

Important

WARNING/CAUTION/NOTE

Please read this manual and follow its instructions carefully. To emphasize special information, the words **WARNING**, **CAUTION** and **NOTE** have special meanings. Pay special attention to the messages highlighted by these signal words.

WARNING:

Indicates a potential hazard that could result in death or injury.

CAUTION:

Indicates a potential hazard that could result in vehicle damage.

NOTE:

Indicates special information to make maintenance easier or instructions clearer.

WARNING:

This service manual is intended for authorized Suzuki dealers and qualified service mechanics only. Inexperienced mechanics or mechanics without the proper tools and equipment may not be able to properly perform the services described in this manual.

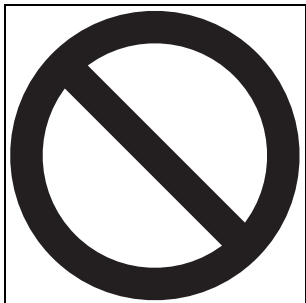
Improper repair may result in injury to the mechanic and may render the vehicle unsafe for the driver and passengers.

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- If the air bag system and another vehicle system both need repair, Suzuki recommends that the air bag system be repaired first, to help avoid unintended air bag system activation.
- Do not modify the steering wheel, instrument panel or any other air bag system component (on or around air bag system components or wiring). Modifications can adversely affect air bag system performance and lead to injury.
- If the vehicle will be exposed to temperatures over 93°C (200°F) (for example, during a paint baking process), remove the air bag system components (air bag (inflator) modules, forward sensor(s), SDM and/or seat belt pretensioners) beforehand to avoid component damage or unintended activation.

The circle with a slash in this manual means “Don’t do this” or “Don’t let this happen”.



Foreword

This SUPPLEMENTARY SERVICE MANUAL is a supplement to GRAND VITARA (SQ416/SQ420/SQ625) SERVICE MANUAL. It has been prepared exclusively for the following applicable model.

Applicable model: SQ420VD/SQ420WD (GRAND VITARA RHW Diesel engine model) on and after the following vehicle identification numbers (VINs).

⌘ JSAFTD83V00100001 ⌘ ~ ⌘ JSAFTD83V00200001 ⌘ ~
⌘ JSAFTB83V00100001 ⌘ ~ ⌘ JSAFTB83V00200001 ⌘ ~

This supplementary service manual describes only different service information of the above applicable model as compared with GRAND VITARA SERVICE MANUAL. Therefore, whenever servicing the above applicable model, consult this supplement first. And for any section, item or description not found in this supplement, refer to the related service manual below.

When replacing parts or servicing by disassembling, it is recommended to use SUZUKI genuine parts, tools and service materials (lubricant, sealants, etc.) as specified in each description.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. And used as the main subject of description is the vehicle of standard specifications among others.

Therefore, note that illustrations may differ from the vehicle being actually serviced.

The right is reserved to make changes at any time without notice.

RELATED MANUAL:

Manual Name	Manual No.
GRAND VITARA (SQ416/SQ420/SQ625) Service Manual	99500-65D20-01E
GRAND VITARA/GRAND VITARA XL-7 (SQ416/SQ420/SQ625/JA627/JA420WD) Unit Repair Manual (for Manual Transmission, Automatic Transmission, Transfer and Differential)	99501-65D50-01E
GRAND VITARA/GRAND VITARA XL-7 Wiring Diagram Manual	99512-68D40-015

SUZUKI MOTOR CORPORATION

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NOTE:

For the screen toned Sections in the above table, refer to the same section of the Related Manuals mentioned in FOREWORD of this manual.

SECTION 0A

0A

GENERAL INFORMATION

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

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Precautions

General Precautions

The WARNING and CAUTION below describe some general precautions that you should observe when servicing a vehicle. These general precautions apply to many of the service procedures described in this manual, and they will not necessarily be repeated with each procedure to which they apply.

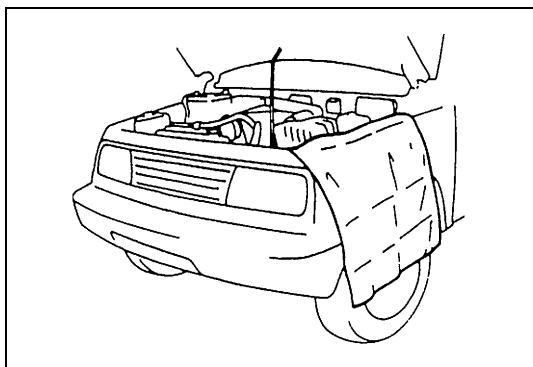
WARNING:

- Whenever raising a vehicle for service, be sure to follow the instructions under “Vehicle Lifting Points” on Section 0A.
- When it is necessary to do service work with the engine running, make sure that the parking brake is set fully and the transmission is in Neutral (for manual transmission vehicles) or Park (for automatic transmission vehicles). Keep hands, hair, clothing, tools, etc. away from the fan and belts when the engine is running.
- When it is necessary to run the engine indoors, make sure that the exhaust gas is forced outdoors.
- Do not perform service work in areas where combustible materials can come in contact with a hot exhaust system. When working with toxic or flammable materials (such as gasoline and refrigerant), make sure that the area you work in is well-ventilated.
- To avoid getting burned, keep away from hot metal parts such as the radiator, exhaust manifold, tailpipe, muffler, etc.
- New and used engine oil can be hazardous. Children and pets may be harmed by swallowing new or used oil. Keep new and used oil and used engine oil filters away from children and pets. Continuous contact with used engine oil has been found to cause [skin] cancer in laboratory animals.

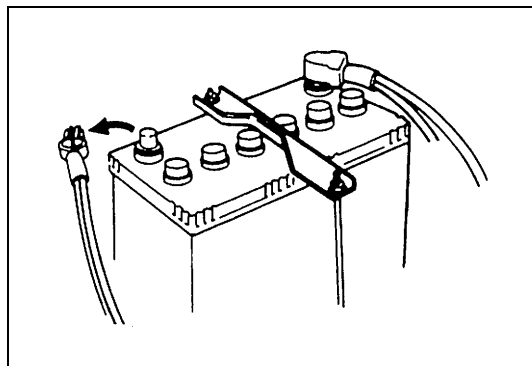
Brief contact with used oil may irritate skin. To minimize your exposure to used engine oil, wear a long-sleeve shirt and moisture-proof gloves (such as dishwashing gloves) when changing engine oil.

If engine oil contacts your skin, wash thoroughly with soap and water. Launder any clothing or rags if wet with oil, recycle or properly dispose of used oil and filters.

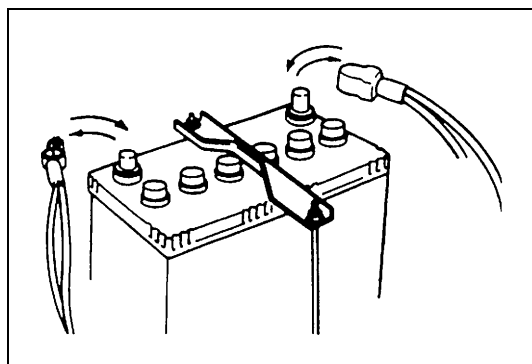
- Make sure the bonnet is fully closed and latched before driving. If it is not, it can fly up unexpectedly during driving, obstructing your view and resulting in an accident.



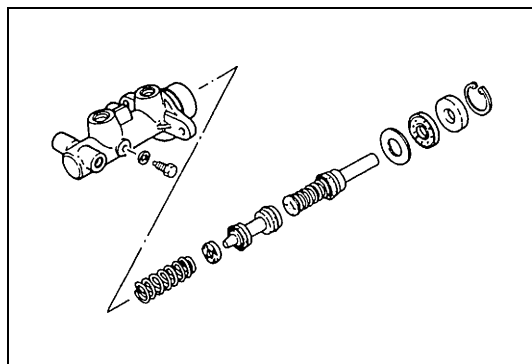
- Before starting any service work, cover fenders, seats and any other parts that are likely to get scratched or stained during servicing. Also, be aware that what you wear (e.g, buttons) may cause damage to the vehicle's finish.



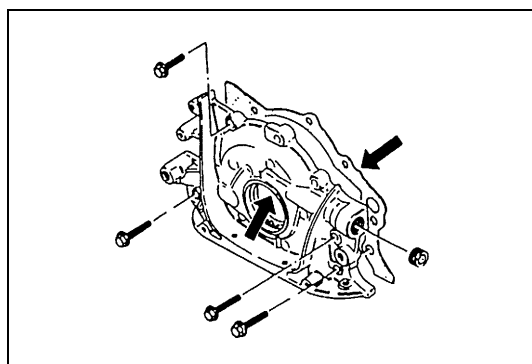
- When performing service to electrical parts that does not require use of battery power, disconnect the negative cable of the battery.



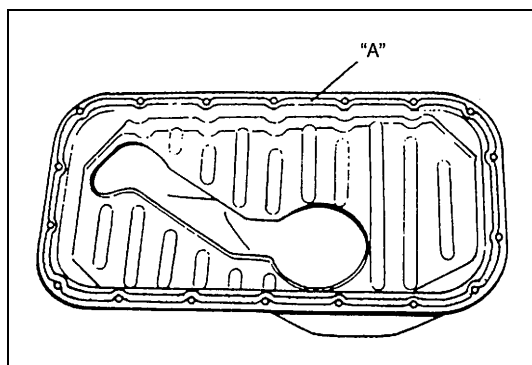
- When removing the battery, be sure to disconnect the negative cable first and then the positive cable. When reconnecting the battery, connect the positive cable first and then the negative cable, and replace the terminal cover.



- When removing parts that are to be reused, be sure to keep them arranged in an orderly manner so that they may be reinstalled in the proper order and position.

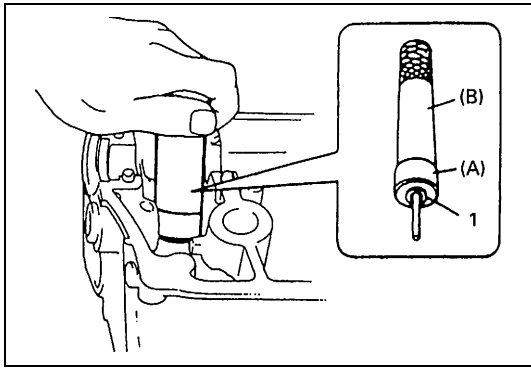


- Whenever you use oil seals, gaskets, packing, O-rings, locking washers, split pins, self-locking nuts, and certain other parts as specified, be sure to use new ones. Also, before installing new gaskets, packing, etc., be sure to remove any residual material from the mating surfaces.



- Make sure that all parts used in reassembly are perfectly clean.
- When use of a certain type of lubricant, bond or sealant is specified, be sure to use the specified type.

“A”: Sealant 99000-31150

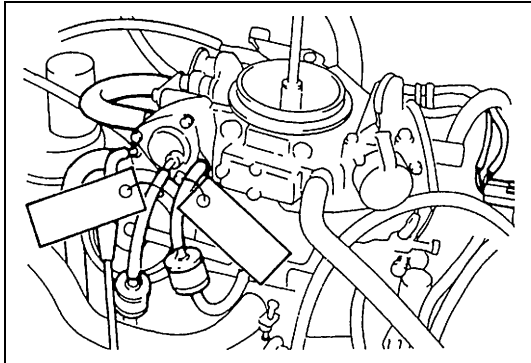


- Be sure to use special tools when instructed.

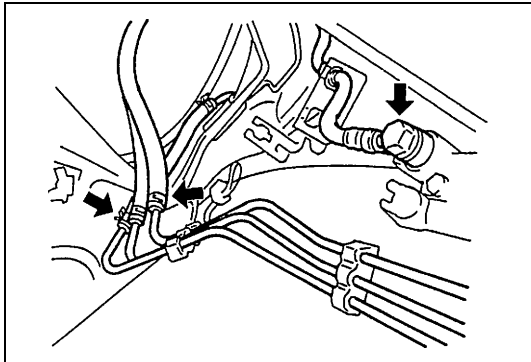
Special tool

(A): 09917-98221

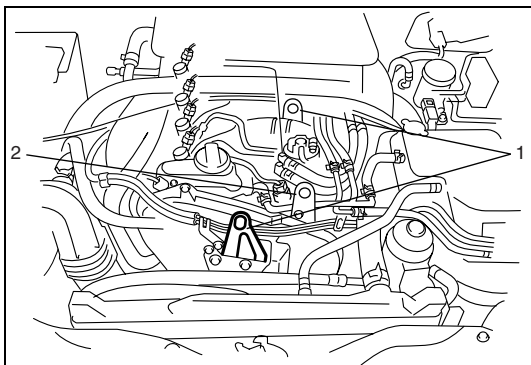
(B): 09916-58210



- When disconnecting vacuum hoses, attach a tag describing the correct installation positions so that the hoses can be reinstalled correctly.



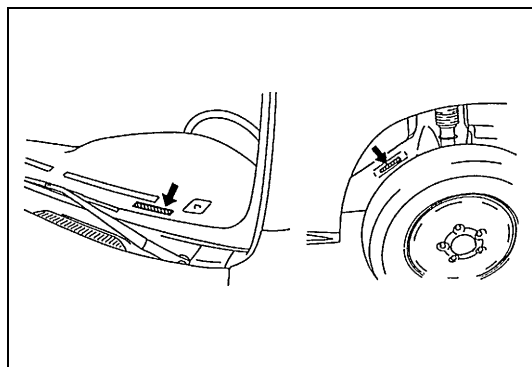
- After servicing fuel, oil, coolant, vacuum, exhaust or brake systems, check all lines related to the system for leaks.



- For vehicles equipped with fuel injection systems, never disconnect the fuel line between the fuel pump and injector within 30 sec. after engine stop, or fuel can be sprayed out under pressure.
- Be sure to use engine hooks (1) for hanging engine. Never use engine hook (2) for this purpose. This prohibited service may damage fuel line.

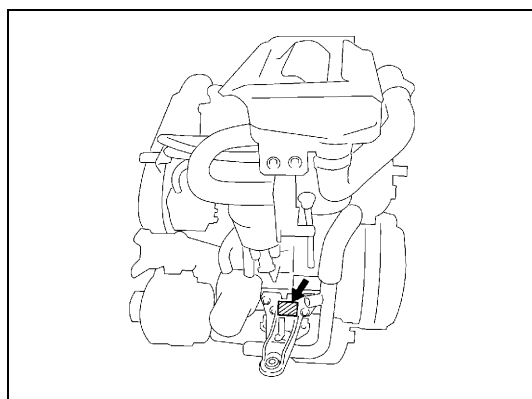
Identification Information

Vehicle Identification Number



The number is punched on the chassis inside the tire housing on the right front side and it is also on the left side of instrument panel depending on the vehicle specification.

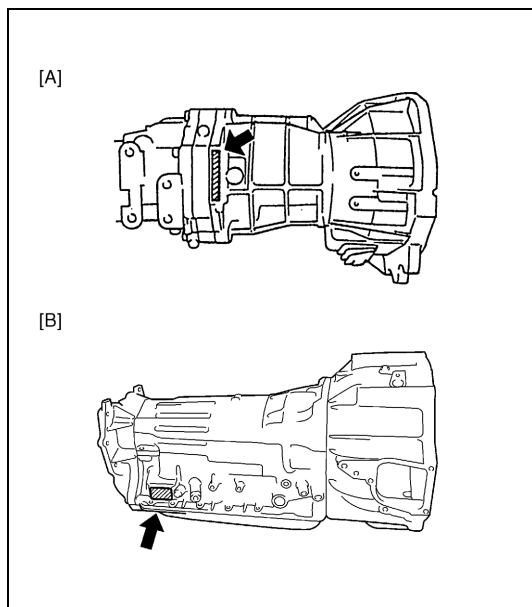
Engine Identification Number



The number is punched on the cylinder block.

Transmission Identification Number

The number is located on the transmission case.



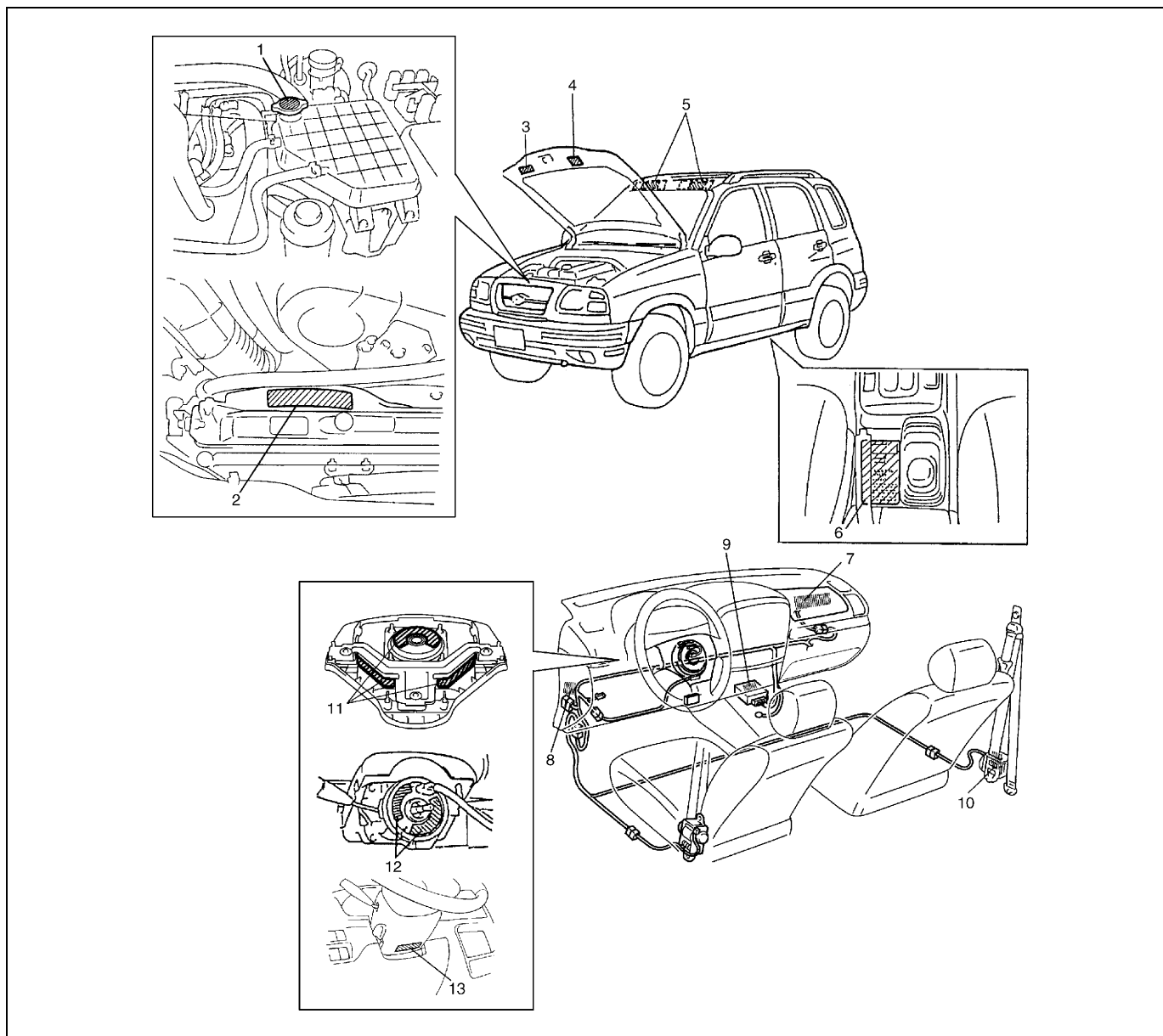
[A]:	M/T
[B]:	A/T

Warning, Caution and Information Labels

The figure below shows main labels among others that are attached to vehicle component parts. When servicing and handling parts, refer to WARNING/CAUTION instructions printed on labels. If any WARNING/CAUTION label is found stained or damaged, clean or replace it as necessary.

NOTE:

Air bag CAUTION/WARNING labels are attached on the vehicle equipped with air bag system only.

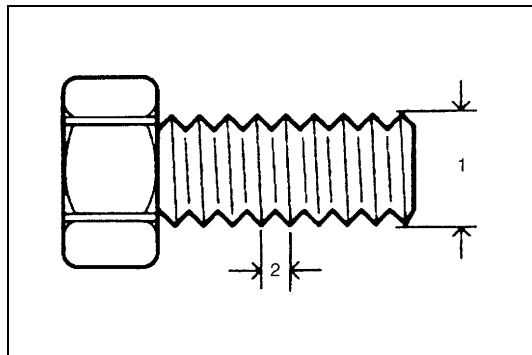


1. Degassing tank cap (radiator cap) label	6. Transfer label	11. Air bag warning label on driver air bag (inflator) module
2. Radiator cooling fan label	7. Air bag label on passenger air bag (inflator) module	12. Air bag warning label on combination switch and contact coil assembly
3. Air bag label	8. Air bag label on wire harness	13. Air bag warning label on steering column
4. Smoke level label	9. Air bag label on SDM	
5. Air bag label on sun visor	10. Seat belt pretensioner label on retractor	

Metric Information

Metric Fasteners

Most of the fasteners used for this vehicle are metric fasteners. When replacing any fasteners, it is most important that replacement fasteners be the correct diameter, thread pitch and strength.



CAUTION:

Note that both ISO and JIS type bolts and nuts are used for the engine assembly and related parts. Even when the diameter (1) of the thread is the same, its pitch (2) may vary between these two types. Installing a mismatched bolt or nut will cause damage to the thread. As the first step, make sure to tighten it by hand temporarily and if it feels tight, check the thread pitch for correct matching.

SECTION 0B

0B

MAINTENANCE AND LUBRICATION

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

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Maintenance Schedule	0B-2	Clutch	*
Maintenance Schedule Under Normal		Brake discs and pads	*
Driving Conditions	0B-2	Brake drums and shoes	*
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Engine coolant	0B-8	Automatic transmission fluid	0B-11
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Heater (Glow) plugs	0B-9	Steering system	*
Fuel System	0B-10	Power steering (P/S) system	
Air cleaner filter	0B-10	(if equipped)	0B-12
Fuel lines and connections	0B-10	All hinges, latches and locks	*
Fuel filter	0B-10	Air conditioning filter (if equipped)	*
Fuel tank	0B-11	Final Inspection	*
Chassis and Body	0B-11	Recommended Fluids and Lubricants	0B-13

Maintenance Schedule

Maintenance Schedule Under Normal Driving Conditions

NOTE:

- This interval should be judged by odometer reading or months, whichever comes first.
- This table includes services as scheduled up to 90,000 km (54,000 miles) mileage. Beyond 90,000 km (54,000 miles), carry out the same services at the same intervals respectively.

Interval	Km (x 1,000)	15	30	45	60	75	90
	Miles (x 1,000)	9	18	27	36	45	54
	Months	12	24	36	48	60	72
ENGINE							
Accessory drive belt		–	–	I	–	–	R
Camshaft timing belt		Replace every 150,000 km (90,000 miles).					
Engine oil and oil filter		Replace every 20,000 km (12,000 miles) or 16 months.					
Engine coolant		–	–	R	–	–	R
Exhaust system		–	I	–	I	–	I
Heater (Glow) plugs		Inspect every 120,000 km (72,000 miles) or 96 months.					
FUEL SYSTEM							
Air cleaner filter		I	I	R	I	I	R
Fuel lines		–	I	–	I	–	I
Fuel filter		Replace every 60,000 km (36,000 miles). Drain water every 20,000 km (12,000 miles).					
Fuel tank		–	–	I	–	–	I
CHASSIS AND BODY							
Clutch (pedal and fluid level)		–	I	–	I	–	I
Brake discs and pads (thickness, wear, damage)		I	I	I	I	I	I
Brake drums and shoes (wear, damage)		–	I	–	I	–	I
Brake hoses and pipes (leakage, damage, clamp)		–	I	–	I	–	I
Brake fluid		–	R	–	R	–	R
Brake lever and cable (damage, stroke, operation)		Inspect at first 15,000 km (9,000 miles) only					
Tires (wear, damage, rotation)		I	I	I	I	I	I
Wheel discs (damage)		I	I	I	I	I	I
Suspension system (tightness, damage, rattle, breakage)		–	I	–	I	–	I
Propeller shafts and drive shafts		–	–	I	–	–	I
Manual transmission oil (leakage, level) (I: 1st 15,000 km only)		I	–	R	–	–	R
Automatic transmission	Fluid level	–	I	–	I	–	I
	Fluid change	Replace every 165,000 km (99,000 miles)					
	Fluid hose	–	–	–	I	–	–
Transfer oil (leakage, level)		I	–	I	–	I	–
Differential oil (leakage, level) (R: 1st 15,000 km only)		R or I	–	I	–	I	–
Steering system (tightness, damage, breakage, rattle)		–	I	–	I	–	I
Power steering (if equipped)		I	I	I	I	I	I
All latches, hinges and locks		–	I	–	I	–	I
Air conditioning filter (if equipped)		–	I	R	–	I	R

NOTE:

- “R” : Replace or change
- “I” : Inspect and correct, replace or lubricate if necessary

Some maintenance items are required to be serviced at times other than the regular maintenance times shown at the top of above table. These items can be serviced at an earlier service opportunity according to customer's maintenance convenience. Their next maintenance service should be done within the specified period.

Maintenance Recommended Under Severe Driving Conditions

If the vehicle is usually used under the conditions corresponding to any severe condition code given below, it is recommended that applicable maintenance operation be performed at the particular interval as given in the chart below.

Severe condition code

A : Repeated short trips

B : Driving on rough and/or muddy roads

C : Driving on dusty roads

D : Driving in extremely cold weather and/or salted roads

E : Repeated short trips in extremely cold weather

F : Leaded fuel use

G : Town use/Towing a trailer/Sustained high speed driving/Hot climates, above 30 °C (86 °F)/Low quality lubricants or fuel

H : Trailer towing (if admitted)

Severe Condition Code	Maintenance	Maintenance Operation	Maintenance Interval
– B C D – – – –	Accessory drive belt (V-rib belt)	I	Every 15,000 km (9,000 miles) or 12 months
		R	Every 45,000 km (27,000 miles) or 36 months
A – C D E – G –	Camshaft timing belt	R	Every 120,000 km (72,000 miles)
A – C D E – G –	Engine oil and oil filter	R	Every 10,000 km (6,000 miles) or 8 months
– B – – – – – –	Exhaust pipe mountings	I	Every 15,000 km (9,000 miles) or 12 months
– – C – – – – –	Air cleaner filter *1	I	Every 2,500 km (1,500 miles)
		R	Every 30,000 km (18,000 miles) or 24 months
– B C D – – – H	Wheel bearing	I	Every 15,000 km (9,000 miles) or 12 months
– B – – – – – –	Suspension bolts and nuts	T	Every 15,000 km (9,000 miles) or 12 months
– B – D E – – H	Propeller shafts and drive shafts	I	Every 15,000 km (9,000 miles) or 12 months

Severe Condition Code	Maintenance	Maintenance Operation	Maintenance Interval
- B - - E - - H	Manual transmission, transfer and differential oil	R	First time only: 15,000 km (9,000 miles) or 12 months
			Second time and after: Every 30,000 km (18,000 miles) or 24 months reckoning from 0 km (0 miles) or 0 months
- B - - E - - H	Automatic transmission fluid	R	Every 30,000 km (18,000 miles) or 24 months
- - C D - - - -	Air conditioning filter *2 (if equipped)	I	Every 15,000 km (9,000 miles) or 12 months
		R	Every 45,000 km (27,000 miles) or 36 months

NOTE:

- “I” : Inspect and correct, replace or lubricate if necessary
- “R” : Replace or change
- “T” : Tighten to the specified torque
- *1 : Inspect or replace more frequently if necessary.
- *2 : Clean or replace more frequently if the air from the air conditioning decreases.

Maintenance Service

Engine

Accessory drive belt

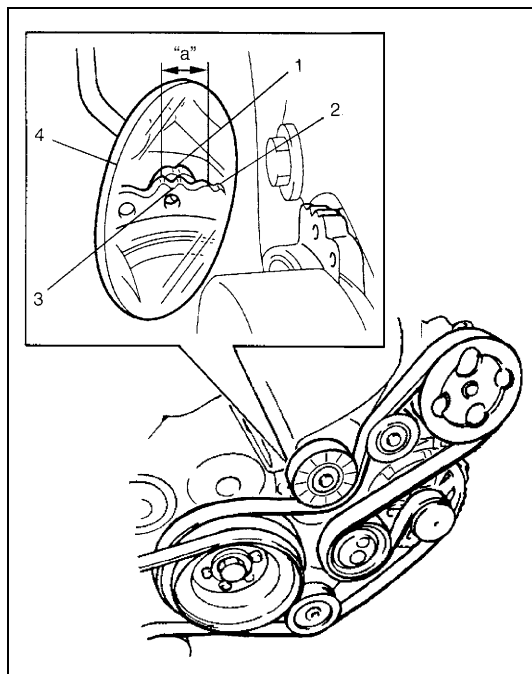
WARNING:

All inspection and replacement are to be performed with **ENGINE NOT RUNNING**.

GENERATOR DRIVE BELT INSPECTION

- 1) Disconnect negative cable at battery.
- 2) Inspect belt for cracks, cuts, deformation, wear and cleanliness using mirror under enough lighting.
If any defect exists, replace.
- 3) Check that belt wear check mark (1) (tension indicator) is within range "a" using mirror (4) under enough lighting.
If wear check mark (1) is aligned with maximum wear mark (2) or out of range "a" passing mark (2), replace accessory drive belt with a new one.
- 4) Connect negative cable to battery.

3. Zero wear mark



GENERATOR DRIVE BELT REPLACEMENT

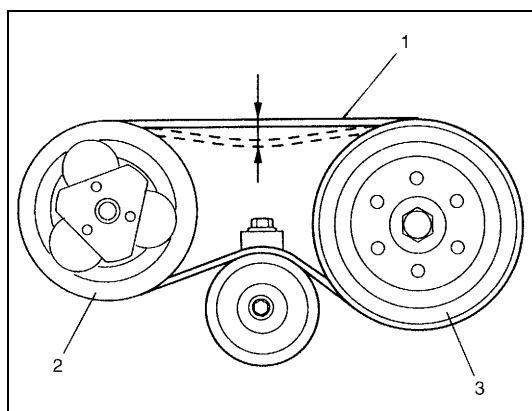
Replace belt with a new one referring to "Generator Belt" in Section 6H.

AIR CONDITIONING COMPRESSOR DRIVE BELT INSPECTION

Check compressor drive belt (1) for wear, cracks and tension referring to "Compressor Drive Belt" in Section 1B.
Repair or replace if any faulty condition is found.

2. Compressor

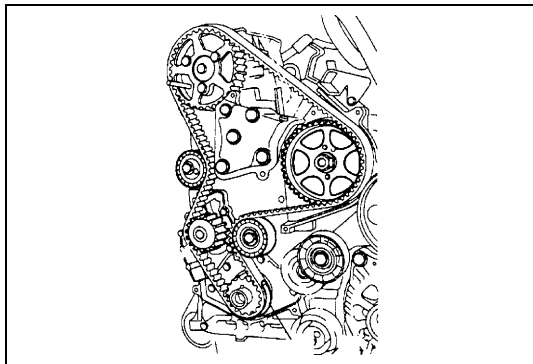
3. Crankshaft pulley



AIR CONDITIONING COMPRESSOR DRIVE BELT REPLACEMENT

Replace belt with a new one referring to “Compressor Drive Belt” in Section 1B.

Camshaft timing belt REPLACEMENT

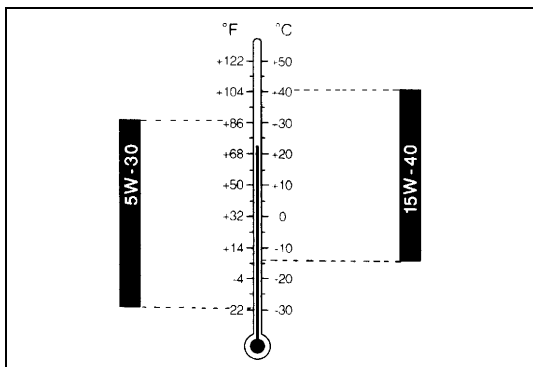


Replace belt with new one. Refer to “Timing Belt” in Section 6A3 for replacement procedure.

CAUTION:

- Do not bend or twist timing belt.
- Do not allow timing belt to come into contact with oil, water, etc.

Engine oil and oil filter CHANGE

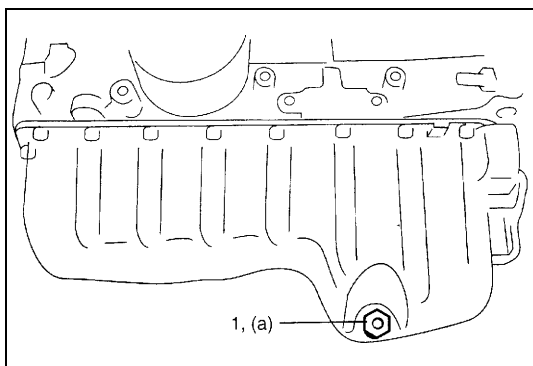


It is recommended to use the following engine oil or higher quality level oils.

5W-30 : API CF (except CF-2) or ACEA B3-98

15W-40 : API SG/CF (except CF-2) or ACEA B2-96

Select the appropriate oil viscosity according to the left chart.

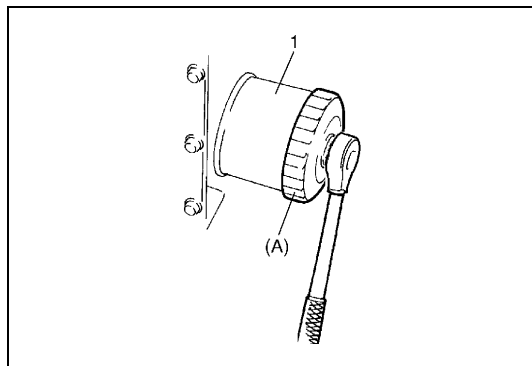


Before draining engine oil, check engine for oil leakage. If any evidence of leakage is found, make sure to correct defective part before performing the following work.

- 1) Remove engine under-cover and drain engine oil by removing drain plug (1).
- 2) After draining oil, wipe drain plug clean. Reinstall drain plug, and tighten it securely as specified below.

Tightening torque

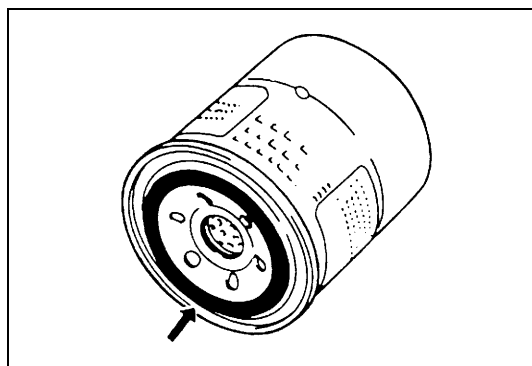
Engine oil drain plug (a): 34 N·m (3.4 kg-m, 25.0 lb-ft)



3) Loosen oil filter (1) by using oil filter wrench (Special tool).

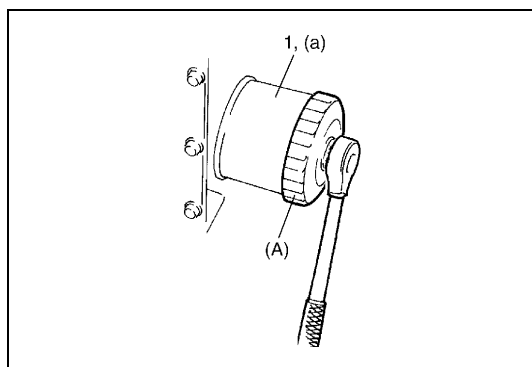
Special tool

(A): 09915-46510



4) Apply engine oil to new oil filter O-ring.

5) Screw new filter on oil filter stand by hand.



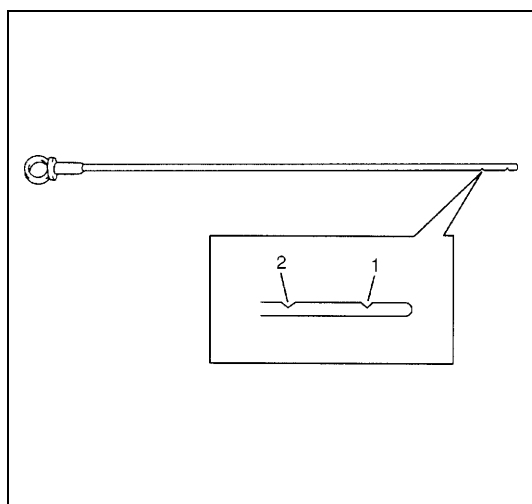
6) Tighten filter (1) to specified torque.

Special tool

(A): 09915-46510

Tightening torque

(a): 14 N·m (1.4 kg-m, 10.5 lb-ft)



7) Replenish oil until oil level is brought to FULL level mark (2) on dipstick. (about 4.75 liters or 10.0/8.4 US/Imp pt.).

NOTE:

Note that amount of oil required when actually changing oil may somewhat differ from this data depending on various conditions (temperature, viscosity, etc.)

8) Start engine and run it for three minutes. Stop it and wait another 5 minutes before checking oil level. Add oil, as necessary, to bring oil level to FULL level mark (2) on dipstick.

9) Check oil filter and drain plug for oil leakage.

1. LOW level mark

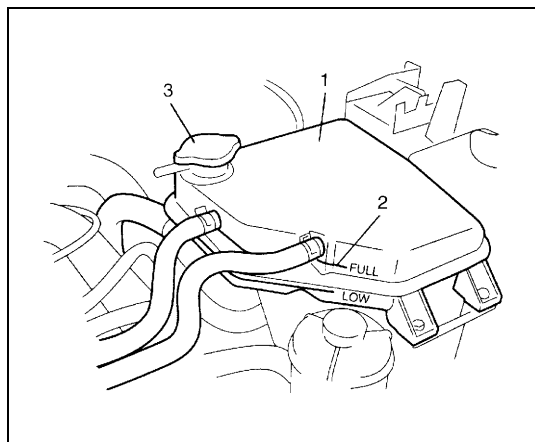
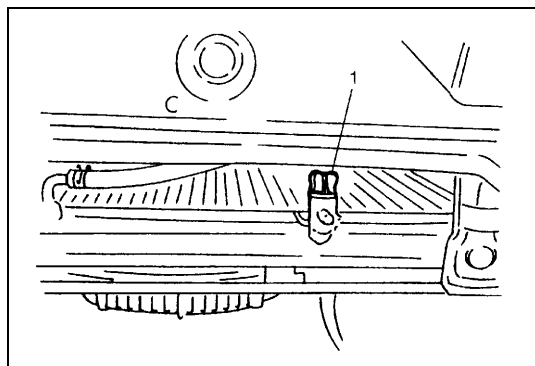
Engine coolant CHANGE

WARNING:

To help avoid danger of being burned, do not remove degassing tank cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

CAUTION:

When changing engine coolant, use mixture of 50% water and 50% ethylene-glycol base coolant (Anti-freeze/Anti-corrosion coolant) for the purpose of corrosion protection and lubrication.



- 1) Remove degassing tank cap when engine is cool.
- 2) Remove engine under cover. Loosen radiator drain plug (1) to drain coolant.
- 3) Tighten drain plug securely.
- 4) Fill cooling system with specified coolant through degassing tank filler inlet, up to "FULL" level mark (2) on degassing tank (1).
- 5) Loosen bleed screw on thermostat cap to bleed air and tighten it after confirmation of overflow.
- 6) Run engine with replenishing coolant, until radiator upper hose is hot.
- 7) Add coolant as necessary until coolant reaches "FULL" level mark on degassing tank.
Reinstall degassing tank cap (3).
Refer to "Coolant" in Section 6B of this manual for Coolant Capacity.

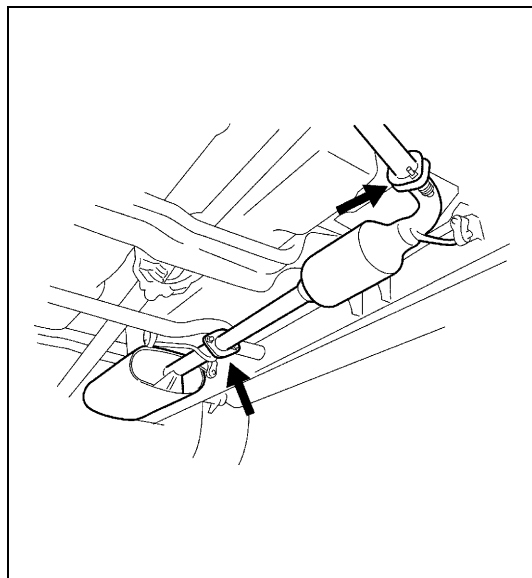
Exhaust system

INSPECTION

WARNING:

To avoid danger of being burned, do not touch exhaust system when it is still hot.

Any service on exhaust system should be performed when it is cool.

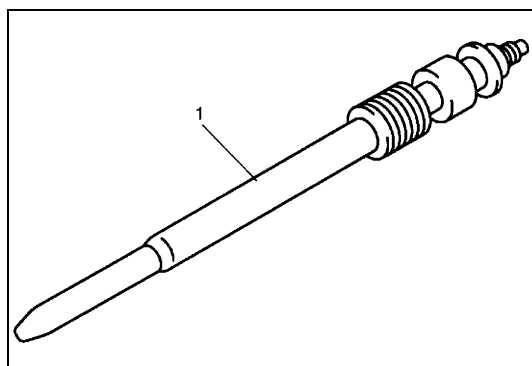


Check exhaust system as follows:

- Check rubber mountings for damage and deterioration.
- Check exhaust system for leakage, loose connections, dents, and damages.
If bolts or nuts are loose, tighten them to specification. Refer to “Exhaust System Components” in Section 6K for torque specification of bolts and nuts.
- Check nearby body areas for damaged, missing or mispositioned parts, open seams, holes, loose connections or other defects which could permit exhaust fumes to seep into vehicle.
- Make sure that exhaust system components have enough clearance from underbody to avoid overheating and possible damage to floor carpet.
- Any defects should be fixed at once.

Heater (Glow) plugs

INSPECTION



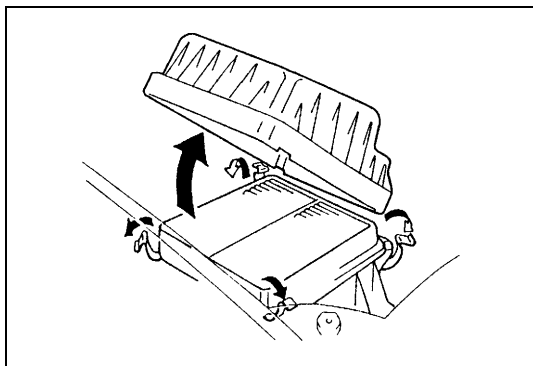
Check heater (Glow) plug (1) for external damage such as deformation, scratch, crack, etc.

If damage is found, replace.

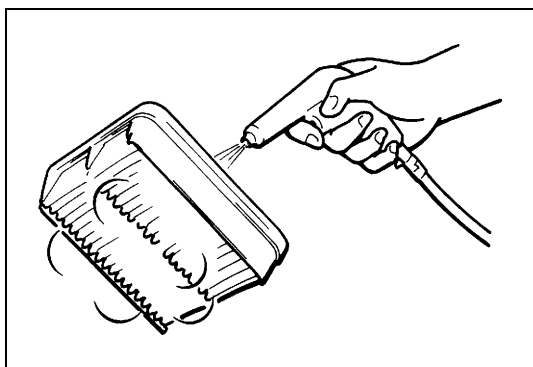
Fuel System

Air cleaner filter

INSPECTION



- 1) Unclamp air cleaner case clamps.
- 2) Take filter out of air cleaner case.
- 3) Check filter for dirt. Replace excessively dirty filter.



- 4) Clean filter with compressed air from air outlet side of filter (i.e., the side facing up when installed).
- 5) Install filter and clamp case securely.

REPLACEMENT

Replace air cleaner filter with new one according to above steps 1), 2) and 5).

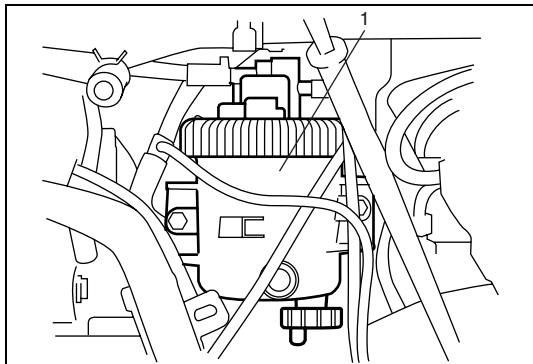
Fuel lines and connections

INSPECTION

- 1) Visually inspect fuel lines and connections for evidence of fuel leakage, hose cracking and damage. Make sure all clamps are secure.
Repair leaky joints, if any.
Replace hoses that are suspected of being cracked.

Fuel filter

REPLACEMENT



WARNING:

This work must be performed in a well ventilated area and away from any open flames (such as gas hot water heaters).

Replace fuel filter element in fuel filter assembly (1) with new one referring to "Fuel Filter" in Section 6C.

WATER DRAINING OF FUEL FILTER

Bleed fuel filter of water referring to “Water Draining of Fuel Filter” in Section 6C.

Fuel tank

INSPECTION

Check fuel tank for damage, cracks, fuel leakage, corrosion and tank bolts looseness.

If a problem is found, repair or replace.

Chassis and Body

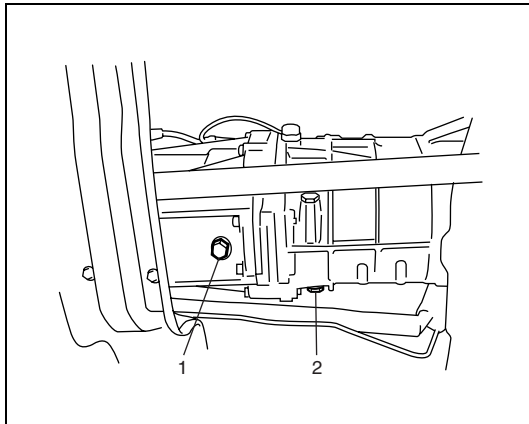
Manual transmission oil

INSPECTION

- 1) Inspect transmission case for evidence of oil leakage.
Repair leaky point if any.
- 2) Make sure that vehicle is placed level for oil level check.
- 3) Remove level plug (2) of transmission.
- 4) Check oil level.

Oil level can be checked roughly by means of level plug hole. That is, if oil flows out of level plug hole or if oil level is found up to hole when level plug is removed, oil is properly filled. If oil is found insufficient, pour specified amount of specified oil.

- 5) Tighten level plug to specified torque.
Refer to “Transmission Gear Oil” in Section 7A2 for installation and tightening torque.



1. Drain plug

CHANGE

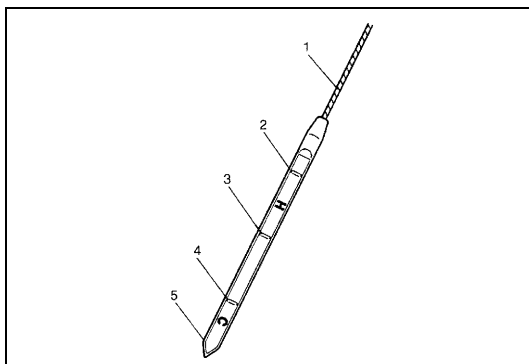
Change transmission oil with new specified oil referring to “Transmission Gear Oil” in Section 7A2.

Automatic transmission fluid

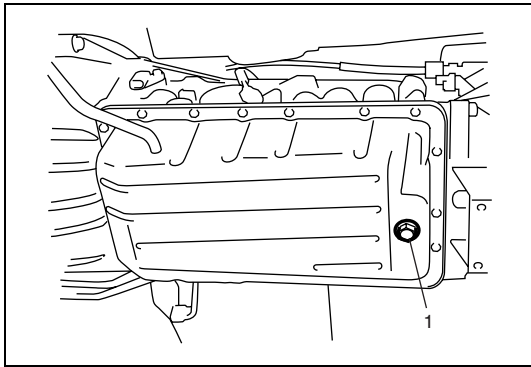
INSPECTION

- 1) Inspect transmission case for evidence of fluid leakage.
Repair leaky point, if any.
- 2) Make sure that vehicle is placed level for fluid level check.
- 3) Check fluid level.

For fluid level checking procedure, refer to “Fluid level” in Section 7B2 and be sure to perform it under specified conditions. If fluid level is low, replenish specified fluid.

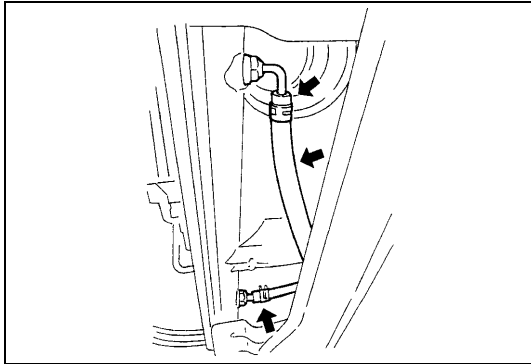


1. Level gauge	4. FULL COLD mark
2. FULL HOT mark	5. LOW COLD mark
3. LOW HOT mark	

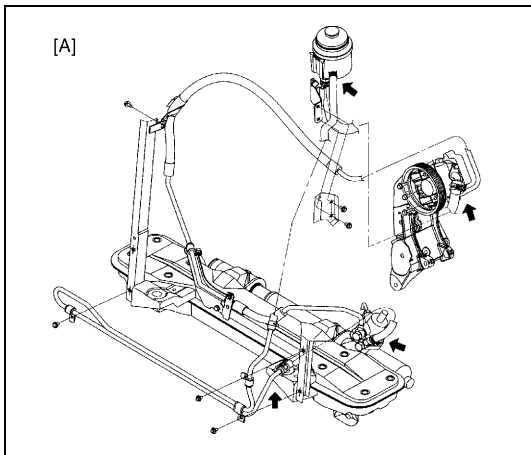
CHANGE

- 1) Inspect transmission case for evidence of fluid leakage.
Repair leaky point, if any.
- 2) Make sure that vehicle is placed level for fluid level check.
- 3) Change fluid. For its procedure, refer to "Fluid Change" in Section 7B2.

1. Drain plug

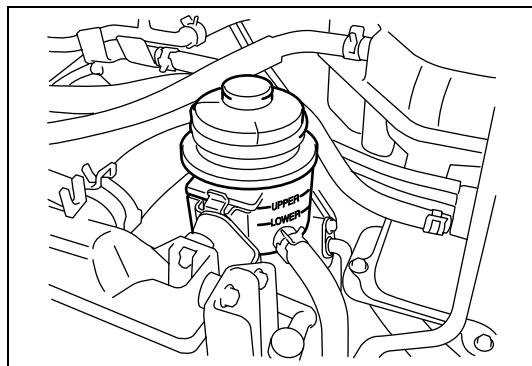
FLUID COOLER HOSE INSPECTION

Check automatic transmission fluid cooler hose for fluid leakage, cracks, damage and deterioration.
Replace hose and/or clamp if any faulty condition is found.

**Power steering (P/S) system (if equipped)
INSPECTION**

- 1) Visually check power steering system for fluid leakage and hose for damage and deterioration.
Repair or replace defective parts, if any.

[A]: Figure shows left-hand steering vehicle



- 2) With engine stopped, check fluid level indicated on fluid tank, which should be between “UPPER” and “LOWER” marks. If it is lower than “LOWER”, fill fluid up to “UPPER” mark.

NOTE:

- **Be sure to use the specified fluid.**
- **Fluid level should be checked when fluid is cool.**

- 3) Visually check pump drive belt for cracks and wear.
- 4) Check belt for tension, referring to “Accessory Drive Belt” in this Section.
If necessary, have belt or replaced.

Recommended Fluids and Lubricants

Engine oil	Refer to “Engine Oil and Oil Filter” in this Section.
Engine coolant	Ethylene-glycol base coolant (“Antifreeze/Anticorrosion coolant”)
Brake fluid	DOT 3
Manual transmission oil	Refer to “Transmission Gear Oil” in Section 7A2.
Transfer oil	Refer to “Transfer Gear Oil” in Section 7D.
Differential oil (front & rear)	Refer to “Gear Oil Change” in Section 7E or “Changing Oil” in Section 7F.
Automatic transmission fluid	Refer to “Fluid Change” in Section 7B1.
Power steering fluid	Refer to “Required Service Material” in Section 3B1.
Door hinges	Engine oil or water resistance chassis grease
Hood latch assembly	
Key lock cylinder	Spray lubricant

SECTION 1A

HEATER AND VENTILATION

1A

WARNING:

For vehicles equipped with a Supplement Restraint (Air Bag) System

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either or these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “Foreword” of this manual.

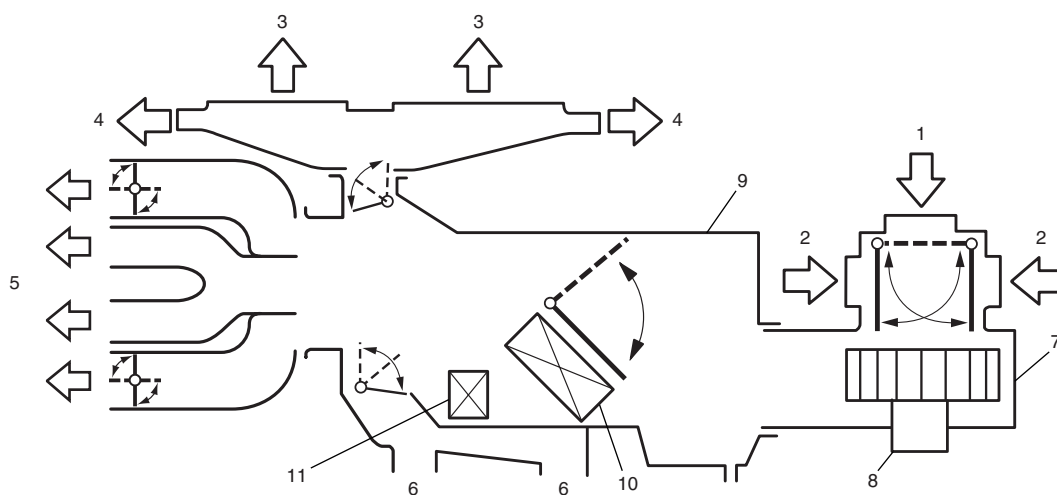
CONTENTS

General Description	1A-2	Blower Motor Controller	*
Major Components	1A-3	HVAC Control Module.....	*
Wiring Circuit.....	1A-4	Air Flow Control Actuator	*
Body Ventilation	*	Temperature Control Actuator	*
General Diagnosis	1A-4	Air Intake Actuator	*
Diagnosis Table	1A-4	Actuator Linkage Assembly	*
HVAC Diagnosis	1A-5	Supplementary Heater	1A-9
On-Board Diagnostic System.....	1A-5	Supplementary heater No.1	1A-9
On-Vehicle Service	1A-6	Supplementary heater No.2	1A-9
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Blower Motor	1A-7	Heater Unit.....	1A-11
Blower Motor Relay	*	Center Ventilation Louver	*
		Rear Duct.....	*

General Description

For this system, the supplementary heater operated by electricity is located in the heater unit near the conventional type heater core and adds more heat to the air. The supplementary heater automatically turns ON under the following conditions.

- Temperature selector of HVAC control module = MAX HOT position
- Blower speed selector = ON position
- Engine coolant temperature = Less than 75 °C (167 °F)
- Battery voltage = More than 9 V
- Air flow selector of HVAC control module = FOOT, DEF/FOOT, or DEF position
- Engine = Running

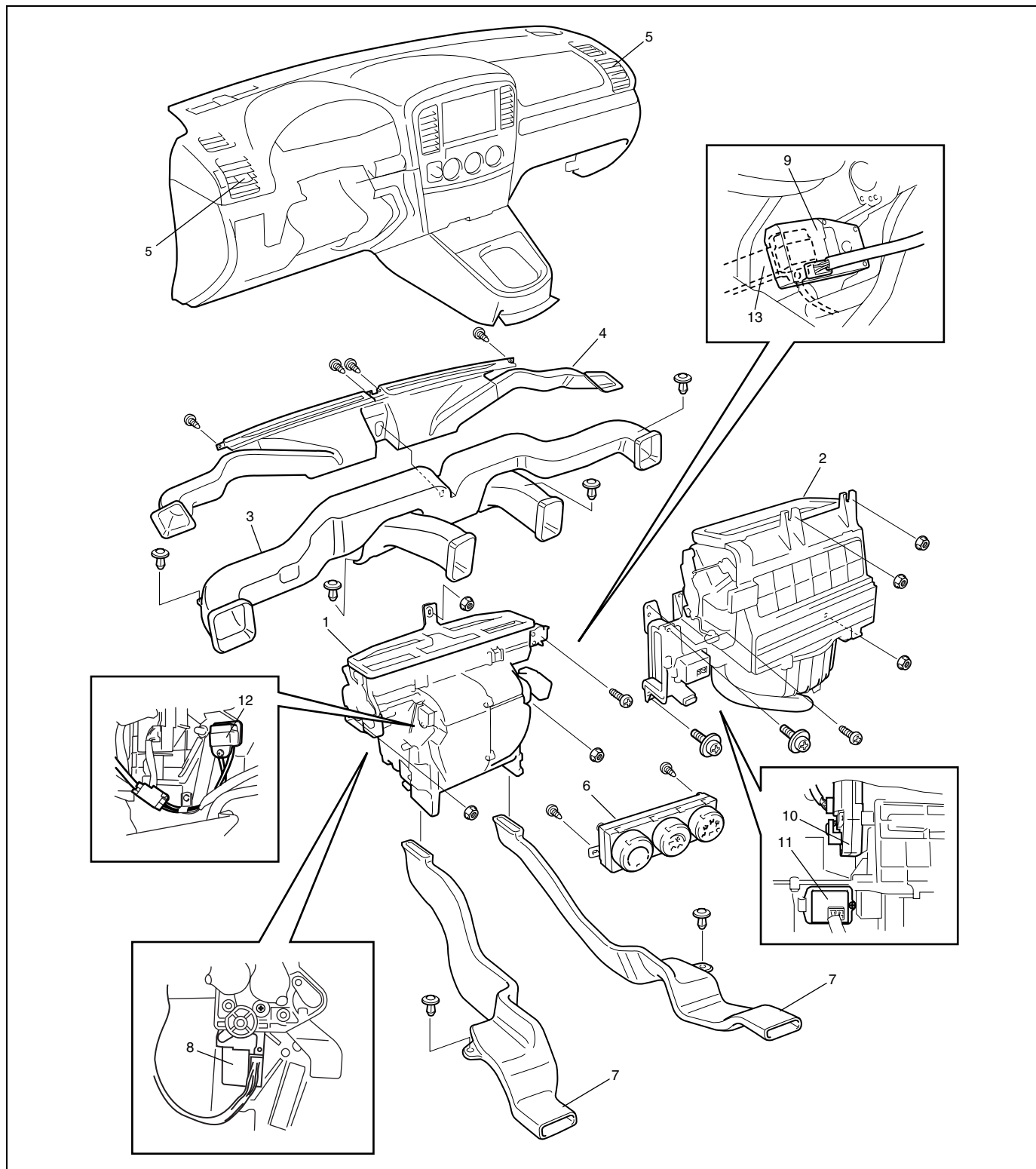


1. Fresh air	3. Defroster air	5. Ventilation air	7. Blower unit	9. Heater unit	11. Supplementary heater
2. Recirculation air	4. Demister air	6. Foot air	8. Blower motor	10. Heater core	

Major Components

NOTE:

The major components shown below are for vehicle with left steering wheel. For vehicle with right steering wheel, position of each component is symmetrical except airflow control actuator (8) and temperature control actuator (9).



1. Heater unit	4. Defroster duct	7. Rear duct	10. Air intake actuator	13. Supplementary heater No.2
2. Blower unit	5. Ventilation louver	8. Air flow control actuator	11. Blower motor controller	
3. Ventilator duct	6. HVAC control module	9. Temperature control actuator	12. Supplementary heater No.1	

Wiring Circuit

Refer to “A/C System Wiring Circuit Diagram” in Section 1B.

General Diagnosis

Diagnosis Table

Condition	Possible Cause	Correction
Blower motor won't work even when blower speed selector is ON	Wiring or grounding faulty	Repair as necessary.
	Fuse blown	Replace fuse.
	Blower motor faulty	Check blower motor referring to “Blower Motor” in this section.
	Blower motor relay faulty	Check relay referring to “Blower Motor Relay” in this section.
	Blower motor controller faulty	Check blower motor controller referring to “Blower Motor Controller” in this section.
	Blower speed selector faulty	Check HVAC control module referring to “Inspection of HVAC Control Module and Its Circuits” in Section 1B.
Insufficient heat	Leakage from heater hoses or clogged up of heater hoses	Replace hoses.
	Leakage from heater core or clogged up of heater core	Replace heater core referring to “Heater Unit” in this section.
	Air leakage from heater unit or air duct	Repair as necessary.
	Air damper broken	Repair damper.
	Heater and ventilation system faulty	Check air intake door and temperature control door operation.
	Supplementary heater faulty	Check supplementary heater referring to “Supplementary Heater” in this section.
	Temperature control actuator faulty	Check temperature control actuator referring to “Temperature Control Actuator” in this section.
	HVAC control module faulty	Check HVAC control module referring to “HVAC Control Module and Its Circuits” in Section 1B.
Air temperature is not changed even when temperature selector is changed	Leakage from heater hoses or clogged up of heater hoses	Replace hoses.
	Leakage from heater core or clogged up of heater core	Replace heater core referring to “Heater Unit” in this section.
	Air damper broken	Repair damper.
	Temperature control actuator faulty	Check temperature control actuator referring to “Temperature Control Actuator” in this section.
	Temperature selector faulty	Check HVAC control module referring to “Inspection of HVAC Control Module and Its Circuits” in Section 1B.

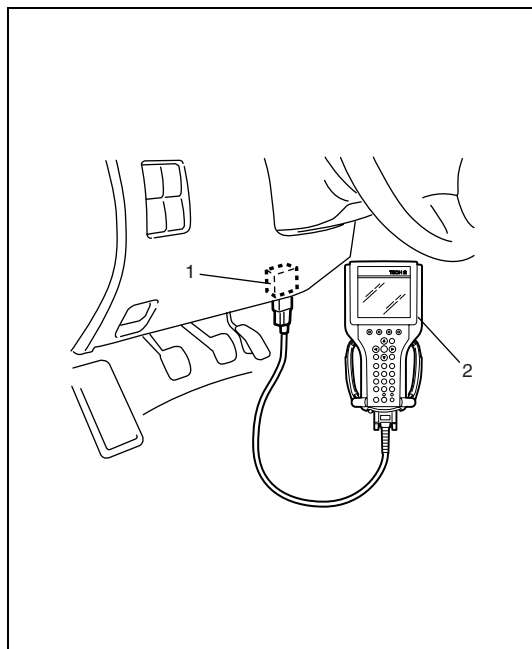
Condition	Possible Cause	Correction
Air outlet port is not changed when air flow selector is changed	Air damper broken	Repair damper.
	Air flow control actuator faulty	Check air flow control actuator referring to “Air Flow Control Actuator” in this section.
	Air flow selector faulty	Check HVAC control module referring to “Inspection of HVAC Control Module and Its Circuits” in Section 1B.

HVAC Diagnosis

On-Board Diagnostic System

HVAC control module detects malfunction(s), which may occur in the following area. Once it detects any malfunction, it stores diagnostic information in its memory.

- ECT sensor
- Temperature control actuator
- Air flow control actuator
- Temperature selector of HVAC control module
- Blower speed selector of HVAC control module
- Air flow selector of HVAC control module



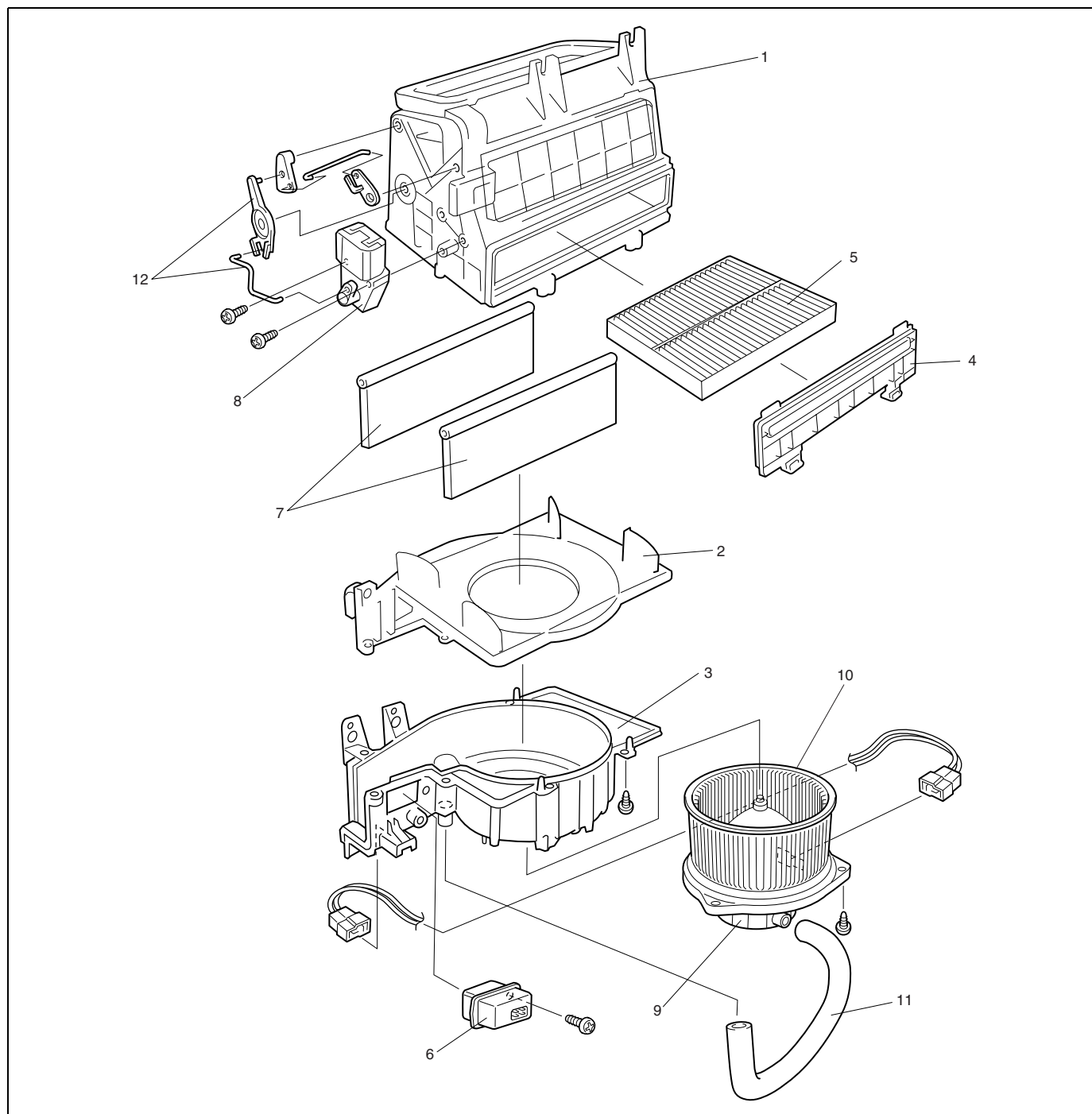
DTC can be checked by using SUZUKI scan tool (2) connected to DLC (1). For more details, refer to “HVAC Diagnosis” in Section 1B.

NOTE:

- For vehicles without air conditioning system, when checking for any DTC by using SUZUKI scan tool, DTC No.1503 (A/C Evaporator Temperature Sensor and its Circuit Malfunction) is displayed on SUZUKI scan tool. Disregard the DTC because the sensor is not equipped for vehicles without air conditioning system.
- For vehicles with air conditioning system, on-board diagnosis by using SUZUKI scan tool or A/C switch of HVAC control module is available. However, only SUZUKI scan tool can be used for on-board diagnosis because A/C switch is not on HVAC control module for vehicles without air conditioning system.

On-Vehicle Service

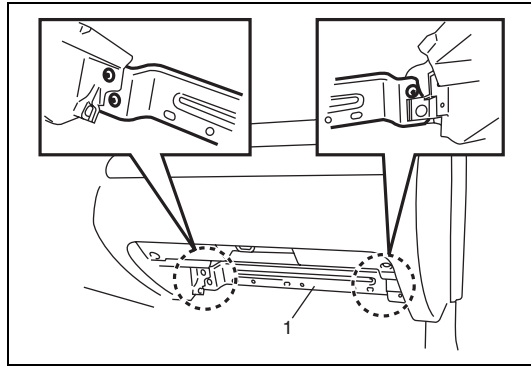
Blower Unit



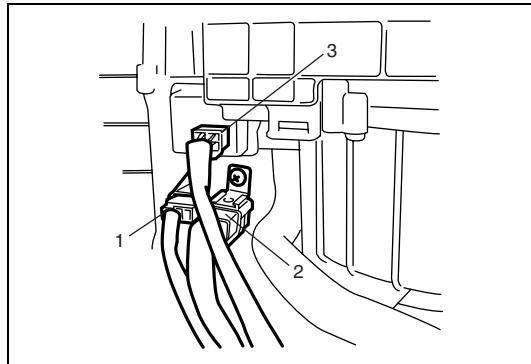
1. Air intake case	4. Air filter cover	7. Air intake door	10. Blower fan
2. Upper scroll	5. Air filter	8. Air intake actuator	11. Air hose
3. Lower scroll	6. Blower motor controller	9. Blower motor	12. Levers and rods

REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system (if equipped) referring to “Disabling Air Bag System” in Section 10B.
- 3) Open glove box, and then remove screw and damper located on the right side of the glove box.
- 4) Remove glove box.

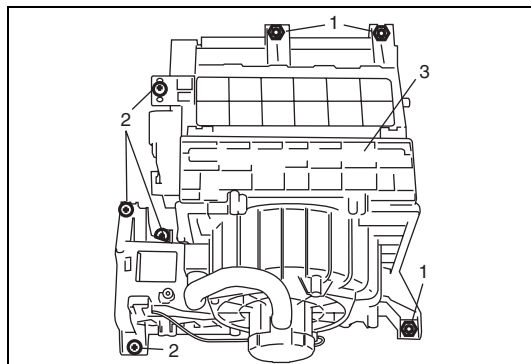


5) Remove passenger lower member (1).



6) Remove A/C controller with bracket from blower unit.

7) Disconnect blower motor lead wire (1), blower motor relay lead wire (2) and blower motor controller lead wire (3) at couplers.



8) Disconnect air intake actuator coupler.

9) Remove fastening nuts (1) and screws (2), and then remove blower unit (3).

INSTALLATION

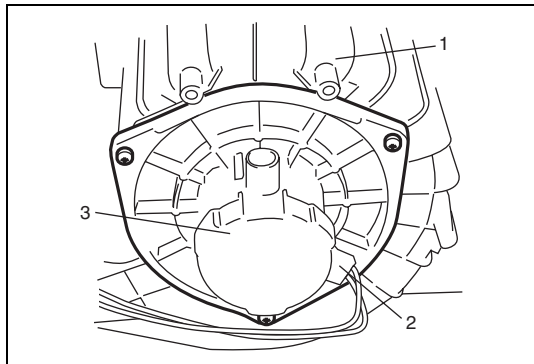
Reverse removal procedure for installation noting the following:

- Enable air bag system (if equipped) referring to “Enabling Air Bag System” in Section 10B.

Blower Motor

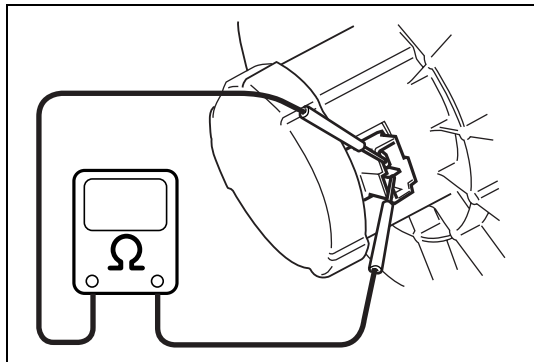
REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system (if equipped) referring to “Disabling Air Bag System” in Section 10B.
- 3) Remove A/C controller with bracket from blower unit.

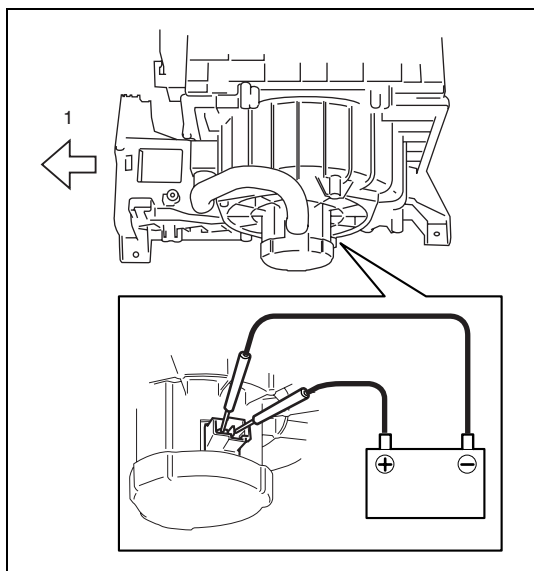


- 4) Disconnect blower motor lead wire (2) at coupler.
- 5) Remove blower motor (3) from blower unit (1).

INSPECTION



- Check for continuity between terminal to terminal as shown in the figure. If check result is good, proceed to the next check. If not, replace.



- Connect battery to the blower motor as shown, and then check if the blower motor operates smoothly.

Blower motor specification: 18 – 24 A at 12 V

1. Airflow

INSTALLATION

Reverse the removal procedure for installation noting the following:

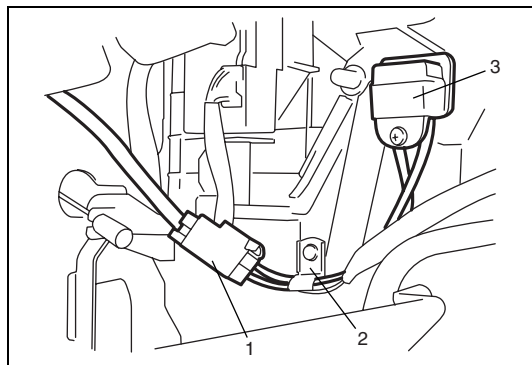
- Enable air bag system (if equipped) referring to “Enabling Air Bag System” in Section 10B.

Supplementary Heater

Supplementary heater No.1

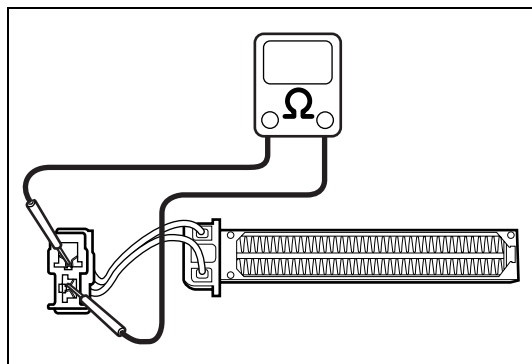
REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system (if equipped) referring to “Disabling Air Bag System” in Section 10A.
- 3) Disconnect supplementary heater No.1 lead wire (1) at coupler.
- 4) Remove bracket (2) and supplementary heater No.1 (3).



INSPECTION

- Check if there is continuity between supplementary heater terminals. If there is no continuity, replace supplementary heater.
- Check supplementary heater for crack or any other damage. Replace if needed.



INSTALLATION

Reverse the removal procedure.

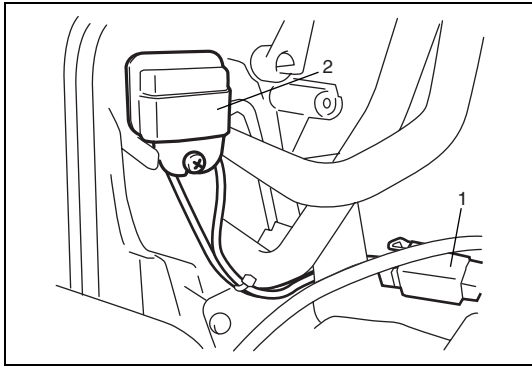
NOTE:

Be careful not to pinch harness in other parts.

Supplementary heater No.2

REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system (if equipped) referring to “Disabling Air Bag System” in Section 10A.
- 3) Remove glove box.
- 4) Remove temperature control actuator referring to “Temperature Control Actuator” in this section.



- 5) Disconnect supplementary heater No.2 lead wire (1) at coupler.
- 6) Remove supplementary heater No.2 (2).

INSPECTION

Inspect supplementary heater No.2 referring to "INSPECTION" under "Supplementary Heater No.1" in this section.

INSTALLATION

Reverse the removal procedure.

NOTE:

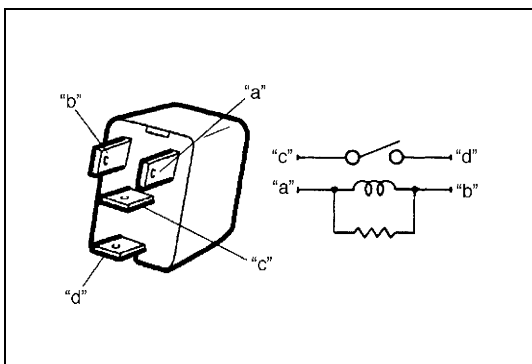
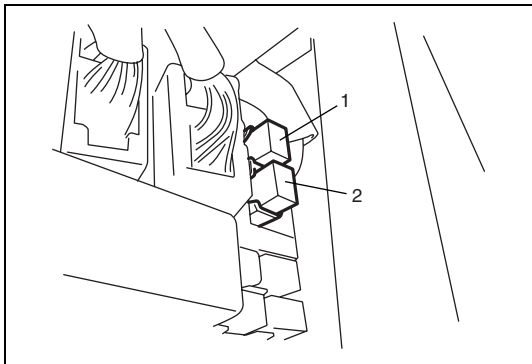
Be careful not to pinch harness in other parts.

Supplementary Heater Relay

INSPECTION

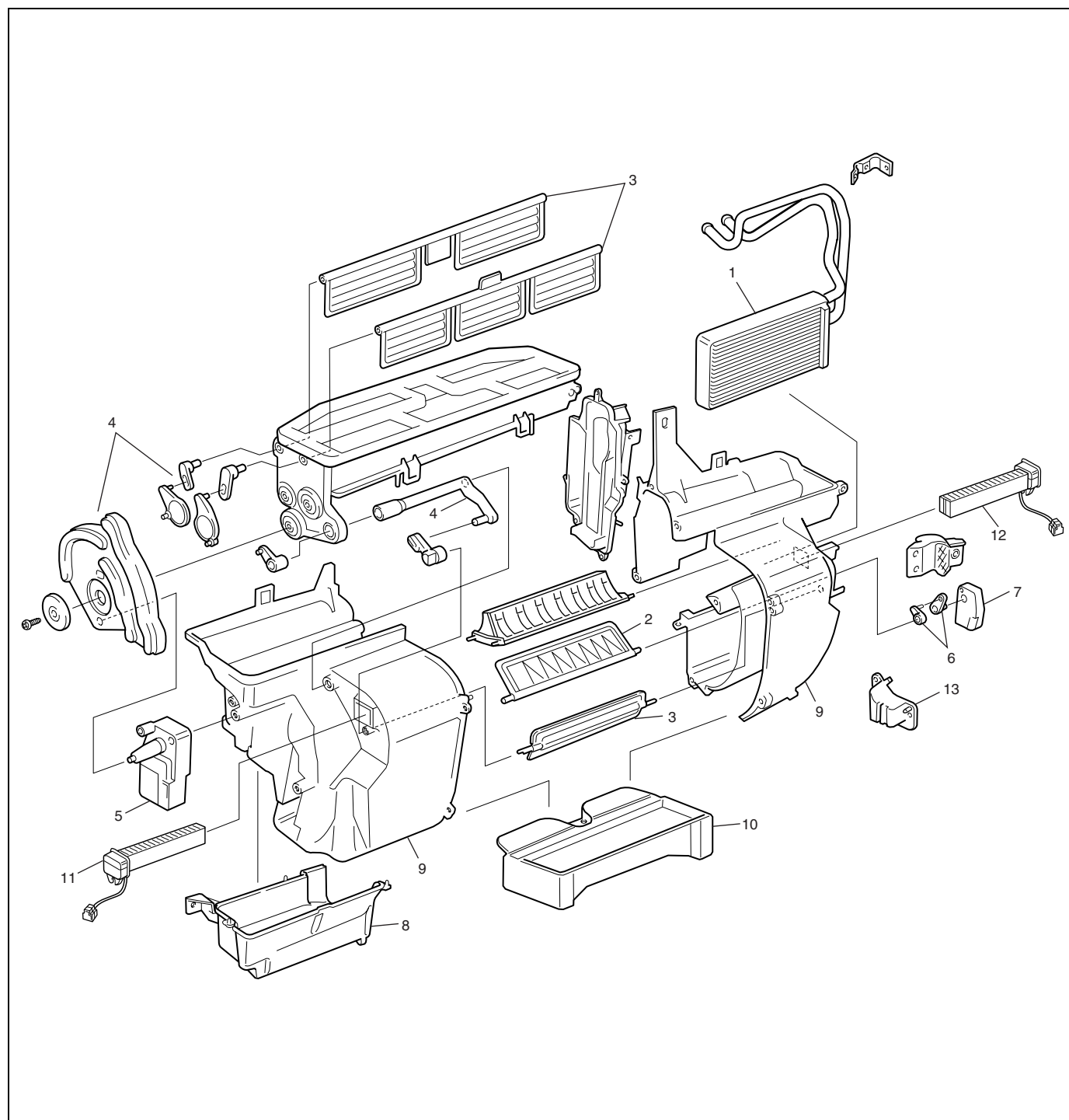
- 1) Disconnect negative (–) cable at battery.
- 2) Remove supplementary heater relay (No.1 and No.2) from circuit fuse box located under the instrument panel on the driver's seat side.

1.	Supplementary heater relay No.1
2.	Supplementary heater relay No.2



- 3) Check if there is no continuity between terminal "c" and "d".
If there is continuity, replace relay.
- 4) Check if there is continuity between terminals "c" and "d" when a 12 V battery is connected to terminals "a" and "b".
If there is no continuity, replace relay.

Heater Unit



1. Heater core	6. Temperature control link assembly	11. Supplementary heater No.1
2. Temperature control door	7. Temperature control actuator	12. Supplementary heater No.2
3. Air flow control door	8. Heater lower case	13. Heater core bracket
4. Air flow control link assembly	9. Heater upper case	
5. Air flow control actuator	10. Foot air duct	

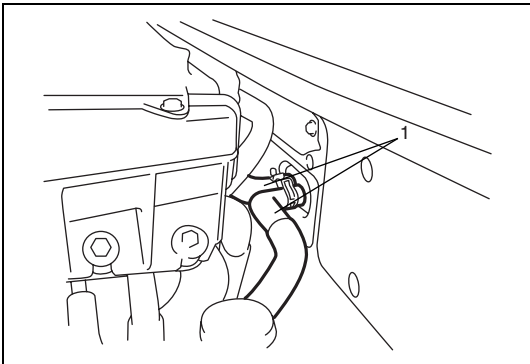
REMOVAL

WARNING:

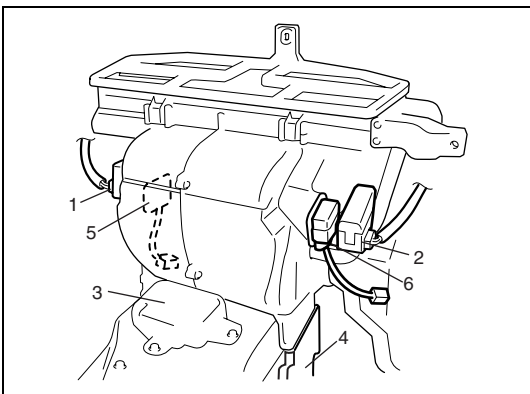
Failure to follow the following procedure and **WARNING** may cause air bag deployment, personal injury, damage to parts, or air bag being unable to deploy.

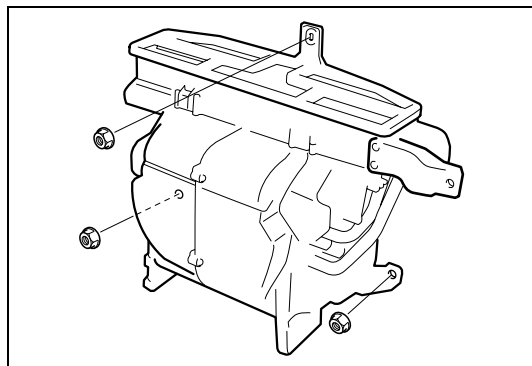
- Never rest a steering column assembly on steering wheel with air bag (inflator) module face down and column vertical.
- When handling the air bag (inflator) modules (driver and passenger), be careful not to drop it or apply an impact to it. If an excessive impact was applied (e.g., dropped from a height of 91.4 cm (3 feet) or more, never attempt disassembly or repair but replace it with a new one.
- When grease, cleaning agent. Oil, water, etc. has got onto air bag (inflator) modules (driver and passenger), wipe off immediately with a dry cloth.

- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system (if equipped) referring to “Disabling Air Bag System” in Section 10B.
- 3) Drain engine coolant and disconnect heater hoses (1) from heater unit.
- 4) Remove instrument panel referring to “Instrument Panel” in Section 9.
- 5) Remove blower unit referring to “Blower Unit” in this section.



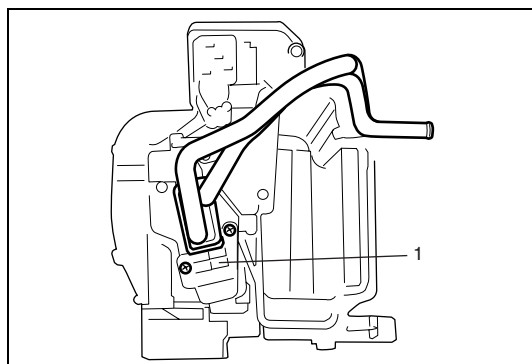
- 6) Disconnect rear duct (4) from heater unit.
- 7) Disconnect air flow control actuator lead wire (1) at coupler and temperature control actuator lead wire (2) at coupler.
- 8) Disconnect supplementary heater No.1 (5), No.2 (6) lead wire at coupler.
- 9) Remove SDM (3) (If equipped).



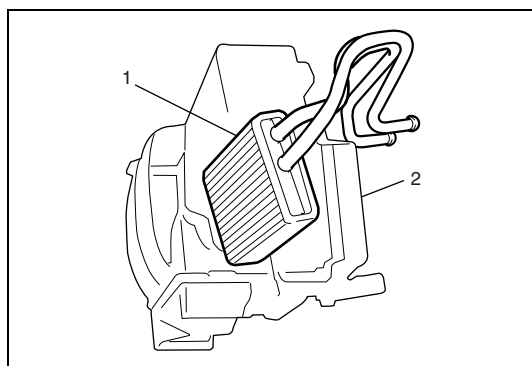


10) Remove heater unit (1).

11) Remove temperature control actuator from heater unit and supplementary heater No.2.



12) Remove heater core pipe clamp and heater core bracket (1).



13) Pull out heater core (1) from heater unit (2).

INSTALLATION

Install heater unit by reversing removal procedure, noting the following items.

- When installing each part, be careful not to pinch any cable or wiring harness.
- When installing steering column assembly, refer to “Steering Column Installation” in Section 3C or 3C1.
- Fill engine coolant to radiator.
- Enable air bag system (if equipped) referring to “Enabling Air Bag System” in Section 10B.

SECTION 1B

AIR CONDITIONING (OPTIONAL)

1B

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

CAUTION:

The air conditioning system of this vehicle uses refrigerant HFC-134a (R-134a).

None of refrigerant, compressor oil and component parts is interchangeable between two types of A/C: one using refrigerant CFC-12 (R-12) and the other using refrigerant HFC-134a (R-134a).

Be sure to check which refrigerant is used before any service work including inspection and maintenance. For identification between these two types, refer to the same section of Service Manual mentioned in FOREWORD of this manual.

When replenishing or changing refrigerant and compressor oil and when replacing parts, make sure that the material or the part to be used is appropriate to the A/C installed in the vehicle being serviced. Use of incorrect one will result in leakage of refrigerant, damage in parts or other faulty condition.

NOTE:

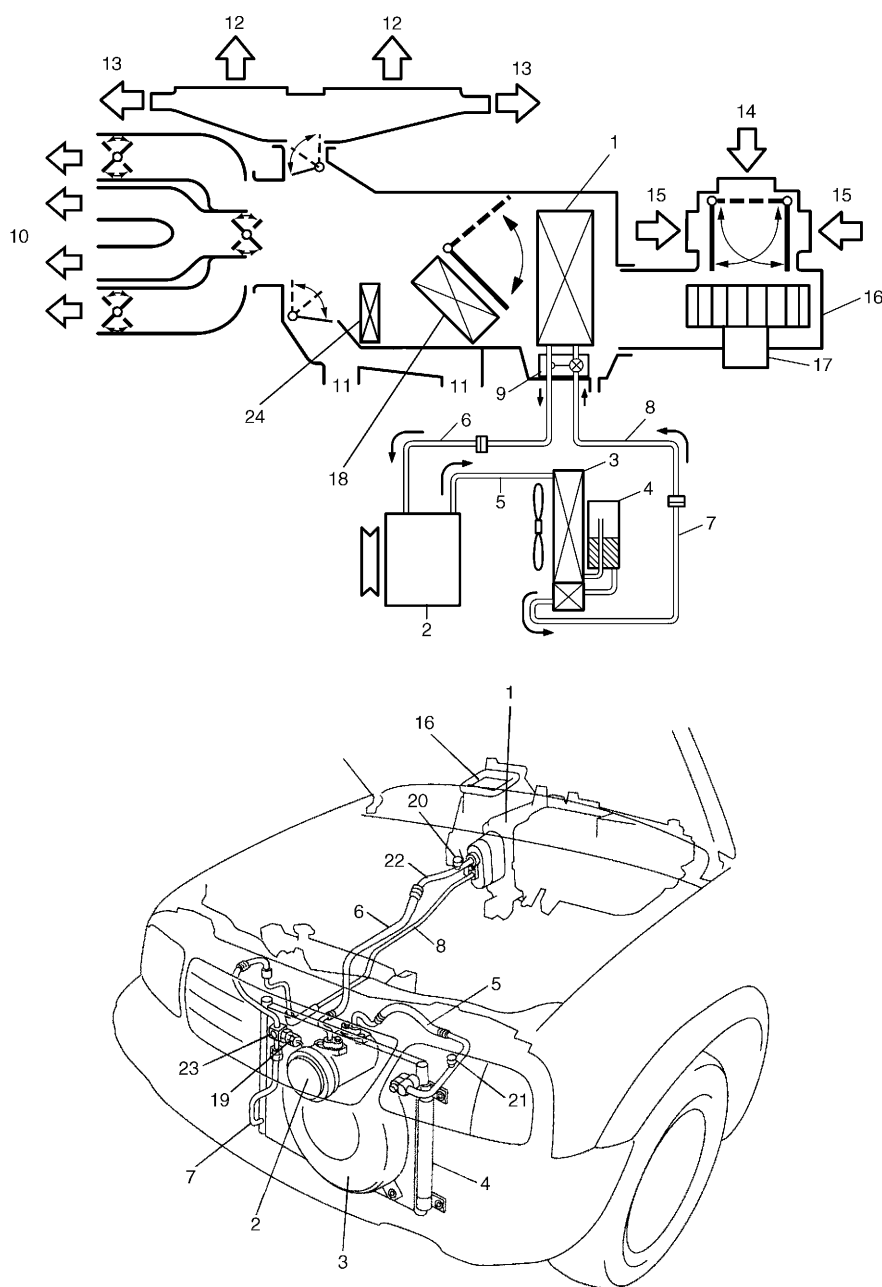
- For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.
- For the basic service method of the air conditioning system that is not described in this section, refer to “Air Conditioning Basic Manual” (99520-02130).

CONTENTS

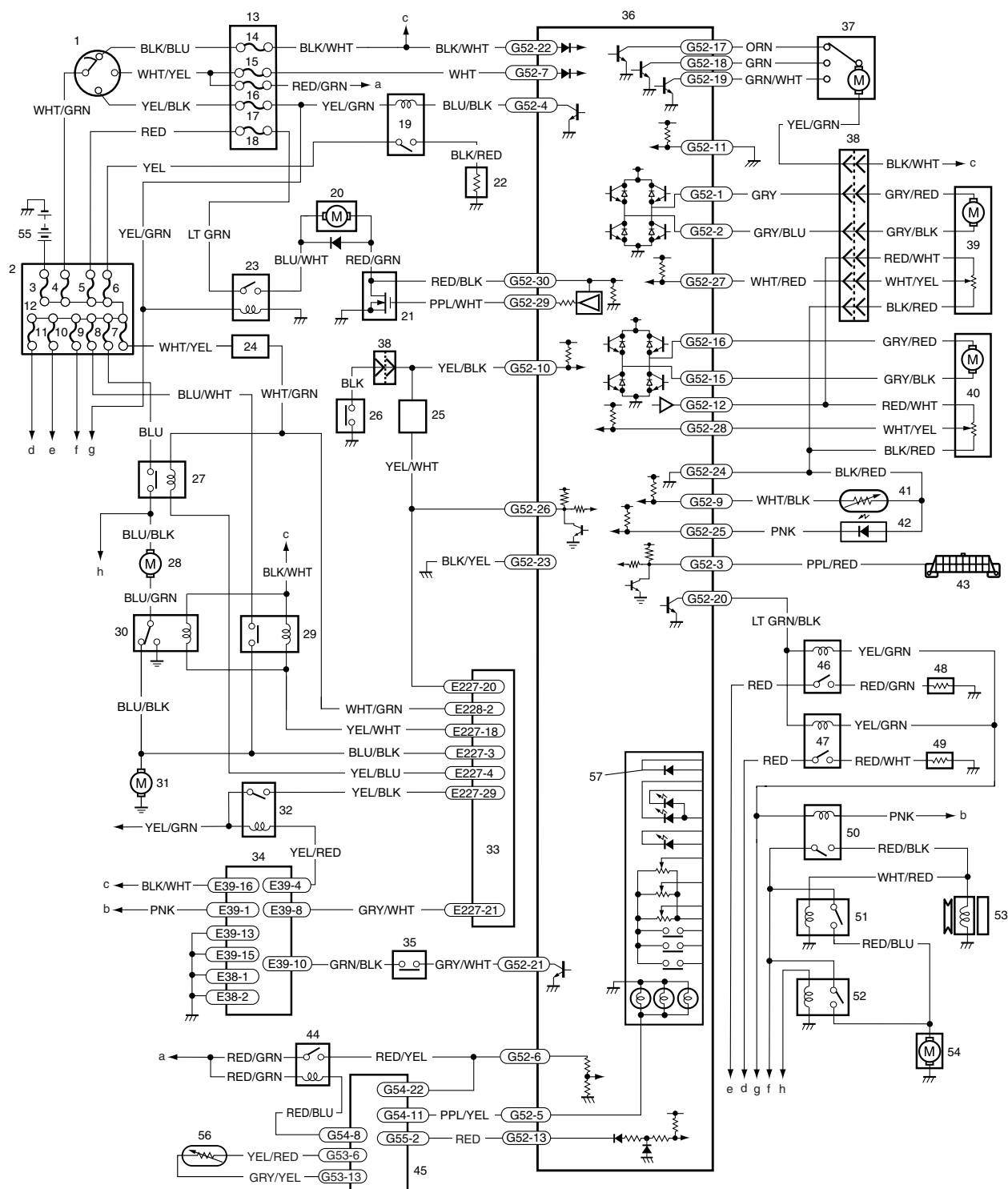
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Major Components and Location



1. A/C evaporator	6. Suction hose	11. Foot air	16. Blower unit	21. High pressure charge valve
2. Compressor	7. Condenser outlet pipe	12. Defrost air	17. Blower fan motor	22. Suction pipe
3. Condenser assembly	8. Liquid pipe	13. Demister air	18. Heater core	23. Sight glass
4. Receiver/dryer	9. Expansion valve	14. Fresh air	19. Dual pressure switch	24. Supplementary heater
5. Discharge hose	10. Ventilation air	15. Recirculation air	20. Low pressure charge valve	



1. Ignition switch	16. "TAIL" fuse	31. Radiator fan motor No.2	46. Supplementary heater relay No.1
2. Main fuse box	17. "HTR" fuse	32. A/C signal relay	47. Supplementary heater relay No.2
3. Main fuse	18. "FRONT BLOW" fuse	33. ECM	48. Supplementary heater No.1
4. "IG" fuse	19. Rear window defogger relay	34. A/C controller	49. Supplementary heater No.2
5. "HTR" fuse	20. Blower motor	35. A/C refrigerant (dual) pressure switch	50. Compressor relay
6. "RR DEF" fuse	21. Blower motor controller	36. HVAC control module	51. Condenser fan motor relay
7. "PTC 1" fuse	22. Rear window defogger	37. Air intake actuator	52. Condenser fan motor high relay
8. "PTC 2" fuse	23. Blower motor relay	38. Connector	53. A/C compressor
9. "RDTR" fuse	24. Double relay	39. Temperature control actuator	54. Condenser fan
10. "A/C" fuse	25. Speedometer	40. Air flow control actuator	55. Battery
11. "PTC 1" fuse	26. Oil pressure switch	41. A/C evaporator temperature sensor	56. Outside air temperature sensor (for vehicle with automatic A/C system)
12. "PTC 2" fuse	27. Radiator fan relay No.3 (LOW)	42. Sunload sensor (for vehicle with automatic A/C system)	57. Inside air temperature sensor (for vehicle with automatic A/C system)
13. Fuse box	28. Radiator fan motor No.1	43. Data link connector	
14. "METER" fuse	29. Radiator fan relay No.2 (HIGH)	44. Headlight relay No.2	
15. "RADIO DOME" fuse	30. Radiator fan relay No.1 (HIGH)	45. BCM	

General Diagnosis

General Diagnosis Table

Condition	Possible Cause	Correction
Cool air does not come out (A/C system does not operate)	No refrigerant	Perform recovery, evacuation and charge referring to “Recovery”, “Evacuating” and “Charging” in this section.
	Fuse blown	Check related fuses, and check short circuit to ground.
	Wiring or grounding faulty	Check wiring and grounding, and repair as necessary.
	A/C evaporator thermistor (A/C evaporator temperature sensor) faulty	Check A/C evaporator thermistor (A/C evaporator temperature sensor) referring to “A/C Evaporator Thermistor (A/C Evaporator Temperature Sensor)” in this section.
	A/C refrigerant (dual) pressure switch faulty	Check A/C refrigerant (dual) pressure switch referring to “A/C Refrigerant (Dual) Pressure Switch” in this section.
	ECT sensor faulty	Check ECT sensor referring to “Engine Coolant Temperature (ECT) Sensor” in Section 6E1 or 6E2.
	A/C controller faulty	Check A/C controller referring to “A/C Controller” in this section.
	HVAC control module faulty	Check HVAC control module referring to “Inspection of HVAC Control Module and Its Circuits” in this section.
Cool air does not come out (A/C compressor does not operate (does not rotate))	Fuse blown	Check related fuses, and check short circuit to ground.
	Drive belt loose or broken	Replace compressor drive belt.
	Magnet clutch faulty	Check magnet clutch referring to “Magnet Clutch” in this section.
	Compressor relay faulty	Check compressor relay referring to “A/C Compressor Relay and A/C Condenser Cooling Fan Relays” in this section.
	A/C compressor faulty	Check compressor referring to “Compressor Assembly” in this section.
	A/C controller faulty	Check A/C controller referring to “A/C Controller” in this section.
	HVAC control module faulty	Check HVAC control module referring to “Inspection of HVAC Control Module and Its Circuits” in this section.

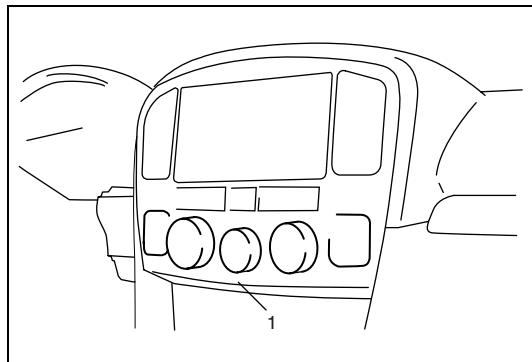
Condition	Possible Cause	Correction
Cool air does not come out (A/C condenser cooling fan motor no operation)	Fuse blown	Check related fuses, and check short circuit to ground.
	Wiring or grounding faulty	Check wiring and grounding, and repair as necessary.
	Condenser cooling fan motor relay faulty	Check compressor relay referring to “A/C Compressor Relay and A/C Condenser Cooling Fan Relays” in this section.
	Condenser cooling fan motor faulty	Check condenser cooling fan motor referring to “Condenser Cooling Fan Assembly” in this section.
Cool air does not come out (Blower motor does not operate)	Fuse blown	Check related fuses, and check short circuit to ground.
	Wiring or grounding faulty	Check wiring and grounding, and repair as necessary.
	Blower motor relay faulty	Check blower motor relay referring to “Blower Motor Relay” in Section 1A.
	Blower motor faulty	Check blower motor referring to “Blower Motor” in Section 1A.
	Blower motor controller faulty	Check blower motor controller referring to “Blower Motor Controller” in Section 1A.
	HVAC control module faulty	Check HVAC control module referring to “Inspection of HVAC Control Module and Its Circuits” in this section.

Condition	Possible Cause	Correction
Cool air does not come out or insufficient cooling (A/C system normal operation)	Insufficient or excessive charge of refrigerant	Check the amount of refrigerant.
	Refrigerant leak in system	Check A/C system for leaks.
	Air in A/C system	Replace desiccant, and perform evacuation and charge.
	Air leaking from cooling unit or air duct	Repair as necessary.
	Drive belt slipping	Check or replace compressor drive belt.
	Magnetic clutch faulty	Check magnetic clutch referring to "Magnetic Clutch" in this section.
	A/C compressor faulty	Check compressor referring to "Compressor Assembly" in this section.
	Excessive compressor oil existing in A/C system	Pull out compressor oil in A/C system circuit, and check compressor referring to "Compressor Assembly" in this section.
	Outside air temperature sensor faulty (for vehicle with automatic air conditioning system)	Check outside air temperature sensor referring to "Outside Air Temperature Sensor Inspection" in Section 8H.
	Sunload sensor faulty (for vehicle with automatic air conditioning system)	Check sunload sensor referring "Sunload Sensor" in this section.
	A/C refrigerant (dual) pressure switch faulty	Check A/C refrigerant (dual) pressure switch referring to "A/C Refrigerant (Dual) Pressure Switch" in this section.
	Condenser cooling fan motor faulty	Check condenser cooling fan motor referring to "Condenser Cooling Fan Assembly" in this section.

Condition	Possible Cause	Correction
Cool air does not come out or insufficient cooling (A/C system normal operation)	Condenser clogged	Check condenser referring to “A/C Condenser Assembly” in this section.
	A/C evaporator clogged or frosted	Check A/C evaporator and A/C evaporator thermistor (A/C evaporator temperature sensor) referring to “A/C Evaporator” and “A/C Evaporator Thermistor (A/C Evaporator Temperature Sensor)” in this section.
	A/C evaporator thermistor (A/C evaporator temperature sensor) faulty	Check A/C evaporator thermistor (A/C evaporator temperature sensor) referring to “A/C Evaporator Thermistor (A/C Evaporator Temperature Sensor)” in this section.
	Expansion valve faulty	Check expansion valve referring to “Expansion Valve” in this section.
	Aspirator hose faulty (for vehicle with automatic air conditioning system)	Check aspirator hose for clogging up or dislocation.
	Blower motor faulty	Check blower motor referring to “Blower Motor” in Section 1A.
	Heater and ventilation system faulty	Check air intake door and temperature control door operation.
	A/C controller faulty	Check A/C controller referring to “A/C Controller” in this section.
	HVAC control module faulty	Check HVAC control module referring to “Inspection of HVAC Control Module and Its Circuits” in this section.
Cool air does not come out only intermittently	Wiring connection faulty	Repair as necessary.
	Excessive moisture in A/C system	Replace desiccant, and perform evacuation and charge.
	Excessive charge of refrigerant	Check the amount of refrigerant.
	Magnetic clutch faulty	Check magnetic clutch referring to “Magnet Clutch” in this section.
	Expansion valve faulty	Check expansion valve referring to “Expansion Valve” in this section.
	A/C controller faulty	Check A/C controller referring to “A/C Controller” in this section.
Cool air comes out only at high speeds	Air in A/C system	Replace desiccant, and perform evacuation and charge.
	Insufficient charge of refrigerant	Check the amount of refrigerant.
	Drive belt slipping	Check or replace compressor drive belt.
	A/C compressor faulty	Check compressor referring to “Compressor Assembly” in this section.
	Condenser clogged	Check condenser referring to “A/C Condenser Assembly” in this section.

Condition	Possible Cause	Correction
Cool air does not come out only at high speeds	Excessive charge of refrigerant	Check the amount of refrigerant.
	A/C evaporator frosted	Check A/C evaporator thermistor (A/C evaporator temperature sensor) referring to “A/C Evaporator Thermistor (A/C Evaporator Temperature Sensor)” in this section.
Insufficient velocity of cooled air	Air leaking from cooling unit or air duct	Repair as necessary.
	Wiring or grounding faulty	Check wiring and grounding, and repair as necessary.
	Blower motor faulty	Check blower motor referring to “Blower Motor” in Section 1A.
	A/C evaporator clogged or frosted	Check A/C evaporator and A/C evaporator thermistor (A/C evaporator temperature sensor) referring to “A/C Evaporator” and “A/C Evaporator Thermistor (A/C Evaporator Temperature Sensor)” in this section.

Inspection of HVAC Control Module and Its Circuits



CAUTION:

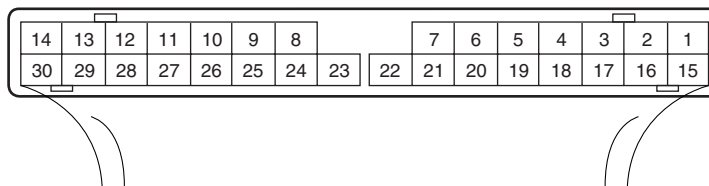
HVAC controller module (1) cannot be checked by itself. It is strictly prohibited to connect voltmeter to HVAC controller module with couplers disconnected from it.

HVAC Control module and its circuits can be checked at HVAC control module wiring couplers by measuring voltage.

VOLTAGE CHECK

- 1) Remove HVAC control module from vehicle referring to “HVAC Control Module” in this section.
- 2) Connect HVAC control module and body control module couplers to HVAC control module and body control module.
- 3) Check each terminal voltage by referring to the “HVAC control module voltage table”.

Terminal arrangement of HVAC control module connector “G52” viewed from harness side



HVAC control module voltage table

Terminal	Wire Color	Circuit	Measurement Ground	Normal Value	Condition
G52-1	GRY	Temperature control actuator (COOL)	Ground to body	about 10.0 V	Ignition switch ON, Temperature selector max HOT to max COOL position
				less than 1.5 V	Ignition switch ON, Temperature selector max COOL to max HOT position
G52-2	GRY/BLU	Temperature control actuator (HOT)	Ground to body	about 10.0 V	Ignition switch ON, Temperature selector max COOL to max HOT position
				less than 1.5 V	Ignition switch ON, Temperature selector max HOT to max COOL position
G52-3	PPL/RED	Serial communication line of data link connector	—	—	—
G52-4	BLU/BLK	Rear defogger relay output	Ground to body	less than 1.0 V	Ignition switch ON, Rear defogger switch ON
				10 – 14 V	Ignition switch ON, Rear defogger switch OFF
G52-5	PPL/YEL	Illumination switch	Ground to body	10 – 14 V	Ignition switch ON, Illumination switch ON, Illumination controller to the lightest position
				0.0 V	Ignition switch ON, Illumination switch OFF
G52-6	RED/YEL	Illumination controller switch	Ground to body	10 – 14 V	Ignition switch ON, Illumination switch ON
				0.0 V	Ignition switch ON, Illumination switch OFF
G52-7	WHT	Power supply	Ground to body	10 – 14 V	—
G52-8	—	—	—	—	—
G52-9	WHT/BLK	A/C evaporator temperature sensor	Ground to body	See reference graph No.1.	Ignition switch ON
G52-10	YEL/BLK	Engine on signal	Ground to body	10 – 14 V	Engine running
				less than 1.0 V	Ignition switch ON
G52-11	BLK	Ground	Ground to body	about 5.0 V	Ignition switch ON
G52-12	RED/WHT	Output of 5 V power source for air flow control actuator and temperature control actuator	Ground to body	about 5.0 V	Ignition switch ON
				less than 0.5 V	Ignition switch OFF

Terminal	Wire Color	Circuit	Measurement Ground	Normal Value	Condition
G52-13	RED	Outside air temperature sensor (for automatic air conditioning system)	Ground to body	See reference waveform No.1.	Ignition switch ON
G52-14	—	—	—	—	—
G52-15	GRY/BLK	Air flow control actuator (VENT)	Ground to body	about 10.0 V	Ignition switch ON, Air flow selector DEF to VENT position
				less than 1.5 V	Ignition switch ON, Air flow selector VENT to DEF position
G52-16	GRY/RED	Air flow control actuator (DEF)	Ground to body	about 10.0 V	Ignition switch ON, Air flow selector VENT to DEF position
				less than 1.5 V	Ignition switch ON, Air flow selector DEF to VENT position
G52-17	ORN	Air intake actuator (FRE)	Ground to body	less than 1.0 V	Ignition switch ON, Air Intake switch to FRE (fresh air)
				10 – 14 V	Ignition switch ON, Air Intake switch to REC (recirculation air)
G52-18	GRN	Air intake actuator (REC)	Ground to body	less than 1.0 V	Ignition switch ON, Air Intake switch to REC (recirculation air)
				10 – 14 V	Ignition switch ON, Air Intake switch to FRE (fresh air)
G52-19	GRN/WHT	Air intake actuator (MIX)	Ground to body	less than 1.0 V	Ignition switch ON, Air intake switch to FRE (fresh air), Engine coolant temperature between 60 °C (140 °F) and 80 °C (176 °F), Air flow selector at any position except VENT position
				10 – 14 V	Ignition switch ON, Air intake switch to REC (recirculation air), Engine coolant temperature between 60 °C (140 °F) and 80 °C (176 °F), Air flow selector at DEF position
G52-20	LT GRN/BLK	Supplementary heater relay	Ground to body	less than 1.0 V	Engine running, Blower speed selector at ON position, Temperature selector at MAX HOT position, Air flow selector at FOOT, DEF/FOOT, or DEF position, Engine coolant temperature less than 75 °C (167 °F), Battery voltage more than 9 V
				10 – 14 V	Ignition switch ON, Blower speed selector at OFF position
G52-21	GRY/WHT	A/C request signal (if equipped)	Ground to body	less than 1.0 V	Ignition switch ON, A/C switch ON
				10 – 14 V	Ignition switch ON, A/C switch OFF
G52-22	BLK/WHT	Ignition switch signal	Ground to body	10 – 14 V	Ignition switch ON
				less than 0.5 V	Ignition switch OFF
G52-23	BLK/YEL	Ground	Ground to body	less than 0.5 V	—

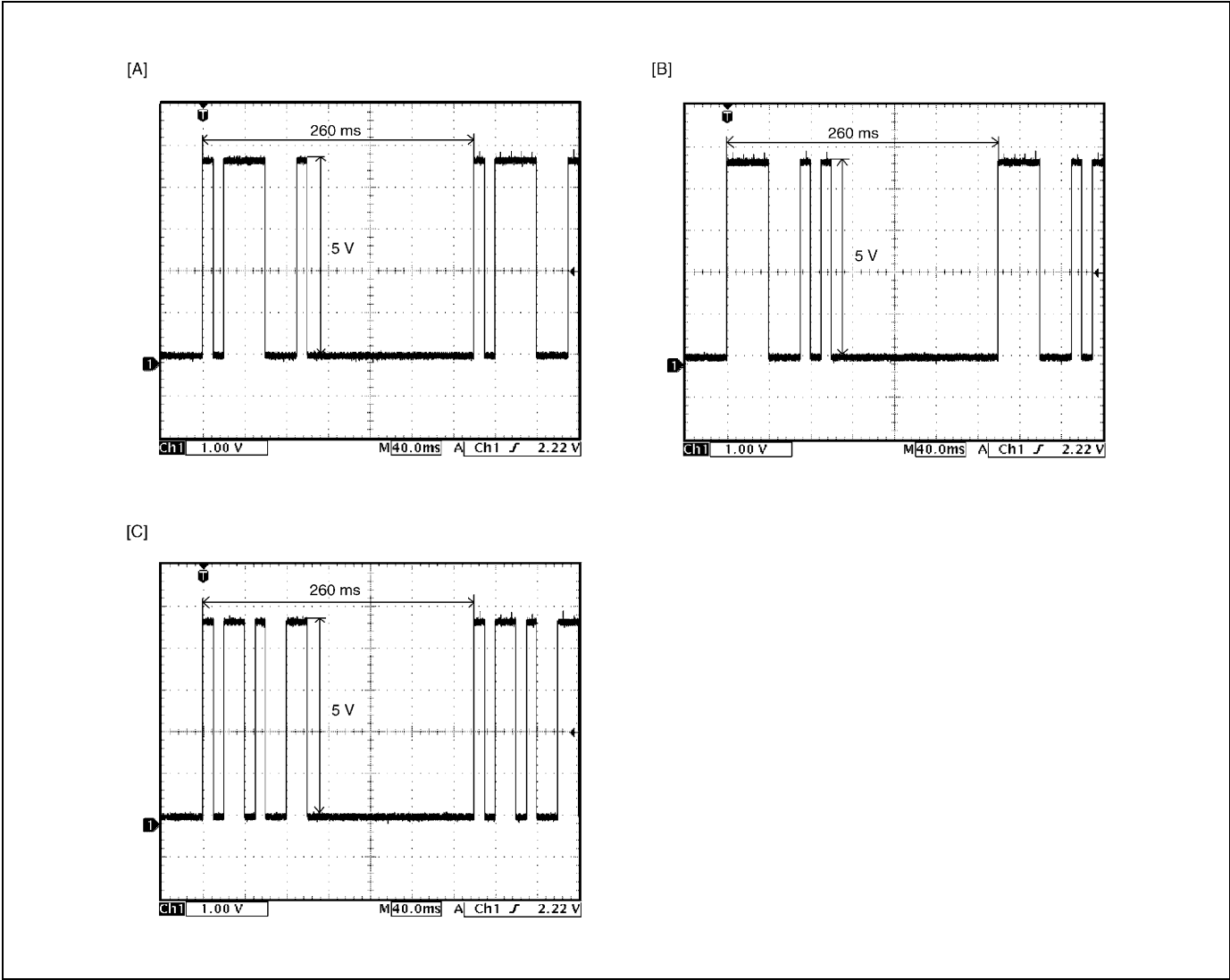
Terminal	Wire Color	Circuit	Measurement Ground	Normal Value	Condition
G52-24	BLK/RED	Sensor ground	Ground to body	less than 0.5 V	—
G52-25	PNK	Sunload sensor (for automatic air conditioning system)	Ground to body	about 2.5 V	Ignition switch ON, Sunload sensor lighted over vertically with incandescent lamp of 100 watt (distance between sunload sensor and incandescent lamp 100 mm (3.94 in.))
				about 4.5 V	Ignition switch ON, Sunload sensor covered
G52-26	YEL/WHT	ECT signal	Ground to body	See reference waveform No.2.	Ignition switch ON
G52-27	WHT/RED	Temperature control actuator position sensor	Ground to body	about 0.5 V	Ignition switch ON, Temperature selector at max COOL position
				about 4.5 V	Ignition switch ON, Temperature selector at max HOT position
G52-28	WHT/YEL	Air flow control actuator position sensor	Ground to body	about 4.5 V	Ignition switch ON, Air flow selector at VENT position
				about 3.7 V	Ignition switch ON, Air flow selector at VENT/FOOT position
				about 2.0 V	Ignition switch ON, Air flow selector at FOOT position
				about 1.4 V	Ignition switch ON, Air flow selector at DEF/FOOT position
				less than 0.5 V	Ignition switch ON, Air flow selector at DEF position
G52-29	PPL/WHT	Blower motor controller	Ground to body	less than 1.0 V	Ignition switch ON, Blower speed selector OFF
				about 2.5 V	Ignition switch ON, Blower speed selector at 1st position (not including OFF and AUTO position)
				about 10.0 V	Ignition switch ON, Blower speed selector at 8th position
G52-30	RED/BLK	Blower motor control voltage feedback	Ground to body	10 – 14 V	Ignition switch ON, Blower speed selector at OFF position
				about 7.5 V	Ignition switch ON, Blower speed selector at 1st position (not including OFF and AUTO position)
				less than 0.2 V	Ignition switch ON, Blower speed selector at 8th position

Reference waveform No.1

NOTE:

The shape of waveform varies with outside air temperature.

