2. Disconnection or short-circuit of sensor harnesses 3. Disconnection or short-circuit of harnesses 4. Inspect automatic transmission fluid level 5. If corresponding items not available, contact to GM Allison Service.
53	08, 18, 28, 29, 38, 39, 48, 49, 58, 59, 68, 69, 78, 99	Off going speed test	1. Connections of speed sensor (turbine/engine) 2. Disconnection or short-circuit of sensor harnesses 3. Inspect automatic transmission fluid level 4. If corresponding items not available, contact to GM Allison Service.
54	01, 07, 10, 12, 17, 21, 23, 24, 27, 32, 34, 35, 42, 43, 45, 46, 53, 54, 56, 64, 65, 70, 71, 72, 80, 81, 82, 83, 85, 86, 92, 93, 95, 96, 97	On camming ratio test	1. Connections of speed sensor (turbine/output) 2. Disconnection or short-circuit of sensor harnesses 3. Inspect automatic transmission fluid level 4. Conform with specifications for EEPROM calibration. 5. If corresponding items not available, contact to GM Allison Service.

Code No.		Symptoms	Inspection and adjustment
Main	Sub		
55	17, 27, 87, 97	C3 switch on test	1. Inspect automatic transmission fluid level 2. Connections of speed sensor (turbine/output) 3. Disconnection or short-circuit of sensor harnesses 4. Connections of automatic transmission connector 5. Connections of automatic transmission electronic control unit connector 6. Disconnection or short-circuit of C3 switch circuit 7. If corresponding items not available, contact to GM Allison Service.
56	00, 11, 22, 33, 44, 55, 66, 77	Range check test	1. Connections of speed sensor (output/turbine) 2. Disconnection or short-circuit of sensor harnesses 3. Connections of automatic transmission connector 4. Connections of automatic transmission electronic control unit connector 5. Inspect automatic transmission fluid level 6. If corresponding items not available, contact to GM Allison Service.
57	11, 22, 44, 66, 88, 99	Range check test: C3 switch	1. Inspect automatic transmission fluid 2. Connections of speed sensor (turbine/output) 3. Disconnection or short-circuit of sensor harnesses 4. Connections of automatic transmission connector 5. Connections of automatic transmission electronic control unit connector 6. Disconnection or short-circuit of C3 switch circuit 7. If corresponding items not available, contact to GM Allison Service.
63	00, 26, 40	Faulty input function	1. Disconnection, short-circuit or faulty contact of wiring, switch, and connector 2. If corresponding items not available, contact to GM Allison Service.
65	00	Engine rating: too high	1. Exceeding the engine rating or maximum speed 2. If corresponding items not available, contact to GM Allison Service.
66	00	Faulty SCI interface	1. Connections of SCI connector 2. Disconnection or short-circuit of SCI wiring 3. Connections of automatic transmission electronic control unit connector 4. If corresponding items not available, contact to GM Allison Service.
69	12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 32, 33, 34, 35, 36, 41	Trouble of automatic transmission electronic control unit	1. Clear the code and restart the engine 2. If corresponding items not available, contact to GM Allison Service.

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Stall test

● Purpose

“Stall test” checks the friction element in transmission, slide of one-way clutch in torque converter, operation of torque converter, or overall performance of the engine; thereby investigates the cause when the vehicle is malfunctioned due to insufficient power, performance, or others.

● Measurement procedure

Before starting the test, check the cooling water and oil of the engine, and automatic transmission fluid level of automatic transmission. Also, conduct sufficient warm-up operation of the engine and transmission.

- Fit the chocks securely at the front (rear) of the front (rear) wheels and engage the parking brake to prevent the vehicle from moving. In addition, when pushing the accelerator pedal down, depress the foot brake strongly.
- Start the engine and engage the range selector lever into D range.
- Push the accelerator pedal down slowly to the full acceleration; when the engine comes into a stable speed at a constant speed, read the revolutions (the stall revolutions) quickly, and then take off the foot from the accelerator pedal.

CAUTION

- **Be sure to set a full stall acceleration time as less than 5 seconds, and complete the measurement during that time.**
 - **Be careful for overheating of the engine and transmission.**
-

- Put the range selector lever in “N” range, and conduct the cooling for two (2) minutes or more per 1000 rpm.

Stall revolutions

1723±150 rpm

● Result of diagnosis

1. In case the stall revolution is too low; if the result of measurement is lower by 150 rpm or more than the standard value, the engine will be malfunctioned.
2. In case the stall revolution is abnormally low (approximately 1/3 of the specified value) even though the engine has no any trouble like emitting black smoke; there may be some abnormality inside the torque converter (one-way clutch failure).
3. In case the stall revolution is too high; if the result of measurement is higher by 150 rpm or more than the standard value, the cause may be due to the slide inside the transmission, cavitations, the bubbling of automatic transmission fluid, or damage of the torque converter.

2. Line pressure test

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
—	Plug	10 to 13 {7.2 to 9.4, 1.0 to 1.3}	—

● Purpose

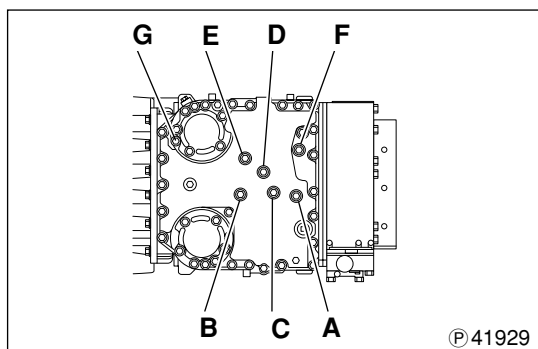
“Line pressure test” checks the performance of oil pump, function of control valve, and the oil leaking of each component.

● Measurement procedure

Decide the pressure item to check according to the content of troubles, and measure the line pressure based on the following procedure.

- Remove the plug from the pressure detecting port of the gearbox casing, and install the pressure gauge.

- A** : Main oil pressure
- B** : C1 clutch oil pressure
- C** : C2 clutch oil pressure
- D** : C3 clutch oil pressure
- E** : C4 clutch oil pressure
- F** : C5 clutch oil pressure
- G** : Lock-up oil pressure



- Conduct a sufficient warm-up operation, and raise oil temperature to 60 to 80°C {140 to 176°F}.
- During the idling, measure the oil pressure in each condition when running, and make sure whether the result is within the standard value.
- When making sure the lock-up pressure, remove the propeller shaft, and conduct it in a dummy running condition.
- When having finished the measurement, tighten the plug with the specified torque.

CAUTION ⚠

- Be sure to prevent foreign particles from entering the pressure detecting port.
- Remove foreign particles in the pressure detection port before installing the plug.

ON-VEHICLE INSPECTION AND ADJUSTMENT

	Engine speed rpm	Range	Pressure clutch	Main oil pressure KPa {psi, kgf/cm ² }	Clutch oil pressure KPa {psi, kgf/cm ² }	Lock-up clutch oil pressure KPa {psi, kgf/cm ² }
Oil pressure when idling the engine	580-620	Neutral	C5	1400 to 2000 {203 to 290, 14.3 to 20.4}	—	—
		Reverse	C3, C5	1400 to 2000 {203 to 290, 14.3 to 20.4}	—	—
		1C	C1, C5	1300 to 1970 {189 to 286, 13.3 to 20.1}	—	—
		2C	C1, C4	1300 to 1970 {189 to 286, 13.3 to 20.1}	—	—
Oil pressure when operating	1980-2020	Neutral	C5	1900 to 2300 {275 to 334, 19.4 to 23.5}	1860 to 2300 {270 to 334, 19.0 to 23.5}	—
		Reverse	C3, C5	1790 to 2300 {261 to 334, 18.3 to 23.5}	1760 to 2300 {255 to 334, 18.0 to 23.5}	—
		1C	C1, C5	1550 to 1970 {225 to 286, 15.8 to 20.1}	1480 to 1970 {215 to 286, 15.1 to 20.1}	—
		2C	C1, C4	1550 to 1970 {225 to 286, 15.8 to 20.1}	1480 to 1970 {215 to 286, 15.1 to 20.1}	—
		2L	C1, C4	1050 to 1400 {152 to 203, 10.7 to 14.3}	980 to 1400 {142 to 203, 10.0 to 14.3}	1000 to 1400 {145 to 203, 10.2 to 14.3}
		3L	C1, C3	1050 to 1400 {152 to 203, 10.7 to 14.3}	980 to 1,400 {142 to 203, 10.0 to 14.3}	1000 to 1400 {145 to 203, 10.2 to 14.3}
		4L	C1, C2	1050 to 1400 {152 to 203, 10.7 to 14.3}	980 to 1400 {142 to 203, 10.0 to 14.3}	1000 to 1400 {145 to 203, 10.2 to 14.3}
		5L	C2, C3	1000 to 1350 {145 to 196, 10.2 to 13.8}	930 to 1350 {135 to 196, 9.5 to 13.8}	950 to 1350 {138 to 196, 9.7 to 13.8}
		6L	C2, C4	1000 to 1350 {145 to 196, 10.2 to 13.8}	930 to 1350 {135 to 196, 9.5 to 13.8}	950 to 1350 {138 to 196, 9.7 to 13.8}

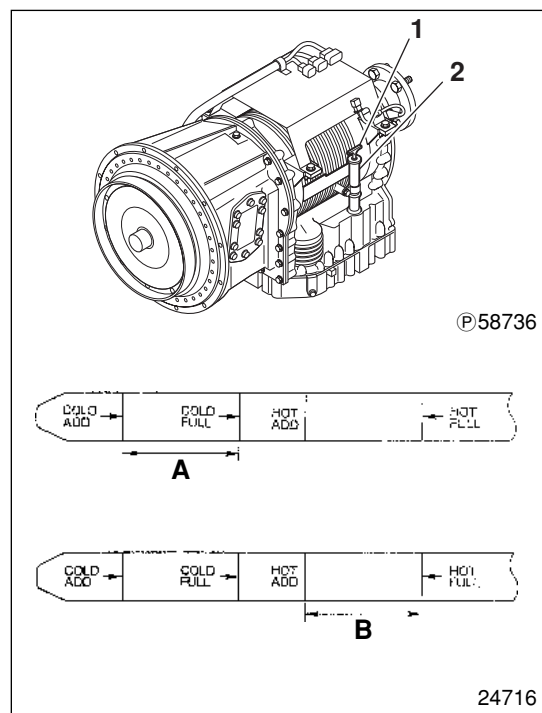
LU: Lock-up
 C: In torque converter
 L: In lock-up

Result of diagnosis

- In case the main oil pressure is low in all ranges:
 - ATF level; too low
 - Filter Element; clogged
 - Suction filter; clogged
 - Main oil pressure regulator valve; adhered, and the spring; weakening or broken
 - Inside of control module; leaked
 - Oil pump; worn or broken
- In case the oil pressure is low in the specific ranges (each clutch oil pressure):
 - If C1 clutch pressure is low; may cause slide or judder at 1st, 2nd, 3rd, or 4th gear.
 - If C2 clutch pressure is low; may cause slide or judder at 4th, 5th, or 6th gear.
 - If C3 clutch pressure is low; may cause slide or judder at 3rd, 5th, or Rev. gear.

- If C4 clutch pressure is low; may cause slide or judder at 2nd, or 6th gear.
- If C5 clutch pressure is low; may cause slide or judder at 1st or Rev. gear.
- If the lock-up clutch pressure is low; the speed extension of vehicle at 2nd or more gear (in lock-up) may be decreased. Or, the shift will not be performed as it is a shift map.

3. Inspection of automatic transmission fluid



(1) Inspection of properties

If having a burnt smell of automatic transmission fluid or finding out some worn particles of metal or friction materials, it is necessary to overhaul the transmission completely. Check automatic transmission fluid adhering to a level gauge **1** carefully. If there are some doubts in a state of automatic transmission fluid, check the automatic transmission fluid again by it extracting its sample.

(2) Inspection of quantity of automatic transmission fluid

- Put the vehicle on a flat place, engage the parking brake surely, and fit the chokes securely at the front (rear) of the front (rear) wheels
- To fill automatic transmission fluid in a hydraulic circuit with idling the engine, return the range selector lever to N range after putting it repeatedly in each range approximately five (5) times in sequence.
- Extract the level gauge **1** with idling the engine; insert it again after wiping off automatic transmission fluid adhered; and after pulling it out, check quantity of the automatic transmission fluid.
- When the oil temperature is low (15 to 50°C {59 to 122°F}) after starting the engine; if automatic transmission fluid is within a "COLD" range **A** of the level gauge **1**, it shows that the quantity of automatic transmission fluid is as specified.
- When the oil temperature is high (79 to 95°C, {158 to 203°F}) after running the vehicle; if automatic transmission fluid is within a "HOT" range **B** of the level gauge **1**, it shows the quantity of automatic transmission fluid is as specified.

WARNING

Since the inspection is conducted with running the engine, be careful of being caught in components, burn hazard, or the safety.

NOTE

- Make sure to inspect the quantity of automatic transmission fluid at the horizontal level.
- Make sure to inspect the quantity of automatic transmission fluid with idling the engine at N range since the apparent quantity of automatic transmission fluid increases in a state of the engine stop.
- Remove any dirt of the protection cap and the upper part of filler tube **2** completely before pulling the level gauge **1** out.
- Do not raise the engine speed with keeping the engine in a state of idling until the adjustment of quantity of automatic transmission fluid is completed.
- Reconfirm the automatic transmission fluid level after the vehicle runs actually. In case the quantity of automatic transmission fluid is insufficient, replenish DEXRON III to the specified level of level gauge **1** using filler tube **2**.

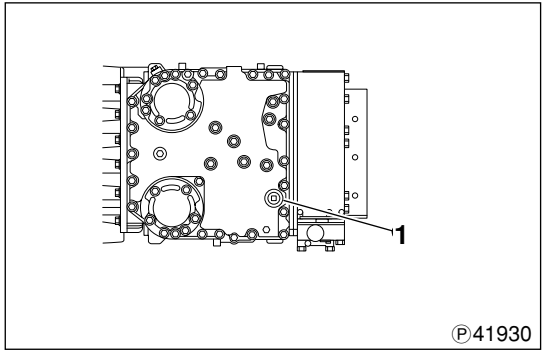
ON-VEHICLE INSPECTION AND ADJUSTMENT

4. Replacement of automatic transmission fluid

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
—	Drain plug	25 to 32 {18 to 24, 2.6 to 3.3}	—



(1) Discharge

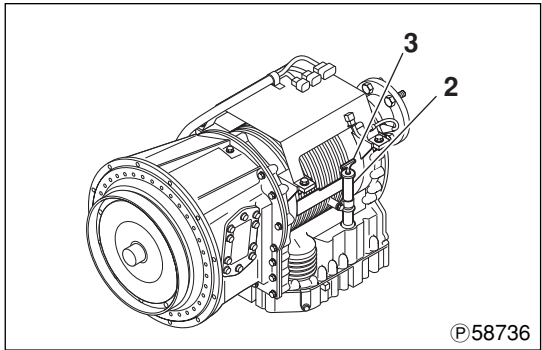
- Put the automatic transmission fluid receptacle under the transmission oil pan; then remove drain plug 1 behind the oil pan to discharge automatic transmission fluid.

WARNING

Do not start any work for engine immediately after the engine is shut down. Wait until the engine cools to a safe temperature since a hot engine can cause burns.

NOTE

- The discharge can be made more quickly by warming automatic transmission fluid due to the warm-up operation.
- It is impossible to discharge automatic transmission fluid which is located around the hydraulic circuit, the converter, or the oil cooler.
- Check any dirt of automatic transmission fluid discharged, and any existence of metallic powder or metal pieces.



(2) Injection

- Prepare DEXRON III of 18 dm³ {18 L}.
- Install oil pan drain plug 1 to its original state.
- Inject automatic transmission fluid from filler tube 2.

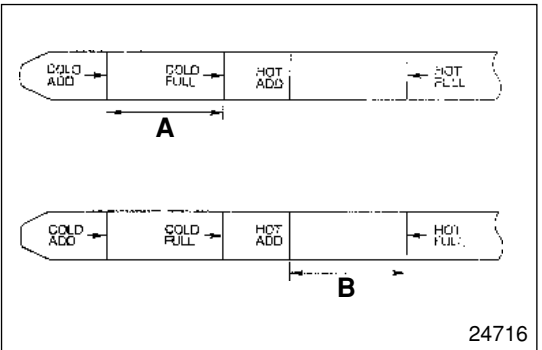
CAUTION

Be careful of the injection so that any dust or foreign particles may not enter.

- After starting the engine, conduct the idling drive for approximately one (1) minute with engaging the range selector to “N” range.
- After rounding the range selector to each range, engage it to “N” range again.

CAUTION

In this process, only conduct the idling drive for the engine; make sure to avoid just revving the engine.



- Replenish automatic transmission fluid until it reaches the low position of the specified range of level gauge 3. Then, check the level of automatic transmission fluid. The level of automatic transmission fluid must be within the specified range of the level gauge.

A : When temperature is low; 15 to 50°C {59 to 122°F}

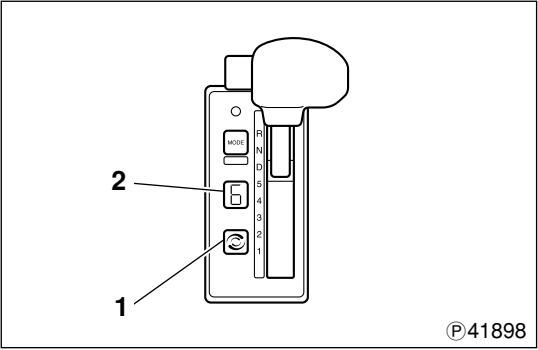
B : When temperature is high; 70 to 95°C {158 to 203°F}

NOTE

- After injecting automatic transmission fluid, it may be difficult to see the level of automatic transmission fluid easily due to the automatic transmission fluid adhering to the inner wall of filler tube 2; therefore, reconfirm it after a short time.
- If injecting automatic transmission fluid too much, the automatic transmission fluid begins to overflow from the air breather; as result, it might be misunderstood that the leakage of automatic transmission fluid be caused.
- Inject automatic transmission fluid gradually with letting the engine idle while paying a careful attention to the level of automatic transmission fluid.

ON-VEHICLE INSPECTION AND ADJUSTMENT

5. Level check of automatic transmission fluid



This automatic transmission can check automatic transmission fluid level by operating the range selector.

Conditions required on check

- Stop the vehicle at the flat place, and put the range selector in “N” position.
(Neutral must be put in.)
- Automatic transmission fluid must be got warm.
(oil temperature 60 to 104°C {140 to 219°F})
- Stabilize oil level at intervals of two (2) minutes or more after stopping the vehicle.
- Put the engine in a state of idling rotation.

Check operation

- Push display switch button **1** of the range selector
- Various code No. are displayed in the position display **2** of the selector following “O” and “L” (indicating check mode of automatic transmission fluid level) after approximately two (2) minutes.

Judgment of check result

The code No. indicated means as follows:

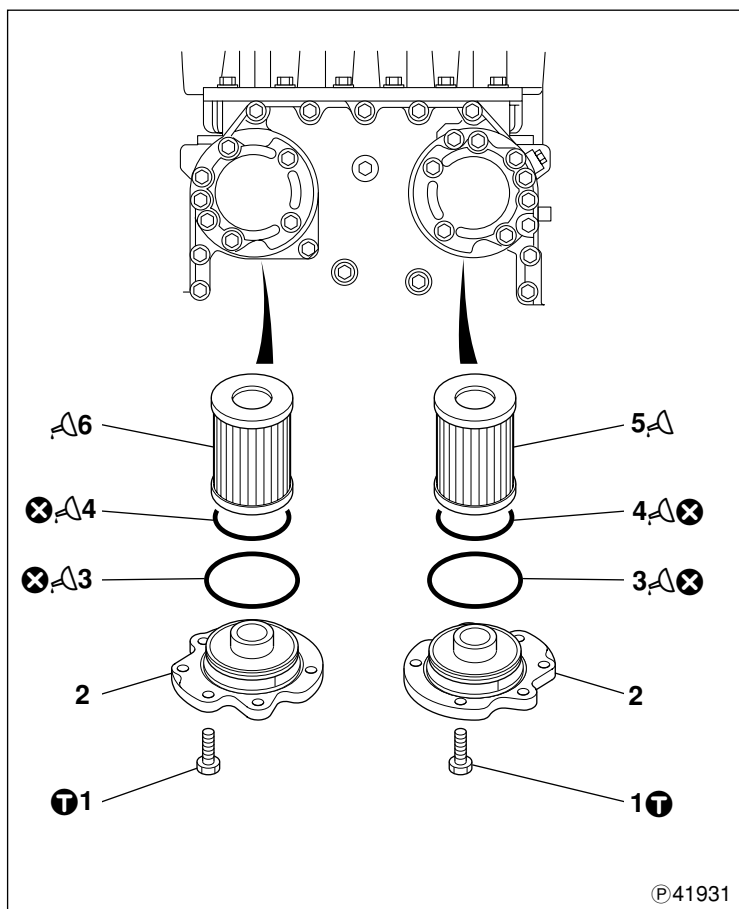
- “OL”, “OK”, and “--” ; automatic transmission fluid level is appropriate.
- “OL”, “LO”, and “XX”; automatic transmission fluid must be added by approximately XX liter.
- “OL”, “HI”, and “XX”; automatic transmission fluid must be extracted by approximately XX liter.
- “OL”, “--”, and “XX” ; check the level again based on the following table since the level could not be checked.

Display code No. XX	Contents
“50”	The engine speed is too low.
“59”	The engine speed is too high.
“65”	The neutral has not be put in.
“70”	Oil temperature is too low.
“79”	Oil temperature is too high.
“89”	The output shaft rotates.
“95”	Trouble of oil temperature sensor

Operation after the check has ended.

After the check has ended, put the range selector in either of position, “Reverse”, “Neutral”, or “Drive”.

6. Replacement of oil filter



● Disassembly sequence

- 1 Bolt
- 2 Filter cover
- 3 Seal
- 4 O-ring
- 5 Main filter
- 6 Lubrication filter

* : Automatic transmission assembly

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Ⓟ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

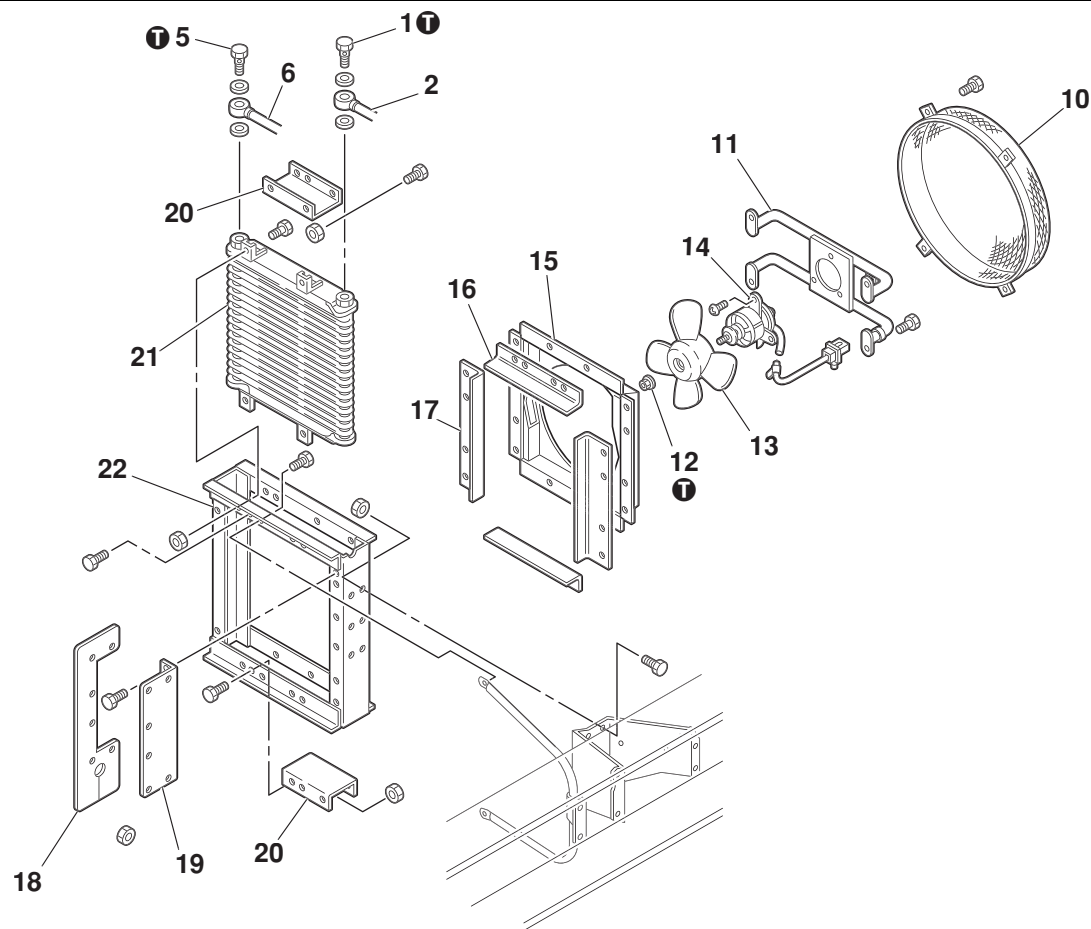
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (installing filter cover)	57 to 68 {42 to 50, 5.8 to 6.9}	—

Ⓟ Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Seal	DEXRON III	As required
4	O-ring	DEXRON III	As required
5, 6	Engagement part of filter	DEXRON III	As required

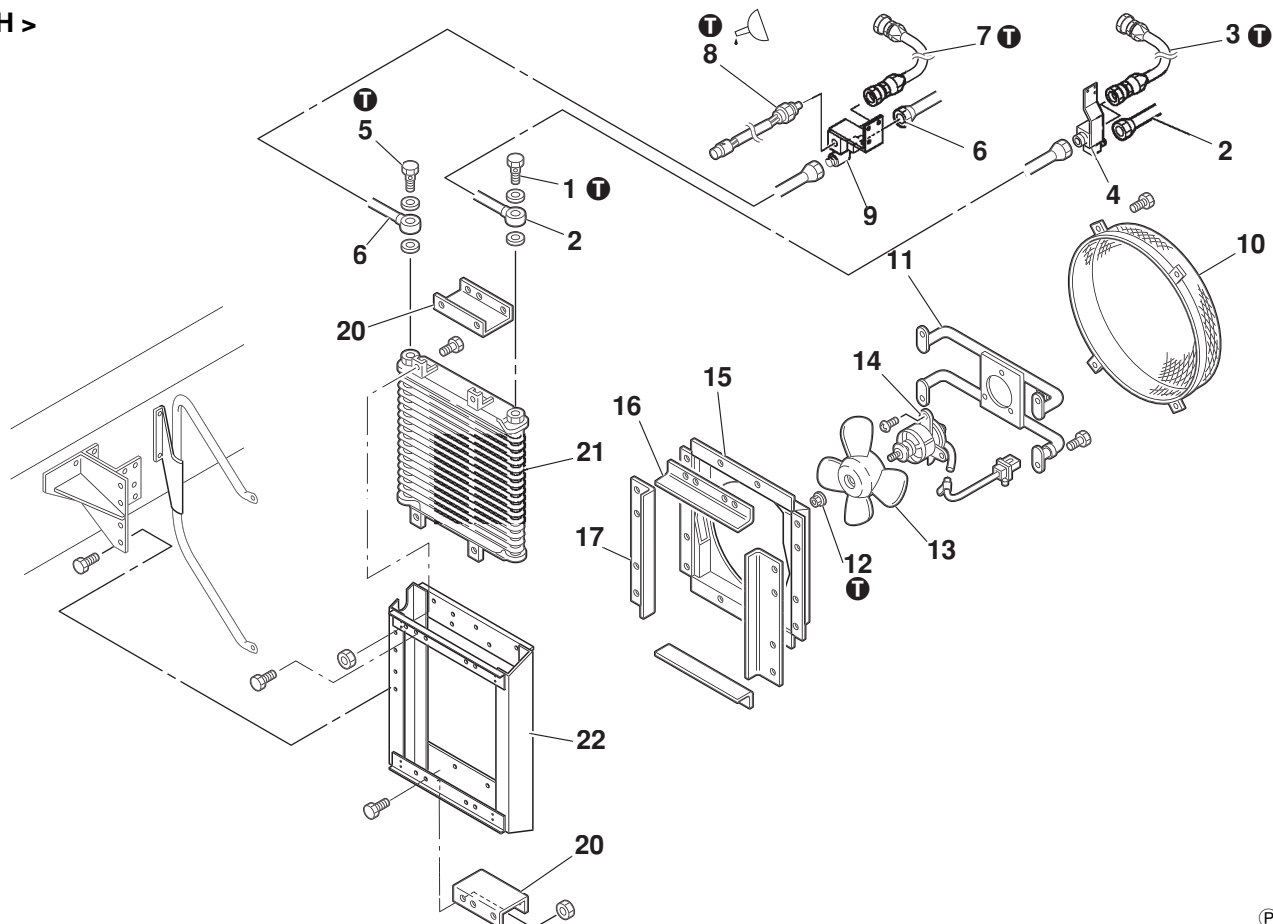
OIL COOLER

< RH >



P58662

< LH >



P58663

● Disassembly sequence

- | | | |
|--------------------------|---|--------------------------------|
| 1 Eye bolt | 9 Connector | 17 Fan shroud B |
| 2 Oil pipe | 10 Fan cover | 18 Baffle plate < RH > |
| 3 Oil hose | 11 Fan Motor bracket | 19 Baffle plate bracket < RH > |
| 4 Connector | 12 Nut | 20 Stay |
| 5 Eye bolt | 13 Fan assembly | 21 Oil cooler |
| 6 Oil pipe | 14 Motor assembly  Gr 54 | 22 Oil cooler bracke |
| 7 Oil hose | 15 Fan shroud | |
| 8 Oil temperature sensor | 16 Fan shroud A | |

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

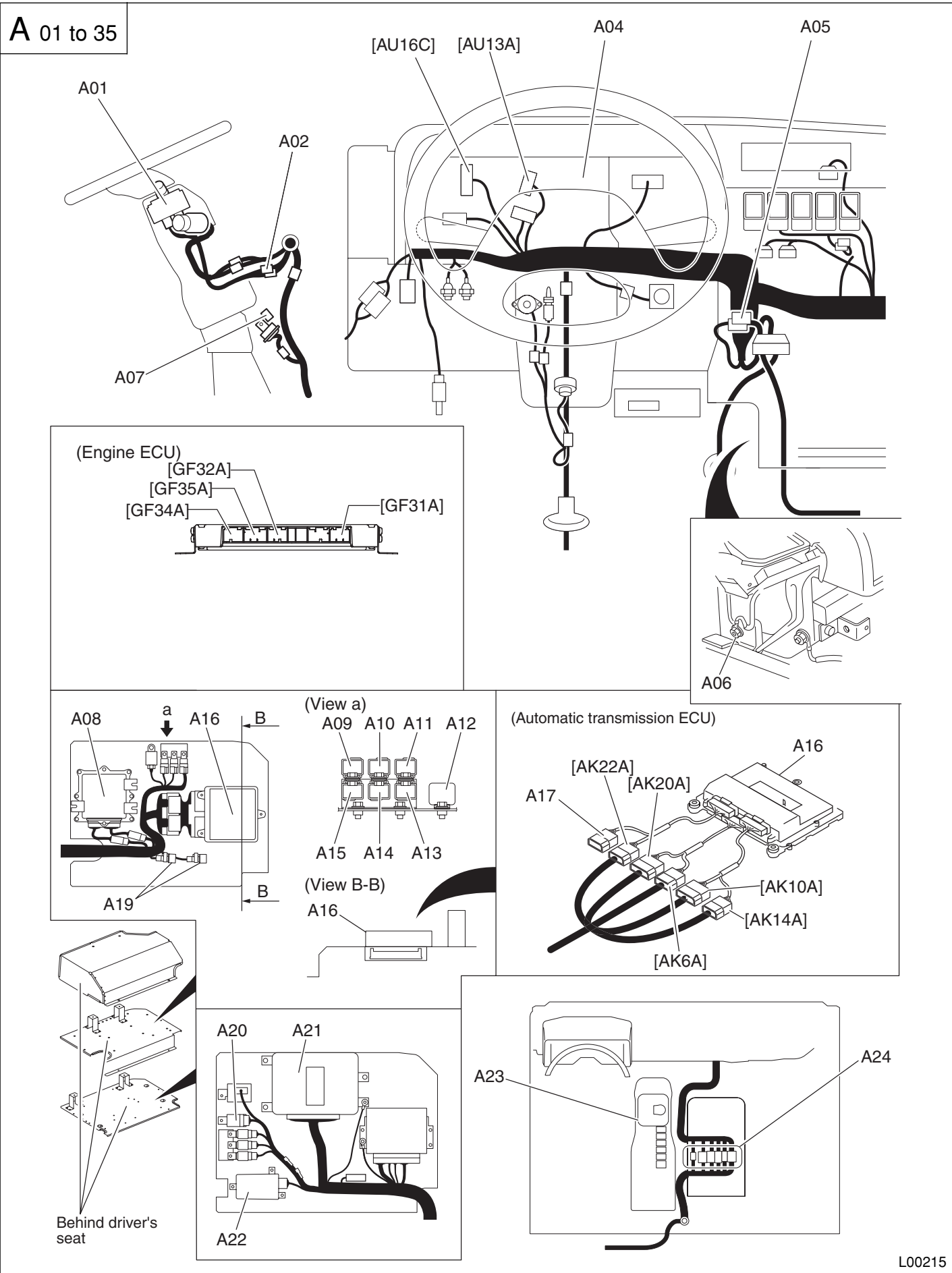
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1, 5	Eye bolt	59 to 88 {43 to 65, 6 to 9}	—
3, 7	Oil hose	118 {87, 12}	—
8	Oil temperature sensor	29 to 39 {22 to 29, 3 to 4}	—
12	Nut (Fan assembly mounting)	4.9 to 7.5 {3.6 to 5.5, 0.50 to 0.76}	—

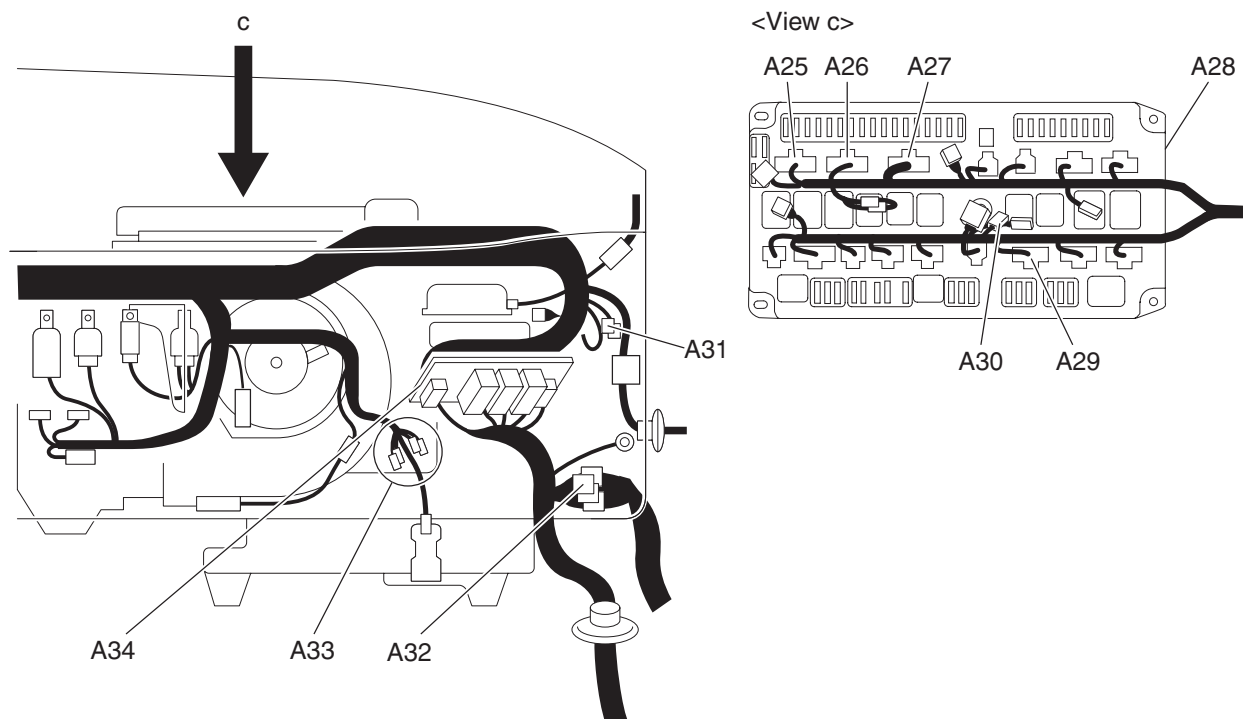
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
8	Apply the sealant on the screw of oil temperature sensor.	THREEBOND 1110B	As required

INSTALLED LOCATIONS OF PARTS



L00215



No relevant parts in a missing number

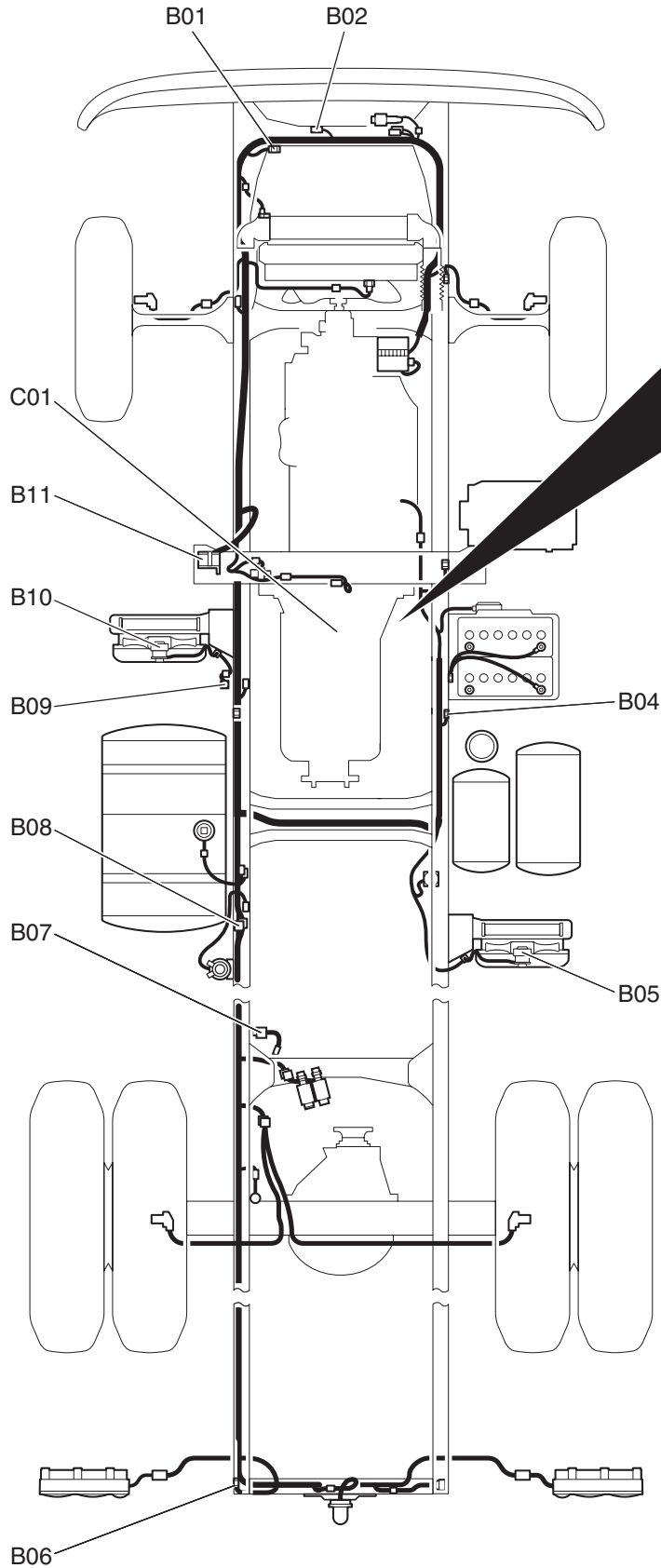
A01 Combination switch
 A02 Connection of cab harness and combination switch harness
 A04 Meter cluster
 A05 Connection of cab harness and center floor harness
 A06 Ground
 A07 Inhibit buzzer
 A08 Vehicle interface module
 A09 Fan motor relay1
 A10 Stop lamp relay
 A11 A/T ABS activation signal relay
 A12 Selector neutral relay
 A13 Neutral start relay
 A14 Transmission neutral relay
 A15 Fan motor relay2
 A16 A/T ECU
 A17 Diagnosis connector
 A19 Fuse holder
 A20 Exhaust brake cut relay
 A21 Engine ECU
 A22 Pulse converter

A23 Range selector
 A24 Connection of cab harness and bed harness
 A25 Connector
 A26 Connector
 A27 Connector
 A28 Relay and fuse box
 A29 Connector
 A30 Diagnostic tool
 A31 Diode unit
 A32 Connection of bed harness and chassis harness
 A33 Diode unit
 A34 Connecton of cab harness and chassis harness

ABS : Anti-lock brake system
 A/T : Automatic transmission
 ECU : Electronic control unit
 Indicate by connector type and color [].
 [connector type : connector color]

INSTALLED LOCATIONS OF PARTS

B 01 to 10, C 01



No relevant parts in a missing number



- B01 Ground
- B02 Stop lamp switch
- B04 Ground
- B05 Motor assembly 2
- B06 Ground
- B07 Stop lamp switch
- B08 Connection of chassis harness and rear chassis harness
- B09 A/T fluid temperature sensor
- B10 Motor assembly 1
- B11 High-current fuse box

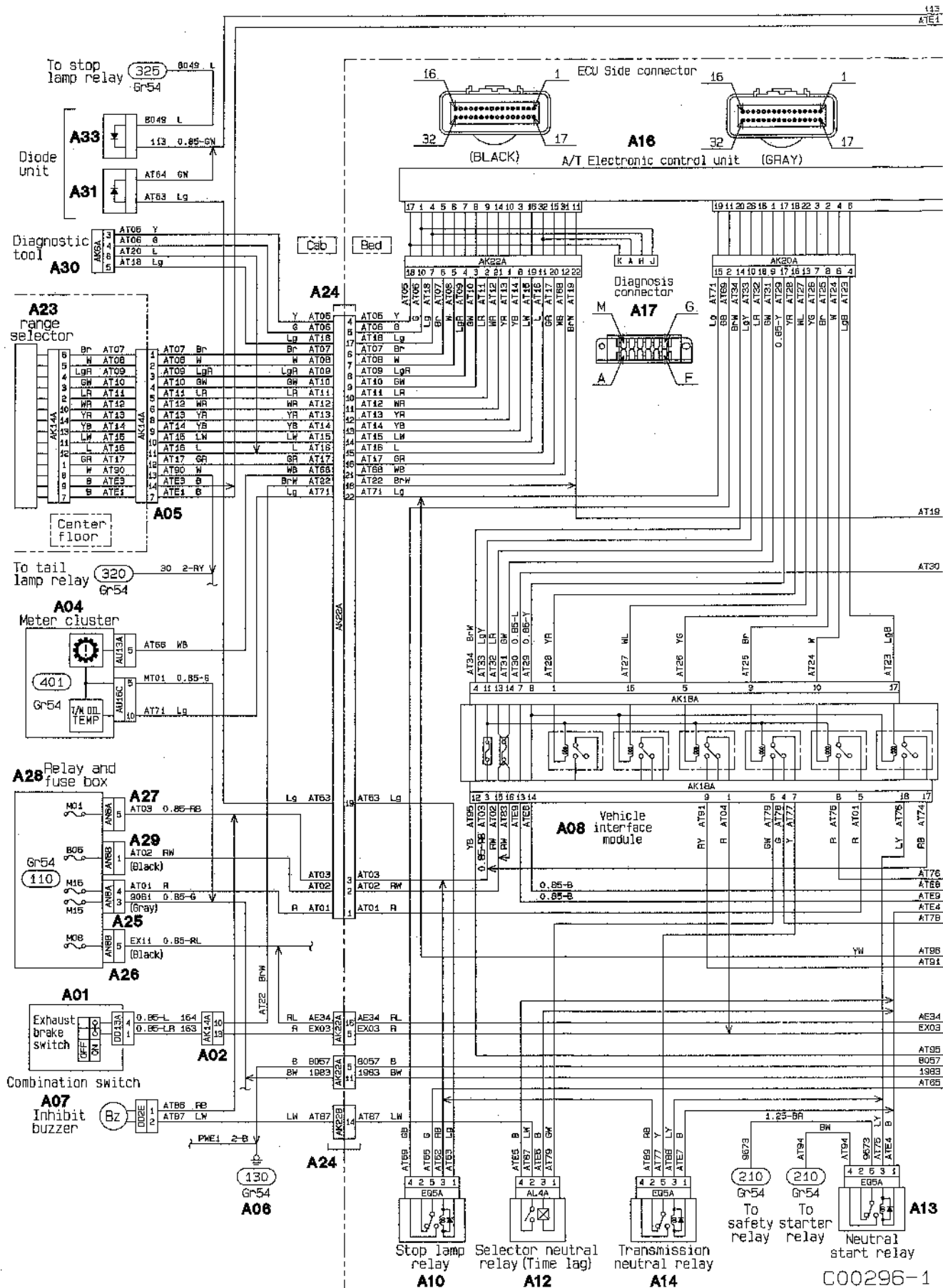
A/T : Automatic transmission



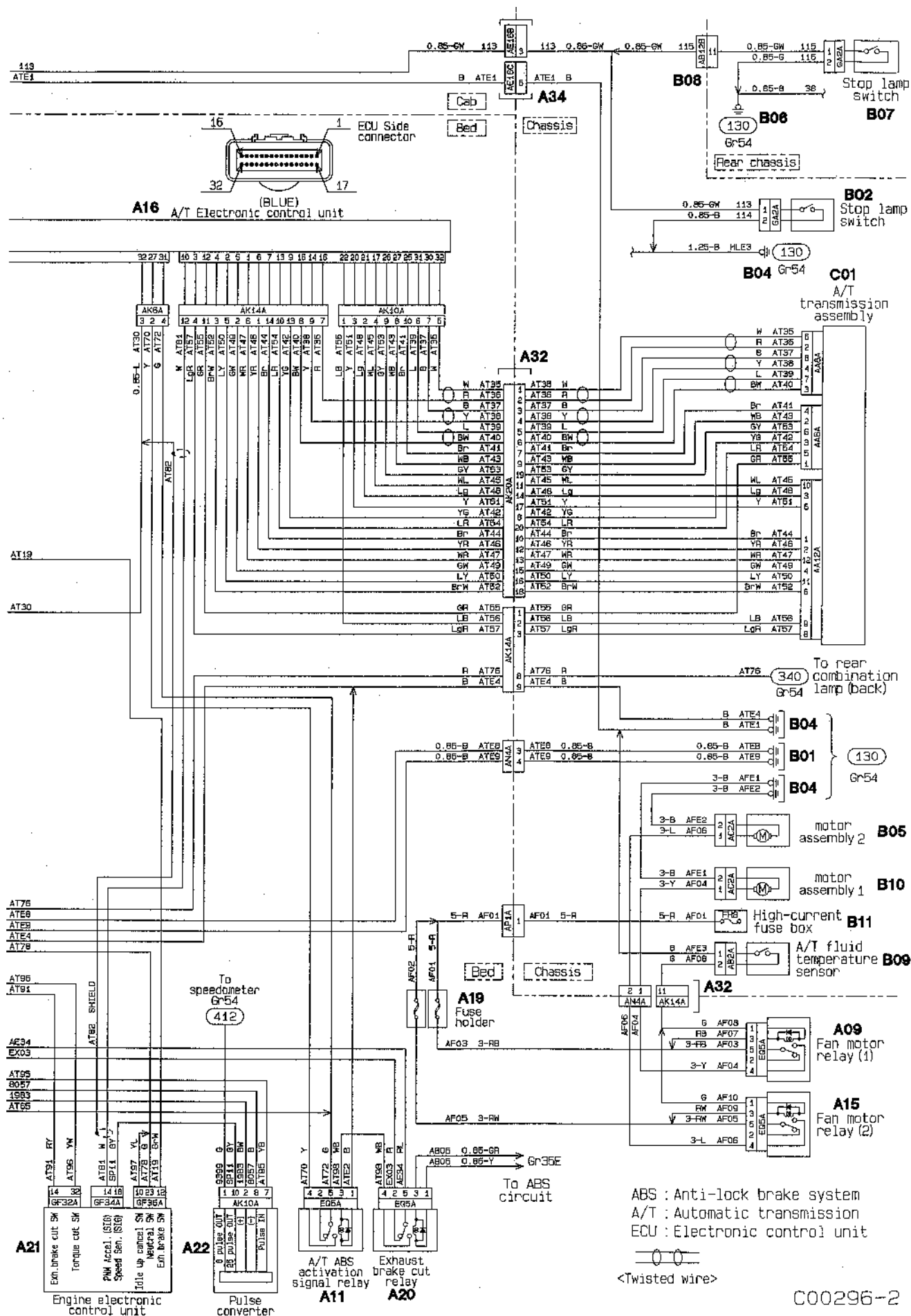
- C01 Automatic transmission assmbly

MEMO

ELECTRIC CIRCUIT DIAGRAM



C00296-1





Group 25

Propeller Shaft

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	25- 2
STRUCTURE AND OPERATION	25- 2
TROUBLESHOOTING	25- 4
REMOVAL AND INSTALLATION OF PROPELLER SHAFT	25- 6
REAR PROPELLER SHAFT	
< P8 >	25- 8
< P10, P12 >	25-12
FRONT PROPELLER SHAFT	
< P8 >	25-16
< P10, P12 >	25-22
BALANCING PROPELLER SHAFT	25-27

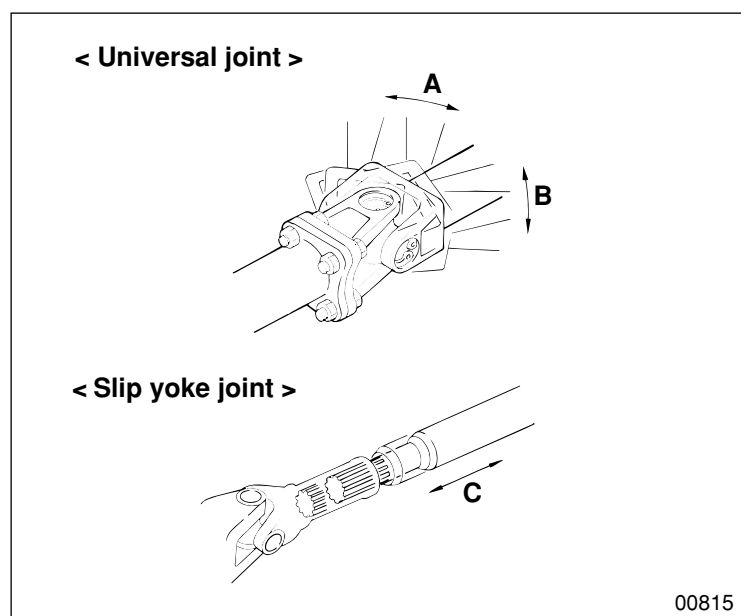
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item \ Vehicle model		FK, FM <Except FM65>	FM65 <Except FM65-C>	FM65-C
Propeller shaft	Model	P8	P10	P12
Pipe	Outer diameter×Wall thickness mm {in.}	90×3.2 {3.54×0.13}	101.6×3.2 {4.00×0.13}	101.6×4 {4.00×0.16}
Universal joint	Spider outer diameter mm {in.}	28.907 {1.14}	30.494 {1.20}	36.25 {1.43}
Needle roller bearing	Outer diameter mm {in.}	3.498 {0.14}	3.839 {0.15}	3.564 {0.14}
	Length of needle roller mm {in.}	21.8 {0.86}	22.8 {0.90}	24.8 {0.98}
	Quantity of needle rollers	29	28	35
Slip yoke joint	Spline diameter mm {in.}	54 {2.13}	54 {2.13}	60.325 {2.37}
Center bearing	Model No.	6211	6211	6211
	Inner diameter×Outer diameter mm {in.}	55×100 {2.17×3.94}	55×100 {2.17×3.94}	55×100 {2.17×3.94}

STRUCTURE AND OPERATION

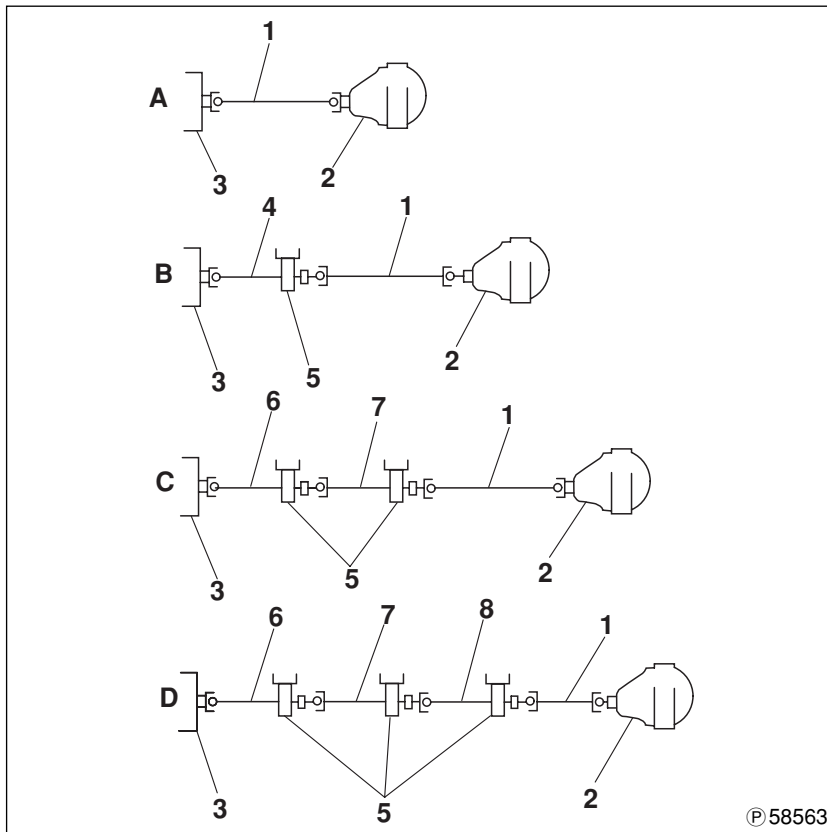
Swing of Propeller Shaft



A : Lateral swing
B : Longitudinal swing
C : Fore-and-aft movement

Relative positions of transmission, rear axle and front axle vary depending on the fluctuation of the road surface and load carried when operating the vehicle. The universal joint and the slip yoke joint are provided to absorb these influences.

Configuration of Propeller Shaft Connection



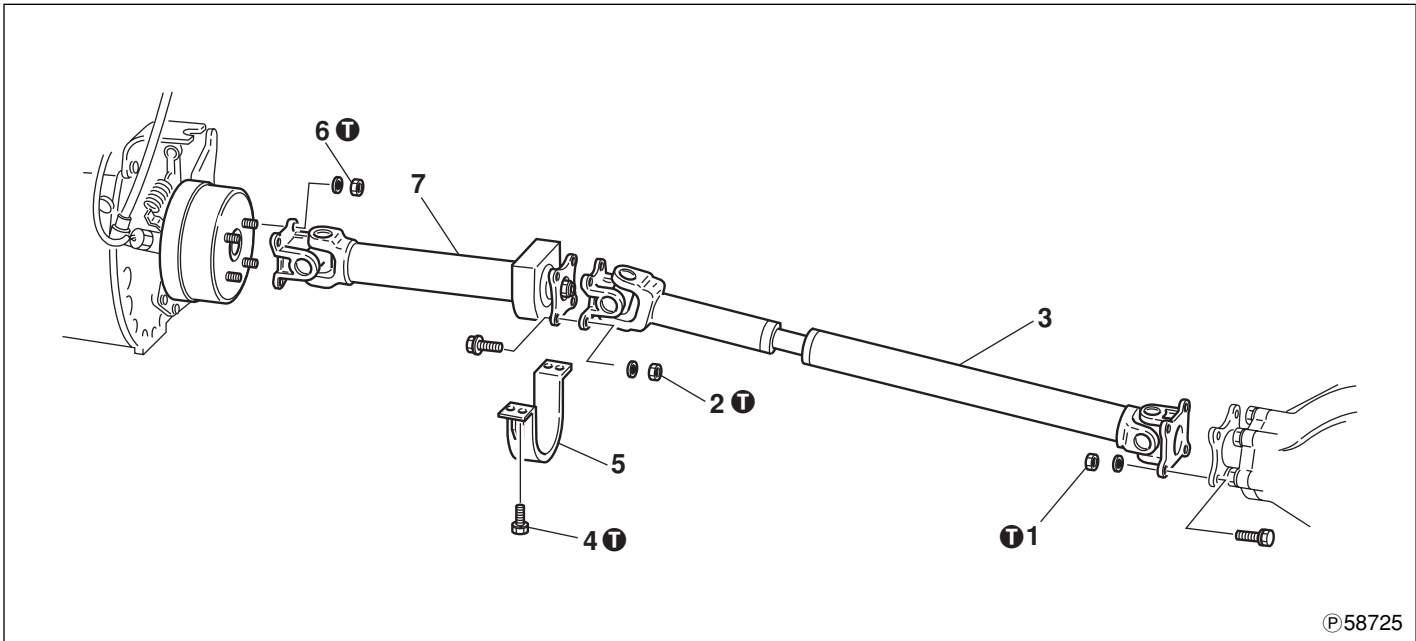
TROUBLESHOOTING

TROUBLESHOOTING

Symptoms		Propeller shaft vibrating		Noise from propeller shaft		
		Vibration at high speed	Vibration at low speed	Noise when starting or while coasting	Noise while cruising	Clicking noise
Possible causes						
Flange yoke assembly direction incorrect		○				
Companion flange tightening torque excessive						○
Slip yoke joint	Lubrication insufficient				○	
	Spline play excessive		○	○		
Universal joint	Clearance in spider axial direction excessive		○		○	
	Needle bearing lubricated insufficiently				○	
	Needle bearing worn	○		○	○	
Center bearing < Twin-shaft, triple-shaft and quadruple-shaft connection >	Lubrication insufficient				○	
	Seized, worn, or rotation faulty	○			○	
	Cushion rubber deteriorated or deformed			○		
	Bracket mounting bolt loose			○		
Propeller shaft	Mounting bolt loose	○		○		
	Bent	○				
	Dynamic balance adjusted incorrectly	○				
Transmission gear selection too high			○			

MEMO

REMOVAL AND INSTALLATION OF PROPELLER SHAFT



The illustration applies to the propeller shaft of the two-piece configuration. It basically applies also to the propeller shafts of the other configurations.

● **Work before removal**

📖 P25-7

● **Removal sequence**

- 1 Nut

2 Nut

3 Rear propeller shaft

📖 P25-8
- 4 Bolt

5 Center bearing bracket

6 Nut
- 7 Front propeller shaft

📖 P25-16

● **Installation sequence**

Follow the removal sequence in reverse.

ⓘ **Tightening torque**

Unit : N·m {ft.lbs, kgf·m}

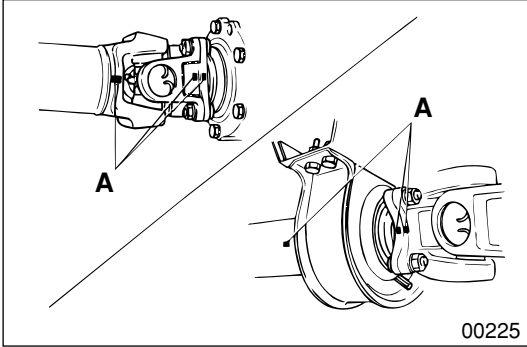
Location	Parts to be tightened		Tightening torque	Remarks
1	Nut (Propeller shaft mounting at rear axle side)	P8	70 to 100 {51 to 72, 7.0 to 10}	—
		P10	120 to 180 {87 to 130, 12 to 18}	—
		P12	180 to 250 {130 to 190, 18 to 26}	—
2	Nut (Propeller shaft mounting at center bearing side)	P8	70 to 100 {51 to 72, 7.0 to 10}	—
		P10	120 to 180 {87 to 130, 12 to 18}	—
		P12	180 to 250 {130 to 190, 18 to 26}	—
4	Bolt (Center bearing bracket mounting)	P8 , P10	70 to 95 {51 to 69, 7.0 to 9.5}	—
		P12	43 to 65 {32 to 48, 4.4 to 6.6}	—
6	Nut (Propeller shaft mounting at propeller shaft side)	P8	70 to 100 {51 to 72, 7.0 to 10}	—
		P10	120 to 180 {87 to 130, 12 to 18}	—
		P12	180 to 250 {130 to 190, 18 to 26}	—

◆ Service procedure

● Work before removal

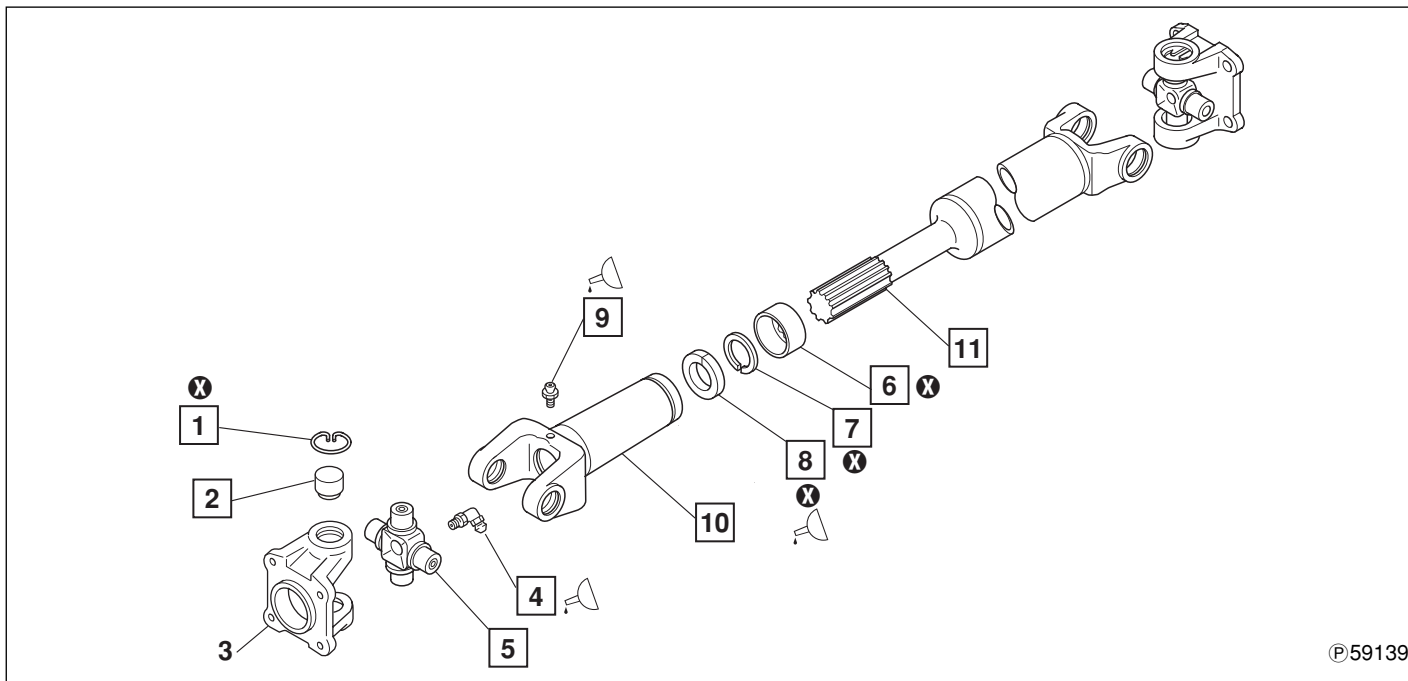
WARNING

- Since the propeller shaft will be removed, the parking brake (center parking brake) cannot be used. Therefore, you must chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.



Remember to make alignment marks **A** before removal.

REAR PROPELLER SHAFT < P8 >



● Inspection before disassembly

📖 P25-9

● Disassembly sequence

- | | | |
|------------------|--------------------|-------------------------|
| 1 Snap ring | 6 Dust cap | 11 Rear propeller shaft |
| 2 Needle bearing | 7 Retainer | |
| 3 Flange yoke | 8 Cork seal | ⊗ : Non-reusable parts |
| 4 Grease nipple | 9 Grease nipple | |
| 5 Spider | 10 Slip yoke joint | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Universal joint spider kit

Service standards

Unit : mm {in.}

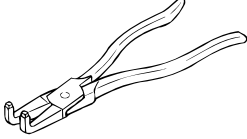
Location	Maintenance item	Standard value (Basic diameter in [J])	Limit	Remedy
1 to 5	Clearance of spider in axial direction	0 to 0.15 {0 to 0.0059}	—	Adjust
2, 3, 10, 11	Clearance between needle bearing and flange yoke, slip yoke joint, rear propeller shaft	[44] 0.010 to -0.031 {[1.73] 0.00039 to -0.0012}	0.1 {0.0039}	Replace
2, 5	Clearance between needle bearing and spider	[28.907] 0.022 to 0.07 {[1.14] 0.00087 to 0.0028}	0.2 {0.0079}	Replace
10, 11	Play to revolving direction between slip yoke joint and rear propeller shaft	0.07 to 0.18 {0.0028 to 0.0071}	0.3 {0.012}	Replace
11	Bend of rear propeller shaft (Center)	—	0.6 {0.024}	Correct or replace

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from spider dust seal
8	Inner surface of cork seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
9	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from dust plug hole

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Snap ring expander  00227	MH061001	Removal and installation of snap ring

◆ Service procedure

● Inspection before disassembly

Clearance in axial direction for spider

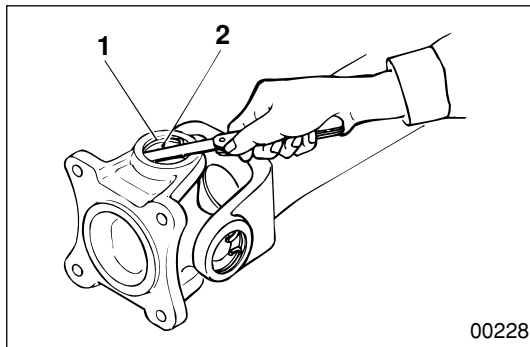
Press needle bearing **2** downward firmly, and measure the clearance between snap ring **1** and the needle bearing. If the measured value is higher than the standard value, adjust it by changing the thickness of the snap ring.

- Available snap ring thicknesses

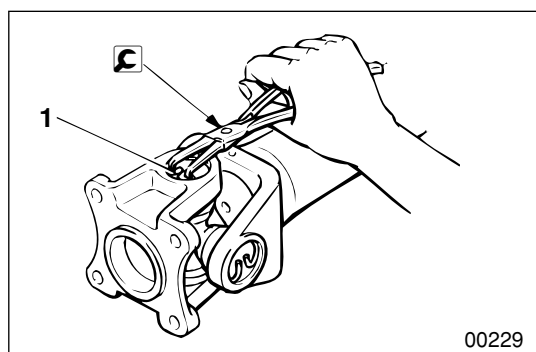
Part name	Thickness	Identification color
Snap ring A	3mm {0.12 in.}	Green
Snap ring B	3.05mm {0.12 in.}	White
Snap ring C	3.1mm {0.12 in.}	Red
Snap ring D	3.15mm {0.12 in.}	Blue
Snap ring E	3.2mm {0.13 in.}	Yellow

NOTE

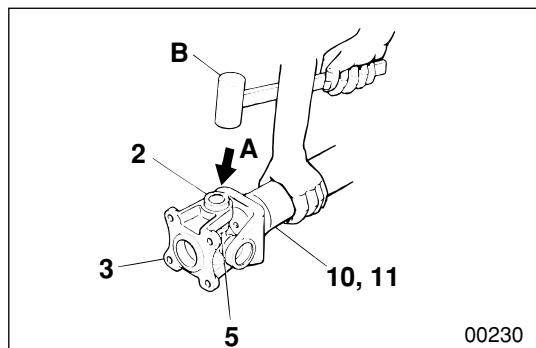
For snap ring **1**, it is recommended that you use rings with the same thickness on both ends to ensure balanced revolution.



REAR PROPELLER SHAFT < P8 >



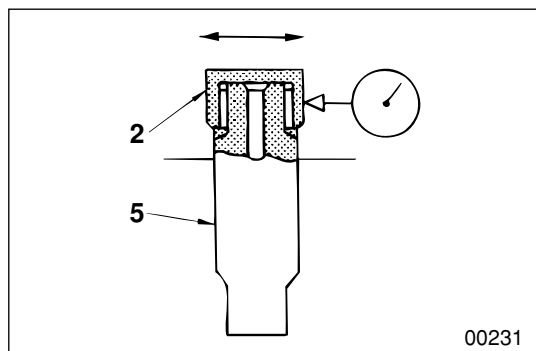
1 Removal and installation of snap ring



2 Removal of needle bearing

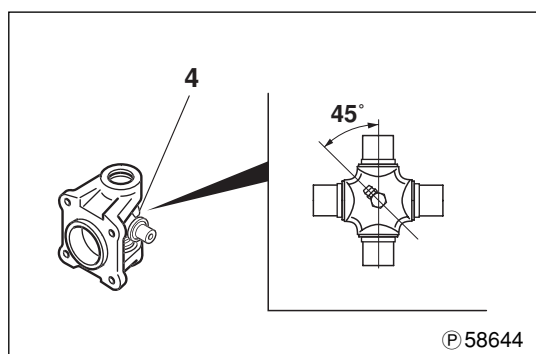
- Put alignment marks on needle bearing 2 and spider 5.
- Put alignment marks across flange yoke 3, slip yoke joint 10 and rear propeller shaft 11.
- Hit the yoke lightly at shoulder area A so that needle bearing 2 bounces out due to reaction.

B : Mallet



2 5 Clearance between needle bearing and spider

Measure the play towards the diameter direction between needle bearing 2 and spider 5. If the measured value is higher than the limit, replace with universal joint spider kit.

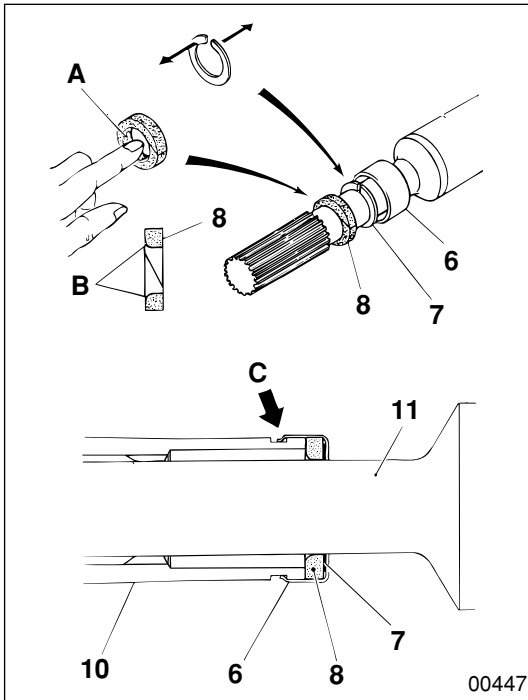


4 Installation of grease nipple

Install grease nipple 5 at the angle indicated in the illustration.

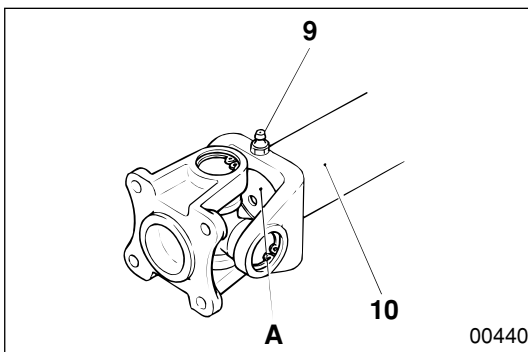
CAUTION ⚠

The angle and direction of grease nipple 5 on the transmission side must be the same as those of the nipple on the differential side.



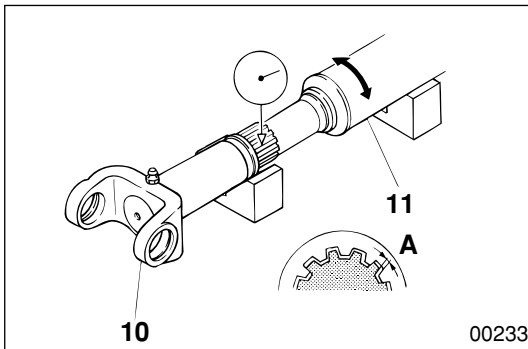
6 to 8 Assembly of dust cap, retainer and cork seal

- Insert dust cap 6 into rear propeller shaft 11 and expand retainer 7 carefully to mount it on the propeller shaft. Then, release the retainer and allow it to return to its original shape.
- Apply grease to inner surface A of cork seal 8, face its chamfered side B towards the spline and mount in the same way as the retainer.
- Press cork seal 8, compressing it by 1 to 2 mm {0.039 to 0.079 in.}, against slip yoke joint 11, then caulk area C.



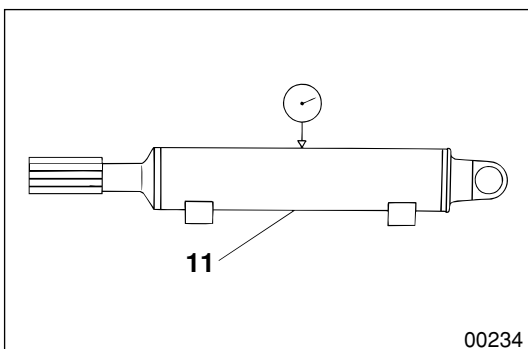
9 Supply of grease via grease nipple

Pack grease via grease nipple 9 until grease starts overflowing from the hole in dust plug A of slip yoke joint 10.



10 11 Play between slip yoke joint and rear propeller shaft spline in rotating direction

Measure play A in the rotation direction between slip yoke joint 10 and rear propeller shaft 11 at the spline area. If the measured value is higher than the limit, replace the faulty parts.



11 Bend of rear propeller shaft

Measure bend of rear propeller shaft 11 at its center. If the measured value is higher than the limit, correct or replace it.

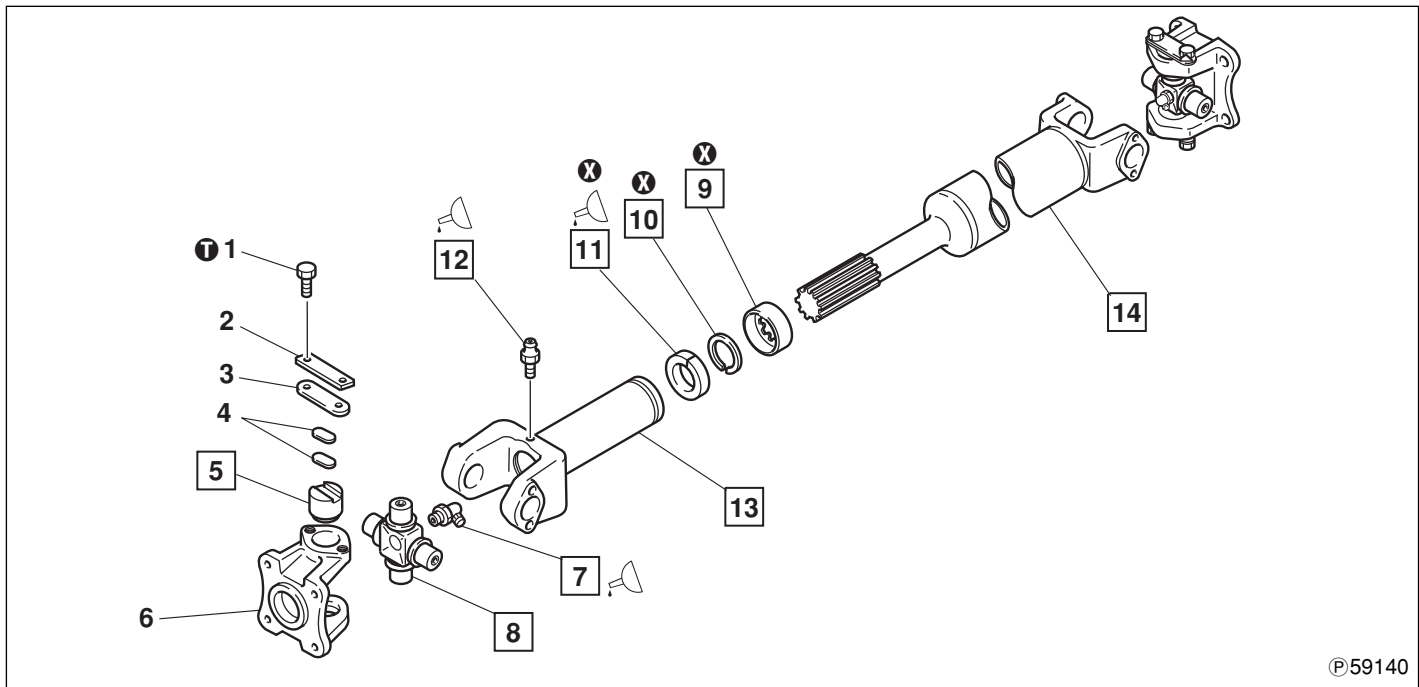
CAUTION ⚠

Be sure to check for cracks at the welded area after straightening has been done by means of a press.

NOTE

To measure the bend of rear propeller shaft 11, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

REAR PROPELLER SHAFT < P10, P12 >



©59140

● Inspection before disassembly

☞ P25-13

● Disassembly sequence

- | | | |
|-------------------------|-----------------|-------------------------|
| 1 Bolt | 7 Grease nipple | 12 Grease nipple |
| 2 Lock plate | 8 Spider | 13 Slip yoke joint |
| 3 Bearing case retainer | 9 Dust cap | 14 Rear propeller shaft |
| 4 Shim | 10 Retainer | |
| 5 Needle bearing | 11 Cork seal | |
| 6 Flange yoke | | |
- ⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Universal joint spider kit

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
1 to 8	Clearance of spider in axial direction		0 to 0.15 {0 to 0.0059}	—	Adjust
5, 6 13, 14	Clearance between needle bearing and flange yoke, slip yoke joint, rear propeller shaft	P10	[46] 0.030 to -0.011 {[1.81] 0.0012 to 0.00043}	0.1 {0.0039}	Replace
		P12	[52] 0.037 to -0.012 {[2.05] 0.0015 to 0.00047}		
5, 8	Clearance between needle bearing and spider	P10	[30.494] 0.023 to 0.07 {[1.20] 0.00091 to 0.0028}	0.2 {0.0079}	Replace
		P12	[36.25] {0.024 to 0.079} {[1.43] 0.00094 to 0.0031}		
13, 14	Play to revolving direction between slip yoke joint and rear propeller shaft	P10	0.07 to 0.18 {0.0028 to 0.0071}	0.3 {0.012}	Replace
		P12	0.01 to 0.17 {0.00039 to 0.0067}		
14	Bend of rear propeller shaft (Center)		—	0.6 {0.024}	Correct or replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

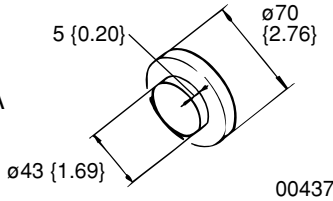
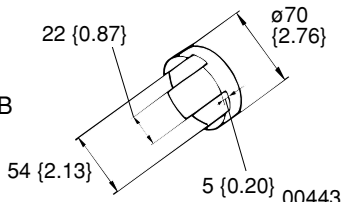
Location	Parts to be tightened		Tightening torque	Remarks
1	Bolt (Needle bearing mounting)	P10	18 to 26 {13 to 20, 1.8 to 2.7}	—
		P12	35 to 53 {26 to 39, 3.6 to 5.4}	

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from spider dust cover
11	Inner surface of cork seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
12	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from dust plug hole

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
5	Spider assembly rest A 	03724-13000	Press-fitting of needle bearing
6	Spider assembly rest B 	03724-14000	Press-fitting of needle bearing

Service procedure

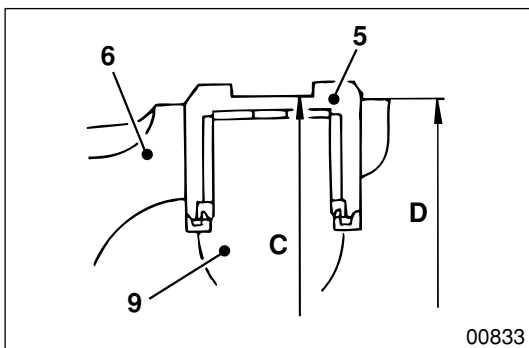
Inspection before disassembly

Clearance in axial direction for spider

Measure the clearance of needle bearing 5 (shim adjustment clearance = $D - C$). If the measured value is higher than the standard value, adjust it by changing the thickness of shim 4.

- Available shim thicknesses

Part name	Thickness
Shim A	0.1 mm {0.0039 in.}
Shim B	0.2 mm {0.0079 in.}



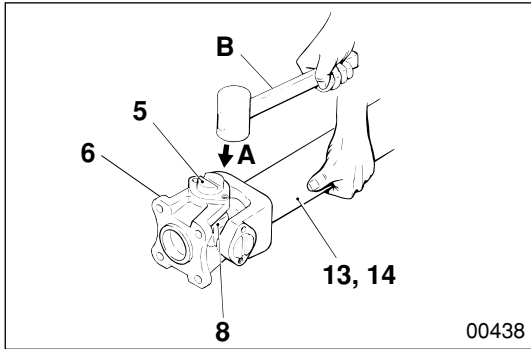
REAR PROPELLER SHAFT < P10, P12 >

CAUTION

Make sure that shim 4 does not protrude above the surface of flange yoke 6 or needle bearing 5 will seize up.

NOTE

For shim 4, it is recommended that you use shims with the same thickness on both ends to ensure balanced revolution.

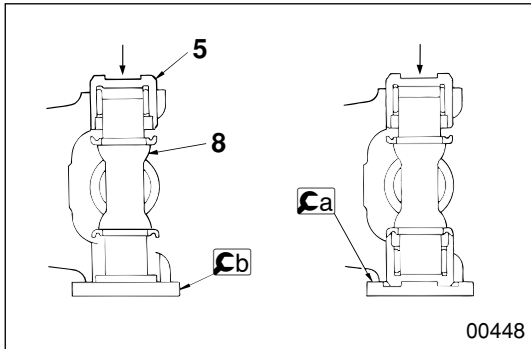


5 Needle bearing

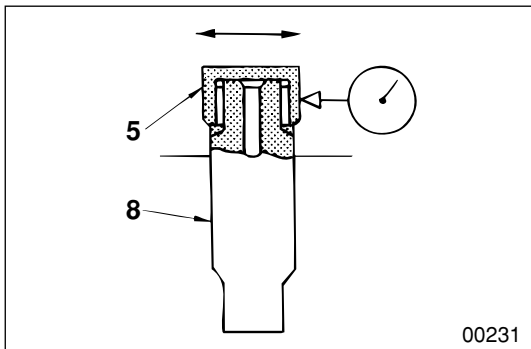
[Removal]

- Put alignment marks on needle bearing 5 and spider 8.
- Put alignment marks across flange yoke 6, slip yoke joint 13 and rear propeller shaft 14.
- Hit the yoke lightly at shoulder area A so that needle bearing 5 bounces out due to reaction.

B : Mallet

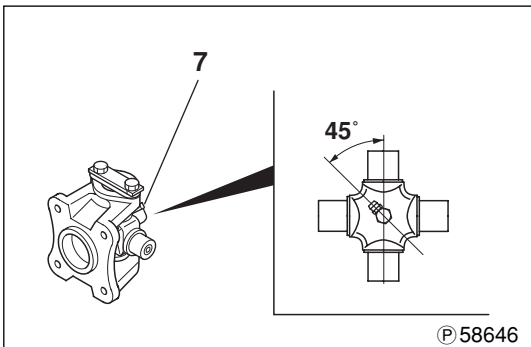


[Removal]



5 8 Clearance between needle bearing and spider

Measure the play towards the diameter direction between needle bearing 5 and spider 8. If the measured value is higher than the limit, replace with universal joint spider kit.

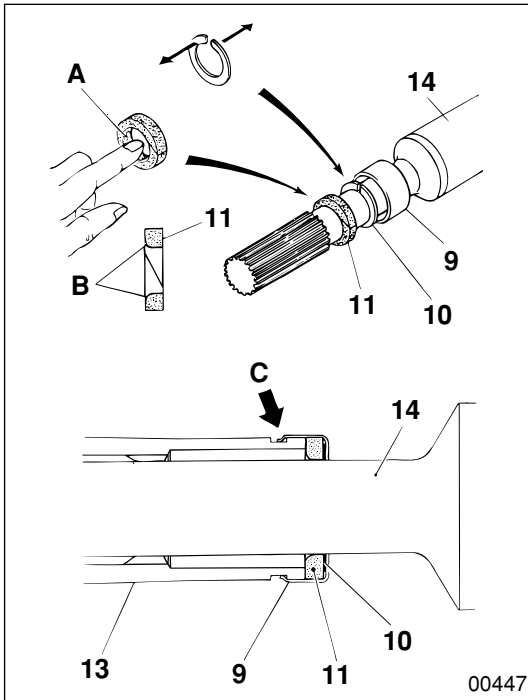


7 Installation of grease nipple

Install grease nipple 7 at the angle indicated in the illustration.

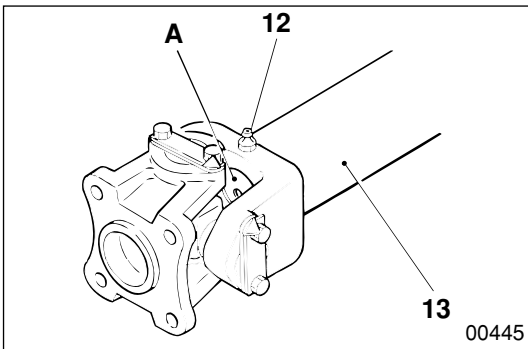
CAUTION

The angle and direction of grease nipple 7 on the transmission side must be the same as those of the nipple on the differential side.



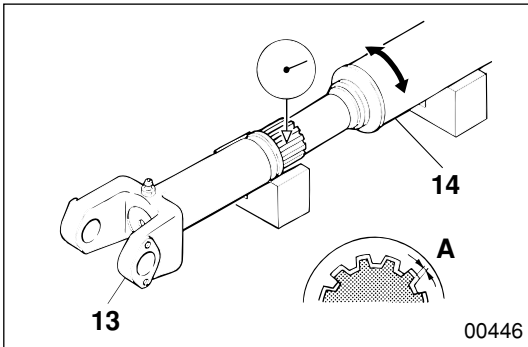
9 to 11 Assembly of dust cap, retainer and cork seal

- Insert dust cap 9 into rear propeller shaft 14 and expand retainer 10 carefully to mount it on the propeller shaft. Then, release the retainer and allow it to return to its original shape.
- Apply grease to inner surface A of cork seal 11, face its chamfered side B towards the spline and mount in the same way as the retainer.
- Press cork seal 11, compressing it by 1 to 2 mm {0.039 to 0.079 in.}, against slip yoke joint 13, then caulk pawl area C.



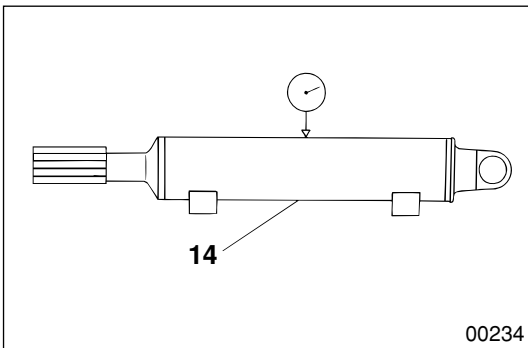
12 Supply of grease via grease nipple

Pack grease via grease nipple 12 until grease starts overflowing from the hole in dust plug A of slip yoke joint 13.



13 14 Play between slip yoke joint and rear propeller shaft spline in rotating direction

Measure play A in the rotation direction between slip yoke joint 13 and rear propeller shaft 14 at the spline area. If the measured value is higher than the limit, replace the faulty parts.



14 Bend of rear propeller shaft

Measure bend of rear propeller shaft 14 at its center. If the measured value is higher than the limit, correct or replace it.

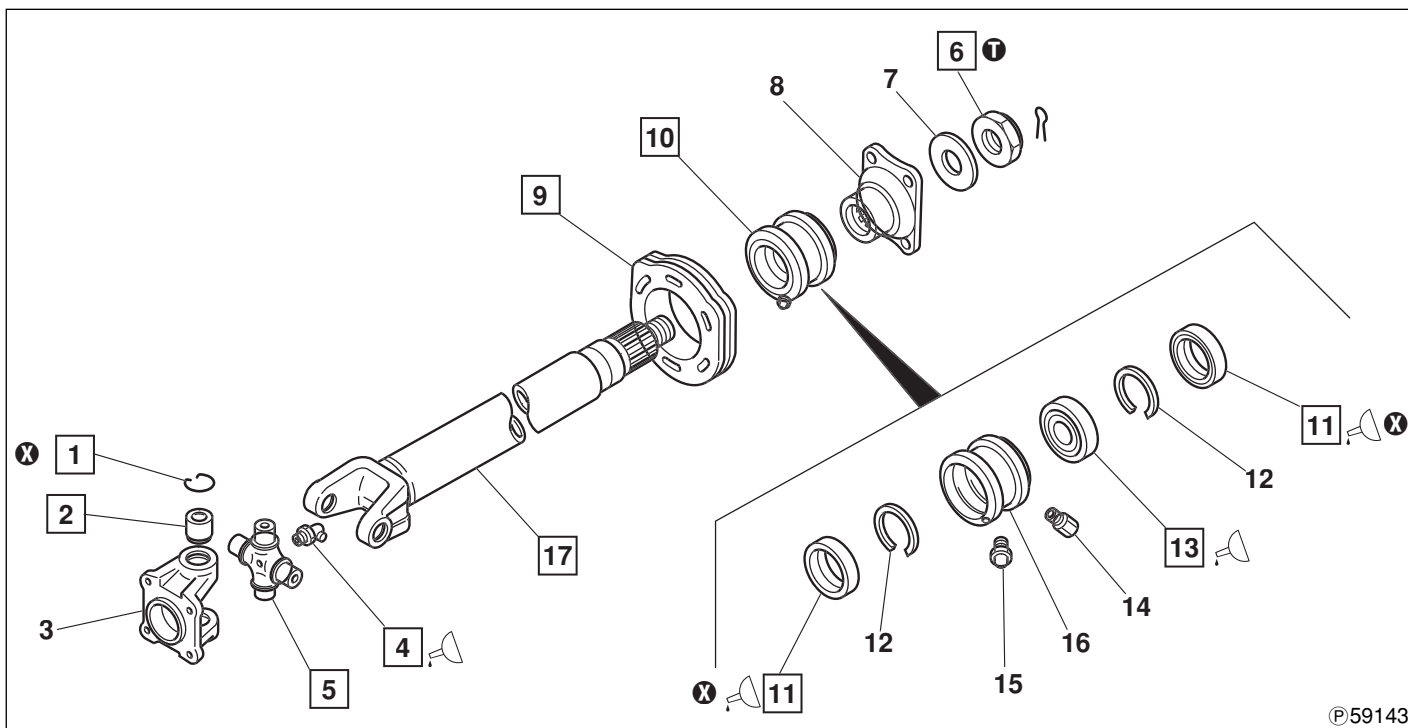
CAUTION

Be sure to check for cracks at the welded area after straightening has been done by means of a press.

NOTE

To measure the bend of rear propeller shaft 14, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

FRONT PROPELLER SHAFT < P8 >



● Inspection before disassembly

📖 P25-18

● Disassembly sequence

- | | | |
|------------------|----------------------------|--------------------------|
| 1 Snap ring | 8 Companion flange | 15 Grease nipple |
| 2 Needle bearing | 9 Cushion rubber | 16 Center bearing case |
| 3 Flange yoke | 10 Center bearing assembly | 17 Front propeller shaft |
| 4 Grease nipple | 11 Oil seal | |
| 5 Spider | 12 Snap ring | |
| 6 Nut | 13 Center bearing | |
| 7 Washer | 14 Relief valve | |
- ⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Universal joint spider kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
1 to 5	Clearance of spider in axial direction	0 to 0.15 {0 to 0.0059}	—	Adjust
2, 3, 17	Clearance between needle bearing and flange yoke, front propeller shaft	[44] 0.010 to -0.031 {[1.73] 0.00039 to -0.0012}	0.1 {0.0039}	Replace
2, 5	Clearance between needle bearing and spider	[28.907] 0.022 to 0.07 {[1.14] 0.00087 to 0.0028}	0.2 {0.0079}	Replace
17	Bend of front propeller shaft (Center)	—	0.6 {0.024}	Correct or replace

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

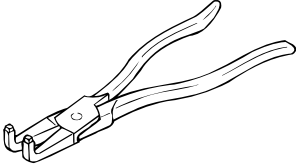
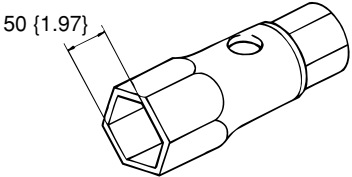
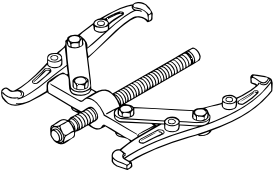
Location	Parts to be tightened	Tightening torque	Remarks
6	Nut (Companion flange mounting)	540 to 740 {395 to 540, 55 to 75}	—

Lubricant and/or sealant

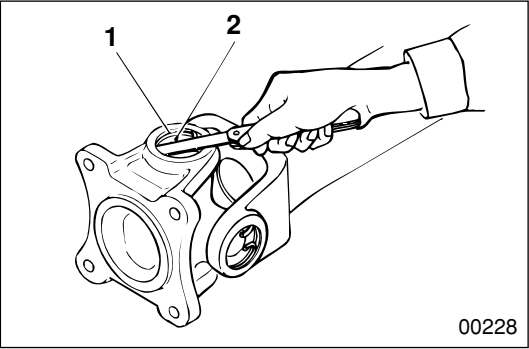
Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from spider dust seal
11	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
13	Pack area of center bearing assembly that houses ball bearings	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from relief valve

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Snap ring expander  00227	MH061001	Removal and installation of snap ring
7	Socket wrench  00561	44490-44101	Removal and installation of companion flange nut (Commercially available equivalent can be used)
11	Gear puller  00553	MH061102	Removal of center bearing assembly

FRONT PROPELLER SHAFT < P8 >



◆ Service procedure

● Inspection before disassembly

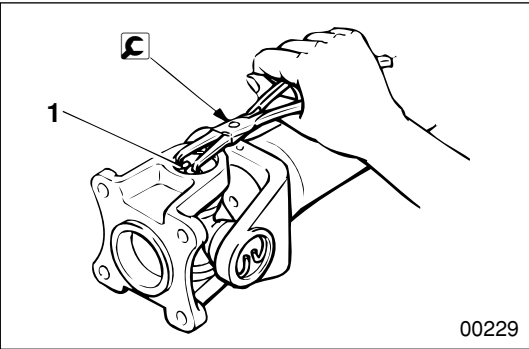
Clearance in axial direction for spider
Press needle bearing 2 downward firmly, and measure the clearance between snap ring 1 and the needle bearing. If the measured value is higher than the standard value, adjust it by changing the thickness of the snap ring.

- Available snap ring thicknesses

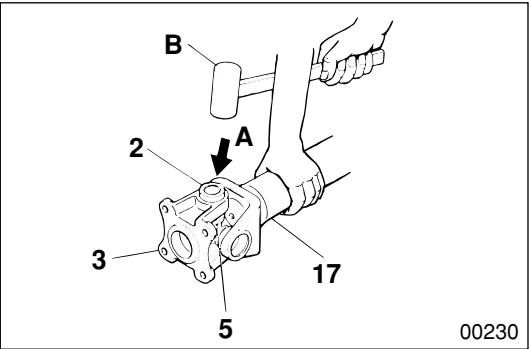
Part name	Thickness	Identification color
Snap ring A	3 mm {0.12 in.}	Green
Snap ring B	3.05 mm {0.12 in.}	White
Snap ring C	3.1 mm {0.12 in.}	Red
Snap ring D	3.15 mm {0.12 in.}	Blue
Snap ring E	3.2 mm {0.13 in.}	Yellow

NOTE

For snap ring 1, it is recommended that you use rings with the same thickness on both ends to ensure balanced revolution.

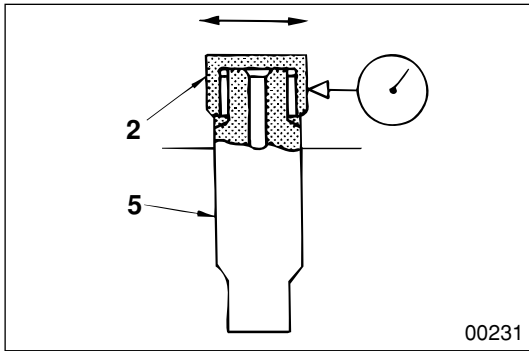


1 Removal and installation of snap ring



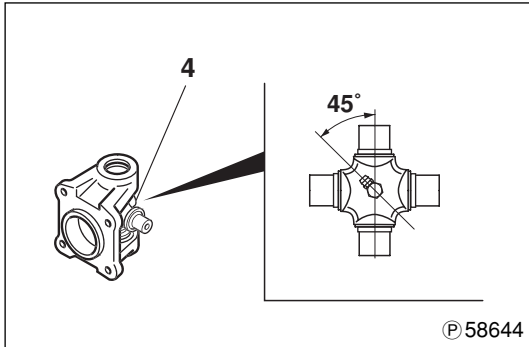
2 Removal of needle bearing

- Put alignment marks on needle bearing 2 and spider 5.
- Put alignment marks across flange yoke 3 and front propeller shaft 17.
- Hit the yoke lightly at shoulder area A so that needle bearing 2 bounces out due to reaction.
B : Mallet



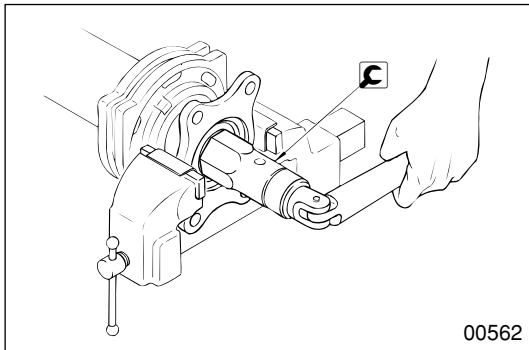
2 5 Clearance between needle bearing and spider

Measure the play towards the diameter direction between needle bearing **2** and spider **5**. If the measured value is higher than the limit, replace with universal joint spider kit.

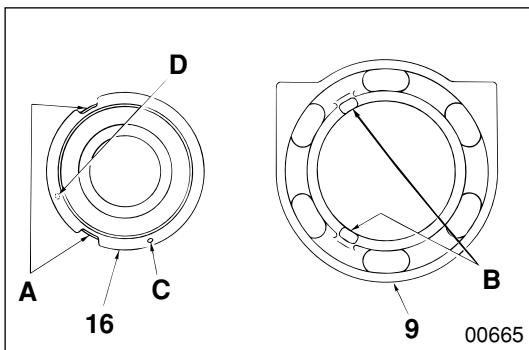


4 Installation of grease nipple

Install grease nipple **5** at the angle indicated in the illustration.



6 Removal and installation of nut



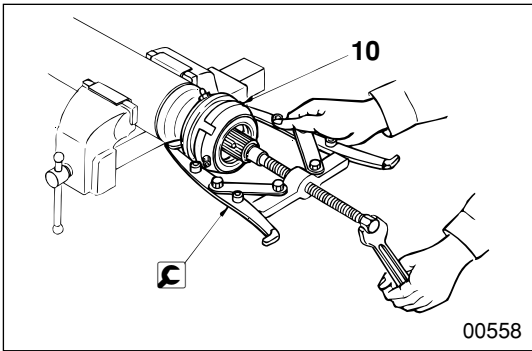
9 Installation of cushion rubber

- Align part **A** of center bearing case **16** with part **B** of cushion rubber **9**, and fit them together. If it is difficult to fit them together, use some soap water to make the job easier.
- Assemble center bearing case **16** so that grease nipple mounting hole **D** faces downward.

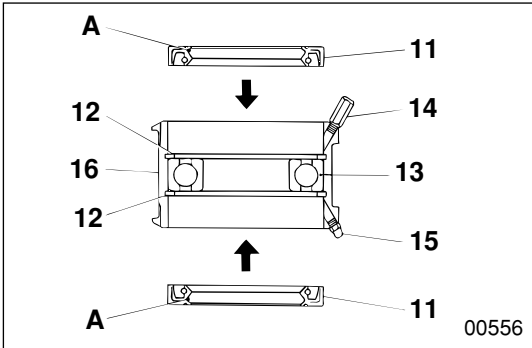
C : Relief valve mounting hole

D : Grease nipple mounting hole

FRONT PROPELLER SHAFT < P8 >

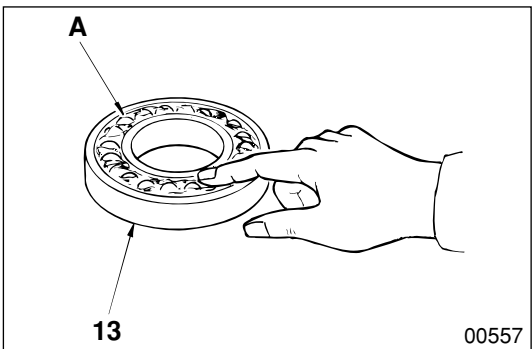


10 Removal of center bearing housing



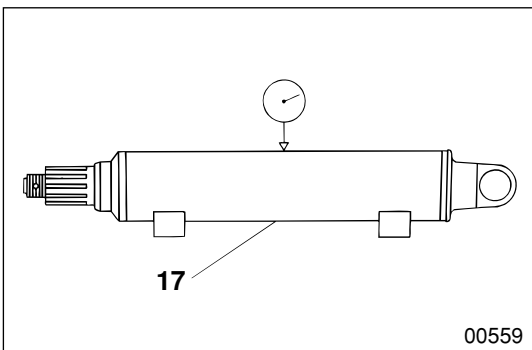
11 Installation of oil seal

- Apply grease to lip area **A** of oil seal **11** and install in the direction as illustrated.
- Install oil seal **11** flush with the end of center bearing case **16**.



13 Packing grease in center bearing

Pack grease into the area that houses ball bearings **A** of center bearing **13**.



17 Bend of front propeller shaft

Measure bend of front propeller shaft **17** at its center. If the measured value is higher than the limit, correct or replace it.

CAUTION

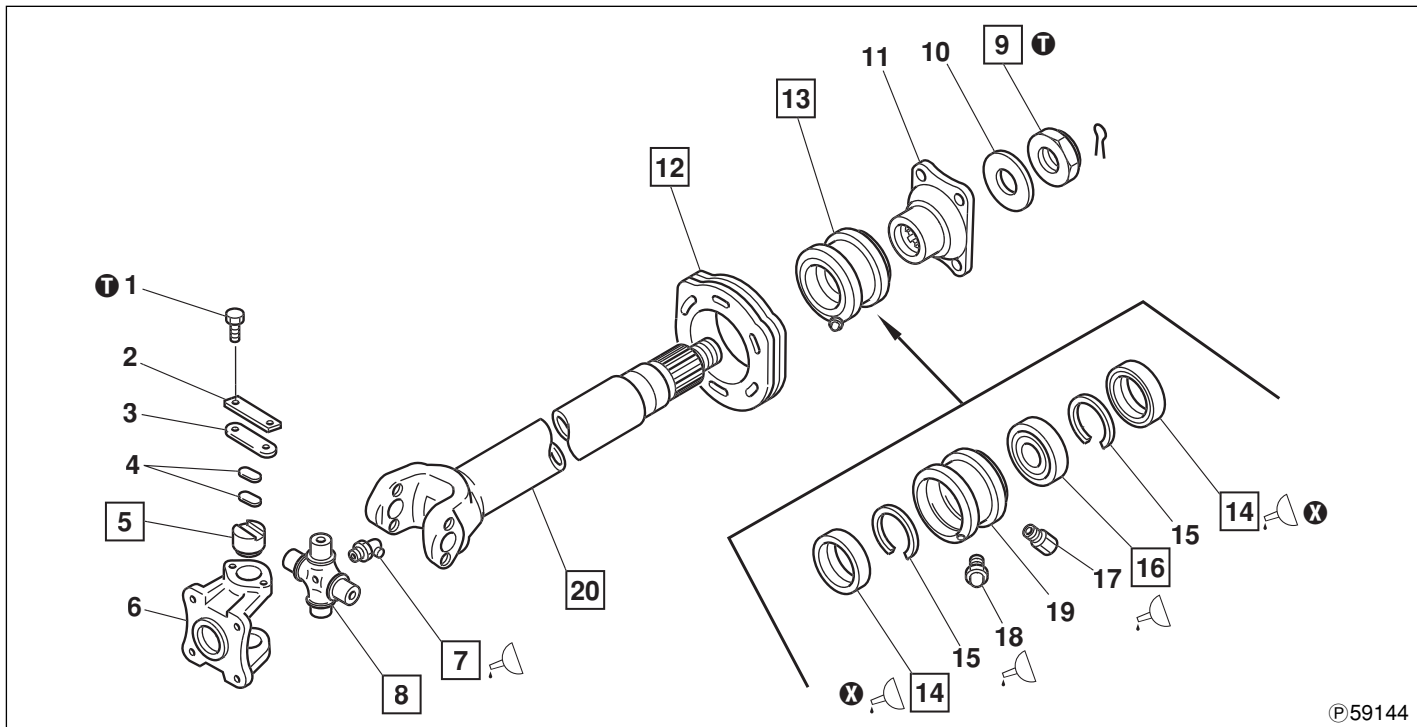
Be sure to check for cracks at the welded area after straightening has been done by means of a press.

NOTE

To measure the bend of front propeller shaft **17**, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

MEMO

FRONT PROPELLER SHAFT < P10, P12 >



● Inspection before disassembly

📖 P25-24

● Disassembly sequence

- | | | |
|-------------------------|----------------------------|--------------------------|
| 1 Bolt | 9 Nut | 17 Relief valve |
| 2 Lock plate | 10 Washer | 18 Grease nipple |
| 3 Bearing case retainer | 11 Companion flange | 19 Center bearing case |
| 4 Shim | 12 Cushion rubber | 20 Front propeller shaft |
| 5 Needle bearing | 13 Center bearing assembly | |
| 6 Flange yoke | 14 Oil seal | |
| 7 Grease nipple | 15 Snap ring | |
| 8 Spider | 16 Center bearing | |

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Universal joint spider kit

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
1 to 8	Clearance of spider in axial direction		0 to 0.15 {0 to 0.0059}	—	Adjust
5, 8	Clearance between needle bearing and spider	P10	[30.494] 0.023 to 0.07 {[1.20] 0.00091 to 0.0028}	0.2 {0.0079}	Replace
		P12	[36.25] 0.024 to 0.079 {[1.43] 0.00094 to 0.0031}		
5, 6 20	Clearance between needle bearing and flange yoke, front propeller shaft	P10	[46] 0.030 to -0.011	0.1 {0.0039}	Replace
		P12	[52] 0.037 to -0.012		
20	Bend of front propeller shaft (Center)		—	0.6 {0.024}	Correct or replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

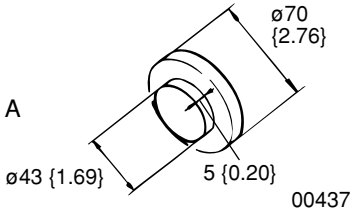
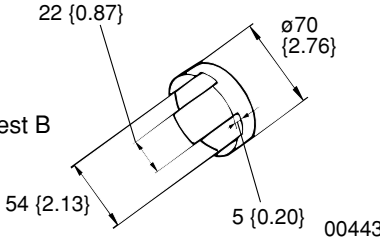
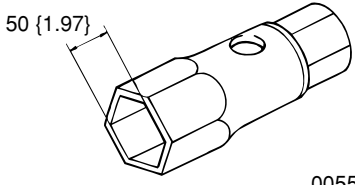
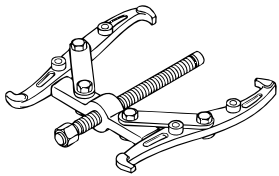
Location	Parts to be tightened		Tightening torque	Remarks
1	Bolt (Needle bearing mounting)	P10	18 to 26 {13 to 20, 1.8 to 2.7}	—
		P12	35 to 53 {26 to 39, 3.6 to 5.4}	
9	Nut (Companion flange mounting)		540 to 740 {395 to 540, 55 to 75}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from spider dust cover
14	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
16	Pack area of center bearing assembly that houses ball bearings	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
18	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	Pack until grease overflows from relief valve

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
5	Spider assembly rest A 	03724-13000	Press-fitting of needle bearing
5	Spider assembly rest B 	03724-14000	Press-fitting of needle bearing
9	Socket wrench 	44490-44101	flange nut (Commercially available equivalent can be used)
19	Gear puller 	MH061102	Removal of center bearing assembly

FRONT PROPELLER SHAFT < P10, P12 >

◆ Service procedure

● Inspection before disassembly

Clearance in axial direction for spider

Measure the clearance of needle bearing 5 (shim adjustment clearance = $D - C$). If the measured value is higher than the standard value, adjust it by changing the thickness of shim 4.

- Available shim thicknesses

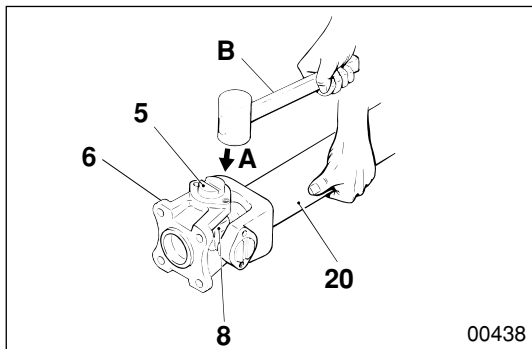
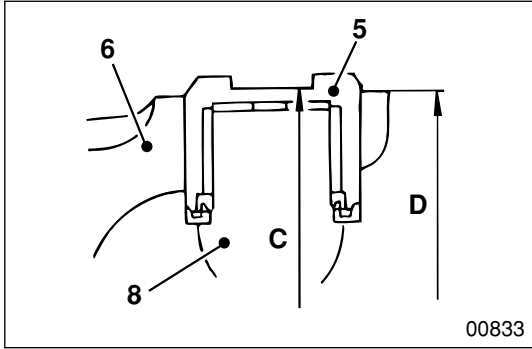
Part name	Thickness
Shim A	0.1 mm {0.0039 in.}
Shim B	0.2 mm {0.0079 in.}

CAUTION ⚠

Make sure that shim 4 does not protrude above the surface of flange yoke 6 or needle bearing 5 will seize up.

NOTE

For shim 4, it is recommended that you use shims with the same thickness on both ends to ensure balanced revolution.



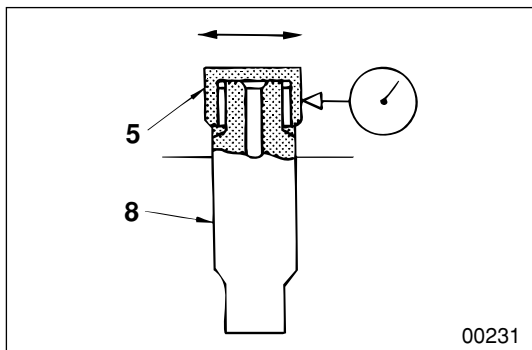
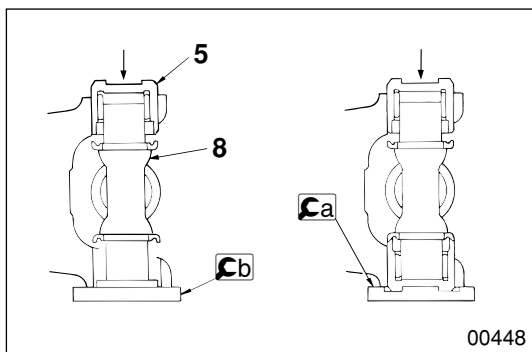
5 Needle bearing

[Removal]

- Put alignment marks on needle bearing 5 and spider 8.
- Put alignment marks across flange yoke 6 and front propeller shaft 20.
- Hit the yoke lightly at shoulder area A so that needle bearing 5 bounces out due to reaction.

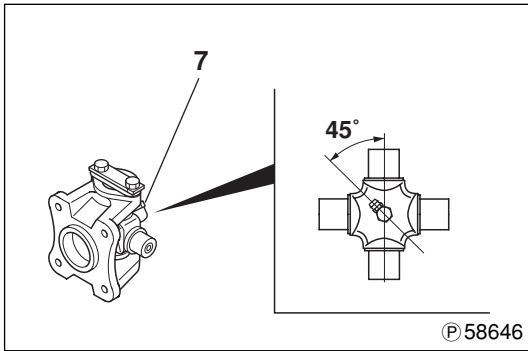
B : Mallet

[Installation]



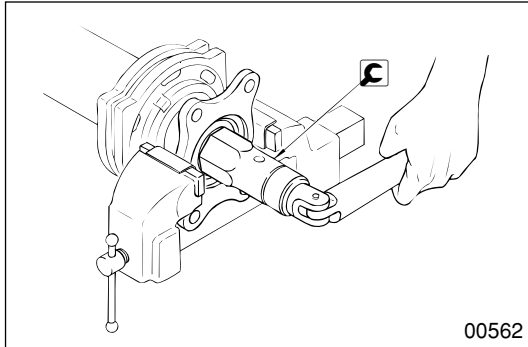
5 8 Clearance between needle bearing and spider

Measure the play towards the diameter direction between needle bearing 5 and spider 8. If the measured value is higher than the limit, replace with universal joint spider kit.

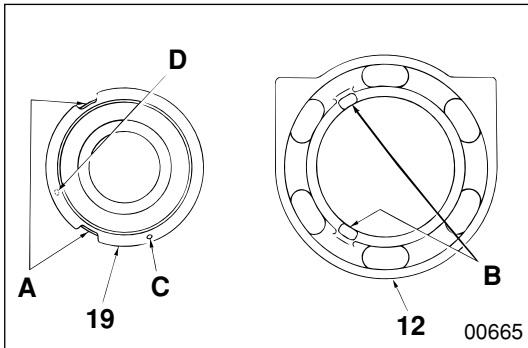


7 Installation of grease nipple

Install grease nipple **7** at the angle indicated in the illustration.



9 Removal and installation of nut



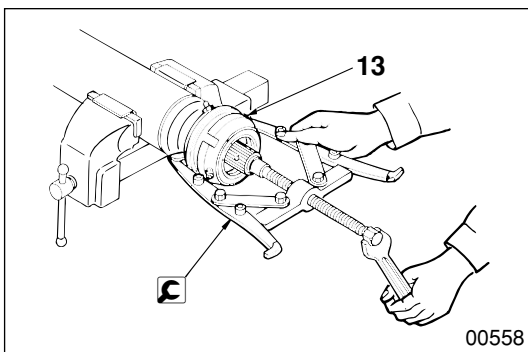
12 Installation of cushion rubber

- Align part **A** of center bearing case **20** with part **B** of cushion rubber **13**, and fit them together. If it is difficult to fit them together, use some soap water to make the job easier.

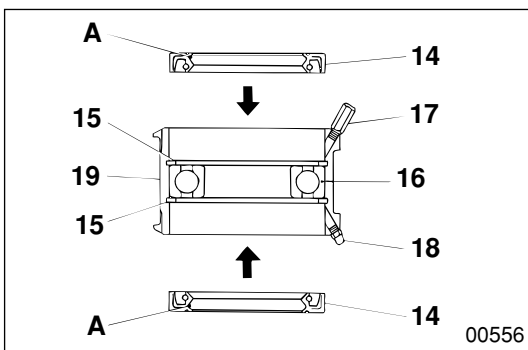
C : Relief valve mounting hole

D : Grease nipple mounting hole

- Assemble center bearing case **20** so that grease nipple mounting hole **D** faces downward.



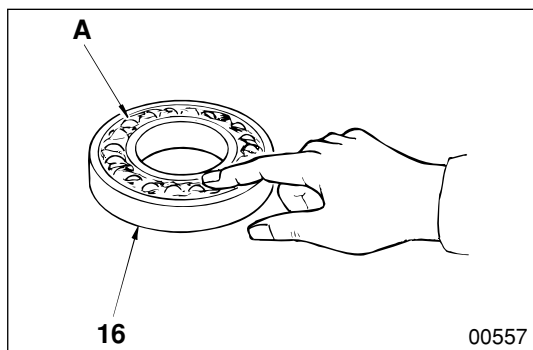
13 Removal of center bearing housing



14 Installation of oil seal

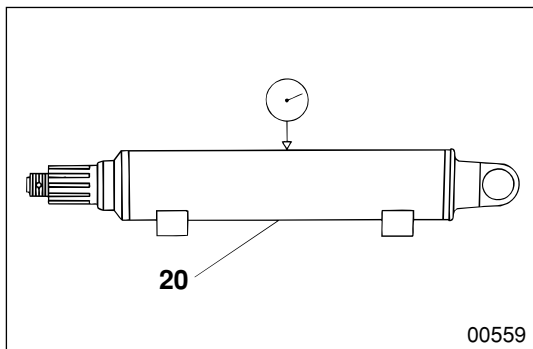
- Apply grease to lip area **A** of oil seal **14** and install in the direction as illustrated.
- Install oil seal **14** flush with the end of center bearing case **19**.

FRONT PROPELLER SHAFT < P10, P12>



16 Packing grease in center bearing

Pack grease into the area that houses ball bearings **A** of center bearing **16**.



20 Bend of front propeller shaft

Measure bend of front propeller shaft **20** at its center. If the measured value is higher than the limit, correct or replace it.

CAUTION

Be sure to check for cracks at the welded area after straightening has been done by means of a press.

NOTE

To measure the bend of front propeller shaft **20**, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

Adjustment after Assembly

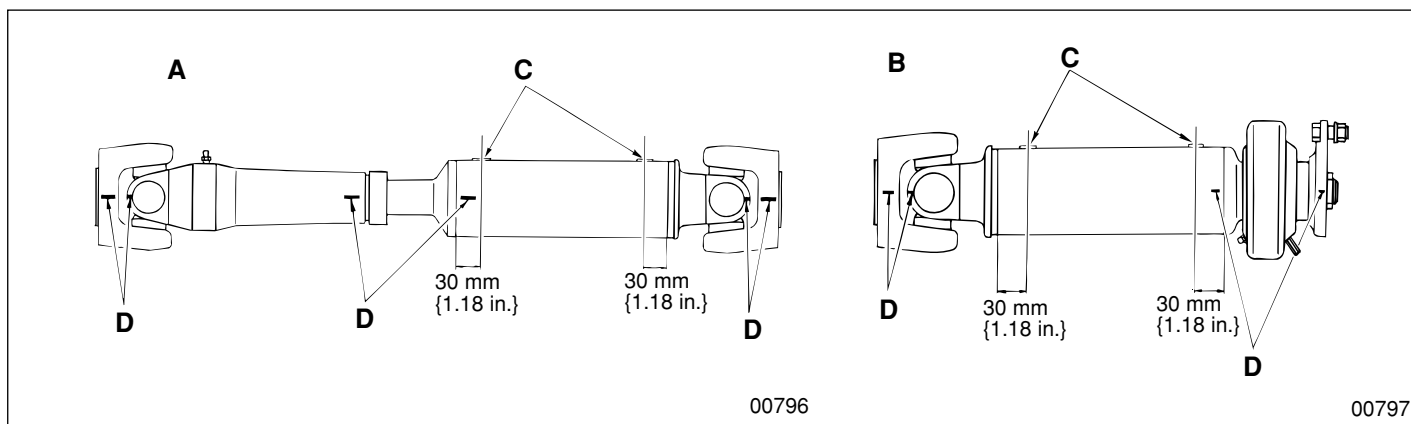
- (1) After any correction has been made of propeller shaft deflection, or replacement of flange yoke and universal joint, adjust the amount of balance of completed propeller shaft assembly on a balancing machine, and make adjustment by installing a balance piece(s) so that the amount comes within the permissible limit.
- (2) There are two methods of correcting dynamic balance: the polar coordinate system method, and the 90-degree component force method.
 - Polar coordinate system method: P8, P10, P12
 - 90-degree component force method: P10, P12
- (3) Permissible amount of unbalance
 - 0.49 N·cm {0.0036 lbf.ft, 50 gf·cm}/1600 rpm (Pipe outer periphery)

NOTE

When adjusting a propeller shaft with a large amount of deflection, the 90-degree component force < P8, P10, P12 > method is preferred since this method requires a smaller number of balance pieces.

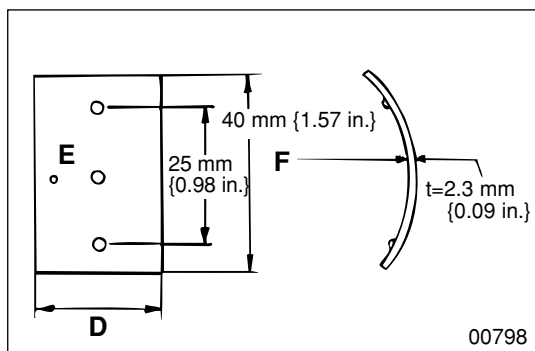
- (4) Method of correction by way of polar coordination method

- Balance piece attachment point



A : Rear propeller shaft
B : Front propeller shaft

C : Balance piece attachment point
D : Aligning mark



- Balance pieces available

Part name	P8, P10, P12	Mass g {oz}	Dimension D mm {in.}
Balance piece	G	10 {0.35}	14 {0.55}
Balance piece	A	20 {0.71}	28 {1.10}
Balance piece	B	40 {1.41}	55.7 {2.19}
Balance piece	C	60 {2.12}	83.5 {3.29}
Balance piece	—	30 {1.06}	42 {1.65}

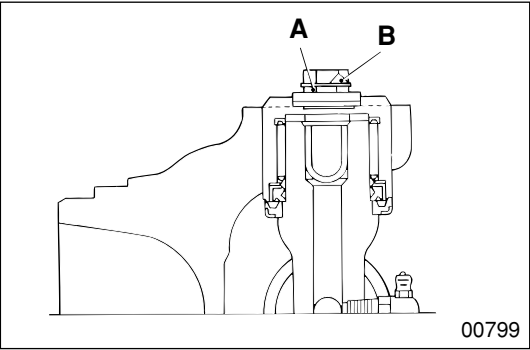
E : Piece punch mark
F : R45 mm {1.77 in.} (R41.3 mm {1.63 in.} only for P8 and P10 balance piece G)

NOTE

- Maximum balance piece allowed for one point is 120g {4.23 oz}.
- Use a combination that keeps balance pieces to the minimum.

BALANCING PROPELLER SHAFT

(5) Correction using 90-degree component force method



● Installation of balance pieces

Alignment marks are the same as for the polar coordinate system.

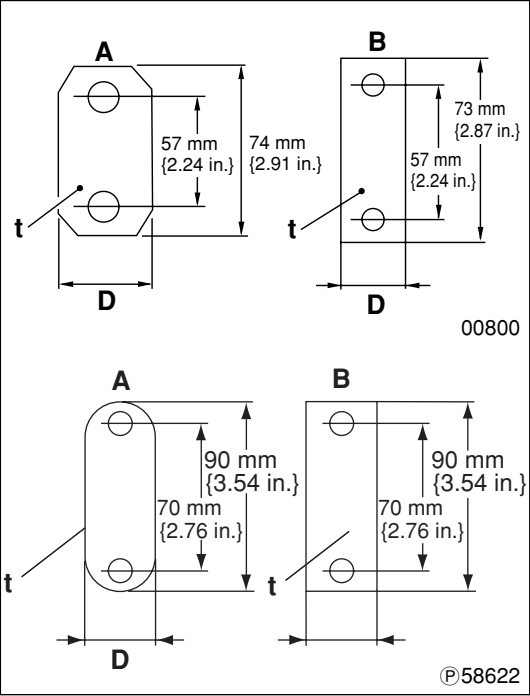
📖 P25-27

A : Balance piece

B : Lock plate

• Available lock plates and balance pieces

Model	Part name	Mass g {oz.}	Dimension D mm {in.}	Plate thickness t mm {in.}
P10	Lock plate	8 {0.28}	18 {0.71}	0.8 {0.031}
	Balance piece A	20 {0.71}	25 {0.98}	1.6 {0.063}
	Balance piece B	35 {1.23}	21.6 {0.85}	3.2 {0.13}
	Balance piece C	50 {1.76}	32.2 {1.27}	3.2 {0.13}
P12	Lock plate	13 {0.46}	20 {0.79}	2.0 {0.079}
	Balance piece A	7 {0.28}	28 {1.10}	0.35 {0.014}
	Balance piece B	20 {0.71}	32 {1.26}	1.0 {0.039}
	Balance piece C	35 {1.23}	29 {1.14}	2.0 {0.079}
	Balance piece D	50 {1.76}	36 {1.42}	2.3 {0.091}



NOTE

- **Maximum balance piece allowance for one point is 120 g {4.23 oz.}.**
- **Use a combination that keeps the number of balance pieces to the minimum.**



Group 26

Front Axle

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	26- 2
STRUCTURE AND OPERATION	26- 2
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Adjustment of Wheel Alignment	26- 8
• Adjustment of Steering Angle	26-12
• Measurement of Side Slip	26-12
WORK BEFORE REMOVAL AND INSTALLATION OF FRONT AXLE ..	26-13
WHEEL HUB AND BRAKE DRUM	
< FK >	26-14
< FM (Air-Over Hydraulic Brake) >	26-28
< FM (Full-Air Brake) >	26-42
FRONT AXLE, KNUCKLE AND KINGPIN	
< FK >	26-56
< FM (Air-Over Hydraulic Brake) >	26-62
< FM (Full-Air Brake) >	26-70

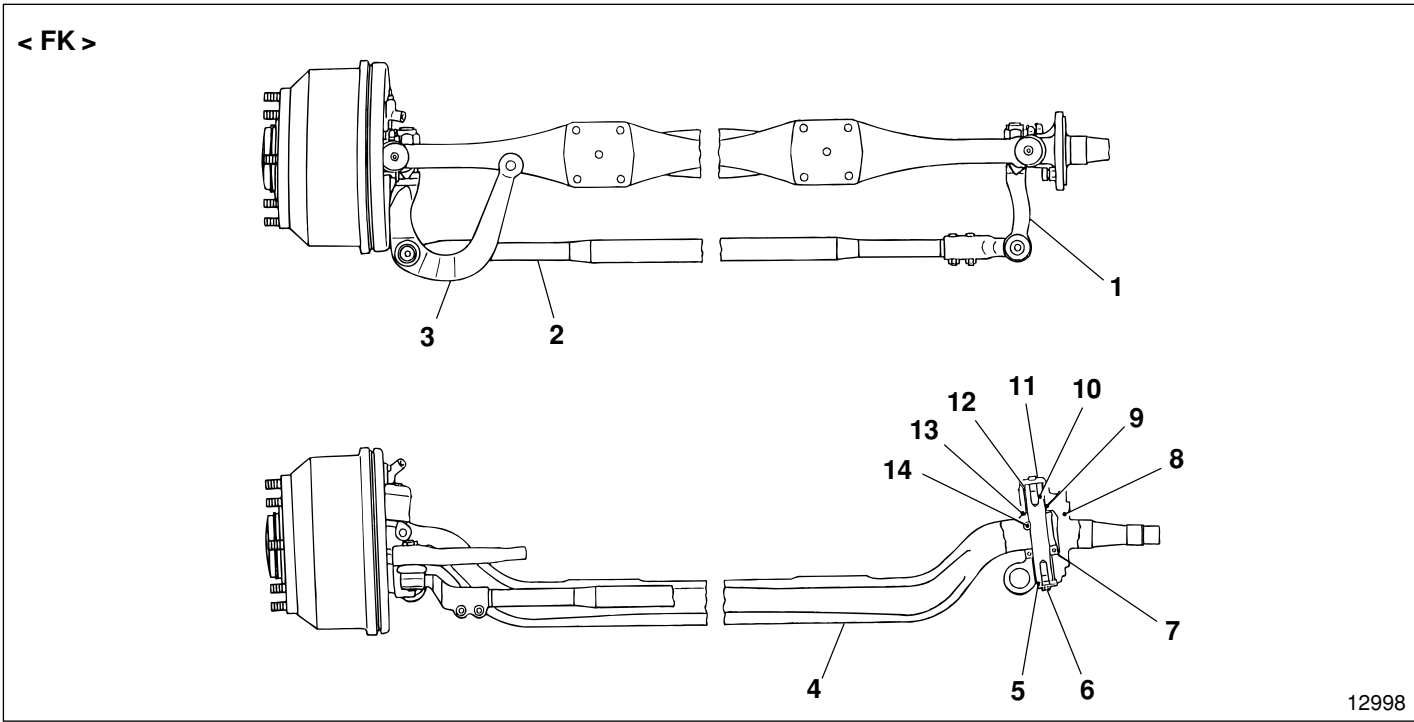
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item \ Vehicle model	FK	FM61, FM64	FM65
Front axle Model Type	F040T I-section, reverse elliot type	F060T I-section, reverse elliot type	F070T I-section, reverse elliot type
Kingpin Outer diameter × Length	mm {in.} 35×195 {1.38×7.68}	45×221 {1.77×8.70}	50×243 {1.97×9.57}
Tread	mm {in.} 1785 {70.3}	1880 {74.0} (11R22.5)	1920 {75.6}
Mass	kg {lb} Approximately 185 {405}	Approximately 300 {660}	Approximately 360 {795}

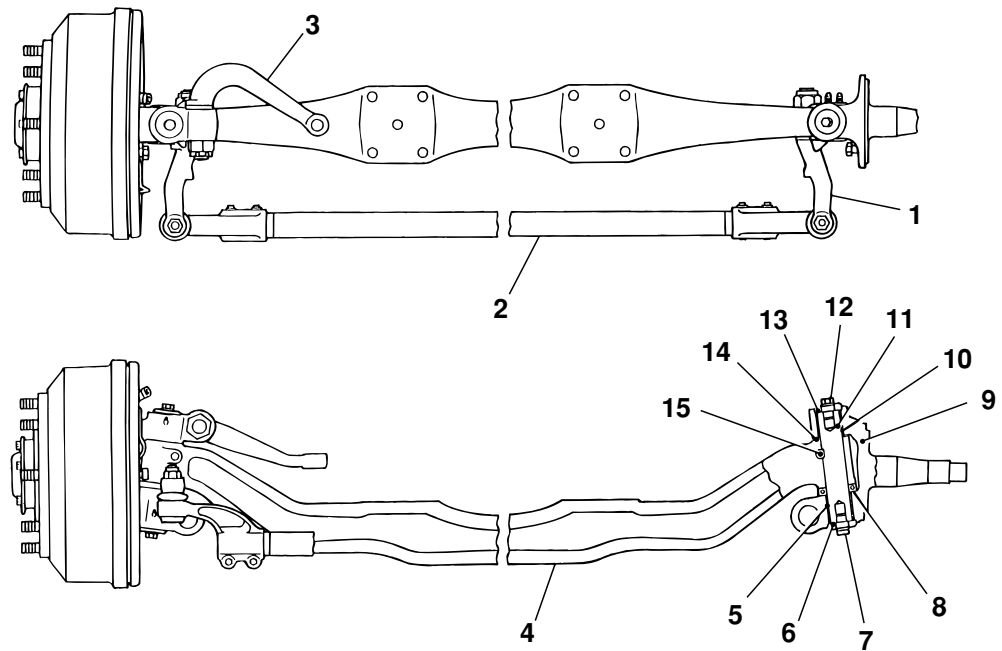
STRUCTURE AND OPERATION

Front Axle, Knuckle and Kingpin



- | | |
|-----------------------|------------------|
| 1 Tie rod arm | 8 Knuckle |
| 2 Tie rod assembly | 9 Oil seal |
| 3 Knuckle arm | 10 Kingpin |
| 4 Front axle | 11 Kingpin cap |
| 5 Dust seal | 12 Bushing |
| 6 Lower kingpin cover | 13 Thrust washer |
| 7 Bearing | 14 Set bolt |

< FM61, FM64 >



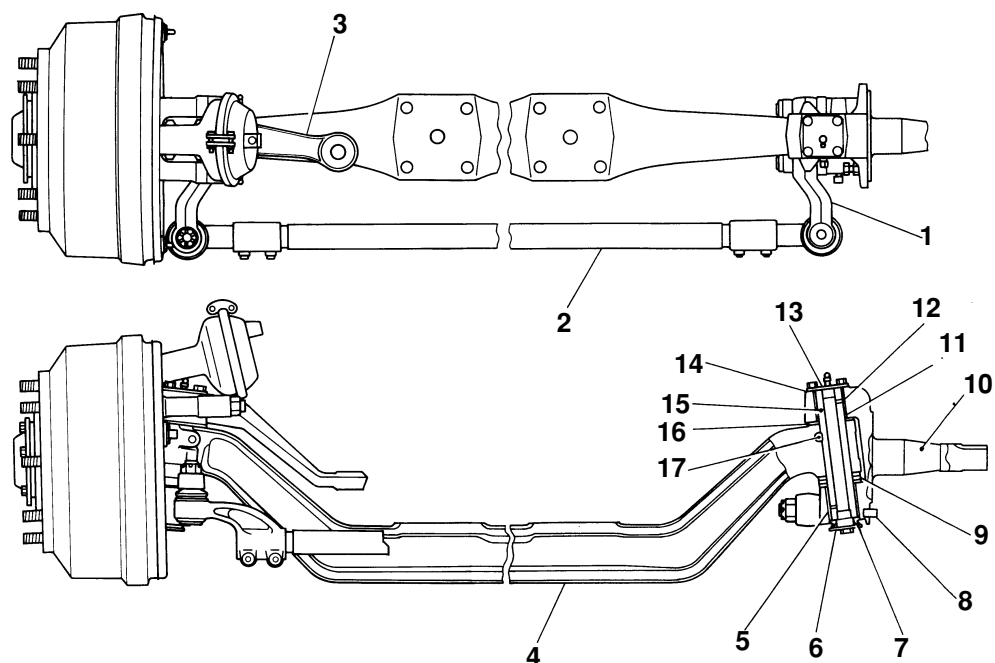
04152

- 1 Tie rod arm
- 2 Tie rod assembly
- 3 Knuckle arm
- 4 Front axle
- 5 Lower bushing
- 6 Dust seal
- 7 Lower kingpin cover
- 8 Bearing

- 9 Knuckle
- 10 Oil seal
- 11 Kingpin
- 12 Upper kingpin cover
- 13 Dust seal
- 14 Thrust washer
- 15 Set bolt

STRUCTURE AND OPERATION

< FM65 >

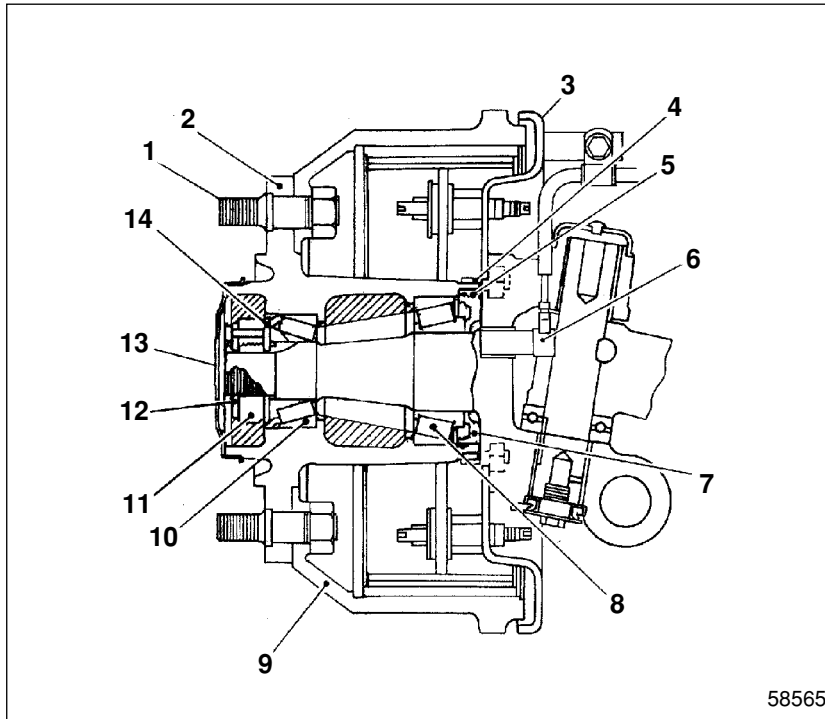


45319

- | | |
|-----------------------|------------------------|
| 1 Tie rod arm | 10 Knuckle |
| 2 Tie rod assembly | 11 Oil seal |
| 3 Knuckle arm | 12 Upper bushing |
| 4 Front axle | 13 Upper kingpin cover |
| 5 Bushing | 14 O-ring |
| 6 Lower kingpin cover | 15 Kingpin |
| 7 Dust seal | 16 Thrust washer |
| 8 Knock pin | 17 Set bolt |
| 9 Bearing | |

Wheel Hub and Brake Drum

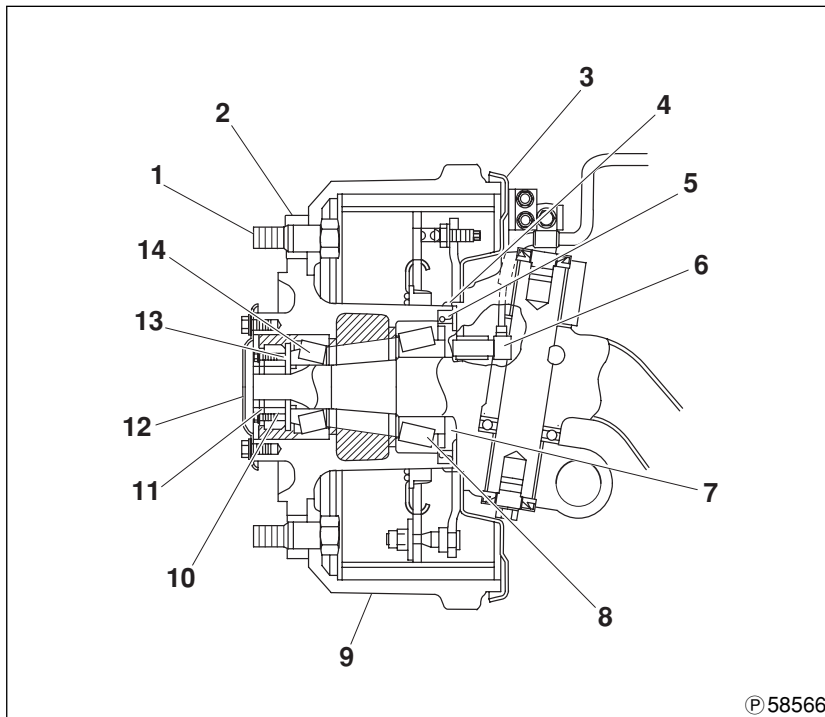
< FK >



- 1 Hub bolt
- 2 Front wheel hub
- 3 Front brake assembly
- 4 Rotor
- 5 Oil seal
- 6 Wheel speed sensor
- 7 Oil seal retainer
- 8 Inner bearing
- 9 Front brake drum
- 10 Outer bearing
- 11 Lock nut
- 12 Lock plate
- 13 Wheel hub cap
- 14 Lock washer

58565

< FM61, FM64 >

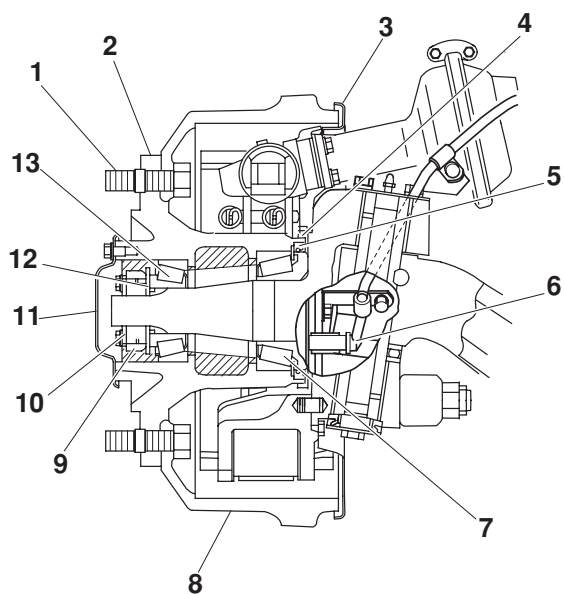


- 1 Hub bolt
- 2 Front wheel hub
- 3 Front brake assembly
- 4 Rotor
- 5 Oil seal
- 6 Wheel speed sensor
- 7 Oil seal retainer
- 8 Inner bearing
- 9 Front brake drum
- 10 Lock nut
- 11 Lock plate
- 12 Wheel hub cover
- 13 Lock washer
- 14 Outer bearing

⒫ 58566

STRUCTURE AND OPERATION

< FM65 >



- 1 Hub bolt
- 2 Front wheel hub
- 3 Front brake assembly
- 4 Rotor
- 5 Oil seal
- 6 Wheel speed sensor
- 7 Inner bearing
- 8 Front brake drum
- 9 Lock nut
- 10 Lock plate
- 11 Wheel hub cover
- 12 Lock washer
- 13 Outer bearing

© 58567

MEMO

ON-VEHICLE INSPECTION AND ADJUSTMENT

Adjustment of Wheel Alignment

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Wheel alignment	Toe-in (with tires on the ground)	5 to 7 {0.20 to 0.28} (Bias tyre) 1 to 3 {0.039 to 0.12} (Radial tyre)	—	Adjust
		Camber	FK	1°30'±1°00'	Adjust
			FM	1°00'±1°00'	Adjust
		Caster	2°30' ^{+1°30'} _{-1°00'}	—	Adjust
		Kingpin inclination angle	7°00'	7°00'±30'	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

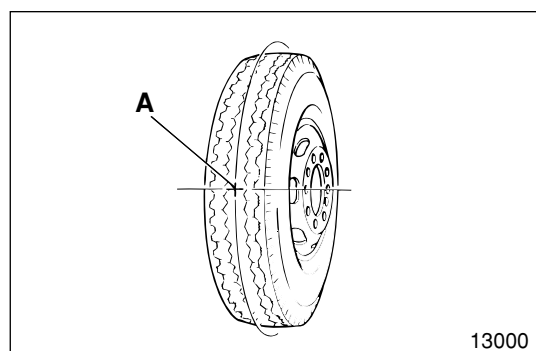
Location	Parts to be tightened		Tightening torque	Remarks
1	Nut (Tie rod end clamp fastening)	FK	78 {58, 8}	Wet
		FM	78 {58, 8}	—

NOTE

- Measure the wheel alignment when the vehicle is empty and level.
- Be sure that each part of the front axle has been serviced perfectly before adjusting the wheel alignment.

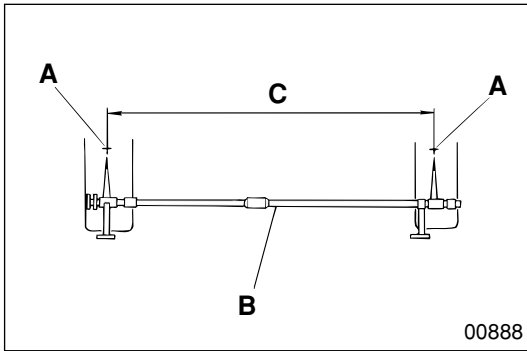
Before adjusting the wheel alignment, check for the following faults:

- Play in front wheel hub
- Play or looseness in kingpin
- Play or looseness in the joint between the tie rod and the knuckle arm
- Looseness of any fasteners
- Fatigued or damaged leaf springs
- Incorrect tire pressure
- Incorrect power steering booster backlash

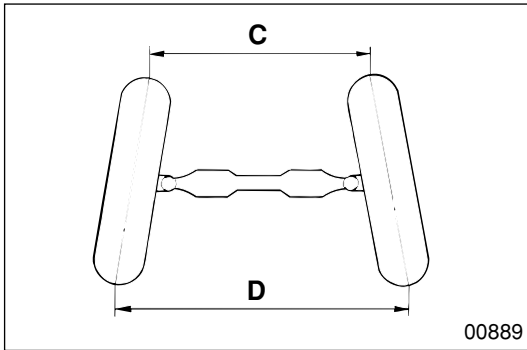


(1) Measurement and adjustment of toe-in

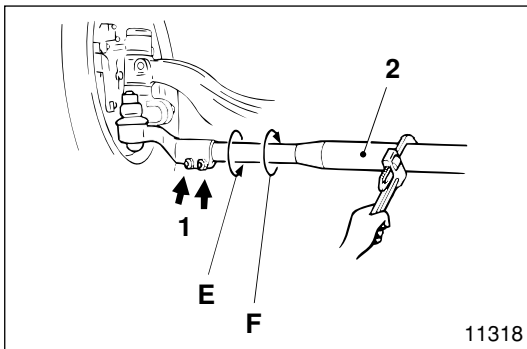
- Point the front wheels exactly forward.
- Put mark **A** on the left and right front tires at the height of front wheel axis and in the middle of the tire width.



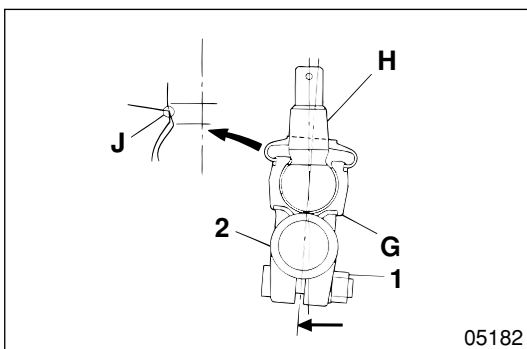
- Align the two points of toe-in gauge **B** to the respective marks **A** on the front tires. Measure the distance **C** between the marks at the front of the vehicle.



- Rotate the tires 180° and measure distance **D** between the marks at the rear of the vehicle with the tires on the ground.
- Check if the difference between distances **C** and **D** is within the standard value.



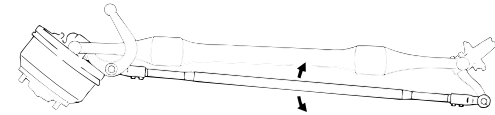
- If the measured value deviates from the standard value, with the tires pointed forward, loosen all four left and right nuts **1**.
- Adjust the toe-in to the standard value by turning tie rod **2** with a pipe wrench.
E : When adjusting to the toe-out direction
F : When adjusting to the toe-in direction
(★ : If tie rod **2** does not swing after the adjustment on P26-10, redo from this item.)



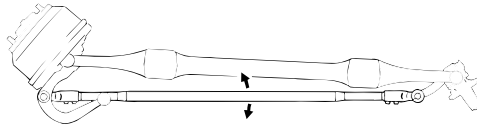
- Hold down tie rod **2** toward the front or rear of the vehicle so that left and right tie rod ends **G** are in contact **J** with ball studs **H** at the same time. In this state tighten four nuts **1**.
- When tightening nuts **1**, do not let tie rod ends **G** move toward the front or rear of the vehicle.
- When you are working on your own: first tighten nut **1** on one tie rod end **G**, then tighten the nut on the other tie rod end. When you tighten the nuts, make sure you hold down tie rod **2** towards the same direction each time.

ON-VEHICLE INSPECTION AND ADJUSTMENT

Steering wheel turned to the left



Steering wheel turned to the right



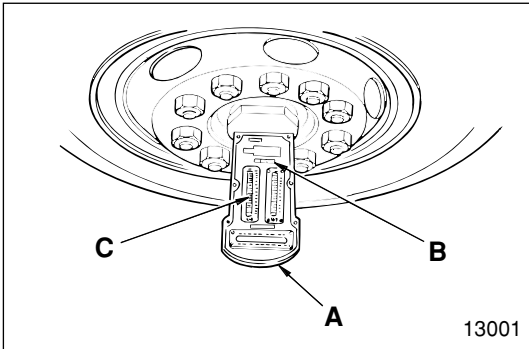
11319

- After adjustment, turn the steering wheel fully to the left until the knuckle stopper bolt is hit. In this state, shake tie rod **2** to check that you can move it toward the front or rear of the vehicle. Carry out the same inspection on the right side.
(Movability of the tie rod indicates that tie rod ends **G** are in contact with ball studs **H** at the same time.)

WARNING

Be very careful that your hand, or anything else, is not caught due to the movement of the tie rod when the steering wheel is turned left and right.

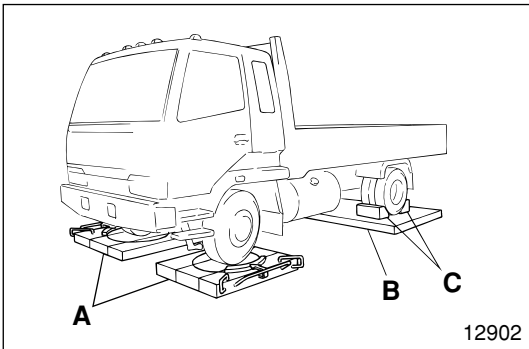
- If tie rod **2** does not swing, redo the procedure from the item marked ★. P26-9



13001

(2) Measurement of camber

- Point the front wheels exactly forward.
- Remove the wheel hub caps <FK> or the wheel hub covers <FM>.
- Wipe off grease from the knuckle end, and attach camber/caster /kingpin gauge **A** to the front wheel hub.
- While keeping the bubble in level **B** centered, measure the camber angle by reading the scale mark at the center of the bubble on camber scale **C**. Follow this procedure to measure the camber angles on the left and right sides.



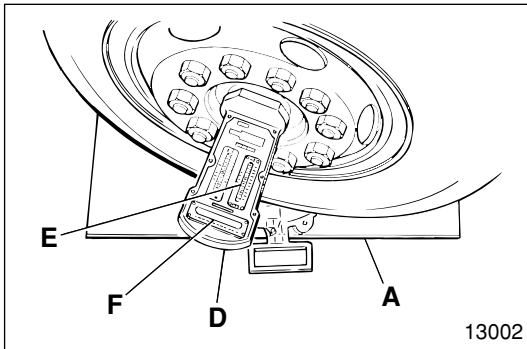
12902

(3) Measurement of caster and kingpin inclination angle

- Align turning radius gauges **A**. Prepare a platform **B** having the same height as the turning radius gauges and place the platform under the rear wheels so that the vehicle is kept level.
- Keep turning radius gauges **A** locked.
- Jack up the vehicle and set the left and right front wheels so that the ground contact area of both front tires and the turntables of turning radius gauge **A** meet at their respective centers.

WARNING

- **After jacking up the vehicle, chock the rear wheels securely with chocks **C**.**
- **Do not remove chocks **C** until the entire operation is completed.**



- Unlock turning radius gauge **A**, and set the scale to 0°.
- As in measuring camber explained previously, attach camber/caster kingpin gauge **D** tightly to the front wheel hub and keep the bubble centered.
- Apply the brake to the front wheels and turn the steering wheel slowly from the 0° point on the scale of turning radius gauge **A**, until direction changes 20° to the left for the left front wheel and 20° to the right for the right front wheel.

NOTE

It is not possible to obtain an exact reading of camber unless the brake is applied to the front wheels because the tires might rotate slightly.

- At the 20° point, align the bubbles in caster scale **E** and kingpin scale **F** to 0° by turning the adjuster.

NOTE

Kingpin scale F has scales for left and right; use the left scale when adjusting the left wheel, and the right scale when adjusting the right wheel.

- Turn the steering wheel slowly until the left front wheel changes its direction 20° to the right, or until the right front wheel changes its direction 20° to the left, past the 0° point of turning radius gauge **A** scale. At this point read the scale marks at the center of the bubbles on caster scale **E** and kingpin scale **F**. The scale marks indicate the caster and kingpin inclination angles.

ON-VEHICLE INSPECTION AND ADJUSTMENT

Adjustment of Steering Angle

Service standards

Location	Maintenance item			Standard value	Limit	Remedy
—	Steering angle	Inside (Outside : reference)	FK61	51° (38°)	—	Adjust
			FM61, FM64	40° (35°)	—	Adjust
			FM65	44° (36°)	—	Adjust

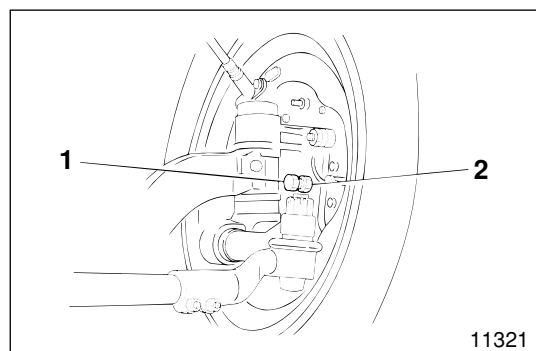
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Lock nut (Knuckle stopper bolt fastening)	78±12 {58±9, 8.0±1.2}	—

NOTE

Be sure that wheel alignment is adjusted perfectly before adjusting the steering angle.



- To adjust the steering angle, set the turning radius gauges and platform in the same way as for caster and kingpin inclination angle measurement.
- Turn the steering wheel to the left or right completely, and from the position where the turning radius gauge is aligned to 0°, adjust knuckle stopper bolt **1**. Adjust so that the steering angle is within the standard inside steering angle value, to the left for the left front wheel, and to the right for the right front wheel. Then, tighten lock nut **2** at specified torque.

Measurement of Side Slip

NOTE

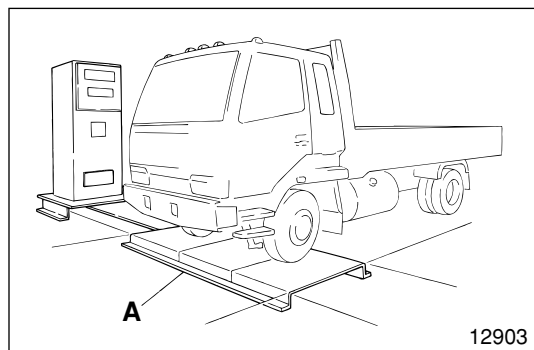
Be sure that wheel alignment is adjusted fully before measuring side slip.

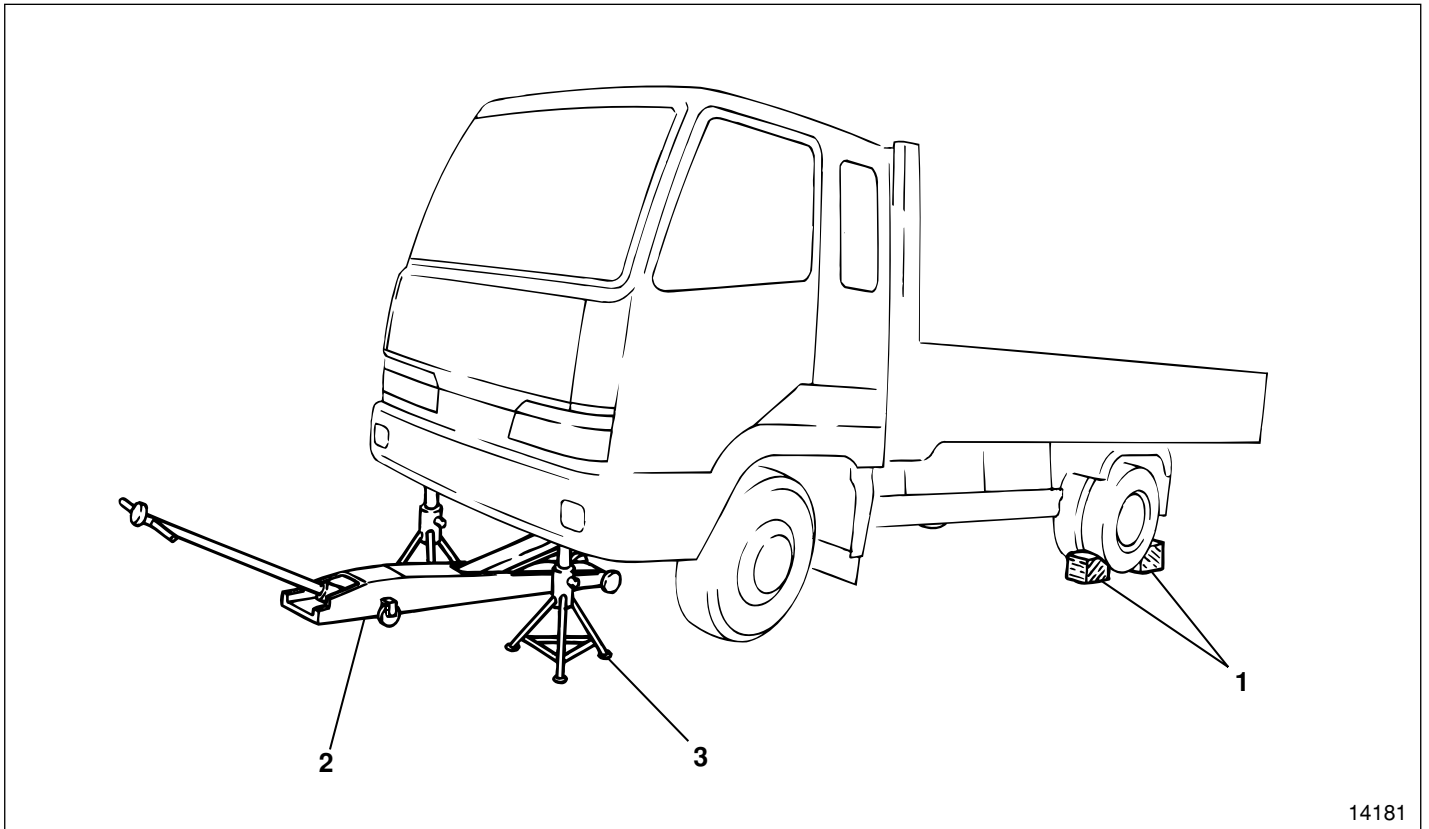
- Point the front wheels exactly forward.
- Maintain this position and slowly move vehicle forward, over side slip tester **A**, as slowly as possible.

NOTE

Make sure, when measuring side slip, that the wheels point exactly forward when the vehicle passes over side slip tester **A. Do not allow the wheels to veer from side-to-side.**

- The side slip is indicated by side slip tester **A** after the vehicle has passed through the tester. Readjust wheel alignment if slippage is deviated from the standard value per meter {3.28 ft.}.





14181

● Work sequence before removal

- 1 Place wheel chocks.
- 2 Jack up the front axle with a garage jack.
- 3 Support the front frame on rigid racks.

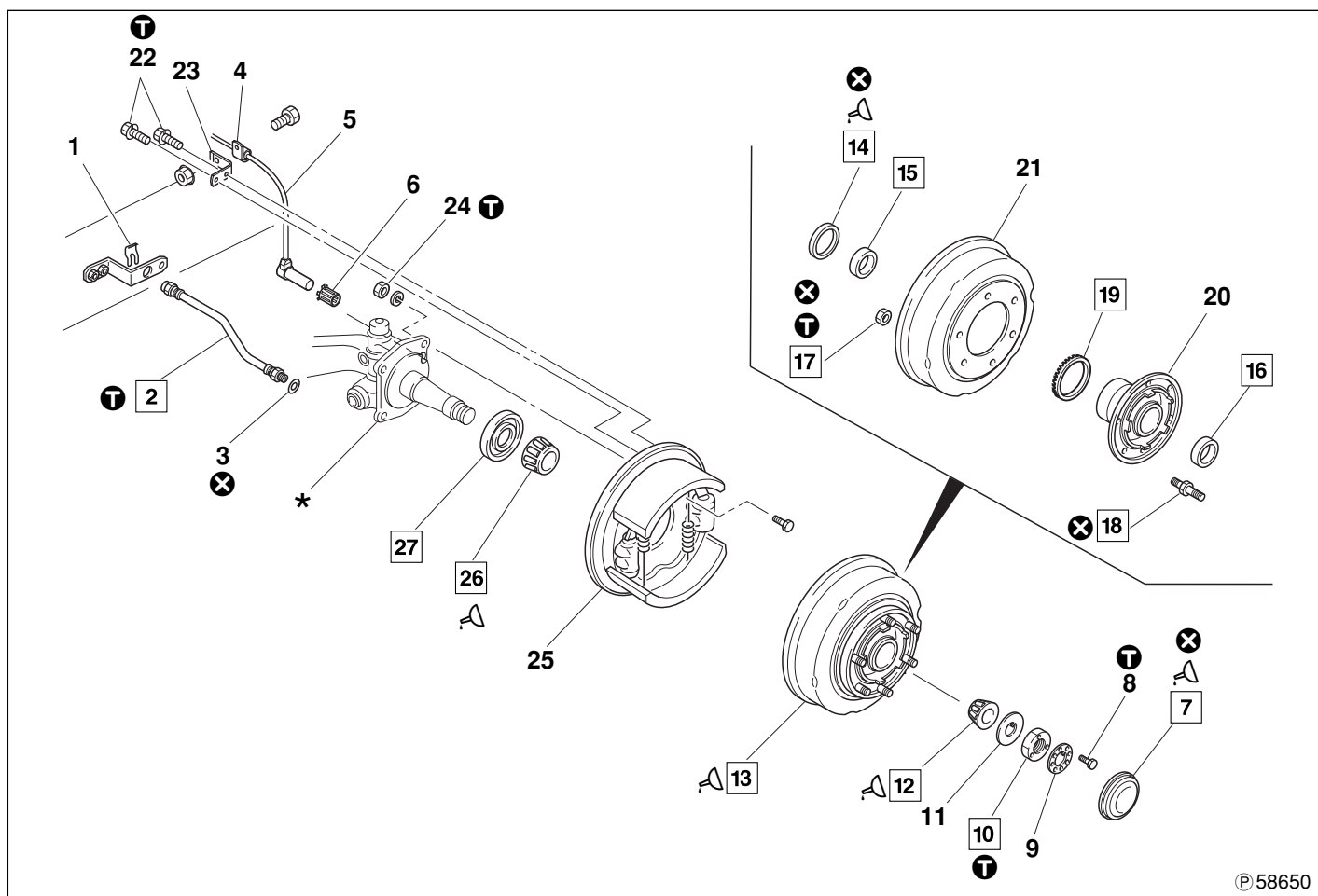
WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

● Work sequence after installation

Follow the work sequence before removal in reverse.

WHEEL HUB AND BRAKE DRUM < FK >



P 58650

● Disassembly sequence

- 1 Clip
- 2 Brake hose
- 3 Packing
- 4 Clip
- 5 Wheel speed sensor
- 6 Spring spacer
- 7 Wheel hub cap
- 8 Bolt
- 9 Lock plate
- 10 Lock nut
- 11 Lock washer
- 12 Outer bearing inner race
- 13 Wheel hub and brake drum assembly
- 14 Oil seal
- 15 Inner bearing outer race

- 16 Outer bearing outer race
- 17 Nut
- 18 Hub bolt
- 19 Rotor
- 20 Wheel hub
- 21 Brake drum Gr 35A
- 22 Bolt
- 23 Clip bracket
- 24 Nut
- 25 Brake assembly Gr 35A
- 26 Inner bearing inner race
- 27 Oil seal retainer

*: Knuckle P26-56

⊗: Non-reusable parts

CAUTION

Be sure to protect brake hose 2 from dust by fitting blanking plugs after removal.

NOTE

Do not disassemble brake drum 21 and wheel hub 20 except for replacement.

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

You must bleed air from the brake system after installing the brake hose, failure to do so would cause the brake to malfunction.  Gr 35A

CAUTION ⚠

- Keep oil and grease off lining surface of front brake assembly * and the inner surface of brake drum 21.
- Be careful not to damage oil seal 14 and rotor 19 when installing wheel hub and brake drum assembly 10 onto knuckle *.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
5	Wheel speed sensor	Resistance between terminals	950 to 1450Ω	—	Replace
		Insulation resistance	1MΩ or higher	—	Replace
12, 15, 16, 26	Starting torque of wheel hub bearing		1 to 4 N·m {0.72 to 2.89 ft.lbs, 0.1 to 0.4 kgf·m}	—	Tangential force at wheel hub bearing 9 to 35 N {1.98 to 7.94 lbf, 0.9 to 3.6 kgf}
19	Wobbling of rotor		0.1 {0.0039}	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Brake hose (Brake side)	21 to 30 {15 to 22, 2.1 to 3.1}	—
8	Bolt (Lock plate mounting)	7 to 11 {5.1 to 8, 0.7 to 1.1}	—
10	Lock nut	200 {145, 20}	Slackening off angle : 30° (one twelfth of a turn)
17	Nut (Wheel hub and brake drum mounting)	322 {235, 32.8}	—
22	Bolt (Bracket mounting)	9.8 to 14.0 {7 to 10, 1.0 to 1.4}	—
24	Nut (Brake assembly mounting)	135 {100, 13.8}	—

Lubricant and/or sealant

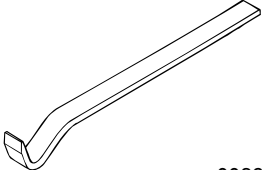
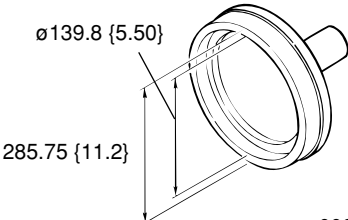
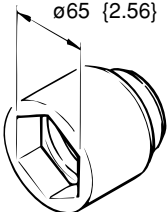
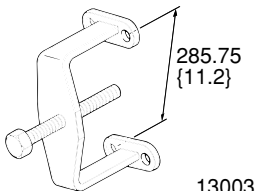
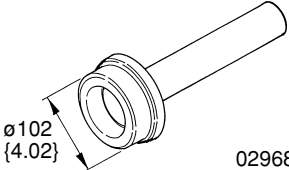
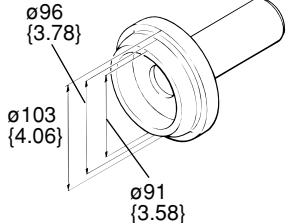
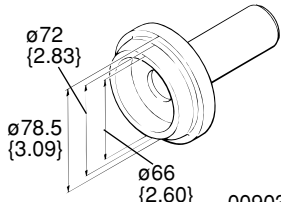
Location	Points of application	Specified lubricant and/or sealant	Quantity
7	Mating area of wheel hub cap and wheel hub	THREEBOND 1104	As required
12	Pack the space between rollers of wheel bearing inner race	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
13	Pack interior of wheel hub	Wheel bearing grease [NLGI No.2 (Li soap)]	300±20 g* {10.6±0.71 oz}
	Pack exterior of wheel hub (wheel hub cap side)		150±10 g* {5.29±0.35 oz}
14	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

*: For a wheel hub

WHEEL HUB AND BRAKE DRUM < FK >

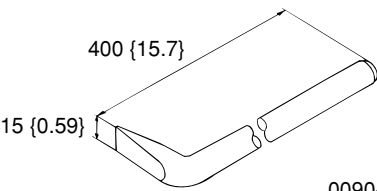
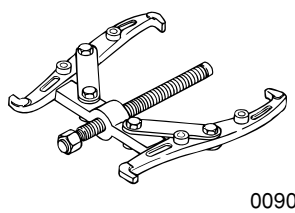
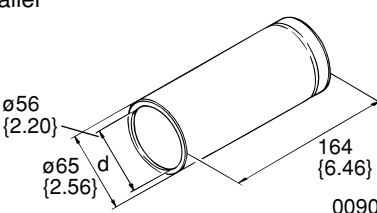
Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
4	Hub cap wrench  00898	MH061948	Removal of wheel hub cap
	Hub cap installer  00899	MH062204	Press-fitting of wheel hub cap
10	Socket wrench  00900	MH061531	Removal and installation of hub bearing lock nut
13	Wheel hub puller  13003	MH061993	Removal of hub and brake drum
14	Anti-lock brake system oil seal installer  02968	MH062305	Press-fitting of oil seal
15	Inner bearing installer  00903	MH061974	Press-fitting of inner bearing outer race
16	Outer bearing installer  00903	MC881484	Press-fitting of outer bearing outer race

Special tools

Unit : mm {in.}

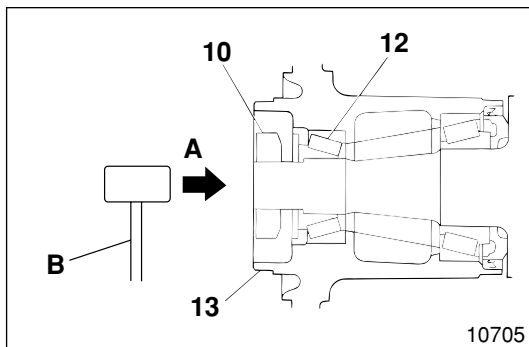
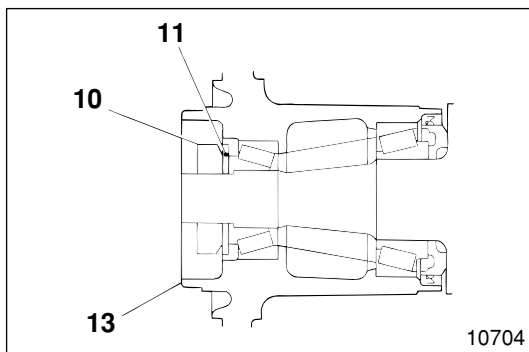
Location	Tool name and shape	Part No.	Application
26, 27	Lever 	MH061683	Prying lever for knuckle to oil seal retainer
	Gear puller 	MH061102	Removal of oil seal retainer and inner bearing inner race
	Inner bearing installer 	MH061475	Press-fitting of inner bearing inner race and oil seal retainer

◆ Service procedure

● Starting torque of wheel hub drum

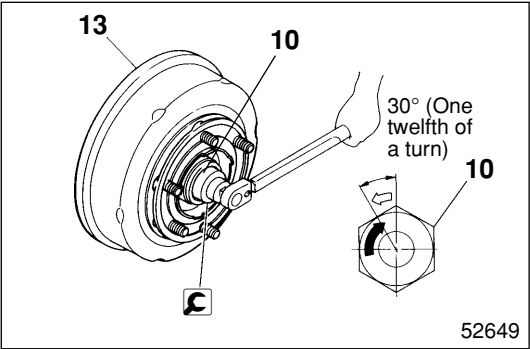
[Adjustment]

- Install lock washer **11** and lock nut **10**, then tighten the lock nut at specified torque while turning wheel hub and brake drum assembly **13** several times.
- Next, slacken off the lock nut fully until a clearance is obtained between lock nut **10** and lock washer **11**.

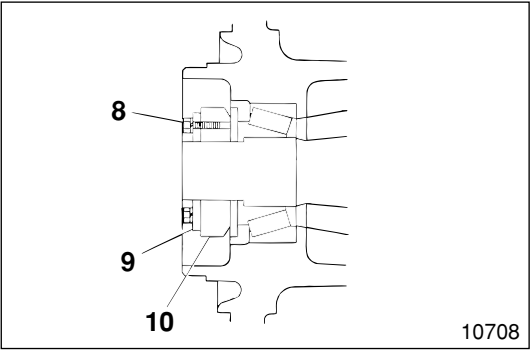


- Return outer bearing **12** toward lock nut **10** by hitting illustrated part **A**, while turning wheel hub and brake drum assembly **13** again.
B : Copper-headed mallet

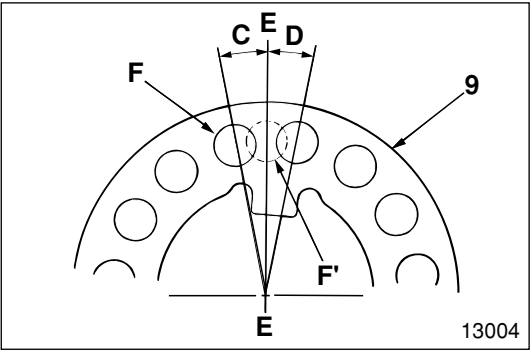
WHEEL HUB AND BRAKE DRUM < FK >



- ★ • After retightening lock nut **10** at specified torque, slacken it off by 30° (one twelfth of a turn).
(★ : If there is any deviation found when you measure the tangential force, carry out following the procedure on P26-19, repeat the work.)

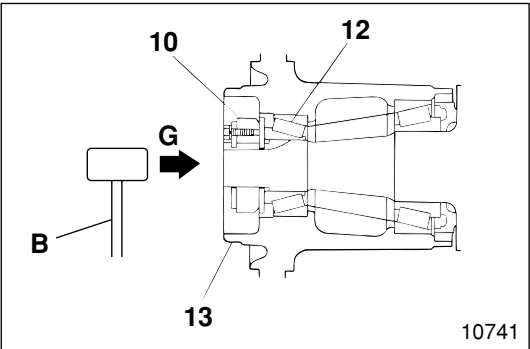


- Install lock plate **9**.
- Make sure that the bolt mounting holes of lock plate **9** and lock nut **10** align.
- Tighten mounting bolts **8** at specified torque.

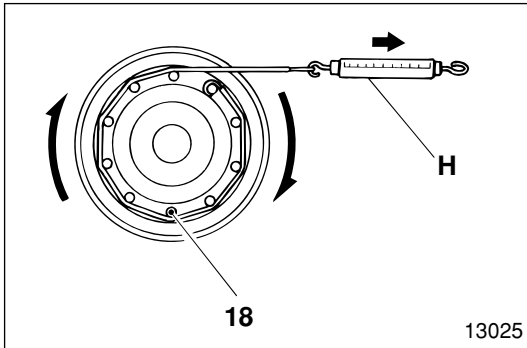


- If the mounting holes of lock plate **9** and lock nut **10** do not align, align as follows:

Hole position of lock nut	How to align hole of lock plate
Within range C	Loosen lock nuts to align holes
Within range D	Turn over lock plate and loosen lock nut to align holes
On E-E line	Turn over the lock plate to align the holes (Lock nut hole position changes from F' to F)



- To slide outer bearing **12** towards lock nut **10**, hit end **G** two or three times with a copper-headed mallet, while turning wheel hub and brake drum assembly **13**.
B : Copper-headed mallet

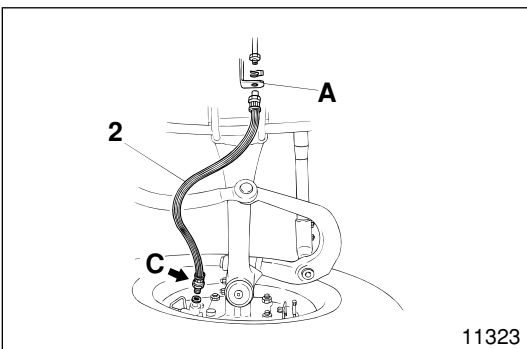


[Measurement]

- Once again, hit one end of the knuckle two or three times with a soft-faced mallet while turning the hub and drum assembly so that the outer bearing fits tightly to the lock nut.
- Fasten spring balance **H** to hub bolt **18** and measure the tangential force.
- If the measured tangential force is the standard value, the starting torque conforms to the standard value.
- Make sure that the starting torque is smaller than the tangential force.
- If the tangential force deviates from the specified value, adjust the starting torque again.
- If the measured value deviates from the specified value, redo the procedure from the item marked ★. P26-18
- If any fault is found after adjustment, replace outer bearings **12**, **16** and inner bearings **15**, **26**.

NOTE

- Measure the starting torque when oil seal **14** has been installed.
- Make sure that the brake lining and brake drum **21** do not drag before measurement.

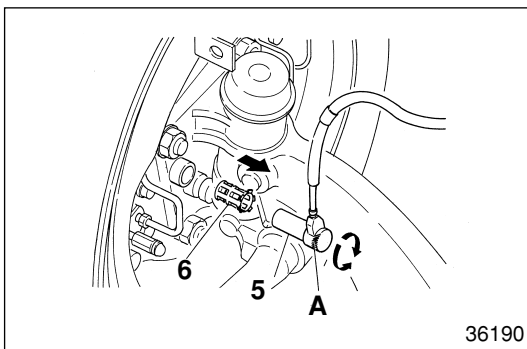


2 Removal and installation of brake hose

Remove the brake hose from frame side **A** first, then disconnect from wheel brake side **B**. For installation, connect the hose in a reverse order.

CAUTION

Make sure that brake hose **2** is not twisted when you install it.



5 Wheel speed sensor

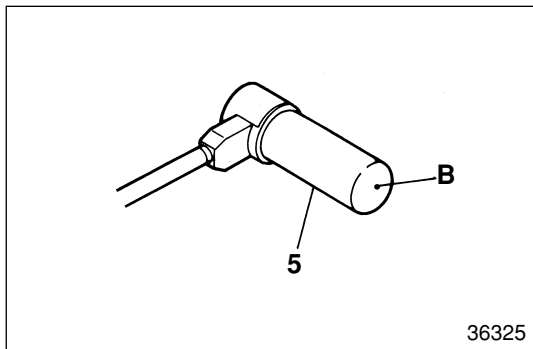
[Removal]

Hold shaded section **A** of wheel speed sensor **5** with pliers, and remove the sensor by twisting it slightly in left and right directions.

CAUTION

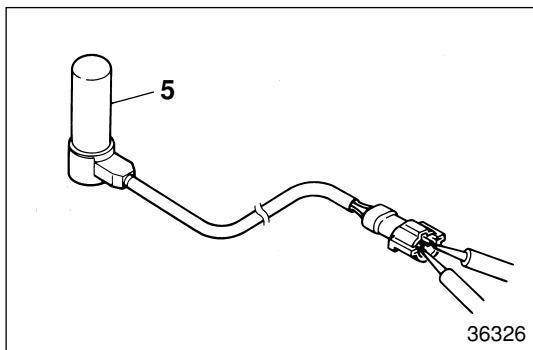
- When holding wheel speed sensor **5** with pliers, do not grip any section except shaded area **A** in the diagram.
- When removing wheel speed sensor **5**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- If wheel speed sensor **5** dismounts easily, replace spring spacer **6**.

WHEEL HUB AND BRAKE DRUM < FK >

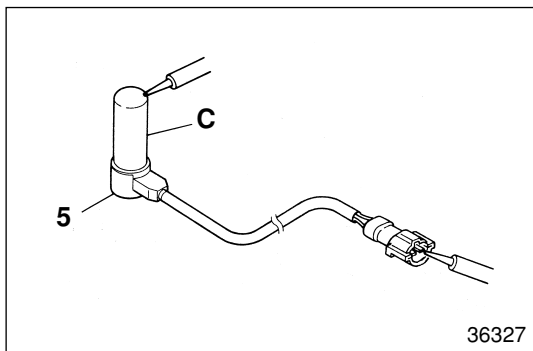


[Inspection]

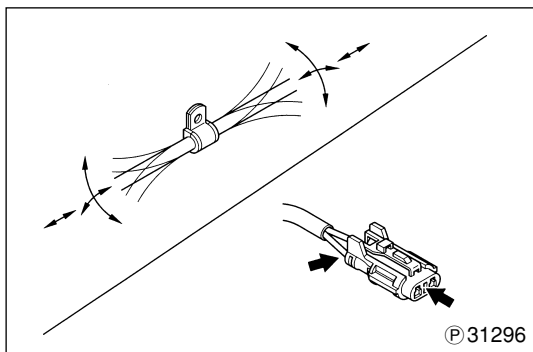
- Since pole piece section **B** is magnetized by the magnet inside wheel speed sensor **5**, it attracts metals. Do not allow the pole piece to collect metallic objects.



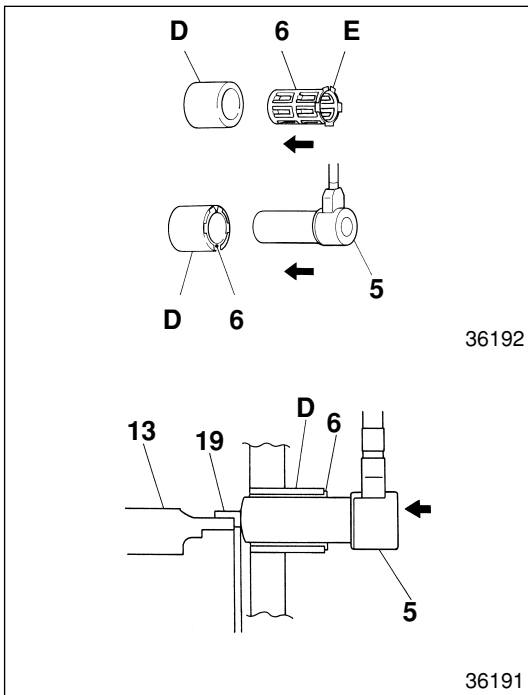
- Measure the resistance between the terminals of wheel speed sensor **5**.
If the measured value deviates from the standard value, replace the wheel speed sensor.



- Measure the insulation resistance between body **C** of wheel speed sensor **5** and each terminal.
If the measured values deviate from the standard value, replace the wheel speed sensor.



- To check for broken wires, remove the harness clamp section from the vehicle. Bend and extend the harness to check if there is any broken wire in the harness. Also, inspect the connector for proper contact.
If a defect is found, replace wheel speed sensor **5**.

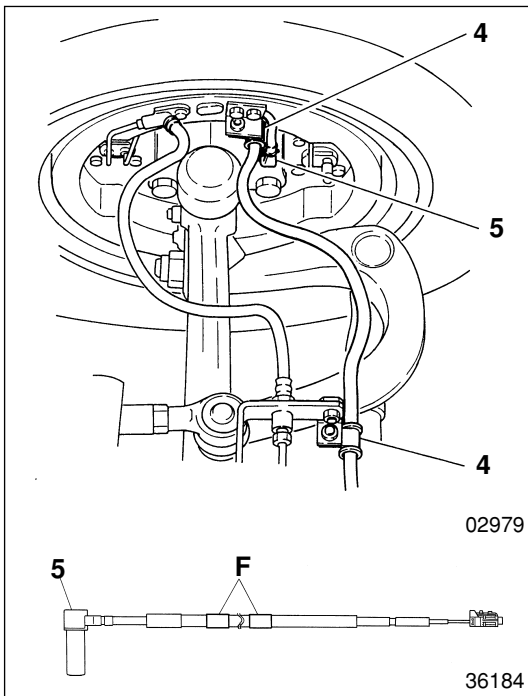


[Installation]

- Insert spring spacer **6** into holder section **D** of the knuckle, and press until stopper section **E** contacts the holder.
- Insert wheel speed sensor **5**, and press until it contacts rotor **19**.
- Rotate hub and brake drum assembly **13** slowly for two or three turns (2 seconds per turn) to make sure it rotates smoothly.

CAUTION ⚠

When installing wheel speed sensor **5**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.

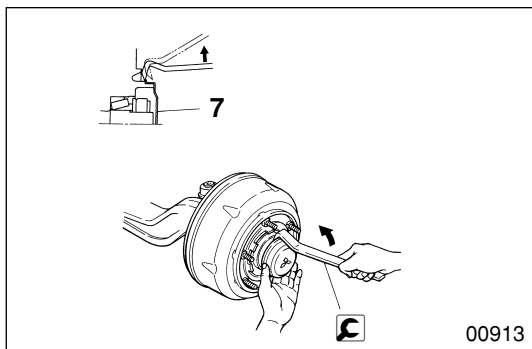


- Secure white tape section **F** of the harness of wheel speed sensor **5** in place using clip **4** on the wheel brake side and clip **4** on the frame side.

CAUTION ⚠

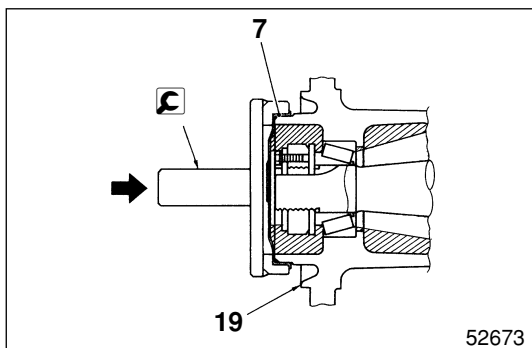
Be sure to clamp the harness of wheel speed sensor **5** at two white tape sections **F**. Make sure the harness does not interfere with other parts and there is no twist or slack in the harness.

WHEEL HUB AND BRAKE DRUM < FK >



7 Wheel hub cap

[Removal]

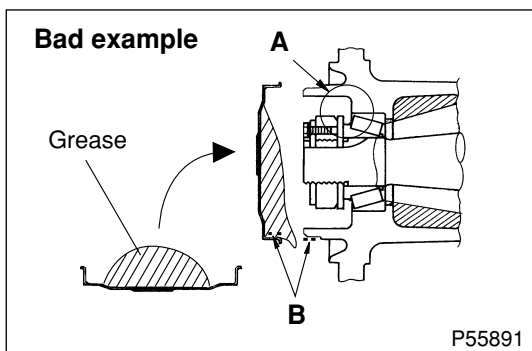
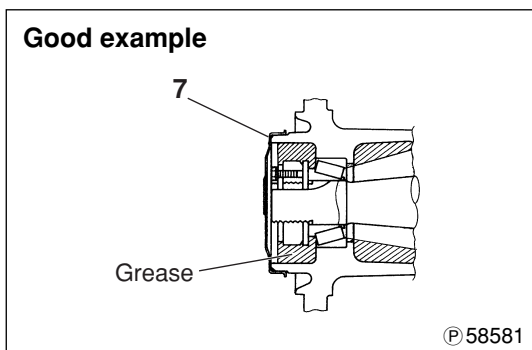


[Installation]

Apply sealant to contact surfaces of wheel hub cap 7, and press-fit it.

CAUTION

Do not use a hammer, etc. when you install wheel hub cap 7, or you might deform the mating surface, destroying watertightness.



CAUTION

- When attaching the wheel hub cap 7, don't heap grease on the wheel hub cap or cover.

If heaping grease on them, following results cause.

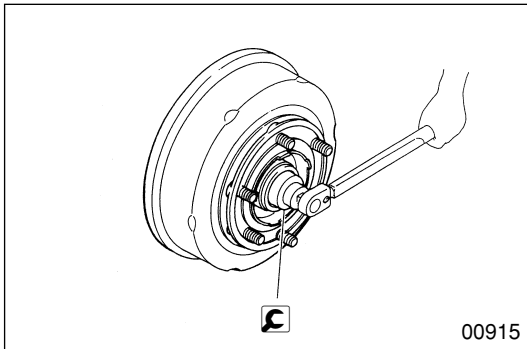
A: Grease doesn't reach to hub bearing. So it causes insufficient greasing to hub bearing.

B: Grease sticks to the edge of hub. So it causes water infiltration and grease leak.

Refer to good and bad examples as illustrated.

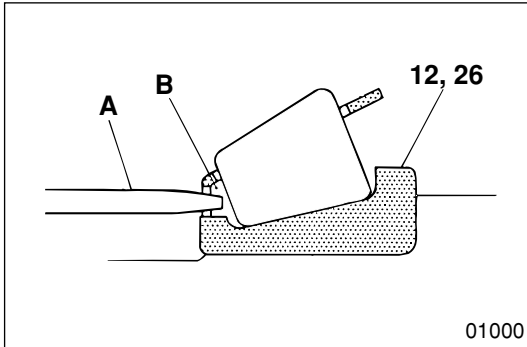
- When attaching the wheel hub cap or cover, take care that grease doesn't leak out of the wheel hub cap or cover and that the interface between hub and wheel hub cap or cover is free from grease.

P26-24



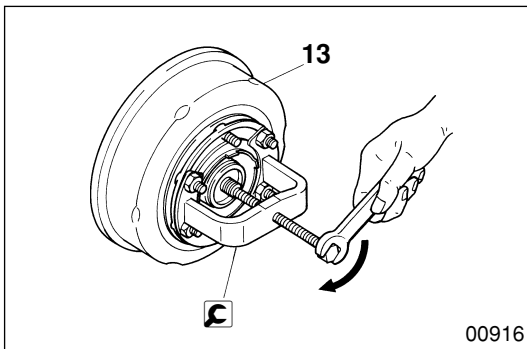
10 Removal and installation of lock nut

See adjustment of wheel hub bearing starting torque. P26-17



12 26 Packing grease in outer bearing inner race and inner bearing inner race

- A : Grease pump nozzle
B : Between rollers

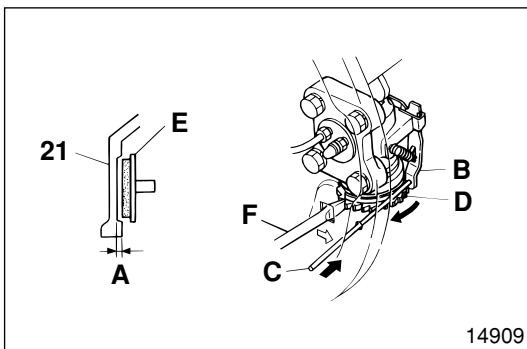


13 Wheel hub and brake assembly

[Removal]

CAUTION

Make sure you remove wheel hub and brake drum assembly 13 in a straight line to prevent damage to oil seal 15.



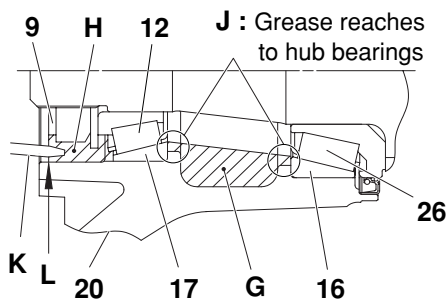
If wheel hub and brake drum assembly 13 cannot be removed because of stepped wear A in brake drum 21, carry out the following:

- Remove the packing plate cover.
- Lift lever B.
- C : Wire approximately $\phi 5$ mm {0.020 in.}
- Turn adjuster D in the opposite direction to the arrow on the packing plate, and expand the clearance between brake drum 21 and brake shoe assembly E.
- F : Screwdriver
- Remove wheel hub and brake drum assembly 13.

CAUTION

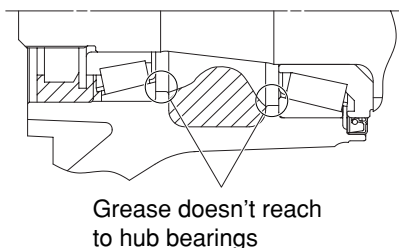
If brake drum 16 is faulty, correct it. Gr 35A

WHEEL HUB AND BRAKE DRUM < FK >



© 55874

Bad example



Grease doesn't reach to hub bearings

P55875

[Installation]

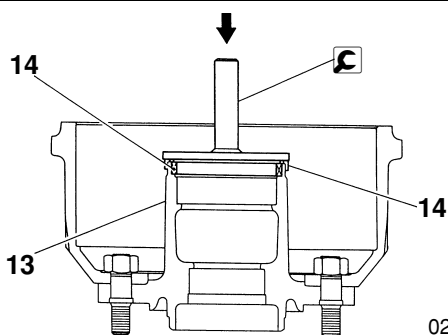
- Lubricate the following areas with specified amount of grease.
G : Inside of wheel hub
H : Outside of wheel hub

CAUTION

- Apply grease to the inside of wheel hub 20 until grease reaches contact areas J between inner bearing outer race 16 and the hub and between outer bearing outer race 17 and the hub.
- It is not acceptable that grease doesn't reach to inner bearing outer race 16 and outer bearing outer race 17 like bad example as illustrated.
- Insert nozzle K near the outer bearing and fill grease as illustrated so as to make a grease wall outside of the bearing. Fill grease at least to the lock plate 9 line L.

- After installing wheel hub and brake drum assembly 13, adjust the brake shoe clearance.

Gr 35A

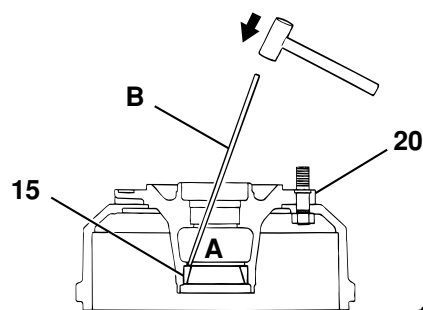


02975

14 Installation of oil seal

CAUTION

When hub and brake drum assembly 13 is removed for a service operation and if rotor 14 is still mounted on the wheel hub, use ABS oil seal installer to press-fit oil seal 15.



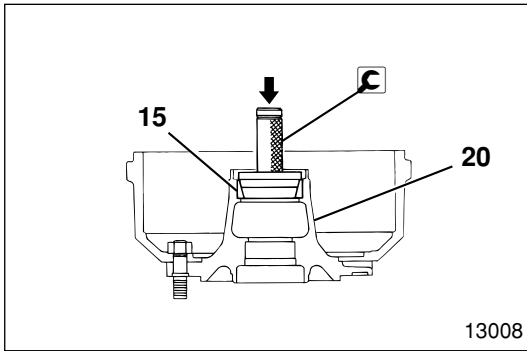
13007

15 Inner bearing outer race

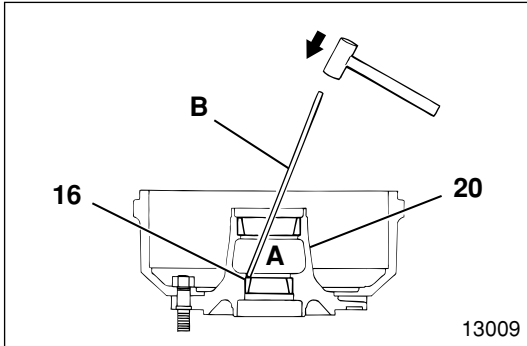
[Removal]

Drive out inner bearing outer race 15 evenly from two indented parts A in wheel hub 20.

B : Pin-punch



[Installation]

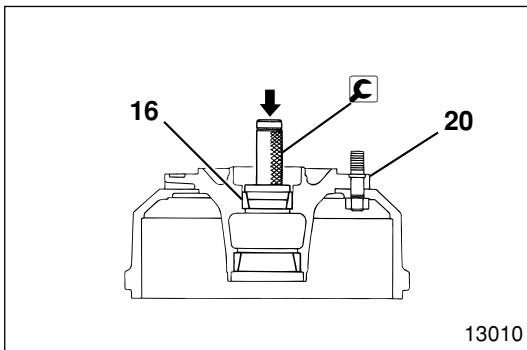


16 Outer bearing outer race

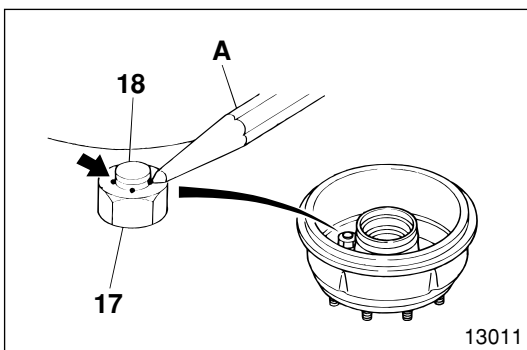
[Removal]

Drive out outer bearing outer race **16** evenly from two indented parts **A** in wheel hub **20**.

B : Pin-punch



[Installation]

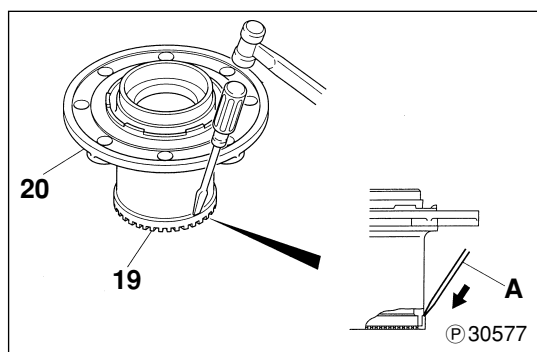


17 18 Installation of nut and hub bolts

Tighten nut **17** at specified torque, then caulk hub bolt **18** evenly at four points.

A : Punch

WHEEL HUB AND BRAKE DRUM < FK >



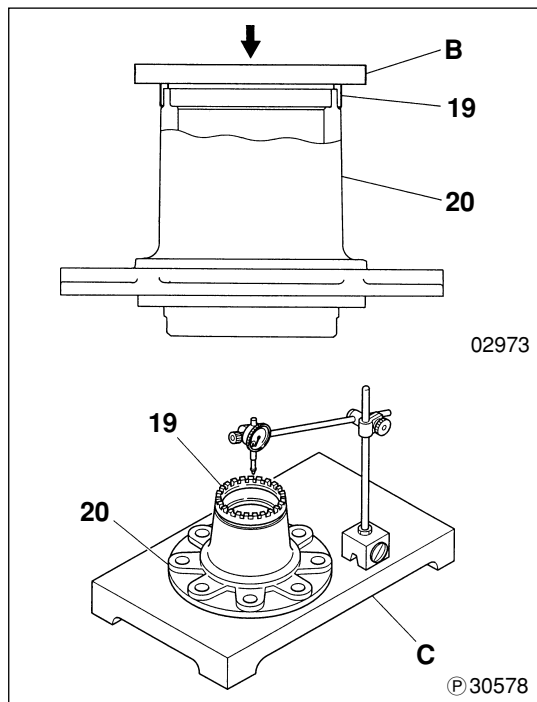
19 Rotor

[Removal]

Strike the outer edge of rotor **19** evenly with flat-tip screwdriver **A** to remove the rotor from the wheel hub.

CAUTION ⚠

Be careful not to damage wheel hub **20**.



[Installation]

Heat rotor **19** to approximately 150°C {302°F}. Press the rotor evenly with iron plate **B** to press-fit the rotor to wheel hub **20**. Make sure there is no space between the rotor and wheel hub.

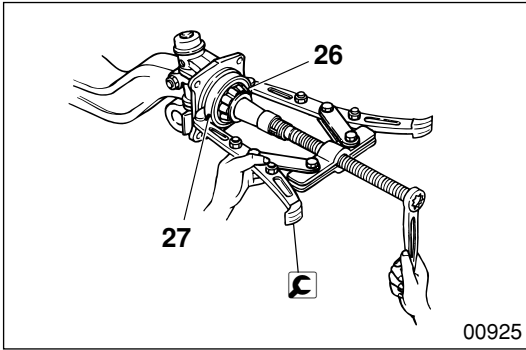
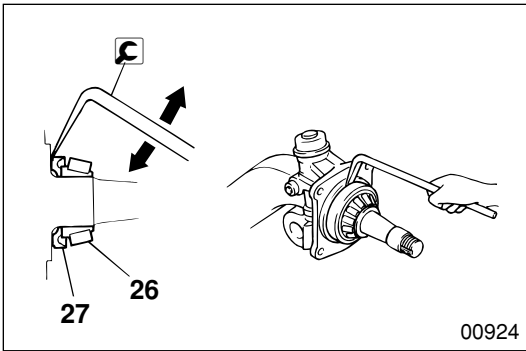
[Inspection]

- If the amount of wobbling exceeds the standard value, repeat the assembly procedure from the beginning.
- If the amount of wobbling exceeds the standard value after reassembly, replace defective parts.

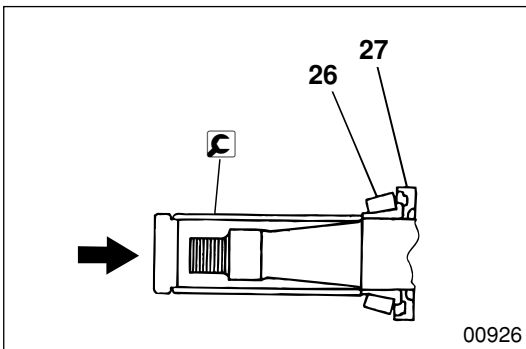
C : Base

26 27 Inner bearing inner race and oil seal retainer

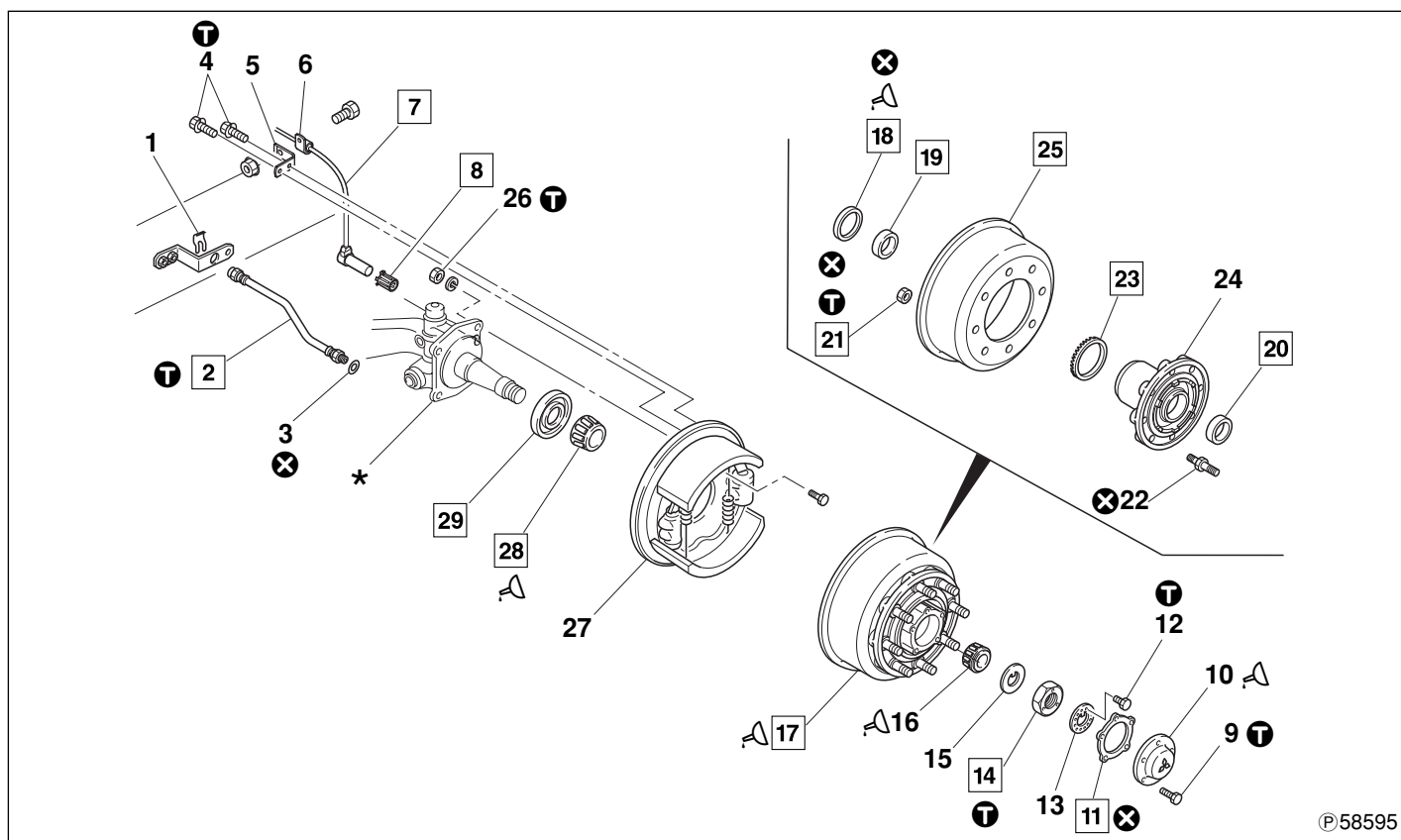
[Removal]



[Installation]



WHEEL HUB AND BRAKE DRUM < FM (AIR-OVER HYDRAULIC BRAKE) >



● Disassembly sequence

- | | |
|-----------------------------|--------------------------------------|
| 1 Clip | 17 Wheel hub and brake drum assembly |
| 2 Brake hose | 18 Oil seal |
| 3 Packing | 19 Inner bearing outer race |
| 4 Bolt | 20 Outer bearing outer race |
| 5 Clip bracket | 21 Nut |
| 6 Clip | 22 Hub bolt |
| 7 Wheel speed sensor | 23 Rotor |
| 8 Spring spacer | 24 Wheel hub |
| 9 Bolt | 25 Brake drum Gr 35A |
| 10 Wheel hub cover | 26 Nut |
| 11 Gasket | 27 Brake assembly Gr 35A |
| 12 Bolt | 28 Inner bearing inner race |
| 13 Lock plate | 29 Oil seal retainer |
| 14 Lock nut | |
| 15 Lock washer | |
| 16 Outer bearing inner race | |
- * : Knuckle P26-62
 X : Non-reusable parts

CAUTION

Be sure to protect brake hose 2 from dust by fitting blanking plugs after removal.

NOTE

Do not disassemble brake drum 25 and wheel hub 24 except for replacement.

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

You must bleed air from the brake system after installing the brake hose, failure to do so would cause the brake to malfunction.  Gr 35A

CAUTION ⚠

- Keep oil and grease off lining surface of front brake assembly * and the inner surface of brake drum 25.
- Be careful not to damage oil seal 18 and rotor 23 when installing wheel hub and brake drum assembly 17 onto knuckle *.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
7	Wheel speed sensor	Resistance between terminals	950 to 1450Ω	—	Replace
		Insulation resistance	1MΩ or higher	—	Replace
16, 19, 20, 28	Starting torque of wheel hub bearing		2.5 to 5.5 N·m {1.81 to 3.98 ft.lbs, 0.25 to 0.55 kgf·m}	—	Tangential force at wheel hub bearing 18 to 38 N {3.97 to 8.60 lbf, 1.8 to 3.9 kgf}
23	Wobbling of rotor		0.1 {0.0039}	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Brake hose (Brake side)	21 to 30 {15 to 22, 2.1 to 3.1}	—
4	Bolt (Bracket mounting)	9.8 to 14.0 {7 to 10, 1.0 to 1.4}	—
9	Bolt (Wheel hub cover mounting)	23±4 {17±3.3, 2.35±0.45}	—
12	Bolt (Lock plate mounting)	7 to 11 {5.1 to 8, 0.7 to 1.1}	—
14	Lock nut	200 {145, 20}	Slackening off angle : 30° (one twelfth of a turn)
21	Nut (Wheel hub and brake drum mounting)	322 {235, 32.8}	—
26	Nut (Brake assembly mounting)	135 {100, 13.8}	—

Lubricant and/or sealant

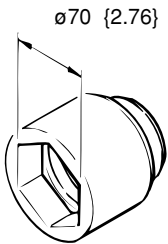
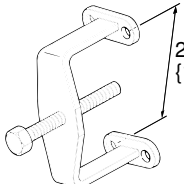
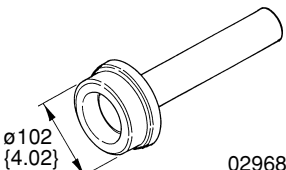
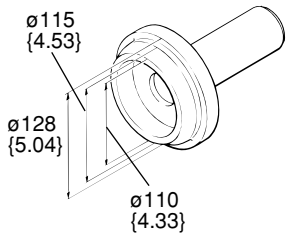
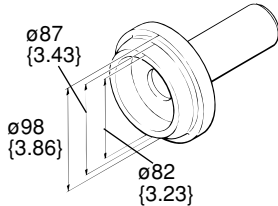
Location	Points of application	Specified lubricant and/or sealant	Quantity
16, 28	Pack the space between rollers of wheel bearing inner race	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
17	Pack interior of wheel hub	Wheel bearing grease [NLGI No.2 (Li soap)]	500±20 g* {17.6±0.71 oz}
	Pack exterior of wheel hub (Wheel hub cover side)		150±10 g* {5.29±0.35 oz}
18	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

*: For a wheel hub

WHEEL HUB AND BRAKE DRUM < FM (AIR-OVER HYDRAULIC BRAKE) >

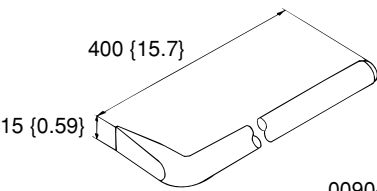
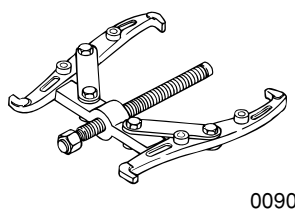
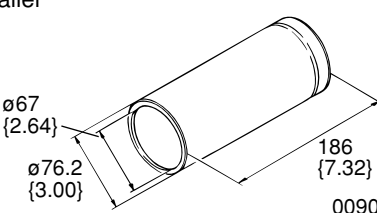
Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
14	Socket wrench  00900	MH061528	Removal and installation of hub bearing lock nut
17	Wheel hub puller  13003	MH061993	Removal of hub and brake drum
18	Anti-lock brake system oil seal installer  02968	MH062305	Press-fitting of oil seal
19	Inner bearing installer  00903	03724-62000	Press-fitting of inner bearing outer race
20	Outer bearing installer  00903	03724-63000	Press-fitting of outer bearing outer race

Special tools

Unit : mm {in.}

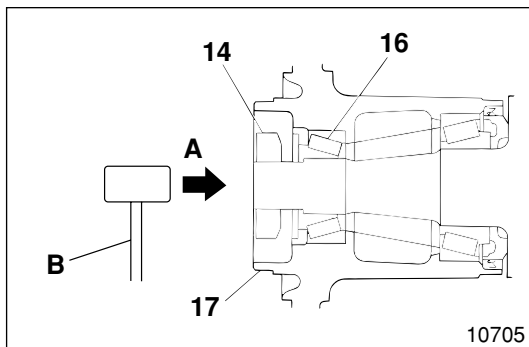
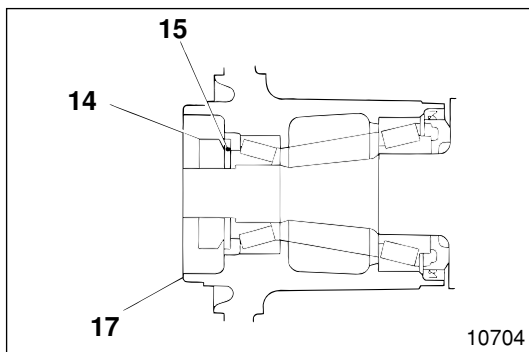
Location	Tool name and shape	Part No.	Application
28, 29	Lever 	MH061683	Prying lever for knuckle to oil seal retainer
	Gear puller 	MH061102	Removal of oil seal retainer and inner bearing inner race
	Inner bearing installer 	MH061473	Press-fitting of inner bearing inner race and oil seal retainer

◆ Service procedure

● Starting torque of wheel hub drum

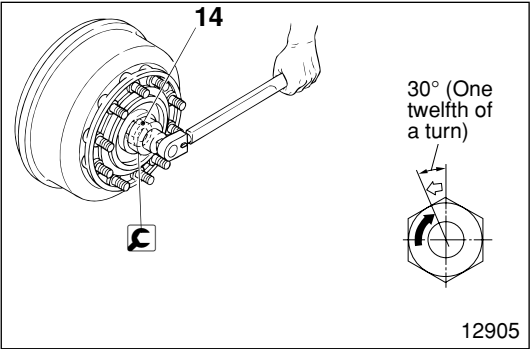
[Adjustment]

- Install lock washer **15** and lock nut **14**, then tighten the lock nut at specified torque while turning wheel hub and brake drum assembly **17** several times.
- Next, slacken off the lock nut fully until a clearance is obtained between lock nut **14** and lock washer **15**.

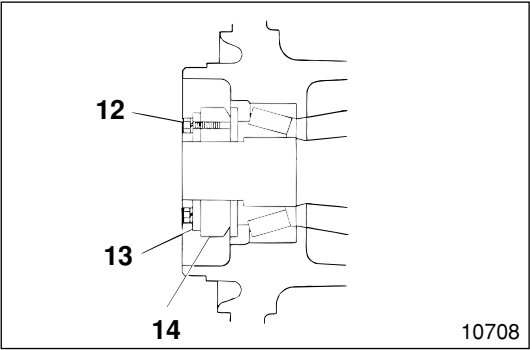


- Return outer bearing **16** toward lock nut **14** by hitting illustrated part **A**, while turning wheel hub and brake drum assembly **17** again.
B : Copper-headed mallet

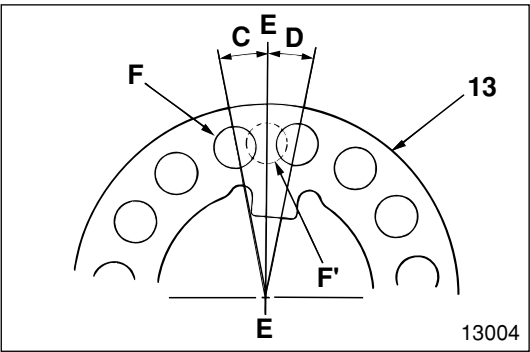
WHEEL HUB AND BRAKE DRUM < FM (AIR-OVER HYDRAULIC BRAKE) >



- ★ • After retightening lock nut **14** at specified torque, slacken it off by 30° (one twelfth of a turn).
- (★ : If there is any deviation found when you measure the tangential force, carried out following the procedure on [P26-33](#), repeat the work.)

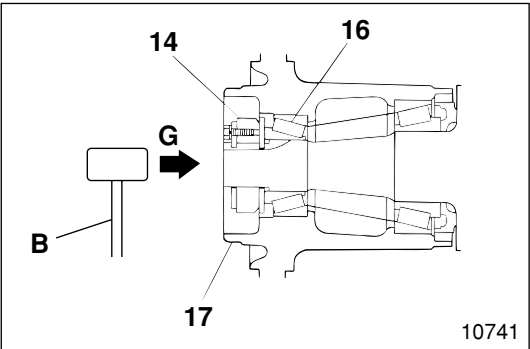


- Install lock plate **13**.
- Make sure that the bolt mounting holes of lock plate **13** and lock nut **14** align.
- Tighten mounting bolts **12** at specified torque.

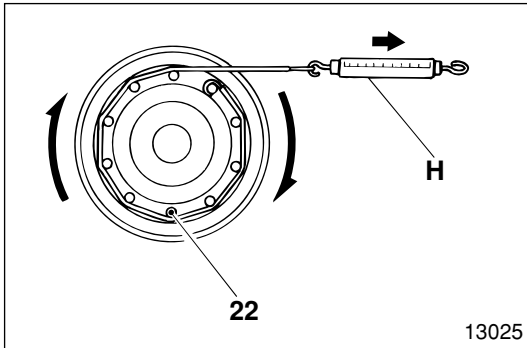


- If the mounting holes of lock plate **13** and lock nut **14** do not align, align as follows:

Hole position of lock nut	How to align hole of lock plate
Within range C	Loosen lock nuts to align holes
Within range D	Turn over lock plate and loosen lock nut to align holes
On E-E line	Turn over the lock plate to align the holes (Lock nut hole position changes from F' to F)



- To slide outer bearing **16** towards lock nut **14**, hit end **G** two or three times with a copper-headed mallet, while turning wheel hub and brake drum assembly **17**.
- B** : Copper-headed mallet



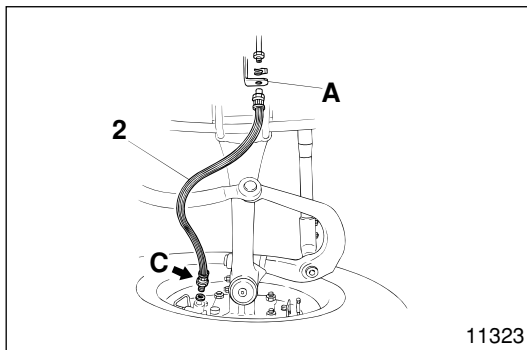
- Once again, hit one end of the knuckle two or three times with a soft-faced mallet while turning the hub and drum assembly so that the outer bearing fits tightly to the lock nut.

[Measurement]

- Fasten spring balance **H** to hub bolt **22** and measure the tangential force.
- If the measured tangential force is the standard value, the starting torque conforms to the standard value.
- Make sure that the starting torque is smaller than the tangential force.
- If the tangential force deviates from the specified value, adjust the starting torque again.
- If the measured value deviates from the specified value, redo the procedure from the item marked ★. P26-32
- If any fault is found after adjustment, replace outer bearings **16**, **20** and inner bearings **19**, **28**.

NOTE

- Measure the starting torque when oil seal **18** has been installed.
- Make sure that the brake lining and brake drum **25** do not drag before measurement.

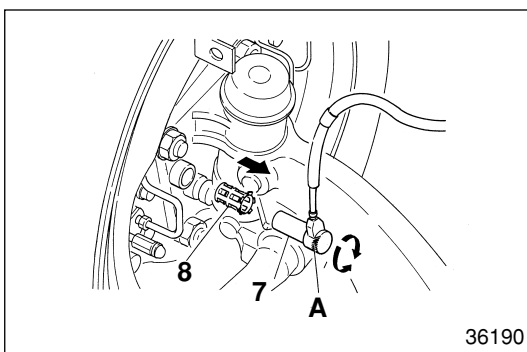


2 Removal and installation of brake hose

First remove brake hose **2** from bracket **A** or connector **B** (on the frame), then remove the brake hose from wheel brake **C** or front brake chamber **D**. For installation, follow this procedure in reverse.

CAUTION

Make sure that brake hose **2** is not twisted when you install it.



7 Wheel speed sensor

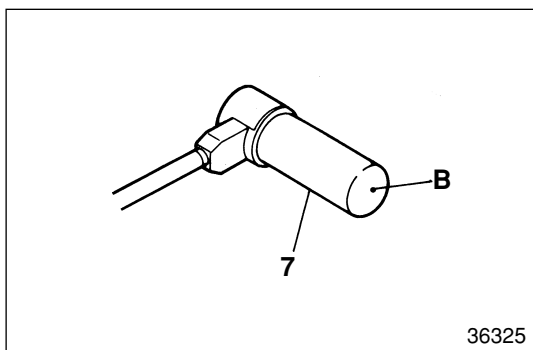
[Removal]

Hold shaded section **A** of wheel speed sensor **7** with pliers, and remove the sensor by twisting it slightly in left and right directions.

CAUTION

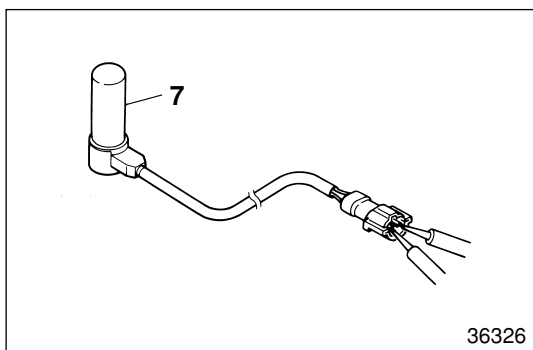
- When holding wheel speed sensor **7** with pliers, do not grip any section except shaded area **A** in the diagram.
- When removing wheel speed sensor **7**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- If wheel speed sensor **7** dismounts easily, replace spring spacer **8**.

WHEEL HUB AND BRAKE DRUM < FM (AIR-OVER HYDRAULIC BRAKE) >

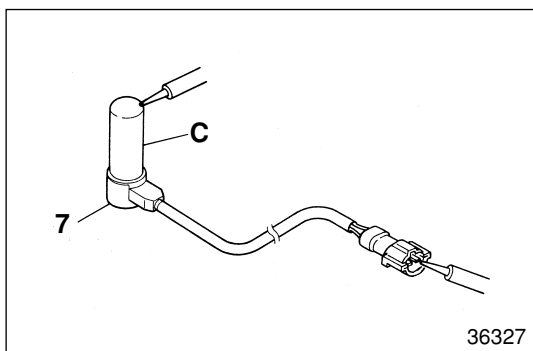


[Inspection]

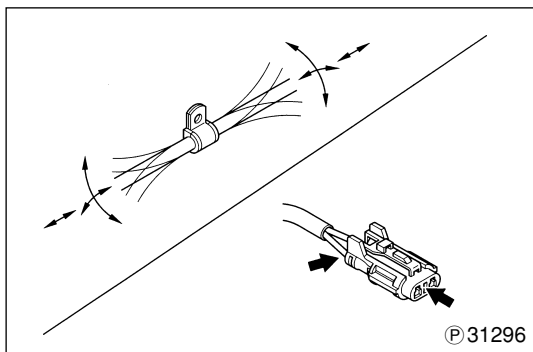
- Since pole piece section **B** is magnetized by the magnet inside wheel speed sensor **7**, it attracts metals. Do not allow the pole piece to collect metallic objects.



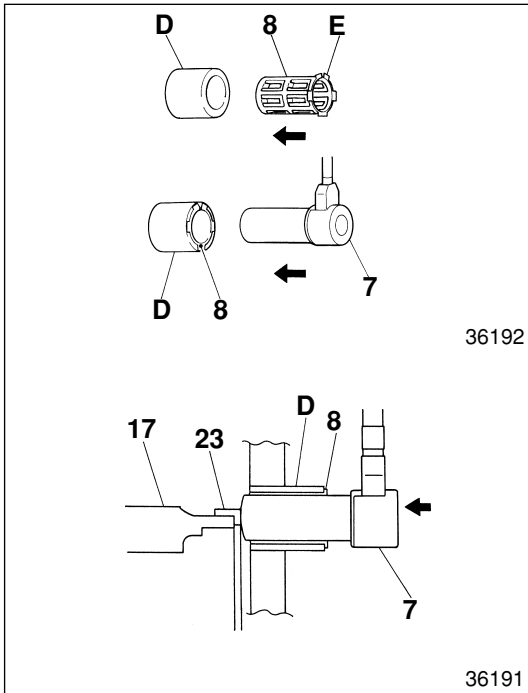
- Measure the resistance between the terminals of wheel speed sensor **7**.
If the measured value deviates from the standard value, replace the wheel speed sensor.



- Measure the insulation resistance between body **C** of wheel speed sensor **7** and each terminal.
If the measured values deviate from the standard value, replace the wheel speed sensor.



- To check for broken wires, remove the harness clamp section from the vehicle. Bend and extend the harness to check if there is any broken wire in the harness. Also, inspect the connector for proper contact.
If a defect is found, replace wheel speed sensor **7**.

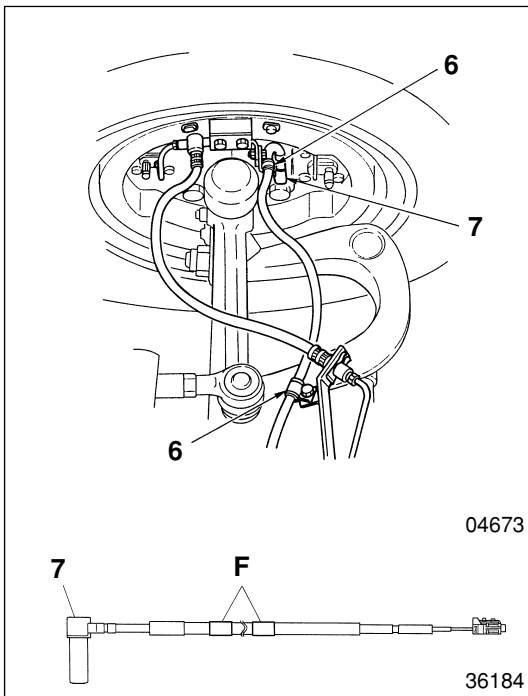


[Installation]

- Insert spring spacer **8** into holder section **D** of the knuckle, and press until stopper section **E** contacts the holder.
- Insert wheel speed sensor **7**, and press until it contacts rotor **23**.
- Rotate hub and brake drum assembly **17** slowly for two or three turns (2 seconds per turn) to make sure it rotates smoothly.

CAUTION ⚠

When installing wheel speed sensor **7**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.

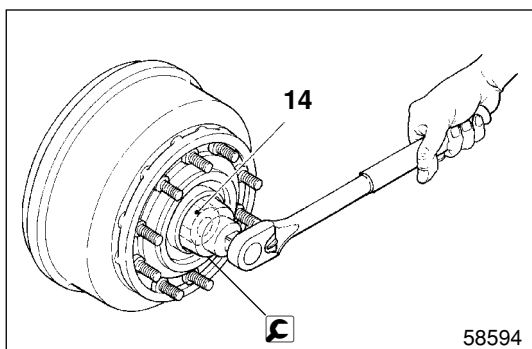
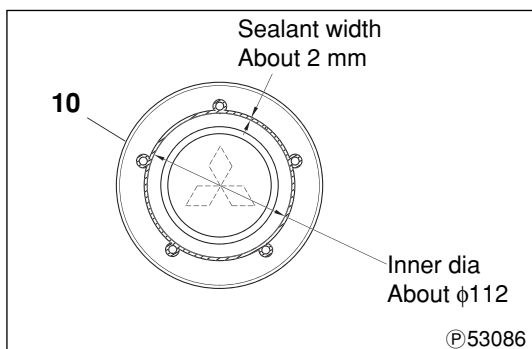
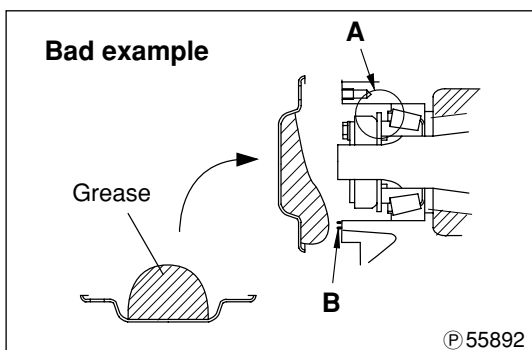
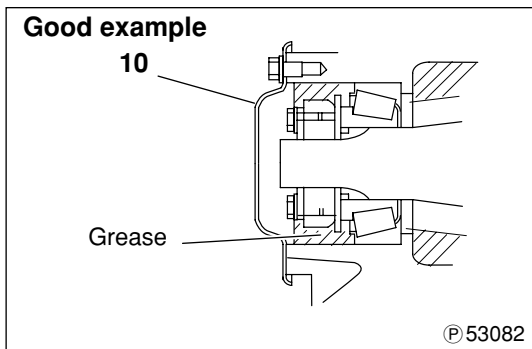


- Secure white tape section **F** of the harness of wheel speed sensor **7** in place using clip **6** on the wheel brake side and clip **6** on the frame side.

CAUTION ⚠

Be sure to clamp the harness of wheel speed sensor **7** at two white tape sections **F**. Make sure the harness does not interfere with other parts and there is no twist or slack in the harness.

WHEEL HUB AND BRAKE DRUM < FM (AIR-OVER HYDRAULIC BRAKE) >



10 Installation of wheel hub cover

CAUTION ⚠

- When attaching the wheel hub cover 10, don't heap grease on the wheel hub cover.

IF heaping grease on them, following results cause.

A: Grease doesn't reach to hub bearing. So it causes insufficient greasing to hub bearing.

B: Grease sticks to the edge of hub. So it causes water infiltration and grease leak.

Refer to good and bad examples as illustrated.

- When attaching the wheel hub cap or cover, take care that grease doesn't leak out of the wheel hub cover and that the interface between wheel hub and wheel hub cover is free from grease.

📖 P26-38

11 Using sealant instead of the gasket <FM>

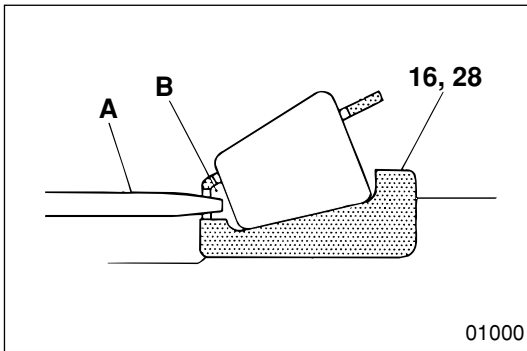
It is possible to use the sealant instead of the gasket 11, when installing wheel hub cover 10. The sealant is applied in shipping vehicle. Remove the old sealant completely on the mating face of wheel hub 24 and wheel hub cover before attaching new gasket or applying sealant.

In case of applying sealant, follow the points below.

- Apply sealant to the circumference without breaking off as illustrated. The part of oblique lines is sealant.
- Before applying sealant, take care that the interface between wheel hub 24 and wheel hub cover 10 is free from grease.
- Specified sealant: THREEBOND 1217F

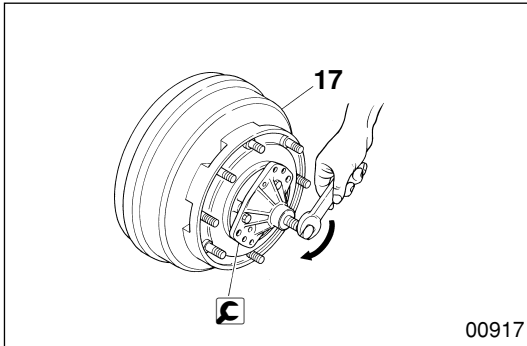
14 Removal and installation of lock nut

See adjustment of wheel hub bearing starting torque. 📖 P26-31



16 28 Packing grease in outer bearing inner race and inner bearing inner race

A : Grease pump nozzle
B : Between rollers

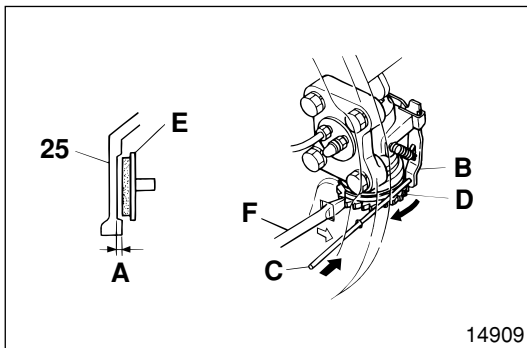


17 Wheel hub and brake assembly

[Removal]

CAUTION ⚠

Make sure you remove wheel hub and brake drum assembly 17 in a straight line to prevent damage to oil seal 19.



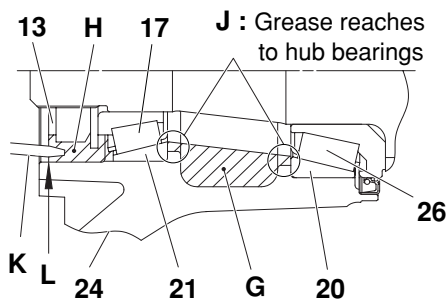
If wheel hub and brake drum assembly **17** cannot be removed because of stepped wear **A** in brake drum **25**, carry out the following:

- Remove the packing plate cover.
- Lift lever **B**.
- **C** : Wire approximately $\varnothing 5$ mm {0.020 in.}
- Turn adjuster **D** in the opposite direction to the arrow on the packing plate, and expand the clearance between brake drum **25** and brake shoe assembly **E**.
- **F** : Screwdriver
- Remove wheel hub and brake drum assembly **17**.

CAUTION ⚠

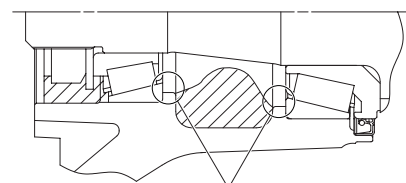
If brake drum 25 is faulty, correct it.  Gr 35A

WHEEL HUB AND BRAKE DRUM < FM (AIR-OVER HYDRAULIC BRAKE) >



© 55874

Bad example



Grease doesn't reach to hub bearings

© 55875

- Lubricate the following areas with specified amount of grease.

G : Inside of wheel hub

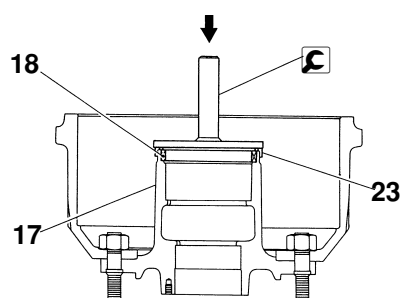
H : Outside of wheel hub

CAUTION

- Apply grease to the inside of wheel hub 24 until grease reaches contact areas J between inner bearing outer race 20 and the hub and between outer bearing outer race 21 and the hub.
- It is not acceptable that grease doesn't reach to inner bearing outer race 20 and outer bearing outer race 21 like bad example as illustrated.
- Insert nozzle K near the outer bearing and fill grease as illustrated so as to make a grease wall outside of the bearing. Fill grease at least to the lock plate 13 line L.

- After installing wheel hub and brake drum assembly 17, adjust the brake shoe clearance.

Gr 35A

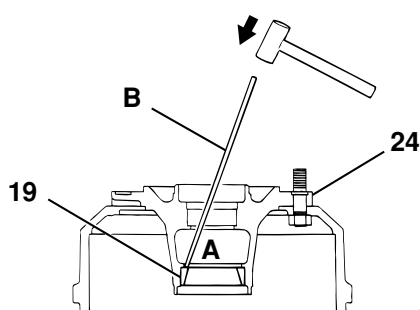


04670

18 Installation of oil seal

CAUTION

When hub and brake drum assembly 17 is removed for a service operation and if rotor 23 is still mounted on the wheel hub, use ABS oil seal installer to press-fit oil seal 18.



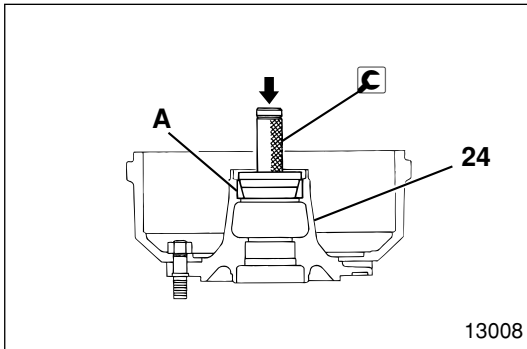
13007

19 Inner bearing outer race

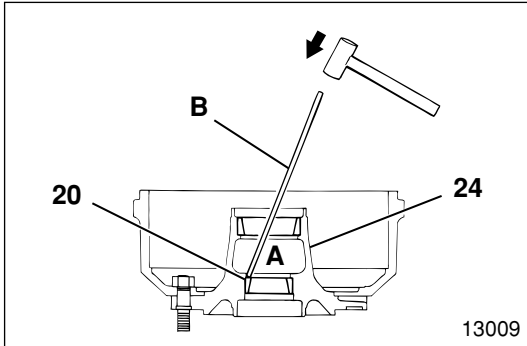
[Removal]

Drive out inner bearing outer race 19 evenly from two indented parts A in wheel hub 24.

B : Pin-punch



[Installation]

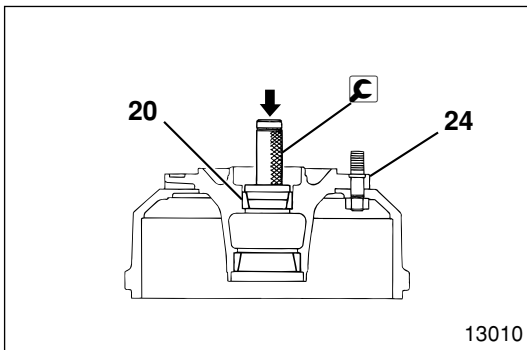


20 Outer bearing outer race

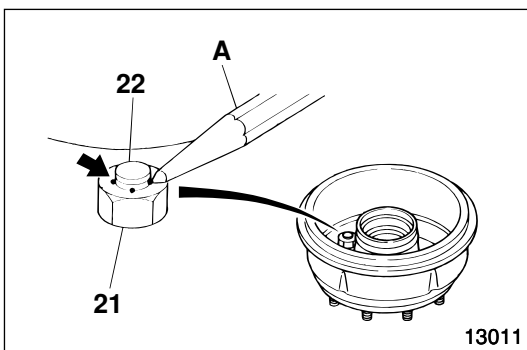
[Removal]

Drive out outer bearing outer race **20** evenly from two indented parts **A** in wheel hub **24**.

B : Pin-punch



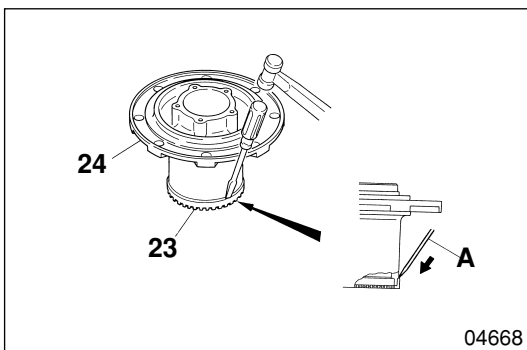
[Installation]



21 22 Installation of nut and hub bolts

Tighten nut **21** at specified torque, then caulk hub bolt **22** evenly at four points.

A : Punch



23 Rotor

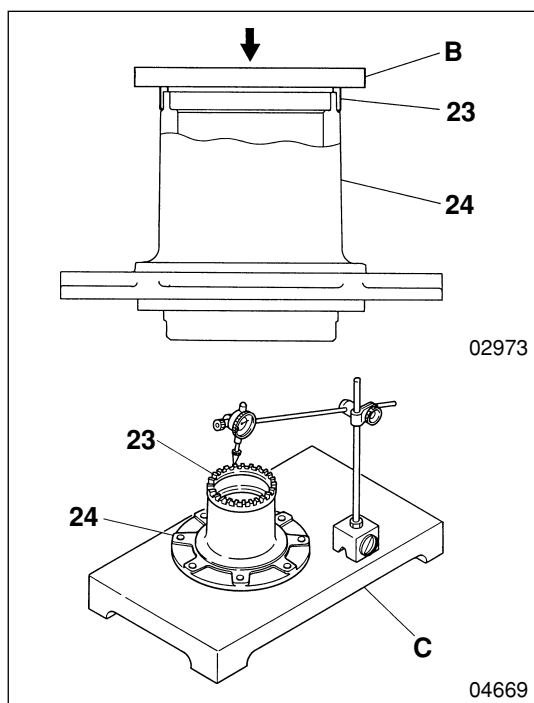
[Removal]

Strike the outer edge of rotor **23** evenly with flat-tip screwdriver **A** to remove the rotor from the wheel hub.

CAUTION ⚠

Be careful not to damage wheel hub **24**.

WHEEL HUB AND BRAKE DRUM < FM (AIR-OVER HYDRAULIC BRAKE) >



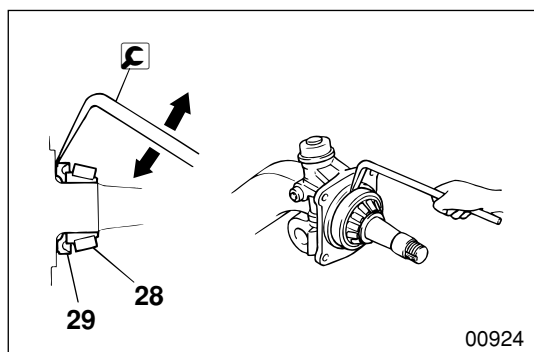
[Installation]

Heat rotor **23** to approximately 150°C {302°F}. Press the rotor evenly with iron plate **B** to press-fit the rotor to wheel hub **24**. Make sure there is no space between the rotor and wheel hub.

[Inspection]

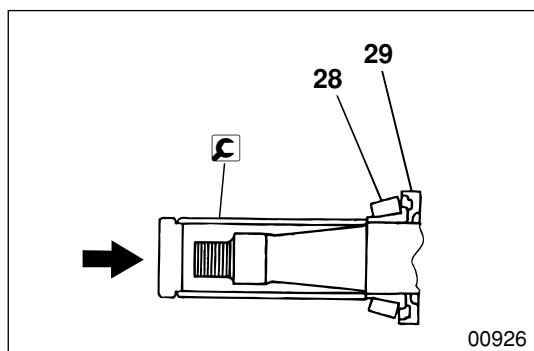
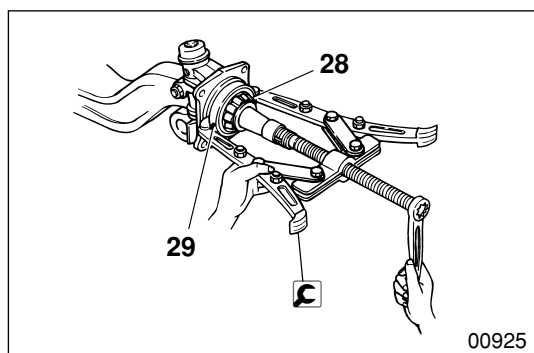
- If the amount of wobbling exceeds the standard value, repeat the assembly procedure from the beginning.
- If the amount of wobbling exceeds the standard value after reassembly, replace defective parts.

C : Base



28 29 Inner bearing inner race and oil seal retainer

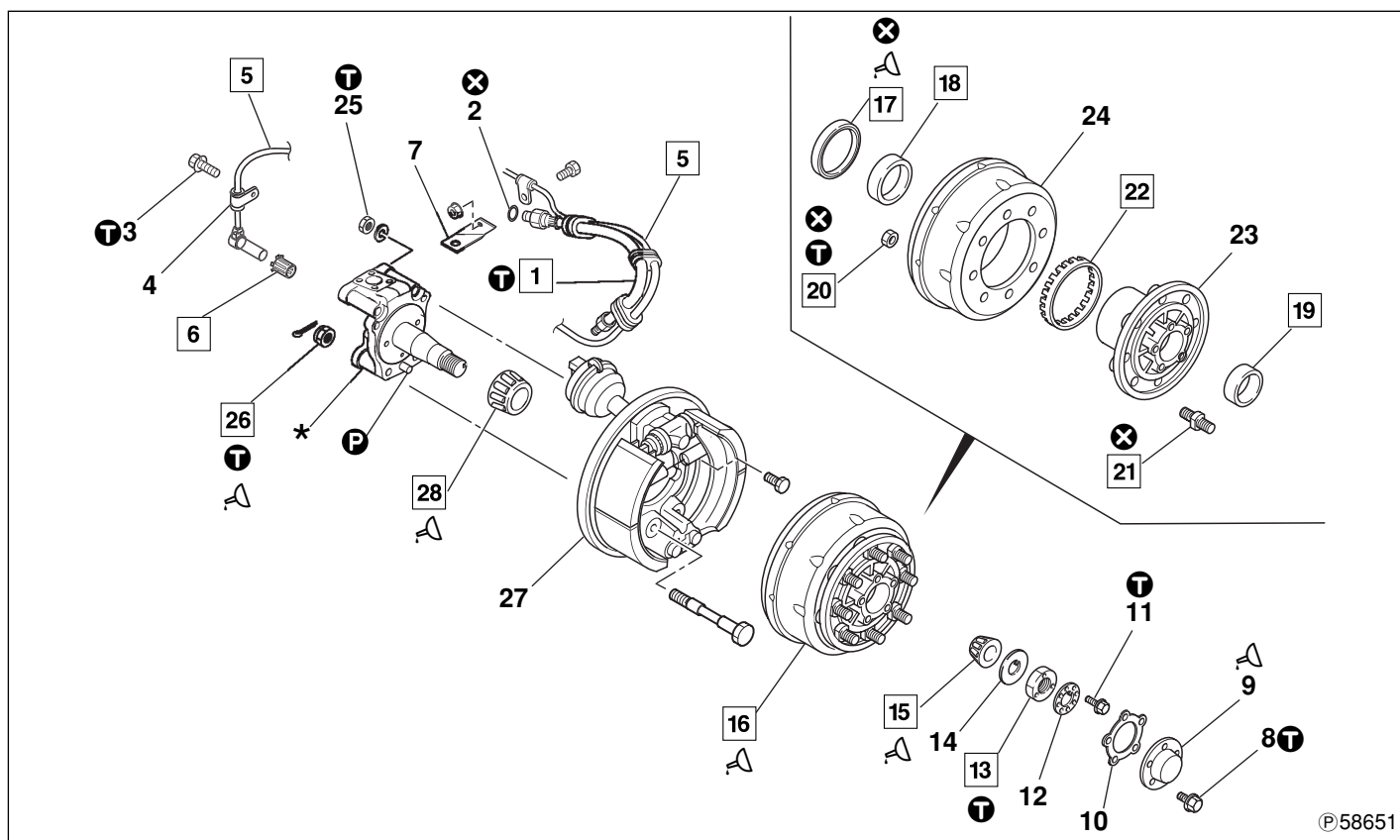
[Removal]



[Installation]

MEMO

WHEEL HUB AND BRAKE DRUM < FM (FULL-AIR BRAKE) >



● Disassembly sequence

- | | |
|--------------------------------------|-----------------------------|
| 1 Brake hose | 17 Oil seal |
| 2 O-ring | 18 Inner bearing outer race |
| 3 Bolt | 19 Outer bearing outer race |
| 4 Clip | 20 Nut |
| 5 Wheel speed sensor | 21 Hub bolt |
| 6 Spring spacer | 22 Rotor |
| 7 Clip bracket | 23 Wheel hub |
| 8 Bolt | 24 Brake drum Gr 35B |
| 9 Wheel hub cover | 25 Nut |
| 10 Gasket | 26 Nut |
| 11 Bolt | 27 Brake assembly Gr 35B |
| 12 Lock plate | 28 Inner bearing inner race |
| 13 Lock nut | |
| 14 Lock washer | |
| 15 Outer bearing inner race | |
| 16 Wheel hub and brake drum assembly | |
- * : Knuckle P26-70
 X : Non-reusable parts
 P : Positioning pin

CAUTION

Be sure to protect brake pipe 1, from dust by fitting blanking plugs after removal.

● Assembly Sequence

Follow this disassembly sequence in reverse.

CAUTION ⚠

- Keep oil and grease off lining surface of front brake assembly * and the inner surface of brake drum 24.
- Be careful not to damage oil seal 12 and rotor 11 when installing wheel hub and brake drum assembly 16 onto knuckle *.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
6	Wheel speed sensor	Resistance between terminals	950 to 1450Ω	—	Replace
		Insulation resistance	1MΩ or higher	—	Replace
15, 18, 19, 28	Starting torque of wheel hub bearing		2.5 to 5.5 N·m {1.81 to 3.98 ft.lbs, 0.25 to 0.55 kgf·m}	—	Tangential force at wheel hub bearing 18 to 38 N {3.97 to 8.60 lbf, 1.8 to 3.9 kgf}
22	Wobbling of rotor		0.1 {0.0039}	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Brake hose (Brake side)	21 to 30 {15 to 22, 2.1 to 3.1}	—
3	Bolt (Bracket mounting)	12±2 {8.7±1.4, 1.2±0.2}	—
8	Bolt (Wheel hub cover mounting)	23±4 {17±33, 2.35±4.5}	—
11	Bolt (Lock plate mounting)	9±2 {6.5±1.4, 0.9±0.2}	—
13	Lock nut	200 {145, 20}	Slackening off angle : 22.5° (one sixteenth of a turn)
20	Nut (Wheel hub and brake drum mounting)	322 {235, 32.8}	—
25	Nut (Brake assembly mounting)	216±32 {160±24, 22±3.3}	—
26	Nut (Brake assembly mounting)	515±123 {380±90, 52.5±12.5}	—

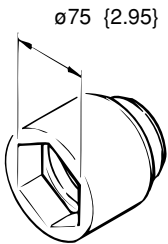
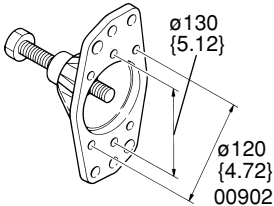
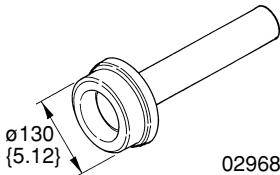
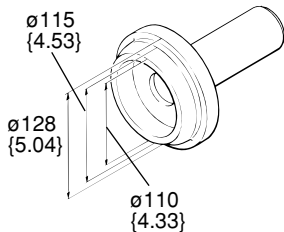
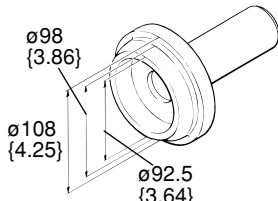
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
15, 28	Pack the space between rollers of wheel bearing inner race	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
16	Pack interior of wheel hub	Wheel bearing grease [NLGI No.2 (Li soap)]	570±20 g {20.1±0.71 oz}
	Pack exterior of wheel hub		150±10 g {5.29±0.35 oz}
17	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

WHEEL HUB AND BRAKE DRUM < FM (FULL-AIR BRAKE) >

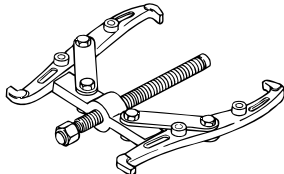
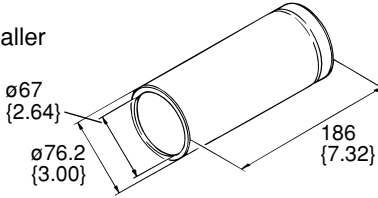
Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
13	Socket wrench  00900	MH061530	Removal and installation of hub bearing lock nut
16	Wheel hub puller  00902	MH061433 or MH061458	Removal of hub and brake drum
17	Anti-lock brake system oil seal installer  02968	MH062609	Press-fitting of oil seal
18	Inner bearing installer  00903	03724-62000	Press-fitting of inner bearing outer race
19	Outer bearing installer  00903	03723-23000	Press-fitting of outer bearing outer race

Special tools

Unit : mm {in.}

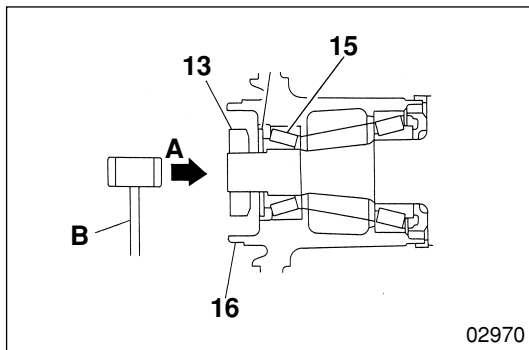
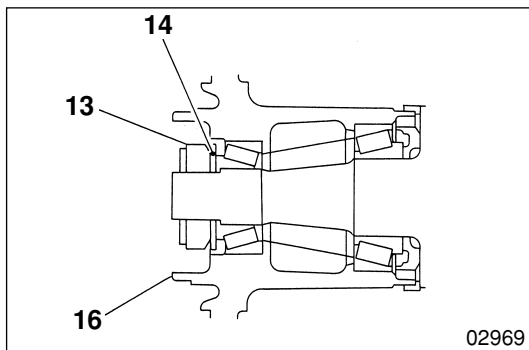
Location	Tool name and shape	Part No.	Application
28	Gear puller  00905	MH061102	Removal of inner bearing inner race
	Inner bearing installer  00906	MH061473	Press-fitting of inner bearing inner race

◆ Service procedure

● Starting torque of wheel hub drum

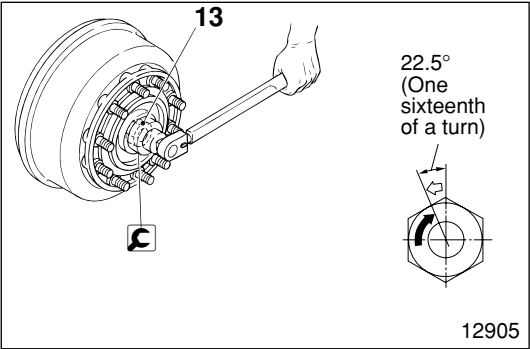
[Adjustment]

- Install lock washer **14** and lock nut **13**, then tighten the lock nut at specified torque while turning wheel hub and brake drum assembly **16** several times.
- Next, slacken off the lock nut fully until a clearance is obtained between lock nut **13** and lock washer **14**.

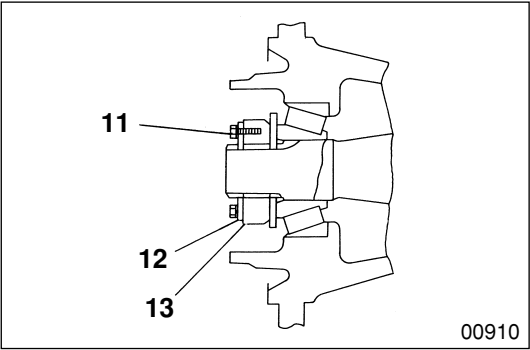


- Return outer bearing **15** toward lock nut **13** by hitting illustrated part **A**, while turning wheel hub and brake drum assembly **16** again.
B : Copper-headed mallet

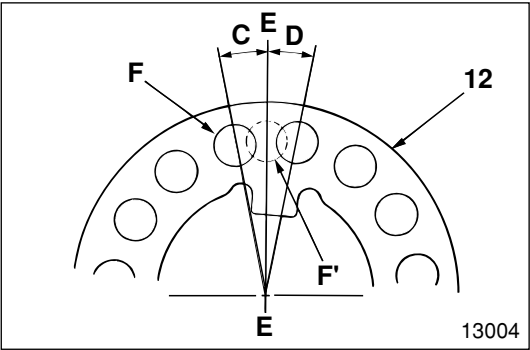
WHEEL HUB AND BRAKE DRUM < FM (FULL-AIR BRAKE) >



- ★ • After retightening lock nut **13** at specified torque, slacken it off by 22.5° (one sixteenth of a turn).
- (★ : If there is any deviation found when you measure the tangential force, carried out following the procedure on [P26-47](#), repeat the work.)

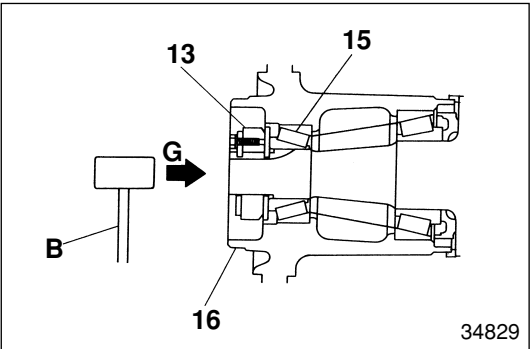


- Install lock plate **12**.
- Make sure that the bolt mounting holes of lock plate **12** and lock nut **13** align.
- Tighten mounting bolts **11** at specified torque.

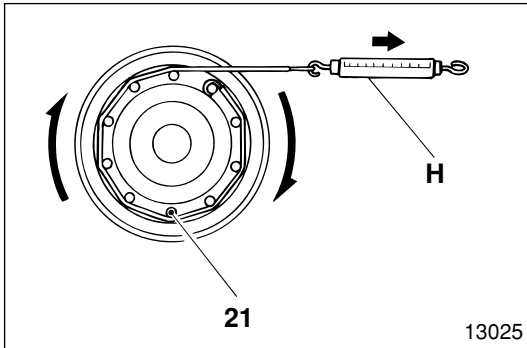


- If the mounting holes of lock plate **12** and lock nut **13** do not align, align as follows:

Hole position of lock nut	How to align hole of lock plate
Within range C	Loosen lock nuts to align holes
Within range D	Turn over lock plate and loosen lock nut to align holes
On E-E line	Turn over the lock plate to align the holes (Lock nut hole position changes from F' to F)



- To slide outer bearing **15** towards lock nut **13**, hit end **G** two or three times with a copper-headed mallet, while turning wheel hub and brake drum assembly **16**.
- B** : Copper-headed mallet

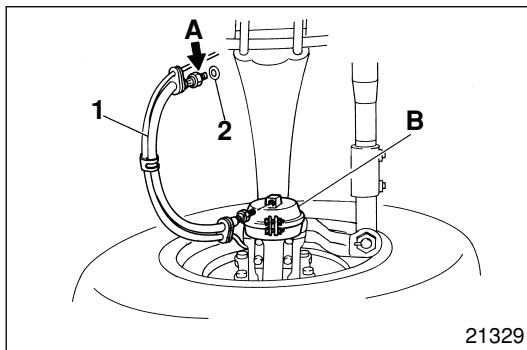


[Measurement]

- Fasten spring balance **H** to hub bolt **21** and measure the tangential force.
- If the measured tangential force is the standard value, the starting torque conforms to the standard value.
- Make sure that the starting torque is smaller than the tangential force.
- If the tangential force deviates from the specified value, adjust the starting torque again.
- If the measured value deviates from the specified value, redo the procedure from the item marked ★. P26-46
- If any fault is found after adjustment, replace outer bearings **15**, **20** and inner bearings **19**, **28**.

NOTE

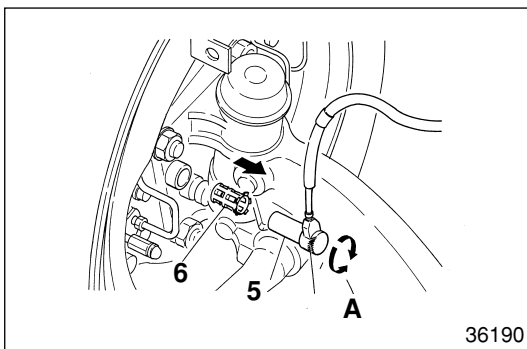
- **Measure the starting torque when oil seal 18 has been installed.**
- **Make sure that the brake lining and brake drum 24 do not drag before measurement.**

**1 Removal and installation of brake hose**

Remove the brake hose from frame side **A** first, then disconnect from brake chamber side **B**. For installation, connect the hose in a reverse order.

CAUTION

Make sure that brake hose 1 is not twisted when you install it.

**5 Wheel speed sensor**

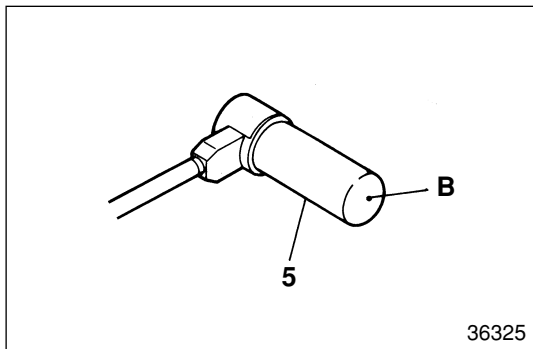
[Removal]

Hold shaded section **A** of wheel speed sensor **5** with pliers, and remove the sensor by twisting it slightly in left and right directions.

CAUTION

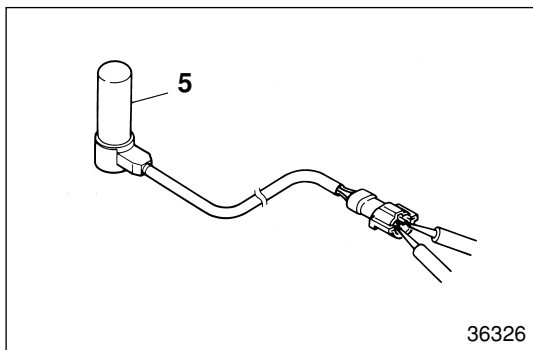
- **When holding wheel speed sensor 5 with pliers, do not grip any section except shaded area A in the diagram.**
- **When removing wheel speed sensor 5, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.**
- **If wheel speed sensor 5 dismounts easily, replace spring spacer 6.**

WHEEL HUB AND BRAKE DRUM < FM (FULL-AIR BRAKE) >

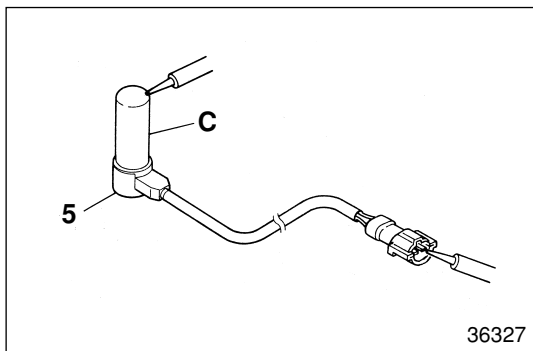


[Inspection]

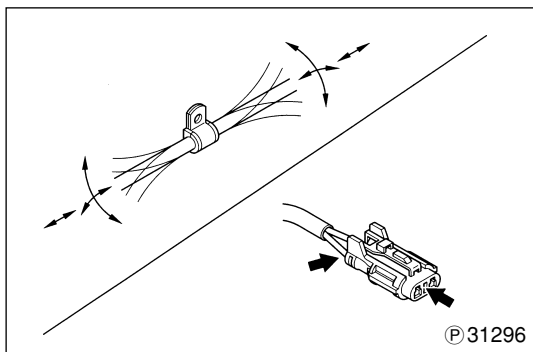
- Since pole piece section **B** is magnetized by the magnet inside wheel speed sensor **5**, it attracts metals. Do not allow the pole piece to collect metallic objects.



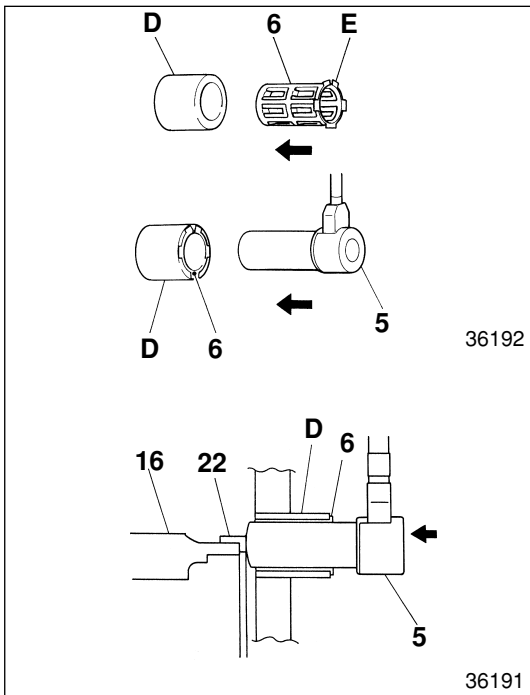
- Measure the resistance between the terminals of wheel speed sensor **5**.
If the measured value deviates from the standard value, replace the wheel speed sensor.



- Measure the insulation resistance between body **C** of wheel speed sensor **5** and each terminal.
If the measured values deviate from the standard value, replace the wheel speed sensor.



- To check for broken wires, remove the harness clamp section from the vehicle. Bend and extend the harness to check if there is any broken wire in the harness. Also, inspect the connector for proper contact.
If a defect is found, replace wheel speed sensor **5**.

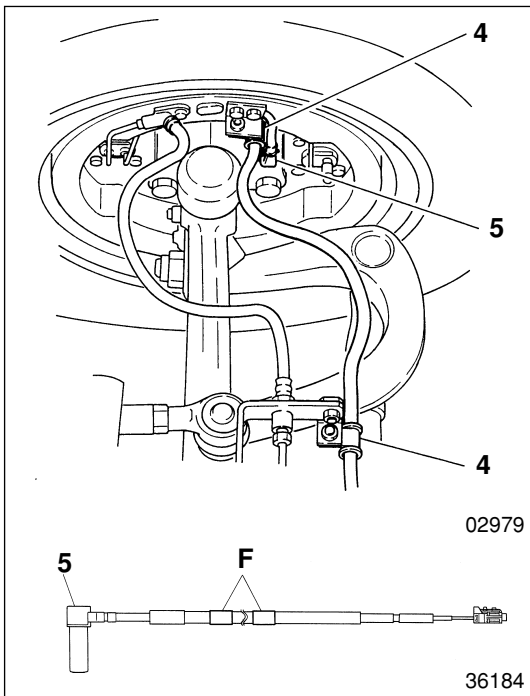


[Installation]

- Insert spring spacer **6** into holder section **D** of the knuckle, and press until stopper section **E** contacts the holder.
- Insert wheel speed sensor **5**, and press until it contacts rotor **22**.
- Rotate hub and brake drum assembly **16** slowly for two or three turns (2 seconds per turn) to make sure it rotates smoothly.

CAUTION ⚠

When installing wheel speed sensor **5**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.



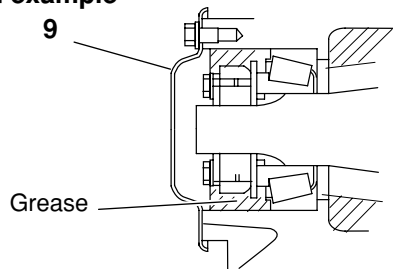
- Secure white tape section **F** of the harness of wheel speed sensor **5** in place using clip **4** on the wheel brake side and clip **4** on the frame side.

CAUTION ⚠

Be sure to clamp the harness of wheel speed sensor **5** at two white tape sections **F**. Make sure the harness does not interfere with other parts and there is no twist or slack in the harness.

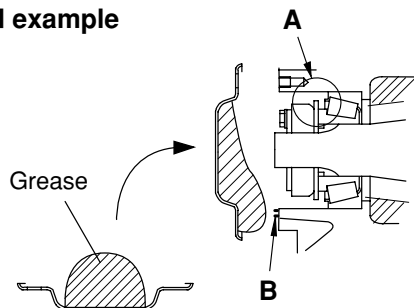
WHEEL HUB AND BRAKE DRUM < FM (FULL-AIR BRAKE) >

Good example



⒫ 53082

Bad example



⒫ 55892

8 Installation of wheel hub cover

CAUTION ⚠

- When attaching the wheel hub cover 9, don't heap grease on the wheel hub cover.

IF heaping grease on them, following results cause.

A: Grease doesn't reach to hub bearing. So it causes insufficient greasing to hub bearing.

B: Grease sticks to the edge of hub. So it causes water infiltration and grease leak.

Refer to good and bad examples as illustrated.

- When attaching the wheel hub cover 9, take care that grease doesn't leak out of the wheel hub cover and that the interface between wheel hub and wheel hub cover is free from grease.

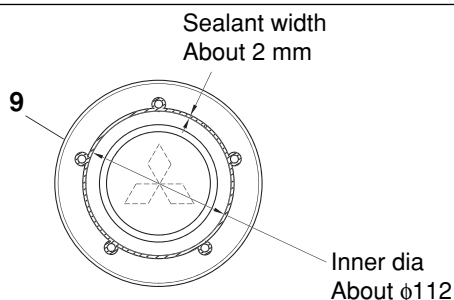
📖 P26-52

10 Installation of wheel hub cov

It is possible to use the sealant instead of the gasket 10, when installing wheel hub cover 9. The sealant is applied in shipping vehicle. Remove the old sedant completely on the mating face of wheel hub 23 and wheel hub cover before attaching new gasket or applying sealant.

In case of applying sealant, follow below points.

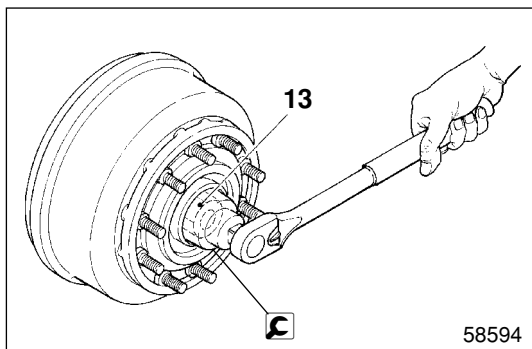
- Apply sealant to the circumference without breaking off as illustrated. The part of oblique lines is sealant.
- Before applying sealant, take care that the interface between wheel hub 23 and wheel hub cover 10 is free from grease.
- Specified sealant: THREEBOND 1217F



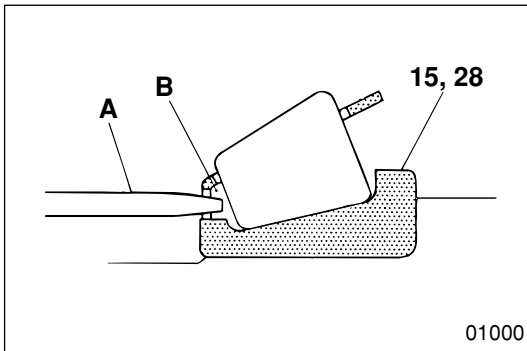
⒫ 53086

13 Removal and installation of lock nut

See adjustment of wheel hub bearing starting torque. 📖 P26-45

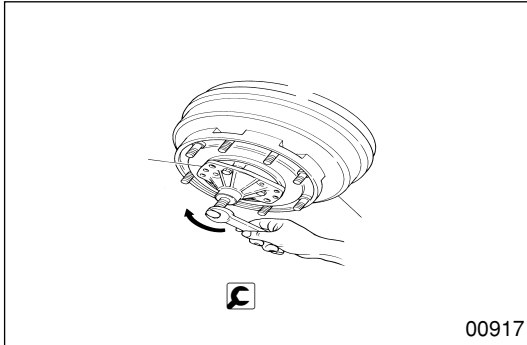


58594



15 28 Packing grease in outer bearing inner race and inner bearing inner race

A : Grease pump nozzle
B : Between rollers

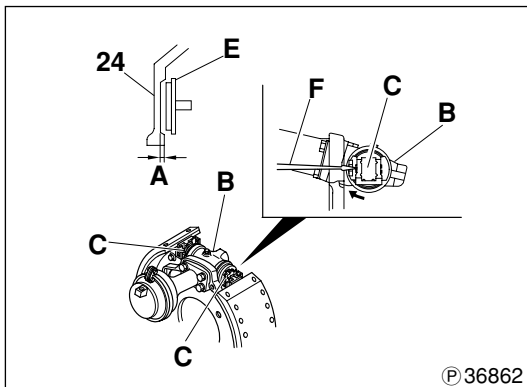


16 Wheel hub and brake assembly

[Removal]

CAUTION ⚠

Make sure you remove wheel hub and brake drum assembly 16 in a straight line to prevent damage to oil seal 18.



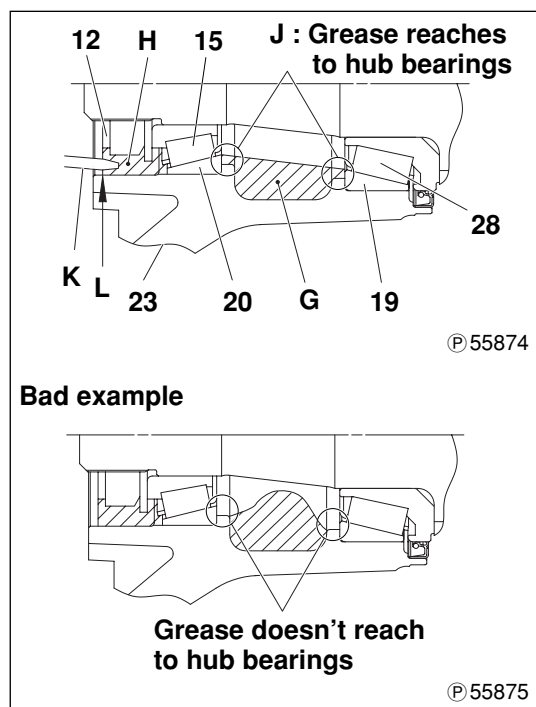
- Remove the dust cover.
- Turn adjuster **C** on expander assembly **B** in direction **D**, and widen gap **A** between brake drum **24** and brake shoe **E**.
- Reinstall the dust cover.

CAUTION ⚠

- Be careful not to damage the boot of expander assembly **B** when inserting flat-tip screwdriver **F**.
- When an abnormality is found in brake drum **24**, correct.

Gr 35B

WHEEL HUB AND BRAKE DRUM < FM (FULL-AIR BRAKE) >



[Installation]

- Lubricate the following areas with specified amount of grease.

G : Inside of wheel hub

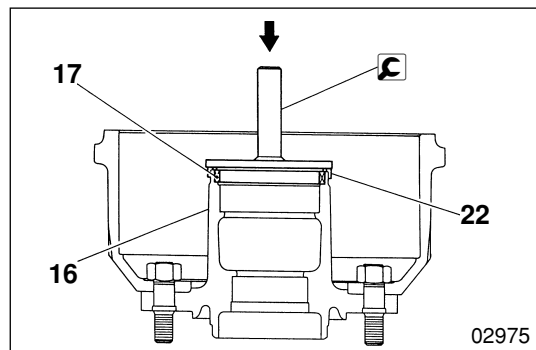
H : Outside of wheel hub

CAUTION ⚠

- Apply grease to the inside of wheel hub 23 until grease reaches contact areas J between inner bearing outer race 19 and the hub and between outer bearing outer race 20 and the hub.
- It is not acceptable that grease doesn't reach to inner bearing outer race 19 and outer bearing outer race 20 like bad example as illustrated.
- Insert nozzle K near the outer bearing and fill grease as illustrated so as to make a grease wall outside of the bearing. Fill grease at least to the lock plate 12 line L.

- After installing wheel hub and brake drum assembly 16, adjust the brake shoe clearance.

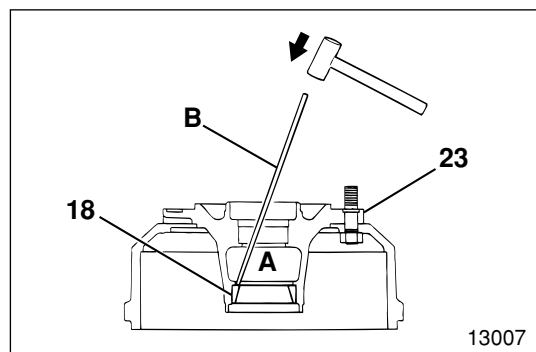
Gr 35B



17 Installation of oil seal

CAUTION ⚠

When hub and brake drum assembly 16 is removed for a service operation and if rotor 22 is still mounted on the wheel hub, use ABS oil seal installer to press-fit oil seal 17.

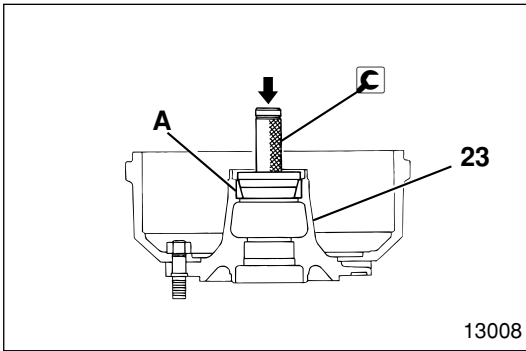


18 Inner bearing outer race

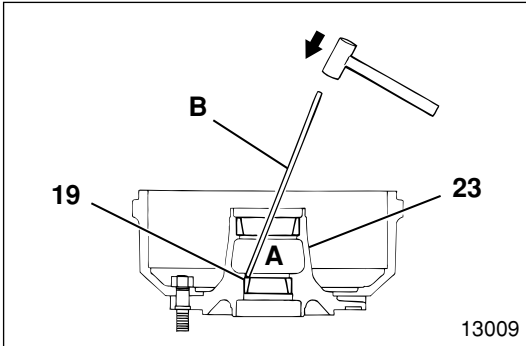
[Removal]

Drive out inner bearing outer race 18 evenly from two indented parts A in wheel hub 23.

B : Pin-punch



[Installation]

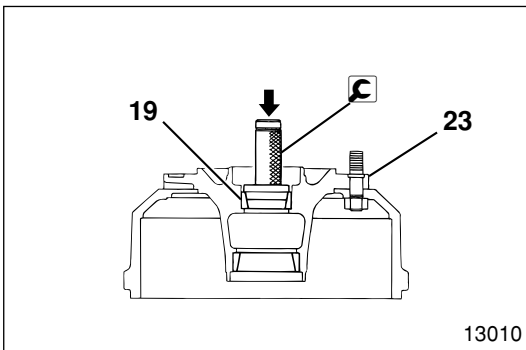


19 Outer bearing outer race

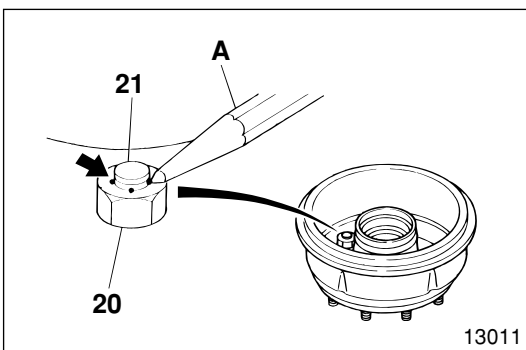
[Removal]

Drive out outer bearing outer race **19** evenly from two indented parts **A** in wheel hub **23**.

B : Pin-punch



[Installation]

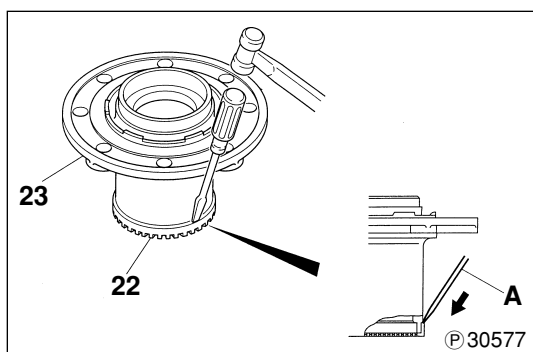


20 21 Installation of nut and hub bolts

Tighten nut **20** at specified torque, then caulk hub bolt **21** evenly at four points.

A : Punch

WHEEL HUB AND BRAKE DRUM < FM (FULL-AIR BRAKE) >



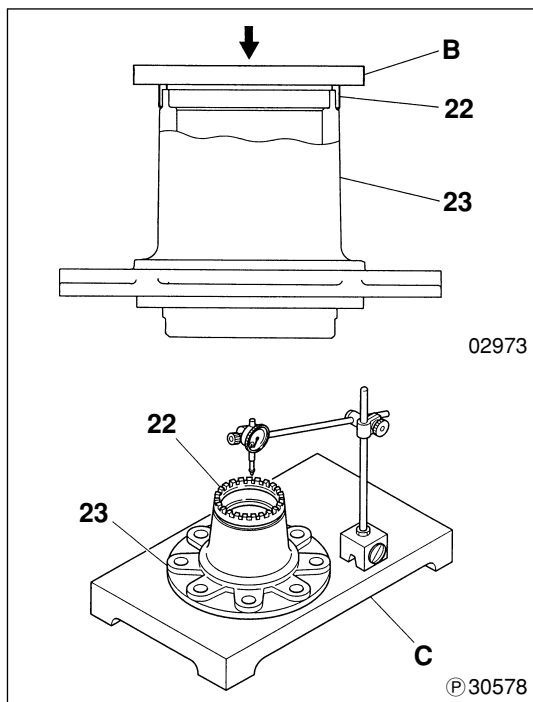
22 Rotor

[Removal]

Strike the outer edge of rotor **22** evenly with flat-tip screwdriver **A** to remove the rotor from the wheel hub.

CAUTION

Be careful not to damage wheel hub **23**.



[Installation]

Heat rotor **22** to approximately 150°C {302°F}. Press the rotor evenly with iron plate **B** to press-fit the rotor to wheel hub **23**. Make sure there is no space between the rotor and wheel hub.

[Inspection]

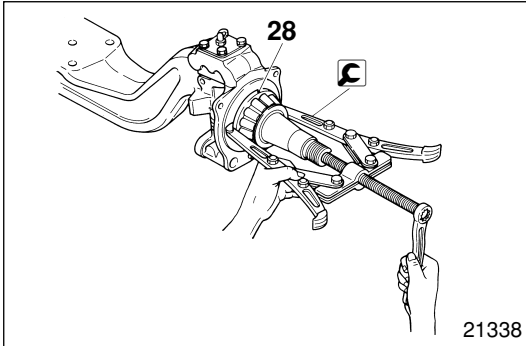
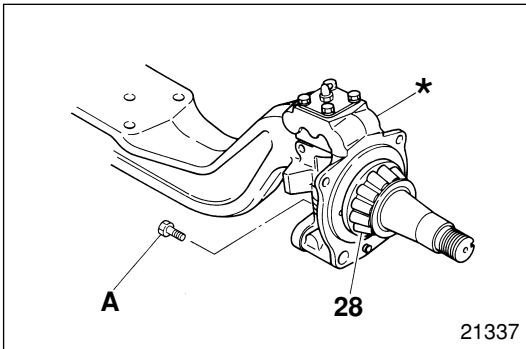
- If the amount of wobbling exceeds the standard value, repeat the assembly procedure from the beginning.
- If the amount of wobbling exceeds the standard value after reassembly, replace defective parts.

C : Base

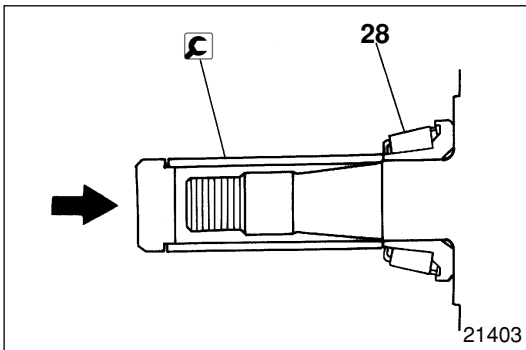
28 Inner bearing inner race

[Removal]

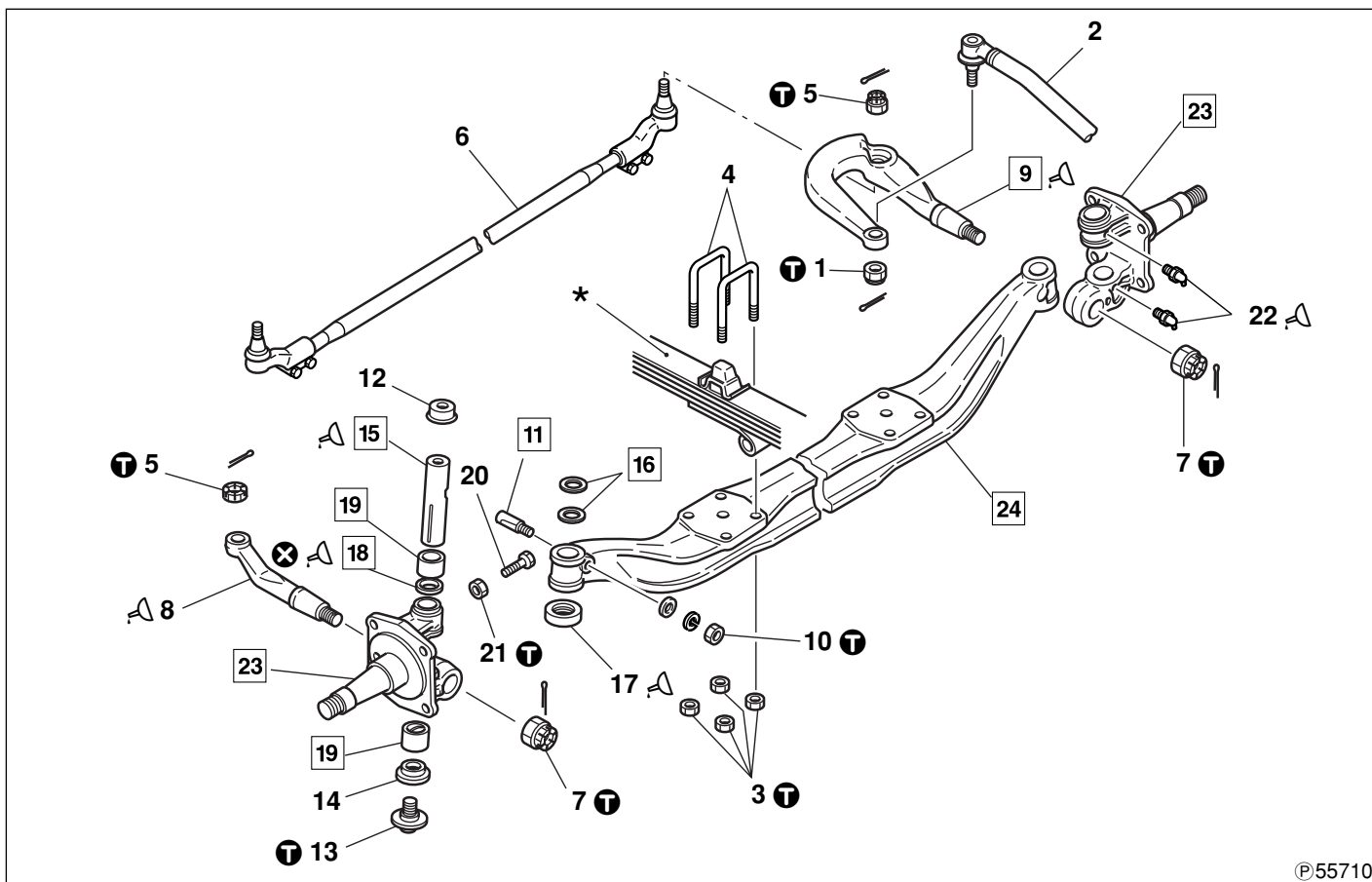
Turn the knuckle stopper bolt on the knuckle *****, or screw two bolts **A** (M14 x 1.5 mm) evenly into the screw plug mounting holes to remove inner bearing inner race **28**.



[Installation]



FRONT AXLE, KNUCKLE AND KINGPIN < FK >



Disassembly sequence

- | | | |
|--|------------------------|---|
| 1 Nut | 10 Nut | 19 Bushing |
| 2 Drag link  | 11 Set bolt | 20 Knuckle stopper bolt |
| 3 U-bolt nut  | 12 Kingpin cap | 21 Nut |
| 4 U-bolt | 13 Lower kingpin cover | 22 Grease nipple |
| 5 Nut | 14 Dust seal | 23 Knuckle |
| 6 Tie rod  | 15 Kingpin | 24 Front axle |
| 7 Nut | 16 Thrust washer | |
| 8 Tie rod arm | 17 Bearing | |
| 9 Knuckle arm | 18 Oil seal | |
| | | * : Front leaf spring  |
| | | ⊗ : Non-reusable parts |

NOTE

Kingpin 15 may have a blackend surface, but this is due to transcription of the resin of bushing 20 and does not present any problem.

Assembly sequence

23 → 22 → 19 → 18 → 15 → 11 → 10 → 14 → 13 → 12 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1
 21 → 20
 24 → 17 → 16

Repair kit : Kingpin kit

Work after assembly

 P26-58

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
15	Kingpin	Outer diameter	[35] $\begin{smallmatrix} -0.002 \\ -0.015 \end{smallmatrix}$ {[1.38] $\begin{smallmatrix} -0.000079 \\ -0.00059 \end{smallmatrix}$ }	34.9 {1.37}	Replace
		Inclination angle	7°00'	7°00'±30'	
19	Kingpin bushing	Inner diameter (After press-fitting knuckle)	[35] $\begin{smallmatrix} +0.045 \\ +0.018 \end{smallmatrix}$ {[1.38] $\begin{smallmatrix} +0.0018 \\ +0.00071 \end{smallmatrix}$ }	—	Replace
		Clearance between kingpin bushing and kingpin	0.02 to 0.06 {0.00079 to 0.0024}	0.15 {0.0059}	
23, 24	Vertical clearance between knuckle and front axle		0.1 {0.0039} or less	0.2 {0.0079}	Adjust with thrust washer
24	Front axle	Bend (Longitudinal)	2.5 {0.098} or less	7 {0.28}	Replace
		Bend (Vertical)	3 {0.12} or less	7 {0.28}	

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	Nut (Drag link mounting)		190±48 {140±35, 19.4±4.85}	—
3	U-bolt nut (U-bolt mounting)	FK	204 to 276 {150 to 205, 20.8 to 28.2}	Wet
		FM	404 to 548 {295 to 405, 41.2 to 55.8}	Wet
5	Nut (Tie rod mounting)		190±48 {140±35, 19.4±4.85}	—
7	Nut (Tie rod arm and knuckle arm mounting)		686±98 {505±72, 70±10}	—
10	Nut (Set bolt tightening)		29 {22, 3}	—
13	Lower kingpin cover		39±10 {29±7, 4±1}	—
21	Nut (Knuckle stopper bolt fastening)		71±12 {53±9.4, 7.3±1.2}	—

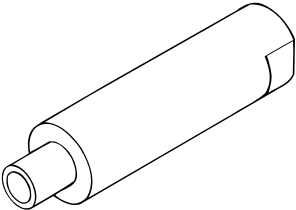
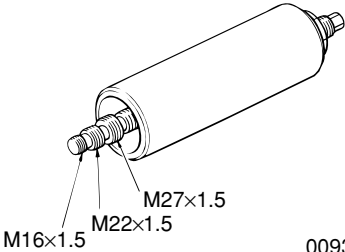
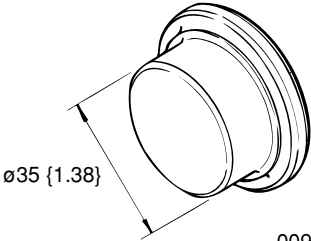
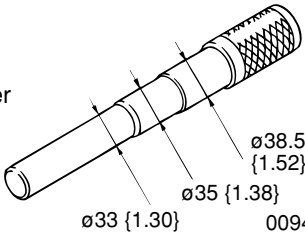
L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
8, 9	Thread area of knuckle arm and tie rod arm	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Periphery of kingpin and hole	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
17	Pack interior of bearing	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
18	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
22	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

FRONT AXLE, KNUCKLE AND KINGPIN < FK >

Special tools

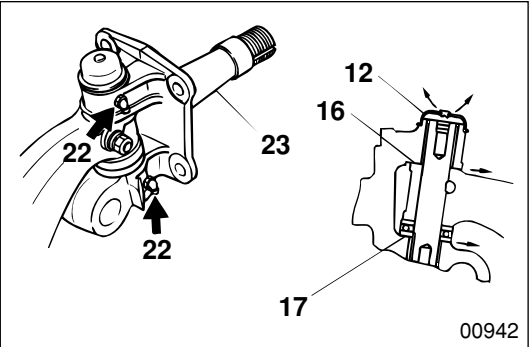
Unit : mm {in.}

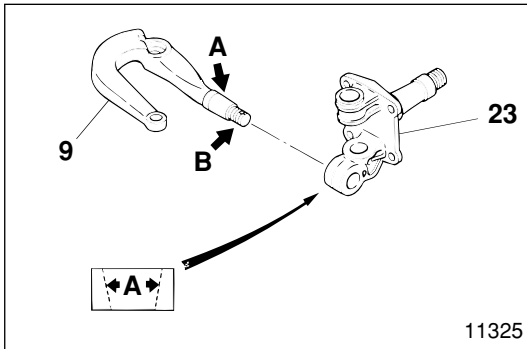
Location	Tool name and shape	Part No.	Application
11	Kingpin set bolt remover 	MH061688	Removal of kingpin set bolt
	00938		
15	Kingpin puller 	MH061684	Removal of kingpin
	00939		
18	Oil seal installer 	MH062201	Press-fitting of oil seal
	00940		
19	Kingpin bushing remover 	MH061037	Removal and installation of kingpin bushing
	00941		

◆ Service procedure

● Work after assembly

Supply grease via grease nipple **22** of knuckle **23**. Supply grease until it overflows from the dust plugs of upper cap **12**, thrust washer **16**, and the press side of ball bearing **17**.





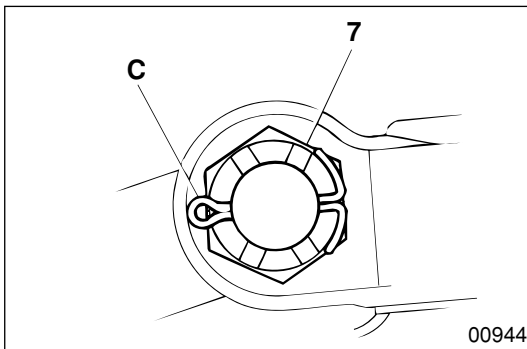
9 23 Installation of knuckle arm and knuckle

(1) Reassembly of existing knuckle arm 9 and/or knuckle 23

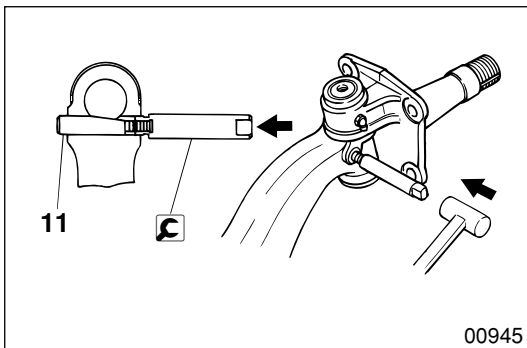
- Evenly polish taper surfaces **A** of knuckle arm **9** and knuckle **23** using emery paper (120 grit or finer), until abrasion traces left by the emery paper are only just visible. For new parts, polishing is not required.
- Clean taper surfaces **A** of knuckle arm **9** and knuckle **23** and thread area **B** of the knuckle arm. (Use a cleaning solvent for acetone color checking or other solvent.)
- Install knuckle arm **9** after applying grease to thread area **B**. (Do not grease the taper surfaces of the knuckle arm and the knuckle.)
- Tighten new nut **7** at specified torque. Without loosening the nut, insert split pin **C** into the pin hole to lock the nut.

(2) Installation of new knuckle arm 9 and knuckle 23

- Clean taper surfaces **A**, or thread area **B**, of knuckle arm **9** and knuckle **23**, and install them without greasing.
- Tighten new nut **7** at specified torque. Without loosening the nut, insert split pin **C** into the pin hole to lock the nut.

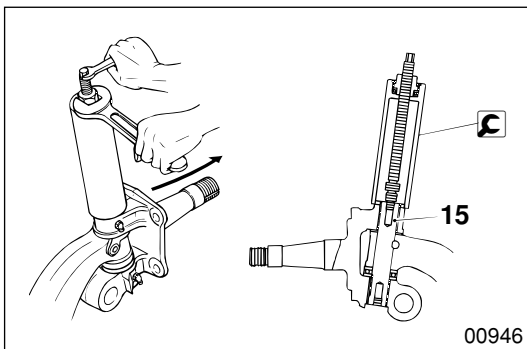


11 Removal of set bolt



15 Removal of kingpin

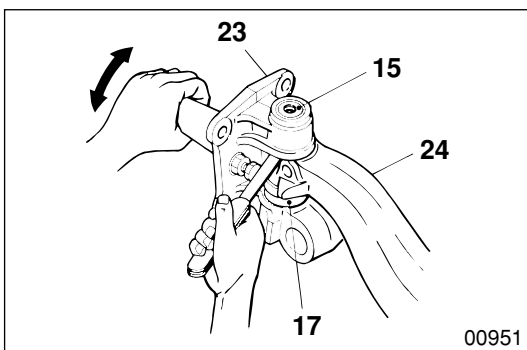
- Remove the kingpin cap. Screw the bolt of  kingpin puller into the threads of kingpin **15**, and remove the kingpin.



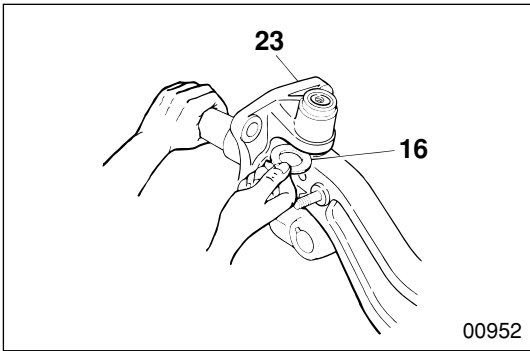
16 23 24 Thrust washer, knuckle, and front axle

[Inspection]

- Assemble kingpin **15** and bearing **17** temporarily, and turn knuckle **23** a couple of times to smooth its operation.
- Measure the clearance between the upper surface of front axle **24** and the lower part of knuckle **23**.
- If the measured value is higher than the limit, adjust with thrust washer **16**.

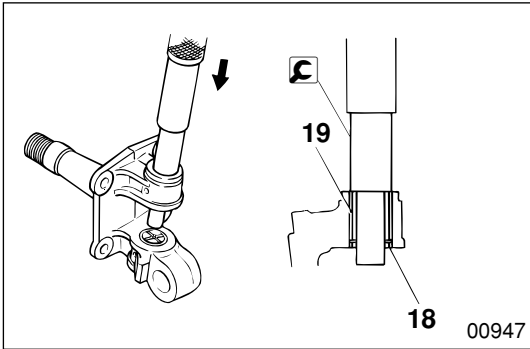


FRONT AXLE, KNUCKLE AND KINGPIN < FK >



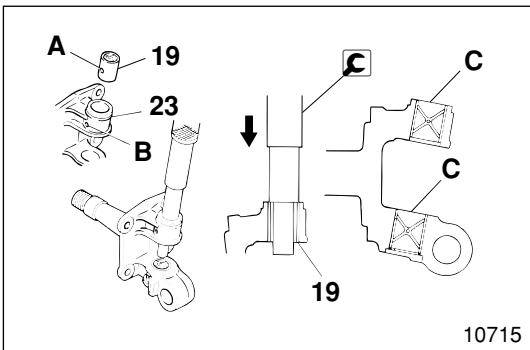
[Adjustment]

- Adjusting thrust washers **16** are available in the following sizes: 2.1 to 2.8 mm {0.083 to 0.11 in.} (eight thicknesses in 0.1 mm {0.0039 in.} increments)
- Be sure to minimize the clearance by selecting appropriate thrust washer **16**.
- Make sure that knuckle **23** moves smoothly after assembly.



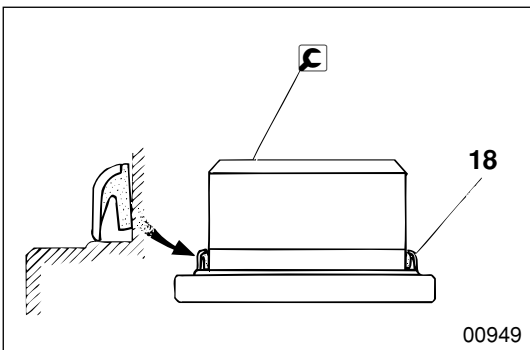
18 19 Oil seal and bushing

[Removal]

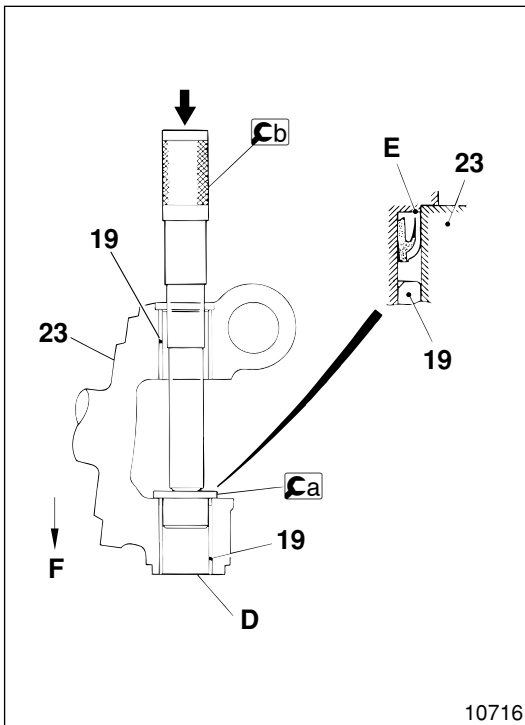


[Installation]

- Press bushing **19** in, with its oil hole **A** aligned to oil hole **B** of knuckle **23**, until end **C** is flush with the knuckle end.



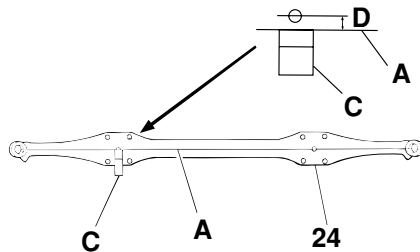
- Apply grease to the lip area of oil seal **18**, and position the oil seal on  oil seal installer.



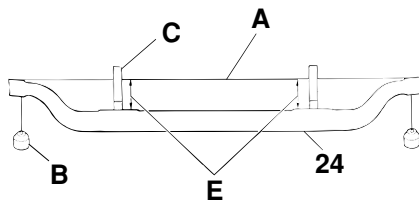
- Next, install **Ca** oil seal installer on knuckle **23** in the direction as illustrated.
- Pass **Cb** kingpin bushing remover through the kingpin hole and position it on **Ca** oil seal installer.
- Hit the head of **Cb** kingpin bushing remover until **Ca** oil seal installer makes contact with the knuckle.
- Make sure that end **D** of bushing **19** makes contact with knuckle **23** on the same level.
- Make sure that oil seal end **E** does not protrude from knuckle **23**.

F : Upper side of vehicle

< Longitudinal direction >



< Vertical direction >



24 Inspection of front axle

(1) Measurement of bend in front axle 24 in longitudinal and vertical directions

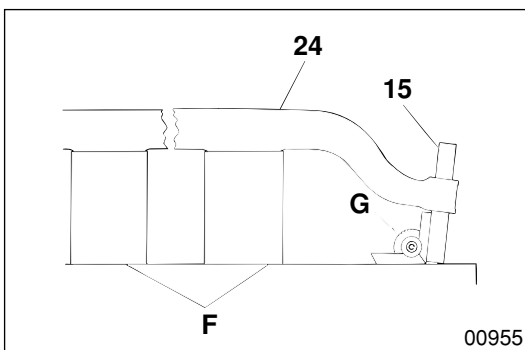
- Pass a piece of thread **A** through the kingpin hole of front axle **24** and hang weights **B** on both ends.
- Use square **C** to find the degree of bend in both the longitudinal direction **D** and the vertical direction **E**.
- If the measured value is higher than the limit, replace front axle **24**.

(2) Measurement of kingpin inclination angle

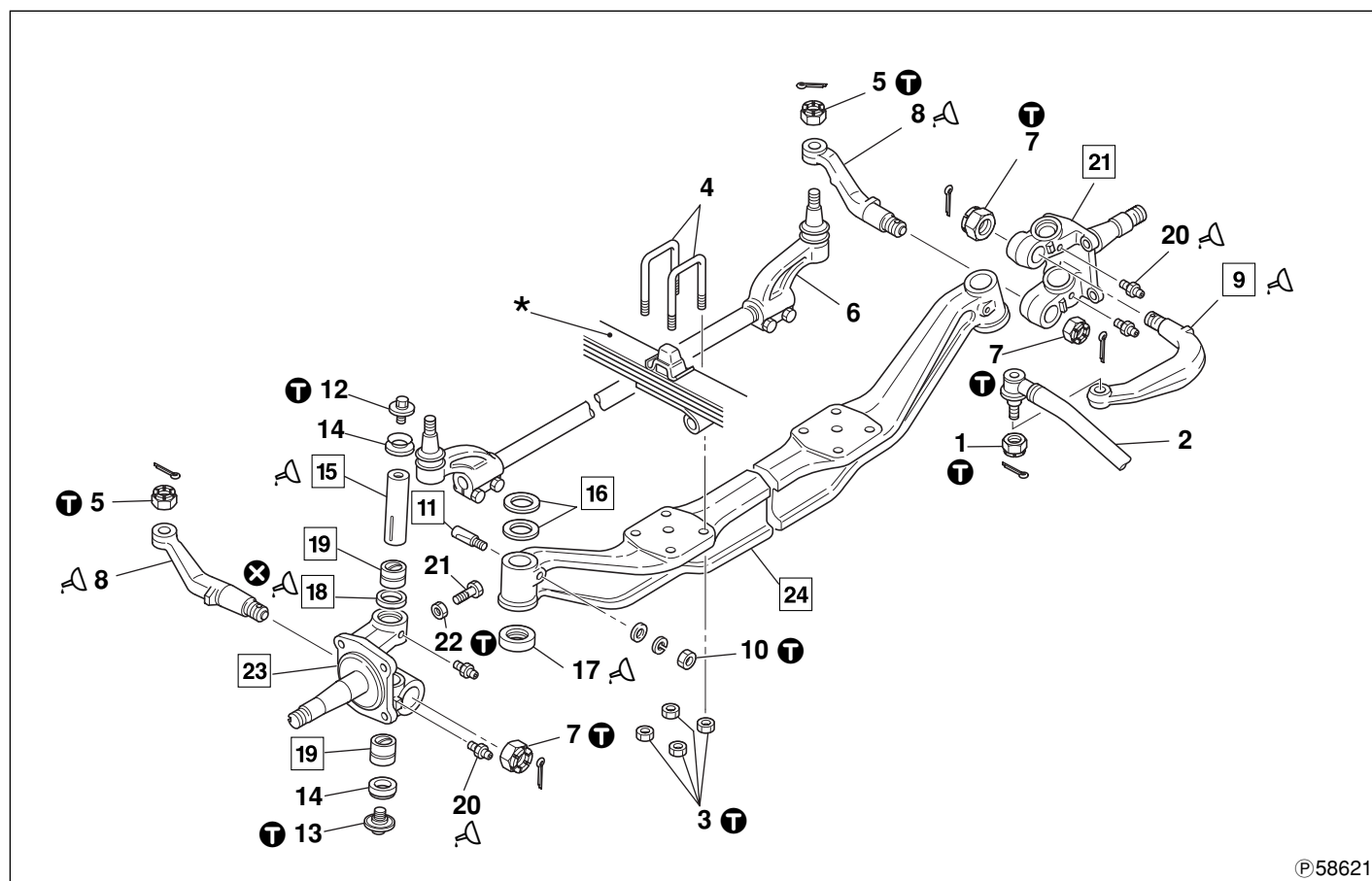
Mount kingpin **15** in front axle **24** as illustrated, and measure the kingpin inclination angle. If the measured value is higher than the limit, replace the front axle.

F : Block gauge

G : Bevel square



FRONT AXLE, KNUCKLE AND KINGPIN < FM (AIR-OVER HYDRAULIC BRAKE) >



● Disassembly sequence

- | | | |
|--|------------------------|---|
| 1 Nut | 10 Nut | 19 Bushing |
| 2 Drag link  | 11 Set bolt | 20 Grease nipple |
| 3 U-bolt nut  | 12 Upper kingpin cover | 21 Knuckle stopper bolt |
| 4 U-bolt | 13 Lower kingpin cover | 22 Nut |
| 5 Nut | 14 Dust seal | 23 Knuckle |
| 6 Tie rod | 15 Kingpin | 24 Front axle |
| 7 Nut | 16 Thrust washer | |
| 8 Tie rod arm | 17 Bearing | * : Front leaf spring  |
| 9 Knuckle arm | 18 Oil seal | ⊗ : Non-reusable parts |

NOTE

Kingpin 15 may have a blackend surface, but this is due to transcription of the resin of bushing 20 and does not present any problem.

● Assembly Sequence

23 → 22 → 19 → 18 → 15 → 11 → 10 → 14 → 13 → 12 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

21 → 20 → 24 → 17 → 16

Repair kit : Kingpin kit

● Work after assembly

 P26-64

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
15	Kingpin	Outer diameter	[45] $\begin{smallmatrix} -0.002 \\ -0.015 \end{smallmatrix}$ {[1.77] $\begin{smallmatrix} -0.000079 \\ -0.00059 \end{smallmatrix}$ }	44.9 {1.77}	Replace
		Inclination angle	7°00'	7°00'±30'	
19	Kingpin bushing	Inner diameter (After press-fitting) knuckle	[45] $\begin{smallmatrix} +0.045 \\ +0.018 \end{smallmatrix}$ {[1.77] $\begin{smallmatrix} +0.0018 \\ +0.00071 \end{smallmatrix}$ }	—	Replace
		Clearance between kingpin bushing and kingpin	0.02 to 0.06 {0.00079 to 0.0024}	0.15 {0.0059}	
23, 24	Vertical clearance between knuckle and front axle		0.1 {0.0039} or less	0.2 {0.0079}	Adjust with thrust washer
24	Front axle	Bend (Longitudinal)	2.5 {0.098} or less	7 {0.28}	Replace
		Bend (Vertical)	3 {0.12} or less	7 {0.28}	

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Drag link mounting)	190±48 {140±35, 19.4±4.85}	—
3	U-bolt nut (U-bolt mounting)	372±56 {275±41, 37.9±5.7}	Wet
5	Nut (Tie rod mounting)	190±48 {140±35, 19.4±4.85}	—
7	Nut (Tie rod arm and knuckle arm mounting)	677 {500, 69}	—
10	Nut (Set bolt tightening)	29 {22, 3}	—
12	Upper kingpin cover	74±15 {54±11, 7.5±1.5}	—
13	Lower kingpin cover	74±15 {54±11, 7.5±1.5}	—
22	Nut (Knuckle stopper bolt fastening)	71±12 {53±9.4, 7.3±1.2}	—

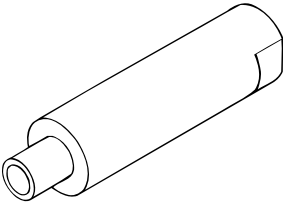
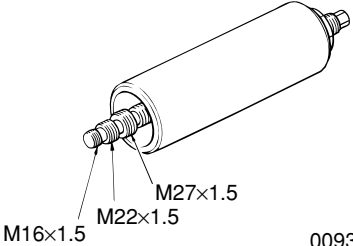
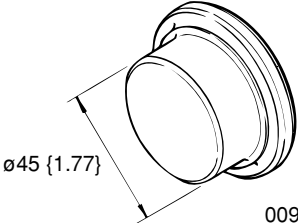
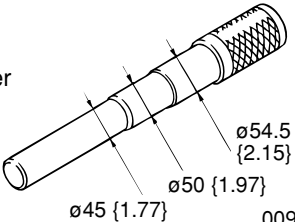
L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
8, 9	Thread areas of tie rod arm and knuckle arm	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Periphery of kingpin and hole	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
17	Pack interior of bearing	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
18	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
20	Supply via knuckle grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

FRONT AXLE, KNUCKLE AND KINGPIN < FM (AIR-OVER HYDRAULIC BRAKE) >

Special tools

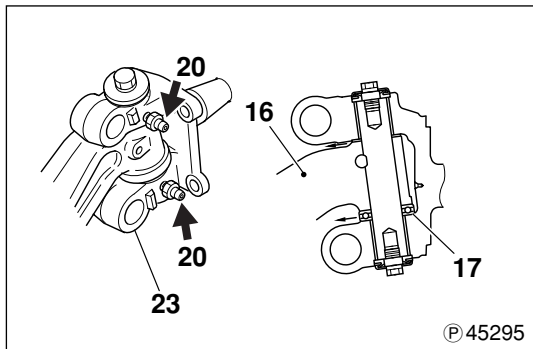
Unit : mm {in.}

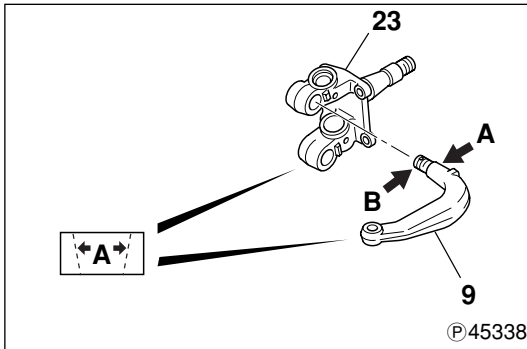
Location	Tool name and shape	Part No.	Application
11	Kingpin set bolt remover  00938	MH061688	Removal of kingpin set bolt
15	Kingpin puller  00939	MH061684	Removal of kingpin
18	Oil seal installer  00940	MH062202	Press-fitting of oil seal
19	Kingpin bushing remover  00941	MH061792 (MH061037)	Removal and installation of kingpin bushing. Tool No. in () is used for press-fitting oil seal installer

◆ Service procedure

● Work after assembly

Supply grease via grease nipple **20** of knuckle **23**. Supply grease until it overflows from thrust washer **16** and the press side of ball bearing **17**.

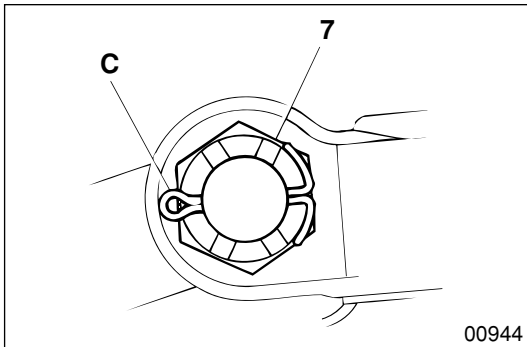




9 23 Installation of knuckle arm and knuckle

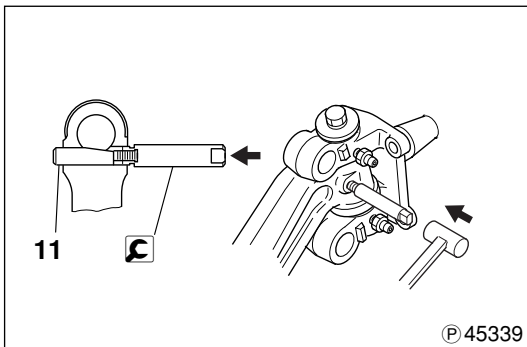
(1) Reassembly of existing knuckle arm 9 and/or knuckle 23

- Evenly polish taper surfaces **A** of knuckle arm **9** and knuckle **23** using emery paper (120 grit or finer), until abrasion traces left by the emery paper are only just visible. For new parts, polishing is not required.
- Clean taper surfaces **A** of knuckle arm **9** and knuckle **23** and thread area **B** of the knuckle arm. (Use a cleaning solvent for acetone color checking or other solvent.)
- Install knuckle arm **9** after applying grease to thread area **B**. (Do not grease the taper surfaces of the knuckle arm and the knuckle.)

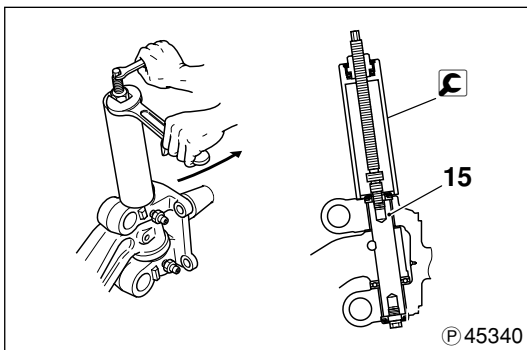


(2) Installation of new knuckle arm 9 and knuckle 23

- Clean taper surfaces **A**, or thread area **B**, of knuckle arm **9** and knuckle **23**, and install them without greasing.
- Tighten new nut **7** at specified torque. Without loosening the nut, insert split pin **C** into the pin hole to lock the nut.



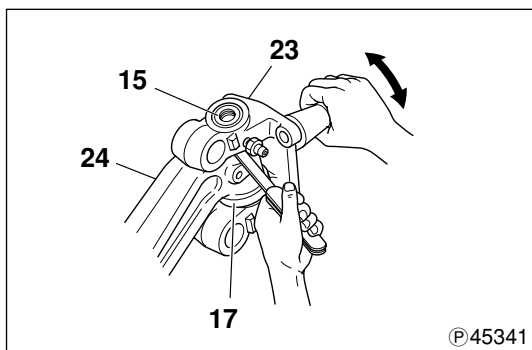
11 Removal of set bolt



15 Removal of kingpin

Remove the kingpin cover and dust seal. Screw the bolt of  kingpin puller into the threads of kingpin **15**, and remove the kingpin.

FRONT AXLE, KNUCKLE AND KINGPIN < FM (AIR-OVER HYDRAULIC BRAKE) >



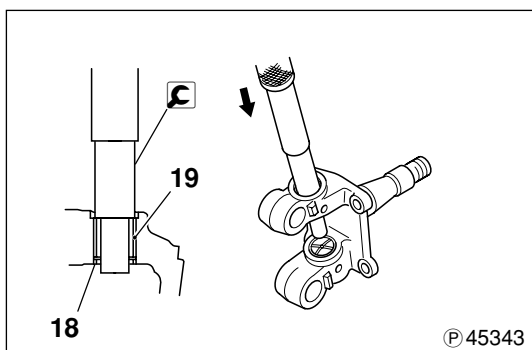
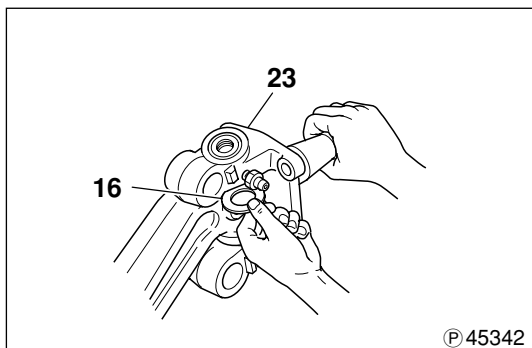
16 23 24 Thrust washer, knuckle, and front axle

[Inspection]

- Assemble kingpin 15 and bearing 17 temporarily, and turn knuckle 23 a couple of times to smooth its operation.
- Measure the clearance between the upper surface of front axle 22 and the lower part of knuckle 23.
- If the measured value is higher than the limit, adjust with thrust washer 16.

[Adjustment]

- Adjusting thrust washers 16 are available in the following sizes: 2.9 to 3.6 mm {0.11 to 0.14 in.} (eight thicknesses in 0.1 mm {0.0039 in.} increments)
- Be sure to minimize the clearance by selecting appropriate thrust washer 16.
- Make sure that knuckle 23 moves smoothly after assembly

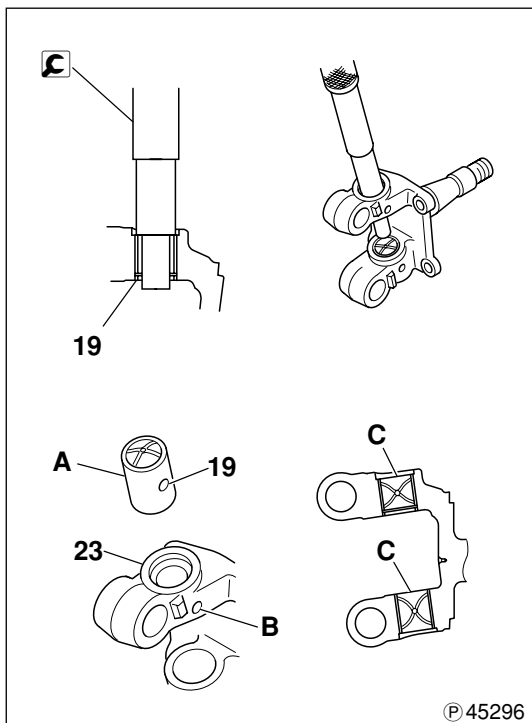


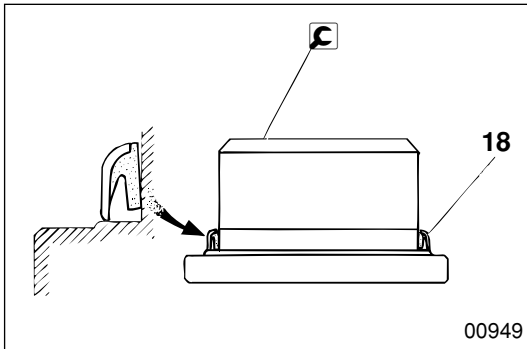
18 19 Oil seal and bushing

[Removal]

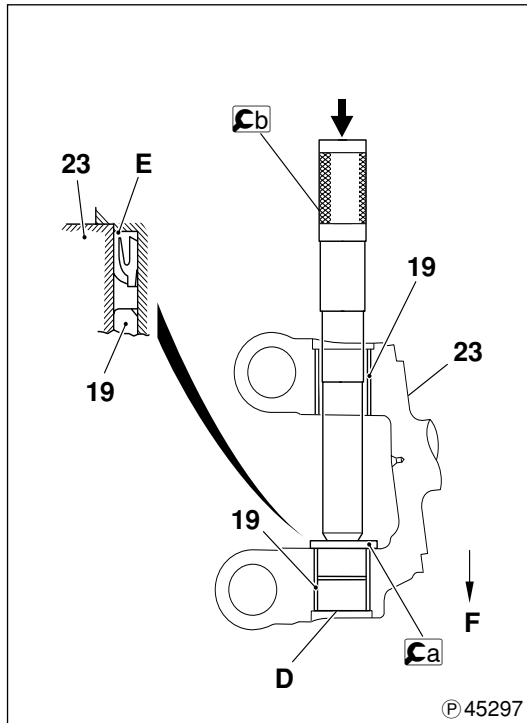
[Installation]

- Press bushing 19 in, with its oil hole A aligned to oil hole B of knuckle 23, until end C is flush with the knuckle end.



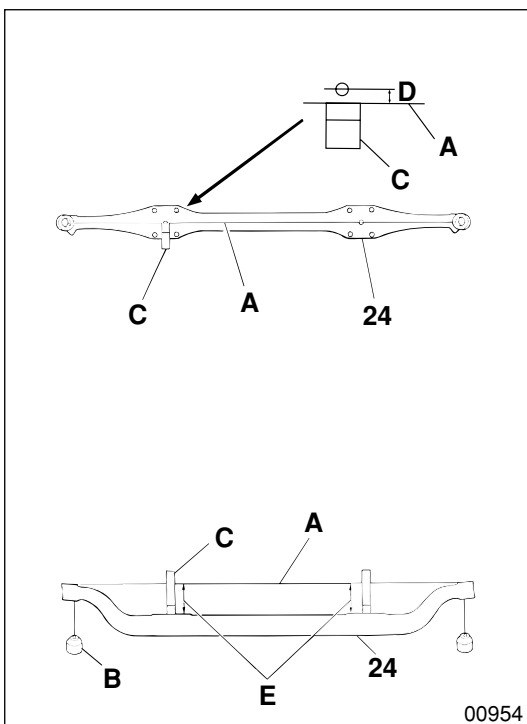


- Apply grease to lip area of oil seal **18**, and position the oil seal on **C** oil seal installer.



- Next, install **Ca** oil seal installer on knuckle **23** in the direction as illustrated.
- Pass **Cb** kingpin bushing remover through the kingpin hole and position it on **Ca** oil seal installer.
- Hit the head of **Cb** kingpin bushing remover until **Ca** oil seal installer makes contact with knuckle **23**.
- Make sure that end **D** of bushing **19** makes contact with knuckle **23** on the same level.
- Make sure that oil seal end **E** does not protrude from knuckle **23**.

F : Upper side of vehicle

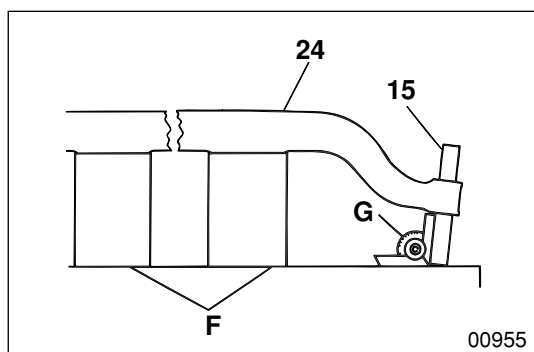


24 Inspection of front axle

(1) Measurement of bend in front axle 24 in longitudinal and vertical directions

- Pass a piece of thread **A** through the kingpin hole of front axle **24** and hang weights **B** on both ends.
- Use square **C** to find the degree of bend in both the longitudinal direction **D** and the vertical direction **E**.
- If the measured value is higher than the limit, replace front axle **24**.

FRONT AXLE, KNUCKLE AND KINGPIN < FM (AIR-OVER HYDRAULIC BRAKE) >



(2) Measurement of kingpin inclination angle

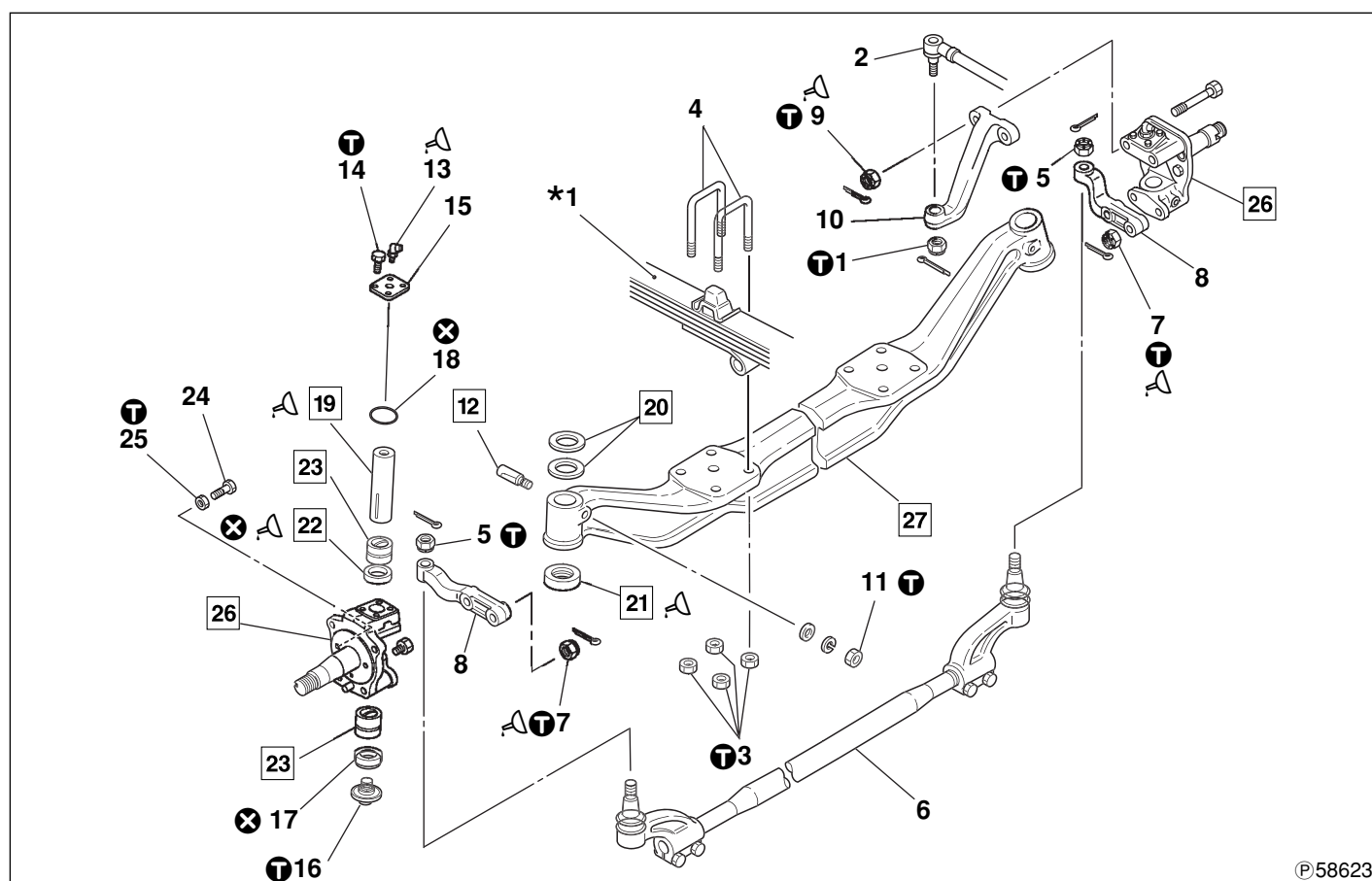
Mount kingpin **15** in front axle **24** as illustrated, and measure the kingpin inclination angle. If the measured value is higher than the limit, replace the front axle.

F : Block gauge

G : Bevel square

MEMO

FRONT AXLE, KNUCKLE AND KINGPIN < FM (FULL-AIR BRAKE) >



● Disassembly sequence

- | | | |
|--|------------------------|--|
| 1 Nut | 12 Set bolt | 23 Bushing |
| 2 Drag link  | 13 Grease nipple | 24 Knuckle stopper bolt |
| 3 U-bolt nut  | 14 Bolt | 25 Lock nut |
| 4 U-bolt | 15 Upper kingpin cover | 26 Knuckle |
| 5 Nut | 16 Lower kingpin cover | 27 Front axle |
| 6 Tie rod | 17 Dust seal | |
| 7 Nut | 18 O-ring | *1 : Front leaf spring  |
| 8 Tie rod arm | 19 Kingpin | *2 : Front brake chamber  |
| 9 Nut | 20 Thrust washer | ⊗ : Non-reusable parts |
| 10 Knuckle arm | 21 Bearing | |
| 11 Nut | 22 Oil seal | |

NOTE

Kingpin 15 may have a blackend surface, but this is due to transcription of the resin of bushing 20 and does not present any problem.