Measurement terminal	G52-13 to G52-23
Oscilloscope setting	CH1: 1 V / DIV TIME: 40 ms / DIV
Measurement condition	Ignition switch turned ON



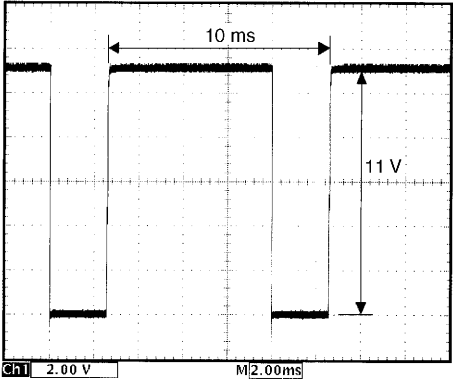
[A]: Waveform at -20 °C (-68 °F) [B]: Waveform at 0 °C (32 °F) [C]: Waveform at 30 °C (86 °F)

Reference waveform No.2

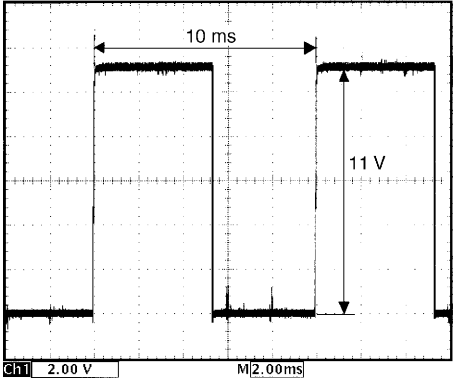
NOTE:
The shape of waveform varies with engine coolant temperature.

Measurement terminal	G52-13 to G52-26
Oscilloscope setting	CH1: 2 V / DIV TIME: 2.00 ms / DIV
Measurement condition	Ignition switch turned ON

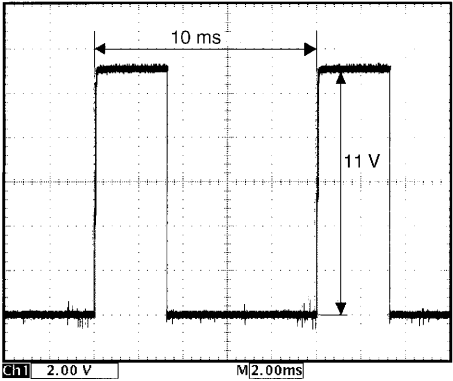
[A]



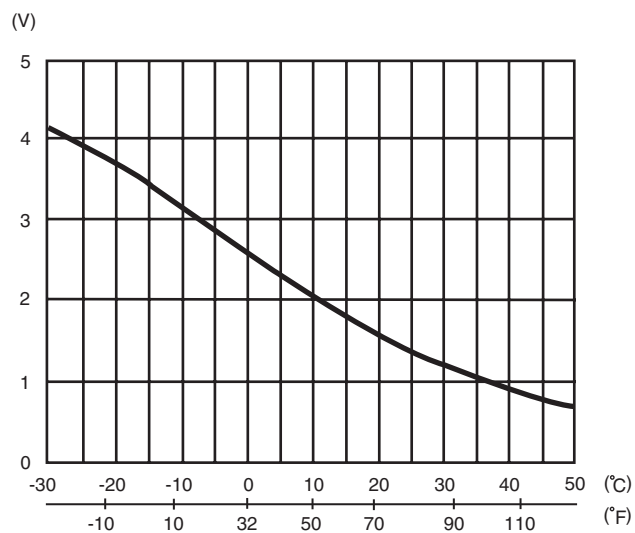
[B]



[C]

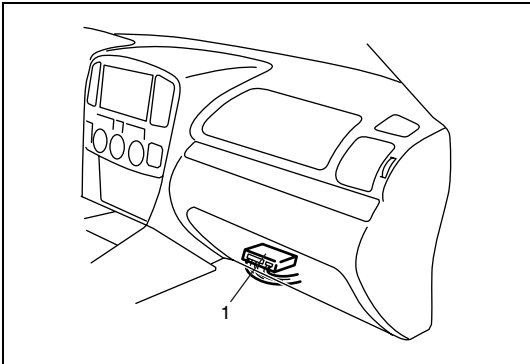


[A]: Waveform at 0 °C (32 °F) [B]: Waveform at 40 °C (104 °F) [C]: Waveform at 80 °C (176 °F)

Reference graph No.1

Inspection of A/C Controller and Its Circuits

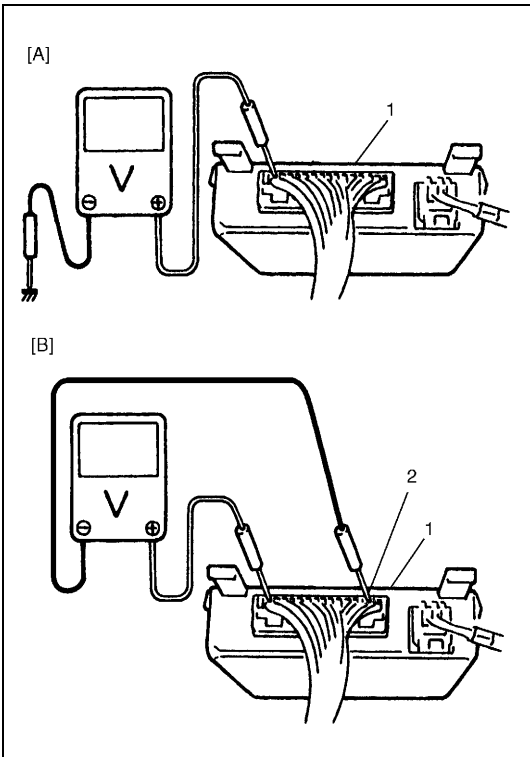
CAUTION:
A/C controller cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to A/C controller with couplers disconnected from it.



A/C controller (1) and its circuits can be checked at A/C controller wiring couplers by measuring voltage.

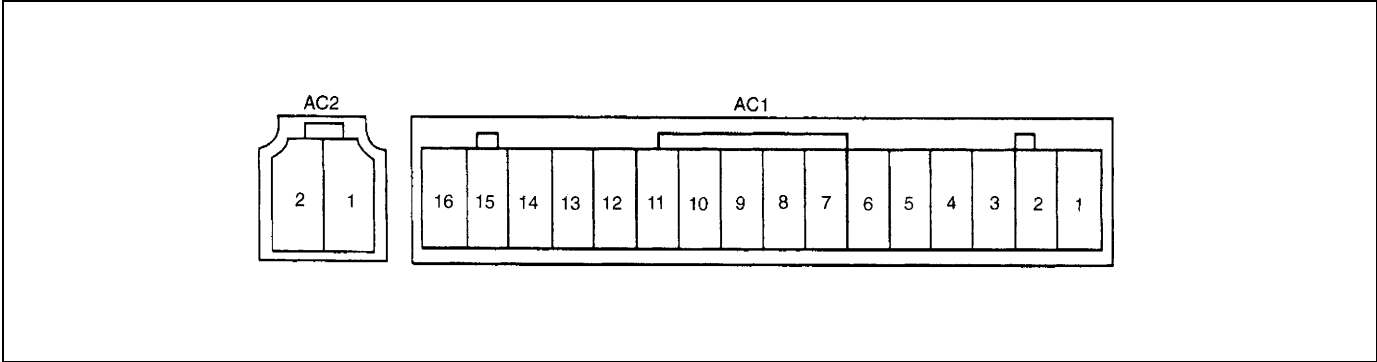
VOLTAGE CHECK

- 1) Remove A/C controller (1) from blower unit referring to “A/C Controller” in this section.
- 2) Connect A/C controller couplers to A/C controller (1).
- 3) Check each terminal voltage referring to “A/C controller voltage value table” in this section.



[A]: Fig. A
[B]: Fig. B
1. A/C controller
2. AC1-15

Terminal arrangement of A/C controller



A/C controller voltage value table

Terminal	Wire color	Circuit	Measurement ground	Normal value	Condition
AC1-1	PNK	Compressor magnet clutch relay drive	Ground to engine (Fig. B)	-0.3 – 0.3 V	Fulfill all of the following conditions. - Blower speed selector ON - Fulfill either one of the following conditions. - A/C switch ON - Air flow selector at DEF or DEF/FOOT position - Engine running - A/C evaporator thermistor (A/C evaporator temperature sensor) temperature input more than approx. 4 °C (39.2 °F) - A/C refrigerant (dual) pressure switch ON - Signal input from ECM ON
				12 – 15 V	Except the above conditions with engine running
AC1-4	YEL/ RED	A/C ON signal output to A/C controller through relay	Ground to engine (Fig. B)	4 – 6 V	Fulfill all of the following conditions. - Blower speed selector ON - Fulfill either one of the following conditions. - A/C switch ON - Air flow selector at DEF or DEF/FOOT position - Engine running - A/C evaporator thermistor (A/C evaporator temperature sensor) temperature input more than approx. 4 °C (39.2 °F) - A/C refrigerant (dual) pressure switch ON
				12 – 15 V	Except the above conditions with engine running
AC1-8	GRY/ WHT	A/C ON permission	Ground to engine (Fig. B)	10 – 14 V	A/C ON permitted
				-0.3 – 0.3 V	A/C ON forbidden
AC1-10	GRN/ BLU	A/C refrigerant (dual) pressure switch input	Ground to engine (Fig. B)	-0.3 – 0.3 V	A/C refrigerant (dual) pressure switch is ON with engine running
				12 – 15 V	A/C refrigerant (dual) pressure switch is OFF with engine running
AC1-13	BLK	Controller main ground	Ground to body (Fig. A)	-0.3 – 0.3 V	Engine running
AC1-15	BLK	Controller main ground	Ground to body (Fig. A)	-0.3 – 0.3 V	Engine running
AC1-16	BLK/ WHT	Controller main power supply	Ground to engine (Fig. B)	10 – 14 V	Ignition switch is ON position
AC2-1	BLK	Controller main ground	Ground to body (Fig. A)	-0.3 – 0.3 V	Engine running
AC2-2	BLK	Controller main ground	Ground to body (Fig. A)	-0.3 – 0.3 V	Engine running

Scan Tool Data

As the data values given below are standard values estimated on the basis of values obtained from the normally operating vehicles by using a scan tool, use them as reference values. Even when the vehicles are in good condition, there may be cases where the checked values do not fall within each specifies data range. Therefore, judgement as abnormal should not be made by checking with these data alone.

Scan Tool Data	Condition	Normal Condition / Reference Value
TEMP CONT SWITCH	<For vehicle with automatic A/C system> Each reference value is relative to the position of temperature selector of HVAC control module.	Max Cool, 20 °C (68 °F), 20.5 °C (68.9 °F) ... 29.5 °C (85.1 °F), 30 °C (86 °F), Max Hot
	<For vehicle with manual A/C system> Each reference value is relative to the position of temperature selector of HVAC control module.	Max Cool, P1, P2 ... P20, P21, Max Hot
CABIN TEMPERATURE (NOTE 1)	Reference value is relative to in-car temperature.	−29 °C – 47.5 °C (−20.2 °F – 117 °F)
OUTSIDE AIR TEMP (NOTE 1)	Reference value is relative to outside air temperature.	−29 °C – 47.5 °C (−20.2 °F – 117.5 °F)
EVAPORATOR TEMP	Reference value is relative to temperature of evaporator.	−29 °C – 47.5 °C (−20.2 °F – 117.5 °F)
COOLANT TEMP	At specified idle speed after warming up engine	80 °C – 100 °C (176 °F – 212 °F)
SUNLOAD (NOTE 1)	Reference value depends on the amount of sunlight.	0 W/m ² – 1963.5 W/m ²
MODE CONT SWITCH	<For vehicle with automatic A/C system> Each reference value is relative to the position of air-flow selector of HVAC control module.	AUTO, VENT, BI-LEVEL, FOOT, DEF-FOOT, DEF
	<For vehicle with manual A/C system> Each reference value is relative to the position of air-flow selector of HVAC control module.	VENT, BI-LEVEL, FOOT, DEF-FOOT, DEF
FAN CONT SWITCH	<For vehicle with automatic A/C system> Each reference value is relative to the position of blower speed selector of HVAC control module.	AUTO, 1st, 2nd ... 7th, 8th
	<For vehicle with manual A/C system> Each reference value is relative to the position of blower speed selector of HVAC control module.	1st, 2nd ... 7th, 8th
FAN DESIRE VOLT	Reference value is relative to the position of blower speed selector of HVAC control module.	0 – 15.5 V
AIR MIX POS SENSOR	Reference value is relative to the position of temperature selector of HVAC control module.	0.5 V (Max Cool)
		4.5 V (Max Hot)
MODE POS SENSOR	Reference value is relative to the position of airflow selector of HVAC control module.	0.5 V (DEF)
		4.5 V (VENT)
A/C CONT SIG	A/C system is ON.	ON
	A/C system is OFF.	OFF
BLOWER FAN LOAD	Position of blower speed selector is at 1st or 2nd position.	ON
	Position of blower speed selector is at more than 3rd position.	OFF

Scan Tool Data	Condition	Normal Condition / Reference Value
AIR INTAKE MODE	Fresh air (FRE) mode is activated.	FRE
	Recirculation air (REC) mode is activated.	REC
	- Engine coolant temperature is less than 60 °C. - Air outlet is other than FACE position. - When air intake mode is changed to recirculation air (REC) mode.	MIX
A/C INDICATOR LAMP	A/C indicator lamp is lighted.	ON
	A/C indicator lamp is not lighted.	OFF
FRE INDICATOR LAMP	Fresh air (FRE) indicator lamp is lighted.	ON
	Fresh air (FRE) indicator lamp is not lighted.	OFF
REC INDICATOR LAMP	Recirculation air (REC) indicator lamp is lighted.	ON
	Recirculation air (REC) indicator lamp is not lighted.	OFF
REAR DEF INDICATOR	Rear defogger indicator lamp is lighted.	ON
	Rear defogger indicator lamp is not lighted.	OFF
ILLUMINATION	Lighting switch is at parking position.	ON
	Lighting switch is at OFF position.	OFF
SUPPLEMENT HEATER	- Engine is running. - Position of temperature selector is at max hot. - Position of blower speed selector is at ON. - Engine coolant temperature is less than 60 °C. - Position of air flow selector is at FOOT, DEF/FOOT, or DEF. - Battery voltage is more than 9 V.	ON
	Other than the above condition	OFF
STEERING WHEEL (NOTE 1)	For vehicle equipped with left steering wheel	Left
	For vehicle equipped with right steering wheel	Right
FUEL TYPE (NOTE 2)	For vehicle which uses gasoline fuel	Gasoline
	For vehicle which uses diesel fuel	Diesel

NOTE1:

This data is for vehicle with automatic air conditioning system.

NOTE2:

This data is for vehicle with manual air conditioning system.

Scan tool data definitions**TEMP CONT SWITCH**

Position of temperature control selector of HVAC control module

CABIN TEMPERATURE (for vehicle with automatic air conditioning system)

In-car temperature detected by inside air temperature sensor installed in HVAC control module

OUTSIDE AIR TEMPERATURE (for vehicle with automatic air conditioning system)

Outside air temperature detected by outside air temperature sensor installed on 4WD air pump assembly bracket

EVAPORATOR TEMP

Temperature of air passed through evaporator

COOLANT TEMP

Engine coolant temperature detected by engine coolant temperature sensor

SUNLOAD (for vehicle with automatic air conditioning system)

Amount of sunlight detected by sunload sensor installed on the driver side on the dashboard

MODE CONT SWITCH

Position of airflow selector of HVAC control module

FAN CONT SWITCH

Position of blower speed selector of HVAC control module

FAN DESIRE VOLT

Voltage for blower motor

AIR MIX POS SENSOR

Input signal from position sensor in temperature control actuator

MODE POS SENSOR

Input signal from position sensor in air flow control actuator

A/C CONT SIG (ON or OFF)

State of A/C indicator lamp

BLOWER FAN LOAD (ON or OFF)

ON: Position of blower speed selector is at 1st or 2nd position.

OFF: Position of blower speed selector is at more than 3rd position.

AIR INTAKE MODE (FRE, REC or MIX)

State of air intake switch

A/C INDICATOR LAMP (ON or OFF)

State of A/C indicator lamp

FRE INDICATOR LAMP (ON or OFF)

State of fresh air (FRE) indicator lamp

REC INDICATOR LAMP (ON or OFF)

State of recirculation air (REC) indicator lamp

REAR DEF INDICATOR (ON or OFF)

State of rear defogger indicator lamp

ILLUMINATION (ON or OFF)

State of lighting switch

STEERING WHEEL (RIGHT or LEFT) (for vehicle with automatic air conditioning system)

Position of steering wheel

FUEL TYPE (GASOLINE or DIESEL) (for vehicle with manual air conditioning system)

Type of fuel which should be used

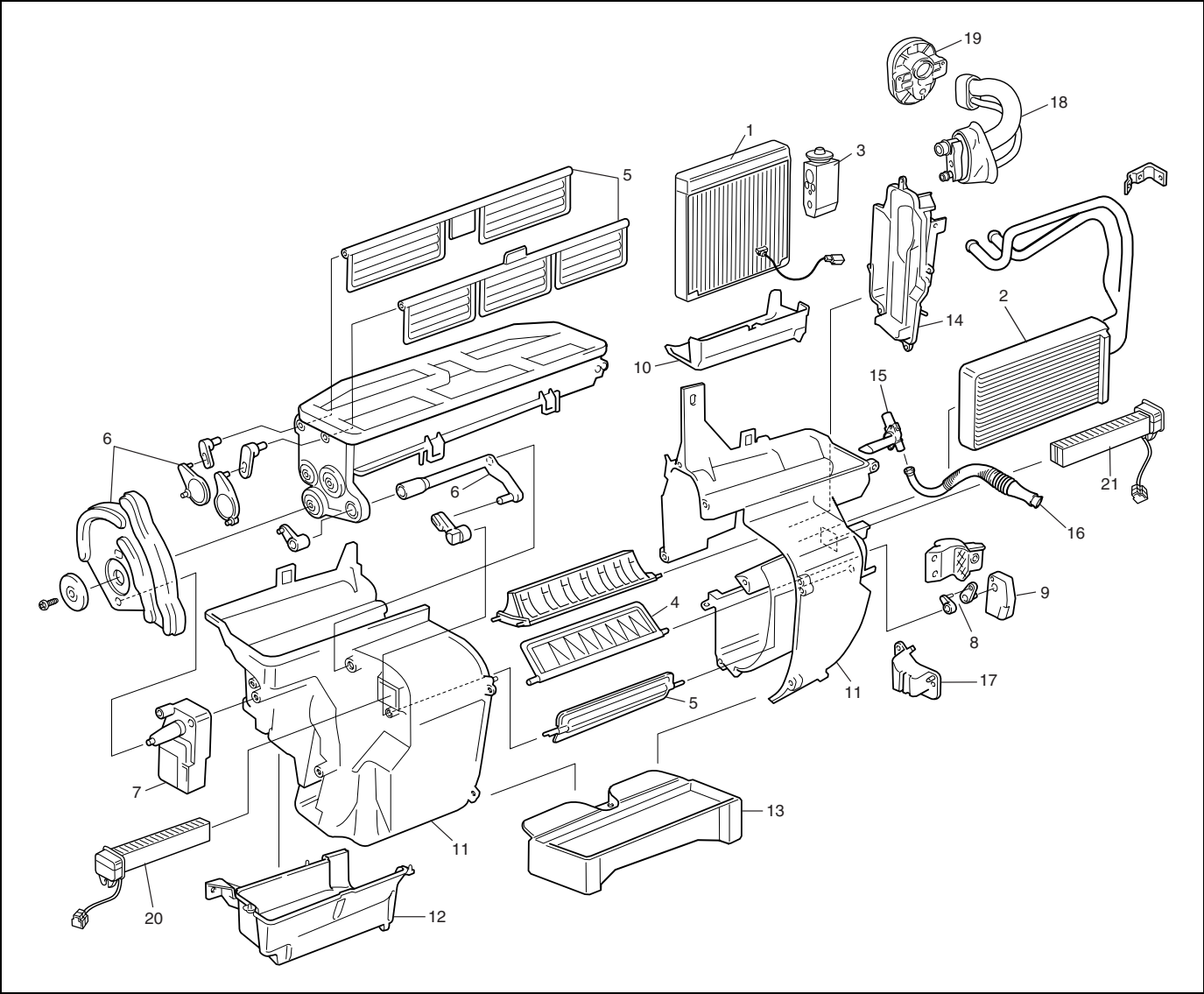
SUPPLEMENT HEATER (ON or OFF)

State of supplementary heater in heater and cooling unit

On-Vehicle Service

Heater and Cooling Unit

CAUTION:
Be careful not to damage A/C evaporator fins. If A/C evaporator fin is bent, straighten the bend by using flat head screwdriver or pair of pliers.



1. A/C evaporator	7. Air flow control actuator	13. Foot air duct	19. Packing
2. Heater core	8. Temperature control link assembly	14. Air joint duct	20. Supplementary heater No.1
3. Expansion valve	9. Temperature control actuator	15. Aspirator (for vehicle with automatic A/C system)	21. Supplementary heater No.2
4. Temperature control door	10. A/C evaporator undercover	16. Aspirator hose (for vehicle with automatic A/C system)	
5. Air flow control door	11. Heater and cooling case	17. Heater core bracket	
6. Air flow control link assembly	12. A/C evaporator undercase	18. Pipe assembly	

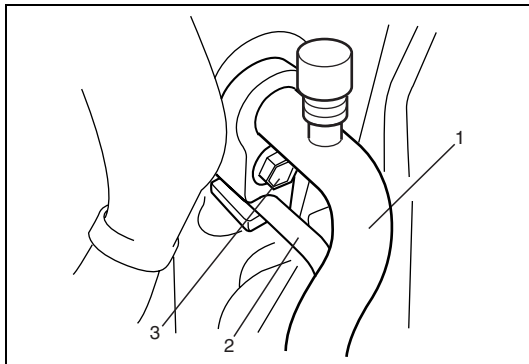
REMOVAL

WARNING:

Failure to follow the following procedure and **WARNING** may cause unexpected deployment, personal injury, damage to parts, or undeployment.

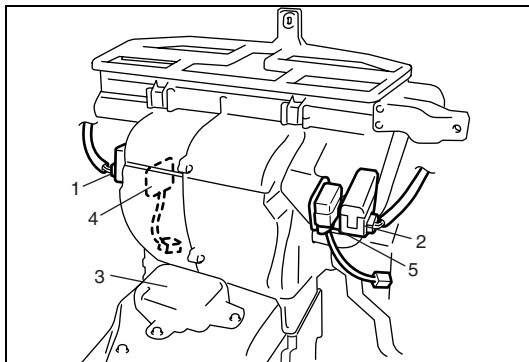
- Never rest a steering column assembly on steering wheel with air bag (inflator) module face down and column vertical.
- When handling the air bag (inflator) modules (driver and passenger), be careful not to drop it or apply an impact to it. If an excessive impact was applied (e.g., dropped from a height of 91.4 cm (3 feet) or more), never attempt disassembly or repair but replace it with a new one.
- When grease, cleaning agent, oil, water, and so forth have got onto air bag (inflator) modules (driver and passenger), wipe off immediately with a dry cloth.

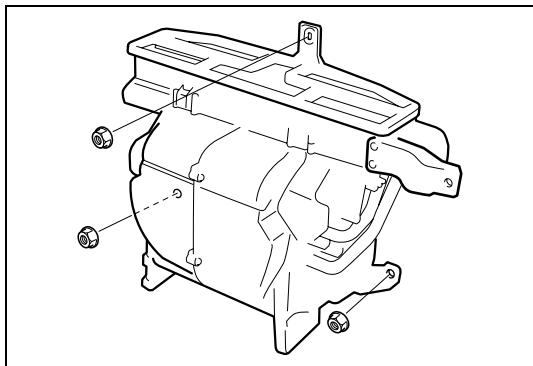
- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system referring to “Disabling Air Bag System” in Section 10B.
- 3) Recover refrigerant by using recovery and recycling equipment.
- 4) Drain engine coolant, and then disconnect heater hoses from heater unit.
- 5) Disconnect suction pipe (1) and condenser outlet pipe (2) after removing attaching bolt (3).

**CAUTION:**

As soon as suction pipe and condenser outlet pipe are disconnected, cap opened fittings to prevent ingress of moisture or dust.

- 6) Remove instrument panel referring to “Instrument Panel” in Section 9.
- 7) Remove blower unit referring to “Blower Unit” in Section 1A.
- 8) Disconnect rear duct from heater unit.
- 9) Disconnect A/C evaporator thermistor wire coupler.
- 10) Disconnect air flow control actuator lead wire at coupler (1) and temperature control actuator lead wire at coupler (2).
- 11) Disconnect supplementary heater No.1 (4) and No.2 (5) lead wires at couplers.
- 12) Remove SDM (3).





- 13) Remove heater and cooling unit from dash panel.

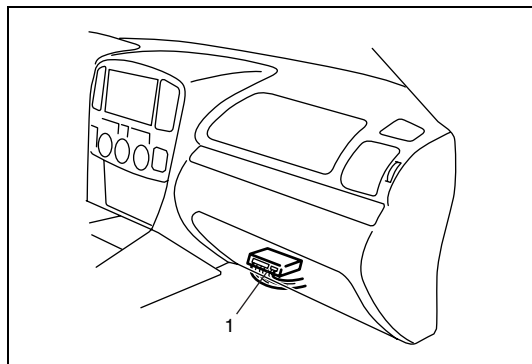
INSTALLATION

- 1) Install heater and cooling unit by reversing removal procedure noting the following items.
 - When installing each part, be careful not to catch any wiring harness.
 - When installing steering column assembly, refer to “Steering Column” in Section 3C.
- 2) Fill engine coolant to radiator.
- 3) Enable air bag system referring to “Enabling Air Bag System” in Section 10B.
- 4) Evacuate and charge system referring to “Evacuating” and “Charging” in this section.

A/C Controller

REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system referring to “Disabling Air Bag System” in Section 10B.
- 3) Remove A/C controller (1) from blower unit by removing brackets and bolts.



INSTALLATION

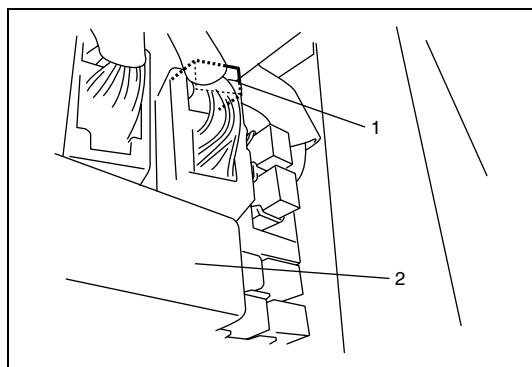
Reverse removal procedure for installation noting the following.

- Enable air bag system referring to “Enabling Air Bag System” in Section 10B.

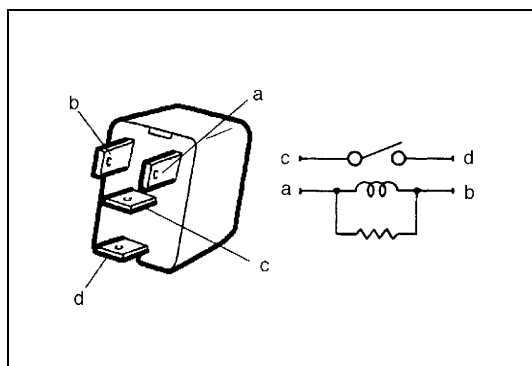
A/C Signal Relay

INSPECTION

- 1) Disconnect negative (–) cable at battery.
- 2) Disable air bag system referring to “Disabling Air Bag System” in Section 10B.
- 3) Remove A/C signal relay (1) under the instrumental panel on the driver's seat side.



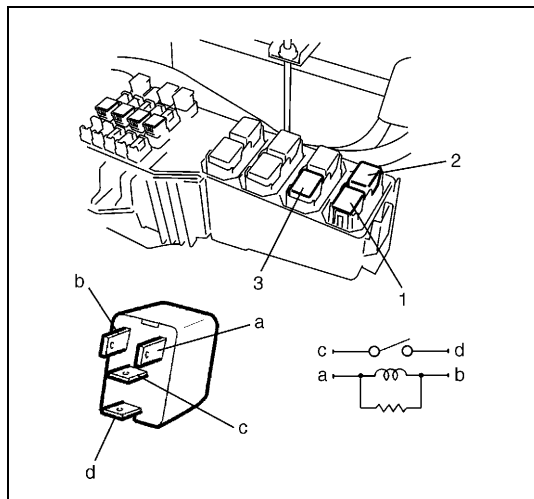
2. Circuit fuse box



- 4) Check for continuity between terminal “c” and “d”. If there is continuity, replace relay with new one.
- 5) Check for continuity between terminals “c” and “d” when 12 V battery is connected to terminals “a” and “b”. If there is no continuity, replace relay with new one.

A/C Compressor Relay and A/C Condenser Cooling Fan Relays

INSPECTION



- 1) Disconnect negative (–) cable at battery.
- 2) Remove condenser cooling fan motor relay (2), condenser cooling fan motor high relay (3), and/or compressor relay (1) from vehicle.
- 3) Check for continuity between terminal “c” and “d”. If there is continuity, replace relay with new one.
- 4) Connect battery positive (+) terminal to terminal “b” of relay and battery negative (–) terminal to terminal “a” of relay. Then, check for continuity between terminal “c” and “d”. If there is no continuity, replace relay with new one.

Compressor Assembly

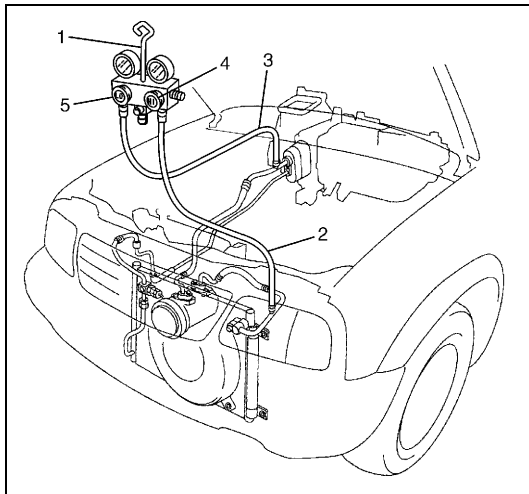
CAUTION:

- None of refrigerant, compressor oil and component parts is interchangeable between two types of A/C system: one using CFC-12 (R-12) refrigerant and the other using HFC-134a (R-134a) refrigerant. For distinguishing between two types of refrigerant, refer to “Identification of Refrigerating System” in this section.
- When replenishing or changing refrigerant and compressor oil and when replacing parts with new ones, make sure if the material or the part to be used is appropriate to the A/C system on the vehicle.
- Use of inappropriate refrigerant and compressor oil will result in leakage of refrigerant, damage in parts or other malfunction.

PRECAUTION

- When servicing the compressor, keep any dirt, particle, or foreign material away from the compressor to prevent those ingression. Clean tools and clean work area are important for proper service.
- The outside of the compressor should be cleaned before any on-vehicle service or before removal of the compressor. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichloroethane, naphtha, kerosene or the equivalent solvent, and then dried with air. Use only lint free cloths to wipe parts.
- The operations described here are based on bench overhaul with compressor removed from the vehicle, except as noted. They have been prepared in order of accessibility of the components.
- When compressor is removed from the vehicle for service, the oil in the compressor should be discarded, and then new refrigerant oil should be added to the compressor.
- Minor repair may be done on the vehicle without discharging the refrigerant from the A/C system. For major repair, the discharge of the refrigerant is required.

INSPECTION



- 1) Install manifold gauge set (1) as shown in the figure.
- 2) Close Hi (4) and Lo (5) hand valves.
- 3) Run engine at fast idle.
- 4) Check compressor assembly for the following items and repair compressor assembly if any abnormality is found.
 - High pressure gauge reading is not low and low pressure gauge reading is not higher than normal.
 - Metallic noise
 - Leakage from shaft seal

2. High pressure side (Delivery side pipe)

3. Lower pressure side (Suction side pipe)

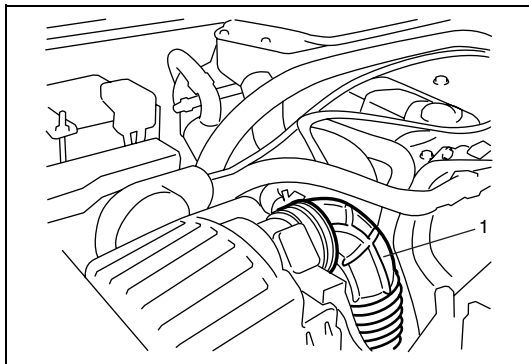
REMOVAL

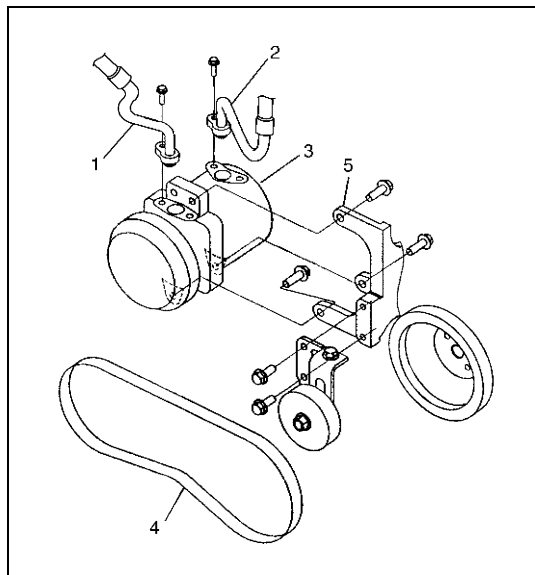
- 1) Run engine at idle with the A/C system ON for 10 minutes.
- 2) Disconnect negative (–) cable at battery.
- 3) Remove air cleaner outlet hose (1).
- 4) Recover refrigerant from the A/C system using recovery and recycling equipment.

NOTE:

The amount of compressor oil removed must be measured and the same amount must be poured before installing the compressor on the vehicle.

- 5) Disconnect thermal protector lead wire.





- 6) Disconnect suction hose (1) and discharge hoses (2) from compressor (3).

NOTE:

Cap open fittings immediately to keep moisture out of system.

- 7) Remove compressor drive belt (4) referring to "Compressor Drive Belt" in this section.
- 8) Remove compressor (3) from engine mounting (5).
- 9) If compressor (3) is replaced, drain oil from compressor (3) and measure its amount.

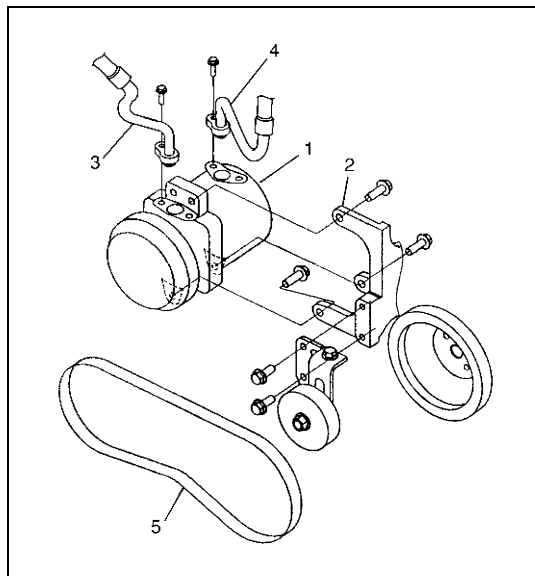
INSTALLATION

- 1) Pour new compressor oil. The amount must be the same with the amount measured in "REMOVAL".

NOTE:

New compressor is filled up with the following amount of oil.

Amount of oil in compressor: 120 cm³ (120 cc)



- 2) Install compressor (1) to engine bracket (2).
- 3) Connect suction hose (3) and discharge hose (4) to compressor (1).
- 4) Install compressor drive belt (5) referring to "Compressor Drive Belt" in this section.
- 5) Connect thermal protector lead wire.
- 6) Install air cleaner outlet hose.
- 7) Perform evacuation and charging referring to "Refrigerant Recovery, Evacuation and Charging" in this section.

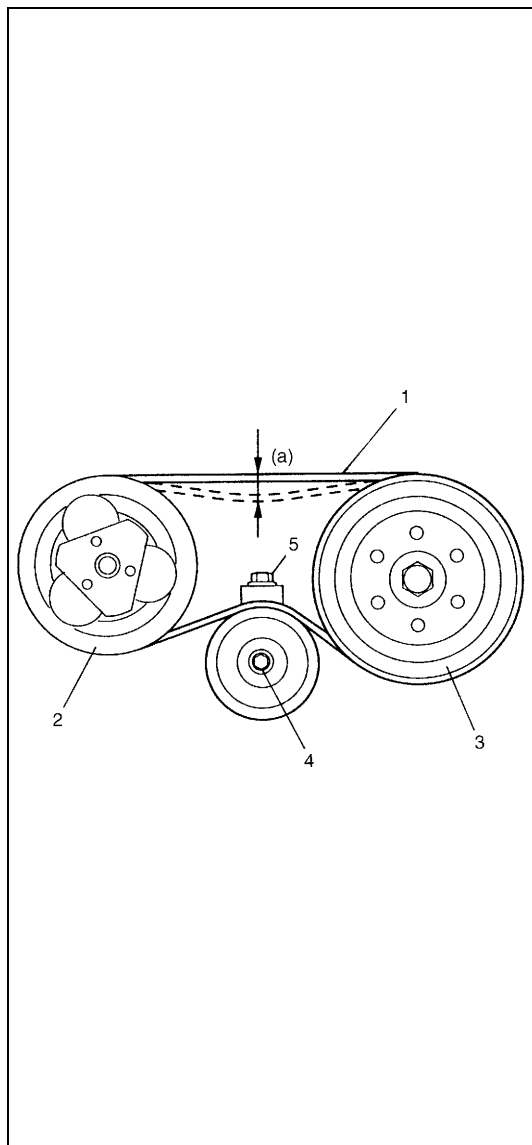
Compressor Drive Belt

INSPECTION

- Check compressor drive belt (1) for wear and cracks. If any abnormality is found, replace it with new one.
- Check for tension of compressor drive belt (1) by measuring how much it deflects when pushed at intermediate point between compressor pulley (2) and crank shaft additional pulley (3) with about 100 N·m (10 kg-m, 7.0 lb-ft) force after crankshaft additional pulley 1 rotating. If belt tension is out of specification, adjust belt tension referring to procedure described below.

Compressor drive belt deflection

(a): 9 mm (0.35 in.)



ADJUSTMENT

- 1) Remove engine undercover.
- 2) Loosen tension pulley nut (4).
- 3) Adjust belt tension by tightening or loosening tension pulley adjusting bolt (5).
- 4) Tighten tension pulley nut (4).
- 5) Turn the crankshaft additional pulley (3) at 360°, then recheck belt for tension.
- 6) Install engine undercover.

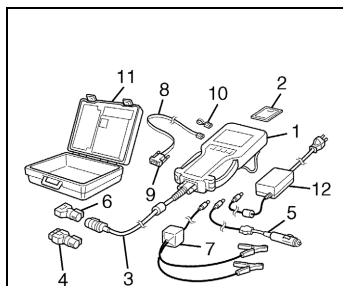
REPLACEMENT

- 1) Remove engine undercover.
- 2) Loosen tension pulley nut (4).
- 3) Loosen belt tension by loosening tension pulley adjusting bolt (5).
- 4) Remove compressor drive belt (1).
- 5) Install new compressor drive belt.
- 6) Adjust belt tension referring to procedure described above.

Required Service Materials

Material	Recommended SUZUKI product (Part Number)	Use
Compressor oil	COMPRESSOR OIL RS20 (150 cc) 99000-99088-00D0	• O-ring • Each component

Special Tool



Tech-2 kit (SUZUKI scan tool) See NOTE below.

NOTE:

This kit includes the following items.

1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 3B1

POWER STEERING (P/S) SYSTEM

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

- Some parts in the Power Steering Gear Box cannot be disassembled or adjusted. For detailed information, refer to the description of “Power Steering Gear Box Assembly”.
- All steering gear fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.
- Although the figures in this section show only the left-hand steering vehicle, the same work procedure and data apply to the right-hand steering vehicle.
- For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

CONTENTS

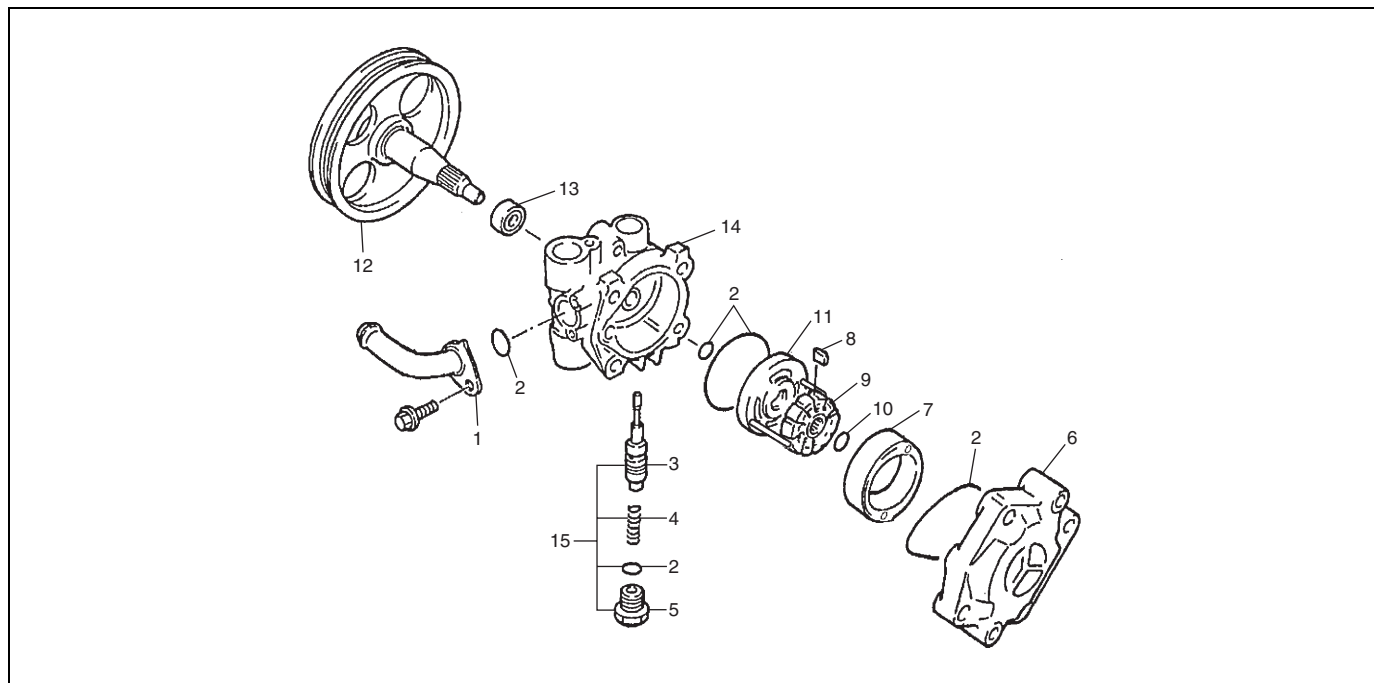
General Description	3B1-3	Fluid	*
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Steering Gear Box.....	*	Hydraulic Pressure in P/S Circuit.....	3B1-4
Power Steering (P/S) Pump	3B1-3	Hydraulic pressure check.....	3B1-4
Diagnosis	3B1-4	Boot.....	*
General Diagnosis Table.....	*	Steering rack boot check.....	*
Steering Wheel.....	*	Tie-rod end boot check	*
Steering wheel play check.....	*	Air Bleeding Procedure	*
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Belt tension adjustment	*	LH Model)	*
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Idle up system check.....	*	Tightening Torque Specifications	3B1-15

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General Description

Power Steering (P/S) Pump

The power steering pump is a vane type and is driven by the V-ribbed belt from the crankshaft.



1. Suction connector	4. Spring	7. Cam ring	10. Snap ring	13. Oil seal
2. O-ring	5. Plug	8. Vane	11. Side plate	14. Pump body
3. Flow control valve (Relief valve)	6. Pump cover	9. Rotor	12. Pulley (pump shaft)	15. Flow control valve assembly

Model		Vane type
Hydraulic pressure control	Relieved pressure	7850 kPa (78.5 kg/cm ² , 1116 psi)
	Control device	Flow control valve
		Relief valve
Capacity		0.75 – 0.8 L (1.59/1.32 – 1.69/1.41 US pt/Imp. pt)
Specified fluid		DEXRON®II A/T fluid or the equivalent

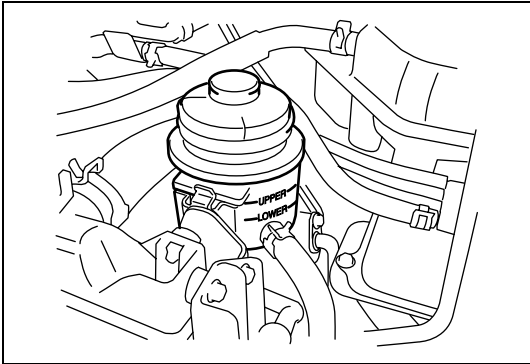
FLOW CONTROL VALVE

As the discharge rate of the P/S pump increases in proportion to the pump revolution speed, a flow control valve is installed to control it so that the optimum amount of fluid for steering operation is supplied according to the engine speed (driving condition).

Diagnosis

Power Steering Fluid

Power steering fluid level check



With engine stopped, check fluid level indicated on P/S fluid reservoir. The fluid level should be between “UPPER” and “LOWER” lines. If it is lower than “LOWER” line, fill fluid up to “UPPER” line.

NOTE:

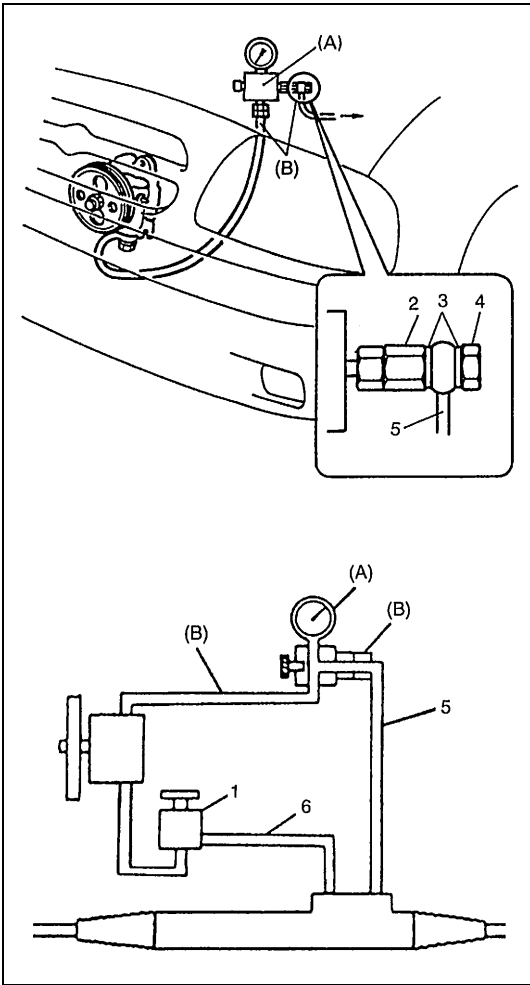
- Be sure to use the specified power steering fluid.
- Fluid level should be checked when fluid is cool.

Power Steering Pump Drive Belt

Refer to “Generator belt” under “Generator” in Section 6H for belt inspection, belt tension check, and belt tension adjustment.

Hydraulic Pressure in P/S Circuit

Hydraulic pressure check



- 1) After cleaning joint of high pressure hose and P/S pump thoroughly, disconnect hose from pump and install special tool (oil pressure gauge, attachment and hose). Then, tighten each flare nut to specified torque.

CAUTION:

Be careful not to cause damage to A/C condenser fins during service operation, if equipped.

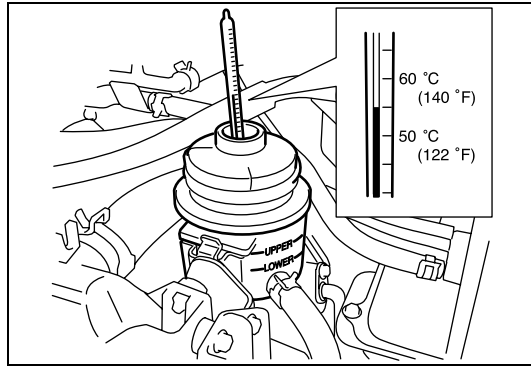
Special tool

(A) : 09915-77411 (Oil pressure gauge)

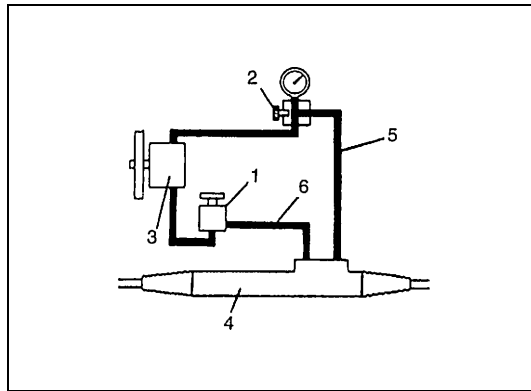
(B) : 09915-77420

- 2) Check each connection for fluid leakage and bleed air referring to “Air Bleeding Procedure” in this section.

1. P/S fluid reservoir	4. Union bolt
2. Attachment	5. High pressure side
3. Gasket	6. Low pressure side



- 3) With engine idling, turn steering wheel and warm up engine till fluid temperature in P/S fluid reservoir rises to 50 – 60 °C (122 – 140 °F).



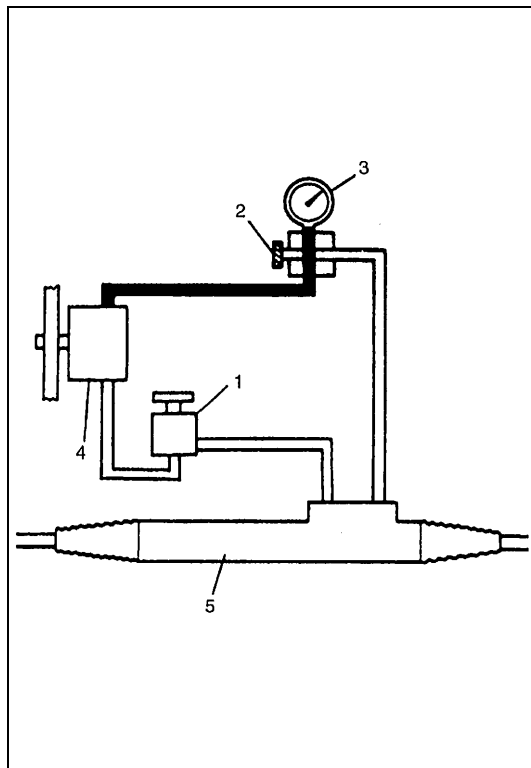
- 4) Check line pressure by measuring hydraulic pressure with engine idling and hands off steering wheel.

Line pressure

Lower than 1000 kPa (10 kg/cm², 142 psi)

When line pressure is higher than specified values, check control valve and piping for clogging.

1. P/S fluid reservoir	4. P/S gear box
2. Gauge valve (open)	5. High pressure side
3. P/S pump	6. Low pressure side



- 5) Checking relief pressure

CAUTION:

Be sure not to close gauge valve for longer than 10 seconds.

- a) Increase engine speed to about 1500 r/min (rpm). Close gauge valve gradually while watching pressure increase indicated by gauge and take reading of relief pressure (maximum hydraulic pressure).

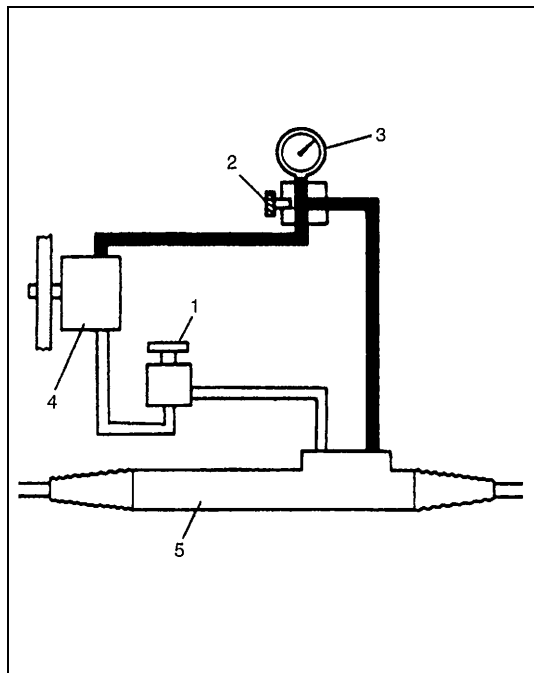
Relief pressure

7650 – 8350 kPa

(76.5 – 83.5 kg/cm², 1088 – 1188 psi)

- When it is higher than specified values, possible cause is malfunction of relief valve.
- When it is lower than specified values, possible cause is either failure of P/S pump or settling of relief valve spring.

1. P/S fluid reservoir	4. P/S pump
2. Gauge valve (shut)	5. P/S gear box
3. Oil pressure gauge	



- b) Next, open gauge valve fully and increase engine speed to about 1500 r/min (rpm). Then, turn steering wheel to the left or right fully and take reading of relief pressure.

CAUTION:

Be sure not to hold steering wheel at fully turned position for longer than 10 seconds.

Relief pressure

7650 – 8350 kPa

(76.5 – 83.5 kg/cm², 1088 – 1188 psi)

- When it is higher than specified values, possible cause is malfunction of relief valve.
- When it is lower than specified values, possible cause is failure in steering gear box. Replace gear box.

1. P/S fluid reservoir	4. P/S pump
2. Gauge valve (open)	5. P/S gear box
3. Oil pressure gauge	

On-Vehicle Service

Power Steering Gear Box Assembly

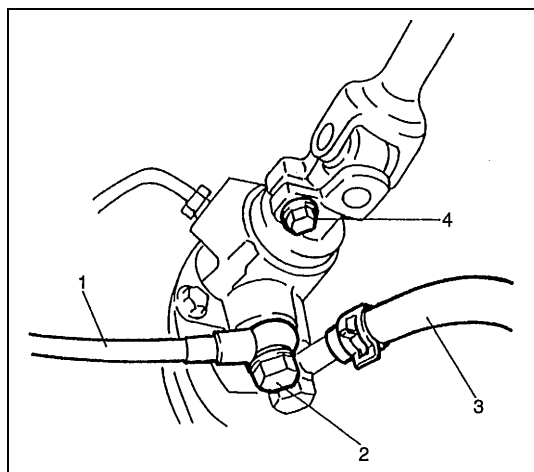
CAUTION:

Never disassemble P/S gear box. Disassembly will affect original performance.

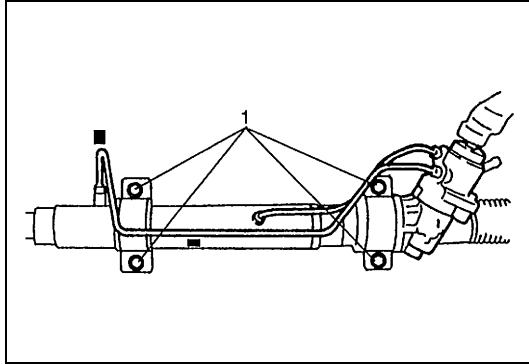
REMOVAL

NOTE:

As fluid flows out of disconnected joints, put a receptacle under joints or a plug to pipe.



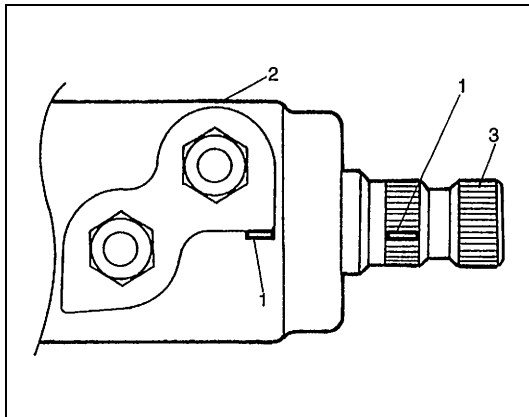
- 1) Take out fluid in P/S fluid reservoir with syringe or the equivalent.
- 2) Disconnect high pressure pipe (1) from steering gear box by removing union bolt (2).
- 3) Disconnect low pressure hose (3) from steering gear box.
- 4) Remove steering lower shaft bolt (4).
- 5) Hoist vehicle and remove both right and left wheels.
- 6) Remove engine undercover.
- 7) Disconnect both right and left tie rod ends from knuckle referring to Steps 2) to 3) of "Tie-Rod End Removal" in this section.



- 8) Remove steering gear box mounting bolts (1), and then remove steering gear box from vehicle.

INSTALLATION

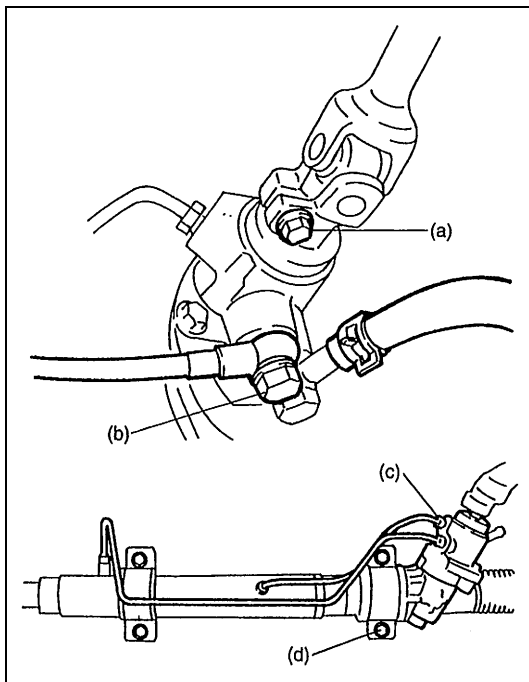
Reverse removal procedure for installation of steering gear box noting the following points.



CAUTION:

Be sure to confirm that steering wheel and front tires (wheels) are in straight position when inserting steering lower joint into steering pinion shaft.

- After confirming that front tire is in straight position, install steering gear box to body temporarily. Next, with tie-rod end installed to knuckle, set rack in position close to neutral. Then obtain the neutral state by aligning match marks (1) on pinion shaft and steering gear case (2) and insert steering lower joint into pinion shaft (3).
- If a plug was put to disconnected pipe when removing steering gear box, remove that plug before reconnecting pipe.



- Use specified torque as given below.

Tightening torque

Steering lower shaft bolt

(a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)

Gear box high pressure pipe union bolt

(b) : 35 N·m (3.5 kg-m, 25.5 lb-ft)

Gear box cylinder pipe flare nut

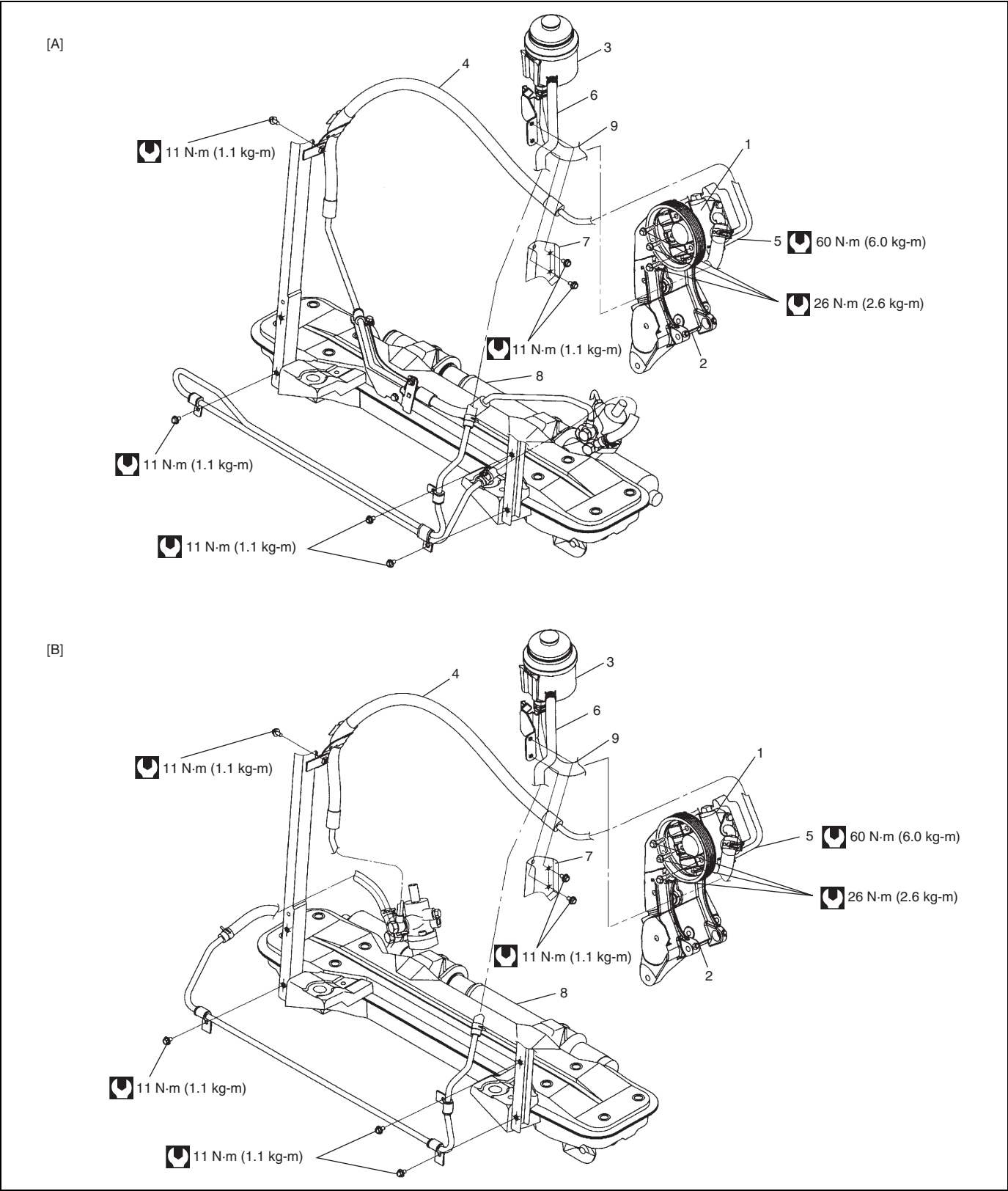
(c) : 25 N·m (2.5 kg-m, 18.0 lb-ft)

Gear box mounting bolt

(d) : 55 N·m (5.5 kg-m, 40.0 lb-ft)

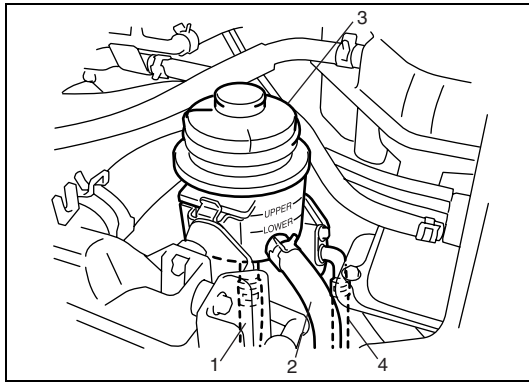
- After installation, be sure to fill specified power steering fluid and bleed air.
- Check toe setting and adjust as required referring to the Section 3A "FRONT END ALIGNMENT".

Power Steering Pump



[A] : LH steering vehicle	2. Power steering pump bracket	5. Pump union bolt	8. Power steering gear box
[B] : RH steering vehicle	3. Power steering fluid reservoir	6. Low pressure hose and pipe	9. Suction hose
1. Power steering pump assembly	4. High pressure hose and pipe	7. Power steering fluid reservoir bracket	Tightening torque

REMOVAL



NOTE:

Be sure to clean each joint of suction and discharge sides thoroughly before removal.

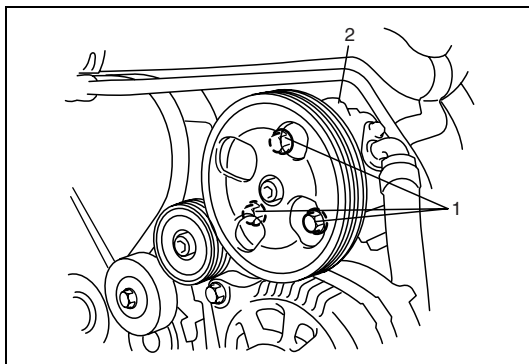
- 1) Remove P/S fluid from P/S fluid reservoir (3).
- 2) Disconnect suction hose (1) and low pressure return hose (2) from P/S fluid reservoir (3).
- 3) Remove suction hose (4) from pump.

- 4) Remove union bolt. Then, disconnect high pressure pipe from pump.

NOTE:

As fluid flows out of disconnected joints, put a receptacle under joints or a plug to pipe.

- 5) Remove P/S drive belt referring to "Generator belt" under "Generator" in Section 6H.



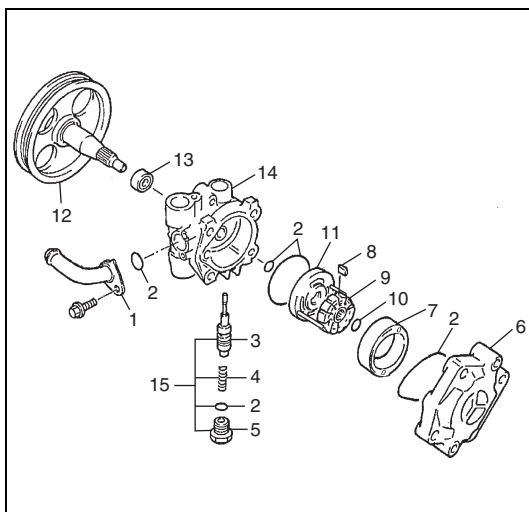
- 6) Remove P/S pump mounting bolts (1).
- 7) Remove P/S pump (2).

NOTE:

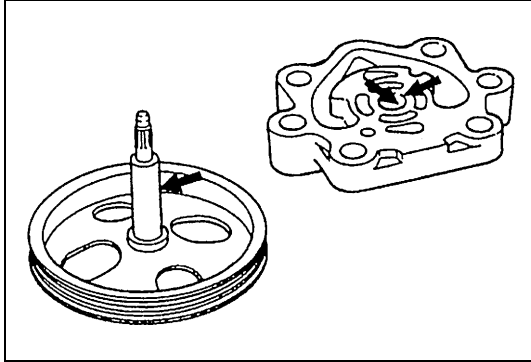
Plug each port of removed P/S pump to prevent interfusion of dust or any other foreign particle.

DISASSEMBLY

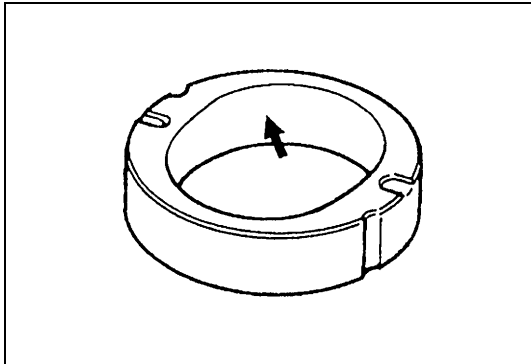
- 1) Clean its exterior thoroughly.
- 2) With aluminum plates placed on vise first, fix pump body with vise.
- 3) Remove suction connector bolt, suction connector (1) and O-ring (2) from pump body (14).
- 4) Remove plug (5), flow control spring (4) and relief valve (flow control valve) (3) from pump body.
- 5) Remove cover bolts, pump cover (6) and O-ring from pump body.
- 6) Remove snap ring (10) from pump shaft.
- 7) Remove vanes (8) from rotor.
- 8) Remove cam ring (7), rotor (9), side plate (11) and O-rings from pump body.
- 9) Pull out P/S pulley (12) from pump body.
- 10) Remove oil seal (13) from pump body.



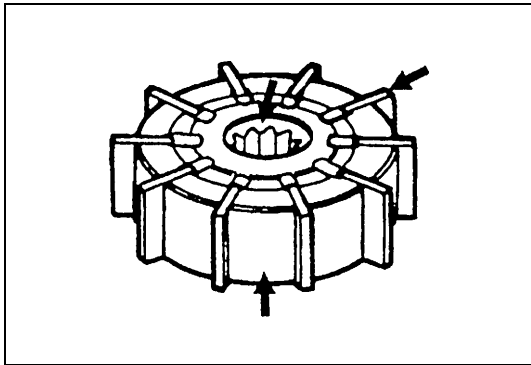
15. Flow control valve Assembly

INSPECTION**Pump Body, Cover, Side Plate and Shaft**

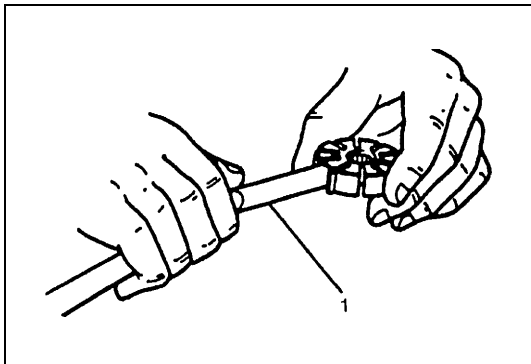
Check sliding surfaces of each part for wear and damage. If any abnormality is found, replace pump assembly.

Cam Ring

Check vane sliding surface of cam ring for wear and damage. If any abnormality is found, replace pump assembly.

Rotor and Vane

- Check sliding surfaces of rotor and vane for wear and damage.



- Check clearance between rotor and vane by using thickness gauge (1).

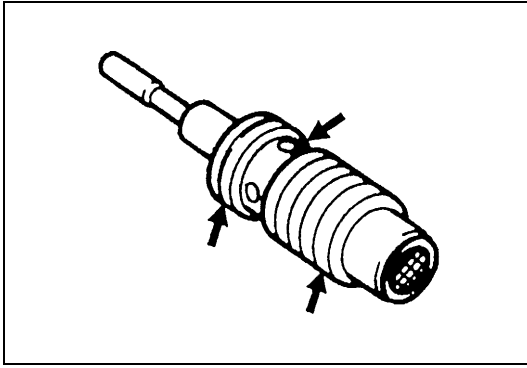
Clearance between rotor and vane

Standard : 0.015 mm (0.0006 in.)

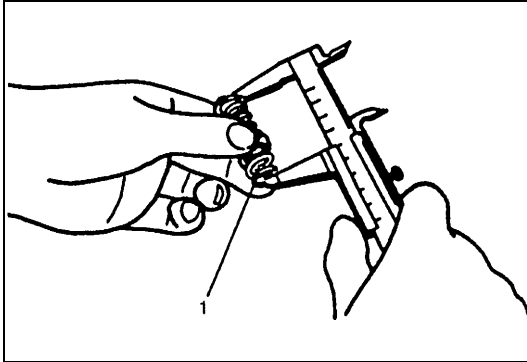
Limit : 0.027 mm (0.0011 in.)

Replace pump assembly if any abnormality is found.

Relief Valve (Flow Control Valve) and its Spring



- Check fluid passage of relief valve and orifice of connector for obstruction (clogged).
- Check sliding surface of relief valve for wear and damage.



- Check free length of relief valve spring (1).

Relief valve spring free length

Standard : 22.0 mm (0.866 in.)

Limit : 19.0 mm (0.748 in.)

Replace pump assembly if any abnormality is found.

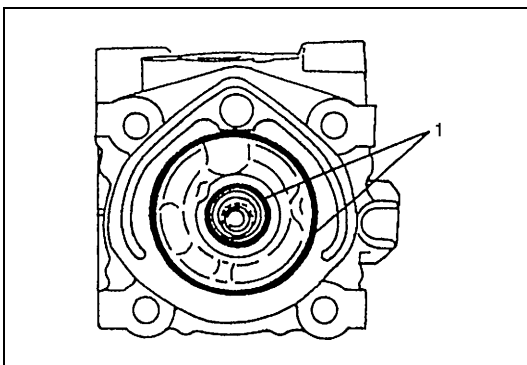
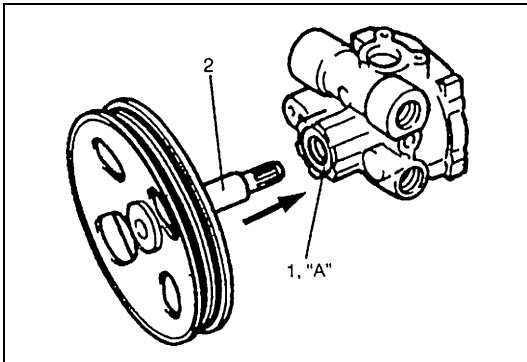
ASSEMBLY

Reverse disassembly procedure for assembly, noting the following.

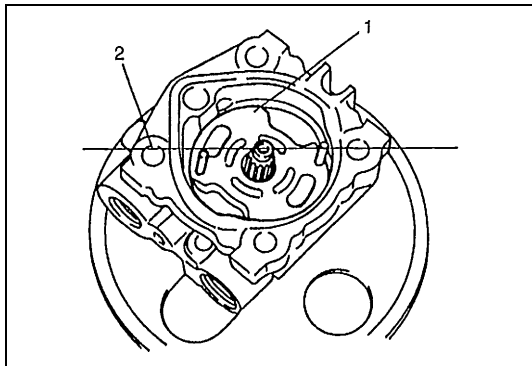
- 1) Apply grease to oil seal lip and apply power steering fluid to sliding surface of the shaft then insert pulley's shaft (2) from oil seal side of the pump body.

“A” : Grease 99000-25010

1. Oil seal



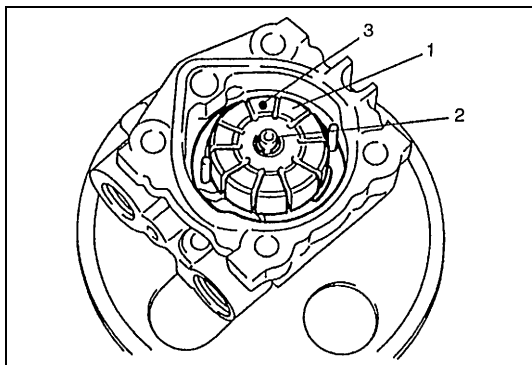
- 2) Apply power steering fluid to O-rings (1) and fit them to pump body.



3) Install side plate (1) to pump body.

NOTE:

Carefully align the dowel pins on the side plate (1) at bolt hole (2) as shown in figure.



4) Apply power steering fluid to sliding surface of rotor (1).

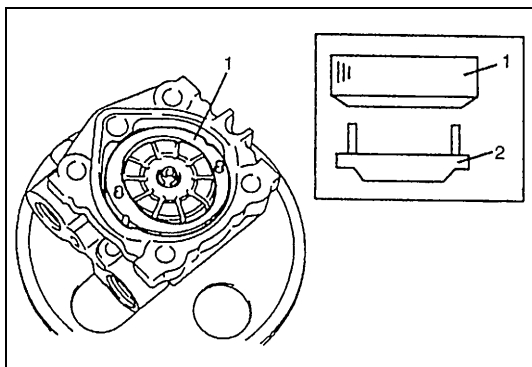
5) Install rotor to shaft, directing dot marked side of rotor facing up.

6) Install new snap ring (2) to shaft, then make sure to fit snap into shaft groove securely.

NOTE:

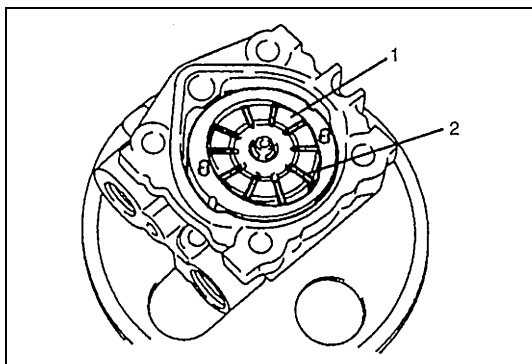
Never reuse the removed snap ring.

3. Dot



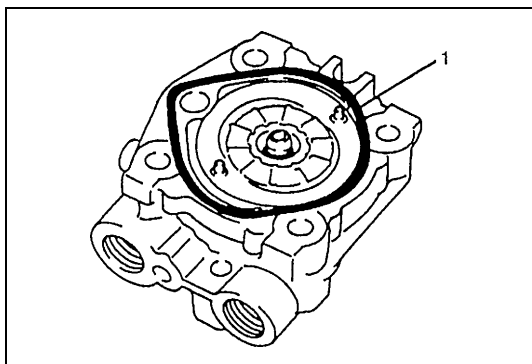
7) Apply power steering fluid to sliding surface of cam ring (1).

8) Install cam ring to pump body. The tapered end of cam ring should face the side plate (2).



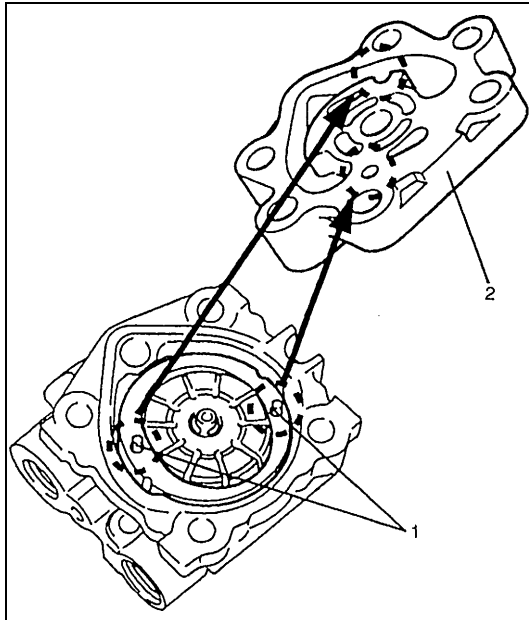
9) Apply power steering fluid to each vane (2).

10) Install vanes (10 pieces) to rotor (1).

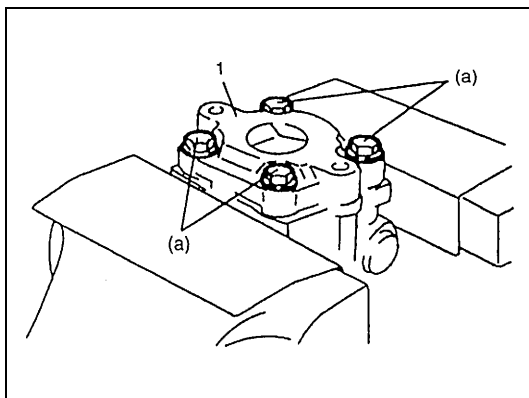


11) Apply power steering fluid to O-ring (1).

12) Install O-ring to pump body.



- 13) Apply power steering fluid to sliding surface of pump cover and rotor.
- 14) Match the dowel pins (1) to the holes of the cover plate (2) as shown and install pump cover to pump body.



- 15) Gradually tighten new pump cover bolts to specified torque.

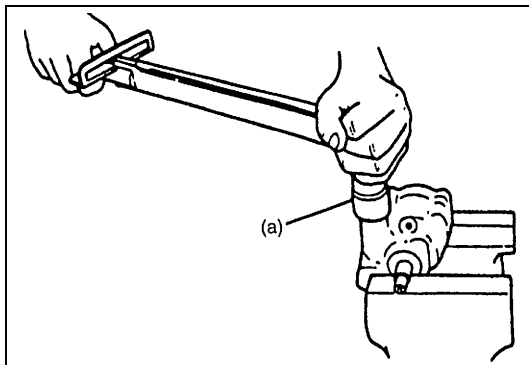
NOTE:

After installing pump cover (1), make sure if shaft can be turned by hand.

Tightening torque

Oil pump cover bolts

(a) : 28 N·m (2.8 kg-m, 20.0 lb-ft)

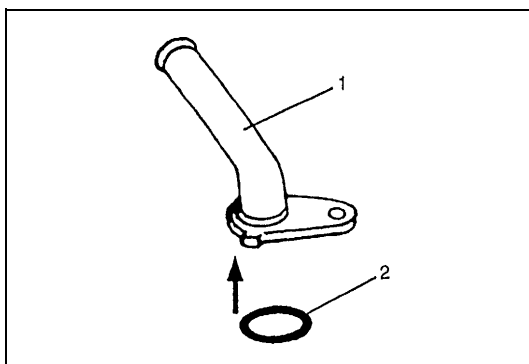


- 16) Apply power steering fluid to relief valve (flow control valve).
- 17) Install relief valve (flow control valve) to pump body.
- 18) Install flow control spring.
- 19) Apply power steering fluid to O-rings of plug.
- 20) Install O-rings to plug.
- 21) Tighten plug to specified torque.

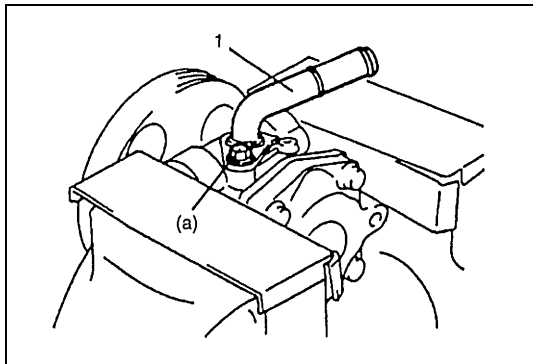
Tightening torque

Plug

(a) : 60 N·m (6.0 kg-m, 43.5 lb-ft)



- 22) Apply power steering fluid to O-ring of suction connector (1).
- 23) Install O-ring (2) to suction connector.



24) Install suction connector (1) to pump body as shown in figure.

Tighten new suction connector bolts to specified torque.

Tightening torque

Suction connector bolt

(a) : 12 N·m (1.2 kg-m, 9.0 lb-ft)

INSTALLATION

Reverse removal procedure noting the following instructions.

- For tightening torques, refer to structural diagram on previous page.
- Adjust power steering pump drive belt by referring to “Belt Tension Adjustment” under “Power Steering Pump Drive Belt” in this section.
- Fill specified power steering fluid after installation and bleed air without failure. (Refer to “Air Bleeding Procedure” in this section.)

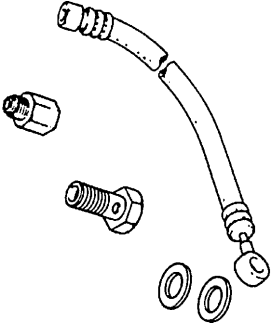
Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Gear box mounting bolts	55	5.5	40.0
Gear box cylinder pipe flare nuts	25	2.5	18.5
Gear box high pressure pipe union bolt	35	3.5	25.5
Pump union bolt	60	6.0	43.5
Oil pump mount bolts	26	2.6	19.0
Pipe clamp bolt/Reservoir bracket bolt	11	1.1	8.0
Steering shaft joint bolt	25	2.5	18.0
Pump cover bolts	28	2.8	20.0
Plug	60	6.0	43.5
Suction connector bolt	12	1.2	9.0

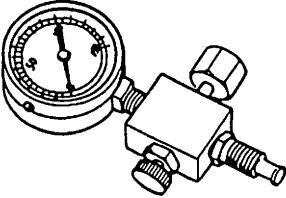
Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUPER GREASE (A) (99000-25010)	• Oil seal lip of P/S pump pulley shaft
Power steering fluid	DEXRON® II A/T fluid or the equivalent	• To fill P/S fluid reservoir • Parts lubrication when installing

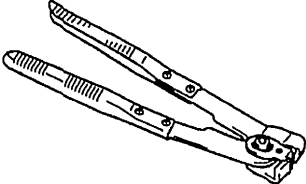
Special Tool



09915-77420
Oil pressure gauge attachment and hose set



09915-77411
Oil pressure gauge



09943-55010
Boot clamp plier

SECTION 3E

REAR SUSPENSION

NOTE:

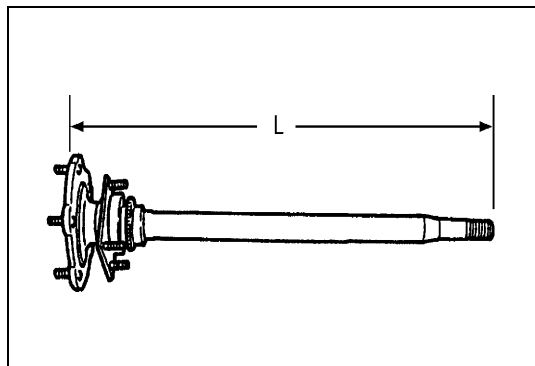
- For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in the FOREWORD of this manual.
- For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.
- All suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.
- Never attempt to heat, quench or straighten any suspension part. Replace it with a new part, or damage to the part may result.

3E

CONTENTS

General Description	*	On-vehicle Service.....	3E-2
Diagnosis	*	Shock Absorber	*
Diagnosis Table	*	Coil Spring	*
Shock Absorber Check	*	Lower Rod.....	*
Lower Rod, Upper Rod, Lateral Rod		Upper Rod.....	*
Check	*	Lateral Rod	*
Axle Housing and Coil Spring Check	*	Rear Axle Shaft and Wheel Bearing	3E-2
Rear suspension fasteners.....	*	Rear Axle Shaft Inner Oil Seal	*
Bearing Retainer and Axle Shaft Inner Oil		Rear Axle Housing	3E-2
Seal Check.....	*	Tightening Torque Specification	3E-3
Wheel Disc, Nut & Bearing Check.....	*	Required Service Material	3E-3

On-vehicle Service



Rear Axle Shaft and Wheel Bearing

REMOVAL

For the details, refer to the same item of the same section in the service manual mentioned in the FOREWORD of this manual noting following points.

Rear axle shaft length "L"

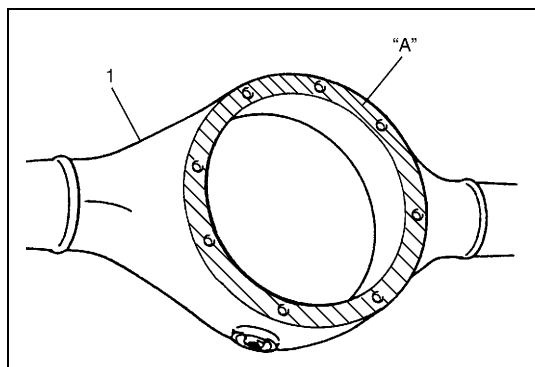
Left side : 702 mm (27.6 in.)

Right side : 771 mm (30.4 in.)

Rear Axle Housing

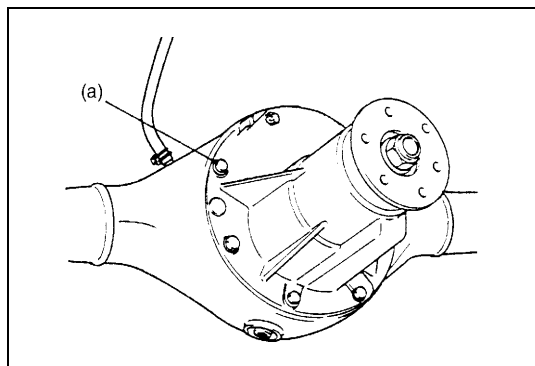
INSTALLATION

For the details, refer to the same item of the same section in the Service Manual mentioned in the FOREWORD of this manual noting following points.



- Clean mating surfaces of axle housing (1) and differential carrier and apply sealant "A" to housing side.

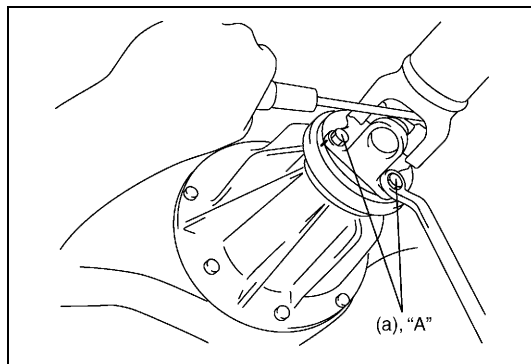
"A": Sealant 99000-31110



- Install differential carrier assembly to axle housing and tighten carrier bolts to specified torque.

Tightening torque

Differential carrier bolt (a): 55 N·m (5.5 kg-m, 40.0 lb-ft)



- Apply thread lock cement to thread of propeller shaft flange bolt if reused. Install propeller shaft to joint flange aligning match marks and torque flange bolts or nuts to specification.

“A”: Cement 99000-32110

Tightening torque

Propeller shaft bolt or nut (a): 55 N·m (5.5 kg·m, 40.0 lb-ft)

Tightening Torque Specification

Fastening part	Tightening torque		
	N·m	kg·m	lb-ft
Shock absorber nut	29	2.9	21.0
Shock absorber lower nut	100	10.0	72.5
Lower rod front bolt	100	10.0	72.5
Lower rod rear bolt	90	9.0	65.0
Upper rod front bolt	95	9.5	69.0
Upper rod rear bolt	90	9.0	65.0
Lateral rod mounting bolt left side	100	10.0	72.5
Lateral rod mounting nut right side	95	9.5	69.0
Differential carrier bolt	55	5.5	40.0
Propeller shaft bolt or nut	55	5.5	40.0
Brake pipe flare nut	16	1.6	11.5
Bearing retainer nut	23	2.3	17.0
Differentiation gear oil filler & drain plug (filler plug)	50	5.0	36.5
Differentiation gear oil filler & drain plug (drain plug)	27	2.7	16.0
Wheel nut	100	10.0	72.5
Wheel speed sensor bolt	21	2.1	15.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lip
Brake fluid	DOT 3	• Brake reservoir tank
Sealant	SUZUKI BOND NO.1215 (99000-31110)	• Joint seam of axle and brake back plate • Joint seam of bearing retainer and brake back plate • Joint seam of differential carrier and axle housing • Drain plug • Mating surface of oil seal and axle housing
Gear oil	For gear oil information, refer to Section 7F	• Differential gear (Rear axle housing)
Thread lock cement	THREAD LOCK CEMENT SUPER 1322 (99000-32110)	• Rear propeller shaft flange bolts

SECTION 5

BRAKES

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

- For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in the FOREWORD of this manual.
- For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.
- When inspecting and servicing vehicle equipped with ABS, be sure to refer to section 5E1 first.
- All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

DIAGNOSIS	5-3
BRAKE PIPE/HOSE/MASTER CYLINDER	5A-1
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Check and Adjustment

Fluid Pressure Test (if equipped with LSPV)

Test procedure for LSPV assembly is as follows.

Before testing, confirm the following.

- Fuel tank is filled with fuel fully.
- Vehicle is equipped with spare tire, tools, jack and jack handle.

- 1) Stop vehicle on level floor and place approximately about 240 kg (529 lbs) weight (2) on rear housing so that rear axle weight 900 kg (1984 lb).

Rear axle weight

“L” : 900 kg (1984 lb)

- 2) Install special tool to front and rear brake.

NOTE:

Special tool should be connected to breather of front (driver's side brake) and rear brakes.

Special tool

Front brake

(A) : 09956-02310

(B) : 09952-46510 (Attachment for vehicle with SUMITOMO ELECTRIC brake caliper)

(C) : 55473-82030 (Air bleeder plug (1) supplied as a spare part)

Rear brake

(A) : 09956-02310

(B) : 09952-36310 (Attachment for thread diameter 7 mm of bleeder plug) or 09952-46510 (Attachment for thread diameter 8 mm of bleeder plug)

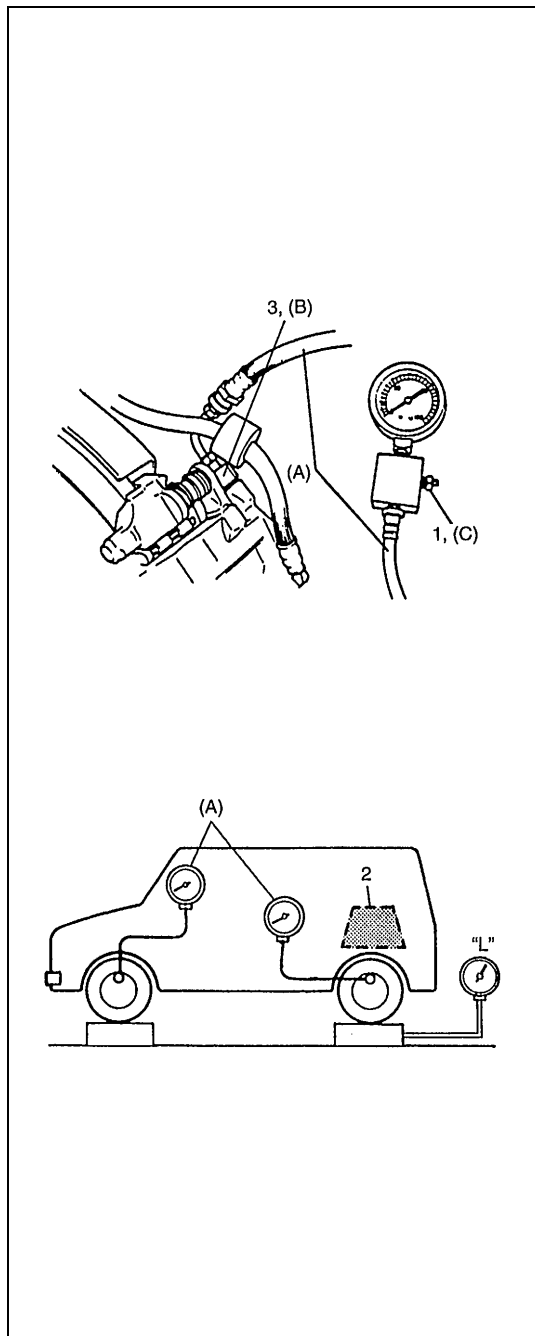
(C) : 55473-82030 (Air bleeder plug supplied as a spare part)

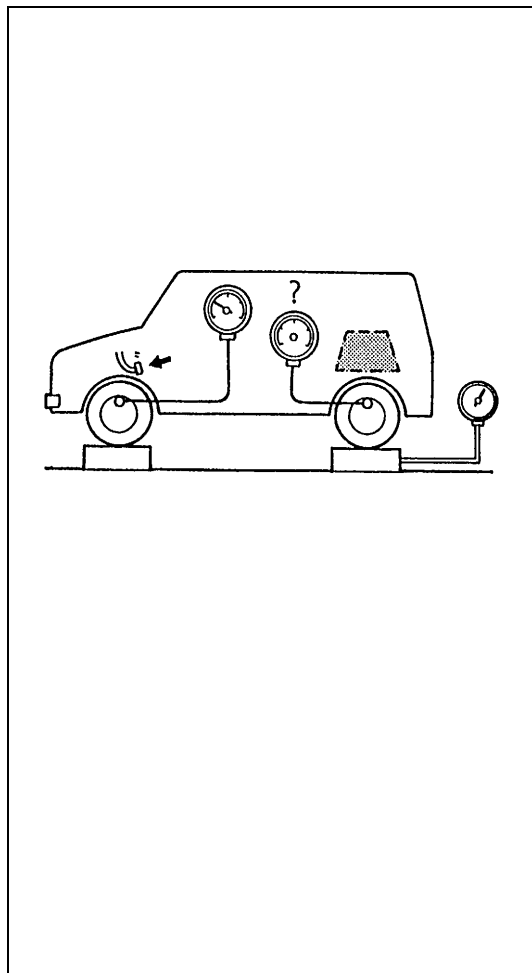
NOTE:

- Special tool (B) is used instead of thread diameter 10 mm attachment (3) of special tool (A).

So remove the attachment from (A) and install (B) as shown in figure.

- For vehicle with TOKICO brake caliper, use the attachment included in special tool (A).
- For identification of brake caliper type, refer to “Disc Brake Caliper Assembly” in Section 5B.





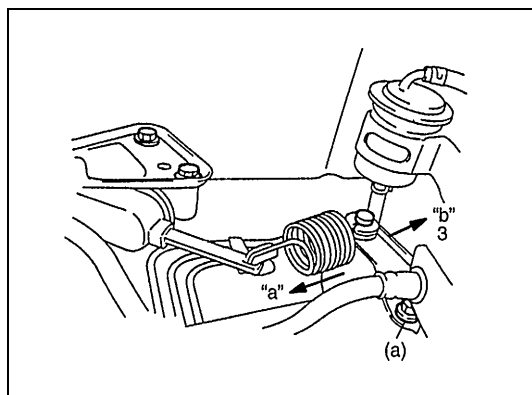
- 3) Depress brake pedal gradually till fluid pressure of front brake becomes as specified below and check corresponding pressure of rear brake then. It should be within specification given below.

Rear brake pressure with applied by 8,000 kPa (80 kg/cm², 1,138 psi) on front brake.

Front brake	Rear brake	
8,000 kPa 80 kg/cm ² 1,138 psi	3 Door model	5,400 – 6,600 kPa 54 – 66 kg/cm ² 768 – 938 psi
	5 Door	4,500 – 7,300 kPa 45 – 73 kg/cm ² 640 – 1,038 psi

- 4) As done above, apply 100 kg/cm² pressure to front brake and check that rear brake pressure then is within specification as given below.

Front brake	Rear brake	
10,000 kPa 100 kg/cm ² 1,422 psi	3 Door model	6,000 – 7,300 kPa 60 – 73 kg/cm ² 853 – 1,038 psi
	5 Door	5,000 – 8,000 kPa 50 – 80 kg/cm ² 711 – 1,138 psi

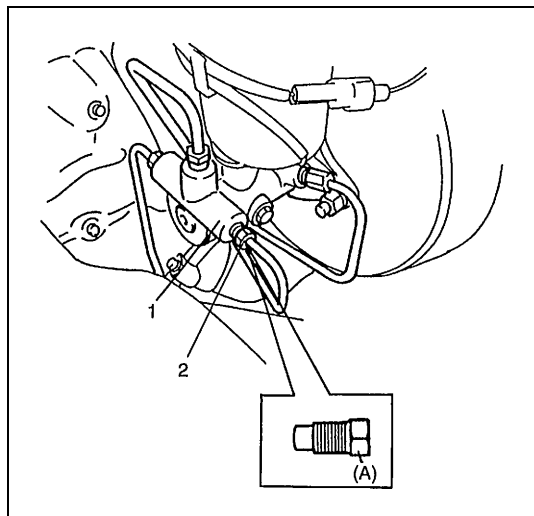


- 5) If rear brake pressure is not within specification, adjust it by changing stay (3) position as follows.

- If rear brake pressure is higher than specification, move stay (3) to direction "a" and if it is lower, to direction "b".
- Repeat steps 3) to 5) until rear brake pressure is within specification.
- After adjustment, be sure to torque bolt to specification.

Tightening torque

LSPV stay bolt (a) : 23 N·m (2.3 kg·m, 17.0 lb·ft)



- 6) Disconnect brake pipe (2) (connecting between master cylinder secondary side and 4-way joint) from master cylinder (1). Tighten plug (special tool) to master cylinder. Depress brake pedal. If rear brake pressure is 95 – 100 kg/cm² when front brake pressure is 100 kg/cm², it means that front failsafe system functions properly.

Front brake	Rear brake
10,000 kPa	9,500 – 10,000 kPa
100 kg/cm ²	95 – 100 kg/cm ²
1,422 psi	1,350 – 1,422 psi

Special tool

(A) : 09956-02210

- 7) Upon completion of fluid pressure test, bleed brake system and perform brake test.

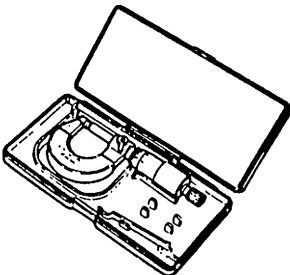
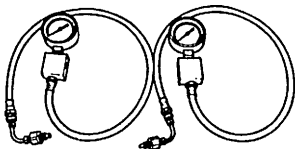
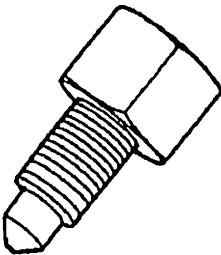
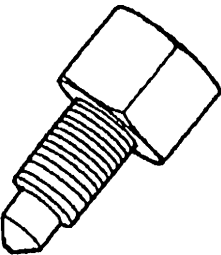
Tightening Torque Specification

Fastening part			Tightening torque		
			N•m	kg-m	lb-ft
Brake pipe 2 – way (or 4 – way) joint bolt			11	1.1	8.0
Brake pipe flare nut			16	1.6	11.5
Brake bleeder plug	Front caliper	M8	8.0	0.8	6.0
		M10	8.5	0.85	6.5
	Wheel cylinder		7.5	0.75	5.5
	LSPV		7.5	0.75	5.5
LSPV mounting bolt			23	2.3	17.0
LSPV stay bolt			23	2.3	17.0
LSPV spring nut			23	2.3	17.0
Wheel nut			100	10.0	72.5
Brake light switch lock nut			7.5	0.75	5.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Brake fluid	Indicated on reservoir cap or described in owner's manual of vehicle	- To fill master cylinder reservoir. - To clean and apply to inner parts of master cylinder, brake caliper and wheel cylinder when they are disassembled.

Special Tool

			
09950-78220 Flare nut wrench (10 mm)	09900-20205 Micrometer (0 – 25 mm)	09956-02310 Fluid pressure gauge	09956-02210 Brake circuit plug
			
09952-36310 Pressure gauge attachment (M7)	09952-46510 Pressure gauge attachment (M8)		

SECTION 6-1

ENGINE GENERAL INFORMATION AND DIAGNOSIS (RHW ENGINE)

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

Service information for two types of emission control system, “Other Than EOBD Spec”, and “EOBD Spec”, is provided in this section. To distinguish between “Other Than EOBD Spec” and “EOBD Spec”, refer to “Identification of Emission Control System” in this section.

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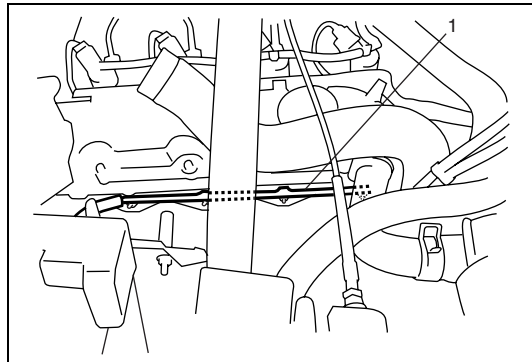
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OTHER THAN EOBD SPEC

General Information

Identification of Emission Control System

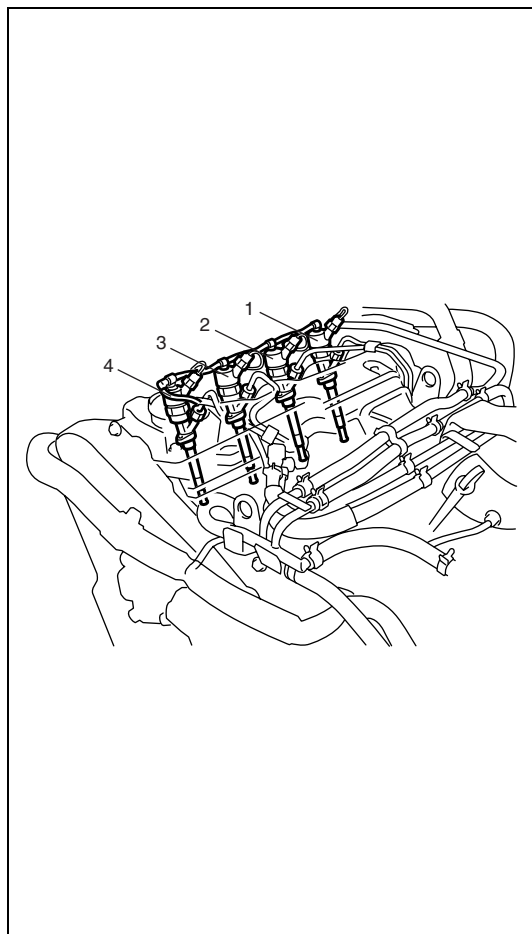


For other than EOBD spec, the metal plate type power supply line (1) for glow plugs is used.

Identify it by the type of glow plug power supply line.

As for the EOBD spec, the wire harness type is used as power supply line to glow plugs.

Statement of Cleanliness and Care



An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of an millimeter (ten thousands of inch). Accordingly, when any internal engine parts are serviced, care and cleanliness are important. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surface on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings and crankshaft journal bearings are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.
- Throughout this manual, the four cylinders of the engine are identified by numbers: No.1 (1), No.2 (2), No.3 (3) and No.4 (4) as counted from flywheel side to crankshaft pulley side.

General Information on Engine Service

The following information on engine service should be noted carefully, as it is important in preventing damage, and in contributing to reliable engine performance.

- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine, that 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, air cleaner outlet hose, turbo-charger, intercooler, intercooler outlet hose, throttle valve assembly or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.

Precaution on fuel system service

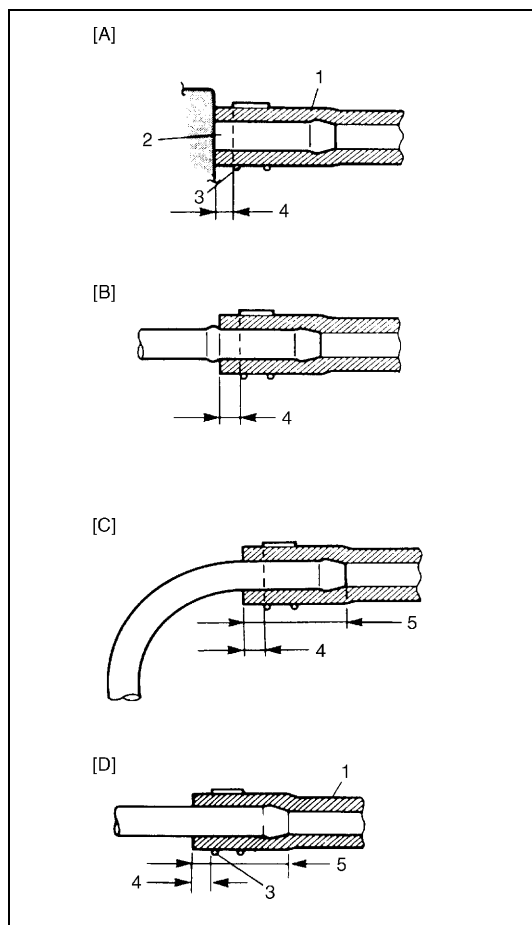
- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- A small amount of fuel may be released after fuel line is disconnected.

In order to reduce the chance of personal injury, cover fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.

- Never run engine with double relay disconnected when engine and exhaust system are hot.

- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to the figure.

After connecting, make sure that it has no twist or kink.



[A]:	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B]:	With following type pipe, fit hose as far as its peripheral projection as shown.
[C]:	With bent pipe, fit hose as its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
[D]:	With straight pipe, fit hose till pipe is, about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
1.	Hose
2.	Pipe
3.	Clamp
4.	Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.
5.	20 to 30 mm (0.79 – 1.18 in.)

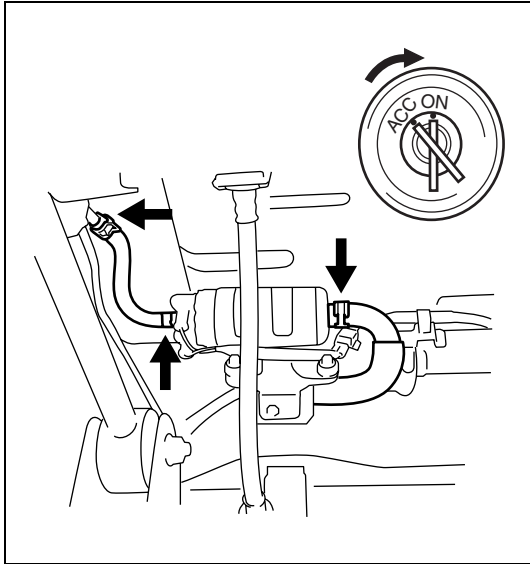
- When installing fuel filter union bolt or plug bolt, always use new gasket and tighten it to specified torque.
- When installing injector, fuel feed pipe or fuel pressure regulator, lubricate its O-ring with spindle oil or fuel.
- When connecting fuel pipe flare nut, first tighten flare nut by hand and then tighten it to specified torque, using back-up wrench.

Fuel pressure relief procedure

Refer to "Precautions" under "Fuel Delivery System" in Section 6E3.

Fuel leakage check procedure

After performing any service on fuel system, check to make sure that there are no fuel leakages as follows.



- 1) Turn ON ignition switch for 5 seconds (to operate fuel pump) and then turn it OFF. Repeat this (ON and OFF) 3 or 4 times and apply fuel pressure to fuel line (till fuel pressure is felt by hand placed on fuel return hose).
- 2) In this state, check to see that there are no fuel leakages from any part of low pressure fuel system between fuel pump and injection pump.
- 3) Check that there are no fuel leakages from any part of high pressure fuel system between injection pump and fuel injector by performing the procedure below.
 - a) Start engine and warm up to normal operating temperature.
 - b) Check fuel leakage after turning off ignition switch.
 - c) Again, start engine and accelerate the vehicle up to 3500 rpm with L range (AT) or 1st gear (MT). Then stop vehicle.
 - d) Check fuel leakage after turning off ignition switch.

Engine Diagnosis

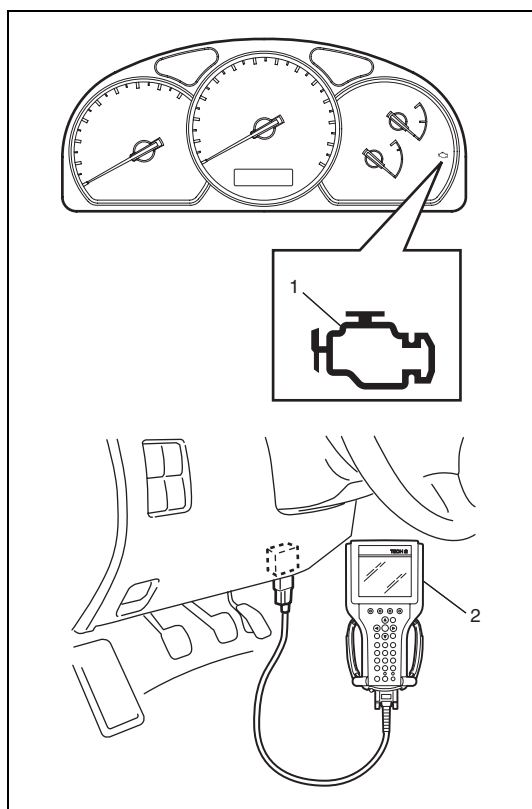
General Description

This vehicle is equipped with an engine and emission control system which are under control of ECM. The engine and emission control system in this vehicle are controlled by ECM. ECM has an On-Board Diagnostic system which detects a malfunction in this system and abnormality of those parts that influence the engine exhaust emission. When diagnosing engine troubles, be sure to have full understanding of the outline of "On-Board Diagnostic System" and each item in "Precaution in Diagnosing Trouble" and execute diagnosis according to "Engine Diagnostic Flow Table" in this section.

There is a close relationship between the engine mechanical, engine cooling system, exhaust system, etc. and the engine and emission control system in their structure and operation. In case of an engine trouble, even when the malfunction indicator lamp (MIL) doesn't turn ON, it should be diagnosed according to this flow table.

On-Board Diagnostic System

ECM in this vehicle has the following functions.



- When the ignition switch is turned ON with the engine at a stop, MIL (1) turns ON to check the malfunction indicator lamp (MIL) and its circuit.
- When ECM detects a malfunction which gives an adverse effect to vehicle emission while the engine is running, it makes the malfunction indicator lamp in the meter cluster of the instrument panel turn ON and stores the malfunction area in its memory.
- As a condition for detecting a malfunction in some areas in the system being monitored by ECM and turning ON the malfunction indicator lamp due to that malfunction, 2 driving cycles detection logic is adopted to prevent erroneous detection.
- When a malfunction is detected, engine and driving conditions then are stored in ECM memory as freeze frame data. (For the details, refer to description on Freeze frame data.)
- It is possible to communicate by using not only SUZUKI scan tool (2) but also generic scan tool. (Diagnostic information can be accessed by using a scan tool.)

Warm-up Cycle

A “warm-up cycle” means sufficient vehicle operation such that the coolant temperature has risen by at least 22°C (40°F) from engine starting and reaches a minimum temperature of 70°C (160°F).

Driving Cycle

A “driving cycle” consists of two parts, engine startup and engine shutoff.

2 Driving Cycle Detection Logic

The malfunction detected in the first driving cycle is stored in ECM memory (in the form of pending DTC) but the malfunction indicator lamp does not light at this time. It lights up at the second detection of same malfunction also in the next driving cycle.

Pending Diagnostic Trouble Code (DTC)

NOTE:

Pending diagnostic trouble code can be read using generic scan tool or GST (Generic Scan Tool) mode of SUZUKI scan tool.

Pending DTC means a DTC detected and stored temporarily at 1 driving cycle of the DTC which is detected in the 2 driving cycle detection logic.

Freeze Frame Data

NOTE:

Freeze frame data can be read using generic scan tool or GST (Generic Scan Tool) mode of SUZUKI scan tool.

ECM stores the engine and driving conditions (in the form of data as shown in the figure) at the moment of the detection of a malfunction in its memory. This data is called “Freeze frame data”. Therefore, it is possible to know engine and driving conditions (e.g., whether the engine was warm or not, where the vehicle was running or stopped) when a malfunction was detected by checking the freeze frame data.

Priority of Freeze Frame Data:

As ECM can store freeze frame data for one malfunction only, the freeze frame data shown as 1 below has a priority for storage. (If malfunction as described in the upper square “1” below is detected while the freeze frame data in the lower square “2” has been stored, the freeze frame data “2” will be updated by the freeze frame data “1”.)

Select Vehicle

Select a Mode

Data List

Data List (GST mode)

Data List (Select)

Data Graph

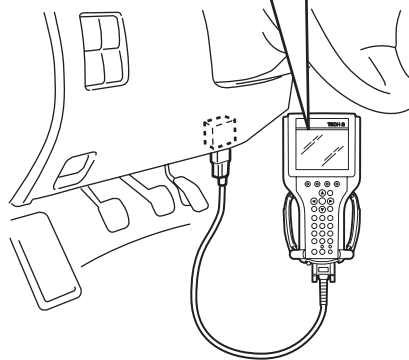
Trouble Codes

Trouble Codes (GST mode)

Snap Shot

Misc Test

SUZUKI -> Other than North America -> SUV -> GRAND VITARA 2.0 TD -> Engine -> SQ420WD (RHW engine) ->



An Example of Freeze Frame Data

1.	Trouble Code	P0102
2.	Engine Speed	782 RPM
3.	Eng Cool Tmp	80°C
4.	Vehicle Spd.	0 km/h
5.	MAP Sensor	39kPa
6.	St. Term FT1	-0.8% Lean
7.	Lg. Term FT1	-1.6% Lean
8.	Fuel 1 Stat.	Closed Loop
9.	Fuel 2 Stat.	Not used
10.	Load value	25.5%

PRIORITY	FREEZE FRAME DATA
1	Freeze frame data at initial detection of diagnostic trouble codes below. P0100, P0120, P0170, P0190, P0200, P0220, P0230, P0235, P0243, P0560, P0903
2	Freeze frame data when a diagnostic trouble code other than those in "1" above is detected.

Freeze Frame Data Clearance:

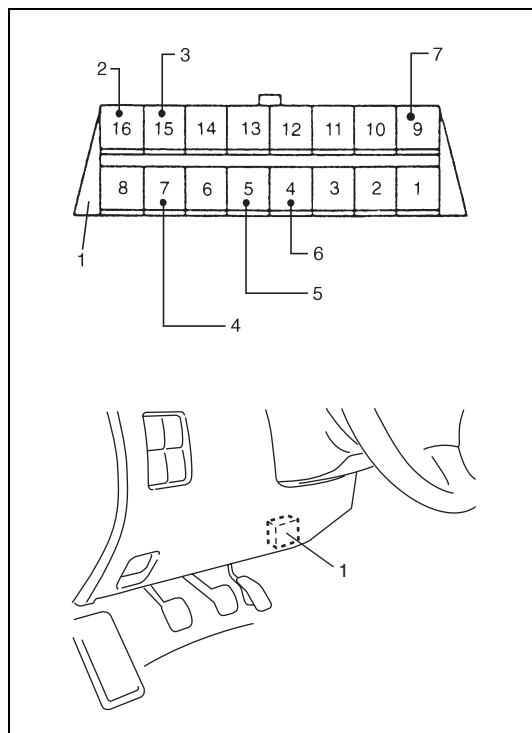
The freeze frame data is cleared at the same time as clearance of diagnostic trouble code (DTC).

Data Link Connector (DLC)

DLC (1) in compliance with SAE J1962 in its installation position, the shape of connector and pin assignment.

K (4) and L (3) lines of ISO 9141 is used for SUZUKI scan tool or generic scan tool to communication with ECM, ABS control module, BCM, HVAC control module and TCM.

SUZUKI serial data line (7) is used for SUZUKI scan tool to communicate with immobilizer control module.



2. B+
5. ECM ground
6. Body ground

Precaution in Diagnosing Trouble

- Don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine or main fuse before confirming diagnostic information (DTC, freeze frame data, etc.) stored in ECM memory.
- Diagnostic information stored in ECM memory can be cleared as well as checked by using SUZUKI scan tool or generic scan tool. Before using scan tool, read its Operator's (Instruction) Manual carefully to have good understanding as to what functions are available and how to use it.

• Priorities for diagnosing troubles

If troubleshooting priorities for multiple diagnostic code are given in the applicable diagnostic flow, these should be followed.

If no instructions are given, troubleshoot diagnostic trouble codes according to the following priorities.

1. Fuel pressure (P1112 for Suzuki mode of SUZUKI scan tool/P0230 for generic scan tool)
2. Diagnostic trouble codes other than listed below

DTC indicated by generic scan tool or GST mode of SUZUKI scan tool	DTC indicated by Suzuki mode of SUZUKI scan tool
P0100, P0120, P0170, P0190, P0200, P0220, P0230, P0235, P0243, P0560, P0903	P0100, P0101, P0121, P0604, P1169, P1170, P0190, P0201, P0202, P0203, P0204, P0221, P1112, P1138, P0235, P0243, P0245, P0246, P0560, P0561, P0401, P0402

3. Diagnostic trouble codes described in above list

- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before inspection and observe what is written there.
- ECM replacement or substitution
When substituting a known-good ECM, check for the following conditions. Neglecting this check may cause damage to known-good ECM.
 - Resistance value of all relays, actuators is as specified respectively.
 - MAF sensor is in good condition and none of power circuit of its sensor is shorted to ground.
- ECU code registration
If ECM is replaced, register ECU code into ECM by performing procedure described in "Procedure after ECM Replacement" of Section 8G. Otherwise, ECM dose not function as Immobilizer Control System.
- Injector code registration
If ECM or injector is replaced, register injector code into ECM by performing procedure described in "ECM Registration" of Section 6E3.
Otherwise, it has an adverse effect on engine.
- The following harness connector number of this section is corresponding to the following harness connector number of WIRING DIAGRAM MANUAL.

Connector number of this section	Connector number of WIRING DIAGRAM MANUAL
E227	C51-1
E228	C51-2
E229	C51-3
G55	G54
G09	G87

Engine Diagnostic Flow Table

Numbers of each step correspond to the numbers of the items after this table.

Refer to "Diagnostic Step Details" following this table for the details of each step.

Step	Action	Yes	No
1	Customer Complaint Analysis 1) Perform customer complaint analysis. Was customer complaint analysis performed?	Go to Step 2.	Perform customer complaint analysis.
2	Diagnostic Trouble Code (DTC) and Freeze Frame Data Check, Record and Clearance 1) Check for DTC referring to "Diagnostic Step Details". Is there any DTC(s)?	1) Print DTC and freeze frame data or write then down and clear by referring to "DTC Clearance" in this section. 2) Go to Step 3.	Go to Step 5.
3	ECM Registration Data Check 1) Check injector class and transmission type of ECM registration data referring to "ECM Registration" in this section. Are registered data in good condition?	Go to Step 4.	Register ECM according to the registration procedure, referring to "ECM Registration" in Section 6E3.
4	Visual Inspection 1) Perform Visual inspection referring to the "Visual Inspection" in this section. Is there any faulty condition?	1) Repair or replace malfunction part. 2) Go to Step 12.	Go to Step 6.
5	Visual Inspection 1) Perform visual inspection referring to the "Visual Inspection" in this section. Is there any faulty condition?		Go to Step 9.
6	Trouble Symptom Confirmation 1) Confirm trouble symptom referring to the "Trouble Symptom Confirmation" in this section. Is trouble symptom identified?	Go to Step 7.	Go to Step 8.
7	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to "DTC Check" in this section. Is there any DTC(s)?	Go to Step 10.	Go to Step 9.
8	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to "DTC Check" in this section. Is there any malfunction DTC(s)?		Go to Step 11.

Step	Action	Yes	No
9	Engine Basic Inspection and Engine Diagnosis Table 1) Check and repair according to “Engine Basic Check” and “Engine Diagnosis Table” in this section. Are check and repair complete?	Go to Step 12.	1) Check and repair malfunction part(s). 2) Go to Step 12.
10	Troubleshooting for DTC 1) Check and repair according to applicable DTC diag. flow table in this section. Are check and repair complete?		
11	Check for Intermittent Problems 1) Check for intermittent problems referring to the “Diagnostic Step Details”. Is there any faulty condition?	1) Repair or replace malfunction part(s). 2) Go to Step 12.	Go to Step 12.
12	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test referring to the “Diagnostic Step Details”. Is there any problem symptom, DTC or abnormal condition?	Go to Step 7.	End.

Diagnostic step details

1. CUSTOMER COMPLAINT ANALYSIS

Record details of the problem (failure, complaint) and how it occurred as described by the customer. For this purpose, use of such an inspection form will facilitate collecting information to the point required for proper analysis and diagnosis.

2. DIAGNOSTIC TROUBLE CODE (DTC)/FREEZE FRAME DATA CHECK, RECORD AND CLEARANCE

First, check DTC (including pending DTC), referring to “DTC check” in this section. If DTC is indicated, print it and freeze frame data or write them down and then clear them by referring to “DTC clearance” in this section. DTC indicates malfunction that occurred in the system but does not indicate whether it exists now or it occurred in the past and the normal condition has been restored now. To check which case applies, check the symptom in question according to Step 6 and recheck DTC according to Step 7 and 8.

Attempt to diagnose a trouble based on DTC in this step only or failure to clear the DTC (including pending DTC) in this step will lead to incorrect diagnosis, trouble diagnosis of a normal circuit or difficulty in troubleshooting.

NOTE:

If DTC P1112 (for Suzuki mode of SUZUKI scan tool) or P0230 (for generic scan tool or GST mode of SUZUKI scan tool) is indicated in this step, proceed to Diag. flow table for DTC P1112/P0230 first.

3. ECM REGISTRATION DATA CHECK

Refer to “ECM Registration Data Check” in Section 6E3 for checking procedure.

4 and 5. VISUAL INSPECTION

As a preliminary step, be sure to perform visual check of the items that support proper function of the engine referring to “Visual Inspection” in this section.

6. TROUBLE SYMPTOM CONFIRMATION

Based on information obtained in Step 1 Customer complaint analysis and Step 2 DTC/freeze frame data check, confirm trouble symptoms. Also, reconfirm DTC according to “DTC Confirmation Procedure” described in each DTC flow.

7 and 8. DTC/FREEZE FRAME DATA RECHECK, RECORD AND CLEARANCE

Refer to “DTC CHECK” in this section for checking procedure.

9. ENGINE BASIC CHECK AND ENGINE DIAGNOSIS TABLE

Perform basic engine check according to the “Engine Basic Check” in this section first. When the end of the flow table has been reached, check the parts of the system suspected as a possible cause referring to “Engine Diagnosis Table” in this section and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or basic engine check) and repair or replace faulty parts, if any.

10. TROUBLESHOOTING FOR DTC (See each DTC Diag. Flow Table)

Based on the DTC indicated in Step 7 or 8 and referring to the applicable DTC diag. flow table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ECM or other part and repair or replace faulty parts.

11. CHECK FOR INTERMITTENT PROBLEM

Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to “Intermittent and Poor Connection” in Section 0A and related circuit of DTC recorded in Step 2.

12. FINAL CONFIRMATION TEST

Confirm that the problem symptom has gone and the engine is free from any abnormal conditions. If what has been repaired is related to the DTC, clear the DTC once and perform DTC confirmation procedure and confirm that no DTC is indicated.

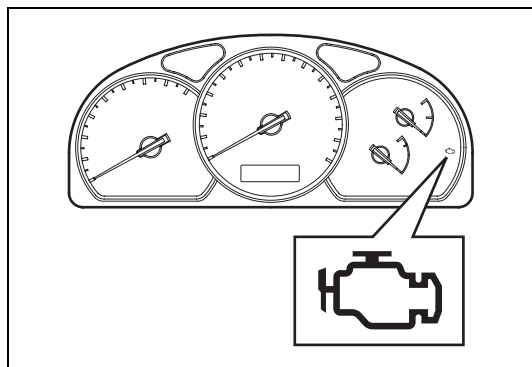
Customer Problem Inspection Form (Example)

User name:		Model:		VIN:	
Date of issue:		Date Reg.		Date of problem:	
				Mileage:	
PROBLEM SYMPTOMS					
☐ Difficult Starting			☐ Poor Driveability		
☐ No cranking ☐ No initial combustion ☐ Poor starting at (☐ Cold/ ☐ Warm/ ☐ Always) ☐ Other _____			☐ Hesitation on acceleration ☐ Back fire/After fire ☐ Loss of power ☐ Surging ☐ Abnormal knocking ☐ Other _____		
☐ Poor Idling			☐ Engine Stall when		
☐ Poor fast idle ☐ Abnormal idling speed (☐ High ☐ Low) (r/min.) ☐ Unstable ☐ Hunting (r/min. to r/min.) ☐ Other _____			☐ Immediately after start ☐ Accel. pedal is depressed ☐ Accel. pedal is released ☐ Load is applied ☐ A/C ☐ Electrical load ☐ P/S ☐ Other _____		
☐ OTHERS:					
VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS					
Environmental Condition					
Weather	☐ Fair ☐ Cloudy ☐ Rain ☐ Snow ☐ Always ☐ Other _____ (°F/ °C)				
Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold ☐ Always				
Frequency	☐ Always ☐ Sometimes (times/ day, month) ☐ Only once ☐ Under certain condition				
Road	☐ Urban ☐ Suburbs ☐ Highways ☐ Mountainous (☐ Uphill ☐ Downhill) ☐ Paved road ☐ Gravel ☐ Other _____				
Vehicle Condition					
Engine condition	☐ Cold ☐ Warming up phase ☐ Warmed up ☐ Always ☐ Other at starting ☐ Immediately after start/ ☐ Racing without load ☐ Engine speed (r/min.)				
Vehicle condition	☐ During driving: ☐ Constant speed (km/h, mile/h) ☐ Accelerating ☐ Decelerating ☐ Right hand corner ☐ Left hand corner ☐ When shifting (Lever position) ☐ At stop ☐ Other ()				
Malfunction indicator lamp condition	☐ Always ON ☐ Sometimes ON ☐ Always OFF ☐ Good condition ☐ Flashing				
Diagnostic trouble code		First check: ☐ No code ☐ Malfunction code ()			
		Second check: ☐ No code ☐ Malfunction code ()			

NOTE:

The above form is standard sample. It should be modified according to conditions characteristic of each market.

Malfunction Indicator Lamp (MIL) Check



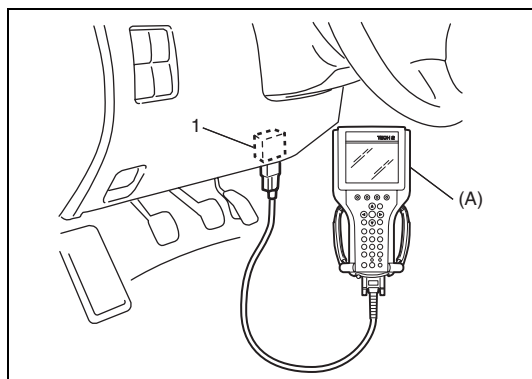
- 1) Turn ON ignition switch (but the engine at stop) and check that MIL lights.
If MIL does not light up or dims, go to "Diagnostic Flow Table A-1" for troubleshooting.
- 2) Start engine and check that MIL turns OFF.
If MIL remains ON, and no DTC is stored in ECM, go to "Diagnostic Flow Table A-2" for troubleshooting.

Diagnostic Trouble Code (DTC) Check

- 1) Prepare generic scan tool or SUZUKI scan tool.
- 2) Connect it to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

Special tool

(A): SUZUKI scan tool



- 3) Turn ignition switch ON and confirm that MIL lights.
- 4) Read DTC, pending DTC and freeze frame data according to instructions displayed on scan tool and print them or write them down. Refer to scan tool operator's manual for further details.
If communication between scan tool and ECM is not possible, check if scan tool is communicable by connecting it to ECM in another car. If communication is possible in this case, scan tool is in good condition. Then check data link connector and serial data line (circuit) in the car with which communication was not possible.
- 5) After completing the check, turn ignition switch off and disconnect scan tool from data link connector.

Diagnostic Trouble Code (DTC) Clearance

- 1) Connect generic scan tool or SUZUKI scan tool to data link connector in the same manner as when making this connection for DTC check.
- 2) Turn ignition switch OFF and then ON (but engine at stop).
- 3) Erase DTC and pending DTC according to instructions displayed on scan tool. Refer to scan tool operator's manual for further details.

NOTE:

When DTC clear command is executed using Suzuki mode of SUZUKI scan tool with engine run, DTC can not be cleared from ECM memory.

- 4) After completing the clearance, turn ignition switch OFF and disconnect scan tool from data link connector.

Fail-Safe Table

When any of the following DTCs is detected, ECM enters fail-safe mode as long as malfunction continues to exist but that mode is canceled when ECM detects normal condition after that.

DTC NO.	TROUBLE AREA	FAIL SAFE OPERATION
P0190 (P0190)	Fuel pressure sensor	Each control is performed based on 150 MPa (1500 bar) fuel pressure and engine speed is restricted to lower than 2200 rpm.
P0560 (P0560)	Battery voltage	Each control is performed based on 7 volts.
P0121 (P0120)	Throttle position sensor	Each control is performed based on 5% throttle valve opening and engine speed is restricted to lower than 2200 rpm.
P0221 (P0220)		
P0115 (P0115)	Engine coolant temperature sensor	Each control is performed based on 111°C with engine run (–10°C with engine stopped).
P0180	Fuel temperature sensor	Each control is performed based on 90°C.
P0110	Intake air temperature sensor (in mass air flow)	Each control is performed based on 50°C.
P0235 (P0235)	Intake air pressure sensor	Each control is performed based on the value measured by barometric pressure sensor (in ECM). If barometric pressure sensor fails, 900 mbar is used as intake air pressure and engine speed is restricted to lower than 2200 rpm.
P1101 (P0105)	Barometric pressure sensor (in ECM)	Each control is performed based on the value measured by intake air pressure sensor. If intake air pressure sensor is failed, 900 mbar is used as barometric pressure.
P0100 (P0100)	Mass air flow sensor	Each control uses the value calculated by barometric pressure and engine speed and engine speed is restricted to lower than 2200 rpm.
P0101 (P0100)	Mass air flow sensor	Each control is performed based on 1000 mg/stroke and engine speed is restricted to lower than 2200 rpm.
P0500 (P0500)	Vehicle speed sensor	Each control is performed based on 20 km/h.
P0191 (P0230)	Fuel pressure sensor/pressure regulator	Engine speed is restricted to lower than 2200 rpm.
P0401 (P0903)	EGR valve/solenoid	Engine speed is restricted to lower than 2200 rpm.
P0561 (P0560)	Sensor supply voltage	Engine speed is restricted to lower than 2200 rpm.
P0246 (P0246)	Turbo pressure solenoid valve	Engine speed is restricted to lower than 2200 rpm.
P1138 (P0230)	Fuel pressure regulator	Engine speed is restricted to lower than 2200 rpm.
P0201 (P0200)	Fuel injector No.1	Engine speed is restricted to lower than 2200 rpm.
P0202 (P0200)	Fuel injector No.2	Engine speed is restricted to lower than 2200 rpm.
P0203 (P0200)	Fuel injector No.3	Engine speed is restricted to lower than 2200 rpm.
P0204 (P0200)	Fuel injector No.4	Engine speed is restricted to lower than 2200 rpm.

NOTE:

For () marked No. in DTC column, it is indicated when generic scan tool is used.

Diagnostic Trouble Code (DTC) Table

	DTC NO. (Generic scan tool)	DTC NO. (SUZUKI scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
-	P0100	P0100	Mass air flow sensor circuit malfunction	Sensor output low or high voltage	1 driving cycle	1 driving cycle
		P0101	Mass air flow sensor circuit range/performance problem	Air flow is lower or higher than specification under specified engine RPM	1 driving cycle	1 driving cycle
	-	P0110	Intake air temperature sensor circuit malfunction	Intake air temperature sensor circuit low or high input	2 driving cycles	-
	P0115	P0115	Engine coolant temperature sensor circuit malfunction	Engine coolant temperature sensor circuit low or high input	2 driving cycles	-
	P0120	P0604	Throttle position sensor monitoring system malfunction	Poor performance of throttle position sensor	1 driving cycle	1 driving cycle
		P0121	Throttle position sensor circuit range/performance	Throttle position sensor circuit low or high input, or poor performance of throttle position sensor	1 driving cycle	1 driving cycle
	P0220	P0221	Throttle position sensor circuit range/performance problem 2			
	-	P0180	Fuel temperature sensor circuit malfunction	Fuel temperature circuit low or high input	2 driving cycles	-
	P0190	P0190	Fuel rail pressure sensor circuit malfunction	Fuel rail pressure sensor circuit low or high input	1 driving cycle	1 driving cycle
		P0191	Fuel rail pressure sensor pressure regulator consistency function (Fuel pump primary circuit malfunction)	Poor performance of fuel rail pressure sensor	1 driving cycle	1 driving cycle
☆	P0230	P1112	Fuel rail pressure monitoring circuit malfunction (Fuel pump primary circuit malfunction)	Fuel pressure in common rail is lower or higher than specification	1 driving cycle	1 driving cycle
☆		P1138	Fuel pressure regulator circuit malfunction	Monitor signal of fuel pressure regulator is different from command signal (circuit open or short), or poor performance of regulator	1 driving cycle	1 driving cycle
☆	P0200	P0201	Injector circuit malfunction cylinder-1	Monitor signal of fuel injection #1 is different from command signal (circuit open or short), or poor performance of fuel Injector #1	1 driving cycle	1 driving cycle
☆		P0202	Injector circuit malfunction cylinder-2	Monitor signal of fuel injection #2 is different from command signal (circuit open or short), or poor performance of fuel Injector #2	1 driving cycle	1 driving cycle
☆		P0203	Injector circuit malfunction cylinder-3	Monitor signal of fuel injection #3 is different from command signal (circuit open or short), or poor performance of fuel Injector #3	1 driving cycle	1 driving cycle

	DTC NO. (Generic scan tool)	DTC NO. (SUZUKI scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
☆	P0200	P0204	Injector circuit malfunction cylinder-4	Monitor signal of fuel injection #4 is different from command signal (circuit open or short), or poor performance of fuel Injector #4	1 driving cycle	1 driving cycle
—	—	P0215	Double relay circuit malfunction	Poor performance of double relay	2 driving cycles	—
	—	P0230	Fuel pump supply circuit malfunction	Fuel pump supply circuit low or high input, or poor performance of fuel pump	1 driving cycle	—
	P0235	P0235	Intake pressure sensor circuit malfunction	Intake air pressure sensor circuit low or high input, or poor performance of intake air pressure sensor	1 driving cycle	1 driving cycle
	P0243	P0243	Turbo pressure solenoid valve circuit range/performance problem	Monitor signal of turbo pressure regulator solenoid valve is different from command signal (circuit open or short)	1 driving cycle	—
		P0245		Intake air pressure is higher than specification	1 driving cycle	—
		P0246		Intake air pressure is lower than specification	1 driving cycle	1 driving cycle
☆	P0335	P0335	Crankshaft position sensor circuit malfunction	Monitor signal of crankshaft position sensor is lower or higher than specification	1 driving cycle	—
☆	P0335/ P0340	P0340	Camshaft position sensor circuit malfunction (crankshaft position sensor circuit malfunction/camshaft position sensor circuit malfunction)	Supply voltage low or high input, or poor performance of camshaft or crankshaft position sensor	1 driving cycle	—
—	P0380	P0380	Pre/post heat relay circuit malfunction	Both pre/post heating relay and diagnostic signals are high or low level	2 driving cycles	—
		P1404	TL4226 circuit function (pre/post heating relay command malfunction)	Monitor signal of pre/post heating relay is different from command signal	2 driving cycles	—
	—	P0381	Glow indicator lamp circuit malfunction	Monitor signal of glow indicator lamp circuit is different from command signal (circuit open or short)	2 driving cycles	—
	P0403	P0403	EGR solenoid valve circuit malfunction	Monitor signal of EGR solenoid valve is different from command signal (circuit open or short)	1 driving cycle	—
	P0903	P0401	EGR solenoid valve flow insufficient detected	Insufficient EGR flow	1 driving cycle	1 driving cycle
		P0402	EGR solenoid valve flow excessive detected	Excessive EGR flow	1 driving cycle	—

	DTC NO. (Generic scan tool)	DTC NO. (SUZUKI scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
-	P0500	P0500	VSS circuit malfunction	Vehicle speed is lower or higher than specification under certain condition	2 driving cycles	-
	P0560	P0560	Power supply circuit malfunction	Power supply low or high input	2 driving cycles	-
		P0561	Stabilization of sensor supply	Poor performance of ECM	1 driving cycle	1 driving cycle
		P1614	Sensor supply function	Sensor power supply low or high voltage	1 driving cycle	-
	-	P0603	ECU function (EEPROM error)	Poor performance of ECM	1 driving cycle	-
☆	-	P0606	ECU function (internal fault)	Poor performance of ECM	1 driving cycle	-
-	-	P1613	ECU not registered	Poor performance of ECM	1 driving cycle	1 driving cycle
	P0105	P1101	Barometric press sensor circuit malfunction	Poor performance of ECM	2 driving cycles	-
	-	P1107	Swirl control solenoid valve circuit malfunction	Monitor signal of swirl control solenoid valve circuit is different from command signal (circuit open or short)	2 driving cycles	2 driving cycles
	-	P1108	Radiator fan high speed circuit malfunction	Monitor signal of radiator relay (high) circuit is different from command signal (circuit open or short)	2 driving cycles	-
	-	P1109	Radiator fan low speed circuit malfunction	Monitor signal of radiator relay (low) circuit is different from command signal (circuit open or short)	2 driving cycles	-
	-	P1110	A/C cut signal circuit malfunction	Monitor signal of A/C cut signal circuit is different from command signal (circuit open or short)	2 driving cycles	-
☆	P0170	P1169	Condenser voltage function 1 (Fuel trim malfunction)	Poor performance of ECM	1 driving cycle	1 driving cycle
☆		P1170	Condenser voltage function 2 (Fuel trim malfunction)	Poor performance of ECM	1 driving cycle	1 driving cycle
-	-	P1171	ECU function (ECU internal fault)	Poor performance of ECM	2 driving cycles	-
	P0510	P1402	Throttle solenoid valve circuit malfunction	Monitor signal of EGR throttle solenoid valve is different from command signal (circuit open or short), or poor performance of valve	1 driving cycle	-
	-	P1511	Ignition switch circuit malfunction	Ignition signal is not memorized in ECM	2 driving cycles	-

	DTC NO. (Generic scan tool)	DTC NO. (SUZUKI scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
☆	—	P1517	Immobilizer system malfunction	No signal or incorrect code inputted from immobilizer control module to ECM	—	—
Δ				Temporary fault of internal memory (status memory) in ECM		
—	—	P1519	Radiator fan circuit malfunction	Radiator fan relay signal is not corresponding to radiator fan state signal	1 driving cycle	—
	—	P1135	3rd piston deactivator (injection pump solenoid valve) circuit malfunction	Monitor signal of injection pump solenoid valve is different from command signal (circuit open or short)	2 driving cycles	—
	—	P1606	MIL circuit malfunction	Monitor signal of MIL circuit is different from command signal (circuit open or short)	2 driving cycles	—
	—	P1608	Engine coolant temperature warning lamp circuit malfunction	Monitor signal of engine coolant temperature warning lamp circuit is different from command signal (circuit open or short)	2 driving cycles	—

NOTE:

- In case that ECM detects a fault (DTC) in column with “☆” mark, engine is hard to start unless DTC is cleared from ECM memory.
- DTC DRIVING CYCLE column indicates the number of driving cycle before DTC is stored in ECM memory.
- In case that ECM detects a fault (DTC) in column with “Δ” mark, it means temporary fault of internal memory (status memory) for communication to immobilizer control module detected. However, it is no adverse affect for communication. Therefore, it dose not affect engine and emission control system.

Visual Inspection

Visually check the following parts and systems.

INSPECTION ITEM	REFERRING SECTION
Engine oil - - - - level, leakage	Section 0B
Engine coolant - - - - level, leakage	Section 0B
Fuel - - - - level, leakage	Section 0B
A/T fluid - - - - level, leakage	Section 0B
Air cleaner element - - - - dirt, clogging	Section 0B
Battery - - - - fluid level, corrosion of terminal	
Drive belt - - - - tension, damage	Section 0B
Accelerator cable - - - - play (after warm up engine), installation	Section 6E3
Vacuum hoses of air intake system - - - - disconnection, looseness, deterioration, bend	
Connectors of electric wire harness - - - disconnection, friction	
Fuses - - - - burning	Section 8A
Parts - - - - installation, bolt - - - - looseness	
Parts - - - - deformation	
Other parts that can be checked visually	
Also add the following items at engine start, if possible.	
Malfunction indicator lamp operation	Section 6-1
Charge warning lamp operation	Section 6H
Engine oil pressure warning lamp operation	Section 8C
Engine coolant temperature warning lamp operation	Section 8C
Engine coolant temperature meter operation	Section 8C
Fuel level meter operation	Section 8C
Abnormal air being inhaled from air intake system	
Exhaust system - - - - leakage of exhaust gas, noise	
Other parts that can be checked visually	

Engine Basic Check

This check is very important for troubleshooting when ECM has detected no DTC and no abnormality has been found in visual inspection.

Follow the flow table carefully.

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check battery voltage. Is it 11 V or more?	Go to Step 3.	Charge or replace battery.
3	Is engine cranked?	Go to Step 4.	Go to "Diagnosis" in Section 6G.
4	Does engine start?	Go to Step 5.	Go to Step 6.
5	Check engine idle speed referring to "Idle speed Inspection" in Section 6E3. Is check result as specified?	Go to Step 11 in "Engine Diag. Flow Table" in this section.	Go to "Improper Engine Idling or Engine Fails to Idle" under "Engine Diagnosis Table" in this section.
6	Do you have SUZUKI scan tool?	Go to Step 7.	Go to "Diagnosis" in Section 8G. If OK, go to Step 8.
7	Check immobilizer system malfunction as follows. 1) Execute Data List mode of Suzuki mode using ECM application of SUZUKI scan tool. Does Suzuki scan tool indicate communication error message?	Go to "Diagnosis" in Section 8G.	Go to Step 8.
8	Check fuel supply as follows: 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn ON ignition switch for 5 seconds and then OFF. Repeat this a few times. Is fuel return pressure (returning sounds) felt from fuel return hose when ignition switch is turned ON?	Go to Step 10.	Go to Step 9.
9	Check fuel pump for operating. 1) Was fuel pump operating sound heard from fuel pump for about 5 seconds after ignition switch ON and stop?	Go to "Low Pressure Fuel Supply Inspection" in Section 6E3.	Go to "Diag. Flow Table B-1" in this section.
10	Check fuel injector referring to "Fuel Injector" in Section 6E3. Is it in good condition?	Go to "Engine Diagnosis Table" in this section.	Go to "DTC P0201/0202/0203/0204 Flow Table" in this section.

Engine Diagnosis Table

Perform troubleshooting referring to the following table when ECM has detected no DTC and no abnormality has been found in visual inspection and engine basic inspection previously.

Condition	Possible Cause	Correction
Hard starting (Engine cranks OK)	Lack of fuel in fuel tank	Refill.
	Dirty or clogged fuel filter	Replace.
	Water mixed in fuel filter	Repair.
	Dirty or clogged fuel hose or pipe	Clean.
	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Correct.
	Clogged fuel injector	Replace.
	Faulty fuel pump	Inspect and replace.
	Faulty ECM	Replace.
	Faulty fuel pressure sensor	Inspect and replace.
	Faulty CKP sensor (Engine speed sensor)	Inspect and replace.
	Faulty CMP sensor	Inspect, adjust and replace.
	Air mixed in fuel injection pump	Refill fuel in fuel tank.
	Fuel injection pump internal damage	Replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Faulty fuel injector	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty glow plug	Inspect and replace.
	Faulty pre post heating relay	Inspect and replace.
	Compression leak from valve seat	Remove cylinder head and lap valves.
	Sticky valve stem	Correct or replace valve.
	Weak or damaged valve springs	Replace valve springs.
	Compression leak at cylinder head gasket	Repair or replace.
	Sticking or damaged piston ring	Replace piston rings.
	Worn piston, ring or cylinder	Replace ring and piston. Rebore or replace cylinder.
	Immobilizer control system out of order.	Refer to Section 8G.
	Broken valve timing belt	Replace timing belt and repair valve train.
	Faulty EGR throttle valve	Inspect and replace.

Condition	Possible Cause	Correction
Improper engine idling or engine fails to idle	Clogged air cleaner element	Clean or replace.
	EGR throttle valve	Inspect and replace.
	Shortage of fuel in fuel tank	Refill.
	Dirty or clogged fuel filter	Replace.
	Water mixed in fuel filter	Repair.
	Dirty or clogged fuel hose or pipe	Clean.
	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Repair.
	Clogged fuel injector	Replace.
	Faulty fuel pump	Inspect and replace.
	Engine overheating	Refer to "Overheating" section.
	Faulty ECM	Replace.
	Faulty mass air flow sensor	Inspect and replace.
	Faulty fuel injector	Inspect and replace.
	Faulty injection pump solenoid valve (3rd piston deactivator)	Inspect and replace.
	Air mixed in fuel injection pump	Refill fuel in fuel tank.
	Fuel injection pump internal damage	Replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Faulty fuel pressure sensor	Inspect and replace.
	Faulty TP sensor (accelerator stroke sensor)	Inspect and replace.
	Faulty VSS	Inspect and replace.
	Faulty CKP sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty glow plug	Inspect and replace.
	Faulty pre post heating relay	Inspect and replace.
	Faulty EGR solenoid valve	Inspect and repair or replace EGR system.
	Faulty EGR valve	Inspect and repair or replace EGR system.
	Faulty swirl control solenoid valve	Inspect and repair or replace swirl system.
	Faulty swirl control valve	Inspect and repair or replace swirl system.
	Low compression	Previously outlined.
	Faulty A/T shift switch	Inspect and replace.
	Faulty A/C signal	Inspect and replace.
	Mal-adjusted accelerator cable	Adjust.

Condition	Possible Cause	Correction
Abnormal knocking	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Repair.
	Faulty fuel injector	Inspect and replace.
	Faulty ECM	Replace.
	Faulty fuel injection pump	Inspect and replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Faulty pre/post heating relay	Inspect and replace.
	Faulty fuel temperature sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty EGR valve	Inspect and replace.
Engine hesitates when accelerating	Clogged air cleaner element	Clean or replace.
	Faulty turbocharger.	Replace.
	Dirty or clogged fuel filter	Replace.
	Water mixed in fuel filter	Repair.
	Dirty or clogged fuel hose or pipe	Clean or replace.
	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Repair.
	Clogged fuel injector	Inspect and replace.
	Engine overheating	Refer to "Overheating" section.
	Faulty ECM	Inspect and replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Air mixed in fuel injection pump	Refill fuel in fuel tank.
	Fuel injection pump internal damage	Inspect and replace.
	Faulty injection pump solenoid valve (3rd piston deactivator)	Inspect and replace.
	Faulty MAF sensor	Inspect and replace.
	Faulty TP sensor (Accelerator stroke sensor)	Inspect and replace.
	Faulty intake air pressure sensor	Inspect and replace.
	Faulty CKP sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty IAT sensor	Inspect and replace.
	Faulty EGR solenoid valve	Inspect and repair or replace EGR system.
	Faulty EGR valve	Inspect and repair or replace EGR system.
	Faulty swirl control solenoid valve	Inspect and repair or replace swirl system.
	Faulty swirl control valve	Inspect and repair or replace swirl system.
	Low compression	Previously outlined.
	Mal-adjusted accelerator cable	Replace.

Condition	Possible Cause	Correction
Overheating	Insufficient coolant	Replenish.
	Loose water pump belt	Adjust.
	Inoperative thermostat	Replace.
	Poor water pump performance	Replace.
	Clogged or leaky radiator	Flush, repair or replace.
	Improper engine oil grade	Replace with proper grade oil.
	Clogged oil filter or oil strainer	Replace or clean (oil strainer).
	Not enough oil	Replenish.
	Poor oil pump performance	Repair or replace.
	Oil leakage	Repair.
	Dragging brakes	Repair or replace.
	Slipping clutch	Repair or replace.
	Blown cylinder head gasket	Replace.
Excessive engine oil consumption	Loose oil drain plug	Tighten.
	Loose oil pan bolts	Tighten.
	Deteriorated or broken oil pan sealant	Replace sealant.
	Leaky crankshaft oil seal	Replace.
	Leaky cylinder head cover gasket	Replace.
	Improper tightening of oil filter	Tighten.
	Loose oil pressure switch	Tighten.
	Blown cylinder head gasket	Replace.
	Leaky crankshaft pulley oil seal	Replace.
	Leaky camshaft oil seal	Replace.
	Loose turbocharger oil hose bolts	Tighten.
	Sticky piston ring	Remove carbon and replace rings.
	Worn piston and cylinder	Replace or rebore cylinder, and replace piston.
	Worn piston ring groove and ring	Replace piston and ring.
	Improper location of piston ring gap	Reposition ring gap.
	Worn or damaged valve stem seal	Replace.
	Worn valve stem	Replace.
Lower oil pressure	Improper oil viscosity	Use oil of proper viscosity.
	Malfunctioning oil pressure switch	Replace.
	Not enough oil	Replenish.
	Clogged oil strainer	Clean.
	Functional deterioration of oil pump	Replace.
	Worn oil pump relief valve	Replace.
	Excessive clearance in various sliding parts	Replace worn parts.

Condition	Possible Cause	Correction
Engine noise (See NOTE:)	Improper valve lash	Adjust.
	Worn valve stem and guide	Replace.
	Weak or broken valve spring	Replace.
	Warped or bent valve	Replace.
	Worn piston, ring and cylinder bore	Rebore or replace cylinder. Replace piston and ring.
	Worn crankpin bearing	Replace.
	Worn crankpin	Repair by grinding or replace crankshaft.
	Loose connecting rod nuts	Tighten nuts to specification.
	Low oil pressure	Previously outlined.
	Worn crankshaft journal bearing	Replace.
	Worn crankshaft journal	Repair by grinding or replace crankshaft.
	Loose lower crankcase (bearing cap) bolts	Tighten bolts to specification.
	Excessive crankshaft thrust play	Replace thrust bearing.
	Engine and emission control system out of order	Refer to Section 6E3.
White or blue smoke	Clogged air cleaner element	Clean or replace.
	EGR throttle valve	Inspect and replace.
	Faulty ECM	Inspect and replace.
	Fuel injection pump internal damage	Replace.
	Faulty fuel injector	Inspect and replace.
	Faulty intake air pressure sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty ECM registration data	Inspect and registered.
	Faulty glow plug	Inspect and replace.
	Faulty pre post heating relay	Inspect and replace.
	Low compression	Previously outlined.
	Improper oil level	Adjust.
Black smoke	Faulty turbocharger	Inspect and replace.
	Clogged air cleaner element	Clean or replace.
	EGR throttle valve	Inspect and replace.
	Faulty ECM	Inspect and replace.
	Faulty fuel injector	Inspect and replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Fuel injection pump internal damage	Replace.
	Faulty MAF sensor	Inspect and replace.
	Faulty IAT sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty TP sensor	Inspect and replace.
	Faulty ECM registration data	Inspect and registered.
	Faulty EGR solenoid valve	Inspect and repair or replace EGR system.
	Faulty EGR valve	Inspect and repair or replace EGR system.
	Faulty swirl control solenoid valve	Inspect and repair or replace swirl system.

Condition	Possible Cause	Correction
Black smoke	Faulty swirl control valve	Inspect and repair or replace swirl system.
	Low compression	Previously outlined.

NOTE:

Before checking the mechanical noise, make sure that:

- Injection timing is properly adjusted.
- Specified fuel is used.

Inspection of ECM and Its Circuits

ECM and its circuits can be checked at ECM wiring couplers by measuring voltage and resistance.

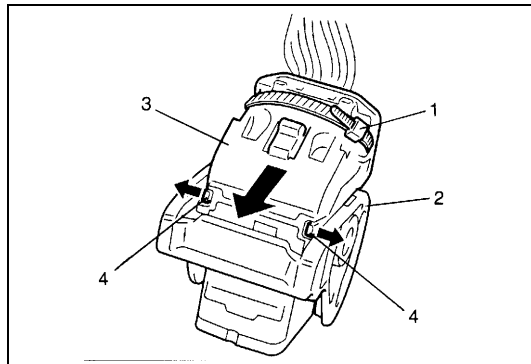
CAUTION:

ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with couplers disconnected from it.

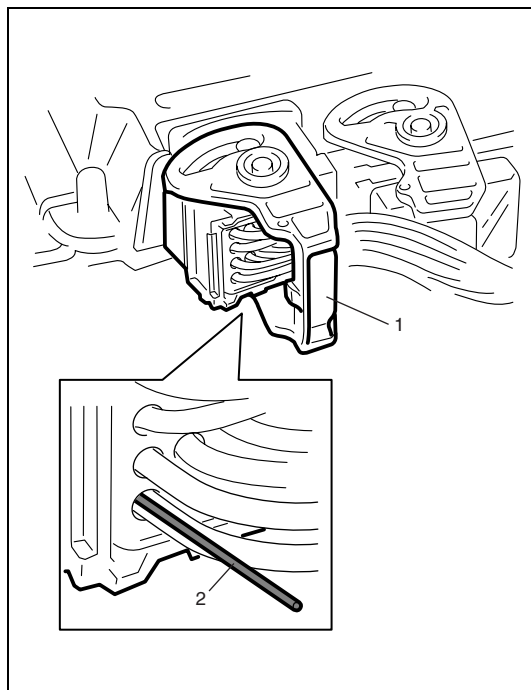
Voltage check

CAUTION:

When measuring the terminal voltages of ECM, try not to damage the waterproof gel applied on the connector terminal of ECM by inserting a pin, whose diameter is less than 0.3 mm, along with the wiring of the ECM terminal. For further details, refer to the figure shown below. Otherwise, ECM and terminals are damaged by entering water into the connector and trouble may occur.



- 1) Remove ECM from ECM bracket referring to "Engine Control Module (ECM)" in Section 6E3.
- 2) Remove harness clamps (1) from ECM harness connector assemblies (2).
- 3) Remove connector covers (3) from ECM harness connector assemblies losing connector cover locks (4).

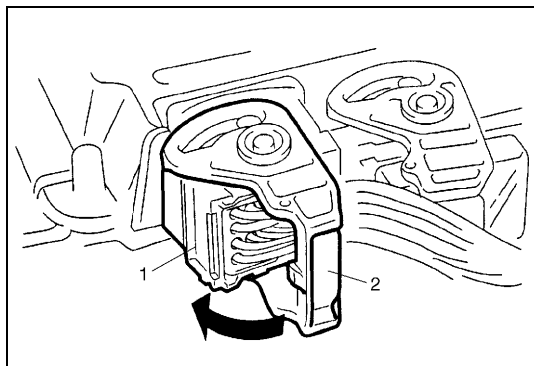


- 4) Connect ECM harness connectors to ECM using connector lock lever (1).
- 5) Measure voltage at each terminal with ignition switch turned ON according to Diag. Flow Table.

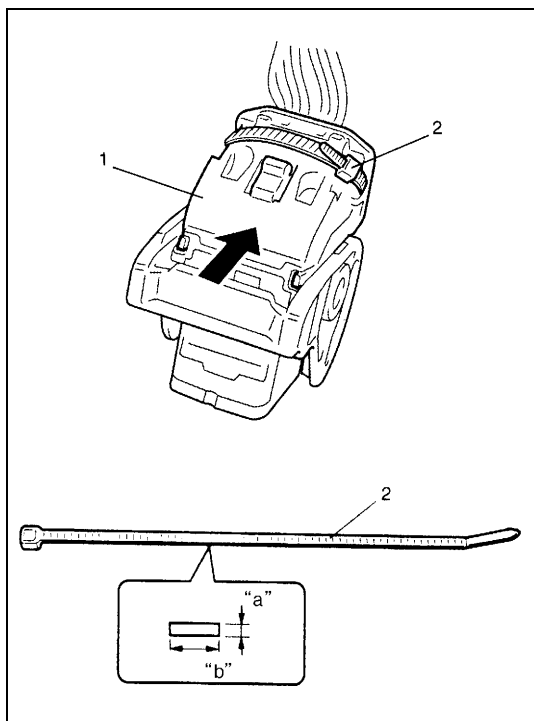
NOTE:

As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON.

2. Pin



- 6) After measuring, disconnect ECM harness connectors (1) from ECM locking connector lock lever (2).



- 7) Install connector covers (1) to ECM harness connectors securely.
 8) Tighten harness clamps (2) with ECM harness and ECM harness connector securely.
 9) Connect ECM connector assemblies to ECM using connector lock lever securely.

NOTE:

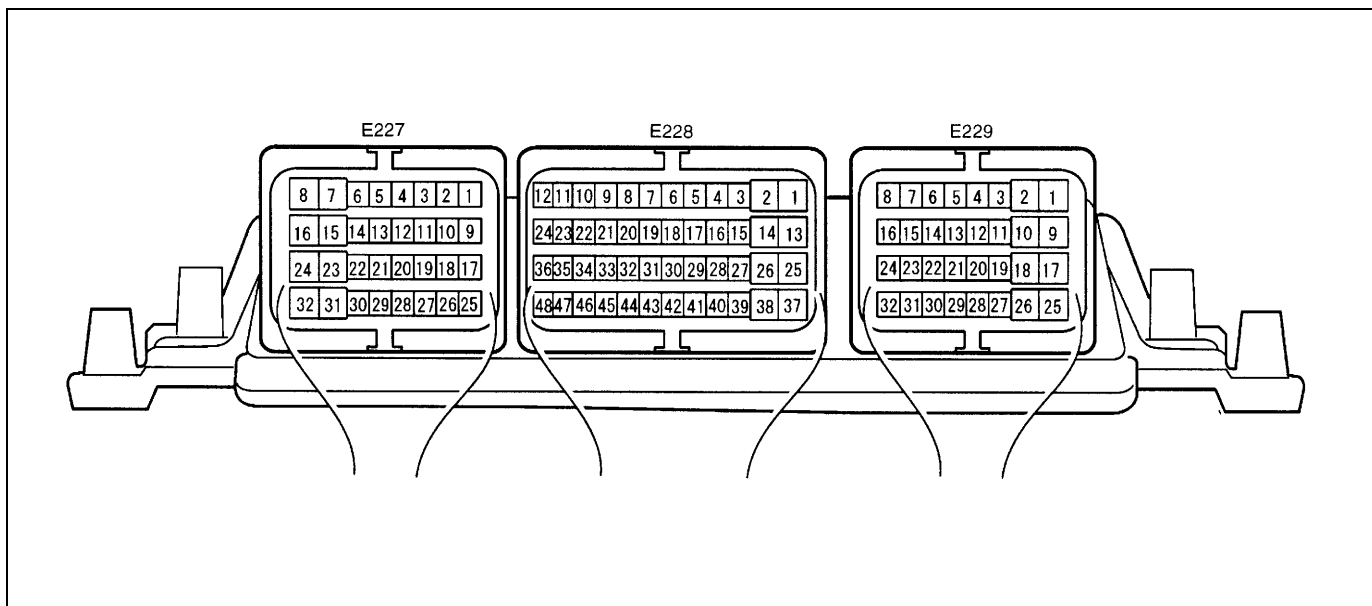
When clamp replacement is necessary, be sure to use a clamp with width and thickness as specified below or less. If a larger clamp is used, lock lever will be caught by clamp and it will be impossible to install ECM connector to ECM.

Width “b”: 2.3 mm

Thickness “a”: 1.2 mm

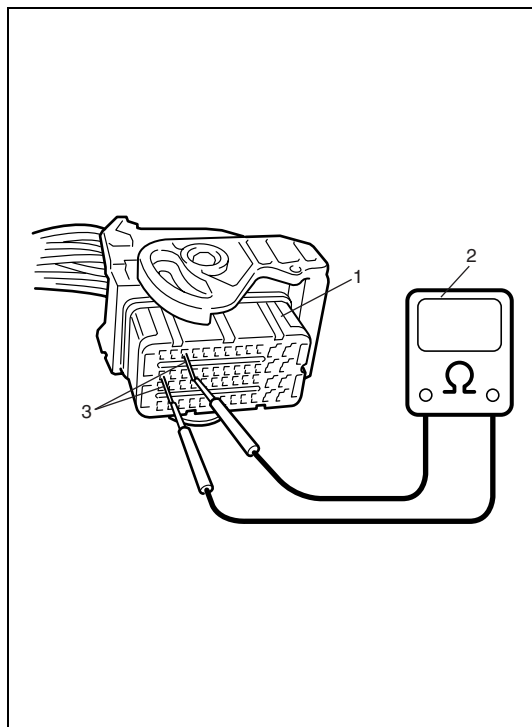
- 10) Install ECM to bracket referring to “Engine Control Module (ECM)” in Section 6E3.

TERMINAL ARRANGEMENT OF ECM CONNECTOR VIEWED FROM HARNESS SIDE



Resistance check

1) Disconnect couplers from ECM with ignition switch OFF.



CAUTION:

Do not touch terminals of ECM itself or connect voltmeter or ohmmeter (2).

2) Check resistance between each pair of terminals of disconnected couplers (1) as listed in the following table.

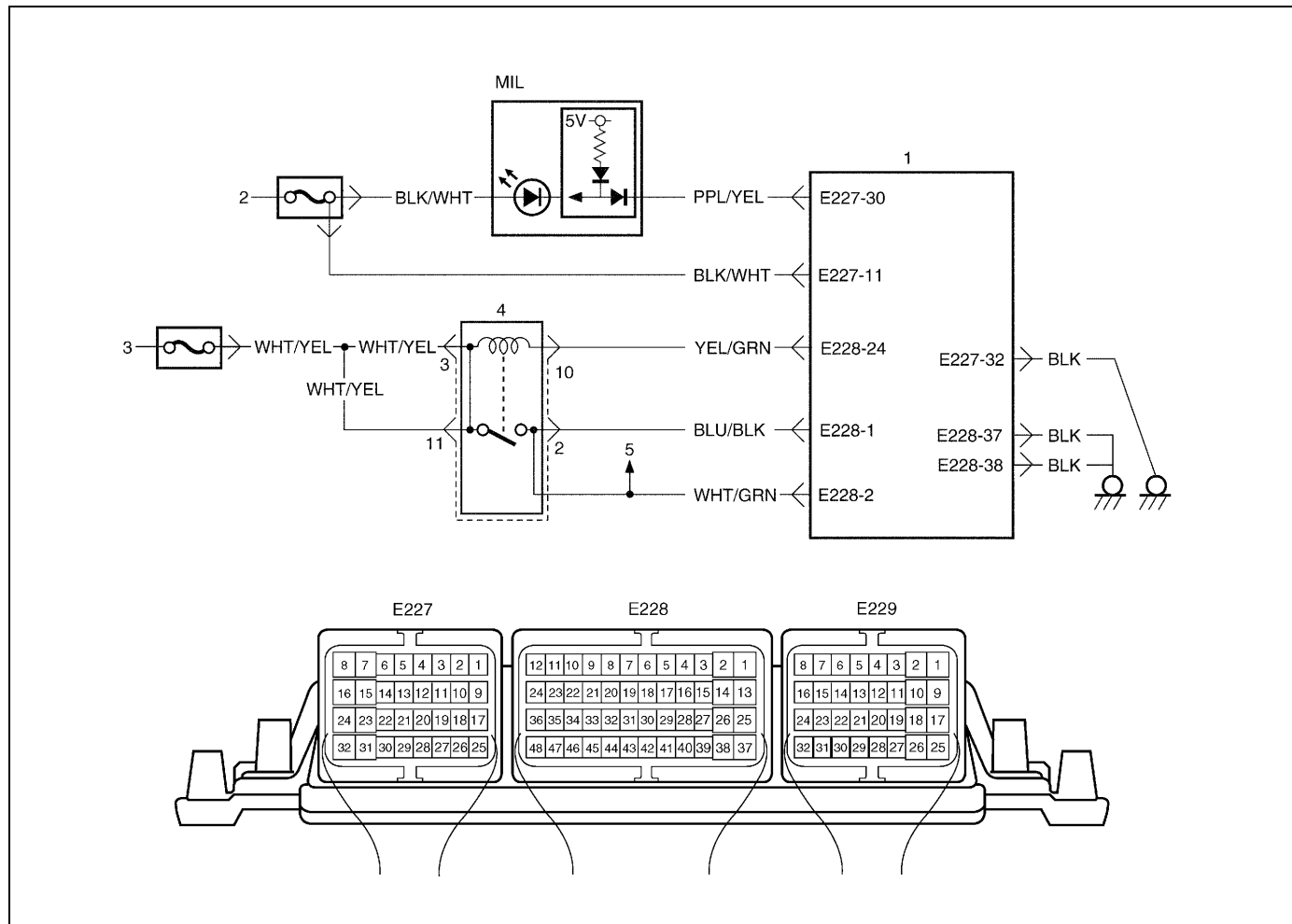
CAUTION:

- Be sure to connect ohmmeter probe from terminal side of coupler.
- When measuring the circuit resistance, use a pin (diameter is less than 0.3 mm) (3) for touching to the connector terminal and be careful not to damage to the terminal of the ECM connectors.
The directly connecting of ohmmeter probe to terminals cause poor connection.
- Be sure to turn OFF ignition switch for this check.
- Resistance in table represents that when parts temperature is 20°C (68°F).

TERMINAL	CIRCUIT	STANDARD RESISTANCE	CONDITION
E229-2 to E229-9	Fuel injector No.1	Max. 1.0 Ω	—
E229-25 to E229-17	Fuel injector No.2	Max. 1.0 Ω	—
E229-26 to E229-18	Fuel injector No.3	Max. 1.0 Ω	—
E229-1 to E229-10	Fuel injector No.4	Max. 1.0 Ω	—
E228-4 to E228-3	CKP sensor	315 – 405 Ω	At 20°C (68°F)
E228-21 to E228-20	Fuel temperature sensor	Refer to “Fuel Temperature Sensor Assembly” in Section 6E3.	
E228-1 to E228-14	Fuel pressure regulator	2 – 3 Ω	At 20°C (68°F)
E228-8 to E228-9	ECT sensor	Refer to “Engine Coolant Temperature Sensor (ECT Sensor)” in Section 6E3.	
E228-37 to Body ground	Ground	Below 1.5 Ω	—
E228-38 to Body ground	Ground	Below 1.5 Ω	—
E227-32 to Body ground	Ground	Below 1.5 Ω	—

Table A-1 Malfunction Indicator Lamp Circuit Check – MIL Does Not Come “ON” or Dims at Ignition Switch ON (But Engine at Stop)

Wiring Diagram



1. ECM	3. Main fuse	5. To radiator fan relay No.3
2. To ignition switch	4. Double relay	

Circuit Description

When the ignition switch is turned ON, ECM causes the double relay to turn ON (close the contact point). Then, ECM being supplied with the main power, turns ON the malfunction indicator lamp (MIL). When the engine starts to run and no malfunction is detected in the system, MIL goes OFF but if a malfunction was or is detected, MIL remains ON even when the engine is running.

Inspection

Step	Action	Yes	No
1	MIL Power Supply Check: 1) Turn ignition switch ON. Do other indicator/warning lights in combination meter comes ON?	Go to Step 2.	"IG COIL" fuse blown, main fuse blown, Ignition switch malfunction, "BLK/WHT" circuit open and poor coupler connection at combination meter.
2	ECM Power and Ground Circuit Check: Does engine start?	Go to Step 3.	Go to "Table A-3 ECM Power and Ground Circuit Check" in this section. If engine is not cranked, go to "Diagnosis" in Section 6G.
3	MIL Circuit Check: 1) Turn ignition switch OFF. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at terminal E227-30. 4) If OK, then using service wire, ground terminal E227-30 in connector disconnected. Does MIL turn on at ignition switch ON?	Substitute a known-good ECM and recheck.	Faulty combination meter or "PPL/YEL" wire circuit open.

Table A-2 Malfunction Indicator Lamp Circuit Check – MIL Remains "ON" after Engine Starts**Wiring Diagram/Circuit Description**

Refer to "Table A-1 Malfunction Indicator Lamp Circuit Check – MIL Does Not Come "ON" or Dims at Ignition Switch ON (But Engine at Stop)" in this section.

Inspection

Step	Action	Yes	No
1	DTC Check. 1) With ignition switch OFF, install scan tool. 2) Start engine and check DTC. Is there any DTC(s).	Go to Step 2 of "Engine Diag. Flow Table" in this section.	Go to Step 2.
2	MIL Circuit Check: 1) Turn ignition switch to OFF position. 2) Disconnect ECM connector referring to "Voltage Check" in this section. Does MIL turn ON at ignition switch ON?	"PPL/YEL" wire shorted to ground circuit.	Substitute a known-good ECM and recheck.

Table A-3 ECM Power and Ground Circuit Check – MIL Doesn't Light at Ignition Switch ON and Engine Doesn't Start Though It Is Cranked Up.

Wiring Diagram

Refer to "Table A-1 Malfunction Indicator Lamp Circuit Check – MIL Does Not Come "ON" or Dims at Ignition Switch ON (But Engine at Stop)" in this section.

Circuit Description

When the ignition switch is turned ON, the double relay turns ON (the contact point closes) and the main power is supplied to ECM.

Inspection

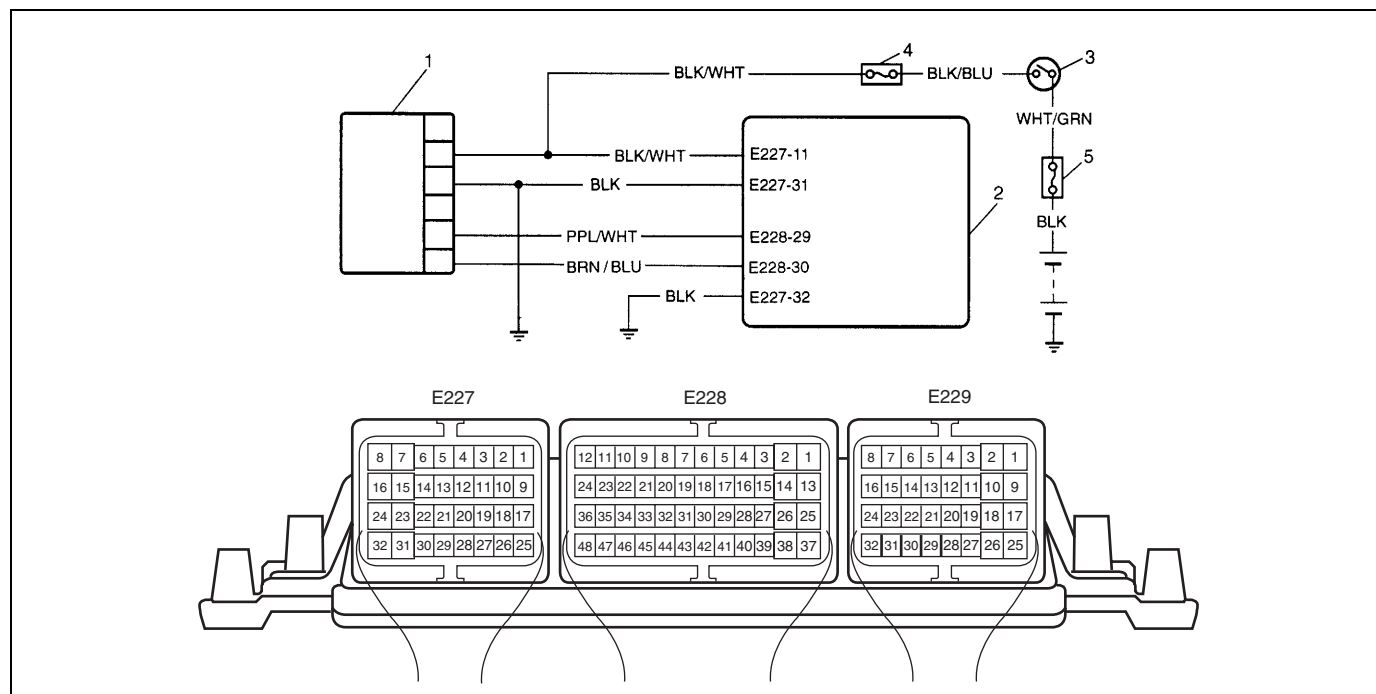
Step	Action	Yes	No
1	Double Relay Operating Sound Check: Is operating sound of double relay heard at ignition switch ON?	Go to Step 5.	Go to Step 2.
2	Fuse Check: Is main "FI" fuse in good condition?	Go to Step 3.	Check for short in circuits connected to this fuse.
3	Double Relay Check: 1) Turn OFF ignition switch and remove double relay. 2) Check for proper connection to double relay at terminal 3 and 10. 3) If OK, check double relay referring to "Double Relay" in Section 6E3. Is check result satisfactory?	Go to Step 4.	Replace double relay.
4	ECM Power Circuit Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector covers referring to "Voltage Check" in this section. 3) Install double relay. 4) Check for proper connection to ECM at terminals E227-11, E228-24, E228-1 and E228-2. 5) If OK, then measure voltage between terminal E227-11 and ground, E228-24 and ground with ignition switch ON. Is each voltage 10 – 14 V?	Go to Step 5.	"BLK/WHT", "YEL/GRN" or "WHT/YEL" circuit open.
5	ECM Power Circuit Check: 1) Using service wire, ground terminal E228-24 and measure voltage between terminal E228-1 and ground, E228-2 and ground at ignition switch ON. Is it 10 – 14 V?	Check ground circuits "BLK" for open. If OK, then substitute a known-good ECM and recheck.	Go to Step 6.
6	Is operating sound of double relay heard in Step 1?	Go to Step 7.	"WHT/YEL" or "BLU/BLK" wire open.
7	Double Relay Check: 1) Check double relay according to procedure in Step 3. Is double relay in good condition?	"WHT/YEL" or "BLU/BLK" wire open.	Replace double relay.

DTC P0100 (DTC P0100) Mass Air Flow Circuit Malfunction

NOTE:

In case that “DTC P0100” is detected by using the generic scan tool, perform “DTC P0100 (P0100) Mass Air Flow Circuit Malfunction” and “DTC P0101 (P0100) MAF Sensor Circuit Range/Performance Problem” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram



1. Mass air flow sensor	3. Ignition switch	5. Main fuse
2. ECM	4. "IG COIL" fuse (20 A)	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage is below 0.1 V on "E228-29" wire terminal of ECM.	- Mass air flow sensor circuit - Mass air flow sensor malfunction - ECM malfunction

DTC Confirmation Procedure

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC Confirmation Procedure.

- Intake air temp.: -8°C , 18°F or higher
- Engine coolant temp.: $-8 - 110^{\circ}\text{C}$ ($18 - 230^{\circ}\text{F}$)
- Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)

- Connect scan tool to DLC with ignition switch OFF.
- Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed.
- Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	MAF sensor power supply Check: 1) With ignition switch OFF, disconnect MAF sensor coupler. 2) With ignition switch ON, check voltage between "BLK/WHT" wire terminal of MAF sensor coupler and "BLK" wire terminal of MAF sensor coupler. Is voltage 10 – 14 V?	Go to Step 3.	Faulty "BLK/WHT", "BLK" wire.
3	Wiring Harness Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Measure resistance between E228-29 terminal of disconnected ECM connector and "PPL/WHT" wire terminal of MAF sensor connector. Is resistance 1 Ω or less?	Poor E228-29 terminal and "PPL/WHT" wire terminal connection. If OK, go to Step 4.	"PPL/WHT" wire circuit open.
4	Wiring Harness Check: 1) Check continuity between E228-29 terminal of disconnected ECM connector and body ground. Is it infinite?	Go to Step 5.	"PPL/WHT" wire circuit shorted to ground.
5	Wiring Harness Check: 1) With ignition switch ON, check voltage between E228-29 terminal of disconnected ECM connector and "PPL/WHT" wire terminal of MAF sensor connector. Is voltage 0 V?	Go to Step 6.	"PPL/WHT" wire shorted to power circuit.
6	Wiring Harness Check: 1) Turn ignition switch to OFF position. 2) Measure resistance between E228-30 terminal of disconnected ECM connector and "BRN/BLU" wire terminal of MAF sensor connector. Is resistance 1 Ω or less?	Poor E228-30 terminal and "BRN/BLU" wire terminal connection. If OK, go to Step 7.	"BRN/BLU" wire circuit open.
7	Wiring Harness Check: 1) Check continuity between E228-30 terminal of disconnected ECM connector and body ground. Is it infinite?	Go to Step 8.	"BRN/BLU" wire circuit shorted to ground.
8	Wiring Harness Check: 1) With ignition switch ON, check voltage between E228-30 terminal of disconnected ECM connector and "BRN/BLU" wire terminal of MAF sensor connector. Is voltage 0 V?	Go to Step 9.	"BRN/BLU" wire shorted to power circuit.

Step	Action	Yes	No
9	MAF Sensor Output Voltage Check: 1) With ignition switch OFF, connect MAF sensor coupler and ECM connector. 2) Start engine and check voltage between E228-29 and E228-30 terminals of ECM connector at idle speed. Is voltage about 2 – 3 V?	Faulty “BLK” wire connection. If OK, substitute a known-good ECM and recheck.	Substitute a known-good MAF sensor and recheck.

DTC P0101 (P0100) MAF Sensor Circuit Range/Performance Problem

NOTE:

In case that “DTC P0100” is detected by using the generic scan tool, perform “DTC P0100 (P0100) Mass Air Flow Circuit Malfunction” and “DTC P0101 (P0100) MAF Sensor Circuit Range/Performance Problem” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram

Refer to “DTC P0100 (DTC P0100) Mass Air Flow Circuit Malfunction” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Engine speed is greater than 3000 rpm and air flow sensor output voltage is lower than specified value for more than 4.5 seconds or engine speed between 700 and 900 rpm and air flow greater than 800 mg/stroke.	• Clogged or leaky air intake system • Mass air flow sensor circuit (Intermittent or high resistance) • Mass air flow sensor malfunction • ECM malfunction

DTC Confirmation Procedure

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC Confirmation Procedure.

- Intake air temp.: -8°C, 18°F or higher
- Engine coolant temp.: -8 – 110°C (18 – 230°F)
- Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)

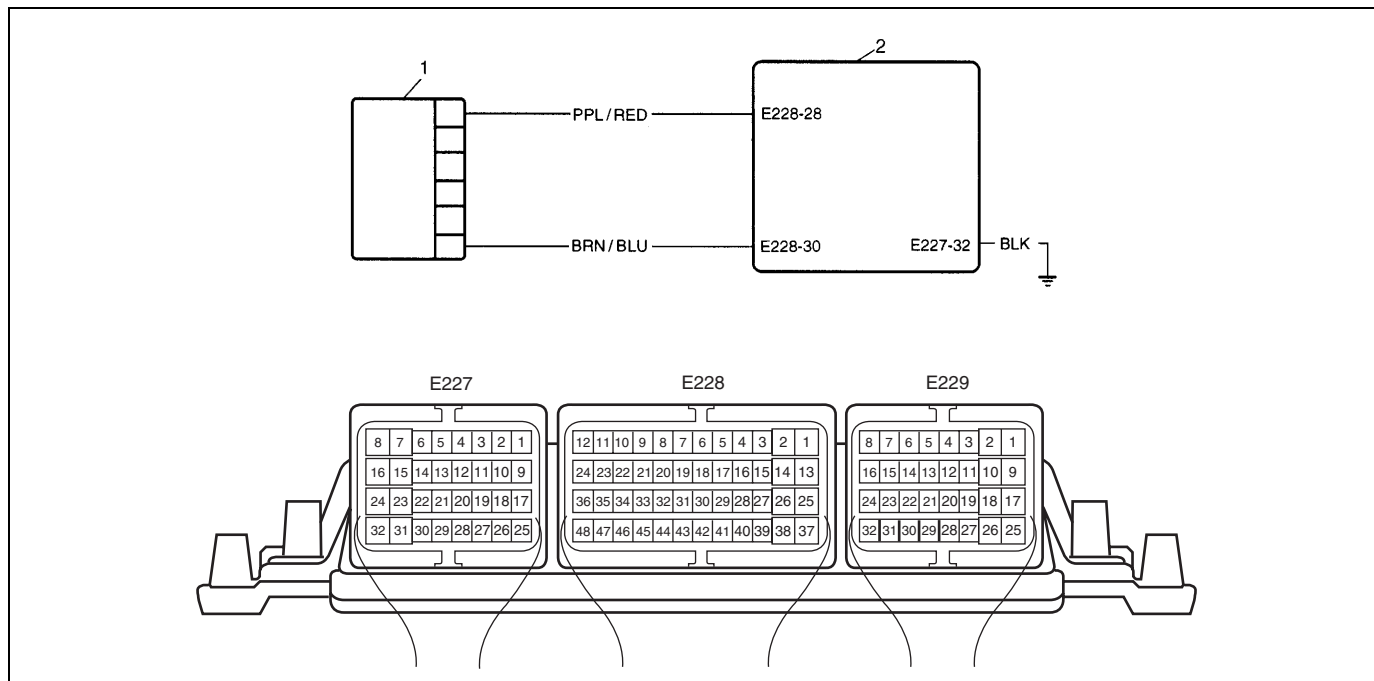
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Then run engine over 3000 rpm for 10 sec. or more.
- 4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table” in this section.
2	1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to “Voltage Check” in this section. 3) Connect ECM connectors from ECM. 4) Start engine and check voltage between E228-29 and E228-30 terminals. Engine speed at 3000 rpm: about 3 – 4 V Engine speed at idling: about 2 – 3 V Is each value satisfied?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Clogged or leaky air intake system. If all are OK, substitute a known-good MAF sensor and recheck.

DTC P0110 Intake Air Temp. (IAT) Circuit Malfunction

Wiring Diagram



1. Mass air flow sensor

2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage is below 0.1 V or "E228-28" wire terminal of ECM or voltage is greater than 4.8 V on "E228-28" wire terminal of ECM.	- IAT sensor circuit - IAT sensor malfunction - ECM malfunction

DTC Confirmation Procedure

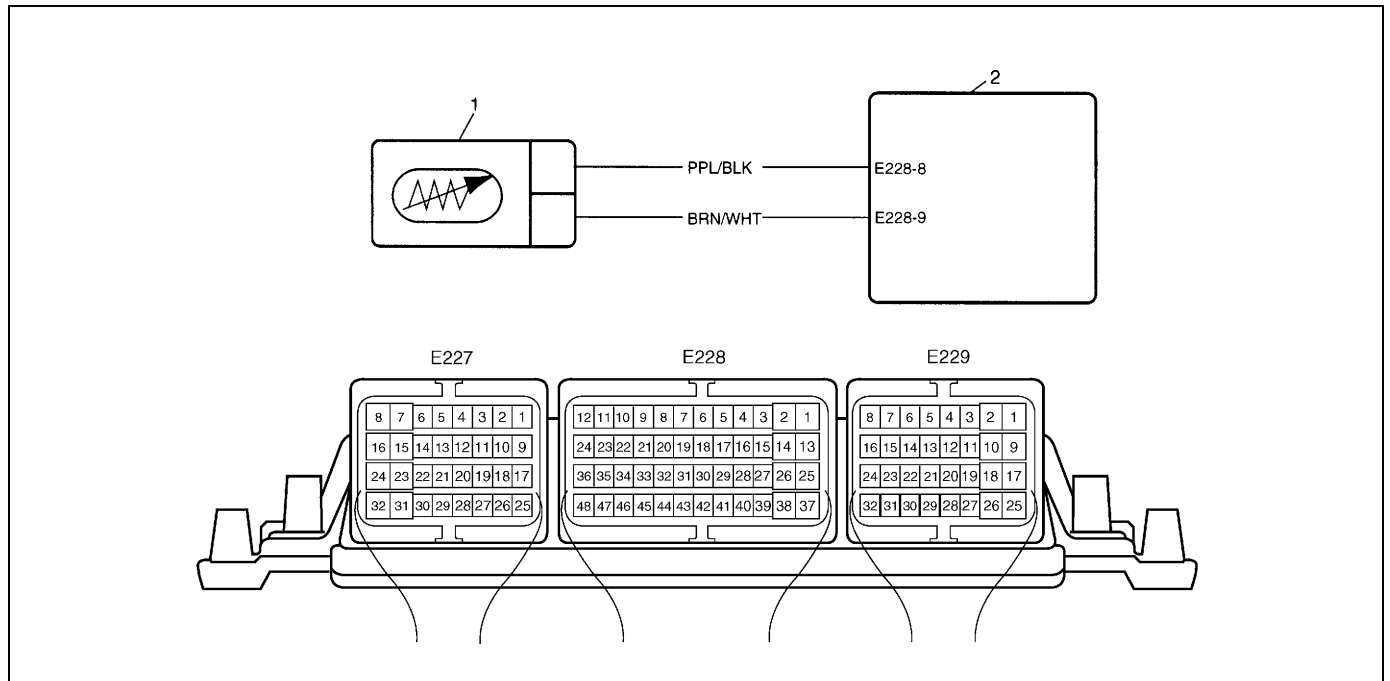
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition switch, then ON.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check IAT Sensor and Its Circuit. 1) Connect scan tool with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) or 131°C (268°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.
3	Check Wire Harness. 1) Disconnect MAF sensor (built-in IAT sensor) connector with ignition switch OFF. 2) Check for proper connection to MAF sensor (built-in IAT sensor) at "PPL/RED" and "BRN/BLU" wire terminals. 3) If OK, then with ignition switch ON, is voltage applied to "PPL/RED" wire terminal of harness side about 5 V?	Go to Step 4.	"PPL/RED" wire open or shorted to power, or poor E228-28 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate -40°C (-40°F) at Step 2?	Go to Step 6.	Go to Step 5.
5	Check Wire Harness. 1) Disconnect MAF sensor (built-in IAT sensor) connector. 2) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) indicated?	Replace MAF sensor (built-in IAT sensor).	"PPL/RED" wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect MAF sensor (built-in IAT sensor) connector terminals. (between "PPL/RED" wire terminal and "BRN/BLU" wire terminal of harness side) 2) Turn ignition switch ON and check intake air temp. displayed on scan tool. Is 131°C (268°F) indicated?	Replace MAF sensor (built-in IAT sensor).	"BRN/BLU" wire open or poor E228-30 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

DTC P0115 (DTC P0115) Engine Coolant Temp. Sensor Circuit Malfunction

Wiring Diagram



- | |
|--|
| 1. Engine coolant temperature (ECT) sensor |
| 2. ECM |

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage is below 0.1 V on "E228-8" wire terminal of ECM.	- Engine coolant temperature sensor circuit - Engine coolant temperature sensor malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

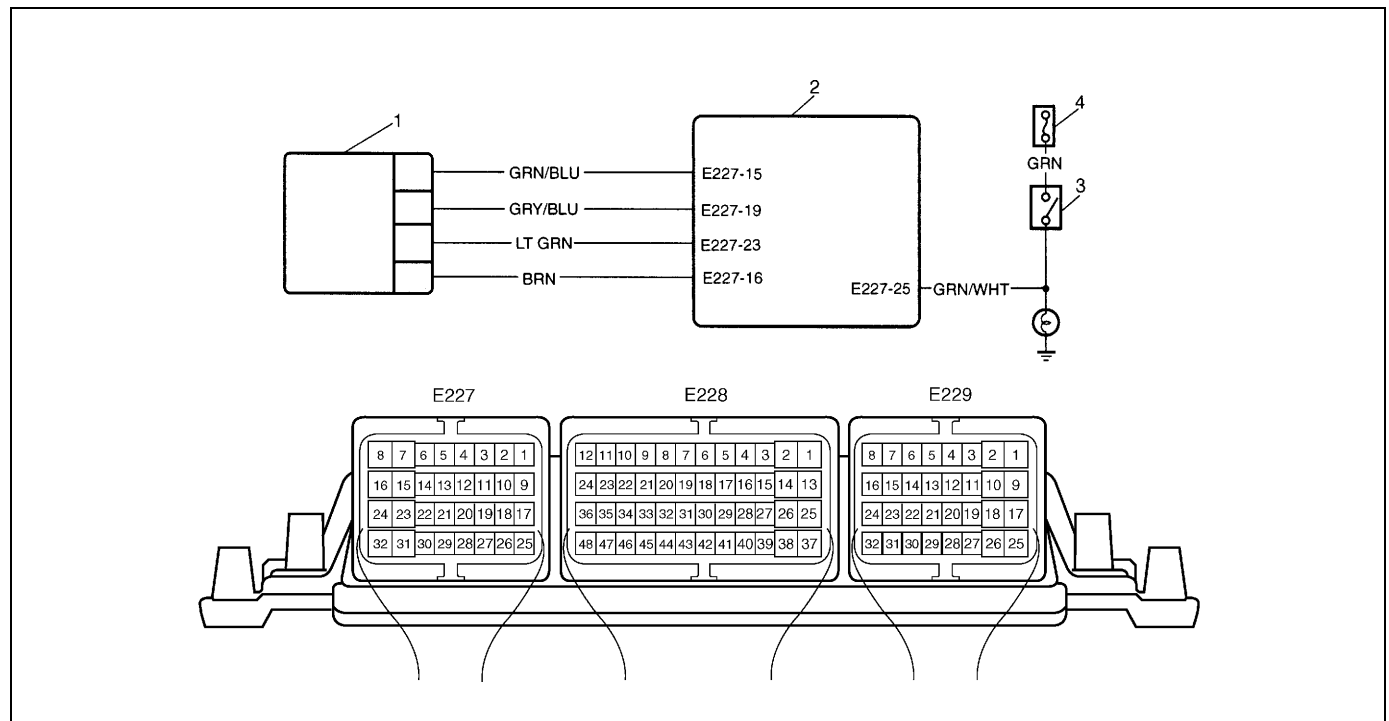
Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness. 1) Remove intercooler referring to "Intercooler" in Section 6A3. 2) Disconnect ECT sensor connector with ignition switch OFF. 3) Check for proper connection to ECT sensor at "PPL/BLK" and "BRN/WHT" wire terminals. 4) If OK, check voltage between "PPL/BLK" and "BRN/WHT" wire terminals of harness side with ignition switch ON. Is voltage about 5 V?	Go to Step 3.	"PPL/BLK" wire open or shorted to power/ground. "BRN/WHT" wire open. Poor E228-8 or E228-9 connection.
3	Check ECT Sensor and Its Circuit 1) Connect ECT sensor to its connector. 2) Connect scan tool to DLC with ignition switch OFF and run engine. Does coolant temp. on scan tool vary?	Substitute a known-good ECM and recheck.	Faulty ECT sensor.

DTC P0121 (DTC P0120) Throttle Position Circuit Range/Performance Problem

DTC P0604 (P0120) Throttle Position Sensor Monitoring System Malfunction

Wiring Diagram



1. Throttle position sensor	3. Brake lamp switch
2. ECM	4. "STOP" fuse (20 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- Voltage is below 0.1 V on "E227-15" wire terminal of ECM or voltage is greater than 4.7 V on "E227-15" wire terminal of ECM. or - Voltage is greater than 5.2 V on "E227-23" wire terminal of ECM or voltage is less than 4.8 V on "E227-23" wire terminal of ECM. or - Simultaneous operation of the accelerator and the brake.	- Throttle position sensor circuit - Throttle position sensor malfunction - Brake (stop) lamp switch - ECM malfunction

DTC Confirmation Procedure

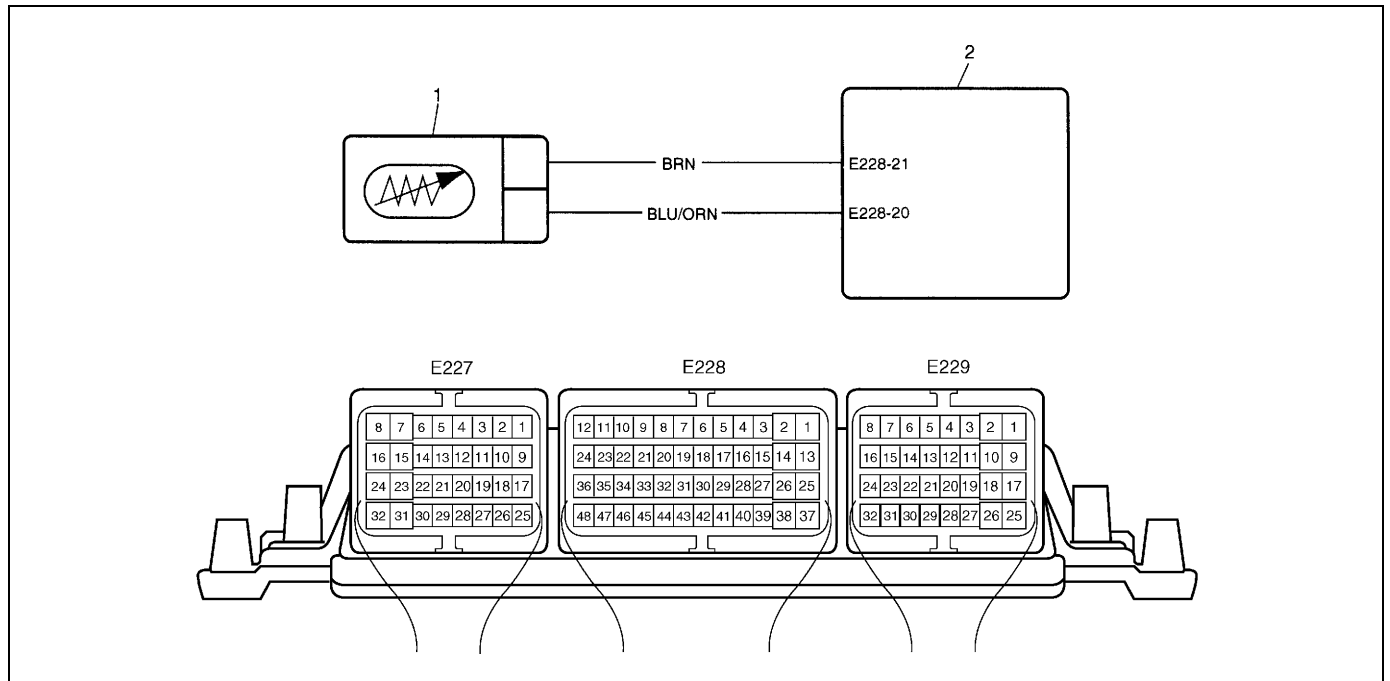
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit Is DTC below also indicated? <Using Suzuki mode of SUZUKI scan tool> P1614 <Using Generic Scan tool or GST mode of SUZUKI scan tool> P0560	Go to "DTC P1614 (P0560) Sensor Supply Function" in this section.	Go to Step 3.
3	Check Wire Harness. 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at each terminals. 3) If OK, then with ignition switch ON, check voltage between "LT GRN" wire and "BRN" wire terminals at connector of TP sensor. Is voltage about 5 V?	Go to Step 4.	"LT GRN" wire open, "BRN" wire open, poor E227-23 connection, or poor E227-16 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor output voltage. 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors from ECM. 4) With ignition switch ON, check voltage between E227-15 and ground, when accelerator pedal is at idle position to fully depressed position. Is voltage 0.5 – 3.35 V?	Substitute a known-good ECM and recheck.	"GRN/BLU" wire open, "GRN/BLU" wire shorted to ground circuit/power circuit. Poor TP sensor connector. If wire and connection are OK, substitute a known-good TP sensor.

DTC P0180 Fuel Temperature Sensor Circuit Malfunction

Wiring Diagram



1. Fuel temperature sensor

2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage is below 0.1 V on "E228-20" wire terminal of ECM or voltage is greater than 4.8 V on "E228-20" wire terminal of ECM.	- Fuel temperature sensor circuit - Fuel temperature sensor malfunction - ECM malfunction

DTC Confirmation Procedure

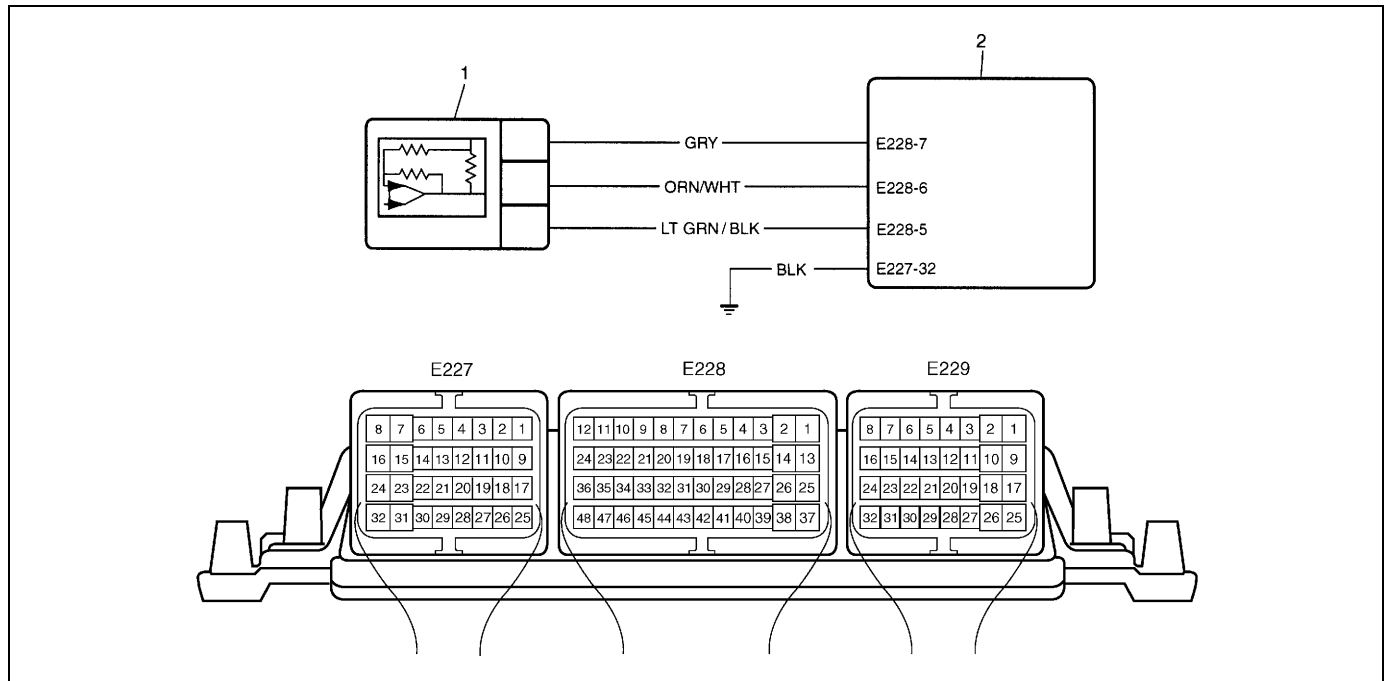
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	1) Remove intercooler referring to "Inter-cooler" in Section 6A3. 2) Disconnect fuel temp. sensor connector with ignition switch OFF. 3) Check for proper connection to fuel temp. sensor at "BLU/ORN" and "BRN" wire terminals. 4) If OK, check voltage between "BLU/ORN" and "BRN" wire terminals with ignition switch ON. Is voltage about 5 V?	Go to Step 3.	"BLU/ORN" wire open or shorted to power/ground. "BRN" wire open. Poor E228-20 or E228-21 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Check fuel temp. sensor for resistance referring to "Fuel Temperature Sensor" in Section 6E3. Is resistance as specified?	Substitute a known-good fuel temp. sensor and recheck.	Replace fuel temp. sensor.

DTC P0190 (P0190) Fuel Rail Pressure Sensor Circuit Malfunction

Wiring Diagram



1. Fuel pressure sensor

2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- Voltage is less than 0.3 V on “E228-6” wire terminal of ECM or voltage is greater than 4.7 V on “E228-6” wire terminal of ECM. or - Voltage is greater than 5.2 V on “E228-5” wire terminal of ECM or voltage is less than 4.8 V on “E228-5” wire terminal of ECM.	- Fuel rail pressure sensor circuit - Fuel rail pressure sensor malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI scan tool> P1614 <Using Generic Scan tool or GST mode of SUZUKI scan tool> P0560	Go to "DTC P1614 (P0560) Sensor Supply Function" in this section.	Go to Step 3.
3	Check Wire Harness 1) Remove intercooler and intercooler outlet hose. 2) Disconnect connector from fuel pressure sensor with ignition switch OFF. 3) Check for proper connection to fuel pressure sensor at each terminals. 4) If OK, then with ignition switch ON, check voltage between "LT GRN/BLK" wire and "GRY" wire terminals at connector of fuel pressure sensor. Is voltage about 5 V?	Go to Step 4.	"LT GRN/BLK" wire open, "LT GRN/BLK" wire shorted to ground circuit/power circuit, "GRY" wire open, poor E228-5 connection, or poor E228-7 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors from ECM. 4) Connect fuel pressure sensor connector. 5) Install intercooler and intercooler outlet hose. 6) Start engine and check voltage between E228-6 and E227-32 terminal at idle speed. Is voltage about 1.3 V?	Substitute a known-good ECM and recheck.	"ORN/WHT" wire open, "ORN/WHT" wire shorted to ground circuit/power circuit. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.

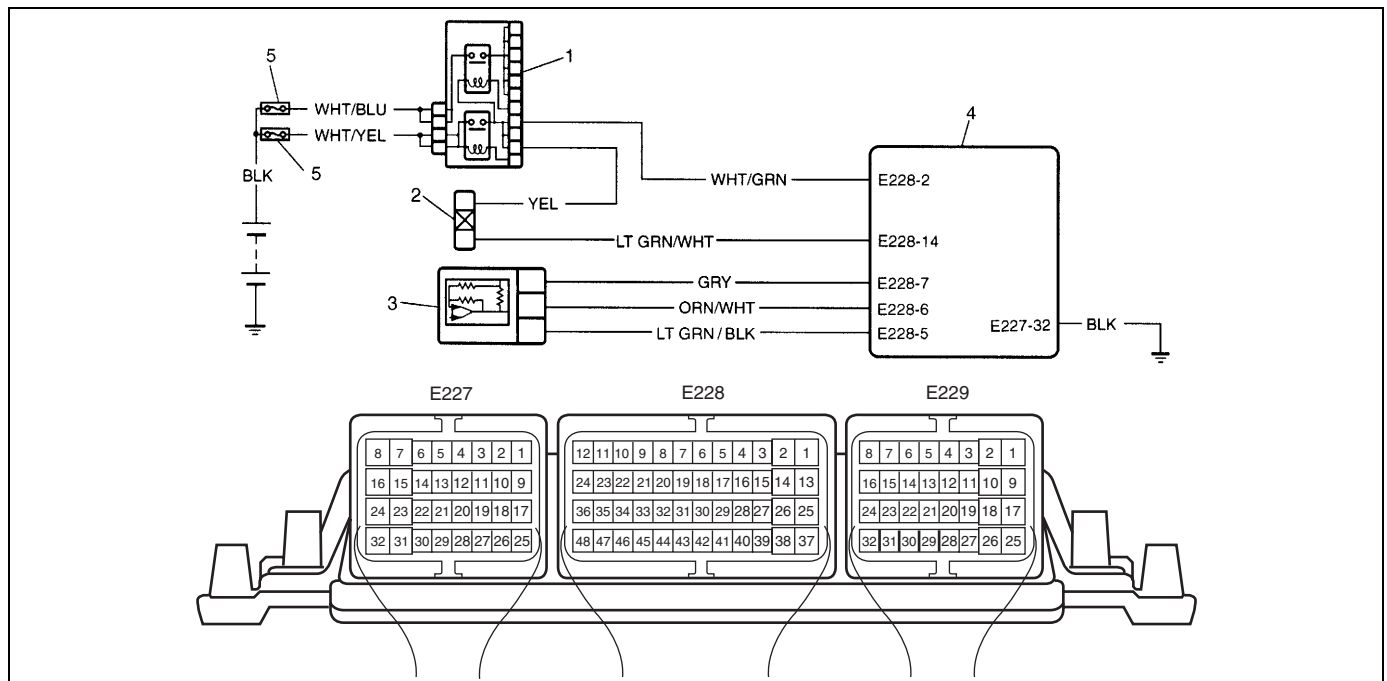
DTC P0191 (P0230) Fuel Rail Pressure Sensor/Pressure Regulator Consistency Function

DTC P1112 (P0230) Fuel Pressure Monitoring Circuit Malfunction

NOTE:

In case that “DTC P0230” is detected by using the generic scan tool, perform “DTC P0191 (P0230) Fuel Rail Pressure Sensor/Pressure Regulator Consistency Function”, “DTC P1112 (P0230) Fuel Rail Pressure Monitoring Circuit Malfunction” and “DTC P1138 (P0230) Fuel Pressure regulator Circuit Malfunction” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram



1. Double relay	3. Fuel pressure sensor	5. Double relay fuse (30 A)
2. Fuel pressure regulator	4. ECM	

DTC Detecting Condition and Trouble Area

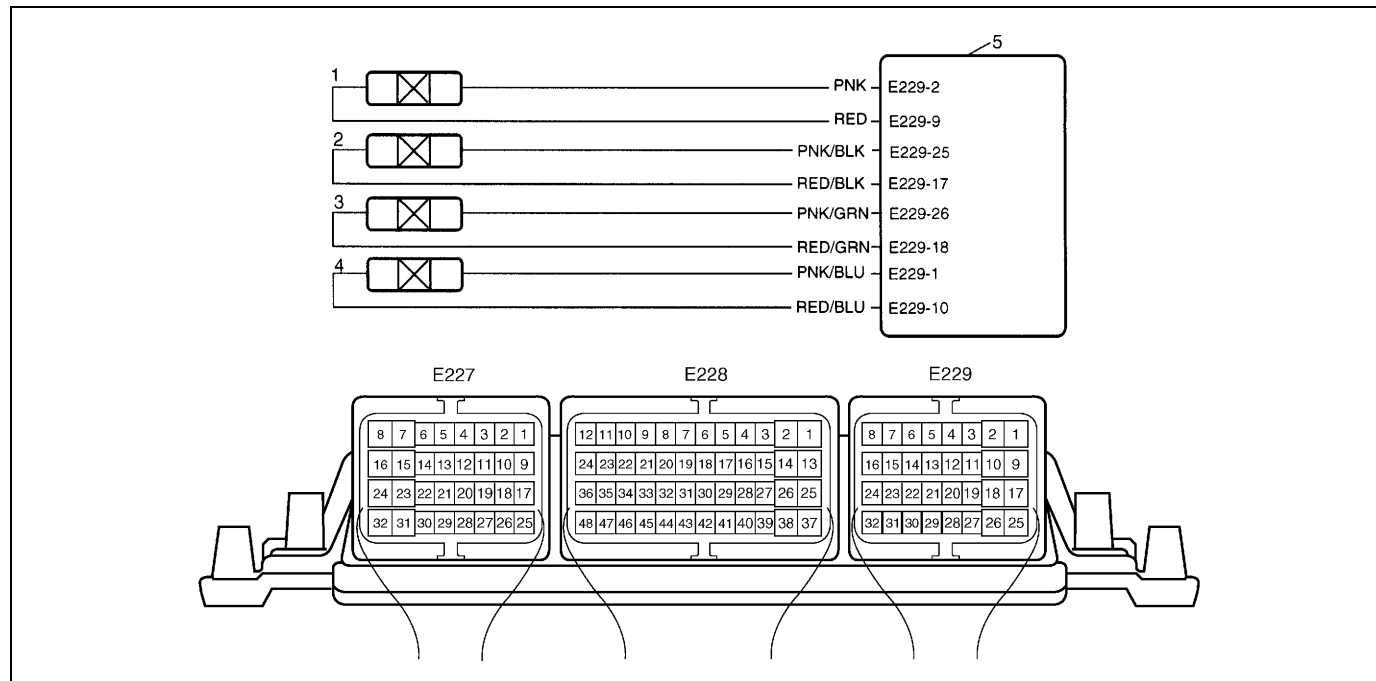
DTC DETECTING CONDITION	TROUBLE AREA
P0191: The current measured on the fuel pressure regulator does not correspond to the pressure given by the fuel rail pressure sensor on basis. P1112: - Fuel rail pressure is higher than 1450 bars. or - Reference pressure + 250 bars lower than the fuel rail pressure measured and fuel pressure regulator below 10% for more than 0.5 seconds. or - Reference pressure + 250 bars greater than the fuel rail pressure measured and fuel pressure regulator above 85% for more than 0.5 seconds.	- Double relay and its circuit - Fuel pressure sensor and its circuit - Fuel line clogged or bended - Injection pump malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Then run engine at 1000 rpm or more for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Fuel Shortage 1) Is there enough fuel in fuel tank?	Go to Step 3.	Supply fuel into fuel tank.
3	Check Wire Harness 1) Turn ignition switch OFF position. 2) Remove ECM connector covers referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E228-2 and E228-14 terminals. 4) If OK, check resistance between E228-2 and E228-14 terminals. Is resistance 2 – 3 Ω ?	Go to Step 4.	Faulty "WHT/GRN" wire, "YEL" wire or "LT GRN/WHT" wire. If wire is OK, substitute a known-good double relay or injection pump and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Connect ECM connectors to ECM. 2) Start engine and check voltage between E228-6 and E227-32 terminal at idle speed. Is voltage about 1.3 V?	Go to Step 5.	"ORN/WHT" wire open, "ORN/WHT" wire shorted to ground circuit/power circuit. Poor fuel pressure sensor connector terminal connection. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.
5	Check Fuel Leakage 1) Perform step 1), 2) and 3) of "DTC Confirmation Procedure". 2) Check fuel leakage on Fuel System. Is it in good condition?	• Fuel line clogged or bended. • Faulty fuel pressure regulator. If OK, substitute a known-good ECM and recheck.	Repair or replace.

DTC P0201 (P0200) Injector Circuit Malfunction Cylinder 1**DTC P0202 (P0200) Injector Circuit Malfunction Cylinder 2****DTC P0203 (P0200) Injector Circuit Malfunction Cylinder 3****DTC P0204 (P0200) Injector Circuit Malfunction Cylinder 4****Wiring Diagram**

1. Fuel injector No.1	3. Fuel injector No.3	5. ECM
2. Fuel injector No.2	4. Fuel injector No.4	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0201: Excess current between “E229-2” and “E229-9” wire terminals of ECM. P0202: Excess current between “E229-25” and “E229-17” wire terminals of ECM. P0203: Excess current between “E229-26” and “E229-18” wire terminals of ECM. P0204: Excess current between “E229-1” and “E229-10” wire terminals of ECM.	- Fuel injector circuit - Fuel injector malfunction - ECM malfunction

DTC Confirmation Procedure

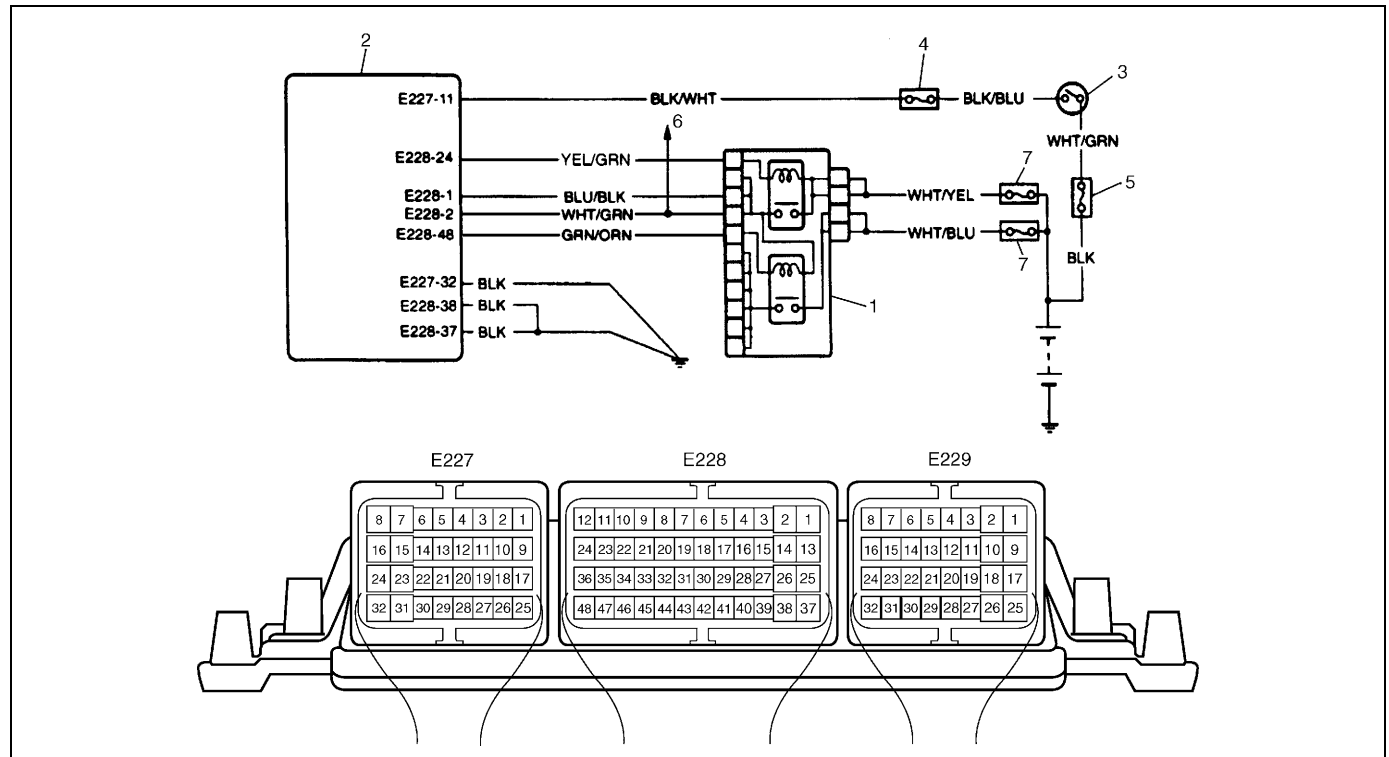
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Fuel Injector Circuit For Short 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E229-2, E229-9, E229-25, E229-17, E229-26, E229-18, E229-1 and E229-10 terminals. 4) If OK, remove intercooler and then disconnect connector at all fuel injectors. 5) Check for proper connection of all fuel injector connector. 6) If OK, measure resistance between the following terminals of fuel injector connectors. "PNK" and "RED": Fuel injector No.1 "PNK/BLK" and "RED/BLK": Fuel injector No.2 "PNK/GRN" and "RED/GRN": Fuel injector No.3 "PNK/BLU" and "RED/BLU": Fuel injector No.4 Is resistance between terminals of all fuel injectors infinity (∞)?	Go to Step 3.	Short circuit between "PNK" wire and "RED" wire, "PNK/BLK" wire and "RED/BLK" wire, "PNK/GRN" wire and "RED/GRN" wire, or "PNK/BLU" wire and "RED/BLU" wire.
3	Check Fuel Injector Circuit For Open 1) Connect connector to all fuel injectors. 2) Measure for resistance between the following terminals of ECM connector. E229-2 and E229-9: 0.56 Ω (maximum) E229-25 and E229-17: 0.56 Ω (maximum) E229-26 and E229-18: 0.56 Ω (maximum) E229-1 and E229-10: 0.56 Ω (maximum) Is check result as specified?	Substitute a known-good ECM and recheck.	Open "PNK" wire, "RED" wire, "PNK/BLK" wire, "RED/BLK" wire, "PNK/GRN" wire, "RED/GRN" wire, "PNK/BLU" wire or "RED/BLU" wire. If wire is OK, substitute a known-good fuel injector and recheck.

DTC P0215 Double Relay Circuit Malfunction

Wiring Diagram



1. Double relay	3. Ignition switch	5. Main fuse	7. Double relay fuse (30 A)
2. ECM	4. "IG COIL" fuse (20 A)	6. To radiator fan relay No.3	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Cutting off the ECM supply (for double relay) with no ECM command and cutting off the ECM supply (for double relay) for more than 2 seconds.	- Double relay circuit - Double relay malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ON ignition switch after OFF for 5 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Double Relay Function 1) Turn ignition switch ON for 5 sec. and then OFF. Is click of double relay heard from double relay at 2 sec. after ignition switch OFF?	Substitute a known-good ECM and recheck.	Go to Step 3.
3	1) Remove ECM connector covers referring to "Voltage Check" in this section. 2) Connect ECM connectors from ECM. 3) Check voltage between E228-1/2 and ground, between E227-11 and ground. Ignition switch ON: 10 – 14 V Ignition switch OFF: about 0 V Is check result as specified?	Poor E228-1/2 and/or E227-11 connection. If connection is OK, substitute a known-good ECM and recheck.	Go to Step 4.
4	Check Double Relay 1) Check double relay referring to "Double Relay" in Section 6E3. Is it in good condition?	Go to Step 5.	Faulty double relay.
5	1) Check voltage between E228-24 and ground. Ignition switch ON: about 0 V Ignition switch OFF: 10 – 14 V Is check result as specified?	• Poor E228-24 connection. • "BLU/BLK" wire open/short. • "WHT/GRN" wire open/short.	"YEL/GRN" wire open or short.

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Turn ON ignition switch after OFF for 5 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

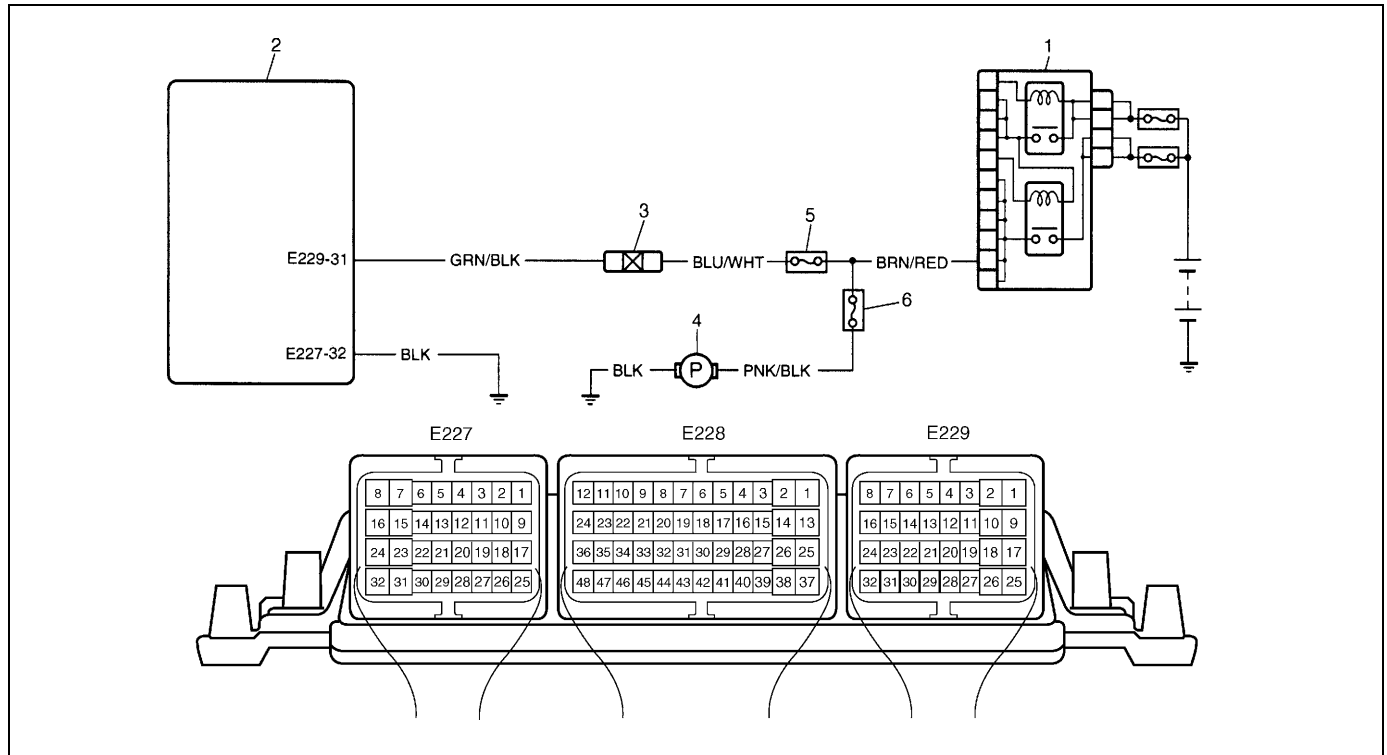
Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Substitute a known-good ECM and recheck.	Go to Step 3.
3	Check Double Relay 1) Check double relay referring to "Double Relay" in Section 6E3. Is it in good condition?	Go to Step 4.	Faulty double relay.
4	Check Fuel Pump Output Circuit 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors from ECM. 4) Check voltage between E228-48 and ground. • Within 5 sec. after ignition switch ON: about 0 V • Over 5 sec. after Ignition switch OFF: 10 – 14 V Is check result as specified?	• Poor E228-48 connection • "BLK", "PNK/BLK" or "BRN/RED" wire open/short • Fuse broken • Faulty fuel pump If all are OK, substitute a known-good ECM and recheck.	"GRN/ORN" wire open/short.