● Assembly sequence

26 → 23 → 22
 25 → 24
 27 → 21 → 20

→ 19 → 12 → 11 → 17 → 16 → 18 → 15 → 14 → 13 → 10 → 9 → 8 → 7 → 6
 → 5 → 4 → 3 → 2 → 1

Repair kit : Kingpin kit

● Work after assembly

 P26-72

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
19	Kingpin	Outer diameter	[50] $_{-0.015}^{-0.002}$ {[1.97] $_{-0.00059}^{-0.000079}$ }	49.9 {1.96}	Replace
		Inclination angle	7°00'	7°00'±30'	
23	Kingpin bushing	Inner diameter (After press-fitting) knuckle	[50] $_{+0.018}^{+0.045}$ {[1.97] $_{+0.00071}^{+0.0018}$ }	—	Replace
		Clearance between kingpin bushing and kingpin	0.02 to 0.06 {0.00079 to 0.0024}	0.15 {0.0059}	
26, 27	Vertical clearance between knuckle and front axle		0.1 {0.0039} or less	0.2 {0.0079}	Adjust with thrust washer
27	Font axle	Bend (Longitudinal)	2.5 {0.098} or less	7 {0.28}	Replace
		Bend (Vertical)	3 {0.12} or less	7 {0.28}	

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Drag link mounting)	353±88 {260±65, 36±9}	—
3	U-bolt nut (U-bolt mounting)	404 to 548 {295 to 405, 41.2 to 55.8}	Wet
5	Nut (Tie rod mounting)	270±68 {200±50, 27.6±6.9}	—
7	Nut (Tie rod arm and knuckle arm mounting)	515±123 {380±90, 52.5±12.5}	—
9	Nut (Knuckle arm mounting)	466±74 {345±54, 47.5±7.5}	Wet
11	Nut (Set bolt tightening)	29 {22, 3}	—
14	Bolt (Upper kingpin cover mounting)	41.2±7.8 {30±5.8, 4.2±0.8}	—
16	Lower kingpin cover	137±29.4 {100±22, 14±3}	—
25	Lock nut (installation of knuckle stopper bolt)	71±12 {53±9.4, 7.3±1.3}	—

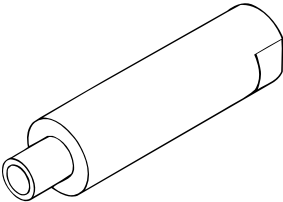
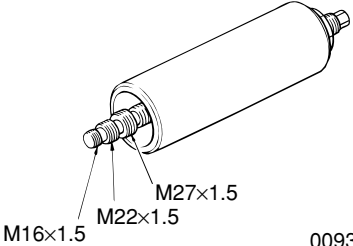
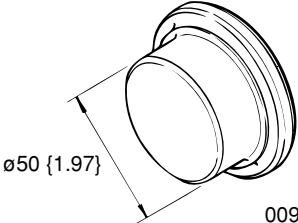
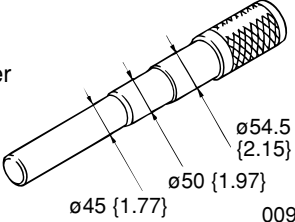
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7, 9	Threaded section of nut	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
13	Supply via knuckle grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
19	Periphery of kingpin and hole	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
21	Pack interior of bearing	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
22	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

FRONT AXLE, KNUCKLE AND KINGPIN < FM (FULL-AIR BRAKE) >


Special tools

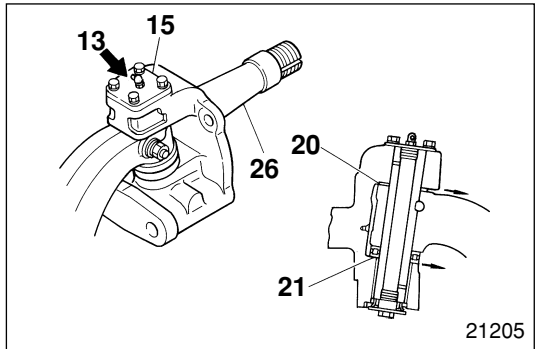
Unit : mm {in.}

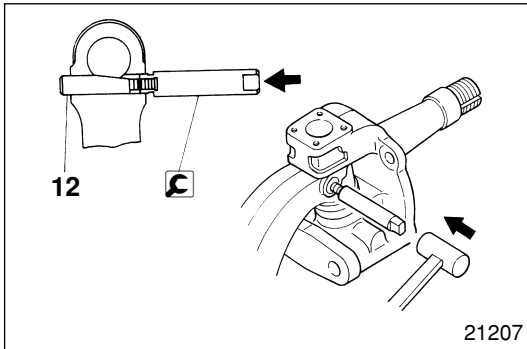
Location	Tool name and shape	Part No.	Application
12	Kingpin set bolt remover  00938	MH061688	Removal of kingpin set bolt
19	Kingpin puller  00939	MH061684	Removal of kingpin
22	Oil seal installer  00940	MH062203	Press-fitting of oil seal
23	Kingpin bushing remover  00941	MH061792 (MH061037)	Removal and installation of kingpin bushing. Tool No. in () is used for press-fitting oil seal installer

◆ Service procedure

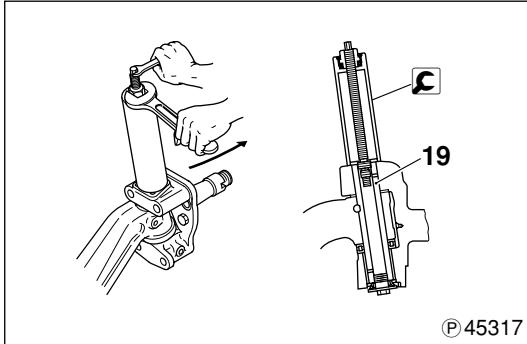
● Work after assembly

Supply grease via grease nipple **13** of knuckle **26**. Supply grease until it overflows from thrust washer **20** and the press side of ball bearing **21**.



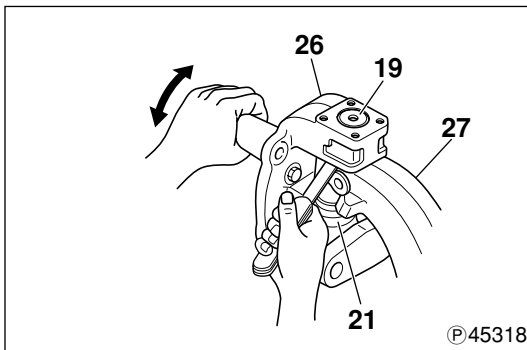


12 Removal of set bolt



19 Removal of kingpin

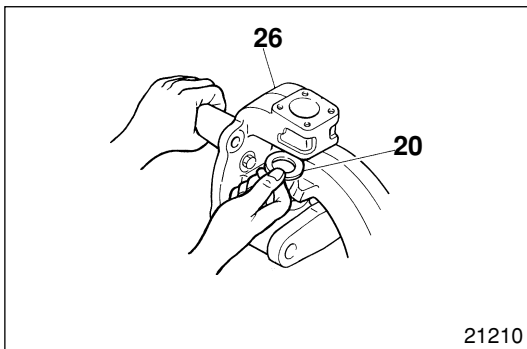
Screw the bolt of  kingpin puller into the threads of kingpin 15, and remove the kingpin.



20 21 26 27 Thrust washer, bearing, knuckle, and front axle

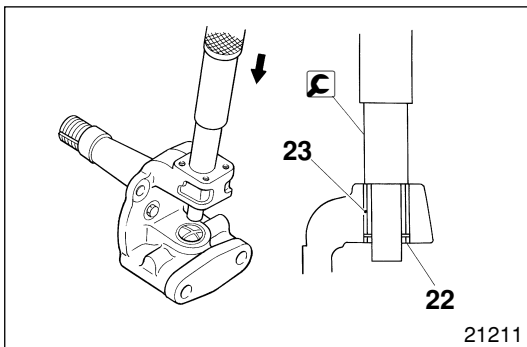
[Inspection]

- Assemble kingpin 19 and bearing 21 temporarily, and turn knuckle 26 a couple of times to smooth its operation.
- Measure the clearance between the upper surface of front axle 27 and the lower part of knuckle 26.
- If the measured value is higher than the limit, adjust with thrust washer 20.



[Adjustment]

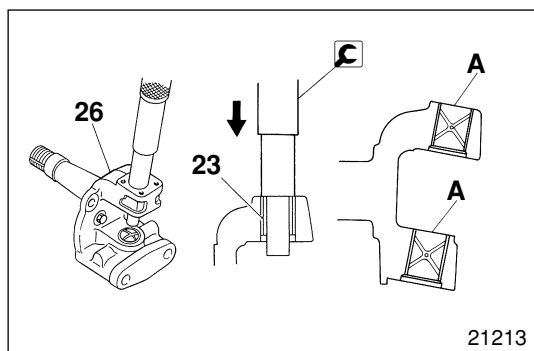
- Adjusting thrust washers 20 are available in the following sizes: 2.9 to 3.6 mm {0.11 to 0.14 in.} (eight thicknesses in 0.1 mm {0.0039 in.} increments)
- Be sure to minimize the clearance by selecting appropriate thrust washer 20.
- Make sure that knuckle 26 moves smoothly after assembly



22 23 Oil seal and bushing

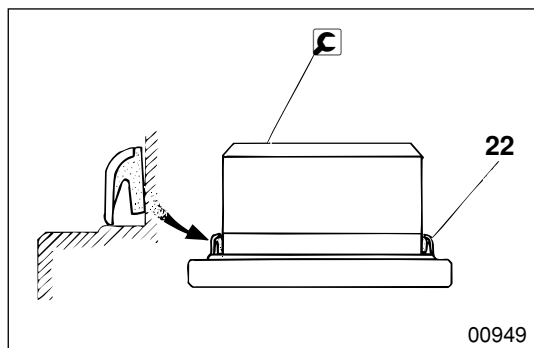
[Removal]

FRONT AXLE, KNUCKLE AND KINGPIN < FM (FULL-AIR BRAKE) >

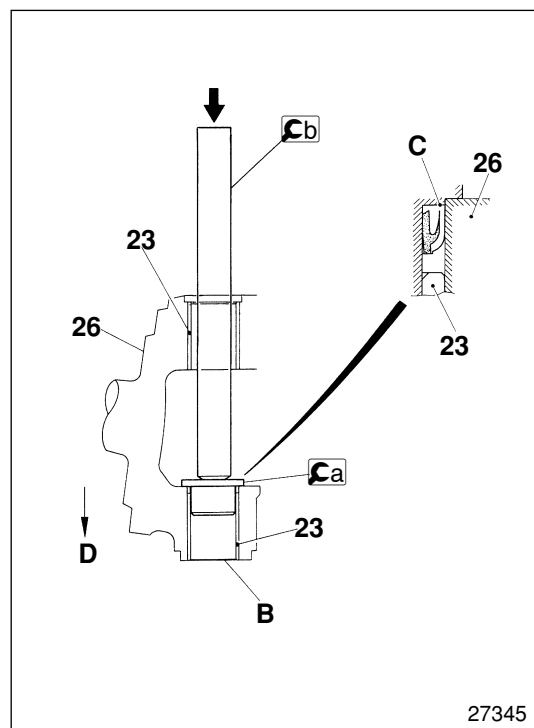


[Installation]

- Install bushing **23**, making sure that its surface is flush with the end face **A** on knuck **26**.



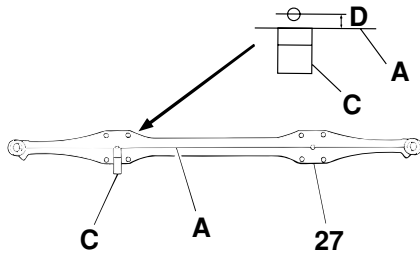
- Apply grease to lip area of oil seal **22**, and position the oil seal on oil seal installer.



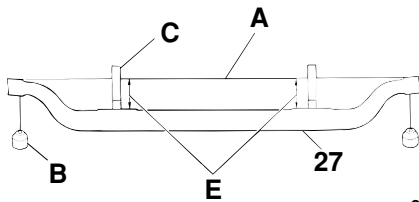
- Next, install oil seal installer on knuckle **26** in the direction as illustrated.
- Pass kingpin bushing remover through the kingpin hole and position it on oil seal installer.
- Hit the head of kingpin bushing remover until oil seal installer makes contact with knuckle **26**.
- Make sure that end **B** of bushing **23** makes contact with knuckle **26** on the same level.
- Make sure that oil seal end **C** does not protrude from knuckle **26**.

D : Upper side of vehicle

< Longitudinal direction >



< Vertical direction >



00954

27 Inspection of front axle**(1) Measurement of bend in front axle 27 in longitudinal and vertical directions**

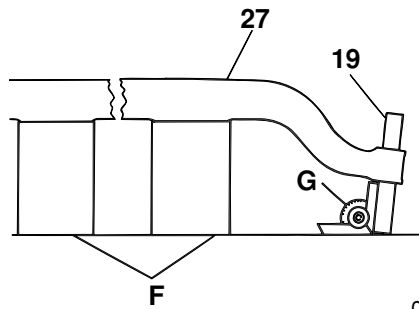
- Pass a piece of thread **A** through the kingpin hole of front axle **27** and hang weights **B** on both ends.
- Use square **C** to find the degree of bend in both the longitudinal direction **D** and the vertical direction **E**.
- If the measured value is higher than the limit, replace front axle **27**.

(2) Measurement of kingpin inclination angle

Mount kingpin **19** in front axle **27** as illustrated, and measure the kingpin inclination angle. If the measured value is higher than the limit, replace the front axle.

F : Block gauge

G : Bevel square



00955



Group 27

Rear Axle

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	27- 2
STRUCTURE AND OPERATION	27- 3
TROUBLESHOOTING	27- 6
WORK BEFORE REMOVAL AND INSTALLATION OF REAR AXLE	27- 8
WHEEL HUB AND BRAKE DRUM	
< FK >	27-10
< FM >	27-24
AXLE HOUSING	27-40
REDUCTION AND DIFFERENTIAL <D050H, D8H>	27-44
REDUCTION AND DIFFERENTIAL <D10H>	27-64

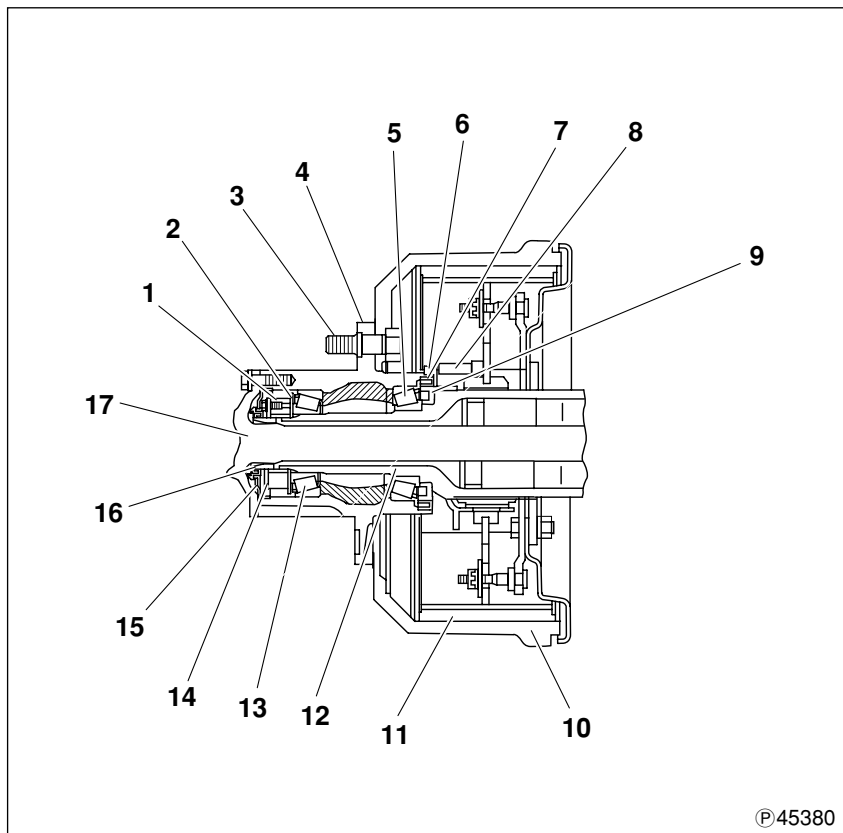
SPECIFICATIONS

Vehicle model		FK	FM61, FM64	FM65■1	FM65■2
Item					
Rear axle	Model	R050T (M)	R060T		R080T
	Type	Banjo type, full floating			
Reduction	Model	D050H	D8H		D10H
	Type	Single-reduction			
	Tooth shape	Hypoid gear			
	Speed reduction ratio	4.111 4.444	5.857	4.625 6.666	4.222
Differential	Tooth shape	Straight bevel gear			
Gear oil	Grade	★ Normal : Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot areas : Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140			
	Quantity L {qts}	6.5 {6.9}			10 {11}
Mass	kg {lb}	Approximately 380 {835}	Approximately 615 {1360}	Approximately 615 {1360}	Approximately 640 {1410}

★ When used under heavily-loaded, severe conditions such as continuous driving on uphill grades, it is recommended that you use gear oil with a SAE viscosity grade of 140. However, the air temperature must be above 10°C {50°F}.

Wheel Hub and Brake Drum

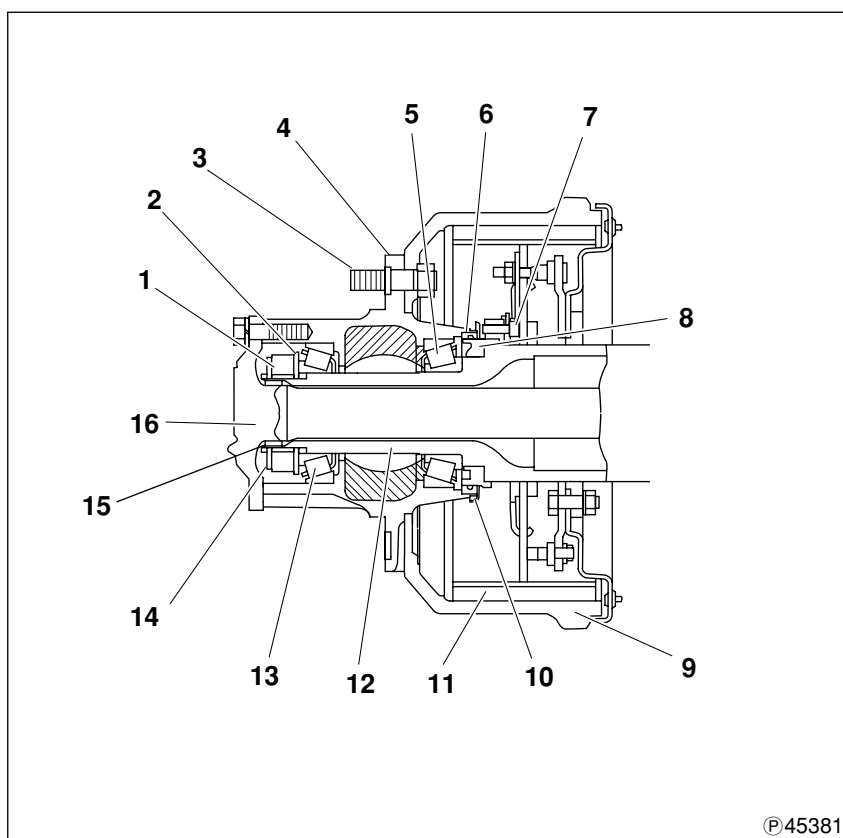
< FK >



- 1 Lock nut
- 2 Lock washer
- 3 Hub bolt
- 4 Wheel hub
- 5 Inner bearing
- 6 Rotor
- 7 Oil seal
- 8 Wheel speed sensor
- 9 Oil seal retainer
- 10 Brake drum
- 11 Brake assembly
- 12 Axle tube
- 13 Outer bearing
- 14 Lock plate
- 15 Oil seal
- 16 Oil seal retainer
- 17 Rear axle shaft

⒫45380

< FM61, FM64 >

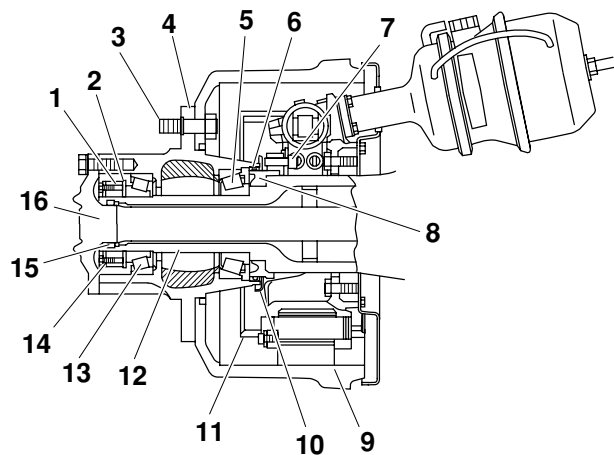


- 1 Lock nut
- 2 Lock washer
- 3 Hub bolt
- 4 Wheel hub
- 5 Inner bearing
- 6 Oil seal
- 7 Wheel speed sensor
- 8 Oil seal retainer
- 9 Brake drum
- 10 Rotor
- 11 Brake assembly
- 12 Axle tube
- 13 Outer bearing
- 14 Lock plate
- 15 Oil seal
- 16 Axle shaft

⒫45381

STRUCTURE AND OPERATION

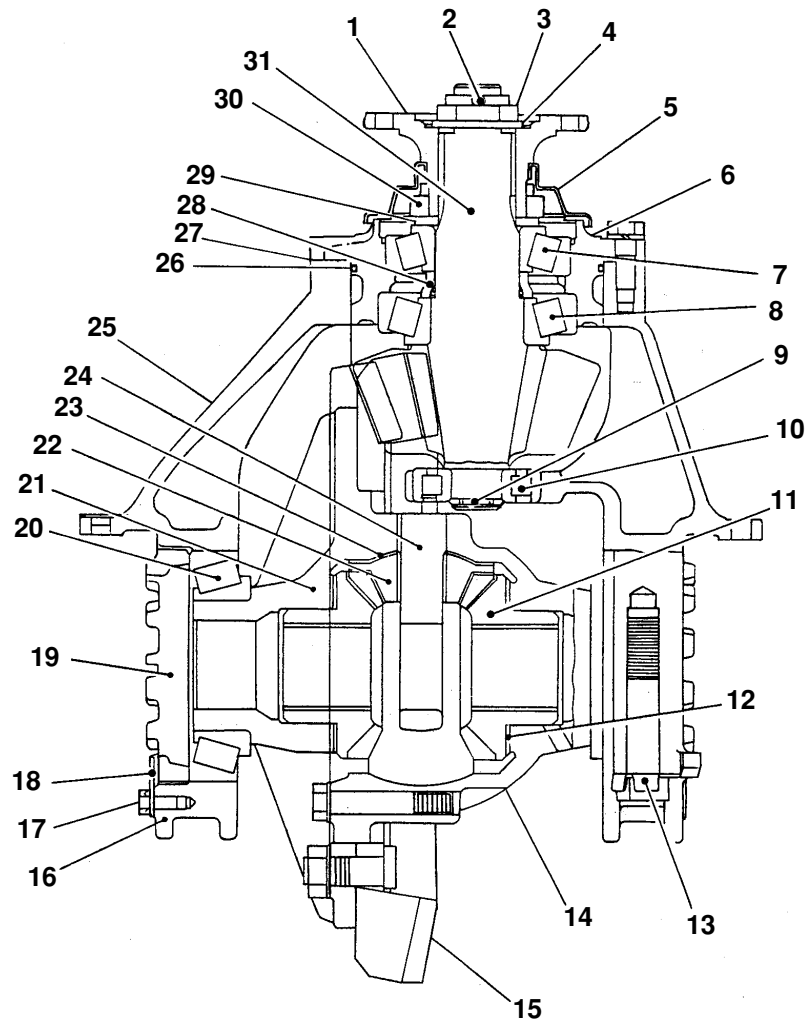
< FM65 >



- 1 Lock nut
- 2 Lock washer
- 3 Hub bolt
- 4 Wheel hub
- 5 Inner bearing
- 6 Oil seal
- 7 Wheel speed sensor
- 8 Oil seal retainer
- 9 Brake drum
- 10 Rotor
- 11 Brake assembly
- 12 Axle tube
- 13 Outer bearing
- 14 Lock plate
- 15 Oil seal
- 16 Axle shaft

⒫45383

Reduction and Differential



46327

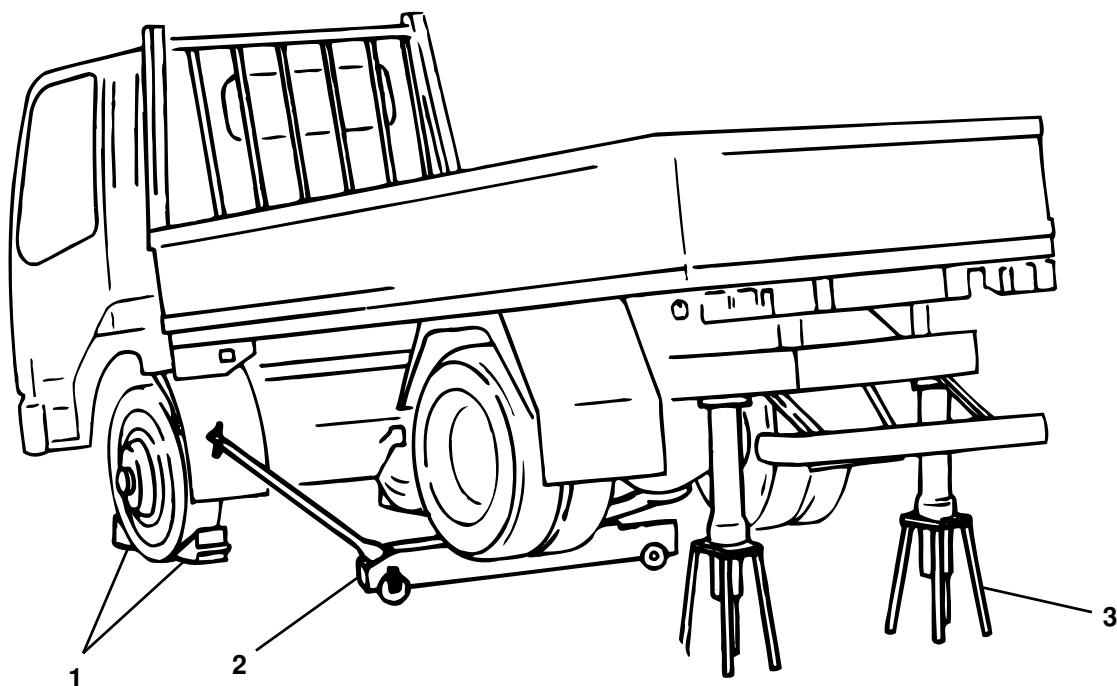
- | | |
|-----------------------------|---|
| 1 Companion flange | 17 Lock sheet |
| 2 Split pin | 18 Lock pawl |
| 3 Lock nut | 19 Adjusting screw |
| 4 Washer < Except D050H > | 20 Side bearing |
| 5 Dust cover | 21 Differential case, LH |
| 6 Bearing retainer | 22 Differential pinion |
| 7 Outer bearing | 23 Differential pinion washer |
| 8 Inner bearing | 24 Pinion spider |
| 9 Lock ring | 25 Differential carrier |
| 10 Pinion pilot bearing | 26 O-ring |
| 11 Differential gear | 27 Shim |
| 12 Differential gear washer | 28 Pinion bearing collar |
| 13 Lock plate | 29 Oil separator < D8H >
Collar < D10H > |
| 14 Differential case, RH | 30 Oil seal |
| 15 Reduction gear | 31 Reduction pinion |
| 16 Bearing cap | |

TROUBLESHOOTING

Symptoms		Power transmission insufficient										
		Oil leaking from companion flange assembly	Oil leaking from differential carrier and axle housing	Oil leaking from axle shaft	Propeller shaft turns but vehicle does not move	Noise when starting and changing speed	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Seizure	Damage
Possible causes												
Wheel hub, axle housing	Axle shaft mounting bolt loose			○				○				
	Axle housing bent						○					
	Axle shaft bent						○					
	Axle shaft fractured				○							
	Axle shaft slips out of engagement			○	○							
	Oil seal faulty			○								
	Air breather clogged			○								
	Wheel hub bearing seized, worn or rotation faulty						○					
	Wheel hub bearing broken							○				
Reduction and differential	Gear oil excessive	○										
	Gear oil insufficient					○	○				○	
	Oil seal faulty	○										
	Sealant faulty		○									
	Side bearing seized, worn or rotation faulty						○		○			
	Side bearing broken							○				
	Side bearing preload adjusted incorrectly						○				○	
	Side bearing starting torque faulty					○	○		○			○
	Reduction and differential assembly mounting bolt and nut loose		○									
	Differential carrier cracked or damaged		○									
	Reduction gear and differential case tightening bolts loose					○		○				
	Reduction gear or reduction pinion broken				○	○	○	○	○			
	Reduction gear or reduction pinion worn						○		○			
	Reduction gear to reduction pinion backlash excessive					○						○
	Reduction gear to reduction pinion backlash insufficient						○				○	
	Reduction gear tooth contact adjusted incorrectly						○					

Symptoms		Oil leaking from companion flange assembly	Oil leaking from differential carrier and axle housing	Oil leaking from axle shaft	Power transmission insufficient							
					Propeller shaft turns but vehicle does not move	Noise when starting and changing speed	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Seizure	Damage
Possible causes												
Reduction and differential	Reduction pinion assembly starting torque excessive					○	○				○	
	Reduction pinion assembly starting torque insufficient					○	○					
	Reduction pinion lock nut loose					○	○					
	Reduction pinion assembly inner bearing and outer bearing seized				○	○						
	Reduction pinion assembly inner bearing or outer bearing worn					○						
	Reduction pinion assembly inner bearing or outer bearing broken							○				
	Reduction pinion pilot bearing worn						○					
	Reduction pinion pilot bearing seized or damaged							○				
	Differential pinion spider broken				○							
	Differential gear or differential pinion broken				○			○	○	○		
	Differential gear or differential pinion seized				○					○		
	Differential gear or differential pinion worn								○	○		
	Differential gear washer worn or damaged							○	○	○		
	Differential gear backlash excessive					○						○
	Differential gear backlash insufficient								○		○	
	Play between differential gear and axle shaft spline excessive					○						○

WORK BEFORE REMOVAL AND INSTALLATION OF REAR AXLE



14176

● Work sequence before removal

- 1 Place wheel chocks.
- 2 Jack up the rear axle using a garage jack.
- 3 Support the rear frame on rigid racks.

WARNING

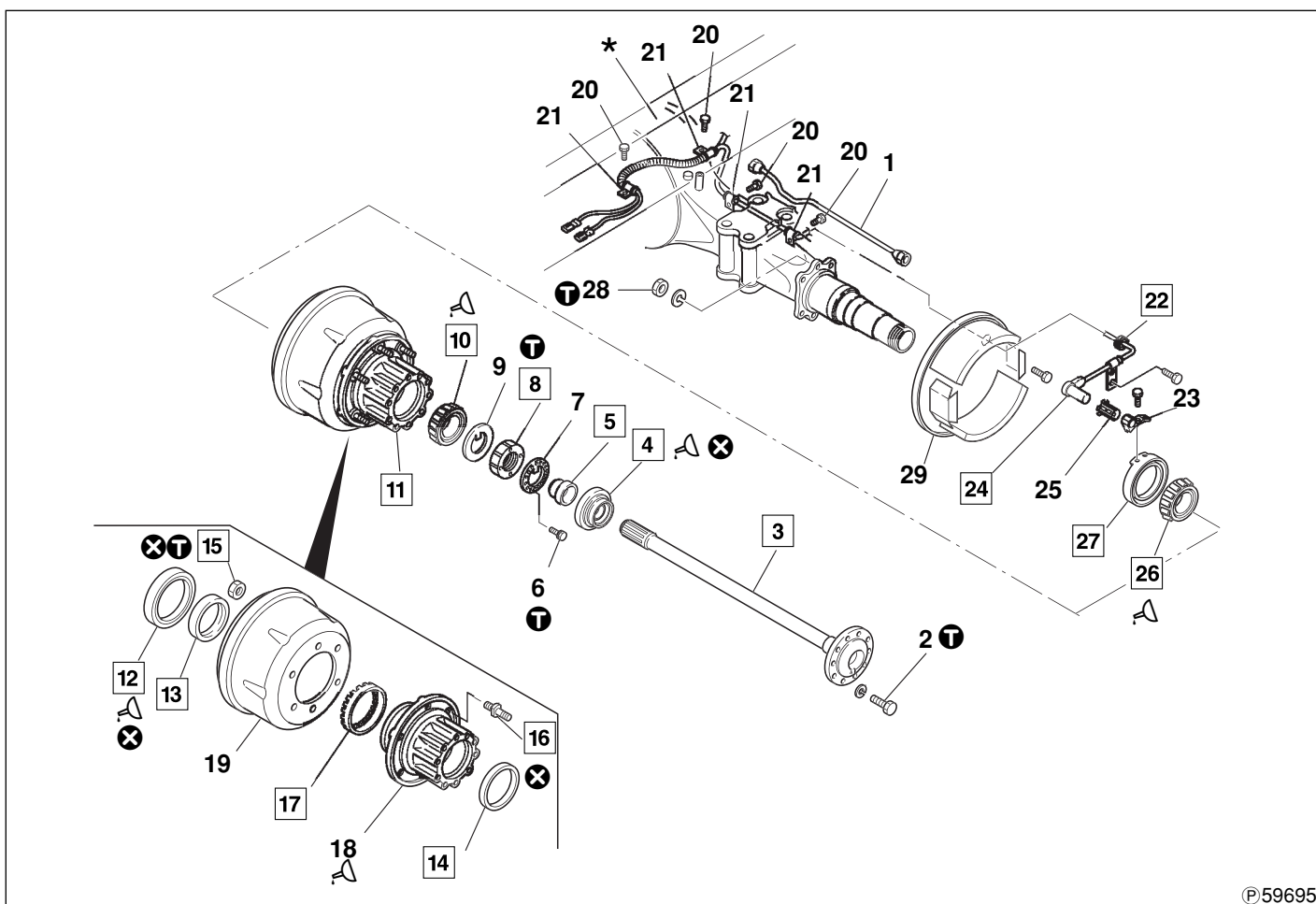
- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

● Work sequence after installation

Follow the work sequence before removal in reverse.

MEMO

WHEEL HUB AND BRAKE DRUM < FK >



©59695

● Disassembly sequence

- | | | |
|---|-----------------------------|-----------------------------|
| 1 Brake pipe | 12 Oil seal | 24 Wheel speed sensor |
| 2 Bolt | 13 Inner bearing outer race | 25 Spring spacer |
| 3 Axle shaft | 14 Outer bearing outer race | 26 Inner bearing inner race |
| 4 Oil seal | 15 Nut | 27 Oil seal retainer |
| 5 Oil seal retainer | 16 Hub bolt | 28 Nut |
| 6 Bolt | 17 Rotor | 29 Brake assembly
Gr 35A |
| 7 Lock plate | 18 Wheel hub | |
| 8 Lock nut | 19 Brake drum | |
| 9 Lock washer | 20 Bolt | |
| 10 Outer bearing inner race | 21 Clip | |
| 11 Wheel hub and brake drum
assembly | 22 Grommet | |
| | 23 Sensor holder | |

* : Axle housing P27-40

⊗ : Non-reusable parts

CAUTION ⚠

Be sure to protect brake pipe 1, from dust by fitting blanking plugs after removal.

NOTE

Do not disassemble brake drum 16 and wheel hub 19 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

You must bleed air from the brake system after assembly, failure to do so would cause the brake to malfunction. Gr 35A

CAUTION ⚠

- When removing or installing wheel hub and brake drum assembly 11, handle rotor 17 with care to prevent damage. Also, do not damage oil seal 12 during assembly.
- Keep oil and grease off lining surface of brake assembly 29 and the inner surface of brake drum 19.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
3	Axle shaft	Bend of shaft center	1.0 {0.039} or less	2.0 {0.079}	Replace
		Wobble of flange face	0.04 {0.0016}	0.5 {0.020}	Replace
10, 13, 14, 26	Starting torque of wheel hub bearing		2.5 to 5.4 N·m {1.8 to 4.0 ft.lbs, 0.25 to 0.55 kgf·m}	—	Tangential force at hub bolt position : 18 to 38 N {4.0 to 8.6 lbf, 1.8 to 3.9 kgf}
18	Wobbling of rotor		0.1 {0.0039}	—	Replace
24	Wheel speed sensor	Resistance between terminals	1570 to 1980 Ω	—	Replace
		Insulation resistance	30 kΩ or higher	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Axle shaft mounting)	105 {80, 11}	—
6	Bolt (Lock plate mounting)	6.9 to 11 {5.1 to 8.0, 0.7 to 1.1}	—
8	Lock nut	195 {145, 20}	Slackening off angle : 22.5° (One sixteenth of a turn)
15	Nut (Wheel hub and brake drum mounting)	320 {235, 32.8}	—
28	Nut (Brake assembly mounting)	76 {56, 7.8}	—

Lubricant and/or sealant

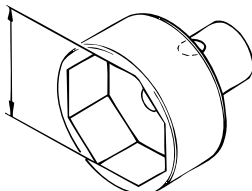
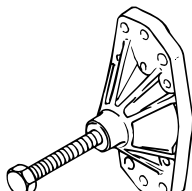
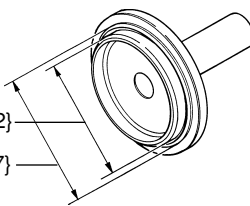
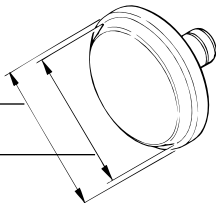
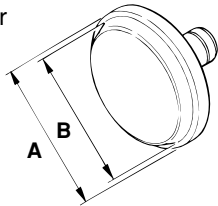
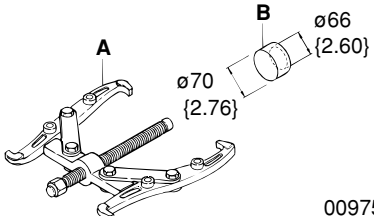
Location	Points of application	Specified lubricant and/or sealant	Quantity
4, 13	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
10, 26	Pack the space between rollers of outer bearing inner race and inner bearing inner race	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
11	Pack interior of wheel hub	Wheel bearing grease [NLGI No.2 (Li soap)]	280 g* {9.88 oz}

* : For a wheel hub

WHEEL HUB AND BRAKE DRUM < FK >

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application									
8	Socket wrench  00969	MH061597	Removal and installation of lock nut									
11	Wheel hub puller  00973	MH061458	Removal of wheel hub and brake drum assembly									
12	Anti-lock brake system oil seal installer  03023	MH062664	Press-fitting of oil seal									
13	Wheel hub inner bearing installer  00974	MH061010	Press-fitting of inner bearing outer race									
14	Wheel hub outer bearing installer <table border="1"><tr><td></td><td>A</td><td>B</td></tr><tr><td>FK</td><td>ø118 {4.65}</td><td>ø112 {4.41}</td></tr><tr><td>FM</td><td>ø149 {5.87}</td><td>ø138 {5.43}</td></tr></table>  00974		A	B	FK	ø118 {4.65}	ø112 {4.41}	FM	ø149 {5.87}	ø138 {5.43}	MH061012	Press-fitting of outer bearing outer race
	A	B										
FK	ø118 {4.65}	ø112 {4.41}										
FM	ø149 {5.87}	ø138 {5.43}										
26	A : Gear puller B : Adapter  00975	A : MH061102 B : MH061962	Removal of inner bearing inner race									

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
26	Wheel bearing installer 00970	MH061009	Press-fitting of inner bearing inner race
27	A : Gear puller B : Adapter 00975	A : MH061102 B : MH061962	Removal of oil seal retainer
	Oil seal retainer installer 00977	MH061008	Press-fitting of oil seal retainer

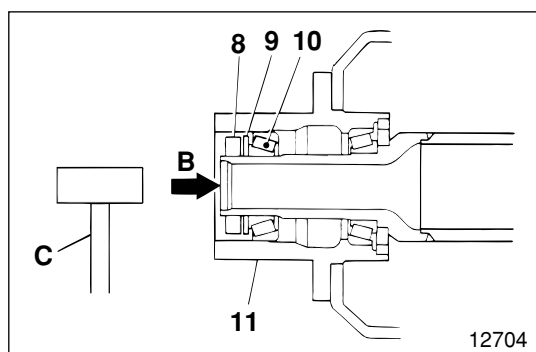
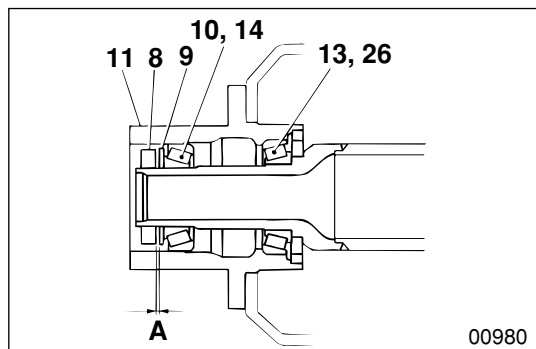
WHEEL HUB AND BRAKE DRUM < FK >

◆ Service procedure

● Starting torque of wheel hub bearing

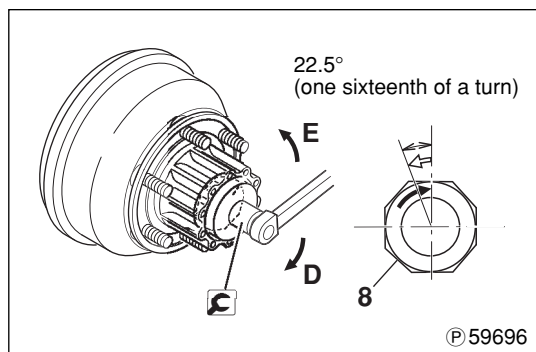
[Adjustment]

- Install lock washer **9** and lock nut **8**.
- Turn wheel hub and brake drum assembly **11** several times to smooth operation of outer bearings **10, 14** and inner bearings **13, 26**.
- Tighten lock nut **9** at specified torque.
- Slacken off lock nut **8** to obtain clearance **A** between the lock nut and lock washer **9**.



- To slide outer bearing inner race **10** towards lock nut **8**, hit end **B** of the axle tube two or three times with a mallet, while turning wheel hub and brake drum assembly **11**.

C : Copper-headed mallet



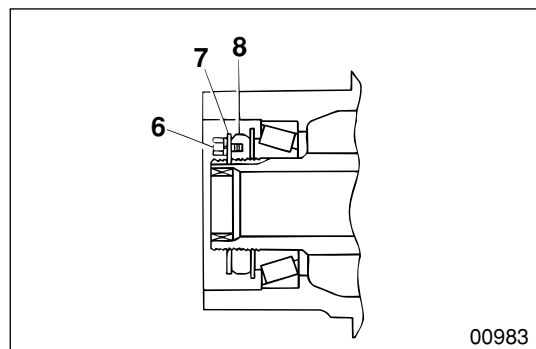
- ★ • Tighten lock nut **8** at specified torque.

D : Tightening direction

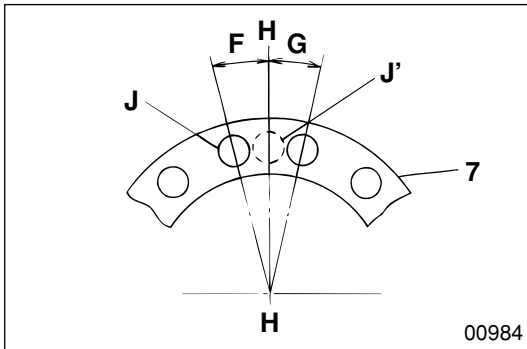
- Slacken off lock nut **8** by 22.5° (one sixteenth of a turn).

E : Slackening off direction

(★ : If any fault is found when measuring tangential force, redo from this item.)

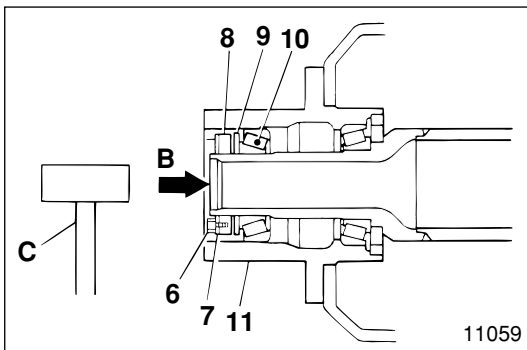


- Install lock plate **7**.
- Make sure that bolt **6** mounting holes of lock nut **8** and lock plate **7** align.
- Tighten bolt **6** at specified torque.



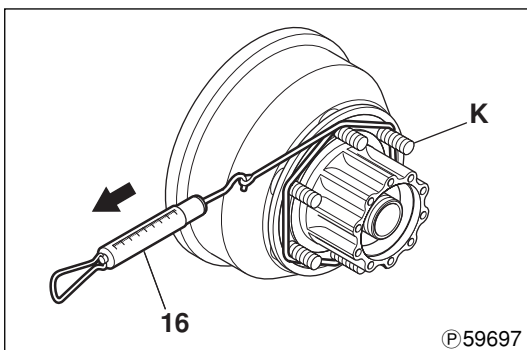
- If mounting holes of lock plate **7** and lock nut **8** do not align, align as follows:

Hole position of lock nut	How to align hole of lock plate
Within range F	Loosen lock nut to align holes
Within range G	Turn over lock plate and loosen lock nut to align holes
On line H-H	Turn over lock plate to align holes (Hole position J' changes to J)



- To slide outer bearing inner race **10** towards lock nut **8**, hit end **B** of the axle tube two or three times with a mallet, while turning wheel hub and brake drum assembly **11**.

C : Copper-headed mallet



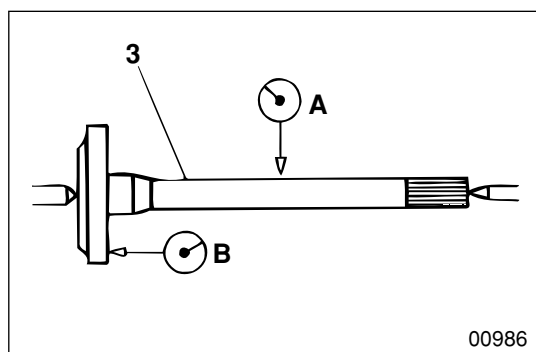
[Measurement]

- Install spring balance **K** on hub bolt **16**.
- Measure the tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
- Do not allow the tangential force to become higher than the upper limit of the specified value.
- If the measured value deviates from the specified value, repeat from step ★. P27-14
- If the result is still not satisfactory, replace outer bearings **10**, **14** and inner bearings **13**, **26**.

NOTE

- Make sure that there is no drag in brake lining and brake drum **19** before you measure the tangential force.
- Measure the starting torque when oil seal **12** has been installed.

WHEEL HUB AND BRAKE DRUM < FK >



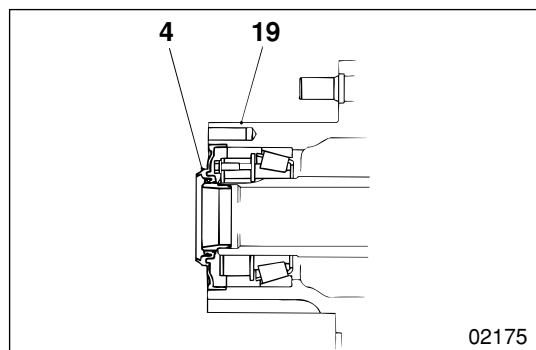
3 Inspection of axle shaft

A : Bend of shaft center

NOTE

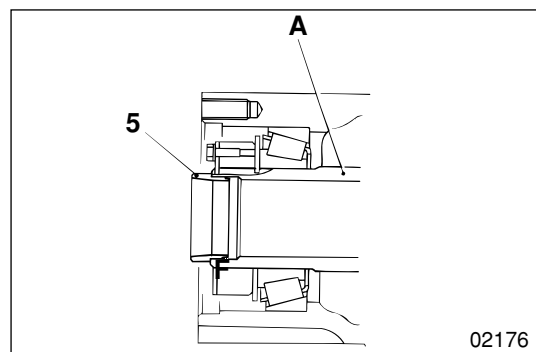
To measure the bend of axle shaft 3, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

B : Wobble of flange face



4 Installation of oil seal

Press-fit oil seal 4 until it is flush with the end of wheel hub 19.



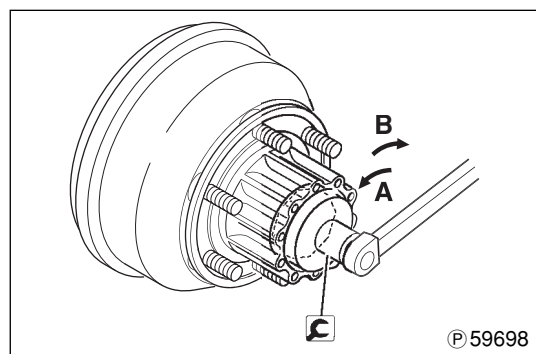
5 Oil seal retainer

[Removal]

It is not necessary to remove oil seal retainer 5 except for replacement of oil seal 4.

[Installation]

Press-fit oil seal retainer 5 until it is flush with the end of axle tube A.



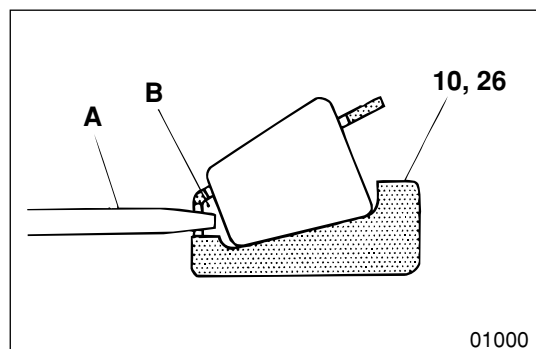
8 Removal and installation of lock nut

After installation, adjust the starting torque of the wheel hub bearing. See

📖 P27-14

A : Removal

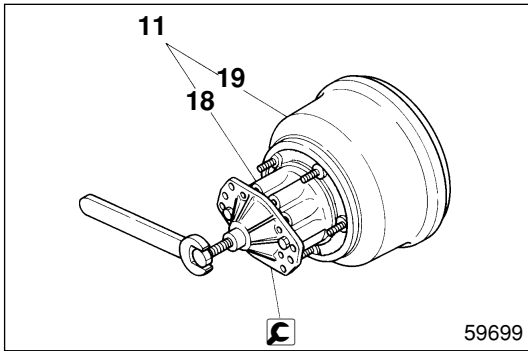
B : Installation



10 26 Packing grease in outer bearing inner race and inner bearing inner race

A : Grease pump nozzle

B : Space between rollers

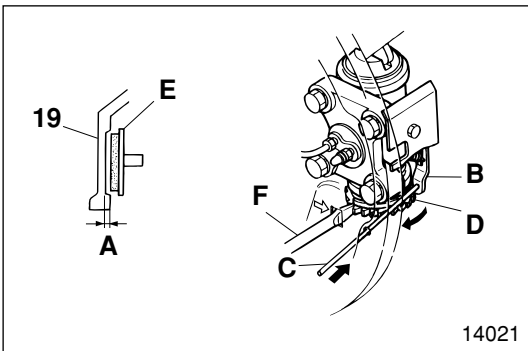


11 Wheel hub and brake drum assembly

[Removal]

CAUTION

Make sure you remove wheel hub and brake drum assembly 11 in a straight line to prevent damage to oil seal 12.

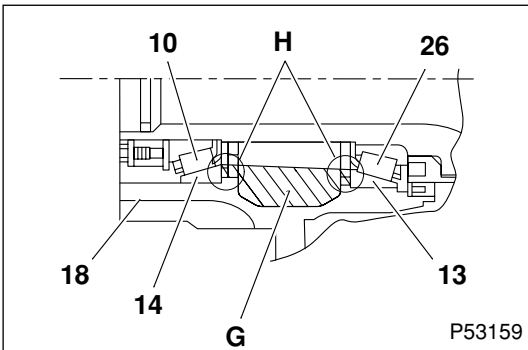


If wheel hub and brake drum assembly 11 cannot be removed because of stepped wear **A** in brake drum 19, carry out the following:

- Remove the packing plate cover.
- Lift lever **B**.
- **C** : Wire approximately $\varnothing 5$ mm {0.020 in.}
- Turn adjuster **D** in the opposite direction to the arrow on the packing plate, and expand the clearance between brake drum 19 and brake shoe assembly **E**.
- **F** : Screwdriver
- Remove wheel hub and brake drum assembly 11.

CAUTION

If brake drum 19 is faulty, correct it. Gr 35A, B



[Installation]

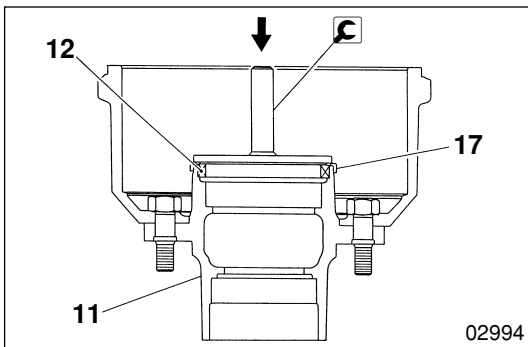
- Lubricate the following areas with grease.
- **G** : Inside of wheel hub

CAUTION

Apply grease to the inside of wheel hub 18 until grease reaches contact areas **H** between the inner bearing's outer race 13 and the hub and between the outer bearing's outer race 14 and the hub.

- After installing wheel hub and brake drum assembly 11, adjust the brake shoe clearance.

Gr 35A

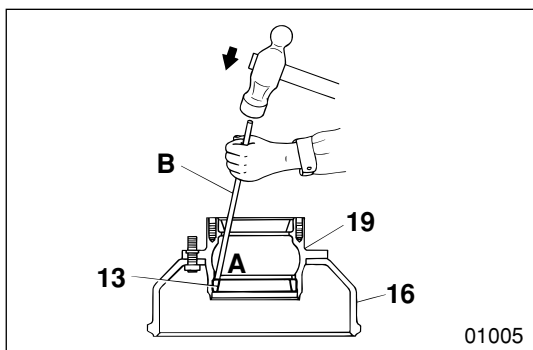


12 Installation of oil seal

NOTE

When hub and brake drum assembly 11 is removed for a service operation and if rotor 17 is still mounted on the wheel hub, use Anti-lock brake system oil seal installer to press-fit oil seal 12.

WHEEL HUB AND BRAKE DRUM < FK >

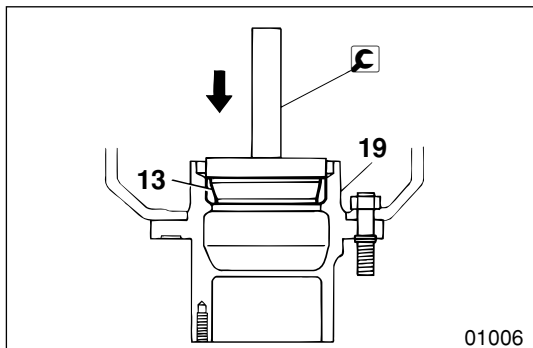


13 Inner bearing outer race

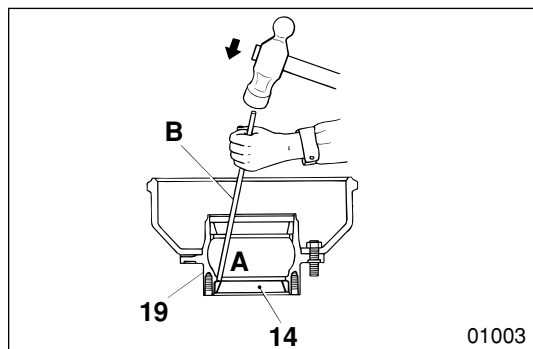
[Removal]

Drive out inner bearing outer race **13** evenly from four indented parts **A** in wheel hub **19**.

B : Pin-punch



[Installation]

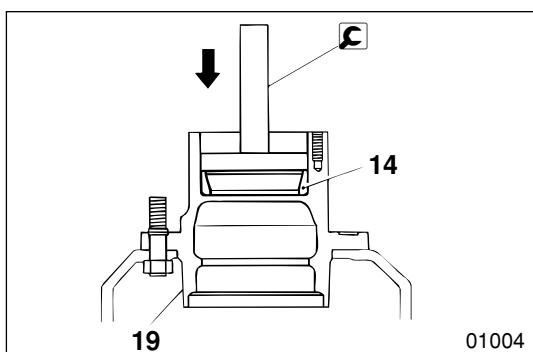


14 Outer bearing outer race

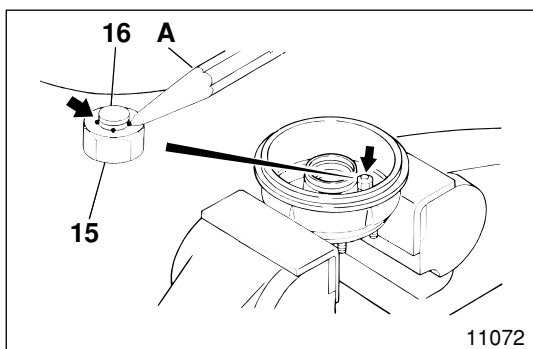
[Removal]

Drive out outer bearing outer race **14** evenly from four indented parts **A** in wheel hub **19**.

B : Pin-punch

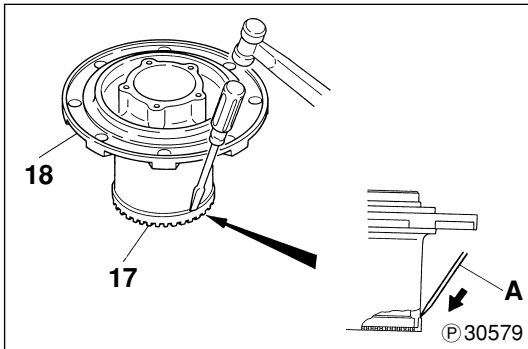


[Installation]



15 16 Installation of hub bolt and nut

- Install hub bolt **16**.
 - Tighten nut **15** at specified torque.
 - Caulk nut **15** evenly at four points to keep it from turning.
- A** : Pin-punch



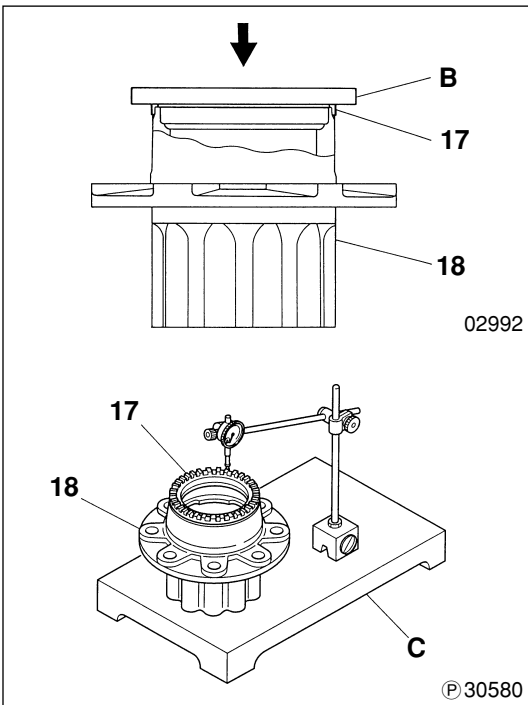
17 Rotor

[Removal]

Strike the outer edge of rotor **17** evenly with flat-tip screwdriver **A** to remove the rotor from the wheel hub.

CAUTION

Be careful not to damage wheel hub **18**.



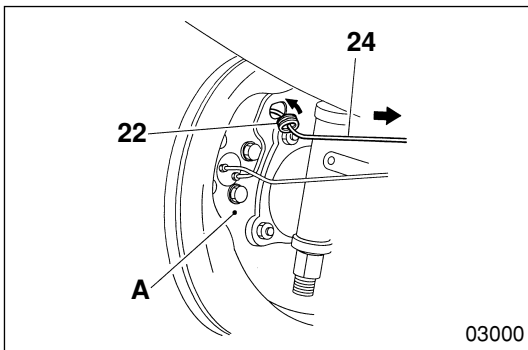
[Installation]

Heat rotor **17** to approximately 150°C {302°F}. Press the rotor evenly with iron plate **B** to press-fit the rotor to wheel hub **18**. Make sure there is no space between the rotor and wheel hub.

[Inspection]

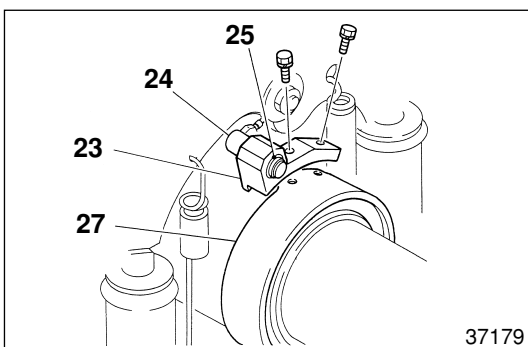
- If the amount of wobbling exceeds the standard value, repeat the assembly procedure from the beginning.
- If the amount of wobbling exceeds the standard value after reassembly, replace defective parts.

C : Base



22 Installation of grommet

Mount grommet **22** on back plate **A**, and pull the harness of wheel speed sensor **24** to make sure there is no slack inside the wheel brake.

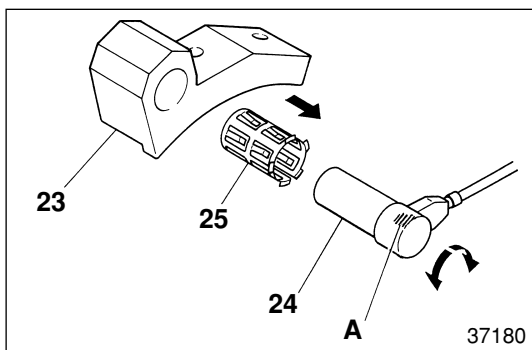


24 Wheel speed sensor

[Removal]

- With wheel speed sensor **24** and spring spacer **25** installed in sensor holder **23**, remove the sensor holder from oil seal retainer **27**.

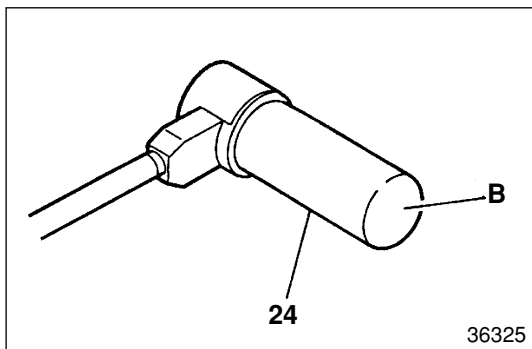
WHEEL HUB AND BRAKE DRUM < FK >



- Hold shaded section **A** of wheel speed sensor **24** with pliers, and remove the sensor by twisting it slightly in left and right directions.

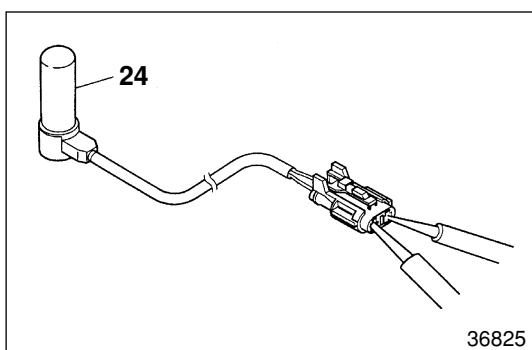
CAUTION ⚠

- When holding wheel speed sensor **24** with pliers, do not grip any section except shaded area **A** in the diagram.
- When removing wheel speed sensor **24**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- If wheel speed sensor **24** dismounts easily, replace spring spacer **25**.

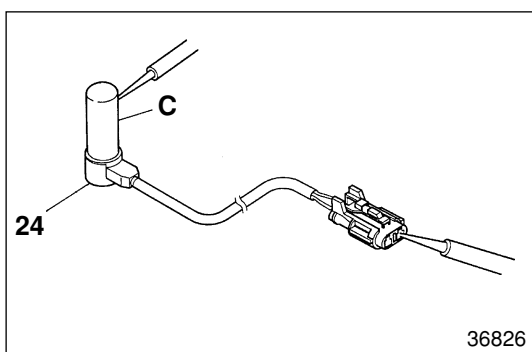


[Inspection]

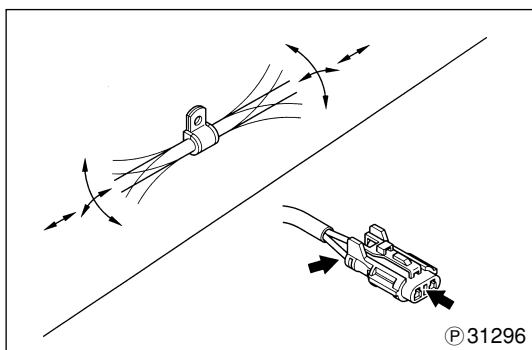
- Since pole piece section **B** is magnetized by the magnet inside wheel speed sensor **24**, it attracts metals. Do not allow the pole piece to collect metallic objects.



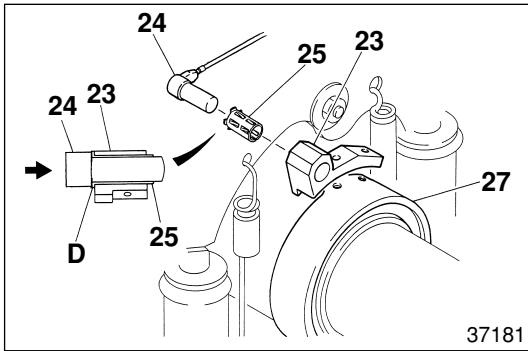
- Measure the resistance between the terminals of wheel speed sensor **24**.
If the measured value deviates from the standard value, replace the wheel speed sensor.



- Measure the insulation resistance between body **C** of wheel speed sensor **24** and each terminal.
If the measured values deviate from the standard value, replace the wheel speed sensor.



- To check for broken wires, remove the harness clamp section from the vehicle. Bend and extend the harness to check if there is any broken wire in the harness. Also, inspect the connector for proper contact.
If a defect is found, replace wheel speed sensor **24**.



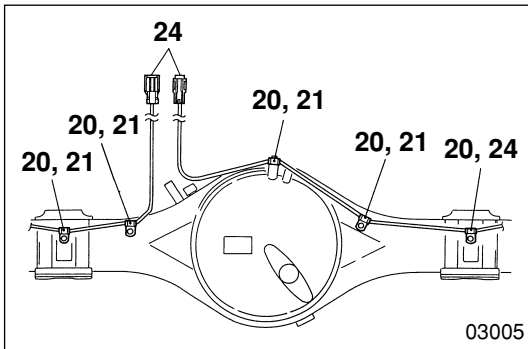
[Installation]

- Insert wheel speed sensor **24** from the back plate, and press until spring spacer **25** and stopper section **D** of the wheel speed sensor contacts sensor holder **23**.
- With wheel speed sensor **24** and spring spacer **25** installed in sensor holder **23**, mount the sensor holder on oil seal retainer **27**.

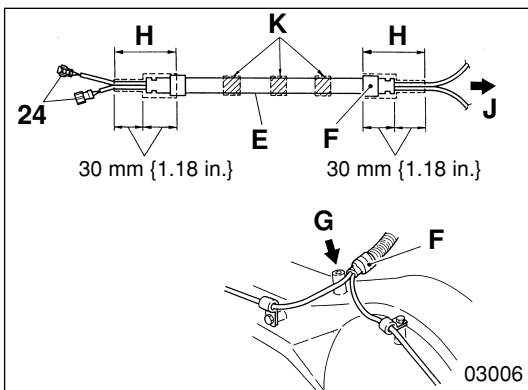
CAUTION ⚠

- When installing wheel speed sensor **24**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- Note that wheel speed sensor **24** is different for left and right wheels.

Location	Harness connector color	Harness connector shape
Left wheel	Gray	Male
Right wheel	Black	Female

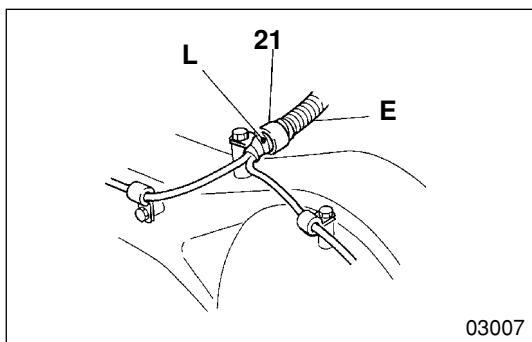


- Rear axle housing section
Starting from the wheel brake side, secure the harness of wheel speed sensor **24** in place with clip **21** and bolt **20**. Make sure the harness does not interfere with other parts and there is no twist or slack in the harness.

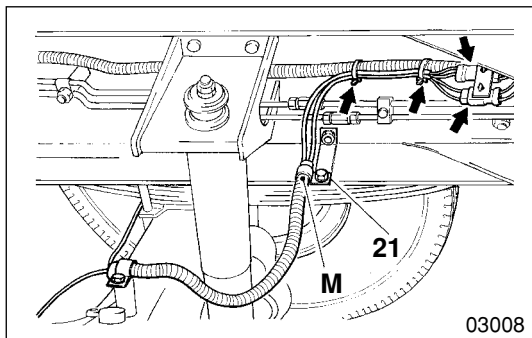


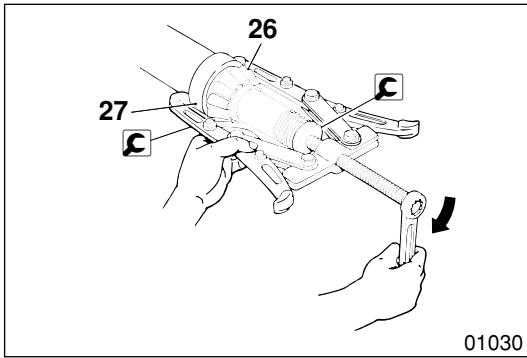
- Binding of harness
 - Gather the harnesses of left and right wheel speed sensors **24**, and bind with corrugated tube **E**.
 - Adjust the position of the corrugated tube **E** so that white tape section **F** is located at clip position **G** on the rear axle housing. Then, turn the corrugated tube so that the slit faces down. Wrap black tape (electric harness tape) on both ends **H** of the corrugated tube. The tape should be placed over the tube end and harness.
- **J** : Rear axle housing side
- Wrap tape on the harnesses of wheel speed sensors **24** at sections **K** (three locations at equal intervals).

WHEEL HUB AND BRAKE DRUM < FK >



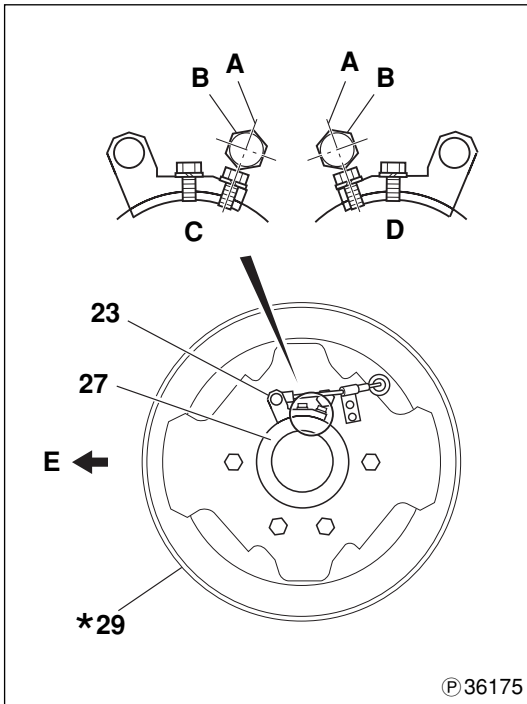
- Clamping of harness
 - Secure section **L** of corrugated tube **E** to the rear axle housing using clip **21**, and attach section **M** of the corrugated tube to the frame using clip **21**.
 - Connect the wheel speed sensor connector to the harness connector on the chassis side, and secure the connectors in place using the bracket.





26 27 Inner bearing inner race and oil seal retainer

[Removal]



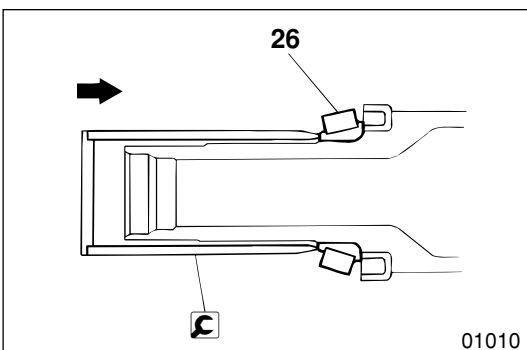
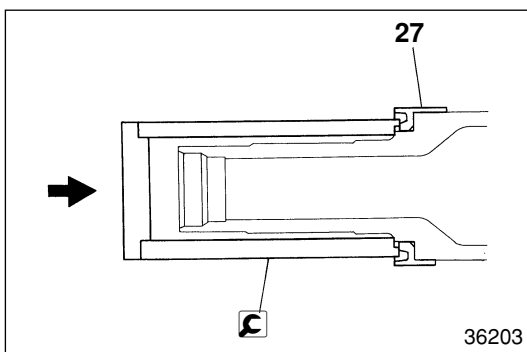
[Installation]

When installing oil seal retainer **27**, align mounting bolt center **A** of sensor holder **23** with the center line of mounting bolt **B** of brake assembly **29**.

- C** : For left wheel
- D** : For right wheel
- E** : Front of vehicle

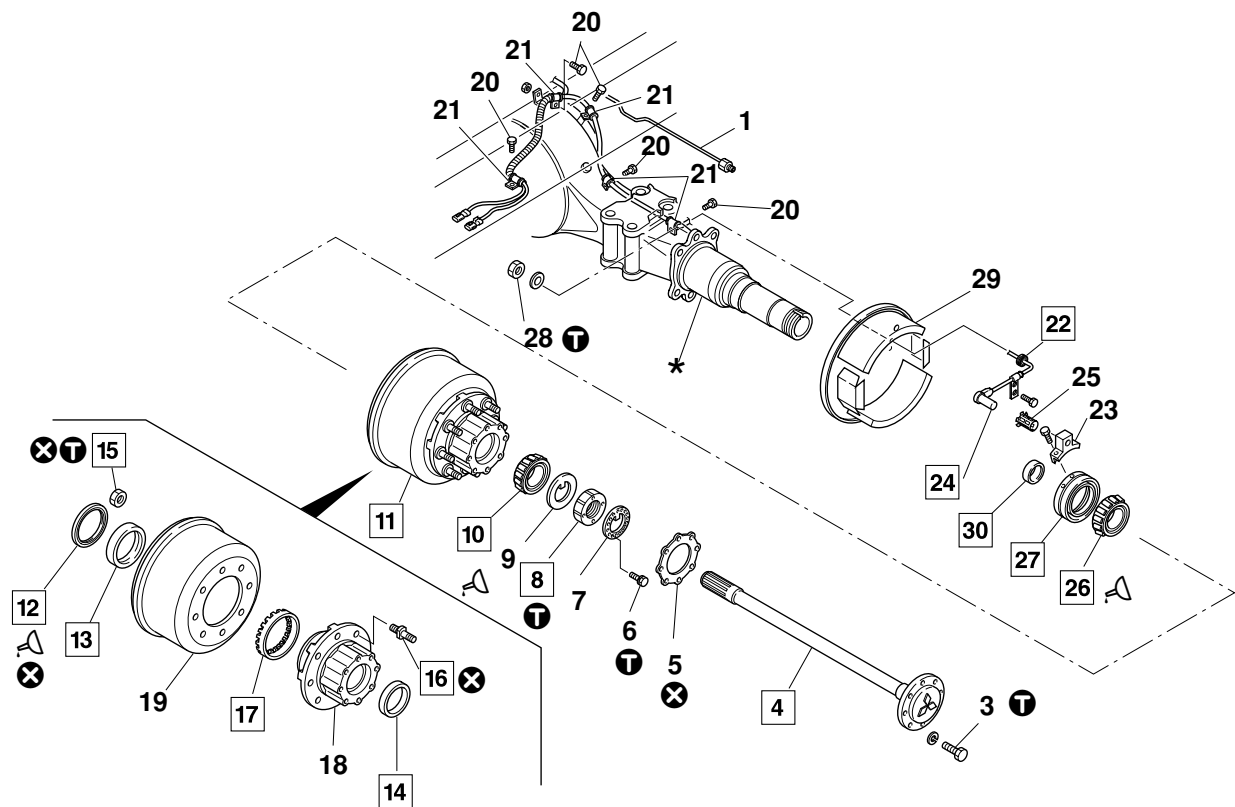
NOTE

The brake assembly diagram shows a left wheel.



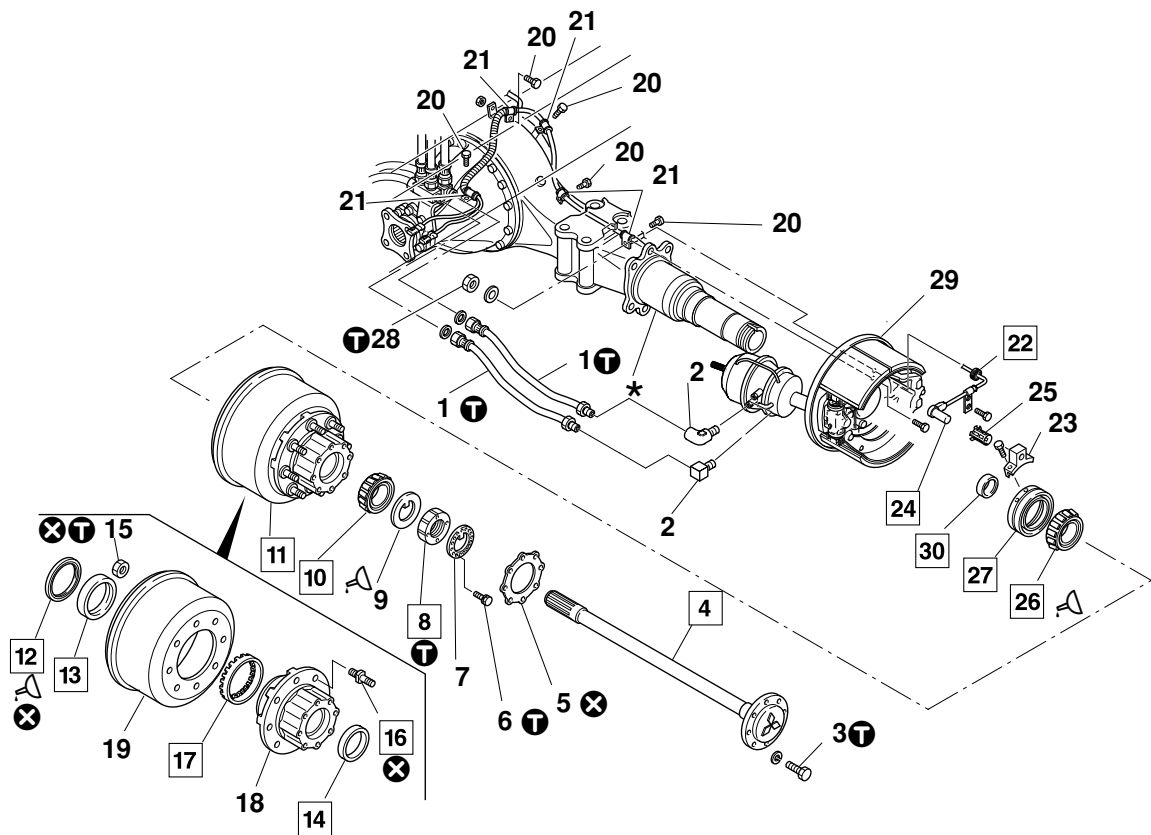
WHEEL HUB AND BRAKE DRUM < FM >

< FM61, FM64 >



© 58688

< FM65 >



© 58687

● Disassembly sequence

- | | | |
|--------------------------------------|-----------------------------|-----------------------------|
| 1 Brake pipe < FM61, FM64 > | 12 Oil seal | 24 Wheel speed sensor |
| Brake hose < FM65 > | 13 Inner bearing outer race | 25 Spring spacer |
| 2 Connector | 14 Outer bearing outer race | 26 Inner bearing inner race |
| 3 Bolt | 15 Nut | 27 Oil seal retainer |
| 4 Axle shaft | 16 Hub bolt | 28 Nut |
| 5 Gasket | 17 Rotor | 29 Brake assembly |
| 6 Bolt | 18 Wheel hub | Gr 35A < FM61, FM64 > |
| 7 Lock plate | 19 Brake drum | Gr 35B < FM65 > |
| 8 Lock nut | 20 Bolt | 30 Oil seal |
| 9 Lock washer | 21 Clip | |
| 10 Outer bearing inner race | 22 Grommet | |
| 11 Wheel hub and brake drum assembly | 23 Sensor holder | |
- ★ : Axle housing P27-40
 ⊗ : Non-reusable parts

CAUTION

Be sure to protect brake pipe 1 < FM61, FM64 >, or brake hose 1 < FM65 >, from dust by fitting blanking plugs after removal.

NOTE

Do not disassemble brake drum 16 and wheel hub 19 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

You must bleed air from the brake system after assembly, failure to do so would cause the brake to malfunction. Gr 35A < FM61, FM64 >

CAUTION

- When removing or installing wheel hub and brake drum assembly 11, handle rotor 18 with care to prevent damage. Also, do not damage oil seal 12 during assembly.
- Keep oil and grease off lining surface of brake assembly 29 and the inner surface of brake drum 19.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
4	Axle shaft	Bend of shaft center	1.0 {0.039} or less	2.0 {0.079}	Replace
		Wobble of flange face	0.05 {0.0020}	0.5 {0.020}	Replace
10, 13, 14, 26	Starting torque of wheel hub bearing		2.5 to 5.4 N·m {1.8 to 4.0 ft.lbs, 0.25 to 0.55 kgf·m}	—	Tangential force at hub bolt position : 18 to 38 N {4.0 to 8.6 lbf, 1.8 to 3.9 kgf}
17	Wobbling of rotor		0.1 {0.0039}	—	Replace
24	Wheel speed sensor	Resistance between terminals	1570 to 1980 Ω	—	Replace
		Insulation resistance	30 kΩ or higher	—	Replace

WHEEL HUB AND BRAKE DRUM < FM >

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	Brake hose (T-connector side)	FM657	39 to 44 {29 to 33, 4.0 to 4.5}	—
3	Bolt (Axle shaft mounting)		270 {200, 27.7}	—
6	Bolt (Lock plate mounting)		6.9 to 11 {5.1 to 8.0, 0.7 to 1.1}	—
8	Lock nut		295 {215, 30}	Slackening off angle : 22.5° (One sixteenth of a turn)
15	Nut (Wheel hub and brake drum mounting)		320 {235, 32.8}	—
28	Nut (Brake assembly mounting)		135 {100, 13.8}	—

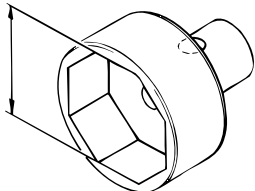
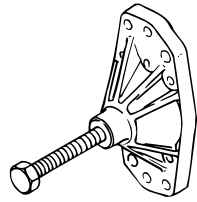
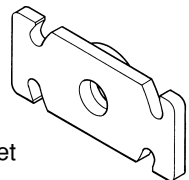
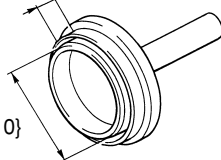
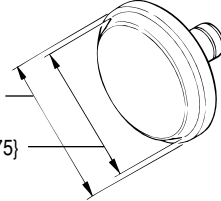
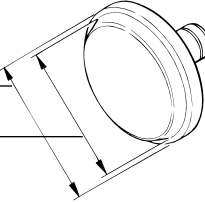
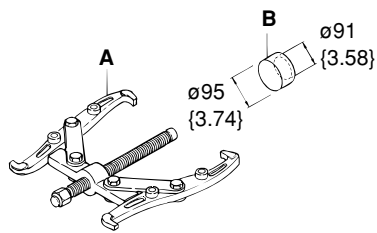
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
12	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
10, 26	Pack the space between rollers of outer bearing inner race and inner bearing inner race	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
11	Pack interior of wheel hub	Wheel bearing grease [NLGI No.2 (Li soap)]	1100 g* {38.8 oz}

*: For a wheel hub

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
8	Socket wrench  00969	MH061536	Removal and installation of lock nut
11	Wheel hub puller  00973	MH061458	Removal of wheel hub and brake drum assembly
	Anti-lock brake system hub stopper Note: Not being used in U.S. Market  04677	MH062058	Installation of wheel hub & brake drum assembly
12	Anti-lock brake system oil seal installer  04719	MH062057	Press-fitting of oil seal
13	Wheel hub inner bearing installer  00974	03723-21000	Press-fitting of inner bearing outer race
14	Wheel outer bearing installer  00974	03723-20000	Press-fitting of outer bearing outer race
26	A : Gear puller B : Adapter  00975	A : MH061102 B : MH061103	Removal of inner bearing inner race

WHEEL HUB AND BRAKE DRUM < FM >

Unit : mm {in.}

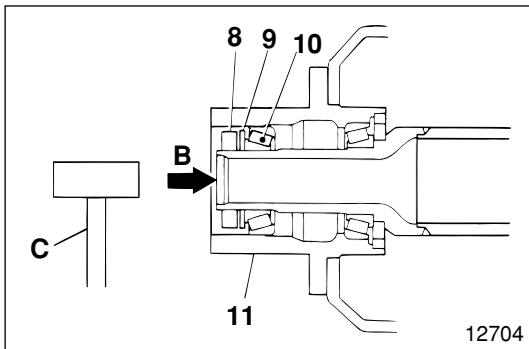
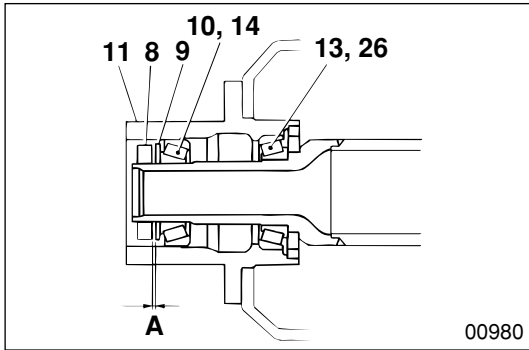
Location	Tool name and shape	Part No.	Application
26	Oil seal retainer installer 00971	03723-31001	Press-fitting of inner bearing inner race
27	A : Gear puller B : Adapter C : Oil seal retainer puller adapter 00975	A : MH061102 B : MH061103 C : 03724-16000	Removal of oil seal retainer
	Oil seal retainer installer 00978	03723-31001	Press-fitting of oil seal retainer
30	Oil seal installer 00979	MH062016	Press-fitting of oil seal at axle tube end

◆ Service procedure

● Starting torque of wheel hub bearing

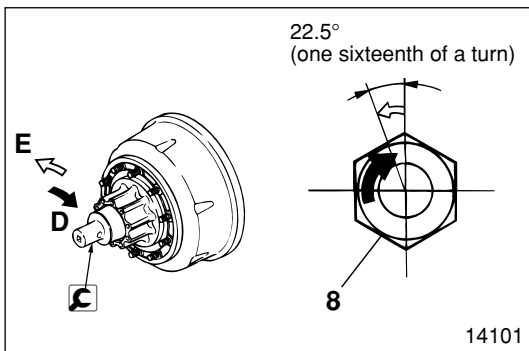
[Adjustment]

- Install lock washer **9** and lock nut **8**.
- Turn wheel hub and brake drum assembly **11** several times to smooth operation of outer bearings **10, 14** and inner bearings **13, 26**.
- Tighten lock nut **9** at specified torque.
- Slacken off lock nut **8** to obtain clearance **A** between the lock nut and lock washer **9**.



- To slide outer bearing inner race **10** towards lock nut **8**, hit end **B** of the axle tube two or three times with a mallet, while turning wheel hub and brake drum assembly **11**.

C : Copper-headed mallet



- ★ • Tighten lock nut **8** at specified torque.

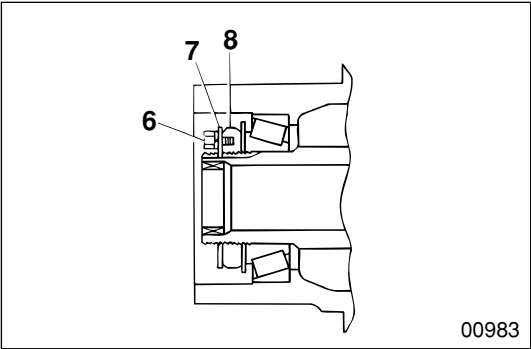
D : Tightening direction

- Slacken off lock nut **8** by 22.5° (one sixteenth of a turn).

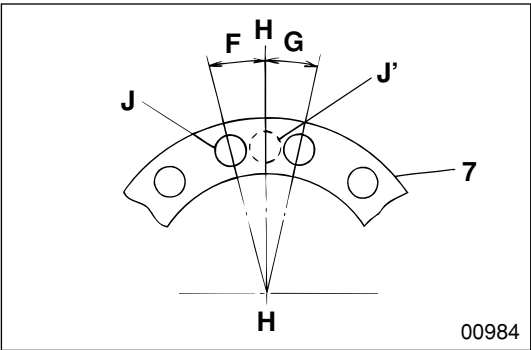
E : Slackening off direction

(★ : If any fault is found when measuring tangential force, redo from this item.)

WHEEL HUB AND BRAKE DRUM < FM >

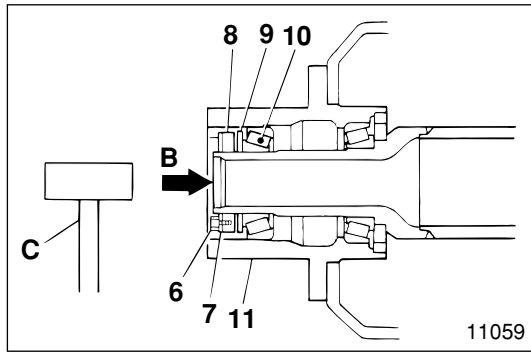


- Install lock plate 7.
- Make sure that bolt 6 mounting holes of lock nut 8 and lock plate 7 align.
- Tighten bolt 6 at specified torque.

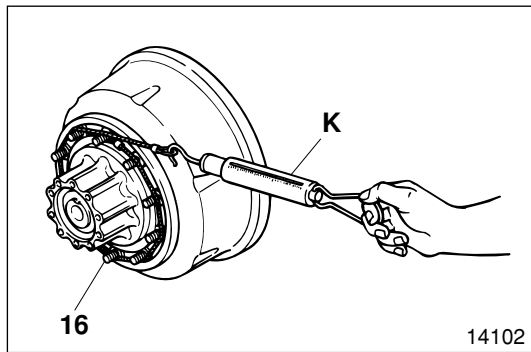


- If mounting holes of lock plate 7 and lock nut 9 do not align, align as follows:

Hole position of lock nut	How to align hole of lock plate
Within range F	Loosen lock nut to align holes
Within range G	Turn over lock plate and loosen lock nut to align holes
On line H-H	Turn over lock plate to align holes (Hole position J' changes to J)



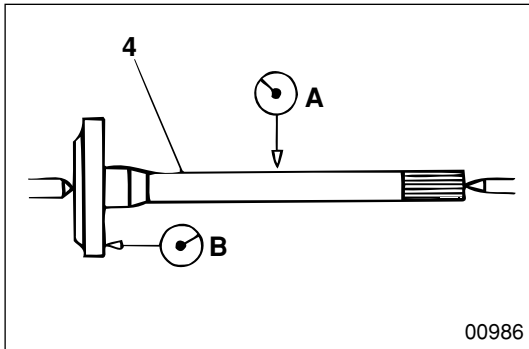
- To slide outer bearing inner race 10 towards lock nut 8, hit end B of the axle tube two or three times with a mallet, while turning wheel hub and brake drum assembly 11.
- C : Copper-headed mallet



- [Measurement]
- Install spring balance K on hub bolt 16.
 - Measure the tangential force.
 - If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
 - Do not allow the tangential force to become higher than the upper limit of the specified value.
 - If the measured value deviates from the specified value, repeat from step ★. P27-29
 - If the result is still not satisfactory, replace outer bearings 10, 14 and inner bearings 13, 26.

NOTE

- Make sure that there is no drag in brake lining and brake drum 19 before you measure the tangential force.
- Measure the starting torque when oil seal 12 has been installed.



4 Axle shaft

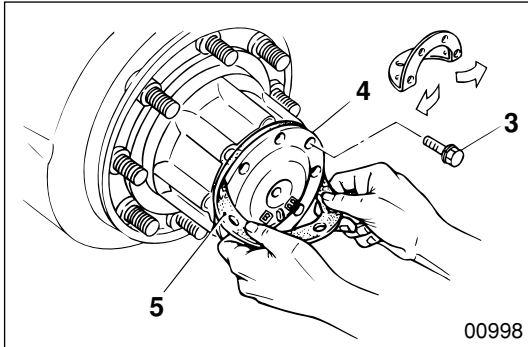
[Inspection]

A : Bend of shaft center

NOTE

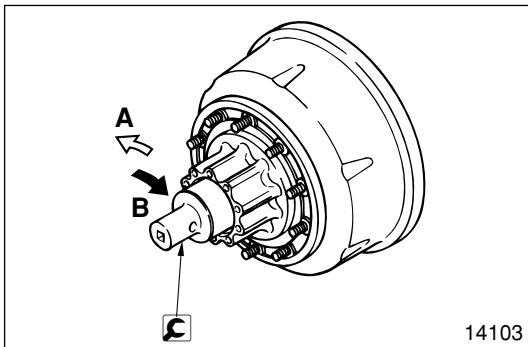
To measure the bend of axle shaft 4, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

B : Wobble of flange face



[Installation]

Install gasket 5 on axle shaft 4, and tighten bolt 3 at specified torque.



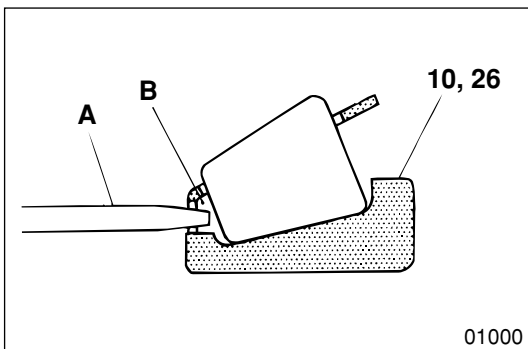
8 Removal and installation of lock nut

After installation, adjust the starting torque of the wheel hub bearing. See

📖 P27-29

A : Removal

B : Installation

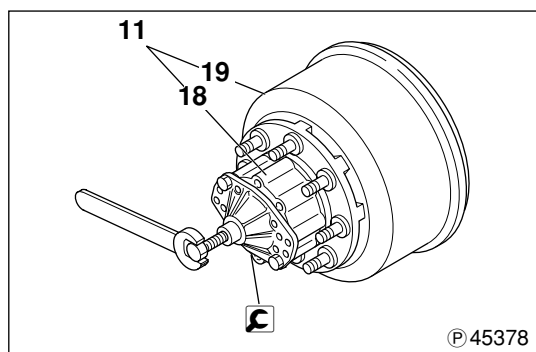


10 26 Packing grease in outer bearing inner race and inner bearing inner race

A : Grease pump nozzle

B : Space between rollers

WHEEL HUB AND BRAKE DRUM < FM >



11 Wheel hub and brake drum assembly

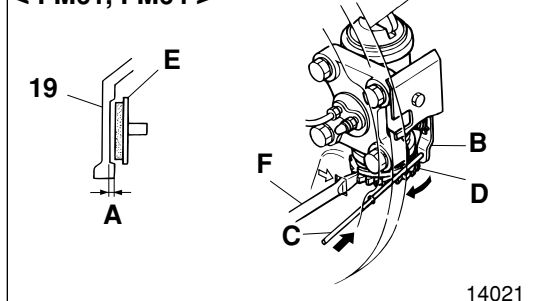
[Removal]

CAUTION

Make sure you remove wheel hub and brake drum assembly 11 in a straight line to prevent damage to oil seal 12.

If wheel hub and brake drum assembly 11 cannot be removed because of stepped wear **A** in brake drum 19, carry out the following:

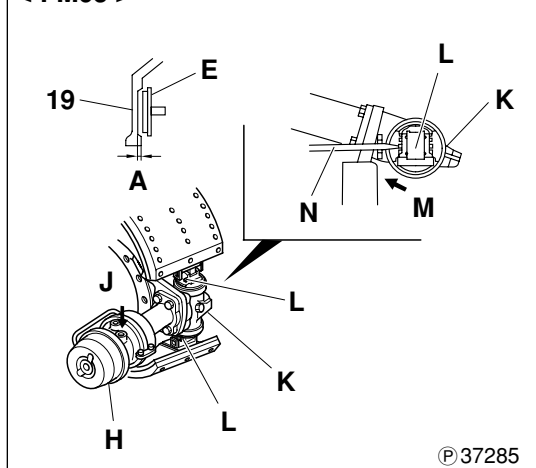
< FM61, FM64 >



< FM61, FM64 >

- Remove the packing plate cover.
- Lift lever **B**.
C : Wire approximately $\varnothing 5$ mm {0.020 in.}
- Turn adjuster **D** in the opposite direction to the arrow on the packing plate, and expand the clearance between brake drum 16 and brake shoe assembly **E**.
F : Screwdriver
- Remove wheel hub and brake drum assembly 11.

< FM65 >

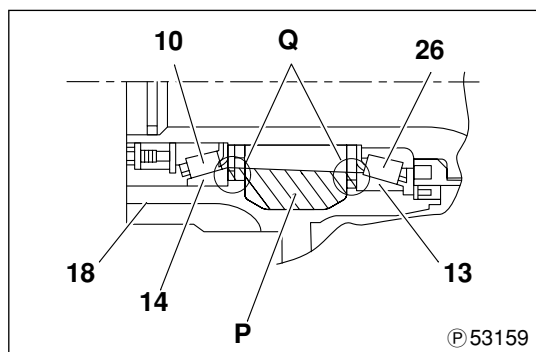


< FM65 >

- Remove the dust cover from the back side of the anchor bracket.
- Supply compressed air at pressure of 640 kpa {92 psi, 6.5 kgf/cm²} to spring brake air inlet **J** of brake chamber assembly **H** to release the spring brake.
- Turn adjuster **L** on expander assembly **K** in direction **M**, and widen the gap between brake drum 19 and brake shoe **E**.
- Reinstall the dust cover on the back side of the anchor bracket.

CAUTION

- Be careful not to damage the boot of expander assembly **K** when inserting flat-tip screwdriver **N**.
- If brake drum 19 is faulty, correct it. Gr 35A, B

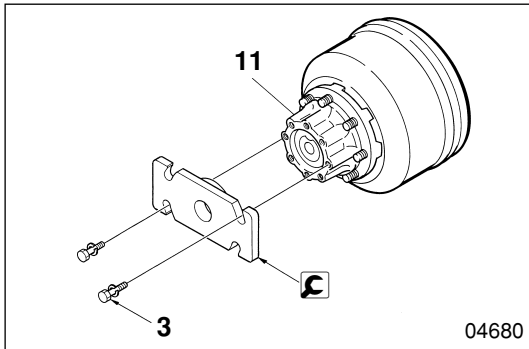


[Installation]

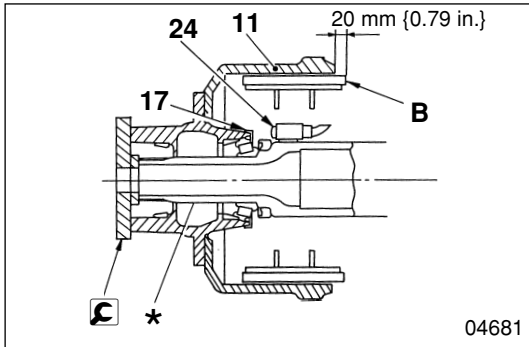
- Lubricate the following areas with grease.
P : Inside of wheel hub

CAUTION

Apply grease to the inside of wheel hub 18 until grease reaches contact areas **Q** between the inner bearing's outer race 13 and the hub and between the outer bearing's outer race 14 and the hub.



- Using two bolts **3**, mount Anti-lock brake system hub stopper on wheel hub and brake drum assembly **11**.



- Mount wheel hub and brake drum assembly **11** on axle housing ***** and press until Anti-lock brake system hub stopper contacts the end surface of the axle housing.
- Remove Anti-lock brake system hub stopper, and mount outer bearing inner race **10**, lock washer **9** and lock nut **8**. Tighten the lock nut slowly.

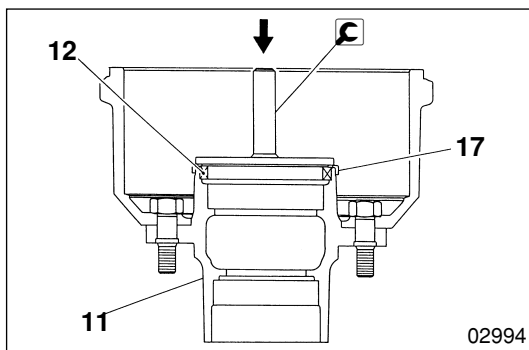
CAUTION

When installing wheel hub and brake drum assembly **11** without using Anti-lock brake system hub stopper, mount the assembly without jiggling until brake lining **B** extends approximately 20 mm {0.79 in.} from the edge of brake drum. Then, tighten lock nut **8** slowly.

- After installing wheel hub and brake drum assembly **11**, adjust the brake shoe clearance.

Gr 35A < FM61, FM64 >

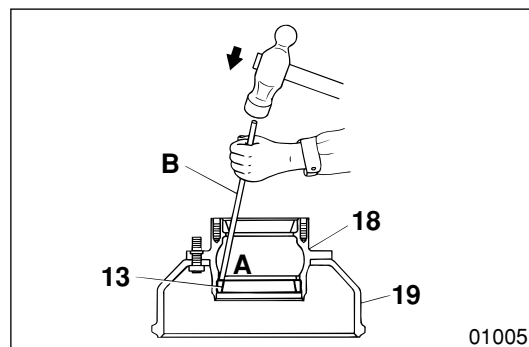
Gr 35B < FM65 >



12 Installation of oil seal

NOTE

When hub and brake drum assembly **11** is removed for a service operation and if rotor **17** is still mounted on the wheel hub, use Anti-lock brake system oil seal installer to press-fit oil seal **12**.



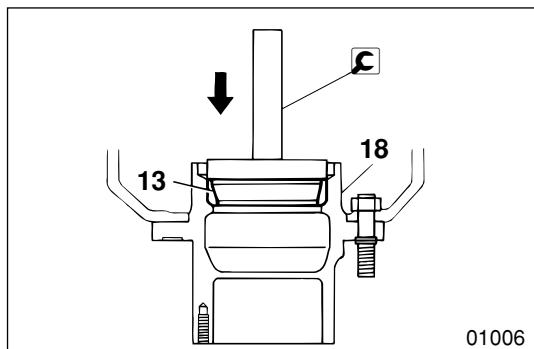
13 Inner bearing outer race

[Removal]

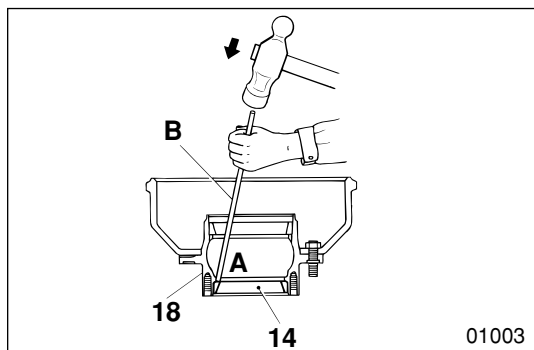
Drive out inner bearing outer race **13** evenly from four indented parts **A** in wheel hub **18**.

B : Pin-punch

WHEEL HUB AND BRAKE DRUM < FM >



[Installation]

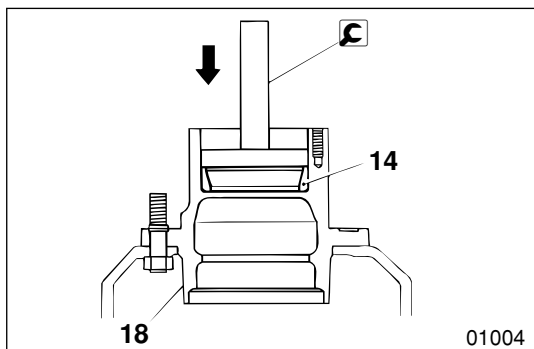


14 Outer bearing outer race

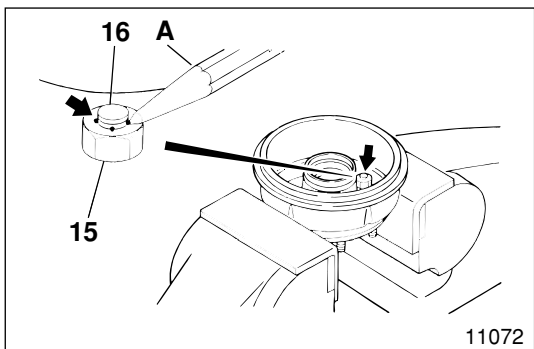
[Removal]

Drive out outer bearing outer race **14** evenly from four indented parts **A** in wheel hub **18**.

B : Pin-punch

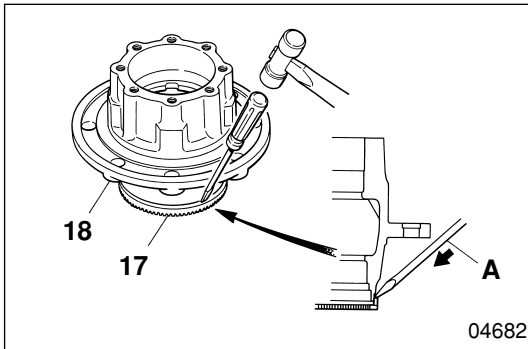


[Installation]



15 16 Installation of hub bolt and nut

- Install hub bolt **16**.
 - Tighten nut **15** at specified torque.
 - Caulk nut **15** evenly at four points to keep it from turning.
- A** : Pin-punch



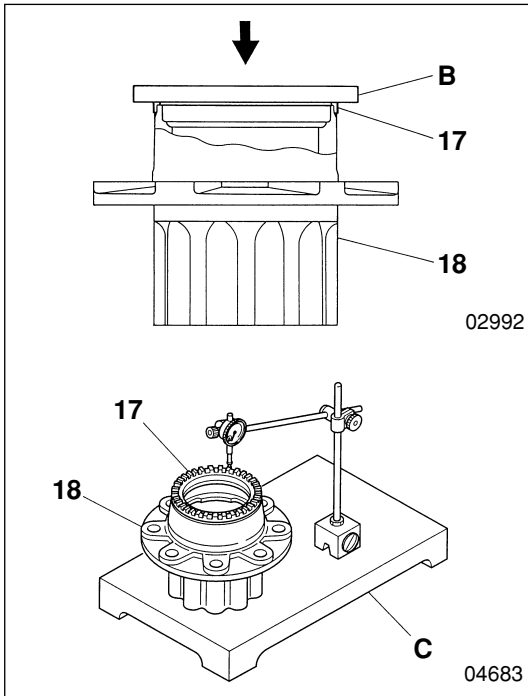
17 Rotor

[Removal]

Strike the outer edge of rotor 17 evenly with flat-tip screwdriver A to remove the rotor from the wheel hub 18.

CAUTION

Be careful not to damage wheel hub 18.



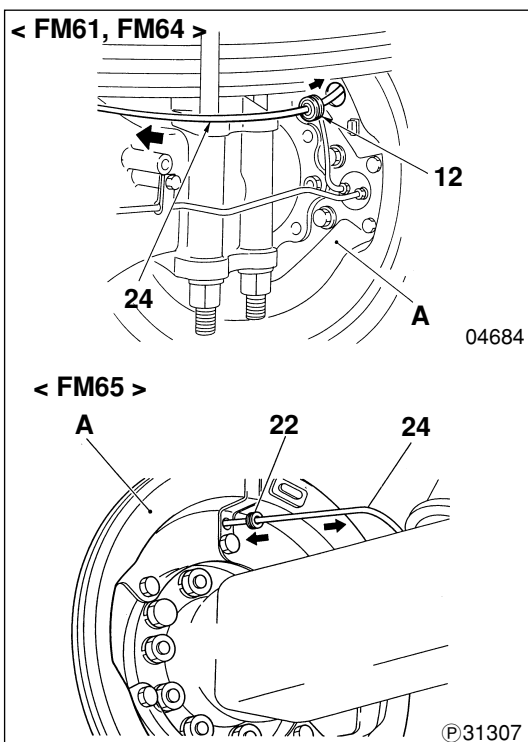
[Installation]

Heat rotor 17 to approximately 150°C {302°F}. Press the rotor evenly with iron plate B to press-fit the rotor to wheel hub 18. Make sure there is no space between the rotor and wheel hub.

[Inspection]

- If the amount of wobbling exceeds the standard value, repeat the assembly procedure from the beginning.
- If the amount of wobbling exceeds the standard value after reassembly, replace defective parts.

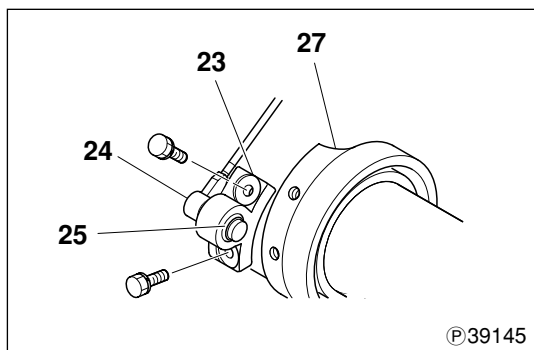
C: Base



22 Installation of grommet

Mount grommet 22 on back plate A, < FM61, FM64 > or dust cover A < FM65 > and pull the harness of wheel speed sensor 24 to make sure there is no slack inside the wheel brake.

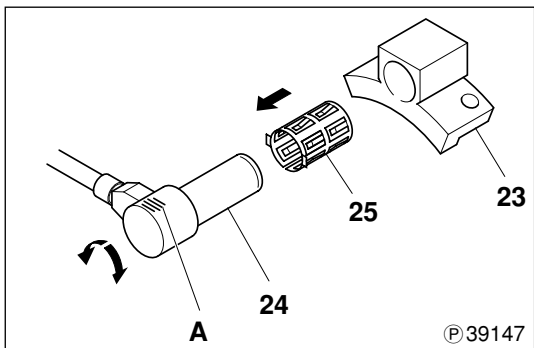
WHEEL HUB AND BRAKE DRUM < FM >



24 Wheel speed sensor

[Removal]

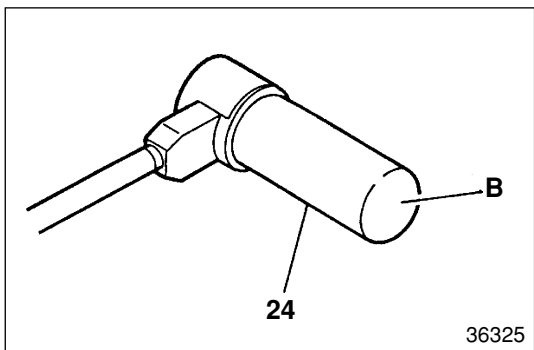
- With wheel speed sensor **24** and spring spacer **25** installed in sensor holder **23**, remove the sensor holder from oil seal retainer **27**.



- Hold shaded section **A** of wheel speed sensor **24** with pliers, and remove the sensor by twisting it slightly in left and right directions.

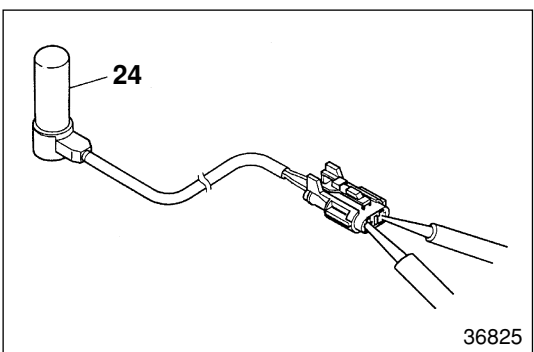
CAUTION ⚠

- When holding wheel speed sensor **24** with pliers, do not grip any section except shaded area **A** in the diagram.
- When removing wheel speed sensor **24**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- If wheel speed sensor **24** dismounts easily, replace spring spacer **25**.

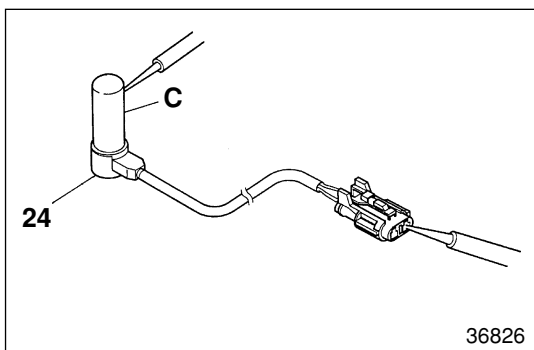


[Inspection]

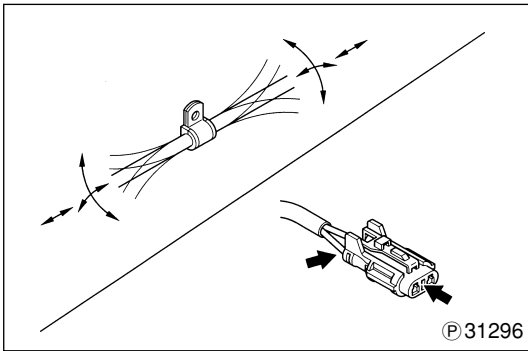
Since pole piece section **B** is magnetized by the magnet inside wheel speed sensor **24**, it attracts metals. Do not allow the pole piece to collect metallic objects.



- Measure the resistance between the terminals of wheel speed sensor **24**.
If the measured value deviates from the standard value, replace the wheel speed sensor.

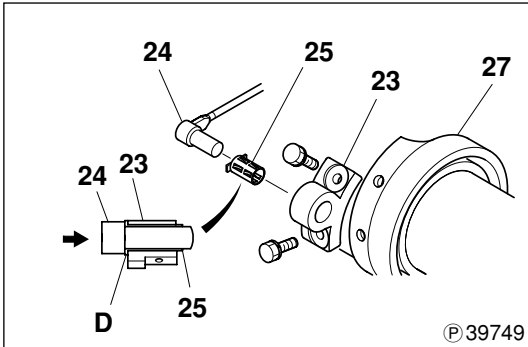


- Measure the insulation resistance between body **C** of wheel speed sensor **24** and each terminal.
If the measured values deviate from the standard value, replace the wheel speed sensor.



- To check for broken wires, remove the harness clamp section from the vehicle. Bend and extend the harness to check if there is any broken wire in the harness. Also, inspect the connector for proper contact.

If a defect is found, replace wheel speed sensor **24**.



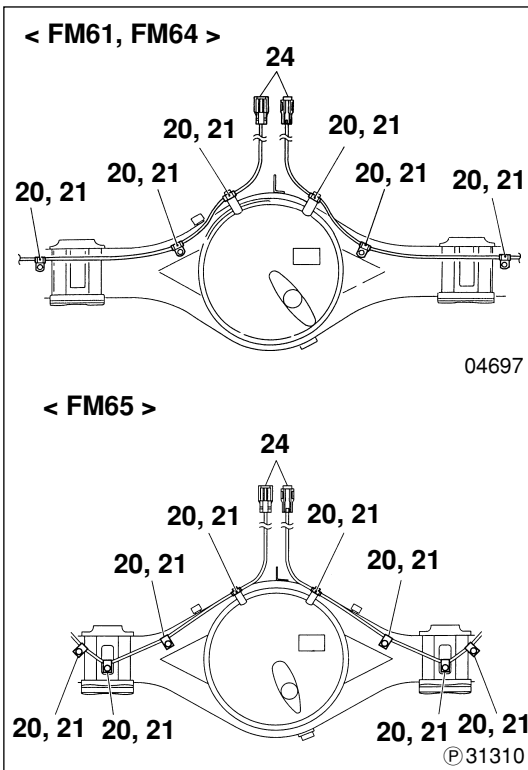
[Installation]

- Insert wheel speed sensor **24** from the back plate, and press until spring spacer **25** and stopper section **D** of the wheel speed sensor contacts sensor holder **23**.
- With wheel speed sensor **24** and spring spacer **25** installed in sensor holder **23**, mount the sensor holder on oil seal retainer **27**.

CAUTION

- When installing wheel speed sensor **24**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- Note that wheel speed sensor **24** is different for left and right wheels.

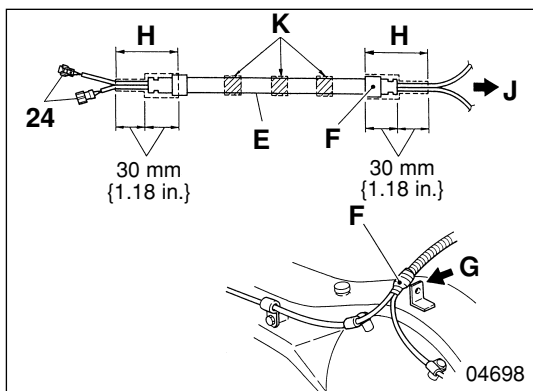
Location	Harness connector color	Harness connector shape
Left wheel	Gray	Male
Right wheel	Black	Female



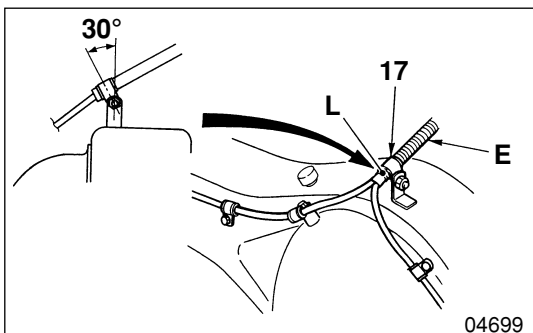
- Rear axle housing section

Starting from the wheel brake side, secure the harness of wheel speed sensor **24** in place with clip **21** and bolt **20**. Make sure the harness does not interfere with other parts and there is no twist or slack in the harness.

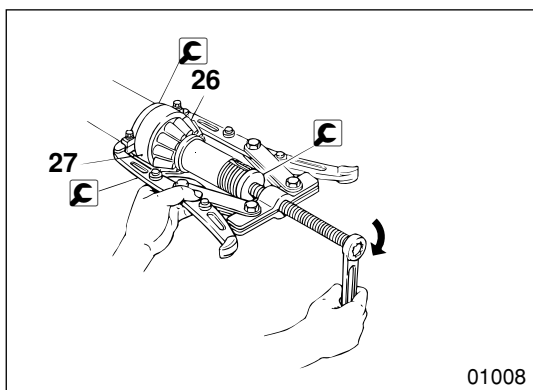
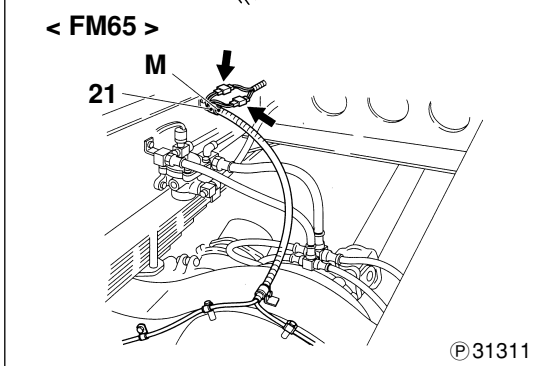
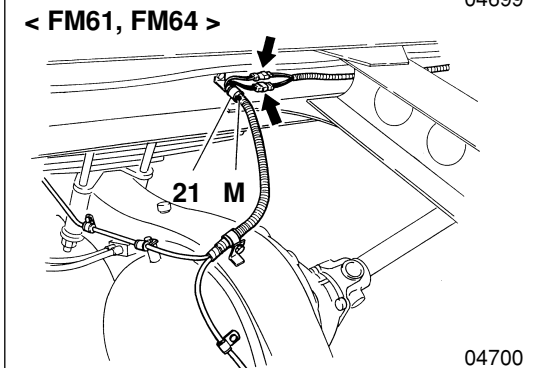
WHEEL HUB AND BRAKE DRUM < FM >



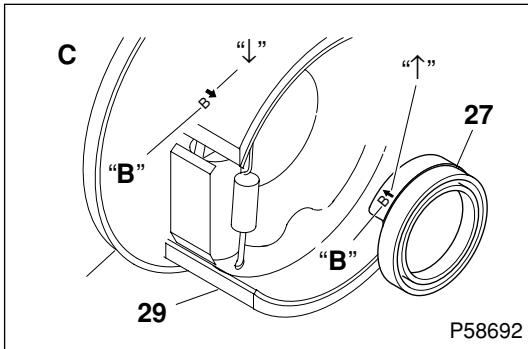
- Binding of harness
 - Gather the harnesses of left and right wheel speed sensors **24**, and bind with corrugated tube **E**.
 - Adjust the position of the corrugated tube **E** so that white tape section **F** is located at clip position **G** on the rear axle housing. Then, turn the corrugated tube so that the slit faces down. Wrap black tape (electric harness tape) on both ends **H** of the corrugated tube. The tape should be placed over the tube end and harness.
- J** : Rear axle housing side
- Wrap tape on the harnesses of wheel speed sensors **24** at sections **K** (three locations at equal intervals).



- Clamping of harness
 - Position section **L** of corrugated tube **E** so that it forms a 30° angle with clip **21**, then secure it to the rear axle housing.
 - Secure section **M** of the corrugated tube to the frame using the clip.
 - Connect the wheel speed sensor connector to the harness connector on the chassis side.



- 26** **27** Inner bearing inner race and oil seal retainer
- [Removal]



[Installation]

< FM61, FM64 >

Install oil retainer **27** by aligning the punched mark "↓" on back plate of brake assembly **29** with the punched mark "↑" on oil seal retainer **27**. The illustration figures right wheel side.

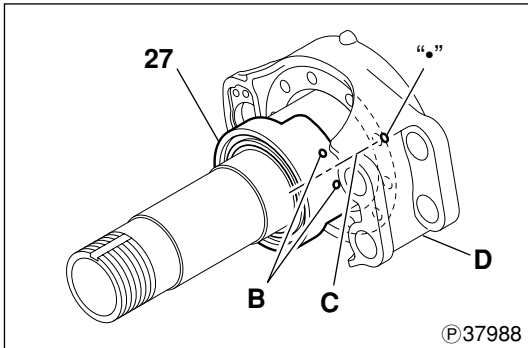
C : Back plate

NOTE

Match up the indentification marks on the back plate of brake assembly 29 and Oil seal retainer 27.

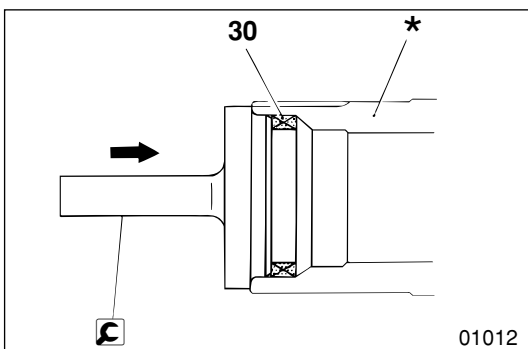
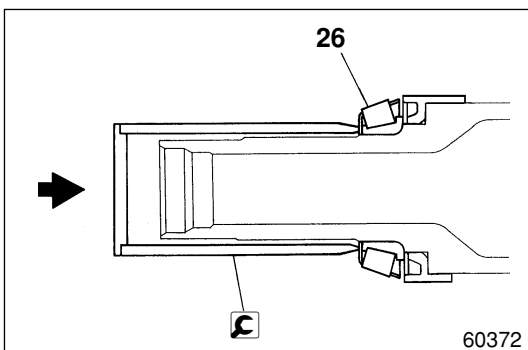
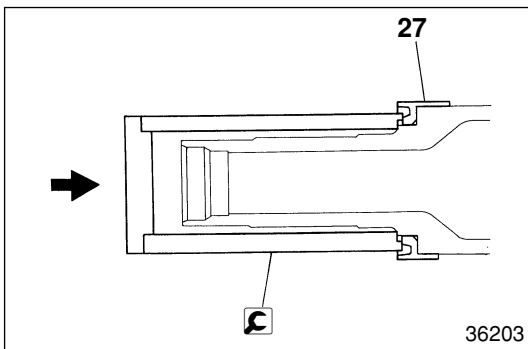
Identification mark "A" : For left wheel

"B" : For right wheel



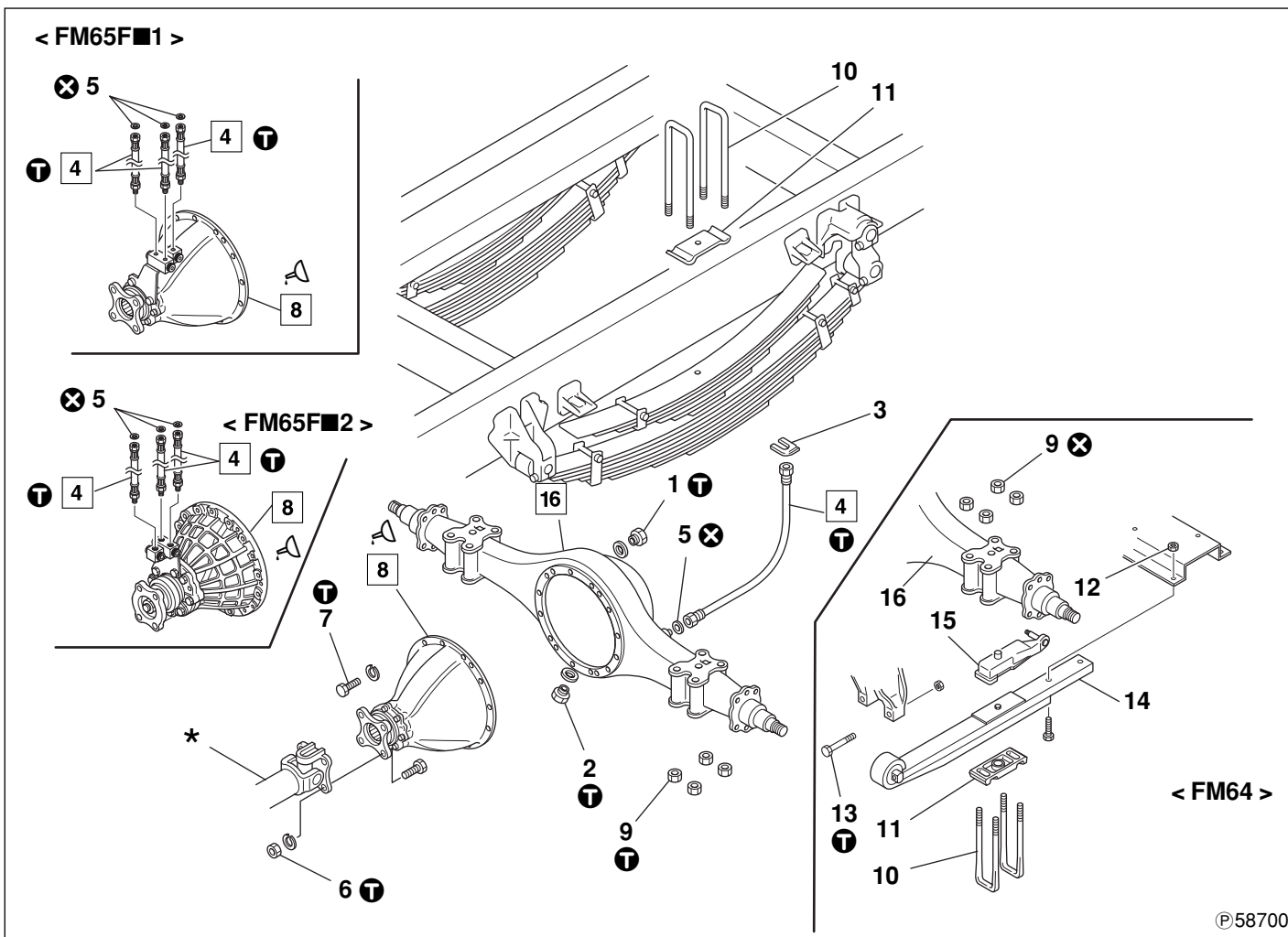
< FM65 >

- Make sure there is an alignment mark "•" on anchor bracket **D** at the location shown in the diagram.
- Install oil seal retainer **27** by aligning center line **C** between sensor holder mounting holes **B** in oil seal retainer **27** with the alignment mark "•" on anchor bracket **D**.



30 Installation of oil seal

AXLE HOUSING



● Work before removal P27-42

● Removal sequence

- | | | |
|---|--------------------------------------|--|
| 1 Inspection plug | 9 U-bolt nut | 14 Leat spring assembly <FM64> Gr 34B |
| 2 Drain plug | 10 U-bolt | 15 Shock absorber lower bracket <FM64> Gr 34B |
| 3 Clip < FK, FM61, FM64 > | 11 Spring upper pad <FK, FM61, FM65> | 16 Axle housing |
| 4 Brake hose | Spring pad < FM64 > | |
| 5 Packing | 12 Nut <FM64> Gr 34B | |
| 6 Nut | 13 Bolt <FM64> Gr 34B | |
| 7 Bolt | | * : Propeller shaft Gr 25 |
| 8 Reduction and differential assembly P27-44 | | |

CAUTION

Be sure to protect brake hose 4 from dust by fitting blanking plugs after removal.

NOTE

- Do not remove axle housing 16 unless it is faulty.
- Remove the suspension parts that are connected to axle housing 16. Gr 34A, B

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

Make sure that brake hose 4 is not twisted when you install it.

NOTE

Do not let sealant ooze from the mounting surfaces of reduction and differential assembly 8 and axle housing 12.

● Work after installation  P27-42

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
12	Bend of axle housing (C-B)	0.2 {0.0079} or less	2.5 {0.020} or more	Replace

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

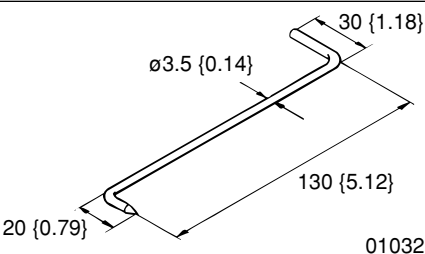
Location	Parts to be tightened			Tightening torque	Remarks	
1	Inspection plug			110±10 {81±7.4, 11±1}	—	
2	Drain plug			110±10 {72 to 87, 11±1}	—	
4	Brake hose	FK, FM61, FM64	Axle housing side	21 to 30 {15 to 22, 2.1 to 3.1}	—	
		FM657	Frame side	39 to 44 {29 to 33, 4.0 to 4.5}	—	
6	Nut (Propeller shaft mounting)		Propeller shaft model	P8	85 {61, 8.5}	—
			P10	120 to 180 {87 to 130, 12 to 18}	—	
			P12	180 to 250 {130 to 185, 18 to 26}	—	
7	Bolt (Reduction and differential assembly mounting)		FK, FM (Except FM65F■2)	120 {90, 12.5}	—	
			FM65F■2	206 {152, 21}	—	
9	U-bolt nut (U-bolt mounting)		FK	292 to 394 {215 to 290, 29.8 to 40.2}	Wet	
			FM61, FM65	404 to 548 {295 to 405, 41.2 to 55.8}	Wet	
			FM64	740 to 830 {545 to 610, 75 to 85}	Wet	
13	Leaf spring bolt (for installing leaf spring assembly)			260 to 350 {190 to 260, 27 to 36}	Wet	

L Lubricant and/or sealant

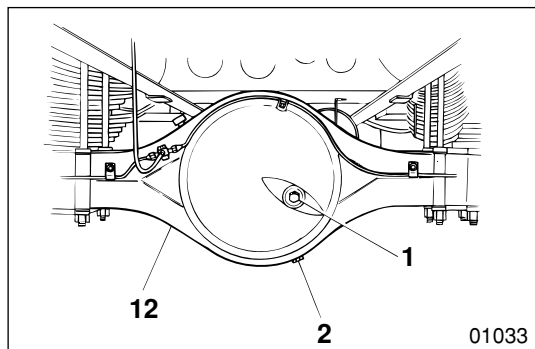
Location	Points of application	Specified lubricant and/or sealant	Quantity
8	Connecting surfaces of reduction and differential assembly and axle housing	THREEBOND 1215	As required

S Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
12	 Measuring bar	MH061003	Measures bend of axle housing : Two required

AXLE HOUSING



◆ Service procedure

● Work before removal

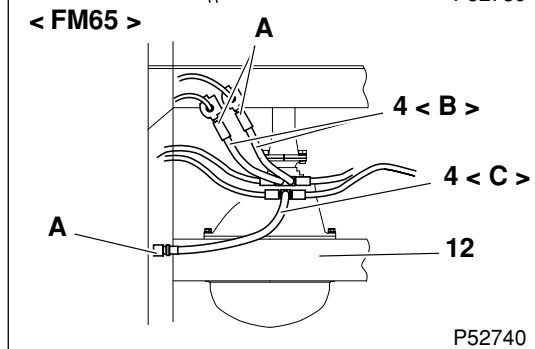
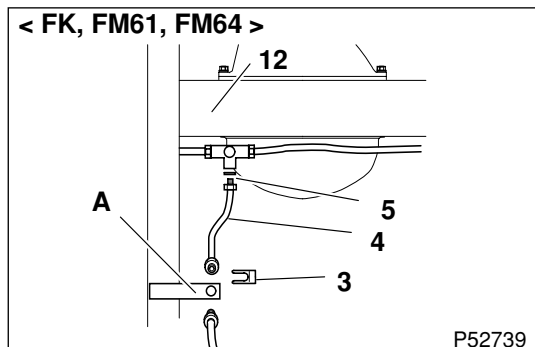
Remove drain plug 2 and drain the gear oil.

WARNING

The oil temperature is high immediately after the vehicle has stopped, so take care not to scald yourself.

● Work after installation

Fill with the specified amount of gear oil via inspection plug 1.

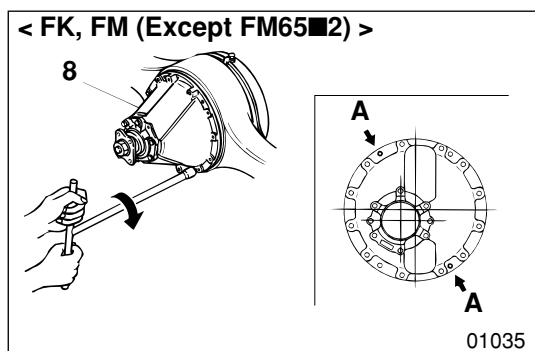


4 Removal and installation of brake hose

- Remove brake hose 4 from frame **A** side first, then from axle housing **12** side.
- For installation, follow the removal sequence in reverse.

B : Service brake hose

C : Spring brake hose



8 Removal of reduction and differential assembly

To remove reduction and differential assembly 8, screw the two following bolts evenly into two screw holes **A**.

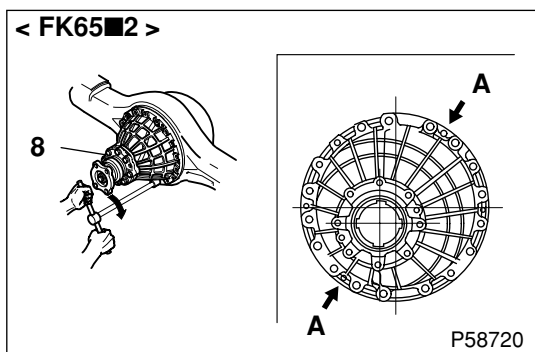
Bolt for removal

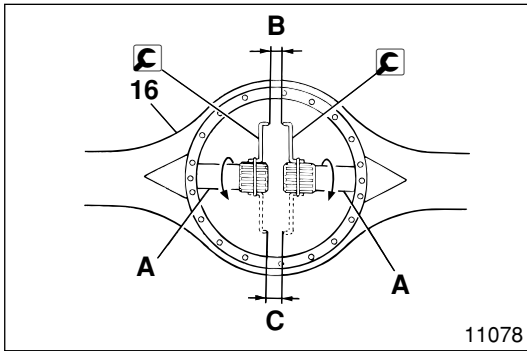
FK, FM (Except FM65■2) : M12×1.25 mm

FK65■2 : M14×1.5 mm

NOTE

Completely remove adhered sealant from the mounting surfaces of reduction differential assembly 8 and axle housing 12.

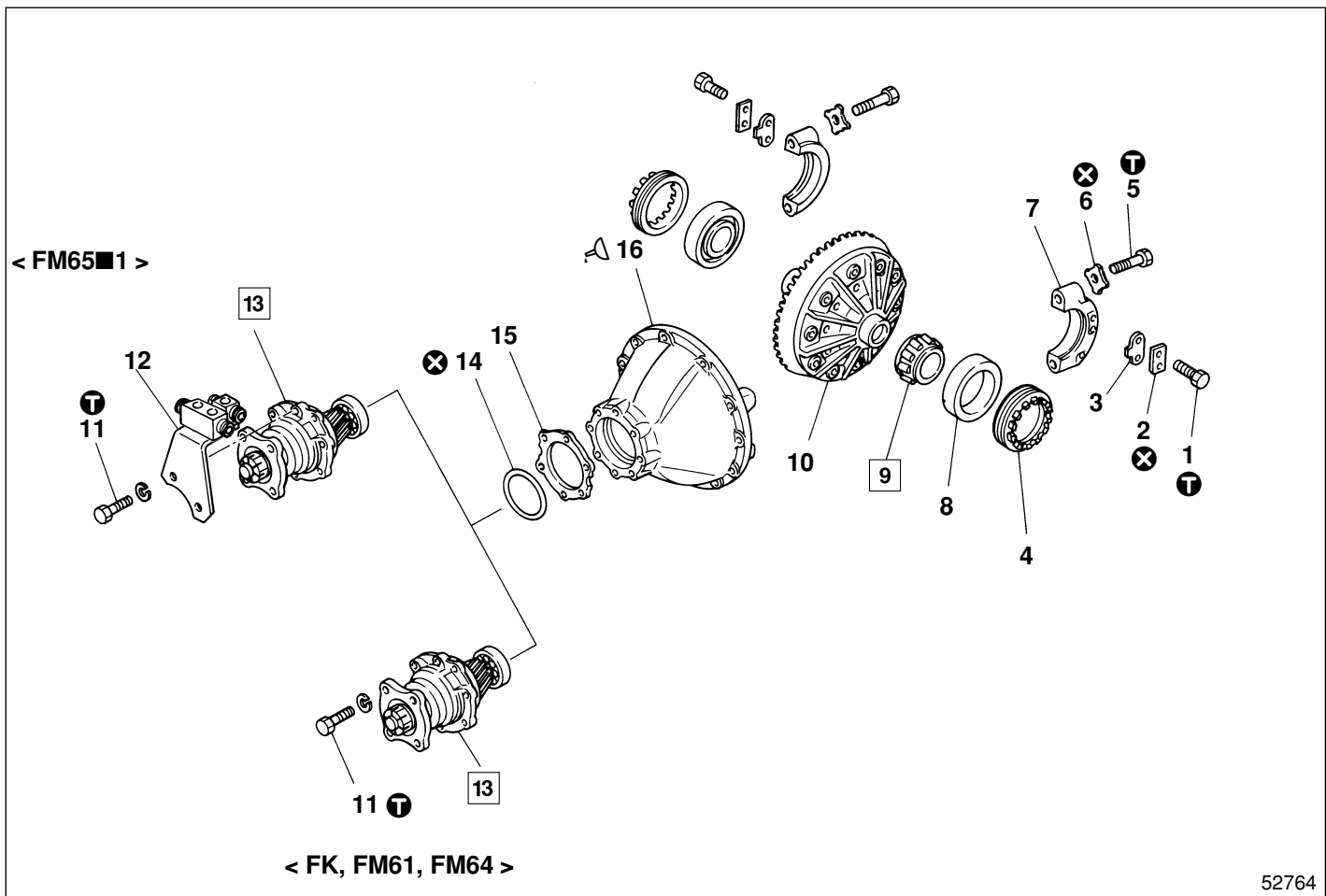


**16 Bend of axle housing**

- Leave axle shaft **A** installed in axle housing **16**.
- Install  measuring bar on axle shaft **A**, and measure clearance **B**.
- Turn axle shaft **A** 180°, and measure clearance **C**.
- The difference between **B** and **C** is the amount of bend of axle housing **16**.
- If the bend of axle housing **16** is higher than the limit, replace the axle housing.

REDUCTION AND DIFFERENTIAL <D050H, D8H>

Reduction and Differential Assembly



52764

● Inspection before disassembly P27-47

● Work before disassembly P27-47

● Disassembly sequence

- | | | |
|-------------------|----------------------------------|----------------------------|
| 1 Bolt | 7 Bearing cap | 13 Pinion assembly P27-58 |
| 2 Lock seat | 8 Side bearing outer race | 14 O-ring |
| 3 Lock pawl | 9 Side bearing inner race | 15 Shim |
| 4 Adjusting screw | 10 Differential assembly P27-54 | 16 Differential carrier |
| 5 Bolt | 11 Bolt | |
| 6 Lock plate | 12 T-connector < FM65■1 > | |

⊗ : Non-reusable pars

CAUTION

- Make sure you replace bearing caps 7, differential carrier 16 and bolt 5 as a differential carrier set.
- Make sure you replace the reduction gear of differential assembly 10 and the reduction pinion of pinion assembly 13 as a reduction gear set.
- Make sure you keep left and right side bearings 8, 9 separate after removal, and be careful not to mix them up when installing them.

NOTE

Write down the thickness of shim 15 before disassembly to use it as reference when assembling.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection and adjustment after assembly P27-48

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
8, 9	Starting torque of side bearing	D050H	2.0 to 2.9 N·m {1.4 to 2.2 ft.lbs, 0.20 to 0.30 kgf·m}	—	- Adjust using adjusting screw - Tangential force at 170 {6.69} outer periphery point of differential case : 24 to 34 N {5.3 to 7.7 lbf, 2.4 to 3.5 kgf}
		D8H	2.5 to 3.4 N·m {1.8 to 2.5 ft.lbs, 0.25 to 0.35 kgf·m}	—	- Adjust using adjusting screw - Tangential force at 213 {8.39} outer periphery point of differential case : 23 to 32 N {5.1 to 7.3 lbf, 2.3 to 3.3 kgf}
10	Wobble of reduction gear back face	D050H	0.15 {0.0059} or less	0.2 {0.0079}	- Adjust or replace as a gear set - Measure at the 145 {5.71} radial point from reduction gear center
		D8H	0.15 {0.0059} or less	0.2 {0.0079}	- Adjust or replace as a gear set - Measure at the 185 {7.28} radial point from reduction gear center
10, 13	Backlash between reduction gear and reduction pinion		0.25 to 0.33 {0.0098 to 0.013}	0.6 {0.024}	Adjust or replace as a gear set

 Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	Bolt (Lock pawl mounting)		27 to 41 {20 to 30, 2.8 to 4.2}	—
5	Bolt (Bearing cap mounting)	D050H	235 {175, 24}	—
		D8H	379 to 513 {280 to 380, 38.7 to 52.3}	—
11	Bolt (Differential carrier and pinion assembly mounting)	D050H	63 to 94 {46 to 69, 6.4 to 9.6}	—
		D8H	94 to 141 {69 to 105, 9.6 to 14.4}	—

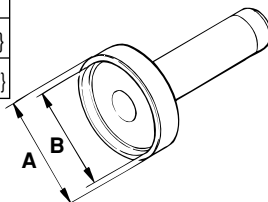
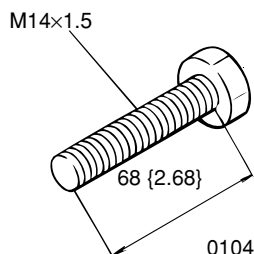
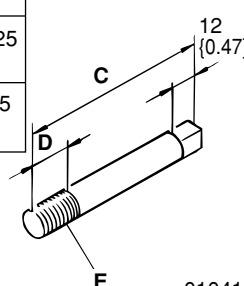
 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
16	Mounting surface of pinion pilot bearing	LOCTITE 601	As required

REDUCTION AND DIFFERENTIAL <D050H, D8H>

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application												
9	Side bearing installer <table><tr><td></td><td>A</td><td>B</td></tr><tr><td>D050H</td><td>ø80 {3.15}</td><td>ø70 {2.76}</td></tr><tr><td>D8H</td><td>ø95 {3.74}</td><td>ø85.5 {3.37}</td></tr></table> 		A	B	D050H	ø80 {3.15}	ø70 {2.76}	D8H	ø95 {3.74}	ø85.5 {3.37}	< D050H > MH061748 < D8H > 03723-25000	Press-fitting of side bearing inner race			
		A	B												
D050H	ø80 {3.15}	ø70 {2.76}													
D8H	ø95 {3.74}	ø85.5 {3.37}													
01039															
13	Bearing retainer remover 	< D8H > MH062172	Removal of pinion assembly : Two required												
	01040														
13	Bearing retainer guide pin <table><tr><td></td><td>C</td><td>D</td><td>E</td></tr><tr><td>D050H</td><td>85 {3.35}</td><td>18 {0.71}</td><td>M12x1.25</td></tr><tr><td>D8H</td><td>95 {3.74}</td><td>23 {0.91}</td><td>M14x1.5</td></tr></table> 		C	D	E	D050H	85 {3.35}	18 {0.71}	M12x1.25	D8H	95 {3.74}	23 {0.91}	M14x1.5	< D050H > MH061745 < D8H > MH061746	Installation of pinion assembly : Two required
		C	D	E											
D050H	85 {3.35}	18 {0.71}	M12x1.25												
D8H	95 {3.74}	23 {0.91}	M14x1.5												
01041															

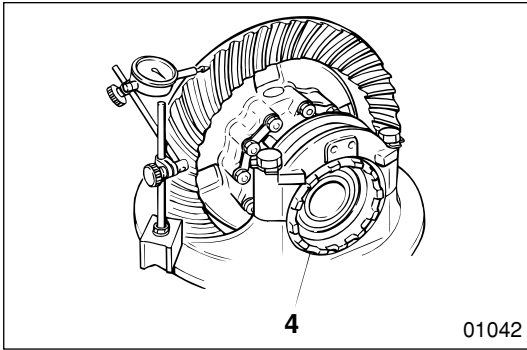
◆ Service procedure

● Inspection before disassembly

Inspect for faulty parts before disassembly.

(1) Backlash of reduction gear and reduction pinion

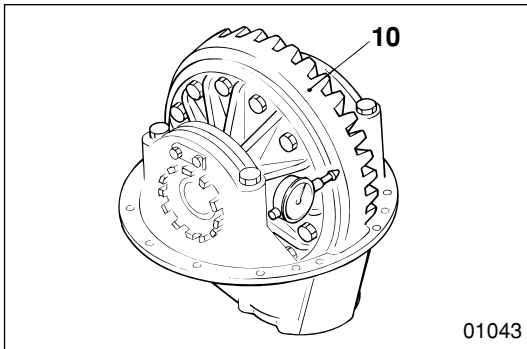
If there is any fault, it is considered to be because of the amount adjusting screw **4** was tightened.



01042

(2) Wobble of back face of reduction gear

Measure wobble at a point 145 mm {5.71 in.} (on the radius) for < D050H >, 185 mm {7.28 in.} for < D8H >, from the center of the reduction gear, turning differential assembly **10** one full revolution.



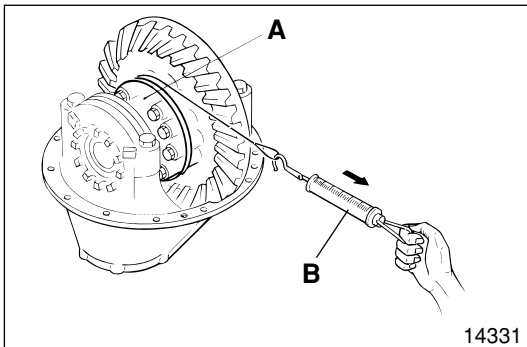
01043

(3) Starting torque of side bearing

- Install spring balance **B** at 170 mm {6.69 in.} for < D050H >, 213 mm {8.39 in.} for < D8H >, outer periphery point of differential case **A**.
- Measure the tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.

NOTE

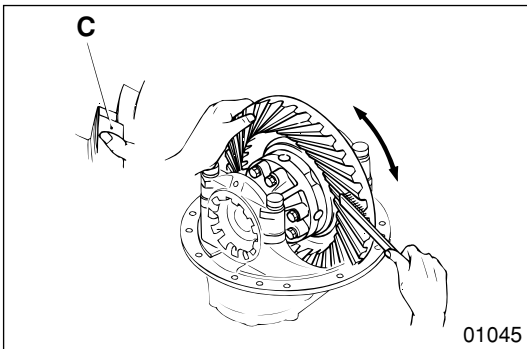
Measure the starting torque within reduction gear and reduction pinion backlash range.



14331

(4) Tooth contact of reduction gear

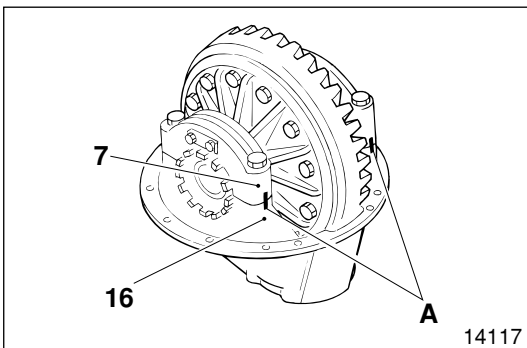
Apply red lead to three or four gear teeth, turn the gear a few times, and examine tooth contact with a piece of paper **C**.



01045

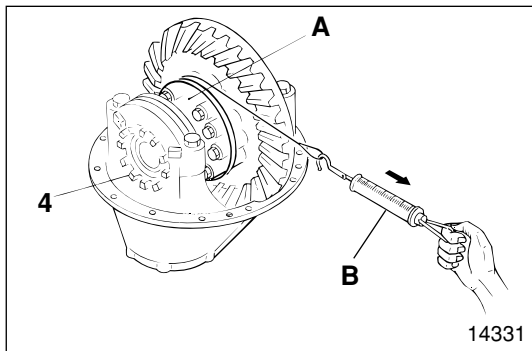
● Work before disassembly

Put alignment marks **A** on bearing cap **7** and differential carrier **16** to identify left and right.



14117

REDUCTION AND DIFFERENTIAL <D050H, D8H>



● Inspection and adjustment after assembly

(1) Starting torque of side bearing

[Inspection]

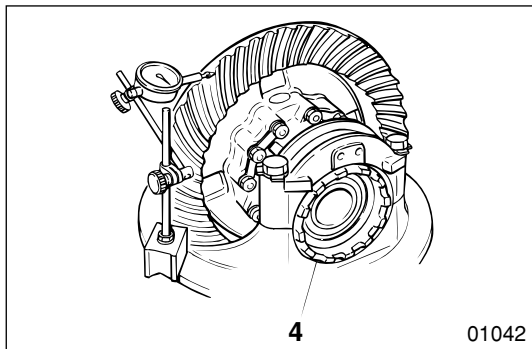
- Install spring balance **B** at 170 mm {6.69 in.} for < D050H >, 213 mm {8.39 in.} for < D8H >, outer periphery point of differential case **A**.
- Measure the tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
- If the measured value deviates from the specified value, adjust.

[Adjustment]

If the measured value does not meet the standard value, adjust using left and right adjusting screws **4**.

CAUTION ⚠

- Tighten left and right adjusting screws **4** the same amount.
- Adjust the starting torque within the reduction gear and reduction pinion backlash range.

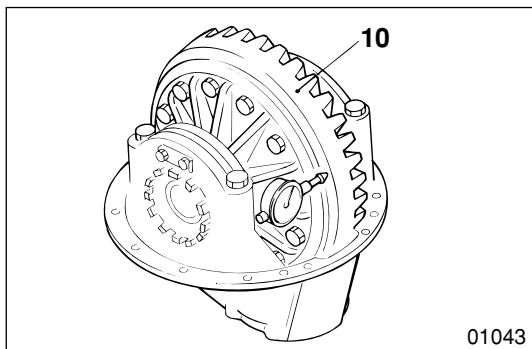


(2) Adjustment of backlash between reduction gear and reduction pinion

Adjust the starting torque of the side bearings using left and right adjusting screws **4**, taking care not to change the starting torque.

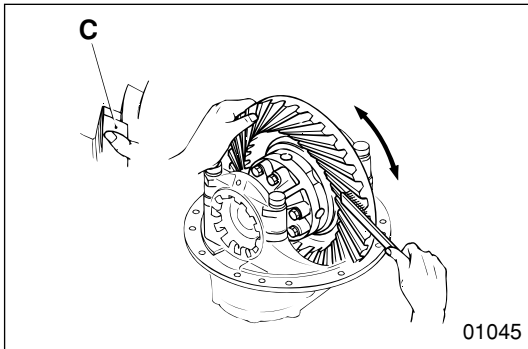
CAUTION ⚠

Make sure when you loosen one adjusting screw **4 that you tighten the other adjusting screw by the same amount, because the starting torque of the side bearing changes.**



(3) Inspection of wobble of back face of reduction gear

Measure wobble at a point 145 mm {5.71 in.} (on the radius) for < D050H >, 185 mm {7.28 in.} for < D8H >, from the center of the reduction gear, turning differential assembly **10** one full revolution.



(4) Tooth contact of reduction gear

[Inspection]

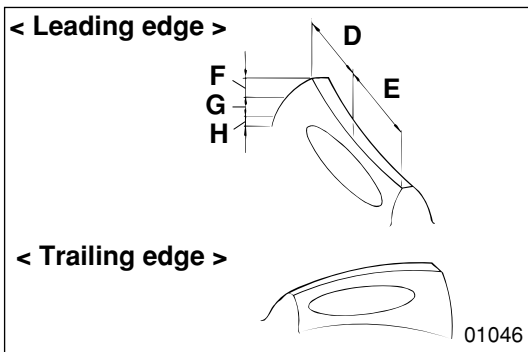
Apply red lead to three or four gear teeth, turn the gear a few times, and examine tooth contact with a piece of paper **C**.

[Adjustment]

If contact area is remarkably offset, adjust with reduction pinion mounting adjusting shims to increase or decrease the backlash.

CAUTION

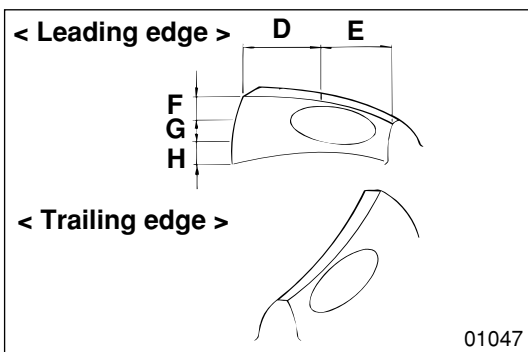
- **Make sure you replace as a reduction gear set (reduction gear and reduction pinion), when you replace the gear because of excessive teeth wear.**
- **When good tooth contact adjustment has been obtained, but backlash does not meet the standard value, tooth contact has priority. It is not necessary to adjust backlash to the standard value if it is less than 0.15 mm {0.0059 in.} out.**



● Normal tooth contact at no load

< Reduction gear >

- D** : Heel
- E** : Toe
- F** : Face
- G** : Flank
- H** : Clearance



< Reduction pinion >

- D** : Heel
- E** : Toe
- F** : Face
- G** : Flank
- H** : Clearance

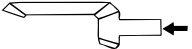
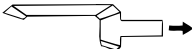
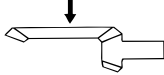
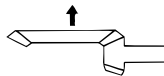
REDUCTION AND DIFFERENTIAL <D050H, D8H>

Maintenance item			Assembly standards
At no load	Tooth contact position	Lengthwise direction of tooth	From center toward toe
		Vertical direction	From center toward top of tooth for reduction gear and center of tooth for pinion
	Tooth contact shape	Length	About 50 to 70% of tooth width
		Width	About 50 to 70% of tooth depth
	Degree of tooth contact		Degree of tooth contact becomes weaker as it comes nearer to root or top

NOTE

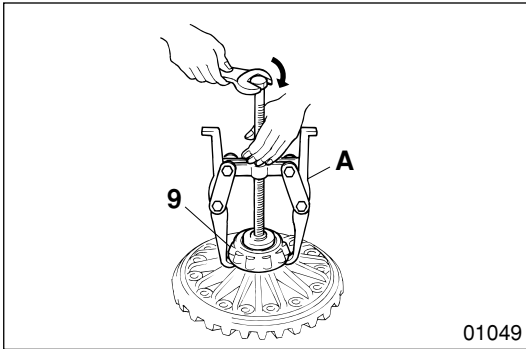
When tooth contact area is nearer to toe at no load, it becomes middle area contact under load.

Adjustment of Tooth Contact

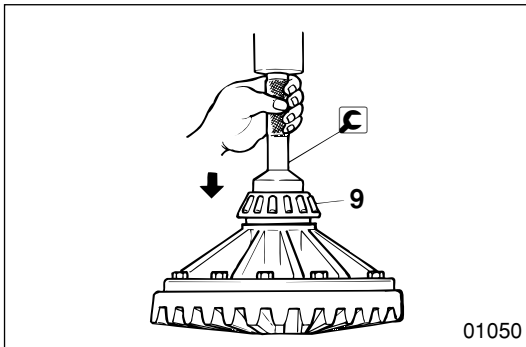
	Mode of adjustment	Moving direction
Adjustment by adding or reducing shims	Advances reduction pinion to reduction gear (Shims are reduced) 	< Leading edge >  Tooth contact moves toward root of tooth < Trailing edge >
	Retards reduction pinion from reduction gear (Shims are added) 	 Tooth contact moves toward top of tooth
Adjustment by controlling adjusting screw	Advance reduction gear to reduction pinion axis (Less backlash) 	 Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to toe and slightly nearer to root of tooth Trailing edge: Nearer to heel and slightly nearer to top of tooth
	Retard reduction gear from reduction pinion axis (More backlash) 	 Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to heel and slightly nearer to top of tooth Trailing edge: Nearer to toe and slightly nearer to root of tooth

9 Side bearing inner race

[Removal]

A : Gear puller (General tool)

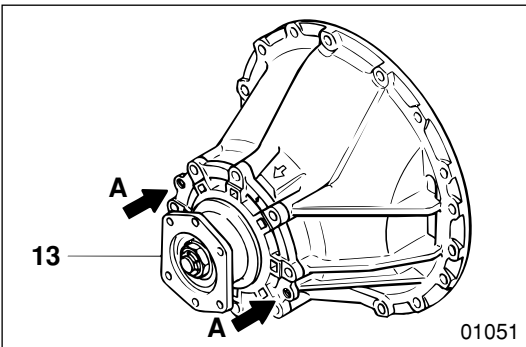
[Installation]

**13 Pinion assembly**

[Removal]

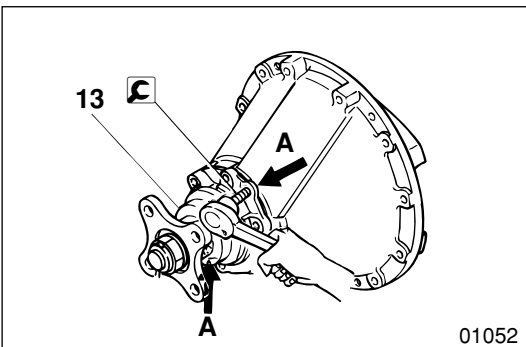
< D050H >

To remove pinion assembly **13**, screw two M12×1.25 mm bolts evenly into the two pinion assembly removal screw holes **A**.

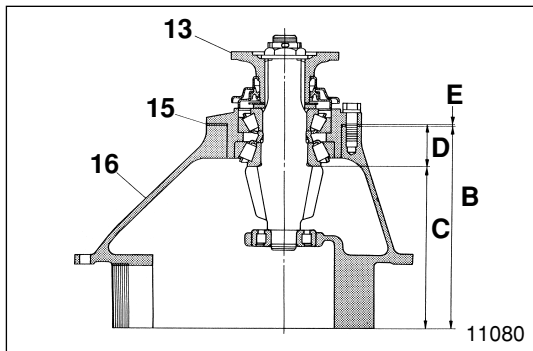


< D8H >

To remove pinion assembly **13**, screw two  bearing retainer removers into the two pinion assembly removal screw holes **A**.



REDUCTION AND DIFFERENTIAL <D050H, D8H>



[Adjustment]

- Carry out the following procedure so that **B**, **C** and **D** conform to the standard dimension.
- Calculate shim thickness **E** according to the following formula based upon the machining error data stamped on pinion assembly **13** and differential carrier **16**.

Formula for calculation

$$E = 0.5 \{0.020\} - b + c + d$$

b : Deviation from basic dimension **B**

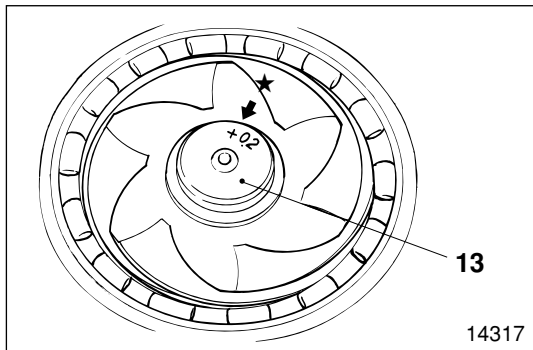
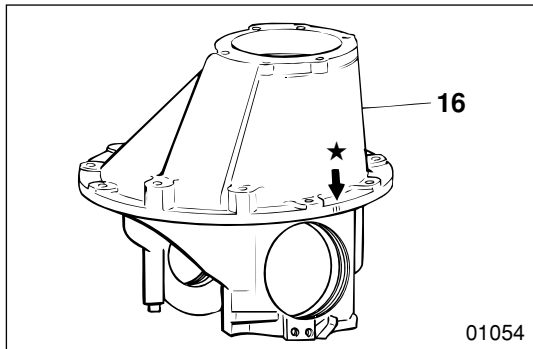
c : Deviation from basic dimension **C**

d : Deviation from basic dimension **D**

NOTE

Thickness is stamped in millimeters.

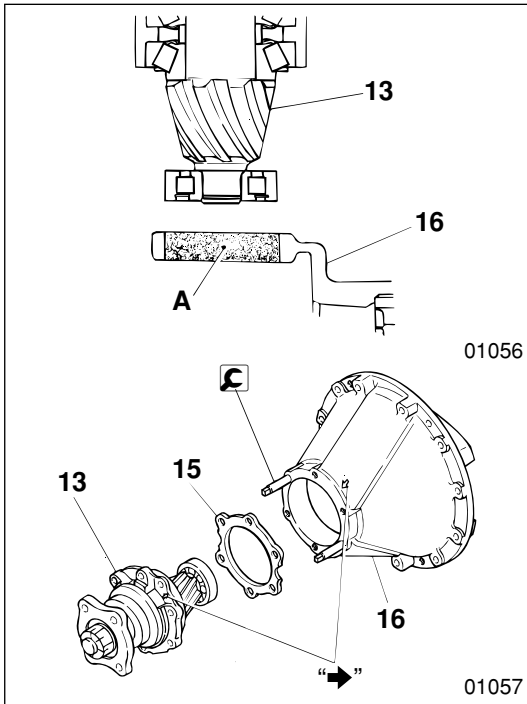
Unit : mm {in.}



Location	Standard dimension		How to calculate deviation
	D050H	D8H	
Shim thickness	0.5 {0.020}		—
B	232 {9.13}	261 {10.3}	The basic dimension, multiplied by 100, is stamped on the periphery of differential carrier 16 flange
C	180 {7.09}	208 {8.19}	The basic dimension is stamped on the top of pinion assembly 13
D	52 {2.05}	53.5 {2.11}	Measure the deviation from D using a dial gauge. However, If it is difficult to measure the actual deviation, assume a value from 0 to 0.2 {0 to 0.0079}

★ : Stamped number position

- Select shim **15** from shim thickness **E**.
Available thicknesses of shim **15** : 0.1 mm {0.0039 in.} and 0.2 mm {0.0079 in.}



[Installation]

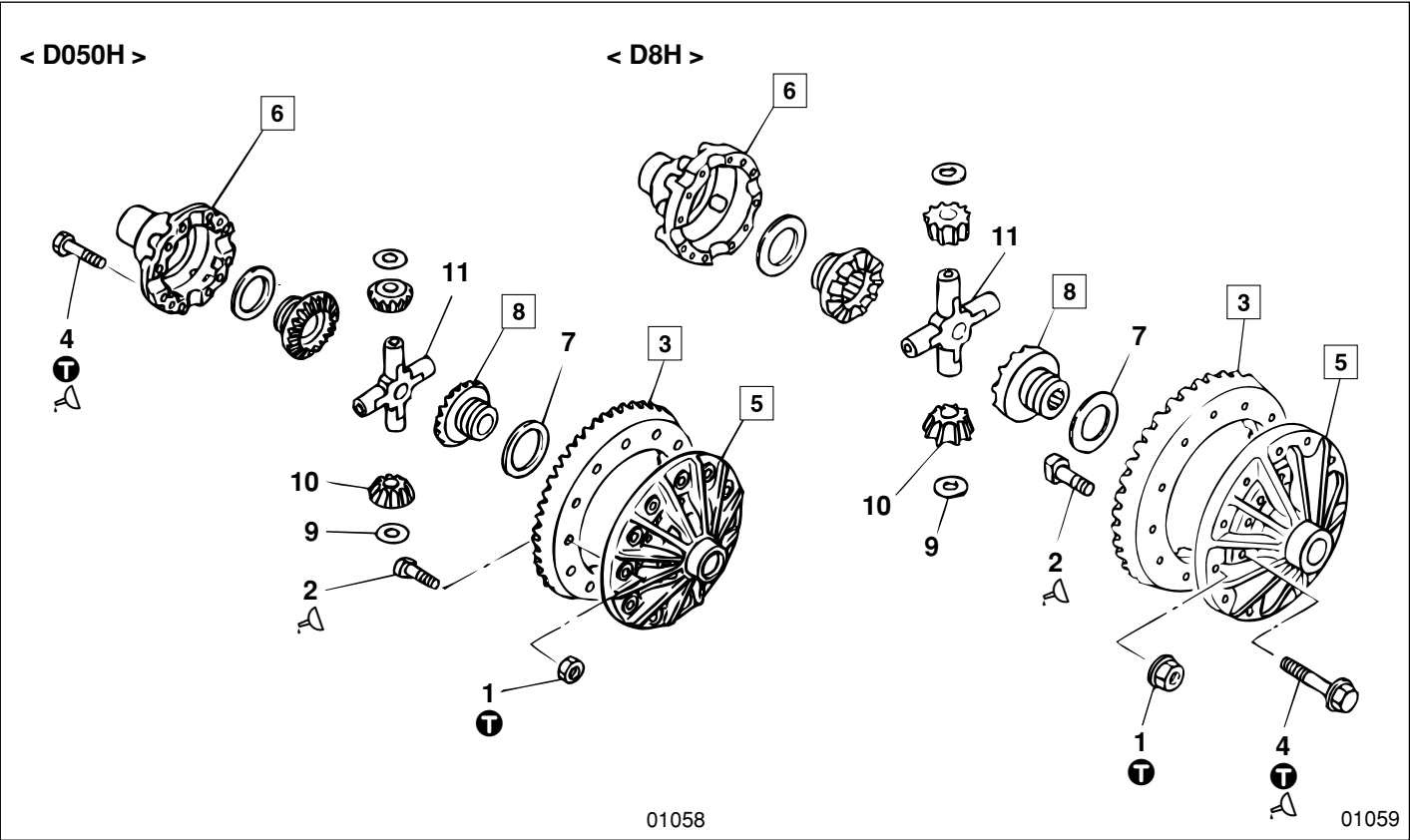
- Apply lock paint to pinion pilot bearing mounting surface **A** of differential carrier **16**.
- Install pinion assembly **13**.

CAUTION ⚠

- **Be sure to let the lock paint harden undisturbed for 30 minutes to two hours after installation.**
- **Be sure to wait at least three hours before running the vehicle, and if possible wait 24 hours to let the lock paint harden.**

REDUCTION AND DIFFERENTIAL <D050H, D8H>

Differential Assembly



Disassembly sequence

- | | |
|--------------------------|------------------------------|
| 1 Nut | 7 Differential gear washer |
| 2 Bolt | 8 Differential gear |
| 3 Reduction gear | 9 Differential pinion washer |
| 4 Bolt | 10 Differential pinion |
| 5 Differential case , LH | 11 Pinion spider |
| 6 Differential case, RH | |

CAUTION  Make sure you replace differential case LH 5 and differential case RH 6 as a differential case set.

Assembly sequence

Follow the disassembly sequence in reverse.

Adjustment after assembly P27-55

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
8	Play between differential gear and axle shaft spline	D050H	0.10 to 0.18 {0.0039 to 0.0071}	0.5 {0.020}	Replace
		D8H	0.07 to 0.22 {0.0028 to 0.0082}	0.5 {0.020}	Replace
8, 10	Backlash between differential pinion and differential gear	D050H	0.19 to 0.25 {0.0075 to 0.0098}	0.5 {0.020}	Replace
		D8H	0.20 to 0.28 {0.0079 to 0.011}	0.8 {0.031}	Replace
10, 11	Clearance between differential pinion and pinion spider	D050H	[26] 0.17 to 0.27 {[1.02] 0.067 to 0.011}	0.5 {0.020}	Replace
		D8H	[35] 0.17 to 0.28 {[1.38] 0.0067 to 0.011}	0.5 {0.020}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	Nut (Reduction gear and differential case LH mounting)	D050H	295 {215, 30}	—
		D8H	490 to 540 {360 to 395, 50 to 55}	—
4	Bolt (Differential case LH and differential case RH mounting)	D050H	181 {135, 18.5}	—
		D8H	167 to 225 {125 to 165, 17 to 23}	—

Lubricant and/or sealant

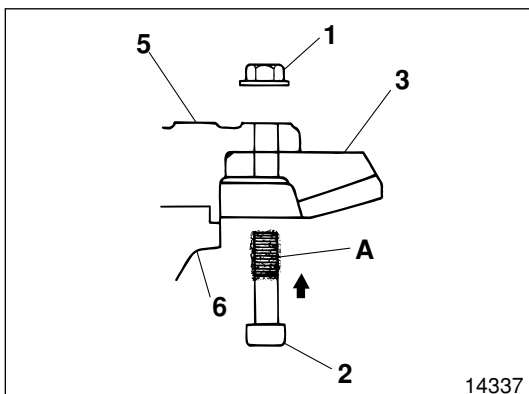
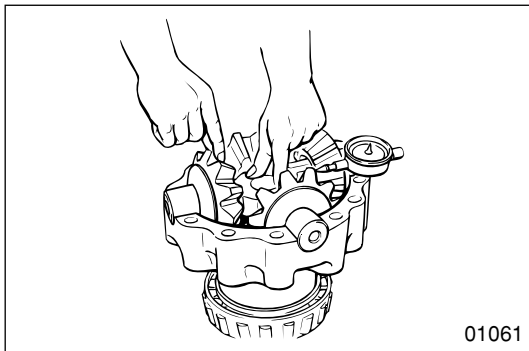
Location	Points of application	Specified lubricant and/or sealant	Quantity
2, 4	Entire bolt	Rust preventive	As required
	Thread area of bolt	LOCTITE 271	As required

Service procedure

Adjustment after assembly

Backlash between differential gear and differential pinion

If the measured value deviates from the standard value, replace differential gear washer 7.



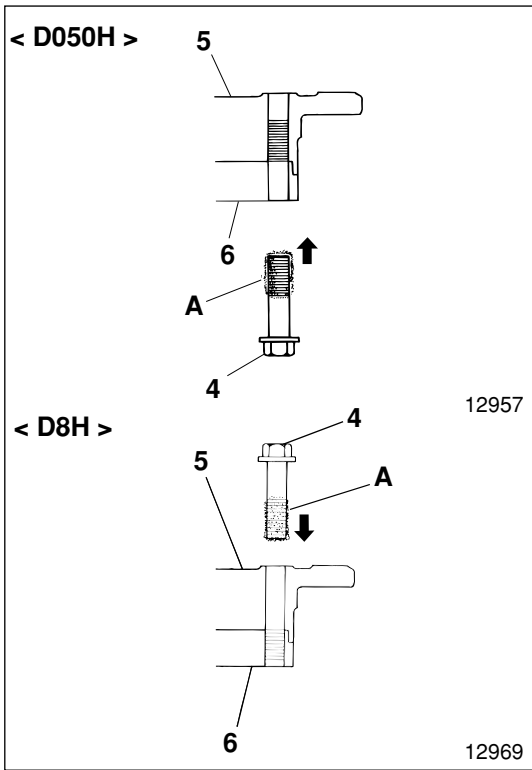
3 5 Installation of differential case LH and reduction gear

- Apply rust preventive to entire surface of bolt 2.
- Apply lock paint to thread area A of bolt 2.
- Tighten nut 1 at specified torque.

CAUTION

- Be sure to apply rust preventive to nut 1 because of the need to tighten it at specified torque.
- Be sure not to operate the vehicle for at least one hour after installation in order to let the lock paint harden.
- Be sure not to operate the vehicle at full torque for at least four hours after installation in order to let the lock paint harden.

REDUCTION AND DIFFERENTIAL <D050H, D8H>

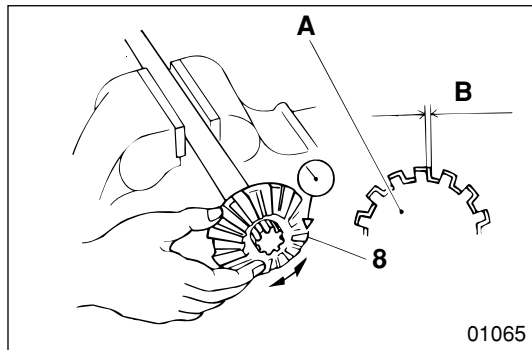


5 6 Installation of differential case LH and differential case RH

- Apply rust preventive to entire surface of bolt 4.
- Apply lock paint to thread area A of bolt 4.
- Tighten bolt 4 at specified torque.

CAUTION ⚠

- Be sure to apply rust preventive to bolt 4 because of the need to tighten it at specified torque.
- Be sure not to operate the vehicle for at least one hour after installation in order to let the lock paint harden.
- Be sure not to operate the vehicle at full torque for at least four hours after installation in order to let the lock paint harden.



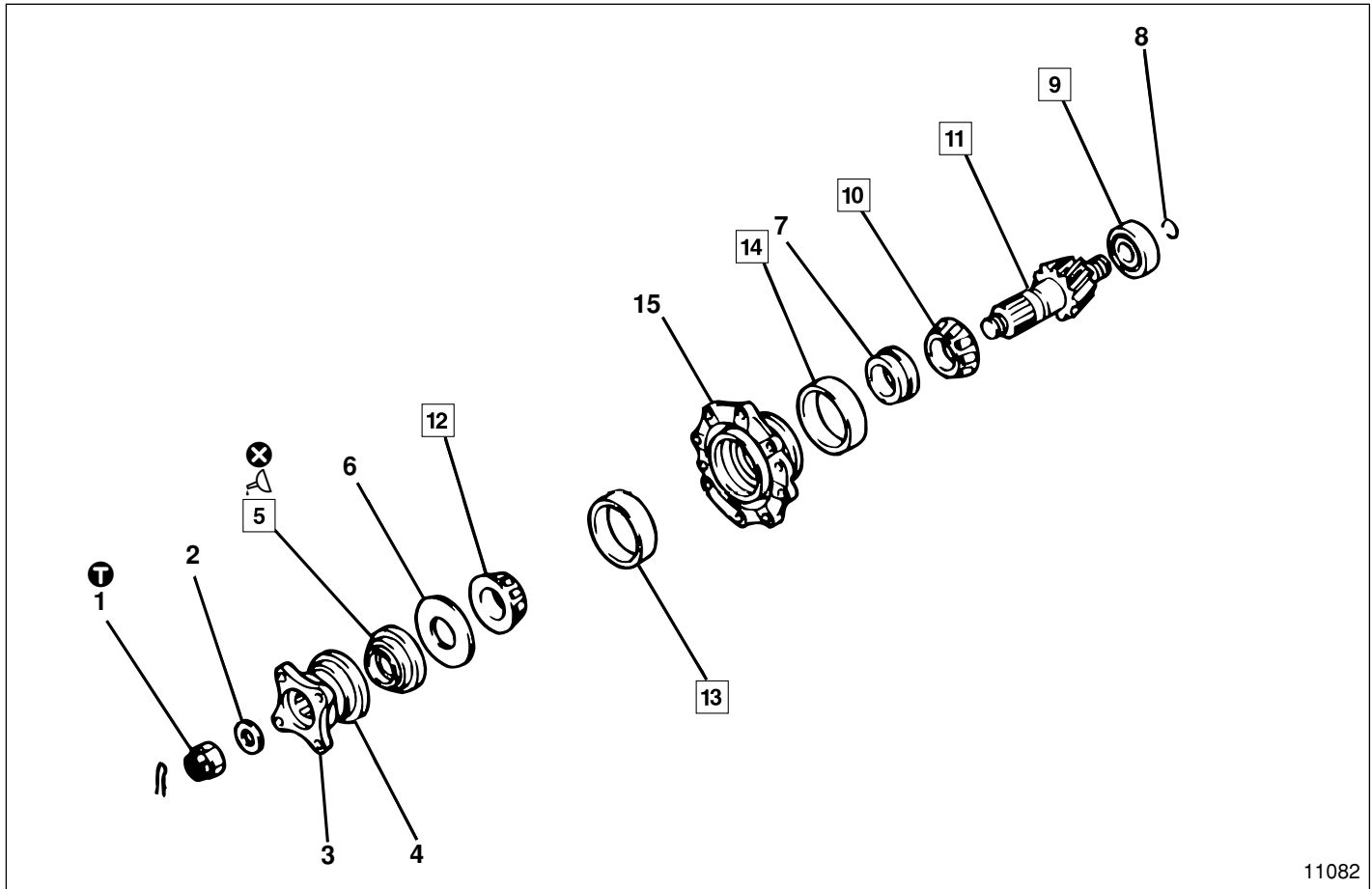
8 Play between differential gear and rear axle shaft at the spline

- A : Axle shaft
B : Play

MEMO

REDUCTION AND DIFFERENTIAL <D050H, D8H>

Pinion Assembly



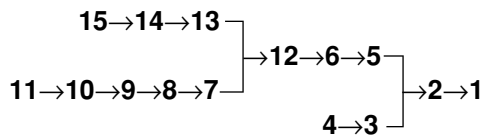
● Disassembly sequence

- | | |
|-------------------------|-----------------------------|
| 1 Lock nut | 10 Inner bearing inner race |
| 2 Washer < D8H > | 11 Reduction pinion |
| 3 Companion flange | 12 Outer bearing inner race |
| 4 Dust cover | 13 Outer bearing outer race |
| 5 Oil seal | 14 Inner bearing outer race |
| 6 Oil separator < D8H > | 15 Bearing retainer |
| 7 Collar | |
| 8 Lock ring | |
| 9 Pinion pilot bearing | |
- ⊗ : Non-reusable parts

NOTE

Record the thicknesses and number of collars 7 before disassembling for reference when assembling.

● Assembly sequence



● Inspection and adjustment after assembly P27-61

Service standards

Unit : mm {in.}

Location	Maintenance item			Standard value	Limit	Remedy
10, 12, 13, 14	Starting torque of pinion bearing	D050H	When new bearings are used	2.0 to 2.9 N·m {1.4 to 2.2 ft.lbs, 0.20 to 0.30 kgf·m}	—	- Adjust using collar - Tangential force at 170 {6.69} outer periphery point of bearing retainer : 24 to 34 N {5.3 to 7.7 lbf, 2.4 to 3.5 kgf}
			When bearings are reused	1.6 to 2.4 N·m {1.2 to 1.7 ft.lbs, 0.16 to 0.24 kgf·m}	—	- Adjust using collar - Tangential force at 170 {6.69} outer periphery point of bearing retainer : 19 to 28 N {4.2 to 6.4 lbf, 1.9 to 2.9 kgf}
		D8H	When new bearings are used	2.5 to 3.4 N·m {1.8 to 2.5 ft.lbs, 0.25 to 0.35 kgf·m}	—	- Adjust using collar - Tangential force at 160 {6.30} outer periphery point of bearing retainer : 30 to 43 N {6.8 to 9.7 lbf, 3.1 to 4.4 kgf}
			When bearings are reused	2.0 to 2.7 N·m {1.4 to 2.0 ft.lbs, 0.20 to 0.28 kgf·m}	—	- Adjust using collar - Tangential force at 160 {6.30} outer periphery point of bearing retainer : 25 to 34 N {5.5 to 7.7 lbf, 2.5 to 3.5 kgf}

 Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	Lock nut (Companion flange and reduction pinion mounting)	D050H	300 to 450 {220 to 330, 31 to 46}	—
		D8H	539 to 735 {395 to 540, 55 to 75}	—

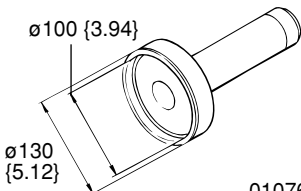
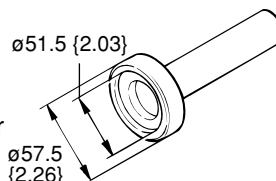
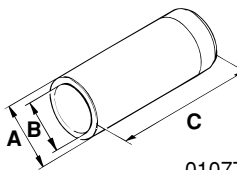
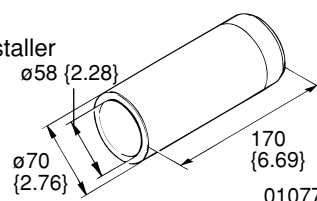
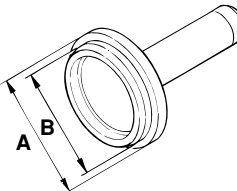
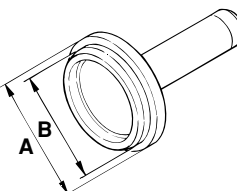
 Lubricant and/or sealant

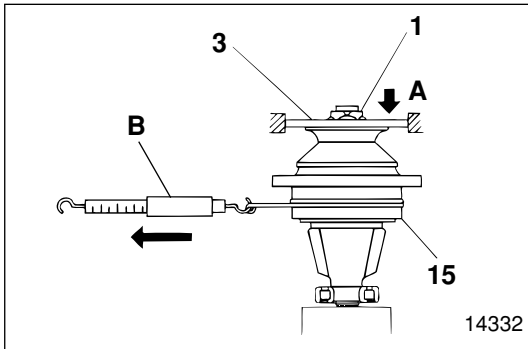
Location	Points of application	Specified lubricant and/or sealant	Quantity
5	Lip area of oil seal	Chassis grease [NLGI No. 1 (Li soap)]	As required

REDUCTION AND DIFFERENTIAL <D050H, D8H>

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application												
5	Oil seal installer  01076	MH061752	Press-fitting of oil seal												
9	Pinion pilot bearing installer  01081	03723-27001	Press-fitting of pinion pilot bearing												
10	Pinion inner bearing installer <table border="1"><thead><tr><th></th><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>D050H</td><td>ø70 {2.76}</td><td>ø58 {2.28}</td><td>170 {6.69}</td></tr><tr><td>D8H</td><td>ø85 {3.35}</td><td>ø65 {2.56}</td><td>180 {7.09}</td></tr></tbody></table>  01077		A	B	C	D050H	ø70 {2.76}	ø58 {2.28}	170 {6.69}	D8H	ø85 {3.35}	ø65 {2.56}	180 {7.09}	< D050H > MH061004 < D8H > 03724-51000	Press-fitting of inner bearing inner race
	A	B	C												
D050H	ø70 {2.76}	ø58 {2.28}	170 {6.69}												
D8H	ø85 {3.35}	ø65 {2.56}	180 {7.09}												
12	Pinion outer bearing installer  01077	MH061004	Press-fitting of outer bearing inner race												
13	Pinion outer bearing installer <table border="1"><thead><tr><th></th><th>A</th><th>B</th></tr></thead><tbody><tr><td>D050H</td><td>ø108 {4.25}</td><td>ø102.5 {4.04}</td></tr><tr><td>D8H</td><td>ø118 {4.65}</td><td>ø103 {4.06}</td></tr></tbody></table>  01078		A	B	D050H	ø108 {4.25}	ø102.5 {4.04}	D8H	ø118 {4.65}	ø103 {4.06}	< D050H > MH061007 < D8H > MH061006	Press-fitting of outer bearing outer race			
	A	B													
D050H	ø108 {4.25}	ø102.5 {4.04}													
D8H	ø118 {4.65}	ø103 {4.06}													
14	Pinion inner bearing installer <table border="1"><thead><tr><th></th><th>A</th><th>B</th></tr></thead><tbody><tr><td>D050H</td><td>ø118 {4.65}</td><td>ø103 {4.06}</td></tr><tr><td>D8H</td><td>ø129 {5.08}</td><td>ø123 {4.84}</td></tr></tbody></table>  01078		A	B	D050H	ø118 {4.65}	ø103 {4.06}	D8H	ø129 {5.08}	ø123 {4.84}	< D050H > MH061006 < D8H > 03724-55000	Press-fitting of inner bearing outer race			
	A	B													
D050H	ø118 {4.65}	ø103 {4.06}													
D8H	ø129 {5.08}	ø123 {4.84}													



◆ Service procedure

● Inspection and adjustment after assembly

Starting torque of pinion bearing

[Inspection]

- Apply load **A** to companion flange **3** or tighten lock nut **1** at specified torque.

A : Approximately 39.2 kN {8.8 klbf, 4000 kgf} < D050H >

Approximately 49 kN {11 klbf, 5000 kgf} < D8H >

- Install spring balance **B** at 170 mm {6.69 in.} for < D050H >, 160 mm {6.30 in.} for < D8H >, outer periphery point of differential case **A**.
- Measure the tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
- If the measured value deviates from the specified value, adjust.

NOTE

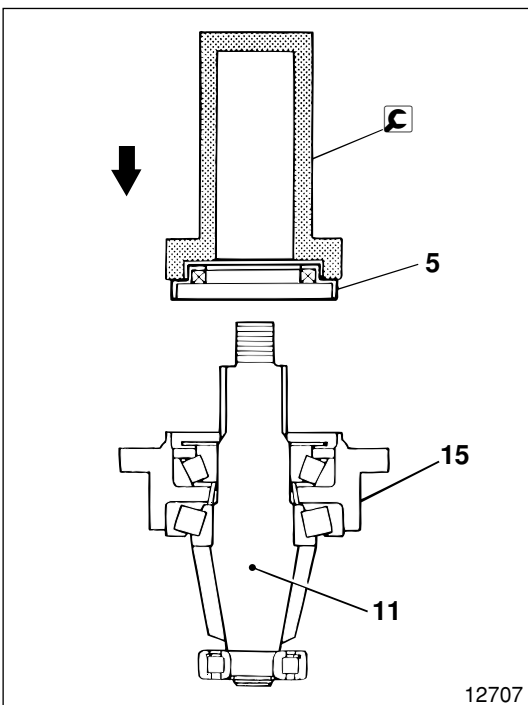
- **Tighten companion flange 3 before measuring.**
- **Oil separator 6 must be installed when you measure. < D8H >**
- **Measure with oil seal 5 removed.**

[Adjustment]

If the measured value does not conform to the specified value, adjust with collar **7** to obtain specified tangential force. Choose an appropriate collar by referring to the table below.

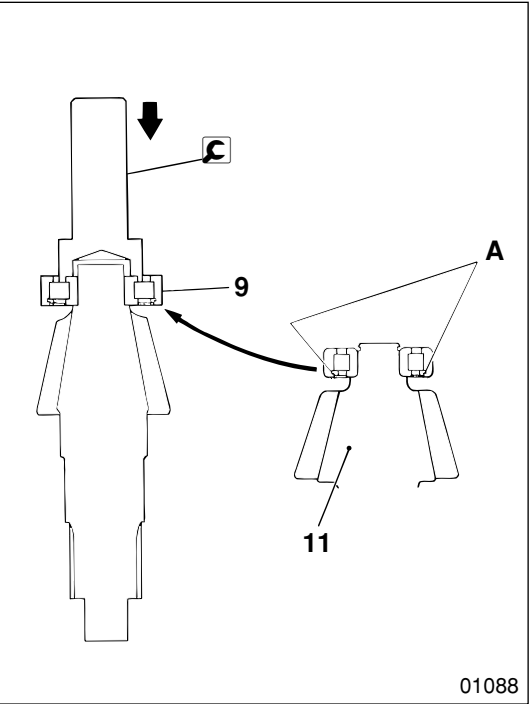
Unit : mm {in.}

Applicable model	Thickness of collar
D050H	13.875 to 14.475 {0.55 to 0.57} (25 thicknesses in 0.025 {0.00098} increments)
D8H	14.975 to 15.575 {0.59 to 0.61} (25 thicknesses in 0.025 {0.00098} increments)



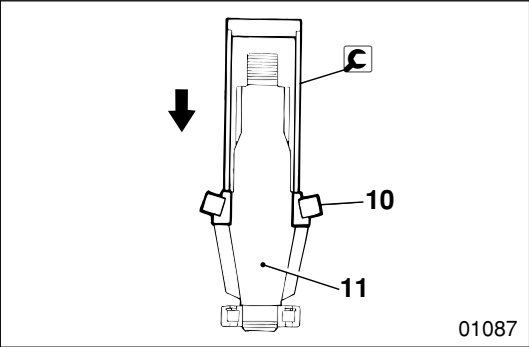
5 Installation of oil seal

REDUCTION AND DIFFERENTIAL <D050H, D8H>

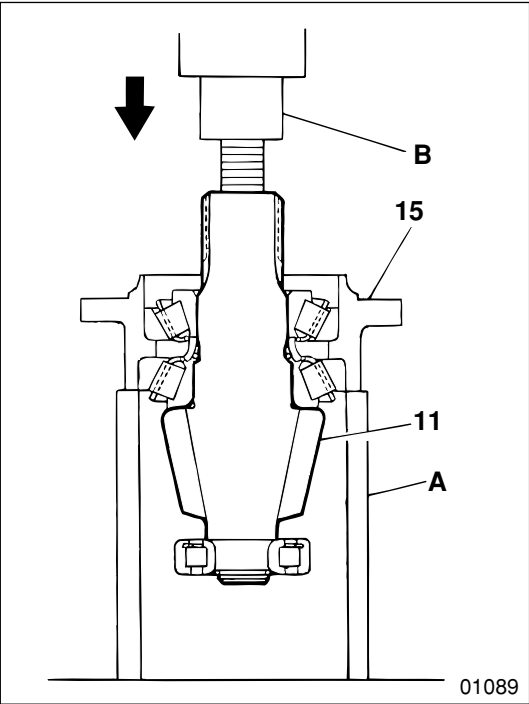


9 Installation of pinion pilot bearing

Press-fit pinion pilot bearing 9 in the direction as illustrated.
A : Lock ring

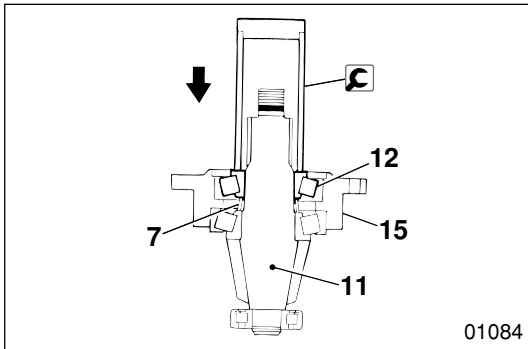


10 Installation of inner bearing inner race

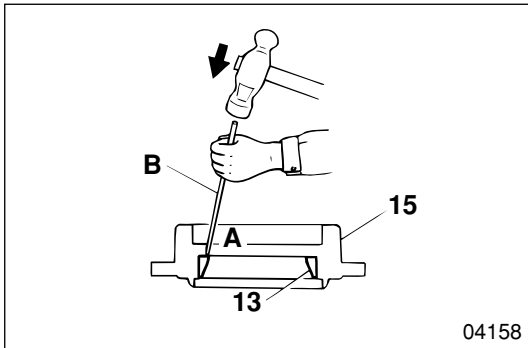


11 Removal of reduction pinion

A : Cylindrical guide
B : Press



12 Installation of outer bearing inner race

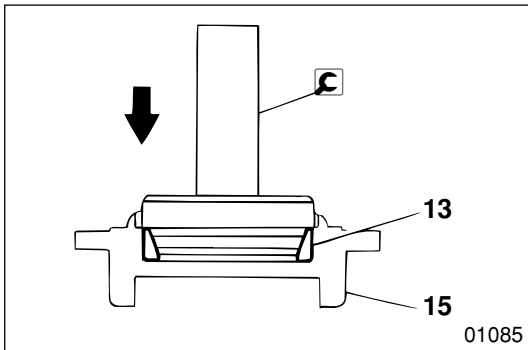


13 Outer bearing outer race

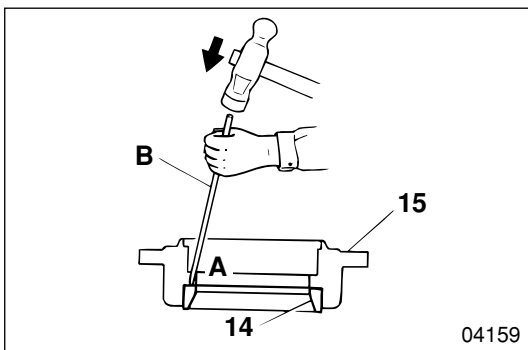
[Removal]

Drive out outer bearing outer race **13** evenly from three indented parts **A** in bearing retainer **15**.

B : Pin-punch



[Installation]

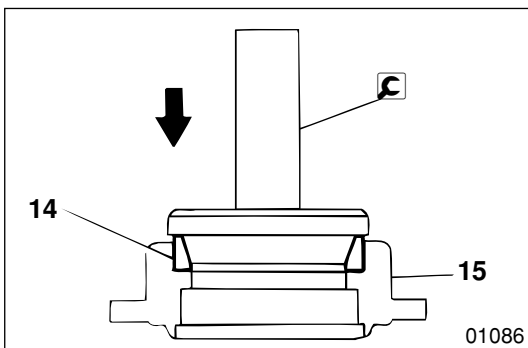


14 Inner bearing outer race

[Removal]

Drive out inner bearing outer race **14** evenly from three indented parts **A** in bearing retainer **15**.

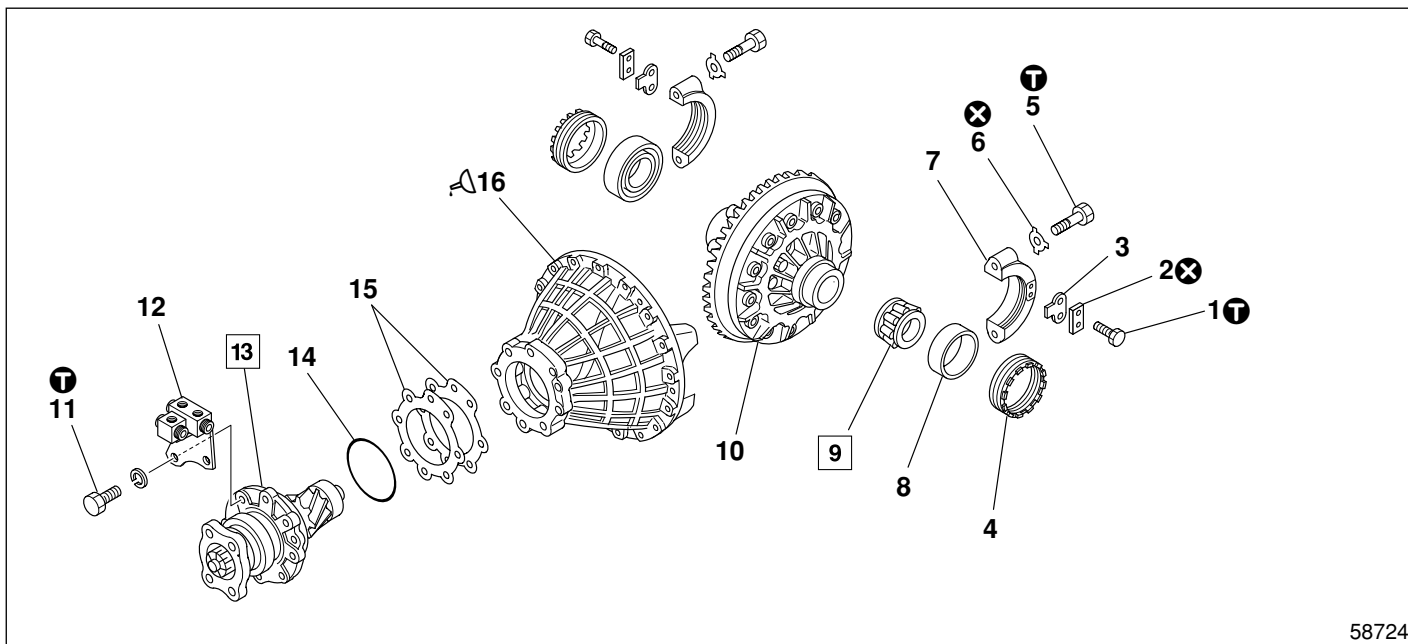
B : Pin-punch



[Installation]

REDUCTION AND DIFFERENTIAL <D10H>

Reduction and Differential Assembly



● Inspection before disassembly

📖 P27-66

● Work before disassembly

📖 P27-67

● Disassembly sequence

- | | | |
|-------------------|---------------------------|-----------------------------|
| 1 Bolt | 8 Side bearing outer race | 13 Pinion assembly 📖 P27-78 |
| 2 Lock seat | 9 Side bearing inner race | 14 O-ring |
| 3 Lock pawl | 10 Differential assembly | 15 Shim |
| 4 Adjusting screw | 📖 P27-74 | 16 Differential carrier |
| 5 Bolt | 11 Bolt | |
| 6 Lock plate | 12 T-connector | |
| 7 Bearing cap | | ⊗: Non-reusable parts |

CAUTION ⚠

- Keep side bearings 8 and 9, which have been removed, separately from each other and ensure that the correct one is placed at the right place at installation.
- Replace bearing cap 7, differential carrier 16, and bolt 5 as a differential carrier set.
- Replace the reduction gear of differential assembly 10 and reduction pinion of pinion assembly 13 as a reduction gear set.

NOTE

Record the number and thickness of shims 15 and use as reference at assembly.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection and adjustment after assembly

📖 P27-67

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
8, 9	Starting torque of side bearing	2.5 to 3.4 N·m {1.8 to 2.5 ft.lbs, 0.25 to 0.35 kgf·m}	—	- Adjust with adjusting screw. - Tangential force at $\phi 217$ {8.54} outer periphery point of differential case: 23 to 32 N {5.2 to 7.2 lbs, 2.3 to 3.2 kgf}
10	Wobble of reduction gear back face	0.15 {0.0059} or less	0.2 {0.0079}	- Adjust or replace as a gear set. - Measure at the 200 {7.87} radial point from reduction gear center.
10, 13	Backlash between reduction gear and reduction pinion	0.30 to 0.41 {0.012 to 0.016}	0.6 {0.024}	Adjust with shim and adjusting screw or replace as a gear set.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

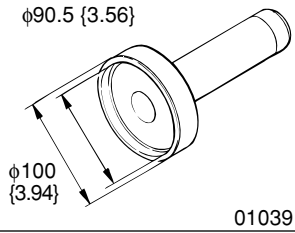
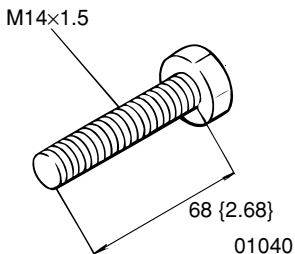
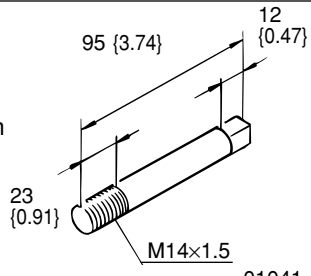
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (lock pawl mounting)	27 to 41 {20 to 30, 2.8 to 4.2}	—
5	Bolt (bearing cap mounting)	379 to 513 {280 to 380, 38.7 to 52.3}	—
11	Bolt (differential carrier and pinion assembly mounting)	94 to 141 {69 to 105, 9.6 to 14.4}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
16	Differential carrier surface to which pinion pilot bearing is mounted	LOCTITE 601	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
9	 Side bearing installer $\phi 90.5$ {3.56} $\phi 100$ {3.94} 01039	03724-53000	Installation of side bearing inner race
13	 Bearing retainer remover M14x1.5 68 {2.68} 01040	MH062172	Removal of pinion assembly : Two required
	 Bearing retainer guide pin 95 {3.74} 12 {0.47} 23 {0.91} M14x1.5 01041	MH061746	Installation of pinion assembly : Two required

REDUCTION AND DIFFERENTIAL <D10H>

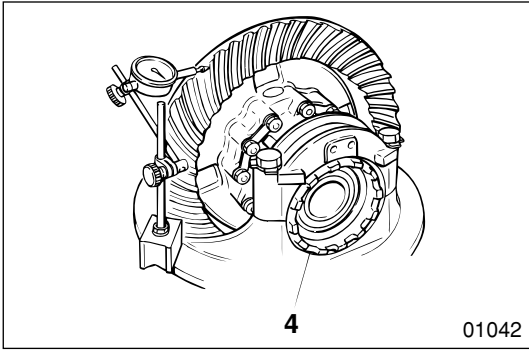
◆ Service procedure

● Inspection before disassembly

Carry out the following inspections to predict a faulty spot.

(1) Backlash between reduction gear and reduction pinion

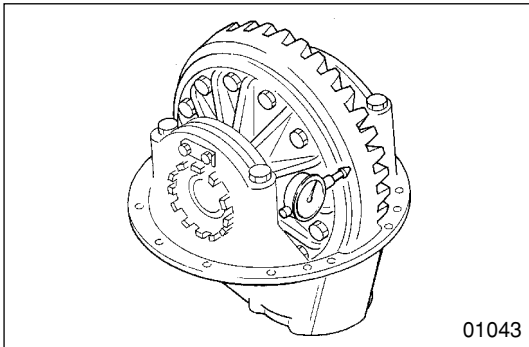
If the backlash is not in the specified range, tightening of adjusting screw **4** is probably inappropriate.



(2) Wobble of back face of reduction gear

Measure wobble at the following point from the center of the reduction gear.

Radius: R200 mm {7.87 in.}



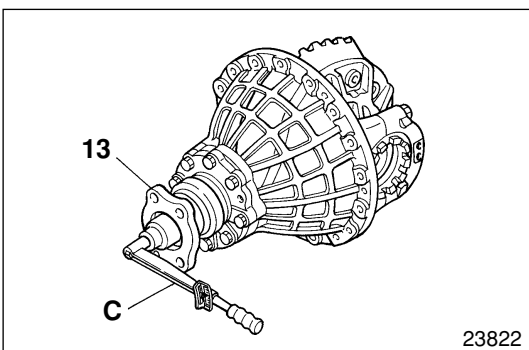
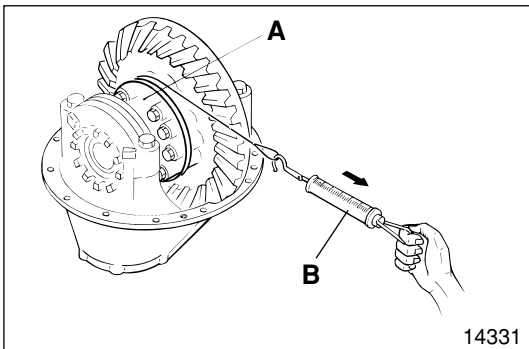
(3) Starting torque of side bearing

- Install spring balancer **B** to the outer periphery of differential case **A**.
- Measure the tangential force.
- If the measured tangential force falls within the specified range, the starting torque conforms to the standard value.

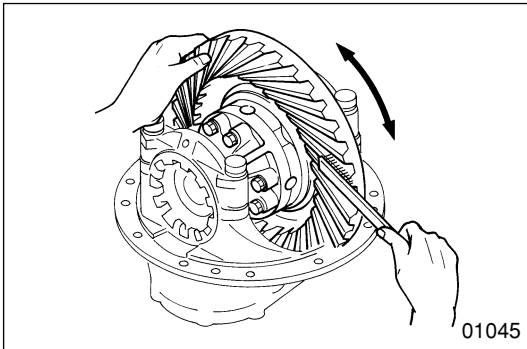
NOTE

Measure the starting torque within the range of backlash between the reduction gear and reduction pinion.

- Torque may be measured of pinion assembly **13** by using torque wrench **C**.

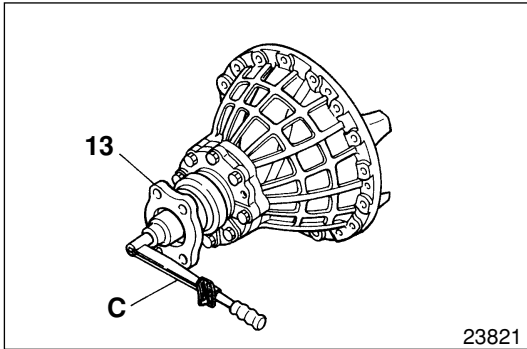


$$\left(\begin{array}{c} \text{pinion bearing} \\ \text{Total starting torque - starting torque} \\ \text{P27-79} \end{array} \right) \times \text{final ratio} = \text{Side bearing starting torque}$$



(4) Tooth contact of reduction gear

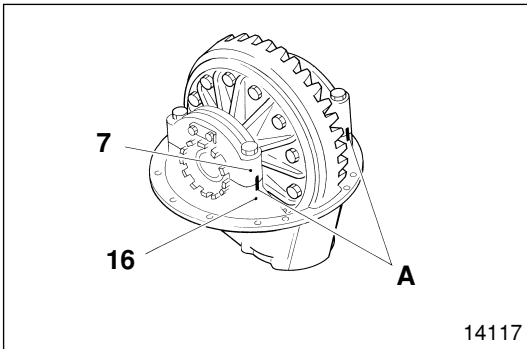
- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn reduction gear several turns to check for tooth contact.



(5) Starting torque of pinion bearing torque

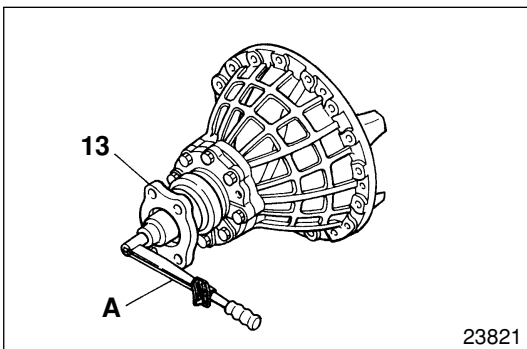
After putting alignment marks before disassembly, remove differential assembly 10 and, using torque wrench C, measure the starting torque of pinion bearing at pinion assembly 13.

📖 P27-79



● Work before disassembly

Put alignment marks A on bearing cap 7 and differential carrier 16 for correct identification of right and left parts.



● Inspection and adjustment after assembly

(1) Starting torque of pinion bearing

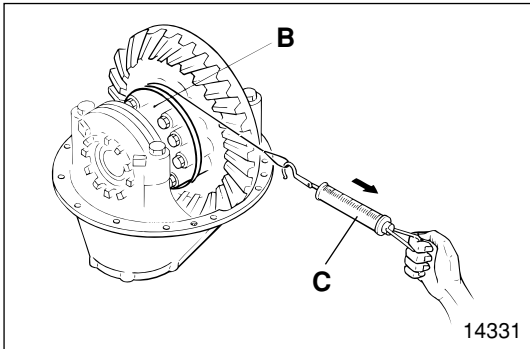
- Using torque wrench A, measure the starting torque of pinion bearing at pinion assembly 13.

📖 P27-79

- If the measured value deviates from the standard value, adjust.

📖 P27-81

REDUCTION AND DIFFERENTIAL <D10H>



(2) Starting torque of side bearing

[Inspection]

- Install spring balancer **C** to the outer periphery of differential case **B**.
- Measure the tangential force.
- If the measured tangential force falls within the specified range, the starting torque conforms to the standard value.
- If the measured value deviates from the standard value, adjust.

NOTE

Measure the starting torque within the range of backlash between the reduction gear and reduction pinion.

- Torque may be measured of pinion assembly **13** by using torque wrench **A**.

$$\left(\begin{array}{c} \text{pinion bearing} \\ \text{Total starting torque - starting torque} \\ \text{P27-79} \end{array} \right) \times \text{final ratio} = \text{Side bearing starting torque}$$

NOTE

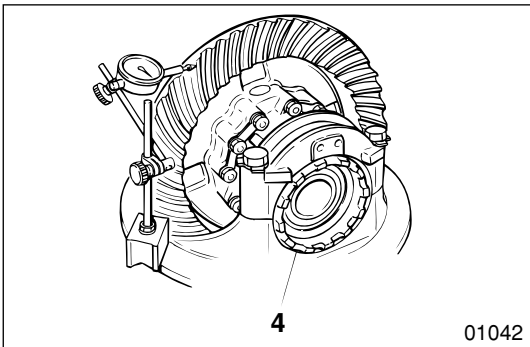
Measure the starting torque within the range of backlash between the reduction gear and reduction pinion.

[Adjustment]

Adjust with adjusting screw **4** to the right and left.

NOTE

- Tighten left and right to adjusting screw **4** with the same amount.
- Adjust the starting torque within the standard value range of backlash between the reduction gear and reduction pinion.

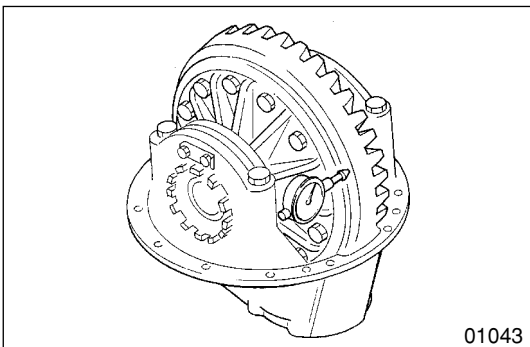


(3) Adjustment of backlash between reduction gear and reduction pinion

Adjust backlash with the left and right adjusting screw **4**, using care not to allow the side bearing starting torque to change.

NOTE

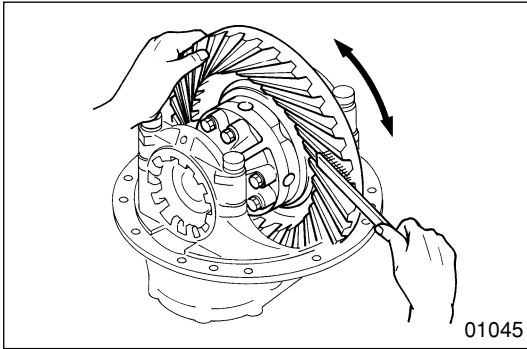
When one adjusting screw 4 is loosened, be sure to tighten the other one the same amount to prevent the side bearing starting torque from changing.



(4) Inspection of wobble of back face of reduction gear

Measure wobble at the following point from the center of the reduction gear.

Radius: R200 mm {7.87 in.}



(5) Tooth contact of reduction gear

[Inspection]

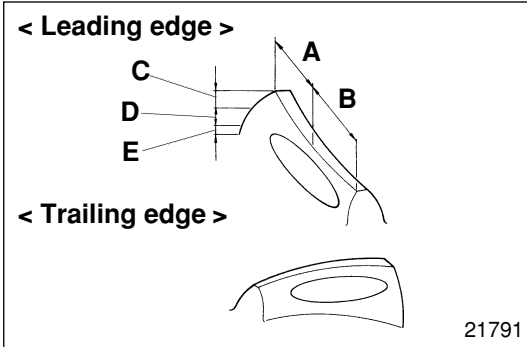
- Apply red lead to three to four teeth at three equally spaced points of the reduction gear.
- Turn the reduction gear several turns to check for tooth contact.
- If the tooth contact is remarkably offset, adjust.

[Adjustment]

Adjust by increasing or decreasing the thickness of shim **15** or the backlash between reduction gear and reduction pinion.

CAUTION

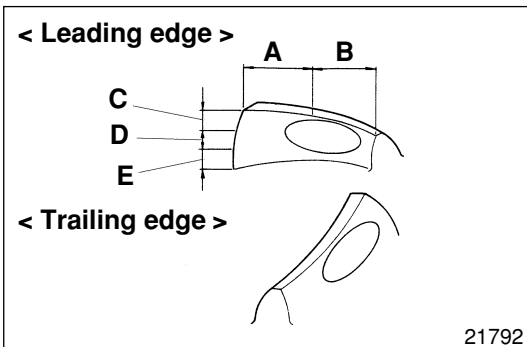
If a gear is to be replaced for abnormal wear in teeth, be sure to replace both reduction gear and reduction pinion as a reduction gear set.



● Normal tooth contact at no load

< Reduction gear >

- A : Heel
- B : Toe
- C : Face
- D : Flank
- E : Clearance



< Reduction pinion >

- A : Heel
- B : Toe
- C : Face
- D : Flank
- E : Clearance

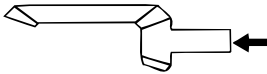
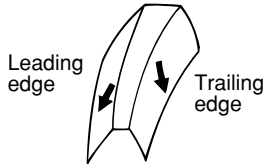
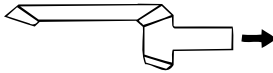
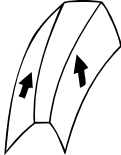
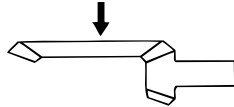
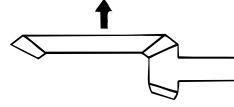
REDUCTION AND DIFFERENTIAL <D10H>

Maintenance item			Assembly standards
At no load	Tooth contact position	Lengthwise direction of tooth	Leading edge: From center towards toe Trailing edge: From center towards heel
		Vertical direction	From center towards top of tooth for final drive gear and center for final drive pinion
	Tooth contact shape	Length	Approximately 50 to 70% of tooth width
		Width	Approximately 50 to 70% of tooth depth
	Degree of tooth contact		It becomes weaker as it nears tooth root or tooth tip

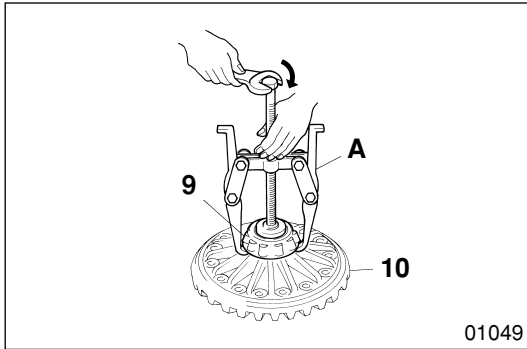
NOTE

When tooth contact is near the toe at no load it becomes middle area contact at load.

Adjustment of tooth contact

	Method of adjustment	Moving direction
Adjustment by adding or reducing shims	Advance final drive pinion to final drive gear (Shims are reduced) 	Tooth contact moves toward tooth root 
	Retard final drive pinion from final drive gear (Shims are added) 	Tooth contact moves towards tooth top 
Adjustment by controlling adjusting screw	Advance final drive gear to final drive pinion center (Less backlash) 	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to toe and slightly nearer to root of tooth Trailing edge: Nearer to heel and slightly nearer to top of tooth 
	Retard final drive gear from final drive pinion center (More backlash) 	Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to heel and slightly nearer to top of tooth Trailing edge: Nearer to toe and slightly nearer to root of tooth 

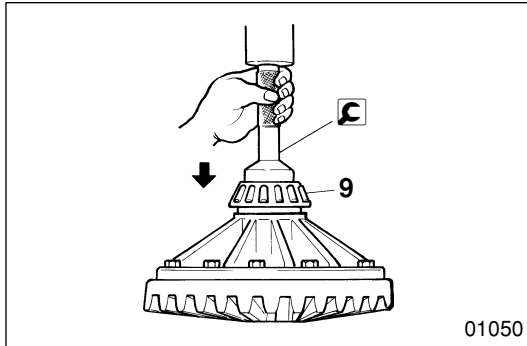
01048



9 Side bearing inner race

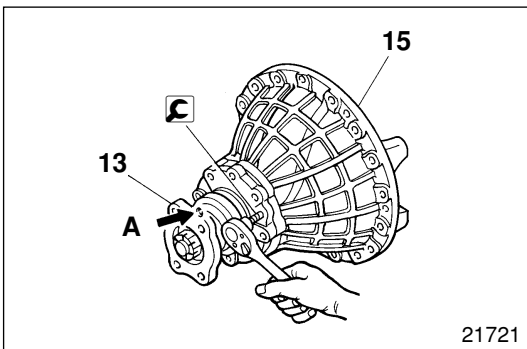
[Removal]

A : Gear puller



[Installation]

C : Side bearing installer

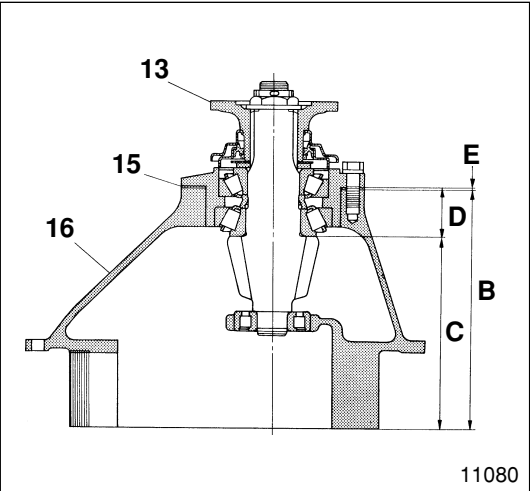


13 Pinion assembly

[Removal]

- Screw bearing retainer remover evenly into pinion assembly **13** removal threaded holes **A**.
- Remove pinion assembly **13** from differential carrier **16**.

REDUCTION AND DIFFERENTIAL <D10H>



[Adjustment]

- Perform the following steps to adjust **B**, **C** and **D** within the specified dimensions.
- Calculate shim thickness **E** by using the following formula based on the machining error data stamped on pinion assembly and differential carrier.

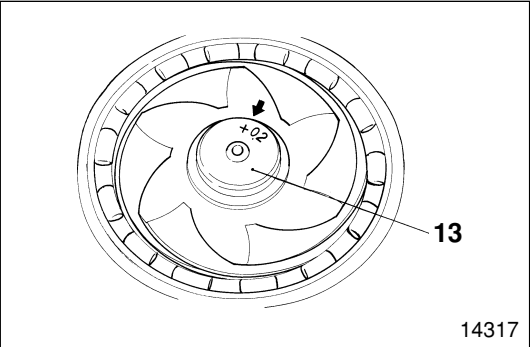
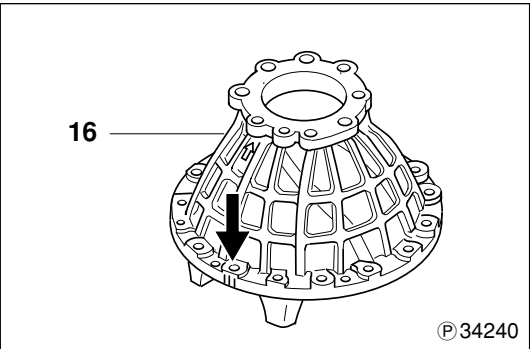
- Formula:

$$E = 0.5 \text{ mm} - b + c + d$$

b=Deviation from standard dimension **B**

c=Deviation from standard dimension **C**

d=Deviation from standard dimension **D**

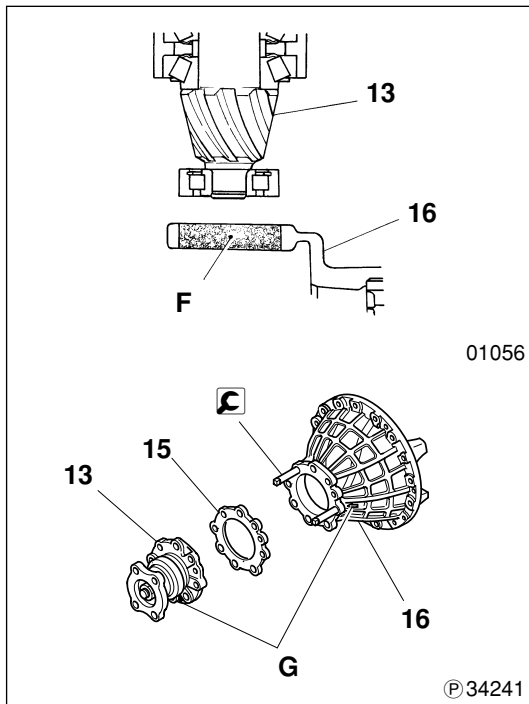


Unit : mm {in.}

Location	Standard dimension	How to calculate deviation
Shim thickness	0.5 {0.02}	—
B	282 {11.1}	A numeral, multiplied by 100, is stamped on the outer periphery of the flange of differential carrier 16 .
C	224 {8.82}	A numeral is stamped on the top of pinion assembly 13 .
D	58.5 {2.30}	Measure deviation from D using a dial gauge. Taking measurement is usually not feasible and assume a value from 0 to 0.2 mm {0.008}.

* : Position at which a numeral is stamped.

- Select shim **15** based on shim thickness **E**.
Thickness of shims **15** available: 0.1, 0.2 mm {0.008}



[Installation]

- Apply sealant to surface **F** of differential carrier **16** to which the pilot bearing is mounted.
- Aligning embossed alignment mark **G** on the bearing retainer of pinion assembly **13** with that on differential carrier **16**, mount the pinion assembly.

Bearing retainer	Differential carrier
↑ mark	↓ mark

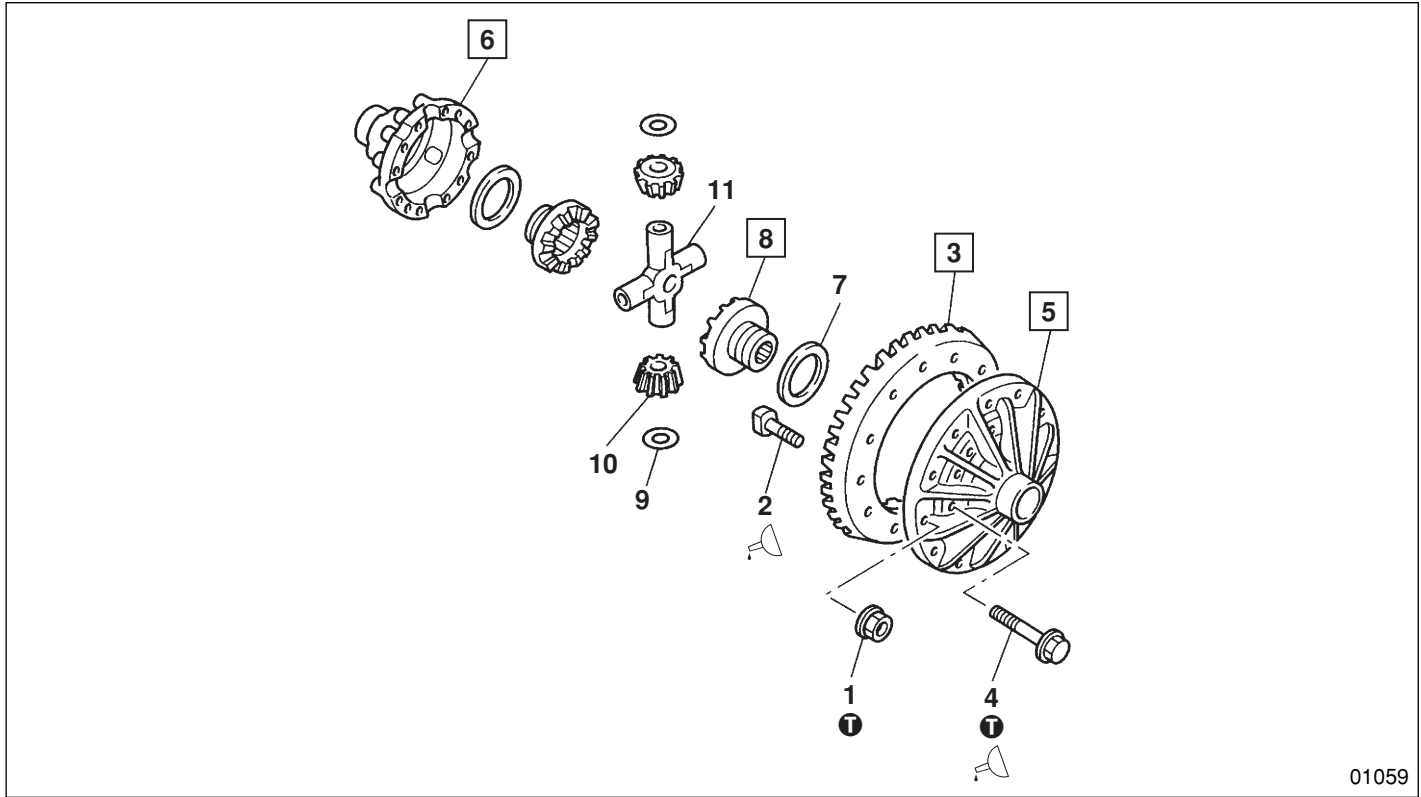
☞ : Bearing retainer guide pin

CAUTION ⚠

- Leave for 30 minutes to 2 hours after installation to let the sealant harden.
- Wait at least three hours or, if feasible 24 hours, before running the vehicle to let the sealant harden.

REDUCTION AND DIFFERENTIAL <D10H>

Differential Assembly



● Disassembly sequence

- | | | |
|------------------|----------------------------|------------------------------|
| 1 Nut | 5 Differential case LH | 9 Differential pinion washer |
| 2 Bolt | 6 Differential case RH | 10 Differential pinion |
| 3 Reduction gear | 7 Differential gear washer | 11 Pinion spider |
| 4 Bolt | 8 Differential gear | |

CAUTION

Replace differential case LH 5 and differential case RH 6 as a differential case set.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Adjustment after assembly

 P27-75

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
8	Backlash between differential gear and axle shaft splines	0.07 to 0.22 {0.0028 to 0.0087}	0.5 {0.020}	Replace
8, 10	Backlash between differential gear and differential pinion	0.20 to 0.28 {0.0079 to 0.011}	0.8 {0.031}	Replace
10, 11	Clearance between differential pinion and pinion spider	[35] 0.17 to 0.28 { [1.38] 0.0067 to 0.011}	0.5 {0.020}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

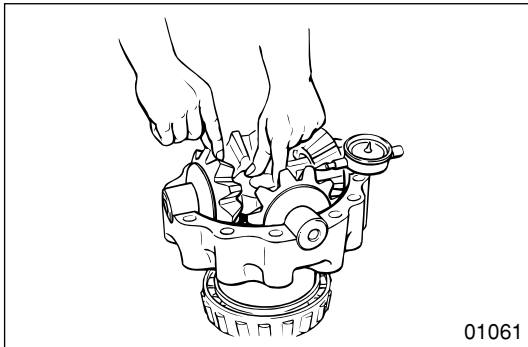
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (reduction gear and differential case LH mounting)	559 to 617 {410 to 455, 57 to 63}	—
4	Bolt (differential case LH and differential case RH mounting)	225 to 265 {165 to 195, 23 to 27}	—

Lubricant and/or sealant

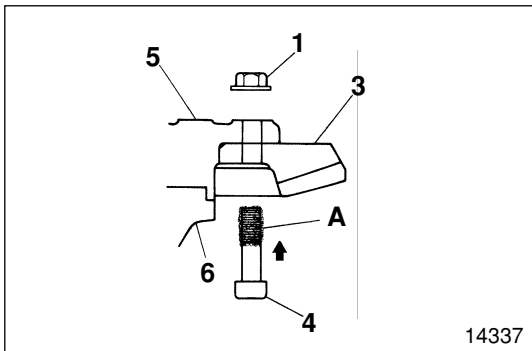
Location	Points of application	Specified lubricant and/or sealant	Quantity
2, 4	Entire bolt surface	Rust preventive	As required
	Bolt threads	LOCTITE 271	As required

Service procedure**Adjustment after assembly**

Backlash between differential pinion and differential gear
If the measured value deviates from the standard value, replace differential gear washer **7**.



REDUCTION AND DIFFERENTIAL <D10H>

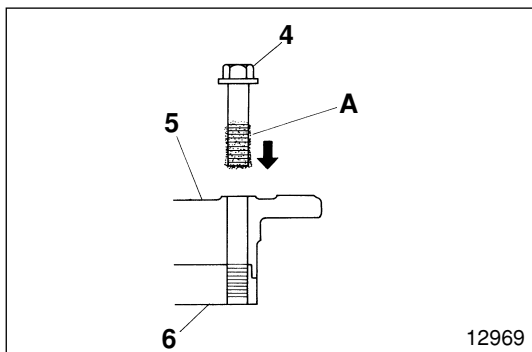


3 5 Installation of differential case LH and reduction gear

- Apply rust preventive to the entire surface of bolt 2.
- Apply sealant to threads A of bolt 2.
- Tighten nut 1 to specified torque.

CAUTION ⚠

- Make sure to apply rust preventive when tightening nut 1 to specified torque.
- Wait at least one hour after installation before actually running the vehicle to ensure that the sealant has hardened sufficiently.
- Wait at least four hours after installation before operating the vehicle at full torque to ensure that the sealant has hardened sufficiently.

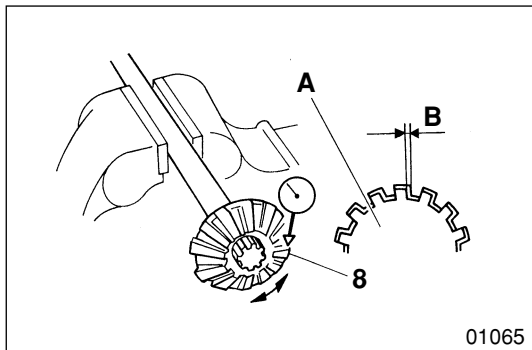


5 6 Installation of differential case LH and differential case RH

- Apply rust preventive to the entire surface of bolt 4.
- Apply sealant to threads A of bolt 4.
- Tighten bolt 4 to specified torque.

CAUTION ⚠

- Make sure to apply rust preventive when tightening nut 1 to specified torque.
- Wait at least one hour after installation before actually running the vehicle to ensure that the sealant has hardened sufficiently.
- Wait at least four hours after installation before operating the vehicle at full torque to ensure that the sealant has hardened sufficiently.



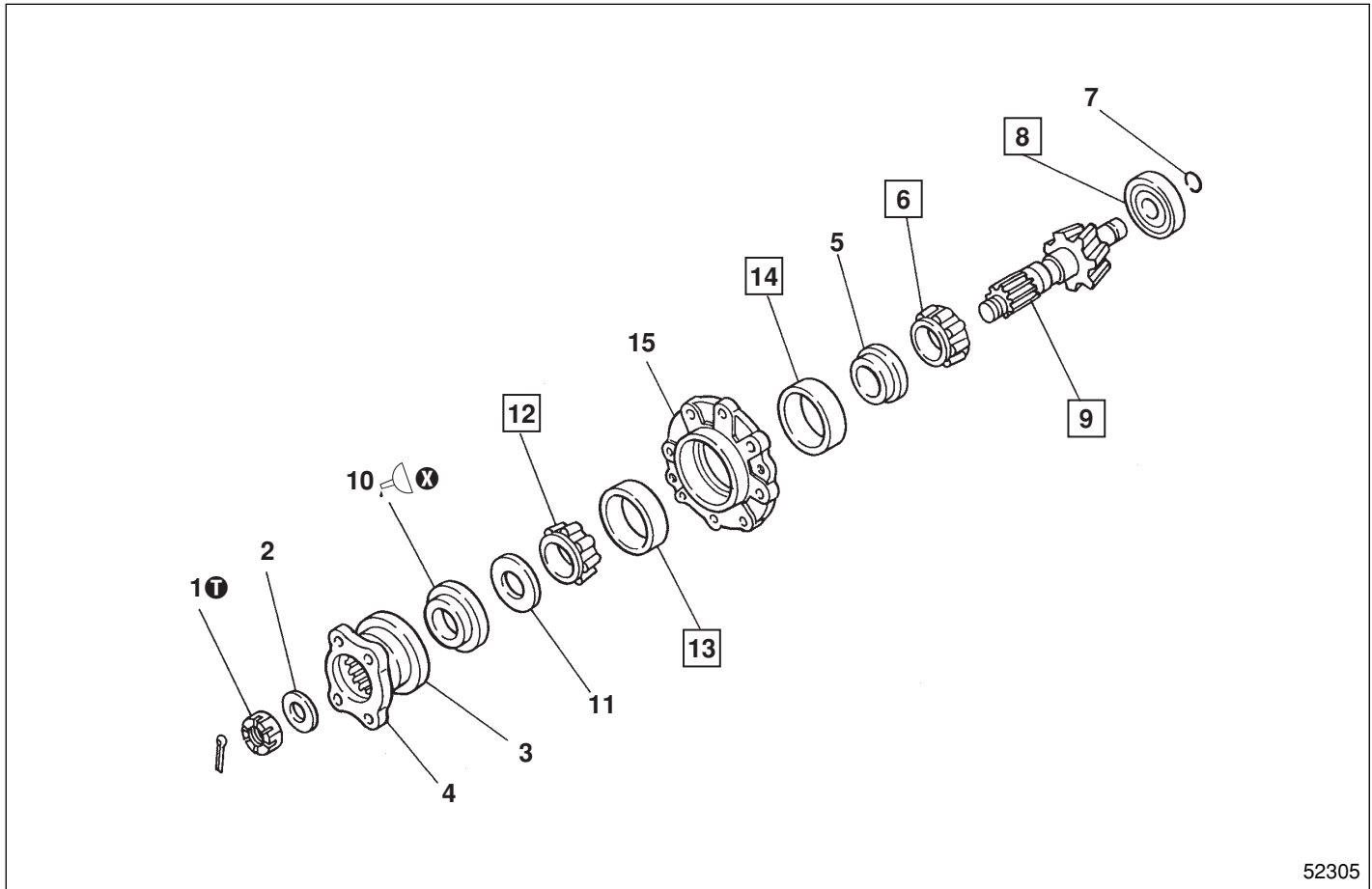
8 Inspection of backlash between differential gear and axle shaft

If the measured value of backlash B between differential gear 8 and axle shaft A exceeds the limit, replace the faulty parts.

MEMO

REDUCTION AND DIFFERENTIAL <D10H>

Pinion Assembly



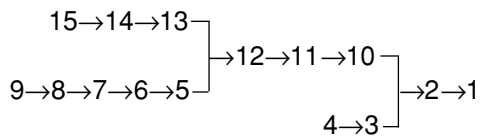
● Disassembly sequence

- | | |
|----------------------------|-----------------------------|
| 1 Lock nut | 10 Oil seal |
| 2 Washer | 11 Collar |
| 3 Dust cover | 12 Outer bearing inner race |
| 4 Companion flange | 13 Outer bearing outer race |
| 5 Pinion bearing collar | 14 Inner bearing outer race |
| 6 Inner bearing inner race | 15 Bearing retainer |
| 7 Lock ring | |
| 8 Pinion pilot bearing | ⊗ : Non-reusable parts |
| 9 Reduction pinion | |

NOTE

Record the thickness of pinion bearing collar 5 at disassembly for reference during assembly.

● Assembly sequence



● Inspection and adjustment after assembly

📖 P27-81

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
6, 12 13, 14	Starting torque of pinion bearing	When new bearing is used	2.5 to 3.4 N·m {1.8 to 2.5 ft.lbs, 0.25 to 0.35 kgf·m}	—	• Adjust with pinion bearing collar. • Tangential force at $\phi 180$ {7.09} outer periphery point of bearing retainer: 27 to 38 N {6.1 to 8.5 lbs, 2.8 to 3.9 kgf}
		When old bearing is reused	2.0 to 2.7 N·m {1.4 to 2.0 ft.lbs, 0.20 to 0.28 kgf·m}	—	• Adjust with pinion bearing collar. • Tangential force at $\phi 180$ {7.09} outer periphery point of bearing retainer: 22 to 30 N {4.9 to 6.7 lbs, 2.2 to 3.1 kgf}

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut (companion flange and reduction pinion mounting)	542 to 733 {400 to 540, 55.3 to 74.8}	—

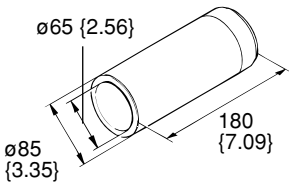
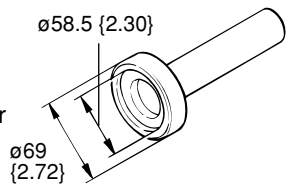
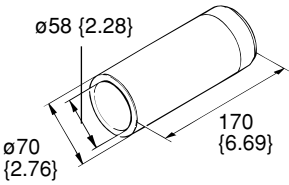
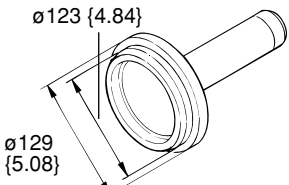
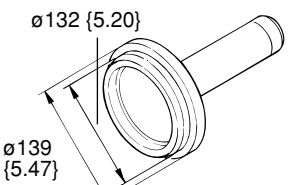
Lubricant and/or sealant

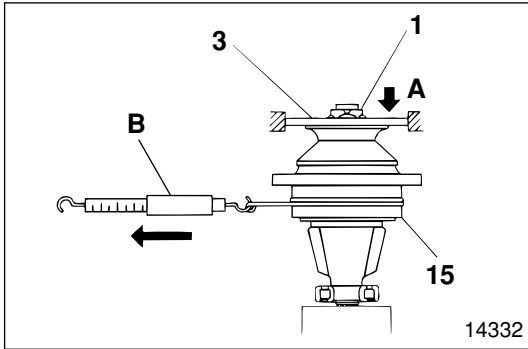
Location	Points of application	Specified lubricant and/or sealant	Quantity
10	Lip of oil seal	Chassis grease [NLGI No. 1 (Li soap)]	As required

REDUCTION AND DIFFERENTIAL <D10H>

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
6	Pinion inner bearing installer  01077	03724-51000	Installation of inner bearing inner race
8	Pinion pilot bearing installer  01081	03724-50001	Installation of pinion pilot bearing
12	Pinion outer bearing installer  01077	MH061004	Installation of outer bearing inner race
13	Pinion outer bearing installer  01078	03724-55000	Installation of outer bearing outer race
14	Pinion inner bearing installer  01078	03724-56000	Installation of inner bearing outer race



◆ Service procedure

● Inspection and adjustment after assembly

Starting torque of pinion bearing

[Inspection]

- Apply load **A** of approximately 49 kN (11 klbf, 5000 kgf) to companion flange **4** or tighten lock nut **1** to specification.
- Install spring balancer **B** to the outer periphery point of bearing retainer **15** and measure the tangential force.

Outer periphery
φ180 mm {7.09 in.}

- If the measured tangential force falls within the specified range, the starting torque conforms to the standard value.
- If the measured value deviates from the standard value, adjust.

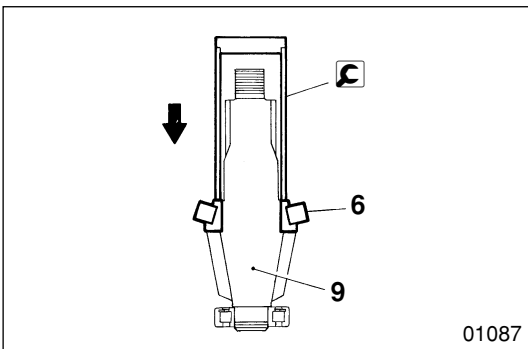
NOTE

- **Secure companion flange 4 in position before measurement.**
- **Measure the starting torque with oil seal 10 removed.**

[Adjustment]

Referring to the table below, select pinion bearing collar **5** of the appropriate thickness to obtain the specified tangential force.

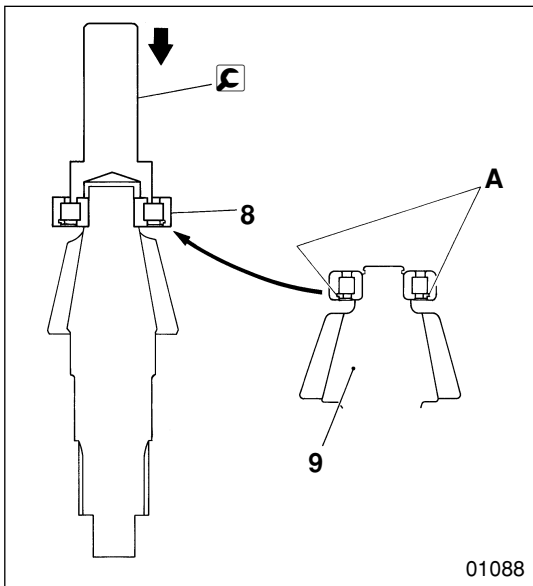
Collar thickness
17.975 to 18.575 mm {0.71 to 0.73 in.} (25 kinds with 0.025 mm {0.00098 in.} increment)



6 Installation of inner bearing inner race

: Pinion inner bearing installer

REDUCTION AND DIFFERENTIAL <D10H>

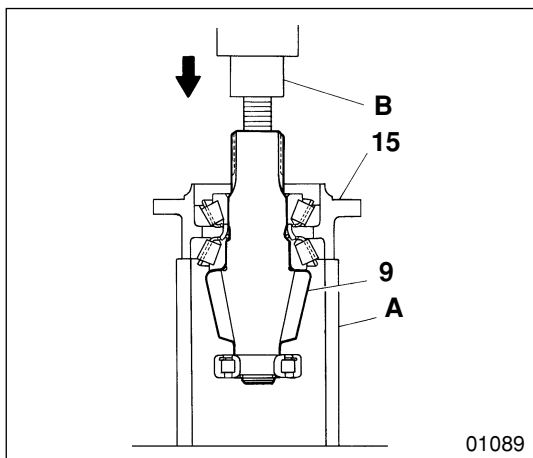


8 Installation of pinion pilot bearing

Fit pinion pilot bearing **8** in the direction shown.

C : Pinion pilot bearing installer

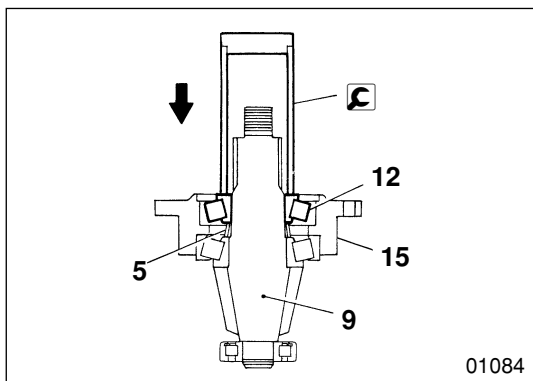
A : Snap ring



9 Removal of reduction pinion

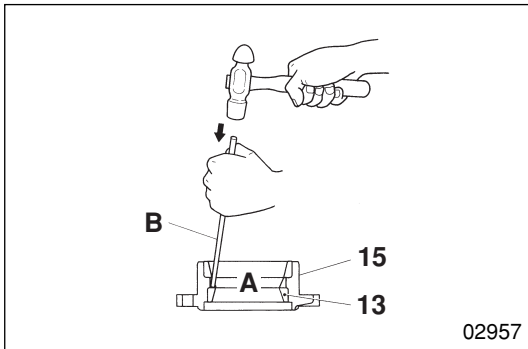
A : Cylinder guide (appropriate diameter)

B : Press



12 Press-fitting of outer bearing inner race

C : Pinion pilot bearing installer

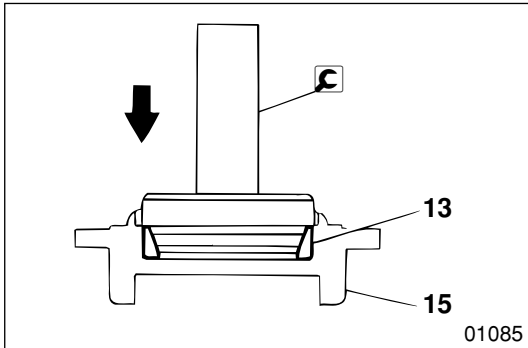


13 Outer bearing outer race

[Removal]

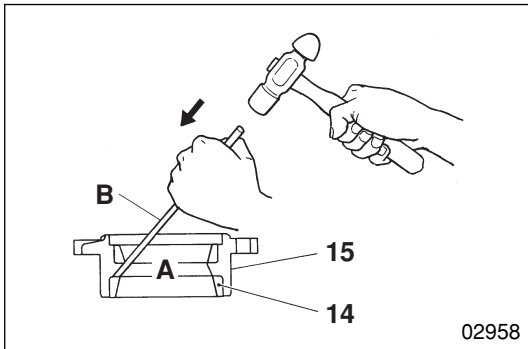
Drive out outer bearing outer race **13** by tapping evenly through three indented parts **A** in bearing retainer **15**.

B : Stick



[Installation]

C : Pinion pilot bearing installer

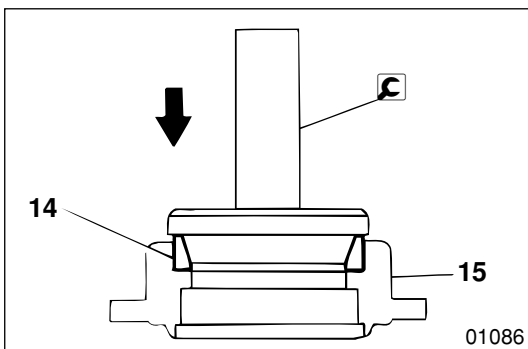


14 Inner bearing outer race

[Removal]

Drive out inner bearing outer race **14** by tapping evenly through three indented parts **A** in bearing retainer **15**.

B : Stick



[Installation]

C : Pinion bearing installer



Group 31

Wheel and Tire

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	31- 2
TROUBLESHOOTING	31- 2
WHEEL AND TIRE	31- 3

SPECIFICATIONS/TROUBLESHOOTING

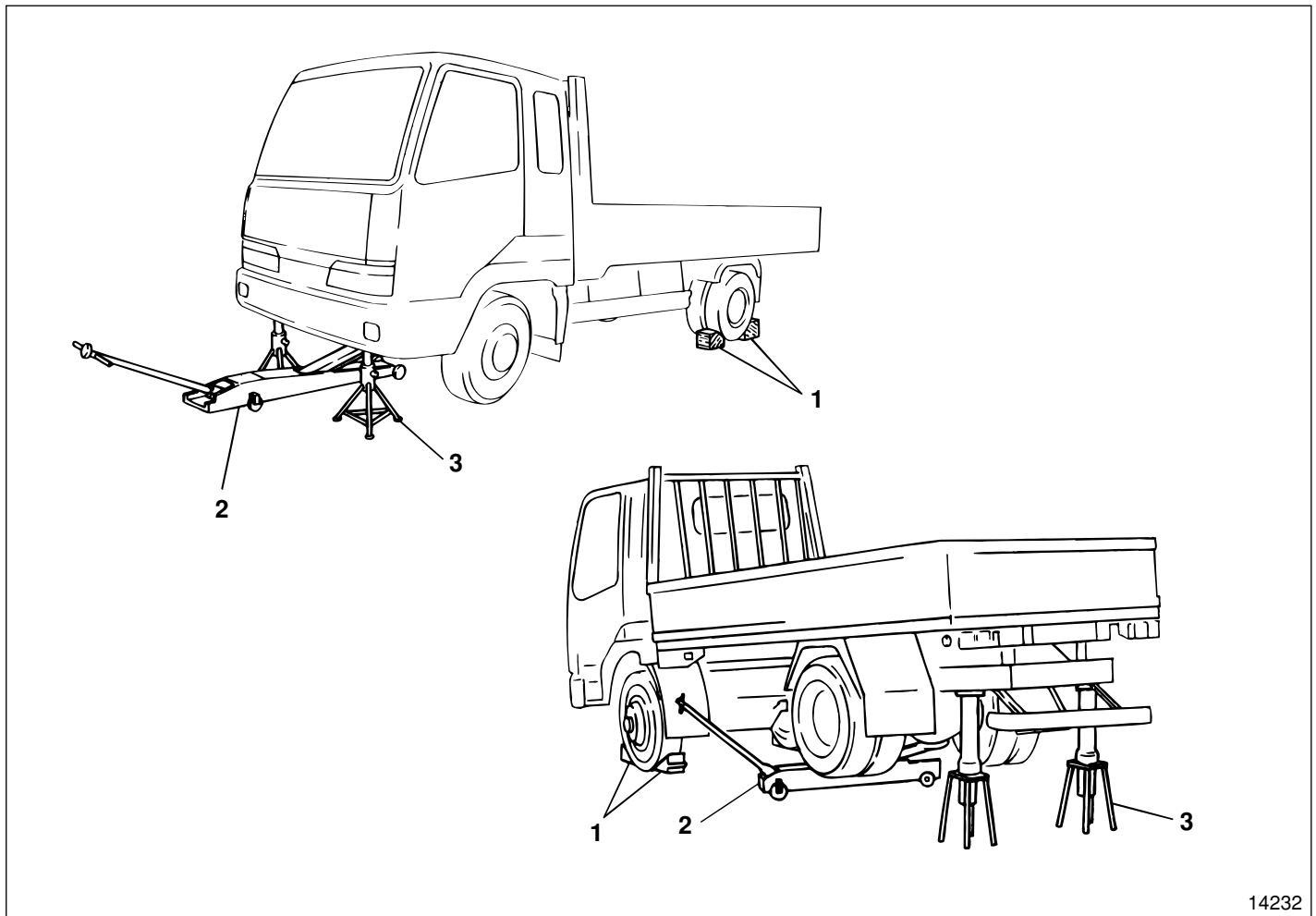
SPECIFICATIONS

Vehicle model \ Item	Tire size	Air pressure kPa {psi, kgf/cm ² }		Application wheel
		Front	Rear	
FK	225/70R19.5	660 {95, 6.71}	660 {95, 6.60}	19.5×6.75-136-12
FM	11R22.5-14PR	720 {105, 7.3}	720 {105, 7.20}	22.5×7.50-162-13

TROUBLESHOOTING

Symptoms			Tire tread worn										Remarks
			Both shoulders worn	Center worn	Outside worn	Inside worn	Feather-edged wear from outside to inside	Feather-edged wear from inside to outside	Wavy wear	Dished wear (one or more spots)	Pitted wear (dented) all around	Jagged wear	
Possible causes													
Overloading			☐										
Tire air pressure		Insufficient	☐						☐	☐	☐	☐	
		Excessive		☐									
Wheel alignment  Gr 26	Toe-in	Excessive			☐		☐						
		Insufficient				☐							
	Camber	Excessive			☐								
		Insufficient				☐							
	Toe-out excessive					☐		☐					
	Overall misalignment		☐		☐	☐	☐	☐	☐	☐			
	Knuckle arm bent					☐	☐	☐	☐				 Gr 26
Left and right tie rod lengths different							☐					 Gr 26	
Wheel balance incorrect									☐	☐	☐	☐	
Wheel bearing loose									☐	☐	☐	☐	 Gr 26, 27
Ball joint loose										☐			 Gr 26
Tie rod end loose										☐			 Gr 37
Brake drum eccentric										☐	☐		 Gr 35A, B
Axle bent									☐	☐			 Gr 26, 27
Sudden starting, sudden braking or sharp turn										☐	☐		
Left and right front wheel turning radius incorrect												☐	 Gr 26
Road surface influence					☐	☐							

Work for Removal and Installation of Wheel and Tire



14232

● Work sequence

- 1 Place wheel chocks.
- 2 Jack up the front or rear axle using a garage jack placed under the center of the axle.
- 3 Support the frame on rigid racks.

WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

● Work sequence after removal and installation

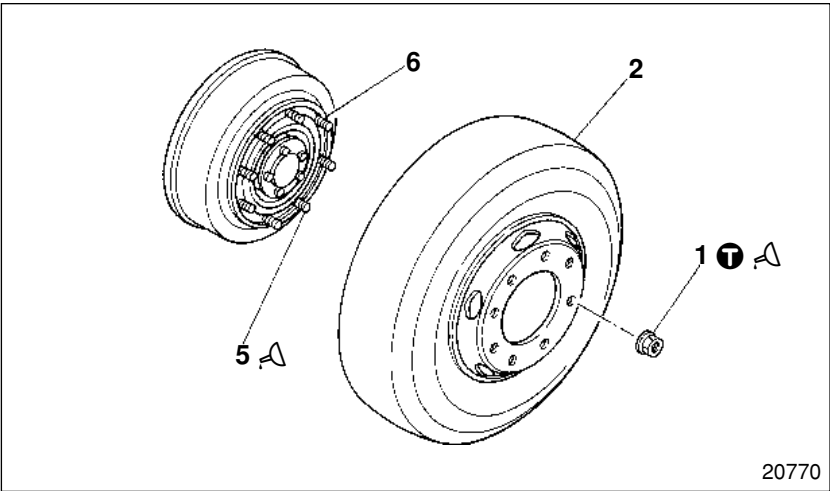
Follow the work sequence in reverse.

WHEEL AND TIRE

NOTE

Use right-hand threaded wheel nuts marked “R” for right side wheel and left-hand threaded wheel nuts marked “L” for left side wheel.

< Single tire >



● Removal sequence

- 1 Wheel nut
- 2 Tire assembly P31-6
- 5 Hub bolt
- 6 Hub

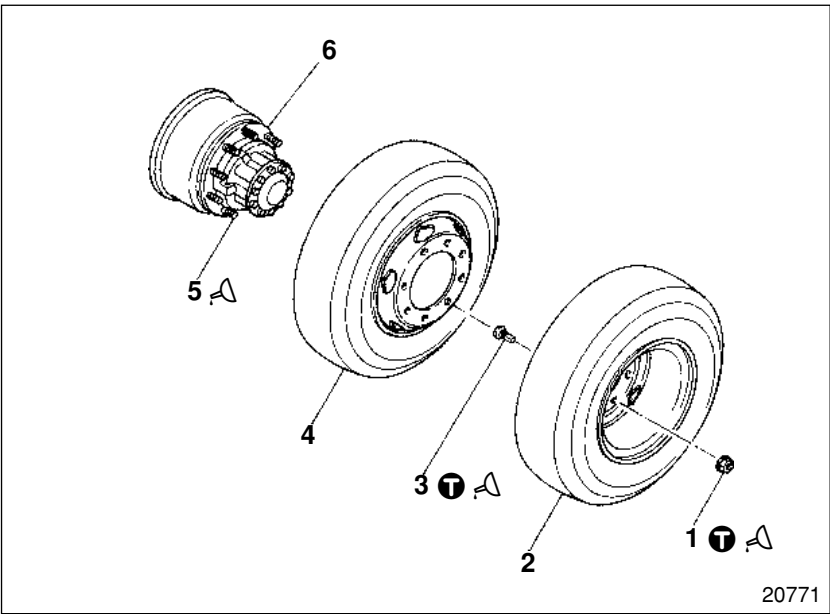
● Cleaning and applying grease before installation

P31-5

● Installation sequence

Follow the removal sequence in reverse.

< Double tire >



● Removal sequence

- 1 Wheel nut (outer)
- 2 Tire assembly P31-6
- 3 Wheel nut (inner)
- 4 Tire assembly P31-6
- 5 Hub bolt
- 6 Hub

● Cleaning and applying grease before installation

P31-5

● Installation sequence

Follow the removal sequence in reverse.

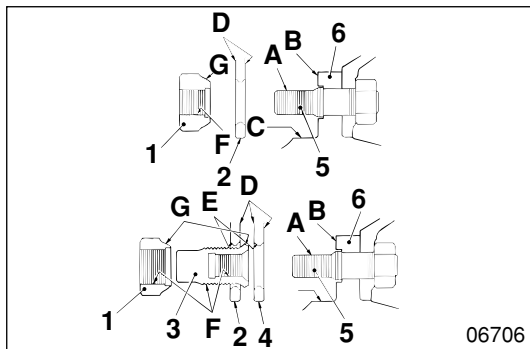
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

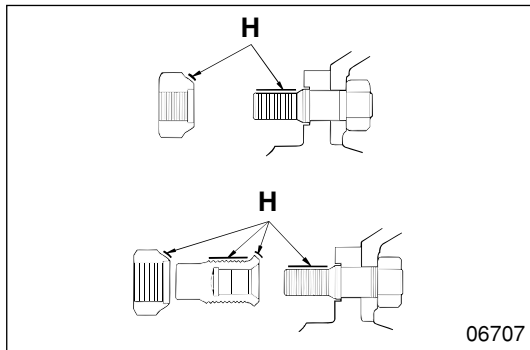
Location	Parts to be tightened		Tightening torque	Remarks
1, 3	Wheel nut	6-stud	370 to 410 {275 to 305, 38 to 42}	Wet
		8-stud	400 to 440 {295 to 325, 41 to 45}	Wet

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Wheel nut spherical area	Chassis grease [NLGI No. 1 (Li soap)] or Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
3	Thread and spherical areas of wheel nut (inner)	Chassis grease [NLGI No. 1 (Li soap)] or Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
5	Thread area of hub bolt	Chassis grease [NLGI No. 1 (Li soap)] or Wheel bearing grease [NLGI No. 2 (Li soap)]	As required



06706



06707

◆ Service procedure

● Cleaning and applying grease before installation

[Cleaning]

To prevent wheel nuts **1** and **3** and hub bolt **5** from becoming loose and to prevent mounting parts (tire assemblies **2** and **4** and hub **6**) from being damaged, remove rust, dust, additional coatings of paint, and foreign particles from the following areas:

- A** : Hub bolt thread area
- B** : Wheel mounting surface of hub
- C** : Wheel alignment area of hub
- D** : Disc wheel mating surface
- E** : Disc wheel nut mounting surface
- F** : Wheel nut thread area
- G** : Wheel nut spherical area

[Applying grease]

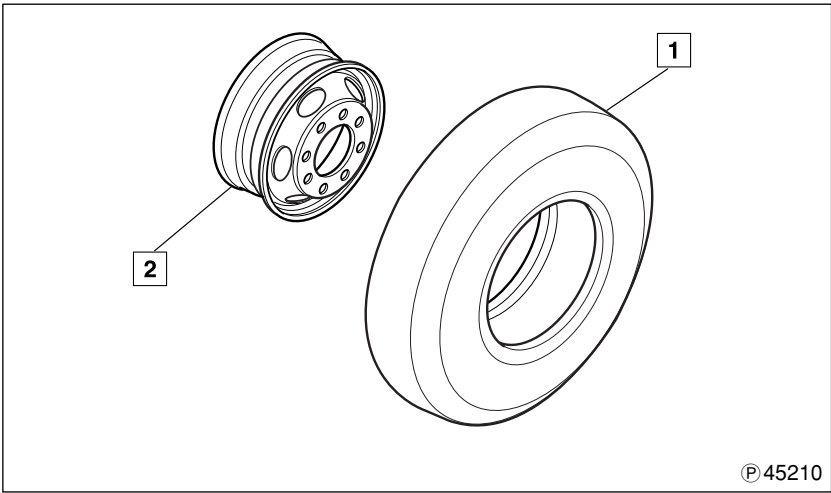
- H** : Grease application location

WARNING

Never use grease containing molybdenum disulfide, since it can cause loosening of fitted screws.

WHEEL AND TIRE

Tire Assembly



● Disassembly sequence

- 1 Tire
- 2 Disc wheel

● Assembly sequence

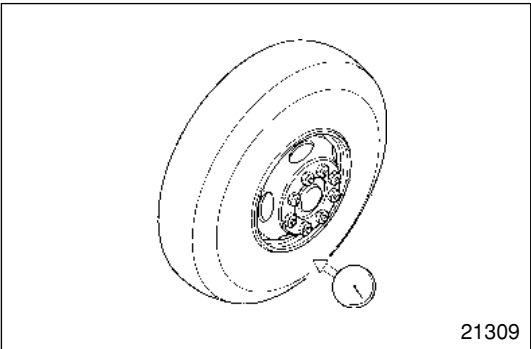
Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Tire assembly static unbalance tolerance		35 g	—	Replace
1	Horizontal deflection of tire (When assembled)		2.0 {0.079} or less	—	—
2	Disc wheel < 19.5×6.75-136-12 >	Flatness	0.2 {0.0079} or less	—	—
		Horizontal deflection	2.0 {0.079} or less	—	—
		Vertical deflection	1.8 {0.071} or less	—	—
	Disc wheel < 22.5×7.50-162-13 >	Flatness	0.2 {0.0079} or less	—	—
		Horizontal deflection	2.0 {0.079} or less	—	—
		Vertical deflection	1.8 {0.071} or less	—	—

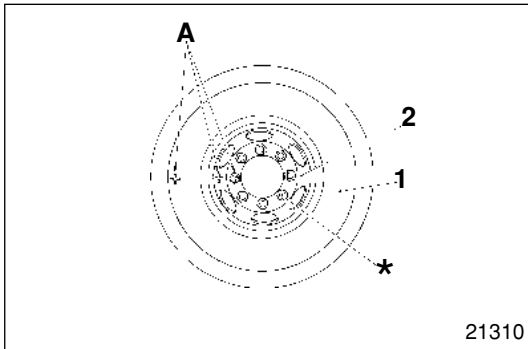
◆ Service procedure



1 Deflection of tire

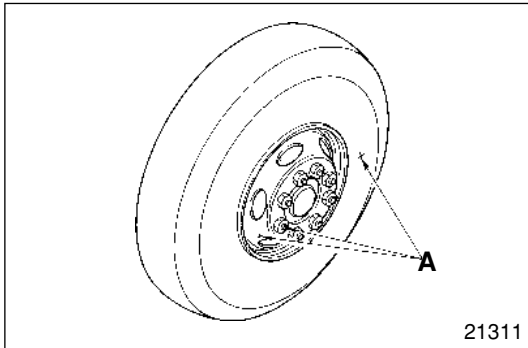
[Inspection]

If the measured value is higher than the standard value, make corrections as follows.

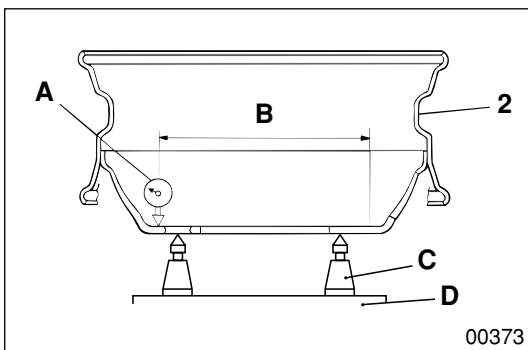


[Correction]

- Put chalk marks on tire **1**, disc wheel **2**, and hub bolt ***** (positions **A** as illustrated).
- Remove tire **1** from disc wheel **2**.



- Measure deflection of disc wheel **2**. If the most deflective position is near the chalk mark, reinstall tire **1** rotating it half a turn from the chalk mark and tighten nuts.
- Remeasure deflection of tire **1**.
- If the measured value is still higher than the limit, replace tire **1** and disc wheel **2** together as an assembly.



2 Inspection of disc wheel

(1) Flatness

- Measure flatness at specified position **B** from the center of disc wheel **2**.

Measure flatness at ten equidistant points on the wheel.

A : Dial gauge

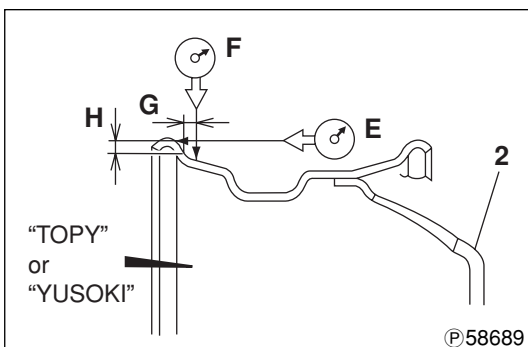
B : $\varnothing 235$ to 340 mm {9.25 to 13.4 in.} <22.5x7.50-162-13>

$\varnothing 175$ to 275 mm {6.89 to 10.8 in.} <19.5x6.79-136-12>

C : Portable screw jacks (x 4)

D : Surface plate

- Replace disc wheel **2** if the measured value is higher than the limit.



(2) Deflection

Replace disc wheel **2** if the measured value is higher than the limit.

E : Horizontal deflection measuring point

F : Vertical deflection measuring point

G : 8 mm {0.31 in.} <TOPY>

7 mm {0.28 in.} <YUSOKI>

H : 8 mm {0.31 in.} <TOPY>

7 mm {0.28 in.} <YUSOKI>



Group 33

Front Suspension

Table of Contents

BACK

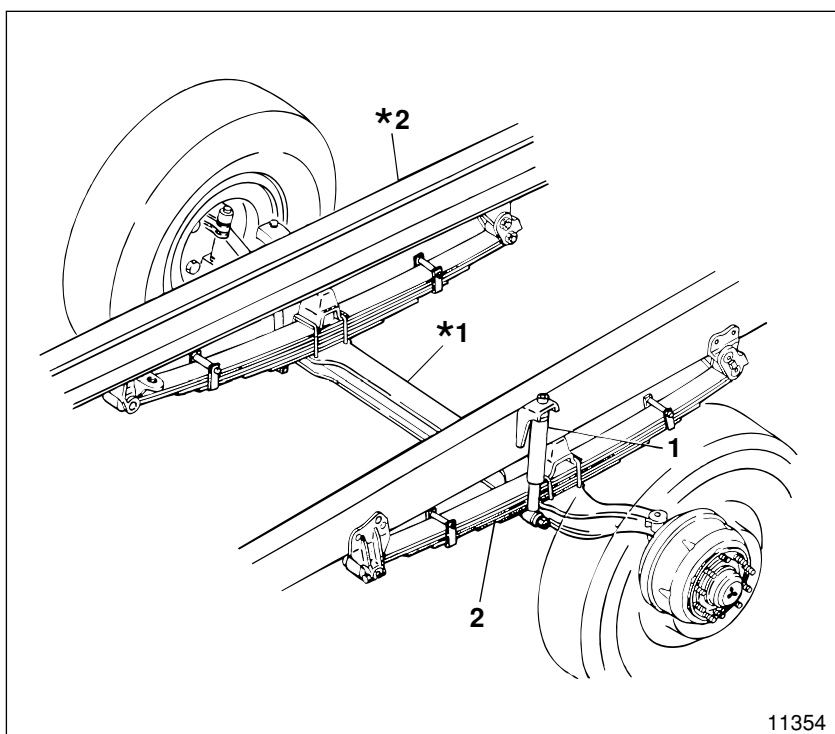
HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

STRUCTURE AND OPERATION	33- 2
TROUBLESHOOTING	33- 3
WORK BEFORE REMOVAL AND INSTALLATION OF FRONT SUSPENSION	33- 4
REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY	33- 6
LEAF SPRING ASSEMBLY	33-10
SHOCK ABSORBER	33-12

STRUCTURE AND OPERATION



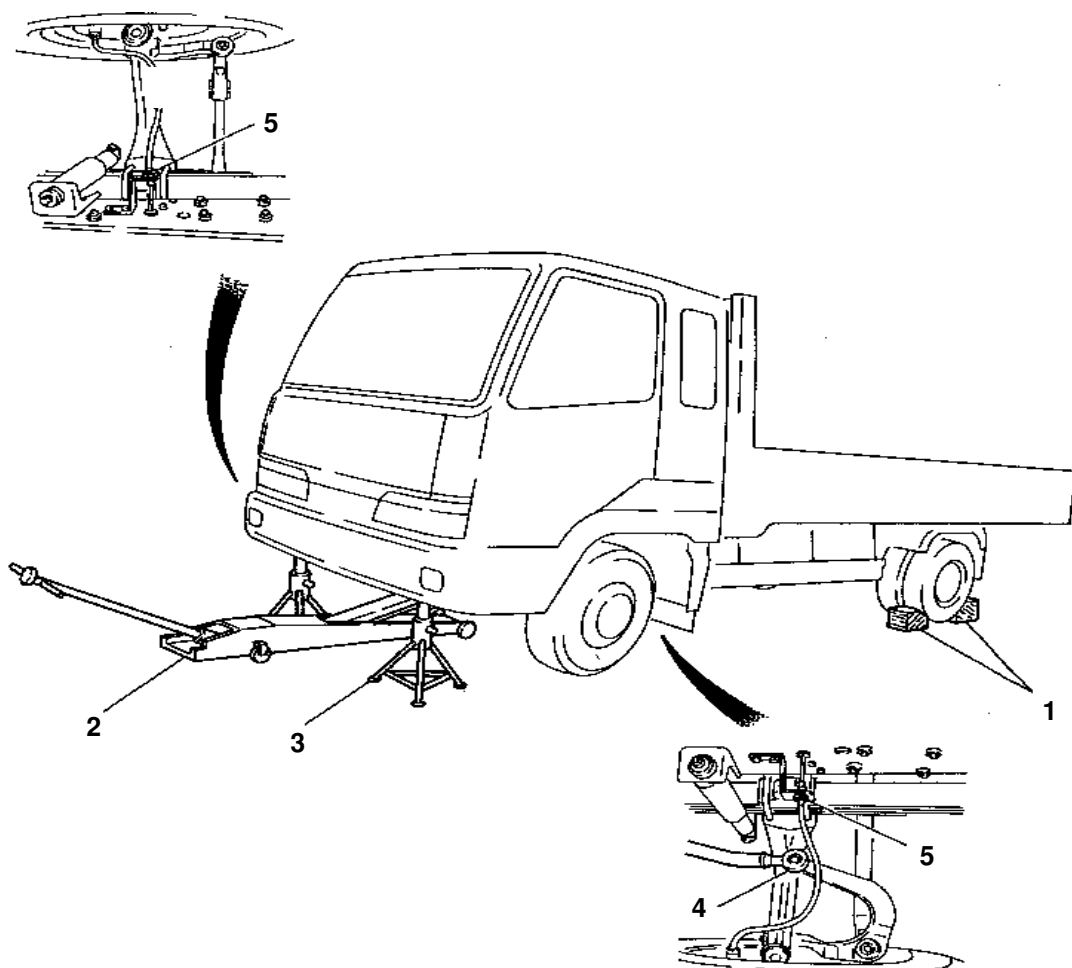
- 1 Shock absorber
- 2 Leaf spring assembly

*1 : Front axle
*2 : Frame

Leaf spring assembly **2** and shock absorber **1** are installed between frame ***2** and front axle ***1** to support the vehicle body mass and absorb vibration and shock from the road surface to prevent them from being directly transmitted to the vehicle body thereby protecting the crew, the vehicle body, and the cargo. In addition, irregular vibration from the wheels is restrained, ensuring driving stability.

Possible causes		Symptoms					Remarks
		Ride soft with gentle swaying	Noise generated when vehicle is unloaded	Impact transmitted from uneven road surface	Noise generated when vehicle is loaded	Periodic jolts received from the road surface	
Leaf spring	Cracked or damaged			○			
	Fractured		○				
	Spring bracket broken				○		
	U-bolts loose				○		
	Spring bushing worn		○				
Shackle pins thrust play excessive			○				
Shackle pin tightening torque excessive					○		
Bump stopper damaged or broken					○		
Shock absorber	Oil leaking noticeably or damping force decreased	○					
	Rubber bushing worn		○				
	Bolt loose		○				
Tire	Tires worn unevenly					○	 Gr 31
	Tires and wheels unbalanced					○	
	Air pressure excessive			○			

WORK BEFORE REMOVAL AND INSTALLATION OF FRONT SUSPENSION



45275

● Removal sequence

- 1 Place wheel chocks.
- 2 Jack up the front axle with a garage jack.
- 3 Support the front frame on rigid racks.
- 4 Remove the nut (on the joint between the knuckle arm and the drag link).  Gr 37
- 5 Remove the brake hose joint and wheel speed sensor (on the frame).  Gr 26

WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame with rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Be sure to protect the brake hose from dust by fitting blanking plugs.

● Installation sequence

Follow the removal sequence in reverse.

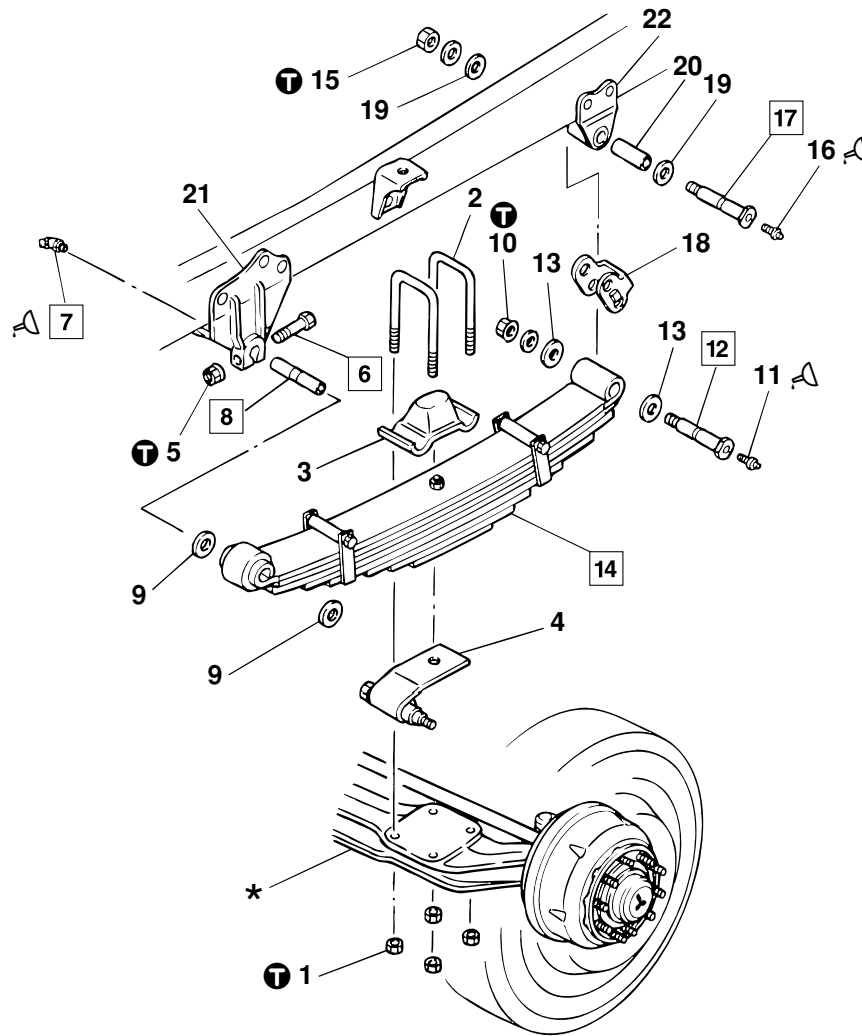
WARNING

You must bleed air from the brake system after connecting the brake hose, failure to do so would cause the brakes to malfunction. <Air over brake>  Gr 35A

CAUTION

Be sure that the brake hose is not twisted when you install it.

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY



11356

● Removal sequence

- | | |
|------------------|---------------------------------|
| 1 U-bolt nut | 13 Side washer |
| 2 U-bolt | 14 Leaf spring assembly P33-10 |
| 3 Bump stopper | 15 Nut |
| 4 Lower bracket | 16 Grease nipple |
| 5 Nut | 17 Shackle pin |
| 6 Bolt | 18 Shackle link |
| 7 Grease nipple | 19 Side washer |
| 8 Shackle pin | 20 Bushing |
| 9 Side washer | 21 Front spring front bracket |
| 10 Nut | 22 Front spring rear bracket |
| 11 Grease nipple | |
| 12 Shackle pin | |

*: Front axle Gr 26

NOTE

Do not remove front spring front bracket 21 or rear bracket 22 unless they are faulty. Gr 41

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
8, 12, 14	Clearance between shackle pin and spring bushing	FK	[28] 0 to 0.12 {[1.10] 0 to 0.0047}	0.3 {0.012}	Replace
		FM	[30] 0 to 0.15 {[1.18] 0 to 0.0059}		
8, 21	Clearance between shackle pin and front spring front bracket	FK	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	0.3 {0.012}	Replace
		FM	[30] 0 to 0.05 {[1.18] 0 to 0.0020}		
12, 17, 18	Clearance between shackle pin and shackle link	FK	[28] 0.02 to 0.24 {[1.10] 0.00079 to 0.0094}	0.3 {0.012}	Replace
		FM	[30] 0.02 to 0.25 {[1.18] 0.00079 to 0.0098}		
14, 18	Clearance between leaf spring assembly and shackle link	FK	0.35 to 2.2 {0.014 to 0.087}	2.5 {0.098}	Replace side washer
		FM	0.27 to 1.6 {0.011 to 0.063}		
14, 21	Clearance between leaf spring assembly and front spring front bracket	FK	0.07 to 1.0 {0.0028 to 0.039}	—	Replace side washer
		FM	0.27 to 1.2 {0.011 to 0.047}		
17, 20	Clearance between shackle pin and bushing	FK	[28] 0.02 to 0.14 {[1.10] 0.00079 to 0.0055}	0.3 {0.012}	Replace
		FM	[30] 0.02 to 0.15 {[1.18] 0.00079 to 0.0059}		
18, 22	Clearance between shackle link and front spring rear bracket	FK	0 to 1.7 {0 to 0.067}	2.0	Replace side washer
		FM	0.07 to 1.3 {0.028 to 0.051}		

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

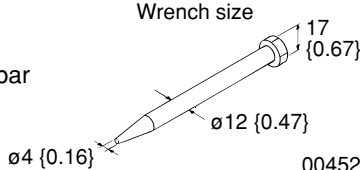
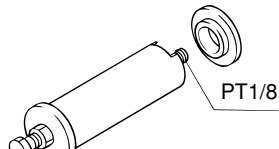
Location	Parts to be tightened		Tightening torque	Remarks
1	U-bolt nut (U-bolt mounting)	FK	204 to 276 {150±205, 20.8±28.2}	Wet
		FM	404 to 548 {295 to 405, 41.2 to 55.8}	
5	Flange nut (Shackle pin mounting)		80 to 110 {58 to 80, 8.0 to 11}	—
10, 15	Shackle pin nut (Shackle pin mounting)	FK	190 to 260 {135 to 190, 19 to 26}	—
		FM	260 to 340 {190 to 255, 26 to 35}	

L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7, 11, 16	Supply via grease nipple	Chassis grease [NLGI No.1 (Li soap)]	As required

C Special tools

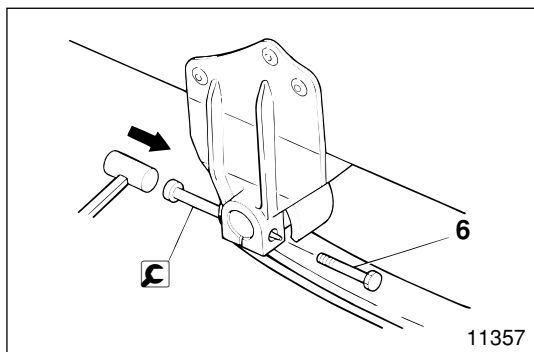
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
6	Shackle pin setting bar 	MC023419 00452	Removal of bolt (shackle pin installation), alignment of the shackle pin bolt groove
8, 12, 17	Shackle pin puller 	MH061452 00453	Removal of shackle pin

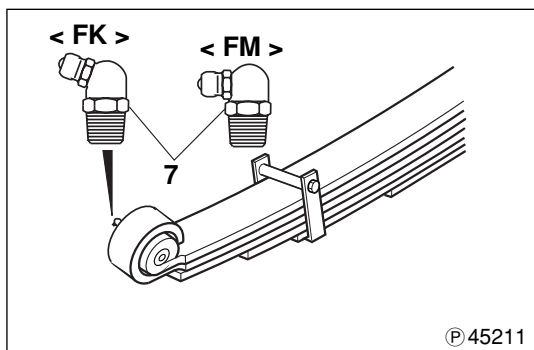
REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY

◆ Service procedure

6 Removal of bolt



7 Grease nipple



<FK>

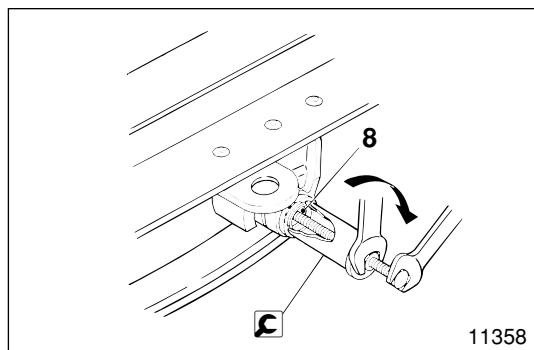
- Install grease nipple **7**, on the driver's side, so that it can be easily accessed for grease supply. This is the only nipple that is installed on the inner side of the vehicle. Grease nipples, **11**, **16** are straight types and are installed on the outer side of the vehicle.
- Grease nipple **7** at the forward side of the assistant driver's seat is a straight type, and it is installed on the outer side of the vehicle.

<FM>

- Install grease nipple **7** on the driver's and assistant driver's sides so that they are installed on inner side of the vehicle. Grease nipples, **11**, **16** are straight types and are installed on the outer side of the vehicle.

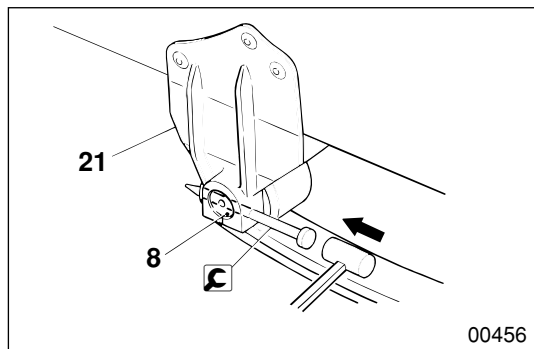
8 Shackle pin

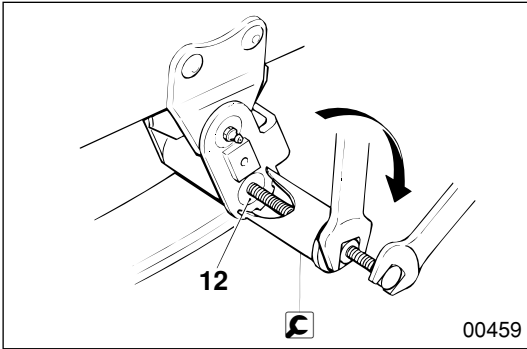
[Removal]



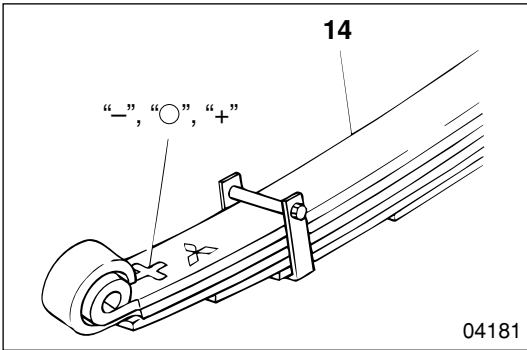
[Installation]

Align the bolt hole of front spring front bracket **21** with the bolt groove of shackle pin **8** using  shackle pin setting bar.





12 Removal of shackle pin



14 Leaf spring assembly left/right height combinations

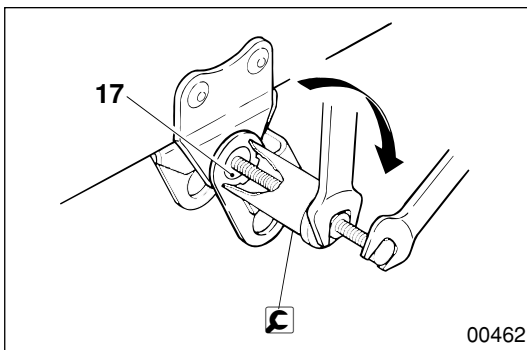
When replacing leaf spring assembly **14**, select the members so that the left and right height marks “+”, “O” and “-” are combined as shown below.

Item	Combination				
	1	2	3	4	5
Right leaf spring assembly, passenger's side	-	-	O	O	+
Left leaf spring assembly, driver's side	-	O	O	+	+

However, this combination shall not be applied according to the condition of body slant.

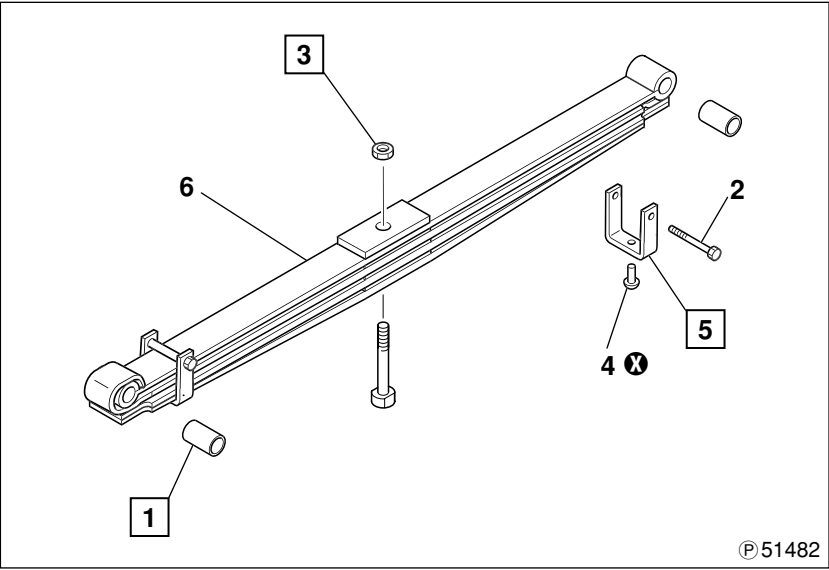
CAUTION ⚠

Passenger's side leaf spring assembly **14** differs from the driver's side leaf spring assembly in camber (arch). Do not mix them up when mounting, or this would cause vehicle tilt.



17 Removal of shackle pin

LEAF SPRING ASSEMBLY



● Disassembly sequence

- 1 Spring bushing
- 2 Clip bolt
- 3 Center nut
- 4 Rivet
- 5 Clip
- 6 Leaf spring

⊗ : Non-reusable parts

● Assembly sequence

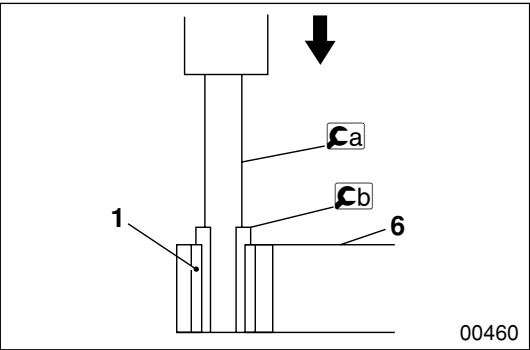
Follow the disassembly sequence in reverse.

🔧 Special tools

Unit : mm {in.}

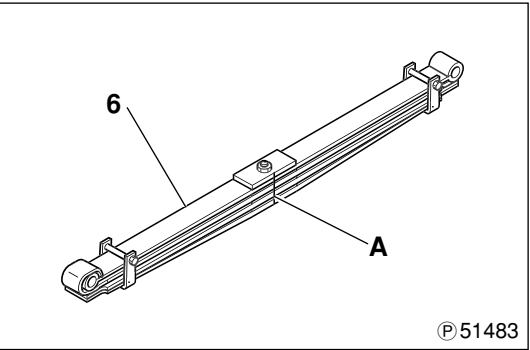
Location	Tool name and shape	Part No.	Application
1	Bushing installer set A : Bushing installer A B : Bushing installer B 00454	MB999066 A : MB999067 B : MB999068	Removal and press-fitting of spring bushing

◆ Service procedure



1 Removal of spring bushing

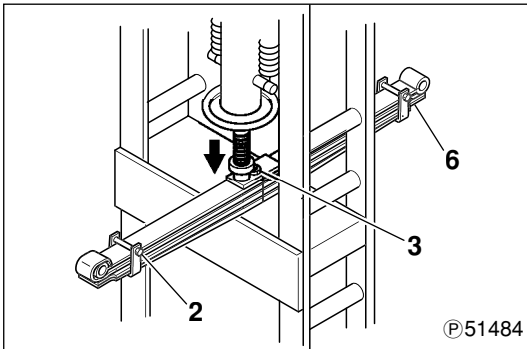
Remove the spring bushing from leaf spring 6 using bushing installer **A** and bushing installer **B**. For installation, follow the removal sequence in reverse.



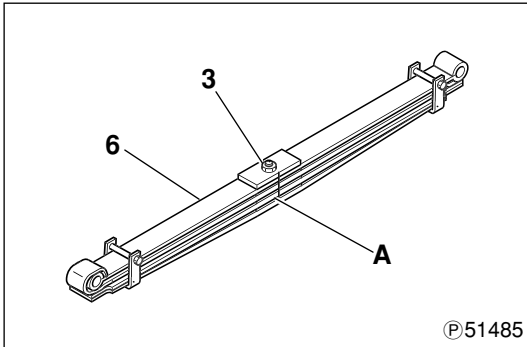
3 Center nut

[Removal]

- Put aligning marks **A** across leaves of leaf spring 6.

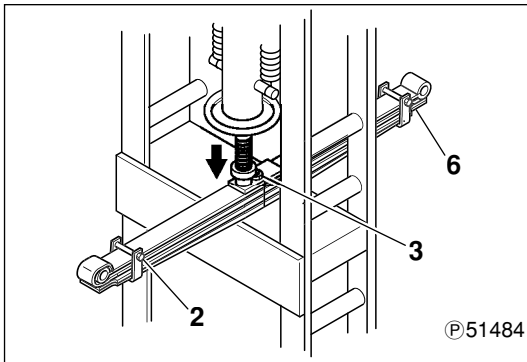


- Compress the leaf springs using a press to remove clip bolt **2** and center nut **3**.

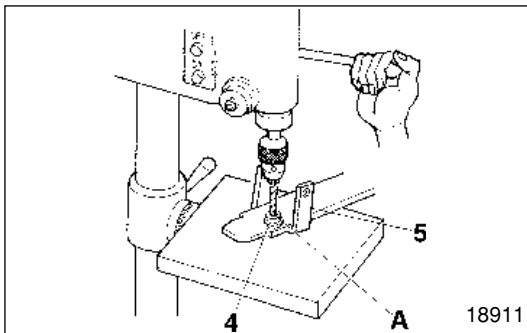


[Installation]

- Align alignment marks **A** on leaf springs **6** and assemble.
- Tighten center nut **3** temporarily.



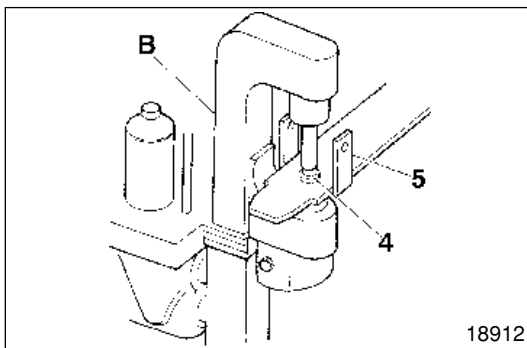
- Compress leaf spring **6** using a press, then install center nut **3**.
- Tighten clip bolt **2**.



5 Clip

[Removal]

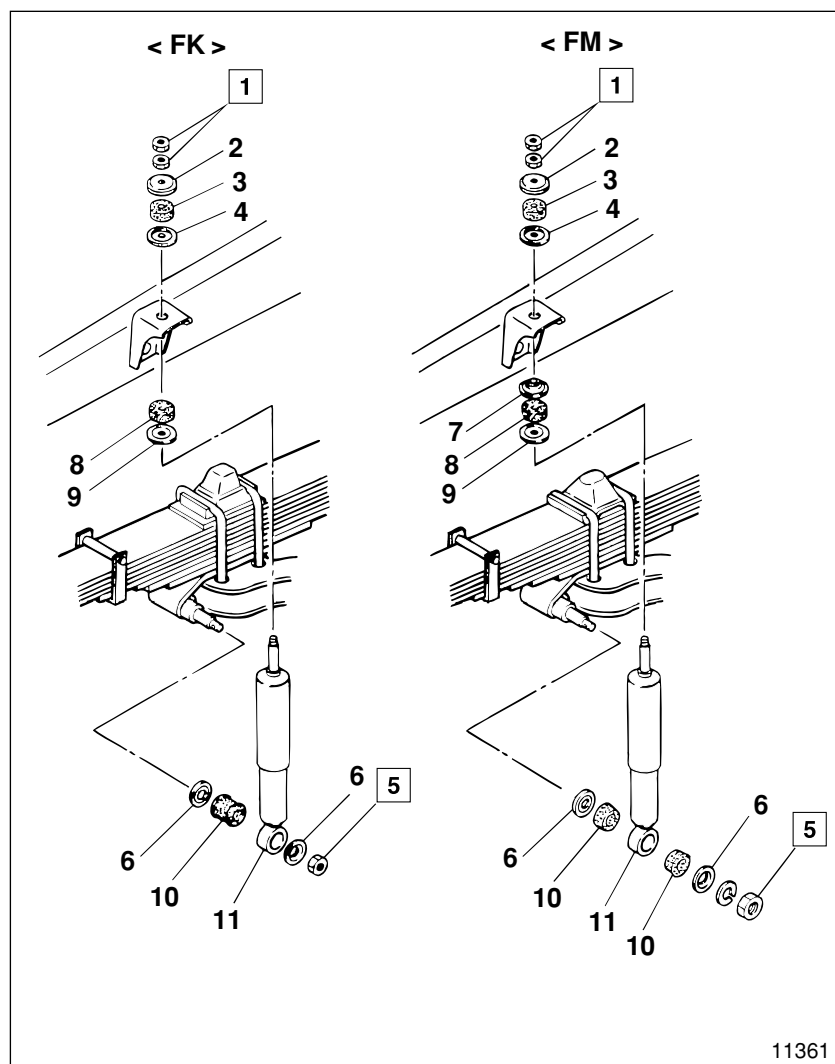
Drill out caulked ends **A** of rivet **4** on a drill press to remove clip **5**.



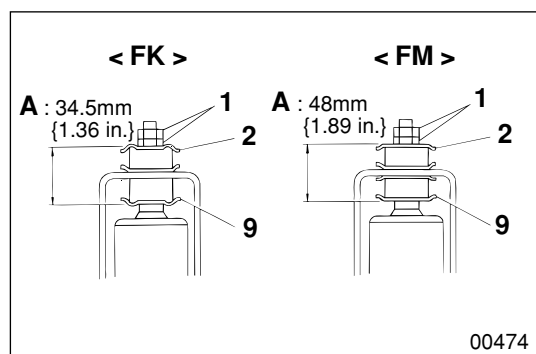
[Installation]

Using riveting machine **B**, install clip **5** by caulking rivet **4**.

SHOCK ABSORBER

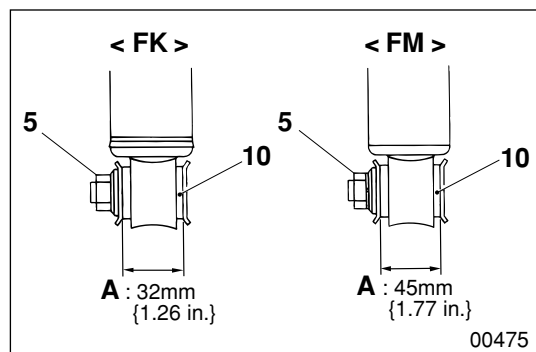


◆ Service procedure



1 Nut

Install nut **1** so that the distance between washers **2**, **9** is **A**.



5 Nut

Install nut **5** so that dimension of rubber bushing **10** is **A**.



34A - Rear Suspension <Leaf>

34B - Rear Suspension <Air>

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**



Group 34A

Rear Suspension

<LEAF>

Table of Contents

BACK

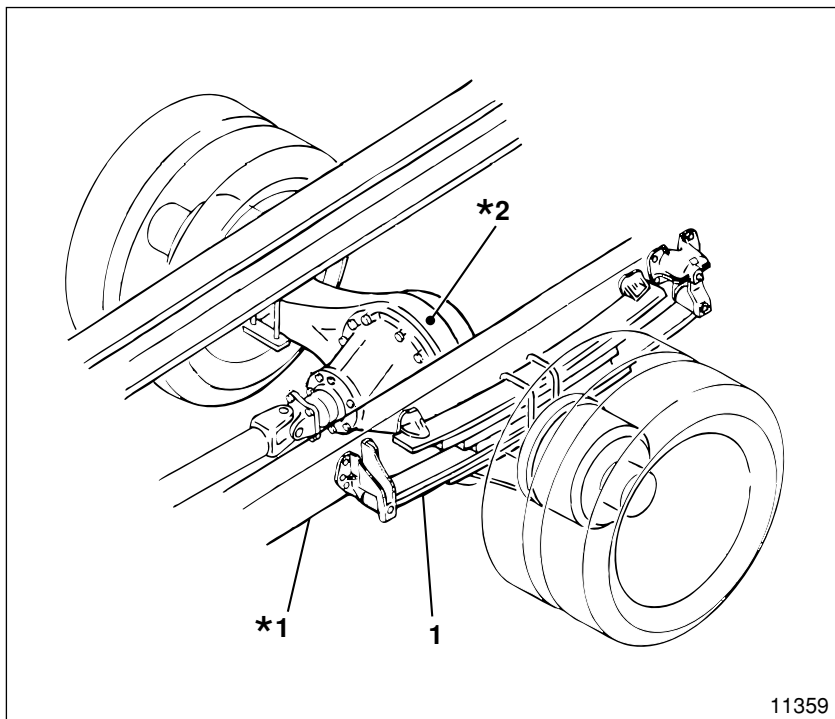
HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

STRUCTURE AND OPERATION	34A- 2
TROUBLESHOOTING	34A- 3
WORK BEFORE REMOVAL AND INSTALLATION OF REAR SUSPENSION	34A- 4
REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY	34A- 6
LEAF SPRING ASSEMBLY	34A-12

STRUCTURE AND OPERATION



1 Leaf spring assembly

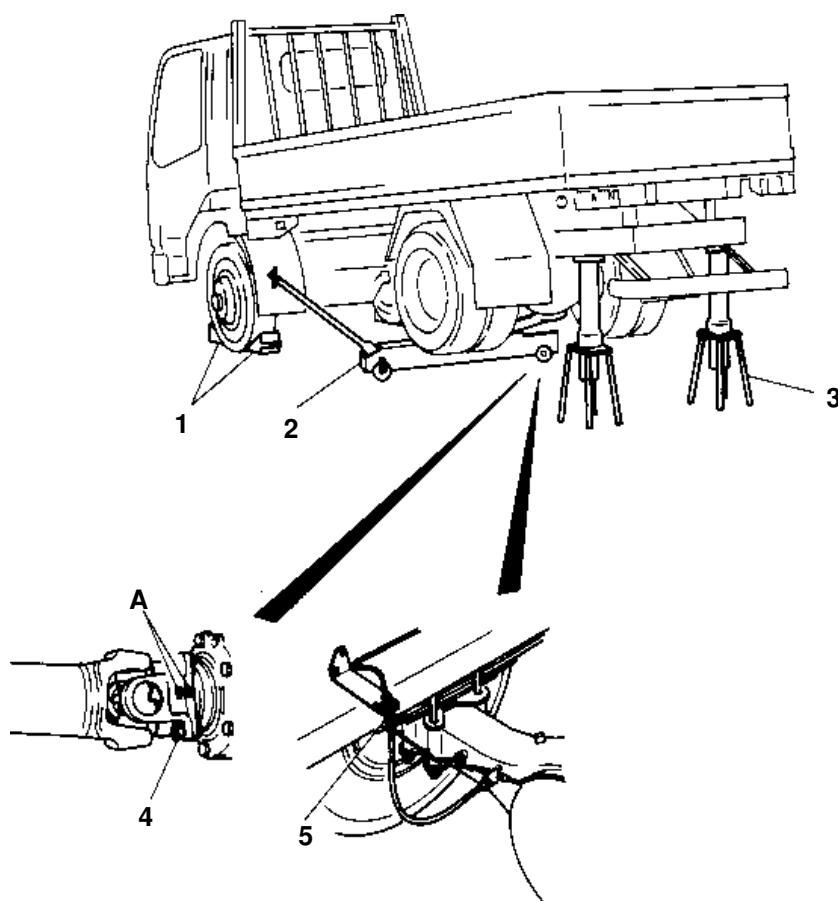
*1 : Frame

*2 : Rear axle

Leaf spring assembly **1** is installed between frame ***1** and rear axle ***2** to support the vehicle body mass and absorb vibration and shock from the road surface to prevent them from being directly transmitted to the vehicle body thereby protecting the crew, the vehicle body, and the cargo. In addition, irregular vibration from the wheels is restrained, ensuring driving stability.

Possible causes		Symptoms						Remarks
		Ride spongy	Noise generated when vehicle is unloaded	Impact transmitted from uneven road surface	Noise generated when vehicle is loaded	Excessive rolling while cruising	Periodic jolts caused by the road surface	
Leaf spring	Cracked or damaged			○				
	Damaged		○					
	Spring bracket broken				○			
	U-bolts loose				○			
	Spring bushing worn		○					
Shackle pins thrust play excessive			○					
Sliding seat < FM > or helper stopper damaged or broken					○			
Tire	Tires worn unevenly						○	Gr 31
	Tires and wheels unbalanced						○	
	Air pressure excessive			○				

WORK BEFORE REMOVAL AND INSTALLATION OF REAR SUSPENSION



45276

● Removal sequence

- 1 Place wheel chocks.
- 2 Jack up the rear axle with a garage jack.
- 3 Support the rear frame on rigid racks.
- 4 Put alignment marks **A** on the rear axle companion flange and the propeller shaft flange yoke, then remove the nuts (on the joint between the rear axle and the propeller shaft). Gr 25
- 5 Remove the brake hose joint and wheel speed sensor (on the frame). Gr 27

WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Be sure to protect the brake hose from dust by fitting blanking plugs.

● Installation sequence

Follow the removal sequence in reverse.

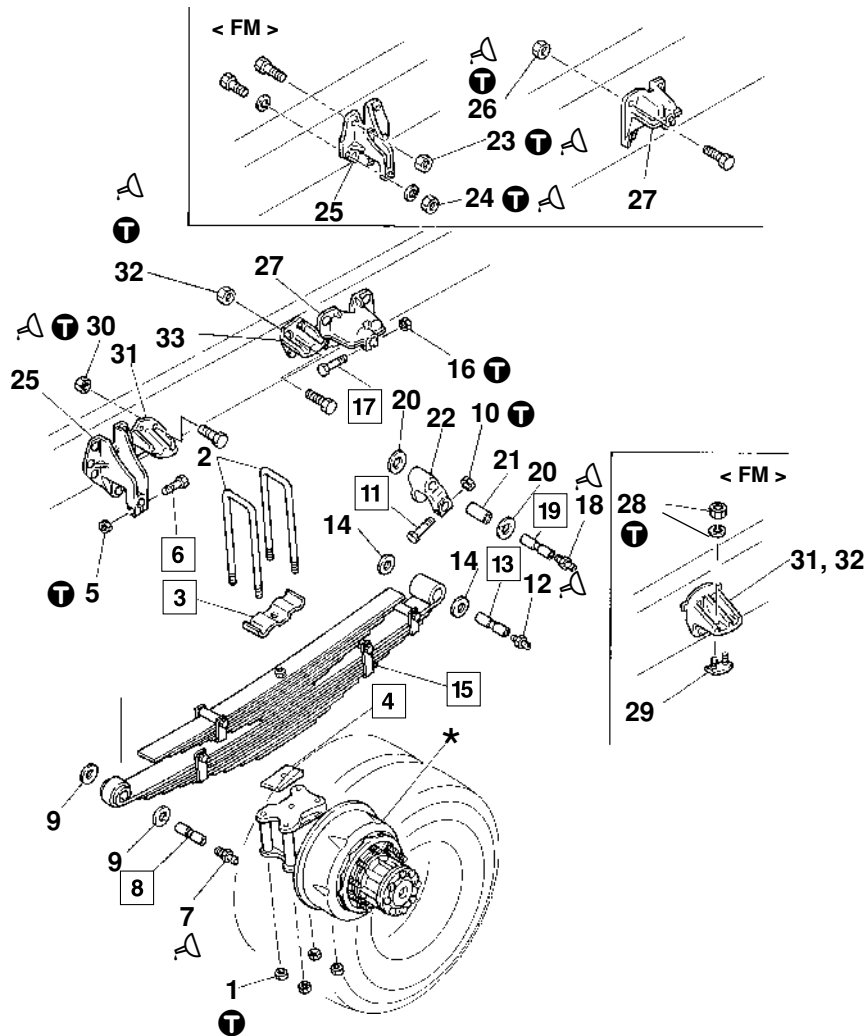
WARNING

You must bleed air from the brake system after installing the brake hose, failure to do so would cause the brake to malfunction.  Gr 35A

CAUTION

Be sure that the brake hose is not twisted when you install it.

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY



59191

● Removal sequence

- | | | |
|-------------------|-------------------------|------------------------------|
| 1 U-bolt nut | 13 Shackle pin | 24 Nut < FM > |
| 2 U-bolt | 14 Side washer | 25 Rear spring front bracket |
| 3 Rear spring pad | 15 Leaf spring assembly | 26 Nut < FM > |
| 4 Shim < FM61FF > | P34A-12 | 27 Rear spring rear bracket |
| 5 Nut | 16 Nut | 28 Nut < FM > |
| 6 Bolt | 17 Bolt | 29 Sliding seat < FM > |
| 7 Grease nipple | 18 Grease nipple | 30 Nut < FM > |
| 8 Shackle pin | 19 Shackle pin | 31 Front helper stopper |
| 9 Side washer | 20 Side washer | 32 Nut < FM > |
| 10 Nut | 21 Bushing | 33 Rear helper stopper |
| 11 Bolt | 22 Shackle link | |
| 12 Grease nipple | 23 Nut < FM > | |

* Rear axle  Gr 27

NOTE

Do not remove rear spring front bracket 25, or rear spring rear bracket 27, front helper stopper 31, or rear helper stopper 32 unless they are faulty.  Gr 41

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
8, 13, 15	Clearance between shackle pin and spring bushing	FK	[28] 0 to 0.12 {[1.10] 0 to 0.0047}	0.3 {0.012}	Replace
		FM	[30] 0 to 0.15 {[1.18] 0 to 0.0059}		
8, 13, 22, 25	Clearance between shackle pin and each of rear spring front bracket and shackle link	FK	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	0.3 {0.012}	Replace
		FM	[30] 0 to 0.05 {[1.18] 0 to 0.0020}		
15, 22	Clearance between leaf spring assembly and shackle link		0.07 to 1.03 {0.0028 to 0.041}	1.3 {0.051}	Replace side washer
15, 25	Clearance between leaf spring assembly and rear spring front bracket		0.07 to 1.03 {0.0028 to 0.041}	1.3 {0.051}	Replace side washer
19, 21	Clearance between shackle pin and bushing	FK	[28] 0.02 to 0.14 {[1.10] 0.00079 to 0.0055}	0.3 {0.012}	Replace
		FM	[30] 0.03 to 0.15 {[1.18] 0.0012 to 0.059}		
19, 27	Clearance between shackle pin and rear spring rear bracket	FK	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	0.3 {0.012}	Replace
		FM	[30] 0 to 0.05 {[1.18] 0 to 0.0020}		
22, 27	Clearance between shackle link and rear spring rear bracket		0.07 to 0.73 {0.0028 to 0.029}	1.0 {0.39}	Replace side washer

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	U-bolt nut (U-bolt mounting)	FK	292 to 394 {215 to 290, 29.8 to 40.2}	Wet
		FM	404 to 548 {295 to 405, 41.2 to 55.8}	
5, 10, 16	Nut (Shackle pin mounting)		80 to 110 {58 to 80, 8 to 11}	—
23, 26	Nut (Rear spring front and rear bracket mounting)	FM	200 to 270 {145 to 200, 20.4 to 27.5}	Wet
24	Nut (Rear spring front bracket mounting)	FM	157 to 216 {115 to 160, 16 to 22}	Wet
28	Nut (Sliding seat mounting)	FM	59 to 84 {43 to 61, 6.0 to 8.5}	—
30	Nut (Helper stopper mounting)	FK	157 to 216 {115 to 160, 16 to 22}	Wet

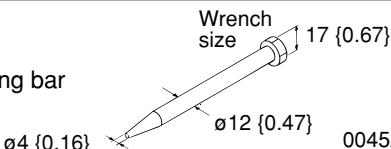
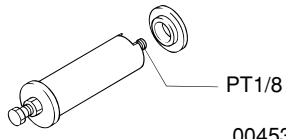
L Lubricant and/or sealant

Location	Points of application		Specified lubricant and/or sealant	Quantity
7, 12, 18	Supply via grease nipple		Chassis grease [NLGI No. 1 (Li soap)]	As required
23, 24, 26	Thread area and contacting surface of nut	FM	LOCTITE 271 and Nippon grease Rusfighter J36	As required
30	Thread area and contacting surface of nut	FK	Engine oil	As required

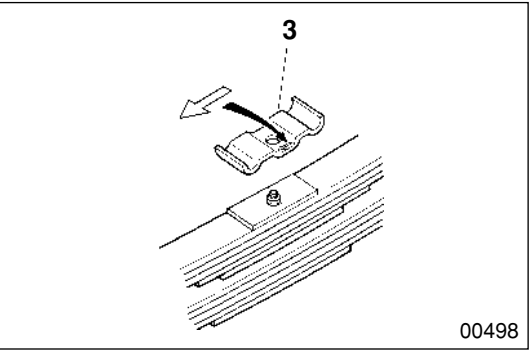
REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY

Special tools

Unit : mm {in.}

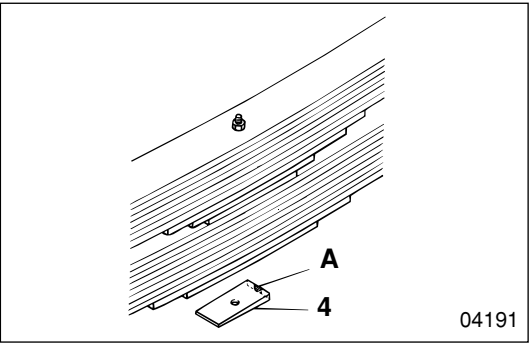
Location	Tool name and shape	Part No.	Application
6, 11, 17	Shackle pin setting bar  Wrench size 17 {0.67} ø4 {0.16} ø12 {0.47} 00452	MC023419	Removal of shackle pin mounting bolt and aligning of holes
8, 13, 19	Shackle pin puller  PT1/8 00453	MH061452	Removal of shackle pin

◆ Service procedure



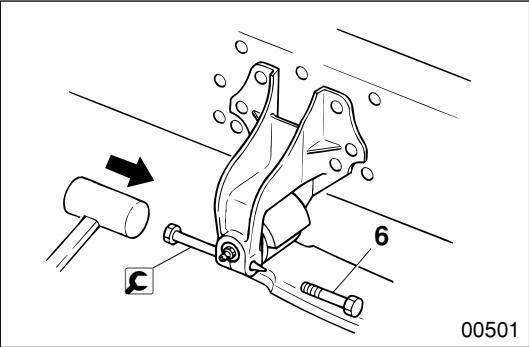
3 Rear spring pad < FK >

Align direction of arrow mark of the rear spring pad to front direction of vehicle.

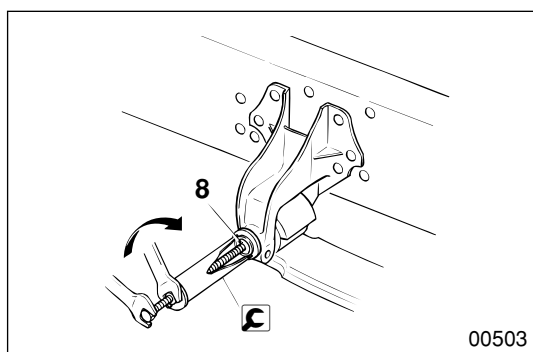


4 Shim < FM61FF >

Yellow identification paint **A** must be positioned toward the front of the vehicle.

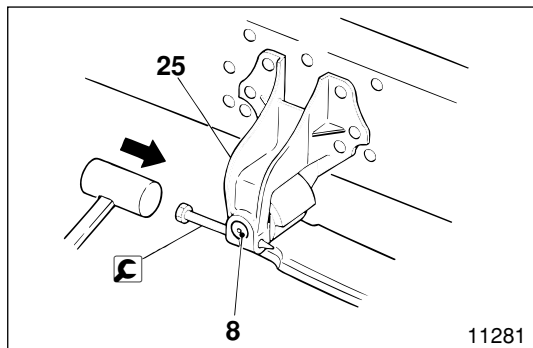


6 Removal of bolt



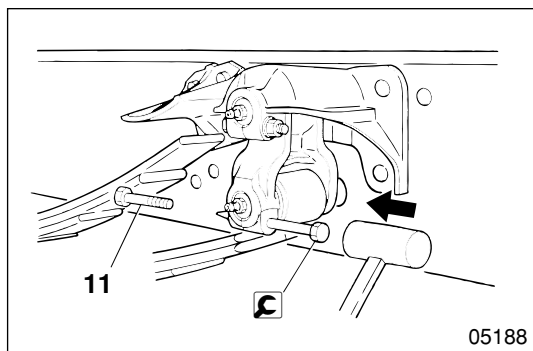
8 Shackle pin

[Removal]

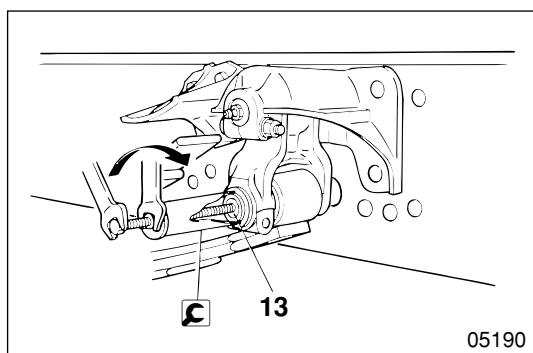


[Installation]

Align the bolt hole of rear spring front bracket **25** with the bolt groove of shackle pin **8** using shackle pin setting bar.

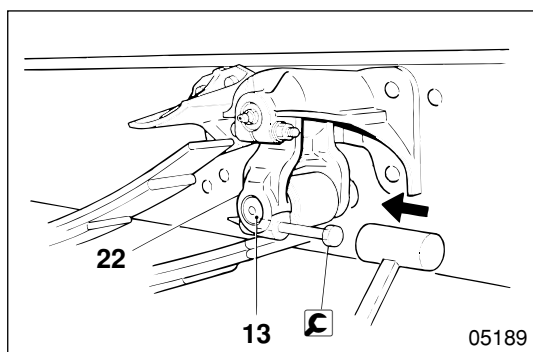


11 Removal of bolt



13 Shackle pin

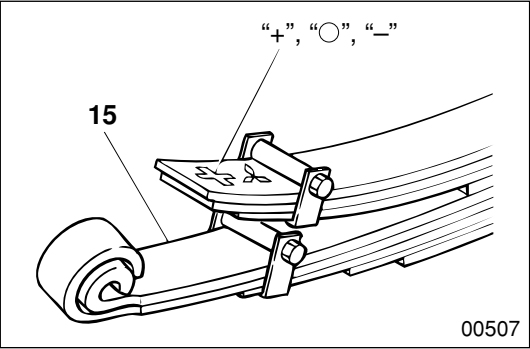
[Removal]



[Installation]

Align the bolt hole of shackle link **22** with the bolt groove of shackle pin **13** using shackle pin setting bar.

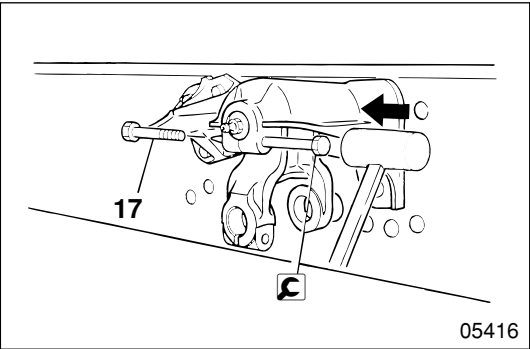
REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY



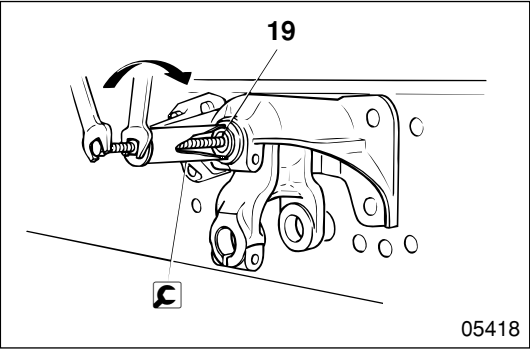
15 Leaf spring assembly left/right height combinations

When replacing leaf spring assembly 15, select the members so that the left and right height marks “+”, “O” and “-” are combined as shown below. However, this combination shall not be applied according to the conditions of body slant.

Item	Combination				
	1	2	3	4	5
Leaf spring assembly, left side	–	○	○	+	+
Leaf spring assembly, right side	–	–	○	○	+

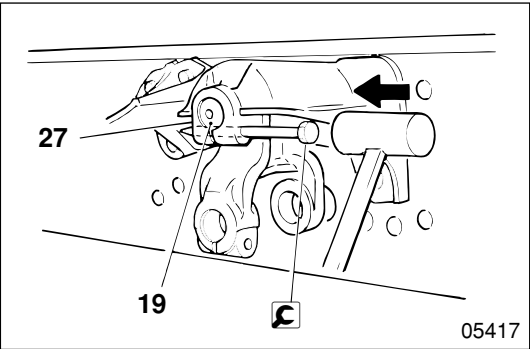


17 Removal of bolt



19 Shackle pin

[Removal]

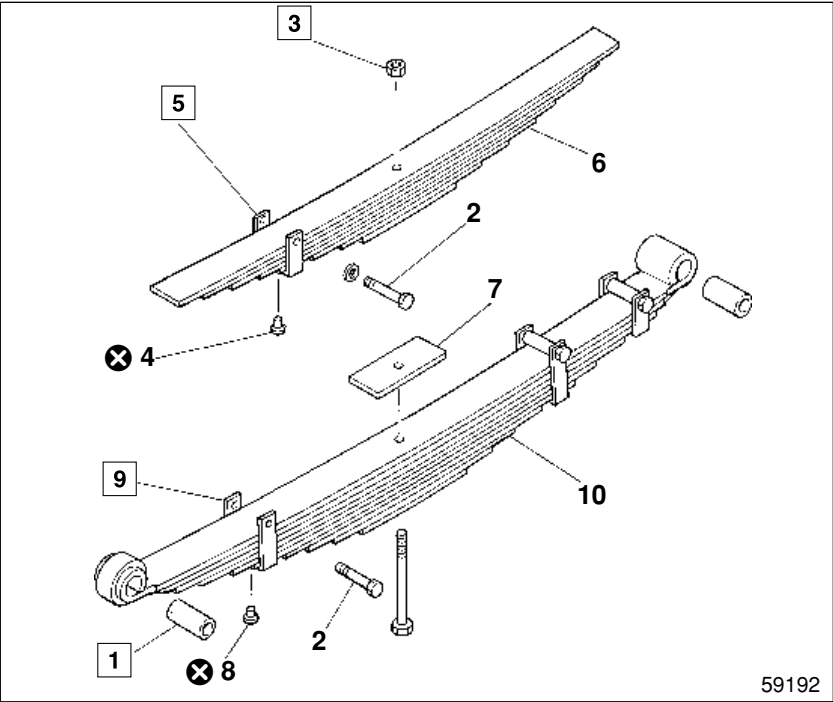


[Installation]

Align the bolt hole of rear spring rear bracket 27 and the bolt groove of shackle pin 19 using  shackle pin setting bar.

MEMO

LEAF SPRING ASSEMBLY



● Disassembly sequence

- 1 Spring bushing
- 2 Clip bolt
- 3 Center nut
- 4 Rivet
- 5 Clip
- 6 Helper spring
- 7 Seat
- 8 Rivet
- 9 Clip
- 10 Main spring

⊗ : Non-reusable parts

● Assembly sequence

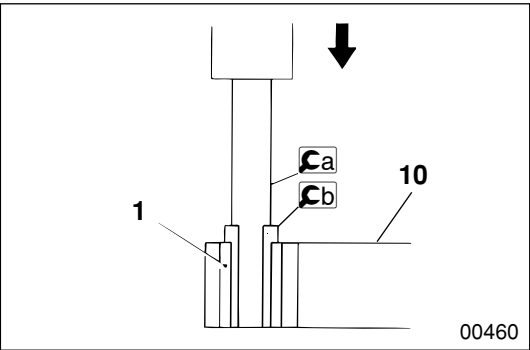
Follow the disassembly sequence in reverse.

🔧 Special tools

Unit : mm {in.}

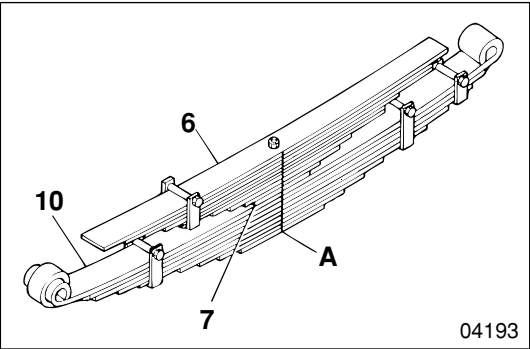
Location	Tool name and shape	Part No.	Application
1	Bushing installer set A : Bushing installer A B : Bushing installer B 00454	MB999066 A : MB999067 B : MB999068	Removal and installation of bushing

◆ Service procedure



1 Removal and installation of spring bushing

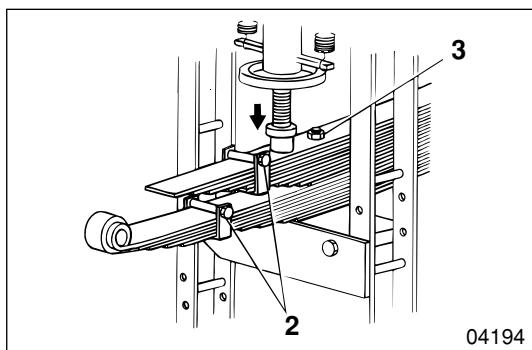
Remove spring bushing 1 from main springs 10 using bushing installer A and bushing installer B. For installation, follow the removal sequence in reverse.



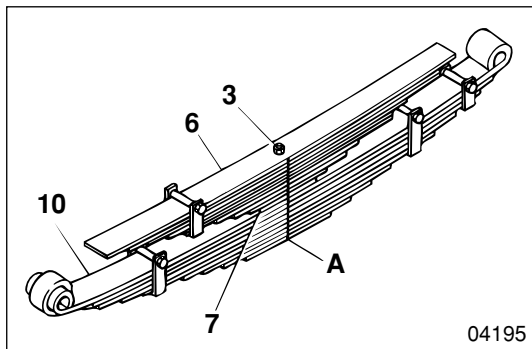
3 Center nut

[Removal]

- Put alignment marks A on the sides of helper springs 6, seat 7, and main springs 10.

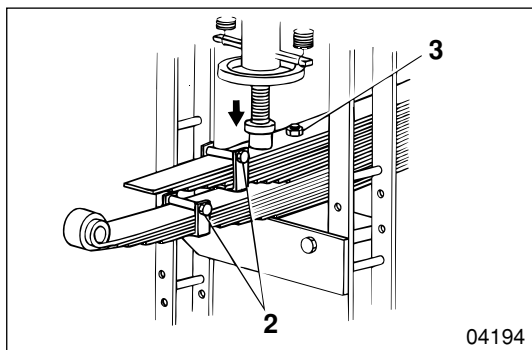


- Compress the leaf springs using a press to remove clip bolt **2** and center nut **3**.

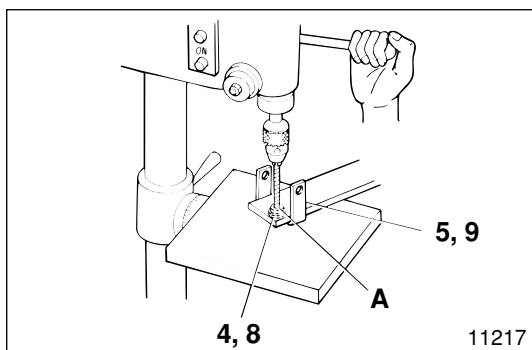


[Installation]

- Align alignment marks **A** on helper springs **6**, seat **7**, and main springs **10** to assemble them.
- Tighten center nut **3** temporarily.



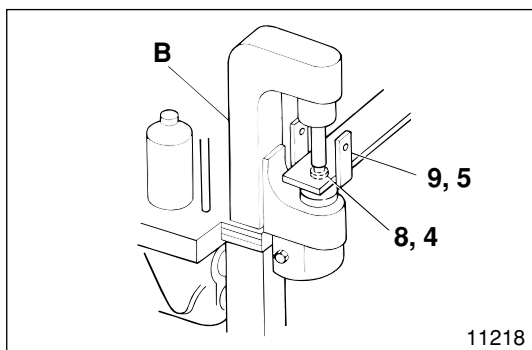
- Compress leaf springs using a press to install center nut **3**.
- Install clip bolt **2**.



5 9 Clip

[Removal]

Drill out caulked ends **A** of rivets **4, 8** on a drill press to remove clips **5, 9**.



[Installation]

Caulk rivets **8, 4** using riveting machine **B** to install clips **9, 5**.