DTC P0243 (P0243) Turbo Pressure Solenoid Valve Circuit Range/Performance Problem

NOTE:

In case that “DTC P0243” is checked by using the generic scan tool, perform “DTC P0243 (P0243) Turbo Pressure Solenoid Valve Circuit Range/Performance Problem” and “DTC P0245 (P0243)/P0246 (P0243) Turbo Pressure Solenoid Valve Circuit Range/Performance Problem” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram



1. Double relay	3. Boost (turbo) pressure regulator solenoid valve	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in "E229-31" wire circuit. or - When ECM detects shorted to power in "E229-31" wire circuit.	- Boost pressure regulator solenoid valve circuit - Boost pressure regulator solenoid valve malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Supply Circuit Malfunction" in this section.
3	Check Wire Harness 1) Disconnect boost pressure regulator solenoid valve connector with ignition switch OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector disconnected and ground. Within 5 sec. after ignition switch ON: about 12 V Over 5 sec. after ignition switch ON: 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check Boost Pressure Regulator Solenoid Valve 1) Check solenoid valve referring to "Boost Pressure Regulator Solenoid Valve" in Section 6E3. Is check result as specified?	"GRN/BLK" wire open or shorted to power/ground. Poor E229-31 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty solenoid valve.

DTC P0245 (P0243)/P0246 (P0243) Turbo Pressure Solenoid Valve Circuit Range/Performance Problem

NOTE:

In case that “DTC P0243” is checked by using the generic scan tool, perform “DTC P0243 (P0243) Turbo Pressure Solenoid Valve Circuit Range/Performance Problem” and “DTC P0245 (P0243)/P0246 (P0243) Turbo Pressure Solenoid Valve Circuit Range/Performance Problem” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram

Refer to “DTC P0243 (P0243) Turbo Pressure Solenoid Valve Circuit Range/Performance Problem” in this section.

DTC Detecting Condition and Trouble Area

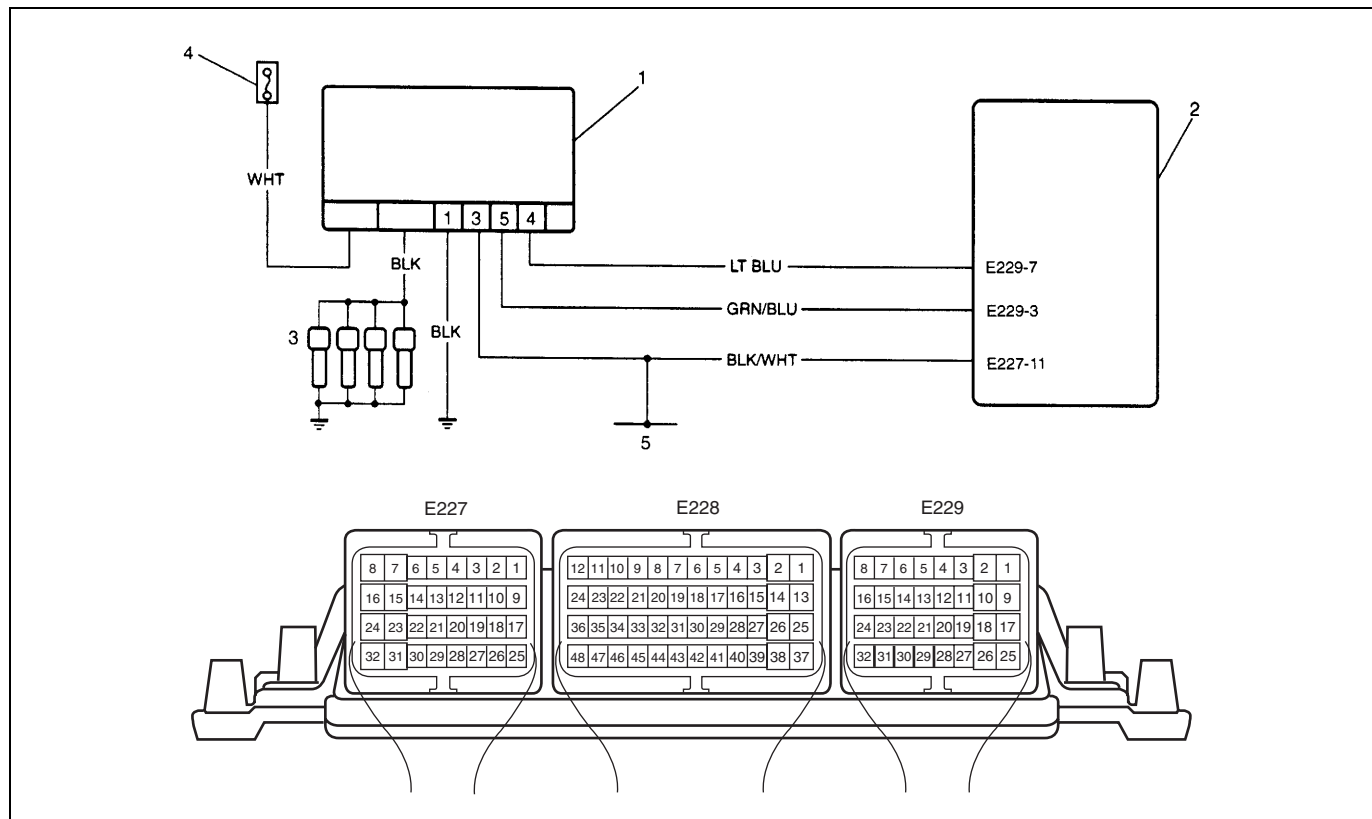
DTC DETECTING CONDITION	TROUBLE AREA
P0245: Reference pressure minus the pressure measured is greater than 200 mbars for more than 10 seconds with engine running at more than 2500 rpm. P0246: Reference pressure minus the pressure measured is greater than 300 mbars for more than 10 seconds with engine running at more than 2500 rpm.	• Vacuum circuit for leak, clogged and bended • Boost pressure regulator solenoid valve malfunction • ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine over 2500 rpm for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table” in this section.
2	Check Vacuum Circuit Check vacuum circuit for leak and clogging. Is it in good condition?	Go to Step 3.	Repair or replace.
3	Check boost pressure regulator solenoid valve for resistance referring to “Boost Pressure Regulator Solenoid Valve” in Section 6E3. Is resistance as specified?	Substitute a known-good ECM and recheck.	Replace boost pressure regulator solenoid valve.

DTC P0380 (P0380)/P1404 (P0380) Pre/Post Heat Relay Circuit Malfunction**Wiring Diagram**

1. Pre/post heating relay (control unit)	3. Glow plugs	5. From ignition switch
2. ECM	4. Main fuse	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
12 V at "E229-3" and "E229-7" of ECM in operation of pre/post heating relay or 0 V at "E229-3" and "E229-7" of ECM in operation of pre/post heating relay.	- Fuse broken - Pre/post heating relay circuit - Pre/post heating relay malfunction - Glow plug malfunction - ECM malfunction

DTC Confirmation Procedure

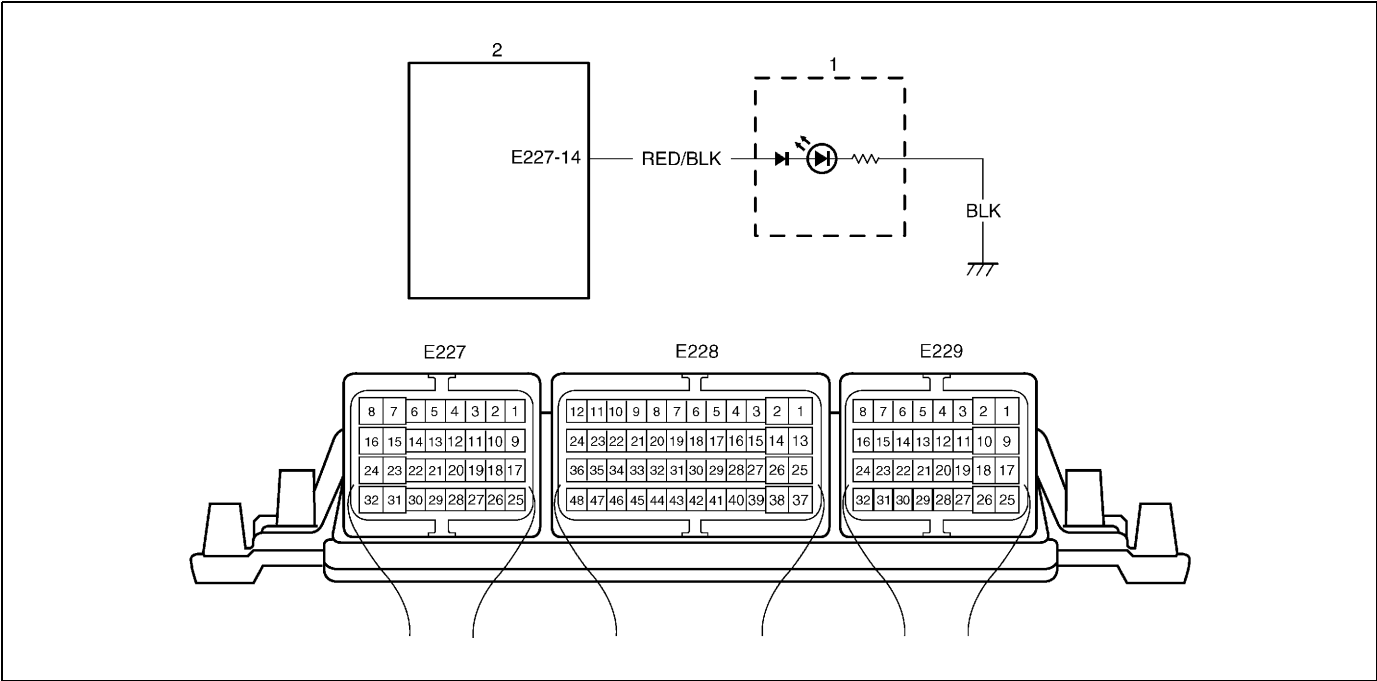
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ignition switch ON for 30 sec. after OFF. Then run engine at idle speed for 30 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Check voltage between pre/post heating relay at "WHT" wire terminal and body ground with ignition switch ON. Is voltage about 12 V?	Go to Step 3.	Main fuse broken. "WHT" wire circuit open or shorted to ground.
3	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Check voltage between glow plug each wire terminals with ignition switch ON. Is voltage about 12 V for limited time?	Poor glow plug "BLK" wire terminals connection. If wire are OK, replace glow plug.	"BLK" wire (between pre/post heating relay and glow plug) open, shorted to power/ground. If OK, go to Step 4.
4	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Disconnect pre/post heating relay connector. 3) Check for proper connection of pre/post heating relay connector at all terminals. 4) If OK, measure resistance between pre/post heating relay connector at "BLK" wire terminal and body ground. Is resistance 1 Ω or less?	Go to Step 5.	"BLK" wire circuit (between pre/post heating relay and ground) open.
5	Check Wire Harness 1) Check voltage between pre/post heating relay connector at "BLK/WHT" wire terminal and body ground with ignition switch ON. Is voltage about 12 V?	Go to Step 6.	"BLK/WHT" wire circuit open.
6	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Connect pre/post heating relay connector. 3) Remove ECM connector cover referring to "Voltage Check" in this section. 4) Check voltage between E229-7/E229-11 and ground with ignition switch ON. Are they about 12 V?	Go to Step 7.	"LT BLU" or "BLK/WHT" wire open or shorted to ground.
7	Check Wire Harness 1) Check voltage between E229-3 and ground with ignition switch ON. Is it about 0 V?	Poor E229-3 or E229-7 connection. If connections are in good condition, substitute a known-good ECM and recheck.	"GRN/BLU" wire open or shorted to ground. If OK, substitute a known-good pre/post heating relay and recheck.

DTC P0381 Glow Indicator Lamp Circuit Malfunction

Wiring Diagram



1. Glow indicator lamp (in combination meter)
2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E227-14” wire circuit. or - When ECM detects shorted to power in “E227-14” wire circuit.	- Glow indicator lamp circuit - Glow indicator lamp (combination meter) malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ignition switch ON for 30 sec. after OFF.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness <Not Using SUZUKI Scan Tool> 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Supply battery power (12 V) to E227-14 wire terminal of disconnected ECM connector by using service wire. Does glow indicator lamp turn ON? <Using SUZUKI Scan Tool> 1) Connect SUZUKI scan tool to DLC. 2) Execute "Glow Indicator Lamp" in Misc Test. Does glow indicator lamp flash?	Substitute a known-good ECM and recheck.	• "RED/BLK" wire open or short. • Poor E227-14 connection. • Replace combination meter.

Reference:

As soon as ignition is switched on, ECM turns on glow indicator lamp for a period which depends on engine coolant temp. as shown below.

Engine coolant temp. (°C)	Time turning on glow indicator lamp (sec.)
-30	20
-10	5
0	0.5
18	0

DTC P0401 (P0903) EGR Solenoid Valve Flow Insufficient Detected**DTC P0402 (P0903) EGR Solenoid Valve Flow Excessive Detected****DTC Detecting Condition and Trouble Area**

DTC DETECTING CONDITION	TROUBLE AREA
Engine speed between 700 and 2700 rpm, injected flow less than 42 mm ³ /stroke, EGR solenoid valve reference value stable and air flow inconsistent.	• EGR vacuum circuit • EGR valve malfunction • EGR solenoid valve malfunction • ECM malfunction

DTC Confirmation Procedure

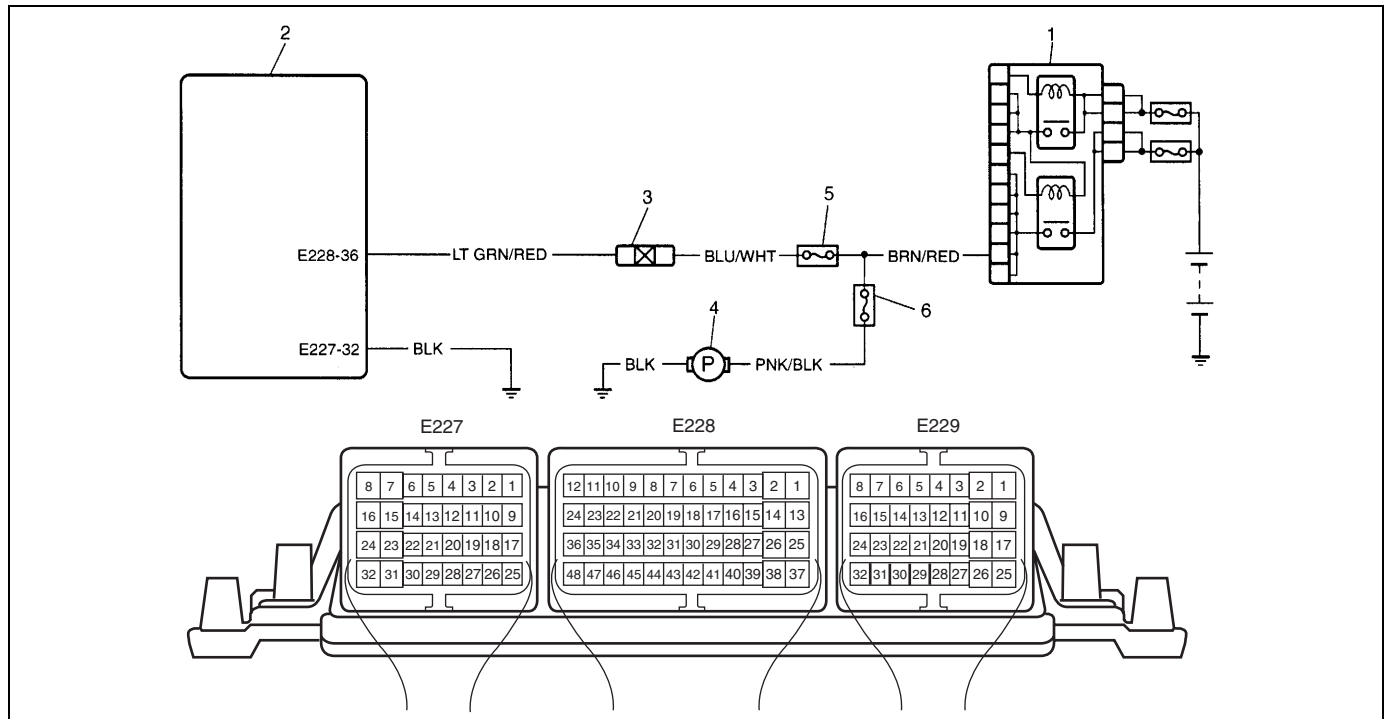
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine between 700 and 2700 rpm for 10 or more.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check EGR vacuum circuit and intake air circuit for leak. Is it in good condition?	Go to Step 3.	Repair or replace.
3	Check EGR valve referring to "EGR Valve and EGR Cooler" in Section 6E3. Is it in good condition?	Go to Step 4.	Faulty EGR valve.
4	Check EGR solenoid valve for resistance referring to "EGR Solenoid Valve" in Section 6E3. Is resistance as specified?	Substitute a known-good ECM and recheck.	Replace EGR solenoid valve.

DTC P0403 (P0403) EGR Solenoid Valve Circuit Malfunction

Wiring Diagram



1. Double relay	3. EGR solenoid valve	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in "E228-36" wire circuit. or - When ECM detects shorted to power in "E228-36" wire circuit.	- Fuse broken - EGR solenoid valve circuit - EGR solenoid valve malfunction - ECM malfunction

DTC Confirmation Procedure

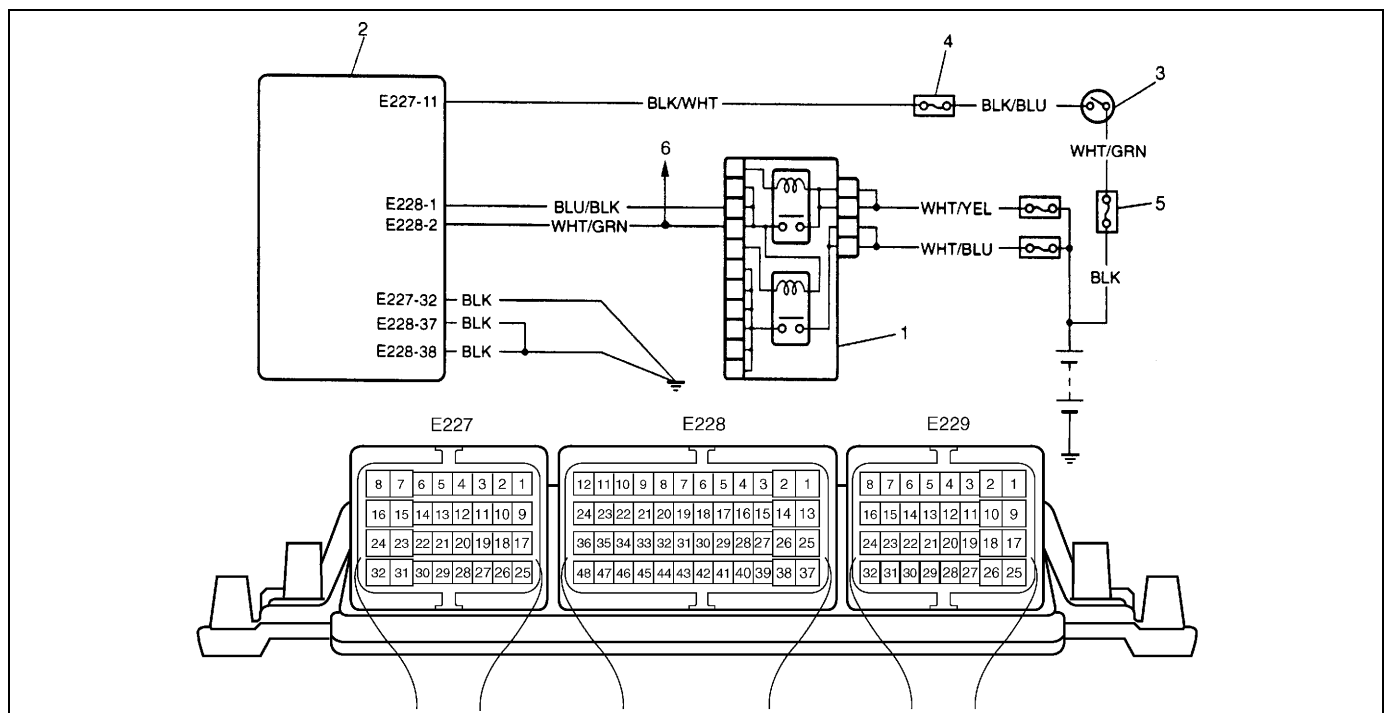
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Supply Circuit Malfunction" in this section.
3	Check Wire Harness 1) Disconnect EGR solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10 – 14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check EGR Solenoid Valve 1) Check solenoid valve referring to "EGR Solenoid Valve" in Section 6E3. Is it in good condition?	• "LT GRN/RED" wire open or shorted to power/ground. • Poor E228-36 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty EGR solenoid valve.

DTC P0561 (P0560) Stabilization of Sensor Supply**DTC P0603/P0606/P1171 ECM Function****DTC P1169 (P0170) Condenser Voltage Function 1****DTC P1170 (P0170) Condenser Voltage Function 2****DTC P1101 (P0105) Barometric Pressure Sensor Circuit Malfunction****NOTE:**

In case that "DTC P0560" is checked by using the generic scan tool, perform "DTC P0560 (P0560) Power Supply Circuit Malfunction", "DTC P0561 (P0560) Stabilization of Sensor Supply" and "DTC P1614 (P0560) Sensor Supply Function" in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram

1. Double relay	3. Ignition switch	5. Main fuse
2. ECM	4. "IG COIL" fuse	6. To radiator fan relay No.3

DTC Detecting Condition

This DTC will be set when an internal fault is detected in the ECM.

DTC Confirmation Procedure

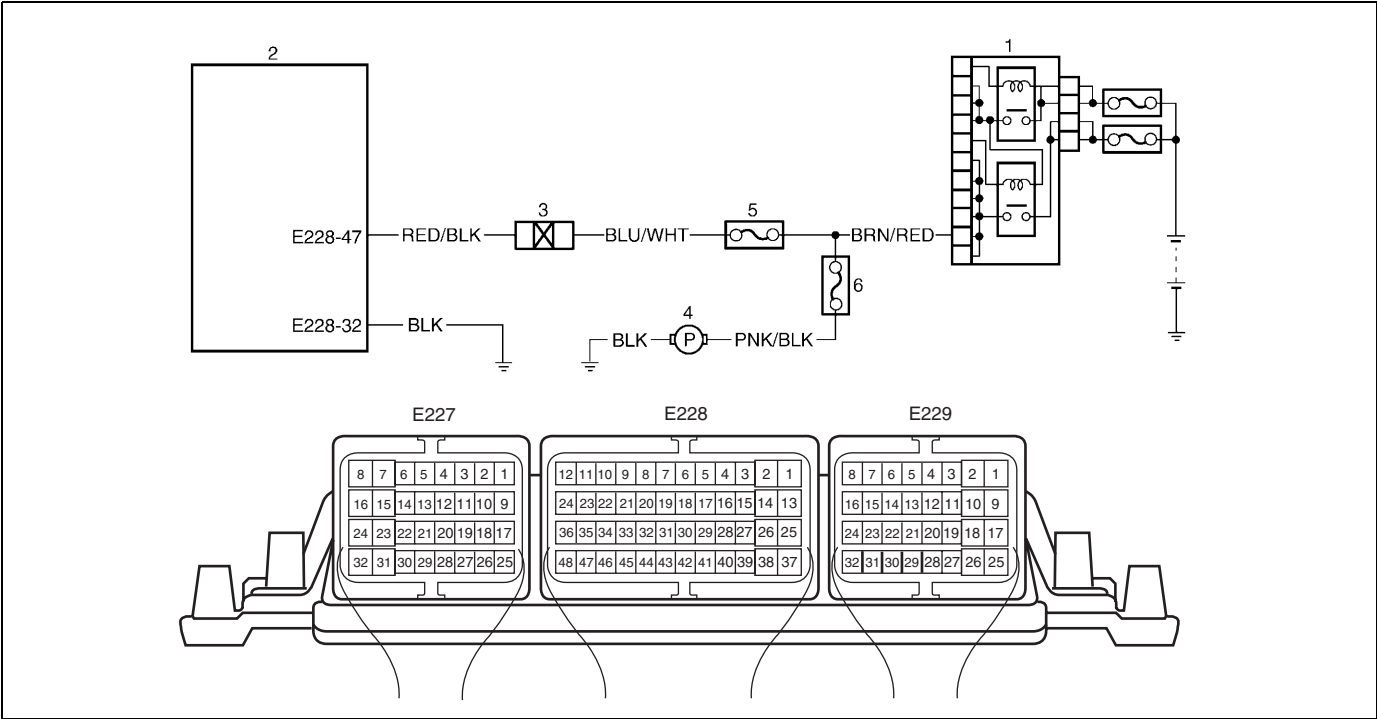
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Substitute a known-good ECM and recheck.	Go to "Engine Diag. Flow Table" in this section.

DCT P1107 Swirl Control Solenoid Valve Circuit Malfunction

Wiring Diagram



1. Double relay	3. Swirl control solenoid valve	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in "E228-47" wire circuit. or - When ECM detects shorted to power in "E228-47" wire circuit.	- Fuse broken - Swirl control solenoid valve circuit - Swirl control solenoid valve malfunction - ECM malfunction

DTC Confirmation Procedure

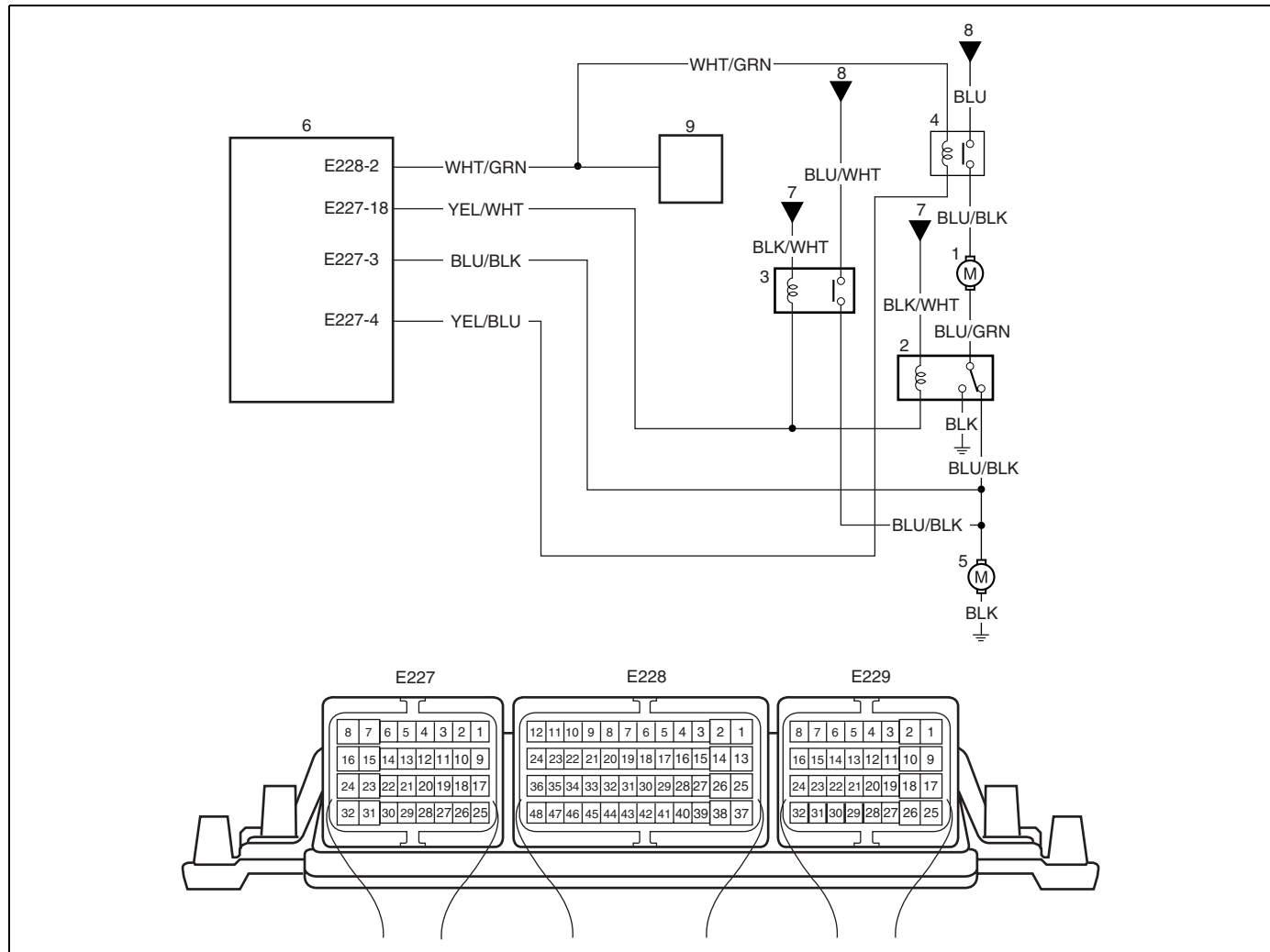
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Supply Circuit Malfunction" in this section.
3	Check Wire Harness 1) Disconnect swirl control solenoid valve connector with ignition switch OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of swirl control solenoid valve connector and ground. Within 5 sec. after ignition switch ON: 10 – 14 V Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check Swirl Control Solenoid Valve 1) Check swirl control solenoid valve referring to "Swirl Control Solenoid Valve" in Section 6E3. Is it in good condition?	• "RED/BLK" wire open or shorted to power/ground. • Poor E228-47 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty swirl control solenoid valve.

DTC P1108 Radiator Fan High Speed Circuit Malfunction

Wiring Diagram



1. Radiator fan motor 1	4. Radiator fan relay 3 (Low)	7. From "IG COIL" fuse (20 A)
2. Radiator fan relay 1 (High/Low)	5. Radiator fan motor 2	8. From main fuse
3. Radiator fan relay 2 (High)	6. ECM	9. Double relay

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E227-18” wire circuit. or - When ECM detects shorted to power in “E227-18” wire circuit.	- Fuse broken - Radiator fan high speed circuit - Radiator fan relay 1 (high/low) or radiator fan relay 2 (high) malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between E227-18 wire terminal of disconnected ECM connector and ground with ignition switch ON. Is it about 12 V?	Poor E227-18 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 1 and 2 referring to "Radiator Fan Relay 1 (High/Low)" and "Radiator Fan Relay 2 (High)" in Section 6E3. Are they in good condition?	• "YEL/WHT" wire open or short to ground. • "BLK/WHT" wire open or short to ground. • Fuse broken.	Faulty radiator fan relay 1 or 2.

DTC P1109 Radiator Fan Low Speed Circuit Malfunction

Wiring Diagram

Refer to “DTC P1108 Radiator Fan High Speed Circuit Malfunction” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E227-4” wire circuit. or - When ECM detects shorted to power in “E227-4” wire circuit.	- Fuse broken - Radiator fan low speed circuit - Radiator fan relay 3 (low) malfunction

DTC Confirmation Procedure

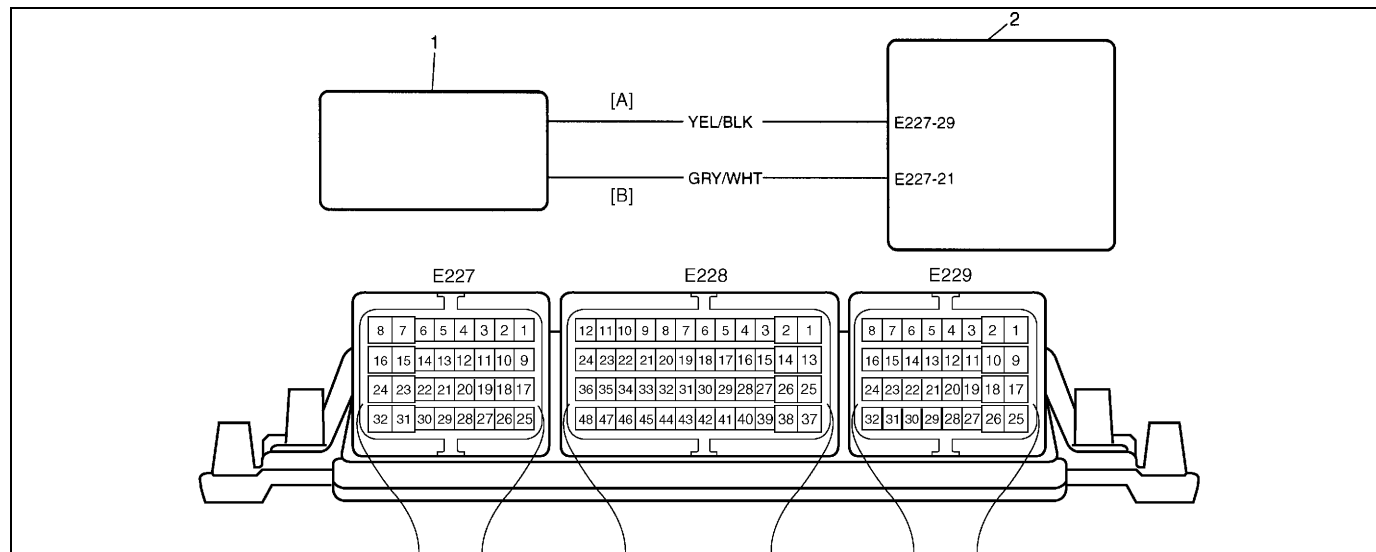
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table” in this section.
2	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to “Voltage Check” in this section. 3) Check voltage between E227-4 wire terminal of disconnected ECM connector and ground with ignition switch ON. Is it about 12 V?	Poor E227-4 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 3 referring to “Radiator Fan Relay 3 (Low)” in Section 6E3. Is it in good condition?	“YEL/BLU” wire open or short to ground. “WHT/GRN” wire open or short to ground. - Fuse broken.	Faulty radiator fan relay 3.

DTC P1110 A/C Signal Circuit Malfunction

Wiring Diagram



1. A/C control module	[A]: Request signal
2. ECM	[B]: Control signal

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E227-21” wire circuit. or - When ECM detects shorted to power in “E227-21” wire circuit.	- A/C compressor cut out circuit - A/C control module malfunction - ECM malfunction

DTC Confirmation Procedure

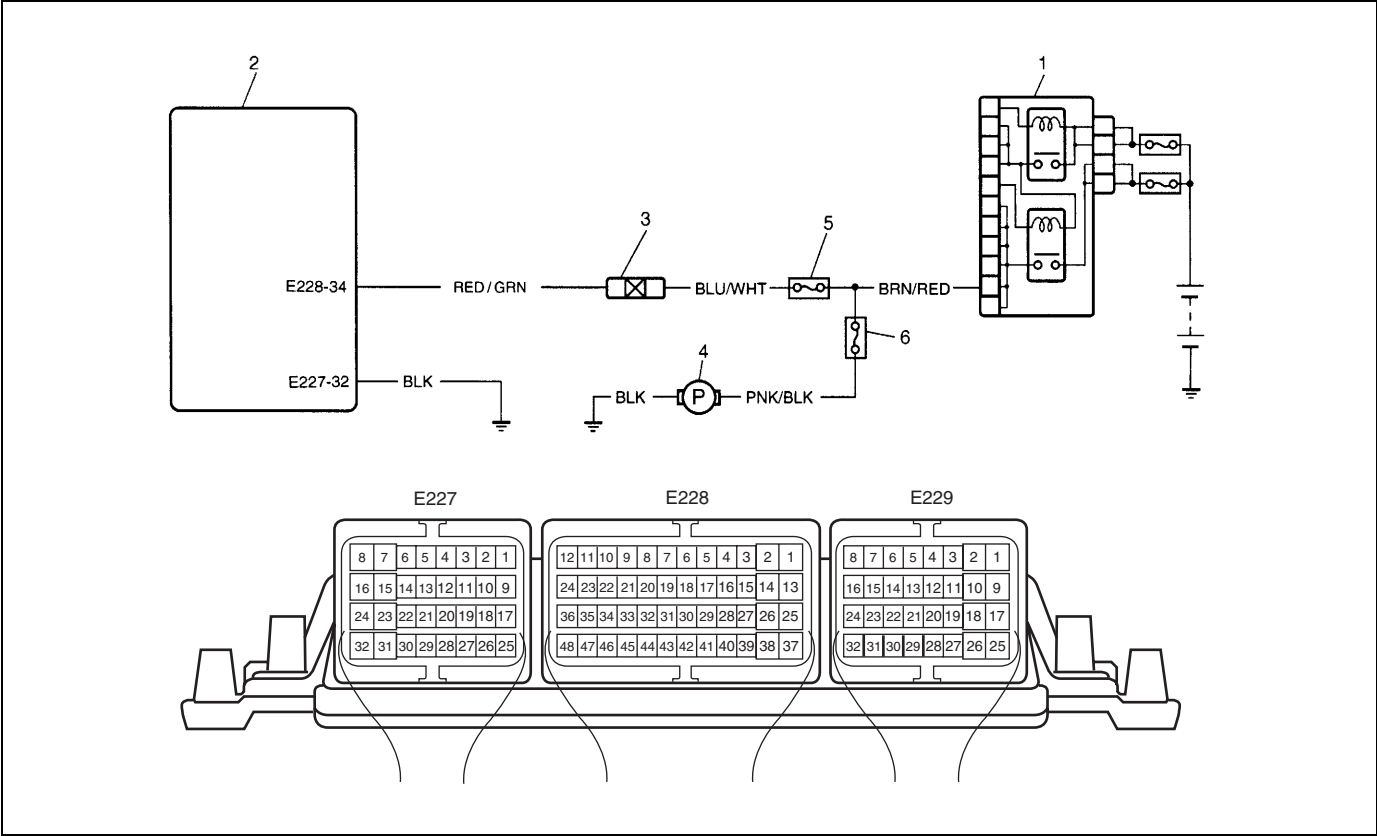
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and turn on A/C switch and heater blower fan switch.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table” in this section.
2	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to “Voltage Check” in this section. 3) Check ECM connectors from ECM. 4) Check voltage between E227-21 and ground at engine idling. Are they as follows? • A/C switch and heater blower switch OFF: 0 V • A/C switch and heater blower switch ON: about 12 V	Poor E227-21 connection. If OK, substitute a known-good ECM and recheck.	• “YEL/BLK” wire open or short. • Poor A/C control module connector connection. If all are in good condition, substitute a known-good A/C control module and recheck.

DTC P1135 3rd Piston Deactivator (Injection Pump Solenoid Valve) Circuit Malfunction

Wiring Diagram



DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in "E228-34" wire circuit. or - When ECM detects shorted to power in "E228-34" wire circuit.	- Fuse broken 3rd piston deactivator circuit - Injection pump (solenoid valve) malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

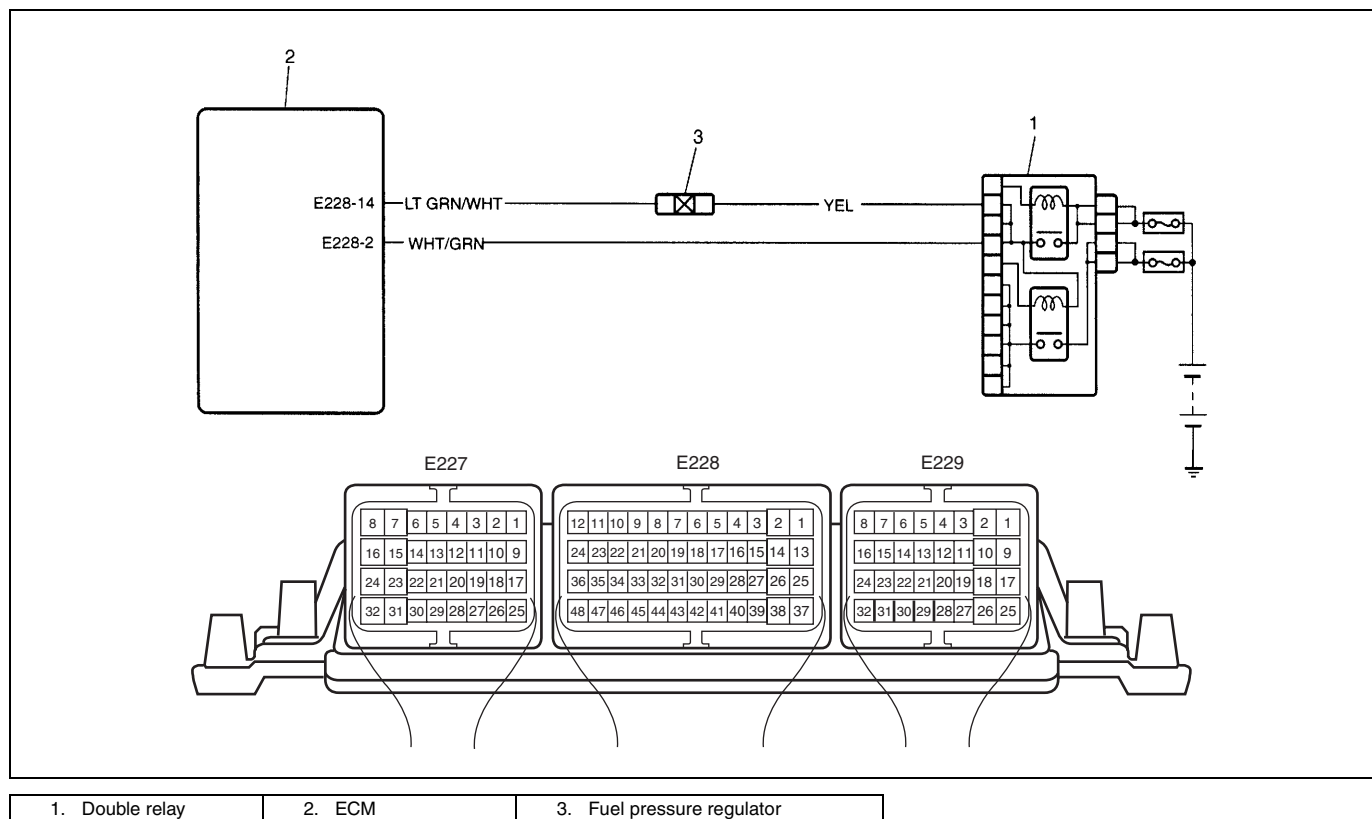
Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Supply Circuit Malfunction" in this section.
3	Check Wire Harness 1) Disconnect injection pump solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10 – 14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, short to power/ground or fuse broken.
4	Check Injector Pump Solenoid Valve Check resistance between "BLU/WHT" wire terminal and "RED/GRN" wire terminal of valve. Is it between 25 – 30 Ω ?	• "RED/GRN" wire open or shorted to power/ground. • Poor E228-34 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty injection pump solenoid valve.

DTC P1138 (P0230) Fuel Pressure Regulator Circuit Malfunction

NOTE:

In case that “DTC P0230” is checked by using the generic scan tool, perform “DTC P0191 (P0230) Fuel Rail Pressure Sensor/Pressure Regulator Consistency Function”, “DTC P1112 (P0230) Fuel Rail Pressure Monitoring Circuit Malfunction” and “DTC P1138 (P0230) Fuel Pressure regulator Circuit Malfunction” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram



DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E228-14” wire circuit. or - When ECM detects shorted to power in “E228-14” wire circuit.	- Fuse pressure regulator circuit - Fuse pressure regulator malfunction - ECM malfunction

DTC Confirmation Procedure

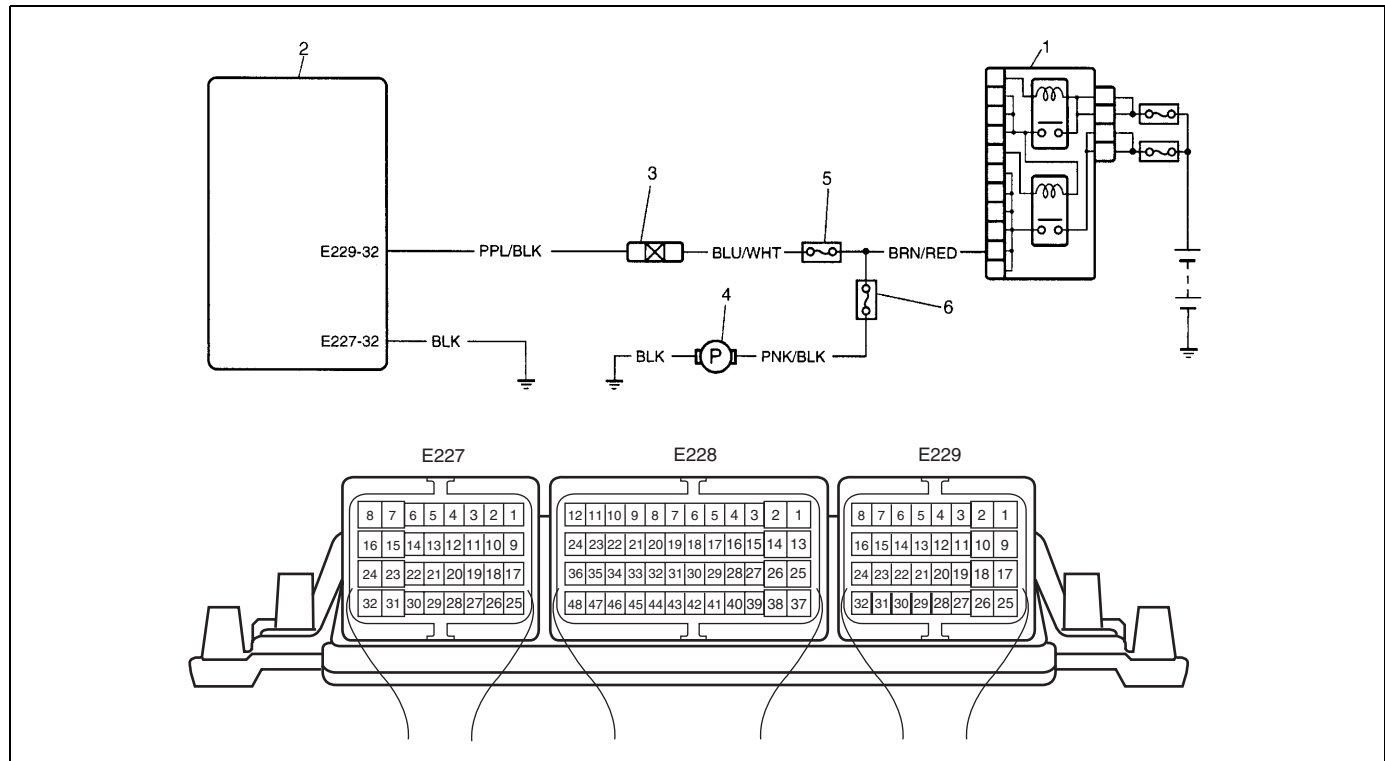
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec. and stop it. Then, turn ignition switch ON.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness 1) Disconnect connector at fuel pressure regulator. 2) Check voltage between "YEL" terminal of regulator connector and ground with ignition switch ON. • Ignition switch ON: 10 – 14 V • Ignition switch OFF: about 0 V Is check result as specified?	Go to Step 3.	"YEL" wire open or shot to ground.
3	Check Fuel Pressure Regulator Check resistance between "YEL" wire terminal and "LT GRN/WHT" wire terminal of valve. Is it between 2 and 3 Ω ?	• "LT GRN/WHT" wire open or shorted to power/ground. • Poor E228-14 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty fuel pressure regulator.

DTC P1402 (P0510) Throttle Solenoid Valve Circuit Malfunction

Wiring Diagram



1. Double relay	3. EGR throttle solenoid valve	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E229-32” wire circuit. or - When ECM detects shorted to power in “E229-32” wire circuit.	- Fuse broken - EGR throttle solenoid valve circuit - EGR throttle solenoid valve malfunction - ECM malfunction

DTC Confirmation Procedure

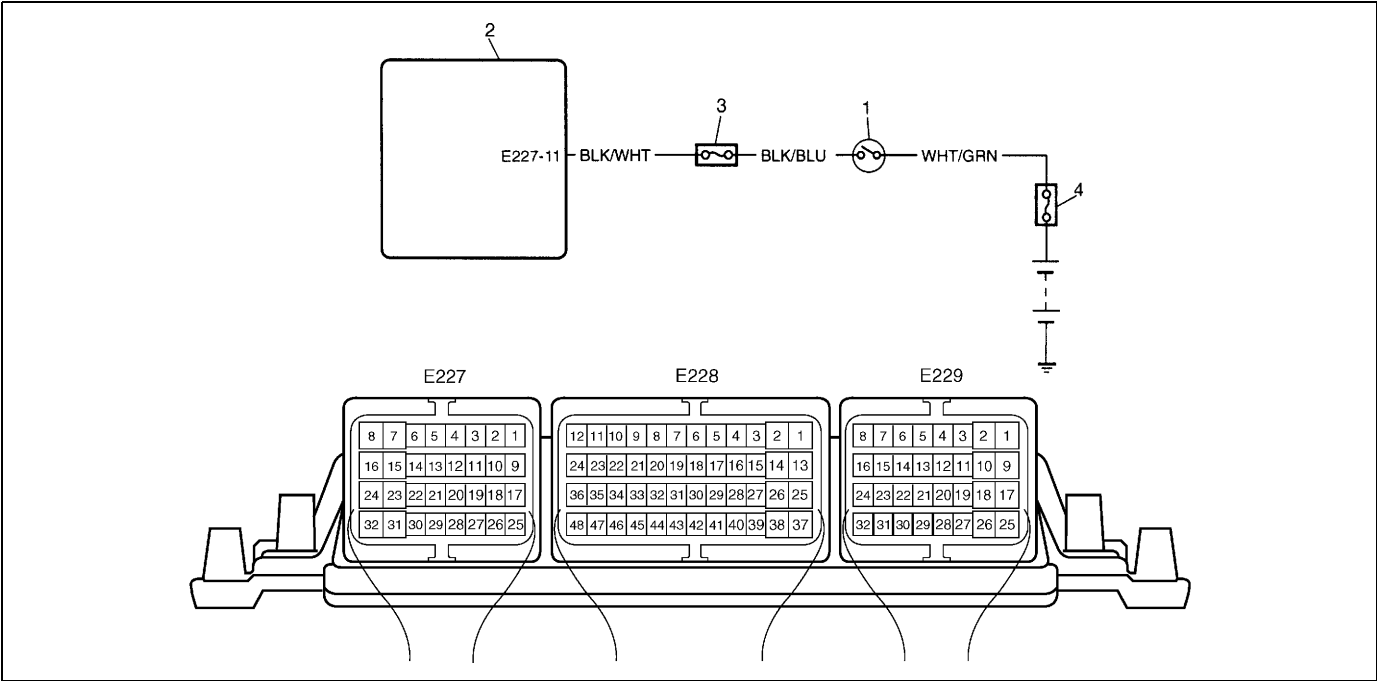
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn off ignition switch and then on.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Supply Circuit Malfunction" in this section.
3	Check Wire Harness 1) Disconnect EGR throttle solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10 – 14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check EGR Throttle Solenoid Valve 1) Check solenoid valve referring to "EGR Throttle Solenoid Valve" in Section 6E3. Is it in good condition?	• "PPL/BLK" wire open or shorted to power/ground. • Poor E229-32 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty EGR throttle solenoid valve.

DTC P1511 Ignition Switch Circuit Malfunction

Wiring Diagram



1. Ignition switch	3. "IG COIL" fuse (20 A)
2. ECM	4. Main fuse

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in "E227-11" wire circuit. or - When ECM detects shorted to power in "E227-11" wire circuit.	- Fuse broken - Ignition switch circuit - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn off ignition switch and then on.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Ignition Signal 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between E227-11 wire terminal of disconnected ECM connector and ground. • Ignition switch ON: 10 – 14 V • Ignition switch OFF: 0 V Is it within specified value?	Poor E227-11 connection. If it is in good condition, substitute a known-good ECM and recheck.	"BLK/WHT" wire open, shorted to power/ground or fuse broken.

DTC P1519 Radiator Fan Circuit Malfunction

Wiring Diagram

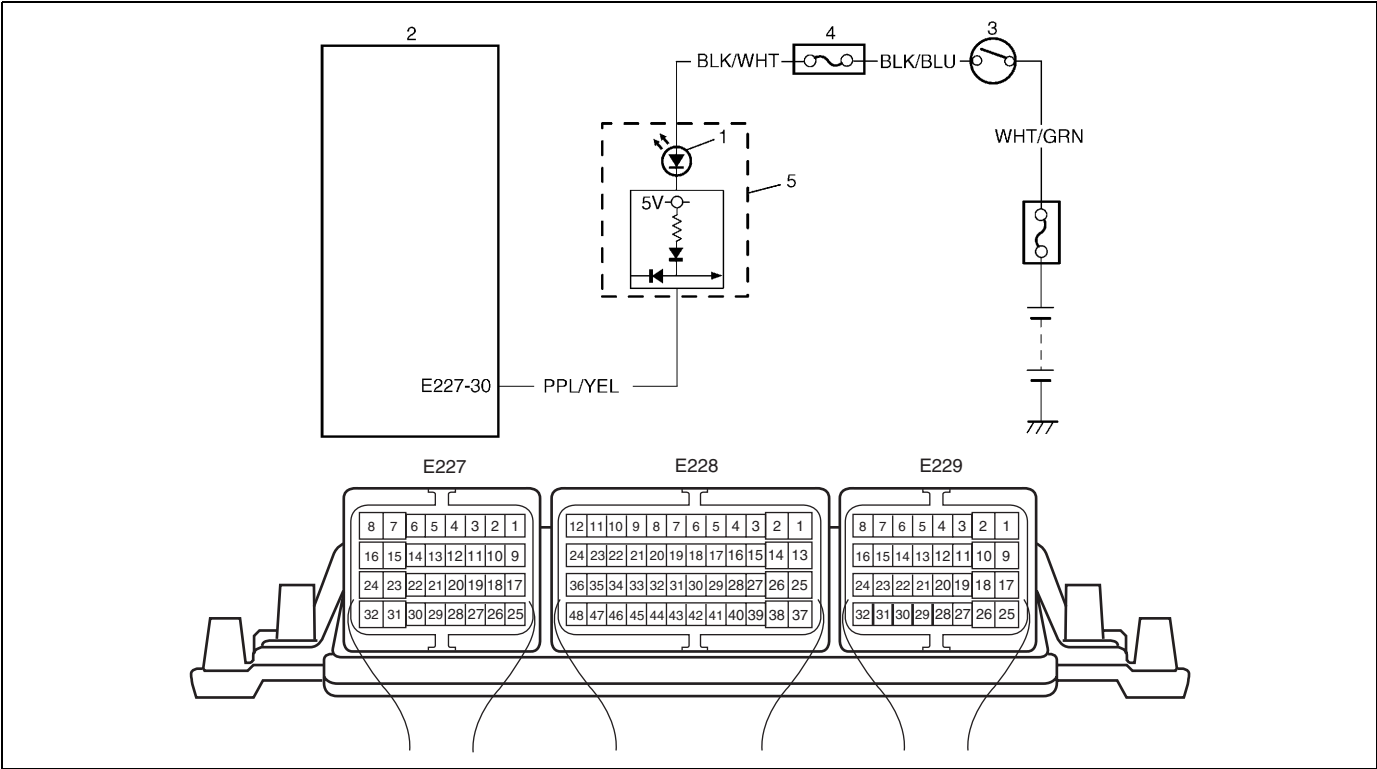
Refer to "DTC P1108 Radiator Fan High Speed Circuit Malfunction" in this section.

Troubleshooting

Proceed to "DTC P1108 Radiator Fan High Speed Circuit Malfunction" and "P1109 Radiator Fan Low Speed Circuit Malfunction" in this section for TROUBLESHOOTING.

DTC P1606 MIL Circuit Malfunction

Wiring Diagram



1. Malfunction indicator lamp (MIL)	4. "METER" fuse (10 A)
2. ECM	5. Combination meter
3. Ignition switch	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in "E227-30" wire circuit. or - When ECM detects shorted to power in "E227-30" wire circuit.	- Fuse broken - MIL circuit - Combination meter malfunction - ECM malfunction

DTC Confirmation Procedure

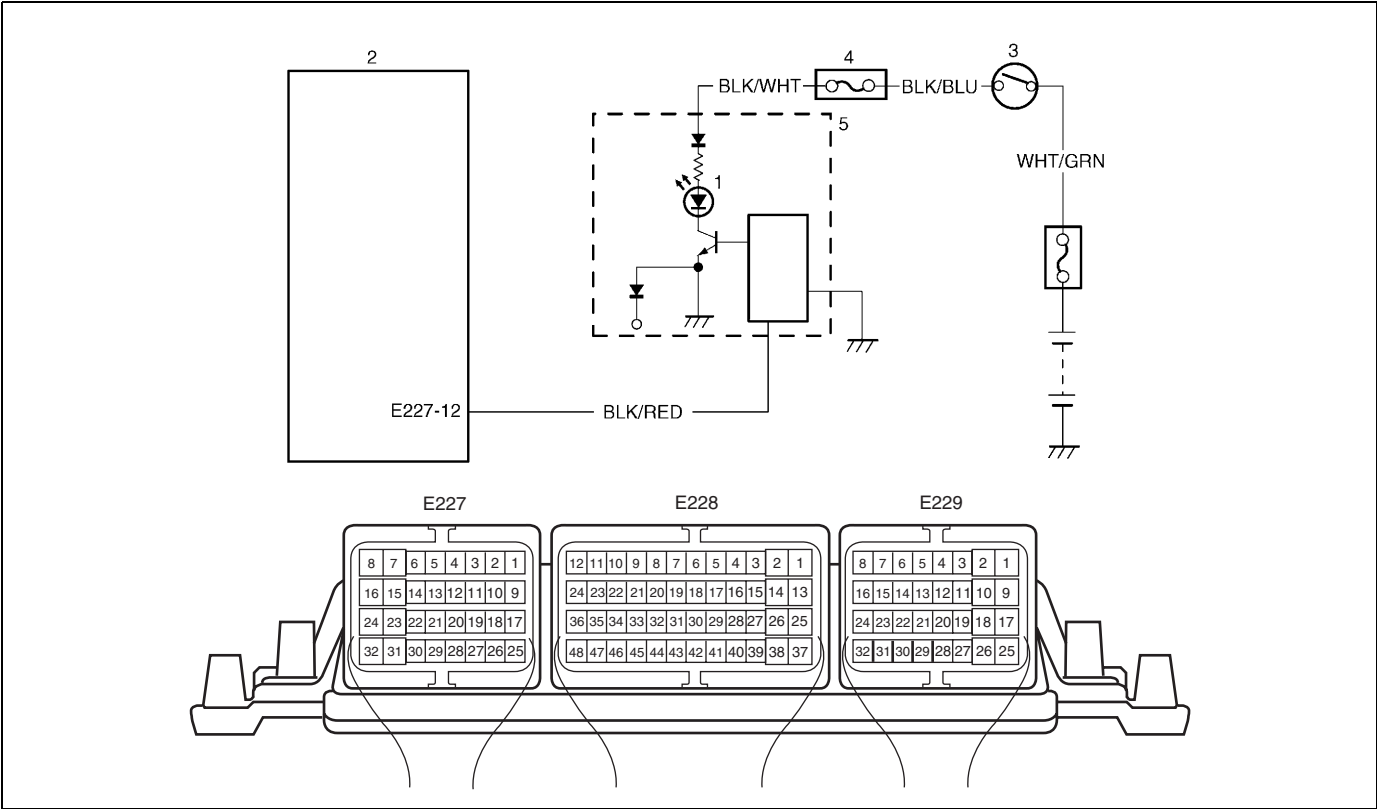
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn off ignition switch and then on.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	MIL Circuit Check 1) Turn ignition switch to ON position. Do other warning lamps come ON?	Go to Step 3.	Go to Step 4.
3	MIL Circuit Check 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between "PPL/YEL" wire terminal of disconnected ECM connector and ground. Ignition switch ON: 10 – 14 V Ignition switch OFF: 0 V Is check result as specified?	Poor E227-30 connection. If it is in good condition, substitute a known-good ECM and recheck.	"PPL/YEL" wire open, shorted to power/ground. If it is in good condition, replace combination meter.
4	1) Turn ignition switch to OFF position. Is "METER" fuse in good condition?	Open circuit in "BLK/WHT" wire to combination meter or poor connection.	Replace fuse and check for short.

DTC P1608 ECT Warning Lamp Circuit Malfunction

Wiring Diagram



1. Engine coolant temperature warning lamp	4. "METER" fuse (10 A)
2. ECM	5. Combination meter
3. Ignition switch	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or short to ground in "E227-12" wire circuit. or - When ECM detects shorted to power in "E227-12" wire circuit.	- Fuse broken - Engine coolant temperature warning lamp circuit - Combination meter malfunction - ECM malfunction

DTC Confirmation Procedure

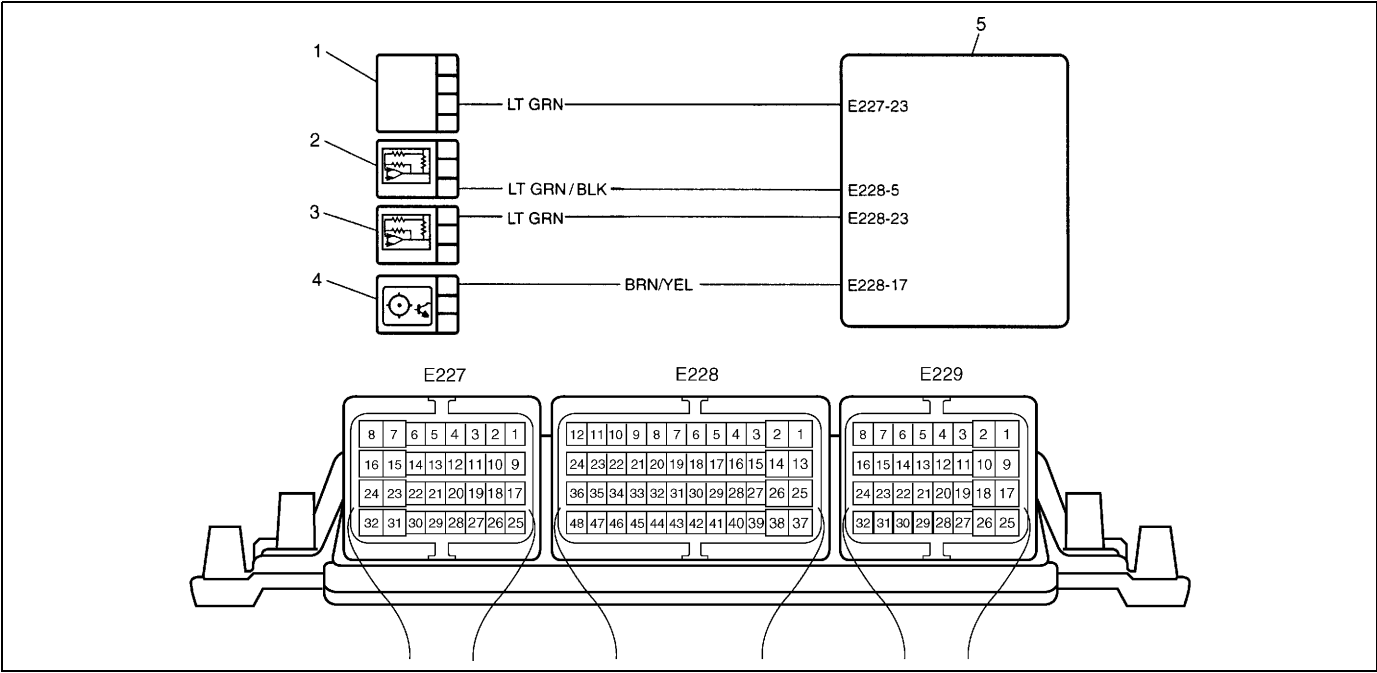
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn off ignition switch and then on.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Engine Coolant Warning Lamp Circuit Check 1) Turn ignition switch to ON position. Do other warning lamps come ON?	Go to Step 3.	Go to Step 4.
3	Engine Coolant Warning Lamp Circuit Check 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between "RED/BLK" wire terminal of disconnected ECM connector and ground. Ignition switch ON: 10 – 14 V Ignition switch OFF: 0 V Is check result as specified?	Poor E227-12 connection. If it is in good condition, substitute a known-good ECM and recheck.	"RED/BLK" wire open, shorted to power/ground. If it is in good condition, replace combination meter.
4	1) Turn ignition switch to OFF position. Is "METER" fuse in good condition?	Open circuit in "BLK/WHT" wire to combination meter or poor connection.	Replace fuse and check for short.

DTC P1614 (P0560) Sensor Supply Function

Wiring Diagram



1. Throttle position sensor	4. Camshaft position sensor
2. Fuel rail pressure sensor	5. ECM
3. Intake air pressure sensor	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage is less than 4.8 V on “E227-23”, “E228-23”, “E228-5” and “E228-17” of ECM or voltage is greater than 5.2 V on “E227-23”, “E228-23”, “E228-5” and “E228-17” of ECM.	- Sensor power supply circuit - Throttle position sensor malfunction - Fuel rail pressure sensor malfunction - Intake air pressure sensor malfunction - Camshaft position (CMP) sensor malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check TP Sensor Circuit 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "LT GRN" wire terminal in TP sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Go to Step 3.	"LT GRN" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
3	Check TP Sensor Circuit 1) Connect connector to TP sensor with ignition switch turned OFF. 2) Remove ECM connector covers referring to "Voltage Check" in this section. 3) Connect ECM connectors from ECM. 4) Turn ON ignition switch. 5) Check voltage between E227-23 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Go to Step 4.	Faulty TP sensor.
4	Check Fuel Rail Pressure Sensor Circuit 1) Disconnect connector from fuel rail pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "LT GRN/BLK" wire terminal in fuel rail pressure sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Go to Step 5.	"LT GRN/BLK" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
5	Check Fuel Rail Pressure Sensor Circuit 1) Connect connector to fuel rail pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-5 terminal in ECM harness connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Go to Step 6.	Faulty fuel rail pressure sensor.
6	Check Intake Air Pressure Sensor Circuit 1) Disconnect connector from intake air pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "LT GRN" wire terminal in intake air pressure sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Go to Step 7.	"LT GRN" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
7	Check Intake Air Pressure Sensor Circuit 1) Connect connector to intake air pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-23 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Go to Step 8.	Faulty intake air pressure sensor.
8	Check CMP Sensor Circuit 1) Disconnect connector from CMP sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "BRN/YEL" wire terminal in CMP sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Go to Step 9.	"BRN/YEL" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
9	Check CMP Sensor Circuit 1) Connect connector to CMP sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-17 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.88 V?	Faulty ECM, substitute a known-good ECM and recheck.	Faulty CMP sensor.

DTC P0221 (P0220) Throttle Position Range/Performance Problem 2

Wiring Diagram

Refer to DTC P0121 (P0120) Throttle Position Range/Performance Problem.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
• Voltage is below 0.1 V on “E227-19” wire terminal of ECM or voltage is greater than 4.7 V on “E227-19” wire terminal of ECM. or • Voltage on “E227-15” wire terminal of ECM approximately double the voltage on “E227-19” wire terminal of ECM. or • Voltage is greater than 5.2 V on “E227-23” wire terminal of ECM or voltage is below 0.1 V on “E227-23” wire terminal of ECM. or • Voltage is greater than 4.8 V on “E227-23” wire terminal of ECM.	• Throttle position sensor circuit • Throttle position sensor malfunction • ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

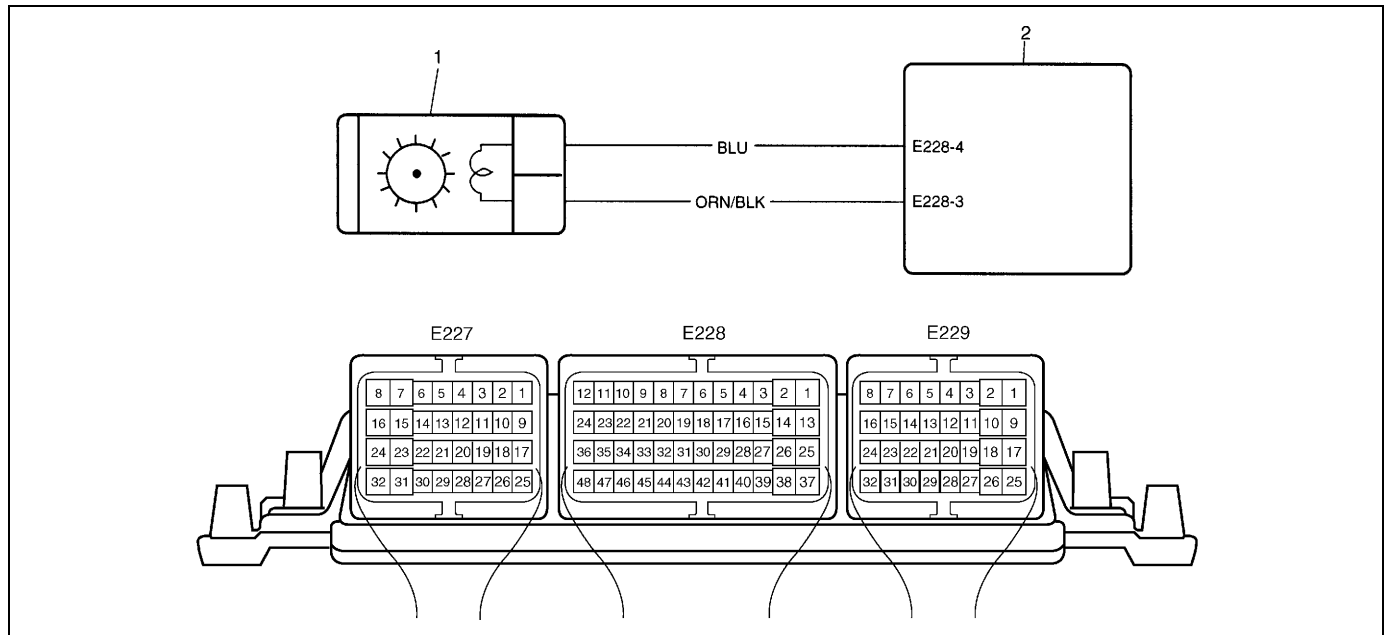
Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI Scan tool> P1614 <Using Generic Scan tool or GST mode of SUZUKI Scan tool> P0560	Go to "DTC P1614 (P0560) Sensor Supply Function" in this section.	Go to Step 3.
3	Check Wire Harness 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at each terminal. 3) If OK, then with ignition switch ON, check voltage between "LT GRN" wire and "BRN" wire terminals at connector of TP sensor. Is voltage about 5 V?	Go to Step 4.	"LT GRN" wire open, "BRN" wire open, poor E227-23 connection, or poor E227-16 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor Output Voltage 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connector from ECM. 4) With ignition switch ON, check voltage between E227-19 and ground, when accelerator pedal is at idle position to fully depressed position. Is voltage 0.2 – 1.6 V?	Substitute a known-good ECM and recheck.	"GRY/BLU" wire open, "GRY/BLU", wire shorted to ground/power or poor TP sensor connector. If wire and connection are OK, substitute a known-good TP sensor and recheck.

DTC P0335 (P0335) Crankshaft Position Sensor Circuit Malfunction

NOTE:

In case that "DTC P0335" is detected by using the generic scan tool, perform "DTC P0335 (P0335) Crankshaft Position Sensor Circuit Malfunction" and "DTC P0340 (P0335/P0340) Camshaft Position Sensor Circuit Malfunction" in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram



- | |
|---|
| 1. Crankshaft position sensor (Engine speed sensor) |
| 2. ECM |

DTC Detecting Condition and Trouble Area

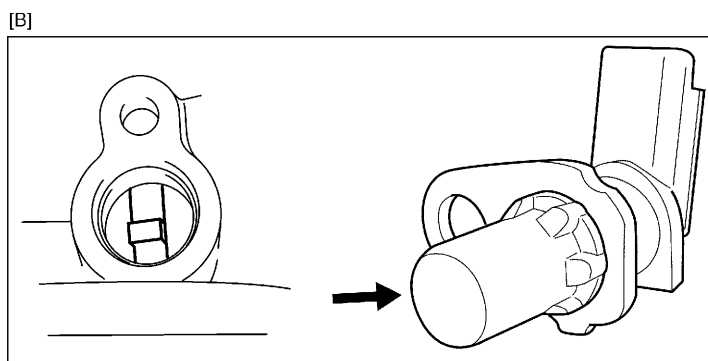
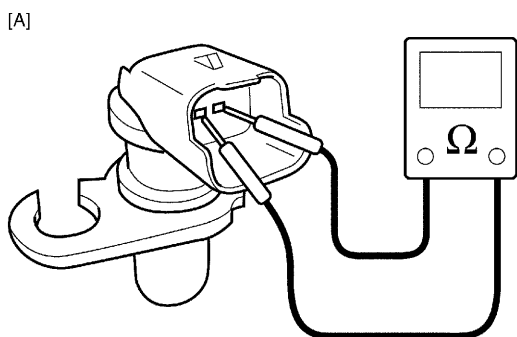
DTC DETECTING CONDITION	TROUBLE AREA
When ECM ("E228-4" wire terminal) judged engine speed 5400 rpm by the signal of crankshaft position sensor.	- Crankshaft position sensor circuit - Crankshaft position sensor rotor malfunction - Crankshaft position sensor malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	CKP Sensor and Its Circuit Resistance Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E228-3 and E228-4 terminals. 4) If OK, check resistance of the followings. Resistance between E228-3 and E228-4 terminals: 315 – 405 Ω at 20°C, 68°F Resistance between each terminal and ground: 1M Ω or more Is check result satisfactory?	Go to Step 4.	Go to Step 3.
3	CKP Sensor Resistance Check: 1) With ignition switch OFF, disconnect CKP sensor coupler and remove CKP sensor. 2) Check resistance between terminals of CKP sensor. (See Fig.) Were measured resistance values as specified in Step 2?	Faulty "ORN/BLK" wire or "BLU" wire.	Faulty CKP sensor.
4	CKP Sensor Visual Inspection: 1) Check visually CKP sensor and sensing rotor for the followings. (See Fig.) • Damage • No foreign material attached • Correct installation Are they in good condition?	Intermittent trouble or faulty ECM. Recheck for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Replace or reinstall.



[A]: Fig. for Step 3

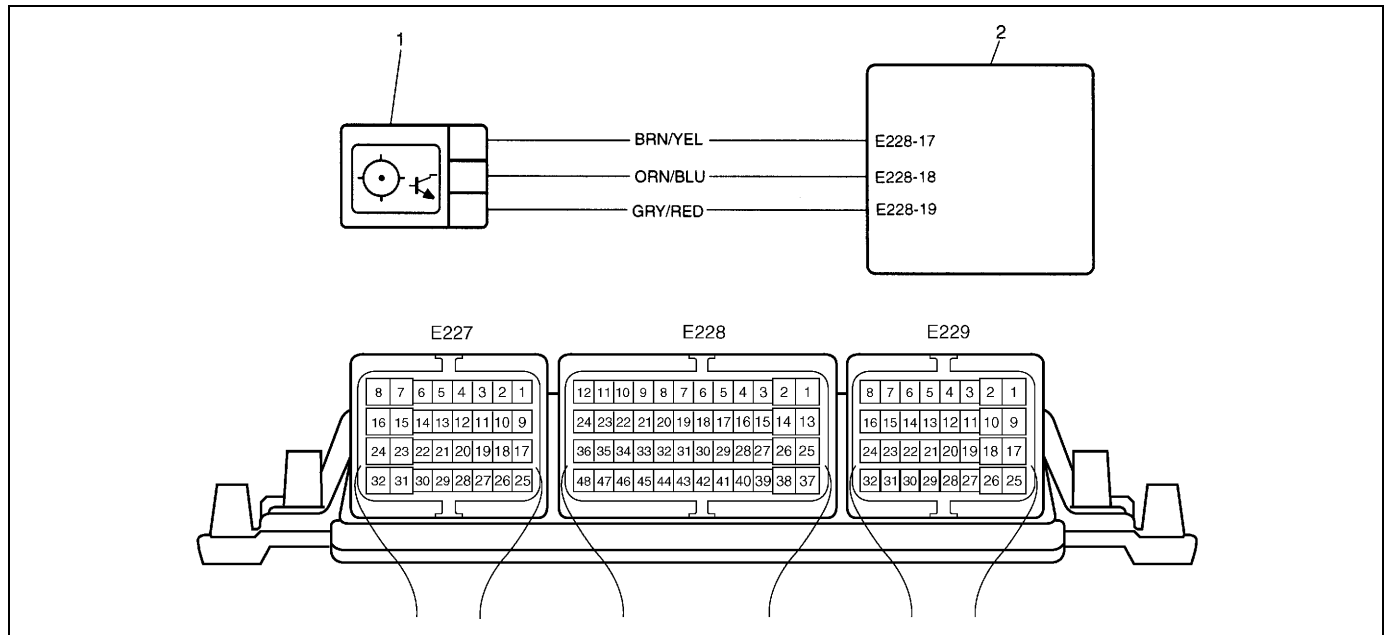
[B]: Fig. for Step 4

DTC P0340 (P0335/P0340) Camshaft Position Sensor Circuit Malfunction

NOTE:

In case that “DTC P0340” is detected by using the generic scan tool, perform “DTC P0340 (P0335/P0340) Camshaft Position Sensor Circuit Malfunction” and “DTC P0335 (P0335) Crankshaft Position Sensor Circuit Malfunction” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram



- | |
|-----------------------------|
| 1. Camshaft position sensor |
| 2. ECM |

DTC Detecting Condition and Trouble Area

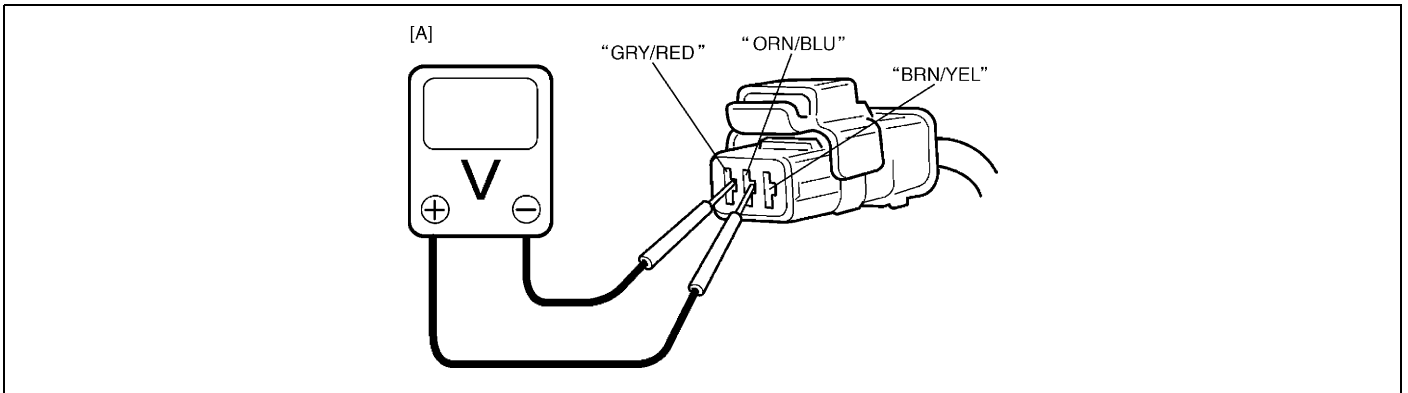
DTC DETECTING CONDITION	TROUBLE AREA
- No camshaft position sensor signal on “E228-18” wire terminal of ECM. or - Voltage is less than 4.8 V on “E228-17” wire terminal of ECM or voltage is greater than 5.1 V on “E228-17” wire terminal of ECM. or - When ECM (“E228-4” wire terminal) judged engine speed 5400 rpm by the signal of crankshaft position sensor.	- Camshaft position sensor circuit - Camshaft position sensor maladjusted - Camshaft position sensor malfunction - Camshaft hub malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Crank engine for 3 seconds or more and keep it at idle for 1 min. if engine start.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

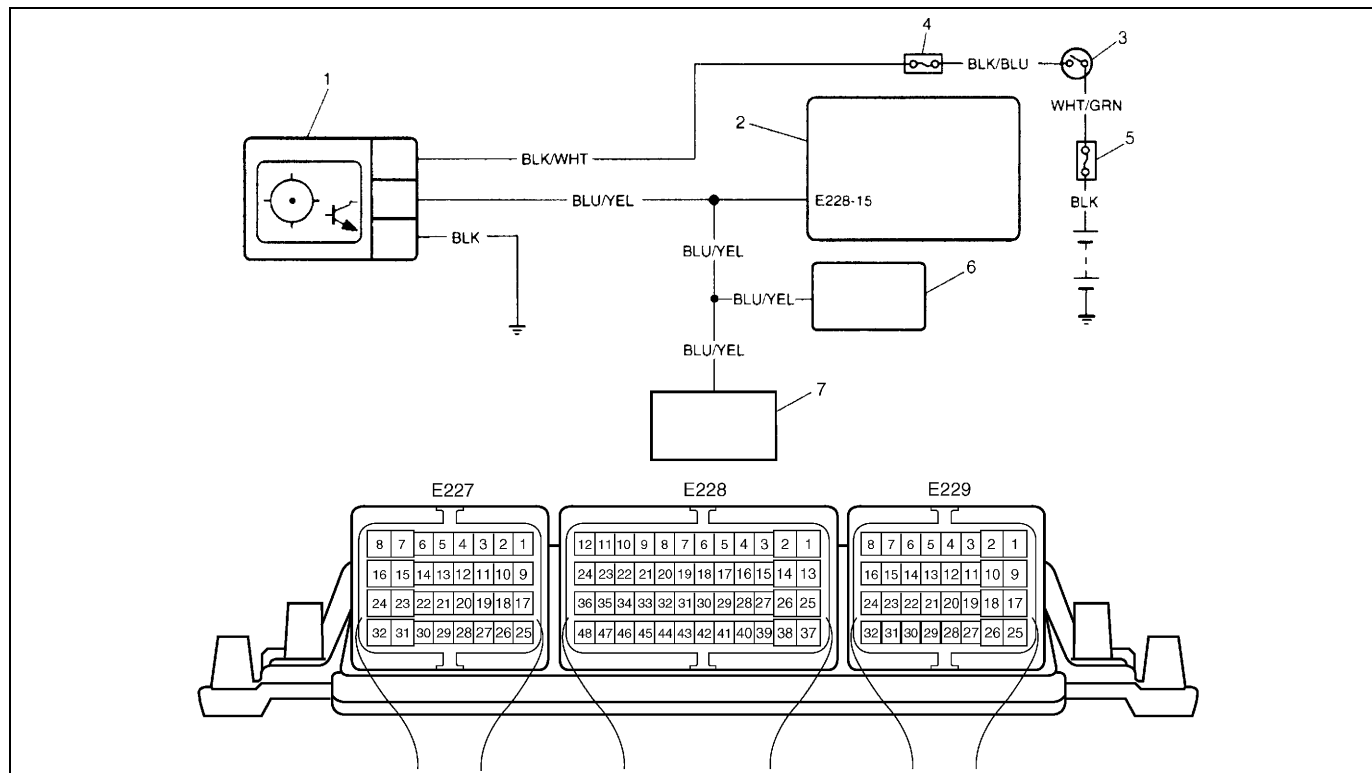
Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI Scan tool> P1614 <Using Generic Scan tool or GST mode of SUZUKI Scan tool> P0560	Go to "DTC P1614 (P0560) Sensor Supply Function" in this section.	Go to Step 3.
3	Is engine cranked?	Go to Step 4.	Go to "Diagnosis" in Section 6G.
4	Is engine started?	Go to Step 5.	Check CKP sensor (Engine speed sensor) and its circuit according to DTC P0335 (P0335) "Crankshaft Position Sensor Circuit Malfunction" in this section.
5	Check CMP Sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step 6.	Correct.
6	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage between "ORN/BLU" and "GRY/RED" terminals of sensor connector disconnected. Is voltage 10 – 14 V?	Go to Step 7.	"ORN/BLU" or "GRY/RED" wire open, short or poor connection.
7	Check for voltage between "BRN/YEL" and "GRY/RED" terminals of sensor connector disconnected. Is voltage about 5 V?	Go to Step 8.	"BRN/YEL" wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.
8	Check Camshaft Hub 1) Remove upper timing belt cover. 2) Check camshaft hub for the following. • Damage • No foreign material attached Is it in good condition?	Check CMP sensor air gap referring to "Camshaft Position Sensor (CMP Sensor)" in Section 6E3. If check result is OK, substitute a known-good CMP sensor and recheck.	Clean surfaces of camshaft hub or replace camshaft hub.



[A]: Fig. for Step 6 and 7

DTC P0500 (P0500) Vehicle Speed Sensor Circuit Malfunction

Wiring Diagram



1. Vehicle speed sensor	4. "IG COIL" fuse (20 A)	7. BCM
2. ECM	5. Main fuse	
3. Ignition switch	6. Combination meter	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM ("E228-15" wire terminal) judged vehicle speed 240 km/h (149 mile/h) by the signal of vehicle speed sensor. or - Engine speed is greater than 2500 rpm and air flow greater than 40 mm³/stroke, when ECM ("E228-15" wire terminal) judged vehicle speed below 15 km/h (9 mile/h).	- Vehicle speed sensor circuit - Vehicle speed sensor drive and/or driven gears malfunction - Vehicle speed sensor malfunction - Combination meter malfunction - BCM malfunction - ECM malfunction

DTC Confirmation Procedure

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

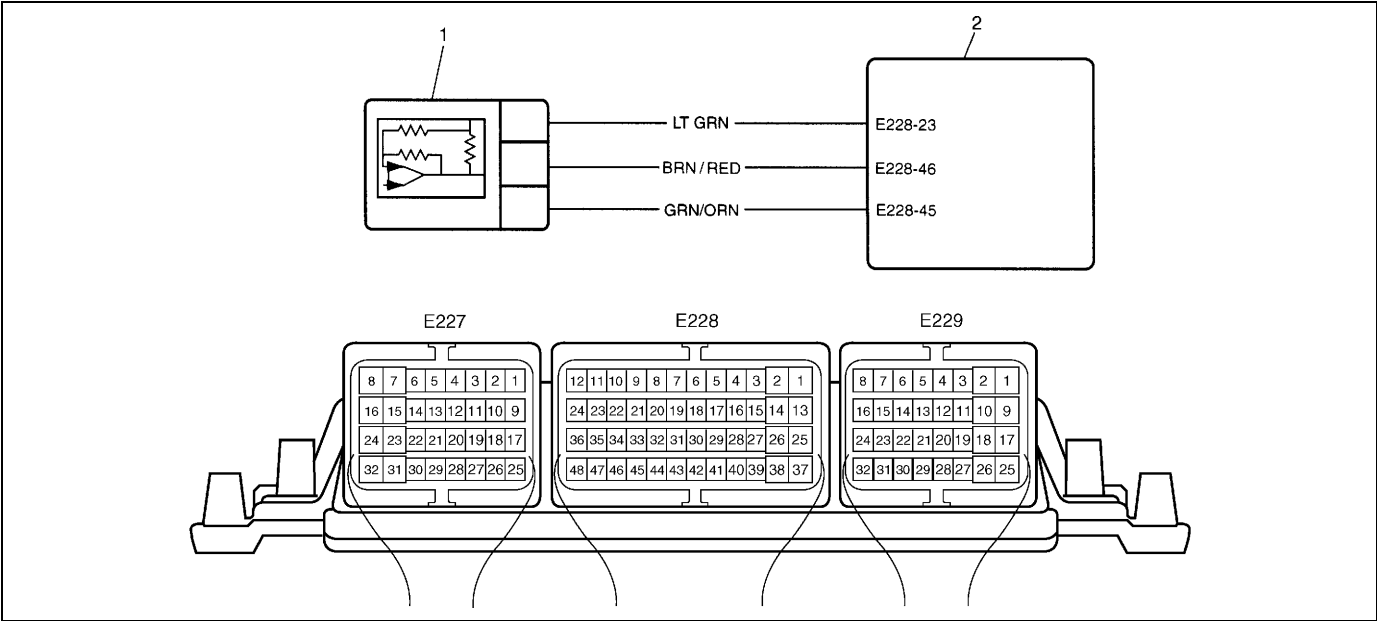
- Connect scan tool to DLC with ignition switch OFF.
- Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and warm up engine completely.
- Increase vehicle speed to 100 – 110 km/h (60 – 70 mph).
- Release accelerator pedal and with engine brake applied, keep vehicle coasting and then stop vehicle.
- Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Does speedometer indicate vehicle speed?	Faulty "BLU/YEL" wire or poor E228-15 connection. If wire and connection are OK, intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.
3	VSS Power Supply Voltage Check: 1) With ignition switch OFF, remove VSS coupler. 2) With ignition switch ON leaving engine OFF, check voltage between "BLK/WHT" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 10 – 14 V?	Go to Step 4.	"BLK/WHT" or "BLK" wire open/short.
4	VSS Signal Harness Check: 1) With ignition switch ON leaving engine OFF, check voltage between "BLU/YEL" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 4 V or more?	Go to Step 5.	Go to Step 6.
5	VSS Visual Inspection: 1) Remove VSS referring to "Speed Sensor" in Section 7D. 2) Check VSS drive and driven gears for damage and excessive wear. Are they in good condition?	Poor VSS connection or VSS malfunction. If connection is OK, substitute a known-good VSS and recheck.	Replace VSS.
6	Speedometer Circuit Check: 1) With ignition switch OFF, disconnect G11 coupler from combination meter. 2) With ignition switch ON leaving engine OFF, check voltage between "BLU/YEL" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 4 V or more?	Substitute a known-good combination meter and recheck.	Go to Step 7.
7	BCM Circuit Check 1) With ignition switch OFF, disconnect G55 coupler from BCM. 2) With ignition switch ON leaving engine OFF, check voltage between "BLU/YEL" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 4 V or more?	Substitute a known-good BCM and recheck.	"BLU/YEL" wire open/short or faulty ECM. If wire and connection are OK, substitute a known-good ECM and recheck.

DTC P0235 (P0235) Intake Air Pressure Sensor Circuit Malfunction

Wiring Diagram



1. Intake air pressure sensor
2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
• Voltage is greater than 5.2 V on “E228-23” wire terminal of ECM or voltage is less than 4.8 V on “E228-23” wire terminal of ECM. or • Voltage is greater than 5 V on “E228-45” wire terminal of ECM or voltage is less than 1 V on “E228-45” wire terminal of ECM. or • When ECM (“E228-45” wire terminal) judged intake air pressure greater than 200 mbars by the signal of crankshaft position sensor with engine speed less than 850 rpm.	• Intake air pressure sensor circuit • Intake air pressure sensor malfunction • ECM malfunction

DTC Confirmation Procedure

WARNING: • When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident. • Road test should be carried out with 2 persons, a driver and a tester, on a level road.

NOTE:
Check to make sure that the following conditions are satisfied when using this DTC Confirmation Procedure.

- Intake air temp.: 5°C, 41°F or higher
- Engine coolant temp.: –8 – 110°C (18 – 230°F)
- Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec or more.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

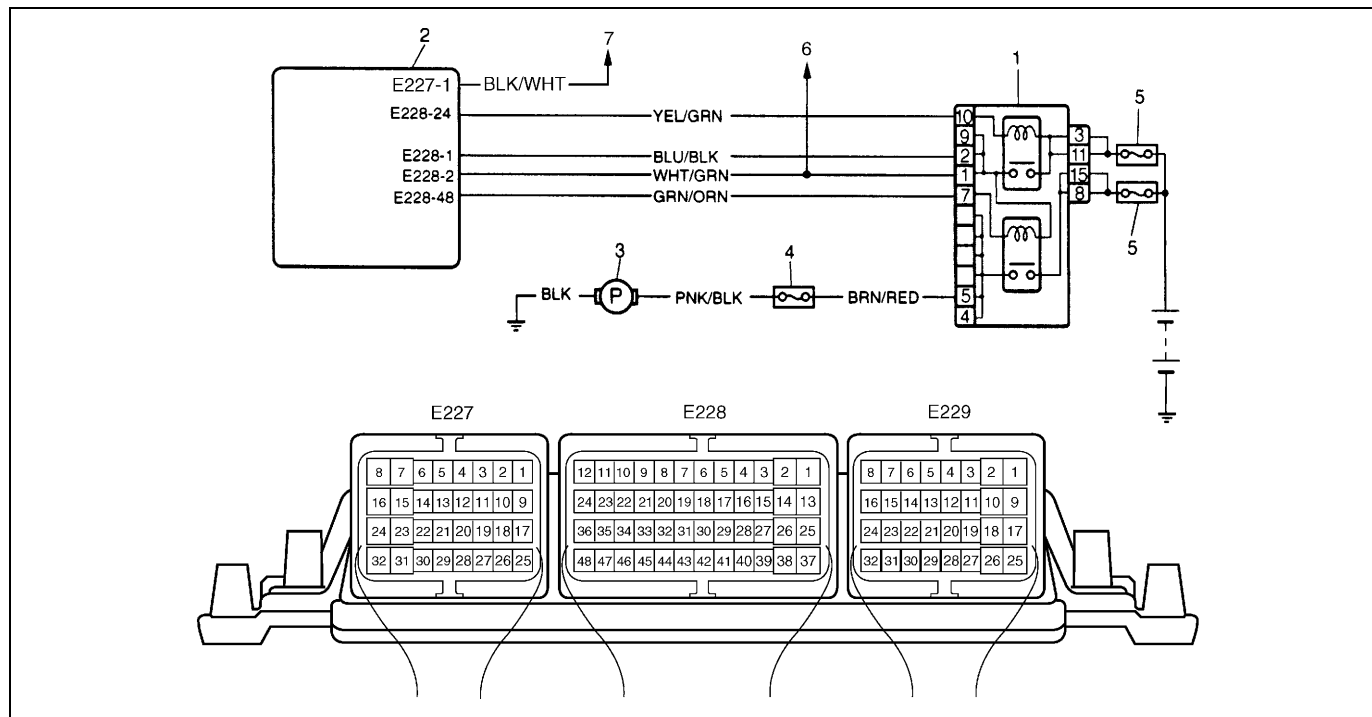
Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI Scan tool> P1614 <Using Generic Scan tool or GST mode of SUZUKI Scan tool> P0560	Go to "DTC P1614 (P0560) Sensor Supply Function" in this section.	Go to Step 3.
3	Intake Air Pressure Sensor Signal Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors from ECM. 4) Check voltage E228-45 and ground with ignition switch ON. Is it between 1 and 5 V?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 4.
4	Intake Air Pressure Sensor Check: 1) Disconnect connector from intake air pressure sensor. 2) Check for proper connection to intake air pressure sensor at each terminal. 3) If OK, check intake air pressure sensor for performance referring to "Intake Air Pressure Sensor (Manifold Absolute Pressure Sensor)" in Section 6E3. Is check result satisfactory?	"LT GRN", "BRN/RED" or "GRN/ORN" circuit open/short. If wire and connections are OK, substitute a known-good ECM and recheck.	Replace intake air pressure sensor.

DTC P0560 (P0560) Power Supply Circuit Malfunction

NOTE:

In case that “DTC P0560” is checked by using the generic scan tool, perform “DTC P0560 (P0560) Power Supply Circuit Malfunction”, “DTC P0561 (P0560) Stabilization of Sensor Supply” and “DTC P1614 (P0560) Sensor Supply Function” in this section before ECM replacement because DTC indication of generic scan tool is different from the one of SUZUKI scan tool.

Wiring Diagram



1. Double relay	3. Fuel pump	5. Main fuse
2. ECM	4. “FUEL PUMP” fuse (15 A)	6. To radiator fan relay No.3

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage is below 7 V on “E227-11”, “E228-1” and “E228-2” wire terminals of ECM or voltage is greater than 17.5 V on “E227-11”, “E228-1” and “E228-2” wire terminals of ECM.	- Power supply circuit - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC/pending DTC and freeze frame data by using scan tool and run engine at idle speed for 1 min.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors to ECM. 4) While engine running, check voltage between following terminals. E227-11 and ground E228-1 and ground E228-2 and ground Is each voltage between 7 and 17.5 V?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If wire and connections are OK, substitute a known-good ECM and recheck.	"BLK/WHT", "BLU/BLK" or "WHT/GRN" circuit open or short.

DTC P1613 ECM Not Registered**DTC Detecting Condition**

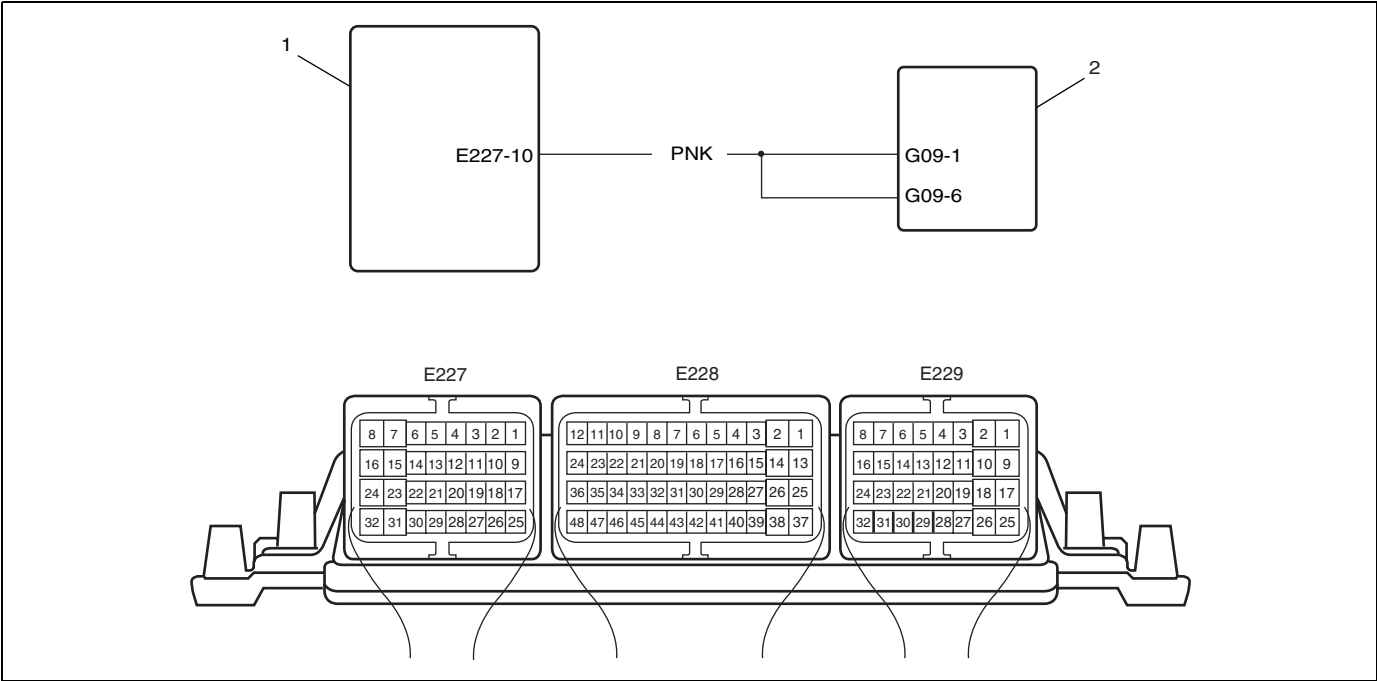
This DTC will be set when not registered of fuel injector class and transmission type are detected in ECM.

Troubleshooting

Step	Action	Yes	No
1	1) Register ECM according to the registration procedure, referring to "ECM Registration" in Section 6E3. 2) Check DTC after performing ECM registration. Is DTC P1613 still indicated?	Substitute a known-good ECM and recheck.	End.

DTC P1517 Immobilizer System Malfunction

Wiring Diagram



1. ECM	2. Immobilizer control module

Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
• This DTC will be set when temporary fault of internal memory (status memory) for communication to immobilizer control module detected in the ECM. • No signal or incorrect code inputted from immobilizer control module to ECM.	• “PNK” wire circuit • Immobilizer control system malfunction • ECM malfunction

DTC Confirmation Procedure

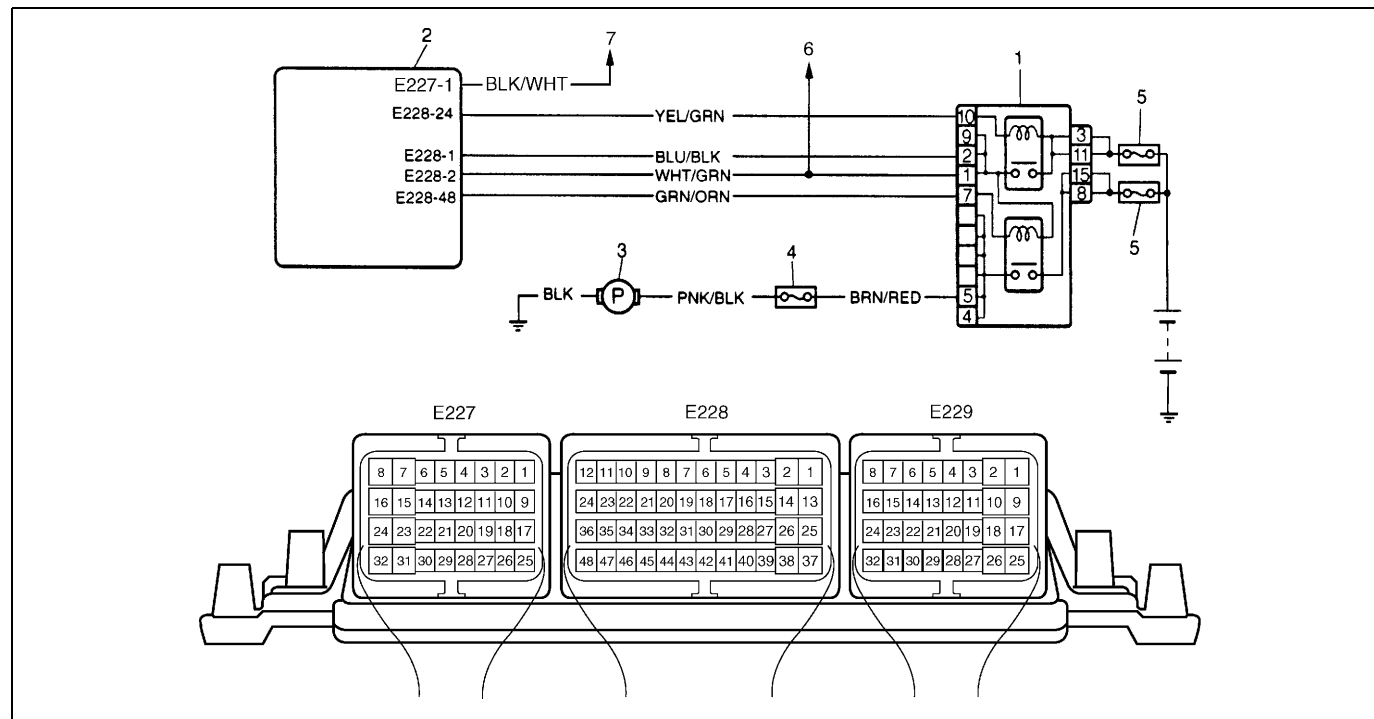
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC by using scan tool.
- 3) Start engine.
- 4) Check DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Does engine start?	Temporary fault of internal memory (status memory) for communication to immobilizer control module. However, it is no adverse affect for communication. Therefore, it does not affect engine and emission control system.	Go to Step 3.
3	Check Wire Harness and Connection 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E227-10 terminal. 4) Disconnect immobilizer control module connector. 5) Check for proper connection to immobilizer control module at G09-1 and G09-6 terminals. 6) If each terminal connection is OK, measure resistance between G09-1 terminal of immobilizer control module and E227-10 terminal of ECM connector, between G09-6 terminal of immobilizer control module and E227-10 terminal of ECM connector. Is each resistance 1 Ω or less?	Go to Step 4.	"PNK" wire is open circuit.
4	Check Wire Harness 1) Measure resistance between E227-10 terminal of ECM connector and vehicle body ground. Is resistance infinity?	Go to Step 5.	"PNK" wire is shorted to ground.
5	Check Wire Harness 1) Turn ignition switch to ON position. 2) Measure voltage between E227-10 terminal of ECM connector and vehicle body ground. Is voltage 0 V?	Go to Step 6.	"PNK" wire is shorted to power circuit.
6	Check Immobilizer Control System 1) Check immobilizer control system referring to "Immobilizer Control System Diagnostic Flow Table" in Section 8G. Is check result satisfactory?	Substitute a known-good ECM and recheck.	Faulty immobilizer control system.

TABLE B-1 Fuel Pump Circuit Inspection

Wiring Diagram



1. Double relay	3. Fuel pump	5. Double relay fuse (30 A)
2. ECM	4. "Fuel Pump" fuse (15 A)	6. To radiator fan relay No.3

Inspection

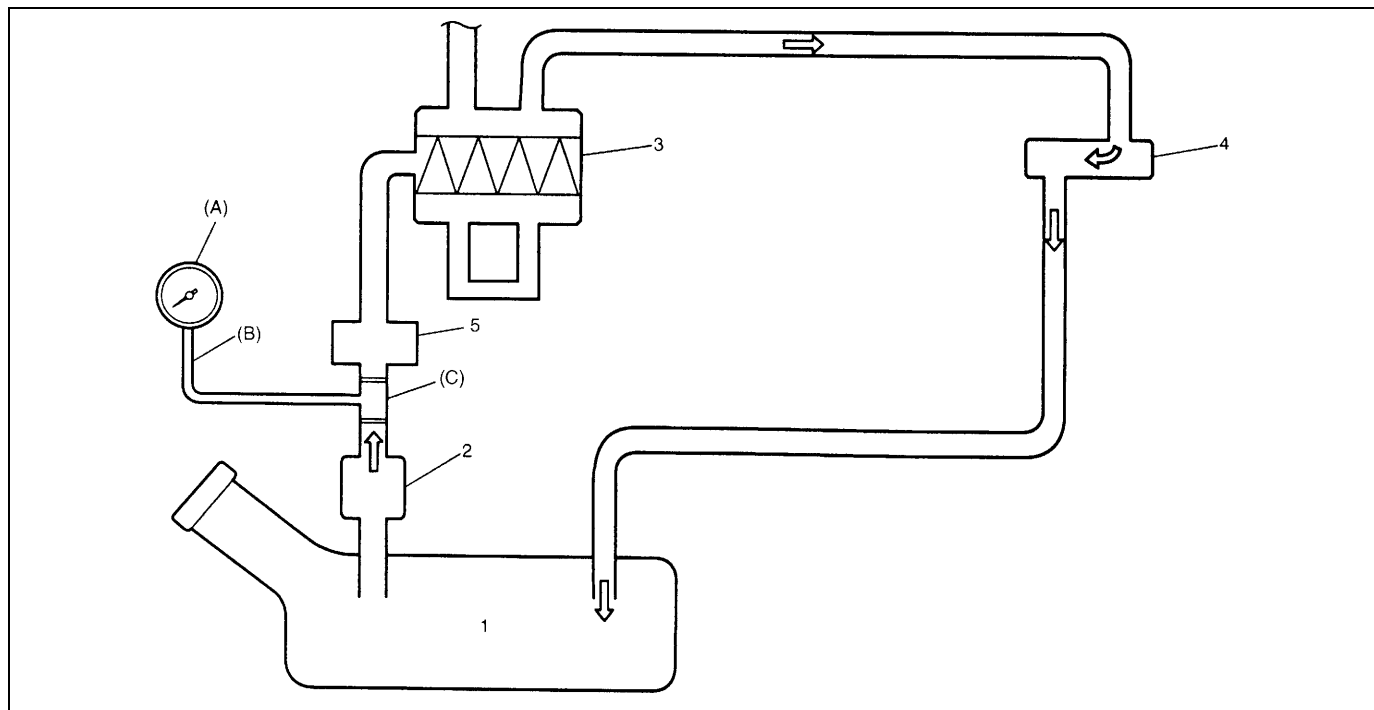
Step	Action	Yes	No
1	Fuel Pump Operation Check: 1) Turn ON ignition switch. Is fuel pump operation sound heard for 5 sec. after ignition switch ON?	Fuel pump circuit is in good condition.	Go to Step 2.
2	Fuel Pump Circuit Check: 1) With ignition switch OFF, remove double relay from connector. 2) Check for proper connection to relay at each terminal. 3) If OK, using service wire, connect terminals 8 and 5 of relay connector. (See CAUTION.) Is fuel pump heard to operate at ignition switch ON?	Go to Step 3.	"BLK", "PNK/BLK" or "BRN/RED" circuit open or fuel pump malfunction.
3	Double Relay Check: 1) Check double relay referring to "Double Relay" in Section 6E3. Is it in good condition?	"GRN/ORN" circuit open.	Replace double relay.

CAUTION:

Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness etc.

TABLE B-2 Fuel Pressure Inspection

System Diagram



(A): Gauge	1. Fuel tank	4. Fuel temperature sensor
(B): Hose	2. Fuel pump	5. Fuel heater
(C): Attachment	3. Fuel filter	

Inspection

NOTE:

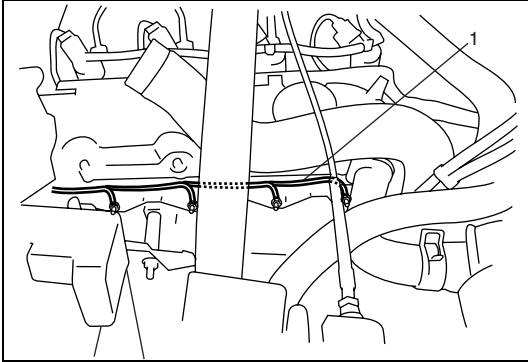
Before using the following flow table, check to make sure that battery voltage is higher than 11 V. If battery voltage is low, pressure becomes lower than specification even if fuel pump and line are in good condition.

Step	Action	Yes	No
1	1) Install fuel pressure gauge and check fuel pressure, referring to "Low Pressure Fuel Supply System" in Section 6E3. Is fuel pressure within specified value?	Normal fuel pressure.	Go to Step 2.
2	Was fuel pressure higher than spec. in Step 1?	Clogged fuel heater, fuel filter, fuel temperature or fuel hose/pipe.	Go to Step 3.
3	Was no fuel pressure applied in Step 1?	- Shortage of fuel - Fuel pump and its circuit defective. (Refer to "Table B-1 Fuel Pump Circuit Inspection" in this section.)	Fuel leakage from fuel line.

EOBD SPEC

General Information

Identification of Emission Control System

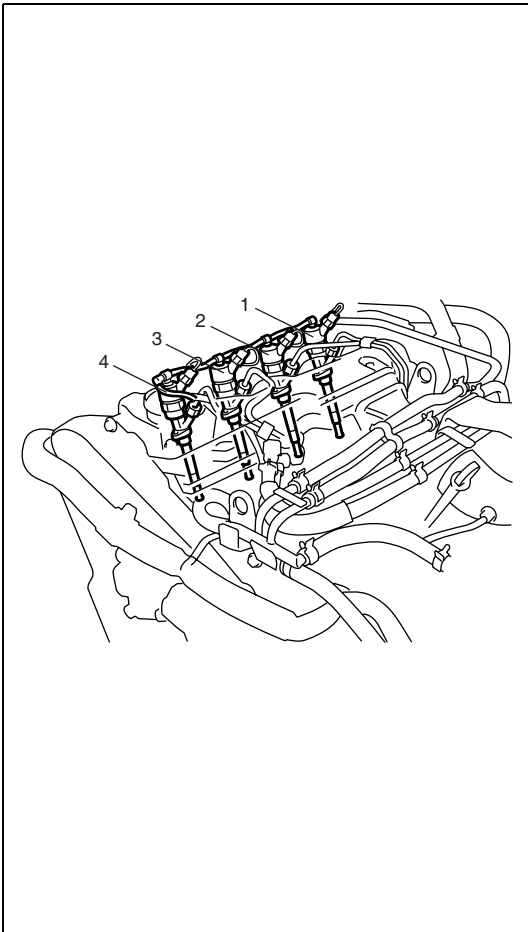


For EOBD spec, the wire harness type power supply line (1) for glow plugs is used.

Identify it by the type of glow plug power supply line.

As for the other than EOBD spec, the metal plate type is used as power supply line to glow plugs.

Statement of Cleanliness and Care



An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of an millimeter (ten thousands of inch). Accordingly, when any internal engine parts are serviced, care and cleanliness are important. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surface on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings and crankshaft journal bearings are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.
- Throughout this manual, the four cylinders of the engine are identified by numbers: No.1 (1), No.2 (2), No.3 (3) and No.4 (4) as counted from flywheel side to crankshaft pulley side.

General Information on Engine Service

The following information on engine service should be noted carefully, as it is important in preventing damage, and in contributing to reliable engine performance.

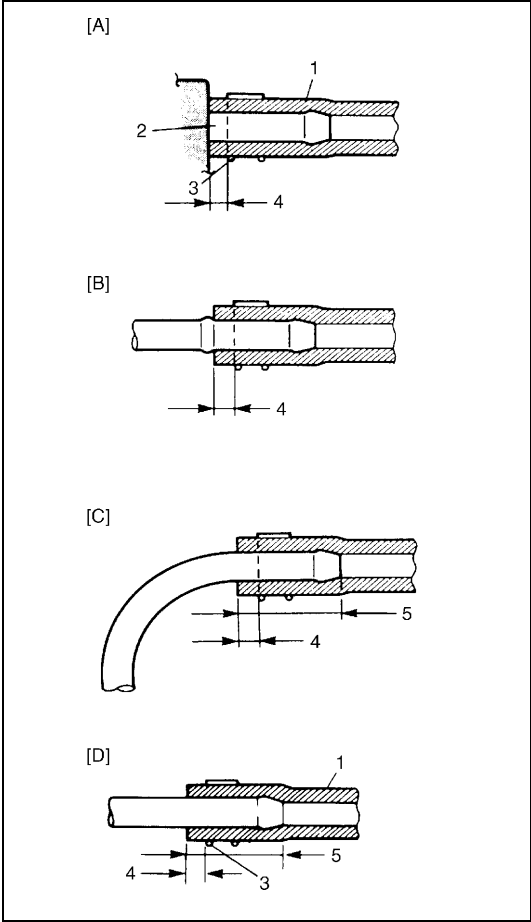
- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine, that 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, air cleaner outlet hose, turbo-charger, intercooler, intercooler outlet hose, throttle valve assembly or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.