Group 34B

Rear Suspension

<AIR>

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

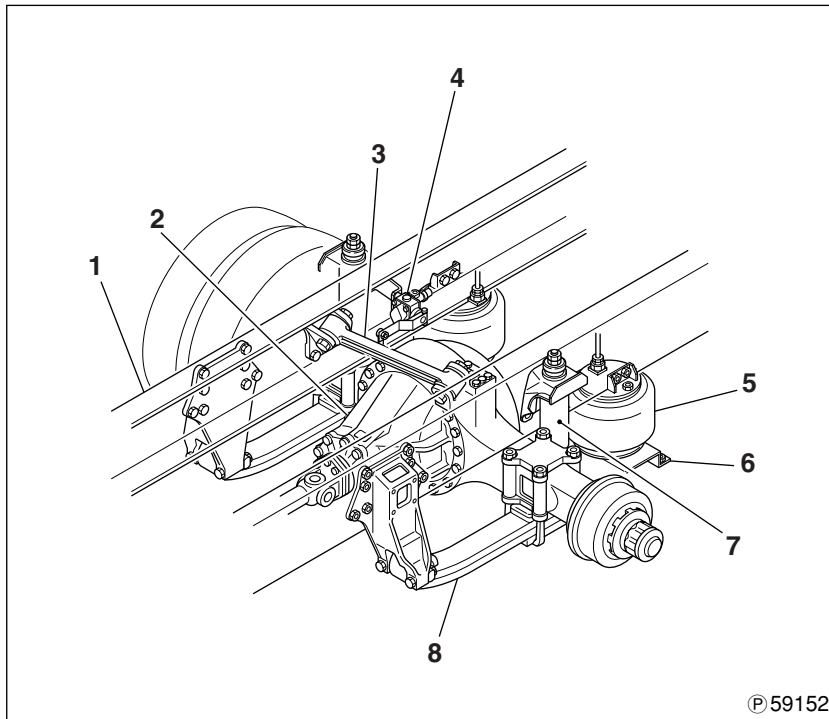
INDEX

SPECIFICATIONS	34B- 2
STRUCTURE AND OPERATION	
1. Air Suspension	34B- 3
2. Air Suspension System	34B- 4
3. Leveling Valve	34B- 6
TROUBLESHOOTING	34B- 8
ON-VEHICLE INSPECTION AND ADJUSTMENT	
Adjustment of Air Spring Height	34B- 9
WORK BEFORE REMOVAL AND AFTER INSTALLATION	
OF REAR SUSPENSION	34B-10
SHOCK ABSORBER	34B-12
REMOVAL AND INSTALLATION OF LEAF SPRING	
ASSEMBLY AND AIR SPRING	34B-14
LEAF SPRING ASSEMBLY	34B-18
AIR SPRING	34B-20
LEVELING VALVE	34B-22

SPECIFICATIONS

Item		Specifications
Air spring (Effective diameter x Installed height)	mm {in.}	$\phi 250 \times 293 \{9.84 \times 11.5\}$
Leaf spring (Length x Width x Thickness – No. of leaves)	mm {in.}	$(643 + 390) \times 80 \times 35 - 2$ $\{(25.2 + 15.4) \times 3.15 \times 1.38 - 2\}$

1. Air suspension

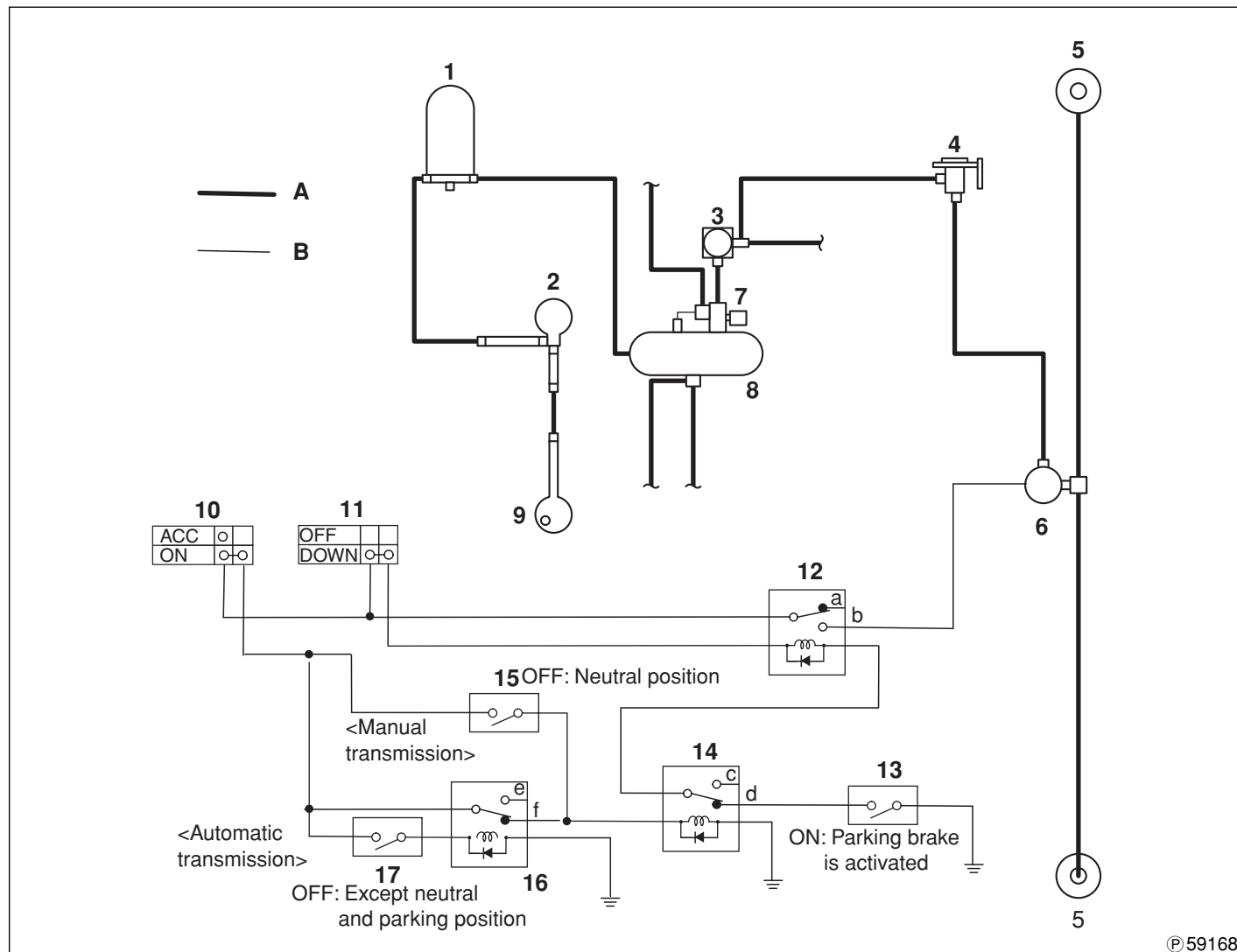


- 1 Frame
- 2 Rear axle
- 3 Lateral rod
- 4 Leveling valve
- 5 Air spring
- 6 Cross beam
- 7 Shock absorber
- 8 Leaf spring assembly

- Air spring 5, leaf spring assembly 8, cross beam 6, and shock absorber 7 are installed between frame 1 and rear axle 2 to support the vehicle body mass and absorb the vibration and shock from the road surface to prevent them from being directly transmitted to the vehicle body, thus protecting the vehicle body, occupants, and cargos. This construction also restricts irregular vibration of the wheels to ensure driving stability. The air spring is characterized by softer spring. Therefore, lateral rod 3 is installed to reduce rolling which is larger in a softer suspension.
- Leveling valve 4 is fitted on the rear axle housing. The leveling valve senses the increase and decrease of loads and controls the internal pressure of the air spring depending upon the load.

STRUCTURE AND OPERATION

2. Air Suspension System



© 59168

- | | |
|--------------------------|--|
| 1 Air drier | 12 Air suspension hold relay |
| 2 Air compressor | 13 Parking brake switch |
| 3 Supply valve | 14 Air suspension release relay |
| 4 Leveling valve | 15 Transmission neutral switch |
| 5 Air spring | <Manual transmission> |
| 6 3-way magnetic valve | 16 Automatic transmission reversing relay |
| 7 Safety valve | <Automatic transmission> |
| 8 Air tank (Wet) | 17 Inhibitor switch <Automatic transmission> |
| 9 Air cleaner | A : Air line |
| 10 Starter switch | B : Electric circuit |
| 11 Height control switch | |

The air suspension circuit operates 3-way magnetic valve **6** to adjust the height of air spring **5**.
(Diagram shows air suspension circuit without current supply.)

Operable condition

If the following conditions are satisfied when height control switch **11** is DOWN, 3-way magnetic valve **6** operates.

In case of starter switch "ACC"

- The parking brake lever is activated. (Parking brake switch **13** is ON.)

In case of starter switch "ON"

- The parking brake lever is activated. (Parking brake switch **13** is ON.)
- The transmission is in the neutral position. (Transmission neutral switch **15** is OFF or inhibitor switch **17** is ON.)

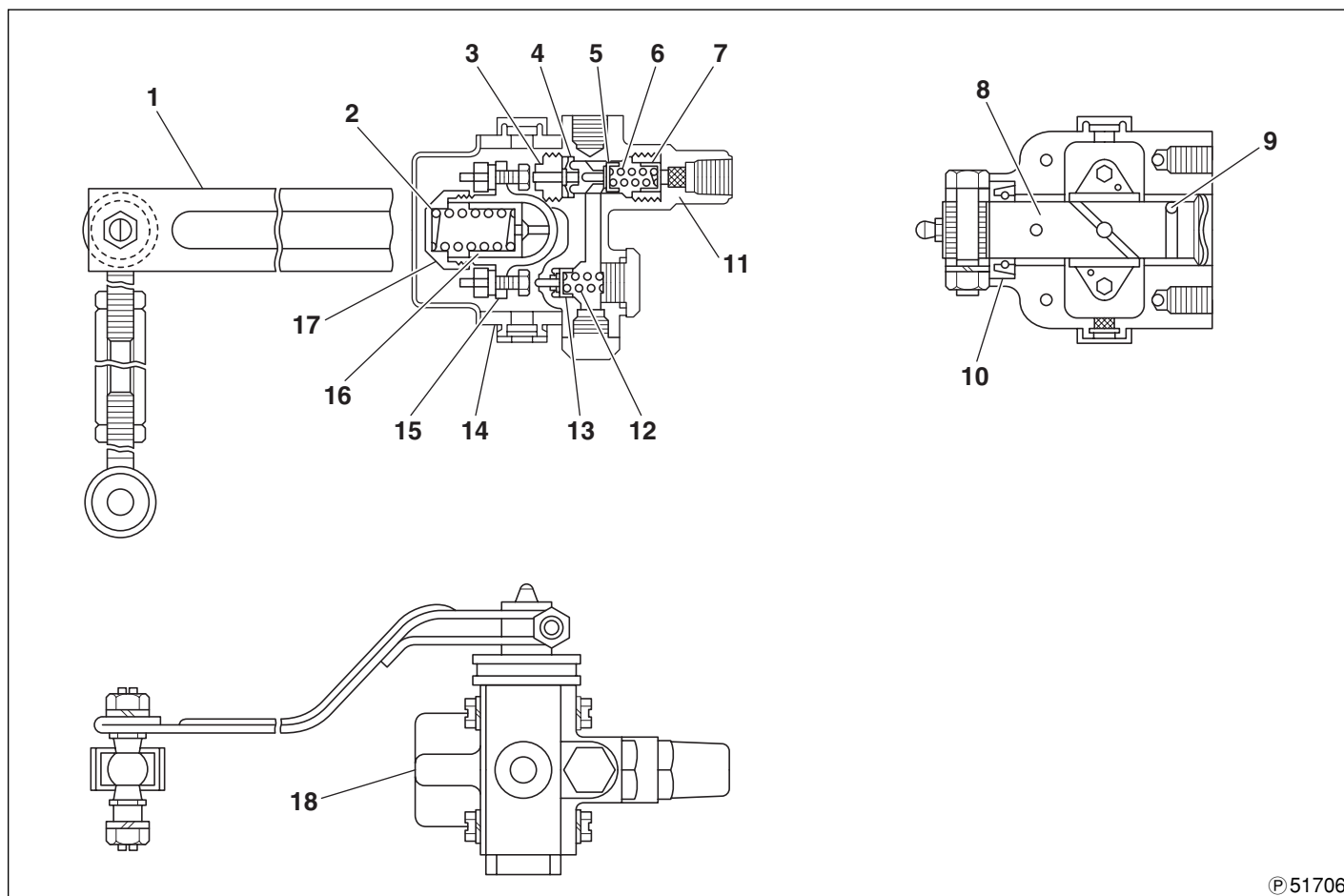
The current flows as indicated below to operate 3-way magnetic valve **6**.

10 → **11** (DOWN) → **12** (contact b) → **14** (ON) → **13** (ON) → GND

Non-operable condition

With the transmission in the neutral position, when the parking brake is not engaged, air suspension hold relay **12** is not activated. Therefore, operating current to 3-way magnetic valve **6** is cut off. So and the 3-way magnetic valve does not operate. When the transmission is not in neutral position, air suspension hold relay **12** is not activated as well.

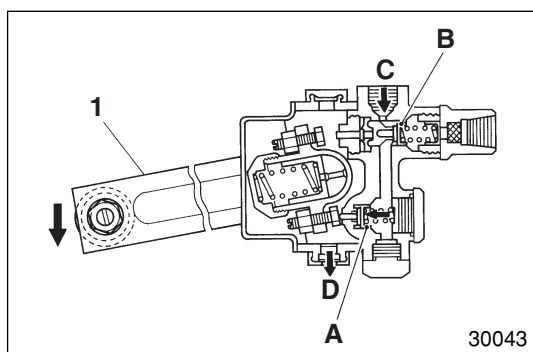
3. Leveling Valve



© 51706

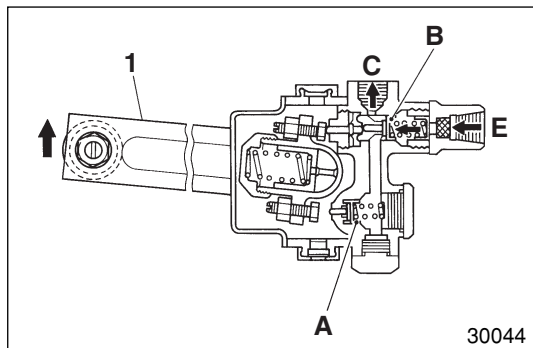
- | | | |
|----------------------|-----------------|------------------|
| 1 Lever | 7 Seal assembly | 13 Seal assembly |
| 2 Spring | 8 Shaft | 14 Actuator body |
| 3 Nut | 9 Spring pin | 15 Rocker body |
| 4 Diaphragm assembly | 10 Oil seal | 16 Piston |
| 5 Seal assembly | 11 Valve body | 17 Plug |
| 6 Spring | 12 Spring | 18 Cover |

The leveling valve is a control device which supplies or discharges compressed air to or from the air spring according to loads. The leveling valve body is mounted on the frame.



When load decreased

The lever **1** of the leveling valve is lowered below the neutral position. When the lever moves down beyond the dead zone, exhaust valve **A** is opened. Since intake valve **B** remains closed, therefore, the air from discharge port **C** flows through the opened exhaust valve and is discharged into the atmosphere from exhaust port **D**.



When load increased

The lever **1** of the leveling valve is raised above the neutral position. When the lever moves up beyond the dead zone, intake valve **B** is opened. Since exhaust valve **A** remains closed, therefore, the air flows from supply port **E** to discharge port **C**.

TROUBLESHOOTING

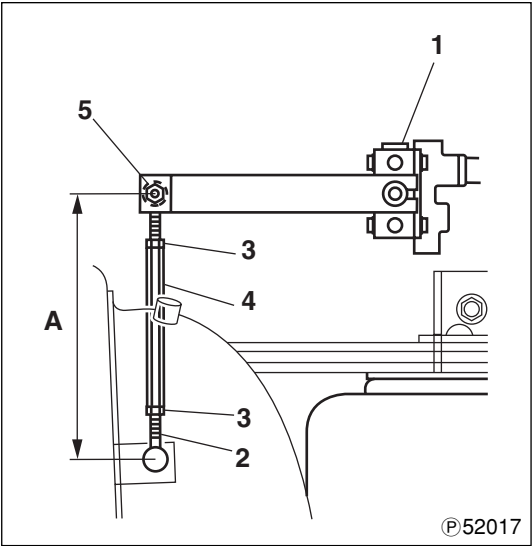
Possible causes		Symptoms										
		Ride spongy	Noise generated with unloaded vehicle	Noise generated with loaded vehicle	Direct impact from uneven road surface	Periodic jolts during driving on smooth road surface	Large rolling	Large bouncing	Hard cushioning		Height control impossible	Too large amounts of air consumed during driving
Leaf spring	Cracked or damaged				○							
	Broken		○									
	Spring bracket broken			○								
	U-bolts loose			○								
	Spring bushing worn		○									
Air spring	Damaged									○		
	Diaphragm cracked											○
Shock absorber	Damping force decreased, oil leaking	○					○	○				
	Rubber bushing worn		○									
	Bolt loose		○									
Leveling valve	Faulty adjustment						○	○	○	○		
	Faulty function						○		○	○		
Tire	Tires worn unevenly					○						
	Tires and wheels out of balance					○						
	Inflation pressure too high				○				○			
Height control switch faulty											○	
Air suspension 3-way magnetic valve operation faulty											○	○
Air line connections to each device loose or broken												○
Transmission neutral relay and parking brake relay operation faulty											○	

Adjustment of Air Spring Height

Tightening torque

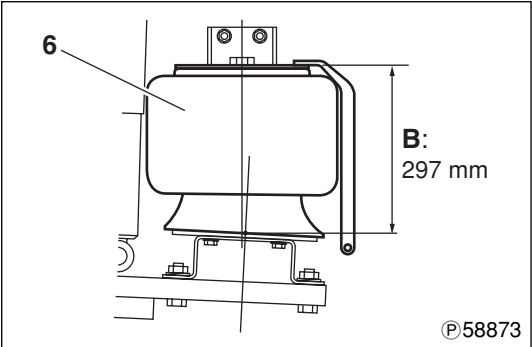
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Lock nut	12 to 15 {8.9 to 11, 1.2 to 1.6}	—



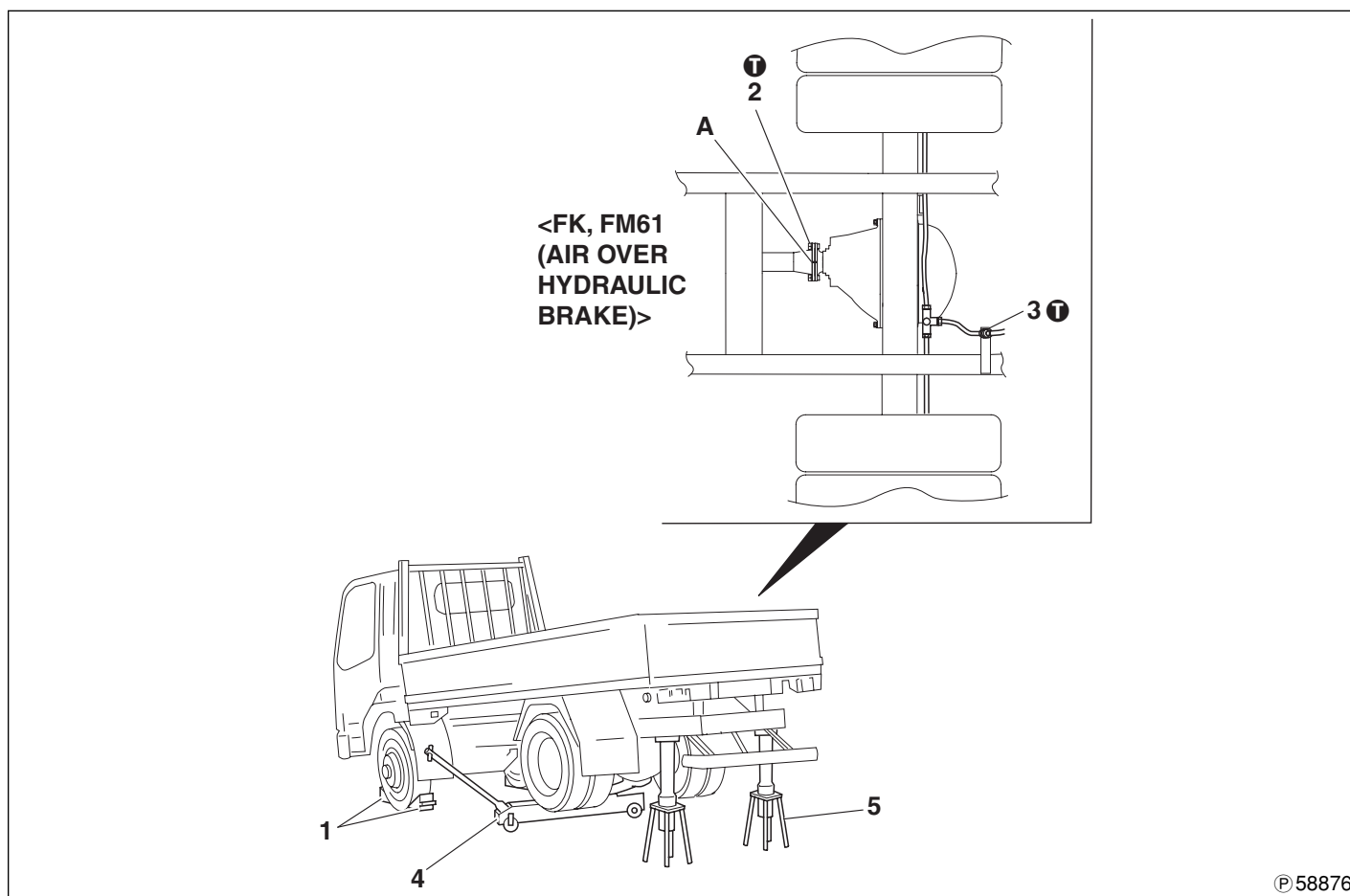
CAUTION  **Adjust air spring 6 with no occupant in the vehicle.**

- Set air pressure in the air tank to the specified value.
- To prevent dead zone (play) of levelling valve 1 from affecting adjustment, loosen lock nut 3 of rod assembly 2 first, then turn rod 4 to shorten rod length A (distance between centers of eye sections at rod end 5). Then gradually extend the distance.



- Measure height B of air spring 6 using standard scale. When height B is 297 mm, tighten lock nut 3 of rod assembly 2.

WORK BEFORE REMOVAL AND AFTER INSTALLATION OF REAR SUSPENSION



● Removal sequence

- 1 Attach safety blocks to wheels.
- 2 Put aligning marks **A** across rear axle companion flange and propeller shaft flange yoke, and remove nut (rear axle and propeller shaft connecting).
- 3 Remove brake hose (Frame side).
- 4 Jack up rear axle with a garage jack.
- 5 Support the frame on rigid racks.

WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Be sure to protect the brake hose from dust by fitting blanking plugs.

● Installation sequence

Follow the removal sequence in reverse.

WARNING

You must bleed air from the brake system after installing the brake hose, failure to do so would cause the brake to malfunction.  Gr 35A

CAUTION

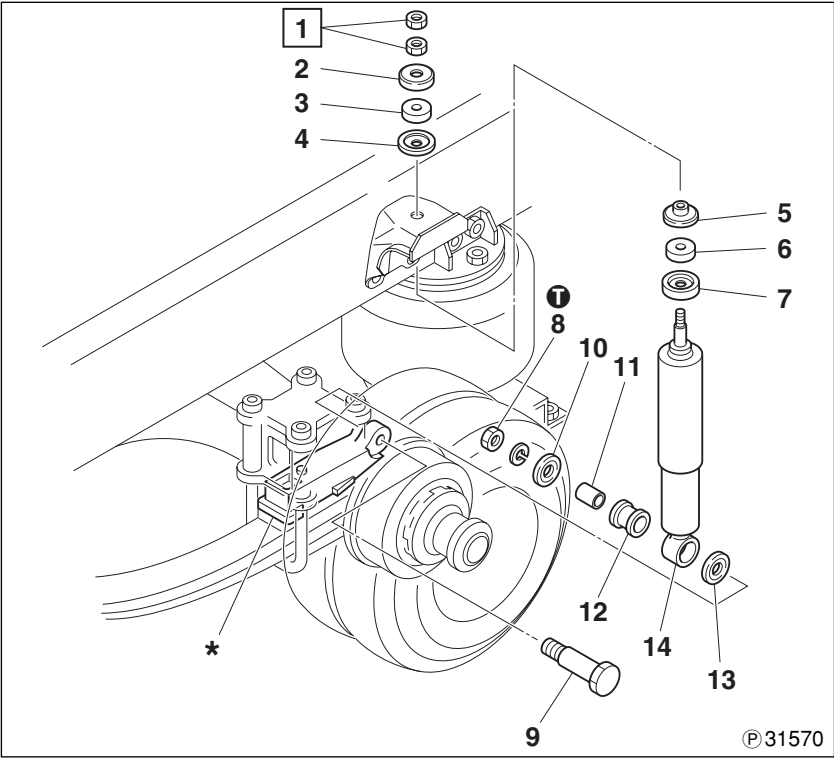
Be sure that the brake hose is not twisted when you install it.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
2	Nut (Rear axle and propeller shaft connecting)	P8	70 to 100 {51 to 72, 7.0 to 10}	—
3	Brake hose (Frame side)		21 to 31 {15 to 23, 2.1 to 3.2}	—

SHOCK ABSORBER



● Removal sequence

- 1 Nut
- 2 Washer
- 3 Rubber bushing
- 4 Centering washer
- 5 Centering washer
- 6 Rubber bushing
- 7 Washer
- 8 Nut
- 9 Bolt
- 10 Washer
- 11 Bush
- 12 Rubber bushing
- 13 Washer
- 14 Shock absorber

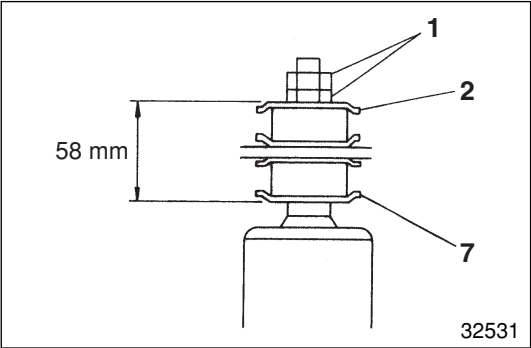
* : Shock absorber lower bracket

📖 P34B-14

● Installation sequence

Follow the disassembly sequence in reverse.

◆ Service procedure

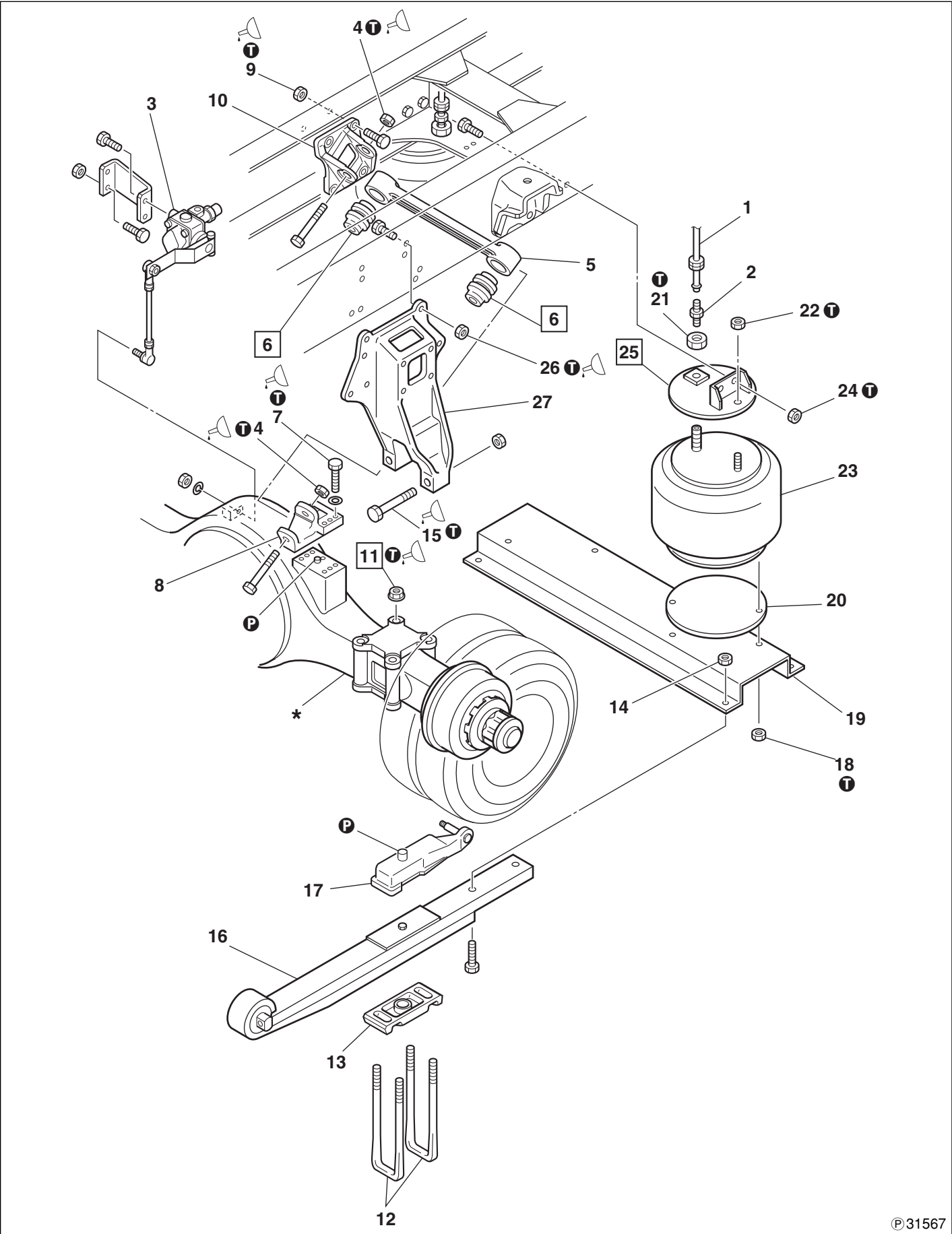


- 1 Nut

Tighten nut 1 so washers 2 and 7 are spaced as indicated in the diagram.

MEMO

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY AND AIR SPRING



● Removal sequence

1 Air pipe	12 U-bolt	21 Nut
2 Connector	13 Spring pad	22 Nut
3 Leveling valve P34B-22	14 Nut	23 Air spring
4 Nut	15 Leaf spring bolt	24 Nut
5 Lateral rod	16 Leaf spring assembly P34B-18	25 Air spring bracket
6 Lateral rod bushing	17 Shock absorber lower bracket	26 Nut
7 Bolt	18 Nut	27 Leaf spring bracket
8 Lateral rod bracket	19 Cross beam	
9 Nut	20 Plate	* : Rear axle Gr 27
10 Lateral rod bracket		Ⓜ : Locating pin
11 U-bolt nut		

CAUTION

Make sure to remove shock absorber before removing leaf spring assembly and air spring P34B-12

● Installation sequence

Follow the disassembly sequence in reverse.

CAUTION

Do not fully tighten leaf spring bolts 15 and nuts 4 before adjusting the height of air spring 23. Otherwise the bushings for the eyes of leaf spring assembly 16 and lateral rod 5 may be twisted. P34B-9

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Nut (for installing lateral rod)	500 to 680 {370 to 500, 51 to 69}	Wet
7	Bolt (for installing lateral rod bracket)	206 ± 31 {150 ± 23, 21 ± 3.15}	—
9	Nut (for installing lateral rod bracket)	160 to 220 {120 to 160, 16 to 22}	Wet
11	U-bolt nut (for installing U-bolt)	740 to 830 {545 to 610, 75 to 85}	Wet
15	Leaf spring bolt (for installing leaf spring assembly)	260 to 350 {190 to 260, 27 to 36}	Wet
18	Nut (for installing air spring)	38 to 42 {28 to 31, 3.8 to 4.2}	—
21	Nut (for installing air spring)	61 to 68 {45 to 50, 6.2 to 6.9}	—
22	Nut (for installing air spring)	30 to 34 {22 to 25, 3.0 to 3.4}	—
24	Nut (for installing air spring bracket)	80 to 110 {59 to 81, 8 to 11}	—
26	Nut (for installing leaf spring bracket)	260 to 350 {190 to 260, 27 to 36}	Wet

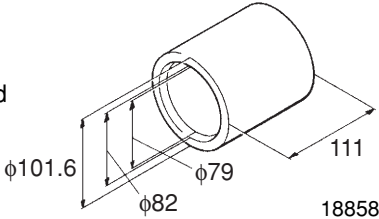
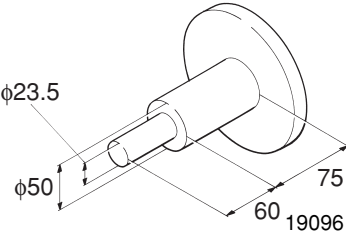
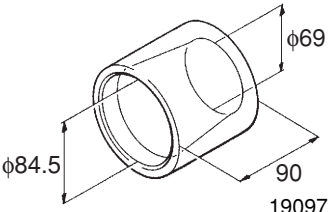
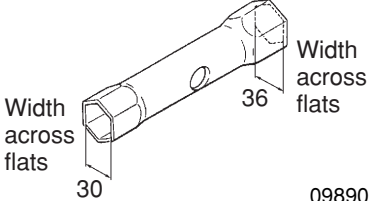
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4, 9, 26	Threaded portion of nut	Chassis grease [NLGI No.1 (Li soap)]	As required
7	Bolt's threaded portion that contacts rear housing	THREEBOND 2430 or 2440	As required
11	Threaded portion of U-bolt nut	Chassis grease [NLGI No.1 (Li soap)]	As required
15	Threaded portion of leaf spring bolt	Chassis grease [NLGI No.1 (Li soap)]	As required

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY AND AIR SPRING

Special tools

Unit : mm

Location	Tool name and shape	Part No.	Application
6	Tool A (Radius Rod Rest) 	MC019916	Removal and installation of lateral rod bushing
	Tool B (Rod Bushing Remover) 	MC019917	
	Tool C (Rod Bushing Guide) 	MC019918	Installation of lateral rod bushing
11	Socket Wrench 	03703-83000	Removal and installation of U-bolt nut

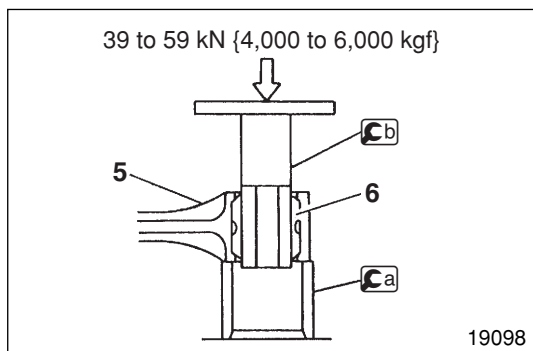
◆ Service procedure

6 Removal and installation of lateral rod bushing

[Removal]

 **a**: Tool A (Radius Rod Rest)

 **b**: Tool B (Rod Bushing Remover)

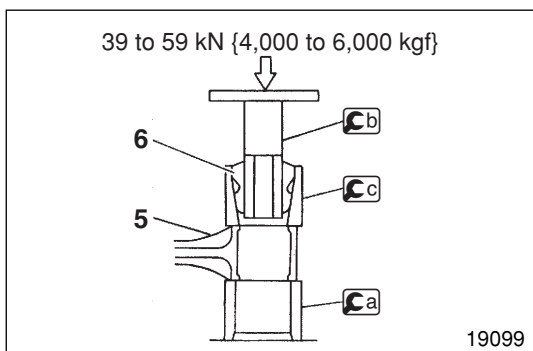


[Installation]

 **a**: Tool A (Radius Rod Rest)

 **b**: Tool B (Rod Bushing Remover)

 **c**: Tool C (Rod Bushing Guide)

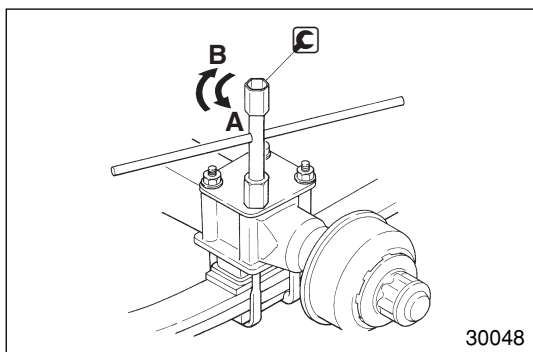


11 Removal and installation of U-bolt nut

: Socket Wrench

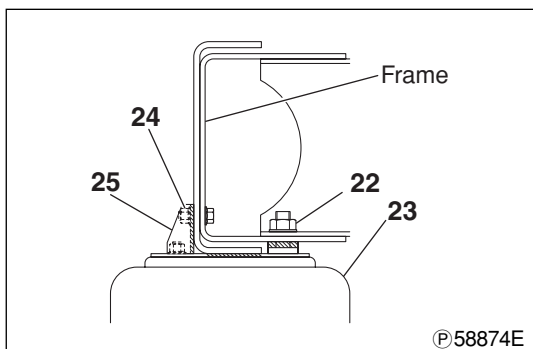
A: Removal

B: Installation

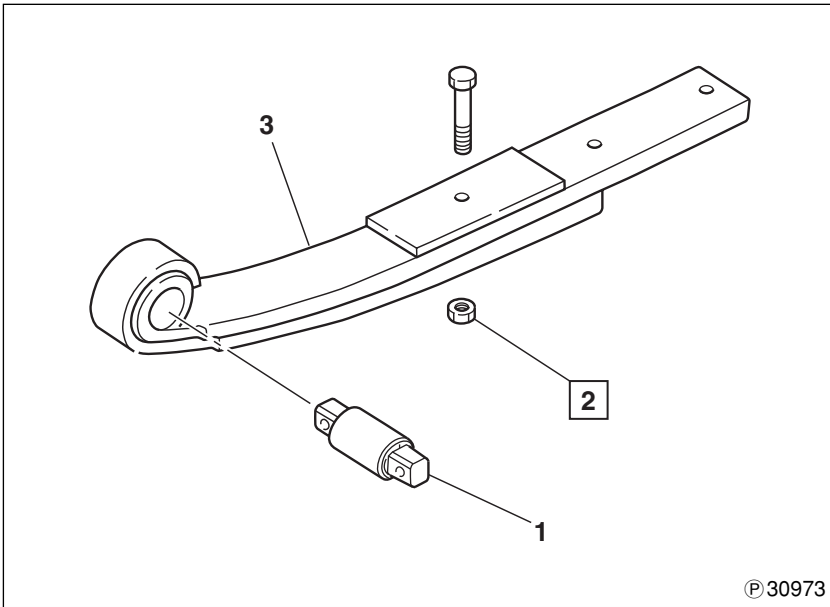


25 Installation of air spring bracket

Fit air spring bracket **25** closely to frame, shaded area in the illustration, and then tighten mounting nut **22** and **24** at specified torque.



LEAF SPRING ASSEMBLY



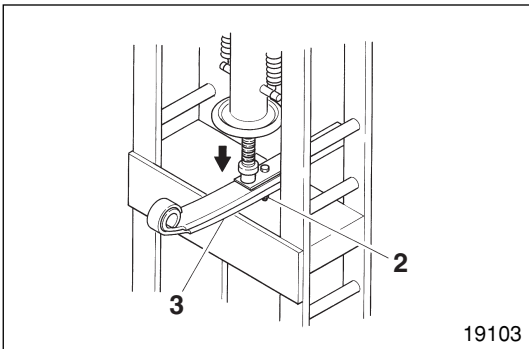
● Disassembly sequence

- 1 Bushing
- 2 Center nut
- 3 Leaf spring

● Assembly sequence

Follow the disassembly sequence in reverse.

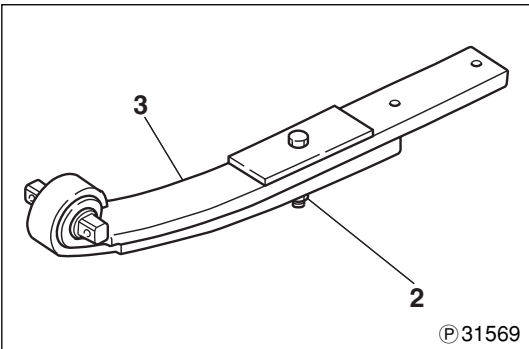
◆ Service procedure



2 Center nut

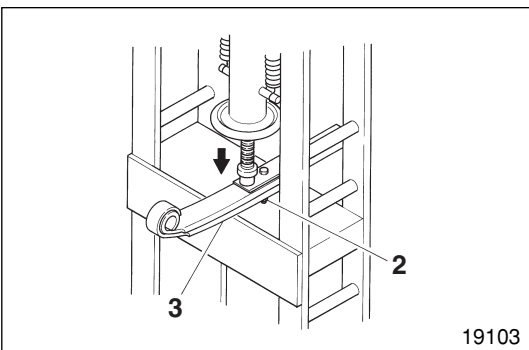
[Removal]

Compress leaf spring 3 using a press and remove center nut 2.



[Installation]

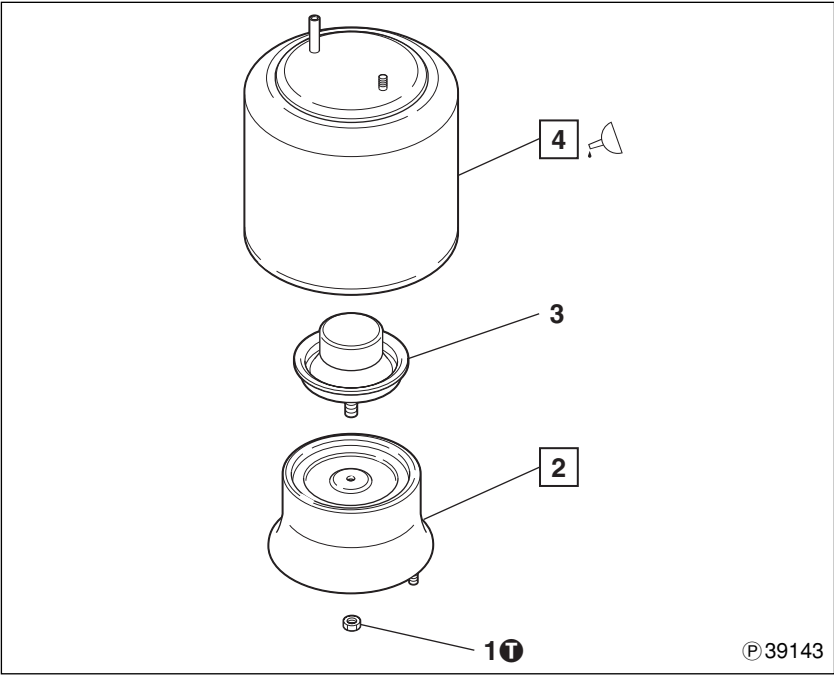
- Assemble leaf spring 3.
- Tighten center nut 2 temporarily.



- Compress leaf spring 3 using a press and fully tighten center nut 2.

MEMO

AIR SPRING



● Works before disassembly

📖 P34B-20

● Disassembly sequence

- 1 Nut
- 2 Piston
- 3 Bump stopper
- 4 Diaphragm assembly

● Assembly sequence

Follow the disassembly sequence in reverse.

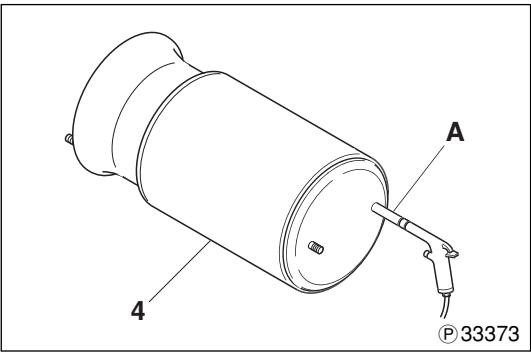
⚙️ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (bump stopper mounting)	27 to 68 {20 to 50, 2.8 to 6.9}	—

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Bump stopper attaching area on diaphragm assembly	Tire cream	As required

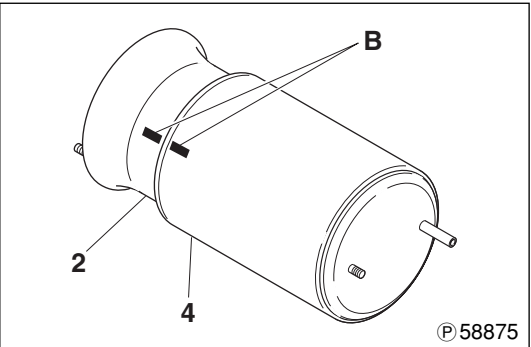


◆ Service procedure

● Works before disassembly

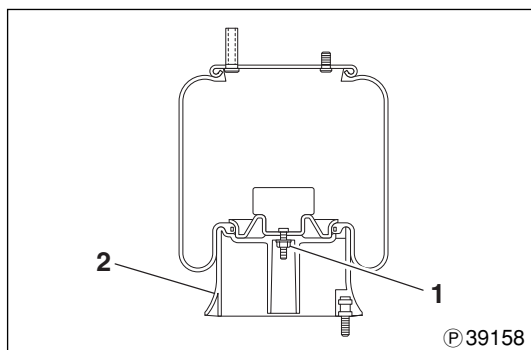
(1) Extending diaphragm assembly

Supply compressed air through port **A** of diaphragm assembly **4** to extend the diaphragm.



(2) Alignment marks

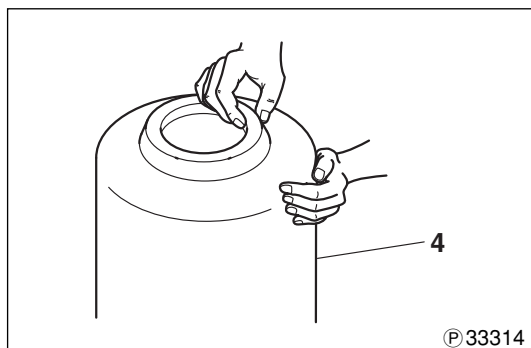
Put marks **B** for phase alignment between diaphragm assembly **4** and piston **2**.



2 4 Piston and diaphragm assembly

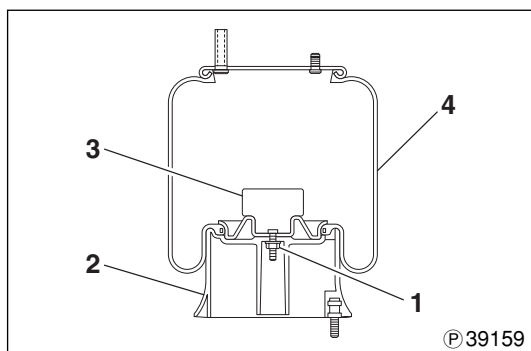
[Removal]

Remove nut **1**, then remove piston **2**.

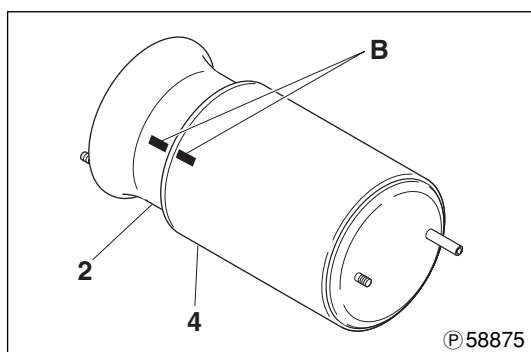


[Installation]

- Coat with tire mounting lubricant the area of diaphragm assembly **4** to which bump stopper **3** is attached

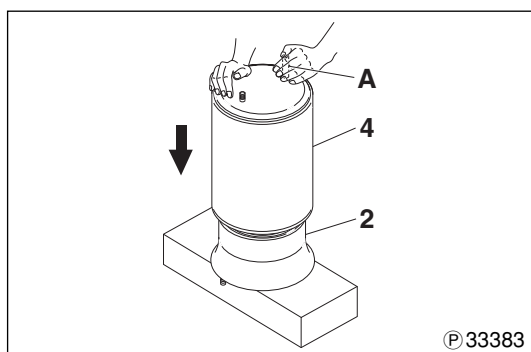


- Put together bump stopper **3** and diaphragm assembly **4** making sure they are in close contact, then install piston **2** and secure it with nut **1**.



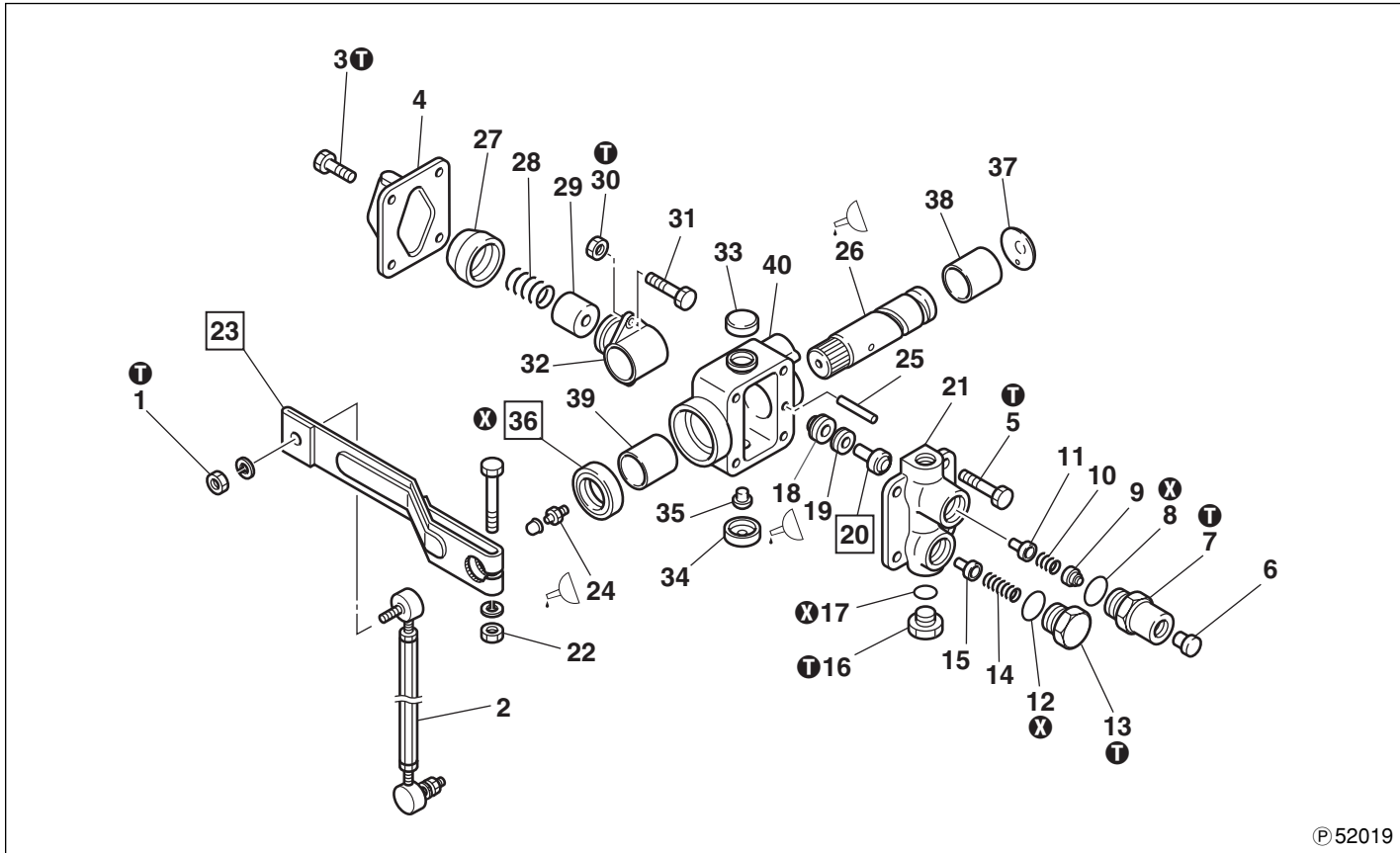
[Inspection]

After installing piston **2** on diaphragm assembly **4**, check marks **B** for correct alignment.



[Adjustment]

With the air spring standing upright, apply a thumb to port **A**, then push down slowly the top of the air spring by hand to expel the air and contact the air spring to a height appropriate for installation on the vehicle.

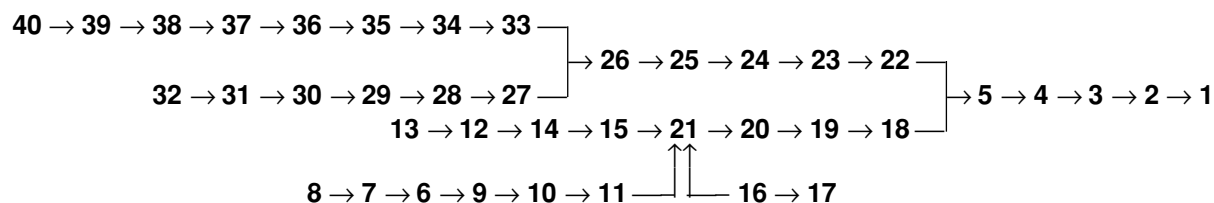


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● Disassembly sequence

- | | | | | | |
|----|---------------|----|--------------------|----|---------------|
| 1 | Nut | 15 | Seal assembly | 29 | Piston |
| 2 | Rod assembly | 16 | Plug | 30 | Nut |
| 3 | Bolt | 17 | O-ring | 31 | Adjuster |
| 4 | Cover | 18 | Nut | 32 | Rocker body |
| 5 | Bolt | 19 | Washer | 33 | Cover |
| 6 | Filter | 20 | Diaphragm assembly | 34 | Cover |
| 7 | Joint | 21 | Valve body | 35 | Filter |
| 8 | O-ring | 22 | Nut | 36 | Oil seal |
| 9 | Seal assembly | 23 | Lever | 37 | Plug |
| 10 | Spring | 24 | Grease nipple | 38 | Bushing |
| 11 | Seal assembly | 25 | Spring pin | 39 | Bushing |
| 12 | O-ring | 26 | Shaft | 40 | Actuator body |
| 13 | Screw plug | 27 | Plug | | |
| 14 | Spring | 28 | Spring | | |
- ⊗ : Non-reusable part

● Assembly sequence



Repair kit: Leveling valve kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
20	Projecting length of diaphragm assembly (stem) when specified air pressure of 590 kPa {174.3 in.Hg, 6 kgf/cm ² } is applied to the inlet side	1.25 ± 0.3 {0.049 ± 0.012}	—	Adjust
23	Dead zone at lever end hole (range where air does not flow in nor out)	8 ± 1 {0.31 ± 0.039}	—	Adjust

T Tightening torque

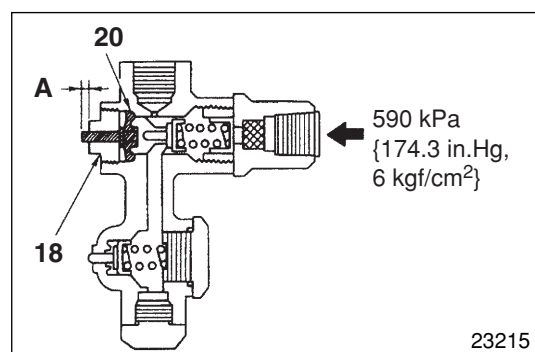
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (for installing rod assembly)	12 to 15 {8.9 to 11, 1.2 to 1.6}	—
3	Bolt (for installing cover)	5.5 to 7.3 {4.1 to 5.4, 0.55 to 0.75}	—
5	Bolt (for installing valve body)	5.5 to 7.3 {4.1 to 5.4, 0.55 to 0.75}	—
7	Joint	20 to 29 {15 to 21, 2 to 3}	—
13	Screw plug	20 to 29 {15 to 21, 2 to 3}	—
16	Plug	16 to 20 {12 to 15, 1.6 to 2.0}	—
30	Nut (for installing adjuster)	5.5 to 7.3 {4.1 to 5.4, 0.55 to 0.75}	—

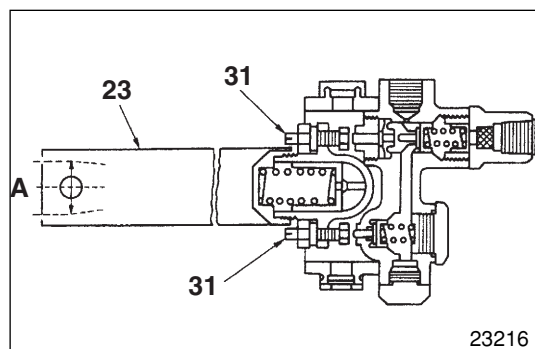
L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
18	Threads of nut	Cemedine No. 575	As required
24	Grease nipple	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
26	Repiphery of shaft	Multipurpose grease [NLGI No. 2 (Li soap)]	As required

◆ Service procedure

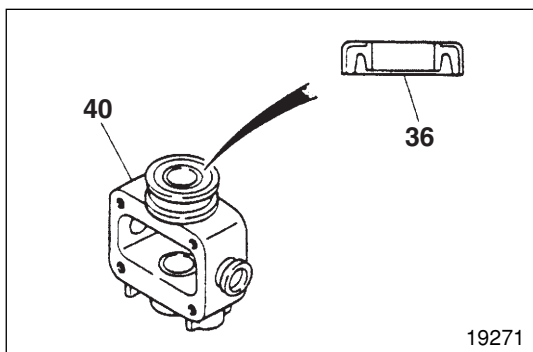
**20** Installation of diaphragm assembly

Install nut **18** such that the projection length **A** of diaphragm assembly **20** (stem) meets the standard value when the specified air pressure of 590 kPa {174.3 in.Hg, 6 kgf/cm²} is applied to the inlet side.

**23** Adjustment of the dead zone at the lever end

Adjust dead zone **A** (lever **23** end hole moving range where no air flow in nor out the valve) for the standard value, using adjuster **31**.

LEVELING VALVE



36 Installation of oil seal

Fit oil seal **36** into actuator body **40** in the direction shown.



35A - Brake <Air Over Hydraulic Brake>

35B - Brake <Full Air Brake>

35C - Anti-lock Brake System (ABS)

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 35A

Brake

<Air Over Hydraulic Brake>

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	35A- 2
STRUCTURE AND OPERATION	35A- 4
TROUBLESHOOTING	35A-23
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Replacement of Brake Fluid	35A-27
• Air Bleeding of Brake System	35A-29
• Inspection and Adjustment of Brake Pedal Free Play	35A-31
• Thickness Inspection and Replacement of Brake Lining	35A-32
• Inspection of Brake Shoe Clearance	35A-32
• Inspection and Maintenance of Air Dryer	35A-32
• Inspection and Adjustment of Air Dryer's Air Pressure Governor	35A-34
HANDLING OF CONNECTOR AND NYLON TUBE PIPING	35A-36
AIR COMPRESSOR	35A-38
AIR DRYER.....	35A-44
BRAKE PEDAL	35A-48
DUAL BRAKE VALVE	35A-50
BRAKE BOOSTER (AIRMASTER)	35A-58
FRONT WHEEL BRAKE	35A-64
< ϕ 320 mm {12.6 in} DRUM BRAKE >	
< ϕ 400 mm {15.7 in} DRUM BRAKE >	
REAR WHEEL BRAKE.....	35A-82
< ϕ 320 mm {12.6 in} DRUM BRAKE >	
< ϕ 400 mm {15.7 in} DRUM BRAKE >	
FLUID TANK	35A-100
CHECK VALVE	35A-101
SAFETY VALVE	35A-101
SUPPLY VALVE	35A-102
EXHAUST BRAKE SYSTEM.....	35A-104

SPECIFICATIONS

< Equipment for Service Brake >

Item		Specifications
Brake booster (Airmaster)	Power cylinder Inner diameter×Stroke mm {in.}	ø114.3×98 {4.50×3.86}
	Hydraulic cylinder Inner diameter×Stroke mm {in.}	ø22.2×95 {0.87×3.74}
	Operating starting pressure kPa {lbs/in ² , kgf/cm ² }	24±9.8 {3.5±1.5, 0.24±0.10}
	Residual pressure kPa {lbs/in ² , kgf/cm ² }	80 to 130 {12 to 19, 0.82 to 1.3}
	Manufacturer	KNORR-BREMZE
Air compressor	Type	Water-cooled one cylinder
	Cylinder diameter×Stroke mm {in.}	ø95×45 {3.74×1.77}
	Cylinder capacity cm ³ {cu.in.}	319 {19.5}
	Manufacturer	SANWA SEIKI
Air dryer	Type	FK61, FM61, FM64
		DU-3
	Heater capacity V-W	12-70
	Thermostat operating temperature °C {°F}	ON 4±4 {39.2±7.2}
		OFF 20 {68} or lower
	Purge chamber capacity L {qts}	1.4 {1.48}
	Required time for recycling desiccant Sec	50
	Manufacturer	Nabtesco
Air tank	Capacity L {qts}	15, 30 (22+8) {16, 31.5 (23+8.5)}

< Wheel Brake >

Item		Specifications	
		FK61	FM61, FM64
Brake type	Front	Drum brake (2-leading type with auto adjuster)	
	Rear	Drum brake (Dual 2-leading type with auto adjuster)	
Brake drum inner diameter	mm {in.}	ø320 {12.6}	ø400 {15.7}
Wheel cylinder inner diameter	Front mm {in.}	ø36.51 {1.44}	ø38.10 {1.50}
	Rear mm {in.}	ø38.10 {1.50}	ø41.3 {1.625}
Brake lining	Front mm {in.}	120×12 {4.72×0.47}	120×15.4 {4.72×0.61}
Width×Thickness	Rear mm {in.}	140×12 {5.51×0.47}	155×15.4 {6.10×0.61}

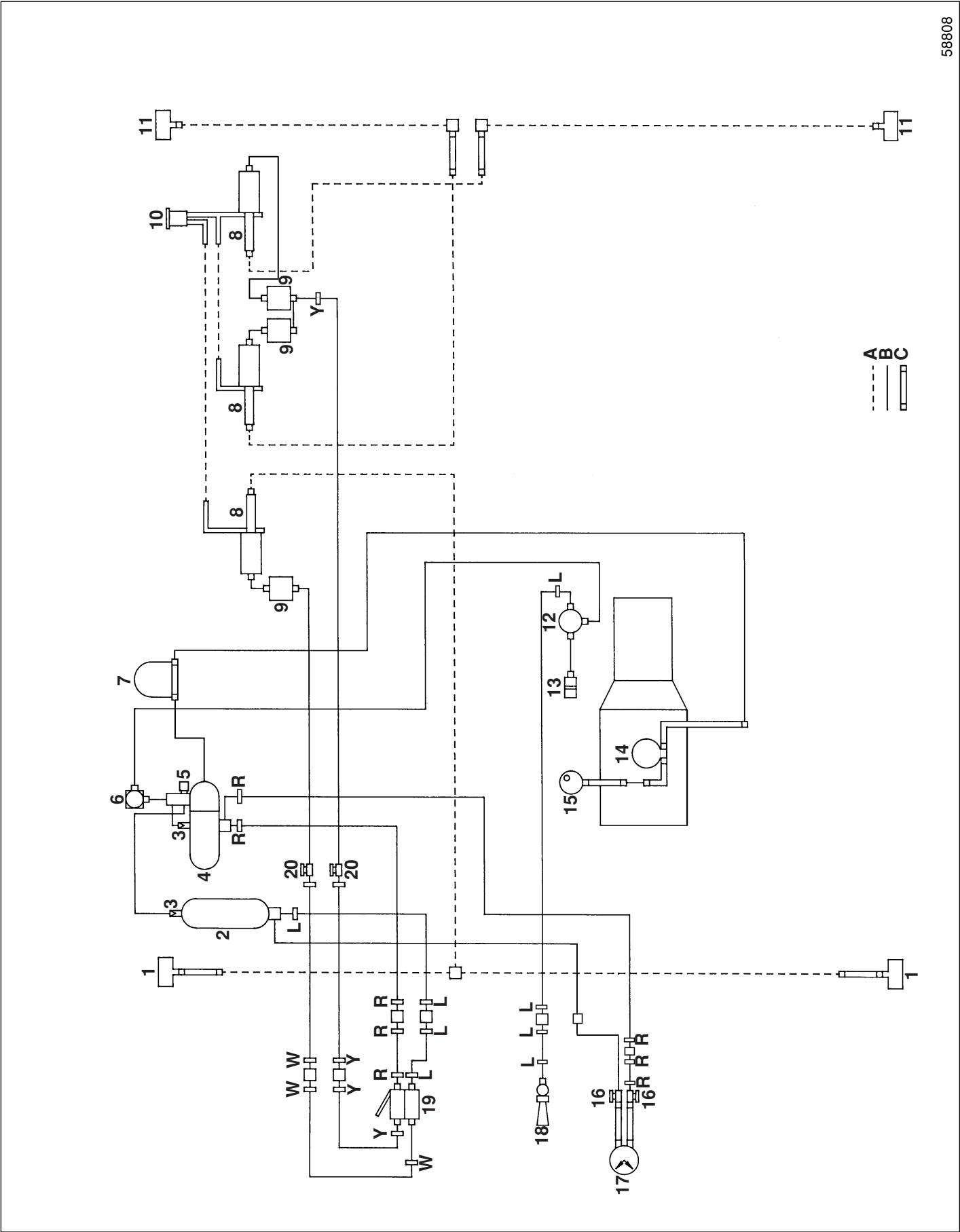
< Exhaust Brake >

Item	Specifications
Control type	Combined electric and air
Valve type	Butterfly valve

MEMO

STRUCTURE AND OPERATION

Brake System



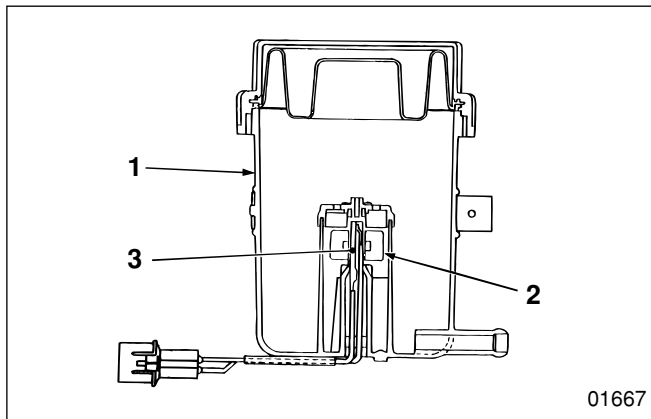
58808

1	Front wheel cylinder	15	Air cleaner
2	Air tank (front)	16	Low air pressure switch
3	Check valve	17	Air pressure gauge
4	Air tank (rear, wet)	18	Air horn
5	Safety valve	19	Dual brake valve
6	Supply valve	20	Stop lamp switch
7	Air dryer		
8	Brake booster	A	: Fluid line
9	Control valve	B	: Air line
10	Brake fluid tank	C	: Hose
11	Rear wheel cylinder	L	: Blue tape
12	3-way magnetic valve	R	: Red tape
13	Exhaust brake unit	W	: White tape
14	Air compressor	Y	: Yellow tape

- The brake system is an air over hydraulic, all wheel brake type consisting of separate front and rear systems.
- The servo system is fitted with brake boosters.
- An exhaust brake system of the exhaust pipe opening and closing valve type, is fitted as a sub-brake system.

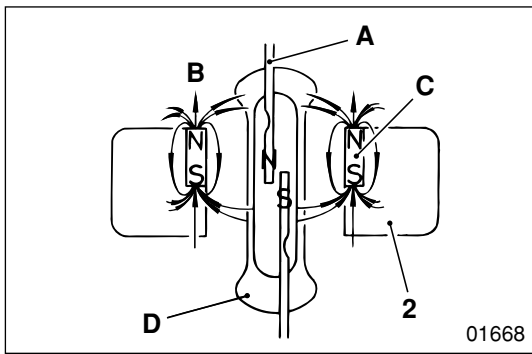
STRUCTURE AND OPERATION

● Brake fluid level switch



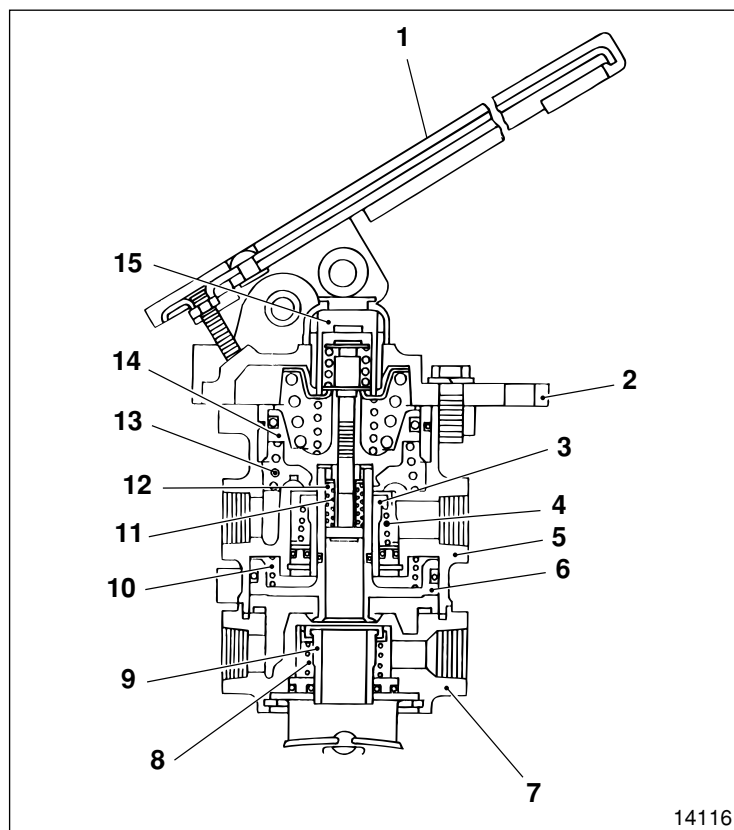
- 1 Fluid tank
- 2 Float
- 3 Brake fluid level switch

- Brake fluid level switch **3**, installed on fluid tank **1**, detects the brake fluid level in the fluid tank. If the brake fluid level drops below the specified level, float **2** moves to turn on the brake fluid level switch and light up the brake fluid warning lamp to alert the driver.



- If the brake fluid level in fluid tank **1** drops and float **2** drops lower than level **L**, magnetic force **B** that passes through the contact points (ferromagnetic material **A**) increase, generating north and south poles at the ends of the contact points. Therefore, the contact points pull each other and overcome the repercussive force of the springs of the contact points, forming an electric circuit.
C : Permanent magnet
D : Glass

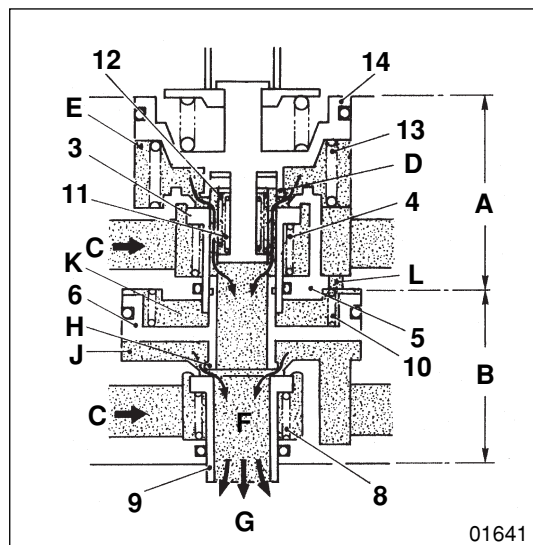
Dual Brake Valve



- 1 Brake pedal
- 2 Plate assembly
- 3 Primary inlet valve
- 4 Primary valve spring
- 5 Body
- 6 Relay piston
- 7 Cover
- 8 Secondary valve spring
- 9 Secondary inlet valve
- 10 Relay piston spring
- 11 Inner spring
- 12 Outer spring
- 13 Primary piston spring
- 14 Primary piston
- 15 Plunger

The dual brake valve controls the braking force of the vehicle by feeding pressurized air to the airmaster in accordance with the brake pedal depression angle of brake pedal 1.

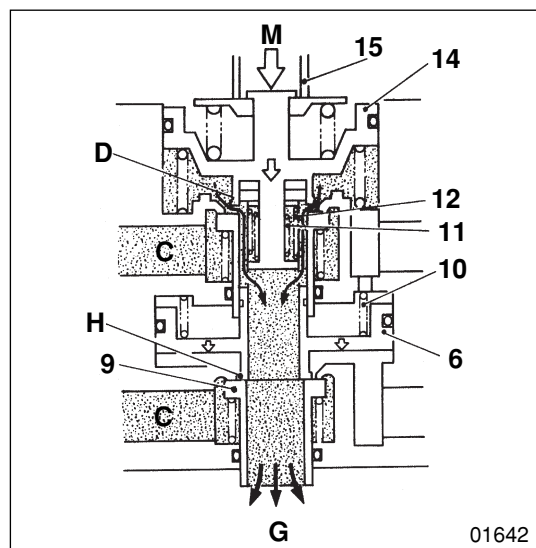
● When brake not operating



- The percussive forces of primary valve springs 4, secondary valve spring 8 seat primary inlet valve 3 at primary side A, and inlet valve 9 at secondary side B, on their respective seats. This shuts off air C from the air tank to maintain airtightness.
- The percussive force of primary piston spring 13 raises primary piston 14 to its upper position. Exhaust valve seat D opens and chamber E is open to atmosphere G via chamber F.
- Since the percussive forces of inner spring 11 and outer spring 12 is stronger than the percussive force of relay piston spring 10, relay piston 6 is raised to its upper position and exhaust valve seat H is opened. This opens chamber J to atmosphere G via chamber F. Chamber E at the primary side and chamber K at the upper part of relay piston 6 at the secondary side are connected via passage port L of body 5.

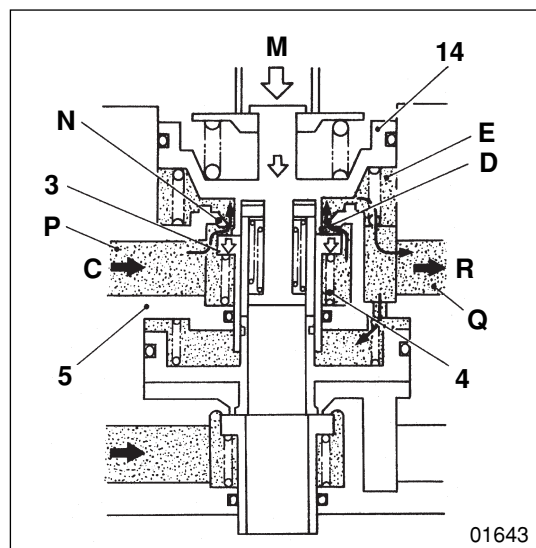
STRUCTURE AND OPERATION

● When depressing brake pedal (before braking pressure is generated)



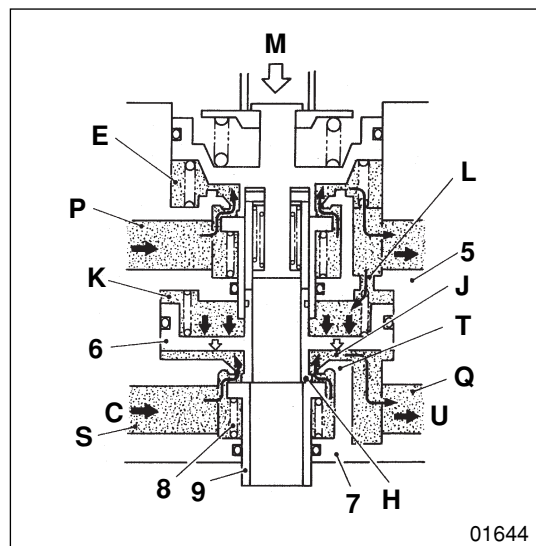
- Depressing the brake pedal (illustrated as pedal action **M**), forces down primary piston **14** via plunger **15**.
- Forcing down primary piston **14** changes the balance between the repercussive forces of inner spring **11** and outer spring **12**, and the repercussive force of relay piston spring **10**, forcing down relay piston **6**. This seats the relay piston on secondary inlet valve **9** and closes exhaust valve seat **H**.
- This closes the secondary side exhaust passage; however, primary side exhaust valve seat **D** remains open. No braking pressure is generated at either primary or secondary sides.

● When depressing brake pedal (braking pressure is generated)



Primary side

- As the brake pedal is depressed further (illustrated as brake pedal action **M**), primary piston **14** is forced down until it is seated on primary inlet valve **3**, closing exhaust valve seat **D**.
- Primary inlet valve **3** is forced down, compressing primary valve spring **4**, and supply valve seat **N** of body **5** separates from the primary inlet valve. The air in chamber **P** flows into chamber **E** and is fed to rear brake system **R** via discharge port **Q** as braking pressure.

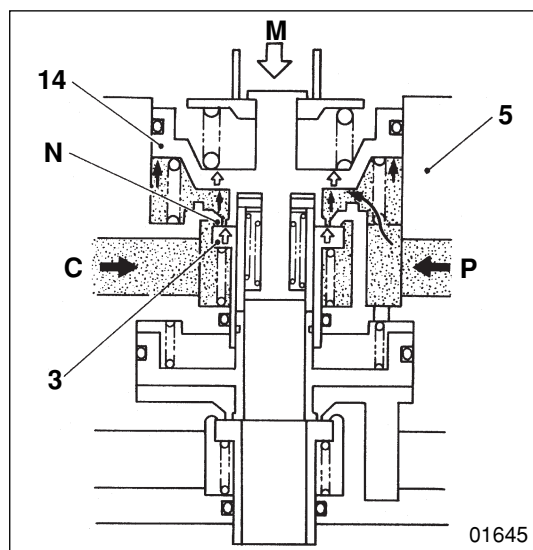


Secondary side

- The air at the primary side flows into chamber **K** via passage port **L** of body **5**.
- The air fed into chamber **K** acts on the upper part of relay piston **6** to force down the relay piston and compress secondary valve spring **8**, forcing down secondary inlet valve **9**.
- This separates supply valve seat **T** and secondary inlet valve **9** of cover **7**.
- The air in supply port chamber **S** flows into chamber **J** and is fed to front brake system **U** via discharge port **Q** as braking pressure.

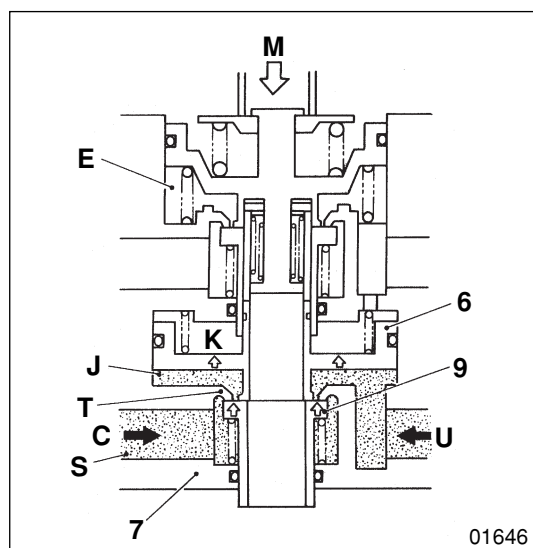
● Stabilization of braking pressure

When the brake pedal remains depressed at the specified depression angle, the braking air pressure stabilizes at the pressure corresponding to the brake pedal depression angle.



Primary side

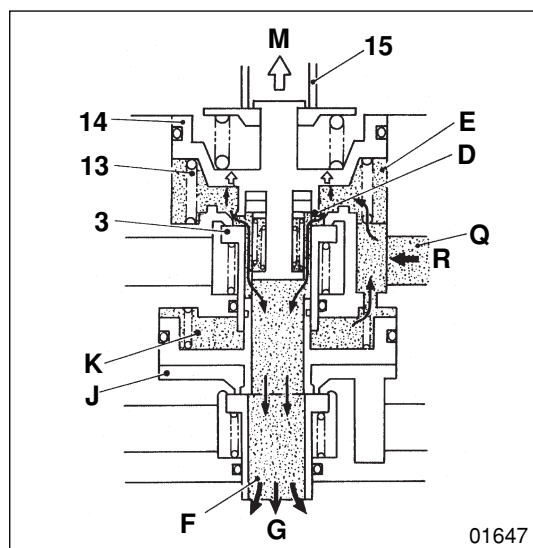
- The braking air pressure fed under the bottom of primary piston 14 raises the primary piston and primary inlet valve 3 together in tandem.
- Primary inlet valve 3 makes contact with supply valve seat N of body 5, then the supply of air C from the air tank ceases and the increases in the braking air pressure stops. This stabilizes braking pressure R for the rear brake system.



Secondary side

- As the braking pressure (pressure in chamber J) for the front brake system balances the pressures in chambers E and K, the force raising relay piston 6 disappears, and the relay piston rises in tandem with secondary inlet valve 9.
- Secondary inlet valve 9 makes contact with supply valve seat T of cover 7, then the supply of air from supply port chamber S to chamber J ceases. This stabilizes brake pressure U for the front system.

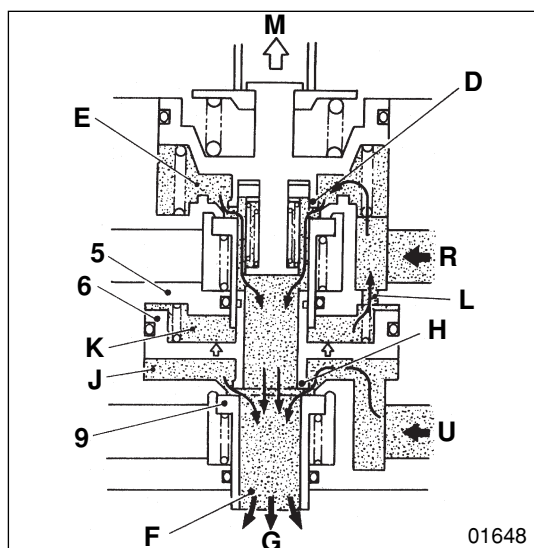
● Release of brake pressure



Primary side

When the brake pedal is released (illustrated as brake pedal action M), primary piston spring 13 and air pressure R at discharge port Q (pressure in chamber E) raise plunger 15 and primary piston 14. Then, exhaust valve seat D at the lower end of the primary piston separates from primary inlet valve 3. The air pressure of the rear brake system flows through chamber E to be discharged from exhaust passage chamber F into atmosphere G.

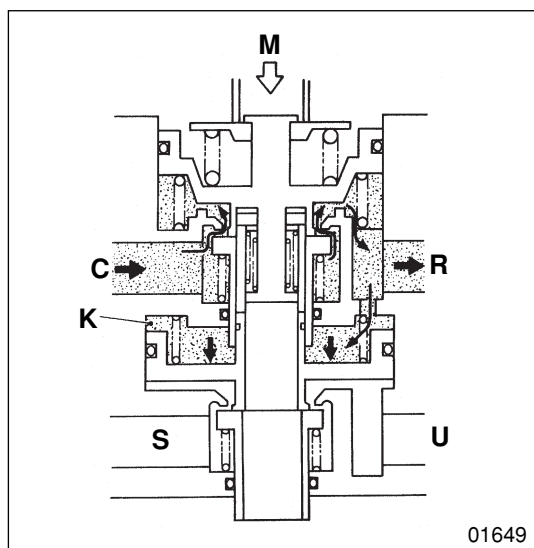
STRUCTURE AND OPERATION



Secondary side

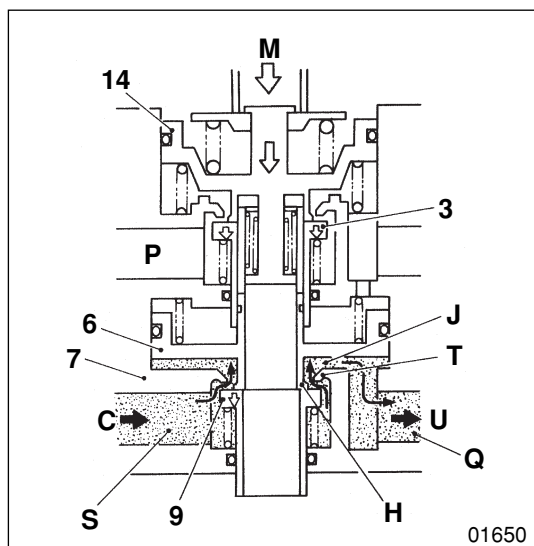
- As the air pressure in the rear brake system drops, the air pressure in chamber **K** is discharged via passage port **L** of body **5**, and chambers **E**, **F** into atmosphere **G**.
- This changes the air pressure balance between chambers **K** and **J**. The air pressure in chamber **J** raises relay piston **6**, and exhaust valve seat **H** at the lower end of the relay piston separates from secondary inlet valve **9**. Air pressure **U** in the front brake system is discharged from exhaust passage chamber **F** into atmosphere **G**.

● When abnormality occurs



Operation when the air pipe of the front brake system fails

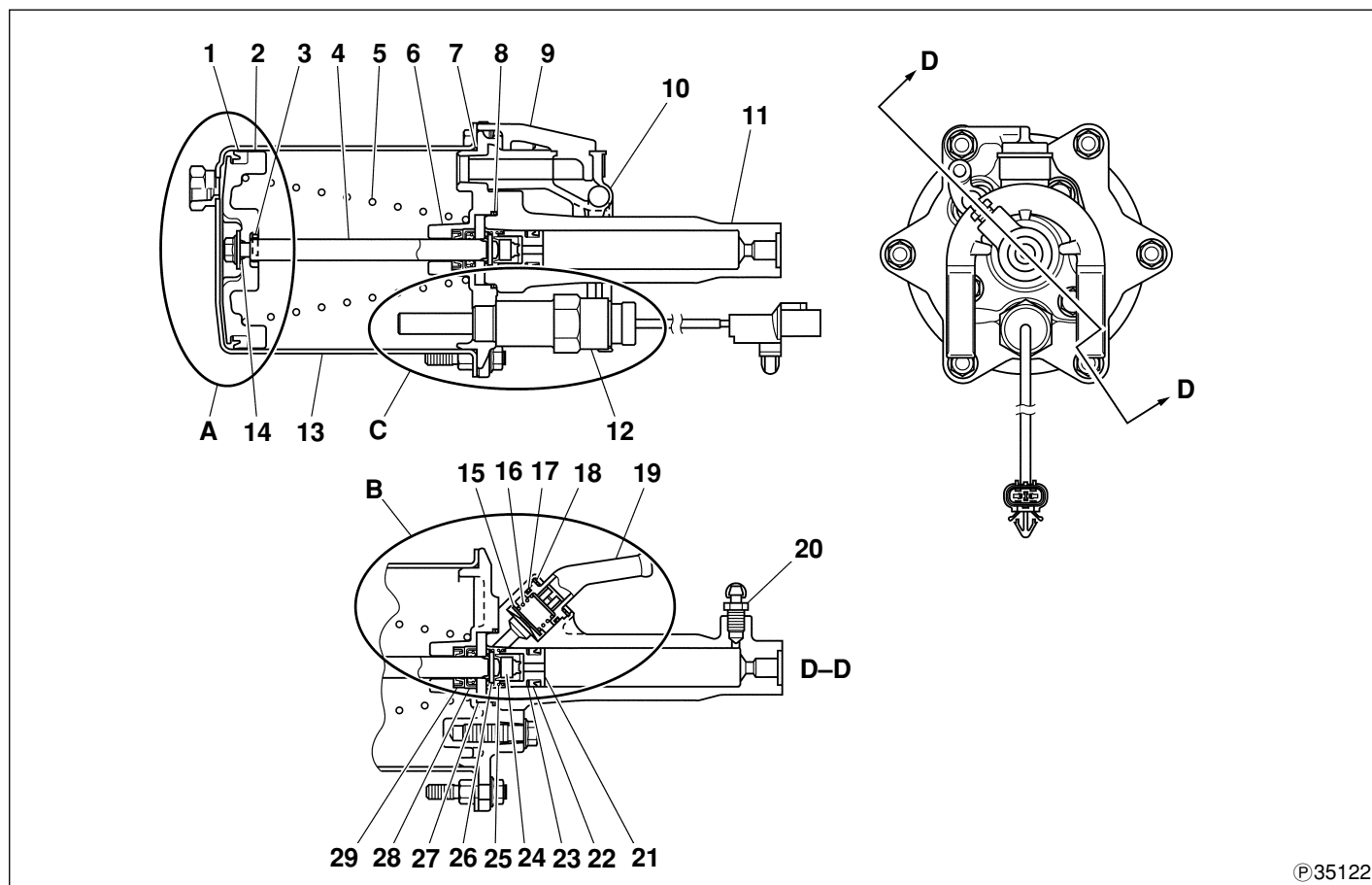
- The primary side operates the same as normal, generating braking pressure in rear brake system **R**.
- At the secondary side, even if the primary side generates air pressure in chamber **K**, braking pressure is not generated in front brake system **U**, since no air pressure is generated in supply port **S**.



Operation when the air pipe of the rear brake system fails

- In the rear brake system, air pressure is not generated up to supply port **P**. Therefore, even if the brake pedal is depressed (causing primary piston **14** to force down primary inlet valve **3**), braking pressure is not generated.
- If the brake pedal is depressed further (illustrated as brake pedal action **M**), primary piston **14** makes contact with relay piston **6** and they force down secondary inlet valve **9**.
- This action separates supply valve seat **T** of cover **7** from secondary inlet valve **9**. The air pressure flows into chamber **J** from chamber **S** and is fed to front brake system **U** via discharge port **Q** as braking pressure.

Brake Booster

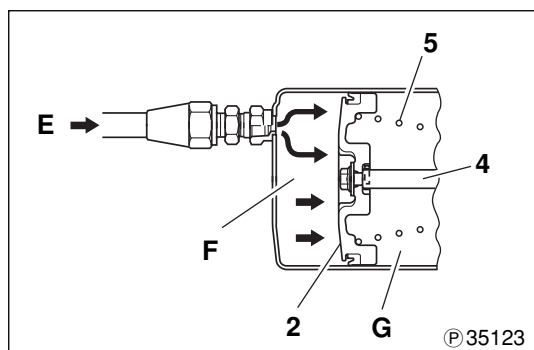


© 35122

- | | | |
|--------------------------------|------------------------|-----------------|
| 1 Cup packing | 13 Cylinder shell | 25 Spring |
| 2 Piston plate | 14 O-ring | 26 Straight pin |
| 3 Straight pin | 15 Valve assembly | 27 Washer |
| 4 Push rod | 16 Spring | 28 Oil seal |
| 5 Return spring | 17 O-ring | 29 Oil seal |
| 6 End plate | 18 Retaining ring | |
| 7 O-ring | 19 Connector assembly | |
| 8 O-ring | 20 Plug | |
| 9 Holder | 21 Hydraulic piston | |
| 10 Exhaust cover | 22 Cup packing | |
| 11 Hydraulic cylinder | 23 Backup ring | |
| 12 Brake booster stroke switch | 24 Valve seal assembly | |

- A** : Power cylinder section
B : Hydraulic piston section
C : Brake booster stroke switch section

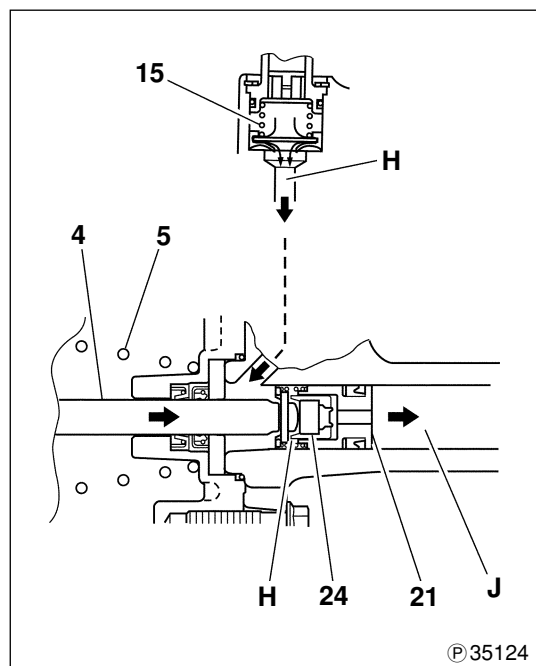
● Power cylinder section



- The action of the dual-brake valve sends compressed air **E** into chamber **F**, which applies pressure to piston plate **2**. Since chamber **G** is open to the atmosphere, an internal pressure difference is created between chambers **F** and **G**. When the force of the pressure difference exceeds the force of return spring **5**, the piston plate moves toward the right.
- Piston plate **2** is attached to push rod **4**. The piston plate transmits the force applied by compressed air to the hydraulic piston section.

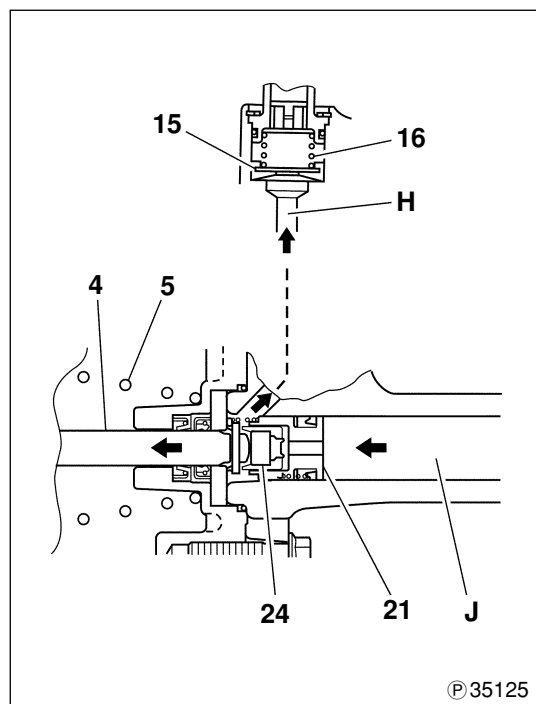
STRUCTURE AND OPERATION

● Hydraulic piston section



When brake is applied

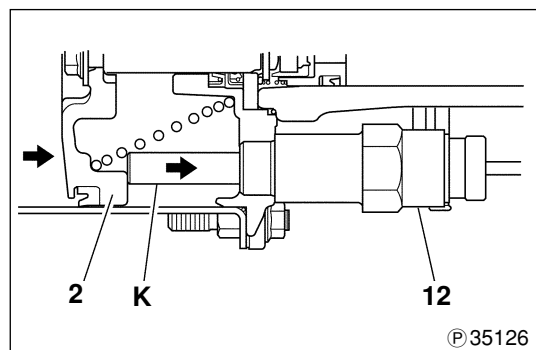
- The movement of piston plate 2 compresses return spring 5, pushes push rod 4, and moves hydraulic piston 21 to the right.
- Valve seal assembly 24 contacts the seat surface of hydraulic piston 21. As a result, the passage between chamber H on the fluid tank side and chamber J on the wheel cylinder side closes, and applies pressure to the brake fluid inside chamber J. This pressure force is transmitted to the wheel cylinder.
- The movement of hydraulic piston 21 increases the volume of chamber H and causes negative pressure in the chamber. As a result, the valve in valve assembly 15 opens, and allows brake fluid to flow from the fluid tank into the valve assembly.



When brake is released

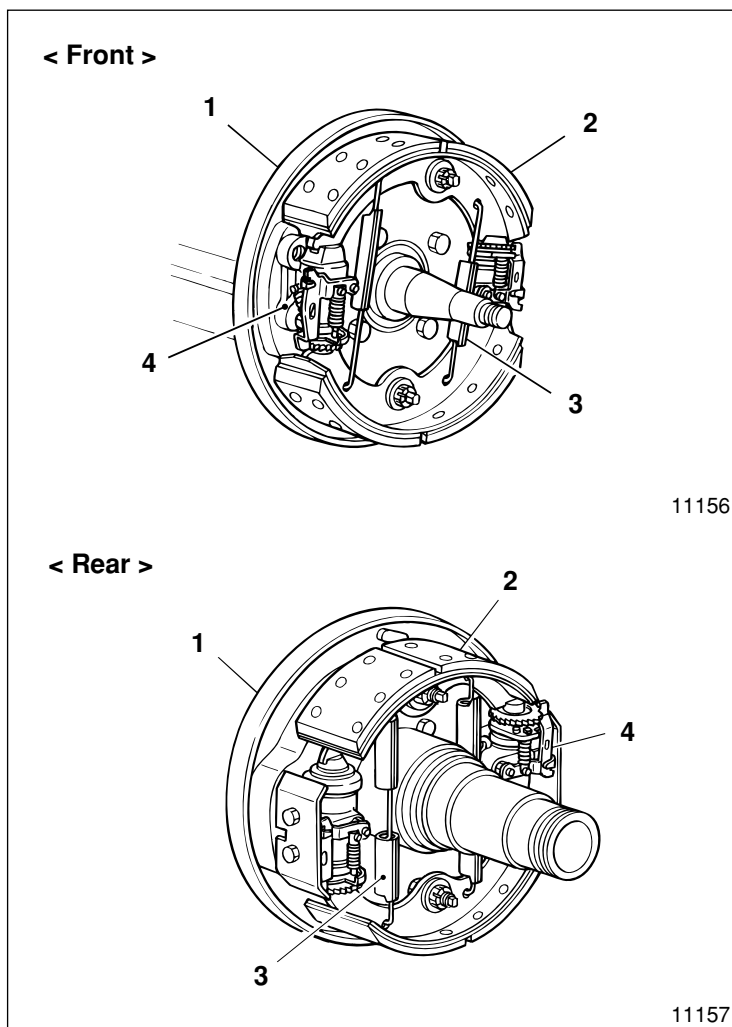
- When the brake pedal is released, compressed air behind piston plate 2 is released to the atmosphere. Hydraulic piston 21 is forced back to the original position by return spring 5 on push rod 4 and the pressure of the brake fluid in chamber J. When valve seal assembly 24 contacts push rod 4, the passage between chambers H and J opens.
- Brake fluid passes through chamber H, compresses spring 16 in valve assembly 15 < not provided in disk brake system >, then flows around the valve assembly and return to the fluid tank.
- Valve assembly 15 remains at a position where the brake fluid pressure is in balance with the force of spring 16.

● Brake booster stroke switch section



- If the brake lining is worn or brake fluid leaks due to damaged brake pipe, the stroke of piston plate 2 increases and causes the piston plate to contact the tip of rod K, thus moving the rod to the right.
- When the rod moves to the right, it activates brake booster stroke switch 12, which in turn lights the warning lamp on the meter cluster to warn the driver.

Wheel Brake

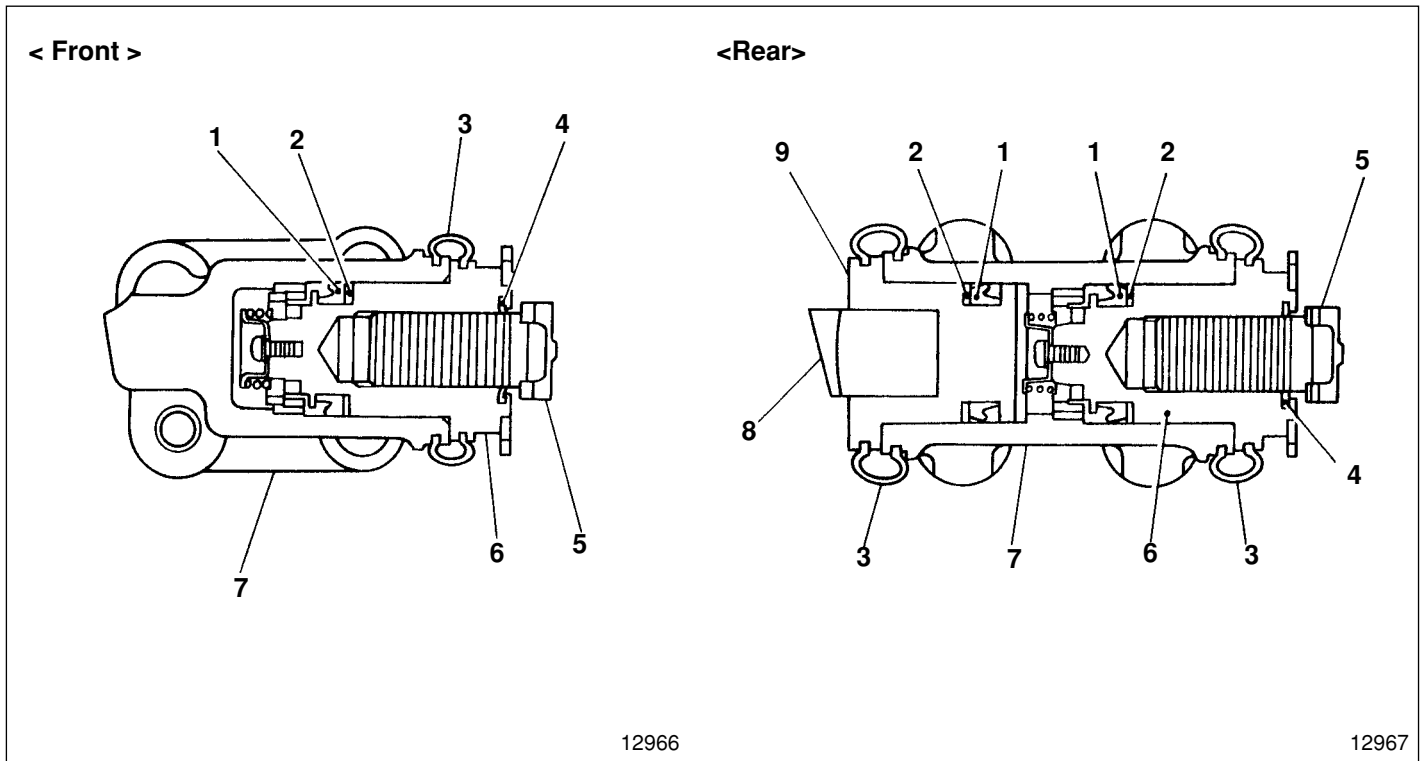


- 1 Backing plate
- 2 Brake shoe assembly
- 3 Return spring
- 4 Wheel cylinder assembly

- The front wheel brake is an internal expanding 2-leading brake type.
- The rear wheel brake is an internal expanding dual 2-leading brake type.
- Front and rear wheel cylinder assemblies 4 have shoe clearance automatic adjusting mechanisms to maintain the shoe clearance within a specific range.

STRUCTURE AND OPERATION

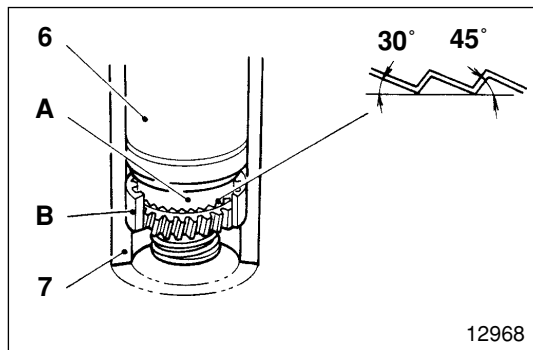
Wheel Cylinder <φ 320 mm {12.6 in.} Drum brake>



- | | |
|---------------|-------------------|
| 1 Piston cup | 6 Piston assembly |
| 2 Backup ring | 7 Cylinder body |
| 3 Boot | 8 Anchor piece |
| 4 Seal | 9 Anchor piston |
| 5 Screw | |

- The automatic brake shoe clearance adjuster automatically adjusts the brake shoe clearance to the proper setting when the brake is applied during forward moving as the brake lining wears and the brake shoe clearance becomes higher than the specified value.
- For vehicles with wheel parking, the adjuster automatically adjusts the clearance of lower shoe when the brake is applied during forward moving, and upper shoe when the brake is applied during backward moving.

● Automatic adjusting mechanism

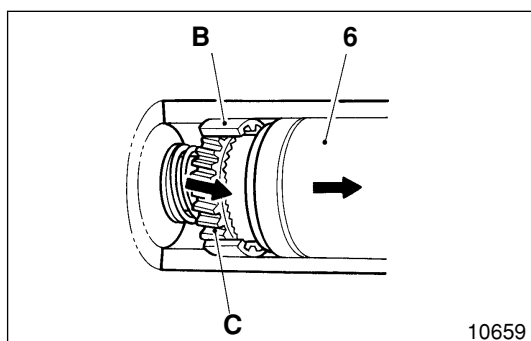


30 degrees: When piston 6 protrudes, double helical gear tends to be displaced.

45 degrees: When piston 6 is rotated, it can receive and retain a force.

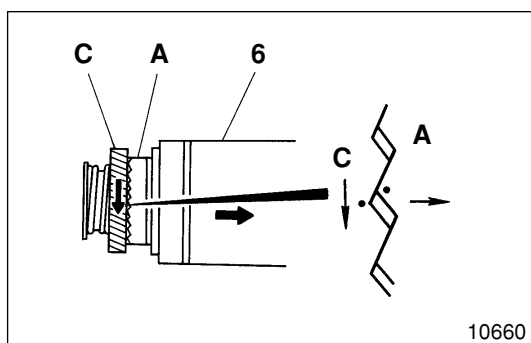
A : Clutch

B : Guide

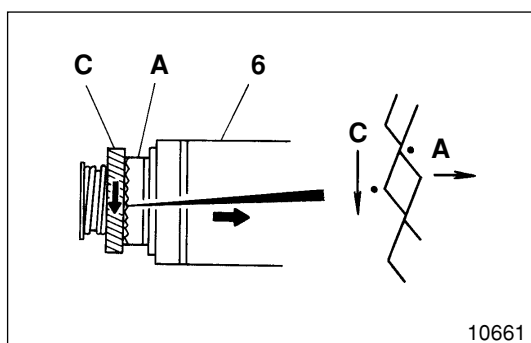


When brake action starts

- When brake fluid pressure acts on the wheel cylinder, piston **6** is pushed out forward.
- Idler **C** of piston **6** pushed out, which is engaged with diagonally cut gears on the inside of guide **B** of the cylinder body, moves forward while rotating, corresponding to the movement amount of the piston.

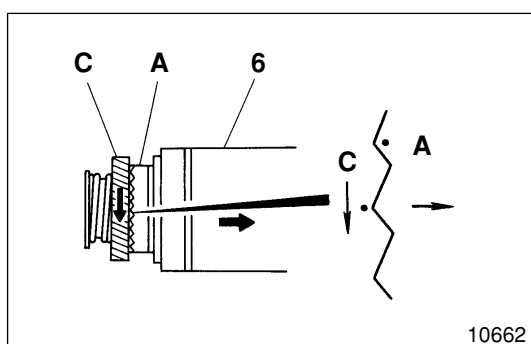


- A double helical gear of clutch **A** is displaced by rotation of idler **C**.



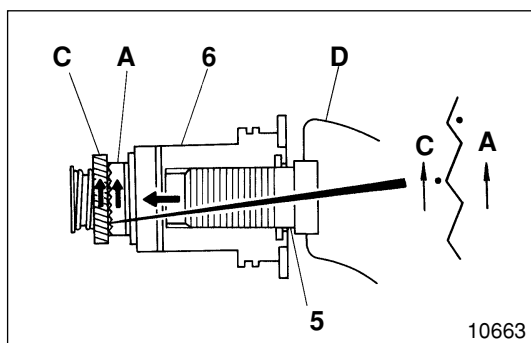
When brake shoe clearance is within the specified value

The rotation amount of idler **C** is proportional to the movement amount of piston **6**. When brake shoe clearance is within the specified value, there is no rotation amount that allows a double helical gear of clutch **A** to override.



When brake shoe clearance is higher than the specified value

When brake shoe clearance becomes higher than the specified value, the rotation amount of idler **C** becomes large to such extent that a double helical gear of clutch **A** overrides a tooth, engaging with the next double helical gear.



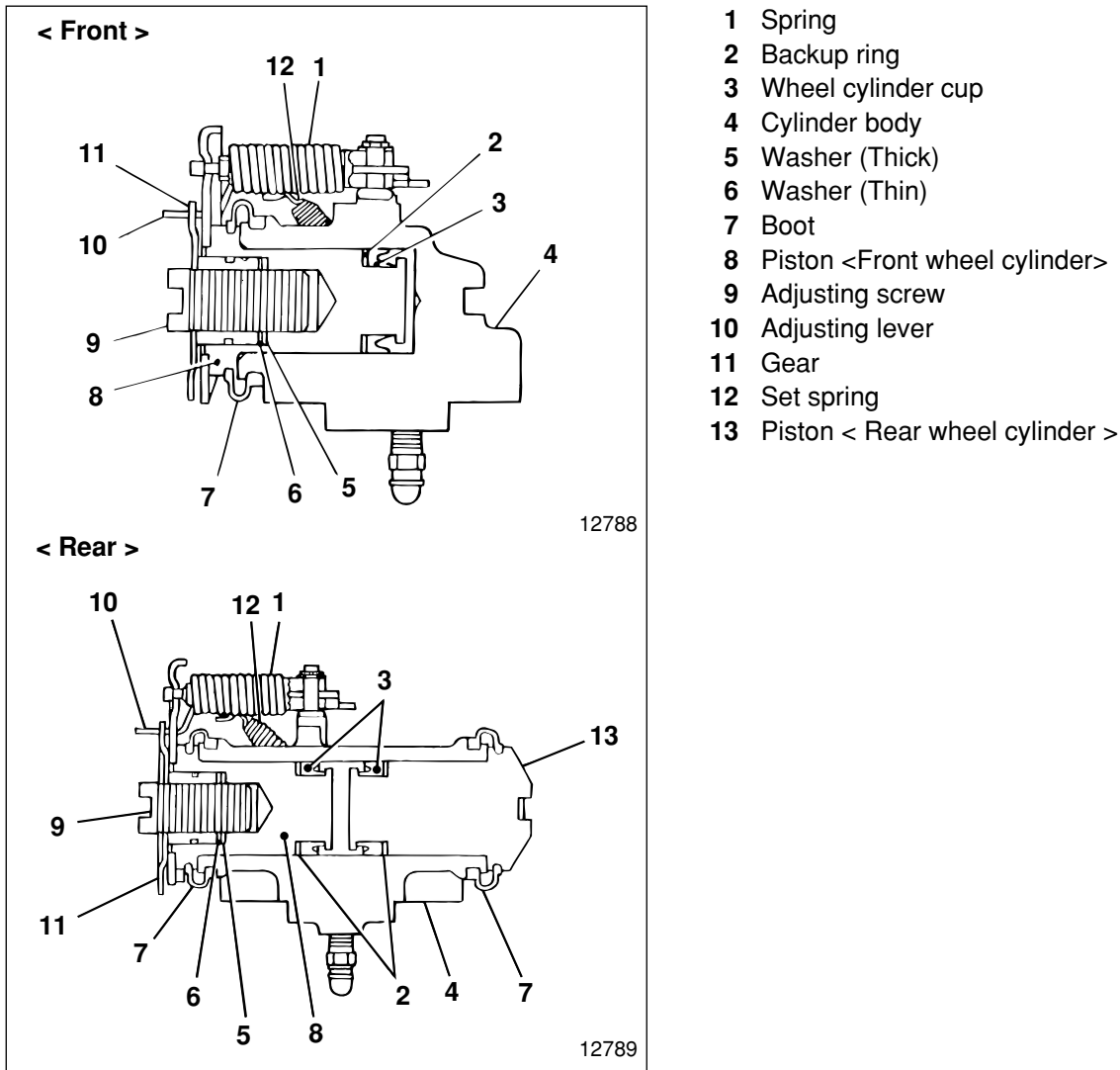
When brake is released

- As brake fluid pressure decreases and piston **6** is returned, idler **C** also returns while counterrotating along guide **B** of the cylinder body.
- When brake shoe clearance is within the specified value, as a double helical gear of clutch **A** does not override, piston **6** returns to its original position without rotating.
- When brake shoe clearance is higher than the specified value, as a double helical gear of clutch **A** has overridden one tooth, piston **6** is returned while rotating by one tooth.

As a result, as screw **5** of the piston, fixed by brake shoe **D**, does not rotate, only the piston returns, causing brake shoe clearance to decrease to be within the specified value.

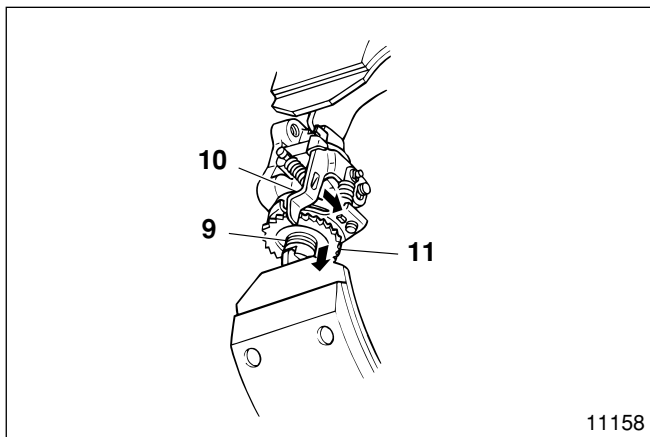
STRUCTURE AND OPERATION

Wheel Cylinder Assembly <φ 400 mm {16.7 in.} Drum brake>

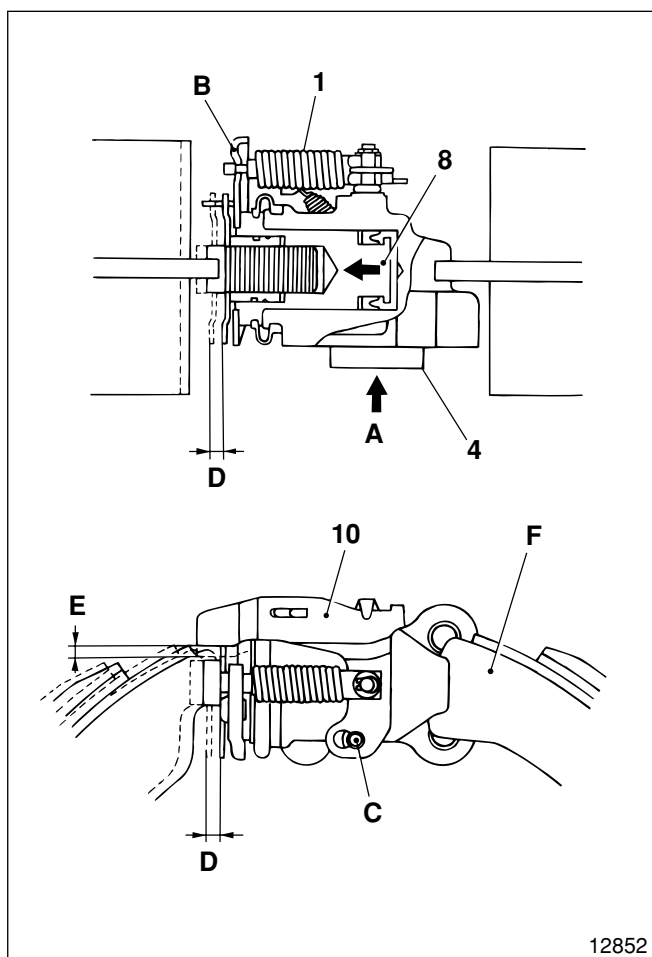


The automatic shoe clearance adjuster automatically adjusts the brake shoe clearance as the lining wears and the brake shoe clearance becomes higher than the specified value.

● Operation of automatic shoe clearance adjusting mechanism



Adjusting lever **10** turns adjuster **11** to push out screw **9**, maintaining correct shoe clearance.



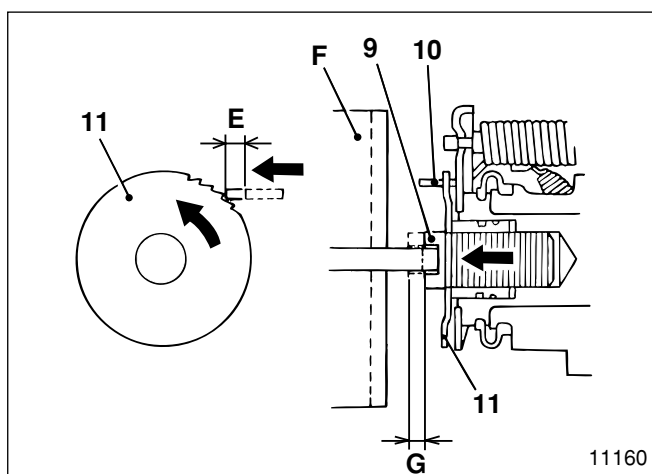
When depressing brake pedal

- Hydraulic pressure **A** acts on cylinder body **4** to push piston **8** forward.
- As spring hanger **B** of piston **8** is pushed forward, spring **1** which is connected to the spring hanger is pulled, and adjuster lever **10** turns around pin **C**.

D : Travel of piston **8**

E : Travel of adjusting lever **10**

F : Brake shoe assembly



When the brake shoe clearance conforms to the specified value

- When the brake shoe clearance conforms to the specified value, the amount of travel of piston **8** is small. Therefore, the amount adjusting lever **10** turns is less than a one-tooth pitch of gear **11** and the gear does not turn, so no adjustment is made.

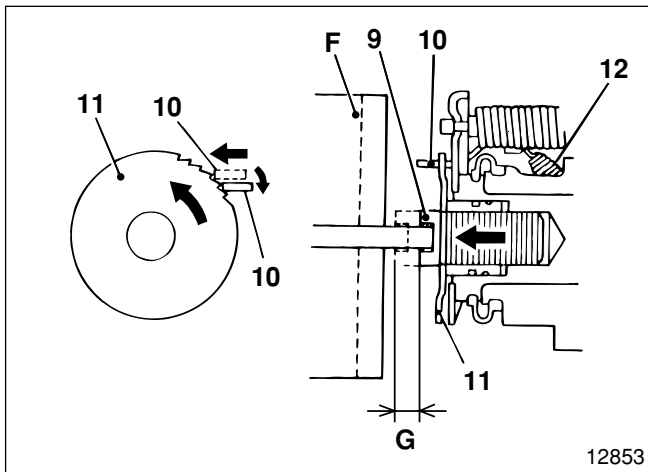
E : Travel of adjusting lever **10**

F : Brake shoe assembly

G : Travel of adjusting screw **9**

- When the brake pedal is released, adjusting lever **10** does not climb one tooth of gear **11**, so the original engagement is maintained.

STRUCTURE AND OPERATION



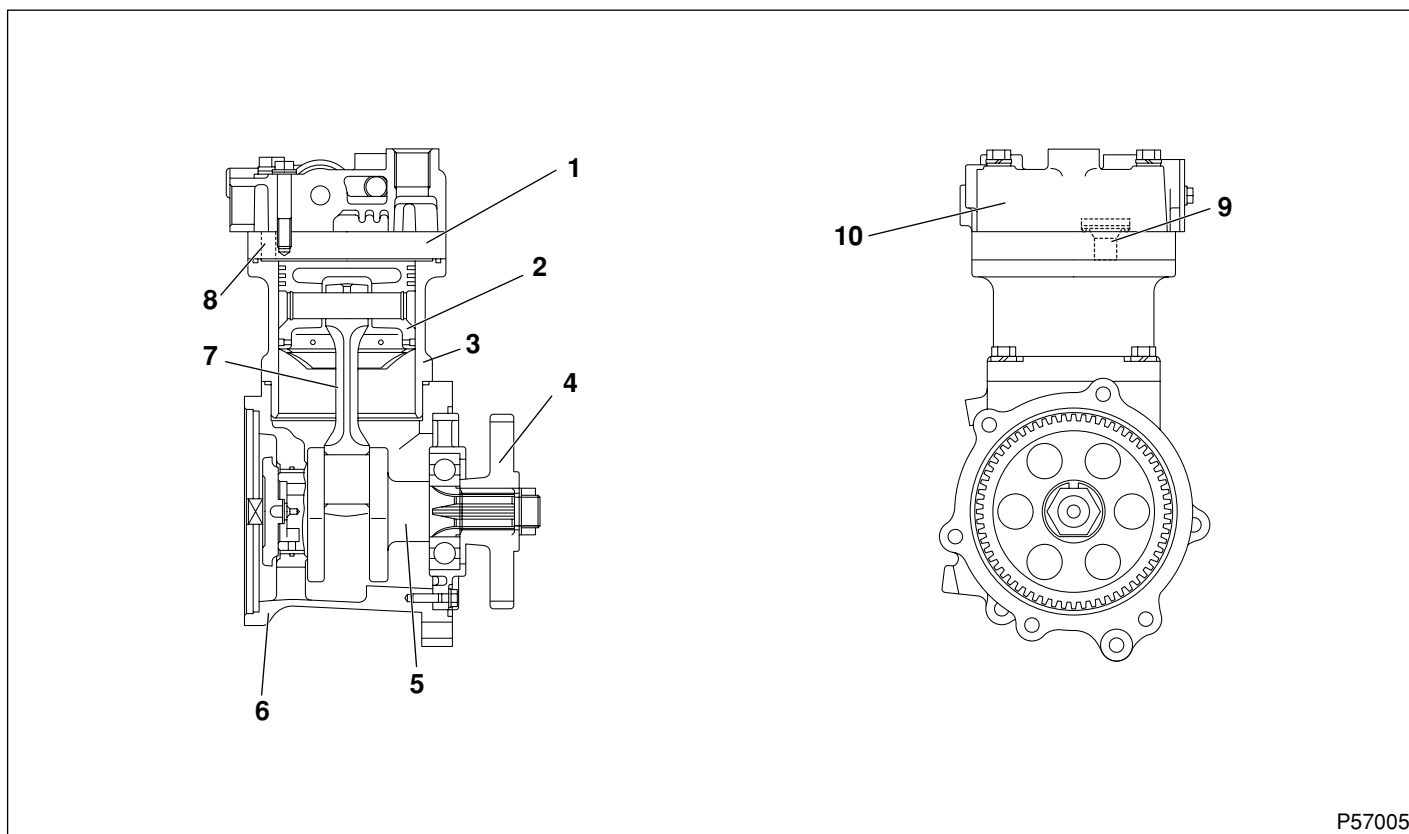
When the brake shoe clearance is higher than the specified value

- When the brake shoe clearance is higher than the specified value, the amount of travel of piston 8 is large. Therefore, adjusting lever 10 and gear 11 turn by a greater amount.
- The further gear 11 turns, the further adjusting screw 9 is pushed out. This regulates the brake shoe clearance to an amount within the specified value.
- When the brake pedal is released, gear 11 maintains the position after turning. Adjusting lever 10 climbs one tooth of the gear due to the action of set spring 12 to change the engagement, and is returned to the original position.

F : Brake shoe assembly

G : Travel of adjusting screw 9

Air Compressor



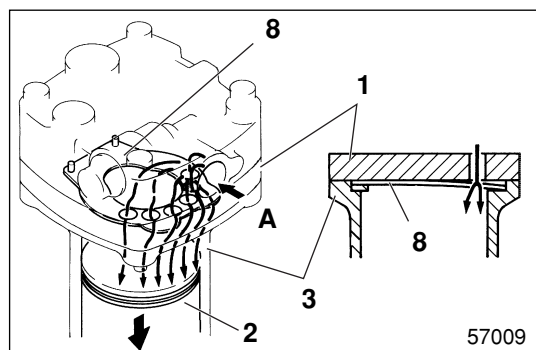
P57005

- 1 Valve seat assembly
- 2 Piston
- 3 Cylinder liner
- 4 Gear

- 5 Crankshaft assembly
- 6 Crankcase assembly
- 7 Connecting rod
- 8 Suction valve

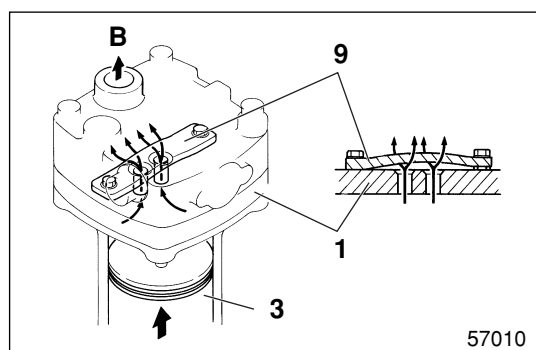
- 9 Delivery valve
- 10 Cylinder head assembly

● During suction



During suction

- When piston 2 moves up and the intake stroke begins, suction valve 8 opens by negative pressure of air, and air A is sucked into cylinder liner 3.

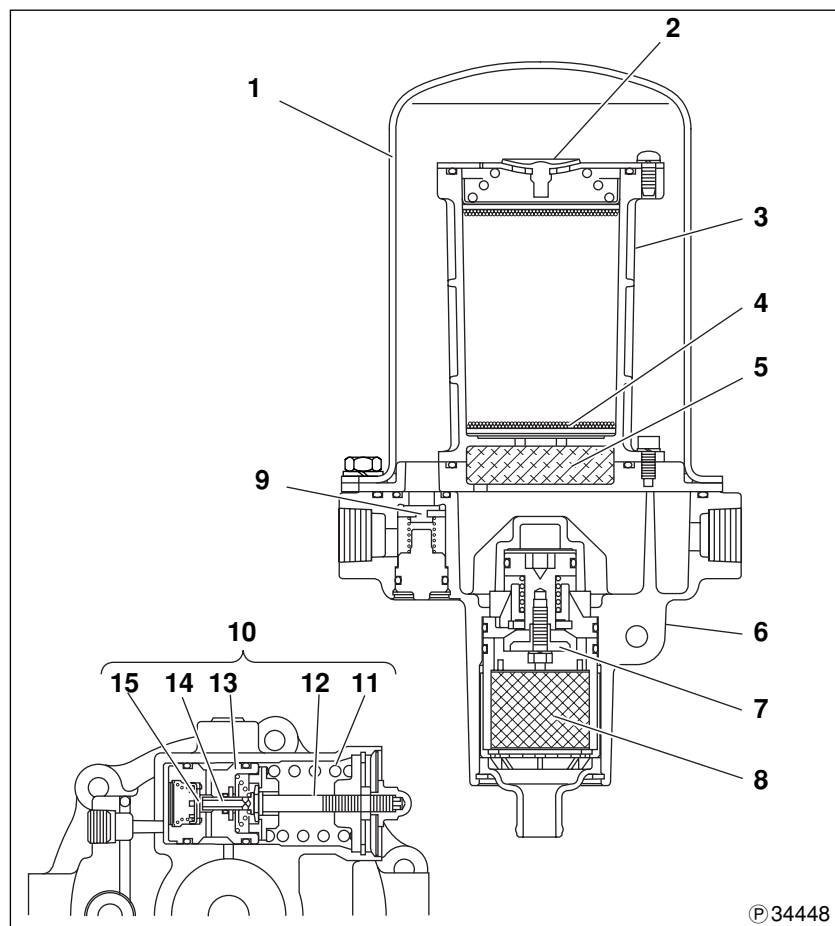


During force feeding

- When piston 2 moves down and the force feeding stroke begins, suction valve 8 in the preceding item is closed by air pressure B.
- Air pressure B compressed by piston 2 pushes open delivery valve 9, and is force fed to the air drier and air tank.

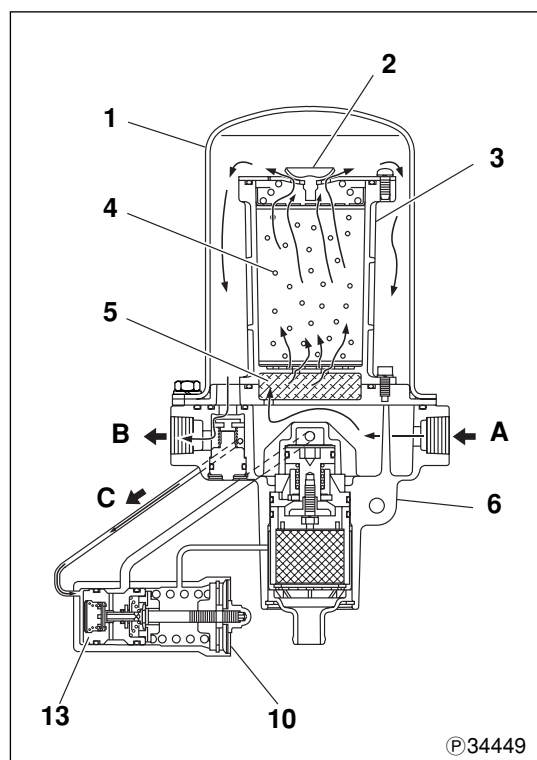
STRUCTURE AND OPERATION

Air Dryer



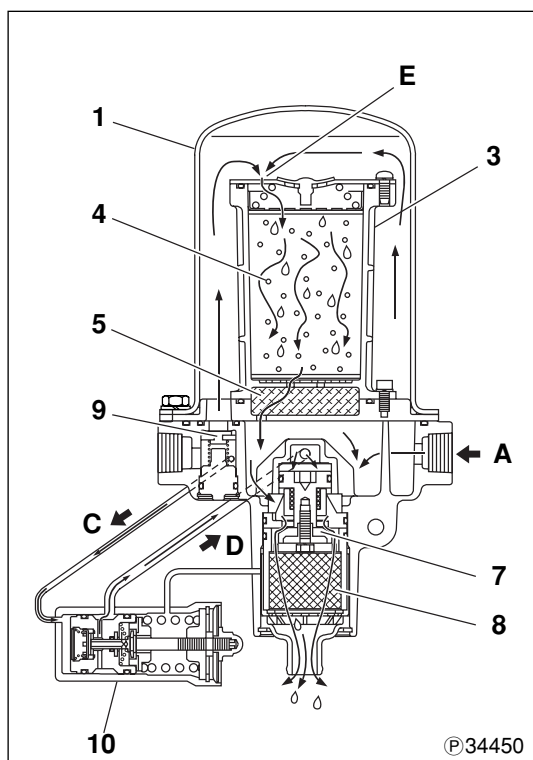
- 1 Purge chamber
- 2 Check valve
- 3 Case
- 4 Desiccant
- 5 Oil filter
- 6 Body
- 7 Valve
- 8 Silencer
- 9 Check valve
- 10 Air pressure governor
- 11 Spring
- 12 Adjusting screw
- 13 Piston
- 14 Exhaust stem
- 15 Valve

- The air dryer protects brake components by removing moisture and oil from air that has been compressed by the air compressor.
- The air dryer incorporates an air pressure governor **10**, which keeps the pressure in the air tank constant by releasing air compressed by the air compressor to the atmosphere when the pressure in the air tank makes such operation necessary.



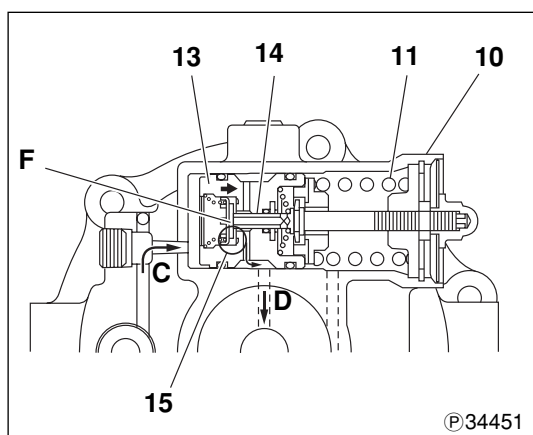
Drying action

- While the air tank is being charged, air from the air compressor enters the air dryer's supply side **A**. Moisture and oil are separated from the air inside the body **6** and collect in the bottom. The air then passes through the oil filter **5**, which removes smaller oil droplets and particles of dust. The air then flows into the case **3**, where any remaining moisture is removed by the desiccant **4**.
- As the air flows upward in the case **3**, it makes contact with increasingly dry desiccant **4** and thus contains less and less moisture. When the air reaches the top of the case, it is dry. It flows through the check valve **2**, purge chamber **1**, and check valve **9**, and it is then supplied from the delivery side **B** to the air tank. Air pressure **C** also acts upon the piston **13** in the air pressure governor **10**.



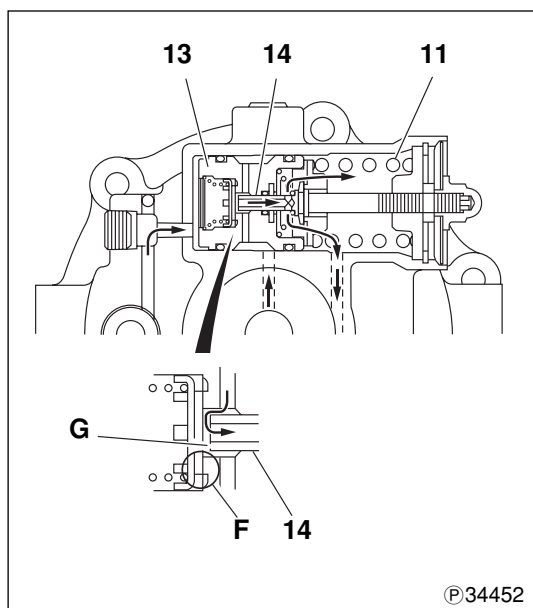
Regeneration of desiccant

- When the air pressure in the air tank reaches the upper threshold level, signal pressure **D** from the air pressure governor **10** causes the valve **7** in the air dryer's control port to open. As a result, the pressure in the case **3** cleans the oil filter **5** and pushes the water and oil out into the atmosphere.
- Following the rapid drop in pressure, dry air in the purge chamber **1** flows through the orifice **E**, expands, and becomes super-dry. As this super-dry air flows backward through the case **3**, it carries moisture from the desiccant **4** out into the atmosphere, thereby completing the desiccant's regeneration.
- During the regeneration process, the check valve **9** is closed. Thus, the signal pressure **D** from the air pressure governor **10** continues to act upon the control port and the valve **7** remains open. Air from the air compressor thus flows through the valve, through the silencer **8**, and out into the atmosphere.
- The regeneration process continues until air consumption causes the pressure in the air tank to decrease to the lower threshold level.



Operation when tank pressure reaches upper threshold level

- Air pressure **C** from the air tank continuously acts upon the piston **13**.
- When the tank pressure increases to such a level that it overcomes the spring **11**, it pushes the piston **13** upward such that the valve **15** closes.
- When the tank pressure increases further and exceeds the upper threshold level, the piston **13** is pushed upward further such that the inlet valve **F** is opened by the exhaust stem **14**. Air pressure from the air tank thus flows out of the air pressure governor **10** as signal pressure **D**, causing the valve **7** to open. Regeneration of the air dryer's desiccant thus begins.

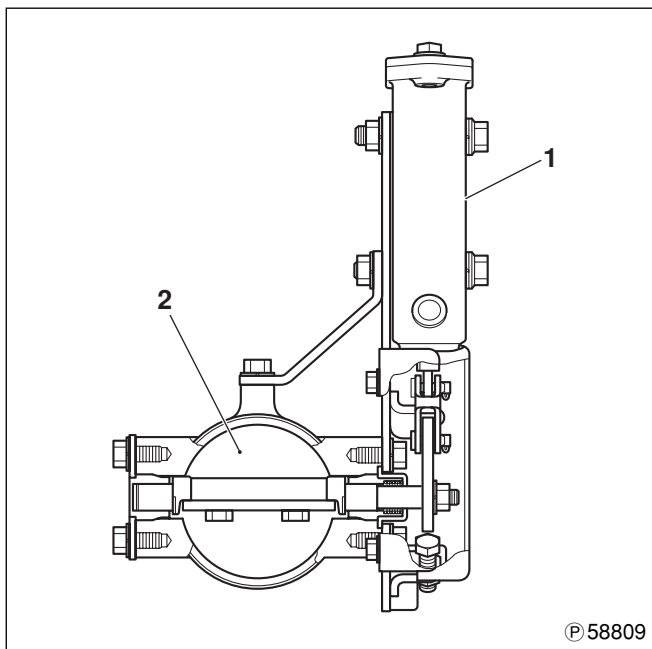


Operation when tank pressure reaches lower threshold level

- When the air pressure **C** from the air tank drops below the lower threshold level, the piston **13** is pushed downward by the spring **11** such that the inlet valve **F** closes and the exhaust valve **G** opens. As a result, air pressure **H** flows through the exhaust stem **14** and escapes to the atmosphere (see exhaust air **J**).

STRUCTURE AND OPERATION

● Exhaust brake unit



● Wheel Brake

Symptoms		Wheel brake does not work effectively				Brake drum over-heating				
		Air leakage when brake pedal depressed	Air leakage when brake pedal released	No air leakage but brake works ineffectively	Air pressure low	Brake shoe self-return poor after releasing brake pedal (Wheel drags)	Noise when brake pedal depressed	One-sided braking	Wheel brake works suddenly	Brake fluid warning lamp lights
Possible causes										
Wheel brake	Wheel cylinder malfunctioning			○				○		○
	Brake lining surface contaminated with oil			○						
	Brake lining surface hardened			○			○			
	Brake fluid leaking because wheel cylinder cup worn			○						
	Brake lining worn									○
	Brake lining worn exposing rivet head						○			
	Brake drum interior worn unevenly						○			
	Brake shoe and brake lining close contact faulty						○			
	Brake drum installation loose						○	○		
	Brake lining materials unequal							○		
	Brake lining contact faulty							○		
	Brake drum runout							○		
	Backing plate warped							○		
	Brake shoe clearance insufficient					○		○	○	
	Brake shoe return spring deteriorated or fractured					○		○		
	Wheel cylinder piston return faulty					○		○		
	Brake fluid return faulty because brake pipe or joints clogged					○				

TROUBLESHOOTING

Possible causes		Symptoms				Wheel brake does not work effectively		Brake drum over-heating				
		Air leakage when brake pedal depressed	Air leakage when brake pedal released	No air leakage but brake works ineffectively	Air pressure low	Brake shoe self-return poor after releasing brake pedal (Wheel drags)	Noise when brake pedal depressed	One-sided braking	Wheel brake works suddenly	Brake fluid warning lamp lights		
Dual brake valve	O-ring damaged	○										
	Primary and secondary valve airtightness faulty	○	○									
	Primary and secondary valve return faulty or exhaust port clogged with foreign particles					○						
Airmaster	Power cylinder lubrication faulty or rubber packing damaged			○								
	Hydraulic piston valve seal close contact faulty			○								
	Hydraulic piston cup packing damaged, wrong combination, or foreign particles adhering to it			○				○				
	Exhaust port clogged with foreign particles					○						
	Push rod bent					○						
	Power cylinder rubber packing lubricated incorrectly					○						
Brake air system	Connector loose	○	○									
	Air leakage				○							
	Air pressure governor adjusted incorrectly				○							
	Air compressor malfunctioning				○							
Brake fluid system	Brake fluid leaking or insufficient			○							○	
	Air mixed in brake fluid system			○							○	
Tire	Left and right air pressure different  Gr 31								○			
Suspension	Leaf spring U-bolt loose  Gr 33, 34								○			

Possible causes		Symptoms						Remarks
		Drainage from air tank drain cock	Drainage not drawn off from exhaust port	Air dryer interior frozen	Air leakage from exhaust port	Air pressure in air reservoir drops extraordinarily	Engine oil coming out exhaust port	
Air Dryer	Desiccant deteriorated	☐						
	Heater not working and air dryer frozen		☐					
	Valve malfunctioning because of foreign particles adhering to it		☐					
	No warming because heater wiring broken			☐				
	Heater malfunctioning because thermostat faulty			☐				
	Temperature extremely low because of snow and ice sticking to air dryer body			☐				
	Heater malfunctioning because wiring to thermostat disconnected			☐				
	Valve seat close contact faulty because of clogging by foreign particles				☐			
	Dry air returning from air tank because air tank check valve malfunctioning during air compressor unloading cycle					☐		
	Air compressor oiling-up						☐	

TROUBLESHOOTING

● Exhaust Brake

Symptoms		Exhaust brake does not work	Exhaust brake cannot be released	Intake silencer does not work	Intake silencer cannot be released	Remarks
Possible causes						
Exhaust brake unit	Valve assembly malfunctioning	☐	☐			
	Valve assembly shaft stuck	☐	☐			
	Control cylinder malfunctioning	☐				
	Butterfly valve adjusted incorrectly	☐				
Intake silencer	Malfunctioning			☐	☐	
3-way magnetic valve	Malfunctioning	☐	☐	☐		 Gr 54
Brake air system	Air pressure abnormal	☐		☐		
	Air pipes crushed	☐		☐		
Electric system	Malfunctioning	☐	☐	☐	☐	 Gr 54

Replacement of Brake Fluid

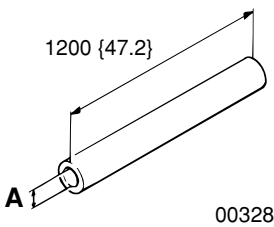
 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	Fluid tank	Brake fluid (SAE J1703 or FMVSS No.116, DOT3)	As required

 Special tools

Unit : mm {in.}

Location	Tool name and shape		Part No.	Application
1	Vinyl hose		<φ320 {12.6} drum brake> MH033102 <φ400 {15.7} drum brake> MS612131	Air bleeding
		A		
	φ320 {12.6} drum brake	φ7 {0.28}		
	φ400 {15.7} drum brake	φ5 {0.20}		



WARNING

- You must use new brake fluid (SAE J1703 or FMVSS No. 116, DOT3).
- Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the brake system, because this will cause the rubber parts of the brake system to swell, resulting in brake dragging or ineffective braking.
- Do not allow foreign particles or water to get mixed in with the brake fluid when you add it.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oil.

CAUTION

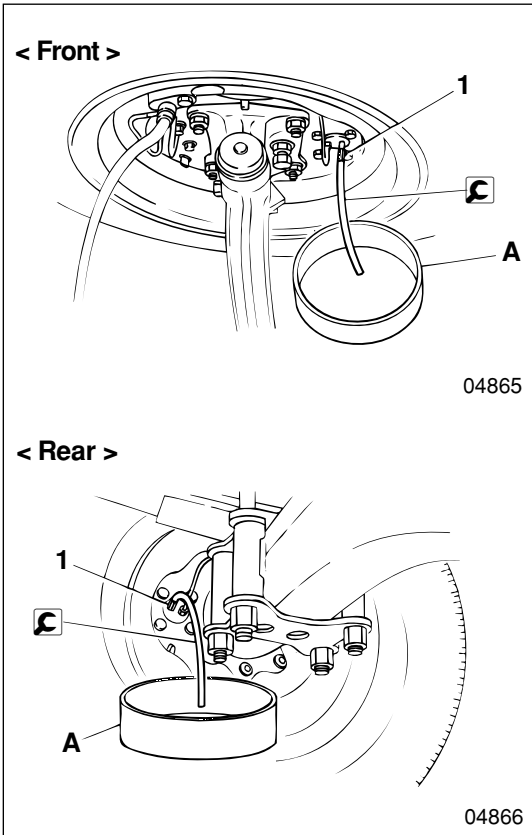
- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

NOTE

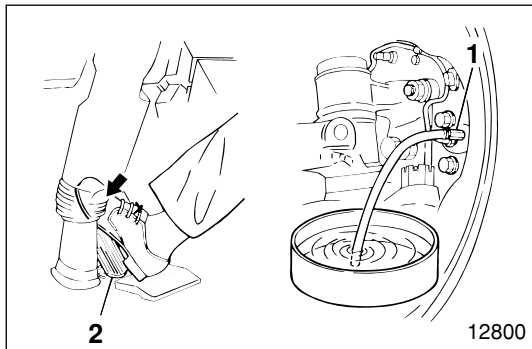
Supply and maintain brake fluid to the “H” level of the fluid tank.

ON-VEHICLE INSPECTION AND ADJUSTMENT

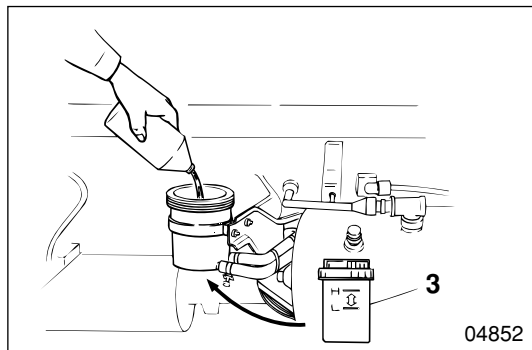
- Start engine and let it idle until brake fluid replacement is completed.



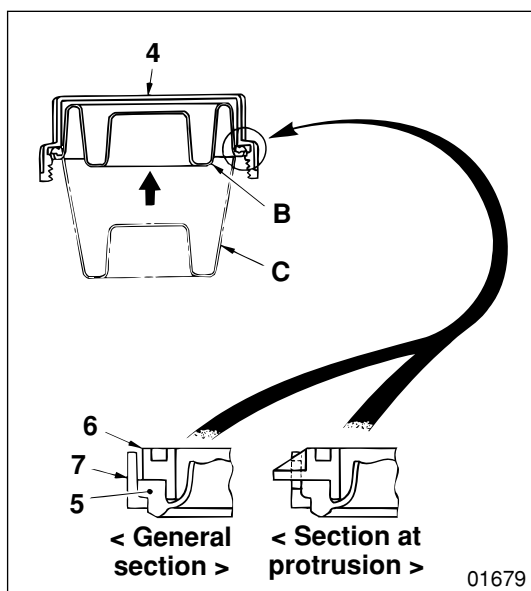
- Attach one end of (C) vinyl hose to air bleeder 1 and place the other end in container A.



- Loosen air bleeder 1 and depress brake pedal 2 to drain brake fluid completely.



- Maintain a supply of new brake fluid up to the “H” level of fluid tank 3, depress the brake pedal repeatedly until the old brake fluid of the brake system is replaced with new fluid.



- If diaphragm **5** is not in its normal posture when the brake fluid is supplied, correct it to its normal posture, and install cap **4**. If brake fluid leaks from the cap area after you have supplied brake fluid, check whether the diaphragm is assembled as illustrated.

6 : Slide ring

7 : Ring cover

B : Correct condition of diaphragm when brake fluid is being supplied

C : Condition when diaphragm is extended when brake fluid has decreased

- Air bleeding of brake system. P35A-29

Air Bleeding of Brake System

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
—	Air bleeder (Airmaster)		7 to 12 {5.2 to 8.9, 0.7 to 1.2}	—
—	Air bleeder (Wheel brake)	φ320 mm {12.6 in.} drum brake	9.8 ± 2.0 {7.2 ± 1.5, 1.0 ± 0.2}	—
		φ400 mm {15.7 in.} drum brake	6.88 to 11.77 {5.1 to 8.7, 0.7 to 1.2}	

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	Fluid tank	Brake fluid (SAE J1703 or FMVSS No.116, DOT3)	As required

Special tools

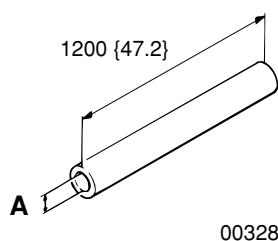
Unit : mm {in.}

Location	Tool name and shape		Part No.	Application
2	Vinyl hose		<φ320 {12.6} drum brake> MH033102 <φ400 {15.7} drum brake> MS612131	Air bleeding
		A		
	φ320 {12.6} drum brake	φ7 {0.28}		
	φ400 {15.7} drum brake	φ5 {0.20}		

1200 {47.2}

A

00328



ON-VEHICLE INSPECTION AND ADJUSTMENT

WARNING

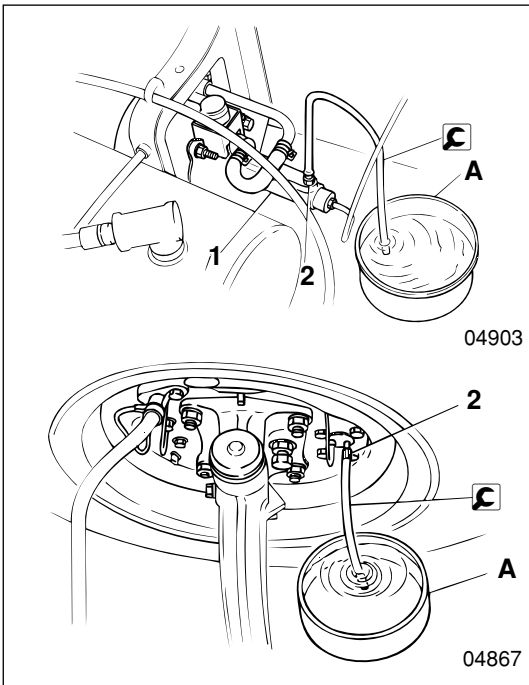
- You must use new brake fluid (SAE J1703 or FMVSS No. 116, DOT3).
- Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the brake system, because this will cause the rubber parts of the brake system to swell, resulting in brake dragging or ineffective braking.
- Do not allow foreign particles or water to get mixed in with the brake fluid when you add it.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oil.

CAUTION

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

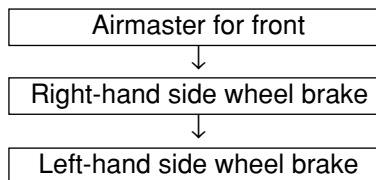
NOTE

- Supply and maintain brake fluid to the “H” level of the fluid tank.
- Make sure you maintain brake fluid at the “H” level of the fluid tank since the brake fluid level drops during air bleeding.



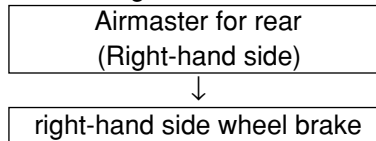
- Start engine and let it idle until brake fluid replacement is completed.
- Attach one end of  vinyl hose to front or rear airmaster 1. Then, attach one end of another vinyl hose to air bleeder 2 of the wheel brake. Finally, place both free ends in container A filled with brake fluid.
- Carry out air bleeding in the following sequence:

Front brake system

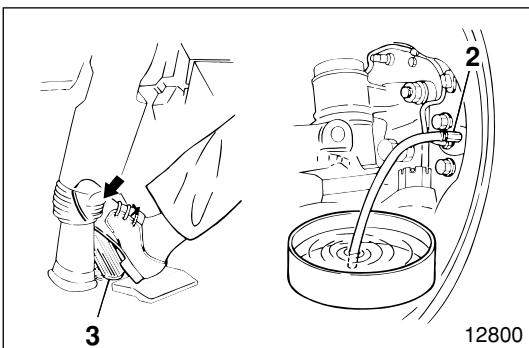
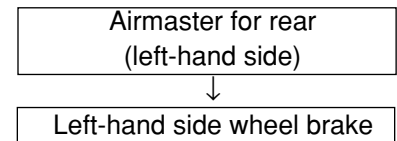


Rear brake system

< Right-hand side >



< Left-hand side >



- Depress brake pedal 3 slowly a few times, and with the brake pedal depressed, loosen air bleeder 2 to drain brake fluid containing air.

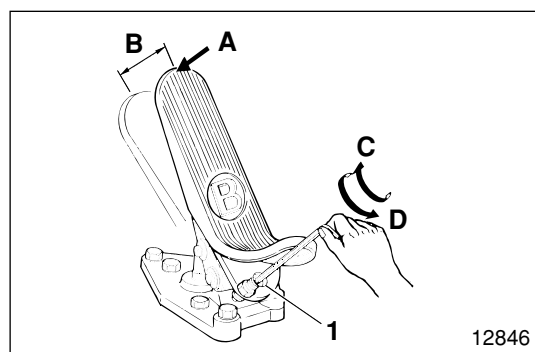
- Tighten air bleeder **2**, and release brake pedal **3**.
- Repeat this service procedure until air is no longer present in the fluid being drained.
- Tighten air bleeder **2** at specified torque as soon as brake fluid flowing out is free of air bubbles.
- Adjust brake shoe clearance when you have finished air bleeding.
 P35A-32
- Check that brake fluid comes up to level “**H**” of fluid tank. If it does not, refill with new brake fluid.
- Depress brake pedal **3** a few times and check for any leakage of brake fluid, then test the brakes.
- When you test the brakes, if the brake fluid warning lamp within the meter cluster lights, it means that air has not been bled completely. Redo air bleeding.

Inspection and Adjustment of Brake Pedal Free Play

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Free play of pedal	Pedal toe	$12_{-2}^{+3.5} \{0.47_{-0.079}^{+0.14}\}$	—	Adjust using set screw
		Depression angle	$3.5^{\circ+1.0^{\circ}}_{-0.5^{\circ}}$	—	



Press pedal toe **A** with your hand and measure free play **B**. If the measured value deviates from the standard value, adjust it by turning set screw **1**.

C : Turning clockwise decreases the free play (For a small angle)

D : Turning counterclockwise increases the free play (For a large angle)

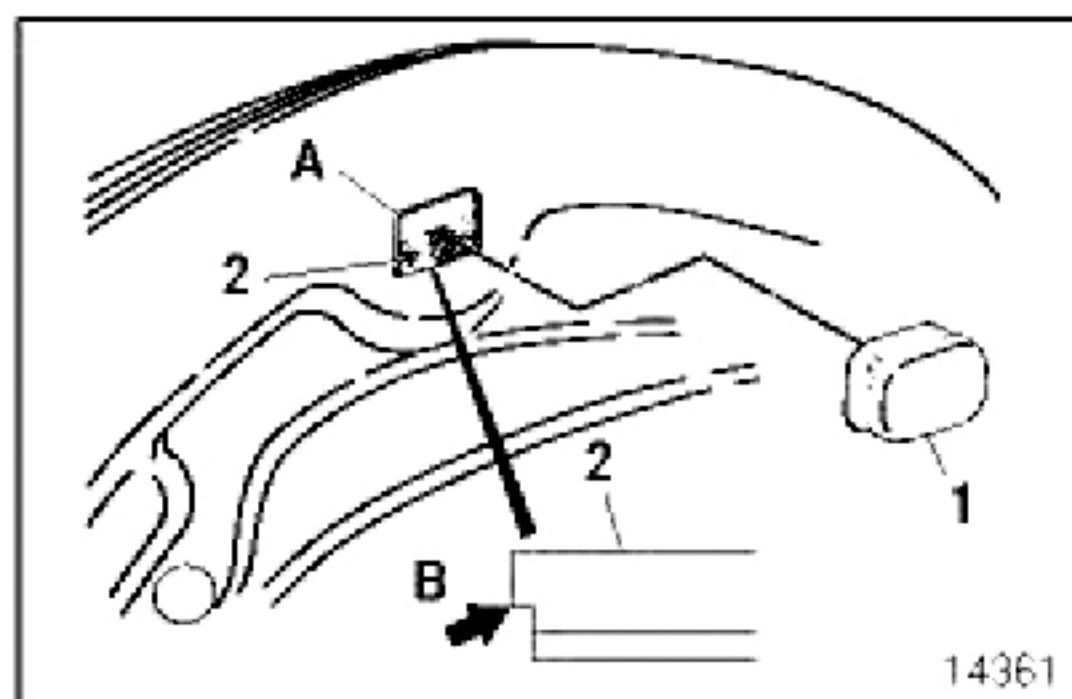
ON-VEHICLE INSPECTION AND ADJUSTMENT

Thickness Inspection and Replacement of Brake Lining

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
2	Thickness of brake lining	φ 320 {12.6}	—	5.0 {0.20}	Replace
		φ 400 {15.7}	—	5.5 {0.22}	Replace



[Inspection]

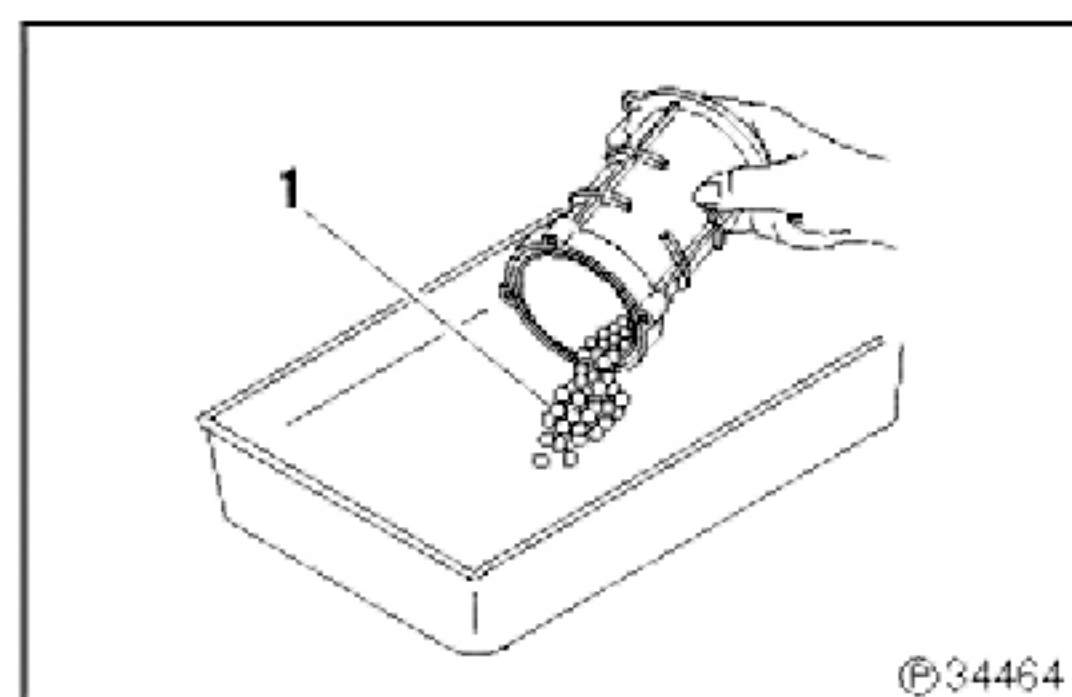
NOTE

Be sure to inspect at two points for each wheel per side.

- Remove check hole plug 1 from the backing plate.
- Inspect through check hole A whether brake lining 2 is worn to the point of side shoulder B of the brake lining (the limit).
- If the measured value is lower than the limit, replace brake lining 2 on the same axle as a unit.
- After inspection, be sure to reinstall check hole plug 1.

[Replacement]

📖 P35A-64, 82



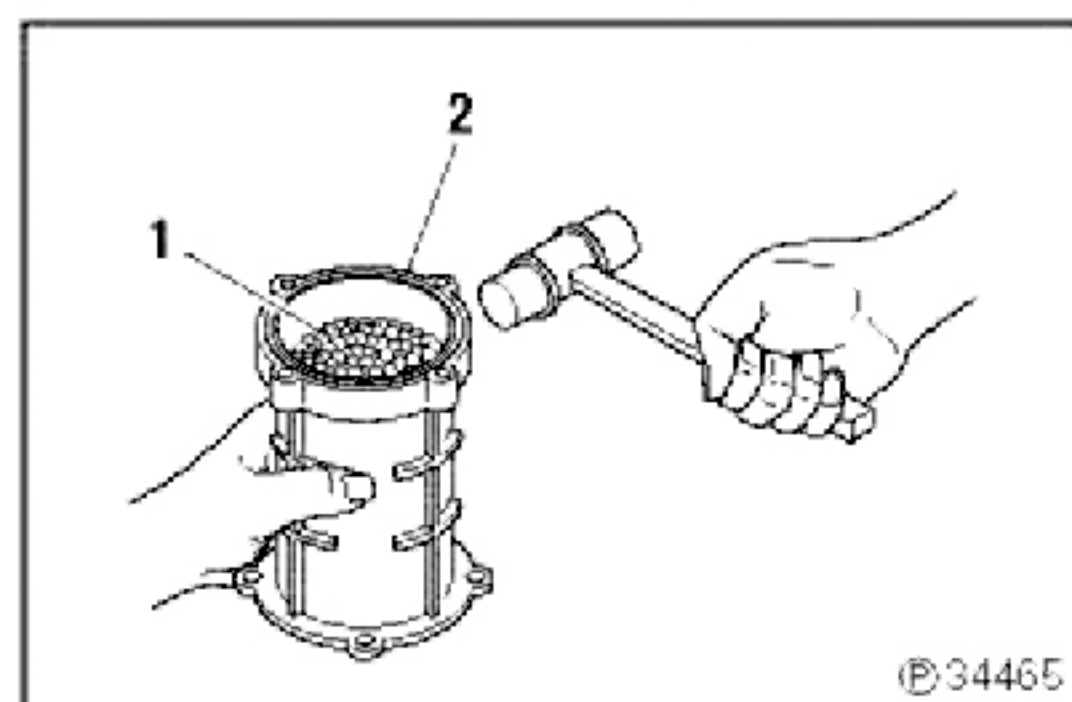
Inspection and maintenance of air dryer

Perform maintenance and inspections at each of the indicated intervals or distances.

(1) Every 10000 km (6000 miles)

- Check whether the air dryer is functioning properly by opening the drain cock on the air tank and checking whether water flows out.
- If a small amount of water flows out, check whether the desiccant 1 has changed color. If one fifth or more of the desiccant has changed in color from white to brown, replace the desiccant.

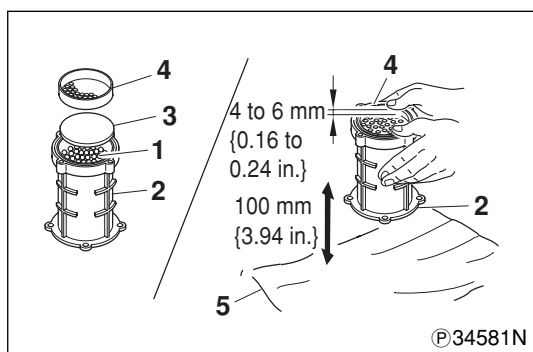
📖 P35A-44



NOTE

A small amount of moisture may collect whenever the temperature in the vicinity of the air tank drops by more than 16°C.

- Place the desiccant 1 in the case 2, then settle the desiccant by tapping gently and evenly around the case with a plastic hammer.



- Place the soft layer side of the filter **3** on the desiccant **1**, and place the filter plate **4** on the case **2**, then tap the desiccant down.

[Tapping]

- Before tapping the case **2** against the work surface, lay two or three layers of rag **5** on the work surface to protect the bottom of the case from scratches.
- Holding down the filter plate **4** with both hands, lift the case **2** to a height of about 100 mm {3.94 in.} and tap it gently against the work surface.
- Tap the case about 30 more times. Make sure the filter plate **4** drops by 4 to 6 mm {0.16 to 0.24 in.} from its original position.

WARNING

Unless the tapping procedure is performed, particles of desiccant may escape and create blockages in brake lines, thus preventing normal brake operation.

- Look carefully at the water that flows out of the air dryer's exhaust port. If the water is contaminated with oil, inspect the air compressor.
 P35A-38

(2) Every 60000 km {36000 miles}

Disassemble the air dryer and replace the desiccant, oil filter, filter, and related rubber parts with repair kit **B**.

P35A-44

(3) Every two years

Disassemble the air dryer and replace the desiccant, oil filter, filter, and related rubber parts with repair kit **A**.

P35A-44

ON-VEHICLE INSPECTION AND ADJUSTMENT

Inspection and Adjustment of Air Dryer's Air Pressure Governor

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
1	Threshold pressures	Upper threshold pressure	829 kPa {130 psi, 9.1 kgf/cm ² }	—	Adjust
		Lower threshold pressure	765 kPa {110 psi, 7.8 kgf/cm ² }	—	Replace relevant parts of air pressure governor

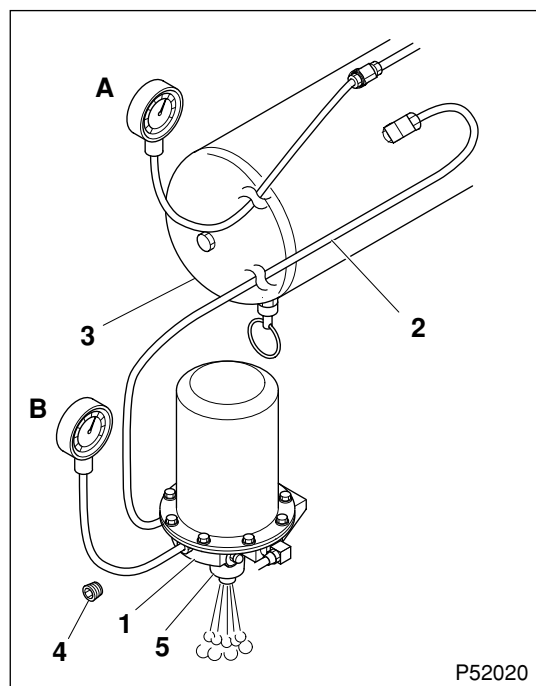
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Plug	14.7 to 24.5 {11 to 18, 1.5 to 2.5}	—
6	Cap nut (for retention of seat and plate)	4.9 to 5.9 {3.6 to 4.4, 0.5 to 0.6}	—
11	Nut (for retention of adjusting screw)	6.9 to 7.8 {5.1 to 5.8, 0.7 to 0.8}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Plug thread	THREEBOND 1110B	As required



[Preparatory steps]

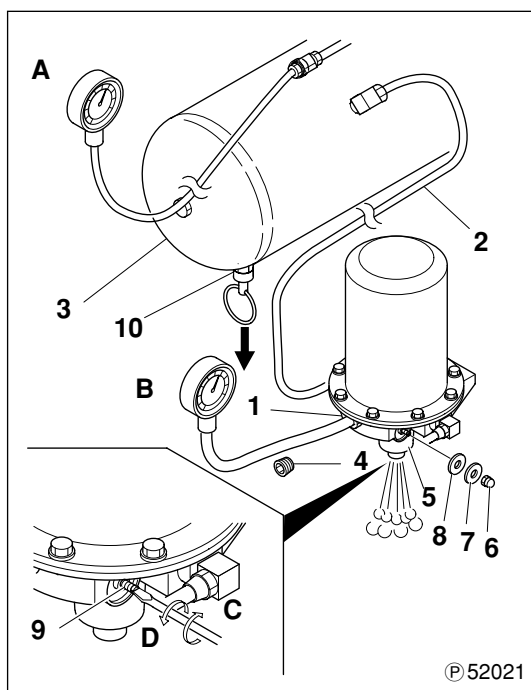
- Connect a pressure gauge **A** to the air tank **3** (wet tank) at the point to which the air pipe **2** from the air dryer **1** is connected.
- Remove the plug **4** from the air dryer **1** at the location shown in the drawing. Connect a pressure gauge **B** at that point.

[Check for air leakage]

- Start the engine to activate the air compressor such that the air pressure in the air tank **3** gradually increases. Check that the pressures indicated by the pressure gauges **A**, **B** do not decrease when air is expelled from the exhaust cover **5**.

CAUTION ⚠

If the pressure indicated by either of the pressure gauges **A**, **B** decreases, air is leaking from the check valve and air pressure governor in the air dryer **1**, causing continuous charging and purging.



[Inspection of threshold pressures]

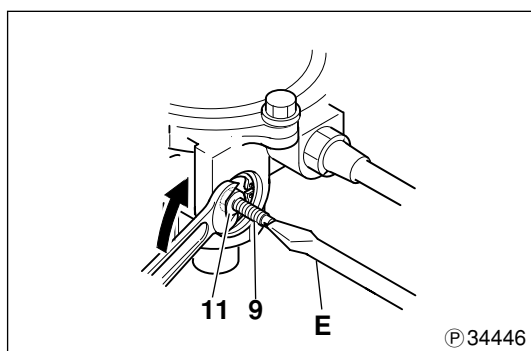
- Remove the cap nut **6**, plate **7**, and seat **8**.
- Start the engine to activate the air compressor such that the air pressure in the air tank **3** gradually increases.
- Check whether the pressure indicated by pressure gauge **A** is the standard value (the upper threshold pressure) when air is expelled from the exhaust cover **5**.
- If the indicated pressure is out of specification, make the necessary adjustment by turning the adjusting screw **9**.
C : Turn clockwise to reduce the pressure.
D : Turn counterclockwise to increase the pressure.

- Reduce the air pressure to 690 kPa {100 psi, 7.0 kgf/cm²} or lower, then gradually increase it again.
 Check whether the pressure indicated by pressure gauge **A** is the standard value (the upper threshold pressure). If the indicated pressure is out of specification, make further adjustments.
- With the upper threshold pressure indicated, air from the air compressor will be expelled from the exhaust cover **5** continuously. With the equipment in this condition, open the drain cock **10** to gradually reduce the air pressure. When air stops being expelled from the exhaust cover, check whether the pressure indicated by pressure gauge **B** is the standard value (the lower threshold pressure). If the indicated pressure is out of specification, replace relevant parts of the air compressor governor as an assembly.

- Tighten the nut **11** to hold the adjusting screw **9** in position.

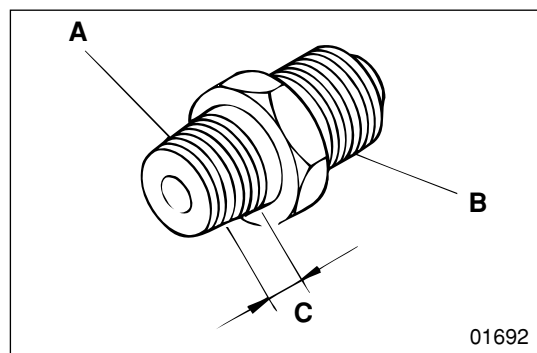
E : Screwdriver

(used to hold adjusting screw in position while nut is tightened)



HANDLING OF CONNECTOR AND NYLON TUBE PIPING

Connector



(1) Installation of connector

- When installing once removed connector of air system, remove remainder of sealer, oil, and water sufficiently, apply THREEBOND TB1110B to threads leaving 1 or 2 threads on top blank, and then screw in.

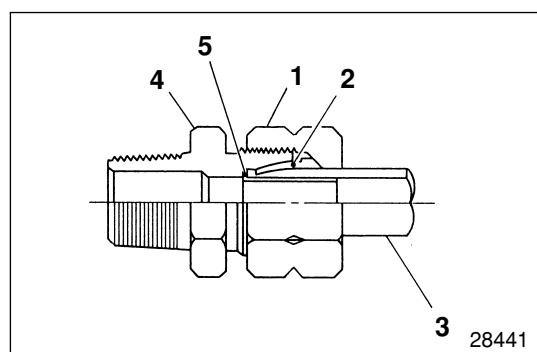
Where alignment is required, stop at aligning point in additional tightening process.

A : Taper screw area

B : Parallel screw area (Do not apply sealer)

C : Area where sealer shall be applied

Nylon Tube

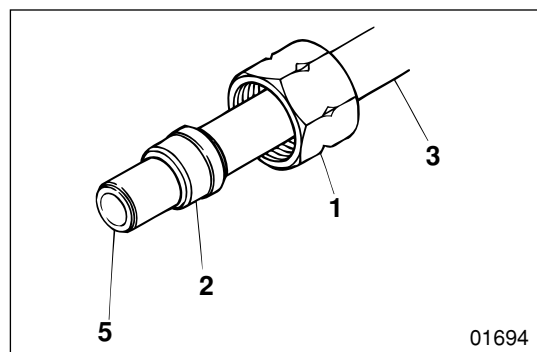


Follow the following process where nylon tube is employed.

- Nylon tube is designed so that as nut **1** is tightened, sleeve **2** advances gripping to tube **3** while itself is being deformed in the process, thus keeping air tightness to prevent leakage. Accordingly, once removed, it cannot be used again: do not fail to replace with new one.

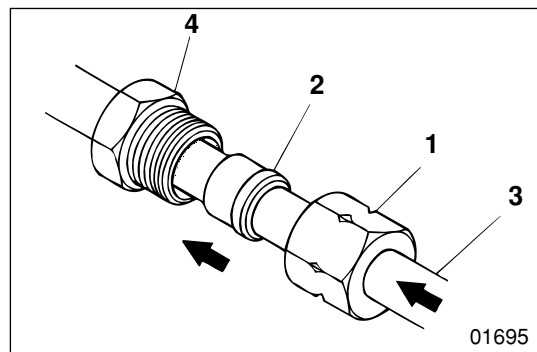
4 : Connector

5 : Insert



(2) Installation of nylon tube

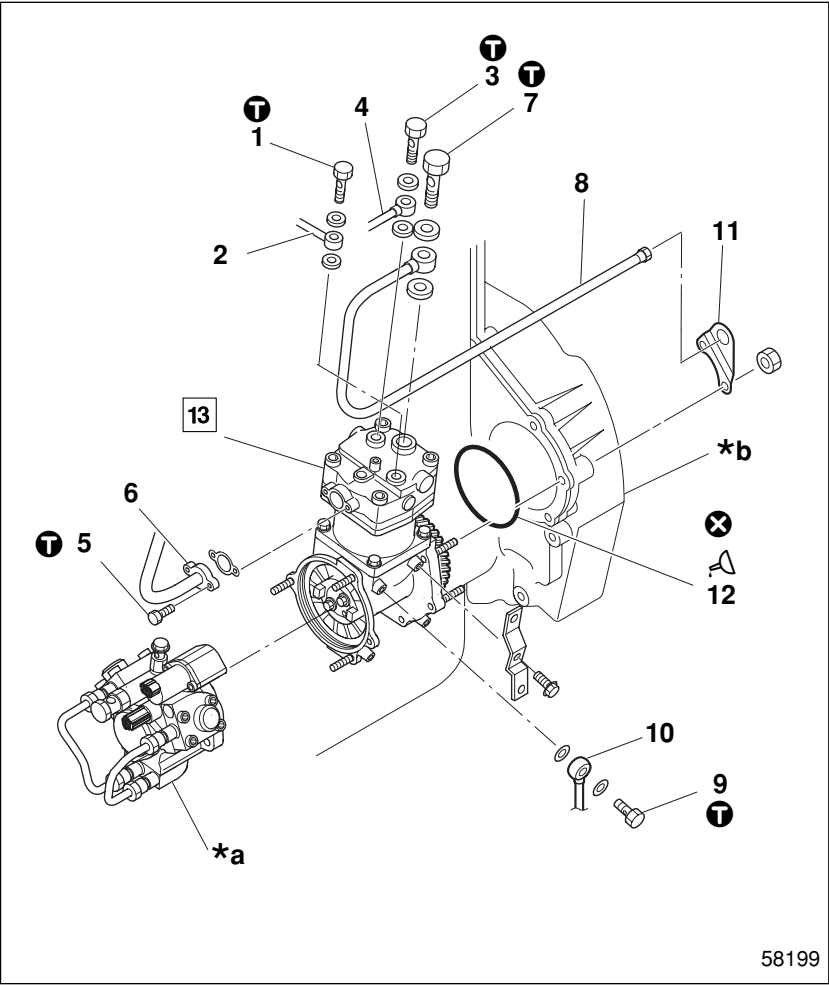
- Make sure that insert **5**, sleeve **2**, nut **1**, and tube **3** are respectively in the state as illustrated.



- Insert tube **3** into connector **4**, push sleeve **2** into connector **4**, and provisionally tighten nut **1** by hand.
- After this, pull tube **3** to make sure that it does not have leakage, and it does not come apart.

MEMO

AIR COMPRESSOR



- **Removal sequence**
- 1 Eyebolt
 - 2 Water inlet pipe
 - 3 Eyebolt
 - 4 Water outlet pipe
 - 5 Bolt
 - 6 Air suction pipe
 - 7 Eyebolt
 - 8 Air outlet pipe
 - 9 Eyebolt
 - 10 Oil pipe
 - 11 Bracket
 - 12 O-ring
 - 13 Air compressor assembly
P35A-40
- ★a : Supply pump assembly
Gr 13A
- ★b : Flywheel housing
- ⊗ : Non-reusable parts

- **Installation sequence**
- Follow the removal sequence in reverse.

Tightening torque Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Eyebolt (Water inlet pipe mounting)	39 {29, 4.0}	—
3	Eyebolt (Water outlet pipe mounting)	39 {29, 4.0}	—
5	Bolt (Air suction pipe mounting)	19 to 28 {14 to 21, 1.9 to 2.8}	—
7	Eyebolt (Air outlet pipe mounting)	98 {72, 10.0}	—
9	Eyebolt (Oil pipe mounting)	21 {15, 2.1}	—

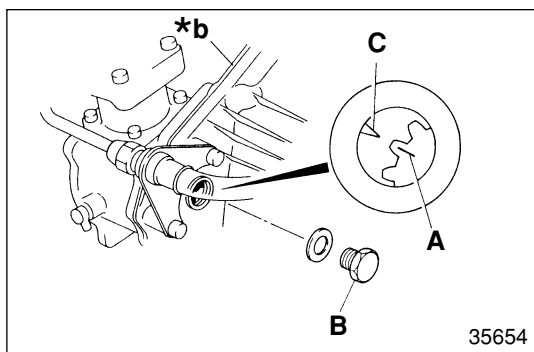
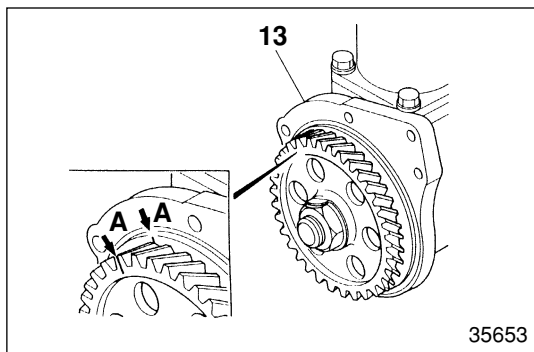
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
12	O-ring	Engine oil	As required

◆ Service procedure

13 Installation of air compressor assembly

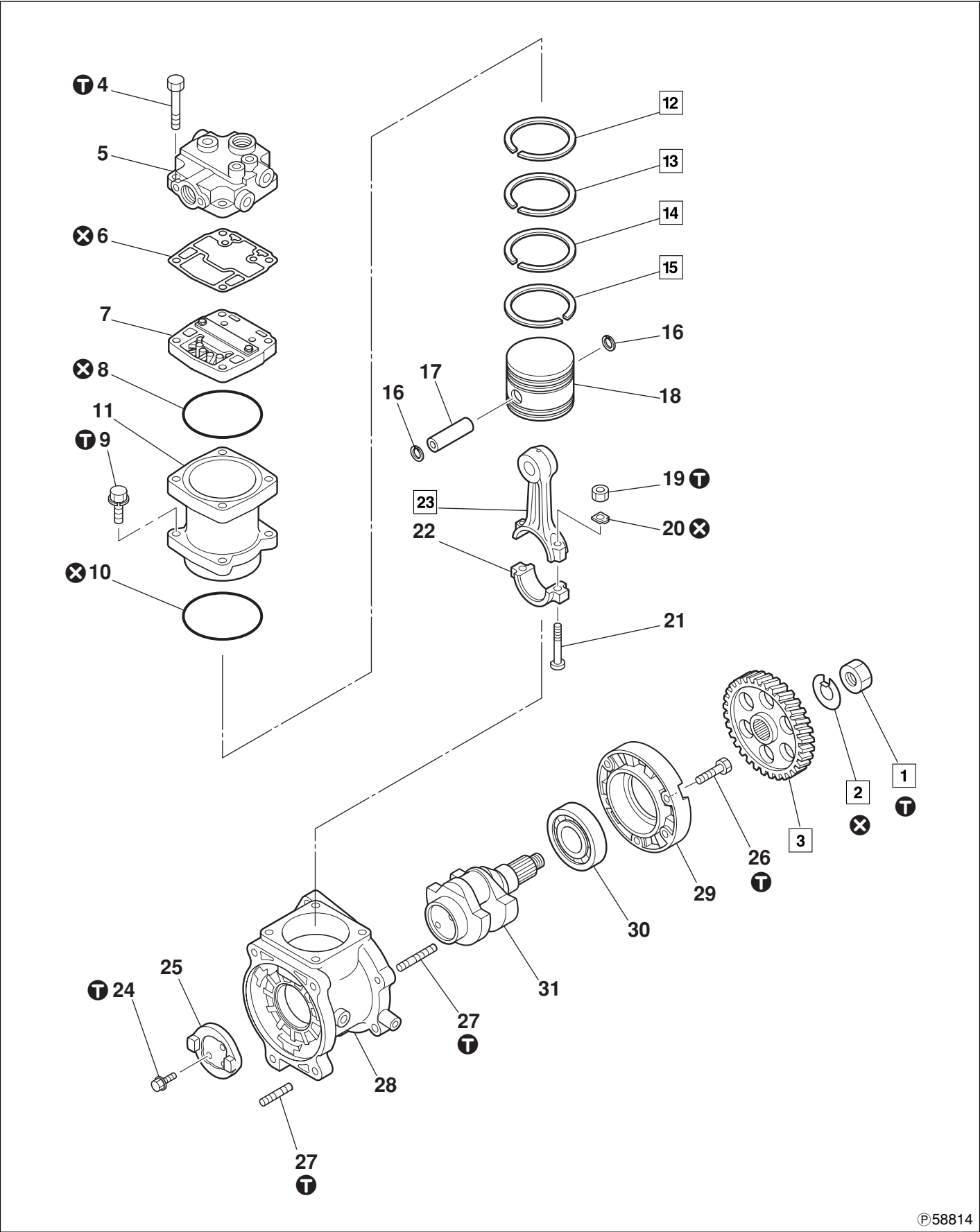
- Set No. 1 cylinder of the engine to top dead center.
Gr 11
- Install air compressor assembly **13** on flywheel housing ***b**, aligning with stamp mark **A**.



- Remove inspection plug **B** to make sure that stamp mark **A** is aligned with pointer **C**.
- If stamp mark **A** is not aligned with pointer **C**, reinstall air compressor assembly **13**.

AIR COMPRESSOR

Air Compressor Assembly



● Disassembly sequence

- | | | |
|--------------------------|-------------------------|------------------------|
| 1 Nut | 12 1st compression ring | 23 Connecting rod |
| 2 Lock washer | 13 2nd compression ring | 24 Bolt |
| 3 Gear | 14 3rd compression ring | 25 Coupling |
| 4 Bolt | 15 Oil ring | 26 Bolt |
| 5 Cylinder head assembly | 16 Snap ring | 27 Stud bolt |
| 6 Gasket | 17 Piston pin | 28 Crankcase assembly |
| 7 Valve seat assembly | 18 Piston | 29 Bearing holder |
| 8 O-ring | 19 Nut | 30 Bearing |
| 9 Bolt | 20 Lock washer | 31 Crankshaft assembly |
| 10 O-ring | 21 Bolt | |
| 11 Cylinder liner | 22 Connecting rod cap | ⊗ : Non-reusable part |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
11, 18	Clearance between piston and cylinder liner	Top	0.27 to 0.33 {0.011 to 0.013}	0.35 {0.014}	Replace
		Skirt	0.11 to 0.17 {0.0043 to 0.0067}	0.19 {0.0075}	
12 to 15	Closed gap of piston ring (measure inside cylinder)	Compression ring	—	1.0 {0.039}	Replace
		Oil ring	—	1.5 {0.059}	
12 to 15, 18	Clearance between piston ring and piston groove	Compression ring	—	0.08 {0.0031}	Replace
		Oil ring	—	0.08 {0.0031}	
17, 18	Clearance between piston pin and piston		—	0.08 {0.0031}	Replace
17, 23	Clearance between piston pin and connecting rod small end		—	0.07 {0.0028}	Replace
23	Connecting rod end play		—	0.5 {0.0020}	Replace
23, 31	Clearance between connecting rod big end and crankshaft assembly		—	0.1 {0.039}	Replace
31	Crankshaft assembly end play		—	1.0 {0.039}	Replace
28, 31	Clearance between crankshaft assembly and inside diameter of crankcase bushing		—	0.12 {0.047}	Replace

ⓘ Tightening torque

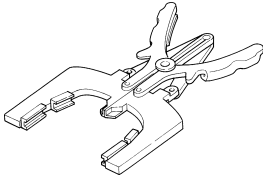
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Compressor gear mounting)	167 to 211 {125 to 155, 17.0 to 21.5}	—
4	Bolt (Cylinder head assembly mounting)	29 to 34 {21 to 25, 3.0 to 3.5}	—
9	Bolt (Cylinder mounting)	25 to 29 {18 to 21, 2.5 to 3.0}	—
19	Nut (Connecting rod cap and connecting rod mounting)	23 to 25 {17 to 18, 2.3 to 2.5}	—
24	Bolt (Coupling mounting)	53 to 65 {39 to 48, 5.4 to 6.6}	—
26	Bolt (Bearing holder mounting)	8.8 to 10.6 {6.5 to 7.8, 0.9 to 1.1}	—
27	Stud bolt	5.9 to 12 {4.4 to 8.9, 0.6 to 1.2}	—

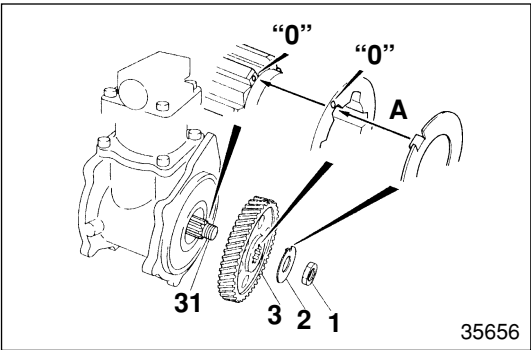
AIR COMPRESSOR

Special tools

Unit : mm {in.}

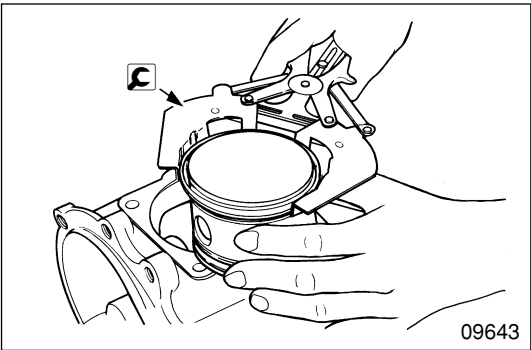
Location	Tool name and shape	Part No.	Application
12 to 15	Piston ring tool 	MH060014	Removal and installation of piston ring
	01732		

Service procedure



1 to 3 Installation of nut, lock washer and gear

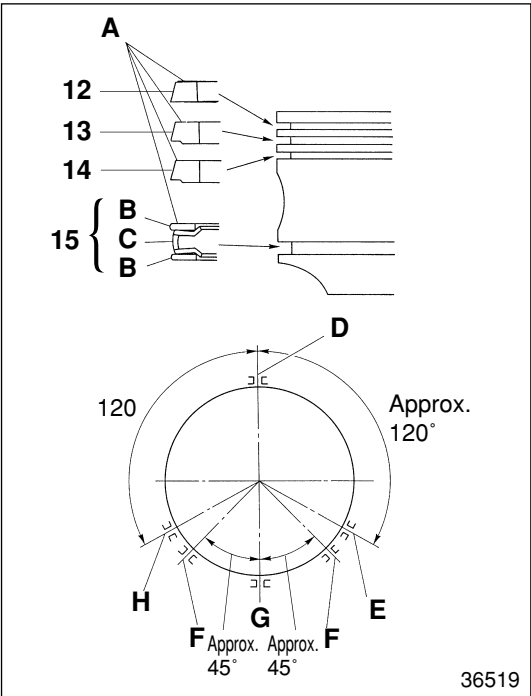
- Align the slit mark of crankshaft **31** with “0” mark of compressor gear **3** to install.
- Insert protrusion **A** of lock washer **2** so that “0” mark of compressor gear **3** is visible.
- After tightening nut **1** to the specified torque, bend one location of the lower side of lock washer **2** toward the nut side to secure the nut.



12 to 15 Piston ring

[Removal and installation]

: Piston ring tool



[Installed position]

A : Character stamped area

B : Side rail

C : Spacer

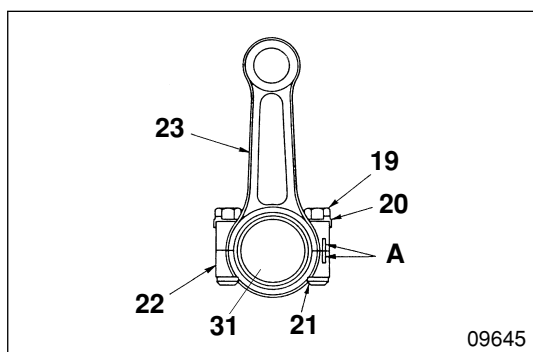
D : Closed gap of 2nd compression ring **13**

E : Closed gap of 1st compression ring **12**

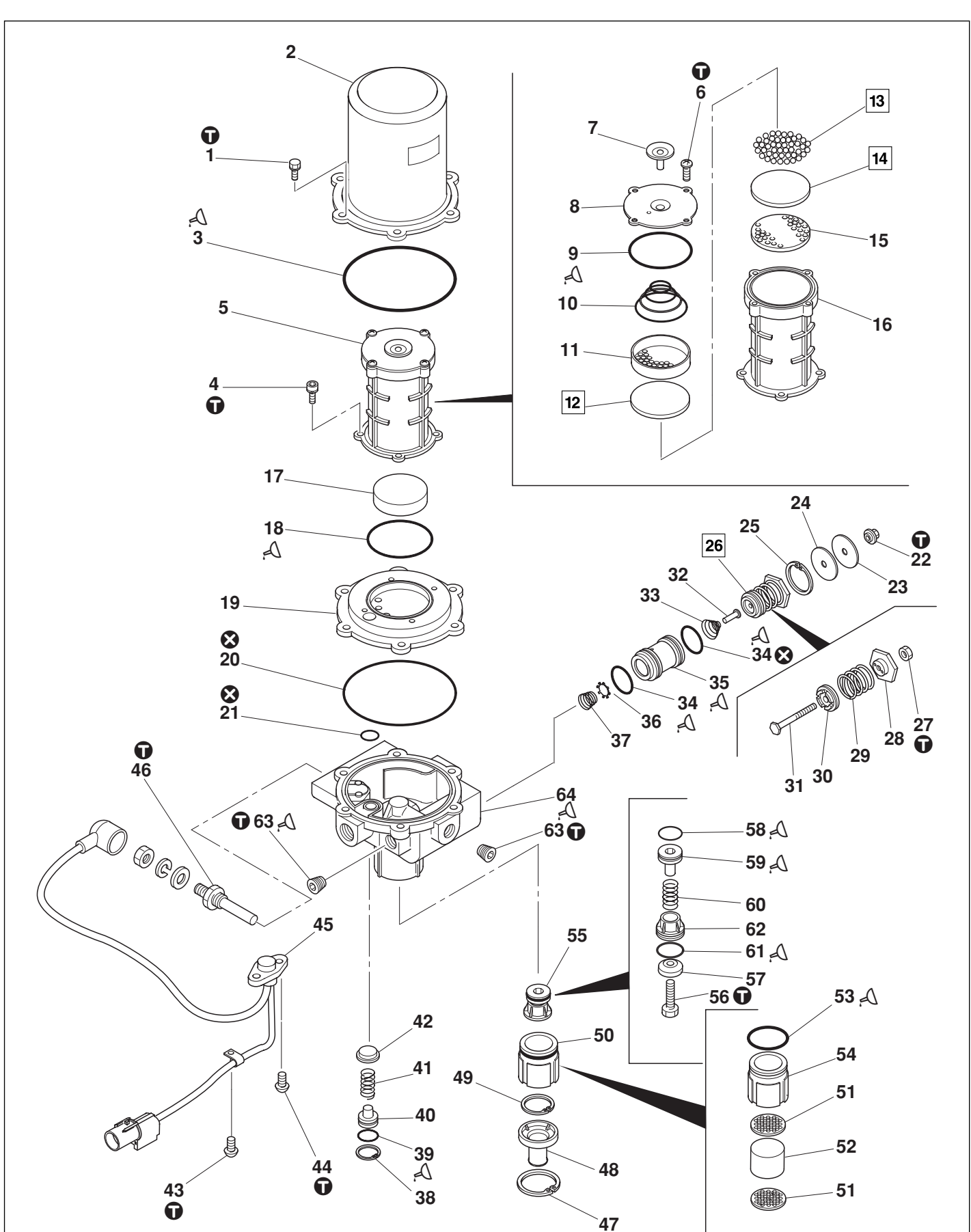
F : Closed gap of oil ring **15** side rail

G : Closed gap of oil ring **15** spacer

H : Closed gap of 3rd compression ring **14**

**23 Assembly of connecting rod**

- Align connecting rod **23** with mating mark **A** of connecting rod cap **22** to assemble.
- Insert bolt **21** with its head notch facing toward inside of connecting rod cap **22**.
- Bend lock washer **20** after assembly.



©34444

● Disassembly sequence

- | | | |
|-----------------|-----------------------------|---|
| 1 Bolt | 23 Plate | 45 Thermostat assembly  Gr54 |
| 2 Purge chamber | 24 Seat | 46 Heater |
| 3 O-ring | 25 Retaining ring | 47 Retaining ring |
| 4 Bolt | 26 Adjusting screw assembly | 48 Exhaust cover |
| 5 Cartridge | 27 Nut | 49 Retaining ring |
| 6 Screw | 28 Upper spring seat | 50 Silencer assembly |
| 7 Check valve | 29 Spring | 51 Silencer plate |
| 8 Case cover | 30 Lower spring seat | 52 Silencer |
| 9 O-ring | 31 Adjusting screw | 53 O-ring |
| 10 Set spring | 32 Exhaust stem | 54 Silencer case |
| 11 Filter plate | 33 Exhaust stem spring | 55 Valve assembly |
| 12 Filter | 34 O-ring | 56 Bolt |
| 13 Desiccant | 35 Piston | 57 Valve |
| 14 Filter | 36 Valve | 58 O-ring |
| 15 Filter plate | 37 Valve spring | 59 Piston |
| 16 Case | 38 Retaining ring | 60 Valve spring |
| 17 Oil filter | 39 O-ring | 61 O-ring |
| 18 O-ring | 40 Check valve guide | 62 Valve body |
| 19 Cover | 41 Check valve spring | 63 Plug |
| 20 Gasket ring | 42 Check valve | 64 Body |
| 21 Gasket ring | 43 Screw | |
| 22 Cap nut | 44 Screw | |

⊗ : Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Air dryer kit A, B

● Inspection after assembly

 P35A-46

● Adjustment after assembly

 P35A-46

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Threshold pressures	Upper threshold pressure	832 kPa {130 psi, 9.1 kgf/cm ² }	—	Adjust
		Lower threshold pressure	765 kPa {110 psi, 7.8 kgf/cm ² }		Replace relevant parts of air pressure governor

AIR DRYER

Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (for installation of purge chamber, cover, and body)	17.7 to 27.5 {13 to 20, 1.8 to 2.8}	—
4	Screw (for installation of cartridge)	2.0 to 3.9 {1.4 to 2.9, 0.2 to 0.4}	—
6	Screw (for installation of case cover)	2.0 to 3.9 {1.4 to 2.9, 0.2 to 0.4}	—
22	Cap nut (for installation of seat and plate)	4.9 to 5.9 {3.6 to 4.4, 0.5 to 0.6}	—
27	Nut (for retention of adjusting screw)	6.9 to 7.8 {5.1 to 5.8, 0.7 to 0.8}	—
43	Screw (for installation of clamp)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.5}	—
44	Screw (for installation of thermostat assembly)	0.5 to 1.0 {0.4 to 0.7, 0.05 to 0.10}	—
46	Heater	19.6 to 29.4 {14 to 22, 2 to 3}	—
56	Bolt (for installation of valve, piston, and valve body)	3.9 to 6.9 {1.4 to 2.0, 0.4 to 0.7}	—
63	Plug	14.7 to 24.5 {11 to 18, 1.5 to 2.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3, 9, 18, 34, 39, 53, 61, 88	O-ring (entire surface)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
31	Adjusting screw (entire surface except thread)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
35, 59	Piston (outside surface and O-ring groove)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
63	Plug thread	THREEBOND 1110B	As required
64	Body (inside surface)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required

Service procedure

Inspection after assembly

Check for air leakage

- Completely plug the delivery side **A** of the air dryer, then apply air pressure of 49 kPa {7.1 psi, 0.5 kgf/cm²} to the supply side **B** and check that no air leaks from any joint.
- Leakage from the valve assembly **55** must not exceed 10 cm³ {0.61 cu.in} per minute.
- Increase the pressure applied to the supply side **B** to 932 kPa {135 psi, 9.5 kgf/cm²} to cause purging (regeneration). Check that no air leaks from the check valve **44** and from the air pressure governor **C** (with the plug **63** removed).

[On-vehicle inspection method  P35A-34]

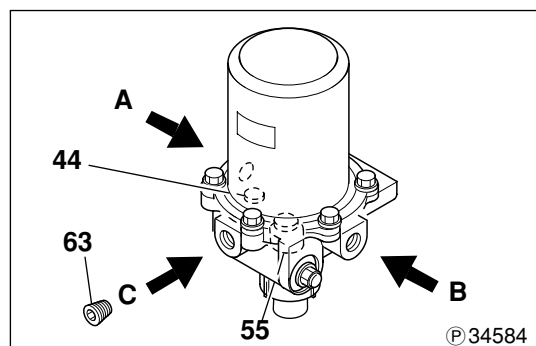
CAUTION

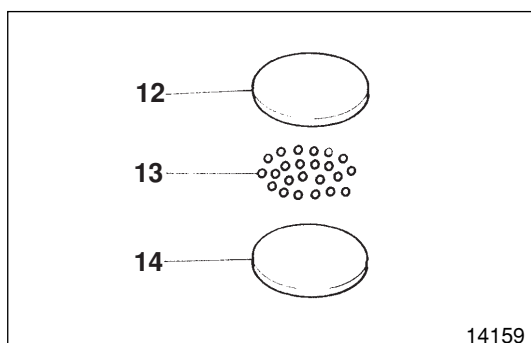
If air leaks from the air pressure governor and from the check valve 44, charging and purging take place continuously.

Adjustment after assembly

Inspection and adjustment of air dryer's air pressure governor

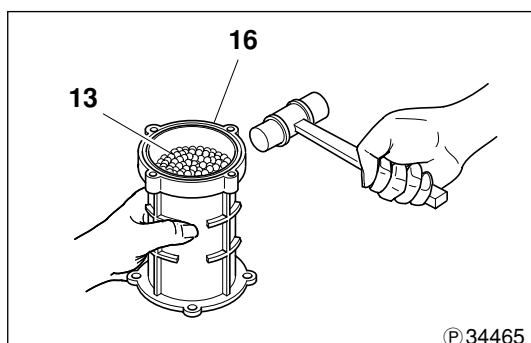
 P35A-34





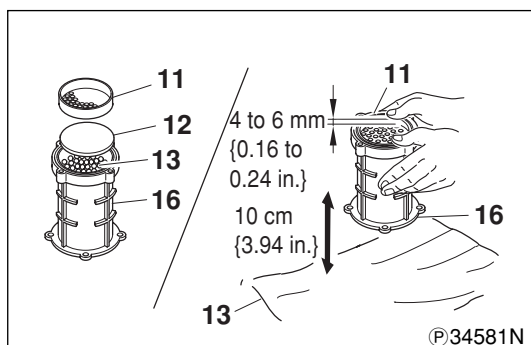
12 14 Installation of filters

Install the filters 12, 14 with their soft layers facing the desiccant 13.



13 Insertion of desiccant

- Place the desiccant 13 in the case 16, then settle the desiccant by tapping gently and evenly around the case with a plastic hammer.



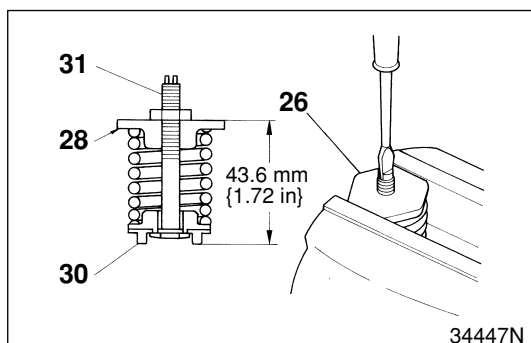
- Place the soft layer side of the filter 12 on the desiccant 13, and place the filter plate 11 on the case 16, then tap the desiccant down.

<Tapping>

- Before tapping the case 16 against the work surface, lay two or three layers of rag A on the work surface to protect the bottom of the case from scratches.
- Holding down the filter plate 11 with both hands, lift the case 16 to a height of about 10 cm {3.94 in.} and tap it gently against the work surface.
- Tap the case about 30 more times. Make sure the filter plate 11 drops by 4 to 6 mm {0.16 to 0.24 in.} from its original position.

WARNING

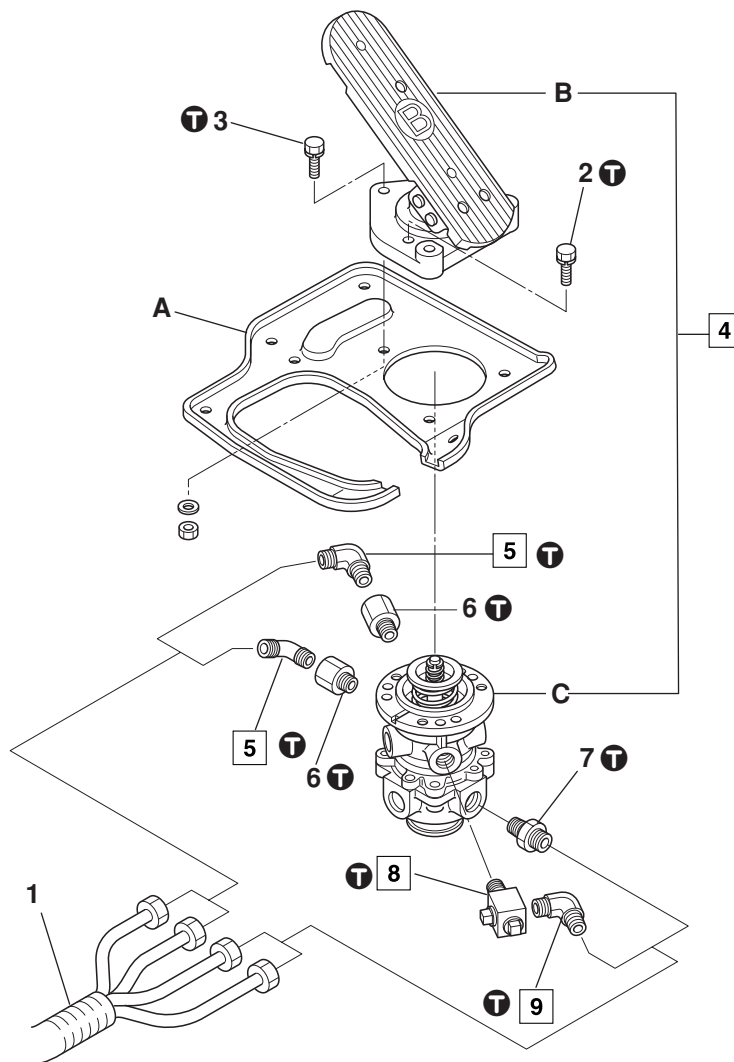
Unless the tapping procedure is performed, particles of desiccant 13 may escape and create blockages in brake lines, thus preventing normal brake operation.



26 Preliminary adjustment of adjusting screw assembly

Turn the adjusting screw 31 to achieve the indicated dimension from the top of the upper spring seat 28 to the bottom of the lower spring seat 30. Doing so will facilitate the threshold pressure adjustment to the standard value.

BRAKE PEDAL



©58810

Remove pedal assembly **B** upward from valve board **A**, and valve assembly **C** downward from the valve board to separate dual brake valve **4** (pedal assembly and valve assembly). Do this without removing the valve board from the vehicle.

● Removal sequence

- | | | |
|--------------|-----------------------------|-------------|
| 1 Nylon tube | 4 Dual brake valve P35A-50 | 7 Connector |
| 2 Bolt | 5 Connector | 8 Connector |
| 3 Bolt | 6 Connector | 9 Connector |

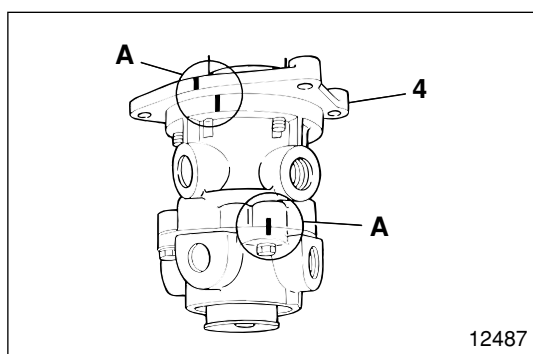
● Assembly sequence

Follow the removal sequence in reverse.

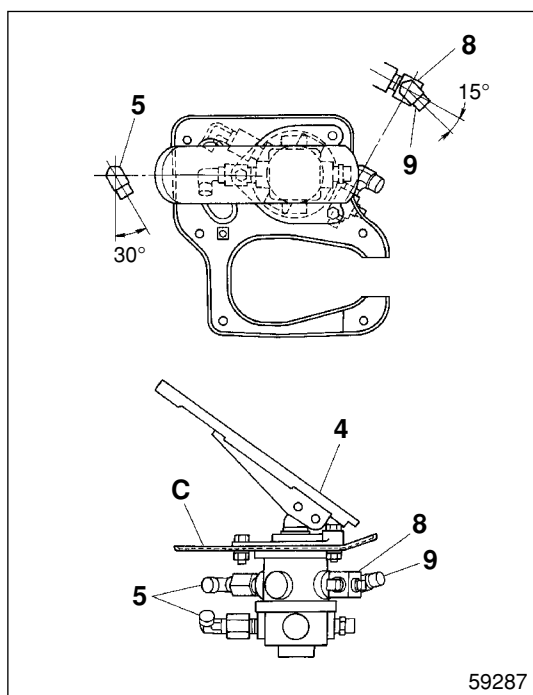
T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

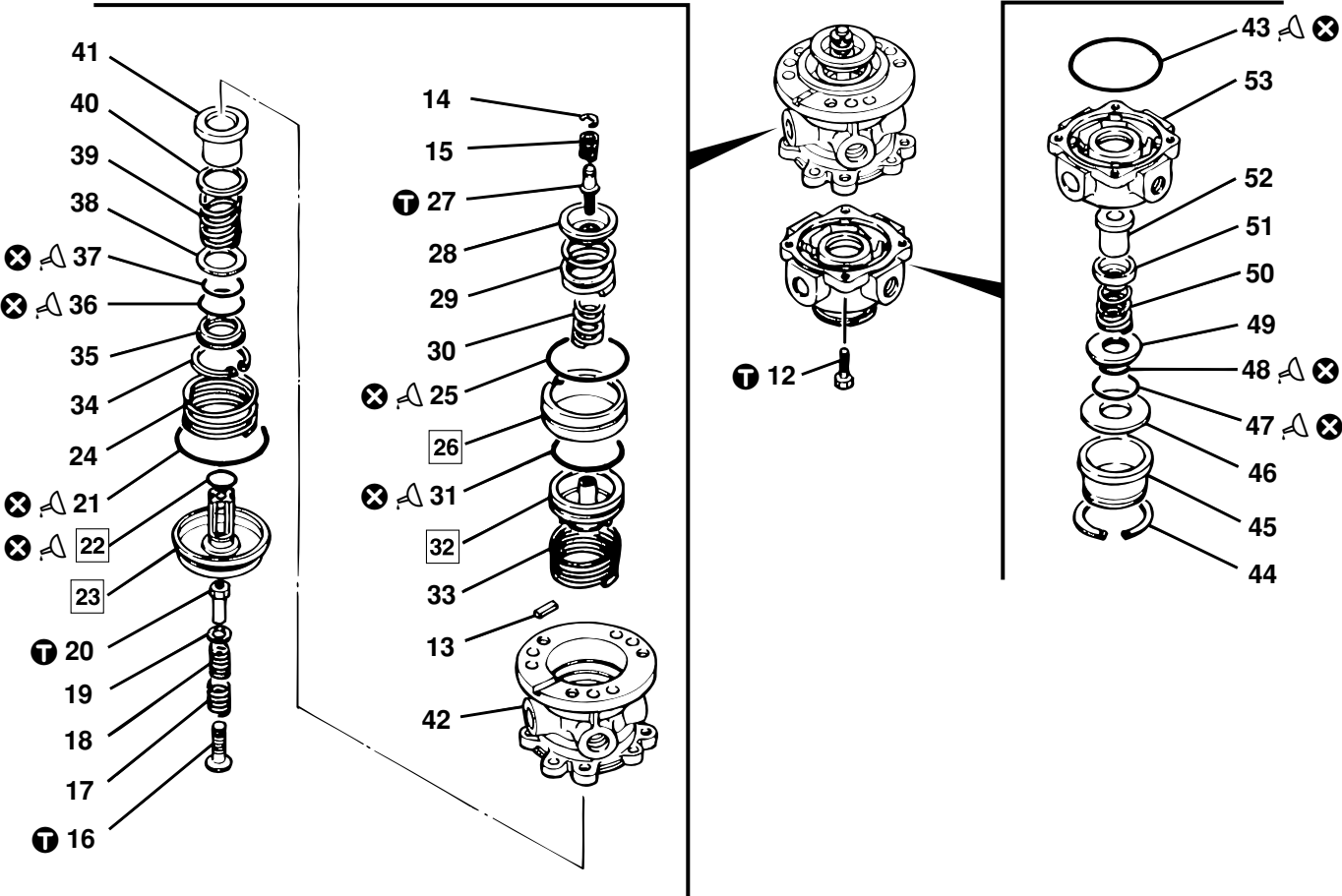
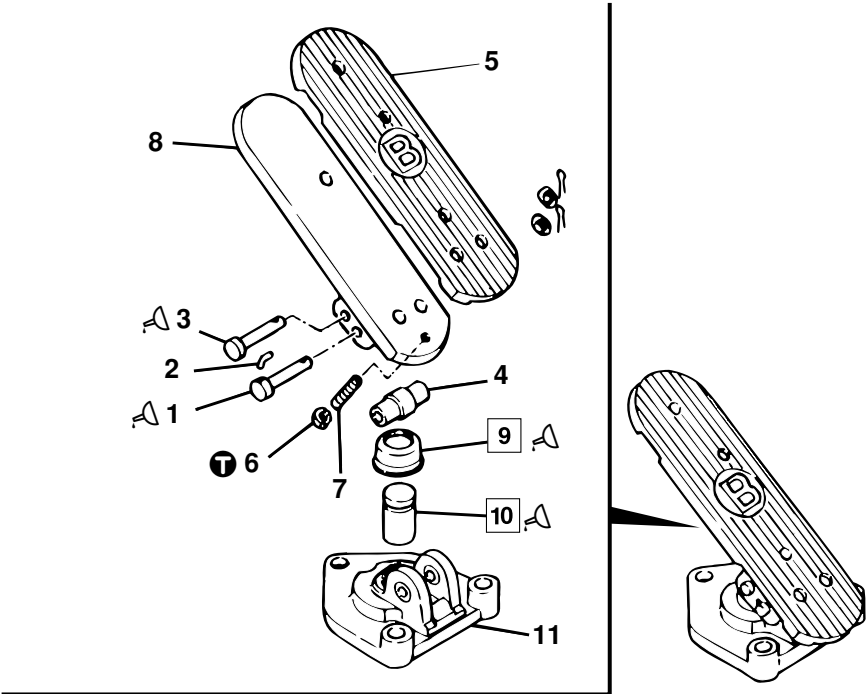
Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Pedal assembly and valve assembly mounting)	12 to 19 {0.047 to 0.075, 1.2 to 1.9}	—
3	Bolt (Dual brake valve and valve board mounting)	12 to 19 {0.047 to 0.075, 1.2 to 1.9}	—
5, 8, 9	Connector	29.4 to 117.7 {0.12 to 0.47, 3.0 to 12}	Determine the direction within one turn immediately after exceeding the lower limit torque. Do not exceed the upper limit torque.
6, 7	Connector	29.4 to 39.2 {0.12 to 0.16, 3 to 4}	—

◆ Service procedure**4 Dual brake valve****A :** Alignment mark**5 8 9 Connector positioning**

Position the connector within one turn after the lower limit tightening torque has been reached.



DUAL BRAKE VALVE



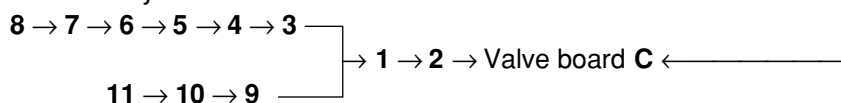
● Disassembly sequence

- | | | |
|-------------------|------------------------|-------------------|
| 1 Straight pin | 20 Sleeve | 39 Valve spring |
| 2 L-pin | 21 O-ring | 40 Washer |
| 3 Straight pin | 22 O-ring | 41 Inlet valve |
| 4 Roller | 23 Relay piston | 42 Body |
| 5 Pedal cover | 24 Relay piston spring | 43 O-ring |
| 6 Lock nut | 25 O-ring | 44 Retaining ring |
| 7 Set screw | 26 Bushing | 45 Exhaust cover |
| 8 Pedal | 27 Self-locking bolt | 46 Washer |
| 9 Boot | 28 Spring seat | 47 O-ring |
| 10 Plunger | 29 Outer spring | 48 O-ring |
| 11 Plate | 30 Inner spring | 49 Valve retainer |
| 12 Bolt | 31 O-ring | 50 Valve spring |
| 13 Plug | 32 Primary piston | 51 Valve retainer |
| 14 Retaining ring | 33 Spring | 52 Inlet valve |
| 15 Spring | 34 Retaining ring | 53 Cover |
| 16 Screw | 35 Valve retainer | |
| 17 Outer spring | 36 O-ring | |
| 18 Inner spring | 37 O-ring | |
| 19 Washer | 38 Washer | |
- ⊗ : Non-reusable parts

● Assembly sequence

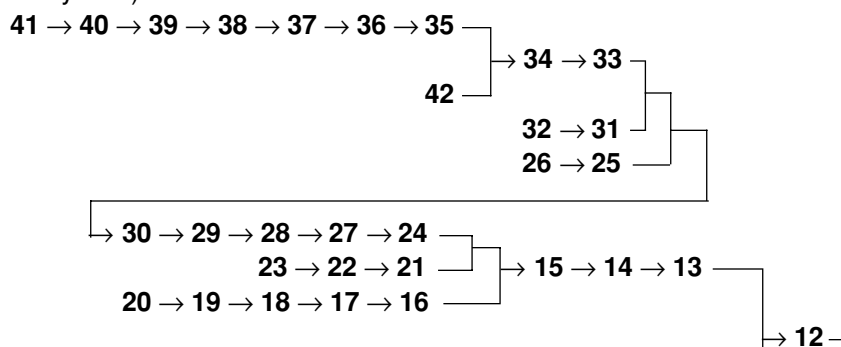
First assemble pedal assembly **A** and valve assembly **B**, then assemble by sandwiching valve board **C** between these two assemblies.

< Pedal assembly **A** >

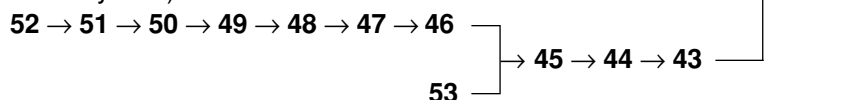


< Valve assembly **B** >

(Primary side)



(Secondary side)



Repair kit : Dual brake valve kit

● Inspection of function after assembly

📖 P35A-53

DUAL BRAKE VALVE

Service standards

Unit : mm {in.}

Location	Maintenance item			Standard value		Limit	Remedy	
1, 3	Outer diameter of straight pin	Roller mounting		9.5 {0.374}		9.44 {0.371}	Replace	
		Pedal mounting		9.5 {0.374}		9.45 {0.372}		
4	Roller	Inner diameter		9.5 {0.374}		9.67 {0.38}	Replace	
		Outer diameter		18.3 {0.72}		18.15 {0.71}		
8	Pedal play	Pedal toe		12 ^{+3.5} ₋₂ {0.47 ^{+0.14} _{-0.079} }		—	Adjust using set screw	
		Depression angle		3.5° ^{+1.0°} _{-0.5°}		—		
10	Outer diameter of plunger			19.9 {0.783}		19.8 {0.780}	Replace	
11	Plate	Inner diameter of straight pin hole		9.5 {0.374}		9.68 {0.381}	Replace	
		Inner diameter of bushing		20 {0.787}		20.08 {0.791}		
15	Spring load (Installed length 12.6 {0.50})			—		215 N {49 lbf, 22 kgf}	Replace	
24	Relay piston spring load (Installed length 12.8 {0.50})			—		47 N {11 lbf, 4.8 kgf}	Replace	
29	Outer spring load (Installed length 26.5 {1.04})			—		215 N {48 lbf, 21.8 kgf}	Replace	
30	Inner spring load (Installed length 19.1 {0.75})			—		60 N {13 lbf, 6.1 kgf}	Replace	
33	Spring load (Installed length 17 {0.67})			—		97 N {22 lbf, 9.9 kgf}	Replace	
39	Valve spring load (Installed length 14.3 {0.56})			—		37 N {8.4 lbf, 3.8 kgf}	Replace	
50	Valve spring load (Installed length 12.9 {0.51})			—		47 N {11 lbf, 4.8 kgf}	Replace	
—	Pressure stroke	Input air pressure 685 kPa {100 psi, 7 kgf/cm ² }	Pedal toe	25.5 {1.00}	Output air pressure	110 ⁺²⁵ ₋₅₄ kPa {16 ^{+3.6} _{-7.8} psi, 1.1 ^{+0.25} _{-0.55} kgf/cm ² }	—	Replace springs
Depression angle			7.5°	358 ⁺⁷⁰ ₋₁₀₀ kPa {52 ⁺¹⁰ ₋₁₅ psi, 3.7 ^{+0.7} _{-1.0} kgf/cm ² }			—	
Pedal toe			46 {1.81}			685 kPa {100 psi, 7 kgf/cm ² }	—	
Depression angle			13.5°					
Pedal toe			53 ^{+8.5} _{-1.5} {2.09 ^{+0.33} _{-0.059} }					
Depression angle			15.5° ^{+2.5°} _{-0.5°}					

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Lock nut	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
12	Bolt (Valve assembly primary and secondary sides assembling)	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
16	Screw	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
20	Sleeve	1.0 to 3.0 {0.7 to 2.2, 0.1 to 0.3}	—
27	Self-locking bolt	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—

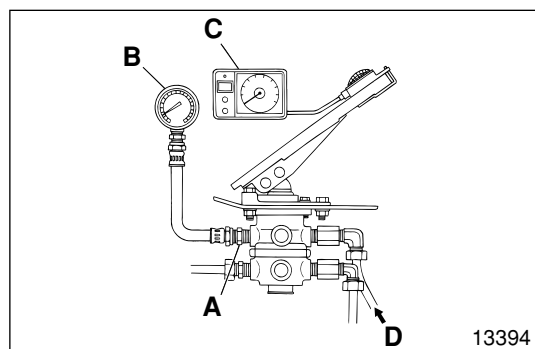
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1, 3	Outer periphery of straight pin	High pressure-resistant, high abrasion-resistant grease [NLGI No.2 (Li soap)]	As required
9, 10	Pack between boot and plunger	High pressure-resistant, high abrasion-resistant grease [NLGI No.2 (Li soap)]	1 cm ³ {0.061 cu. in.}
10	Friction surfaces of plunger and other parts	High pressure-resistant, high abrasion-resistant grease [NLGI No.2 (Li soap)]	As required
—	Friction surface and groove of O-ring, friction surfaces of metals	Multipurpose grease [NLGI No.2 (Li soap)]	As required

Special tools

Location	Tool name and shape	Part No.	Application
21	Insert tool	*910-24461	Installation of O-ring
32	Retainer	*910-24590	Holding of primary piston

* : KNORR-BREMZE part No.

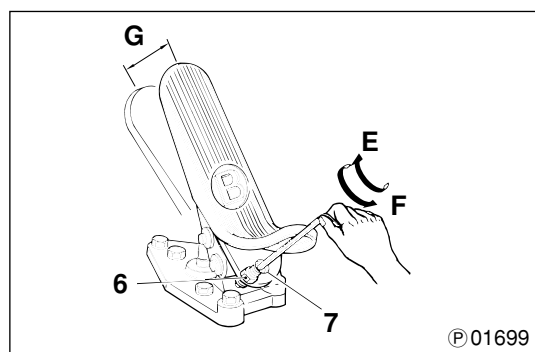


◆ Service procedure

● Inspection of function after assembly

Check that the output air pressure, corresponding to the pedal depression angle, conforms to the specified value.

- Mount pressure gauge **B**, capable of measuring 980 kPa {142 psi, 10 kgf/cm²} or more, on primary output side port **A**.
- Mount depression gauge **C** on the brake pedal.
- Apply air pressure of 685 kPa {100 psi, 7 kgf/cm²} to primary input side port **D** and inspect related parts for air leakage.
- If air leakage is found, do the following:
 - Tighten connectors.
 - Disassemble the dual brake valve and inspect the O-ring assemblies of all parts.



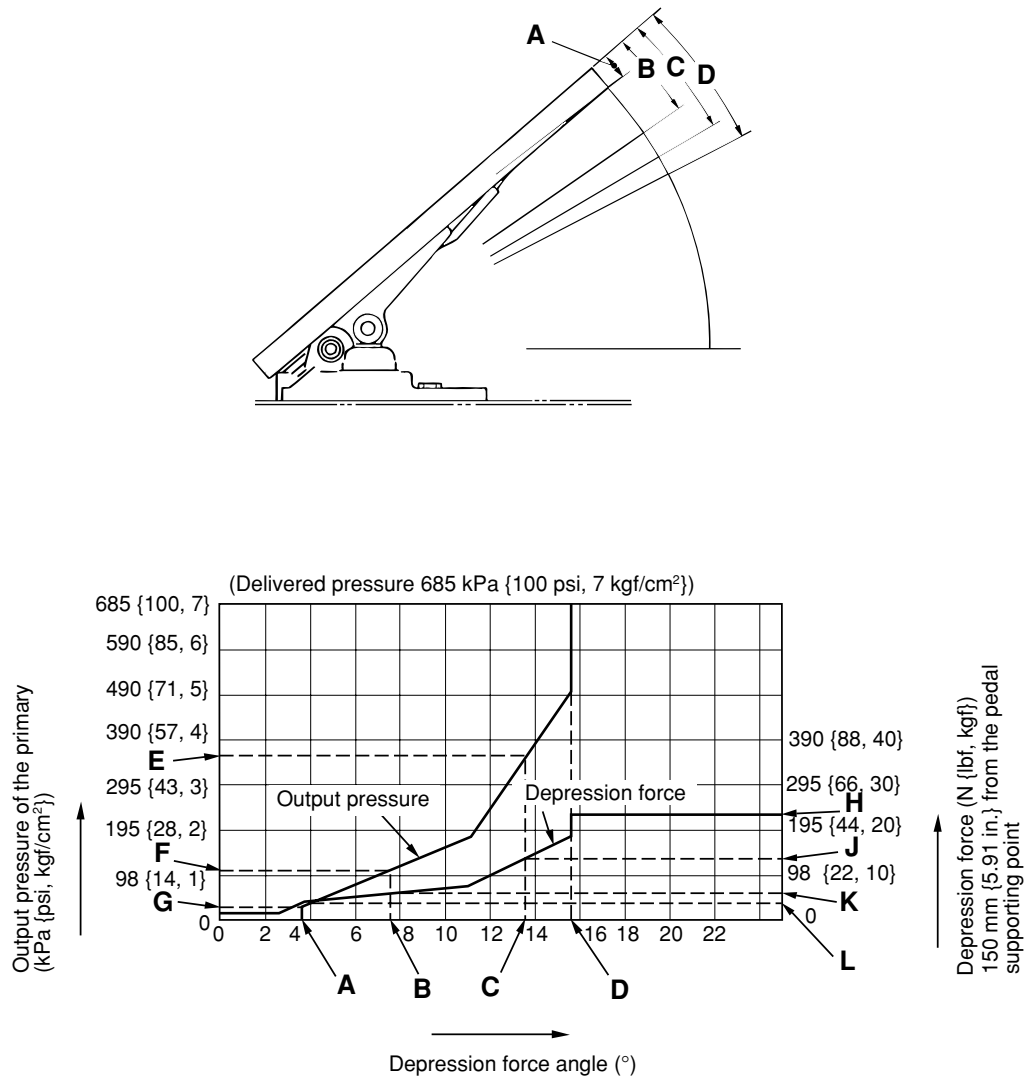
- Turn set screw **7** and adjust brake pedal play **G** to the standard value.
- Tighten lock nut **6** at specified torque to lock set screw **7**.
- Read pressure gauge **B** and make sure that the primary output pressure and brake pedal depression force angle, corresponding to the brake pedal depression angle, conform to the standard values shown in the input/output characteristic curve diagram overleaf.
- If the output air pressure is lower than the standard value, replace the following springs:
 - Spring **15**
 - Outer spring **29**
 - Inner spring **30**

E : Turning clockwise decreases the play (To decrease brake pedal depression angle)

F : Turning counterclockwise increases the play (To increase brake pedal depression angle)

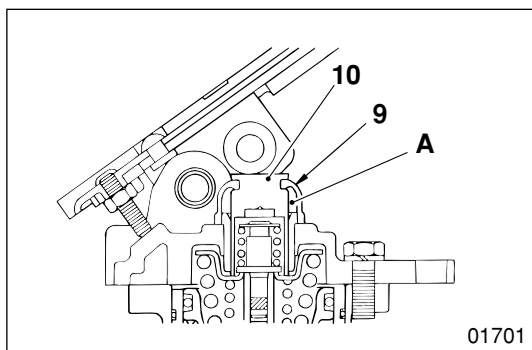
DUAL BRAKE VALVE

Input/Output Characteristic Curve Diagram



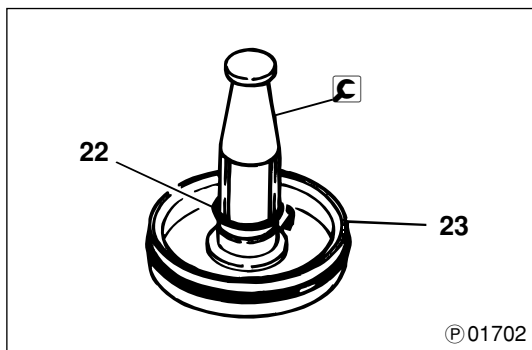
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- A : Depression angle (Free play) $3.5^{\circ} \begin{smallmatrix} +1.0^{\circ} \\ -0.5^{\circ} \end{smallmatrix}$ ($12 \begin{smallmatrix} +3.0 \\ -1.5 \end{smallmatrix}$ mm { $0.47 \begin{smallmatrix} +0.12 \\ -0.059 \end{smallmatrix}$ in.})
- B : Depression angle 7.5° (25.5 mm {1.0 in.})
- C : Depression angle 13.5° (46 mm {1.81 in.})
- D : Depression angle $15.5^{\circ} \begin{smallmatrix} +2.5^{\circ} \\ -0.5^{\circ} \end{smallmatrix}$ ($53 \begin{smallmatrix} +8.5 \\ -0.5 \end{smallmatrix}$ mm { $2.09 \begin{smallmatrix} +0.33 \\ -0.020 \end{smallmatrix}$ in.})
- E : $358 \begin{smallmatrix} +70 \\ -100 \end{smallmatrix}$ kPa { $52 \begin{smallmatrix} +5.7 \\ -1.4 \end{smallmatrix}$ psi, $3.65 \begin{smallmatrix} +0.4 \\ -1.0 \end{smallmatrix}$ kgf/cm²}
- F : $110 \begin{smallmatrix} +25 \\ -54 \end{smallmatrix}$ kPa { $16 \begin{smallmatrix} +3.6 \\ -7.8 \end{smallmatrix}$ psi, $1.1 \begin{smallmatrix} +0.25 \\ -0.55 \end{smallmatrix}$ kgf/cm²}
- G : 30 kPa {4.4 psi, 0.3 kgf/cm²} or less
- H : 230.5 ± 20 N { 52 ± 4.4 lbf, 23.5 ± 2 kgf}
- J : 132 ± 25 N { 30 ± 5.5 lbf, 13.5 ± 2.5 kgf}
- K : 59 ± 25 N { 13 ± 5.5 lbf, 6 ± 2.5 kgf}
- L : 39 ± 10 N { 8.8 ± 2.2 lbf, 4 ± 1 kgf}

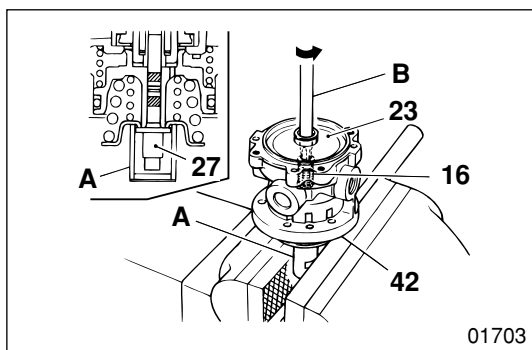


9 10 Packing grease between boot and plunger

Pack area A with 1 cm³ {0.061 cu in.} of grease.



22 Installation of O-ring



23 Removal of relay piston

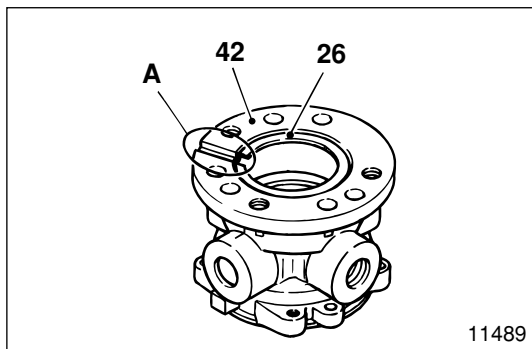
- Grip (14 mm {0.55 in.}) socket wrench **A** in a vise.
- Insert the head of self-locking bolt **27** into socket wrench **A** to tighten body **42**.

WARNING

You must be careful when you loosen screw **16**, because the spring in body **42** can forcibly eject relay piston **23**. To avoid this hazard, press down on the relay piston with your hand when you carry out the above work.

- Loosen screw **16** gradually to remove relay piston **23**.

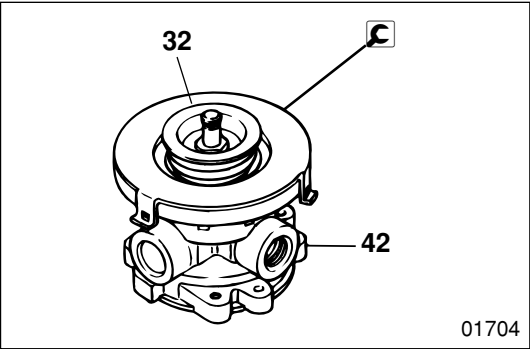
B : Phillips screwdriver



26 Installation of bushing

A : Indent

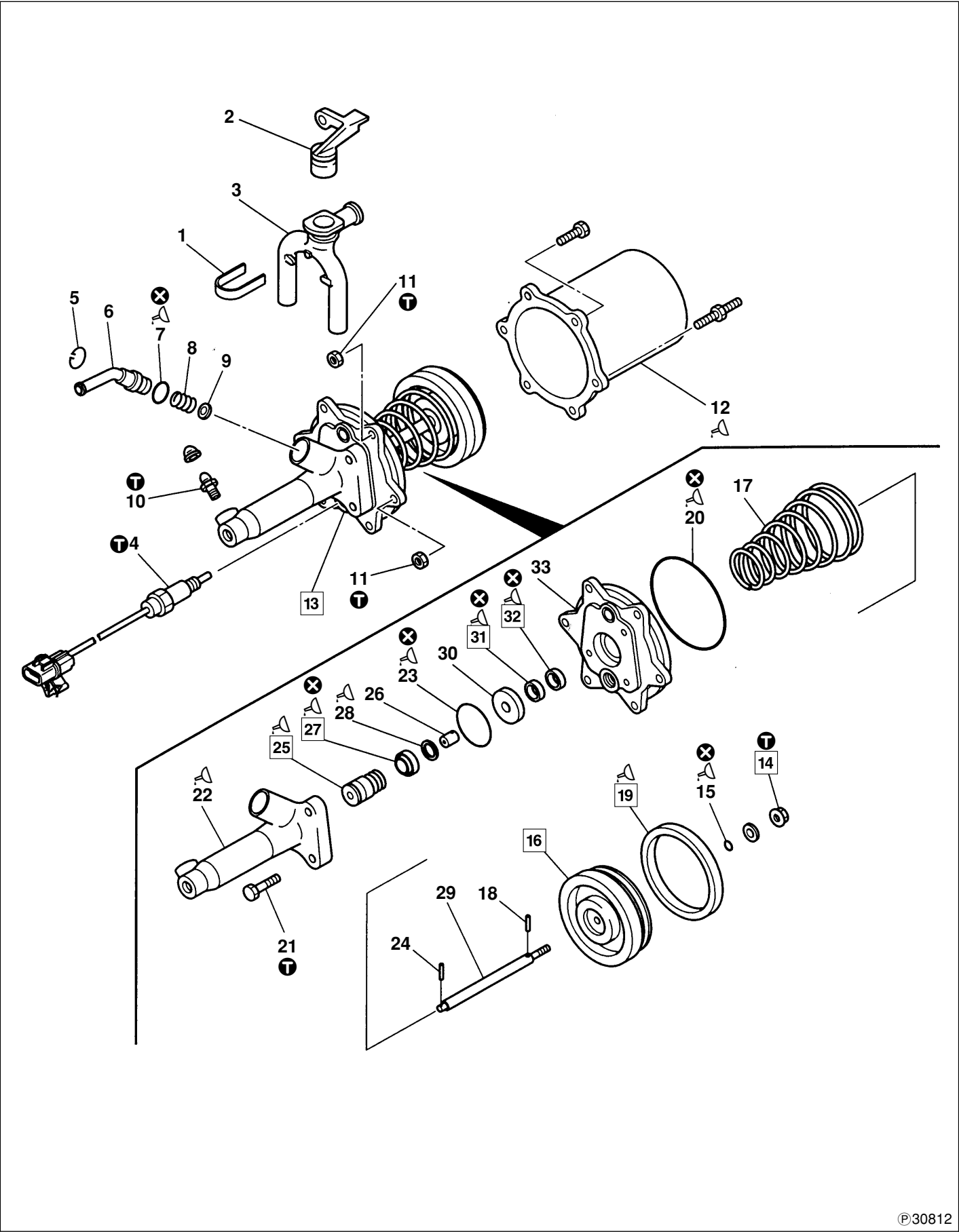
DUAL BRAKE VALVE



32 Removal and installation of primary piston

MEMO

BRAKE BOOSTER (AIRMASTER)



● Disassembly sequence

- | | | |
|--|-----------------------|------------------------|
| 1 Clamp | 13 Body assembly | 26 Valve seal assembly |
| 2 Holder | 14 Nut | 27 Cup packing |
| 3 Exhaust cover | 15 O-ring | 28 Backup ring |
| 4 Stroke switch
 Gr 54 | 16 Piston plate | 29 Push rod |
| 5 Retaining ring | 17 Return spring | 30 Washer |
| 6 Connector | 18 Straight pin | 31 Oil seal |
| 7 O-ring | 19 Cup packing | 32 Oil seal |
| 8 Spring | 20 O-ring | 33 End plate |
| 9 Valve assembly | 21 Bolt | |
| 10 Air bleeder | 22 Hydraulic cylinder | ⊗ : Non-reusable parts |
| 11 Nut | 23 O-ring | |
| 12 Cylinder shell | 24 Straight pin | |
| | 25 Hydraulic piston | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Brake booster kit

● Inspection of function after assembly

 P35A-60

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
12, 16	Clearance between cylinder shell and piston plate	[114.3] 0.9 to 1.6 {[4.50] 0.035 to 0.063}	2.0 {0.079}	Replace piston plate
17	Return spring load (Installed length:132 {5.20})	137.3±20 N {31±4.4 lbf, 14±2 kgf}	107.3 N {26 lbf, 12 kgf}	Replace
22, 25	Clearance between hydraulic cylinder and hydraulic piston	[22.2] 0.04 to 0.11 {[0.87] 0.0016 to 0.0043}	0.2 {0.0079}	Replace hydraulic piston
29	Push rod deflection	0.05 {0.002}	0.15 {0.0059}	Replace

Ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Stroke switch	8 to 12 {5.8 to 8.7, 0.8 to 1.2}	Overtightening prohibited
10	Air bleeder	7 to 12 {5.1 to 8.7, 0.7 to 1.3}	—
11	Nut (Mounting of body assembly and cylinder shell)	11 to 15 {8 to 12, 1.1 to 1.6}	—
14	Nut (Mounting of piston plate and push rod)	11 to 15 {8 to 12, 1.1 to 1.6}	Punch for installation
21	Bolt (Mounting of hydraulic cylinder)	20 to 29 {14 to 22, 2 to 3}	—

BRAKE BOOSTER (AIRMMASTER)

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7, 23	Entire surface of O-ring	Brake fluid (SAE J1703f or FMVSS No. 116, DOT3)	As required
12	Cylinder shell bore	Multipurpose grease [NLGI No.2 (Li soap)]	10 g (0.35 oz)
15, 20	O-ring	Multipurpose grease [NLGI No.2 (Li soap)] or Silicon grease	As required
19	Entire surface of cup packing	Multipurpose grease [NLGI No.2 (Li soap)]	5 g (0.18oz)
22, 25, 27	Entire surface of cup packing, and friction surfaces of hydraulic piston and hydraulic cylinder	Brake fluid (SAE J1703f or FMVSS No. 116, DOT3)	As required
31	Entire surface of oil seal	Silicon oil	As required
32	Groove on oil seal	Silicon grease	As required

Special tools

Location	Tool name and shape	Part No.	Application
13	Stand	★910-00450	Working bench
16	Holder	★910-24831	Removal and installation of piston plate
27	Cup Insert Guide	★910-23295	Mounting of cup packing
31, 32	Puller	★910-20350	Removal of oil seal
31, 32	Press-fit bar	★910-20195	Press-fitting of oil seal
—	Portable Tester	★916-00021	Function check after assembly

★ BOSCH BRAKING SYSTEMS part No.

◆ Service procedure

● Inspection of function after assembly

(1) Install the brake booster on the vehicle, and conduct the performance test using  Portable Tester.

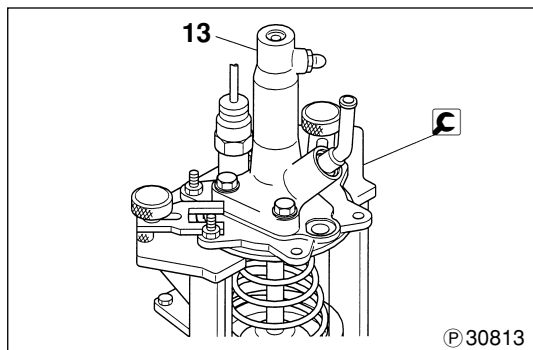
- Setting up of pressure gauge
 - Connect a pressure gauge (PG4) for measuring the command pressure to the air supply port of the power cylinder.
 - Remove air bleeder **10** from the hydraulic cylinder and connect an oil pressure gauge (PG2). Then bleed air from the inside of the tester.
- Raise the air pressure in the air tank to 590 kPa {85 psi, 6 kgf/cm²}, then inspect the functions given in the following table with the engine stopped.

Test item	Test condition	Standard value in assembled condition	Limit	Remedy
Air-tightness at full load	Air pressure decrease after keeping brake pedal fully depressed for 15 seconds	—	Air pressure gauge (PG4) reading less than 59 kPa {8.5 psi, 0.6 kgf/cm ² }	Replace O-ring 15 and/or cup packing 19
Operation at full load	Confirm that command air pressure (PG4) is 590 kPa {85 psi, 6 kgf/cm ² } with the brake pedal fully depressed	Oil pressure gauge (PG2) reading 14.0 to 15.4 MPa {2030 to 2230 psi, 143 to 157 kgf/cm ² }	Oil pressure gauge (PG2) reading 13.7 to 15.7 Mpa {1990 to 2280 psi, 140 to 160 kgf/cm ² }	Replace hydraulic piston 26 and/or cup packing 27
Brake booster operation starting pressure	Depress brake pedal gradually and read the command pressure when oil pressure gauge (PG2) starts rising	Air pressure gauge (PG4) reading 14 to 33 kPa {2.0 to 4.8 psi, 0.14 to 0.34 kgf/cm ² }	Air pressure gauge (PG4) reading 43 kPa {6.3 psi, 0.44 kgf/cm ² }	Replace valve seal assembly 26 , cup packing 19 and/or cup packing 27
Residual pressure	When brake pedal is released after depressed	Oil pressure gauge (PG2) reading 78 to 125 kPa {11 to 18 psi, 0.8 to 1.3 kgf/cm ² }	Oil pressure gauge (PG2) reading 59 to 155 kPa {8.5 to 23.0 psi, 0.6 to 1.6 kgf/cm ² }	Replace valve assembly 9 and/or spring 8

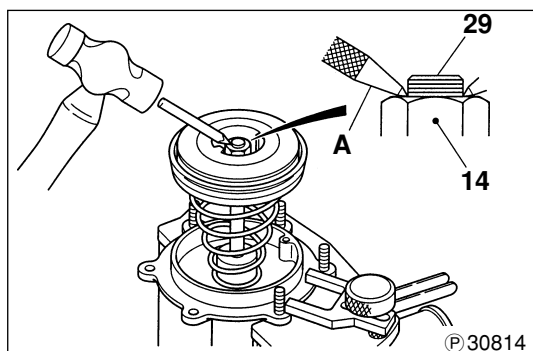
(2) After completion of the above tests, conduct the function test of stroke switch **4**. Loosen the air bleeder so as to allow fluid to leak out. Depress the brake pedal to let the power piston move full stroke so that stroke switch **4** may be operated. Then confirm that the brake warning lamp on the meter cluster comes on.

(3) Always bleed the brake system and pour brake fluid to the "H" line of the brake fluid tank after performing the brake booster function check.

◆ Service procedure



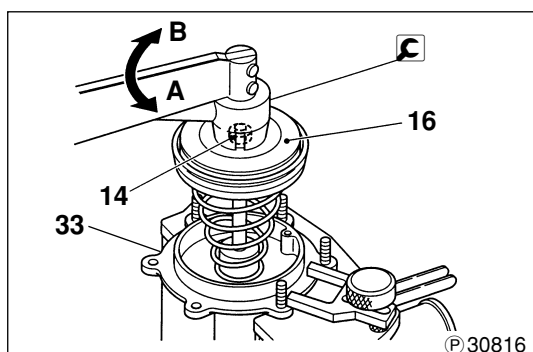
13 Installation of body assembly



14 Installation of nut

After tightening nut 14 at specified torque, stake the nut and push rod 29 thread area.

A : Center punch



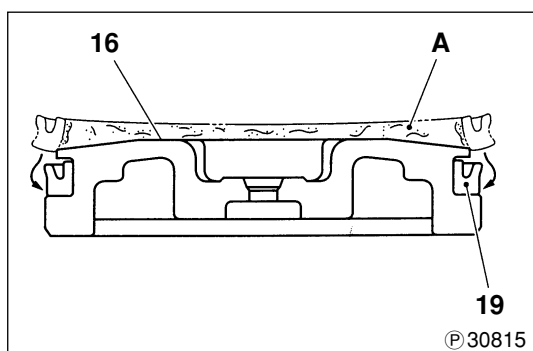
16 Removal and installation of piston plate

A : Removal

B : Installation

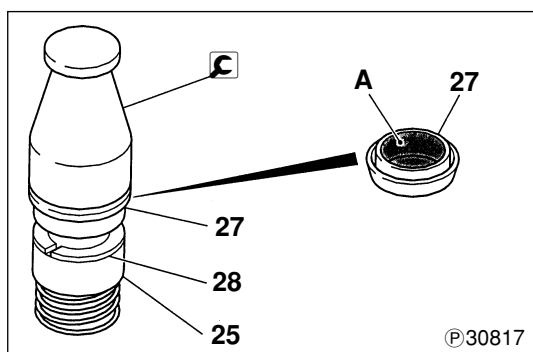
NOTE

To install, while pressing piston plate 16 to end plate 33 with sufficient force, tighten nut 14 to specified torque.



19 Installation of cup packing

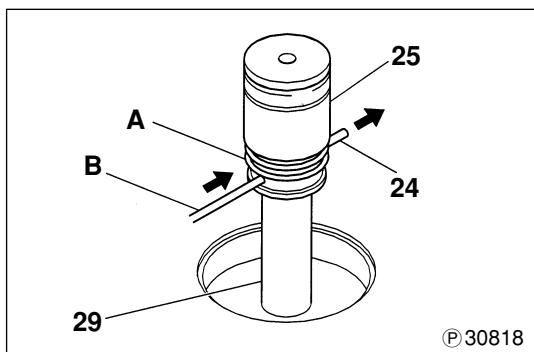
A : Grease



27 Installation of cup packing

A : Brake fluid

BRAKE BOOSTER (AIRMASTER)

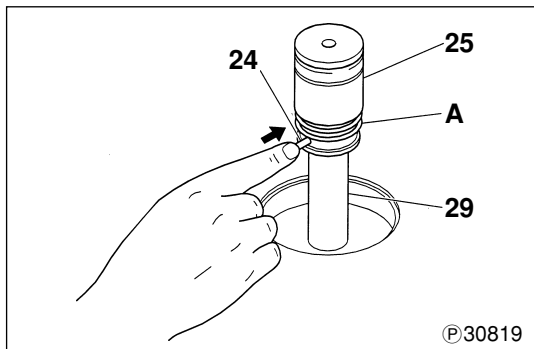


25 Hydraulic piston

[Removal]

A : Spring

B : Needle



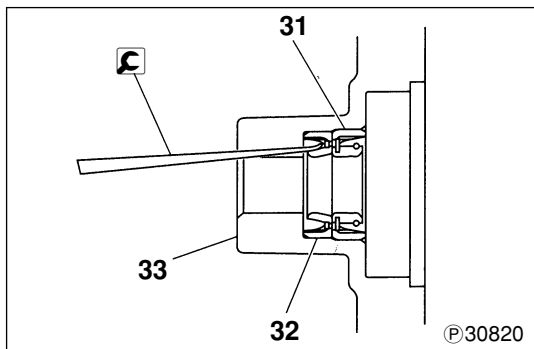
[Installation]

Align the holes of hydraulic piston 25, valve seal assembly 26 and push rod 29, and insert straight pin 24.

A : Spring

NOTE

After inserting straight pin 24, make sure that the hydraulic piston spring is hanging over the straight pin and working as a stopper.

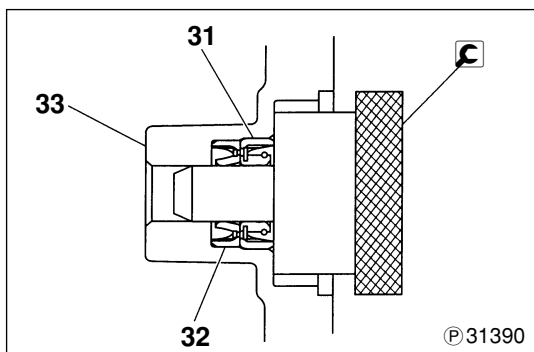


31 32 Oil seals

[Removal]

CAUTION

Remove oil seals 31, 32 by tapping evenly. Be careful not to scratch inner surface of end plate 33.



[Installation]

Install oil seals on end plate 33 in the direction shown in the diagram.

MEMO

● Initial adjustment of brake shoe clearance after installation

📖 P35A-65

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
9	Return spring load (Installed length 192 {7.6})		460±39 N {340±29 lbf 47±4 kgf}		Clearance between coils or coil and cover	Replace
13	Thickness of lining of brake shoe assembly		12 {0.47}		5.2 {0.20} (Side shoulder means wear limit)	Replace
*	Brake drum	Inner diameter	320 {12.59}	*321 {12.63}	322 {12.67}	Replace
		Cylindrical accuracy	0.05 {0.0020}		0.2 {0.0079}	Correct

* : Indicates correction limit.

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4, 8	Brake pipe	13.7±2.0 {10±1.5, 1.4±0.2}	—
5	Bolt (Joint mounting)	9.8±2.0 {7.2±1.5, 1.0±0.2}	—
3, 7	Bolt (Pipe clamp mounting)	4.9±1.0 {3.6±0.74, 0.5±0.1}	—
17	Bolt (Wheel cylinder assembly mounting)	44.1±8.8 {33±6.5, 4.5±0.9}	—
18	Bolt (Wheel cylinder assembly mounting)	78±16 {58±12, 8.0±1.6}	—
20	Nut (Holder pin mounting)	29.4±5.9 {22±4.4, 3.0±0.6}	—

🛢 Lubricant and/or sealant

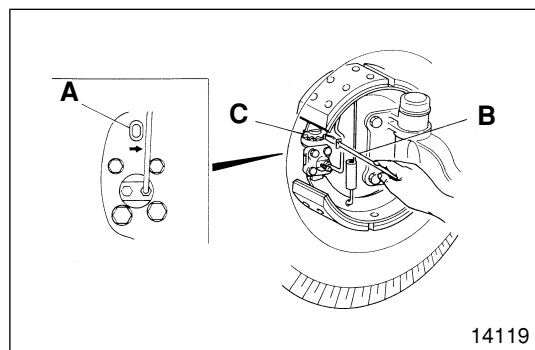
Location	Points of application	Specified lubricant and/or sealant	Quantity
12, 13	Brake shoe assembly contact surface with washer	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
13, 19	Brake shoe assembly contact surface with wheel cylinder assembly	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure

● Initial adjustment of brake shoe clearance after installation

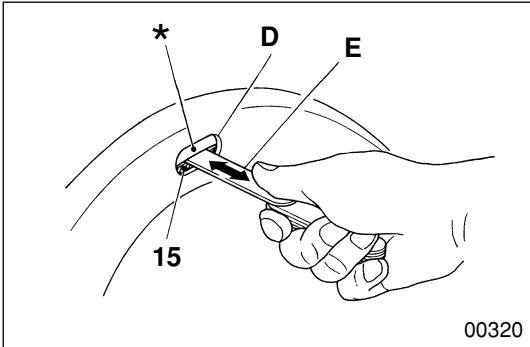
Initial adjustment of clearance between brake drum and brake shoe assembly

- Jack up front wheels to make sure that the wheel hub bearing has no play. If there is any play, correct it. 📦 Gr 26
- Insert screwdriver **B** into adjusting hole **A**, and turn adjuster **C** in the direction of the stamped arrow on backing plate **22** to such an extent that the tire, when turned by hand, slightly drags. Perform this adjustment at both of the two locations per wheel on one side.
- Depress the brake pedal a few times to release, and make sure that the tire, when turned by hand, slightly drags. If the tire lightly turns, repeat the above procedure again.

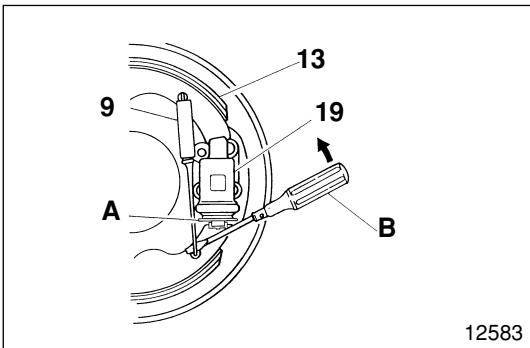


FRONT WHEEL BRAKE <φ 320 mm {12.6 in.} Drum brake>

- Return adjuster **B** by 8 to 9 notches in the opposite direction to the arrow stamp direction. Perform this adjustment at both of the two locations per wheel on one side.
- Turn the tire by hand to make sure that it does not drag. If it drags, repeat the above procedure again.



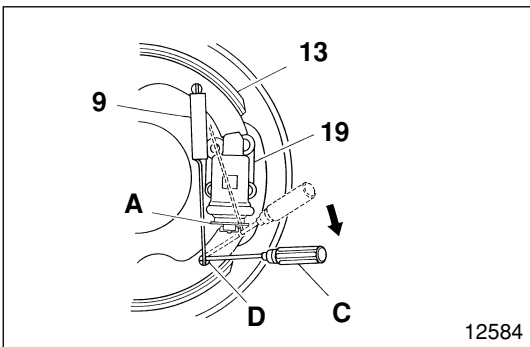
- Insert a 0.2 mm {0.0079 in.} feeler gauge between brake drum * and brake lining 15 through check hole D, and make sure that it can be inserted or extracted with a little resistance. Perform this check at both of two locations per wheel on one side.



9 Return spring

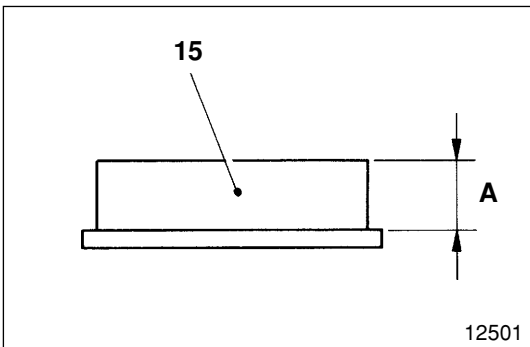
[Removal]

Pry and remove return spring 9 with flat head screwdriver **B** making use of wheel cylinder assembly 19 adjuster **A** as a fulcrum.



[Installation]

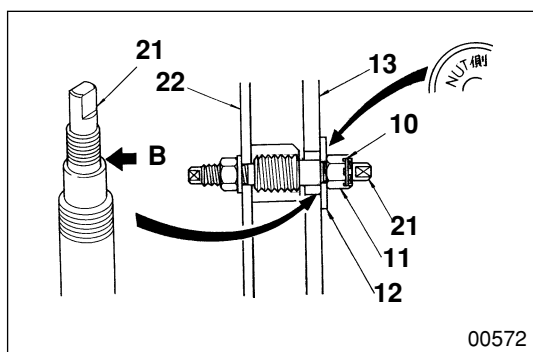
- Install the shorter hook of return spring 9 on brake shoe assembly 13 on the opposite side to adjuster **A** of wheel cylinder assembly 19.
- Hang small Phillips screwdriver **C** on the hook of return spring 9, and insert the tip of the screwdriver into return spring mounting hole **D** of brake shoe assembly 13 and pry it to install the return spring.



13 Brake shoe assembly

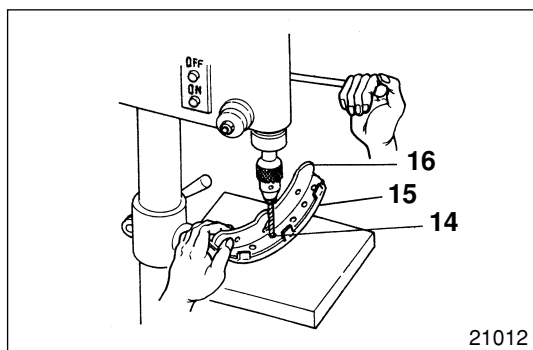
[Inspection]

If thickness **A** of brake lining 15 is below the limit, replace brake linings in axle sets.

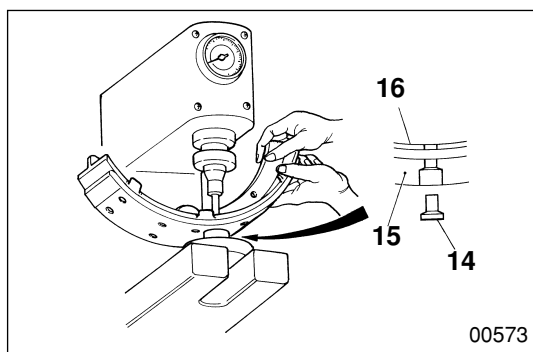


[Installation]

- Install brake shoe assembly **13**.
- Insert washer **12** with stamp mark "NUT SIDE" on the front. Tighten holder pin nut **11** and return the holder pin nut in the range of 0 to 60 degrees to the split pin hole of the holder pin with which the washer matches for the first time after lightly contacting stepped area **B** of holder pin **21**.
- Insert split pin **10** and bend it.

**15 Brake lining**

[Removal]



[Installation]

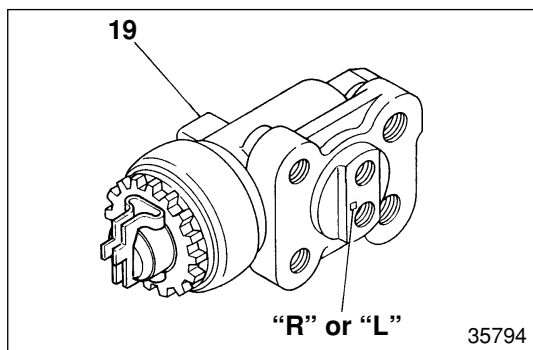
- Clean the brake lining **15** mounting surfaces of brake shoe **16** with cleaning fluid and dry them.
- Insert rivet **14** from brake lining **15** side, and stake it gradually from the center toward both ends.
- Staking load for rivet **14** shall be 21.6 ± 1 kN {15930 $\pm$ 735 lbs-ft, 2200 $\pm$ 100 kgf}.
- Stake the rivet so that clearance between brake shoe **16** and brake lining **15** will be 0.05 mm {0.0020 in.} or less around the rivet **14** hole of $\phi 20$ mm {0.79 in.} and 0.2 mm {0.0079 in.} or less in other areas.
- Inspect contact of brake drum * to brake lining **15**, and correct poor locations, if any. Perform correction with the brake drum and brake lining assembled into the brake assembly.

WARNING ⚠

Do not leave lubricant on the surface of brake lining **15** because this reduces brake performance.

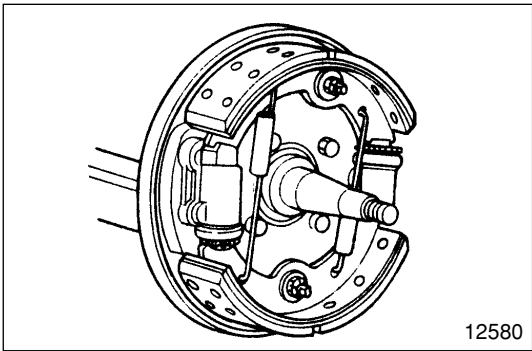
CAUTION ⚠

- Use linings of the same size and identification mark for brake lining **15** to avoid poor contact.
- Be sure to replace brake lining **15** in axle sets to avoid pulling.

**19 Installation of wheel cylinder assembly**

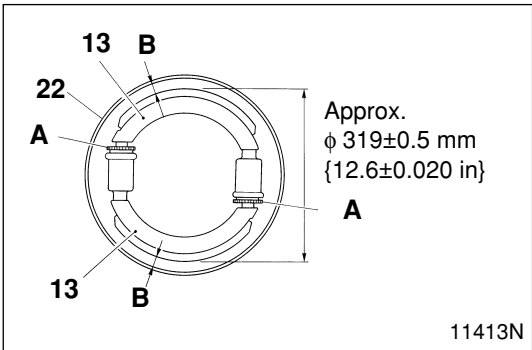
Identification mark	Installed position
R	Right wheel
L	Left wheel

FRONT WHEEL BRAKE <φ 320 mm {12.6 in.} Drum brake>

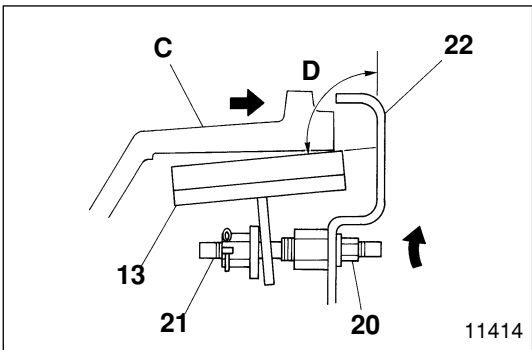


21 Adjustment of holder pin

- Install the front wheel brake assembly on the front axle.
📦 Gr 26

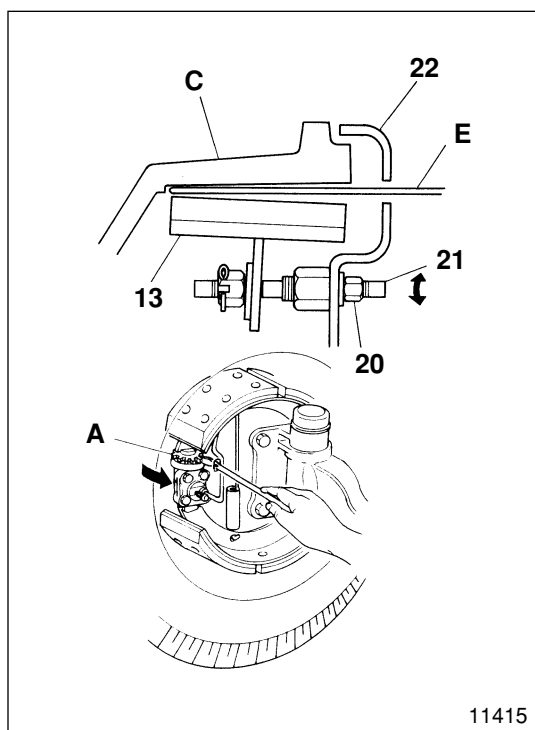


- Turn adjuster **A** for adjustment so that brake shoe assembly **13** will be to the dimension as shown in the figure.
- Move brake shoe assembly **13** to evenly adjust clearance **B**.



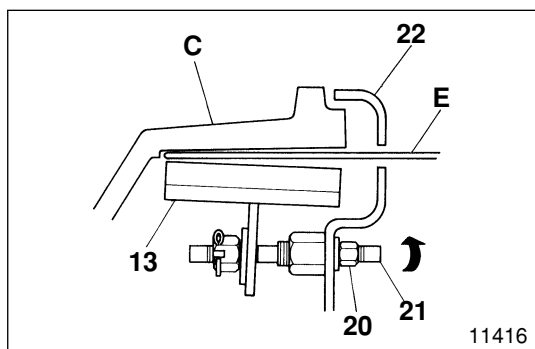
- Install wheel hub and brake drum assembly **C** on the front wheel brake assembly. 📦 Gr 26
If squareness **D** is 90 degrees or more, the wheel hub and brake drum assembly does not go into the designated position. Loosen nut **20** and turn holder pin **21** to bring squareness **D** close to 90 degrees.

- Bleed air from the brake system.
📖 P35A-29



11415

- ★•Turn adjuster **A** to such an extent that 0.2 mm {0.0079 in.} feeler gauge **E** is not pulled out lightly to widen brake shoe assembly **13**.
- ★•Loosen nut **20** and turn holder pin **21** to the right or left so that feeler gauge **E** can be lightly inserted and extracted.
 - Repeat operation of items with “★” until feeler gauge **E** cannot be lightly inserted and extracted.
 - Lightly depress the brake pedal a few times to make clearance **B** adjusted in the preceding item equal.
 - Repeat operation of items with “★” until feeler gauge **E** cannot be lightly inserted and extracted.



11416

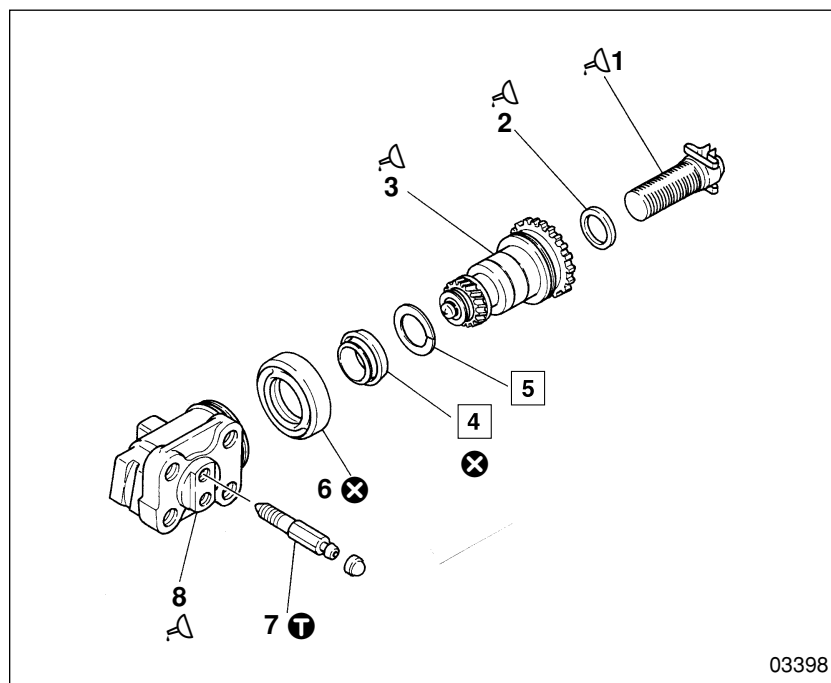
- If feeler gauge **E** cannot be lightly inserted and extracted, the feeler gauge contacts brake shoe assembly **13** at full width.
- Extract feeler gauge **E** under the above condition. Turn holder pin **21** for adjustment so that the feeler gauge, when inserted again, feels heavy at the back in insertion and extraction.
- After adjustment, tighten nut **20** to the specified torque.

★ Correction of brake drum

If the brake drum ★ has a cylindricity that exceeds the limit or is scratched, correct to the repair limit together with the wheel hub.

FRONT WHEEL BRAKE <φ 320 mm {12.6 in.} Drum brake>

Wheel Cylinder Assembly



● Disassembly sequence

- 1 Screw
- 2 Seal
- 3 Piston assembly
- 4 Piston cup
- 5 Backup ring
- 6 Boot
- 7 Air bleeder (Rear side only)
- 8 Body

✕ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [J])	Limit	Remedy
3, 8	Clearance between piston and cylinder body	[36.51 {1.44}] 0.03 to 0.09 {0.0012 to 0.0035}	0.2 {0.0079}	Replace piston

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

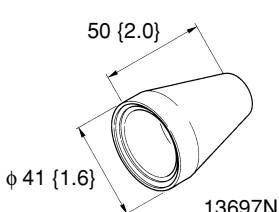
Location	Parts to be tightened	Tightening torque	Remarks
7	Air bleeder	9.8±2.0 {7.2±1.5, 1.0±0.2}	—

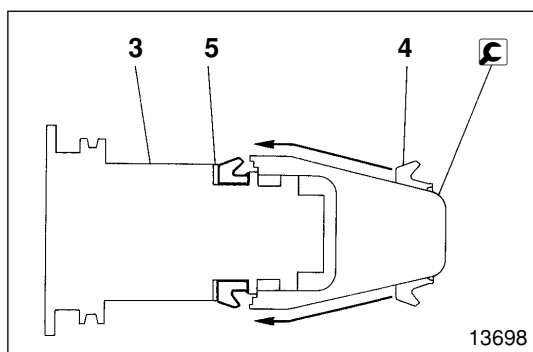
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Thread of screw	Rubber grease	As required
2	Periphery of seal	Rubber grease	As required
3	Periphery of piston and boot mounting groove	Rubber grease	As required
8	Inside surface of cylinder body and boot mounting groove	Rubber grease	As required

 Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
4	Piston cup guide 	MK356233	Piston cup mounting

◆ **Service procedure**

4

5

Installation of piston cup and backup ring

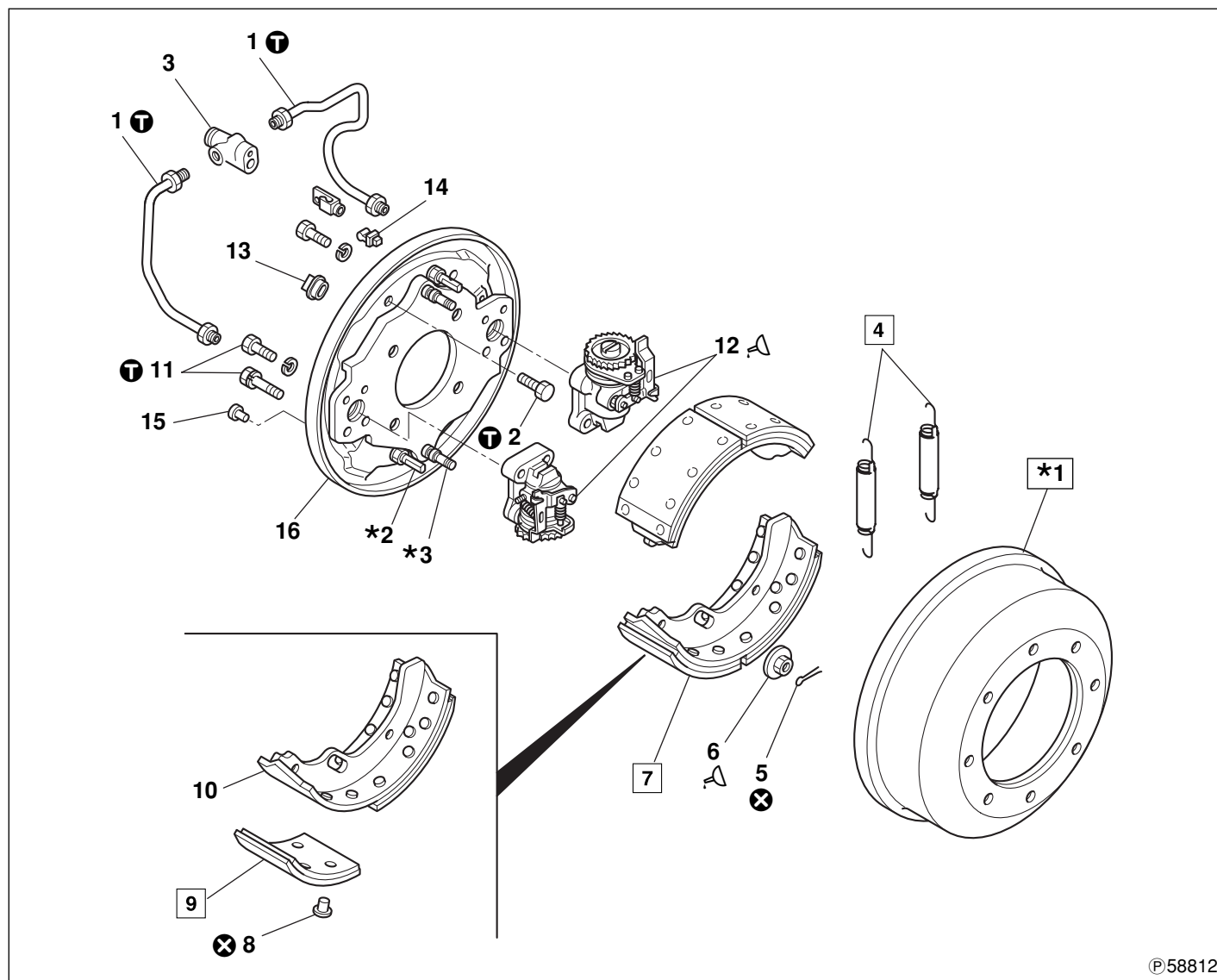
- Install piston cup 4 in the direction as shown in the figure using  piston cup guide.

CAUTION

- Be sure to install piston cup 4 of the correct size in the correct direction to avoid poor braking performance and brake fluid leaks.
- Be sure to install backup ring 5 of the correct size to avoid poor braking performance and brake fluid leaks.

FRONT WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

Front Wheel Brake Assembly



©58812

● Disassembly sequence

- | | | |
|-----------------------|----------------------------|------------------------|
| 1 Brake pipe | 9 Brake lining | 16 Backing plate |
| 2 Bolt | 10 Brake shoe | ⊗ : Non-reusable parts |
| 3 Joint | 11 Bolt | *1 : Brake drum Gr 26 |
| 4 Return spring | 12 Wheel cylinder assembly | *2 : Bolt |
| 5 Cotter pin | P35A-78 | *3 : Stud pin |
| 6 Nut | 13 Check hole plug | |
| 7 Brake shoe assembly | 14 Adjusting hole plug | |
| 8 Rivet | 15 Cover | |

WARNING

Do not leave grease or oil on the surface of brake lining 9 or inner surface of brake drum *1 because this reduces braking performance.

CAUTION

- If you are replacing only brake lining 9, clean the adjuster and screw thread area of wheel cylinder assembly 12 and apply rubber grease to the thread area.
- Do not turn or remove bolt *2 that is fitted to keep brake shoe assembly 7 at 90°.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Brake lining kit

● Initial adjustment of brake shoe clearance after installation

 P35A-74

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
4	Return spring load (Installed length 228.4 {8.99})		380 N {86 ft.lbs, 39 kgf}		Clearance between coils or coil and cover	Replace
7	Thickness of brake lining		15.4 {0.61}		5.5 {0.22} (Side shoulder means wear limit)	Replace brake lining
*1	Brake drum	Inner diameter	400 {15.75}	*401 {15.79}	402 {15.83}	Repair or replace
		Cylindrical accuracy	0.025 {0.00098}		0.2 {0.0079}	Correct

* : Indicates correction limit.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Brake pipe flare nut	12.75 to 17.65 {9.4 to 13, 1.3 to 1.8}	—
2	Bolt (Joint mounting)	37.27 to 49.03 {27 to 36, 3.8 to 5.0}	—
11	Bolt (Wheel cylinder assembly mounting)	37.27 to 49.03 {27 to 36, 3.8 to 5.0}	M10
		122.58 to 166.7 {90 to 120, 12.5 to 17.0}	M12

** Lubricant and/or sealant**

Location	Points of application	Specified lubricant and/or sealant	Quantity
6	Brake shoe assembly contact surface of nut	Brake grease	As required
12	Wheel cylinder assembly anchor and screw groove contact area with brake shoe	Brake grease	As required

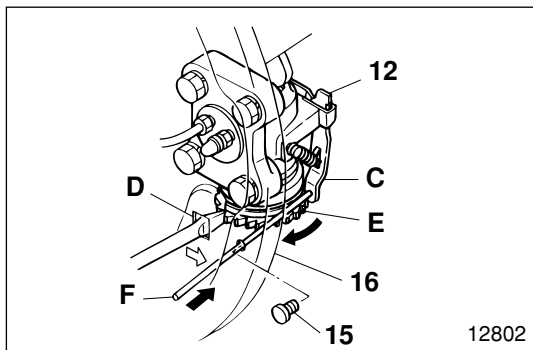
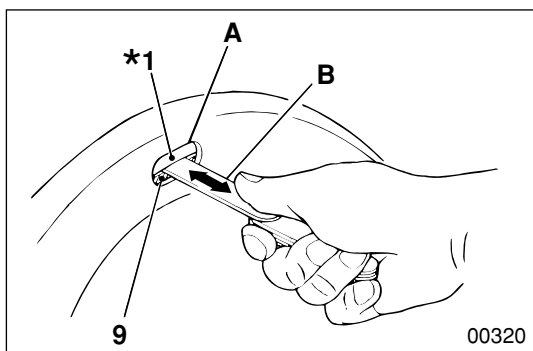
FRONT WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

◆ Service procedure

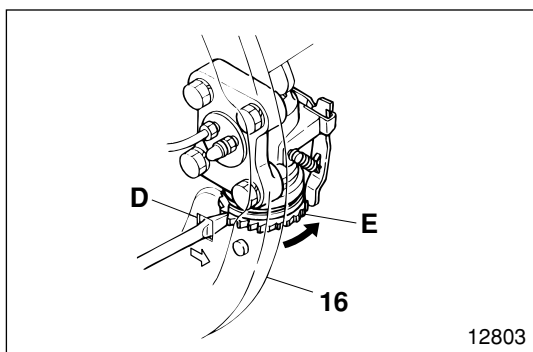
● Initial adjustment of brake shoe clearance after installation

Turning the adjuster of wheel cylinder assembly **12** in arrow ⇨ direction expands brake shoe assembly **7**, narrowing the clearance between brake drum ***1** and brake lining **9**.

- Jack up the vehicle to make sure that the wheel hub bearing has no play. If there is any play, correct it.  Gr 26
- Remove adjusting hole plug **14** and check hole plug **13**.
- Adjust the brake shoe clearance as follows, so that 0.3 mm {0.012 in.} feeler gauge **B** can be inserted or extracted through check hole **A**, between brake drum ***1** and brake lining **9** with a little resistance.



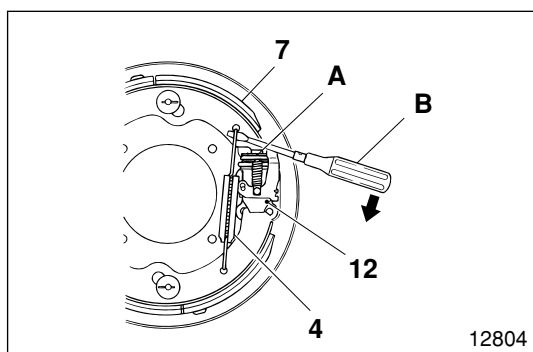
- To increase brake shoe clearance
 - Remove cover **15** on the rear of backing plate **16**.
 - Insert a wire (approximately φ5 mm {0.20 in.}) into the hole of cover **15** and lift adjusting lever **C** of wheel cylinder **12**.
 - Turn adjuster **E** of wheel cylinder **12**, through adjusting hole **D**, in the opposite direction to arrow ⇨ on backing plate **16**.



- To decrease brake shoe clearance
Turn adjuster **E** in the arrow ⇨ direction marked on backing plate **16** through adjusting hole **D**.

- Extract the feeler gauge and depress the brake pedal two or three times fully, then the specified value brake shoe clearance can be obtained.
- Insert a 0.2 mm {0.0079 in.} feeler gauge through check hole **A** and make sure that it can be inserted or extracted with a little resistance. If there is any fault, disassemble and inspect wheel cylinder **12**.

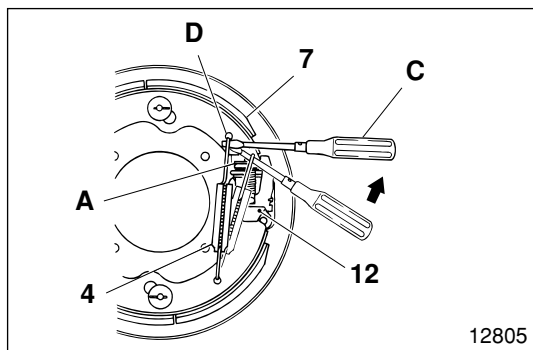
 P35A-78



4 Return spring

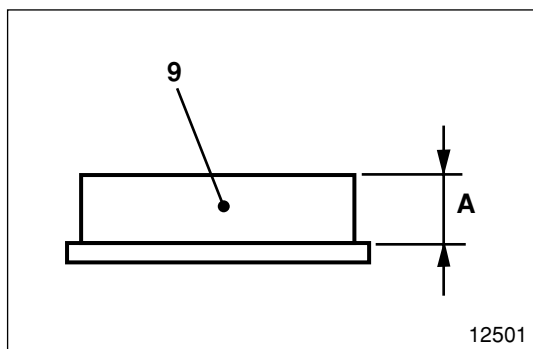
[Removal]

To remove the return spring, place screwdriver **B** on the hook of the return spring, then pry and remove the return spring making use of wheel cylinder **12** adjusting screw **A** as a fulcrum.



[Installation]

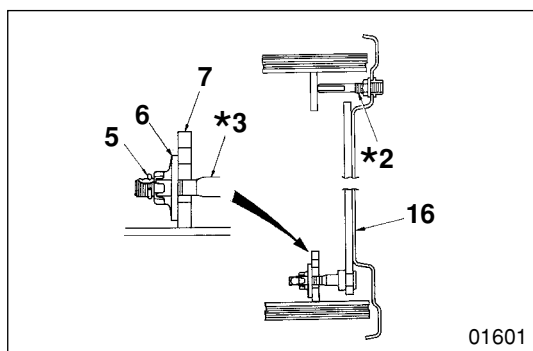
- Install the shorter hook of return spring **4** on brake shoe assembly **7**.
- Insert a small Phillips screwdriver **C** into the hook of return spring **4**, insert the tip of the screwdriver into return spring installation hole **D** of brake shoe assembly **7** to pry on the return spring.



8 Brake shoe assembly

[Inspection]

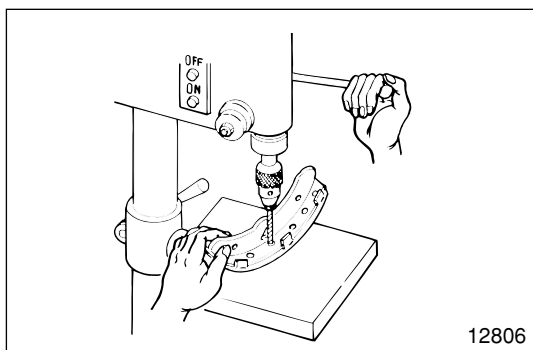
If thickness **A** of brake lining **9** is lower than the limit replace the brake lining on the same axle as a unit.



[Installation]

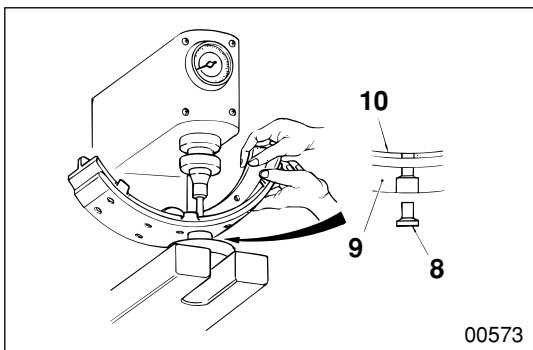
- Install brake shoe assembly **7**.
- Tighten nut **16**. When brake shoe assembly **7** makes contact with bolt ***2** of backing plate **16**, slacken off the nut by one third of a turn.
- Slacken off nut **6** until the holes of stud pin ***3** align with each other.
- Install cotter pin **5** and bend it.

FRONT WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>



10 Brake lining

[Removal]



[Installation]

- Clean the mounting surfaces of brake lining **9** and brake shoe **10** with cleaning fluid and dry them.
- Insert rivets **8** from brake lining **9** side, and caulk the rivets at the specified load so that there is no clearance between brake shoe **10** and the brake lining.

Caulking load for rivets : 17 to 19 kN {3750 to 4190 lbf, 1700 to 1900 kgf}

- Make sure that you inspect contact with the inner surface of brake drum ***1** after you replace brake linings **9**. If contact is incorrect, correct with the brake assembled.

WARNING ⚠

Do not leave lubricant on the surface of brake lining **9** because this reduces braking performance.

CAUTION ⚠

Make sure that the type of brake linings **9** you fit are suitable for the intended use of the vehicle. Make sure that you fit identical size and color coated linings on the left and right sides of one shaft.

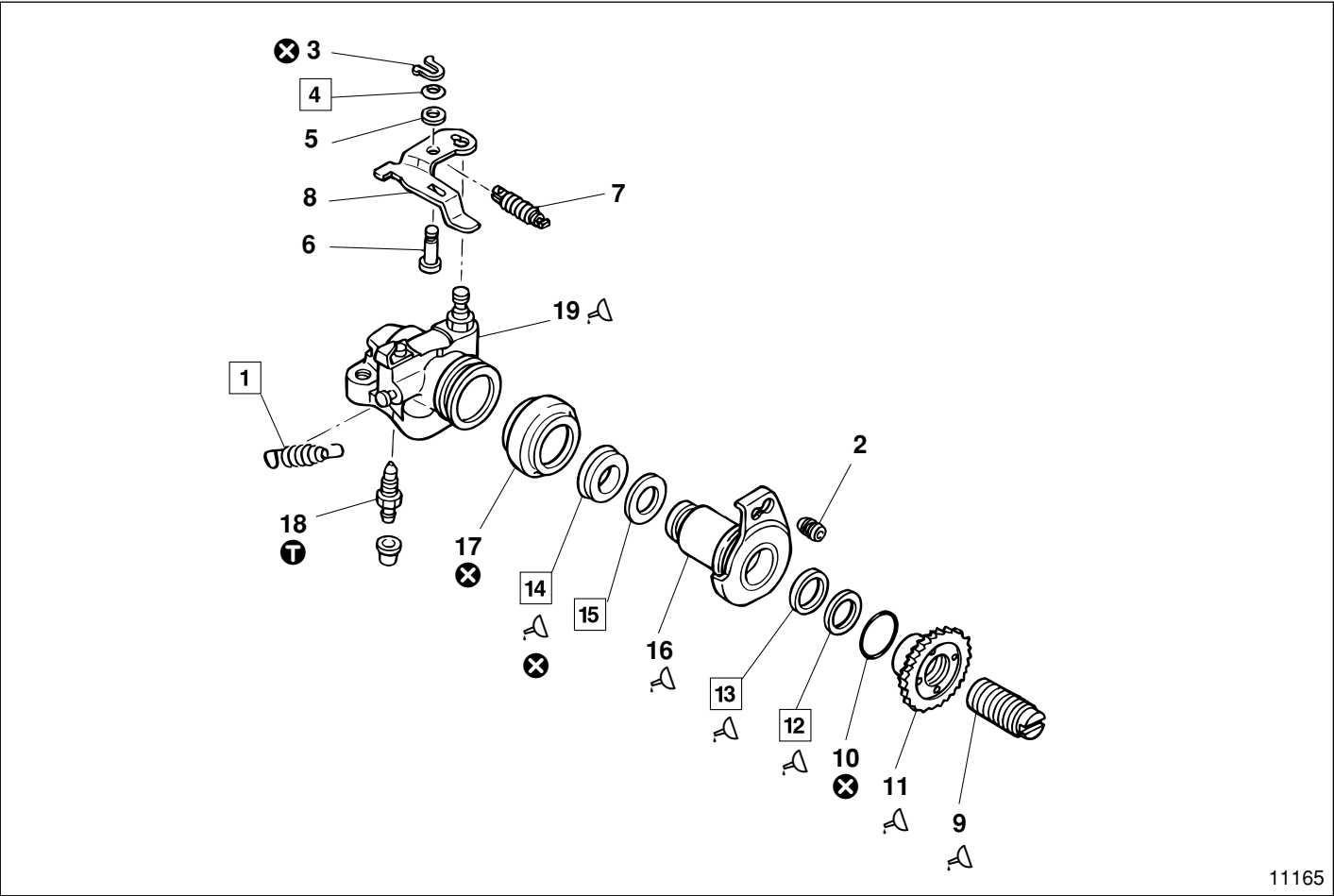
*1 Correction of brake drum

If the cylindrical accuracy of brake drum ***1** is higher than the limit, or there are seams, correct by machining to the correction limit. Machining of the brake drum should be done with the wheel hub attached as an integral part.

MEMO

FRONT WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

Wheel Cylinder Assembly



Disassembly sequence

- | | | |
|---------------|-----------------------|----------------------------------|
| 1 Set spring | 8 Adjusting lever | 15 Backup ring |
| 2 Cover | 9 Adjusting screw | 16 Piston <Front wheel cylinder> |
| 3 Retainer | 10 O-ring | 17 Boot |
| 4 Wave washer | 11 Gear | 18 Air bleeder |
| 5 Washer | 12 Washer (Thin) | 19 Cylinder body |
| 6 Pin | 13 Washer (Thick) | |
| 7 Spring | 14 Wheel cylinder cup | |
- ⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.
Repair kit : Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
16, 19	Clearance between piston and cylinder body	[34.93] 0.03 to 0.13 [[1.38] 0.0012 to 0.0051]	0.2 {0.0079}	Replace piston

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

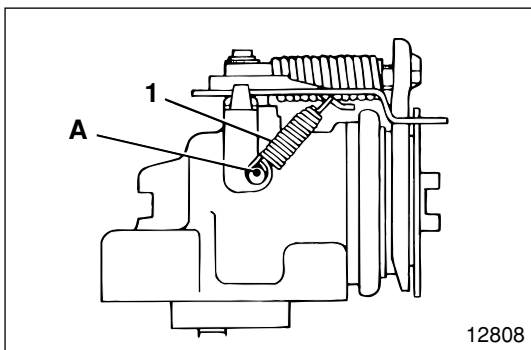
Location	Parts to be tightened	Tightening torque	Remarks
18	Air bleeder	6.86 to 11.77 {5.1 to 8.7, 0.7 to 1.2}	—

Lubricant and/or sealant

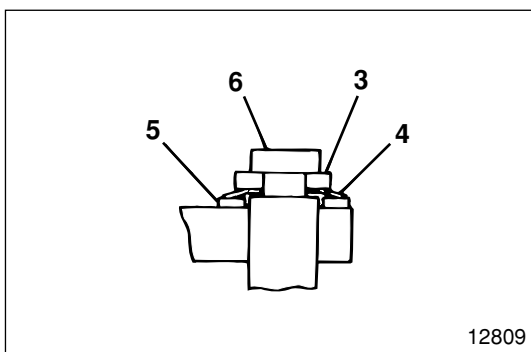
Location	Points of application	Specified lubricant and/or sealant	Quantity
9	Thread area of adjusting screw	Rubber grease	As required
11	Screw mounting thread of gear and friction surface with piston	Rubber grease	As required
12, 13	Both sides of washer	Rubber grease	As required
14	Periphery of wheel cylinder cup	Rubber grease	As required
16	Periphery and interior of piston	Rubber grease	As required
19	Boot mounting groove of cylinder body	Rubber grease	As required

Service procedure

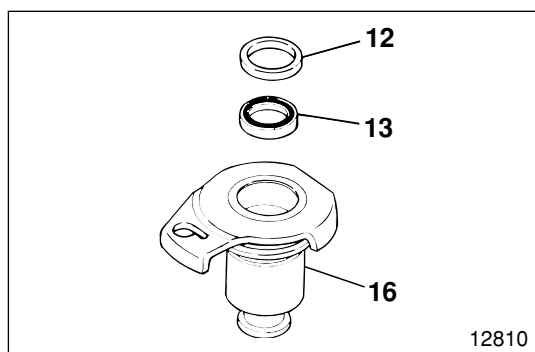
1 Installation direction of set spring

Fasten the closed end hook of set spring **1** on pin **A**.

4 Installation direction of wave washer

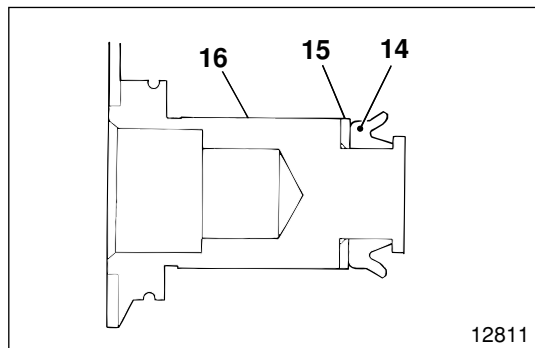
Caulk retainer **3**.

FRONT WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

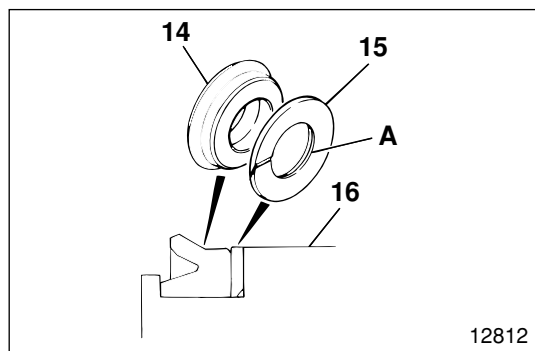


12 13 Installation sequence and direction of washer

- Install thicker washer **13** first.
- Install washer **13** with its black face upward.



14 Installation direction of wheel cylinder cup



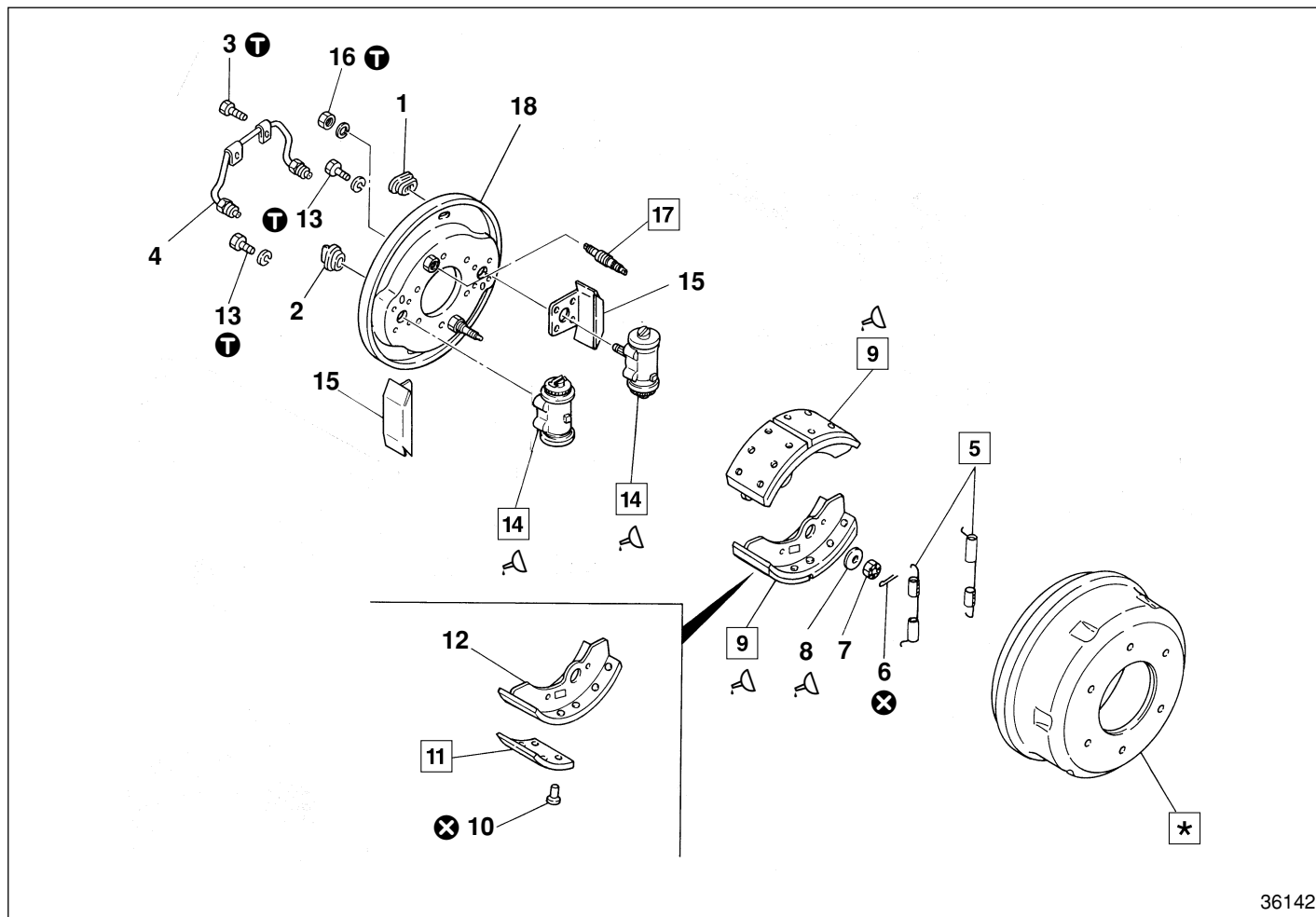
15 Installation direction of backup ring

Install backup ring **15** facing the side without chamfer **A** to wheel cylinder cup **14**.

MEMO

REAR WHEEL BRAKE <φ 320 mm {12.6 in.} Drum brake>

Rear Drum Brake Assembly



36142

● Disassembly sequence

- | | | |
|-----------------------|---|--|
| 1 Check hole plug | 9 Brake shoe assembly | 16 Nut |
| 2 Adjusting hole plug | 10 Rivet | 17 Holder pin |
| 3 Bolt | 11 Brake lining | 18 Backing plate |
| 4 Brake pipe | 12 Brake shoe | * : Brake drum  Gr 27 |
| 5 Return spring | 13 Bolt | ⊗ : Non-reusable parts |
| 6 Split pin | 14 Wheel cylinder assembly | |
| 7 Holder pin nut |  P35A-88 | |
| 8 Washer | 15 Wheel cylinder cover | |

CAUTION

Do not turn or remove holder pin 17 that is fitted to keep brake shoe 12 at 90 degrees unless necessary, since doing so can cause brake drag.

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

Do not leave grease or oil on the surface of brake lining 11 of brake shoe assembly 9 or inner surface of brake drum* because this reduces braking performance.

● Initial adjustment of brake shoe clearance after installation

📖 P35A-83

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
5	Return spring load (Installed length 217 {8.5})		530±49 N {390±36, 54±5 kgf}		Clearance between coils or coil and cover	Replace
9	Thickness of brake lining of brake shoe assembly		12 {0.47}		5 (Side shoulder means wear limit)	Replace brake lining
*	Brake drum	Inner diameter	320 {12.59}	*321 {12.63}	322 {12.67}	Replace
		Cylindrical accuracy	0.05 {0.0020}		0.2 {0.0079}	Correct

* : Indicates correction limit.

⚙ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Bolt (Pipe clamp mounting)	4.9±1.0 {3.6±0.74, 0.5±0.1}	—
4	Brake pipe	14±2.0 {10±1.5, 1.4±0.21}	—
13	Bolt (Wheel cylinder assembly mounting)	78±16 {58±12, 8.0±1.6}	—
16	Nut (Holder pin mounting)	29±5.9 {21±4.4, 3.0±0.6}	—

🛢 Lubricant and/or sealant

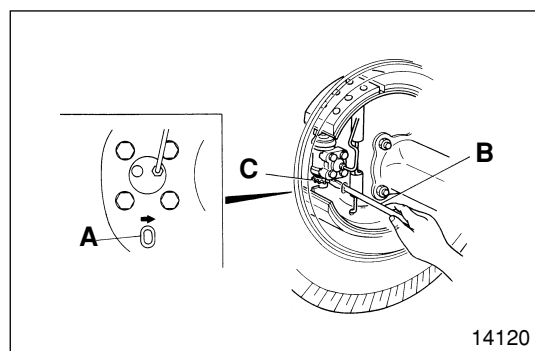
Location	Points of application	Specified lubricant and/or sealant	Quantity
8, 9	Brake shoe assembly contact surface with washer	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
9, 14	Brake shoe assembly contact surface with wheel cylinder assembly	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure

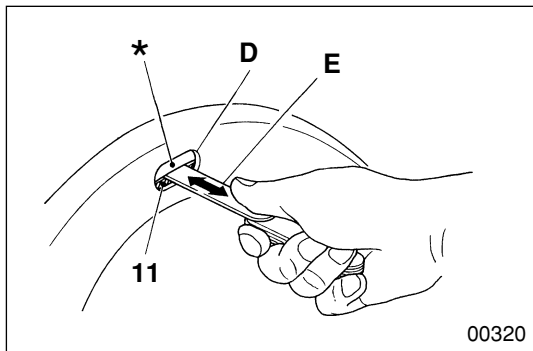
● Initial adjustment of brake shoe clearance after installation

Initial adjustment of clearance between brake drum and brake shoe assembly

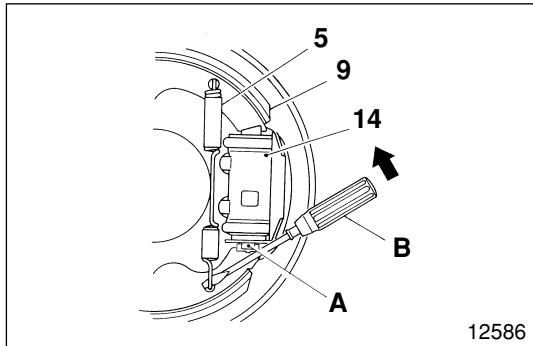
- Jack up rear wheels to make sure that the wheel hub bearing has no play. If there is any play, correct it. 📖 Gr 27
- Insert screwdriver **B** into adjusting hole **A**, and turn adjuster **C** in the direction of the stamped arrow on backing plate **18** to such an extent that the tire, when turned by hand, slightly drags. Perform this adjustment at both of the two locations per wheel on one side.
- Depress the brake pedal a few times to release, and make sure that the tire, when turned by hand, slightly drags. If the tire lightly turns, repeat the above procedure again.
- Return adjuster **C** by 8 to 9 notches in the opposite direction to the arrow stamp direction. Perform this adjustment at both of the two locations per wheel on one side.
- Turn the tire by hand to make sure that it does not drag. If it drags, repeat the above procedure again.



REAR WHEEL BRAKE <φ 320 mm {12.6 in.} Drum brake>



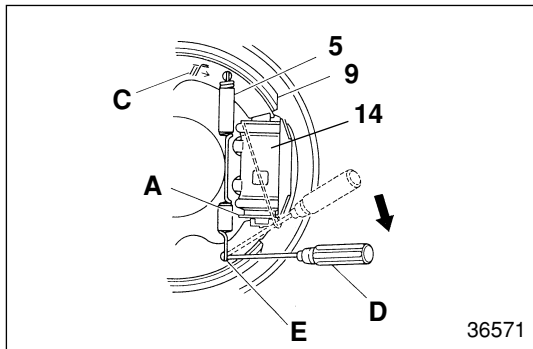
- Insert a 0.2 mm feeler gauge between brake drum * and brake lining 11 through check hole D, and make sure that it can be inserted or extracted with a little resistance. Perform this check at both of two locations per wheel on one side.



5 Return spring

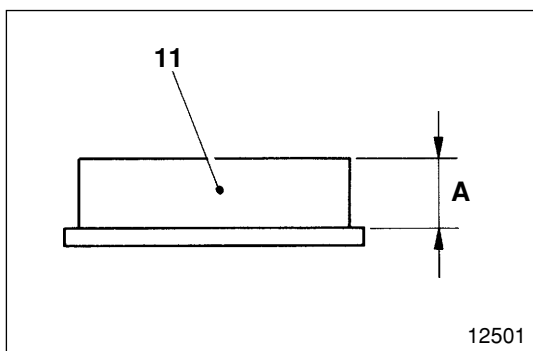
[Removal]

Pry and remove return spring 5 with flat head screwdriver B making use of wheel cylinder assembly 14 adjuster A as a fulcrum.



[Installation]

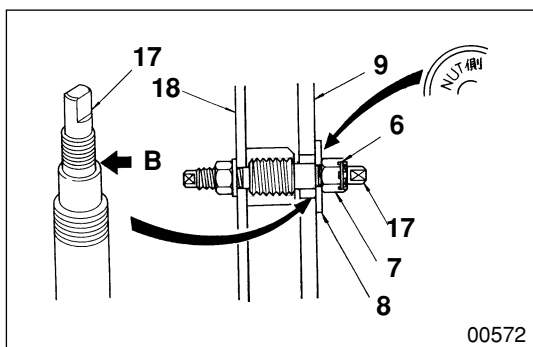
- As shown by stamp C on brake shoe assembly 9, install the shorter hook of return spring 5 on the brake shoe assembly on the opposite side to adjuster A of wheel cylinder assembly 14.
- Hang small Phillips screwdriver D on the hook of return spring 5, and insert the tip of the screwdriver into return spring mounting hole E of brake shoe assembly 9 and pry it to install the return spring.



9 Brake shoe assembly

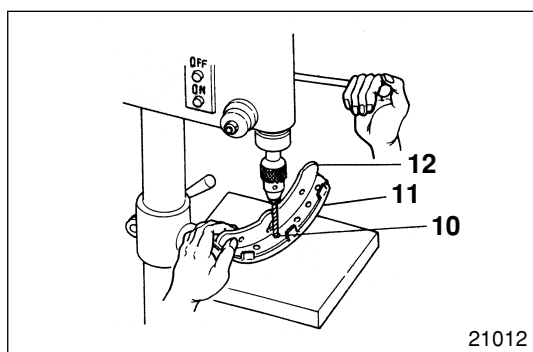
[Inspection]

If thickness A of brake lining 11 is below the limit, replace brake linings in axle sets.



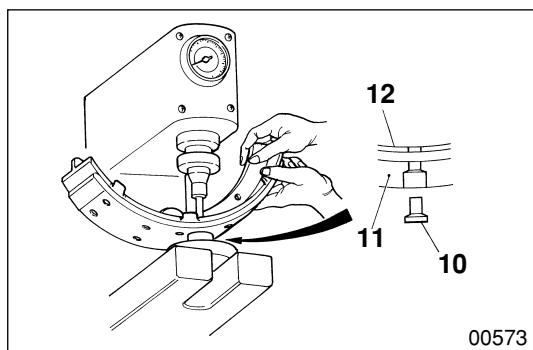
[Installation]

- Install brake shoe assembly 9.
- Insert washer 8 with stamp mark "NUT SIDE" on the front. Tighten holder pin nut 7 and return the holder pin nut in the range of 0 to 60 degrees to the split pin hole of the holder pin with which the washer matches for the first time after lightly contacting stepped area B of holder pin 17.
- Insert split pin 6 and bend it.



11 Brake lining

[Removal]



[Installation]

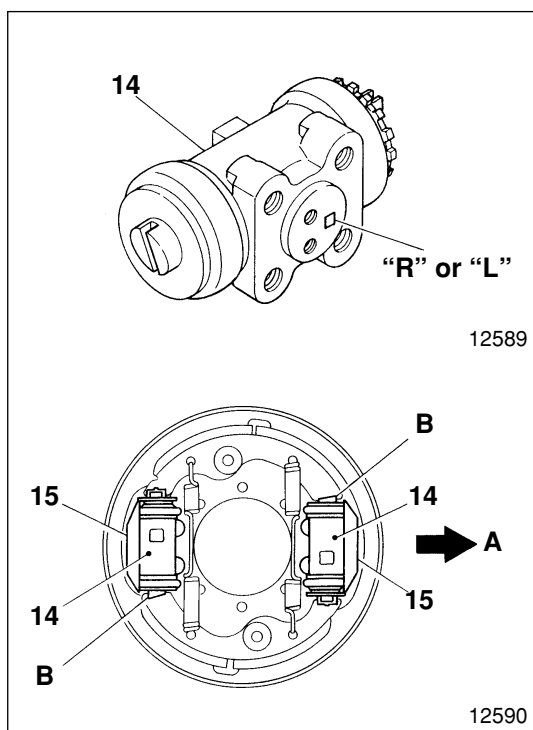
- Clean the brake lining **11** mounting surfaces of brake shoe **12** with cleaning fluid and dry them.
- Insert rivet **10** from brake lining **11** side, and caulk the rivet from the center gradually to both ends.
- The caulking load for rivet **10** shall be 22 ± 0.98 kN [16220 ± 722 ft.lbs, 2200 ± 100 kgf].
- Caulk the rivet so that clearance between brake shoe **12** and brake lining **11** will be 0.05 mm {0.0020 in.} or less around the rivet **10** hole of $\phi 20$ mm {0.79 in.} and 0.2 mm {0.0079 in.} or less in other areas.
- Inspect contact of brake drum* to brake lining **11**, and correct poor locations, if any. Perform correction with the brake drum and brake lining assembled into the brake assembly.

WARNING

Do not leave lubricant on the surface of brake lining **11** because this reduces braking performance.

CAUTION

- Use linings of the same size and identification mark for brake lining **11** to avoid poor contact.
- Be sure to replace brake lining **11** in axle sets to avoid pulling.



14 Installation of wheel cylinder assembly

Identification mark	Installed position
R	Right wheel
L	Left wheel
No mark	Rear of right and left wheels

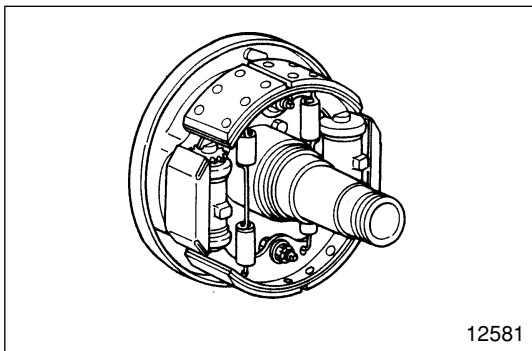
A: Forward direction of vehicle

CAUTION

This figure shows RH. LH is symmetrical with this figure.

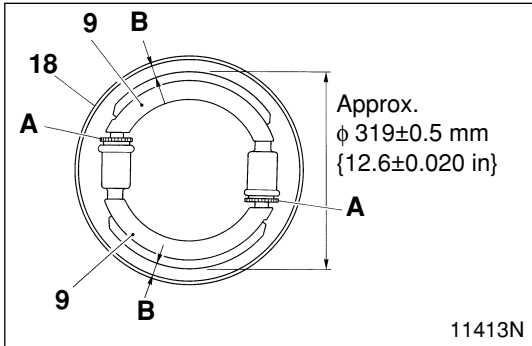
Install anchor piece **B** in the direction as shown in the figure.

REAR WHEEL BRAKE <φ 320 mm {12.6 in.} Drum brake>

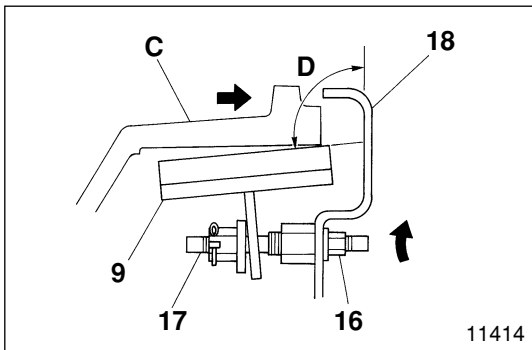


17 Adjustment of holder pin

- Install the rear wheel brake assembly on the rear axle.
 Gr 27

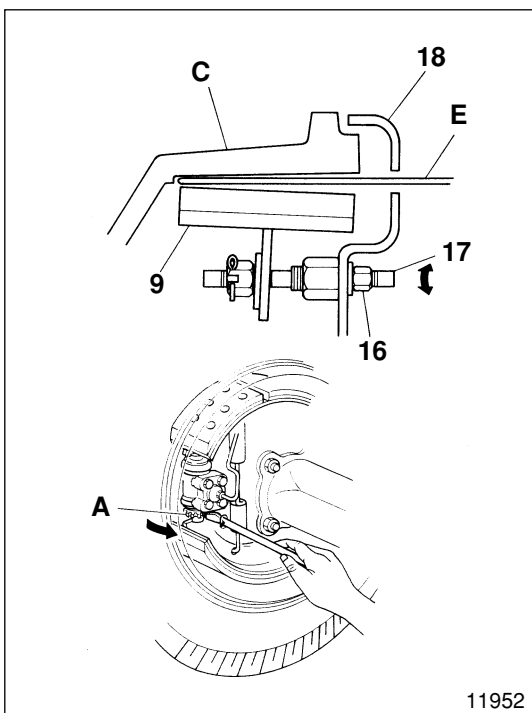


- Turn adjuster **A** so that brake shoe assembly **9** will be to the dimension as shown in the figure.
- Move brake shoe assembly **9** to evenly adjust clearance **B**.

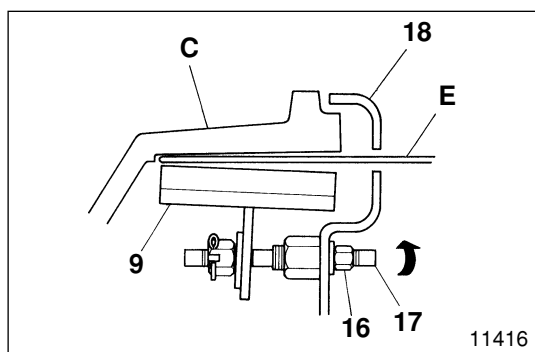


- Install wheel hub and brake drum assembly **C** on the rear wheel brake assembly.  Gr 27
 If squareness **D** is 90 degrees or more, the wheel hub and brake drum assembly does not go into the designated position. Loosen nut **16** and turn holder pin **17** to bring squareness **D** close to 90 degrees.

- Bleed air from the brake system.
 P35A-29



- ★•Turn adjuster **A** to such an extent that 0.2 mm feeler gauge **E** is not pulled out lightly to widen brake shoe assembly **9**.
- ★•Loosen nut **16** and turn holder pin **17** to the right or left so that feeler gauge **E** can be lightly inserted and extracted.
- Repeat operation of items with “★” until feeler gauge **E** cannot be lightly inserted and extracted.
- Lightly depress the brake pedal a few times to make clearance **B** adjusted in the preceding item equal.
- Repeat operation of items with “★” until feeler gauge **E** cannot be lightly inserted and extracted.



- If feeler gauge **E** cannot be lightly inserted and extracted, the feeler gauge contacts brake shoe assembly **9** at full width.
- Extract feeler gauge **E** under the above condition. Turn holder pin **17** for adjustment so that the feeler gauge, when inserted again, feels heavy at the back in insertion and extraction.
- After adjustment, tighten nut **16** to the specified torque.

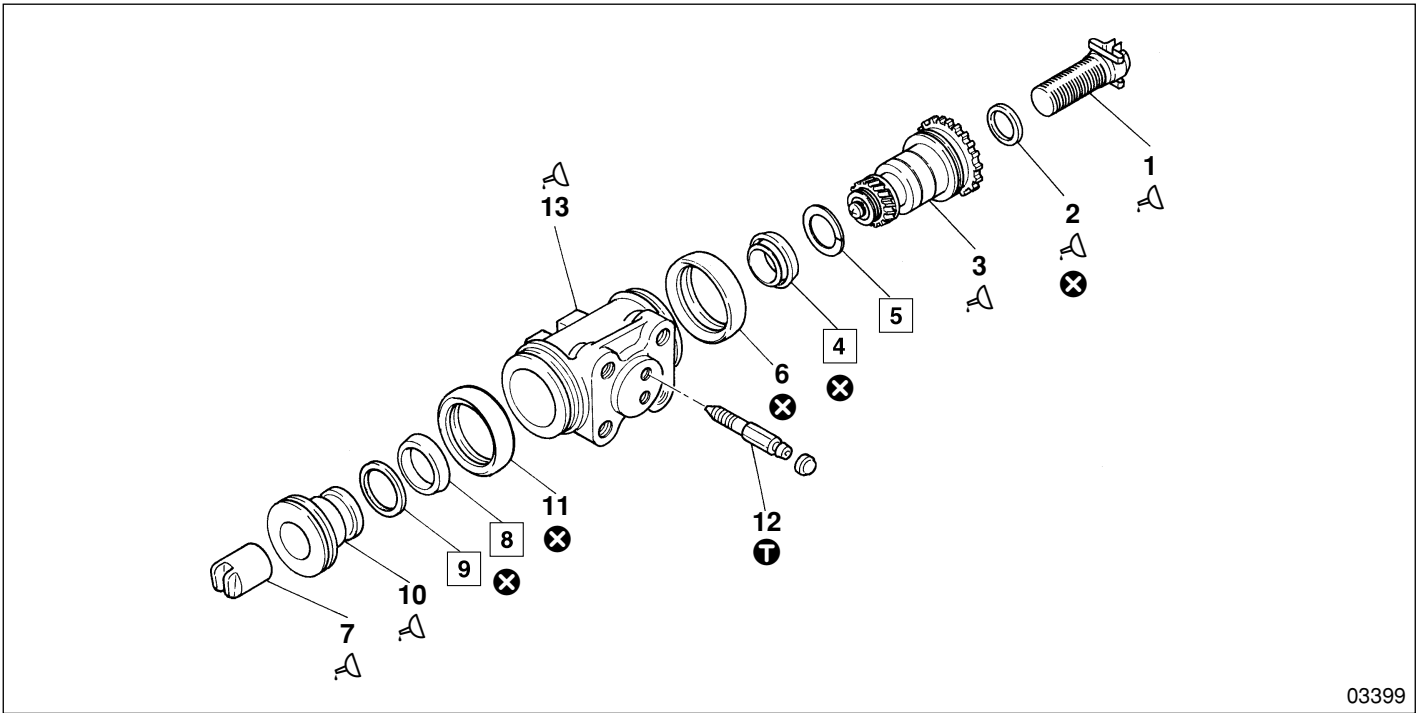


Correction of brake drum

If the brake drum ***** has a cylindricity that exceeds the limit or is scratched, correct to the repair limit together with the wheel hub.

REAR WHEEL BRAKE <φ 320 mm {12.6 in.} Drum brake>

Wheel Cylinder Assembly



Disassembly sequence

- 1 Screw

2 Seal

3 Anchor piston

4 Piston cup

5 Backup ring
- 6 Boot

7 Anchor piece

8 Piston cup

9 Backup ring

10 Piston <Rear wheel cylinder>
- 11 Boot

12 Air bleeder (Front side only)

13 Body
- ⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3, 10, 13	Clearance between piston and cylinder body	[38.10 {1.50}] 0.03 to 0.09 {0.0012 to 0.0035}	0.2 {0.0079}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

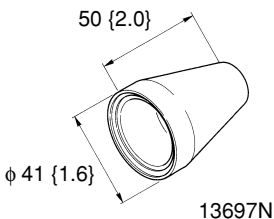
Location	Parts to be tightened	Tightening torque	Remarks
12	Air bleeder	9.8±2.0 {7.2±1.5, 1.0±0.2}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Thread of adjusting screw	Rubber grease	As required
2	Periphery of seal	Rubber grease	As required
3, 10	Periphery of piston and boot mounting groove	Rubber grease	As required
7	Bottom face of anchor piece	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
13	Inside surface of cylinder body and boot mounting groove	Rubber grease	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
4, 8	Piston cup guide 	MK356233	Piston cup mounting

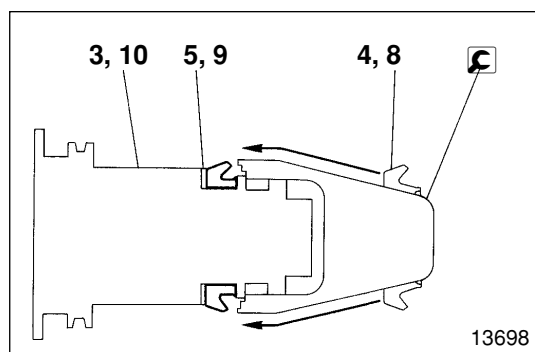
◆ Service procedure

4 5 8 9 Installation of piston cup and backup ring

- Install piston cups **4** and **8** in the direction as shown in the figure using  piston cup guide.

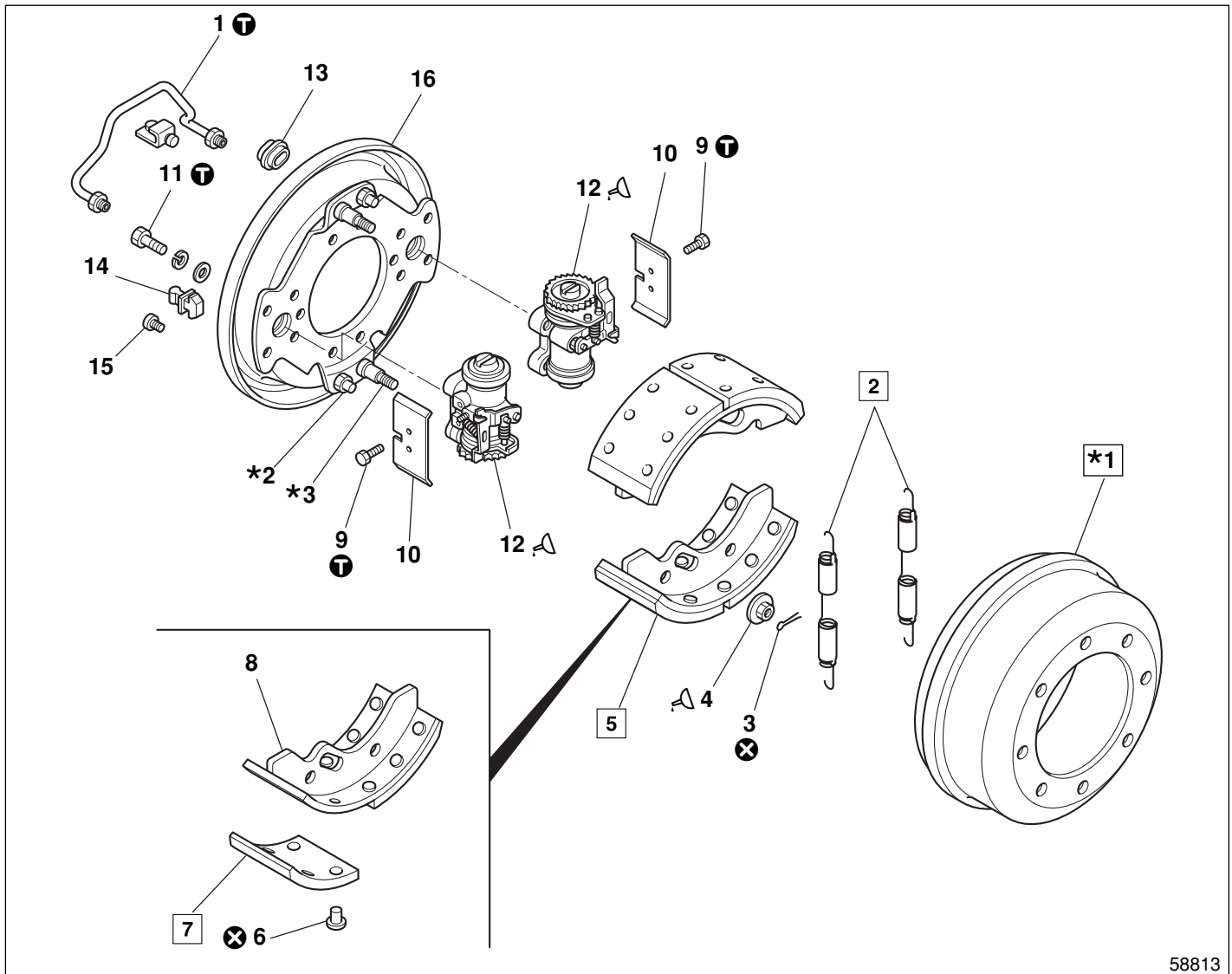
CAUTION

- Be sure to install piston cups **4** and **8** of the correct size in the correct direction to avoid poor braking performance and brake fluid leaks.
- Be sure to install backup rings **5** and **9** of the correct size to avoid poor braking performance and brake fluid leaks.



REAR WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

Rear Wheel Brake Assembly



58813

● Disassembly sequence

- | | | |
|-----------------------|--|---|
| 1 Brake pipe | 9 Bolt | 16 Backing plate |
| 2 Return spring | 10 Wheel cylinder cover | ⊗ : Non-reusable parts |
| 3 Cotter pin | 11 Bolt | *1 : Brake drum  Gr 27 |
| 4 Nut | 12 Wheel cylinder assembly | *2 : Bolt |
| 5 Brake shoe assembly |  35A-96 | *3 : Stud pin |
| 6 Rivet | 13 Check hole plug | |
| 7 Brake lining | 14 Adjusting hole plug | |
| 8 Brake shoe | 15 Cover | |

WARNING

Do not leave grease or oil on the surface of brake lining 7 or inner surface of brake drum *1 because this reduces braking performance.

CAUTION ⚠

- If you are replacing only brake lining 7, clean the adjuster and screw thread area of wheel cylinder assembly 12 and apply rubber grease to the thread area.
- Do not turn or remove bolt *2 that is fitted to keep brake shoe assembly 5 at 90°.

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit : Brake lining kit

● **Adjustment of initial brake shoe clearance after installation**

📖 P35A-92

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
2	Return spring load (Installed length 266.5 {10.5})		420 N {95 lbf, 43 kgf}		Clearance between coils or coil and cover	Replace
5	Thickness of Brake lining		15.4 {0.61}		5.5 {0.22} (Side shoulder means wear limit)	Replace brake lining
*1	Brake drum	Inner diameter	400 {15.75}	*401 {15.79}	402 {15.83}	Correct or replace
		Cylinder accuracy	0.025 {0.00098}		0.2 {0.0079}	Correct

* : Indicates correction limit

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Brake pipe flare nut	12.75 to 17.65 {9.4 to 13, 1.3 to 1.8}	—
9	Bolt (Wheel cylinder assembly cover mounting)	7.85 to 11.77 {5.8 to 8.7, 0.8 to 1.2}	—
11	Bolt (Wheel cylinder assembly mounting)	122.58 to 166.7 {90 to 120, 12.5 to 17.0}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Brake shoe assembly contact surface of nut	Brake grease	As required
12	Wheel cylinder assembly anchor and screw groove contact areas with brake shoe	Brake grease	As required

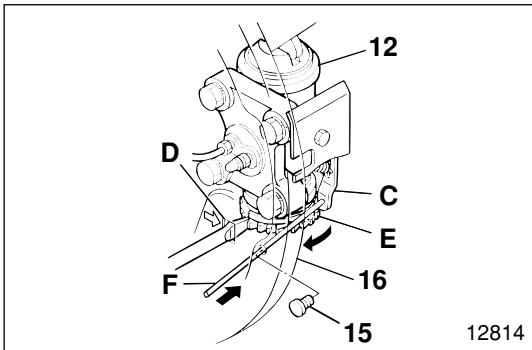
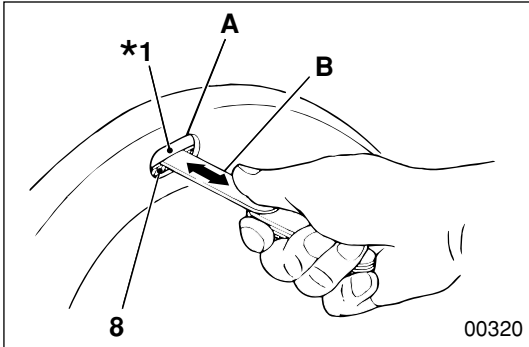
REAR WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

◆ Service procedure

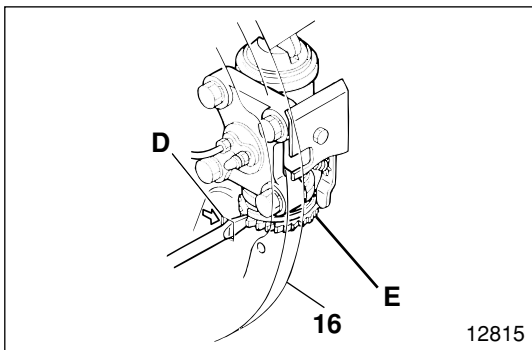
● Adjustment of initial brake shoe clearance after installation

Turning the adjuster of wheel cylinder **12** in arrow ⇨ direction expands brake shoe assembly **5**, narrowing the clearance between brake drum ***1** and brake lining **7**.

- Jack up the vehicle to make sure that the wheel hub bearing has no play. If there is any play, correct it.  Gr 27
- Remove adjusting hole plug **14** and check hole plug **13**.
- Adjust the brake shoe clearance as follows, so that 0.3 mm {0.012 in.} feeler gauge **B** can be inserted or extracted through check hole **A**, between brake drum ***1** and brake lining **7** with a little resistance.



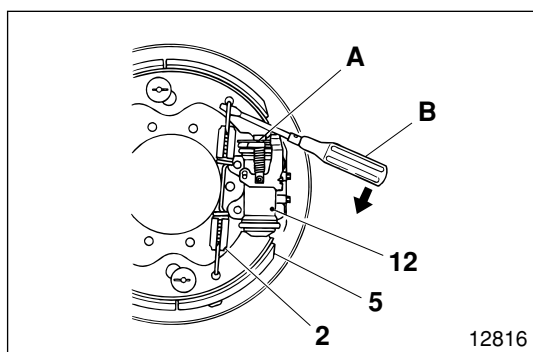
- To increase brake shoe clearance
 - Remove cover **15** on the rear of backing plate **16**.
 - Insert a wire (approximately φ5 mm {0.20 in.}) into the hole of cover **15** and lift adjusting lever **C** of wheel cylinder **12**.
 - Turn adjuster **E** of wheel cylinder **12**, through adjusting hole **D**, in the opposite direction to arrow ⇨ on backing plate **16**.



- To decrease brake shoe clearance
 - Turn adjuster **E** in the arrow ⇨ direction marked on backing plate **16** through adjusting hole **D**.

- Extract the feeler gauge and depress the brake pedal two or three times fully, then the specified value brake shoe clearance can be obtained.
- Insert a 0.2 mm {0.0079 in.} feeler gauge through check hole **A** and make sure that it can be inserted or extracted with a little resistance. If there is any fault, disassemble and inspect wheel cylinder **12**.

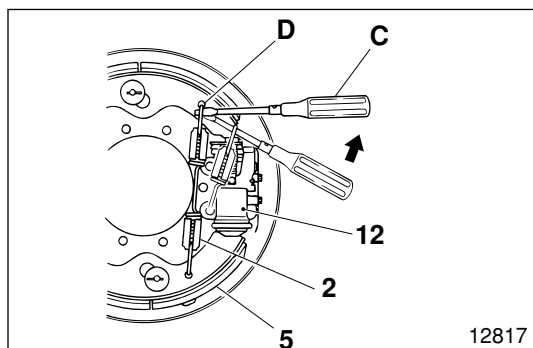
 P35A-87



2 Return spring

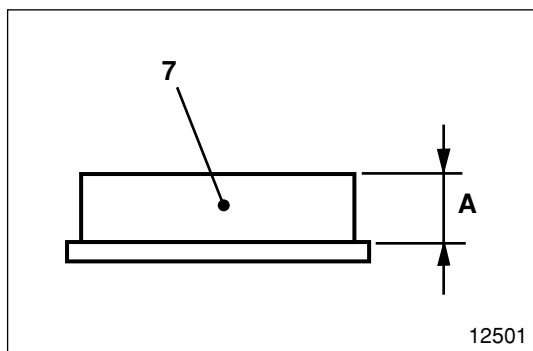
[Removal]

To remove the return spring, place screwdriver **B** on the hook of the return spring, then pry and remove the return spring making use of wheel cylinder assembly **12** adjusting screw **A** as a fulcrum.



[Installation]

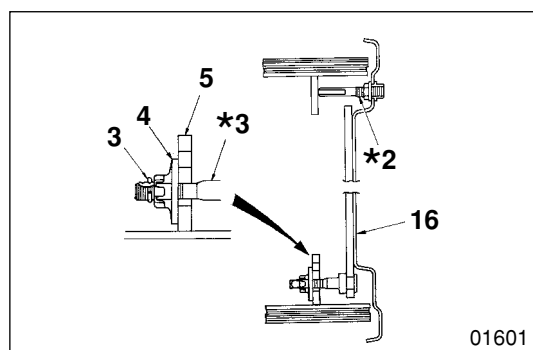
- Install the shorter hook of return spring **2** on brake shoe assembly **5**.
- Insert a small Phillips screwdriver **C** into the hook of return spring **2**, insert the tip of the screwdriver into return spring installation hole **D** of brake shoe assembly **5** to pry on the return spring.