Precaution on fuel system service

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- A small amount of fuel may be released after fuel line is disconnected.
In order to reduce the chance of personal injury, cover fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.
- Never run engine with double relay disconnected when engine and exhaust system are hot.

- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to the figure.

After connecting, make sure that it has no twist or kink.



[A]:	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B]:	With following type pipe, fit hose as far as its peripheral projection as shown.
[C]:	With bent pipe, fit hose as its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
[D]:	With straight pipe, fit hose till pipe is, about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
1.	Hose
2.	Pipe
3.	Clamp
4.	Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.
5.	20 to 30 mm (0.79 – 1.18 in.)

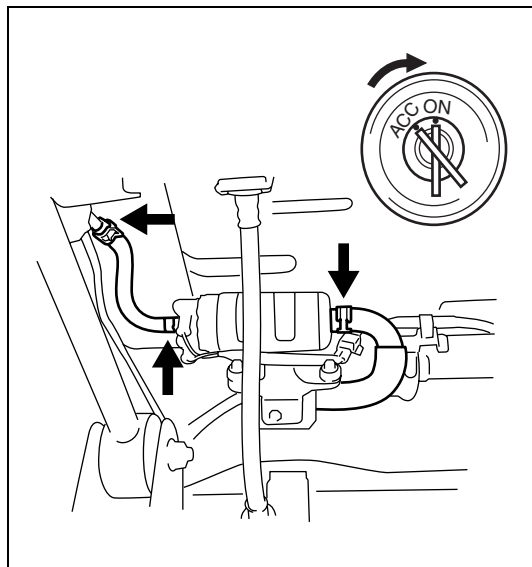
- When installing fuel filter union bolt or plug bolt, always use new gasket and tighten it to specified torque.
- When installing injector, fuel feed pipe or fuel pressure regulator, lubricate its O-ring with spindle oil or fuel.
- When connecting fuel pipe flare nut, first tighten flare nut by hand and then tighten it to specified torque, using back-up wrench.

Fuel pressure relief procedure

Refer to "Precautions" under "Fuel Delivery System" in Section 6E3.

Fuel leakage check procedure

After performing any service on fuel system, check to make sure that there are no fuel leakages as follows.



- 1) Turn ON ignition switch for 5 seconds (to operate fuel pump) and then turn it OFF. Repeat this (ON and OFF) 3 or 4 times and apply fuel pressure to fuel line (till fuel pressure is felt by hand placed on fuel return hose).
- 2) In this state, check to see that there are no fuel leakages from any part of low pressure fuel system between fuel pump and injection pump.
- 3) Check that there are no fuel leakages from any part of high pressure fuel system between injection pump and fuel injector by performing the procedure below.
 - a) Start engine and warm up to normal operating temperature.
 - b) Check fuel leakage after turning off ignition switch.
 - c) Again, start engine and accelerate the vehicle up to 3500 rpm with L range (AT) or 1st gear (MT). Then stop vehicle.
 - d) Check fuel leakage after turning off ignition switch.

Engine Diagnosis

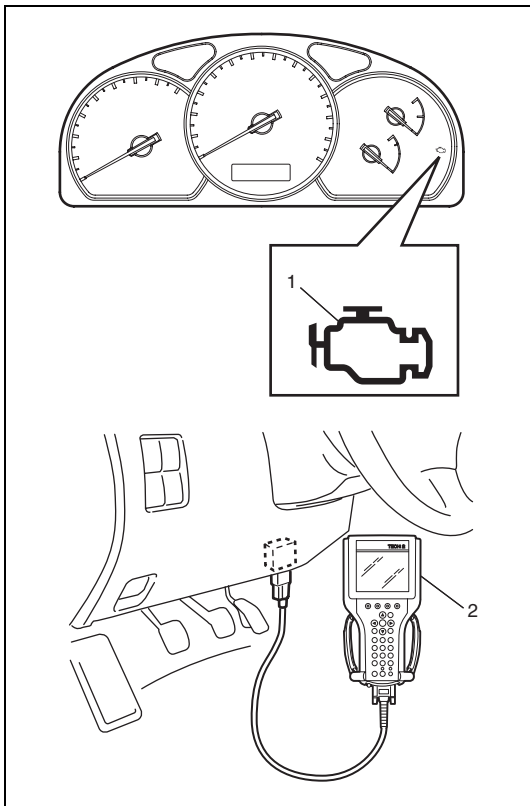
General Description

This vehicle is equipped with an engine and emission control system which are under control of ECM. The engine and emission control system in this vehicle are controlled by ECM. ECM has an On-Board Diagnostic system which detects a malfunction in this system and abnormality of those parts that influence the engine exhaust emission. When diagnosing engine troubles, be sure to have full understanding of the outline of “On-Board Diagnostic System” and each item in “Precaution in Diagnosing Trouble” and execute diagnosis according to “Engine Diagnostic Flow Table” in this section.

There is a close relationship between the engine mechanical, engine cooling system, exhaust system, etc. and the engine and emission control system in their structure and operation. In case of an engine trouble, even when the malfunction indicator lamp (MIL) doesn't turn ON, it should be diagnosed according to this flow table.

On-Board Diagnostic System

ECM in this vehicle has the following functions.



- When the ignition switch is turned ON with the engine at a stop, MIL (1) turns ON to check the malfunction indicator lamp (MIL) and its circuit.
- When ECM detects a malfunction which gives an adverse effect to vehicle emission while the engine is running, it makes the malfunction indicator lamp in the meter cluster of the instrument panel turn ON and stores the malfunction area in its memory.
- As a condition for detecting a malfunction in some areas in the system being monitored by ECM and turning ON the malfunction indicator lamp due to that malfunction, 2 driving cycles detection logic is adopted to prevent erroneous detection.
- When a malfunction is detected, engine and driving conditions then are stored in ECM memory as freeze frame data. (For the details, refer to description on Freeze frame data.)
- It is possible to communicate by using not only SUZUKI scan tool (2) but also generic scan tool. (Diagnostic information can be accessed by using a scan tool.)

Warm-up Cycle

A “warm-up cycle” means sufficient vehicle operation such that the coolant temperature has risen by at least 22°C (40°F) from engine starting and reaches a minimum temperature of 70°C (160°F).

Driving Cycle

A “driving cycle” consists of two parts, engine startup and engine shutoff.

2 Driving Cycle Detection Logic

The malfunction detected in the first driving cycle is stored in ECM memory (in the form of pending DTC) but the malfunction indicator lamp does not light at this time. It lights up at the second detection of same malfunction also in the next driving cycle.

Pending Diagnostic Trouble Code (DTC)

NOTE:

Pending diagnostic trouble code can be read using generic scan tool or GST (Generic Scan Tool) mode of SUZUKI scan tool.

Pending DTC means a DTC detected and stored temporarily at 1 driving cycle of the DTC which is detected in the 2 driving cycle detection logic.

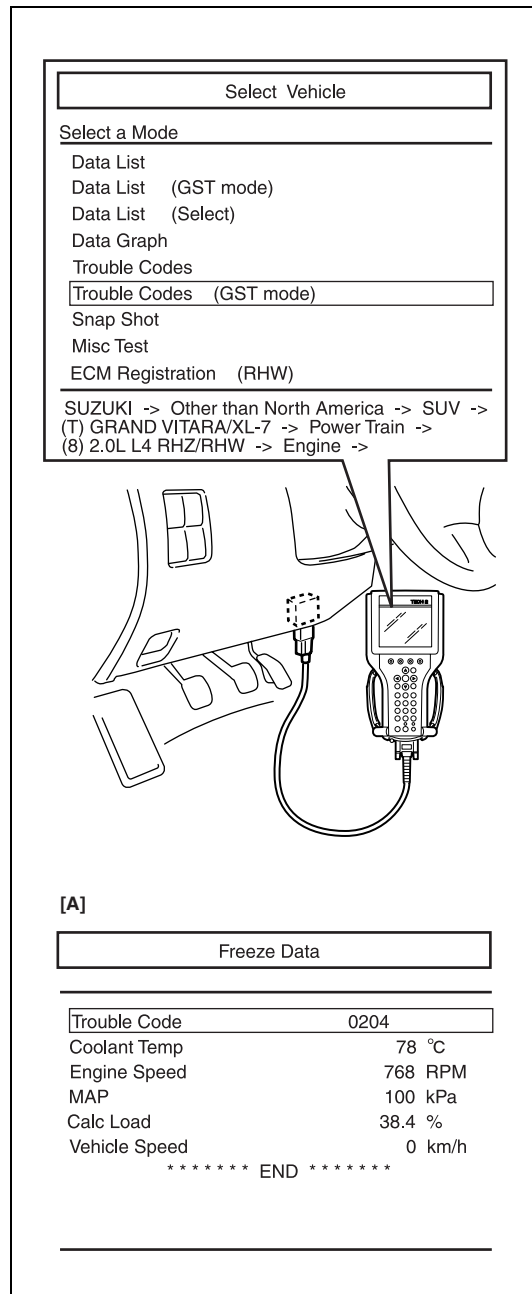
Freeze Frame Data

NOTE:

Freeze frame data can be read using generic scan tool or GST (Generic Scan Tool) mode of SUZUKI scan tool.

ECM stores the engine and driving conditions (in the form of data as shown in the figure) at the moment of the detection of a malfunction in its memory. This data is called “Freeze frame data”. Therefore, it is possible to know engine and driving conditions (e.g., whether the engine was warm or not, where the vehicle was running or stopped) when a malfunction was detected by checking the freeze frame data.

[A]: An example of freeze frame data



Priority of Freeze Frame Data:

As ECM can store freeze frame data for one malfunction only, the freeze frame data shown as 1 below has a priority for storage. (If malfunction as described in the upper square “1” below is detected while the freeze frame data in the lower square “2” has been stored, the freeze frame data “2” will be updated by the freeze frame data “1”.)

PRIORITY	FREEZE FRAME DATA
1	Freeze frame data at initial detection of diagnostic trouble codes below. P1166, P1113, P0088, P0094, P0087, P0089, P0091, P0092, P0090, P0192, P0193, P0194, P0261, P0262, P0201, P1372, P0264, P0265, P0202, P1373, P0267, P0268, P0203, P1374, P0204
2	Freeze frame data when a diagnostic trouble code other than those in “1” above is detected.

Freeze Frame Data Clearance:

The freeze frame data is cleared at the same time as clearance of diagnostic trouble code (DTC).

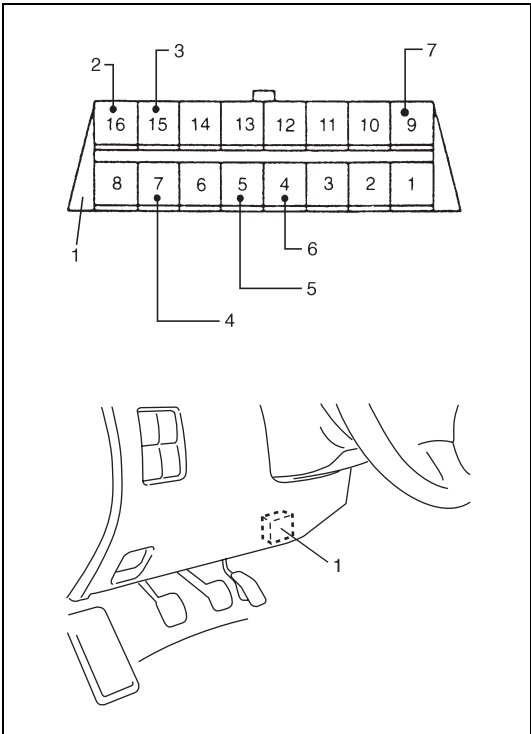
Data Link Connector (DLC)

DLC (1) in compliance with SAE J1962 in its installation position, the shape of connector and pin assignment.

K (4) and L (3) lines of ISO 9141 is used for SUZUKI scan tool or generic scan tool to communication with ECM, ABS control module, BCM, HVAC control module and TCM.

SUZUKI serial data line (7) is used for SUZUKI scan tool to communicate with immobilizer control module.

2. B+
5. ECM ground
6. Body ground



Precaution in Diagnosing Trouble

- Don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine or main fuse before confirming diagnostic information (DTC, freeze frame data, etc.) stored in ECM memory.
- Diagnostic information stored in ECM memory can be cleared as well as checked by using SUZUKI scan tool or generic scan tool. Before using scan tool, read its Operator's (Instruction) Manual carefully to have good understanding as to what functions are available and how to use it.

• Priorities for diagnosing troubles

If troubleshooting priorities for multiple diagnostic code are given in the applicable diagnostic flow, these should be followed.

If no instructions are given, troubleshoot diagnostic trouble codes according to the following priorities.

1. Fuel pressure (P0089 for Suzuki mode of SUZUKI scan tool/P0087, P0088, P0089, P0094, P1113, P1166 for generic scan tool)

2. Diagnostic trouble codes other than listed below

DTC indicated by generic scan tool or GST mode of SUZUKI scan tool	DTC indicated by Suzuki mode of SUZUKI scan tool
P1166, P1113, P0088, P0094, P0087, P0089, P0091, P0092, P0090, P0192, P0193, P0194, P0261, P0262, P0201, P1372, P0264, P0265, P0202, P1373, P0267, P0268, P0203, P1374, P0204	P0089, P0090, P0190, P201, P202, P203, P0204

3. Diagnostic trouble codes described in above list

- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before inspection and observe what is written there.
- ECM replacement or substitution
When substituting a known-good ECM, check for the following conditions. Neglecting this check may cause damage to known-good ECM.
 - Resistance value of all relays, actuators is as specified respectively.
 - MAF sensor is in good condition and none of power circuit of its sensor is shorted to ground.
- ECU code registration
If ECM is replaced, register ECU code into ECM by performing procedure described in "Procedure after ECM Replacement" of Section 8G. Otherwise, ECM dose not function as Immobilizer Control System.
- Injector code registration
If ECM or injector is replaced, register injector code into ECM by performing procedure described in "ECM Registration" of Section 6E3.
Otherwise, it has an adverse effect on engine.
- The following harness connector number of this section is corresponding to the following harness connector number of WIRING DIAGRAM MANUAL.

Connector number of this section	Connector number of WIRING DIAGRAM MANUAL
E227	C51-1
E228	C51-2
E229	C51-3
G55	G54
G09	G87

Engine Diagnostic Flow Table

Numbers of each step correspond to the numbers of the items after this table.

Refer to "Diagnostic Step Details" following this table for the details of each step.

Step	Action	Yes	No
1	Customer Complaint Analysis 1) Perform customer complaint analysis. Was customer complaint analysis performed?	Go to Step 2.	Perform customer complaint analysis.
2	Diagnostic Trouble Code (DTC) and Freeze Frame Data Check, Record and Clearance 1) Check for DTC referring to "Diagnostic Step Details". Is there any DTC(s)?	1) Print DTC and freeze frame data or write then down and clear by referring to "DTC Clearance" in this section. 2) Go to Step 3.	Go to Step 5.
3	ECM Registration Data Check 1) Check injector class and transmission type of ECM registration data referring to "ECM Registration" in this section. Are registered data in good condition?	Go to Step 4.	Register ECM according to the registration procedure, referring to "ECM Registration" in Section 6E3.
4	Visual Inspection 1) Perform Visual inspection referring to the "Visual Inspection" in this section. Is there any faulty condition?	1) Repair or replace malfunction part. 2) Go to Step 12.	Go to Step 6.
5	Visual Inspection 1) Perform visual inspection referring to the "Visual Inspection" in this section. Is there any faulty condition?		Go to Step 9.
6	Trouble Symptom Confirmation 1) Confirm trouble symptom referring to the "Trouble Symptom Confirmation" in this section. Is trouble symptom identified?	Go to Step 7.	Go to Step 8.
7	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to "DTC Check" in this section. Is there any DTC(s)?	Go to Step 10.	Go to Step 9.
8	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to "DTC Check" in this section. Is there any malfunction DTC(s)?		Go to Step 11.

Step	Action	Yes	No
9	Engine Basic Inspection and Engine Diagnosis Table 1) Check and repair according to “Engine Basic Check” and “Engine Diagnosis Table” in this section. Are check and repair complete?	Go to Step 12.	1) Check and repair malfunction part(s). 2) Go to Step 12.
10	Troubleshooting for DTC 1) Check and repair according to applicable DTC diag. flow table in this section. Are check and repair complete?		
11	Check for Intermittent Problems 1) Check for intermittent problems referring to the “Diagnostic Step Details”. Is there any faulty condition?	1) Repair or replace malfunction part(s). 2) Go to Step 12.	Go to Step 12.
12	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test referring to the “Diagnostic Step Details”. Is there any problem symptom, DTC or abnormal condition?	Go to Step 7.	End.

Diagnostic step details

1. CUSTOMER COMPLAINT ANALYSIS

Record details of the problem (failure, complaint) and how it occurred as described by the customer. For this purpose, use of such an inspection form will facilitate collecting information to the point required for proper analysis and diagnosis.

2. DIAGNOSTIC TROUBLE CODE (DTC)/FREEZE FRAME DATA CHECK, RECORD AND CLEARANCE

First, check DTC (including pending DTC), referring to “DTC check” in this section. If DTC is indicated, print it and freeze frame data or write them down and then clear them by referring to “DTC clearance” in this section. DTC indicates malfunction that occurred in the system but does not indicate whether it exists now or it occurred in the past and the normal condition has been restored now. To check which case applies, check the symptom in question according to Step 6 and recheck DTC according to Step 7 and 8.

Attempt to diagnose a trouble based on DTC in this step only or failure to clear the DTC (including pending DTC) in this step will lead to incorrect diagnosis, trouble diagnosis of a normal circuit or difficulty in troubleshooting.

3. ECM REGISTRATION DATA CHECK

Refer to “ECM Registration Data Check” in Section 6E3 for checking procedure.

4 and 5. VISUAL INSPECTION

As a preliminary step, be sure to perform visual check of the items that support proper function of the engine referring to “Visual Inspection” in this section.

6. TROUBLE SYMPTOM CONFIRMATION

Based on information obtained in Step 1 Customer complaint analysis and Step 2 DTC/freeze frame data check, confirm trouble symptoms. Also, reconfirm DTC according to “DTC Confirmation Procedure” described in each DTC flow.

7 and 8. DTC/FREEZE FRAME DATA RECHECK, RECORD AND CLEARANCE

Refer to “DTC CHECK” in this section for checking procedure.

9. ENGINE BASIC CHECK AND ENGINE DIAGNOSIS TABLE

Perform basic engine check according to the “Engine Basic Check” in this section first. When the end of the flow table has been reached, check the parts of the system suspected as a possible cause referring to “Engine Diagnosis Table” in this section and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or basic engine check) and repair or replace faulty parts, if any.

10. TROUBLESHOOTING FOR DTC (See each DTC Diag. Flow Table)

Based on the DTC indicated in Step 7 or 8 and referring to the applicable DTC diag. flow table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ECM or other part and repair or replace faulty parts.

NOTE:

If DTC P0089 (for Suzuki mode of SUZUKI scan tool) or P0087, P0088, P0089, P0094, P1113, P1166 (for generic scan tool or GST mode of SUZUKI scan tool) together with other DTC are indicated in this step, proceed to Diag. flow table for DTC P0089 (P0087, P0088, P0089, P0094, P1113, P1166) first.

11. CHECK FOR INTERMITTENT PROBLEM

Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to “Intermittent and Poor Connection” in Section 0A and related circuit of DTC recorded in Step 2.

12. FINAL CONFIRMATION TEST

Confirm that the problem symptom has gone and the engine is free from any abnormal conditions. If what has been repaired is related to the DTC, clear the DTC once and perform DTC confirmation procedure and confirm that no DTC is indicated.

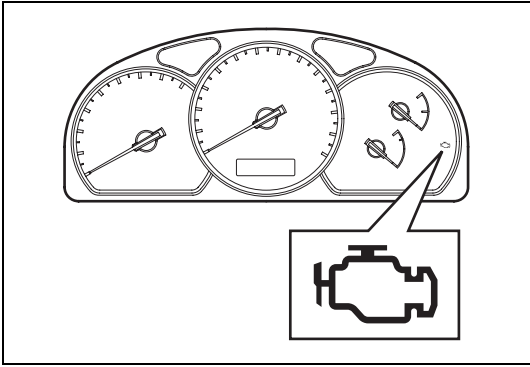
Customer Problem Inspection Form (Example)

User name:		Model:		VIN:	
Date of issue:		Date Reg.		Date of problem:	
				Mileage:	
PROBLEM SYMPTOMS					
☐ Difficult Starting			☐ Poor Driveability		
☐ No cranking ☐ No initial combustion ☐ Poor starting at (☐ Cold/ ☐ Warm/ ☐ Always) ☐ Other _____			☐ Hesitation on acceleration ☐ Back fire/After fire ☐ Loss of power ☐ Surging ☐ Abnormal knocking ☐ Other _____		
☐ Poor Idling			☐ Engine Stall when		
☐ Poor fast idle ☐ Abnormal idling speed (☐ High ☐ Low) (r/min.) ☐ Unstable ☐ Hunting (r/min. to r/min.) ☐ Other _____			☐ Immediately after start ☐ Accel. pedal is depressed ☐ Accel. pedal is released ☐ Load is applied ☐ A/C ☐ Electrical load ☐ P/S ☐ Other _____		
☐ OTHERS:					
VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS					
Environmental Condition					
Weather	☐ Fair ☐ Cloudy ☐ Rain ☐ Snow ☐ Always ☐ Other _____ (°F/ °C)				
Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold ☐ Always				
Frequency	☐ Always ☐ Sometimes (times/ day, month) ☐ Only once ☐ Under certain condition				
Road	☐ Urban ☐ Suburbs ☐ Highways ☐ Mountainous (☐ Uphill ☐ Downhill) ☐ Paved road ☐ Gravel ☐ Other _____				
Vehicle Condition					
Engine condition	☐ Cold ☐ Warming up phase ☐ Warmed up ☐ Always ☐ Other at starting ☐ Immediately after start/ ☐ Racing without load ☐ Engine speed (r/min.)				
Vehicle condition	☐ During driving: ☐ Constant speed (km/h, mile/h) ☐ Accelerating ☐ Decelerating ☐ Right hand corner ☐ Left hand corner ☐ When shifting (Lever position) ☐ At stop ☐ Other ()				
Malfunction indicator lamp condition	☐ Always ON ☐ Sometimes ON ☐ Always OFF ☐ Good condition ☐ Flashing				
Diagnostic trouble code	First check: ☐ No code ☐ Malfunction code ()				
	Second check: ☐ No code ☐ Malfunction code ()				

NOTE:

The above form is standard sample. It should be modified according to conditions characteristic of each market.

Malfunction Indicator Lamp (MIL) Check



- 1) Turn ON ignition switch (but the engine at stop) and check that MIL lights.
If MIL does not light up or dims, go to "Diagnostic Flow Table A-1" for troubleshooting.
- 2) Start engine and check that MIL turns OFF.
If MIL remains ON, and no DTC is stored in ECM, go to "Diagnostic Flow Table A-2" for troubleshooting.

Diagnostic Trouble Code (DTC) Check

- 1) Prepare generic scan tool or SUZUKI scan tool.
- 2) Connect it to data link connector (DLC) (1) located on under-side of instrument panel at driver's seat side.

Special tool

(A): SUZUKI scan tool

- 3) Turn ignition switch ON and confirm that MIL lights.
- 4) Read DTC, pending DTC and freeze frame data according to instructions displayed on scan tool and print them or write them down. Refer to scan tool operator's manual for further details.

If communication between scan tool and ECM is not possible, check if scan tool is communicable by connecting it to ECM in another car. If communication is possible in this case, scan tool is in good condition. Then check data link connector and serial data line (circuit) in the car with which communication was not possible.

- 5) After completing the check, turn ignition switch off and disconnect scan tool from data link connector.

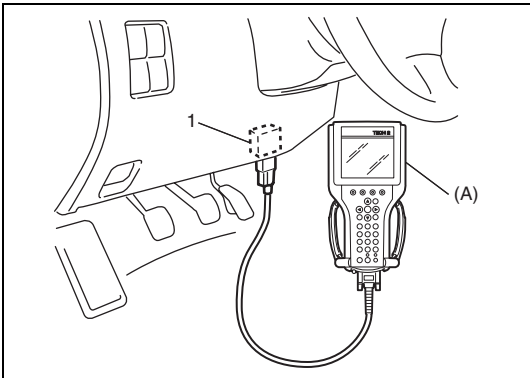
Diagnostic Trouble Code (DTC) Clearance

- 1) Connect generic scan tool or SUZUKI scan tool to data link connector in the same manner as when making this connection for DTC check.
- 2) Turn ignition switch OFF and then ON (but engine at stop).
- 3) Erase DTC and pending DTC according to instructions displayed on scan tool. Refer to scan tool operator's manual for further details.

NOTE:

When DTC clear command is executed using Suzuki mode of SUZUKI scan tool with engine run, DTC can not be cleared from ECM memory.

- 4) After completing the clearance, turn ignition switch OFF and disconnect scan tool from data link connector.



Fail-Safe Table

When any of the following DTCs is detected, ECM enters fail-safe mode as long as malfunction continues to exist but that mode is canceled when ECM detects normal condition after that.

DTC NO.	TROUBLE AREA	FAIL SAFE OPERATION
P0190 (P0192) (P0193) (P0194)	Fuel pressure sensor	Each control is performed based on 150 MPa (1500 bar) fuel pressure and engine speed is restricted to lower than specified value.
P0220 (P0222) (P0223) (P0224)	Throttle position sensor	Each control is performed based on specified accelerator pedal opening and engine speed is restricted to lower than specified value.
P0225 (P0224) (P0227) (P0228) (P2137)		
P0115 (P0115) (P0117) (P0118)	Engine coolant temperature sensor	Each control is performed based on 111°C with engine run.
P0180 (P0182) (P0183)	Fuel temperature sensor	Each control is performed based on 90°C.
P0110 (P0112) (P0113)	Intake air temperature sensor (in mass air flow)	Each control is performed based on 50°C.
P0235 (P0069) (P0235) (P0237) (P0238) (P1281)	Intake air pressure sensor	Each control is performed based on the value measured by barometric pressure sensor (in ECM). If barometric pressure sensor fails, 900 mbar is used as intake air pressure and engine speed is restricted to lower than specified value.
P0105 (P0107) (P0108)	Barometric pressure sensor (in ECM)	Each control is performed based on the value measured by intake air pressure sensor. If intake air pressure sensor is failed, 900 mbar is used as barometric pressure.
P0100 (P0102) (P0103) (P3007) (P3008)	Mass air flow sensor	Each control uses the value calculated by barometric pressure and engine speed.
P0500 (P0500) (P0501)	Vehicle speed sensor	Each control is performed based on 80 km/h.

DTC NO.	TROUBLE AREA	FAIL SAFE OPERATION
P0089 (P0087) (P0088) (P0089) (P0094) (P1113) (P1166)	Fuel pressure sensor/ pressure regulator	Engine speed is restricted to lower than specified value or engine stops.
P0401 (P0401)	EGR valve/solenoid	Engine speed is restricted to lower than specified value.
P2141 (P2141)		
P2144 (P2144)		
P0561 (P0642) (P0643)	Sensor supply voltage	Engine speed is restricted to lower than specified value.
P0234 (P0234)	Turbo pressure solenoid valve	Engine speed is restricted to lower than specified value.
P0245 (P0245)		
P0090 (P0090) (P0091) (P0092)	Fuel pressure regulator	Engine speed is restricted to lower than specified value.
P0201 (P0201) (P0261) (P0262) (P1372)	Fuel injector No.1	Engine speed is restricted to lower than specified value or engine stops.
P0202 (P0202) (P0264) (P0265) (P1373)	Fuel injector No.2	Engine speed is restricted to lower than specified value or engine stops.
P0203 (P0203) (P0267) (P0268) (P1374)	Fuel injector No.3	Engine speed is restricted to lower than specified value or engine stops.
P0204 (P0204) (P0267) (P0268) (P1374)	Fuel injector No.4	Engine speed is restricted to lower than specified value or engine stops.
P1613	ECM	Engine speed is restricted to lower than specified value.
P0335	CKP sensor	Engine stops and does not start.
P0604	ECM internal memory	Engine speed is restricted to lower than specified value.
P0606	ECM	Engine stops
P1169	ECM	Engine stops and does not start.
P1170	ECM	Engine stops and does not start.

DTC NO.	TROUBLE AREA	FAIL SAFE OPERATION
P1517	ECM	Engine does not start or normal operates depending on trouble condition.

NOTE:

For () marked No. in DTC column, it is indicated when generic scan tool is used.

Diagnostic Trouble Code (DTC) Table

	DTC NO. (SUZUKI scan tool)	DTC NO. (Generic scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
☆	P0089	P0087 P1113 P0088 P1166	Fuel rail pressure too low/too high	Fuel pressure in common rail is lower or higher than specification	1 driving cycle	1 driving cycle
		P0094	Fuel system leak detected - small leak			
		P0089	Fuel pressure regulator performance malfunction			
—	P0090	P0091 P0092	Fuel pressure regulator control circuit low/high	Monitor signal of fuel pressure regulator is different from command signal (circuit open or short), or poor performance of regulator	1 driving cycle	1 driving cycle
		P0090	Fuel pressure regulator control circuit malfunction			
	P0100	P0102 P0103	Mass air flow circuit low input/high input	Sensor output low or high voltage, or air flow is lower or higher than specification under specified engine RPM	1 driving cycle	3 driving cycles
		P3007 P3008	Mass air flow plausibility at low flow/high flow			
	P0105	P0107 P0108	Barometric pressure sensor circuit low input/high input	Poor performance of ECM	1 driving cycle	3 driving cycles
	P0110	P0112 P0113	Intake air temperature sensor circuit low/high	Intake air temperature sensor circuit low or high input	1 driving cycle	3 driving cycles
	P0115	P0117 P0118	Engine coolant temperature circuit low/high	Engine coolant temperature sensor circuit low or high input, or poor performance of engine coolant temperature sensor	1 driving cycle	3 driving cycles
		P0115	Engine coolant temperature circuit malfunction			
	P0120	P2142	Exhaust gas recirculation throttle position control circuit high	Monitor signal of EGR throttle solenoid valve is different from command signal (circuit open or short), or poor performance of valve	1 driving cycle	—
		P0487	Exhaust gas recirculation throttle position control circuit malfunction		1 driving cycle	—
	P2141	P2141	Exhaust gas recirculation throttle position control circuit low		1 driving cycle	1 driving cycle
	P0180	P0182 P0183	Fuel temperature sensor circuit low/high	Fuel temperature circuit low or high input	1 driving cycle	—
	P0190	P0192 P0193	Fuel rail pressure sensor circuit low/high	Fuel rail pressure sensor circuit low or high input	1 driving cycle	1 driving cycle
		P0194	Fuel rail pressure sensor circuit intermittent	Fuel rail pressure sensor supply circuit voltage is out of specification		

	DTC NO. (SUZUKI scan tool)	DTC NO. (Generic scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
☆	P0201	P0261	Injector circuit - cylinder 1 low	Monitor signal of fuel injection #1 is different from command signal (circuit open or short), or poor performance of fuel Injector #1 and ECM	1 driving cycle	1 driving cycle
		P0262	Injector circuit - cylinder 1 high			
		P0201	Injector circuit - cylinder 1 malfunction			
		P1372	Injector circuit - cylinder 1 short			
☆	P0202	P0264	Injector circuit - cylinder 2 low	Monitor signal of fuel injection #2 is different from command signal (circuit open or short), or poor performance of fuel Injector #2 and ECM	1 driving cycle	1 driving cycle
		P0265	Injector circuit - cylinder 2 high			
		P0202	Injector circuit - cylinder 2 malfunction			
		P1373	Injector circuit - cylinder 2 short			
☆	P0203	P0267	Injector circuit - cylinder 3 low	Monitor signal of fuel injection #3 is different from command signal (circuit open or short), or poor performance of fuel Injector #3 and ECM	1 driving cycle	1 driving cycle
		P0268	Injector circuit - cylinder 3 high			
		P0203	Injector circuit - cylinder 3 malfunction			
		P1374	Injector circuit - cylinder 3 short			
☆	P0204	P0267	Injector circuit - cylinder 4 low	Monitor signal of fuel injection #4 is different from command signal (circuit open or short), or poor performance of fuel Injector #4 and ECM	1 driving cycle	1 driving cycle
		P0268	Injector circuit - cylinder 4 high			
		P0204	Injector circuit - cylinder 4 malfunction			
		P1374	Injector circuit - cylinder 4 short			
—	P0215	—	Engine shutoff solenoid	Poor performance of double relay	1 driving cycle	—
	P0220	P0222	Pedal position sensor “No.1” circuit low/high	Throttle position sensor circuit low or high input	1 driving cycle	1 driving cycle
		P0224		Throttle position sensor supply circuit voltage is out of specification		
	P0225	P0227	Pedal position sensor “No.2” circuit low/high	Throttle position sensor 2 circuit low or high input	1 driving cycle	1 driving cycle
		P0228		Throttle position sensor 2 supply circuit voltage is out of specification		
		P2137	Pedal position sensor “No.2” circuit voltage correlation	Poor performance of throttle position sensor		

	DTC NO. (SUZUKI scan tool)	DTC NO. (Generic scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
-	P0230	-	Fuel pump primary circuit	Fuel pump supply circuit low or high input, poor performance of fuel pump	1 driving cycle	-
	P0234	P0234	Turbo charger over boost condition	Intake air pressure is higher than specification	1 driving cycle	1 driving cycle
	P0235	P0237 P0238	Turbo charger boost sensor circuit low/high	Intake air pressure sensor circuit low or high input	1 driving cycle	1 driving cycle
		P0235 P1281	Turbo charger boost sensor circuit malfunction	Intake pressure sensor supply circuit voltage is out of specification		
		P0069	Manifold absolute pressure - barometric pressure correlation	Poor performance of intake air pressure sensor		
	P0243	P0243	Turbo charger waste gate solenoid malfunction	Monitor signal of turbo pressure regulator solenoid valve is different from command signal (circuit open or short)	1 driving cycle	-
		P0246	Turbo charger waste gate solenoid high		1 driving cycle	
	P0245	P0245	Turbo charger waste gate solenoid low		1 driving cycle	1 driving cycle
-	P0299	P0299	Turbo charger under boost	Intake air pressure is higher than specification	1 driving cycle	-
	☆ P0335	P0335	Crankshaft position sensor circuit	Monitor signal of crankshaft position sensor is higher than specification	1 driving cycle	-
	P0340	P0343	Camshaft position sensor circuit high	Supply voltage low or high input, or poor performance of camshaft or crankshaft position sensor	1 driving cycle	-
		P0344	Camshaft position sensor circuit intermittent			
		P0341	Camshaft position sensor circuit performance			
		P0016	Crankshaft position - camshaft position correlation			
	P0380	P1352	Glow plug circuit relay jammed	Both pre/post heating relay and diagnostic signals are high or low level	1 driving cycle	-
		P1351	Glow plug circuit excess voltage			
		P1349 P1350	Glow plug circuit short/open			
	P0381	-	Glow plug indicator circuit	Monitor signal of glow indicator lamp circuit is different from command signal (circuit open or short)	1 driving cycle	-

DTC NO. (SUZUKI scan tool)	DTC NO. (Generic scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
P0400	P2145 P2143	Exhaust gas recirculation vent control circuit high/open	Monitor signal of EGR solenoid valve is different from command signal (circuit open or short), or excessive EGR flow	1 driving cycle	—
	P0402	Exhaust gas recirculation flow excessive detected		1 driving cycle	3 driving cycles
	P0400	Exhaust gas recirculation flow malfunction		1 driving cycle	1 driving cycle
P2144	P2144	Exhaust gas recirculation vent control circuit low	Insufficient EGR flow	1 driving cycle	1 driving cycle
P0401	P0401	Exhaust gas recirculation flow insufficient detected		1 driving cycle	1 driving cycle
P0480	—	Fan 1 control circuit	Monitor signal of radiator relay (high) circuit is different from com- mand signal (circuit open or short)	1 driving cycle	—
P0481	—	Fan 2 control circuit	Monitor signal of radiator relay (high) circuit is different from com- mand signal (circuit open or short)	1 driving cycle	—
P0485	—	Fan power/ground circuit	Radiator fan relay signal is not corresponding to radiator fan state signal	1 driving cycle	—
P0500	P0500	Vehicle speed sensor mal- function	Vehicle speed is lower or higher than specification under certain condition, or poor performance of ECM	1 driving cycle	3 driving cycles
	P0501	Vehicle speed sensor perfor- mance		1 driving cycle	3 driving cycles
P0560	P0562 P0563	System voltage low/high	Power supply low or high input	1 driving cycle	3 driving cycles
P0561	P0642 P0643	Sensor reference voltage cir- cuit low/high	Poor performance of ECM	1 driving cycle	1 driving cycle
P0603	P0603	Internal control module keep alive memory (KAM) error	Poor performance of ECM	1 driving cycle	1 driving cycle
P0604	P0604	Internal control module ran- dom access memory (RAM) error	Poor performance of ECM	1 driving cycle	1 driving cycle
☆ P0606	P0606	ECM processor	Poor performance of ECM	1 driving cycle	—
P0608	P0658 P0659	Actuator supply voltage cir- cuit 1 low/high	Sensor power supply low or high voltage	1 driving cycle	3 driving cycles
	P2670 P2671	Actuator supply voltage cir- cuit 2 low/high	Sensor power supply 2 low or high voltage	1 driving cycle	3 driving cycles
	P0650	Malfunction indicator lamp (MIL) control circuit malfunc- tion	Monitor signal of MIL circuit is dif- ferent from command signal (cir- cuit open or short)	1 driving cycle	—
P1642	P1642	Malfunction indicator lamp (MIL) circuit open		1 driving cycle	—

	DTC NO. (SUZUKI scan tool)	DTC NO. (Generic scan tool)	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
–	P1107	P2009 P2010	Intake manifold runner control circuit low/high	Monitor signal of swirl control solenoid valve circuit is different from command signal more than specified detecting times (circuit open or short)	1 driving cycle	–
☆	P1169	–	Condenser 1 voltage too low/high	Poor performance of ECM	1 driving cycle	–
☆	P1170	–	Condenser 2 voltage too low/high	Poor performance of ECM	1 driving cycle	–
	P1171	–	ECU function (ECU internal fault)	Poor performance of ECM	1 driving cycle	–
	P1404	–	TL4226 circuit malfunction	Monitor signal of pre/post heating relay is different from command signal	1 driving cycle	–
	P1507	–	Anti-boiling activated	Fuel temperature or ECT is more than specified with high engine load	1 driving cycle	–
	P1511	–	Ignition switch circuit malfunction	Ignition signal is not memorized in ECM	1 driving cycle	–
☆	P1517	–	Immobilizer system malfunction	No signal or incorrect code inputted from immobilizer control module to ECM	1 driving cycle	–
Δ				Temporary fault of internal memory (status memory) in ECM		
–	P1613	–	ECU not registered	Fuel injector class and transmission type are not registered	1 driving cycle	1 driving cycle
	P2299	–	Accelerator pedal position incompatible	Simultaneous operation of the accelerator and the brake	1 driving cycle	–
	P3004	P3005 P3006	3rd piston deactivator circuit short/open	Monitor signal of injection pump solenoid valve is different from command signal (circuit open or short)	1 driving cycle	–

NOTE:

- In case that ECM detects a fault (DTC) in column with “☆” mark, engine is hard to start unless DTC is cleared from ECM memory.
- DTC DRIVING CYCLE column indicates the number of driving cycle before DTC is stored in ECM memory.
- In case that ECM detects a fault (DTC) in column with “Δ” mark, it means temporary fault of internal memory (status memory) for communication to immobilizer control module detected. However, it is no adverse affect for communication. Therefore, it dose not affect engine and emission control system.

Visual Inspection

Visually check the following parts and systems.

INSPECTION ITEM	REFERRING SECTION
Engine oil - - - - level, leakage	Section 0B
Engine coolant - - - - level, leakage	Section 0B
Fuel - - - - level, leakage	Section 0B
A/T fluid - - - - level, leakage	Section 0B
Air cleaner element - - - - dirt, clogging	Section 0B
Battery - - - - fluid level, corrosion of terminal	
Drive belt - - - - tension, damage	Section 0B
Accelerator cable - - - - play (after warm up engine), installation	Section 6E3
Vacuum hoses of air intake system - - - - disconnection, looseness, deterioration, bend	
Connectors of electric wire harness - - - disconnection, friction	
Fuses - - - - burning	Section 8A
Parts - - - - installation, bolt - - - - looseness	
Parts - - - - deformation	
Other parts that can be checked visually	
Also add the following items at engine start, if possible.	
Malfunction indicator lamp operation	Section 6-1
Charge warning lamp operation	Section 6H
Engine oil pressure warning lamp operation	Section 8C
Engine coolant temperature warning lamp operation	Section 8C
Engine coolant temperature meter operation	Section 8C
Fuel level meter operation	Section 8C
Abnormal air being inhaled from air intake system	
Exhaust system - - - - leakage of exhaust gas, noise	
Other parts that can be checked visually	

Engine Basic Check

This check is very important for troubleshooting when ECM has detected no DTC and no abnormality has been found in visual inspection.

Follow the flow table carefully.

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check battery voltage. Is it 11 V or more?	Go to Step 3.	Charge or replace battery.
3	Is engine cranked?	Go to Step 4.	Go to "Diagnosis" in Section 6G.
4	Does engine start?	Go to Step 5.	Go to Step 6.
5	Check engine idle speed referring to "Idle speed Inspection" in Section 6E3. Is check result as specified?	Go to Step 11 in "Engine Diag. Flow Table" in this section.	Go to "Improper Engine Idling or Engine Fails to Idle" under "Engine Diagnosis Table" in this section.
6	Do you have SUZUKI scan tool?	Go to Step 7.	Go to "Diagnosis" in Section 8G. If OK, go to Step 8.
7	Check immobilizer system malfunction as follows. 1) Execute Data List mode of Suzuki mode using ECM application of SUZUKI scan tool. Does Suzuki scan tool indicate communication error message?	Go to "Diagnosis" in Section 8G.	Go to Step 8.
8	Check fuel supply as follows: 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn ON ignition switch for 5 seconds and then OFF. Repeat this a few times. Is fuel return pressure (returning sounds) felt from fuel return hose when ignition switch is turned ON?	Go to Step 10.	Go to Step 9.
9	Check fuel pump for operating. 1) Was fuel pump operating sound heard from fuel pump for about 5 seconds after ignition switch ON and stop?	Go to "Low Pressure Fuel Supply Inspection" in Section 6E3.	Go to "Diag. Flow Table B-1" in this section.
10	Check fuel injector referring to "Fuel Injector" in Section 6E3. Is it in good condition?	Go to "Engine Diagnosis Table" in this section.	Go to "DTC P0201, P0202, P0203, P0204 Flow Table" in this section.

Engine Diagnosis Table

Perform troubleshooting referring to the following table when ECM has detected no DTC and no abnormality has been found in visual inspection and engine basic inspection previously.

Condition	Possible Cause	Correction
Hard starting (Engine cranks OK)	Lack of fuel in fuel tank	Refill.
	Dirty or clogged fuel filter	Replace.
	Water mixed in fuel filter	Repair.
	Dirty or clogged fuel hose or pipe	Clean.
	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Correct.
	Clogged fuel injector	Replace.
	Faulty fuel pump	Inspect and replace.
	Faulty ECM	Replace.
	Faulty fuel pressure sensor	Inspect and replace.
	Faulty CKP sensor (Engine speed sensor)	Inspect and replace.
	Faulty CMP sensor	Inspect, adjust and replace.
	Air mixed in fuel injection pump	Refill fuel in fuel tank.
	Fuel injection pump internal damage	Replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Faulty fuel injector	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty glow plug	Inspect and replace.
	Faulty pre post heating relay	Inspect and replace.
	Compression leak from valve seat	Remove cylinder head and lap valves.
	Sticky valve stem	Correct or replace valve.
	Weak or damaged valve springs	Replace valve springs.
	Compression leak at cylinder head gasket	Repair or replace.
	Sticking or damaged piston ring	Replace piston rings.
	Worn piston, ring or cylinder	Replace ring and piston. Rebore or replace cylinder.
	Immobilizer control system out of order.	Refer to Section 8G.
	Broken valve timing belt	Replace timing belt and repair valve train.
	Faulty EGR throttle valve	Inspect and replace.

Condition	Possible Cause	Correction
Improper engine idling or engine fails to idle	Clogged air cleaner element	Clean or replace.
	EGR throttle valve	Inspect and replace.
	Shortage of fuel in fuel tank	Refill.
	Dirty or clogged fuel filter	Replace.
	Water mixed in fuel filter	Repair.
	Dirty or clogged fuel hose or pipe	Clean.
	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Repair.
	Clogged fuel injector	Replace.
	Faulty fuel pump	Inspect and replace.
	Engine overheating	Refer to "Overheating" section.
	Faulty ECM	Replace.
	Faulty mass air flow sensor	Inspect and replace.
	Faulty fuel injector	Inspect and replace.
	Faulty injection pump solenoid valve (3rd piston deactivator)	Inspect and replace.
	Air mixed in fuel injection pump	Refill fuel in fuel tank.
	Fuel injection pump internal damage	Replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Faulty fuel pressure sensor	Inspect and replace.
	Faulty TP sensor (accelerator stroke sensor)	Inspect and replace.
	Faulty VSS	Inspect and replace.
	Faulty CKP sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty glow plug	Inspect and replace.
	Faulty pre post heating relay	Inspect and replace.
	Faulty EGR solenoid valve	Inspect and repair or replace EGR system.
	Faulty EGR valve	Inspect and repair or replace EGR system.
	Faulty swirl control solenoid valve	Inspect and repair or replace swirl system.
	Faulty swirl control valve	Inspect and repair or replace swirl system.
	Low compression	Previously outlined.
	Faulty A/T shift switch	Inspect and replace.
	Faulty A/C signal	Inspect and replace.
	Mal-adjusted accelerator cable	Adjust.

Condition	Possible Cause	Correction
Abnormal knocking	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Repair.
	Faulty fuel injector	Inspect and replace.
	Faulty ECM	Replace.
	Faulty fuel injection pump	Inspect and replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Faulty pre/post heating relay	Inspect and replace.
	Faulty fuel temperature sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty EGR valve	Inspect and replace.
Engine hesitates when accelerating	Clogged air cleaner element	Clean or replace.
	Faulty turbocharger.	Replace.
	Dirty or clogged fuel filter	Replace.
	Water mixed in fuel filter	Repair.
	Dirty or clogged fuel hose or pipe	Clean or replace.
	Fuel injection pipe cracks	Replace.
	Fuel leakage from fuel injection pipe joints	Repair.
	Clogged fuel injector	Inspect and replace.
	Engine overheating	Refer to "Overheating" section.
	Faulty ECM	Inspect and replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Air mixed in fuel injection pump	Refill fuel in fuel tank.
	Fuel injection pump internal damage	Inspect and replace.
	Faulty injection pump solenoid valve (3rd piston deactivator)	Inspect and replace.
	Faulty MAF sensor	Inspect and replace.
	Faulty TP sensor (Accelerator stroke sensor)	Inspect and replace.
	Faulty intake air pressure sensor	Inspect and replace.
	Faulty CKP sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty IAT sensor	Inspect and replace.
	Faulty EGR solenoid valve	Inspect and repair or replace EGR system.
	Faulty EGR valve	Inspect and repair or replace EGR system.
	Faulty swirl control solenoid valve	Inspect and repair or replace swirl system.
	Faulty swirl control valve	Inspect and repair or replace swirl system.
	Low compression	Previously outlined.
	Mal-adjusted accelerator cable	Replace.

Condition	Possible Cause	Correction
Overheating	Insufficient coolant	Replenish.
	Loose water pump belt	Adjust.
	Inoperative thermostat	Replace.
	Poor water pump performance	Replace.
	Clogged or leaky radiator	Flush, repair or replace.
	Improper engine oil grade	Replace with proper grade oil.
	Clogged oil filter or oil strainer	Replace or clean (oil strainer).
	Not enough oil	Replenish.
	Poor oil pump performance	Repair or replace.
	Oil leakage	Repair.
	Dragging brakes	Repair or replace.
	Slipping clutch	Repair or replace.
	Blown cylinder head gasket	Replace.
Excessive engine oil consumption	Loose oil drain plug	Tighten.
	Loose oil pan bolts	Tighten.
	Deteriorated or broken oil pan sealant	Replace sealant.
	Leaky crankshaft oil seal	Replace.
	Leaky cylinder head cover gasket	Replace.
	Improper tightening of oil filter	Tighten.
	Loose oil pressure switch	Tighten.
	Blown cylinder head gasket	Replace.
	Leaky crankshaft pulley oil seal	Replace.
	Leaky camshaft oil seal	Replace.
	Loose turbocharger oil hose bolts	Tighten.
	Sticky piston ring	Remove carbon and replace rings.
	Worn piston and cylinder	Replace or rebore cylinder, and replace piston.
	Worn piston ring groove and ring	Replace piston and ring.
	Improper location of piston ring gap	Reposition ring gap.
	Worn or damaged valve stem seal	Replace.
	Worn valve stem	Replace.
Lower oil pressure	Improper oil viscosity	Use oil of proper viscosity.
	Malfunctioning oil pressure switch	Replace.
	Not enough oil	Replenish.
	Clogged oil strainer	Clean.
	Functional deterioration of oil pump	Replace.
	Worn oil pump relief valve	Replace.
	Excessive clearance in various sliding parts	Replace worn parts.

Condition	Possible Cause	Correction
Engine noise (See NOTE:)	Improper valve lash	Adjust.
	Worn valve stem and guide	Replace.
	Weak or broken valve spring	Replace.
	Warped or bent valve	Replace.
	Worn piston, ring and cylinder bore	Rebore or replace cylinder. Replace piston and ring.
	Worn crankpin bearing	Replace.
	Worn crankpin	Repair by grinding or replace crankshaft.
	Loose connecting rod nuts	Tighten nuts to specification.
	Low oil pressure	Previously outlined.
	Worn crankshaft journal bearing	Replace.
	Worn crankshaft journal	Repair by grinding or replace crankshaft.
	Loose lower crankcase (bearing cap) bolts	Tighten bolts to specification.
	Excessive crankshaft thrust play	Replace thrust bearing.
	Engine and emission control system out of order	Refer to Section 6E3.
White or blue smoke	Clogged air cleaner element	Clean or replace.
	EGR throttle valve	Inspect and replace.
	Faulty ECM	Inspect and replace.
	Fuel injection pump internal damage	Replace.
	Faulty fuel injector	Inspect and replace.
	Faulty intake air pressure sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty ECM registration data	Inspect and registered.
	Faulty glow plug	Inspect and replace.
	Faulty pre post heating relay	Inspect and replace.
	Low compression	Previously outlined.
	Improper oil level	Adjust.
Black smoke	Faulty turbocharger	Inspect and replace.
	Clogged air cleaner element	Clean or replace.
	EGR throttle valve	Inspect and replace.
	Faulty ECM	Inspect and replace.
	Faulty fuel injector	Inspect and replace.
	Faulty fuel pressure regulator	Inspect and replace.
	Fuel injection pump internal damage	Replace.
	Faulty MAF sensor	Inspect and replace.
	Faulty IAT sensor	Inspect and replace.
	Faulty ECT sensor	Inspect and replace.
	Faulty TP sensor	Inspect and replace.
	Faulty ECM registration data	Inspect and registered.
	Faulty EGR solenoid valve	Inspect and repair or replace EGR system.
	Faulty EGR valve	Inspect and repair or replace EGR system.
	Faulty swirl control solenoid valve	Inspect and repair or replace swirl system.

Condition	Possible Cause	Correction
Black smoke	Faulty swirl control valve	Inspect and repair or replace swirl system.
	Low compression	Previously outlined.

NOTE:

Before checking the mechanical noise, make sure that:

- Injection timing is properly adjusted.
- Specified fuel is used.

Inspection of ECM and Its Circuits

ECM and its circuits can be checked at ECM wiring couplers by measuring voltage and resistance.

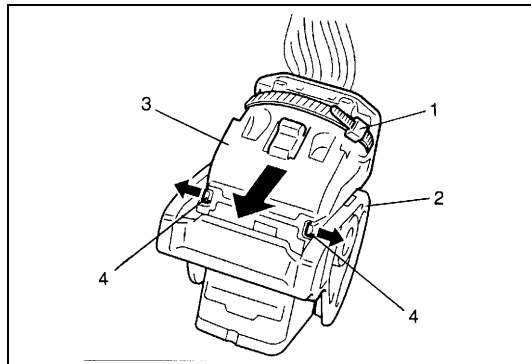
CAUTION:

ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with couplers disconnected from it.

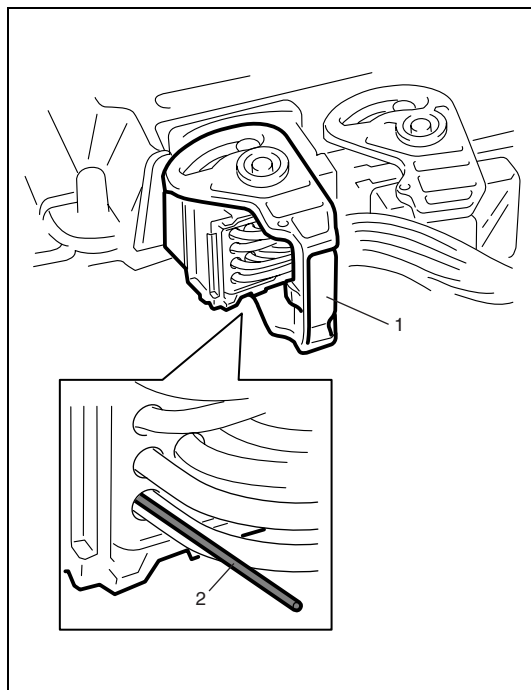
Voltage check

CAUTION:

When measuring the terminal voltages of ECM, try not to damage the waterproof gel applied on the connector terminal of ECM by inserting a pin, whose diameter is less than 0.3 mm, along with the wiring of the ECM terminal. For further details, refer to the figure shown below. Otherwise, ECM and terminals are damaged by entering water into the connector and trouble may occur.



- 1) Remove ECM from ECM bracket referring to "Engine Control Module (ECM)" in Section 6E3.
- 2) Remove harness clamps (1) from ECM harness connector assemblies (2).
- 3) Remove connector covers (3) from ECM harness connector assemblies loosening connector cover locks (4).

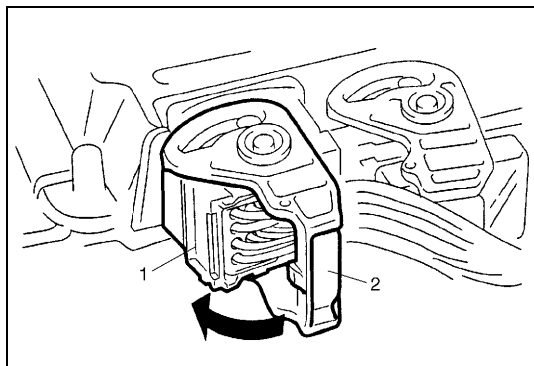


- 4) Connect ECM harness connectors to ECM using connector lock lever (1).
- 5) Measure voltage at each terminal with ignition switch turned ON according to Diag. Flow Table.

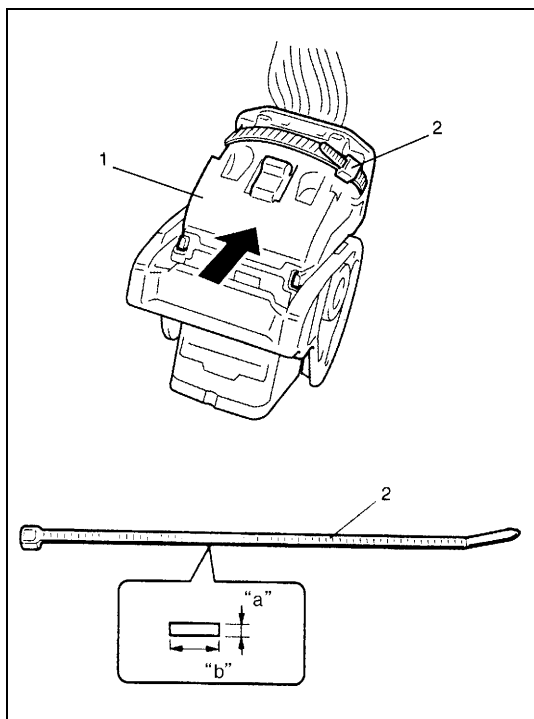
NOTE:

As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON.

2. Pin



- 6) After measuring, disconnect ECM harness connectors (1) from ECM locking connector lock lever (2).



- 7) Install connector covers (1) to ECM harness connectors securely.
 8) Tighten harness clamps (2) with ECM harness and ECM harness connector securely.
 9) Connect ECM connector assemblies to ECM using connector lock lever securely.

NOTE:

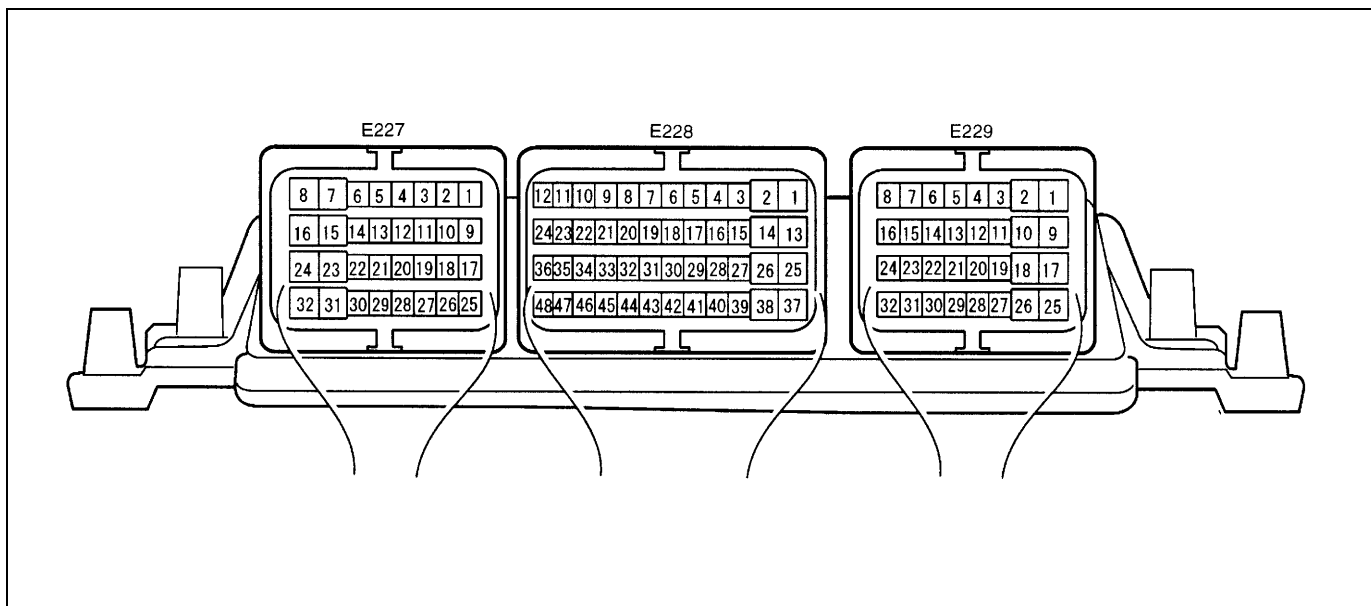
When clamp replacement is necessary, be sure to use a clamp with width and thickness as specified below or less. If a larger clamp is used, lock lever will be caught by clamp and it will be impossible to install ECM connector to ECM.

Width “b”: 2.3 mm

Thickness “a”: 1.2 mm

- 10) Install ECM to bracket referring to “Engine Control Module (ECM)” in Section 6E3.

TERMINAL ARRANGEMENT OF ECM CONNECTOR VIEWED FROM HARNESS SIDE



Resistance check

1) Disconnect couplers from ECM with ignition switch OFF.

CAUTION:

Do not touch terminals of ECM itself or connect voltmeter or ohmmeter (2).

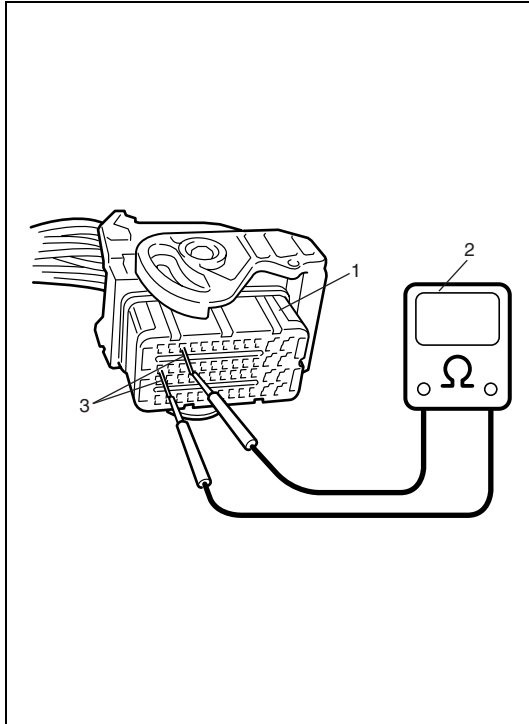
2) Check resistance between each pair of terminals of disconnected couplers (1) as listed in the following table.

CAUTION:

- Be sure to connect ohmmeter probe from terminal side of coupler.
- When measuring the circuit resistance, use a pin (diameter is less than 0.3 mm) (3) for touching to the connector terminal and be careful not to damage to the terminal of the ECM connectors.

The directly connecting of ohmmeter probe to terminals cause poor connection.

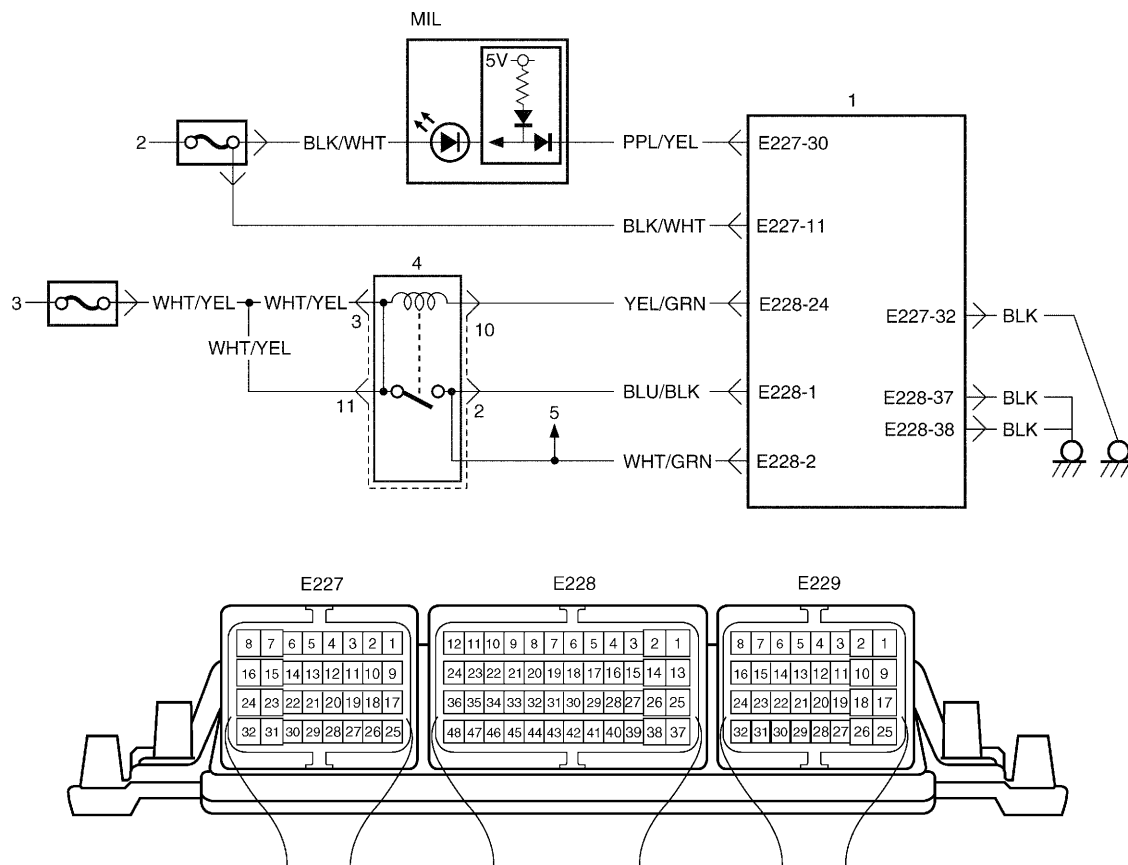
- Be sure to turn OFF ignition switch for this check.
- Resistance in table represents that when parts temperature is 20°C (68°F).



TERMINAL	CIRCUIT	STANDARD RESISTANCE	CONDITION
E229-2 to E229-9	Fuel injector No.1	Max. 1.0 Ω	—
E229-25 to E229-17	Fuel injector No.2	Max. 1.0 Ω	—
E229-26 to E229-18	Fuel injector No.3	Max. 1.0 Ω	—
E229-1 to E229-10	Fuel injector No.4	Max. 1.0 Ω	—
E228-4 to E228-3	CKP sensor	315 – 405 Ω	At 20°C (68°F)
E228-21 to E228-20	Fuel temperature sensor	Refer to “Fuel Temperature Sensor Assembly” in Section 6E3.	
E228-1 to E228-14	Fuel pressure regulator	2 – 3 Ω	At 20°C (68°F)
E228-8 to E228-9	ECT sensor	Refer to “Engine Coolant Temperature Sensor (ECT Sensor)” in Section 6E3.	
E228-37 to Body ground	Ground	Below 1.5 Ω	—
E228-38 to Body ground	Ground	Below 1.5 Ω	—
E227-32 to Body ground	Ground	Below 1.5 Ω	—

Table A-1 Malfunction Indicator Lamp Circuit Check – MIL Does Not Come “ON” or Dims at Ignition Switch ON (But Engine at Stop)

Wiring Diagram



1. ECM	3. Main fuse	5. To radiator fan relay No.3
2. To ignition switch	4. Double relay	

Circuit Description

When the ignition switch is turned ON, ECM causes the double relay to turn ON (close the contact point). Then, ECM being supplied with the main power, turns ON the malfunction indicator lamp (MIL). When the engine starts to run and no malfunction is detected in the system, MIL goes OFF but if a malfunction was or is detected, MIL remains ON even when the engine is running.

Inspection

Step	Action	Yes	No
1	MIL Power Supply Check: 1) Turn ignition switch ON. Do other indicator/warning lights in combination meter comes ON?	Go to Step 2.	"IG COIL" fuse blown, main fuse blown, Ignition switch malfunction, "BLK/WHT" circuit open and poor coupler connection at combination meter.
2	ECM Power and Ground Circuit Check: Does engine start?	Go to Step 3.	Go to "Table A-3 ECM Power and Ground Circuit Check" in this section. If engine is not cranked, go to "Diagnosis" in Section 6G.
3	MIL Circuit Check: 1) Turn ignition switch OFF. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at terminal E227-30. 4) If OK, then using service wire, ground terminal E227-30 in connector disconnected. Does MIL turn on at ignition switch ON?	Substitute a known-good ECM and recheck.	Faulty combination meter or "PPL/YEL" wire circuit open.

Table A-2 Malfunction Indicator Lamp Circuit Check – MIL Remains "ON" after Engine Starts**Wiring Diagram/Circuit Description**

Refer to "Table A-1 Malfunction Indicator Lamp Circuit Check – MIL Does Not Come "ON" or Dims at Ignition Switch ON (But Engine at Stop)" in this section.

Inspection

Step	Action	Yes	No
1	DTC Check. 1) With ignition switch OFF, install scan tool. 2) Start engine and check DTC. Is there any DTC(s).	Go to Step 2 of "Engine Diag. Flow Table" in this section.	Go to Step 2.
2	MIL Circuit Check: 1) Turn ignition switch to OFF position. 2) Disconnect ECM connector referring to "Voltage Check" in this section. Does MIL turn ON at ignition switch ON?	"PPL/YEL" wire shorted to ground circuit.	Substitute a known-good ECM and recheck.

Table A-3 ECM Power and Ground Circuit Check – MIL Doesn't Light at Ignition Switch ON and Engine Doesn't Start Though It Is Cranked Up.

Wiring Diagram

Refer to "Table A-1 Malfunction Indicator Lamp Circuit Check – MIL Does Not Come "ON" or Dims at Ignition Switch ON (But Engine at Stop)" in this section.

Circuit Description

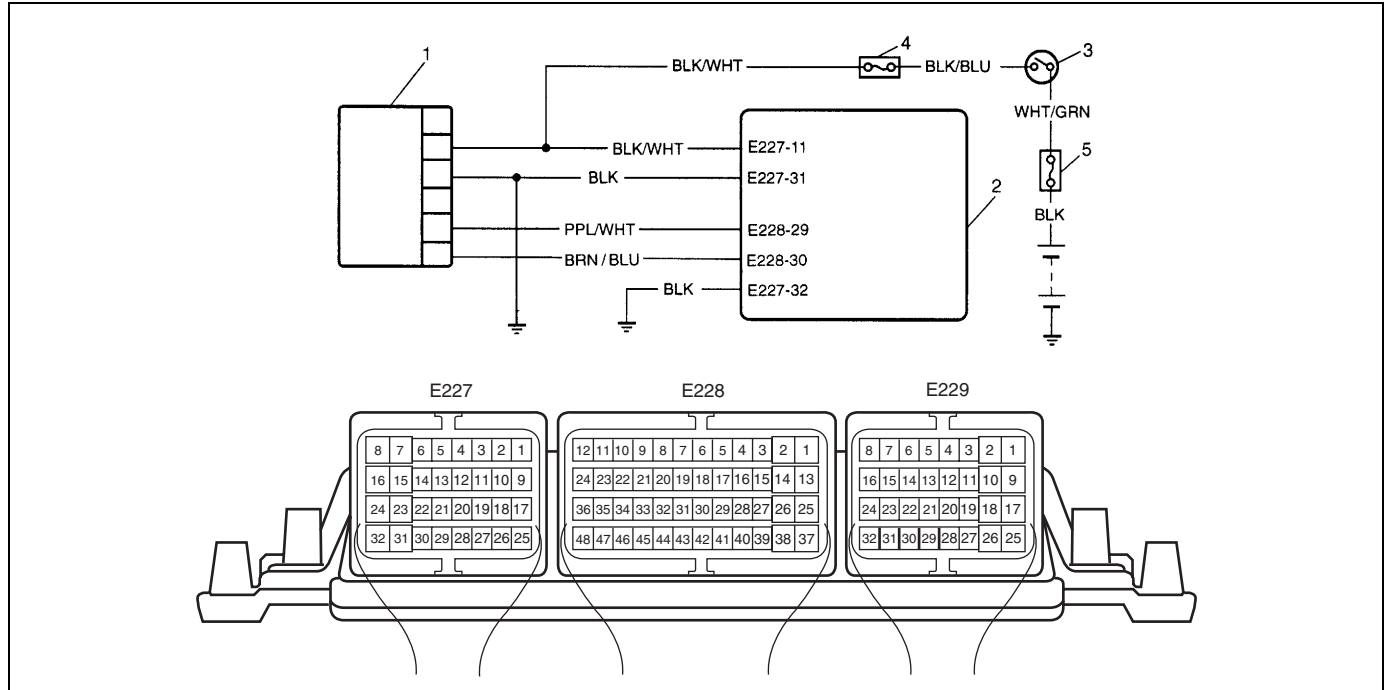
When the ignition switch is turned ON, the double relay turns ON (the contact point closes) and the main power is supplied to ECM.

Inspection

Step	Action	Yes	No
1	Double Relay Operating Sound Check: Is operating sound of double relay heard at ignition switch ON?	Go to Step 5.	Go to Step 2.
2	Fuse Check: Is main "FI" fuse in good condition?	Go to Step 3.	Check for short in circuits connected to this fuse.
3	Double Relay Check: 1) Turn OFF ignition switch and remove double relay. 2) Check for proper connection to double relay at terminal 3 and 10. 3) If OK, check double relay referring to "Double Relay" in Section 6E3. Is check result satisfactory?	Go to Step 4.	Replace double relay.
4	ECM Power Circuit Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector covers referring to "Voltage Check" in this section. 3) Install double relay. 4) Check for proper connection to ECM at terminals E227-11, E228-24, E228-1 and E228-2. 5) If OK, then measure voltage between terminal E227-11 and ground, E228-24 and ground with ignition switch ON. Is each voltage 10 – 14 V?	Go to Step 5.	"BLK/WHT", "YEL/GRN" or "WHT/YEL" circuit open.
5	ECM Power Circuit Check: 1) Using service wire, ground terminal E228-24 and measure voltage between terminal E228-1 and ground, E228-2 and ground at ignition switch ON. Is it 10 – 14 V?	Check ground circuits "BLK" for open. If OK, then substitute a known-good ECM and recheck.	Go to Step 6.
6	Is operating sound of double relay heard in Step 1?	Go to Step 7.	"WHT/YEL" or "BLU/BLK" wire open.
7	Double Relay Check: 1) Check double relay according to procedure in Step 3. Is double relay in good condition?	"WHT/YEL" or "BLU/BLK" wire open.	Replace double relay.

DTC P0100 (P0102/P0103/P3007/P3008) Mass Air Flow Circuit (Low Input/High Input/Plausibility at Low Flow/Plausibility at High Flow)

Wiring Diagram



1. Mass air flow sensor	3. Ignition switch	5. Main fuse
2. ECM	4. "IG COIL" fuse (20 A)	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0100 (P0102): When ECM detects open or shorted to ground in "E228-29" wire circuit. P0100 (P0103): When ECM detects shorted to power in "E228-29" wire circuit. P0100 (P3008): Engine speed between 700 and 5000 rpm and air flow greater than 700 mg/stroke at 1000 rpm or 600 mg/stroke at 4000 rpm. P0100 (P3007): Engine speed between 700 and 5000 rpm and air flow below 320 mg/stroke.	• Mass air flow sensor circuit • Mass air flow sensor malfunction • ECM malfunction • Clogged or leaky air intake system

DTC Confirmation Procedure

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC Confirmation Procedure.

- Intake air temp.: -8°C , 18°F or higher
- Engine coolant temp.: $-8 - 110^{\circ}\text{C}$ ($18 - 230^{\circ}\text{F}$)
- Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed.
- 3) Then keep engine running over 4000 rpm for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

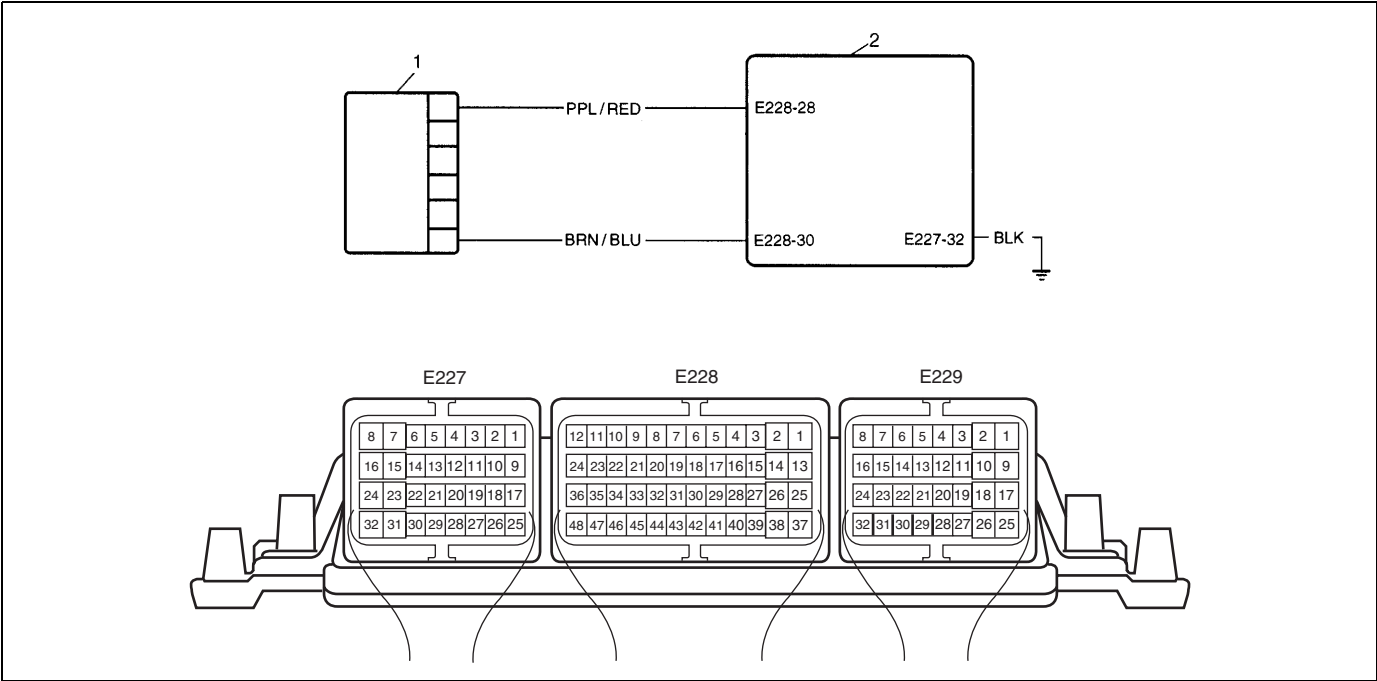
Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	MAF sensor power supply Check: 1) With ignition switch OFF, disconnect MAF sensor coupler. 2) With ignition switch ON, check voltage between "BLK/WHT" wire terminal of MAF sensor coupler and "BLK" wire terminal of MAF sensor coupler. Is voltage 10 – 14 V?	Go to Step 3.	Faulty "BLK/WHT", "BLK" wire.
3	Wiring Harness Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Measure resistance between E228-29 terminal of disconnected ECM connector and "PPL/WHT" wire terminal of MAF sensor connector. Is resistance 1 Ω or less?	Poor E228-29 terminal and "PPL/WHT" wire terminal connection. If OK, go to Step 4.	"PPL/WHT" wire circuit open.
4	Wiring Harness Check: 1) Check continuity between E228-29 terminal of disconnected ECM connector and body ground. Is it infinite?	Go to Step 5.	"PPL/WHT" wire circuit shorted to ground.
5	Wiring Harness Check: 1) With ignition switch ON, check voltage between E228-29 terminal of disconnected ECM connector and "PPL/WHT" wire terminal of MAF sensor connector. Is voltage 0 V?	Go to Step 6.	"PPL/WHT" wire shorted to power circuit.

Step	Action	Yes	No
6	Wiring Harness Check: 1) Turn ignition switch to OFF position. 2) Measure resistance between E228-30 terminal of disconnected ECM connector and “BRN/BLU” wire terminal of MAF sensor connector. Is resistance 1 Ω or less?	Poor E228-30 terminal and “BRN/BLU” wire terminal connection. If OK, go to Step 7.	“BRN/BLU” wire circuit open.
7	Wiring Harness Check: 1) Check continuity between E228-30 terminal of disconnected ECM connector and body ground. Is it infinite?	Go to Step 8.	“BRN/BLU” wire circuit shorted to ground.
8	Wiring Harness Check: 1) With ignition switch ON, check voltage between E228-30 terminal of disconnected ECM connector and “BRN/BLU” wire terminal of MAF sensor connector. Is voltage 0 V?	Go to Step 9.	“BRN/BLU” wire shorted to power circuit.
9	MAF Sensor Output Voltage Check: 1) With ignition switch OFF, connect MAF sensor coupler and ECM connector. 2) Start engine and check voltage between E228-29 and E228-30 terminals of ECM connector under following condition. Engine speed at 3000 rpm: about 3 – 4 V Engine speed at idling: about 2 – 3 V Is each voltage within specified value?	Faulty “BLK” wire connection. If OK, substitute a known-good ECM and recheck.	Clogged or leaky air intake system. If all are OK, substitute a known-good MAF sensor and recheck.

DTC P0110 (P0112/P0113) Intake Air Temperature Sensor Circuit (Low/High)

Wiring Diagram



1. Mass air flow sensor
2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0110 (P0112): Voltage is below 0.1 V or “E228-28” wire terminal of ECM. P0110 (P0113): Voltage is greater than 4.8 V at “E228-28” wire terminal of ECM.	• IAT sensor circuit • IAT sensor malfunction • ECM malfunction

DTC Confirmation Procedure

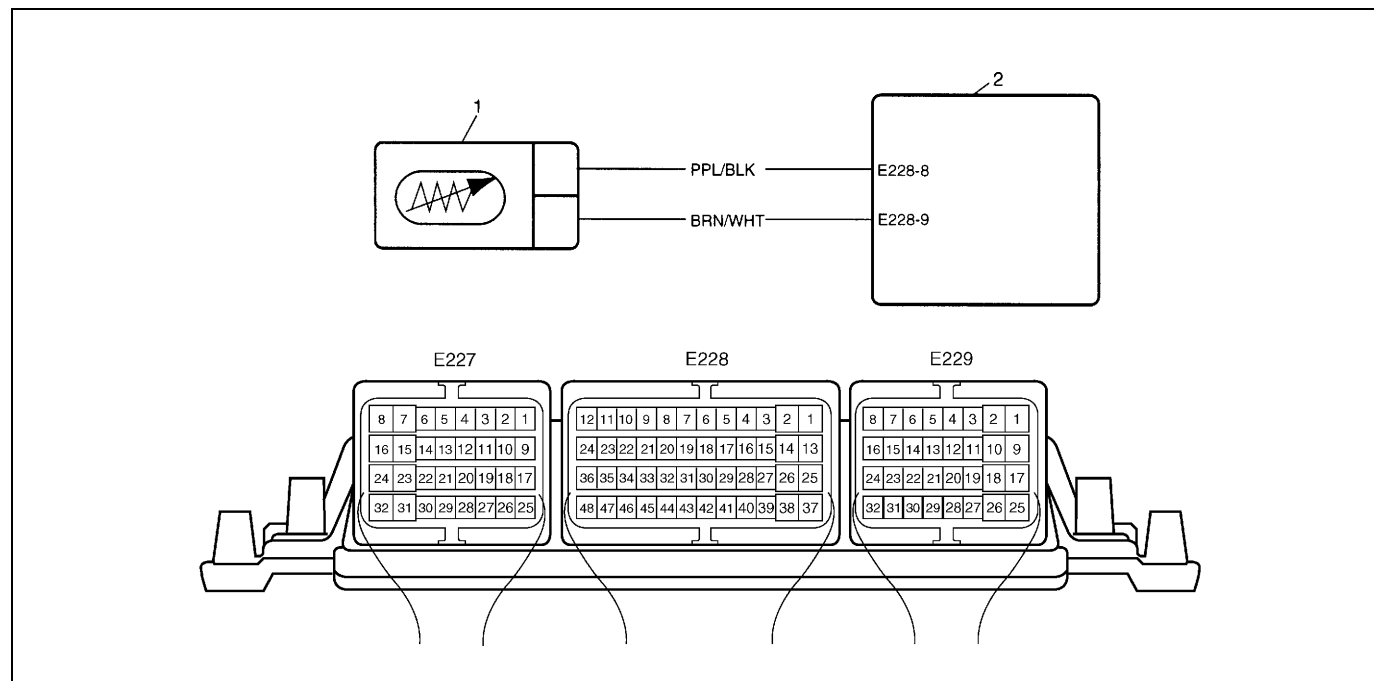
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition switch, then ON.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check IAT Sensor and Its Circuit. 1) Connect scan tool with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) or 131°C (268°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.
3	Check Wire Harness. 1) Disconnect MAF sensor (built-in IAT sensor) connector with ignition switch OFF. 2) Check for proper connection to MAF sensor (built-in IAT sensor) at "PPL/RED" and "BRN/BLU" wire terminals. 3) If OK, then with ignition switch ON, is voltage applied to "PPL/RED" wire terminal of harness side about 5 V?	Go to Step 4.	"PPL/RED" wire open or shorted to power, or poor E228-28 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate -40°C (-40°F) at Step 2?	Go to Step 6.	Go to Step 5.
5	Check Wire Harness. 1) Disconnect MAF sensor (built-in IAT sensor) connector. 2) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) indicated?	Replace MAF sensor (built-in IAT sensor).	"PPL/RED" wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect MAF sensor (built-in IAT sensor) connector terminals. (between "PPL/RED" wire terminal and "BRN/BLU" wire terminal of harness side) 2) Turn ignition switch ON and check intake air temp. displayed on scan tool. Is 131°C (268°F) indicated?	Replace MAF sensor (built-in IAT sensor).	"BRN/BLU" wire open or poor E228-30 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

DTC P0115 (P0117/P0118) Engine Coolant Temperature Circuit (Malfunction/Low/High)

Wiring Diagram



- | |
|--|
| 1. Engine coolant temperature (ECT) sensor |
| 2. ECM |

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0115 (P0117): Voltage is below 0.1 V at "E228-8" wire terminal of ECM. P0115 (P0118): Voltage is greater than 5 V at "E228-8" wire terminal of ECM. P0115 (P0115): Engine coolant temp. fails to reach normal operating temperature even after driving for specified time or engine coolant temp. variation is less than specified value.	• Engine coolant temperature sensor circuit • Engine coolant temperature sensor malfunction • Thermostat malfunction • ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 20 min. or more.
- 3) Check DTC and pending DTC by using scan tool.

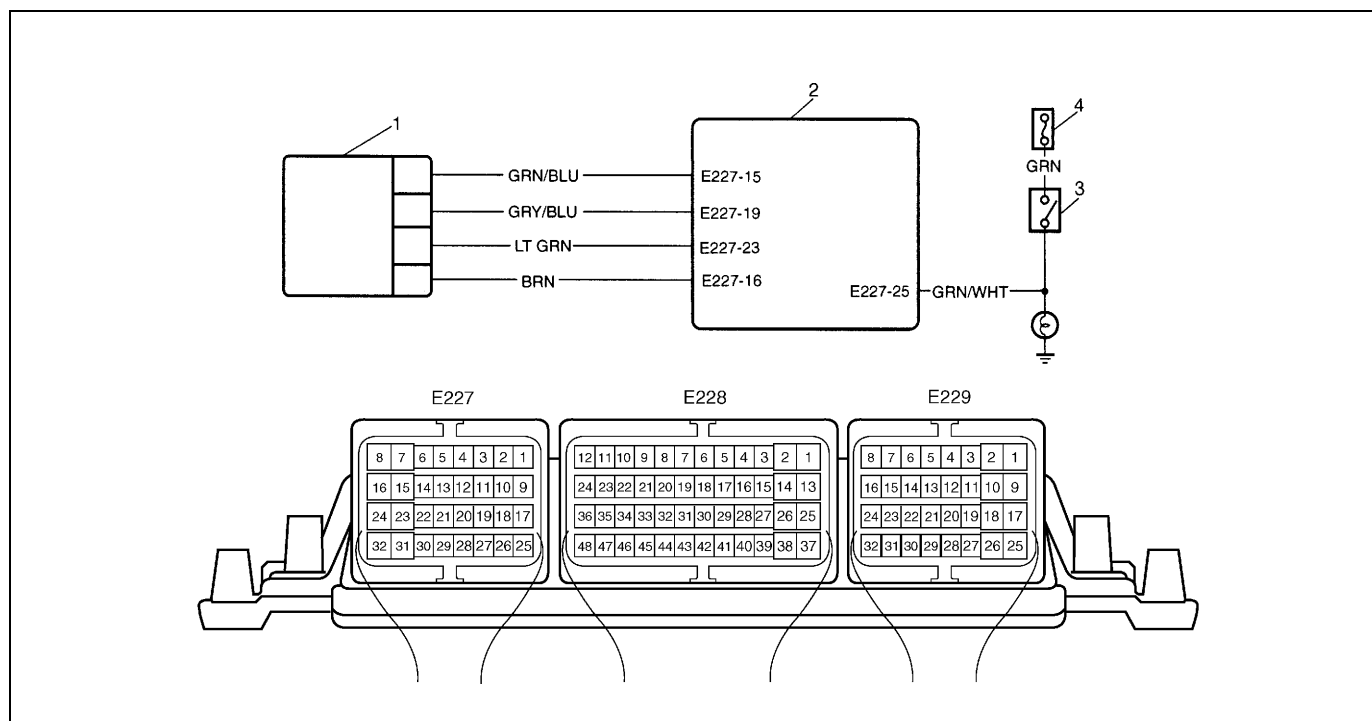
Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check engine coolant temp. 1) With ignition switch turned OFF, install scan tool to DLC. 2) Turn ON ignition switch and check engine coolant temp. displayed on scan tool. 3) Warm up engine to normal operating temp. and check engine coolant temp. displayed on scan tool. Does engine coolant temp. rise more than 5°C (41°F) and is higher than 30°C (86°F)?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.
3	Check thermostat Is there a symptom due to thermostat remaining open (it takes a long time before vehicle heater becomes effective or before engine is warmed to normal operating temp., etc.)?	Check thermostat referring to "Thermostat" in Section 6B.	Go to Step 4.
4	Check Wire Harness. 1) Remove intercooler referring to "Intercooler" in Section 6A3. 2) Disconnect ECT sensor connector with ignition switch OFF. 3) Check for proper connection to ECT sensor at "PPL/BLK" and "BRN/WHT" wire terminals. 4) If OK, check voltage between "PPL/BLK" and "BRN/WHT" wire terminals of harness side with ignition switch ON. Is voltage about 5 V?	Go to Step 5.	"PPL/BLK" wire open or shorted to power/ground. "BRN/WHT" wire open. Poor E228-8 or E228-9 connection.
5	Check ECT Sensor 1) Check ECT sensor referring to "Engine Coolant Temperature Sensor (ECT Sensor)" in Section 6E3. Is check result as specified?	Substitute a known-good ECM and recheck.	Faulty ECT sensor.

DTC P0220 (P0222/P0223/P0224) Pedal Position Sensor “No.1” Circuit (Low/High/Intermittent)

DTC P2299 Accelerator Pedal Position Incompatible

Wiring Diagram



1. Throttle position sensor	3. Brake lamp switch
2. ECM	4. "STOP" fuse (20 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0220 (P0222): Voltage is below 0.1 V at "E227-15" wire terminal of ECM. P0220 (P0223): Voltage is greater than 4.7 V at "E227-15" wire terminal of ECM. P0220 (P0224): Voltage is greater than 5.1 V at "E227-23" wire terminal of ECM or voltage is less than 4.8 V at "E227-23" wire terminal of ECM. P2299: Simultaneous operation of the accelerator and the brake.	• Throttle position sensor circuit • Throttle position sensor malfunction • Brake (stop) lamp switch • ECM malfunction

DTC Confirmation Procedure

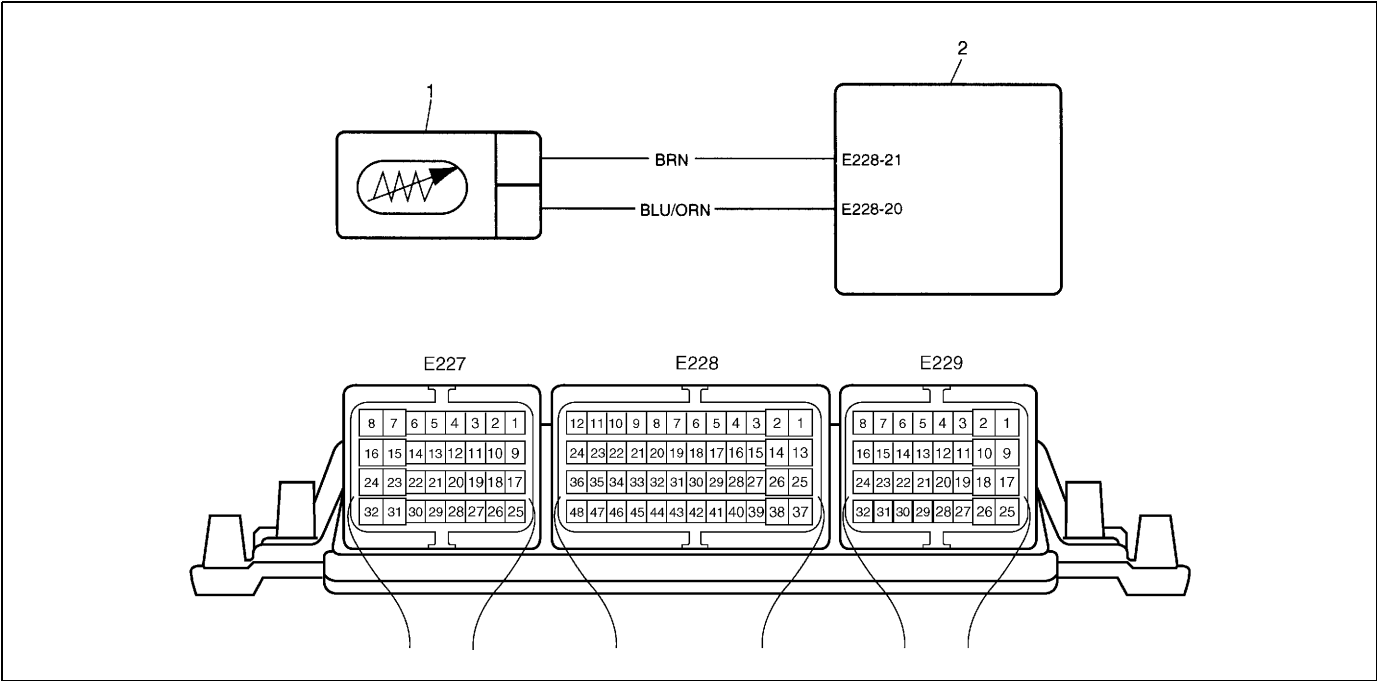
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and warm up to normal operating temperature.
- 4) Drive vehicle at more than 1300 rpm. for 1 min.
- 5) Stop vehicle.
- 6) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit Is DTC below also indicated? <Using Suzuki mode of SUZUKI scan tool> P0609 <Using Generic Scan tool or GST mode of SUZUKI scan tool> P2670 or P2671	Go to "DTC P0609 (P2670/P2671) Actuator Supply Voltage Circuit 2 (Low/High)" in this section.	Go to Step 3.
3	Check Wire Harness. 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at each terminals. 3) If OK, then with ignition switch ON, check voltage between "LT GRN" wire and "BRN" wire terminals at connector of TP sensor. Is voltage about 5 V?	Go to Step 4.	"LT GRN" wire open, "BRN" wire open, poor E227-23 connection, or poor E227-16 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor output voltage. 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors to ECM. 4) With ignition switch ON, check voltage between E227-15 and ground, when accelerator pedal is at idle position to fully depressed position. Is voltage 0.5 – 3.35 V?	Substitute a known-good ECM and recheck.	"GRN/BLU" wire open, "GRN/BLU" wire shorted to ground circuit/power circuit. Poor TP sensor connector. If wire and connection are OK, substitute a known-good TP sensor and recheck.

DTC P0180 (P0182/P0183) Fuel Temperature Sensor Circuit (Low/High)

Wiring Diagram



1. Fuel temperature sensor
2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0180 (P0182): Voltage is below 0.1 V at “E228-20” wire terminal of ECM. P0180 (P0183): Voltage is greater than 4.8 V at “E228-20” wire terminal of ECM.	- Fuel temperature sensor circuit - Fuel temperature sensor malfunction - ECM malfunction

DTC Confirmation Procedure

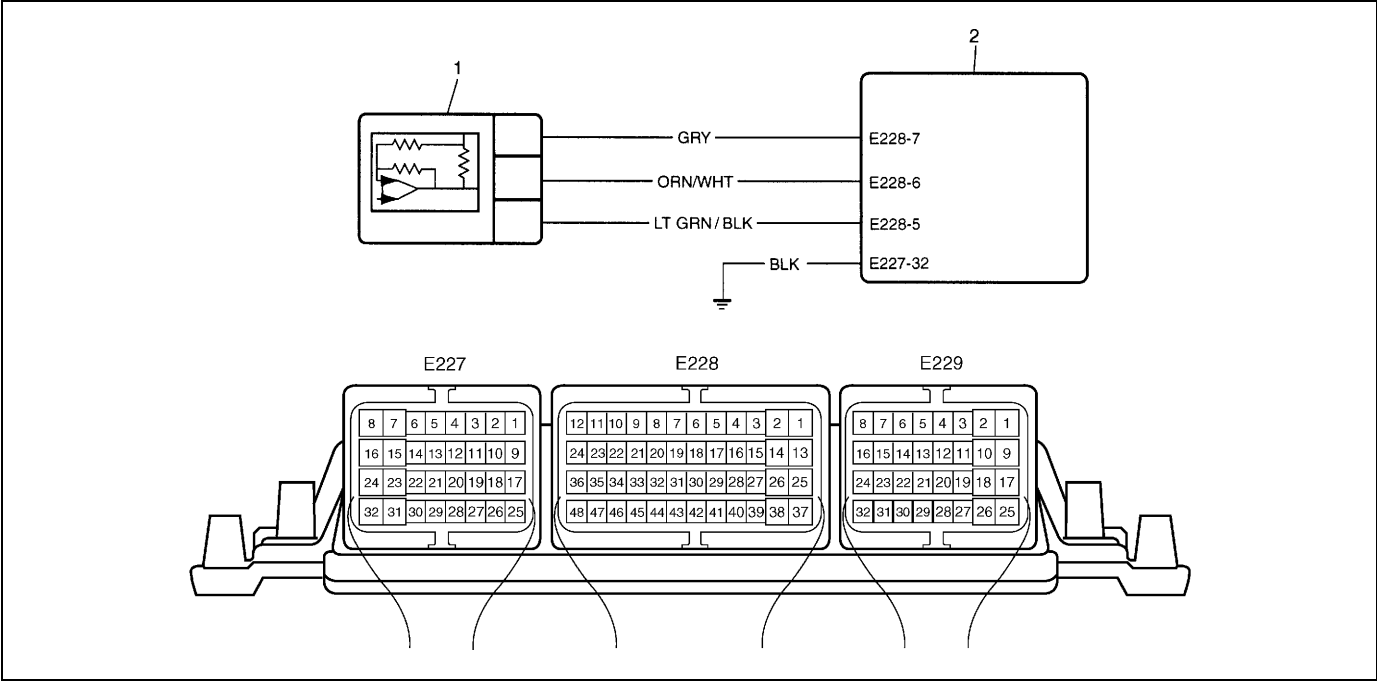
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	1) Remove intercooler referring to "Inter-cooler" in Section 6A3. 2) Disconnect fuel temp. sensor connector with ignition switch OFF. 3) Check for proper connection to fuel temp. sensor at "BLU/ORN" and "BRN" wire terminals. 4) If OK, check voltage between "BLU/ORN" and "BRN" wire terminals with ignition switch ON. Is voltage about 5 V?	Go to Step 3.	"BLU/ORN" wire open or shorted to power/ground. "BRN" wire open. Poor E228-20 or E228-21 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Check fuel temp. sensor for resistance referring to "Fuel Temperature Sensor Assembly" in Section 6E3. Is resistance as specified?	Substitute a known-good ECM and recheck.	Replace fuel temp. sensor.

DTC P0190 (P0192/P0193/P0194) Fuel Rail Pressure Sensor Circuit (Low/High/Intermittent)

Wiring Diagram



1. Fuel pressure sensor
2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0190 (P0192): Voltage is less than 0.3 V at “E228-6” wire terminal of ECM. P0190 (P0193): Voltage is greater than 4.7 V at “E228-6” wire terminal of ECM. P0190 (P0194): Voltage is greater than 5.1 V at “E228-5” wire terminal of ECM or voltage is less than 4.8 V at “E228-5” wire terminal of ECM.	- Fuel rail pressure sensor circuit - Fuel rail pressure sensor malfunction - ECM malfunction

DTC Confirmation Procedure

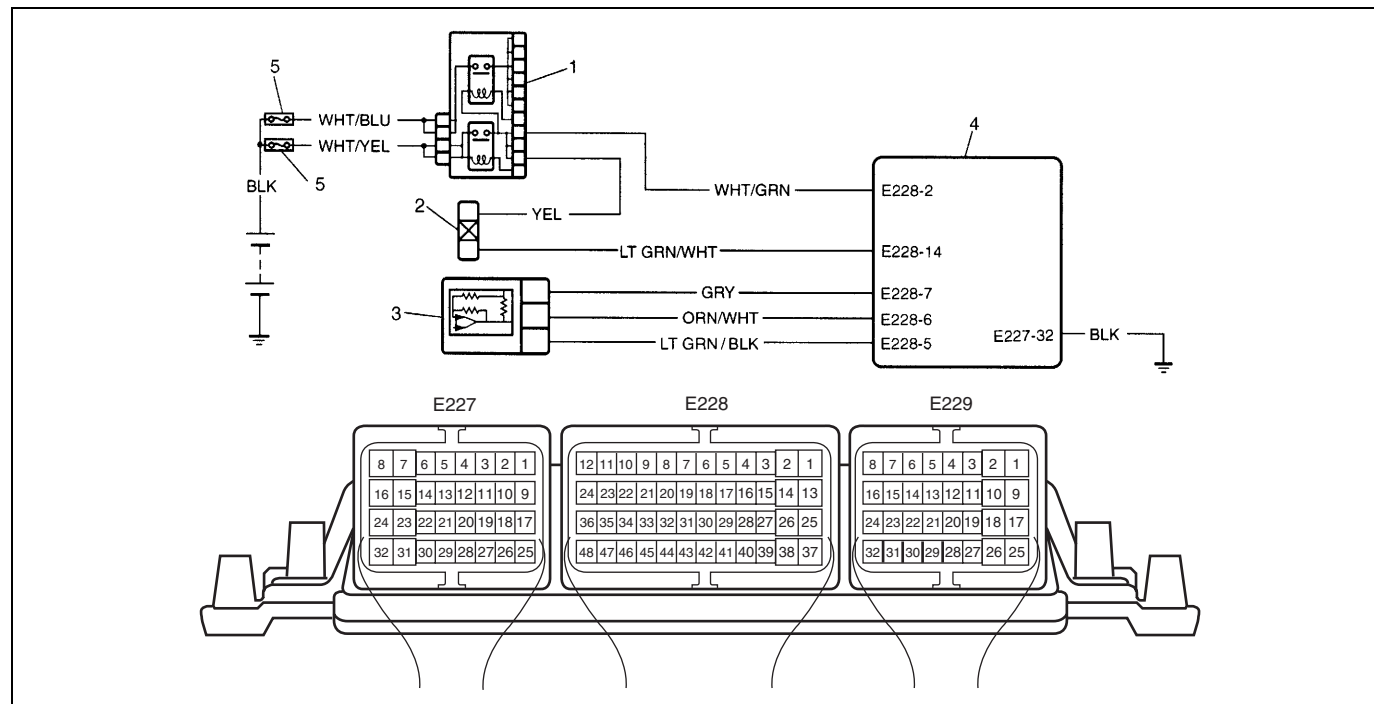
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI scan tool> P0608 <Using Generic Scan tool or GST mode of SUZUKI scan tool> P0658 or P0659	Go to "DTC P0608 (P0658/P0659) Actuator Supply Voltage Circuit 1 (Low/High)" in this section.	Go to Step 3.
3	Check Wire Harness 1) Remove intercooler and intercooler outlet hose. 2) Disconnect connector from fuel pressure sensor with ignition switch OFF. 3) Check for proper connection to fuel pressure sensor at each terminal. 4) If OK, then with ignition switch ON, check voltage between "LT GRN/BLK" wire and "GRY" wire terminals at connector of fuel pressure sensor. Is voltage about 5 V?	Go to Step 4.	"LT GRN/BLK" wire open, "LT GRN/BLK" wire shorted to ground circuit/power circuit, "GRY" wire open, poor E228-5 connection, or poor E228-7 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors to ECM. 4) Connect fuel pressure sensor connector. 5) Install intercooler and intercooler outlet hose. 6) Start engine and check voltage between E228-6 and E227-32 terminal at idle speed. Is voltage about 1.3 V?	Substitute a known-good ECM and recheck.	"ORN/WHT" wire open, "ORN/WHT" wire shorted to ground circuit/power circuit. Poor fuel pressure sensor connector. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.

DTC P0089 (P0089/P0087, P1113/P0088, P1116/P0094) Fuel Pressure Regulator Performance (Malfunction/Fuel Rail Pressure Too Low/Too High/Fuel System Leak Detected – Small Leak)

Wiring Diagram



1. Double relay	3. Fuel pressure sensor	5. Double relay fuse (30 A)
2. Fuel pressure regulator	4. ECM	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0089 (P1166): Fuel rail pressure is higher than 1450 bars. P0089 (P1113): Fuel rail pressure is below the minimum permissible pressure for a given engine speed. P0089 (P0088): Measured fuel rail pressure minus reference fuel rail pressure is greater than 250 bars and fuel pressure regulate ratio is below 10%. P0089 (P0094): Reference fuel rail pressure minus measured fuel rail pressure is greater than 250 bars and fuel pressure regulate ratio is greater than 79%. P0089 (P0087): Reference fuel rail pressure minus measured fuel rail pressure is greater than 250 bars and fuel pressure regulate ratio is criterion. P0089 (P0089): The calculated value based on current measured on fuel pressure regulator and engine speed does not correspond to the pressure given by fuel pressure sensor on basis.	• Double relay and its circuit • Fuel pressure sensor and its circuit • Fuel line clogged or bended • Injection pump malfunction • ECM malfunction

DTC Confirmation Procedure

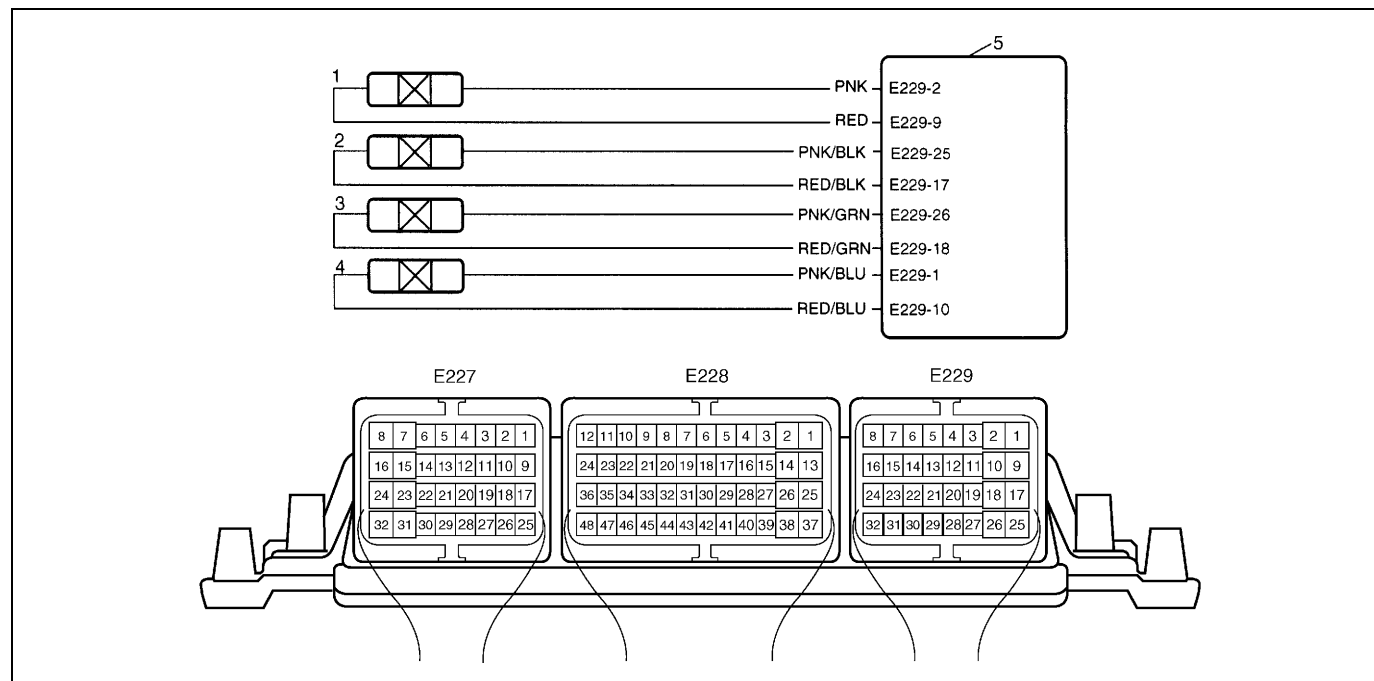
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Then run engine at 1000 rpm or more for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Fuel Shortage 1) Is there enough fuel in fuel tank?	Go to Step 3.	Supply fuel into fuel tank.
3	Check Wire Harness 1) Turn ignition switch OFF position. 2) Remove ECM connector covers referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E228-2 and E228-14 terminals. 4) If OK, check resistance between E228-2 and E228-14 terminals. Is resistance 2 – 3 Ω?	Go to Step 4.	Faulty "WHT/GRN" wire, "YEL" wire or "LT GRN/WHT" wire. If wire is OK, substitute a known-good double relay or injection pump and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Connect ECM connectors to ECM. 2) Start engine and check voltage between E228-6 and E227-32 terminal at idle speed. Is voltage about 1.3 V?	Go to Step 5.	"ORN/WHT" wire open, "ORN/WHT" wire shorted to ground circuit/power circuit. Poor fuel pressure sensor connector terminal connection. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.
5	Check Fuel Leakage 1) Perform step 1), 2) and 3) of "DTC Confirmation Procedure". 2) Check fuel leakage on Fuel System. Is it in good condition?	• Fuel line clogged or bended. • Faulty fuel pressure regulator. If OK, substitute a known-good ECM and recheck.	Repair or replace.

DTC P0201 (P0201/P0261/P0262/P1372) Injector Circuit – Cylinder 1 (Malfunction/Low/High/ Short)

Wiring Diagram



1. Fuel injector No.1	3. Fuel injector No.3	5. ECM
2. Fuel injector No.2	4. Fuel injector No.4	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0201 (P0261): Excessive high voltage at “E229-9” wire terminal of ECM. P0201 (P0262): Excessive high voltage at “E229-2” wire terminal of ECM. P0201 (P0201): Insufficient current between “E229-2” and “E229-9” wire terminals during injection command. P0201 (P1372): The current between “E229-2” and “E229-9” wire terminals is still present after the injection.	- Fuel injector circuit - Fuel injector malfunction - ECM malfunction - Battery or charging system malfunction

NOTE:

When DTC P0201 (P0261/P0262), P0202 (P0264/P0265), P0203 (P0267/P0268) and P0204 (P0267/P0268) are indicated together, it is possible that battery or charging system is malfunction.

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Charging Voltage 1) Check battery referring to "Battery" under "Diagnosis" in Section 6H. 2) If OK, start engine and check charging voltage. Is charging voltage 12 – 15 V?	Go to Step 3.	Check charging system referring to "Under-charged Battery" or "Overcharged Battery" in Section 6H.
3	Check Fuel Injector Circuit 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E229-2 and E229-9 terminals. 4) If OK, remove intercooler and then disconnect connector from fuel injector No.1. 5) Check for proper connection to fuel injector at "PNK" and "RED" wire terminals. 6) Connect connector to fuel injector. 7) Measure resistance between E229-2 and E229-9 terminals of ECM connector. Is resistance 0.56 Ω (maximum)?	Go to Step 4.	Open "PNK" wire or "RED" wire. If wire is OK, substitute a known-good fuel injector and recheck.
4	Check Fuel Injector Circuit 1) Disconnect connector from fuel injector No.1. 2) Measure resistance between E229-2 and E229-9 terminals of ECM connector. Is resistance infinity?	Go to Step 5.	"PNK" wire is shorted to "RED" wire.
5	Check Fuel Injector Circuit 1) Turn ignition switch to ON position. 2) Measure voltage between E229-9 terminal of ECM connector and engine ground. Is voltage 0 V?	Substitute a known-good ECM and recheck.	"RED" wire is shorted to power circuit.

DTC P0202 (P0202/P0264/P0265/P1373) Injector Circuit – Cylinder 2 (Malfunction/Low/High/ Short)

Wiring Diagram

Refer to “DTC P0201 (P0201/P0261/P0262/P1372) Injector Circuit – Cylinder 1 (Malfunction/Low/High/Short)” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0202 (P0264): Excessive high voltage at “E229-17” wire terminal of ECM. P0202 (P0265): Excessive high voltage at “E229-25” wire terminal of ECM. P0202 (P0202): Insufficient current between “E229-17” and “E229-25” wire terminals during injection command. P0202 (P1373): The current between “E229-17” and “E229-25” wire terminals is still present after the injection.	• Fuel injector circuit • Fuel injector malfunction • ECM malfunction • Battery or charging system malfunction

NOTE:

When DTC P0201 (P0261/P0262), P0202 (P0264/P0265), P0203 (P0267/P0268) and P0204 (P0267/P0268) are indicated together, it is possible that battery or charging system is malfunction.