6 Brake shoe assembly

[Inspection]

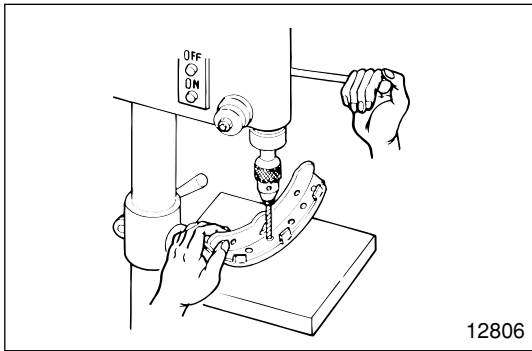
If thickness **A** of brake lining **7** is lower than the limit replace the brake lining on the same axle as a unit.



[Installation]

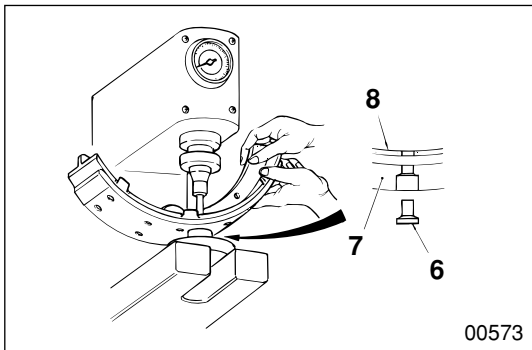
- Install brake shoe assembly **5**.
- Tighten nut **4**. When brake shoe assembly **5** makes contact with bolt ***2** of backing plate **16**, slacken off the nut by one third of a turn.
- Slacken off nut **4** until the holes of stud pin ***3** align with each other.
- Install cotter pin **3** and bend it.

REAR WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>



8 Brake lining

[Removal]



[Installation]

- Clean the mounting surfaces of brake lining **7** and brake shoe **8** with cleaning fluid and dry them.
- Insert rivets **6** from brake lining **7** side, and caulk the rivets at the specified load so that there is no clearance between brake shoe **8** and the brake lining.

Caulking load for rivets : 17 to 19 kN {3750 to 4190 lbf, 1700 to 1900 kgf}

- Make sure that you inspect contact with the inner surface of brake drum ***1** after you replace brake linings **7**. If contact is incorrect, correct with the brake assembled.

WARNING

Do not leave lubricant on the surface of brake lining **7 because this reduces braking performance.**

CAUTION

Make sure that the type of brake linings **7 you fit are suitable for the intended use of the vehicle. Make sure that you fit identical size and color coated linings on the left and right sides of one shaft.**

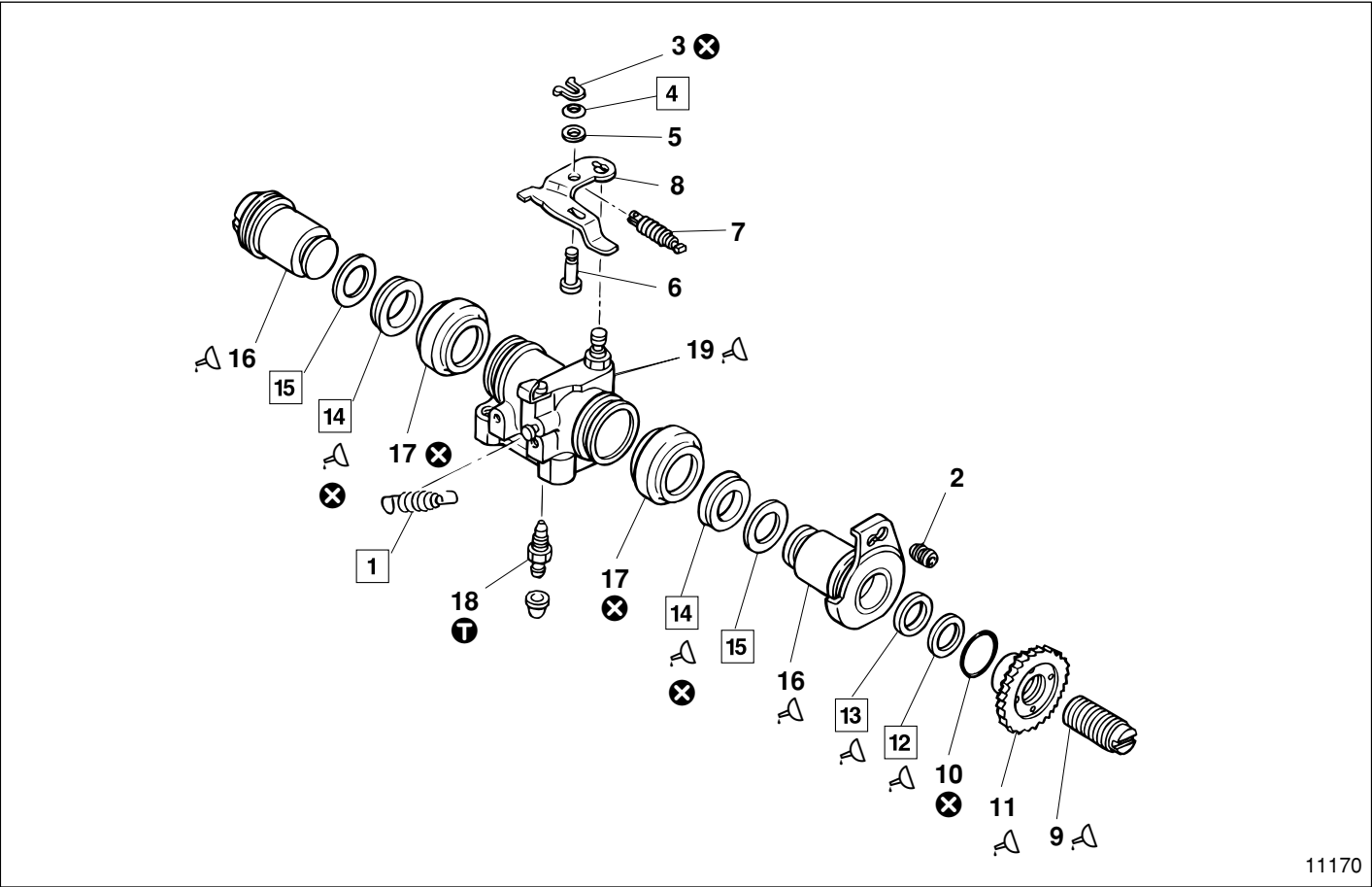
***1** Correction of brake drum

If the cylindrical accuracy of brake drum ***1** is higher than the limit, or there are seams, correct by machining to the correction limit. Machining of the brake drum should be done with the wheel hub attached as an integral part.

MEMO

REAR WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

Wheel Cylinder Assembly



Disassembly sequence

- 1 Set spring

2 Cover

3 Retainer

4 Wave washer

5 Washer

6 Pin

7 Spring
- 8 Adjusting lever

9 Adjusting screw

10 O-ring

11 Gear

12 Washer (Thin)

13 Washer (Thick)

14 Wheel cylinder cup
- 15 Backup ring

16 Piston <Rear wheel cylinder>

17 Boot

18 Air bleeder

19 Cylinder body
- ⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.
Repair kit : Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
16, 19	Clearance between piston and cylinder body	[38.10] 0.03 to 0.13 {[1.50] 0.0012 to 0.0051}	0.2 {0.0079}	Replace piston

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

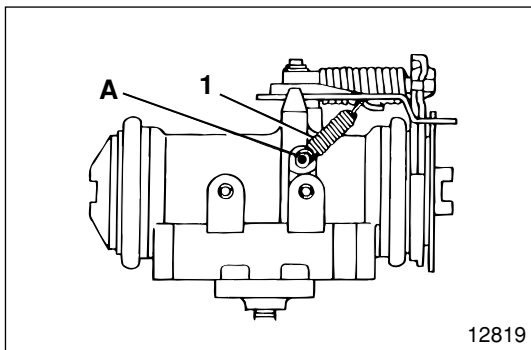
Location	Parts to be tightened	Tightening torque	Remarks
18	Air bleeder	6.86 to 11.77 {5.1 to 8.7, 0.7 to 1.2}	—

Lubricant and/or sealant

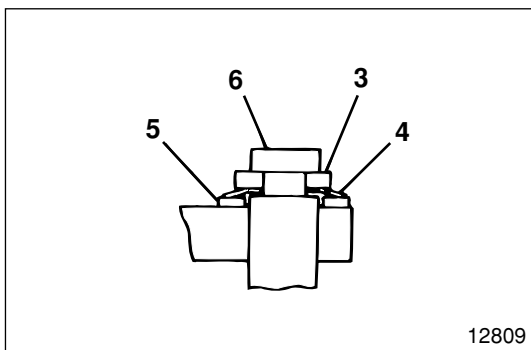
Location	Points of application	Specified lubricant and/or sealant	Quantity
9	Thread area of adjusting screw	Rubber grease	As required
11	Screw mounting thread of gear and friction surface with piston	Rubber grease	As required
12, 13	Both sides of washer	Rubber grease	As required
14	Periphery of wheel cylinder cup	Rubber grease	As required
16	Periphery and interior of piston	Rubber grease	As required
19	Boot mounting groove of cylinder body	Rubber grease	As required

◆ Service procedure

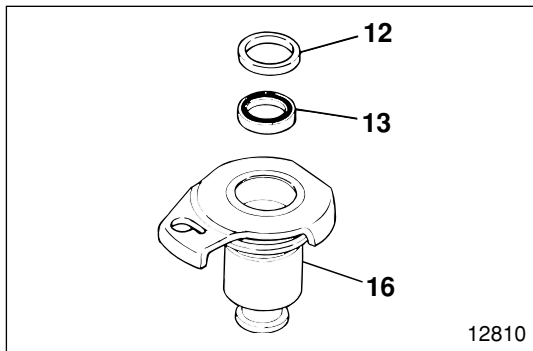
1 Installation direction of set spring

Fasten the closed end hook of set spring **1** on pin **A**.

4 Installation direction of wave washer

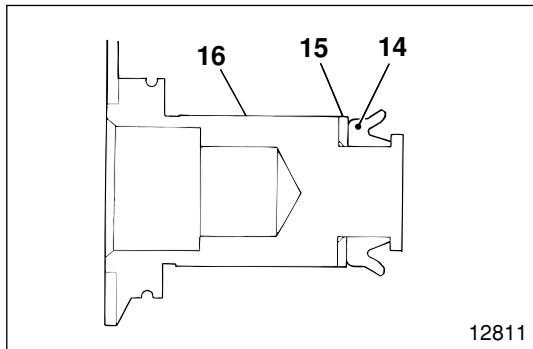
Caulk retainer **3**.

REAR WHEEL BRAKE <φ 400 mm {15.7 in.} Drum brake>

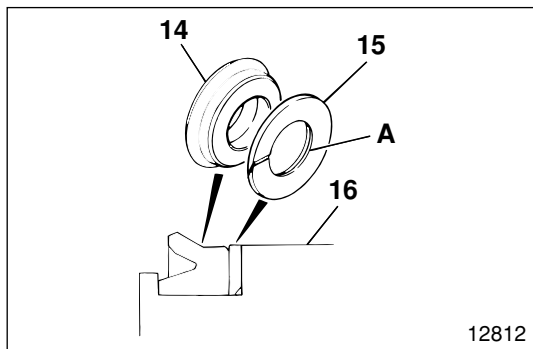


12 13 Installation sequence and direction of washer

- Install thicker washer **13** first.
- Install washer **13** with its black face upward.



14 Installation direction of wheel cylinder cup

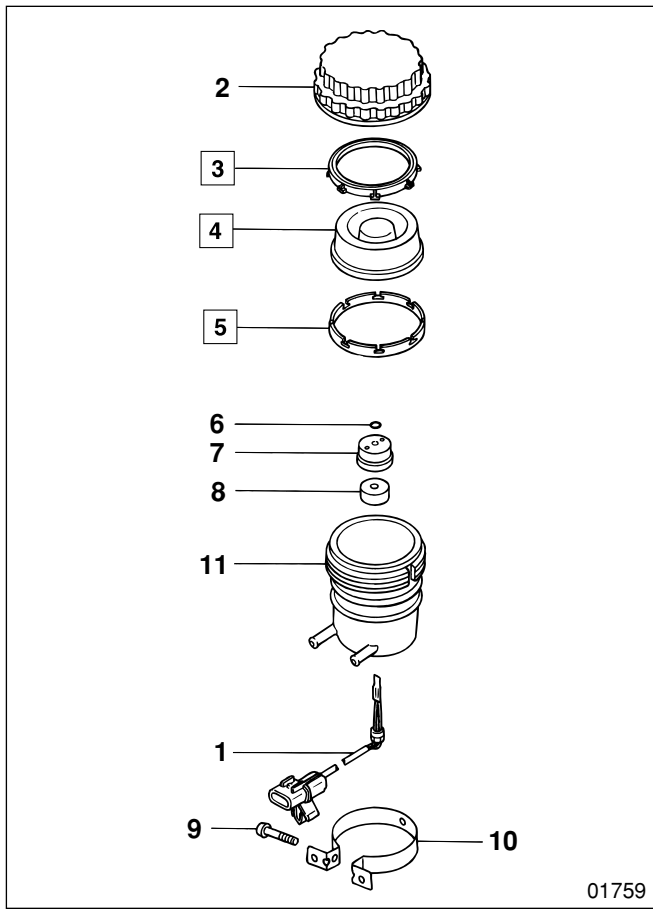


15 Installation direction of backup ring

Install backup ring **15** facing the side without chamfer **A** to wheel cylinder cup **14**.

MEMO

FLUID TANK

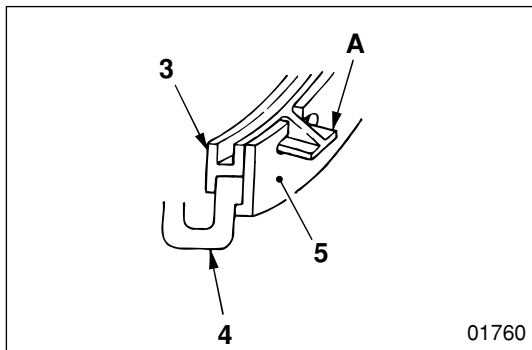


● Disassembly sequence

- 1 Brake fluid level switch  Gr 54
- 2 Cap
- 3 Slide ring
- 4 Diaphragm
- 5 Ring cover
- 6 Stopper ring
- 7 Float stopper
- 8 Float
- 9 Screw
- 10 Fluid tank bracket
- 11 Tank

● Assembly sequence

Follow the disassembly sequence in reverse.

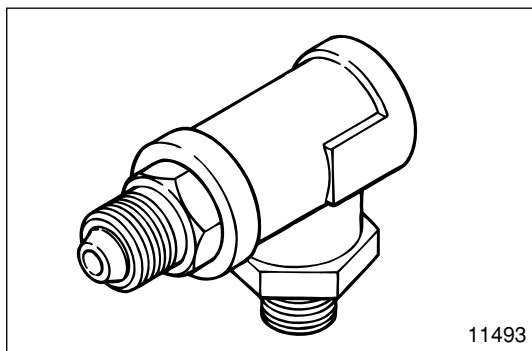


◆ Service procedure

3 to 5 Installation of slide ring, diaphragm and ring cover

Be sure to install claw **A** of slide ring **3** to ring cover **5** securely. Install diaphragm **4** in the direction as illustrated.

CHECK VALVE

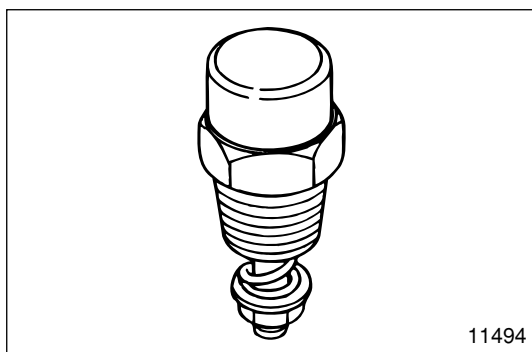
**CAUTION** ⚠

Do not disassemble this check valve because it is a unit construction.

Service standards

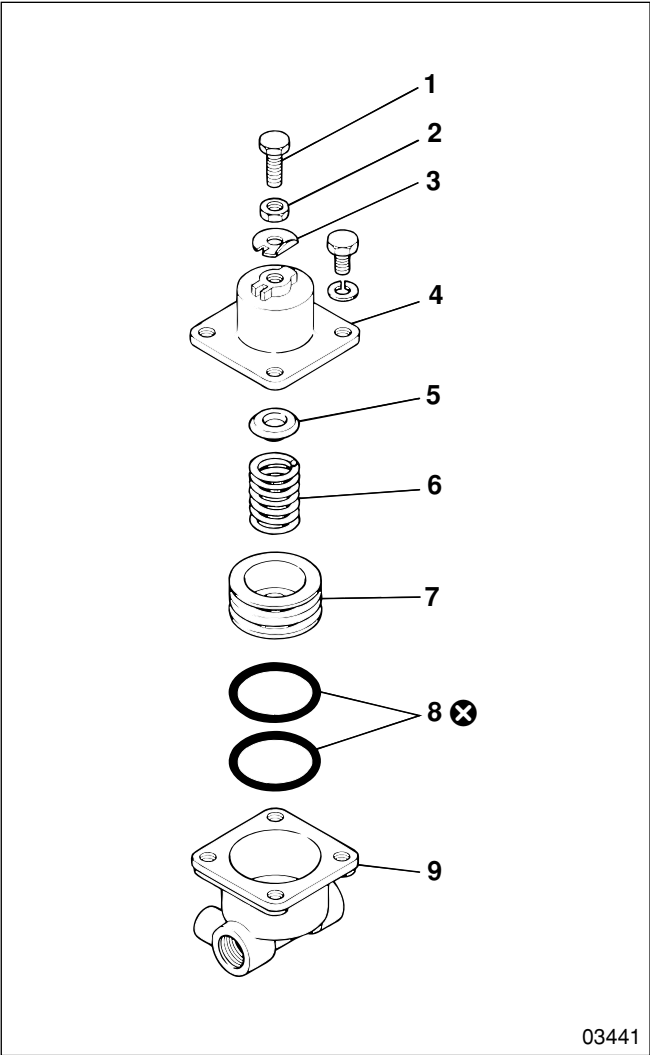
Location	Maintenance item	Standard value	Limit	Remedy
—	Pressure difference between inlet and outlet	29 kPa {4.3 psi, 0.3 kgf/cm ² } or less	—	Replace

SAFETY VALVE

**Service standards**

Location	Maintenance item	Standard value	Limit	Remedy
—	Release pressure of safety valve	950±20 kPa {135±2.8 psi, 9.7±0.2 kgf/cm ² }	—	Replace

SUPPLY VALVE



● Disassembly sequence

- 1 Adjusting bolt
- 2 Lock nut
- 3 Claw washer
- 4 Cap
- 5 Spring retainer
- 6 Spring
- 7 Piston
- 8 O-ring
- 9 Valve body

⊗ : Non-reusable parts

CAUTION ⚠

Make sure that adjusting bolt 1 is not turned except for adjustment.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection after assembly

📖 P35A-102

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	FK61, FM61	Specified pressure	Valve opening pressure	345±29 kPa {50±4.3 psi, 3.5±0.3 kgf/cm ² }	—
			Valve closing pressure	314±20 kPa {46±2.8 psi, 3.2±0.2 kgf/cm ² }	
—	FM64	Specified pressure	Valve opening pressure	471±29 kPa {68±4.3 psi, 4.8±0.3 kgf/cm ² }	—
			Valve closing pressure	441±20 kPa {64±2.8 psi, 4.5±0.2 kgf/cm ² }	

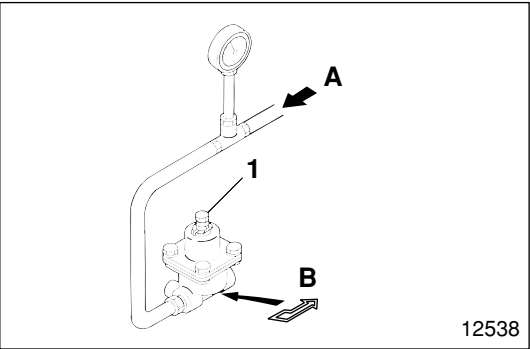
◆ Service procedure

● Inspection after assembly

Adjust by turning adjusting bolt 1 after loosening lock nut 2. After adjusting, tighten the lock nut without turning the adjusting bolt, and bend claw washer 3 to secure the lock nut.

- Adjust adjusting bolt 1 so that air is discharged from the outlet port (arrow mark B in the illustration), when valve opening pressure is applied to the inlet port (arrow mark A in the illustration).
- After adjusting valve opening pressure, adjust adjusting bolt 1 so that air is not discharged from the outlet port (arrow mark B in the illustration) when valve closing pressure is applied to the inlet port (arrow mark A in the illustration).

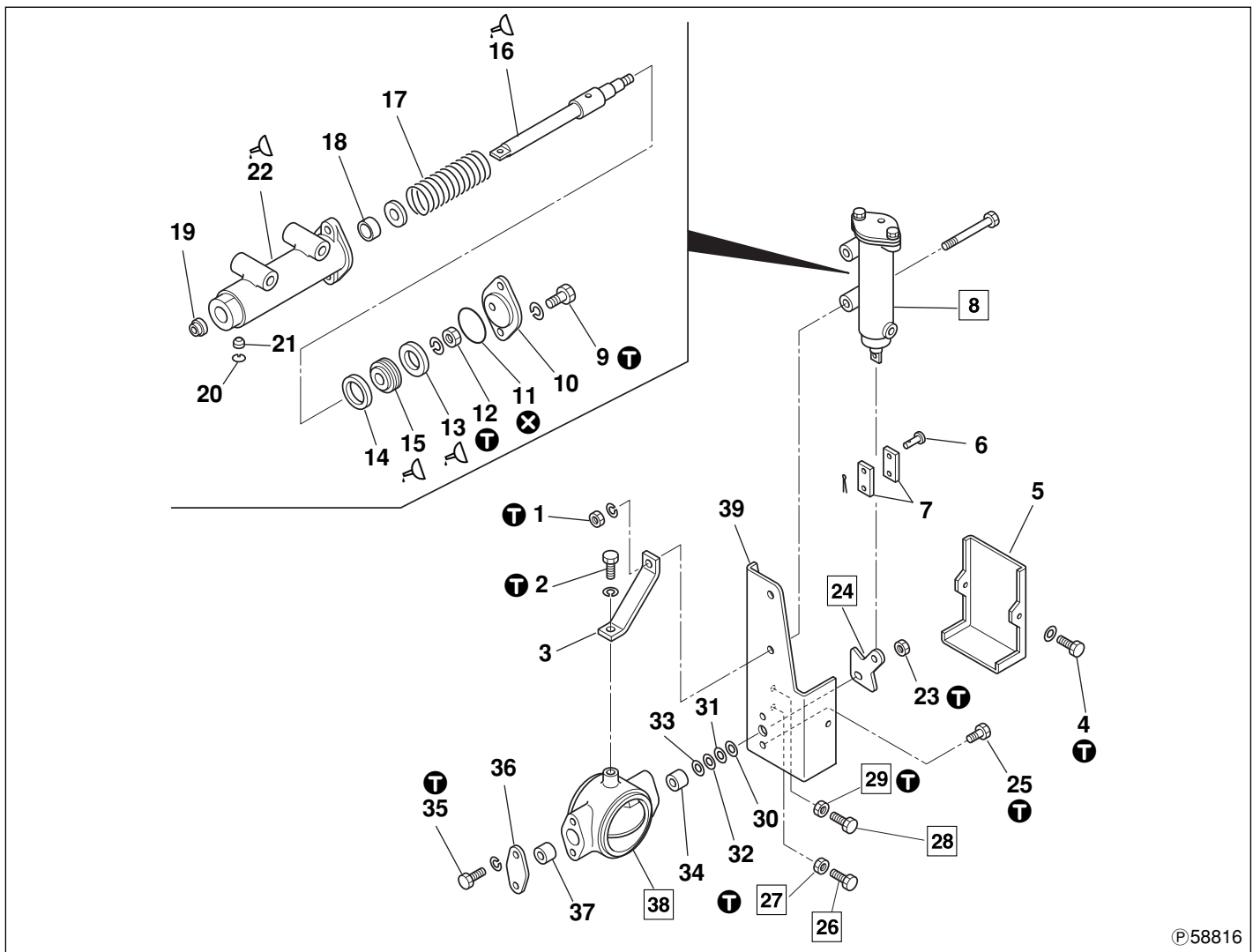
B : Arrow showing the air flow direction



MEMO

EXHAUST BRAKE SYSTEM

Exhaust Brake Unit



© 58816

Disassembly sequence

- | | | |
|--------------------|-------------------|----------------------|
| 1 Nut | 15 Piston | 29 Lock nut |
| 2 Bolt | 16 Shaft | 30 Seal ring (Large) |
| 3 Arm | 17 Spring | 31 Seal ring (Small) |
| 4 Screw | 18 Bush | 32 Seal ring (Large) |
| 5 Cover | 19 Dust seal | 33 Seal ring (Small) |
| 6 Pin | 20 Retaining ring | 34 Bush |
| 7 Clevis | 21 Filter | 35 Bush |
| 8 Control cylinder | 22 Cylinder | 36 Cover |
| 9 Bolt | 23 Nut | 37 Bush |
| 10 Cover | 24 Lever | 38 Valve assembly |
| 11 O-ring | 25 Bolt | 39 Plate |
| 12 Nut | 26 Adjusting bolt | |
| 13 Packing cup | 27 Lock nut | |
| 14 Wear ring | 28 Adjusting bolt | |

⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
8	Airtightness of control cylinder (Air leakage at air pressure 880 kPa {125 psi, 9.0 kgf/cm ² })	—	3.0 kPa {0.4 psi, 0.03 kgf/cm ² }	Replace
17	Spring load (Installed length 109 {4.3})	72 N {16 lbf, 7.3 kgf}	61 N {13.7 lbf, 6.2 kgf}	Replace
38	Clearance between butterfly valve and body when valve assembly butterfly valve operating (Air pressure 640±50 kPa {93±7.3 psi, 6.5±0.5 kgf/cm ² } supplied to control cylinder)	0.2 to 0.4 {0.0079 to 0.016}	0.1 {0.0039}	Adjust

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Control cylinder mounting)	22.6 to 28.4 {17 to 21, 2.3 to 2.9}	—
2	Bolt (Arm mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
4	Screw (Cover mounting)	4.9 to 6.9 {3.6 to 5.1, 0.5 to 0.7}	—
9	Bolt (Cover mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
12	Nut (Piston mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
23	Nut (Lever mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
25	Bolt (Valve assembly mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
27	Lock nut	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
29	Lock nut	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
35	Bolt (cover mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—

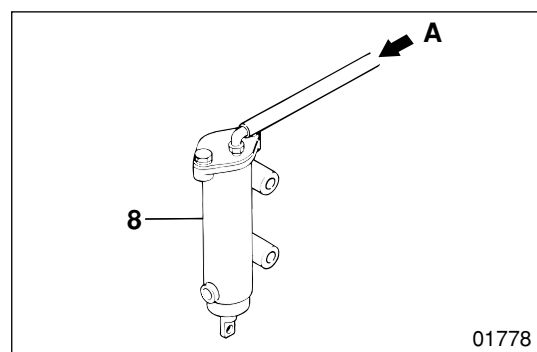
L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
13	Surface of packing cup	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15, 16	Mounting areas of piston and shaft	Sealant [Hermetic GA (SANNOW KOGYO CO)]	As required
16	Shaft at $\phi 12$ {0.47}	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
22	Interior of cylinder	Wheel bearing grease [NLGI No.2 (Li soap)]	2 cm ³ {0.12 cu. in.}

◆ Service procedure

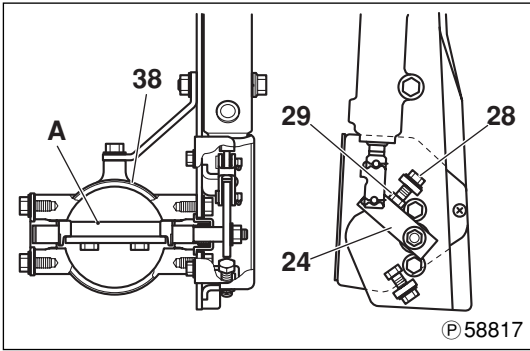
8 Inspection on airtightness of control cylinder

Make sure that there is no air leakage when air pressure of 980 kPa {140 psi, 10 kgf/cm²} is applied to control cylinder **8**. If any air leakage is found, replace the control cylinder assembly.



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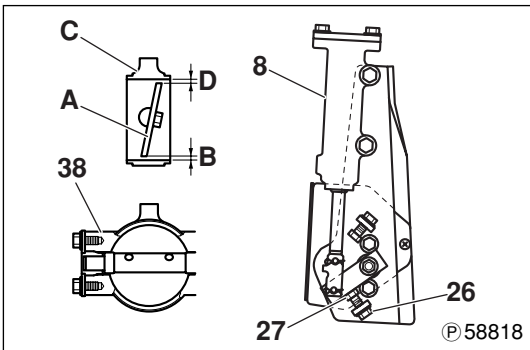
EXHAUST BRAKE SYSTEM



24 26 to 29 38 Lever, adjusting bolt, lock nut, and valve assembly

[Butterfly valve **A** fully-opened adjustment]

- Turn the adjusting bolt so that lever **24** and the head of adjusting bolt **28** make contact horizontally.
- Tighten lock nut **29** at specified torque.



[Butterfly valve **A** fully-closed adjustment]

- Turn adjusting bolt **26** so that the average value of clearances **B**, **D** between butterfly valve **A** and body **C** conforms to the standard value.
- Calculate the average of clearances **B**, **D** by $(B+D)/2$.
- Tighten lock nut **27** at specified torque.



Group 35B

Brake

<Full Air Brake>

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	35B- 2
STRUCTURE AND OPERATION	35B- 4
TROUBLESHOOTING	35B-21
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Inspection and Adjustment of Brake Pedal Free Play	35B-25
• Thickness Inspection and Replacement of Brake Lining	35B-25
• Inspection of Brake Shoe Clearance	35B-26
• Inspection and Maintenance of Air Dryer	35B-27
• Inspection and Adjustment of Air Dryer's Air Pressure Governor	35B-28
HANDLING OF CONNECTOR AND NYLON TUBE PIPING	35B-30
AIR COMPRESSOR	35B-32
AIR DRYER	35B-38
BRAKE PEDAL	35B-42
DUAL BRAKE VALVE	35B-44
RELAY VALVE	35B-52
QUICK RELEASE VALVE	35B-54
FRONT WHEEL BRAKE	35B-56
REAR WHEEL BRAKE	35B-66
EXPANDER ASSEMBLY	35B-76
CHECK VALVE	35B-82
SAFETY VALVE	35B-82
SUPPLY VALVE	35B-83
EXHAUST BRAKE SYSTEM	35B-84

SPECIFICATIONS

< Equipment for Service Brake >

Item			Specifications
Air compressor	Type		Water-cooled one cylinder
	Cylinder diameter×Stroke mm {in.}		ø95×45 {3.74×1.77}
	Cylinder capacity cm ² {cu.in.}		319 {19.5}
	Manufacturer		SANWA SEIKI
Air dryer	Type		DU-5
	Heater capacity V-W		12 - 70
	Thermostat operating temperature °C {°F}	ON	4±4 {39±7.2}
		OFF	20 {68} or less
	Purge chamber capacity L {gts}		Approximately 2.7 {2.9}
	Required time for recycling desiccant Sec.		60
	Manufacturer		Nabtesco
Air tank	Capacity L {gts}		30(21+9), 38(26+12) {31.5(22+9.5), 40(27+13)}

< Wheel Brake >

Item			Specifications
Brake type			Leading-trailing type
Brake drum	Inner diameter	mm {in.}	ø410 {16.1}
Brake lining	Width×Thickness	Front	150×16 {5.91×0.63}
		Rear	200×16 {7.87×0.63}
mm {in.}			
Brake shoe clearance adjustment method			Auto adjustment type

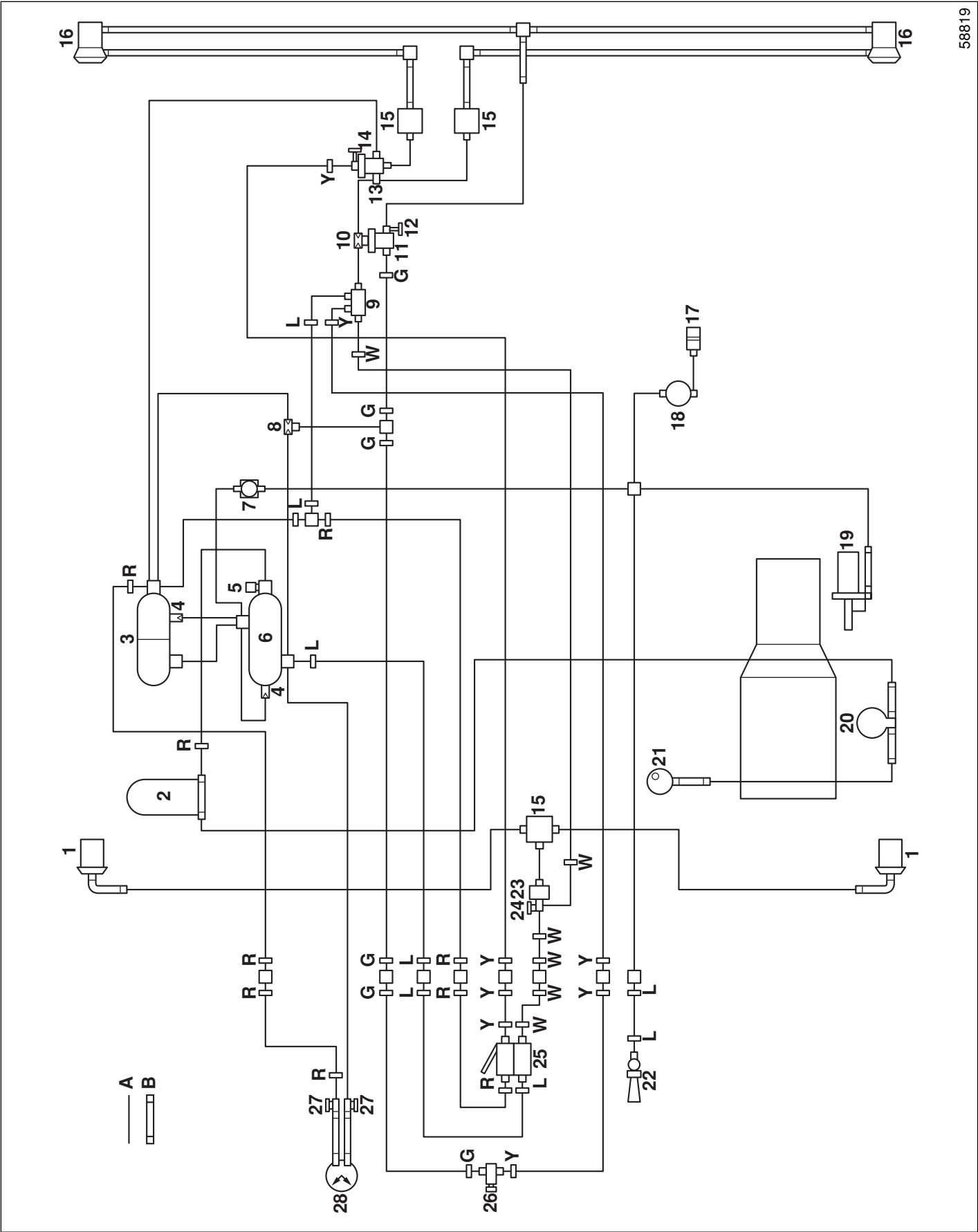
< Exhaust Brake >

Item		Specifications
Control type		Combined electric and air
Valve type		Butterfly valve

MEMO

STRUCTURE AND OPERATION

Brake System



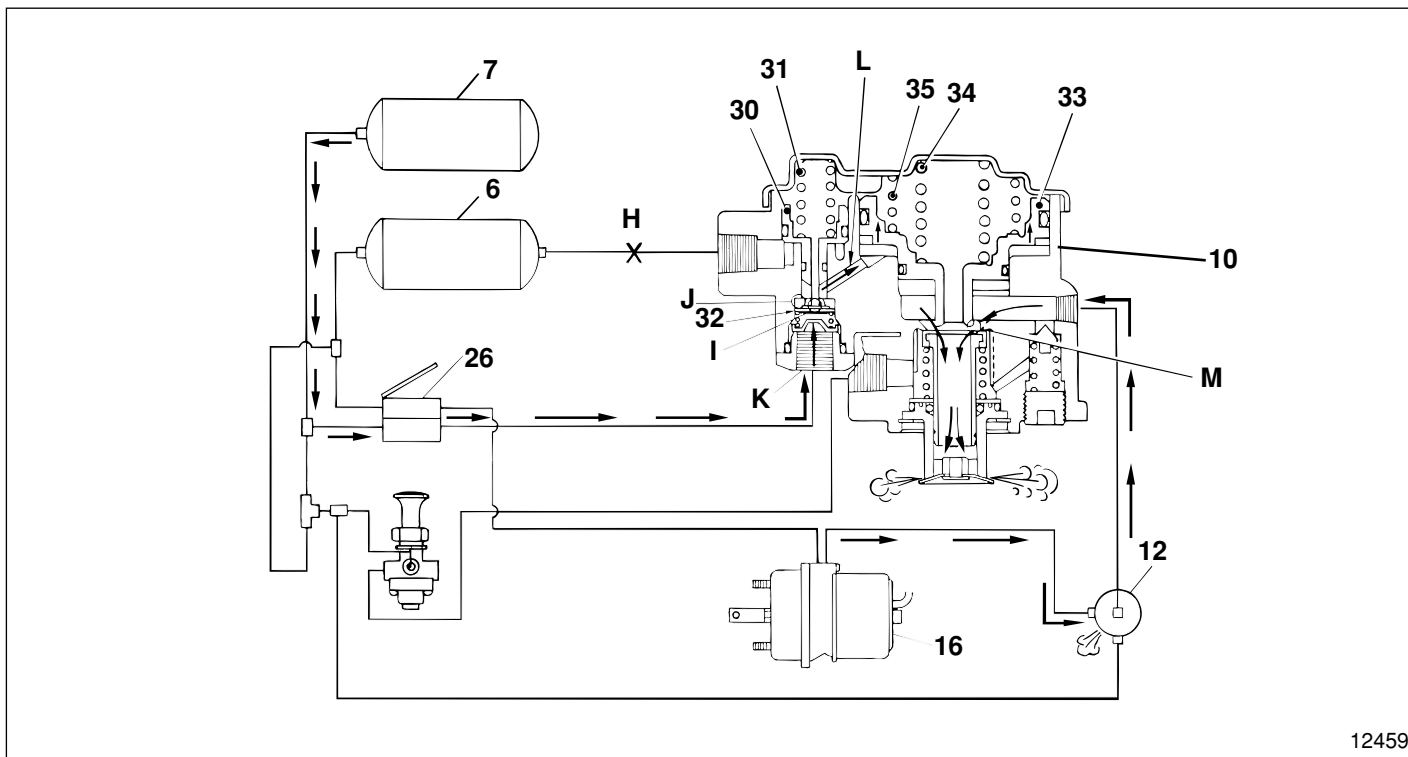
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1 Front brake chamber	14 Stop lamp switch	26 Parking brake control valve
2 Air dryer	15 Control valve	27 Low air pressure switch
3 Air tank (Rear, Parking brake)	16 Rear brake chamber	28 Air pressure gauge
4 Check valve	17 Exhaust brake unit	
5 Safety valve	18 3-way magnetic valve	A : Air pipe
6 Air tank (Front, Wet)	19 Clutch booster < EATON FS8209 >	B : Hose
7 Supply valve	20 Air compressor	G : Green tape
8 Double check valve	21 Air cleaner	L : Blue tape
9 Spring brake valve	22 Air horn	R : Red tape
10 Double check valve	23 Quick release valve	Y : Yellow tape
11 Relay valve	24 Stop lamp switch	W : White tape
12 Parking brake switch	25 Dual brake valve	
13 Relay valve		

- The brake system is a full-air, all wheel brake type consisting of separate front and rear systems.
- Parking brake control valve **27** is fitted as a safety mechanism. It provides normal braking action on the spring brake of rear brake chamber **16** even if the rear brake system air line fails.
- An exhaust brake system, of the exhaust pipe opening and closing valve type, is fitted as a sub-brake system.

STRUCTURE AND OPERATION

● Safety mechanism for rear brake system failure (Spring brake)



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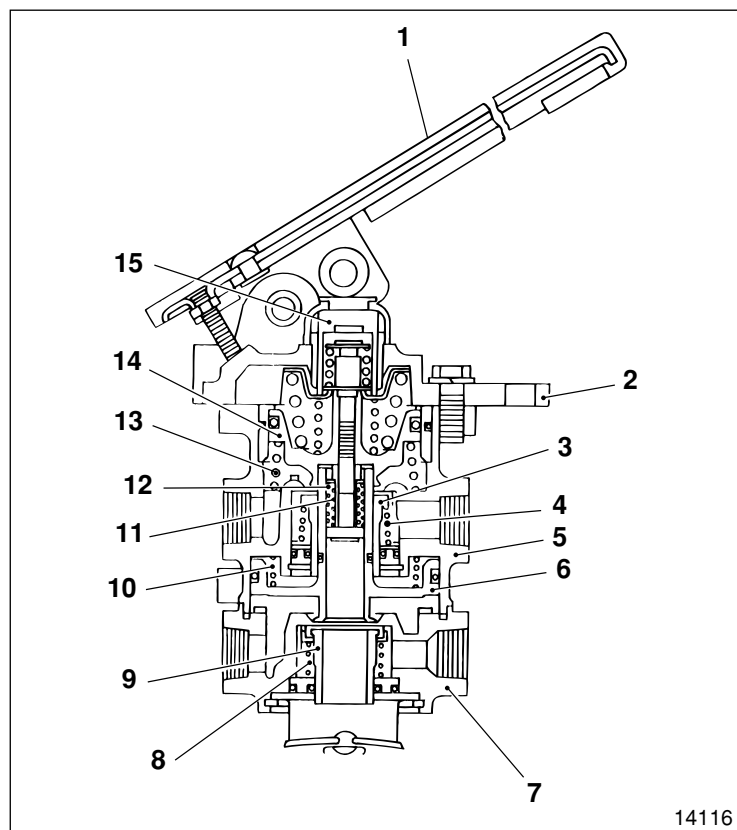
- If any part of the rear brake system fails and the air pressure in air tank 6 (for the rear brake system) drops below the specified pressure, the air pressure under piston 30 of spring brake valve 10 is overcome by the repercussive force of spring 31 and the piston is forced down.
- When forced down, piston 30 makes contact with valve 32 to close exhaust port I and open inlet port J.
- When brake pedal 26 is depressed, the air pressure in the air tank (for the front brake system) is fed to control port K of spring brake valve 10, and is then fed under piston 33 via inlet port J and passage L.
- The air pressure under piston 33 overcomes the repercussive force of springs 34, 35 to raise the piston and open exhaust valve M.
- When exhaust valve M opens, the pressurized air that flowed from spring brake valve 10 to relay valve 12 is discharged through the exhaust port in accordance with brake pedal 26 depression force.
- Since relay valve 12 opens the exhaust valve when air pressure is lost, and discharges the air in the spring brake of rear brake chamber 16, the spring brake works to generate braking force.

H : Failure

MEMO

STRUCTURE AND OPERATION

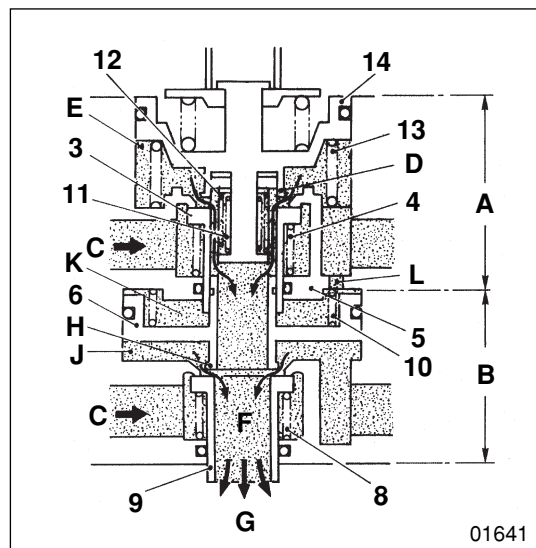
Dual Brake Valve



- 1 Brake pedal
- 2 Plate assembly
- 3 Primary inlet valve
- 4 Primary valve spring
- 5 Body
- 6 Relay piston
- 7 Cover
- 8 Secondary valve spring
- 9 Secondary inlet valve
- 10 Relay piston spring
- 11 Inner spring
- 12 Outer spring
- 13 Primary piston spring
- 14 Primary piston
- 15 Plunger

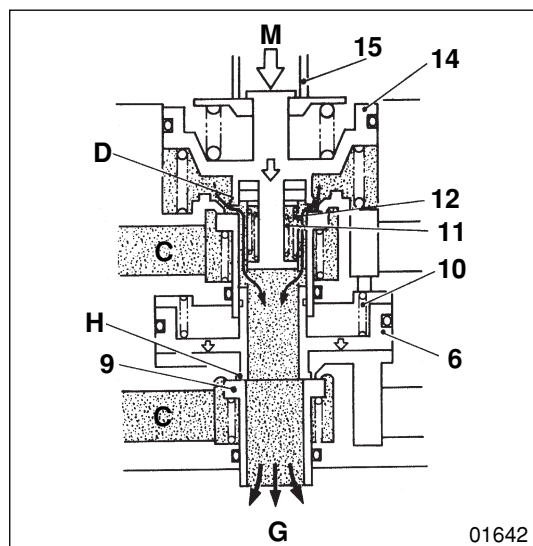
The dual brake valve controls the braking force of the vehicle by feeding pressurized air to the air master in accordance with the brake pedal depression angle of brake pedal 1.

● When brake not operating



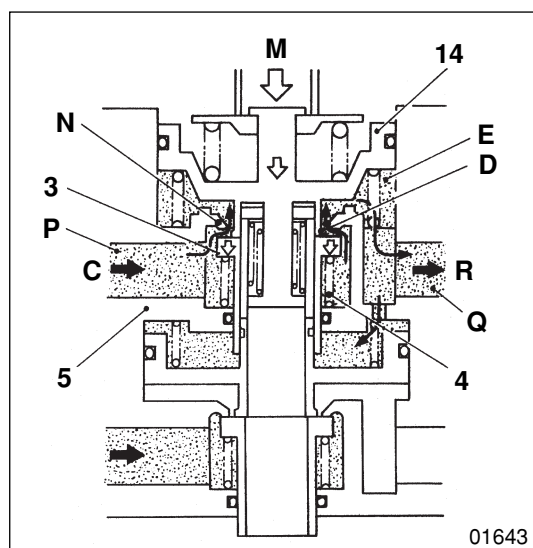
- The repercussive forces of primary valve springs 4, secondary valve spring 8 seat primary inlet valve 3 at primary side A, and inlet valve 9 at secondary side B, on their respective seats. This shuts off air C from the air tank to maintain airtightness.
- The repercussive force of primary piston spring 13 raises primary piston 14 to its upper position. Exhaust valve seat D opens and chamber E is open to atmosphere G via chamber F.
- Since the repercussive forces of inner spring 11 and outer spring 12 is stronger than the repercussive force of relay piston spring 10, relay piston 6 is raised to its upper position and exhaust valve seat H is opened. This opens chamber J to atmosphere G via chamber F. Chamber E at the primary side and chamber K at the upper part of relay piston 6 at the secondary side are connected via passage port L of body 5.

● When depressing brake pedal (before braking pressure is generated)



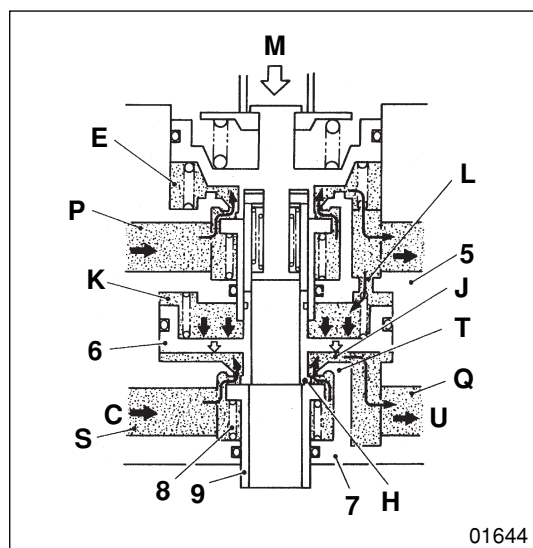
- Depressing the brake pedal (illustrated as pedal action **M**), forces down primary piston **14** via plunger **15**.
- Forcing down primary piston **14** changes the balance between the repercussive forces of inner spring **11** and outer spring **12**, and the repercussive force of relay piston spring **10**, forcing down relay piston **6**. This seats the relay piston on secondary inlet valve **9** and closes exhaust valve seat **H**.
- This closes the secondary side exhaust passage; however, primary side exhaust valve seat **D** remains open. No braking pressure is generated at either primary or secondary sides.

● When depressing brake pedal (braking pressure is generated)



Primary side

- As the brake pedal is depressed further (illustrated as brake pedal action **M**), primary piston **14** is forced down until it is seated on primary inlet valve **3**, closing exhaust valve seat **D**.
- Primary inlet valve **3** is forced down, compressing primary valve spring **4**, and supply valve seat **N** of body **5** separates from the primary inlet valve. The air in chamber **P** flows into chamber **E** and is fed to rear brake system **R** via discharge port **Q** as braking pressure.



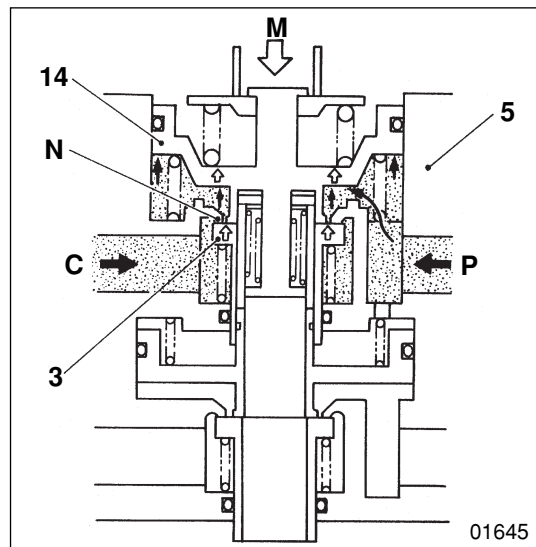
Secondary side

- The air at the primary side flows into chamber **K** via passage port **L** of body **5**.
- The air fed into chamber **K** acts on the upper part of relay piston **6** to force down the relay piston and compress secondary valve spring **8**, forcing down secondary inlet valve **9**.
- This separates supply valve seat **T** and secondary inlet valve **9** of cover **7**.
- The air in supply port chamber **S** flows into chamber **J** and is fed to front brake system **U** via discharge port **Q** as braking pressure.

STRUCTURE AND OPERATION

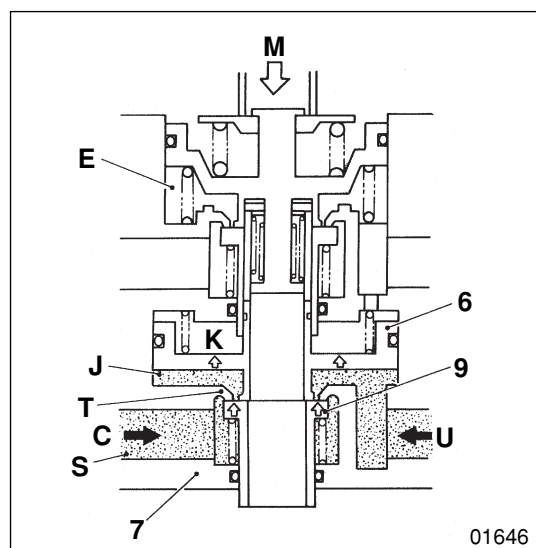
● Stabilization of braking pressure

When the brake pedal remains depressed at the specified depression angle, the braking air pressure stabilizes at the pressure corresponding to the brake pedal depression angle.



Primary side

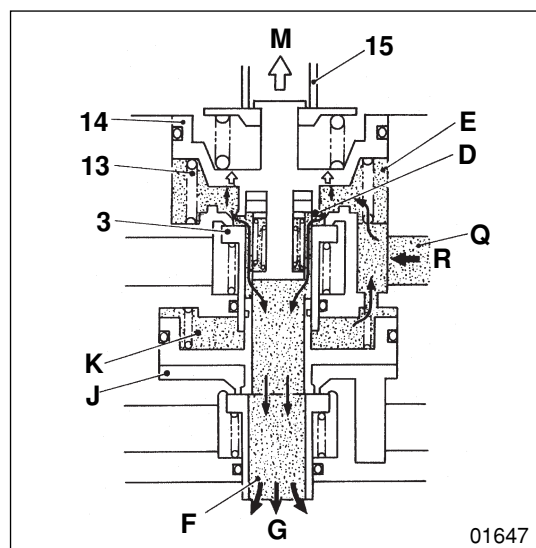
- The braking air pressure fed under the bottom of primary piston 14 raises the primary piston and primary inlet valve 3 together in tandem.
- Primary inlet valve 3 makes contact with supply valve seat N of body 5, then the supply of air C from the air tank ceases and the increases in the braking air pressure stops. This stabilizes braking pressure R for the rear brake system.



Secondary side

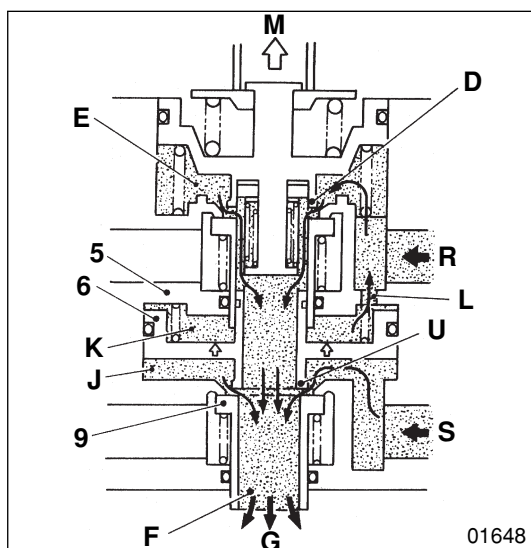
- As the braking pressure (pressure in chamber J) for the front brake system balances the pressures in chambers E and K, the force raising relay piston 6 disappears, and the relay piston rises in tandem with secondary inlet valve 9.
- Secondary inlet valve 9 makes contact with supply valve seat T of cover 7, then the supply of air from supply port chamber S to chamber J ceases. This stabilizes brake pressure U for the front system.

● Release of brake pressure



Primary side

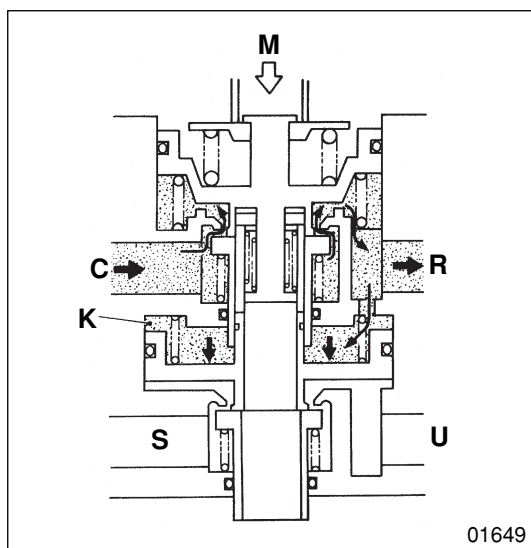
When the brake pedal is released (illustrated as brake pedal action M), primary piston spring 13 and air pressure R at discharge port Q (pressure in chamber E) raise plunger 15 and primary piston 14. Then, exhaust valve seat D at the lower end of the primary piston separates from primary inlet valve 3. The air pressure of the rear brake system flows through chamber E to be discharged from exhaust passage chamber F into atmosphere G.



Secondary side

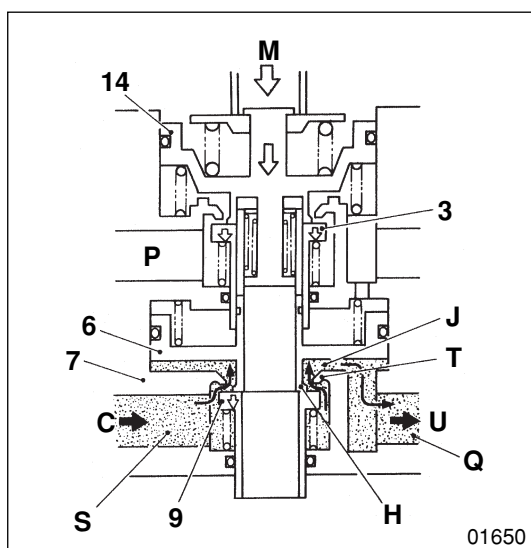
- As the air pressure in the rear brake system drops, the air pressure in chamber **K** is discharged via passage port **L** of body **5**, and chambers **E**, **F** into atmosphere **G**.
- This changes the air pressure balance between chambers **K** and **J**. The air pressure in chamber **J** raises relay piston **6**, and exhaust valve seat **H** at the lower end of the relay piston separates from secondary inlet valve **9**. Air pressure **U** in the front brake system is discharged from exhaust passage chamber **F** into atmosphere **G**.

● When abnormality occurs



Operation when the air pipe of the front brake system fails

- The primary side operates the same as normal, generating braking pressure in rear brake system **R**.
- At the secondary side, even if the primary side generates air pressure in chamber **K**, braking pressure is not generated in front brake system **U**, since no air pressure is generated in supply port **S**.



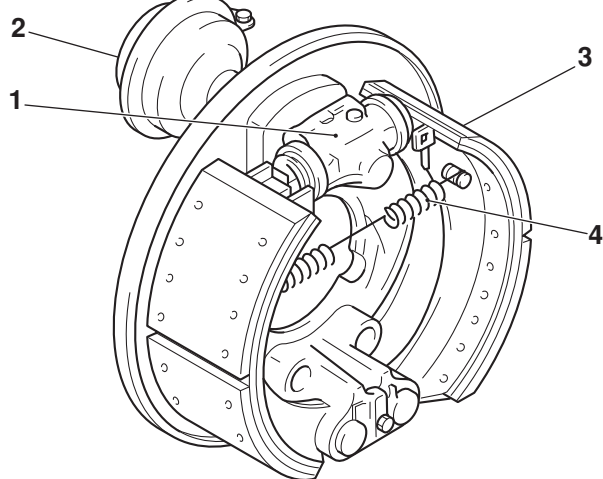
Operation when the air pipe of the rear brake system fails

- In the rear brake system, air pressure is not generated up to supply port **P**. Therefore, even if the brake pedal is depressed (causing primary piston **14** to force down primary inlet valve **3**), braking pressure is not generated.
- If the brake pedal is depressed further (illustrated as brake pedal action **M**), primary piston **14** makes contact with relay piston **6** and they force down secondary inlet valve **9**.
- This action separates supply valve seat **T** of cover **7** from secondary inlet valve **9**. The air pressure flows into chamber **J** from chamber **S** and is fed to front brake system **U** via discharge port **Q** as braking pressure.

STRUCTURE AND OPERATION

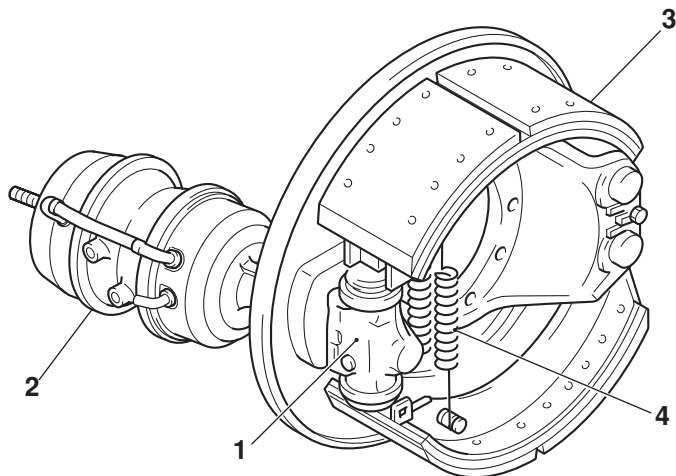
Wheel Brake

< Front >



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< Rear >

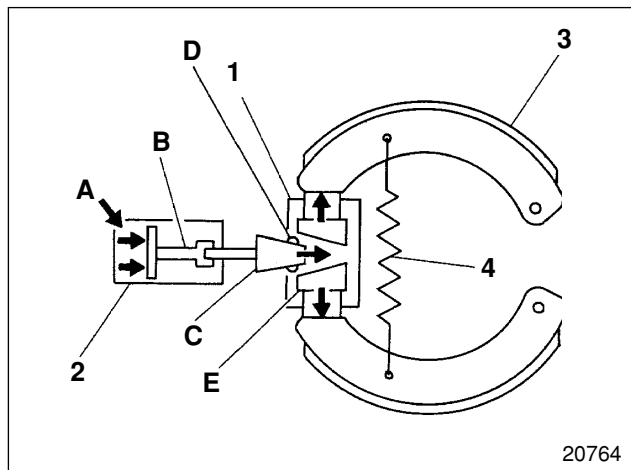


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- 1 Expander
- 2 Brake chamber
- 3 Brake shoe
- 4 Return spring

- Drum brake expands brake shoe **3** by a wedge mechanism.
- Expander **1** incorporates an auto adjustment mechanism that automatically adjusts the brake shoe clearance.

● Wedge mechanism

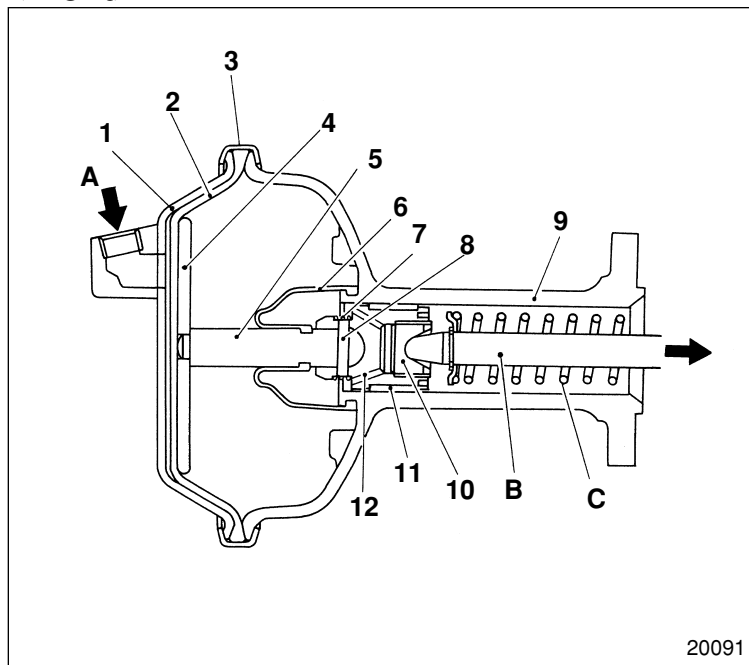


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- When applying air pressure **A** on brake chamber **2**, the push rod **B** pushes wedge **C**.
- The wedge **C** pushes the sleeve **E** of expander **1** through roller **D** to expand brake shoe **3**.

Brake Chamber

<Front>

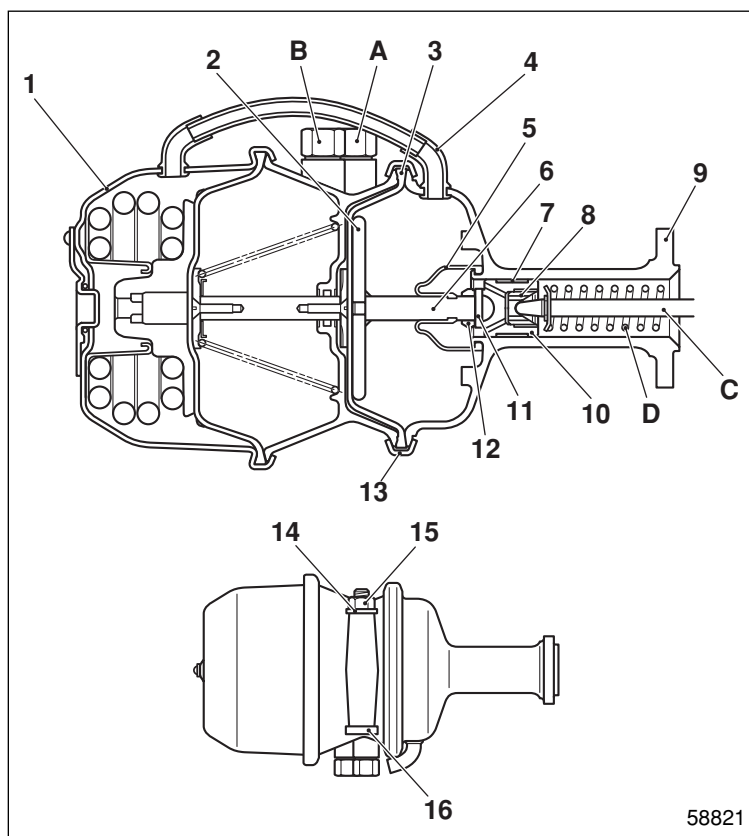


- 1 Pressure plate
- 2 Diaphragm
- 3 Clamp ring
- 4 Push plate
- 5 Push rod
- 6 Dust cover
- 7 Ring
- 8 Pin
- 9 Base
- 10 Guide head
- 11 Bush
- 12 Push rod guide

A : Air pressure
 B : Wedge (expander)
 C : Spring (expander)

- When applying air pressure **A** on the brake chamber < front >, the push rod **5** and wedge **B** are pushed through diaphragm **2**.
- When releasing air pressure **A**, wedge **B** and push rod **5** are returned by spring force of spring **C**.

<Rear>



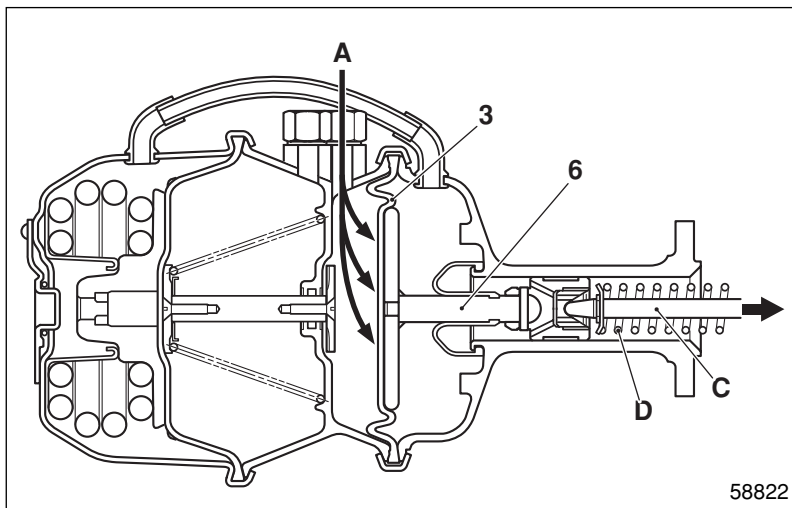
- 1 Piggyback
- 2 Push plate
- 3 Diaphragm
- 4 Elbow
- 5 Dust cover
- 6 Push rod
- 7 Bush
- 8 Guide head
- 9 Base
- 10 Push rod guide
- 11 Pin
- 12 Ring
- 13 Clamp ring
- 14 Washer
- 15 Release nut
- 16 Release bolt

A : Service port
 B : Emergency port
 C : Wedge (expander)
 D : Spring (expander)

- The brake chamber < rear > has a spring brake mechanism except the service brake.
- The washer **14**, release nut **15**, and release bolt **16** are used when releasing the spring brake by a mechanical release.

STRUCTURE AND OPERATION

● Service brake



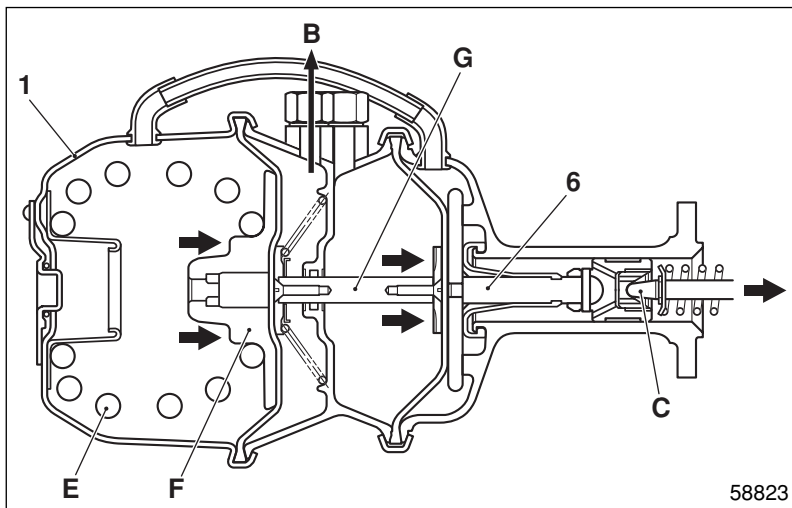
Operation

When applying air pressure on service brake port **A**, the push rod **6** and wedge **C** are pushed through diaphragm **3**.

Release

When releasing the air pressure of the service port **A**, wedge **C** and push rod **6** are returned by spring force of spring **D**.

● Spring brake

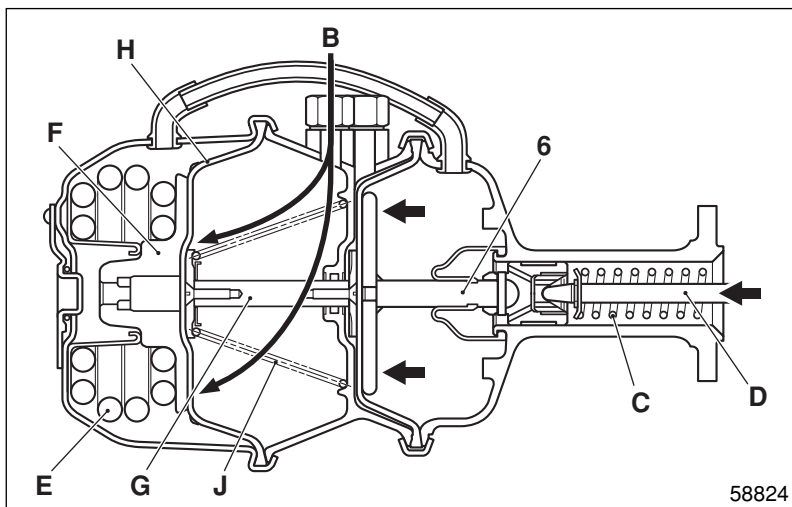


Operation

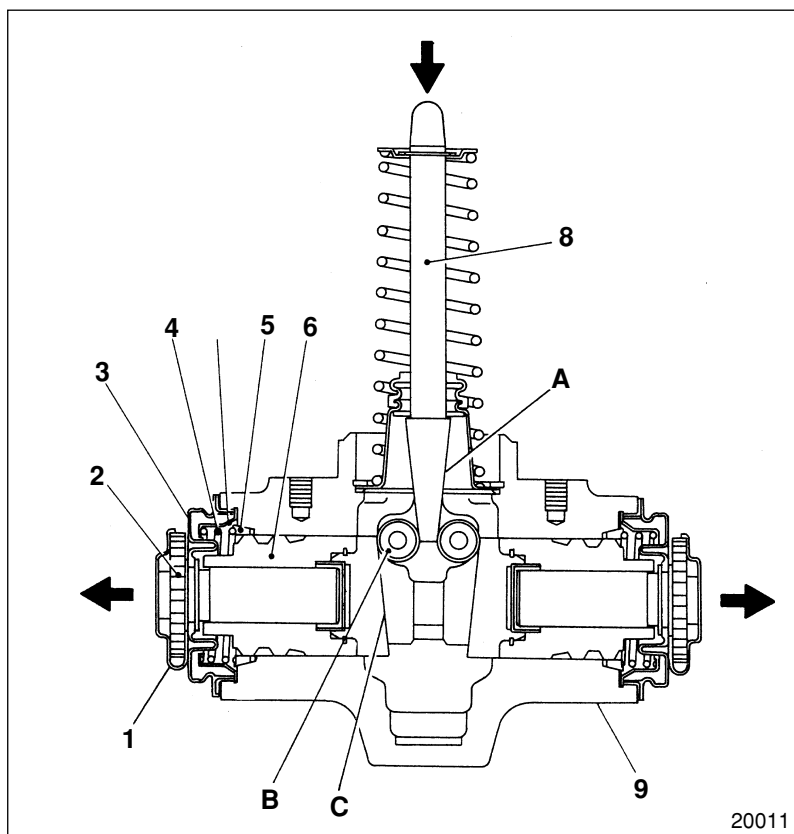
When releasing the air pressure of emergency port **B**, piston **F**, push rod **G**, **6**, and wedge **C** are pushed by spring force of spring **E** of piggyback **1**.

Release

- When applying air pressure on emergency port **B**, piston **F** is pushed back through diaphragm **H**, and thereby spring **E** is compressed.
- Push rod **G** is returned by spring force of spring **J**.
- Wedge **C** and push rod **6** are returned by spring force of spring **D**.



Expander



- 1 Clip
- 2 Adjusting screw
- 3 Boot
- 4 Spring
- 5 Drive ring
- 6 Sleeve assembly
- 7 Cage
- 8 Wedge
- 9 Housing

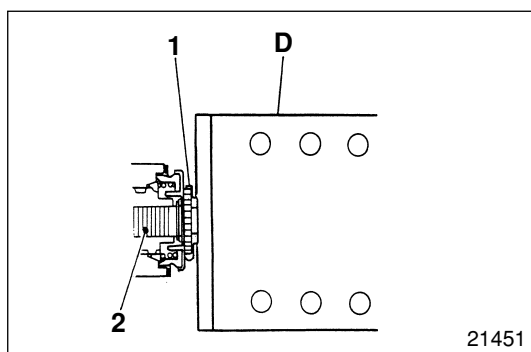
A : Inclination part (wedge)

B : Roller

C : Inclination part (sleeve assembly)

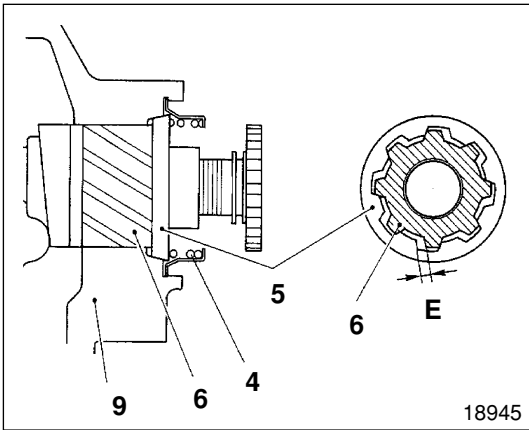
- When wedge 8 being pushed, roller B is spread out along inclination part A of the wedge.
- Roller B pushes out sleeve assembly 6 and adjusting screw 2 along inclination part C of sleeve assembly 6.
- Body 9 of the expander incorporates an auto adjustment mechanism.

● Auto adjustment mechanism



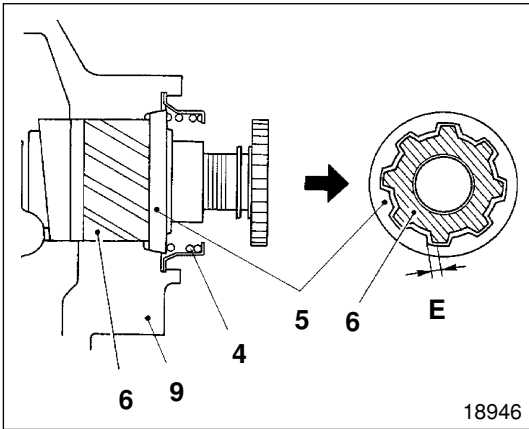
- The rotation direction of adjusting screw 2 is fixed by clip 1.
- The rotation direction of clip 1 is fixed by brake shoe D.

STRUCTURE AND OPERATION

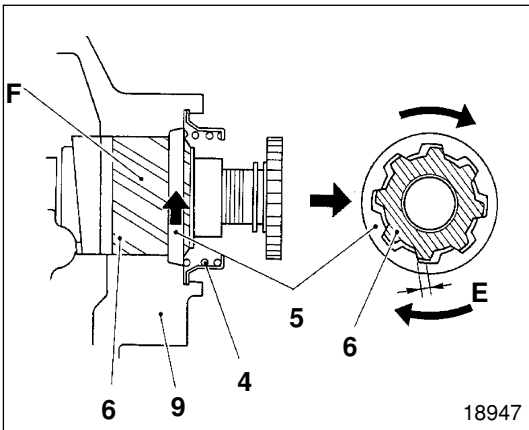


When brake shoe clearance is the standard value

- Before applying the brake, a low part of sleeve assembly 7 strikes housing 9.
- Drive ring 6 is pushed by spring 4, strikes housing 9, and fixed.
E : Backlash

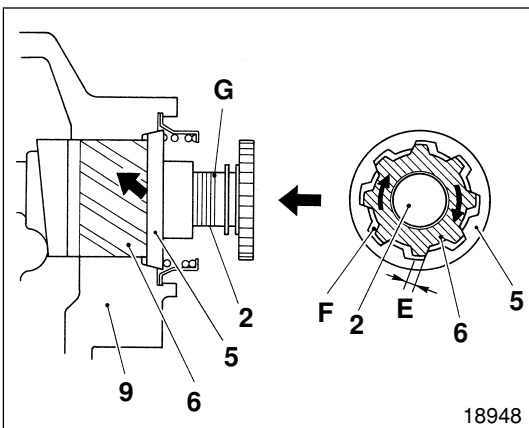


- If applying the brake, sleeve assembly 6 moves within a range of backlash E.



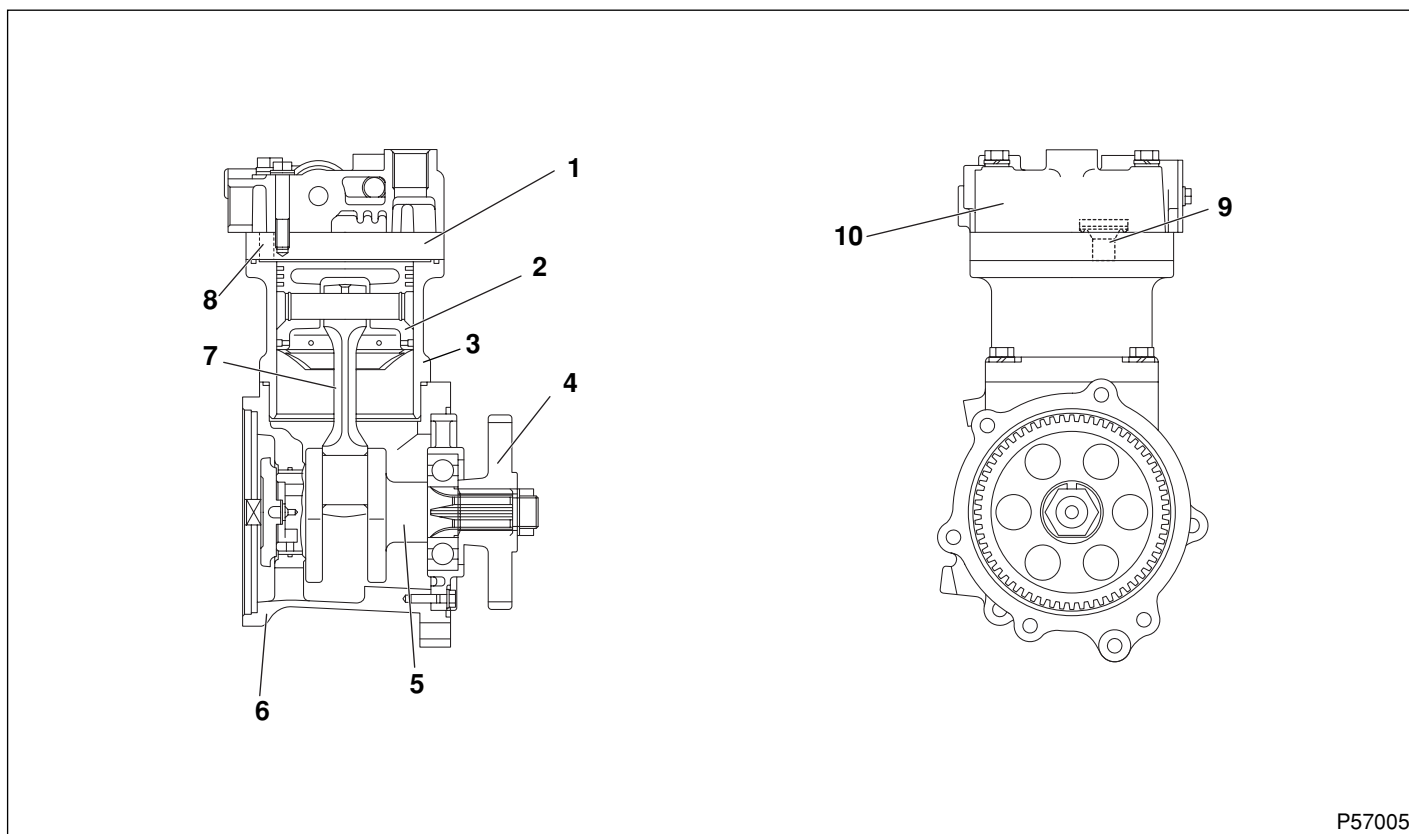
When brake shoe clearance exceeds the standard value

- If applying the brake, sleeve assembly 6 moves over backlash E, and rotates along screw lead face F of the sleeve assembly since drive ring 5 is pushed by spring 4.
- Drive ring 5 remains to strike housing 9 with being pushed to spring 4.



- If releasing the brake, a low part of sleeve assembly 6 moves until it strikes housing 9.
Thereby the sleeve assembly moves just to the extent of backlash E without any rotation; after that, it rotates along the screw lead face F of drive ring 6; it pushes out the adjusting screw 2 by the action of screw G; and it adjusts the brake shoe clearance to the standard value.

Air Compressor



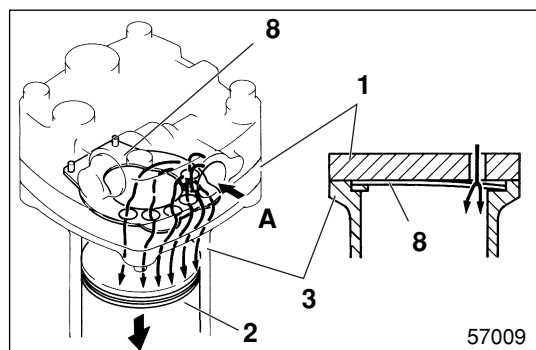
P57005

- 1 Valve seat assembly
- 2 Piston
- 3 Cylinder liner
- 4 Gear

- 5 Crankshaft assembly
- 6 Crankcase assembly
- 7 Connecting rod
- 8 Suction valve

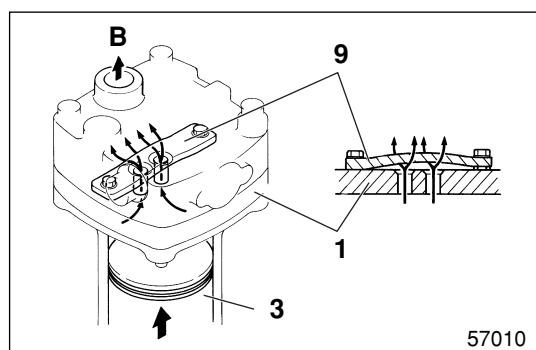
- 9 Delivery valve
- 10 Cylinder head assembly

● During suction



During suction

- When piston 2 moves up and the intake stroke begins, suction valve 8 opens by negative pressure of air, and air A is sucked into cylinder liner 3.

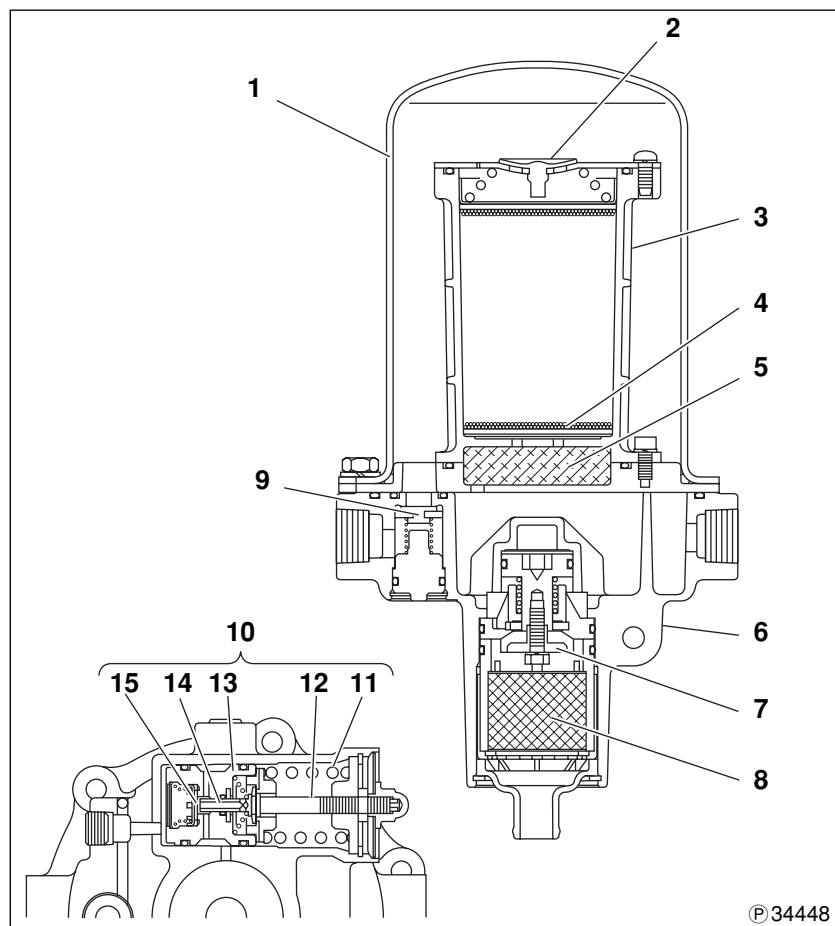


During force feeding

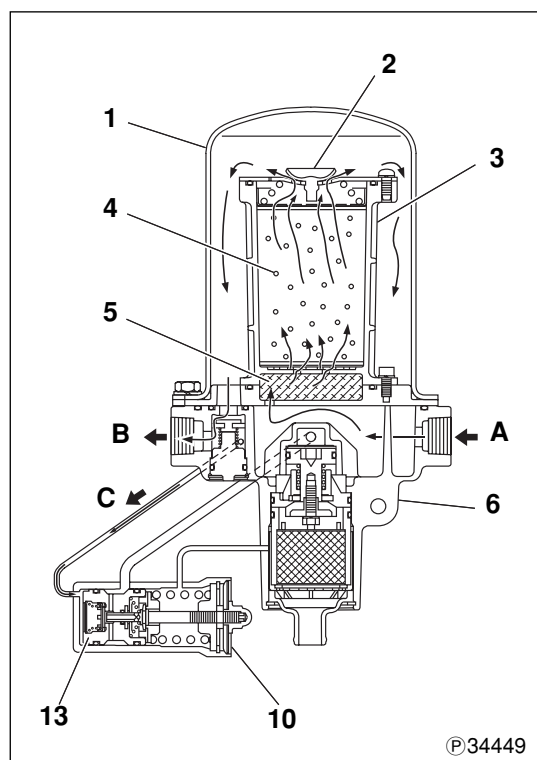
- When piston 2 moves down and the force feeding stroke begins, suction valve 8 in the preceding item is closed by air pressure B.
- Air pressure B compressed by piston 2 pushes open delivery valve 9, and is force fed to the air drier and air tank.

STRUCTURE AND OPERATION

Air Dryer

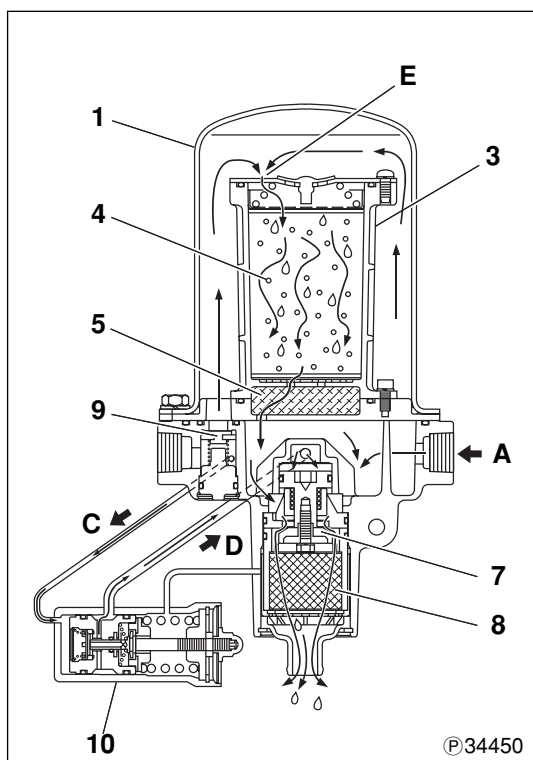


- The air dryer protects brake components by removing moisture and oil from air that has been compressed by the air compressor.
- The air dryer incorporates an air pressure governor **10**, which keeps the pressure in the air tank constant by releasing air compressed by the air compressor to the atmosphere when the pressure in the air tank makes such operation necessary.



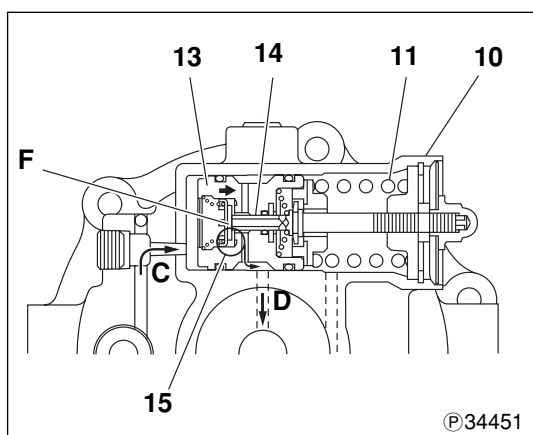
Drying action

- While the air tank is being charged, air from the air compressor enters the air dryer's supply side **A**. Moisture and oil are separated from the air inside the body **6** and collect in the bottom. The air then passes through the oil filter **5**, which removes smaller oil droplets and particles of dust. The air then flows into the case **3**, where any remaining moisture is removed by the desiccant **4**.
- As the air flows upward in the case **3**, it makes contact with increasingly dry desiccant **4** and thus contains less and less moisture. When the air reaches the top of the case, it is dry. It flows through the check valve **2**, purge chamber **1**, and check valve **9**, and it is then supplied from the delivery side **B** to the air tank. Air pressure **C** also acts upon the piston **13** in the air pressure governor **10**.



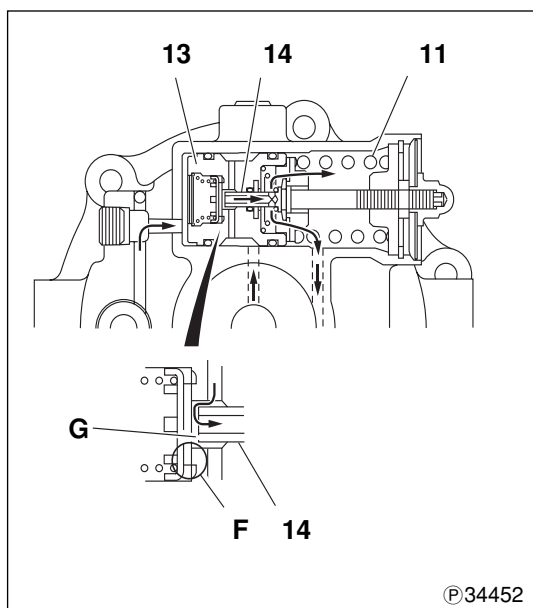
Regeneration of desiccant

- When the air pressure in the air tank reaches the upper threshold level, signal pressure **D** from the air pressure governor **10** causes the valve **7** in the air dryer's control port to open. As a result, the pressure in the case **3** cleans the oil filter **5** and pushes the water and oil out into the atmosphere.
- Following the rapid drop in pressure, dry air in the purge chamber **1** flows through the orifice **E**, expands, and becomes super-dry. As this super-dry air flows backward through the case **3**, it carries moisture from the desiccant **4** out into the atmosphere, thereby completing the desiccant's regeneration.
- During the regeneration process, the check valve **9** is closed. Thus, the signal pressure **D** from the air pressure governor **10** continues to act upon the control port and the valve **7** remains open. Air from the air compressor thus flows through the valve, through the silencer **8**, and out into the atmosphere.
- The regeneration process continues until air consumption causes the pressure in the air tank to decrease to the lower threshold level.



Operation when tank pressure reaches upper threshold level

- Air pressure **C** from the air tank continuously acts upon the piston **13**.
- When the tank pressure increases to such a level that it overcomes the spring **11**, it pushes the piston **13** upward such that the valve **15** closes.
- When the tank pressure increases further and exceeds the upper threshold level, the piston **13** is pushed upward further such that the inlet valve **F** is opened by the exhaust stem **14**. Air pressure from the air tank thus flows out of the air pressure governor **10** as signal pressure **D**, causing the valve **7** to open. Regeneration of the air dryer's desiccant thus begins.

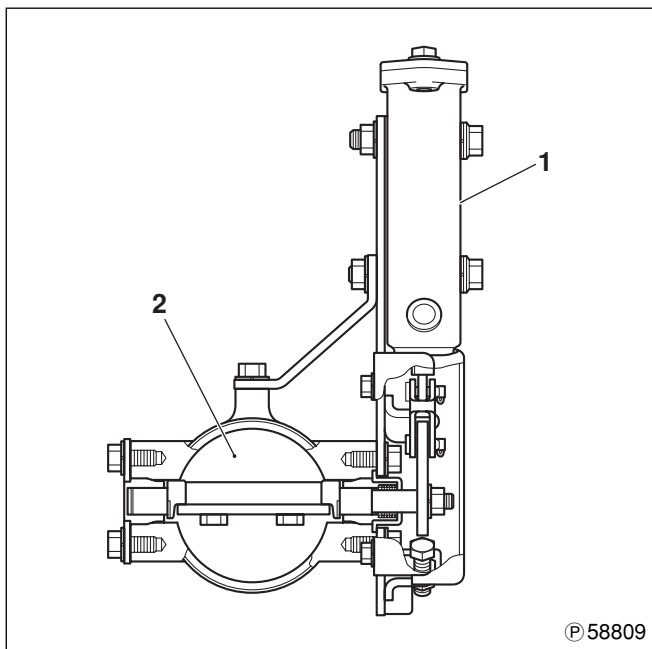


Operation when tank pressure reaches lower threshold level

- When the air pressure **C** from the air tank drops below the lower threshold level, the piston **13** is pushed downward by the spring **11** such that the inlet valve **F** closes and the exhaust valve **G** opens. As a result, air pressure **H** flows through the exhaust stem **14** and escapes to the atmosphere (see exhaust air **J**).

STRUCTURE AND OPERATION

● Exhaust brake unit



- 1 Control cylinder
- 2 Butterfly valve

Wheel Brake

Possible causes		Symptoms				Wheel brake does not work efficiently		Brake drum overheating					
		Air leakage when brake pedal depressed	Air leakage when brake pedal released	Air pressure low	No air leakage but brake works inefficiently	Brake shoe self-return poor after releasing brake pedal (Wheel drags)		Noise when brake pedal depressed	One-sided braking	Wheel brake works suddenly			
Wheel brake	Excessive brake shoe clearance				○				○			○	
	Brake lining surface contaminated with oil				○				○				
	Brake lining surface hardened				○			○					
	Brake lining worn exposing rivet head							○					
	Brake lining materials unequal								○				
	Worn brake linings											○	
	Auto adjustment mechanism malfunctioning  P35B-56, 66, 76				○	○			○	○			
	Brake shoe return faulty because anchor pin rusted					○							
	Anchor pin loose							○					
	Camshaft rusted					○							
	Brake shoe return spring fractured					○			○				
	Brake shoe return spring deteriorated					○							
	Faulty return of sleeve assembly of expander					○			○				
	Rusting of wedge or anchor pin					○			○				
	Brake drum interior worn unevenly							○					
	Improper contact of brake shoe and linings							○					
	Brake drum and brake linings close contact faulty							○					
	Brake drum runout								○				
	Brake drum installation loose							○	○				
	Brake drum and brake linings contact faulty								○				
	Improper contact of brake linings								○				
	Insufficient brake shoe clearance					○			○	○			
	Air pressure fed to brake chambers unequally								○				
	Air pressure in brake chamber not released					○							
	Wheel parking brake working  Gr 36B					○							

TROUBLESHOOTING

Possible causes		Symptoms				Wheel brake does not work efficiently	Brake drum overheating			
		Air leakage when brake pedal depressed	Air leakage when brake pedal released	Air pressure low	No air leakage but brake works inefficiently	Brake shoe self-return poor after releasing brake pedal (Wheel drags)	Noise when brake pedal is depressed	One-sided braking	Wheel brake works suddenly	
Air compressor	Malfunctioning			○						
Dual brake valve	Primary and secondary valves airtightness faulty	○	○							
	Primary and secondary valves return faulty					○				
	O-ring damaged	○								
	Exhaust port clogged with foreign particles					○				
Air pressure governor	Specified pressure set incorrectly			○						
Air piping	Air leakage in air piping	○	○	○						
Tire	Left and right air pressure different  Gr 31							○		
Suspension	U-bolt loose  Gr 33, 34							○		

Air Dryer

Possible causes		Symptoms						Remarks
		Drainage from air reservoir drain cock	Drainage not drawn off from exhaust port	Air dryer interior frozen	Air leakage from exhaust port	Air pressure in air reservoir drops extraordinarily	Engine oil coming out exhaust port	
Air dryer	Desiccant deteriorated	☐						
	Heater not working and air dryer interior frozen		☐					
	No warming because heater wiring broken			☐				
	Heater or thermostat wiring disconnected			☐				
	Heater not working because thermostat faulty			☐				
	Temperature extremely low because of snow or ice sticking to air dryer body			☐				
	Valves clogged with foreign particles		☐					
	Valve seat clogged with foreign particles				☐			
Check valve	Air returning from air tank because air tank side check valve malfunctioning during air compressor unloading cycle					☐		
Air compressor	Air compressor oiling-up						☐	

TROUBLESHOOTING

Exhaust Brake

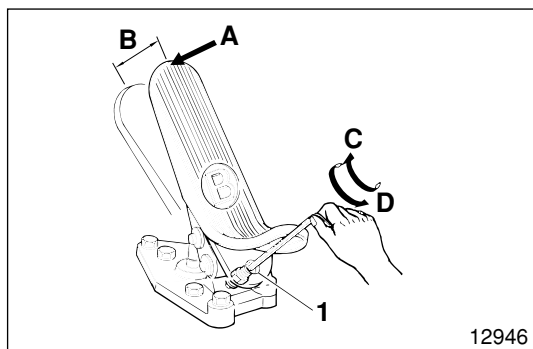
Symptoms			Remarks
	Exhaust brake does not work	Exhaust brake cannot be released	
Possible causes			
Air pressure low	☐		
Electrical system faulty	☐	☐	
Air pipe crushed	☐		
3-way magnetic valve does not work	☐	☐	
Exhaust brake unit does not work	☐	☐	
Exhaust brake unit shaft stuck	☐	☐	
Control cylinder does not work	☐		

Inspection and Adjustment of Brake Pedal Free Play

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Pedal play	Pedal toe	$12^{+3.5}_{-2}$ { $0.47^{+0.14}_{-0.079}$ }	—	Adjust using set screw
		Depression angle	$3.5^{\circ+1.0^{\circ}}_{-0.5^{\circ}}$	—	



Press pedal toe **A** with your hand and measure free play **B**. If the measured value deviates from the standard value, adjust it by turning set screw **1**.

C : Turning clockwise decreases the free play (For a small angle)

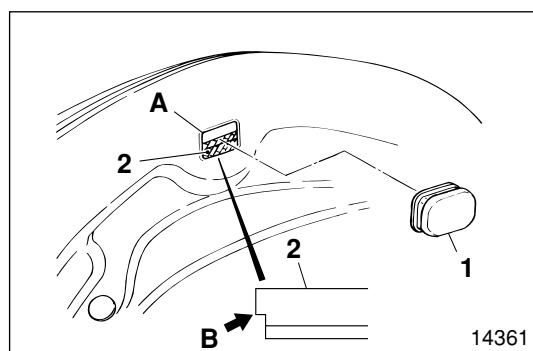
D : Turning counterclockwise increases the free play (For a large angle)

Thickness Inspection and Replacement of Brake Lining

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Thickness of brake lining	16 {0.63}	6{0.24}	Replace



[Inspection]

NOTE

Be sure to inspect at two points for each wheel per side.

- Remove check hole plug **1** from the backing plate.
- Inspect through check hole **A** whether brake lining **2** is worn to the point of side shoulder **B** of the brake lining (the limit).
- If the measured value is lower than the limit, replace brake lining **2** on the same axle as a unit.
- After inspection, be sure to reinstall check hole plug **1**.

[Replacement]

📖 P35B-56, 66

ON-VEHICLE INSPECTION AND ADJUSTMENT

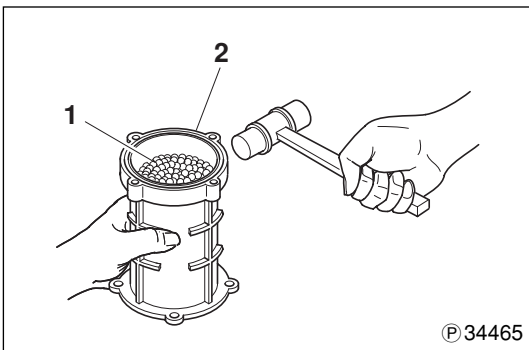
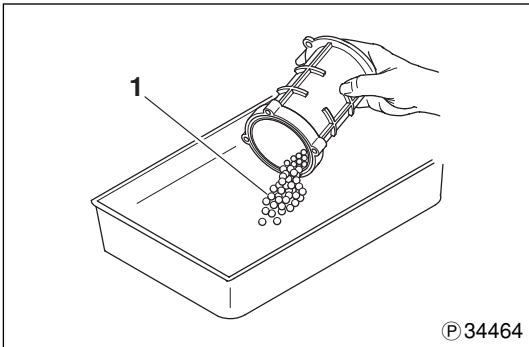
Inspection and Maintenance of Air Dryer

Perform maintenance and inspections at each of the indicated intervals or distances.

(1) Every 10000 km (6000 miles)

- Check whether the air dryer is functioning properly by opening the drain cock on the air tank and checking whether water flows out.
- If a small amount of water flows out, check whether the desiccant **1** has changed color. If one fifth or more of the desiccant has changed in color from white to brown, replace the desiccant.

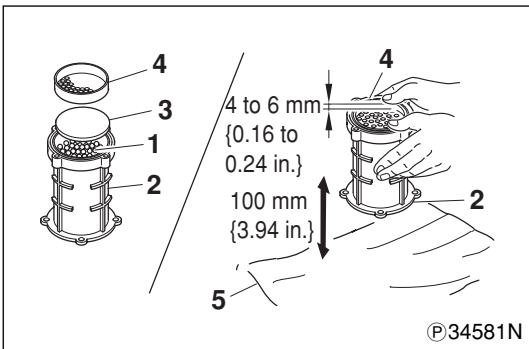
📖 P35B-38



NOTE

A small amount of moisture may collect whenever the temperature in the vicinity of the air tank drops by more than 16°C.

- Place the desiccant **1** in the case **2**, then settle the desiccant by tapping gently and evenly around the case with a plastic hammer.



- Place the soft layer side of the filter **3** on the desiccant **1**, and place the filter plate **4** on the case **2**, then tap the desiccant down.

[Tapping]

- Before tapping the case **2** against the work surface, lay two or three layers of rag **5** on the work surface to protect the bottom of the case from scratches.
- Holding down the filter plate **4** with both hands, lift the case **2** to a height of about 100 mm {3.94 in.} and tap it gently against the work surface.
- Tap the case about 30 more times. Make sure the filter plate **4** drops by 4 to 6 mm {0.16 to 0.24 in.} from its original position.

WARNING ⚠

Unless the tapping procedure is performed, particles of desiccant may escape and create blockages in brake lines, thus preventing normal brake operation.

- Look carefully at the water that flows out of the air dryer's exhaust port. If the water is contaminated with oil, inspect the air compressor.

📖 P35B-32

(2) Every 60000 km {36000 miles}

Disassemble the air dryer and replace the desiccant, oil filter, filter, and related rubber parts with repair kit.

 P35B-38

(3) Every two years

Disassemble the air dryer and replace the desiccant, oil filter, filter, and related rubber parts with repair kit.

 P35B-38

ON-VEHICLE INSPECTION AND ADJUSTMENT

Inspection and Adjustment of Air Dryer's Air Pressure Governor

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
1	Threshold pressures	Upper threshold pressure	892 kPa {130 psi, 9.1 kgf/cm ² }	—	Adjust
		Lower threshold pressure	765 kPa {110 psi, 7.8 kgf/cm ² }	—	Replace relevant parts of air pressure governor

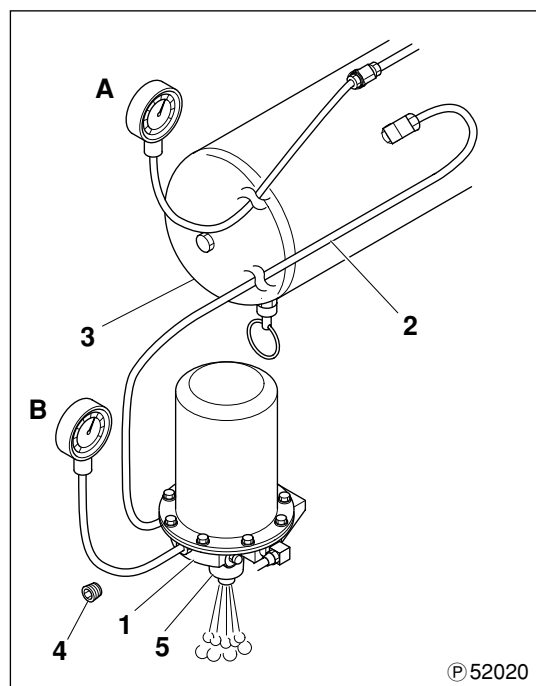
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Plug	14.7 to 24.5 {11 to 18, 1.5 to 2.5}	—
6	Cap nut (for retention of seat and plate)	4.9 to 5.9 {3.6 to 4.4, 0.5 to 0.6}	—
11	Nut (for retention of adjusting screw)	6.9 to 7.8 {5.1 to 5.8, 0.7 to 0.8}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Plug thread	THREEBOND 1110B	As required



[Preparatory steps]

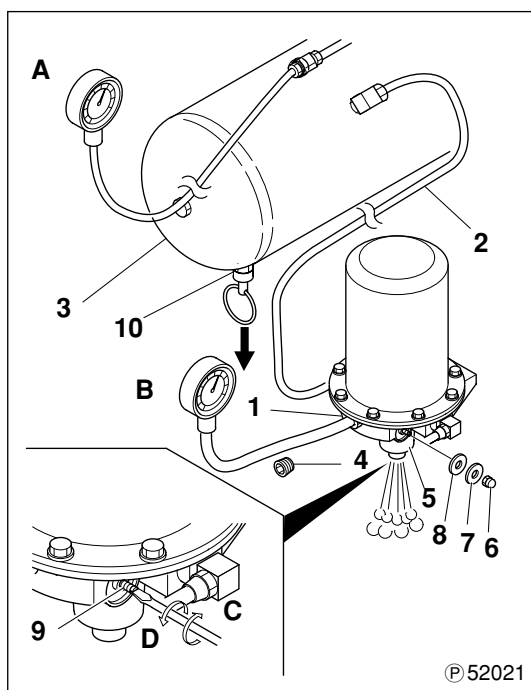
- Connect a pressure gauge **A** to the air tank **3** (wet tank) at the point to which the air pipe **2** from the air dryer **1** is connected.
- Remove the plug **4** from the air dryer **1** at the location shown in the drawing. Connect a pressure gauge **B** at that point.

[Check for air leakage]

- Start the engine to activate the air compressor such that the air pressure in the air tank **3** gradually increases. Check that the pressures indicated by the pressure gauges **A**, **B** do not decrease when air is expelled from the exhaust cover **5**.

CAUTION

If the pressure indicated by either of the pressure gauges **A**, **B** decreases, air is leaking from the check valve and air pressure governor in the air dryer **1**, causing continuous charging and purging.



[Inspection of threshold pressures]

- Remove the cap nut **6**, plate **7**, and seat **8**.
- Start the engine to activate the air compressor such that the air pressure in the air tank **3** gradually increases.
- Check whether the pressure indicated by pressure gauge **A** is the standard value (the upper threshold pressure) when air is expelled from the exhaust cover **5**.
- If the indicated pressure is out of specification, make the necessary adjustment by turning the adjusting screw **9**.
C : Turn clockwise to reduce the pressure.
D : Turn counterclockwise to increase the pressure.

- Reduce the air pressure to 690 kPa {100 psi, 7.0 kgf/cm²} or lower, then gradually increase it again.

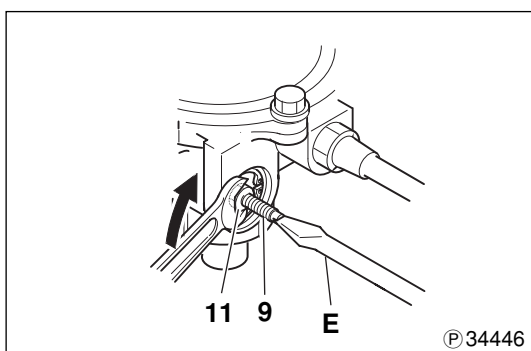
Check whether the pressure indicated by pressure gauge **A** is the standard value (the upper threshold pressure). If the indicated pressure is out of specification, make further adjustments.

- With the upper threshold pressure indicated, air from the air compressor will be expelled from the exhaust cover **5** continuously. With the equipment in this condition, open the drain cock **10** to gradually reduce the air pressure. When air stops being expelled from the exhaust cover, check whether the pressure indicated by pressure gauge **B** is the standard value (the lower threshold pressure). If the indicated pressure is out of specification, replace relevant parts of the air compressor governor as an assembly.

- Tighten the nut **11** to hold the adjusting screw **9** in position.

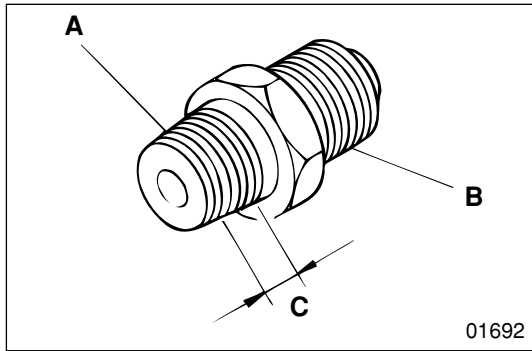
E : Screwdriver

(used to hold adjusting screw in position while nut is tightened)



HANDLING OF CONNECTOR AND NYLON TUBE PIPING

Connector



(1) Installation of connector

- When installing once removed connector of air system, remove remainder of sealer, oil, and water sufficiently, apply THREEBOND TB1110B to threads leaving 1 or 2 threads on top blank, and then screw in.

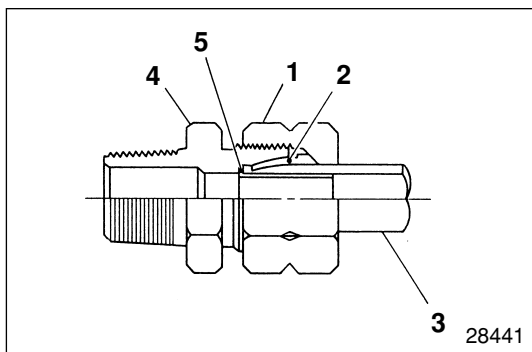
Where alignment is required, stop at aligning point in additional tightening process.

A : Taper screw area

B : Parallel screw area (Do not apply sealer)

C : Area where sealer shall be applied

Nylon Tube

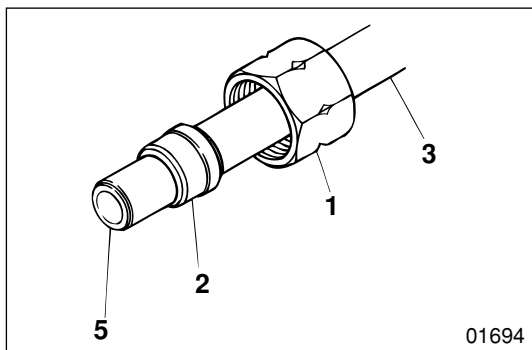


Follow the following process where nylon tube is employed.

- Nylon tube is designed so that as nut **1** is tightened, sleeve **2** advances gripping to tube **3** while itself is being deformed in the process, thus keeping air tightness to prevent leakage. Accordingly, once removed, it cannot be used again: do not fail to replace with new one.

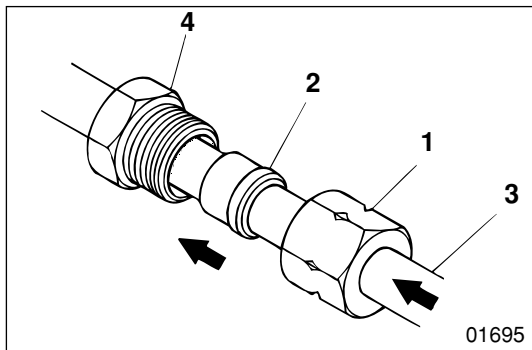
4 : Connector

5 : Insert



(2) Installation of nylon tube

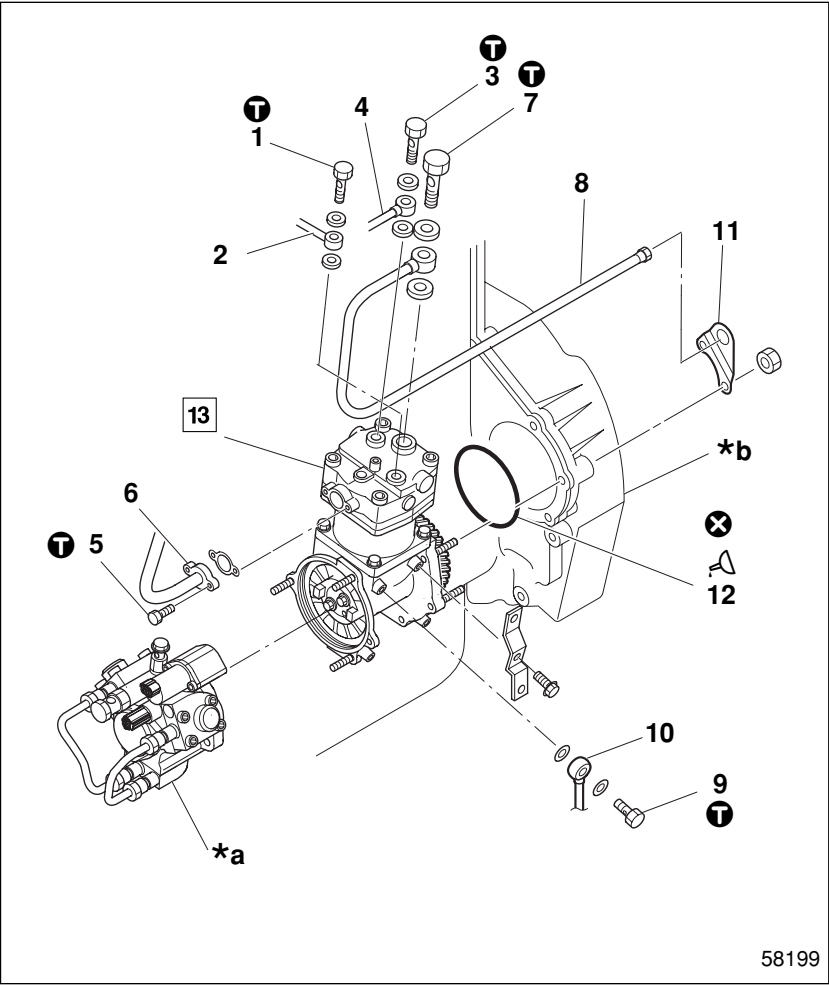
- Make sure that insert **5**, sleeve **2**, nut **1**, and tube **3** are respectively in the state as illustrated.



- Insert tube **3** into connector **4**, push sleeve **2** into connector **4**, and provisionally tighten nut **1** by hand.
- After this, pull tube **3** to make sure that it does not have leakage, and it does not come apart.

MEMO

AIR COMPRESSOR



● Removal sequence

- 1 Eyebolt
- 2 Water inlet pipe
- 3 Eyebolt
- 4 Water outlet pipe
- 5 Bolt
- 6 Air suction pipe
- 7 Eyebolt
- 8 Air outlet pipe
- 9 Eyebolt
- 10 Oil pipe
- 11 Bracket
- 12 O-ring
- 13 Air compressor assembly
P35B-34

*a : Supply pump assembly
Gr 13A

*b : Flywheel housing
X : Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Eyebolt (Water inlet pipe mounting)	39 {29, 4.0}	—
3	Eyebolt (Water outlet pipe mounting)	39 {29, 4.0}	—
5	Bolt (Air suction pipe mounting)	19 to 28 {14 to 21, 1.9 to 2.8}	—
7	Eyebolt (Air outlet pipe mounting)	98 {72, 10.0}	—
9	Eyebolt (Oil pipe mounting)	21 {15, 2.1}	—

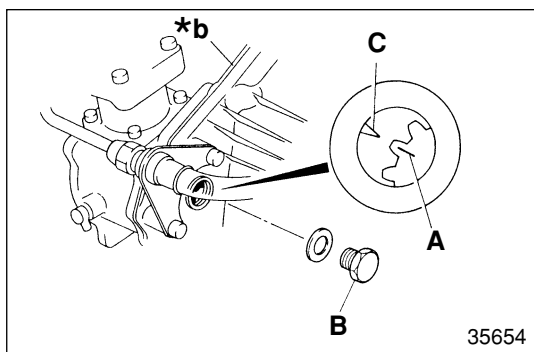
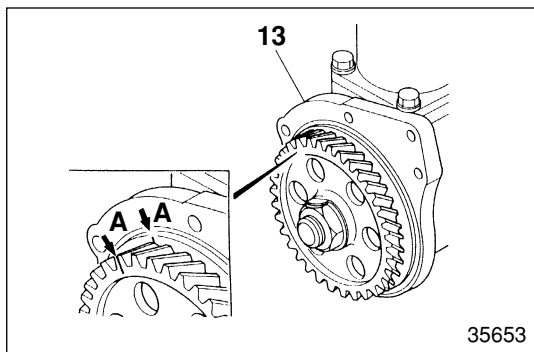
L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
12	O-ring	Engine oil	As required

◆ Service procedure

13 Installation of air compressor assembly

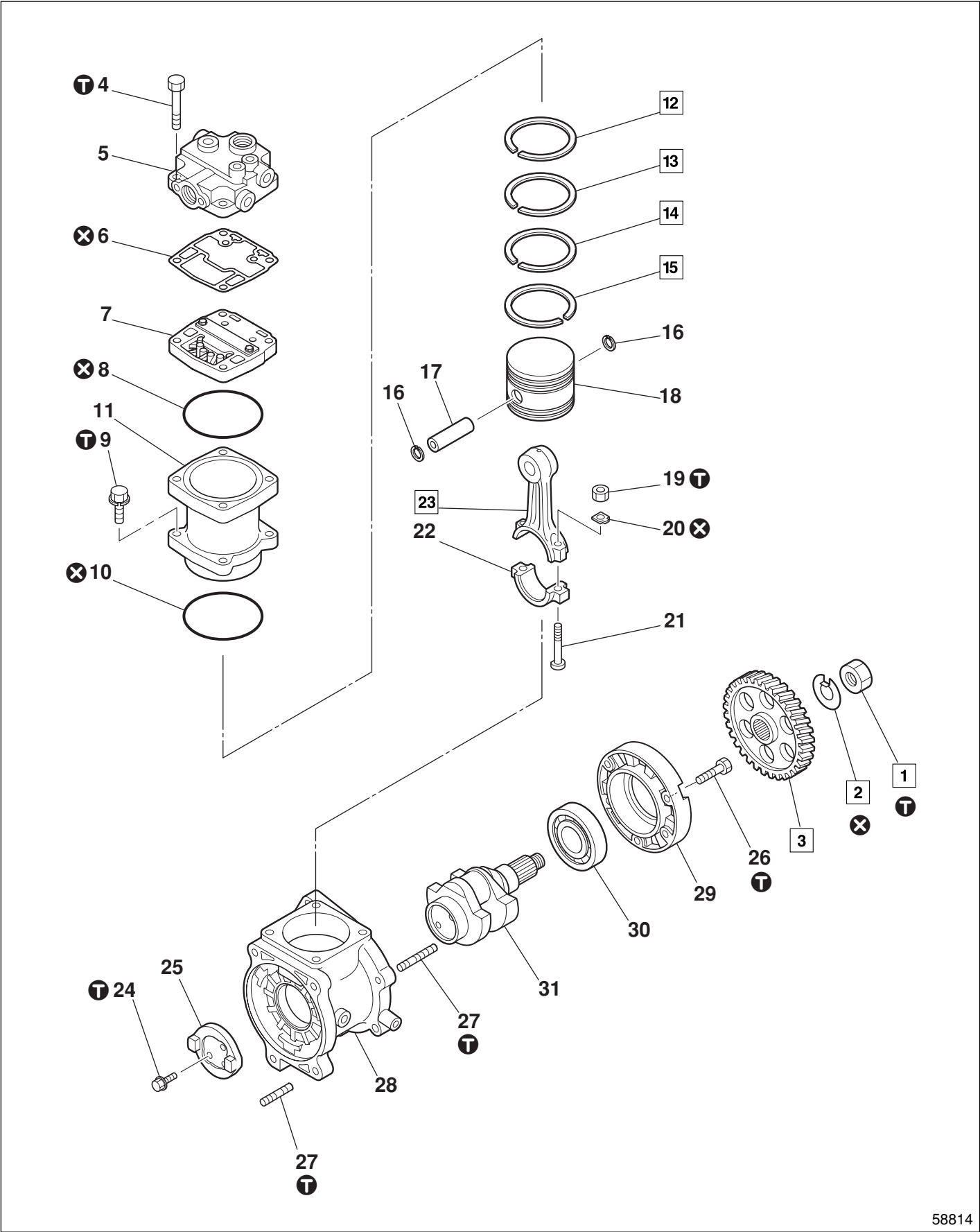
- Set No. 1 cylinder of the engine to top dead center.
Gr 11
- Install air compressor assembly **13** on flywheel housing ***b**, aligning with stamp mark **A**.



- Remove inspection plug **B** to make sure that stamp mark **A** is aligned with pointer **C**.
- If stamp mark **A** is not aligned with pointer **C**, reinstall air compressor assembly **13**.

AIR COMPRESSOR

Air Compressor Assembly



● Disassembly sequence

- | | | |
|--------------------------|-------------------------|------------------------|
| 1 Nut | 12 1st compression ring | 23 Connecting rod |
| 2 Lock washer | 13 2nd compression ring | 24 Bolt |
| 3 Gear | 14 3rd compression ring | 25 Coupling |
| 4 Bolt | 15 Oil ring | 26 Bolt |
| 5 Cylinder head assembly | 16 Snap ring | 27 Stud bolt |
| 6 Gasket | 17 Piston pin | 28 Crankcase assembly |
| 7 Valve seat assembly | 18 Piston | 29 Bearing holder |
| 8 O-ring | 19 Nut | 30 Bearing |
| 9 Bolt | 20 Lock washer | 31 Crankshaft assembly |
| 10 O-ring | 21 Bolt | |
| 11 Cylinder liner | 22 Connecting rod cap | ⊗ : Non-reusable part |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
11, 18	Clearance between piston and cylinder liner	Top	0.27 to 0.33 {0.011 to 0.013}	0.35 {0.014}	Replace
		Skirt	0.11 to 0.17 {0.0043 to 0.0067}	0.19 {0.0075}	
12 to 15	Closed gap of piston ring (measure inside cylinder)	Compression ring	—	1.0 {0.039}	Replace
		Oil ring	—	1.5 {0.059}	
12 to 15, 18	Clearance between piston ring and piston groove	Compression ring	—	0.08 {0.0031}	Replace
		Oil ring	—	0.08 {0.0031}	
17, 18	Clearance between piston pin and piston		—	0.08 {0.0031}	Replace
17, 23	Clearance between piston pin and connecting rod small end		—	0.07 {0.0028}	Replace
23	Connecting rod end play		—	0.5 {0.0020}	Replace
23, 31	Clearance between connecting rod big end and crankshaft assembly		—	0.1 {0.039}	Replace
31	Crankshaft assembly end play		—	1.0 {0.039}	Replace
28, 31	Clearance between crankshaft assembly and inside diameter of crankcase bushing		—	0.12 {0.047}	Replace

ⓘ Tightening torque

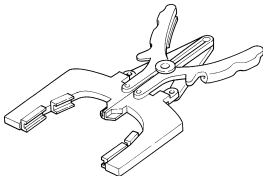
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Compressor gear mounting)	167 to 211 {125 to 155, 17.0 to 21.5}	—
4	Bolt (Cylinder head assembly mounting)	29 to 34 {21 to 25, 3.0 to 3.5}	—
9	Bolt (Cylinder mounting)	25 to 29 {18 to 21, 2.5 to 3.0}	—
19	Nut (Connecting rod cap and connecting rod mounting)	23 to 25 {17 to 18, 2.3 to 2.5}	—
24	Bolt (Coupling mounting)	53 to 65 {39 to 48, 5.4 to 6.6}	—
26	Bolt (Bearing holder mounting)	8.8 to 10.6 {6.5 to 7.8, 0.9 to 1.1}	—
27	Stud bolt	5.9 to 12 {4.4 to 8.9, 0.6 to 1.2}	—

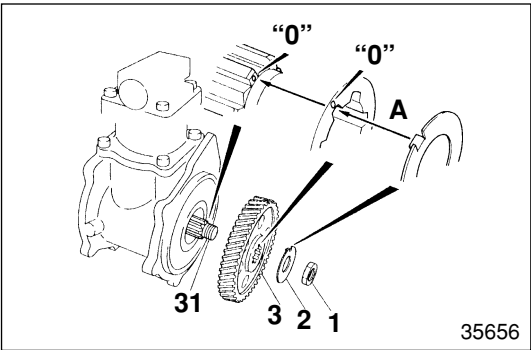
AIR COMPRESSOR

Special tools

Unit : mm {in.}

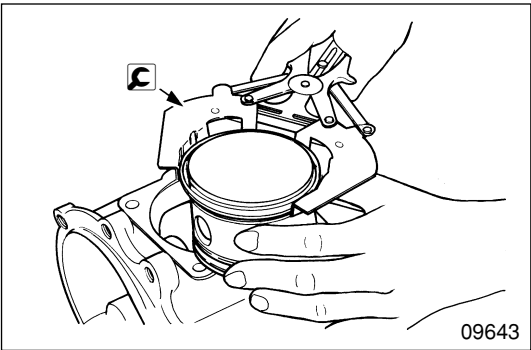
Location	Tool name and shape	Part No.	Application
12 to 15	Piston ring tool 	MH060014	Removal and installation of piston ring
	01732		

Service procedure



1 to 3 Installation of nut, lock washer and gear

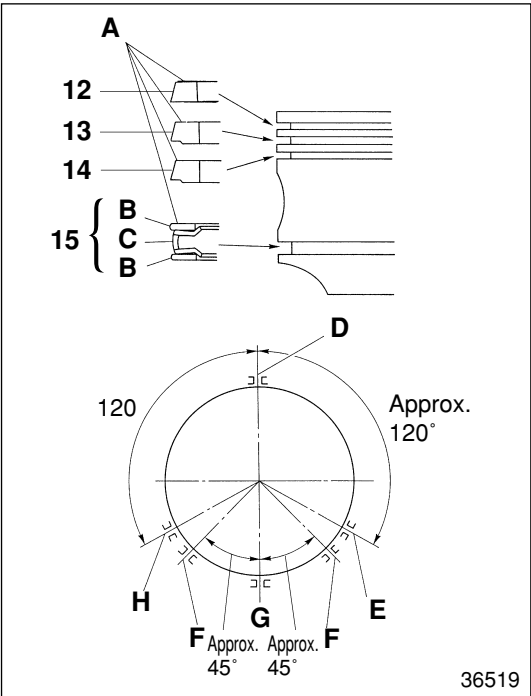
- Align the slit mark of crankshaft **31** with “0” mark of compressor gear **3** to install.
- Insert protrusion **A** of lock washer **2** so that “0” mark of compressor gear **3** is visible.
- After tightening nut **1** to the specified torque, bend one location of the lower side of lock washer **2** toward the nut side to secure the nut.



12 to 15 Piston ring

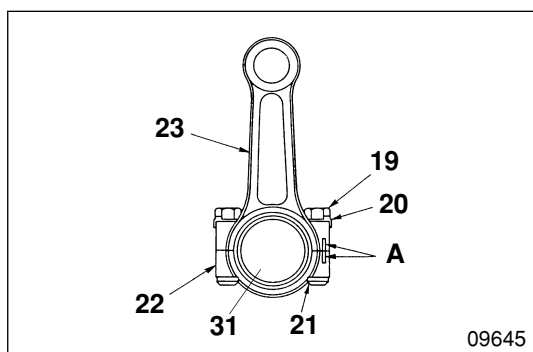
[Removal and installation]

: Piston ring tool

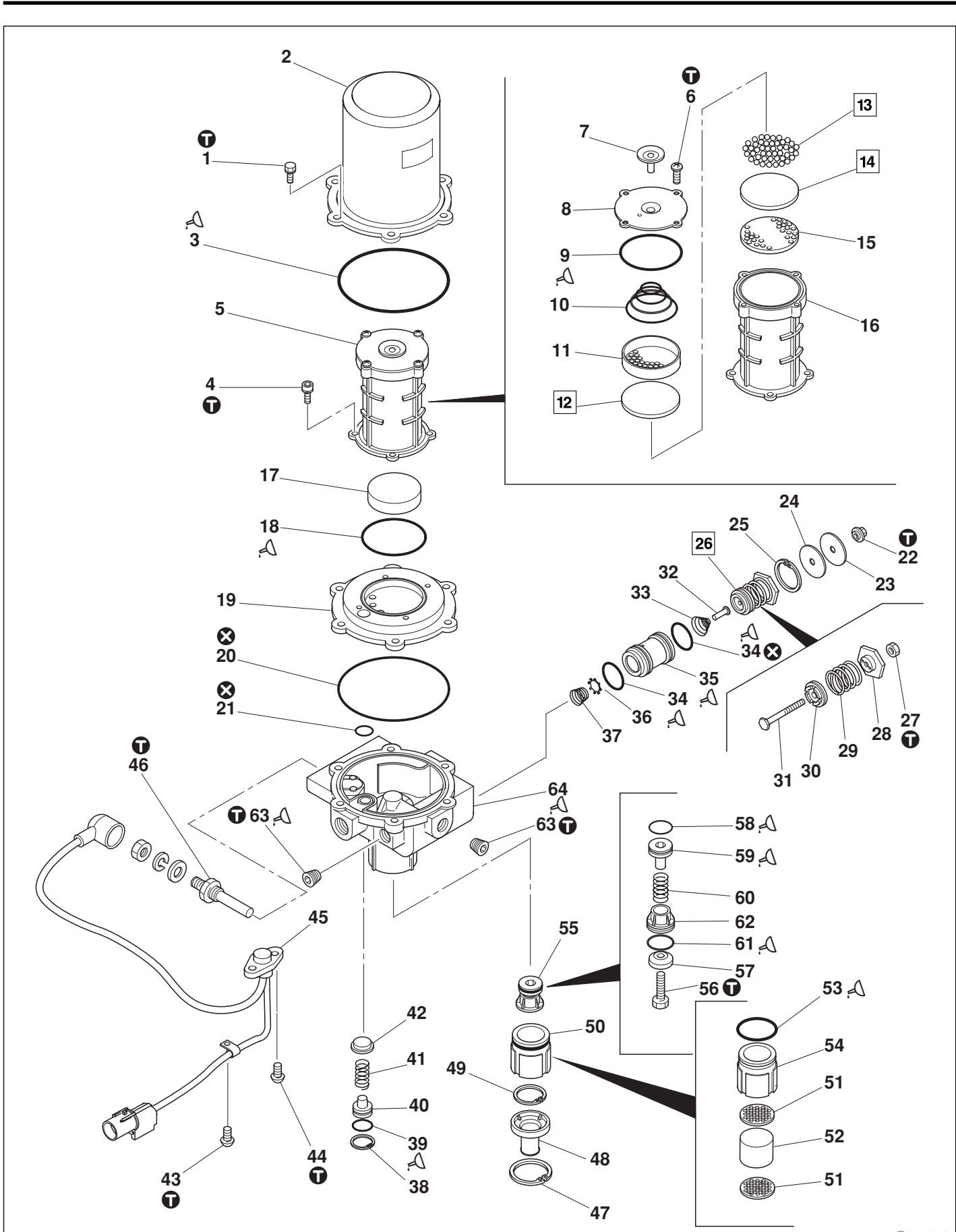


[Installed position]

- A** : Character stamped area
- B** : Side rail
- C** : Spacer
- D** : Closed gap of 2nd compression ring **13**
- E** : Closed gap of 1st compression ring **12**
- F** : Closed gap of oil ring **15** side rail
- G** : Closed gap of oil ring **15** spacer
- H** : Closed gap of 3rd compression ring **14**

**23 Assembly of connecting rod**

- Align connecting rod **23** with mating mark **A** of connecting rod cap **22** to assemble.
- Insert bolt **21** with its head notch facing toward inside of connecting rod cap **22**.
- Bend lock washer **20** after assembly.



P34444

● Disassembly sequence

- | | | |
|-----------------|-----------------------------|---|
| 1 Bolt | 23 Plate | 45 Thermostat assembly  Gr54 |
| 2 Purge chamber | 24 Seat | 46 Heater |
| 3 O-ring | 25 Retaining ring | 47 Retaining ring |
| 4 Bolt | 26 Adjusting screw assembly | 48 Exhaust cover |
| 5 Cartridge | 27 Nut | 49 Retaining ring |
| 6 Screw | 28 Upper spring seat | 50 Silencer assembly |
| 7 Check valve | 29 Spring | 51 Silencer plate |
| 8 Case cover | 30 Lower spring seat | 52 Silencer |
| 9 O-ring | 31 Adjusting screw | 53 O-ring |
| 10 Set spring | 32 Exhaust stem | 54 Silencer case |
| 11 Filter plate | 33 Exhaust stem spring | 55 Valve assembly |
| 12 Filter | 34 O-ring | 56 Bolt |
| 13 Desiccant | 35 Piston | 57 Valve |
| 14 Filter | 36 Valve | 58 O-ring |
| 15 Filter plate | 37 Valve spring | 59 Piston |
| 16 Case | 38 Retaining ring | 60 Valve spring |
| 17 Oil filter | 39 O-ring | 61 O-ring |
| 18 O-ring | 40 Check valve guide | 62 Valve body |
| 19 Cover | 41 Check valve spring | 63 Plug |
| 20 Gasket ring | 42 Check valve | 64 Body |
| 21 Gasket ring | 43 Screw | |
| 22 Cap nut | 44 Screw | |

⊗ : Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Air dryer kit A, B

● Inspection after assembly

 P35B-40

● Adjustment after assembly

 P35B-40

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Threshold pressures	Upper threshold pressure	892 kPa {130 psi, 9.1 kgf/cm ² }	—	Adjust
		Lower threshold pressure	765 kPa {110 psi, 7.8 kgf/cm ² }		Replace relevant parts of air pressure governor

AIR DRYER

Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (for installation of purge chamber, cover, and body)	17.7 to 27.5 {13 to 20, 1.8 to 2.8}	—
4	Screw (for installation of cartridge)	2.0 to 3.9 {1.4 to 2.9, 0.2 to 0.4}	—
6	Screw (for installation of case cover)	2.0 to 3.9 {1.4 to 2.9, 0.2 to 0.4}	—
22	Cap nut (for installation of seat and plate)	4.9 to 5.9 {3.6 to 4.4, 0.5 to 0.6}	—
27	Nut (for retention of adjusting screw)	6.9 to 7.8 {5.1 to 5.8, 0.7 to 0.8}	—
43	Screw (for installation of clamp)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.5}	—
44	Screw (for installation of thermostat assembly)	0.5 to 1.0 {0.4 to 0.7, 0.05 to 0.10}	—
46	Heater	19.6 to 29.4 {14 to 22, 2 to 3}	—
56	Bolt (for installation of valve, piston, and valve body)	3.9 to 6.9 {1.4 to 2.0, 0.4 to 0.7}	—
63	Plug	14.7 to 24.5 {11 to 18, 1.5 to 2.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3, 9, 18, 34, 39, 53, 61, 88	O-ring (entire surface)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
31	Adjusting screw (entire surface except thread)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
35, 59	Piston (outside surface and O-ring groove)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
63	Plug thread	THREEBOND 1110B	As required
64	Body (inside surface)	Multipurpose grease [NLGI No. 2 (Li soap)]	As required

Service procedure

Inspection after assembly

Check for air leakage

- Completely plug the delivery side **A** of the air dryer, then apply air pressure of 49 kPa {7.1 psi, 0.5 kgf/cm²} to the supply side **B** and check that no air leaks from any joint.
- Leakage from the valve assembly **55** must not exceed 10 cm³ {0.61 cu.in} per minute.
- Increase the pressure applied to the supply side **B** to 932 kPa {135 psi, 9.5 kgf/cm²} to cause purging (regeneration). Check that no air leaks from the check valve **44** and from the air pressure governor **C** (with the plug **63** removed).

[On-vehicle inspection method  P35B-28]

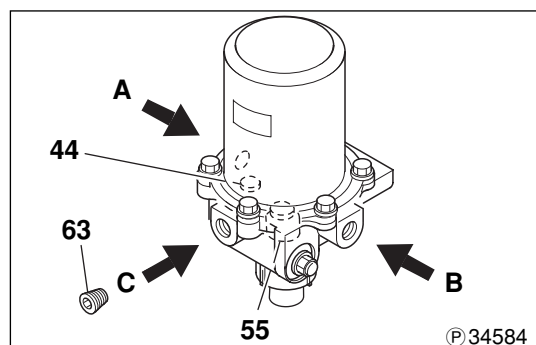
CAUTION

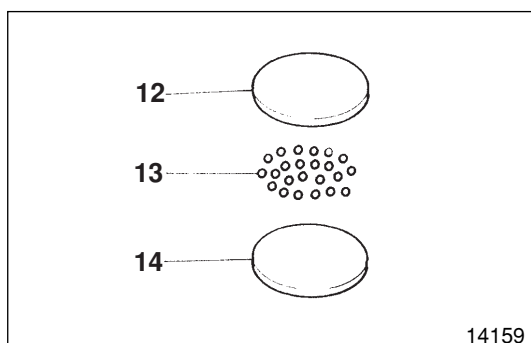
If air leaks from the air pressure governor and from the check valve **44**, charging and purging take place continuously.

Adjustment after assembly

Inspection and adjustment of air dryer's air pressure governor

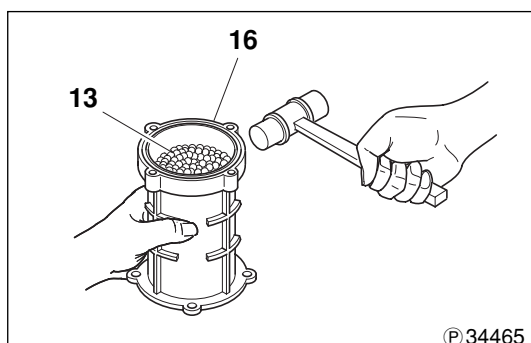
 P35B-28





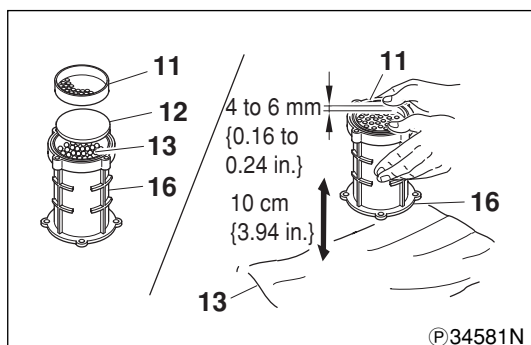
12 14 Installation of filters

Install the filters 12, 14 with their soft layers facing the desiccant 13.



13 Insertion of desiccant

- Place the desiccant 13 in the case 16, then settle the desiccant by tapping gently and evenly around the case with a plastic hammer.



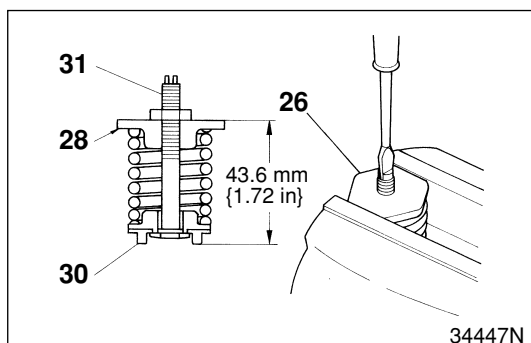
- Place the soft layer side of the filter 12 on the desiccant 13, and place the filter plate 11 on the case 16, then tap the desiccant down.

<Tapping>

- Before tapping the case 16 against the work surface, lay two or three layers of rag A on the work surface to protect the bottom of the case from scratches.
- Holding down the filter plate 11 with both hands, lift the case 16 to a height of about 10 cm {3.94 in.} and tap it gently against the work surface.
- Tap the case about 30 more times. Make sure the filter plate 11 drops by 4 to 6 mm {0.16 to 0.24 in.} from its original position.

WARNING

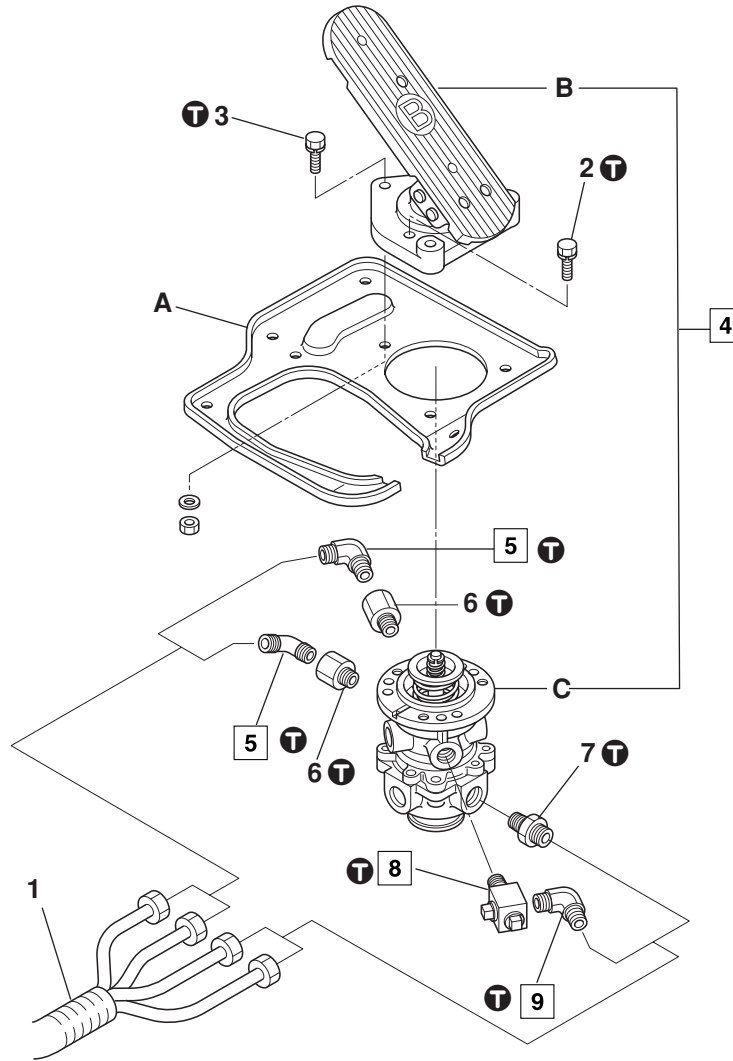
Unless the tapping procedure is performed, particles of desiccant 13 may escape and create blockages in brake lines, thus preventing normal brake operation.



26 Preliminary adjustment of adjusting screw assembly

Turn the adjusting screw 31 to achieve the indicated dimension from the top of the upper spring seat 28 to the bottom of the lower spring seat 30. Doing so will facilitate the threshold pressure adjustment to the standard value.

BRAKE PEDAL



©58810

Remove pedal assembly **B** upward from valve board **A**, and valve assembly **C** downward from the valve board to separate dual brake valve **4** (pedal assembly and valve assembly). Do this without removing the valve board from the vehicle.

● Removal sequence

- | | | |
|--------------|-----------------------------|-------------|
| 1 Nylon tube | 4 Dual brake valve P35B-44 | 7 Connector |
| 2 Bolt | 5 Connector | 8 Connector |
| 3 Bolt | 6 Connector | 9 Connector |

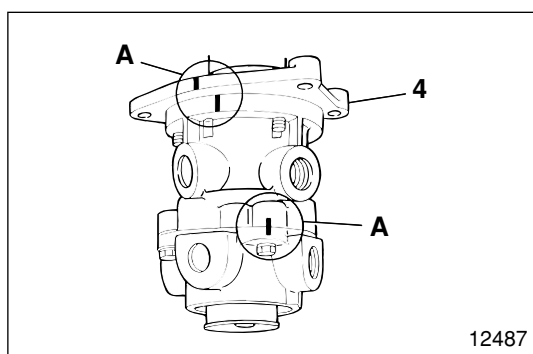
● Assembly sequence

Follow the removal sequence in reverse.

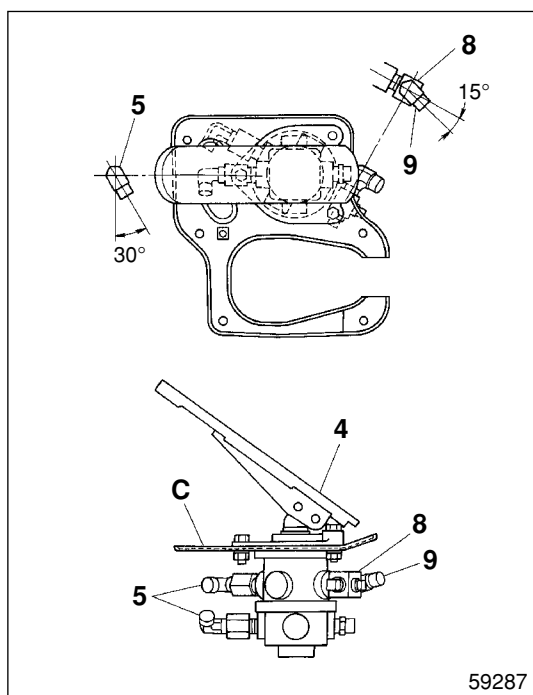
T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

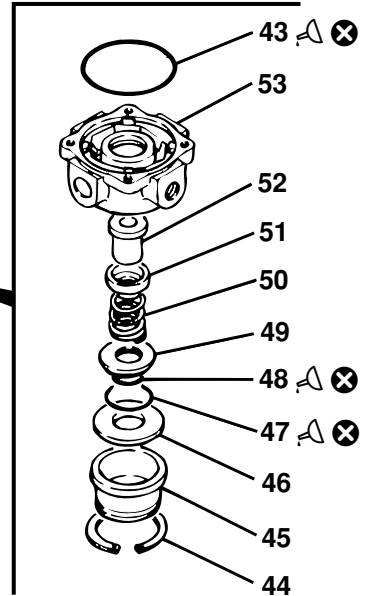
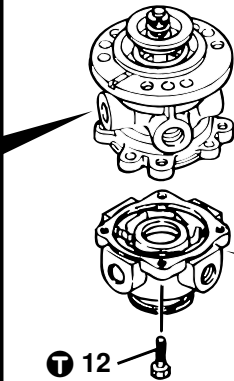
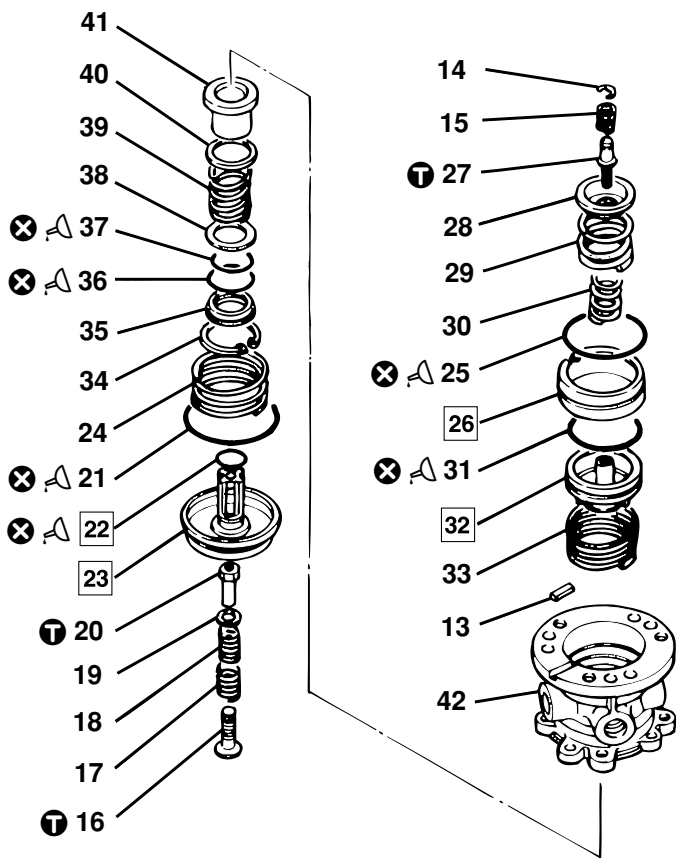
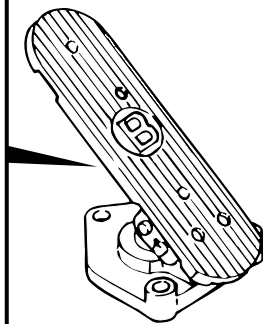
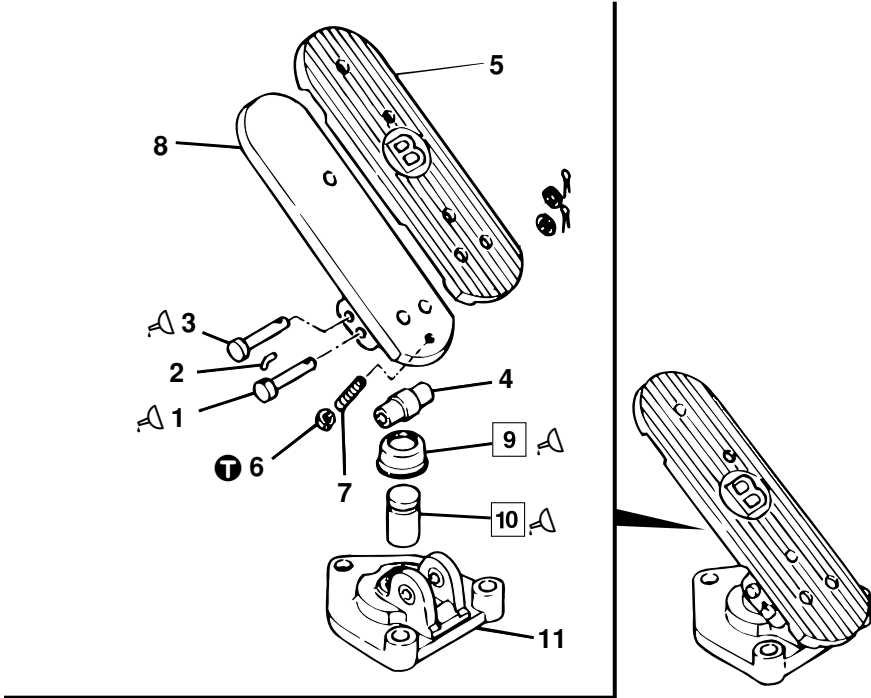
Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Pedal assembly and valve assembly mounting)	12 to 19 {0.047 to 0.075, 1.2 to 1.9}	—
3	Bolt (Dual brake valve and valve board mounting)	12 to 19 {0.047 to 0.075, 1.2 to 1.9}	—
5, 8, 9	Connector	29.4 to 117.7 {0.12 to 0.47, 3.0 to 12}	Determine the direction within one turn immediately after exceeding the lower limit torque. Do not exceed the upper limit torque.
6, 7	Connector	29.4 to 39.2 {0.12 to 0.16, 3 to 4}	—

◆ Service procedure**4 Dual brake valve****A :** Alignment mark**5 8 9 Connector positioning**

Position the connector within one turn after the lower limit tightening torque has been reached.



DUAL BRAKE VALVE



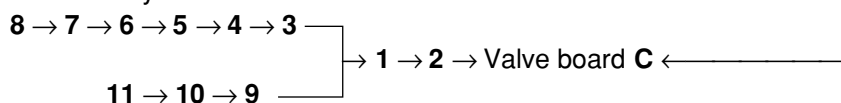
● Disassembly sequence

- | | | |
|-------------------|------------------------|-------------------|
| 1 Straight pin | 20 Sleeve | 39 Valve spring |
| 2 L-pin | 21 O-ring | 40 Washer |
| 3 Straight pin | 22 O-ring | 41 Inlet valve |
| 4 Roller | 23 Relay piston | 42 Body |
| 5 Pedal cover | 24 Relay piston spring | 43 O-ring |
| 6 Lock nut | 25 O-ring | 44 Retaining ring |
| 7 Set screw | 26 Bushing | 45 Exhaust cover |
| 8 Pedal | 27 Self-locking bolt | 46 Washer |
| 9 Boot | 28 Spring seat | 47 O-ring |
| 10 Plunger | 29 Outer spring | 48 O-ring |
| 11 Plate | 30 Inner spring | 49 Valve retainer |
| 12 Bolt | 31 O-ring | 50 Valve spring |
| 13 Plug | 32 Primary piston | 51 Valve retainer |
| 14 Retaining ring | 33 Spring | 52 Inlet valve |
| 15 Spring | 34 Retaining ring | 53 Cover |
| 16 Screw | 35 Valve retainer | |
| 17 Outer spring | 36 O-ring | |
| 18 Inner spring | 37 O-ring | |
| 19 Washer | 38 Washer | |
- ⊗ : Non-reusable parts

● Assembly sequence

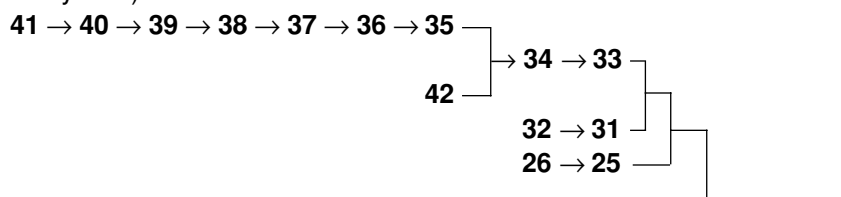
First assemble pedal assembly **A** and valve assembly **B**, then assemble by sandwiching valve board **C** between these two assemblies.

< Pedal assembly **A** >

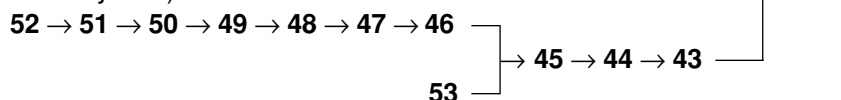


< Valve assembly **B** >

(Primary side)



(Secondary side)



Repair kit : Dual brake valve kit

● Inspection of function after assembly

📖 P35B-47

DUAL BRAKE VALVE

Service standards

Unit : mm {in.}

Location	Maintenance item			Standard value		Limit	Remedy	
1, 3	Outer diameter of straight pin	Roller mounting		9.5 {0.374}		9.44 {0.371}	Replace	
		Pedal mounting		9.5 {0.374}		9.45 {0.372}		
4	Roller	Inner diameter		9.5 {0.374}		9.67 {0.38}	Replace	
		Outer diameter		18.3 {0.72}		18.15 {0.71}		
8	Pedal play	Pedal toe		12 ^{+3.5} ₋₂ {4.7 ^{+0.14} _{-0.079} }		—	Adjust using set screw	
		Depression angle		3.5° ^{+1.0°} _{-0.5°}		—		
10	Outer diameter of plunger			19.9 {0.783}		19.8 {0.780}	Replace	
11	Plate	Inner diameter of straight pin hole		9.5 {0.374}		9.68 {0.381}	Replace	
		Inner diameter of bushing		20 {0.787}		20.08 {0.791}		
15	Spring load (Installed length 12.6 {0.50})			—		215 N {49 lbf, 22 kgf}	Replace	
24	Relay piston spring load (Installed length 12.8 {0.50})			—		47 N {11 lbf, 4.8 kgf}	Replace	
29	Outer spring load (Installed length 26.5 {1.04})			—		215 N {48 lbf, 21.8 kgf}	Replace	
30	Inner spring load (Installed length 19.1 {0.75})			—		60 N {13 lbf, 6.1 kgf}	Replace	
33	Spring load (Installed length 17 {0.67})			—		97 N {22 lbf, 9.9 kgf}	Replace	
39	Valve spring load (Installed length 14.3 {0.56})			—		37 N {8.4 lbf, 3.8 kgf}	Replace	
50	Valve spring load (Installed length 12.9 {0.51})			—		47 N {11 lbf, 4.8 kgf}	Replace	
—	Pressure stroke	Input air pressure 685 kPa {100 psi, 7 kgf/cm ² }	Pedal toe	25.5 {1.00}	Output air pressure	110 ⁺²⁵ ₋₅₄ kPa {16 ^{+3.6} _{-7.8} psi, 1.1 ^{+0.25} _{-0.55} kgf/cm ² }	—	Replace springs
			Depression angle	7.5°		358 ⁺⁷⁰ ₋₁₀₀ kPa {52 ⁺¹⁰ ₋₁₅ psi, 3.7 ^{+0.7} _{-1.0} kgf/cm ² }	—	
			Pedal toe	46 {1.81}	685 kPa {100 psi, 7 kgf/cm ² }			
			Depression angle	13.5°				
			Pedal toe	53 ^{+8.5} _{-1.5} {2.09 ^{+0.33} _{-0.059} }				
			Depression angle	15.5° ^{+2.5°} _{-0.5°}				

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Lock nut	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
12	Bolt (Valve assembly primary and secondary sides assembling)	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
16	Screw	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
20	Sleeve	1.0 to 3.0 {0.7 to 2.2, 0.1 to 0.3}	—
27	Self-locking bolt	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1, 3	Outer periphery of straight pin	High pressure-resistant, high abrasion-resistant grease [NLGI No.2 (Li soap)]	As required
9, 10	Pack between boot and plunger	High pressure-resistant, high abrasion-resistant grease [NLGI No.2 (Li soap)]	1 cm ³ {0.061 cu. in.}
10	Friction surfaces of plunger and other parts	High pressure-resistant, high abrasion-resistant grease [NLGI No.2 (Li soap)]	As required
—	Friction surface and groove of O-ring, friction surfaces of metals	Multipurpose grease [NLGI No.2 (Li soap)]	As required

Special tools

Location	Tool name and shape	Part No.	Application
21	Insert tool	*910-24461	Installation of O-ring
32	Retainer	*910-24590	Holding of primary piston

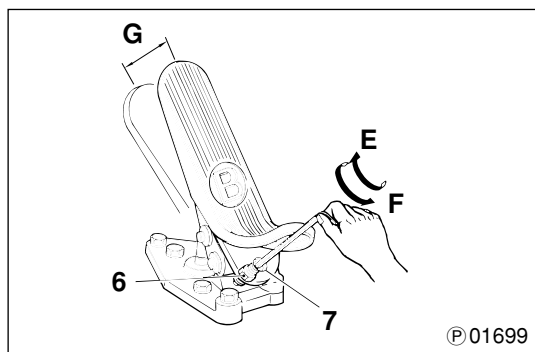
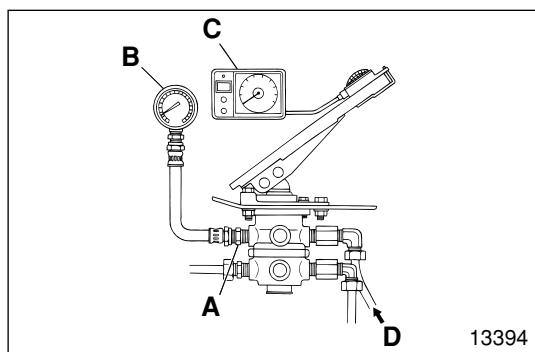
* : BOSCH BRAKING SYSTEMS part No.

◆ Service procedure

● Inspection of function after assembly

Check that the output air pressure, corresponding to the pedal depression angle, conforms to the specified value.

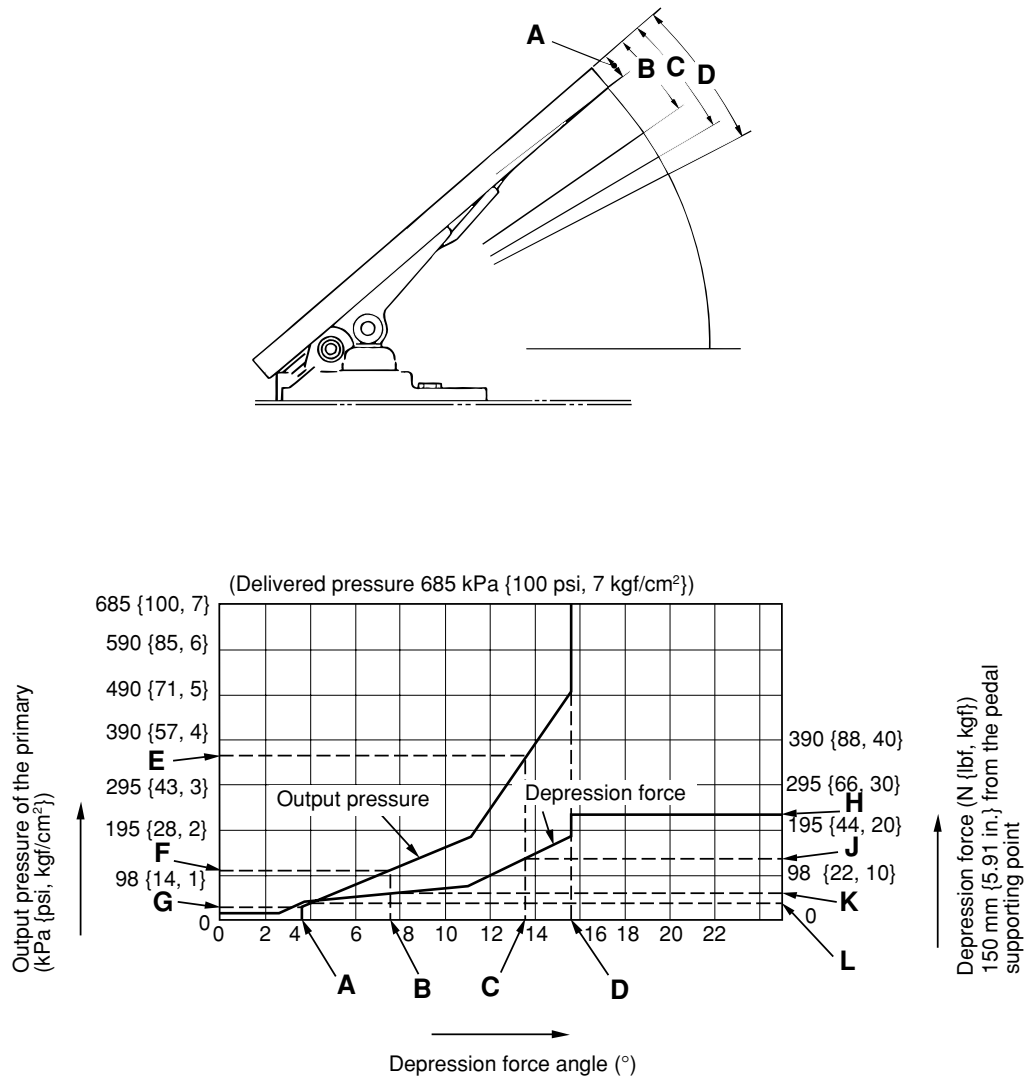
- Mount pressure gauge **B**, capable of measuring 980 kPa {142 psi, 10 kgf/cm²} or more, on primary output side port **A**.
- Mount depression gauge **C** on the brake pedal.
- Apply air pressure of 685 kPa {100 psi, 7 kgf/cm²} to primary input side port **D** and inspect related parts for air leakage.
- If air leakage is found, do the following:
 - Tighten connectors.
 - Disassemble the dual brake valve and inspect the O-ring assemblies of all parts.



- Turn set screw **7** and adjust brake pedal play **G** to the standard value.
- Tighten lock nut **6** at specified torque to lock set screw **7**.
- Read pressure gauge **B** and make sure that the primary output pressure and brake pedal depression force angle, corresponding to the brake pedal depression angle, conform to the standard values shown in the Input/Output characteristic curve diagram overleaf.
- If the output air pressure is lower than the standard value, replace the following springs:
 - Spring **15**
 - Outer spring **29**
 - Inner spring **30**
- E** : Turning clockwise decreases the play (To decrease brake pedal depression angle)
- F** : Turning counterclockwise increases the play (To increase brake pedal depression angle)

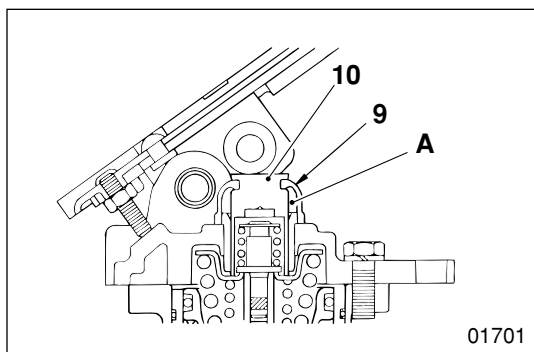
DUAL BRAKE VALVE

Input/Output Characteristic Curve Diagram



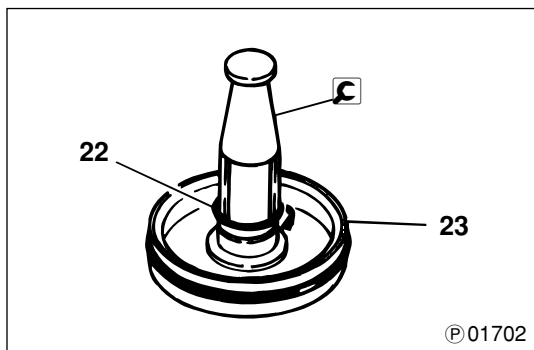
01700

- A : Depression angle (Free play) $3.5^{\circ} \begin{smallmatrix} +1.0^{\circ} \\ -0.5^{\circ} \end{smallmatrix}$ ($12 \begin{smallmatrix} +3.0 \\ -1.5 \end{smallmatrix}$ mm { $0.47 \begin{smallmatrix} +0.12 \\ -0.059 \end{smallmatrix}$ in.})
- B : Depression angle 7.5° (25.5 mm {1.0 in.})
- C : Depression angle 13.5° (45.5 mm {1.8 in.})
- D : Depression angle $15.5^{\circ} \begin{smallmatrix} +2.5^{\circ} \\ -0.5^{\circ} \end{smallmatrix}$ ($52 \begin{smallmatrix} +8.5 \\ -0.5 \end{smallmatrix}$ mm { $2.0 \begin{smallmatrix} +0.33 \\ -0.020 \end{smallmatrix}$ in.})
- E : $358 \begin{smallmatrix} +70 \\ -100 \end{smallmatrix}$ kPa { $52 \begin{smallmatrix} +5.7 \\ -1.4 \end{smallmatrix}$ psi, $3.65 \begin{smallmatrix} +0.4 \\ -1.0 \end{smallmatrix}$ kgf/cm²}
- F : $110 \begin{smallmatrix} +25 \\ -54 \end{smallmatrix}$ kPa { $16 \begin{smallmatrix} +3.6 \\ -7.8 \end{smallmatrix}$ psi, $1.1 \begin{smallmatrix} +0.25 \\ -0.55 \end{smallmatrix}$ kgf/cm²}
- G : 30 kPa {4.4 psi, 0.3 kgf/cm²} or less
- H : 230.5 ± 20 N { 52 ± 4.4 lbf, 23.5 ± 2 kgf}
- J : 132 ± 25 N { 30 ± 5.5 lbf, 13.5 ± 2.5 kgf}
- K : 59 ± 25 N { 13 ± 5.5 lbf, 6 ± 2.5 kgf}
- L : 39 ± 10 N { 8.8 ± 2.2 lbf, 4 ± 1 kgf}

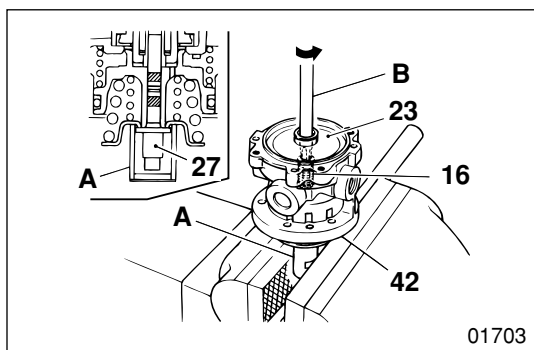


9 10 Packing grease between boot and plunger

Pack area **A** with 1 cm³ {0.061 cu. in.} of grease.



22 Installation of O-ring



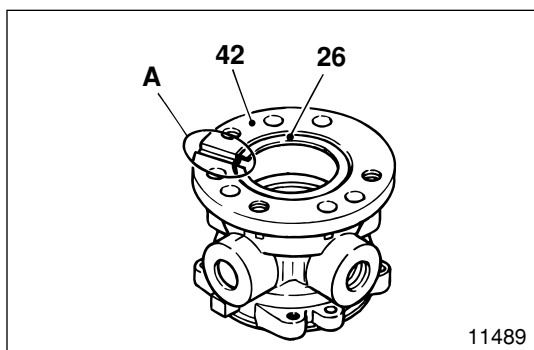
23 Removal of relay piston

- Grip (14 mm {0.55 in.}) socket wrench **A** in a vise.
- Insert the head of self-locking bolt **27** into socket wrench **A** to tighten body **42**.

WARNING

You must be careful when you loosen screw **16**, because the spring in body **42** can forcibly eject relay piston **23**. To avoid this hazard, press down on the relay piston with your hand when you carry out the above work.

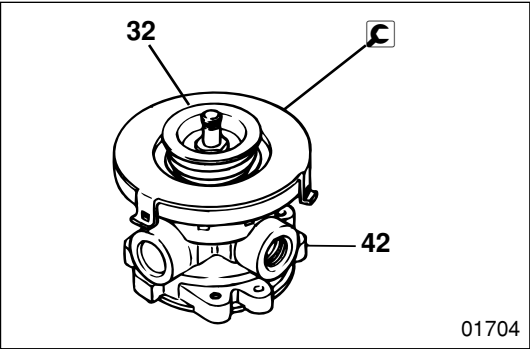
- Loosen screw **16** gradually to remove relay piston **23**.
B : Phillips screwdriver



26 Installation of bushing

A : Indent

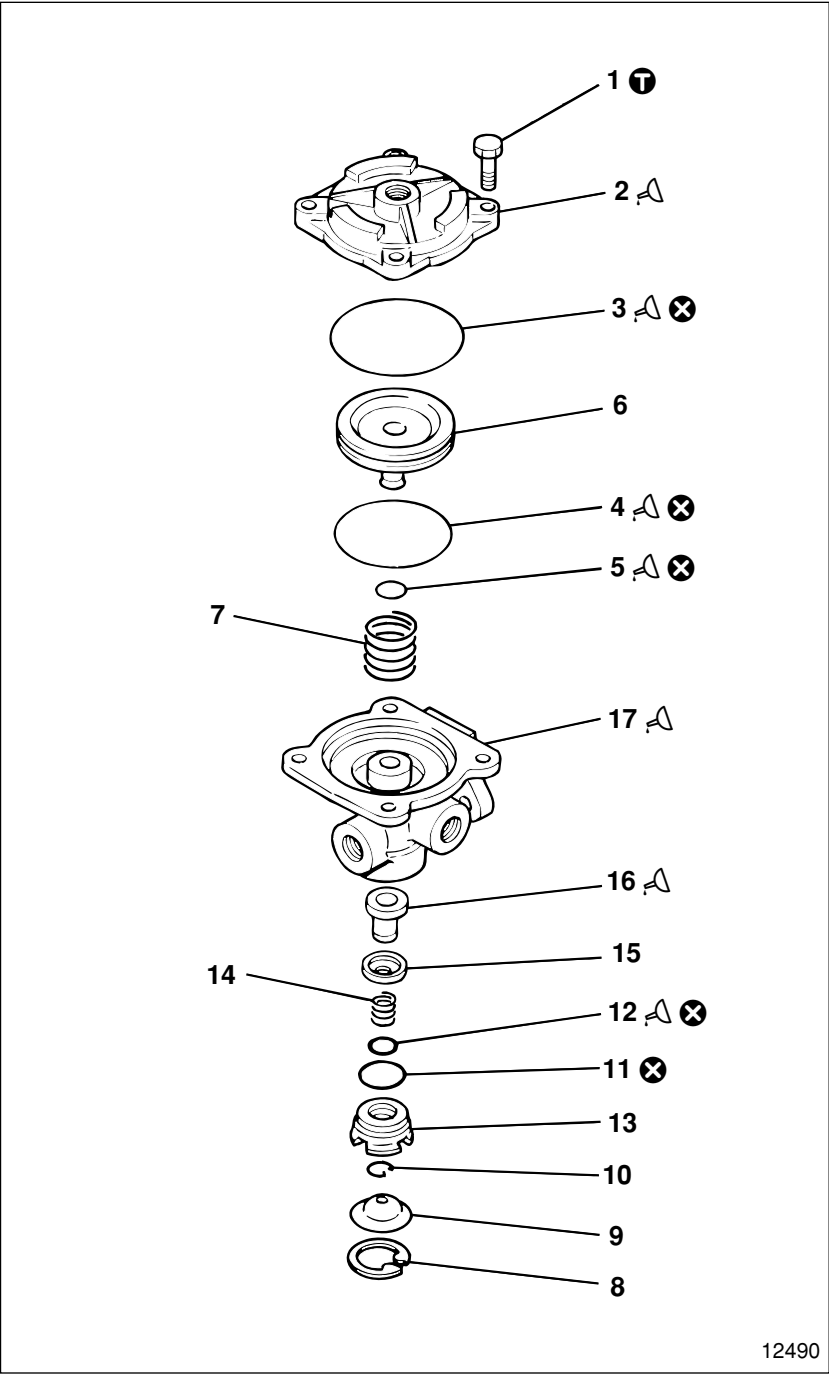
DUAL BRAKE VALVE



32 Removal and installation of primary piston

MEMO

RELAY VALVE



● Disassembly sequence

- 1 Bolt
- 2 Cover
- 3 O-ring
- 4 O-ring
- 5 O-ring
- 6 Relay piston
- 7 Spring
- 8 Retaining ring
- 9 Exhaust cover
- 10 Retaining ring
- 11 O-ring
- 12 O-ring
- 13 Valve guide
- 14 Spring
- 15 Valve retainer
- 16 Inlet valve
- 17 Body

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Relay valve kit

● Inspection after assembly ⓘ P35B-53

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
7	Spring load (Installed length 10.3 {0.41})	16 N {3.6 lbf, 1.65 kgf}	13 N {3.0 lbf, 1.35 kgf}	Replace
14	Spring load (Installed length 15.7 {0.62})	29 N {6.6 lbf, 3.0 kgf}	24 N {5.3 lbf, 2.4 kgf}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Cover and body mounting)	12 to 19 {8.7 to 14, 1.2 to 1.9}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Friction surface of cover and piston	Multipurpose grease [NLGI No.2 (Li soap)]	As required
3, 4, 5, 12	Periphery of O-ring	Multipurpose grease [NLGI No.2 (Li soap)]	As required
16	Friction surface of inlet valve and valve guide	Multipurpose grease [NLGI No.2 (Li soap)]	As required
17	Friction surface of body and piston	Multipurpose grease [NLGI No.2 (Li soap)]	As required

Service procedure

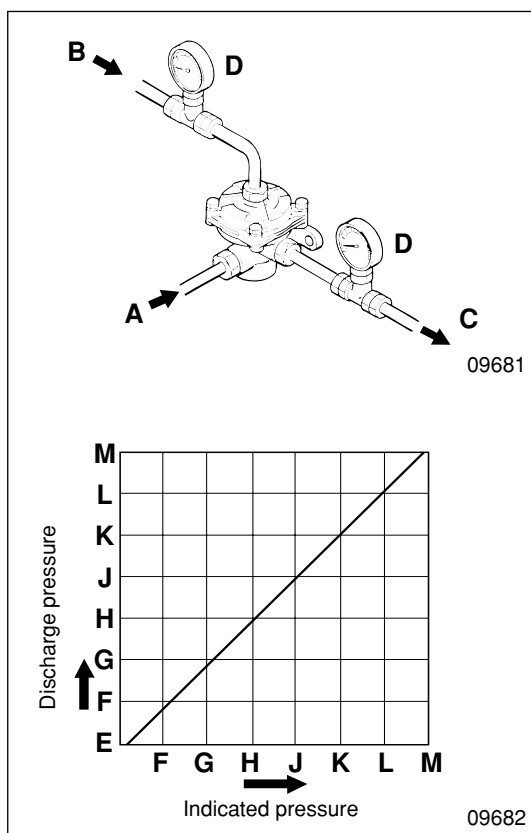
Inspection after assembly

Mount the gauges on the pipes as illustrated. Apply pressurized air to air supply port **A** and indicated pressure port **B**, and measure the difference in operating pressure between the indicated pressure and the discharge pressure.

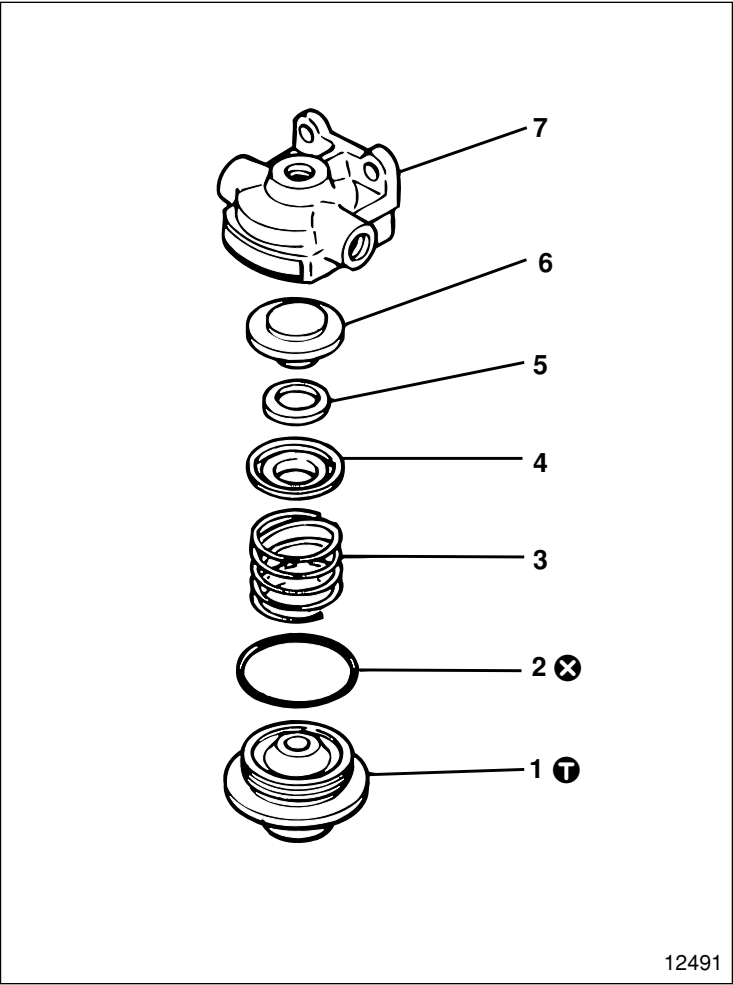
Operational pressure difference : 25 kPa {3.6 psi, 0.25 kgf/cm²}

- C** : Discharge port
- D** : Pressure gauge
- E** : 0 kPa {0 psi, 0 kgf/cm²}
- F** : 98 kPa {14 psi, 1 kgf/cm²}
- G** : 195 kPa {28 psi, 2 kgf/cm²}
- H** : 295 kPa {43 psi, 3 kgf/cm²}
- J** : 390 kPa {57 psi, 4 kgf/cm²}
- K** : 490 kPa {71 psi, 5 kgf/cm²}
- L** : 590 kPa {85 psi, 6 kgf/cm²}
- M** : 685 kPa {100 psi, 7 kgf/cm²}

If any fault is found, replace springs **7, 14**.



QUICK RELEASE VALVE



● **Disassembly sequence**

- 1 Body
- 2 O-ring
- 3 Spring
- 4 Retainer
- 5 Ring
- 6 Diaphragm & ring assembly
- 7 Housing

⊗ : Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit : Quick release valve kit

● **Inspection after assembly**

📖 P35B-55

T **Tightening torque**

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Body	17 to 23 {12 to 17, 1.7 to 2.3}	—

◆ Service procedure

● Inspection after assembly

Mount the gauge on the pipe as illustrated. Apply pressurized air from air supply port **A** gradually. Make sure that air flows out discharge port **B** when the applied air pressure reaches the operating starting pressure.

Operational starting pressure : 9.8 ± 4.9 kPa { 1.4 ± 0.7 psi, 0.15 ± 0.05 kgf/cm²}

C : Pressure gauge

D : Operating starting pressure point

E : 0 kPa {0 psi, 0 kgf/cm²}

F : 98 kPa {14 psi, 1 kgf/cm²}

G : 195 kPa {28 psi, 2 kgf/cm²}

H : 295 kPa {43 psi, 3 kgf/cm²}

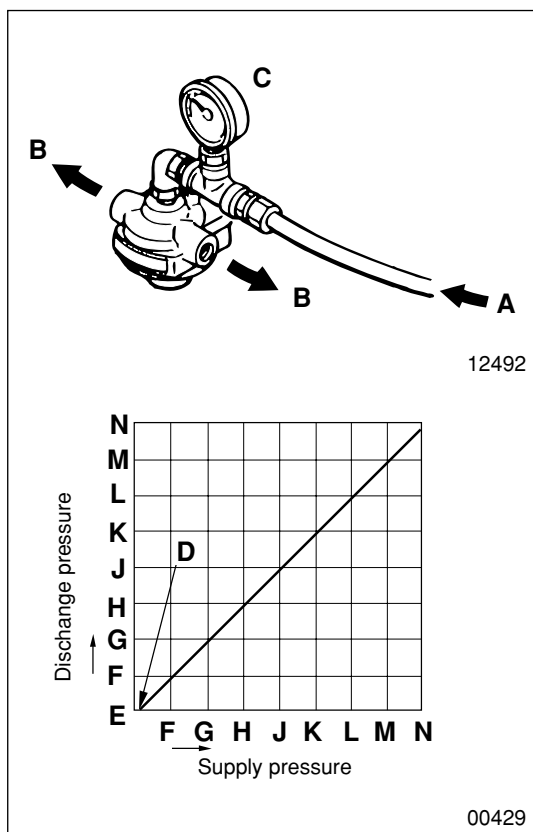
J : 390 kPa {57 psi, 4 kgf/cm²}

K : 490 kPa {71 psi, 5 kgf/cm²}

L : 590 kPa {85 psi, 6 kgf/cm²}

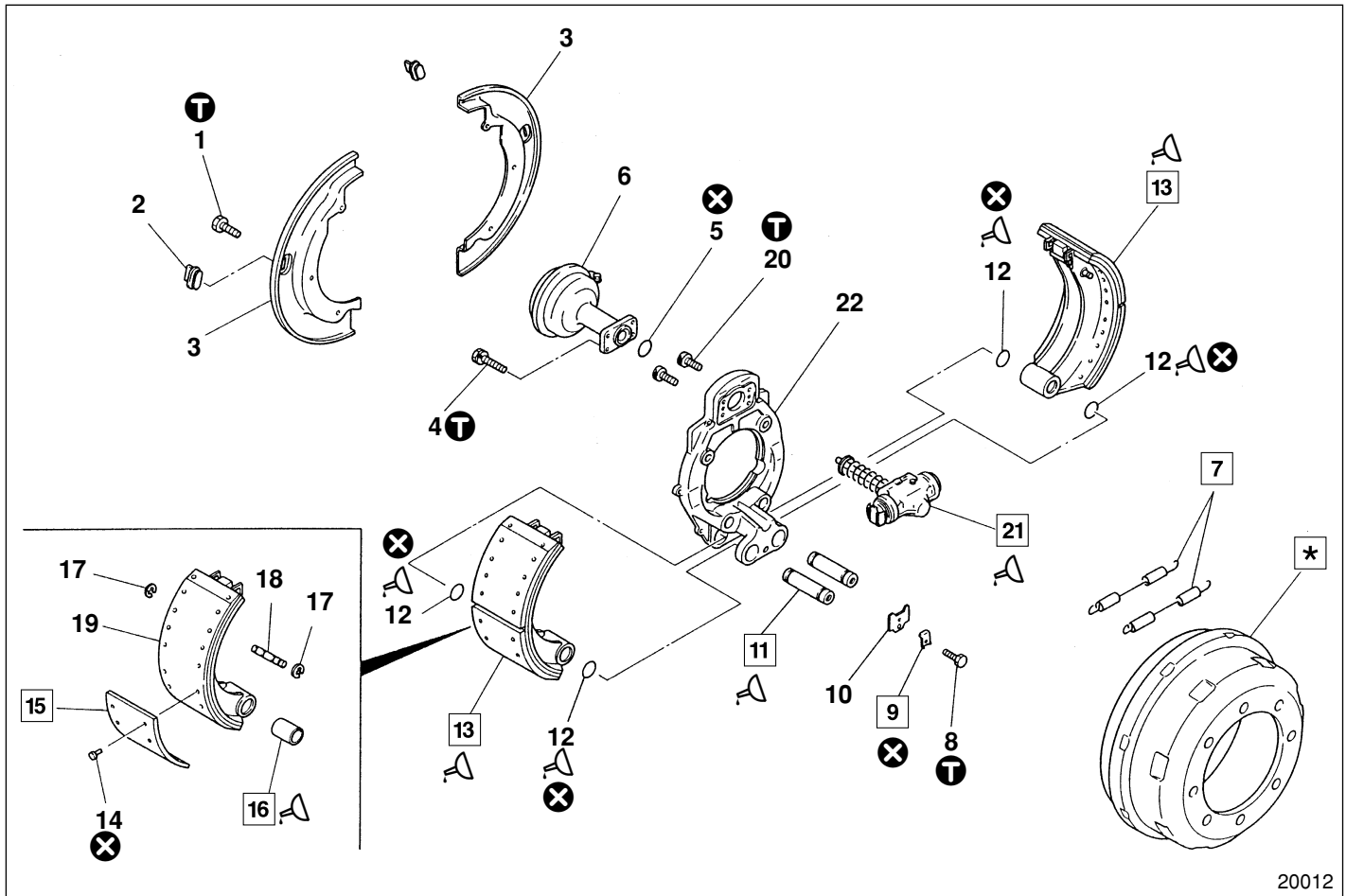
M : 685 kPa {100 psi, 7 kgf/cm²}

N : 785 kPa {115 psi, 8 kgf/cm²}



FRONT WHEEL BRAKE

Front Drum Brake Assembly



20012

● Disassembly sequence

- | | | |
|--------------------------|------------------------|------------------------|
| 1 Bolt | 10 Lock plate | 20 Screw |
| 2 Check hall plug | 11 Anchor Pin | 21 Expander assembly |
| 3 Dust cover | 12 O-ring | P35B-76 |
| 4 Bolt | 13 Brake shoe assembly | 22 Anchor bracket |
| 5 O-ring | 14 Rivet | |
| 6 Brake chamber assembly | 15 Brake lining | * : Brake drum |
| P35B-64 | 16 Bush | Gr 26 |
| 7 Return spring | 17 Snap ring | X : Non-reusable parts |
| 8 Bolt | 18 Pin | |
| 9 Lock washer | 19 Brake shoe | |

WARNING

Do not adhere oil and fat to the surface of brake lining 15 of brake shoe assembly 13 and the inside surface * of the brake drum, which may cause the malfunctioning of the brake.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: brake lining kit

● Work after assembly

 P35B-58

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])		Limit	Remedy
7	Load of return spring (installation length: 258{10})	292±29 N {66±21 lbf, 29.8±3.0 kgf}		Space must exist between coils, and between coils and cover.	Replace
11, 16	Space between anchor pin and bush	[35] 0.05 to 0.14 {[1.38] 0.0020 to 0.0055}		0.3 {0.012}	Replace bush
15	Thickness of brake lining	16 {0.63}		6 {0.24} (side stagger is wear limit).	Replace brake lining
*	Brake drum	Inside diameter	410 {16.1} (*1) 412 {16.2}	414 {16.3}	Replace
		Cylindrical degree	0.05 {0.0020}		0.2 {0.0079} Correct

(*1) Indicating the repair limit value

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (installation of dust cover)	20±3.9 {15±2.9, 2±0.4}	—
4	Bolt (installation of brake chamber assembly)	50±7.5 {37±5.1, 5.1±0.7}	—
6	Release bolt for brake chamber assembly, Release nut used when being stored	14.7 to 20.0 {10 to 15, 1.4 to 2.0}	—
8	Bolt (installation of lock plate)	20.0±3.9 {15±2.9, 2.0±0.4}	—
20	Screw (installation of expander assembly)	19.0±4.9 {14±3.6, 1.9±0.5}	—

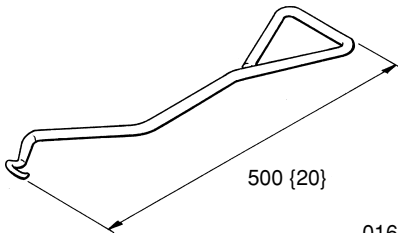
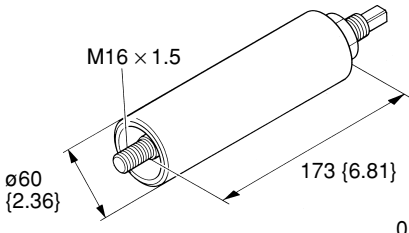
L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
11	Grease groove of anchor pin	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
12	O-ring	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
13, 21	Contact surface of brake shoe assembly and expander assembly	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
16	Inside surface of bush	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
21	Wedge tip of expander assembly	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
	Wedge insertion part of expander assembly	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	10 g {22 lb}

FRONT WHEEL BRAKE

 Special tools

Unit : mm {in.}

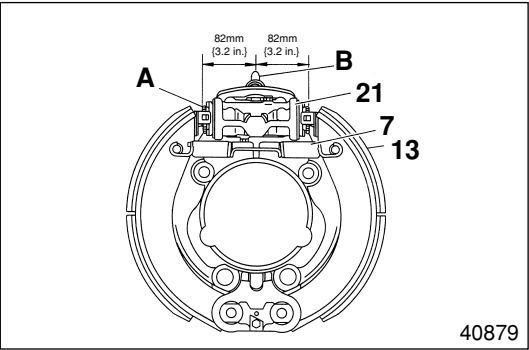
Location	Tool name and shape	Part No.	Application
7	Return spring setter  500 {20} 01610	MC809749	Remove return spring
11	Anchor pin puller  M16 × 1.5 ø60 {2.36} 173 {6.81} 01611	03727-60000	Remove anchor

◆ **Service procedure**

● **Work after assembly**

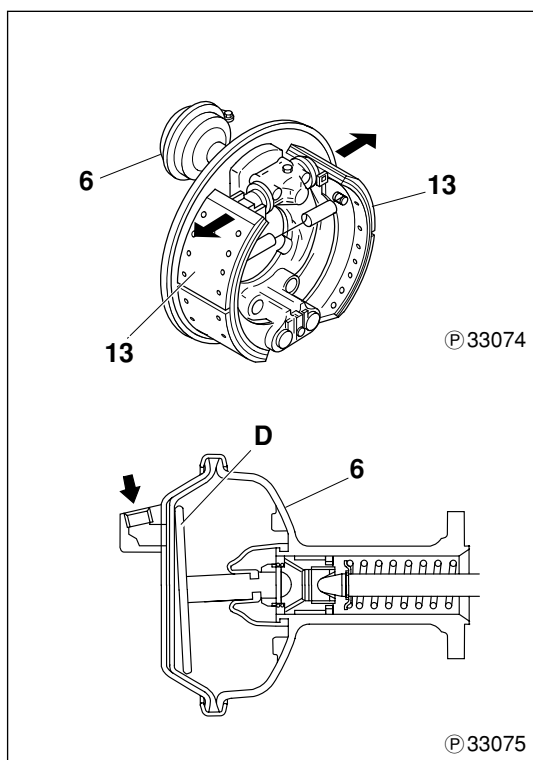
(1) **Check for operation**

- Confirm whether the installation dimension of expander assembly **21** is 82 mm {3.2 in.}.
If it is incorrect, reconfirm it according to the following procedure.
- Set the part indicated in Figure to 82 mm {3.2 in.} by adjusting the adjusting screw **A**.
- Expand brake shoe assembly **13** under a full stroke by pushing bush rod **B**.
- Confirm whether expander assembly **21** returns to 82 mm {3.2 in.} when returning push rod **B**.
- If it is incorrect, inspect again spring force of return spring **7**, tightening of brake shoe assembly **13**, and expander assembly **21**.



WARNING

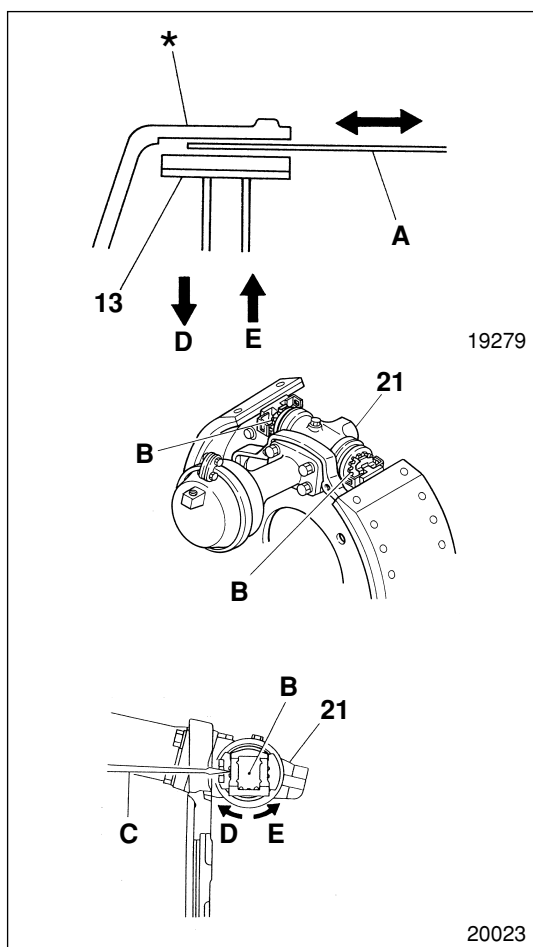
The auto adjustment mechanism may not operate normally unless it is surely confirmed whether the mechanism is properly operated after having assembled it.



- When disassembling brake chamber assembly 6, inspect the following.

< When disassembling brake chamber assembly 6 >

- Confirm whether brake shoe assembly 13 does not move with the adjusting screw C of expander assembly 21 when pulling the brake shoe assembly 13 with a force of 20 to 30 N {4.4 to 6.6 lbf, 2 to 3 kgf}.
- If brake shoe assembly 13 moves, push rod and pressure plate D of brake chamber assembly 6 are diagonally installed; therefore, correct the push rod and the pressure plate to a regular position by depressing brake pedal 2 to 3 times with not installing brake drum.



(2) Initial adjustment of brake shoe clearance after assembly

< When not replacing brake lining 15 with the new one >

- Remove dust cover 3.
- Turn adjusting screw B of expander assembly 21 to the extent that the thickness gauge A of 0.3 to 0.5 mm {0.012 to 0.02 in.} can be easily pulled in and out at the check hall of the 2-points/one wheel.

C : Minus driver

D : Increasing brake shoe clearance

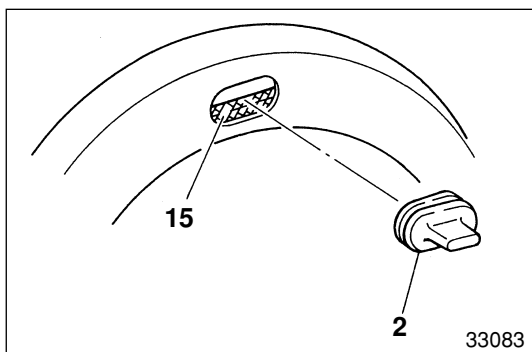
E : Decreasing brake shoe clearance

- Install dust cover 3

CAUTION ⚠

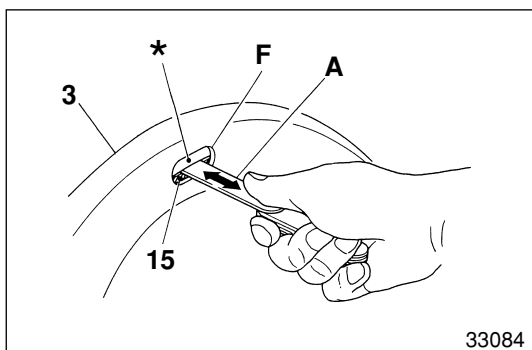
Do not damage the boot of expander assembly 21 when inserting minus driver C.

FRONT WHEEL BRAKE

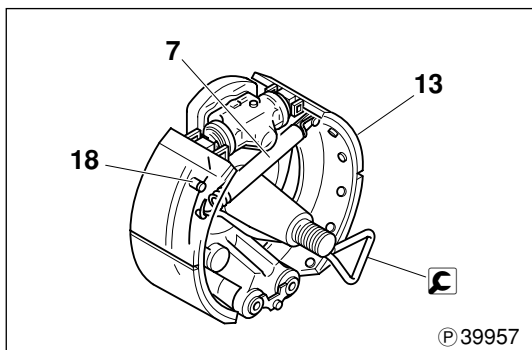


< When replacing brake lining 15 with the new one >

- Adjust expander assembly 21.
P35B-61
- Start the engine after having assembled brake drum *, and confirm whether brake air pressure is sufficient.
- Operate auto adjuster by fully depressing brake pedal ten times.
- Remove check hall plug 2.



- Insert thickness gauge A into the check hall F of dust cover 3, and confirm whether brake shoe clearance is 0.4 to 1.0 mm {0.016 to 0.039 in.}, as well as 0.3 mm {0.012 in.} or less in the right and left difference.
- In case the clearance is not in a scope of 0.4 to 1.0 mm {0.016 to 0.039 in.}, adjust it as required.



7 Return spring

[Removal]

- Remove the return spring with hanging the return spring setter on the hook of return spring 7.

WARNING

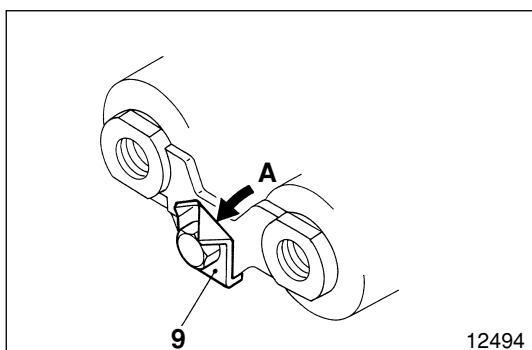
Do not hang return spring setter on the sliding area of oil seal.

[Installation]

- Hang one hook of return spring 7 on the pin 18 of brake shoe assembly 13.
- Hang another hook on return spring setter, and install it while pressing against pin 18.

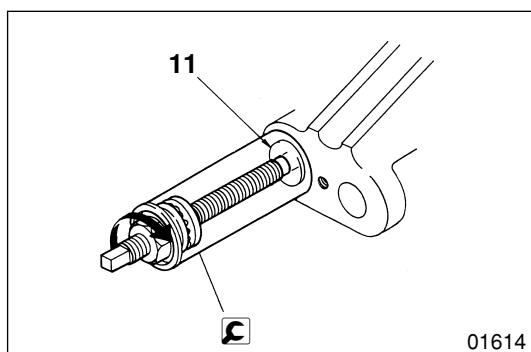
WARNING

Do not hang return spring setter on the sliding area of oil seal.



9 Installation of lock washer

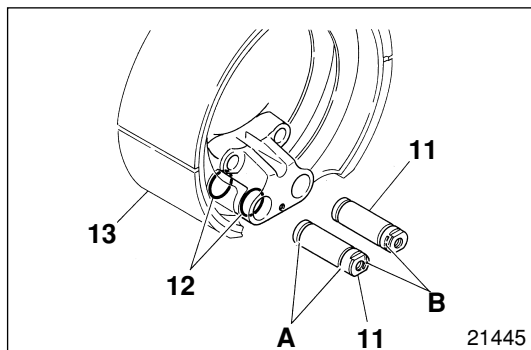
A : Bend



11 Anchor pin

[Removal]

: Anchor pin puller

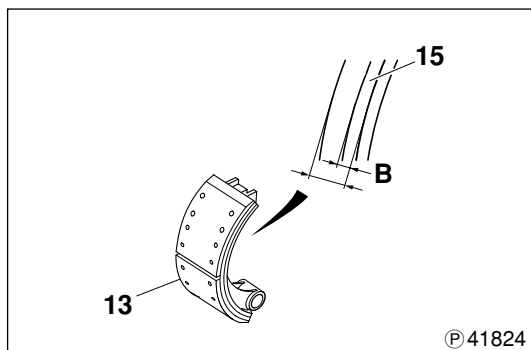


[Installation]

- Apply grease on the grease groove **A** of anchor pin **11**.
- Install anchor pin **11** in the direction shown in Figure.
- B** : Groove installing lock plate

CAUTION

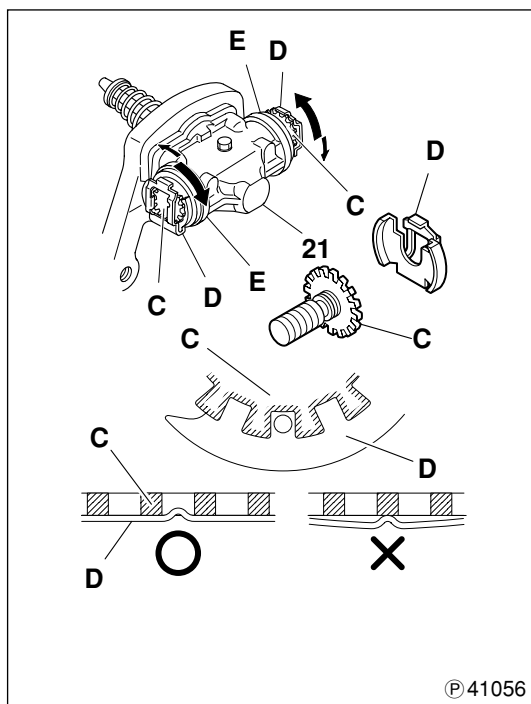
If anchor pin **11** is installed in the wrong direction of the anchor pin, O-ring **12** will be damaged; therefore, be sure to mount it as required.



13 Brake shoe assembly

[Inspection]

If the thickness **A** of brake lining **15** reaches below the limit **B**, replace the brake lining by every one axis.



[Installation]

- Turn adjusting screw **C** of expander assembly **21** fully clockwise by hand.
(Return of a screwing portion of adjusting screw)
- Confirm whether the open part of clip **D** is in the drum side; if it is not in the drum side, turn adjusting screw **C** further clockwise to match the position. (This rotation is due to the rotation of sleeve assembly)

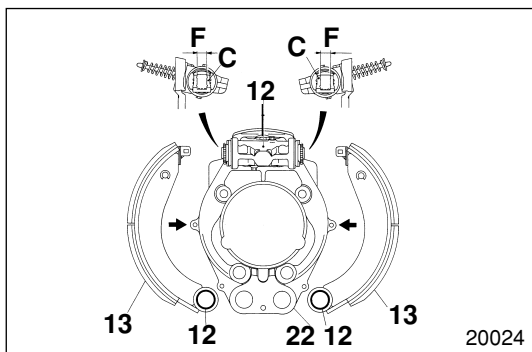
WARNING

- Be sure to apply grease appropriately on the contact part of adjusting screw **C** in boot **E**; otherwise auto adjuster may be caused the malfunctioning due to breakage of boot.

CAUTION

- Turn it slowly so that boot **E** may not be jammed.
- Be sure to keep the convex part of clip **D** between teeth of adjusting screw **C** (2 points).
- Take care whether clip **D** is misaligned, and return adjusting screw **C** anticlockwise by two revolutions. (Only if the lining is replaced.)

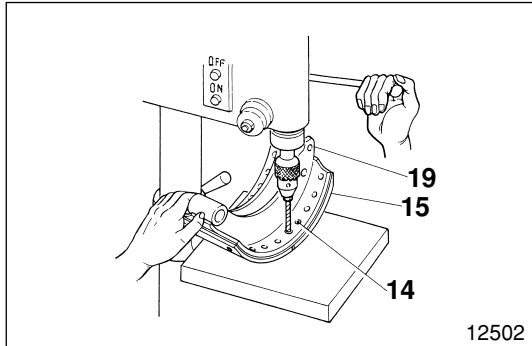
FRONT WHEEL BRAKE



- Install brake shoe assembly **13** so that it may surely enter into the two-sided width **F** of clip **C**.

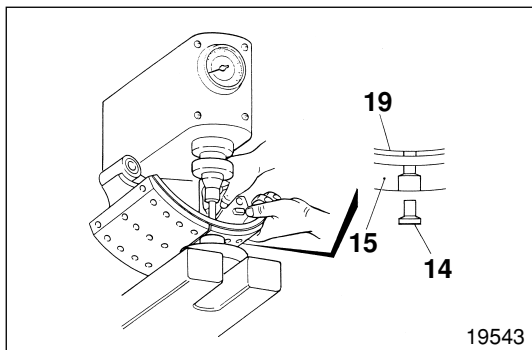
CAUTION

When installing brake shoe assembly **13**, do not damage clip **C** and O-ring **12**.



15 Brake lining

[Removal]

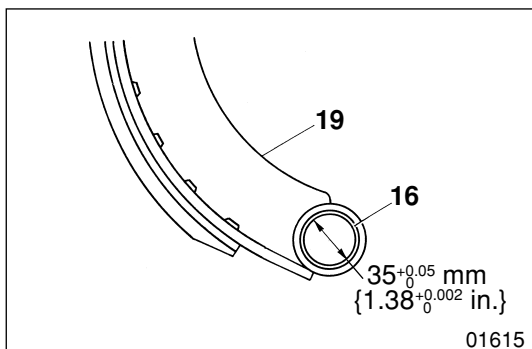


[Installation]

- Wash a surface installing the brake lining **15** of brake shoe **19** with washings, and then dry it.
- Insert rivet **14** from brake lining **15**, and stake the rivet in sequence from the center to both ends.
- Put a staking load of rivet **14** as 19.61 ± 0.98 kN { 4410 ± 2200 lbf, 2000 ± 1000 kgf}.
- Caulk the rivet so that clearance between brake shoe **19** and brake lining **15** will be 0.05 mm { 0.0020 in.} or less around the rivet **14** hole of $\phi 20$ mm { 0.79 in.} and 0.2 mm { 0.0079 in.} or less in other areas.
- Inspect how brake drum ***** and brake lining **15** touches: correct any faulty points if they are found. Such correction must be performed in a state that the brake has been assembled.

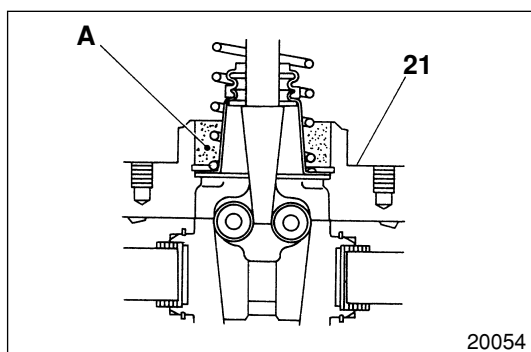
WARNING

- Be sure to replace brake lining **15** by every one axis since the lining may cause the one-sided braking.
- Do not adhere oil and fat to the brake lining **15**, which may cause the malfunctioning of braking.

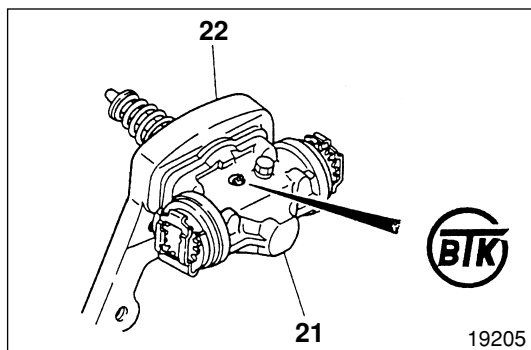


16 Installation of bush

- Install bush **16** on brake shoe **19**.
- Measure the inside diameter of bush **16**.
- If the inside diameter is not $35^{+0.05}_0$ mm { $1.38^{+0.002}_0$ in.}; align it with the same required dimensions, or $35^{+0.05}_0$ mm { $1.38^{+0.002}_0$ in.} by drilling it with reamer.

**21 Installation of expander assembly**

- Fill the grease of the specified amount in **A** part of expander assembly **21**.



- Install expander assembly **21** on anchor bracket **22** in the direction shown in Figure.

*** Correction of brake drum**

If the cylindrical degree of brake drum ***** exceeds the limit, or has seams; cut them to the specified limit as one body with wheel hub.

Exploded view diagram of a door handle assembly. The diagram shows the following components and their assembly sequence:

- 1**: Door plate with a torque symbol (T) indicating tightening.
- 2**: Lock cylinder pin.
- 3**: Lock cylinder housing.
- 4**: Lock cylinder with a warning symbol (X).
- 5**: Lock cylinder pin with a warning symbol (X).
- 6**: Spindle with a warning symbol (X).
- 7**: Washer.
- 8**: Washer.
- 9**: Screw with a warning symbol (X).
- 10**: Screw with a warning symbol (X).
- 11**: Screw with a warning symbol (X).
- 12**: Screw with a warning symbol (X).
- 13**: Door handle.

● Work before disassembly

● Disassembly sequence

- ⊗ : Non-reusable parts

Do not damage the seat surface of diaphragm 5 of pressure plate 4 and base 13 when removing clamp ring 3, which may cause air leakage.

Follow the disassembly sequence in reverse.

WARNING ⚠

35B-64

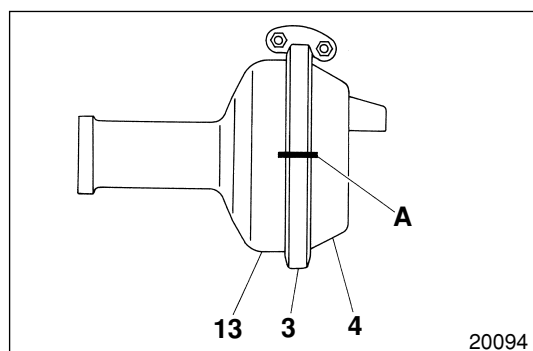
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut	14.7 to 20.0 {11 to 14, 1.5 to 2.0}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7 to 12	Each contact surface	Multipurpose grease [NLGI No.2 (Li soap)]	As required
13	Internal circumference of the base	Multipurpose grease [NLGI No.2 (Li soap)]	As required



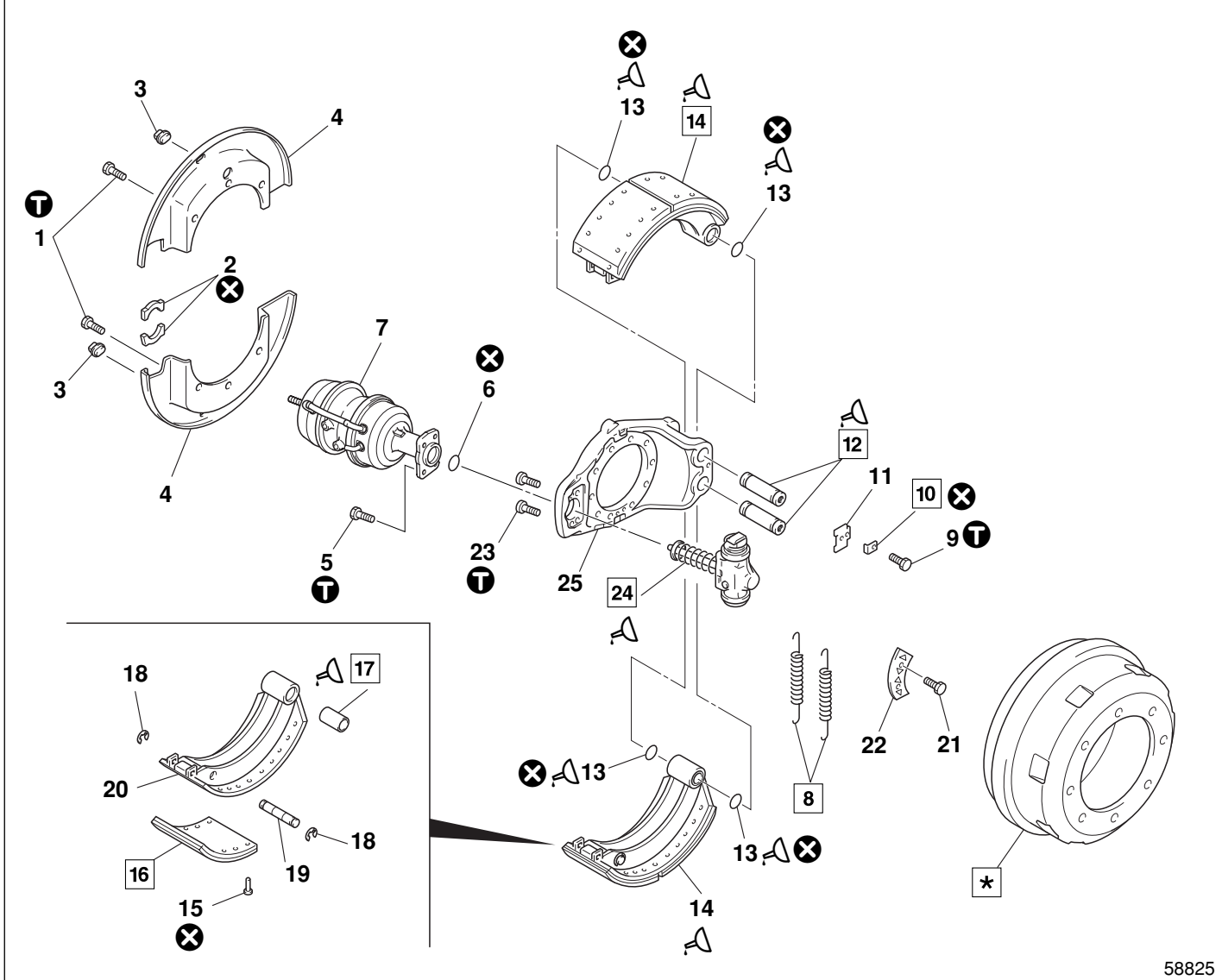
Service procedure

Work before assembly

A : Counter mark

CAUTION

Be sure to match counter mark A when assembling, and install clamp ring 3, pressure plate 4, and base 13.



- **Work before disassembly**

 P35B-68

● Disassembly sequence

- | | | |
|---|-------------------------------|---|
| 1 Bolt | 11 Lock plate | 22 Stopper Plate |
| 2 Seal | 12 Anchor pin | 23 Screw |
| 3 Check hole plug | 13 O-ring | 24 Expander assembly |
| 4 Dust cover | 14 Brake shoe assembly |  P35B-76 |
| 5 Bolt | 15 Rivet | 25 Anchor bracket |
| 6 O-ring | 16 Brake lining | |
| 7 Brake chamber assembly | 17 Bushing | * : Brake drum |
|  P35B-74 | 18 Snap ring |  Gr27 |
| 8 Return spring | 19 Pin | ⊗ : Non-reusable parts |
| 9 Bolt | 20 Brake shoe | |
| 10 Lock washer | 21 Bolt | |

WARNING ⚠

Do not apply oil or grease to the surface of brake lining 16 of brake shoe assembly 14 and the inside surface of brake drum *, which may cause a malfunction of the braking system.

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Repair kit: brake lining kit

● **Work after assembly**

📖 P35B-69

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])		Limit	Remedy
8	Load of return spring (installation length: 258 {10})		292 N {66 lbf, 29.8 kgf}		Space must exist between coils, and between coils and cover.	Replace
12, 17	Space between anchor pin and bushing		[35] 0.05 to 0.14 [[1.38] 0.0020 to 0.0055]		0.3 {0.012}	Replace bush
16	Thickness of brake lining		16 {0.63}		6 {0.24} (side stagger is wear limit).	Replace brake lining
*	Brake drum	Inside diameter	410 {16.1}	(★1) 412 {16.2}	414 {16.3}	Replace
		Cylindrical degree	0.05 {0.0020}		0.2 {0.0079}	Correct

(★1) Indicating the repair limit value

T **Tightening torque**

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Installation of dust cover)	19.6±3.9 {14±2.9, 2±0.4}	—
5	Bolt (Installation of brake chamber assembly)	44.1±7.8 {33±5.8, 4.5±0.8}	—
7	Release bolt for brake chamber assembly, Release nut used when being stored	14.7 to 20.0 {10 to 15, 1.4 to 2.0}	—
9	Bolt (Installation of lock plate)	19.6±3.9 {14±2.9, 2±0.4}	—
23	Screw (Installation of expander assembly)	18.6±4.9 {14±3.6, 1.9±0.5}	—

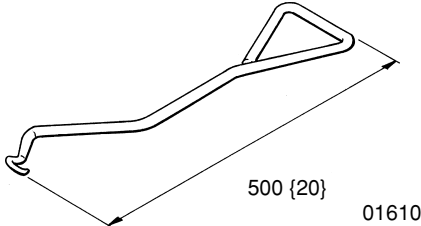
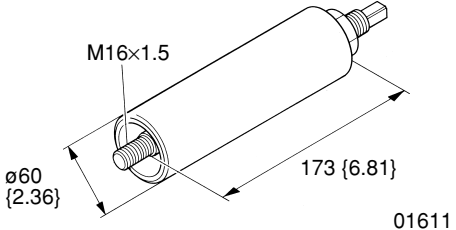
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
12	Grease groove of anchor pin	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
13	O-ring	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
14, 24	Contact surface of brake shoe assembly and expander assembly	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
17	Inside surface of bushing	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
24	Wedge tip of expander assembly	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	As required
	Wedge insertion part of expander assembly	Shell Darina Grease 2 [NLGI No.2 (Non soap)]	10 g {22 lb}

REAR WHEEL BRAKE

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
8	Return spring setter  500 {20} 01610	03727-15001	Remove return spring
12	Anchor pin puller  M16×1.5 ø60 {2.36} 173 {6.81} 01611	03727-60000	Remove anchor pin

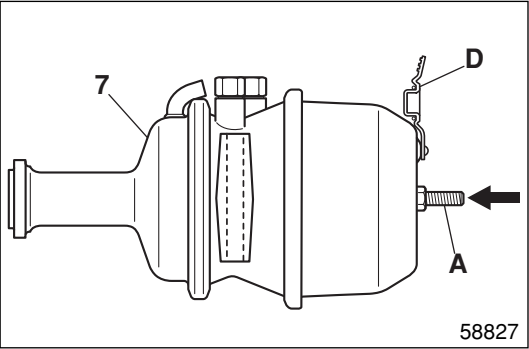
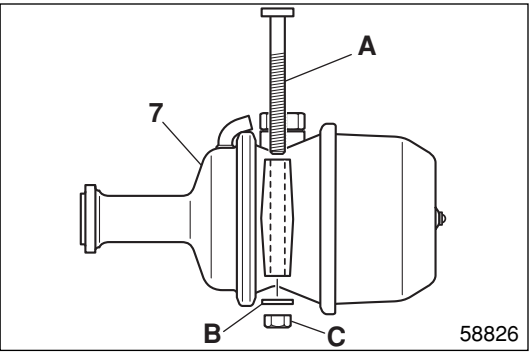
Service procedure

Work before disassembly

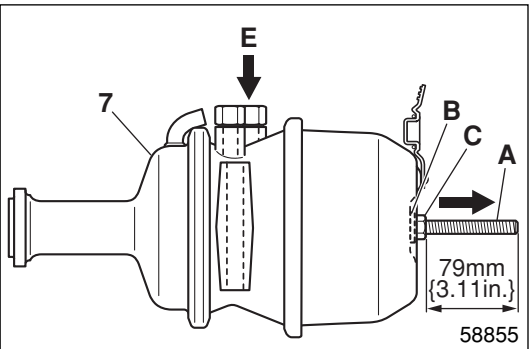
Release of spring brake

Release the spring brake by mechanical release.

- Remove the release bolt **A**, the washer **B**, and the release nut **C** from brake chamber assembly **7**.



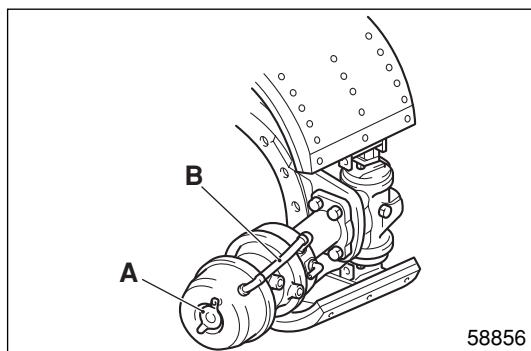
- Remove end cap **D**.
- Insert the release bolt **A** into the inner part, and turn it one quarter (1/4) turn.
- Pull up the release bolt **A**, and confirm that the release bolt does not come off.
- In case the release bolt **A** comes off, insert the release bolt again into the inner part, and turn it one quarter (1/4) turn.



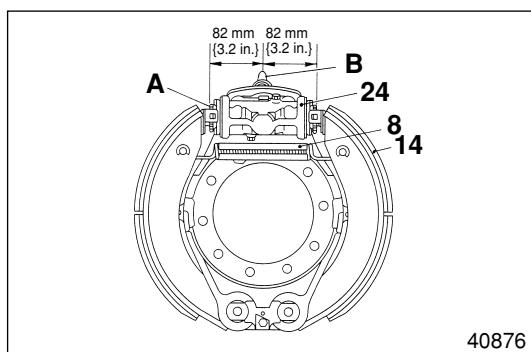
- Install the washer **B** and the release Nut **C**.
- Turn the release nut **C**, and draw out the screw of release bolt **A** by 79 mm {3.1 in.}, while applying air pressure of 640 kPa {92 psi, 6.5 kgf/cm²} to spring brake port **E**, while setting the hand control valve to the release position.

CAUTION

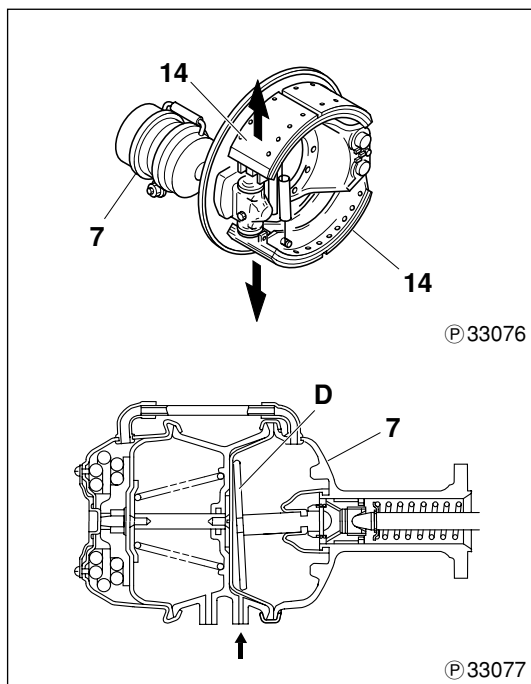
- Do not turn the release nut **C** by a strong torque; (68.6 N·m {51 ft.lbs, 7 kgf·m} or more): because brake chamber assembly **6** may be damaged if turning it by such a strong torque.
- Use air pressure **E** so that the release nut **C** may be easily turned.



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P 33076

P 33077

● Work after assembly

(1) Release of spring brake

Follow the work sequence before disassembly in reverse to release the mechanical release of spring brake. P35B-68

NOTE

- Confirm that end cap A is surely installed.
- Confirm that there is no damage in bleeder pipe B. Also, confirm that the bleeder pipe is surely installed.

(2) Confirmation of operation

- Confirm that the installation dimension of expander assembly 24 is 82 mm {3.2 in.}.
- If it is incorrect, reconfirm it according to the following procedure.
- Set the part indicated in Figure to 82 mm {3.2 in.} by adjusting the adjusting screw A.
- Expand the brake shoe assembly 14 under a full stroke by pushing push rod B.
- Confirm that expander assembly 24 returns to 82 mm {3.2 in.} when returning the push rod B.
- If it operates incorrectly, inspect the spring force of return spring 8, inactivation of brake shoe assembly 14, and expander assembly 24 again.

WARNING ⚠

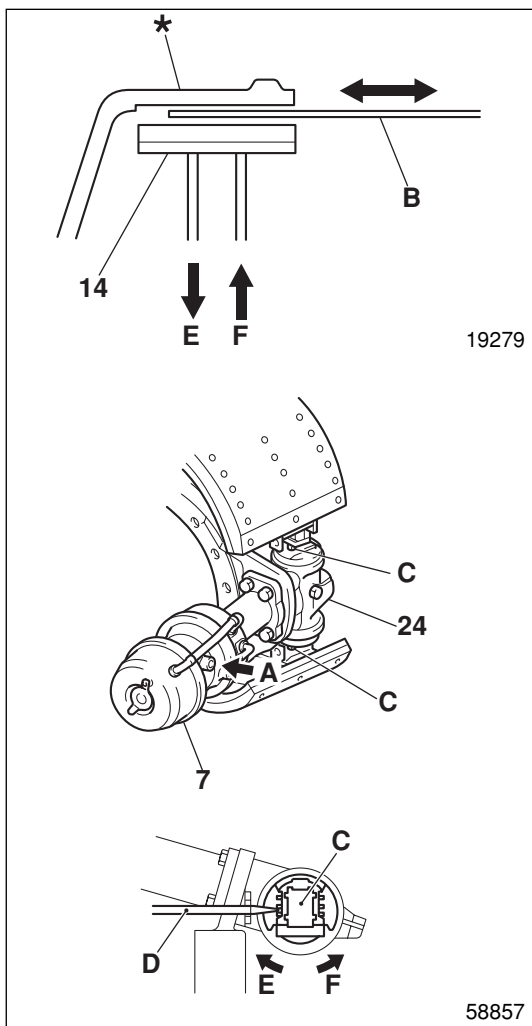
The auto adjustment mechanism might not operate normally if the assembly work is not surely executed.

- When disassembling brake chamber assembly 7, inspect the following.

< When disassembling brake chamber assembly 7 >

- Confirm that brake shoe assembly 14 does not move with the adjusting screw C of expander assembly 24 when pulling the brake shoe assembly with a force of 20 to 30 N {4.4 to 6.6 lbf, 2 to 3 kgf}.
- If brake shoe assembly 14 moves, push rod and pressure plate D of brake chamber assembly 7 are diagonally installed; therefore, correct the push rod and the pressure plate to a regular position by depressing brake pedal 2 to 3 times with not installing brake drum *.

REAR WHEEL BRAKE



(2) Initial adjustment of brake shoe clearance

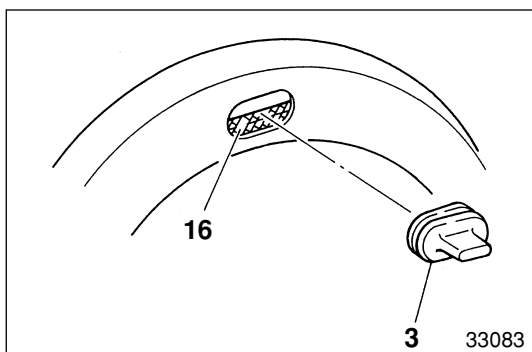
< When not replacing brake lining 16 with the new one >

- Remove dust cover 4.
- Apply air pressure of 640 kPa {92 psi, 6.5kgf/cm²} on the spring brake air supply port **A** of brake chamber assembly **7** (thereby putting the hand control valve to the release position), and then release the spring brake.
- Turn adjusting screw **C** of expander assembly **24** until a feeler gauge **B** of 0.4 mm {0.016 in.} can be easily pulled in and out at the inspection hole of each shoe.
D : Screw driver
E : Increasing brake shoe clearance
F : Decreasing brake shoe clearance

- Install dust cover 4.

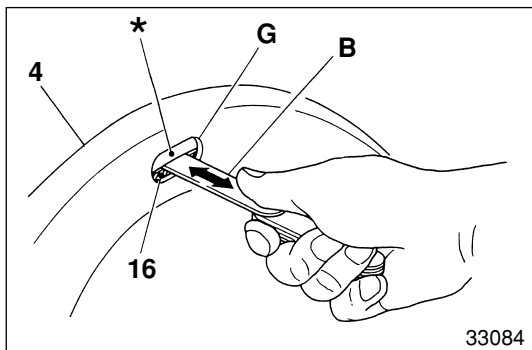
CAUTION ⚠

Do not damage the boot of expander assembly 24 when inserting screw driver D.

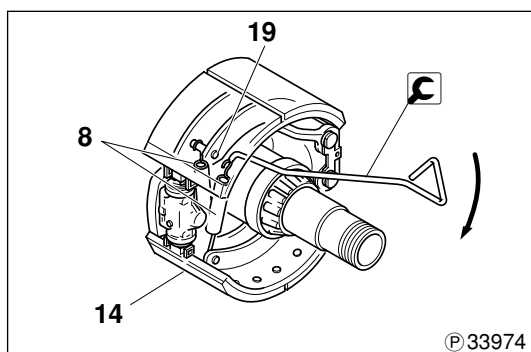


< When replacing brake lining 16 with the new one >

- Adjust expander assembly 24. P35B-72
- Start the engine after having assembled brake drum *, and confirm whether brake air pressure is sufficient.
- Operate auto adjuster by fully depressing brake pedal ten times.
- Remove check hole plug 3.



- Insert feeler gauge **B** into check hole **G** of dust cover **4**, and confirm whether brake shoe clearance is 0.4 to 1.0 mm {0.016 to 0.039 in.}, as well as 0.3 mm {0.012 in.} or less in the right and left difference.
- If the clearance is not 0.4 to 1.0 mm {0.016 to 0.039 in.}, adjust it again.



8 Return spring

[Removal]

- Remove the return spring with the return spring setter as shown.

WARNING

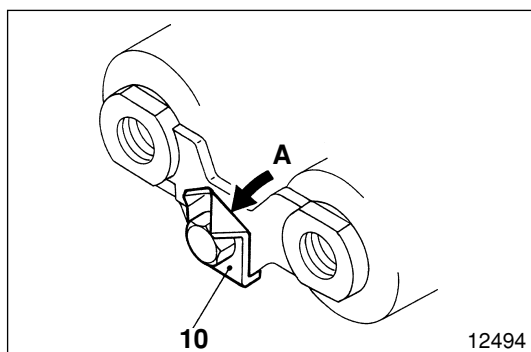
Do not allow the return spring setter to contact the mating surface of oil seal.

[Installation]

- Attach one hook of return spring 8 on the pin 19 of brake shoe assembly 14.
- Attach the other hook on the return spring setter, and install it while pressing against pin 19.

WARNING

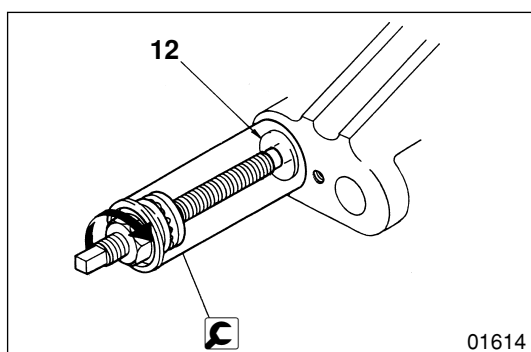
Do not hang the return spring setter on the sliding area of oil seal.



10 Installation of lock washer

A : Bend

- After installing the lock washer, bend the tab over the bolt head as shown in the figure on the left.

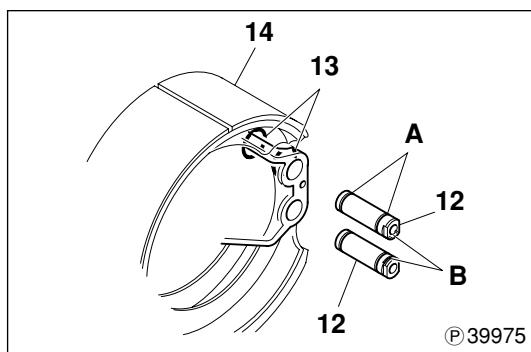


12 Anchor pin

[Removal]

: Anchor pin puller

- Remove the anchor pin using anchor pin puller as shown in the figure on the left.



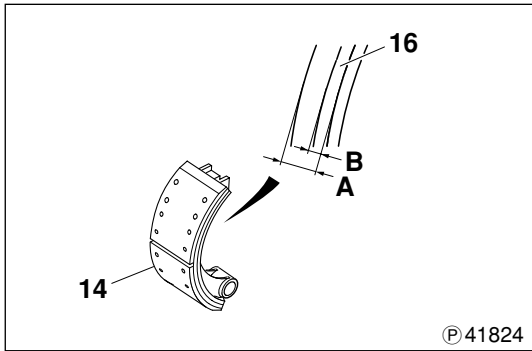
[Installation]

- Apply grease in the grease grooves A of anchor pin 12.
- Install anchor pin 12 in the direction shown in Figure.
- B : Groove installing lock plate

CAUTION

If anchor pin 12 is installed in the wrong direction of the anchor pin, O-ring 13 will be damaged; therefore, be sure to install it as required.

REAR WHEEL BRAKE



14 Brake shoe assembly

[Inspection]

If the thickness **A** of brake lining **16** reaches below the limit **B**, replace the brake lining by every one axis.

[Installation]

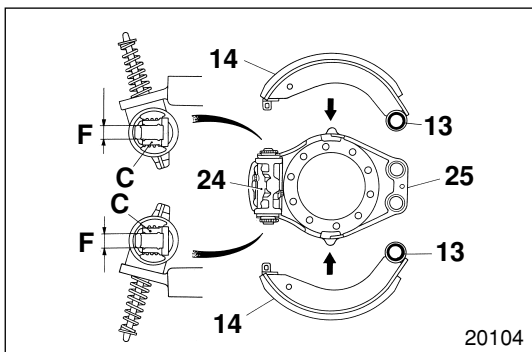
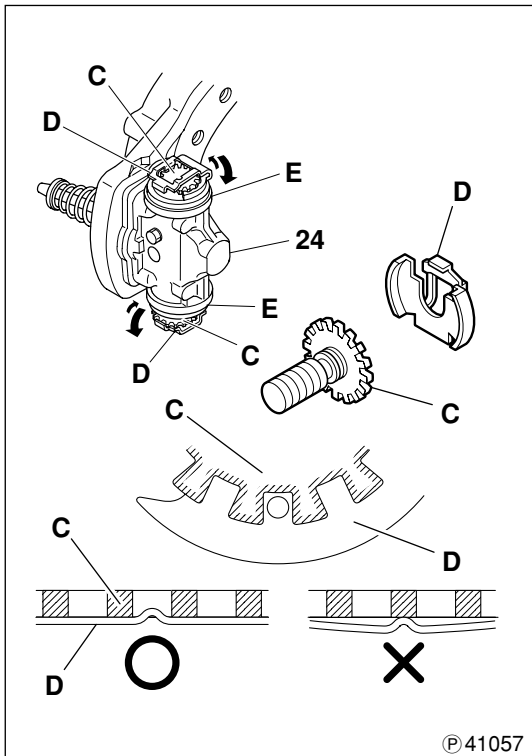
- Turn adjusting screw **C** of expander assembly **24** fully clockwise by hand.
- Install clip **D** with the open side facing the drum. Turn adjusting screw **C** further clockwise to match the position if alignment is incorrect.

WARNING ⚠

Be sure to apply grease as required on the contact part of adjusting screw **C** in boot **E**; otherwise the auto adjuster may malfunction due to breakage of boot.

CAUTION ⚠

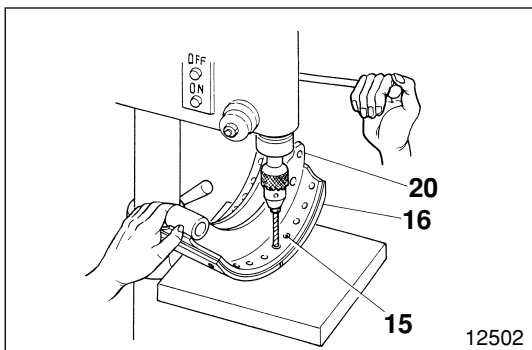
- Turn it slowly so that boot **E** is not jammed.
 - Be sure to keep the convex part of clip **D** between teeth of adjusting screw **C** (2 points).
- If clip **D** is misaligned, rotate adjusting screw **C** counterclockwise by two revolutions to center of clip.



- Install brake shoe assembly **14** so that it securely enters into the two-sided width **F** of clip **C**.

CAUTION ⚠

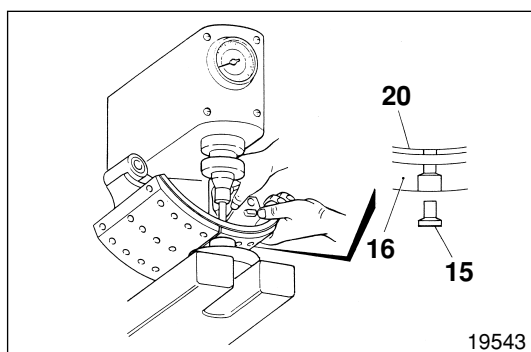
When installing brake shoe assembly **14**, do not damage clip **C** and O-ring **13**.



16 Brake lining

[Removal]

- Remove the rivets **15** by drilling, taking care not to damage the brake shoe **20**. Then, remove the brake lining **16**.

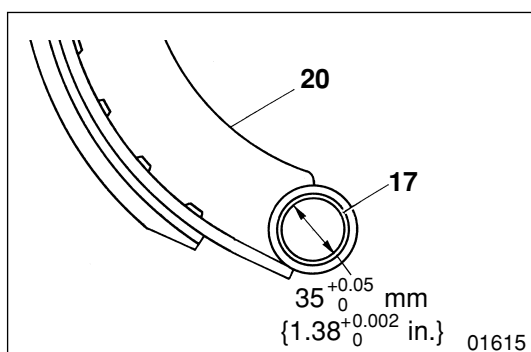


[Installation]

- Clean the surface of the brake lining **16** and brake shoe **20**.
- Insert rivet **15** through brake lining **16**, and stake the rivet in sequence from the center to both ends.
- Stake the rivet **15** with a load of 19.61 ± 0.98 kN {4410 $\pm$ 220 lbf, 2000 $\pm$ 100 kgf}.
- Caulk the rivet so that clearance between brake shoe **20** and brake lining **16** will be 0.05 mm {0.0020 in.} or less around the rivet **15** hole of ϕ 20 mm {0.79 in.} and 0.2 mm {0.0079 in.} or less in other areas.
- Inspect brake drum ***** to brake lining **16** contact: correct any faulty points if they are found. Such correction must be performed in a state that the brake has been assembled.

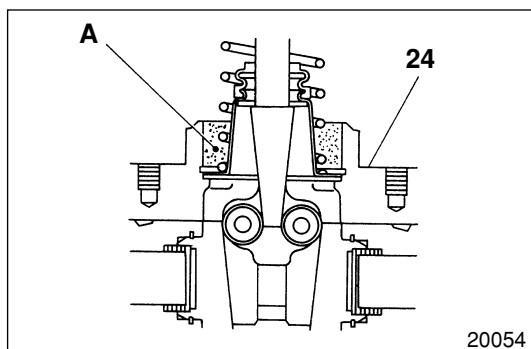
WARNING ⚠

- Be sure to replace brake lining **16** to prevent uneven braking.
- Do not apply oil or grease to the brake lining **16**, which may cause the malfunctioning of braking system.



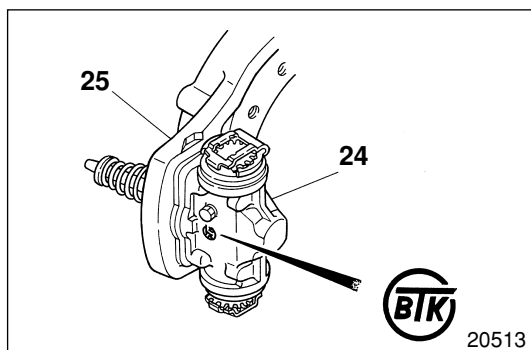
17 Installation of bushing

- Install bushing **17** on brake shoe **20**.
- Measure the inside diameter of bushing **17**.
- If the inside diameter is not $35^{+0.05}_0$ mm { $1.38^{+0.002}_0$ in.}; correct by reaming to specification.



24 Installation of expander assembly

- Fill the grease of the specified amount in **A** part of expander assembly **24**.



- Install expander assembly **24** on anchor bracket **25** in the direction shown in Figure.

***** Correction of brake drum

If the taper of brake drum ***** exceeds the limit, or has deep grooves, cut them to the specified limit.

 P35B-75 P35B-75

- | | | | | | |
|----------|------------|-----------|-------------------|-----------|------------|
| 1 | Nut | 7 | Diaphragm | 13 | Dust cover |
| 2 | Bolt | 8 | Push rod assembly | 14 | Push plate |
| 3 | Clamp ring | 9 | Pin | 15 | Base |
| 4 | Elbow A | 10 | Ring | | |
| 5 | Elbow B | 10 | Bush | | |
| 6 | Piggy back | 12 | Push rod guide | | |
- ⊗** : Non-reusable parts

WARNING

Make sure not to disassemble piggy back 6 since its built-in spring with a very strong spring force may cause a very dangerous result.

CAUTION

When removing clamp ring 3, do not damage piggy back 6 and the seat surface of diaphragm 7 of base 15, which may cause air leakage.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: chamber kit

WARNING **Do not use this product if you are pregnant or breastfeeding, or if you are taking any medication. Consult your doctor before use.**

Do not apply oil and grease to diaphragm 7 so that the diaphragm may not come off.

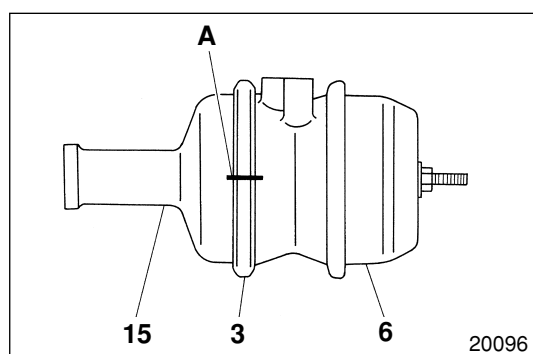
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut	14.7 to 20.0 {11 to 14, 1.5 to 2.0}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Installation surface of nylon tube	LOCKTITE 414	As required
9 to 14	Each contact surface	Multipurpose grease [NLGI No.2 (Li soap)]	As required
15	Internal circumference of the base	Multipurpose grease [NLGI No.2 (Li soap)]	As required



Service procedure

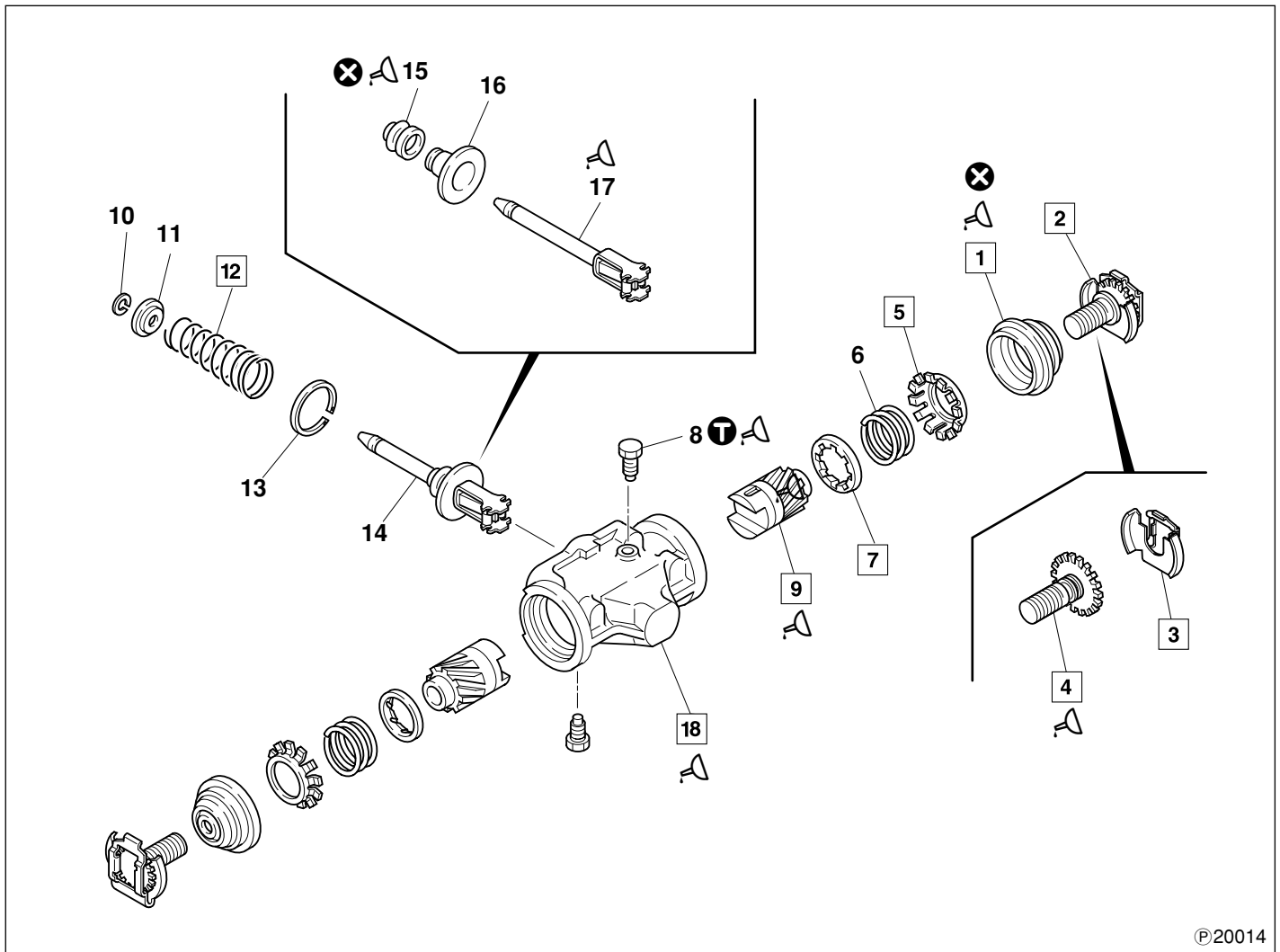
Work before assembly

A : Alignment mark

CAUTION

Be sure to match alignment mark A when assembling, and install clamp ring 3, piggy back 6 and base 15.

EXPANDER ASSEMBLY



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● Disassembly sequence

- | | | |
|----------------------------|-------------------|---------------------------|
| 1 Boot | 8 Screw | 15 Wedge boot |
| 2 Adjusting screw assembly | 9 Sleeve assembly | 16 Cap assembly |
| 3 Clip | 10 Snap ring | 17 Wedge, cage and roller |
| 4 Adjusting screw | 11 Retainer | 18 Housing |
| 5 Spring cage | 12 Spring | |
| 6 Spring | 13 Snap ring | ⊗ : Non-reusable parts |
| 7 Drive ring | 14 Wedge assembly | |

● Assembly sequence

(18→14→13→12→11→10→9→8→7→6→5)→(4→1)→3

2: The number is missing in the assembly sequence since the adjusting screw is not used for the assembly.

14 : 16→15→17

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Clip holding torque	1.5 to 5.0 N·m {1.1 to 3.6 ft.lbs, 0.15 to 0.5 kgf·m}	—	Replace
6	Load of spring (installation length 11.3 {0.44})	83.4 N {19 lbf, 8.5 kgf}	73.6 N {17 lbf, 7.5 kgf} or less	Replace
12	Load of spring (installation length 105.8 {4.17})	147 N {33 lbf, 15 kgf}	132.3 N {30 lbf, 13.5 kgf} or less	Replace
4, 9	Rotation between adjusting screw and sleeve assembly	To be rotated smoothly	—	Replace
7, 9	Backlash between drive ring and sleeve assembly	2.9 to 3.4 {0.11 to 0.13}	—	Replace
9	Rotating torque of sleeve assembly	Clockwise	0.6 N·m {0.4 ft.lbs, 0.06 kgf·m} or less	Replace
		Counterclockwise	2.0 N·m {1.4 ft.lbs, 0.20 kgf·m} or less	Replace
9, 17	Dent on roller-rotation-moving surface of sleeve assembly and wedge, cage & roller	—	0.010 {0.0004} or less	Replace
17	Roller appearance of wedge, cage & roller	No damage allowed	—	Replace
18	Wear of inside bore of housing	ø38.1 to 38.2 {1.5}	Wear to be 0.030 {0.0012} or less	Replace
—	Application force of auto adjustment mechanism of expander assembly (pushing-back force of sleeve assembly)	147 N {33 lbf, 15 kgf} or less	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8	Screw	15±3 {11±2.2, 1.5±0.3}	—

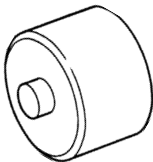
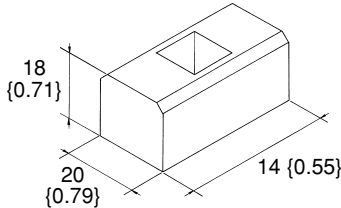
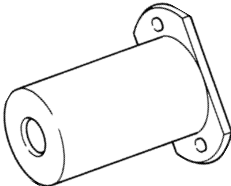
Lubricant and/or sealant

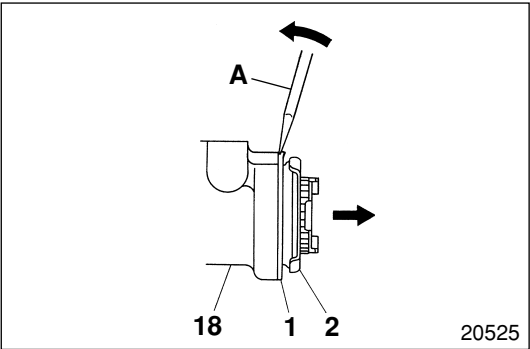
Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Contact part of the adjusting screw of boot	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
4	Screw of the adjusting screw	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
8	Screw of screw	LOCTITE 202 or THREEBOND 2415	As required
9	Outer of screw assembly, screw, and contact part of roller	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Wedge boot, and contact surface of wedge, cage & roller	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
17	Inside surface of bushing	Wheel bearing grease [NLGI No.2 (Li soap)]	2 g {0.07 oz}
18	Inside surface of housing	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
	Inside surface of housing	Wheel bearing grease [NLGI No.2 (Li soap)]	8 g {0.282 lb}

EXPANDER ASSEMBLY

 Special tools

Unit : mm {in.}

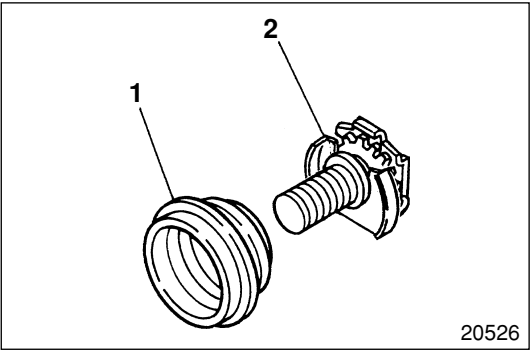
Location	Tool name and shape	Part No.	Application
1	Boot setterr 	MC889862 19000	Install boot
2, 9	Clip adaptor 	MC889860 19111	Measure holding torque of clip and rotating torque of sleeve assembly
12	Spring holder 	MC889861 18999	Remove spring



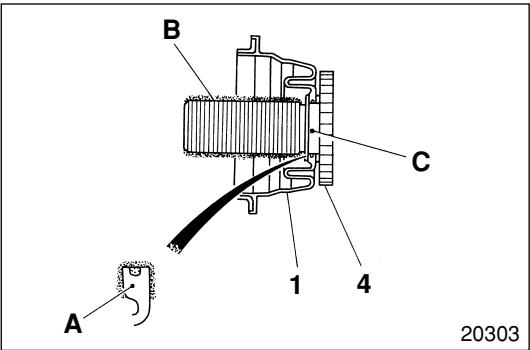
◆ Service procedure

1 2 Removal of boot and adjusting screw assembly

- Remove the boot **1** from the housing **18** with screw driver **A**.
- Remove adjusting screw assembly **2** and boot **1** by turning the adjusting screw assembly counterclockwise.

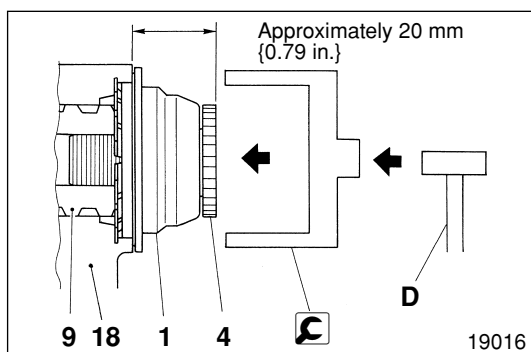


- Remove boot **1** from adjusting screw assembly **2**.

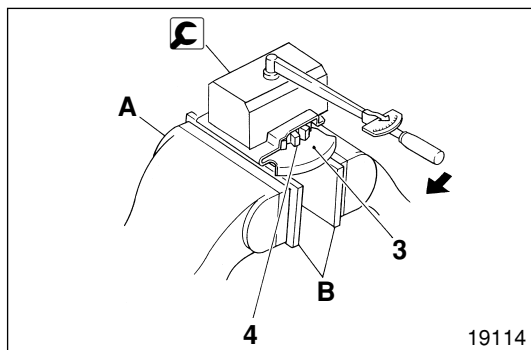


1 4 Installation of boot and adjusting screw

- Apply grease on the contact part **A** of adjusting screw **4** of boot **1** and the threads **B** of the adjusting screw.
- Install boot **1** in groove **C** of adjusting screw **4**.



- Thread adjusting screw 4 into the sleeve assembly 9 until the adjusting screw reaches a distance of approximately 20 mm {0.79 in.} from the housing 18.
- Confirm that sleeve assembly 9 slides by pulling adjusting screw 4 lightly.
- Press boot 1 fit with C boot installer.
D : Plastic hammer



2 Inspection of clip-holding torque of adjusting screw assembly

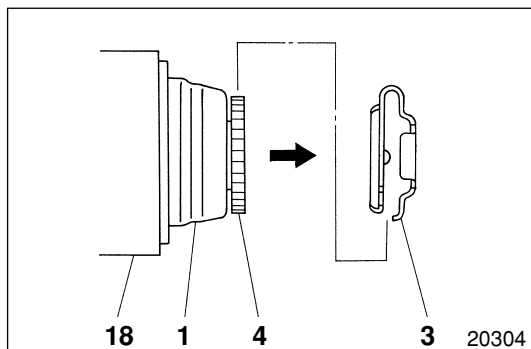
- Fix adjusting screw 4 with vise A.
B : Buffer (jaw protectors.)

CAUTION

Use buffer B such as jaw protectors so as not to give damage to adjusting screw 4.

Also, the auto adjustment mechanism will not operate when the threaded part of the adjusting screw is damaged.

- Install C clip adaptor
- The holding torque is a value indicated when clip 3 has begun to turn.
- Replace clip 3 if the measurement value comes off from the standard value.

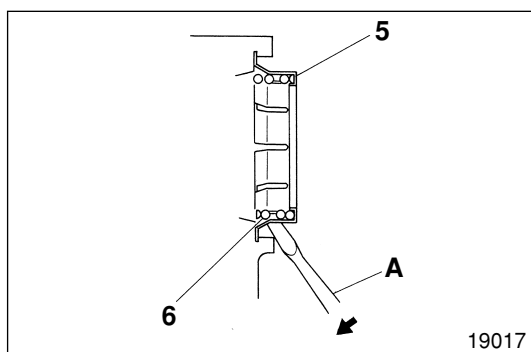


3 Installation of clip

- To install the clip 3 on adjusting screw 4, extend the adjusting screw out to the extent that it does not come in contact with boot 1.
- Install clip 3.

CAUTION

Do not damage boot 1 when installing clip 3.



5 Spring cage

[Removal]

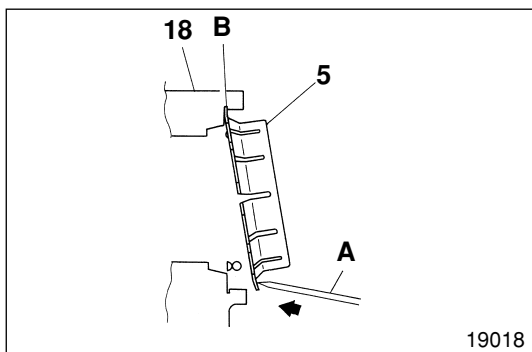
Remove spring cage 5 with holding it by hand so that spring 6 may not pop out.

A : Screw driver

WARNING

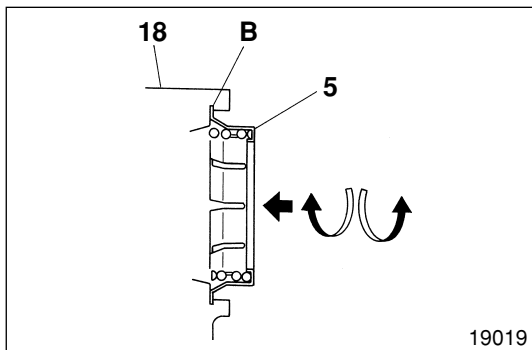
Take care that spring 6 may pop out.

EXPANDER ASSEMBLY

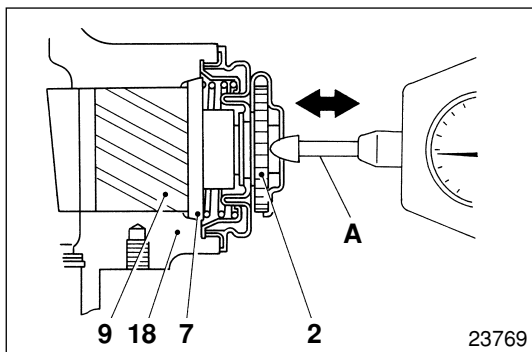


[Installation]

- Fit the one side of spring cage 5 into groove B of housing 18.
- Push the other side of spring cage 5 with screw driver A.



- To check the spring cage 5 for proper installation into the groove of housing 18, push in on the spring cage while rotating the cage. It should rotate smoothly.

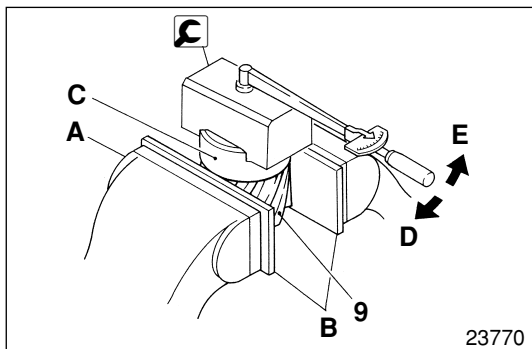


7 9 Inspection of backlash between drive ring and sleeve assembly

- Measure the backlash between drive ring 7 and sleeve assembly 9 with a dial indicator A while moving the adjusting screw assembly 2 in the direction of the arrow.
- If the measured value is out of specification, replace drive ring 7 and sleeve assembly 9.

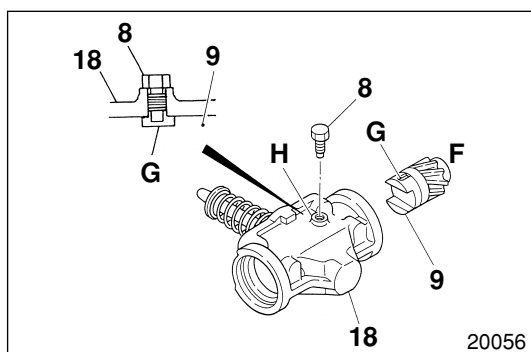
CAUTION ⚠

Measure the backlash with care so that drive ring 7 may not separate from housing 18 with being pushed by sleeve assembly 9.



[Inspection]

- Fix sleeve assembly 9 with vise A.
- B : Buffer (jaw protectors)
- Install clip adaptor.
- Measure the torque at the time when tappet C begins to rotate.
- D : Clockwise
- E : Counterclockwise
- If the measured value is out of specification, replace sleeve assembly 9.



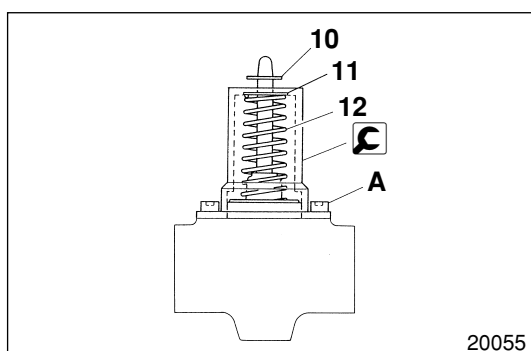
9 Sleeve assembly

[Installation]

- Install sleeve assembly 9 by aligning the identification groove **F** in the tip of the sleeve assembly with the threaded hole **H** of the housing 18.
- Apply grease on the outer, the screw part and the roller contact part of sleeve assembly 9.
- Install screw 8 after groove **G** is aligned.
- Tighten the sleeve assembly with the specified torque after applying the sealing compound on the screw of screw 8.
- Confirm whether sleeve assembly 9 does not come off.

NOTE

Recheck that the sleeve assembly 9 does not pull out of the housing 18.



12 Spring

[Removal]

- Compress spring holder with bolt **A**, and compress spring 12.
- Remove snap ring 10.
- Remove bolt **A** and spring holder.

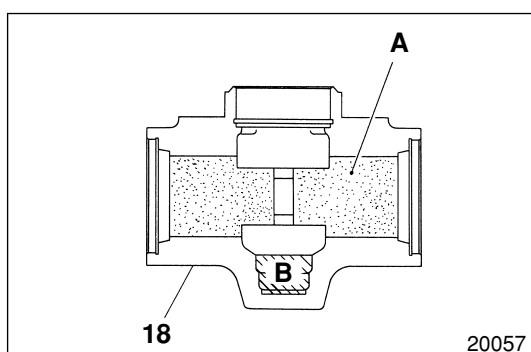
CAUTION

When removing bolt **A**, use caution as the spring 12 may pop out.

- Remove retainer 11 and spring 12.

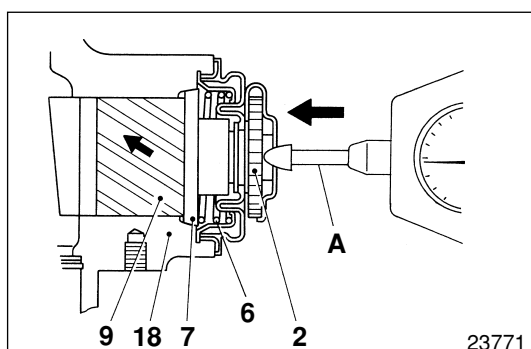
[Installation]

- Follow the removal sequence in reverse.



18 Applying and filling grease on housing

- Apply grease on the inside surface **A** of housing 18.
- Fill grease in the **B** part.

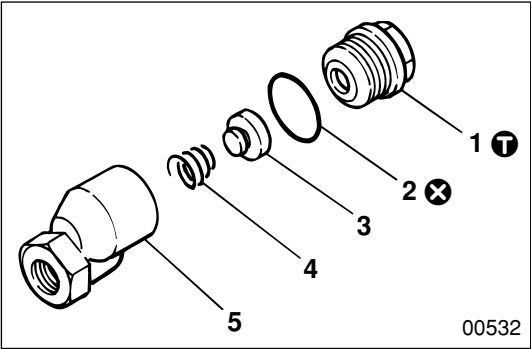
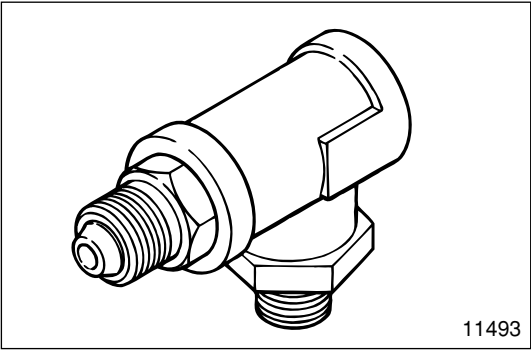


– Inspection of auto adjustment mechanism operation of expander assembly

- Pull the adjusting screw assembly 2 as far out as possible by hand.
- Push the adjusting screw assembly 2 back slightly until you feel the resistance change.
- Place the push-pull gauge **A** on the adjusting screw assembly 2, then push the gauge **A** in the direction of the arrow as shown in the figure on the left, and measure the maximum moving resistance of the adjusting screw assembly 2.
- If the measured value is out of specification, replace sleeve assembly 9.

CHECK VALVE/SAFETY VALVE

CHECK VALVE



CAUTION ⚠ **Do not disassemble this check valve because it is a unit construction.**

- **Disassembly sequence**
- 1 Cap
 - 2 O-ring
 - 3 Valve
 - 4 Spring
 - 5 Valve body
- ⊗ : Non-reusable parts

- **Assembly sequence**
- Follow the disassembly sequence in reverse.

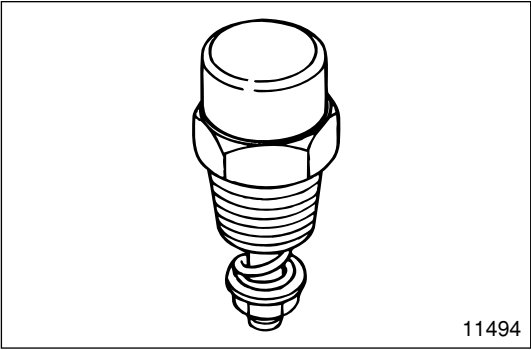
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Pressure difference between check valve inlet and outlet ports	29 kPa {4.3 psi, 0.3 kgf/cm ² } or less	—	Replace

T **Tightening torque** Unit : N·m {ft.lbs, kgf·m}

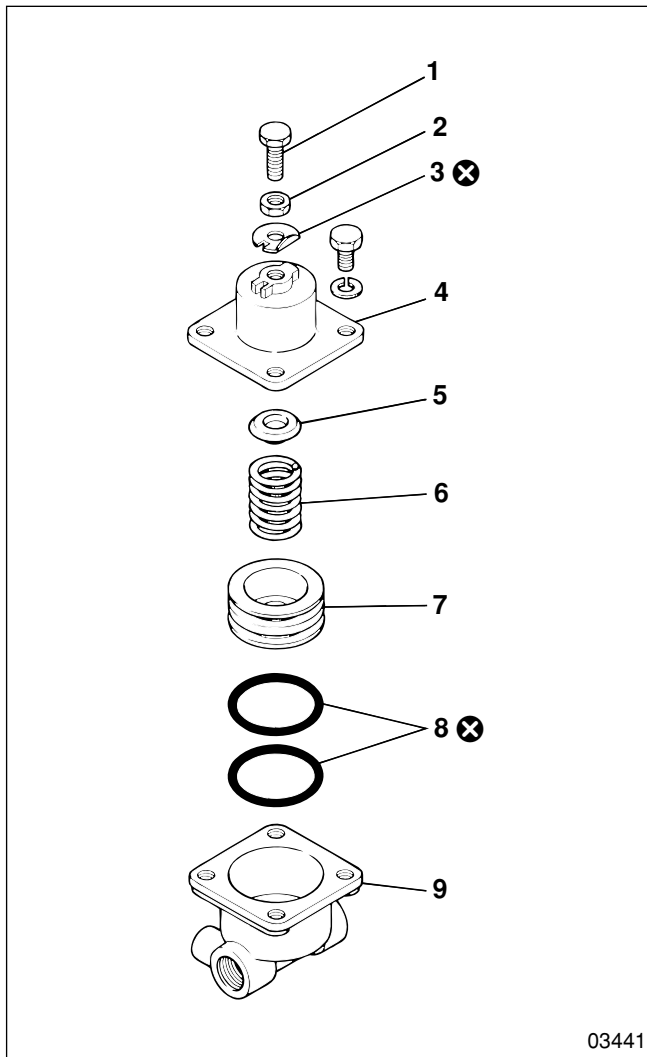
Location	Parts to be tightened	Tightening torque	Remarks
1	Cap	44 to 55 {33 to 40, 4.5 to 5.5}	—

SAFETY VALVE



Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Release pressure of safety valve	950±20 kPa {135±2.8 psi, 9.7±0.2 kgf/cm ² }	—	Replace



● Disassembly sequence

- 1 Adjusting bolt
- 2 Lock nut
- 3 Claw washer
- 4 Cap
- 5 Spring retainer
- 6 Spring
- 7 Piston
- 8 O-ring
- 9 Valve body

⊗ : Non-reusable parts

CAUTION ⚠

Make sure that adjusting bolt 1 is not turned except for adjustment.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection after assembly

📖 P35B-83

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Specified pressure	Valve opening pressure	345±29 kPa {50±4.3 psi, 3.5±0.3 kgf/cm ² }	Adjust or replace
		Valve closing pressure	315±20 kPa {46±2.8 psi, 3.2±0.2 kgf/cm ² }	

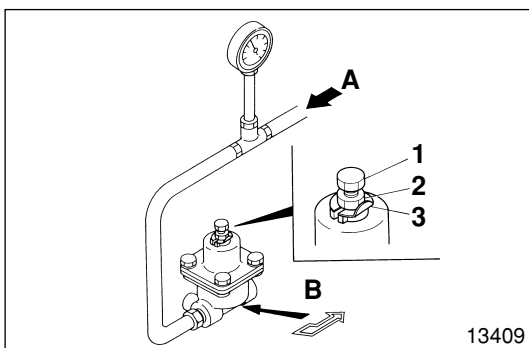
◆ Service procedure

● Inspection after assembly

Adjust by turning adjusting bolt 1 after loosening lock nut 2. After adjusting, tighten the lock nut without turning the adjusting bolt, and bend claw washer 3 to secure the lock nut.

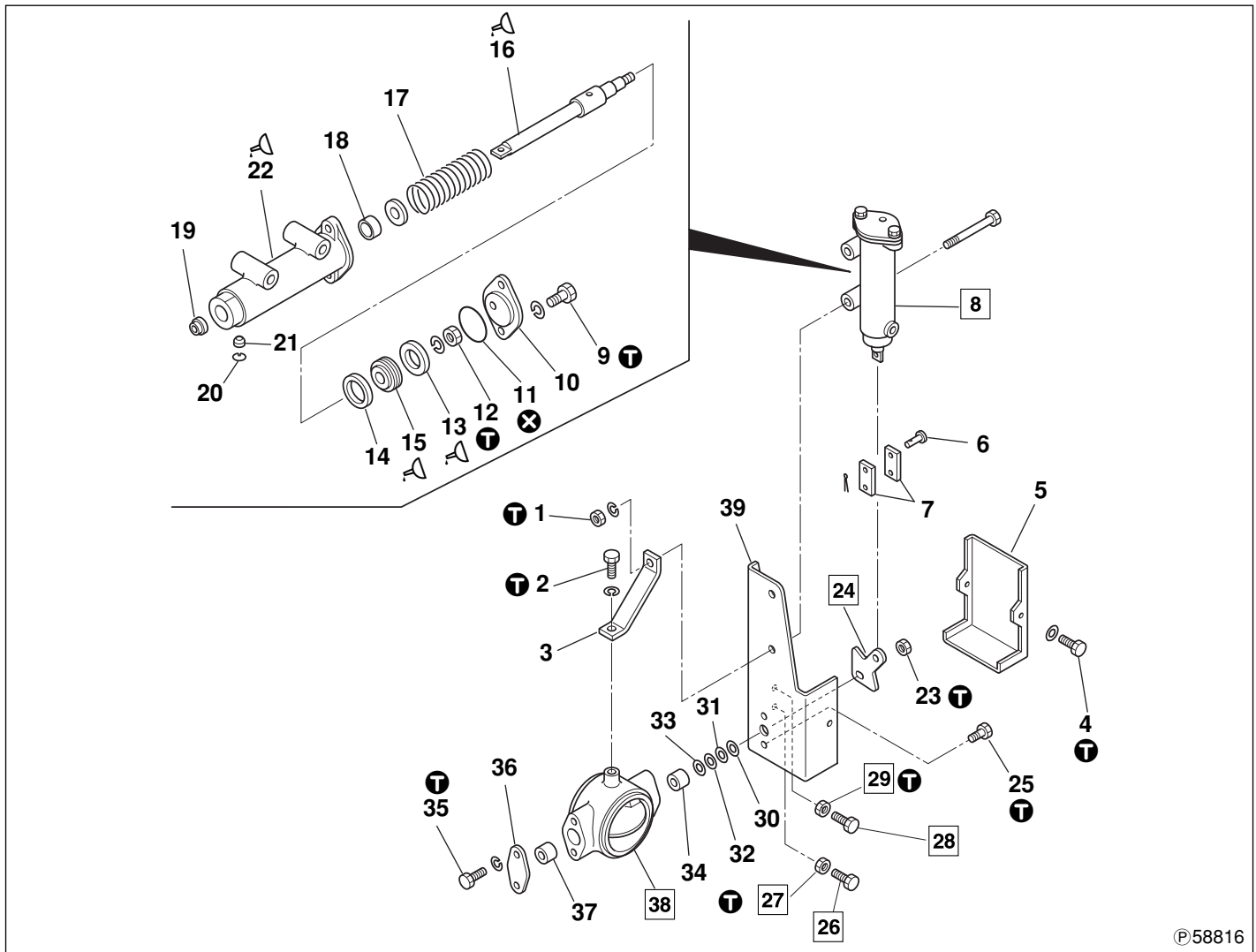
- Adjust adjusting bolt 1 so that air is discharged from the outlet port (arrow mark **B** in the illustration), when the air at valve opening pressure is applied to the inlet port (arrow mark **A** in the illustration).
- After adjusting valve opening pressure, adjust adjusting bolt 1 so that air is not discharged from the outlet port (arrow mark **B** in the illustration) when the air at valve closing pressure is applied to the inlet port (arrow mark **A** in the illustration).

B : Arrow showing the air flow direction



EXHAUST BRAKE SYSTEM

Exhaust Brake Unit



© 58816

Disassembly sequence

- | | | |
|--------------------|-------------------|----------------------|
| 1 Nut | 15 Piston | 29 Lock nut |
| 2 Bolt | 16 Shaft | 30 Seal ring (Large) |
| 3 Arm | 17 Spring | 31 Seal ring (Small) |
| 4 Screw | 18 Bush | 32 Seal ring (Large) |
| 5 Cover | 19 Dust seal | 33 Seal ring (Small) |
| 6 Pin | 20 Retaining ring | 34 Bush |
| 7 Clevis | 21 Filter | 35 Bolt |
| 8 Control cylinder | 22 Cylinder | 36 Cover |
| 9 Bolt | 23 Nut | 37 Bush |
| 10 Cover | 24 Lever | 38 Valve assembly |
| 11 O-ring | 25 Bolt | 39 Plate |
| 12 Nut | 26 Adjusting bolt | |
| 13 Packing cup | 27 Lock nut | |
| 14 Wear ring | 28 Adjusting bolt | |

⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
8	Airtightness of control cylinder (Air leakage at air pressure 880 kPa {125 psi, 9.0 kgf/cm ² })	—	3.0 kPa {0.4 psi, 0.03 kgf/cm ² }}	Replace
17	Spring load (Installed length 109 {4.3})	72 N {16 lbf, 7.3 kgf}	61 N {13.7 lbf, 6.2 kgf}	Replace
38	Clearance between butterfly valve and body when valve assembly butterfly valve operating (Air pressure 640±50 kPa {93±7.3 psi, 6.5±0.5 kgf/cm ² } supplied to control cylinder)	0.2 to 0.4 {0.0079 to 0.016}	0.1 {0.0039}	Adjust

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Control cylinder mounting)	22.6 to 28.4 {17 to 21, 2.3 to 2.9}	—
2	Bolt (Arm mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
4	Screw (Cover mounting)	4.9 to 6.9 {3.6 to 5.1, 0.5 to 0.7}	—
9	Bolt (Cover mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
12	Nut (Piston mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
23	Nut (Lever mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
25	Bolt (Valve assembly mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
27	Lock nut	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
29	Lock nut	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—
35	Bolt (cover mounting)	10.8 to 16.7 {8.0 to 12, 1.1 to 1.7}	—

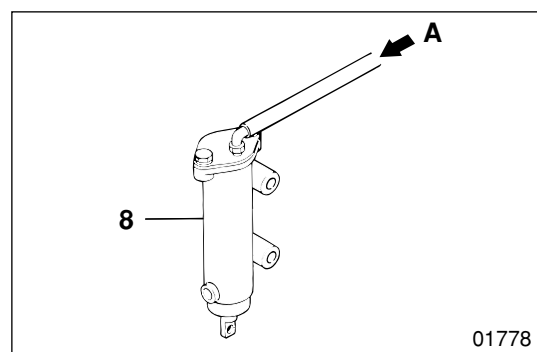
L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
13	Surface of packing cup	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15, 16	Mounting areas of piston and shaft	Sealant [Hermetic GA (SANNOW KOGYO CO)]	As required
16	Shaft at $\phi 12$ {0.47}	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
22	Interior of cylinder	Wheel bearing grease [NLGI No.2 (Li soap)]	2 cm ³ {0.12 cu. in.}

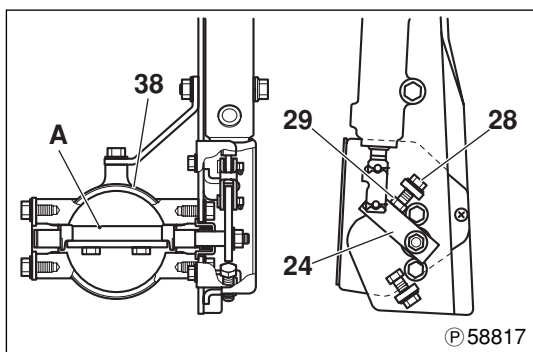
◆ Service procedure

8 Inspection on airtightness of control cylinder

Make sure that there is no air leakage when air pressure of 980 kPa {140 psi, 10 kgf/cm²} is applied to control cylinder **8**. If any air leakage is found, replace the control cylinder assembly.



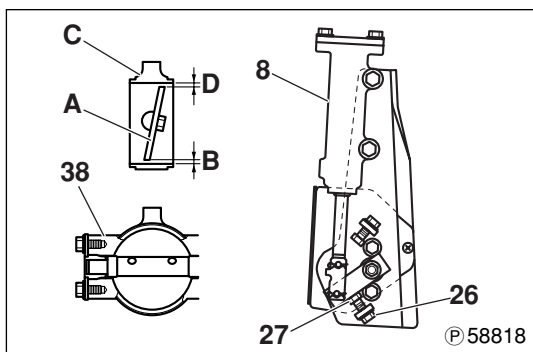
EXHAUST BRAKE SYSTEM



24 26 to 29 38 Lever, adjusting bolt, lock nut, and valve assembly

[Butterfly valve **A** fully-opened adjustment]

- Turn the adjusting bolt so that lever **24** and the head of adjusting bolt **28** make contact horizontally.
- Tighten lock nut **29** at specified torque.



[Butterfly valve **A** fully-closed adjustment]

- Turn adjusting bolt **26** so that the average value of clearances **B**, **D** between butterfly valve **A** and body **C** conforms to the standard value.
- Calculate the average of clearances **B**, **D** by $(B+D)/2$.
- Tighten lock nut **27** at specified torque.



Group 35E

Anti-Lock Brake System

(ABS)

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	35E- 2
STRUCTURE AND OPERATION	35E- 2
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Periodic Inspection Procedures	35E-16
• Adjustment of Wheel Speed Sensor Clearance	
<Air-over hydraulic brake>	35E-18
• Inspection of Wheel Speed Sensor Signal Waveform	
Using Oscilloscope	35E-19
TROUBLESHOOTING	
• Inspection Procedures	35E-20
• Inspection Flowchart	35E-21
• Diagnosis Code Chart	35E-22
• Service Data Chart	35E-24
• Actuator Drive Chart.....	35E-25
LOCATIONS OF PARTS	35E-26
ELECTRICAL WIRING DIAGRAM	35E-30

SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

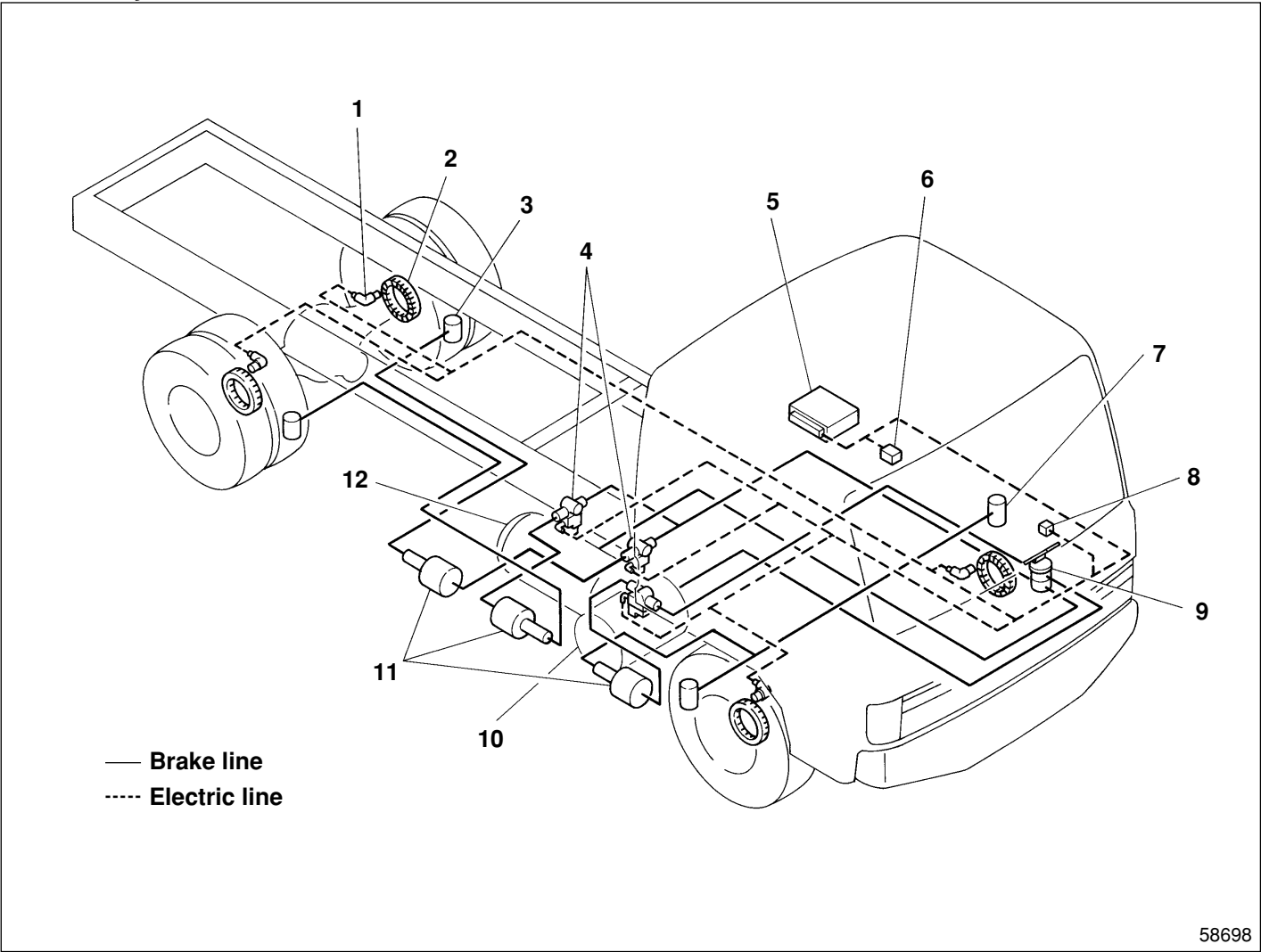
Item	Model	FK61F, FM61F, FM64F	FM65F
Brake system		Air-over hydraulic brake	Full-air brake
Anti-lock brake system		Anti-lock brake system	
Manufacturer		Knorr-Bremse	

STRUCTURE AND OPERATION

Anti-lock Brake System (ABS)

● System outline

< Air-over hydraulic brake >



- 1 Wheel speed sensor

2 Rotor

3 Rear wheel cylinder

4 Control valve

5 Electronic control unit

6 Exhaust brake cut relay

7 Front wheel cylinder
- 8 Anti-lock brake system warning lamp

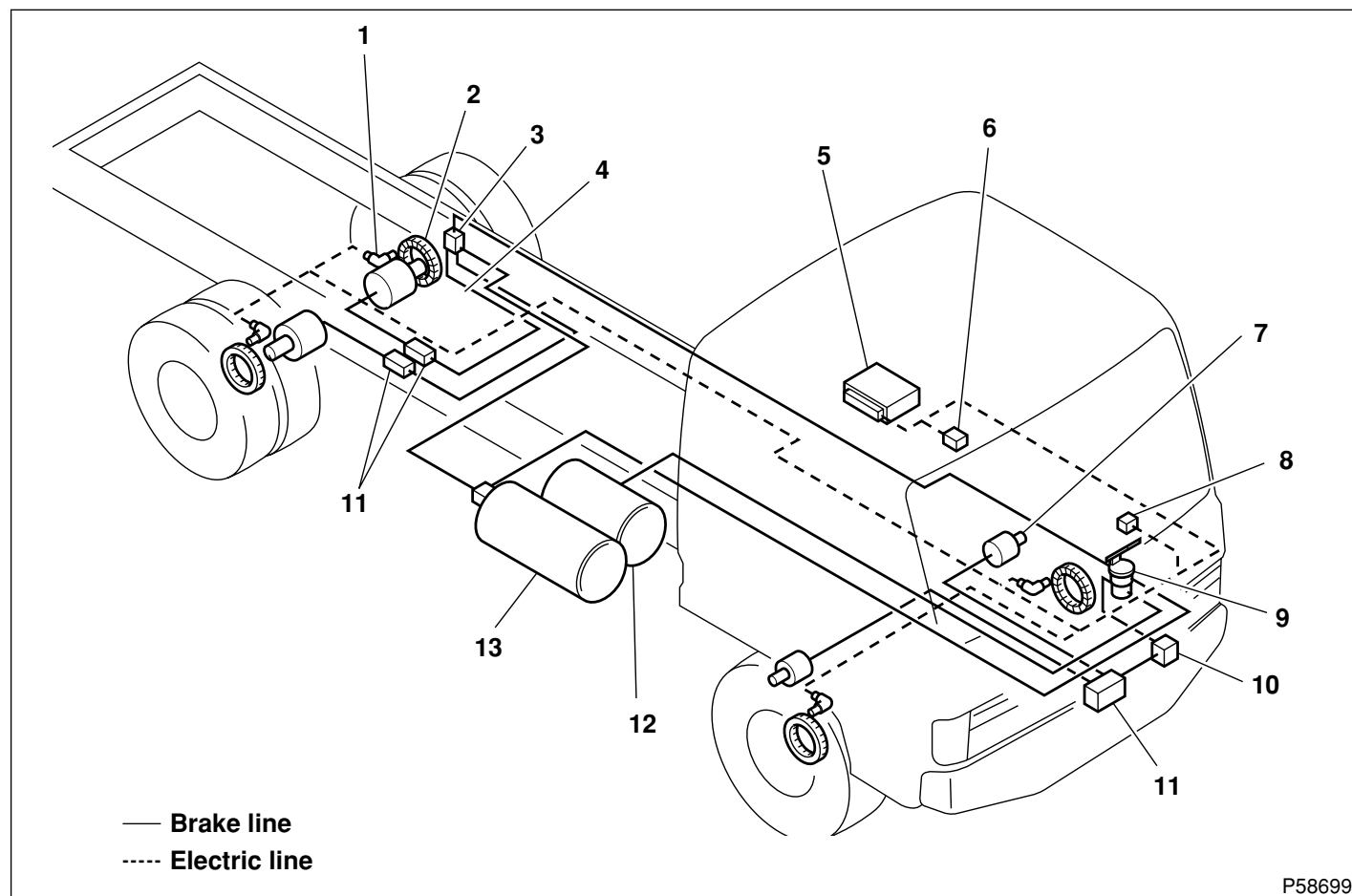
9 Dual brake valve

10 Air tank (for front brake system)

11 Brake booster

12 Air tank (for rear brake system)

< Full-air brake >



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- | | |
|---------------------------|---------------------------------------|
| 1 Wheel speed sensor | 8 Anti-lock brake system warning lamp |
| 2 Rotor | 9 Dual brake valve |
| 3 Relay valve | 10 Quick release valve |
| 4 Rear brake chamber | 11 Control valve |
| 5 Electronic control unit | 12 Air tank (for front brake system) |
| 6 Exhaust brake cut relay | 13 Air tank (for rear brake system) |
| 7 Front brake chamber | |

Anti-lock brake system prevents the slippage of tires resulting from wheel lockup that occurs during sudden braking on slippery pavement, thus helping maintain controllability and directional stability of the vehicle.

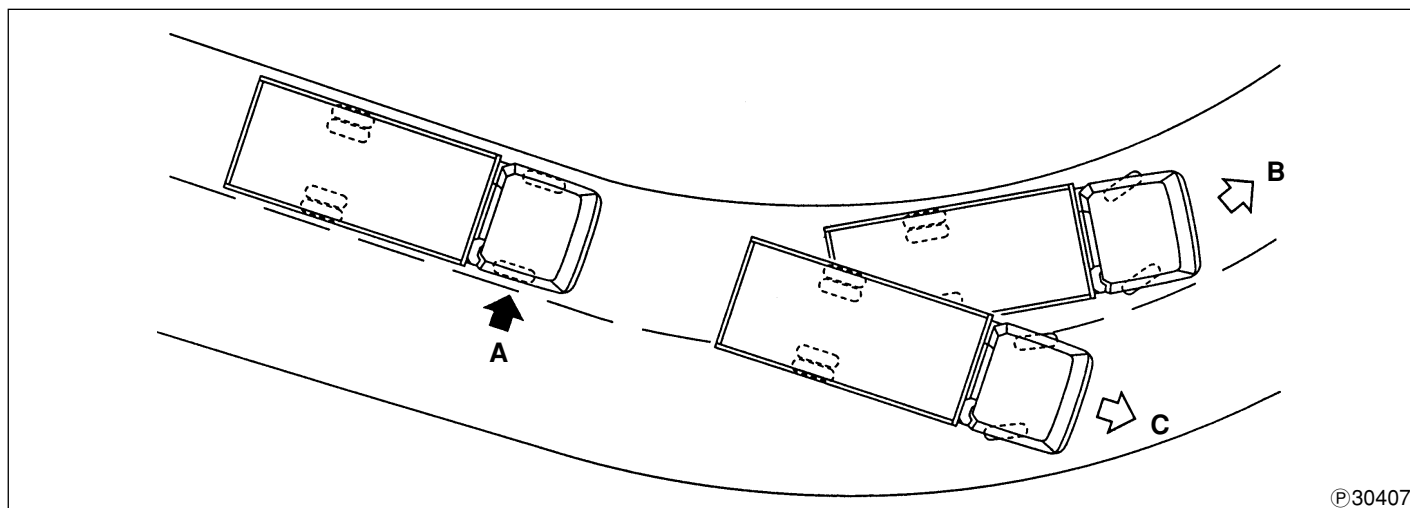
The following section explains how wheel lockup affects the vehicle's movement and directional stability.

STRUCTURE AND OPERATION

Wheel lockup

Rotating tires of a moving vehicle have a tendency to travel in the direction of tire rotation. Therefore, a driver can control the vehicle's movement by turning the steering wheel to move the front tires to a desired direction. In a vehicle not equipped with Anti-lock brake system, when a driver presses the brake pedal all the way, wheel lockup occurs and tires stop rotating while the vehicle is still moving. Tires in this condition lose the tendency to maintain the direction of travel and slip in a direction of an externally applied force regardless of the tires' rotating direction. In other words, when wheels lock, the vehicle loses its directional stability, disallowing the driver to control the vehicle's movement. Anti-lock brake system eases the braking force on wheels before wheel lockup occurs, thus maintaining controllability and directional stability.

(1) Wheel lockup during cornering on slippery road



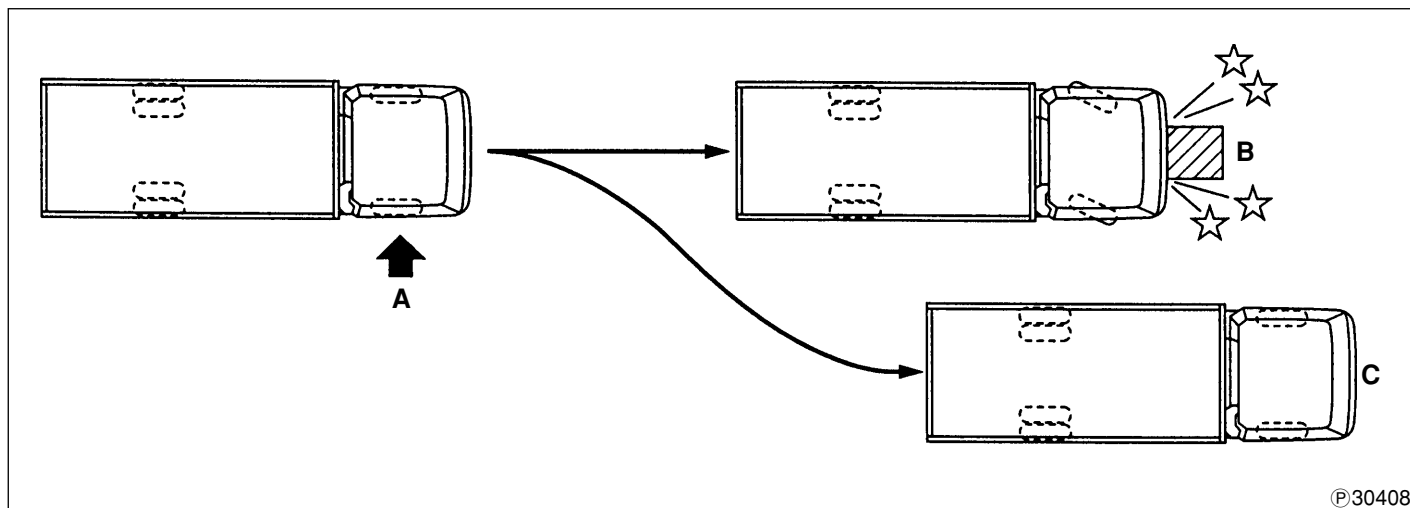
When wheel lockup occurs during braking at a curve on slippery pavement, the vehicle loses its directional stability and does not move in the steered direction.

A : Braking point (wheel lockup)

B : Steered direction

C : Vehicle continues to travel straight

(2) Wheel lockup on straightway on slippery pavement



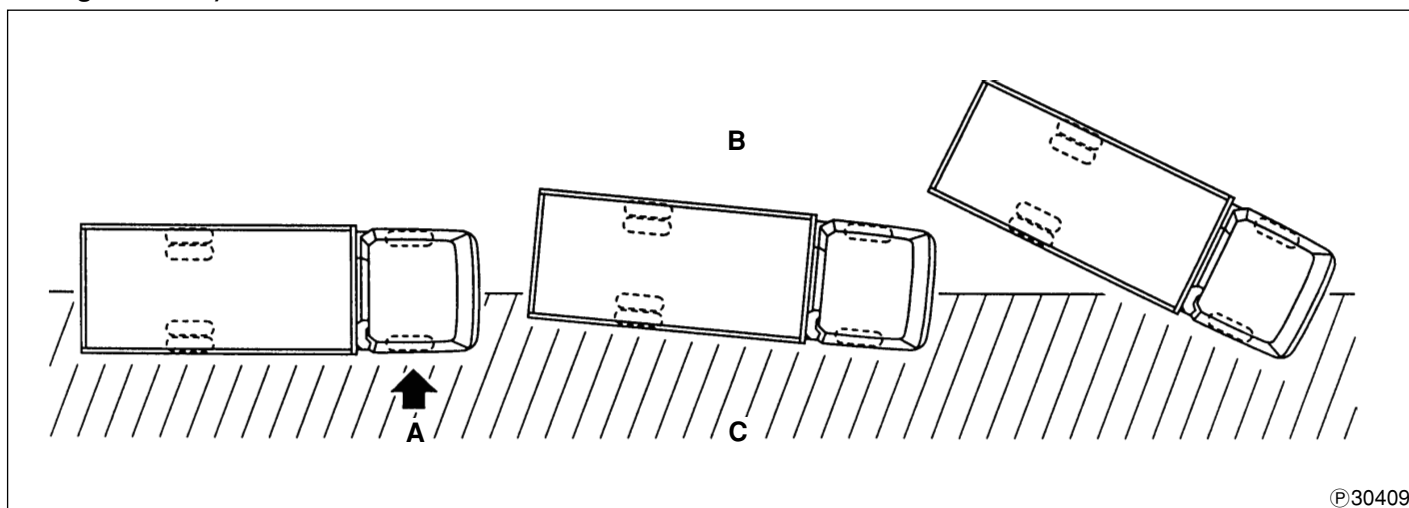
When wheel lockup occurs as a driver applies sudden braking on a straightway to avoid an obstacle ahead, the vehicle loses its directional stability and controllability. When this happens, the driver cannot control the vehicle's movement to avoid hitting the obstacle.

A : Braking point (wheel lockup)

B : Obstacle

C : Intended direction of vehicle movement

(3) Wheel lockup on surfaces with split μ factors (road surface with different friction coefficients for left and right wheels)



If the brake is applied hard when the friction coefficient of a road surface is different for the left and right tires, the tires which are on a surface with a lower friction coefficient lock up first and start sliding. Since the sliding of the tires on one side of the vehicle causes an imbalance in the stopping power between the left and right tires, one side of the vehicle slows down while the other side continues traveling at the same speed, resulting in the loss of directional stability. In this condition, the driver cannot maneuver the vehicle properly. When this happens during sudden braking, the vehicle spins.

A : Braking point (wheel lockup)

B : Slippery pavement

C : Non-slippery pavement

To prevent the above mentioned conditions, Anti-lock brake system controls the braking force to provide optimum stopping power to each wheel and prevents wheel lockup. Therefore, the vehicle maintains controllability and directional stability during hard braking without slipping or sliding.

STRUCTURE AND OPERATION

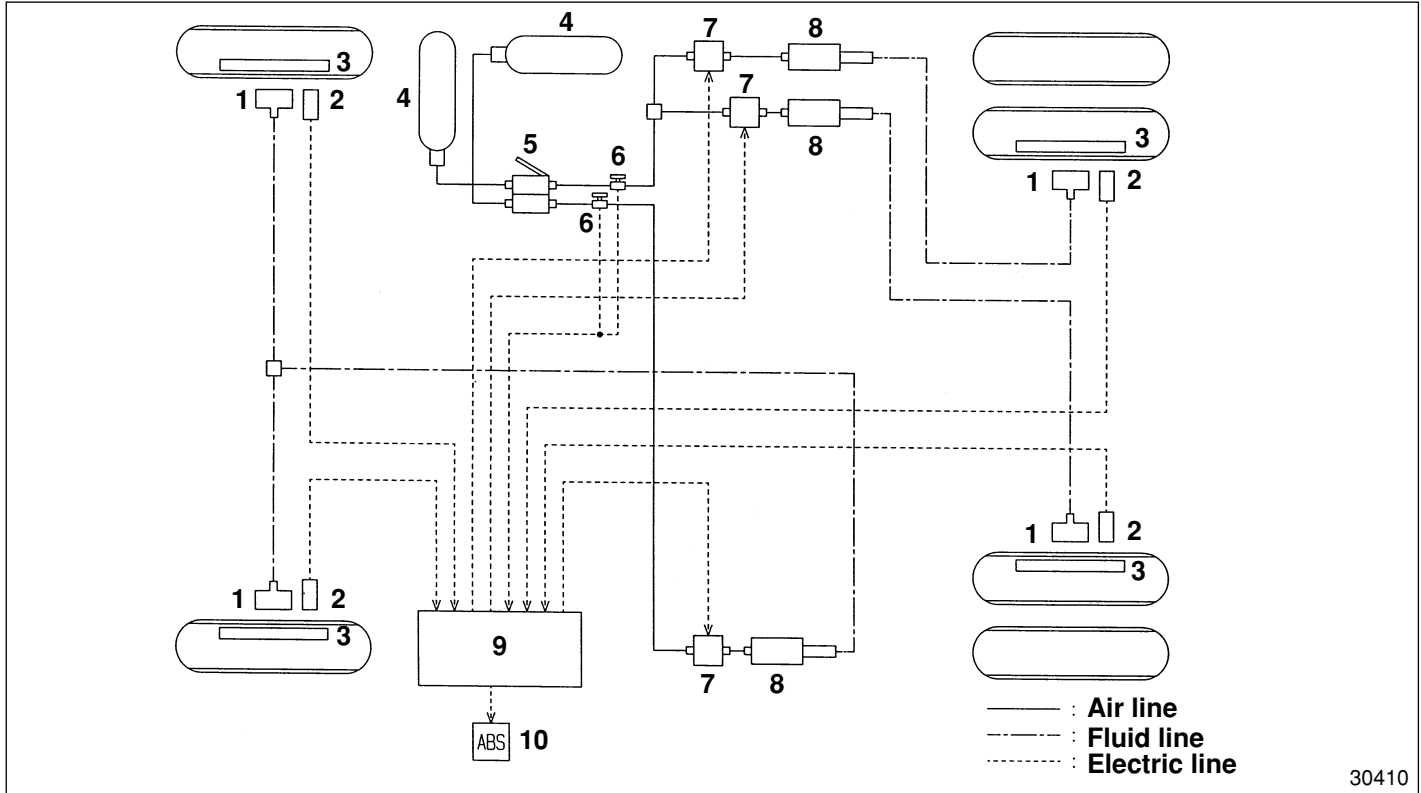
● Anti-lock brake system structure

Anti-lock brake system consists of wheel speed sensors **2** that detect wheel speed, control unit **9** that detects wheel lockup tendencies based on wheel speed data and outputs signals to control the braking force, control valves **7** that physically regulate the braking force, and Anti-lock brake system warning lamp **10** that indicates system abnormalities.

The following shows the Anti-lock brake system control process in a wheel lockup condition.

Schematic system diagram

< Air-over hydraulic brake >

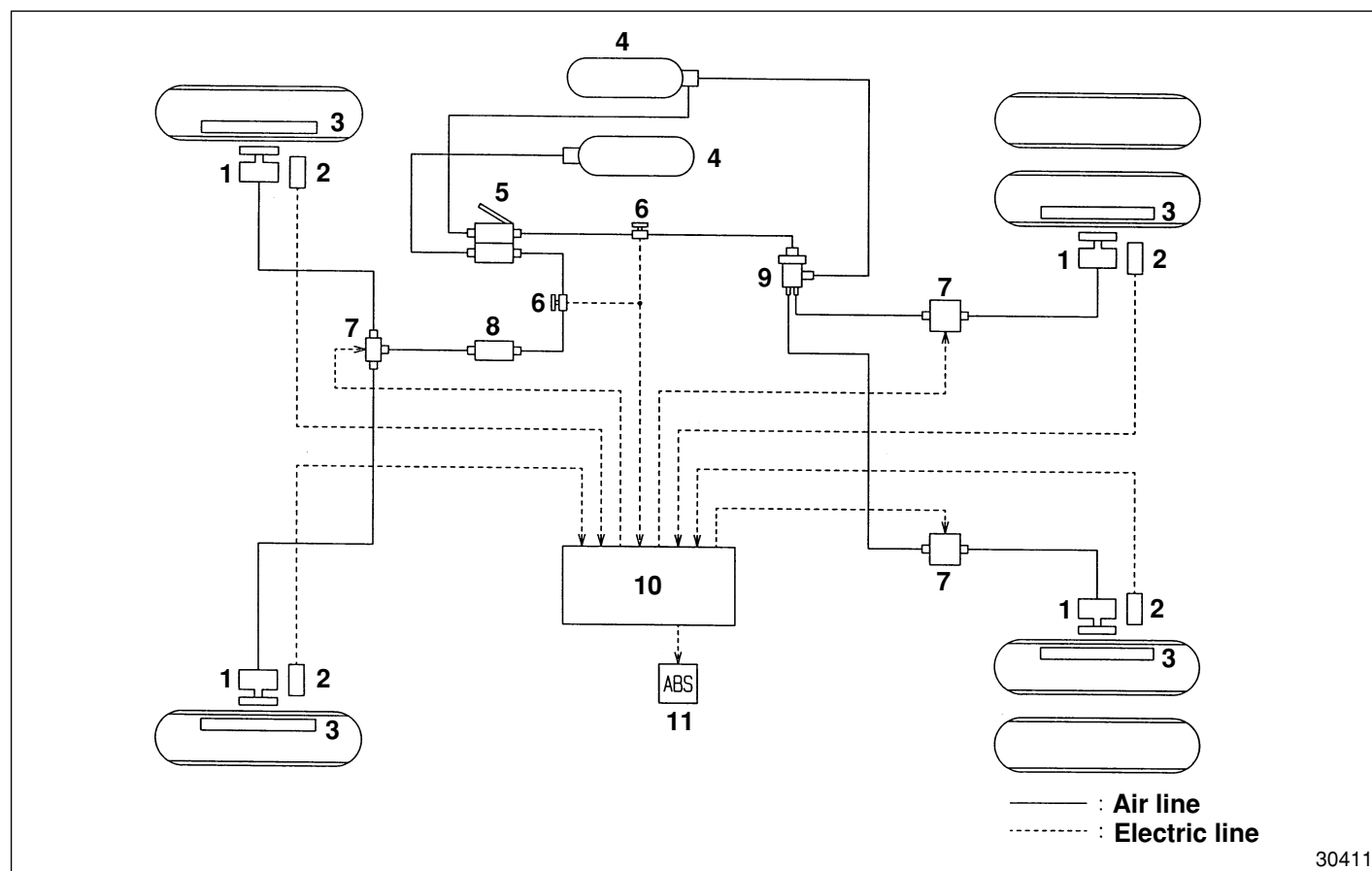


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- Anti-lock brake system uses wheel speed sensors **2** and Electronic control unit **9** to monitor the rotating speed of wheels. When the wheel speed exceeds the preset deceleration speed or slip rate, the Electronic control unit detects it as the tendency leading to wheel lockup and activates control valves **7** to reduce air pressure inside brake boosters **8**. This decreases the braking force and prevents wheel lockup. Then, when the wheel speed increases, the wheel speed sensors send signals to the control valves by way of the Electronic control unit to increase air pressure in the brake boosters to augment the braking force.
- This control cycle is repeated to prevent wheel lockup on slippery pavements and ensure the vehicle's directional stability during braking. The 4-sensor 3-control valve Anti-lock brake system uses four wheel speed sensors **2**, which are located at the front and rear wheels, to control each of the four wheels. For the front wheels, the control function is integrated for the left and right wheels.

Schematic system diagram

< Full-air brake >



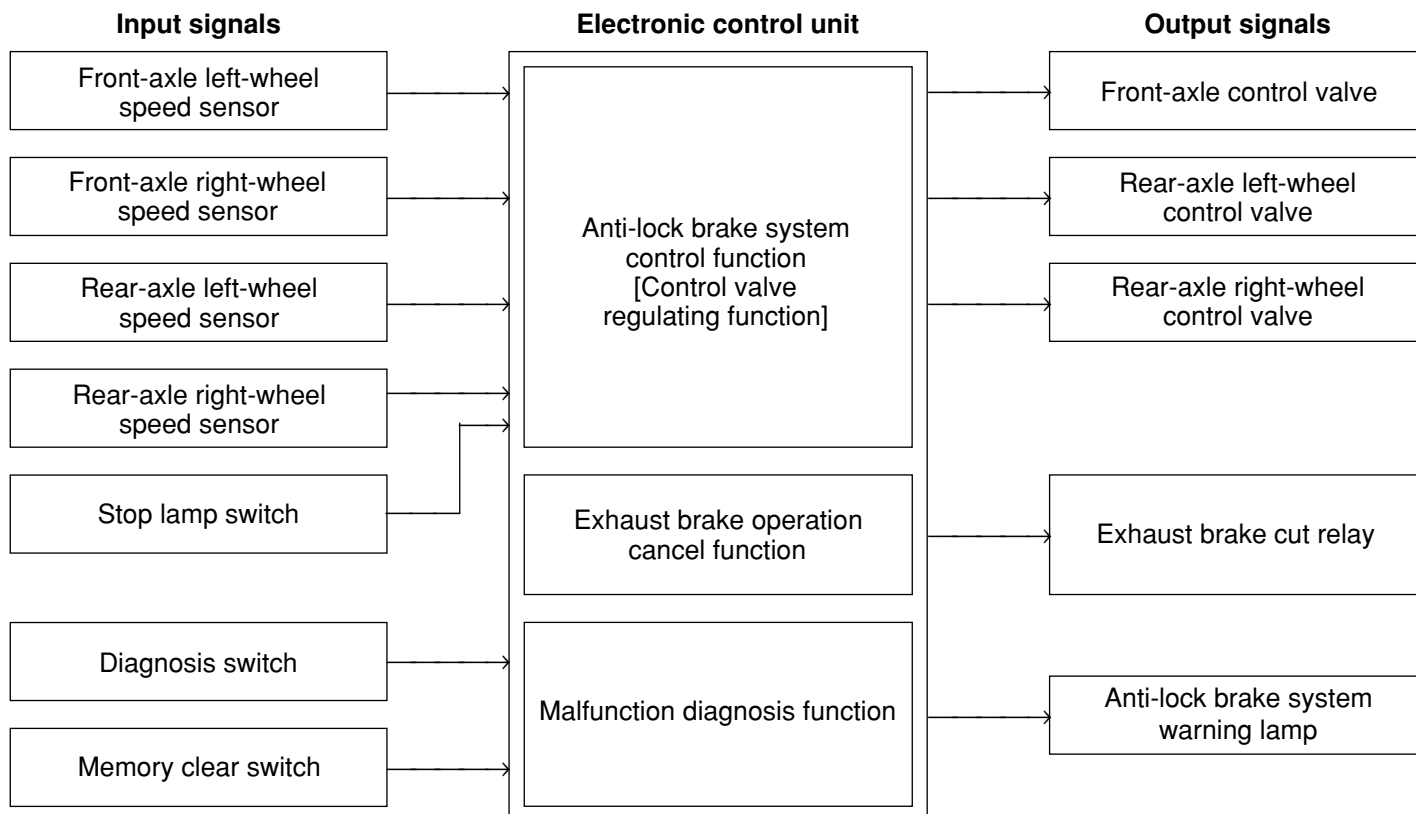
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- | | |
|----------------------|--|
| 1 Brake chamber | 7 Control valve |
| 2 Wheel speed sensor | 8 Quick release valve |
| 3 Rotor | 9 Relay valve |
| 4 Air tank | 10 Electronic control unit |
| 5 Dual brake valve | 11 Anti-lock brake system warning lamp |
| 6 Stop lamp switch | |

- Anti-lock brake system uses wheel speed sensors **2** and Electronic control unit **10** to monitor the rotating speed of wheels. When the wheel speed exceeds the preset deceleration speed or slip rate, the Electronic control unit detects it as a wheel lockup tendency and activates control valves **7** to reduce air pressure inside brake chambers **1**. This decreases the braking force and prevents wheel lockup. Then, when the wheel speed increases, the wheel speed sensors send signals to the control valves by way of the Electronic control unit to increase air pressure in the brake chambers to augment the braking force.
- This control cycle is repeated to prevent wheel lockup on slippery pavements and ensure the vehicle's directional stability during braking. The 4-sensor 3-control valve Anti-lock brake system uses four wheel speed sensors **2**, which are located at the front and rear wheels, to control each of the four wheels. For the front wheels, the control function is integrated for the left and right wheels.

STRUCTURE AND OPERATION

Anti-lock brake system function



Anti-lock brake system malfunction diagnosis function

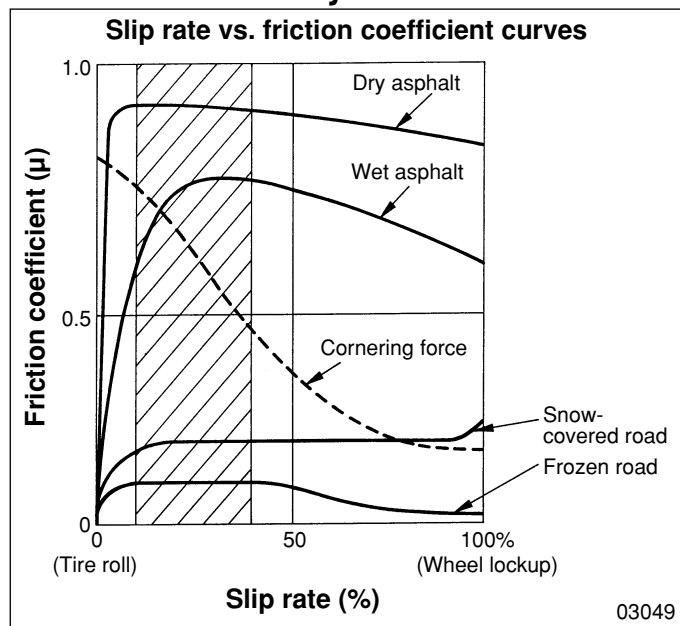
When the Electronic control unit detects malfunction of the following components, it turns on the Anti-lock brake system warning lamp to indicate the system abnormality.

- Broken wire, short-circuit or output abnormality in wheel speed sensors
- Broken wire or short-circuit in outlet and holding valves of control valves
- Broken wire, short-circuit or power supply voltage abnormality in power relays
- Abnormal detection of Electronic control unit

MEMO

STRUCTURE AND OPERATION

● Anti-lock brake system control



To provide optimum stopping power, Anti-lock brake system controls the braking force based on the slip rate determined by the relationship between the wheel speed and vehicle speed. When the brake is applied, the resulting force creates resistance which slows down the wheel rotation, thus reducing the speed of the vehicle. However, inertia acts on the vehicle and maintains the vehicle's forward movement despite the stopping force applied by the tires. When there is a difference between the wheel speed and vehicle speed, slipping occurs. The degree of slippage is expressed by a slip rate.

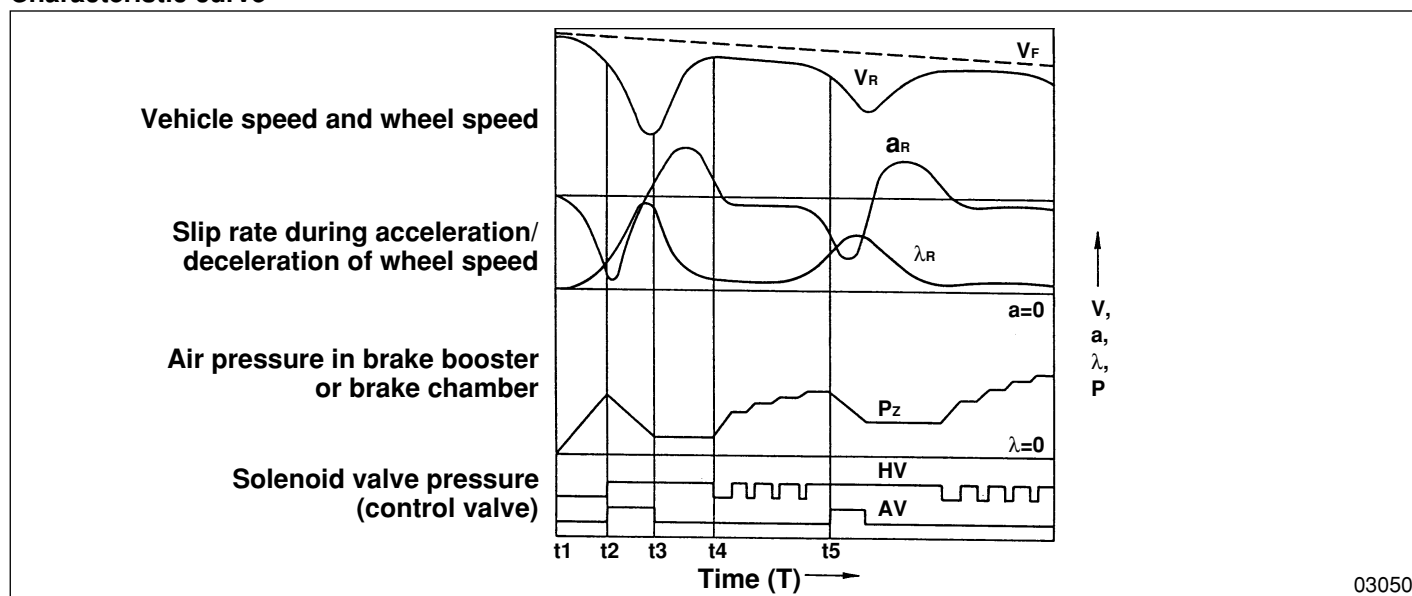
$$\text{Slip rate (\%)} = \frac{\text{Vehicle speed} - \text{Wheel speed}}{\text{Vehicle speed}} \times 100$$

When the slip rate is 0%, there is no slippage between the tires and pavement. The slip rate of 100% refers to a wheel lockup condition.

The graph shows the relationship between the slip rate and the friction coefficient of tire and pavement. In a vehicle equipped with Anti-lock brake system, the Electronic control unit and control valves adjust the braking force and maintains it within the shaded area on the graph where the friction coefficient is high, thus preventing tire slippage and maintaining stability during stopping.

● Anti-lock brake system operation

Characteristic curve



The above Anti-lock brake system characteristic graph shows the time-based changes in vehicle speed, wheel speed of individual tires, and brake pressure levels during braking. The Electronic control unit calculates the wheel speed and estimates the vehicle speed based on signals sent from wheel speed sensors, and continuously monitors the slip rate and deceleration speed. When the Electronic control unit detects a tendency toward wheel lockup, it sends a signal to the solenoid valves of the control valves. The following shows the control system.

V_F : Vehicle speed

V_R : Wheel speed

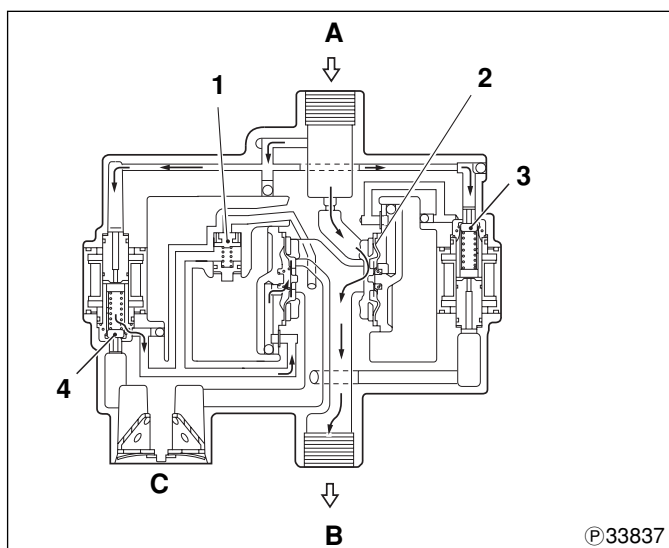
a_R : Acceleration/deceleration of wheel speed

λ_R : Slip rate

P_z : Airpressure inside brake booster < air-over hydraulic brake > or brake chamber < full-air brake >

HV : Solenoid valve (Pressure holding valve of control valve)

AV : Solenoid valve (Outlet valve of control valve)



Normal braking control

- During normal braking when there are no tendencies toward wheel locking, solenoid valves **3** and **4** are not activated, allowing the air from the dual brake valve to flow to the brake boosters or brake chambers without altering the pressure.
- When the brake pedal is released under a normal braking condition, the pressure air from delivery port **B** is discharged through release port **C**. If the release port is frozen up or otherwise closed, the pressure air from the delivery port would act on pressure holding valve **2**, causing the brakes to drag. When this happens, check valve **1** opens to allow the pressure air from the delivery port to be discharged through solenoid valve (outlet side) **4** toward supply port **A**.

A : <Air-over hydraulic brake system>

From dual brake valve

<Full-air brake system>

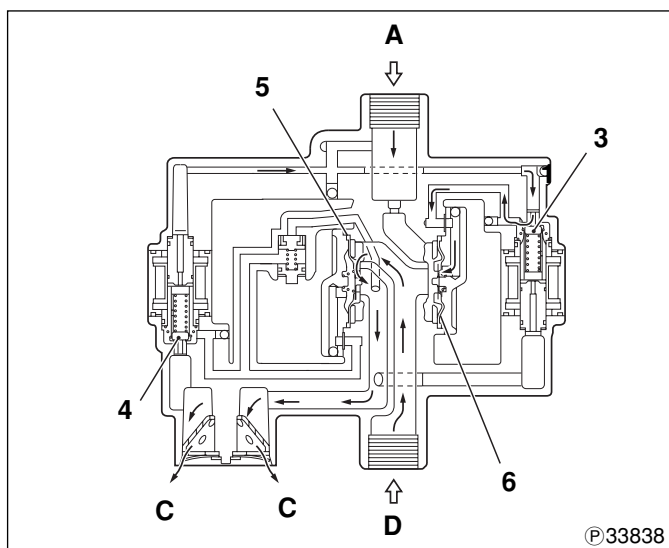
From relay valve or quick release valve

B : <Air-over hydraulic brake system>

To brake boosters

<Full-air brake system>

To brake chambers



Pressure reduction control

- When the brakes are applied at point t1 in the characteristic curve diagram on the preceding page, the air pressures in the brake boosters or brake chambers increase. As both vehicle speed and wheel speed begin decreasing, the wheels show tendencies toward locking at point t2. When this occurs, the electronic control unit issues control signals to turn on solenoid valve (holding valve) **3** and solenoid valve (outlet valve) **4**.
- Then pressure holding valve **6** closes and outlet valve **5** opens, which allows pressure air in the brake boosters or brake chambers to be partly released so that their pressures are reduced. The tendency toward wheel locking is thus reduced. (t2→t3)

A : <Air-over hydraulic brake system>

From dual brake valve

<Full-air brake system>

From relay valve or quick release valve

C : Discharged air

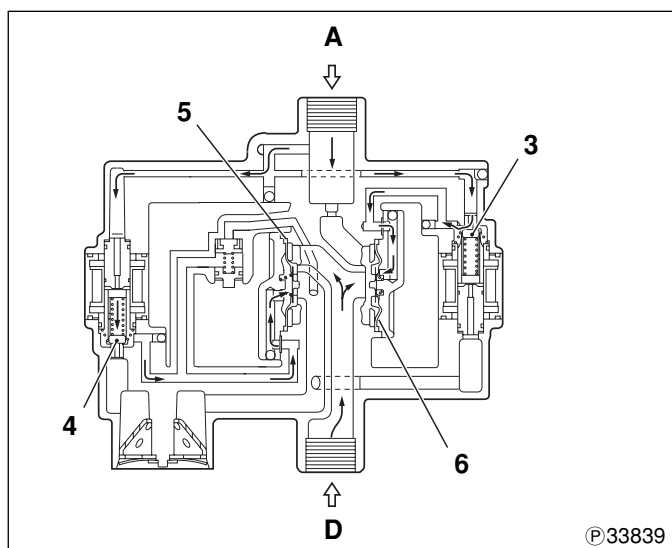
D : <Air-over hydraulic brake system>

From brake booster

<Full-air brake system>

From brake chamber

STRUCTURE AND OPERATION



Pressure holding control

- At point t3 in the characteristic curve diagram, solenoid valve (outlet valve) 4 turns off and outlet valve 5 closes. The air pressures in the brake boosters or brake chambers are retained and the slip ratio λ becomes close to zero; the wheel speed then increases.
- At point t4, solenoid valve (holding valve) 3 repeatedly cycles between on and off states until point t5 is reached. This on-off actions of the solenoid valve makes pressure holding valve 6 momentarily open and close repeatedly, which increases the pressure step by step and the wheel speed decreases as a result. This cycle of control (t2 → t5) is repeated until the vehicle stops.

A : <Air-over hydraulic brake system>

From dual brake valve

<Full-air brake system>

From relay valve or quick release valve

D : <Air-over hydraulic brake system>

From brake booster

<Full-air brake system>

From brake chamber

Anti-lock brake system and exhaust brake

On slippery pavement, the use of the exhaust brake can result in a condition similar to wheel lockup. Therefore, if the exhaust brake is activated while the Anti-lock brake system control is in operation, it hinders the Anti-lock brake system from providing proper brake control. To prevent this, when the Anti-lock brake system is in operation, the exhaust brake is deactivated even when the exhaust brake switch is turned ON.

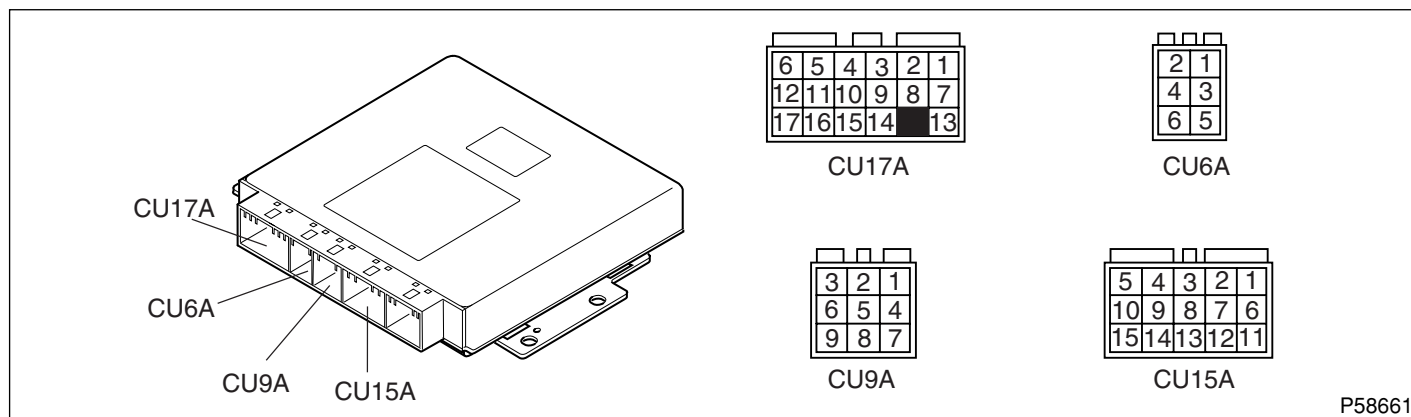
When the Anti-lock brake system deactivates, the exhaust brake provides its normal function when the exhaust brake switch is ON.

● Anti-lock brake system components

Electronic control unit

This component calculates the wheel speed and estimates the vehicle speed based on a signal sent from the wheel speed sensors. Based on the calculation results, it determines a tendency for wheel lockup, and sends a brake pressure control signal to the solenoid valves of the control valves to regulate air pressure accordingly.

The Electronic control unit is equipped with a self-diagnosis function. If an abnormality occurs, the Electronic control unit turns on the warning lamp to indicate the system malfunction and deactivates the Anti-lock brake system control to set the brake system in the normal condition (without Anti-lock brake system control).



Connector type: CU17A

Terminal No.	Connection destination
1	—
2	Multi-Use Tester connector
3	Grounding
4	Fuse (M12 Electronic control unit power supply)
5	Memory clear switch
6	—
7	Exhaust brake cut relay
8	Multi-Use Tester connector
9	Grounding
10	Fuse (B20 control valve power supply)
11	Diagnosis switch
12	—
13	Anti-lock brake system warning lamp
14	Grounding
15	Fuse (B20 control valve power supply)
16	—
17	—

Connector type: CU15A

Terminal No.	Connection destination
1	—
2	Control valve (rear RH outlet)
3	—
4	—
5	Control valve (rear LH outlet)
6	—
7	Control valve (rear RH holding)
8	Wheel speed sensor (rear-axle right-wheel input)
9	Wheel speed sensor (rear-axle left-wheel input)
10	Control valve (rear LH holding)
11	—
12	Control valve (rear RH grounding)
13	Wheel speed sensor (rear-axle right-wheel grounding)
14	Wheel speed sensor (rear-axle left-wheel grounding)
15	Control valve (rear LH grounding)

Connector type: CU9A

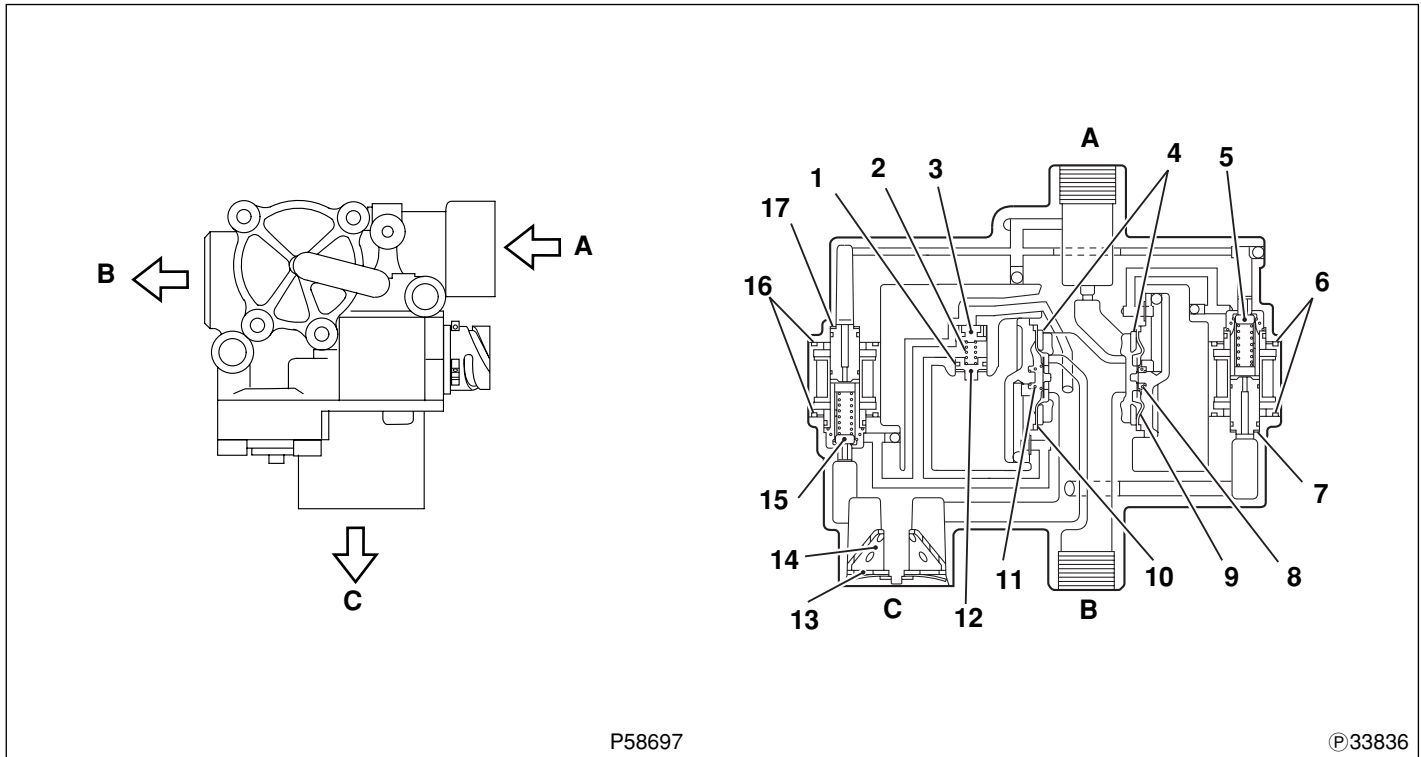
Terminal No.	Connection destination
1	—
2	Wheel speed sensor (front-axle right-wheel input)
3	—
4	Control valve (front holding)
5	Wheel speed sensor (front-axle right-wheel grounding)
6	—
7	—
8	—
9	—

Connector type: CU6A

Terminal No.	Connection destination
1	Wheel speed sensor (front-axle left-wheel input)
2	Control valve (front outlet)
3	Wheel speed sensor (front-axle left-wheel grounding)
4	—
5	Stop lamp relay
6	Control valve (front grounding)

STRUCTURE AND OPERATION

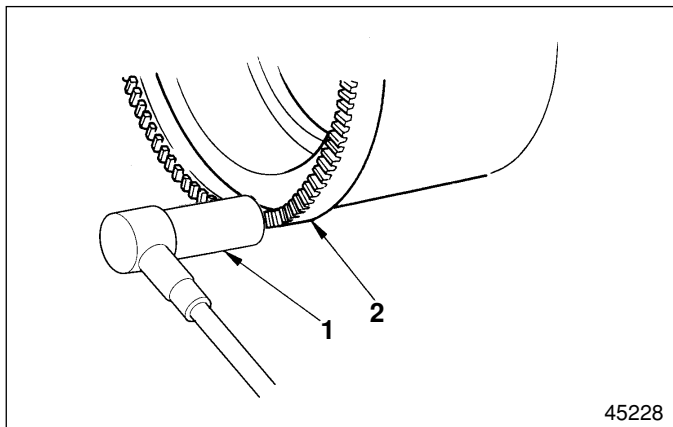
Control valve



- | | | |
|--|--|---------------------------------|
| 1 Check valve | 8 Pressure holding valve return spring | 15 Solenoid valve (outlet side) |
| 2 Return spring | 9 Pressure holding valve | 16 O-ring |
| 3 O-ring | 10 Outlet valve | 17 Waved washer |
| 4 Diaphragm retainer | 11 Outlet valve return spring | |
| 5 Solenoid valve (pressure holding side) | 12 Valve stopper | A : Air inlet port |
| 6 O-ring | 13 Exhaust plate | B : Delivery port |
| 7 Waved washer | 14 Silencer | C : Discharge port |

The valve is comprised of solenoid valves **5**, **15** that receive a signal from the Electronic control unit and controls air pressure supplied from the dual brake valve, and diaphragm valves **9**, **10**.

The two solenoid valves operate in different combinations to increase, maintain and decrease air pressure.



Wheel speed sensor

Wheel speed sensor **1** detects the rotating speed of the wheel and sends a signal to the Electronic control unit. The sensor unit houses an electromagnetic pickup with a permanent magnet core placed inside the coil.

Rotor **2** is connected to the wheel hub. The rotor has a ring gear, and the evenly spaced tooth ridges are positioned perpendicular to the sensor. When the wheel rotates and the rotor teeth cross the magnetic flux of the sensor, the electric potential difference generated by the coil results in an alternate-current voltage that is directly proportional to the rotating speed. The resulting signal is then sent to the Electronic control unit.

MEMO

ON-VEHICLE INSPECTION AND ADJUSTMENT

Periodic Inspection Procedures

(1) Periodic inspection of Anti-lock brake system

- Inspect the vehicle's Anti-lock brake system following the procedure below.
- If an abnormality is found in this inspection, further inspect the Anti-lock brake system using  Multi-Use Tester II or the diagnosis switch by referring to TROUBLESHOOTING section.

 P35E-20

- Inspection procedure

- ① With the vehicle stationary, press the brake pedal and inspect the control valves for air leaks.

If air leaks from the control valve unit, replace it. If air leaks from the air pipe or connector, tighten the joint.

Then, release the brake pedal and inspect the air discharge condition of the control valve. If there is no air discharging operation, replace the control valve.

Conduct the above inspection for each control valve.

- ② Inspection using brake tester

Check the braking force at each wheel with a brake tester by following the inspection procedure for ordinary vehicles.

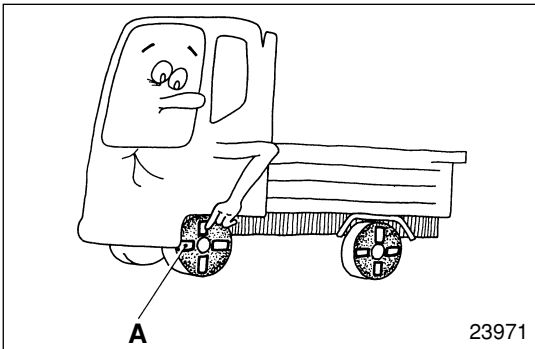
If an abnormality is found, inspect the wheel brake units, service brake system and control valves.

- ③ Drive the vehicle and check the operation of the Anti-lock brake system.

- Conduct a test drive at an open area to ensure safety.
- Conduct a test drive without cargo.

Attach white tape **A** on the sides of tires, so that it is easy to observe the rotation of the front and rear wheels.

- Turn the starter switch from the OFF position to the ON position, and make sure that the **[ABS]** warning lamp lights. Then, check that the **[ABS]** warning lamp turns off approximately two seconds after the starter switch is turned on.
- Drive the vehicle at a speed of 20 to 30 km/h {12 to 19 mph}, and apply a sudden brake. Make sure that wheel lockup does not occur in any of the tires.



(2) Operating conditions resulting from Anti-lock brake system malfunction

Lamp condition	Possible causes	Fail-safe functions (operation in the case of malfunction)
[ABS] warning lamp [ABS] Warning lamp does not turn off two seconds after starter switch is turned on. ① [ABS] warning lamp lights when starter switch is turned to ON position, does not turn off two seconds after starter switch is turned on. ② [ABS] warning lamp lights during driving. ③ [ABS] warning lamp lights after 30 to 60 minutes regardless of whether vehicle is driven or stationary.	Power supply system (Lamp condition: ①, ②) Electronic control unit Blown fuse Broken wire in harness, short-circuit or disconnected connector, faulty contact or faulty grounding Low battery voltage	Anti-lock brake system control becomes inactive for all systems, and all wheels operate under normal brake system.
	Wheel speed sensor system Excessive clearance between wheel speed sensor and rotor (Lamp condition: ②) Defective wheel speed sensor (Lamp condition: ①, ②) Broken wire, short-circuit or disconnected connector or faulty contact in wheel speed sensor harness (Lamp condition: ①, ②)	- When malfunction occurs in one front wheel Properly operating front wheel speed sensor of the other front wheel is used for Anti-lock brake system control of the wheel with malfunctioning sensor. - When malfunction occurs in both front wheels Anti-lock brake system control is deactivated for front wheels. - When malfunction occurs in one rear wheel Anti-lock brake system control is provided only to the rear wheel with properly operating sensor.
	Control valve system (Lamp condition: ①, ②)	Anti-lock brake system control becomes inactive for all systems, and all wheels operate under normal brake system.
	Control valve	Only the properly operating control valves are used for Anti-lock brake system control.
	Electronic control unit (Lamp condition: ①, ③)	Anti-lock brake system control becomes inactive for all systems, and all wheels operate under normal brake system.
	[ABS] warning lamp system (Lamp condition: ①, ②)	Anti-lock brake system control operates normally.
	Faulty relay (for power supply) inside Electronic control unit	
	Broken wire in harness, short-circuit or disconnected connector, faulty contact or faulty grounding	
	Low battery voltage	
	Excessive clearance between wheel speed sensor and rotor (Lamp condition: ②)	

ON-VEHICLE INSPECTION AND ADJUSTMENT

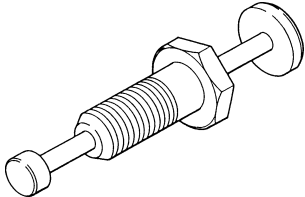
Adjustment of Wheel Speed Sensor Clearance <Air-Over hydraulic brake>

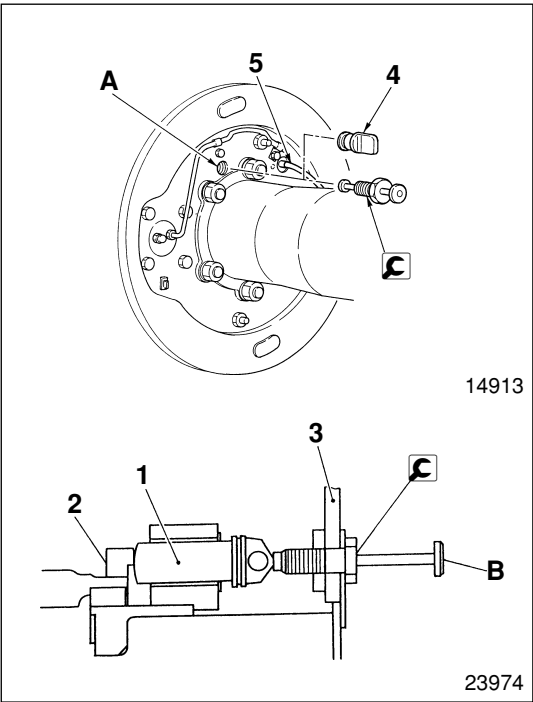
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
7	Bolt (Anchor bracket mounting)	135 {100, 13.8}	—

Special tools

Location	Tool name and shape	Part No.	Application
1	Adjuster 	MH062080	Adjustment of wheel speed sensor clearance



Tighten  adjuster to extend wheel speed sensor 1, and adjust clearance between the sensor and rotor 2.

- Remove plug 4 located on the back side of back plate 3.
- Mount  adjuster in adjustment hole A, and tighten the adjuster.
- Wheel speed sensor 1 contacts the rotor before  adjuster is completely tightened. Therefore, do not press shaft B, and tighten the adjuster until resistance is felt.
- Be sure to reinstall plug 4 after adjustment.

5 : Wheel speed sensor harness

Inspection of Wheel Speed Sensor Signal Waveform Using Oscilloscope

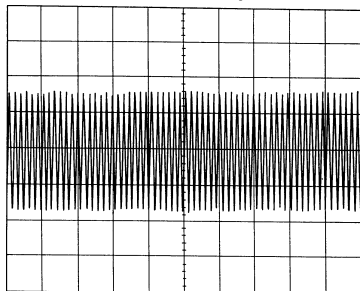
Inspect the rotor for dents using an oscilloscope, since the tester cannot be used for dent detection.

NOTE

Use an oscilloscope with a waveform recording function.

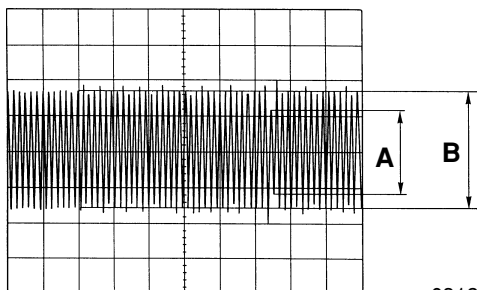
- Lift the wheel to be tested off the ground, and disconnect the connector at the wheel speed sensor.
- Connect the terminal of the oscilloscope to the terminal of the disconnected connector. Rotate the wheel at a constant speed. Check the waveform shown on the oscilloscope to check for dents on the rotor.
- Rotor dents are often made by the rotor press-fit on the hub end contacting the axle during installation of the hub and brake drum assembly on the axle. When installing the hub & brake drum assembly, pay close attention to prevent the rotor from contacting other parts.

Normal waveform (no dent on rotor)



03122

Abnormal waveform (with dents on rotor)



03123

A : Vmin (Minimum peak)

B : Vmean (Average of maximum peaks)

$$\frac{V_{\text{mean}} - V_{\text{min}}}{V_{\text{mean}}} = 0.2(20\% \text{ or lower})$$

If more than 20%, replace the rotor.

TROUBLESHOOTING

Inspection Procedures

Diagnostic Function

- Whenever the starter switch is placed at ON, the diagnostic function is activated to check all the sensors, etc. If any of them is found faulty, the ABS warning lamp in the meter cluster is lit to alert the driver. At the same time, the fault location is stored in memory, and the system enters the backup mode.
- The stored fault location can be read as a diagnostic trouble code by the Multi-Use Tester or the diagnosis switch.

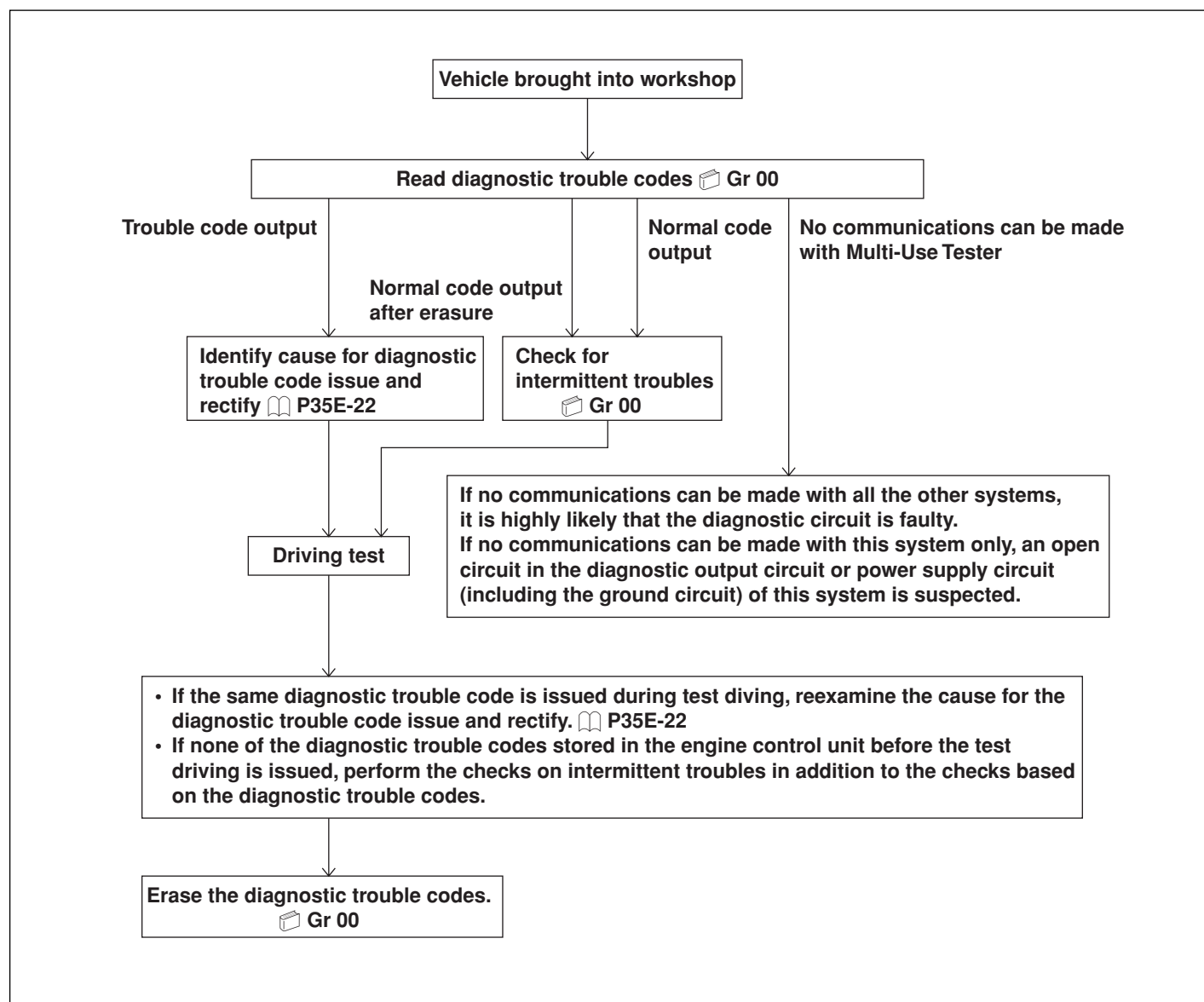
CAUTION

- Check to ensure that the battery voltage is within the specified range.
 - Check all the harness and device connectors for looseness. Always remove a connector at least 20 seconds after placing the starter switch at the LOCK position.
 - Do not forget to clear the diagnostic trouble code by the Multi-Use Tester or memory clear switch after a fault has been rectified.
 - As a rule, inspection operations should be performed with the starter switch at the LOCK position. Some checks, however, may have to be made with the starter switch at the ON position. In such a case, use care to make sure that no short circuit develops between pins of the connectors or with the body.
 - The resistance value of each component is affected by the temperature and the accuracy of the tester. The reading therefore, does not always fall within the standard limits. Note that the check values shown in the text are the values obtained at normal temperature (10 to 35°C {58 to 95°F}).
 - Whether or not the system automatically returns to normal from the backup mode after a fault has been removed depends on the diagnostic trouble code (fault location). When the system returns to normal, the warning lamp will be OFF.
 - Even when the fault has been removed and the system has been automatically returned to the normal mode, the diagnostic trouble code of the fault remains stored in the engine control unit.
 - When a fault occurs at a point where the system is not automatically reset, perform the memory clear procedure to let the system exit from the backup mode.  Gr 00
-

Inspection Flowchart

The system inspection can be performed effectively by use of the Multi-Use Tester. The types of system inspections may be broadly divided as shown below in accordance with the trouble symptoms and diagnostic trouble code outputs.

- Inspections based on diagnostic trouble codes stored in the engine control unit
- Inspections of intermittent troubles



TROUBLESHOOTING

Diagnosis Code Chart

Multi-Use Tester II indication		Possible cause
Diagnosis code	Problem location	
11	NO ERR	Normal
21	FL-SNSR GAP	Front-axle left-wheel speed sensor: Improper clearance
22	FL-ROTA	Excessive wobbling of front-axle left rotor
23	FL-ROTA	Damaged front-axle left rotor
24	FL-SNSR SHORT	Front-axle left-wheel speed sensor: Prolonged period of unstable output
25	FL-SNSR OPEN	Front-axle left-wheel speed sensor: Abnormally fast speed drop
26	FL-SNSR WIRE	Front-axle left-wheel speed sensor: Short-circuit to positive (+) wire, short-circuit to grounding wire, broken wire
27	FL-SNSR electronic control unit	Front-axle left-wheel speed sensor: Electronic control unit internal damage
31	FR-SNSR GAP	Front-axle left-wheel speed sensor: Improper clearance
32	FR-ROTA	Excessive wobbling of front-axle right rotor
33	FR-ROTA	Damaged front-axle right rotor
34	FR-SNSR SHORT	Front-axle right-wheel speed sensor: Prolonged period of unstable output
35	FR-SNSR OPEN	Front-axle right-wheel speed sensor: Abnormally fast speed drop
36	FR-SNSR WIRE	Front-axle right-wheel speed sensor: Short-circuit to positive (+) wire, short-circuit to grounding wire, broken wire
37	FR-SNSR electronic control unit	Front-axle right-wheel speed sensor: Electronic control unit internal damage
41	RL-SNSR GAP	Rear-axle right-wheel speed sensor: Improper clearance
42	RL-ROTA	Excessive wobbling of rear-axle left rotor
43	RL-ROTA	Damaged rear-axle left rotor
44	RL-SNSR SHORT	Rear-axle left-wheel speed sensor: Prolonged period of unstable output
45	RL-SNSR OPEN	Rear-axle left-wheel speed sensor: Abnormally fast speed drop
46	RL-SNSR WIRE	Rear-axle left-wheel speed sensor: Short-circuit to positive (+) wire, short-circuit to grounding wire, broken wire
47	RL-SNSR electronic control unit	Rear-axle left-wheel speed sensor: Electronic control unit internal damage
51	RR-SNSR GAP	Rear-axle right-wheel speed sensor: Improper clearance
52	RR-ROTA	Excessive wobbling of rear-axle right rotor
53	RR-ROTA	Damaged rear-axle right rotor
54	RR-SNSR SHORT	Rear-axle right-wheel speed sensor: Prolonged period of unstable output
55	RR-SNSR OPEN	Rear-axle right-wheel speed sensor: Abnormally fast speed drop
56	RR-SNSR WIRE	Rear-axle right-wheel speed sensor: Short-circuit to positive (+) wire, short-circuit to grounding wire, broken wire
57	RR-SNSR electronic control unit	Rear-axle right-wheel speed sensor: Electronic control unit internal damage
61	F-DV 2BATT	Front-axle control valve: Short-circuit of outlet valve to positive (+) wire
62	F-DV 2GND	Front-axle control valve: Short-circuit of outlet valve to grounding wire
63	F-DV OPEN	Front-axle control valve: Broken wire in outlet valve
64	F-SOL OPEN	Front-axle control valve: Broken grounding wire
68	VALVE CONFIG	Front-axle control valve: Configuration error (*1)
75	F-HV 2BATT	Front-axle control valve: Short-circuit of holding valve to positive (+) wire
76	F-HV 2GND	Front-axle control valve: Short-circuit of holding valve to grounding wire
77	F-HV OPEN	Front-axle control valve: Broken wire in holding valve
78	VALVE CONFIG	Front-axle control valve: Configuration error (*1)
81	RL-DV 2BATT	Rear-axle left-wheel control valve: Short-circuit of outlet valve to positive (+) wire
82	RL-DV 2GND	Rear-axle left-wheel control valve: Short-circuit of outlet valve to grounding wire
83	RL-DV OPEN	Rear-axle left-wheel control valve: Broken wire in outlet valve
84	RL-SOL OPEN	Rear-axle left-wheel control valve: Broken grounding wire
85	RL-HV 2BATT	Rear-axle left-wheel control valve: Short-circuit of holding valve to positive (+) wire
86	RL-HV 2GND	Rear-axle left-wheel control valve: Short-circuit of holding valve to grounding wire
87	RL-HV OPEN	Rear-axle left-wheel control valve: Broken wire in holding valve
89	SOL 2BATT	Control valve grounding 2: Short-circuit to positive (+) wire
8A	SOL 2GND	Control valve grounding 2: Short-circuit to negative (-) wire

Multi-Use Tester II indication		Possible cause
Diagnosis code	Problem location	
91	RR-DV 2BATT	Rear-axle right-wheel control valve: Short-circuit of outlet valve to positive (+) wire
92	RR-DV 2GND	Rear-axle right-wheel control valve: Short-circuit of outlet valve to grounding wire
93	RR-DV OPEN	Rear-axle right-wheel control valve: Broken wire in outlet valve
94	RR-SOL OPEN	Rear-axle right-wheel control valve: Broken grounding wire
95	RR-HV 2BATT	Rear-axle right-wheel control valve: Short-circuit of holding valve to positive (+) wire
96	RR-HV 2GND	Rear-axle right-wheel control valve: Short-circuit of holding valve to grounding wire
97	RR-HV OPEN	Rear-axle right-wheel control valve: Broken wire in holding valve
99	SOL 2BATT	Control valve grounding 1: Short-circuit to positive (+) wire
9A	SOL 2GND	Control valve grounding 1: Short-circuit to negative (-) wire
D1	Electronic control unit ERR	Electronic control unit internal damage
D2	EEPROM ERR	Electronic control unit internal damage
D3	CAN RAM ERR	Electronic control unit internal damage
D4	Electronic control unit RLY ERR	Electronic control unit internal damage
D5	Electronic control unit RLY ERR	Electronic control unit internal damage
E1	SOL OVER VOLT	Control valve power supply voltage 1: Overvoltage
E2	SOL LOW VOLT	Control valve power supply voltage 1: Low voltage
E3	SOL OPEN	Control valve power supply voltage 1: Broken wire
E4	SOL OPEN	Control valve grounding 1: Broken wire
E5	SOL OVER VOLT	Control valve power supply voltage 2: Overvoltage
E6	SOL LOW VOLT	Control valve power supply voltage 2: Low voltage
E7	SOL OPEN	Control valve power supply voltage 2: Broken wire
E8	SOL OPEN	Control valve grounding 2: Broken wire
E9	Electronic control unit OVER VOLT	Electronic control unit power supply voltage: Overvoltage
EA	Electronic control unit LOW VOLT	Electronic control unit power supply voltage: Low voltage
EB	SOL VOLT ERR	Excessive voltage difference between control valve power supply voltages 1 and 2
F1	EXB RLY OPEN	Exhaust brake cut relay: Short-circuit to positive (+) wire, broken wire
F2	EXB RLY 2GND	Exhaust brake cut relay: Short-circuit to grounding wire
F5	ILLEGAL WHEEL	Wheel arrangement error: Excessive wheel speed difference between front and rear wheels
F6	ILLEGAL WHEEL	Wheel arrangement error: Wheel speed difference between front and rear wheels exceeding allowed range

*1 : Configuration error (mismatch between vehicle system and Electronic control unit system)

TROUBLESHOOTING

Service Data Chart

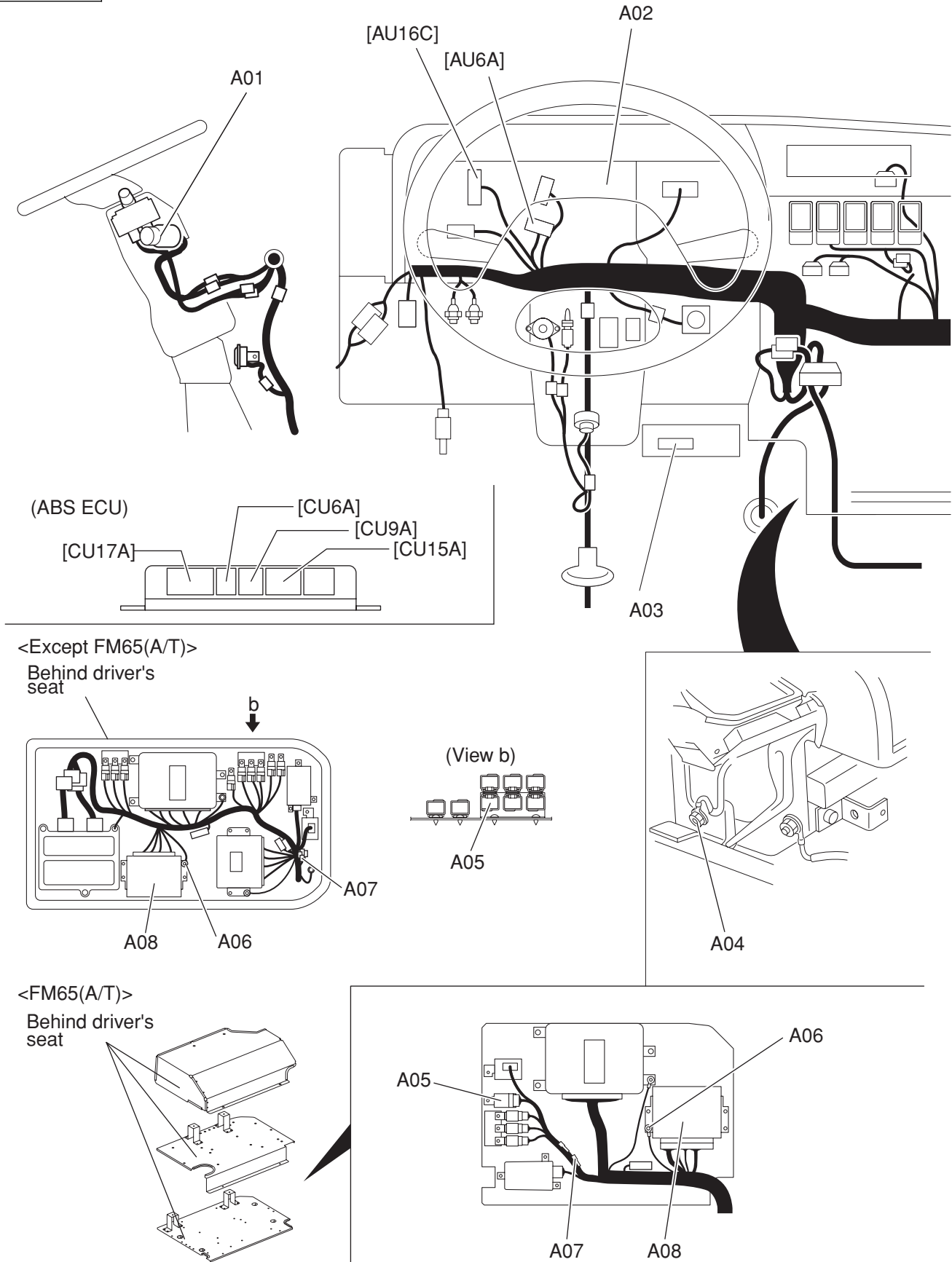
Multi-Use Tester II indication			Data description	Inspection condition	Judgement criterion
Item No.	Item name	Service data			
21	SPEED FL	■■■■.■MPH	Front-axle left-wheel speed	Drive at constant speed.	Should synchronize with speedometer
22	SPEED FR	■■■■.■MPH	Front-axle right-wheel speed		
23	SPEED RL	■■■■.■MPH	Rear-axle left-wheel speed		
24	SPEED RR	■■■■.■MPH	Rear-axle right-wheel speed		
25	GAP SPEED FL	■■■■.■MPH	Front-axle left-wheel speed sensor clearance	Drive prior to inspection.	Less than 8.7 MPH
26	GAP SPEED FR	■■■■.■MPH	Front-axle right-wheel speed sensor clearance		
27	GAP SPEED RL	■■■■.■MPH	Rear-axle left-wheel speed sensor clearance		
28	GAP SPEED RR	■■■■.■MPH	Rear-axle right-wheel speed sensor clearance		
35	VALVE VOLTAGE	■■.■■V	Front-axle control valve power supply voltage	Starter switch OFF	Same as battery voltage
36	VALVE VOLTAGE	■■.■■V	Rear-axle control valve power supply voltage		
45	BATT VOLTAGE	■■.■■V	Electronic control unit power supply voltage	Starter switch ON	Same as battery voltage
51	DIAGNOSIS switch	OPEN/CLOSE	Diagnosis switch connector	Diagnosis switch connector in connection	ON
52	RR-DV	ON/OFF	Rear-axle right-wheel control valve	In all conditions	ON/OFF
54	RR-HV	ON/OFF		In all conditions	ON/OFF
55	RL-DV	ON/OFF	Rear-axle left-wheel control valve	In all conditions	ON/OFF
56	RL-HV	ON/OFF		In all conditions	ON/OFF
58	F-HV	ON/OFF	Front-axle control valve	In all conditions	ON/OFF
59	F-DV	ON/OFF		In all conditions	ON/OFF
61	STOP LAMP switch	ON/OFF	Stop lamp switch	Brake pedal depressed	ON
62	EXB CUT RLY	ON/OFF	Exhaust brake cut relay	Exhaust brake in operation	ON

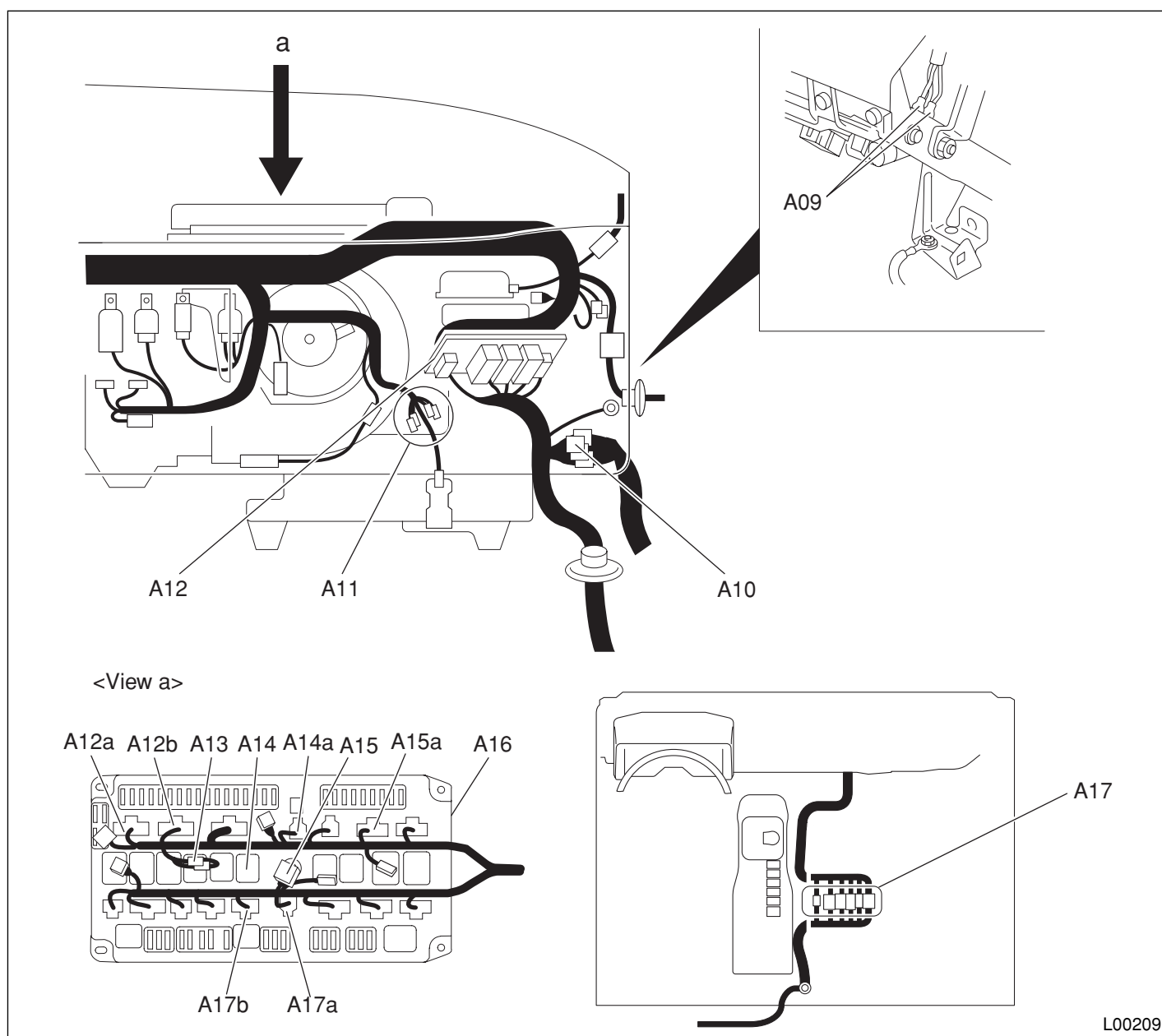
Actuator Drive Chart

MULTI-USE TESTER II indication		Operation description
Item No.	Item name	
06	F-HV ON	Holding valve of front-axle control valve: ON
07	RL-HV ON	Holding valve of rear-axle left-wheel control valve: ON
08	RR-HV ON	Holding valve of rear-axle right-wheel control valve: ON
09	F-DV ON	Outlet valve of front-axle control valve: ON
11	RL-DV ON	Outlet valve of rear-axle left-wheel control valve: ON
12	RR-DV ON	Outlet valve of rear-axle right-wheel control valve: ON
15	EXB RLY ON	Exhaust brake cut relay: ON
16	EXB RLY OFF	Exhaust brake cut relay: OFF
19	Anti-lock brake system LAMP ON	 warning lamp: ON
20	Anti-lock brake system LAMP OFF	 warning lamp: OFF

LOCATIONS OF PARTS

A 01 to 20





No relevant parts in a missing number

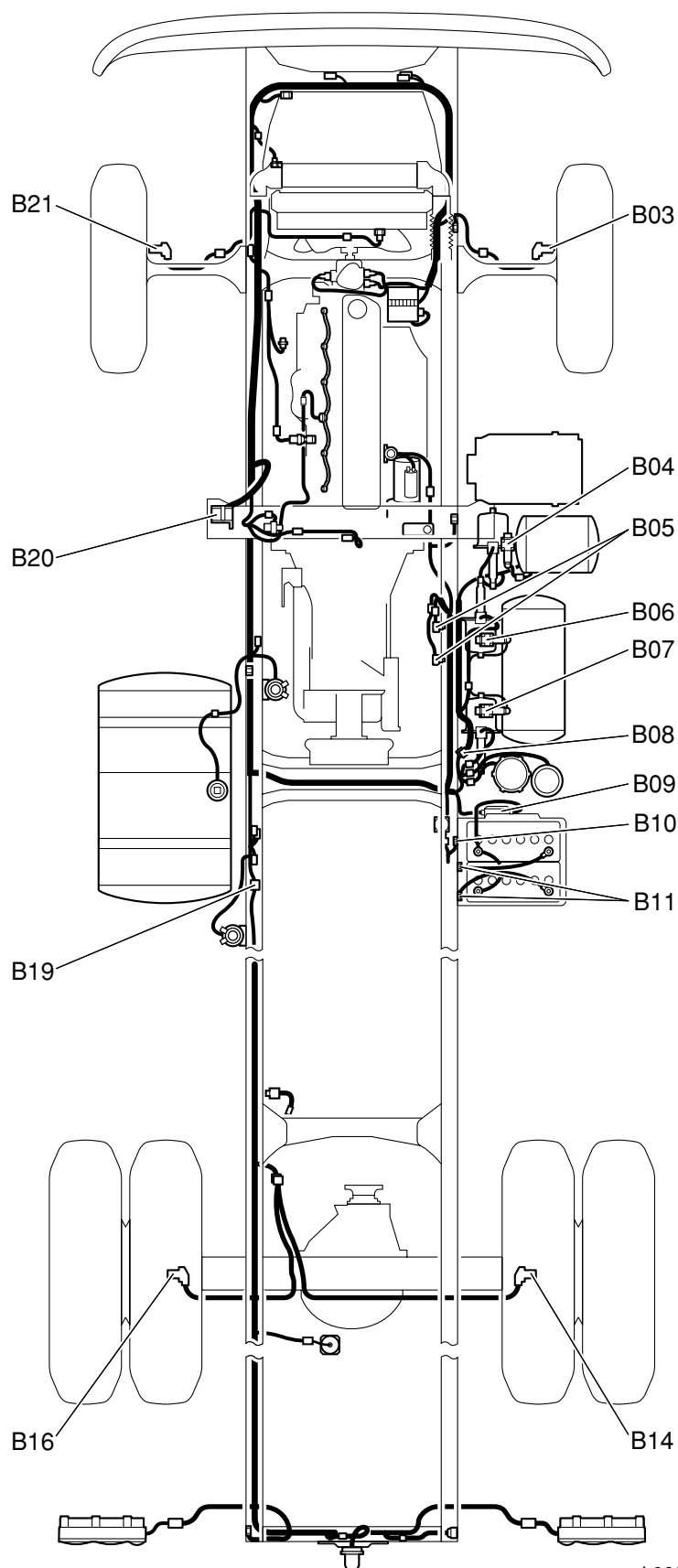
- | | |
|---|--|
| A01 Starter switch | A13 Diagnosis switch and memory clear switch (anti-lock brake system electronic control unit) |
| A02 Meter cluster | A14 Stop lamp relay |
| A03 Multi-use tester connector (for inspection) | A15 Multi-use tester connector (for recorder) |
| A04 Ground | A16 Relay and fuse box |
| A05 Exhaust brake cut relay | A17 Connection of cab harness and bed harness |
| A06 Electronic control unit case ground | |
| A07 Diode unit | |
| A08 Anti-lock brake system electronic control unit | |
| A09 Ground | |
| A10 Connection of bed harness and chassis harness | |
| A11 Diode unit | |
| A12 Connection of cab harness and chassis harness | |

Indicate by connector type and color [].
[Connector type: connector color]

LOCATIONS OF PARTS

B 01 to 25

<FK,FM61,FM64>



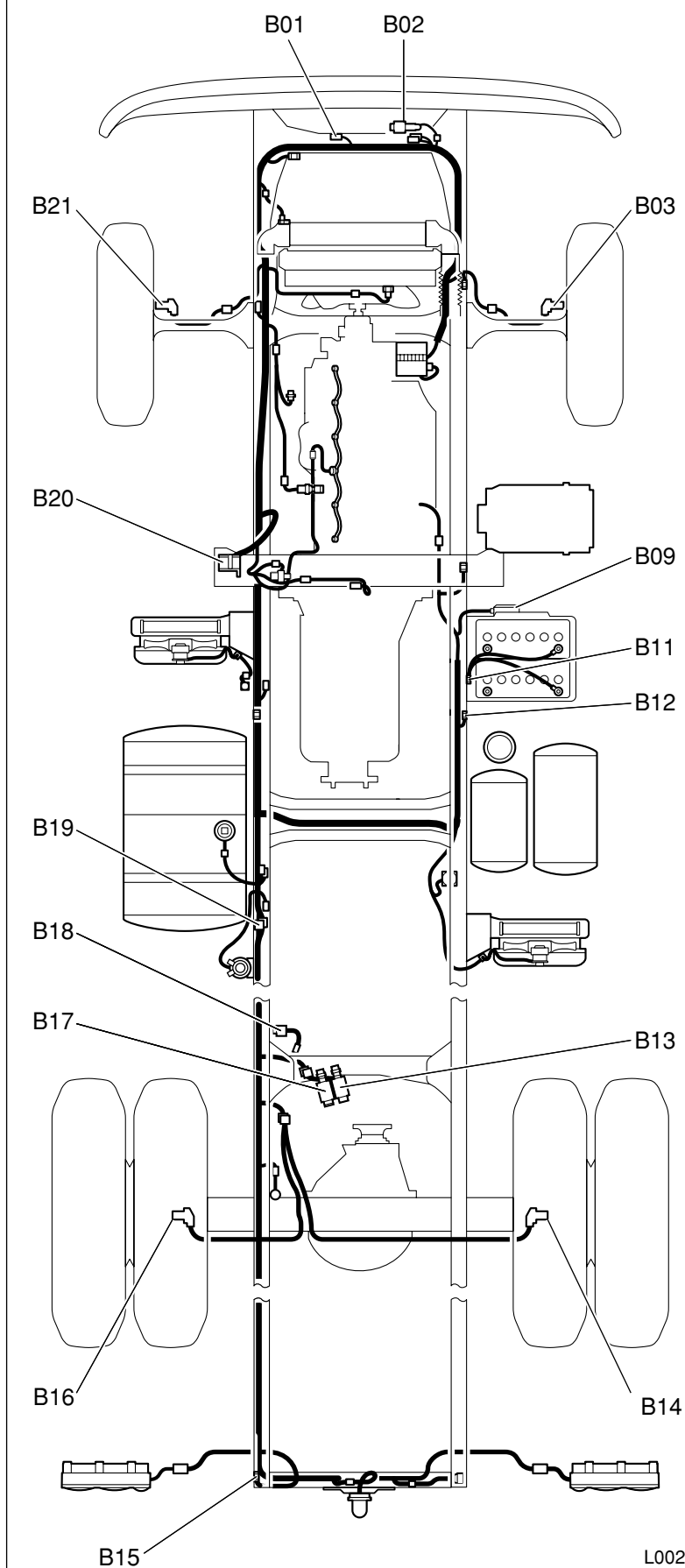
No relevant parts in a missing number

- B03** Front wheel speed sensor, RH
- B04** Front anti-lock brake system control valve
- B05** Stop lamp switch
- B06** Rear anti-lock brake system control valve, LH
- B07** Rear anti-lock brake system control valve, RH
- B08** Connection of chassis harness and anti-lock brake system harness
- B09** Main high-current fuse
- B10** Ground
- B11** Battery ground
- B14** Rear wheel speed sensor, RH
- B16** Rear wheel speed sensor, LH
- B19** Connection of chassis harness and rear chassis harness
- B20** High-current fuse box
- B21** Front wheel speed sensor, LH

L00210

B 01 to 25

<FM65>

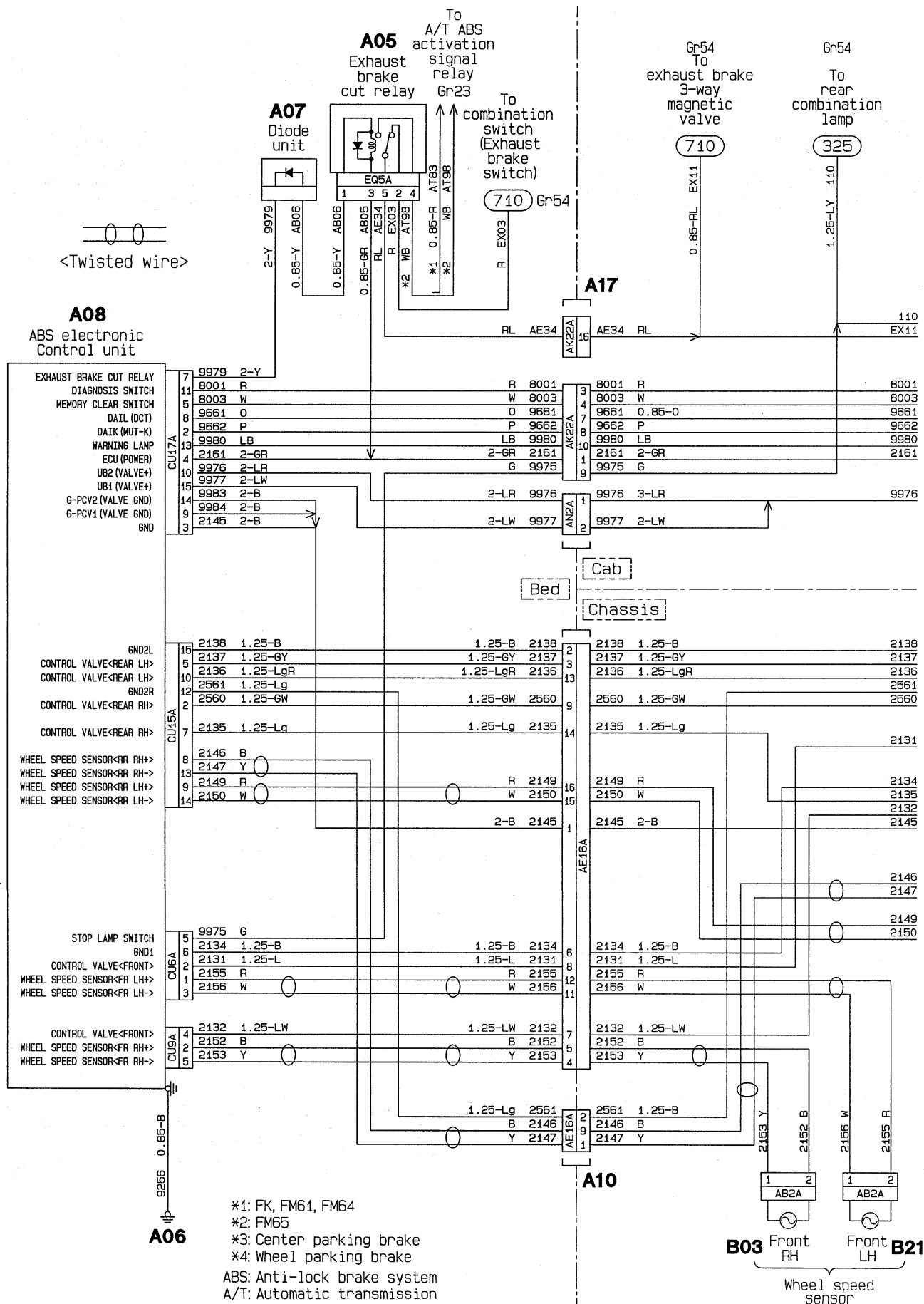


No relevant parts in a missing number

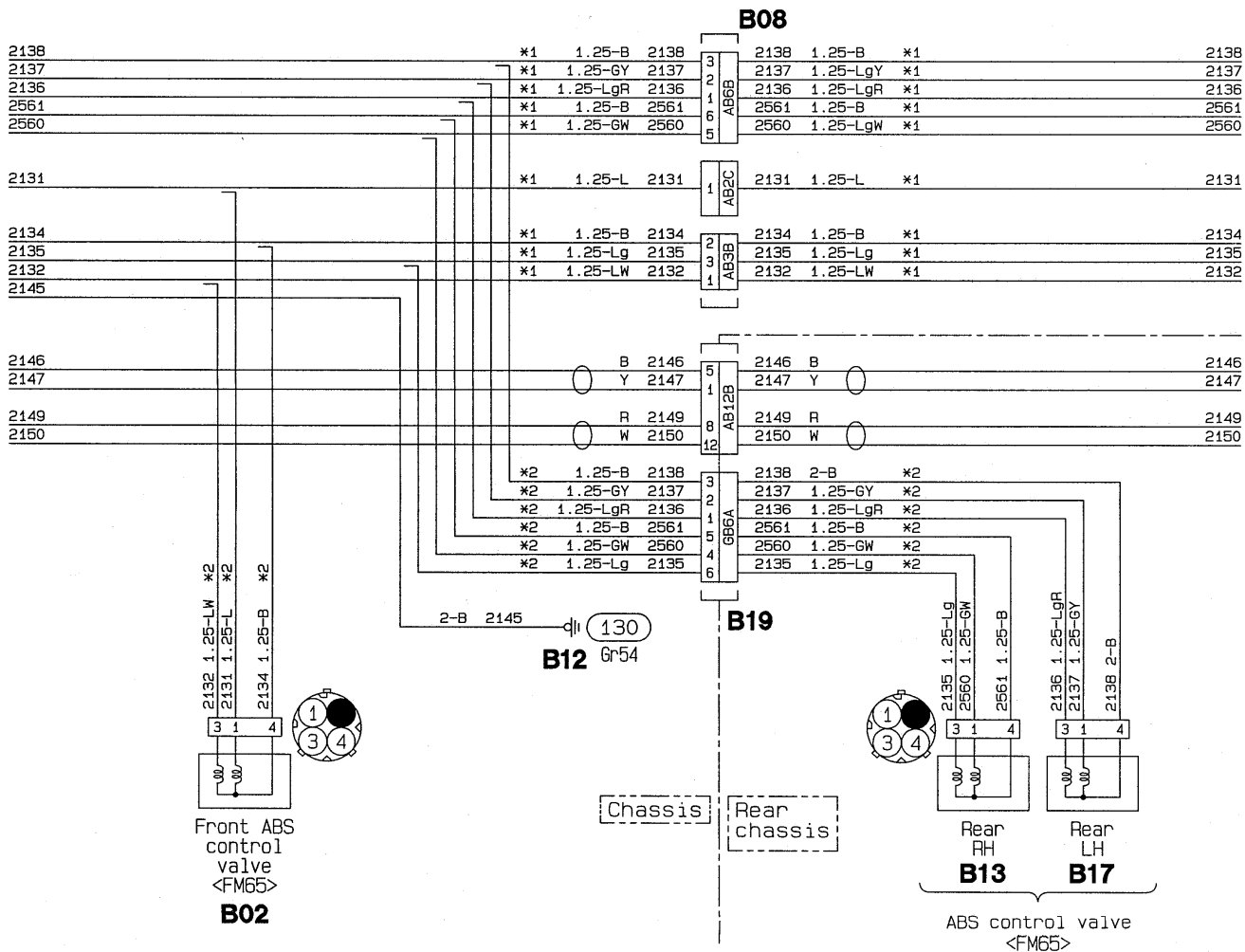
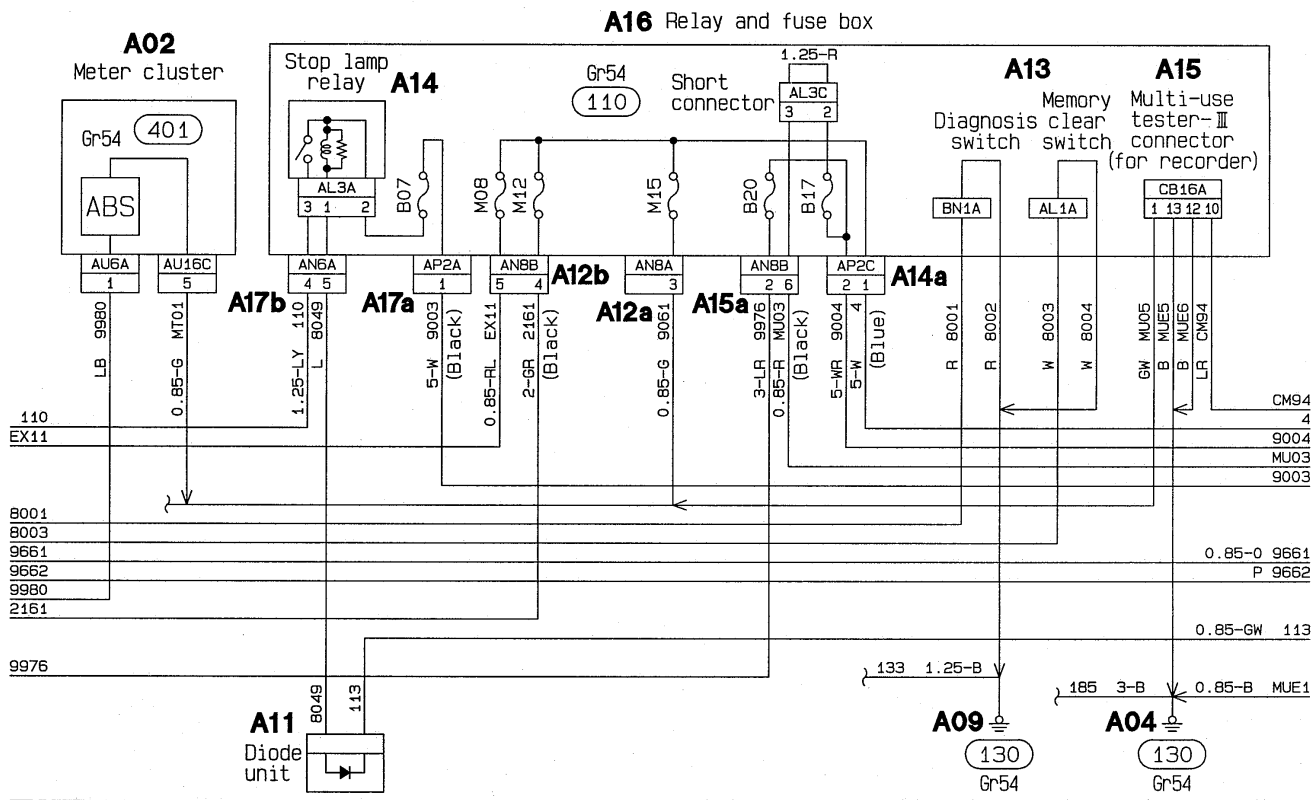
- B01** Stop lamp switch
- B02** Front anti-lock brake system control valve
- B03** Front wheel speed sensor, RH
- B09** Main high-current fuse
- B11** Battery ground
- B12** Ground
- B13** Rear anti-lock brake system control valve, RH
- B14** Rear wheel speed sensor, RH
- B15** Ground
- B16** Rear wheel speed sensor, LH
- B17** Rear anti-lock brake system control valve, LH
- B18** Stop lamp switch
- B19** Connection of chassis harness and rear chassis harness
- B20** High-current fuse box
- B21** Front wheel speed sensor, LH

L00211

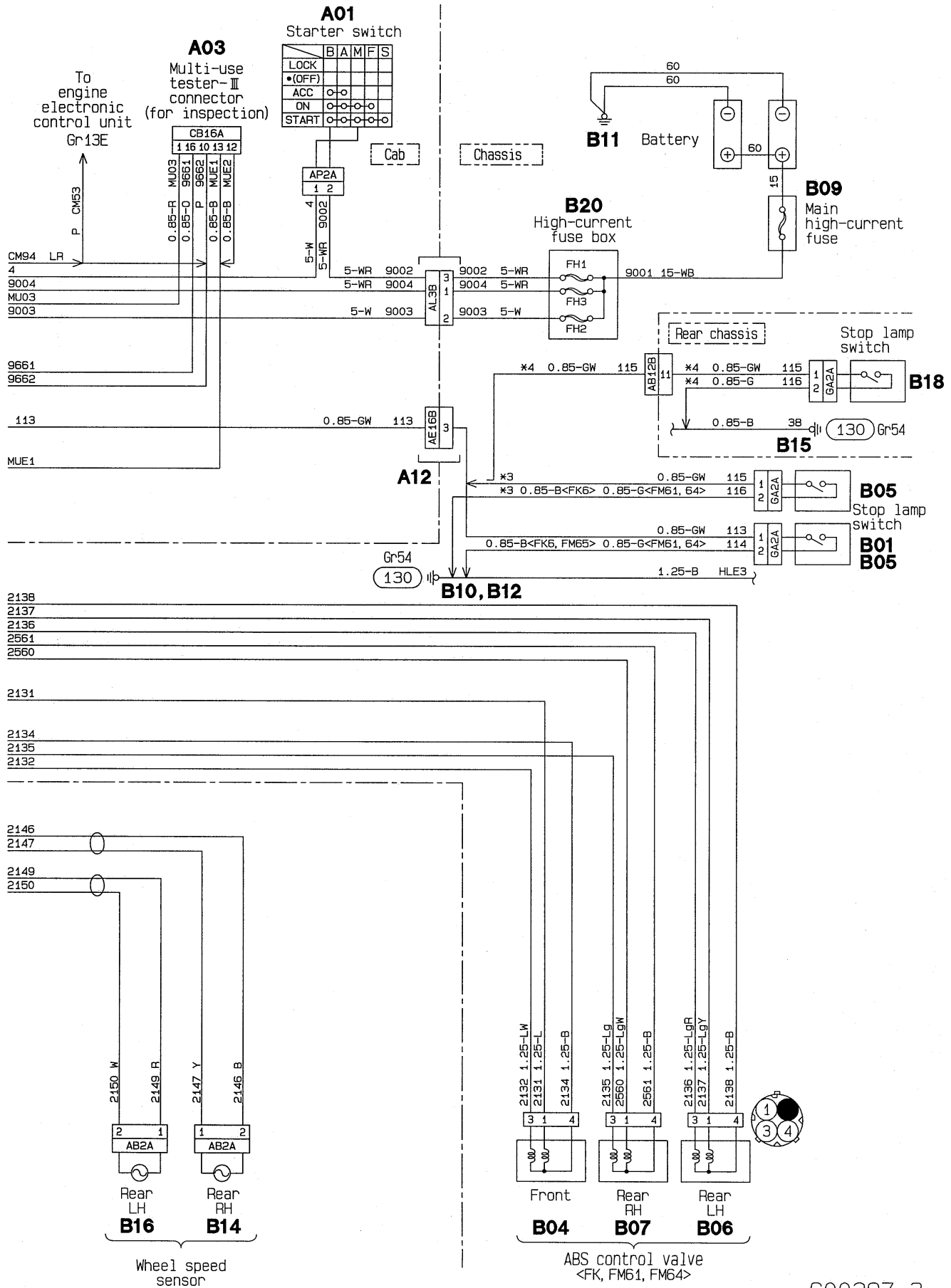
ELECTRICAL WIRING DIAGRAM



C00297-1



ELECTRICAL WIRING DIAGRAM



C00297-3



36A - Parking Brake <Center Parking Brake>

36B - Parking Brake <Wheel Parking Brake>

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 36A

Parking Brake

<Center Parking Brake>

Table of Contents

BACK

HOME

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	36A- 2
STRUCTURE AND OPERATION	36A- 2
TROUBLESHOOTING	36A- 4
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Adjustment of Parking Brake Shoe Clearance and Lever Stroke	36A- 5
PARKING BRAKE CONTROL	36A- 6
PARKING BRAKE ASSEMBLY	36A- 8
SUPPORT PLATE AND SHOE ASSEMBLY	36A-12

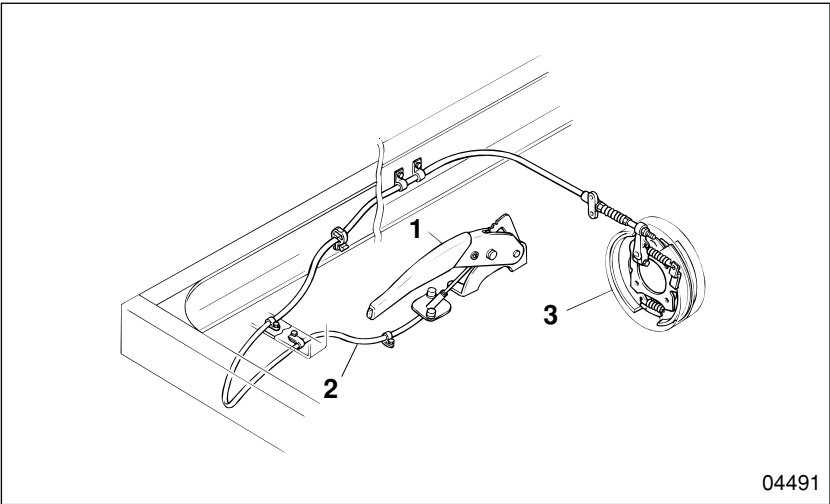
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item		Vehicle model	FK, FM61, FM64	
			A/T	M/T
Brake	Type	Propeller shaft internal expanding type brake		
	Operation type	Mechanical cable type		
Parking brake assembly	Type	Duo-servo type		
	Inner diameter of drum mm {in.}	ø254 {10}		
	Lining width×Thickness mm {in.}	60×2.65 {2.36×0.10}		60×2.95 {2.36×0.12}

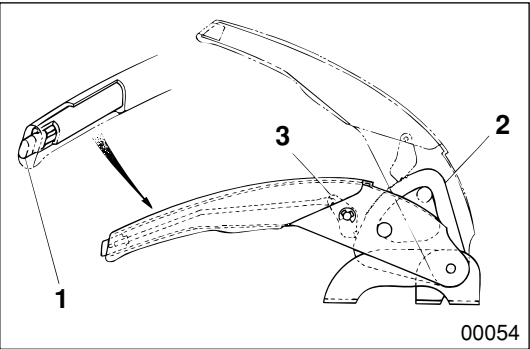
STRUCTURE AND OPERATION

Parking Brake Control



- 1 Parking brake lever
- 2 Parking brake cable
- 3 Parking brake assembly

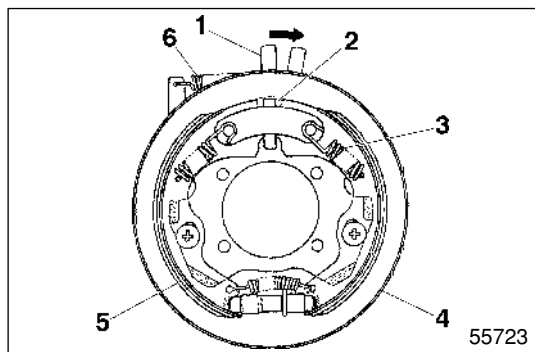
Parking Brake Lever



- 1 Release rod knob
- 2 Lever bracket
- 3 Locking latch

The parking brake has a built-in locking mechanism that prevents inadvertent release of the brake.
To release locking, push release rod knob 1 which will disengage from the serration of lever bracket 2 and the tooth of locking latch 3 freeing the parking brake lever and allowing it to return.

Parking Brake Assembly < Dual-servo Type >



- 1 Camshaft lever
- 2 Camshaft
- 3 Shoe return spring
- 4 Brake drum
- 5 Shoe and lining assembly
- 6 Camshaft lever return spring

Pulling the parking brake lever pulls the parking brake cable, which in turn pulls camshaft lever **1**. At the same time, camshaft **2** rotates in conjunction with the camshaft lever, and expands shoe and lining assembly **5** making it press against brake drum **4**. This frictional force locks the propeller shaft that is connected to the drum. When the brake lever is released, the repercussive force of shoe return spring **3** releases the brake.

TROUBLESHOOTING

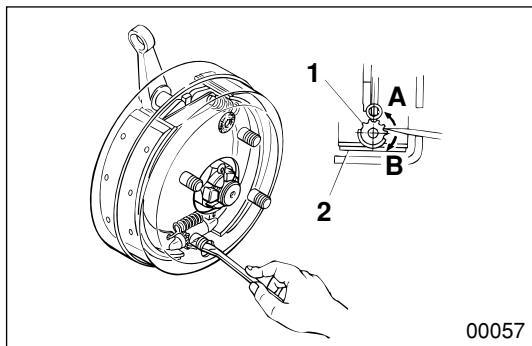
Possible causes		Symptoms				Remarks
		Parking brake does not work	Parking brake does not release smoothly (dragging)	Too light parking brake operating force	Too heavy parking brake operating force	
Parking brake cable	Inner cable stretched or damaged	☐	☐	☐	☐	
	Inner cable rusted	☐	☐	☒	☐	
Parking brake lever	Locking ratchet and lever bracket serration engagement faulty	☐				
	Pulling stroke insufficient		☐		☐	
	Pulling stroke excessive	☐		☐		
Parking brake assembly	Shoe clearance insufficient		☐		☐	
	Shoe clearance excessive	☐		☐		
	Parking brake drum inner surface deformed or distorted	☐		☐		
	Parking brake drum inner surface greasy or oily	☐		☒		
	Linings worn unevenly	☐		☐		
	Lining surface greasy or oily	☐				
	Camshaft lever return spring permanently set or fractured		☐			
	Shoe return spring fatigued or fractured		☐			

Adjustment of Parking Brake Shoe Clearance and Lever Stroke

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Brake shoe clearance	0.1 to 0.25 {0.0039 to 0.0098}	—	Adjust
3	Brake lever pulling stroke (at operation force of 490 N {110 lbf, 50 kgf})	7 to 10 notches	—	Adjust

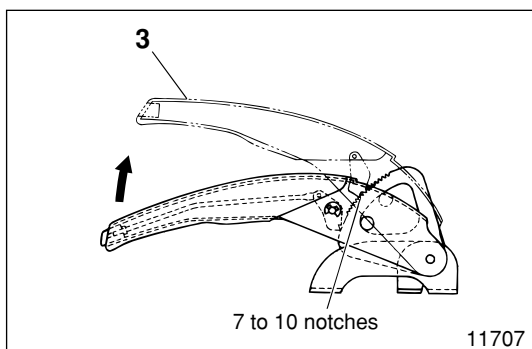


(1) Shoe clearance

When the camshaft lever is released, turn adjusting screw **1** in the expansion direction, using a screwdriver inserted through the shoe adjusting hole of the brake drum, and return 8 notches from the position where shoe **2** is in close contact with the drum. Then, the shoe clearance will be the standard value.

A : Expansion

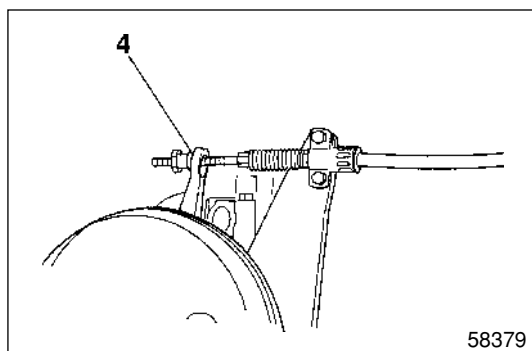
B : Contraction



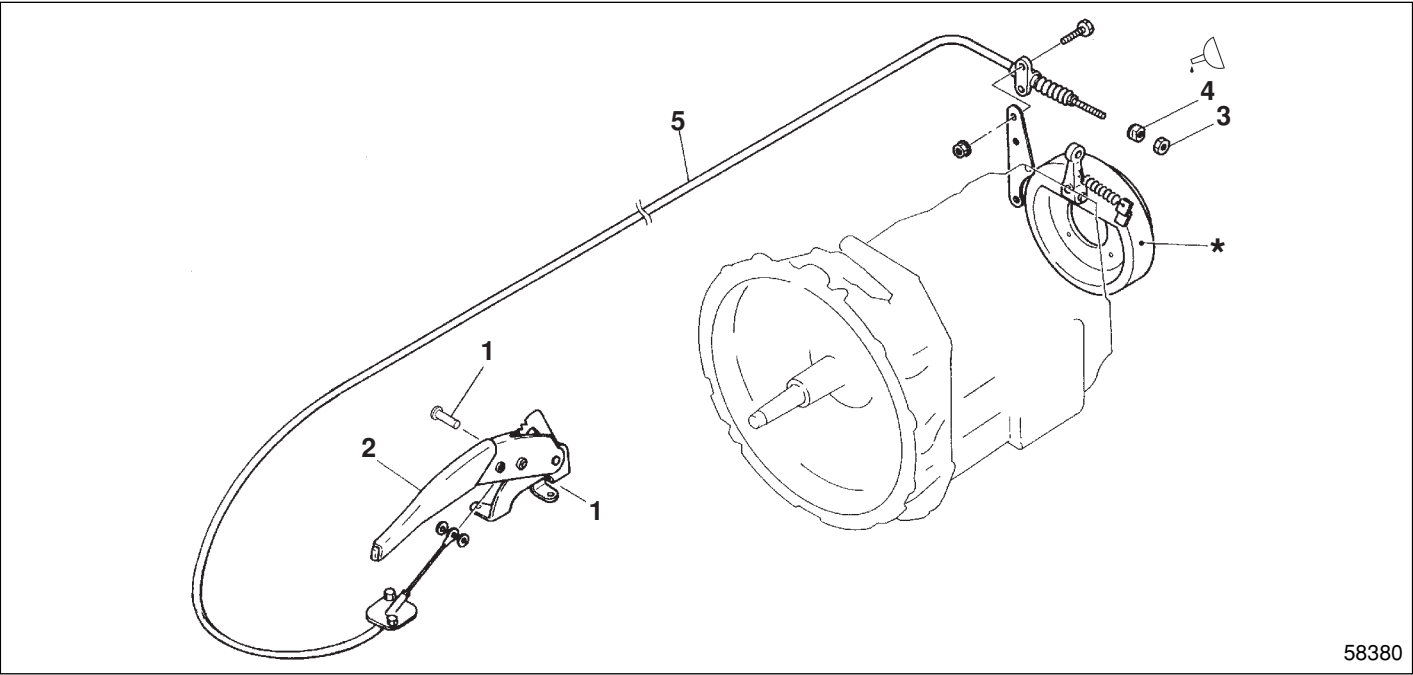
(2) Lever pulling stroke

Adjust camshaft lever lock nut and ball bushing **4** so that the number of notches (clicks heard) is the standard value when parking brake lever **3** is pulled from the released position by an operating force of 490 N {110 lbf, 50 kgf}.

Operate the parking brake lever two or three times after adjusting to verify the pulling stroke, to make sure that the parking brake is operating properly and that the parking brake drum does not drag when the parking brake is released.



PARKING BRAKE CONTROL



● Removal sequence

- 1 Clevis pin
- 2 Parking brake lever assembly P36A-7
- 3 Camshaft lever lock nut
- 4 Ball bushing
- 5 Parking brake cable

* : Parking brake assembly P36A-8

WARNING

- You must place wheel chocks securely in place to prevent the vehicle from moving.
- Do not remove the chocks until the entire operation is completed.

● Installation sequence

Follow the removal sequence in reverse.

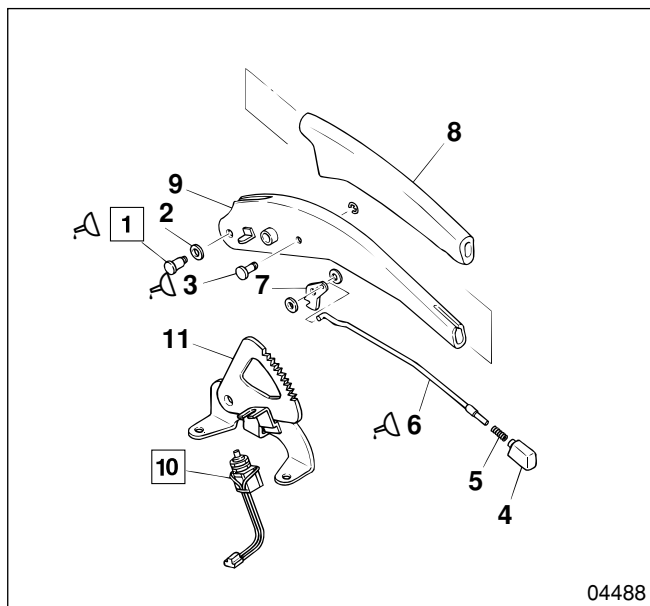
CAUTION

- Do not soil camshaft lever lock nut 3 with grease when it is installed.

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Spherical part of ball bushing	Chassis grease [NLGI No.1 (Li soap)]	As required

Parking Brake Lever Assembly



● Disassembly sequence

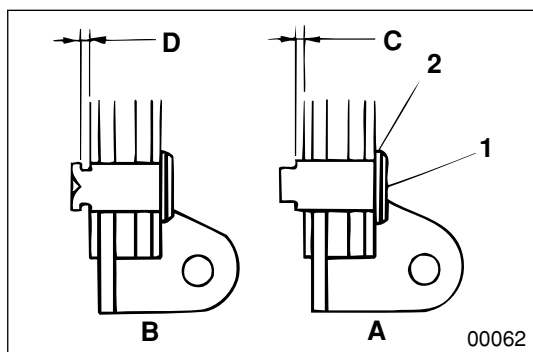
- 1 Pin
- 2 Spacer
- 3 Pin
- 4 Release rod knob
- 5 Return spring
- 6 Release rod
- 7 Locking latch
- 8 Grip
- 9 Parking brake lever
- 10 Parking brake switch Gr 54
- 11 Lever bracket

● Assembly sequence

Follow the disassembly sequence in reverse.

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1, 3	Rotating area and friction surface of pins	Chassis grease [NLGI No.1 (Li soap)]	As required
6	Thread area of release rod	Cemedine 1500	As required



◆ Service procedure

1 Installation of pin

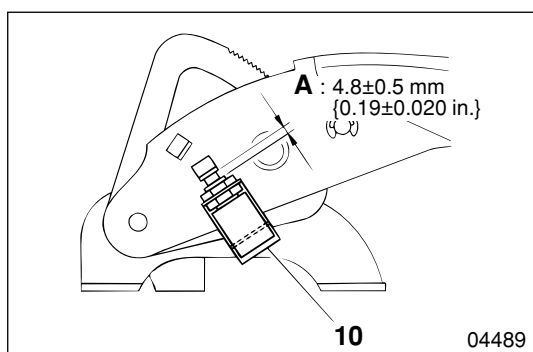
A : Before caulking

B : After caulking

When clearance **C** before caulking is less than 0.6 mm {0.024 in.}, do not use spacer **2**.

Also, use spacer to adjust if it is 0.6 to 0.96 mm {0.024 to 0.038 in.}.

	Without spacer	With spacer
Dimension D	0.06 to 0.6 mm {0.0024 to 0.024 in.}	0 to 0.36 mm {0 to 0.014 in.}

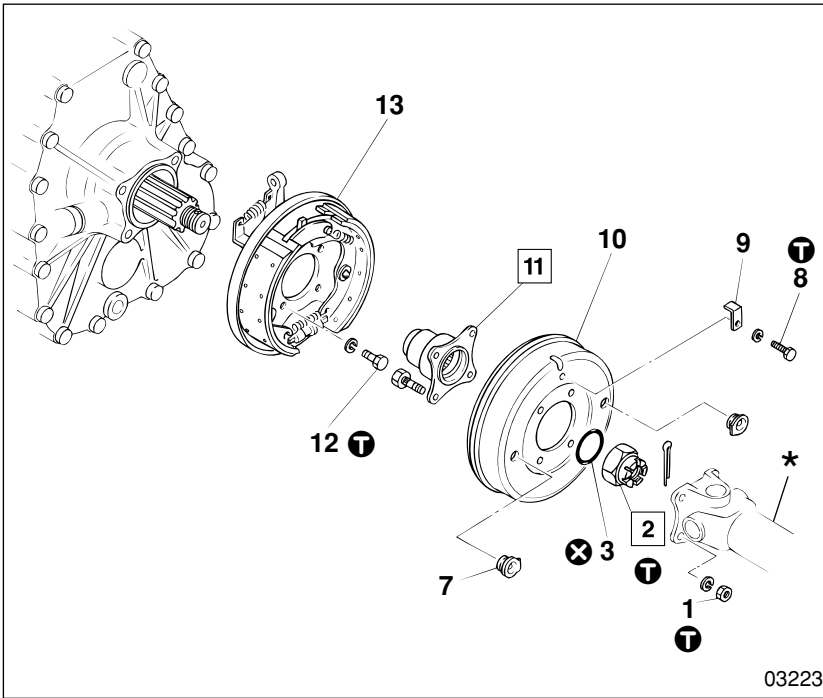


10 Installation of parking brake switch

Install parking brake switch **10** so that the stroke equals **A**.

PARKING BRAKE ASSEMBLY

< Manual Transmission >



● Inspection before disassembly

📖 P36A-10

● Disassembly sequence

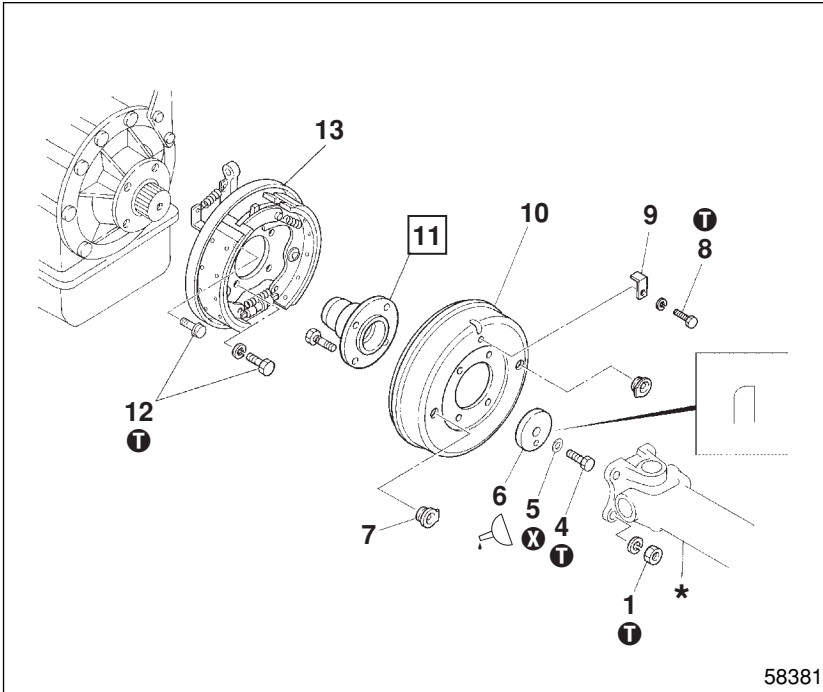
- 1 Nut
- 2 Lock nut
- 3 O-ring
- 4 Flange set bolt
- 5 Sealing washer
- 6 Retainer washer
- 7 Dust plug
- 8 Bolt
- 9 Drum plate
- 10 Parking brake drum
- 11 Companion flange
- 12 Bolt
- 13 Support plate and shoe assembly

📖 P36A-12

* : Propeller shaft 📦 Gr 25

✕ : Non-reusable parts

< Automatic Transmission >



WARNING ⚠

- You must place wheel chocks securely in place to prevent the vehicle from moving.
- Do not remove the chocks until the entire operation is completed.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
10	Parking brake drum	Deflection at mating recession	0.15 {0.0059} or less	0.5 {0.020}	Replace
		Inner diameter	$\varnothing 254.0^{+0.5}_0 \{10^{+0.020}_0\}$	$\varnothing 255.5 \{10.1\}$	Replace
		Squareness	0.05 {0.0020} or less	—	Replace
		Coaxial trueness	$\varnothing 0.1 \{0.0039\}$ or less	—	Replace
		Cylindrical trueness	0.05 {0.0020} or less	—	Replace
		Static revolution unbalance	0.88 N·cm {0.0065 ft.lbs, 90 gf·cm} or less	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

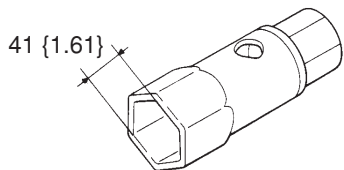
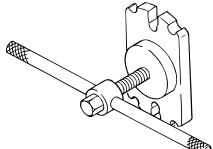
Location	Parts to be tightened		Tightening torque		Remarks
1	Nut (Propeller shaft mounting)		70 to 100 {51 to 72, 7.0 to 10}		—
2	Lock nut (Companion flange mounting)		245 to 343 {180 to 255, 25 to 35}		—
4	Flange set bolt (Companion flange mounting)		M065A5	108 to 136 {80 to 100, 11 to 14}	—
			M100A6	228 to 266 {170 to 195, 23 to 27}	—
8	Bolt (Drum plate mounting)		20 {14, 2}		—
12	Bolt (Support plate and shoe assembly mounting)	Manual transmission	40.2 {30, 4.1}		—
		Automatic transmission	228 to 266 {170 to 195, 23 to 27}		

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
6	Outer periphery of retainer washer	THREEBOND 1215	As required

Special tools

Unit : mm {in.}

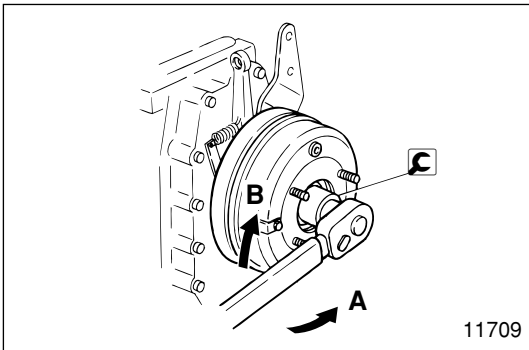
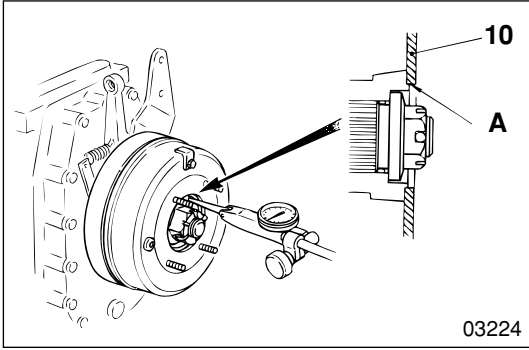
Location	Tool name and shape	Part No.	Application
2	Socket wrench  00069	MH061532	Removal and installation of main shaft rear lock nut < Manual transmission >
10, 11	Flange puller  02153	MH061393	Removal of parking brake drum and companion flange

PARKING BRAKE ASSEMBLY

◆ Service procedure

● Inspection before disassembly

Measure parking brake drum **10** at mating area **A**, and replace the brake drum if the measured value is higher than the limit.

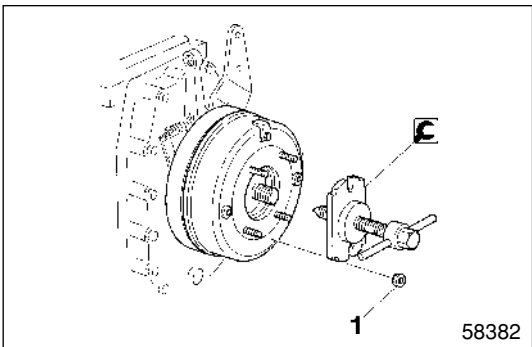


2 Removal and installation of lock nut < Manual transmission >

⌚ : Socket wrench

A : Removal

B : Installation

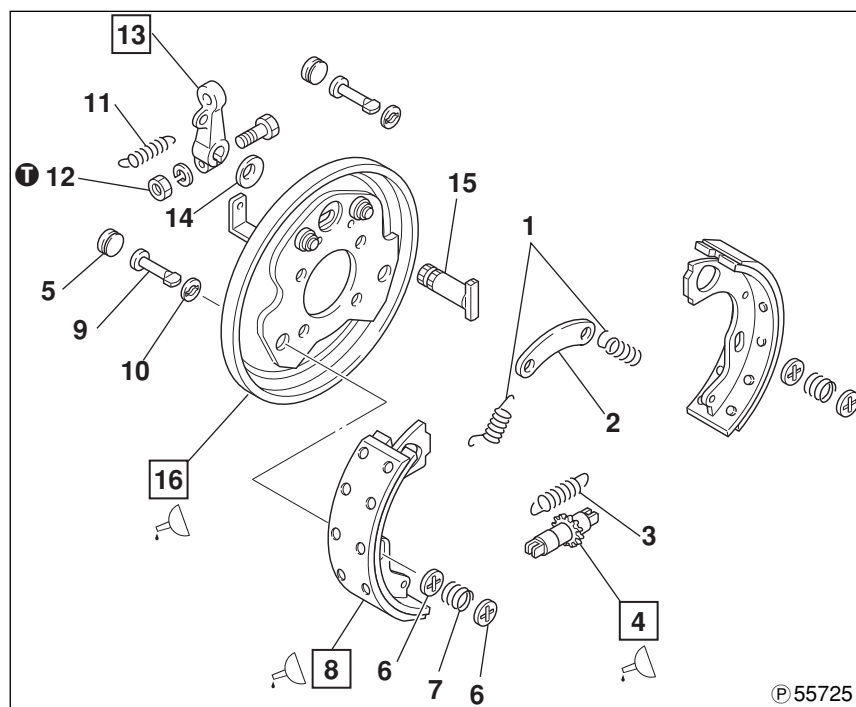


11 Removal of parking brake drum and companion flange

⌚ : Flange puller

MEMO

SUPPORT PLATE AND SHOE ASSEMBLY



● Disassembly sequence

- 1 Shoe return spring
- 2 Anchor pin brace
- 3 Adjusting wheel return spring
- 4 Adjusting screw
- 5 Cover
- 6 Shoe hold-down cup
- 7 Shoe hold-down spring
- 8 Shoe and lining assembly
- 9 Shoe hold-down pin
- 10 Shoe hold-down washer
- 11 Camshaft lever return spring
- 12 Nut
- 13 Camshaft lever
- 14 Spring spacer
- 15 Camshaft
- 16 Support plate and cover assembly

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

Do not leave grease or oil on the surface of shoe and lining assembly 8 because this reduces braking performance.

NOTE

If shoe and lining assembly 8 has been replaced with a new part, check correctness of contact with the parking brake drum.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Installed load of shoe return spring (Installed length 75 {2.95})	180±18 N {41±4.0 lbf, 18.5±1.8 kgf}	145 N {33 lbf, 15 kgf}	Replace
3	Installed load of adjusting wheel return spring (Installed length 85 {3.35})	105±11 N {24±2.4 lbf, 11±1.1 kgf}	86 N {19 lbf, 8.8 kgf}	Replace
7	Installed load of shoe hold-down spring (Installed length 14 {0.55})	145±15 N {33±3.3 lbf, 15±1.5 kgf}	115 N {26 lbf, 12 kgf}	Replace
8	Brake lining thickness of shoe and lining assembly	5.8 {0.23}	3.5 {0.14}	Replace
11	Installed load of camshaft lever return spring (Installed length 85 {3.35})	62±5.9 N {14±1.3 lbf, 6.3±0.6 kgf}	49 N {11 lbf, 5 kgf}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
12	Nut (Camshaft lever mounting)	13.72 to 22.56 {10 to 17, 1.4 to 2.3}	—

Lubricant and/or sealant

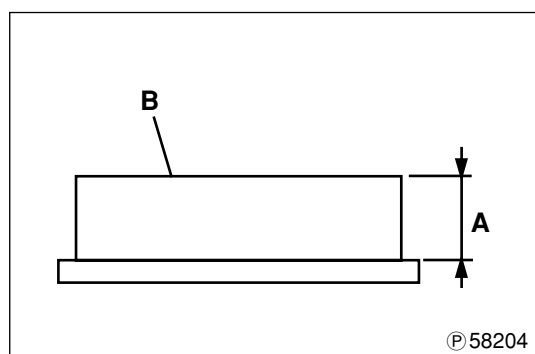
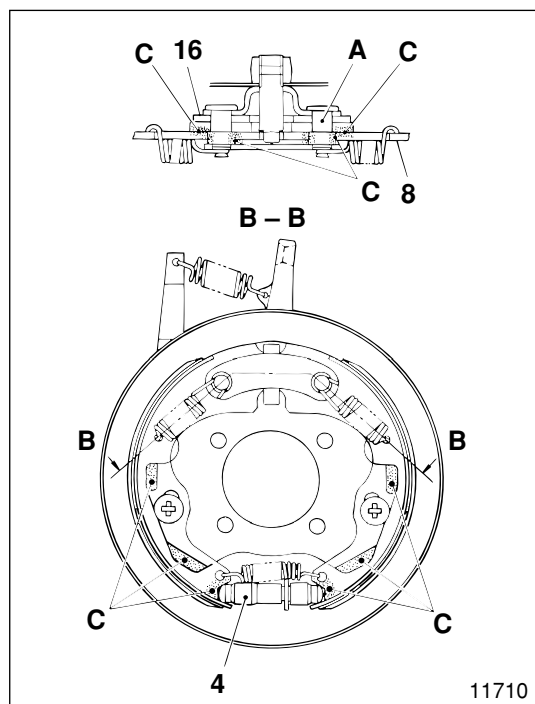
Location	Points of application	Specified lubricant and/or sealant	Quantity
4, 8	Apply to both ends of adjusting screw which makes contact with shoe and lining assembly	Brake grease (AKB 100)	As required
8, 16	Apply to support plate and cover assembly at the place which makes contact with shoe and lining assembly	Brake grease (AKB 100)	As required
	Apply to anchor pin area of support plate and cover assembly at the place which makes contact with shoe and lining assembly	Brake grease (AKB 100)	As required

◆ Service procedure

4 8 16 Applying grease to adjusting screw, shoe and lining assembly, and support plate and cover assembly

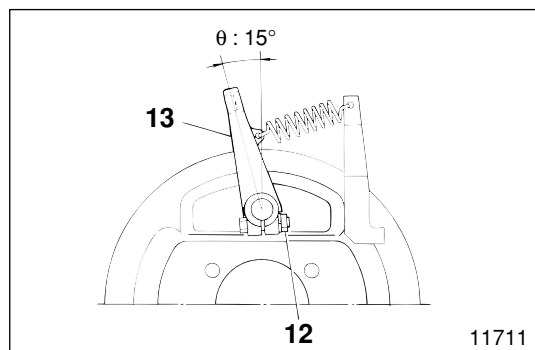
Apply grease to area **C**.

A : Anchor pin area



8 Inspection of brake lining thickness of shoe and lining assembly

Measure thickness **A** of brake lining **B**. If the measured value is lower than the limit, replace the shoe and lining assembly **8**.



13 Installation of camshaft lever

Align camshaft lever **13** to lever mounting angle θ , and tighten nut **12** at specified torque.



Group 36B

Parking Brake

<Wheel Parking Brake>

Table of Contents

BACK

HOME

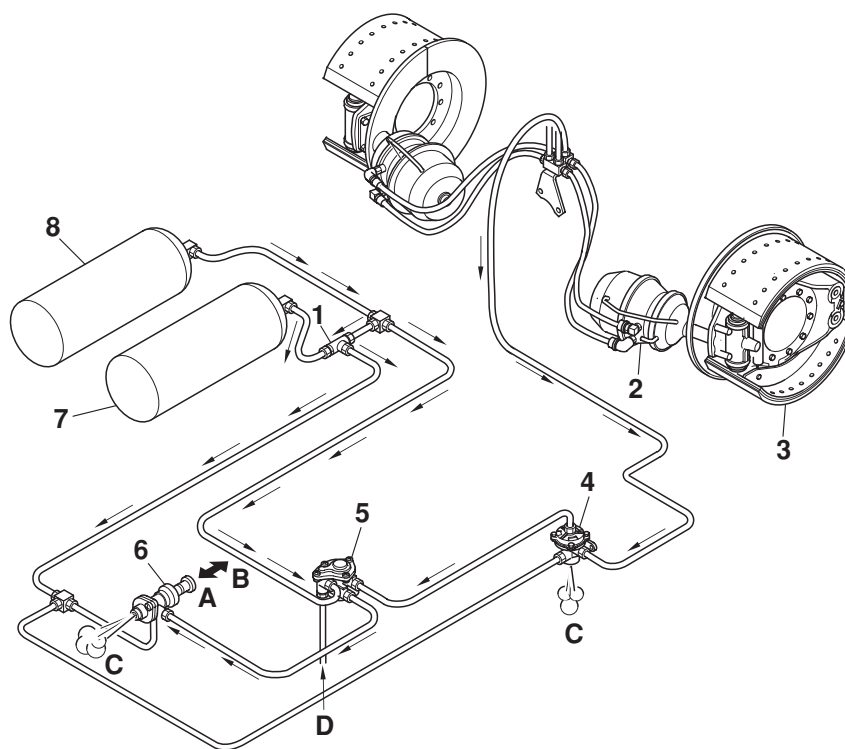
 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

INDEX

STRUCTURE AND OPERATION	36B- 2
TROUBLESHOOTING	36B- 7
PARKING BRAKE CONTROL VALVE	36B- 8
SPRING BRAKE VALVE	36B-10
DOUBLE CHECK VALVE	36B-13

STRUCTURE AND OPERATION

Parking Brake System

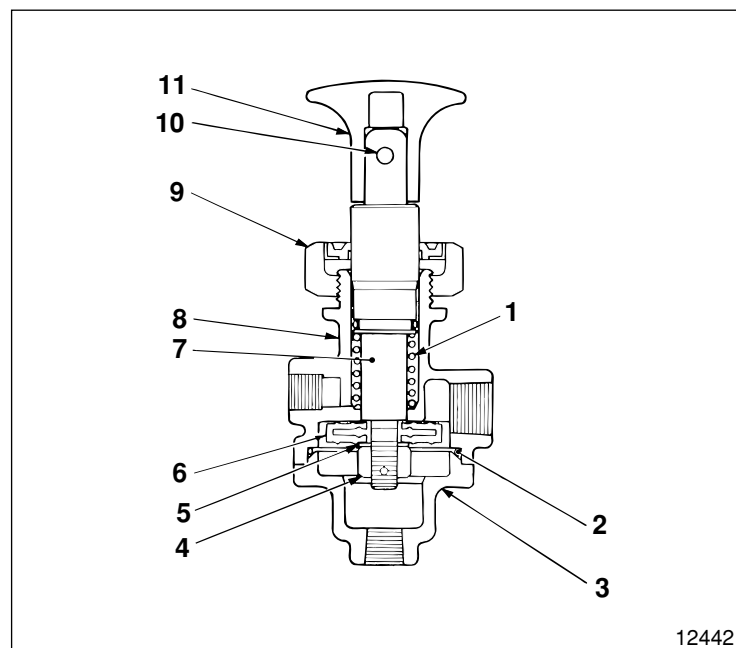


©58732

- | | | |
|----------------------|-------------------------------|-----------------------------|
| 1 Double check valve | 5 Spring brake valve | A : RELEASE position |
| 2 Rear brake chamber | 6 Parking brake control valve | B : PARK position |
| 3 Rear wheel brake | 7 Front brake air tank | C : Pressurized air |
| 4 Relay valve | 8 Rear brake air tank | D : From front brake system |

- In the wheel parking brake system, operating parking brake control valve 6 causes rear brake chamber 2, which contains a spring brake, to apply rear wheel brake 3, generating braking force.
- Pulling out the knob of parking brake control valve 6 to the PARK position, feeds pressurized air C from the parking brake control valve and spring brake valve 5 to relay valve 4. This exhausts pressurized air C in the spring brake in rear brake chamber 2 through the exhaust port of the relay valve, causing the spring brake to generate braking force.
- Pushing in the knob of parking brake control valve 6 to the RELEASE position, feeds pressurized air from rear brake air tank 8 to relay valve 4 via the parking brake control valve. Consequently in the separate air system, pressurized air from the rear brake air tank is fed to the spring brake of rear brake chamber 2 via the relay valve, releasing the wheel parking brake.

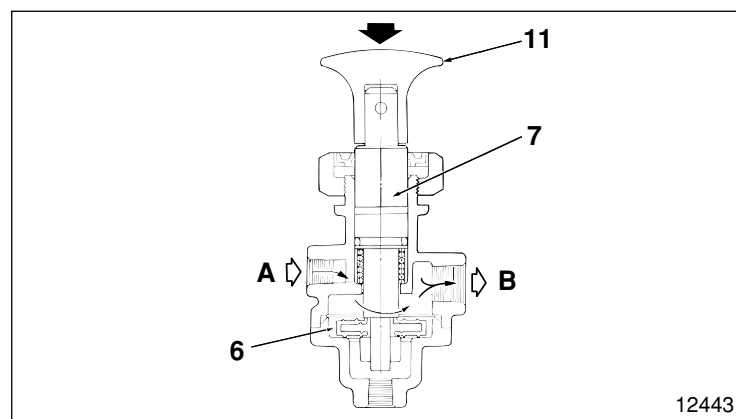
Parking Brake Control Valve



- 1 Plunger spring
- 2 Seal ring
- 3 Cover
- 4 Nut
- 5 Washer
- 6 Valve
- 7 Plunger
- 8 Body
- 9 Seal nut
- 10 Spring pin
- 11 Knob

12442

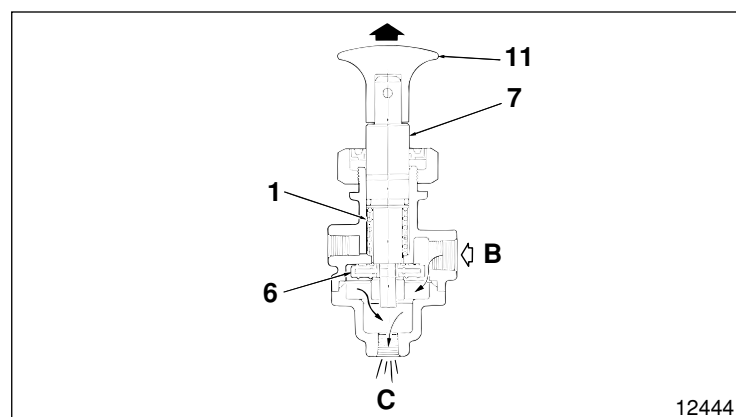
● Feed action (RELEASE)



When the air pressure at feed port **A** reaches 420 kPa {61 psi, 4.3 kgf/cm²} or higher, pushing in knob **11** causes valve **6** at the top of plunger **7** to close the exhaust port, feeding pressurized air to exit port **B**.

12443

● Exhaust action (PARK)

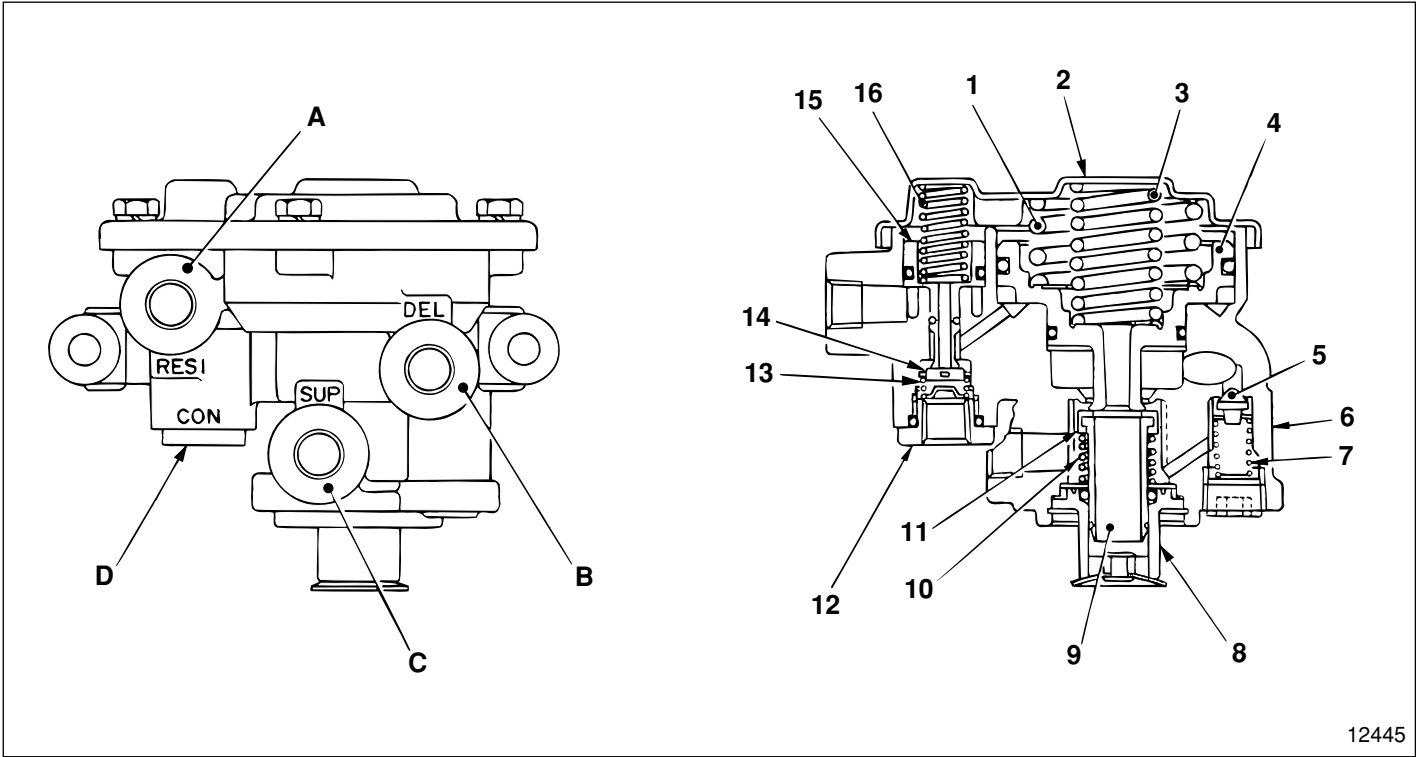


- Pulling out knob **11** causes valve **6** at the top of plunger **7** to open exhaust port **C**, and remains in that position, closing the supply port. This exhausts the air returned from exit port **B** through the air exhaust port.
- When the air pressure at the supply port drops to 275 kPa {40 psi, 2.8 kgf/cm²} or lower, the repercussive force of plunger spring **1** overcomes the air pressure acting on valve **6** pushing out knob **11** automatically. This exhausts the air through exit port **B**.

12444

STRUCTURE AND OPERATION

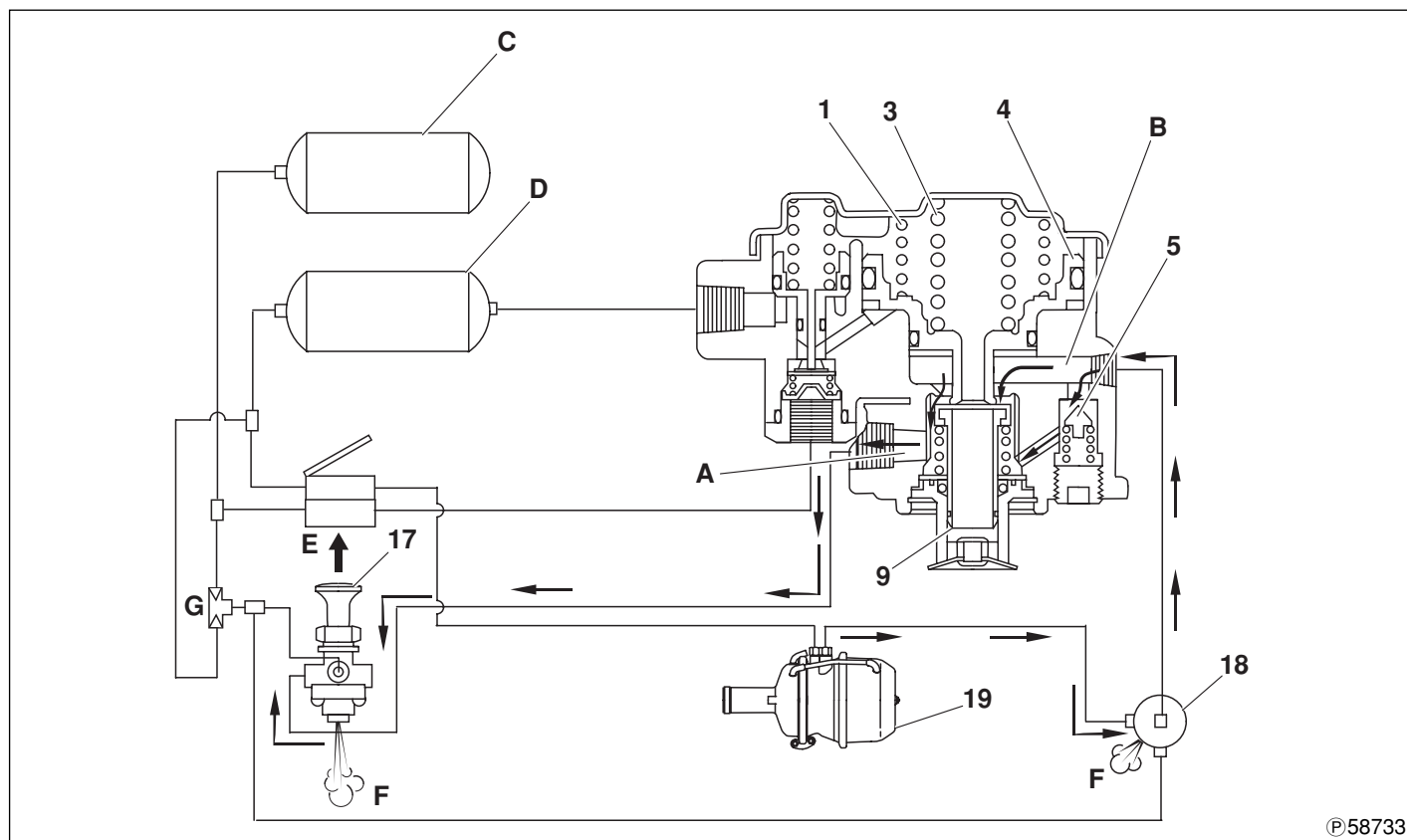
Spring Brake Valve



12445

- | | | |
|-----------------|---------------------------|--------------------------------------|
| 1 Piston spring | 8 Exhaust cover | 15 Piston |
| 2 Cover | 9 Inlet and exhaust valve | 16 Piston spring |
| 3 Spring | 10 Valve spring | A : From rear brake air tank |
| 4 Piston | 11 Valve retainer | B : To spring brake |
| 5 Check valve | 12 Cap nut | C : From parking brake control valve |
| 6 Body | 13 Valve spring | D : From front brake system |
| 7 Spring | 14 Valve | |

● When parking brake is operated



- Pulling out the knob of parking brake control valve **17** to PARK position **E**, exhausts the pressurized air in chamber **A** of the spring brake valve through the parking brake control valve. Then, the pressurized air in chamber **B** of the spring brake valve forces down check valve **5**, passes through chamber **A**, and is exhausted through the parking brake control valve.
- When the air pressure in chamber **B** of the spring brake valve drops sufficiently, springs **1**, **3** at the top of piston **4** force the piston down, opening inlet and exhaust valve **9**. This exhausts the pressurized air, which is fed to relay valve **18**, from the spring brake valve.
- Relay valve **18** exhausts the pressurized air from the spring brake in rear brake chamber **19** through the exhaust port.
- The spring brake of rear brake chamber **19** operates to generate braking force.

C : Front brake air tank

D : Rear brake air tank

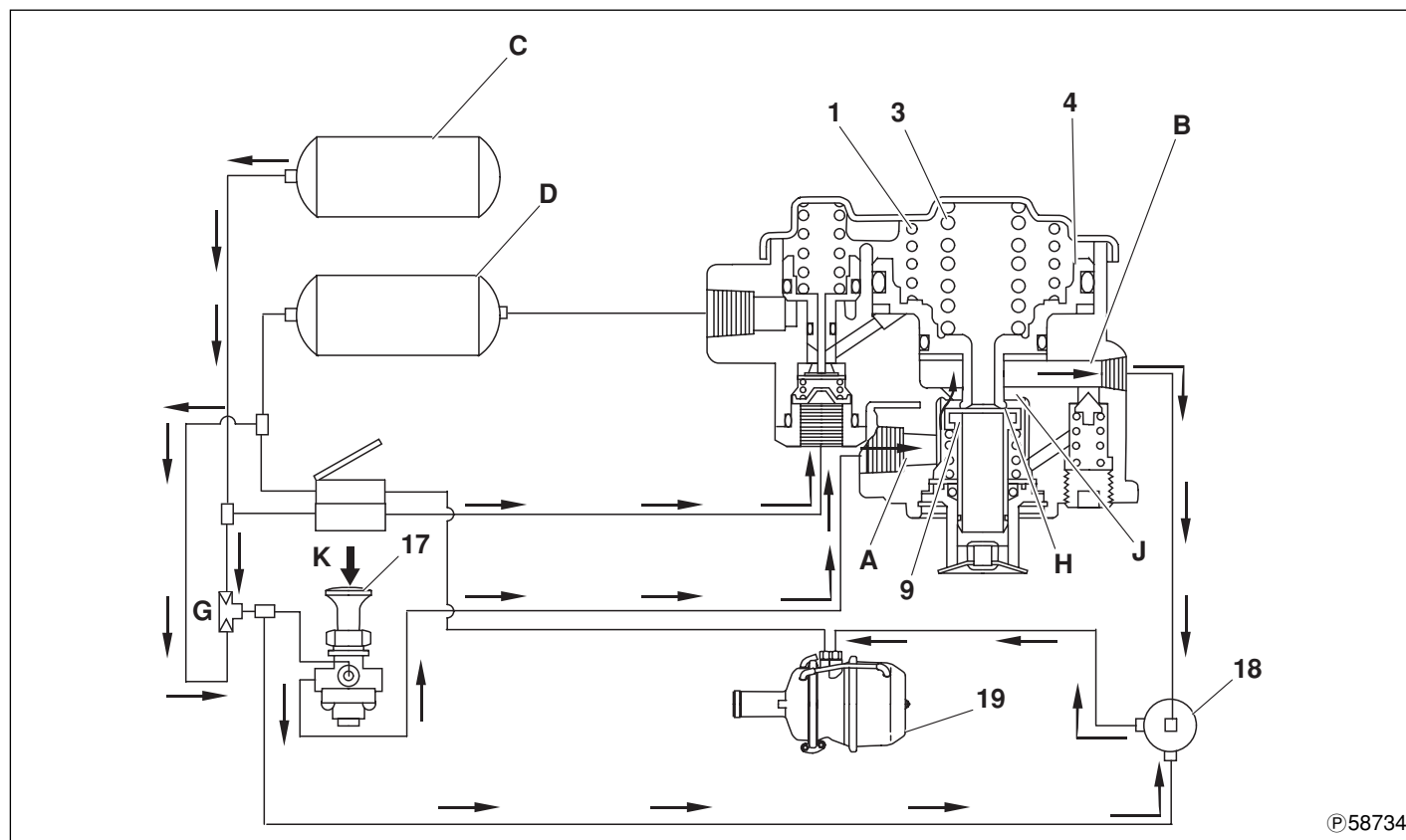
E : PARK position

F : Pressurized air

G : Double check valve

STRUCTURE AND OPERATION

● When parking brake is released



- Pushing in the knob of parking brake control valve **17** to **RELEASE** position **K**, causes the pressurized air to flow through chamber **A** of the spring brake valve to chamber **B**, then the pressurized air is fed to relay valve **18** as air pressure.
- As the air pressure in chamber **B** rises further, the rising force of piston **4** overcomes the repercussive force of springs **1, 3**. This closes exhaust valve **H** of inlet and exhaust valve **9**, and at the same time lifts the piston and the inlet and exhaust valve together.
- As piston **4** and inlet and exhaust valve **9** rise further, the inlet and exhaust valve closes inlet valve **J**, isolating chambers **A** and **B** from each other, stopping the air flow between them.
- When it receives pressurized air, relay valve **18** feeds pressurized air in the separate air system to the spring brake, releasing the wheel parking brake.

C : Front brake air tank

D : Rear brake air tank

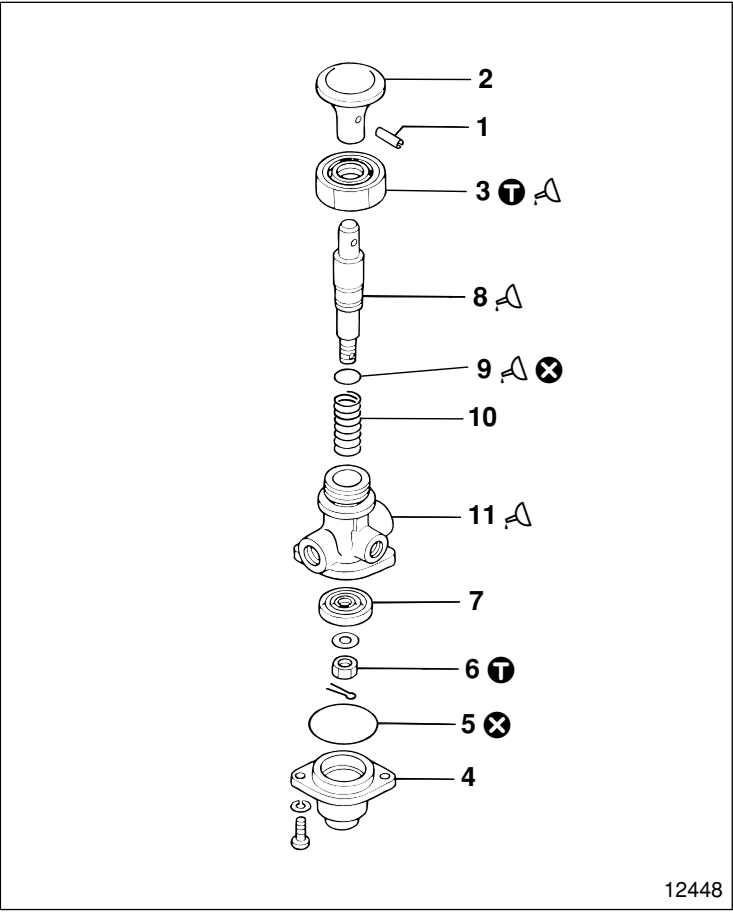
G : Double check valve

K : **RELEASE** position

TROUBLESHOOTING

Symptoms		Parking brake does not work	Parking brake does not release	Remarks
Parking control valve	Malfunctioning	☐	☐	
Spring brake valve	Malfunctioning	☐	☐	
Brake chamber	Malfunctioning	☐	☐	 Gr 35B
Wheel brake	Malfunctioning	☐	☐	 Gr 35B
Air line	Air leaking		☐	
	Air pressure low		☐	

PARKING BRAKE CONTROL VALVE



● Disassembly sequence

- 1 Spring pin
- 2 Knob
- 3 Seal nut
- 4 Cover
- 5 Seal ring
- 6 Nut
- 7 Valve
- 8 Plunger
- 9 O-ring
- 10 Plunger spring
- 11 Body

✕ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Parking brake control valve kit

● Inspection after assembly

📖 P36B-9

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Operating pressure (Air pressure when the knob is automatically pushed out from its pushed-in position)	235 to 315 kPa {34 to 45 psi, 2.4 to 3.2 kgf/cm ² }	—	Replace

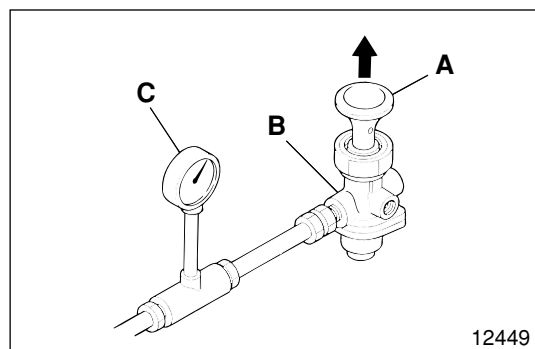
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Seal nut	25 to 34 {18 to 25, 2.5 to 3.5}	—
6	Nut (Valve mounting)	3.4 to 4.4 {2.5 to 3.3, 0.35 to 0.44}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3	Friction surfaces of seal nut and plunger	Multipurpose grease [NLGI No.2 (Li soap)]	As required
8	Friction surface and O-ring groove of plunger	Multipurpose grease [NLGI No.2 (Li soap)]	As required
9	Periphery of O-ring	Multipurpose grease [NLGI No.2 (Li soap)]	As required
11	Friction surfaces of body and plunger	Multipurpose grease [NLGI No.2 (Li soap)]	As required



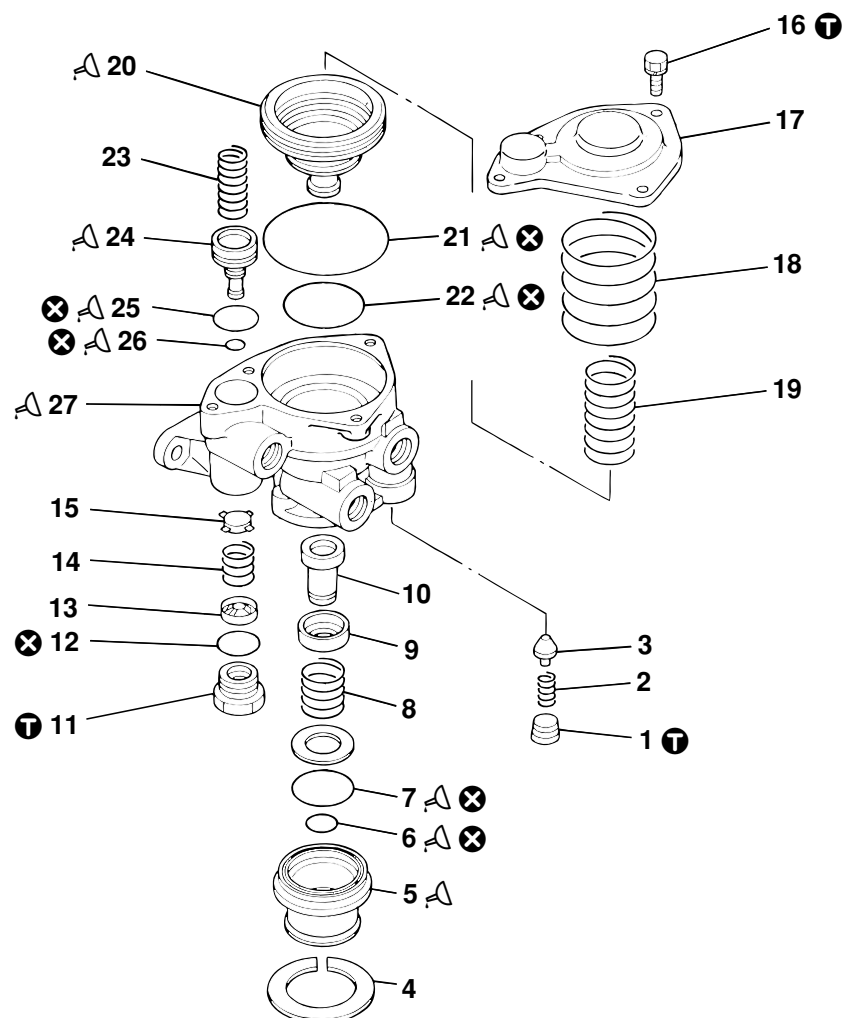
◆ Service procedure

● Inspection after assembly

- While pushing in knob **A**, feed air pressure of 685 kPa {100 psi, 7 kgf/cm²} via air supply port **B**.
- Gradually decrease the air pressure and confirm that the air pressure required to push out the knob from its pushed-in position is the standard value.

C : Air gauge

SPRING BRAKE VALVE



12450

● Disassembly sequence

- | | | |
|----------------------------|------------------|------------------|
| 1 Plug | 11 Cap nut | 21 O-ring |
| 2 Spring | 12 O-ring | 22 O-ring |
| 3 Check valve | 13 Valve stop | 23 Piston spring |
| 4 Retaining ring | 14 Valve spring | 24 Piston |
| 5 Exhaust cover | 15 Valve | 25 O-ring |
| 6 O-ring | 16 Bolt | 26 O-ring |
| 7 O-ring | 17 Cover | 27 Body |
| 8 Valve spring | 18 Piston spring | |
| 9 Valve retainer | 19 Piston | |
| 10 Inlet and exhaust valve | 20 Piston | |

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Spring brake valve kit

● Inspection of operation after assembly

📖 P36B-11

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Plug	15 to 20 {11 to 14, 1.5 to 2.0}	—
11	Cap nut	11 to 14 {8.0 to 10, 1.1 to 1.4}	—
16	Bolt (Cover mounting)	5.9 to 8.8 {4.3 to 6.5, 0.6 to 0.9}	—

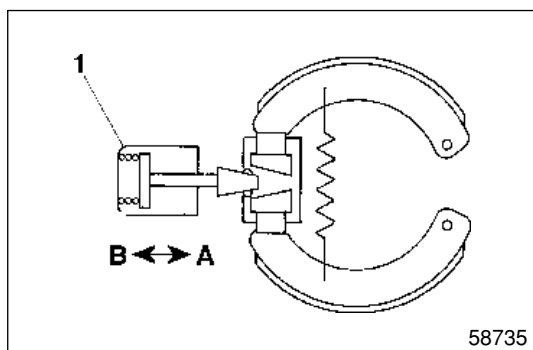
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5	Friction surfaces of exhaust cover and inlet and exhaust valve	Silicon grease	As required
20, 24	O-ring groove and outer periphery of piston	Silicon grease	As required
27	Friction surfaces of body and piston	Silicon grease	As required
—	Periphery of O-ring	Silicon grease	As required

Service procedure

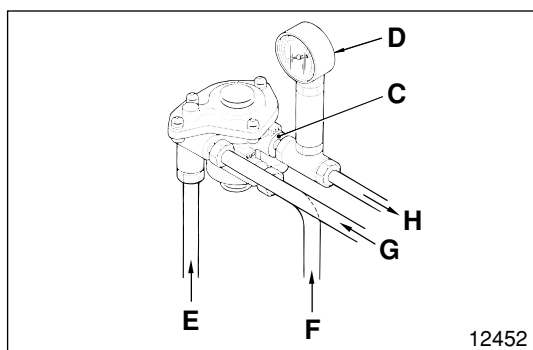
Inspection of operation after assembly

- Place wheel chocks at the rear wheels to prevent the vehicle from moving.
- Start the engine to raise the air pressure until the air pressure gauge reads 805^{+29}_{-20} kPa { $115^{+4.3}_{-2.8}$ psi, $8.2^{+0.3}_{-0.2}$ kgf/cm²}.



- Confirm that when the knob of the parking brake control valve is pulled out to the PARK position, rear brake chamber **1** operates immediately, applying the wheel parking brake.
- Confirm that when the knob of the parking brake control valve is pushed in to the RELEASE position, rear brake chamber **1** operates, releasing the wheel parking brake.

A : Applied
B : Released



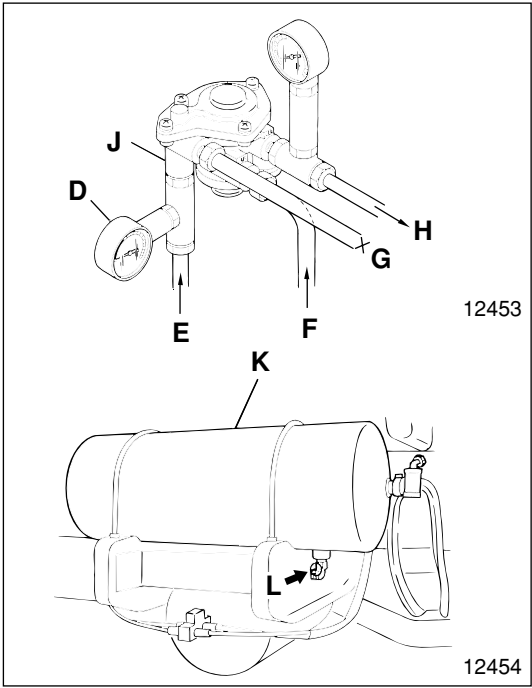
- Mount air pressure gauge **D** on delivery port **C** of the spring brake valve.
- Read air pressure gauge **D** when the knob of the parking brake control valve is pushed to the RELEASE position.

Specified value: 65 kPa {951 psi, 6.67 kgf/cm²}

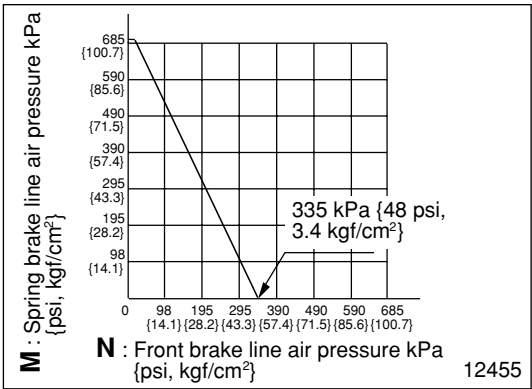
E : From front brake system
F : From parking brake control valve
G : From rear brake air tank
H : To spring brake of rear brake chamber

SPRING BRAKE VALVE

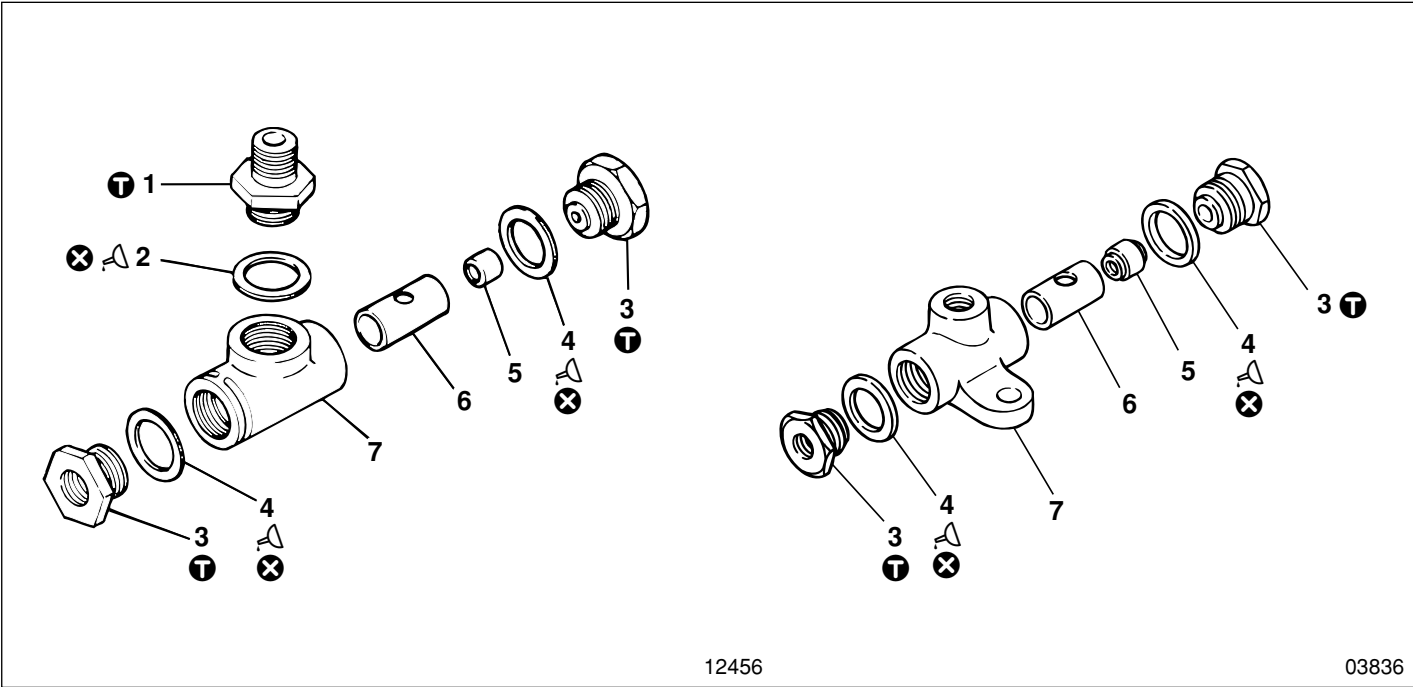
- Confirm that when the knob of the parking brake control valve is pulled out to the PARK position, the reading of air pressure gauge **B** drops immediately to 0 kPa {0 psi, 0 kgf/cm²}. If the air pressure gauge indicator needle drops slowly, replace check valve **3**, since it is probably faulty.



- Mount air pressure gauge **D** on control port **J**.
 - Push in the knob of the parking brake control valve to the RELEASE position and pull drain cock **L** to completely bleed tank **K** of the rear brake system.
- E** : From front brake system
F : From parking brake control valve
G : No pressurized air from rear brake air tank
H : To spring brake of rear brake chamber



- Have the brake pedal depressed several times and read the drop in the air pressure on both air pressure gauges **D** every time the brake is pressed to confirm that each value conforms to the specified value indicated on the performance curve diagram.
- Press the brake pedal several times to compress the air until rear brake chamber **1** operates on the wheel parking brake locking the rear wheels completely.



Disassembly sequence

- 1 Joint
- 2 Packing
- 3 Joint
- 4 Packing
- 5 Check valve
- 6 Sleeve
- 7 Body

X : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Double check valve kit

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1, 3	Joint	34 to 44 {25 to 33, 3.5 to 4.5}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2, 4	Surfaces of packing	THREEBOND 1101	As required



Group 37

Steering

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

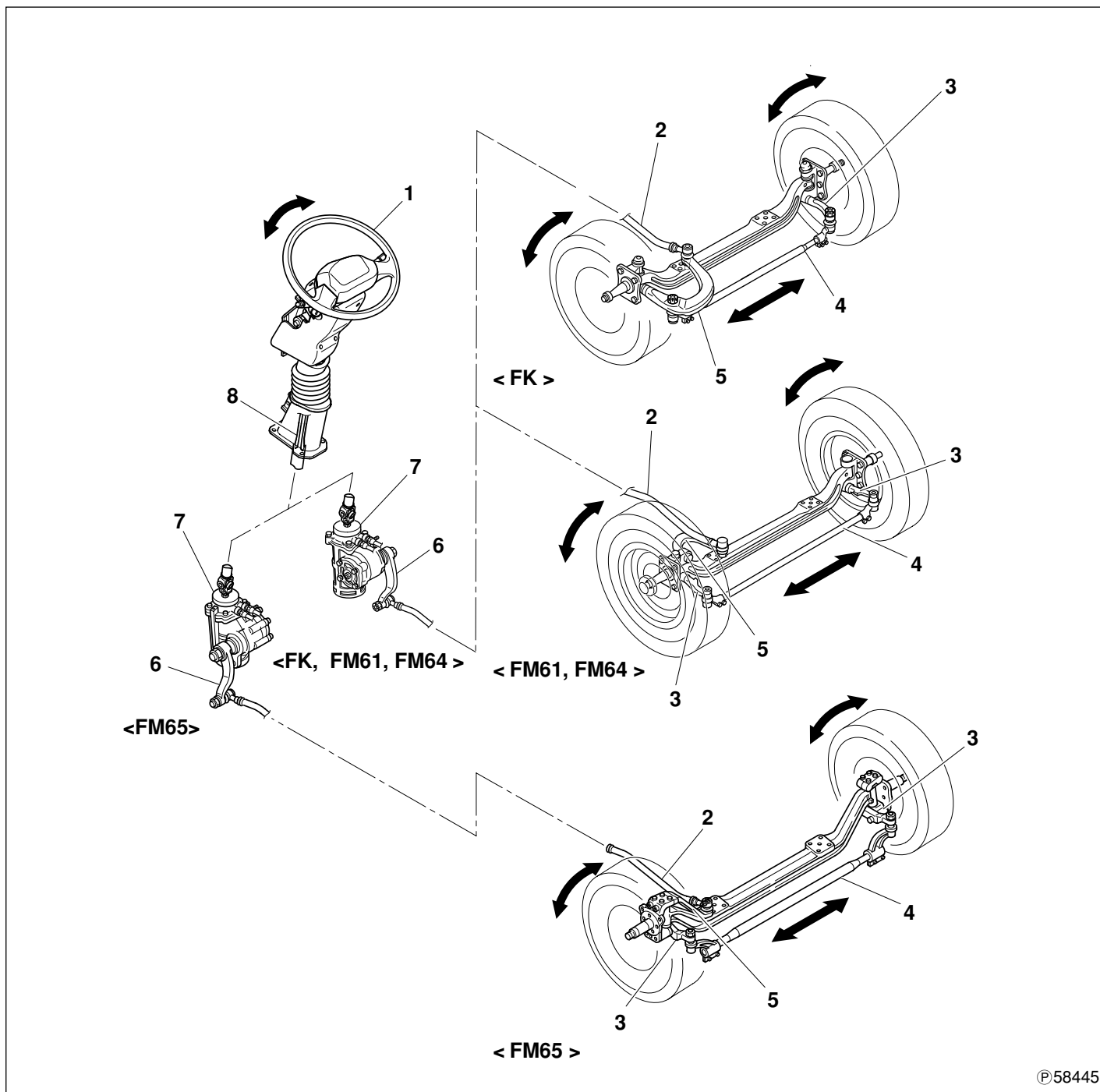
INDEX

SPECIFICATIONS	37- 2
STRUCTURE AND OPERATION	37- 3
TROUBLESHOOTING	37-12
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Change of Power Steering Fluid	37-15
• Bleeding of Power Steering System	37-15
• Steering Wheel Play	37-16
• Performance Verification Test of Power Steering System	37-17
STEERING SYSTEM	37-18
LINKAGE AND BRACKET	37-24
POWER STEERING BOOSTER.....	37-26
POWER STEERING OIL PUMP	
<FK, FM61, FM64>	37-40
<FM65>	37-46
POWER STEERING OIL TANK	37-51
DRAG LINK	37-52
TIE ROD ASSEMBLY	37-54

SPECIFICATIONS

Vehicle model		FK	FM61 FM64	FM65
Steering wheel	Type	2-spoke type		
	Outer diameter mm {in.}	480 {18.9}		
Steering shaft	Type	Universal joint type (Tilt and telescopic type)		
Power steering booster	Manufacturer	Unisia JKC steering system		
	Type	Ball nut type		
	Form	Integral type		
	Model No.	443-00053	446-00305	446-00645
	Gear ratio	17.1 to 20	19.05	22.4
	Cylinder diameter mm {in.}	85 {3.35}	90 {3.54}	100 {3.94}
	Mass (without pitman arm and fluid) kg {lb}	21 {46}	24 {53}	30 {66}
Power steering oil pump	Manufacturer	Unisia JKC steering system		
	Type	Vane type		
	Model No.	470-03330	475-03480	
	Discharge amount cm ³ {cu.in.}/rotation	12.8 {0.78}	17.5 {1.07}	
	Regulated flow amount L {qts}/min	12 {13}	18 {19}	
	Regulated pressure (relief valve) MPa {psi, kgf/cm ² }	13.2 ^{+0.49} _{-0.20} {1910 ⁺⁷¹ ₋₂₈ , 135 ^{+5.0} _{-2.0} }		12.3 ^{+0.49} _{-0.20} {1780 ⁺⁷¹ ₋₂₈ , 125 ^{+5.0} _{-2.0} }
	Permissible revolutions rpm	600 to 4000		
	Mass (without drive gear, and fluid) kg {lb}	4.9 {11}		

Steering System

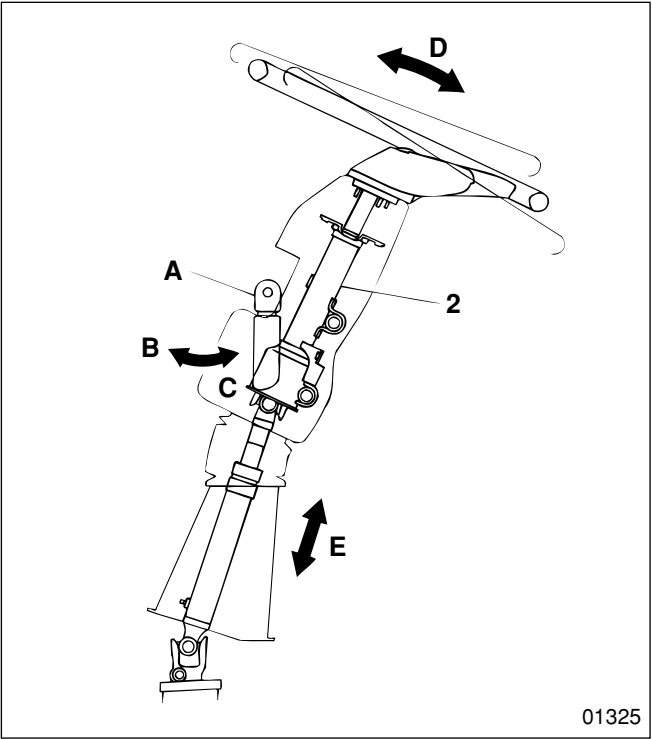


© 58445

- 1 Steering wheel
- 2 Drag link
- 3 Tie rod arm
- 4 Tie rod

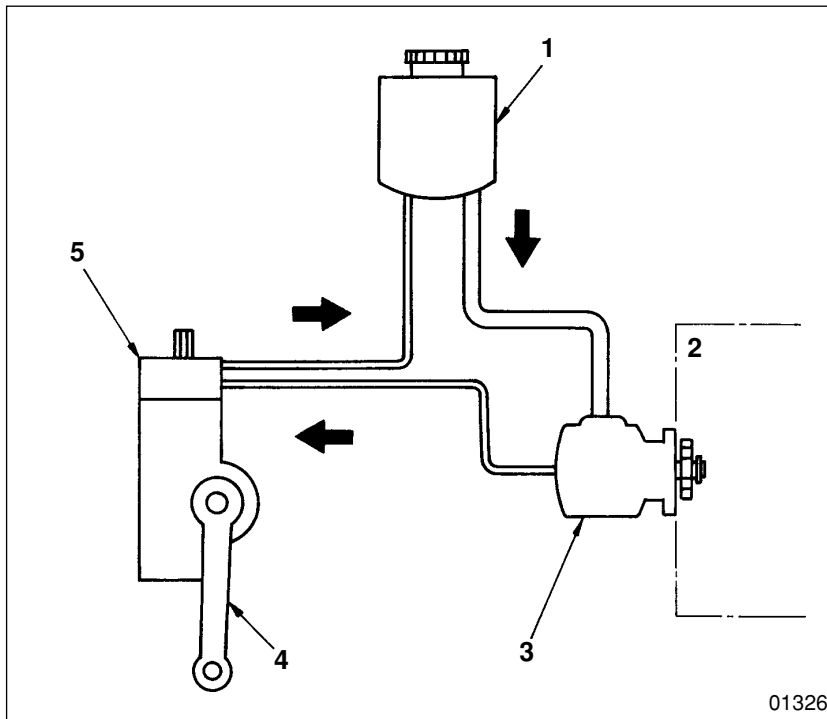
- 5 Knuckle arm
- 6 Pitman arm
- 7 Power steering booster
- 8 Steering shaft

STRUCTURE AND OPERATION



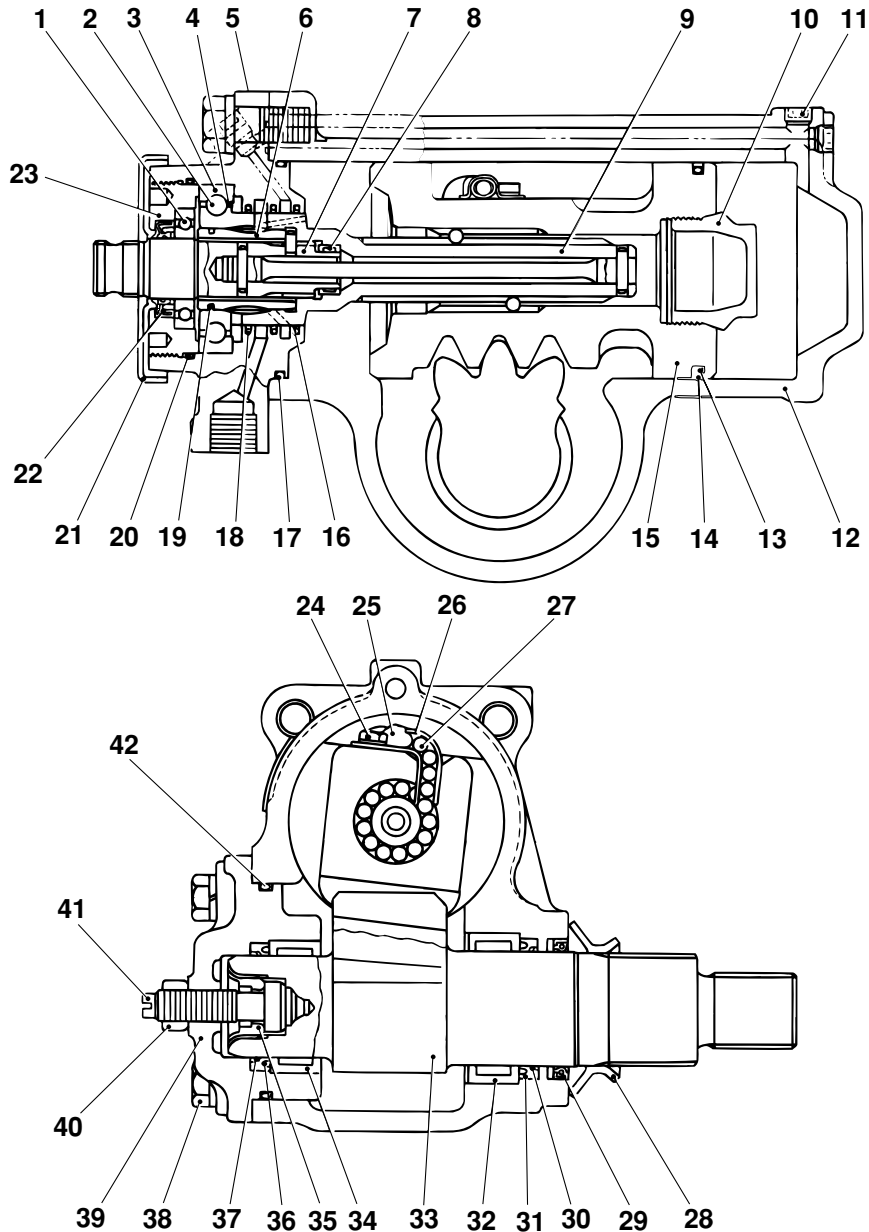
Shifting lock lever **A** from lock position **B** to release position **C** allows you to adjust tilt **D** and telescopic movement **E** of steering shaft **2** to the optimum driving position.

Power Steering System



STRUCTURE AND OPERATION

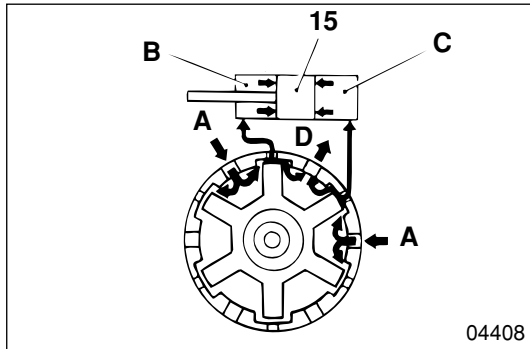
Power Steering Booster



12848

- | | | |
|------------------|-------------------|--------------------|
| 1 Ball bearing | 15 Piston | 29 Oil seal |
| 2 Steel ball | 16 Seal ring | 30 Backup ring |
| 3 Side race | 17 O-ring | 31 Y-packing |
| 4 Bearing cage | 18 O-ring | 32 Needle bearing |
| 5 Valve housing | 19 Seal ring | 33 Sector shaft |
| 6 Rotor | 20 O-ring | 34 Needle bearing |
| 7 Stub shaft | 21 Dust cover | 35 Retainer |
| 8 Needle bearing | 22 Oil seal | 36 Y-packing |
| 9 Worm shaft | 23 Adjusting plug | 37 Backup ring |
| 10 Plug | 24 Screw | 38 Bolt |
| 11 Taper plug | 25 Ball tube clip | 39 Side cover |
| 12 Body | 26 Ball tube | 40 Nut |
| 13 O-ring | 27 Steel ball | 41 Adjusting screw |
| 14 Seal ring | 28 Dust cover | 42 O-ring |

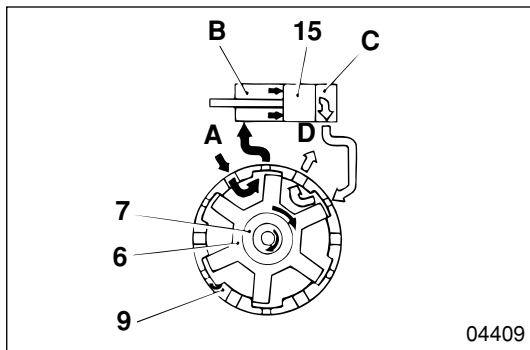
The rotary valve is the central part of the power steering booster. The torsion bar allows the steering reaction force and valve return to operate lightly and smoothly at low speed, and ensures stable steering feel even at high speed.



Straight-ahead operation

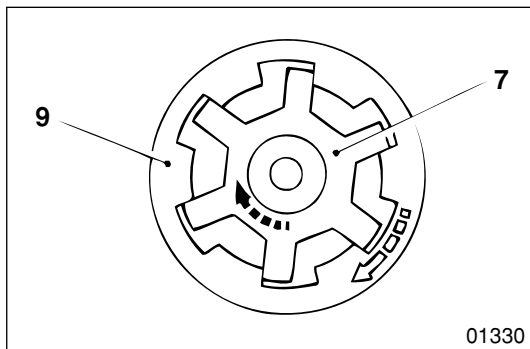
Piston **15** is in the neutral position as chambers **B** and **C** of the piston are under equal pressure.

- A** : From oil pump
- D** : To oil tank



Steering operation

Turning the steering wheel rotates stub shaft **7**, causing rotor **6** to close the fluid feed passage to cylinder chamber **C**. This produces a pressure difference between cylinder chambers **B**, **C**, which causes piston **15** to move, and facilitates rotation of worm shaft **9**.

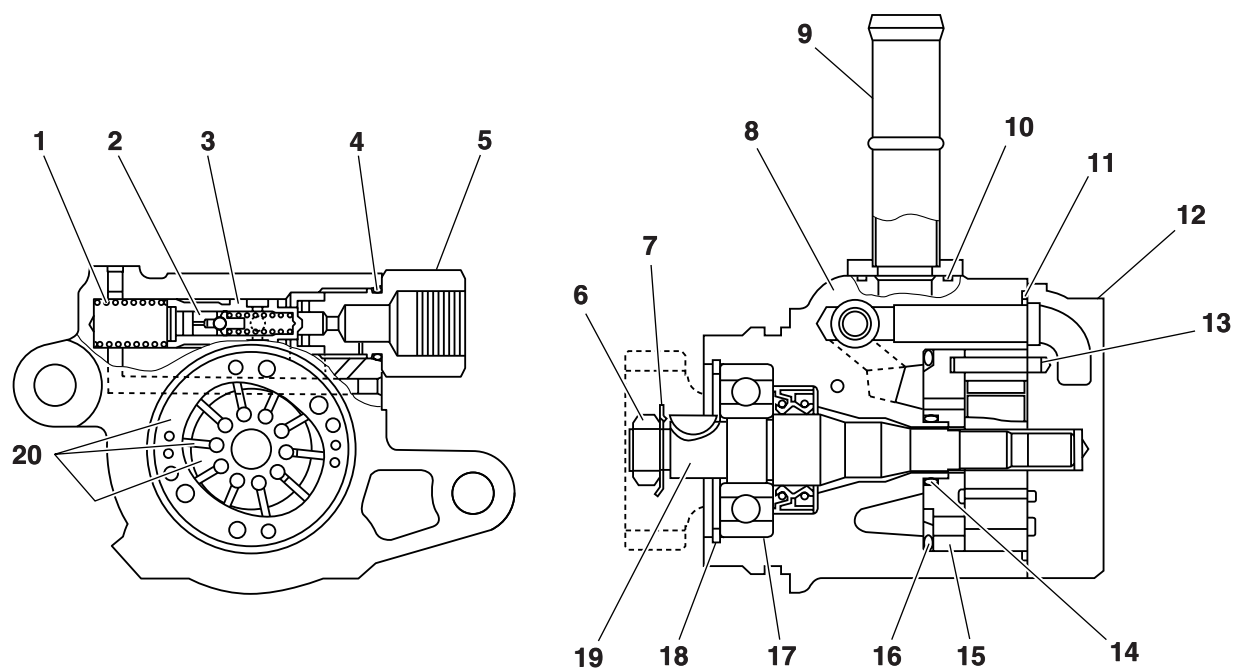


If the hydraulic circuit fails

The safety mechanism allows the vehicle to be steered manually, when the rotating force of stub shaft **7** alone directly turns worm shaft **9**, transmitting the steering force.

STRUCTURE AND OPERATION

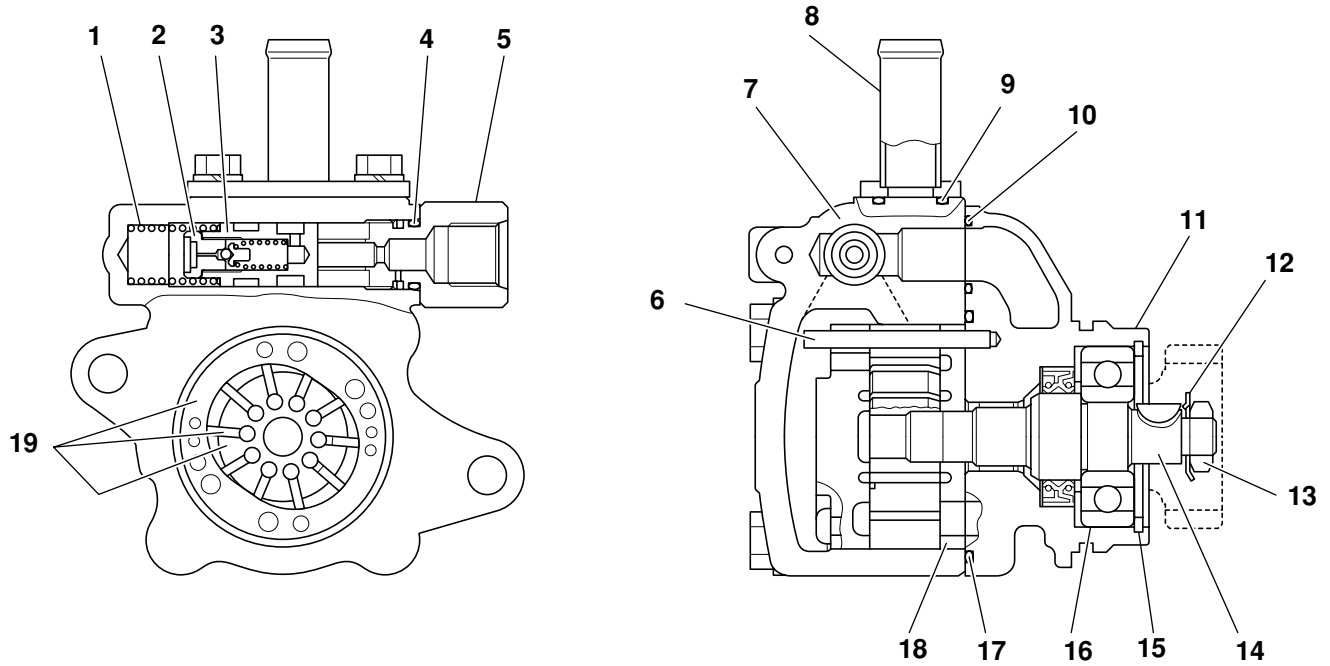
Power Steering Oil Pump < FK, FM61, FM64 >



©52475

- | | | |
|-------------------------------|------------------|-----------------------|
| 1 Flow control spring | 8 Front body | 15 Pressure plate |
| 2 Relief valve | 9 Hose connector | 16 O-ring |
| 3 Flow control valve assembly | 10 O-ring | 17 Ball bearing |
| 4 O-ring | 11 O-ring | 18 Retaining ring |
| 5 Connector | 12 Rear body | 19 Shaft |
| 6 Nut | 13 Straight pin | 20 Cartridge assembly |
| 7 Lock washer | 14 O-ring | |

< FM65 >



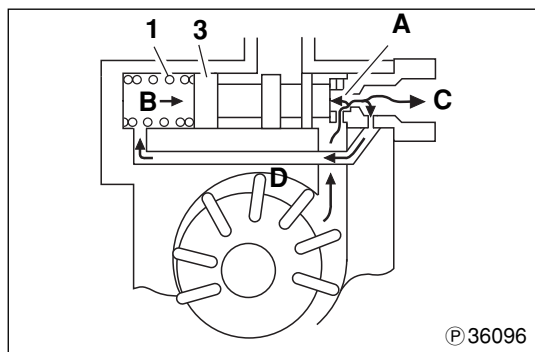
P51403

- | | | |
|-------------------------------|------------------|-----------------------|
| 1 Flow control spring | 8 Hose connector | 15 Retaining ring |
| 2 Relief valve | 9 O-ring | 16 Ball bearing |
| 3 Flow control valve assembly | 10 O-ring | 17 O-ring |
| 4 O-ring | 11 Front body | 18 Pressure plate |
| 5 Connector | 12 Lock washer | 19 Cartridge assembly |
| 6 Straight pin | 13 Nut | |
| 7 Rear body | 14 Shaft | |

STRUCTURE AND OPERATION

Relief Valve Assembly

● Flow control valve assembly

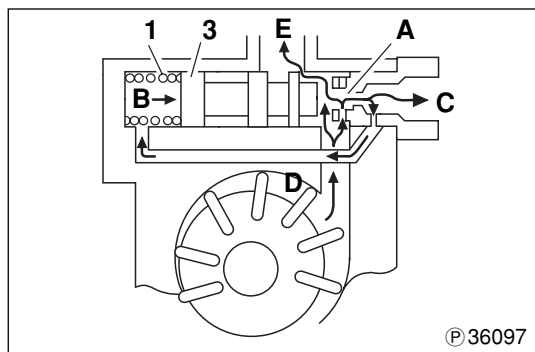


When not functioning

Oil pressure in chamber **A** is weaker than the sum of oil pressure of chamber **B** plus flow control spring **1**, and flow control valve assembly **3** is stationary.

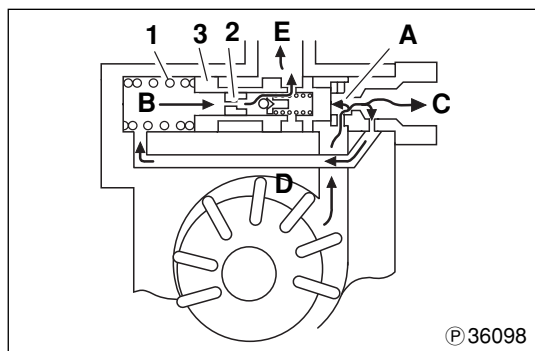
C : To power steering booster

D : Pressure chamber



When functioning

Oil pressure in chamber **A** overcomes the sum of oil pressure of chamber **B** plus flow control spring **1**, and shifts flow control valve assembly **3**. Circuit **E** is made open, oil pressure is released, and oil pressure of chamber **A** is maintained.



When oil circuit is shut off

The sum of oil pressure in chamber **B** plus force of flow control spring **1** overcomes oil pressure of chamber **A**, and moves flow control valve assembly **3**.

As pressure rises in chamber **B**, it presses relief valve **2**, and opens circuit **E**, thus maintaining oil pressure in chamber **B** constant.

MEMO

TROUBLESHOOTING

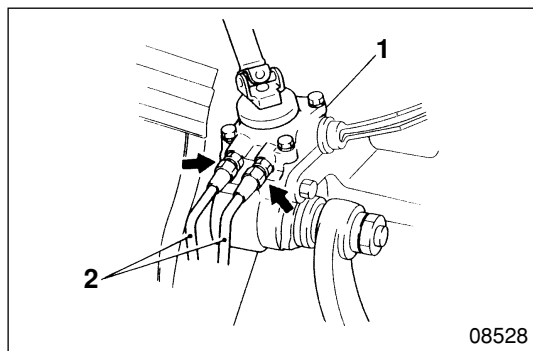
Symptoms														Remarks
		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure abnormal	Oil pump gurgles	Oil pump squeaks	Oil pump growls	
Possible causes														
Power steering mechanism faulty	Thrust bearing damaged or worn	☐			☐	☐								
	Ball or groove of ball screw worn	☐	☐		☐									
	Air bled insufficient	☐												
	Fluid viscosity unsuitable	☐												
	Power steering booster system faulty	☐												
	Flow control valve malfunctioning	☐												
	Ball screw unit rack and gear worn		☐											
	Sector shaft bearing worn		☐		☐									
	Power steering booster mounting bolt loose		☐											
	Ball screw unit and sector shaft play incorrect				☐									
	Valve control edge damaged or control seal ring broken				☐									
	Power steering system fluid unsuitable				☐									
	Rack engagement starting torque adjusted incorrectly	☐				☐								
	Fluid circuit clogged	☐				☐								
	Sector shaft gear worn		☐											
	Torsion shaft serration damaged or worn		☐											
	Power steering booster body faulty			☐	☐									
	O-ring, oil seal faulty								☐					
	Sealant applied incorrectly								☐					
Steering column and linkage mechanism faulty	Universal joint worn abnormally, damaged, lubricated incorrectly	☐	☐											
	Linkage deformed	☐												
	Drag link ball stud play		☐		☐									
	Tie rod end ball stud play		☐		☐									
	Tie rod bent						☐							
	Pitman arm mounting position incorrect							☐						
	Steering wheel turning center offset			☐										

Symptoms		Possible causes											Remarks	
		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure abnormal	Oil pump gurgles	Oil pump squeaks		Oil pump growls
Front axle faulty	Kingpin lubricated incorrectly	☐				☐								📦 Gr 26
	Front wheel alignment (toe-in, camber, caster) incorrect	☐		☐	☐	☐								
	Thrust bearing damaged	☐												
	Wheel hub bearing worn or damaged		☐	☐	☐									
	Kingpin or bushing worn or damaged		☐	☐	☐									
	Front axle deformed			☐										
	Knuckle arm, tie rod arm, or knuckle tightened incorrectly				☐									📦 Gr 33
	Front spring U-bolt, nut loose				☐									
	Front axle parts overtightened					☐								📦 Gr 26
	Turning angle adjusted incorrectly						☐	☐						
	Mounting parts, connection point loose		☐											
	Knuckle stopper bolt adjusted incorrectly							☐						
Oil pump faulty	Oil pump body faulty								☐					
	O-ring or oil seal faulty								☐					
	Bolt tightened incorrectly								☐					
	Maximum generated fluid pressure insufficient									☐				
	Fluid line crushed or clogged									☐				
	Air lock in oil pump										☐			
	Oil pump interior seized									☐	☐	☐		
	Mounting bolt or nut loose												☐	
	Pump body faulty												☐	
	Valve malfunctioning									☐				
Oil tank faulty	Oil tank leaking due to overflowing								☐					
	Oil tank leaking due to air lock								☐					
	Fluid level insufficient	☐												

TROUBLESHOOTING

Symptoms		Possible causes												Remarks
		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure abnormal	Oil pump gurgles	Oil pump squeaks	Oil pump growls	
Other malfunctions	Load too far forward of load-carrying platform	○												
	Load too far rearward of load-carrying platform		○											
	Load too far to one side of load-carrying platform			○										
	Leaf spring fatigued or cracked			○										Gr 33
	Braking force unbalanced			○										Gr 35A, B
	Tire wear difference between left and right excessive			○										Gr 31
	Tire outer diameter difference between left and right			○										
	Front tire radial and lateral runout, static balance or dynamic balance faulty				○									
	Wheelbase difference between left and right excessive			○										
	Propeller shaft runout excessive				○									Gr 25
	Rear axle housing bent			○										Gr 27
	Reduction pinion and gear damaged or engaged incorrectly				○									

Change of Power Steering Fluid



[Draining]

- Jack up the front wheels.
- Loosen oil pipe **2** connected to power steering booster **1**.
- Turn the steering wheel fully left and right repeatedly, and drain the fluid from power steering booster **1**.
- After draining the fluid, tighten oil pipe **2** at specified torque.

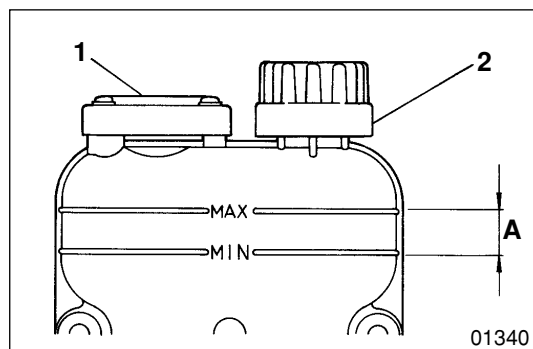
[Filling]

See below Bleeding of Power Steering System.

Bleeding of Power Steering System

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Power steering oil tank	Automatic transmission fluid (DEXRON or DEXRON II type)	Between MIN and MAX of the power steering oil tank



CAUTION ⚠

Do not keep the steering wheel turned fully to the left or right for more than fifteen seconds when the engine is running, as this can cause the power steering oil pump to seize up.

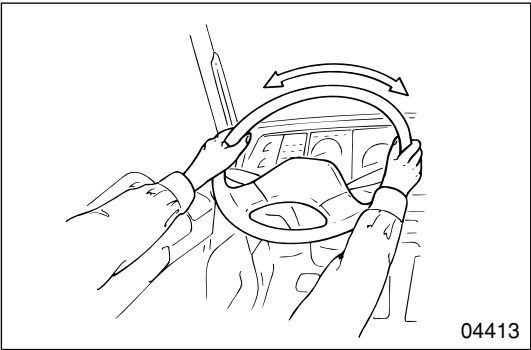
- Pour fluid into power steering oil tank **1** up to the bottom of filler cap **2**.
- With the engine stopped, jack up the front wheels and turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**.
- Start the engine and letting it idle, turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**. Repeat these steps until the fluid level does not drop.
- If there is an abnormal noise, air is still in the system. Turn the steering wheel several times to raise the fluid temperature to approximately 60 to 80°C {140 to 175°F}, then stop the engine and wait for approximately five minutes.
- Lower the front wheels and turn the steering wheel several times. If there is no noise, bleeding is completed.
- When bleeding is finished, check the fluid level of power steering oil tank **1**, and pipe and hose connections for fluid leaks.

ON-VEHICLE INSPECTION AND ADJUSTMENT

Steering Wheel Play

Service standards Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Steering wheel play (Measure at the outer circumference of steering wheel)	10 to 40 {0.39 to 1.57}	—	Adjust

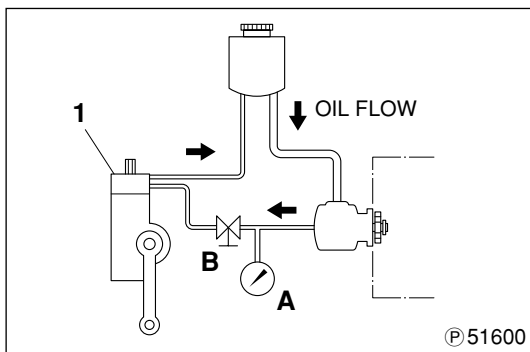


Point the wheels directly forward and gently turn the steering wheel left and right and measure the outer circumference play. If the play deviates from the standard value, adjust tightening points and power steering booster backlash.  P37-32

Performance Verification Test of Power Steering System

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Steering system fluid pressure (With hands off steering wheel)	490 kPa {71 psi, 5.0 kgf/cm ² }	—	Repair
—	Relief set pressure (Measure with engine speed at 1000 to 1500 rpm and stop valve closed)	< FK, FM61, FM64 >: 13.2 MPa {1920 psi, 135 kgf/cm ² }, < FM65 >: 12.3 MPa {1780 psi, 125 kgf/cm ² },	Maximum +490 KPa {71 psi, 5.0 kgf/cm ² } Minimum -200 KPa {29 psi, 2.0 kgf/cm ² }	Adjust or replace



Verify that the power steering booster and the power steering oil pump are operating properly by testing the following items.

CAUTION

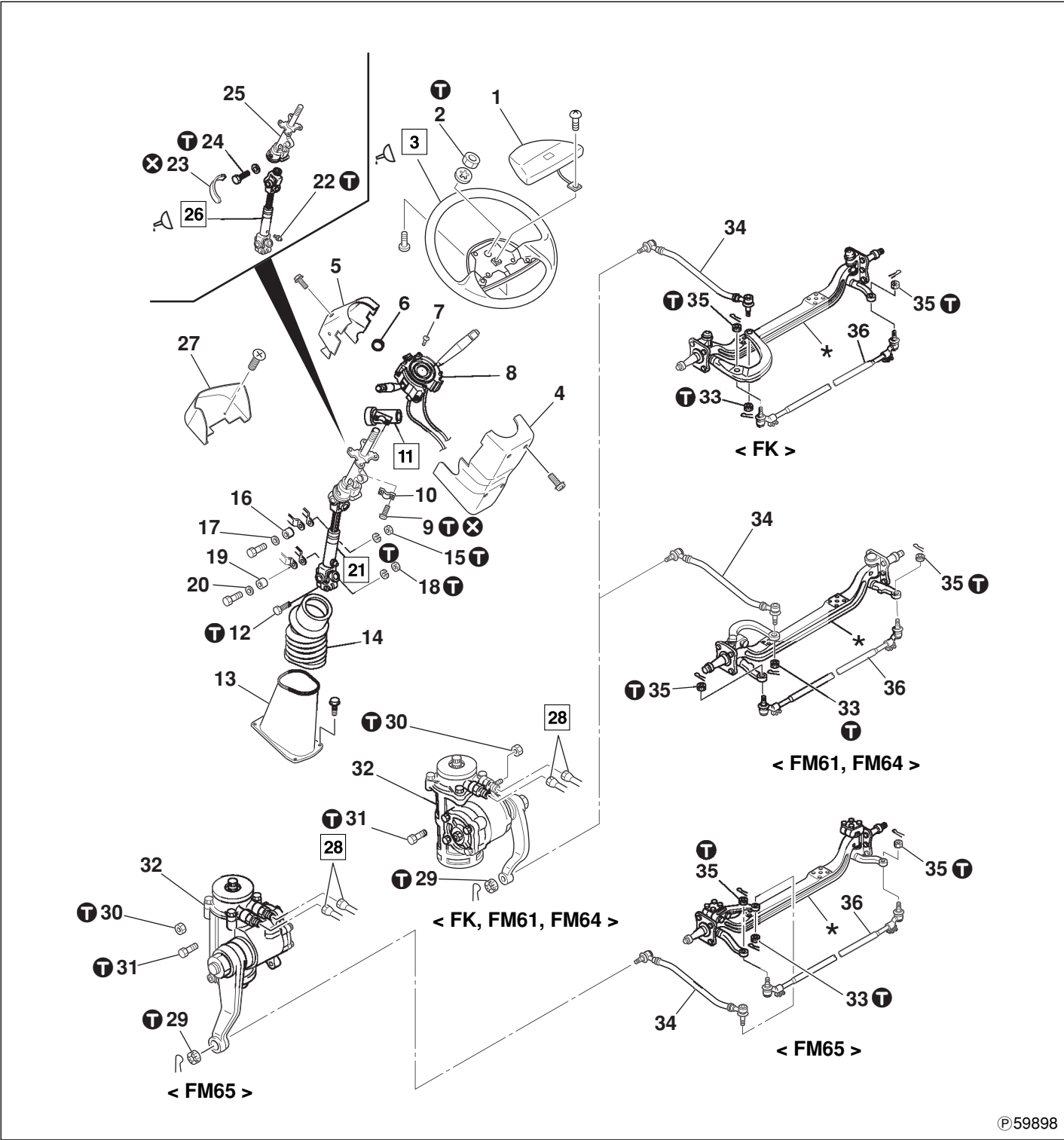
Do not keep stop valve B closed for more than fifteen seconds as this can cause the power steering oil pump to seize up.

NOTE

If the fluid pressure is higher than 490 kPa {71 psi, 5.0 kgf/cm²} with engine idling and the steering wheel free, inspect power steering booster 1 and fluid circuit for clogging.

Test item	Test procedure	Assembly standards
Verification of smooth operation	Jack up the front wheels and turn steering wheel fully left and right	Smooth operation throughout test
Measurement conditions	- Install oil pressure gauge A capable of measuring above 14.7 MPa {2130 psi, 150 kgf/cm²} and stop valve B, then bleed air - With engine idling, turn steering wheel left and right several times to raise fluid temperature to 50 to 60°C {120 to 140°F} - With the engine idling, open stop valve B	
Measurement of fluid pressure	Measure fluid pressure with hands off steering wheel	490 kPa {71 psi, 5.0 kgf/cm ² }
Measurement of relief pressure	- Gradually increase engine speed and maintain it at 1000 to 1500 rpm, and close stop valve B to measure maximum fluid pressure - Do not keep stop valve B closed for more than fifteen seconds	Relief set pressure < FK, FM61, FM64 >: 13.2 MPa {1920 psi, 135 kgf/cm ² } < FM65 >: 12.3 MPa {1780 psi, 125 kgf/cm ² }

STEERING SYSTEM



● Disassembly sequence

- | | | | | | |
|----|--------------------|----|-------------------------------|----|---------------------------|
| 1 | Horn Pad | 15 | Nut | 29 | Nut |
| 2 | Nut | 16 | Collar | 30 | Nut |
| 3 | Steering wheel | 17 | Wave washer | 31 | Bolt |
| 4 | Rear column cover | 18 | Nut | 32 | Power steering booster |
| 5 | Front column cover | 19 | Collar | | 📖 P37-26 |
| 6 | Grommet | 20 | Wave washer | 33 | Nut |
| 7 | Screw | 21 | Steering shaft assembly | 34 | Drag link 📖 P37-52 |
| 8 | Combination switch | 22 | Grease nipple | 35 | Nut |
| 9 | Head cutting bolt | 23 | Seal | 36 | Tie rod assembly 📖 P37-54 |
| 10 | Bracket | 24 | Bolt | | |
| 11 | Starter switch | 25 | Steering upper shaft assembly | * | Front axle assembly |
| 12 | Bolt | 26 | Steering lower shaft assembly | | 📖 Gr26 |
| 13 | Support | 27 | Harness cover | | |
| 14 | Collar | 28 | Oil pipe | | |

NOTE

Before removing oil pipe 28, clean the port area to prevent dust from entering.

● Assembly sequence

Follow the disassembly sequence in reverse.

STEERING SYSTEM

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
26, 27	Play in rotating direction of joint	15' or less	—	Replace
	Play in axial direction of steering shaft	0.2 {0.0079} or less	—	Replace
25	Play in rotating direction of spline	30' or less	—	Replace

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

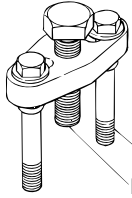
Location	Parts to be tightened		Tightening torque	Remarks
2	Nut (Steering wheel mounting)		68 to 78 {50 to 57, 6.9 to 7.9}	—
15	Nut (Upper lever and steering shaft assembly mounting)		9.8 {7.2, 1.0}	—
18	Nut (Lower lever and steering shaft assembly mounting)		36 {27, 3.7}	—
12	Bolt (Steering shaft assembly and integral power steering assembly mounting)		51.45±2.45 {38±1.8, 5.25±0.25}	—
24	Bolt (Steering lower shaft assembly mounting)		48 to 63 {35 to 46, 4.9 to 6.4}	—
22	Grease nipple		3.0 to 5.0 {2.2 to 3.7, 0.3 to 0.5}	—
9	Head cutting bolt (Starter switch mounting)		14.2±1.47 {10±1.1, 1.4±0.1}	—
29	Nut (Drag link assembly and integral power steering assembly mounting)	FK, FM61, FM64	190±47.5 {140±35, 19.4±4.85}	—
		FM65	353±88 {260±65, 36±9}	—
30	Nut (Integral power steering booster assembly mounting)	FK, FM61, FM64	175.4±26.5 {130±20, 17.9±2.7}	—
		FM65	270±34 {200±25, 27.5±3.5}	—
31	Bolt (Integral power steering booster assembly mounting)	FK, FM61, FM64	175.4±26.5 {130±20, 17.9±2.7}	—
		FM65	270±34 {200±25, 27.5±3.5}	—
33	Nut (Drag link assembly and front axle assembly mounting)	FK, FM61, FM64	190±47.5 {140±35, 19.4±4.85}	—
		FM65	353±88 {260±65, 36±9.0}	—
35	Nut (Tie rod assembly and front axle assembly mounting)	FK, FM61, FM64	190±48 {140±35, 19.4±4.85}	—
		FM65	270±68 {200±50, 27.6±6.9}	—

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
3	Horn contact ring on combination switch side	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
22	Supply via grease nipple after assembling spline	Chassis grease [NLGI No.1 (Li soap)]	Supply until grease overflows from grease escape hole
26	Spline	Chassis grease [NLGI No.1 (Li soap)]	As required

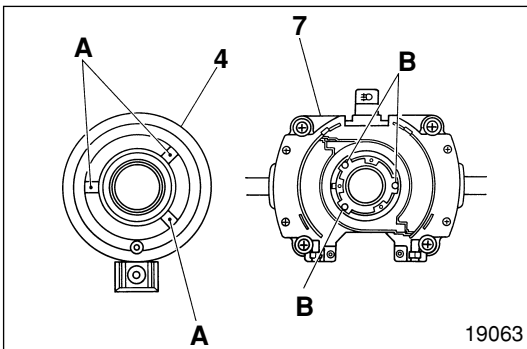
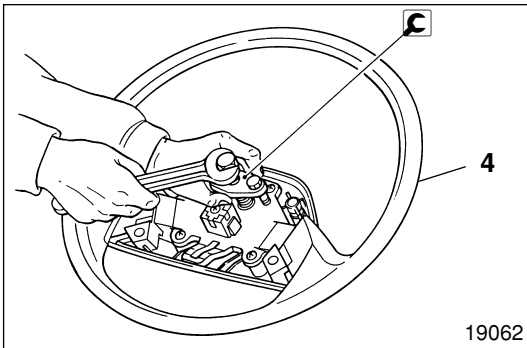
Special tools

Unit : mm

Location	Tool name and shape	Part No.	Application
3	Steering wheel puller 	MH062421	Removal of steering wheel

◆ Service procedure

4 Removal of steering wheel



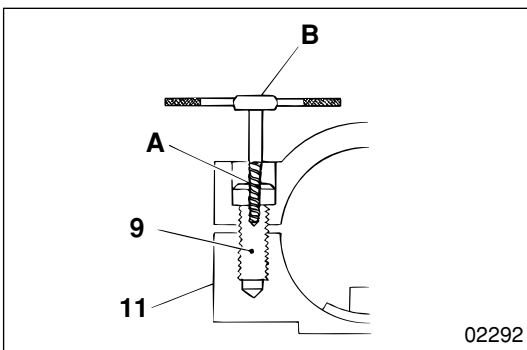
[Installation]

Align slots **A** in steering wheel **4** with cancel cam protrusions **B** of combination switch **7**.

11 Starter switch

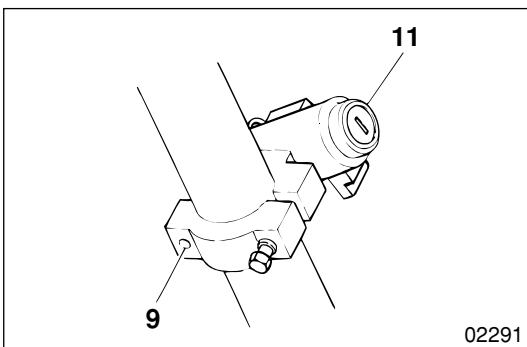
[Removal]

- Grip one end of the column in a vise, then drill a $\varnothing 5.5$ to 6 mm {0.22 to 0.24 in.} hole 15 mm {0.59 in.} deep in surface **A**, where the head was cut off, of head cutting bolt **9** for mounting starter switch **11**.
- Screw in screw extractor **B** counterclockwise, then remove head cutting bolt **9** from the steering column.

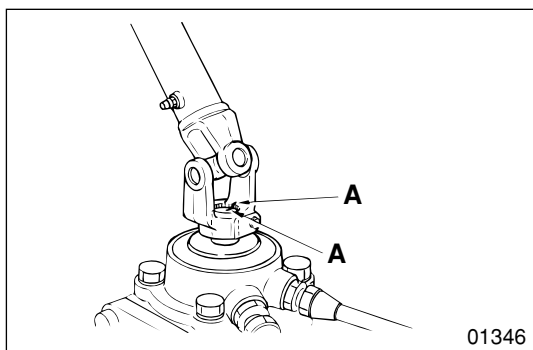


[Installation]

- Tighten new head cutting bolt **9** at specified torque to cut the head off the bolt.
- Check the steering lock mechanism after installation.

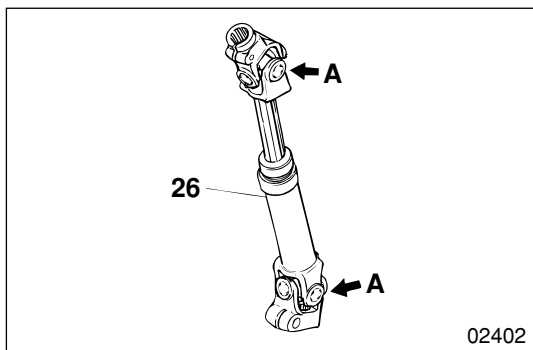


STEERING SYSTEM



21 Removal of steering shaft assembly

A : Alignment mark

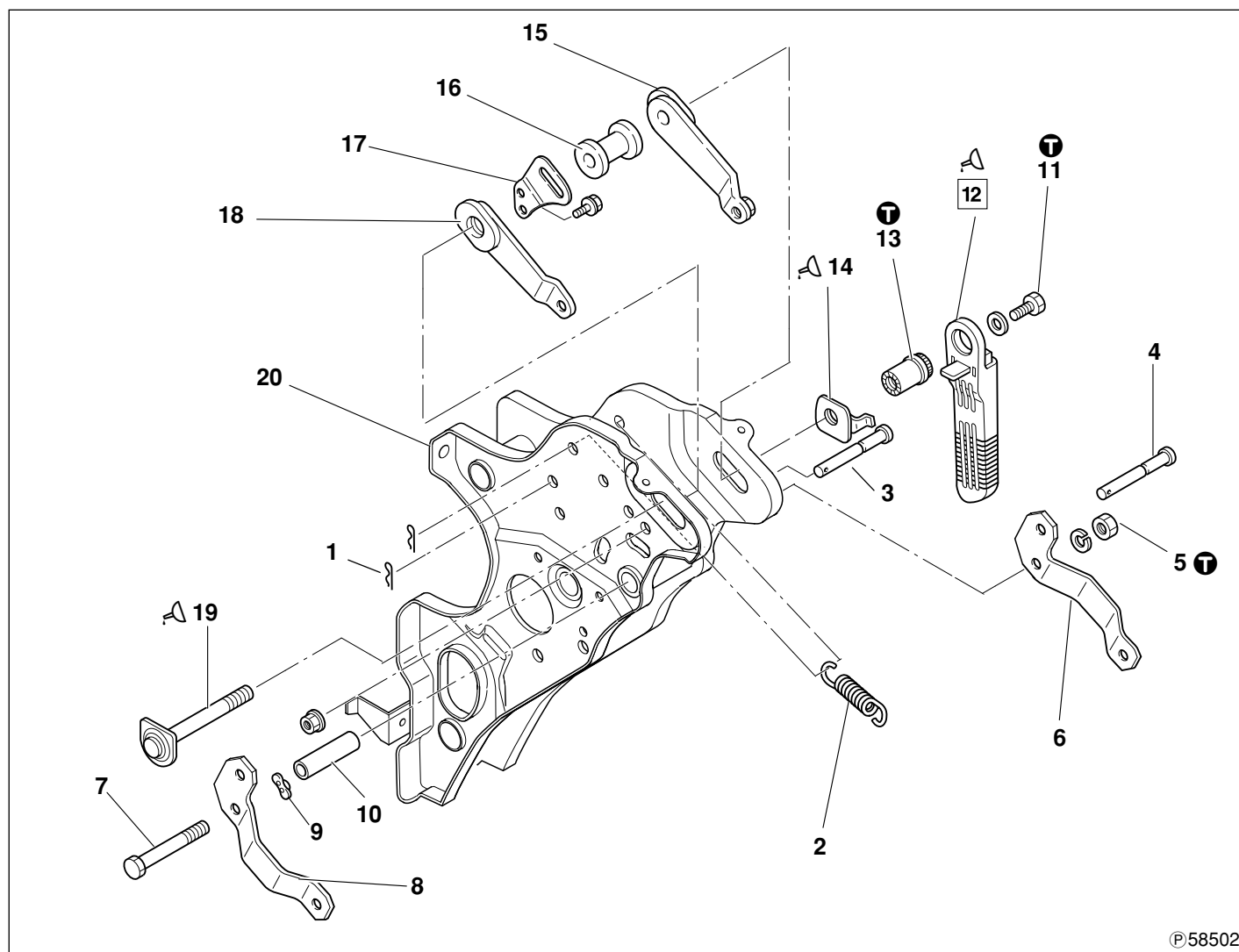


26 Steering lower shaft assembly

When the spline of steering lower shaft assembly **26** has been disconnected, align marks **A** on the yokes to face the same direction.

MEMO

LINKAGE AND BRACKET



©58502

● Disassembly sequence

- | | |
|-------------------|----------------------------|
| 1 Snap ring | 11 Bolt |
| 2 Coil spring | 12 Lock lever |
| 3 Clevis pin | 13 Nut |
| 4 Clevis pin | 14 Washer and stopper set |
| 5 Nut | 15 Upper lever, RH |
| 6 Lower lever, RH | 16 Collar |
| 7 Bolt | 17 Steering column plate |
| 8 Lower lever, LH | 18 Upper lever, LH |
| 9 Wave washer | 19 Adjusting bolt |
| 10 Collar | 20 Steering column bracket |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Coil spring load (Installed length 106.5 {4.19})	115 N {26 lbf, 11.9 kg}	—	Replace
12	Play at lock lever tip	2.5 {0.098} or less	3.0 {0.12} or less	Replace
	Lock lever working angle	36 to 46°	—	Adjust

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Nut (Lower lever mounting)	36.3 {27, 3.7}	—
11	Bolt (Lock lever mounting)	9.8 {7.2, 1.0}	—
13	Nut (Upper lever mounting)	41.2 to 44.1 {30 to 33, 4.2 to 4.5}	—

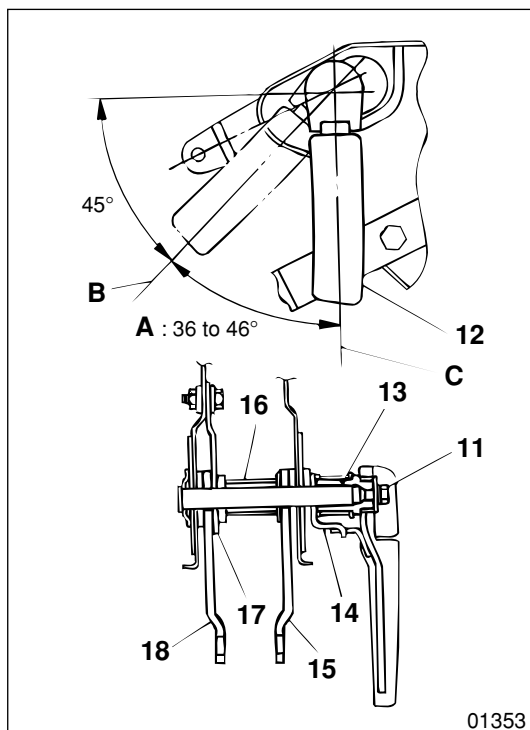
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
12	Serration area on lock lever	Chassis grease [NLGI No.1 (Li soap)]	As required
14	Friction surfaces of stopper and steering column bracket	Chassis grease [NLGI No.1 (Li soap)]	As required
19	Friction surfaces of adjusting bolt and steering column bracket	Chassis grease [NLGI No.1 (Li soap)]	As required
	Adjusting bolt thread area	Chassis grease [NLGI No.1 (Li soap)]	As required

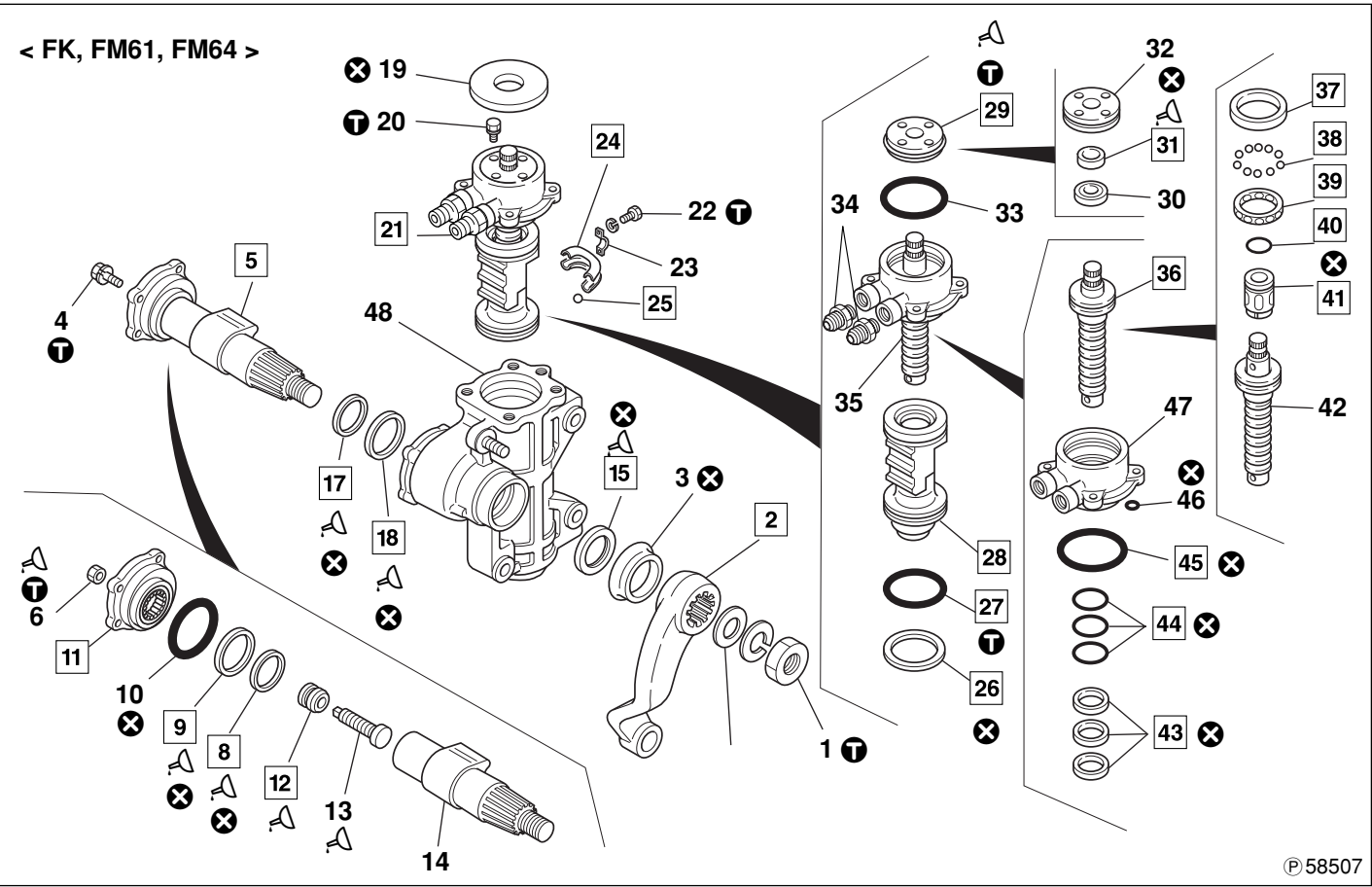
Service procedure

13 Installation of lock lever

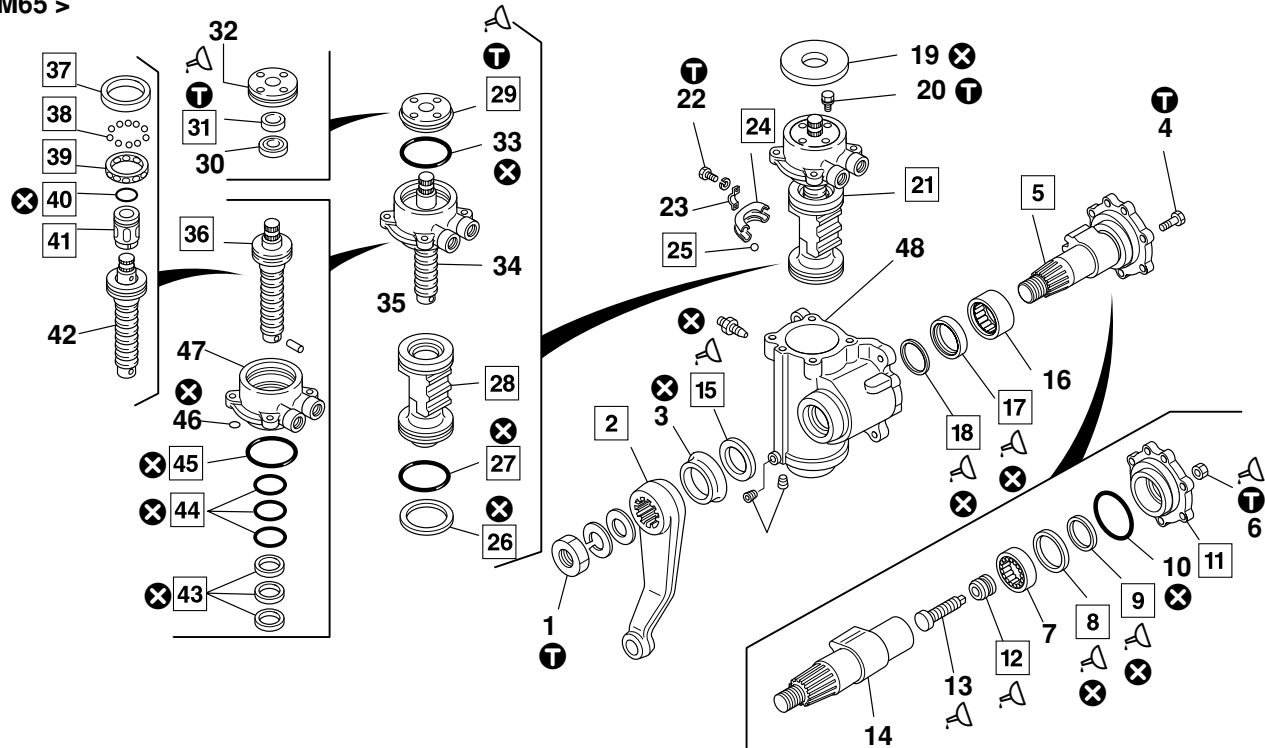
- Tighten nut **13** at specified torque.
- Install lock lever **12** at position **B** so it is within standard working angle **A** from where the lock lever hits stopper **14**.
- Pull up lock lever **12** to position **B**, and make sure that upper levers **15**, **18** moves vertically, as well as horizontally, smoothly.
- Pull down lock lever **12** to position **C**, and make sure that upper levers **15**, **18** are securely locked.



POWER STEERING BOOSTER



< FM65 >



P58508

● Work before disassembly

📖 P37-31

● Disassembly sequence

- | | | |
|---|---------------------------|--|
| 1 Lock nut | 18 Backup ring | 35 Worm shaft and valve housing assembly |
| 2 Pitman arm | 19 Dust cover | 36 Worm shaft assembly |
| 3 Dust cover | 20 Bolt | 37 Side race |
| 4 Bolt | 21 Ball screw assembly | 38 Steel ball |
| 5 Sector shaft assembly and side cover assembly | 22 Screw | 39 Bearing cage |
| 6 Nut | 23 Ball tube clip | 40 Seal ring |
| 7 Needle bearing < FM65 > | 24 Ball tube | 41 Rotor |
| 8 Y-packing | 25 Steel ball | 42 Worm and stub shaft |
| 9 Backup ring | 26 Seal ring | 43 Seal ring |
| 10 O-ring | 27 O-ring | 44 O-ring |
| 11 Side cover | 28 Piston | 45 O-ring |
| 12 Retainer | 29 Plug and seal assembly | 46 O-ring |
| 13 Adjusting screw | 30 Ball bearing | 47 Valve housing |
| 14 Sector shaft | 31 Oil seal | 48 Body (Cylinder) |
| 15 Oil seal | 32 Adjusting plug | |
| 16 Needle bearing < FM65 > | 33 O-ring | |
| 17 Y-packing | 34 Connector | |
- ⊗ : Non-reusable parts

NOTE

- Do not remove needle bearing 7, 16 unless anomaly is found.
- Do not remove retainer 12 and adjusting screw 13 unless anomaly is found.
- Prepare receiving tray upon disassembly of steel balls 25, 38.

POWER STEERING BOOSTER

● Assembly sequence

48 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 5 → 4 → 3 → 2 → 1

36 : 42 → 41 → 40 → 39 → 38 → 37

35 : 47 → 46 → 45 → 44 → 43 → 36

29 : 32 → 31 → 30

21 : 35 → 33 → 29 → 28 → 27 → 26 → 25 → 24 → 23 → 22

5 : 14 → 13 → 12 → 6
11 → 10 → 9 → 8 → 7 → 6

● Adjustment after assembly

📖 P37-31

Service standards

Unit : mm {in.}

Location	Maintenance item			Standard value (Basic diameter in [J])	Limit	Remedy
5, 21	Backlash between sector shaft and ball screw (Measure at the end of pitman arm)		FK	0.05 to 0.25 {0.0020 to 0.0098}	0.5 {0.020}	l=250 {9.84}*1
			FM61, FM64	0.05 to 0.30 {0.0020 to 0.012}	0.5 {0.020}	l=300 {11.8}*1
			FM65	0.05 to 0.35 {0.0020 to 0.014}	0.5 {0.020}	l=220 {8.66}*2
12	Retainer			Tighten the retainer then slacken off by 180°, retighten at 39 N·m {29 ft.lbs, 4 kgf·m}, then slacken off by 20°. Make sure that the adjusting screw turns smoothly, then caulk it	—	—
13, 14	Axial play of adjusting screw and sector shaft			0.01 to 0.10 {0.00039 to 0.0039}	0.2 {0.0079}	Replace
14	Outer diameter of sector shaft	Adjusting screw side	FK	ø39.975 {1.57}	ø39.875 {1.57}	Replace
			FM61,FM64	ø47.975 {1.89}	ø47.875 {1.88}	
			FM65	ø47.975 {1.89}	ø47.875 {1.88}	
		Pitman arm side	FK	ø44.975 {1.77}	ø44.875 {1.77}	
			FM61,FM64	ø47.975 {1.89}	ø47.875 {1.88}	
			FM65	ø57.975 {2.28}	ø57.875 {2.28}	
28, 36	Side play (Play towards the diameter direction)			—	0.5 {0.020} or less	Replace
28, 48	Clearance between outer diameter of piston and inner diameter of body (Cylinder)		FK	[85 {3.35}] 0.11 {0.0043}	0.16 {0.0063}	Replace
			FM61,FM64	[90 {3.54}] 0.11 {0.0043}	0.16 {0.0063}	
			FM65	[100 {3.94}] 0.11 {0.0043}	0.16 {0.0063}	
41, 42	Clearance between outer diameter of rotor and worm shaft			[35.5 {1.40}] 0.01 to 0.03 {0.00039 to 0.00012}	0.03 {0.0012}	Replace

*1 : Adjust (Measure with applied load of ±15 N {3.3 lbf, 1.5 kgf})

*2 : Adjust (Measure with applied load of ±20 N {4.4 lbf, 2 kgf})

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

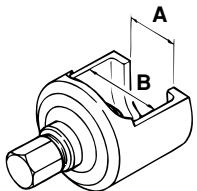
Location	Parts to be tightened		Tightening torque	Remarks
1	Lock nut (Pitman arm mounting)	FK	269.5±24.5 {200±18, 27.5±2.5}	—
		FM61, FM64	338.1±24.5 {250±18, 34.5±2.5}	
		FM65	417±25 {305±18, 43±2.5}	
4	Bolt (Side cover mounting)	Except FM61	73.6 to 83.4 {54 to 62, 7.5 to 8.5}	—
		FM61	49.1 to 53.9 {36 to 40, 5.0 to 5.5}	
6	Nut (Adjusting screw tightening)	FK	63.7 to 73.5 {47 to 54, 6.5 to 7.5}	—
		FM61, FM64	117.7 to 127.5 {87 to 94, 12 to 13}	
		FM65	118 to 127 {87 to 94, 12 to 13}	
20	Bolt (Valve housing tightening)	FK, FM61, FM64	98.1 to 107.9 {72 to 80, 10 to 11}	—
		FM65	118 to 127 {87 to 94, 12 to 13}	
22	Screw (Ball tube clip mounting)	FK, FM61, FM64	4.41 to 5.39 {3.3 to 4.0, 0.4 to 0.5}	—
		FM65	4.4 to 5.4 {3.3 to 4.0, 0.45 to 0.55}	
29	Adjusting plug assembly	FK	177 to 195 {130 to 145, 18 to 20}	—
		FM	226 to 245 {165 to 180, 23 to 25}	
34	Connector		109 to 127 {80 to 94, 11 to 13}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
6	Contact surfaces of nut and side cover	Hermetic seal 101Y or THREEBOND 1102	As required
8, 17	Backup ring inner periphery	Multipurpose grease [NLGI No.2 (Li soap)]	As required
9, 18	Pack interior of Y-packing	Multipurpose grease [NLGI No.2 (Li soap)]	As required
12	Pack interior of retainer	Multipurpose grease [NLGI No.2 (Li soap)]	As required
13	Contact surfaces of adjusting screw and sector shaft	Multipurpose grease [NLGI No.2 (Li soap)]	As required
	Thread area of adjusting screw	Hermetic seal 101Y or THREEBOND 1102	As required
15, 31	Pack interior of oil seal	Multipurpose grease [NLGI No.2 (Li soap)]	As required
24	Pack interior of role tube	Multipurpose grease [NLGI No.2 (Li soap)]	As required
29	Adjusting plug assembly outer periphery	Hermetic seal 101Y or THREEBOND 1102	As required

Special tools

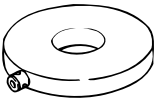
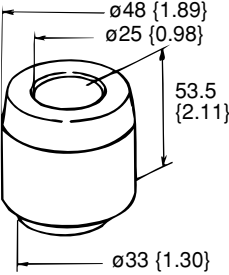
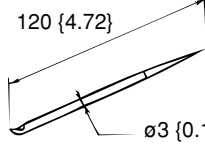
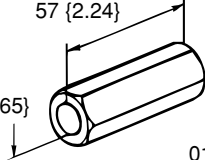
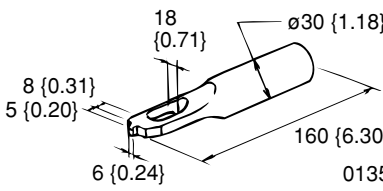
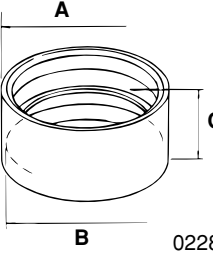
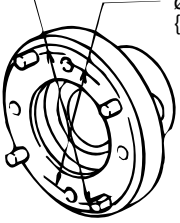
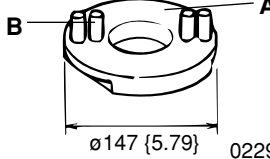
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Pitman arm puller 	MH061687 *910-00183 *910-00184	Removal of pitman arm

* Unisia JKC Steering System part No.

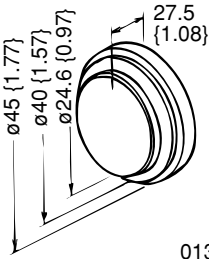
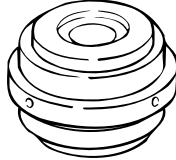
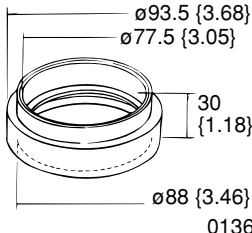
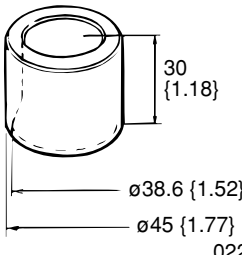
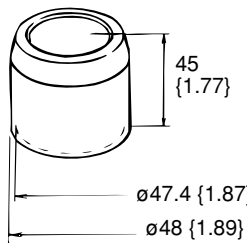
POWER STEERING BOOSTER

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application												
9, 15, 18	Inserting tool assembly  01356	MC811971 *910-11001	Forming of backup ring and press-fitting of oil seal												
9, 18	Inserting tool  01358	MC811974 *910-21715	Forming of backup ring												
10, 26, 27, 33, 40, 43, 44, 45, 46	Needle  02288	MC811948 *910-21200	Removal of O-ring and seal ring												
12	Bar  01360	MC811955 *910-22811	Turning of retainer												
	Squeeze tool  01359	MC811950 *910-21801	Caulking of retainer												
26	Inserting tool <table border="1"> <thead> <tr> <th>Part No.</th><th>A</th><th>B</th><th>C</th></tr> </thead> <tbody> <tr> <td>MC813516 *910-21718</td><td>ø98 {3.86}</td><td>ø90.05 {3.55}</td><td>50 {1.97}</td></tr> <tr> <td>MC811985 *910-21701</td><td>ø110 {4.33}</td><td>ø103 {4.06}</td><td>37 {1.46}</td></tr> </tbody> </table>  02289	Part No.	A	B	C	MC813516 *910-21718	ø98 {3.86}	ø90.05 {3.55}	50 {1.97}	MC811985 *910-21701	ø110 {4.33}	ø103 {4.06}	37 {1.46}	MC813516 *910-21718 < FK, FM61, FM64 > MC811985 *910-21701 < FM65 >	Forming of piston seal ring
Part No.	A	B	C												
MC813516 *910-21718	ø98 {3.86}	ø90.05 {3.55}	50 {1.97}												
MC811985 *910-21701	ø110 {4.33}	ø103 {4.06}	37 {1.46}												
29	Wrench assembly  01357	MC811970 *910-10743	Removal and installation of adjusting plug assembly												
	Attachment (A : Adapter) (B : Bolt)  02290	MC811969 *910-10671 (A : *910-23581) (B : *910-23194)	Holding down of valve housing												

* Unisia JKC Steering System part No.

Unit : mm {in.}

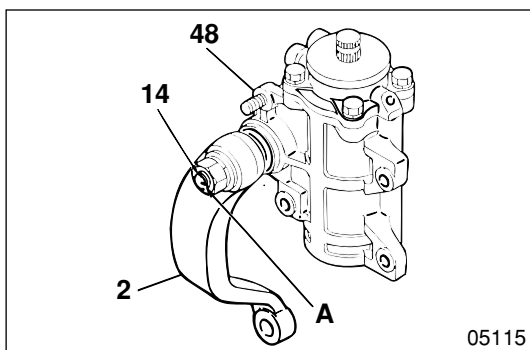
Location	Tool name and shape	Part No.	Application
31	Press-fitting tool 	MC811972 *910-20404	Press-fitting of oil seal
37 to 39	Tool assembly 	MC811968 *910-10611	Assembly of thrust bearing
	Guide assembly 	MC090148 *910-23033	
40, 43	Inserting tool 	*910-22777	Forming of rotor seal ring < FK, FM61, FM64 >
40, 43	Inserting tool 	MC811975 *910-22722	Forming of rotor seal ring < FM65 > and forming of valve housing seal ring

* Unisia JKC Steering System part No.

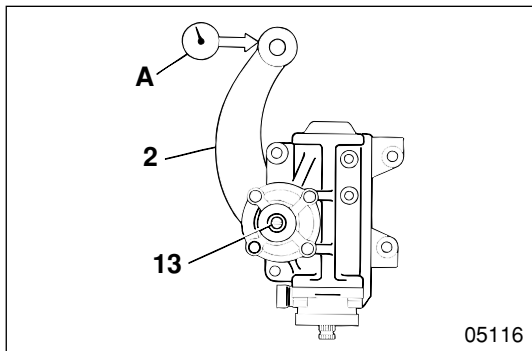
◆ Service procedure

● Work before disassembly

Move pitman arm 2, and align slit **A** of the V-groove of sector shaft 14 to the center of body 48 so that the gears are in neutral position.



POWER STEERING BOOSTER

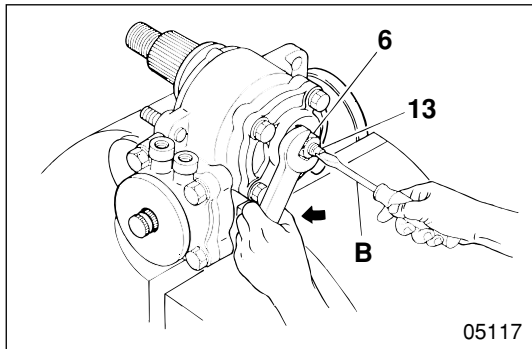


● Adjustment after assembly

Adjustment of backlash

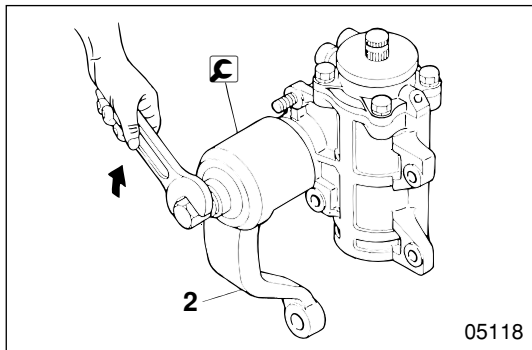
- (Carry out this work with the gears in neutral position.)
Measure play at the end of pitman arm **2** with dial gauge **A**, and adjust adjusting screw **13** so that reading meets the standard value.

Measuring load : < FK, FM61, FM64 > ± 15 N {3.3 lbf, 1.5 kgf}
< FM65 > ± 20 N {4.4 lbf, 2 kgf}



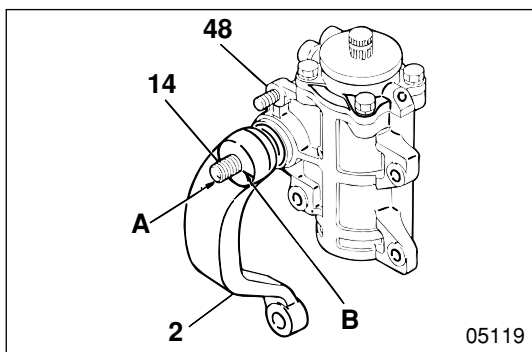
Tightening nut

- After adjusting backlash, apply sealer to thread area of adjusting screw **13**. Hold it in place with screwdriver **B** and tighten nut **6** at specified torque.



2 Pitman arm

[Removal]

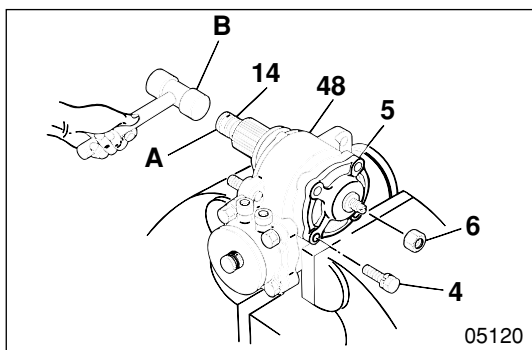


[Installation]

Align slit **A** of the V-groove of sector shaft **14** to the center of body **48**, and align slit **B** of the V-groove of pitman arm **2** on the same line.

NOTE

Have pitman arm **2** make a full stroke of the piston to make sure that the piston moves smoothly.

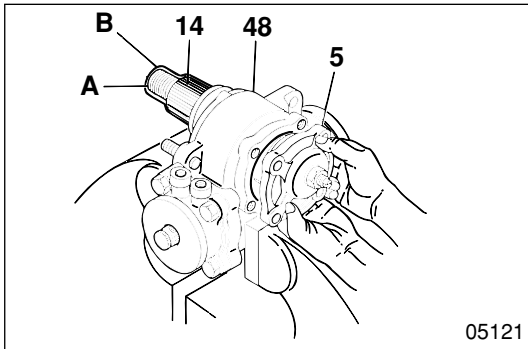


5 Sector shaft assembly and side cover assembly

[Removal]

- Make sure that the piston is in the neutral position (slit **A** of the V-groove at one end of sector shaft **14** is aligned with the center of body **48**).
- Tap the end of sector shaft **14** and pull out sector shaft assembly and side cover assembly **5**.

B : Plastic-headed mallet

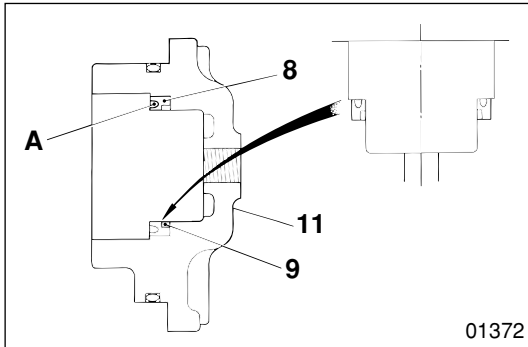


[Installation]

Position sector shaft **14** of sector shaft assembly and side cover assembly **5** so that slit **A** of its V-groove is aligned with the center of body **48**, and the piston gear and sector shaft gear engage at their centers.

CAUTION

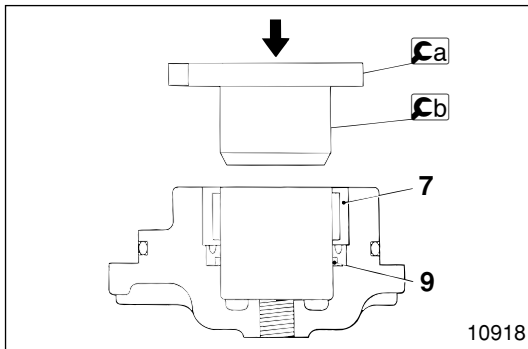
Before installation, apply tape **B** to the Y-packing to prevent it being damaged by the threads of sector shaft **14**.



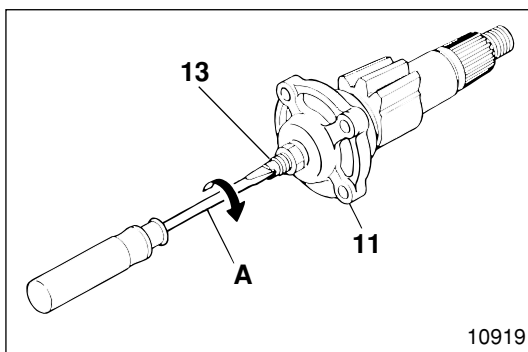
8 9 Y-packing, Backup ring

[Installation]

- Install Y-packing **8** into side cover **11** in the direction as illustrated.
- After installing backup ring **9**, pack groove **A** of Y-packing **8** with grease.



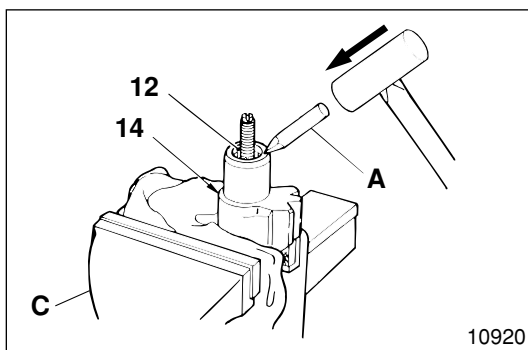
- After installing needle bearing **7** into backup ring **9**, form the bent up part of the backup ring using insert tool assembly and insert tool.



11 Removal of side cover

Screw in adjusting screw **13** and remove side cover **11**.

A : Screwdriver



12 Retainer

Disassemble sector shaft **14**, as follows, only if it is faulty :

[Removal]

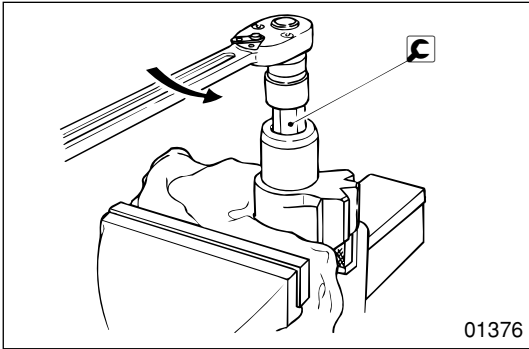
- Pry up (2 points) of retainer **12**.

A : Chisel

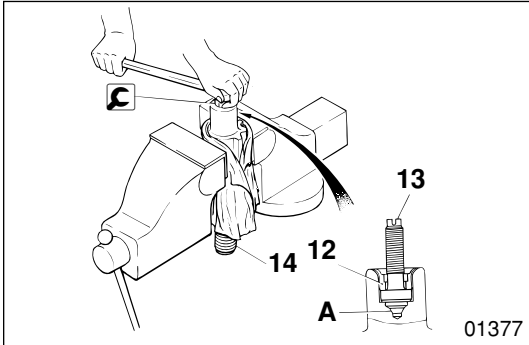
CAUTION

Make sure you use a cloth when you grip sector shaft **14** in vise **C** to prevent damage.

POWER STEERING BOOSTER

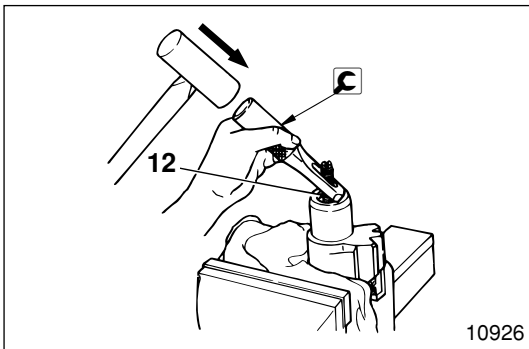


- Remove retainer **12** using bar.

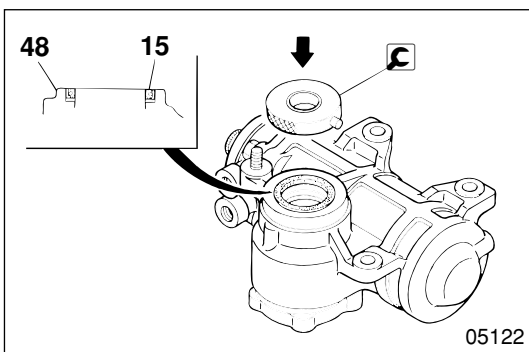


[Installation]

- Pack adjusting screw **13** mounting hole **A** of sector shaft **14** with grease.
- Install adjusting screw **13** into sector shaft **14**.
- Install retainer **12** into sector shaft **14** using bar.
- After installation, slacken off by 180°, retighten at 39 N·m {29 ft.lbs, 4.0 kgf·m}, then slacken off by 20°.
- Make sure that adjusting screw **13** turns smoothly.

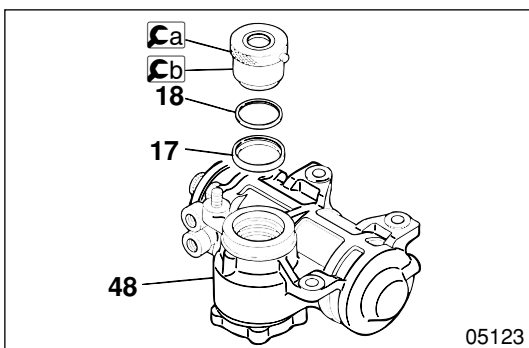


- After installing retainer **12**, caulk the retainer (2 points) using squeeze tool.



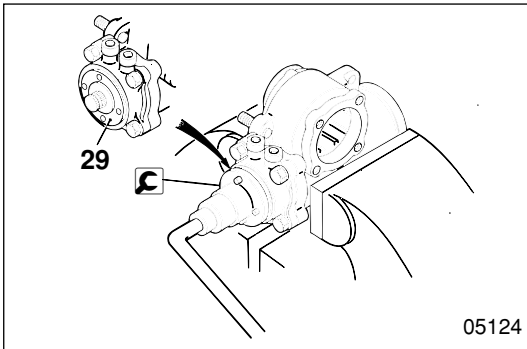
15 Installation of oil seal

Install oil seal **15** into body **48** in the direction as illustrated.



17 **18** Installation of Y-packing and backup ring

- Install Y-packing **17** and backup ring **18** to body **48**.
- Pack the groove of Y-packing **17** with grease.
- Form the shape of backup ring **18** using insert tool assembly and insert tool.



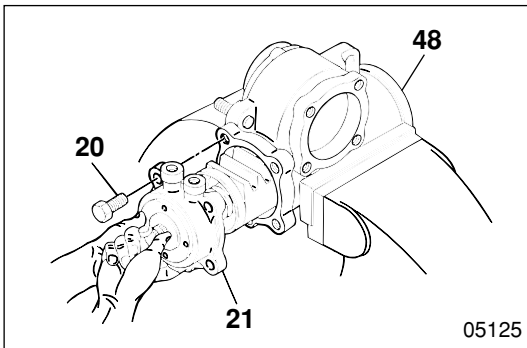
21 Ball screw assembly

[Removal]

- Loosen adjusting plug assembly 29 by approximately 180° using wrench assembly.

CAUTION

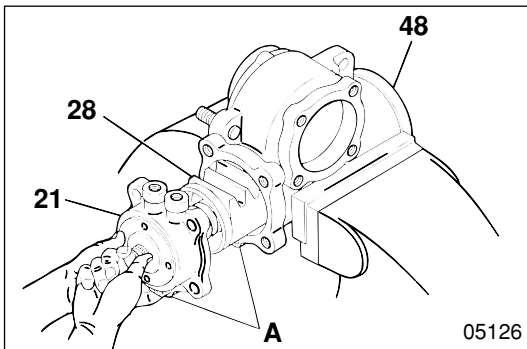
Make sure you only loosen adjusting plug assembly 29, do not undo it completely because the bearing inside the valve housing might spring out.



- Loosen bolt 20 and remove ball screw assembly 21 from body 48.

CAUTION

- Make sure that the balls of the ball screw do not spring out.
- Be careful not to damage the piston or the interior of body 48.



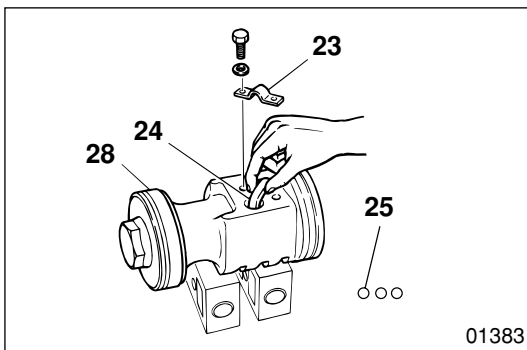
[Installation]

- Install ball screw assembly 21 into body 48, holding piston 28 so it will not turn.

CAUTION

Be careful not to damage the piston seal ring or the interior of body 48.

- Align oil passage ports A of ball screw assembly 21 and body 48, then tighten.



24 25 Ball tube and steel ball

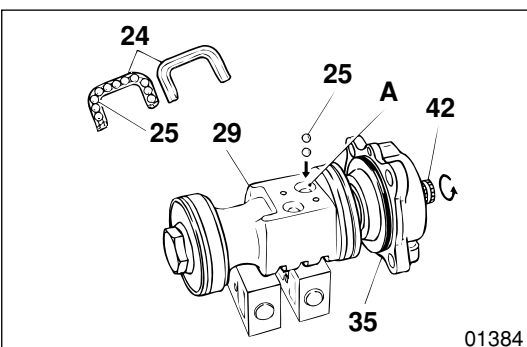
First remove steel balls 25 from piston 28 and place them in the receiving tray, remove ball clip 23, grip ball tube 24 with your fingers and pull it out gently.

CAUTION

Be careful not to loose any steel balls 25.

< FK, FM61, FM64 (×30) >

< FM65 (×32) >



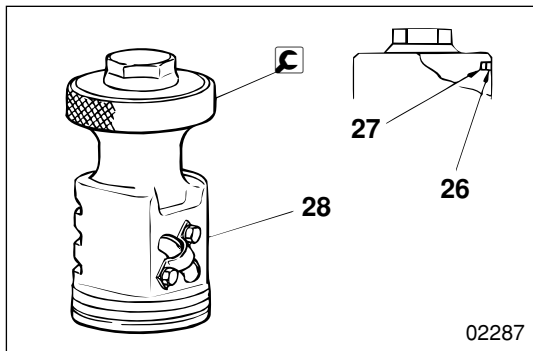
[Installation]

- Pack the interior of ball tube 24 with grease, lay 10 or 11 steel balls 25 in place, then mount the other side of the ball tube.
- Place piston 29 on a level surface, align assembled worm shaft assembly and valve housing assembly 35 and the piston ball race, then drop steel balls 25 through ball tube hole A while turning worm and stub shaft 42.

CAUTION

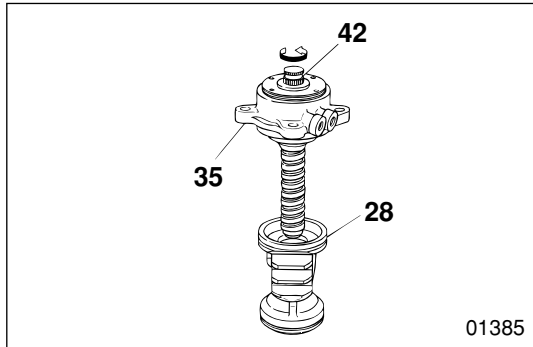
Make sure that you do not pull out worm shaft assembly and valve housing assembly 35 too far, or steel balls 25 will drop out of the ball race.

POWER STEERING BOOSTER



26 27 Installation of seal-ring and O-ring

Install O-ring **27** and seal ring **26** in the outside grooves of piston **28**, then form the shape of the seal ring with  inserting tool.



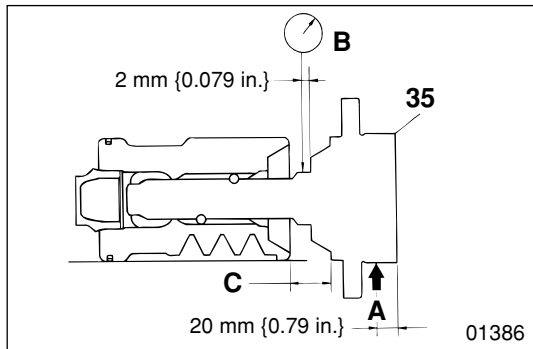
28 Piston

[Removal]

Holding worm shaft assembly and valve housing assembly **35** so that piston **28** is at the bottom, turn worm and stub shaft **42** and remove the piston.

CAUTION

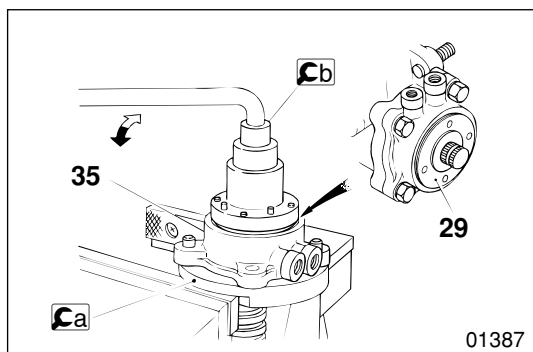
Be careful not to tilt piston at this instance, as otherwise steel balls, being assembled into race of piston **28 and worm and stub shaft **42**, will fall off into piston.**



[Inspection]

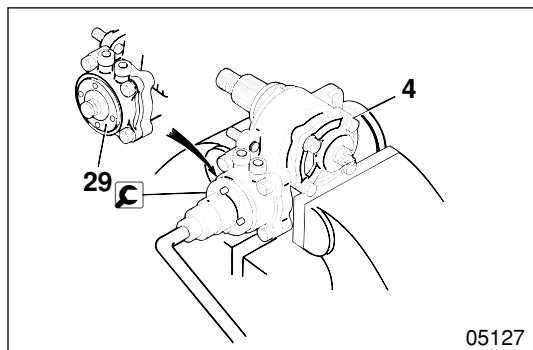
Measure side play (play in axial direction) **B** of worm shaft assembly and valve housing assembly **35** when 49 N {11 lbf, 5.0 kgf} is applied to **A** as illustrated.

C : < FK >	30.45 mm {1.20 in.}
< FM61, FM64 >	30.24 mm {1.19 in.}
< FM65 >	42.8 mm {1.69 in.}

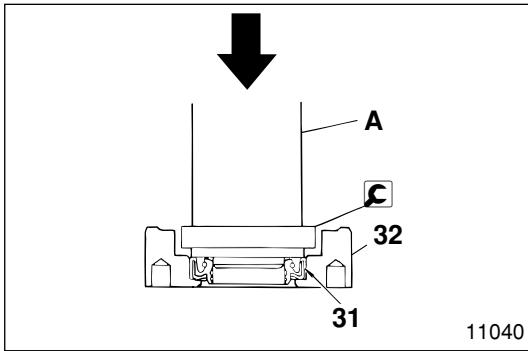


29 Installation of plug and seal assembly

- Clamp  attachment in vise **A** and set worm shaft and valve housing assembly **35** on it. Tighten plug and seal assembly **29** to the specified torque using  wrench assembly, then back off by approximately 180°.



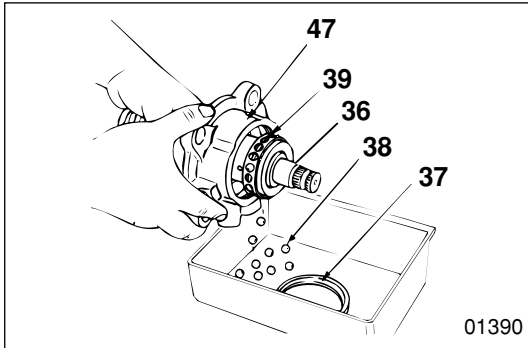
- Tighten bolt **4** at specified torque, then retighten plug and seal assembly **29** at specified torque using  wrench assembly.



31 Installation of oil seal

Install oil seal **31** into adjusting plug **32** in the direction as illustrated.

A : Hand press



36 Worm shaft assembly

[Removal]

Push out worm shaft assembly **36** from valve housing **47** by pushing out the side of the worm shaft assembly where the piston is assembled.

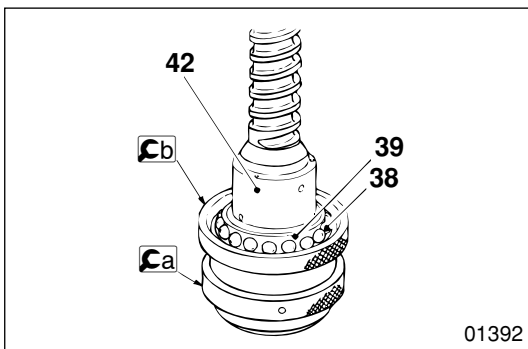
NOTE

Have a tray or box ready to catch side race **37**, steel balls **38**, and bearing cage **39** as these items separate on removal.

[Installation]

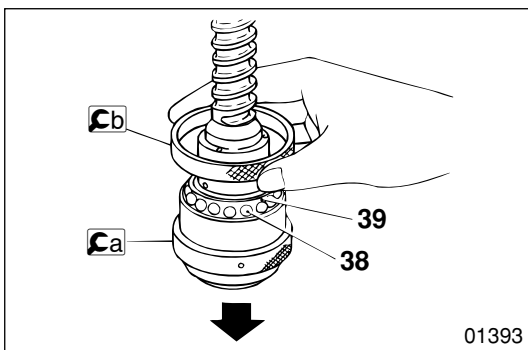
CAUTION

Be careful that worm shaft assembly **36** ball race does not damage seal ring **43**.



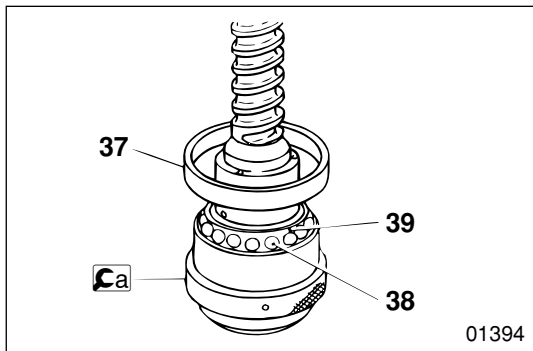
37 to 39 Installation of side race, steel ball, and bearing cage

- Install  **b** guide assembly on  **a** tool assembly, and insert worm and stub shaft **42** in the direction as illustrated.
- Assemble bearing cage **39** and steel balls **38** on worm and stub shaft **42**.

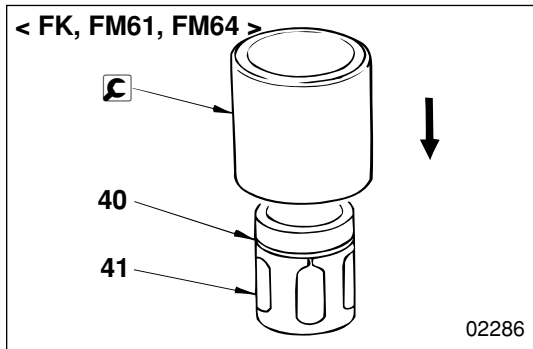


- Hold down  **b** with your hand and slide  **a** downward, so that you can position steel balls **38** as specified.

POWER STEERING BOOSTER

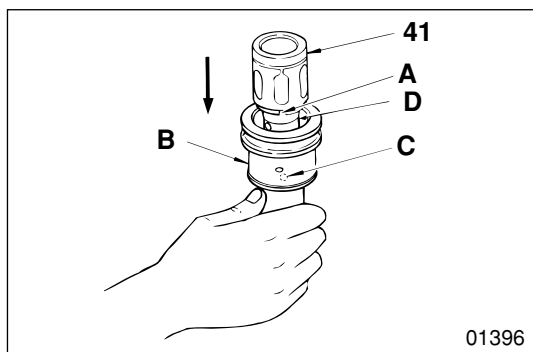
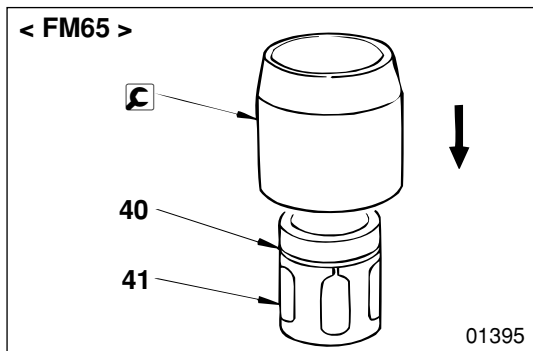


- Install side race **37** on top of steel balls **38** and bearing cage **39**.



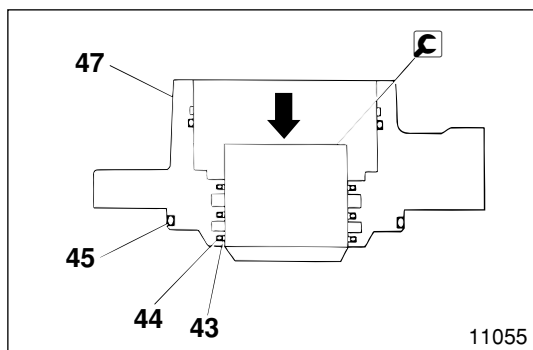
40 Installation of seal ring

- Install seal ring **40** onto rotor **41**.
- Form seal ring **40** using  insert tool.



41 Installation of rotor

Install rotor **41** between stub shaft **D** and worm shaft **B** so that indent **A** of the rotor fits positioning pin **C** of the worm shaft.

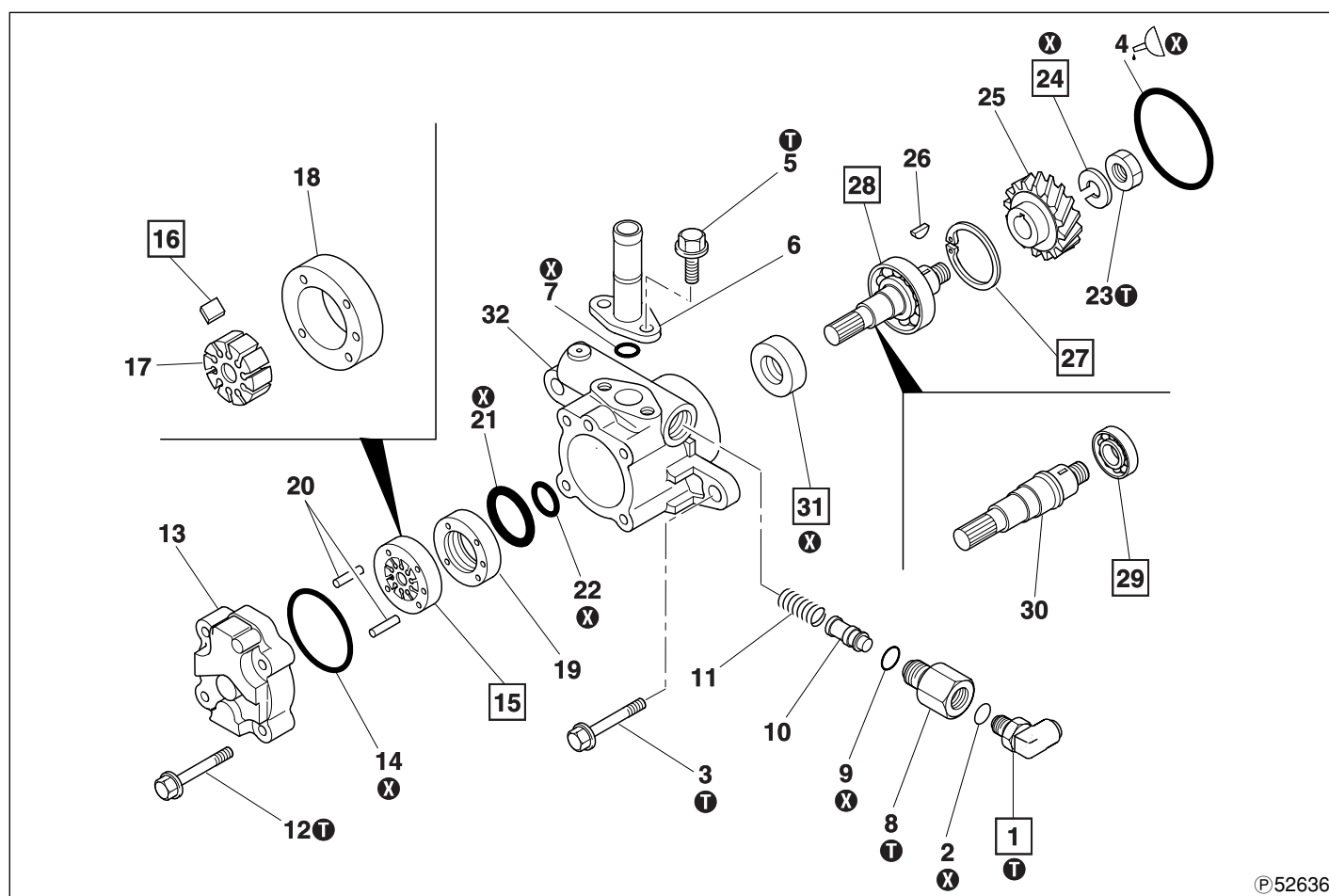


43 to 45 Installation of seal ring and O-ring

- Install seal ring **43** and O-rings **44**, **45** into valve housing **47**.
- Form seal ring **43** using  insert tool.

MEMO

POWER STEERING OIL PUMP < FK, FM61, FM64 >



© 52636

● Disassembly sequence

- | | | |
|--------------------------------|-----------------------|-------------------------|
| 1 Elbow | 13 Rear body | 25 Oil pump gear |
| 2 O-ring | 14 O-ring | 26 Key |
| 3 Bolt | 15 Cartridge assembly | 27 Retaining ring |
| 4 O-ring | 16 Vane | 28 Drive shaft assembly |
| 5 Bolt | 17 Rotor | 29 Bearing |
| 6 Flow control spring | 18 Cam | 30 Drive shaft |
| 7 O-ring | 19 Pressure plate | 31 Oil seal |
| 8 Connector | 20 Straight pin | 32 Front body |
| 9 O-ring | 21 O-ring | |
| 10 Flow control valve assembly | 22 O-ring | |
| 11 Flow control spring | 23 Nut | |
| 12 Bolt | 24 Washer | |

⊗ : Non-reusable part

NOTE

- Do not disassemble flow control valve assembly 10 unless it is faulty.
- Do not remove ball bearing 29 and oil seal 31 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.
Repair kit: Seal kit, cartridge assembly kit.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
10, 32	Clearance between flow control valve assembly and front body	—	0.03 {0.0012}	*1
13, 19	Stepped wear on rear body and pressure plate where it is subject to friction against rotor and vane	—	0.01 {0.00039}	*2

*1 No seizure, wear, or scoring sufficient to catch a finger nail. Replace flow control valve assembly or rear body.

*2 No seizure, wear, or scoring sufficient to catch a finger nail. Replace if any.

Tightening torque

Unit : N·m {lbs.ft., kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Elbow	68 {51, 7.0}	—
3	Bolt (Power steering oil pump mounting)	49 to 64 {36 to 47, 5.0 to 6.5}	—
5	Bolt (Hose connector mounting)	17.7 to 24.5 {13 to 18, 1.8 to 2.5}	—
8	Connector (Flow control valve mounting)	44.1 to 53.9 {33 to 40, 4.5 to 5.5}	—
12	Bolt (Rear body mounting)	17.7 to 24.5 {13 to 18, 1.8 to 2.5}	—
23	Nut (Gear mounting)	29.4 to 39.2 {22 to 29, 3.0 to 4.0}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	O-ring (Power steering oil pump mounting)	Engine oil	As required

Special tools

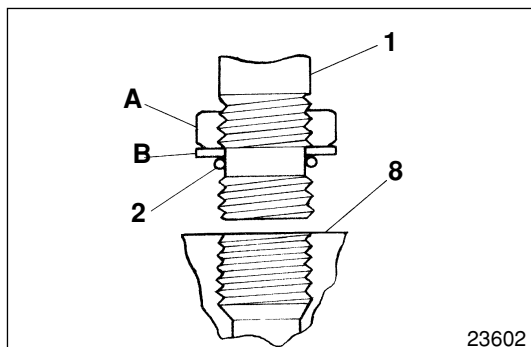
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
27	Pliers	*910-22570	Removal and installation of retaining ring
29	Press-fitting tool	*910-23061	Removal and installation ball bearing
31	Stick	*910-21632	Removal of oil seal
	Press-fitting tool	*910-21664	Installation of oil seal

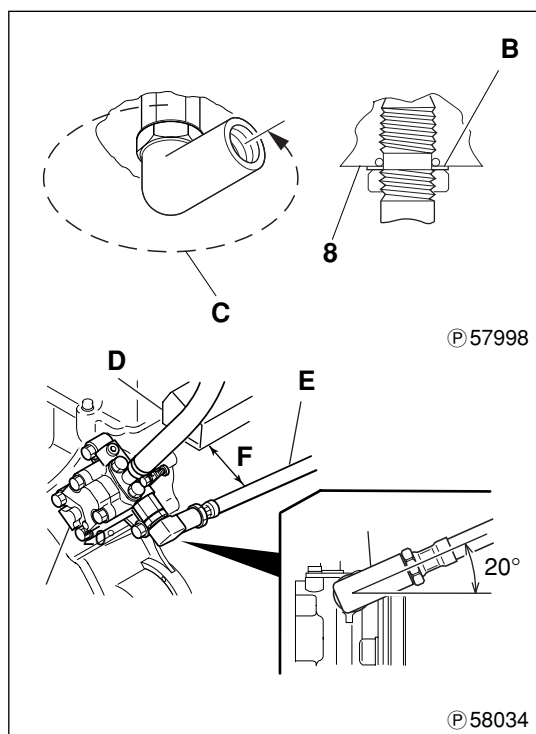
* Unisia JKC Steering System part No.

Service procedure**1 Installation of elbow**

- Check elbow **1** to ensure that the nut **A**, washer **B** and O-ring **2** are properly positioned. Clean the inside of the O-ring groove well, then apply oil to the O-ring and the threaded section connected to connector **8**.



POWER STEERING OIL PUMP < FK, FM61, FM64 >



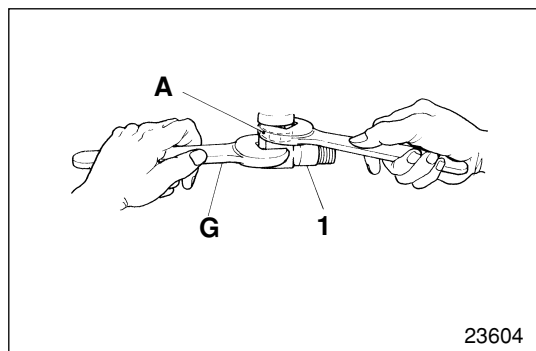
- To install, screw in with hand until the face of washer **B** comes in contact with connector **8**. Then, back off until the position is reached to the down angle 10° from horizontal line as illustrated.

C : Direction of loosening (Within 270°)

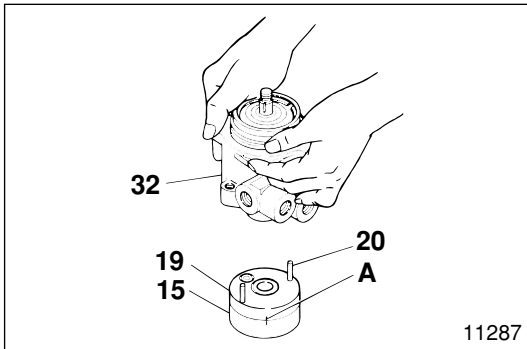
NOTE

DO not back off more than 270° turn to achieve the specified position.

- When installing oil hose **E**, keep the distance **F** more than 50 mm from exhaust manifold insulator **D**.



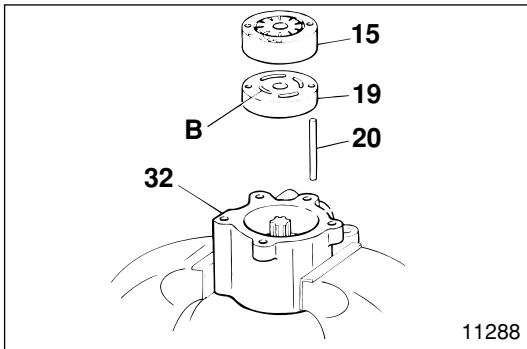
- When tightening, hold elbow **1** with spanner **G** and torque nut **A** to the specification so that the elbow will not be displaced.



15 Removal and installation of cartridge assembly

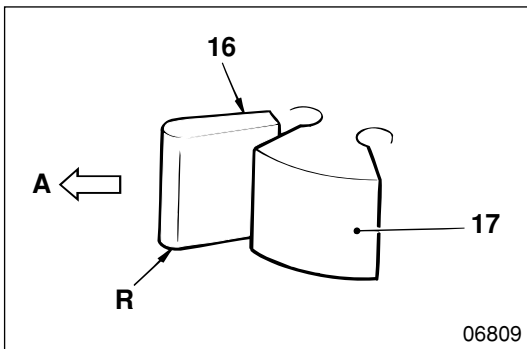
[Removal]

- Remove cartridge assembly **15**, pressure plate **19** and straight pin **20** together from front body **30**.
- Put alignment marks **A** around the outer circumferences of cartridge assembly **15** and pressure plate **19**.



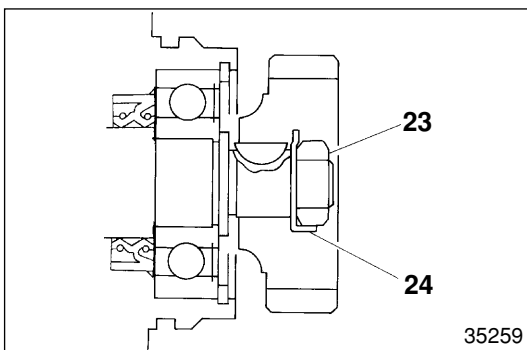
[Installation]

- Install straight pin **20** into front body **32**.
- Install pressure plate **19** onto front body **32**, so that groove **B** of the pressure plate faces the direction as illustrated.
- Align cartridge assembly **15** with straight pin **20**, then install the cartridge assembly.



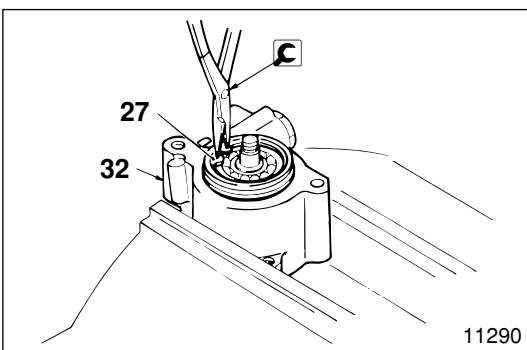
16 Installation of vane

With point **R** of vane **16** facing outside **A**, install it into rotor **17** and make sure that the vane moves smoothly. If it is faulty, replace the cartridge assembly.



24 Installation of washer

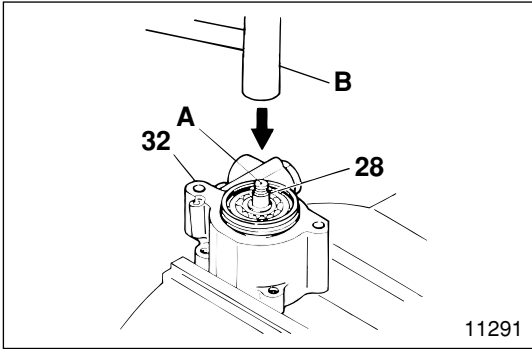
After installing nut **23**, bend up one lug on the circumference of lock washer **24**.



27 Removal of retaining ring

Remove retaining ring **27** using  pliers.

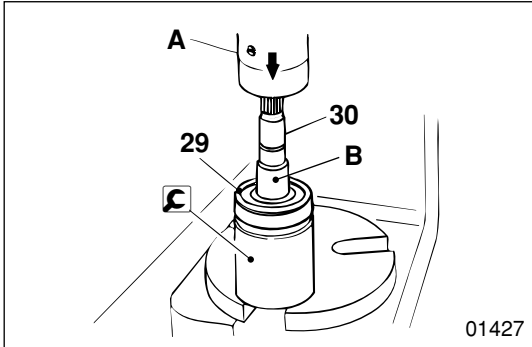
POWER STEERING OIL PUMP < FK, FM61, FM64 >



28 Installation of drive shaft assembly

If it is hard to install drive shaft assembly **28** in the correct position of front body **32** by hand, tap the shaft to install it.

B : Plastic-headed mallet



29 Removal and installation of ball bearing

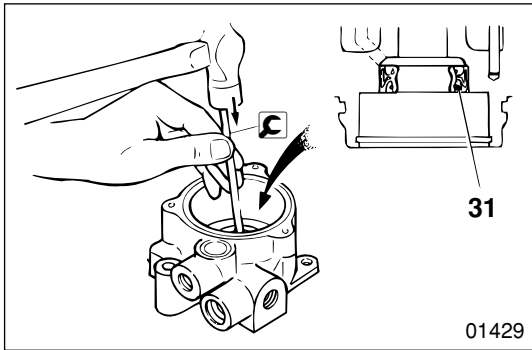
Remove ball bearing **29** from shaft **30** using  press-fitting tool.

A : Hand press

For installation, follow the removal sequence in reverse.

CAUTION

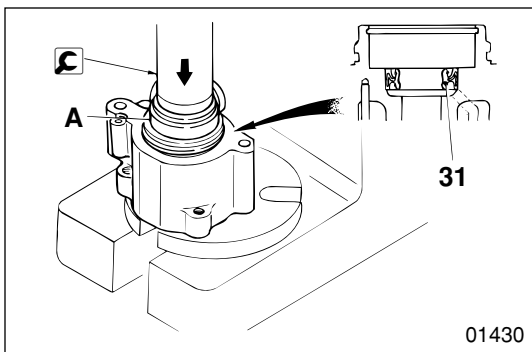
Be careful not to damage oil seal contact surface **B**.



31 Oil seal

[Removal]

Remove oil seal **31** using  stick.



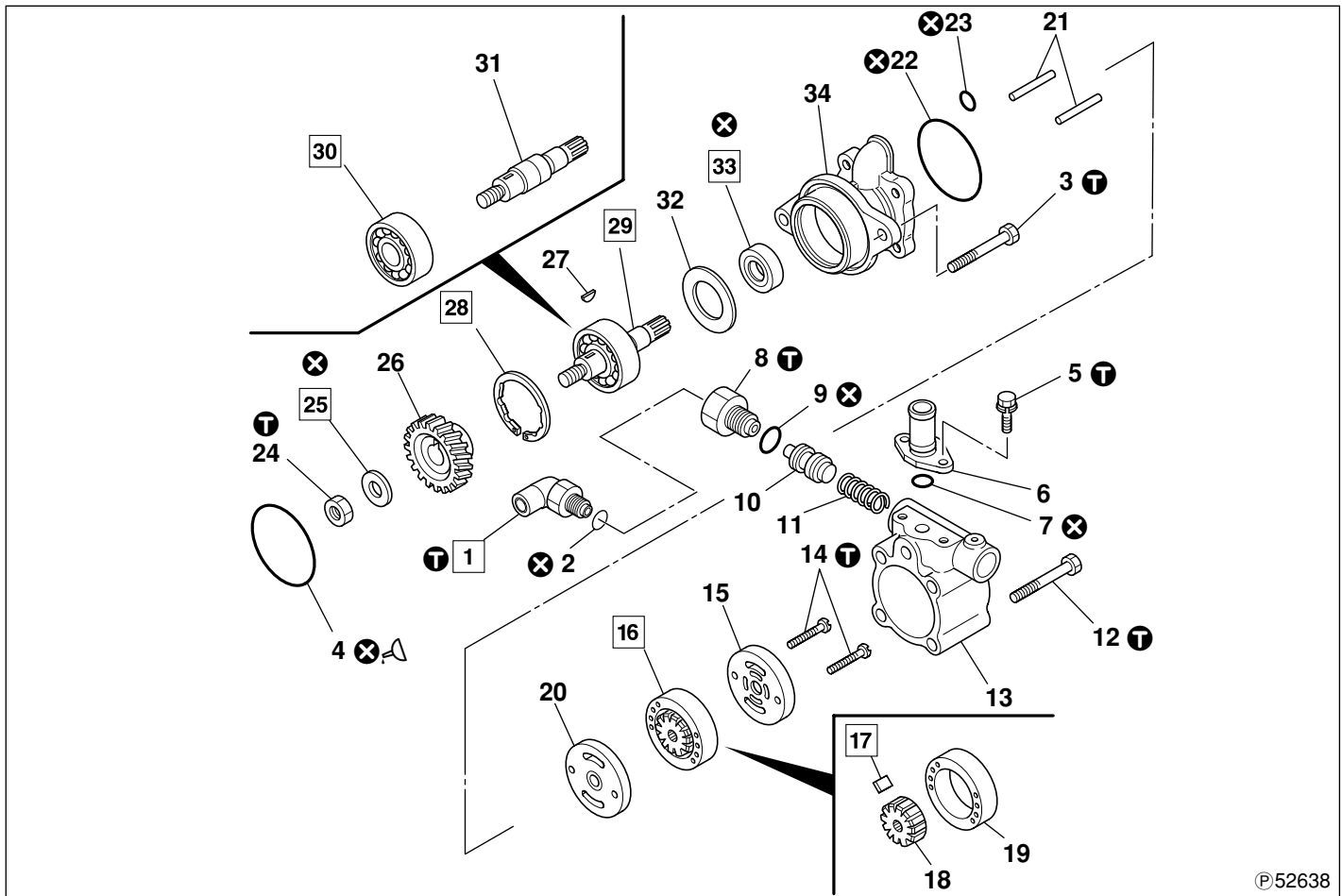
[Installation]

Install oil seal **31** in the direction as illustrated using  press-fitting tool.

A : Hand press

MEMO

POWER STEERING OIL PUMP < FM65 >



© 52638

Disassembly sequence

- | | | |
|--------------------------------|-----------------------|-------------------------|
| 1 Elbow | 13 Rear body | 25 Washer |
| 2 O-ring | 14 Screw | 26 Gear |
| 3 Bolt | 15 Pressure plate | 27 Key |
| 4 O-ring | 16 Cartridge assembly | 28 Retaining ring |
| 5 Bolt | 17 Vane | 29 Drive shaft assembly |
| 6 Hose connector | 18 Rotor | 30 Ball bearing |
| 7 O-ring | 19 Cam | 31 Shaft |
| 8 Connector | 20 Side plate | 32 Retaining ring |
| 9 O-ring | 21 Straight pin | 33 Oil seal |
| 10 Flow control valve assembly | 22 O-ring | 34 Front body |
| 11 Flow control spring | 23 O-ring | |
| 12 Bolt | 24 Nut | |

⊗ : Non-reusable parts

NOTE

- Do not disassemble flow control valve assembly 10 unless it is faulty.
- Do not remove ball bearing 30 and oil seal 33 unless they are faulty.

Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit: Seal kit, cartridge assembly kit.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
10, 13	Clearance between flow control valve assembly and front body	—	0.03 {0.0012}	*1
15, 20	Stepped wear on rear body and pressure plate where it is subject to friction against rotor and vane	—	0.01 {0.00039}	*2

*1 No seizure, wear, or scoring sufficient to catch a finger nail. Replace flow control valve assembly or rear body.

*2 No seizure, wear, or scoring sufficient to catch a finger nail. Replace if any.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Elbow	68 {51, 7.0}	—
3	Bolt (Power steering oil pump mounting)	29 {21, 3.0}	—
5	Bolt (Hose connector mounting)	17.7 to 24.5 {13 to 18, 1.8 to 2.5}	—
8	Connector	49.0 to 58.8 {36 to 43, 5.0 to 6.0}	—
12	Bolt (Rear body mounting)	49.0 to 58.8 {36 to 43, 5.0 to 6.0}	—
14	Screw tightening	5.9 to 8.8 {4.4 to 6.5, 0.6 to 0.9}	—
24	Nut (Gear mounting)	29.4 to 39.2 {22 to 29, 3.0 to 4.0}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	O-ring (Power steering oil pump mounting)	Engine oil	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
25	Pliers	*910-22570	Removal and installation of retaining ring
28	Pliers	*910-22570	Removal and installation of retaining ring
30	Press-fitting tool	*910-22972	Removal and installation of ball bearing
33	Stick	*910-21632	Removal of oil seal
	Press-fitting tool	*910-22974	Installation of oil seal

* Unisia JKC Steering System part No.

POWER STEERING OIL PUMP < FM65 >

◆ Service procedure

1 Installation of elbow

- Check elbow **1** to ensure that the nut **A**, washer **B** and O-ring **2** are properly positioned. Clean the inside of the O-ring groove well, then apply oil to the O-ring and the threaded section connected to connector **8**.

- To install, screw in with hand until the face of washer **B** comes in contact with connector **8**. Then, back off until the position is reached to the down angle 10° from horizontal line as illustrated.

C: Direction of loosening (Within 270°)

NOTE

Do not back off more than 270° turn to achieve the specified position.

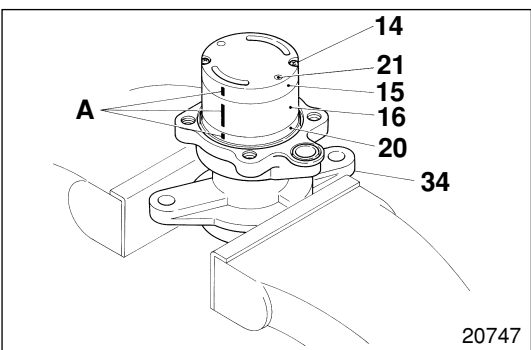
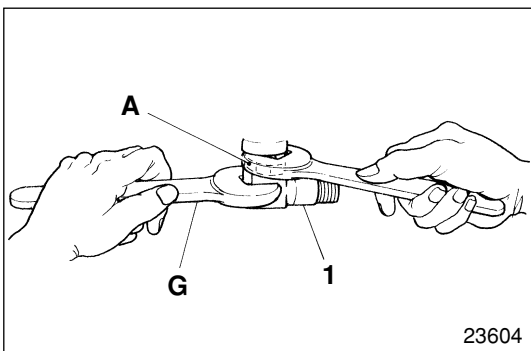
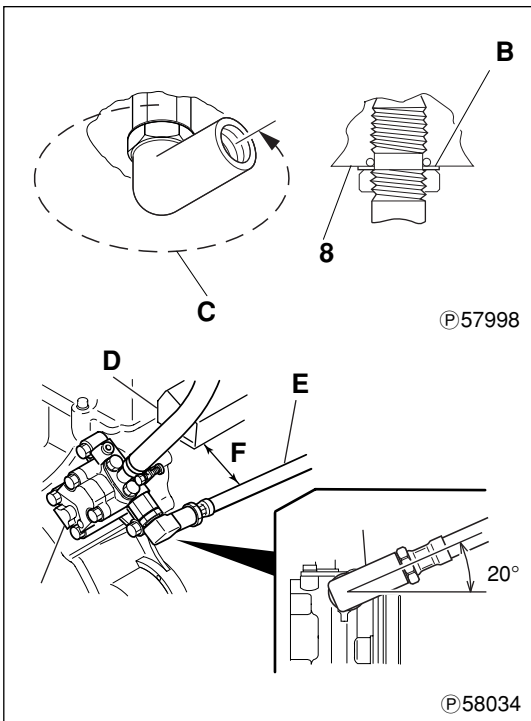
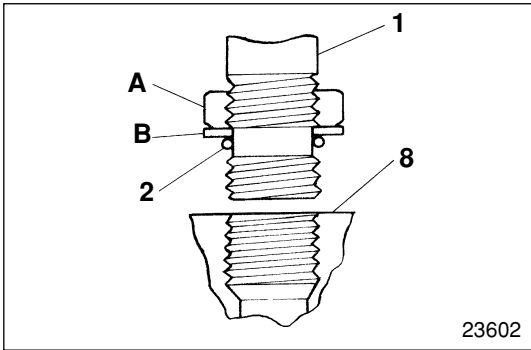
- When installing oil hose **E**, keep the distance **F** more than 50 mm from exhaust manifold insulator **D**.

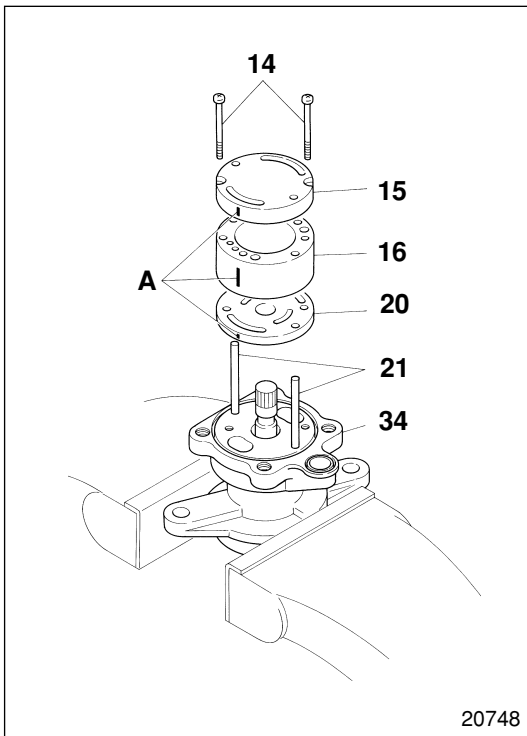
- When tightening, hold elbow **1** with spanner **G** and torque nut **A** to the specification so that the elbow will not be displaced.

16 Removal and installation of cartridge assembly

[Removal]

- Put alignment marks **A** on the peripheries of pressure plate **15**, cartridge assembly **16** and side plate **20**.
- Remove screw **14** and take out pressure plate **15**, cartridge assembly **16**, side plate **20** and straight pin **21** all together from front body **34**.



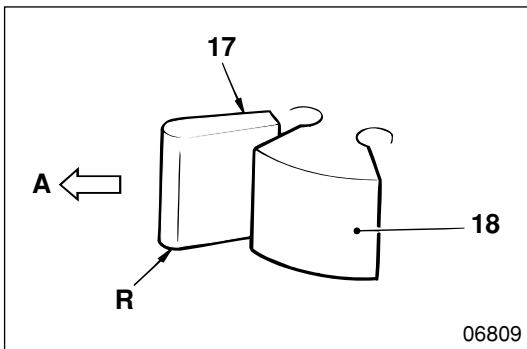


[Installation]

- Install straight pin **21** into front body **34**.
- Install side plate **20**, cartridge assembly **16** and pressure plate **15** aligning alignment marks **A** put before disassembly, and then tighten screw **14** to the specified torque.

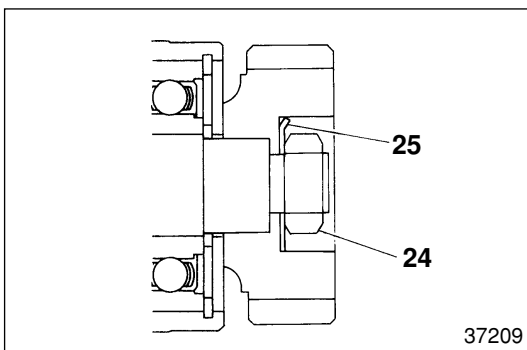
NOTE

Be sure to install respective parts through their proper pin holes.



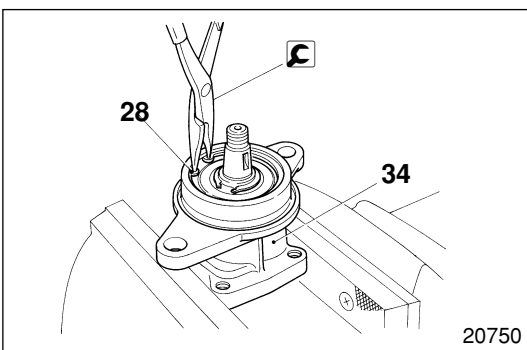
17 Installation of vane

With point **R** of vane **17** facing outside **A**, install it into rotor **18** and make sure that the vane moves smoothly. If it is faulty, replace the cartridge assembly.



25 Installation of washer

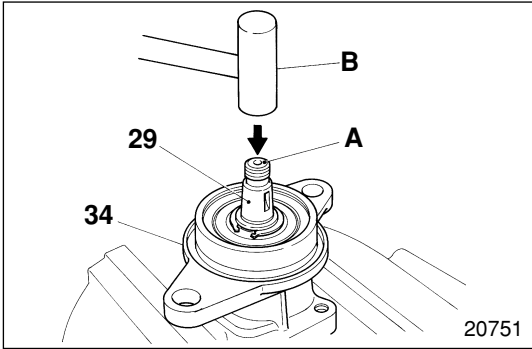
After installing nut **24**, bend up one lug on the circumference of lock washer **25**.



28 Removal of retaining ring

Remove retaining ring **28** using  pliers.

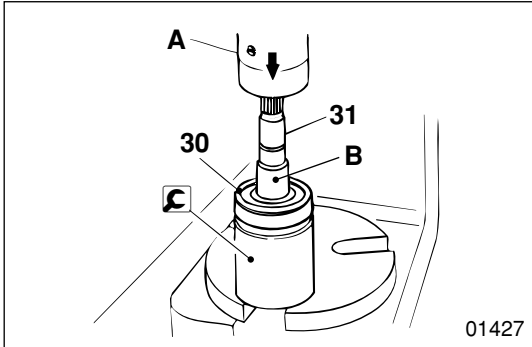
POWER STEERING OIL PUMP < FM65 >



29 Installation of drive shaft assembly

If it is hard to install drive shaft assembly 29 in the correct position of front body 34 by hand, tap the shaft end A to install it.

B : Plastic-headed mallet



28 Removal and installation of ball bearing

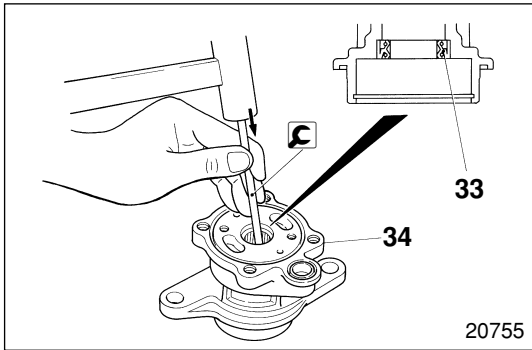
Remove ball bearing 30 from shaft 31 using C press-fitting tool.

A : Hand press

For installation, follow the removal sequence in reverse.

CAUTION ⚠

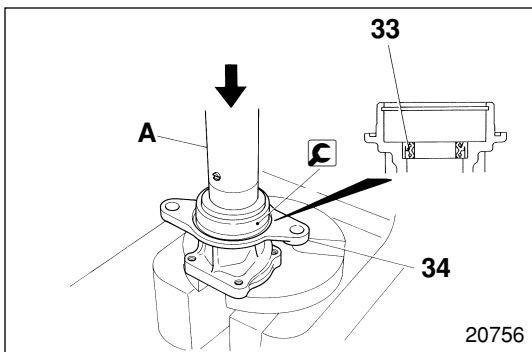
Be careful not to damage oil seal contact surface B.



33 Oil seal

[Removal]

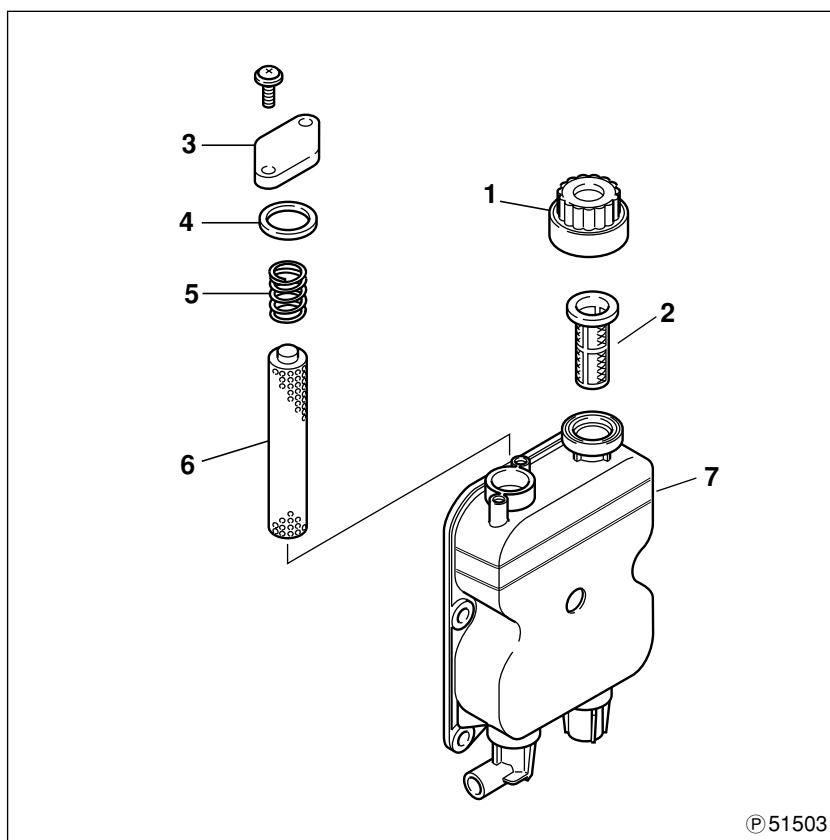
Remove oil seal 33 using C stick.



[Installation]

Install oil seal 33 in the direction as illustrated using C press-fitting tool.

A : Hand press



● Disassembly sequence

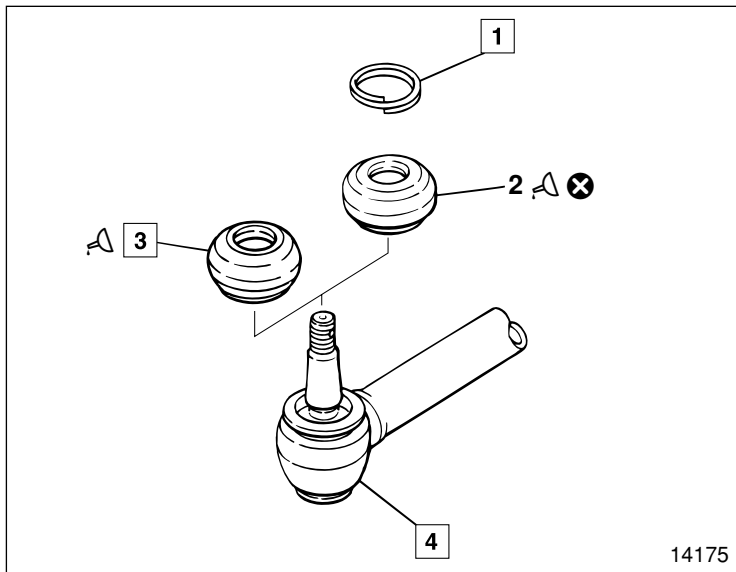
- 1 Filler cap
- 2 Strainer
- 3 Plate
- 4 Packing
- 5 Spring
- 6 Return filter
- 7 Tank body assembly

● Assembly sequence

Follow the disassembly sequence in reverse.

© 51503

DRAG LINK



● Disassembly sequence

- 1 Clip < FK >
- 2 Dust cover < FK >
- 3 Dust cover < FM >
- 4 Drag link

⊗ : Non-reusable parts

NOTE

- Do not remove clip 1 and dust covers 2, 3 unless they are faulty.
- Do not disassemble drag link 4 because it is a unit construction.

● Assembly sequence

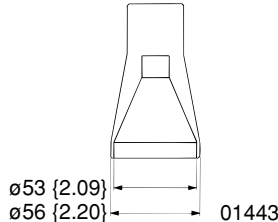
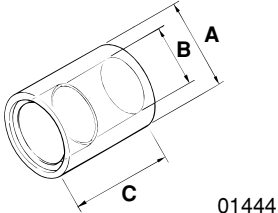
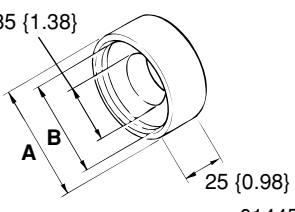
Follow the disassembly sequence in reverse.

🔧 Lubricant and/or sealant

Location	Points of application		Specified lubricant and/or sealant	Quantity
2, 3	Lip area of dust cover		Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
2	Pack interior of dust cover	FK	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	11 g {0.39 oz}
3	Pack interior of dust cover	FM61 FM64	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	13 to 14 g {0.46 to 0.49 oz}
		FM65	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	19 to 20 g {0.67 to 0.71 oz}

🔧 Special tools

Unit : mm {in.}

Location	Tool name and shape		Part No.	Application												
1	Clip guide		< FK > MH061831	Installation of clip												
3	Dust cover installer <table><tr><th></th><th>A</th><th>B</th><th>C</th></tr><tr><td>MH061828</td><td>ø60.3 {2.37}</td><td>ø45 {1.77}</td><td>80 {3.15}</td></tr><tr><td>MH061827</td><td>ø65 {2.56}</td><td>ø51 {2.01}</td><td>ø100 {3.94}</td></tr></table> 			A	B	C	MH061828	ø60.3 {2.37}	ø45 {1.77}	80 {3.15}	MH061827	ø65 {2.56}	ø51 {2.01}	ø100 {3.94}	< FM61, FM64 > MH061828 < FM65 > MH061827	Installation of dust cover
		A	B	C												
MH061828	ø60.3 {2.37}	ø45 {1.77}	80 {3.15}													
MH061827	ø65 {2.56}	ø51 {2.01}	ø100 {3.94}													
End holder <table><tr><th></th><th>A</th><th>B</th></tr><tr><td>MH061830</td><td>ø60 {2.36}</td><td>ø50.5 {1.99}</td></tr><tr><td>MH061829</td><td>ø64 {2.52}</td><td>ø55.7 {2.19}</td></tr></table> 			A	B	MH061830	ø60 {2.36}	ø50.5 {1.99}	MH061829	ø64 {2.52}	ø55.7 {2.19}	< FM61, FM64 > MH061830 < FM65 > MH061829					
	A	B														
MH061830	ø60 {2.36}	ø50.5 {1.99}														
MH061829	ø64 {2.52}	ø55.7 {2.19}														

◆ Service procedure

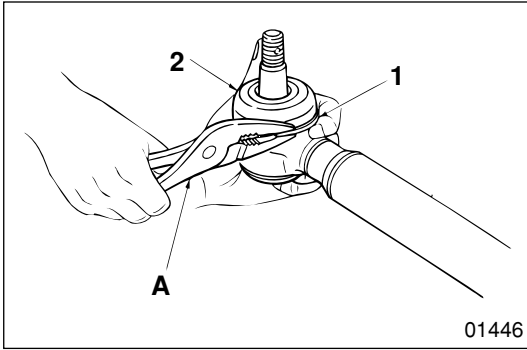
1 Clip < FK >

A : Long nose pliers

[Removal]

CAUTION ⚠

- Be careful not to damage clip 1 or dust cover 2 when you remove the clip.
- If clip 1 is deformed, do not reuse it.

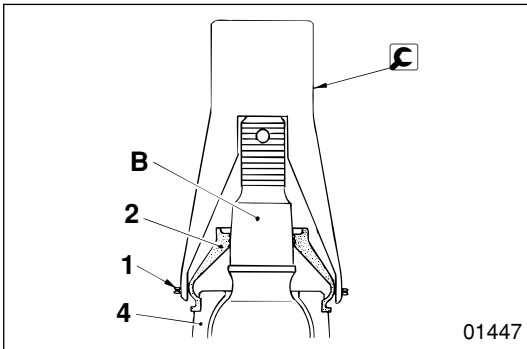


[Installation]

- Position the assembly so ball stud B is vertical.
- Place clip guide on drag link 4.
- Install clip 1 into the groove of dust cover 2.

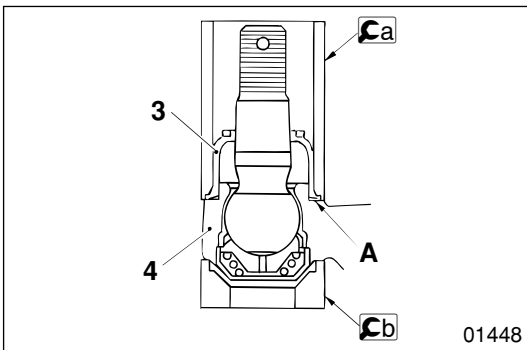
CAUTION ⚠

- Be careful that clip guide end does not dig into dust cover 2.
- Be especially careful that clip 1 end does not damage dust cover 2.



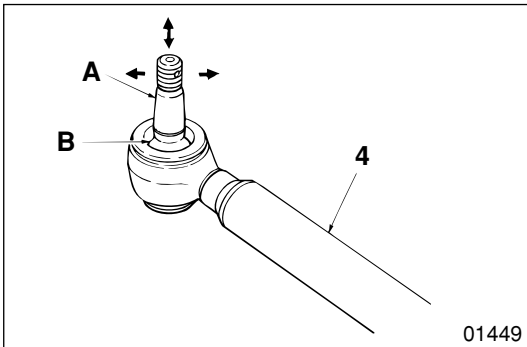
3 Installation of dust cover < FM >

- Place dust cover 3 on drag link 4.
- Hold drag link 4 between clip guide (Ca) dust cover installer and clip guide (Cb) end cover.
- Using a vise, press-fit dust cover 3 onto drag link 4 so as the dust cover is perpendicular to the drag link, and reinforcing ring A is in close contact with the drag link.



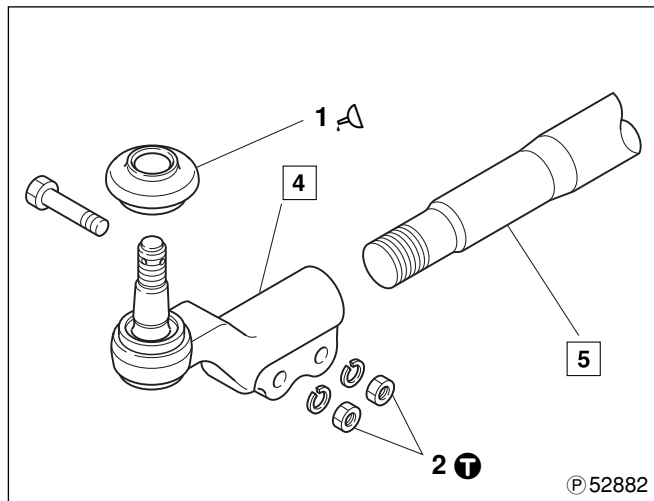
4 Inspection of drag link

Move ball stud area A of drag link 4 vertically and horizontally to make sure that there is no play. Also, check that ball section B moves evenly. If any fault is found, replace the tie rod assembly.



TIE ROD ASSEMBLY

< FK >



● Disassembly sequence

- 1 Dust cover
- 2 Nut < FK >
- 3 Nut < FM >
- 4 Tie rod end assembly
- 5 Tie rod

⊗ : Non-reusable parts

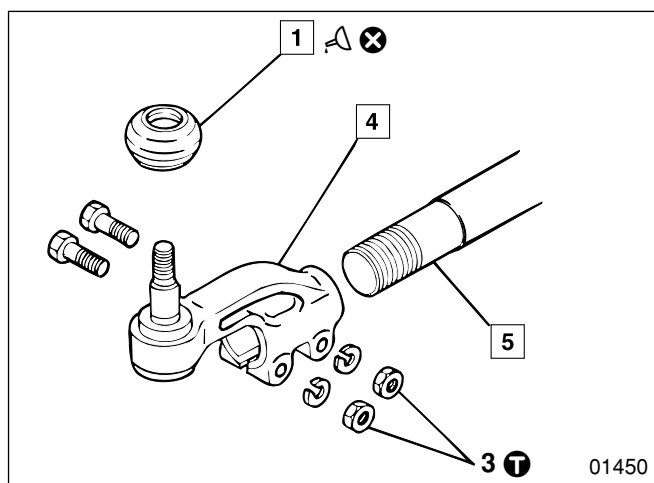
NOTE

- Do not remove dust cover 1 unless they are faulty.
- Do not disassemble tie rod end assembly 4 because it is a unit construction.

● Assembly sequence

Follow the disassembly sequence in reverse.

< FM >



Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
5	Bend of tie rod	1 {0.039} or less	1 {0.039}	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

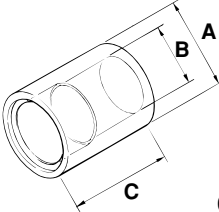
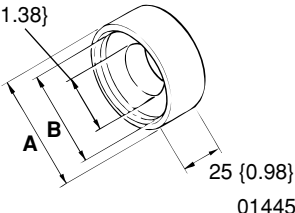
Location	Parts to be tightened	Tightening torque	Remarks
2	Nut < FK > (Tie rod end assembly fastening)	78±12 {58±8.9, 8.0±1.2}	Wet
3	Nut < FM > (Tie rod end assembly fastening)	7.8 {5.8, 0.8}	—

Lubricant and/or sealant

Location	Points of application		Specified lubricant and/or sealant	Quantity
1	Lip area of dust cover		Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
	Pack into dust cover	FK	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	13 to 14 g {0.46 to 0.49 oz}
		FM61, FK64	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	8 to 10 g {0.28 to 0.35 oz}
		FM65	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	20 to 21 g {0.71 to 0.74 oz}

 Special tools

Unit : mm {in.}

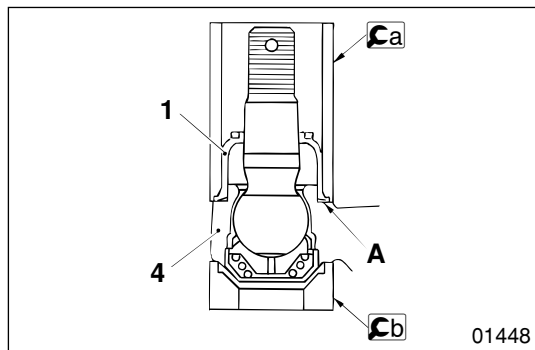
Location	Tool name and shape	Part No.	Application												
2	Dust cover installer <table><tr><th></th><th>A</th><th>B</th><th>C</th></tr><tr><td>MH061828</td><td>ø60.3 {2.37}</td><td>ø45 {1.77}</td><td>80 {3.15}</td></tr><tr><td>MH061827</td><td>ø65 {2.56}</td><td>ø51 {2.01}</td><td>ø100 {3.94}</td></tr></table>  01444		A	B	C	MH061828	ø60.3 {2.37}	ø45 {1.77}	80 {3.15}	MH061827	ø65 {2.56}	ø51 {2.01}	ø100 {3.94}	< FK, FM61, FM64> MH061828 < FM65 > MH061827	Installation of dust cover
		A	B	C											
MH061828	ø60.3 {2.37}	ø45 {1.77}	80 {3.15}												
MH061827	ø65 {2.56}	ø51 {2.01}	ø100 {3.94}												
End holder <table><tr><th></th><th>A</th><th>B</th></tr><tr><td>MH061830</td><td>ø60 {2.36}</td><td>ø50.5 {1.99}</td></tr><tr><td>MH061829</td><td>ø64 {2.52}</td><td>ø55.7 {2.19}</td></tr></table>  01445		A	B	MH061830	ø60 {2.36}	ø50.5 {1.99}	MH061829	ø64 {2.52}	ø55.7 {2.19}	< FK, FM61, FM64> MH061830 < FM65 > MH061829					
	A	B													
MH061830	ø60 {2.36}	ø50.5 {1.99}													
MH061829	ø64 {2.52}	ø55.7 {2.19}													

TIE ROD ASSEMBLY

◆ Service procedure

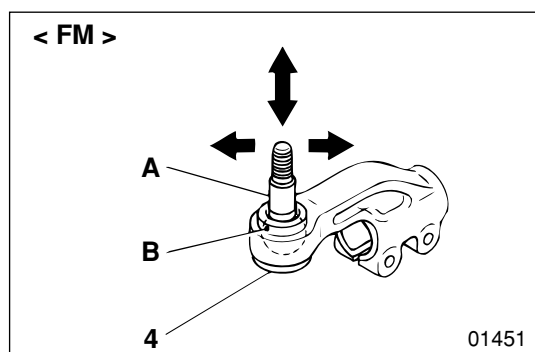
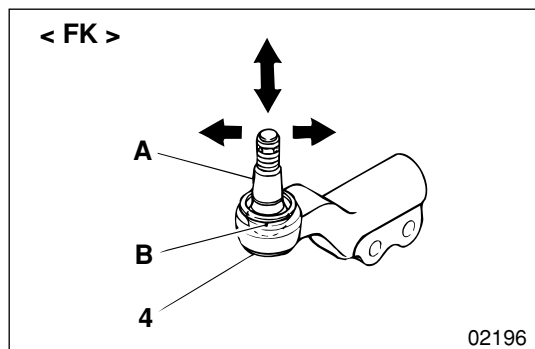
1 Installation of dust cover < FK, FM >

- Place dust cover 1 on tie rod end assembly 4.
- Hold tie rod end assembly 4 between  and .
- Using a vise, press-fit dust cover 1 onto tie rod end assembly 4 so as the dust cover is perpendicular to the tie rod end assembly, and reinforcing ring A is in close contact with the tie rod end assembly.



4 Inspection of tie rod end assembly

Move ball stud area A of tie rod end assembly 4 vertically and horizontally to make sure that there is no play. Also, check that ball section B moves evenly. If any fault is found, replace the tie rod end assembly.



5 Bend of tie rod

Measure the bend of tie rod 5 at the center point. If the measured value exceeds the limit, correct or replace the tie rod.

NOTE

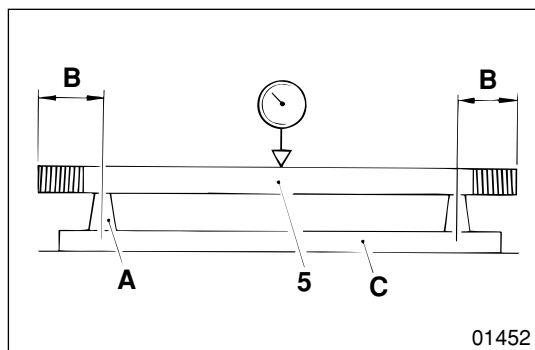
To measure the deflection of tie rod 5, turn it one full rotation and read the dial gauge indicator. The deflection is one half of the indicated value.

A : V-block

B : Approximately 300 mm {11.8 in.} < FK >

Approximately 250 mm {9.84 in.} < FM >

C : Surface plate





Group 41

Frame

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

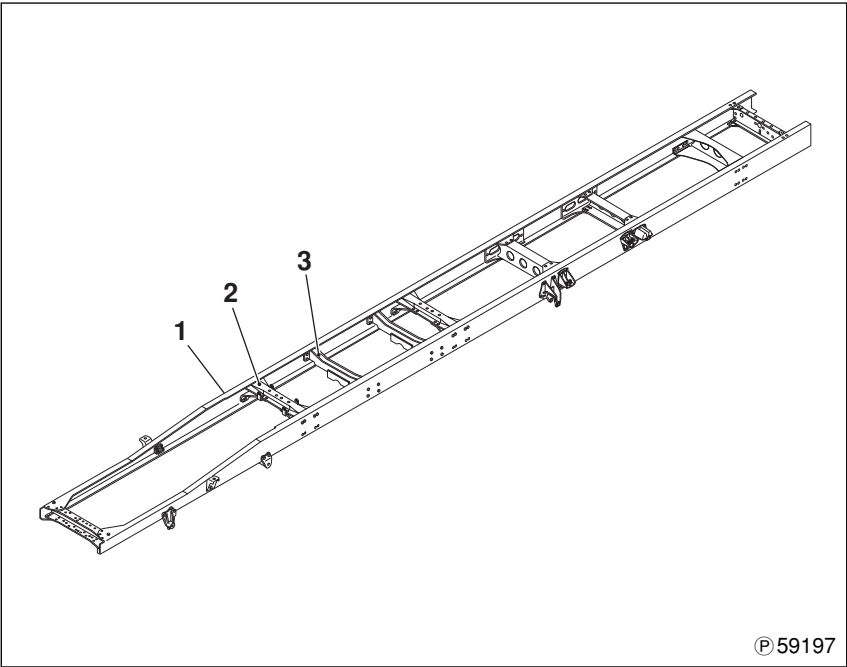
INDEX

SPECIFICATIONS	41- 2
STRUCTURE AND OPERATION	41- 2
INSPECTION AND REPAIR OF FRAMES	41- 2

SPECIFICATIONS

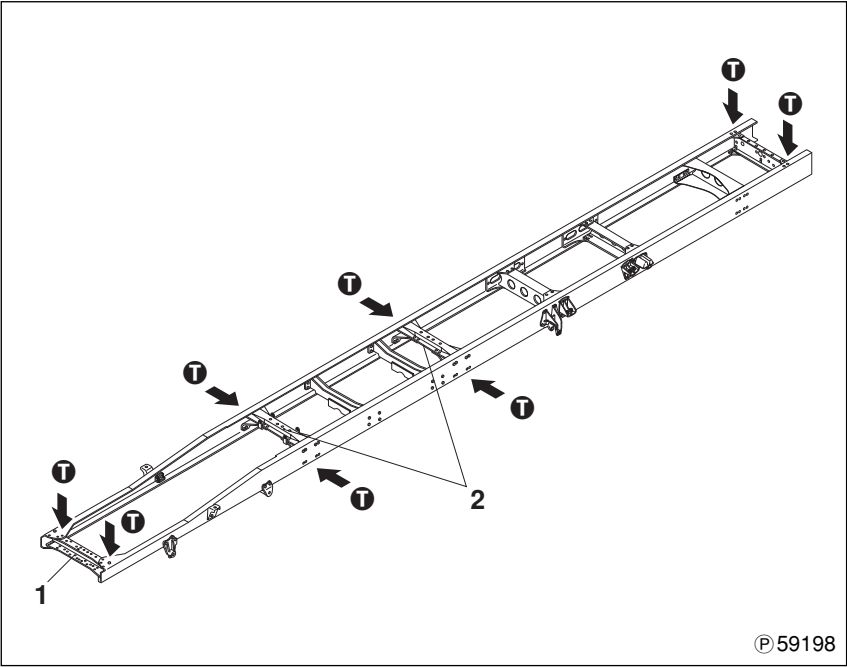
Item	Specifications
Frame type	Ladder type
Cross section configuration of side rail	 shape channel section

STRUCTURE AND OPERATION



- 1 Side rail
- 2 Cross member
- 3 Center bearing bracket

INSPECTION AND REPAIR OF FRAMES



- 1 No. 1 cross member
- 2 No. 2 and No. 3 cross member
- 3 Final cross member

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	Nut (No. 1 cross member to top of side rail mounting)	FM	120 to 160 {89 to 120, 12 to 16}	—
2	Nut (No. 2 and No. 3 cross members to side of side rail mounting)	FK	85 to 110 {61 to 80, 8.5 to 11}	—
		FM	200 to 270 {145 to 200, 20 to 28}	—
3	Nut (Final cross member to top of side rail mounting)		45 to 60 {33 to 43, 4.5 to 6}	—

◆ Service procedure

● Cleaning of frame

Carefully remove mud, grease, rust, etc. that is stuck to the outer and inner surfaces of the frame.

● Inspection for frame deformation

If any fault such as deformation is found, repair the frame.

● Inspection for cracks in frame

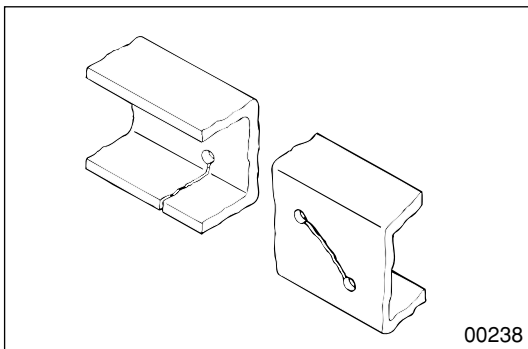
- Remove paint from any areas that are seemingly faulty and carefully inspect.
 - If visual inspection is difficult, inspect using color contrast penetrant examination or other methods.
- If a crack is found, repair as follows.

● Repair of crack in frame

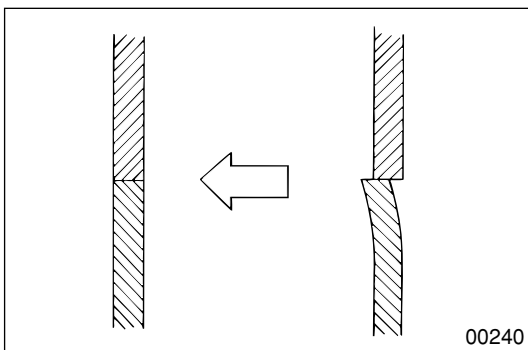
- With the vehicle unloaded, level the frame.
- Drill a hole, about twice the thickness of the frame, 10 mm {0.39 in.} from the end of the crack.

NOTE

If a crack is found inside the frame, drill holes at both ends of the crack.



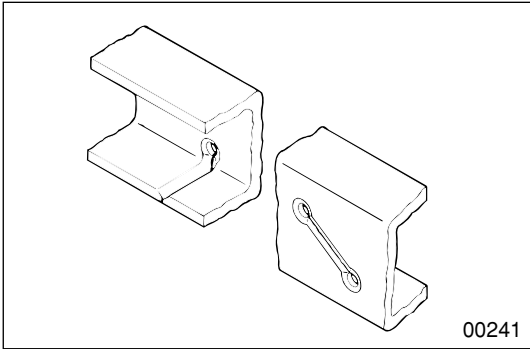
00238



00240

- If the edges of the crack are not flush, make them flush with each other.

INSPECTION AND REPAIR OF FRAMES



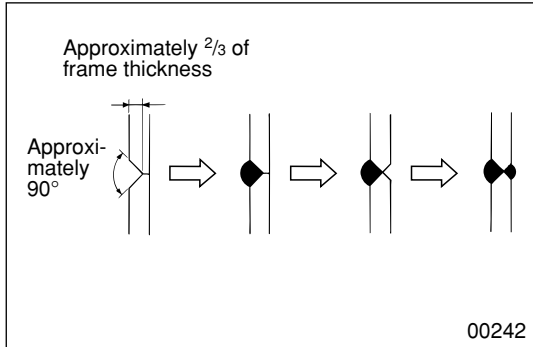
- Using a grinder, etc., grind a 90° V-section channel, two-thirds of the frame thickness, then weld.

WARNING

You must cover any flammable materials, such as pipelines, wiring harnesses, rubber parts, and the fuel tank, that are near the welding site.

CAUTION

- Do not use gas welding because the high temperature produced alters the material properties and weakens the welded area. Be sure, therefore, to use electric welding.
- Be sure to remove the negative terminal of the battery, then ground the welder near the area to be welded to prevent reversed flow of current from the welder which might burn out electrical components.
- Be sure to protect mountings such as main sills that can be damaged by heat, by using heat insulators, etc.



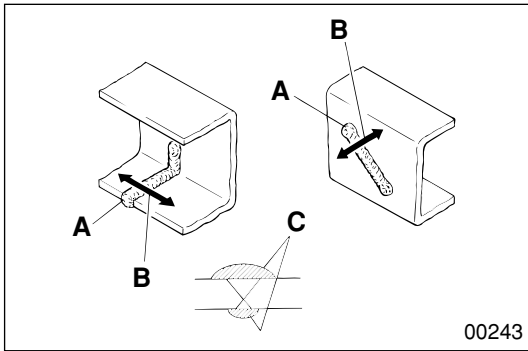
NOTE

- Use low-hydrogen type coated CO₂ and arc welding electrodes for welding to prevent harmful defects such as undercutting, blow holes, etc.
- Preheat the area to be welded to approximately 50 to 350°C {120 to 660°F} before welding when the workshop temperature is below 0°C {32°F}.

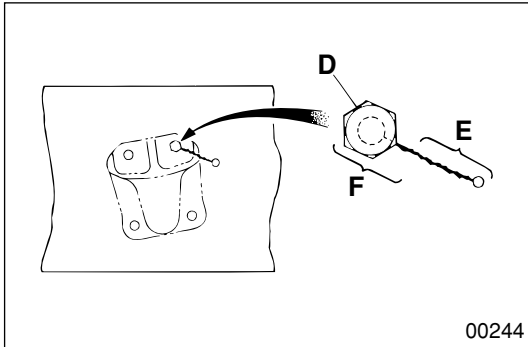
- Next, grind a V-section channel, as described above, on the opposite side of the weld and weld. At the same time, fill the holes at both ends of the crack by welding.

NOTE

In cold districts, heat the welded area to approximately 200°C {390°F} after welding.

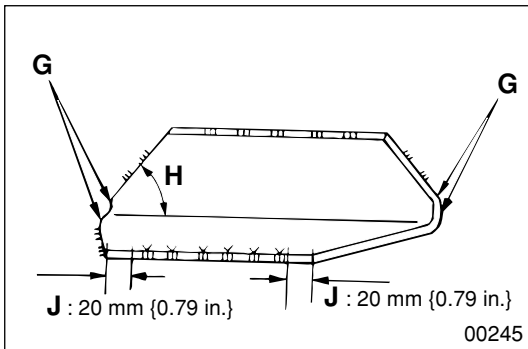


- After welding, grind bead **A** at right angles **B** to remove shaded area **C** as illustrated and grind the area flat.
- Finish the surface so that the frame thickness is identical to the original thickness.



[Repairing cracks caused by rivets or bolt holes]

- To make the edges of the holes flush at the cracked area, temporarily tighten bolt **D** in the hole.
 - Weld cracked point **E** at least 20 mm {0.79 in.} from the center of the bolt.
- For welding method refer to the above-mentioned procedures for repairing cracks. P41-3.
- After removing the bolt and making the edges flush, weld remaining area **F** and fill the hole.
 - After drilling a hole in the filled area, install a rivet or bolt.

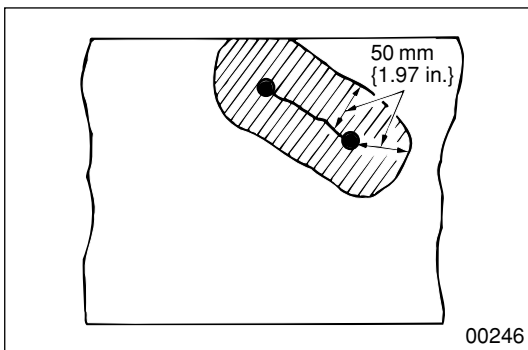


[Repairing using reinforcement plate]

- To prevent concentrated stress being produced at ends **G** of the reinforcement plate, weld the plate with angle **H** at both ends opened 30° or less.
- Do not weld area **J**.
- The reinforcement plate must have enough strength for the cracked area.

NOTE

- **Thickness of reinforcement plate : same as frame thickness**
- **Reinforcement plate material : SAPH440 (hot-rolled sheet steel for automobiles), SS400 (sheet steel for general construction), or equivalent strength.**

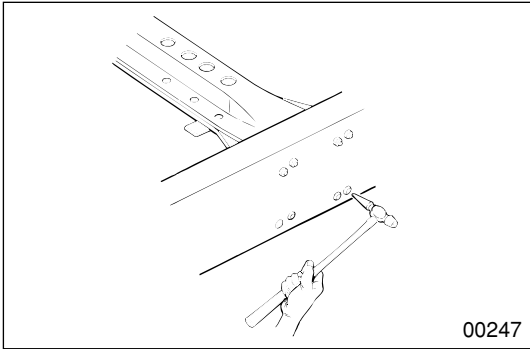


- After welding, heat the shaded area to 600 to 700°C {1110 to 1290°F}.

CAUTION ⚠

Be sure to protect mountings such as main sills that can be damaged by heat, by using heat insulators, etc.

INSPECTION AND REPAIR OF FRAMES

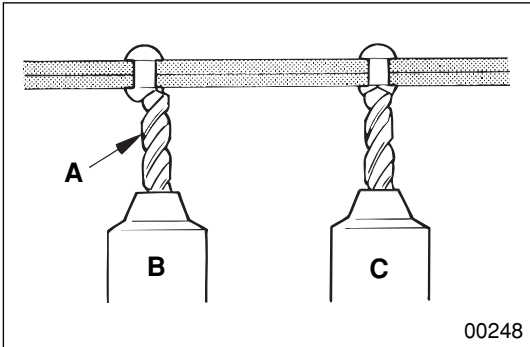


● Inspection for loose rivets

- Gently tap the rivet head using an inspection hammer and judge the condition by checking the vibration using the tip of your finger, or by listening to the sound.
- Rust between rivet and frame indicates that the rivet is loose.

CAUTION

Be sure to replace loose rivets because they can break or cause cracking of the frame in the area around the rivet hole, causing accidents.



● Repair of rivet

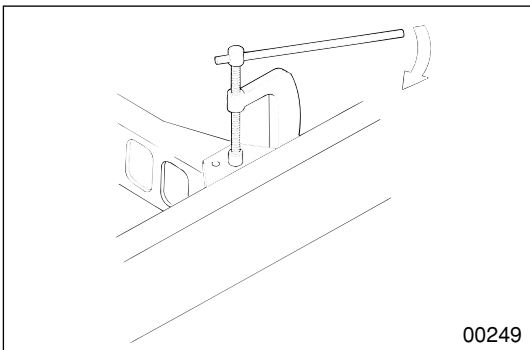
- When removing rivets, use a center punch to make an indent in the center of the rivet head; then, drill out using drill **A** or grind.

B : Incorrect

C : Correct

CAUTION

Make sure that you do not damage the rivet hole.



- When rivetting, first clamp both plates tightly near the rivet hole using a clamp to eliminate gaps between plates.

- Using a rivetting machine, insert the rivet (cold rivet).
- If rivetting is impossible, ream the rivet hole, drive in a reamer bolt, fully tightening the nut, then weld it in place.
A flange bolt and flange nut should be used for the reamer bolt and nut.

● Inspection for loose bolts and nuts

- Inspect the mounting bolts in all areas for looseness. Loosened bolts should be tightened at specified torque.  P41-2



Group 42

Cab

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	42- 2
STRUCTURE AND OPERATION	42- 4
TROUBLESHOOTING	42-14
ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Adjustment of Door Fitting	42-20
REMOVAL AND INSTALLATION OF CAB	42-22
FRONT CAB MOUNTING.....	42-28
REAR CAB MOUNTING	42-31
CAB STAY	42-32
CAB TILT LINK	42-34
DOOR	42-36
MIRROR	42-42
SEAT	
< DRIVER >	42-44
< PASSENGER >	42-50
SEAT BELT	42-52
WIPER AND WASHER	42-54
INSTRUMENT PANEL	42-60
SCUFF PLATE AND TRIM.....	42-64
HEADLINING	42-66
FRONT PANEL	42-70
RADIATOR GRILLE AND CORNER PANEL	42-72
STEP	42-74
FENDER	42-76
MUD GUARD	42-78
WINDOW GLASS	42-80

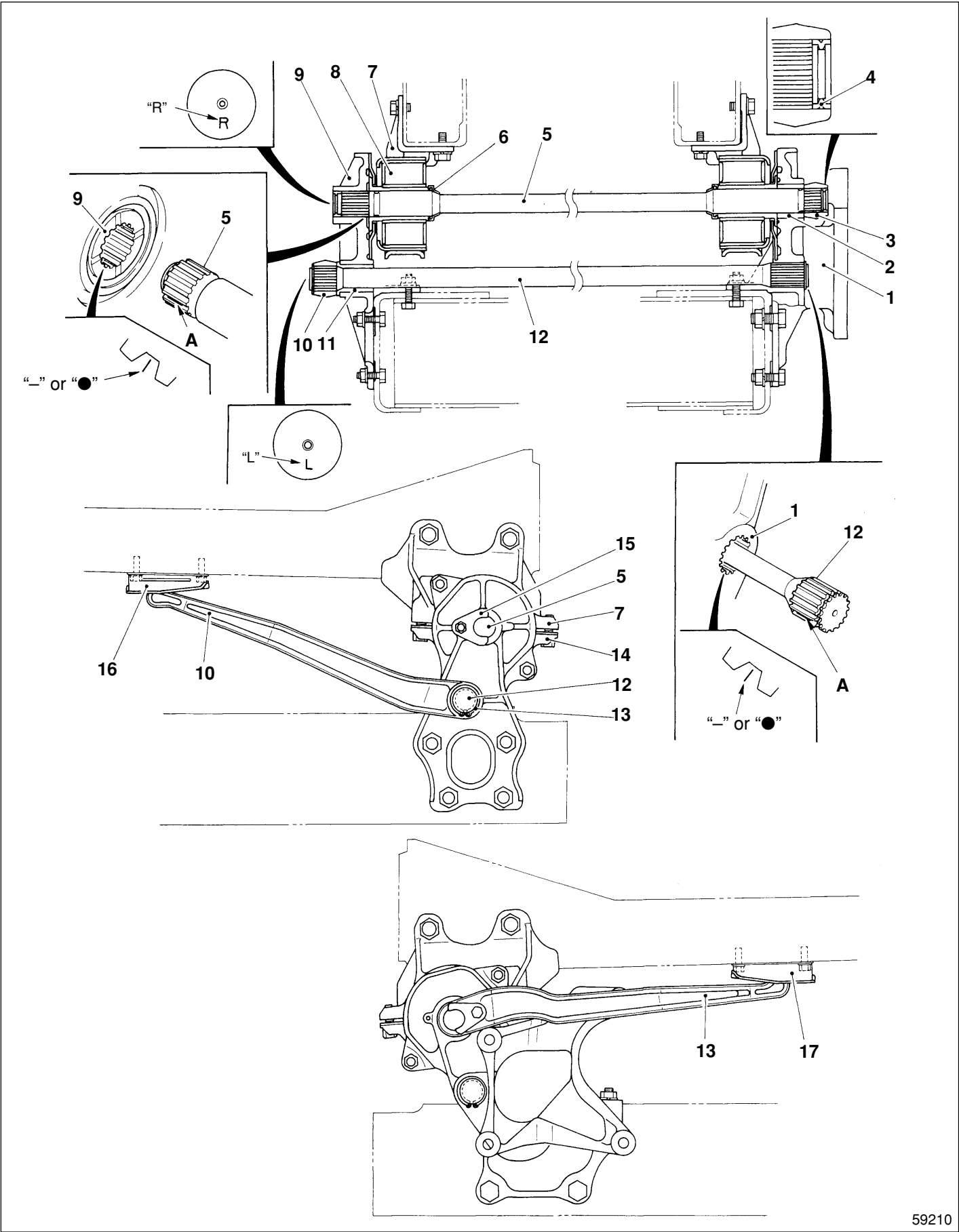
SPECIFICATIONS

Item		Specifications
Cab assembly	Type	Cab over type (Forward control type)
	Mass kg {lb}	Approximately 440 {970}
Cam mounting	Type	Semi-floating type
	Mountings	Liquid-filled rubber mountings
Cab tilt mechanism	Type	Torsion bar type
	Tilt angle	44°
	Cab tilt lock	Manually operated hook type
Seat adjustment		Manual
Seat suspension		Fixed type or air spring type
Seatbelts	Retractor	Emergency locking retractor
	Type	3-point seatbelt

MEMO

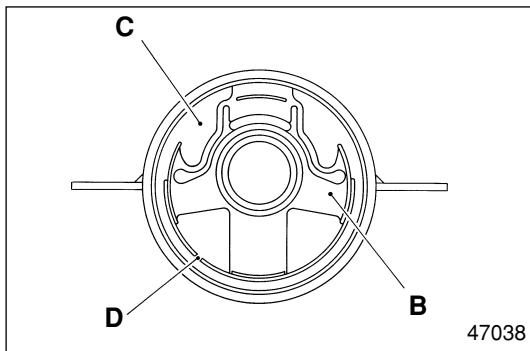
STRUCTURE AND OPERATION

Front Cab Mounting



- | | |
|----------------------------------|-------------------------------|
| 1 Gearbox bracket | 11 Bushing |
| 2 Bushing | 12 Lower torsion bar |
| 3 Torsion bar arm | 13 Snap ring |
| 4 Dust cover | 14 Cab hinge cap |
| 5 Upper torsion bar | 15 Stopper plate |
| 6 Dust cover | 16 Torsion bar support |
| 7 Cab hinge upper bracket | 17 Torsion bar support |
| 8 Cab hinge cushion | |
| 9 Cab hinge bracket | A : White paint |
| 10 Torsion bar arm | |

- Upper torsion bar **5** and lower torsion bar **12** have their particular torsional directions. To ensure that they are installed correctly, the upper and lower torsion bars have letter “L” or “R” indicating the direction of torsion stamped at the RH end faces.
- Upper torsion bar **5** has alignment mark **A** (white paint) which should be aligned with alignment mark “—” or “●” on cab hinge bracket **9**.
- Lower torsion bar **12** has alignment mark **A** (white paint) which should be aligned with alignment mark “—” or “●” on gearbox bracket **1**.

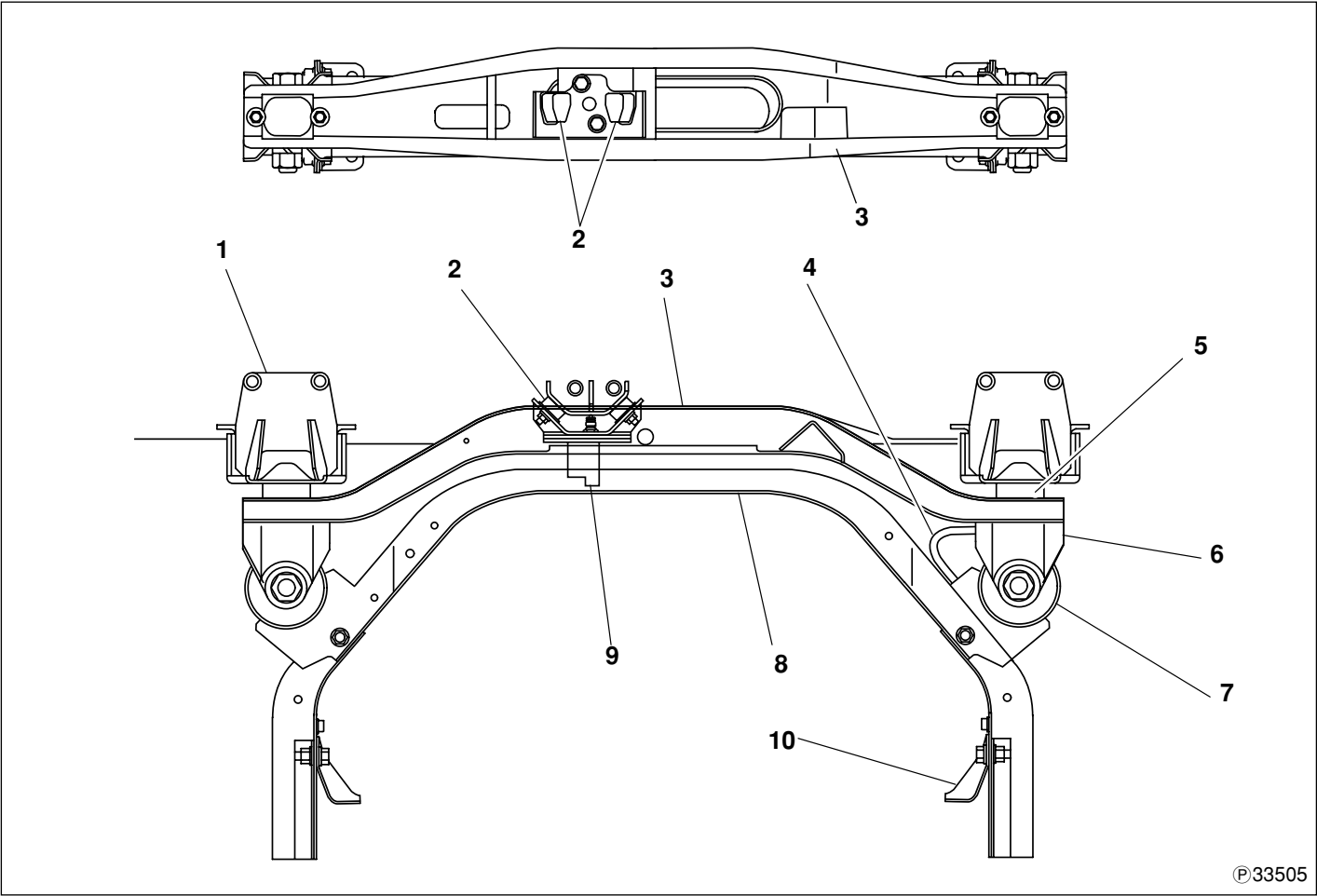


- Cab hinge cushion **8** uses a liquid-filled rubber element **B**.

C : Ethylene glycol (liquid chamber)
D : Orifice

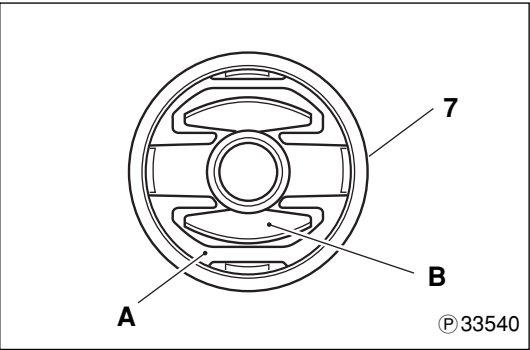
STRUCTURE AND OPERATION

Rear Cab Mounting



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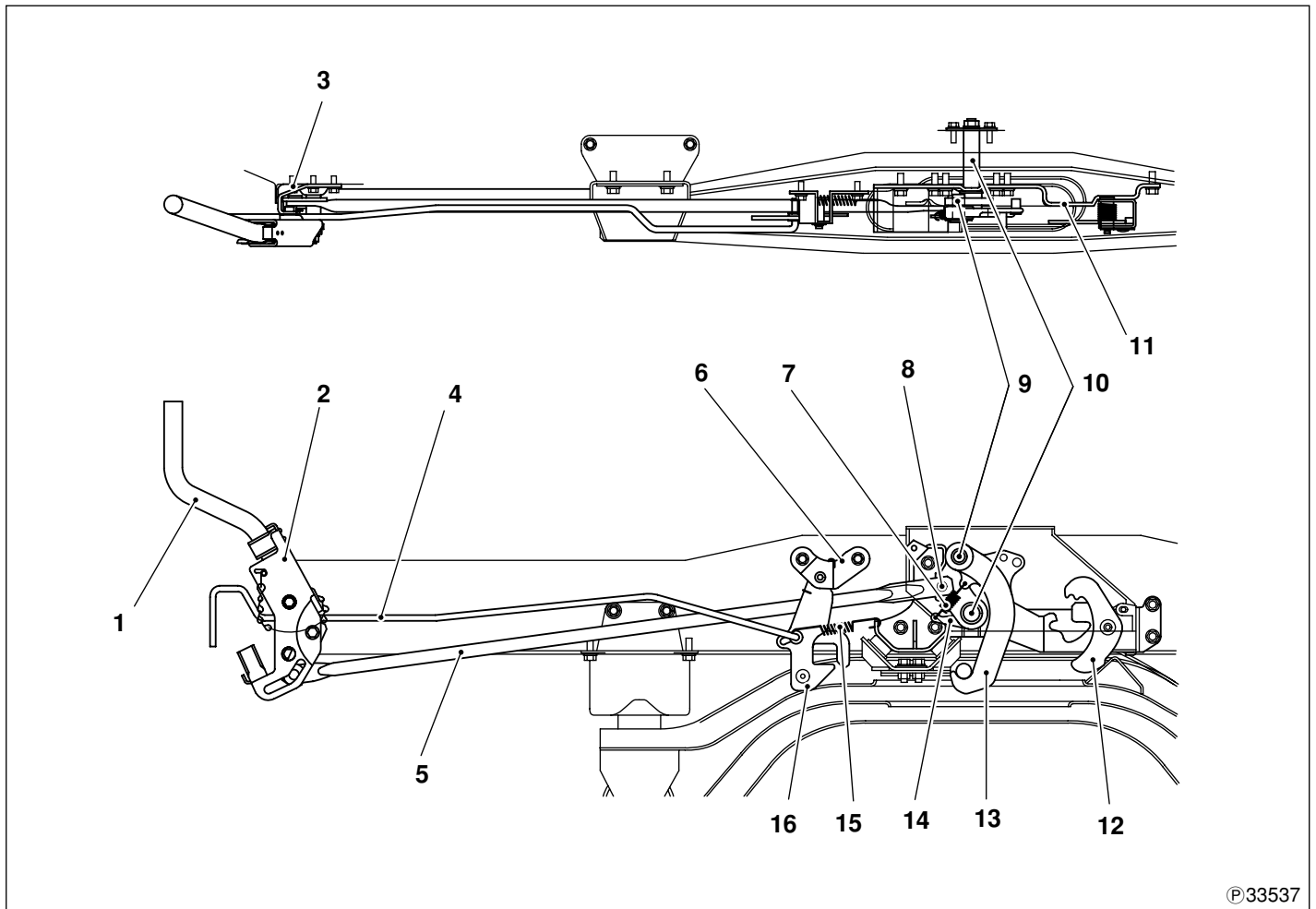
- | | | |
|-------------------|--------------------------|-------------------------|
| 1 Bottom bracket | 5 Buffer rubber | 8 Cab bridge |
| 2 Rebound cushion | 6 Cushion rubber bracket | 9 Cab tilt lock switch |
| 3 Floating bar | 7 Cushion rubber | 10 Cab bridge stiffener |
| 4 Earth strap | | |



- Cushion rubber 7 uses a liquid-filled rubber element A.

B : Ethylene glycol (liquid chamber)

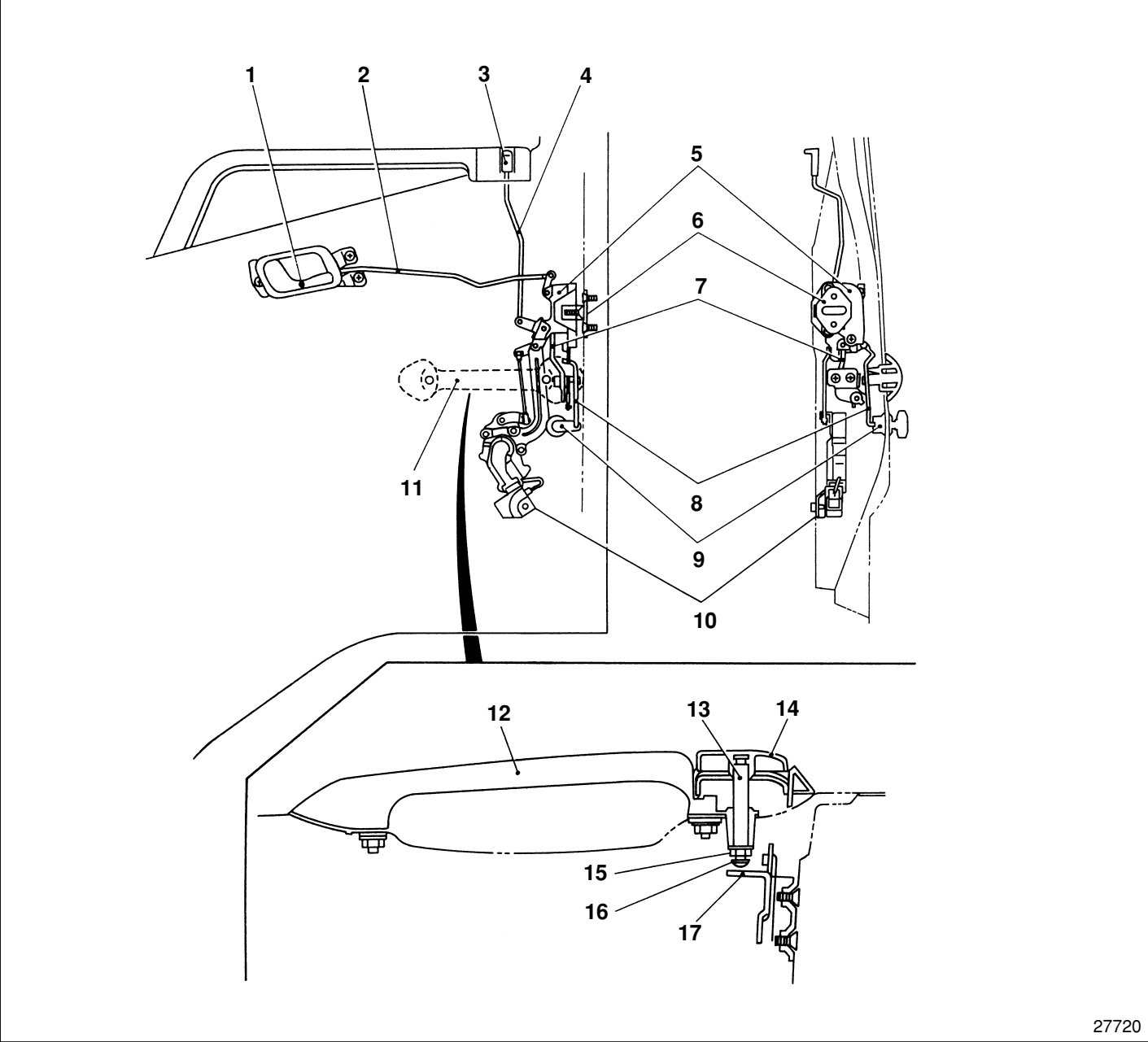
Cab Tilt Link



©33537

- | | | |
|------------------------------|----------------------|------------------|
| 1 Hook control lever | 7 Return spring | 12 L-lever |
| 2 Hook control lever bracket | 8 Lock pin | 13 Main hook |
| 3 Hinge bracket | 9 Main hook pin | 14 Main hook arm |
| 4 L-lever rod | 10 Main hook shaft | 15 Return spring |
| 5 Control rod | 11 Main hook bracket | 16 L-lever |
| 6 L-lever bracket | | |

Lock pin **8**, main hook pin **9** and main hook shaft **10** all have their heads caulked after installation. Therefore, the part **5** and the parts **8** to **14** form a main hook assembly and cannot be disassembled.

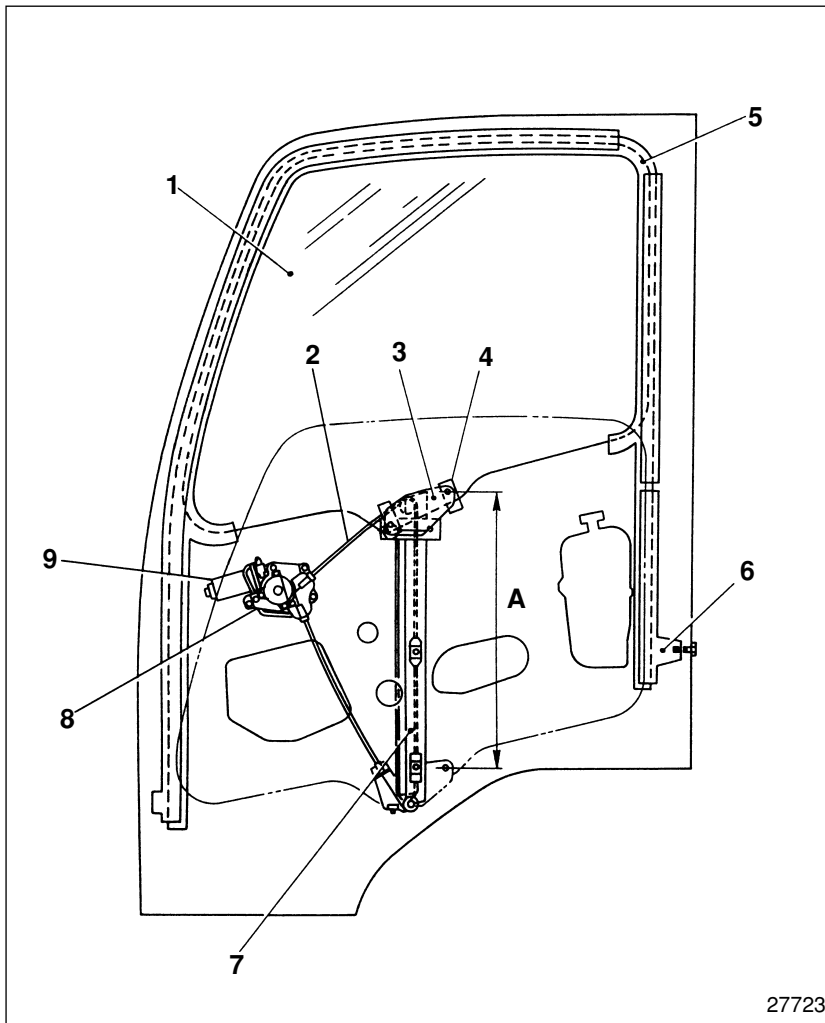


27720

- | | | |
|---------------------------|---------------------------------|-----------------------|
| 1 Inside handle | 7 Door opening rod | 13 Shaft |
| 2 Door opening rod | 8 Door lock cylinder rod | 14 Push button |
| 3 Door lock knob | 9 Door lock cylinder | 15 Nut |
| 4 Door lock rod | 10 Door lock actuator | 16 Screw |
| 5 Door latch | 11 Outside handle | 17 Stay |
| 6 Striker | 12 Handle | |

- Push button **14** stroke of outside handle **11** can be adjusted to optimize opening and closing of the door .
- To adjust the stroke, turn screw **16** on shaft **13**.
- The head of screw **16** pushes stay **17**, and this moves door opening rod **7**, releasing door latch **5**.