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Charging Voltage 1) Check battery referring to "Battery" under "Diagnosis" in Section 6H. 2) If OK, start engine and check charging voltage. Is charging voltage 12 – 15 V?	Go to Step 3.	Check charging system referring to "Under-charged Battery" or "Overcharged Battery" in Section 6H.
3	Check Fuel Injector Circuit 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E229-25 and E229-17 terminals. 4) If OK, remove intercooler and then disconnect connector from fuel injector No.2. 5) Check for proper connection to fuel injector at "PNK/BLK" and "RED/BLK" wire terminals. 6) Connect connector to fuel injector. 7) Measure resistance between E229-25 and E229-17 terminals of ECM connector. Is resistance 0.56 Ω (maximum)?	Go to Step 4.	Open "PNK/BLK" wire or "RED/BLK" wire. If wire is OK, substitute a known-good fuel injector and recheck.
4	Check Fuel Injector Circuit 1) Disconnect connector from fuel injector No.2. 2) Measure resistance between E229-25 and E229-17 terminals of ECM connector. Is resistance infinity?	Go to Step 5.	"PNK/BLK" wire is shorted to "RED/BLK" wire.
5	Check Fuel Injector Circuit 1) Turn ignition switch to ON position. 2) Measure voltage between E229-17 terminal of ECM connector and engine ground. Is voltage 0 V?	Substitute a known-good ECM and recheck.	"RED/BLK" wire is shorted to power circuit.

DTC P0203 (P0203/P0267/P0268/P1374) Injector Circuit – Cylinder 3 (Malfunction/Low/High/ Short)

Wiring Diagram

Refer to “DTC P0201 (P0201/P0261/P0262/P1372) Injector Circuit – Cylinder 1 (Malfunction/Low/High/Short)” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0203 (P0267): Excessive high voltage at “E229-18” wire terminal of ECM. P0203 (P0268): Excessive high voltage at “E229-26” wire terminal of ECM. P0203 (P0203): Insufficient current between “E229-18” and “E229-26” wire terminals during injection command. P0203 (P1374): The current between “E229-18” and “E229-26” wire terminals is still present after the injection.	• Fuel injector circuit • Fuel injector malfunction • ECM malfunction • Battery or charging system malfunction

NOTE:

When DTC P0201 (P0261/P0262), P0202 (P0264/P0265), P0203 (P0267/P0268) and P0204 (P0267/P0268) are indicated together, it is possible that battery or charging system is malfunction.

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Charging Voltage 1) Check battery referring to "Battery" under "Diagnosis" in Section 6H. 2) If OK, start engine and check charging voltage. Is charging voltage 12 – 15 V?	Go to Step 3.	Check charging system referring to "Under-charged Battery" or "Overcharged Battery" in Section 6H.
3	Check Fuel Injector Circuit 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E229-26 and E229-18 terminals. 4) If OK, remove intercooler and then disconnect connector from fuel injector No.3. 5) Check for proper connection to fuel injector at "PNK/GRN" and "RED/GRN" wire terminals. 6) Connect connector to fuel injector. 7) Measure resistance between E229-26 and E229-18 terminals of ECM connector. Is resistance 0.56 Ω (maximum)?	Go to Step 4.	Open "PNK/GRN" wire or "RED/GRN" wire. If wire is OK, substitute a known-good fuel injector and recheck.
4	Check Fuel Injector Circuit 1) Disconnect connector from fuel injector No.3. 2) Measure resistance between E229-26 and E229-18 terminals of ECM connector. Is resistance infinity?	Go to Step 5.	"PNK/GRN" wire is shorted to "RED/GRN" wire.
5	Check Fuel Injector Circuit 1) Turn ignition switch to ON position. 2) Measure voltage between E229-18 terminal of ECM connector and engine ground. Is voltage 0 V?	Substitute a known-good ECM and recheck.	"RED/GRN" wire is shorted to power circuit.

DTC P0204 (P0204/P0267/P0268/P1374) Injector Circuit – Cylinder 4 (Malfunction/Low/High/ Short)

Wiring Diagram

Refer to “DTC P0201 (P0201/P0261/P0262/P1372) Injector Circuit – Cylinder 1 (Malfunction/Low/High/Short)” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0204 (P0267): Excessive high voltage at “E229-10” wire terminal of ECM. P0204 (P0268): Excessive high voltage at “E229-1” wire terminal of ECM. P0204 (P0204): Insufficient current between “E229-10” and “E229-1” wire terminals during injection command. P0204 (P1374): The current between “E229-10” and “E229-1” wire terminals is still present after the injection.	• Fuel injector circuit • Fuel injector malfunction • ECM malfunction • Battery or charging system malfunction

NOTE:

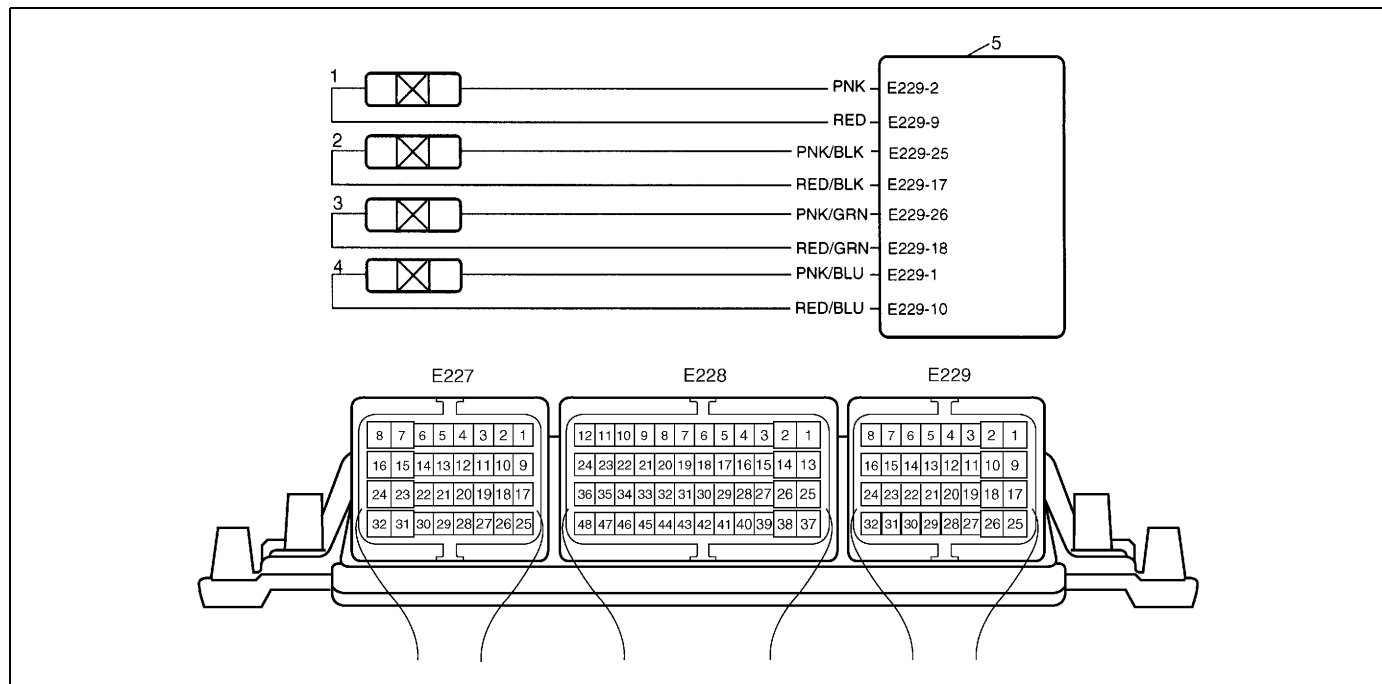
When DTC P0201 (P0261/P0262), P0202 (P0264/P0265), P0203 (P0267/P0268) and P0204 (P0267/P0268) are indicated together, it is possible that battery or charging system is malfunction.

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Charging Voltage 1) Check battery referring to "Battery" under "Diagnosis" in Section 6H. 2) If OK, start engine and check charging voltage. Is charging voltage 12 – 15 V?	Go to Step 3.	Check charging system referring to "Under-charged Battery" or "Overcharged Battery" in Section 6H.
3	Check Fuel Injector Circuit 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E229-1 and E229-10 terminals. 4) If OK, remove intercooler and then disconnect connector from fuel injector No.4. 5) Check for proper connection to fuel injector at "PNK/BLU" and "RED/BLU" wire terminals. 6) Connect connector to fuel injector. 7) Measure resistance between E229-1 and E229-10 terminals of ECM connector. Is resistance 0.56 Ω (maximum)?	Go to Step 4.	Open "PNK/BLU" wire or "RED/BLU" wire. If wire is OK, substitute a known-good fuel injector and recheck.
4	Check Fuel Injector Circuit 1) Disconnect connector from fuel injector No.4. 2) Measure resistance between E229-1 and E229-10 terminals of ECM connector. Is resistance infinity?	Go to Step 5.	"PNK/BLU" wire is shorted to "RED/BLU" wire.
5	Check Fuel Injector Circuit 1) Turn ignition switch to ON position. 2) Measure voltage between E229-10 terminal of ECM connector and engine ground. Is voltage 0 V?	Substitute a known-good ECM and recheck.	"RED/BLU" wire is shorted to power circuit.

DTC P1169 Condenser 1 Voltage Too Low/High**DTC P1170 Condenser 2 Voltage Too Low/High****Wiring Diagram**

1. Fuel injector No.1	3. Fuel injector No.3	5. ECM
2. Fuel injector No.2	4. Fuel injector No.4	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Electromotive force of fuel injector is greater than 90 V or below 40 V with over 500 rpm.	- Fuel injector circuit - Fuel injector malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

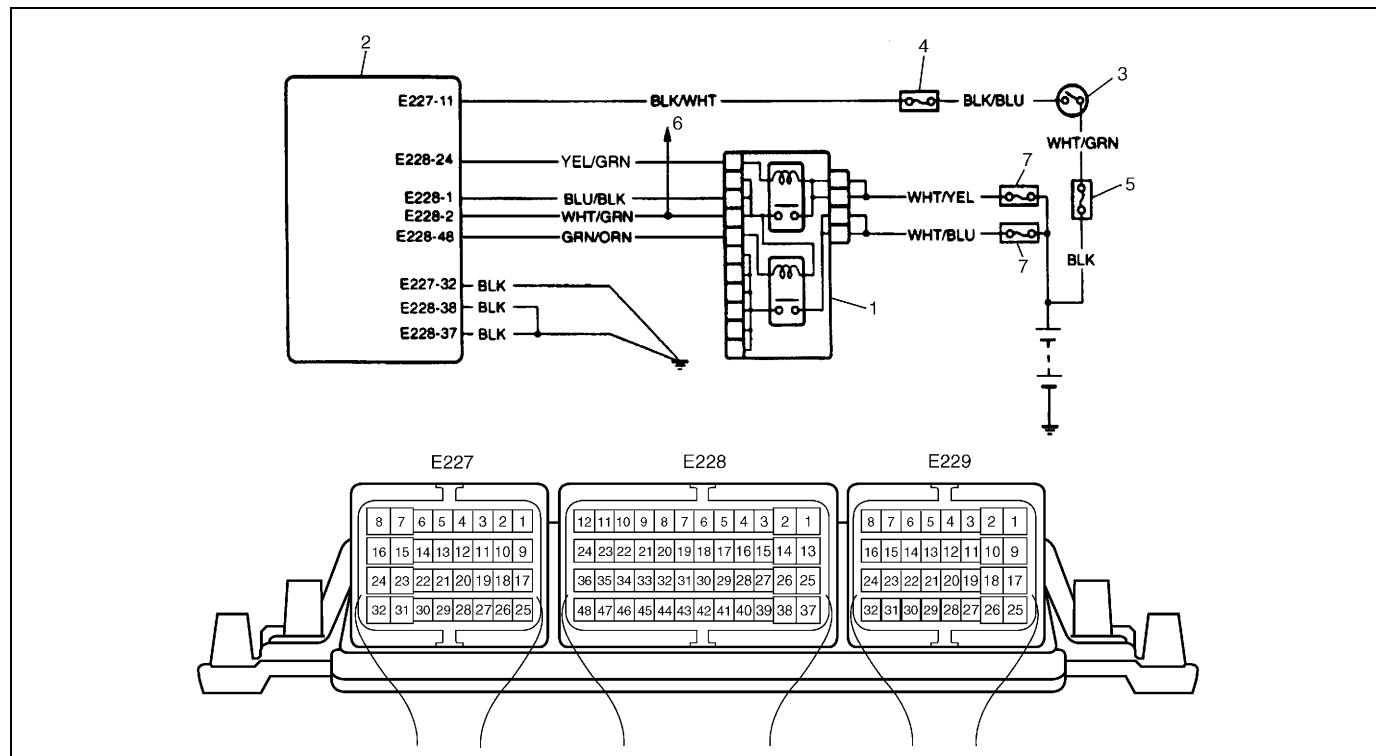
Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Fuel Injector Circuit for Short 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E229-2, E229-9, E229-25, E229-17, E229-26, E229-18, E229-1 and E229-10 terminals. 4) If OK, remove intercooler and then disconnect connector at all fuel injectors. 5) Check for proper connection of all fuel injector connector. 6) If OK, measure resistance between the following terminals of fuel injector connectors. "PNK" and "RED": Fuel injector No.1 "PNK/BLK" and "RED/BLK": Fuel injector No.2 "PNK/GRN" and "RED/GRN": Fuel injector No.3 "PNK/BLU" and "RED/BLU": Fuel injector No.4 Is resistance between terminals of all fuel injectors infinity (∞)?	Go to Step 3.	Short circuit between "PNK" wire and "RED" wire, "PNK/BLK" wire and "RED/BLK" wire, "PNK/GRN" wire and "RED/GRN" wire, or "PNK/BLU" wire and "RED/BLU" wire.
3	Check Fuel Injector Circuit for Short 1) Measure resistance between "PNK", "RED", "PNK/BLK", "RED/BLK", "PNK/GRN", "RED/GRN", "PNK/BLU", "RED/BLU" wires and engine ground. Is each resistance infinity?	Go to Step 4.	"PNK" wire, "RED" wire, "PNK/BLK" wire, "RED/BLK" wire, "PNK/GRN" wire, "RED/GRN" wire, "PNK/BLU" wire or "RED/BLU" wire shorted to ground circuit.
4	Check Fuel Injector Circuit for Short 1) Turn ignition switch to ON position. 2) Measure voltage between "PNK", "RED", "PNK/BLK", "RED/BLK", "PNK/GRN", "RED/GRN", "PNK/BLU", "RED/BLU" wires and engine ground. Is each voltage 0 V?	Go to Step 5.	"PNK" wire, "RED" wire, "PNK/BLK" wire, "RED/BLK" wire, "PNK/GRN" wire, "RED/GRN" wire, "PNK/BLU" wire or "RED/BLU" wire shorted to other circuit.

Step	Action	Yes	No
5	Check Fuel Injector Circuit for Open 1) Turn ignition switch to OFF position. 2) Connect connector to all fuel injectors. 3) Measure for resistance between the following terminals of ECM connector. E229-2 and E229-9: 0.56 Ω (maximum) E229-25 and E229-17: 0.56 Ω (maximum) E229-26 and E229-18: 0.56 Ω (maximum) E229-1 and E229-10: 0.56 Ω (maximum) Is check result as specified?	Substitute a known-good ECM and recheck.	Substitute a known-good fuel injector and recheck.

DTC P0215 Engine Shutoff Solenoid

Wiring Diagram



1. Double relay	3. Ignition switch	5. Main fuse	7. Double relay fuse (30 A)
2. ECM	4. "IG COIL" fuse (20 A)	6. To radiator fan relay No.3	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Cutting off the ECM supply (for double relay) with no ECM command or cutting off the ECM supply (for double relay) for more than 2 seconds.	- Double relay circuit - Double relay malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ON ignition switch after OFF for 5 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Double Relay Function 1) Turn ignition switch ON for 5 sec. and then OFF. Is click of double relay heard from double relay at 2 sec. after ignition switch OFF?	Substitute a known-good ECM and recheck.	Go to Step 3.
3	1) Remove ECM connector covers referring to "Voltage Check" in this section. 2) Connect ECM connectors to ECM. 3) Check voltage between E228-1/2 and ground, between E227-11 and ground. Ignition switch ON: 10 – 14 V Ignition switch OFF: about 0 V Is check result as specified?	Poor E228-1/2 and/or E227-11 connection. If connection is OK, substitute a known-good ECM and recheck.	Go to Step 4.
4	Check Double Relay 1) Check double relay referring to "Double Relay" in Section 6E3. Is it in good condition?	Go to Step 5.	Faulty double relay.
5	1) Check voltage between E228-24 and ground. Ignition switch ON: about 0 V Ignition switch OFF: 10 – 14 V Is check result as specified?	• Poor E228-24 connection. • "BLU/BLK" wire open/short. • "WHT/GRN" wire open/short.	"YEL/GRN" wire open or short.

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Turn ON ignition switch after OFF for 5 sec.
- 4) Check DTC and pending DTC by using scan tool.

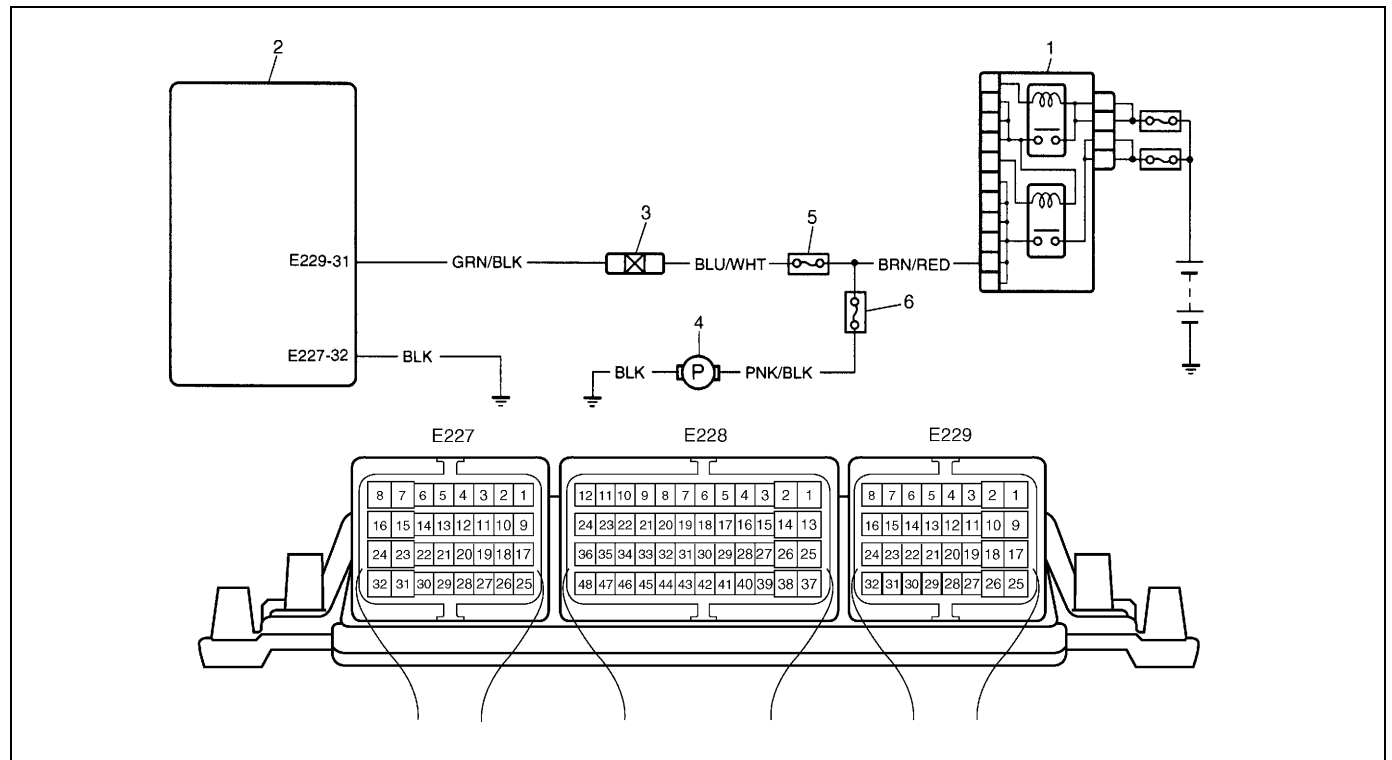
Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Substitute a known-good ECM and recheck.	Go to Step 3.
3	Check Double Relay 1) Check double relay referring to "Double Relay" in Section 6E3. Is it in good condition?	Go to Step 4.	Faulty double relay.
4	Check Fuel Pump Output Circuit 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors to ECM. 4) Check voltage between E228-48 and ground. • Within 5 sec. after ignition switch ON: about 0 V • Over 5 sec. after Ignition switch OFF: 10 – 14 V Is check result as specified?	• Poor E228-48 connection • "BLK", "PNK/BLK" or "BRN/RED" wire open/short • Fuse broken • Faulty fuel pump If all are OK, substitute a known-good ECM and recheck.	"GRN/ORN" wire open/short.

DTC P0243 (P0243/P0246) Turbo Charger Waste Gate Solenoid (Malfunction/High)

DTC P0245 (P0245) Turbo Charger Waste Gate Solenoid Low

Wiring Diagram



1. Double relay	3. Boost pressure regulator solenoid valve	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0243 (P0243): When ECM detects open in "E229-31" wire circuit. P0243 (P0246): When ECM detects shorted to power in "E229-31" wire circuit. P0245 (P0245): When ECM detects shorted to ground in "E229-31" wire circuit.	- Boost pressure regulator solenoid valve circuit - Boost pressure regulator solenoid valve malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Primary Circuit" in this section.
3	Check Wire Harness 1) Disconnect boost pressure regulator solenoid valve connector with ignition switch OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector disconnected and ground. Within 5 sec. after ignition switch ON: about 12 V Over 5 sec. after ignition switch ON: 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check Boost Pressure Regulator Solenoid Valve 1) Check solenoid valve referring to "Boost Pressure Regulator Solenoid Valve" in Section 6E3. Is check result as specified?	"GRN/BLK" wire open or shorted to power/ground. Poor E229-31 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty solenoid valve.

DTC P0234 (P0234) Turbo Charger Over Boost Condition**DTC P0299 (P0299) Turbo Charger Under Boost****Wiring Diagram**

Refer to “DTC P0243 (P0243/P0246) Turbo Charger Waste Gate Solenoid (Malfunction/High)” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0299 (P0299): Reference pressure minus the pressure measured is greater than 200 mbars for more than 10 seconds. P0234 (P0234): Reference pressure minus the pressure measured is less than -300 mbars for more than 10 seconds.	• Vacuum circuit for leak, clogged and bended • Boost pressure regulator solenoid valve malfunction • ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

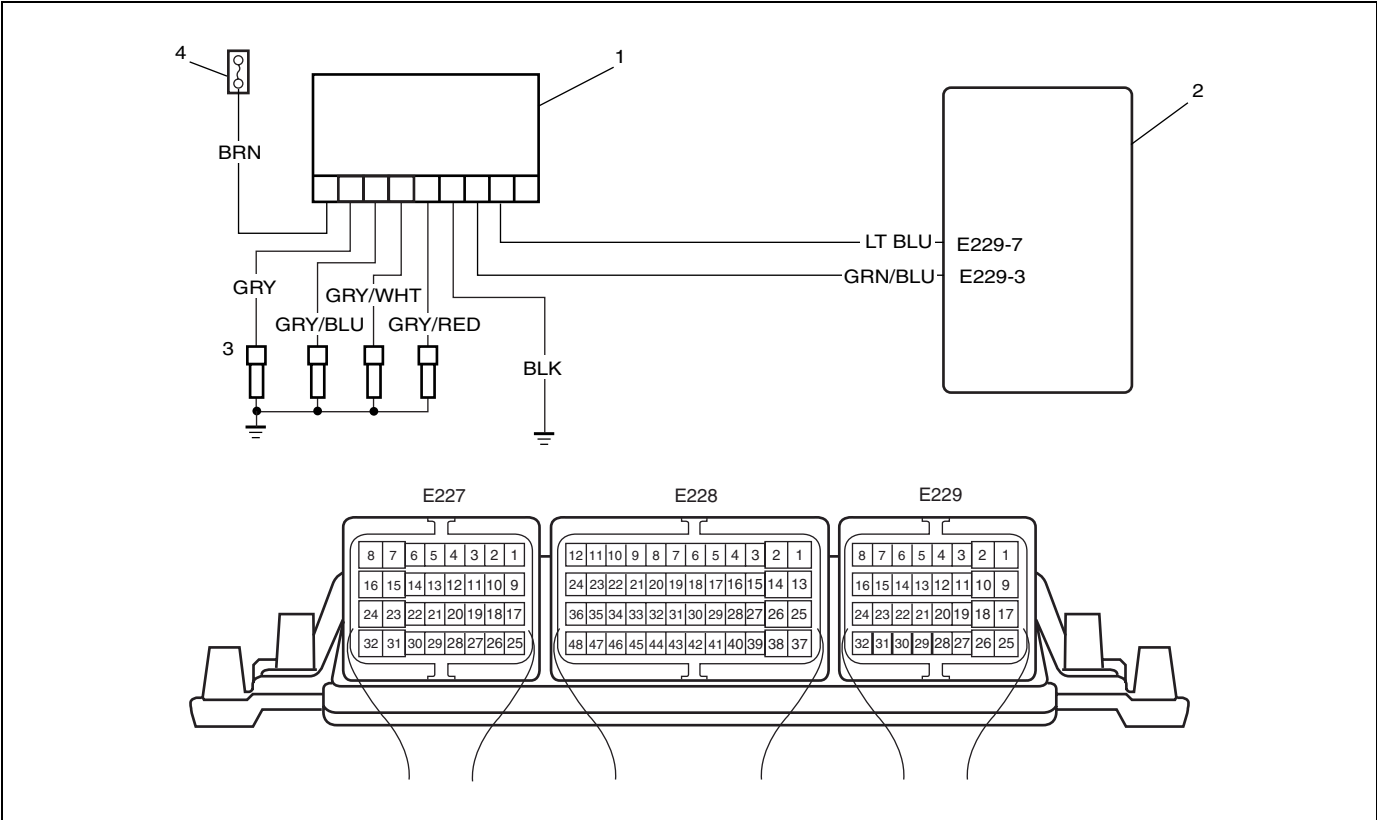
Troubleshooting

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table” in this section.
2	Check Vacuum Circuit Check vacuum circuit for leak and clogging. Is it in good condition?	Go to Step 3.	Repair or replace.
3	Check boost pressure regulator solenoid valve for resistance referring to “Boost Pressure Regulator Solenoid Valve” in Section 6E3. Is resistance as specified?	Substitute a known-good ECM and recheck.	Replace boost pressure regulator solenoid valve.

DTC P0380 (P1351/P1352/P1349/P1350) Glow Plug Circuit (Excess Voltage/ Relay Jammed/Short/Open)

DTC P1404 TL4226 Circuit Malfunction

Wiring Diagram



1. Pre/post heating relay (control unit)	3. Glow plugs
2. ECM	4. Main fuse

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0380 (P1352): Pre/post heating relay is jammed open, “E229-3” wire terminal is low voltage or at least one of the 4 glow plugs is burnt-out. P0380 (P1351): When ECM detects high voltage at “E229-3” wire terminal. P0380 (P1349): When ECM detects shorted to power or ground in “E229-7” wire circuit. P0380 (P1350): When ECM detects open in “E229-7” wire circuit. P1404: When ECM detects open in both “E229-3” and “E229-7” wire circuits or glow fuse (main fuse) broken.	• Fuse broken • Pre/post heating relay circuit • Pre/post heating relay malfunction • Glow plug malfunction • ECM malfunction

DTC Confirmation Procedure

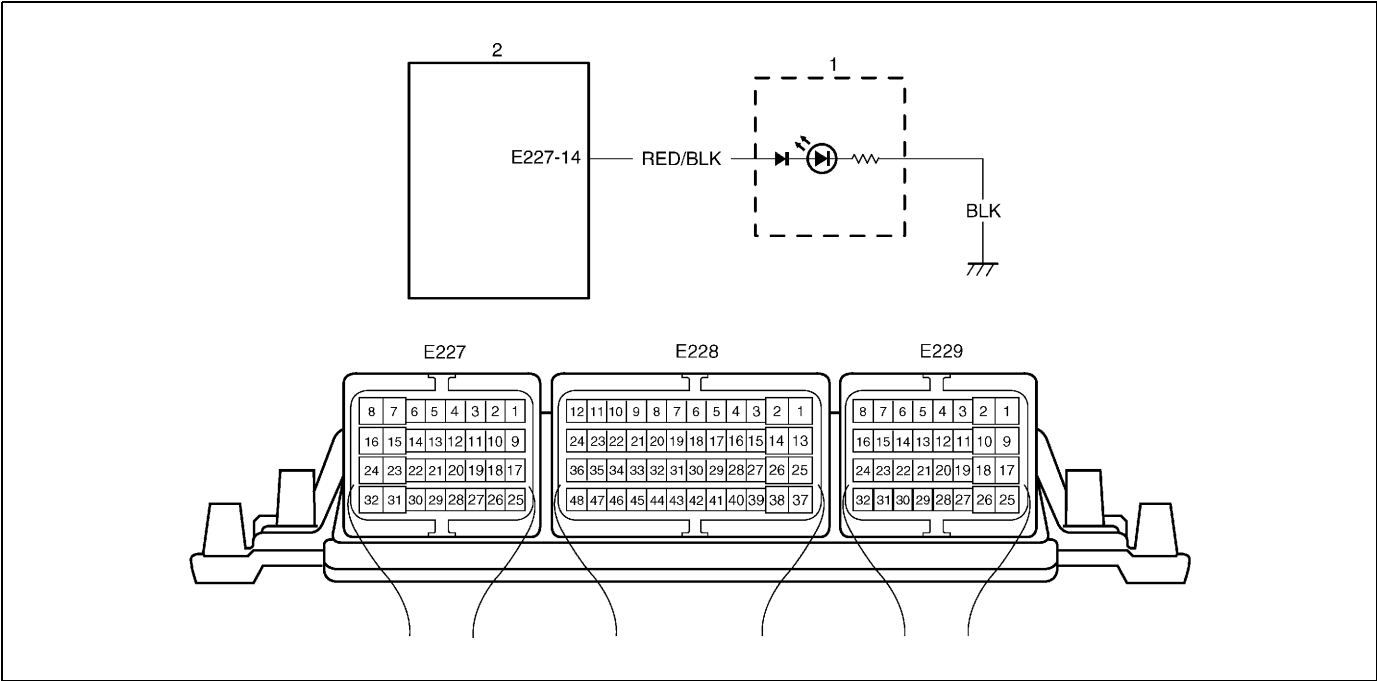
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ignition switch ON for 30 sec. after OFF. Then run engine at idle speed for 30 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Check voltage between pre/post heating relay at "BRN" wire terminal and body ground with ignition switch ON. Is voltage about 12 V?	Go to Step 3.	Main fuse broken. "BRN" wire circuit open or shorted to ground.
3	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Check voltage between glow plug each wire terminals with ignition switch ON. Is voltage about 12 V for limited time?	Poor glow plug "GRY", "GRY/BLU", "GRY/WHT" or "GRY/RED" wire terminals connection. If wire are OK, replace glow plug.	"GRY", "GRY/BLU", "GRY/WHT" or "GRY/RED" wire (between pre/post heating relay and glow plug) open, shorted to power/ground. If OK, go to Step 4.
4	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Disconnect pre/post heating relay connector. 3) Check for proper connection of pre/post heating relay connector at all terminals. 4) If OK, measure resistance between pre/post heating relay connector at "BLK" wire terminal and body ground. Is resistance 1 Ω or less?	Go to Step 5.	"BLK" wire circuit (between pre/post heating relay and ground) open.
5	Check Wire Harness 1) Connect pre/post heating relay connector. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between E229-7 and ground with ignition switch ON. Is voltage about 12 V?	Go to Step 6.	"LT BLU" wire open or shorted to ground.
6	Check Wire Harness 1) Check voltage between E229-3 and ground with ignition switch ON. Is it about 0 V?	Poor E229-3 or E229-7 connection. If connections are in good condition, substitute a known-good ECM and recheck.	"GRN/BLU" wire open or shorted to ground. If OK, substitute a known-good pre/post heating relay and recheck.

DTC P0381 Glow Plug Indicator Circuit

Wiring Diagram



1. Glow indicator lamp (in combination meter)
2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E227-14” wire circuit. or - When ECM detects shorted to power in “E227-14” wire circuit.	- Glow indicator lamp circuit - Glow indicator lamp (combination meter) malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ignition switch ON for 30 sec. after OFF.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness <Not Using SUZUKI Scan Tool> 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Supply battery power (12 V) to E227-14 wire terminal of disconnected ECM connector by using service wire. Does glow indicator lamp turn ON? <Using SUZUKI Scan Tool> 1) Connect SUZUKI scan tool to DLC. 2) Execute "Glow Indicator Lamp" in Misc Test. Does glow indicator lamp flash?	Substitute a known-good ECM and recheck.	• "RED/BLK" wire open or short. • Poor E227-14 connection. • Replace combination meter.

Reference:

As soon as ignition is switched on, ECM turns on glow indicator lamp for a period which depends on engine coolant temp. as shown below.

Engine coolant temp. (°C)	Time turning on glow indicator lamp (sec.)
-30	20
-10	5
0	0.5
18	0

DTC P0401 (P0401) Exhaust Gas Recirculation Flow Insufficient Detected

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
EGR flow gap between reference value and measured value is greater than 75 mg/stroke, EGR solenoid valve reference value stable and air flow inconsistent.	• EGR vacuum circuit • EGR valve malfunction • EGR solenoid valve malfunction • Intake air circuit • MAF sensor malfunction • ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine between 700 and 2700 rpm for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

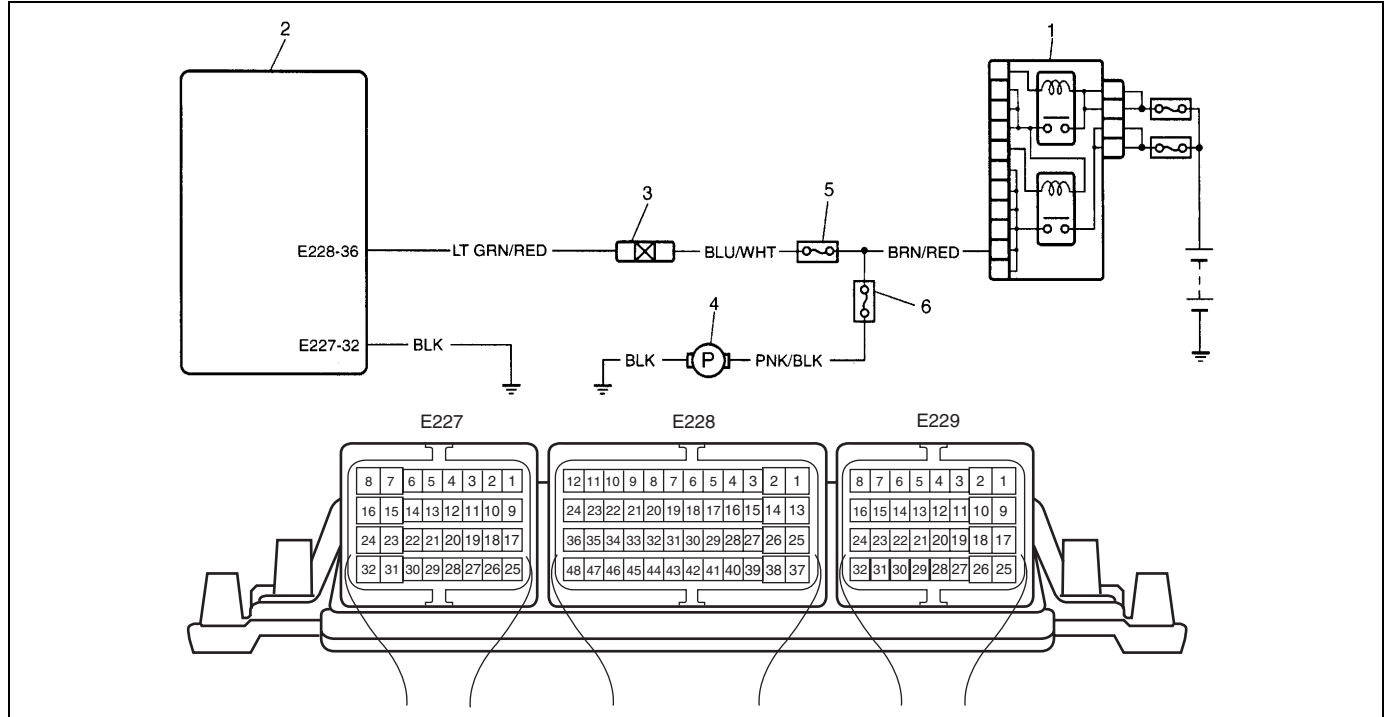
Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check EGR vacuum circuit and intake air circuit for leak. Is it in good condition?	Go to Step 3.	Repair or replace.
3	Check EGR valve referring to "EGR Valve and EGR cooler" in Section 6E3. Is it in good condition?	Go to Step 4.	Replace EGR valve.
4	Check EGR solenoid valve for resistance referring to "EGR Solenoid Valve" in Section 6E3. Is resistance as specified?	Go to Step 5.	Replace EGR solenoid valve.
5	Check MAF sensor referring to "Mass Air Flow Sensor (MAF Sensor)" in Section 6E3. Is it in good condition?	Substitute a known-good ECM and recheck.	Replace MAF sensor.

DTC P0400 (P0400/P0402/P2143/P2145) Exhaust Gas Recirculation Flow (Malfunction/Excessive Detected/Exhaust Gas Recirculation Vent Control Circuit Open/High)

DTC P2144 (P2144) Exhaust Gas Recirculation Vent Control Circuit Low

Wiring Diagram



1. Double relay	3. EGR solenoid valve	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

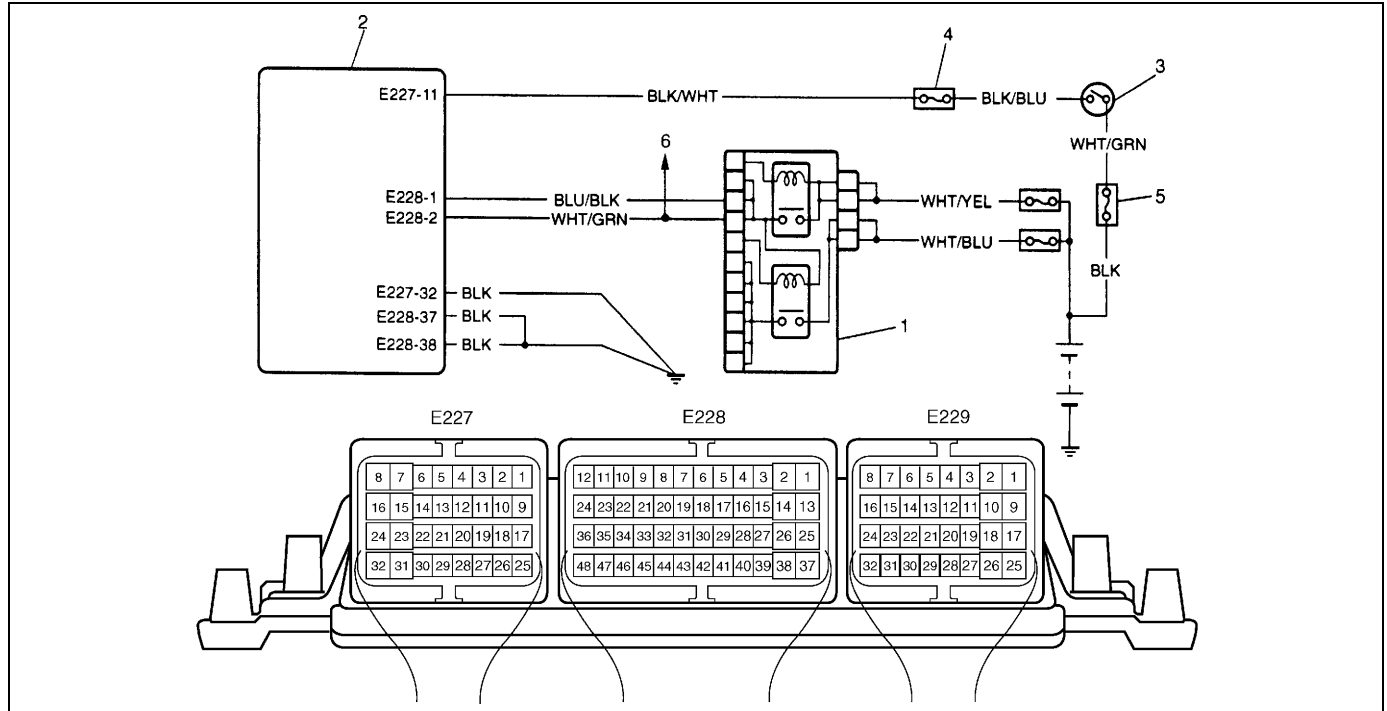
DTC DETECTING CONDITION	TROUBLE AREA
P0400 (P2145): When ECM detects short to power in "E228-36" wire circuit.	• Fuse broken • EGR solenoid valve circuit • EGR solenoid valve malfunction • ECM malfunction • EGR valve malfunction • Intake air circuit • MAF sensor malfunction
P0400 (P2143): When ECM detects open in "E228-36" wire circuit.	
P0400 (P0402): EGR flow gap between reference value and measured value is greater than -200 mg/stroke.	
P0400 (P0400): EGR flow variety when EGR valve opened and closed is below 100 mg.	
P2144 (P2144): When ECM detects short to ground in "E228-36" wire circuit.	

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine between 700 and 2700 rpm for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Primary Circuit" in this section.
3	Check Wire Harness 1) Disconnect EGR solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10 – 14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check EGR Solenoid Valve 1) Check solenoid valve referring to "EGR Solenoid Valve" in Section 6E3. Is it in good condition?	• "LT GRN/RED" wire open or shorted to power/ground. • Poor E228-36 connection. If wire and connection are OK, go to Step 5.	Replace EGR solenoid valve.
5	Check EGR Valve 1) Check EGR valve referring to "EGR Valve and EGR Cooler" in Section 6E3. Is it in good condition?	Go to Step 6.	Replace EGR valve.
6	Check Intake Air Circuit 1) Check intake air circuit for leak. Is it in good condition?	Go to Step 7.	Repair or replace.
7	Check MAF Sensor 1) Check MAF sensor referring to "Mass Air Flow Sensor (MAF Sensor)" in Section 6E3. Is it in good condition?	Substitute a known-good ECM and recheck.	Replace MAF sensor.

DTC P0105 (P0107/P0108) Barometric Pressure Sensor Circuit (Low Input/High Input)**DTC P0561 (P0642/P0643) Sensor Reference Voltage Circuit (Low/High)****DTC P0603 (P0603) Internal Control Module Keep Alive Memory (KAM) Error****DTC P0604 (P0604) Internal Control Module Random Access Memory (RAM) Error****Wiring Diagram**

1. Double relay	3. Ignition switch	5. Main fuse
2. ECM	4. "IG COIL" fuse	6. To radiator fan relay No.3

DTC DETECTING CONDITION

This DTC will be set when an internal fault is detected in the ECM.

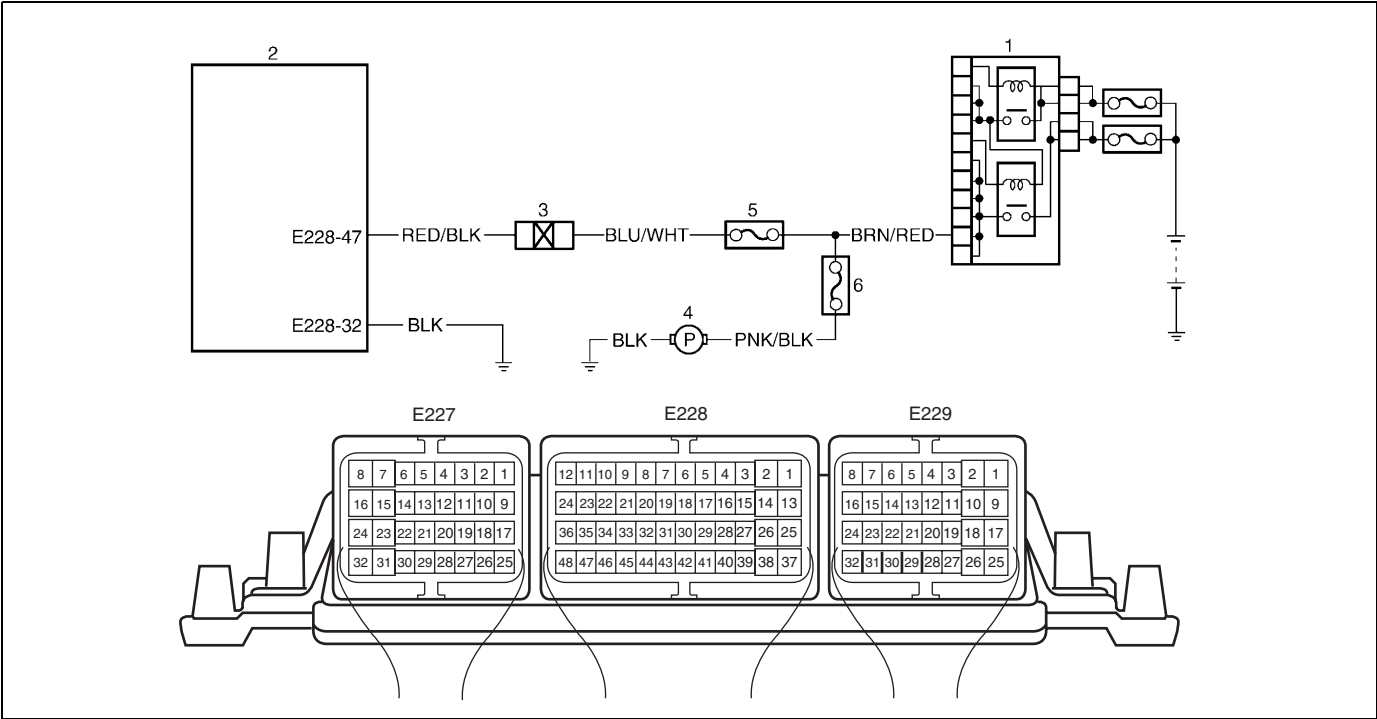
DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Substitute a known-good ECM and recheck.	Go to "Engine Diag. Flow Table" in this section.

DTC P1107 (P2009/P2010) Intake Manifold Runner Control Circuit (Low/High)
Wiring Diagram



1. Double relay	3. Swirl control solenoid valve	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P1107 (P2009): When ECM detects open or shorted to ground in "E228-47" wire circuit. P1107 (P2010): When ECM detects shorted to power in "E228-47" wire circuit.	• Fuse broken • Swirl control solenoid valve circuit • Swirl control solenoid valve malfunction • ECM malfunction

DTC Confirmation Procedure

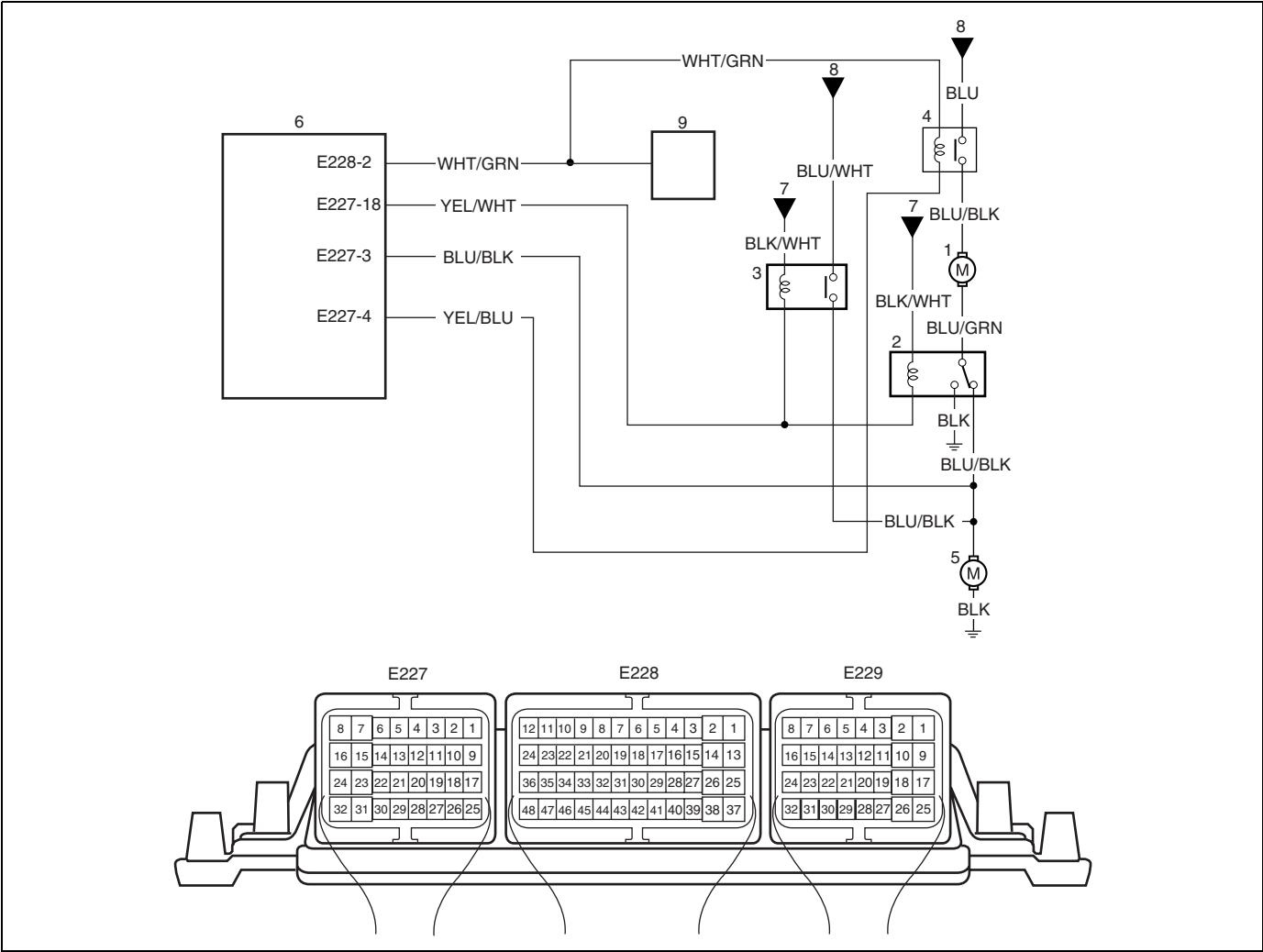
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Primary Circuit" in this section.
3	Check Wire Harness 1) Disconnect swirl control solenoid valve connector with ignition switch OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of swirl control solenoid valve connector and ground. Within 5 sec. after ignition switch ON: 10 – 14 V Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check Swirl Control Solenoid Valve 1) Check swirl control solenoid valve referring to "Swirl Control Solenoid Valve" in Section 6E3. Is it in good condition?	• "RED/BLK" wire open or shorted to power/ground. • Poor E228-47 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty swirl control solenoid valve.

DTC P0480 Fan 1 Control Circuit

Wiring Diagram



1. Radiator fan motor 1	4. Radiator fan relay 3 (Low)	7. From "IG COIL" fuse (20 A)
2. Radiator fan relay 1 (High/Low)	5. Radiator fan motor 2	8. From main fuse
3. Radiator fan relay 2 (High)	6. ECM	9. Double relay

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in "E227-18" wire circuit. or - When ECM detects shorted to power in "E227-18" wire circuit.	- Fuse broken - Radiator fan high speed circuit - Radiator fan relay 1 (high/low) or radiator fan relay 2 (high) malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between E227-18 wire terminal of disconnected ECM connector and ground with ignition switch ON. Is it about 12 V?	Poor E227-18 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 1 and 2 referring to "Radiator Fan Relay 1 (High/Low)" and "Radiator Fan Relay 2 (High)" in Section 6E3. Are they in good condition?	• "YEL/WHT" wire open or short to ground. • "BLK/WHT" wire open or short to ground. • Fuse broken.	Faulty radiator fan relay 1 or 2.

DTC P0481 Fan 2 Control Circuit

Wiring Diagram

Refer to “DTC P0480 Fan 1 Control Circuit” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or shorted to ground in “E227-4” wire circuit. or - When ECM detects shorted to power in “E227-4” wire circuit.	- Fuse broken - Radiator fan low speed circuit - Radiator fan relay 3 (low) malfunction

DTC Confirmation Procedure

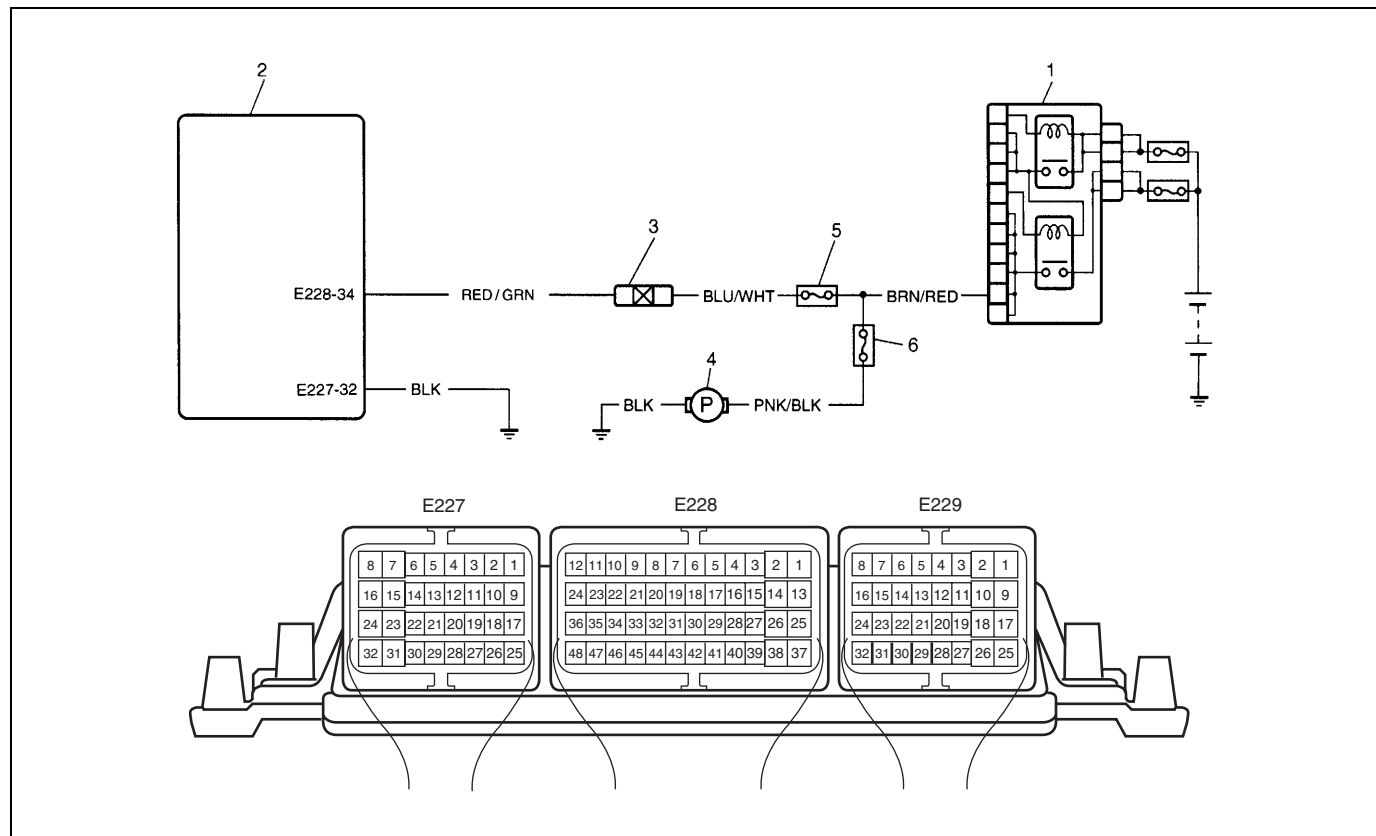
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table” in this section.
2	Check Wire Harness 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to “Voltage Check” in this section. 3) Check voltage between E227-4 wire terminal of disconnected ECM connector and ground with ignition switch ON. Is it about 12 V?	Poor E227-4 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 3 referring to “Radiator Fan Relay 3 (Low)” in Section 6E3. Is it in good condition?	“YEL/BLU” wire open or short to ground. “WHT/GRN” wire open or short to ground. - Fuse broken.	Faulty radiator fan relay 3.

DTC P3004 (P3005/P3006) 3rd Piston Deactivator Circuit (Short/Open)

Wiring Diagram



1. Double relay	3. Injection pump solenoid valve (3rd piston deactivator)	5. "ENG" fuse (15 A)
2. ECM	4. Fuel pump	6. "FUEL PUMP" fuse (15 A)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P3004 (P3006): When ECM detects open in "E228-34" wire circuit. P3004 (P3005): When ECM detects shorted to power in "E228-34" wire circuit.	- Fuse broken 3rd piston deactivator circuit - Injection pump (solenoid valve) malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Primary Circuit" in this section.
3	Check Wire Harness 1) Disconnect injection pump solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10 – 14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, short to power/ground or fuse broken.
4	Check Injector Pump Solenoid Valve 1) Check resistance between "BLU/WHT" wire terminal and "RED/GRN" wire terminal of valve. Is it resistance 25 – 30 Ω ?	• "RED/GRN" wire open or shorted to power/ground. • Poor E228-34 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty injection pump solenoid valve.

DTC DETECTING CONDITION	TROUBLE AREA
P0090 (P0091): When ECM detects shorted to power or ground in “E228-14” wire circuit. P0090 (P0092): When ECM detects open in “E228-14” wire circuit. P0090 (P0090): Engine runs on with 500 rpm over 1.5 sec. even though ignition switch is turned OFF. (fuel pressure regulator faulty) P0606 (P0606): Engine speed does not drop fast enough when ignition switch is turned OFF. P1171: Engine runs on with 500 rpm over 1.5 sec. even though ECM is commanded cut-off of injection.	• Fuse pressure regulator circuit • Fuse pressure regulator malfunction • ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec. and stop it. Then, turn ignition switch ON.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Wire Harness 1) Disconnect connector at fuel pressure regulator. 2) Check voltage between "YEL" terminal of regulator connector and ground with ignition switch ON. • Ignition switch ON: 10 – 14 V • Ignition switch OFF: about 0 V Is check result as specified?	Go to Step 3.	"YEL" wire open or shot to ground.
3	Check Fuel Pressure Regulator Check resistance between "YEL" wire terminal and "LT GRN/WHT" wire terminal of valve. Is it resistance 2 – 3 Ω ?	• "LT GRN/WHT" wire open or shorted to power/ground. • Poor E228-14 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty fuel pressure regulator.

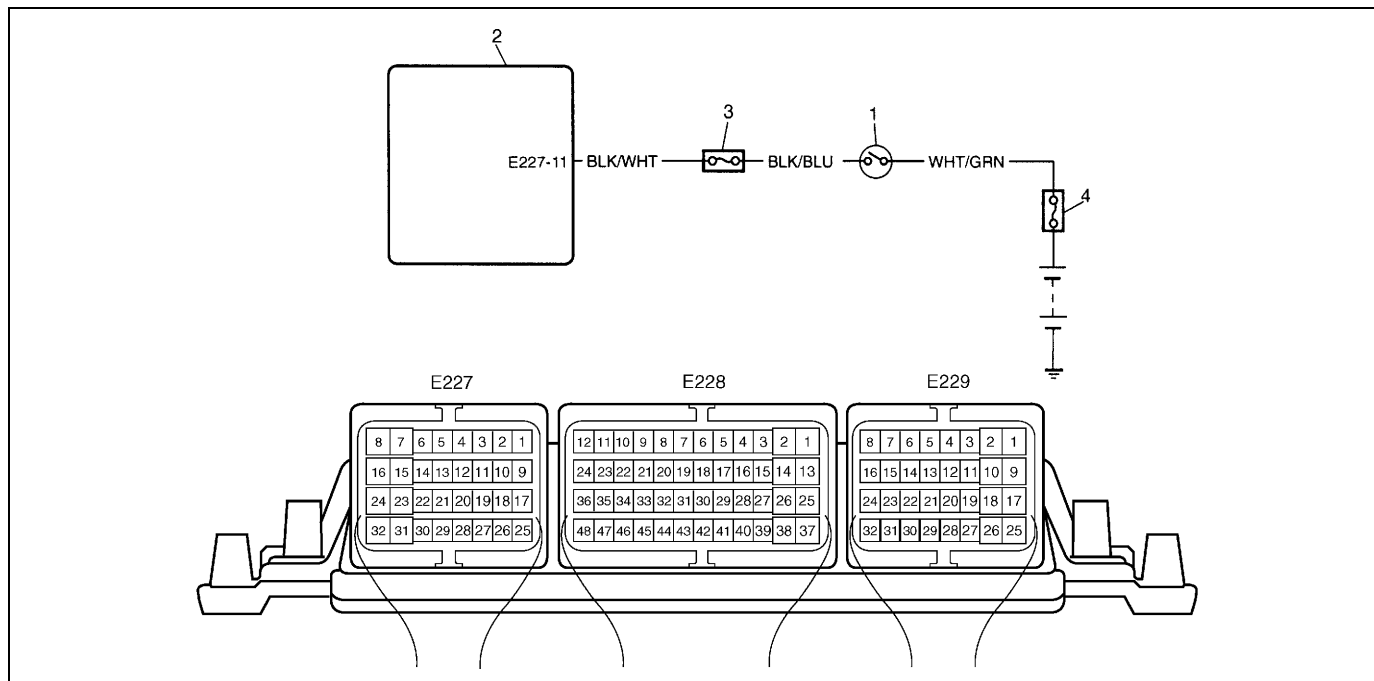
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn off ignition switch and then on.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to "DTC P0230 Fuel Pump Primary Circuit" in this section.
3	Check Wire Harness 1) Disconnect EGR throttle solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "BLU/WHT" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10 – 14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"BLU/WHT" wire open, shorted to power/ground or fuse broken.
4	Check EGR Throttle Solenoid Valve 1) Check solenoid valve referring to "EGR Throttle Solenoid Valve" in Section 6E3. Is it in good condition?	• "PPL/BLK" wire open or shorted to power/ground. • Poor E229-32 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty EGR throttle solenoid valve.

DTC P1511 Ignition Switch Circuit Malfunction

Wiring Diagram



1. Ignition switch	3. "IG COIL" fuse (20 A)
2. ECM	4. Main fuse

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
- When ECM detects open or short to ground in "E227-11" wire circuit. or - When ECM detects short to power in "E227-11" wire circuit.	- Fuse broken - Ignition switch circuit - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn off ignition switch and then on.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Ignition Signal 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between E227-11 wire terminal of disconnected ECM connector and ground. • Ignition switch ON: 10 – 14 V • Ignition switch OFF: 0 V Is it within specified value?	Poor E227-11 connection. If it is in good condition, substitute a known-good ECM and recheck.	"BLK/WHT" wire open, shorted to power/ground or fuse broken.

DTC P0485 Fan Power/Ground Circuit

Wiring Diagram

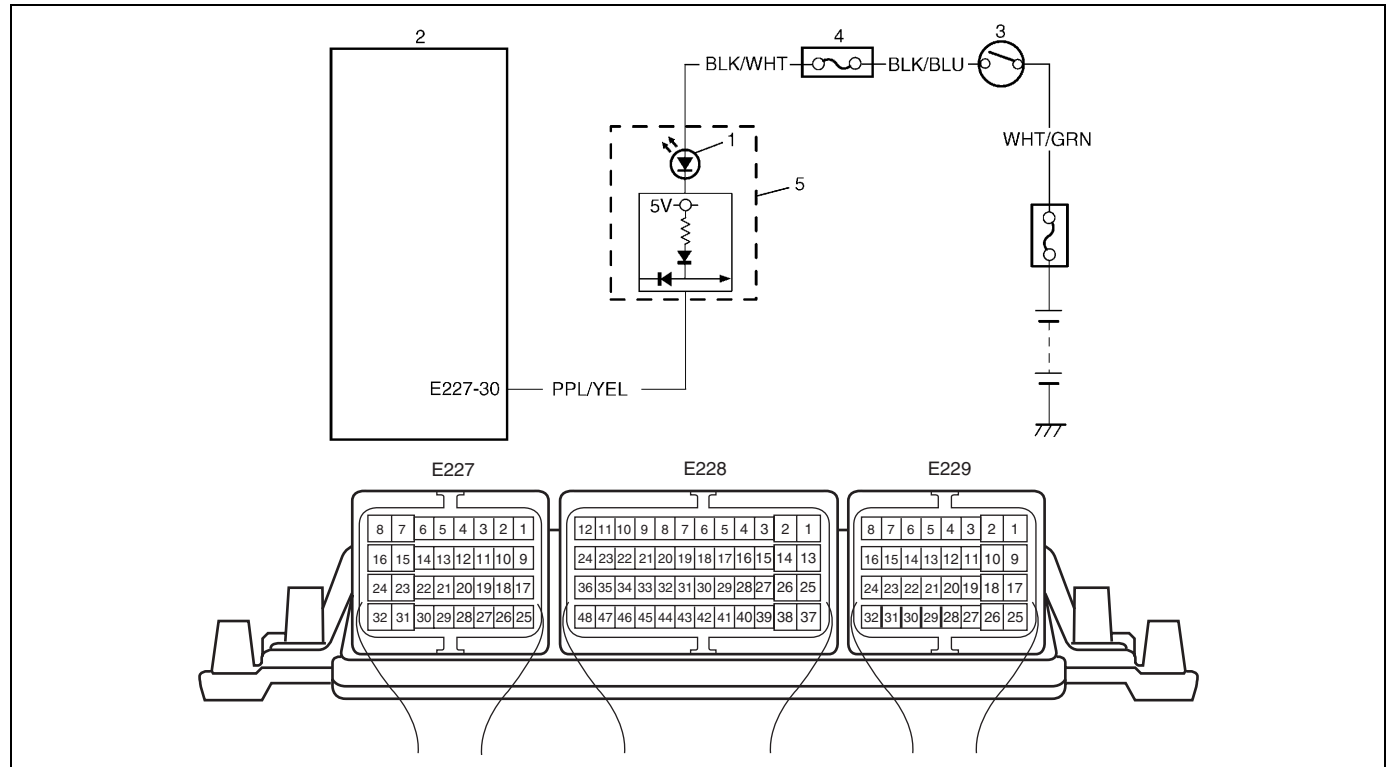
Refer to "DTC P0480 Fun 1 Control Circuit" in this section.

Troubleshooting

Proceed to "DTC P0480 Fun 1 Control Circuit" and "P0481 Fan 2 Control Circuit" in this section for TROUBLESHOOTING.

DTC P0650 (P0650/P1642) Malfunction Indicator Lamp (MIL) Control Circuit Malfunction (Malfunction/Open)

Wiring Diagram



1. Malfunction indicator lamp (MIL)	4. "METER" fuse (10 A)
2. ECM	5. Combination meter
3. Ignition switch	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0650 (P0650): When ECM detects shorted to power or ground in "E227-30" wire circuit.	- Fuse broken - MIL circuit - Combination meter malfunction - ECM malfunction
P0650 (P1642): When ECM detects open in "E227-30" wire circuit.	

DTC Confirmation Procedure

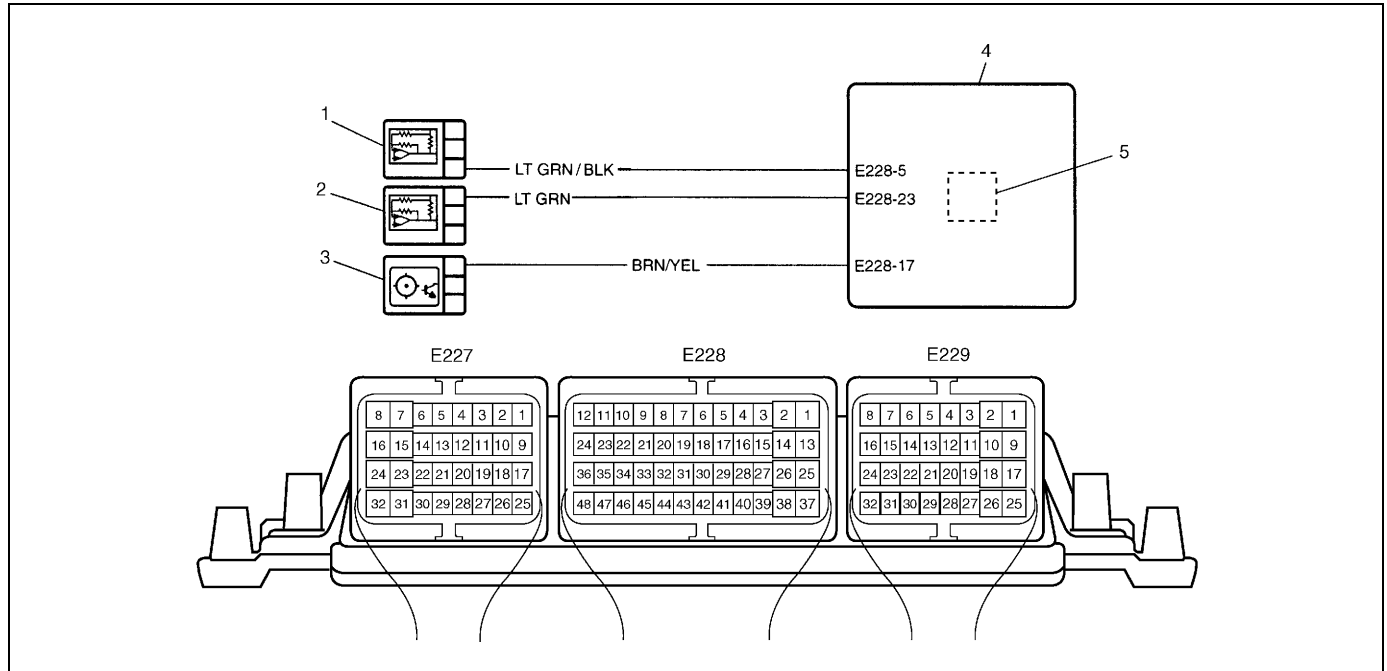
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn off ignition switch and then on.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	MIL Circuit Check 1) Turn ignition switch to ON position. Do other warning lamps come ON?	Go to Step 3.	Go to Step 4.
3	MIL Circuit Check 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check voltage between "PPL/YEL" wire terminal of disconnected ECM connector and ground. Ignition switch ON: 10 – 14 V Ignition switch OFF: 0 V Is check result as specified?	Poor E227-30 connection. If it is in good condition, substitute a known-good ECM and recheck.	"PPL/YEL" wire open, shorted to power/ground. If it is in good condition, replace combination meter.
4	1) Turn ignition switch to OFF position. Is "METER" fuse in good condition?	Open circuit in "BLK/WHT" wire to combination meter or poor connection.	Replace fuse and check for short.

DTC P0608 (P0658/P0659) Actuator Supply Voltage Circuit 1 (Low/High)

Wiring Diagram



1. Fuel rail pressure sensor	4. ECM
2. Intake air pressure sensor	5. Barometric pressure sensor
3. Camshaft position sensor	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0608 (P0658): Voltage is less than 4.8 V at “E228-23”, “E228-5” and “E228-17” terminal of ECM connector. ECM detects less than 4.8 V at internal power supply of barometric pressure sensor. P0608 (P0659): Voltage is greater than 5.1 V at “E228-23”, “E228-5” and “E228-17” terminal of ECM connector. ECM detects greater than 5.1 V at internal power supply of barometric pressure sensor.	• Sensor power supply circuit • Fuel rail pressure sensor malfunction • Intake air pressure sensor malfunction • Camshaft position (CMP) sensor malfunction • ECM malfunction

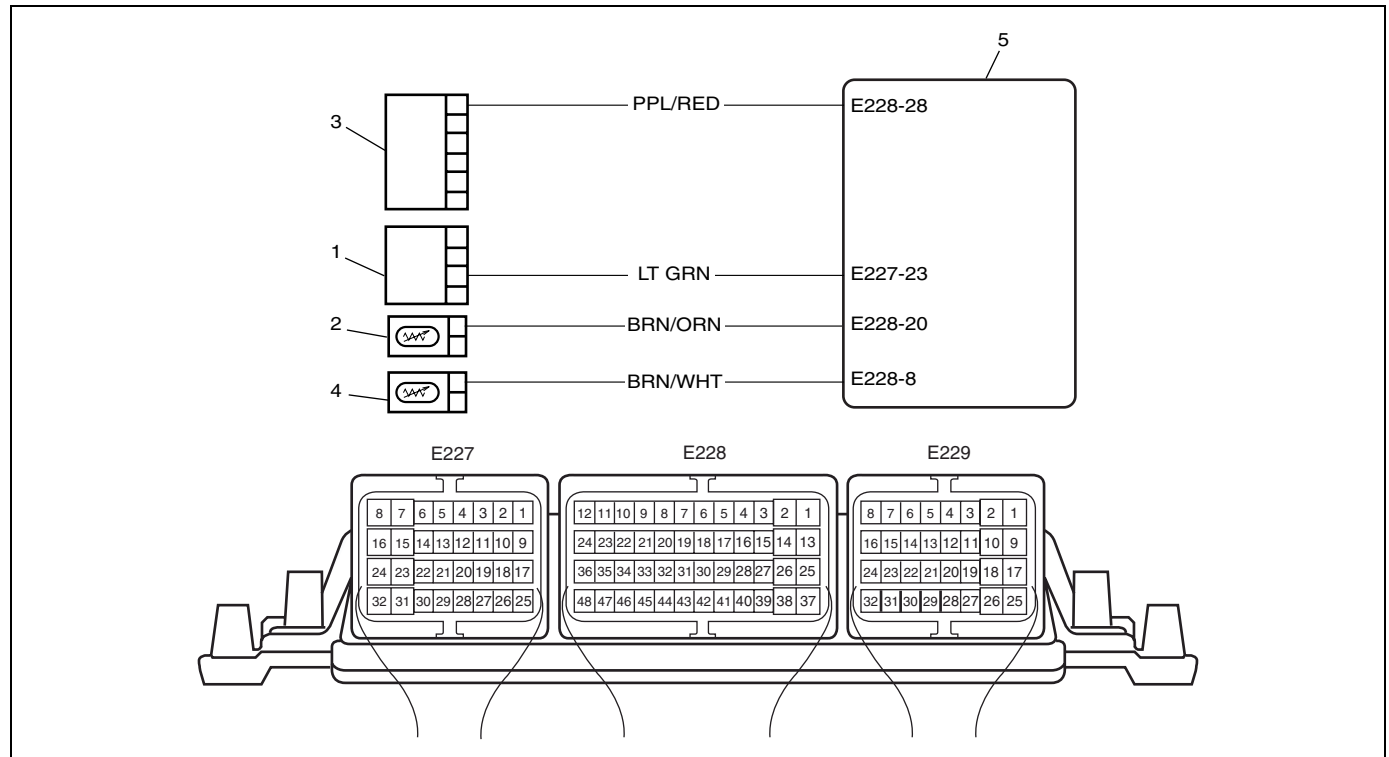
DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table” in this section.

Step	Action	Yes	No
2	Check Fuel Rail Pressure Sensor Circuit 1) Disconnect connector from fuel rail pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "LT GRN/BLK" wire terminal in fuel rail pressure sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 3.	"LT GRN/BLK" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
3	Check Fuel Rail Pressure Sensor Circuit 1) Connect connector to fuel rail pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-5 terminal in ECM harness connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 4.	Faulty fuel rail pressure sensor.
4	Check Intake Air Pressure Sensor Circuit 1) Disconnect connector from intake air pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "LT GRN" wire terminal in intake air pressure sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 5.	"LT GRN" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
5	Check Intake Air Pressure Sensor Circuit 1) Connect connector to intake air pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-23 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 6.	Faulty intake air pressure sensor.
6	Check CMP Sensor Circuit 1) Disconnect connector from CMP sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "BRN/YEL" wire terminal in CMP sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 7.	"BRN/YEL" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
7	Check CMP Sensor Circuit 1) Connect connector to CMP sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-17 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Faulty ECM, substitute a known-good ECM and recheck.	Faulty CMP sensor.

DTC P0609 (P2670/P2671) Actuator Supply Voltage Circuit 2 (Low/High)**Wiring Diagram**

1. Throttle position sensor	4. Engine coolant temperature sensor
2. Fuel temperature sensor	5. ECM
3. Intake air temperature sensor	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0609 (P2670): Voltage is less than 4.8 V at “E227-23”, “E228-28”, “E228-8” and “E228-20” terminal of ECM connector P0609 (P2671): Voltage is greater than 5.1 V at “E227-23”, “E228-28”, “E228-8” and “E228-20” terminal of ECM connector.	• Sensor power supply circuit • Throttle position sensor malfunction • Fuel temperature sensor malfunction • Intake air temperature sensor (built-in mass air flow sensor) malfunction • Engine coolant temperature sensor malfunction • ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check TP Sensor Circuit 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "LT GRN" wire terminal in TP sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 3.	"LT GRN" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
3	Check TP Sensor Circuit 1) Connect connector to TP sensor with ignition switch turned OFF. 2) Remove ECM connector covers referring to "Voltage Check" in this section. 3) Connect ECM connectors from ECM. 4) Turn ON ignition switch. 5) Check voltage between E227-23 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 4.	Faulty TP sensor.
4	Check Fuel Temperature Sensor Circuit 1) Disconnect connector from fuel rail pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "BRN/ORN" wire terminal in fuel temperature sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 5.	"BRN/ORN" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
5	Check Fuel Temperature Sensor Circuit 1) Connect connector to fuel temperature sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-20 terminal in ECM harness connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 6.	Faulty fuel temperature sensor.
6	Check Intake Air Temperature Sensor Circuit 1) Disconnect connector from intake air temperature sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "PPL/RED" wire terminal in intake air temperature sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 7.	"PPL/RED" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
7	Check Intake Air Temperature Sensor Circuit 1) Connect connector to intake air temperature sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-28 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 8.	Faulty intake air temperature sensor (built-in mass air flow sensor).
8	Check Engine Coolant Temperature Sensor Circuit 1) Disconnect connector from engine coolant temperature sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "BRN/WHT" wire terminal in engine coolant temperature sensor connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Go to Step 9.	"BRN/WHT" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
9	Check Engine Coolant Temperature Sensor Circuit 1) Connect connector to engine coolant temperature sensor with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between E228-8 terminal in ECM connector and vehicle body ground. Is voltage about 5.1 V to 4.8 V?	Faulty ECM, substitute a known-good ECM and recheck.	Faulty engine coolant temperature sensor.

DTC P0225 (P0224/P0227/P0228/P2137) Pedal Position Sensor “No.2” Circuit (Intermittent/Low/High/Voltage Correlation)

Wiring Diagram

Refer to “DTC P0220 (P0222/P0223/P0224) Pedal Position Sensor “No.1” Circuit (Low/High/Intermittent)” in this section.

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0225 (P0227): Voltage is below 0.1 V at “E227-19” wire terminal of ECM connector. P0225 (P0228): Voltage is greater than 4.7 V at “E227-19” wire terminal of ECM connector. P0225 (P2137): Voltages ratio between PPS 1 signal (voltage at “E227-15” terminal) and PPS 2 signal (voltage at “E227-19” terminal) is greater than specified value. P0225 (P0224): Voltage is greater than 5.1 V at “E227-23” wire terminal of ECM connector or voltage is below 4.8 V at “E227-23” wire terminal of ECM connector.	• Throttle position sensor circuit • Throttle position sensor malfunction • ECM malfunction

DTC Confirmation Procedure

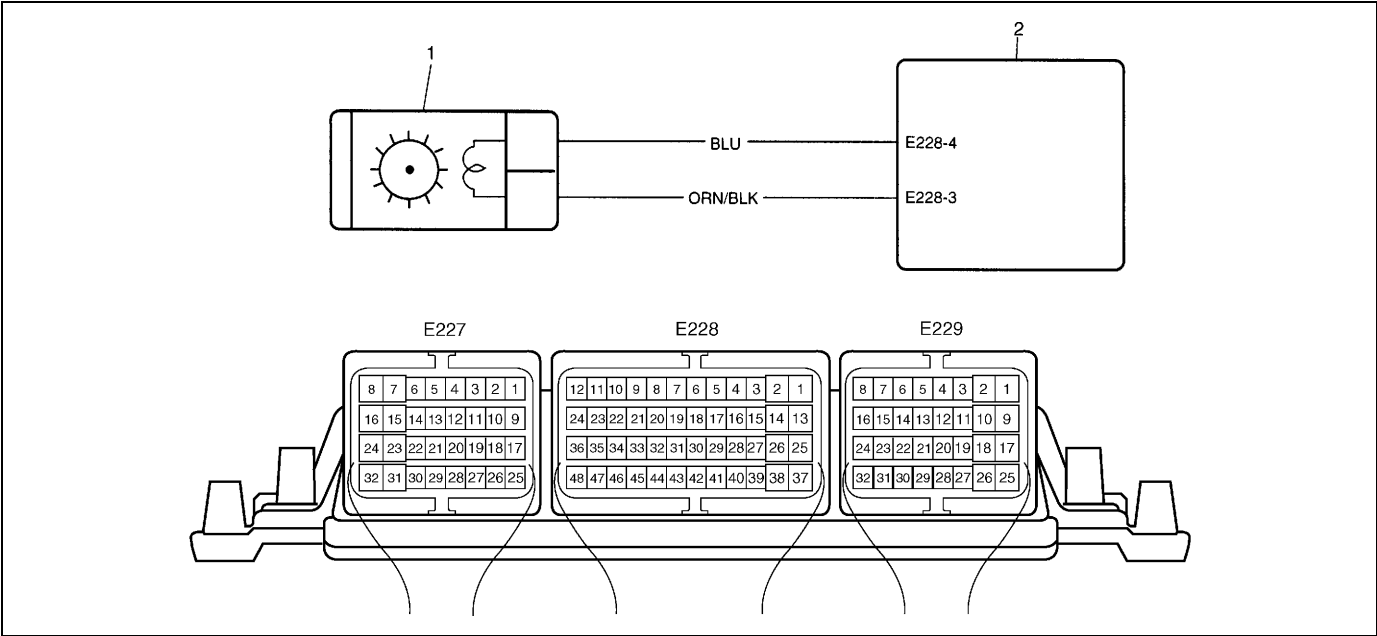
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI Scan tool> P0609 <Using Generic Scan tool or GST mode of SUZUKI Scan tool> (P2670/P2671)	Go to "DTC P0609 (P2670/P2671) Actuator Supply Voltage Circuit 2 (Low/High)" in this section.	Go to Step 3.
3	Check Wire Harness 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at each terminal. 3) If OK, then with ignition switch ON, check voltage between "LT GRN" wire and "BRN" wire terminals at connector of TP sensor. Is voltage about 5 V?	Go to Step 4.	"LT GRN" wire open, "BRN" wire open, poor E227-23 connection, or poor E227-16 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor Output Voltage 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connector from ECM. 4) With ignition switch ON, check voltage between E227-19 and ground, when accelerator pedal is at idle position to fully depressed position. Is voltage 0.2 – 1.6 V?	Substitute a known-good ECM and recheck.	"GRY/BLU" wire open, "GRY/BLU", wire shorted to ground/power or poor TP sensor connector. If wire and connection are OK, substitute a known-good TP sensor and recheck.

DTC P0335 (P0335) Crankshaft Position Sensor Circuit

Wiring Diagram



- | |
|---|
| 1. Crankshaft position sensor (Engine speed sensor) |
| 2. ECM |

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
When ECM (“E228-4” wire terminal) judged engine speed 5500 rpm by the signal of crankshaft position sensor.	• Crankshaft position sensor circuit • Crankshaft position sensor rotor malfunction • Crankshaft position sensor malfunction • ECM malfunction

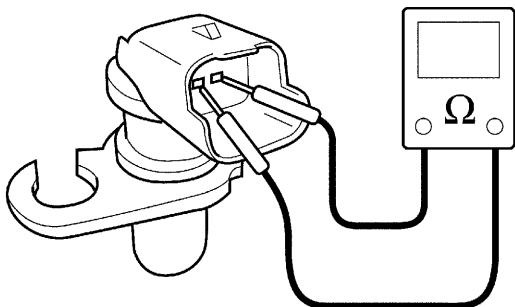
DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec.
- 3) Check DTC and pending DTC by using scan tool.

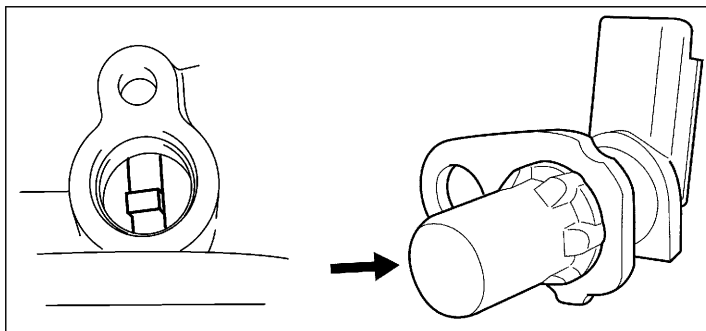
Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	CKP Sensor and Its Circuit Resistance Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E228-3 and E228-4 terminals. 4) If OK, check resistance of the followings. Resistance between E228-3 and E228-4 terminals: 315 – 405 Ω at 20°C, 68°F Resistance between each terminal and ground: 1M Ω or more Is check result satisfactory?	Go to Step 4.	Go to Step 3.
3	CKP Sensor Resistance Check: 1) With ignition switch OFF, disconnect CKP sensor coupler and remove CKP sensor. 2) Check resistance between terminals of CKP sensor. (See Fig.) Were measured resistance values as specified in Step 2?	Faulty "ORN/BLK" wire or "BLU" wire.	Faulty CKP sensor.
4	CKP Sensor Visual Inspection: 1) Check visually CKP sensor and sensing rotor for the followings. (See Fig.) • Damage • No foreign material attached • Correct installation Are they in good condition?	Intermittent trouble or faulty ECM. Recheck for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Replace or reinstall.

[A]



[B]

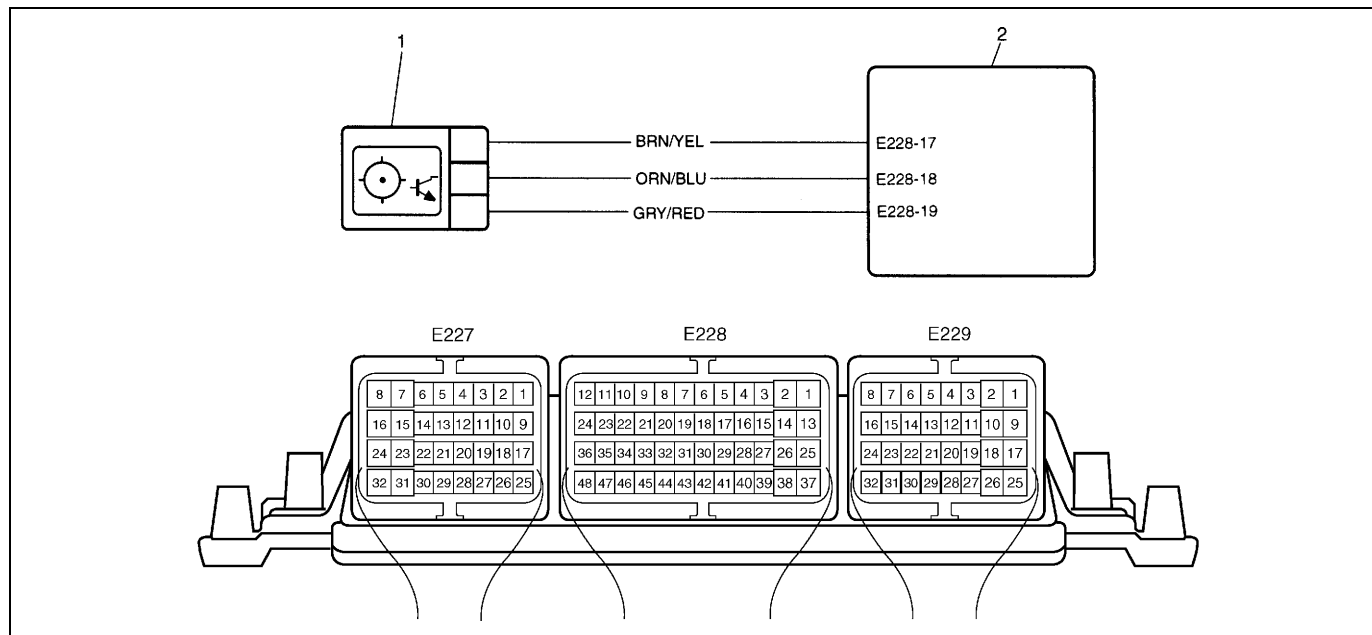


[A]: Fig. for Step 3

[B]: Fig. for Step 4

DTC P0340 (P0341/P0343/P0344/P0016) Camshaft Position Sensor Circuit (Performance/High/Intermittent/Crankshaft Position – Camshaft Position Correlation)

Wiring Diagram



1. Camshaft position sensor

2. ECM

DTC Detecting Condition and Trouble Area

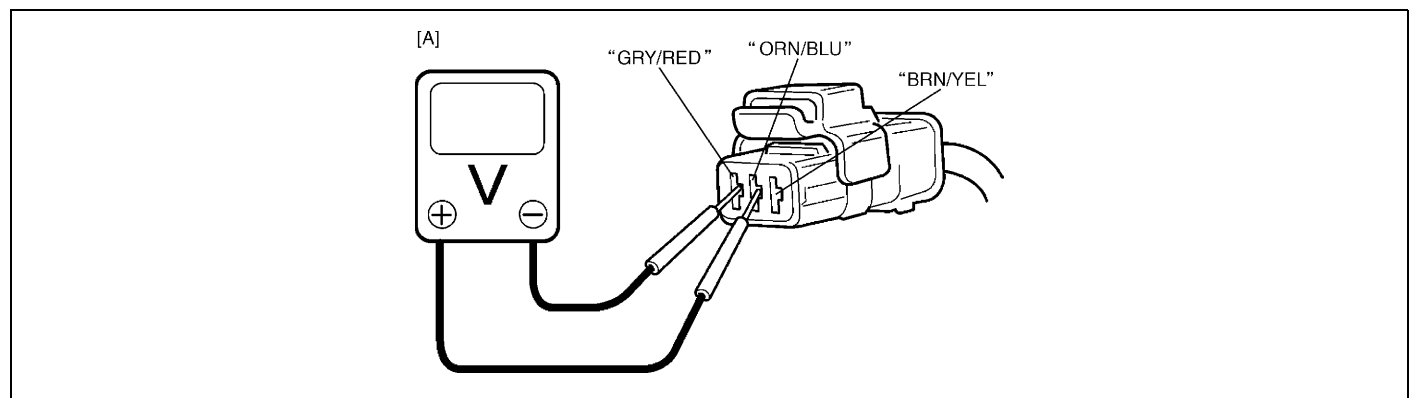
DTC DETECTING CONDITION	TROUBLE AREA
P0340 (P0343): Camshaft frequency is greater than 100 Hz. P0340 (P0344): Voltage is less than 4.8 V at “E228-17” wire terminal of ECM connector or voltage is greater than 5.1 V at “E228-17” wire terminal of ECM connector. P0340 (P0016): Engine speed calculated based on CMP sensor signal is different from actual engine speed (CKP sensor signal). P0340 (P0341): Camshaft position signal is out of specified angle.	• Camshaft position sensor circuit • Camshaft position sensor maladjusted • Camshaft position sensor malfunction • Camshaft hub malfunction • ECM malfunction • Crankshaft position sensor circuit • Crankshaft position sensor malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Crank engine for 3 seconds or more and keep it at idle for 1 min. if engine start.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

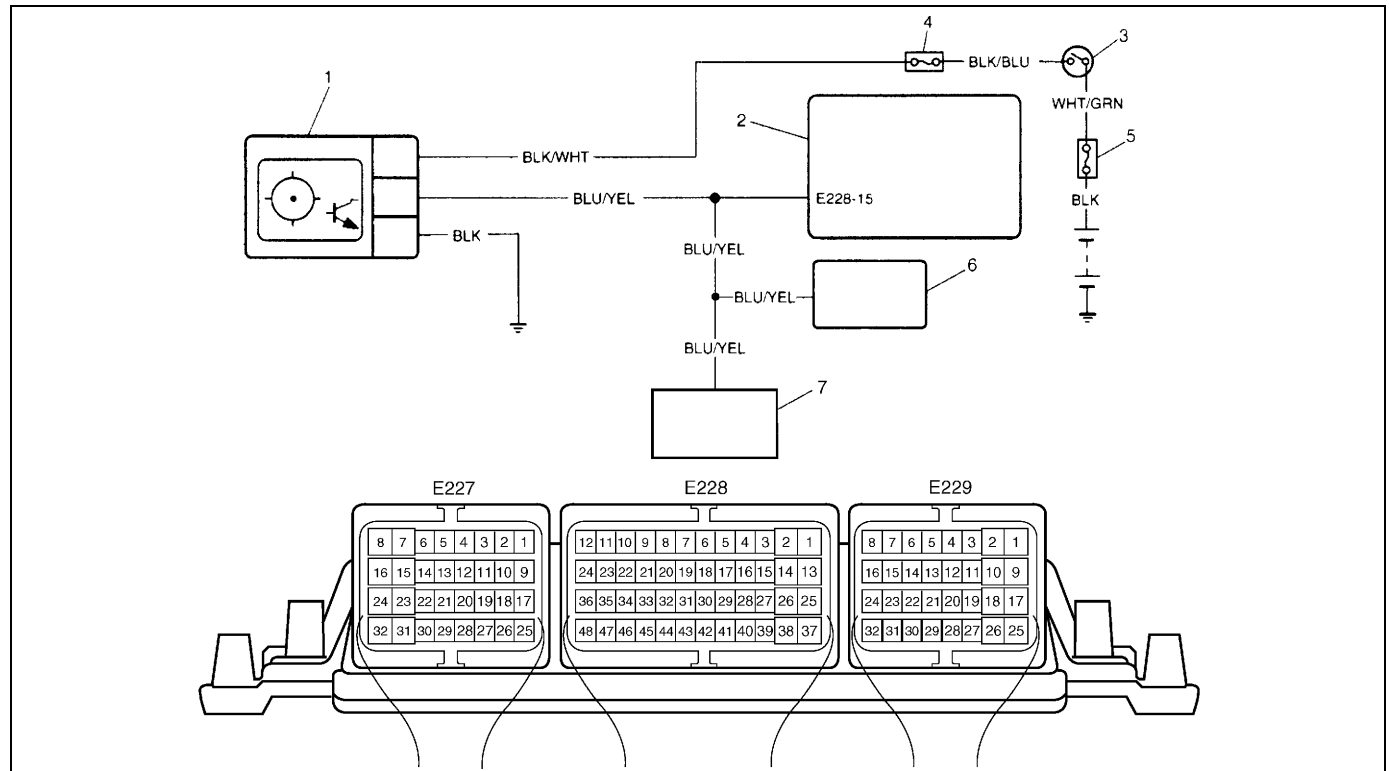
Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI Scan tool> P0608 <Using Generic Scan tool or GST mode of SUZUKI Scan tool> P0658 or P0659	Go to "DTC P0608 (P0658/P0659) Actuator Supply Voltage Circuit 1 (Low/High)" in this section.	Go to Step 3.
3	Is engine cranked?	Go to Step 4.	Go to "Diagnosis" in Section 6G.
4	Is engine started?	Go to Step 5.	Check CKP sensor (Engine speed sensor) and its circuit according to DTC P0335 (P0335) "Crankshaft Position Sensor Circuit" in this section.
5	Check CMP Sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step 6.	Correct.
6	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage between "ORN/BLU" and "GRY/RED" terminals of sensor connector disconnected. Is voltage 10 – 14 V?	Go to Step 7.	"ORN/BLU" or "GRY/RED" wire open, short or poor connection.
7	Check for voltage between "BRN/YEL" and "GRY/RED" terminals of sensor connector disconnected. Is voltage about 5 V?	Go to Step 8.	"BRN/YEL" wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.
8	Check Camshaft Hub 1) Remove upper timing belt cover. 2) Check camshaft hub for the following. • Damage • No foreign material attached Is it in good condition?	Check CMP sensor air gap referring to "Camshaft Position Sensor (CMP Sensor)" in Section 6E3. If check result is OK, substitute a known-good CMP sensor and recheck.	Clean surfaces of camshaft hub or replace camshaft hub.



[A]: Fig. for Step 6 and 7

DTC P0500 (P0500/P0501) Vehicle Speed Sensor (Malfunction/Performance)

Wiring Diagram



1. Vehicle speed sensor	4. "IG COIL" fuse (20 A)	7. BCM
2. ECM	5. Main fuse	
3. Ignition switch	6. Combination meter	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0500 (P0500): When ECM ("E228-15" wire terminal) judges vehicle speed 327 km/h (203 mile/h) by the signal of vehicle speed sensor.	- Vehicle speed sensor circuit - Vehicle speed sensor drive and/or driven gears malfunction - Vehicle speed sensor malfunction - Combination meter malfunction - BCM malfunction - ECM malfunction
P0500 (P0501): ECM detects vehicle speed signal (E228-15 terminal) below 15 km/h (9 mil/h) although engine speed is greater than 2500 rpm and air flow is greater than 40 mm ³ /stroke.	

DTC Confirmation Procedure

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

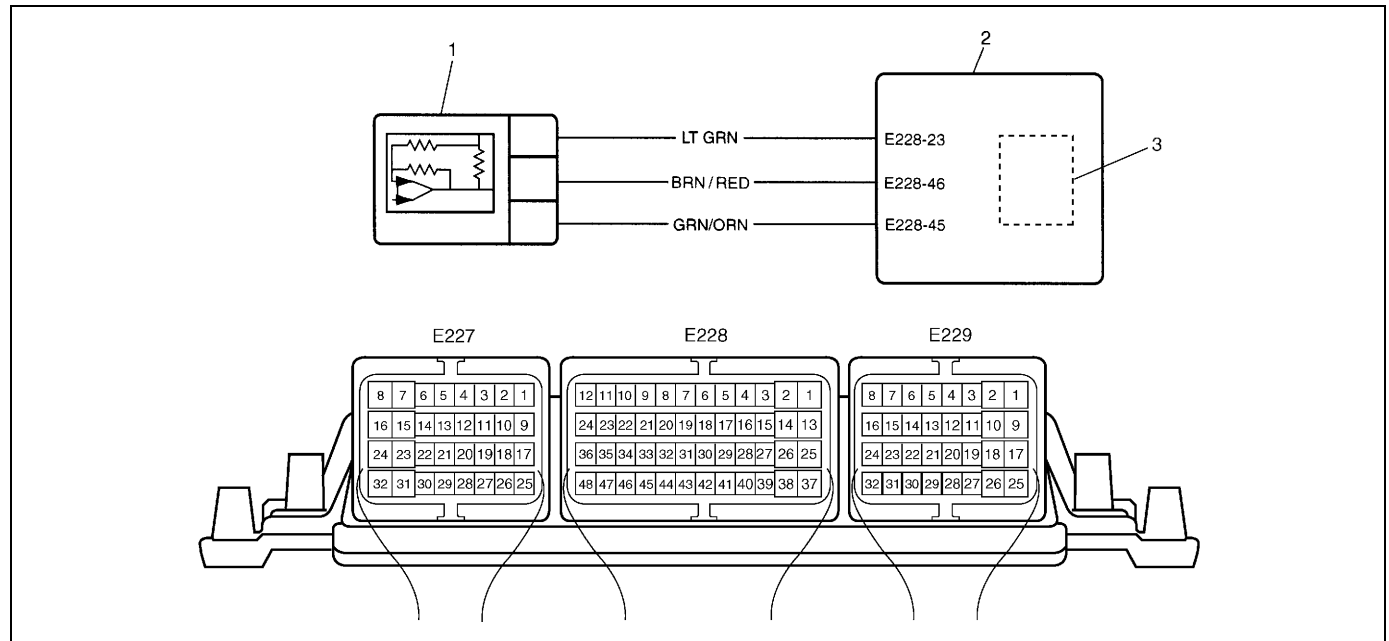
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and warm up engine completely.
- 3) Increase vehicle speed to 100 – 110 km/h (60 – 70 mph).
- 4) Release accelerator pedal and with engine brake applied, keep vehicle coasting and then stop vehicle.
- 5) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Does speedometer indicate vehicle speed?	Faulty "BLU/YEL" wire or poor E228-15 connection. If wire and connection are OK, intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.
3	VSS Power Supply Voltage Check: 1) With ignition switch OFF, remove VSS coupler. 2) With ignition switch ON leaving engine OFF, check voltage between "BLK/WHT" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 10 – 14 V?	Go to Step 4.	"BLK/WHT" or "BLK" wire open/short.
4	VSS Signal Harness Check: 1) With ignition switch ON leaving engine OFF, check voltage between "BLU/YEL" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 4 V or more?	Go to Step 5.	Go to Step 6.
5	VSS Visual Inspection: 1) Remove VSS referring to "Speed Sensor" in Section 7D. 2) Check VSS drive and driven gears for damage and excessive wear. Are they in good condition?	Poor VSS connection or VSS malfunction. If connection is OK, substitute a known-good VSS and recheck.	Replace VSS.
6	Speedometer Circuit Check: 1) With ignition switch OFF, disconnect G11 coupler from combination meter. 2) With ignition switch ON leaving engine OFF, check voltage between "BLU/YEL" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 4 V or more?	Substitute a known-good combination meter and recheck.	Go to Step 7.
7	BCM Circuit Check 1) With ignition switch OFF, disconnect G55 coupler from BCM. 2) With ignition switch ON leaving engine OFF, check voltage between "BLU/YEL" wire terminal and "BLK" wire terminal of VSS coupler. Is voltage 4 V or more?	Substitute a known-good BCM and recheck.	"BLU/YEL" wire open/short or faulty ECM. If wire and connection are OK, substitute a known-good ECM and recheck.

DTC P0235 (P0069/P0235, P1281/P0237/P0238) Turbo Charger Boost Sensor Circuit (Manifold Absolute Pressure – Barometric Pressure Correlation/Malfunction/Low/High)

Wiring Diagram



1. Intake air pressure sensor

3. Barometric pressure sensor

2. ECM

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0235 (P0235, P1281): Voltage is greater than 5.1 V at “E228-23” wire terminal of ECM connector or voltage is less than 4.8 V at “E228-23” wire terminal of ECM connector. P0235 (P0237): Voltage is less than 0.1 V at “E228-45” wire terminal of ECM connector. P0235 (P0238): Voltage is greater than 4.75 V at “E228-45” wire terminal of ECM connector. P0235 (P0069): When ECM detects difference of 100 millibar or more between intake air pressure and atmospheric pressure with engine speed less than 850 rpm.	- Intake air pressure sensor circuit - Intake air pressure sensor malfunction - ECM malfunction

DTC Confirmation Procedure

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- **Intake air temp.: 5°C, 41°F or higher**
- **Engine coolant temp.: -8 – 110°C (18 – 230°F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

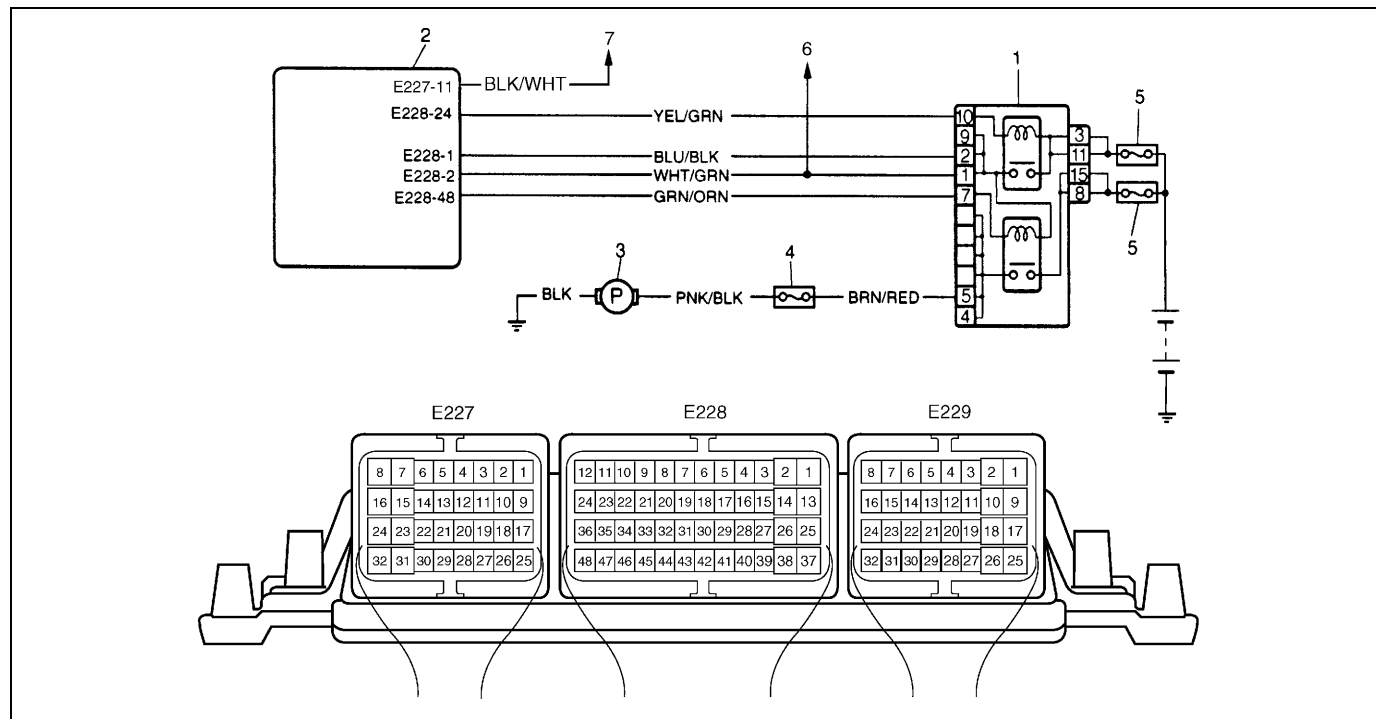
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec or more.
- 4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of SUZUKI Scan tool> P0608 <Using Generic Scan tool or GST mode of SUZUKI Scan tool> P0658 or P0659	Go to "DTC P0608 (P0658/P0659) Actuator Supply Voltage Circuit 1 (Low/High)" in this section.	Go to Step 3.
3	Intake Air Pressure Sensor Signal Check: 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors to ECM. 4) Check voltage E228-45 and ground with ignition switch ON. Is voltage 0.1 – 5 V?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 4.
4	Intake Air Pressure Sensor Check: 1) Disconnect connector from intake air pressure sensor. 2) Check for proper connection to intake air pressure sensor at each terminal. 3) If OK, check intake air pressure sensor for performance referring to "Intake Air Pressure Sensor (Manifold Absolute Pressure Sensor)" in Section 6E3. Is check result satisfactory?	"LT GRN", "BRN/RED" or "GRN/ORN" circuit open/short. If wire and connections are OK, substitute a known-good ECM and recheck.	Replace intake air pressure sensor.

DTC P0560 (P0562/P0563) System Voltage (Low/High)

Wiring Diagram



1. Double relay	3. Fuel pump	5. Main fuse	7. To ignition switch
2. ECM	4. "FUEL PUMP" fuse (15 A)	6. To radiator fan relay No.3	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
P0560 (P0562): Voltage is below 7 V at "E227-11", "E228-1" and "E228-2" wire terminals of ECM connector.	- Power supply circuit - ECM malfunction
P0560 (P0563): Voltage is greater than 17.5 V at "E227-11", "E228-1" and "E228-2" wire terminals of ECM connector.	

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC/pending DTC and freeze frame data by using scan tool and run engine at idle speed for 1 min.
- 3) Check DTC and pending DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Connect ECM connectors to ECM. 4) While engine running, check voltage between following terminals. E227-11 and ground E228-1 and ground E228-2 and ground Is each voltage 7 – 17.5 V?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If wire and connections are OK, substitute a known-good ECM and recheck.	"BLK/WHT", "BLU/BLK" or "WHT/GRN" circuit open or short.

DTC P1613 ECM Not Registered

DTC Detecting Condition

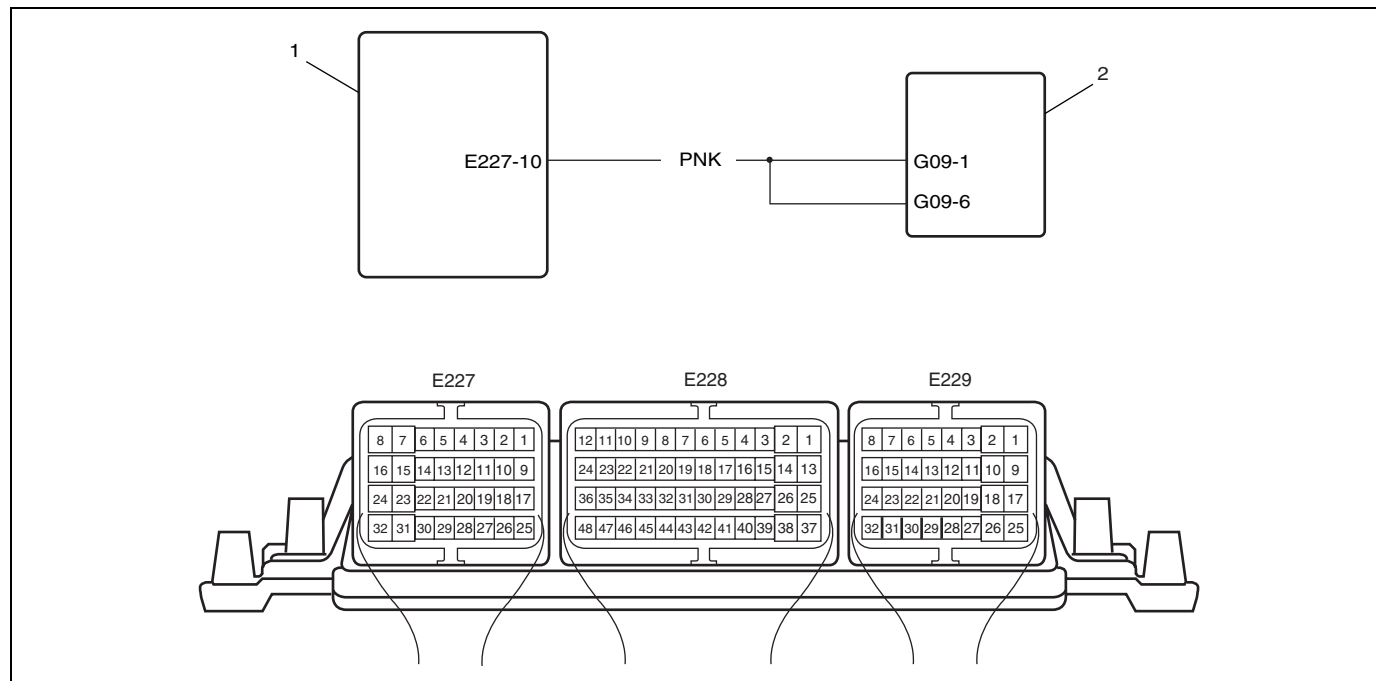
This DTC will be set when fuel injector class and transmission type are not registered to ECM.
 (When ECM replaced new one. etc.)

Troubleshooting

Step	Action	Yes	No
1	1) Register ECM according to the registration procedure, referring to "ECM Registration" in Section 6E3. 2) Check DTC after performing ECM registration. Is DTC P1613 still indicated?	Substitute a known-good ECM and recheck.	End.