Door Glass Opening System



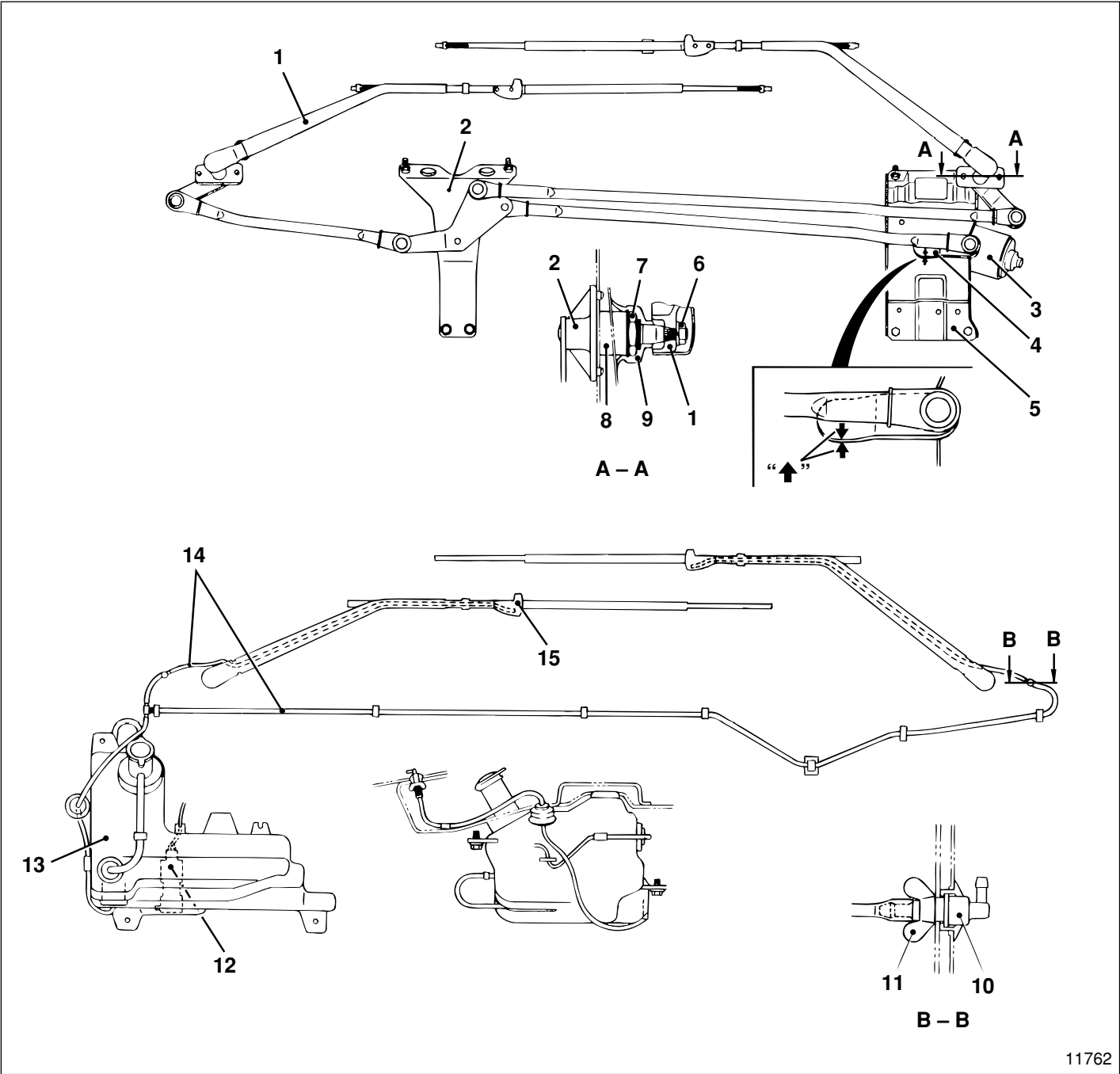
- 1 Door glass
- 2 Wire
- 3 Carrier plate
- 4 Glass holder
- 5 Run channel
- 6 Lower sash
- 7 Rail
- 8 Regulator
- 9 Power window motor

A : Carrier plate moving range

- Regulator **8** is so constructed that it is interlocked with power window motor **9** and carrier plate **3** through wire **2**.
- When power window motor **9** is rotated, carrier plate **3** is wound up or down by wire **2** to raise or lower door glass **1**.

STRUCTURE AND OPERATION

Wiper and Washer

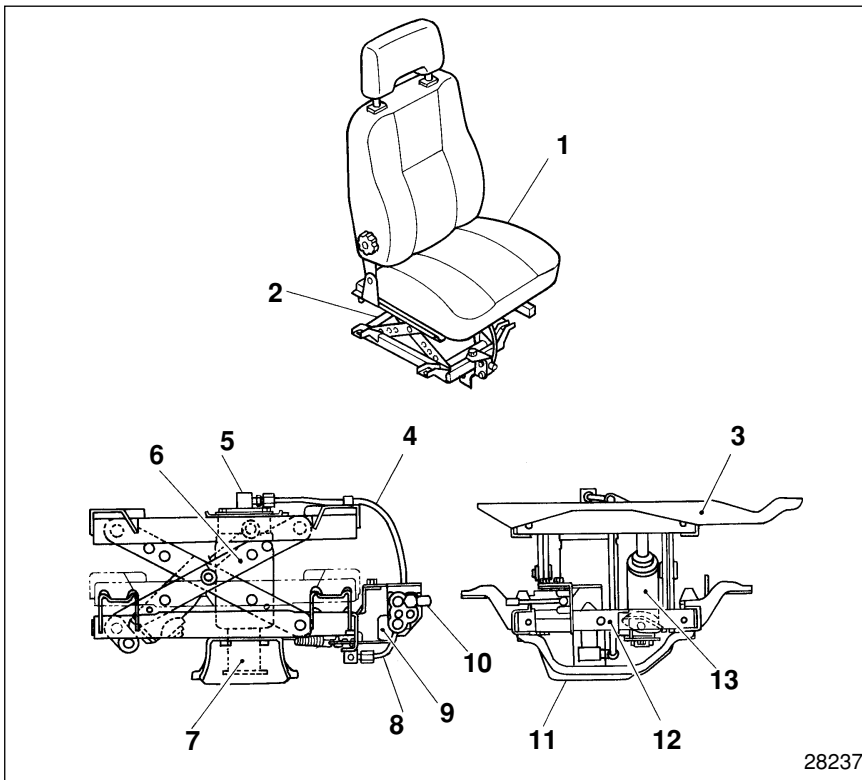


11762

- | | | |
|--------------------------------|---------------|------------------|
| 1 Wiper arm and blade assembly | 6 Nut | 11 Nut |
| 2 Wiper link assembly | 7 Nut | 12 Washer motor |
| 3 Wiper motor | 8 Collar | 13 Washer tank |
| 4 Crank arm | 9 Pivot cap | 14 Washer hose |
| 5 Wiper motor bracket | 10 Hose joint | 15 Washer nozzle |

Crank arm 4 and wiper motor bracket 5 have alignment marks “↑” that align when wiper arm and blade assembly 1 stop at the specified position.

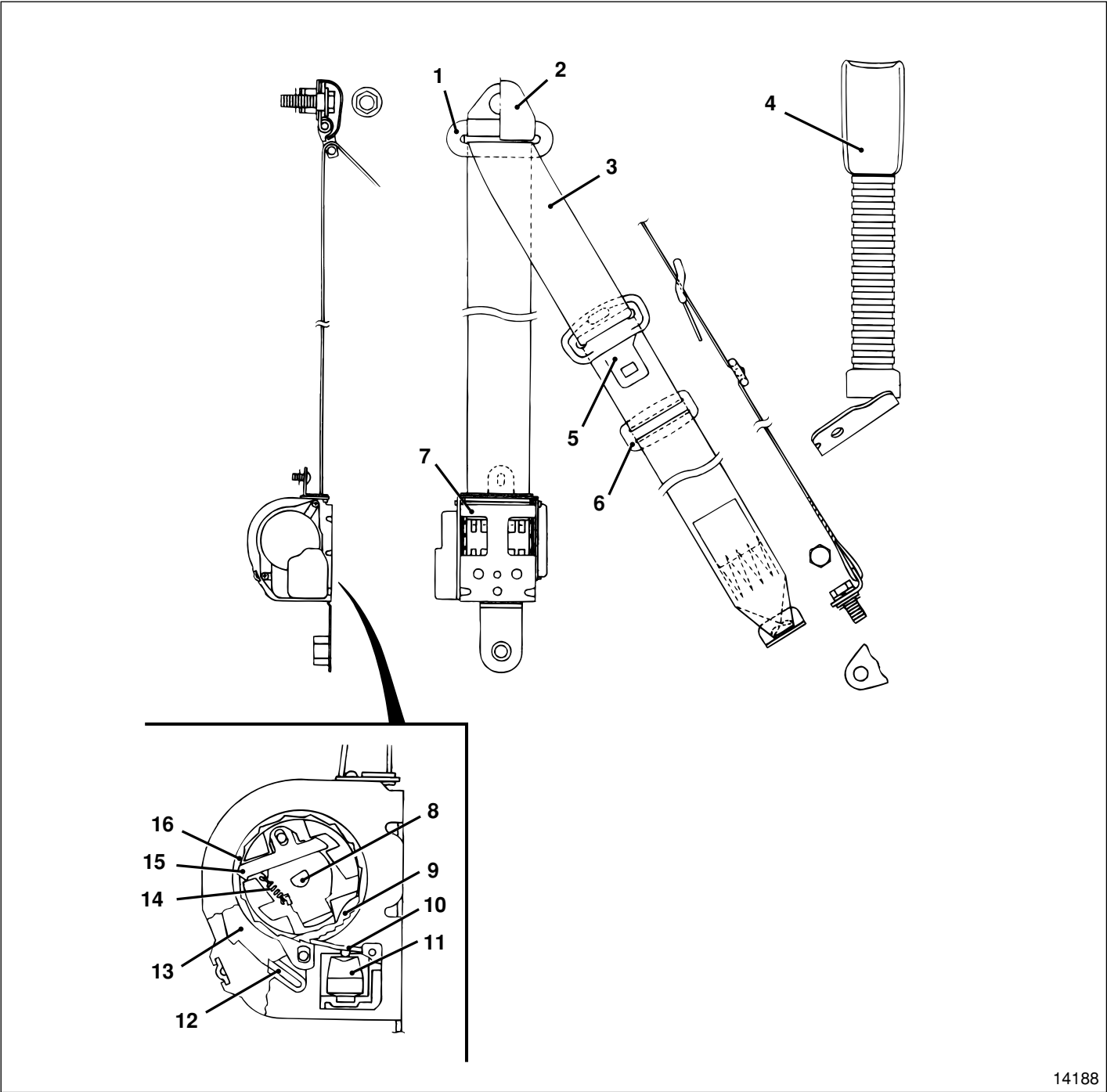
Air Suspension Seat



- 1 Driver seat
- 2 Air suspension
- 3 Upper frame
- 4 Air tube
- 5 Upper reinforcement
- 6 Link
- 7 Air sleeve
- 8 Air pipe
- 9 Lever
- 10 Seat control valve
- 11 Lower reinforcement
- 12 Lower frame
- 13 Shock absorber

STRUCTURE AND OPERATION

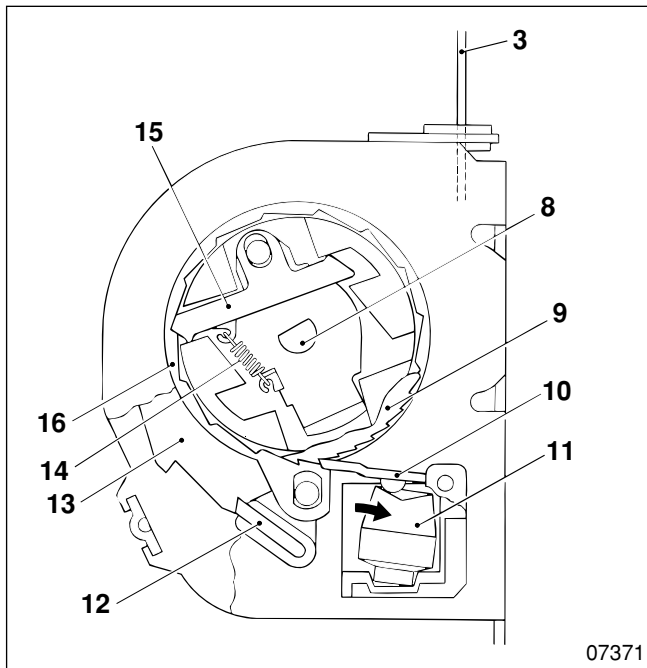
Emergency Locking Retractor (ELR) Type Seat Belt



14188

- | | | |
|-------------------|--|------------------|
| 1 Sash guide | 7 Emergency locking retractor assembly | 12 Pawl |
| 2 Cover | 8 Spindle | 13 Ratchet gear |
| 3 Webbing | 9 Locking gear | 14 Sensor spring |
| 4 Buckle assembly | 10 Mechanism lever | 15 Lock arm |
| 5 Tongue plate | 11 Mechanism weight | 16 Clutch |
| 6 Tongue stopper | | |

CAUTION ⚠ Do not disassemble emergency locking retractor assembly 7, or malfunctions might occur.



Webbing detecting lock

- When the vehicle is subjected to a sudden impact, such as a crash, webbing **3** retracts according to the movement of passengers, and spindle **8** rotates.
- As the rotation of spindle **8** is higher than the specified value, the repercussive force of sensor spring **14** can no longer retain lock arm **15**. Then, the arm is pulled out from the specified position and is locked by clutch **16**.
- If spindle **8** further rotates, clutch **16** lifts pawl **12** to lock with ratchet gear **13**, making spindle rotation impossible.

Body detecting lock

- When the body is tilted excessively, mechanism weight **11** is tilted, engaging mechanism lever **10** with locking gear **9**, locking it.
- If spindle **8** further rotates, clutch **16** operates as described above, and the spindle cannot rotate.

TROUBLESHOOTING

Cab in general

Possible causes				Symptoms							Remarks
				Cab shimmy (vibration accompanying pitching and rolling motions)	High-frequency vibration (above 20Hz) and noise in cab and steering wheel						
Cab-related Problems	Front cab mounting	Semi-floating cab mounting	Looseness and play in cab hinge caps, cab hinge brackets and attaching parts	☐	☐						
			Deterioration of cab hinge cushions	☐							
	Rear cab mounting	Semi-floating cab mounting	Deterioration of cushion rubbers	☐							
			Defective rebound cushions or improperly installed side cushions or rebound cushions on bottom brackets	☐	☐						
	Improperly installed cab			☐	☐						
	Blown fuse and/or high-current fuse						☐		 Gr 54		
	Improperly connected connectors, open circuit, poor grounding						☐				

Symptoms			Cab shimmy (vibration accompanying pitching and rolling motions)	High-frequency vibration (above 20Hz) and noise in cab and steering wheel	Too large roll during driving	Cab tilt warning lamp fails to come on	Cab tilt warning lamp fails to go out	Remarks
Possible causes								
Cab-related problems	Cab tilt lock switch	Poor adjustment				☐	☐	
		Defective switch				☐	☐	 Gr 54
Engine-related problems	Too large propeller shaft inclination angle due to increased lean of engine following deterioration of engine mountings			☐				 Gr 11
	Improper engine installation			☐				
	Improper installation of intake and exhaust system components			☐				
Transmission-related problems	Improper installation of transmission			☐				 Gr 22
Propeller-shaft-related problems	Too large run-out of propeller shaft			☐				 Gr 25
	Too large wear of universal joint			☐				
	Too large backlash in slip yoke joint splines			☐				
	Too large play in center bearing			☐				
	Too large angle at propeller shaft joint due to deterioration of center bearing rubber cushions or other causes			☐				
	Too large angle at propeller shaft joint due to increased tilt of drive shafts because of excessive loading			☐				
Front-axle-related problems	Resonance occurring at axle seats		☐					 Gr 26
Rear-axle-related problems	Improper meshing of reduction gears			☐				 Gr 27
	Improper meshing of differential gears			☐				
Wheel-and-tire-related problems	Excessive run out of wheel and tire		☐					 Gr 31
	Imbalance of wheel and tire		☐					
	Mixed use of tires different in size and type		☐					
	Deformed wheel mounting surface		☐					
Front-suspension-related problems	Too large friction between spring leaves		☐					 Gr 33
Brake-related problems	Imbalance of brake drum		☐					 Gr 35
	Eccentric drum		☐					

TROUBLESHOOTING

Manual cab tilt system

Symptoms					Remarks
	Cab does not tilt up	Cab cannot be locked in position on cab bridge	Cab tilt warning lamp fails to come on	Cab tilt warning lamp fails to go out	
Possible causes					
Main hook fails to be released	☐				
Damaged or fatigued torsion bar	☐				
Torsion bar arm installed out of position	☐				
Main hook failing to engage with hook pin bracket		☐			
Poorly adjusted cab tilt lock switch			☐	☐	
Defective cab tilt lock switch			☐	☐	Gr 54
Defective cab tilt warning lamp on metter cluster			☐		
Blown fuse and/or high-current fuse			☐		
Open or poorly connected wiring			☐		

Door Lock

Symptoms		Inside handle can not open door	Inside handle heavy to operate	Outer handle can not open door	Outer handle heavy to operate	Door does not open and close smoothly	Auto door lock system does not operate			Remarks
							Procedure by key	Procedure by door lock knob	Procedure by auto door lock switch	
Possible causes										
Door setting out of adjustment			○		○	○				
Each door rod	Rod deformed		○		○					
	Rod out of position	○		○			○	○	○	
	Rod interference		○		○					
Door lock cylinder deformed or damaged							○			
Power window and door lock switch assembly defective									○	 Gr 54
Door lock actuator defective							○	○	○	
Door latch deformed or damaged			○		○	○				
Fuse of high current fuse blown							○	○	○	 Gr 54
Connector improperly connected, harness open-circuited, improperly grounded							○	○	○	
Battery capacity insufficient							○	○	○	
Power window electronic control unit defective							○	○	○	
Striker deformed		○		○		○				
Outer handle out of adjustment					○					

TROUBLESHOOTING

Power Window

Symptoms						Remarks
	Door window glass falls of its own accord in cruising	Power window regulator generates strange sound in cruising	Power window does not operate	Power window does not stop	Power window generates strange sound when it operates	
Possible causes						
Power window switch defective			☐	☐		 Gr 54
Power window control unit defective			☐	☐		
Power window regulator defective	☐	☐	☐		☐	
Power window regulator improperly mounted					☐	
Fuse or high current fuse blown			☐			
Connector improperly connected, harness open-circuited, improperly grounded			☐			

Wiper and Washer

Symptoms	Wiper does not work	Wiper does not stop	Wiper intermittent operation does not work	Wiper blade stop position incorrect	Wiper operation inadequate	Noise during wiper operation	Washer motor does not work	Washer fluid jetting insufficient	Washer fluid does not jet	Remarks
Possible causes										
Wiper motor faulty	☐	☐		☐		☐				 Gr 54
Washer motor faulty							☐	☐	☐	
Wiper and washer switch faulty	☐	☐	☐				☐			
Multipurpose timing control unit faulty			☐							
Wiper relay faulty	☐						☐			
Fuse, high-current fuse blown	☐						☐			
Wiring broken or connection faulty	☐		☐				☐		☐	
Wiper motor crank arm set position faulty				☐						
Wiper link and wiper arm connection faulty						☐				
Wiper blade faulty					☐	☐				
Wiper arm faulty					☐					
Washer hose twisted								☐		
Washer hose connected incorrectly									☐	
Washer nozzle clogged								☐	☐	
Washer fluid insufficient									☐	

ON-VEHICLE INSPECTION AND ADJUSTMENT

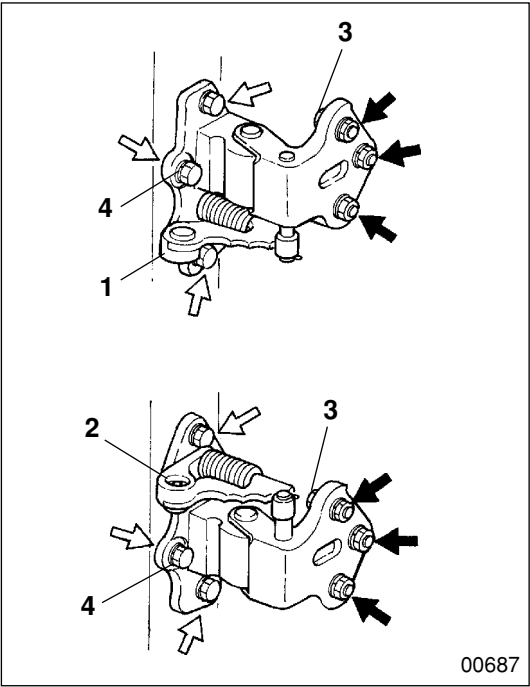
Adjustment of Door Fitting

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

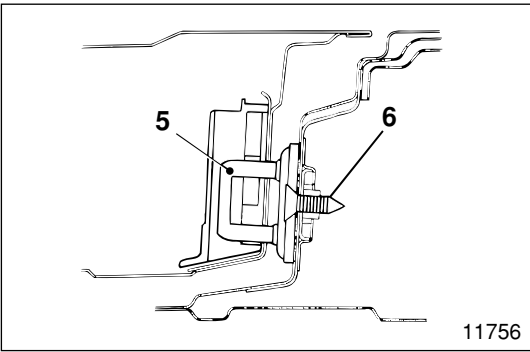
Location	Parts to be tightened	Tightening torque	Remarks
3	Bolt (Upper and lower hinge mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
4	Bolt (Door assembly mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
6	Screw (Striker mounting)	8.8 to 14 {6.5 to 10, 0.9 to 1.4}	—

Adjust door fitting at hinge and striker.
(For door fitting dimensions :  P42-21)



(1) Adjustment of hinge

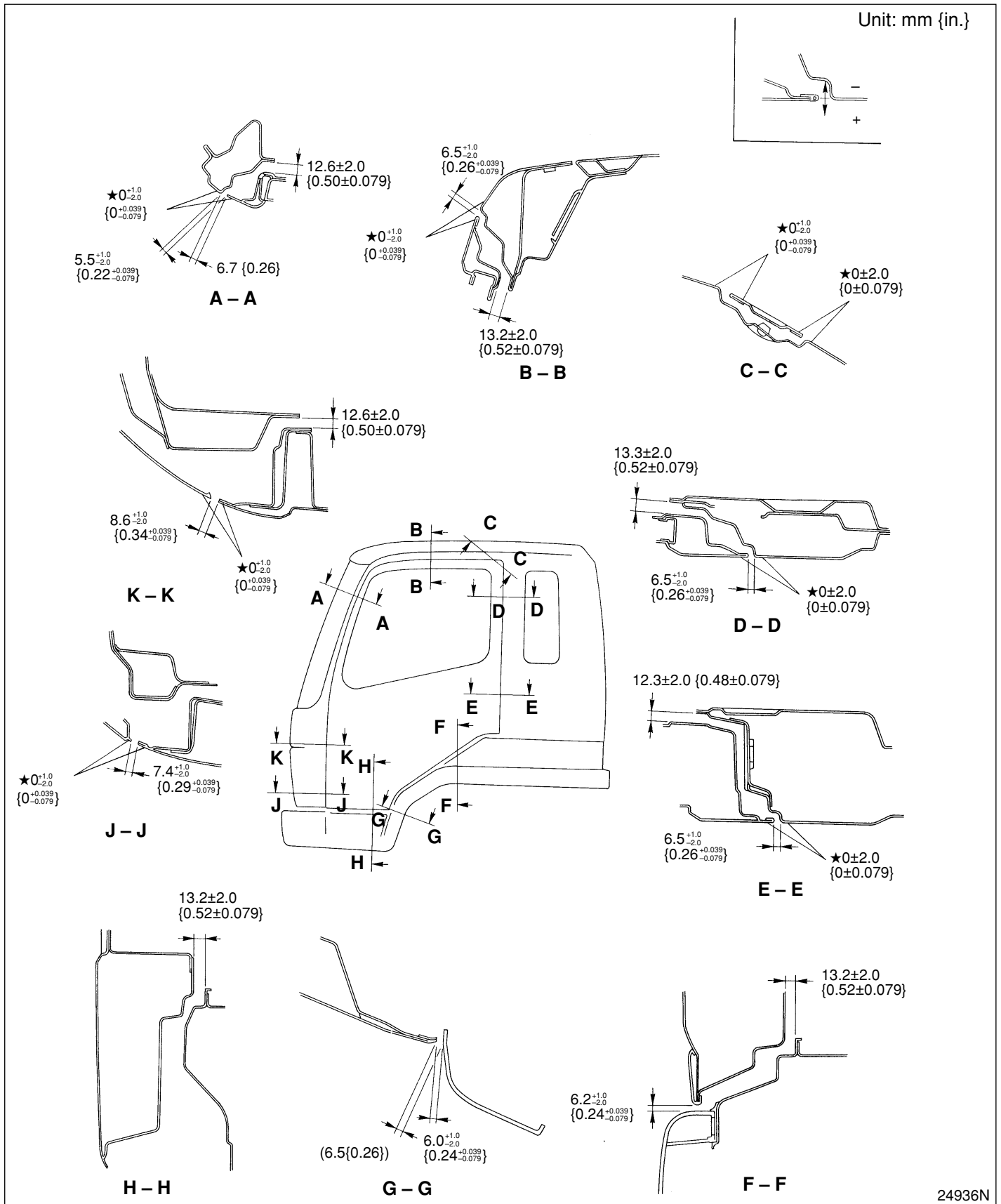
- Adjust clearance in the opening with bolt 3 (➡).
- Adjust step dimensions with bolt 4 (⇄).



(2) Adjustment of striker

Adjust installation screw 6 of striker 5.

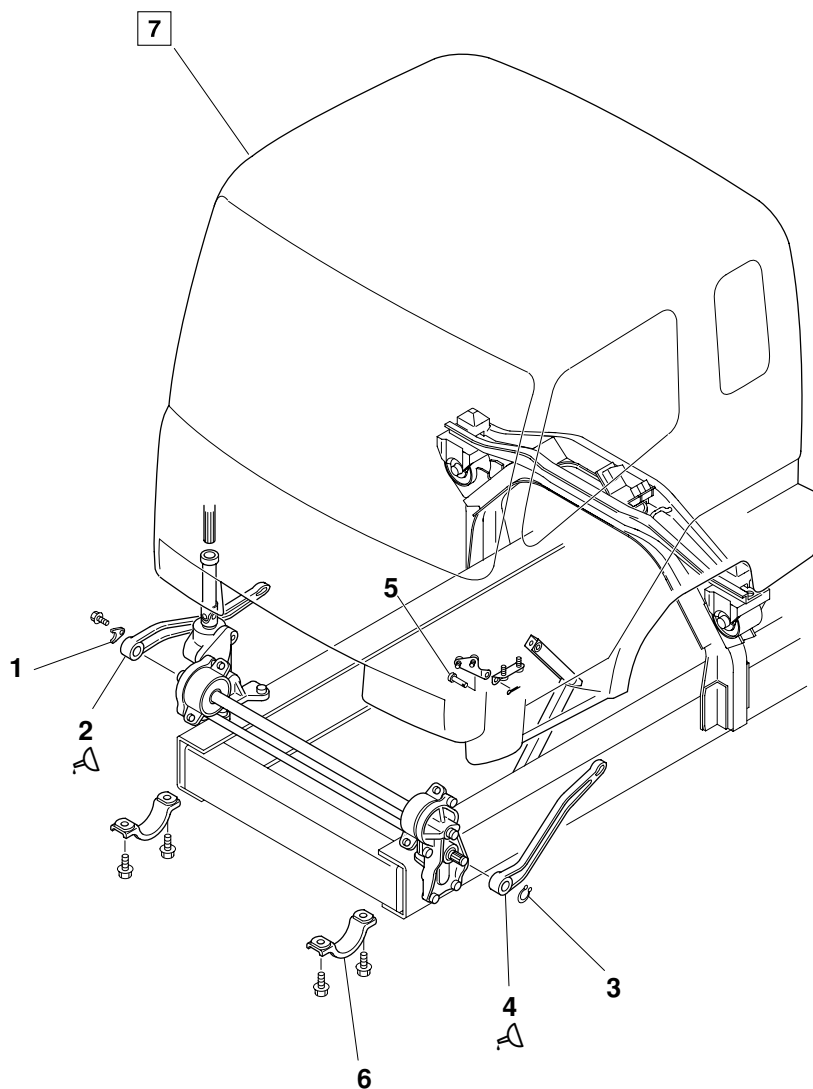
Fitting dimensions of door



“★” shows step dimensions. “☆” shows a tolerance direction of step dimensions, + indicating the outside dimension and – indicating the inside dimension.

The figure inside the parentheses is a reference value.

REMOVAL AND INSTALLATION OF CAB



© 56174E

● Removal sequence

- | | |
|-------------------|-----------------|
| 1 Stopper plate | 5 Clevis pin |
| 2 Torsion bar arm | 6 Cab hinge cap |
| 3 Snap ring | 7 Cab assembly |
| 4 Torsion bar arm | |

CAUTION

- During removal and installation of the cab, the parking brake is not available for holding the vehicle at a standstill. Therefore, be sure to apply chocks to the tires to ensure that the vehicle does not move.
- Never remove the chocks until all the operations are completed.
- Disconnect all cables, hoses and wires before removal and installation of the cab.

● Installation sequence

Follow the removal sequence in reverse.

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2, 4	Areas of torsion bar arms and torsion bar supports which make contact with each other	Chassis grease [NLGI No.1 (Li soap)]	As required

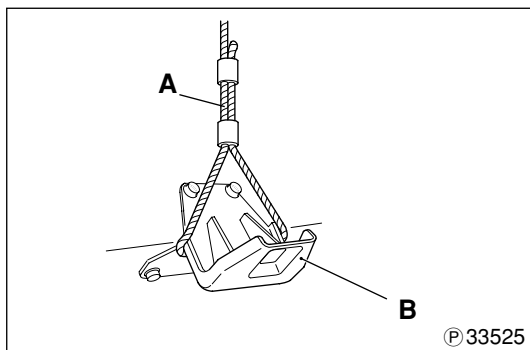
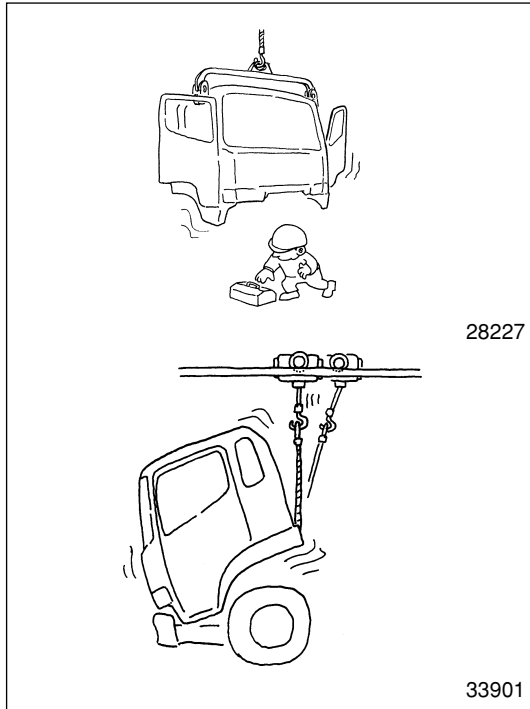
◆ Service procedure

7 Cab assembly

During removal or installation of cab assembly **7**, disconnect or reconnect all the connections on both the cab and chassis sides while tilting the cab up or down.

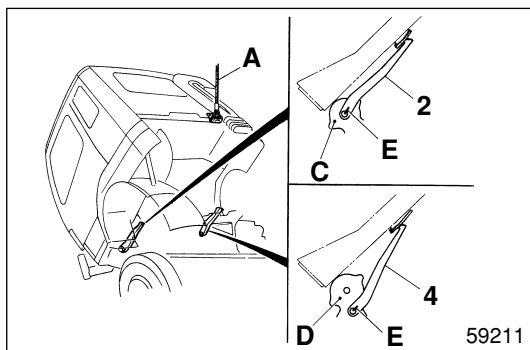
WARNING

- When cab assembly **7** is lifted, never get under the cab.
- When cab assembly **7** is tilted up or down using crane **A**, use special care to make sure that the wire never slips off. When you operate the crane, keep the wire always vertical by moving the crane as necessary.



[Removal]

- With the cab tilted up, attach the wire rope to bottom bracket **B** securely to enable the cab to be tilted down while being supported by crane **A**.

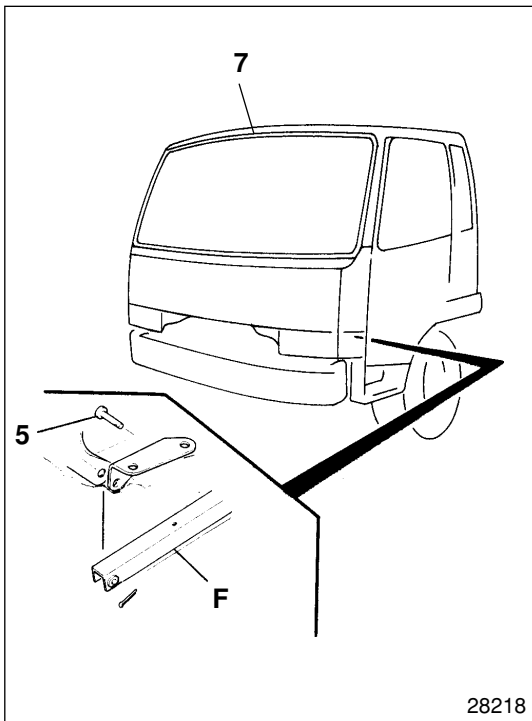


- Make alignment marks **E** on torsion bar arms **2** and **4**, gear box bracket **C** and cab hinge bracket **D**, then remove the torsion bar arms.

WARNING

After torsion bar arms **2** and **4** have been removed, be extremely careful as there is a risk of the cab falling down under its own weight.

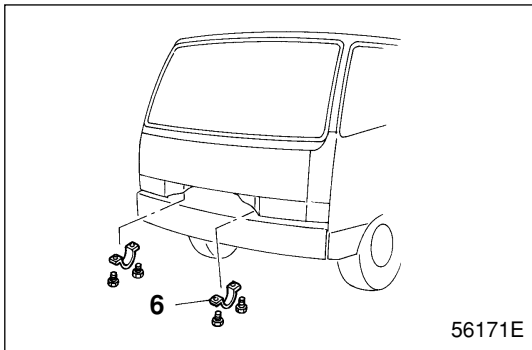
REMOVAL AND INSTALLATION OF CAB



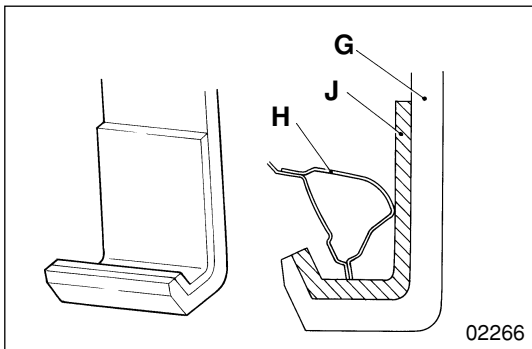
- Tilt down cab assembly 7 slowly while supporting it by the crane.
- Remove clevis pin 5 to separate cab stay F and cab assembly 7.

WARNING ⚠

Never tilt up cab assembly 7 after clevis pin 5 has been removed. Doing so is extremely dangerous as the cab will fall forward and down.



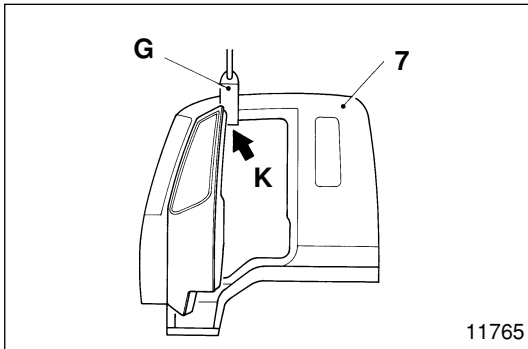
- From the front of the cab, remove cab hinge caps 6.



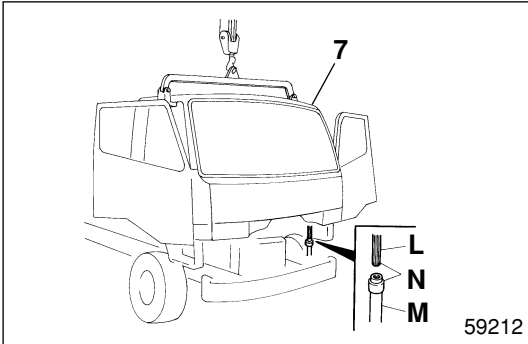
- Have ready cab sling G like a one shown in the drawing.

CAUTION ⚠

- Cab assembly 7 weighs the mass indicated in the Specification section. Get ready a sling G rigid enough to support the mass.
- Sling G must be lined with rubber piece J to prevent deformation of roof H of the cab when the cab is lifted.



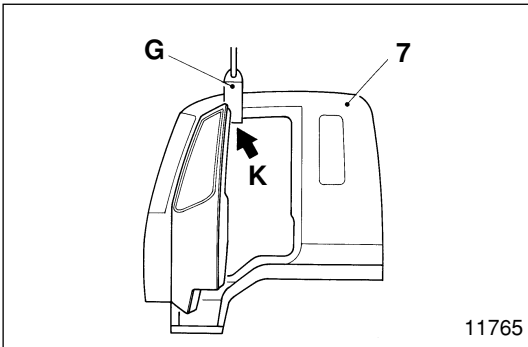
- Install sling **G** at center-of-gravity **K** of cab assembly **7**. To check the sling position, slightly lift the cab and see whether the cab remains horizontal. If necessary, adjust the sling position.



- Slowly lift cab assembly **7** and stop lifting when steering yoke **L** comes out of steering shaft **M**. Before the steering yoke comes out of the steering shaft, make alignment marks **N**.

WARNING

- When cab assembly **7** is lifted, never get used under the cab.
- After cab assembly **7** has been slightly lifted, check to ensure that all the parts such as wires, cables and hoses have been completely disconnected.

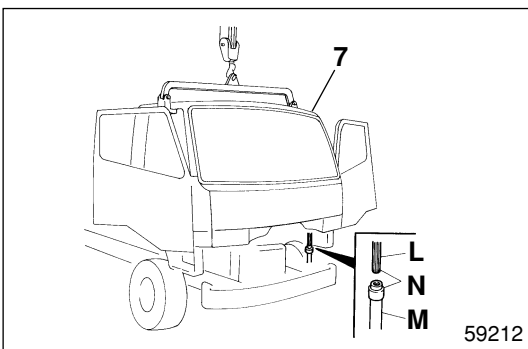


- Now removal of cab assembly **7** is complete.

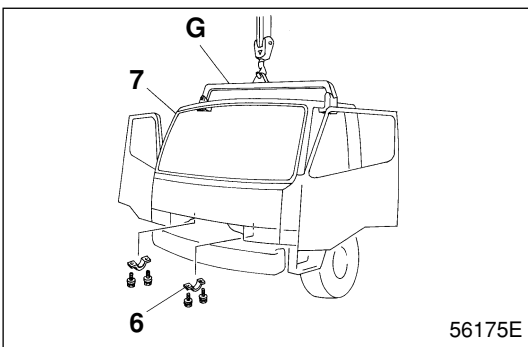
[Installation]

- Install sling **G** at the center-of-gravity **K** of cab assembly **7**.

P42-25

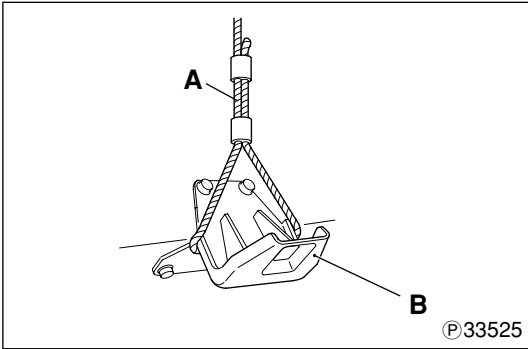


- Slowly lower cab assembly **7**, while keeping it horizontal, and insert steering yoke **L** into shaft **M**, while lining up alignment marks **N**.

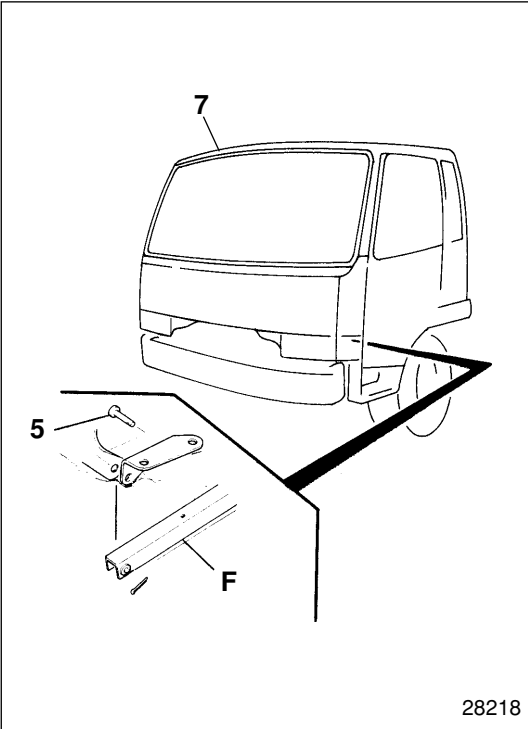


- Slowly lower cab assembly **7** further down until it is seated on the cab hinges. At this point, check for lateral alignment of the cab at the right and left cab hinges. If necessary, make adjustments for proper seating of the cab.
- Install cab hinge caps **6** then remove sling **G**.

REMOVAL AND INSTALLATION OF CAB



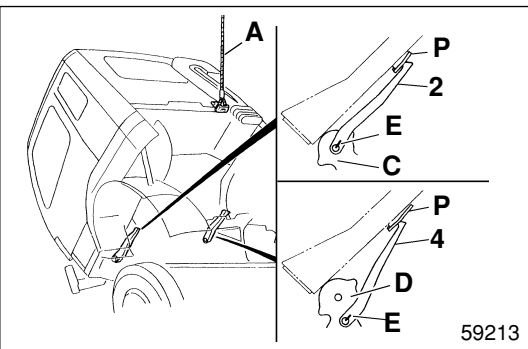
- Attach the wire rope to bottom bracket **B** securely to enable the cab to be tilted up in the later step using crane **A**.



- Link cab assembly **7** to cab stay **F** by installing clevis pin **5**.

WARNING ⚠

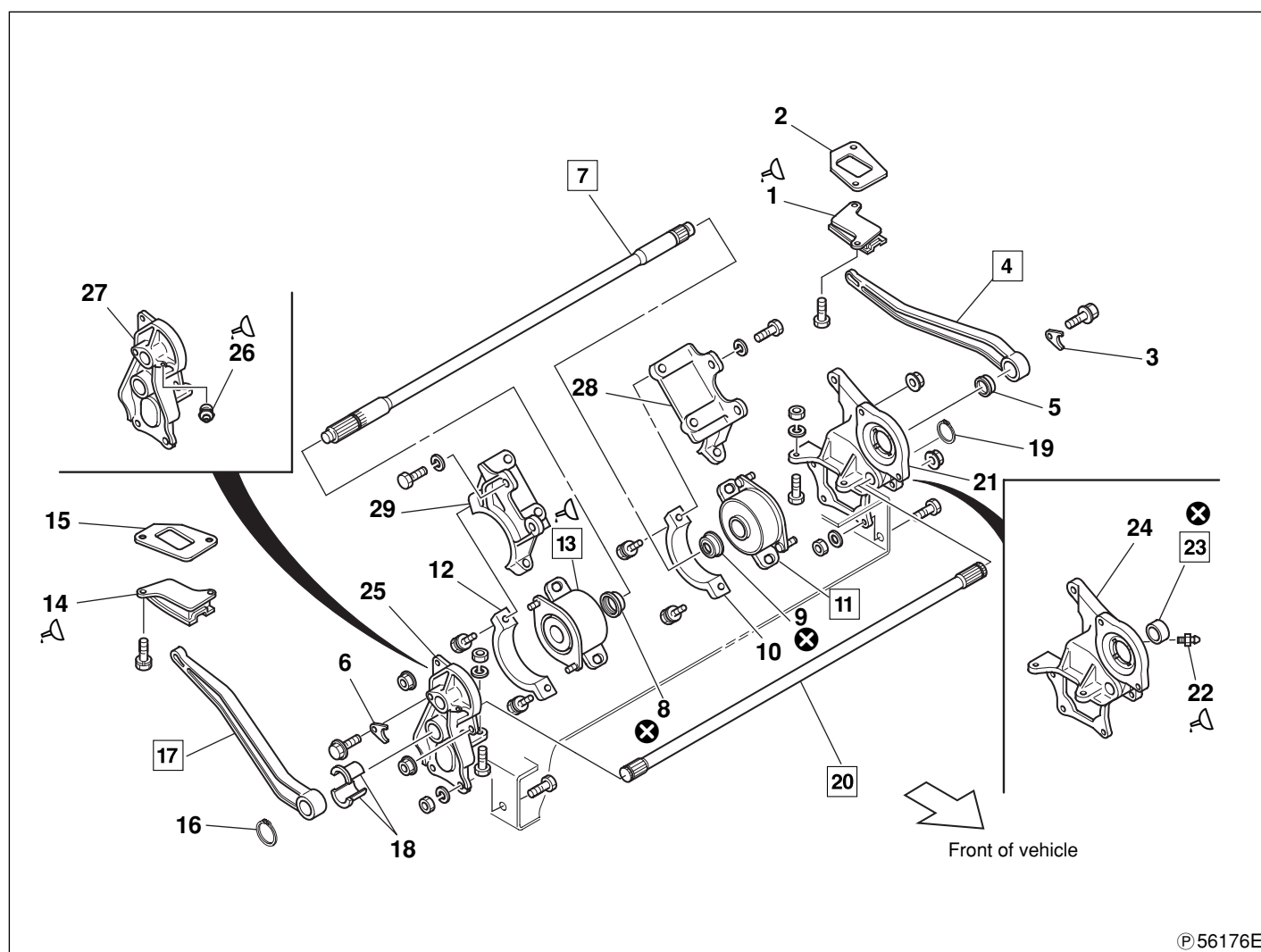
When cab assembly **7** is tilted using crane **A**, be careful not to tilt more than necessary. Doing so is extremely dangerous as the cab assembly will fall down forward.



- Slowly tilt up cab assembly **7** using crane **A**.
- Install torsion bar arms **4** and **2** while aligning mating marks **E** on them with those on cab hinge bracket **D** and gear box bracket **C**.
If torsion bar supports **P** were removed, install them after the torsion bar arms have been installed.
- After all the cab components have been installed, slowly tilt the cab assembly **7** fully down, securely lock the cab stay and detach crane **A** from the cab.

MEMO

FRONT CAB MOUNTING



● Disassembly sequence

- | | | |
|-----------------------|------------------------|-------------------------------|
| 1 Torsion bar support | 11 Cab hinge cushion | 21 Gearbox bracket assembly |
| 2 Shim | 12 Cab hinge cap | 22 Grease nipple |
| 3 Stopper plate | 13 Cab hinge cushion | 23 Bushing |
| 4 Torsion bar arm | 14 Torsion bar support | 24 Gear box bracket |
| 5 Dust cover | 15 Shim | 25 Cab hinge bracket assembly |
| 6 Stopper plate | 16 Snap ring | 26 Grease nipple |
| 7 Upper torsion bar | 17 Torsion bar arm | 27 Cab hinge bracket |
| 8 Dust cover | 18 Bushing | 28 Cab hinge upper bracket |
| 9 Dust cover | 19 Snap ring | 29 Cab hinge upper bracket |
| 10 Cab hinge cap | 20 Lower torsion bar | |

⊗ : Non-reusable part

NOTE

- Shims 2 and 15 may not have been installed.
- Do not remove bushing 23 unless it is faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

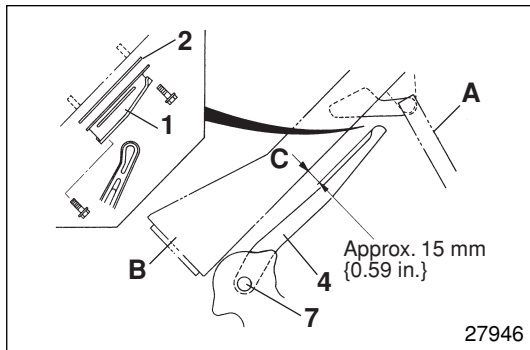
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Torsion bar arm bearing surface of torsion bar support	Chassis grease [NLGI No. 1 (Li soap)]	As required
11, 13	Inner surface of cab hinge cushion	Chassis grease [NLGI No. 1 (Li soap)]	As required
14	Torsion bar arm bearing surface of torsion bar support	Chassis grease [NLGI No. 1 (Li soap)]	As required
22, 26	Through grease nipple	Chassis grease [NLGI No. 1 (Li soap)]	As required

◆ Service procedure

4 Installation of torsion bar arm

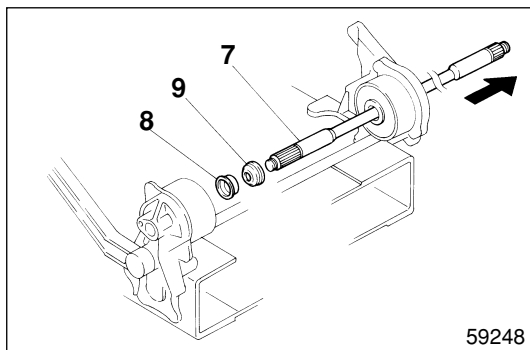
- Tilt the cab and support it with cab stay **A**.
- Install torsion bar arm **4** onto upper torsion bar **7** such that clearance **C** between the arm and cab main sill **B** is as specified in the illustration.
- If the specified clearance cannot be obtained, adjust it using shim **2**. Insert the shim between the cab main sill and torsion bar support **1** when installing the support onto the sill.



7 Upper torsion bar

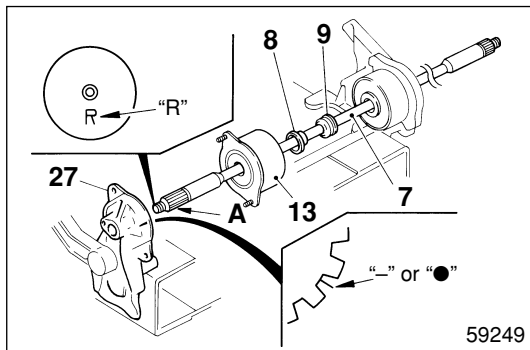
[Removal]

Remove upper torsion bar **7** in the direction shown.



[Installation]

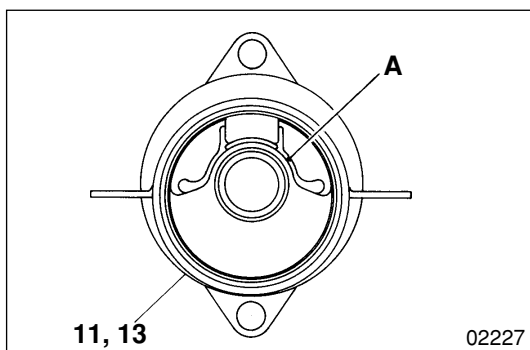
Install upper torsion bar **7** onto cab hinge bracket **27** in the illustrated direction. Make sure that mark **A** (white paint) on the bar is aligned with “—” or “●” mark on the cab hinge bracket.



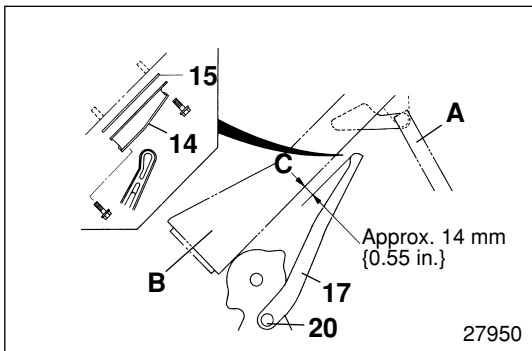
11 13 Installation of cab hinge cushion

Install cab hinge cushions **11** and **13** in the illustrated direction after ensuring that there is no fluid leak.

A : Cab side

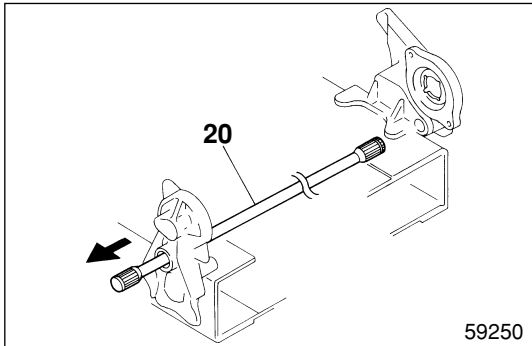


FRONT CAB MOUNTING



17 Installation of torsion bar arm

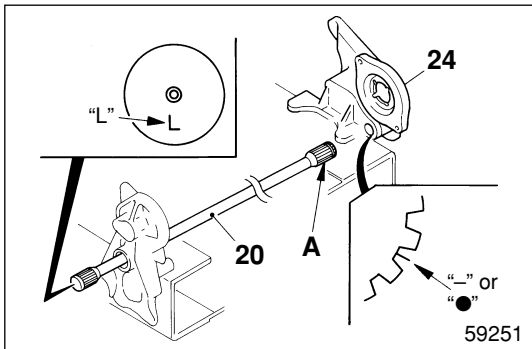
- Tilt the cab and support it with cab stay **A**.
- Install torsion bar arm **17** onto lower torsion bar **20** such that clearance **C** between the arm and cab main sill **B** is as specified in the illustration.
- If the specified clearance cannot be obtained, adjust it using shim **15**. Insert the shim between the cab main sill and torsion bar support **14** when installing the support onto the sill.



20 Lower torsion bar

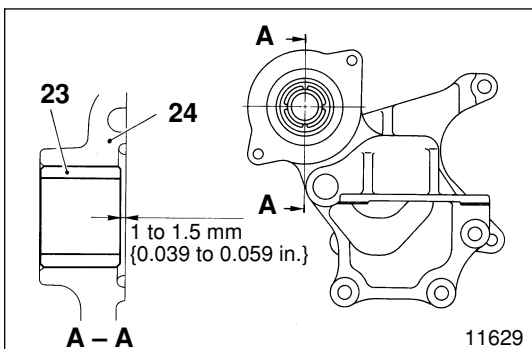
[Removal]

Remove lower torsion bar **20** in the direction shown.



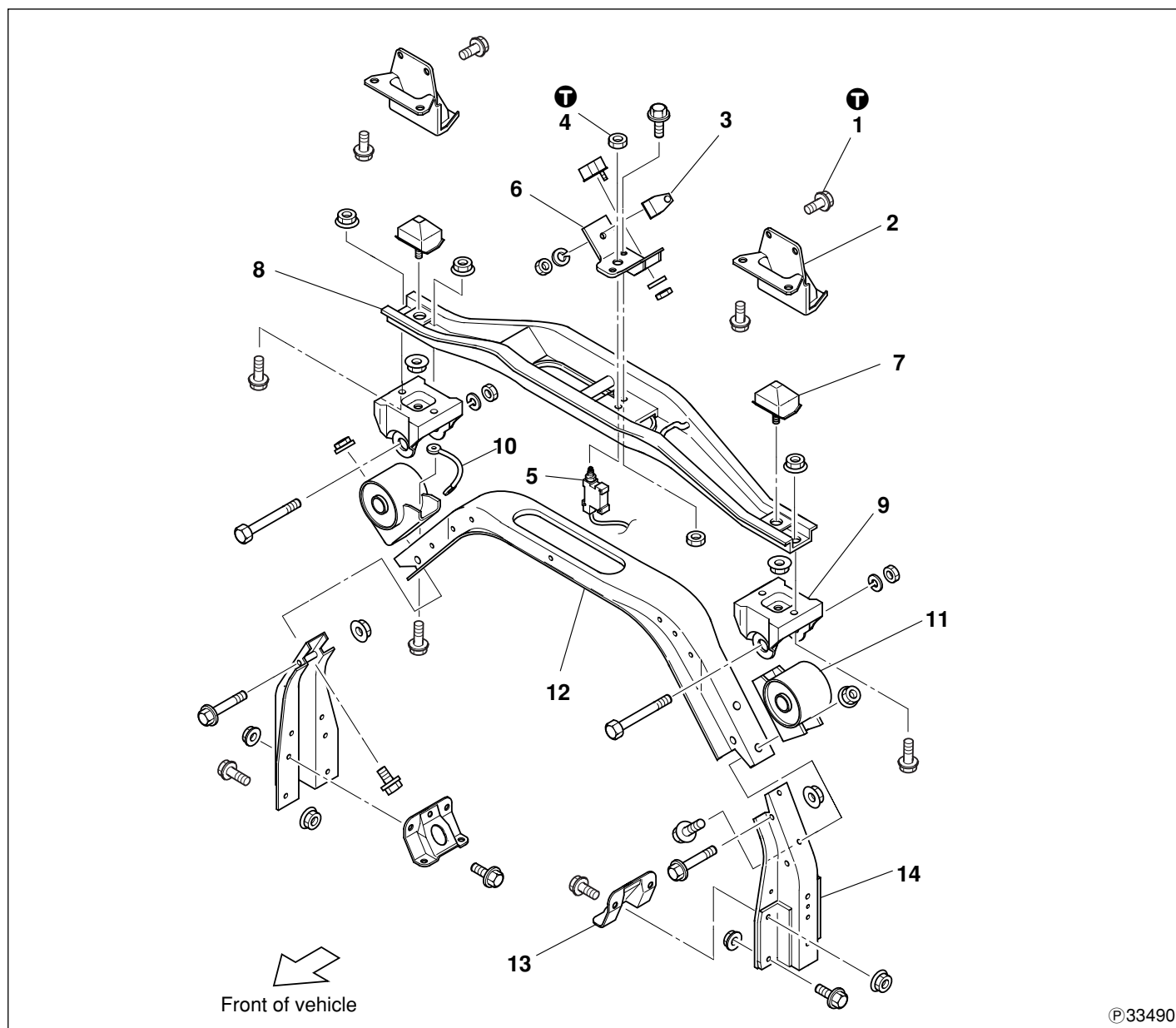
[Installation]

Install lower torsion bar **20** onto gearbox bracket **24** in the illustrated direction. Make sure that mark **A** (white paint) on the bar is aligned with “—” or “●” mark on the gearbox bracket.



23 Installation of bushing

Install bushing **23** into gearbox bracket **24** such that the dimension shown in the illustration is as specified.



©33490

● Disassembly sequence

- | | | |
|---|---------------------------|-------------------------|
| 1 Bolt | 6 Rebound cushion bracket | 11 Cushion rubber |
| 2 Bottom bracket | 7 Buffer rubber | 12 Center bridge |
| 3 Rebound cushion | 8 Floating bar | 13 Cab bridge stiffener |
| 4 Nut | 9 Cushion rubber bracket | 14 Side bridge |
| 5 Cab tilt switch  Gr 54 | 10 Earth strap | |

● Assembly sequence

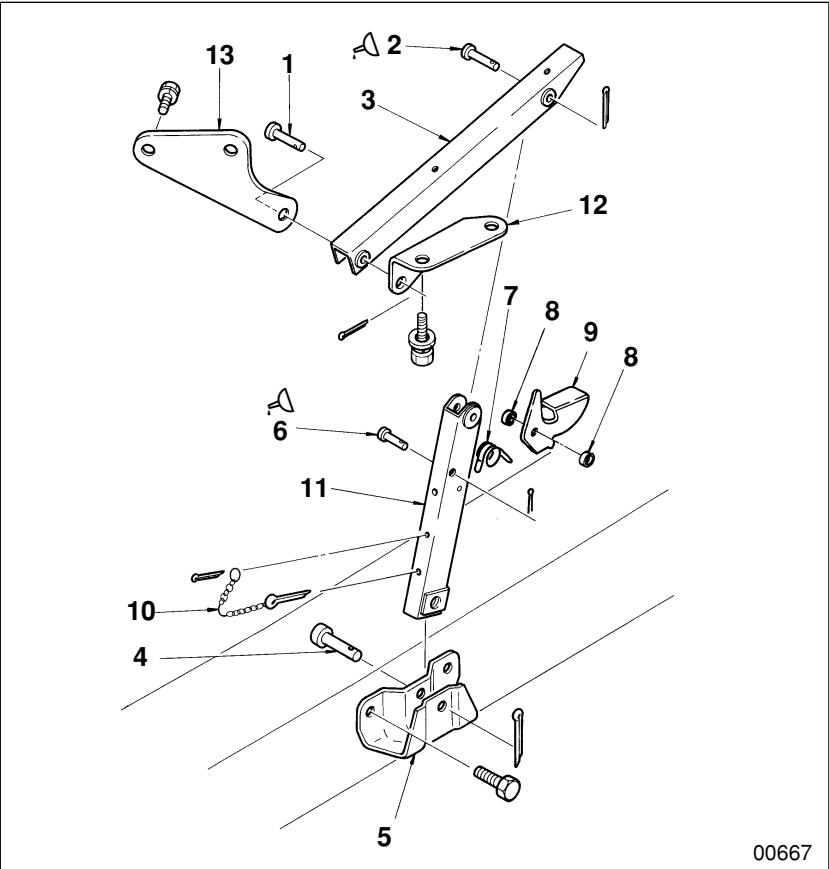
Follow the disassembly sequence in reverse.

T Tightening torque

Unit: N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (bottom bracket installation)	34 to 54 {25 to 40, 3.5 to 5.3}	—
4	Nut (cab tilt switch installation)	9.8 ± 2.0 (7.2 ± 1.5, 1.0 ± 0.2)	—

CAB STAY



● **Disassembly sequence**

- 1 Clevis pin
- 2 Clevis pin
- 3 Stay
- 4 Clevis pin
- 5 Lower bracket
- 6 Clevis pin
- 7 Return spring
- 8 Spacer
- 9 Lock latch
- 10 Chain
- 11 Stay
- 12 Upper bracket
- 13 Upper bracket

WARNING ⚠
Never remove the cab stay unless the cab is prevented from falling down by properly supporting it with a crane or other proper means.

● **Disassembly sequence**

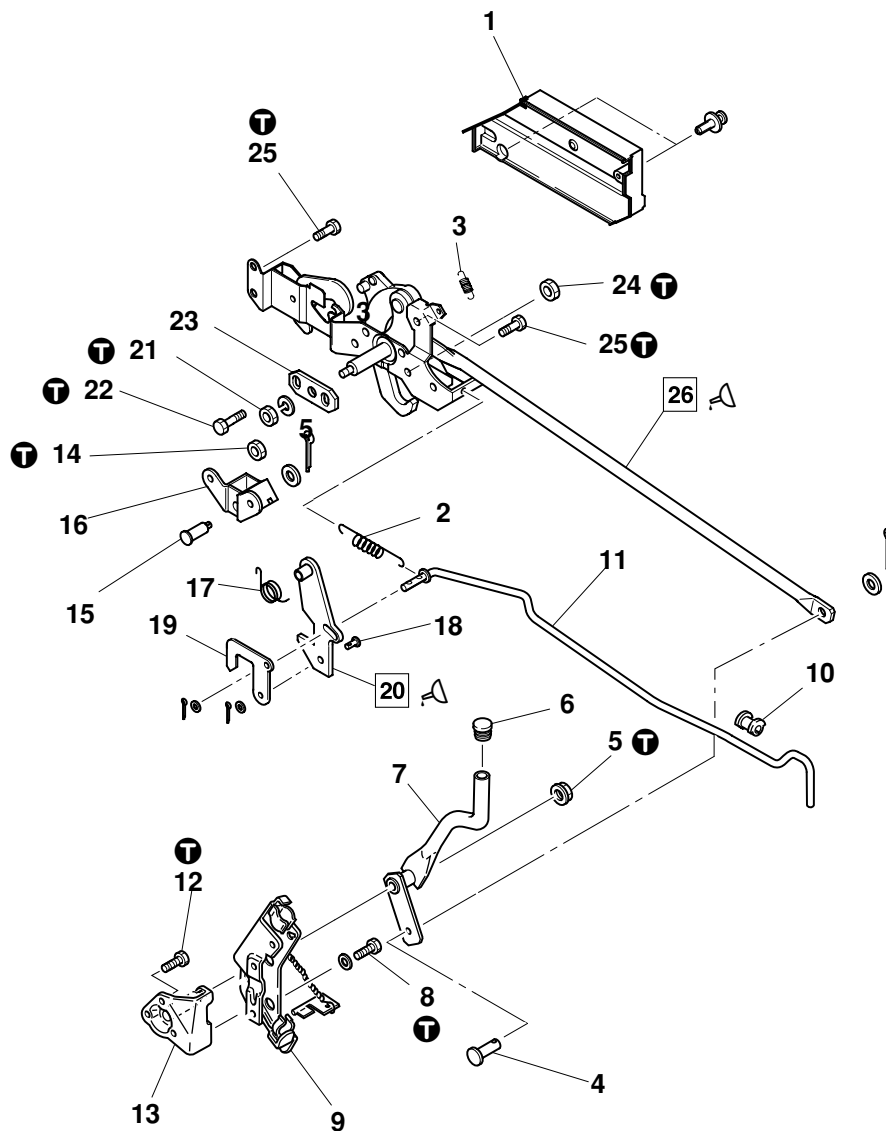
Follow the disassembly sequence in reverse.

🔧 **Lubricant and/or sealant**

Location	Points of application	Specified lubricant and/or sealant	Quantity
2, 6	Clevis pins	Chassis grease [NLGI No. 1 (Li soap)]	As required

MEMO

CAB TILT LINK



©33483

● Disassembly sequence

- | | | |
|---------------------------------------|--------------------|-----------------------|
| 1 Main hook cover | 10 Rubber sleeve | 19 L-lever |
| 2 Return spring | 11 L-lever rod | 20 L-lever |
| 3 Return spring | 12 Bolt | 21 Nut |
| 4 Clevis pin | 13 Hinge bracket | 22 Bolt |
| 5 Nut | 14 Nut | 23 Holder plate |
| 6 Plug | 15 Shaft | 24 Nut |
| 7 Hook control lever | 16 L-lever bracket | 25 Bolt |
| 8 Bolt | 17 Return spring | 26 Main hook assembly |
| 9 Hook control lever bracket assembly | 18 Clevis pin | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit: N·m {ft.lbs, kgf·m}

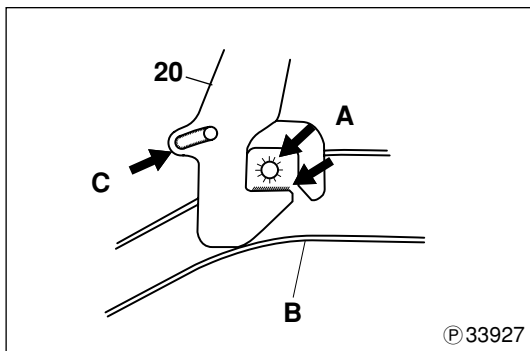
Location	Points to be tightened	Tightening torque	Remarks
5	Nut (installation of hook control lever)	21 to 30 {15 to 22, 2.1 to 3.1}	–
8	Bolt (installation of hook control lever bracket assembly)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–
12	Bolt (hinge bracket installation)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–
14	Nut (L-lever bracket installation)	10 to 15 {7.4 to 11, 1 to 1.5}	–
21	Nut (installation of main hook assembly)	33 to 49 {24 to 36, 3.4 to 5}	–
22	Bolt (holder plate installation)	9 to 14 {6.6 to 10, 0.9 to 1.4}	–
24	Nut (installation of main hook assembly)	21 to 30 {15 to 22, 2.1 to 3.1}	–
25	Bolt (installation of main hook assembly)	34 to 54 {25 to 40, 3.5 to 5.5}	–

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
20	Contact surfaces of L-lever and floating bar	Chassis grease [NLGI No. 1 (Li Soap)]	As required
	Sliding surfaces of L-lever and L-lever rod		
26	Main hook assembly roller, sliding surface of main hook assembly roller	Chassis grease [NLGI No. 1 (Li soap)]	As required
	Eyes at both ends of main hook assembly control rod		
	Contact surfaces of main hook assembly L-lever and floating lever		

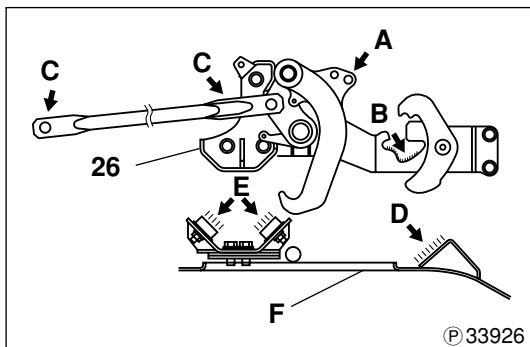
Service procedure

20 Greasing points of L-lever



- A : Contact surfaces of L-lever and floating lever
- B : Floating bar
- C : Sliding surface of L-lever rod

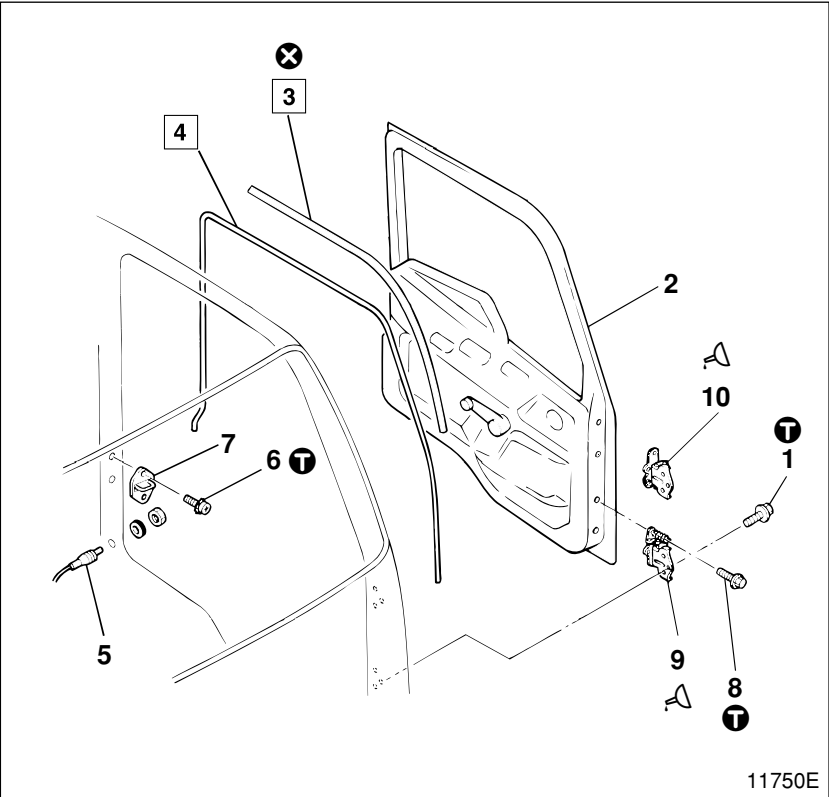
26 Greasing points of main hook assembly



- A : Roller
- B : Sliding surface of roller
- C : Eyes at control rod ends
- D : Contact surfaces of floating bar and L-lever
- E : Rebound cushion
- F : Floating bar

DOOR

Door Hinge and Striker



● Removal sequence

- 1 Bolt
- 2 Door assembly P42-38
- 3 Roof side weatherstrip
- 4 Door inner weatherstrip
- 5 Door switch
- 6 Screw
- 7 Striker
- 8 Bolt
- 9 Lower hinge
- 10 Upper hinge

X : Non-reusable parts

● Inspection and adjustment after installation P42-20

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

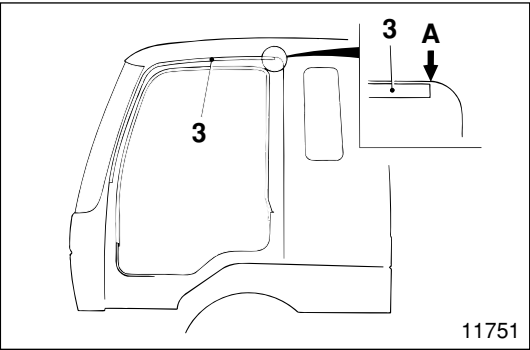
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Door assembly mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
6	Screw (Striker mounting)	9 to 14 {6.5 to 10.1, 0.9 to 1.4}	—
8	Bolt (Lower and upper hinge mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—

Lubricant and/or sealant

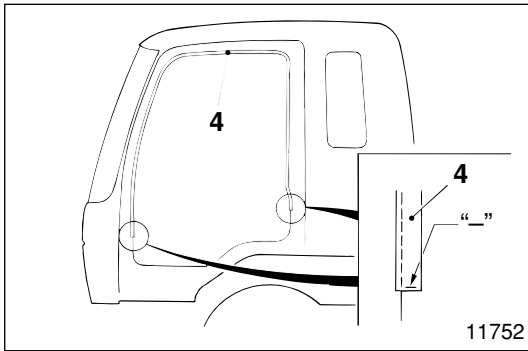
Location	Points of application	Specified lubricant and/or sealant	Quantity
9, 10	Rotating and friction areas of lower hinge and upper hinge	Chassis grease [NLGI No.1 (Li soap)]	As required

◆ Service procedure



3 Installation of roof side weatherstrip

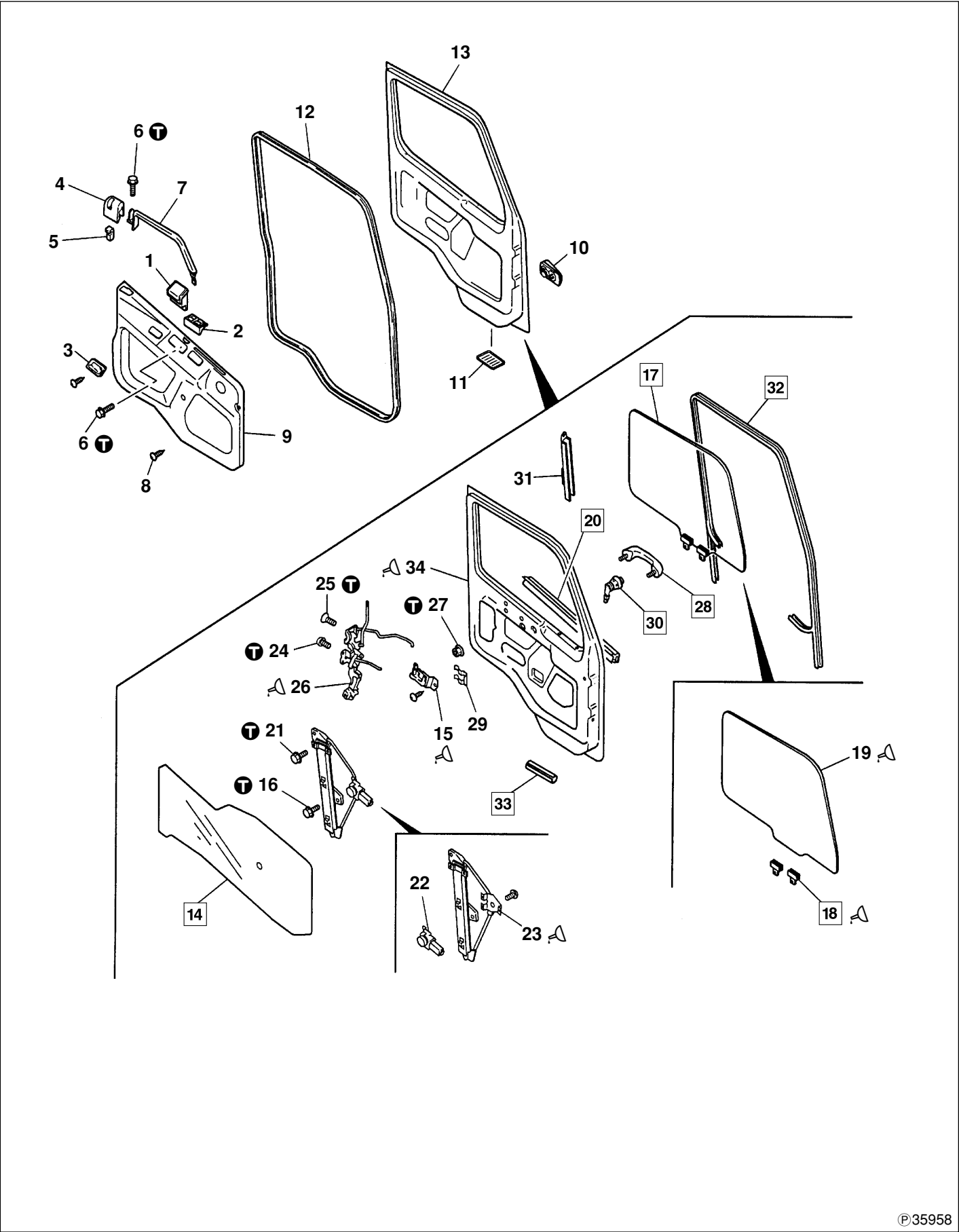
Install roof side weatherstrip **3** on the cab starting from point **A** as illustrated.

**4 Installation of door inner weatherstrip**

Install door weatherstrip **4** on the cab, aligning both ends of the weatherstrip with alignment marks “—” on the cab side.

DOOR

Door Assembly



● Disassembly sequence

- | | |
|--|---|
| 1 Ashtray | 18 Glass holder |
| 2 Power window switch  Gr 54 | 19 Door glass |
| 3 Inside handle cover | 20 Door belt line molding |
| 4 Door lock knob cover | 21 Bolt |
| 5 Door lock knob | 22 Power window motor  Gr 54 |
| 6 Bolt | 23 Regulator & rail assembly |
| 7 Door bar | 24 Screw |
| 8 Screw | 25 Screw |
| 9 Door trim assembly | 26 Door lock actuator  Gr 54 |
| 10 Cover < FK > | 27 Nut |
| Front side turn signal lamp < FM >  Gr 54 | 28 Outside handle |
| 11 Step lamp cover | 29 Clip |
| 12 Weather strip | 30 Door lock cylinder |
| 13 Door panel assembly | 31 Lower sash |
| 14 Waterproof cover | 32 Run channel |
| 15 Inside handle | 33 Cushion rubber |
| 16 Bolt | 34 Door panel |
| 17 Door glass assembly | |

CAUTION

Do not remove weather strip 12, glass holder 18 and cushion rubber 33 unless abnormalities are found.

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

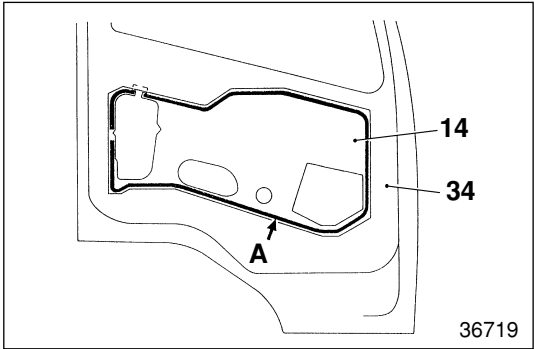
Location	Parts to be tightened	Tightening torque	Remarks
6	Bolt (Door cover mounting)	9 to 14 {65 to 100, 0.9 to 1.4}	—
16	Bolt (Door glass assembly mounting)	4 to 6 {29 to 43, 0.4 to 0.6}	—
21	Bolt (Regulator & rail assembly mounting)	4 to 6 {29 to 43, 0.4 to 0.6}	—
24	Screw (Door lock actuator mounting)	4 to 6 {29 to 43, 0.4 to 0.6}	—
25	Screw (Door lock actuator mounting)	4 to 6 {29 to 43, 0.4 to 0.6}	—
27	Nut (Outside handle mounting)	4 to 6 {29 to 43, 0.4 to 0.6}	—

DOOR

Lubricant and/or sealant

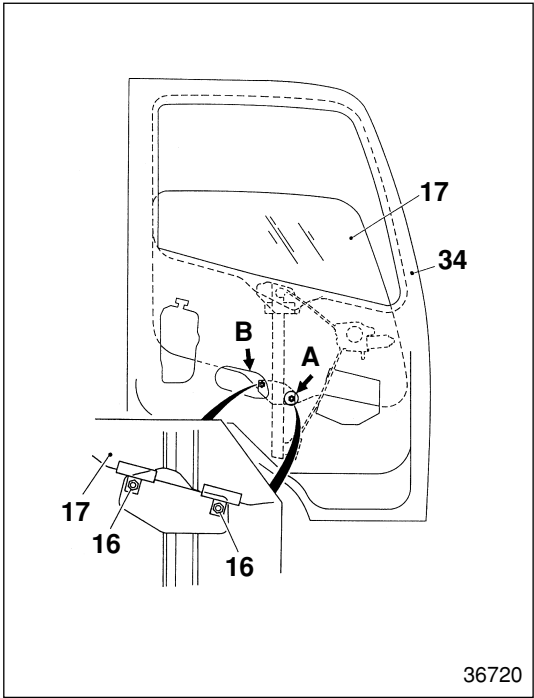
Location	Points of application	Specified lubricant and/or sealant	Quantity
15	Rotating surface of inside handle	Multipurpose grease [NLGI No.2 (Li soap)]	As required
18	Door glass mounting surface of glass holder	YH America Inc. M(RC-50KE) Primer	As required
19	Glass holder mounting surface of door glass	YH America Inc. G(MS-90) Primer	As required
	Glass holder mounting surface, 5 minutes after application of above primer	YH America Inc. WS-70FK Sealant (Urethane Base)	As required
23	Regulator sliding section of regulator & rail assembly	Multipurpose grease [NLGI No.1 (Li soap)]	As required
26	Sliding surface of door lock actuator	Multipurpose grease [NLGI No.2 (Li soap)]	As required
34	Waterproof cover installation surface of door panel	Butyl tape	As required

◆ Service procedure



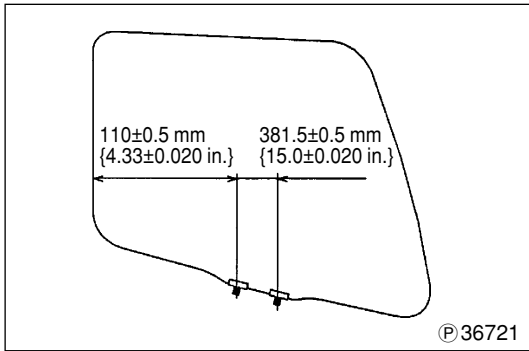
14 Installation of waterproof cover

- Apply butyl tape **A** to door panel **34**, as indicated in the illustration.
- Install waterproof cover **14** by pasting onto butyl tape **A**.



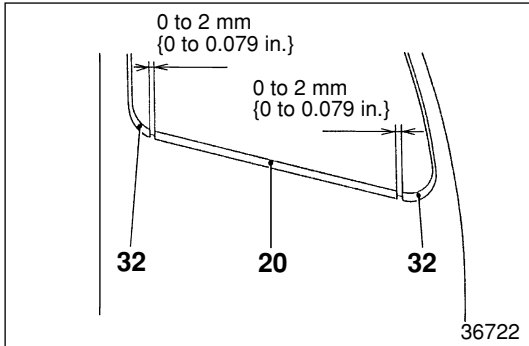
17 Removal and installation of door glass assembly

- Move door glass assembly **17** until bolts **16** of the door glass assembly become visible through holes **A** and **B** in the door panel **34**.
- While supporting door glass assembly **17** by hand, remove bolts **16**.
- Remove door glass assembly **17** through the open space in the door.
- To install, follow the removal procedure in reverse.



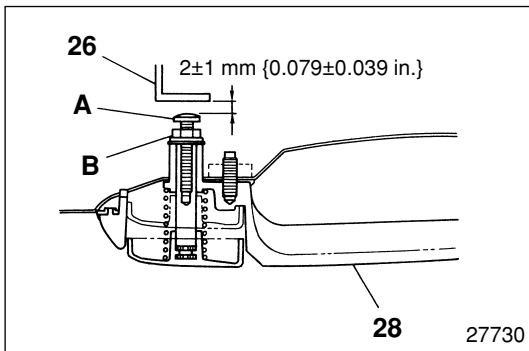
18 Installation of glass holder

Install glass holder **18** to door glass **19** at the location indicated in the illustration.



20 Installation of door belt line molding

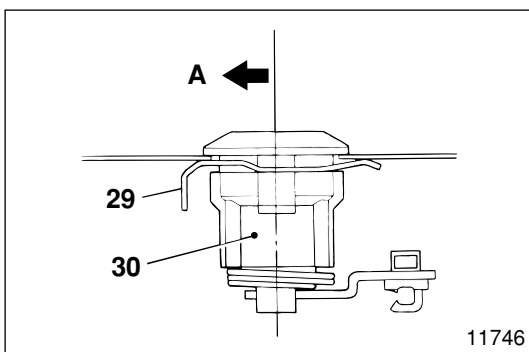
Install door belt line molding **20** so that gaps between the molding and run channel **32** are as indicated in the illustration.



28 Installation of outside handle

Turn push bolt **A** of outside handle **28** to adjust the gap between the push bolt and door actuator **26** as indicated in the illustration.

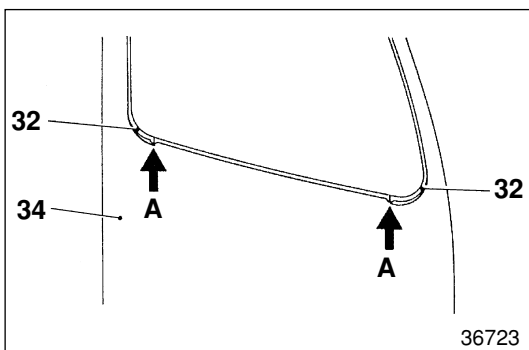
B : Lock nut



30 Installation of door lock cylinder

Install door lock cylinder **30** with clip **29** in the direction indicated in the illustration.

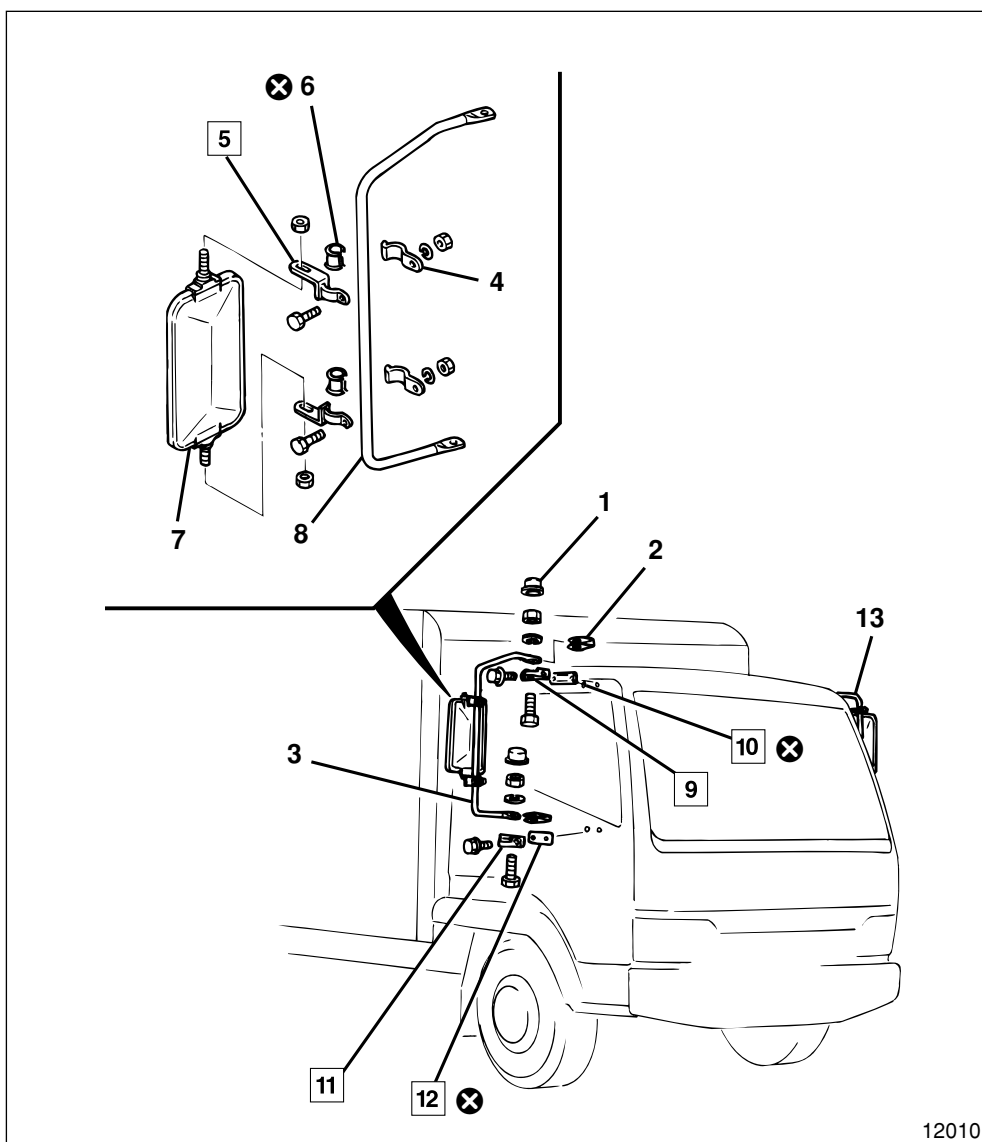
A : Vehicle front side



32 Installation of run channel

Install run channel **32** by aligning it with notches **A** on door panel **34**.

MIRROR



● Removal sequence

- 1 Cap
- 2 U-washer
- 3 Outside mirror stay assembly, RH
- 4 Mirror holder B
- 5 Mirror holder
- 6 Packing
- 7 Outside mirror
- 8 Mirror stay
- 9 Mirror stay upper bracket
- 10 Packing
- 11 Mirror stay lower bracket
- 12 Packing
- 13 Outside mirror stay assembly, LH

⊗ : Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

NOTE

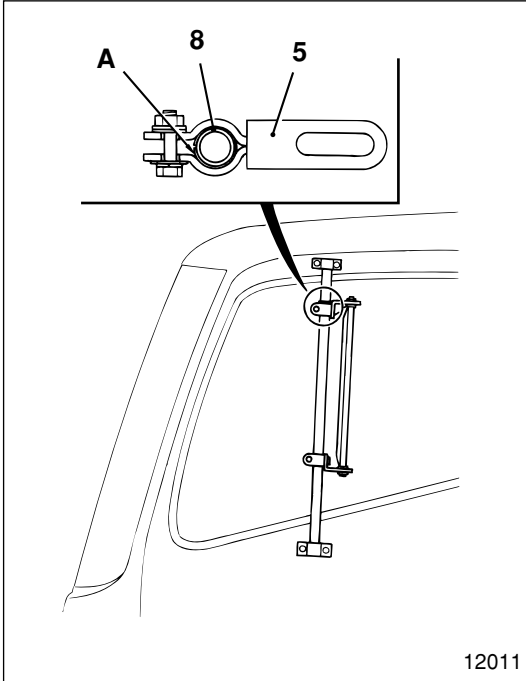
For outside mirror stay assembly LH 13, follow the same service procedure as for outside mirror stay assembly RH 3.

◆ Service procedure

5 Installation of mirror holder

Install mirror holder **5** onto mirror stay **8** in the direction as illustrated.

A : Indent of mirror stay **8**



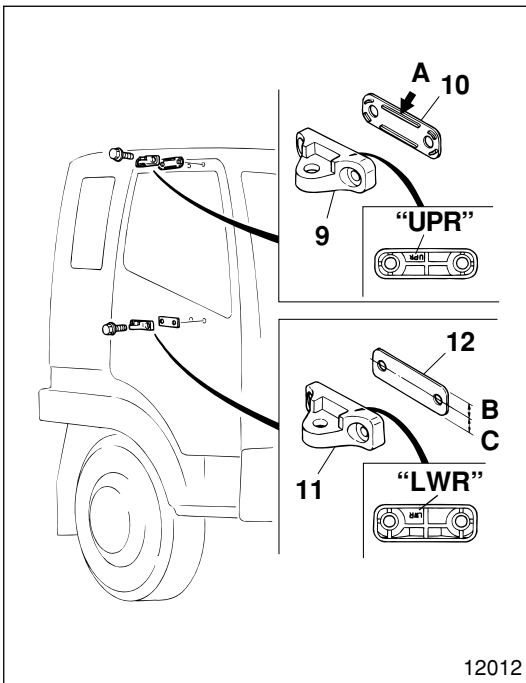
12011

9 to 12 Installation of mirror stay bracket and packing

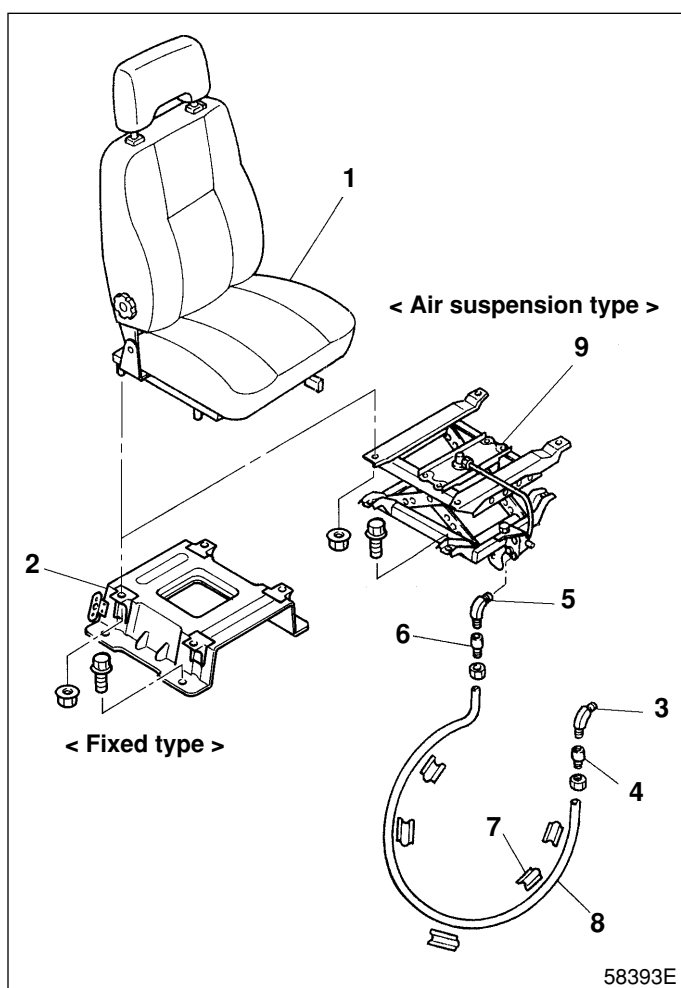
- “UPR” and “LWR” identification marks are marked on mirror stay upper bracket **9** and mirror stay lower bracket **11** respectively.
- Install indent **A** on packing **10**, facing mirror stay upper bracket **9**.
- Installation hole is offset on packing **12**.

B : 13.8 mm {0.54 in.}

C : 17.2 mm {0.68 in.}



12012



● Removal sequence

- 1 Seat assembly P42-46
- 2 Seat support
- 3 Connector
- 4 Sleeve
- 5 Connector
- 6 Sleeve
- 7 Tape
- 8 Air hose
- 9 Air suspension assembly P42-48

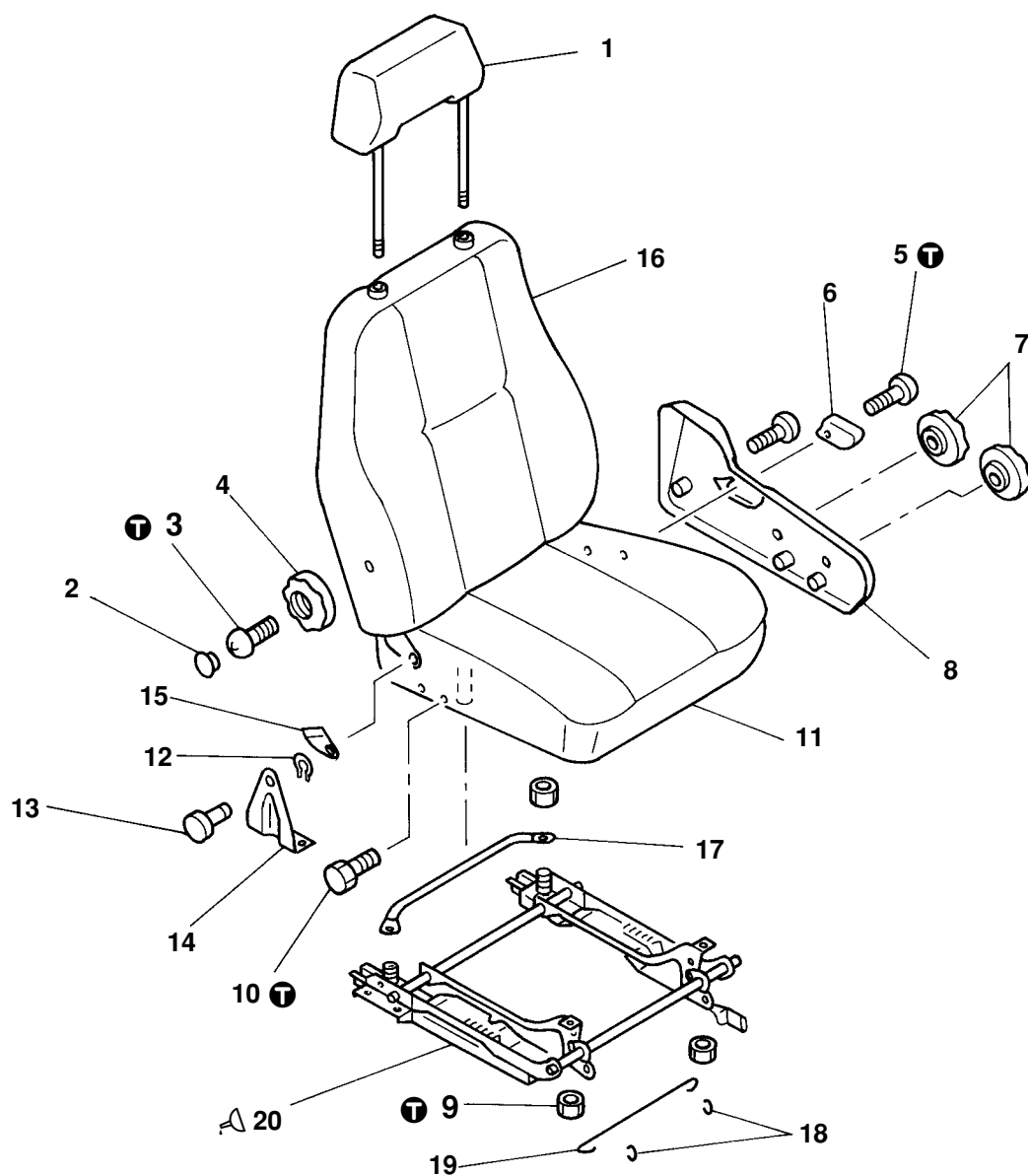
● Installation sequence

Follow the removal sequence in reverse.

MEMO

SEAT <DRIVER>

Seat Assembly



28057

● Disassembly sequence

- | | | |
|-------------------------------|--------------------------|----------------------------|
| 1 Headrest | 8 Shield cover | 15 Hinge cover |
| 2 Cap | 9 Nut | 16 Seatback assembly |
| 3 Screw | 10 Bolt | 17 Frame support |
| 4 Lumber support knob | 11 Seat cushion assembly | 18 Clip |
| 5 Screw | 12 Snap ring | 19 Wire |
| 6 Reclining adjustment knob | 13 Bushing | 20 Slide adjuster assembly |
| 7 Tilt/height adjustment knob | 14 Side bracket | |

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

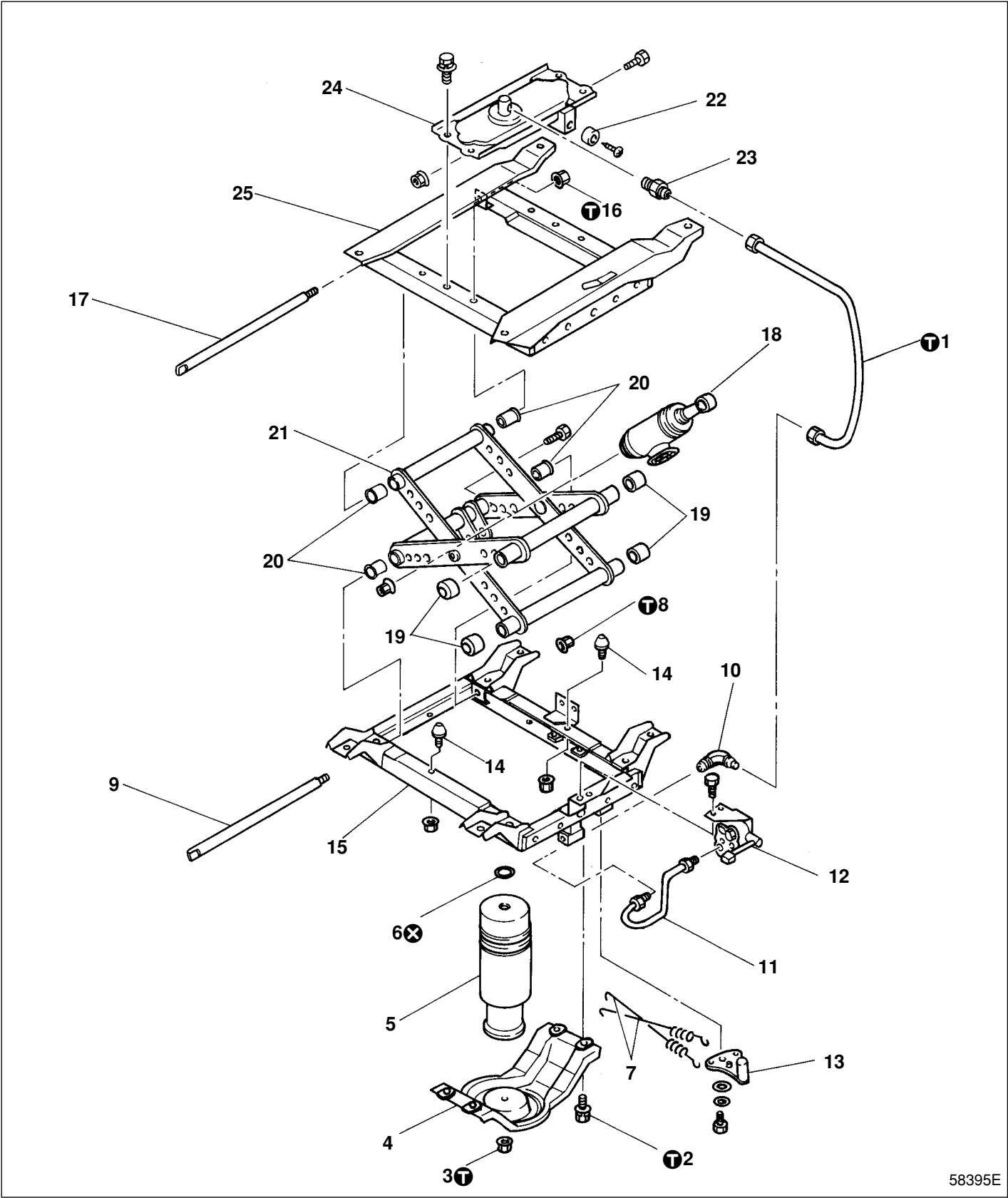
Location	Parts to be tightened	Tightening torque	Remarks
3	Screw (Lumber support knob mounting)	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.6}	—
5	Screw (Reclining adjustment knob mounting)	1.3 {1.0, 0.14}	—
9	Nut (Seat cushion assembly and slide adjuster assembly mounting)	8.8 to 13.7 {6.5 to 10, 0.9 to 1.4}	—
10	Bolt (Seat cushion assembly and slide adjuster assembly mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—

L Lubricant and/or sealant

Location	Points of application		Specified lubricant and/or sealant	Quantity
20	Slide adjuster assembly	Spring and sliding area	Chassis grease [NLGI No. 0 (Li soap)]	As required
		Gear engagement area and each sliding area	Chassis grease [NLGI No. 1 (Li soap)]	As required
		Rivet and rotating shaft	Hydraulic fluid	As required

SEAT <DRIVER>

Air Suspension Assembly



58395E

● Disassembly sequence

- | | | |
|-----------------------|-----------------------|------------------------|
| 1 Air tube | 10 Connector | 19 Cap |
| 2 Bolt | 11 Air pipe | 20 Bushing |
| 3 Nut | 12 Seat control valve | 21 Link |
| 4 Lower reinforcement | 13 Lever | 22 Dumper |
| 5 Air sleeve | 14 Stopper | 23 Connector |
| 6 O-ring | 15 Lower frame | 24 Upper reinforcement |
| 7 Spring | 16 Nut | 25 Upper frame |
| 8 Nut | 17 Shaft | |
| 9 Shaft | 18 Shock absorber | ⊗: Non-reusable parts |

● Assembly sequence

Follow the removal sequence in reverse.

T Tightening torque

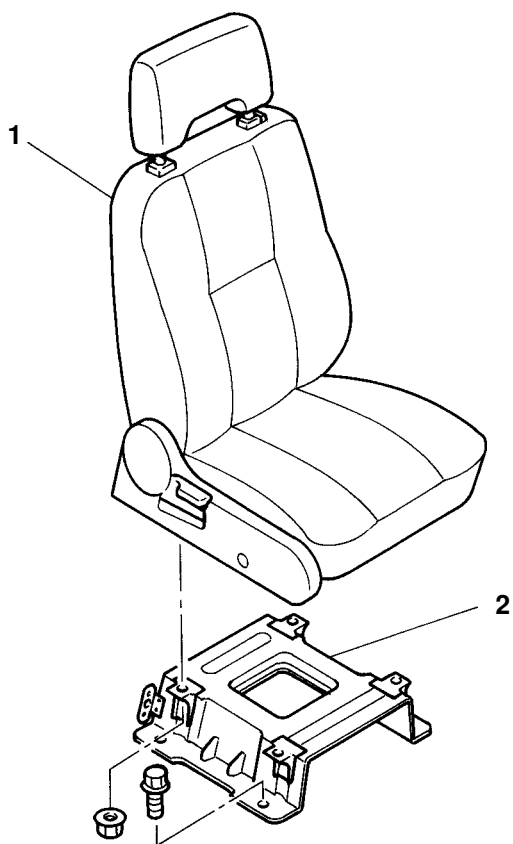
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Air tube	19.6 to 25.5 {14 to 19, 2 to 2.6}	—
2	Bolt (Lower reinforcement mounting)	8.8 to 13.7 {6.5 to 10, 0.9 to 1.4}	—
3	Nut (Air sleeve mounting)	3.9 to 5.9 {2.9 to 3.6, 0.4 to 0.6}	—
8, 16	Nut (Link and shaft mounting)	8.8 to 13.7 {6.5 to 10, 0.9 to 1.4}	—

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
—	All sliding parts	Molybdenum disulfide grease	As required

SEAT <PASSENGER>



58399E

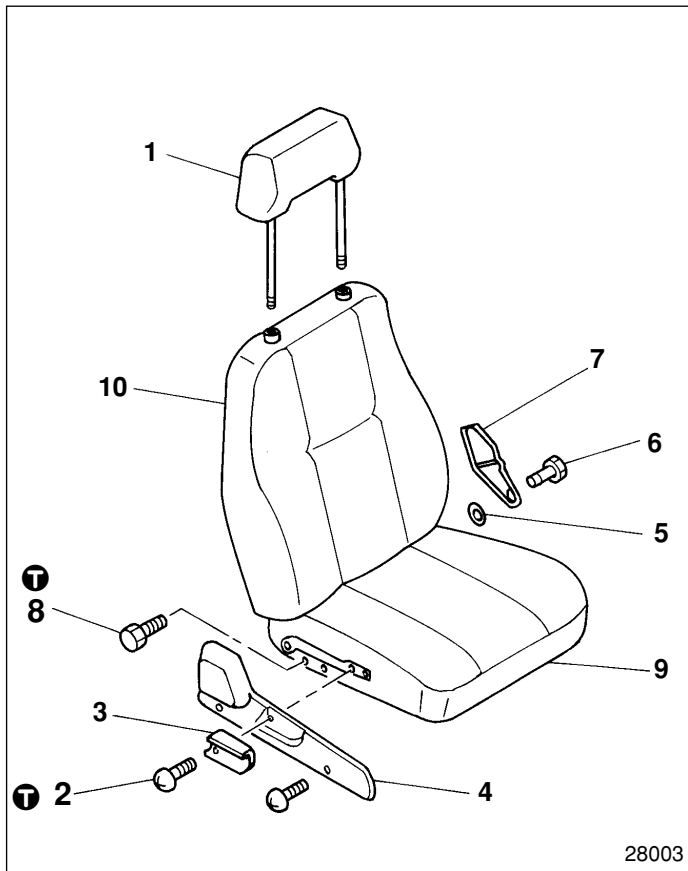
● Removal sequence

- 1 Seat assembly  P42-51
- 2 Seat support

● Installation sequence

Follow the removal sequence in reverse.

Seat Assembly



● Disassembly sequence

- 1 Headrest
- 2 Screw
- 3 Reclining adjustment knob
- 4 Cushion cover
- 5 Snap ring
- 6 Bushing
- 7 Hinge cover
- 8 Bolt
- 9 Seat cushion assembly
- 10 Seatback assembly

● Assembly sequence

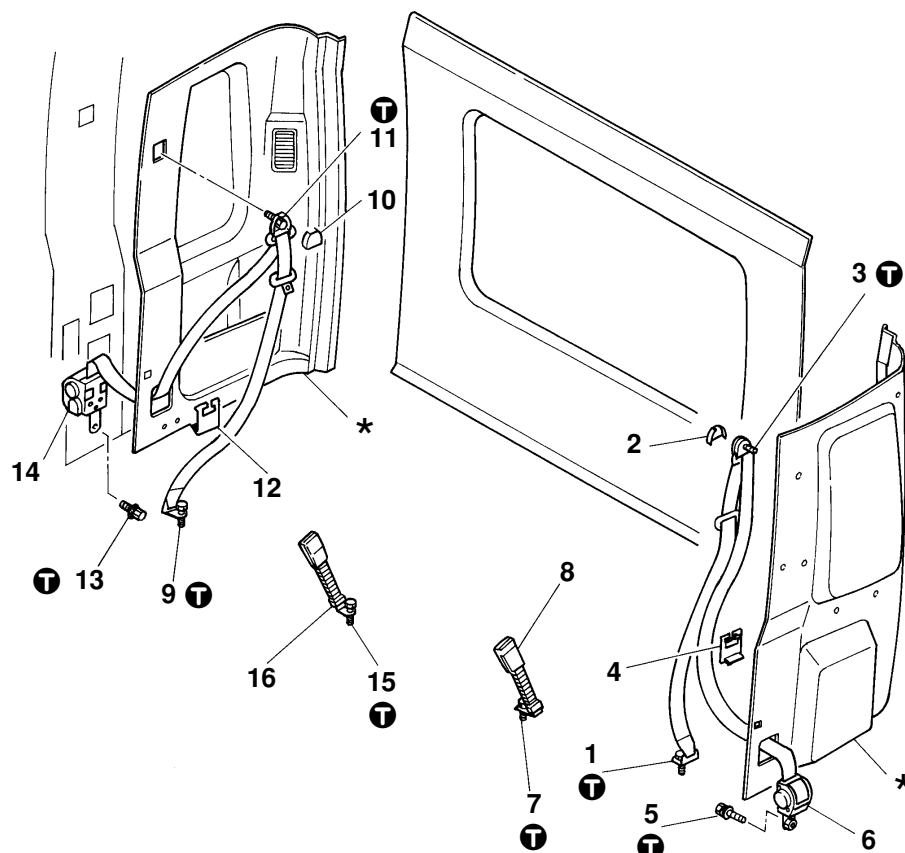
Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Screw (Reclining adjustment knob mounting)	1.3 {1.0, 0.14}	—
8	Bolt (Seat cushion assembly mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—

SEAT BELT



58400E

● Removal sequence

- | | | |
|-------------------------------|--------------------------------|----------------------|
| 1 Bolt | 8 Backle | 15 Bolt |
| 2 Shoulder anchor cover | 9 Bolt | 16 Backle |
| 3 Bolt | 10 Shoulder anchor cover | |
| 4 Seat belt guide | 11 Bolt | *: Side trim P42-64 |
| 5 Bolt | 12 Seat belt guide | |
| 6 Emergency locking retractor | 13 Bolt | |
| 7 Bolt | 14 Emergency locking retractor | |

● Installation sequence

Follow the removal sequence in reverse.

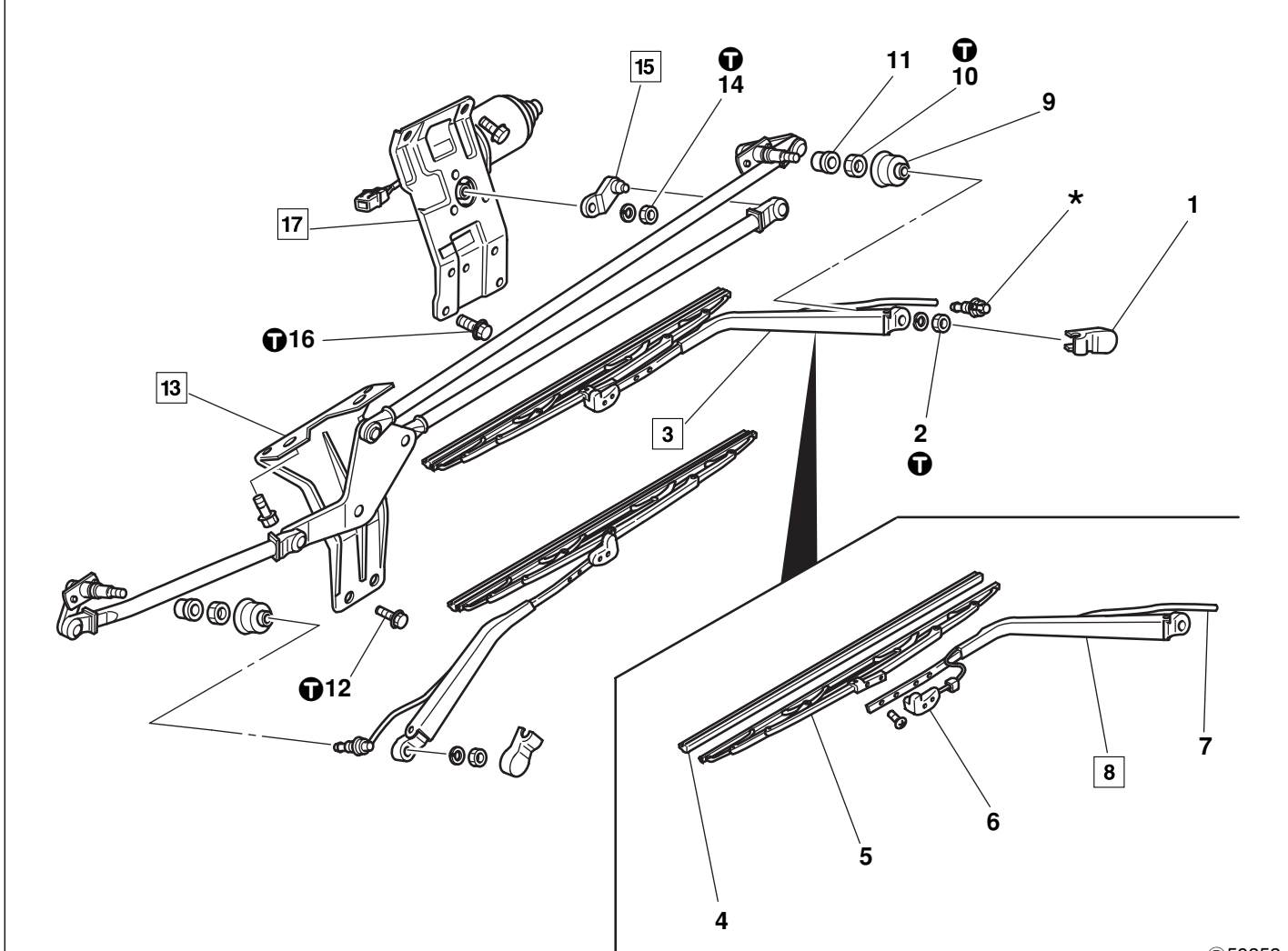
CAUTION

Never disassemble emergency locking retractors 6 and 14.

T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1, 9	Bolt (Floor anchor mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—
3, 11	Bolt (Shoulder anchor mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—
5, 13	Bolt (Emergency locking retractor mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—
7	Bolt (Buckle mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—
15	Bolt (Floor anchor and buckle mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—



● Disassembly sequence

- | | |
|--|--|
| 1 Head cover | 12 Bolt |
| 2 Nut | 13 Wiper link assembly |
| 3 Wiper arm and blade assembly | 14 Nut |
| 4 Blade rubber | 15 Crank arm |
| 5 Wiper blade | 16 Bolt |
| 6 Washer nozzle assembly  P42-58 | 17 Wiper motor and bracket assembly |
| 7 Washer hose  P42-58 |  Electrical |
| 8 Wiper arm | |
| 9 Pivot cap | *: Hose joint |
| 10 Nut |  P42-58 |
| 11 Collar | |

CAUTION

Do not remove crank arm 15 unless it is defective. The crank arm is installed in a position precisely adjusted to the park position of wiper motor and bracket assembly 17.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
8	Wiping force of wiper arm	7.65±0.49 N {1.72±0.11 lbf, 0.78±0.05 kgf}	—	Replace

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

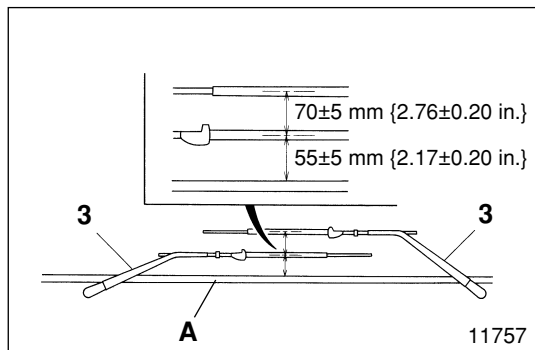
Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (Wiper arm and blade assembly mounting)	17 to 23 {12.3 to 16.6, 1.7 to 2.3}	—
10	Nut (Wiper link and motor assembly mounting)	17 to 23 {12.3 to 16.6, 1.7 to 2.3}	—
12	Bolt (Link assembly mounting)	10 to 15 {7.2 to 10.8, 1.0 to 1.5}	—
14	Nut (Crank arm mounting)	16.7 to 23.5 {12.3 to 17.4, 1.7 to 2.4}	—
16	Bolt (Wiper motor bracket mounting)	9 to 14 {6.5 to 10.1, 0.9 to 1.4}	—

WIPER AND WASHER

◆ Service procedure

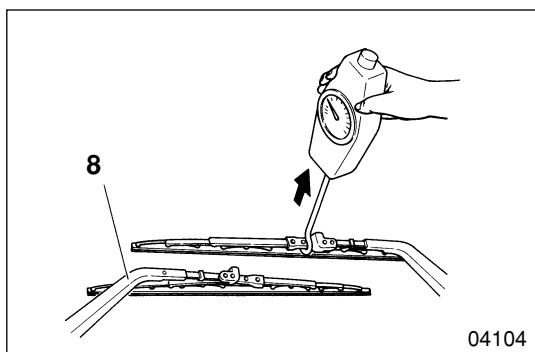
3 Installation of wiper arm and blade assemblies

Install wiper arm and blade assembly **3** to wiper link assembly **13** from the end face of weather strip **A** to the dimension shown in illustration.



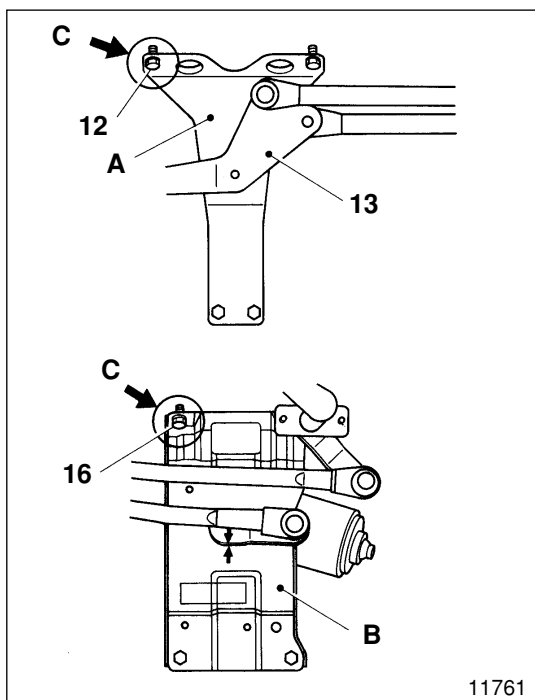
8 Inspection of wiper arm

If the measured value is out of the standard, replace wiper arm **8**.



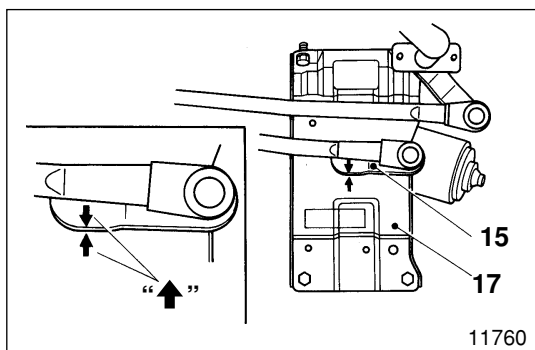
13 17 Installation of wiper link assembly and motor and bracket assembly

- Both idler bracket **A** of wiper link assembly **13** and bracket **B** of wiper motor and bracket assembly **17** have installation reference holes **C**.
- Tighten bolts **12** and **16** starting with the locations identified by these reference holes.



15 Installation of crank arm

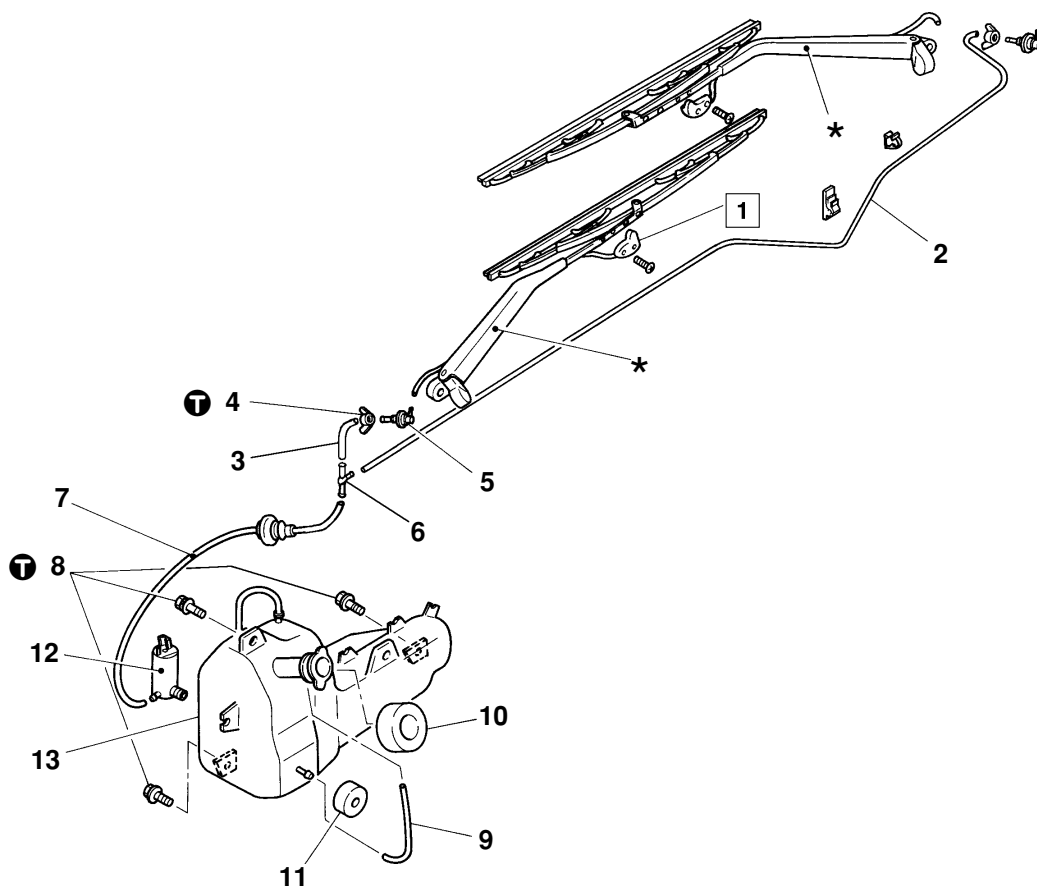
Align wiper motor and bracket assy **17** with mating mark “↑” of crank arm **15** to install.



MEMO

WIPER AND WASHER

Washer



59261

● Removal sequence

- | | |
|--------------------------|---|
| 1 Washer nozzle assembly | 9 Washer hose |
| 2 Washer hose | 10 Packing |
| 3 Washer hose | 11 Packing |
| 4 Nut | 12 Washer motor  Gr 54 |
| 5 Hose joint | 13 Washer tank |
| 6 Hose joint | |
| 7 Washer hose | |
| 8 Bolt | |

*: Wiper arm and blade assembly  P42-54

● Installation sequence

Follow the removal sequence in reverse.

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Wing nut (Hose joint mounting)	0.6 to 0.9 {0.43 to 0.65, 0.06 to 0.09}	—
8	Bolt (Washer tank mounting)	7.8 to 11.8 {5.8 to 8.7, 0.8 to 1.2}	—

◆ Service procedure

1 Installation of washer nozzle assembly

- Make sure that the target landing position of washer fluid is to the dimensions shown in the table below.

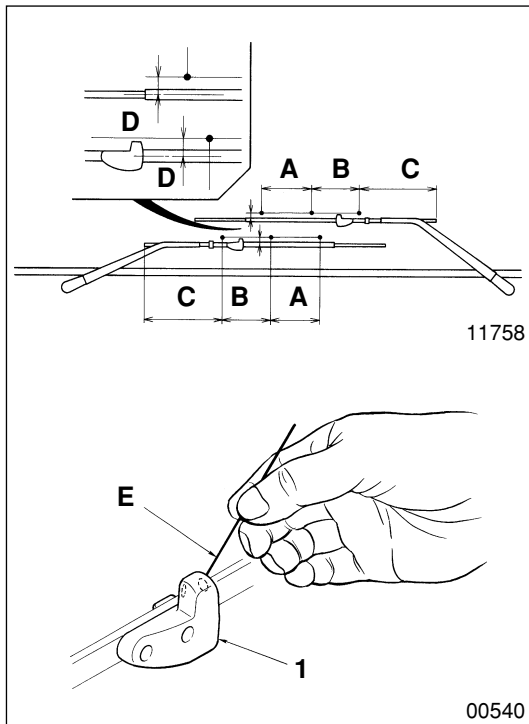
Unit: mm {in.}

A	B	C	D
130 {5.12}	130 {5.12}	210 {8.27}	15 {0.59}

- If the target landing position of washer fluid is misaligned, adjust the angle of the spray hole of washer nozzle assembly 1 with wire E.

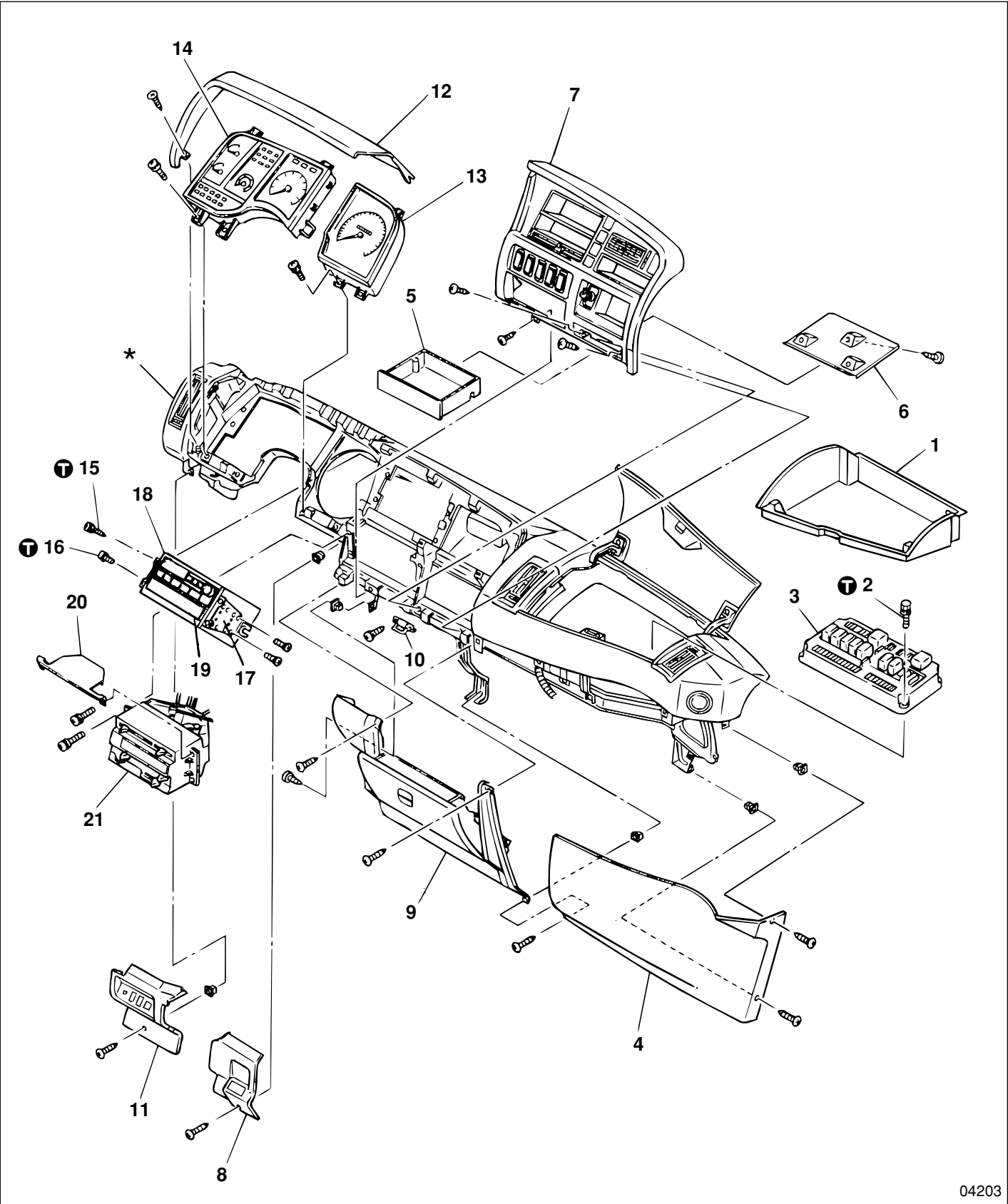
CAUTION

Be careful not to damage the spray hole of washer nozzle assembly 1 with wire E.



INSTRUMENT PANEL

Lower Cover, Meter Cluster and Center Panel



04203

● Disassembly sequence

- 1 Glove box
- 2 Bolt
- 3 Relay and fuse box
 Gr 54
- 4 Lower cover
- 5 Ashtray
- 6 Ashtray outer case
- 7 Center panel
- 8 Driver side lower cover B
- 9 Parcel box and cover
- 10 Parcel box lock
- 11 Driver side lower cover A
- 12 Meter hood
- 13 Speedometer
 Gr 54

- 14 Meter cluster
 Gr 54
- 15 Screw
- 16 Screw
- 17 Radio bracket
- 18 Radio < Option >
- 19 Pocket
- 20 Harness protector
- 21 Heater control assembly
 Gr 55B

* : Instrument panel assembly  P42-62

● Assembly sequence

Follow the disassembly sequence in reverse.

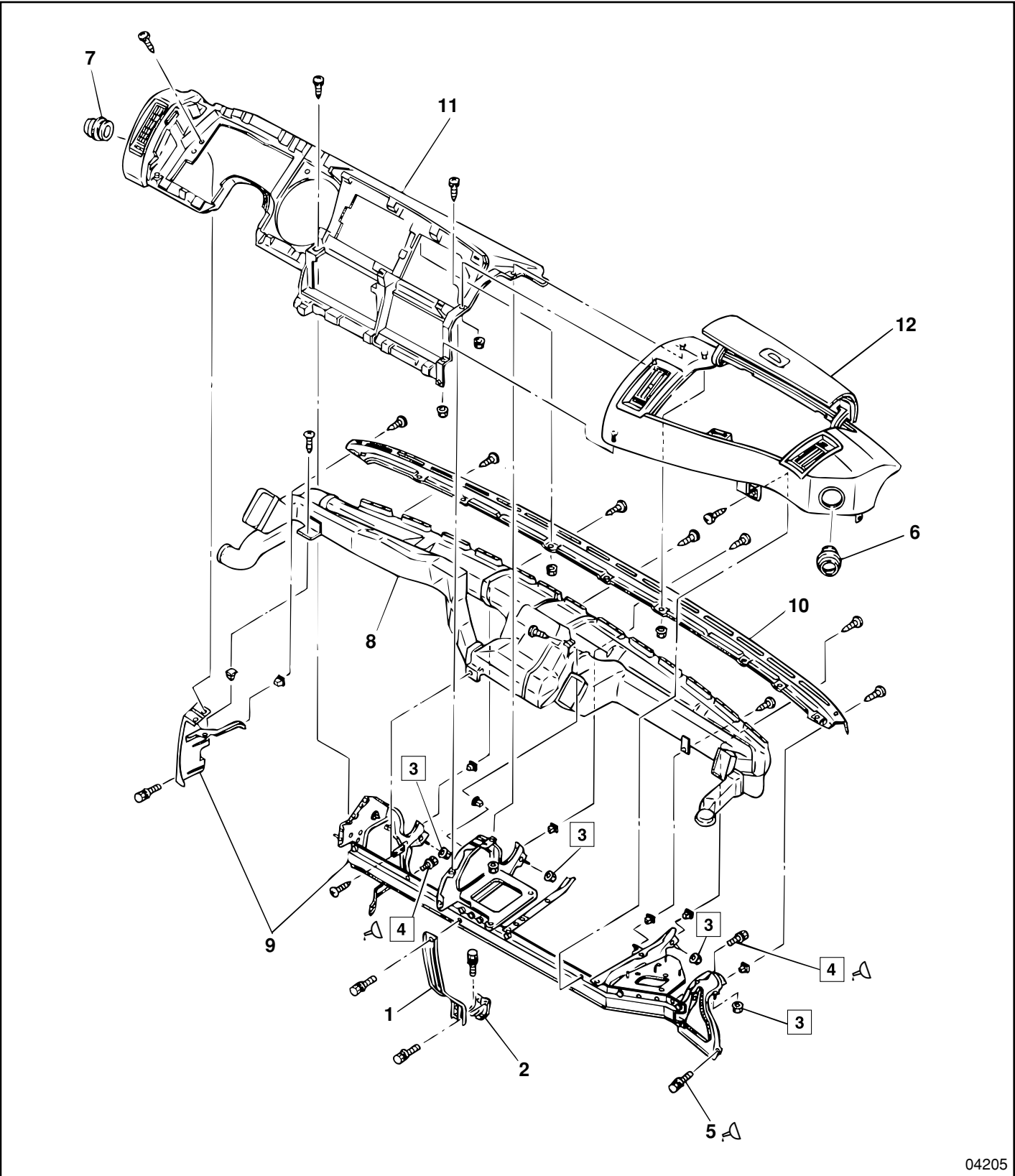
T Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Relay and fuse box mounting)	7.8±1.5 {5.8±1.1, 0.8±0.15}	—
15	Screw (Radio bracket mounting on instrument panel assembly)	1.8 {1.3, 0.18}	—
16	Screw (Radio bracket mounting on radio)	1.8 {1.3, 0.18}	M5×0.8 mm
		1.2 {0.87, 0.12}	M4×0.7 mm

INSTRUMENT PANEL

Instrument Panel Assembly



04205

● Disassembly sequence

- | | | |
|------------------|--|-----------------------|
| 1 Vertical frame | 6 Side defroster joint | 10 Duct cover |
| 2 Lower bracket | 7 Side defroster joint | 11 Instrument panel |
| 3 Nut | 8 Defroster and duct assembly | 12 Crash pad assembly |
| 4 Bolt |  Gr 55B | |
| 5 Bolt | 9 Instrument panel frame assembly | |

● Assembly sequence

Follow the disassembly sequence in reverse.

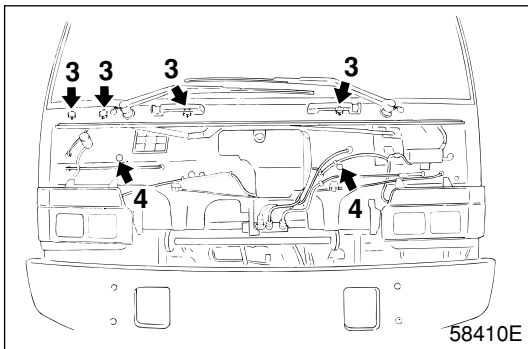
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4, 5	Bolt (Instrument panel frame mounting)	SUMITOMO 3M scotch grip 2353	For re-use

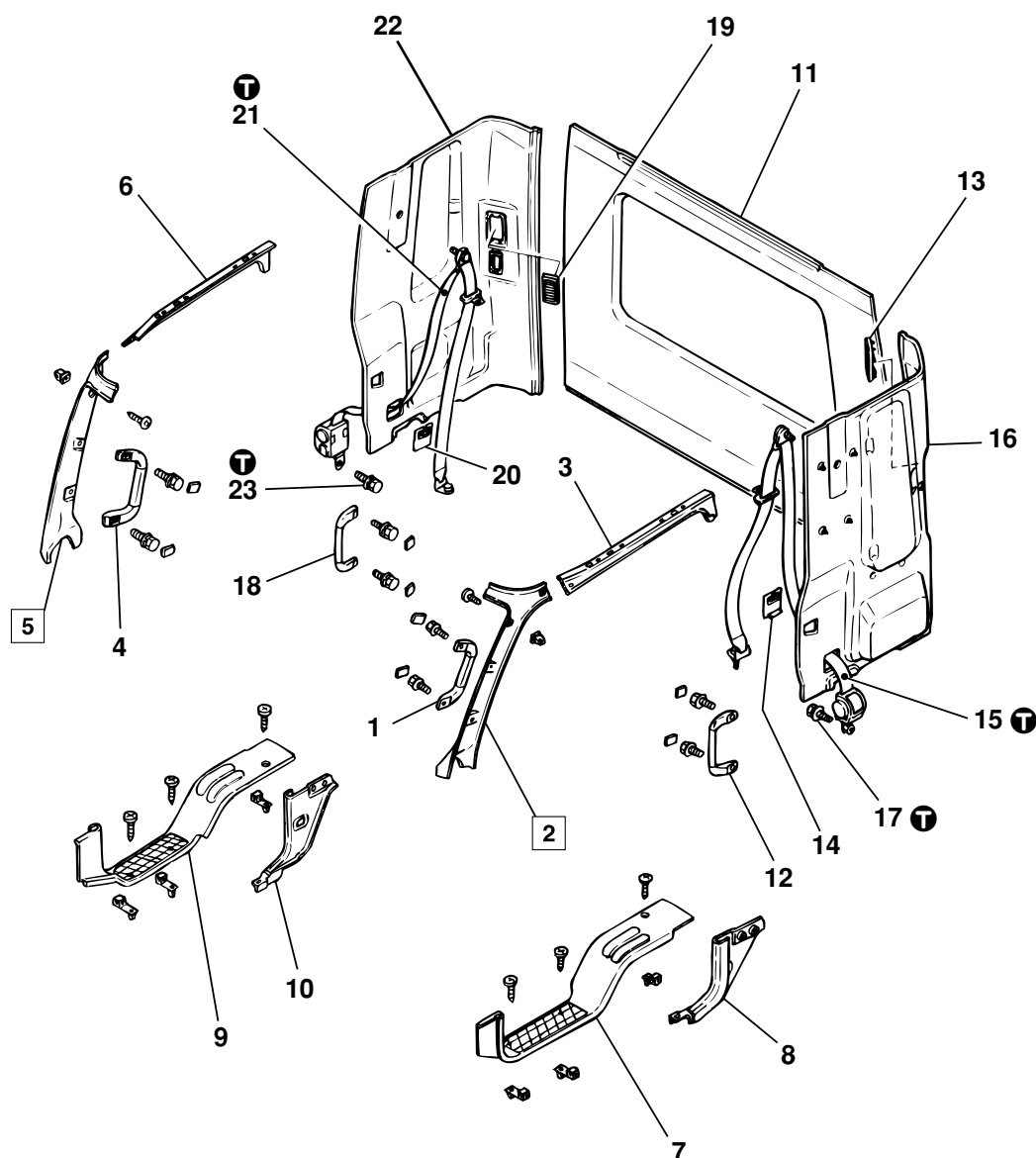
◆ Service procedure

3 4 Mounting position of nut and bolt

- The four mounting positions for nut **3** are indicated by **3 ➡**.
- The two mounting positions for bolt **4** are indicated by **4 ➡**.



SCUFF PLATE AND TRIM



12152

● Removal sequence

- | | | |
|-------------------------|------------------------------|------------------------------|
| 1 Front pillar grip, LH | 9 Front scuff plate, RH | 17 Bolt |
| 2 Front pillar trim, LH | 10 Rear scuff plate, RH | 18 Rear pillar grip, RH |
| 3 Door header trim, LH | 11 Rear trim | 19 Inside air outlet garnish |
| 4 Front pillar grip, RH | 12 Rear pillar grip, LH | 20 Seat belt guide, RH |
| 5 Front pillar trim, RH | 13 Inside air outlet garnish | 21 Seat belt assembly |
| 6 Door header trim, RH | 14 Seat belt guide, LH | 22 Side trim, RH |
| 7 Front scuff plate, LH | 15 Seat belt assembly | 23 Bolt |
| 8 Rear scuff plate, RH | 16 Side trim, LH | |

CAUTION

Do not disassemble seat belt assemblies 15, 21 because this might cause malfunction of the emergency locking retractor.

● Installation sequence

Follow the removal sequence in reverse.

Tightening torque

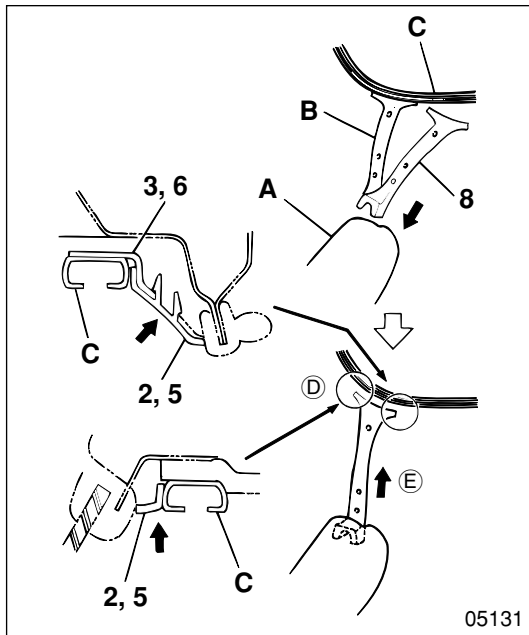
Unit : N·m {ft.lbs, kgf·m}

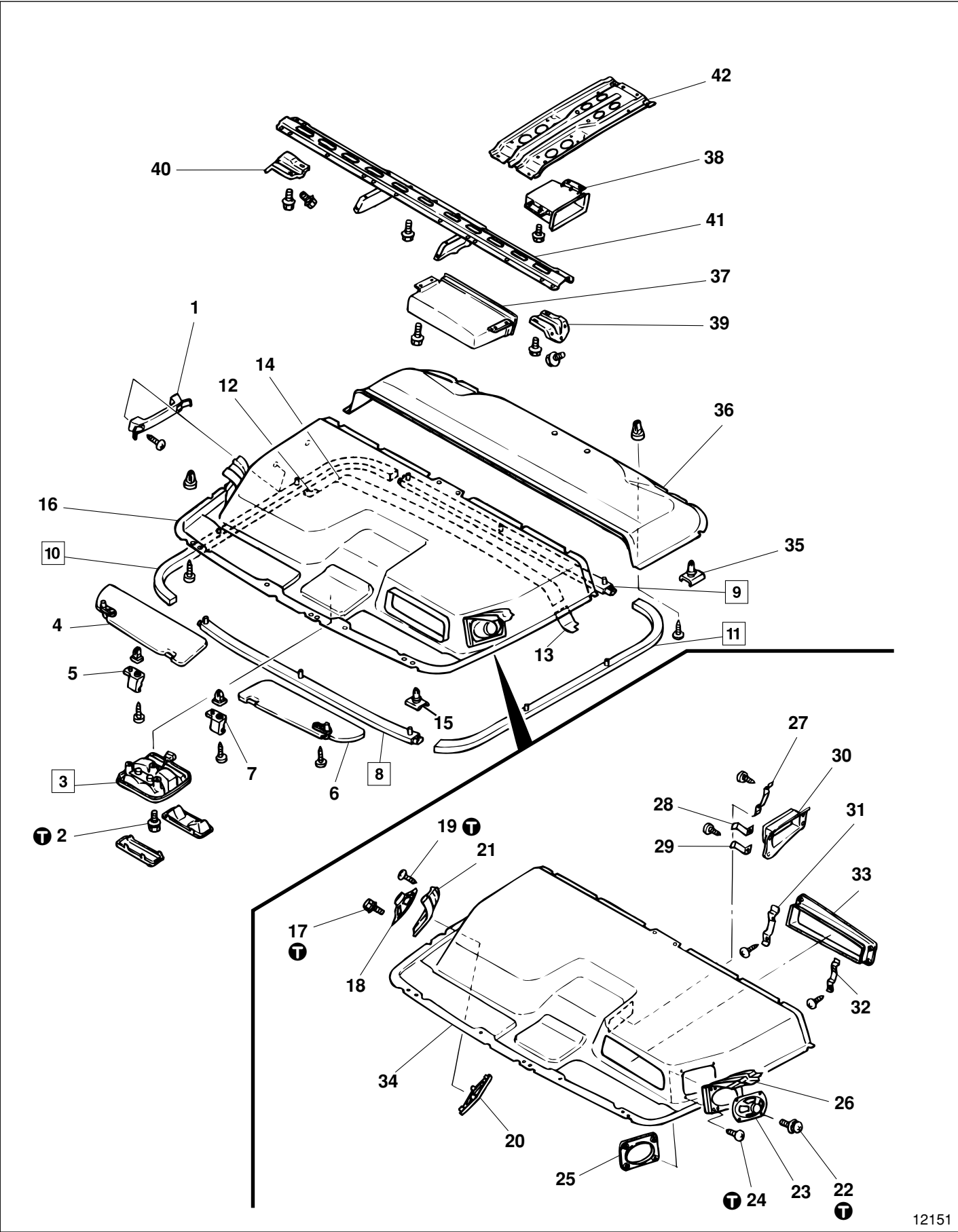
Location	Parts to be tightened	Tightening torque	Remarks
15, 21	Bolts of seat belt assembly shoulder anchor and floor anchor	34 to 54 {25 to 40, 3.5 to 5.5}	—
17, 23	Bolt (Seat belt assembly mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—

◆ Service procedure

2 5 Installation of front pillar trim

- Insert lower end of front pillar trim LH 2, RH 5 between instrument panel **A** and front pillar inner panel **B**.
- Insert upper end of trim between curtain rail **C** and front pillar inner panel **B**.
- Fit in part **D** of trim as illustrated.
- Fit in part **E** of trim as illustrated.





● Removal sequence

- | | | |
|---|--|------------------------------|
| 1 Grip | 15 Headlining clip | 29 Bracket |
| 2 Bolt | 16 Front headlining assembly | 30 Facing |
| 3 Cab and spot lamp  Gr 54 | 17 Screw | 31 Bracket |
| 4 Sun visor, RH | 18 Speaker, RH  Gr 54 | 32 Bracket |
| 5 Sun visor catch | 19 Screw | 33 Facing |
| 6 Sun visor, LH | 20 Speaker cover | 34 Front headlining |
| 7 Sun visor catch | 21 Speaker bracket, RH | 35 Headlining clip |
| 8 Front curtain rail | 22 Screw | 36 Rear headlining |
| 9 Rear curtain rail | 23 Speaker, LH  Gr 54 | 37 Overhead console box A |
| 10 Side curtain rail, RH | 24 Screw | 38 Overhead console box C |
| 11 Side curtain rail, LH | 25 Speaker cover | 39 Overhead side bracket, LH |
| 12 Center curtain rail end cover, RH | 26 Speaker bracket, LH | 40 Overhead side bracket, RH |
| 13 Center curtain rail end cover, LH | 27 Bracket | 41 Overhead cross frame |
| 14 Center curtain rail | 28 Bracket | 42 Overhead center frame |

● Installation sequence

Follow the removal sequence in reverse.

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Cab and spot light lamp mounting)	2.9±0.5 {2.2±0.36, 0.3±0.05}	—
17, 22	Screw (Speaker mounting)	2.5 {1.8, 0.25}	—
19, 24	Screw (Speaker cover mounting)	1.8 {1.3, 0.18}	—

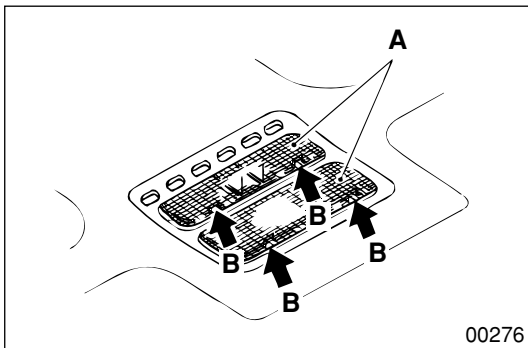
◆ Service procedure

3 Removal of cab and spot lamp

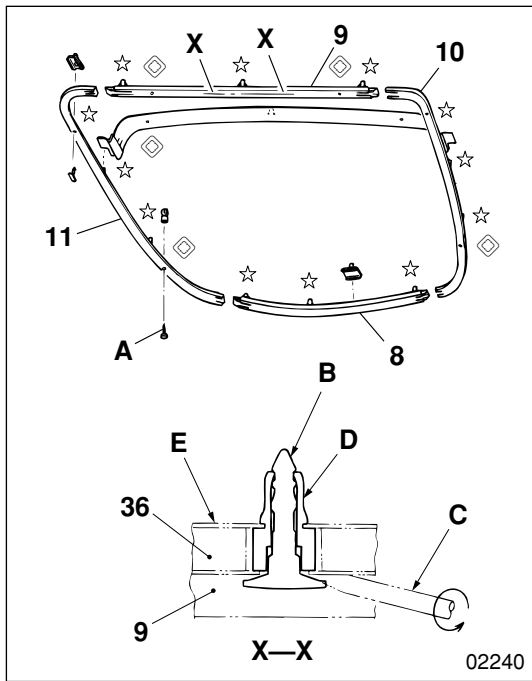
Insert the tip of a screwdriver in groove area **B** of lens **A**, and use the screwdriver as a pry bar.

CAUTION

Make sure that you do not pry at any area except **B** or you will damage the lens.



HEADLINING



8 to 11 Removal of curtain rail

- Remove tapping screws **A**. (six points in ◇ mark)
- Insert screwdriver **C** into the taper of rail pins **B** and lever out curtain rails **8** to **11** from rail clips **D** by turning the screwdriver. (13 points in ☆ mark)

36 : Rear head lining

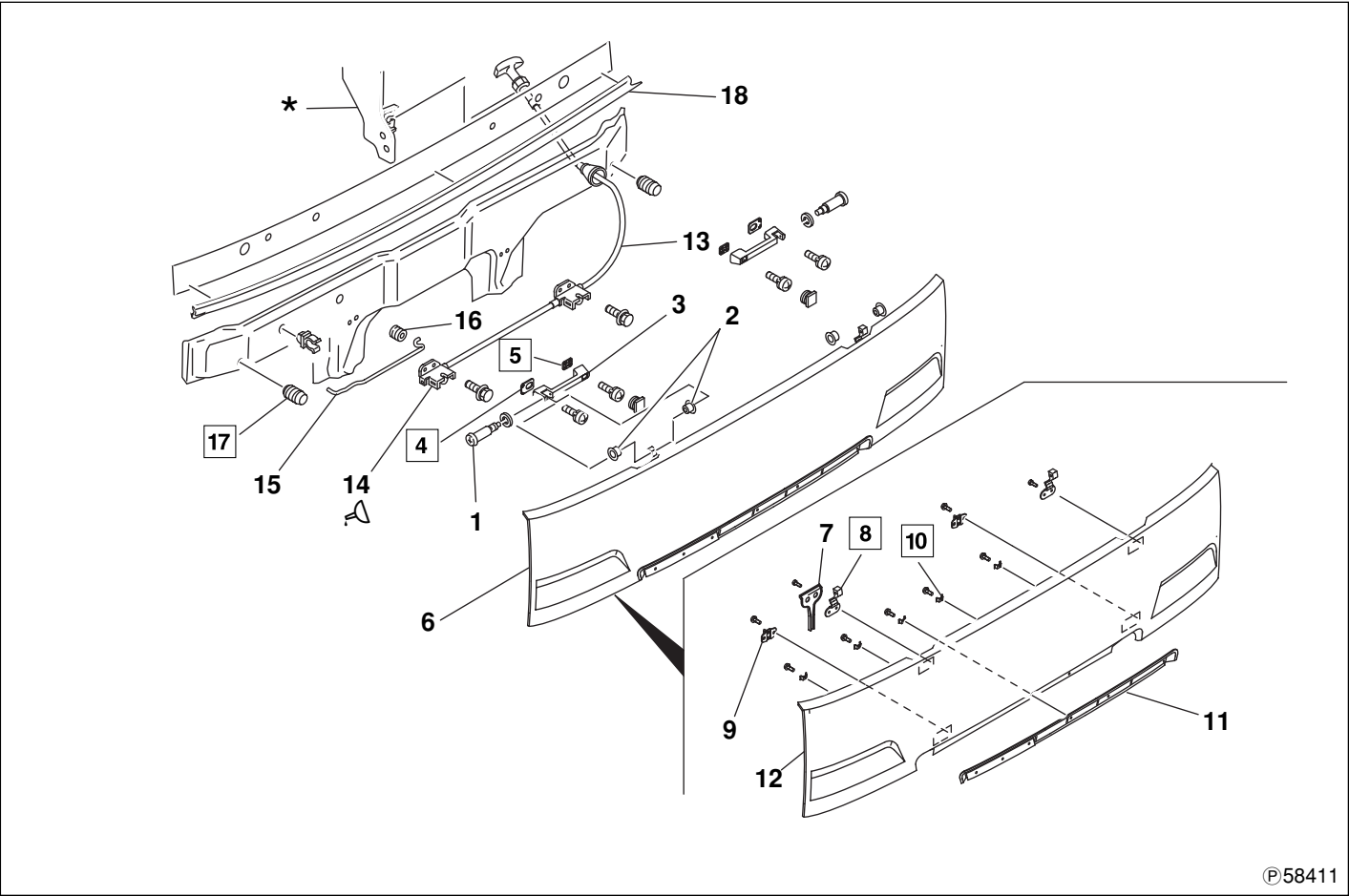
E : Cab metal

CAUTION ⚠

- Be sure that you remove rail pins **B** first because the curtain rails would be deformed if you were to remove the rail pins after levering out curtain rails **8** to **11**.
- Prepare extra fittings in advance because rail pins **B** and rail clips **D** might be damaged during removal.

MEMO

FRONT PANEL



● Disassembly sequence

- | | | |
|-------------------------|-----------------------------|----------------------------|
| 1 Front panel hinge pin | 8 Front panel hinge | 15 Front panel support rod |
| 2 Bushing | 9 Striker | 16 Grommet |
| 3 Front grip | 10 Retainer | 17 Bumper |
| 4 Packing | 11 Upper grille | 18 Weatherstrip |
| 5 Packing | 12 Front panel | |
| 6 Front panel assembly | 13 Front panel opener cable | *: Brake pedal bracket |
| 7 Shield plate | 14 Front panel latch | |

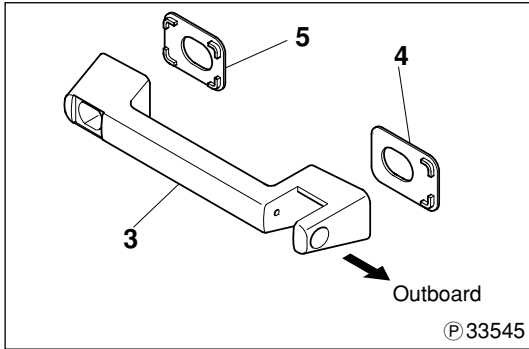
 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
14	Striker contacting portion of front panel latch, and spring	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

◆ Service procedure

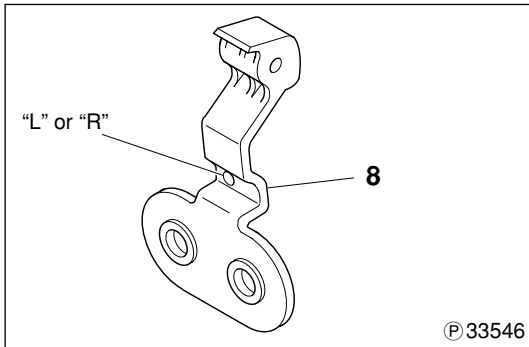
4 5 Installation of packings

Install packings **4** and **5** in the illustrated direction.



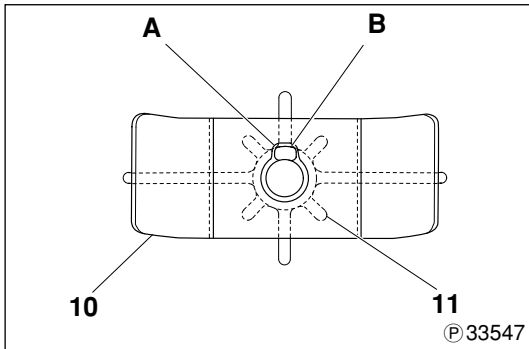
8 Installation of front panel hinge

Front panel hinges **8** are marked with a letter ("L" or "R") indicating the installation position. Be sure to install them on the specified side according to the identification mark.



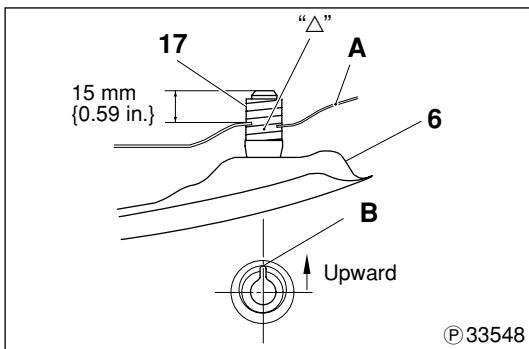
10 Installation of retainer

Install retainer **10** onto upper grille **11** while aligning notch **A** in the retainer with tab **B** on the grille.

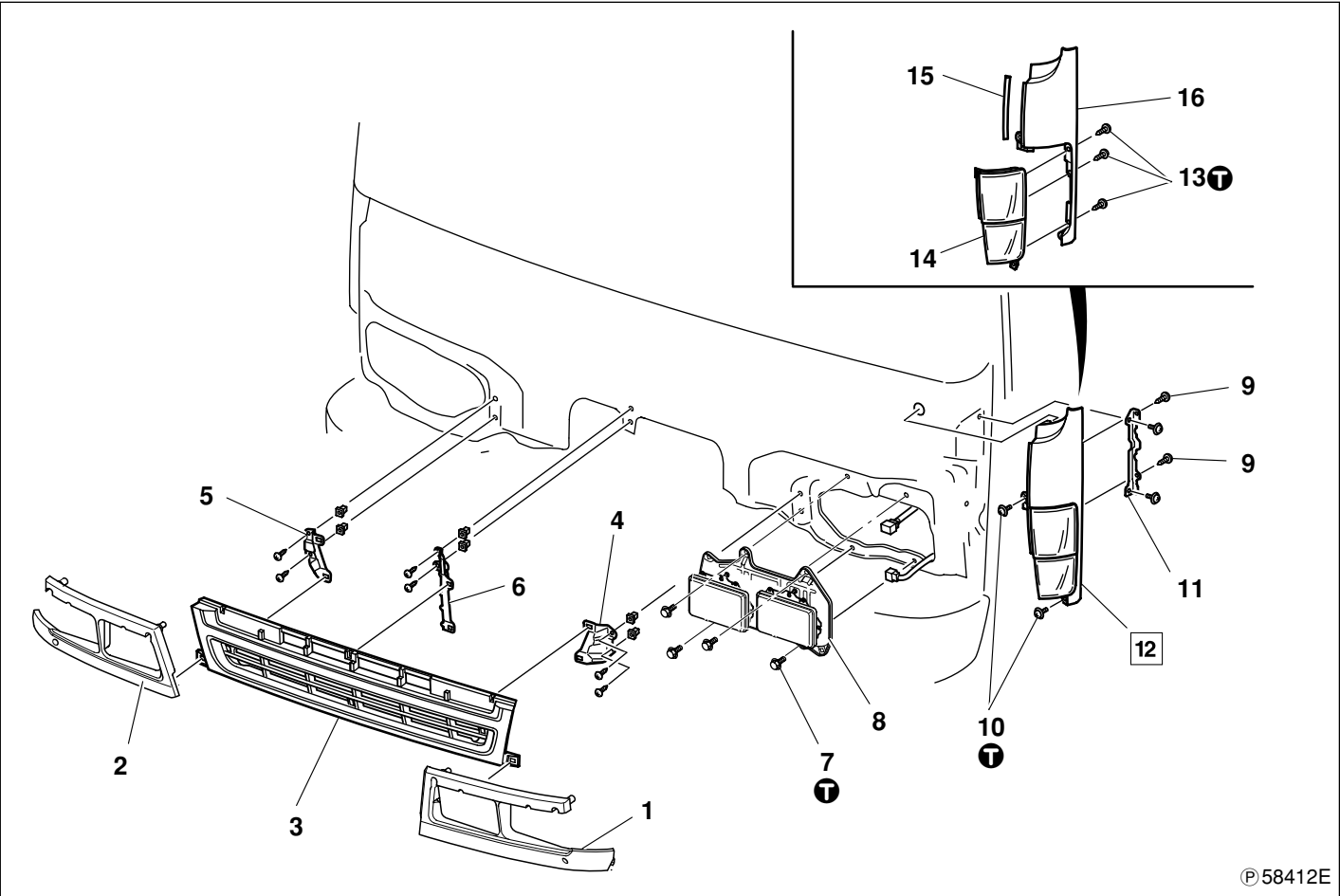


17 Installation of bumper

- Screw bumper **17** in notched hole **B** in dash panel member **A** such that the dimension shown in the illustration may be obtained with mark "△" on the bumper pointing upwards.
- If bumper **17** is apart from or pressed hard against the front panel assembly **6**, make fine adjustment.



RADIATOR GRILLE AND CORNER PANEL



© 58412E

● Disassembly sequence

- | | | |
|-----------------------|---|---|
| 1 Head lamp bezel | 7 Bolt | 13 Screw |
| 2 Head lamp bezel | 8 Head lamp  Gr 54 | 14 Front combination lamp |
| 3 Lower center grille | 9 Screw |  Gr 54 |
| 4 Grille stay | 10 Screw | 15 Corner panel weatherstrip |
| 5 Grille stay | 11 Corner panel bracket | 16 Front corner panel |
| 6 Grille stay center | 12 Front corner panel assembly | |

NOTE

Do not disassemble corner panel weatherstrip 15 unless it is faulty.

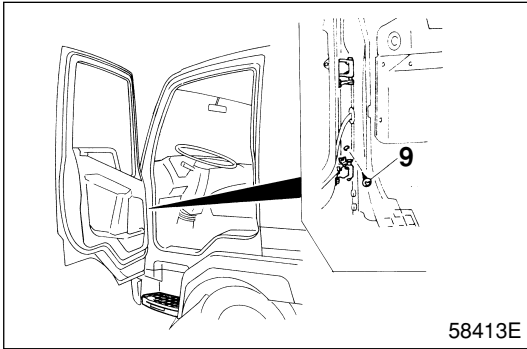
● Assembly sequence

Follow the disassembly sequence in reverse.

ⓘ Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
7	Bolt (headlamp installation)	4 to 6 {3.0 to 4.4, 0.4 to 0.6}	—
10	Screw (installation of front corner panel assembly)	0.8 to 1.0 {0.6 to 0.7, 0.08 to 0.1}	—
13	Screw (installation of front combination lamp)	15.7 {12, 1.6} or more	—

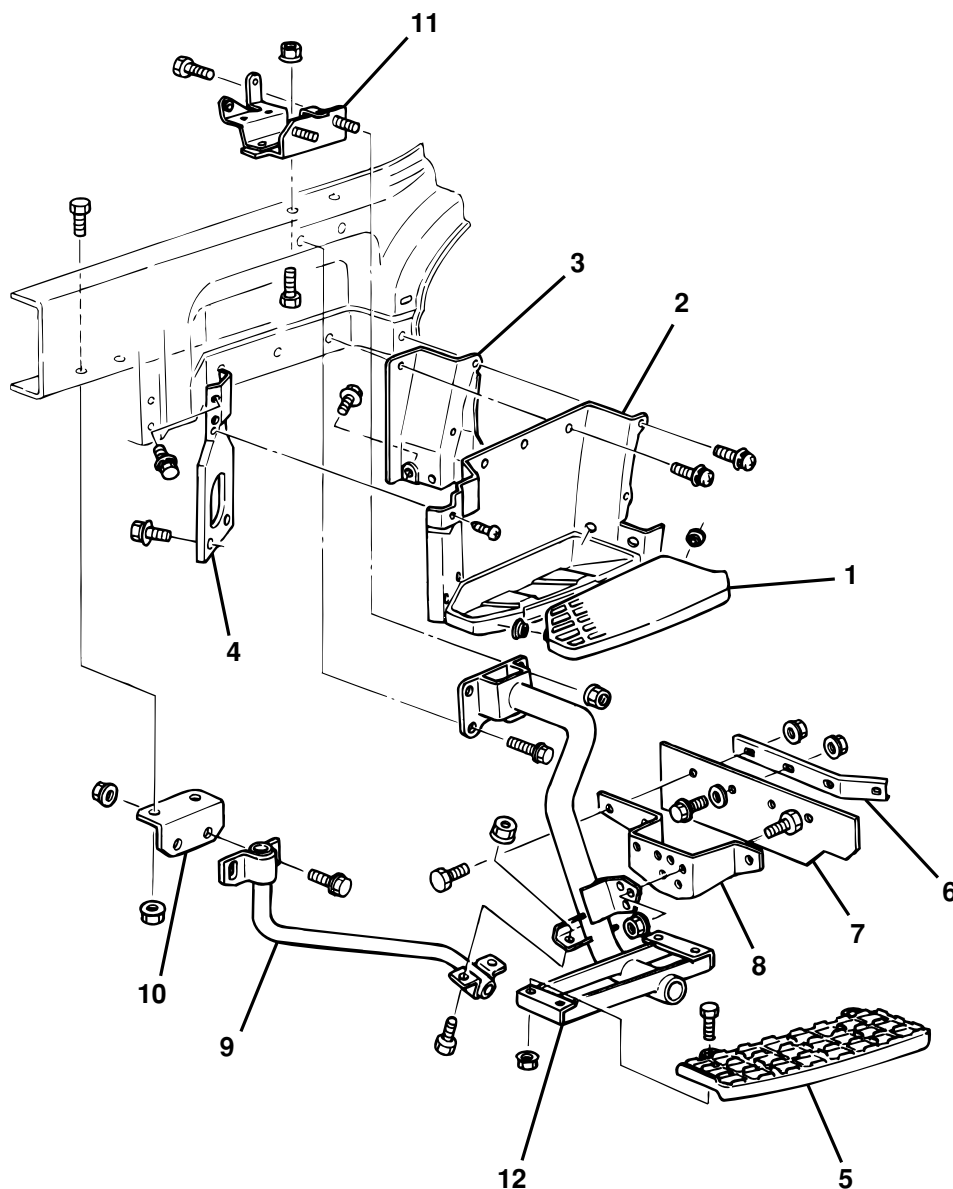
**12 Removal and installation of front corner panel assembly**

- Open the door. Remove two screws **9** securing the panel assembly from inside the cab.
- Close the door. Remove two screws **10** securing the panel assembly from outside the cab.
- Remove front corner panel assembly **12** by pulling it outboard.
- Install the front corner panel assembly in the reverse order of the removal.

CAUTION ⚠

Be sure to remove the inside screws first. If the outside screws are removed first, front corner panel assembly **12** will expand outward, possibly hitting against the door when it is opened, which may lead to deformed panels.

STEP



12150

● Removal sequence

- | | | |
|----------------------|------------------------|---------------------------------|
| 1 Upper step | 5 Lower step < FM > | 9 Step stay < FM > |
| 2 Step wall | 6 Apron support < FM > | 10 Stay bracket < FM > |
| 3 Step rear bracket | 7 Splash apron < FM > | 11 Step bracket < FM > |
| 4 Step front bracket | 8 Apron support < FM > | 12 Step bracket assembly < FM > |

● Installation sequence

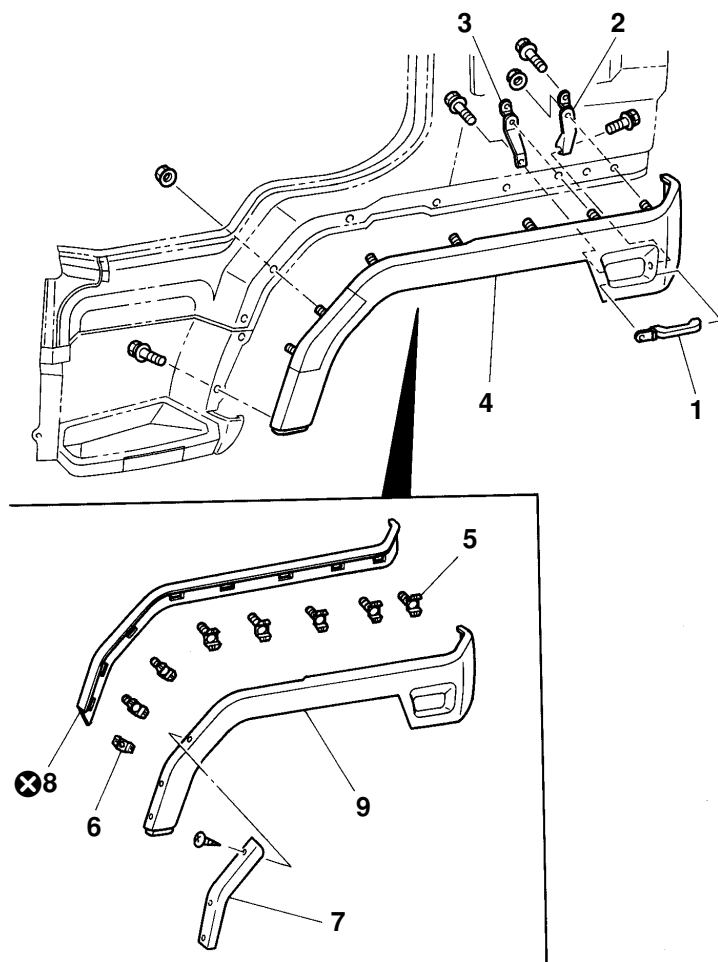
Follow the removal sequence in reverse.

NOTE

This illustration only shows the step for the left side; the same service procedure described above is used for the right side.

MEMO

< FK >



28137

● Disassembly sequence

- 1 Cab tilt grip
- 2 Cab tilt grip rear stay
- 3 Cab tilt grip front stay
- 4 Fender assembly
- 5 Bolt plate
- 6 Nut plate

- 7 Fender protector
- 8 Welt
- 9 Fender

⊗ : Non-reusable parts

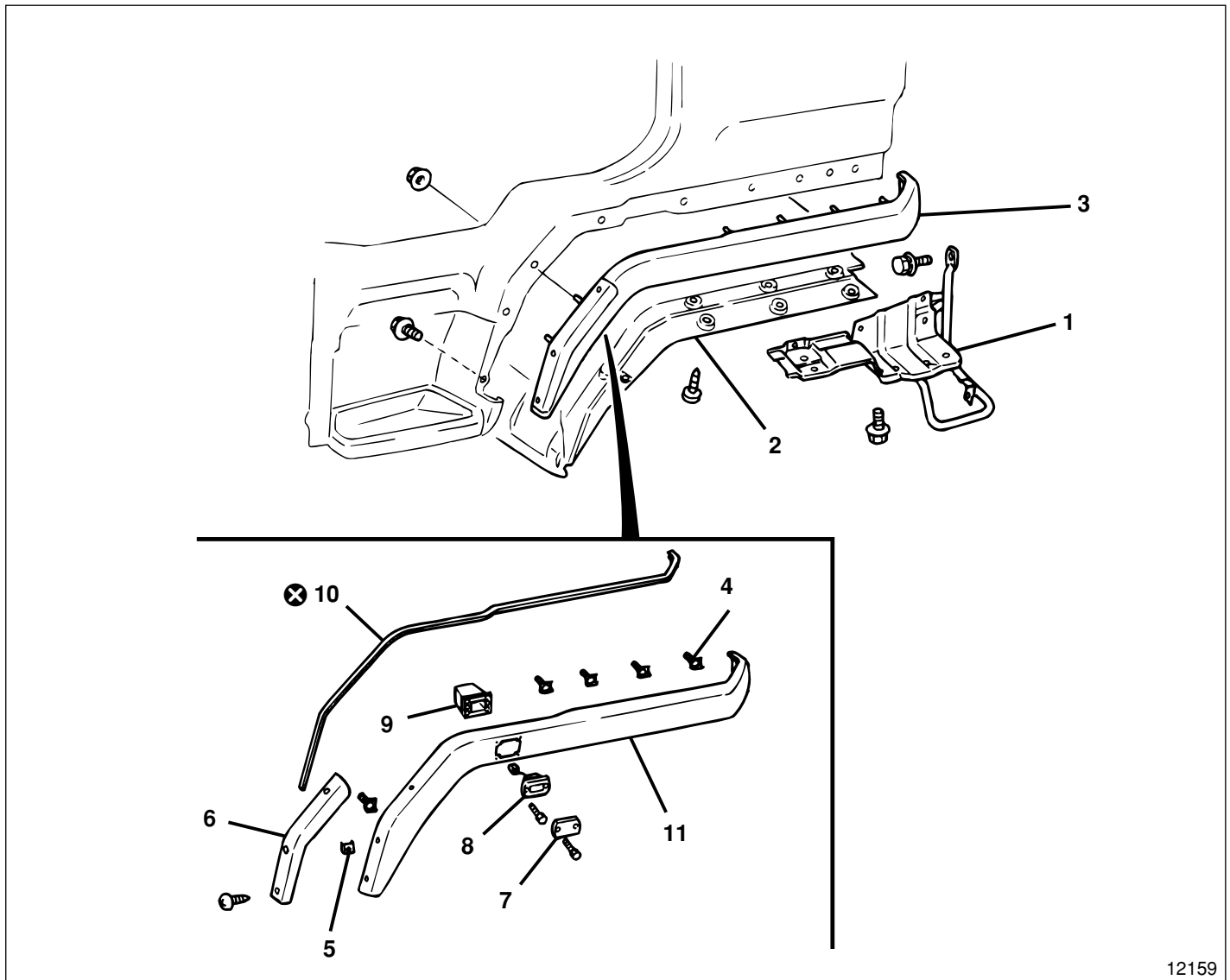
● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

The illustration shows the left side. The right side is symmetrical to the left side except that the right side does not have cab tilt grip 1.

< FM >



12159

● Disassembly sequence

- | | |
|--------------------|---|
| 1 Cab tilt grip | 8 Side turn signal lamp  Gr 54 |
| 2 Wheel arch cover | 9 Side turn signal lamp cover |
| 3 Fender assembly | 10 Welt |
| 4 Bolt plate | 11 Fender |
| 5 Nut plate | |
| 6 Fender protector | |
| 7 Lens | |

⊗ : Non-reusable parts

● Assembly sequence

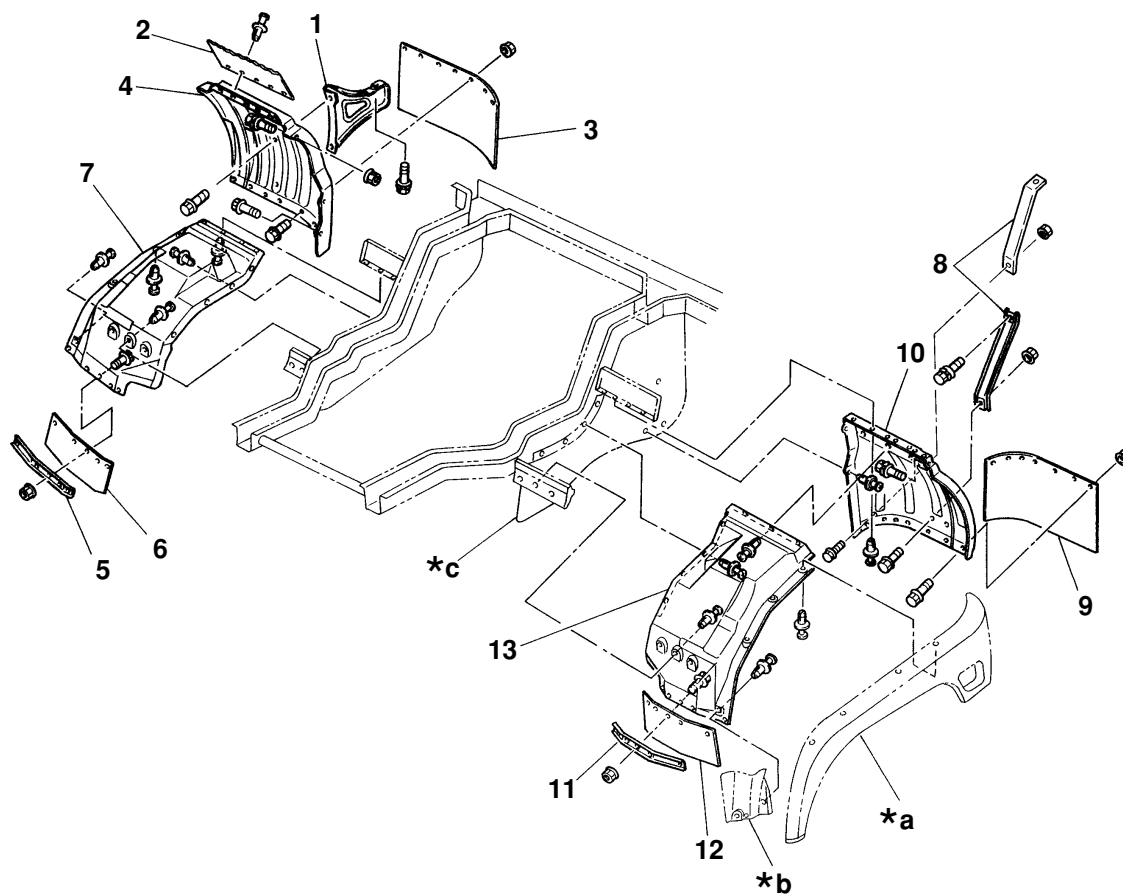
Follow the disassembly sequence in reverse.

NOTE

The illustration shows the left side. The right side is symmetrical to the left side except that the right side does not have cab tilt grip 1.

MUD GUARD

< FK >



59262

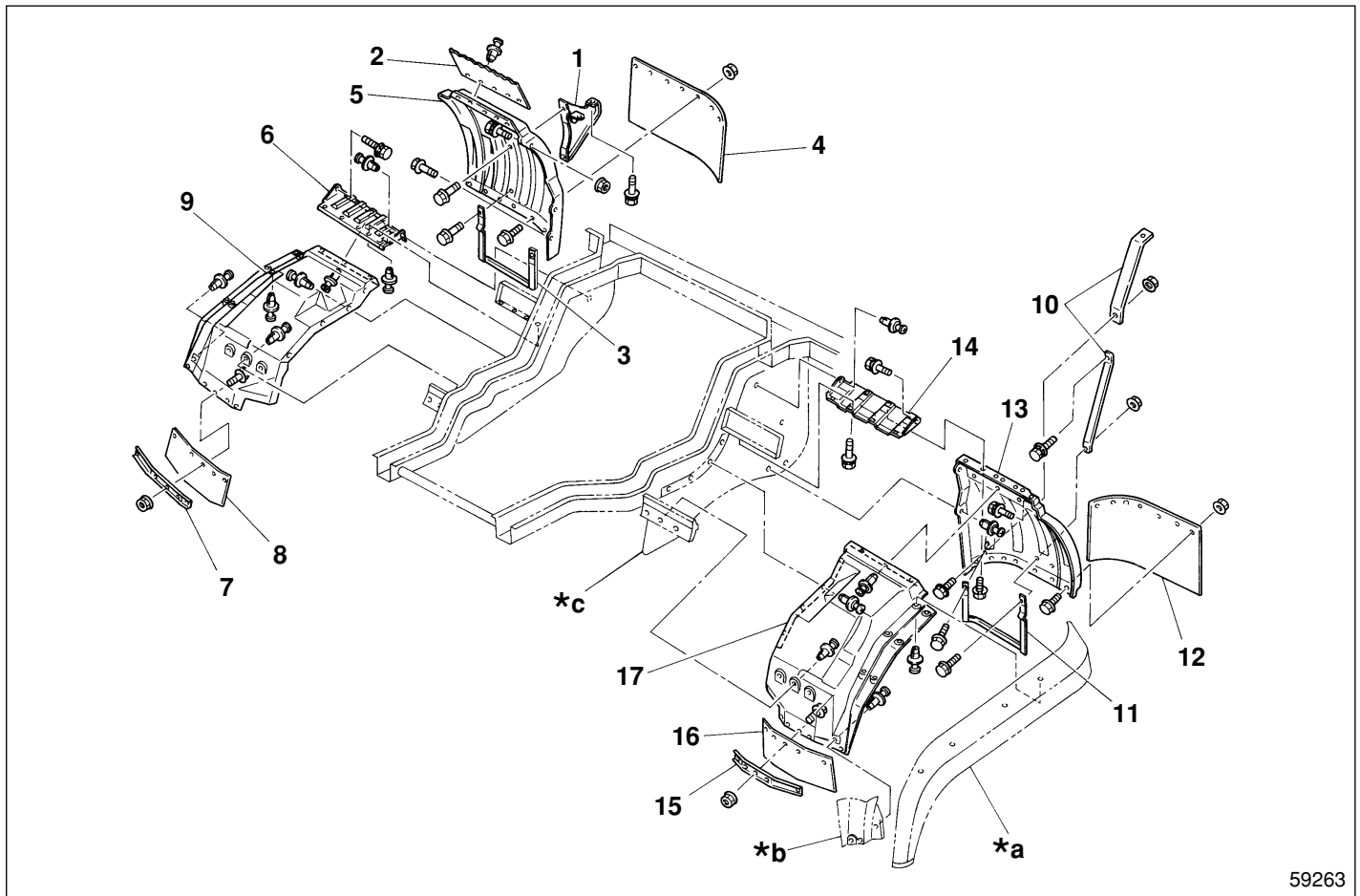
● Disassembly sequence

- | | | |
|---------------------|------------------------|--------------------------|
| 1 Mud guard bracket | 7 Wheel house cover RH | 13 Wheel house cover LH |
| 2 Upper apron | 8 Mud guard stay | |
| 3 Lower apron | 9 Lower apron | |
| 4 Mud guard RH | 10 Mud guard LH | |
| 5 Apron support | 11 Apron support | *a: Fender P42-76 |
| 6 Splash apron RH | 12 Splash apron LH | *b: Step bracket P42-74 |
| | | *c: Side cover |

● Assembly sequence

Follow the disassembly sequence in reverse.

< FM >



59263

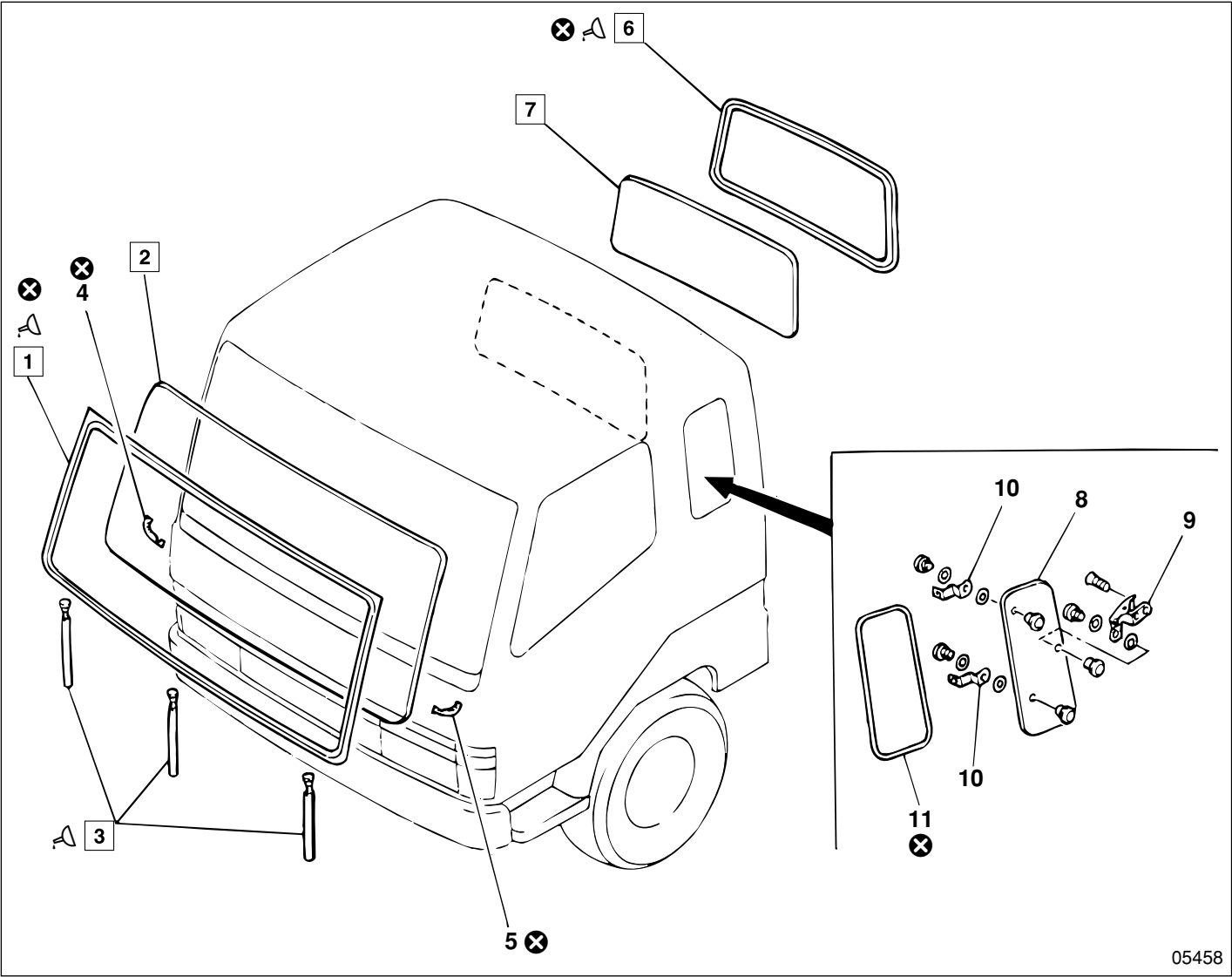
● Disassembly sequence

- | | | |
|---------------------|------------------------|--------------------------|
| 1 Mud guard bracket | 8 Splash apron RH | 15 Apron support |
| 2 Upper apron | 9 Wheel house cover RH | 16 Splash apron LH |
| 3 Protector | 10 Mud guard stay | 17 Wheel house cover LH |
| 4 Lower apron | 11 Protector | |
| 5 Mud guard RH | 12 Lower apron | |
| 6 Mud shield RH | 13 Mud guard LH | *a: Fender P42-77 |
| 7 Apron support | 14 Mud shield LH | *b: Step bracket P42-74 |
| | | *c: Side cover |

● Assembly sequence

Follow the disassembly sequence in reverse.

WINDOW GLASS



05458

● Disassembly sequence

- | | |
|----------------------------|-----------------------------|
| 1 Windshield weatherstrip | 7 Rear window glass |
| 2 Windshield | 8 Side window glass |
| 3 Drain hose | 9 Side window link |
| 4 Seal tape, LH | 10 Side window hinge |
| 5 Seal tape, RH | 11 Side window weatherstrip |
| 6 Rear window weatherstrip | |

(X) : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

The illustration shows the left side. The right side is symmetrical to the left side.

(L) Lubricant and/or sealant

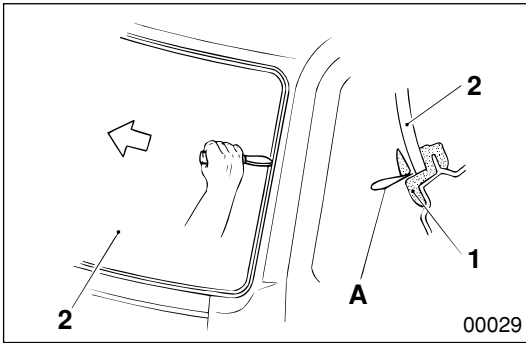
Location	Points of application	Specified lubricant and/or sealant	Quantity
1, 6	Lip area of weatherstrip	Soapy water	As required
3	Fill the area around the drain hose mounting flange on cab	CEMEDINE 3061-D	As required

◆ Service procedure

1 2 Weatherstrip and windshield

[Removal]

- Cut weatherstrip **1** with knife **A** at the area as illustrated.
- Support windshield **2**, and remove by pressing it from inside the cab.



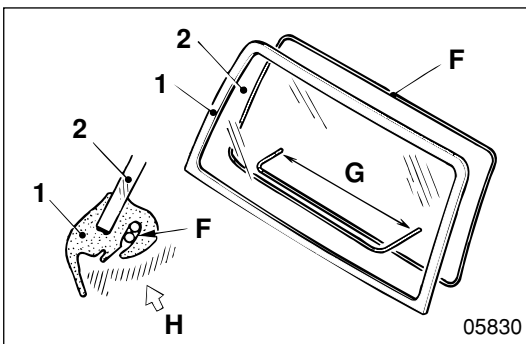
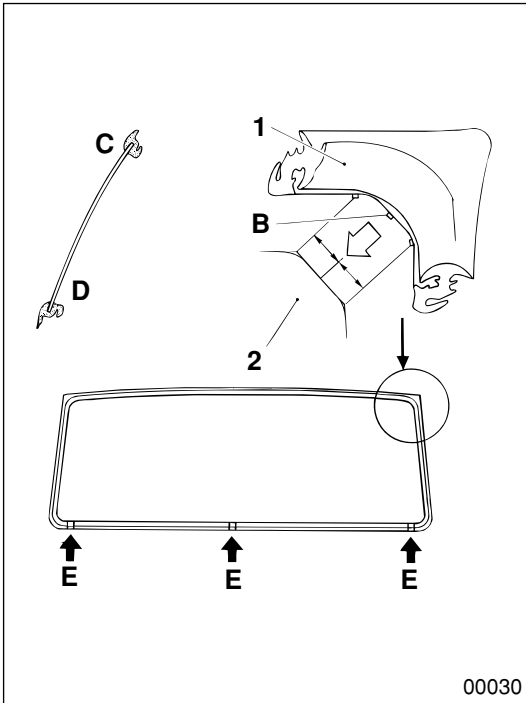
[Installation]

- Install weatherstrip **1** so that central basic point **B** meets the middle at the chamfered part of windshield **2**.

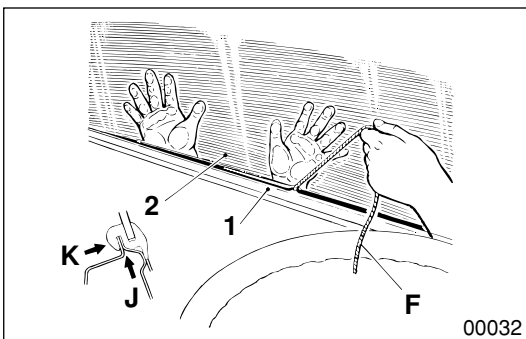
C : Outside

D : Inside

E : Water drain hole

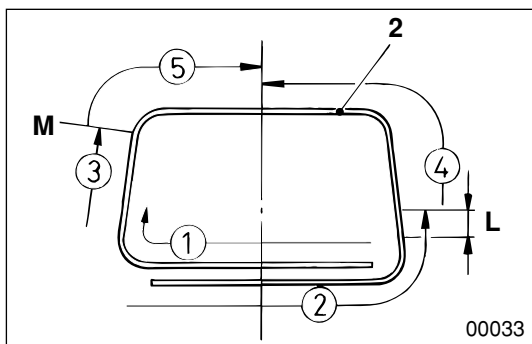


- Lay cord **F** in the cab mounting groove of weatherstrip **1** as illustrated, and overlap the cord at the lower side of the glass by the specified length, see **G**.
- Apply soapy water **H** to weatherstrip **1**.
- Align windshield **2** with the cab.



- Push windshield **2** inward from the outside of the cab firmly.
- Inside the cab, pull one end of cord **F** to install lip **K** of weatherstrip **1** into flange lip **J** of the cab.

WINDOW GLASS



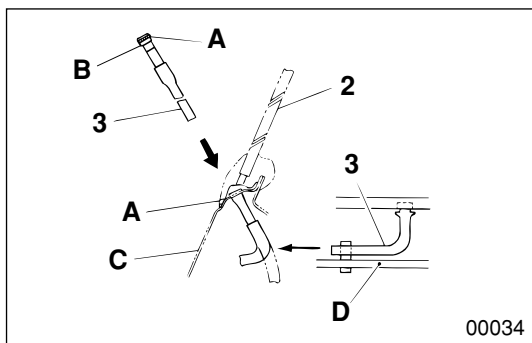
- Pull cord **F** in the numbered order as illustrated and at the same time have someone push windshield **2** into weatherstrip **1**, tapping the windshield with a rubber-headed mallet.

L : approximately 100 mm {3.94 in.} from the starting point of the straight section

M : up to the end of the straight section

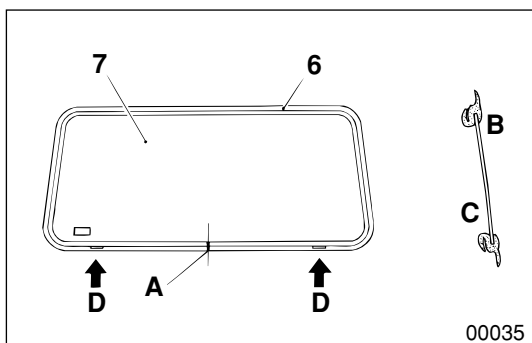
CAUTION ⚠

Make sure that windshield 2 is installed correctly into the cab before hitting the windshield with the rubber-headed mallet, otherwise the windshield might be broken.



3 Installation of drain hose

- Fill the area around the flange of drain hose **3** with sealant **A**, and press the drain hose in until its flared area **B** fits into cab **C**. Carefully smooth down excess sealant that is squeezed out so that the hose opening is not clogged.
- Secure drain hose **3** at the middle of the vehicle together with windshield washer hose **D**.



6 7 Weatherstrip and rear window glass

- Install so that joint **A** of weatherstrip **6** is at the bottom center of rear window glass **7**.

B : Outside

C : Inside

D : Drain hole

- Except for the point mentioned above, follow the same service procedure as for installation of the windshield.

📖 P42-81



Group 54

Electrical

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

HOW TO READ THIS GROUP

0 GENERAL

SPECIFICATIONS 54-0-2

STRUCTURE AND OPERATION

1. Starter 54-0-6
2. Alternator 54-0-8
3. Lamp 54-0-11
4. Daytime running light (DRL) system 54-0-12
5. MUTIC (Multipurpose Timing Control Unit) 54-0-14
6. Engine electronic control unit 54-0-18

TROUBLESHOOTING

1. Fault diagnosis function 54-0-25
2. Power and charging 54-0-36
3. Engine starting, preheating and stopping 54-0-37
4. Lighting 54-0-38
5. Meter 54-0-41
6. Cigarette lighter and Audio 54-0-42
7. Accessory noise generation source 54-0-42
8. Horn 54-0-43

1 POWER, CHARGE AND GROUND CIRCUIT

- (104)** RELAY AND FUSE BOX CIRCUIT 54-1-2
- (110)** POWER CIRCUIT 54-1-3
- (111)** ELECTRONIC CONTROL UNIT POWER CIRCUIT 54-1-13
- (115)** RESERVE POWER CIRCUIT 54-1-14
- (125)** BATTERY CHARGING CIRCUIT 54-1-15
- (130)** GROUND 54-1-16

2 STARTING AND PREHEATING CIRCUIT

- (210)** ENGINE STARTING CIRCUIT 54-2-2
- (215)** ENGINE STOPPING CIRCUIT  Gr 13
- (220)** ENGINE PREHEATING CIRCUIT 54-2-4

3 LIGHTING CIRCUIT

- (310)** HEADLAMP CIRCUIT 54-3-2
- (313)** DAYTIME RUNNING LIGHT CIRCUIT 54-3-4
- (320)** TAIL, CLEARANCE AND LICENSE PLATE LAMP CIRCUIT 54-3-6
- (325)** STOP LAMP CIRCUIT 54-3-7
- (330)** TURN SIGNAL AND HAZARD LAMP CIRCUIT 54-3-8
- (340)** BACKUP LAMP CIRCUIT 54-3-9
- (345)** CAB LAMP CIRCUIT 54-3-12
- (348)** ILLUMINATION LAMP CIRCUIT 54-3-13
- (349)** MARKER AND IDENTIFICATION LAMP CIRCUIT 54-3-14
- (352)** VAN BODY DOME LIGHT CIRCUIT 54-3-15

4 METER CIRCUIT

- (401)** METER CLUSTER INTERNAL CIRCUIT 54-4-2
- (410)** TACHOMETER CIRCUIT 54-4-4
- (412)** SPEEDOMETER CIRCUIT 54-4-5
- (420)** FUEL GAUGE CIRCUIT 54-4-8
- (425)** WATER TEMPERATURE GAUGE CIRCUIT 54-4-9

5 INDICATOR AND WARNING LAMP CIRCUIT

- (510)** PARKING BRAKE INDICATOR CIRCUIT 54-5-2
- (515)** BRAKE WARNING CIRCUIT 54-5-4
- (530)** WATER LEVEL WARNING CIRCUIT 54-5-6
- (535)** ENGINE OIL LEVEL WARNING CIRCUIT 54-5-7
- (536)** ENGINE OIL PRESSURE WARNING CIRCUIT 54-5-8
- (537)** OVERHEATING WARNING CIRCUIT 54-5-9

548	TRANSMISSION HIGH/LOW INDICATOR CIRCUIT	54-5-10
550	CAB TILT WARNING CIRCUIT	54-5-11
566	FUEL FILTER WARNING CIRCUIT	54-5-12

6 CAB SIDE ELECTRICAL CIRCUIT

610	CIGARETTE LIGHTER CIRCUIT	54-6-2
612	AUDIO CIRCUIT	54-6-3
614	WIPER AND WASHER CIRCUIT	54-6-4
616	HORN CIRCUIT	54-6-5
620	AIR-CONDITIONER CIRCUIT	54-6-6
622	POWER WINDOW AND AUTO DOOR LOCK CIRCUIT	54-6-7
629	MIRROR HEATER CIRCUIT	54-6-8

7 CHASSIS SIDE ELECTRICAL CIRCUIT

710	EXHAUST BRAKE CIRCUIT	54-7-2
718	AIR DRYER CIRCUIT	54-7-5
722	AIR SUSPENSION CIRCUIT	54-7-6

8 ENGINE AND TRANSMISSION SIDE ELECTRICAL CIRCUIT

850	TRANSMISSION POWER TAKE-OFF CIRCUIT	54-8-2
------------	---	--------

9 OTHERS CIRCUIT

910	MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT	54-9-2
------------	--	--------

ELECTRONICALLY CONTROLLED FUEL SYSTEM CIRCUIT  Gr 13

AUTOMATIC TRANSMISSION CIRCUIT  Gr 23

ANTI-LOCK BRAKE SYSTEM CIRCUIT  Gr 35E

10 PARTS INSTALLATION POSITION

Cab side

A	SWITCH	54-10-2
B	RELAY AND ELECTRONIC CONTROL UNIT	54-10-4
C	FUSE, METER, SENSOR, BUZZER AND MOTOR	54-10-6
D	HEATER	54-10-8
E	DOOR AND MIRROR	54-10-9
F	ROOF	54-10-10
G	CAB	54-10-12
J	JOINT OF MAIN HARNESS CONNECTORS	54-10-14

Engine and transmission side

R	ENGINE	54-10-16
S	TRANSMISSION	54-10-18

Chassis side

T	SWITCH AND SENSOR	54-10-20
U	FUSE AND CONNECTOR	54-10-24
V	MAGNETIC VALVE	54-10-26
W	BUZZER	54-10-26

11 INSPECTION OF PARTS

#001 to #179	SWITCH	54-11-2
#180 to #249	RELAY	54-11-11
#250 to #349	SENSOR	54-11-14
#350 to #409	CONTROL UNIT	54-11-17
#410 to #509	MOTOR	54-11-18
#510 to #559	ACTUATOR	54-11-19
#560 to #609	MAGNETIC VALVE	54-11-20
#610 to #649	BUZZER AND HORN	54-11-21
#650 to #699	LAMP	54-11-22
#750 to #859	OTHER	54-11-23
#860	BATTERY	54-11-25
#870 to #889	FUSE	54-11-28
#890	METER CLUSTER	54-11-32

12 STARTER AND ALTERNATOR

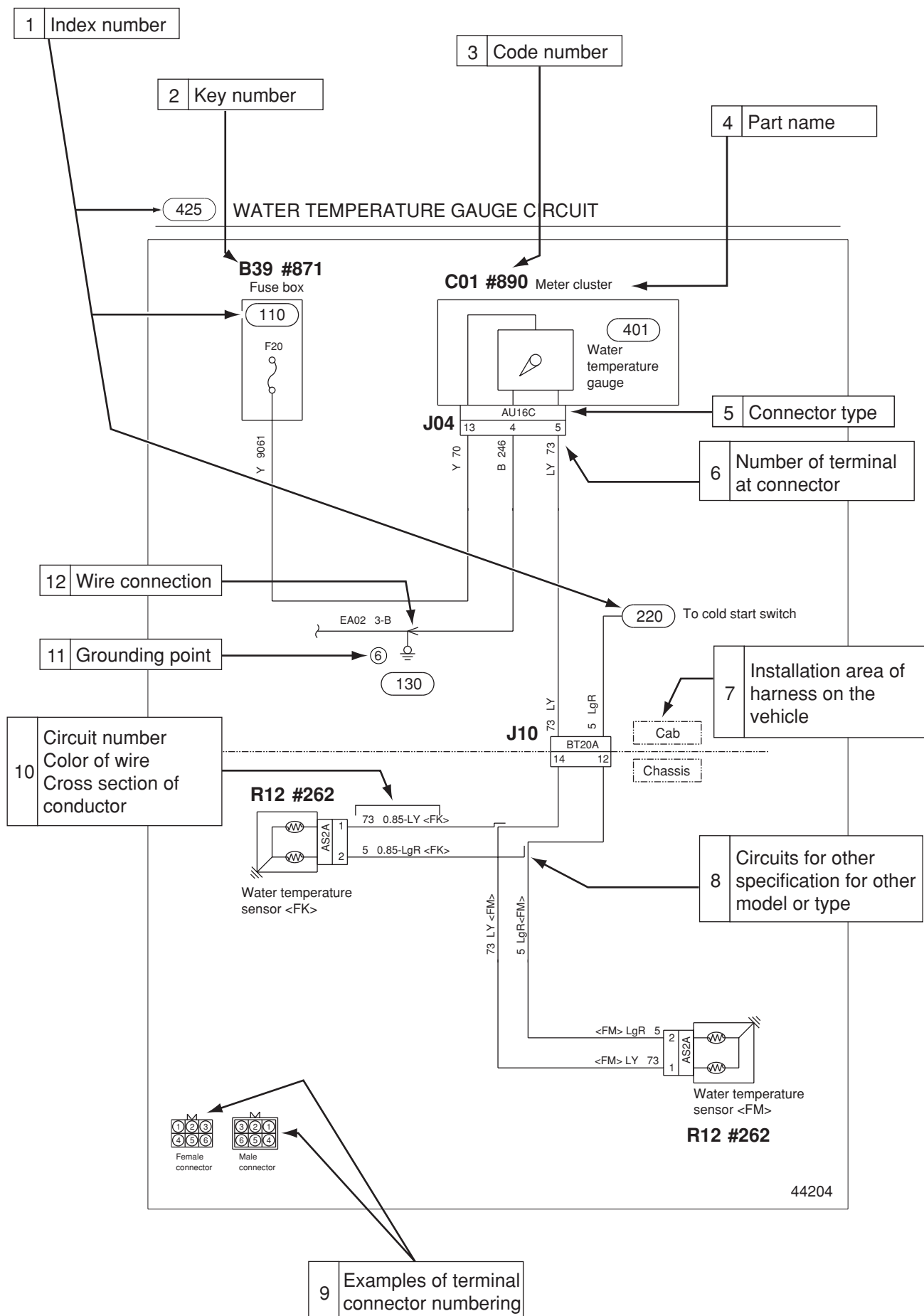
#930 STARTER	54-12-2
#940 ALTERNATOR	54-12-16
#950 INSPECTION OF ALTERNATOR	54-12-23
#951 INSPECTION OF REGULATOR	54-12-24

13 ON-VEHICLE INSPECTION AND ADJUSTMENT

#955 INSPECTION OF PREHEATING SYSTEM	54-13-2
#960 ADJUSTMENT OF HEADLAMP AIMING	54-13-4
#965 INSPECTION OF BRAKE FLUID LEVEL SWITCH	54-13-6

HOW TO READ THIS GROUP

HOW TO READ CIRCUITS (GROUP 54)



1 Index number: (110)

Each circuit has its own Index number respectively and has three digits ((110)).

How to read index number

- By proper using of the index number, it is possible to locate right place immediately since the circuit drawing of the manual book are classified as function by function. (including “POWER CIRCUIT” (110) and “GROUND” (130) .)
- How to check the location of circuit drawing in each part
The circuit drawing which can not be diagramed in one page due to its complicated structure (such as meter cluster and electronic control unit etc.), has its remarked index number to be connected to other circuit drawing. ((401) , (910) , etc.)

2 Key number: A01 to A99

Key number is the number to indicate the installation position of the parts, and is shown by A01 ~ Z.

The details of the installation position are described in GROUP 10 .

3 Code number: #001 to #999

Code number is the number to indicate the one portion of the parts to be checked and has three digits (#001).

The details of the parts to be checked are described in GROUP 11 .

4 Part name

5 Connector type

Connectors are shown by □ without mentioning Male or Female and in the box it is described model of connector, number of terminals and its classification, etc.

Table of connectors is described in GROUP 14.

6 Number of terminal at connector

Terminal numbers of connector are shown by figures in the box.

7 Installation area of harness on the vehicle

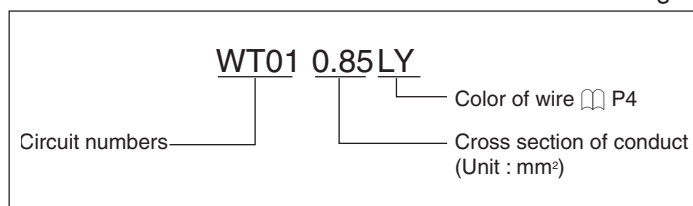
The location and boundary of the harnesses in the vehicle are shown in the each circuit drawing and it may help to check mounting position of connectors.

8 Circuits for other specification for other model or type

9 Examples of terminal connector numbering

As it is shown, for female connectors, with placing the lock upward then starting to put numbers from the upper left. And when it is male connector, put numbers from the upper right, also with placing the lock upward.

10 Circuit number, color of wire, and cross section of conductor are shown in circuit drawings.



Except for 0.5 mm², Wire thickness is described in the circuit drawing. The reason why only wire thickness, 0.5 mm² is not described in the drawings is 0.5 mm² is so common and so that the circuit drawing can be seen more easily.

(Examples) 0.5 mm²: Y
0.85 mm²: 0.85 — LY
3 mm²: 3 — B

11 Grounding point

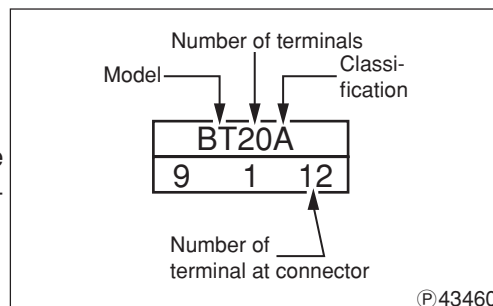
The actual locations of grounding points on the vehicle are shown. Refer to (130) for detailed information.

12 Wire connection

When the wires are connected into one point of the harnesses, the circuit drawing shows “Arrow mark”.

CAUTION !

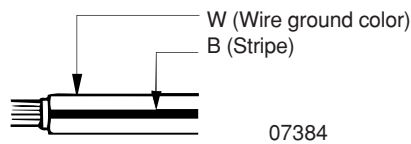
Be careful that direction of the arrow does not show the direction of the electric current flow.



(P43460)

● Wire Colors

Example: WB means a wire whose ground color is white and whose stripe is black.

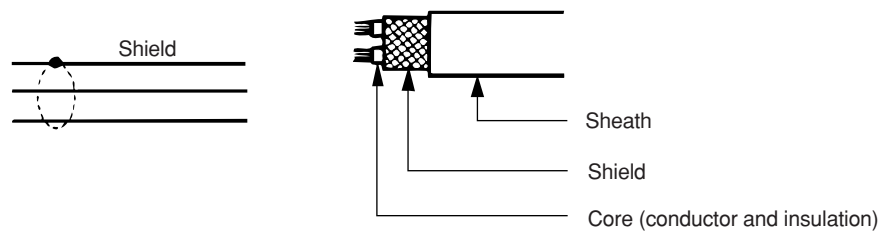


Wire ground color		Wire ground color + Stripe									
W	White	WR	White red	WB	White black	WL	White blue	WG	White green	WO	White orange
B	Black	BW	Black white	BY	Black yellow	BR	Black red	BG	Black green	BL	Black blue
R	Red	RW	Red white	RB	Red black	RY	Red yellow	RG	Red green	RL	Red blue
		RO	Red orange								
Y	Yellow	YR	Yellow red	YB	Yellow black	YG	Yellow green	YL	Yellow blue	YW	Yellow white
		YO	Yellow orange	YP	Yellow pink	YV	Yellow violet				
G	Green	GW	Green white	GR	Green red	GY	Green yellow	GB	Green black	GL	Green blue
		GO	Green orange								
Gr	Gray	GrL	Gray blue	GrR	Gray red						
Br	Brown	BrW	Brown white	BrB	Brown black	BrY	Brown yellow	BrR	Brown red	BrG	Brown green
L	Blue	LW	Blue white	LR	Blue red	LY	Blue yellow	LB	Blue black	LO	Blue orange
		LG	Blue green								
Lg	Light green	LgR	Light green red	LgY	Light green yellow	LgB	Light green black	LgW	Light green white		
O	Orange	OL	Orange blue	OB	Orange black	OG	Orange green				
P	Pink	PB	Pink black	PG	Pink green	PL	Pink blue	PW	Pink white		
Pu	Purple										
Sb	Sky blue										
V	Violet	VY	Violet yellow	VW	Violet white	VR	Violet red	VG	Violet green		

● Shield Wire

A shield wire is clearly identified as follows:

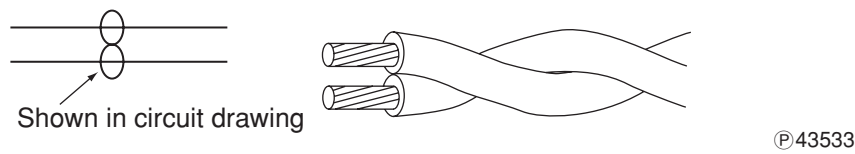
Example



● Twist wire

Twist wires are made by twisting the core of wires by the constant pitch.

Example:



0 GENERAL

SPECIFICATIONS

Battery

Item	Specifications
Model	115E41R
Voltage × Quantity V	12 × 2 (Parallel connection)
Capacity (5-hour rating)	88

Alternator

Item	Specifications
Manufacturer	DENSO CORPORATION
Type	Alternator with built-in regulator
	Brushless type
	External fan
Model	101211-8260
Output V-A	12-100

Engine starter, Glow

Item		Specifications
Starter	Manufacturer	MITSUBISHI ELECTRIC
	Reduction gear system	Planetary gear
	Model	M9T50371
	Output V-kW	12-5
	Magnetic switch operating voltage V	8 or less
Starter relay	Model	U1X11972
	Excitation current V-A	12-4
	Closing voltage V	8 or less
	Operating voltage V	3.5 or less
	Allowable cutoff current A	200
Glow plug	Model	Sheathed type
	Rated voltage current V-A	11-3.8
Glow relay	Model	U1T11872
	Excitation current V-A	12-4
	Closing voltage V	8 or less
	Operating voltage V	3.5 or less
	Allowable cutoff current A	60
	Temperature fuse capacity A	127

SPECIFICATIONS

Lighting

Item		Specifications
Headlamp	Model	Sealed beam
	Main beam W	50
	Dipped beam W	40/60 (Main/Dipped)
Front turn signal lamp (serving also as hazard warning lamp)		W 21
Parking lamp		W 5
Side turn signal lamp (serving also as hazard warning lamp)		W 10
Clearance and side marker lamp		W 7.5
Rear combination lamp	Stop / Tail lamp W	21/5
	Backup lamp W	21
	Turn signal lamp (serving also as hazard warning lamp) W	21
Cab and spot lamp		W 10/8 (Cab/Spot)
Identification lamp		W 7.5
License plate lamp		W 7.5

All bulbs of the lamps shown above voltage rating of 12 V.

Meter

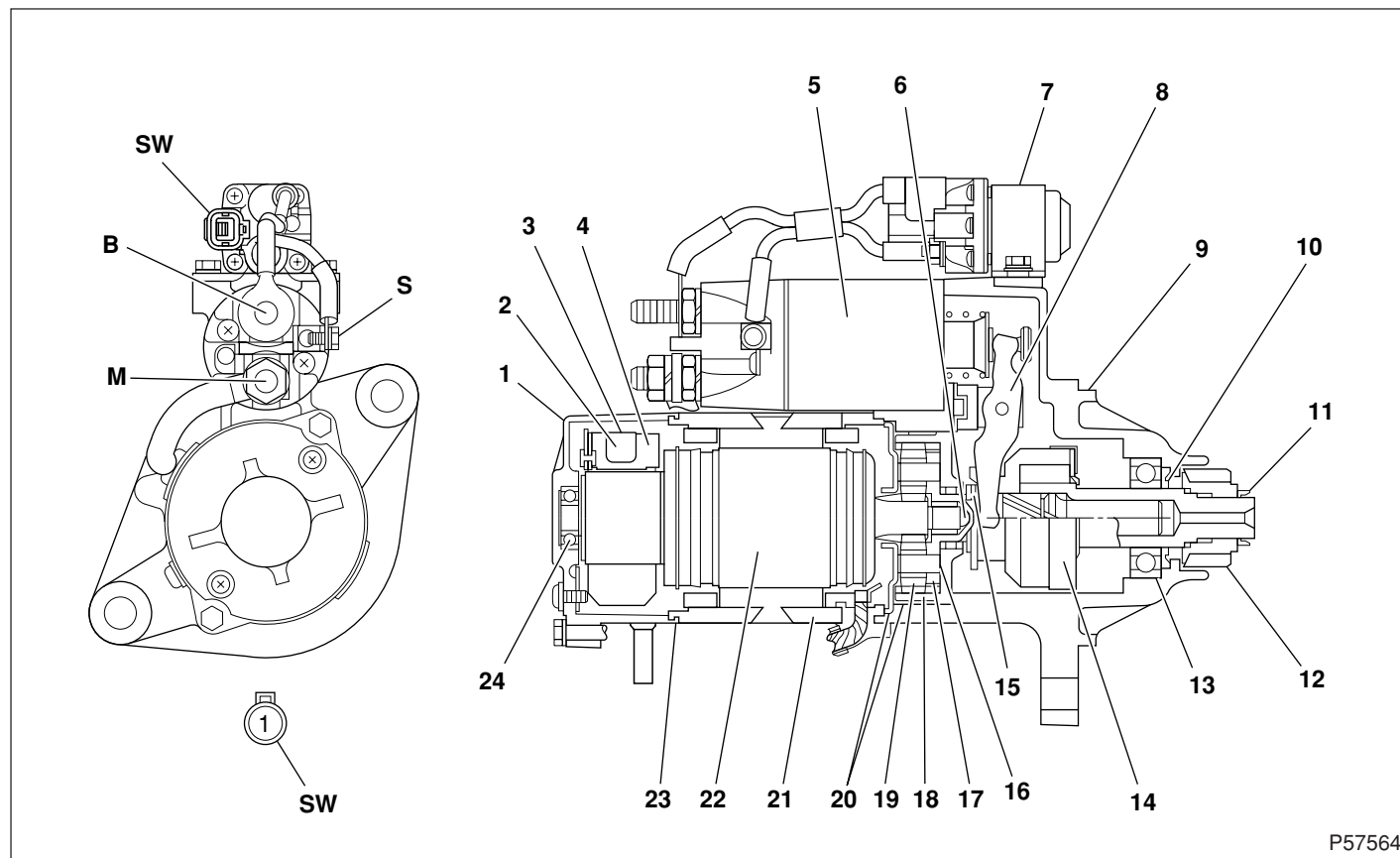
Item			Specifications
Meter cluster	Manufacturer		DENSO CORPORATION
	Rated voltage	V	12
	Lighting bulb	W	3
	Indicator lamp bulb	W	1.4
	Warning lamp bulb	W	1.4
	Meter warning buzzer (Overrunning buzzer) < EATON transmission >	Rated current mA	50 or less (Mean value)
		Sound pressure dB	60 ⁺⁶ ₀ (at 1 m {3.3 ft.})
Speedometer	Manufacturer		DENSO CORPORATION
	Lighting bulb	W	2

Relay, Motor, Horn, Buzzer

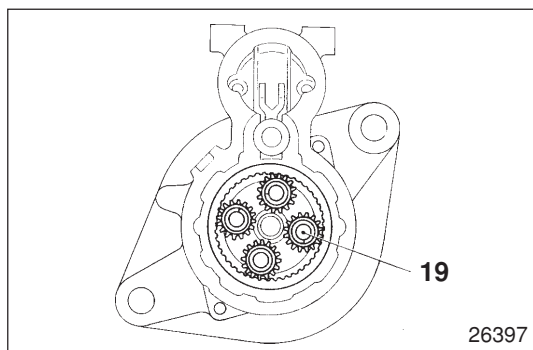
Item		Specifications
Relay	Rated voltage V	12
	Minimum operating voltage V	8 or less
Speaker	Rated input W	12
	Maximum input W	25
	Impedance Ω	4 $\pm$ 0.6
Power window motor	Rated voltage V	13.5
	Rated current A	9 or less < Up >, 7 or less < Down >
Door lock actuator	Rated voltage V	12
	Bound current A	6 or less
Air horn	Rated voltage V	12
	Current consumption A	3.2 or less
	Sound pressure dB	104 (at 2 m {6.6 ft.})
Wiper motor	Rated voltage V	12
	Non-load current A	6 or less
	Bound current A	40 or less
Windshield washer motor	Rated voltage V	12
	Rated current A	3.8 or less
Back buzzer (Outside)	Rated voltage V	12
	Rated current mA	50 or less
	Sound pressure dB	85 $\pm$ 10 (at 1 m {3.3 ft.})
	Intermittent frequency frequency per minute	85 $\pm$ 15
Back buzzer (Inside) <A/T (FK61, FM61,64)>	Rated voltage V	12
	Rated current mA	50 or less
	Sound pressure dB	70 $\pm$ 10 (at 1 m {3.3 ft.})
	Intermittent frequency frequency per minute	85 $\pm$ 15
Low air pressure buzzer	Rated voltage V	12
	Rated current mA	150 or less
	Sound pressure dB	75 $\pm$ 10 (at 1 m {3.3 ft.})
Inhibit buzzer <A/T (FM65)>	Rated voltage V	12
	Rated current mA	66 or less
	Sound pressure dB	80 $\pm$ 10 (at 1 m {3.3 ft.})

STRUCTURE AND OPERATION

1. Starter



- | | | |
|-------------------|-----------------------|-------------------|
| 1 Rear bracket | 11 Pinion stopper | 21 Yoke assembly |
| 2 Brush | 12 Pinion | 22 Armature |
| 3 Brush spring | 13 Front bearing | 23 Rubber packing |
| 4 Brush holder | 14 Overrunning clutch | 24 Rear bearing |
| 5 Magnetic switch | 15 E-ring | |
| 6 Ball | 16 Washer | B : Terminal B |
| 7 Starter relay | 17 Gear shaft | M : Terminal M |
| 8 Lever | 18 Internal gear | S : Terminal S |
| 9 Front bracket | 19 Planetary gear | SW : Terminal SW |
| 10 Spring | 20 Rubber packing | |

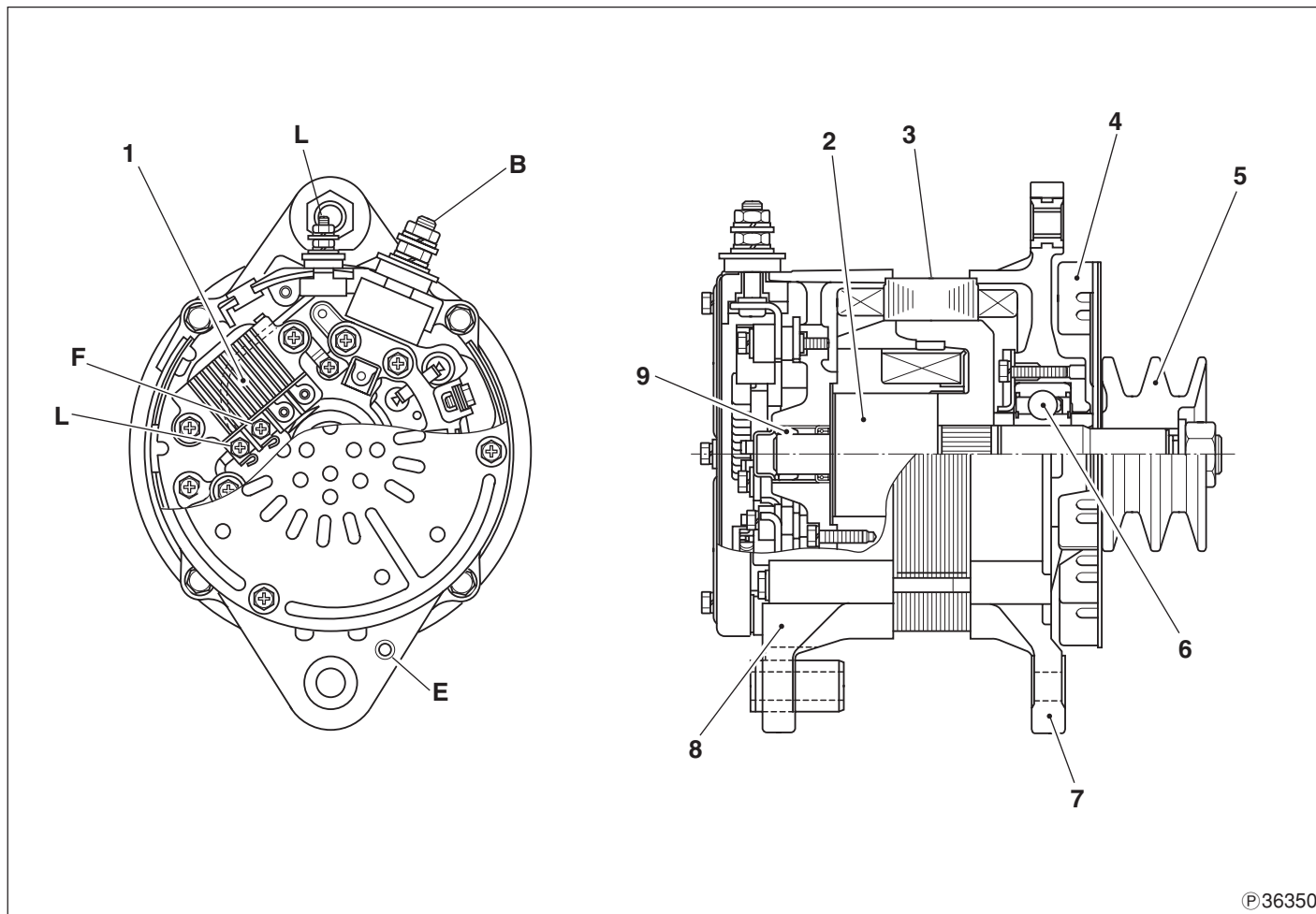


This starter uses planetary gear **19** in a deceleration gear mechanism.

MEMO

STRUCTURE AND OPERATION

2. Alternator



1 Regulator

2 Coil

3 Stator

4 Fan

5 Pulley

6 Front bearing

7 Drive frame

8 Rear frame

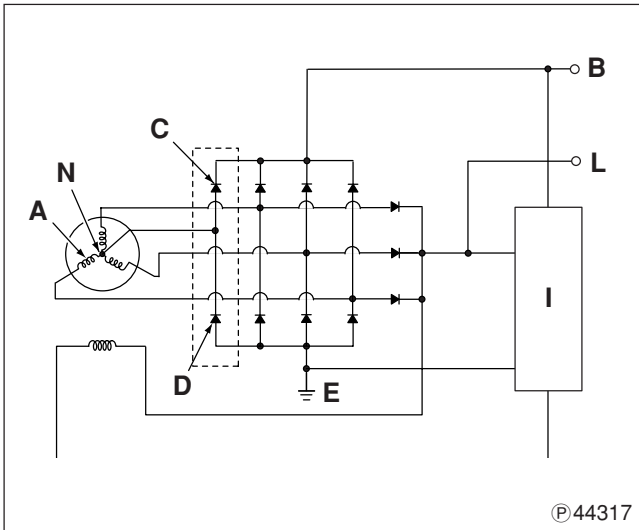
9 Rear bearing

B : Terminal B

E : Terminal E

F : Terminal F

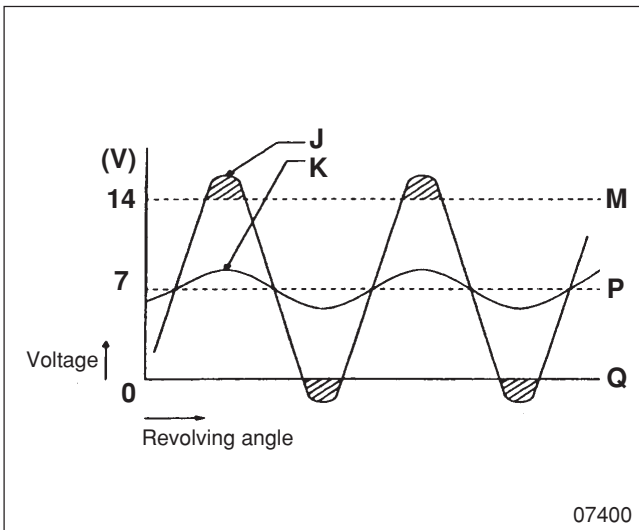
L : Terminal L



Features of alternator with neutral diodes

- The alternator is the same as the current alternator except that neutral diodes **C** and **D** have been added.
- These neutral diodes **C** and **D** enable this alternator to provide higher DC output during operation at high speeds than the alternator without neutral diodes.

A : Stator coil
B : Alternator terminal B
E : Alternator terminal E
I : IC regulator
L : Alternator terminal L
N : Neutral point



Variations of voltage at neutral point and operation of neutral diodes

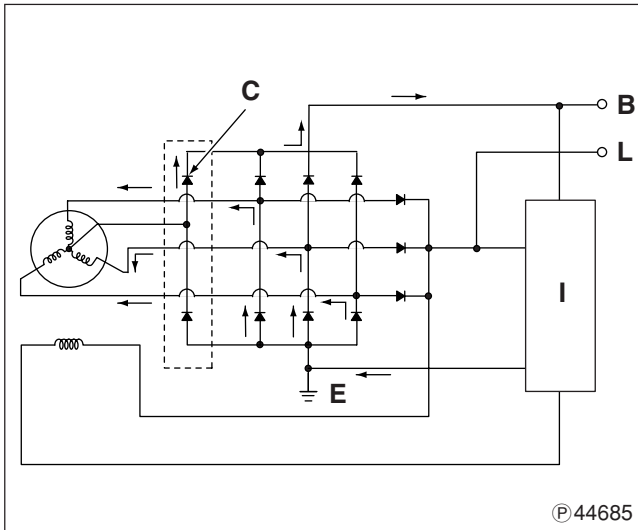
- The potential at the neutral point **N** varies up and down with the neutral point DC voltage **P** as a center as shown.
- When the alternator is operated at high speeds, the voltage at the neutral point **N** can increase to exceed the output voltage **M** (16 volts) and decrease to become lower than the ground voltage **Q** (0 volt). To adjust these over-voltage and under-voltage (shaded portions of diagram) the current from the excess voltages is taken by neutral diodes **C** and **D** and added to the DC output.

J : Voltage waveform at neutral point during high speed operation
K : Voltage waveform at neutral point during low speed operation
M : Output voltage
P : Average voltage at neutral point (1/2 of output voltage)
Q : Ground potential

The operation of neutral diodes **C** and **D** for each voltage and potential is as follows.

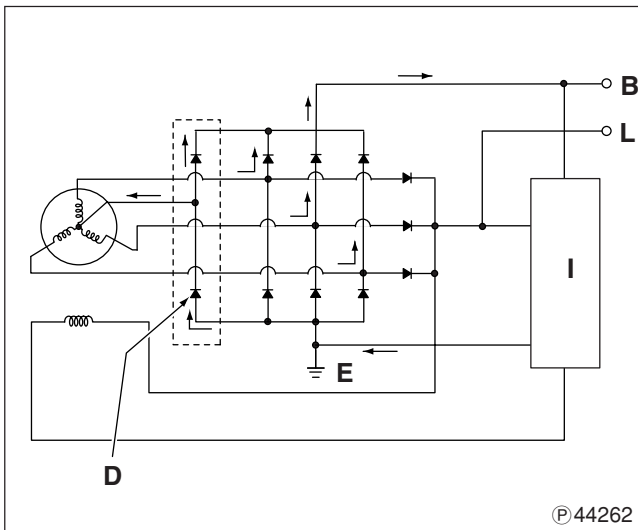
- When the voltage at neutral point is in the range from 0 to 16 volts, the other 6 diodes are operated. Neutral diodes are not operated.

STRUCTURE AND OPERATION



● When the voltage at neutral point exceeds 14 volts

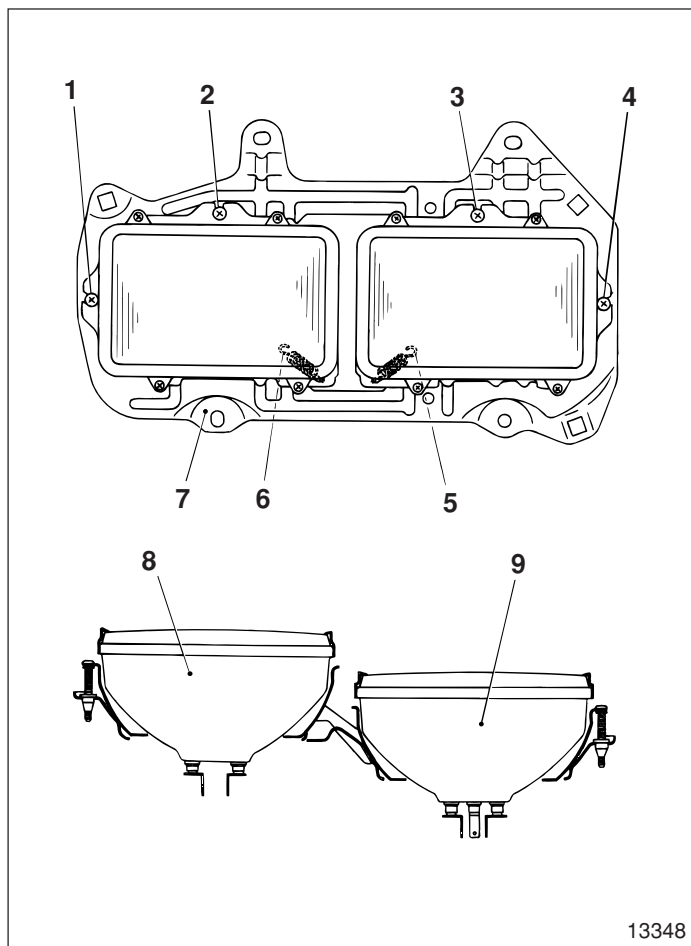
The positive diode **C** adds extra output to the DC output for supply to each electric equipment.



● When the voltage at neutral point drops below 0 volt

The negative diode **D** supplies the output from neutral point through other 3 diodes.

3. Lamp Headlamp



- 1 Screw (Main beam, horizontal adjustment)
- 2 Screw (Main beam, vertical adjustment)
- 3 Screw (Dipped beam, vertical adjustment)
- 4 Screw (Dipped beam, horizontal adjustment)
- 5 Extension spring
- 6 Extension spring
- 7 Housing
- 8 Sealed beam unit (Main beam)
- 9 Sealed beam unit (Dipped beam)

- The headlamp unit consists of sealed beam units **8, 9** separately installed in housing **7**. Sealed beam unit **8** is for Main beam, and sealed beam unit **9** is for Dipped beam.
- The headlamp aiming can be adjusted by changing the installation angle of sealed beam units **8, 9**.
- To adjust the installation angle of sealed beam unit **8**, turn screws **1, 2**. Extension spring **6** sets the angle of the sealed beam unit.
- To adjust the installation angle of sealed beam unit **9**, turn screws **3, 4**. Extension spring **5** sets the angle in the same way as for sealed beam unit **8**.

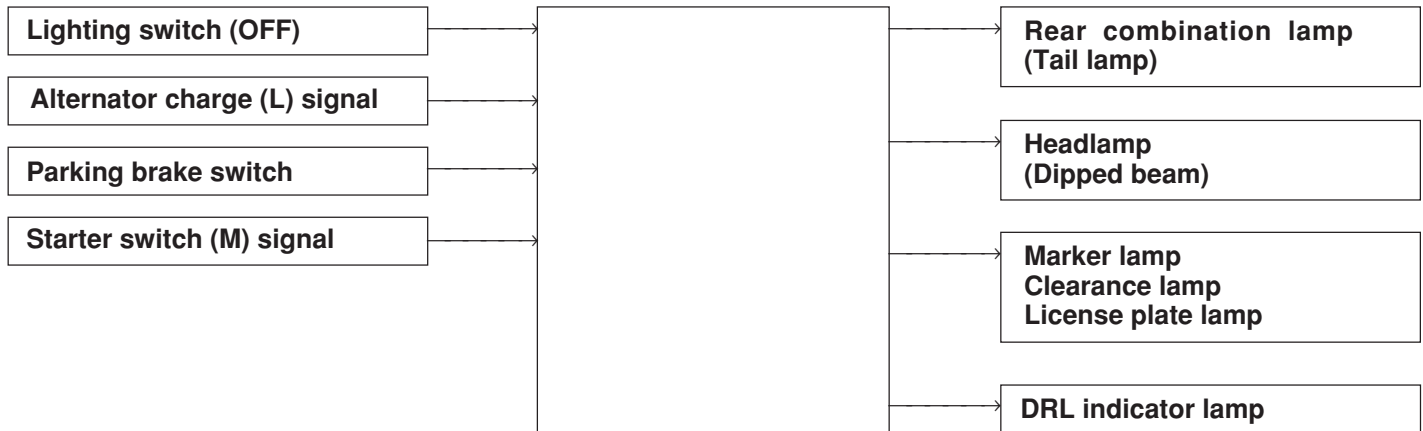
STRUCTURE AND OPERATION

4. Daytime running light (DRL) system

Input signal (IN)

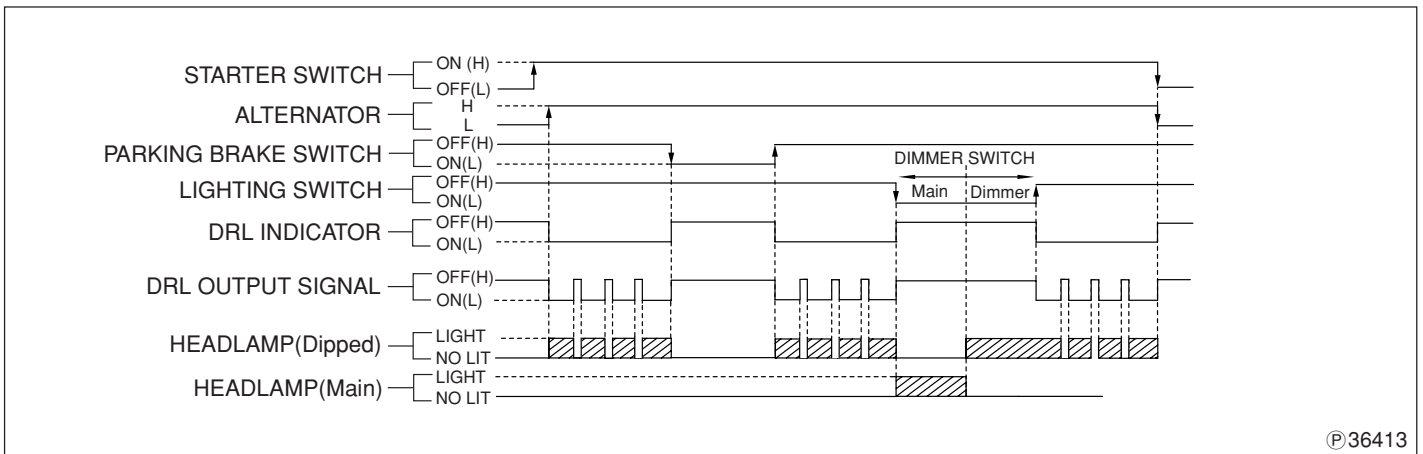
Daytime running light electronic control unit

Output signal (OUT)



- In a daytime running light system, regardless the position of lighting switch while engine is running, the dipped beam of the headlamp and the tail lamp of the rear combinations, position lamp, license plate lamp will light on.
- Except for that the lighting switch is OFF or when the passing switch is ON, the same lamps as usual switch operation will light.

• Timing chart

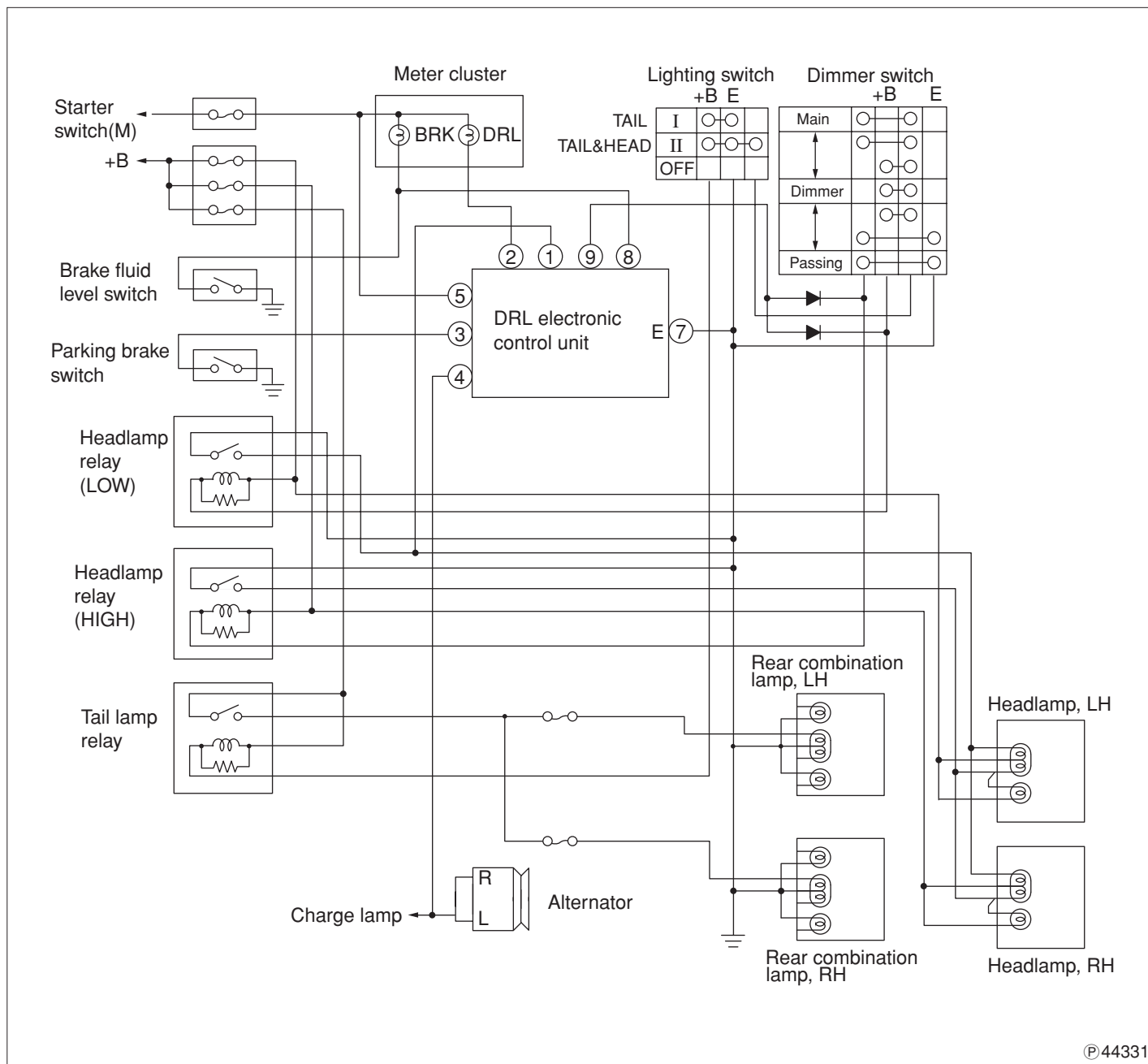


Headlamps repeat ON/OFF operations at 120 Hz according to the above timing chart. Because of the cyclic ON/OFF operations, the headlamps are dimmer than when the headlamp switch is ON.

Explanation of timing chart

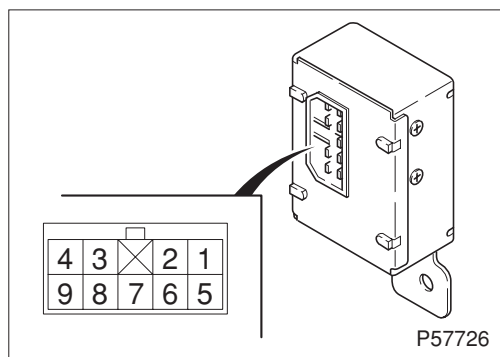
- After the engine starts, when alternator begins generating electricity with starter switch in the ON position, headlamps light.
- When parking brake switch is ON, the DRL turns off to switch off the headlamps.

• Daytime running light electronic control unit circuit diagram



P44331

• DRL electronic control unit



P57726

Terminal No.	Connecting destinations	Terminal No.	Connecting destinations
①	Head lamp (Dipped)	⑥	—
②	DRL indicator lamp	⑦	Ground
③	Parking brake switch	⑧	Parking brake indicator lamp
④	Alternator L terminal	⑨	Lighting switch
⑤	Starter switch M terminal	—	—

STRUCTURE AND OPERATION

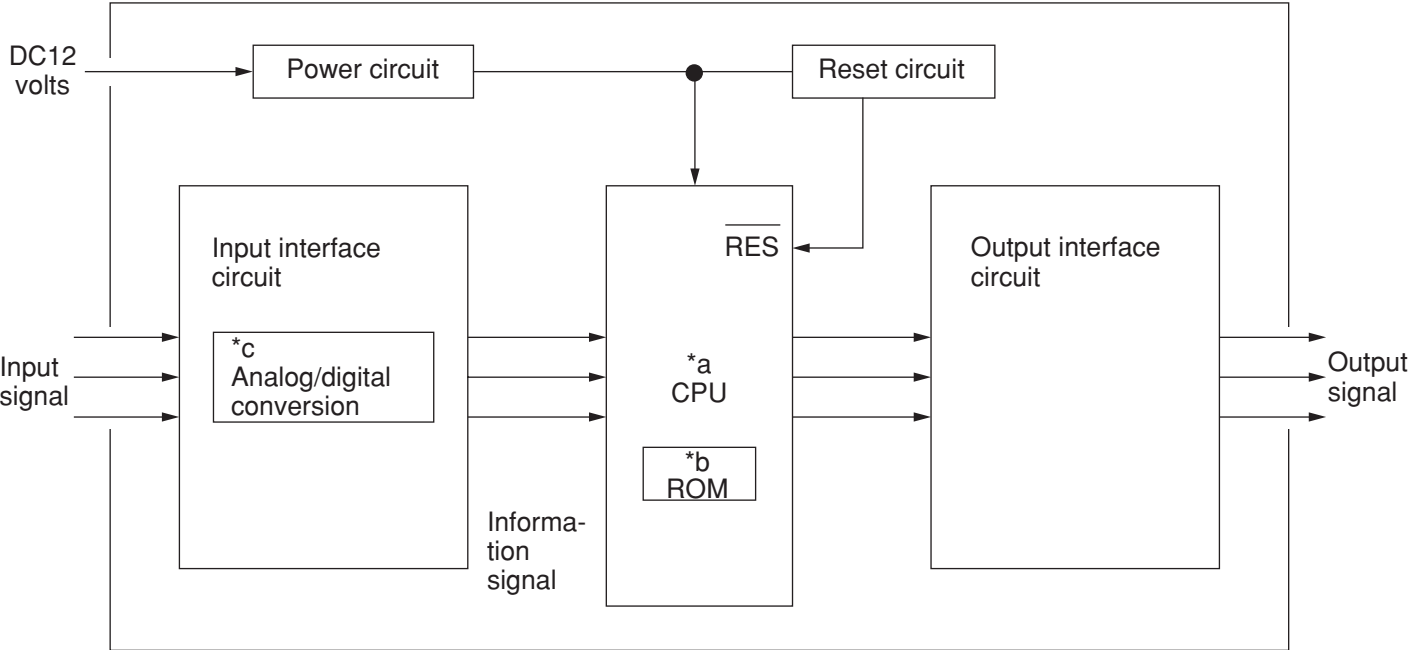
5. MUTIC (Multipurpose Timing Control Unit)

- This control unit is an integrated control unit for controlling the following functions.

Intermittent wiper activation function	 Gr 42
Wiper activation function (Even if the wiper switch is OFF, this function automatically activates the wiper when the window washer works)	 Gr 42
Water level warning function	 Gr 14

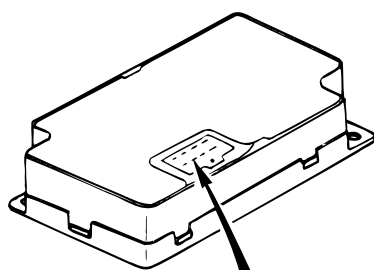
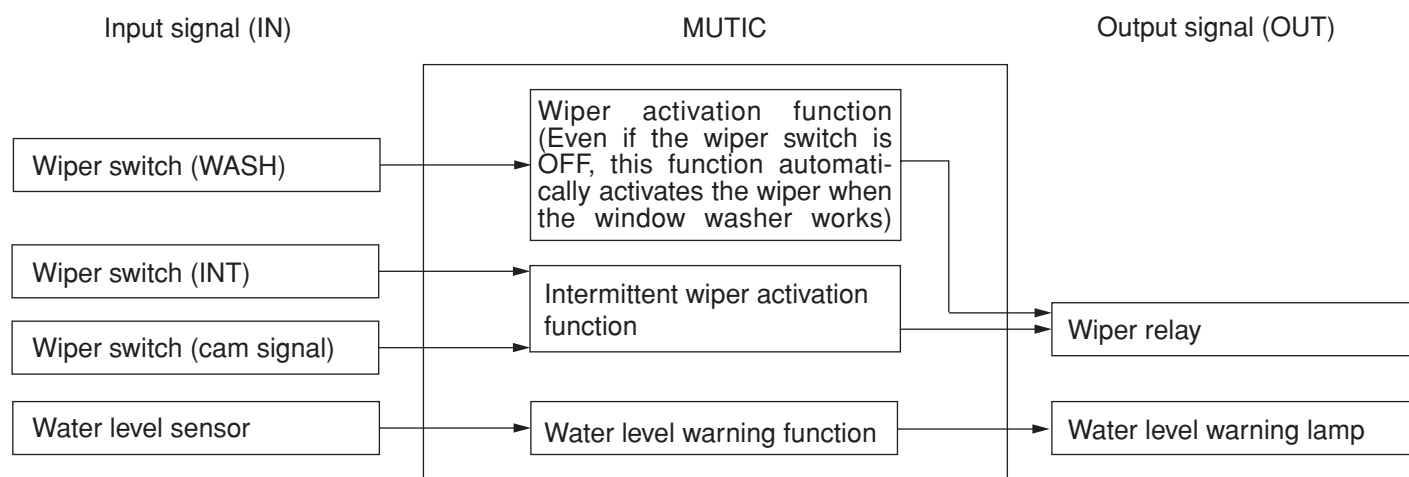
- For controlling each function, sensors and switches are needed as sources of information, and they are provided for respective systems.
- Based on the information provided by the sensors and switches, the MUTIC controls above functions by means of the circuits inside itself.

● Internal structure of MUTIC



- The MUTIC is internally made up roughly of the input interface circuit, CPU***a**, ROM***b**, and output interface circuit.
 - ***a**: An abbreviation for Central Processing Unit. It compares the input information and the information stored in the ROM and makes a decision and sends commands to the outputs.
 - ***b**: An abbreviation for Read-Only Memory. It is an element used exclusively to have its contents read. It stores fixed data and program, and such retained information is not deleted even after power is cut off.
- Information sources such as sensor and switch send input signal to the input interface circuit.
- The input interface circuit performs A/D conversion***c** of the input signals, and the converted signals are transmitted to the CPU as information signals.
 - ***c**: An abbreviation for Analog/Digital conversion. It is a conversion from analog to digital signals. This conversion enables calculation to be made in the CPU.
- The CPU compares the received signals with the data in the ROM, makes a decision, and sends the results to the output interface circuit.
- The output interface circuit transmits these results to each system as output signals to instruct operations.
- Performing these series of operations continuously enables optimum control of each function.

System function schematic

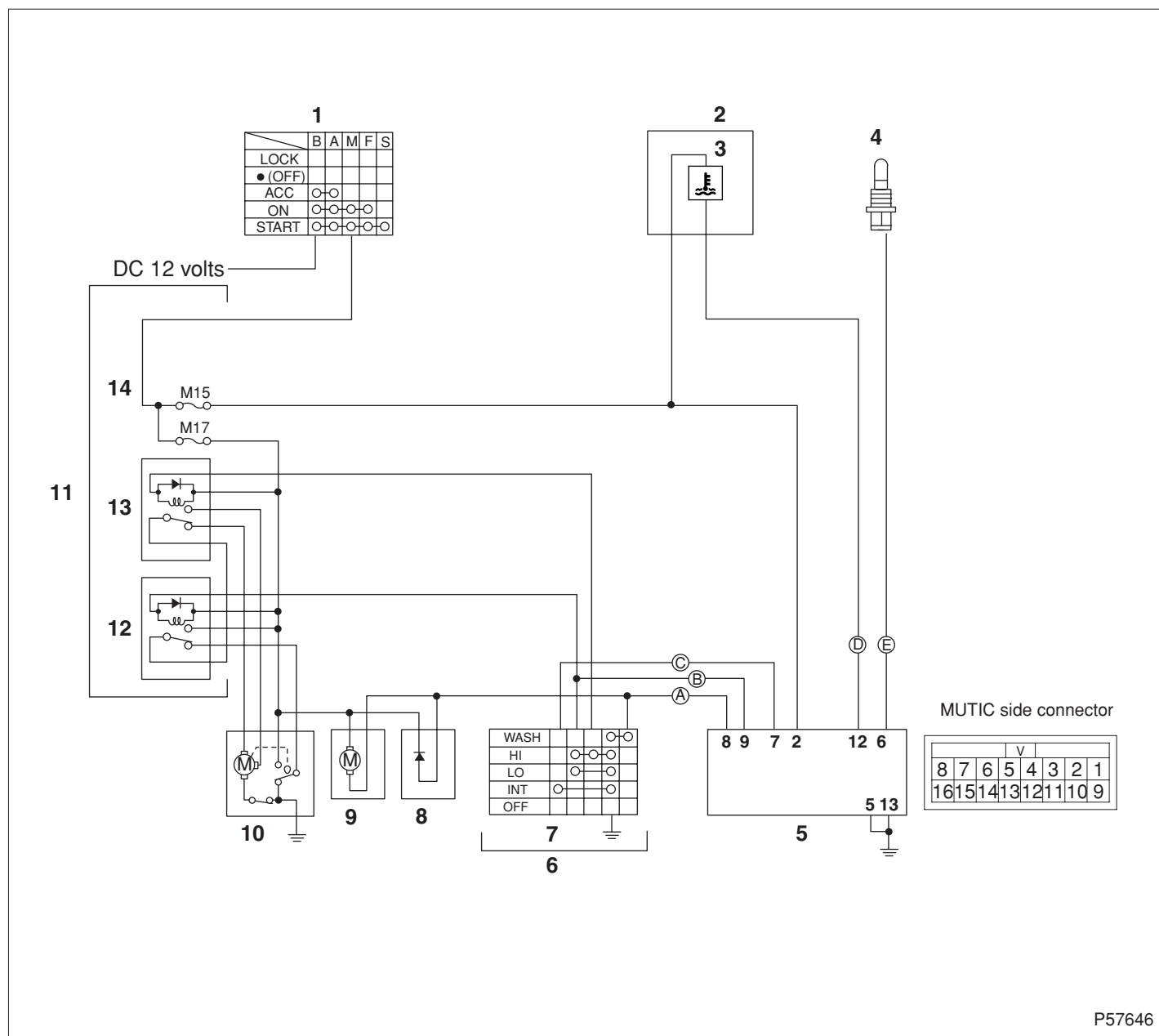


				V				
8	7	6	5	4	3	2	1	
16	15	14	13	12	11	10	9	

12582

Terminal No.	Connecting destinations	Terminal No.	Connecting destinations
1	—	9	Wiper relay (LOW)
2	Starter switch (ON power supply)	10	—
3	—	11	—
4	—	12	Water level warning lamp
5	Ground	13	Ground
6	Water level sensor	14	—
7	Wiper switch (Intermittent)	15	—
8	Washer switch	16	—

MUTIC (Multipurpose Timing Control Unit) Functional Circuit Diagram



No.	Part name	Principal function sensors	Information signal
1	Starter switch	—	—
2	Meter cluster	—	—
3	Water level warning lamp	—	Ⓓ :  Lamp ON signal
4	Water level sensor	Detection of engine coolant level	Ⓔ : Engine coolant level signal
5	MUTIC	—	—
6	Combination switch	—	—
7	Wiper and washer switch	—	Ⓒ : Intermittent wiper switch signal
8	Diode unit	—	—
9	Washer motor	—	Ⓐ : Washer switch signal
10	Wiper motor	—	—
11	Relay and fuse box	—	—
12	Wiper relay (LOW)	Intermittent wiper operation	Ⓑ : Wiper relay activation signal
13	Wiper relay (HIGH)	—	—
14	Fuse	—	—

STRUCTURE AND OPERATION

6. Engine electronic control unit

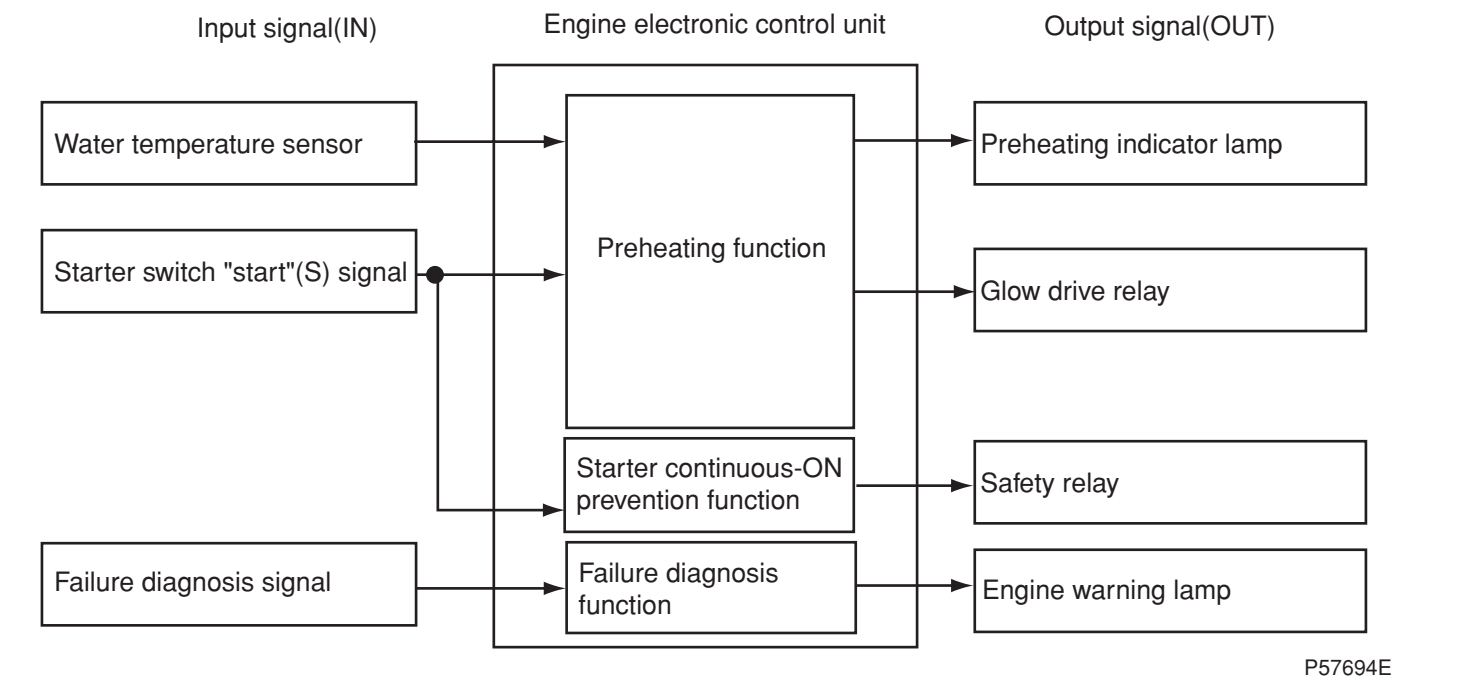
- This control unit is an integrated control unit for controlling the following functions.

Preheating function

Starter continuous-ON prevention function

- For controlling each function, sensors and switches are needed as sources of information, and they are provided for respective systems.
- Based on the information provided by the sensors and switches, the engine electronic control unit above functions by means of the circuits inside itself.

System function schematic



P57694E

Engine ECU side connector

A: GF34A

7	6	5	4	3	2	1
17	16	15	14	13	12	11
27	26	25	24	23	22	21
34	33			32	31	30

B: GF35A

7	6	5	4	3	2	1
19	18	17	16	15	14	13
27	26	25	24	23	22	21
35	34		33	32	31	30

C: GF32A

7	6	5	4	3	2	1
17	16	15	14	13	12	11
27	26	25	24	23	22	21
32	31			30	29	28

D: GF35A

6	5	4	3	2	1
16	15	14	13	12	11
27	26	25	24	23	22
35	34	33	32	31	30

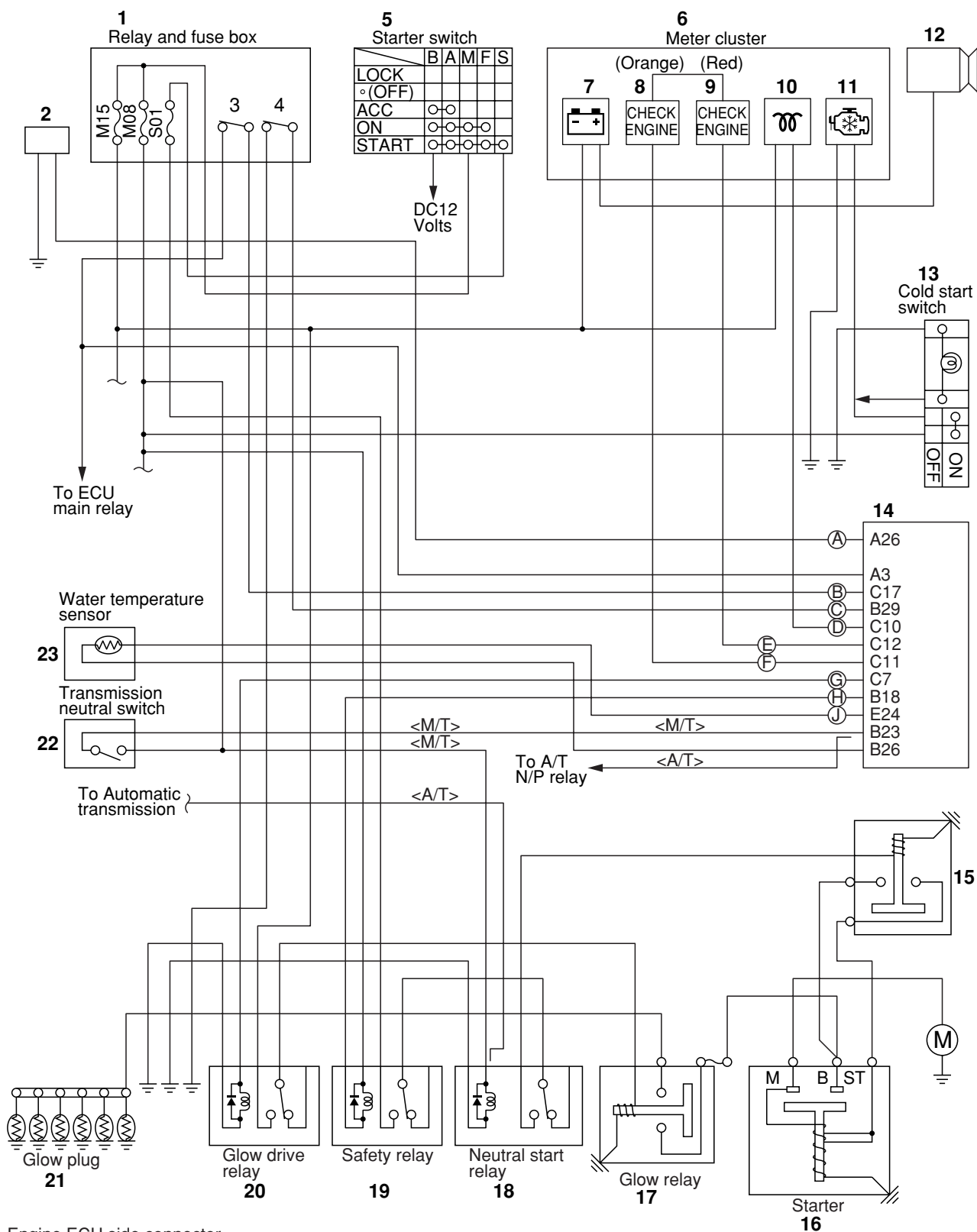
E: GF31A

7	6	5	4	3	2	1
17	16	15	14	13	12	11
25	24			23	22	21
31	30			29	28	27

P57693E

Terminal No.	Connecting Destinations
A3	+VB-1 (ECU POWER)
A26	MUT-III
B18	Safety relay
B23	Transmission neutral switch
B26	Sensor GND-5
B29	Diagnosis switch
C7	Glow drive relay
C10	Glow indicator lamp
C11	Warning lamp (Orange)
C12	Warning lamp (Red)
C17	Memory clear switch
E24	Water temperature sensor

Engine electronic control unit functional circuit diagram



Engine ECU side connector

A: GF34A

7	6	5	4	3	2	1
17	16	15	14	13	12	11
27	26	25	24	23	22	21
34	33	32	31	30	29	28

B: GF35A

7	6	5	4	3	2	1
17	16	15	14	13	12	11
27	26	25	24	23	22	21
34	33	32	31	30	29	28

C: GF32A

7	6	5	4	3	2	1
17	16	15	14	13	12	11
27	26	25	24	23	22	21
32	31	30	29	28	27	26

D: GF35B

6	5	4	3	2	1
16	15	14	13	12	11
27	26	25	24	23	22
35	34	33	32	31	30

E: GF31A

7	6	5	4	3	2	1
17	16	15	14	13	12	11
27	26	25	24	23	22	21
31	30	29	28	27	26	25

STRUCTURE AND OPERATION

No.	Parts name	Part function sensors	Information signal
1	Relay and fuse box	—	—
2	Multi-use tester-III connector (for inspection)	Connection of Multi-use tester-III	Ⓐ : Communication signal with Multi-use tester-III system
3	Memory clear switch	Eraser of diagnosis codes	Ⓑ : Diagnosis code eraser signal
4	Diagnosis switch	Generation of diagnosis codes	Ⓒ : Diagnosis code signal
5	Starter switch	Start position detection	—
6	Meter cluster	—	—
7	Battery charge indicator lamp	—	—
8	Engine warning lamp (orange)	Indication of system faults and diagnosis codes	Ⓕ : Warning lamp ON signal
9	Engine warning lamp (red)		Ⓖ : Warning lamp ON signal
10	Glow indicator lamp	—	Ⓓ : Indicator lamp ON signal
11	Cold start indicator lamp	—	—
12	Alternator	—	—
13	Cold start switch	—	—
14	Engine electronic control unit	Preheating function and starter continuous-ON prevention function	—
15	Starter relay	—	—
16	Starter	—	—
17	Glow relay	—	—
18	Neutral start relay	—	—
19	Safety relay	—	Ⓗ : Starter continuous-ON cancellation signal
20	Glow drive relay	—	Ⓖ : Glow relay activation signal
21	Glow plug	—	—
22	Transmission neutral switch	—	—
23	Water temperature sensor	Detection of engine coolant temperature	Ⓙ : Engine coolant temperature signal

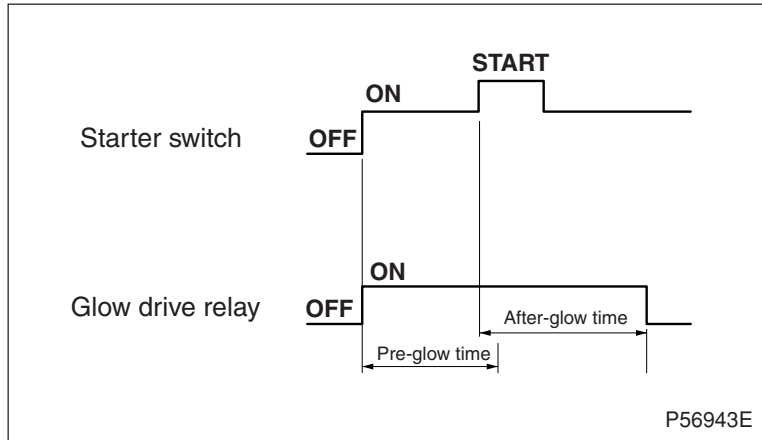
MEMO

STRUCTURE AND OPERATION

Preheating Function

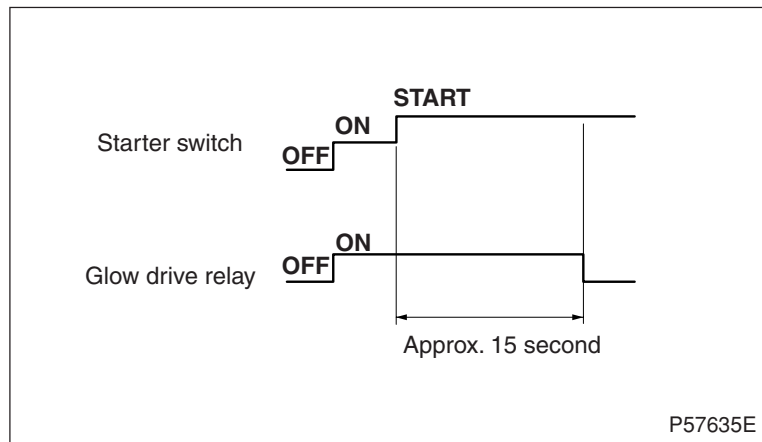
This preheating function aims to enhance the engine start up when the engine coolant is low in cold weather or temperature.

Engine electronic control unit the entire function as follows:



Pre-glow and After-glow

The preheating is operated with a pre-glow before the engine starting and an after-glow after the engine starting.

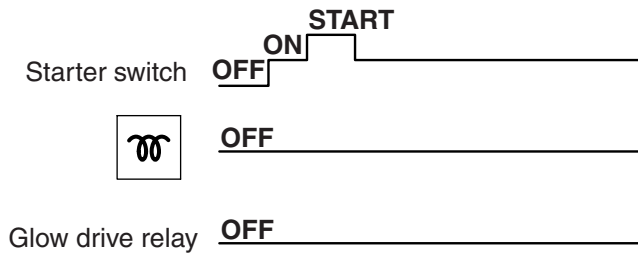


Fail Safe

- In case the contact point operating the glow relay in Engine electronic control unit has melted, the preheating indicator lamp flashes to warn this abnormality.
- Operation mode turns glow relay activation signal to OFF only after all the following conditions are met.
 - Where the engine coolant temperature is 60°C or less.
 - Starter switch signal is ON for 15 seconds continuously.
 - Starter switch (S terminal) signal is ON.

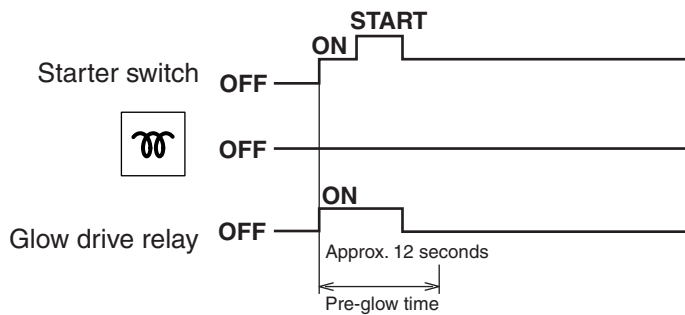
Operation mode

- Where the engine coolant temperature is 60°C {140°F} or more.



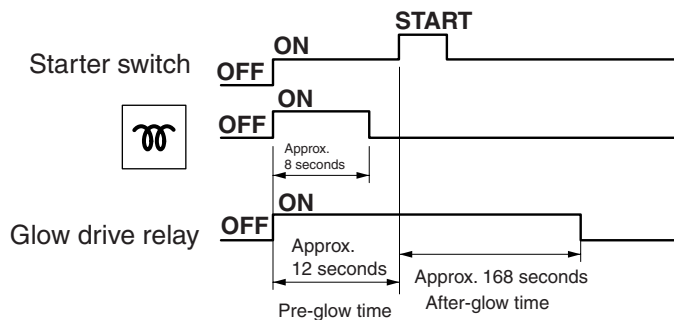
P56944E

- Where the engine coolant temperature is 0 to 60°C {32 to 140°F}.



P56945E

- Where the engine coolant temperature is 0°C {32°F} or less.



P56946E

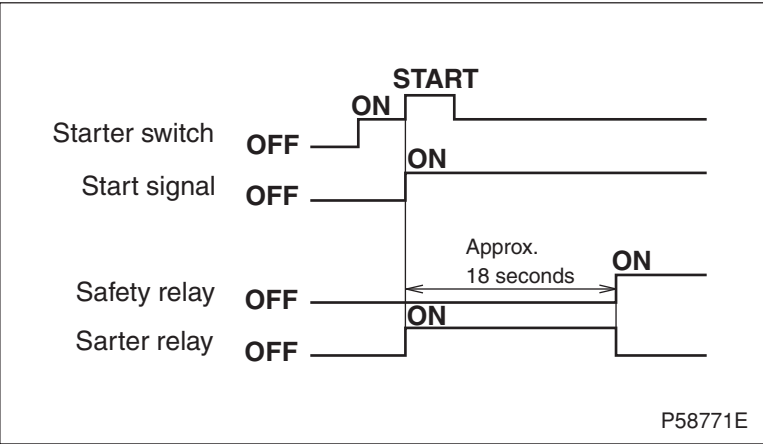
STRUCTURE AND OPERATION

Starter Continuous-ON Prevention Function

- This function prevents a starter overrun.
- If the start continues to operate for more than a preset time after the engine starts, the engine electronic control unit detects a starter continuous-ON condition, and stops the current to the starter and starter relay to prevent the starter from seizing.

When a preset time elapses after the engine starts, the safety relay is activated (opening of contact) by start signal.

Operation mode



1. Fault diagnosis function

1.1 Inspection Procedures

- While the starter switch is in the ON position, the fault diagnosis function continuously monitors relevant sensors for faults.
In the event that a fault is detected, the function illuminates a  warning lamp (red or orange) in the meter cluster to alert the driver, memorizes the location of the fault, and switches to a backup mode.
- The memorized fault location can be read as a diagnosis code using an Multi-use tester-III or the diagnosis switch.

Warning lamp illumination

	 (Orange)	 (Red)
1. Safety-critical error (vehicle must not be driven)	OFF	ON
2. Non-safety-critical error (vehicle can be driven despite poor control feeling)	ON	OFF

CAUTIONS

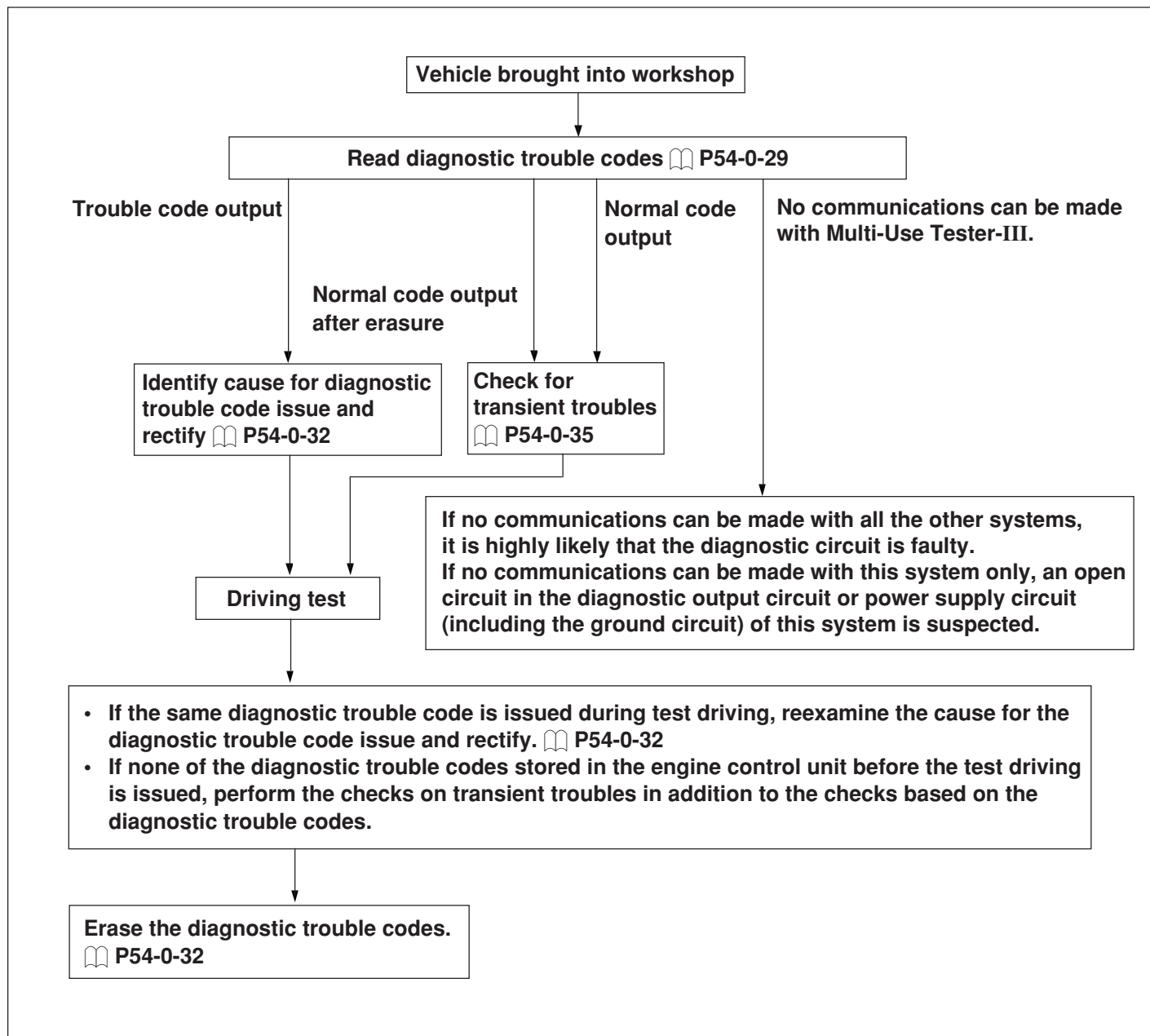
- The fault diagnosis function requires a battery voltage of 12 V or higher.
- In the event of fault detection, check the harnesses and connectors for looseness. Before undoing any connector, turn the starter switch to the LOCK position and wait for 20 seconds.
- After rectifying a fault, delete the fault code using the Multi-use tester-III or memory clear switch.
- As a general rule, inspections should be performed with the starter switch in the LOCK position. If any inspection requires that the starter switch be in the ON position, be careful to avoid short circuits between connector terminals and with the vehicle body.
- All component resistances shown in this manual assume a temperature range of 10 to 35°C {50 to 95°F}. In practice, component values may not comply with standard values owing to temperature effects and/or to inaccuracy in the test instrument.
- After the rectification of a fault, the system’s ability to return to normal operation automatically depends upon the diagnosis code, i.e., the fault location. When the system returns to normal operation, the warning lamp goes out.
- When the system returns to normal operation after the rectification of a fault, the diagnosis code remains stored in engine control unit.

TROUBLESHOOTING

Inspection Procedure

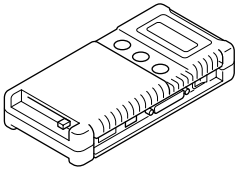
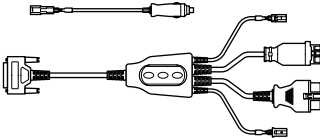
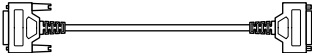
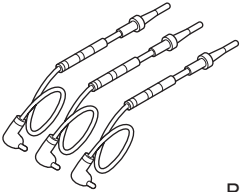
The system inspection can be performed effectively by use of the Multi-Use Tester-III. The types of system inspections may be broadly divided as shown below in accordance with the trouble symptoms and diagnostic trouble code outputs.

- Inspections based on diagnostic trouble codes stored in the engine-electronic control unit
- Inspections of transient troubles

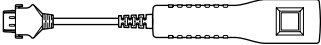


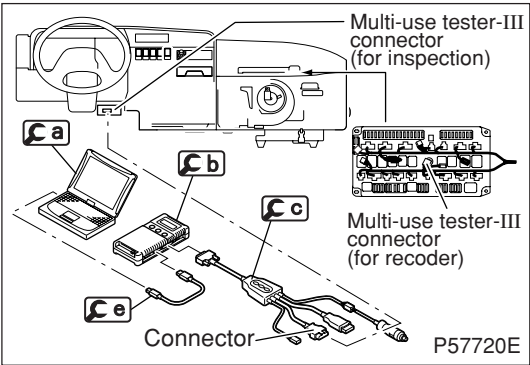
1.2 Connection of Multi-Use Tester-III

Special tools

Location	Tool name and shape	Part No.	Application
 a	Personal computer  P57295	—	Transmission and reception of data with V.C.I.
 b	V.C.I.  P57296	MH062927	Transmission and reception of data between ECU and personal computer
 c	Test harness B for Multi-use tester-III (for communication)  P57298	MH062929	Power supply to V.C.I. and communication with ECU
 d	Harness D (for extension)  P57299	MH062931	Extension of test harness B for Multi-use tester-III with V.C.I.
 e	USB cable  P57300	MB991827	Communication between V.C.I. and personal computer
—	Adaptor for measurement  P57302	MB991825	Used when external signals from circuit tester, oscilloscope, and drive recorder are recorded
—	Probe set for measurement  P57303	MB991943	Multi-use tester-III to be used as a circuit tester

TROUBLESHOOTING

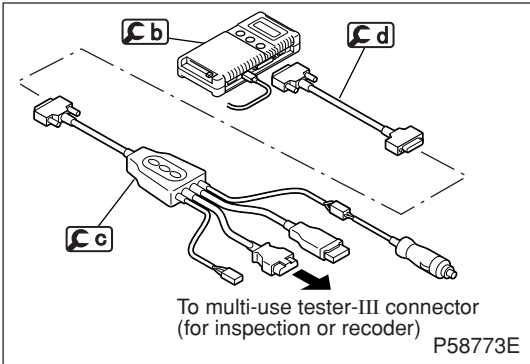
Location	Tool name and shape	Part No.	Application
—	Trigger harness  P57304	MB991826	For operating a manual trigger



- Set starter SW to “LOCK.”
- Connect , , , and .
- Connect Multi-use tester-III (for inspection) with connector.

CAUTION

- When utilizing drive recorder function, connect to Multi-use tester-III connector (for recorder)
- Refer to Multi-use tester-III instruction manual for operating Multi-use tester-III.



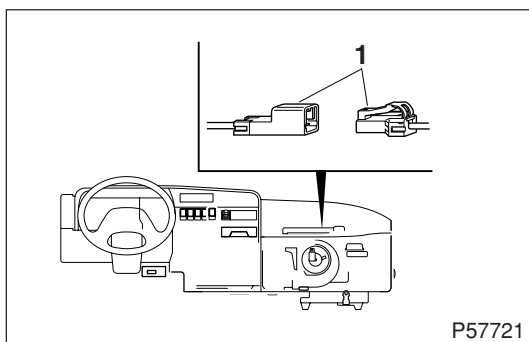
- If  is not long enough when using Multi-use tester-III outside vehicle, utilize .

1.3 Reading and Erasing Diagnostic Trouble Codes

There are two types of diagnostic trouble codes, i.e., current and past.

- **Current diagnostic trouble code**
This means a diagnostic trouble code issued for a fault which is detected after the starter switch is turned on (electronic control unit power on) and not eliminated yet when it is turned off again.
- **Past diagnostic trouble code**
This means a diagnostic trouble code for a fault which has already been registered when the starter switch is turned on or for a fault which disappeared before the starter switch is turned off again.

Two types of methods are available for reading or erasing a diagnostic trouble code; one using the Multi-Use Tester-III and one using the vehicle side diagnostic functions.



(1) Method using Multi-Use Tester-III

● Current Diagnostic Trouble Code

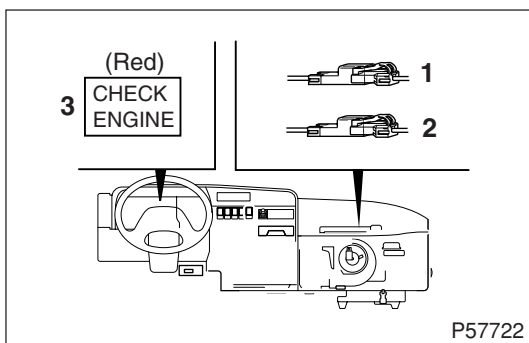
- Check to see that the memory clear switch **1** is connected.
- Set the starting switch to ON.
- Operate the Multi-Use Tester-III to read the current diagnostic trouble code and determine the fault location.

● Past Diagnostic Trouble Code

- Set the starting switch to ON.
- Disconnect the memory clear switch **1**.
- Operate the Multi-Use Tester-III to read the past registered diagnostic trouble codes and determine the fault location.

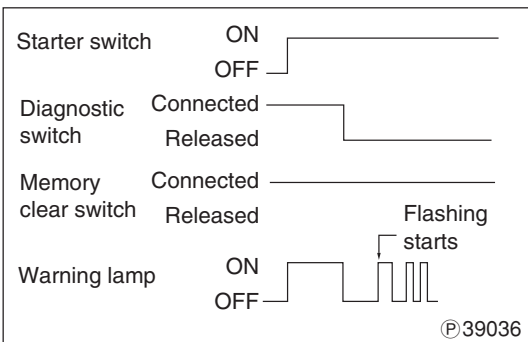
● Erasing Diagnostic Trouble Code

- Set the starting switch to ON.
- Operate the Multi-Use Tester-III to erase all of the diagnostic trouble codes stored in the engine control unit.



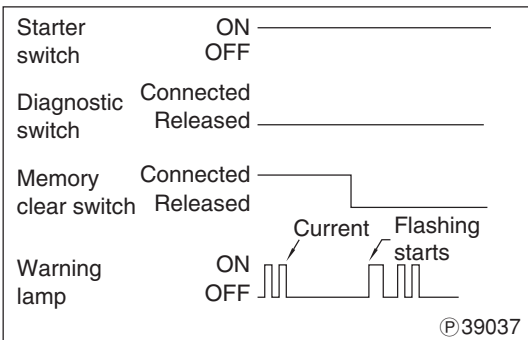
(2) Method Not Using Multi-Use Tester-III (Method Using Diagnostic Switch and Memory Clear Switch)

- 1 Memory clear switch
- 2 Diagnostic switch
- 3 Warning lamp (LED)



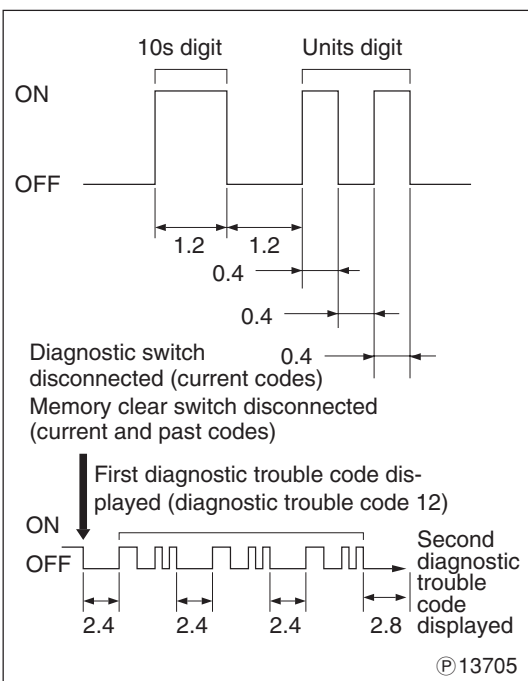
● Current Diagnostic Trouble Code

- Set the starting switch to ON.
- Disconnect the diagnostic switch **2**.
- The diagnostic trouble code is displayed by flashes of the warning lamp **3**.



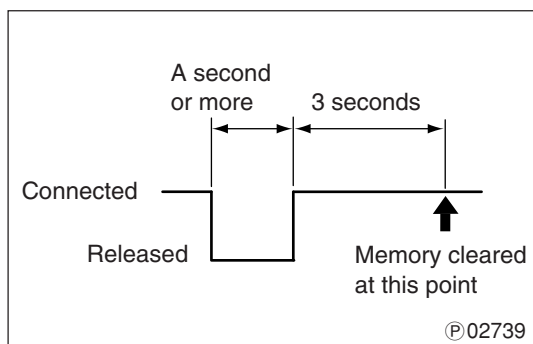
● Past Diagnostic Trouble Code

- After reading the current diagnostic trouble codes (with the diagnostic switch **2** disconnected), disconnect the memory clear switch **1**. Then the  warning lamp **3** will restart flashing.
- This time, the warning lamp displays the past diagnostic trouble codes. Determine the fault locations based on the indicated codes.



● Reading Diagnostic Trouble Code

- Diagnostic trouble codes are indicated by the number of times the warning lamp **3** flashes and their duration.
- The flashing intervals also differ between the 10s digit and units digit.
 - 10s digit: 1.2 second interval
 - Units digit: 0.4 second interval
- Each diagnostic trouble code is displayed from the 10s digit followed by the units digit. As for a code which has no 10s digit, units digit only is displayed.
- Each diagnostic trouble code is displayed three times in succession.
- If there is no more code stored, the sequence is then repeated from the beginning with each code indicated three times.
- When the diagnostic switch **2** is connected, the engine control unit will immediately stop displaying codes.



● Erasing Diagnostic Trouble Code

Disconnect the memory clear switch **1**, then reconnect it. Then all the diagnostic trouble codes stored in the engine control unit will be cleared.

CAUTION

- Stored diagnostic trouble codes are cleared by the operation of the memory clear switch **1** alone.
- If clearing the memory of the electronic control unit is not desired after a stored diagnostic trouble code is displayed, turn off the starter switch with the memory clear switch **1** disconnected, then reconnect the memory clear switch.

TROUBLESHOOTING

1.4 Diagnostic trouble code and check items

Diagnostic trouble code list

Diagnostic trouble code		Message
Multi-use tester-III screen display	Blinking of engine warning lamp	
P0380	26	Relay for Glow Relay
P0616	48	Starter Safety Relay
P0617		Starter Safety Relay

Blinking of engine warning lamp	26	
Multi-use tester-III screen display	P0380 Relay for Glow Relay	
Code issued condition [Reset condition]	Short circuit, break, or overload in glow drive relay [If normal signals are produced when starter switch is ON, condition is reset.]	
Action taken by electronic control unit	Suspension of glow control	
State of vehicle	Deteriorated ease of starting at low temperature	
Warning lamp illuminated	—	
Probable cause and check item	• Open or short circuit in harness between electronic control unit and glow drive relay • Each connector faulty • Glow drive relay faulty • Electronic control unit faulty • Perform checks at electronic control unit connector. • Perform checks on the basis of Multi-Use Tester-III actuator test. No. AF : Relay for Glow relay • Perform checks on the basis of Multi-Use Tester-III service data. No. 8D : Glow Relay • Check Glow drive relay. • Check circuit between electronic control unit and glow drive relay.	

Blinking of engine warning lamp	48
Multi-use tester-III screen display	P0616 Starter Safety Relay
Code issued condition [Reset condition]	Short circuit on power supply side [If normal signals are produced when starter switch is ON, condition is reset.]
Action taken by electronic control unit	Normal control
State of vehicle	Normal running
Warning lamp illuminated	ENGINE CHECK (Orange)
Probable cause and check item	• Short to battery in harness between electronic control unit safety relay • Each connector faulty • Safety relay faulty • Electronic control unit faulty • Perform checks at electronic control unit connector. • Perform checks on the basis of Multi-Use Tester-III actuator test. No. B1 : Starter Safety Relay • Perform checks on the basis of Multi-Use Tester-III service data. No. 8F : Starter Safety Relay • Check safety relay. • Check circuit between electronic control unit and safety relay.

Blinking of engine warning lamp	48
Multi-use tester-III screen display	P0617 Starter Safety Relay
Code issued condition [Reset condition]	Grounded without through engine ECU or broken wire (when safety relay is not operating) [If normal signals are produced when starter switch is ON, condition is reset.]
Action taken by electronic control unit	Normal control
State of vehicle	Normal running
Warning lamp illuminated	ENGINE CHECK (Orange)
Probable cause and check item	• Open or short circuit in harness between electronic control unit safety relay • Each connector faulty • Safety relay faulty • Electronic control unit faulty • Perform checks at electronic control unit connector. • Perform checks on the basis of Multi-Use Tester-III actuator test. No. B1 : Starter Safety Relay • Perform checks on the basis of Multi-Use Tester-III service data. No. 8F : Starter Safety Relay • Check meter cluster. • Check circuit between electronic control unit and safety relay.

TROUBLESHOOTING

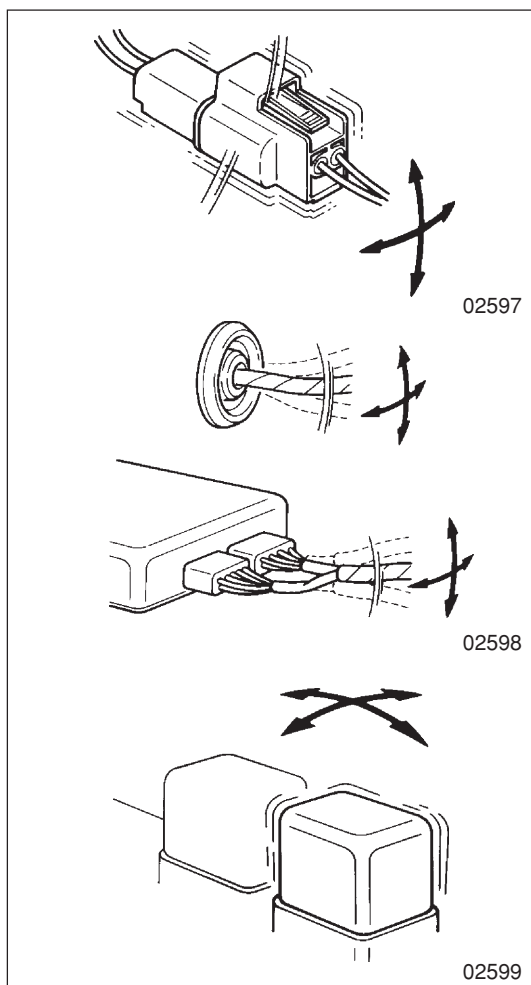
1.5 Service Data of Multi-Use Tester-III

Screen Display of Multi-Use Tester-III			Condition When Checking	Judging Criteria
No.	Item Name	Data		
8D	Glow Relay	ON/OFF	Stater switch ON, Engine coolant temperature < 60 °C	ON
			Stater switch OFF	OFF
8E	Glow Relay Indicator Lamp	ON/OFF	Stater switch ON, Engine coolant temperature < 60 °C	ON
			Stater switch OFF	OFF
8F	Starter Safety Relay	ON/OFF	Stater switch ON, Perform the actuator test No.B1 Starter Safety Relay test.	ON
			Stater switch OFF	OFF

1.6 Actuator Test by Multi-Use Tester-III

Screen Display of Multi-Use Tester-III		Operation check procedure
No.	Item Name	
AF	Relay for Glow Relay	ON/OFF sound of relay
B0	Glow Indicator Lamp	Lamp status inverted during
B1	Starter Safety Relay	ON/OFF sound of relay

1.7 Checks on Transient Troubles



A transient trouble often occurs in a specific condition. Therefore, pinpointing the condition will make it easy to estimate the cause. To pinpoint the condition for a transient trouble, ask the customer in detail about the driving condition when the trouble occurs, weather, occurrence frequency and symptoms, and reproduce the symptoms of the trouble.

Depending on the condition where the trouble occurs, determine whether the cause of the trouble is vibration, temperature or any other factor. If the probable cause is vibration, perform the following checks on the relevant connectors harnesses, etc., and check whether the symptoms of the trouble are reproduced.

- Lightly move the connector up and down and to the right and left.
- Lightly move the harness up and down and to the right and left.
- Lightly shake the sensors and other devices by hand.
- Lightly shake the wiring harness located in the moving components such as the suspension.

The connectors and other parts to be checked are identifiable from the descriptions in the Probable Causes or the Checking Procedures for the displayed diagnostic trouble code.

TROUBLESHOOTING

2. Power and charging

Symptoms							Remarks
Possible causes		Battery electrolyte decreases too early	Battery overheating	Battery is normal but overdischarged	Charge warning lamp  does not light when starter switch is turned ON, with engine stopped	Alternator is normal but battery over-discharged	
Defective connector connection, harness open/short circuit, defective grounding				☐		☐	
Fuse blown				☐	☐	☐	
V-belts loose				☐		☐	 Gr 14
V-belts damaged				☐		☐	 Gr 14
Battery faulty		☐				☐	
Alternator	Stator coil broken			☐			
	Stator coil short-circuited with core			☐			
	Field coil faulty			☐			
	Rectifier faulty			☐			
	Regulator faulty		☐	☐	☐		
	Wiring faulty			☐			
Meter cluster faulty					☐		

3. Engine starting, preheating and stopping

Symptoms		Starter does not operate	Starter operates but engine does not start			Engine does not stop	Engine cannot be preheated	Engine is hard to start	Remarks
			Pinion does not engage with ring gear	Pinion engages with ring gear but does not rotate	Flywheel rotates but engine does not start				
Possible causes									
Defective connector connection, harness open/short circuit, defective grounding		☐			☐	☐	☐		
High-current fuse blown		☐							
Fuse blown		☐				☐	☐		
Battery insufficiently charged		☐		☐					
Starter	Magnetic switch contacts stuck or fused together	☐							
	Open circuit in magnetic switch coil	☐							
	Overrunning clutch malfunctioning			☐					
	Pinion worn or damaged		☐						
Starter relay defective		☐							
Starter switch defective		☐				☐			
Flywheel ring gear worn or damaged			☐						 Gr 11
Glow plugs defective							☐	☐	
Glow relay defective							☐	☐	
Water temperature sensor defective							☐	☐	
Engine ECU defective		☐					☐	☐	
Faulty connection of connecting plate							☐	☐	 Gr 11
Transmission neutral switch faulty < M/T >		☐							
Transmission neutral relay faulty < M/T >		☐							
Neutral start relay faulty		☐							
Vehicle interface module faulty < FM65 (A/T) >		☐							 Gr 23
Safety relay faulty		☐							

A/T : Automatic transmission

M/T : Manual transmission

ECU: Electronic control unit

[illegible]

Possible causes		Does not light.	Dimmer	Does not switch to main beam.	Does not switch to dipped beam.	Tail lamp does not light.	Stop lamp does not light.	Parking lamp does not light.	Position lamp does not light.	License plate lamp does not light.	Backup lamp does not light.	Back buzzer does not sound.	Remarks
Defective connector connection, harness open/short circuit, defective grounding		☐				☐	☐	☐	☐	☐	☐	☐	
Fuse blown		☐				☐	☐	☐	☐	☐	☐	☐	
Battery capacity insufficient			☐										
Alternator output insufficient			☐										
Bulb burnt-out		☐				☐	☐	☐	☐	☐	☐	☐	
Power (wattage) of bulb is lower than specified value													
Power (wattage) of bulb is higher than specified value													
Combination switch	Lighting switch faulty	☐				☐		☐	☐	☐			
	Turn signal lamp switch faulty												
	Dimmer switch faulty			☐	☐								
	Hazard warning lamp switch faulty												
Relay box	Headlamp relay (HIGH, LOW) faulty	☐		☐	☐								
	Tail lamp relay faulty					☐		☐	☐	☐			
	Flasher unit faulty												
Stop lamp switch faulty							☐						
Backup lamp switch faulty											☐	☐	
Back buzzer faulty												☐	
Cab lamp switch faulty													
Cab lamp faulty													
Door switch faulty													
Rheostat switch faulty													
Tail lamp bulb burnt-out												☐	

Symptoms		Turn signal lamp (also used as hazard)					Cab lamp does not light.	Interior illumination lamps for meters, heater control panel, etc. cannot be adjusted	Marker lamp does not light.	Remarks
		Does not blink.	Stays ON.	Blinks too slowly.	Blinks too quickly.	Blinks irregularly.				
Possible causes										
Defective connector connection, harness open/short circuit, defective grounding		☐					☐	☐	☐	
Fuse blown		☐					☐		☐	
Battery capacity insufficient			☐							
Alternator output insufficient			☐							
Bulb burnt-out		☐			☐			☐	☐	
Power (wattage) of bulb is lower than specified value					☐					
Power (wattage) of bulb is higher than specified value				☐						
Combination switch	Lighting switch faulty								☐	
	Turn signal lamp switch faulty									
	Dimmer switch faulty									
	Hazard warning lamp switch faulty	☐	☐							
Relay box	Headlamp relay (HIGH, LOW) faulty									
	Tail lamp relay faulty							☐	☐	
	Flasher unit faulty	☐	☐	☐	☐	☐				
Stop lamp switch faulty										
Backup lamp switch faulty										
Back buzzer faulty										
Cab lamp switch faulty							☐			
Cab lamp faulty						☐				
Door switch faulty							☐			
Rheostat switch faulty								☐		

TROUBLESHOOTING

Lighting

Symptoms		Van body dome light does not light	Daytime running light system does not operate after engine starts, and headlamps do not light	Identification lamp does not light	Remarks
Defective connector connection, harness open/short circuit, defective grounding		☐	☐	☐	
Fuse blown		☐		☐	
Battery capacity insufficient					
Alternator output insufficient			☐		
Bulb burnt-out		☐	☐	☐	
Power (wattage) of bulb is lower than specified value					
Power (wattage) of bulb is higher than specified value					
Combination switch	Lighting switch faulty	☐			
	Turn signal lamp switch faulty				
	Dimmer switch faulty				
	Hazard warning lamp switch faulty				
Relay box	Headlamp relay (HIGH, LOW) faulty	☐	☐		
	Tail lamp relay faulty			☐	
	Flasher unit faulty				
Van body dome light relay faulty		☐			
Van body dome light switch faulty		☐			
Daytime running light electronic control unit faulty			☐		

5. Meter

Possible causes		Symptoms				Remarks
		Pointer does not move	Pointer movement unstable	Indication error large	Abnormal noise from meter	
Defective connector connection, harness open/short circuit, defective grounding		☐	☐			
Fuse blown		☐				
Internal circuits of meter cluster faulty		☐	☐	☐		
Printed wiring board of meter cluster faulty		☐				
Tachometer	Engine speed sensor coil open-circuited	☐				
	Engine speed sensor improperly mounted	☐	☐			 Gr 11, 13
	Tachometer faulty	☐	☐	☐	☐	
	Engine electronic control unit faulty	☐	☐	☐		 Gr 13
Speedometer	Speedometer cable broken	☐				
	Speedometer cable connection faulty		☐		☐	
	Speedometer cable lubricant exhausted		☐		☐	
	Specified tires not used			☐		 Gr 31
	Tires worn or inflation pressure incorrect			☐		 Gr 31
	Specified L-joint of transmission not used (Difference in gear ratio)			☐		 Gr 22
	Specified speedometer gear of transmission not used (Difference in gear ratio)			☐		 Gr 22
	Installation angle of speedometer gear bushing on transmission incorrect (Not set at correct gear ratio position)			☐		 Gr 22
	Speedometer faulty	☐	☐	☐	☐	
Water temperature gauge	Water temperature sensor faulty	☐		☐		
	Water temperature gauge faulty	☐		☐		
	Thermostat does not close	☐				 Gr 14
Fuel gauge	Fuel level sensor faulty	☐		☐		
	Fuel gauge faulty	☐		☐		

TROUBLESHOOTING

6. Cigarette lighter and Audio

Symptoms	Cigarette lighter			Audio				Remarks
	Does not glow	Does not return	Night lamp does not light up	Specific frequency band does not work	Spurious noise generated	Sound quality poor	Sound from one side only	Left and right volume different
Possible causes								
Defective connector connection, harness open/short circuit, defective grounding	☐	☐	☐	☐	☐	☐	☐	
Fuse blown	☐	☐	☐	☐	☐	☐	☐	
Cigarette lighter faulty	☐	☐	☐	☐	☐	☐	☐	
Tail lamp relay faulty	☐	☐	☐	☐	☐	☐	☐	
Antenna and antenna cable connection faulty	☐	☐	☐	☐	☐	☐	☐	
Speaker faulty	☐	☐	☐	☐	☐	☐	☐	
Left and right speaker impedance different	☐	☐	☐	☐	☐	☐	☐	

7. Accessory noise generation source

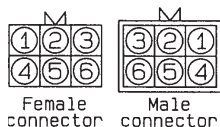
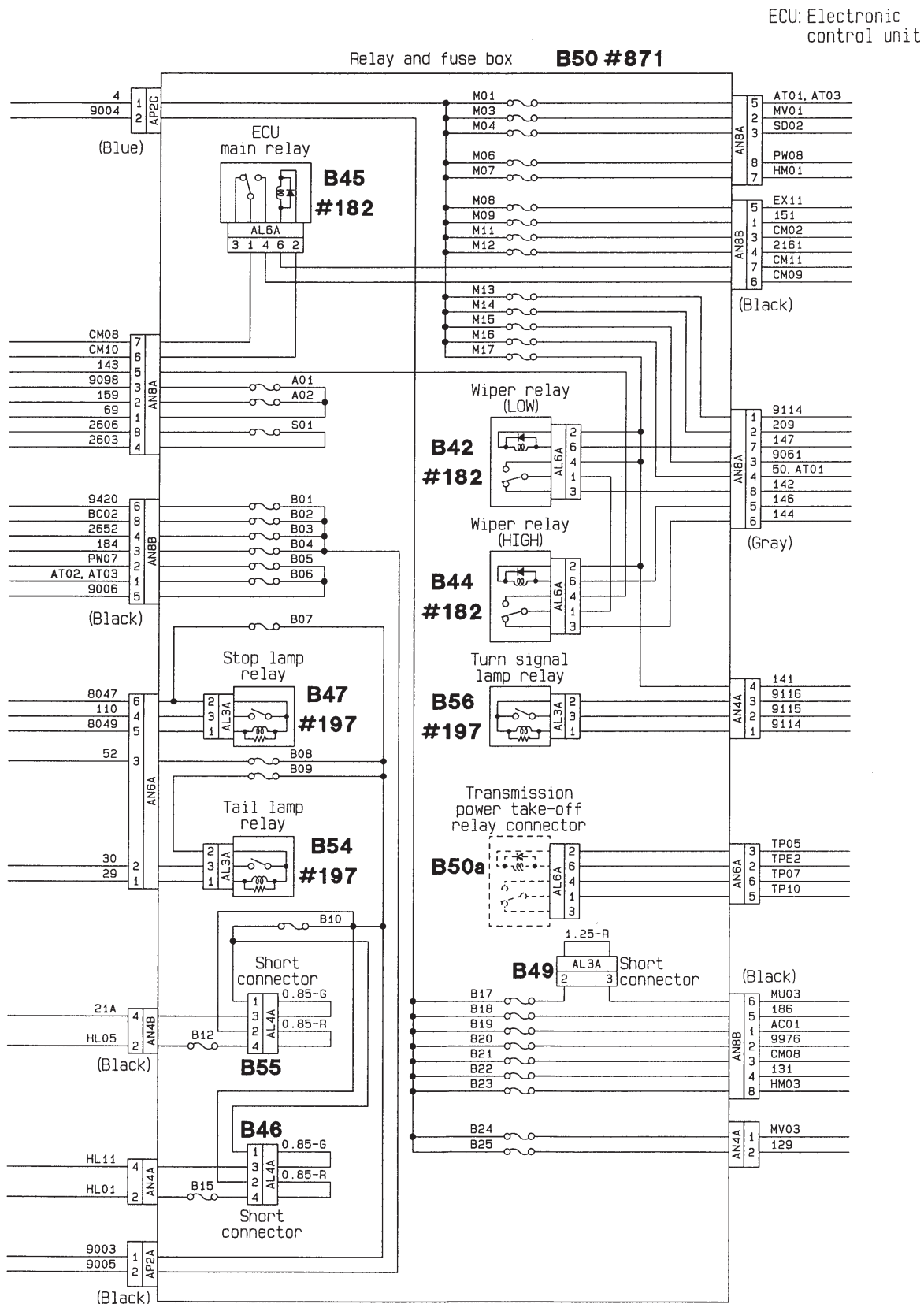
Accessory	Noise	Symptoms
Alternator	Whistling	High pitch sound when accelerator pedal suddenly depressed (Stops soon after engine stopped)
Water temperature gauge	Scratching	Occurs when engine running (Continues for a while after engine stops)
Engine oil pressure switch	Rattling	Depends on engine speed (Does not occur during idling)
Fuel level sensor	Scratching	Occurs when engine suddenly revved, while running on rough roads, or starter switch turned ON
Flasher unit	Banging	When turn signal blinks
Horn	Hissing	Occurs when horn button pressed or released
Wiper motor	Whining	Depends on wiper speed
Windshield washer motor	Whining	When windshield washer operates

8. Horn

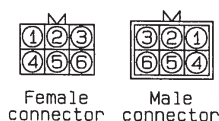
Symptoms	Horn				Remarks
	No Sound	Continuous sound	Small sound	Sound quality poor	
Possible causes					
Defective connector connection, harness open/short circuit, defective grounding	☐	☐	☐	☐	
Fuse blown	☐	☐	☐	☐	
Horn switch faulty	☐	☐	☐	☐	
Horn faulty	☐	☐	☐	☐	
Horn stay warped	☐	☐	☐	☐	
Battery voltage insufficient	☐	☐	☐	☐	
Air leaking from air system	☐	☐	☐	☐	

1 POWER, CHARGE AND GROUND CIRCUIT

104 RELAY AND FUSE BOX CIRCUIT

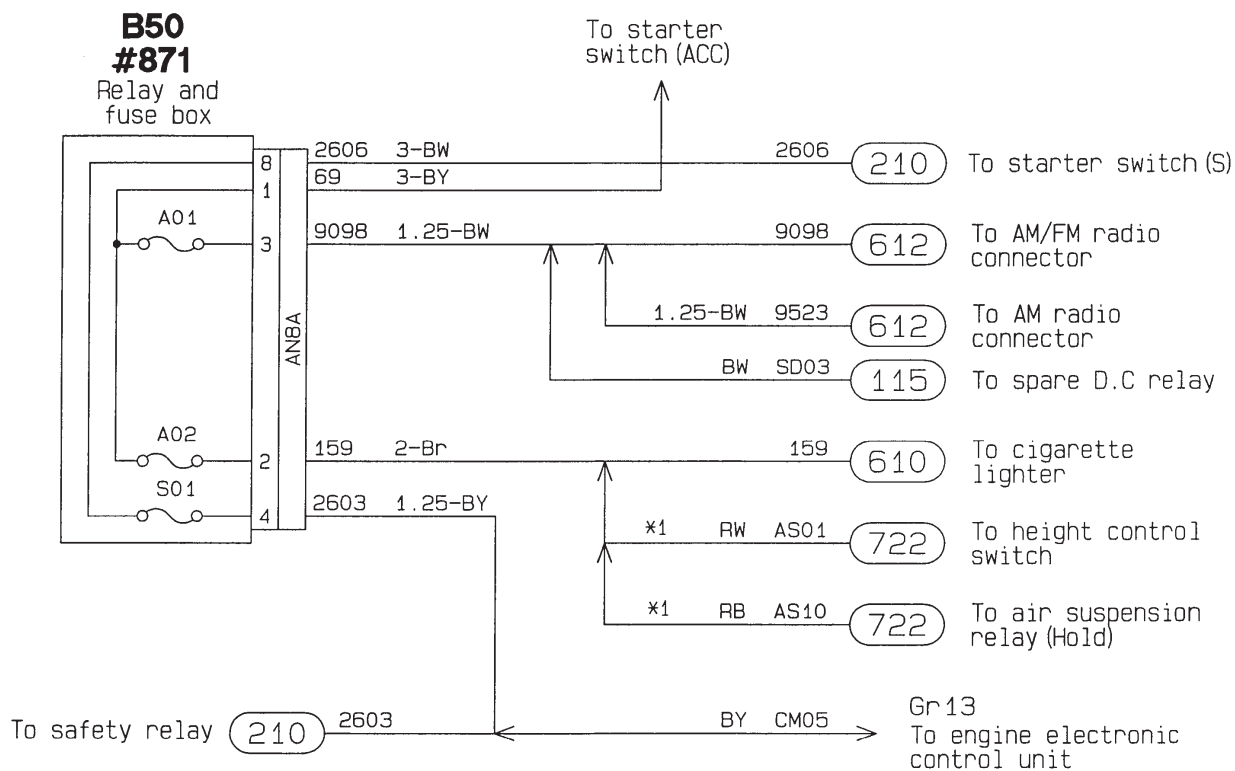


C00362



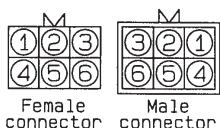
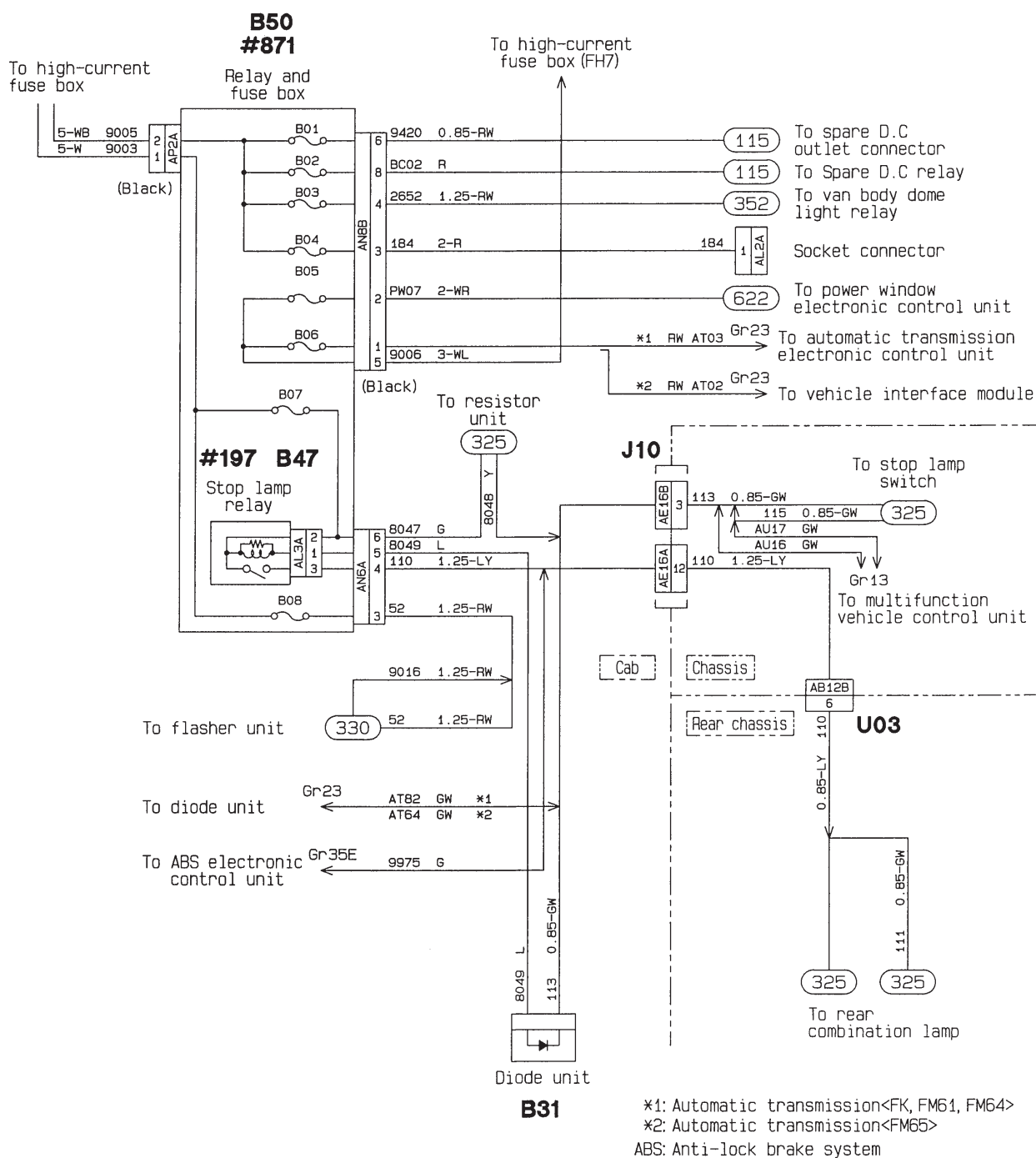
110 POWER CIRCUIT

Fuse A01, A02, S01



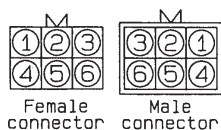
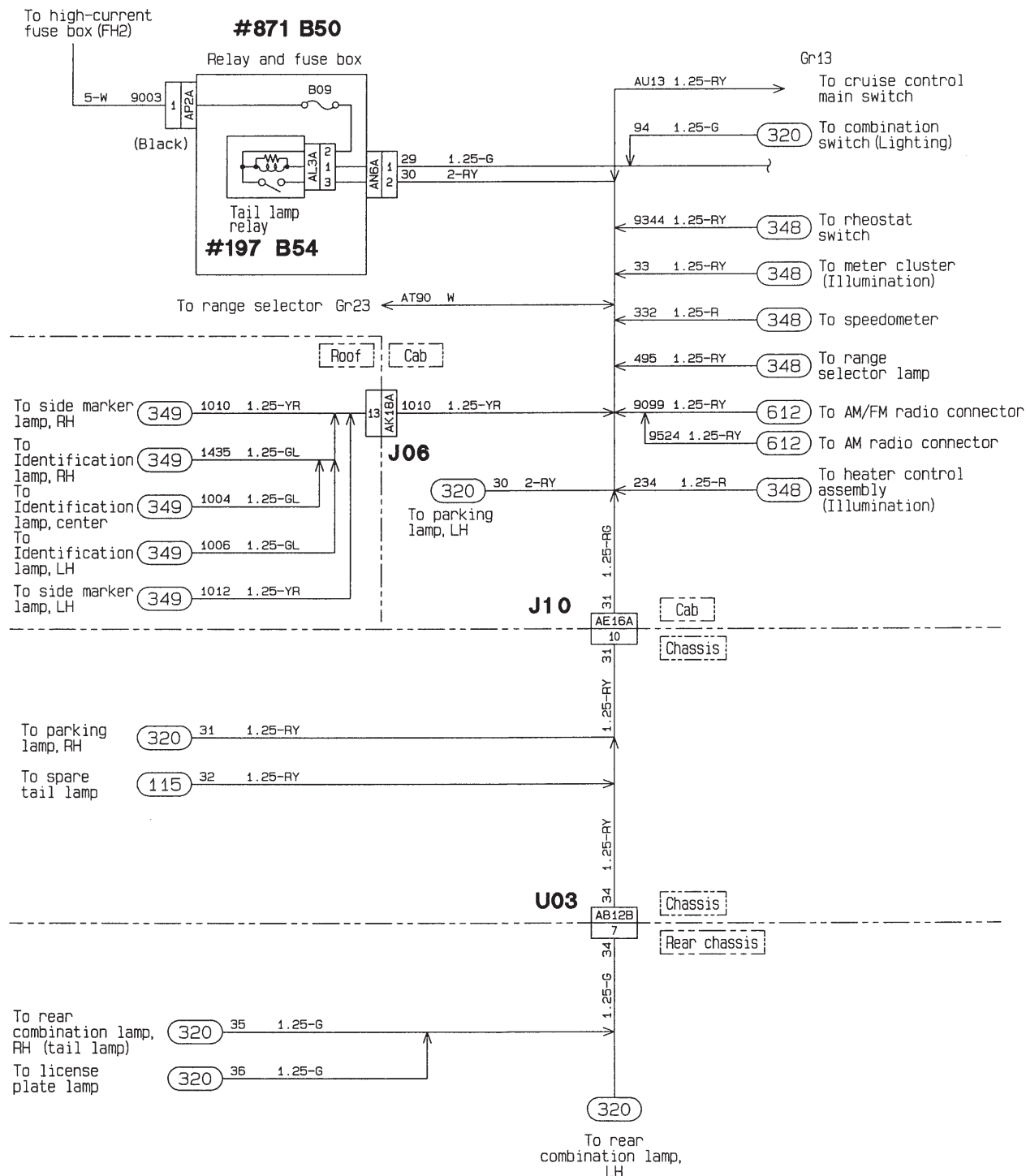
*1: Air suspension

Fuse B01 to B08



110 POWER CIRCUIT

Fuse B09



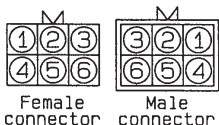
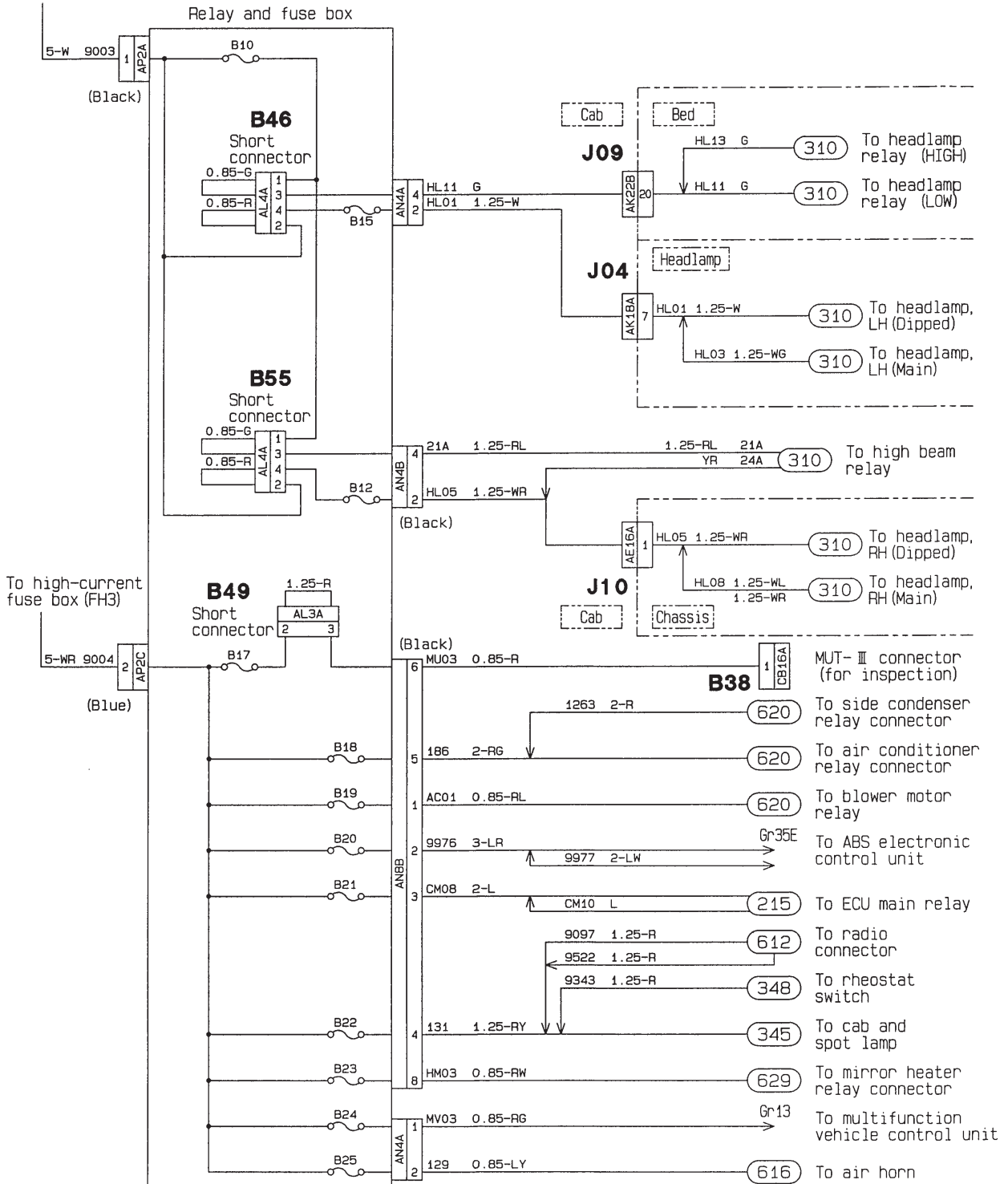
C00366

Fuse B10 to B25

To high-current
fuse box (FH2)

#871 B50

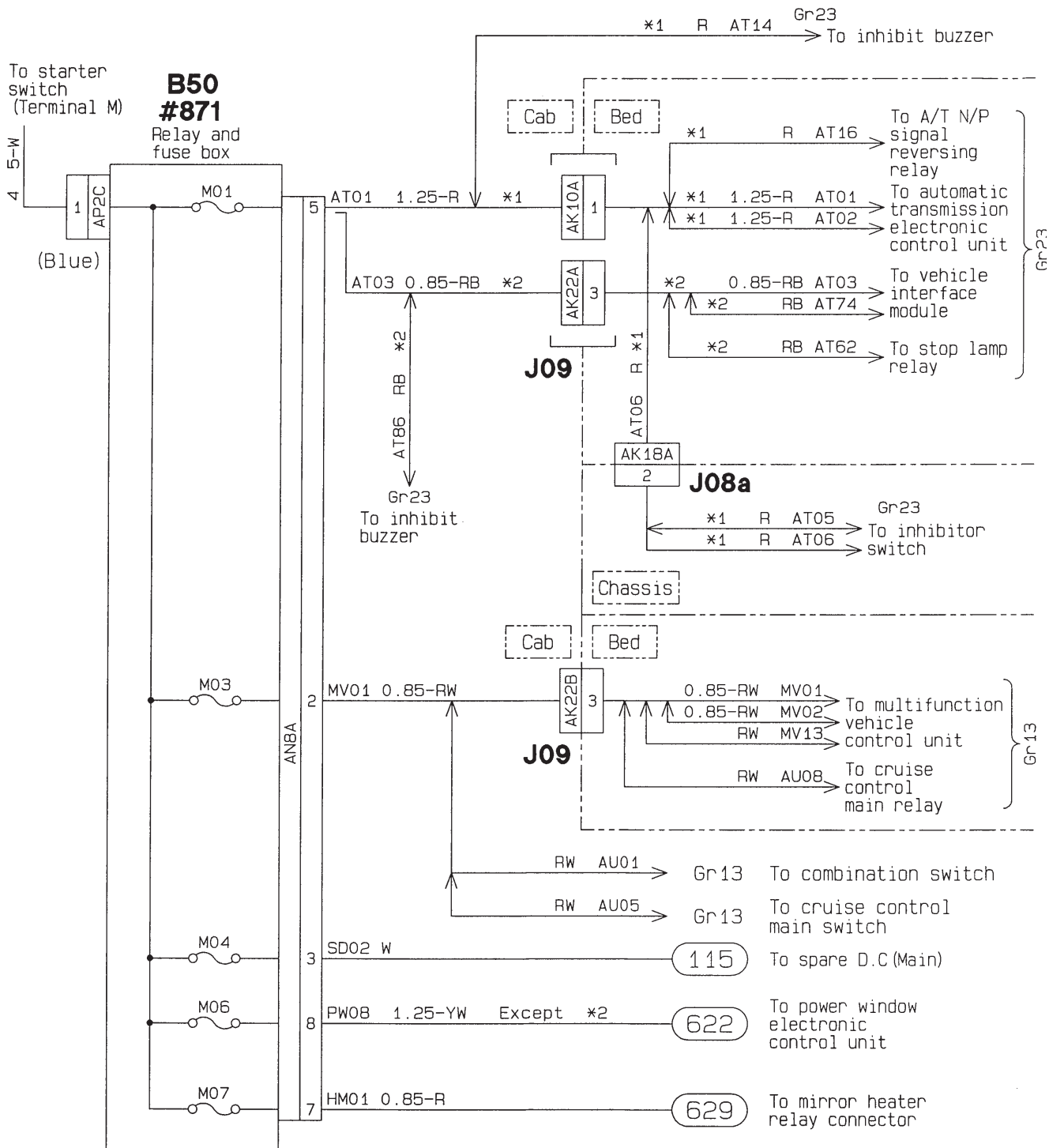
Relay and fuse box



ABS: Anti-lock brake system
MUT: Multi-use tester
ECU: Electronic control unit

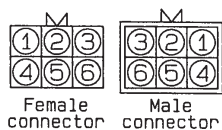
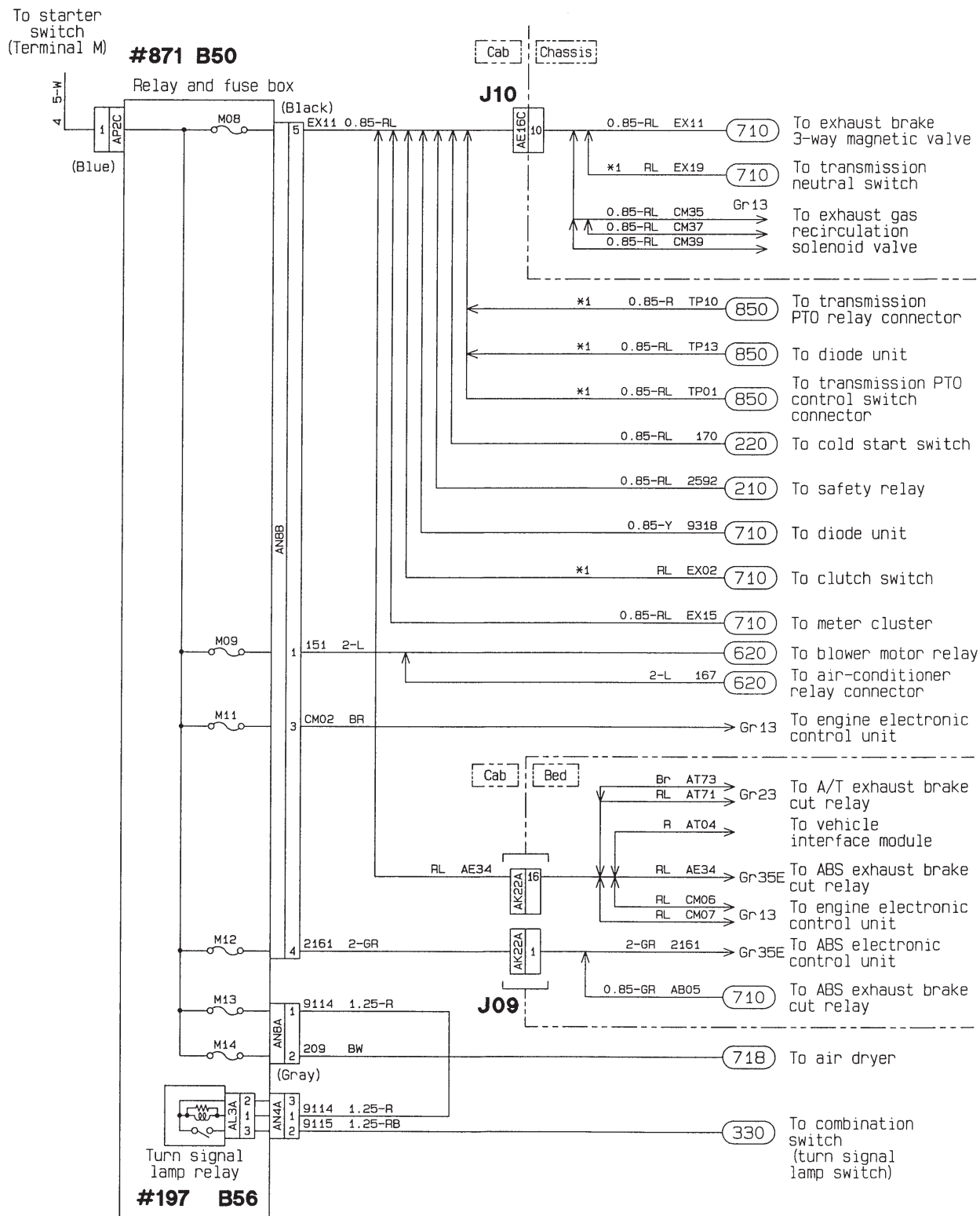
110 POWER CIRCUIT

Fuse M01 to M07



C00368

Fuse M08 to M14



*1: Manual transmission

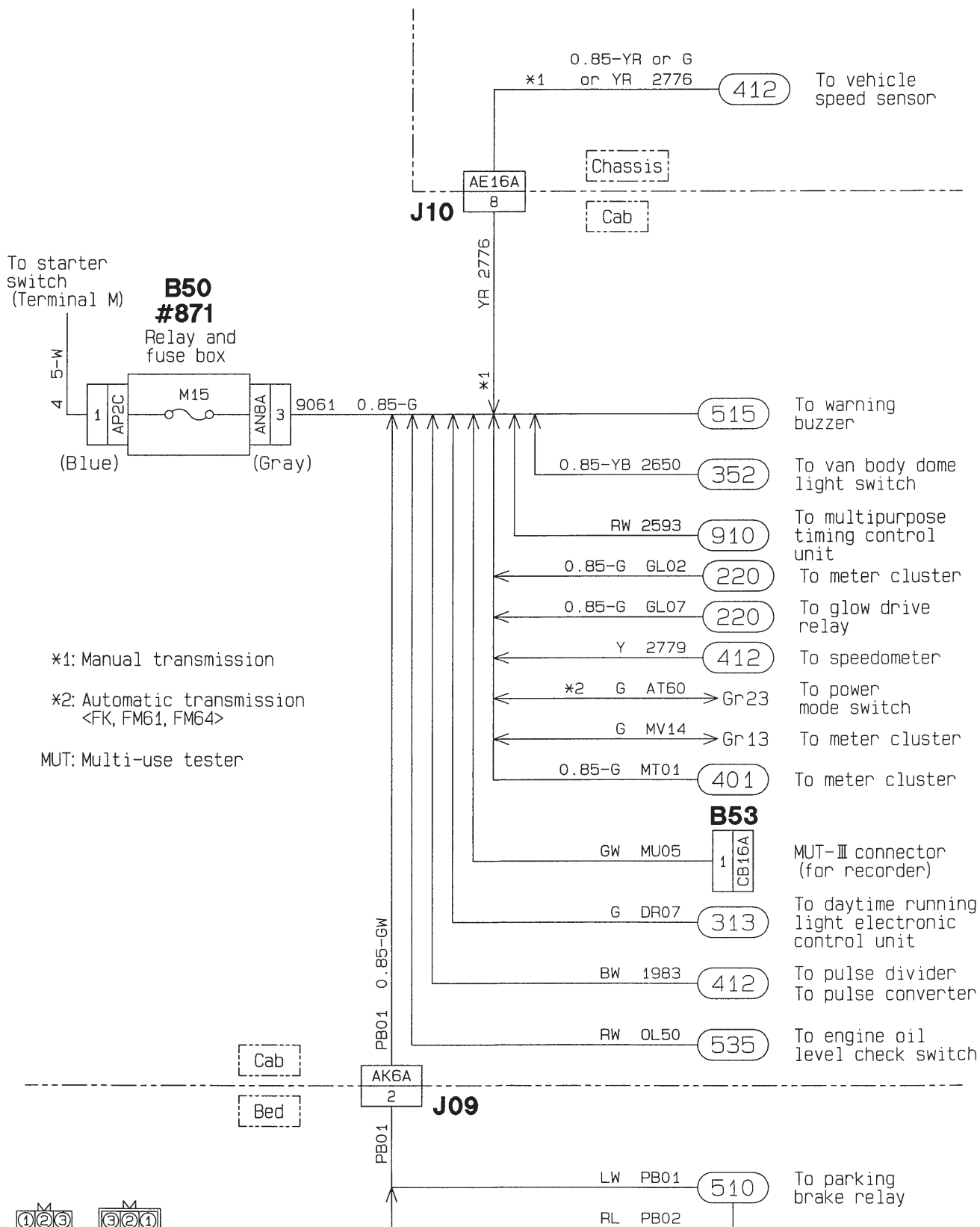
ABS: Anti-lock brake system

PTO: Power take-off

A/T: Automatic transmission

110 POWER CIRCUIT

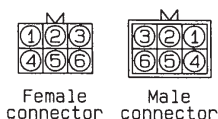
Fuse M15



*1: Manual transmission

*2: Automatic transmission
<FK, FM61, FM64>

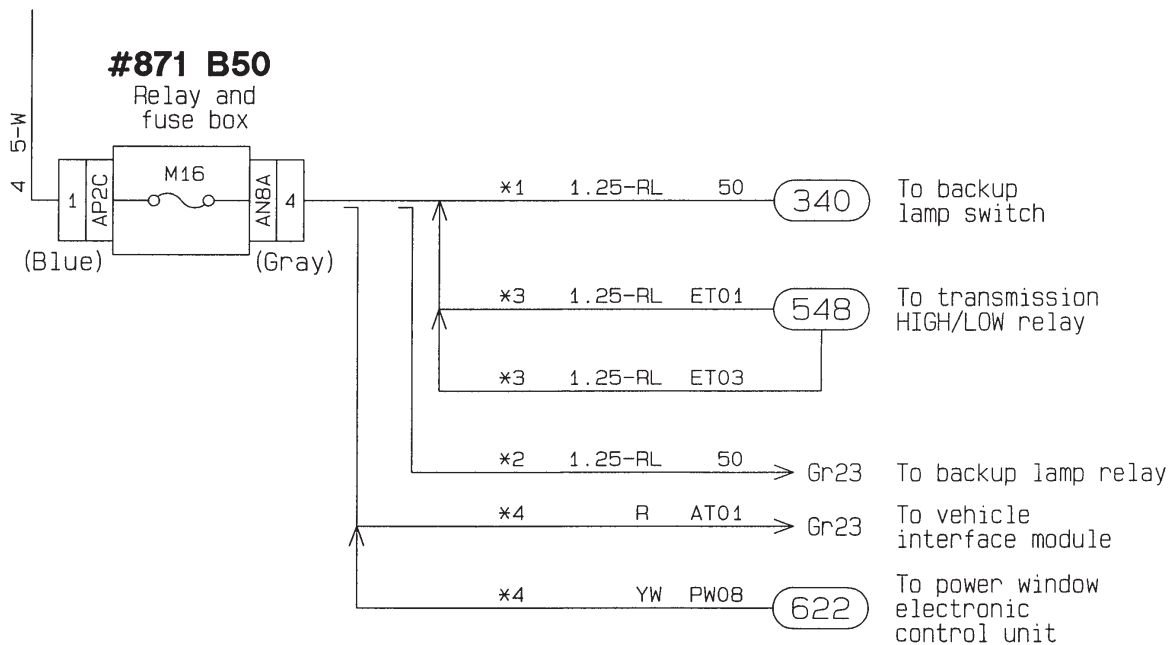
MUT: Multi-use tester



C00370

Fuse M16

To starter switch
(Terminal M)

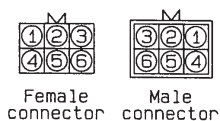


*1: Manual transmission

*2: Automatic transmission<FK, FM61, FM64>

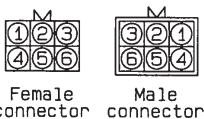
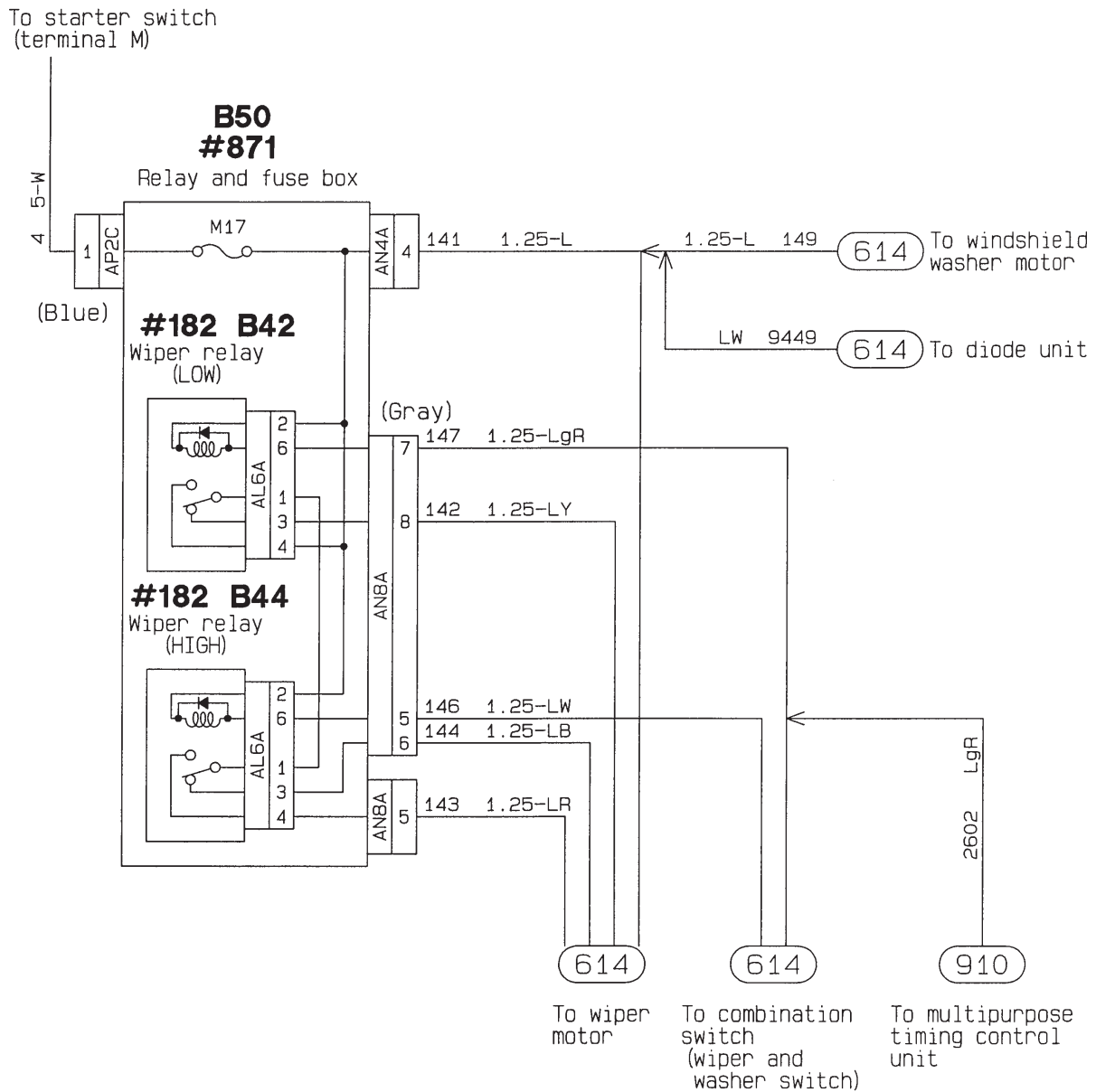
*3: EATON transmission

*4: Automatic transmission<FM65>



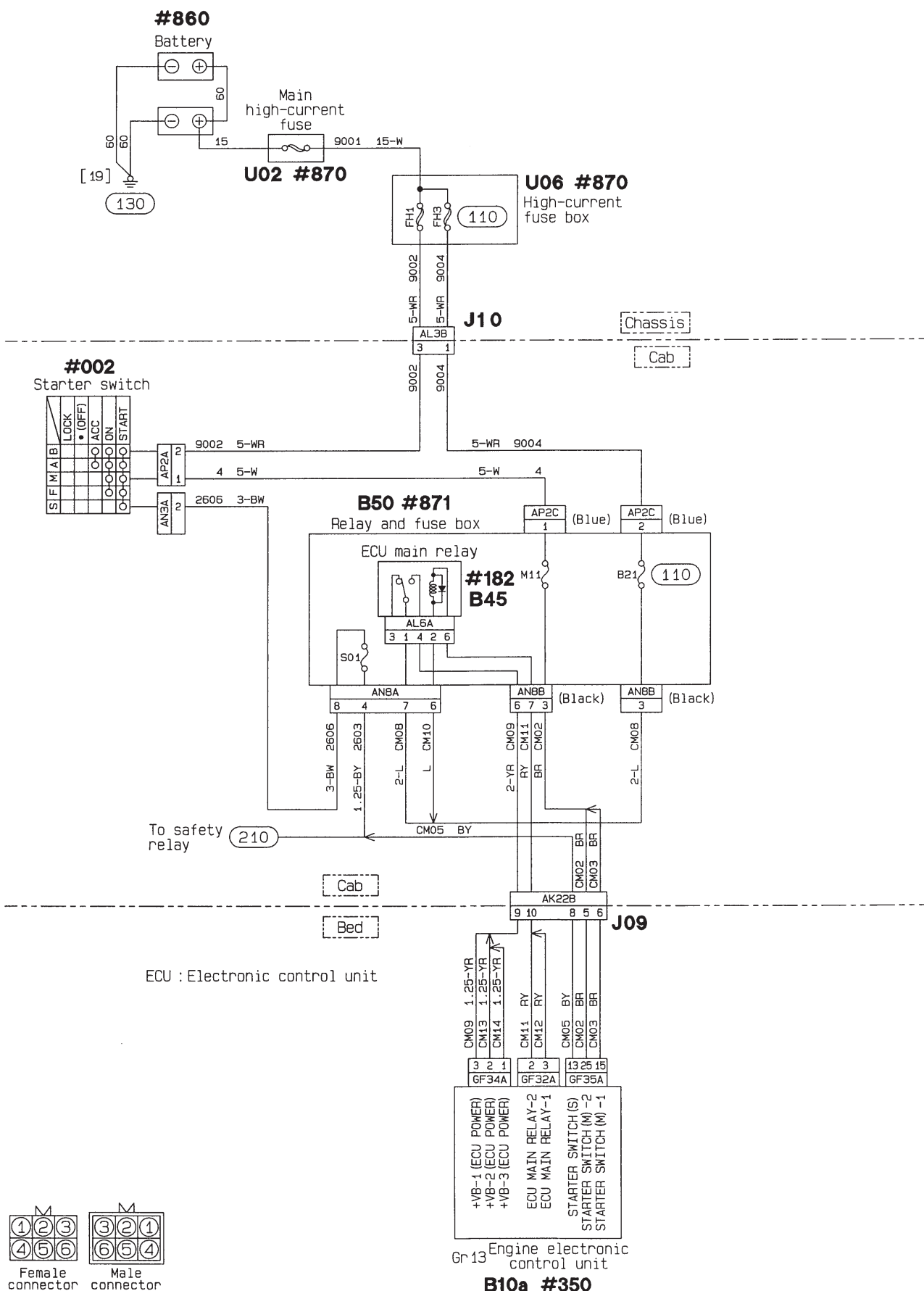
110 POWER CIRCUIT

Fuse M17

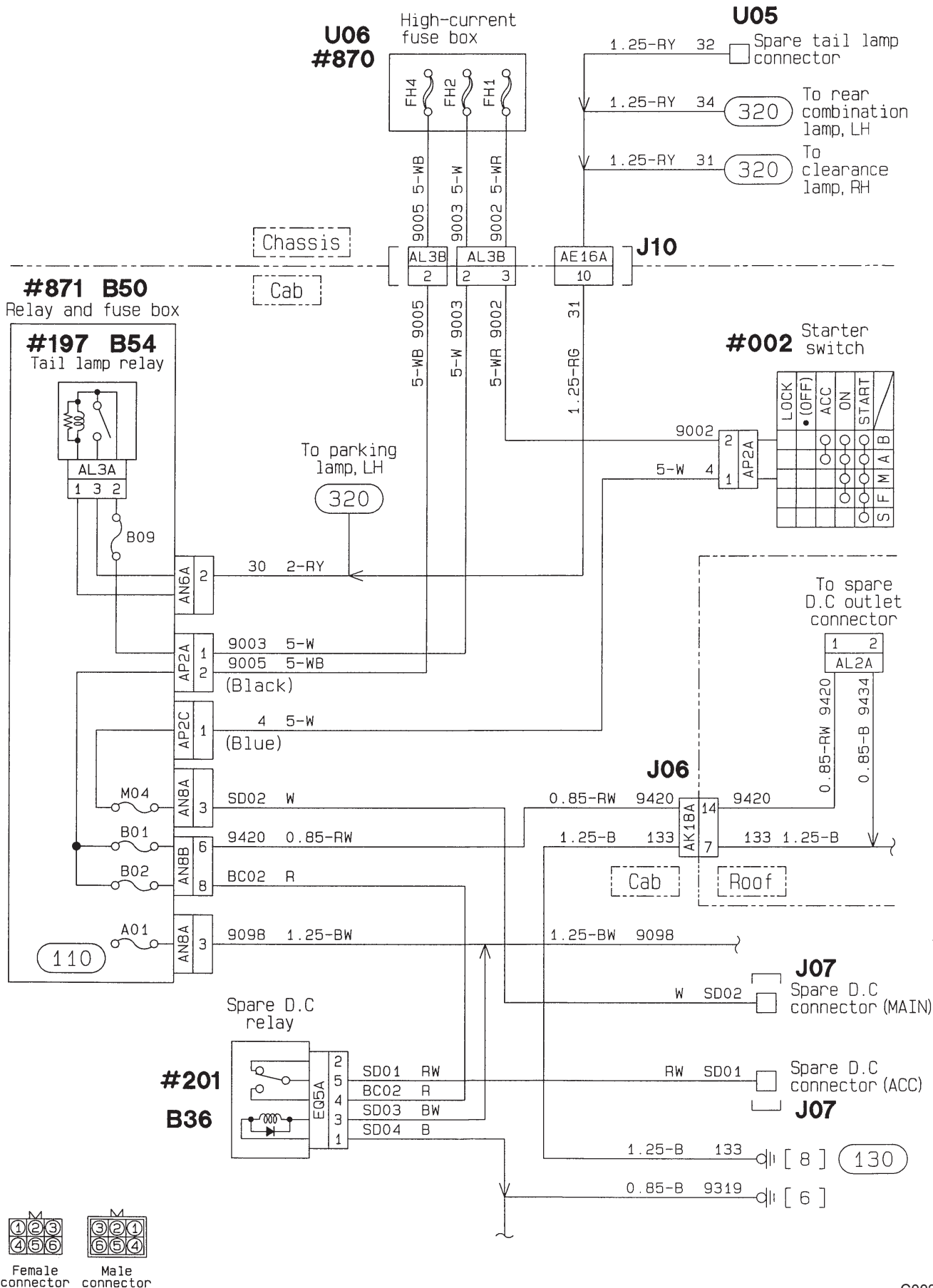


C00372

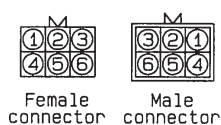
<Engine electronic control unit>



115 RESERVE POWER CIRCUIT

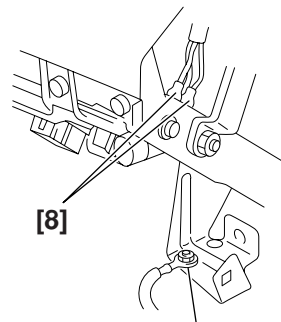
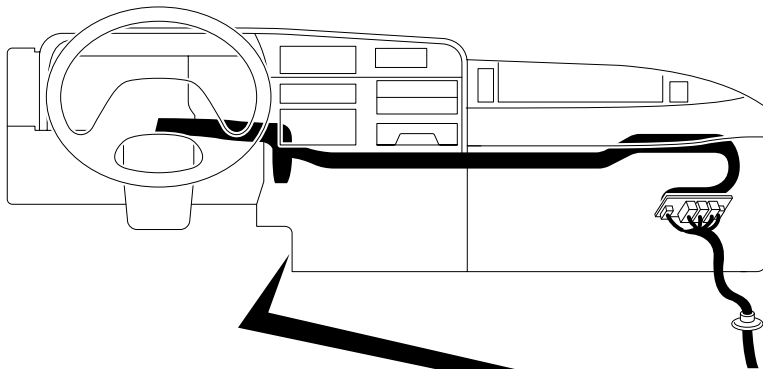


C00373



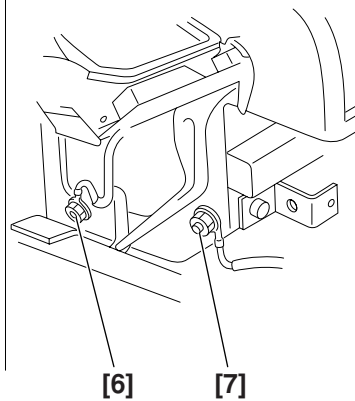
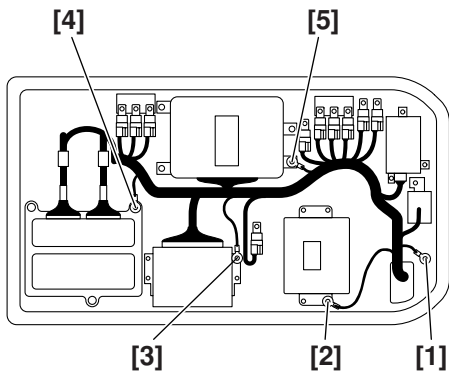
130 GROUND

[1] to [12]

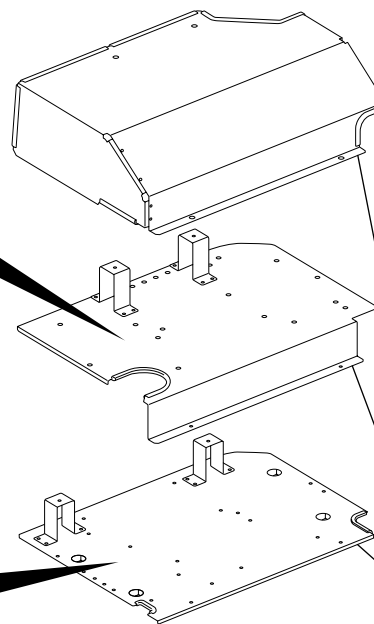
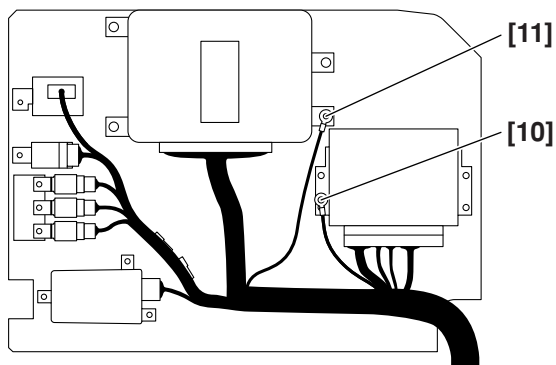
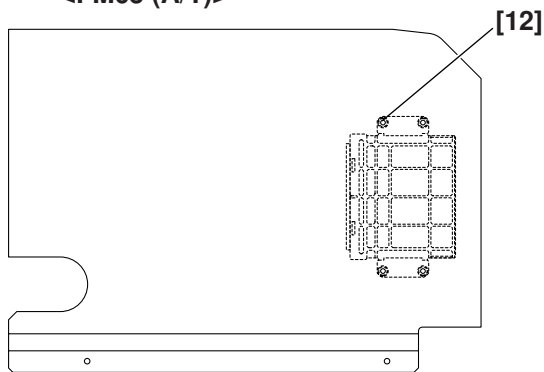


[9] <FM65 (A/T)>

<Except FM65 (A/T)>



<FM65 (A/T)>



Behind driver's seat

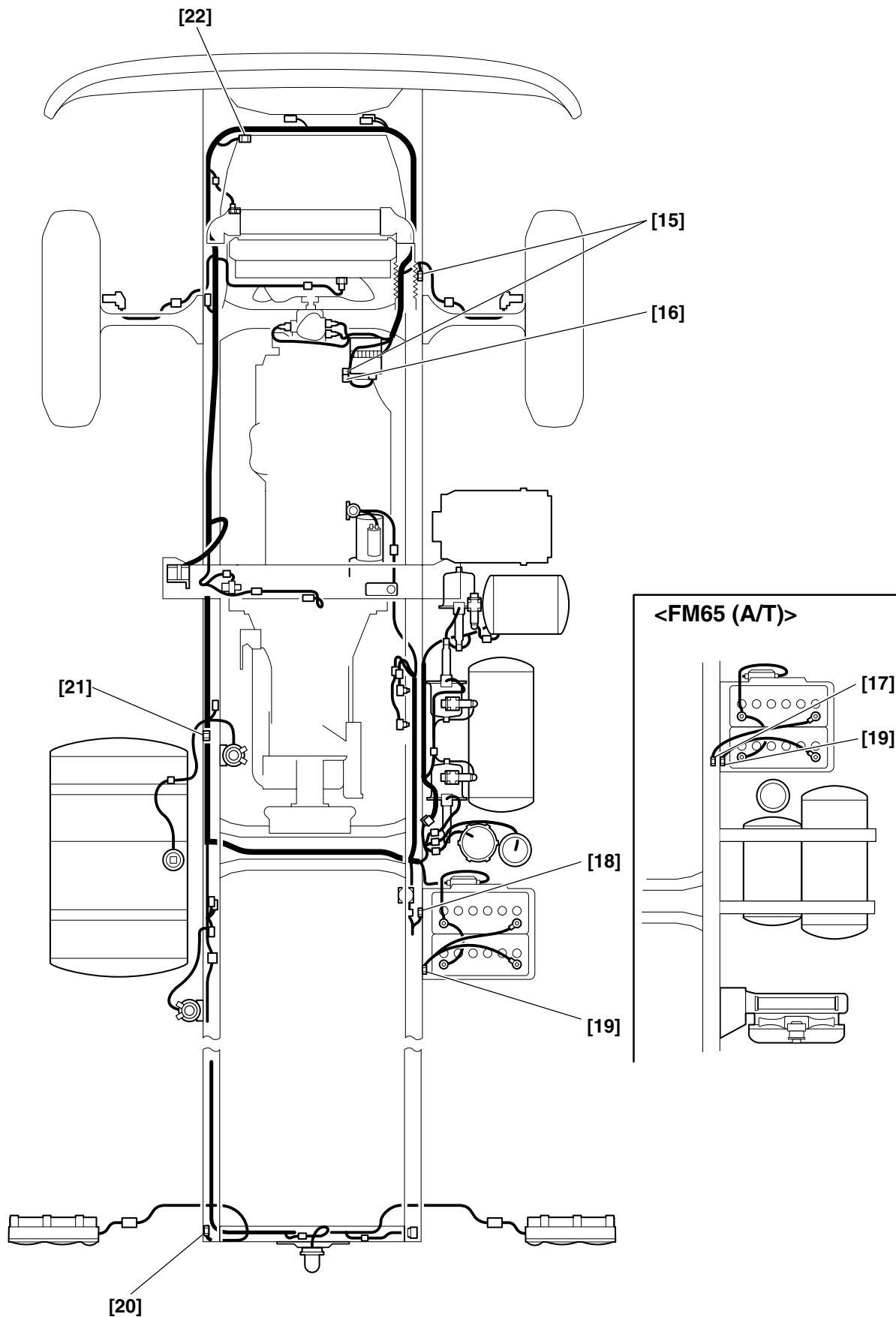
L00148

Location	Circuit No.	Wire diameter-wire color	Remarks
[1]	ATE0	B	Except FM65 <A/T>
	MVE9	B	Except FM65 <A/T>
	9256	0.85-B	Except FM65 <A/T>
	CME6	1.25-B	Except FM65 <A/T>
	CME7	0.85-B	Except FM65 <A/T>
[2]	MVE9	B	Except FM65 <A/T>
[3]	9256	0.85-B	Except FM65 <A/T>
[4]	ATE0	B	Except FM65 <A/T>
[5]	CM64	YR	Except FM65 <A/T>
	CME7	0.85-B	Except FM65 <A/T>
[6]	185	3-B	
	9319	0.85-B	
	CME7	0.85-B	
	PWE1	2-B	
[7]	9106	1.25-B	
[8]	68	1.25-B	
	133	1.25-B	
	160	1.25-B	
	210	8-B	
[9]	9256	0.85-B	FM65 <A/T>
	MVE9	B	FM65 <A/T>
	CME7	0.85-B	FM65 <A/T>
[10]	9256	0.85-B	FM65 <A/T>
[11]	CME6	1.25-B	FM65 <A/T>
	CME7	0.85-B	FM65 <A/T>
[12]	MVE9	B	FM65 <A/T>

A/T : Automatic transmission

130 GROUND

[15] to [22]



L00149

Location	Circuit No.	Wire diameter-wire color	Remarks
[15]	2423	20-BL	
[16]	—	20-B	Alternator ground
[17]	ATE1	B	FM65 <A/T>
	ATE4	B	FM65 <A/T>
	2145	2-B	FM65
	HLE3	1.25-B	FM65
	AFE1	3-B	FM65 <A/T>
	AFE2	3-B	FM65 <A/T>
[18]	HLE3	1.25-B	FK, FM61, FM64
	2145	2-B	FK, FM61, FM64
	ATE1	1.25-B	A/T <FK, FM61, FM64>
[19]	60	—	Battery ground
[20]	38	0.85-B	
	39	0.85-B	
[21]	74	B	
[22]	CME1	1.25-B	
	CME2	1.25-B	
	CME3	1.25-B	
	CME4	1.25-B	
	CME5	1.25-B	
	210	8-B	
	1265	2-B	
	MVE3	0.85-B	
	OL56	B	FK
	ATE8	0.85-B	FM65 <A/T>
	ATE9	0.85-B	FM65 <A/T>

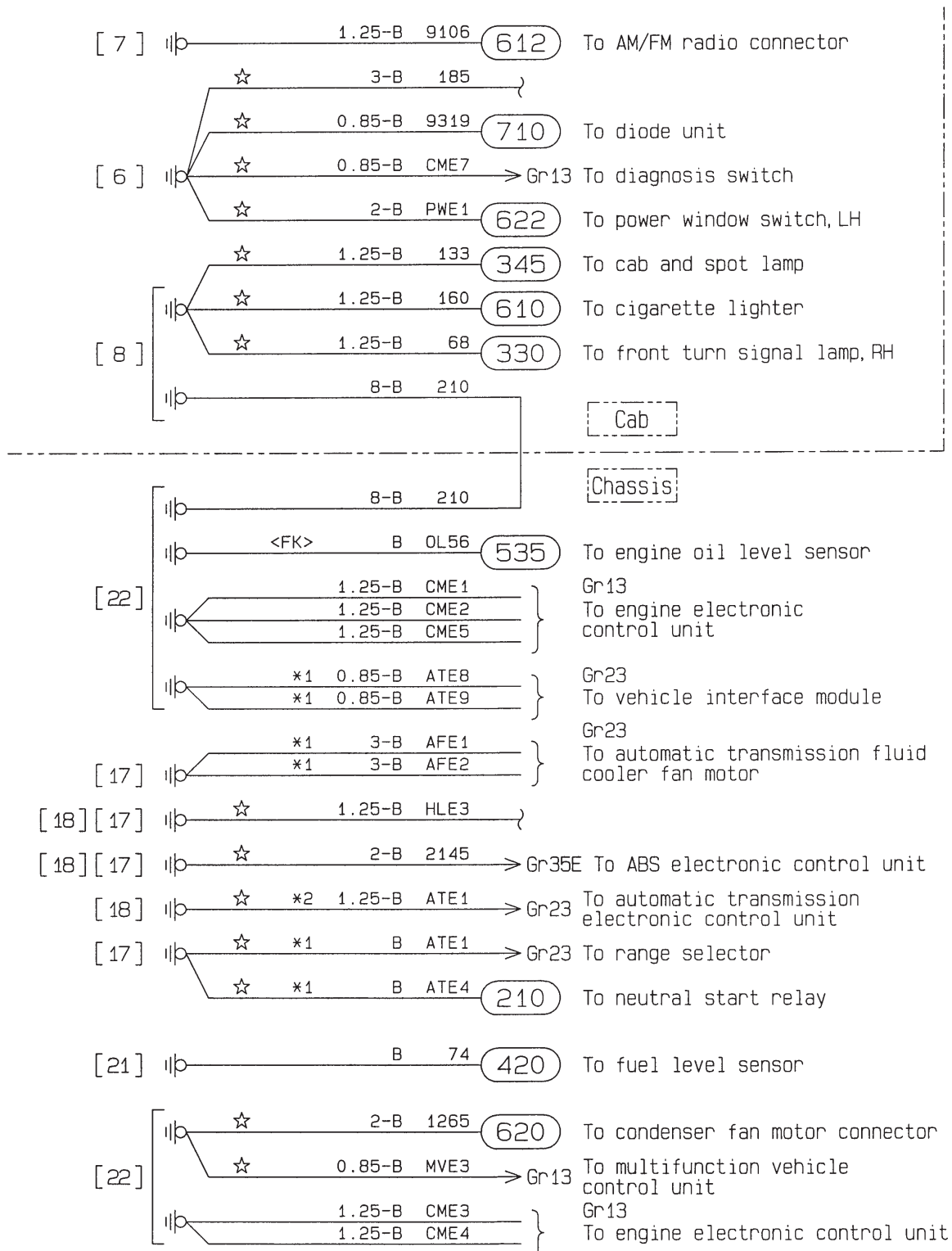
A/T : Automatic transmission

130 GROUND

Entire ground

·This diagram indicates grounding points.

·See the following pages for branching of grounding(wiring for ☆). (In circuit No.order)



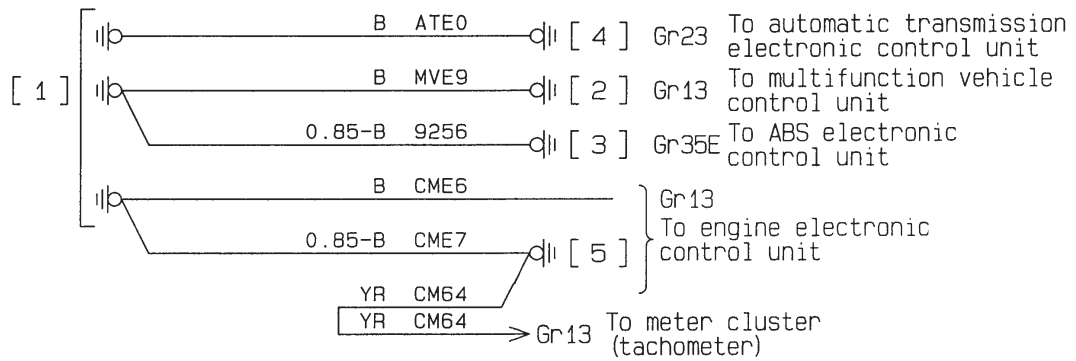
*1 : Automatic transmission<FM65>

*2 : Automatic transmission<FK, FM61, FM64>

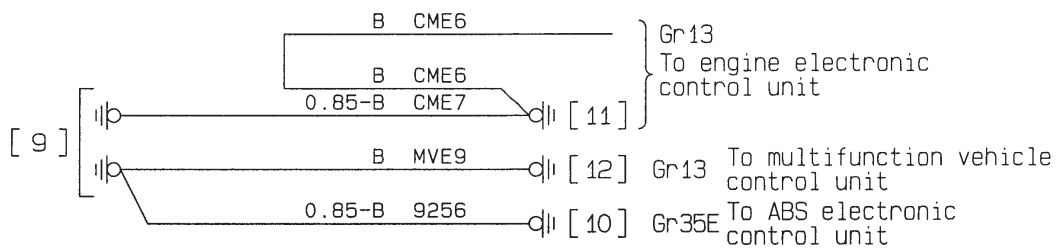
ABS : Anti-lock brake system

C00375-1

<FM65 (Except automatic transmission), FK, FM61, FM64>

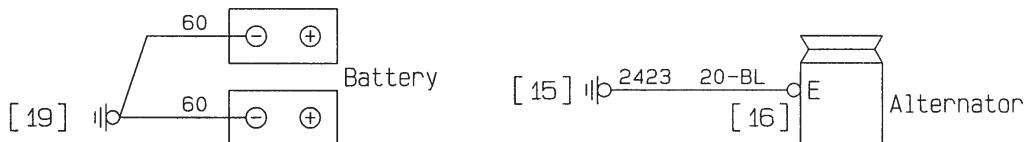


<FM65 (Automatic transmission)>



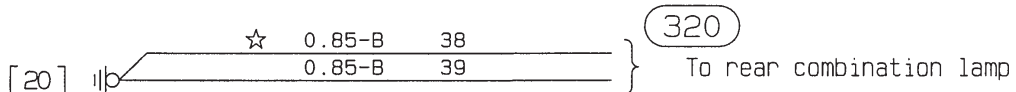
Bed

Chassis



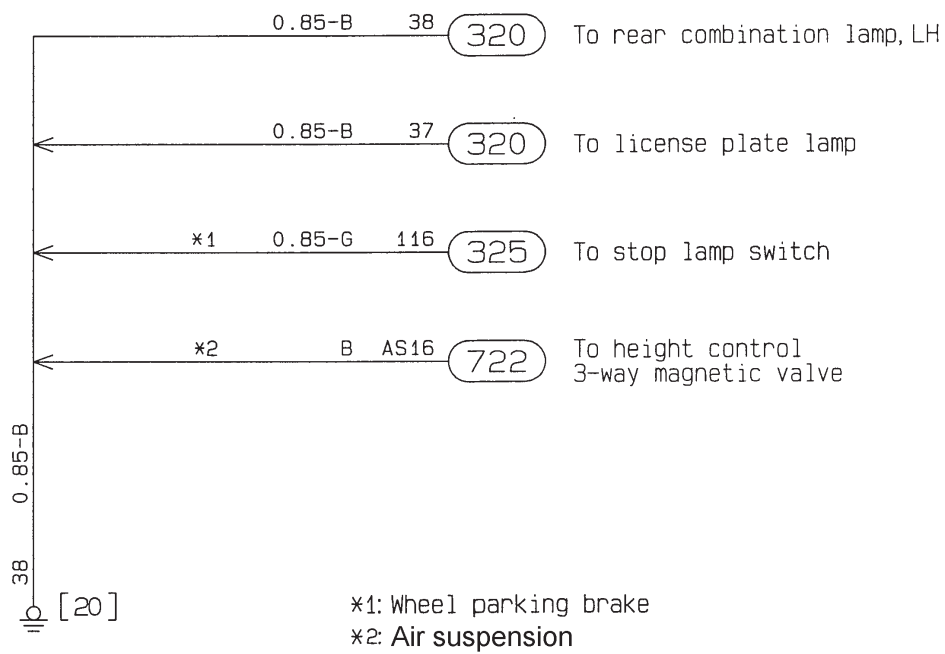
Chassis

Rear chassis

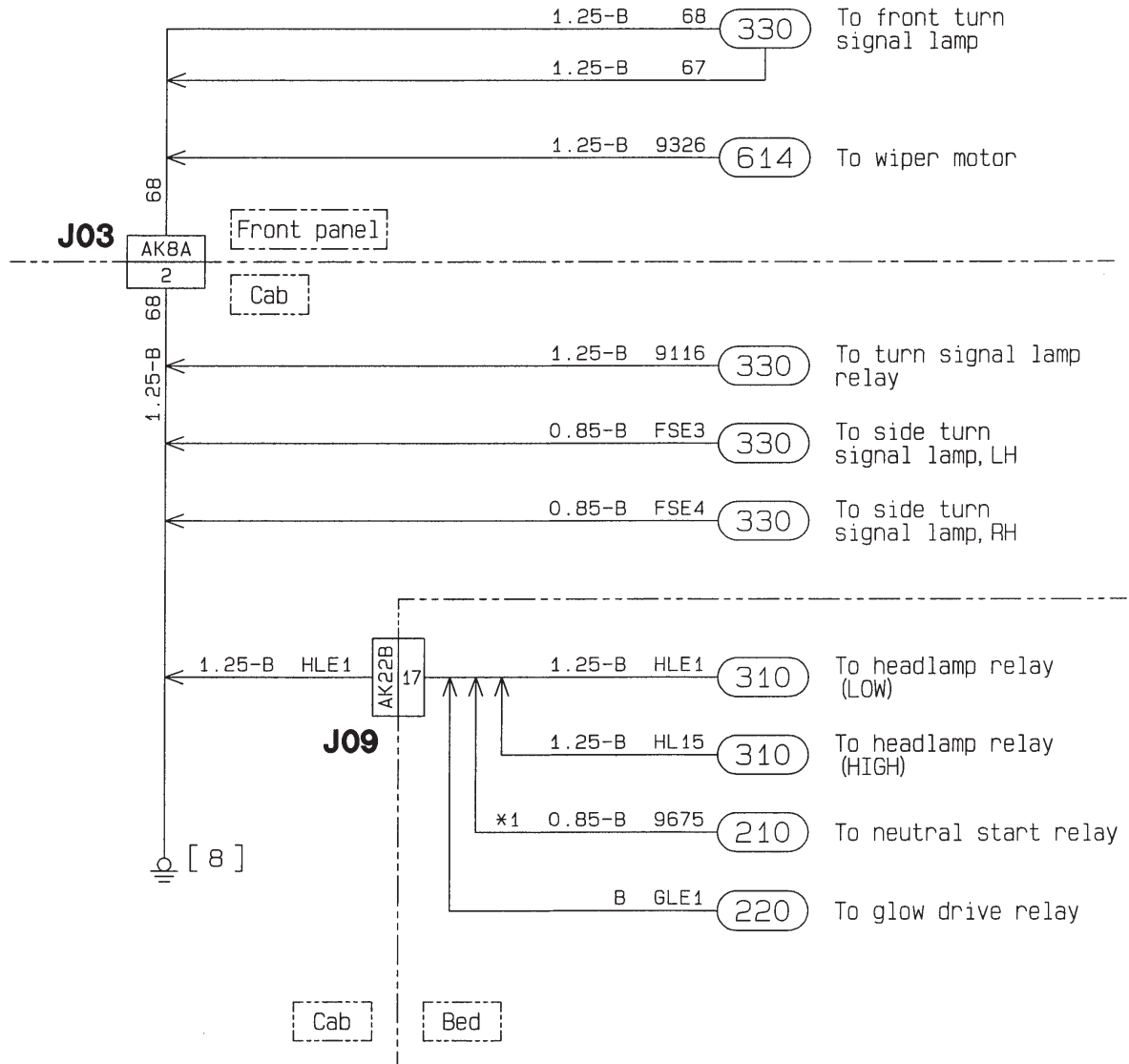


130 GROUND

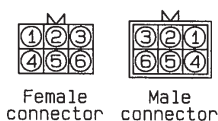
Circuit No.38 rear chassis ground



Circuit No.68 cab ground

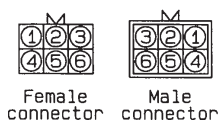
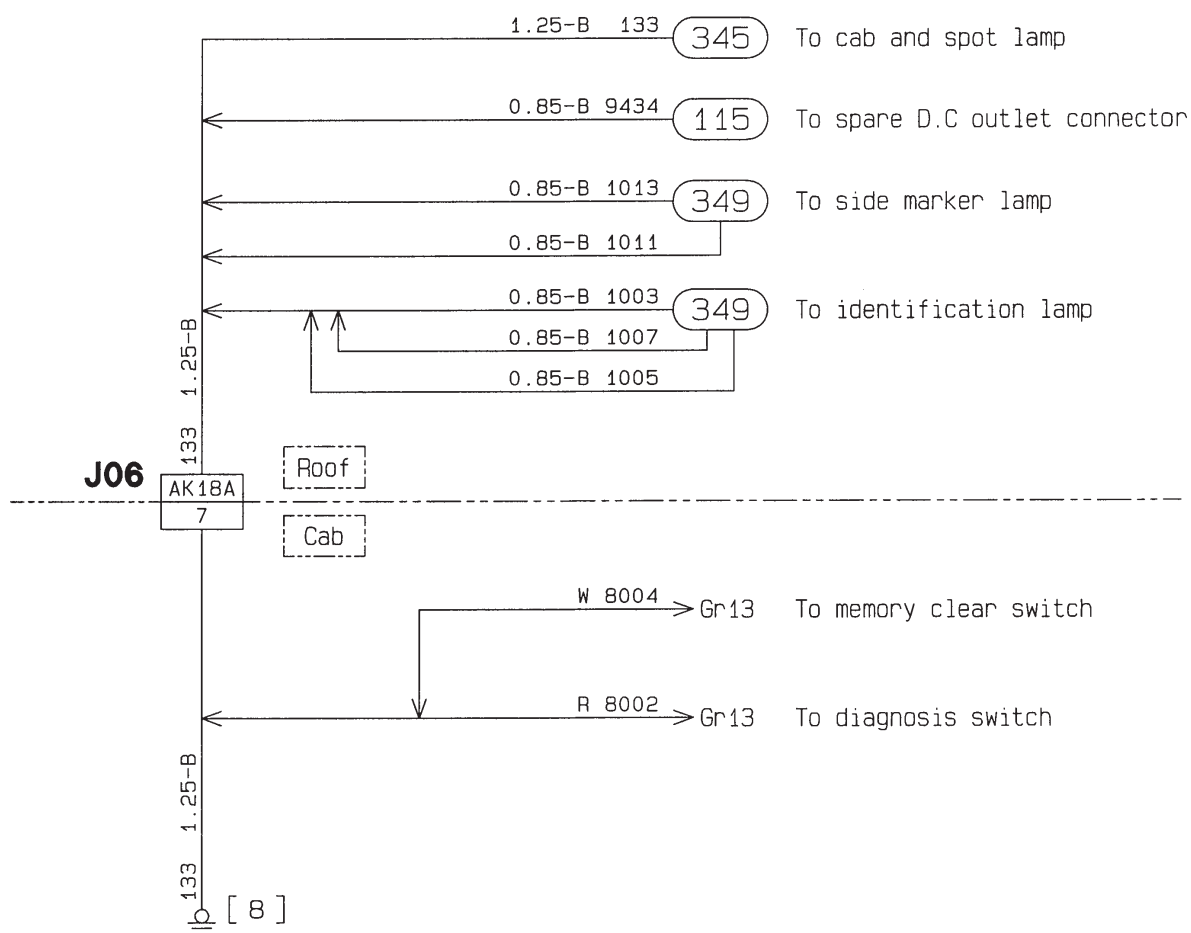


*1: Manual transmission



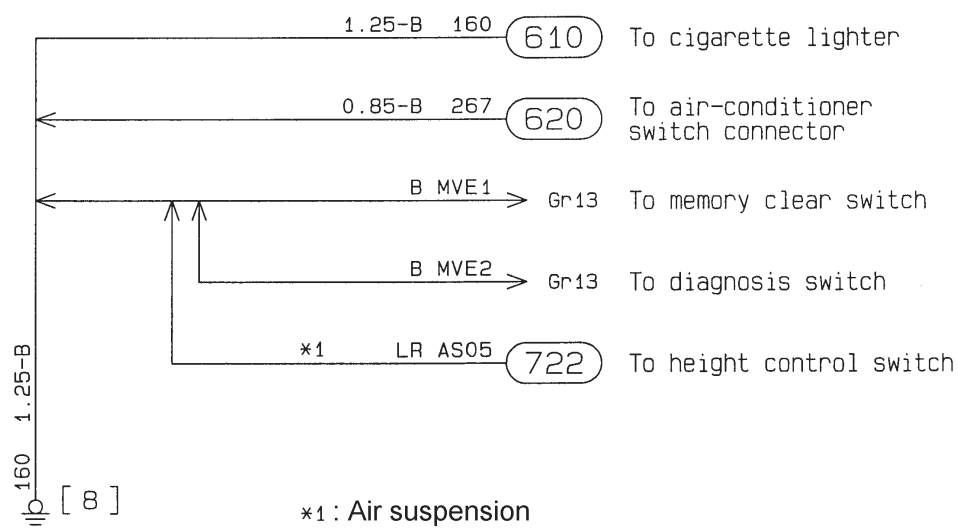
130 GROUND

Circuit No.133 cab ground



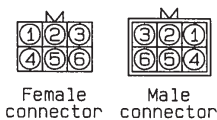
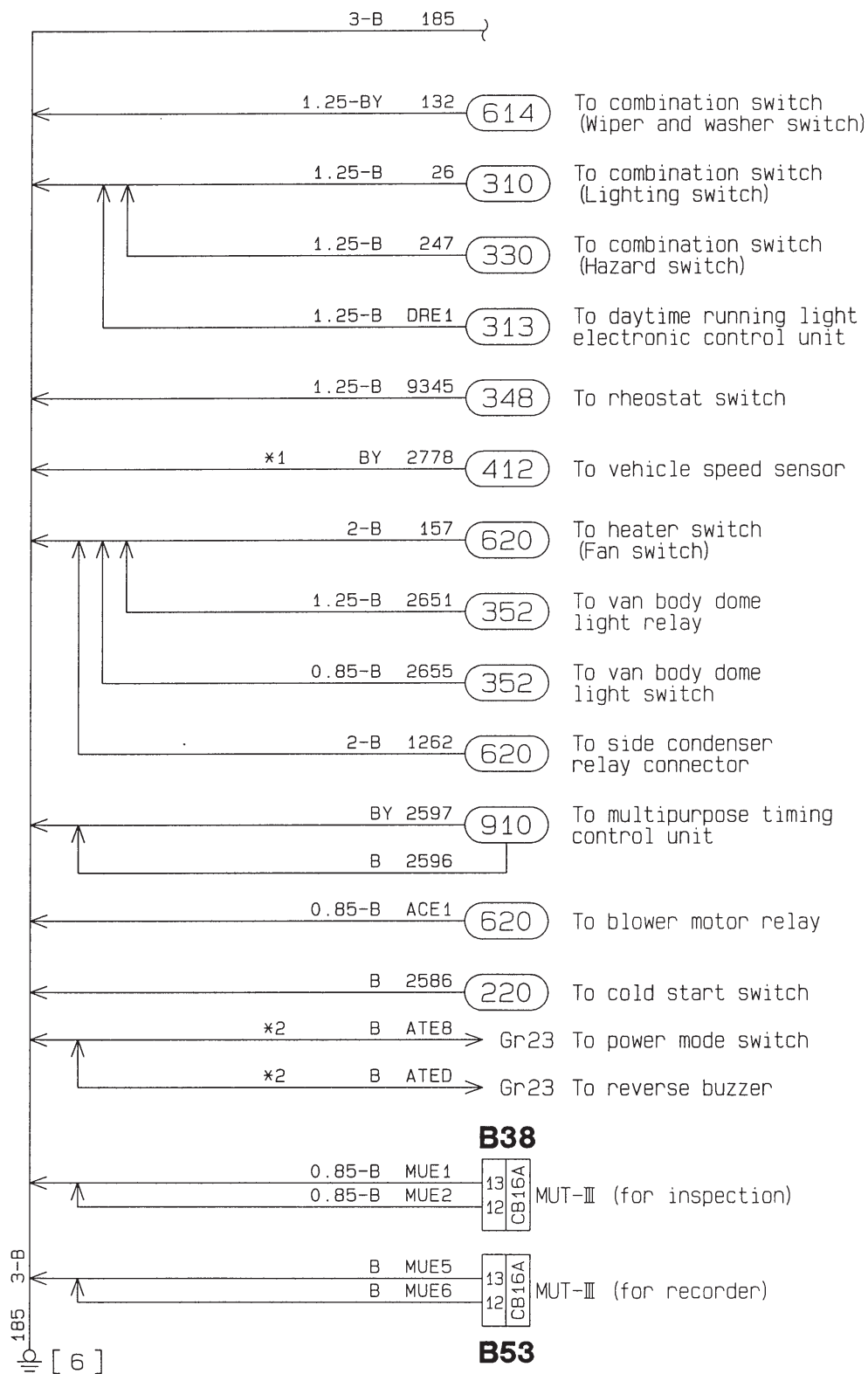
C00378

Circuit No.160 cab ground



130 GROUND

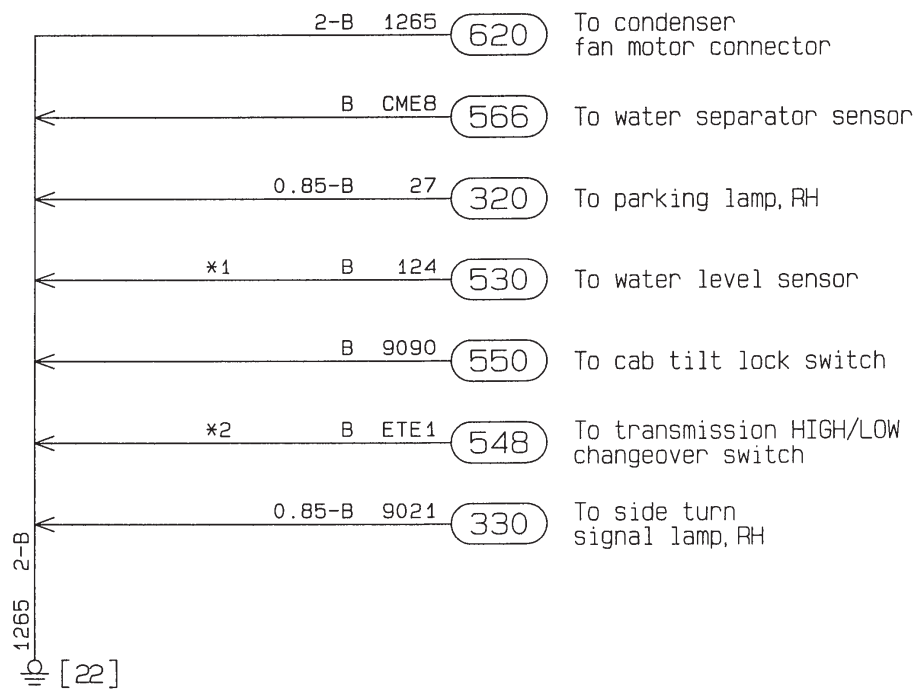
Circuit No.185 cab ground



*1: Manual transmission
 *2: Automatic transmission<FK, FM61, FM64>
 MUT: Multi-use tester

C00380

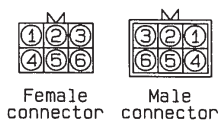
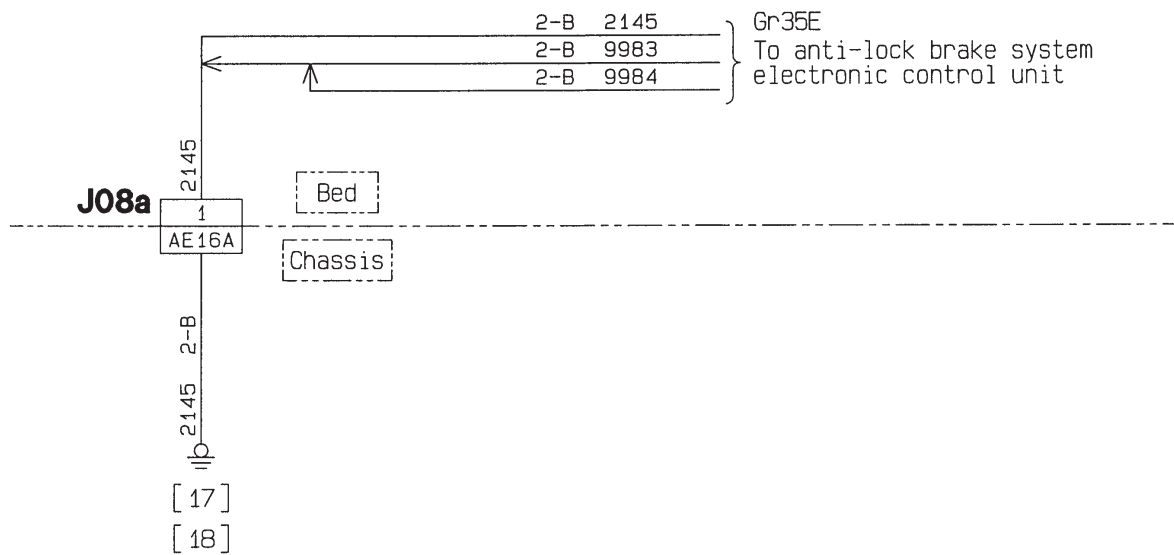
Circuit No.1265 chassis ground



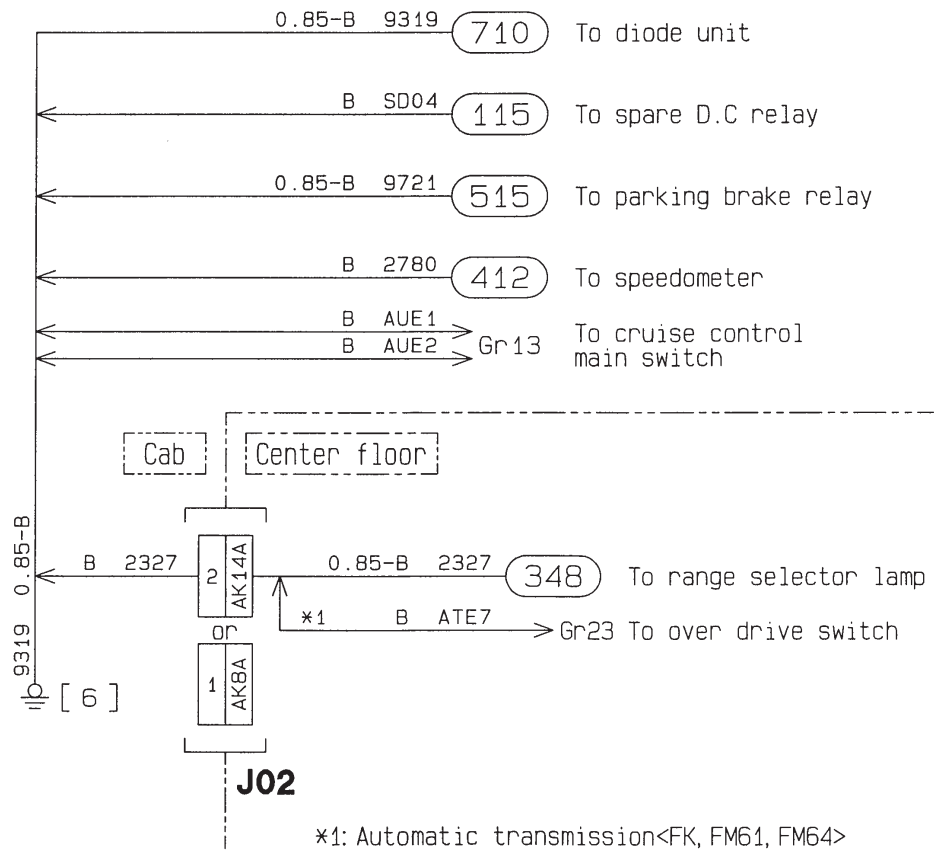
*1: FK, FM65
*2: EATON transmission

130 GROUND

Circuit No.2145 chassis ground
<Anti-lock brake system>

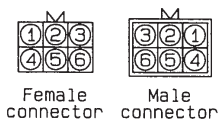
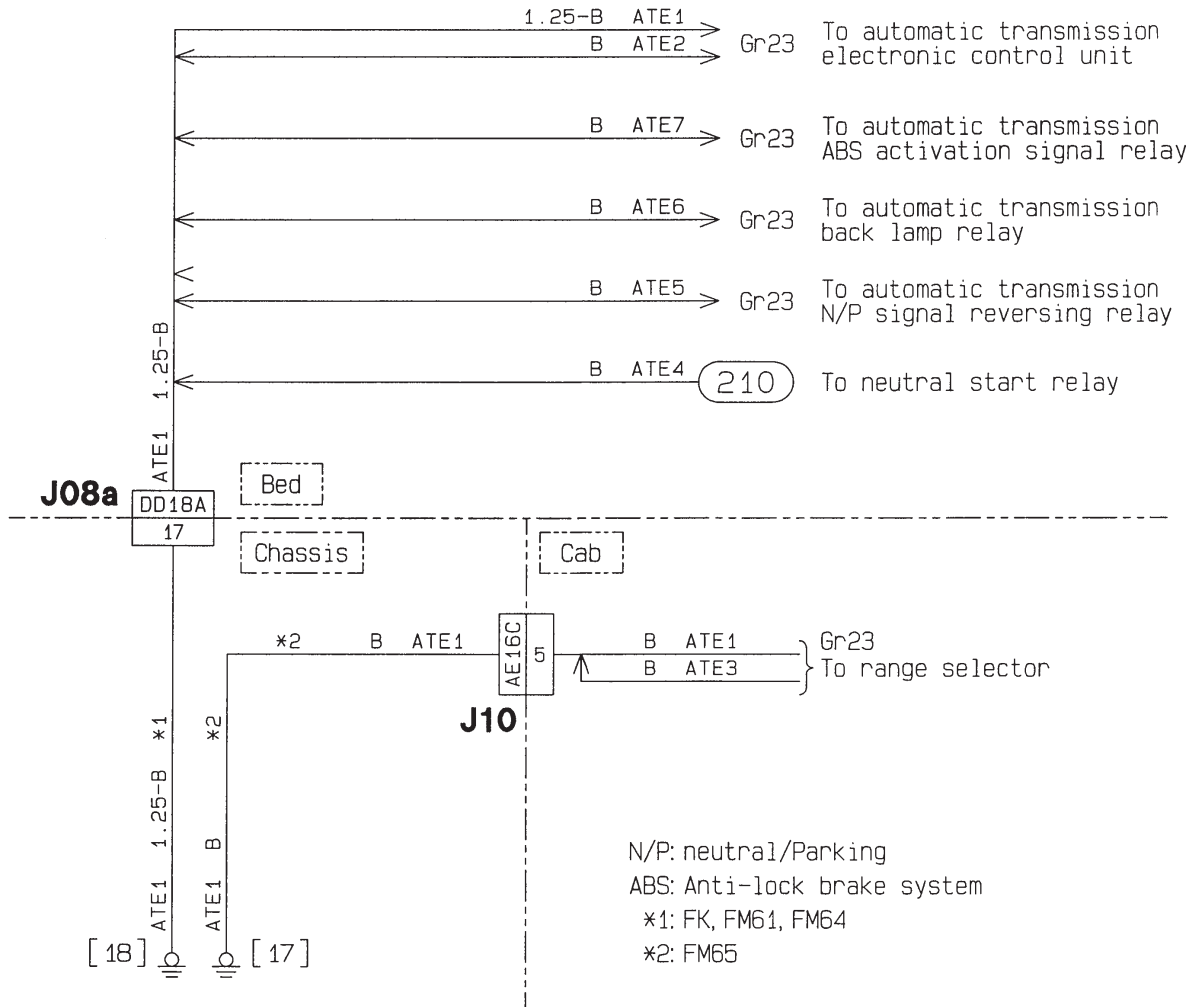


Circuit No.9319 cab ground

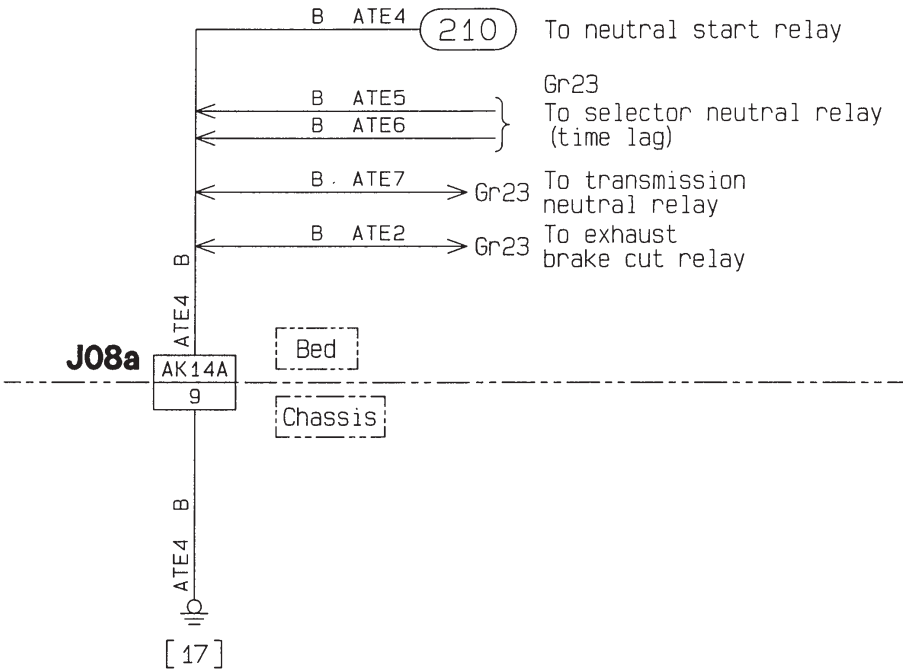


130 GROUND

Circuit No.ATE1 chassis ground
<Automatic transmission>



Circuit No.ATE4 chassis ground
<Automatic transmission (FM65)>



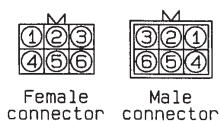
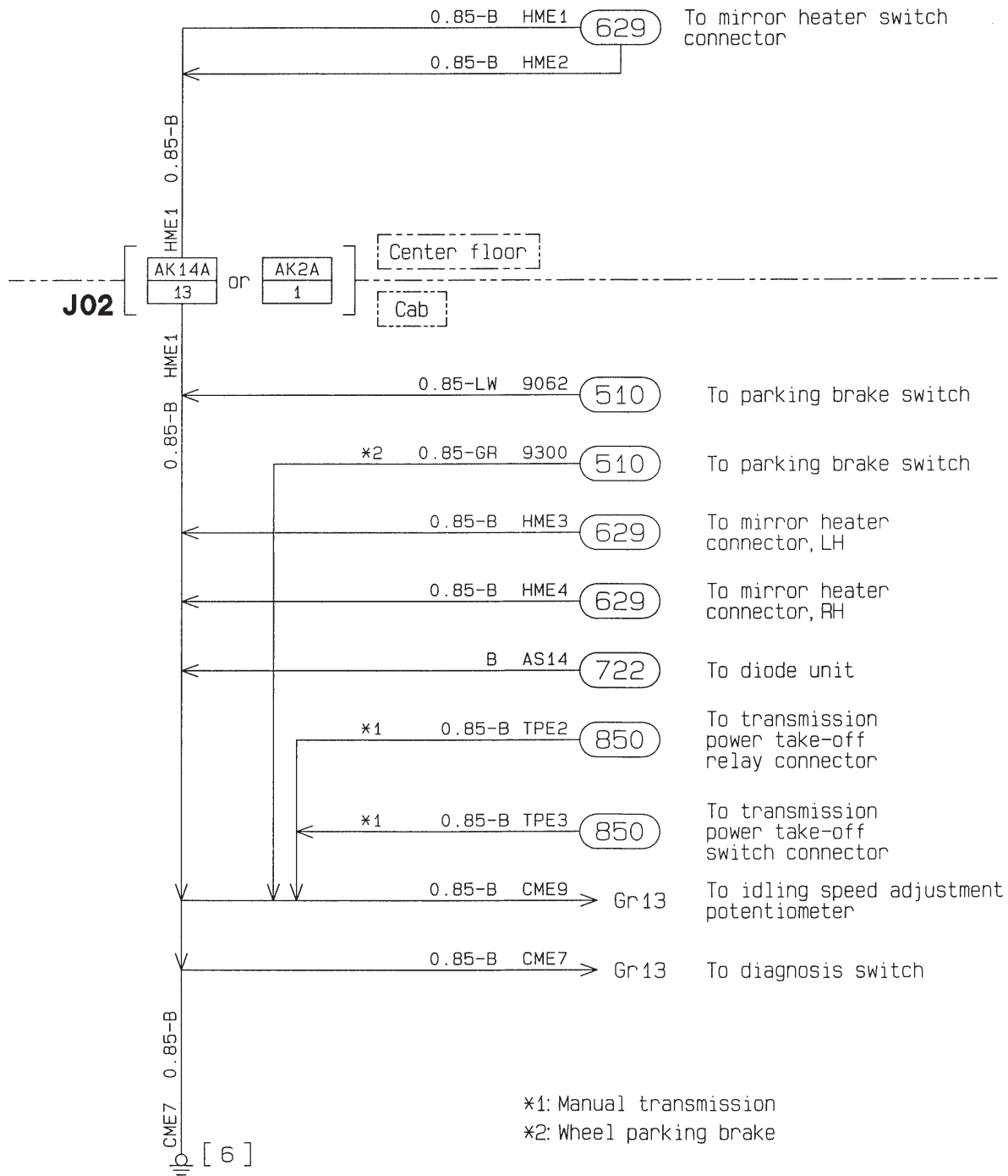
Female connector



Male connector

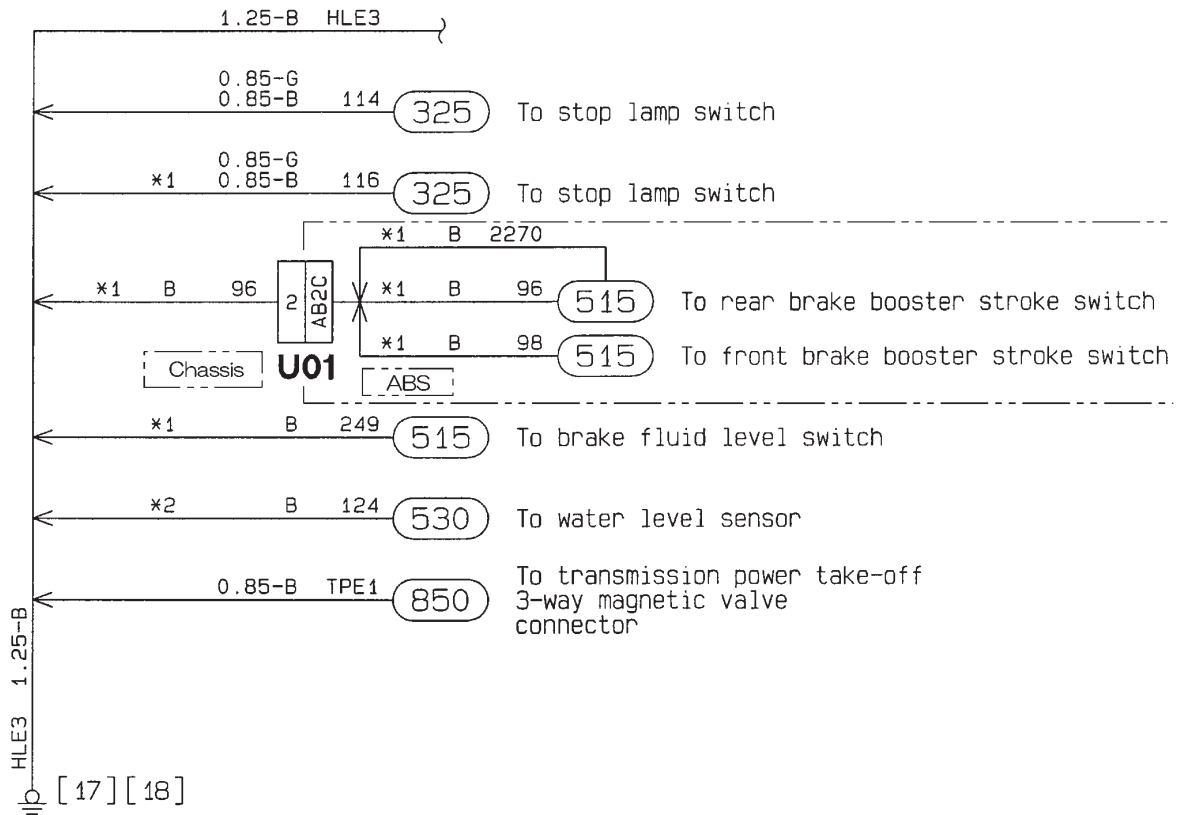
130 GROUND

Circuit No.CME7 cab ground



C00384

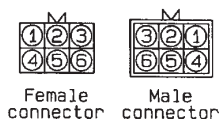
Circuit No.HLE3 chassis ground



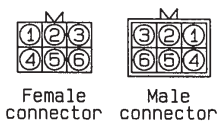
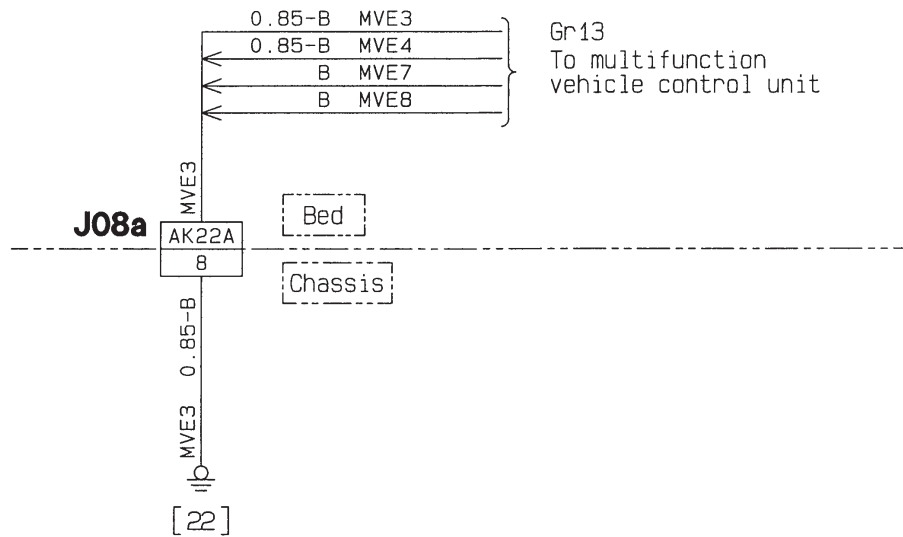
*1: Center parking brake

*2: FM61, FM64

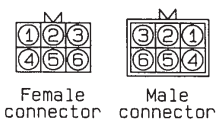
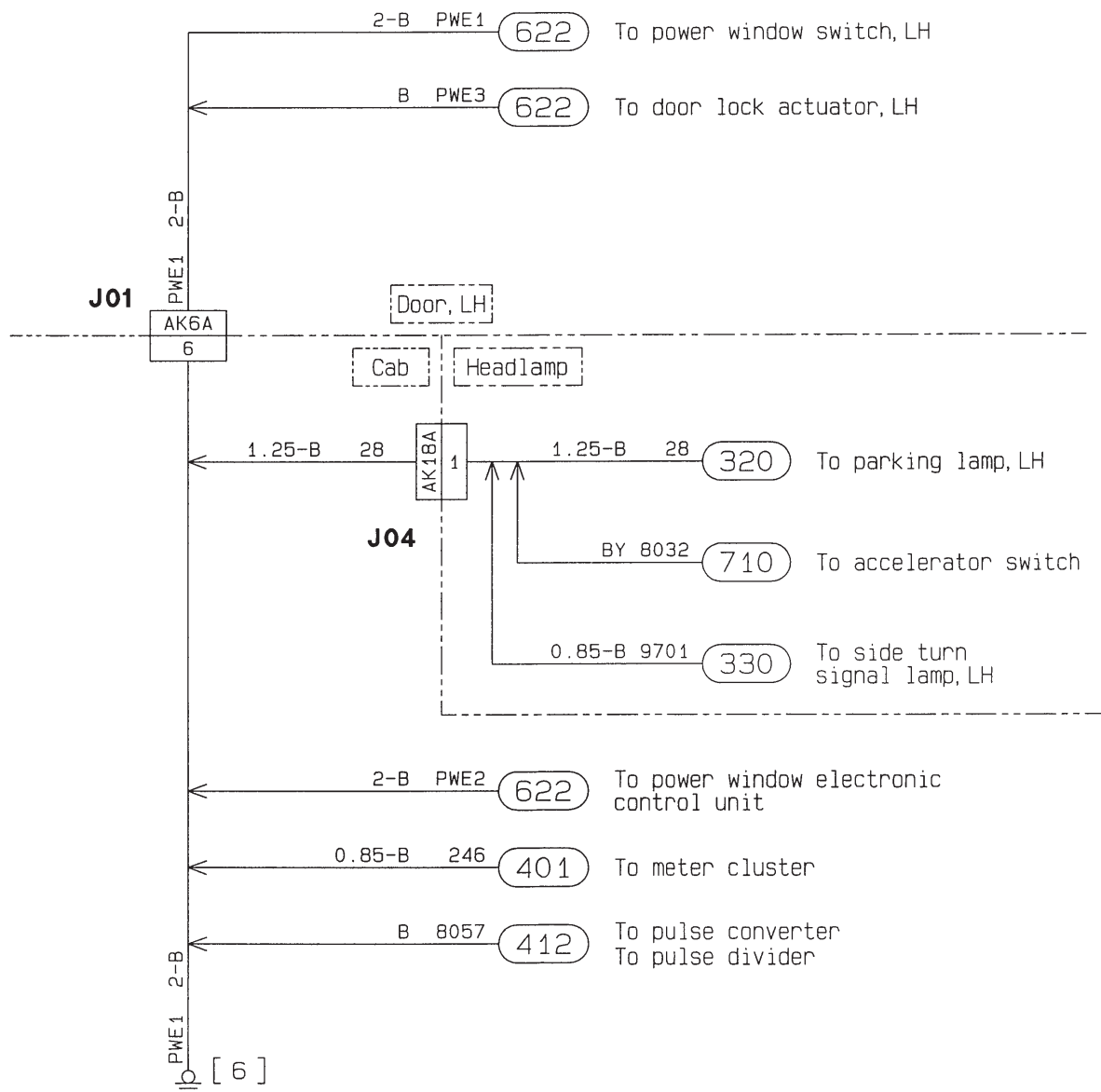
ABS: Anti-lock brake system



Circuit No.MVE3 chassis ground



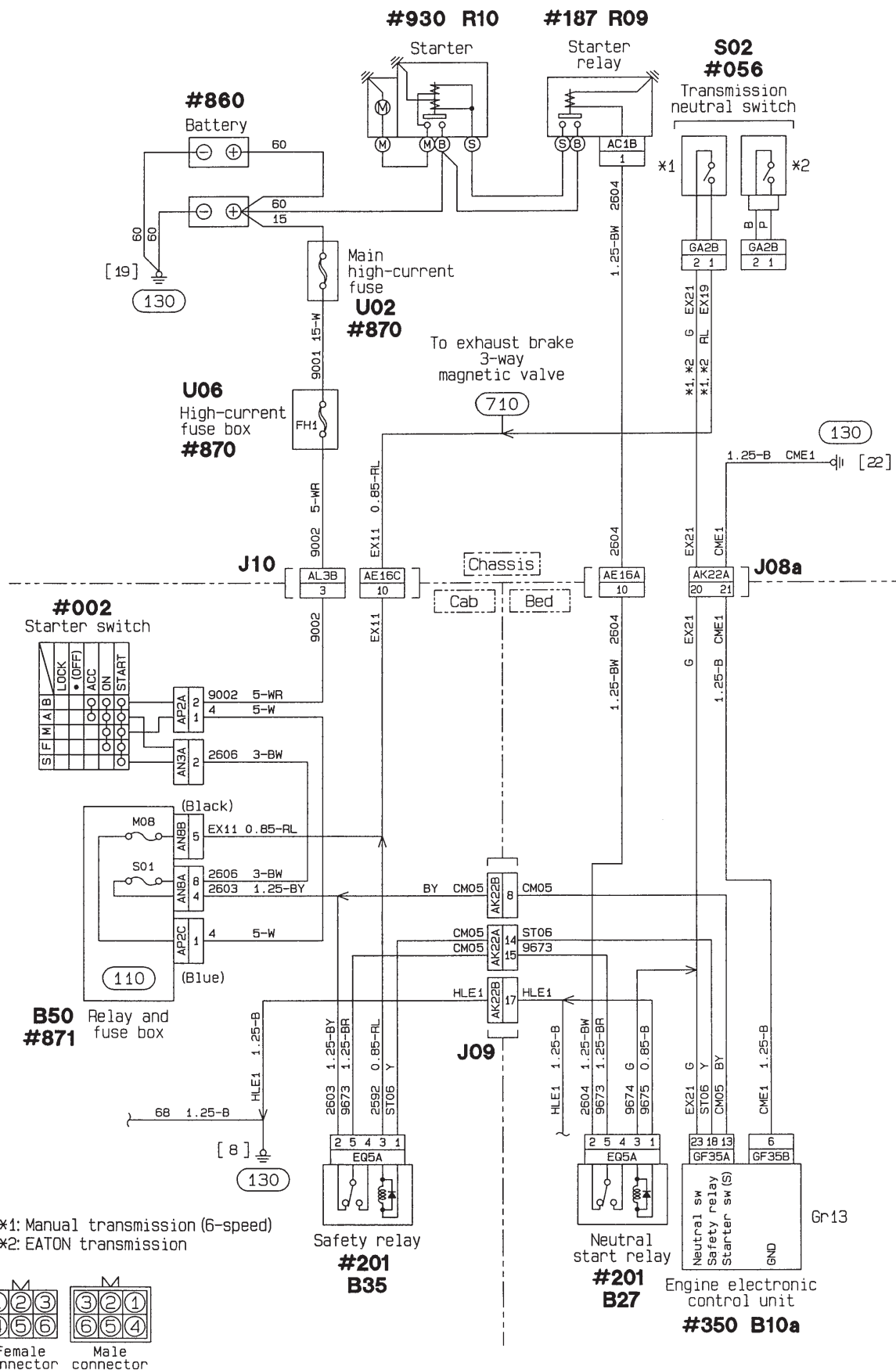
Circuit No. PWE1 cab ground



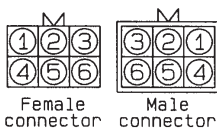
2 STARTING AND PREHEATING CIRCUIT

210 ENGINE STARTING CIRCUIT

<Manual transmission>

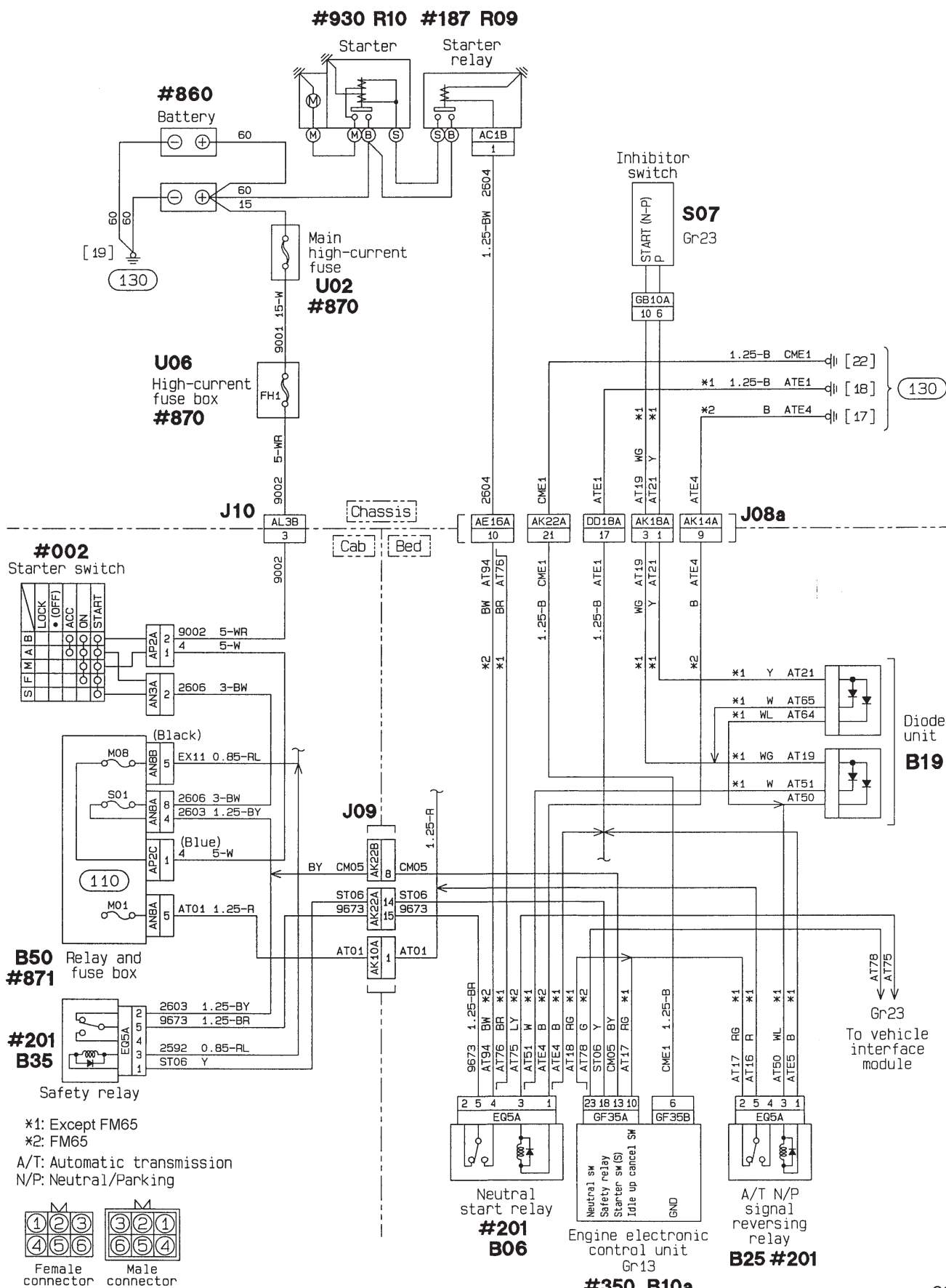


*1: Manual transmission (6-speed)
*2: EATON transmission

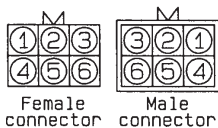


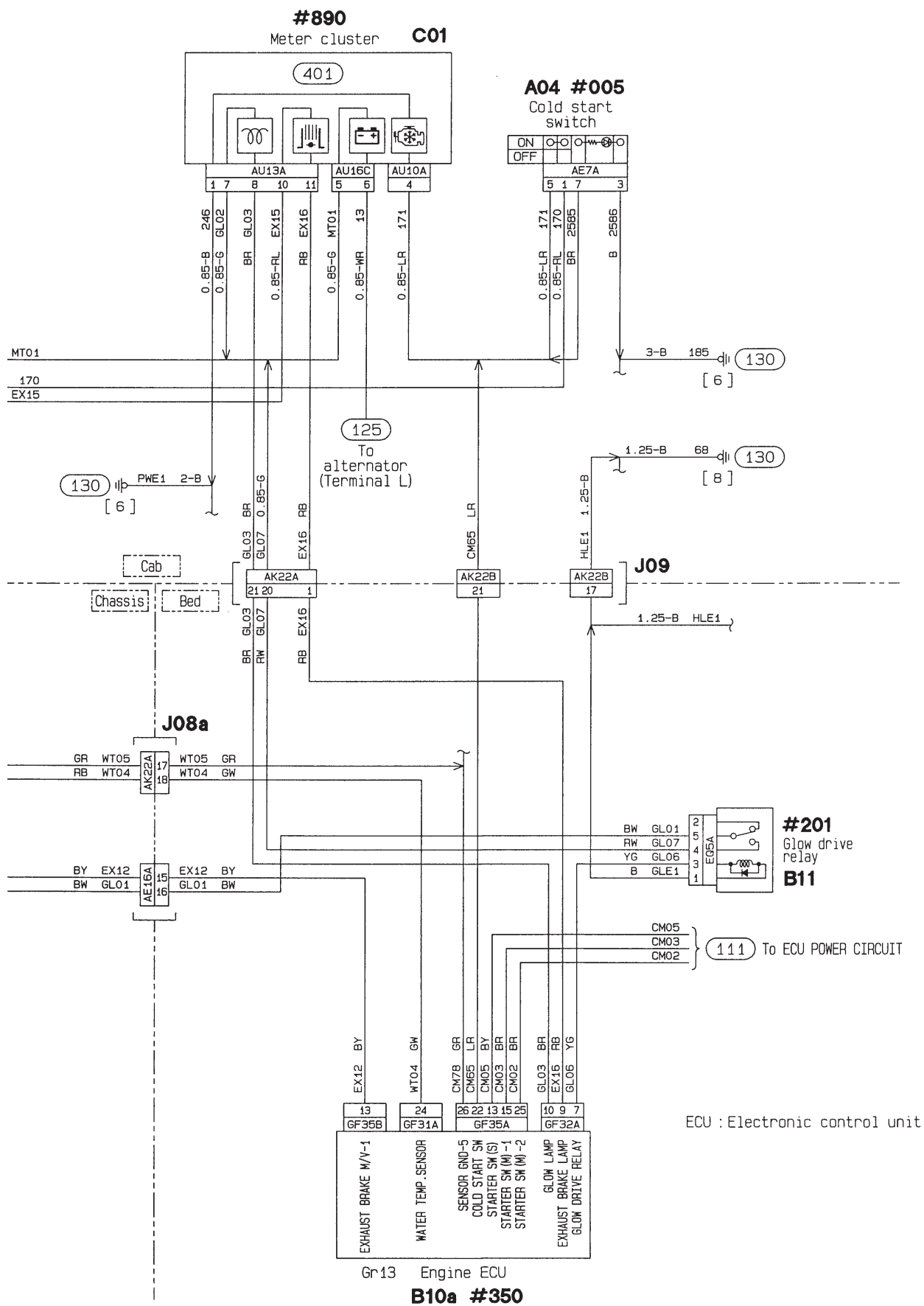
C00387

<Automatic transmission>



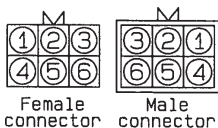
220

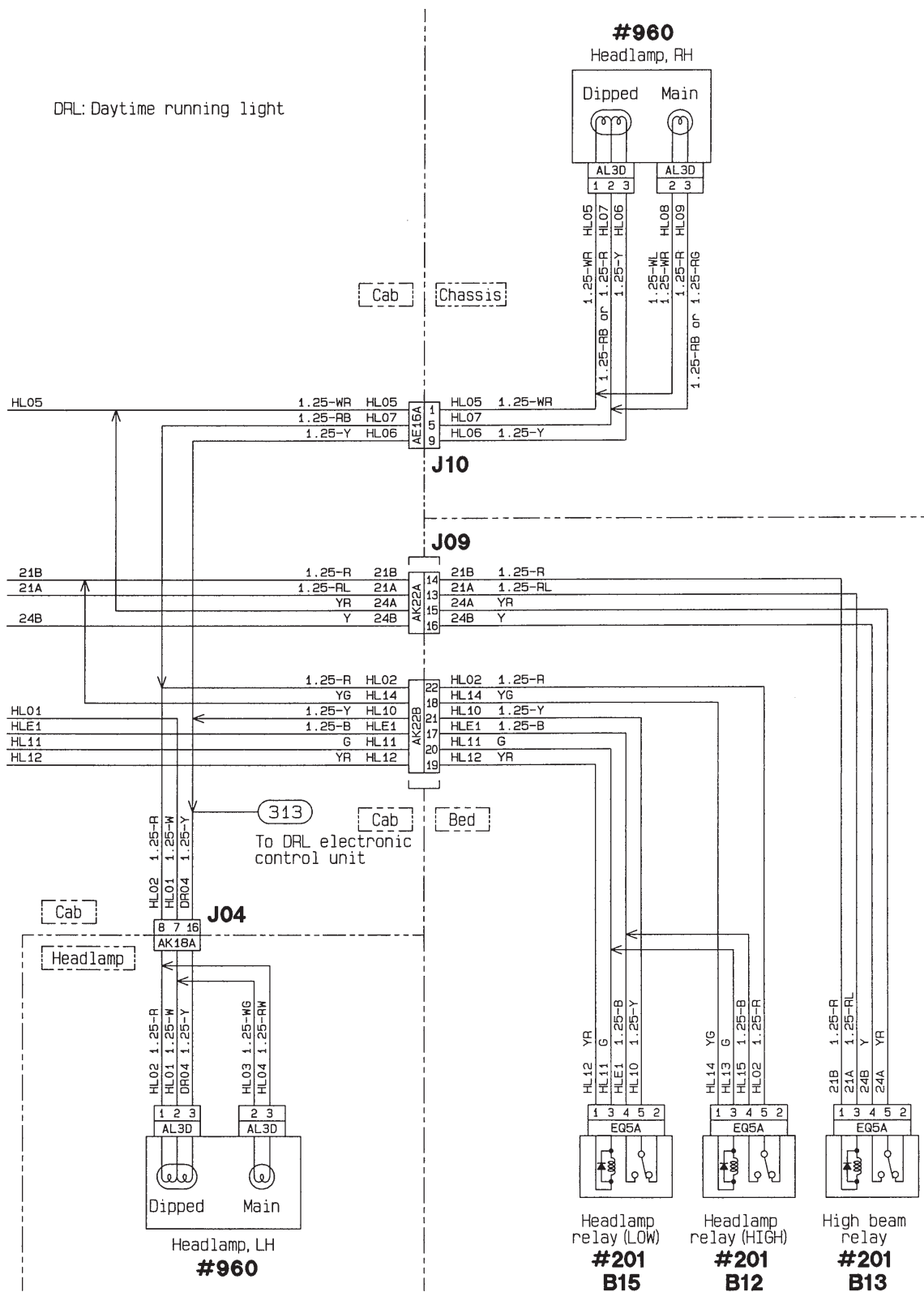




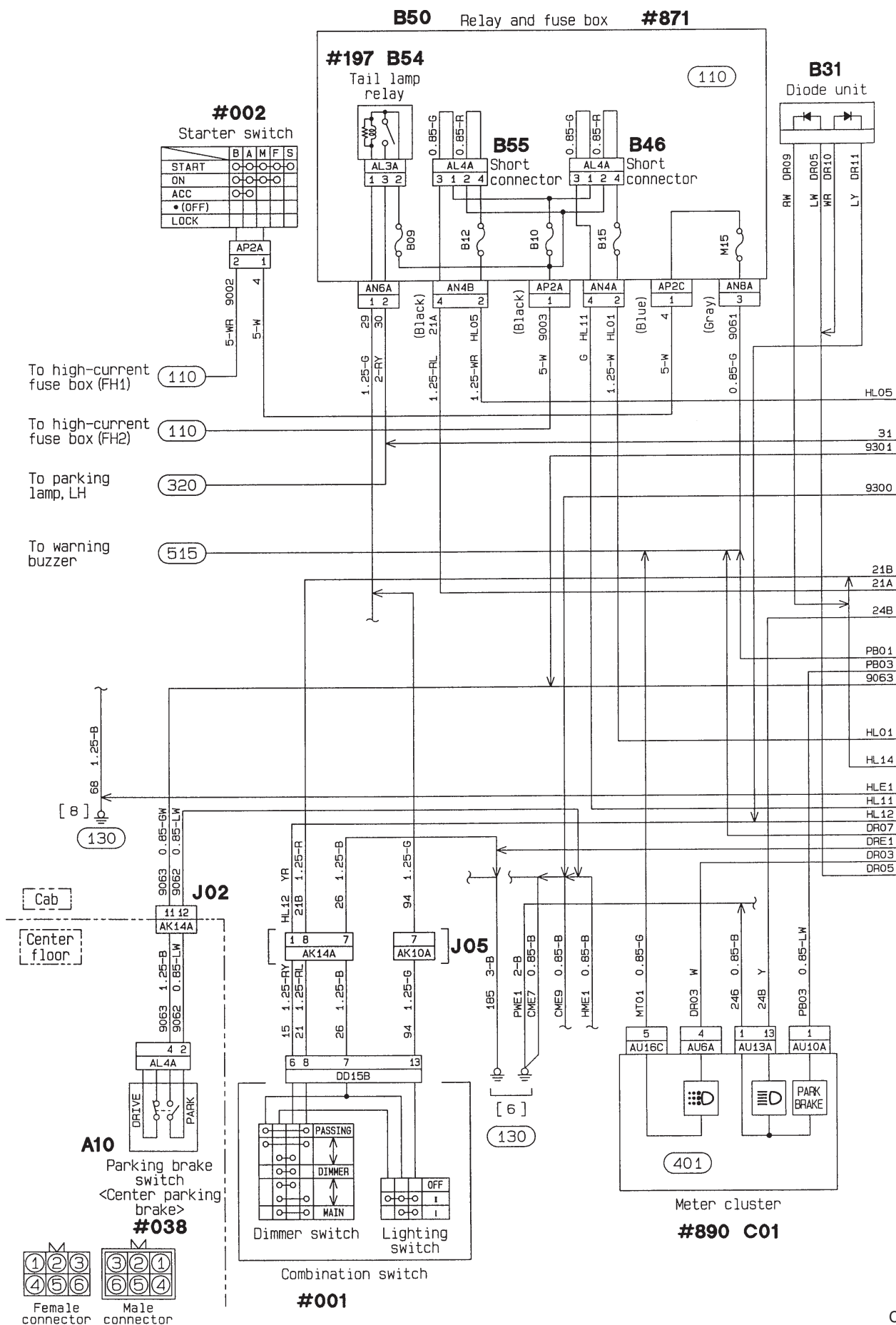
3 LIGHTING CIRCUIT

310





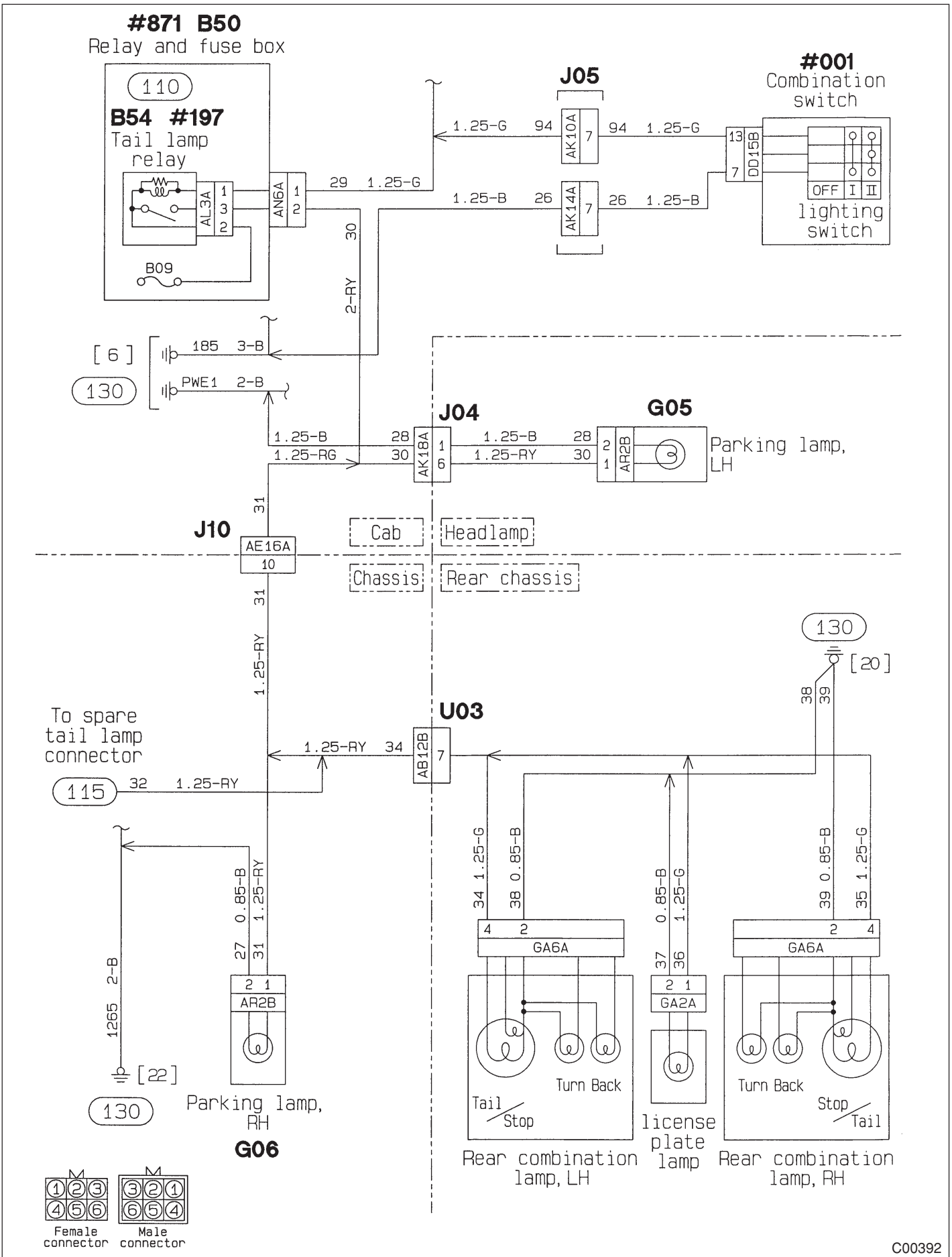
313 DAYTIME RUNNING LIGHT CIRCUIT

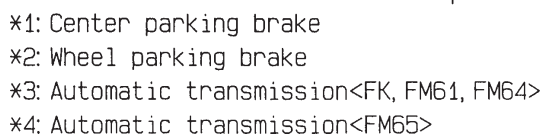


C00391-1



320 TAIL, CLEARANCE AND LICENSE PLATE LAMP CIRCUIT

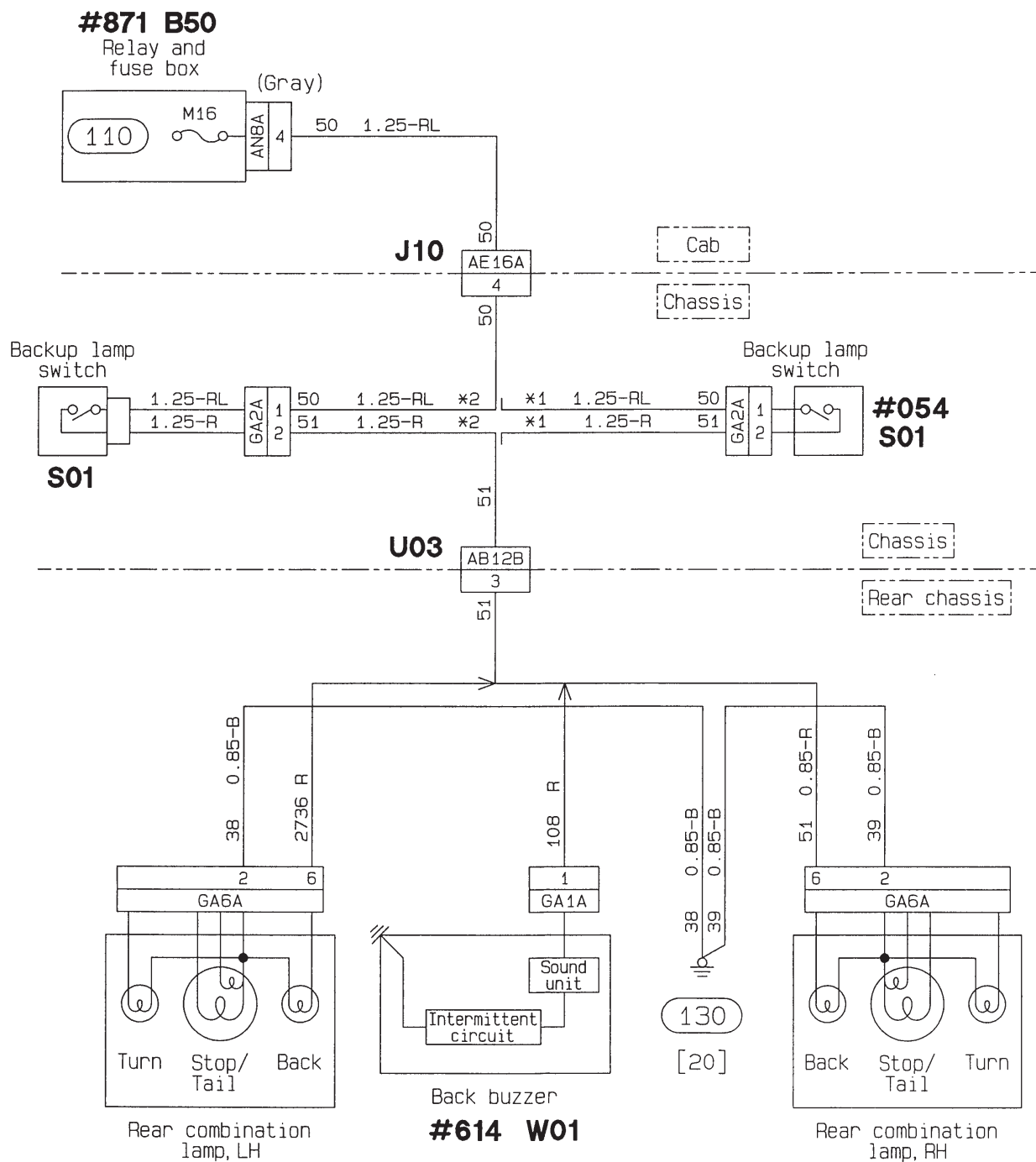




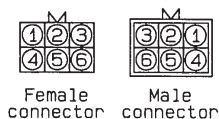
330



<Manual transmission>

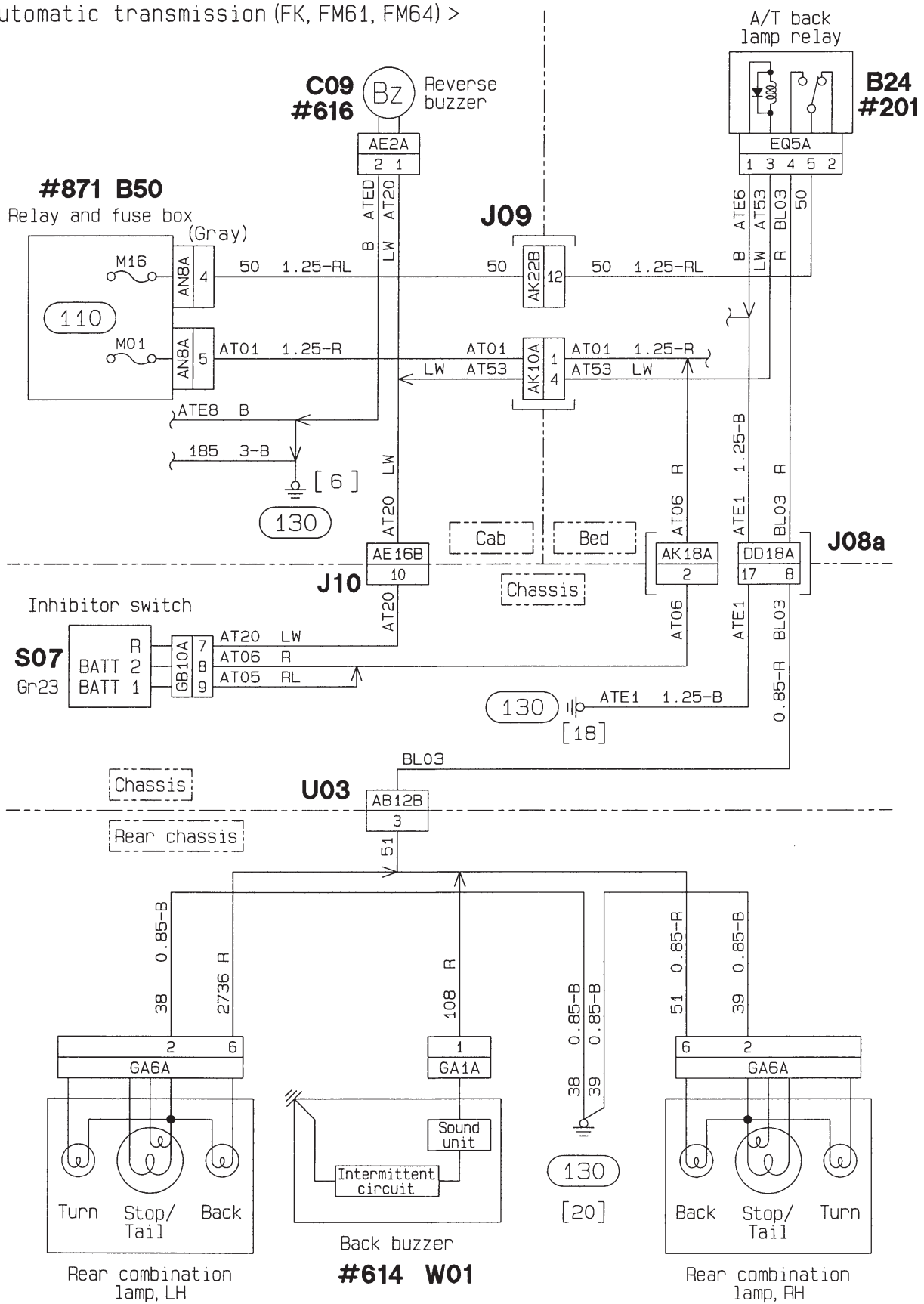


*1: Manual transmission (6-speed)
*2: EATON transmission



340 BACKUP LAMP CIRCUIT

<Automatic transmission (FK, FM61, FM64) >



Female
connector

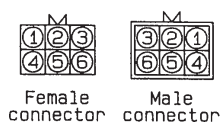
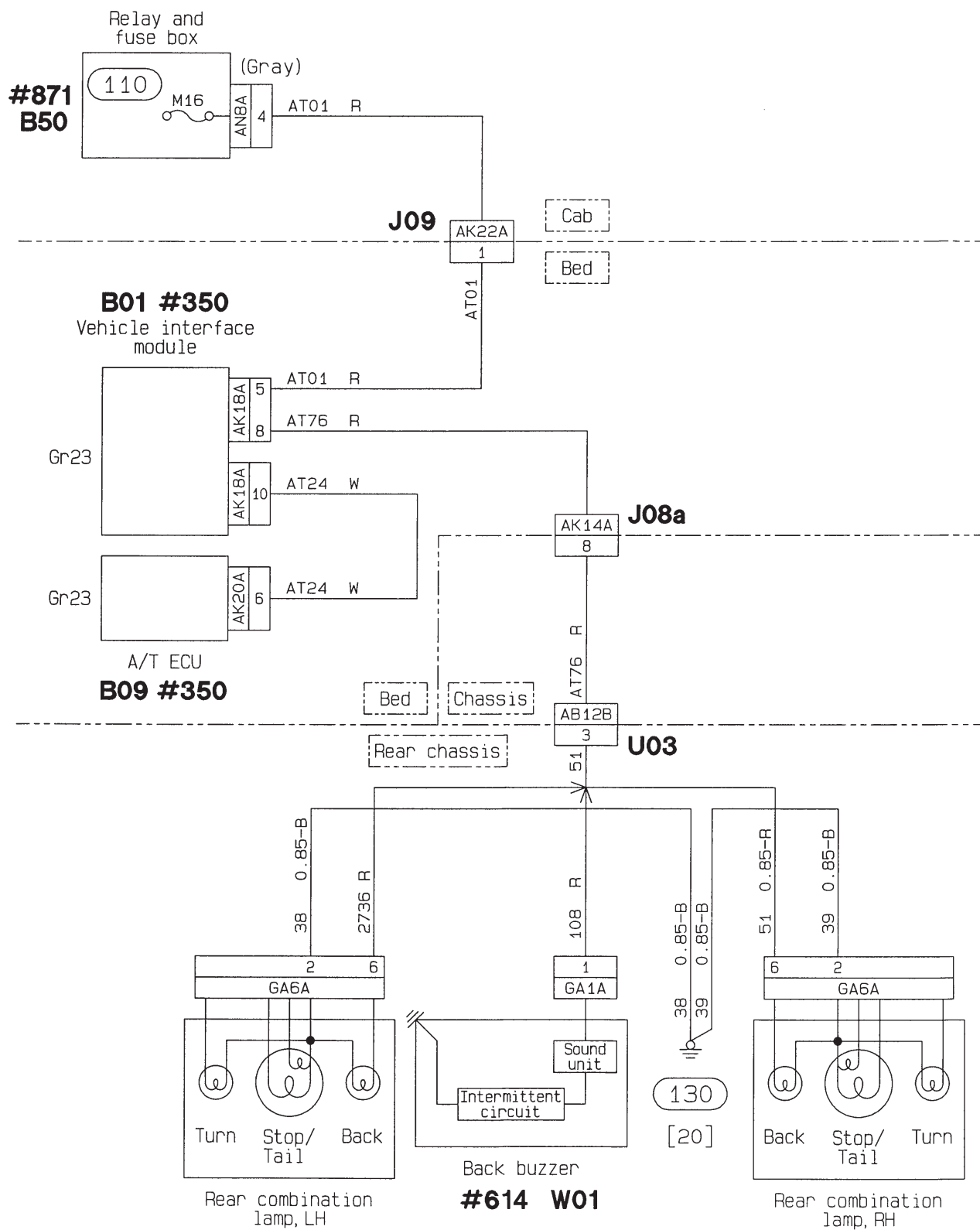


Male
connector

A/T: Automatic transmission

C00645

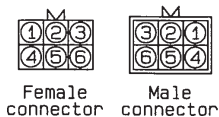
<Automatic transmission (FM65) >

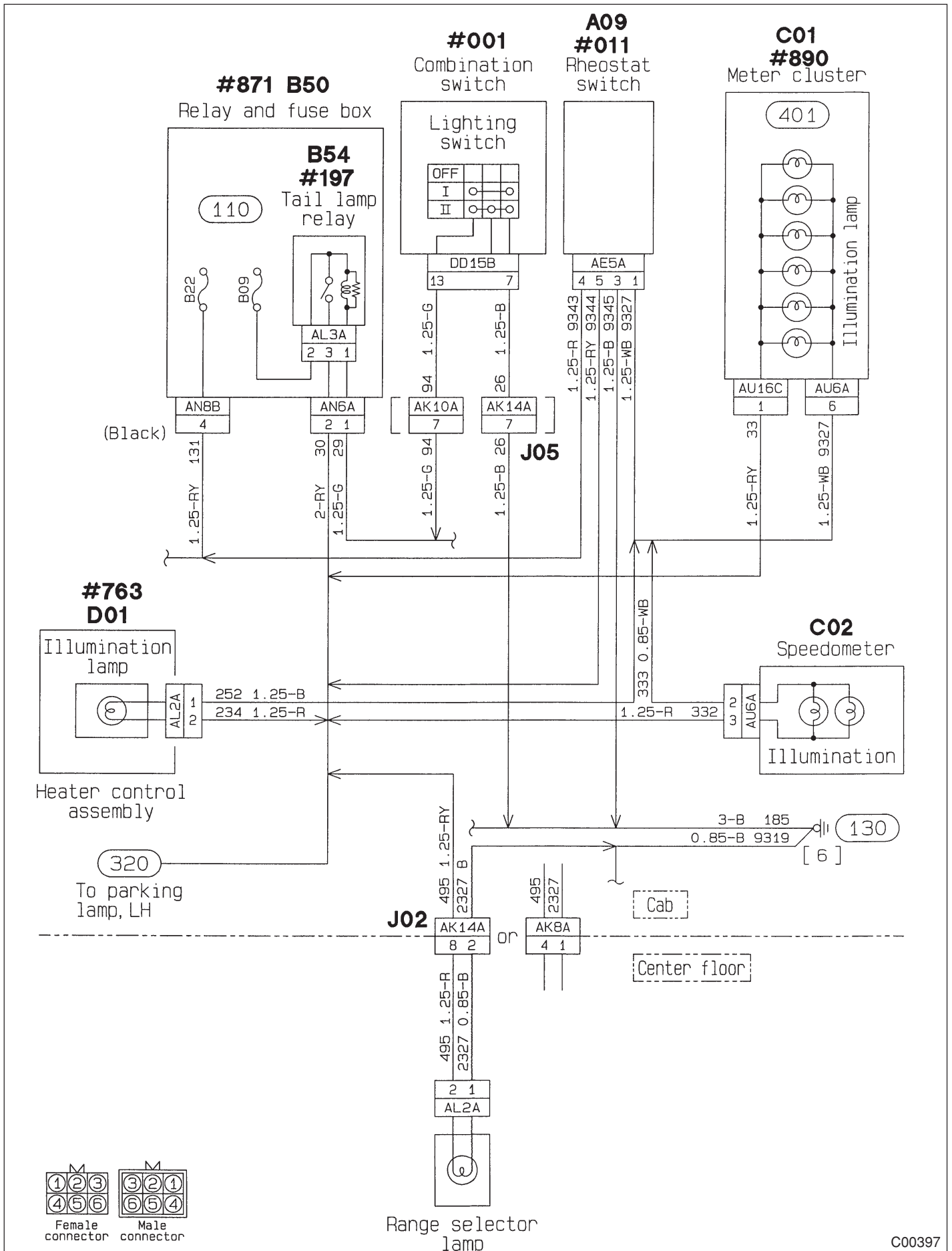


A/T: Automatic transmission
ECU: Electronic control unit

C00646

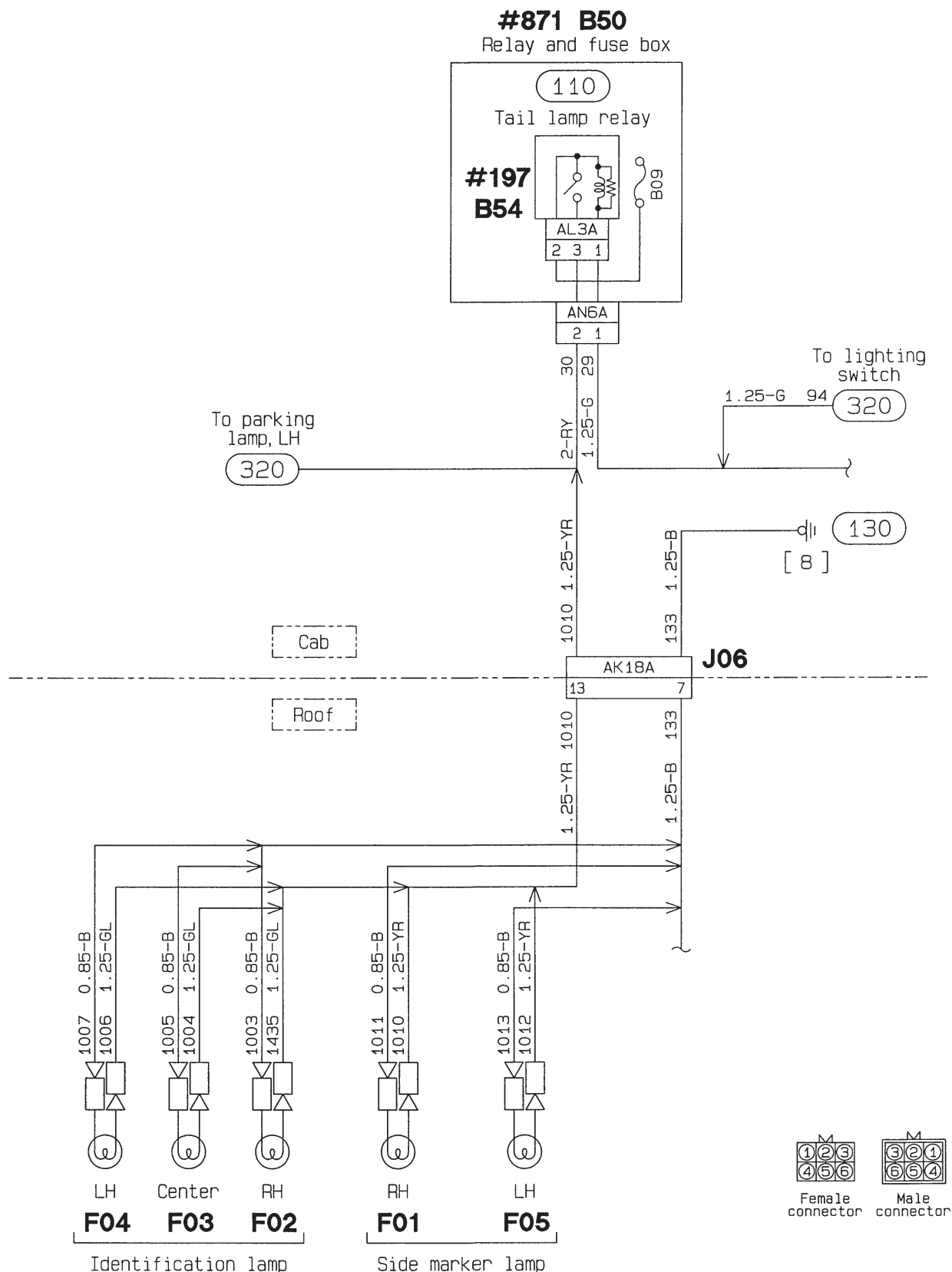
345



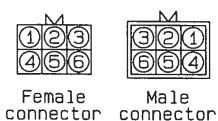
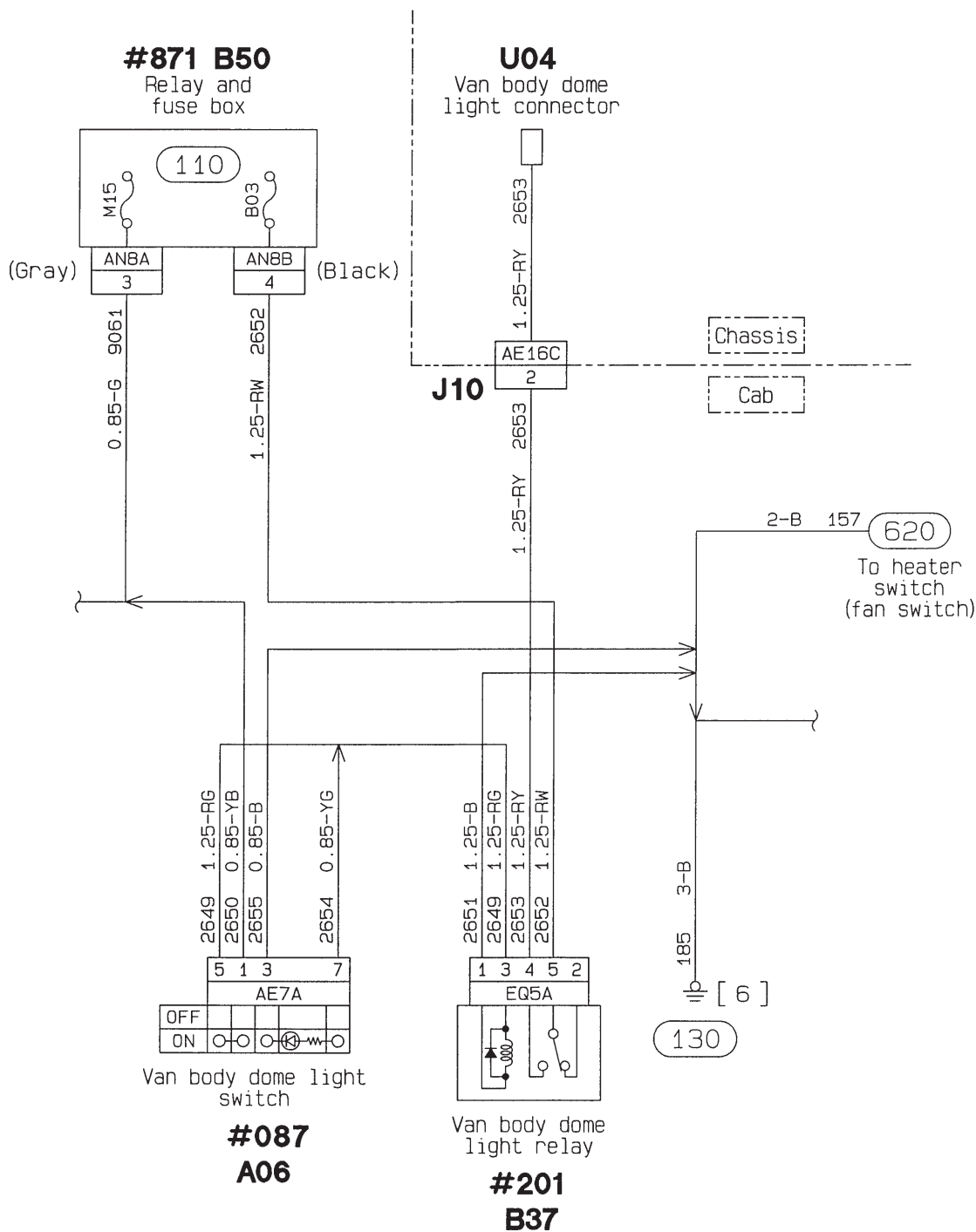


C00397

349 MARKER AND IDENTIFICATION LAMP CIRCUIT

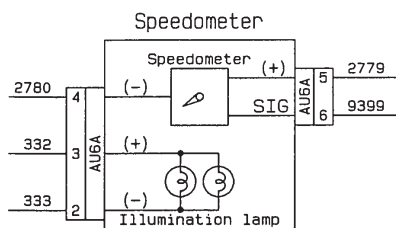


C00398



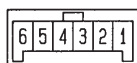
4 METER CIRCUIT

401 METER CLUSTER INTERNAL CIRCUIT



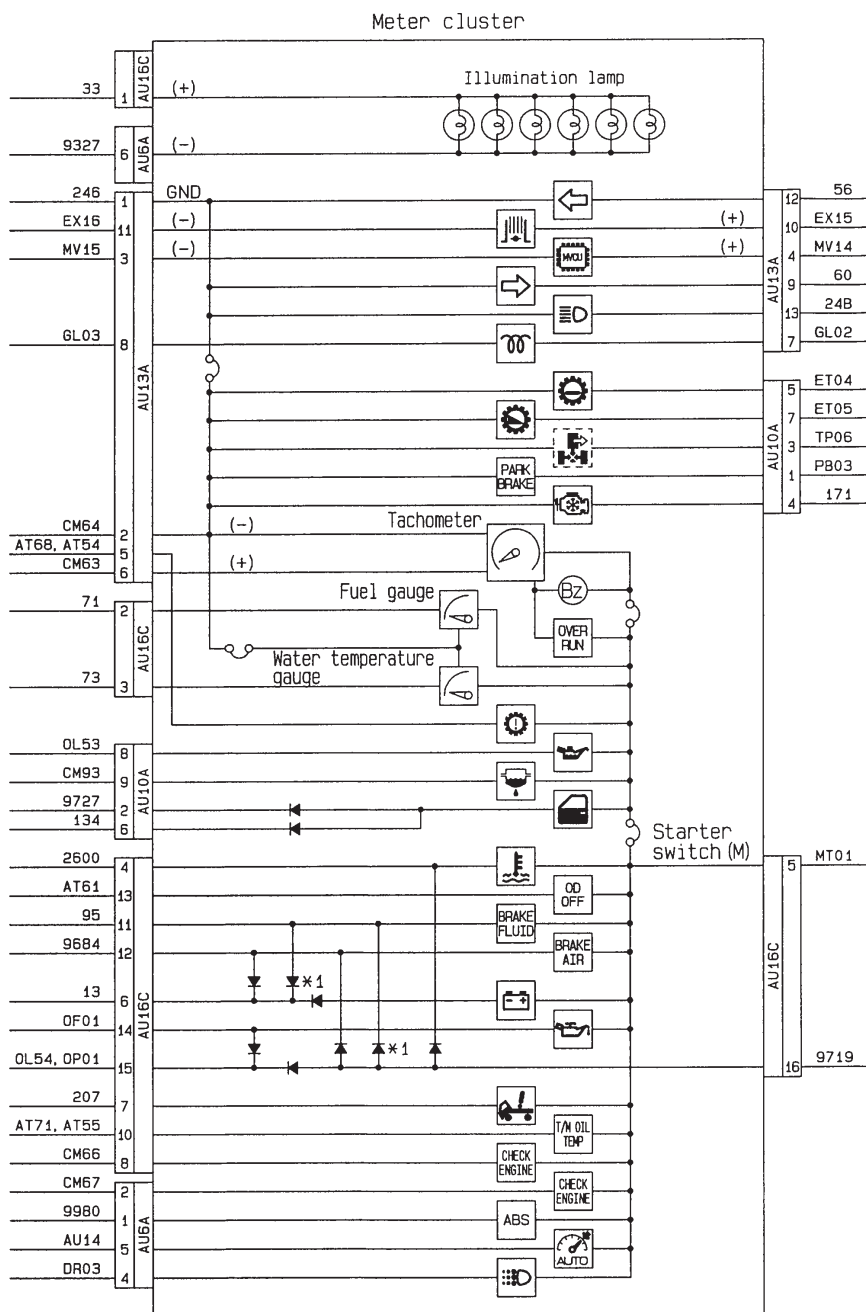
Speedometer side connector

AU6A

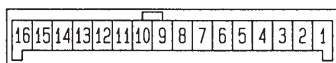


⌋: Jump cable

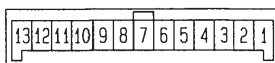
*1: Center parking brake



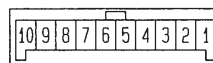
AU16C



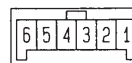
AU13A

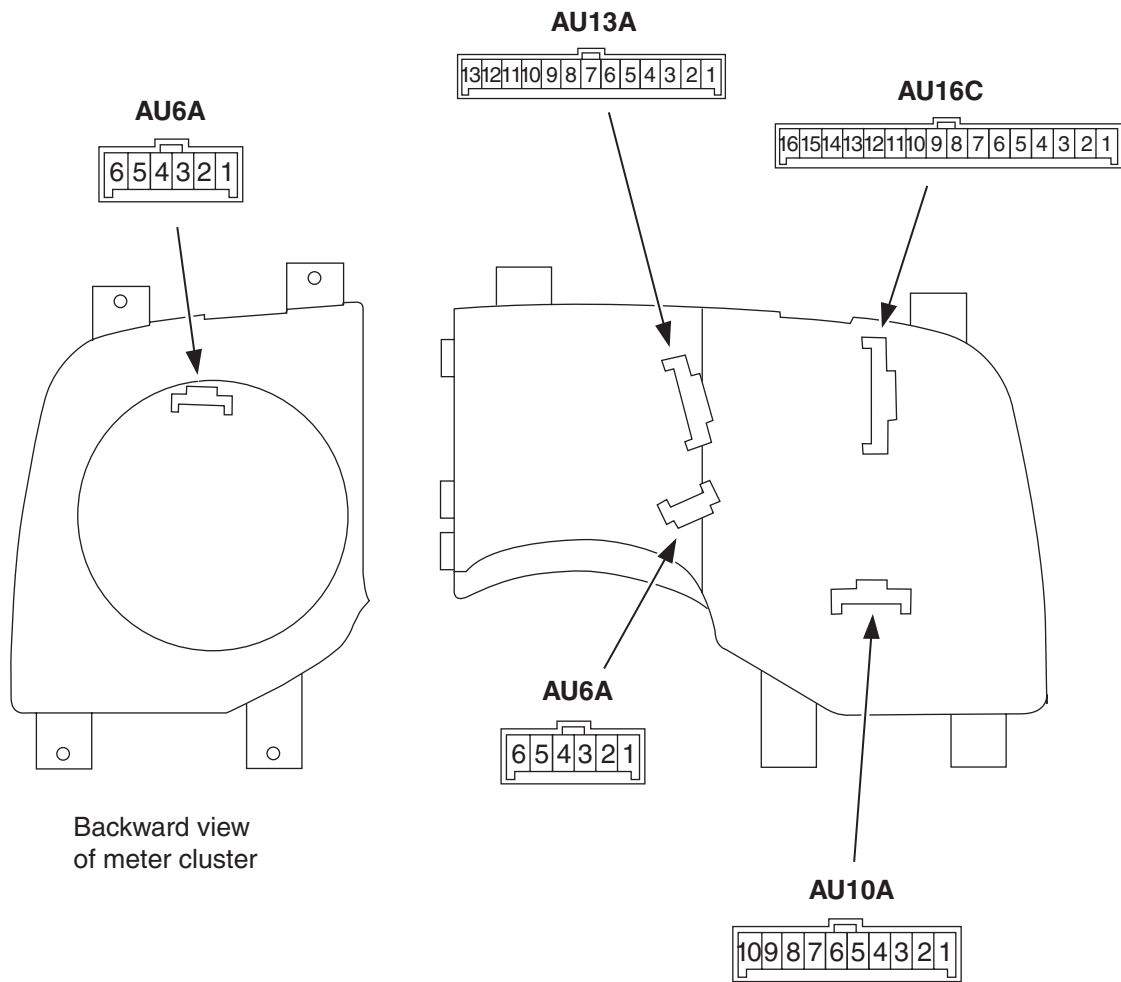


AU10A

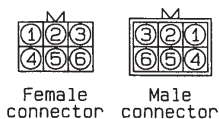


AU6A

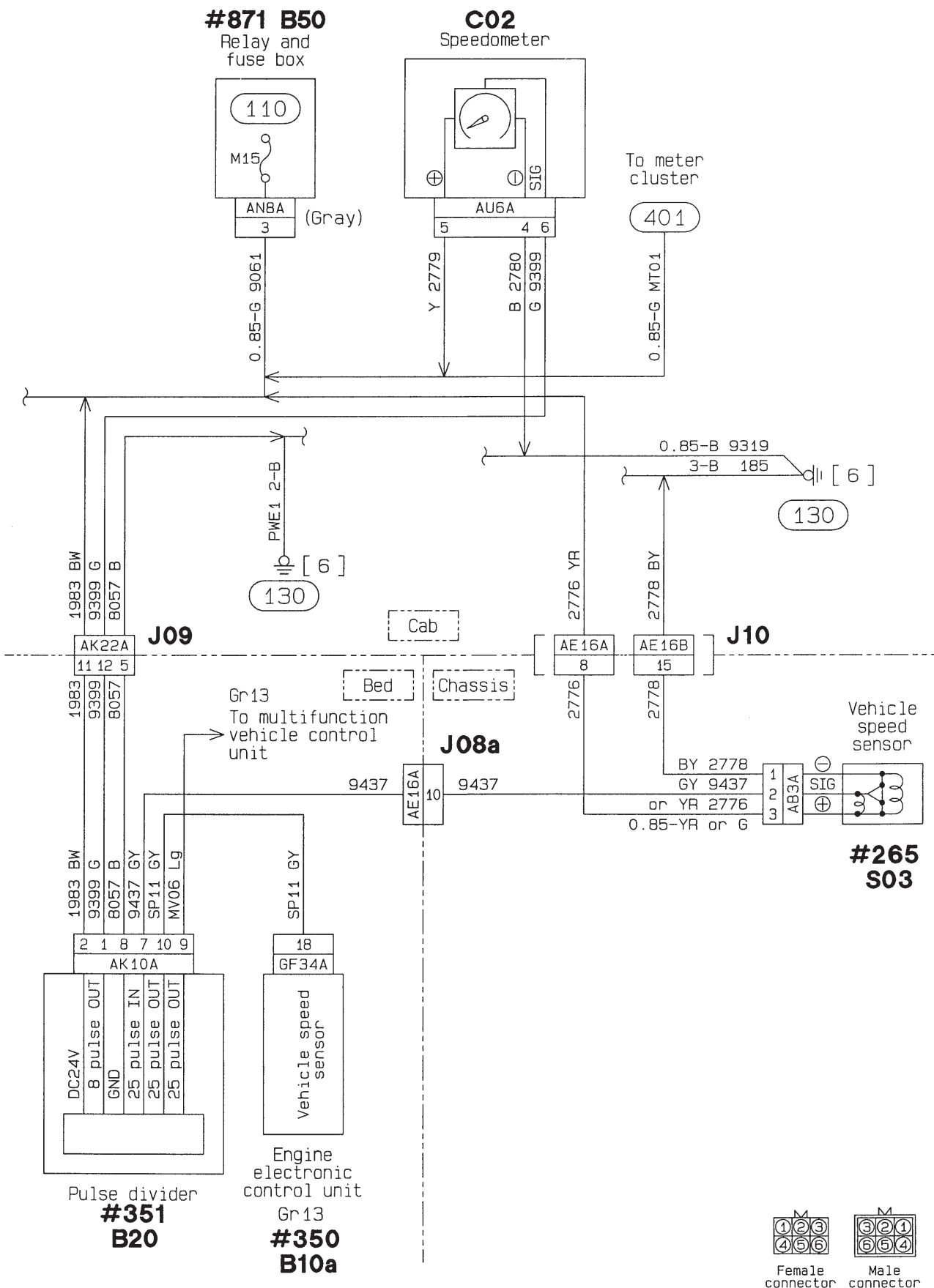




410

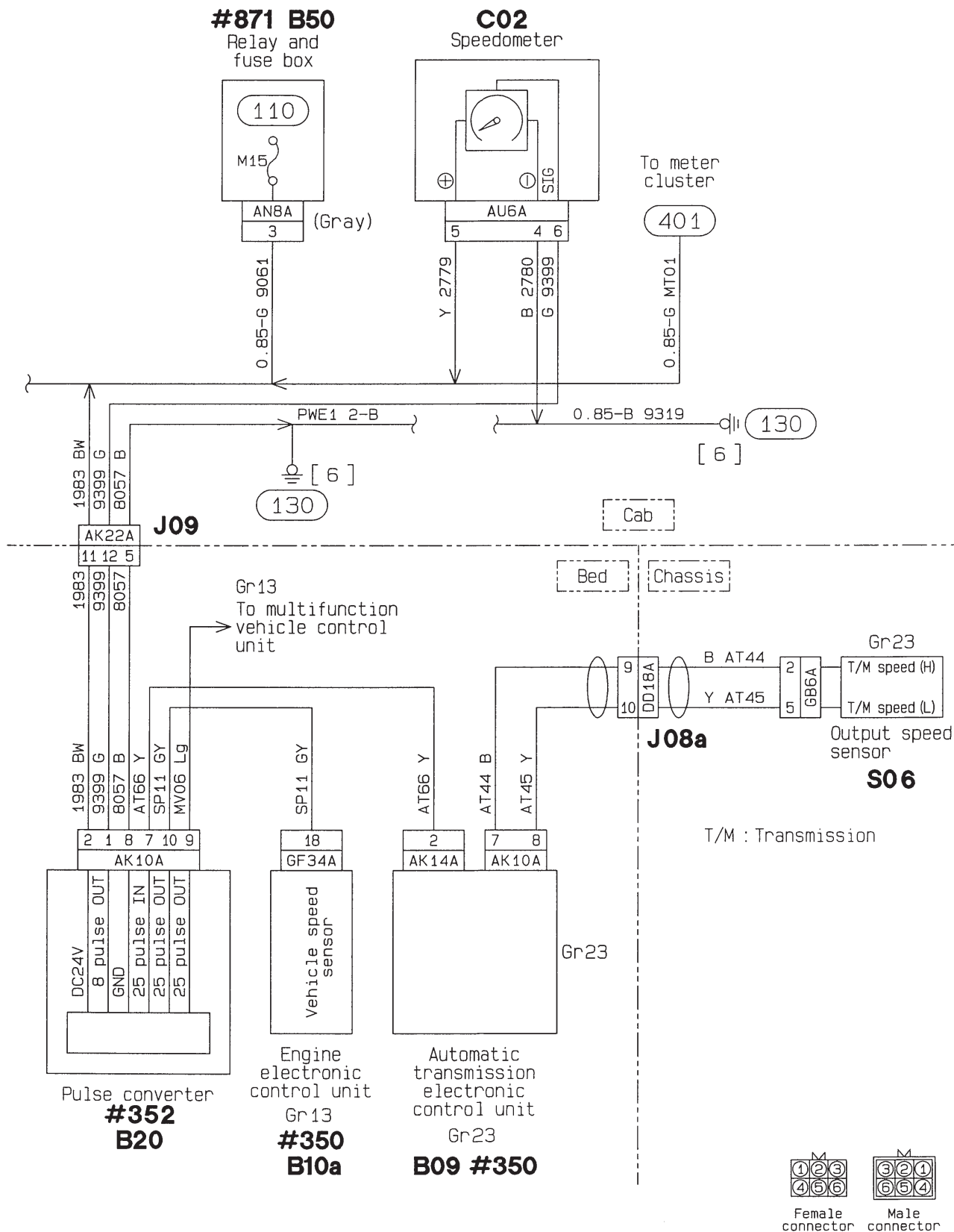


<Manual transmission>



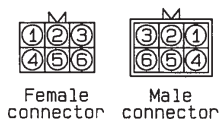
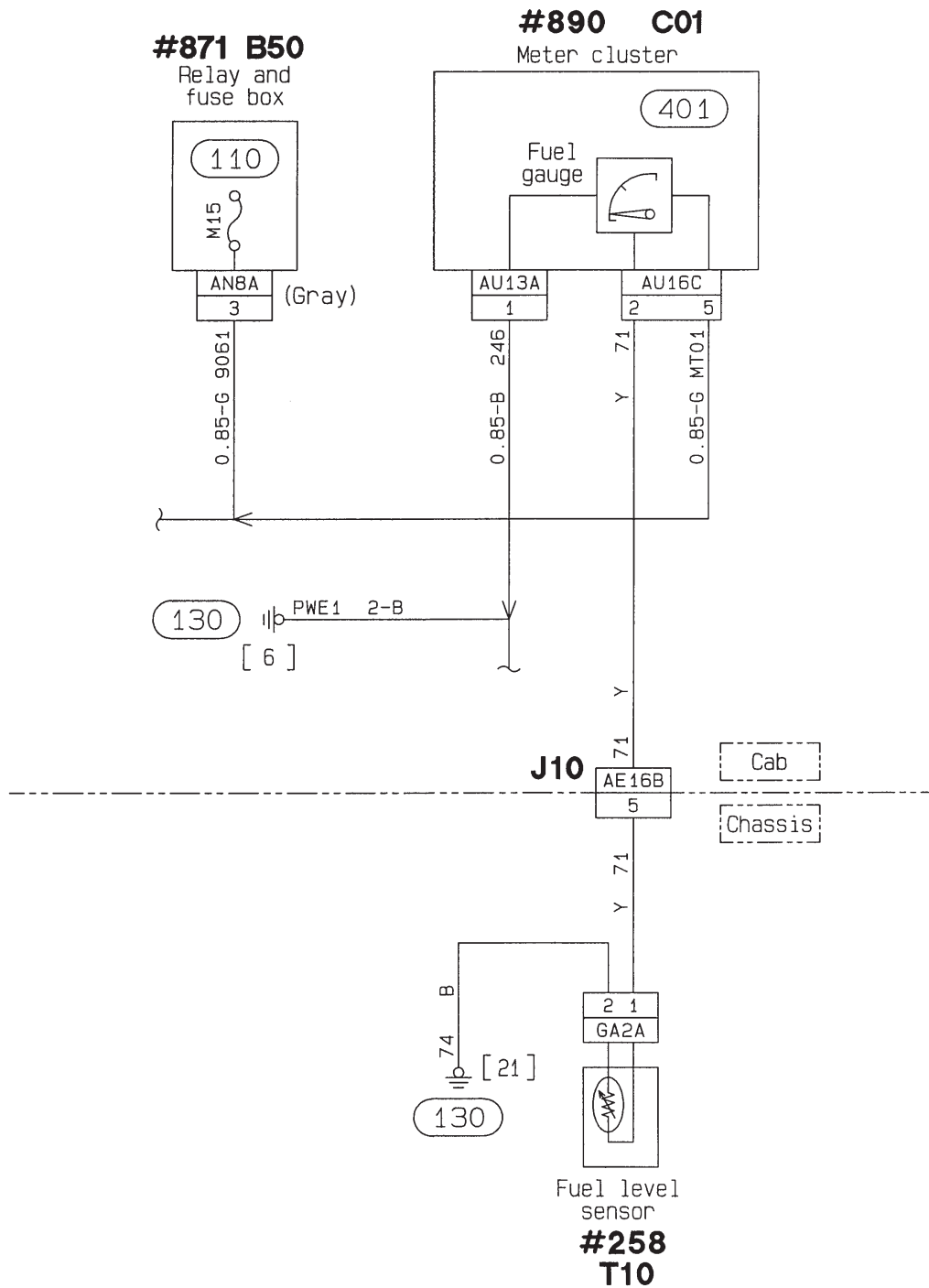
412 SPEEDOMETER CIRCUIT

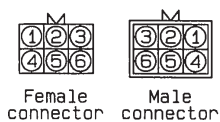
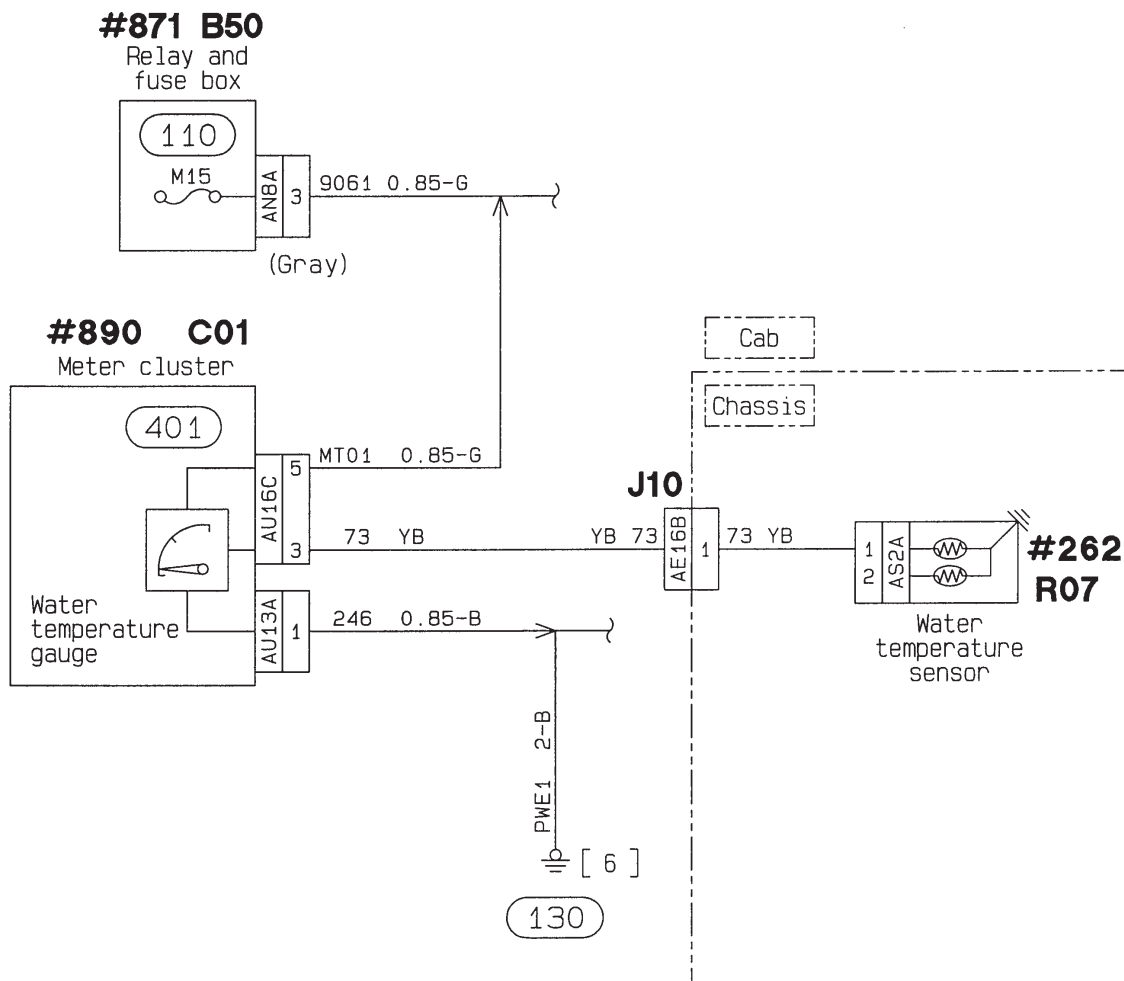
<Automatic transmission (FK, FM61, FM64) >



C00540

420 FUEL GAUGE CIRCUIT

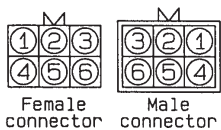
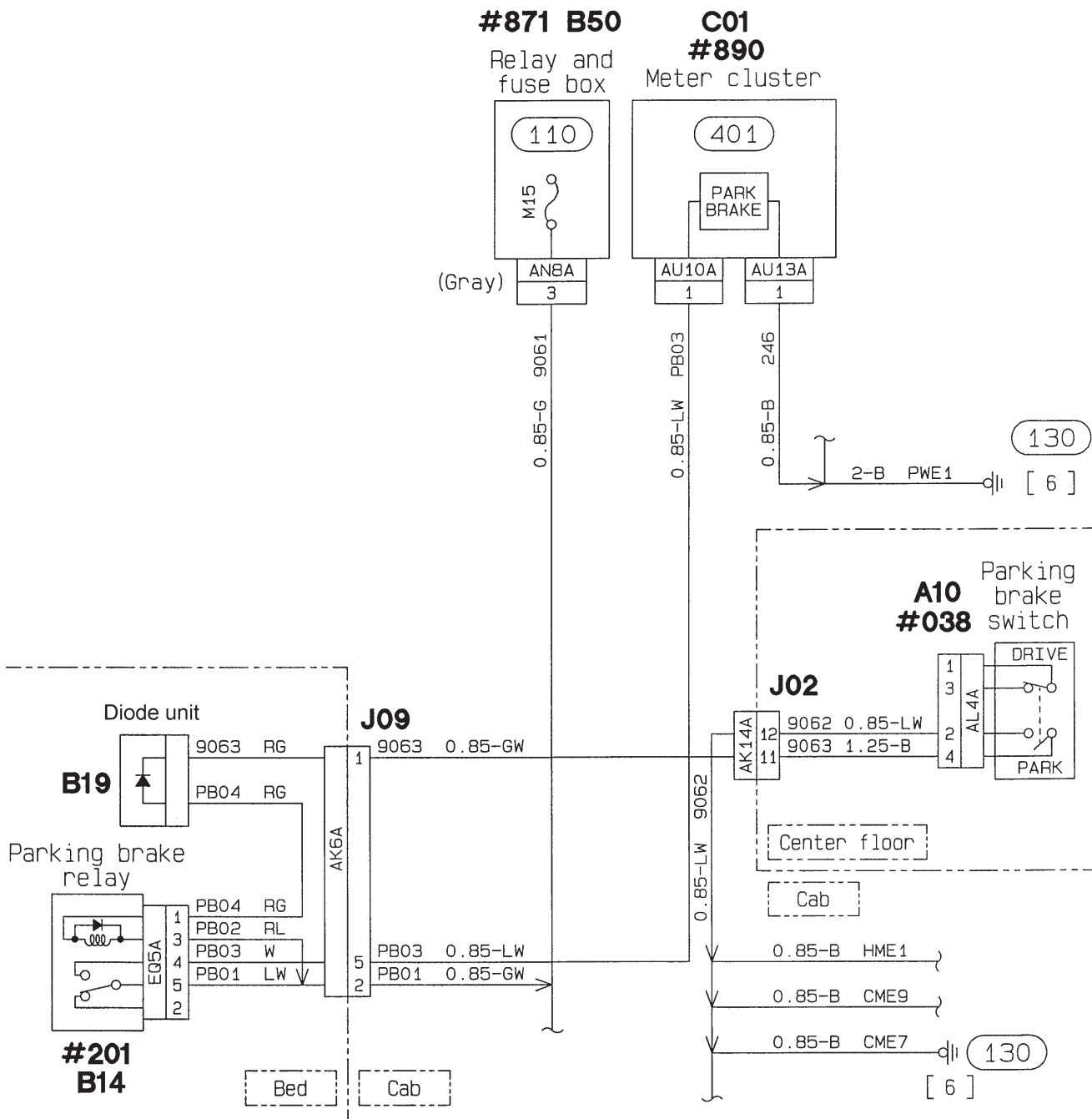




5 INDICATOR AND WARNING LAMP CIRCUIT

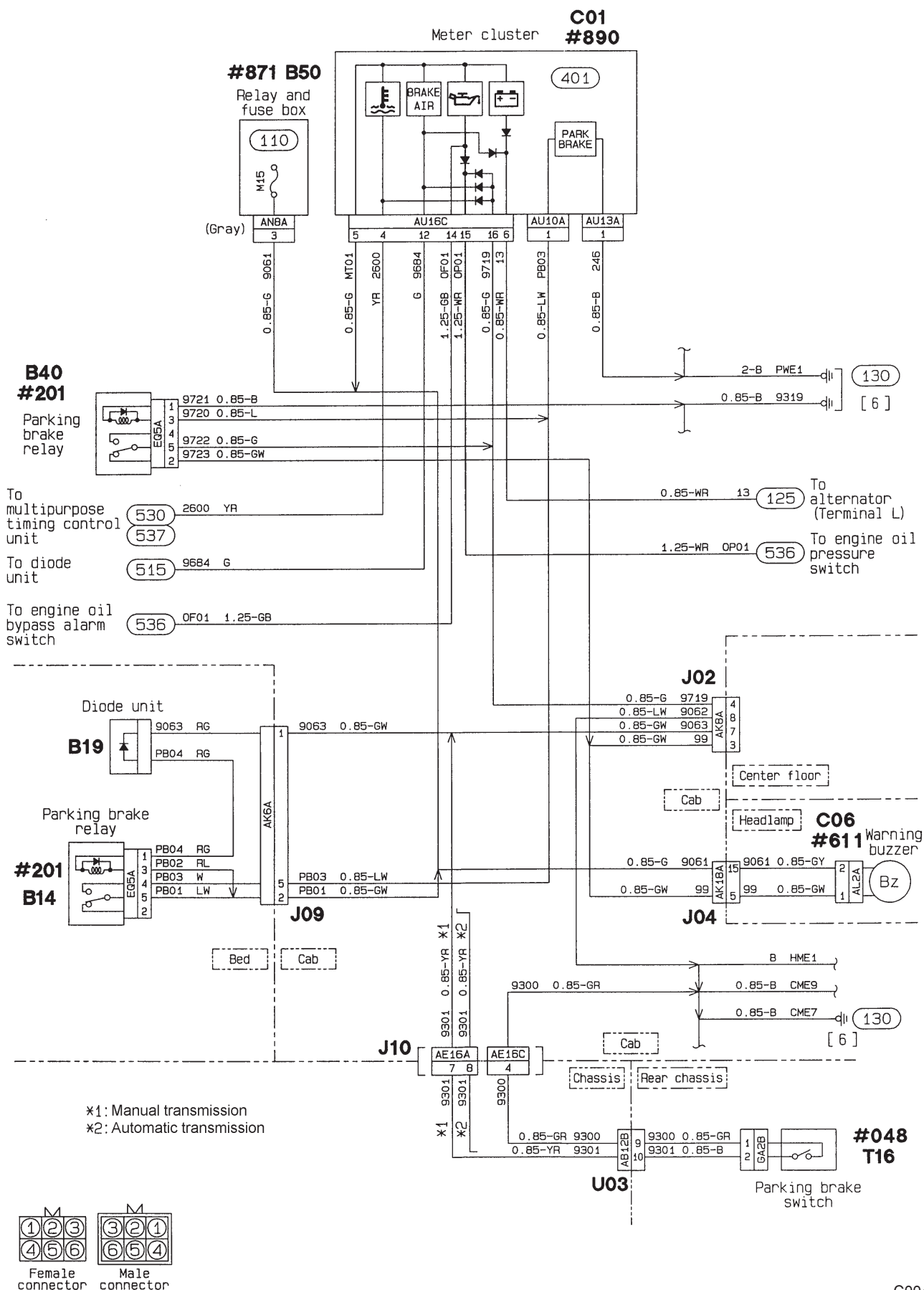
510

<Center parking brake>



C00405

<Wheel parking brake>

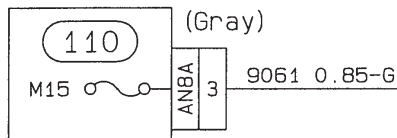


515 BRAKE WARNING CIRCUIT

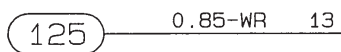
<Center parking brake>

#871

B50 Relay and fuse box



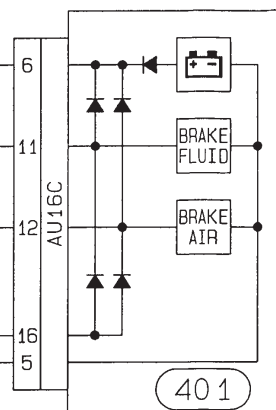
To alternator
(Terminal L)



C01

#890

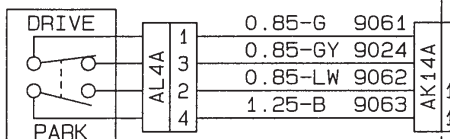
Meter cluster



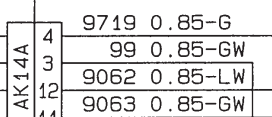
Parking
brake
switch

A10
#038

Center floor



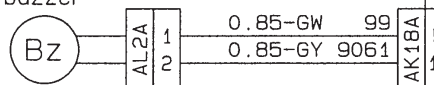
J02



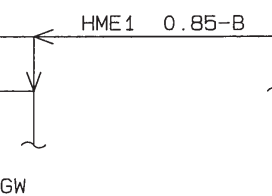
Warning
buzzer

C06
#611

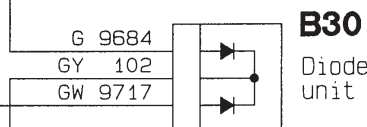
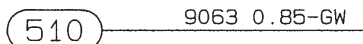
Headlamp



J04

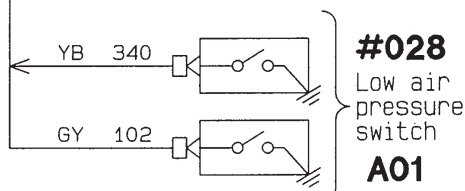


To diode unit



B30

Diode unit



#028

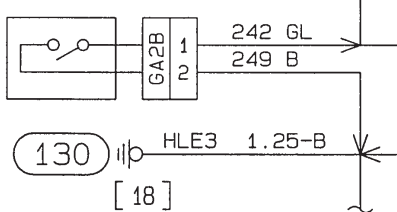
Low air
pressure
switch

A01

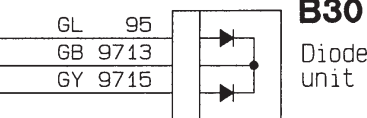
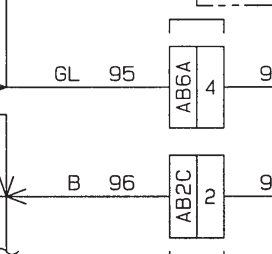
T08

#041

Brake fluid
level switch



J10



B30

Diode unit

ABS : Anti-lock brake system

Chassis

U01

#040
T06

Brake booster
stroke switch
(Front)

#040
T06

Brake booster
stroke switch
(Rear)



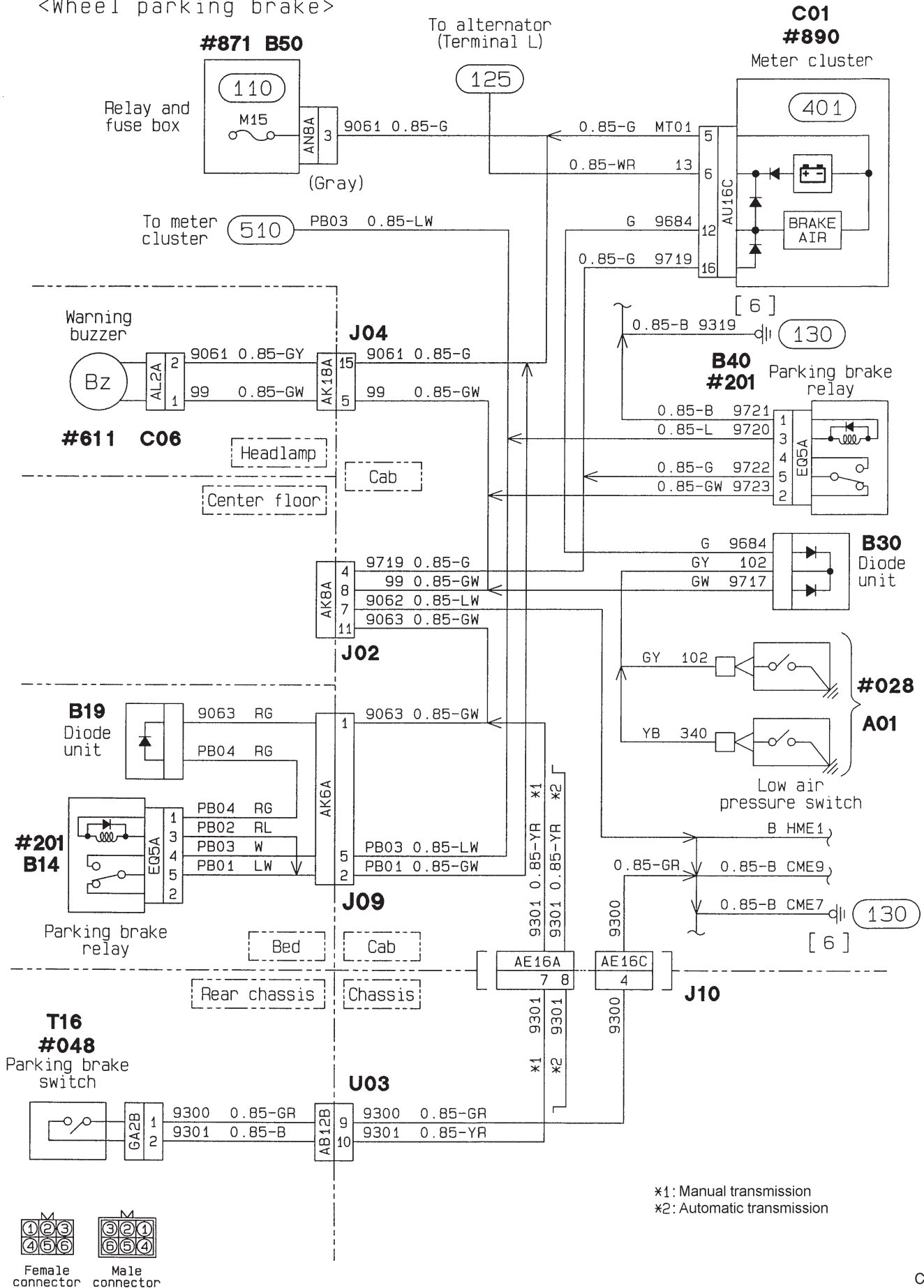
Female
connector



Male
connector

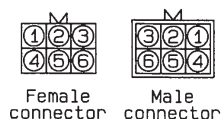
C00407

<Wheel parking brake>

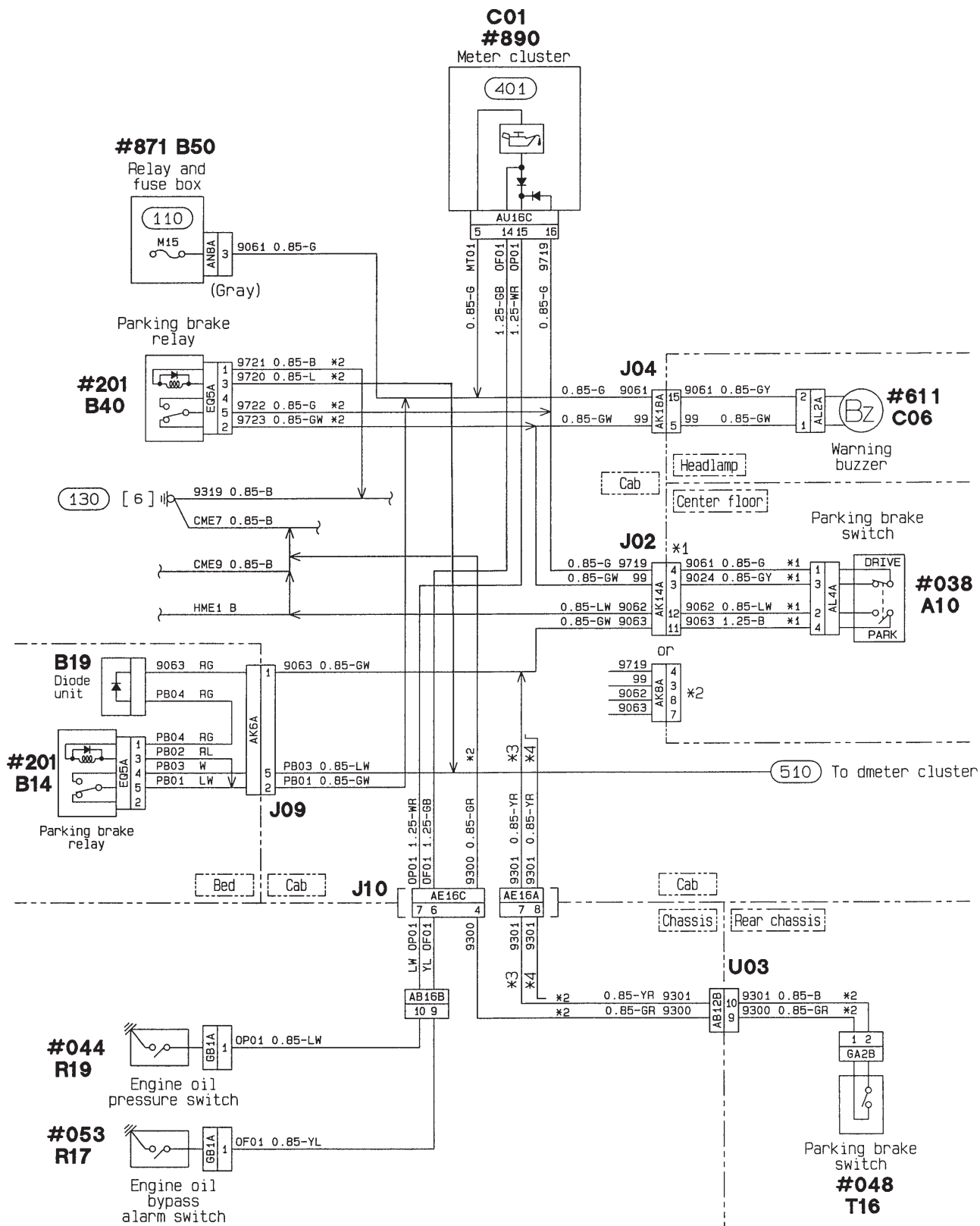


530

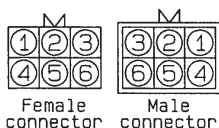




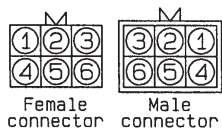
536 ENGINE OIL PRESSURE WARNING CIRCUIT



- *1: Center parking brake
- *2: Wheel parking brake
- *3: Manual transmission
- *4: Automatic transmission

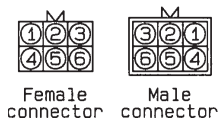
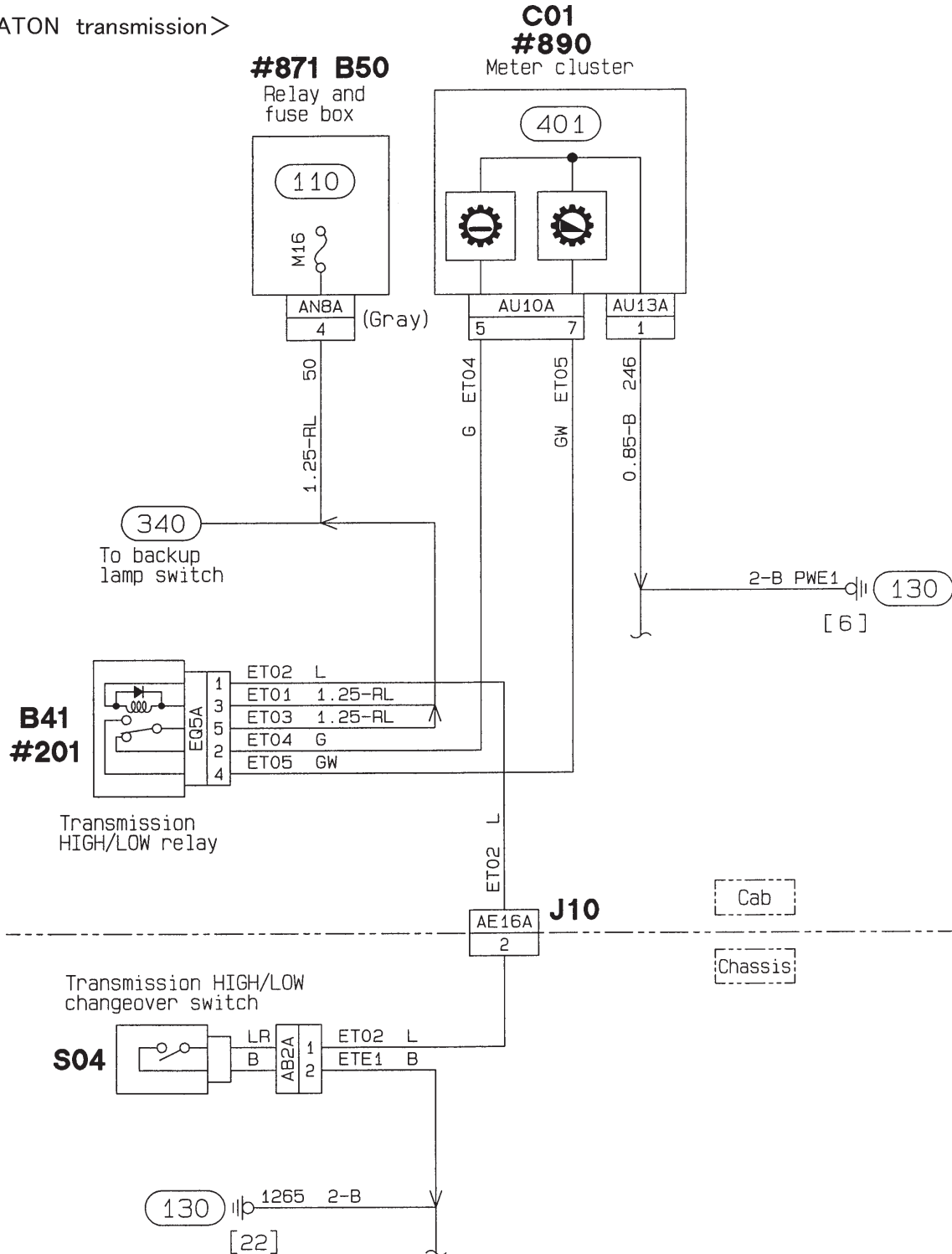


C00411

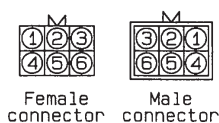
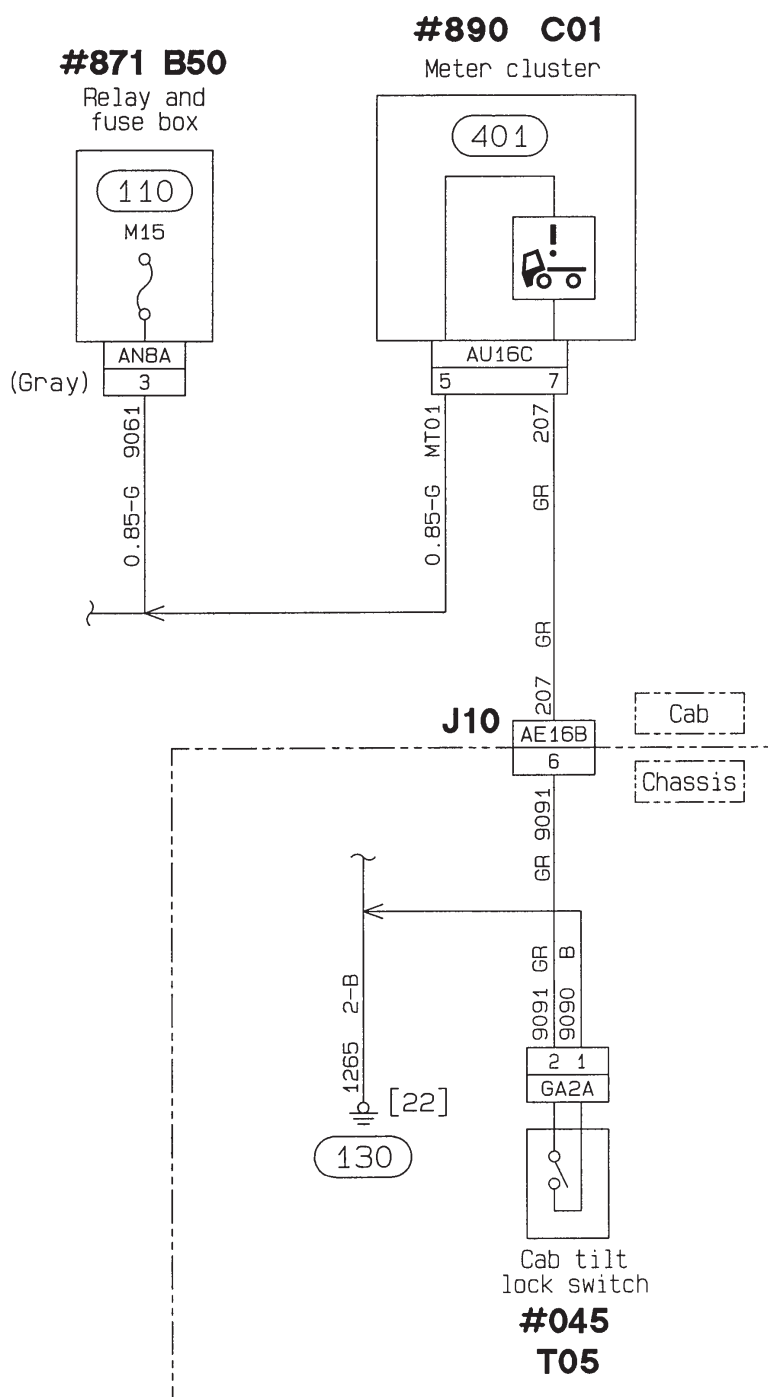


548 TRANSMISSION HIGH/LOW INDICATOR CIRCUIT

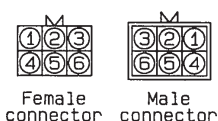
<EATON transmission>



C00413



566

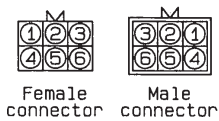
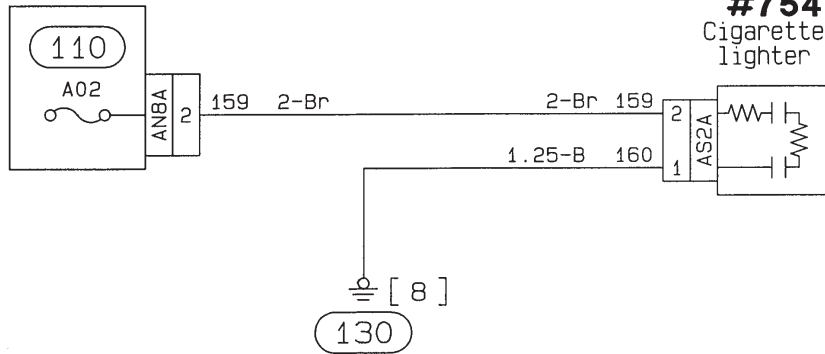


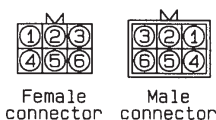
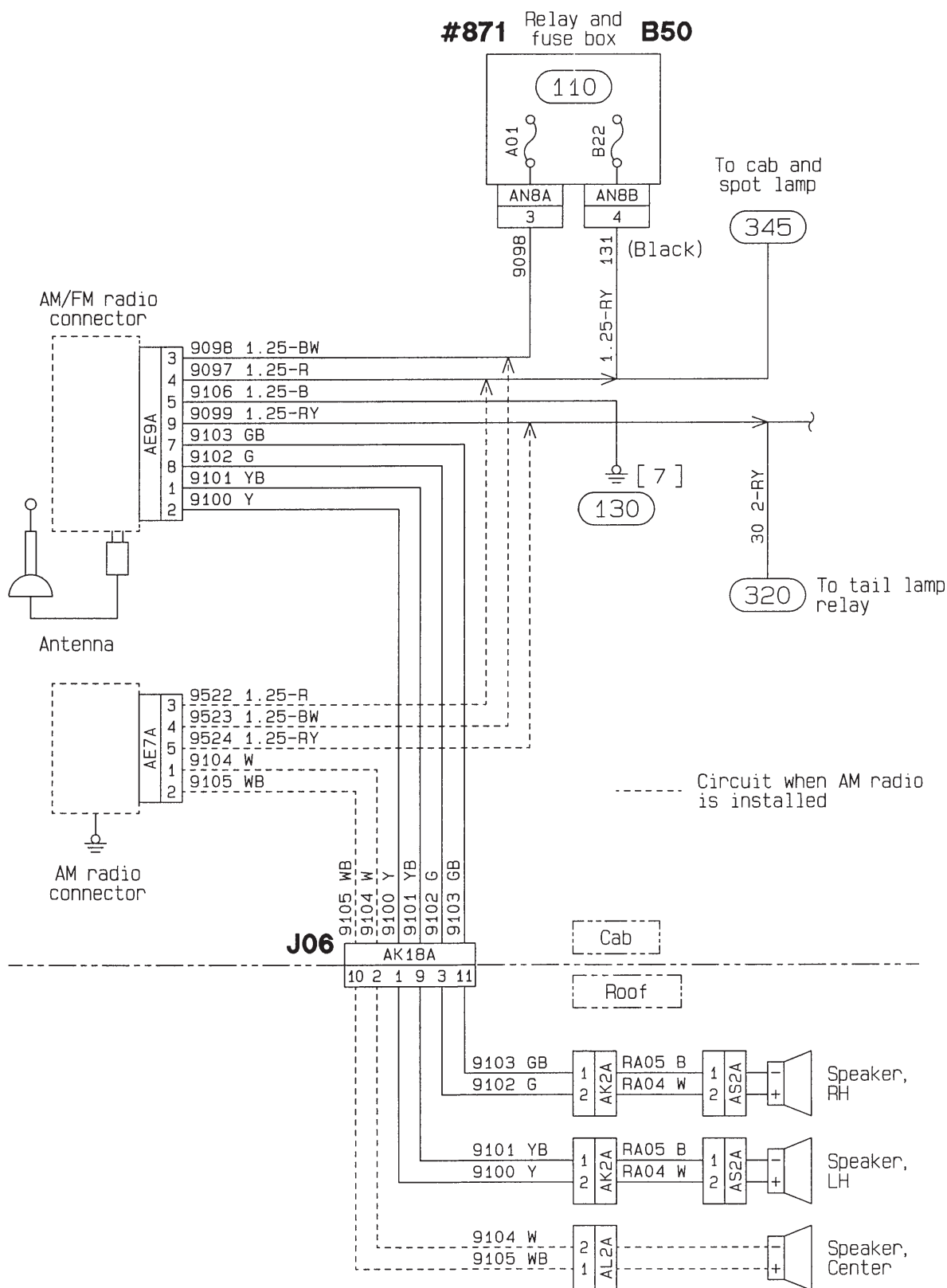
6 CAB SIDE ELECTRICAL CIRCUIT

610 CIGARETTE LIGHTER CIRCUIT

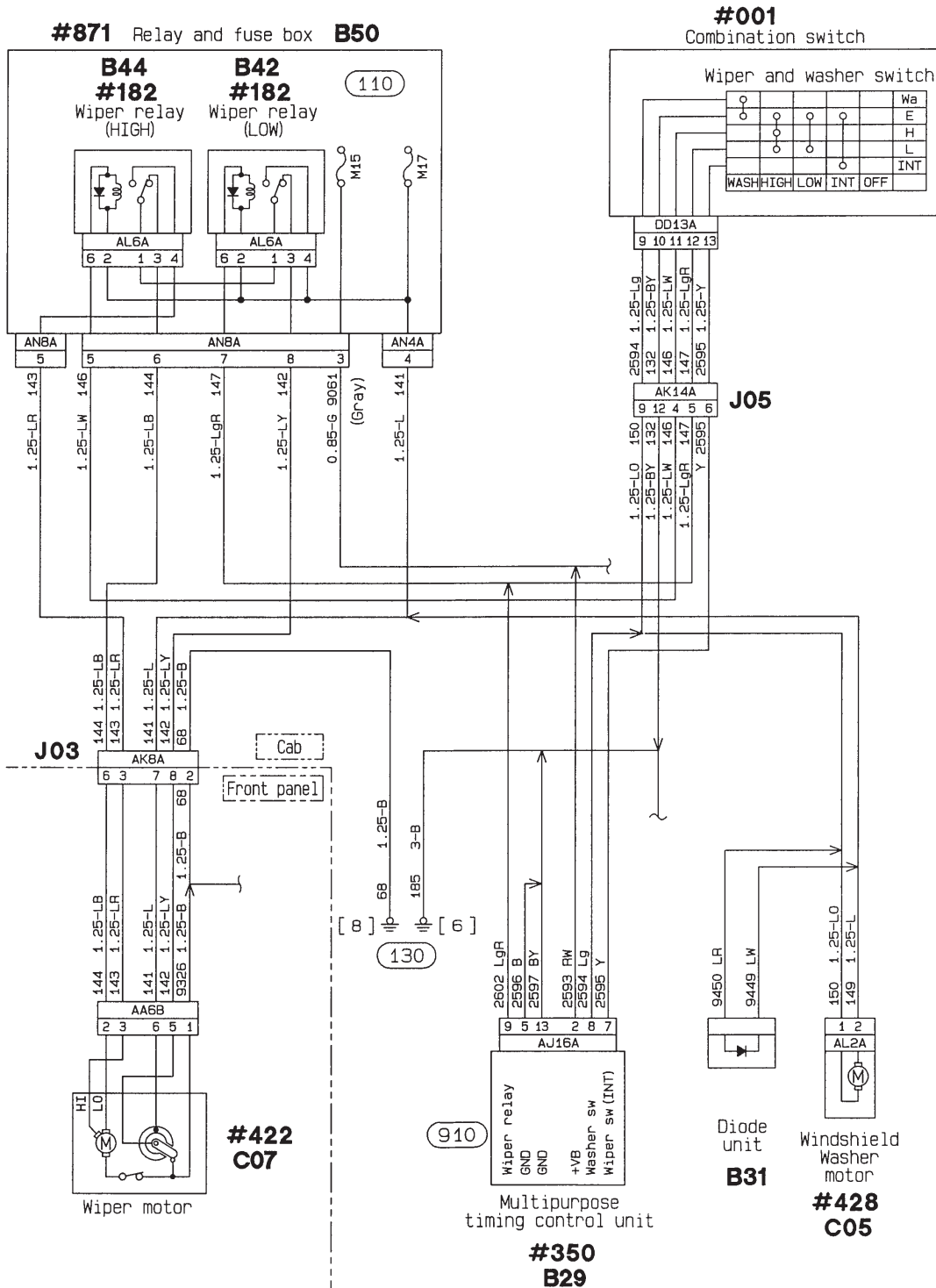
#871 B50

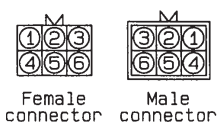
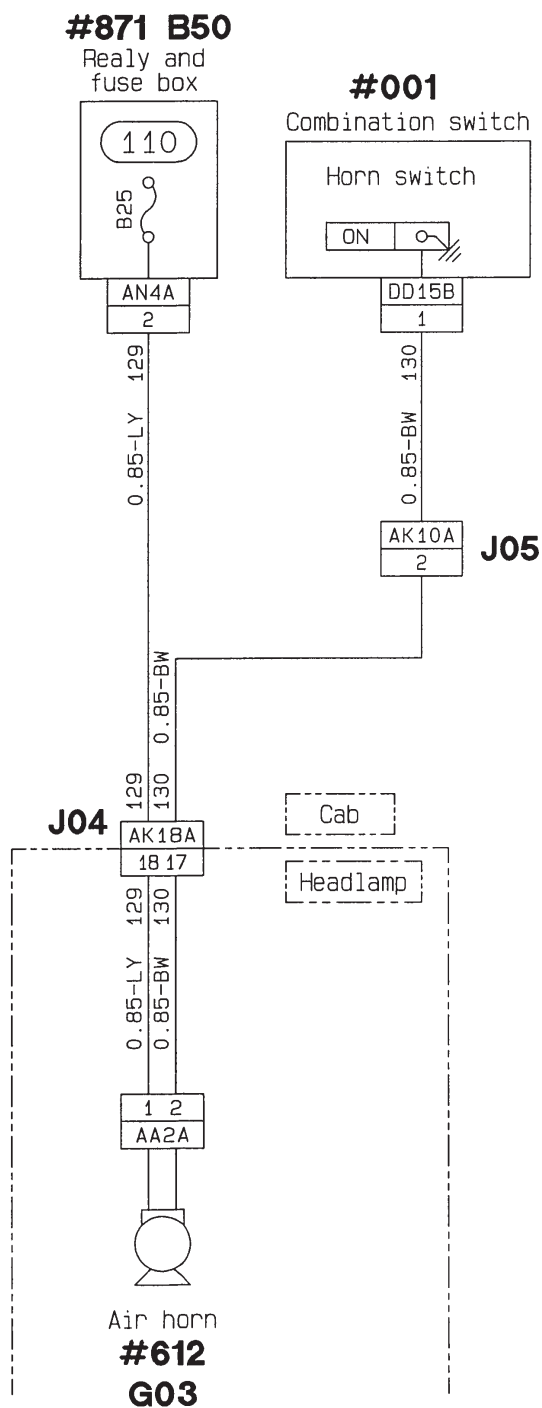
Relay and
fuse box





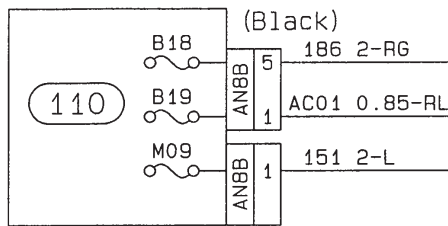
614 WIPER AND WASHER CIRCUIT



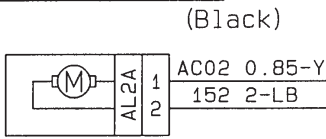


620 AIR-CONDITIONER CIRCUIT

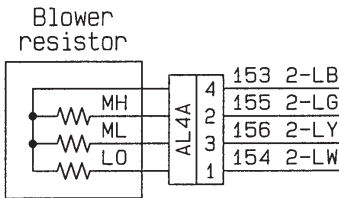
#871 Relay and fuse box B50



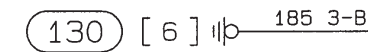
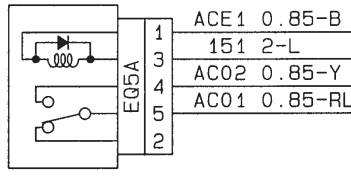
D06 #411 Blower motor



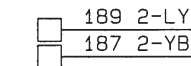
#750 D05 Blower resistor



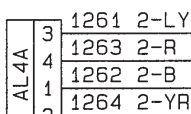
B33 #201 Blower motor relay



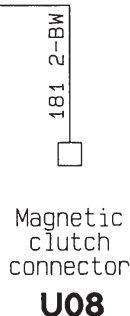
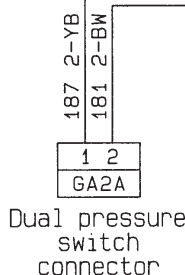
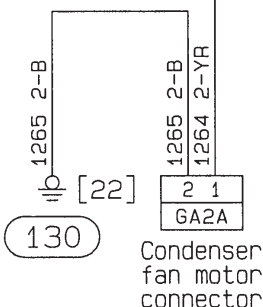
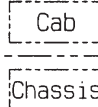
D04 Thermostat connector



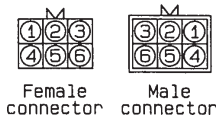
D03 Side condenser relay connector



J10



LO: Low
ML: Middle low
MH: Middle high
HI: High



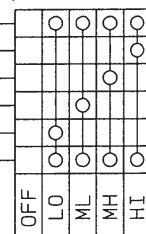
D02

Air-conditioner relay connector

Heater control assembly

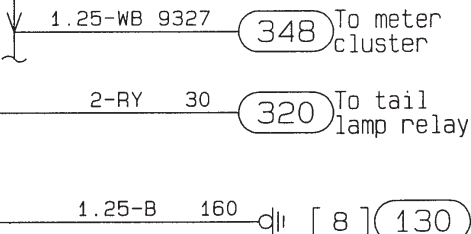
Air-conditioner switch connector

Heater switch (Fan switch)



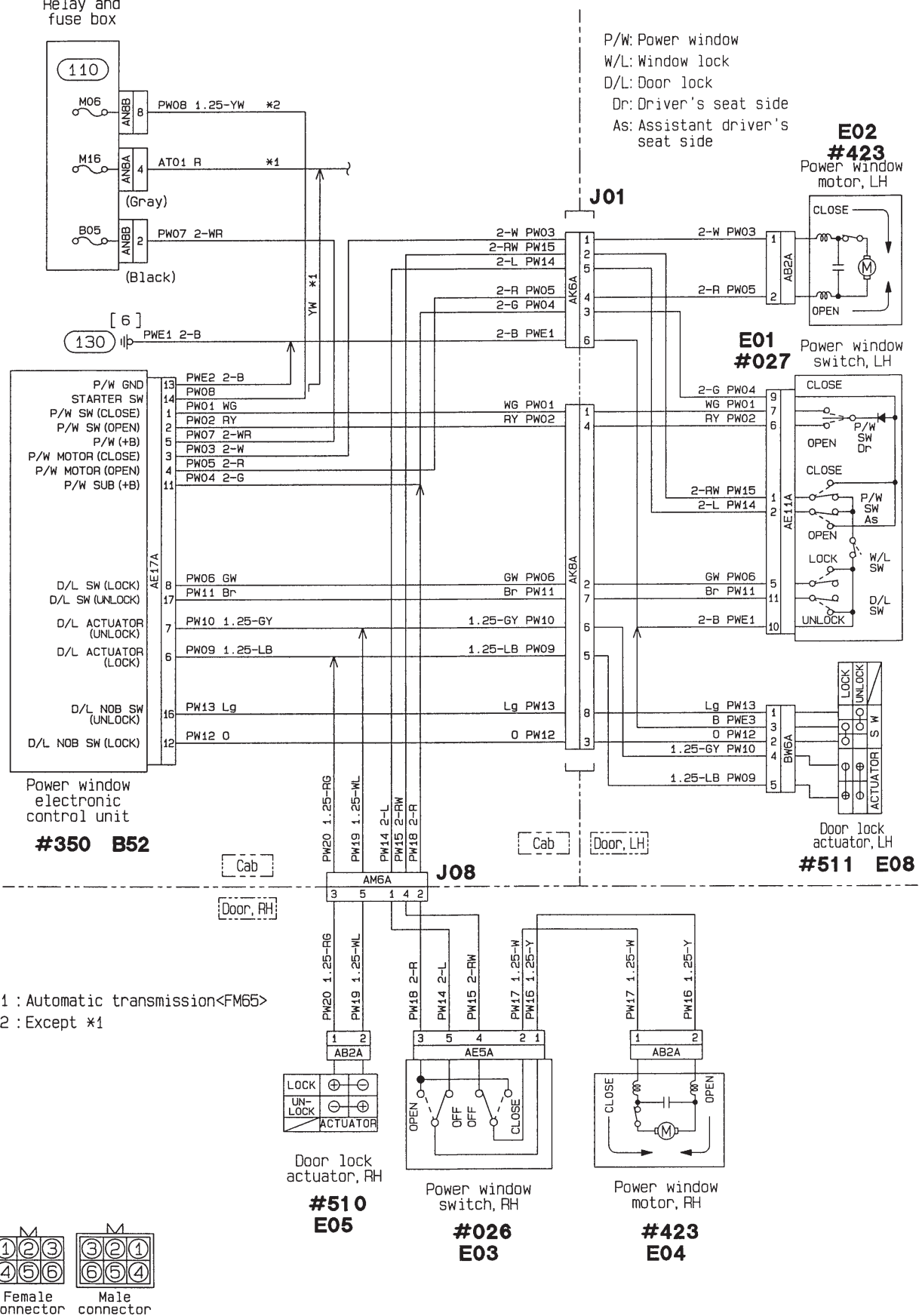
Illumination lamp

#763 D01

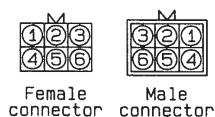
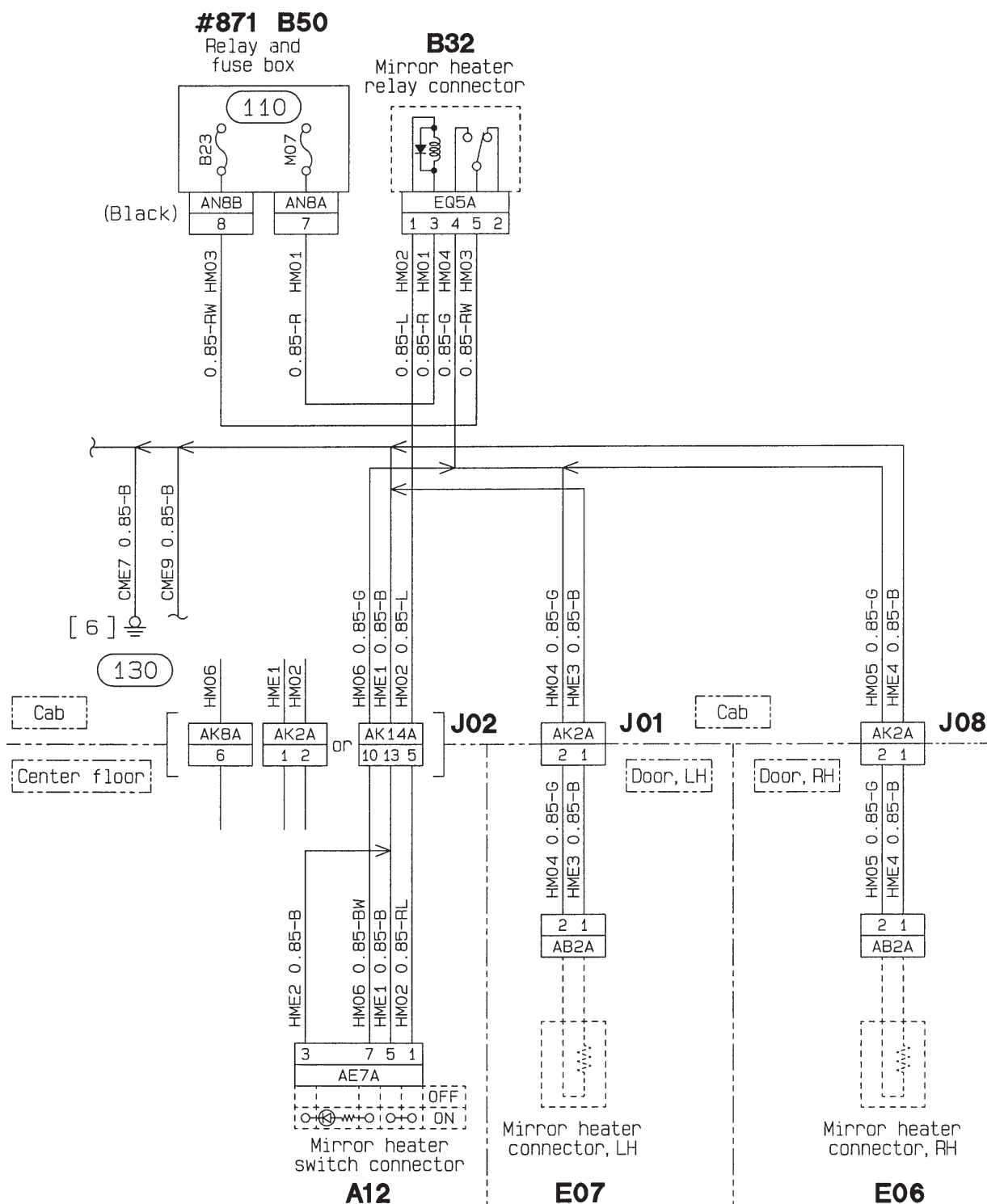


#871 B50

Relay and fuse box



629 MIRROR HEATER CIRCUIT

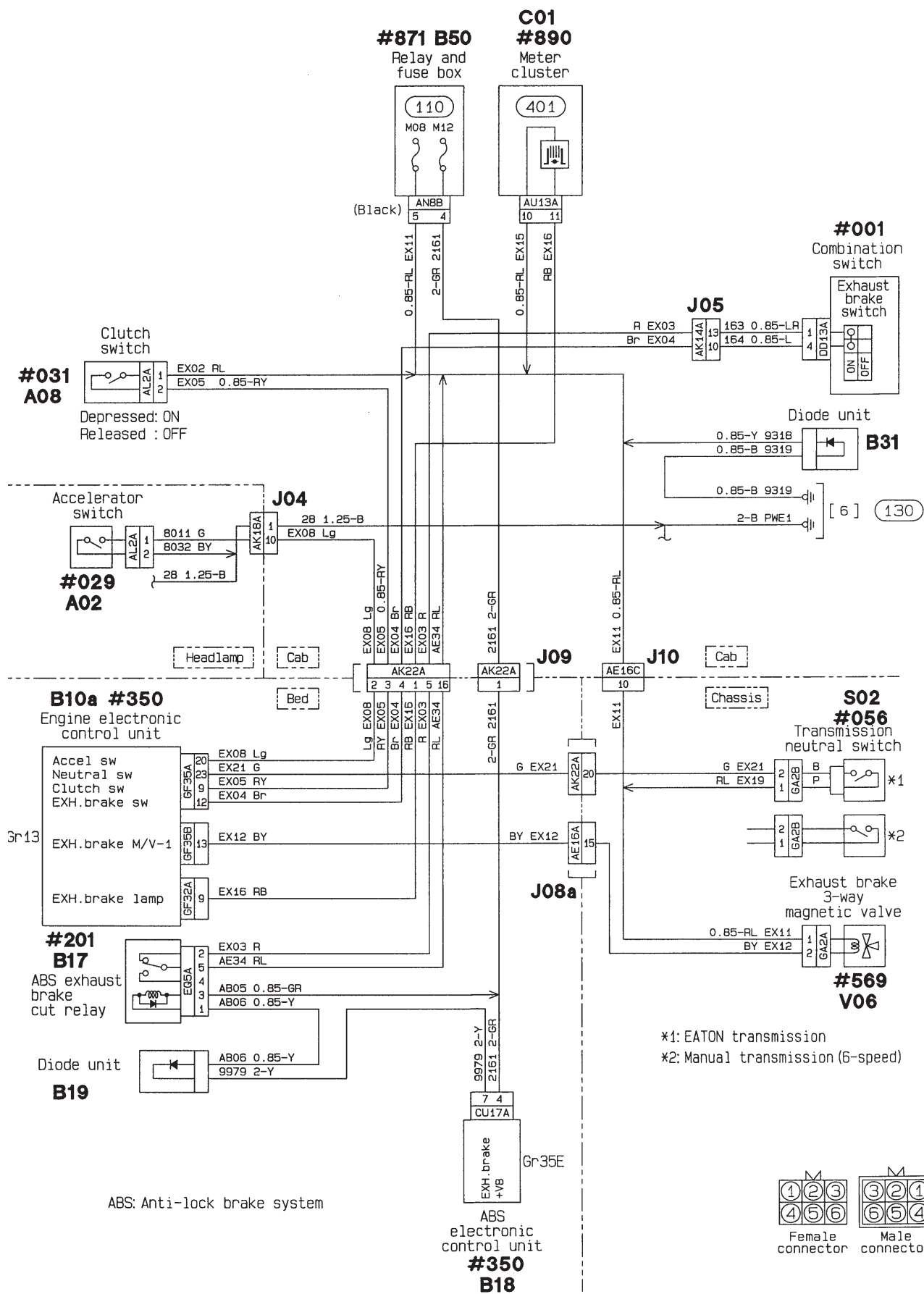


C00422

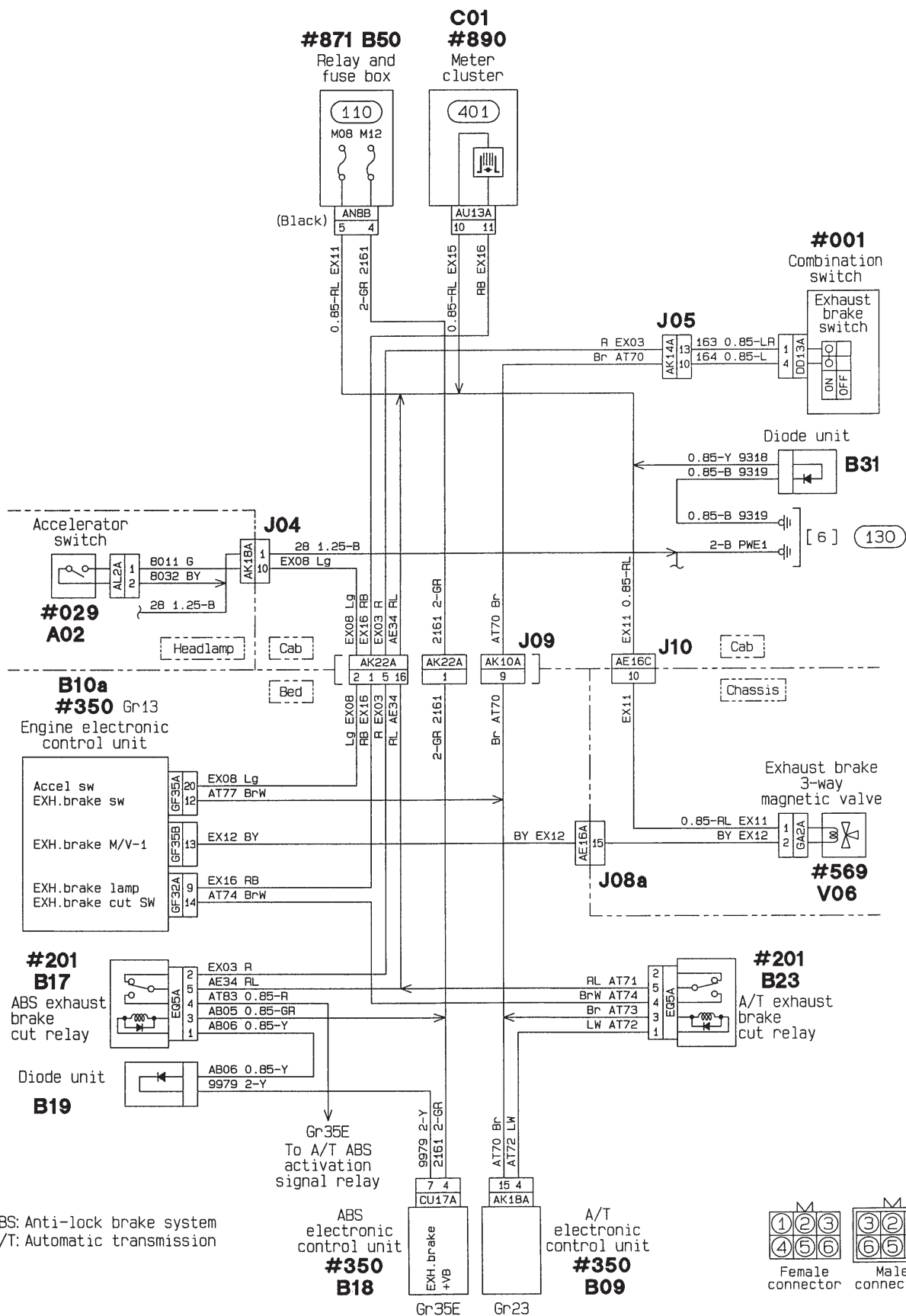
7 CHASSIS SIDE ELECTRICAL CIRCUIT

710

<Manual transmission>



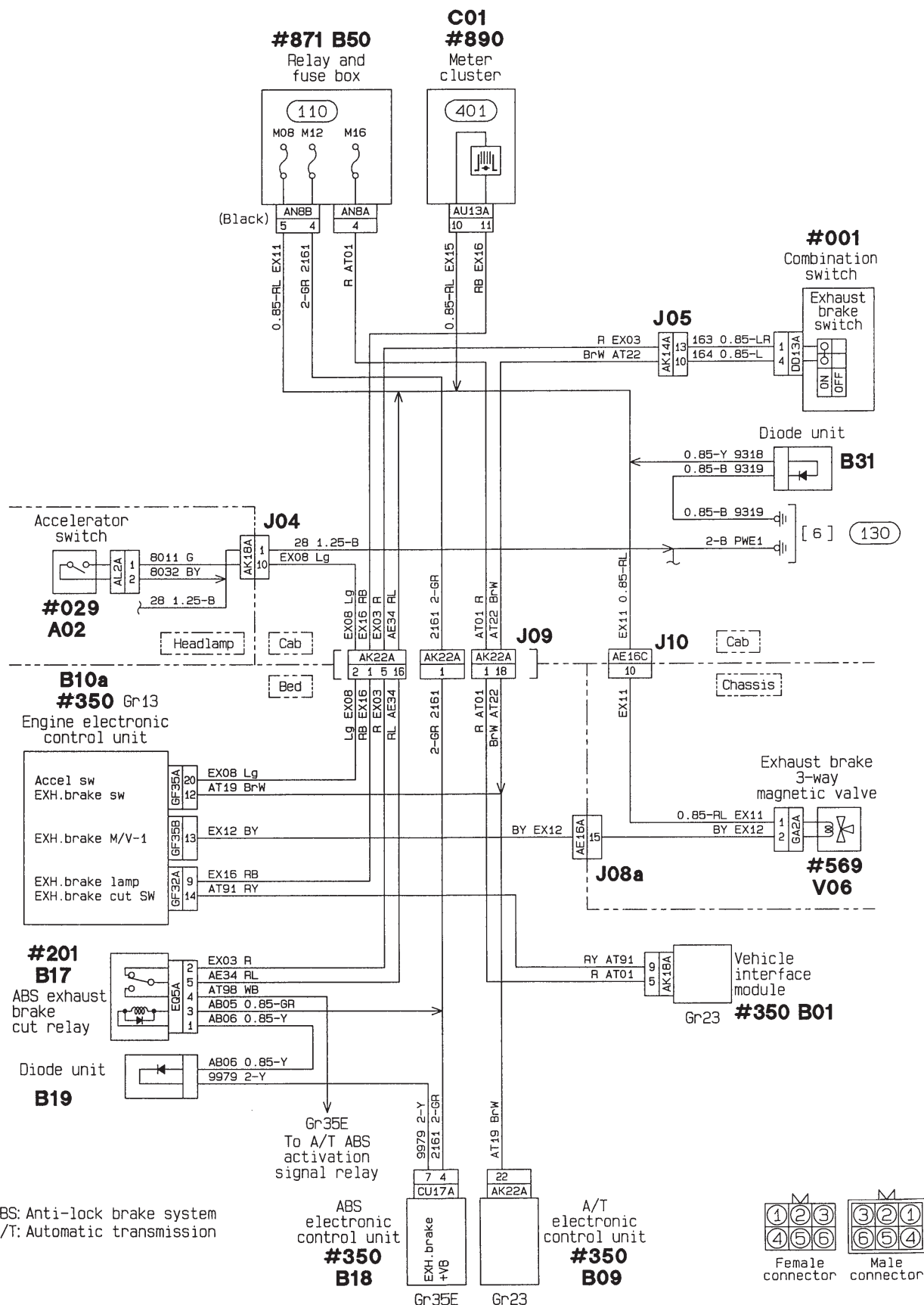
<Automatic transmission (FK, FM61, FM64) >

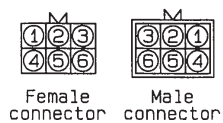
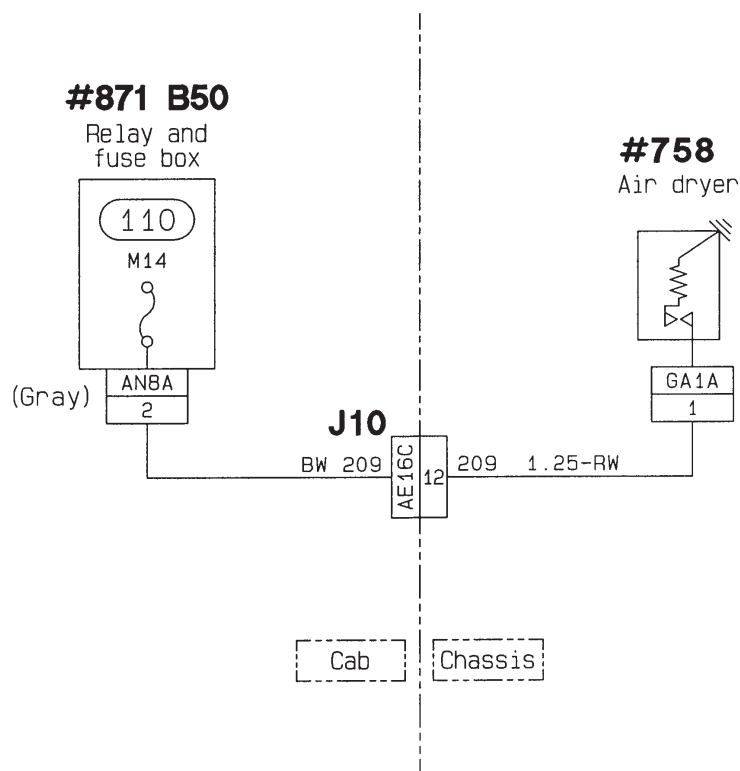


C00537

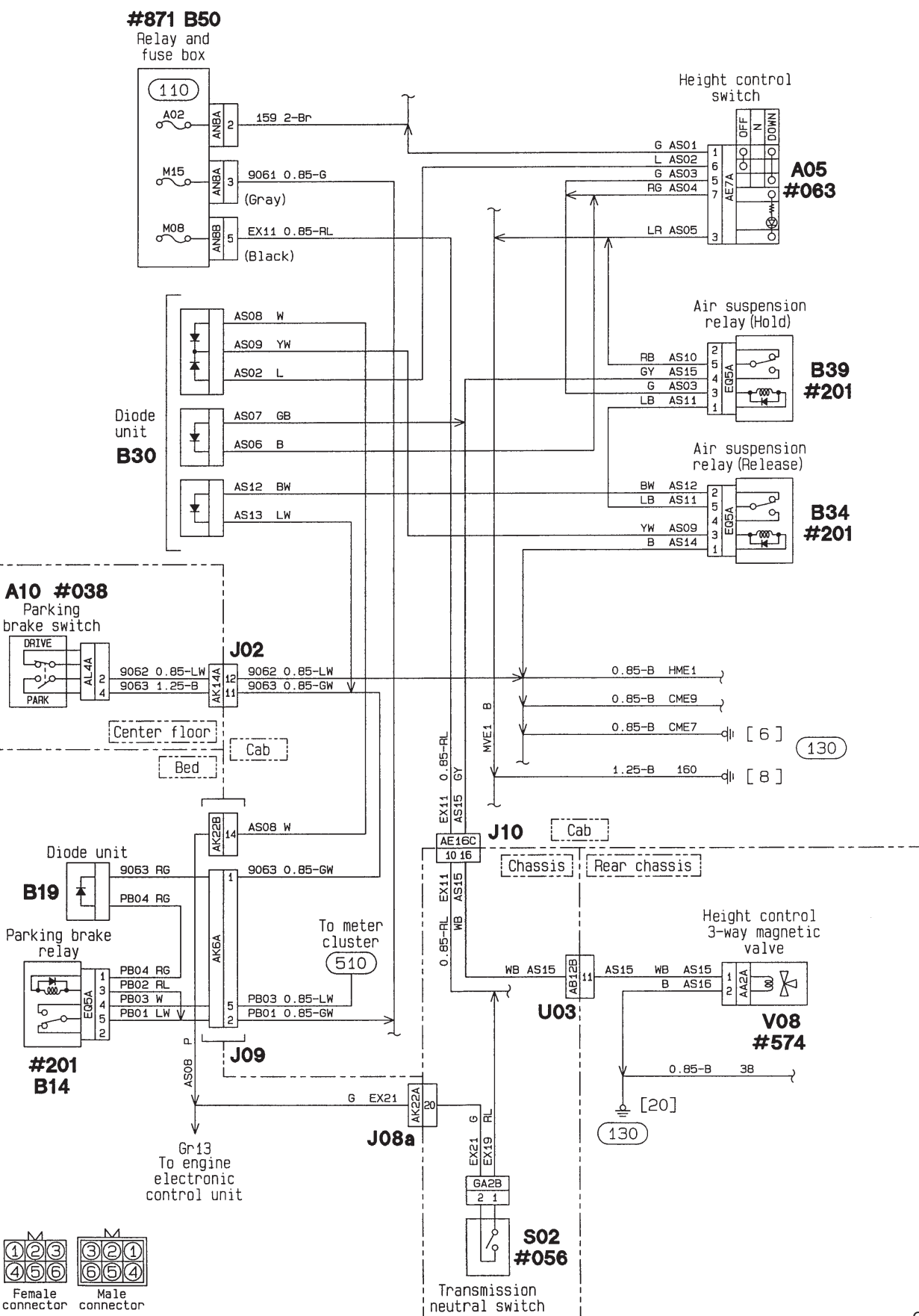
710 EXHAUST BRAKE CIRCUIT

<Automatic transmission (FM65) >

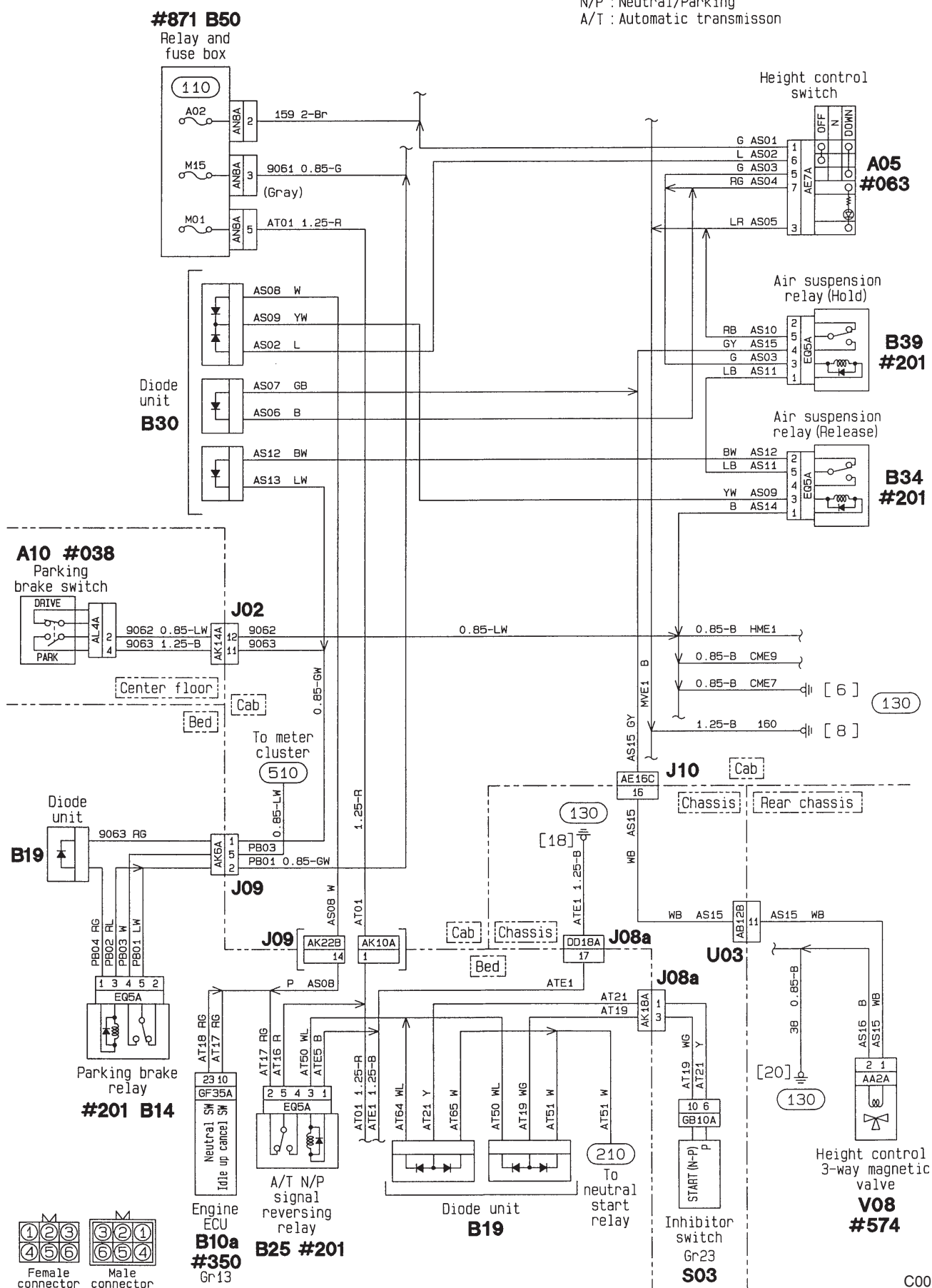




<Manual transmission>

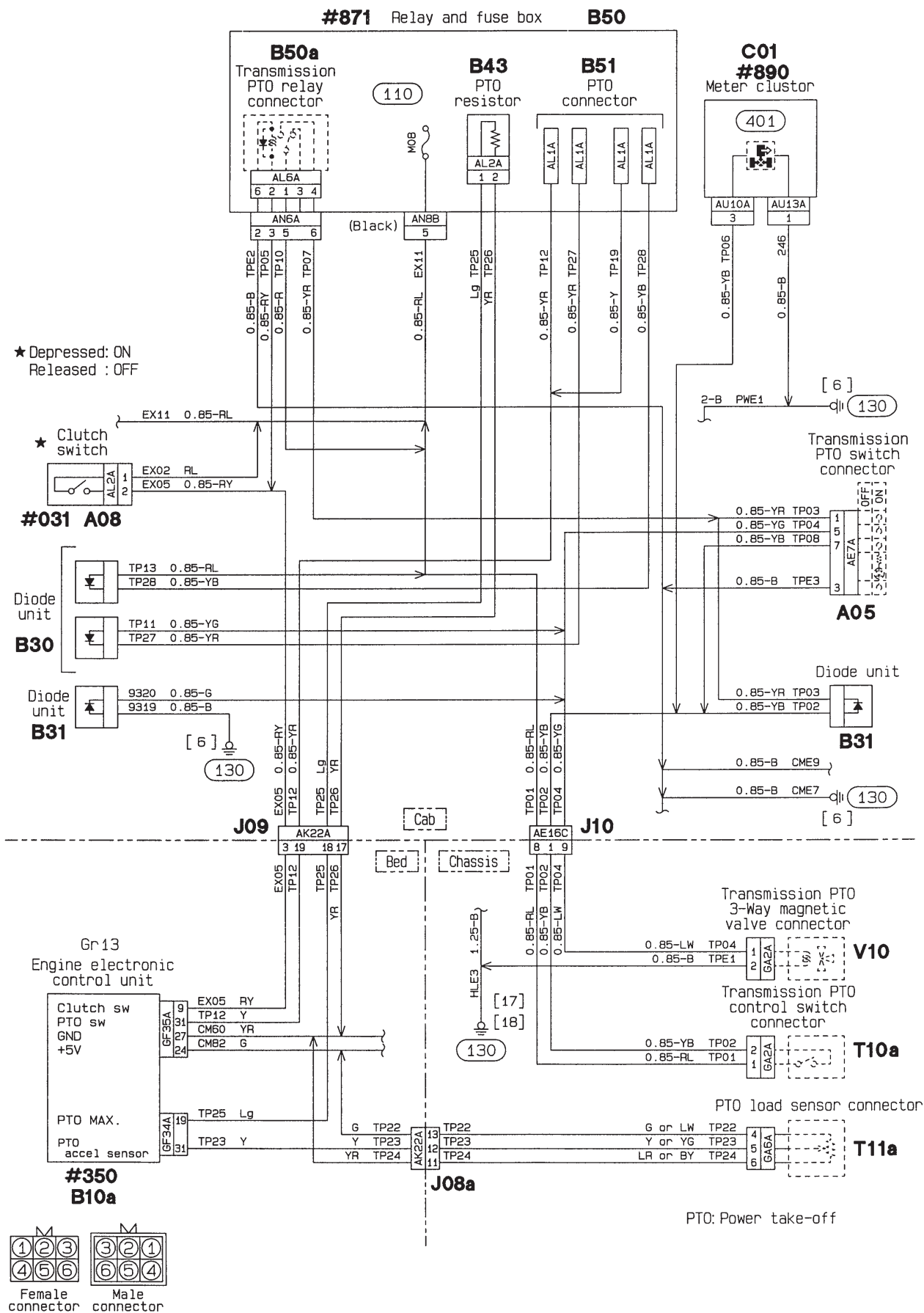


ECU : Electronic control unit
N/P : Neutral/Parking
A/T : Automatic transmission



8 ENGINE AND TRANSMISSION SIDE ELECTRICAL CIRCUIT

850 TRANSMISSION POWER TAKE-OFF CIRCUIT

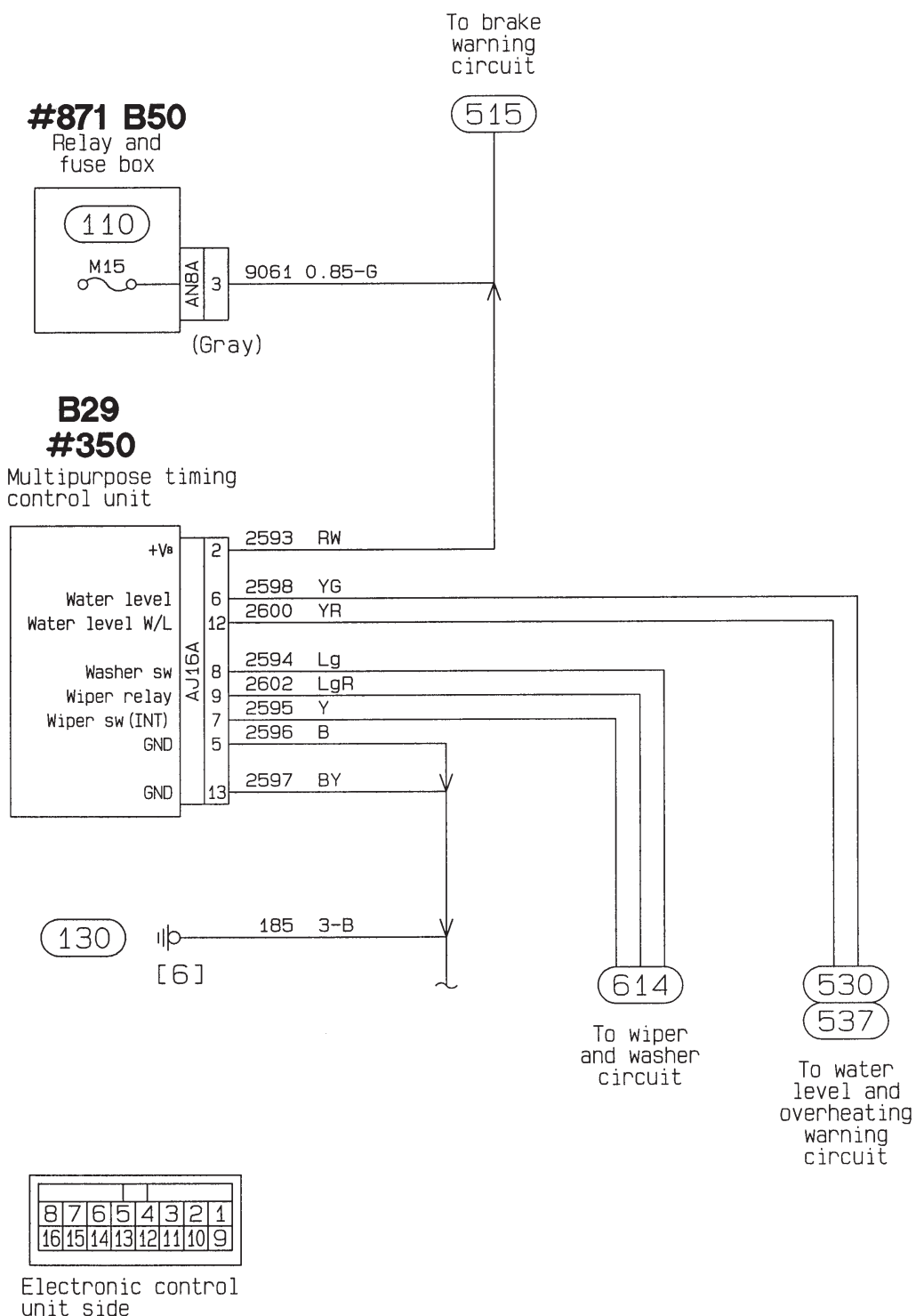


PTO: Power take-off

C00426

9 OTHERS CIRCUIT

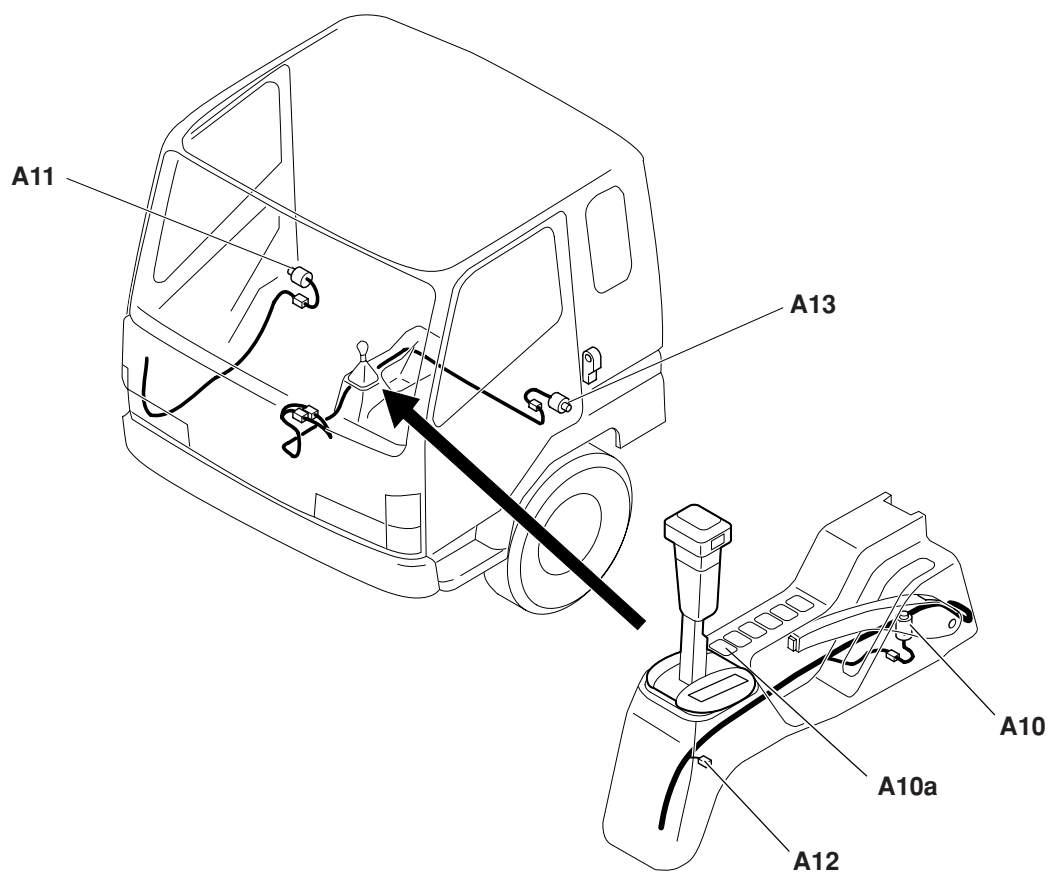
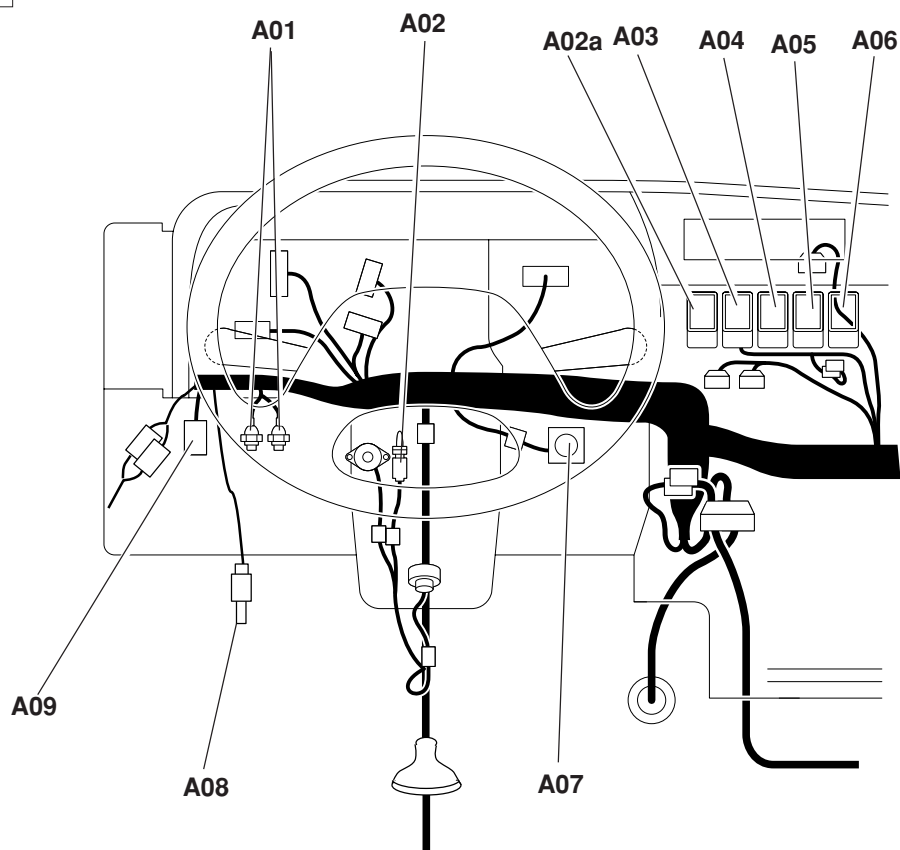
910 MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT



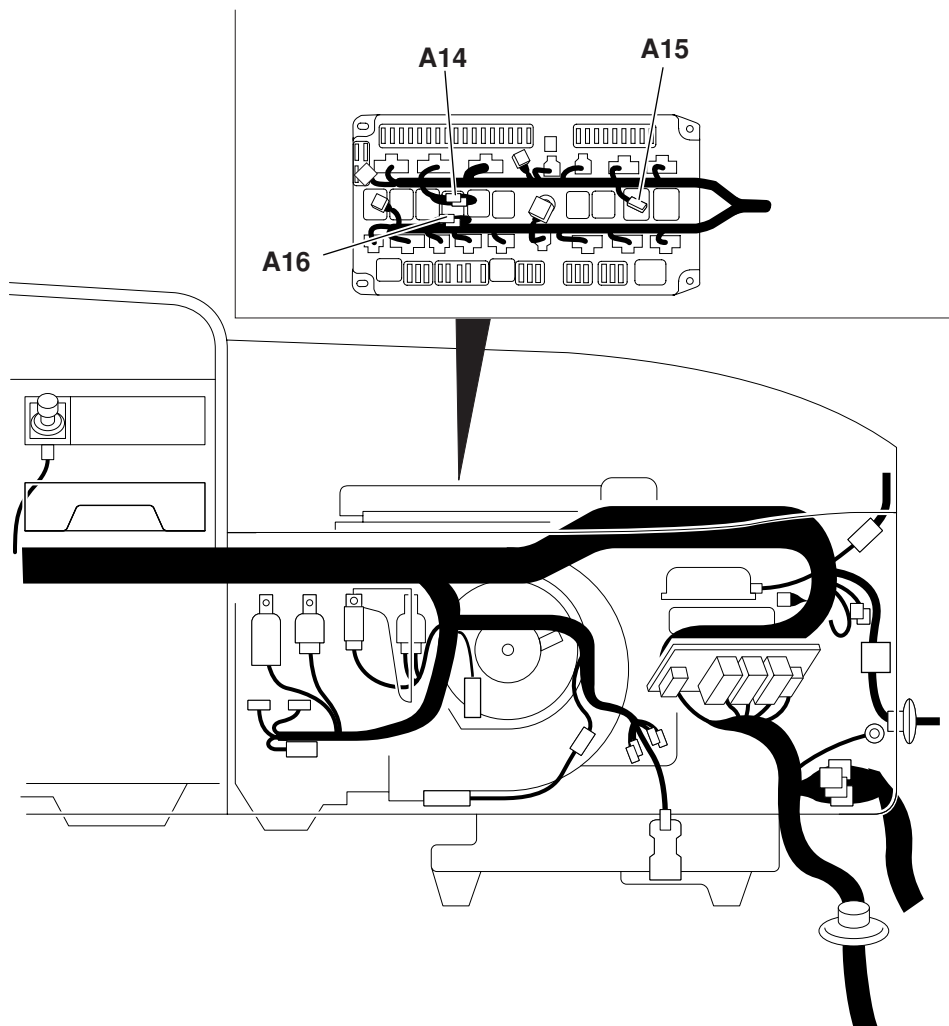
10 PARTS INSTALLATION POSITION

A SWITCH

A 01 to 16



L00111



L00112

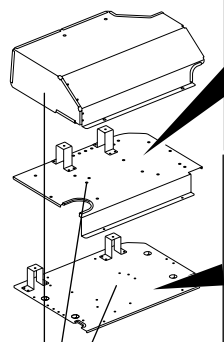
No relevant parts in a missing number

- | | |
|---|--|
| A01 Low air pressure switch | A11 Door switch, RH |
| A02 Accelerator switch | A12 Mirror heater switch connector |
| A02a Power mode switch <A/T(FK,FM61,FM64)> | A13 Door switch, LH |
| A03 Cruise control main switch | A14 Diagnosis switch and memory clear switch (ABS ECU) |
| A04 Cold start switch | A15 Diagnosis switch and memory clear switch (engine ECU) |
| A05 Transmission power take-off switch connector
Height control switch <FM64> | A16 Diagnosis switch and memory clear switch (MVCU) |
| A06 Van body dome light switch | |
| A07 Idling speed adjustment potentiometer | |
| A08 Clutch switch | ABS : Anti-lock brake system |
| A09 Rheostat switch | ECU : Electronic control unit |
| A10 Parking brake switch <center parking brake> | MVCU : Multifunction vehicle control unit |
| A10a Engine oil level check switch | A/T : Automatic transmission |

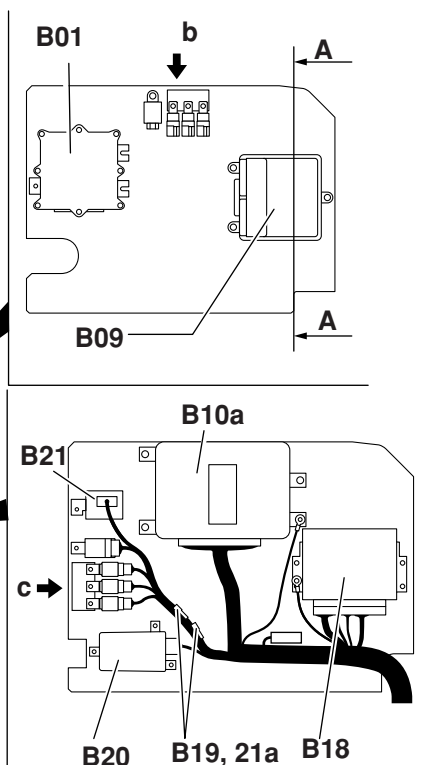
B RELAY AND ELECTRONIC CONTROL UNIT

B 01 to 27

<FM65(A/T)>

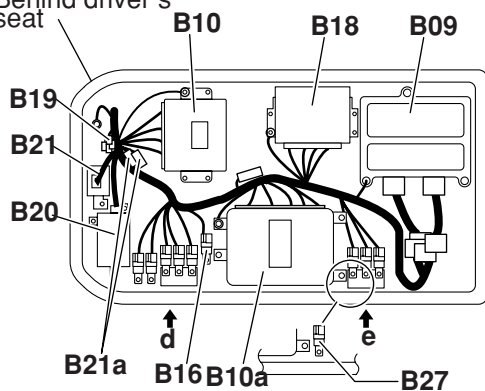


Behind driver's seat

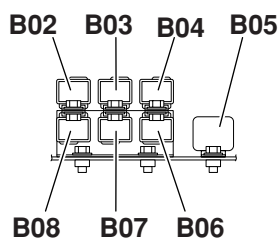


<Except FM65(A/T)>

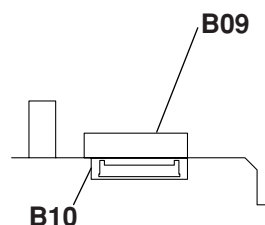
Behind driver's seat



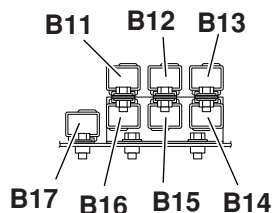
(View b)



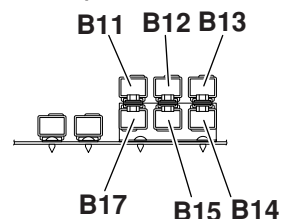
(View A-A)



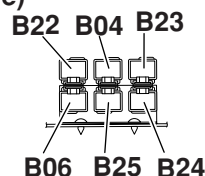
(View c)



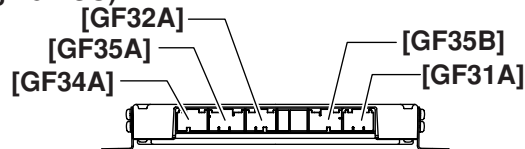
(View d)



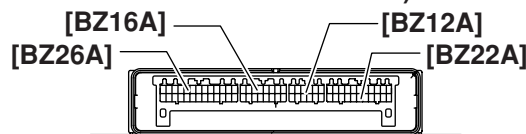
(View e)



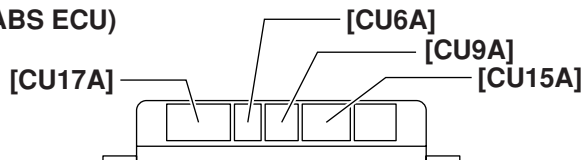
(Engine ECU)



(Multifunction vehicle control unit)



(ABS ECU)



No relevant parts in a missing number

B01 Vehicle interface module
<FM65(A/T)>

B02 Fan motor relay1 <FM65(A/T)>

B03 Stop lamp relay <FM65(A/T)>

B04 A/T ABS activation signal relay

B05 Selector neutral relay
<FM65(A/T)>

B06 Neutral start relay <A/T>

B07 Transmission neutral relay
<FM65(A/T)>

B08 Fan motor relay2 <FM65(A/T)>

B09 A/T ECU

B10 Multifunction vehicle control unit

B10a Engine ECU

B11 Glow drive relay

B12 Headlamp relay (HIGH)

B13 High beam relay

B14 Parking brake relay

B15 Headlamp relay (LOW)

B16 Cruise control main relay

B17 ABS Exhaust brake cut relay

B18 ABS ECU

B19 Diode unit

B20 Pulse converter <A/T>

Pulse divider <M/T>

B21 Daytime running light electronic control unit

B21a Resistor unit

B22 ABS indicator relay
<A/T(FK, FM61, FM64)>

B23 A/T exhaust brake cut relay
<A/T(FK, FM61, FM64)>

B24 A/T back lamp relay
<A/T(FK, FM61, FM64)>

B25 A/T N/P signal reversing relay
<A/T(FK, FM61, FM64)>

B27 Neutral start relay <M/T>

A/T : Automatic transmission

M/T : Manual transmission

ECU : Electronic control unit

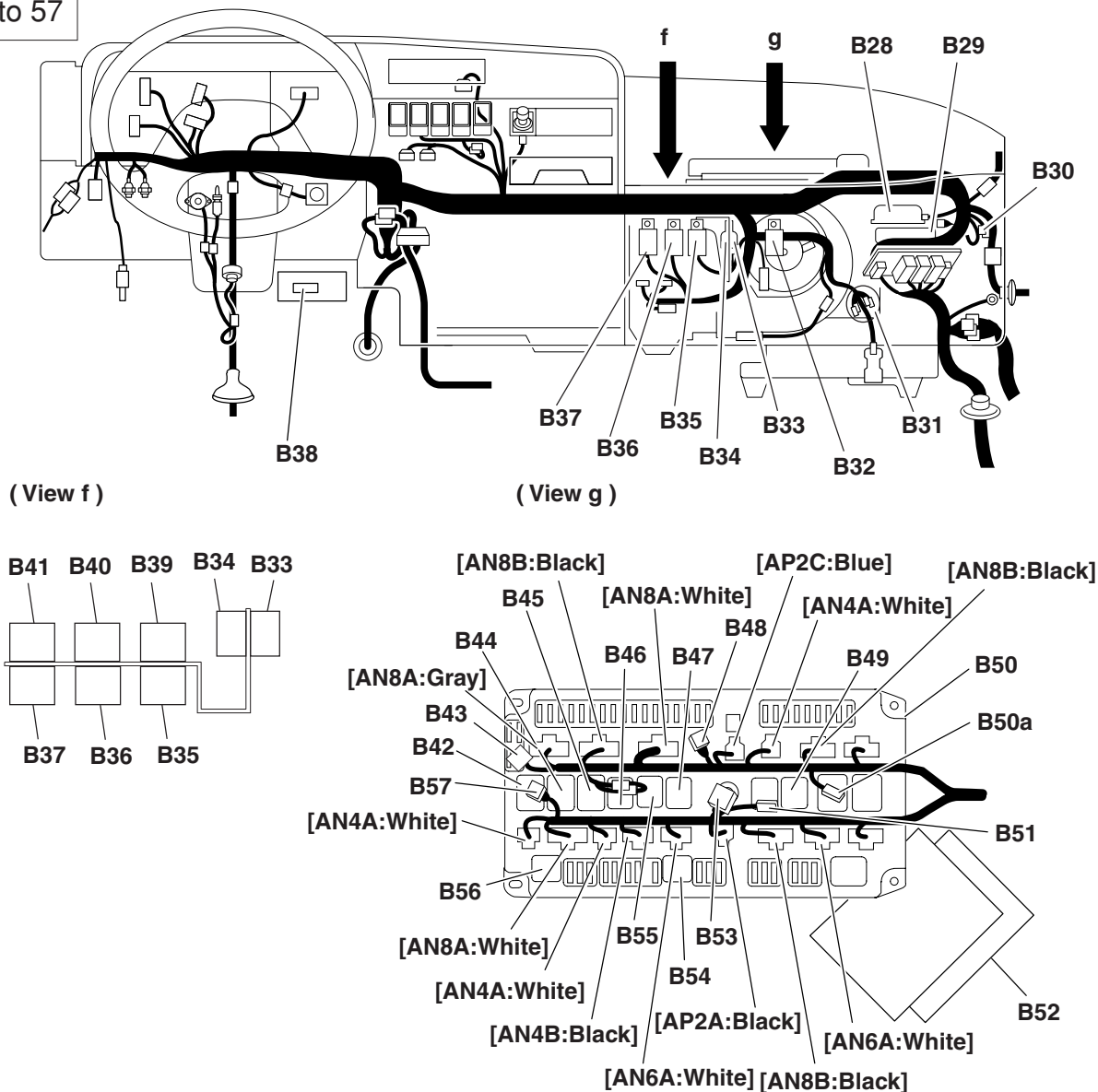
ABS : Anti-lock brake system

N/P : Neutral/Parking

Indicate by connector type []

L00109

B 28 to 57



L00110

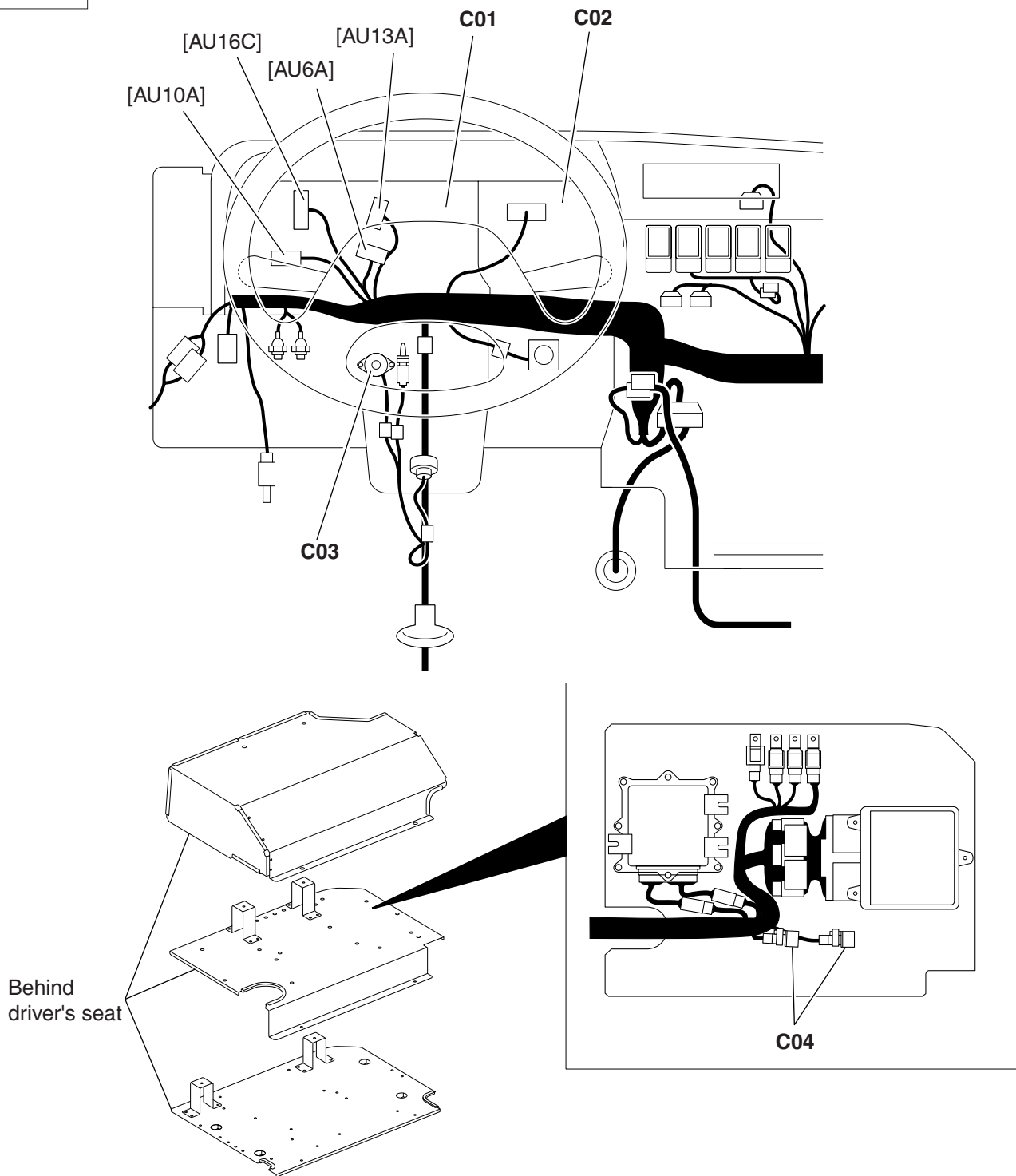
No relevant parts in a missing number

B28 Flasher unit	B40 Parking brake relay <FM65>	B53 Multi-use tester-III connector (For recorder)
B29 Multipurpose timing control unit	B41 Transmission HIGH/LOW relay <FM65F-C>	B54 Tail lamp relay
B30 Diode unit	B42 Wiper relay (LOW)	B55 Short connector
B31 Diode unit	B43 Power take-off resistor <M/T>	B56 Turn signal lamp relay
B32 Mirror heater relay (connector)	B44 Wiper relay (HIGH)	B57 Fuel injection rate adjustment resistor
B33 Blower motor relay	B45 ECU main relay	
B34 Air suspension relay (release) <FM64>	B46 Short connector	
B35 Safety relay	B47 Stop lamp relay	
B36 Spare D.C relay	B48 Resistor unit	
B37 Van body dome light relay	B49 Short connector	
B38 Multi-use tester-III connector (For inspection)	B50 Relay and fuse box	
B39 Air suspension relay (hold) <FM64> Engine oil level relay <FK6>	B50a Transmission power take-off relay connector	
	B51 Power take-off connector	
	B52 Power window electronic control unit	

ABS : Anti-lock brake system
A/T : Automatic transmission
M/T : Manual transmission
ECU : Electronic control unit
Indicate by connector type and color [].
[connector type : connector color]

C FUSE, METER, SENSOR, BUZZER AND MOTOR

C 01 to 04



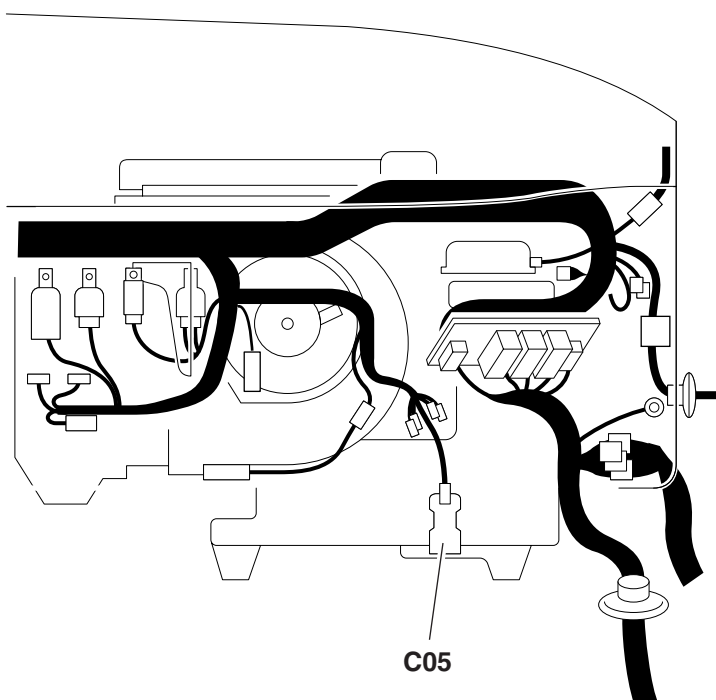
L00113

No relevant parts in a missing number

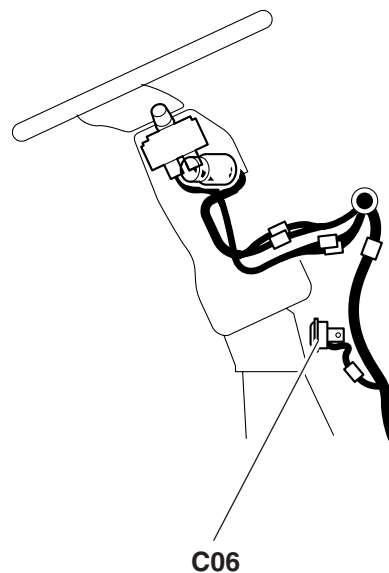
- C01** Meter cluster
- C02** Speedometer
- C03** Accelerator pedal position sensor
- C04** Fuse holder <FM65(A/T)>

A/T : Automatic transmission
Indicate by connector type [].

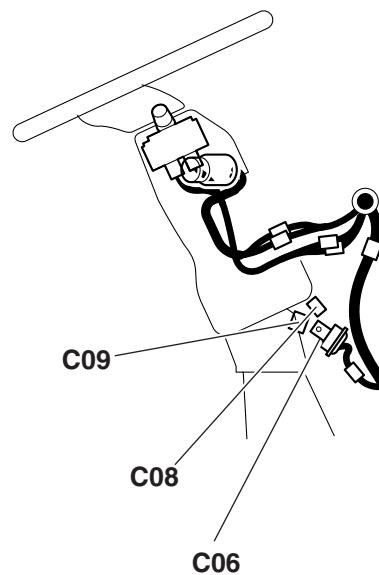
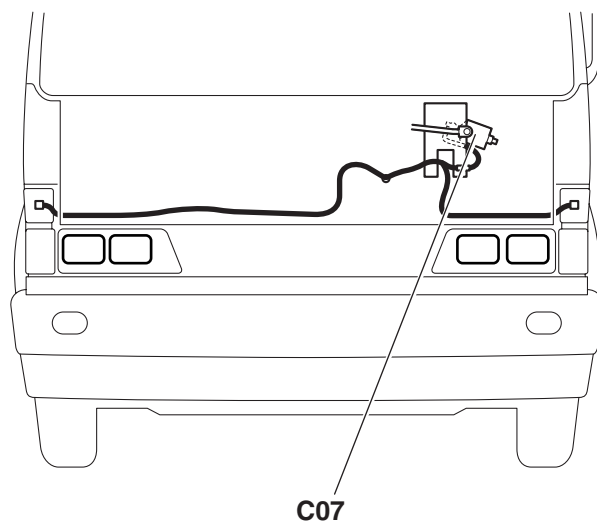
C 05 to 07



<Except A/T>



<A/T>



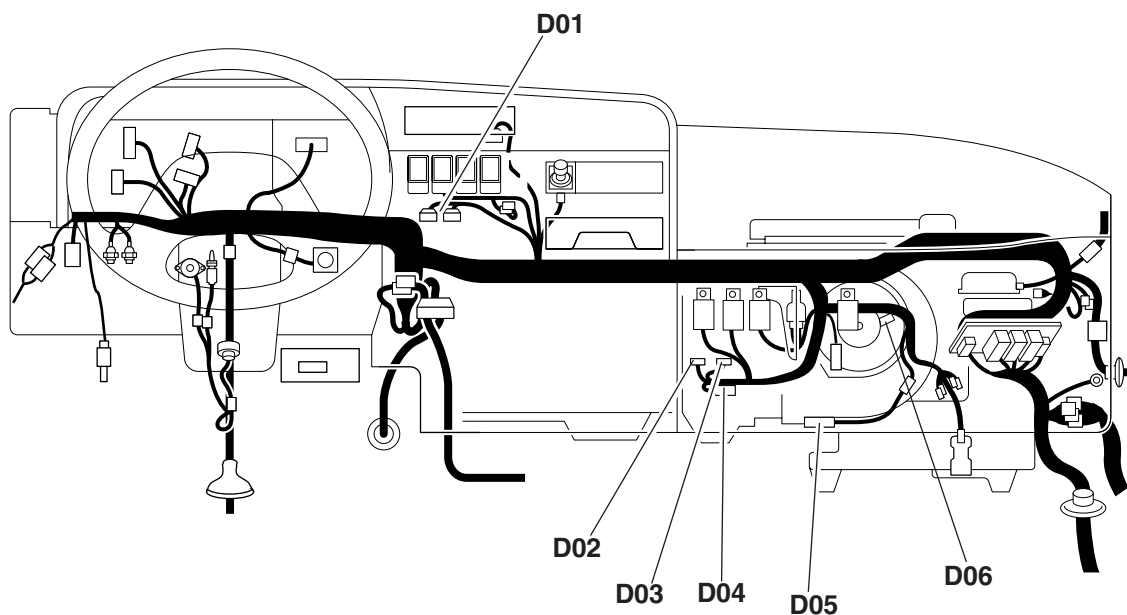
L00114

No relevant parts in a missing number

C05 Windshield washer motor**C06** Warning buzzer**C07** Wiper motor**C08** Inhibit buzzer <A/T>**C09** Reverse buzzer <A/T>**A/T** : Automatic transmission

D HEATER

D 01 to 06



L00124

No relevant parts in a missing number

D01 Heater control assembly

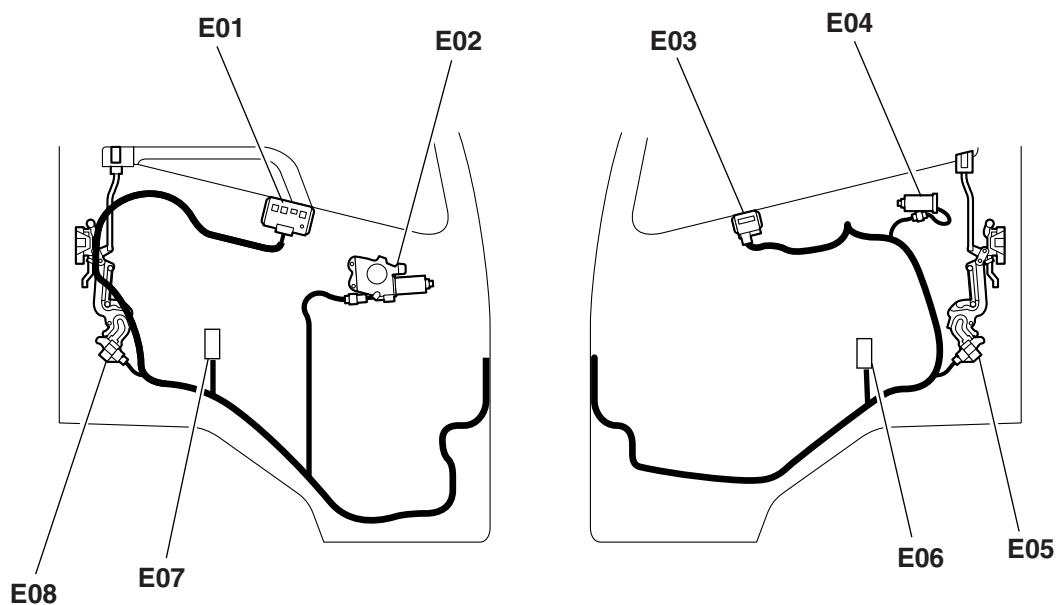
D02 Air-conditioner relay connector

D03 Side condenser relay connector

D04 Thermostat connector

D05 Blower resistor

D06 Blower motor

E 01 to 08

L00128

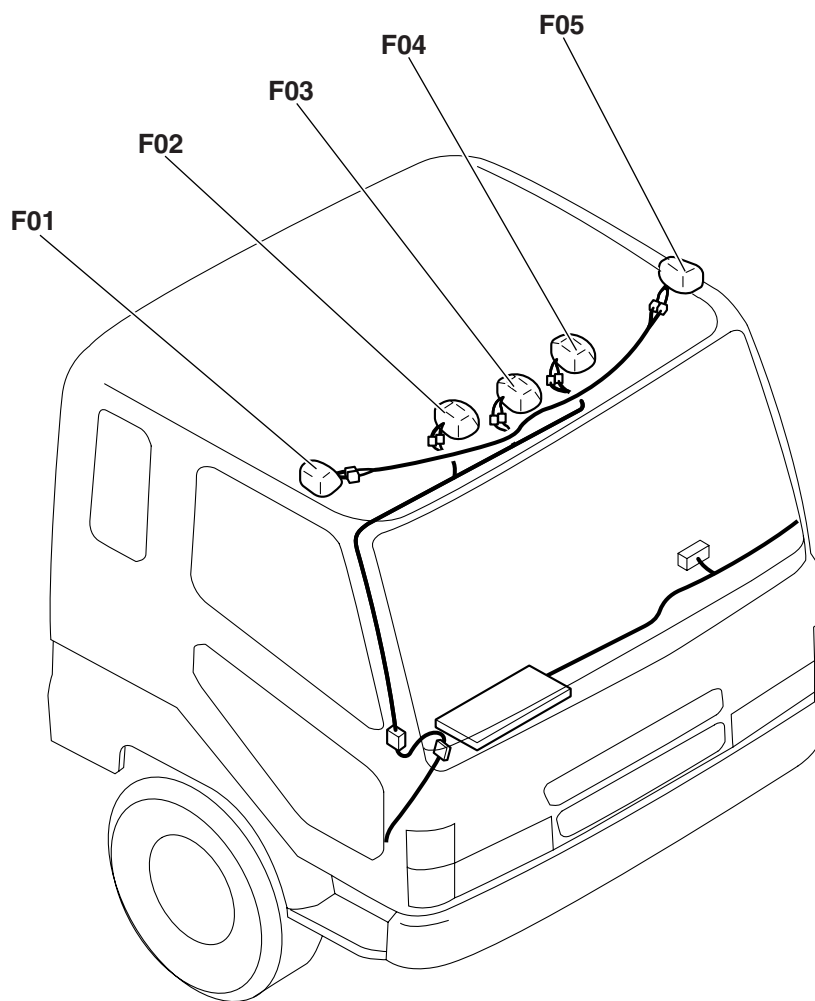
No relevant parts in a missing number

- E01** Power window switch, LH
- E02** Power window motor, LH
- E03** Power window switch, RH
- E04** Power window motor, RH

- E05** Door lock actuator, RH
- E06** Mirror heater connector, RH
- E07** Mirror heater connector, LH
- E08** Door lock actuator, LH

F ROOF

F 01 to 05



L00125

No relevant parts in a missing number

F01 Side marker lamp, RH

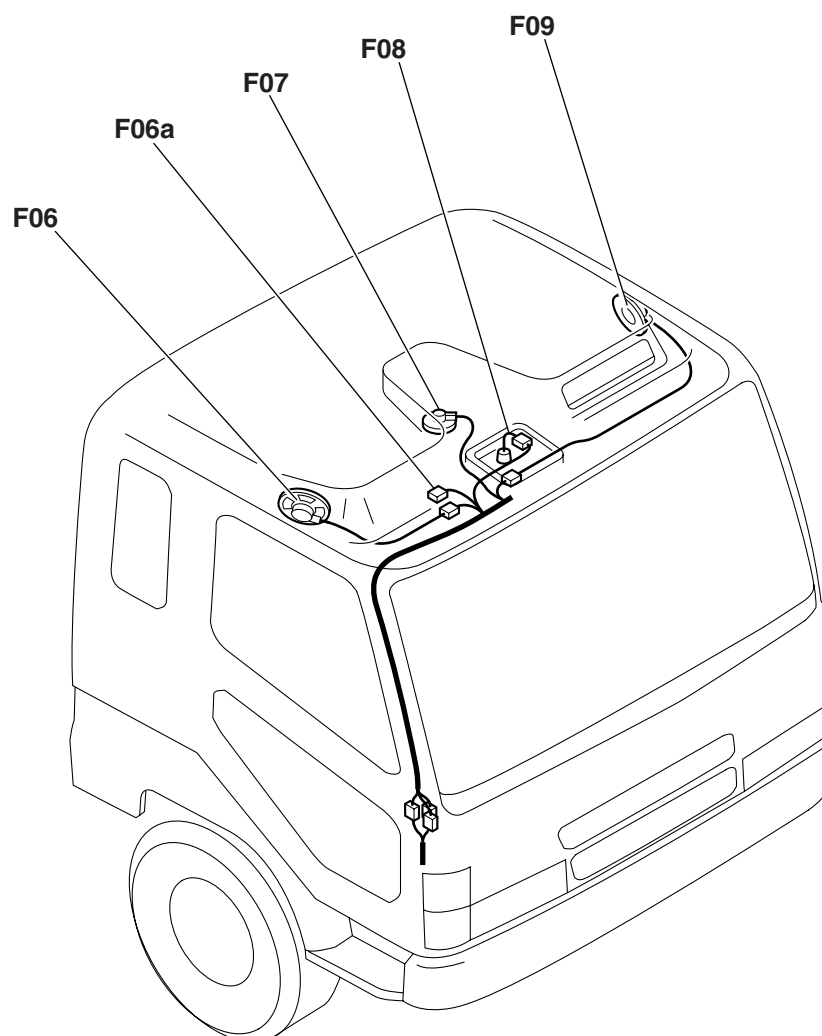
F02 Identification lamp, RH

F03 Identification lamp, CENTER

F04 Identification lamp, LH

F05 Side marker lamp, LH

F 06 to 09



L00126

No relevant parts in a missing number

F06 Speaker, RH

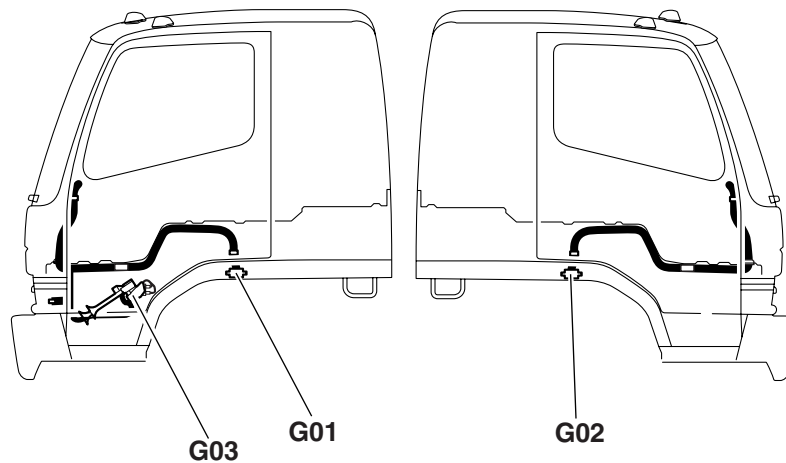
F06a Spare DC connector

F07 Speaker, CENTER

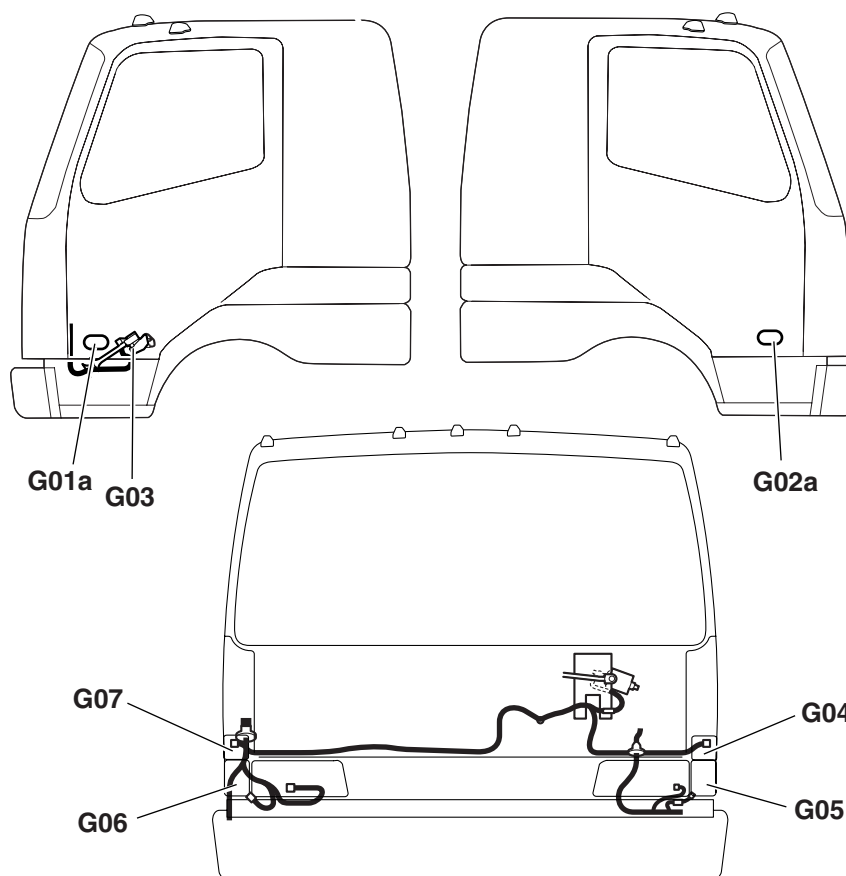
F08 Cab and spot lamp

F09 Speaker, LH

<FM>



<FK>



L00127

No relevant parts in a missing number

G01 Side turn signal lamp, LH <FM>

G01a Front side turn signal lamp, LH <FK>

G02 Side turn signal lamp, RH <FM>

G02a Front side turn signal lamp, RH <FK>

G03 Air horn

G04 Front turn signal lamp, LH

G05 Parking lamp, LH

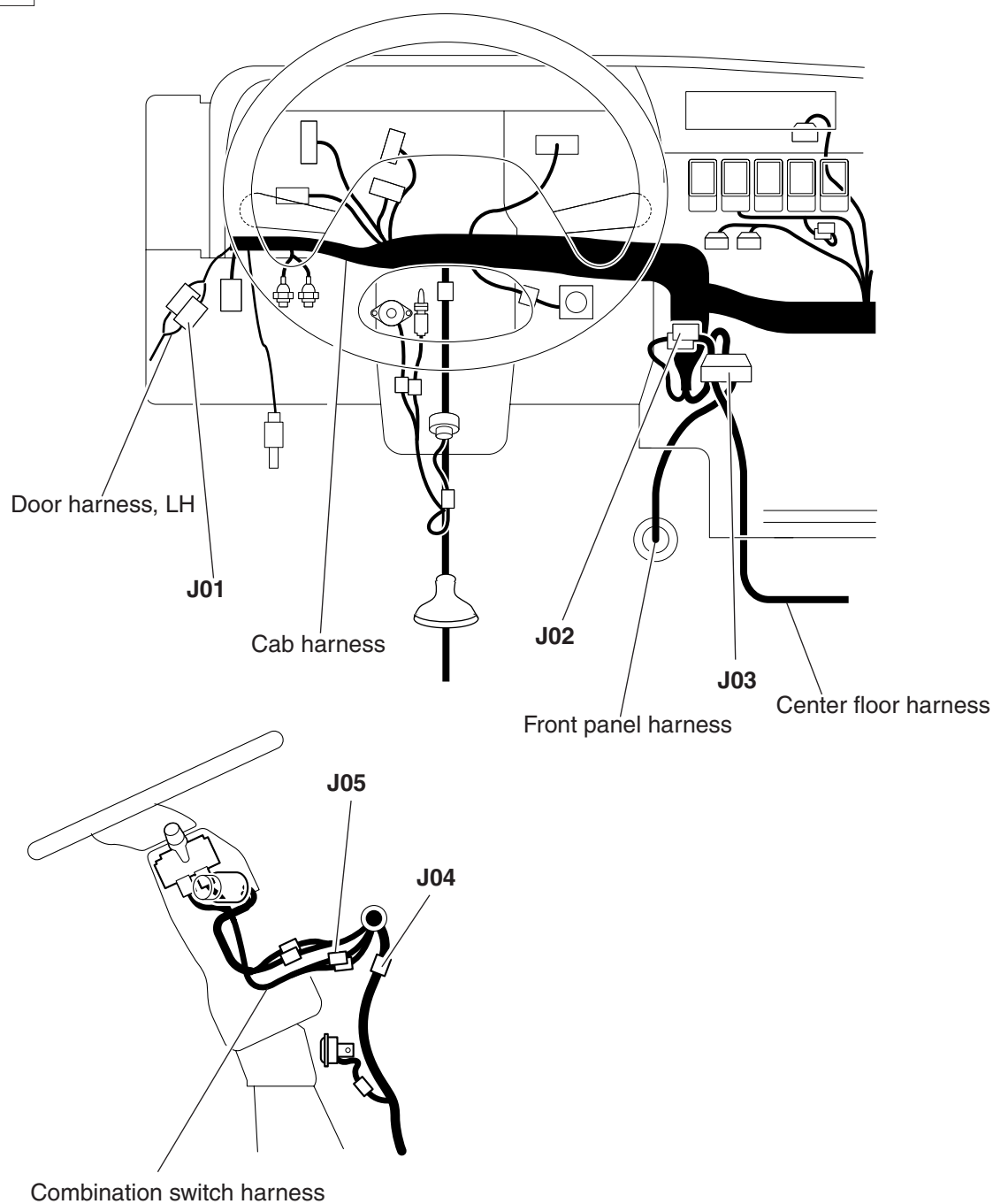
G06 Parking lamp, RH

G07 Front turn signal lamp, RH

MEMO

J JOINT OF MAIN HARNESS CONNECTORS

J 01 to 05



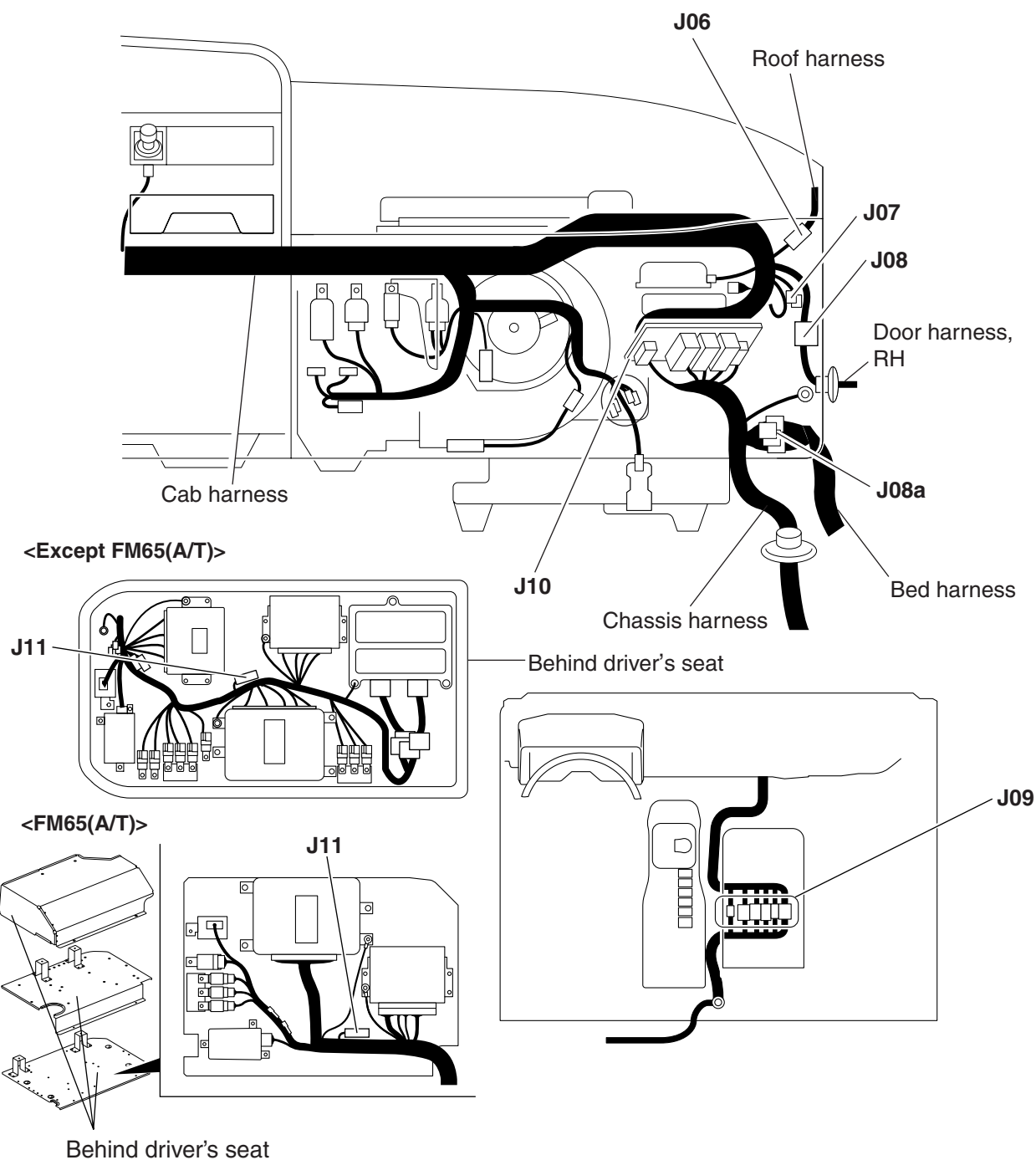
L00129

No relevant parts in a missing number

J01 Connection of cab harness and door harness, LH
J02 Connection of cab harness and center floor harness
J03 Connection of cab harness and front panel harness

J04 Connection of cab harness and headlamp harness
J05 Connection of cab harness and combination switch harness

J 06 to 11



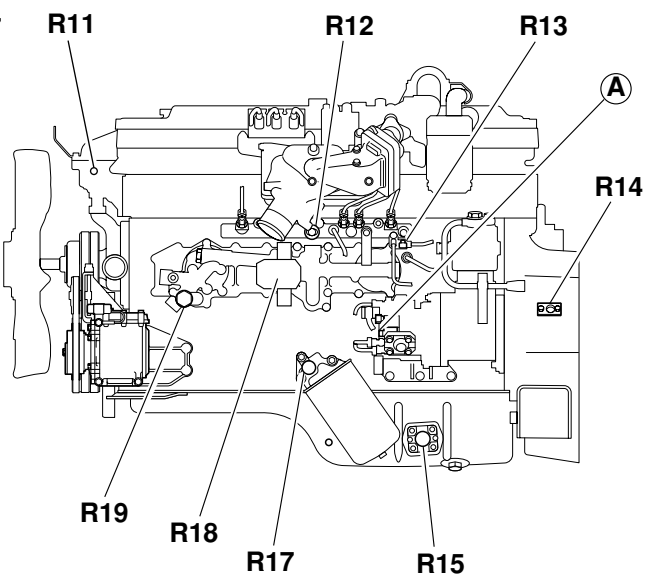
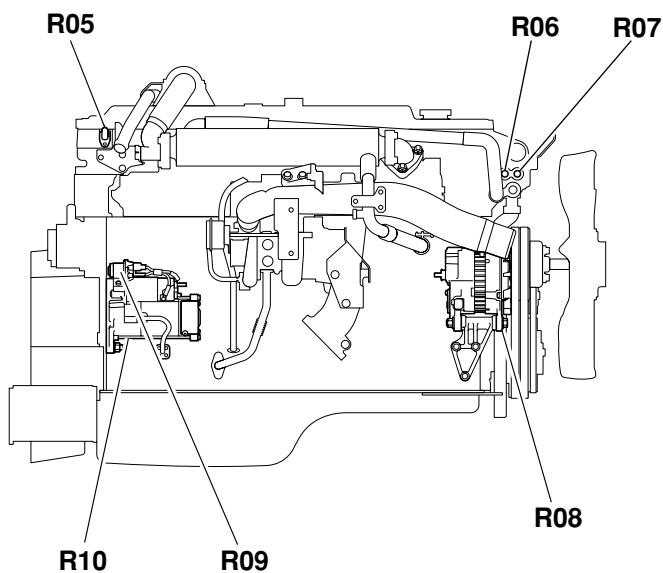
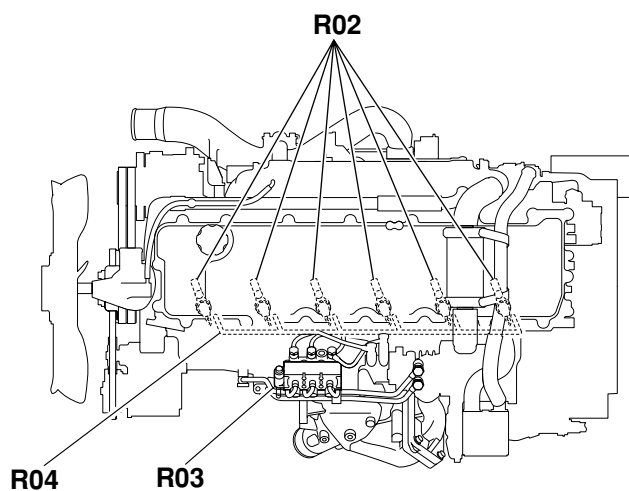
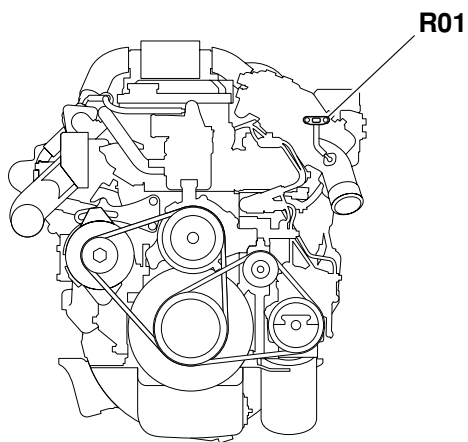
L00130

No relevant parts in a missing number

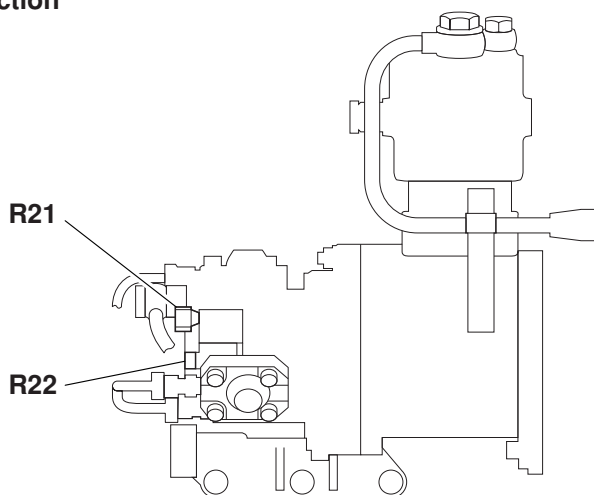
- J06** Connection of cab harness and roof harness
J07 Spare D.C connector
J08 Connection of cab harness and door harness, RH
J08a Connection of bed harness and chassis harness

- J09** Connection of cab harness and bed harness
J10 Connection of cab harness and chassis harness
J11 Joint connector (J/C-M1)

A/T : Automatic transmission



Ⓐ section



L00151

No relevant parts in a missing number

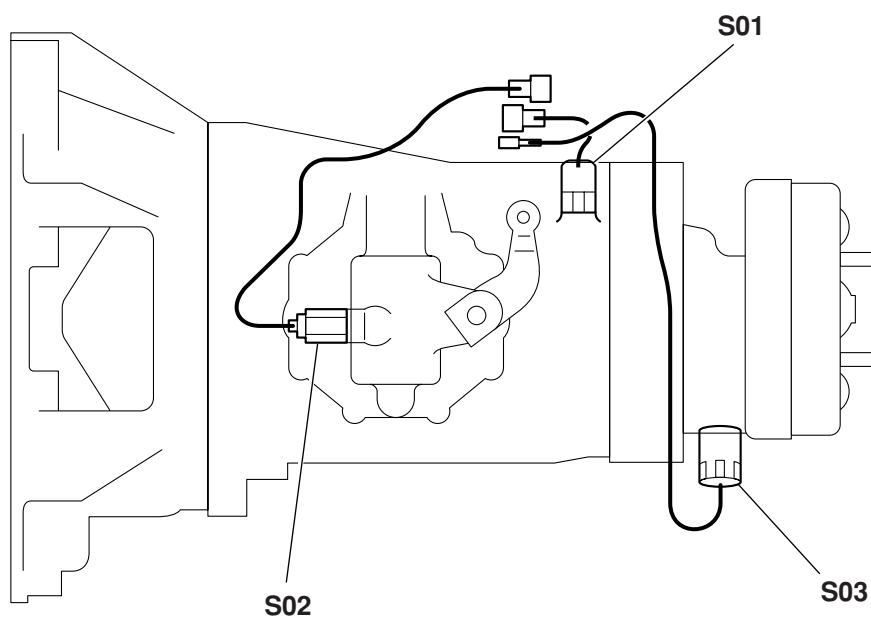
R01 Boost pressure sensor	R11 Overheating switch
R02 Injector	R12 Common rail pressure sensor
R03 EGR solenoid valve	R13 Fuel temperature sensor (OUT)
R04 Glow plug	R14 Engine speed sensor
R05 Cylinder recognition sensor	R15 Engine oil level sensor <FK>
R06 Water temperature sensor (Connects to engine electronic control unit)	R17 Engine oil bypass alarm switch
R07 Water temperature sensor (Connects to water temperature gauge)	R18 Glow relay
R08 Alternator	R19 Engine oil pressure switch
R09 Starter relay	R21 Suction control valve
R10 Starter	R22 Fuel temperature sensor (IN)
	EGR: Exhaust gas recirculation

S TRANSMISSION

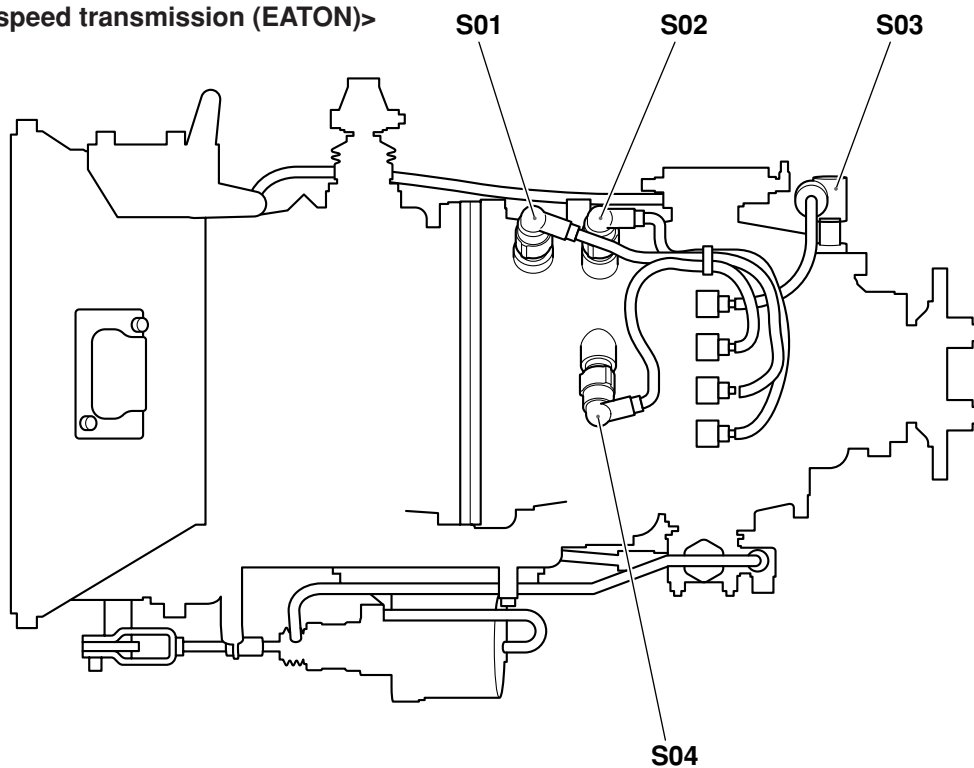
S 01 to 04

<Manual transmission>

<6-speed transmission>



<9-speed transmission (EATON)>



L00146

S01 Backup lamp switch

S02 Transmission neutral switch

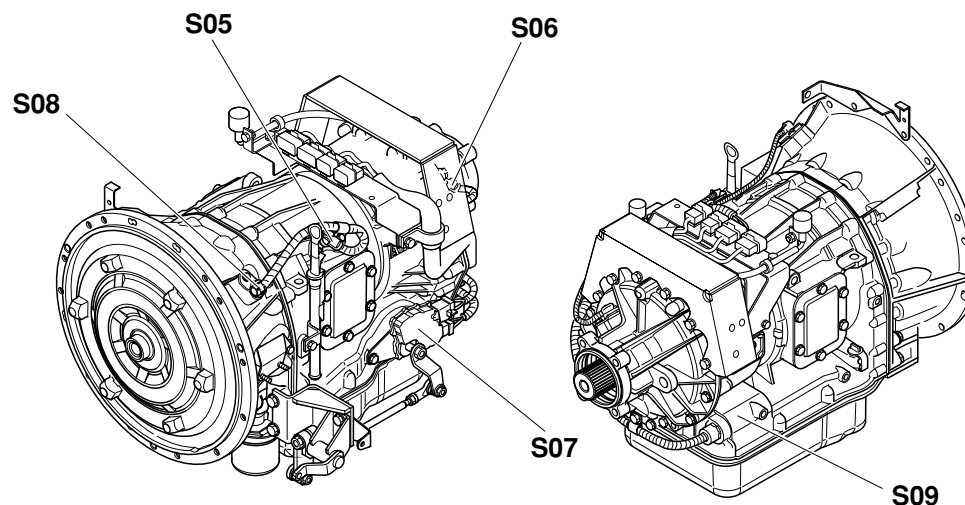
S03 Vehicle speed sensor

S04 Transmission high/low change over switch

S 05 to 14

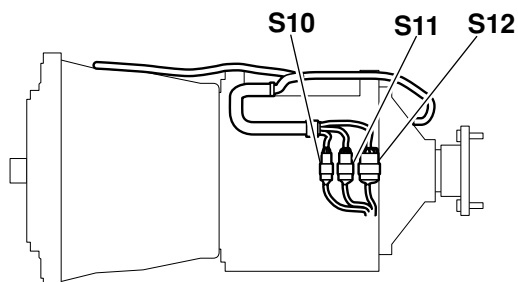
<Automatic transmission>

<FK6, FM61, FM64>

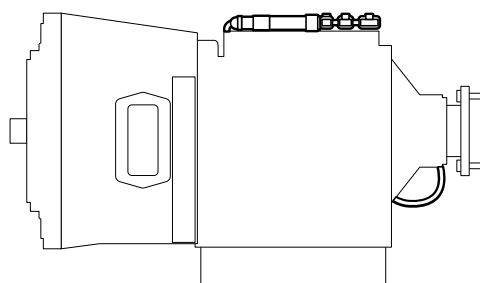


<FM65>

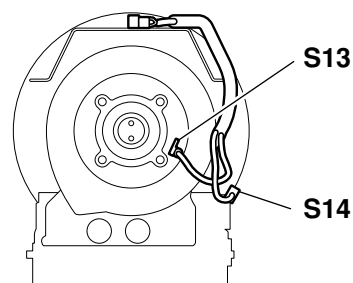
Upper view



Left side view



Rear view



L00147

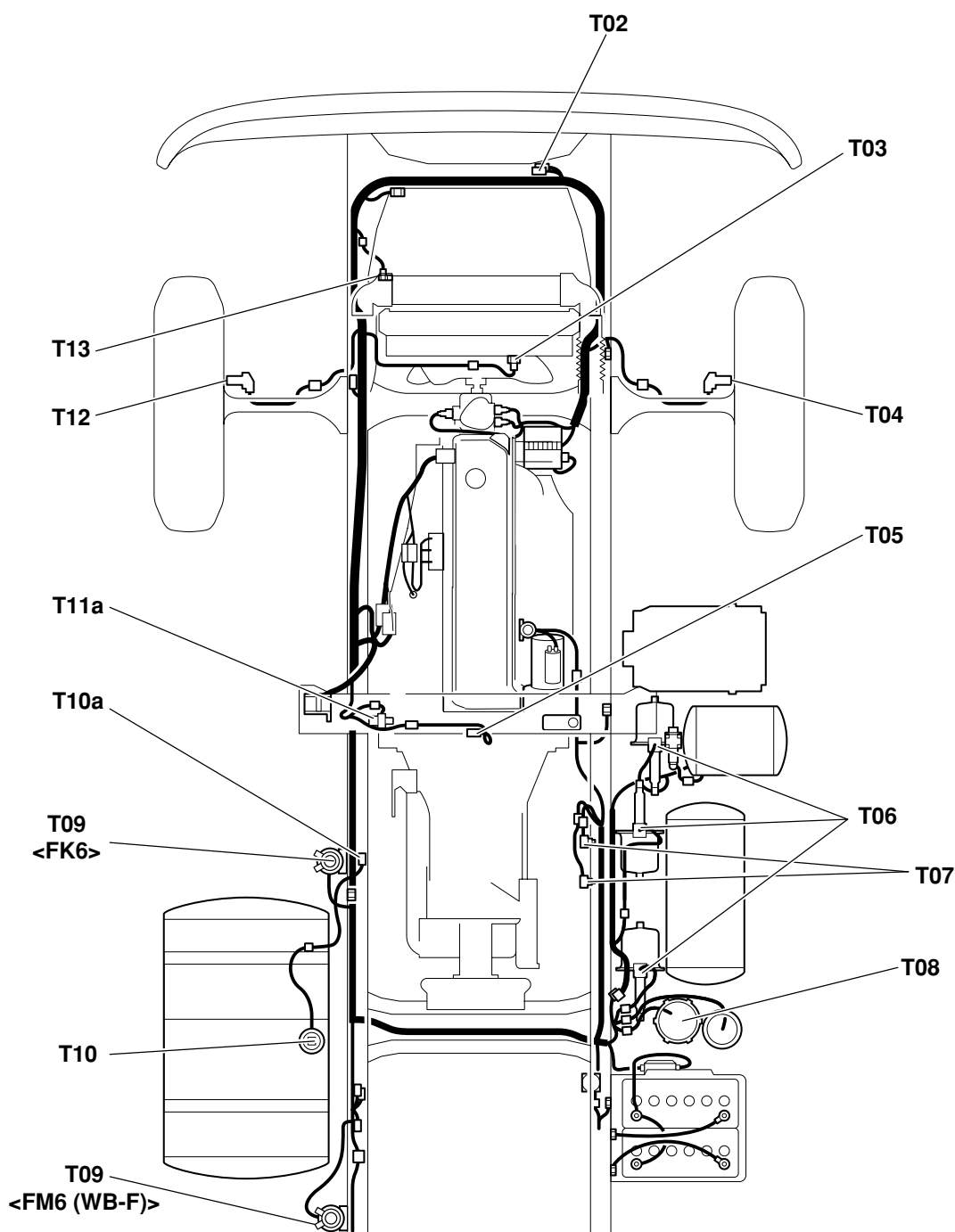
No relevant parts in a missing number

S05 Turbine speed sensor <FK, FM61, FM64>**S06** Output speed sensor <FK, FM61, FM64>**S07** Inhibitor switch <FK, FM61, FM64>**S08** Input speed sensor <FK, FM61, FM64>**S09** Solenoid <FK, FM61, FM64>**S10** Connector (for fluid temperature sensor and fluid level sensor) <FM65>**S11** Connector (for engine speed sensor, turbine speed sensor and vehicle speed sensor) <FM65>**S12** Connector (for transmission solenoid) <FM65>**S13** Connector (for transmission output speed sensor) <FM65>**S14** Connector (for input speed sensor : engine speed) <FM65>

T SWITCH AND SENSOR

T 01 to 17

<FK, FM61, FM64>

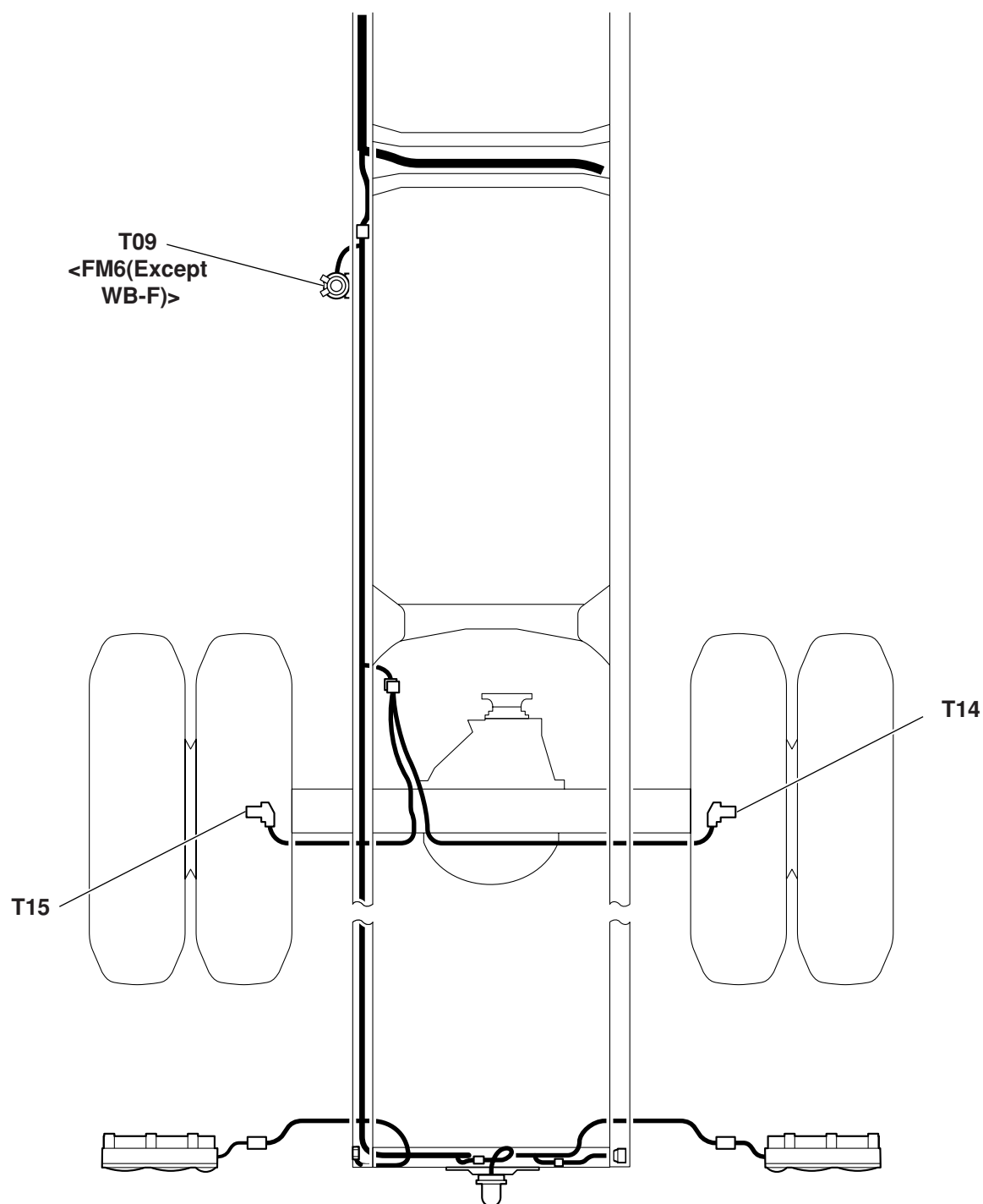


WB : Wheel base

L00139

No relevant parts in a missing number

T02 Dual pressure switch connector	T08 Brake fluid level switch	T12 Front wheel speed sensor,LH
T03 Water level sensor	T09 Water separator sensor	T13 Boost air temperature sensor
T04 Front wheel speed sensor,RH	T10 Fuel level sensor	T14 Rear wheel speed sensor,RH
T05 Cab tilt lock switch	T10a Transmission power take-off control switch connector	T15 Rear wheel speed sensor,LH
T06 Brake booster stroke switch	T11a Transmission power take-off load sensor connector	
T07 Stop lamp switch		

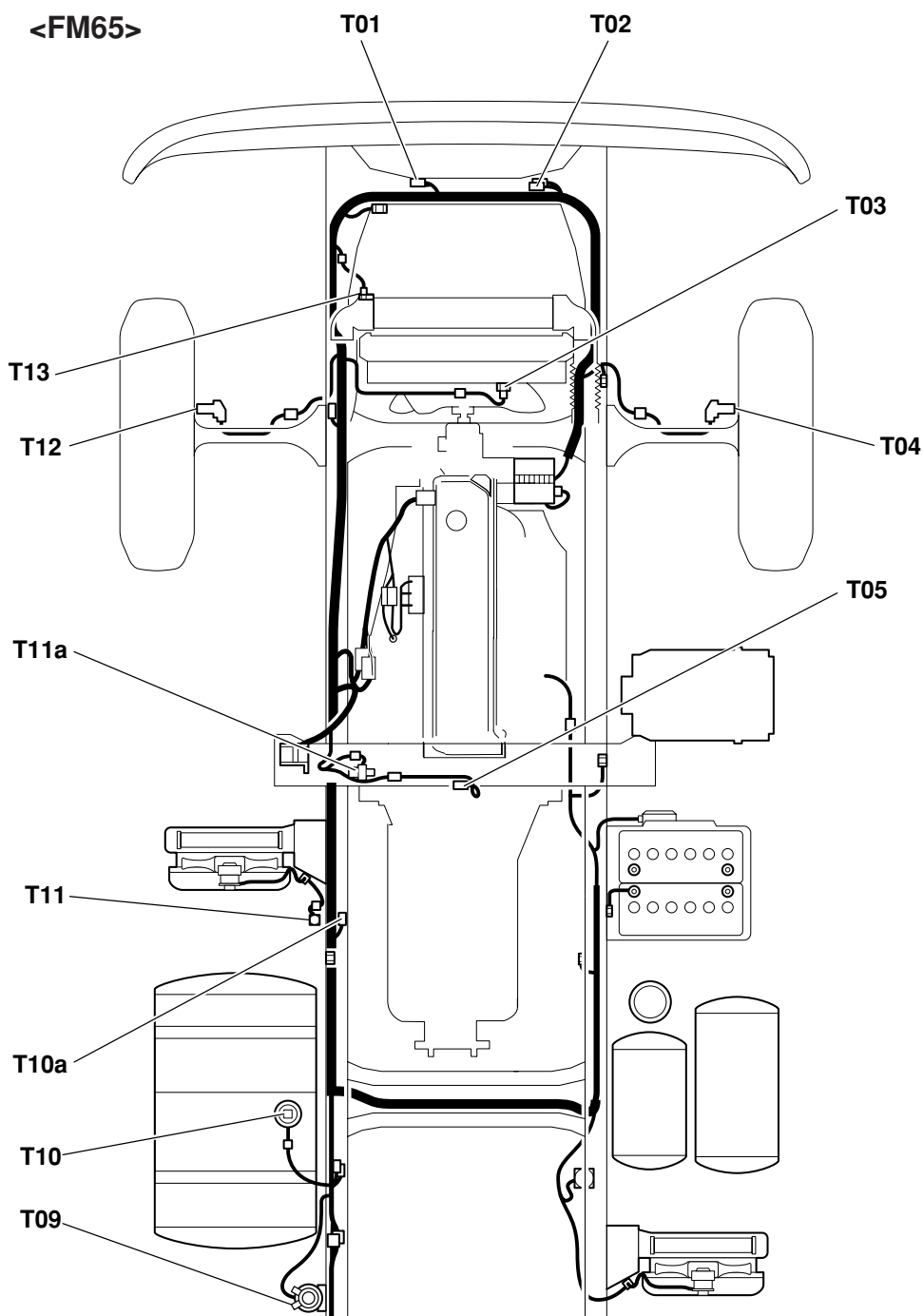


WB: Wheel base

T SWITCH AND SENSOR

T 01 to 17

<FM65>



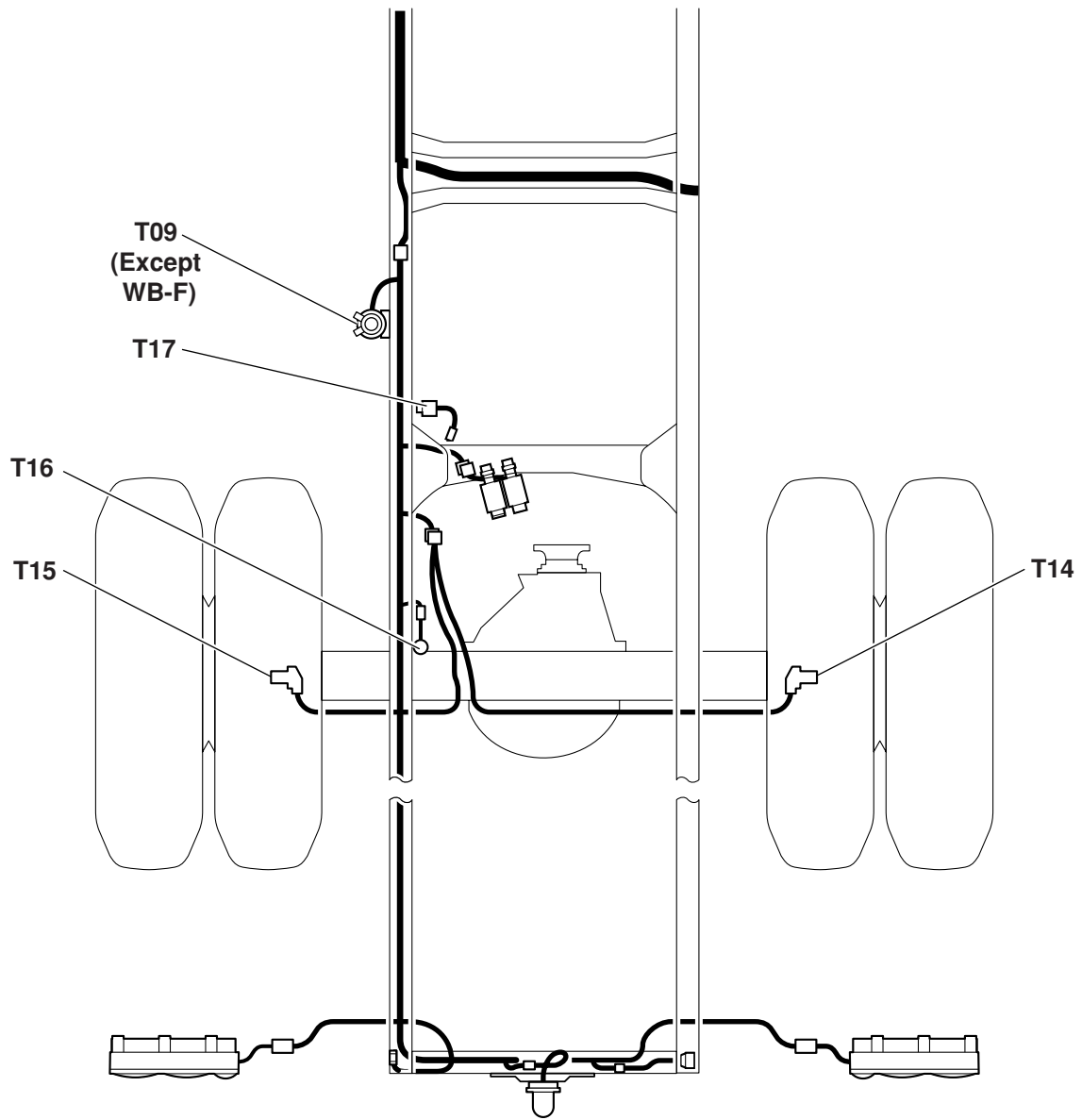
L00141

No relevant parts in a missing number

- T01** Stop lamp switch
- T02** Dual pressure switch connector
- T03** Water level sensor
- T04** Front wheel speed sensor, RH
- T05** Cab tilt lock switch
- T09** Fuel filter fail switch
- T10** Fuel level sensor
- T10a** Transmission power take-off control switch connector
- T11** Automatic transmission fluid temperature sensor (for fan motor) <A/T>

- T11a** Transmission power take-off load sensor
- T12** Front wheel speed sensor, LH
- T13** Boost air temperature sensor
- T14** Rear wheel speed sensor, RH
- T15** Rear wheel speed sensor, LH
- T16** Parking brake switch
- T17** Stop lamp switch

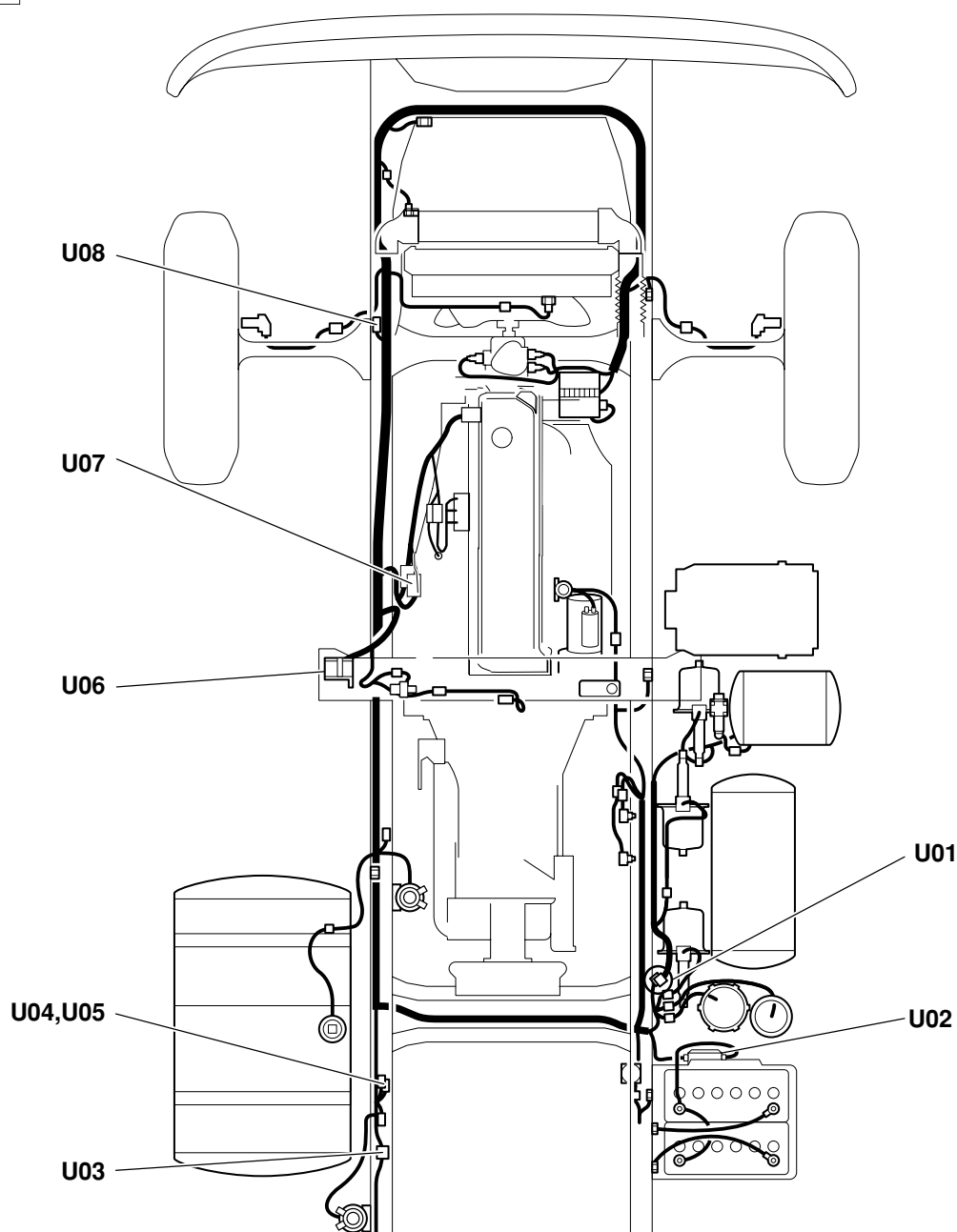
A/T : Automatic transmission



WB: Wheel base

U FUSE AND CONNECTOR

U 01 to 08



L00143

U01 Connection of chassis harness and anti-lock brake system harness

U02 Main high-current fuse

U03 Connection of chassis harness and rear chassis harness

U04 Van body dome light connector

U05 Spare tail lamp connector

U06 High-current fuse box

U07 Connection of chassis harness and engine harness

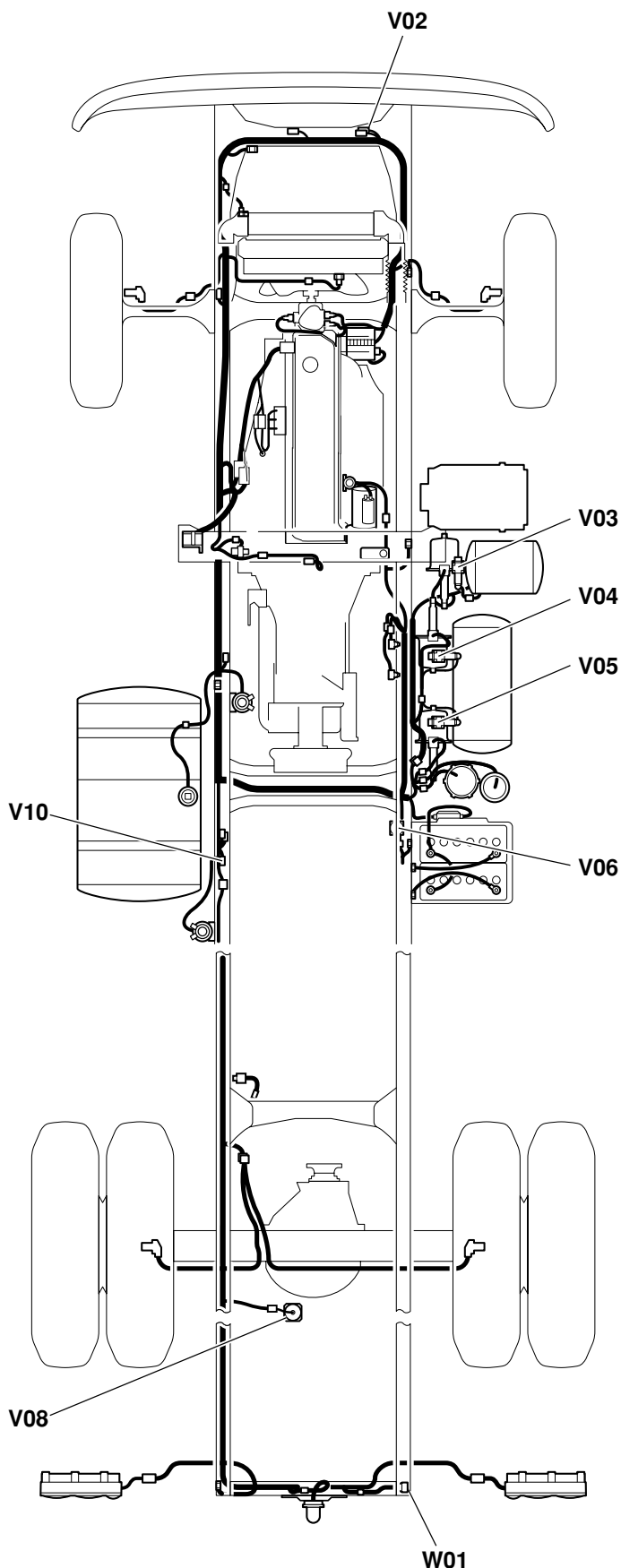
U08 Magnetic clutch connector

MEMO

V MAGNETIC VALVE W BUZZER

V 01 to 10, W 01

<FK, FM61, FM64>



V

No relevant parts in a missing number

- V02** Condenser fan motor connector
- V03** Front ABS control valve
- V04** Rear ABS control valve, LH
- V05** Rear ABS control valve, RH
- V06** Exhaust brake 3-way magnetic valve
- V08** Height control 3-way magnetic valve
<FM64>
- V10** Transmission power take-off
3-way magnetic valve connector

W

No relevant parts in a missing number

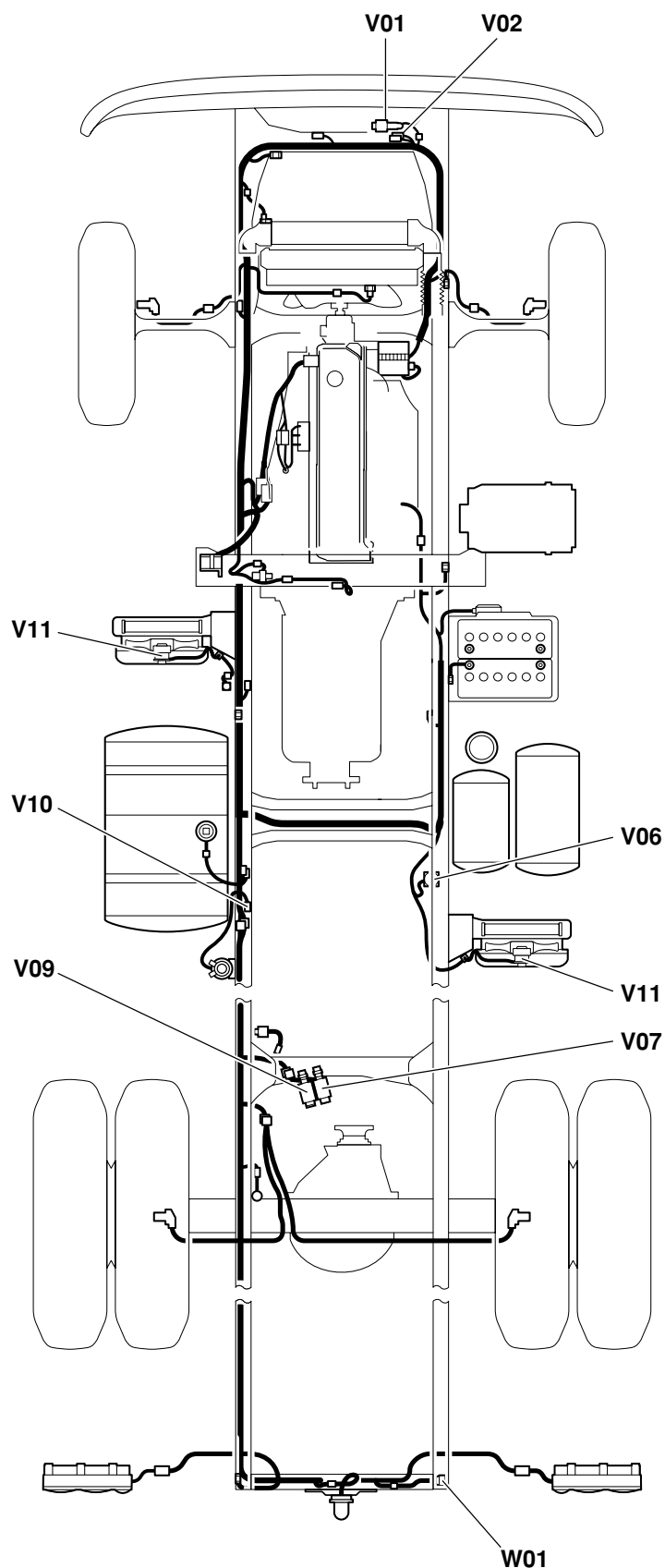
- W01** Back buzzer

ABS : Anti-lock brake system

L00144

V 01 to 11, W 01

<FM65>

**V**

No relevant parts in a missing number

- V01** Front ABS control valve
- V02** Condenser fan motor connector
- V06** Exhaust brake 3-way magnetic valve
- V07** Rear ABS control valve, RH
- V09** Rear ABS control valve, LH
- V10** Transmission power take-off 3-way magnetic valve connector
- V11** Automatic transmission fluid cooler fan motor

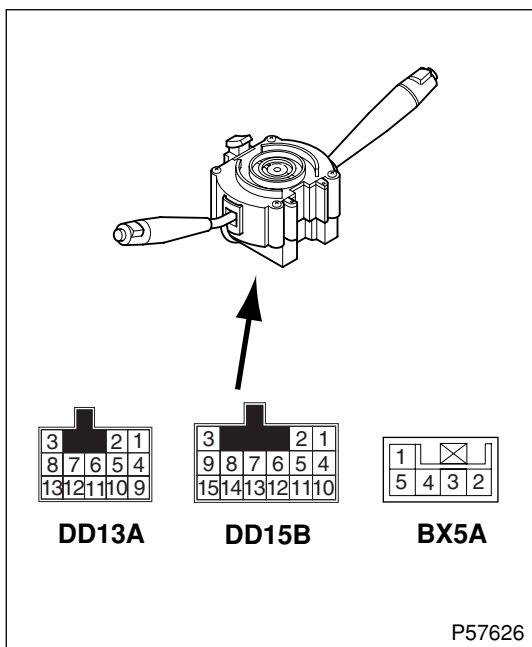
W

No relevant parts in a missing number

W01 Back buzzer**ABS** : Anti-lock brake system

1 1 INSPECTION OF PARTS

#001 to #179 SWITCH



#001 Inspection of combination switch

- Follow the table below to check for continuity.
- : There is continuity between terminals.
- If any fault is found, replace the switch.

BX5A Connector connection table

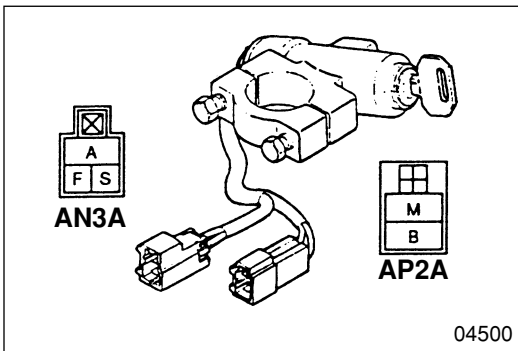
		①	②	③	④	⑤
Set, resume and cancel switch	SET		○—○			
	CANCEL			○—○		
	OFF					
	RESUME			○—○		

DD15B Connector connection table

		①	②	③	⑤	⑥	⑦	⑧	⑨	⑬	Body ground
Lighting switch	OFF										
	I						○—○				
	II				○—○		○—○				
Dimmer switch	Main				○—○			○—○			
	↕				○—○			○—○			
	↕				○—○						
	Dimmer				○—○						
	↕				○—○						
	Passing						○—○	○—○			
Turn signal switch	LH		○—○							○—○	
	N (neutral)										
	RH			○—○						○—○	
Horn switch	OFF										
	ON	○—○									○—○

DD13A Connector Connection Table

		①	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬
Wiper switch	OFF											
	INT (intermittent)								○—○			○—○
	LO (LOW)								○—○		○—○	
	HI (HIGH)								○—○	○—○		
	WASH (washer)							○—○				
Exhaust brake switch	OFF											
	ON	○—○										
Hazard switch	OFF											
	ON				○—○	○—○	○—○					



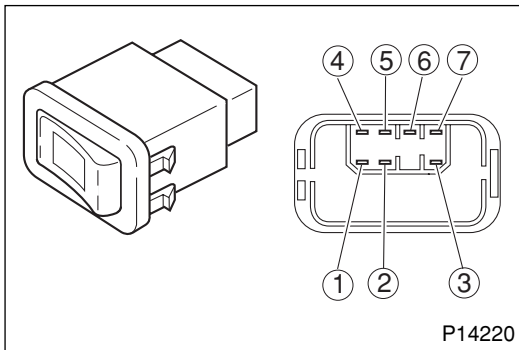
#002 Inspection of starter switch

- Follow the table below to check for continuity.

	AP2A		AN3A		
	②	①	①	③	②
LOCK					
ACC	○		○		
ON	○	○	○	○	
START	○	○	○	○	○
	B	M	A	F	S

○—○ : There is continuity between terminals.

- If any fault is found, replace the switch. Gr 37



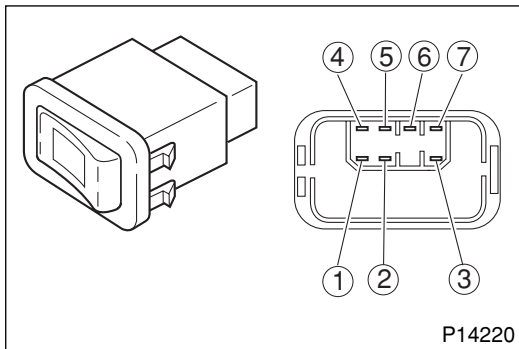
#005 Inspection of cold start switch

- Follow the table below to check for continuity.

	①	⑥	⑤	④	②	⑦	LED (Operation indication light)	③
ON	○	○				○	—	○
OFF	○	○		○	○			

○—○ : There is continuity between terminals.

- If any fault is found, replace the switch.



#007 Inspection of cruise control main switch

- Follow the table below to check for continuity.

	①	⑥	⑤	④	⑦	LED (Operation indication light)	③
ON	○		○		○	—	○
OFF		○	○	○			

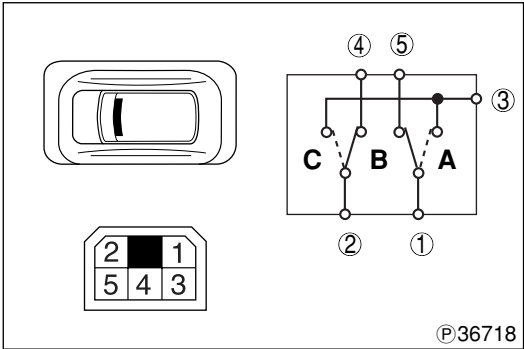
○—○ : There is continuity between terminals.