DTC P1517 Immobilizer System Malfunction

Wiring Diagram



1. ECM

2. Immobilizer control module

Detecting Condition and Trouble Area

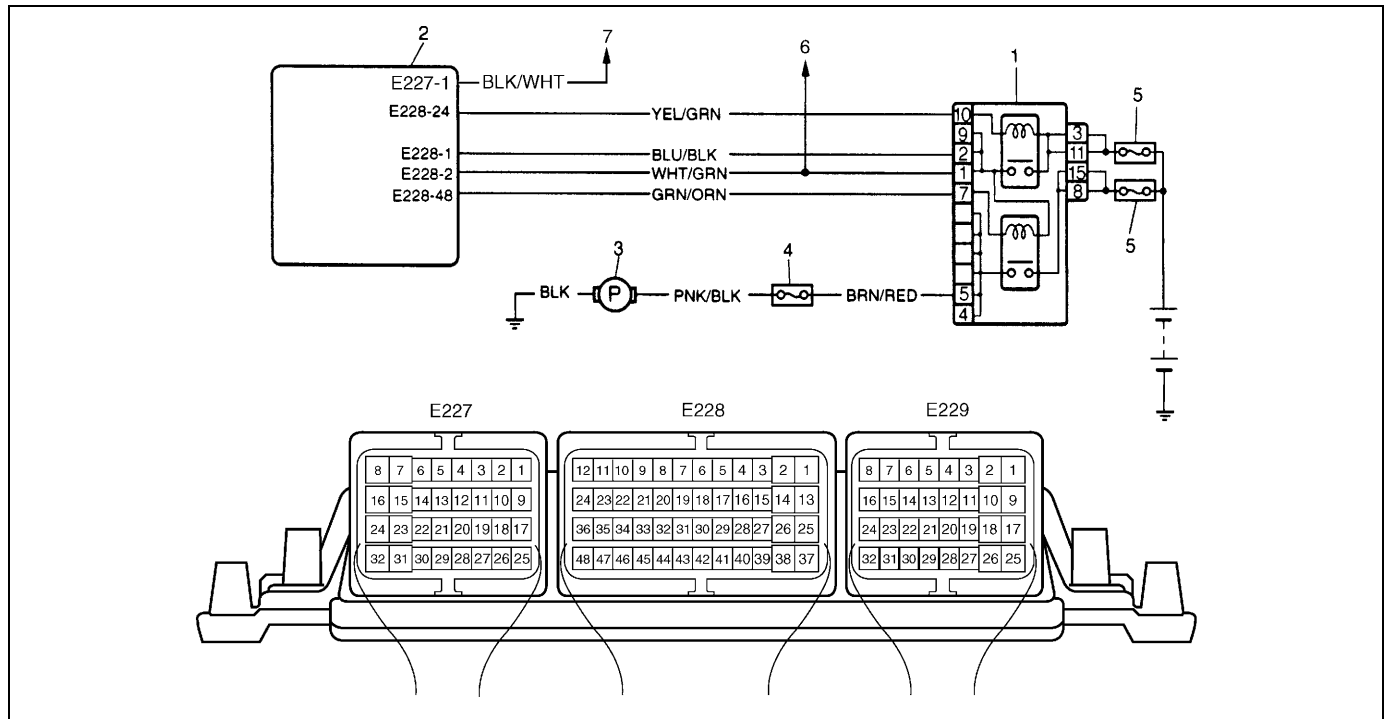
DTC DETECTING CONDITION	TROUBLE AREA
- This DTC will be set when temporary fault of internal memory (status memory) for communication to immobilizer control module detected in the ECM. - No signal or incorrect code inputted from immobilizer control module to ECM.	“PNK” wire circuit - Immobilizer control system malfunction - ECM malfunction

DTC Confirmation Procedure

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC by using scan tool.
- 3) Start engine.
- 4) Check DTC by using scan tool.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table" in this section.
2	Does engine start?	Temporary fault of internal memory (status memory) for communication to immobilizer control module. However, it is no adverse affect for communication. Therefore, it does not affect engine and emission control system.	Go to Step 3.
3	Check Wire Harness and Connection 1) Turn ignition switch to OFF position. 2) Remove ECM connector cover referring to "Voltage Check" in this section. 3) Check for proper connection to ECM at E227-10 terminal. 4) Disconnect immobilizer control module connector. 5) Check for proper connection to immobilizer control module at G09-1 and G09-6 terminals. 6) If each terminal connection is OK, measure resistance between G09-1 terminal of immobilizer control module and E227-10 terminal of ECM connector, between G09-6 terminal of immobilizer control module and E227-10 terminal of ECM connector. Is each resistance 1 Ω or less?	Go to Step 4.	"PNK" wire is open circuit.
4	Check Wire Harness 1) Measure resistance between E227-10 terminal of ECM connector and vehicle body ground. Is resistance infinity?	Go to Step 5.	"PNK" wire is shorted to ground.
5	Check Wire Harness 1) Turn ignition switch to ON position. 2) Measure voltage between E227-10 terminal of ECM connector and vehicle body ground. Is voltage 0 V?	Go to Step 6.	"PNK" wire is shorted to power circuit.
6	Check Immobilizer Control System 1) Check immobilizer control system referring to "Immobilizer Control System Diagnostic Flow Table" in Section 8G. Is check result satisfactory?	Substitute a known-good ECM and recheck.	Faulty immobilizer control system.

TABLE B-1 Fuel Pump Circuit Inspection**Wiring Diagram**

1. Double relay	3. Fuel pump	5. Double relay fuse (30 A)
2. ECM	4. "Fuel Pump" fuse (15 A)	6. To radiator fan relay No.3

Inspection

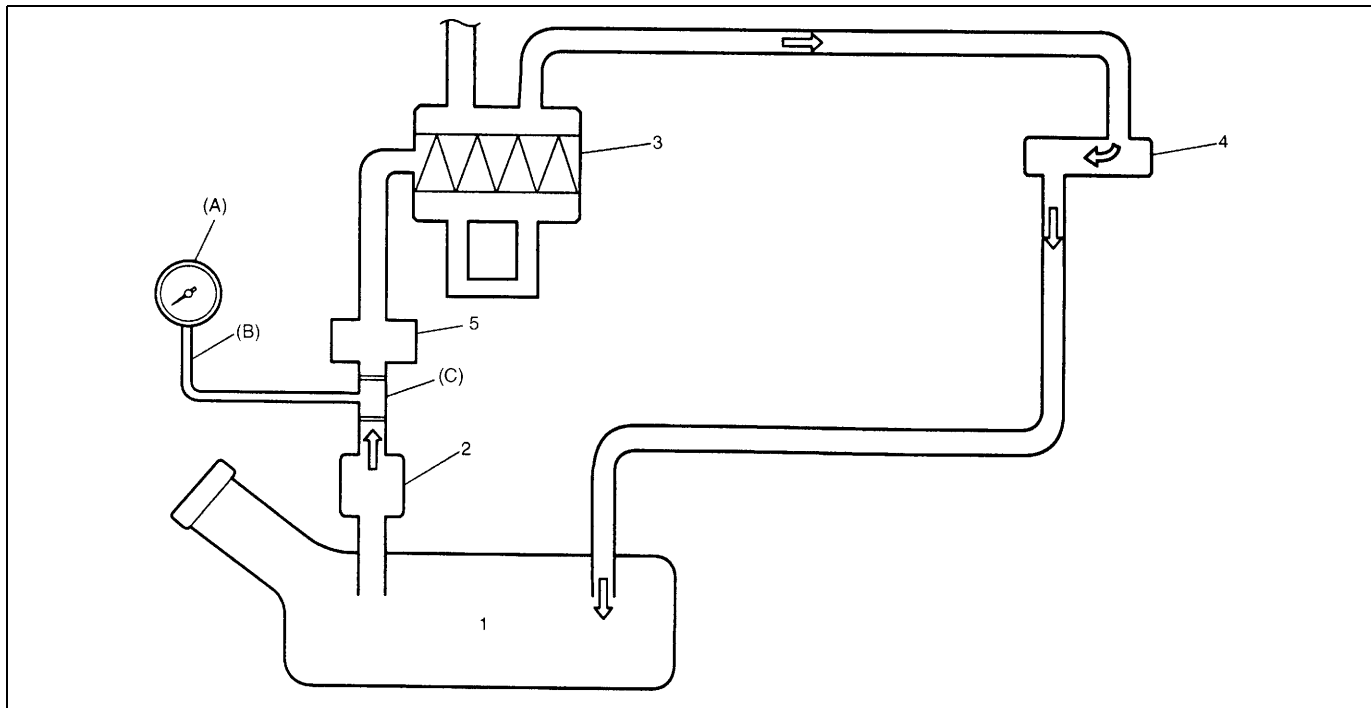
Step	Action	Yes	No
1	Fuel Pump Operation Check: 1) Turn ON ignition switch. Is fuel pump operation sound heard for 5 sec. after ignition switch ON?	Fuel pump circuit is in good condition.	Go to Step 2.
2	Fuel Pump Circuit Check: 1) With ignition switch OFF, remove double relay from connector. 2) Check for proper connection to relay at each terminal. 3) If OK, using service wire, connect terminals 8 and 5 of relay connector. (See CAUTION.) Is fuel pump heard to operate at ignition switch ON?	Go to Step 3.	"BLK", "PNK/BLK" or "BRN/RED" circuit open or fuel pump malfunction.
3	Double Relay Check: 1) Check double relay referring to "Double Relay" in Section 6E3. Is it in good condition?	"GRN/ORN" circuit open.	Replace double relay.

CAUTION:

Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness etc.

TABLE B-2 Fuel Pressure Inspection

System Diagram



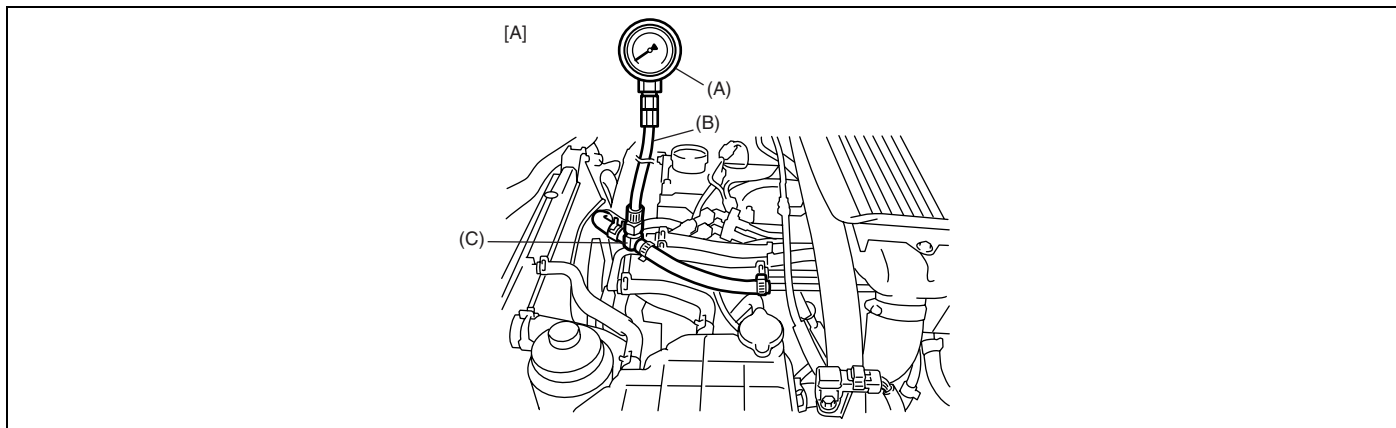
(A): Gauge	1. Fuel tank	4. Fuel temperature sensor
(B): Hose	2. Fuel pump	5. Fuel heater
(C): Attachment	3. Fuel filter	

Inspection

NOTE:

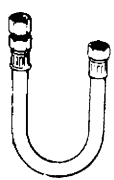
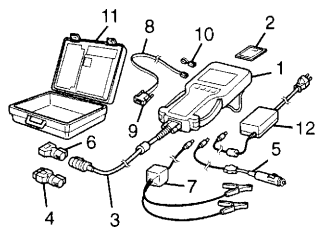
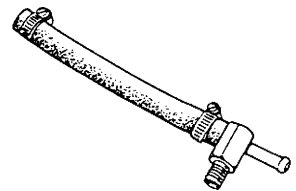
Before using the following flow table, check to make sure that battery voltage is higher than 11 V. If battery voltage is low, pressure becomes lower than specification even if fuel pump and line are in good condition.

Step	Action	Yes	No
1	1) Install fuel pressure gauge and check fuel pressure referring to "Low Pressure Fuel Supply System" in Section 6E3. Is fuel pressure within specified value?	Normal fuel pressure.	Go to Step 2.
2	Was fuel pressure higher than spec. in Step 1?	Clogged fuel heater, fuel filter, fuel temperature or fuel hose/pipe.	Go to Step 3.
3	Was no fuel pressure applied in Step 1?	- Shortage of fuel - Fuel pump and its circuit defective. (Refer to "Table B-1 Fuel Pump Circuit Inspection" in this section.)	Fuel leakage from fuel line.



[A]: Fig. for Step 1

Special tool**(A): 09912-58442****(B): 09912-58432****(C): 09912-56530****Special Tool**

 09912-58442 Pressure gauge	 09912-58432 Pressure hose	 Tech 2 kit (SUZUKI scan tool) (See NOTE "B".)	 09912-56530 3 way joint and hose

NOTE:**"B": This kit includes the following items.**

1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable,
6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter,
10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 6A3

ENGINE MECHANICAL (RHW ENGINE)

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

CAUTION:

Be sure to read “Precaution” in Section 6E before disconnecting fuel line or removing fuel system part(s). Failure to follow “Precautions” could result in unneeded fuel system repairs.

CONTENTS

6A3

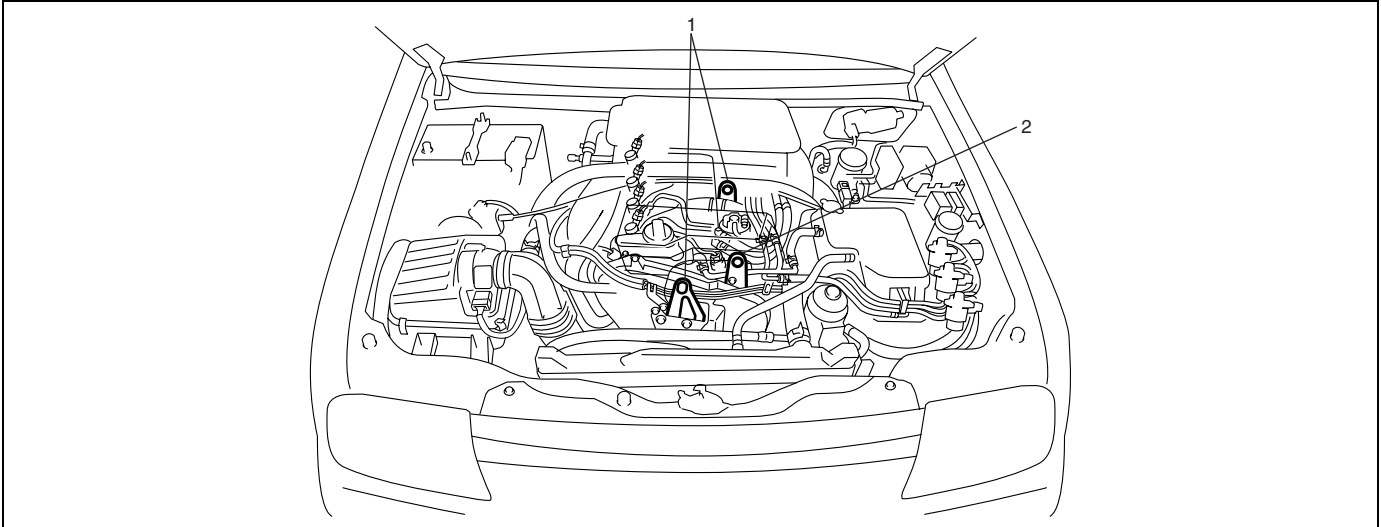
Service Precaution.....	6A3-2	Oil Pump	6A3-29
On-Vehicle Service.....	6A3-2	Camshafts and Valve Rockers.....	6A3-33
Compression Check	6A3-2	Valves and Cylinder Head	6A3-40
Oil Pressure Check	6A3-3	Swirl Control Solenoid Valve.....	6A3-47
Air Cleaner Element	6A3-4	Piston, Piston Rings, Connecting Rods and Cylinders	6A3-49
Intercooler	6A3-5	Unit Repair Overhaul	6A3-54
Cylinder Head Cover	6A3-6	Engine Assembly	6A3-54
Turbocharger.....	6A3-10	Main Bearings, Crankshaft and Cylinder Block	6A3-57
Intake Manifold	6A3-12	Special Tools.....	6A3-67
Exhaust Manifold.....	6A3-12	Required Service Materials	6A3-68
Timing Belt and Belt Tensioner	6A3-15	Tightening Torque Specifications	6A3-69
Oil Pressure Switch	6A3-23		
Oil Cooler	6A3-23		
Oil Pan and Oil Pump Strainer	6A3-24		

Service Precaution

CAUTION:

Be sure to use engine hooks (1) for hanging engine.

Never use engine hook (2) for this purpose. This prohibited service may damage fuel line.



On-Vehicle Service

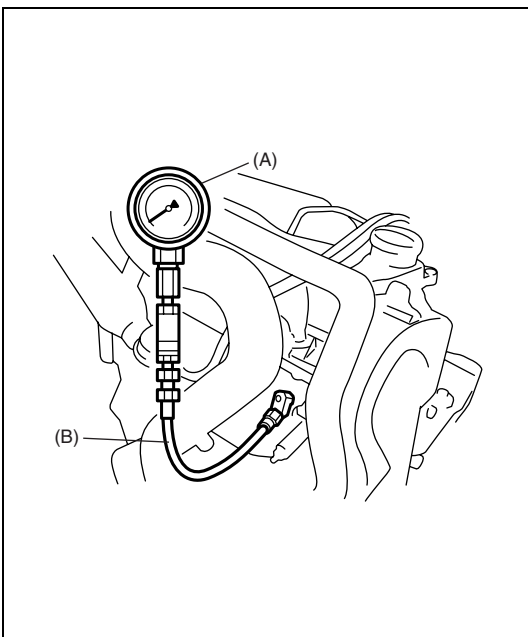
Compression Check

- 1) Cool off engine if it is hot.
- 2) Disconnect negative cable at battery.
- 3) Disconnect ECM connectors from ECM.
- 4) Remove all glow plugs referring to "Glow Plug" in Section 6E3.
- 5) Place transmission gear shift lever in "Neutral" for M/T model (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.
- 6) Install special tool to glow plug hole.

Special tool

(A): 09912-57820

(B): 09916-96520



- 7) Connect negative cable at battery.
- 8) Depress clutch pedal fully (to lighten starting load on engine) for M/T model.
- 9) Crank engine and inspect compression pressure.

Compression pressure specification

(at cranking engine (engine speed is 250 rpm or more))

Minimum: 2.5 MPa (25 kg/cm², 356 psi)

Maximum difference between cylinders:

0.5 MPa (5 kg/cm², 72 psi)

- 10) Carry out step 6) through 9) on each cylinder in order to obtain 4 readings.

- 11) If compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder and recheck compression.
 - If compression increases, piston, piston rings or cylinder wall may be worn.
 - If compression stays low, valve may be stuck or seating improperly.
 - If compression in adjacent cylinders stays low, cylinder head gasket may be damaged or cylinder head distorted.
- 12) Disconnect negative cable at battery.
- 13) Remove special tool and install all glow plugs referring to "Glow Plug" in Section 6E3.
- 14) Connect ECM connectors to ECM.
- 15) Connect negative cable at battery.

Oil Pressure Check

WARNING:

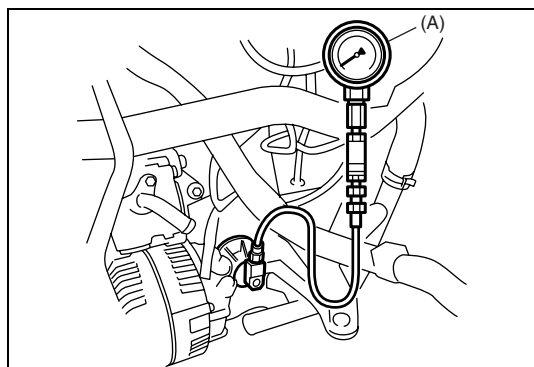
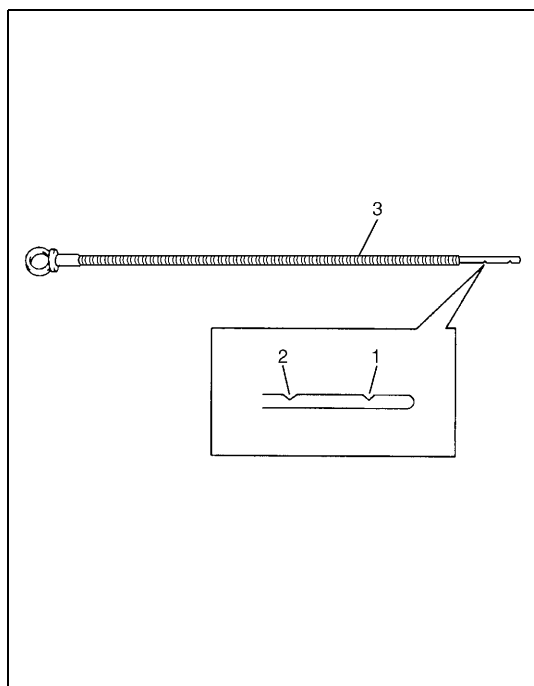
To avoid danger of being burned, do not touch exhaust manifold when exhaust system is hot.

NOTE:

Prior to checking oil pressure, check and perform the following.

- Oil level in oil pan.
If oil level is low, add oil up to full level mark (2) on oil level gauge (3).
- Oil quality.
If oil is discolored, or deteriorated, change it.
For particular oil to be used, refer to "Engine" in Section 0B.
- Oil leaks.
If leak is found, repair it.
- Be sure to place transmission gear shift lever in "Neutral" for M/T model (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

1. Low level mark



- 1) Remove oil filter from oil filter stand referring to "Engine Oil and Filter" in Section 0B.
- 2) Install special tool to oil cooler.

Special tool

(A): 09915-76530/OUT0000057

CAUTION:

Be careful not to make special tool touch exhaust manifold when installing because exhaust manifold becomes very hot.

- 3) Start engine and warm it up to normal operating temperature.
- 4) After warming up, raise engine speed to specified speed, and measure oil pressure.

Oil pressure specification

Approx. 200 kPa (2.04 kg/cm², 29.0 psi) at 1,000 r/min (rpm)

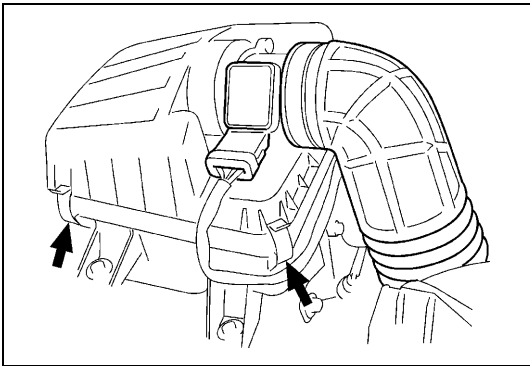
Approx. 400 kPa (4.08 kg/cm², 58.0 psi) at 2,000 r/min (rpm)

- 5) Stop engine and remove oil pressure gauge.
- 6) Install new oil filter referring to "Engine" in Section 0B.
- 7) Start engine and check oil filter for oil leakage.

Air Cleaner Element

REMOVAL

- 1) Remove air cleaner case clamps.
- 2) Remove air cleaner element from case.

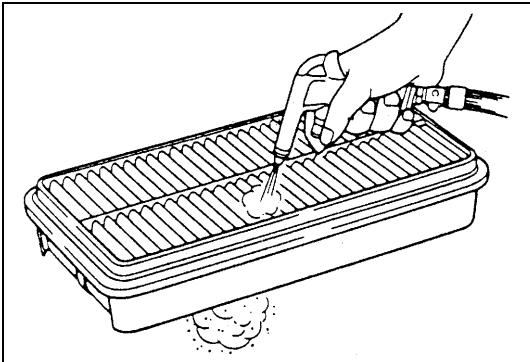


INSPECTION

Check air cleaner element for dirt. Replace excessively dirty element.

CLEAN

Blow off dust by compressed air from air outlet side of element.

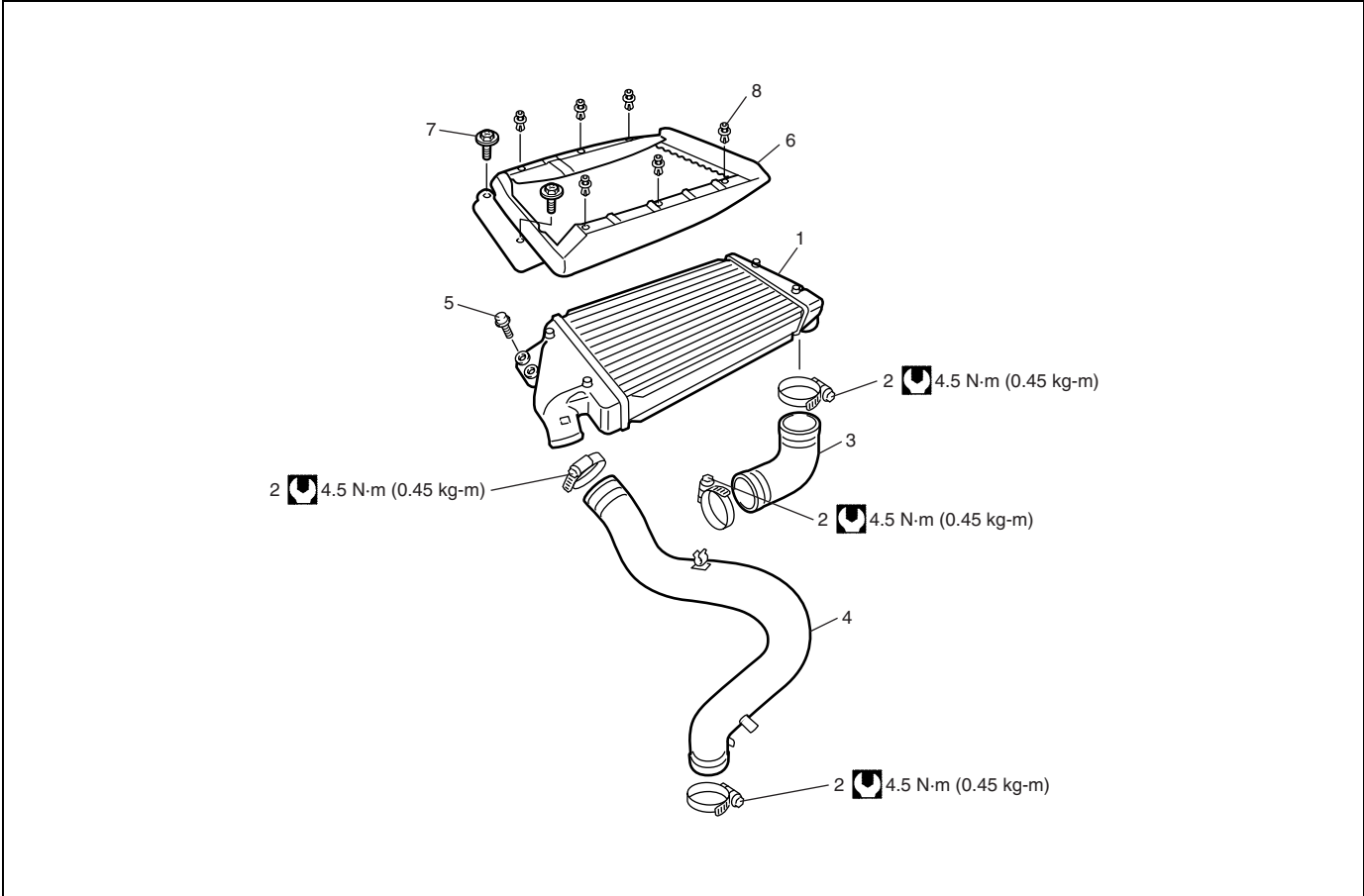


INSTALLATION

Reverse removal procedure for installation.

Intercooler

COMPONENTS



1. Intercooler	3. Intercooler outlet hose	5. Intercooler bolt	7. Intercooler duct bolt	Tightening Torque
2. Clamp	4. Intercooler inlet hose	6. Intercooler duct	8. Intercooler duct clip	

REMOVAL

- 1) Loosen intercooler hose clamps.
- 2) Remove intercooler.

INSTALLATION

Reverse removal procedure for installation noting the following.

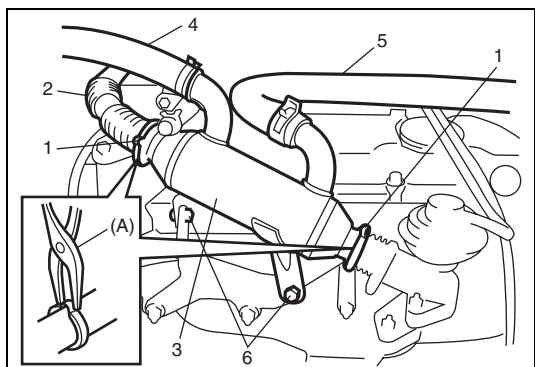
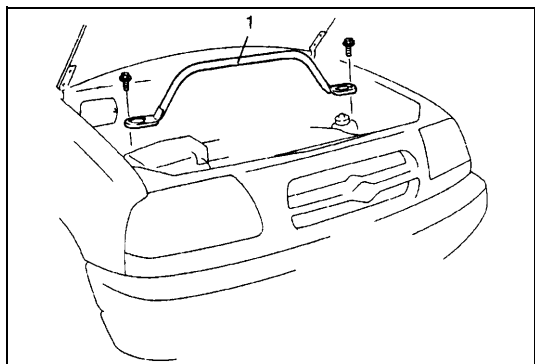
- Tighten hose clamp to specified torque.

Tightening torque
Intercooler outlet and inlet hose clamps:
4.5 N·m (0.45 kg-m, 3.5 lb-ft)

Cylinder Head Cover

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Detach fuse/relay box and TP sensor (Accelerator stroke sensor) with air cleaner upper case.
- 3) Remove intake air pressure sensor and strut tower bar (1).
- 4) Remove intercooler and intercooler inlet hose referring to "Intercooler" in this section.
- 5) Remove battery from vehicle.

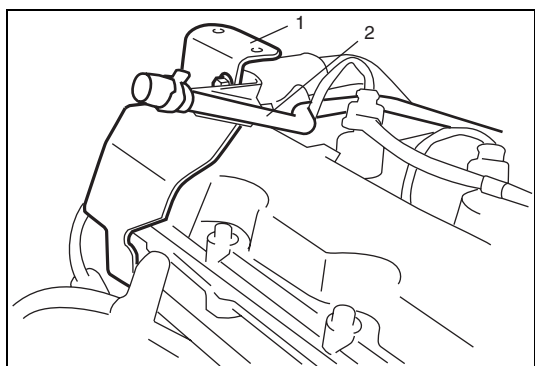


- 6) Remove clamps (1) using special tool, and remove EGR pipe (2) from EGR cooler (3).

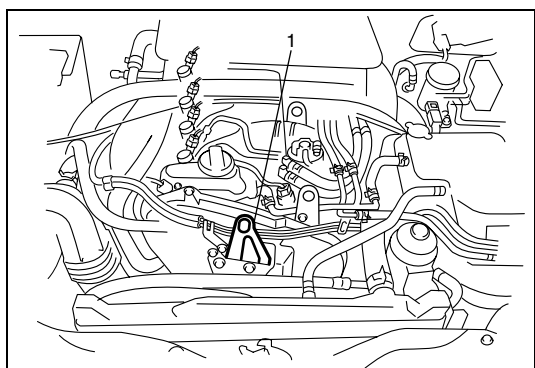
Special tool

(A): 09919-46510/OUT0000110

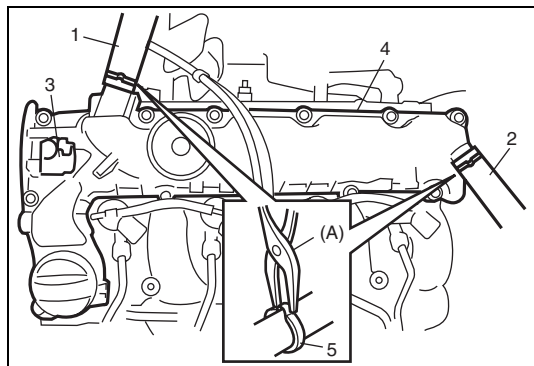
- 7) Move aside EGR cooler (3) with heater outlet hose (4) and heater outlet No.2 hose (5) removing EGR cooler bolt No.1 and No.2 (6).



- 8) Remove intercooler bracket (1) and vacuum pipe (2).
- 9) Disconnect fuel injector couplers, and move aside harness for fuel injectors from cylinder head cover.



- 10) Remove engine front hook (1) on engine bracket, and remove upper timing belt cover.

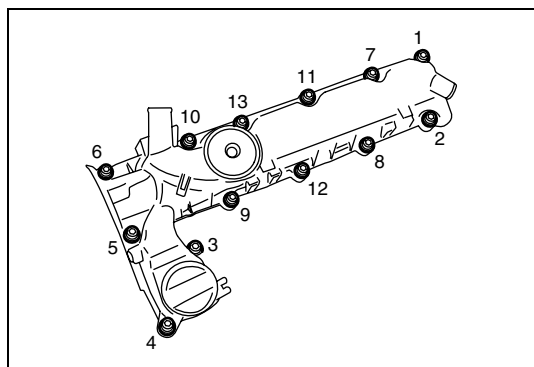


- 11) Disconnect breather hose (1) and oil filler hose (2) from cylinder head cover (4) after removing clamps (5) using special tool.

Special tool

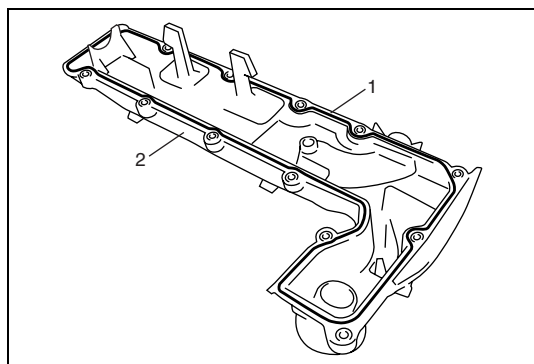
(A): 09919-46510/OUT0000110

- 12) Disconnect CMP sensor connector.
- 13) Remove CMP sensor (3) from cylinder head cover.



- 14) Loosen cylinder head cover bolts in such order as indicated in figure and remove them.
- 15) Remove cylinder head cover with its gasket.

INSTALLATION

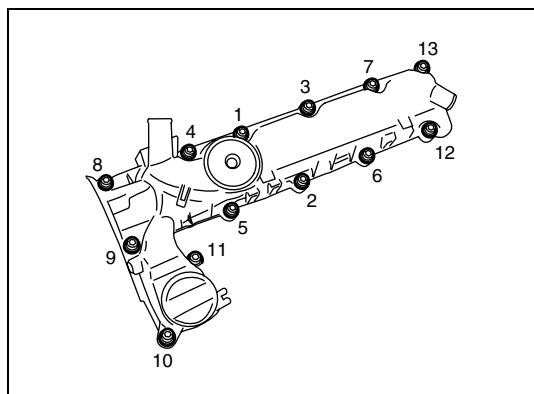


- 1) Install new gasket (1) to cylinder head cover (2).

NOTE:

Ensure that new gasket is positioned correctly in groove of cover.

- 2) Install cylinder head cover to cylinder head.



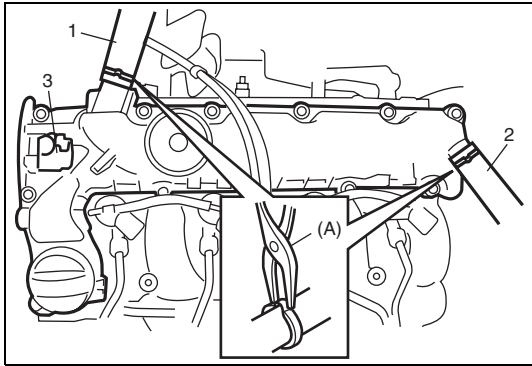
- 3) Tighten bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

Tightening torque

Cylinder head cover bolt: 10 N·m (1.0 kg-m, 7.5 lb-ft)

NOTE:

When installing cylinder head cover, use care so that cylinder head cover gasket will not get out of place or fall off.

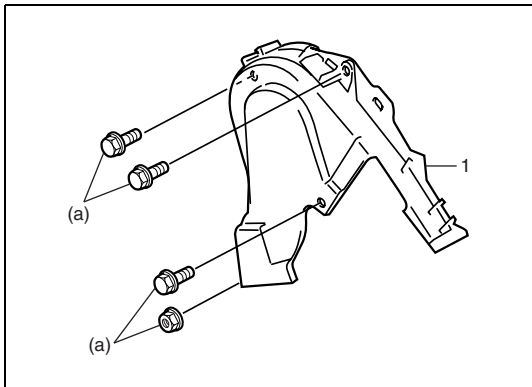


- 4) Connect breather hose (1) and oil filler hose (2) to cylinder head cover, and fix hoses with new clamps using special tool.

Special tool

(A): 09919-46510/OUT0000110

- 5) Install CMP sensor (3) to cylinder head cover.
6) Check CMP sensor air gap referring to "Camshaft Position Sensor" in Section 6E3.



- 7) Install upper timing belt cover (1).
Apply sealant to timing belt cover bolts, and then tighten bolts to specified torque.

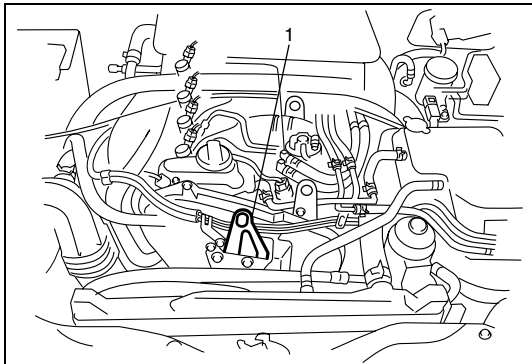
"A": Sealant LOCKTITE FRENETANCH

Tightening torque

Timing belt cover bolt and nut (a):

10 N·m (1.0 kg-m, 7.5 lb-ft)

- 8) Connect fuel injector couplers, and fix harness for fuel injector to cylinder head cover.

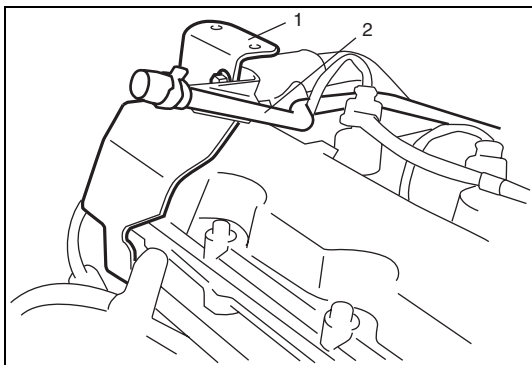


- 9) Install engine front hook (1) to engine bracket, and tighten engine front hook mounting bolt to specified torque.

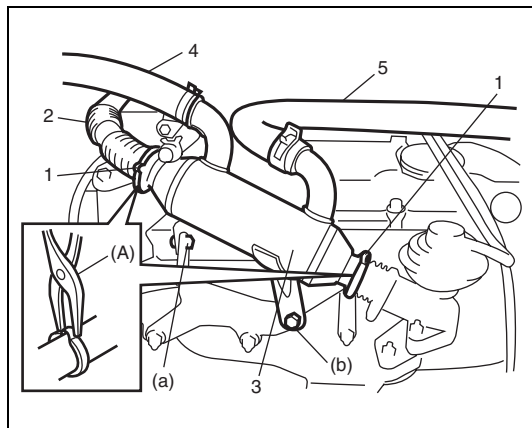
Tightening torque

Engine front hook mounting bolt:

50 N·m (5.0 kg-m, 36.5 lb-ft)



- 10) Install vacuum pipe (2) and intercooler bracket (1).



- 11) Bring back EGR cooler (3) with heater outlet hose (4) and heater outlet No.2 hose (5), and tighten EGR cooler bolt No.1 and No.2 to specified torque.

Tightening torque

EGR cooler bolt No.1 (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

EGR cooler bolt No.2 (b): 23 N·m (2.3 kg-m, 16.5 lb-ft)

- 12) Install EGR pipe (2) and fix pipe with new clamps (1) using special tool.

Special tool

(A): 09919-46510/OUT0000110

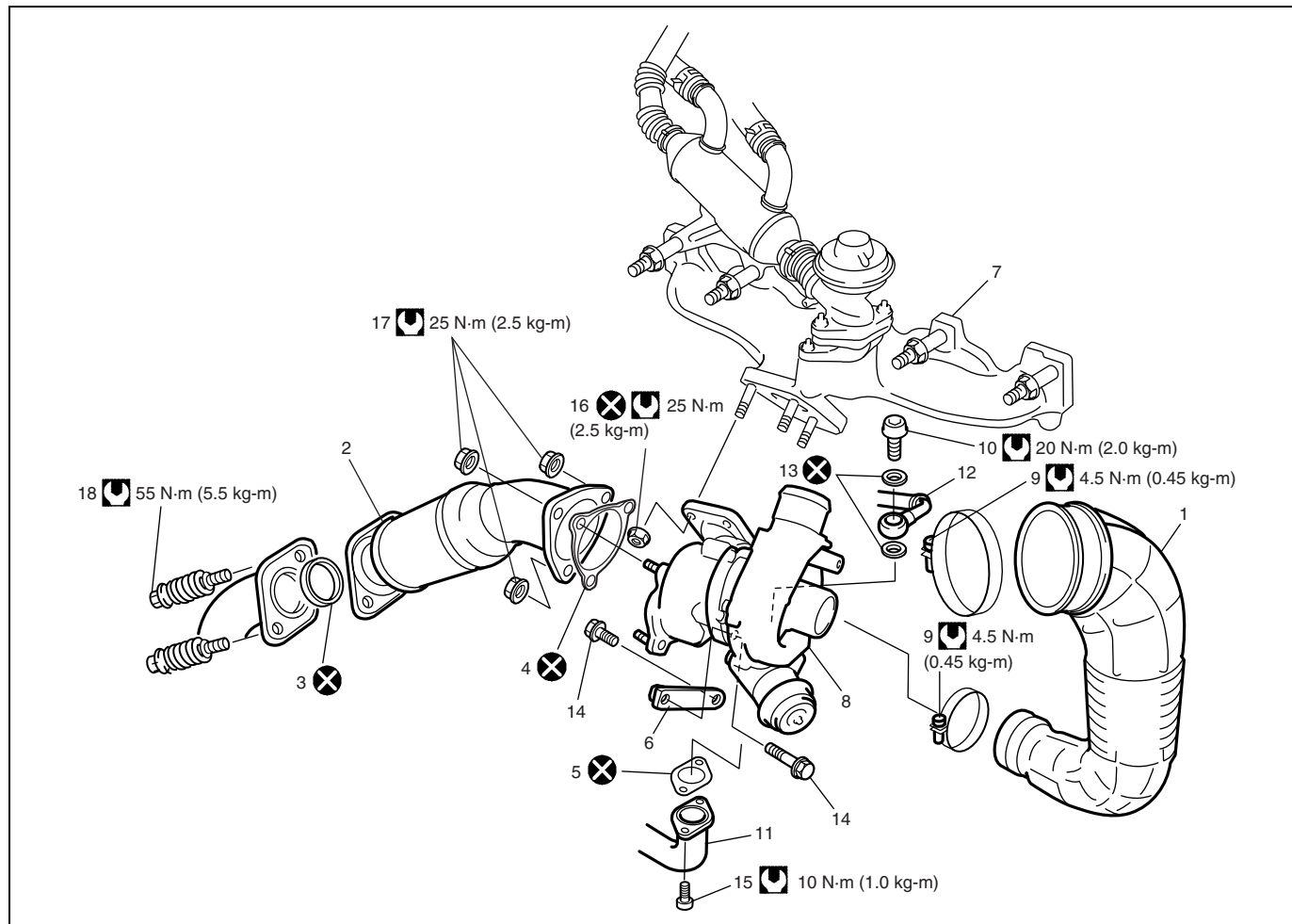
- 13) Install battery to vehicle.
 14) Install intercooler inlet hose and intercooler referring to "Intercooler" in this section.
 15) Install strut tower bar, TP sensor (Accelerator stroke sensor) with air cleaner upper case, and intake air pressure sensor.
 16) Install fuse/relay box.
 17) Connect negative cable at battery.

Turbocharger

WARNING:

To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.

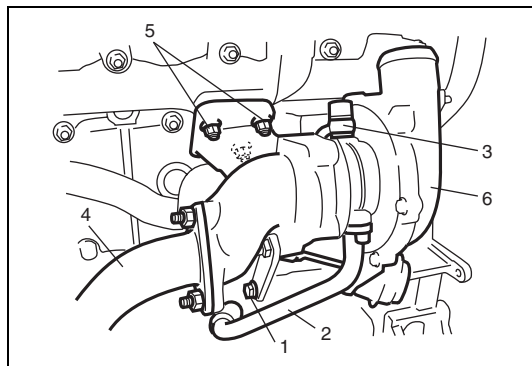
COMPONENTS



1. Air cleaner outlet hose	6. Turbocharger bracket	11. Oil return pipe	16. Turbocharger nut
2. Turbocharger outlet pipe	7. Exhaust manifold	12. Lubrication pipe	17. Turbocharger outlet pipe nut
3. Seal ring	8. Turbocharger	13. Gasket	18. Exhaust No.2 pipe bolt
4. Gasket	9. Air cleaner outlet hose clamp	14. Turbocharger bracket bolt	Tightening Torque
5. Oil return pipe gasket	10. Lubrication pipe union bolt	15. Oil return pipe bolt	Do not reuse.

REMOVAL

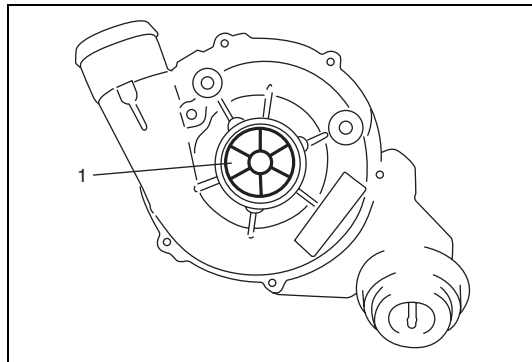
- 1) Disconnect negative cable at battery.
- 2) Detach fuse/relay box and remove intake air pressure sensor.
- 3) Remove strut tower bar.
- 4) Remove intercooler and intercooler inlet hose referring to "Intercooler" in this section.
- 5) Detach air cleaner assembly with TP sensor (Accelerator stroke sensor).
- 6) Remove air cleaner outlet hose from turbocharger.
- 7) Disconnect vacuum hose from waste gate actuator.



- 8) Remove turbocharger outlet pipe (4) from turbocharger (6).
- 9) Remove turbocharger bracket bolt (1) from turbocharger (6).
- 10) Disconnect oil return pipe (2) and lubrication pipe (3) from turbocharger (6).
- 11) Remove turbocharger from exhaust manifold removing 3 turbocharger nuts (5).

INSPECTION

Rotate turbine shaft (1) by hand and verify that it turns smoothly without any abnormal noise and excessive runout.
If not as specified, replace the turbocharger.



INSTALLATION

Reverse removal procedure for installation noting the following.

- Clean mating surfaces of turbocharger, turbocharger outlet pipe and exhaust manifold.
- Use new gaskets.
- Use new turbocharger bolts.
- Tighten each nuts and bolts to specified torque.

Tightening torque

Turbocharger nut (a):

25 N·m (2.5 kg-m, 18.0 lb-ft)

Lubrication pipe union bolt (b):

20 N·m (2.0 kg-m, 14.5 lb-ft)

Turbocharger outlet pipe nut (c):

25 N·m (2.5 kg-m, 18.0 lb-ft)

Oil return pipe bolt (d):

10 N·m (1.0 kg-m, 7.5 lb-ft)

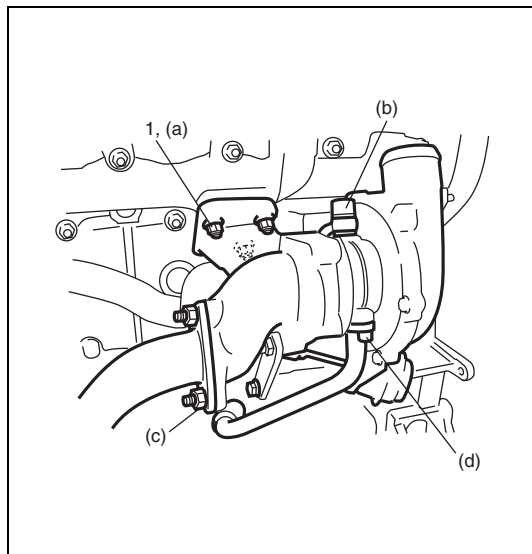
Exhaust No.2 pipe bolt:

55 N·m (5.5 kg-m, 40.0 lb-ft)

Air cleaner outlet hose clamp:

4.5 N·m (0.45 kg-m, 3.5 lb-ft)

- Tighten strut tower bar bolts to specified torque referring to “Strut Damper” in Section 3D.



Intake Manifold

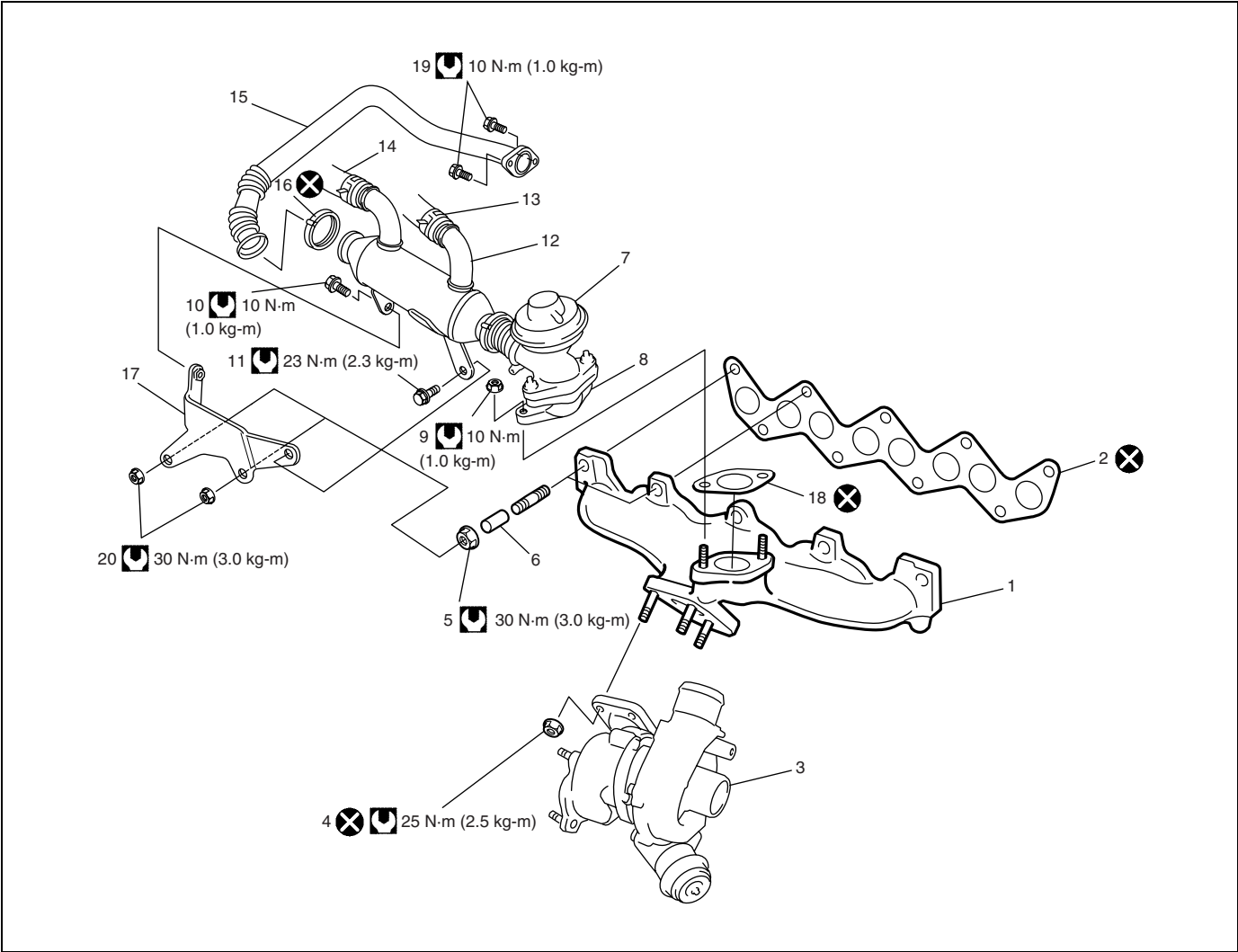
REMOVAL/INSTALLATION

Refer to “Camshafts and Valve Lash Adjusters” in this section.

Exhaust Manifold

WARNING:
To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.

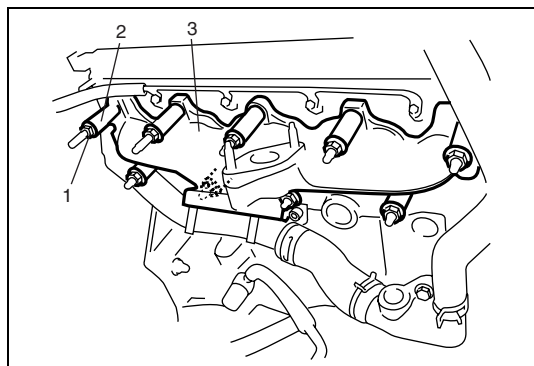
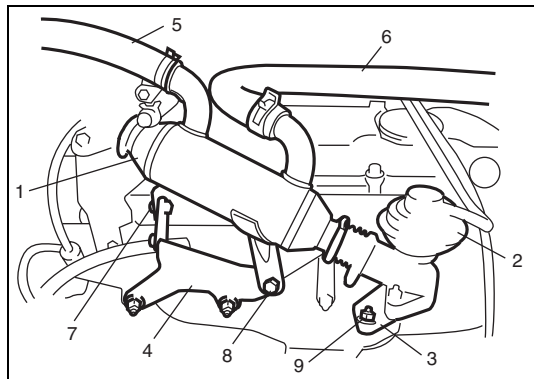
COMPONENTS



1. Exhaust manifold	7. EGR valve	13. Heater outlet No.2 hose	19. EGR pipe bolt
2. Exhaust manifold gasket	8. EGR valve spacer	14. Heater outlet hose	20. EGR cooler bracket nut
3. Turbocharger	9. EGR valve spacer nut	15. EGR pipe	Tightening Toque
4. Turbocharger nut	10. EGR cooler bolt No.1	16. Clamp	Do not reuse.
5. Exhaust manifold nut	11. EGR cooler bolt No.2	17. EGR cooler bracket	
6. Spacer	12. EGR cooler	18. EGR valve gasket	

REMOVAL

- 1) Remove battery.
- 2) Remove turbocharger from exhaust manifold referring to "Turbocharger" in this section.
- 3) Disconnect vacuum hose from EGR valve.
- 4) Remove swirl control solenoid valve referring to "Swirl Control Solenoid Valve" in Section 6E3.
- 5) Remove EGR cooler bolt No.1 (7), No.2 (8) and EGR valve spacer nut (9).
- 6) Detach EGR cooler (1) with EGR valve (2), EGR valve spacer (3), heater outlet hose (5) and heater outlet No.2 hose (6).
- 7) Remove EGR cooler bracket (4).



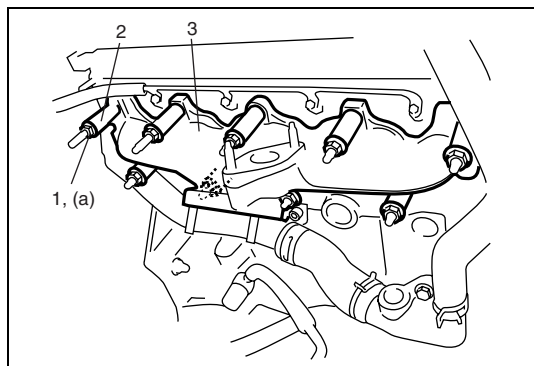
- 8) Remove exhaust manifold nuts (1) and spacers (2).
- 9) Remove exhaust manifold (3) and its gasket from cylinder head.

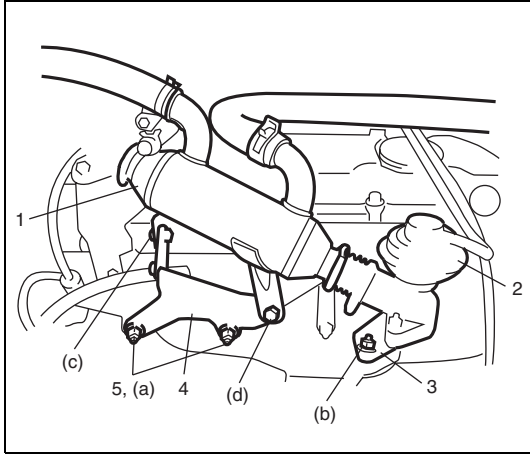
INSTALLATION

- 1) Install new exhaust manifold gasket to cylinder head.
- 2) Install exhaust manifold (3) and spacers (2), and tighten exhaust manifold nuts (1) to specified torque.

Tightening torque

Exhaust manifold nut (a): 30 N·m (3.0 kg-m, 22.0 lb-ft)





- 3) Install EGR cooler bracket (4), and tighten EGR cooler bracket nut (5) to specified torque.

Tightening torque

EGR cooler bracket nut (a): 30 N·m (3.0 kg-m, 22.0 lb-ft)

- 4) Install new EGR valve spacer gasket.
- 5) Install EGR cooler (1) with EGR valve (2) and EGR valve spacer (3), and tighten bolts and nuts to specified torque.

Tightening torque

EGR valve spacer nut (b): 10 N·m (1.0 kg-m, 7.5 lb-ft)

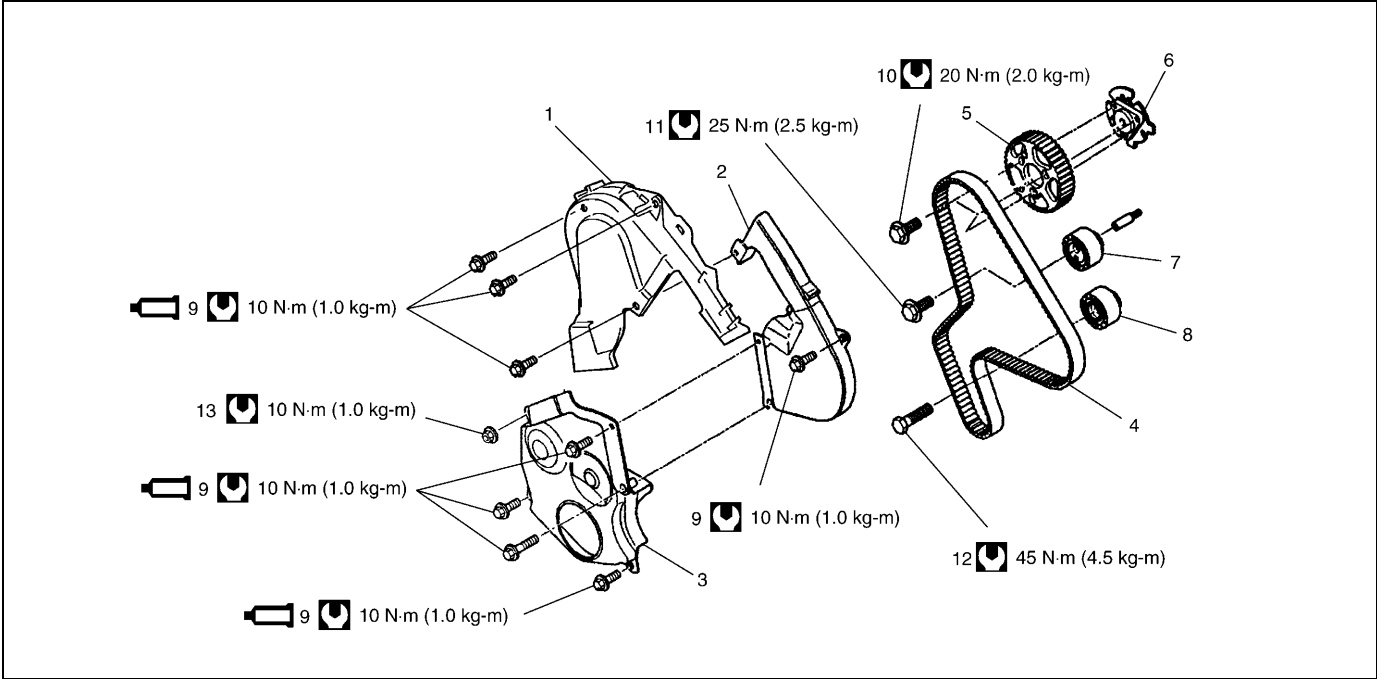
EGR cooler bolt No.1 (c): 10 N·m (1.0 kg-m, 7.5 lb-ft)

EGR cooler bolt No.2 (d): 23 N·m (2.3 kg-m, 16.5 lb-ft)

- 6) Install swirl control valve referring to "Swirl Control Solenoid Valve" in Section 6E3.
- 7) Connect vacuum hose to EGR valve.
- 8) Install turbocharger to exhaust manifold referring to "Turbocharger" in this section.
- 9) Install battery to vehicle.

Timing Belt and Belt Tensioner

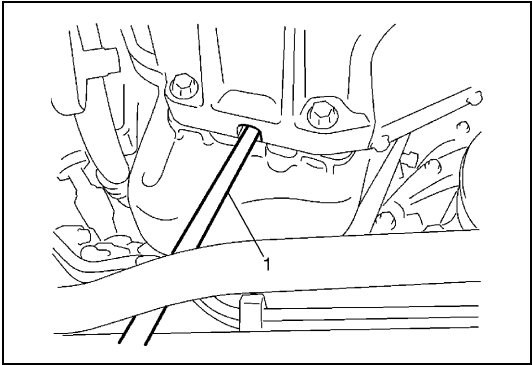
COMPONENTS

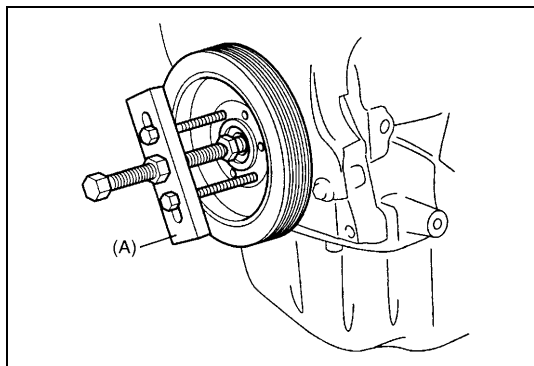


1. Upper timing belt cover	5. Camshaft timing belt pulley	 9. Timing belt cover bolt :Apply LOCKTITE FRENE TANCH to thread part of bolt.	13. Timing belt cover nut
2. Right timing belt cover	6. Camshaft hub	10. Camshaft timing belt pulley bolt	 Tightening Torque
3. Lower timing belt cover	7. Timing belt tensioner	11. Timing belt tensioner bolt	
4. Timing belt	8. Roller	12. Roller bolt	

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove A/C compressor belt, if equipped.
- 3) Remove generator belt referring to “Generator Belt” in Section 6H.
- 4) Remove radiator referring to “Radiator” in Section 6B.
- 5) Remove crankshaft pulley bolt with crankshaft locked by using flat end rod (1) or the like as shown in figure.





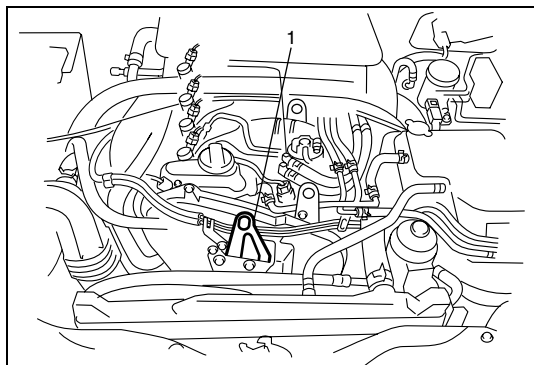
- 6) Remove crankshaft pulley.

If it is hard to remove, install crankshaft pulley bolt without washer and use special tool after replacing fixing bolts included special tool to specified bolts as follows.

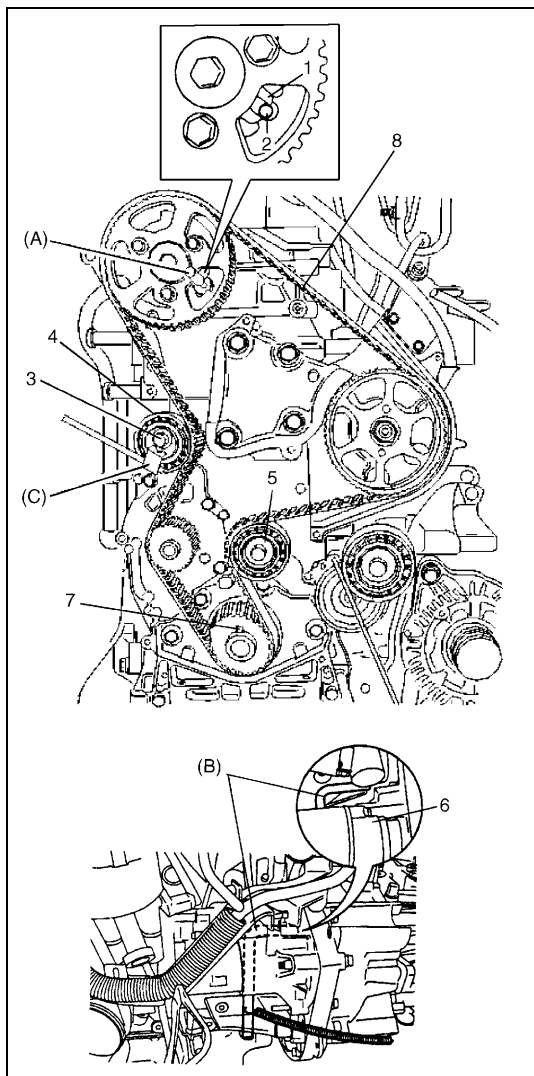
Special tool fixing bolt size: M6, P1.0, L=75 mm (2.95 in.)

Special tool

(A): 09944-36011



- 7) Remove engine front hook (1) on engine bracket, and remove timing belt covers.



- 8) Turn crankshaft so that crank timing pulley key (7) turns upward, and then lock camshaft hub (1) inserting special tool (A) into cylinder head hole (2) as shown in figure.

Special tool

(A): 09910-26540/OUT0000151

- 9) Lock flywheel (for M/T model) or drive plate (for A/T model) inserting special tool (B) into holes in both cylinder block and flywheel (for M/T model) (or drive plate (for A/T model)) with crank timing pulley key turned upward.

Special tool

(B): 09910-26530/OUT0000160

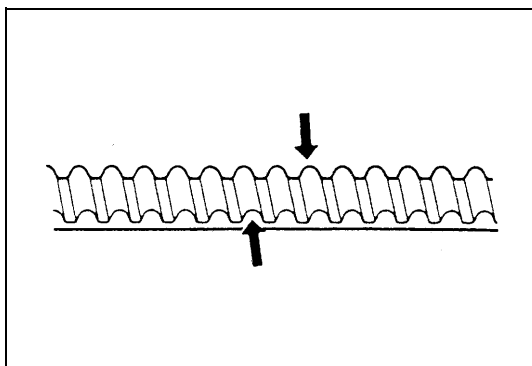
- 10) Loosen timing belt tensioner bolt (3). Then remove timing belt (8) turning timing belt tensioner (4) clockwise with special tool (C).

Special tool

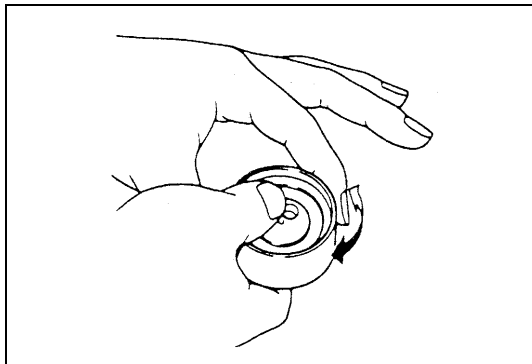
(C): 09919-56550/OUT0000141

- 11) Remove timing belt tensioner (4) and roller (5).

6. Starting motor

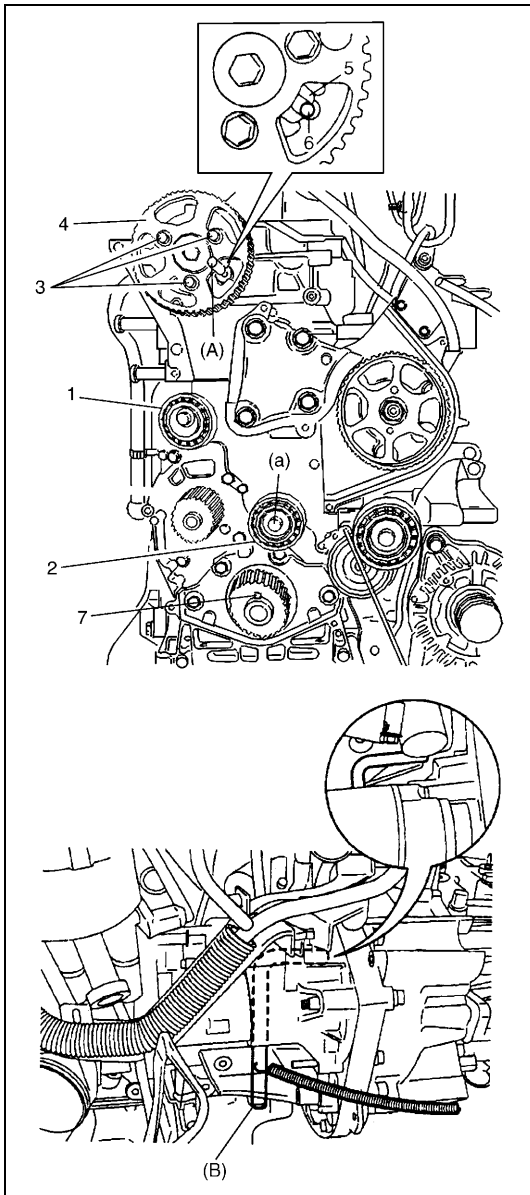
INSPECTION

- Inspect timing belt for wear or crack.
Replace it as necessary.



- Inspect timing belt tensioner and roller for smooth rotation.

INSTALLATION



- 1) Install timing belt tensioner (1) and roller (2).
Do not tighten timing belt tensioner bolt with wrench yet.
Tighten by hand only at this time.

Tightening torque

Roller bolt (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

- 2) Check that camshaft hub (5) is locked inserting special tool (A) into cylinder head hole (6) as shown in figure.

Special tool

(A): 09910-26540/OUT0000151

- 3) Check that flywheel (for M/T model) or drive plate (for A/T model) is locked inserting special tool (B) into holes in both cylinder block and flywheel (for M/T model) (or drive plate (for A/T model)) with crank timing pulley key (7) turned upward.

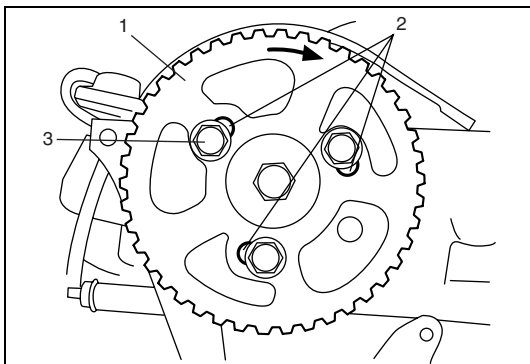
Special tool

(B): 09910-26530/OUT0000160

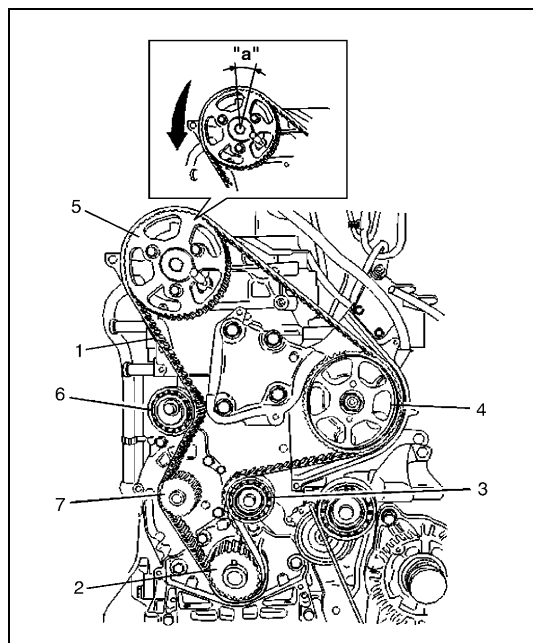
- 4) Loosen camshaft timing belt pulley bolts (3) and check that camshaft timing belt pulley (4) rotates freely on camshaft hub (5).

NOTE:

Do not remove camshaft timing belt pulley bolts (3).



- 5) Turn camshaft timing belt pulley (1) clockwise until the oblong hole (2) end contacts pulley bolt (3) as shown.



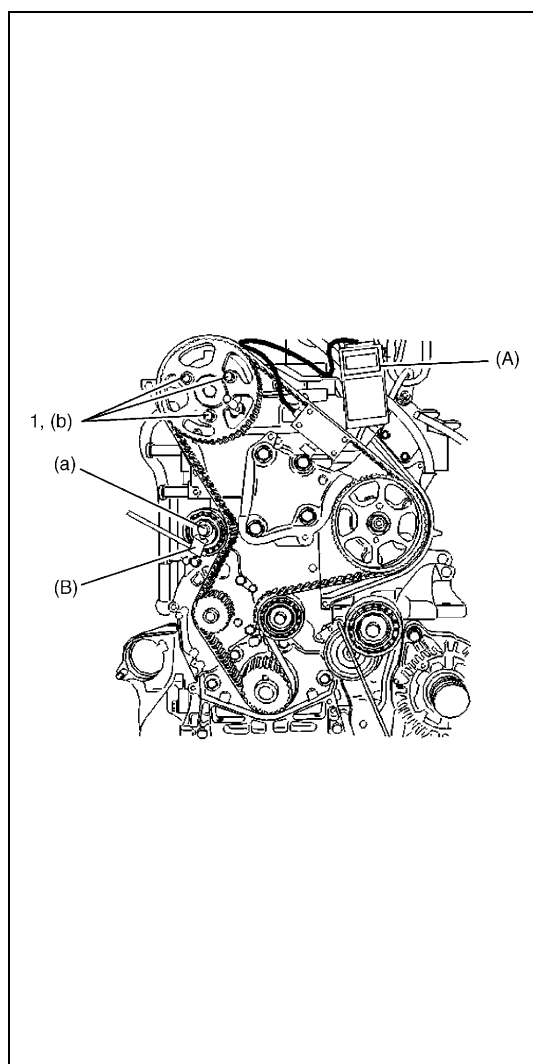
6) Install timing belt (1) with fully taut, in the following order.

- a) Crankshaft timing belt pulley (2).
- b) Roller (3).
- c) Injection pump pulley (4).
- d) Camshaft timing belt pulley (5).

NOTE:

Slightly turn camshaft timing belt pulley (5) counter clockwise within one teeth width in order to engage timing belt on pulley.

- e) Water pump pulley (7).
- f) Timing belt tensioner (6).



7) Fit special tool as shown in figure.

NOTE:

Check that special tool is not touching anything in the near vicinity.

Special tool

(A): 09919-56560/OUT0000138

8) Turn timing belt tensioner counterclockwise using special tool (B) until special tool (A) indicates 98 ± 2 . Then tighten timing belt tensioner bolt (2) to specified torque.

Special tool

(B): 09919-56550/OUT0000141

Tightening torque

Timing belt tensioner bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

9) Remove special tool (A).
10) By removing one of camshaft timing belt pulley bolts (1), check to make sure that bolt hole is not at the oblong hole end in pulley.

If bolt hole is at the oblong hole end in pulley, repeat step 2) through 9) after removing timing belt.

11) Install camshaft timing belt pulley bolt (1) removed at step 10).

Tighten bolts (1) to specified torque.

Tightening torque

Camshaft timing belt pulley bolt (b):

20 N·m (2.0 kg-m, 14.5 lb-ft)

- 12) Remove all special tools.
- 13) Install crankshaft pulley temporarily, and then turn crankshaft 8 rotations clockwise.

NOTE:

Never turn crankshaft counterclockwise.

- 14) Install special tools referring to step 2) and 3).
- 15) Loosen camshaft timing belt pulley bolts (1) and timing belt tensioner bolt (2).

NOTE:

Do not remove camshaft timing belt pulley bolts (1).

- 16) Fit special tool as shown.

Special tool

(A): 09919-56560/OUT0000138

- 17) Turn timing belt tensioner clockwise using special tool (B) until special tool (A) indicates 54 ± 2 . Then tighten timing belt tensioner bolt (2) to specified torque.

Special tool

(B): 09919-56550/OUT0000141

Tightening torque

Timing belt tensioner bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

- 18) Tighten camshaft timing belt pulley bolts (1) to specified torque.

Tightening torque

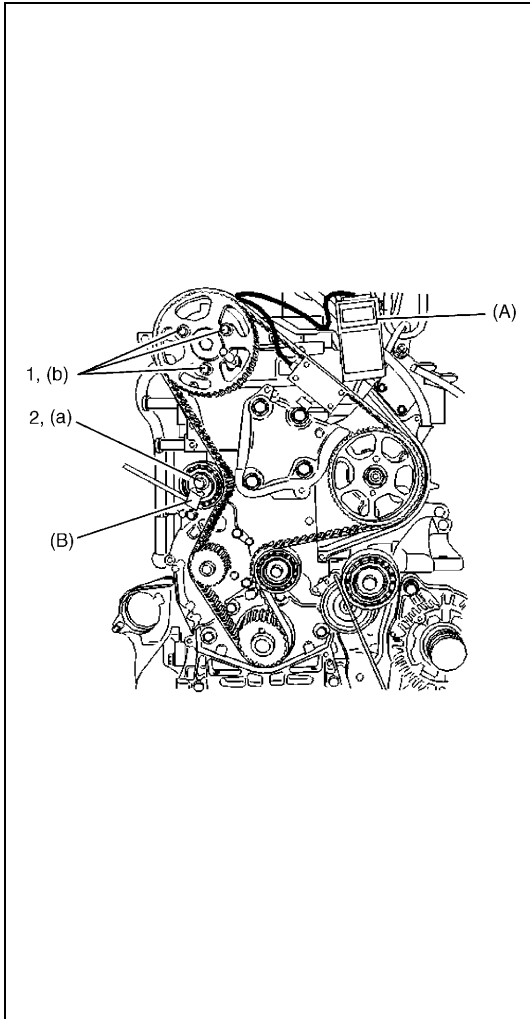
Camshaft timing belt pulley bolt (b):

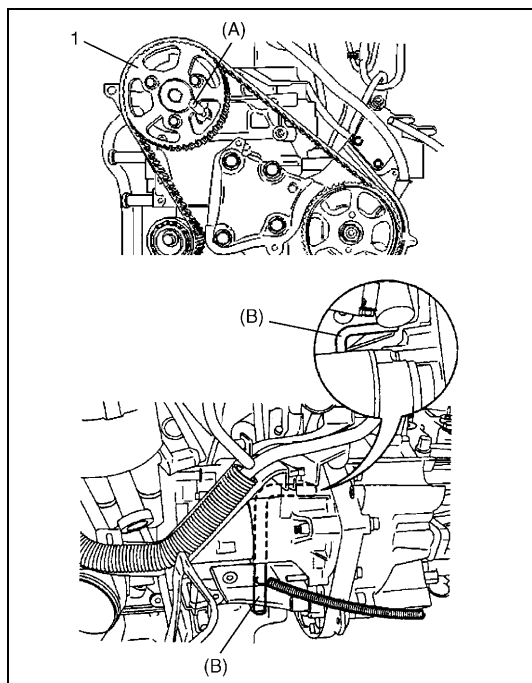
20 N·m (2.0 kg-m, 14.5 lb-ft)

- 19) Remove special tool (A), and then install it again.
- 20) Check that special tool (A) indicates between 51 and 57. If indication of tool is out of specified value, perform step 2) through 19) again after removing timing belt.
- 21) Remove all special tools, and then turn crankshaft 2 revolutions in clockwise.

NOTE:

Never turn crankshaft counterclockwise.





- 22) Check timing belt installed properly by installing special tools (A) and (B) as follows.

If special tool(s) can not install, preform step 2) through 21) again after removing timing belt.

- a) Camshaft timing belt pulley (1) is locked inserting special tool (A) into cylinder head hole as shown in figure.

Special tool

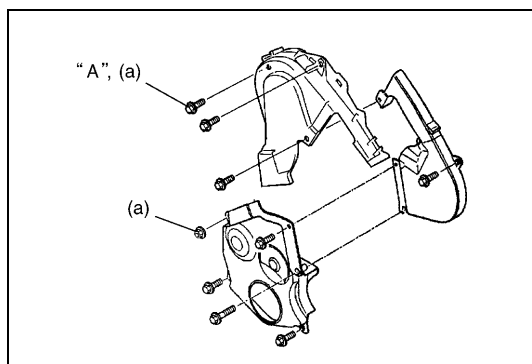
(A): 09910-26540/OUT0000151

- b) Flywheel (for M/T model) or drive plate (for A/T model) is locked inserting special tool (B) into holes in both cylinder block and flywheel (for M/T model) (or drive plate (for A/T model)).

Special tool

(B): 09910-26530/OUT0000160

- 23) Remove crankshaft pulley.
24) Remove special tools (A and B).



- 25) Install timing belt covers.

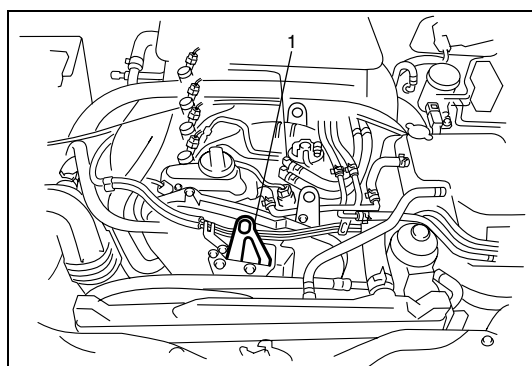
Apply sealant to timing belt cover bolts, and then tighten timing belt cover bolts and nut to specified torque.

“A”: Sealant LOCTITE FRENETANCH

Tightening torque

Timing belt cover bolt and nut (a):

10 N·m (1.0 kg-m, 7.5 lb-ft)

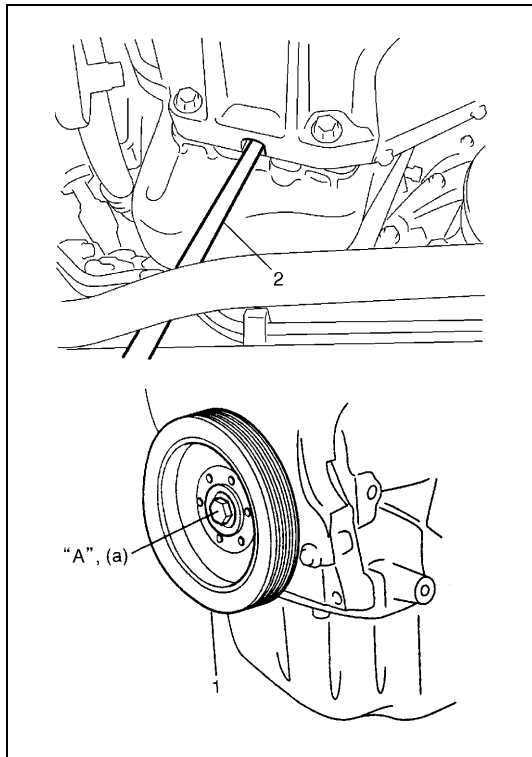


- 26) Install engine front hook (1) to engine bracket, and tighten engine front hook mounting bolts to specified torque.

Tightening torque

Engine front hook mounting bolt:

50 N·m (5.0 kg-m, 36.5 lb-ft)



27) Install crankshaft pulley (1) with crankshaft locked by using flat end rod (2) or the like, apply sealant to crankshaft pulley bolt and tighten it gradually as follows.

- a) Tighten bolt to 50 N·m (5.0 kg-m, 36.5 lb-ft)
- b) Tighten bolt to 145 N·m (14.5 kg-m, 105 lb-ft)

Tightening torque

Crankshaft pulley bolt (a): 145 N·m (14.5 kg-m, 105 lb-ft)

“A”: Sealant LOCTITE 273

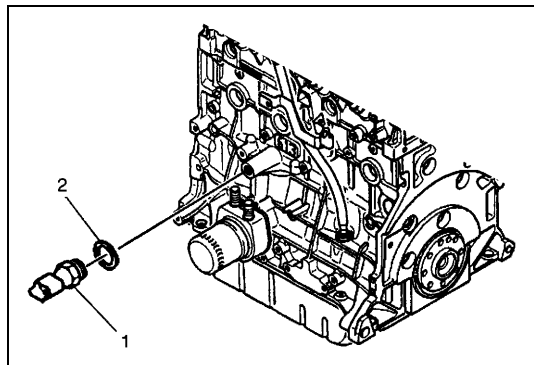
- 28) Install radiator referring to “Radiator” in Section 6B.
- 29) Refill cooling system referring to “Cooling System Flush and Refill” in Section 6B.
- 30) Install generator belt referring to “Generator Belt” in Section 6H.
- 31) Connect negative cable to battery.

Oil Pressure Switch

REMOVAL

- 1) Detach degassing tank from its bracket.
- 2) Disconnect oil pressure switch connector.
- 3) Remove oil pressure switch (1).

2. Gasket



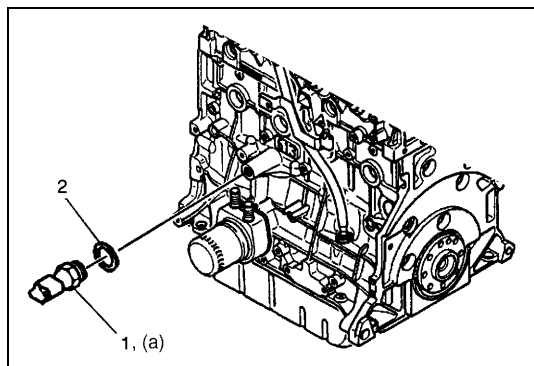
INSTALLATION

- 1) Install oil pressure switch (1) with new gasket (2).
- 2) Tighten oil pressure switch (1) to specified torque.

Tightening torque

Oil pressure switch (a): 32 N·m (3.2 kg-m, 23.5 lb-ft)

- 3) Connect oil pressure switch connector.
- 4) Install degassing tank to its bracket.
- 5) Start engine and check for oil leakage.

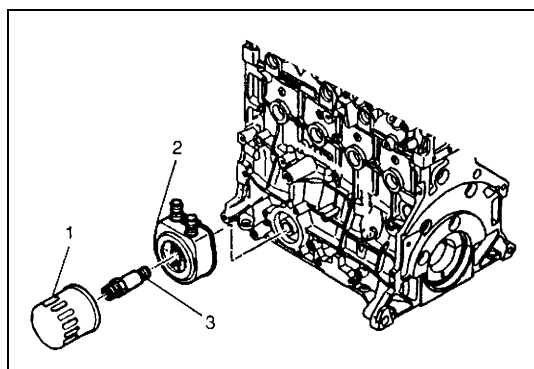


Oil Cooler

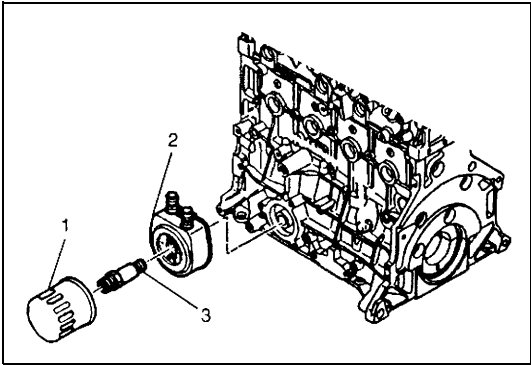
REMOVAL

- 1) Drain engine coolant.
- 2) Detach degassing tank from its bracket.
- 3) Remove oil filter (1).
- 4) Disconnect hoses and remove oil cooler (2).

3. Oil filter stud

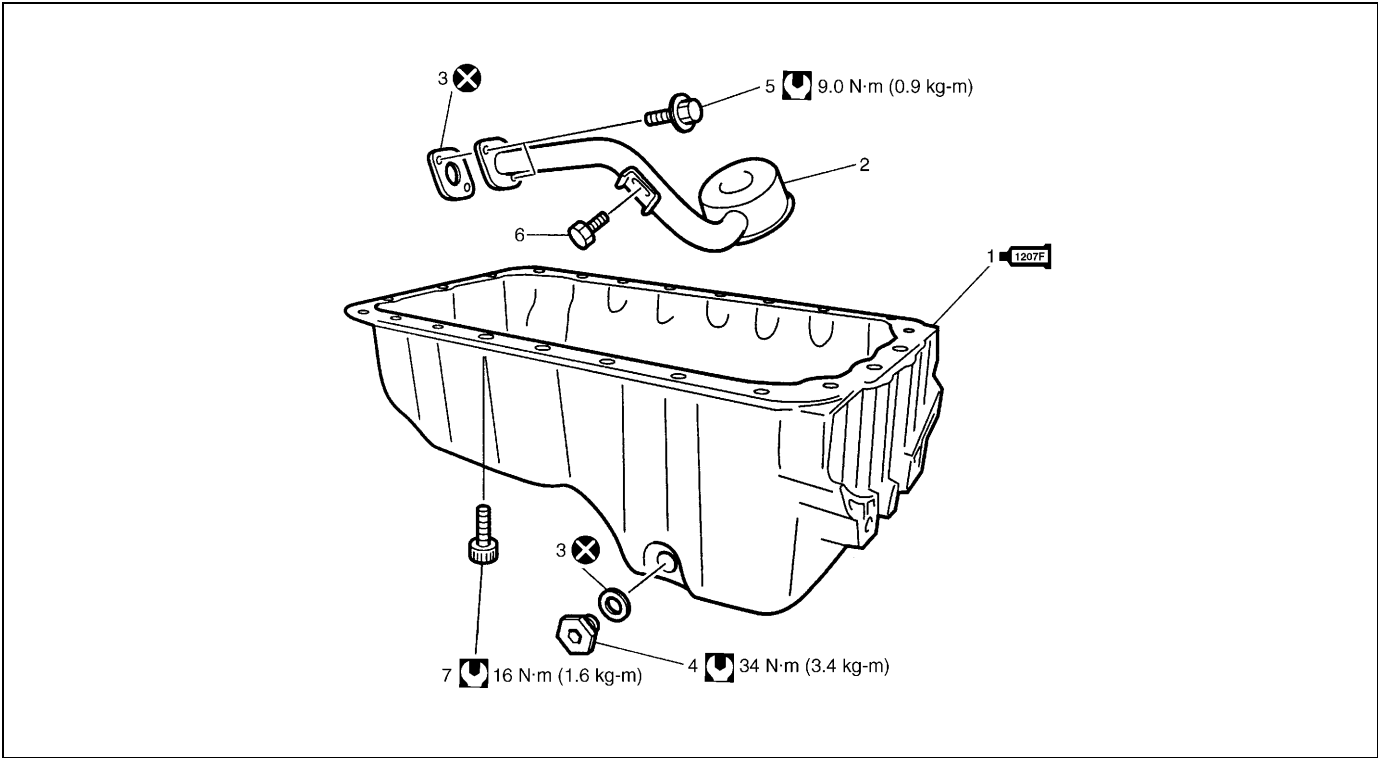


INSTALLATION



- 1) Install oil cooler (2) with new gasket.
- 2) Tighten oil filter stud.
- 3) Connect hoses and tighten oil filter (1) referring to “Engine and Oil Filter Change” in Section 0B.
- 4) Install degassing tank to its bracket.
- 5) Fill engine coolant.
- 6) Check engine oil level referring to “Engine and Oil Filter Change” in Section 0B.
- 7) Check for oil leakage.

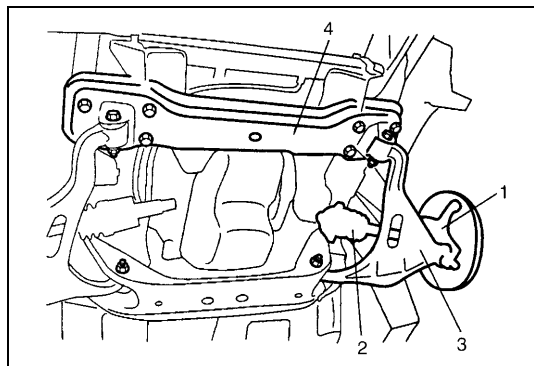
Oil Pan and Oil Pump Strainer
 COMPONENTS



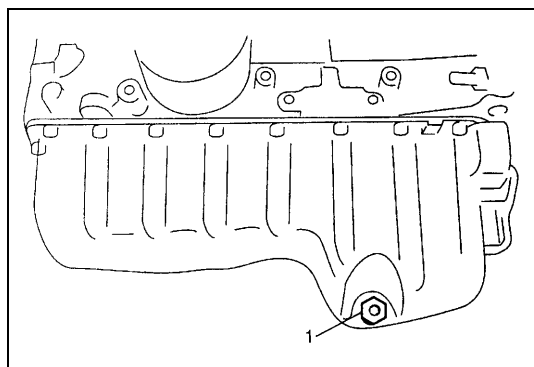
1. Oil pan :Apply sealant 1207F 99000-31250 to mating surface.	5. Strainer bolt	Tightening Torque
2. Strainer	6. Bracket bolt	Do not reuse.
3. Gasket	7. Oil pan bolt	
4. Drain plug		

REMOVAL

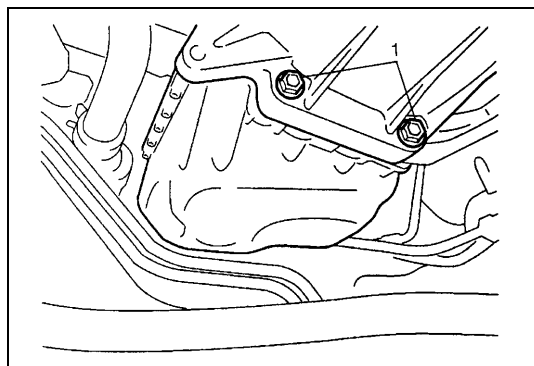
- 1) Remove oil level gauge.
- 2) Raise vehicle and remove both front wheels.
- 3) Remove engine under cover.
- 4) Remove steering gear box (1) from vehicle referring to “Power Steering Gear Box Assembly” in Section 3B1.
- 5) Remove front differential housing (2) with differential from chassis referring to “Dismounting” in Section 7E.



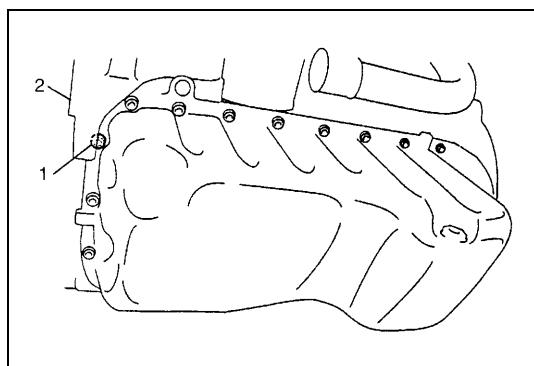
- 6) Remove knuckle (1), drive shaft (2) and suspension control arm (3) of either side after removing stabilizer bar. Refer to "Stabilizer Bar/Bushings", "Knuckle/Wheel Spindle" and "Suspension Control Arm/Bushings" in Section 3D and "Drive Shaft" in Section 4A2.
- 7) Detach suspension frame (4) from chassis.



- 8) Drain engine oil removing drain plug (1).



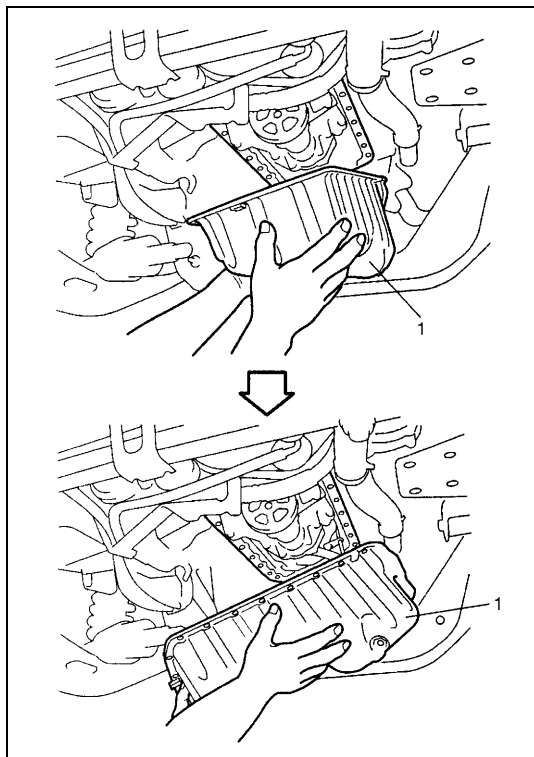
- 9) Remove transmission fastening bolts (1).



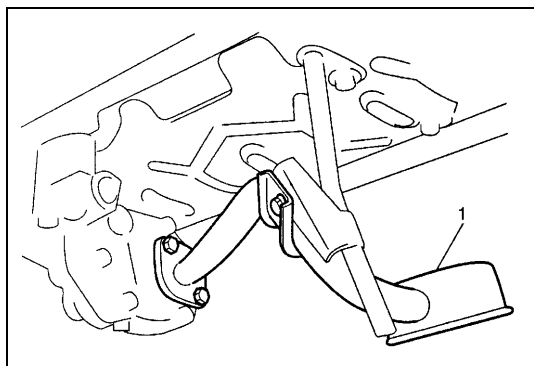
- 10) Remove oil pan bolts.

NOTE:

Bolt (1) at the rear of power steering pump bracket (2) should be loosened only. It is not possible to remove it due to interference with bracket.



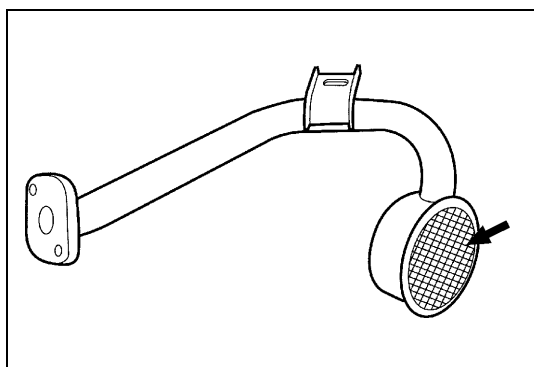
11) Remove oil pan (1) from cylinder block as shown.

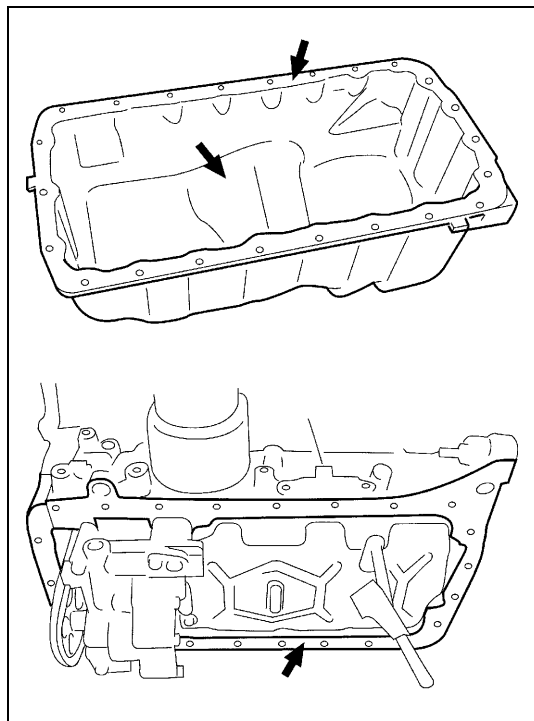


12) Remove oil pump strainer (1).

CLEANING

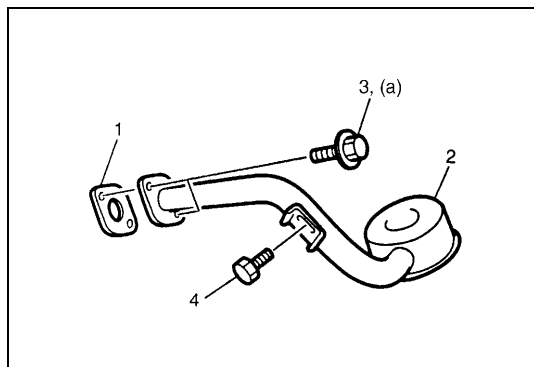
- Clean oil pump strainer screen.





- Clean mating surfaces of oil pan and cylinder block. Remove oil, old sealant, and dust from mating surfaces and inside of oil pan.

INSTALLATION

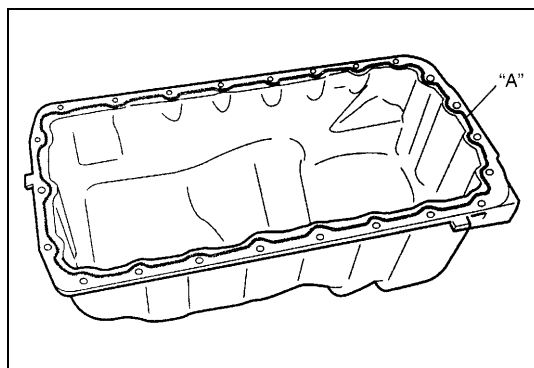


- 1) Using new gasket (1), install oil pump strainer (2) to oil pump.

Tighten strainer bolts (3) first and then bracket bolt (4) to specified torque.

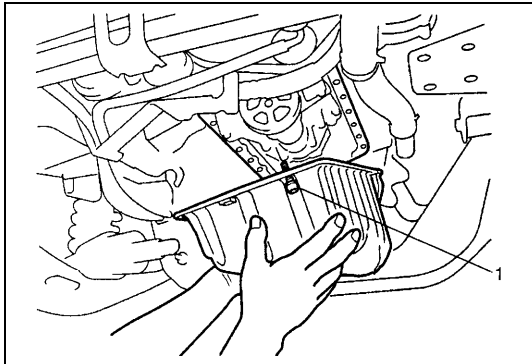
Tightening torque

Oil pump strainer bolt (a): 9.0 N·m (0.9 kg·m, 6.5 lb·ft)

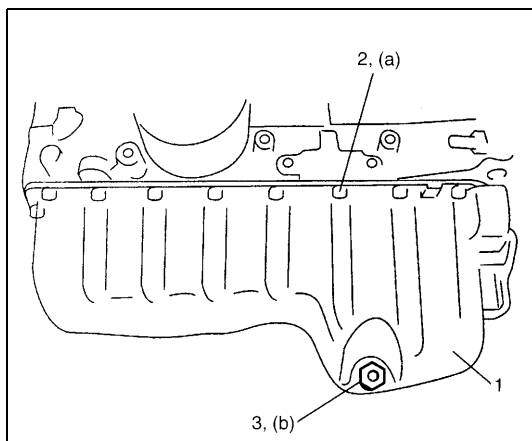


- 2) Apply sealant to oil pan mating surface continuously as shown in figure.

“A”: Sealant 99000-31250



- 3) Fit oil pan to cylinder block using bolt (1) at the position as shown in figure.



- 4) After fitting oil pan (1) to cylinder block, run in securing bolts (2) and start tightening at the center: move wrench outward, tightening one bolt at a time.
Tighten bolts to specified torque.

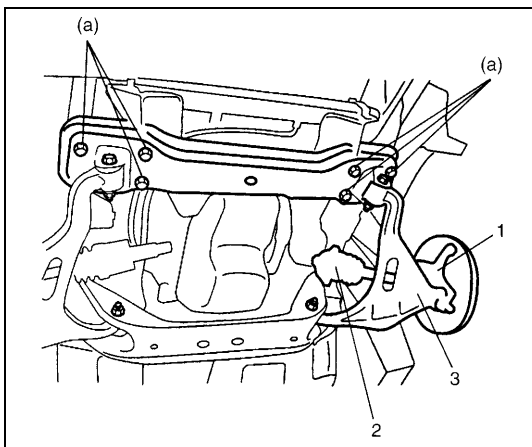
Tightening torque

Oil pan bolt (a): 16 N·m (1.6 kg-m, 11.5 lb-ft)

- 5) Install new gasket and drain plug (3) to oil pan.
Tighten drain plug to specified torque.

Tightening torque

Drain plug (b): 34 N·m (3.4 kg-m, 24.5 lb-ft)



- 6) Install suspension frame to chassis.
Tighten bolts to specified torque.

Tightening torque

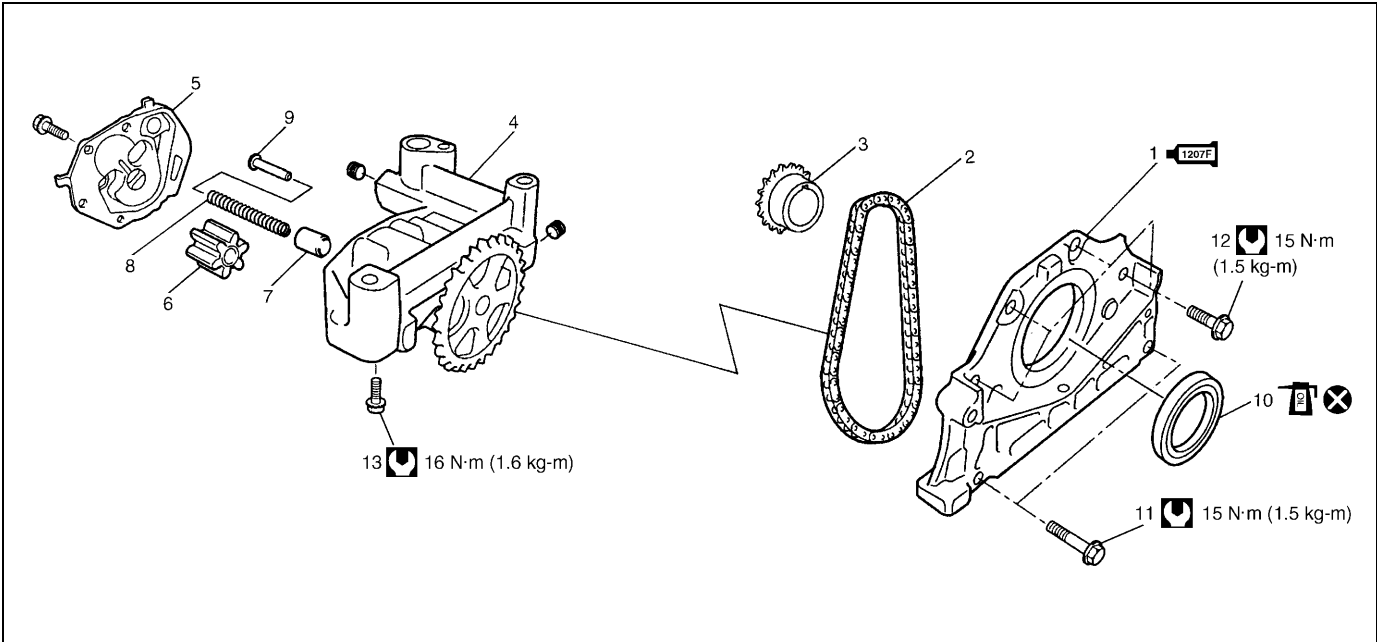
Suspension frame bolt (a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

- 7) Install knuckle (1), drive shaft (2) and suspension control arm (3) and stabilizer bar referring to "Knuckle/Wheel Spindle", "Suspension Control Arm/Bushings" and "Stabilizer Bar/Bushings" in Section 3D and "Drive Shaft" in Section 4A2.

- 8) Install front differential housing referring to "Remounting" in Section 7E.
9) Refill front differential housing with gear oil referring to "Maintenance Service" in Section 7E.
10) Install steering gear box to vehicle referring to "Power Steering Gear Box Assembly" in Section 3B1.
11) Install engine under cover.
12) Install oil level gauge.
13) Refill engine with engine oil referring to "Engine Oil and Filter" in Section 0B.
14) Refill power steering system with specified fluid referring to "Power Steering Fluid Level Check" in Section 3B1.
15) Check to make sure that there is no engine oil leakage, differential oil leakage and power steering fluid leakage at each connection.

Oil Pump

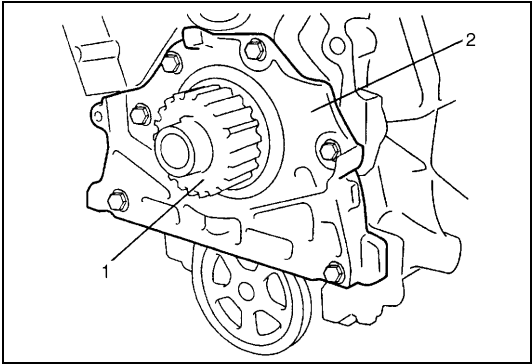
COMPONENTS

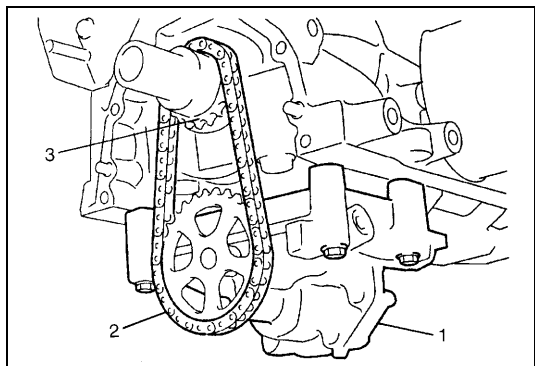


	1. Gasket holder plate :Apply sealant 1207F 99000-31250 to mating surface.	5. Oil pump case No.2	9. Retainer	Tightening Torque
	2. Oil pump chain	6. Rotor		10. Gasket holder plate oil seal :Apply engine oil to oil seal lip.
	3. Oil pump drive sprocket	7. Relief valve	11. Gasket holder plate bolt (long)	
	4. Oil pump case No.1	8. Relief spring	12. Gasket holder plate bolt (short)	

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove timing belt referring to “Timing Belt and Belt Tensioner” in this section.
- 3) Remove oil pan and oil pump strainer referring to “Oil Pan and Oil Pump Strainer” in this section.
- 4) Remove generator.
- 5) Remove power steering pump bracket.
- 6) Remove crankshaft timing belt pulley (1) and then remove gasket holder plate (2).

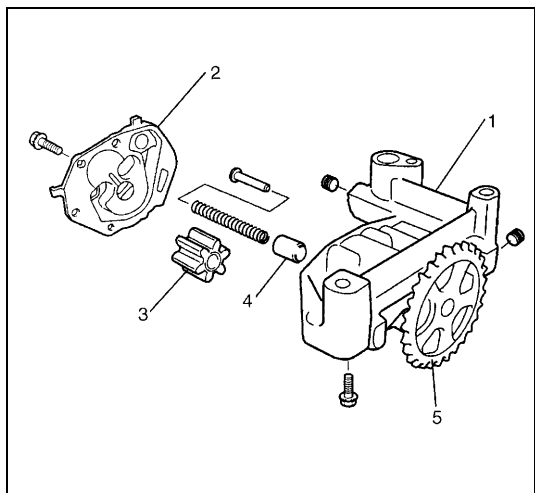




- 7) After removing sprocket key from crankshaft, remove oil pump (1), oil pump chain (2) and oil pump drive sprocket (3) all together.

DISASSEMBLY

Disassemble oil pump as shown in figure.

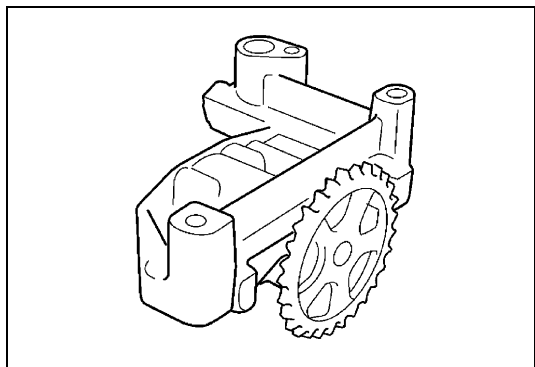
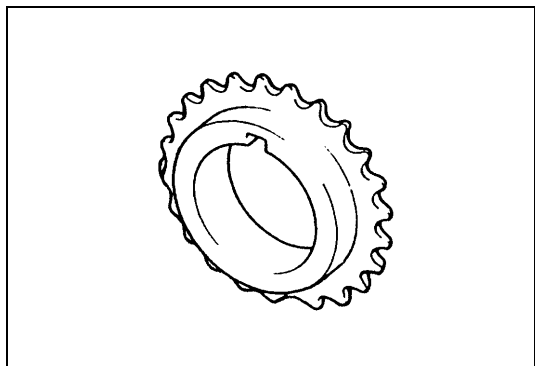


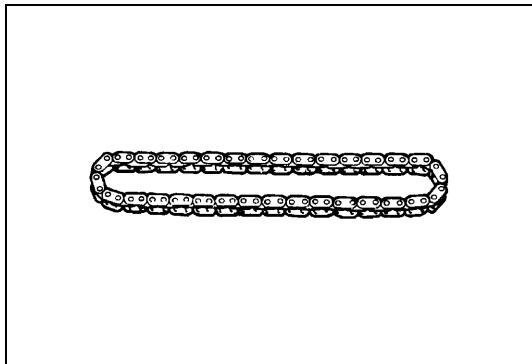
CAUTION:

Do not remove oil pump sprocket (5). Otherwise, oil pump sprocket and/or oil pump rotor shaft might be damaged.