- If any fault is found, replace the switch.

#011 Inspection of rheostat switch

- Rheostat switch contains a control circuit, because of this it is difficult to inspect rheostat switch independently, therefore you should inspect the rheostat switch indirectly, by inspecting the system harness and the related parts.
- If no fault is found in the related parts but the system is faulty, replace the switch.

#001 to #179 SWITCH

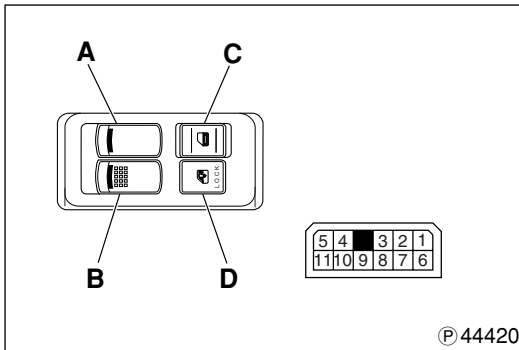


#026 Inspection of power window switch (assistant driver's seat side)

- Follow the table below to check for continuity.

	①	②	③	④	⑤
A : OPEN					
B : OFF					
C : CLOSE					

- : There is continuity between terminals.
- If any fault is found, replace the switch.



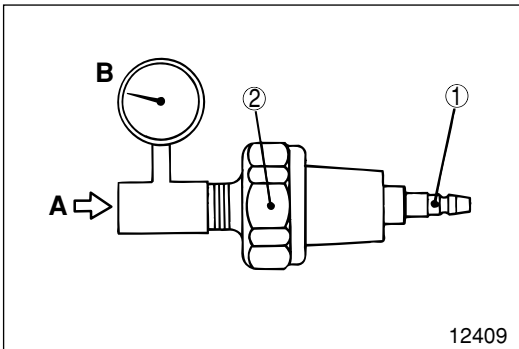
#027 Inspection of power window switch (driver's seat side)

- Follow the table below to check for continuity.

		①	②	⑤	⑥	⑦	⑧	⑨	⑩	⑪
A : Assistant driver's seat side window switch	UP	○	○					○	○	
	NEUTRAL	○	○						○	
	DOWN	○	○					○	○	
B : Driver's seat side window switch	UP					○	○	○		
	NEUTRAL									
	DOWN				○		○	○		
C : Door lock switch	UNLOCK								○	○
	LOCK			○					○	
D : Assistant driver's seat side window lock switch	UP	○						○		
	NEUTRAL	○	○							
	DOWN		○					○		

○—○ : There is continuity between terminals.

- If any fault is found, replace the switch.



#028 Inspection of low air pressure switch

Perform the following checks, and if any fault is found, replace the switch.

(1) Inspection by without applying air pressure

Make sure that there is continuity between terminals ① and ② (body).

(2) Inspection by applying air pressure

- Gradually apply air pressure **A** to the switch starting from 0 kPa {0 psi, 0 kgf/cm²}.
- Measure the degree of air pressure at the moment when continuity is not detected between terminals ① and ② (body), and make sure to confirm if the value meets the standard.

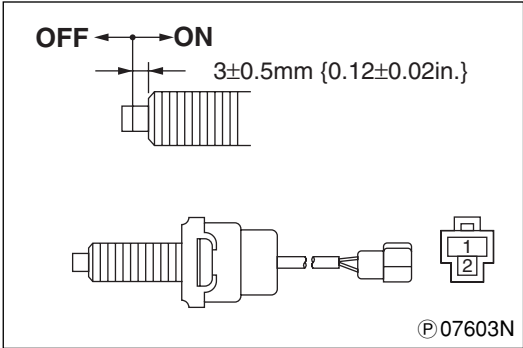
B : Air pressure gauge

Standard value (When applying pressure ON → OFF)	470 to 510 kPa {68 to 74 psi, 4.8 to 5.2 kgf/cm ² }
---	---

- Apply air pressure **A** up to 785 kPa {115 psi, 8 kgf/cm²} then gradually decrease the air pressure.
- Measure the degree of air pressure at the moment when continuity is detected between terminals ① and ② (body), and make sure to confirm if the value meets the standard.

Standard value (When releasing pressure OFF → ON)	470 to 559 kPa {68 to 81 psi, 4.8 to 5.7 kgf/cm ² }
--	---

#001 to #179 SWITCH

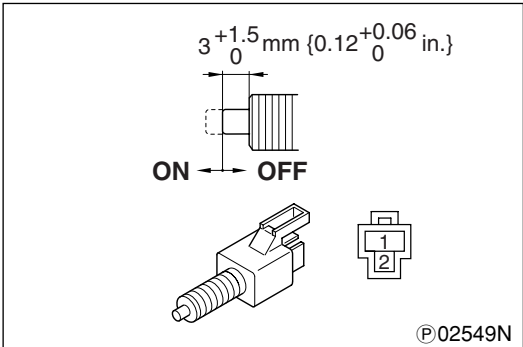


#029 Inspection of accelerator switch

- Follow the table below to check for continuity.

	①	②
OFF		
ON	○—○	

- : There is continuity between terminals.
- If any fault is found, replace the switch.

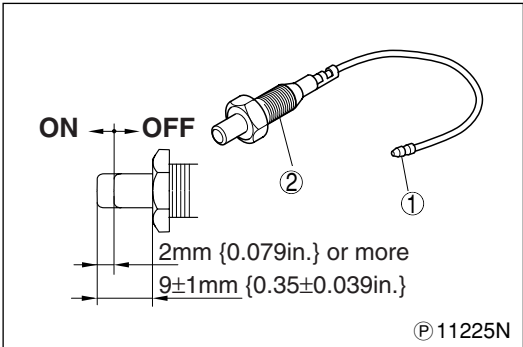


#031 Inspection of clutch switch

- Follow the table below to check for continuity.

	①	②
OFF		
ON	○—○	

- : There is continuity between terminals.
- If any fault is found, replace the switch. Gr 21

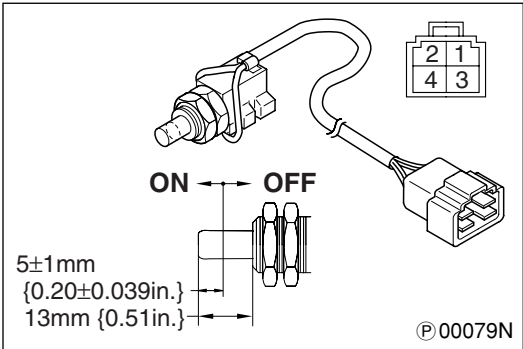


#035 Inspection of door switch

- Follow the table below to check for continuity.

	①	②
OFF		
ON	○—○	

- : There is continuity between terminals.
- If any fault is found, replace the switch. Gr 42

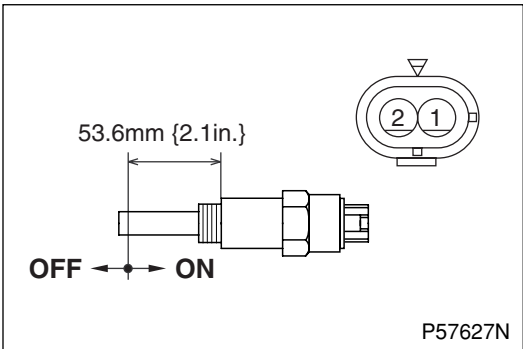


#038 Inspection of parking brake switch

- Follow the table below to check for continuity.

	①	②	③	④
ON (PARK)		○—○		
OFF (DRIVE)	○—○		○—○	

- : There is continuity between terminals.
- If any fault is found, replace the switch. Gr 36A

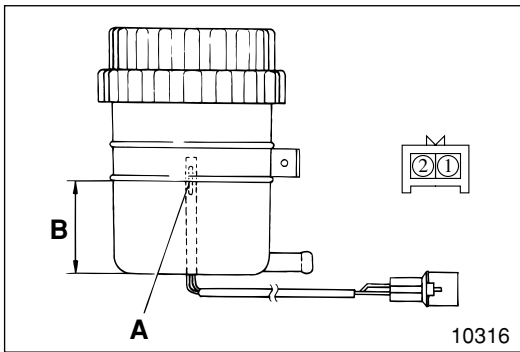


#040 Inspection of brake booster stroke switch

- Follow the table below to check for continuity.

	①	②
OFF		
ON	○—○	

- : There is continuity between terminals.
- If any fault is found, replace the switch. Gr 35A



#041 Inspection of brake fluid level switch

- Remove brake fluid slowly from fluid tank assembly.

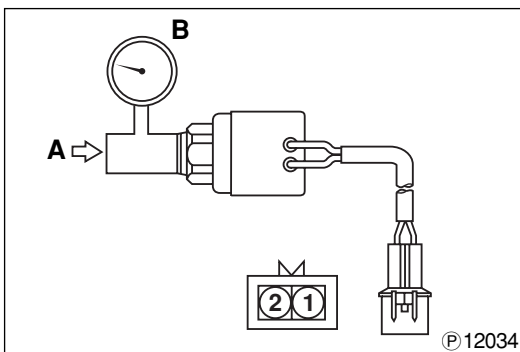
CAUTION

If brake fluid gets on a painted surface it will dissolve the paint, so wipe it off immediately.

- Measure the height **B** of switch **A** when the continuity is detected between terminals ① and ②.

Standard value	$57^{+3.5}_{-0.5}$ mm { $2.24^{+0.14}_{-0.02}$ in.} (equivalent to 345 cm ³ {21.1 cu.in., 0.345 L})
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- If the measured value deviates from the standard value, replace the brake fluid tank assembly. Gr 42



#042 Inspection of stop lamp switch

Perform the following checks, and if any fault is found, replace the switch. Gr 35

(1) Inspection by without applying air pressure

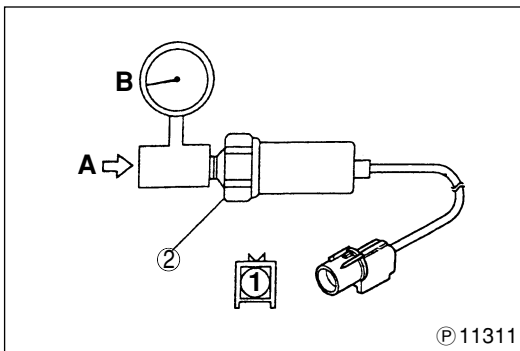
Make sure that there is no continuity between terminals ① and ②.

(2) Inspection by applying air pressure

- Gradually apply air pressure **A** to the switch starting from 0 kPa {0 psi, 0 kgf/cm²}.
- Measure the degree of air pressure at the moment when continuity is detected between terminals ① and ②, and make sure to confirm if the value meets the standard.

B : Air pressure gauge

Standard value (operating pressure)	29 ± 9.8 kPa { 4.3 ± 1.4 psi, 0.3 ± 0.1 kgf/cm ² }
--	---



#044 Inspection of engine oil pressure switch

Perform the following checks, and if any fault is found, replace the switch.

(1) Inspection by without applying air pressure

Make sure that there is continuity between terminals ① and ② (body).

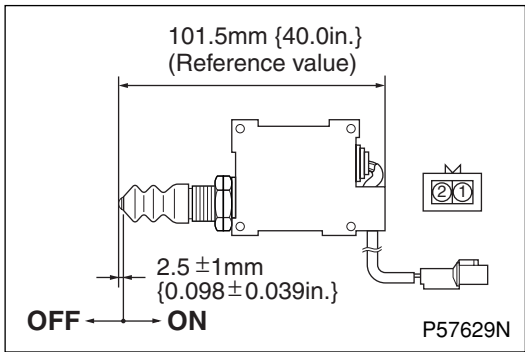
(2) Inspection by applying air pressure

- Gradually apply air pressure **A** to the switch starting from 0 kPa {0 psi, 0 kgf/cm²}.
- Measure the degree of air pressure at the moment when continuity is not detected between terminals ① and ② (body), and make sure to confirm if the value meets the standard.

B : Air pressure gauge

Standard value (operating pressure)	49 ± 9.8 kPa { 7.1 ± 1.4 psi, 0.5 ± 0.1 kgf/cm ² }
--	---

#001 to #179 SWITCH

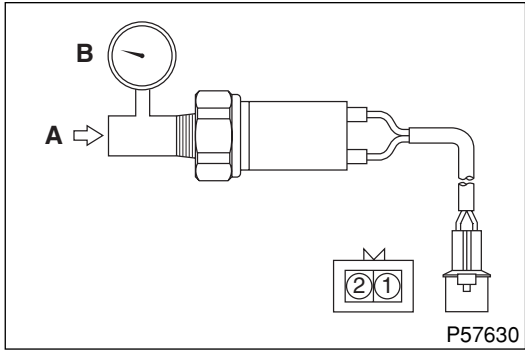


#045 Inspection of cab tilt lock switch

- Follow the table below to check for continuity.

	①	②
ON	○—○	
OFF		

- : There is continuity between terminals.
- If any fault is found, replace the switch. Gr 42



#048 Inspection of parking brake switch

Perform the following checks, and if any fault is found, replace the switch. Gr 36B

(1) Inspection by without applying air pressure

Make sure that there is no continuity between terminals ① and ②.

(2) Inspection by applying air pressure

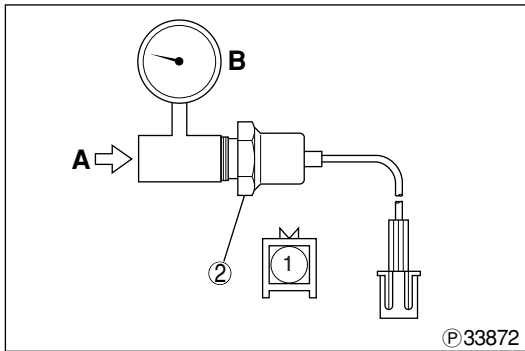
- Gradually apply air pressure **A** to the switch starting from 0 kPa {0 psi, 0 kgf/cm²}.
- Measure the degree of air pressure at the moment when continuity is not detected between terminals ① and ②, and make sure to confirm if the value meets the standard.

B : Air pressure gauge

Standard value (When applying pressure ON → OFF)	68.6 to 167 kPa {10 to 24 psi, 0.7 to 1.7 kgf/cm ² }
---	--

- Apply air pressure **A** up to 785 kPa {115 psi, 8 kgf/cm²} then gradually decrease the air pressure.
- Measure the degree of air pressure at the moment when continuity is detected between terminals ① and ② (body), and make sure to confirm if the value meets the standard.

Standard value (When releasing pressure OFF → ON)	49 to 147 kPa {7.1 to 21 psi, 0.5 to 1.5 kgf/cm ² }
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#053 Inspection of engine oil bypass alarm switch

Perform the following checks, and if any fault is found, replace the switch. Gr 12

(1) Inspection by without applying air pressure

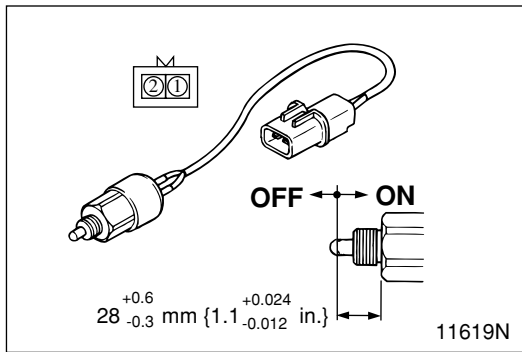
Make sure that there is no continuity between terminals ① and ② (body).

(2) Inspection by applying air pressure

- Gradually apply air pressure **A** to the switch starting from 0 kPa {0 psi, 0 kgf/cm²}.
- Measure the degree of air pressure at the moment when continuity is detected between terminals ① and ② (body), and make sure to confirm if the value meets the standard.

B : Air pressure gauge

Standard value (operating pressure)	185 ⁺⁴⁹ ₀ kPa {27 ^{+7.1} ₀ psi, 1.9 ^{+0.5} ₀ kgf/cm ² }
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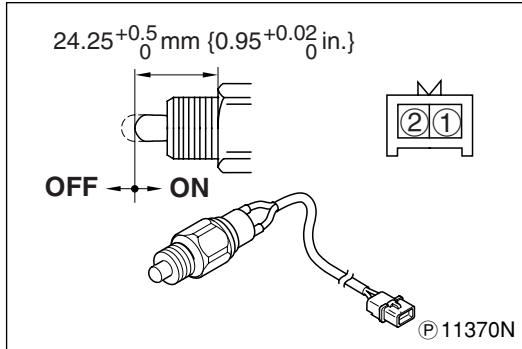
#054 Inspection of backup lamp switch

- Follow the table below to check for continuity.

	①	②
OFF		
ON	○—○	

○—○ : There is continuity between terminals.

- If any fault is found, replace the switch. Gr 22



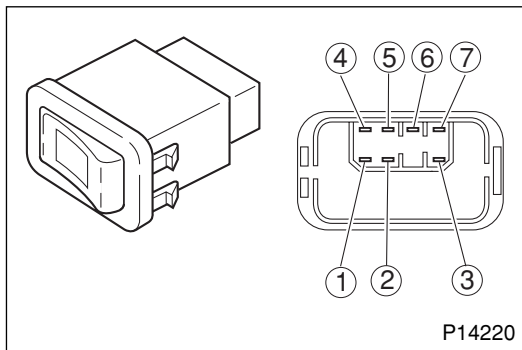
#056 Inspection of transmission neutral switch

- Follow the table below to check for continuity.

	①	②
OFF		
ON	○—○	

○—○ : There is continuity between terminals.

- If any fault is found, replace the switch. Gr 22



#063 Inspection of height control switch

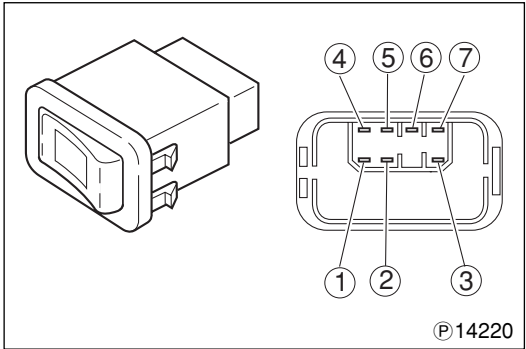
- Follow the table below to check for continuity.

	①	⑥	⑤	⑦	LED (Operation indication light)	③
DOWN	○—○		○—○	○		○
N						
OFF	○—○					

○—○ : There is continuity between terminals.

- If any fault is found, replace the switch.

#001 to #179 SWITCH

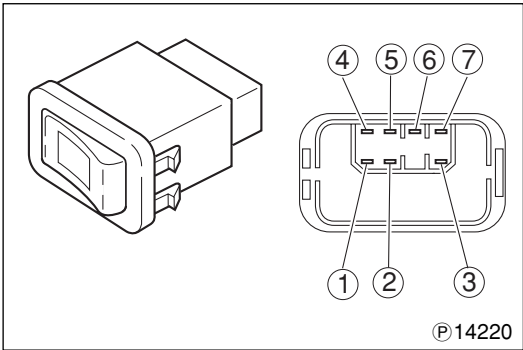


#087 Inspection of van body dome light switch

- Follow the table below to check for continuity.

	①	⑤	⑦	LED (Operation indication light)	③
ON	○	○	○	—	○
OFF					

- : There is continuity between terminals.
- If any fault is found, replace the switch.

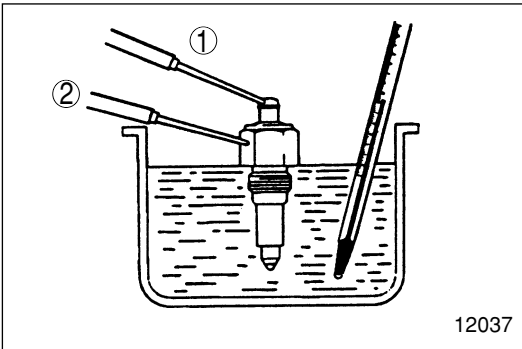


#092 Inspection of engine oil level check switch

- Follow the table below to check for continuity.

	①	⑤
CHECK	○	○
—		

- : There is continuity between terminals.
- If any fault is found, replace the switch.

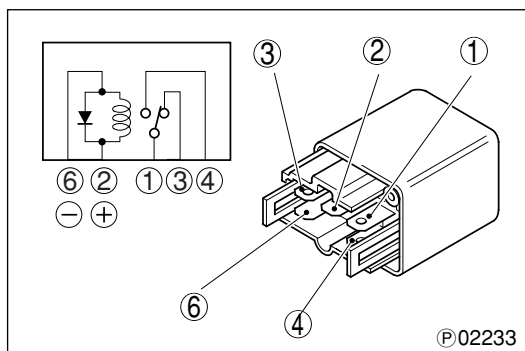


#160 Inspection of overheating switch

- Place the switch in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the operating temperature between terminals ① and ② (body) respectively.

Standard Value	When temperature increase (OFF→ON)	110±2.5°C {230±36.5°F}
	When temperature decrease (ON→OFF)	99.5 to 112.5 °C {211 to 235 °F}

- If the measured value deviates from the standard value, replace the switch. Gr 14



#182 Inspection of relay (Open type 6-pin)

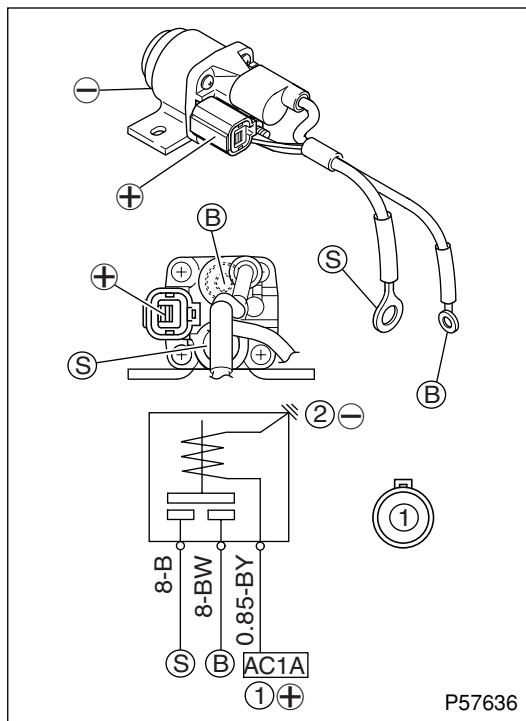
- Follow the table below to check for continuity and operation.

	①	②	③	④	⑥
No current	○	○	○		○
Current	○	⊕		○	⊖

○—○ : There is continuity between terminals.

⊕—⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the relay.



#187 Inspection of starter relay

- Follow the table below to check for continuity and operation.

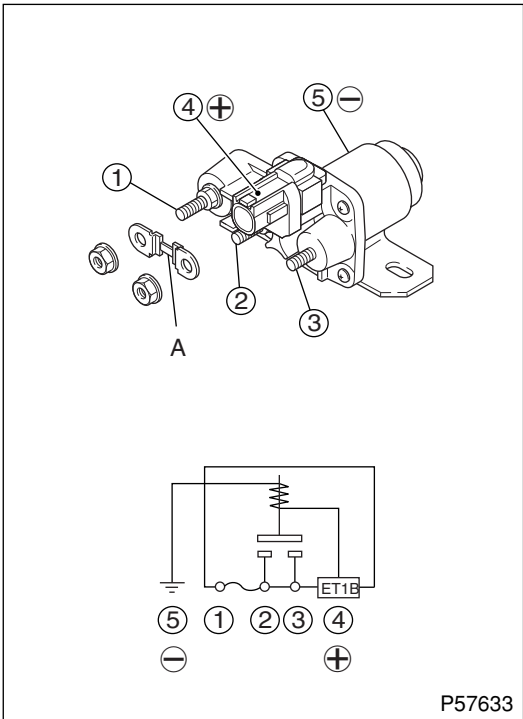
	B	S	①	② (Body)
No current			○	○
Current	○	○	⊕	⊖

○—○ : There is continuity between terminals.

⊕—⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the relay.

#180 to #249 RELAY



#195 Inspection of glow relay

(1) Inspection of fuse

If any fault is found, replace the fuse **A** (127 ampere).

(2) Inspection of main body

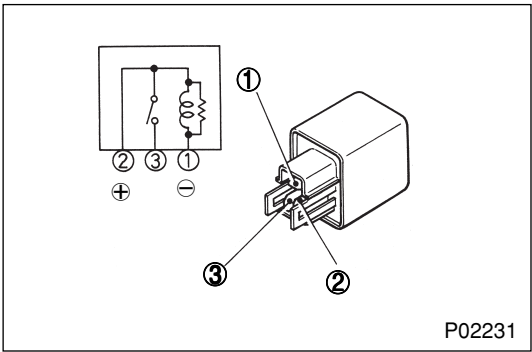
- Follow the table below to check for continuity and operation.

	①	②	③	④	⑤ (Body)
OFF	○—○	○—○		○—○	○—○
ON	○—○	○—○	○—○	⊕—⊖	⊕—⊖

○—○ : There is continuity between terminals.

⊕—⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the relay.



#197 Inspection of relay (Open type 3-pin)

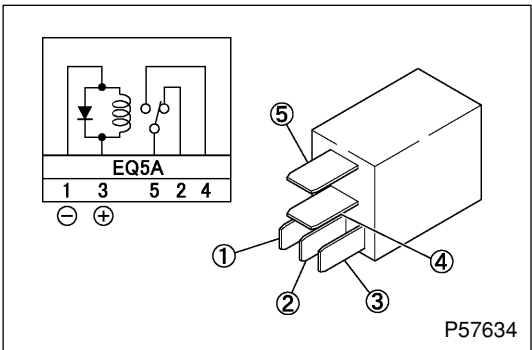
- Follow the table below to check for continuity and operation.

	①	②	③
No current	○—○	○—○	
Current	○—○	○—○	⊕—⊖

○—○ : There is continuity between terminals.

⊕—⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the relay.



#201 Inspection of relay (Open type 5-pin)

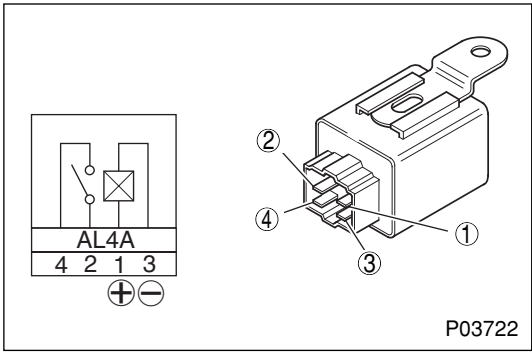
- Follow the table below to check for continuity and operation.

	①	②	③	④	⑤
No current		○—○			○—○
Current	○—○		○—○		
	⊕—⊖		⊕—⊖		

○—○ : There is continuity between terminals.

⊕—⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the relay.



#203 Inspection of relay (Open type 4-pin: Time rag relay)

- Follow the table below to check for continuity and operation.

	①	②	③	④	
No current	○	—	○		—
Current	⊕	○	—	○	Measure the delay until current flows. Check whether it is within standard value.

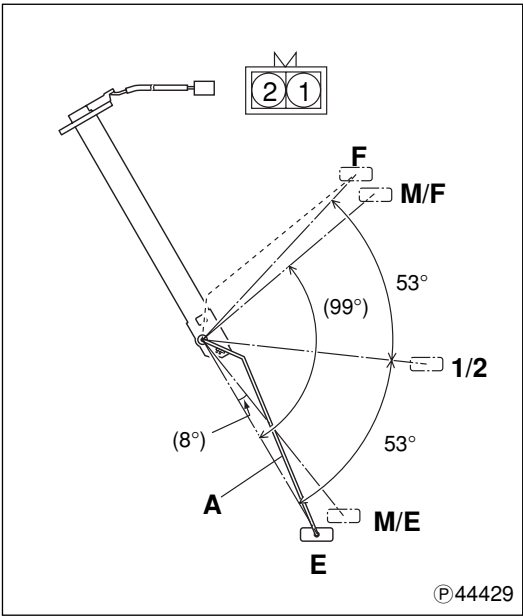
○—○ : There is continuity between terminals.

⊕—○ : Indicates the terminals where battery voltage is to be applied.

Standard value	1.0 ± 0.1 seconds
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- If any fault is found, replace the relay.

#250 to #349 SENSOR



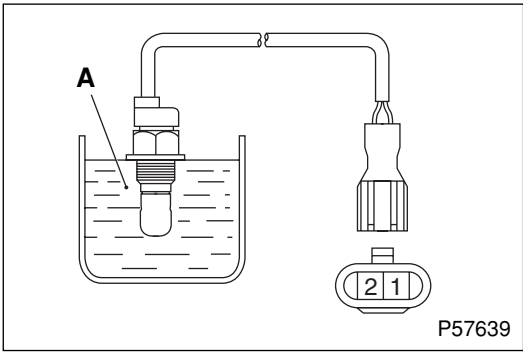
#258 Inspection of fuel level sensor

- Measure the resistance between terminals ① and ② when float arm **A** contacts to both stoppers (positions **E** and **F**) and also M/E, 1/2 and M/F position.

Standard value	F (FULL)	0 Ω
	M/F (MIDDLE FULL)	4 Ω
	1/2	50±3 Ω
	M/E (MIDDLE EMPTY)	135 Ω
	E (EMPTY)	150±10 Ω

- If the measured value deviates from the standard value, replace the sensor. Gr 13

(): Reference value.



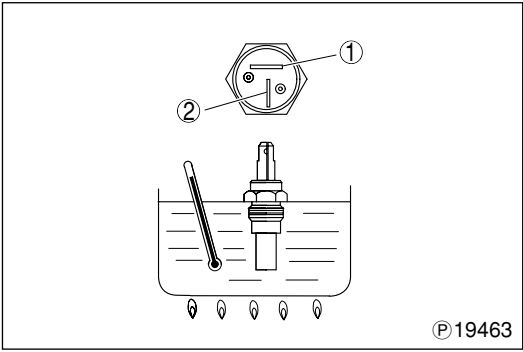
#259 Inspection of water level sensor

- Follow the table below to check for continuity.

	①	②
When water level sensor is out of the water		
When water level sensor is in the water	○	○

○—○ : There is continuity between terminals.

- If any fault is found, replace the sensor. Gr 14
- A** : Engine coolant



#262 Inspection of water temperature sensor

< For water temperature gauge >

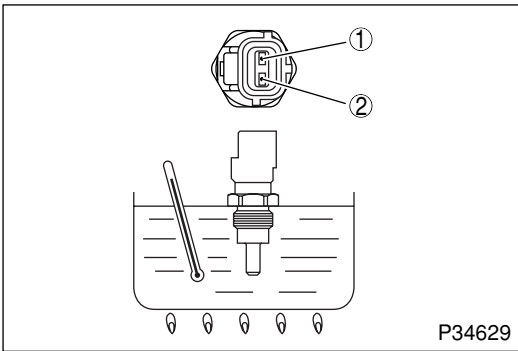
- Place the sensor in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the resistance between terminals ① and the body respectively.

Terminal ① : Water temperature gauge connection

Terminal ② : Is not use

Standard value	①—Body (connection side of water temperature gauge)	50°C {122°F}	153.9 Ω (Reference value)
		80°C {176°F}	51.9 ^{+4.9} _{-4.4} Ω
		100°C {212°F}	27.4 ^{+1.9} _{-1.2} Ω

- If the measured value deviates from the standard value, replace the sensor. Gr 14

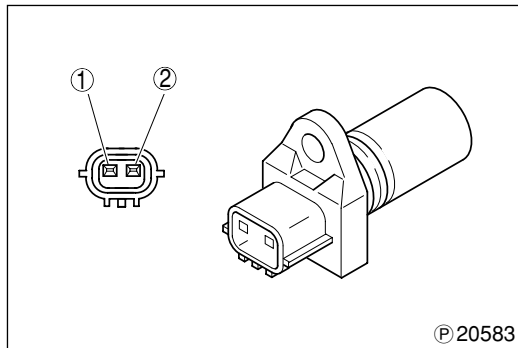


< For engine control >

- Place the sensor in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the resistance between terminals ① and ②.

Standard value	20°C {68°F}	2.45±0.14 kΩ
	80°C {176°F}	322.2 Ω (Reference value)
	110°C {230°F}	147.1±2 Ω

- If the measured value deviates from the standard value, replace the sensor. Gr 14

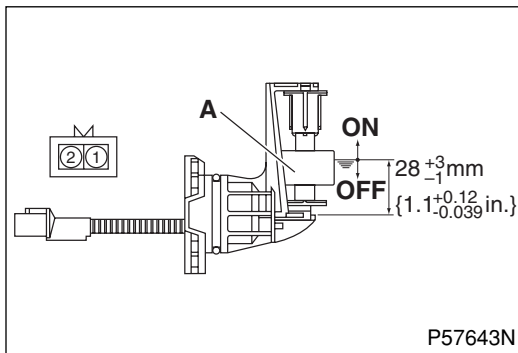


#263 Inspection of engine speed sensor

- Measure the resistance between terminals ① and ②.

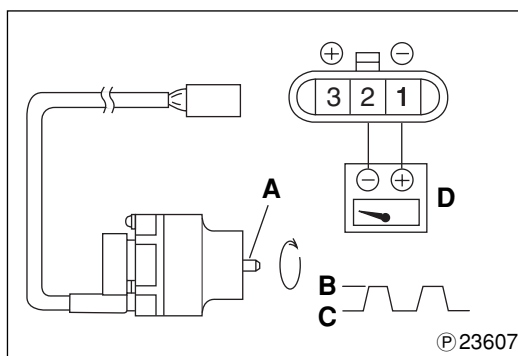
Standard value (at 20°C {68°F})	125.5±17 kΩ
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- If the measured value deviates from the standard value, replace the sensor. Gr 13E



#264 Inspection of engine oil level sensor

- Place the engine oil level sensor in engine oil in a container.
- The resistance of the float A at each position is measured.
- If the measured value deviates from the standard value, replace the sensor. Gr 14

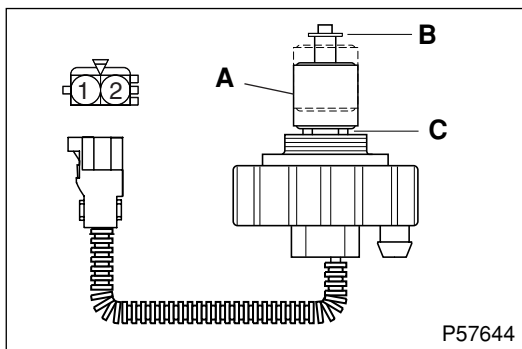


#265 Inspection of vehicle speed sensor

- Perform the following checks, and if any fault is found, replace the sensor. Gr 22, 23A
 - Turn slowly the portion A of the sensor with battery voltage applied between terminals ① and ③.
 - Measure the maximum value (high level B) and minimum value (low level C) of the voltages generated between terminals ① and ②.
- D : Tester

Standard value	Low level of pulse	0.5 V or less
	High level of pulse	8±1 V

#250 to #349 SENSOR

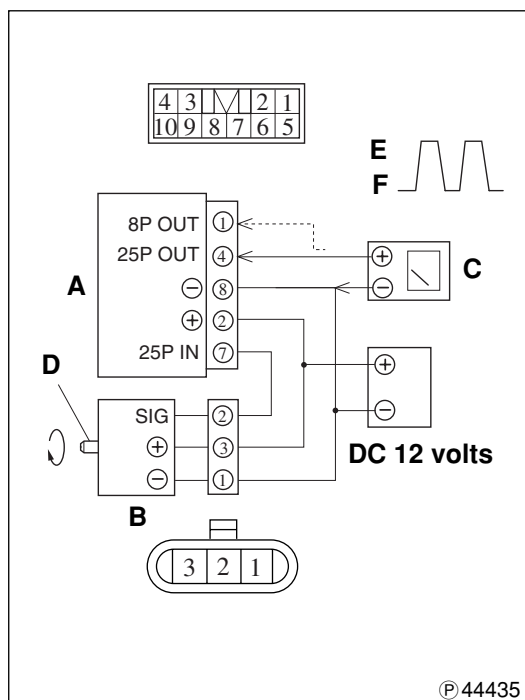


#274 Inspection of water separator sensor

- Move float **A** to the specified positions to check continuity.
- There must be continuity between terminals ① and ② when the sensor is **B** (maximum water level) side.
C : minimum water Level
- If the measured value deviates from the standard value, replace the sensor.

#350 Inspection of control units and other units

- Since the units alone cannot be readily checked in the off-vehicle state, check the harness, switch and other related parts in each system.
- If any fault is not found in the related parts, and the problem still remains in the system, replace the control units or other units.

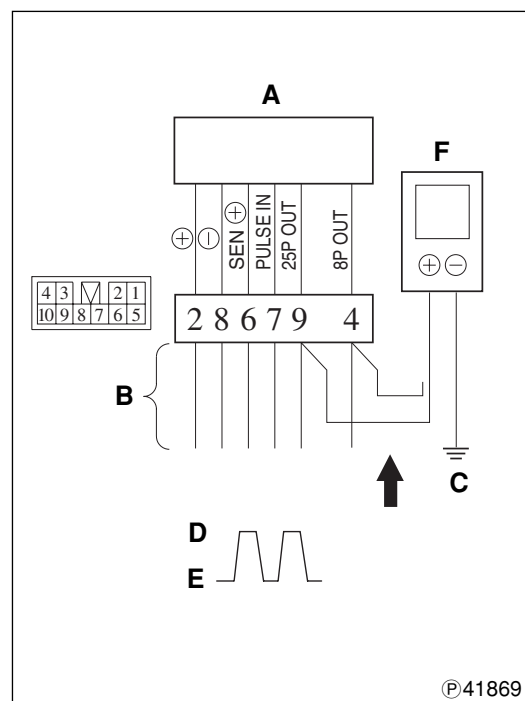


#351 Inspection of pulse divider

- Connect the pulse divider **A** as shown.
B : Vehicle speed sensor (25-pulse)
C : Tester
- Slowly rotate the shaft **D** of the vehicle speed sensor **B** by hand and measure the maximum voltage (high pulse voltage **E**) and the minimum voltage (low pulse voltage **F**) of the voltage generated across each of the output terminals ①, ④ and terminal ⑧ of the pulse divider **A**.

Standard value (Output voltage)	8-pulse	Low pulse voltage F	1.5 V or less
		High pulse voltage E	8 ± 1 V
	25-pulse	Low pulse voltage F	0.6 V or less
		High pulse voltage E	8 ± 1 V

- If the measured value deviates from the standard value, replace the pulse divider **A**.



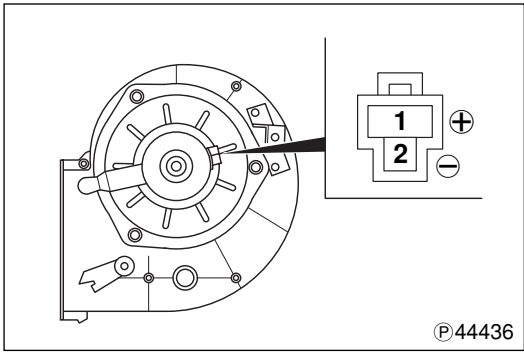
#352 Inspection of pulse converter

- Inspect with the engine speed sensor installed in the engine.
- Install the inspection harness **C** on the connector between pulse converter **A** and body harness **B**.
- Start the engine and measure the maximum (high pulse voltage **D**) and minimum (low pulse voltage **E**) value generated at inspection harness **C**.
F : Tester

Standard value (Output voltage)	8-pulse	Low pulse voltage E	1.5 V or less
		High pulse voltage D	11.5 V or more
	25-pulse	Low pulse voltage E	0.5 V or less
		High pulse voltage D	8 ± 1 V

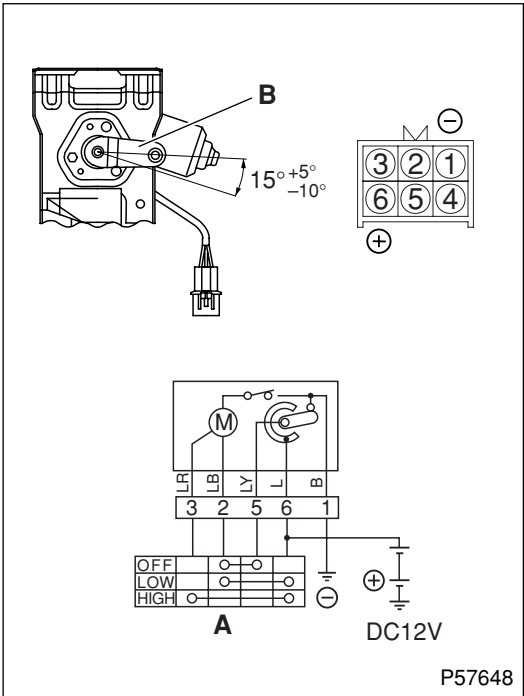
- If the measured value deviates from the standard value, replace the pulse converter **A**.

#410 to #509 MOTOR



#411 Inspection of blower motor

- Make sure that the motor operates when battery voltage is applied between terminals ① and ②.
- If any fault is found, replace the motor. Gr 55



#422 Inspection of wiper motor

- Connect a switch to the motor as shown.

A : Switch

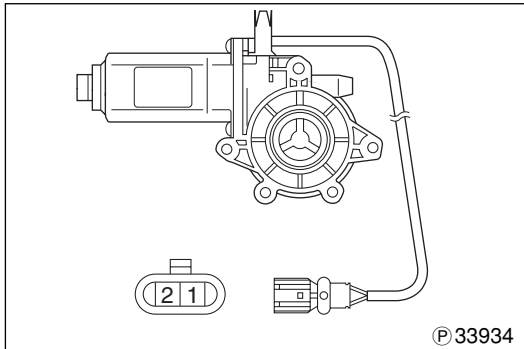
- Check the motor for correct operation as follows. If any fault is found, replace the motor. Gr 42

(1) Inspection of motor operation

- Set switch **A** in HIGH position to check that the motor rotates at high speed.
- Set switch **A** in LOW position to check that the motor rotates at low speed.

(2) Inspection of automatic stop position

- Set switch **A** in LOW position to let the motor rotates at low speed.
- When crank arm **B** is at a position other than the automatic stop position (outside the angles shown), set switch **A** in OFF position.
- Check to see the crank arm **B** stops at the automatic stop position (within the angles range shown).



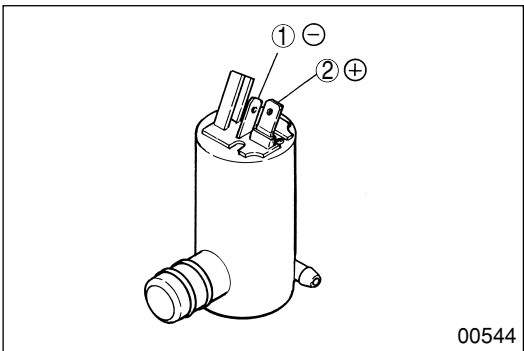
#423 Inspection of power window motor

- Follow the table below to check for operation.

	①	②
UP	⊖	⊕
DOWN	⊕	⊖

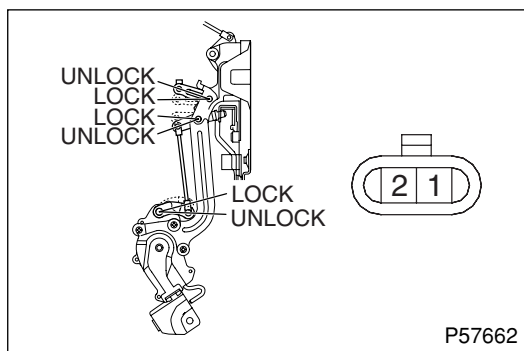
⊕ — ⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the motor. Gr 42



#428 Inspection of windshield washer motor

- Make sure that the motor operates when battery voltage is applied between terminals ① and ②.
- If any fault is found, replace the motor. Gr 42



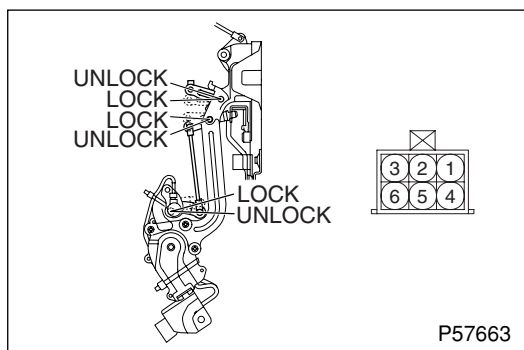
#510 Inspection of door lock actuator (Assistant driver's seat side)

- Follow the table below to check for operation.

	①	②
LOCK	⊕	⊖
UNLOCK	⊖	⊕

⊕ — ⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the actuator. Gr 42



#511 Inspection of door lock actuator (Driver's seat side)

- Follow the table below to check for continuity and operation.

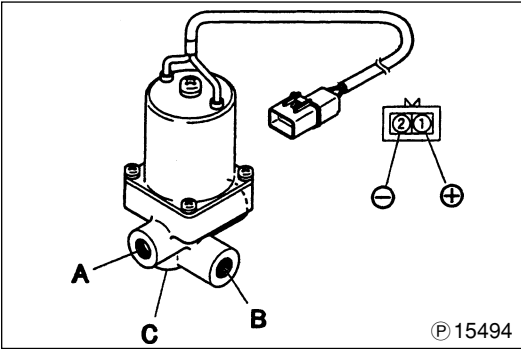
	①	③	②	④	⑤
LOCK		○ — ○		⊖	⊕
UNLOCK	○ — ○			⊕	⊖

○ — ○ : There is continuity between terminals. (OFF in LOCK position)

⊕ — ⊖ : Indicates the terminals where battery voltage is to be applied.

- If any fault is found, replace the actuator. Gr 42

#560 to #609 MAGNETIC VALVE



#569 Inspection of 3-way magnetic valve

Perform the following checks, and if any fault is found, replace the 3-way magnetic valve.

(1) Operation test

- Gradually apply battery voltage to between terminals ① and ② from 0 volt.
- Measure the voltage (minimum operating voltage) at the moment when the 3-way magnetic valves starts operating. (The OFF to ON operating can be noticed from a sound the magnetic valve generates.)

Standard value (Minimum operating voltage)	10 V or less
---	--------------

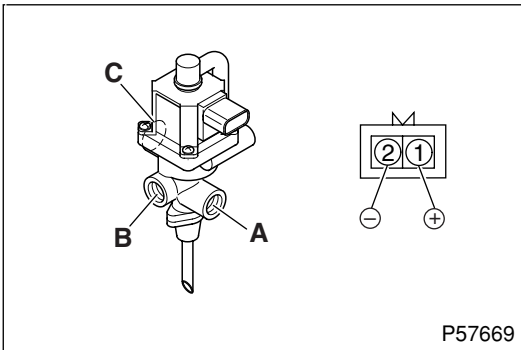
(2) Continuity and airtightness test

Follow the table below to check for continuity.

	Input port B	Output port A	Exhaust port C
ON			
OFF			

Air circuit table (○—○ : Air passage is open between ports.)

Air pressure at the time of check : 981 kPa {140 psi, 10 kgf/cm²}



#574 Inspection of 3-way magnetic valve

Perform the following checks, and if any fault is found, replace the 3-way magnetic valve.

(1) Operation test

- Gradually apply battery voltage to between terminals ① and ② from 0 volt.
- Measure the voltage (minimum operating voltage) at the moment when the 3-way magnetic valves starts operating. (The OFF to ON operating can be noticed from a sound the magnetic valve generates.)

Standard value (Minimum operating voltage)	10 V or less
---	--------------

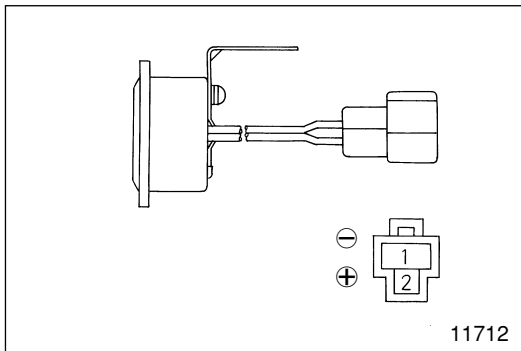
(2) Continuity and airtightness test

Follow the table below to check for continuity.

	Input port A	Output port B	Exhaust port C
ON			
OFF			

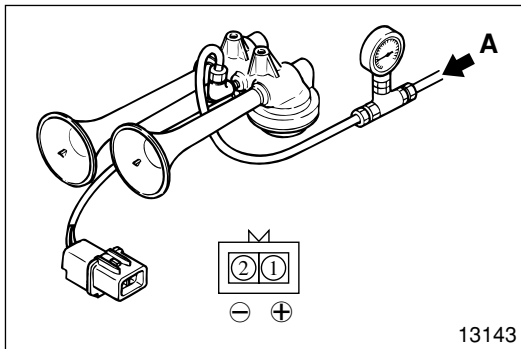
Air circuit table (○—○ : Air passage is open between ports.)

Air pressure at the time of check : 981 kPa {140 psi, 10 kgf/cm²}



#611 Inspection of warning buzzer

- Make sure that the buzzer sounds when battery voltage is applied between terminals ① and ②.
- If any fault is found, replace the buzzer.



#612 Inspection of air horn

Perform the following checks, and if any fault is found, replace the horn.

(1) Minimum operating voltage of air horn valve

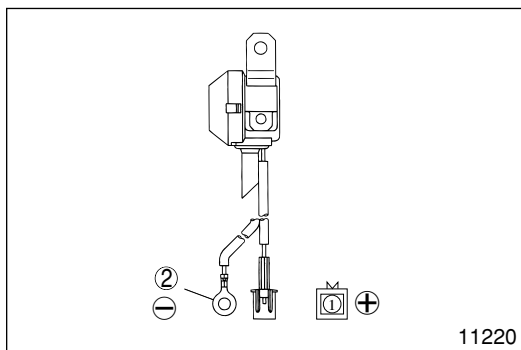
- Apply air pressure **A** of 785 kPa {115 psi, 8 kgf/cm²} to the horn.
- Apply voltage between terminals ① and ② starting from 0 volt gradually.
- Measure the voltage when the horn sounds.

Standard value	10 V or less
----------------	--------------

(2) Operating pressure of horn

- Apply battery voltage between terminals ① and ②.
- Apply air pressure **A** to the horn starting from 0 kPa {0 psi, 0 kgf/cm²} gradually.
- Measure air pressure **A** when the horn sounds.

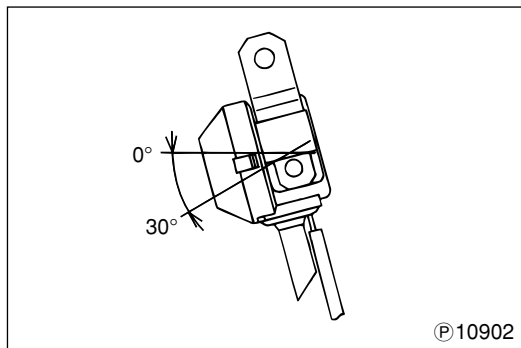
Standard value	195 to 980 kPa {28 to 142 psi, 2 to 10 kgf/cm ² }
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#614 Back buzzer

[Inspection]

- Make sure that the buzzer sounds intermittently when battery voltage is applied between terminals ① and ②.
- If any fault is found, replace the buzzer.



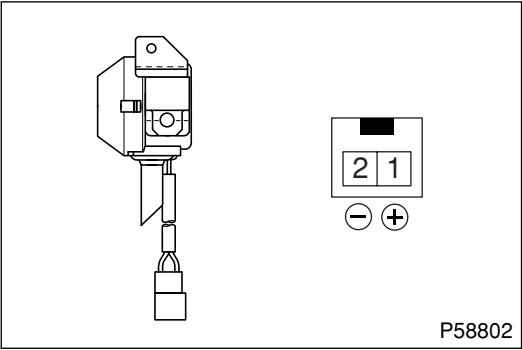
[Installation]

Attach the buzzer to the frame at an angle within the range shown.

CAUTION ⚠

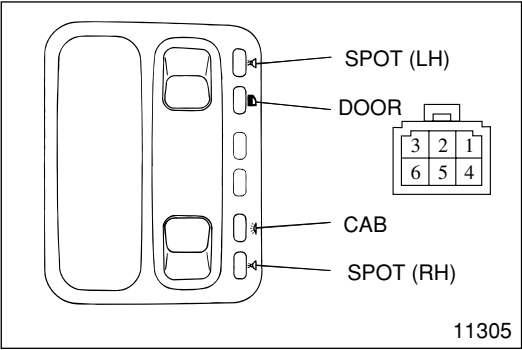
Be careful to install the buzzer within the illustrated angle range or the buzzer will not be drained normally.

#610 to #649 BUZZER AND HORN, #650 to #699 LAMP



#616 Inspection of reverse buzzer

- Make sure that the buzzer sounds when battery voltage is applied between terminals ① and ②.
- If any fault is found, replace the buzzer.



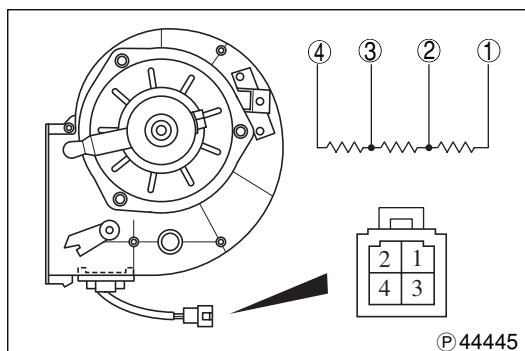
#656 Inspection of cab and spot lamp

- Follow the table below to check for continuity.

	①	③	⑤
OFF			
SPOT (LH)	○—○		
SPOT (RH)	○—○		
DOOR	○—○		○—○
CAB	○—○		

○—○ : There is continuity between the terminals. (when bulb is installed)

- If any fault is found, replace the lamp.

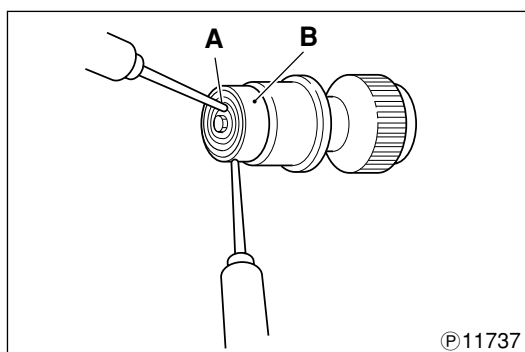


#750 Inspection of blower resistor

- Follow the table below to check for resistance of between terminals

Standard value	LOW	①—④	1.78 Ω
	MIDDLE LOW	③—④	0.88 Ω
	MIDDLE HIGH	②—④	0.27 Ω

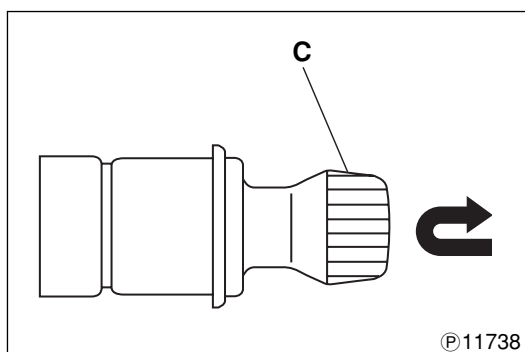
- If the measured value deviates from the standard value, replace the blower resistor.



#754 Inspection of cigarette lighter

Perform the following checks, and if any fault is found, replace the cigarette lighter.

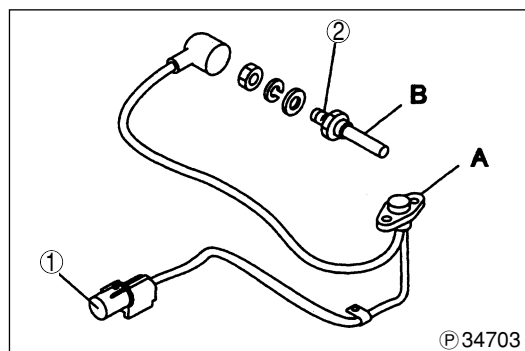
- Make sure that there is continuity between heater element **A** and body **B**.



- Make sure that when plug **C** is pushed in by hand, it immediately returns to its original position.
- Turn the starter switch at ACC or ON position.
- Push plug **C** into the socket in the cab.
- Measure the time required for plug **C** automatically returns.

Standard value	15±5 seconds
----------------	--------------

- Check to see that heater element **A** is red-hot.



#758 Inspection of air dryer

Perform the following checks, and if any fault is found, replace the air dryer. Gr 35

(1) Inspection of thermostat assembly

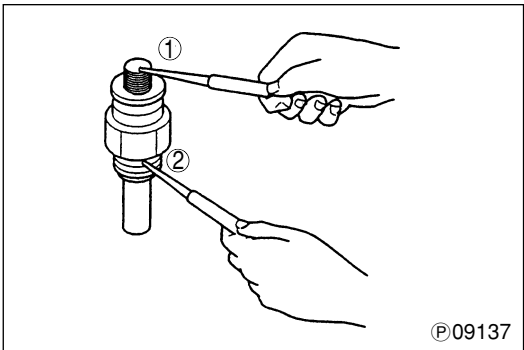
- Lower the temperature at thermostat **A** to 0°C {32°F} or lower, then gradually raise the temperature.
- Measure the degree of temperature at the moment when continuity is detected between terminals ① and ②, and make sure to confirm if the value meets the standard.

Standard value (During temperature increase: OFF → ON)	4±4.0°C {39.2±39.2°F}
---	-----------------------

- Raise the temperature at thermostat **A** to 20°C {68°F} or higher, then gradually lower the temperature.
- Measure the degree of temperature at the moment when continuity is not detected between terminals ① and ②, and make sure to confirm if the value meets the standard.

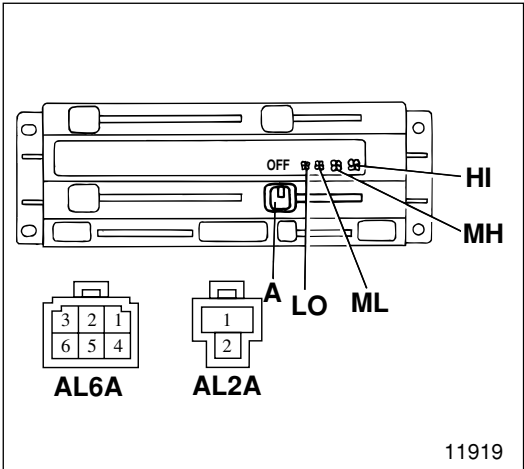
Standard value (During temperature decrease: ON → OFF)	20°C {68°F} or less
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#750 to #859 OTHER



(2) Inspection of heater

- Make sure that there is continuity between terminals ① and ②.
- If any fault is found, replace the heater.

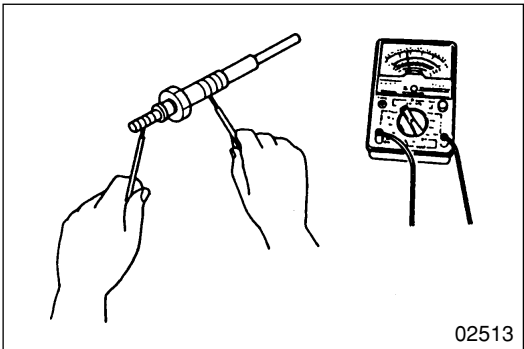


#763 Inspection of heater control assembly

- Follow the table below to check for continuity.

	AL6A						AL2A	
	①	③	②	⑤	⑥	④	①	②
OFF								
LOW	○	○				○		
MIDDLE LOW	○		○			○		
MIDDLE HIGH	○			○		○		
HIGH	○				○	○		
	C	L	ML	MH	H	E	ILL	

- :There is continuity between terminals.
- If any fault is found, replace the switch **A** or heater control assembly.
 - If the illumination lamp has blown out, replace the bulb.



#764 Inspection of glow plug

- Measure the resistance of glow plug as shown.

Standard Value (Cold resistance of glow plug)	1.1 Ω (Reference value)
--	-------------------------

- If the measured value deviates from the standard value, replace the glow plug. Gr 11

DANGER ⚠

- Because flammable hydrogen gas is generated from battery, be sure to obey the following:
 - Never attempt to short-circuit the positive and negative terminals of battery, and generate sparks, or smoke a cigarette near it.
 - Do not wear metal objects on your arms or do not lean over battery.
- Sulfuric acid of the electrolyte is very corrosive. Whenever handling battery, wear safety goggles and rubber gloves to protect your eyes and hands.
- Battery posts, terminals and related accessories contain lead and lead compounds. Wash hands after handling.

WARNING ⚠

- When you disconnect battery cables, disconnect the negative battery cable $\ominus$ first.

CAUTION ⚠

- Make sure that all electrical switches of the vehicle are off before connecting battery cables.
- Be sure to connect the positive battery cable $\oplus$ first before you connect the negative battery cable $\ominus$.
- To prevent a short-circuit, take care that disconnected battery cables may not accidentally touch the battery terminals.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Specific gravity of battery electrolyte (20°C {68°F})	1.280	1.220	Charge or replace

◆ Service procedure

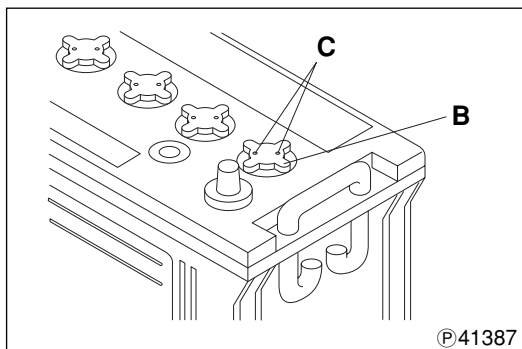
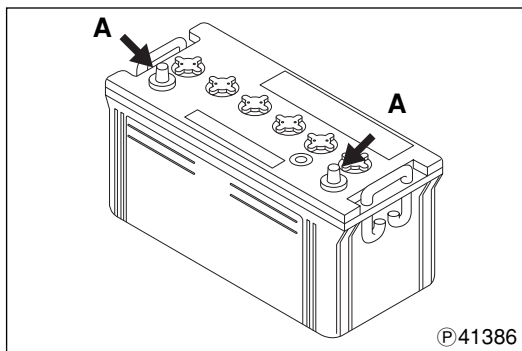
Inspection of battery

(1) Visual inspection

- If terminal **A** is corroded, scrub off the corrosion from it using a wire brush.
- If cracks or defects are found on battery, replace it since the cracks or defects can cause liquid spills.

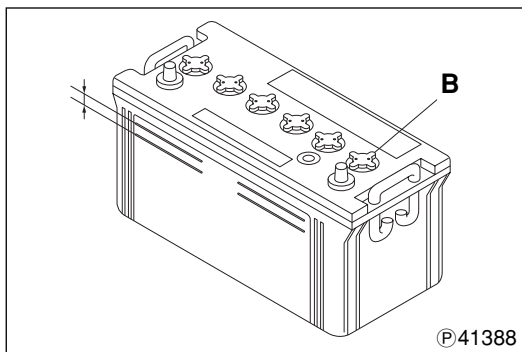
CAUTION ⚠

Make sure you grease the $\oplus$ side of terminal **A** because it is easily corroded.



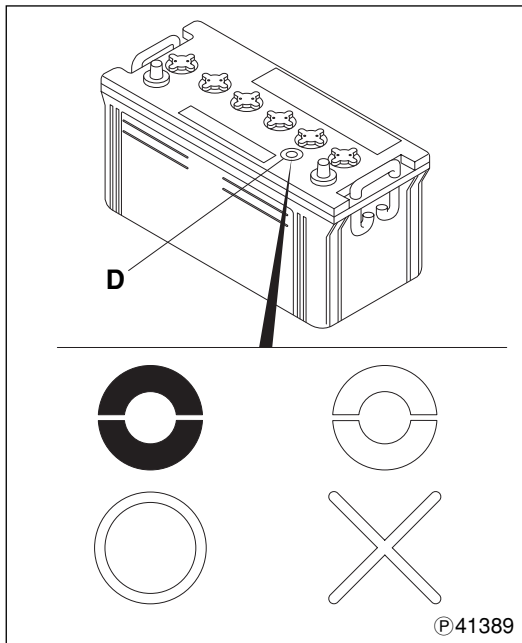
- If bleed hole **C** of vent plug **B** is clogged, clean the hole.

#860 BATTERY



(2) Inspection of fluid level

- Make sure that the battery electrolyte level is between UPPER and LOWER.
- If the level is below LOWER, remove vent plug **B** and fill the battery with distilled water or battery replenisher to UPPER.

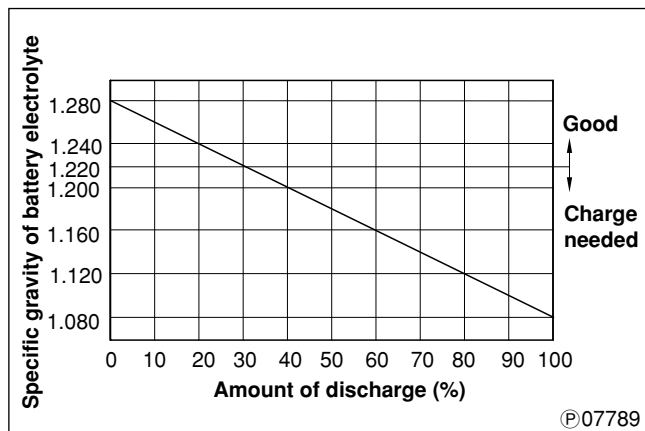


(3) Measurement of specific gravity

You can tell the specific gravity of the battery electrolyte by the color shown in indicator **D**.

Blue : Good

White : Charge or replace



(4) Charging

- Although, as a rule, battery charging should be done with the battery removed from the vehicle, if you have to charge the battery while it is on the vehicle, make sure that you stop the engine and disconnect battery cable ⊖.
- Remove vent plug before charging the battery.
- For the recommended charge time and current, see the following table to avoid overcharging.

	Charge current (A)	Charge time (H)	Upper limit of fluid temperature (°C {°F})
Normal charge	Value of 5-hour rating capacity 10	$\frac{* \text{Amount of discharge (Ah)}}{\text{Charge current (A)}} \times 1.2 \text{ (to 1.5)}$	45 {113}
Quick charge	Value of 5-hour rating capacity 1.5	0.5	55 {131}

* Amount of discharge (Ah) = 5-hour rating capacity (Ah) $\times \frac{\text{Amount of discharge (\%)}}{100}$

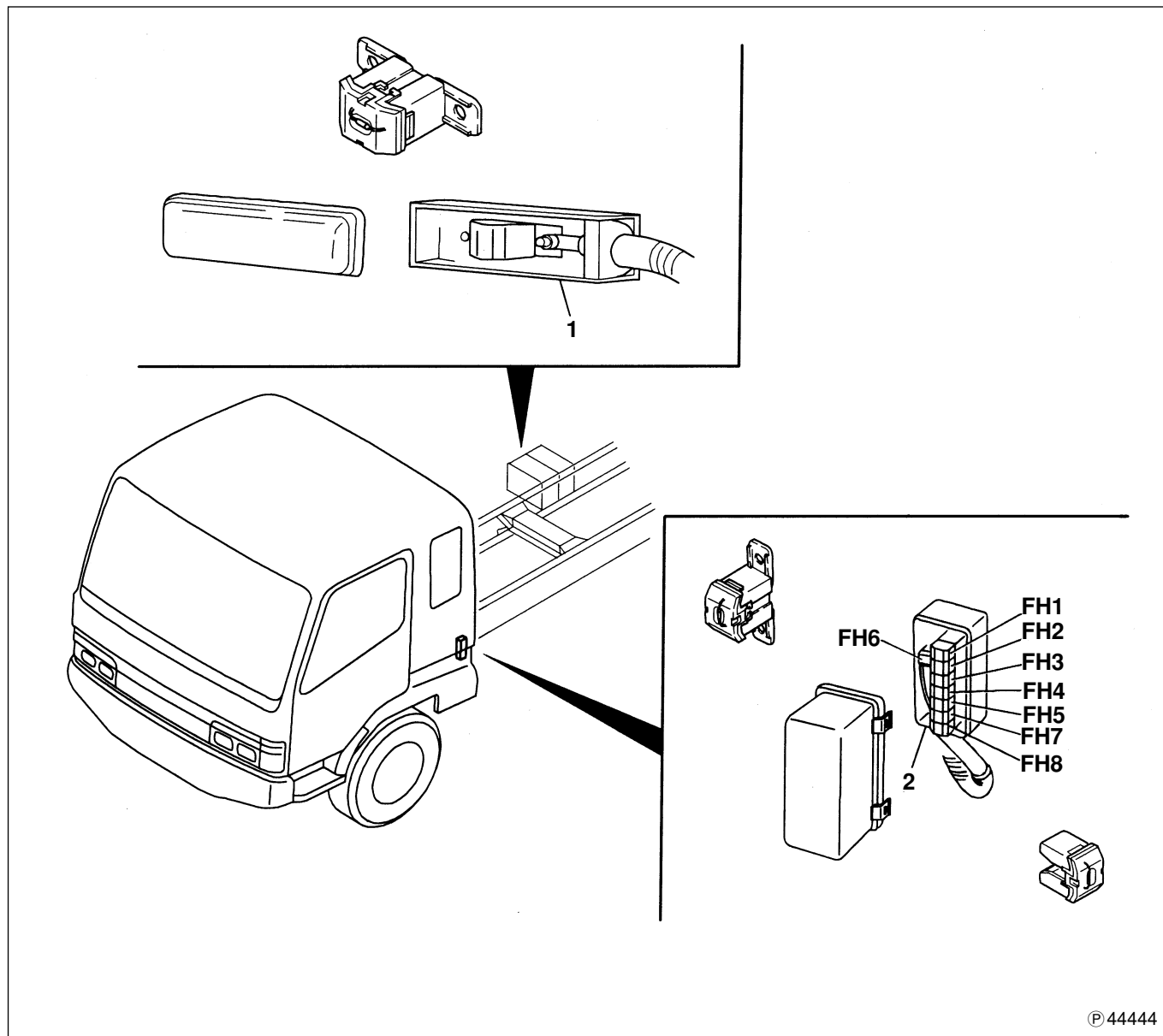
- Use the graph shown on the left to calculate the amount of discharge (%).
- Use diluted sulfuric acid, made up of sulfuric acid and refined or distilled water, as the battery electrolyte.
- The specific gravity of fully-charged battery electrolyte is 1.280 with the temperature at 20°C {68°F}.

DANGER ⚠

- **Do not let the battery electrolyte level rise and overflow while charging the battery.**
- **Keep open flame away from the battery while charging it or it might explode.**
- **Be careful not to generate sparks while charging the battery because it is dangerous.**
- **After charging the battery, tighten the vent plugs, wash away sulfuric acid from the battery using water, and dry the surface.**
- **Be sure to check the electrolyte level before charging the battery. Charging with the electrolyte level below the lower limit (LOWER LEVEL) can cause premature deterioration, heat generation and explosion of the battery.**

#870 to #889 FUSE

#870 High-current fuse box



- 1 Main high-current fuse
- 2 High-current fuse box

WARNING

To prevent possible injury, be sure to disconnect the negative terminal $\ominus$ of the battery and insulate it with tape before removing high-current fuses (FH1 to FH8).  #860

With the negative terminal $\ominus$ of the battery connected, battery voltage is always applied to each fuse.

The battery voltage is applied to the fuses under the following conditions:

Always (directly connected to the battery): FH1 to FH8

CAUTION

- If a fuse blows out, identify and remedy the cause, then replace the fuse.
- Be sure to use the fuse of the specified ampere.

Main high-current fuse

Fuse No.	Main load	Capacity
—	High-current fuse box	140A

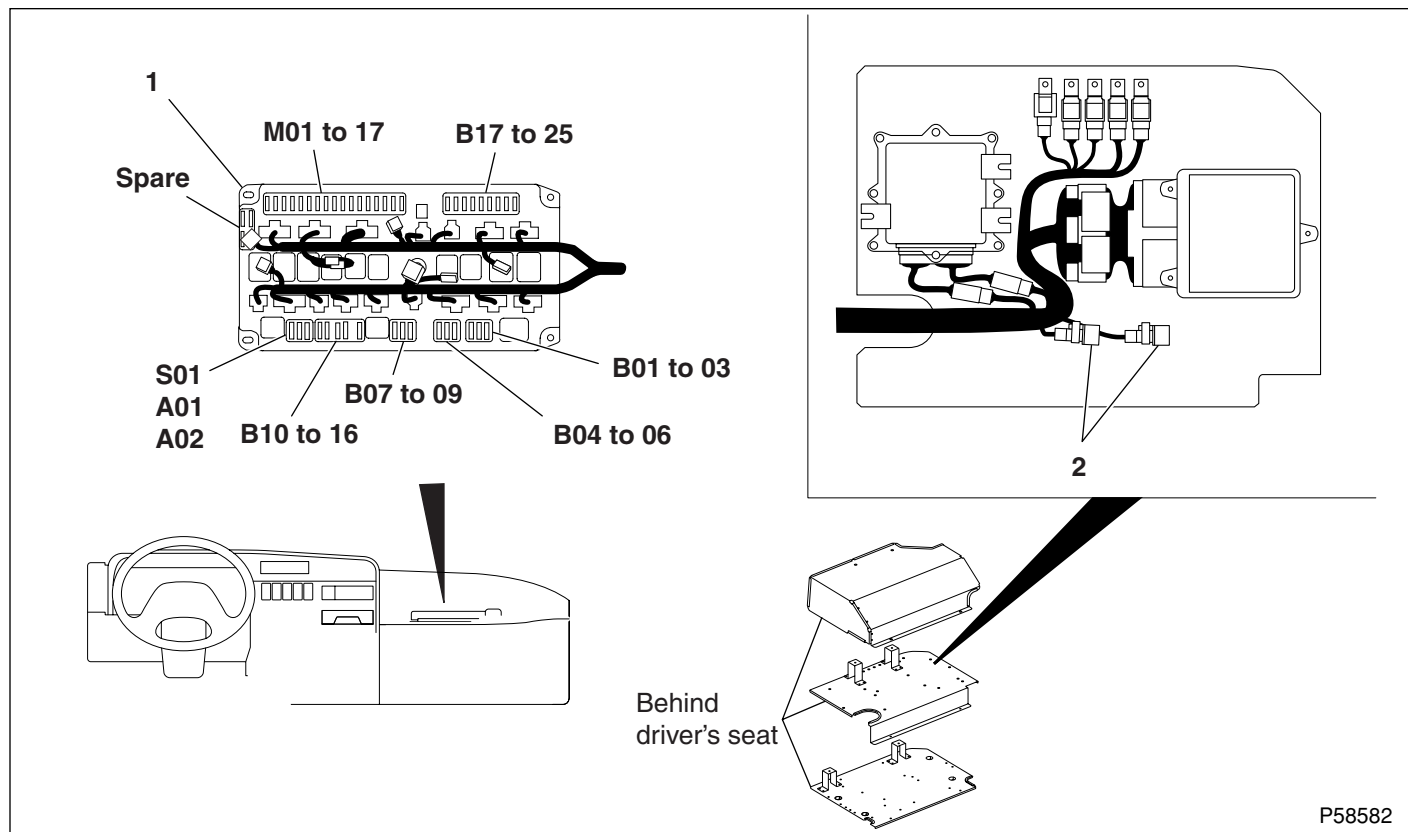
High-current fuse box

Fuse No.	Main load	Capacity
FH1	Starter switch (terminal B)	50A
FH2	Fuse (B07 to B16)	40A
FH3	Fuse (B17 to B25)	40A
FH4	Fuse (B01 to B04)	40A
FH5	Glow relay (terminal B)	50A
FH6	Alternator (terminal B)	140A
FH7	Fuse (B05 to B06)	40A
FH8	A/T<FM65>	60A

A/T : Automatic transmission

#870 to #889 FUSE

#871 Relay and fuse box



1 Relay and fuse box

2 Fuse holder

WARNING

To prevent possible injury, be sure to disconnect the negative terminal $\ominus$ of the battery and insulate it with tape before removing fuses.  #860

With the negative terminal $\ominus$ of the battery connected, battery voltage is always applied to each fuse.

The battery voltage is applied to the fuses under the following conditions:

Always (directly connected to the battery) : B01 to B25

When starter switch is in ON position : M01 to M17

When starter switch is in ACC position : A01 to A02

When starter switch is in START position : S01

CAUTION

- If a fuse blows out, identify and remedy the cause, then replace the fuse.
- Be sure to use a fuse of the specified ampere.

Relay and fuse box

Fuse No.	Main load	Capacity	Fuse No.	Main load	Capacity
A01	Audio	10A	B22	Cab lamp	10A
A02	Cigarette lighter	15A	B23	Mirror heater	10A
B01	Reserve power (BATT)	10A	B24	MVCU (Back up)	10A
B02	Reserve power (ACC)	10A	B25	Horn	15A
B03	Van body dome light	15A	M01	Automatic transmission	10A
B04	Socket connector	20A	M02	Spare	—
B05	Power window	25A	M03	MVCU (Main)	10A
B06	Automatic transmission	15A	M04	Reserve power (MAIN)	10A
B07	Stop lamp	10A	M05	—	—
B08	Turn/hazard	15A	M06	Power window	10A
B09	Tail lamp	20A	M07	Mirror heater	10A
B10	Headlamp relay	10A	M08	Exhaust brake, etc.	15A
B11	—	—	M09	Air-conditioner	10A
B12	Headlamp, RH	15A	M10	—	—
B13	—	—	M11	Engine control	10A
B14	—	—	M12	ABS electronic control unit	10A
B15	Headlamp, LH	15A	M13	Turn/hazard	10A
B16	—	—	M14	Air dryer	15A
B17	MUT-III	15A	M15	Meter, DRL	10A
B18	Air-conditioner	20A	M16	Backup lamp	10A
B19	Blowermotor	20A	M17	Wiper	20A
B20	ABS	30A	S01	Safety relay	10A
B21	Engine ECU (Main)	20A			

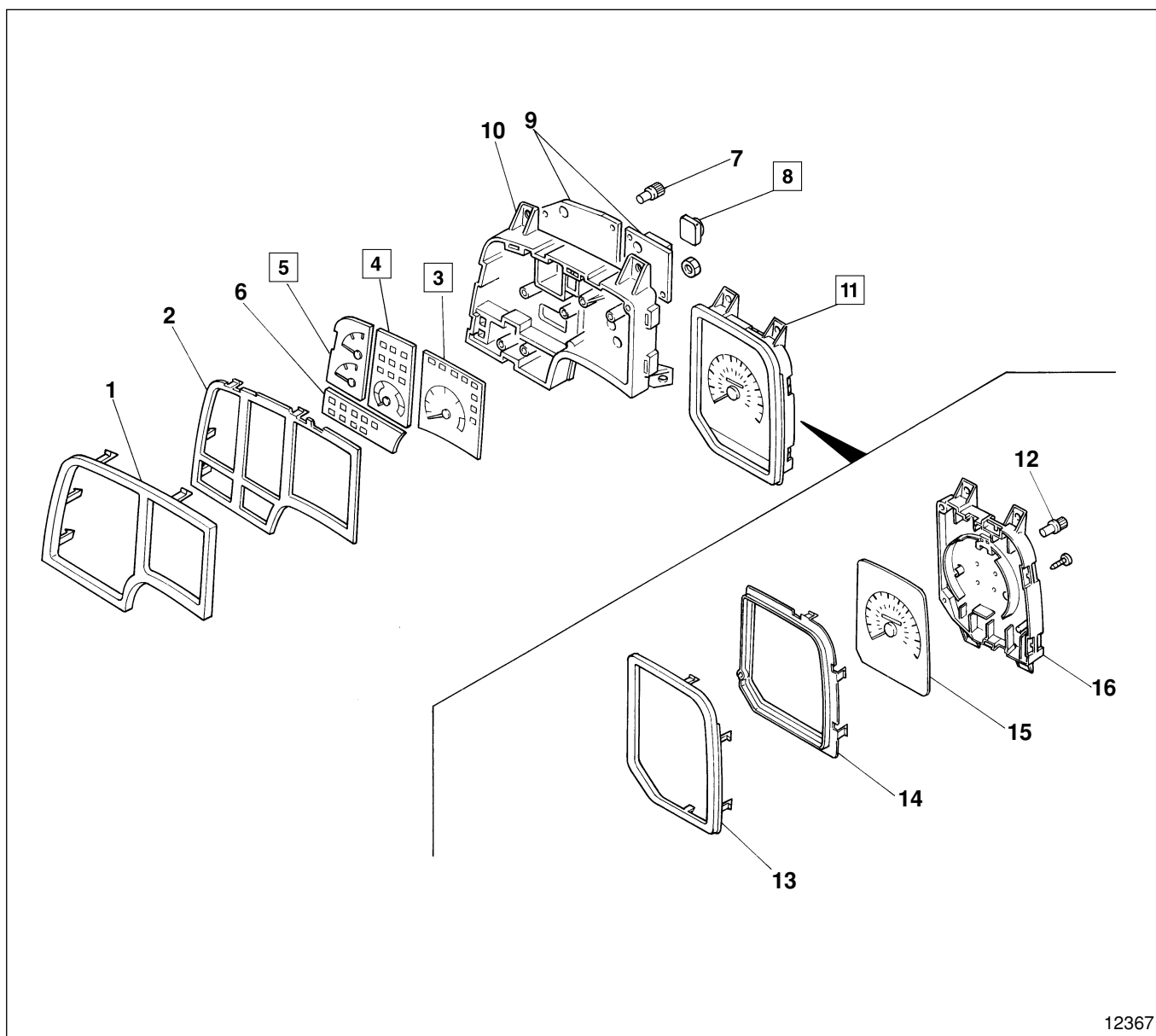
Fuse holder

Fuse No.	Main load	Capacity
—	A/T cooler fan <FM65>	30A

ABS : Anti-lock brake system
 DRL : Daytime running light
 ECU : Electronic control unit
 MVCU: Multifunction vehicle control unit
 MUT : Multi-use tester

A/T : Automatic transmission

#890 METER CLUSTER



12367

● Disassembly sequence

- | | |
|---|-------------------------|
| 1 Front plate | 9 Print panel |
| 2 Retainer | 10 Case |
| 3 Tachometer | 11 Speedometer assembly |
| 4 Air pressure gauge and indicator lens | 12 Bulb |
| 5 Fuel gauge and water temperature gauge | 13 Plate |
| 6 Indicator lens | 14 Window plate |
| 7 Bulb | 15 Speedometer |
| 8 Meter warning buzzer (Overrunning buzzer)
< EATON transmission > | 16 Case |

● Assembly sequence

Follow the disassembly sequence in reverse.

Removal and installation of meter cluster speedometer.  Gr 42

Service standards

Service Standards

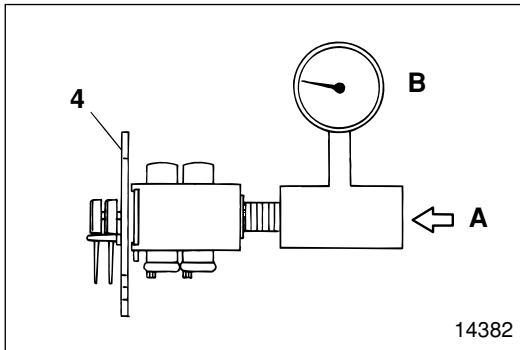
Location	Maintenance item		Standard value		Limit	Remedy
3	Indication range of tachometer 20±2°C {68±36°F} 13.5±0.1 V		At 550 rpm	550±35 rpm	—	Replace
			At 1000 rpm	1000±50 rpm		
			At 1500 rpm	1500±60 rpm		
			At 2000 rpm	2000±65 rpm		
			At 2500 rpm	2500±70 rpm		
			At 3000 rpm	3000±75 rpm		
4	Indication range of air pressure gauge	At 40 psi	275±50 kPa {40±7 psi, 2.8±0.5 kgf/cm²}	—	Replace	
		At 75.4 psi	520±50 kPa {75.4±7 psi, 5.3±0.5 kgf/cm²}			
		At 120 psi	825±50 kPa {120±7 psi, 8.4±0.5 kgf/cm²}			
	Tolerance of reading by two needles under the same pressure	At 75.4 psi	±50 kPa or less {±7 psi, ±0.5 kgf/cm²}	—	Replace	
		At 120 psi	±50 kPa or less {±7 psi, ±0.5 kgf/cm²}			
5	Resistance of fuel gauge	Needle position	FULL	4 Ω	—	Replace
			1/2	50 Ω		
			EMPTY	135 Ω		
	Resistance of water temperature gauge	Needle position	65°C {149°F}	81.8 Ω	—	Replace
			100°C {212°F}	26.6 Ω		
11	Inspection range of speedometer 14 V 20±2°C {68±36°F}	Inspection using mph	At 10 mph	10 ⁺² ₀ mph	—	Replace
			At 20 mph	20 ⁺² ₀ mph		
			At 40 mph	40 ^{+2.5} ₀ mph		
			At 50 mph	50 ⁺³ ₀ mph		
			At 60 mph	60 ⁺³ ₀ mph		
		Inspection using km/h	At 20 km/h	20 ⁺³ ₀ km/h	—	Replace
			At 35 km/h	35 ⁺³ ₀ km/h		
			At 40 km/h	40 ⁺³ ₀ km/h		
			At 60 km/h	60 ^{+3.5} ₀ km/h		
			At 80 km/h	80 ^{+4.5} ₀ km/h		
			At 100 km/h	100 ⁺⁵ ₀ km/h		

◆ Service procedure

3 Inspection of tachometer

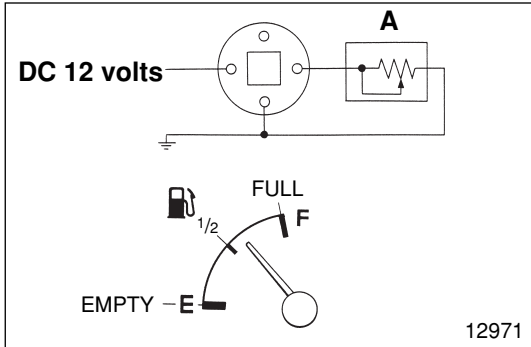
- Use the engine revolution counter to check that the indication area of tachometer **3** is in the standard value at each revolution.
- If the measured value deviates from the standard value, replace tachometer **3**.

#890 METER CLUSTER



4 Inspection of air pressure gauge

- Apply air pressure **A** to air pressure gauge 4.
- **B** : Air pressure gauge
- Measure the indication range of air pressure gauge 4 at standard pressure.
- If the measured value deviates from the standard value, replace air pressure gauge 4.



5 Inspection of fuel gauge and water temperature gauge

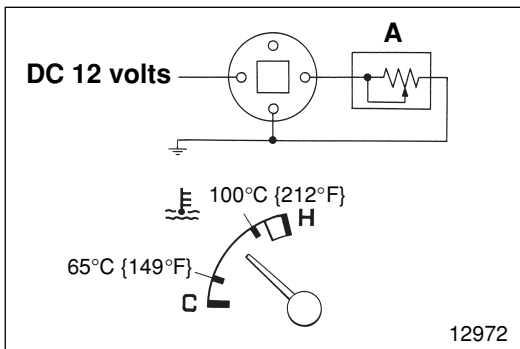
(1) Inspection of fuel gauge

- Connect a variable resistor to fuel gauge 5 as shown.
- **A** : Variable resistor
- Measurement order
FULL → 1/2 → EMPTY

NOTE

The movement of the gauge needle is subject to hysteresis (oscillation). Be sure to measure following the measurement order.

- Increase the value of variable resistor **A** gradually from 0 Ω .
- Measure the resistance respectively when the needle of fuel gauge 5 indicates FULL, 1/2, and EMPTY.
- If the measured value deviates from the standard value, replace fuel gauge 5.



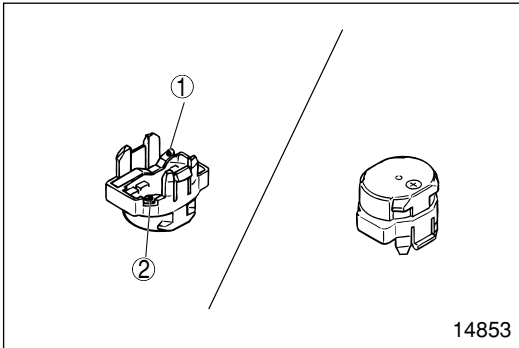
(2) Inspection of water temperature gauge

- Connect a variable resistor to water temperature gauge 5 as shown.
- **A** : Variable resistor
- Measurement order
65°C {149°F} → 100°C {212°F}

NOTE

The movement of the gauge needle is subject to hysteresis (oscillation). Be sure to measure following the measurement order.

- Increase the value of variable resistor **A** gradually from 0 Ω .
- Measure the resistance respectively when the needle of water temperature gauge 5 indicates 65°C {149°F} and 100°C {212°F}.
- If the measured value deviates from the standard value, replace water temperature gauge 5.

**8 Inspection of meter warning buzzer**

- Make sure that the buzzer operates when battery voltage is applied between terminals ① and ②.

CAUTION ⚠

- Be careful not to mix up $\oplus$ and $\ominus$ when you apply voltage to the buzzer 8, because this would damage the meter warning buzzer.
- Make sure you check $\oplus$ and $\ominus$ on the top of the buzzer 8.

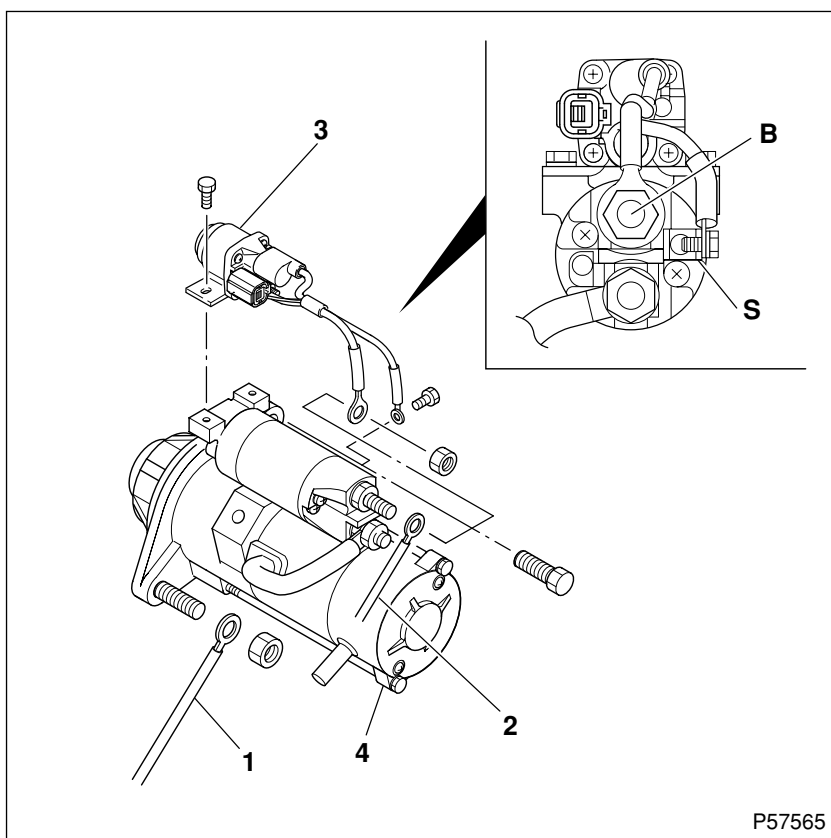
- If any fault is found, replace the buzzer.

11 Inspection of speedometer

Use the speedometer tester to check that the indication area of speedometer 11 does not deviate from the standard value at each speed. If the measured value deviates from the standard value, replace the speedometer.

12 **STARTER AND ALTERNATOR**

#930 STARTER



● Removal sequence

- 1 Ground strap
- 2 Starter cable
- 3 Starter relay #187
- 4 Starter P54-12-4

B : Connect to terminal B

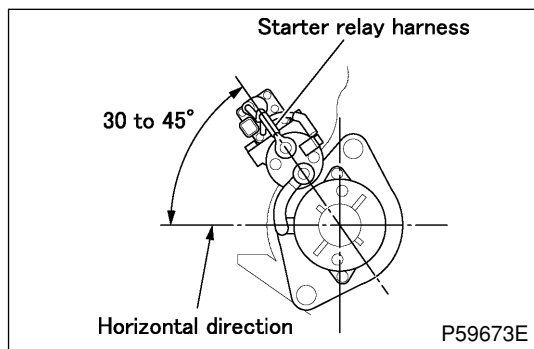
S : Connect to terminal S

WARNING

Never touch the starter 4 with tools when you remove the harness from terminal B. This is because voltage is always supplied to it from starter cable 2, and you will short-circuit the starter. Before removing the harness from terminal B, remove the $\ominus$ battery terminal and tape it up to insulate it.

● Installation sequence

Follow the removal sequence in reverse.

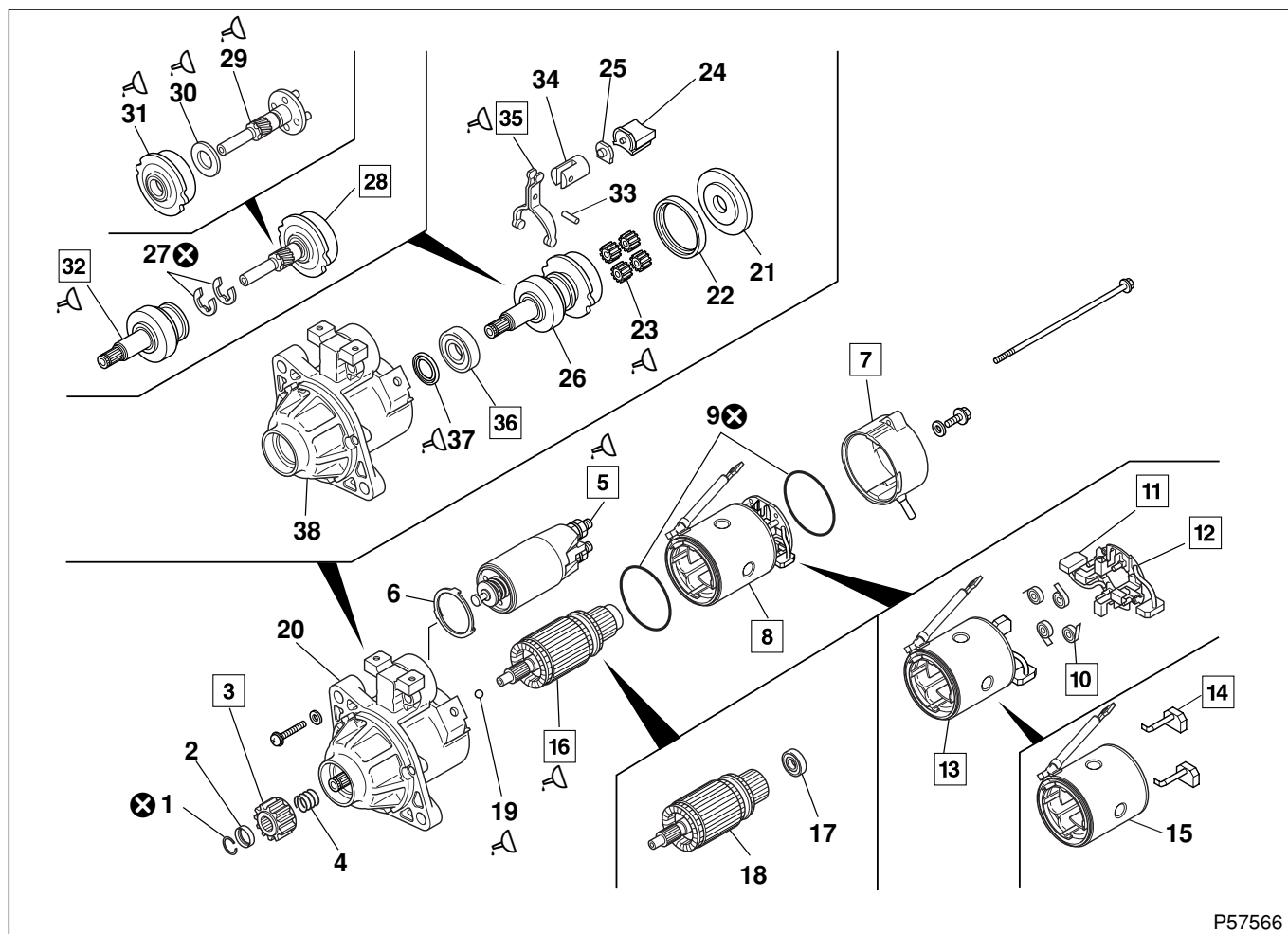


- To prevent the interference with the air intake hose, route the starter relay harness within the range shown in the drawing.

MEMO

#930 STARTER

Starter



P57566

● Disassembly sequence

- | | | |
|----------------------------------|---|--|
| 1 Stopper ring | 15 Yoke | 28 Gear shaft and internal gear assembly |
| 2 Pinion stopper | 16 Armature assembly | 29 Gear shaft assembly |
| 3 Pinion | 17 Rear bearing | 30 Washer |
| 4 Spring | 18 Armature | 31 Internal gear |
| 5 Magnetic switch assembly | 19 Ball | 32 Overrunning clutch |
| 6 Shim | 20 Front bracket assembly | 33 Pin |
| 7 Rear bracket | 21 Cover | 34 Holder |
| 8 Yoke and brush holder assembly | 22 Rubber packing | 35 Lever |
| 9 Rubber packing | 23 Planetary gear | 36 Front bearing |
| 10 Brush spring | 24 Rubber packing | 37 Oil seal |
| 11 Brush ⊖ | 25 Plate | 38 Front bracket |
| 12 Brush holder assembly | 26 Gear shaft and overrunning clutch assembly | |
| 13 Yoke assembly | 27 E-ring | |
| 14 Brush ⊕ | | |

⊗ : Non-reusable parts

CAUTION ⚠

- Do not remove bearings 17, 36 unless they are faulty.
- Be careful not to lose ball 19, since it might come out together with armature assembly 16 when you remove it.

NOTE

- You do not have to remove pinion 3 when you disassemble or inspect only the motor assembly, for example: when inspection of the brush assembly is required.
- Except for the above, make sure you remove pinion 3 before disassembling any parts.

● **Assembly sequence**

Follow the disassembly sequence in reverse.

NOTE

Whenever magnetic switch assembly 5 has been replaced, be sure to adjust the pinion gap.

● **Inspection after assembly**

📖 P54-12-6

Service standards

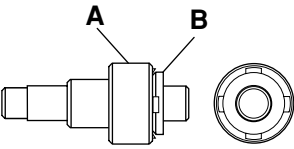
Unit : mm {in.}

Location	Maintenance item			Standard value	Limit	Remedy
—	Pinion gap			0.5 to 2.0	—	Adjust
—	No-load characteristic	With current of 11 V	Current	230 A or less	—	Inspect
			Revolutions per minute	3400 rpm or more	—	
10	Pressure of brush spring			33.0 to 45.0 N {7.4 to 10.0 lbs, 3.4 to 4.6}	17.7 N {4.0 lbs, 1.8 kgf}	Replace
11, 14	Length of brush			18 {0.71}	11 {0.43}	Replace
16	Outer diameter of commutator			38.7 {1.52}	38.1 {1.50}	Replace
	Deflection of commutator periphery			—	0.1 {0.0039} or more	Replace
	Mica depth between segments			—	0.2 {0.0079} or less	Correct or replace

🔧 **Lubricant**

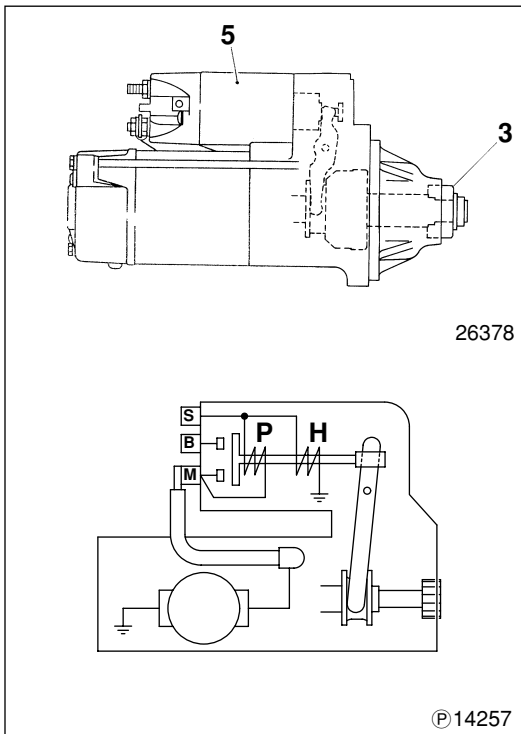
Location	Points of application	Specified lubricant	Quantity
5	Lever contact surface of magnetic switch assembly	Multipurpose grease [NLGI No.2 (Li soap)]	As required
16	Teeth of armature assembly gear and shaft	MOLYKOTE AG650	As required
16, 29	Sliding surface of armature assembly and gear shaft assembly	MOLYKOTE AG650	As required
19	Ball	MOLYKOTE AG650	As required
23, 31	Teeth of internal gear and planetary gear	MOLYKOTE AG650	As required
29, 32	Friction surfaces of gear shaft assembly and overrunning clutch	Multipurpose grease [NLGI No.2 (Li soap)]	As required
30	Washer	MOLYKOTE AG650	As required
32	Spline of overrunning clutch	Multipurpose grease [NLGI No.2 (Li soap)]	As required
35	Friction surfaces of lever and overrunning clutch	Multipurpose grease [NLGI No.2 (Li soap)]	As required
37	Oil Seal	Multipurpose grease [NLGI No.2 (Li soap)]	As required

🔧 **Special tools**

Location	Tool name and shape	Part No.	Application
36	Bearing remover and installer  A: Bearing remover and installer B: Bearing installer	MH063597 A: MH063615 B: MH063619	Removal and installation of front bearing

P50804

#930 STARTER



◆ Service procedure

● Inspection after assembly

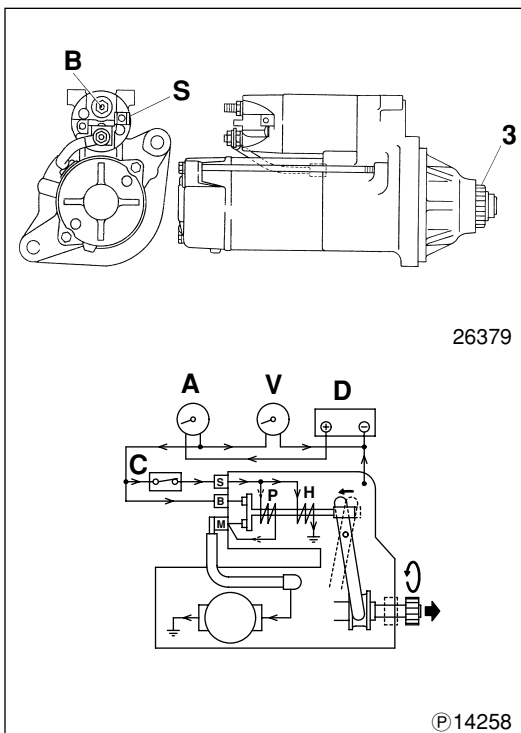
Inspection after assembling the starter should be carried out with current fed to the starter.

WARNING ⚠

- Do not touch pinion 3 because it jumps out and turns when current is fed to the starter.
- Take care not to burn your hand, magnetic switch assembly 5 might be hot during inspection.

CAUTION ⚠

- The current feeding time to the starter should be within 10 seconds at pull-in coil P side and within 30 seconds at holding coil H side. If the current feeding time exceeds these limits the coil might burn due to overheating.
- The current, when fed to the starter, is over 100 amperes. When inspecting, use thick cable, such as a booster cable, and make secure connections.



(1) Performance test

- Connect the starter as shown.

A : Ammeter

D : 12 volts DC

B : Terminal B of starter

S : Terminal S of starter

C : Switch

V : Voltmeter

- Set the voltage to 11 volts DC.

CAUTION ⚠

Up to 12 volts can be loaded.

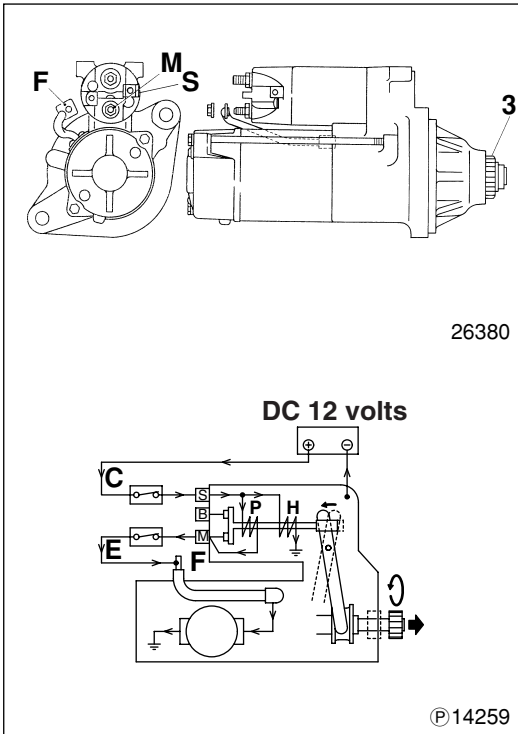
- The following work should be done with current fed to the starter. You must complete measurement of the current and the number of revolutions within 30 seconds.
- Turn switch C ON and feed current to the starter. In this state, pinion 3 jumps out and rotates.

CAUTION ⚠

When switch C is turned ON, current is fed both to pull-in coil P and holding coil H. When a large amount of current is fed into terminal M from DC power supply D, via terminal B of the starter, the current stops flowing into the pull-in coil but continues to flow into the holding coil.

To avoid burning the holding coil, be sure to carry out the performance test within 30 seconds.

- Measure the current and the number of revolutions of the starter. Train a strobe light on pinion 3 to measure the number of revolutions.
- Turn switch C OFF to stop current to the starter.
- If the measured value deviates from the standard value, disassemble the starter again and inspect it.



(2) Pinion gap

[Inspection]

- Connect the starter as shown.

C : Switch

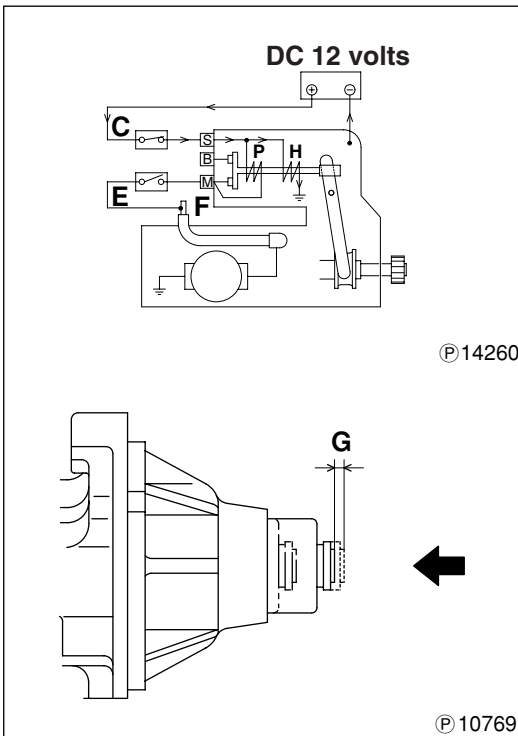
M : Terminal M of starter

E : Switch

S : Terminal S of starter

F : Cable

- The following work should be done with current fed to the starter. You must complete measurement of the pinion gap within 30 seconds.
- Turn switches **C** and **E** ON and feed current to the starter. In this state, pinion **3** jumps out and rotates.



- Within 5 seconds of pinion **3** rotating, turn switch **E** OFF to stop rotation of the pinion.

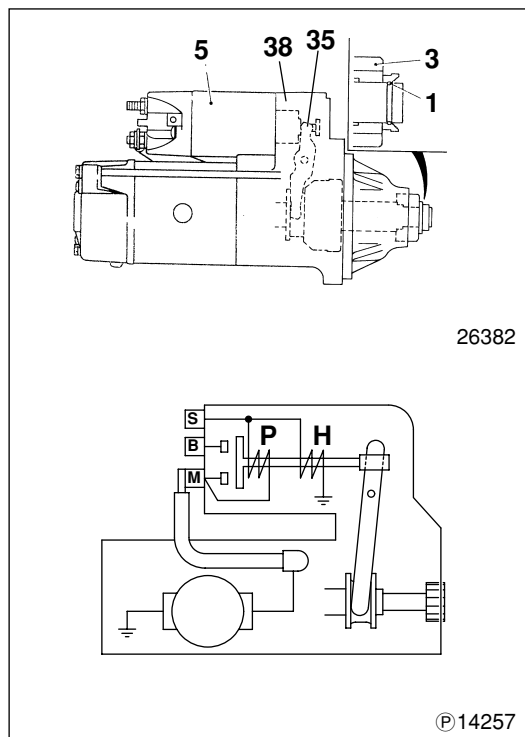
CAUTION

When switches **C** and **E** are turned ON, current is fed both to pull-in coil **P** and holding coil **H**. The circuit is wired in such a way that the voltage is not applied to terminal **B** of the starter, so the current continues to flow into the pull-in coil while pinion **3** rotates.

To avoid burning the pull-in coil, be sure to turn switch **E** OFF within 5 seconds of the pinion rotating.

- Hold the end of overrunning clutch **32** with fingers, and pull it. Measure the distance **G** (pinion gap) in the shaft direction that the overrunning clutch moves when it is lightly pushed back by hand.
- Turn switch **C** OFF to stop current to the starter.
- If the measured value deviates from the standard value, replace lever **35**.

#930 STARTER



3 Pinion

[Removal]

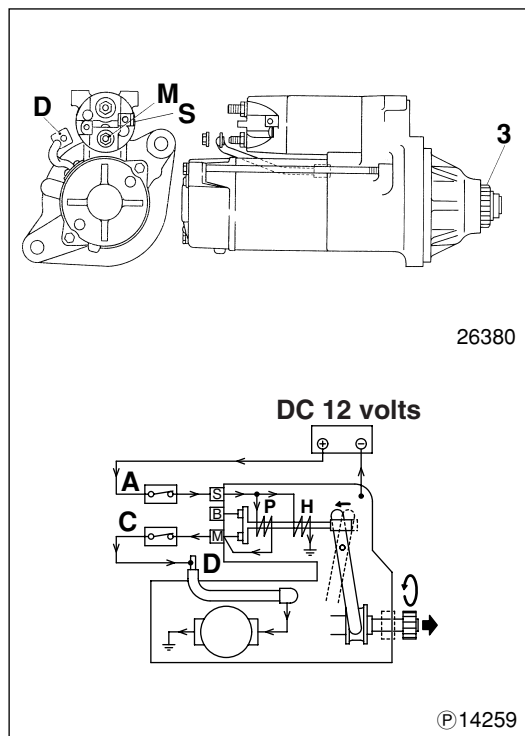
Feed current to the starter and protrude pinion 3 to remove the pinion.

WARNING ⚠

- Do not touch pinion 3 because it jumps out and turns when current is fed to the starter.
- Take care not to burn your hand, magnetic switch assembly 5 might be hot after inspection.

CAUTION ⚠

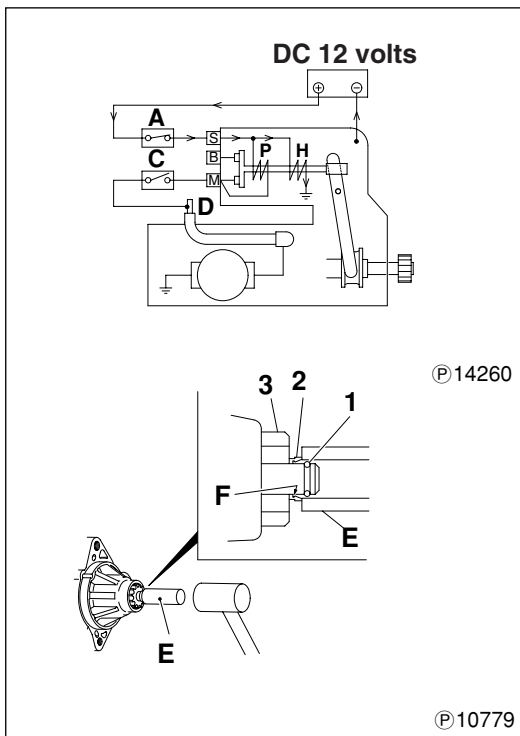
- The current feeding time to the starter should be within 10 seconds at pull-in coil P side and within 30 seconds at holding coil H side. If the current feeding time exceeds these limits, the coil might burn due to overheating.
- Before making pinion 3 jump out, be sure to feed current to the starter to obtain the correct state. If current is not fed to the starter and lever 35 is pulled to protrude the pinion, front bracket 38 or the lever might be damaged due to the shock produced on removal of stopper ring 1.
- The current, when fed to the starter, is over 100 amperes. When inspecting, use thick cable, such as a booster cable, and make secure connections.



- Connect the starter as shown.

A : Switch **M** : Terminal M of starter
C : Switch **S** : Terminal S of starter
D : Cable

- The following work should be done with current fed to the starter. You must complete removal of pinion 3 within 30 seconds.
 - Turn switches **A** and **C** ON and feed current to the starter. In this state, pinion 3 jumps out and rotates.



- Within 5 seconds of pinion **3** rotating, turn switch **C** OFF to stop rotation of the pinion.

CAUTION

When switches **A** and **C** are turned ON, current is fed both to pull-in coil **P** and holding coil **H**. The circuit is wired in such a way that the voltage is not applied to terminal **B** of the starter, so the current continues to flow into the pull-in coil while pinion **3** rotates.

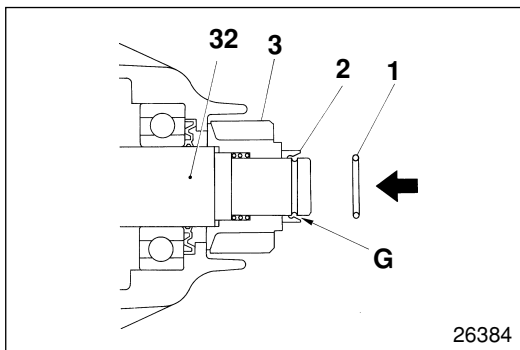
To avoid burning pull-in coil **P**, be sure to turn switch **C** OFF within 5 seconds after the pinion rotates.

- Apply pipe-shaped tool **E** onto pinion stopper **2**.
- Hit tool **E** lightly using a mallet to remove stopper ring **1** from ring groove **F** of pinion stopper **2**.
- Remove stopper ring **1** and pinion **3**.
- Turn switch **A** OFF to stop current to the starter.

NOTE

When the current to the starter is stopped, stopper ring **1** might fall back into ring groove **F** of pinion stopper **2** because pinion **3** is pushed inside.

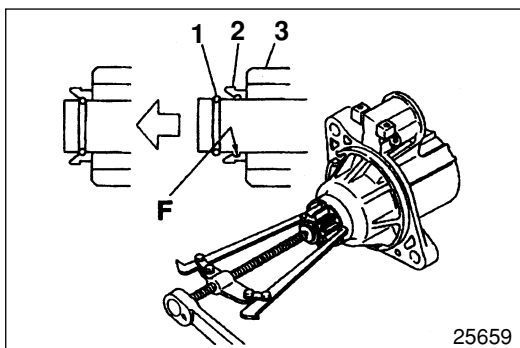
If this occurs, feed current to the starter again and carry out the work.



[Installation]

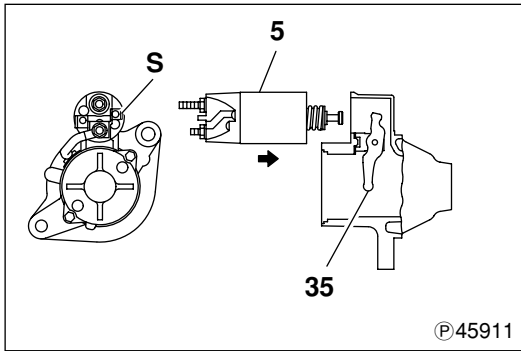
When installing pinion **3**, it is not necessary to feed current to the starter.

- Install pinion stopper **2** and pinion **3** onto overrunning clutch **32** in the direction as shown.
- Fit stopper ring **1** into ring groove **G** of overrunning clutch **32**.



- Pull pinion **3** firmly and set stopper ring **1** on groove **F** of pinion stopper **2** securely.

#930 STARTER



5 Magnetic switch assembly

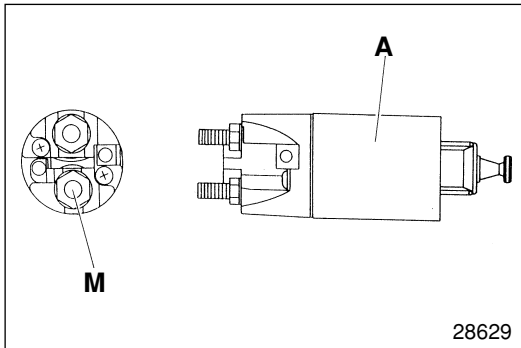
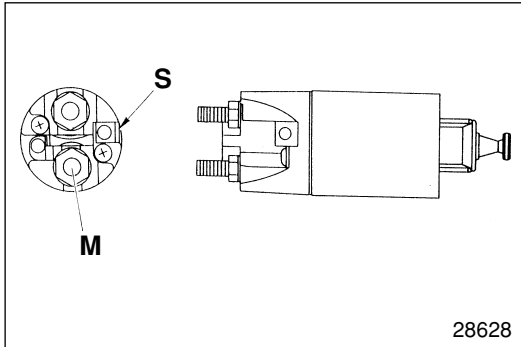
[Installation]

Install magnetic switch assembly 5 to lever 35, with terminal S facing the direction as shown.

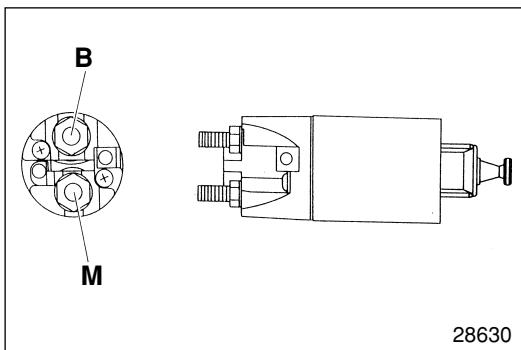
[Inspection]

(1) Testing for coil breakage

- Make sure that there is continuity between terminals S and M.
- If there is no continuity, replace magnetic switch assembly 5.

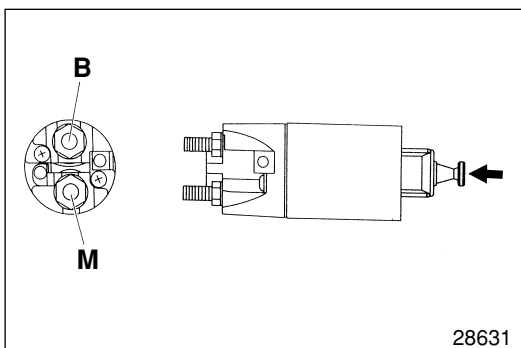


- Make sure that there is continuity between terminal M and body A.
- If there is no continuity, replace magnetic switch assembly 5.



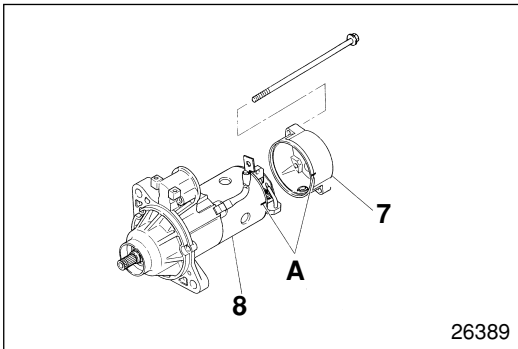
(2) Inspection of welded connections

- Make sure that there is no continuity between terminals B and M.
- If there is continuity, replace magnetic switch assembly 5.



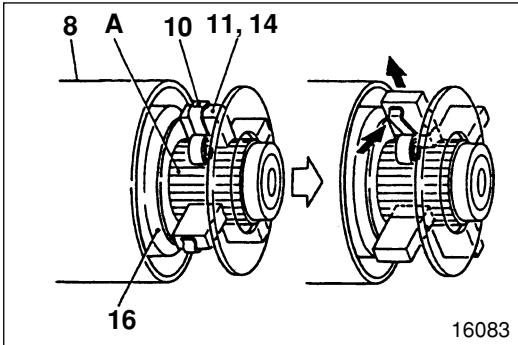
(3) Inspection of connections

- Push the tip of magnetic switch assembly 5 to close the internal connection.
Make sure that there is continuity between terminals B and M.
- If there is no continuity, replace magnetic switch assembly 5.



7 Installation of rear bracket

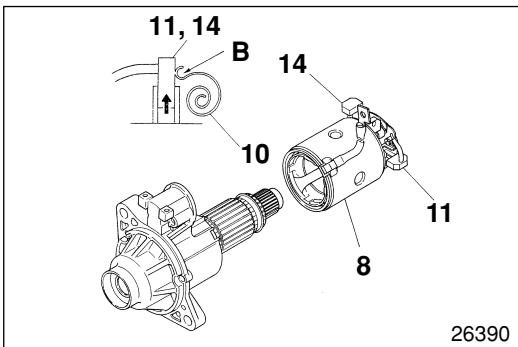
A : Alignment mark



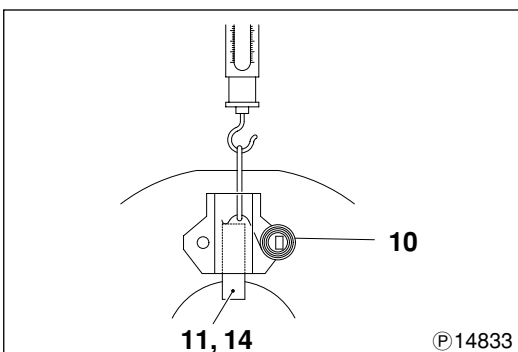
8 Removal and installation of yoke and brush holder assembly

Use the following method to remove the yoke and brush holder assembly **8** in order to prevent the commutator **A** of the armature assembly **16** from being damaged by the brushes **11** and **14**.

- Lift the brushes **11** and **14** away from the commutator **A** and hold them lifted by applying the brush springs **10** against the sides of the brush.

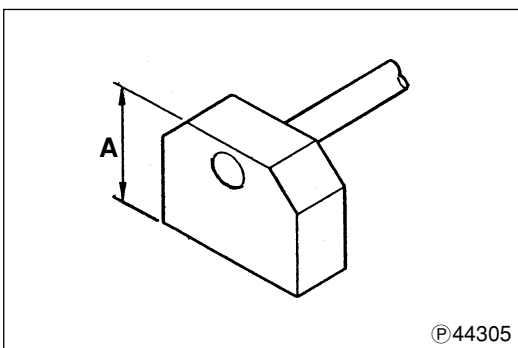


- Pull part **B** of each brush spring **10** and pull up the brushes **11** and **14**.
- Hold the brushes **11** and **14** in position with brush spring **10** as shown.
- Remove yoke and brush holder assembly **8**.
- To reinstall the yoke and brush holder assembly **8**, follow the removal instructions in reverse.



10 Inspection of brush spring

- Use new brushes **11**, **14** and measure the load when brush spring **10** is detached from the brushes.
- If the measured value is lower than the limit, replace brush spring **10**.



11 14 Inspection of brush

(1) Length of brush

If the measured value **A** is lower than the limit, replace brushes **11**, **14**.

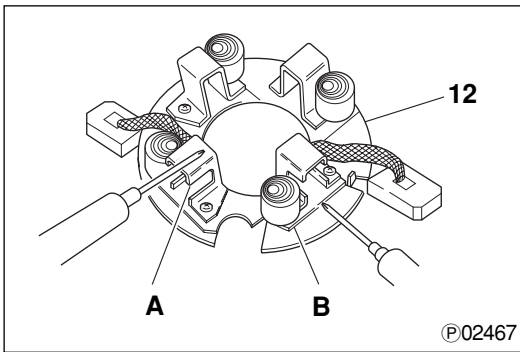
NOTE

To replace brush $\ominus$ 11, replace entire brush holder assembly **12**.

(2) Contact surface with commutator

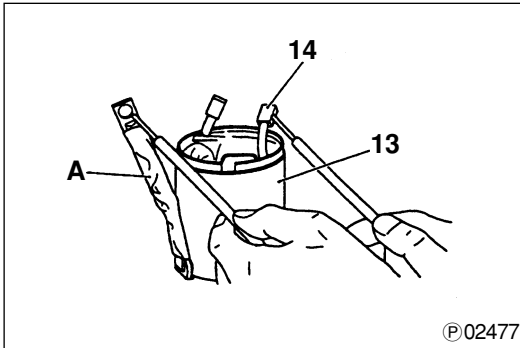
If the surface where the brushes contact the commutator is rough or is worn unevenly, polish the surface with emery paper (300 to 500 grit)

#930 STARTER



12 Inspection of brush holder assembly

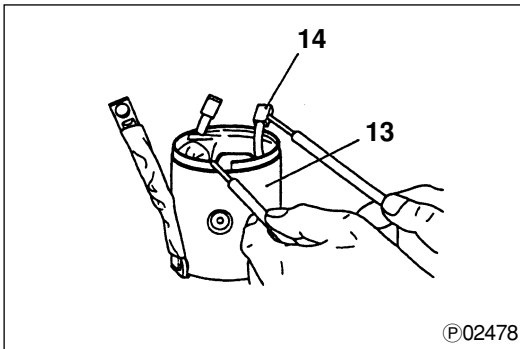
- Cleaning the brush holder **A** and holder plate **B**.
- Make sure that there is no continuity between the $\oplus$ side of the brush holder **A** and the $\ominus$ side of the holder plate **B**.
- If there is continuity between them, they are short-circuited. Replace brush holder assembly **12**.



13 Inspection of yoke assembly

(1) Testing for coil breakage

- Make sure that there is continuity between cable **A** and brush $\oplus$ **14**.
- If there is no continuity, they are broken. Replace brush $\oplus$ **14** or yoke assembly **13**.

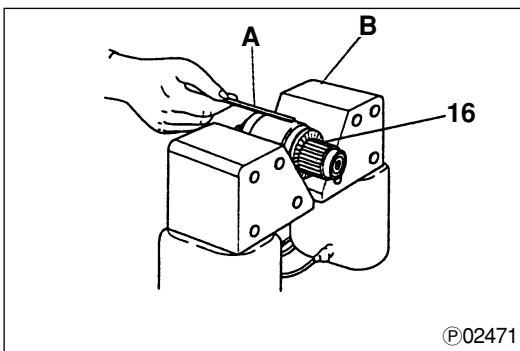


(2) Testing for coil grounding

- Make sure that there is no continuity between yoke assembly **13** and brush $\oplus$ **14**.
- If there is continuity, they are short-circuited. Inspect the insulated point. If it is hard to repair, replace brush $\oplus$ **14** or yoke assembly **13**.

NOTE

The coil may be short-circuited to the yoke assembly **13** due to the accumulation of worn-off metal particles from the brushes and/or armature.



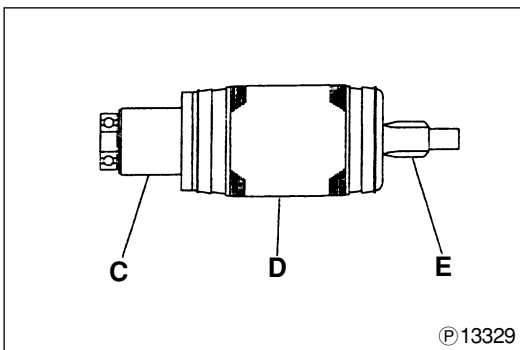
16 Inspection of armature assembly

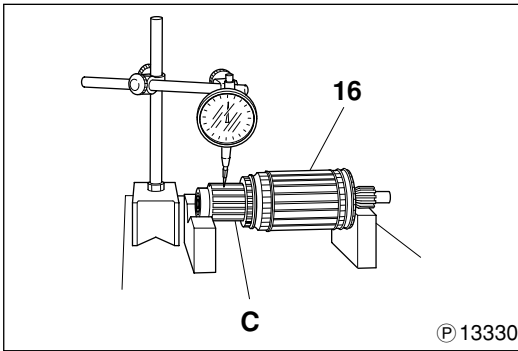
(1) Testing for coil short-circuit

- Hold an iron rod **A** parallel with the armature assembly **16**.
- **B** : Armature tester
- Slowly rotate the armature assembly **16** by hand.
- If the iron rod **A** vibrates or is pulled toward the armature assembly **16**, the coil is short-circuited and the armature assembly must be replaced.

(2) Testing for coil grounding

- Make sure that there is no continuity between commutator **C** and core **D** (or shaft **E**).
- If there is continuity between them, they are short-circuited. Replace armature assembly **16**.



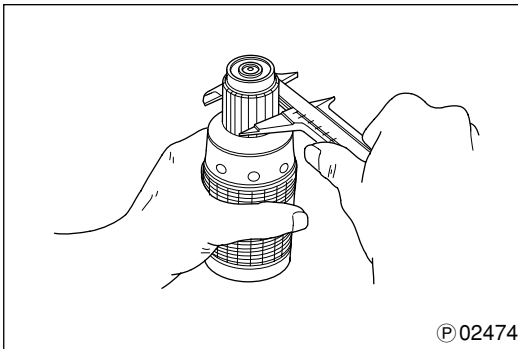


(3) Deflection of commutator

If the measured value is higher than the limit, correct the outer diameter of commutator **C** within the limit.

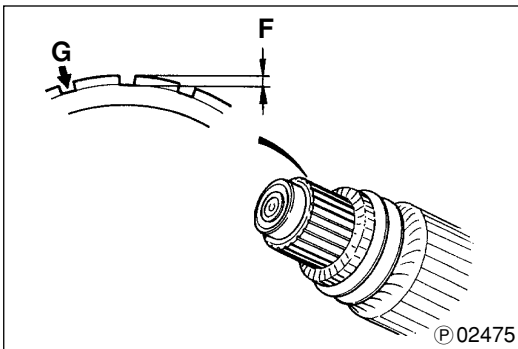
(4) Condition of the surface of commutator

- If the surface is rough or has stepped wear, polish the surface with emery paper (300 to 500 grit).
- After polishing, check deflection of commutator **C**.



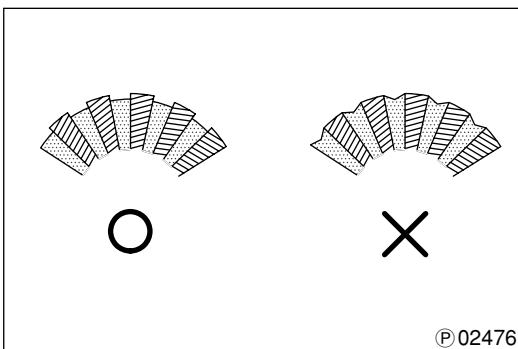
(5) Outer diameter of commutator

If the measured value is higher than the limit, replace armature assembly **16**.



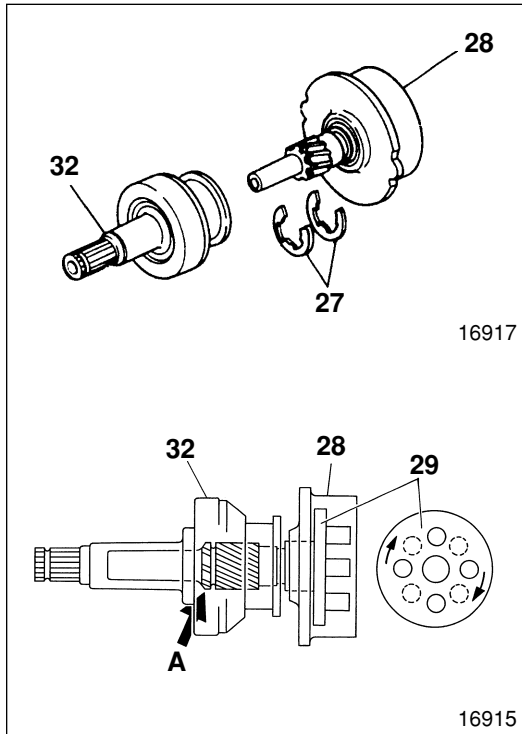
(6) Mold depth between segments

- If the measured value is lower than the limit, replace armature assembly **16**.
F : Mold depth
- To rectify the armature assembly **16**, grind the shown portions **G**.



- If the mold is worn as shown, correct or replace armature assembly **16**.
 ○ : Good
 × : Faulty

#930 STARTER

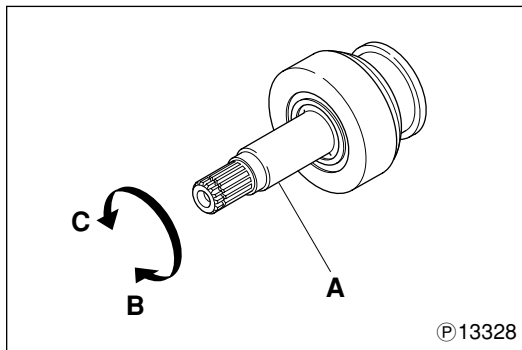


28 Removal of gear shaft and internal gear assembly

Remove the E-rings **27** and then the gear shaft and internal gear assembly **28** from the overrunning clutch **32**.

Proceed as follows if the gear shaft and internal gear assembly **28** cannot be removed due to interference of the splined section **A** of gear shaft assembly **29** with internal parts of the overrunning clutch **32**.

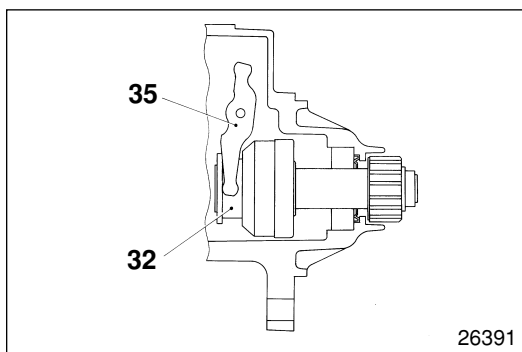
- Press the gear shaft assembly **29** against the overrunning clutch **32**.
- Turn the gear shaft assembly **29** approx. 1/8 of a turn to change the position of splined section **A**.



32 Inspection of overrunning clutch

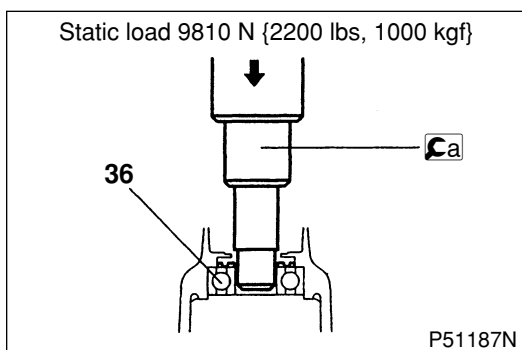
Perform the following checks, and if any fault is found, replace the overrunning clutch **32**.

- Make sure that shaft **A** turns smoothly when turned in direction **B**.
- Make sure that shaft **A** locks when turned in direction **C**.



35 Installation of lever

Install lever **35** onto overrunning clutch **32** in the direction as shown.

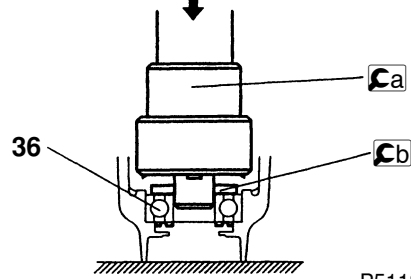


36 Front bearing

[Removal]

Ca: Bearing remover and installer

Static load 9810 N {2200 lbs, 1000 kgf}

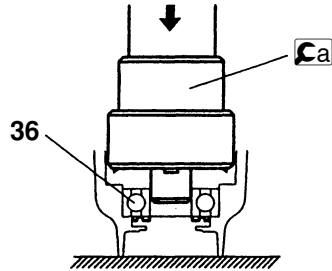


P51188N

[Installation]

-  **Ca**: Bearing remover and installer
-  **Cb**: Bearing installer

Dynamic load 29420 N {6610 lbs, 3000 kgf}



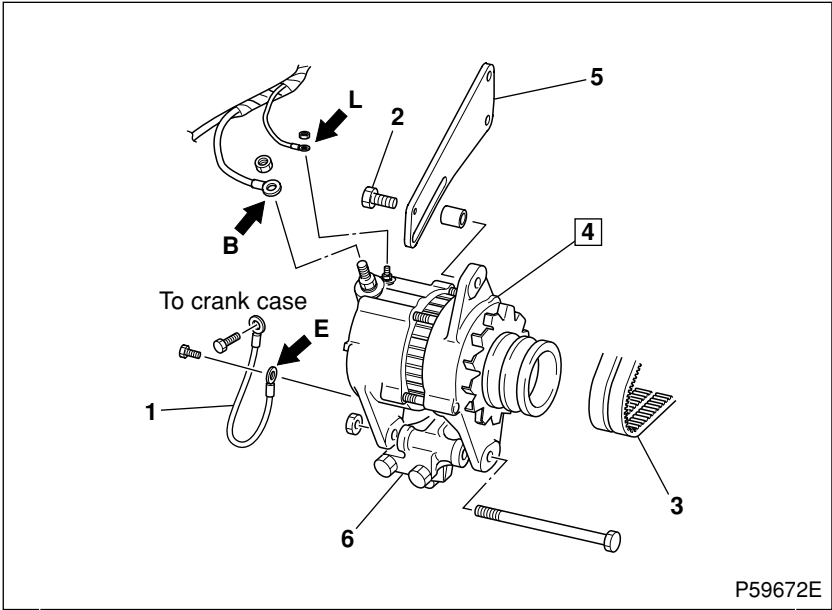
P51189N

-  **Ca**: Bearing remover and installer

CAUTION

Avoid re-caulking previously caulked points.

#940 ALTERNATOR



● Removal sequence

- 1 Chassis harness
- 2 Adjusting bolt
- 3 V-belts
- 4 Alternator P54-12-18
- 5 Adjusting plate
- 6 Alternator bracket

B : To terminal B
E : To terminal E
L : To terminal L

WARNING

To prevent possible injury, be sure to disconnect the negative terminal $\ominus$ of the battery and insulate it with tape before removing alternator 4.

With the negative terminal $\ominus$ of the battery connected, battery voltage is always applied to the terminal B.

● Installation sequence

Follow the removal sequence in reverse.

● Adjustment after installation

For adjustment of V-belt 3 tension Gr 14

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
4	Alternator output current (*When alternator is hot and producing 13.5 V) at 25°C {77°F}	At 1000 rpm	Approximately 20 A	—	Inspect
		At 2000 rpm	Approximately 80 A	—	
		At 3500 rpm	Approximately 100 A	—	
	Adjustment voltage of regulator (At 5000 rpm, 10 A is loaded) at 25°C {77°F}		14.2±0.2 V	—	Replace

* The hot condition is the one after the alternator has been run at normal ambient temperature with 5000 rpm and maximum output for 30 minutes.

◆ Service procedure

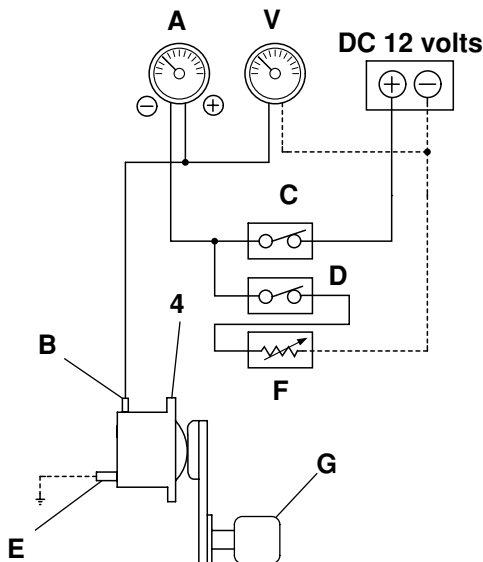
4 Inspection of alternator

(1) Alternator performance check (bench test)

- Connect the alternator **4** as shown.

CAUTION

Sufficiently thick wires should be used for wiring and each connection should be securely fastened.



⒫ 36697

- A : Ammeter
- B : Alternator terminal B
- C : Switch
- D : Switch
- E : Alternator terminal E
- F : Load resistance (variable resistance)
- G : Alternator drive motor
- V : Voltmeter

- Increase load resistance **F** to the maximum (condition which the load current hardly flow).
- Turn switches **C** and **D** ON.
- Run alternator at 5000 rpm for 30 minutes by adjusting load resistance **F** so that electric current can conform to the specified standard.

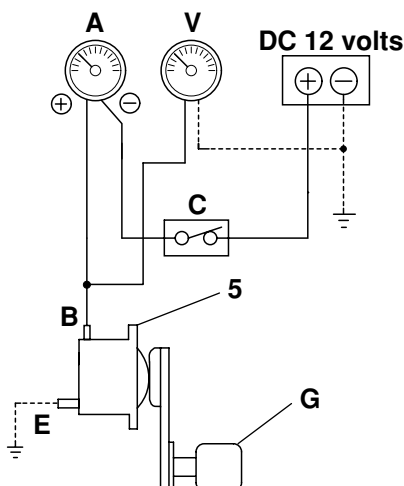
Alternator nominal current

12V-100A

- Measure the current at each specified revolution of alternator **4**.
- If the measured value deviates from the standard value, disassemble and check alternator **4**.  P54-12-18

(2) Regulator performance check (bench test)

- Connect the alternator **4** as shown.

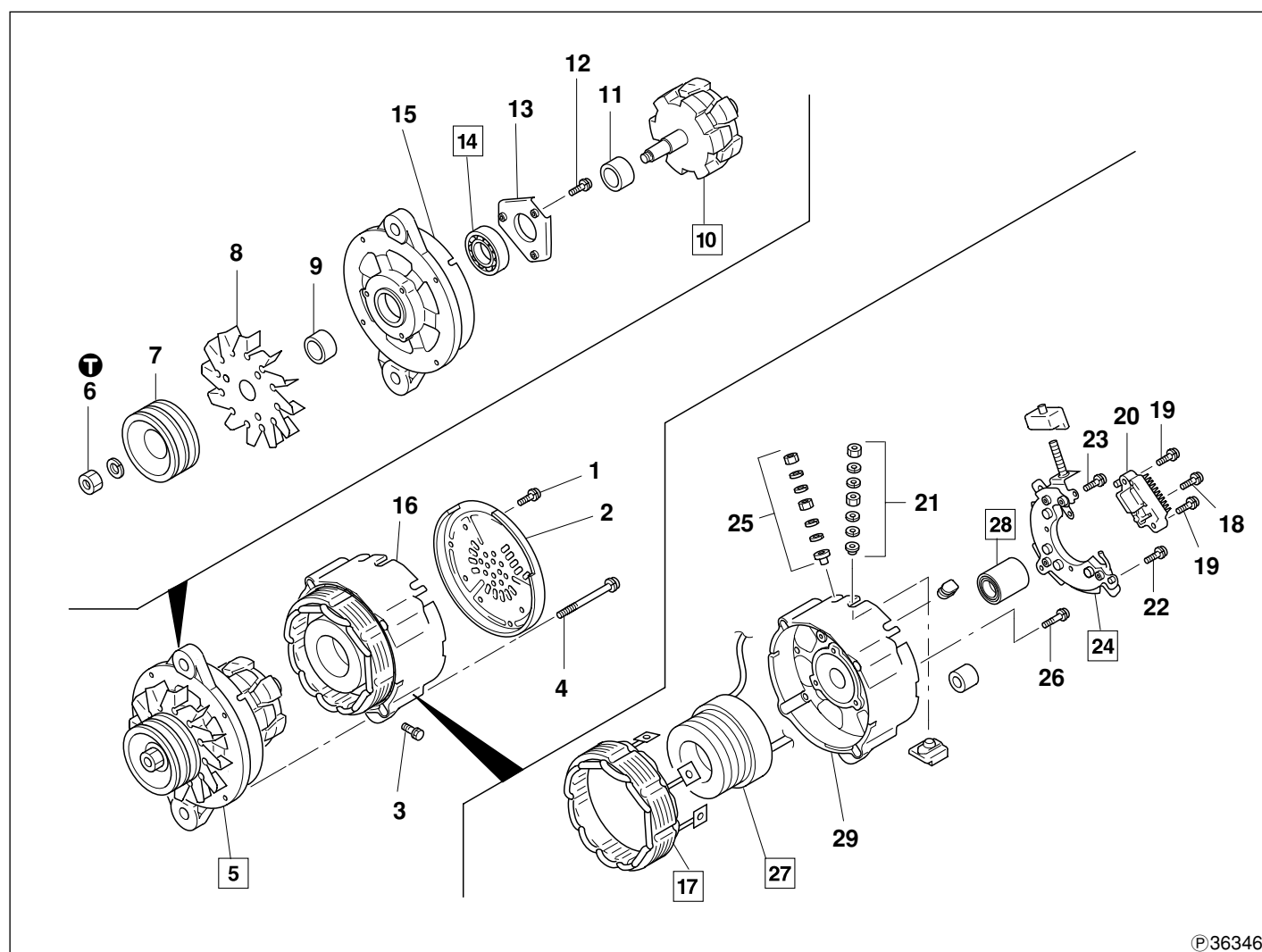


⒫ 36698

- A : Ammeter
- B : Alternator terminal B
- C : Switch
- E : Alternator terminal E
- G : Alternator drive motor
- V : Voltmeter

- Turn switches **C** ON.
- Run alternator **4** at low speeds.
- Increase the speed of alternator **4** to 5000 rpm and measure the voltage (adjustment voltage) at this speed. At the same time, make sure that the current is 10 amperes or less at 5000 rpm.
- If the measured value deviates from the standard value, do as follows:
 - If higher than the standard value: Replace the regulator.
 - If follow than the standard value: Inspect the alternator related parts before replacing the regulator.

#940 ALTERNATOR



©36346

● Disassembly sequence

- | | | |
|------------------------|------------------------|------------------|
| 1 Screw | 11 Collar | 21 Terminal L |
| 2 Rear cover | 12 Screw | 22 Screw |
| 3 Screw | 13 Bearing cover | 23 Screw |
| 4 Bolt | 14 Front bearing | 24 Rectifier |
| 5 Drive frame assembly | 15 Drive frame | 25 Terminal B |
| 6 Nut | 16 Rear frame assembly | 26 Screw |
| 7 Pulley | 17 Stator | 27 Exciting coil |
| 8 Fan | 18 Screw | 28 Rear bearing |
| 9 Collar | 19 Screw | 29 Rear frame |
| 10 Rotor | 20 Regulator | |

NOTE

Do not remove parts 14, 28 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
10	Outer diameter of the portion that presses into the front bearing	25.00 to 25.01 {0.9842 to 0.9846}	24.99 {0.9838}	Replace
	Outer diameter of the portion that presses into the rear bearing	16.99 to 17.00 {0.6689 to 0.6693}	16.98 {0.6685}	
	Outer diameter of the portion that joins with the pulley	22.189 to 22.202 {0.8735 to 0.8741}	22.18 {0.8732}	
17	Resistance between the coil outlet terminals	0.01 to 0.10 Ω	—	Replace
	Resistance between the coil outlet terminal and core	1M Ω min.	—	
27	Resistance between the coil outlet terminal	2 to 3 Ω	—	Replace

T Tightening torque

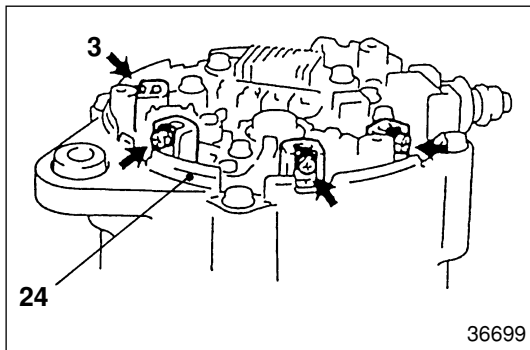
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Nut (Pulley mounting)	117.6 to 137.2 {26 to 31, 12 to 14}	—

◆ Service procedure

5 Drive frame assembly

Remove screw **3** and separate the stator **17** outlet terminal and the rectifier **24**.



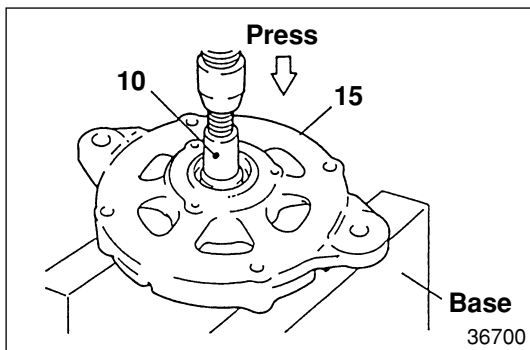
10 Rotor

[Removal]

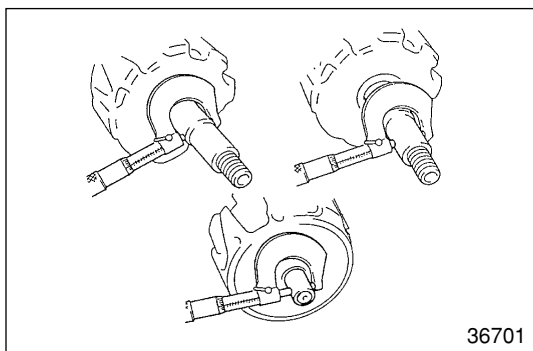
Using a press, remove the rotor **10** from the drive frame **15**.

CAUTION ⚠

Do not drop the rotor **10**.

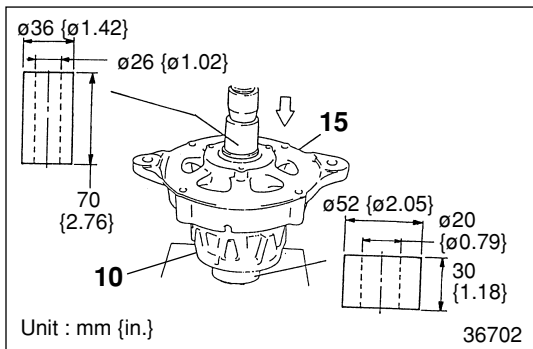


#940 ALTERNATOR



[Inspection]

- Measure the outer diameter of the portion as shown.
- If the measured value deviates from the standard value, replace the rotor **10**.

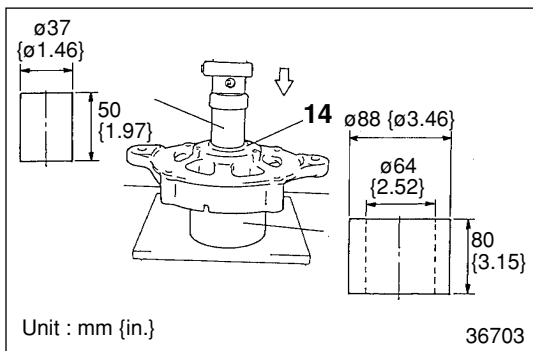


[Installation]

Using a press, press the rotor **10** into the bearing in the drive frame **15**.

CAUTION

Press the rotor **10** while making sure that the rotor's shaft is perpendicular to the bearing. During pressing, make sure not to damage the portion of the rotor **10** that presses into the rear bearing **28**.



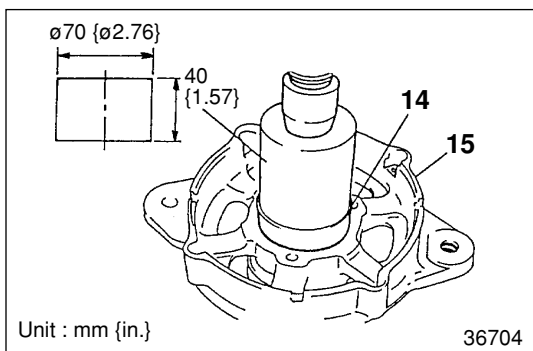
14 Front bearing

[Removal]

Using a press, remove the front bearing **14** from the drive frame **15**.

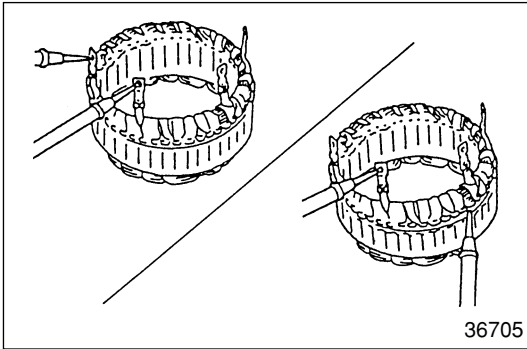
CAUTION

Do not drop the front bearing **14**.



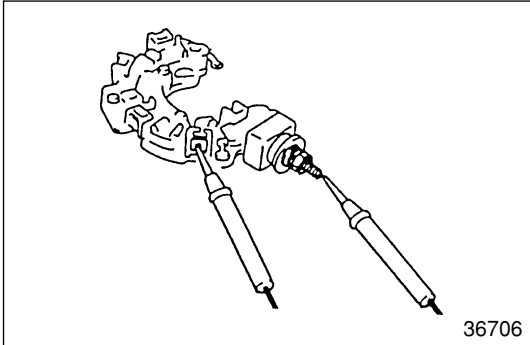
[Installation]

Using a press, press the front bearing **14** into the drive frame **15**.



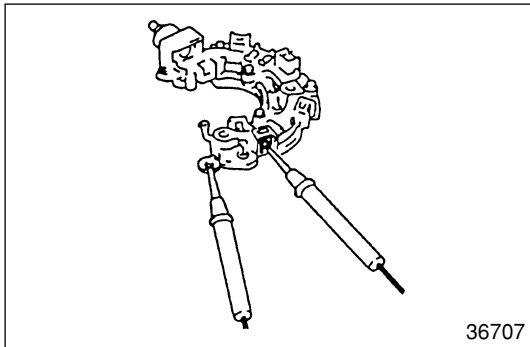
17 Inspection of stator

- Measure the resistance between the coil outlet terminals. (using a circuit tester)
- Measure the resistance between the coil outlet terminal and core. (using a megger tester)
- If the measured value deviates from the standard value, replace the stator **17**.

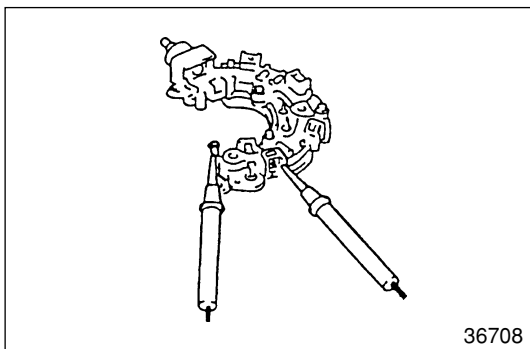


24 Inspection of rectifier

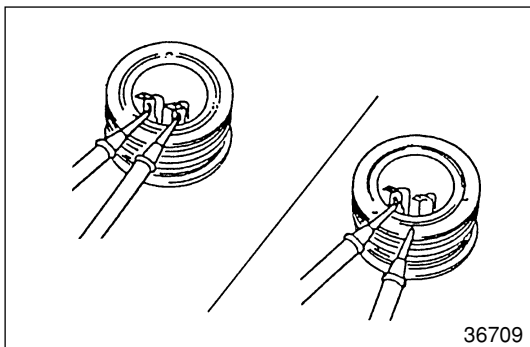
- Check for continuity between the terminal **B** and the heat sink.
- When polarity is changed, there is continuity in one direction but not in the opposite direction.



- Check for continuity between the terminal $\ominus$ and the heat sink.
- When polarity is changed, there is continuity in one direction but not in the opposite direction.



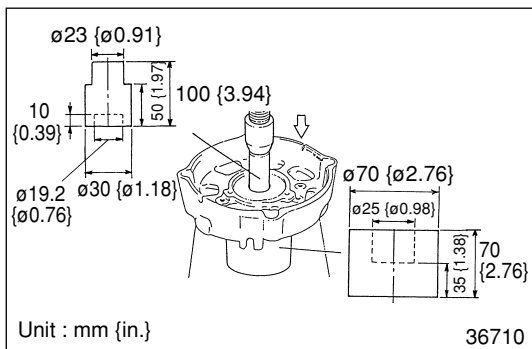
- Check for continuity between the auxiliary diode terminal and the heat sink.
- When polarity is changed, there is continuity in one direction but not in the opposite direction.



27 Inspection of exciting coil

- Measure the resistance between the coil outlet terminal. (using a circuit tester)
- Measure the resistance between the coil outlet terminal and core.
- If the measured value deviates from the standard value, replace the exciting coil **27**.

#940 ALTERNATOR



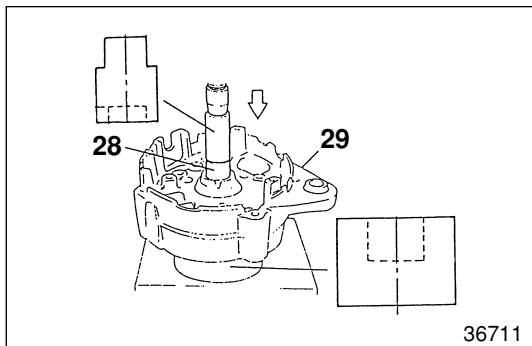
28 Rear bearing

[Removal]

Using a press, remove the rear bearing **28** from the rear frame **29**.

CAUTION ⚠

Do not drop the rear bearing **28**.

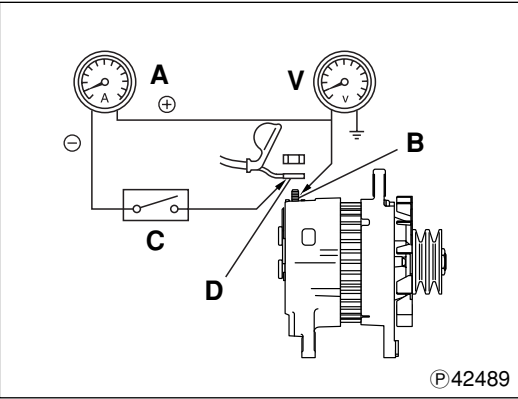


[Installation]

Using a press, press a new rear bearing **28** into the rear frame **29**.

CAUTION ⚠

Once a bearing is removed, do not reuse it.



Performance test

- Connect the meters to the alternator as shown.

- A : Ammeter (100 amperes class)
- B : Alternator terminal B
- C : Switch
- D : Terminal
- V : Voltmeter

WARNING ⚠

- To prevent possible injury, be sure to disconnect the negative terminal of the battery and insulate it with tape before working on the wiring. With the negative terminal ⊖ of the battery connected, battery voltage is always applied to the terminal B.
- To connect to switch C, use a lead wire with the same or larger diameter than that of the chassis harness connected to terminal B.

- Turn on switch C and make sure that voltmeter V indicates battery voltage.
- Start the engine.
- Immediately turn on the switches for all lamps on the vehicle.
- Immediately accelerate the engine to the speed indicated below and measure the alternator's output current.

Engine speed	Approx. 2400 rpm
--------------	------------------

- The alternator is considered to be good if the measured value is 70% or more of the nominal output current.

Alternator nominal output

Voltage	Output current
12V	100A

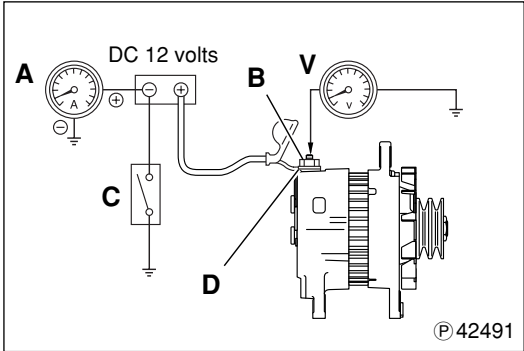
NOTE

The on-vehicle inspection is only a simplified check. Use a test bench for accurate checking. 📖 #940

#951 INSPECTION OF REGULATOR

Service standards

Location	Check item	Standard value	Limit	Remedy
—	Regulator adjusting voltage	14.2±0.2V	—	Replace



- Connect the meters to the alternator as shown.

A : Ammeter (100 amperes class)
B : Alternator terminal B
C : Switch
D : Terminal
V : Voltmeter

WARNING ⚠

- To prevent possible injury, be sure to disconnect the negative terminal of the battery and insulate it with tape before working on the wiring. With the negative terminal ⊖ of the battery connected, battery voltage is always applied to the terminal B.
- To connect to switch C, use a lead wire with the same or larger diameter than that of the chassis harness connected to terminal B.

- Turn off the switches for lamps, heater, etc. so that electric loads may not be applied during the inspection.
- Turn on switch C and then start the engine.
- If the output current is 10 amperes or less when the engine speed is raised to the appropriate speed indicated below, then measure the voltage at terminal B.

Speed (rpm)
Approx. 2400

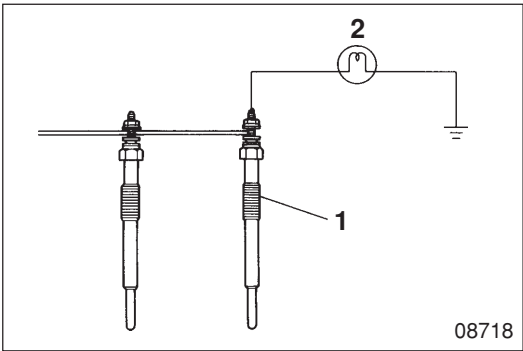
- If the output current is 10 amperes or more, do one of the following:
 - Run the engine for a while to charge the battery.
 - Replace the battery with a fully-charged one.
- If the measured value deviates from the standard value, conduct checking again on the test bench.

13 ON-VEHICLE INSPECTION AND ADJUSTMENT

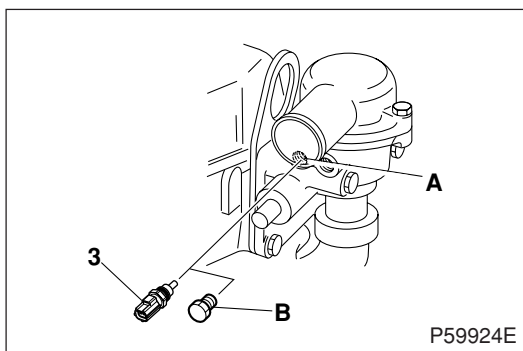
#955 INSPECTION OF PREHEATING SYSTEM

Service standards

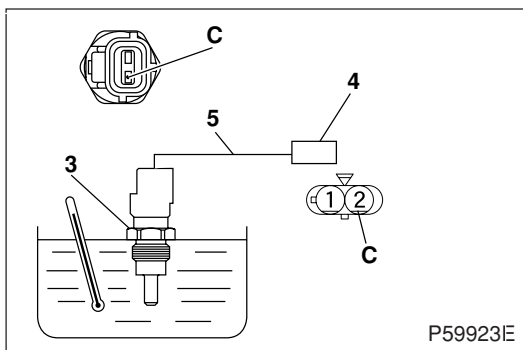
Location	Maintenance item			Standard value	Limit	Remedy
—	Pre-glow time	Coolant temperature	60°C {140°F} or more	Does not pre-glow	—	Inspect
			0 to 60°C {32 to 140°F}	About 12 seconds	—	
			0°C {32°F} or less	About 12 seconds	—	
	After-glow time	Coolant temperature	60°C {140°F} or more	Does not after-glow	—	
			0 to 60°C {32 to 140°F}	Does not after-glow	—	
			0°C {32°F} or less	About 20 seconds	—	
	Indicator lamp ON time	Coolant temperature	60°C {140°F} or more	Does not illuminate	—	
			0 to 60°C {32 to 140°F}	Does not illuminate	—	
			0°C {32°F} or less	About 8 seconds	—	



- Turn the starter switch to OFF.
- Connect a check lamp **2** to the glow plug **1** as shown.



- Remove the water temperature sensor **3** from the engine, and close the sensor mounting hole **A** with the plug **B** (M16 × 1.5 mm).
- Removal and installation of the water temperature sensor **3** Gr 14



- Connect the extension harness **5** between the water temperature sensor **3** and connector **4**.

NOTE

Connect the extension harness **5** to the terminal **C** on the Engine ECU (Engine electronic control unit).

- Put water temperature sensor **3** into a container filled with water.
- Carry out the following inspection while changing the water temperature in the container. If any fault is found, inspect each unit.

(1) Inspection of pre-glow time and indicator lamp lighting time

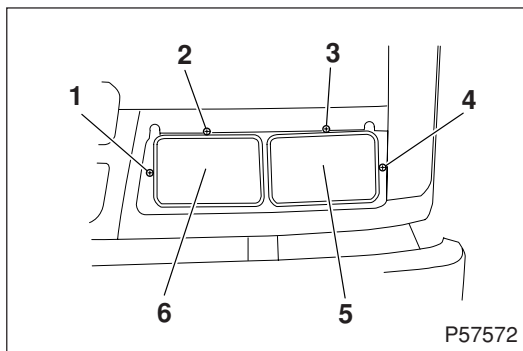
Turn the starter switch ON but do not start the engine. Make sure that the pre-glow time and the indicator lamp lighting time at each water temperature conform to the standard value.

- For pre-glow time inspection, measure the lighting time of inspection lamp **2**.
- For indicator lamp lighting time inspection, measure the lighting time of lamp within the meter cluster directly.

(2) Inspection of after-glow time

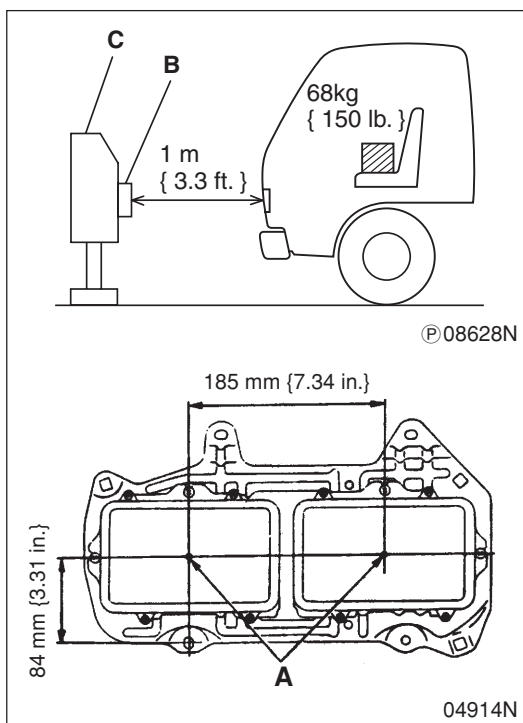
Start the engine and measure the lighting time of inspection lamp **2** from the point lamp within the meter cluster goes off, and make sure that the after-glow time conforms to the standard value.

#960 ADJUSTMENT OF HEADLAMP AIMING



- 1 Screw (Main beam, horizontal adjustment)
- 2 Screw (Main beam, vertical adjustment)
- 3 Screw (Dipped beam, vertical adjustment)
- 4 Screw (Dipped beam, horizontal adjustment)
- 5 Dipped beam
- 6 Main beam

To adjust the headlamp move the optical axis of Main beam **6** by turning screws **1, 2** and move the optical axis of Dipped beam **5** by turning screws **3, 4**. You need to adjust the aiming of both the Main and the Dipped beams on both the left and right headlamps.



(1) Preparation before adjustment

- Park the vehicle on a level place.

WARNING

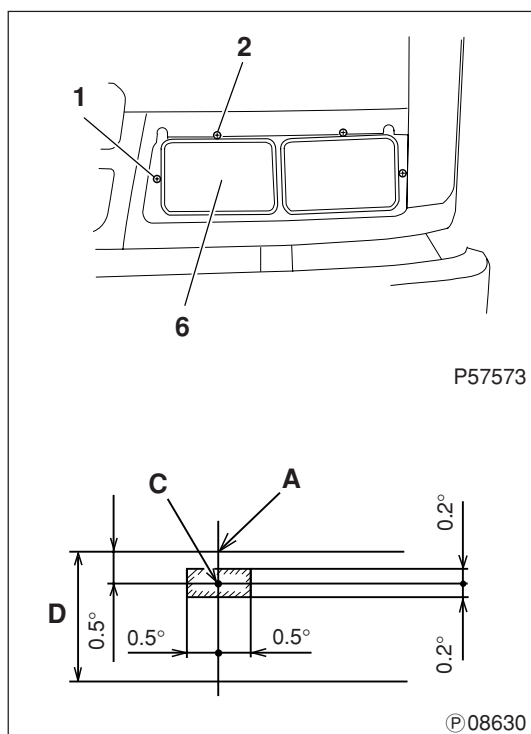
Be sure to put tire chocks securely in place.

- Unload the vehicle and make sure no one is in it.
- Inflate the tires to the specified pressure. Gr 31
- Seat one person of an equivalent mass (68 kg {150 lb.}) in the vehicle
- Start the engine and check that the battery is being charged.
- Place convergent headlamp tester **C** in line with Main beam **6** or Dipped beam **5** of either the left or right headlamp.
- Align the center of convergent lens **B** of convergent headlamp tester **C** with lamp center **A** of Main beam **6** or Dipped beam **5**. (The illustration shows a left headlamp.)
- When adjusting one headlamp, mask the other to avoid light leakage.

(2) Adjustment

WARNING

Do not mask a lit headlamp for more than 10 minutes or the heat generated might cause a fire.



● Adjustment of Main beam unit

- Turn on Main beam 6.
- Adjust as follows so that the optical axis (max luminous illumination point) **C** of Main beam 6 is located as shown:
 - Vertical adjustment: Turn screw 2 to adjust.
 - Horizontal adjustment: Turn screw 1 to adjust.

The aiming of both left and right Main beams 6 should be adjusted to the position as shown.

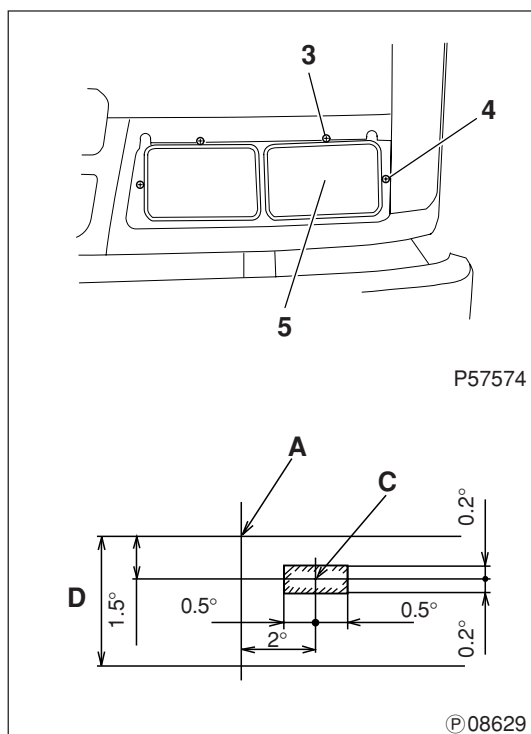
: Tolerance of adjustment

A : Center of headlamp

D : Height from the ground to headlamp center

	Adjusting direction for optical axis			
	Upward	Downward	Leftward	Rightward
Screw 1	—	—	 (Counter-clockwise)	 (Clockwise)
Screw 2	 (Clockwise)	 (Counter-clockwise)	—	—

Turning direction of the screws in the table is as viewed from the front.



● Adjustment of Dipped beam unit

- Turn on the LOW beam of Dipped beam 5.
 - Adjust as follows so that the optical axis (max luminous illumination point) **C** of Dipped beam is located as shown:
 - Vertical adjustment: Turn screw 3 to adjust.
 - Horizontal adjustment: Turn screw 4 to adjust.
- The aiming of both left and right Dipped beams 5 should be adjusted to the position as shown.

: Tolerance of adjustment

A : Center of lamp

D : Height from the ground to headlamp center

	Adjusting direction for optical axis			
	Upward	Downward	Leftward	Rightward
Screw 3	 (Clockwise)	 (Counter-clockwise)	—	—
Screw 4	—	—	 (Clockwise)	 (Counter-clockwise)

Turning direction of the screws in the table is as viewed from the front.

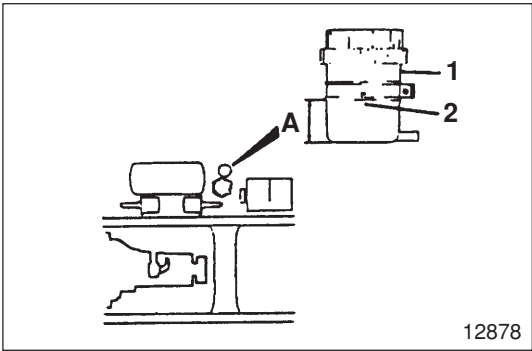
#965 INSPECTION OF BRAKE FLUID LEVEL SWITCH

< Center parking >

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Warning lamp lighting position for brake fluid level switch	$57^{+3.5}_{-0.5}$ { $2.24^{+0.14}_{-0.02}$ }	—	Replace



- Start engine.
- Drain the brake fluid gradually from fluid tank assembly 1.

CAUTION ⚠

If brake fluid is spilt on any part of the vehicle, wipe it off immediately, since the solvent in the fluid can damage the paintwork.

- Measure height **A** of brake fluid level switch **2** when  warning lamp within the meter cluster lights.
- If the measured value deviates from the standard value, remove and check fluid tank assembly 1.

Removal and installation :  Gr 35

Inspection :  #041



55A - Air Conditioner

55B - Heater

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**



Group 55A

Air-Conditioner

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	55A-2
STRUCTURE AND OPERATION	
1. Air System	55A-3
2. Refrigerating Circuit	55A-4
3. Engine Room	55A-5
4. Cabin Room	55A-6
5. Compressor	55A-7
6. Magnetic Clutch	55A-8
7. Check Valve	55A-8
8. Side Condenser Assembly	55A-9
9. Relief Valve	55A-9
10. Receiver Assembly	55A-10
11. Cooling Unit Assembly	55A-10
12. Expansion Valve	55A-11
13. Dual Pressure Switch	55A-11
14. Power Relay	55A-12
15. Air Conditioner Switch	55A-12
16. Thermostat	55A-12
17. Control System	55A-14
TROUBLESHOOTING	55A-16
ON-VEHICLE INSPECTION AND ADJUSTMENT	
1. Recovery of Refrigerant	55A-18
2. Inspection and Adjustment of V-Belt	55A-18
3. Inspection of Magnetic Clutch	55A-19
4. Charging System with Refrigerant	55A-20
5. Inspection of Refrigerant	55A-22
6. Replenishment of Refrigerant	55A-23
7. Inspection of Receiver Assembly	55A-24
CONNECTION OF AIR CONDITIONER PIPING	55A-25
COMPRESSOR AND TENSION PULLEY	55A-26
SIDE CONDENSER ASSEMBLY AND RECEIVER ASSEMBLY ..	55A-30
COOLING UNIT	55A-32
AIR-CONDITIONER CIRCUIT	55A-36

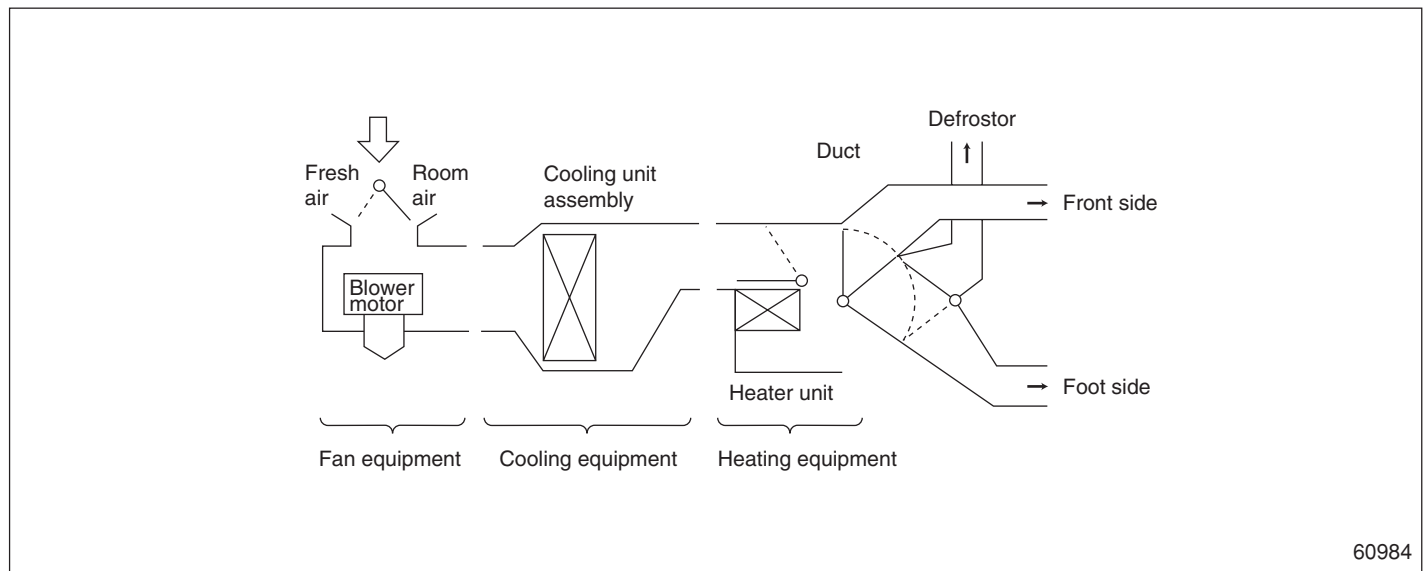
* This air-conditioner is dealer's option. When installing the air-conditioner kit in your shop, please refer to installation manual in the kit.

SPECIFICATIONS

Item		Specifications
Manufacturer		MITSUBISHI HEAVY INDU5, STRIES, LTD.
*Cooling capacity (on JIS conditions) W {BTu/h, kcal/h}		4,650 {15865, 3999}
Compressor	Model	MSC90TA
	Displacement cm ³ {cu.in., mL}	90 {5.49, 90}
	Maximum revolution min ⁻¹	MAX 9000
	Compressor oil cm ³ {cu.in., mL}	SUN PAG 56, 120 {7.32, 120}
Magnetic clutch	Type	Dry single disc magnet
	Voltage & input V, W	DC12, 45
Cooling unit assembly	Type	Laminated fin type
Controls	Air flow control	Slide switch, Four step type
	Temperature control	Electric thermostat
Condenser	Type	Corrugate fin type
Receiver assembly	cm ³ {cu.in., mL}	Cylinder type, approx 350 {21.4, 350}
Protective equipment	Frost prevention (Thermostat) °C {°F}	OFF : 1.6 {35} ON : 4.6 {40}
	Relief valve MPa {psi, kg/cm ² }	Open : 3.50 to 4.10 {505 to 595, 36 to 42} Close : 2.94 {425, 30}
	Dual pressure switch	Low pressure switch MPa {psi, kg/cm ² }
		High pressure switch MPa {psi, kg/cm ² }
	Fuse (Fan equipment) A	10
	Fuse (Magnetic clutch)	10
Refrigerant and quantity g {oz}		HFC-134a, 740 {26.1}

- The * marked cooling capacity is based on JIS conditions.
- Compressor speed : 1,800 min⁻¹
- Condensing temperature : 55°C {130°F}
- Cooling unit inlet air dry bulb temperature : 27°C {81°F}
- Cooling unit inlet air wet bulb temperature : 19.5°C {67°F}
- Terminal voltage : DC24V

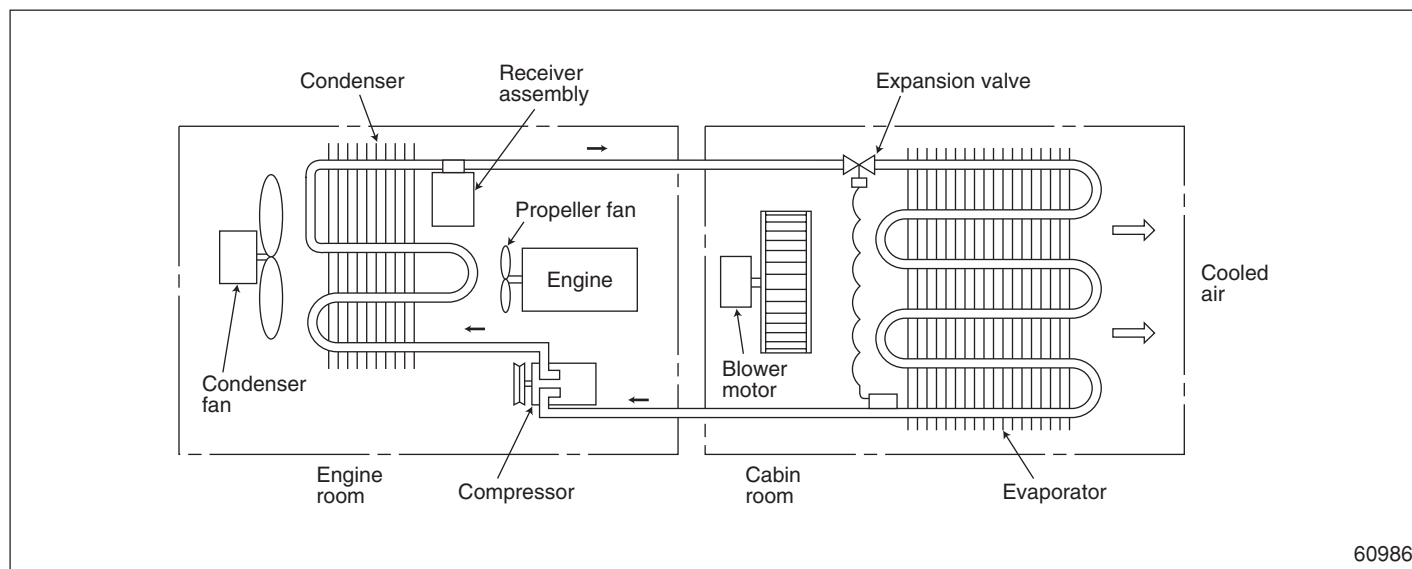
1. Air System



- **Cooling operation**
Fresh air is induced to the cooling unit assembly by a blower fan, where it is cooled down and dehydrated, charged at the front side outlet through a duct.
- **Heating operation**
Fresh air is induced to the heater unit by a blower fan through the cooling unit assembly, where it is heated, then discharged at the foot side outlet through a duct.
- **Dehumidifying operation**
Fresh air is induced to the cooling unit by a blower fan, where it is cooled down and dehydrated, and succeedingly to the heater unit for warming, then discharged at the front side outlet through a duct.
- **Temperature control**
Cooled air and warmed air are mixed for temperature control of the room inside.

STRUCTURE AND OPERATION

2. Refrigerating Circuit



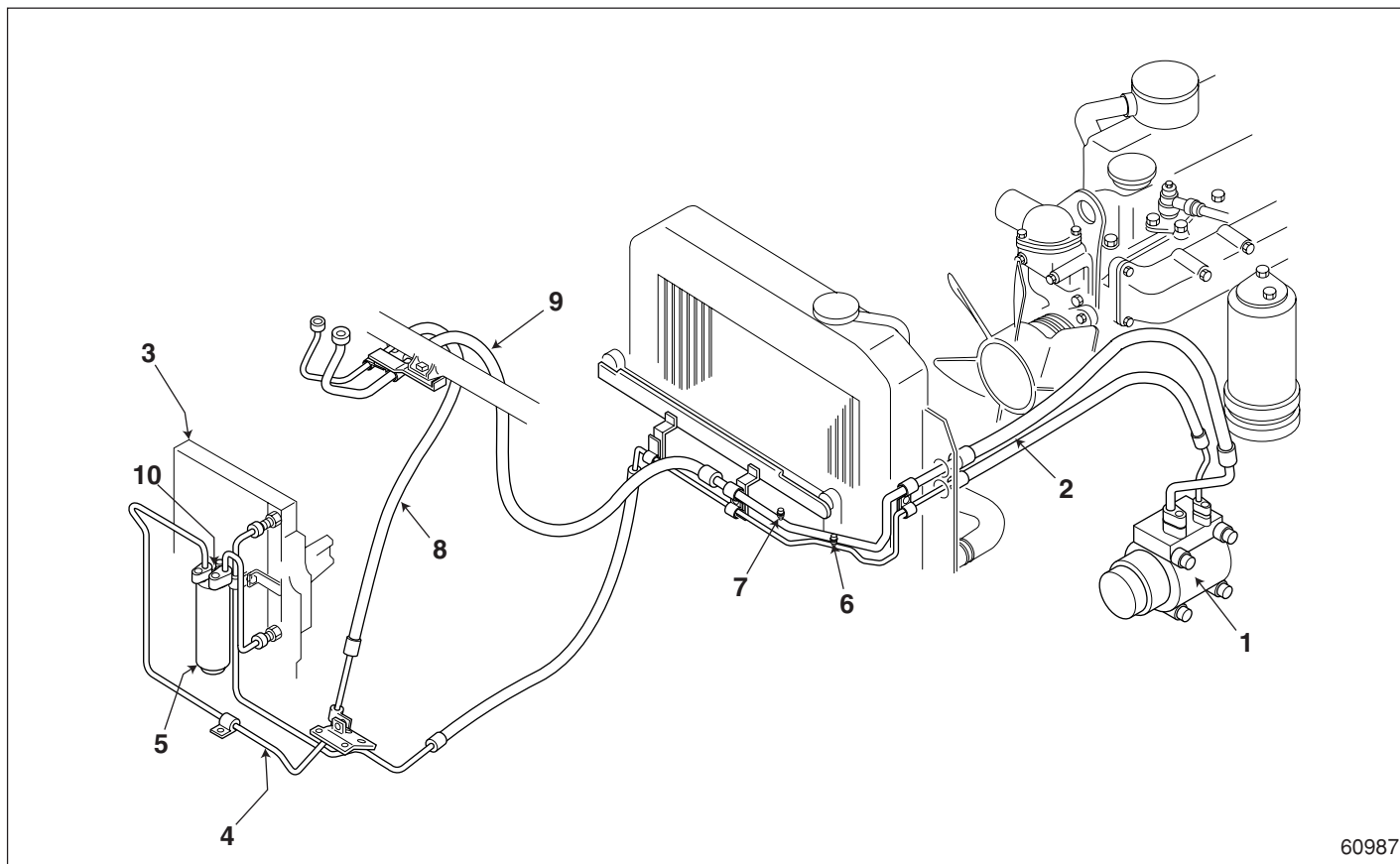
While the refrigerant, HFC-134a is cooling the air drawn into the evaporator, it evaporates and becomes a gas. This gas is compressed to high pressure and temperature in the compressor, and sent into the condenser, where it is cooled and becomes liquid.

This cooling in the condenser is carried out by the open air passing through the condenser sucked by condenser fan and vehicle motion of the vehicle.

The liquid refrigerant flows through the receiver assembly where water and dirt are removed, and then it enters the expansion valve. Here the liquid refrigerant is throttled and changed to a mixture of liquid and gas in low temperature and low pressure, and is sent to the evaporator.

In the evaporator, the refrigerant absorbs heat from the surroundings and becomes a gas. That is, because the evaporator itself is cooled at this time, the return air to the cooling unit assembly is cooled, and the interior of the vehicle becomes cool. In this way the refrigerant flow makes a complete circuit.

3. Engine Room



60987

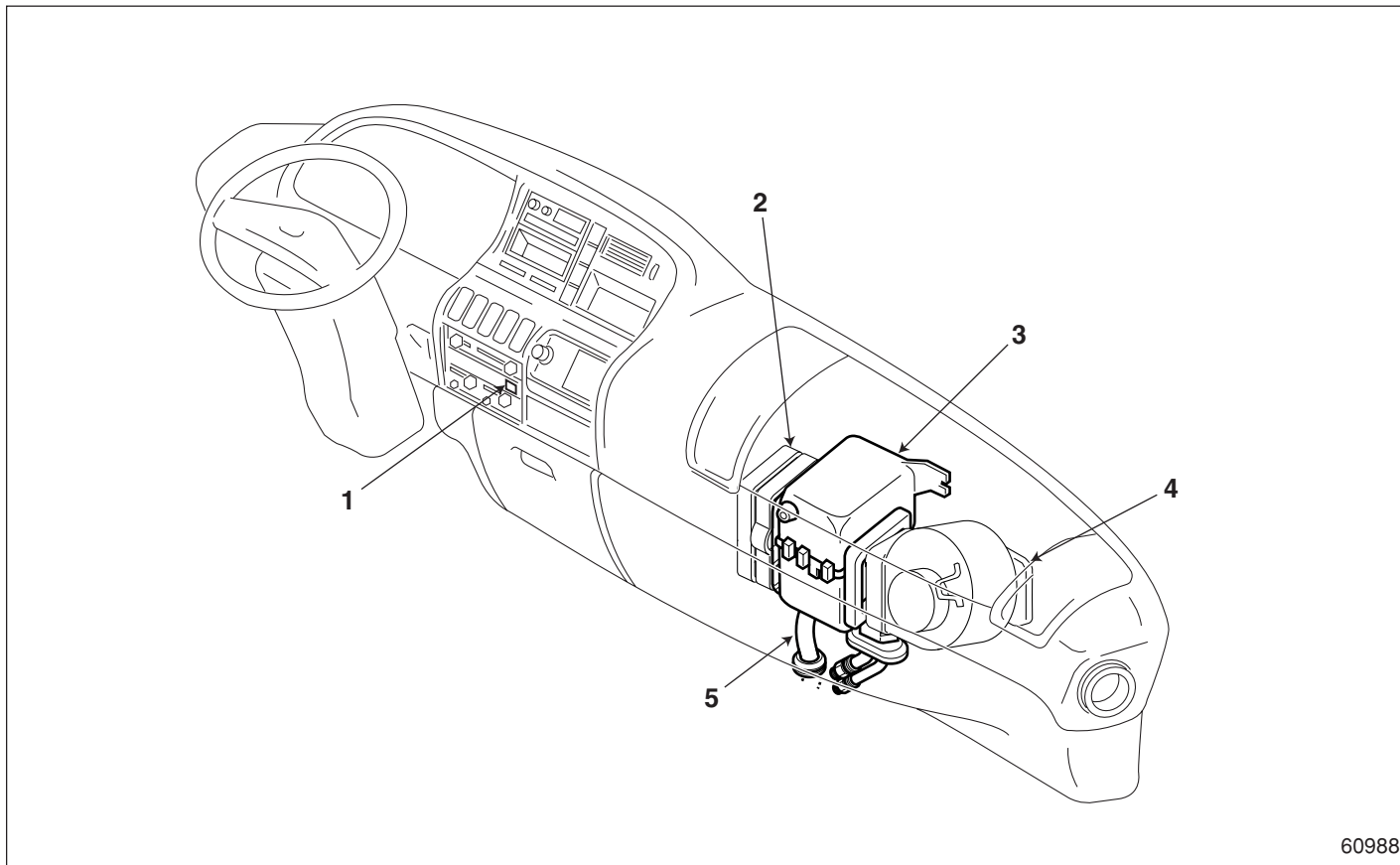
- 1 Compressor & clutch assembly
- 2 Discharge hose
- 3 Side condenser assembly
- 4 Pipe (LQ)
- 5 Receiver assembly

- 6 Check valve (HP)
- 7 Check valve (LP)
- 8 Liquid hose
- 9 Suction hose
- 10 Sight glass

LQ : Liquid
HP : High pressure
LP : Low pressure

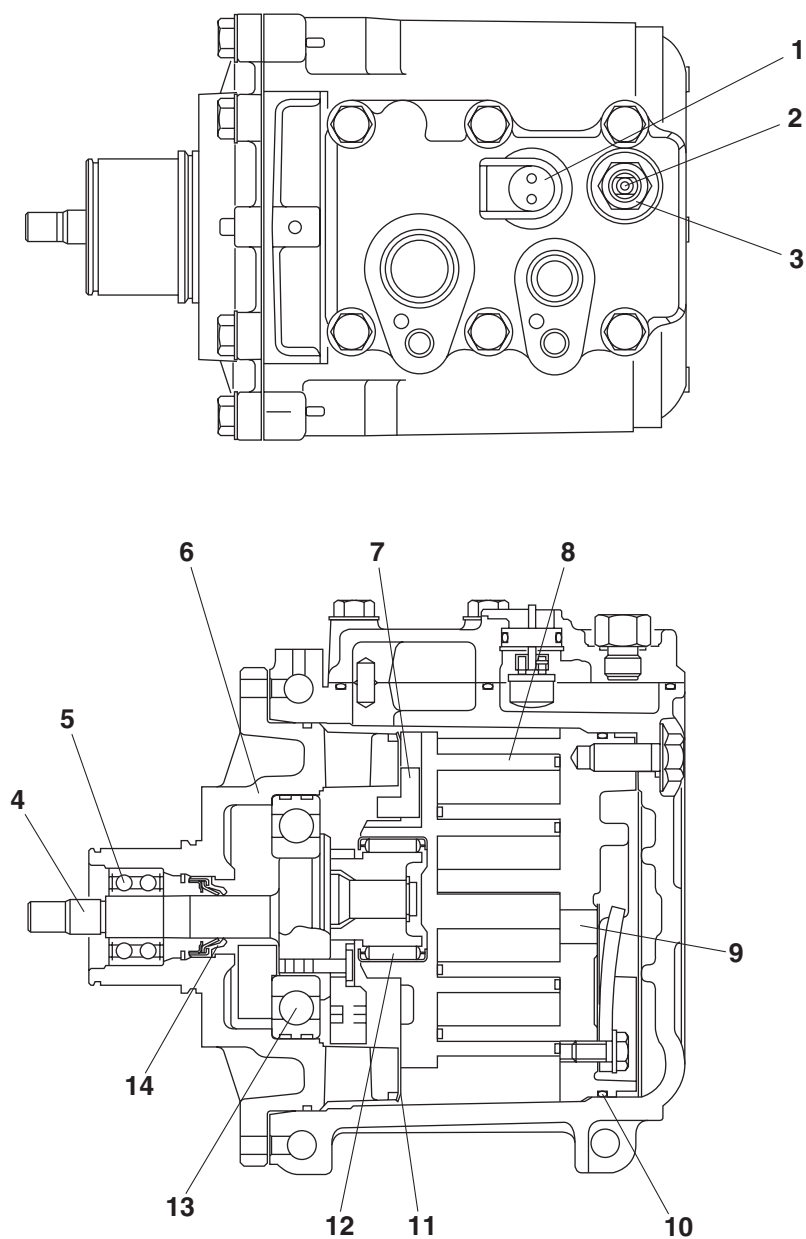
STRUCTURE AND OPERATION

4. Cabin Room



- 1 Air conditioner switch
- 2 Heater unit
- 3 Cooling unit assembly
- 4 Blower motor
- 5 Drain hose

5. Compressor

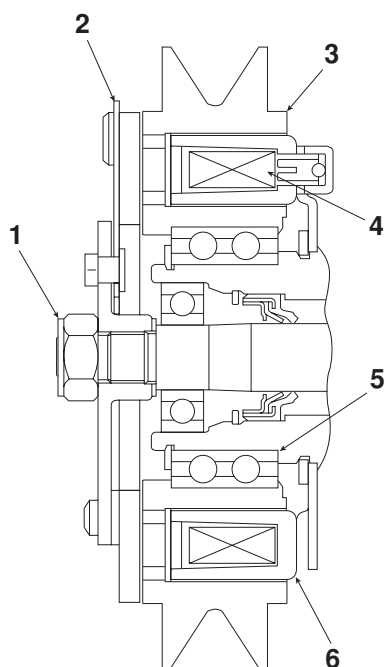


60989

- | | |
|-----------------------|-------------------------|
| 1 Thermostat | 8 Orbit scroll assembly |
| 2 H/P relief valve | 9 Port hole |
| 3 Dust seal | 10 O-ring |
| 4 Crankshaft | 11 Thrust plate |
| 5 Bearing | 12 Needle bearing |
| 6 Front case assembly | 13 Bearing |
| 7 Housing assembly | 14 Shaft seal |

STRUCTURE AND OPERATION

6. Magnetic Clutch

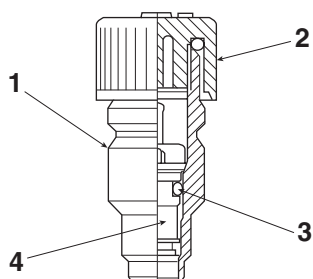


60990

- 1 Lock nut
- 2 Armature plate
- 3 Rotor
- 4 Coil
- 5 Ball bearing
- 6 Field core

The magnetic clutch is mounted on the compressor crankshaft to start and stop the compressor. This means that the magnetic clutch is actuated to control the compressor operation electrically by the thermostat.

7. Check Valve



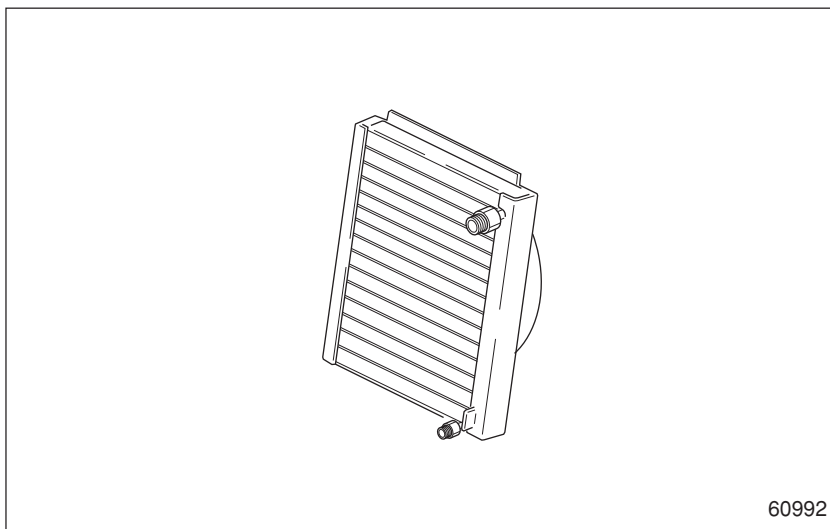
60991

- 1 Valve body
- 2 Cap
- 3 Packing
- 4 Valve core

The suction hose and discharge hose are provided with check valve, and designed for gas evacuation and charging service. (shown left) In the valves, a valve rubber tube, as in automobile tire tubes, is provided as shown in the figure.

Loosening the flare nut on the gauge manifold causes the passage to close automatically by the spring force, and tightening the flare nut causes the passage to open while pressing the compressed spring.

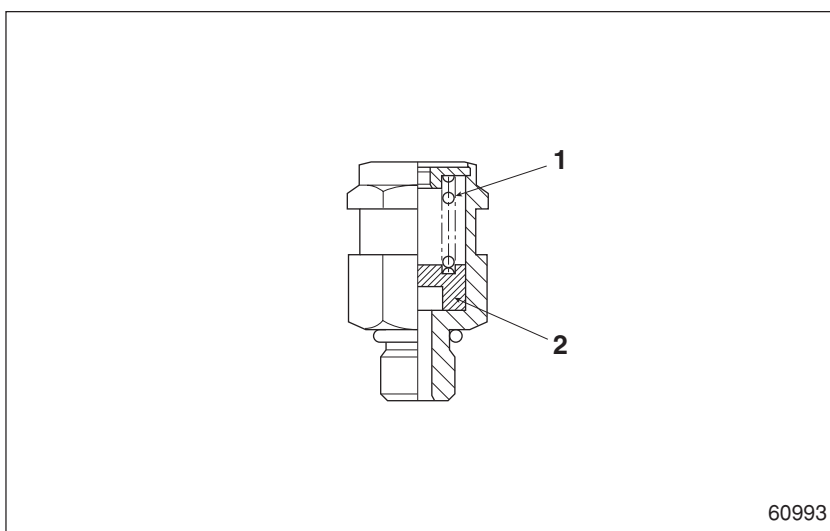
8. Side Condenser Assembly



The condenser is a means to liquefy the refrigerant gas.

As the condenser is cooled by the air pulled in by the condenser fan, the refrigerant in the condenser is cooled into liquid. Therefore, when any obstacle prevents the air from flowing evenly to the condenser or the air flow is short circuited, the cooling effect is reduced, with a decrease in the performance of the condenser. When the vehicle is driven at a high speed, the air flow increases resulting in an increase of the cooling effect, and performance of the condenser.

9. Relief Valve



- 1 Spring
- 2 Valve

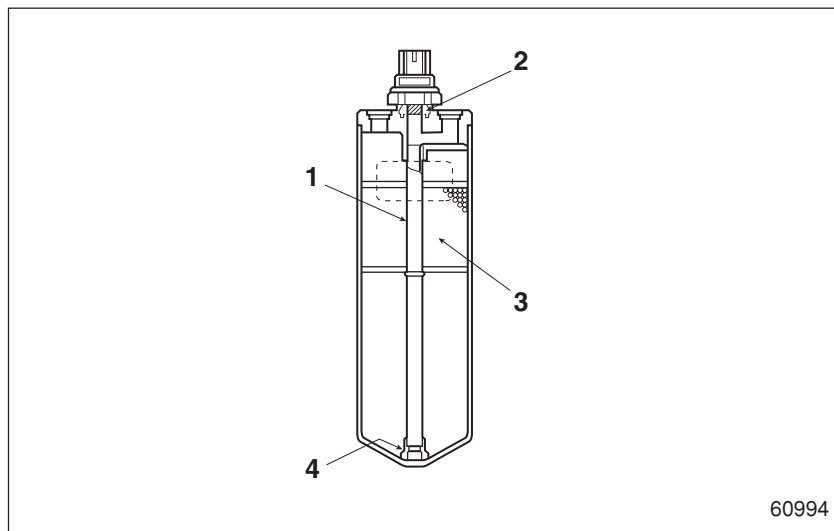
The relief valve is mounted to the compressor & clutch assembly. The relief valve is usually closed by spring. If pressure of refrigerant in air conditioner system is higher than spring pressure, refrigerant is discharged from relief valve. The pressure drop due to discharge refrigerant, and relief valve is closed again.

Unit: MPa {psi, kg/cm²}

Open	3.50 to 4.10 {505 to 595, 36 to 42}
Close	2.94 {425, 30}

STRUCTURE AND OPERATION

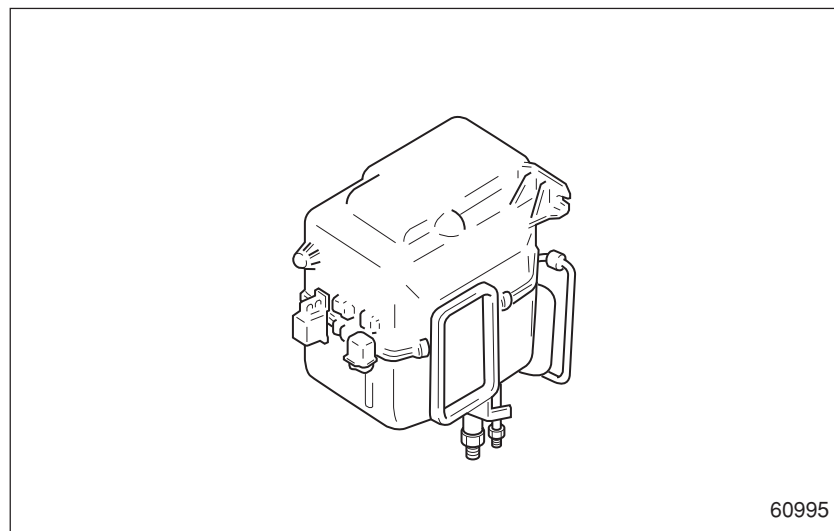
10. Receiver Assembly



- 1 Suction tube
- 2 Sight glass
- 3 Drier assembly
- 4 Strainer

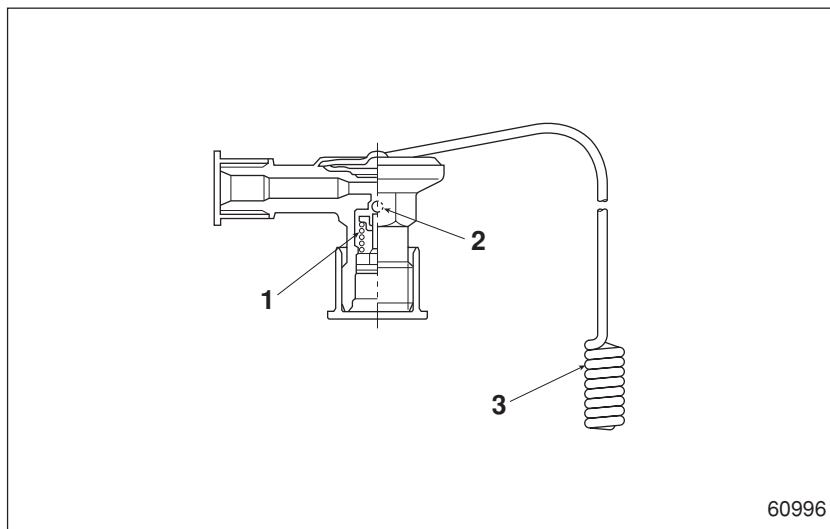
The receiver assembly is served as a refrigerant reservoir located between the condenser and expansion valve. The receiver assembly consists of a filter and a sight glass. The filter is used to remove dust, the drier is used to remove moisture from the refrigerant in the circuit, and the sight glass is used to check the refrigerant charge. Any moisture in the refrigerant may not only corrode metal surfaces in the refrigerant circuit, but also cause the throttle of the expansion valve to be frosted, resulting in the interruption of refrigerant circulation. Therefore, the receiver assembly must be handled very carefully. When storing or installing it, care should be taken to protect it from the deterioration of drying performance due to exposure to the air. The retardation of heat exchange, or any fire around the refrigerant circuit will cause excessive pressurization or heating of the refrigerant. Should such an accident occur, the refrigerant in the circuit must be expelled to the outside to prevent the above hazards. The sight glass is a sort of peep window used to check the refrigerant flow in the refrigerant circuit. The sight glass appears clear when the refrigerant flow is enough, and shows bubbles flowing when the refrigerant flow is short.

11. Cooling Unit Assembly



The evaporator core is a type of corrugated fin and tube. The tube is arranged in zigzag to achieve high efficiency, and to make the core system compact. A thicker reinforced plastic plate is used as the enclosure to increase heat and shock resistance, and to protect the core from humidity. This case is a split type, and in a simple design to facilitate installation on the floor panel and the instrument panel frame of the vehicle.

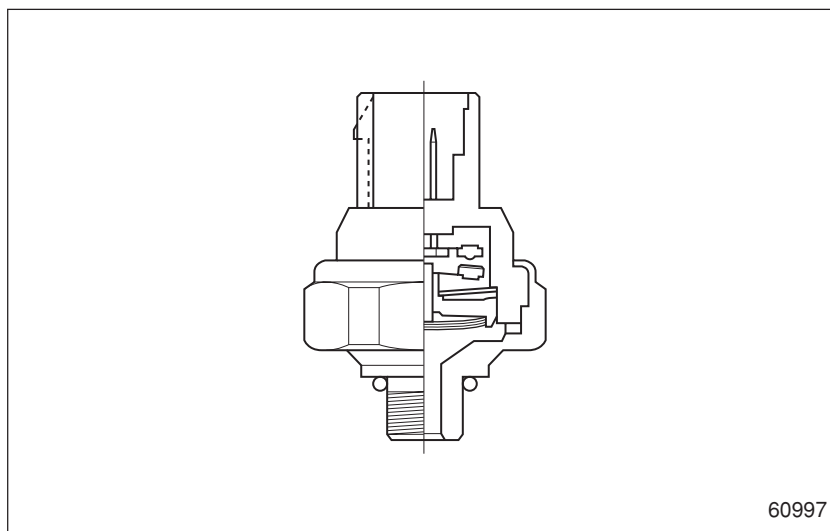
12. Expansion Valve



- 1 Adjusting spring
- 2 Ball valve
- 3 Feeler bulb

The expansion valve is mounted at the inlet of the cooling unit. The liquid refrigerant from the receiver is led to it through a narrow passage (for throttle action), where-in, the liquid refrigerant is condensed with pressure dropping and at the same time the flow rate is adjusted before the refrigerant is sent to the cooling unit. The refrigeration load in the cooling unit is not constant, but usually fluctuates over a certain range. So the refrigerant flow should under go the control in design. An automatic expansion valve performs this function automatically. The air condenser uses a thermal type automatic expansion valve.

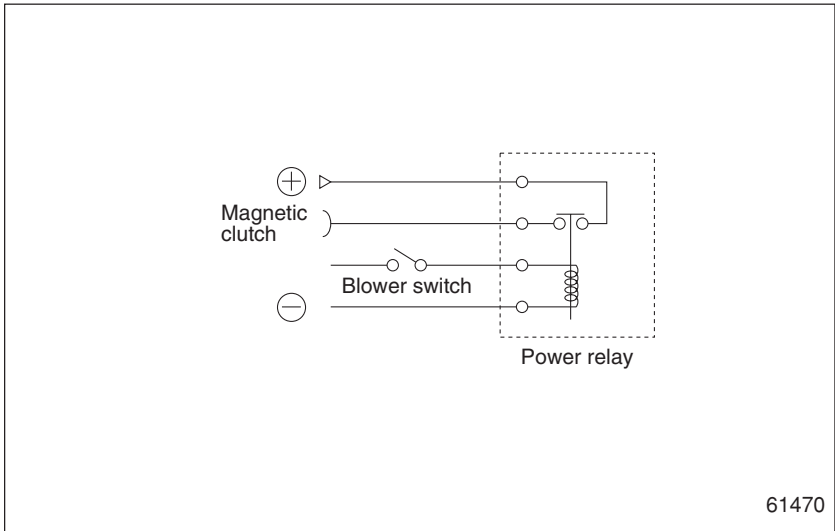
13. Dual Pressure Switch



The dual pressure switch, fixed to the receiver functions as a protector for stopping the compressor (OFF) at a preset value of pressure in the refrigerant circuit.

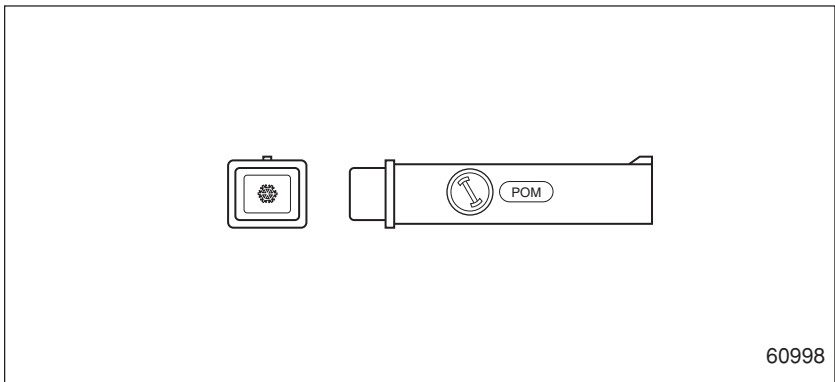
STRUCTURE AND OPERATION

14. Power Relay



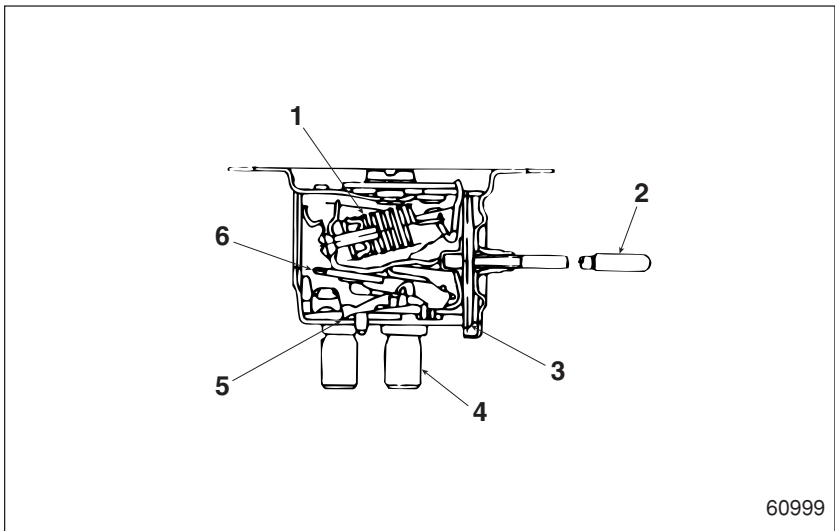
The power relay is excited at a closed position of the micro switch and enables the magnetic clutch to be ready for engaging electrically.

15. Air Conditioner Switch



The air conditioner switch functions as an operation controller for starting or stopping the compressor in cooling and dehumidifying. By initially depressing it, the magnetic clutch becomes engaged and the compressor starts with the indication lamp signing. By secondarily depressing it, the magnetic clutch becomes disengaged and the compressor stops with the indication lamp signing.

16. Thermostat



- 1 Spring
- 2 Feeler bulb
- 3 Diaphragm
- 4 Terminal
- 5 Inner toggle
- 6 Belows lever

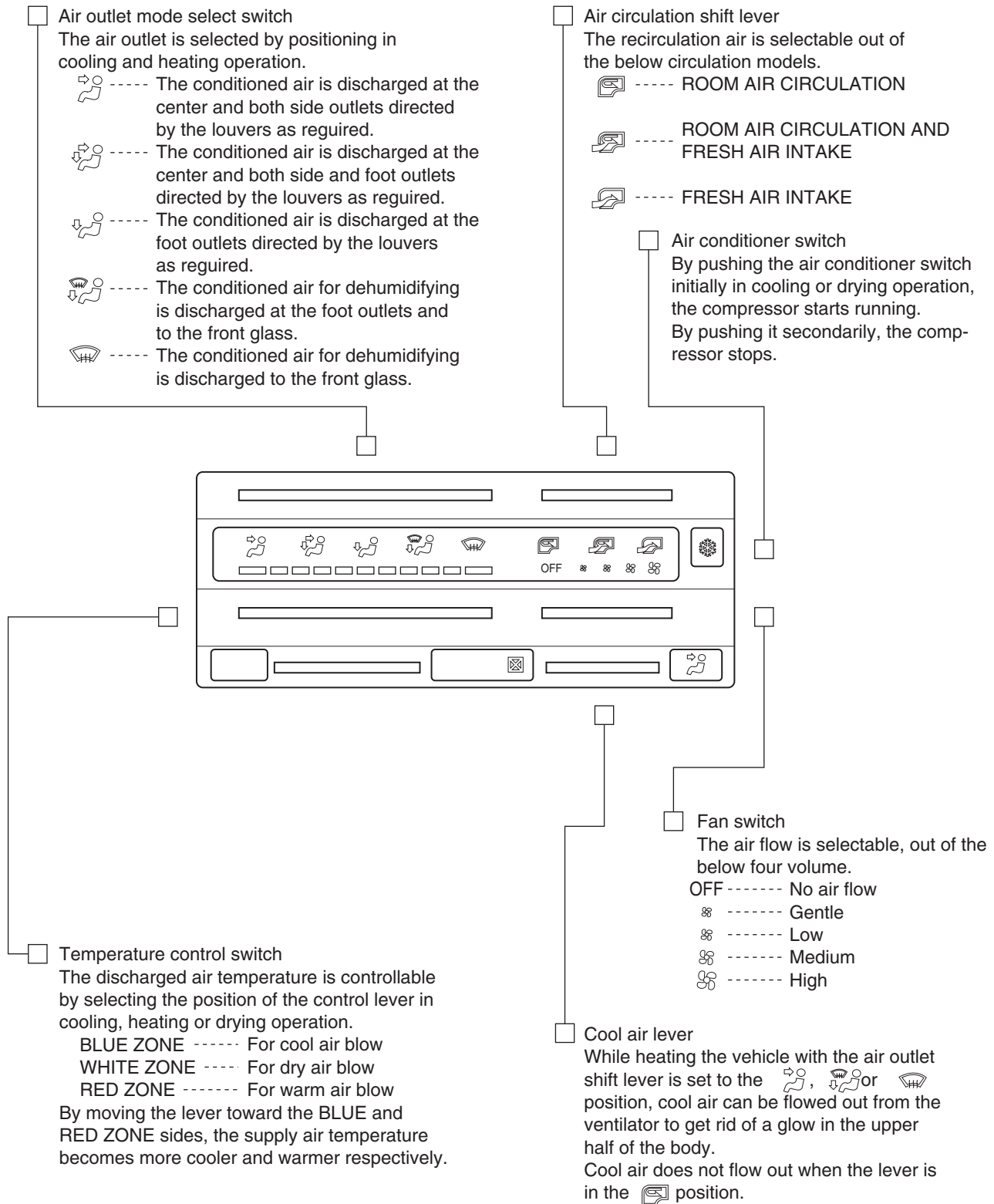
The thermostat is mounted on the evaporator case. It senses the temperature of evaporator fins, and controls the compressor operation for ON or OFF.

MEMO

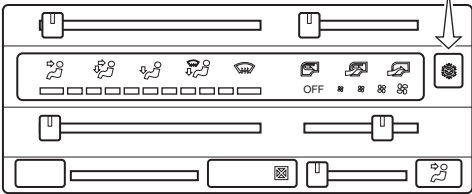
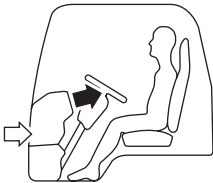
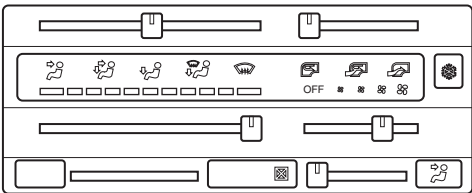
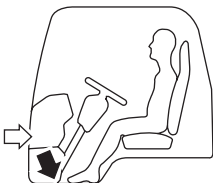
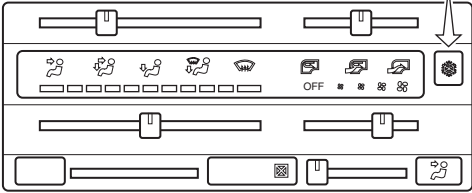
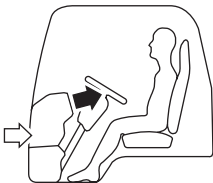
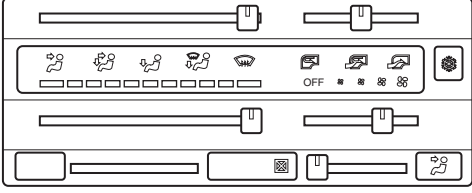
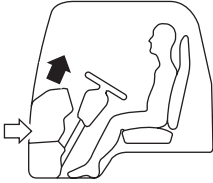
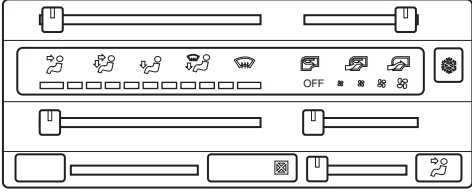
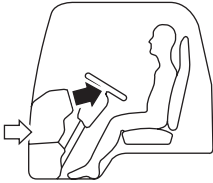
STRUCTURE AND OPERATION

17. Control System

17-1 Control panel



17-2 Operation control

Operation mode	Setting control lever	Air delivery	Remarks
COOL			Earlier cooling service, or conditioning at dusty, polluted air prevailing places : Shift lever : Air circulation 
HEAT			Earlier cooling service, or conditioning at dusty, polluted air prevailing places : Shift lever : Air circulation Air outlet mode select switch 
DEHUMIDIFY			Wetty conditioning in head cooled, and foot warmed : Shift lever : Air outlet Air outlet mode select switch 
DEFROST			
VENTILATION			

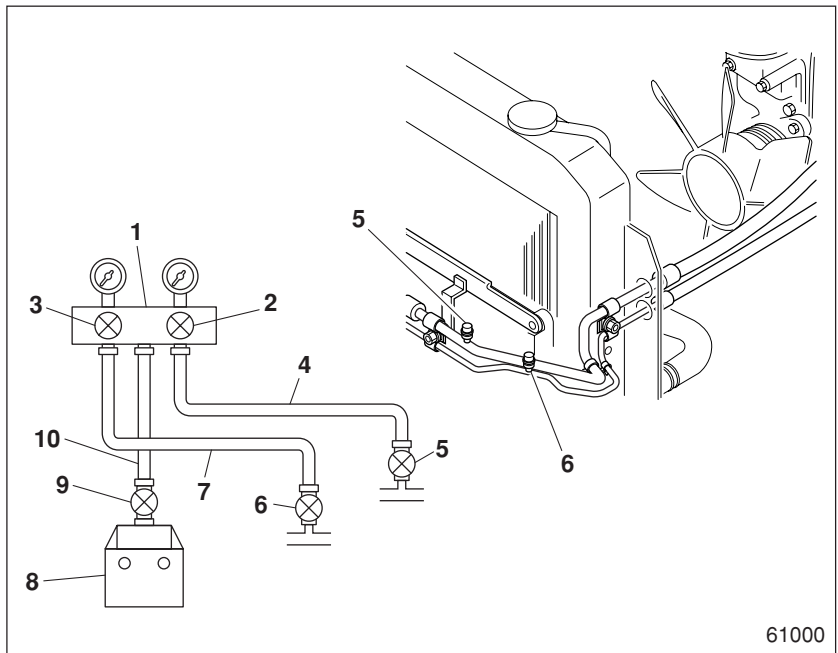
TROUBLESHOOTING

Symptoms						Remark
		Air is discharge but not cooled down	Cooling effect is insufficient	Air flow is short	Intermittent cooling down of discharge air	
Possible causes						
Magnetic clutch fails to engage	Air conditioner fuse blown	☐				
	Conditioner switch fault	☐	☐			
	Dual pressure switch fault	☐	☐			
	Thermostat fault	☐	☐			
	Power relay fault	☐	☐			
	Magnetic clutch seized or malfunctioning	☐	☐			
Insufficient refrigerant		☐	☐			
Receiver assembly clogged		☐	☐			
Improper compressor revolution due to loosening V-belt		☐	☐			
Expansion valve clogged		☐	☐			
Ineffective compression		☐				
Condenser fins portion clogged			☐			
Refrigerant overcharged			☐			
Air inclusion in refrigerant circuit			☐			
Thermostat defect			☐			
Evaporation frosting				☐		
Blower motor defect				☐		
Water inclusion in refrigerant circuit					☐	
Expansion valve malfunctioning					☐	

MEMO

ON-VEHICLE INSPECTION AND ADJUSTMENT

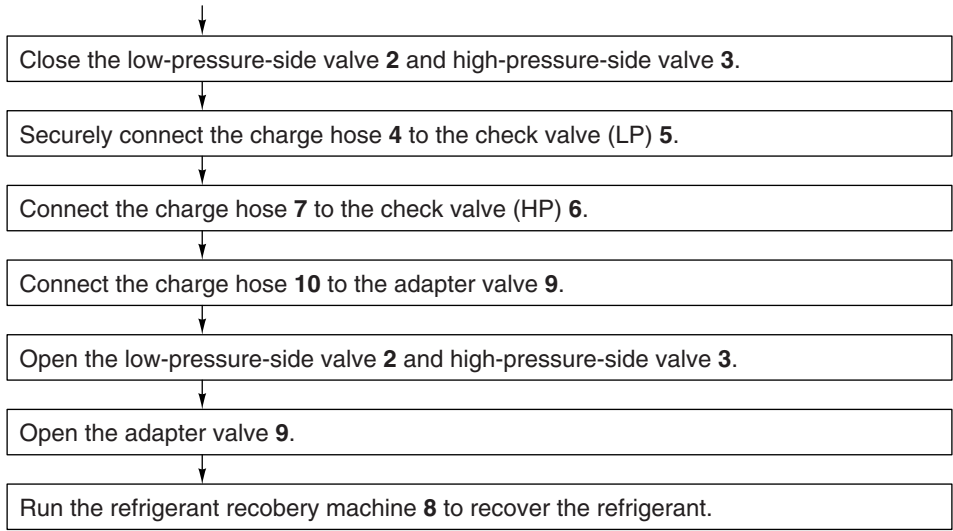
1. Recovery of Refrigerant



- 1 Gauge manifold
- 2 Low-pressure-side valve
- 3 High-pressure-side valve
- 4 Charge hose
- 5 Check valve (LP)
- 6 Check valve (HP)
- 7 Charge hose
- 8 Refrigerant recovery machine
- 9 Adapter valve
- 10 Charge hose

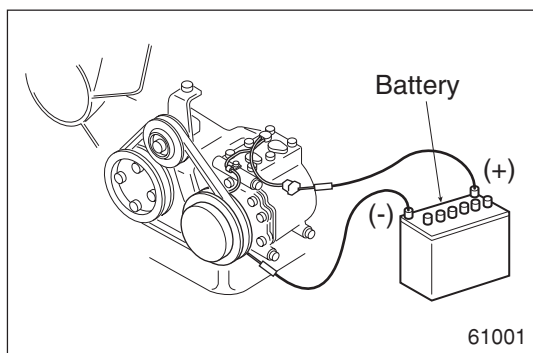
HP : High pressure
LP : Low pressure

- Recover the refrigerant in accordance with the following flow chart.
- Installation of refrigerant recovery machine



2. Inspection and Adjustment of V-Belt Gr14

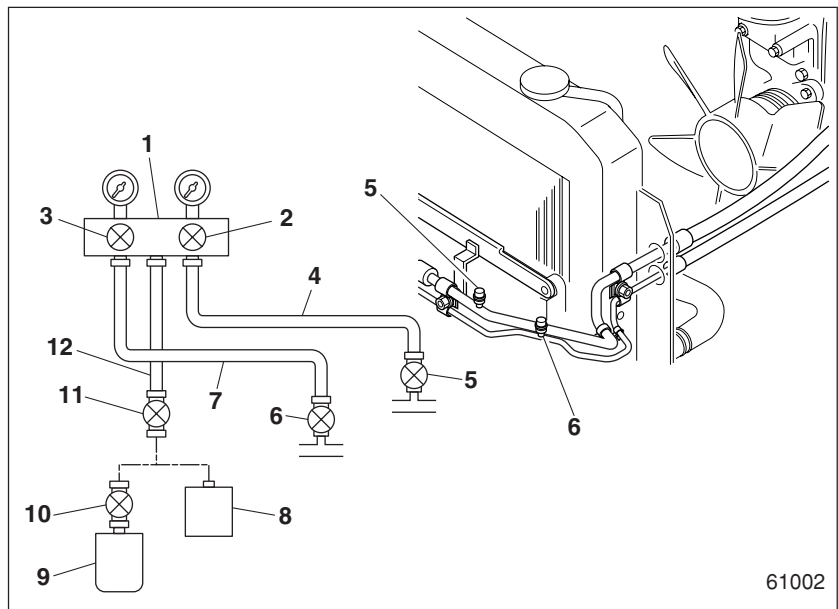
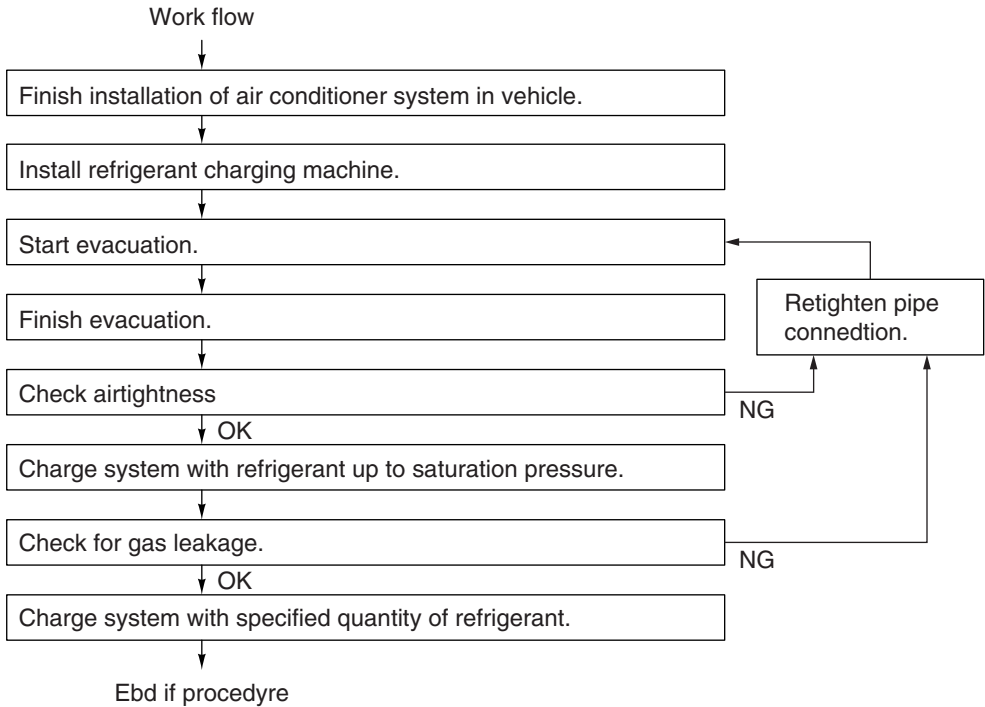
3. Inspection of Magnetic Clutch



- Disconnect the wiring to the magnetic clutch.
- Apply a positive side power voltage to the magnetic clutch through the wiring.
- In the case of regular functioning, the pulley and magnetic clutch are engaged with a clicking sound. The falling means any malfunction of the magnetic clutch.

ON-VEHICLE INSPECTION AND ADJUSTMENT

4. Charging System with Refrigerant

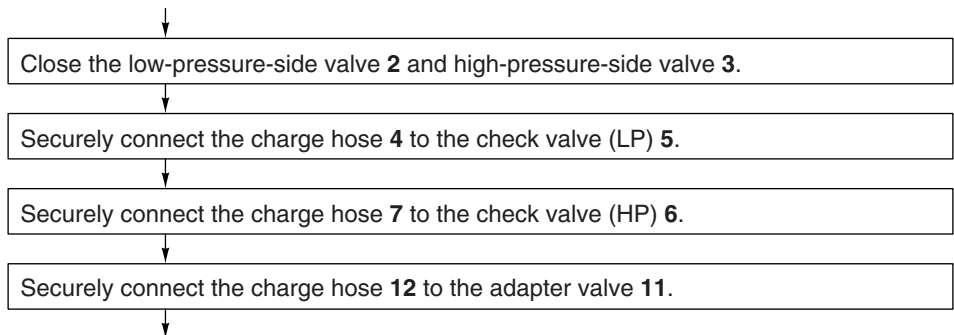


- 1 Gauge manifold
- 2 Low-pressure-side valve
- 3 High-pressure-side valve
- 4 Charge hose
- 5 Check valve (LP)
- 6 Check valve (HP)
- 7 Charge hose
- 8 Vacuum pump
- 9 Service can
- 10 Service can valve
- 11 Adapter valve
- 12 Charge hose

HP : High pressure

LP : Low pressure

- Charge the system with refrigerant in accordance with the following flow chart.
- Installation of refrigerant recovery machine



Evacuation procedure

Open the low-pressure-side valve **2** and high-pressure-side valve **3**.

Open the adapter valve **11**.

Start the vacuum pump **8**.

Evacuate for 10 to 15 minutes, then close the adapter valve **11**.

Stop the vacuum pump **8**.

CAUTION ⚠

Be sure to close the adapter valve 11 before stopping the vacuum pump 8.

Close the low-pressure-side valve **2** and high-pressure-side valve **3**.

Wait five minutes with the equipment in this condition. Check that the gauge needle on the gauge manifold **1** does not move toward zero.

End of evacuation

Refrigerant-charging procedure

With the adapter valve **11** closed, disconnect the vacuum pump **8** and connect the service can valve **10** (with the service can attached to it).

Open the service can valve **10**, then open the adapter valve **11**.

Open the low-pressure-side valve **2** and charge the system with gaseous refrigerant.

CAUTION ⚠

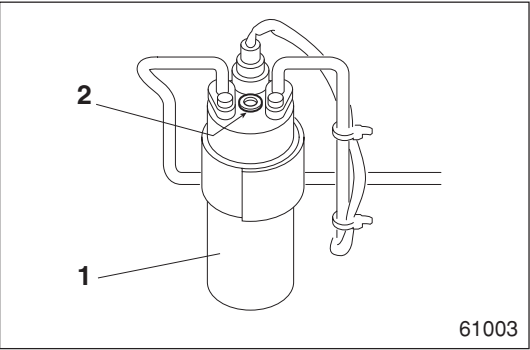
If refrigerant was drawn into the system in a liquid state, compression of the liquid would result in damage to the compressor. Keep the service can 9 upright to enable charging of the system with refrigerant in a gaseous state.

When the service can **9** is empty, close the adapter valve **11**, fit a new service can, and continue charging in the same manner.

If the system stops drawing refrigerant due to a balance of air conditioning cycle pressures reached part-way through the charging procedure, start the engine, turn ON the air conditioner switch to  activate the compressor, and continue the procedure until the system is charged with the specified quantity of refrigerant.

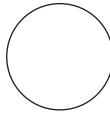
ON-VEHICLE INSPECTION AND ADJUSTMENT

5. Inspection of Refrigerant

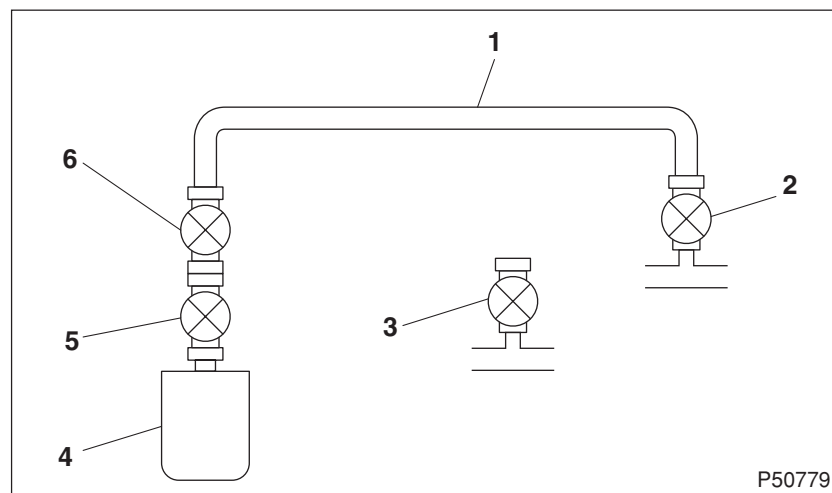


- Check the refrigerant volume by observing and evaluating the flow of refrigerant past the sight glass 2 in the receiver 1. P55A-15
- Perform the inspection with the following conditions satisfied.
 - Engine speed: 1,500 rpm
 - Air conditioner switch : ON
 - Fan switch: Position for highest air flow
 - Temperature adjustment lever: Position for maximum cooling
 - Inside/outside air selection: Outside air
 - Doors: Completely open
 - Door windows: Completely open

CAUTION **Never run the air conditioner without refrigerant. Doing so would damage the compressor.**

	Normal	Insufficient refrigerant in system	Hardly any refrigerant in system
View through sight glass	 P06554 Slight flow cloudy substance	 P06553 Bubbles constantly visible. Bubbles may be transparent or white.	 P06552 Almost clear. Some bubbles visible, but increases/decreases in engine speed cause them to disappear.
Condition of high-pressure and low-pressure pipes	High-pressure pipe hot. Low-pressure pipe cold. Distinct temperature difference.	High-pressure pipe warm. Low-pressure pipe moderately cool.	No discernable temperature difference between high-pressure and low-pressure pipes.

6. Replenishment of Refrigerant

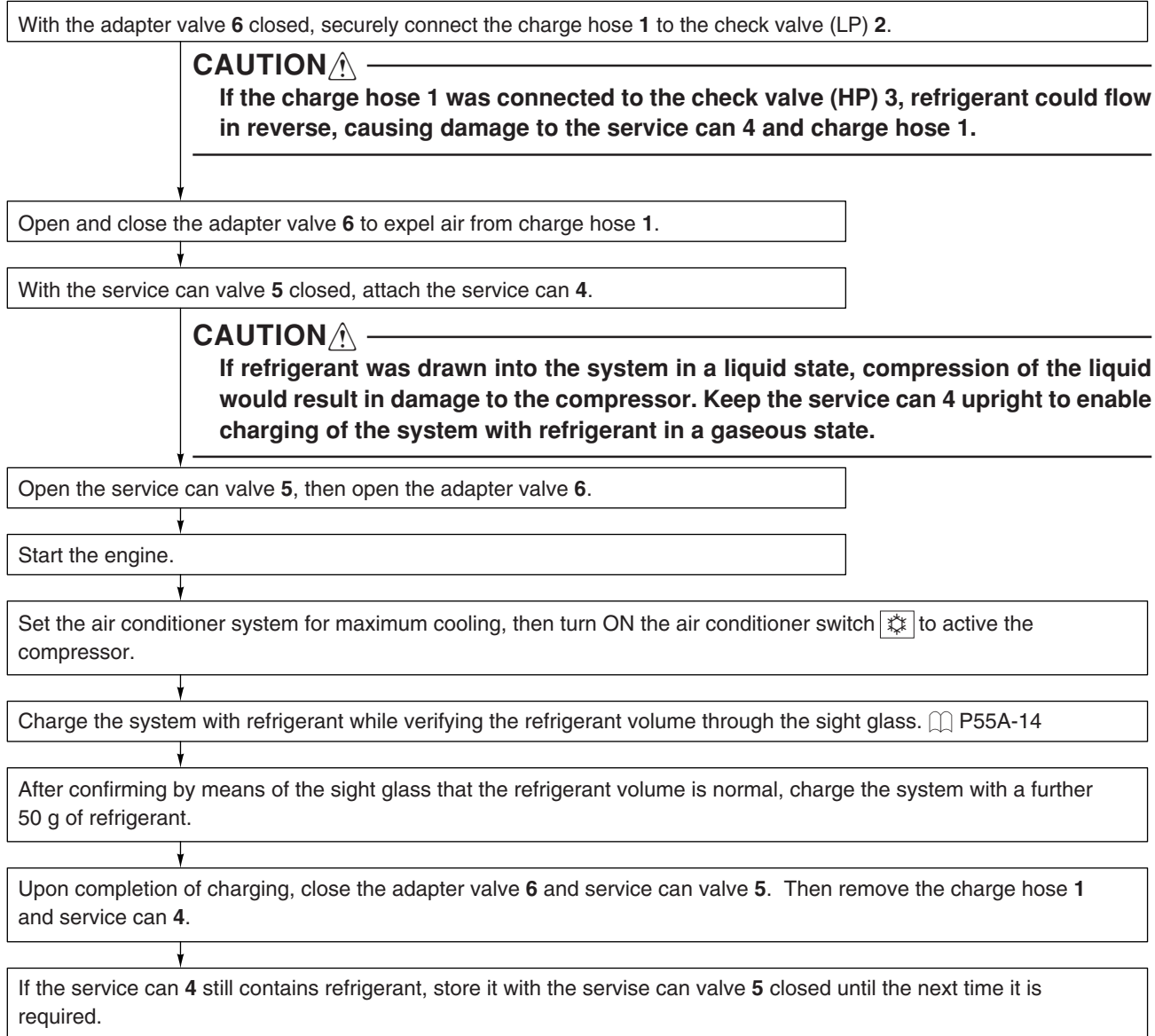


- 1 Charge hose
- 2 Check valve (LP)
- 3 Check valve (HP)
- 4 Service can
- 5 Service can valve
- 6 Adapter valve

HP : High pressure

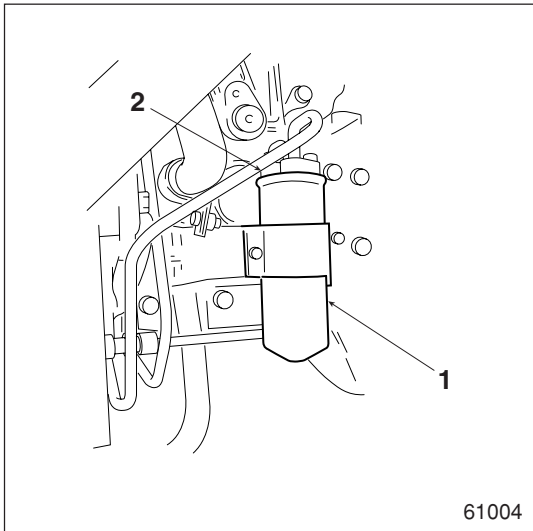
LP : Low pressure

- Replenish the refrigerant in accordance with the following flow chart.



ON-VEHICLE INSPECTION AND ADJUSTMENT

7. Inspection of Receiver assembly



(1) Receiver

- While operating the air conditioner, touch the refrigerant piping with a hand at the inlet and outlet portions.
- Sensed temperature difference:
It is possible that clogging is happening at the inside, liquid receiver assembly **1** is to be replaced with a new one.

(2) Dual pressure switch

- The dual pressure switch **2** is attached to the receiver assembly **1** for controlling the operation of the air conditioner by checking the inside pressure of the receiver assembly.

Switching point Unit: MPa {psi, kg/cm²}

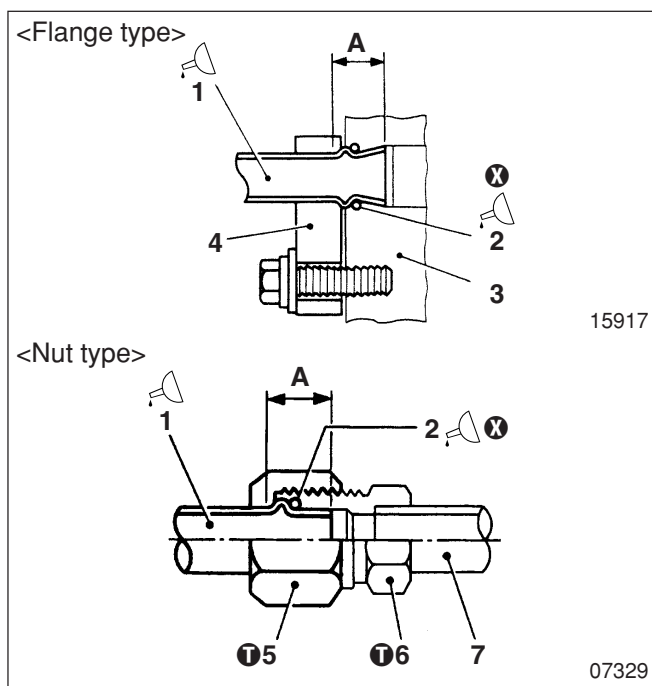
	LP side	HP side
OFF	0.20 {29, 2.0}	2.94 {425, 30}
ON	0.22 {33, 2.2}	2.35 {340, 24}

HP : High pressure

LP : Low pressure

- Unplug the connector at the receiver assembly **1**.
- Check the continuity between terminals of the connector with a tester.
- When electric continuity is found, connect the connector to the high pressure switch.
- Attach the high pressure gauge and low pressure gauge.
- Operate the air conditioner.
- Cover the surface of the condenser by using a piece of paper.
- When the high pressure exceeds 2.94 MPa {425 psi, 30 kg/cm²}, if the magnetic clutch is turned off, the switch is normal.
- If the magnetic clutch is not turned off, replace pressure switch with new one.
- Check the accuracy of the preset as below.
 - (1) Stop the air conditioner.
 - (2) Purge the air conditioner of refrigerant slowly starting at over 0.22 MPa {33 psi, 2.2 kg/cm²}.
 - (3) At reading the pressure 0.20 MPa {29 psi, 2.0 kg/cm²}, the switch opens.
 - (4) Here, stop the purging, then turn it to charging.
 - (5) At reading the pressure 0.22 MPa {33 psi, 2.2 kg/cm²}, the switch closes.

If the dual pressure switch does not meet specifications, replace the switch.



- 1 Pipe
- 2 O-ring
- 3 Flange <Flange type>
- 4 Flange (on mating part) <Flange type>
- 5 Nut <Nut type>
- 6 Union <Nut type>
- 7 Pipe <Nut type>

A : Area of application of refrigerating machine oil
 X : Non-reusable part

Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
5, 6	Rubber hose and pipe flare nut	Pipe outside diameter ϕ 8 mm { ϕ 0.31 in.}	12 to 15 {8.9 to 11, 1.2 to 1.5}	—
		Pipe outside diameter ϕ 12.7 mm { ϕ 0.50 in.}	20 to 25 {15 to 18, 2.0 to 2.5}	—
		Pipe outside diameter ϕ 15.88 mm { ϕ 0.63 in.}	29 to 34 {21 to 25, 3.0 to 3.5}	—

Lubricant and/or sealant

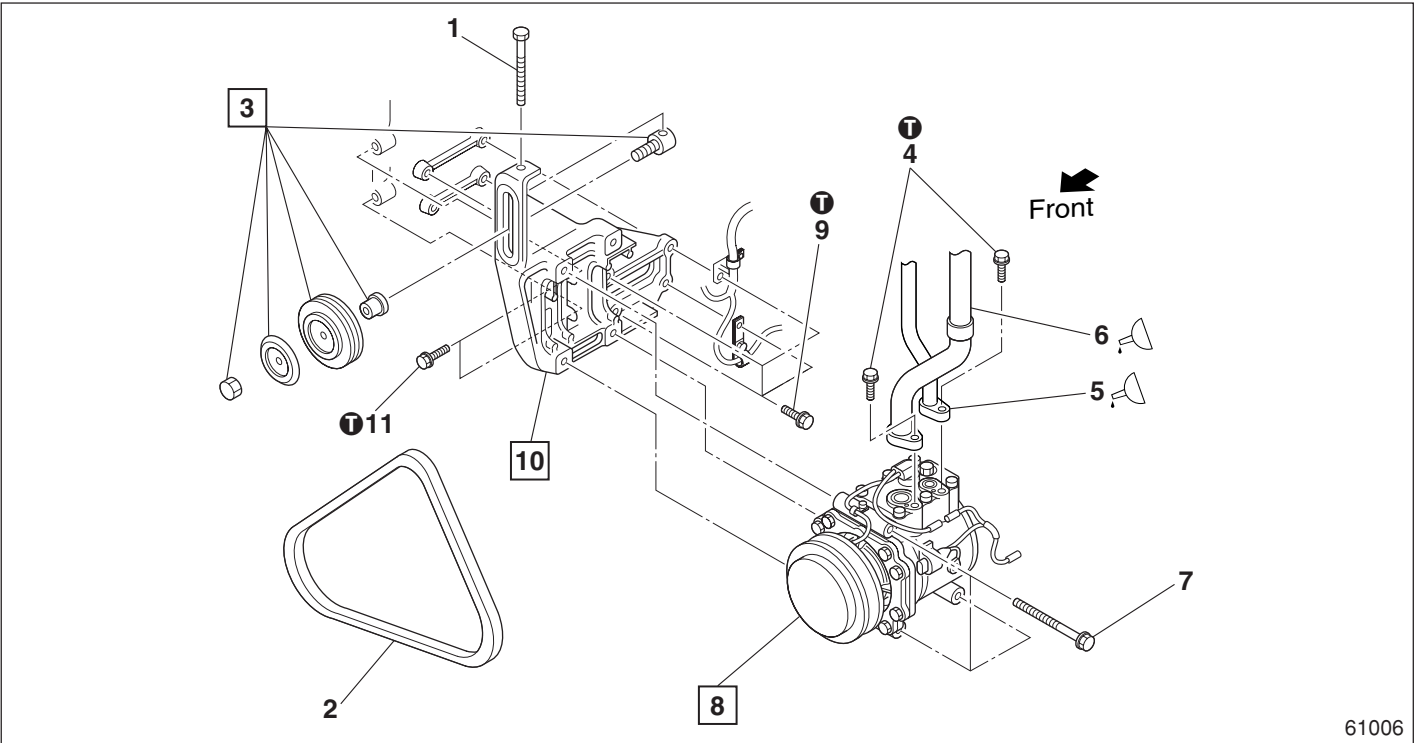
Location	Points of application	Specified lubricant and/or sealant	Quantity
1	Periphery of pipe end	Refrigerant machine oil S-PAG56	As required
2	Entire surface of O-ring	Refrigerant machine oil S-PAG56	As required

The air conditioner pipes and hoses may have either flange-type connectors or nut-type connectors. When tightening each connector, be sure to observe the cautions given below.

CAUTION

- The O-ring 2 seals the joint. Be careful not to let it get gouged, twisted or otherwise damaged.
- The O-ring 2 is designed only for use with HFC134a refrigerant and cannot be reused. Obtain new O-rings from the nearest Mitsubishi Heavy Industries service station.
- When tightening a nut-type connector, firmly retain the union 6 (to stop it from turning) before turning the nut 5. If the union turned, the pipe 7 would become deformed and refrigerant could leak as a result.

COMPRESSOR AND TENSION PULLEY



61006

● Removal sequence

- | | | |
|------------------|----------------------------------|-----------------------|
| 1 Adjusting bolt | 5 Discharge hose | 9 Bolt |
| 2 V-belt | 6 Suction hose | 10 Compressor bracket |
| 3 Tension pulley | 7 Bolt | 11 Flange bolt |
| 4 Bolt | 8 Compressor and clutch assembly | |

CAUTION

- Recover the refrigerant before removing the discharge hose 5 and suction hose 6.  P55A-18
- Plug discharge hose 5 suction hose 6, and compressor and clutch assembly 8 after removal to keep them from dust etc.

● Installation sequence

Follow the removal sequence in reverse except the sequence below.

3 → 10 → 1

CAUTION

After installation, tension V-belt 2 to specification.  Gr14

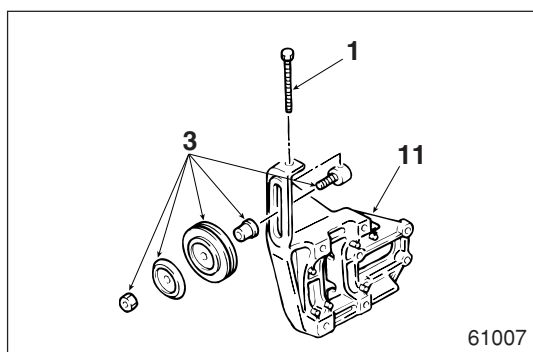
Tightening torque

Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Bolt (discharge hose and suction hose installation)	19 to 28 {14 to 21, 1.9 to 2.8}	—
9, 11	Bolt (compressor bracket mounting)	40 to 50 {28 to 36, 4.0 to 5.0}	—

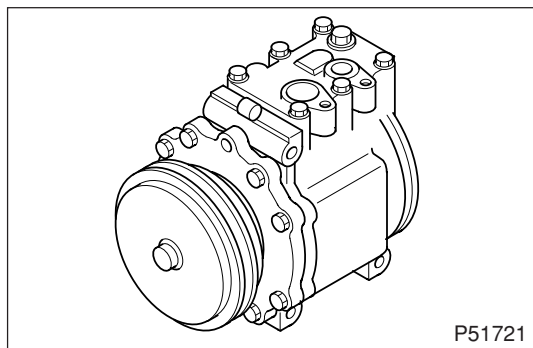
Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
5, 6	End of hose and entire surface of O-ring  P55A-25	Refrigerant machine oil S-PAG56	As required



3 Installation of tension pulley

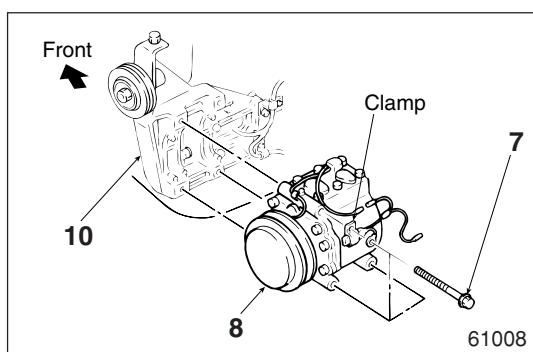
Loosely assemble the tension pulley 3 to the compressor bracket 11 using bolt 1 to install V-belt.



8 Compressor and clutch assembly

[Inspection]

If you observe defective operation of the compressor and clutch assembly 8, oil leakage from the oil seals, or some other abnormality, have the compressor overhauled at the nearest Mitsubishi Heavy Industries service station.

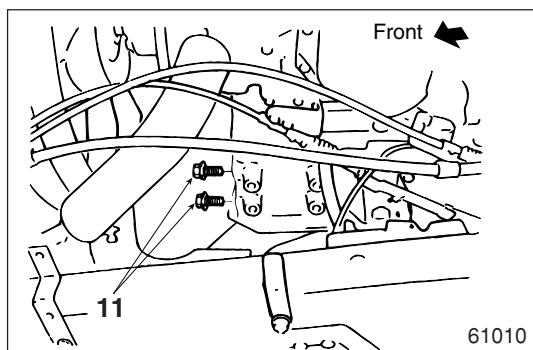


[Installation]

Install the compressor and clutch assembly 8 and clamp to the compressor bracket 10 using three bolts 7.

NOTE

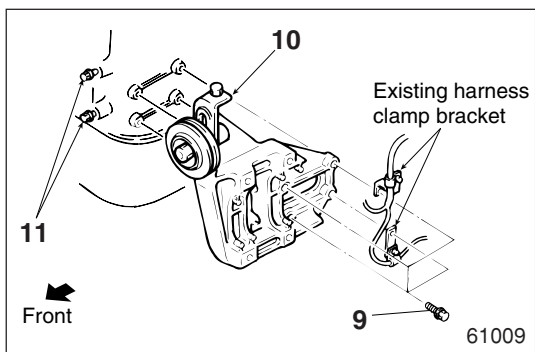
Install the compressor & clutch assembly 8 from under the vehicle, when installing the compressor & clutch assembly.



10 Installation of compressor bracket

- Loosely install bolts 11 to the engine block as shown.

COMPRESSOR AND TENSION PULLEY



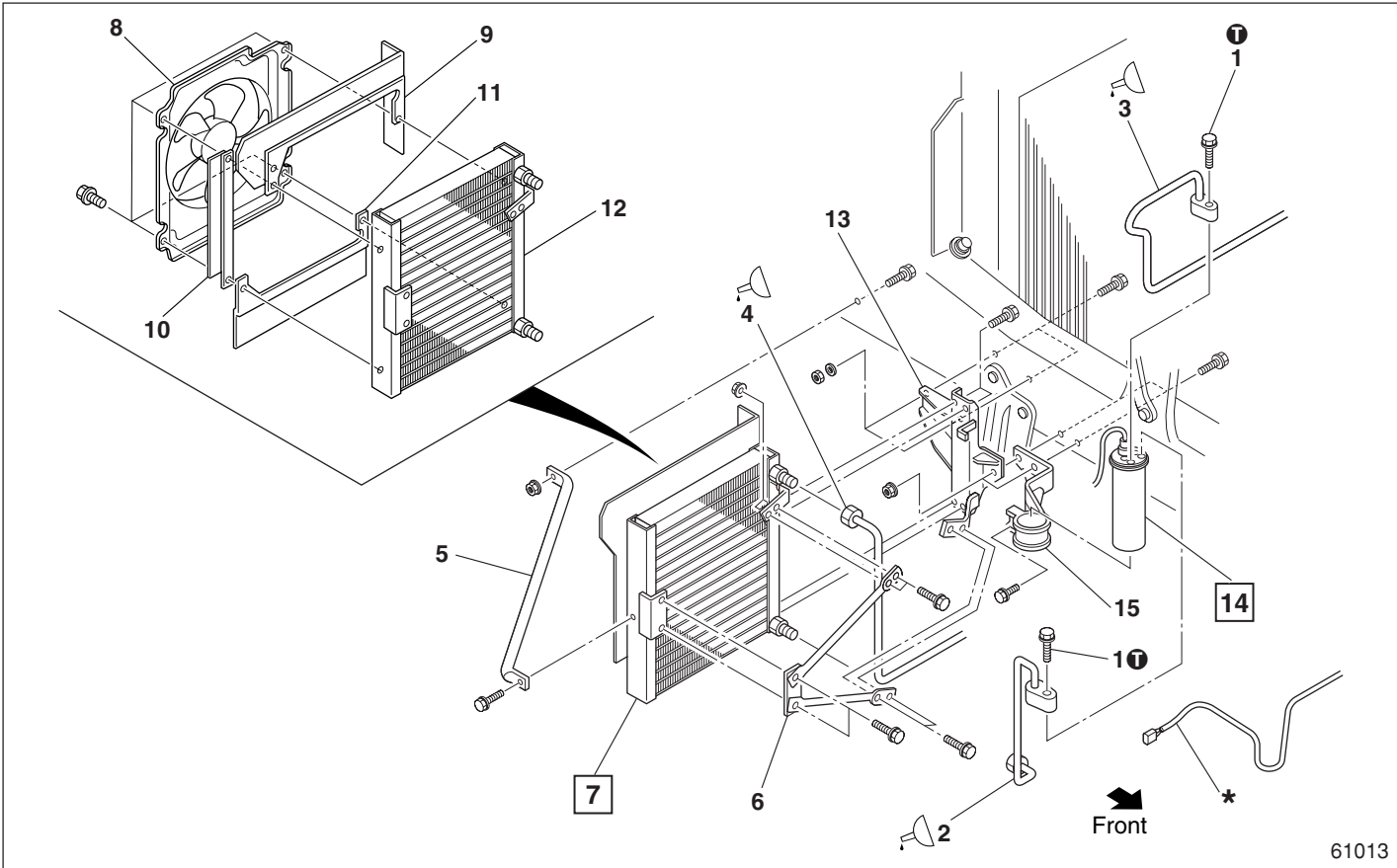
- Install the compressor bracket **10** and two existing harness clamp brackets to the engine block using four bolts **9**. Then tighten the two bolts **11**.

NOTE

Before installing the compressor bracket 10, clean off paint from the mounting surfaces on the crank case side (six areas on the top surface of the boss).

MEMO

SIDE CONDENSER ASSEMBLY AND RECEIVER ASSEMBLY



● Removal sequence

- | | | |
|-----------------------|---------------------------|------------------------------|
| 1 Bolt | 7 Side condenser assembly | 13 Condenser bracket A |
| 2 Liquid pipe | 8 Condenser fan shroud | 14 Receiver assembly |
| 3 Liquid hose | 9 Baffle plate A | 15 Receiver bracket assembly |
| 4 Discharge hose | 10 Baffle plate B | |
| 5 Condenser bracket B | 11 Baffle plate C | ★: Harness |
| 6 Condenser bracket C | 12 Side condenser | |

CAUTION ⚠

- Recover the refrigerant before removing the liquid pipe 2, liquid hose 3, and discharge hose 4. 📖 P55A-18
- Plug liquid pipe 2, liquid hose 3, discharge hose 4, and side condenser 12 after removal to keep them free from dust etc.

● Installation sequence

Follow the removal sequence in reverse.

ⓘ Tightening torque

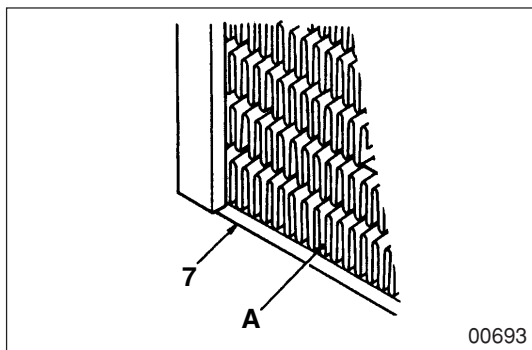
Unit : N·m {ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (liquid pipe mounting)	3 to 4 {2.2 to 3.0, 0.3 to 0.6}	—

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2, 3, 4	End of pipe and entire surface of O-ring 📖 P55A-25	Refrigerant machine oil S-PAG56	As required

◆ Service procedure



00693

7 Inspection of condenser

Remove any mud, dust, or other substance with which the fins **A** of the condenser **7** are clogged. Return any crushed fin to its original shape using a spatula.

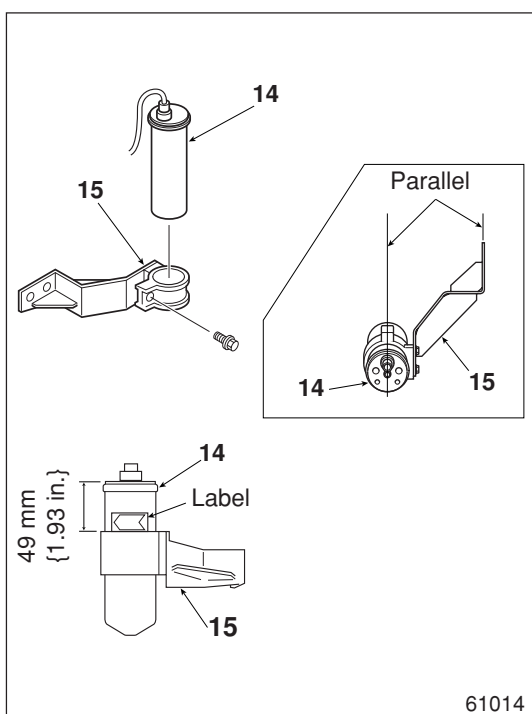
14 Receiver assembly

[Inspection]

- If any need arise to inspect the receiver, contact the MITSUBISHI HEAVY INDUSTRIES, LTD. Service station.

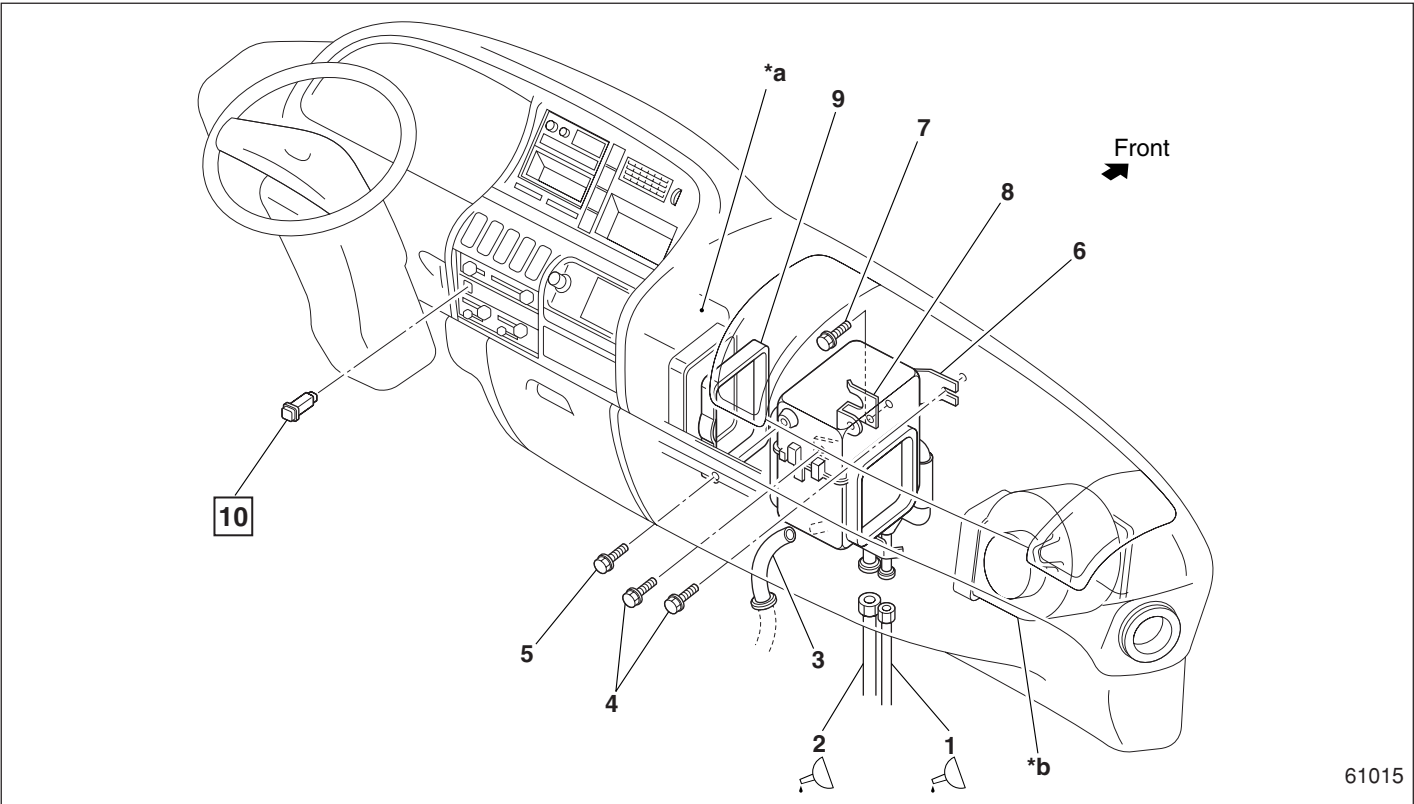
[Installation]

- Align receiver assembly **14** with receiver bracket assembly **15** in parallel as illustrated.
- While aligning the top end of the receiver bracket assembly **15** on the receiver assembly **14** to 49 mm {1.93 in.} from the center of the piping port of the assembly (or, to the bottom end of the label), fix the bracket.



61014

COOLING UNIT



● Removal sequence

- | | | |
|----------------------------------|------------------------------------|---------------------------|
| 1 Air conditioner hose (liquid) | 6 Cooling unit assembly
P55A-34 | 10 Air conditioner switch |
| 2 Air conditioner hose (suction) | 7 Bolt | *a : Heater unit Gr55A |
| 3 Drain hose | 8 Bracket | *b : Blower Gr55B |
| 4 Bolt | 9 Band | |
| 5 Bolt | | |

CAUTION ⚠

- Recover the refrigerant before removing the air conditioner hose 1, 2. P55A-18
- Plug air conditioner hoses 1, 2, cooling unit assembly 6 after removal to keep them free from dust etc.

● Installation sequence

Follow the removal sequence in reverse.

🔧 Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
1, 2	End of pipe P55A-25	Refrigerant machine oil S-PAG56	As required

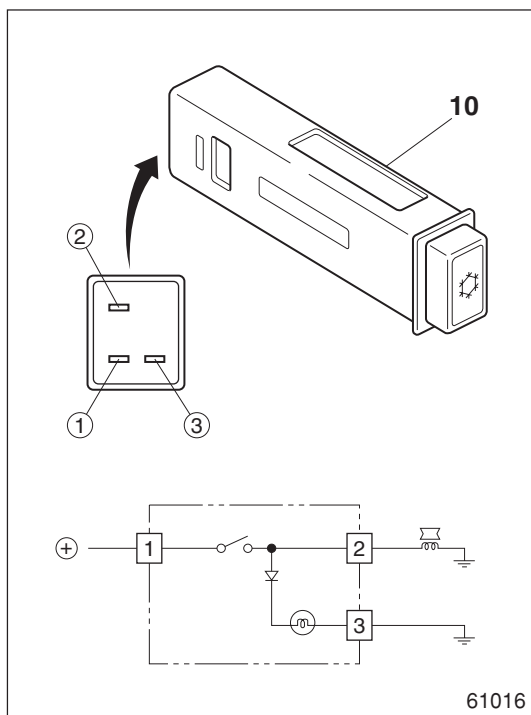
◆ Service procedure

10 Inspection of air conditioner switch

- Check the continuity between terminals of the air conditioner switch with a tester.

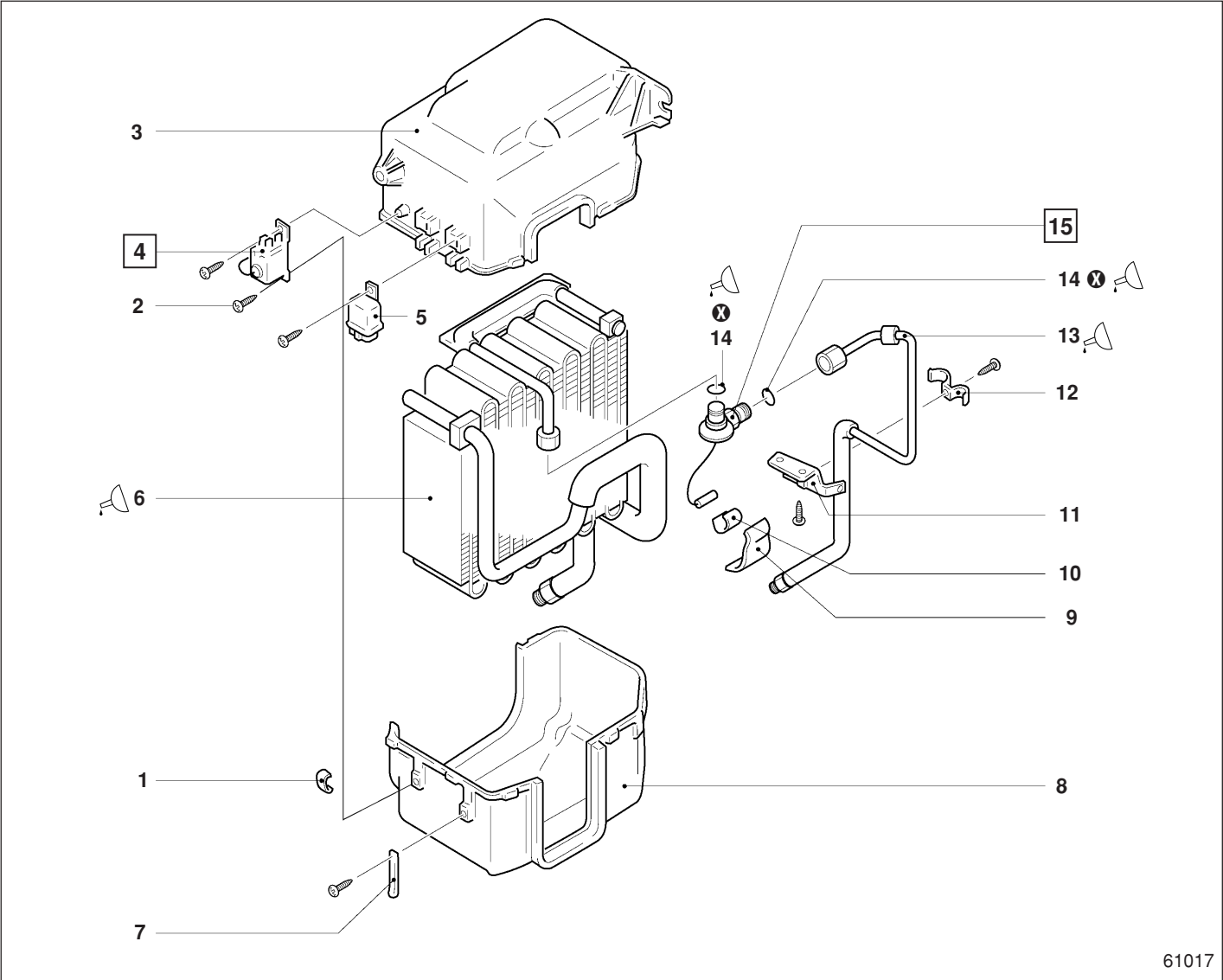
Switch position	Continuity terminal	Operation illumination
OFF	②-③	—
ON	①-②	①-③

- If any fault is found, replace the switch.



COOLING UNIT

Cooling unit assembly



Disassembly sequence

- | | | |
|-----------------------|-----------------------|--------------------|
| 1 Clip | 7 Clamp | 13 Pipe |
| 2 Screw | 8 Cooler case (lower) | 14 O-ring |
| 3 Cooler case (upper) | 9 Insulation rubber | 15 Expansion valve |
| 4 Thermostat | 10 Clip | |
| 5 Power relay | 11 Bracket | |
| 6 Evaporator | 12 Clamp | |
- ⊗ : Non-reusable parts

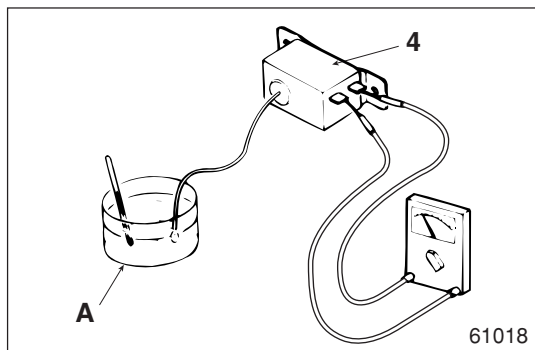
CAUTION

- Plug evaporator 6, pipe 13, and expansion valve 15 after disassembly to keep them free from dust etc.

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
6, 13, 14	End of pipe and entire surface of O-ring ⓘ P55A-25	Refrigerant machine oil S-PAG56	As required

◆ Service procedure

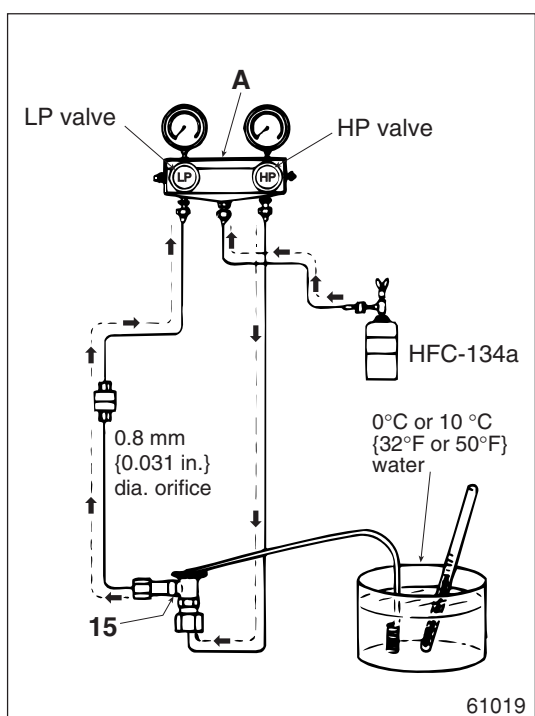


4 Inspection of thermostat

- Check the accuracy of the preset as below.
- Soak the sensor of the thermostat **4** in ice-water **A** of below 1.6°C.
- Check the continuity between the switch terminals.
- Pull the sensor out of the ice-water **A**, and check the continuity at over 4.6°C of the sensor.

Switching point Unit: °C {°F}

OFF	1.6 {35}
ON	4.6 {40}



15 Inspection of expansion valve

- Build up the test circuit with a gauge manifold **A**.
- Soak the sensor bulb in ice water of 0°C {32°F}, and of 10°C {50°F} respectively.
- Pressurize the HP side with dry nitrogen gas of 1.03 MPa {150 psi, 11 kgf/cm²}.
- Check the reading of the LP side pressure gauge for the standard range.
At 0°C {32°F} 0.127 MPa {18 psi, 1.3 kg/cm²}
At 10°C {50°F} 0.23 MPa {33 psi, 2.3 kg/cm²}

55A-36



MEMO



Group 55B

Heater

Table of Contents

BACK

HOME

 **mitsubishi FUSO TRUCK OF AMERICA, Inc.**

INDEX

SPECIFICATIONS	55B- 2
STRUCTURE AND OPERATION	55B- 3
TROUBLESHOOTING	55B- 8
HEATER HOSE.....	55B-10
HEATER CONTROL	55B-12
AIR DUCT	55B-15
HEATER UNIT AND BLOWER	55B-16
AIR OUTLET VENTILATION	55B-17

SPECIFICATIONS

Items		Specifications
System	Type	Inside/outside air combining, hot-water type heating system
	Standard voltage V	12
	Damper changeover system	Manual cable type
Blower assembly	Manufacturer	DENSO
	Power consumption W	170
	Maximum rotation rpm	3550
Heater unit assembly	Manufacturer	DENSO
	Temperature control system	Air mixing type
	*Heating performance kW {BTU/h, kcal/h}	*4.31{14720, 3710}

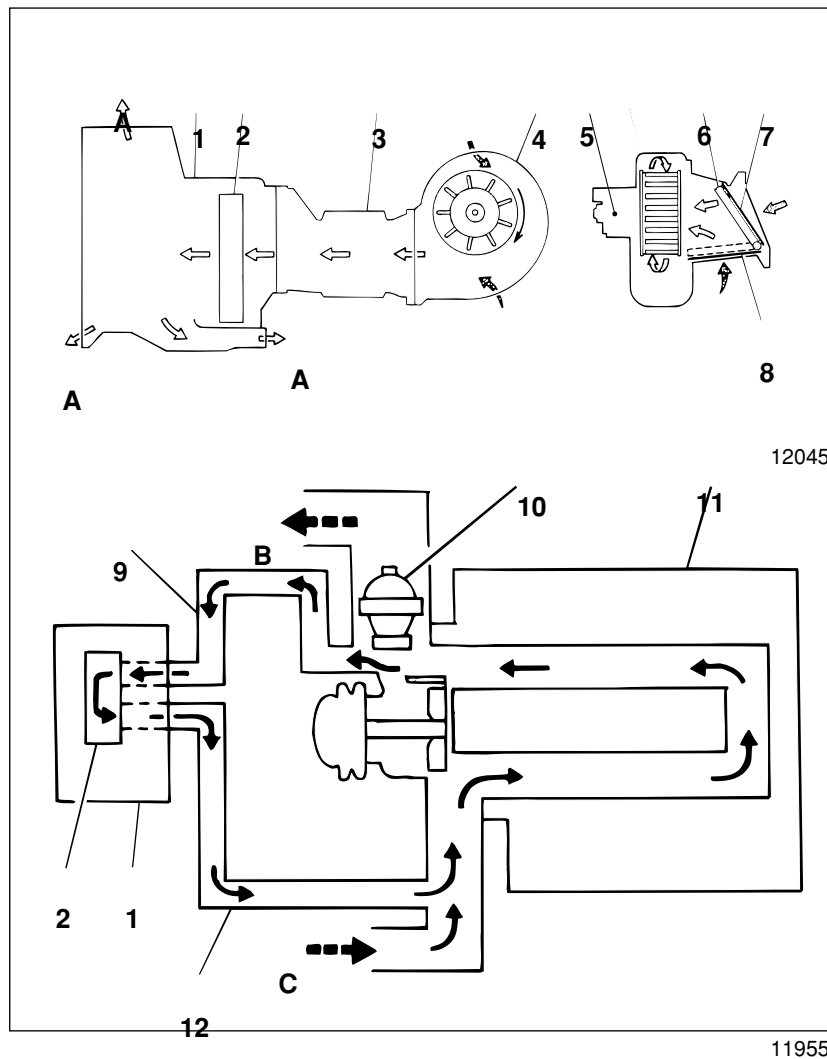
* : Heating performance is shown under the following conditions.

Temperature difference : 65°C {119°F}

Water flow : 6 L/min {0.0035 ft³/s}

Voltage : 12 V DC

Heater



- 1 Heater unit
- 2 Heater core
- 3 Joint duct
- 4 Blower assembly
- 5 Blower motor
- 6 Damper
- 7 Air filter (Outside air)
- 8 Air filter (Inside air)
- 9 Heater hose (Heater in)
- 10 Thermostat
- 11 Engine
- 12 Heater hose (Heater out)

A : To duct

B : To radiator

C : From radiator

➡ Outside air (Intake)

➡ Inside air (Circulation)

➡ Filtered air

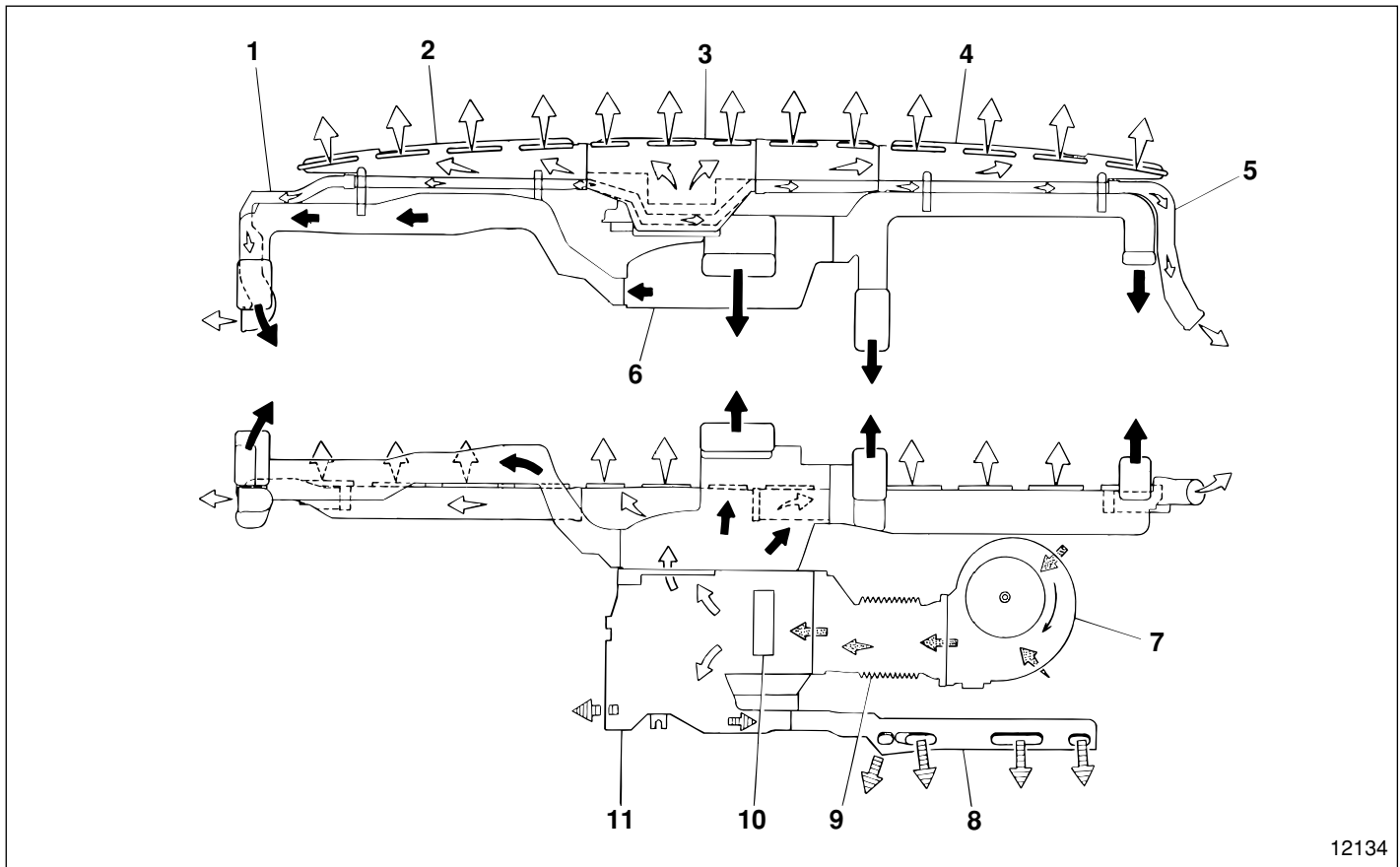
- Warm engine coolant that has absorbed heat from engine **11** does not flow through thermostat **10** but circulates as follows:

9→2→12→11

- Air sent to heater unit **1** from blower assembly **4** is warmed by heater core **2** (heat exchanger). Then the ducts deliver the warmed air to the cab.

STRUCTURE AND OPERATION

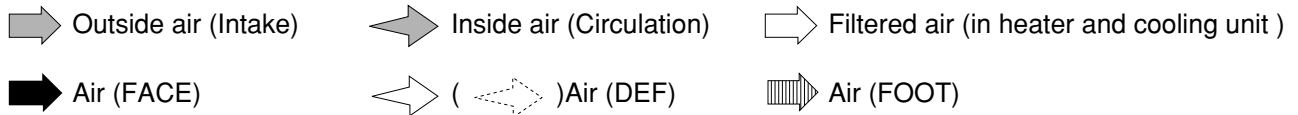
Air Duct



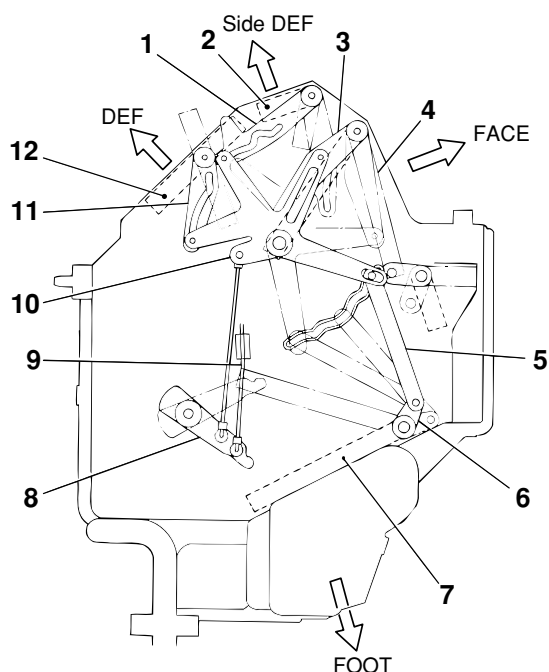
12134

- 1 Defroster side duct, LH
- 2 Front duct, LH
- 3 Center duct
- 4 Front duct, RH
- 5 Defroster side duct, RH
- 6 Face center duct

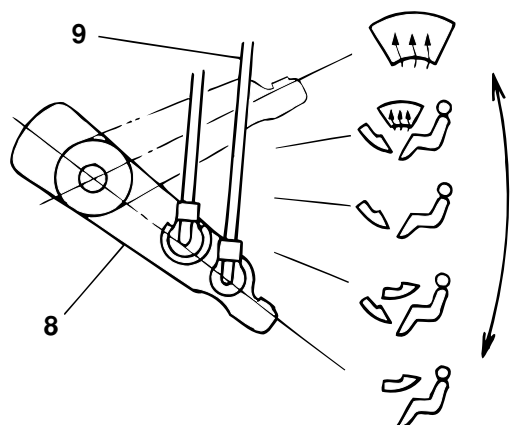
- 7 Blower assembly
- 8 Foot duct
- 9 Joint duct
- 10 Heater core
- 11 Heater unit



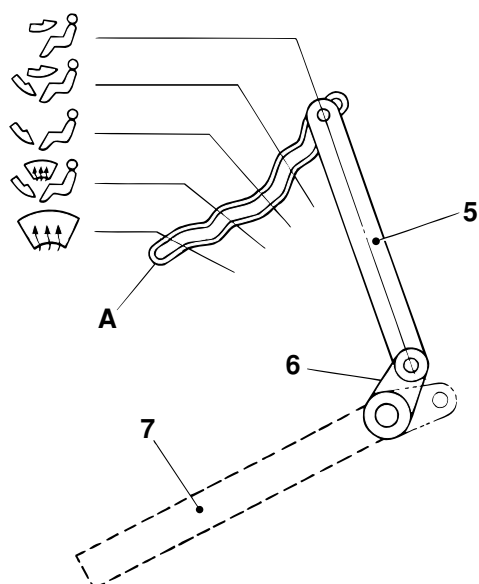
Since the opening and closing of the dampers of heater unit 11 is controlled by the switching operation of the heater unit assembly, the outside air and the inside air from blower assembly 7 flow as illustrated.



12203



12204



12205

● Mode changeover system

- 1 Plate
- 2 Damper (Side DEF)
- 3 Plate
- 4 Damper (FACE)
- 5 Plate
- 6 Plate
- 7 Damper (FOOT)
- 8 Lever (MODE-SUB)
- 9 Mode changeover control cable
- 10 Lever (MODE-MAIN)
- 11 Plate
- 12 Damper (DEF)

A : Rail

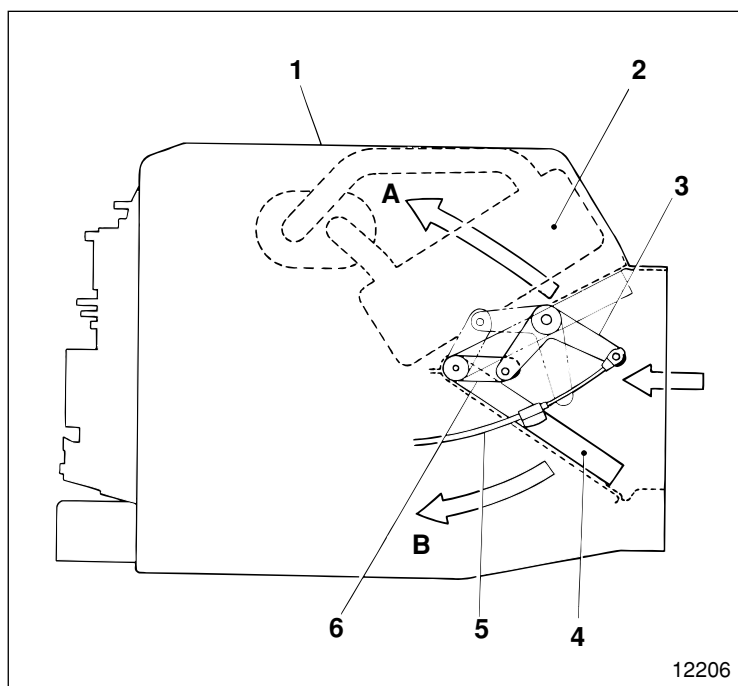
- The opening and closing of dampers 2, 4, 7, 12 is mechanically controlled by the movement of mode changeover control cable 9, transmitted as follows:
9→8→10→11→12 (DEF)
 →1→2 (Side DEF)
 →3→4 (FACE)
 →5→6→7 (FOOT)

Plates 1, 3, 5, 6, 11 move together with lever 10.

Dampers 2, 4, 7, 12 move together with plates 1, 3, 5, 6, 11, but the degree of opening of the dampers is determined by the shape of the plate grooves.

- Plate 5 is connected to rail A. Since the plate moves along the groove of the rail, damper 7 (FOOT) can be opened and closed in combination with other modes to activate bi-level mode.

STRUCTURE AND OPERATION



● Air mixing control

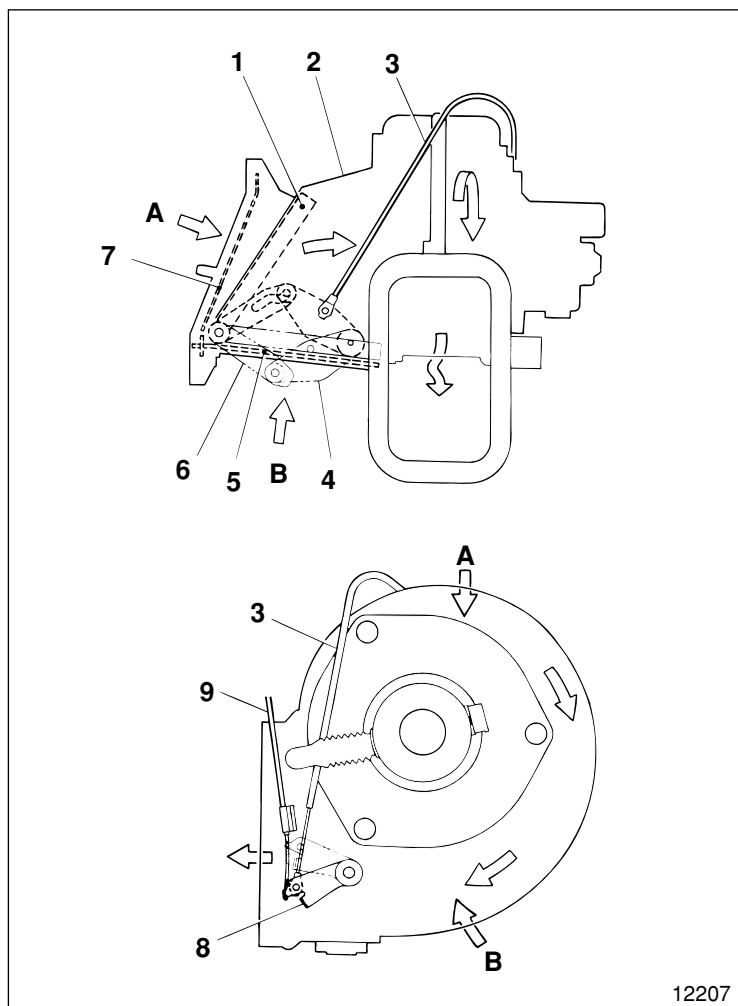
- 1 Heater unit
- 2 Heater core
- 3 Lever
- 4 Damper
- 5 Air mixing control cable
- 6 Plate

A : Warm air
B : Unwarmed air

- The degree of opening of damper 4 controls the flow of both air A that has passed through and been warmed by heater core 2, and air B that has not been warmed.
- Damper 4 is mechanically operated by the movement of air mixing control cable 5, transmitted as follows:

5→3→6→4

Plate 6 moves together with damper 4.



● Air intake control

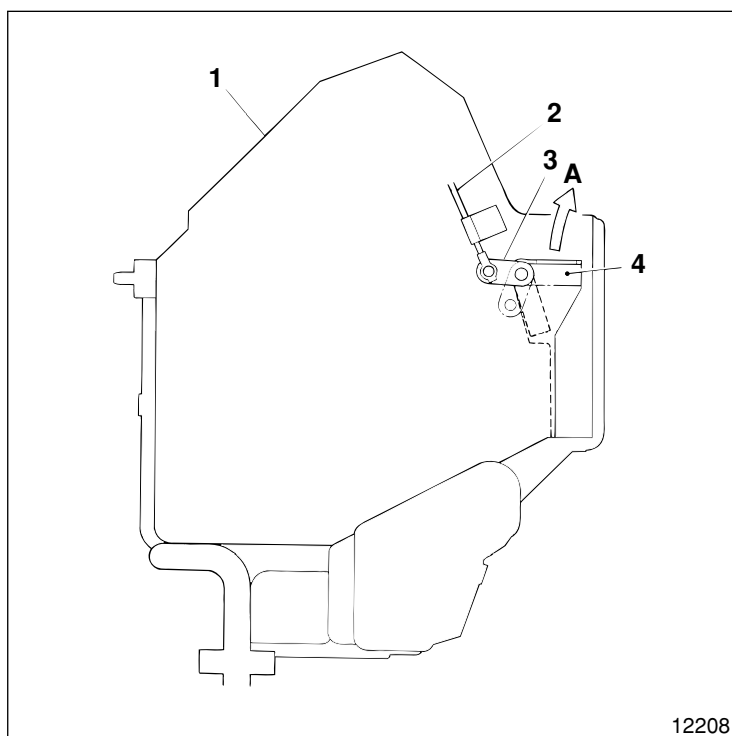
- 1 Damper
- 2 Blower assembly
- 3 Control cable
- 4 Lever
- 5 Air filter (Inside air)
- 6 Shaft
- 7 Air filter (Outside air)
- 8 Lever
- 9 Air intake control cable

A : Outside air
B : Inside air

- Changeover of air intake from inside to outside is controlled by the opening and closing of damper 1.
- Damper 1 is mechanically operated by the movement of air intake control cable 9.

9→8→3→4→6→1

Shaft 6 moves together with damper 1.



● Air flow bypass changeover

- 1 Heater unit
- 2 Air bypass changeover control cable
- 3 Plate
- 4 Damper

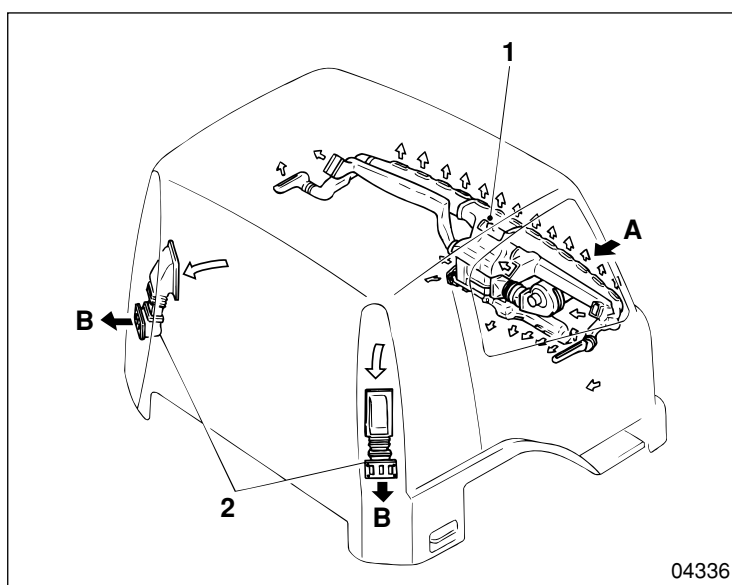
A : Air not warmed by heater unit

- Damper **4** is opened and closed to change the air flow from warm air to air that has not passed through and been warmed by the heater core.
- Damper **4** is mechanically operated by the movement of air flow bypass changeover control cable **2**, transmitted as follows:

2→**3**→**4**

Plate **3** moves together with damper **4**.

Ventilation System



- 1 Heater and duct assembly
- 2 Air outlet ventilation

A : Incoming outside air

B : Outgoing inside air

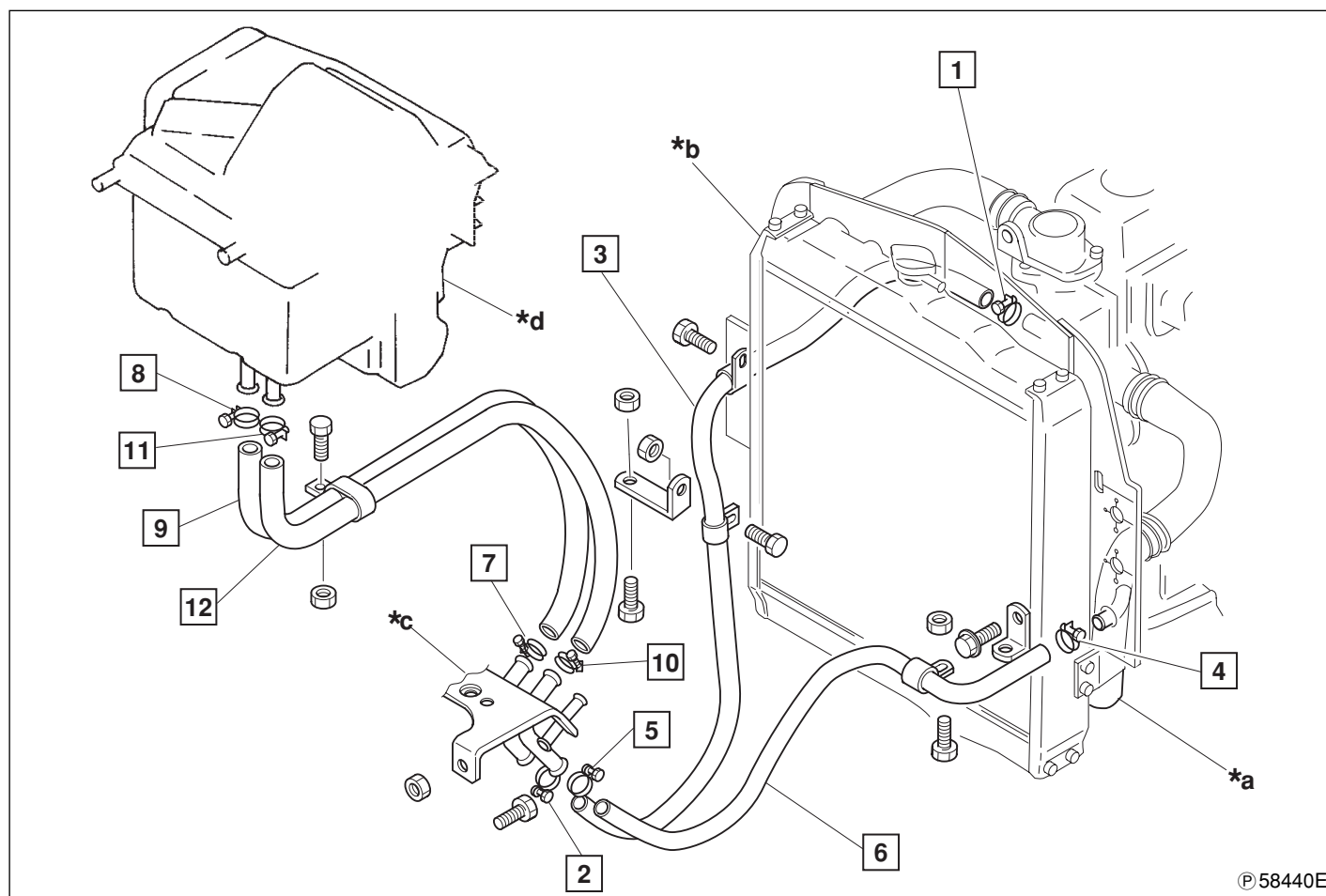
The ventilation system replaces the air in the cabin using frontal air pressure, generated when the vehicle is in motion.

TROUBLESHOOTING

Symptoms										Remarks
	Air does not flow from vents	Heater does not work well	Airflow control setting cannot be changed	Drafts from vents	Temperature control setting cannot be adjusted	Outside/inside air control cannot be changed	Air volume from vents unstable	Control switches operation heavy	Air flow bypass cannot be changed	
Possible causes										
Blower motor coil broken or short-circuited	○									
Blower resistor operation malfunctioning							○			
Mode damper opening and closing faulty			○	○				○		
Air mixing damper opening and closing faulty				○	○			○		
Inside/outside air changeover damper opening and closing faulty				○		○		○		
Heater control assembly faulty	○	○	○	○	○	○			○	
Thermostat does not close		○								 Gr 14
Engine coolant insufficient		○								 Gr 14
Connector connection faulty, harness broken or grounding faulty	○		○	○	○	○				
Fuse blown	○									
Heater pipes clogged, loose or connection faulty		○								
Duct connection faulty				○						
Heater unit clogged		○								
Control cable sliding movement faulty, installation faulty			○	○		○		○	○	
Control cable connecting lever of units bent			○	○		○		○		
Control cable connecting lever sliding parts of units worn or lubricated insufficiently			○	○		○		○		
Air flow bypass changeover damper opening and closing faulty									○	

MEMO

HEATER HOSE



● Removal sequence

- | | |
|---------------|----------------|
| 1 Hose clamp | 10 Hose clamp |
| 2 Hose clamp | 11 Hose clamp |
| 3 Heater hose | 12 Heater hose |
| 4 Hose clamp | |
| 5 Hose clamp | |
| 6 Heater hose | |
| 7 Hose clamp | |
| 8 Hose clamp | |
| 9 Heater hose | |

- *a : Inlet pipe  Gr 14
 *b : Radiator assembly  Gr 14
 *c : Hose bracket
 *d : Heater unit  P55B-16

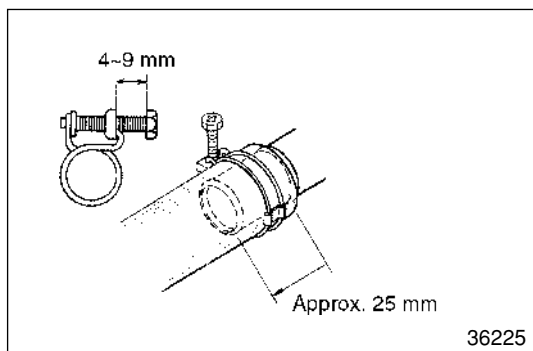
CAUTION

Drain the coolant from the radiator assembly *b before removing the heater hoses 3, 6, 9, 12.  Gr 14

● Installation sequence

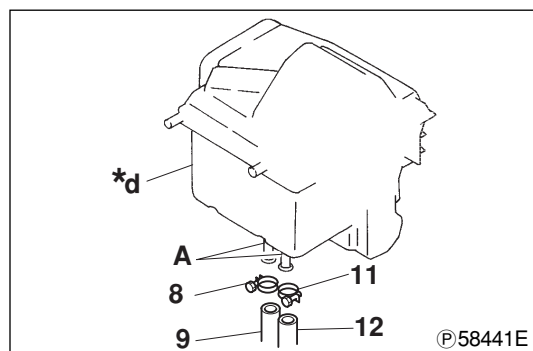
Follow the removal sequence in reverse.

◆ Service procedure



1 to 12 Installation of heater hoses and hose clamps

- Push the hose to the dimension shown in the drawing.
- Tighten the hose clamp to the dimension shown in the drawing.

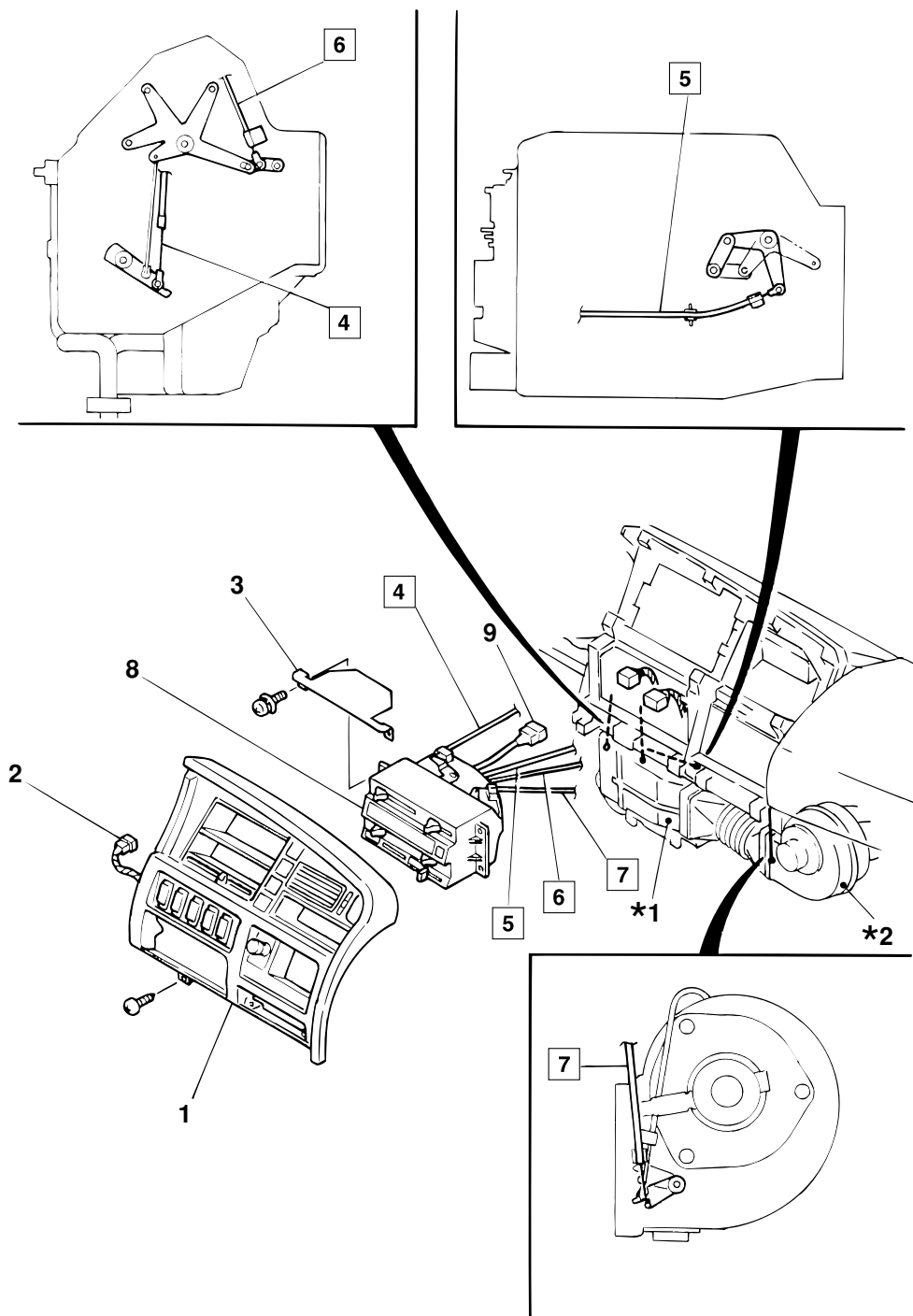


9 12 Removal of heater hoses

CAUTION ⚠

The hose fittings A on the heater unit *d can be damaged easily. Work carefully when removing the hose clamps 8, 11 and the heater hoses 9, 12.

HEATER CONTROL



12375

● Disassembly sequence

- 1 Center panel
- 2 Harness
- 3 Harness protector
- 4 Mode changeover control cable
- 5 Air mixing control cable
- 6 Air bypass changeover control cable

- 7 Inside/outside air changeover control cable
- 8 Heater control assembly  Gr 54
- 9 Harness

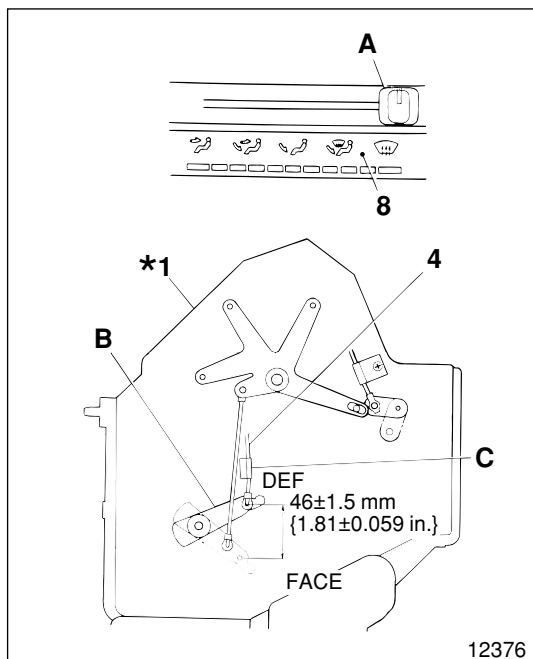
*1 : Heater unit  P55B-16

*2 : Blower assembly  P55B-16

● Assembly sequence

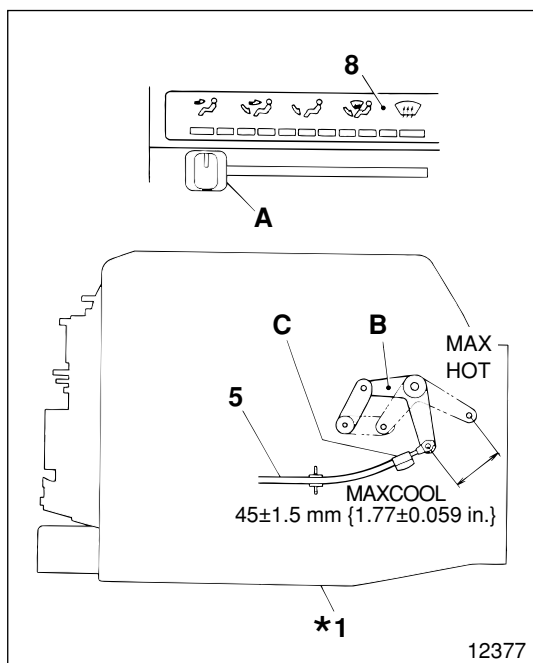
Follow the disassembly sequence in reverse.

◆ Service procedure



4 Installation of mode changeover control cable

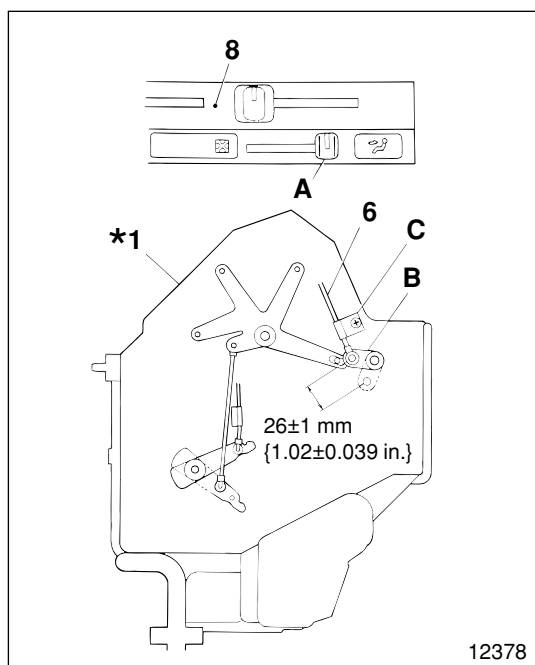
- Set mode changeover lever **A** of heater control assembly **8** to  (DEF).
- Set lever **B** of heater unit assembly ***1** to DEF.
- Under these conditions, install mode changeover control cable **4** onto lever **B**.
- Gently pull outer shield of mode changeover control cable **4** to DEF side (load of 4.9 N {1.1 lbf, 0.5 kgf}) and fasten by locking clamp **C**.



5 Installation of air mixing control cable

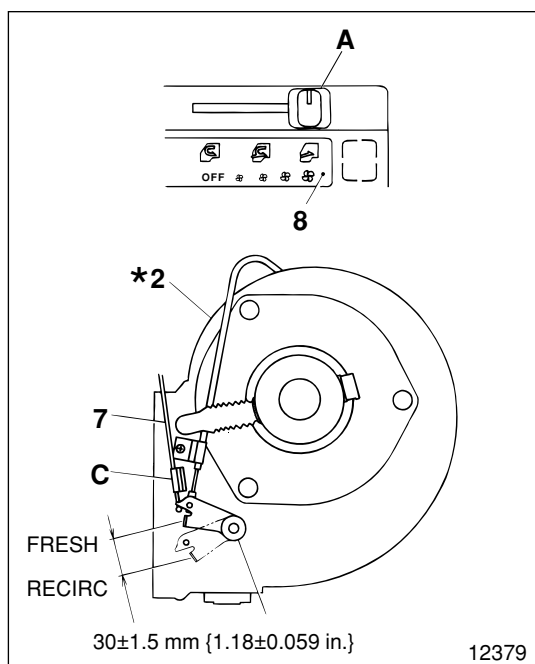
- Set temperature control lever **A** of heater control assembly **8** to MAX COOL.
- Set lever **B** of heater unit assembly ***1** to MAX COOL.
- Under these conditions, install air mixing control cable **5** onto lever **B**.
- Gently pull outer shield of air mixing control cable **5** to MAX COOL side (load of 4.9 N {1.1 lbf, 0.5 kgf}) and fasten by locking clamp **C**.

HEATER CONTROL



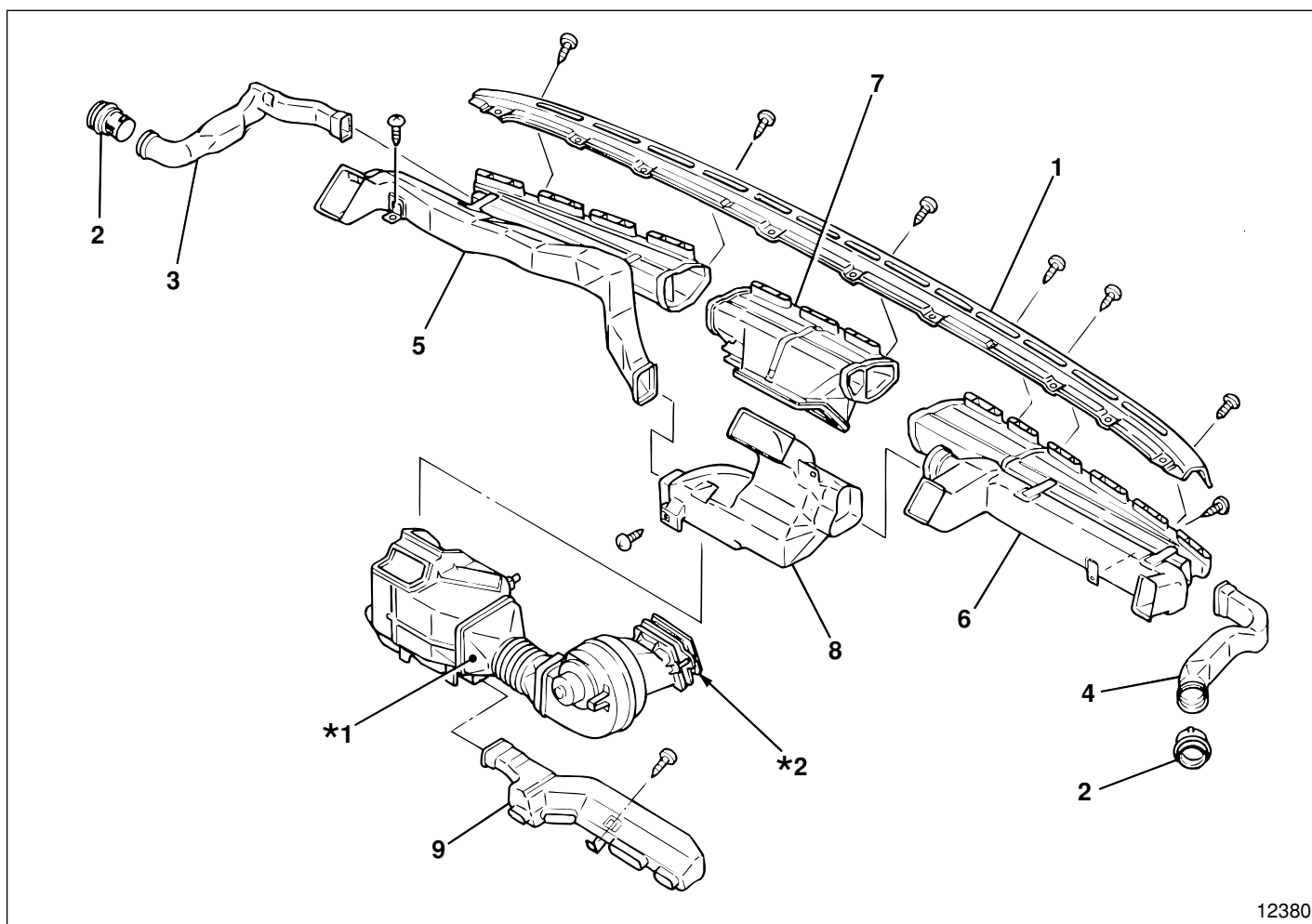
6 Installation of air bypass changeover control cable

- Set air bypass changeover control lever **A** of heater control assembly **8** to  (OPEN).
- Set plate **B** of heater unit assembly ***1** to OPEN.
- Under these conditions, install air bypass changeover control cable **6** onto plate **B**.
- Gently pull outer shield of air bypass changeover control cable **6** to OPEN side (load of 4.9 N {1.1 lbf, 0.5 kgf}) and fasten by locking clamp **C**.



7 Installation of inside/outside air changeover control cable

- Set inside/outside air changeover lever **A** of heater control assembly **8** to  (FRESH).
- Set lever **B** of blower assembly ***2** to FRESH.
- Under these conditions, install inside/outside air changeover control cable **7** onto lever **B**.
- Gently pull outer shield of inside/outside air changeover control cable **7** to FRESH side (load of 4.9 N {1.1 lbf, 0.5 kgf}) and fasten by locking clamp **C**.



12380

● Disassembly sequence

- | | |
|--|------------------|
| 1 Duct cover  Gr 42 | 6 Front duct, RH |
| 2 Side defroster joint | 7 Center duct |
| 3 Side defroster duct, LH | 8 Face duct |
| 4 Side defroster duct, RH | 9 Foot duct |
| 5 Front duct, LH | |

*1 : Joint duct  P55B-16

*2 : Air intake duct  P55B-16

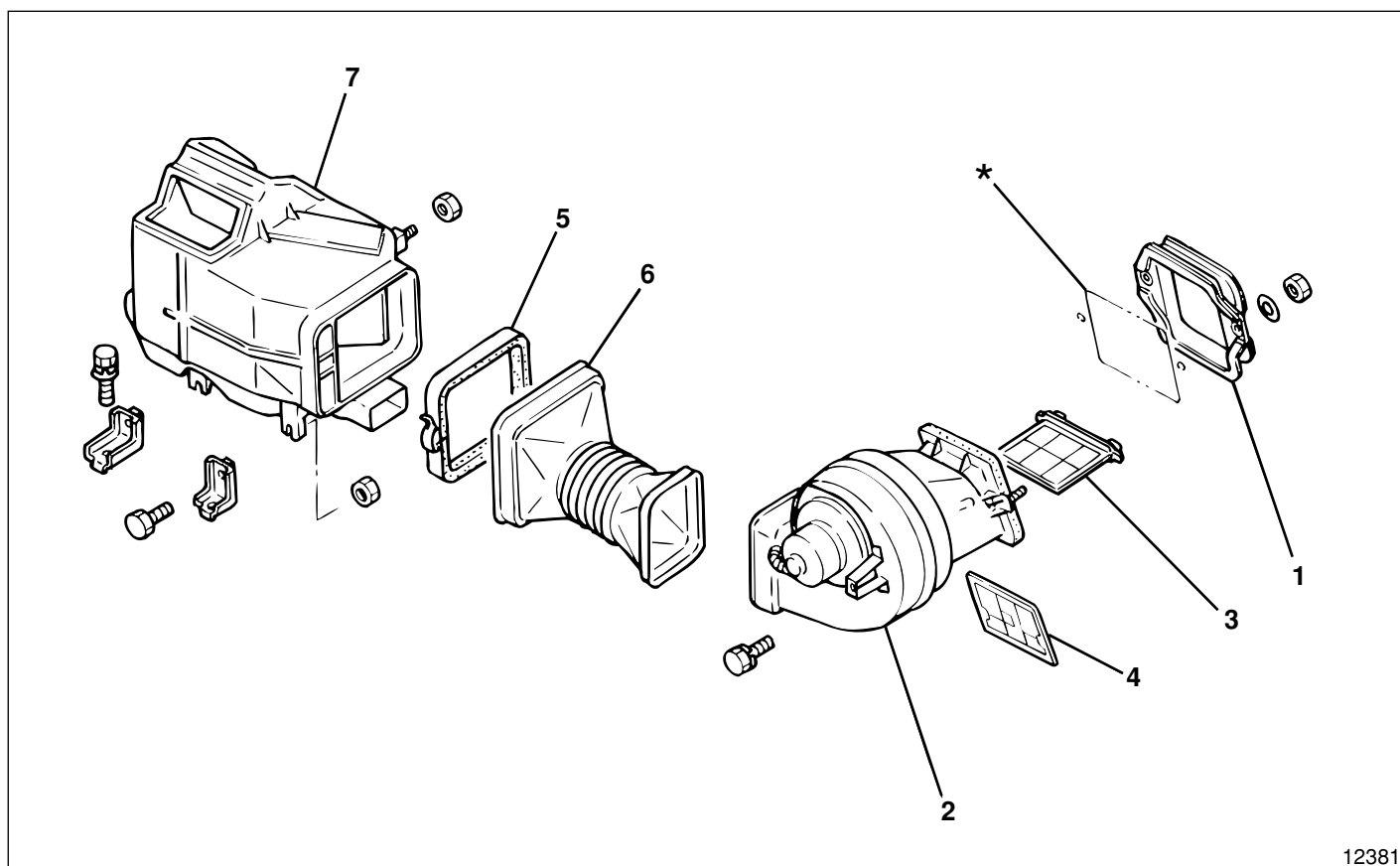
NOTE

Remove the instrument panels, crash pads and lower panels as a unit before removing ducts.  Gr 42

● Assembly sequence

Follow the disassembly sequence in reverse.

HEATER UNIT AND BLOWER



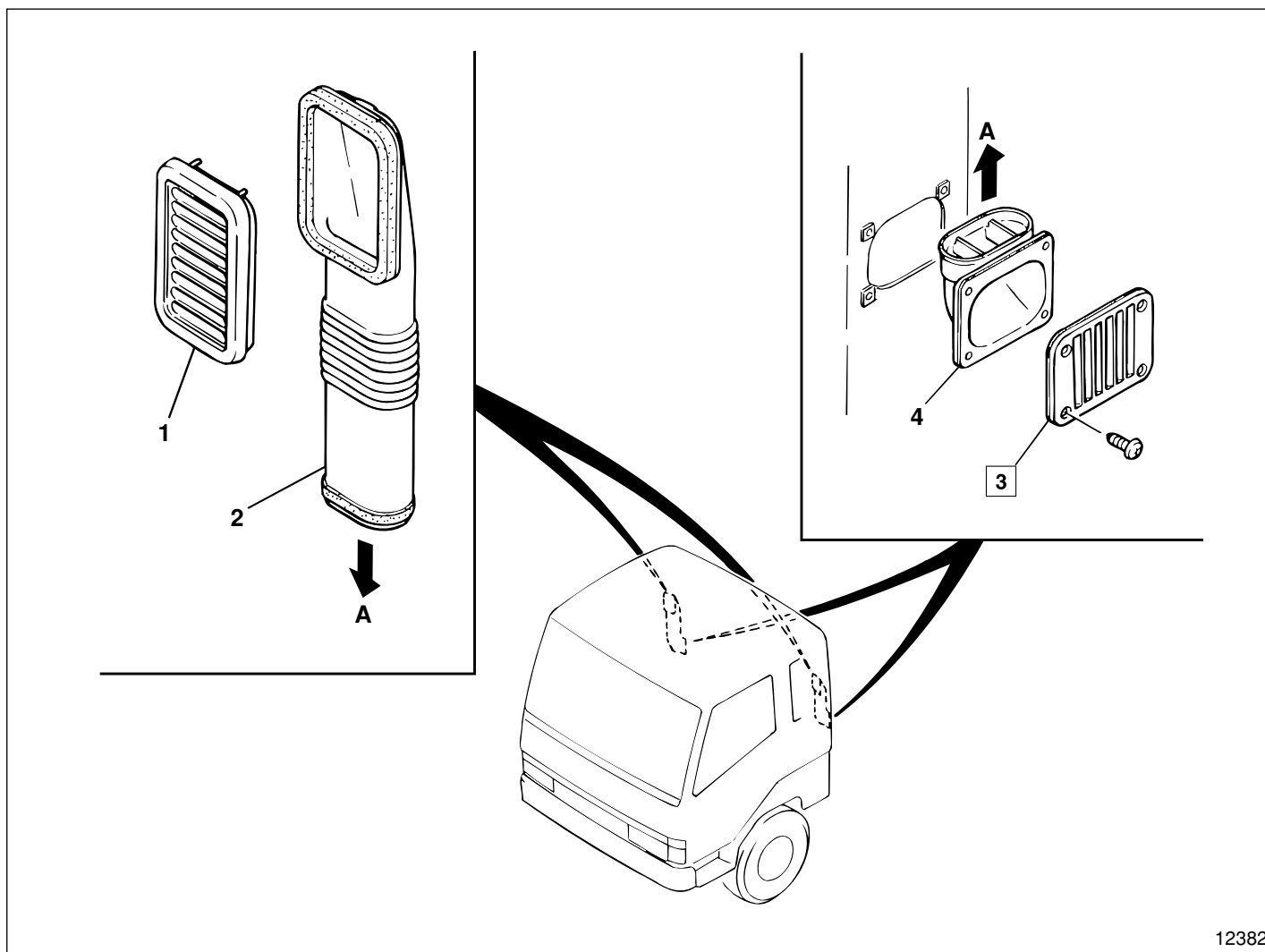
● Disassembly sequence

- 1 Air intake duct
- 2 Blower assembly P55B-12, Gr 54
- 3 Air filter (Inside air)
- 4 Air filter (Outside air)
- 5 Band
- 6 Joint duct
- 7 Heater unit P55B-12, Gr 54

* : Dashboard

● Assembly sequence

Follow the disassembly sequence in reverse.



12382

● Disassembly sequence

- 1 Inside air outlet garnishment
- 2 Air outlet duct (Upper)

- 3 Outside air outlet garnishment
- 4 Air outlet duct (Lower)

NOTE

Remove inside air outlet garnishment 1 and air outlet duct 2 after removing the side trim.  Gr 42

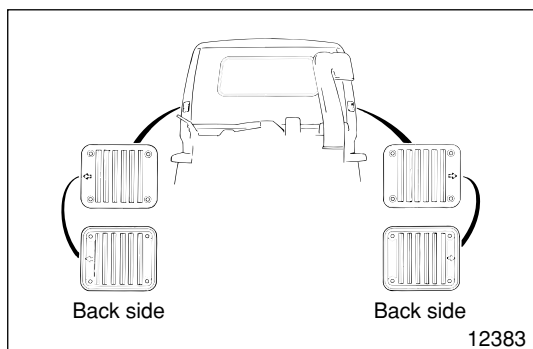
● Assembly sequence

Follow the disassembly sequence in reverse.

◆ Service procedure

3 Installation of outside air outlet garnishment

Install air outlet garnishment 3 in the direction as illustrated.



12383