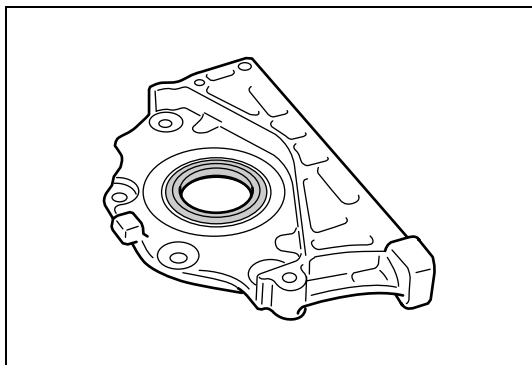
INSPECTION

- Check rotor (3) and oil pump cases (1 and 2) for excessive wear or damage.
If any malcondition is found, replace oil pump assembly.
- Check relief valve (4) for excessive wear or damage.
If any malcondition is found, replace relief valve.
- Check teeth of oil pump drive sprocket for wear or damage.
If any malcondition is found, replace oil pump drive sprocket.
- Check teeth of oil pump sprocket for wear or damage.
If any malcondition is found, replace oil pump assembly.





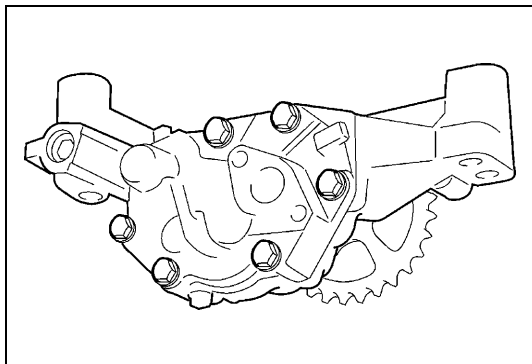
- Check oil pump chain for wear or damage.
If any malfunction is found, replace oil pump chain.



- Check gasket holder plate oil seal lip for fault or damage.
If any malfunction is found, replace gasket holder plate oil seal.

ASSEMBLY

- 1) Wash, clean and then dry all disassembled parts.
- 2) Apply thin coat of engine oil to rotors and inside surface of each oil pump case.
- 3) Assemble oil pump. After assembling oil pump, check to be sure that rotor turns smoothly by hand.



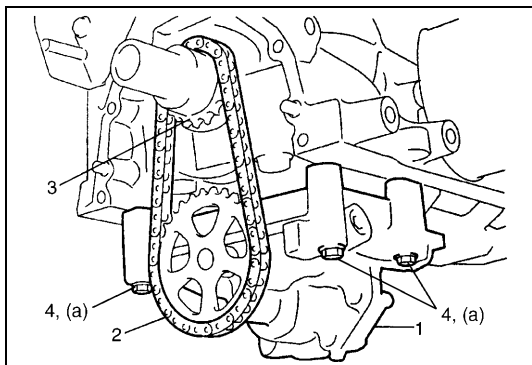
INSTALLATION

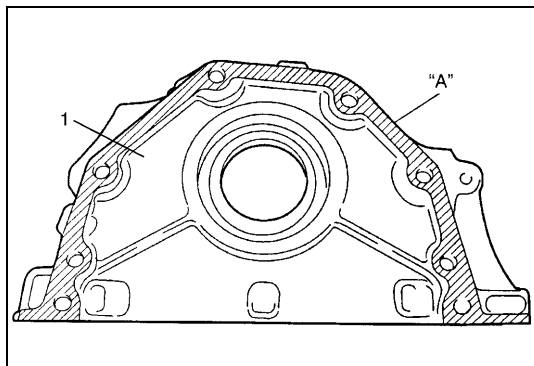
- 1) Install oil pump (1), oil pump chain (2) and oil pump drive sprocket (3) all together to cylinder block and crankshaft.
Tighten oil pump bolts to specified torque.

Tightening torque

Oil pump bolt (a): 16 N·m (1.6 kg-m, 11.5 lb-ft)

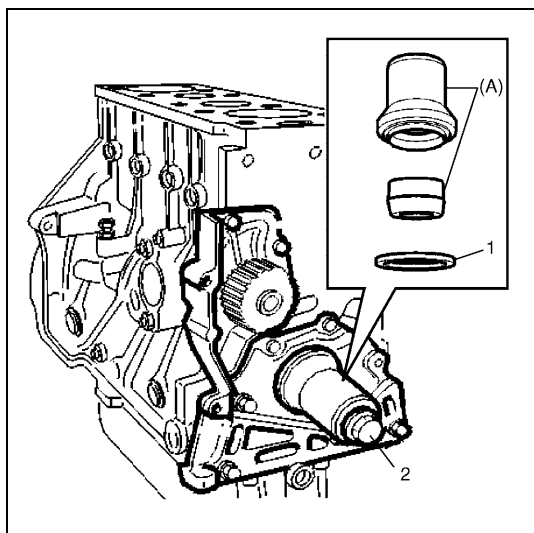
- 2) Install sprocket key to crankshaft.





3) Apply sealant to mating surface of gasket holder plate (1).

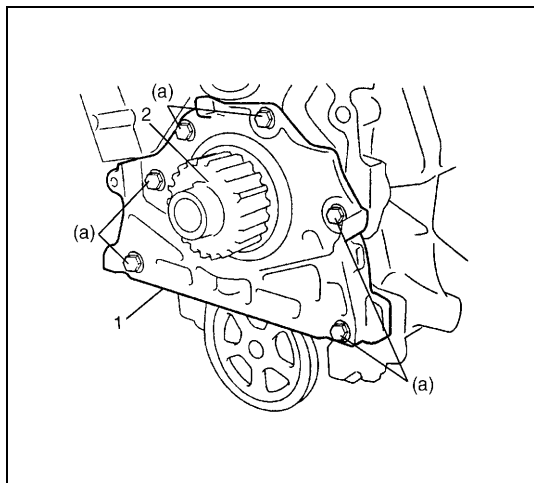
"A": Sealant 99000-31250



4) Install gasket holder plate oil seal (1) by using special tools and bolt (2) tapping them with plastic hammer, if removed.

Special tool

(A): 09916-51910/OUT0000132



5) Install gasket holder plate (1) to cylinder block.

Tighten gasket holder plate bolts to specified torque.

Tightening torque

Gasket holder plate bolt (a): 15 N·m (1.5 kg-m, 11.0 lb-ft)

6) Install crankshaft timing belt pulley (2).

7) Install power steering pump bracket.

8) Install generator referring to "Generator" in Section 6H.

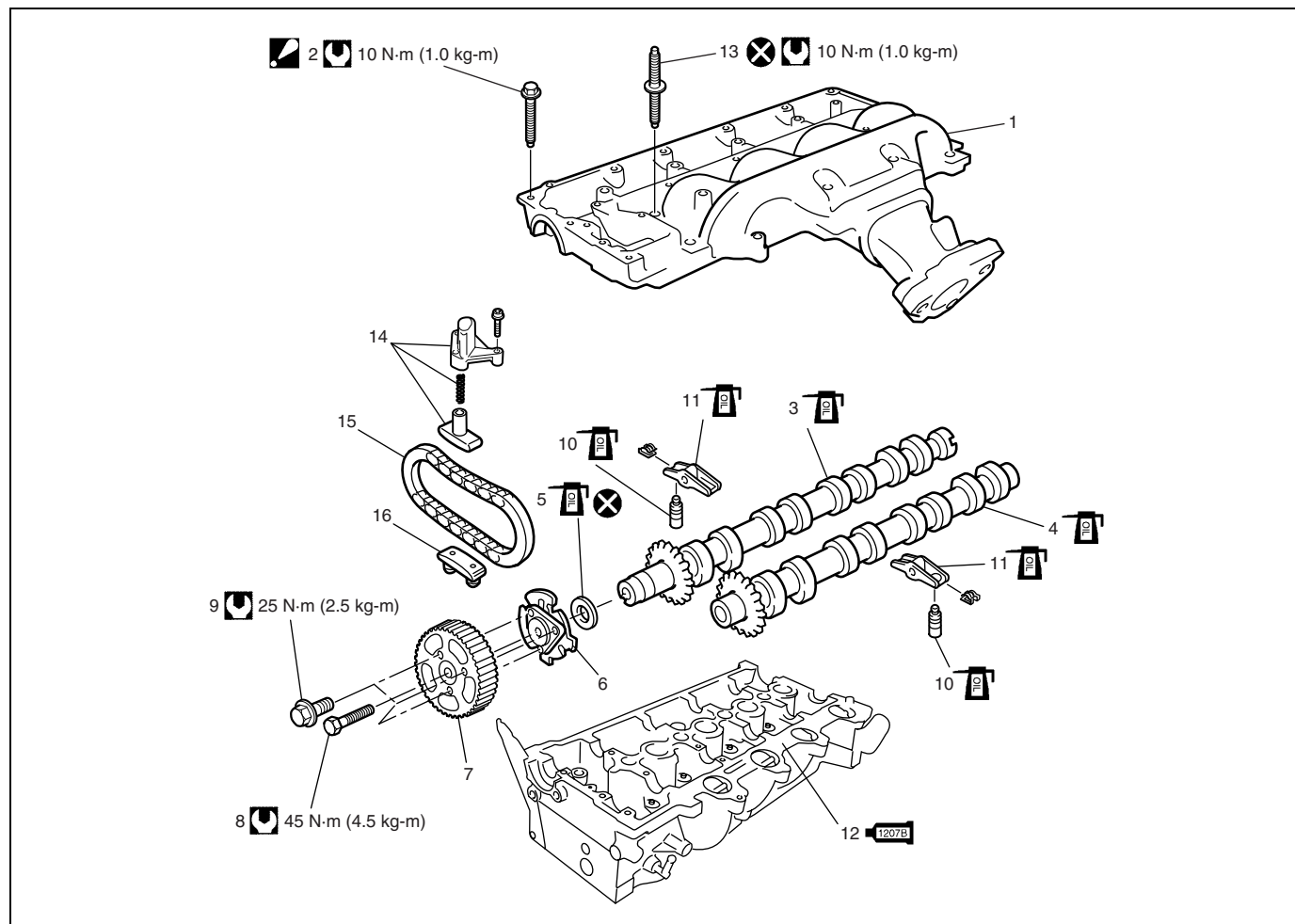
9) Install oil pump strainer and oil pan referring to "Oil Pan and Oil Pump Strainer" in this section.

10) Install timing belt referring to "Timing Belt and Belt Tensioner" in this section.

11) Connect negative cable at battery.

Camshafts and Valve Rockers

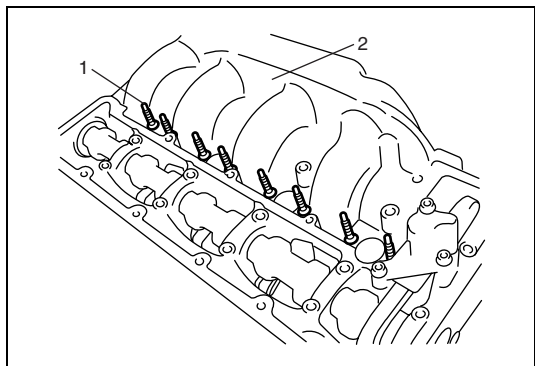
COMPONENTS



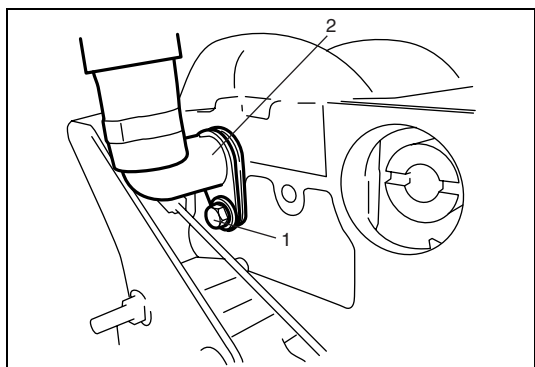
1. Camshaft housing/intake manifold	6. Camshaft hub	11. Valve rocker	16. Camshaft chain guide
2. Camshaft housing/intake manifold bolt : For tightening order, refer to "Installation".	7. Camshaft timing belt pulley	12. Cylinder head :Apply sealant 1207B 99000-31140 to mating surface of cylinder head.	Tightening Torque
3. Exhaust camshaft	8. Camshaft hub bolt	13. Fuel injector pillar bolt	Do not reuse.
4. Intake camshaft	9. Camshaft timing belt pulley bolt	14. Camshaft chain tensioner assembly	Apply engine oil to sliding surface of each part.
5. Camshaft oil seal :Apply engine oil to oil seal lip.	10. Ball valve rocker	15. Camshaft chain	

REMOVAL

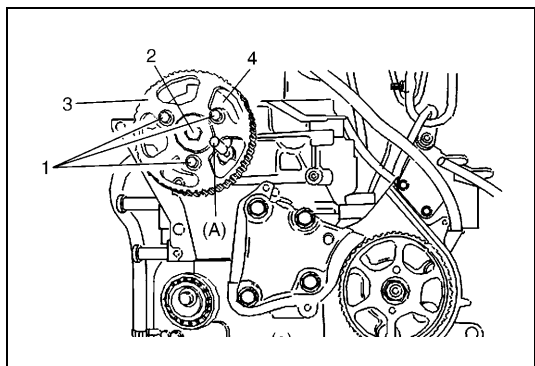
- 1) Disconnect negative cable at battery.
- 2) Remove timing belt referring to "Timing Belt and Belt Tensioner" in this section.
- 3) Remove cylinder head cover referring to "Cylinder Head Cover" in this section.
- 4) Remove vacuum pump from cylinder head referring to "Vacuum Pump" in Section 6E3.
- 5) Remove throttle valve assembly referring to "Throttle Valve Assembly" in Section 6E3.
- 6) Remove oil level gauge guide bolt.
- 7) Remove high pressure pipes and fuel injectors referring to "Fuel Injector" in Section 6E3.



- 8) Remove fuel injector pillar bolts (1) from camshaft housing/intake manifold (2).



- 9) Remove oil vapor breather tube (2).

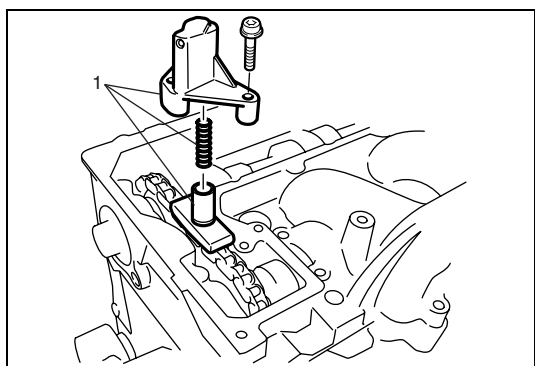


- 10) Remove camshaft timing belt pulley bolts (1) and camshaft hub bolt (2) with locking camshaft timing belt pulley (3) by special tool.

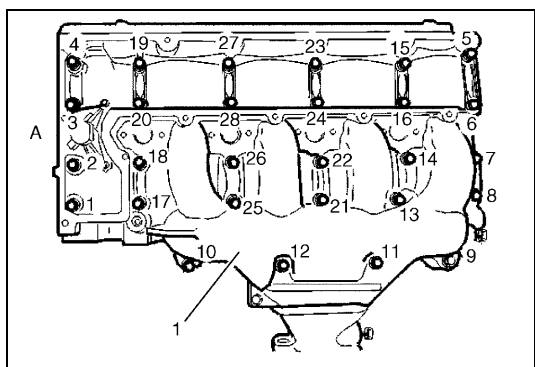
Special tool

(A): 09910-26540/OUT0000151

- 11) Remove camshaft timing belt pulley (3) and camshaft hub (4).

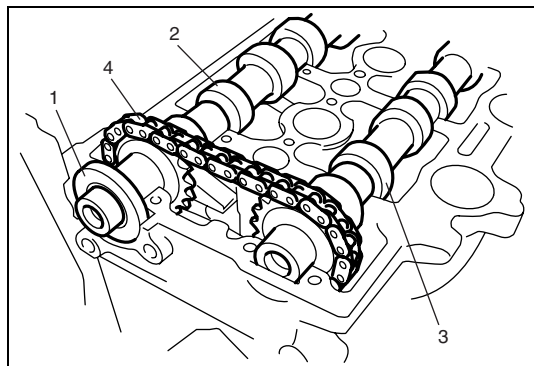


- 12) Remove camshaft chain tensioner assembly (1).
13) Remove oil level gauge guide bolt.
14) Detach intercooler left side bracket.

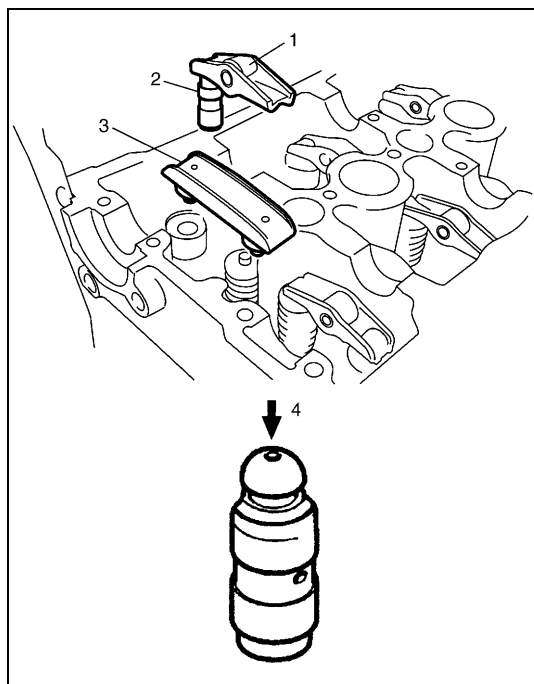


- 15) Loosen camshaft housing/intake manifold (1) bolts in such order as indicated in figure and remove them.
16) Remove camshaft housing/intake manifold (1).

A: Camshaft timing belt pulley side



- 17) Remove camshaft oil seal (1) from exhaust camshaft (2).
 18) Remove exhaust camshaft (2) and intake camshaft (3) with camshaft chain (4) from cylinder head.



- 19) Remove valve rocker (1) with ball valve rocker (2).

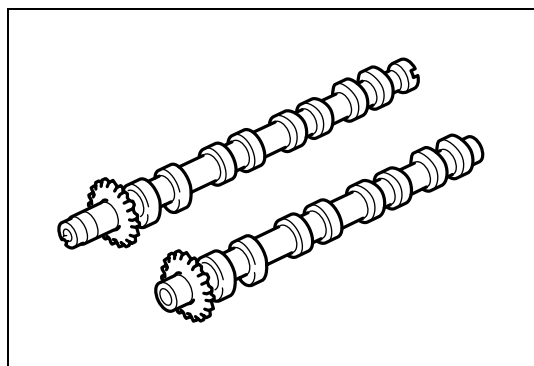
NOTE:

- **Never disassemble ball valve rocker.**
- **Don't apply force (4) to body of ball valve rocker, for oil in high pressure chamber in it will leak.**
- **Immerse removed ball valve rocker in clean engine oil and keep it there till reinstalling it so as to prevent oil leakage. If it is left in air, place it with its bucket body facing down. Don't place on its side or with bucket body facing up.**

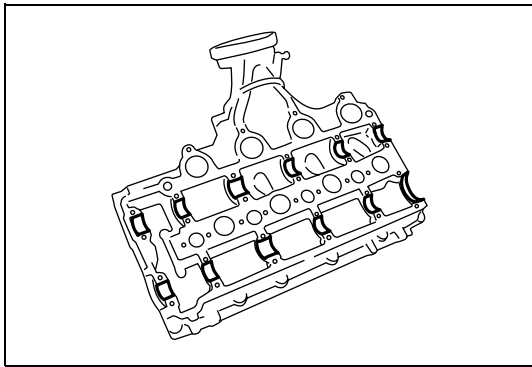
- 20) Remove camshaft chain guide (3) from cylinder head.

INSPECTION

Camshafts



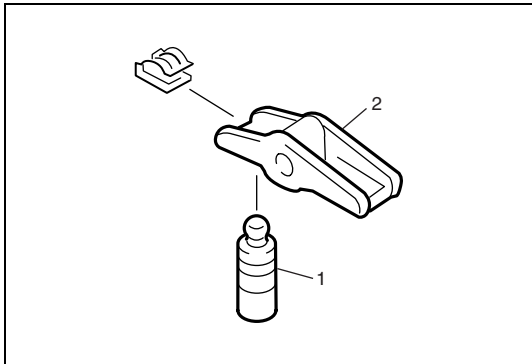
- Check teeth of sprocket for wear or damage.
 - Check journals and cam faces for wear or damage.
- If any malcondition is found, replace camshaft.



Camshaft housing/intake manifold

Check camshaft housing/intake manifold for pitting, scratches, wear or damage.

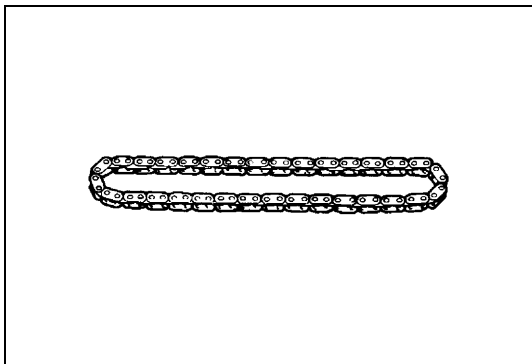
If any malcondition is found, replace cylinder head with cylinder head with camshaft housing/intake manifold. Never replace cylinder head without replacing camshaft housing/intake manifold.



Ball valve rockers and valve rockers

Check ball valve rocker (1) and valve rocker (2) for pitting, scratches, wear or damage.

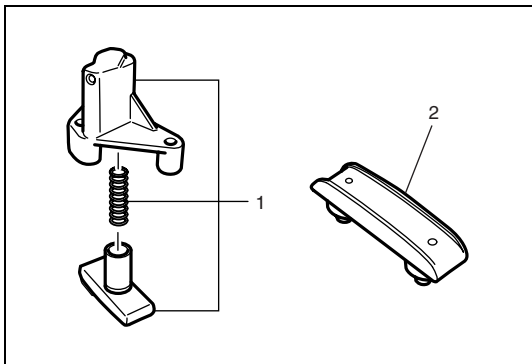
If any malcondition is found, replace them.



Camshaft chain

Check camshaft chain for wear or damage.

If any malcondition is found, replace camshaft chain, camshaft chain tensioner assembly and camshaft chain guide all together.

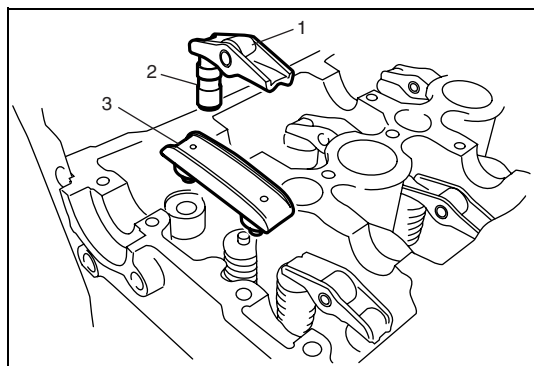


Camshaft chain tensioner assembly and camshaft chain guide

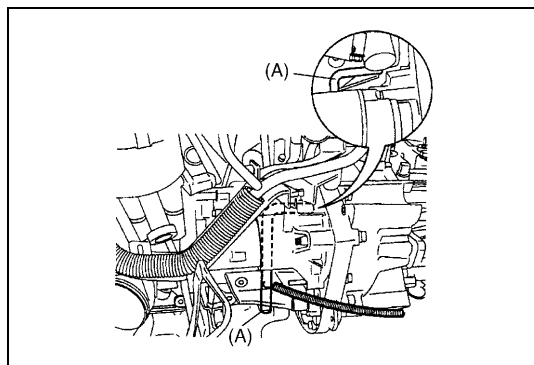
Check shoe of tensioner and guide for wear or damage.

If any malcondition is found, replace camshaft chain, camshaft chain tensioner assembly (1) and camshaft chain guide (2) all together.

INSTALLATION



- 1) Apply engine oil around valve rocker and ball valve rocker, and install valve rocker (1) with ball valve rocker (2) to cylinder head.
- 2) Install camshaft chain guide (3) to cylinder head.

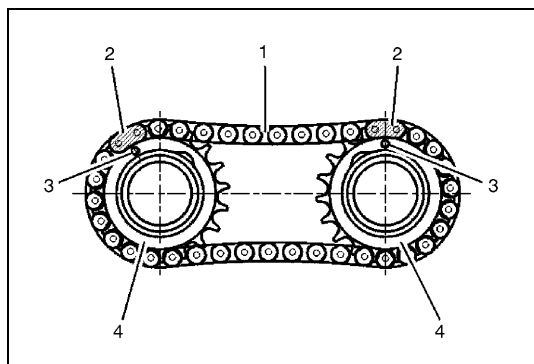


- 3) Remove special tool (A).

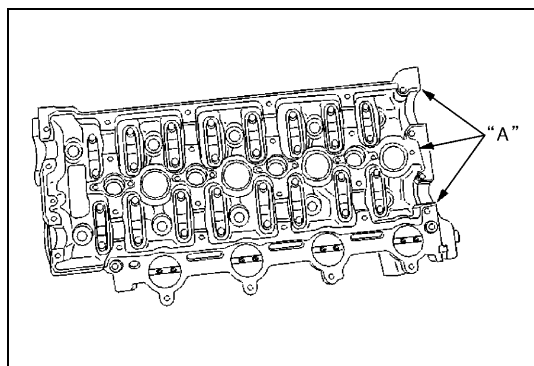
Special tool

(A): 09910-26530/OUT0000160

- 4) Install crankshaft pulley temporarily, and turn crankshaft counter clockwise through 90°.
- 5) Remove crankshaft pulley.

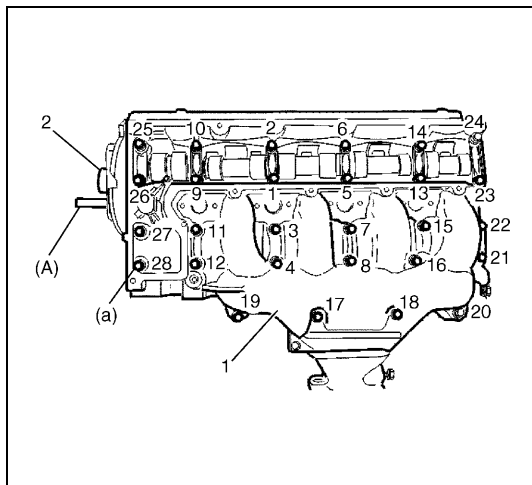


- 6) Install camshaft chain (1) to camshafts aligning plates (gold) (2) of chain to marks or paint (3) on camshaft sprockets (4).
- 7) Fit camshafts and camshaft chain with cylinder head.



- 8) Apply a line of sealant around the edge of mating surfaces of cylinder head.

"A": Sealant 99000-31140



- 9) Fit camshaft hub (2), special tool (A) and camshaft housing/intake manifold (1) to cylinder head, and tighten camshaft housing/intake manifold bolts temporarily first. Then tighten them by the following sequence as indicated in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

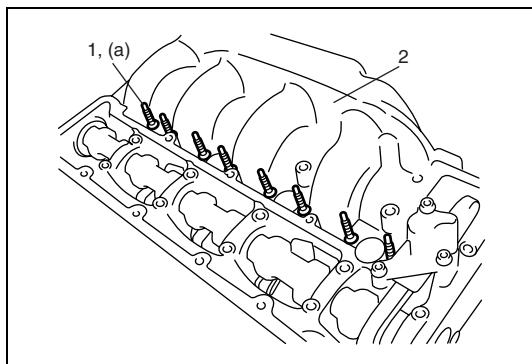
Special tool

(A): 09910-26540/OUT0000151

Tightening torque

Camshaft housing/intake manifold bolt (a):

10 N·m (1.0 kg-m, 7.5 lb-ft)



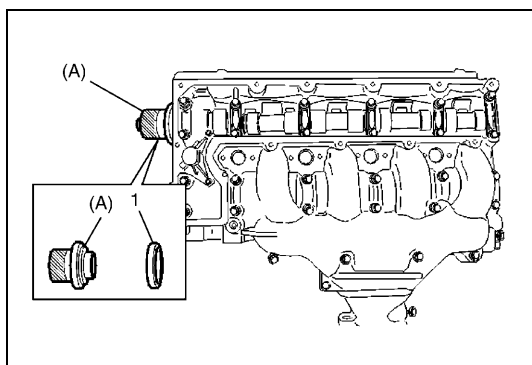
- 10) Install new fuel injector pillar bolts (1) to camshaft housing/intake manifold (2). Tighten pillar bolts to specified torque.

Tightening torque

Fuel injector pillar bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

- 11) Install intercooler left side bracket.

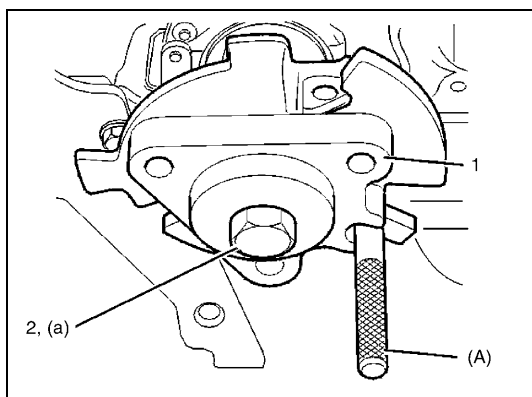
- 12) Install oil level gauge guide bolt.



- 13) After applying grease to oil seal lip, fit new camshaft oil seal (1) using special tool.

Special tool

(A): 09913-56510/OUT0000152



- 14) Install camshaft hub (1) and special tool.

Tighten camshaft hub bolt (2) to specified torque with locking hub (1) by special tool.

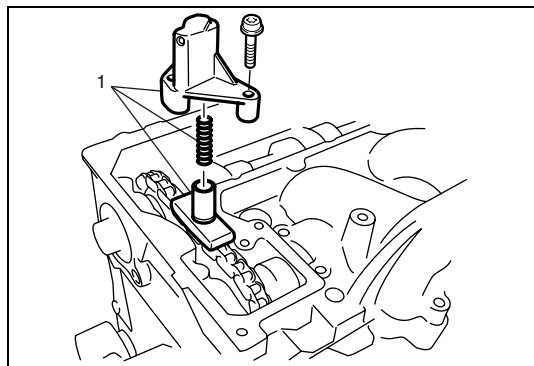
Special tool

(A): 09910-26540/OUT0000151

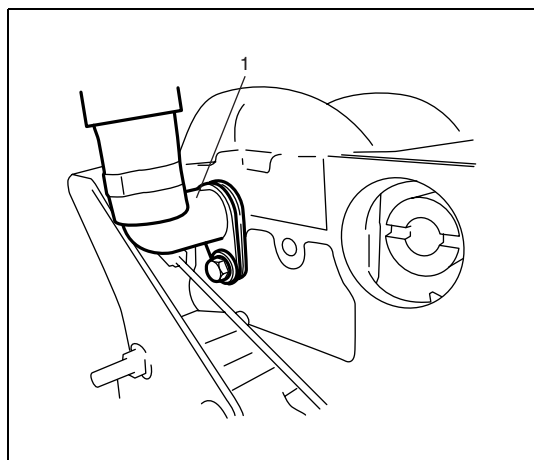
Tightening torque

Camshaft hub bolt (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

- 15) Install camshaft timing belt pulley and tighten bolts by hand.



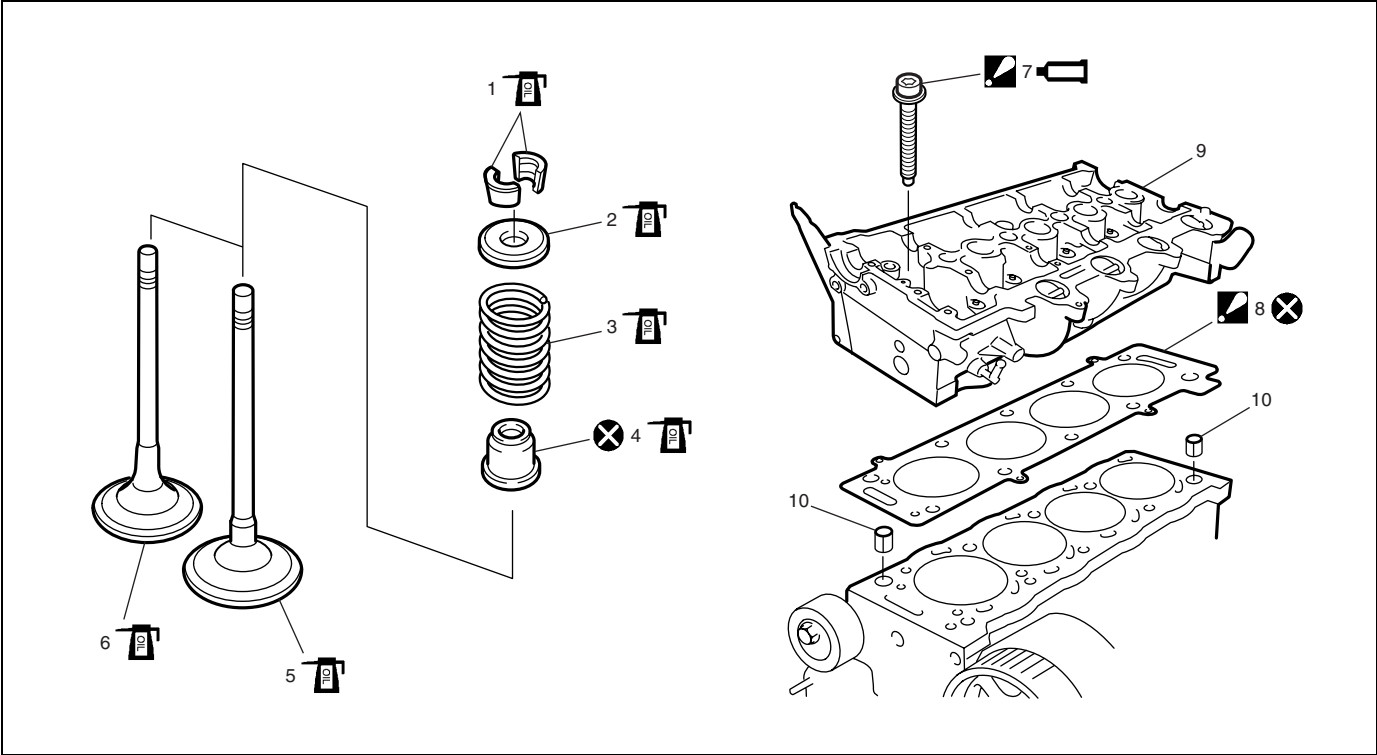
16) Install camshaft chain tensioner assembly (1) to cylinder head.



- 17) Install oil vapor breather tube (1).
- 18) Install fuel injectors and high pressure pipes referring to "Fuel Injector" in Section 6E3.
- 19) Install throttle valve assembly referring to "Throttle Valve Assembly" in Section 6E3.
- 20) Install vacuum pump to cylinder head referring to "Vacuum Pump" in Section 6E3.
- 21) Install cylinder head cover referring to "Cylinder Head Cover" in this section.
- 22) Install timing belt referring to referring to "Timing Belt and Belt Tensioner" in this section.
- 23) Connect negative cable at battery.

Valves and Cylinder Head

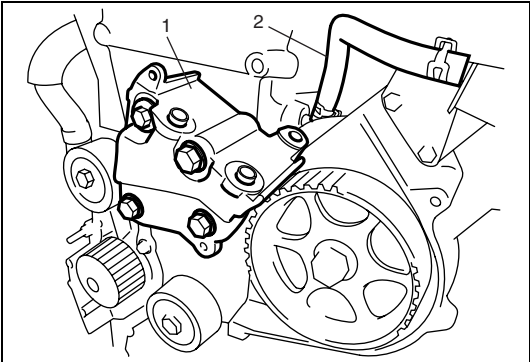
COMPONENTS

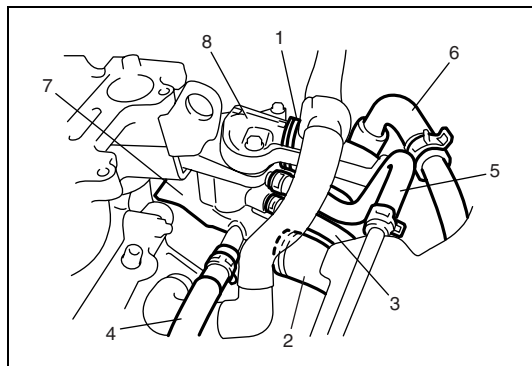


1. Valve cotters	6. Exhaust valve	9. Cylinder head
2. Valve spring retainer	7. Cylinder head bolt	10. Knock pin
3. Valve spring	:Apply sealant MOLYKOTE G RAPID PLUS to threads and under bolt head.	 Tightening Torque
4. Valve stem seal	:Replace bolt if it is longer than specified value. :For tightening procedure, refer to "Installation".	 Do not reuse.
5. Intake valve	8. Cylinder head gasket	 Apply engine oil to sliding surface of each part.
	:Thickness identification holes provided on gasket should come to oil filter side.	

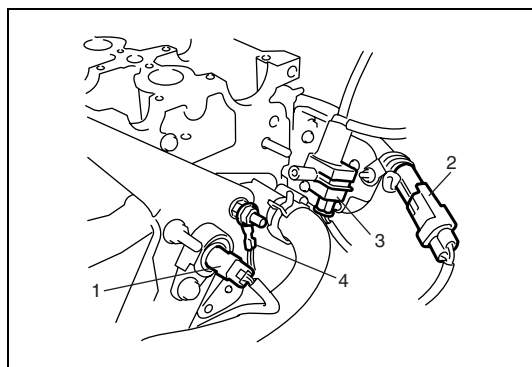
REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove turbocharger referring to "Turbocharger" in this section.
- 3) Remove camshaft from cylinder head referring to "Camshaft and Valve Rockers" in this section.
- 4) Remove engine bracket (1) from cylinder head and cylinder block.
- 5) Disconnect vent hose (2) from cylinder head.

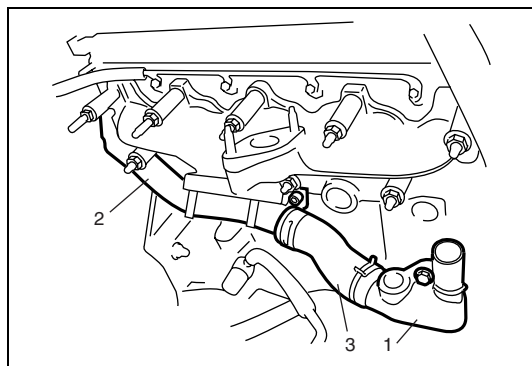




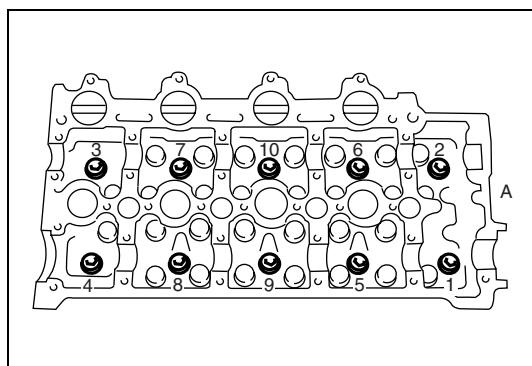
- 6) Disconnect radiator inlet hose (1) from thermostat cap (8).
- 7) Disconnect radiator outlet No.2 hose (2), oil cooler inlet hose (3) and oil cooler outlet hose (4) from water outlet box (7).
- 8) Disconnect vent hose (5) and heater inlet No.2 hose (6) from intercooler bracket pipes.



- 9) Disconnect ECT sensor connector (1), glow plug supply wire connector (2), swirl control solenoid valve connector (3) and ground terminal (4).
- 10) Remove engine harness clamp nut from water outlet box.



- 11) Remove water inlet box (1) and water inlet pipe (2) with water inlet hose (3) connected.
- 12) Remove common rail from cylinder head referring to "Common Rail (High Pressure Fuel Injection Rail)" in Section 6E3.

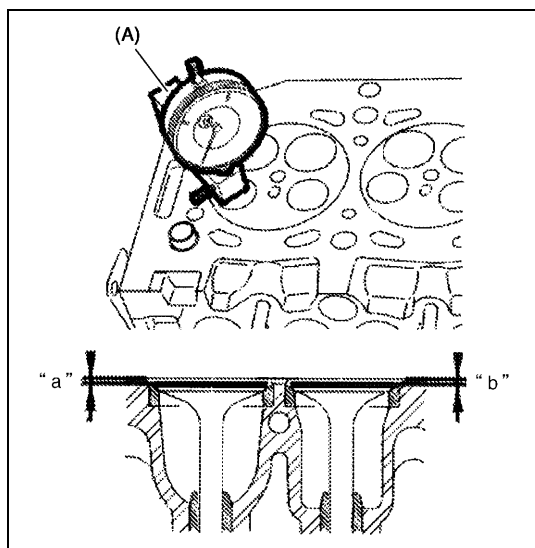


- 13) Loosen cylinder head bolts in such order as indicated in figure and remove them.
- 14) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
- 15) Remove cylinder head with exhaust manifold, water outlet box, glow plugs and swirl control solenoid valve using lifting device.

A: Camshaft timing belt pulley side

DISASSEMBLY

- 1) For ease in servicing cylinder head, remove exhaust manifold with water outlet box, swirl control solenoid valve and glow plugs.
- 2) Check valve protrusion average as follows.
If average is out of specification, grind valve seat and then lap valve on seat.



- a) Clean valve face and then measure protrusion of each valve using special tool and dial gauge as shown in figure.

Special tool

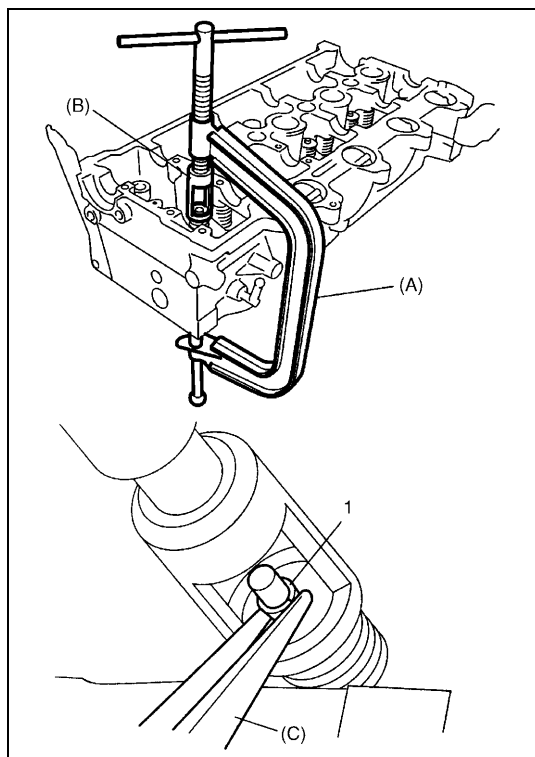
(A): 09910-26510/OUT0000005

Valve protrusion

Intake valve protrusion "a": 0.5 – 1.0 mm (0.020 – 0.039 in.)

Exhaust valve protrusion "b": 0.9 – 1.4 mm (0.035 – 0.055 in.)

2. Intake valve
3. Exhaust valve



- 3) Using special tool (Valve lifter), compress valve springs and then remove valve cotteners (1) using special tool (Forceps) as shown.

Special tool

(A): 09916-14510

(B): 09916-14521

(C): 09916-84511

- 4) Release special tool, and remove spring retainer and valve spring.
- 5) Remove valve from combustion chamber side.

INSPECTION

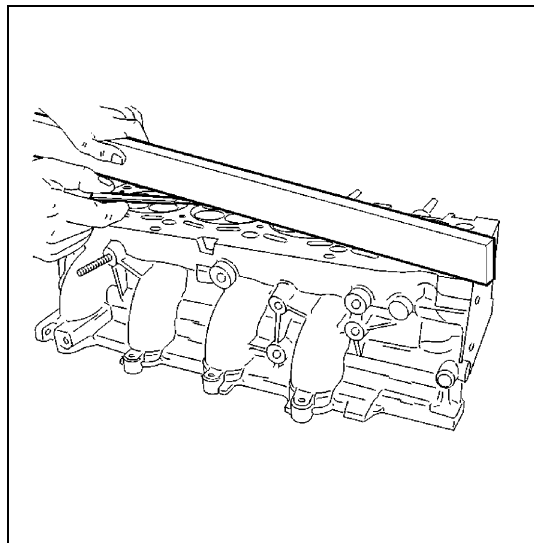
Cylinder Head

- Remove all carbon from cylinder head surface.

NOTE:

Do not use any sharp-edged tool to scrape off carbon. Be careful not to scuff or nick metal surfaces when decarboning. The same applies to valves and valve seats, too.

- Check cylinder head for cracks in intake, exhaust ports and head surface.



- Flatness of gasketed surface:

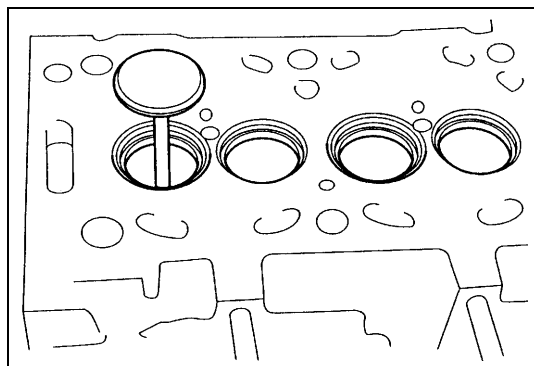
Using a straightedge and thickness gauge, check surface at 6 locations in total. If distortion limit, given below, is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head.

Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

**Cylinder head gasket surface distortion limit:
0.03 mm (0.0012 in.)**

ASSEMBLY

- 1) Install valve to valve guide.
Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore, and valve stem.
- 2) Install valve spring and spring retainer.



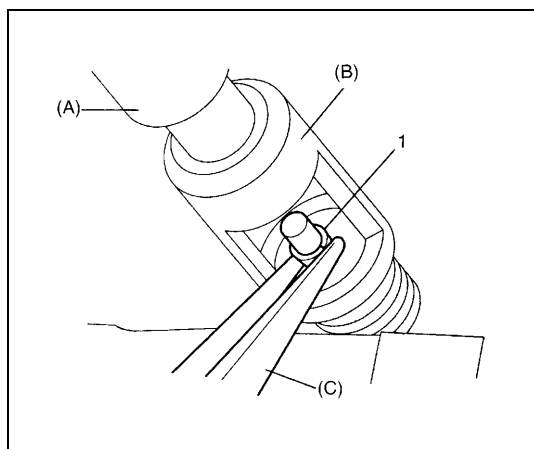
- 3) Using special tool (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

Special tool

(A): 09916-14510

(B): 09916-14521

(C): 09916-84511



- 4) Install exhaust manifold with water outlet box referring to "Exhaust Manifold" in this section.
- 5) Install swirl control valve referring to "Swirl Control Solenoid Valve" in Section 6E3.
- 6) Install glow plugs referring to "Glow Plug" in Section 6E3.

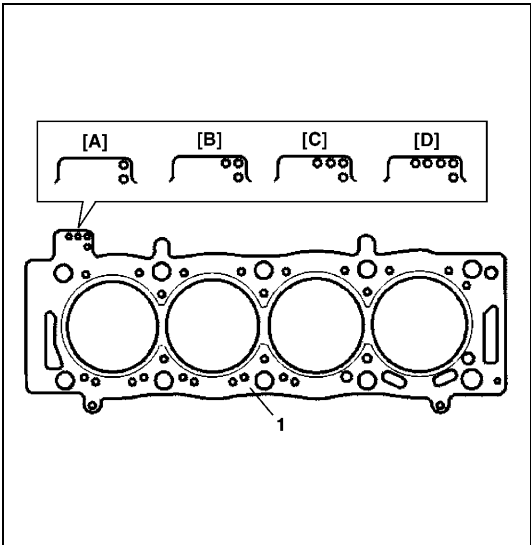
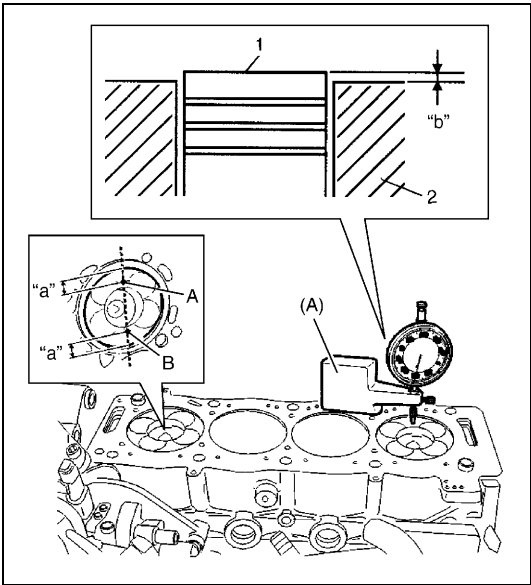
INSTALLATION

- 1) Clean mating surface of cylinder head and cylinder block.
Remove oil, old gasket and dust from mating surface.
- 2) Prepare optimum cylinder head gasket according to the following procedure.
 - a) As shown in figure, piston (1) protrudes above cylinder block (2) when it reaches top dead center. Using special tool and dial gauge, measure protrusion "b" at two points "A" and "B" and take an average. Repeat this procedure with each piston.

Special tool

(A): 09910-26510/OUT 0000005

"a": 10 mm (0.40 in.)



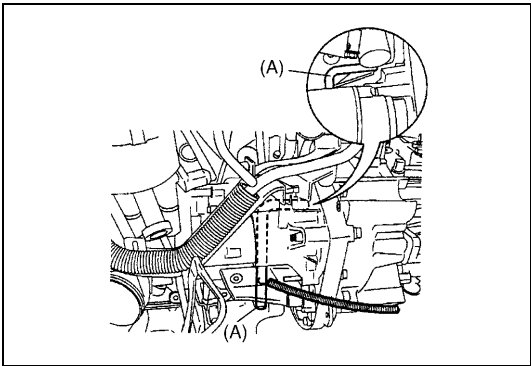
- b) Using the largest value among averages obtained at step a), prepare optimum cylinder head gasket (1) referring to the following table and figure.

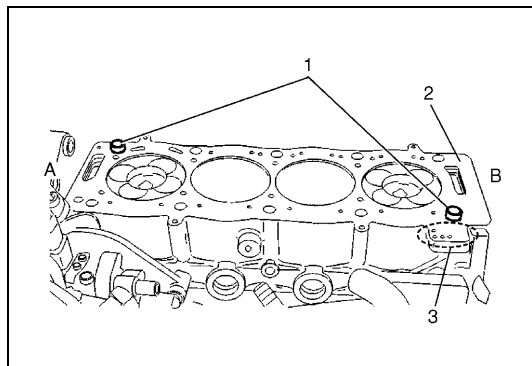
Measured piston protrusion	Thickness of gasket	Identification of gasket
0.55 – 0.60 mm (0.022 – 0.023 in.)	1.21 – 1.29 mm (0.048 – 0.050 in.)	[A]
0.61 – 0.65 mm (0.024 – 0.025 in.)	1.26 – 1.34 mm (0.050 – 0.052 in.)	[B]
0.66 – 0.70 mm (0.026 – 0.027 in.)	1.31 – 1.39 mm (0.052 – 0.054 in.)	[C]
0.71 – 0.75 mm (0.028 – 0.029 in.)	1.36 – 1.44 mm (0.054 – 0.056 in.)	[D]

- 3) Lock flywheel (for M/T model) or drive plate (for A/T model) inserting special tool (A) into holes in both cylinder block and flywheel (for M/T model) or drive plate (for A/T model) with crankshaft timing pulley key turned up.

Special tool

(A): 09919-26530/OUT0000160

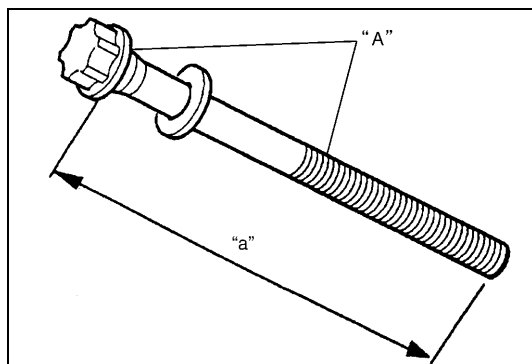




- 4) Install knock pins (1) to cylinder block.
- 5) Install new cylinder head gasket (2) to cylinder block.
Thickness identification holes (3) provided on gasket should come to oil filter side.

A: Crankshaft pulley side

B: Flywheel side



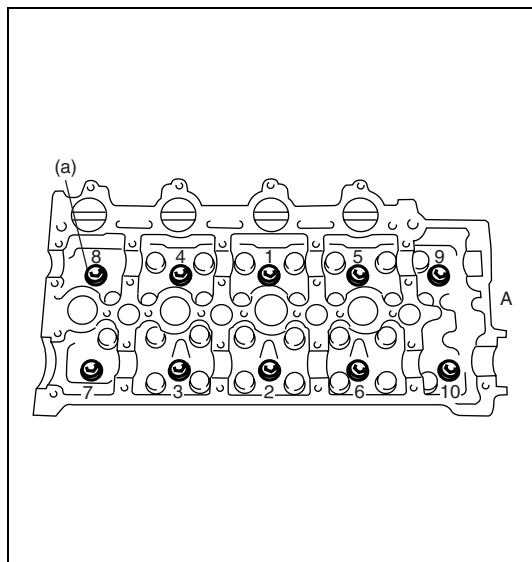
- 6) Check to make sure that length "a" of cylinder head bolts.
If length "a" exceeds specified value, replace cylinder head bolt.

Cylinder head bolt length

"a": Less than 134 mm (5.27 in.)

- 7) Install cylinder head to cylinder head block, and apply sealant to threads and bottom of cylinder head bolt head.

"A": Sealant MOLYKOTE G RAPID PLUS



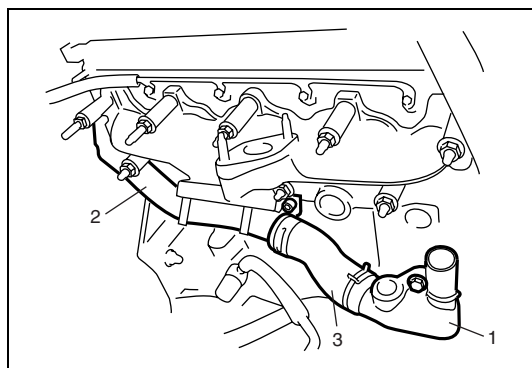
- 8) Tighten cylinder head bolts gradually as follows.
 - a) Tighten all bolts to 20 N·m (2.0 kg-m, 14.5 lb-ft) according to numerical order in figure.
 - b) In the same manner as in step a), tighten them to 60 N·m (6.0 kg-m, 43.5 lb-ft).
 - c) Loosen all bolts 1 revolution according to numerical order in figure.
 - d) Repeat step a) and b).
 - e) Retighten all bolts 220° according to numerical order in figure.

Tightening torque

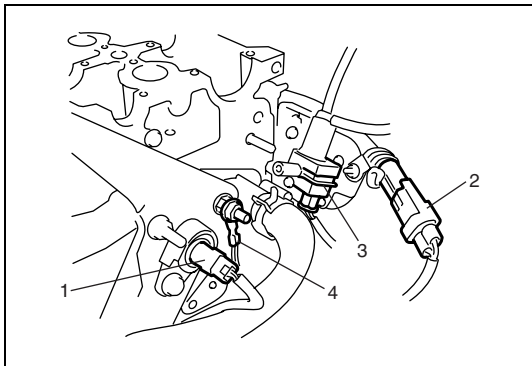
Cylinder head bolt (a):

60 N·m (6.0 kg-m, 43.5 lb-ft) and extra tightening 220°

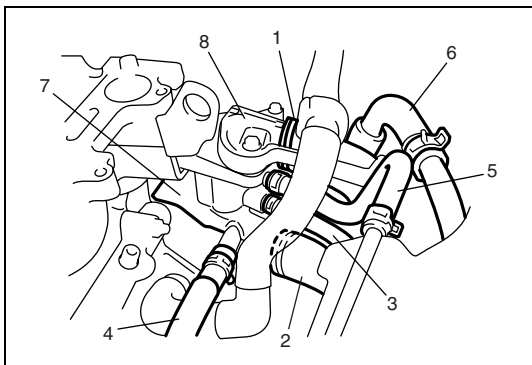
A: Crankshaft pulley side



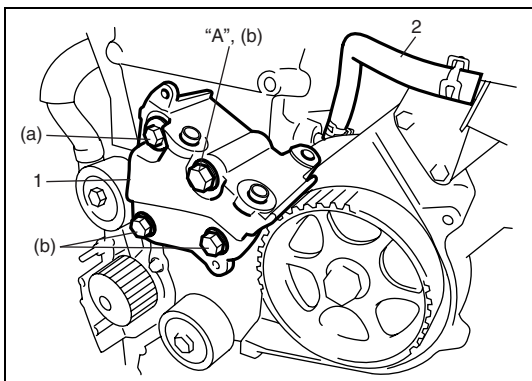
- 9) Install common rail to cylinder head referring to "Common Rail (High Pressure Fuel Injection Rail)" in Section 6E3.
- 10) Using new water inlet box gasket and new water inlet pipe O-ring, install water inlet box (1) and water inlet pipe (2), water inlet hose (3).
- 11) Install engine harness clamp nut to water outlet box.



- 12) Connect ECT sensor connector (1), glow plug supply wire connector (2), swirl control solenoid valve connector (3) and ground terminal (4).



- 13) Connect vent hose (5) and heater inlet No.2 hose (6) to inter-cooler bracket pipes.
 14) Connect radiator outlet No.2 hose (2), oil cooler inlet hose (3) and oil cooler outlet hose (4) to water outlet box (7).
 15) Connect radiator inlet hose (1) to thermostat cap (8).



- 16) Install engine bracket (1).
 Tighten bolts to specified torque after applying sealant to thread of bolt indicated in figure.

“A”: Sealant LOCKTITE FRENETANCH

Tightening torque

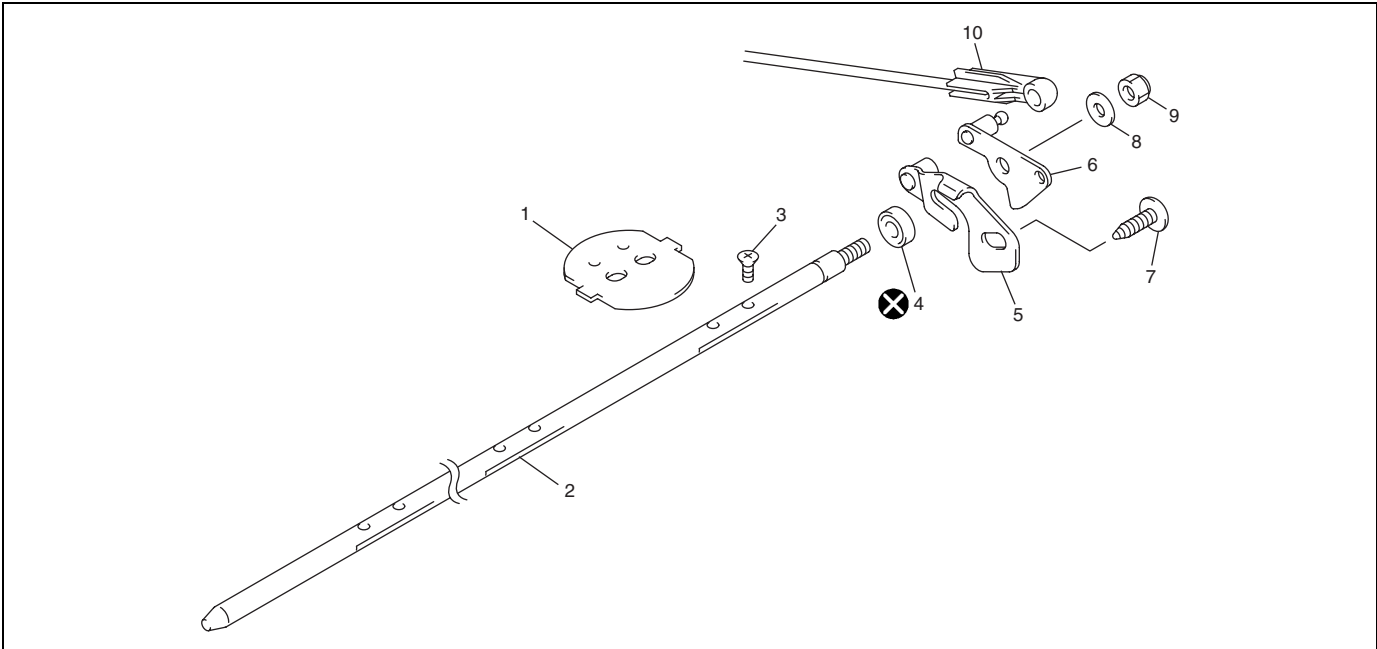
Engine bracket bolts No.1 (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

Engine bracket bolt No.2 (b): 20 N·m (2.0 kg-m, 14.5 lb-ft)

- 17) Connect vent hose (2) to cylinder head.
- 18) Install valve rockers and camshafts to cylinder head referring to “Camshaft and Valve Rockers” in this section.
- 19) Install turbocharger to exhaust manifold referring to “Turbo-charger” in this section.
- 20) Adjust generator belt tension referring to “Generator Belt” in Section 6H.
- 21) Adjust A/C compressor belt tension (if equipped) referring to “Compressor Drive Belt” in Section 1B.
- 22) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- 23) Refill cooling system with coolant referring to “Cooling System Flush and Refill” in Section 6B.
- 24) Refill A/T with specified A/T fluid (vehicle with A/T) referring to “Fluid Change” in Section 7B.
- 25) Connect negative cable at battery.
- 26) Check to make sure that there is no fuel leakage, coolant leakage, oil leakage, A/T fluid leakage (vehicle with A/T) and exhaust gas leakage at each connection.

Swirl Control Solenoid Valve

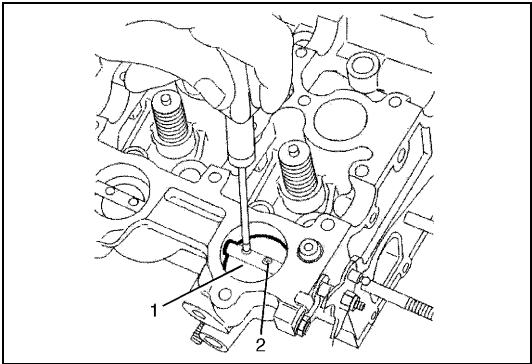
COMPONENTS



1. Swirl control solenoid valve	5. Bumper	9. Nut
2. Swirl control solenoid valve shaft	6. Control lever	10. Swirl control solenoid valve
3. Swirl control solenoid valve mounting bolt	7. Stopper	⊗ Do not reuse.
4. Gasket	8. Washer	

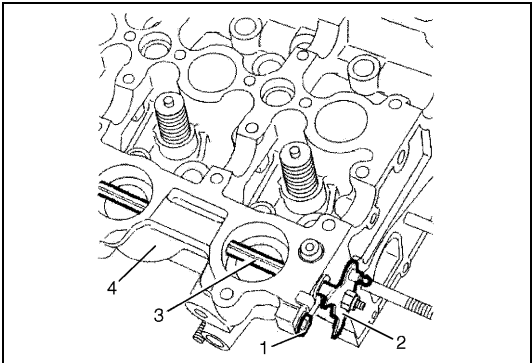
REMOVAL

- 1) Remove cylinder head referring to “Valves and Cylinder Head” in this section.
- 2) Remove swirl control solenoid valves (1) from swirl control solenoid valve shaft (2).



NOTE:

Make matching mark on solenoid valves (1) to identify its direction and location.

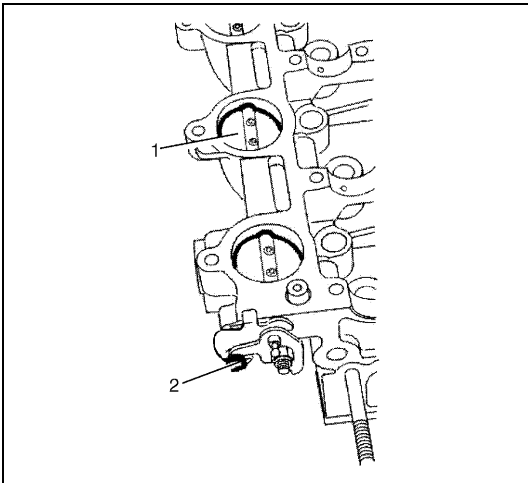


- 3) Remove bumper (1) and control lever (2) from solenoid valve shaft (3).
- 4) Remove solenoid valve shaft (3) from cylinder head (4).

INSTALLATION

Reverse removal procedure for installation noting the following.

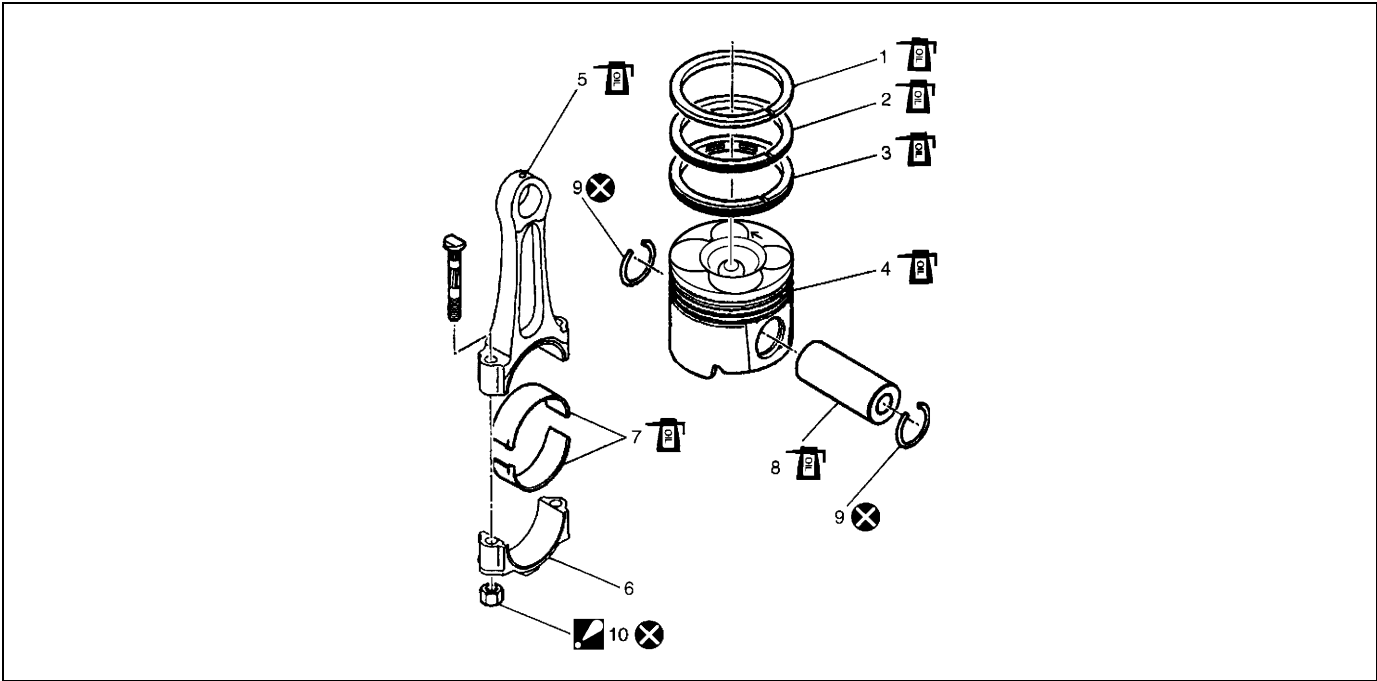
- Install swirl control solenoid valve at proper direction and location by matching mark made in "REMOVAL".



- Adjust swirl control solenoid valve as follow.
 - a) Close swirl control solenoid valves (1).
 - b) Actuate stopper (2) until swirl control solenoid valves (1) become detached.
 - c) Tighten stopper (2).
 - d) Confirm that swirl control solenoid valve (1) close correctly and do not any hard spots on opening.

Piston, Piston Rings, Connecting Rods and Cylinders

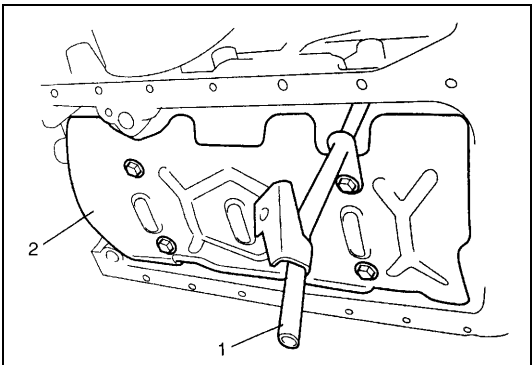
COMPONENTS

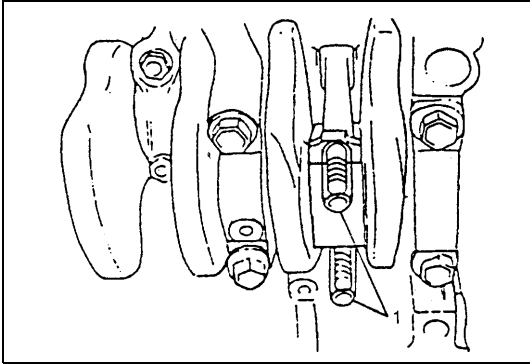


1. Top ring	5. Connecting rod	9. Piston pin circlip	Do not reuse.
2. 2nd ring	6. Connecting rod bearing cap	10. Connecting rod bearing cap nut :For tightening procedure, refer to "Installation".	
3. Oil ring	7. Connecting rod bearing	Tightening Torque	
4. Piston	8. Piston pin	Apply engine oil to sliding surface of each parts.	

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Drain engine oil and engine coolant.
- 3) Remove oil pan and oil pump strainer referring to "Oil Pan and Oil Pump Strainer" in this section.
- 4) Remove oil pump referring to "Oil Pump" in this section.
- 5) Remove cylinder head referring to "Valves and Cylinder Head" in this section.
- 6) Mark cylinder number on all pistons, connecting rods and rod bearing caps using silver pencil or quick drying paint.
- 7) Remove oil level gauge lower guide (1) and oil partition (2).
- 8) Remove connecting rod bearing caps.

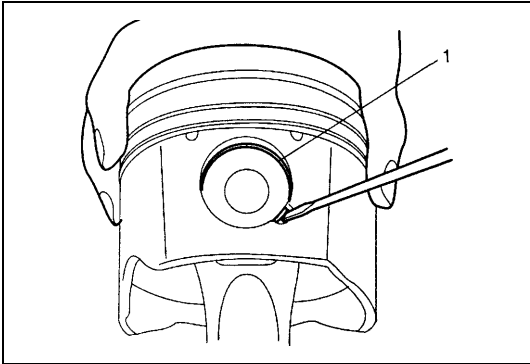




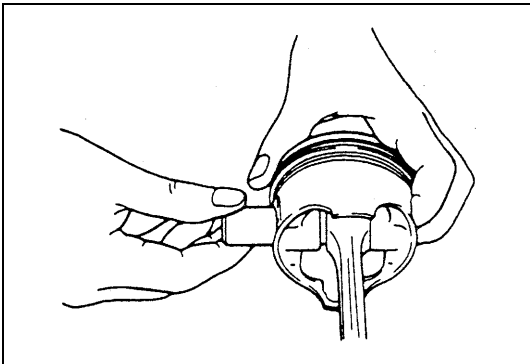
- 9) Install guide hoses (1) over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads when removing connecting rod.
- 10) Decarbon top of cylinder bore before removing piston from cylinder.
- 11) Push piston and connecting rod assembly out through the top of cylinder bore.

DISASSEMBLY

- 1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
- 2) Remove piston pin from connecting rod as follows.
 - a) Ease out piston pin circlips (1) as shown.



- b) Force piston pin out.



CLEANING

Clean carbon from piston head and ring grooves using a suitable tool.

INSPECTION

Cylinders

- Inspect cylinder walls for scratches, roughness, or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched, or ridged, rebore cylinder.

Pistons

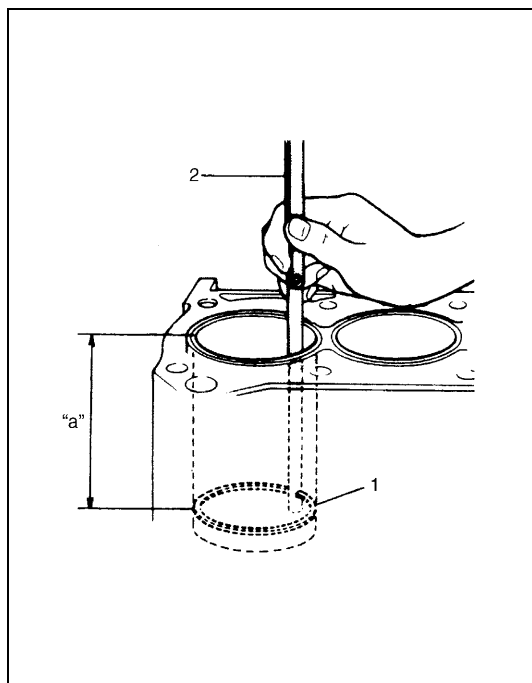
- Inspect piston for faults, cracks or other damaged. Damaged or faulty piston should be replaced.

Piston Pin

- Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod and/or piston.

Piston Rings

To measure end gap, insert piston ring (1) into cylinder bore and then measure the gap by using thickness gauge (2).
If measured gap is out of specification, replace ring.



NOTE:

Decarbonize and clean top of cylinder bore before inserting piston ring.

Piston ring end gap

Top ring: 0.20 – 0.35 mm (0.0079 – 0.0137 in.)

2nd ring: 0.80 – 1.00 mm (0.0315 – 0.0393 in.)

Oil ring: 0.25 – 0.50 mm (0.0099 – 0.0196 in.)

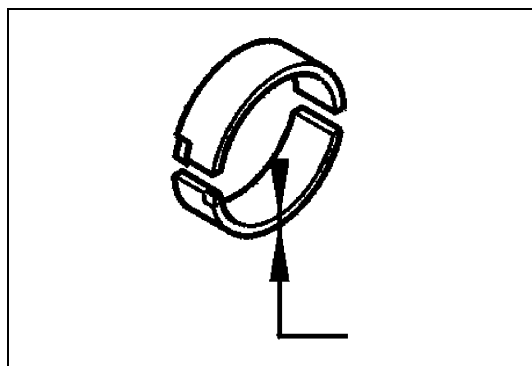
Piston ring thickness

Top ring: 3.50 mm (0.138 in.)

2nd ring: 2.00 mm (0.079 in.)

Oil ring: 3.00 mm (0.119 in.)

"a": 120 mm (4.72 in.)

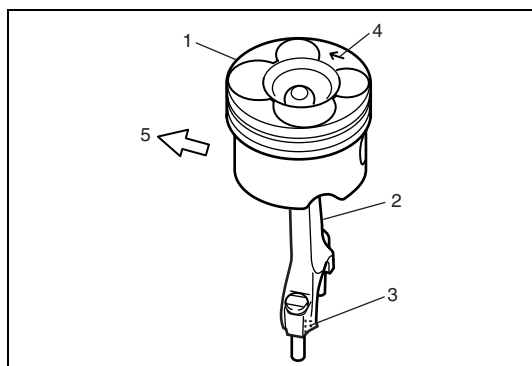


- Rod bearing:
Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.
Two kinds of rod bearing are available; standard size bearing and 0.15 mm (0.0059 in.) undersize bearing. For identification of undersize bearing, it is painted red (1) at the position as indicated in figure, undersize bearing thickness is 1.978 – 1.988 mm (0.0779 – 0.0782 in.) at the center of it.

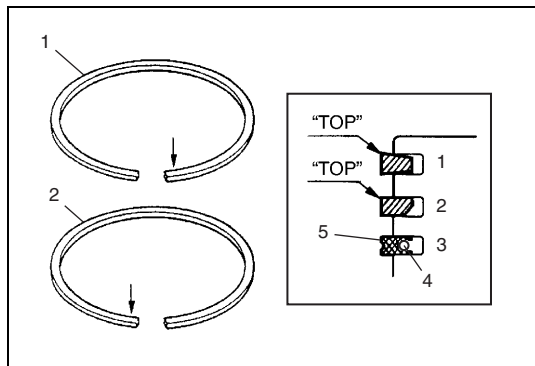
ASSEMBLY

- 1) Install piston pin to piston (1) and connecting rod (2):

After applying engine oil to piston pin and piston pin holes in piston and connecting rod, fit connecting rod to piston so that bearing lock tab (3) and arrow mark (4) come on the opposite side and insert piston pin to piston and connecting rod, and install piston pin circlips.

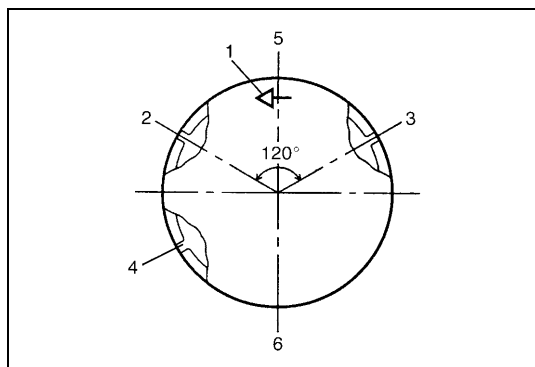


5. Camshaft pulley side



2) Install piston rings to piston:

- As indicated in figure, 1st and 2nd rings have “TOP” mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
- 1st ring (1) differs from 2nd ring (2) in thickness and shape. Distinguish 1st ring from 2nd ring by referring to figure.
- When installing oil ring (3), install spiral ring (4) first and then rail (5).



3) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

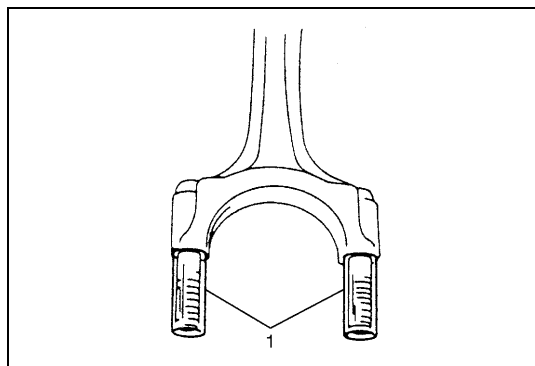
1. Arrow mark
2. 1st ring end gap
3. 2nd ring end gap and oil ring spacer gap
4. Oil ring rail gap
5. Exhaust manifold side
6. Oil filter side

INSTALLATION

- 1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crankpins.

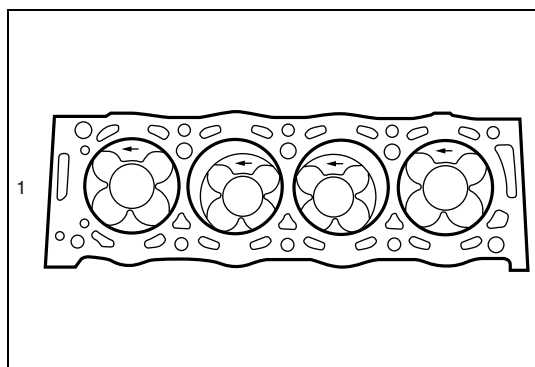
NOTE:

Do not apply oil between connecting rod and bearing or between bearing cap and bearing.

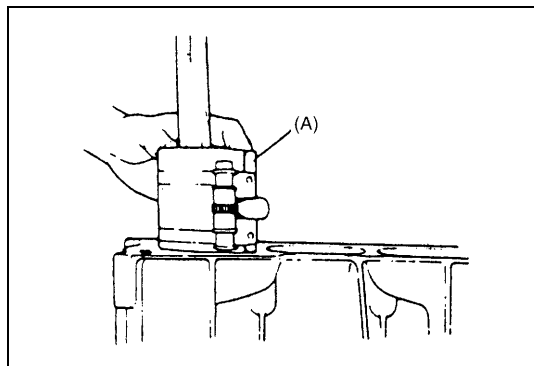


- 2) Install guide hoses (1) over connecting rod bolts.

These guide hoses (1) protect crankpin and threads of rod bolt from damage during installation of connecting rod and piston assembly.



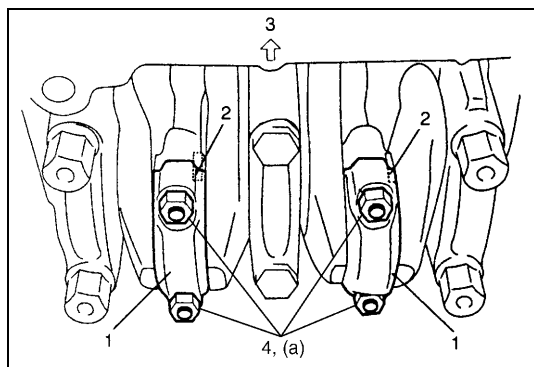
- 3) When installing piston and connecting rod assembly into cylinder bore, point arrow mark on piston head to crankshaft pulley side (1).



- 4) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft. Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

Special tool

(A): 09916-77310

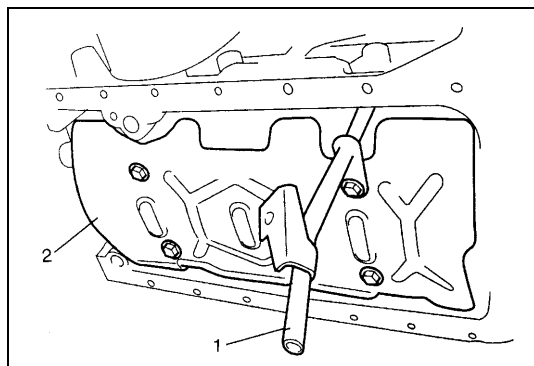


- 5) Install bearing cap (1):
At this time, make sure that bearing lock tab (2) of bearing cap faces oil filter side (3).
Tighten new cap nuts (4) gradually as follows.
a) Tighten all cap nuts to 20 N·m (2.0 kg-m, 14.5 lb-ft).
b) Retighten them by turning through 70°.

Tightening torque

Connecting rod bearing cap nut (a):

20 N·m (2.0 kg-m, 14.5 lb-ft) and extra tightening 70°.



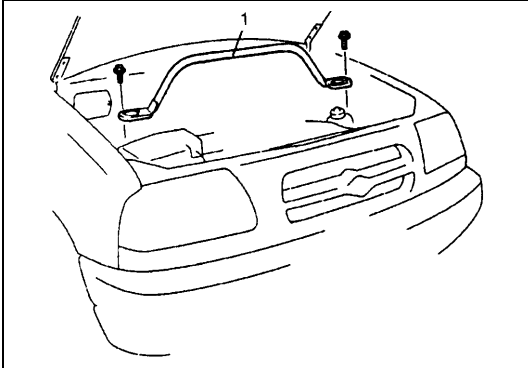
- 6) Install oil partition (2) and oil level gauge lower guide (1).
7) Adjust generator belt tension referring to "Generator Belt" in Section 6H.
8) Adjust A/C compressor belt tension, if equipped. Refer to "Compressor Drive Belt" in Section 1B.
9) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
10) Refill engine with engine oil referring to "Engine Oil and Oil Filter Change" in Section 0B.
11) Refill cooling system referring to "Cooling System Flush and Refill" in Section 6B.
12) Refill front differential housing with gear oil referring to "Transfer Gear Oil" in Section 7E.
13) Connect negative cable at battery.
14) Check to make sure that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

Unit Repair Overhaul

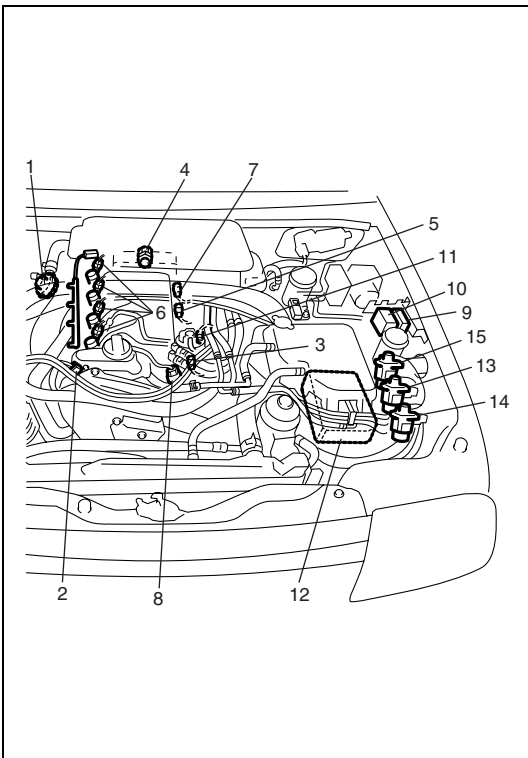
Engine Assembly

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove engine hood after disconnecting windshield washer hose.
- 3) Remove TP sensor (Accelerator stroke sensor) and intake air pressure sensor.



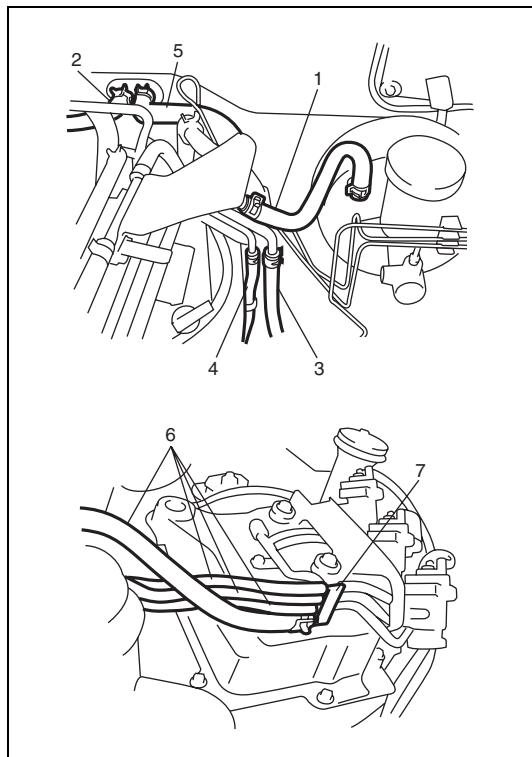
- 4) Detach fuse/relay box and remove strut tower bar (1).
- 5) Remove engine under cover.
- 6) Drain cooling system.
- 7) Remove degassing tank and radiator with radiator fan motor assembly referring to "Radiator" in Section 6B.
- 8) Remove air cleaner outlet hose.
- 9) Remove intercooler referring to "Intercooler" in this section.
- 10) Remove transmission assembly referring to "Dismounting of Transmission Unit" in Section 7A2 or "Automatic Transmission Assembly (with Transfer)" in Section 7B1.



- 11) Disconnect the following electric wires:

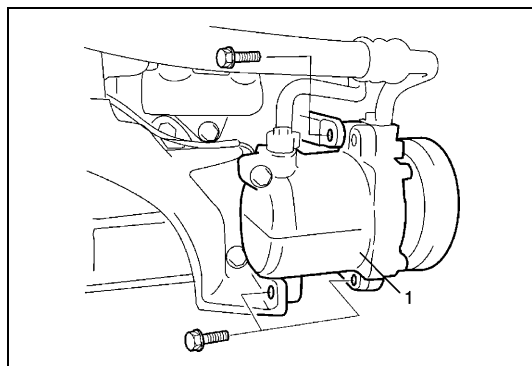
- Swirl control solenoid valve (1)
- Camshaft position sensor (2)
- Fuel pressure regulator (3)
- Glow plug supply wire at the connector
- Engine coolant temp. sensor (4)
- Fuel pressure sensor (5)
- Fuel injectors (6)
- Fuel temp. sensor (7)
- Injection pump solenoid valve (8)
- Generator
- Engine oil pressure switch
- Double relay (9)
- Pre post heating control unit (10)
- Fuel heater (11)
- Ground terminal from water outlet box
- ECM (12)
- EGR solenoid valve (14)
- EGR throttle solenoid valve (15)

and then release wire harnesses from clamps.



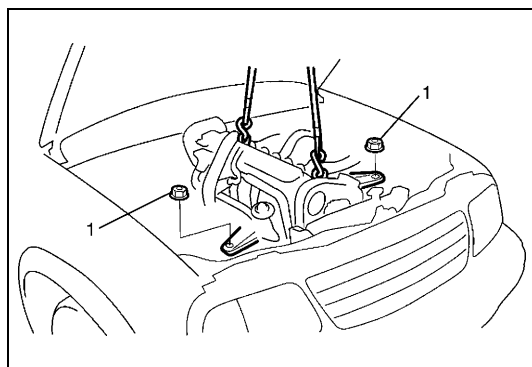
12) Disconnect the following hoses:

- Brake booster hose (1) from vacuum pipe
- Vacuum hoses (6) from vacuum pipe (7)
- Heater inlet hose (5) and outlet hose (2) from pipe
- Fuel feed hose (3) and return hose (4) from each pipe



13) With hose connected, detach A/C compressor (1) (if equipped) and power steering pump from bracket.

14) Drain engine oil, if necessary.



15) Install lifting device.

16) Remove engine side mounting bracket nuts (1).

17) Before lifting engine, check to ensure all hoses, electric wires and cables are disconnected from engine.

18) Remove engine assembly from chassis.

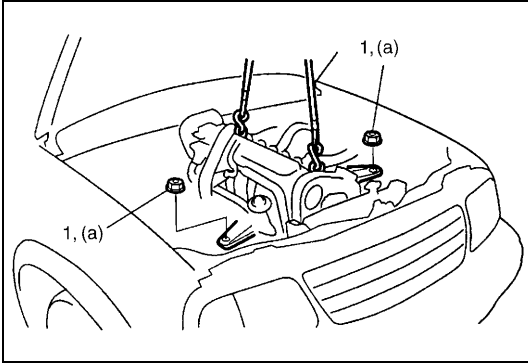
INSTALLATION

- 1) Lower engine assembly into engine compartment.
- 2) Tighten engine side mounting bracket nuts (1).

Tightening torque

Engine side mounting bracket nut (a):

55 N·m (5.5 kg-m, 40.0 lb-ft)



- 3) Reverse removal procedure for installation noting the following.

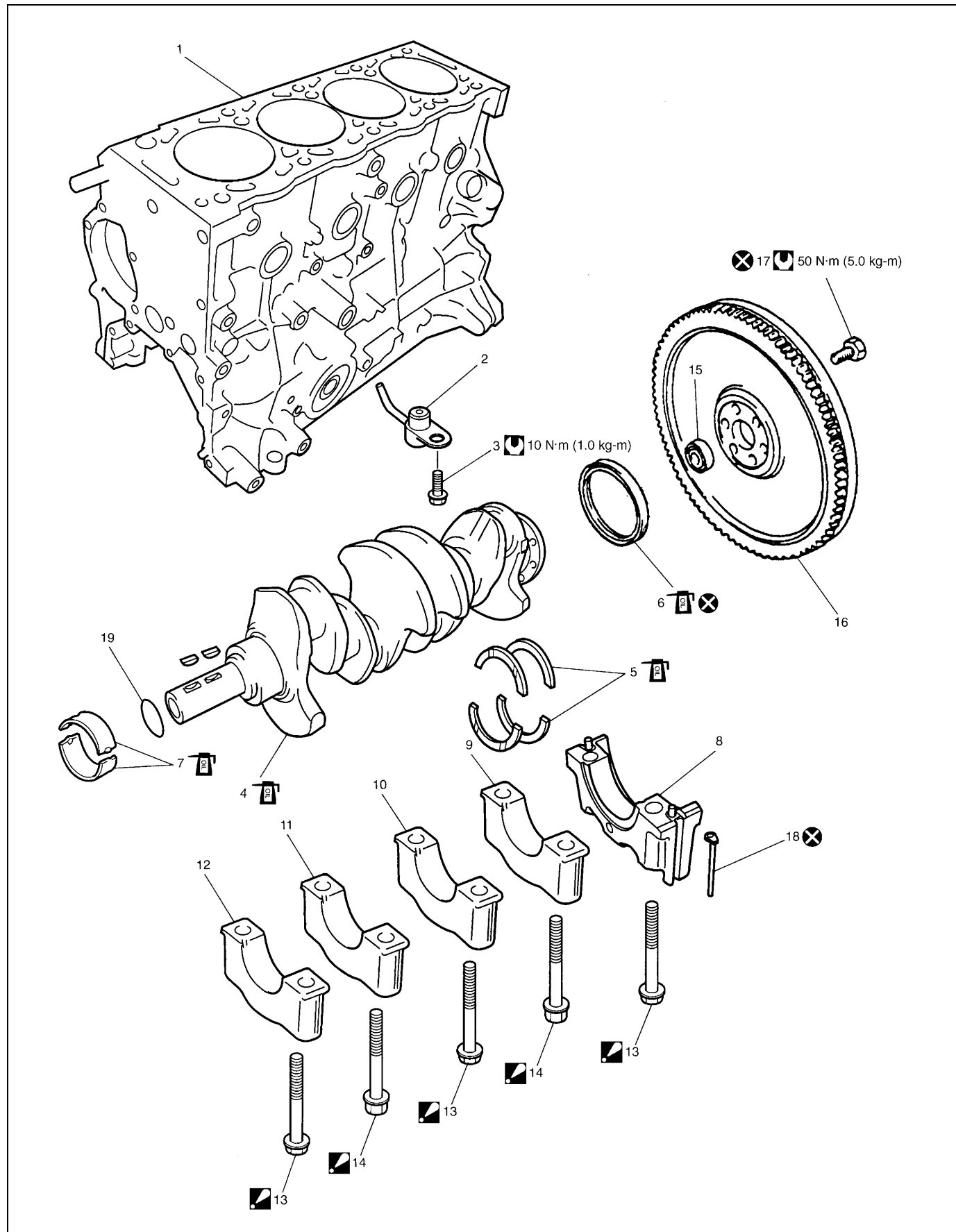
CAUTION:

Before installing intake air pressure sensor hose, degrease connect part of hose and intercooler outlet hose. Otherwise hose may become detached and cause turbo system failure.

- Install transmission assembly referring to “Remounting of Transmission Unit” in Section 7A2 or “Automatic Transmission Assembly (with Transfer)” in Section 7B1.
- Adjust generator belt tension, referring to “Generator Belt” in Section 6H.
- Adjust A/C compressor belt tension, if equipped. Refer to “Compressor Drive Belt” in Section 1B.
- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Refill engine with engine oil referring to “Engine Oil and Filter” in Section 0B.
- Refill cooling system referring to “Cooling System Refill” in Section 6B.
- Check to make sure that there is no fuel leakage, coolant leakage and exhaust gas leakage at each connection.

Main Bearings, Crankshaft and Cylinder Block

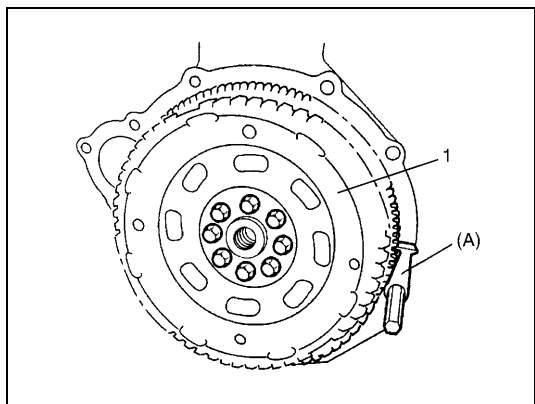
COMPONENTS



1. Cylinder block	 7. Main bearing: Apply engine oil to bearing inside surfaces.	 13. Main bearing cap bolt No.1 :Follow tightening procedure referring to "Installation".	19. O-ring
2. Oil jet	8. Main bearing cap No.1	 14. Main bearing cap bolt No.2 :Follow tightening procedure referring to "Installation".	 Tightening Torque
3. Oil jet bolt	9. Main bearing cap No.2	15. Input shaft bearing	 Do not reuse.
 4. Crankshaft :Apply engine oil to sliding surface.	10. Main bearing cap No.3	16. Flywheel	
 5. Thrust bearing :Apply engine oil to sliding surface.	11. Main bearing cap No.4	17. Flywheel bolt	
 6. Rear oil seal :Apply engine oil to sliding surface.	12. Main bearing cap No.5	18. Bearing cap seal	

REMOVAL

- 1) Remove engine assembly from body referring to "Engine Assembly" in this section.
- 2) Remove oil pan and oil pump strainer referring to "Oil Pan and Oil Pump Strainer" in this section.
- 3) Remove exhaust manifold referring to "Exhaust Manifold" in this section.
- 4) Remove cylinder head cover referring to "Cylinder Head Cover" in this section.
- 5) Remove timing belt, belt tensioner, roller and crankshaft timing belt pulley and timing belt cover referring to "Timing Belt and Belt Tensioner" in this section
- 6) Remove oil pump, oil pump drive sprocket and gasket holder plate referring to "Oil Pump" in this section.
- 7) Remove camshafts referring to "Camshafts and Valve Rockers" in this section.
- 8) Remove cylinder head assembly referring to "Valve and Cylinder Head" in this section.
- 9) Remove piston and connection rod referring to "Piston, Piston Rings, Connecting Rods, Connecting Rods and Cylinders" in this section.
- 10) Remove clutch cover, clutch disc and flywheel (for M/T model) or drive plate (for A/T model) and CKP (Engine speed) sensor ring.

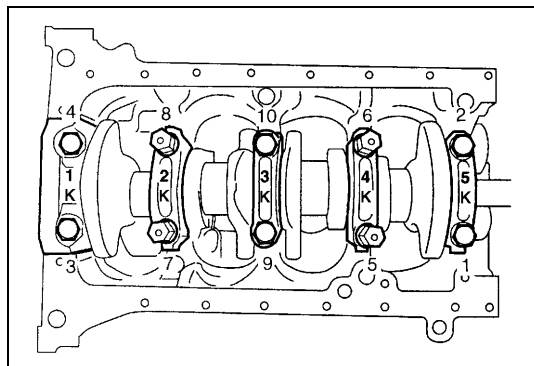


CAUTION:

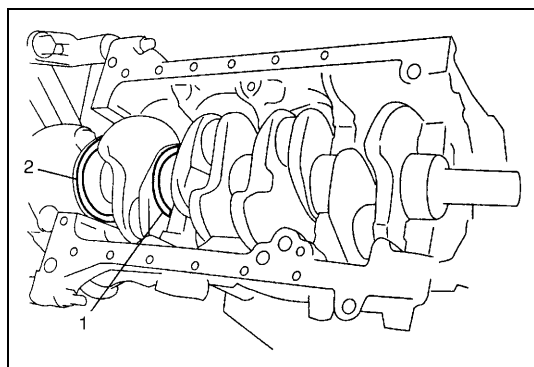
Do not use CKP sensor ring (1) to lock crankshaft rotation. This prohibited service may damage CKP sensor ring.

Special tool

(A): 09924-17811



11) Loosen crankshaft bearing cap bolts in such order as indicated in figure a little at a time and remove bearing caps.



12) Remove thrust bearings (lower side) (1) and rear oil seal (2).

13) Remove crankshaft from cylinder block.

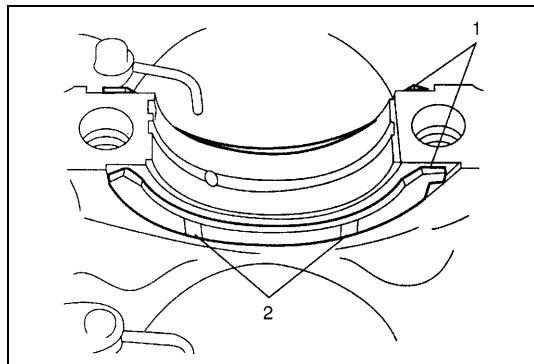
14) Remove thrust bearings (upper side).

15) Remove oil jet.

INSPECTION

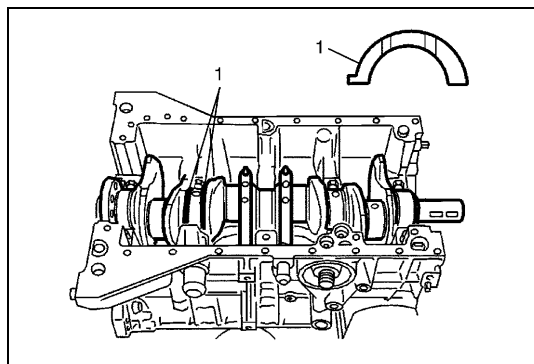
Crankshaft thrust play

Measure this play with crankshaft set in cylinder block in the normal manner as follows.

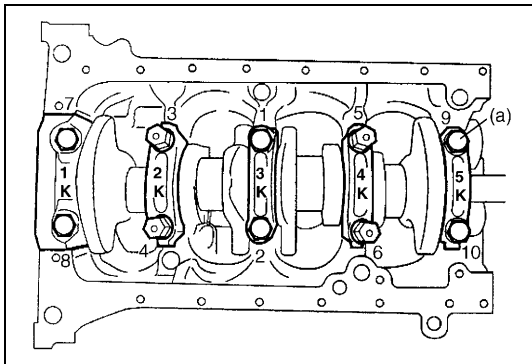


1) Install upper thrust bearings (1) to cylinder block between No.1 and No.2 cylinders, Face oil groove (2) sides to crank webs.

2) Install crankshaft to cylinder block.



3) Install lower thrust bearing (1) contacting its oil grooved surface crankshaft.

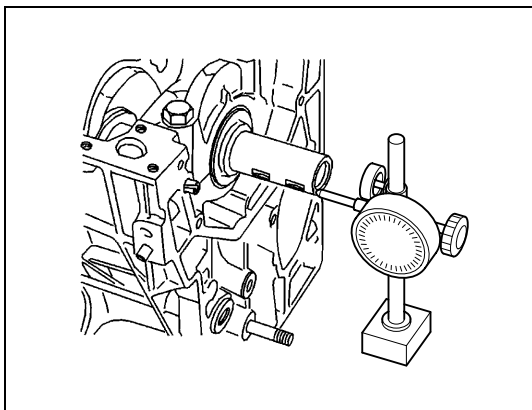


- 4) Install main bearing caps in the right place as shown figure.
- 5) Tighten main bearing cap bolts as follows.
 - a) Tighten bolts to 25 N·m (2.5 kg-m, 24.5 lb-ft) according to numerical order in figure.
 - b) In the same manner as in step a), retighten them by turning through 60°.

Tightening torque

Crankshaft main bearing cap bolt (a):

25 N·m (2.5 kg-m, 24.5 lb-ft) and extra tightening 60°



- 6) Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.

If measured value is out of specification, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Crankshaft thrust play

: 0.07 – 0.32 mm (0.0028 – 0.0125 in.)

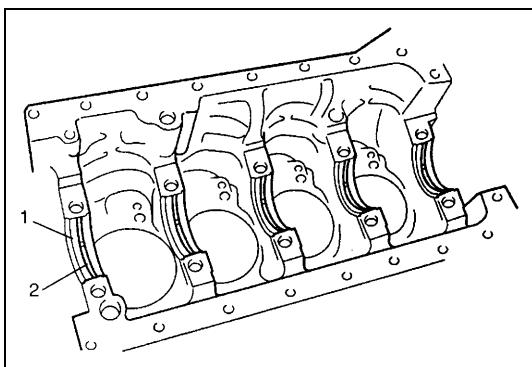
Crankshaft thrust bearing thickness

Standard: 2.28 mm (0.0898 in.)

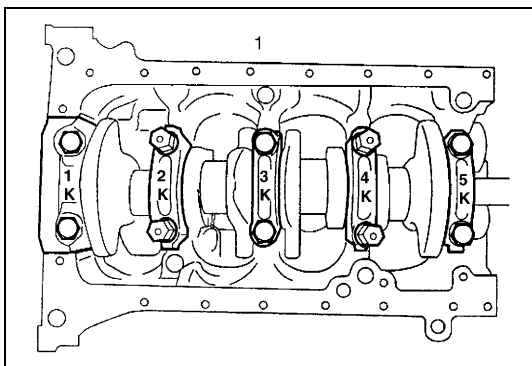
Oversize: 2.33 mm (0.0917 in.)

Main Bearings

General information



- Service main bearings are available in standard size and 0.15 mm (0.0059 in.) undersize.
- Upper half of bearing (1) has oil groove (2) as shown in figure. Install this half with oil groove to cylinder block.
- Lower half of bearing does not have oil groove.



- On each main bearing cap, number is embossed as shown in figure.

When installing each bearing cap to cylinder block, point bearing lock tab toward oil filter side (1) and install each cap from that side to crankshaft pulley side in ascending order of numbers "1K", "2K", "3K", "4K" and "5K".

Visual inspection

Check bearings for pitting, scratches, wear or damage.

If any malcondition is found, replace both upper and lower halves.

Never replace one half without replacing the other half.

Crankshaft

- Regrind crankshaft journal to the following finished diameter, if necessary.

Regrind crankshaft journal diameter

59.777 – 59.800 mm (2.3535 – 2.3543 in.)

Cylinder Block

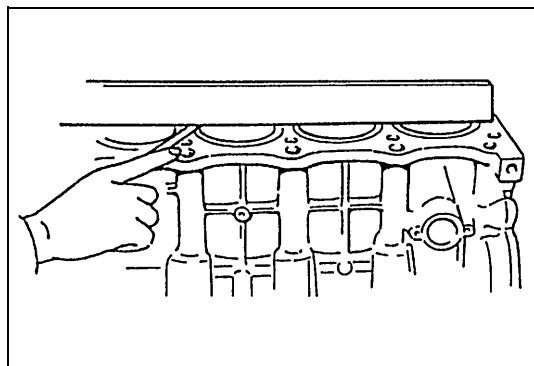
Distortion of gasketed surface

- Using straightedge and thickness gauge, check gasketed surface for distortion.

If flatness exceeds its limit, correct it.

Cylinder block flatness

Limit: 0.03 mm (0.0012 in.)



Honing or reboring cylinders

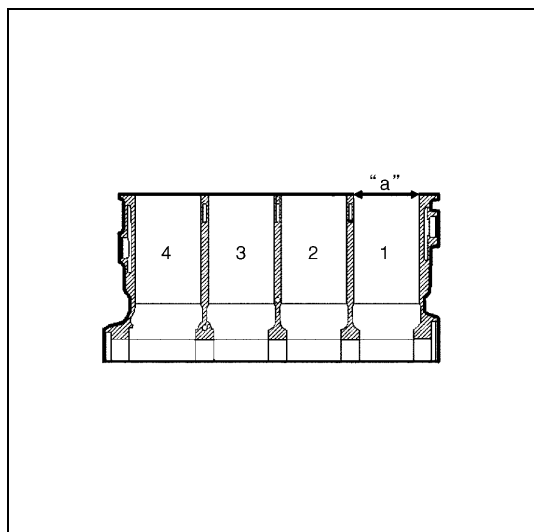
- 1) When any cylinder needs reboring, all other cylinders must also be rebored at the same time.

NOTE:

- Before reboring, install all main bearing caps in place and tighten to specification to avoid distortion of bearing bores.
- Cylinder block can rebore up to reboring limit below.

Cylinder reboring limit diameter "a":

90.018 mm (3.544 in.)



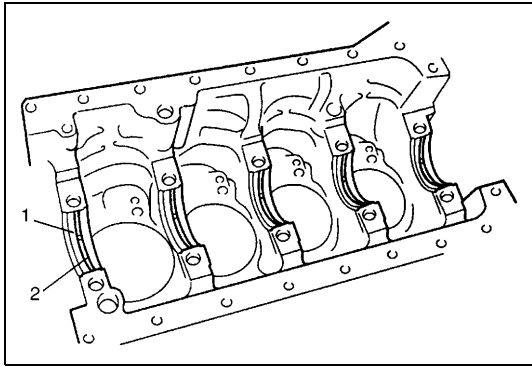
1.	No.1 cylinder
2.	No.2 cylinder
3.	No.3 cylinder
4.	No.4 cylinder

- 2) Measure piston clearance after honing or reboring.

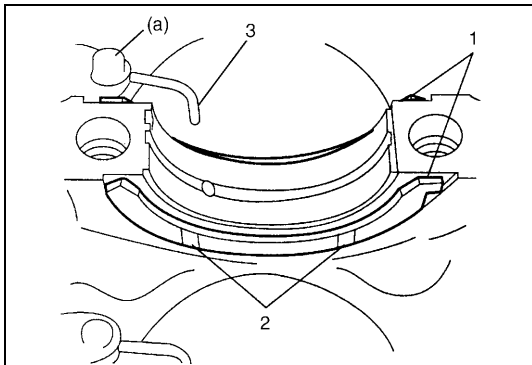
INSTALLATION

NOTE:

- All parts to be installed must be perfectly clean.
- Be sure to apply oil to crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.
- Journal bearings, bearing caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.



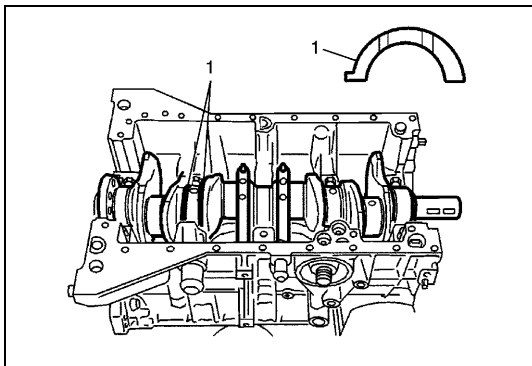
- 1) Install main bearings (1) to cylinder block.
One of two halves of main bearing has an oil groove (2).
Install it to cylinder block, and the other half without oil groove to bearing cap.



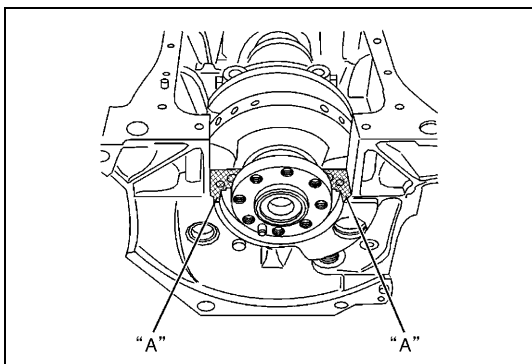
- 2) Install oil jet (3) to cylinder block.
Tighten oil jet bolt to specified torque.

Oil jet bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

- 3) Install thrust bearings (1) to cylinder block between No.1 and No.2 cylinders. Face oil groove (2) sides to crank webs.
- 4) Install crankshaft to cylinder block.

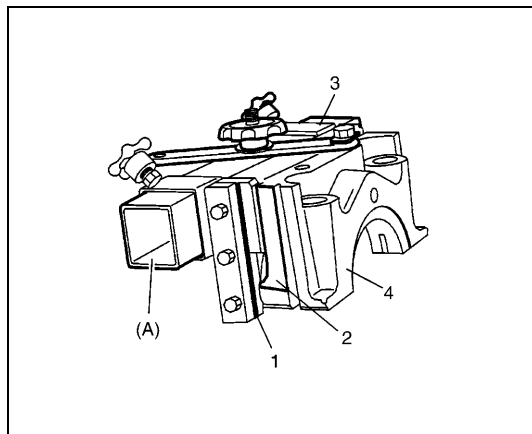


- 5) Install thrust bearing (1) contacting its oil grooved surface to crankshaft.



- 6) Apply sealant to cylinder block hatched part as shown in figure.

"A": Sealant 99000-31140



- 7) Install main bearing cap No.1 to cylinder block as follows.
- Install special tool (A) to main bearing cap No.1 (4) tightening its clamp (3).

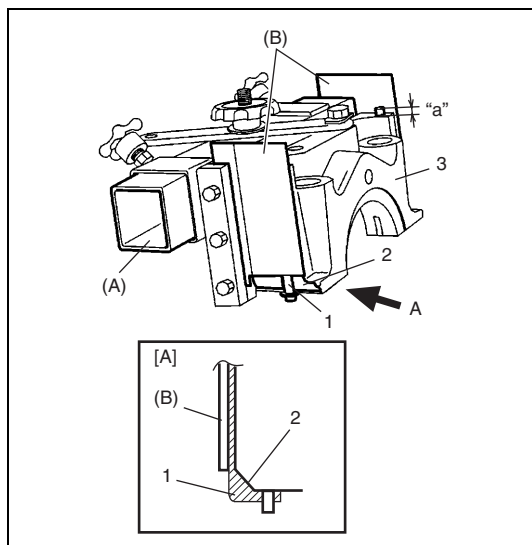
NOTE:

Shim slide (1) of special tool (A) must be in extension of surface (2) of bearing cap No.1 (4).

Special tool

(A): 09911-16510/OUT0000002

3. Bolt and washer



- Install new bearing cap seals (1) to groove of bearing cap with specified protrusion below.

Bearing cap seal protrusion

"a": approximately 1.5 mm (0.059 in.)

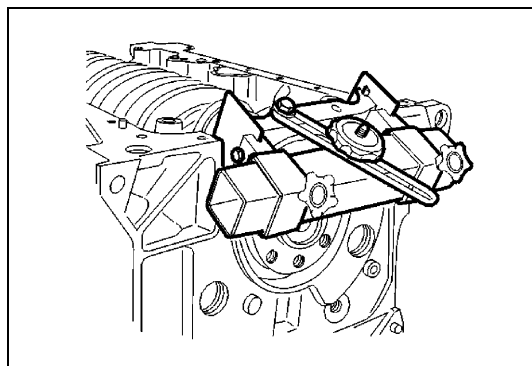
- Install special tool (B) to special tool (A) on the heel (2) of bearing cap No.1 (3).

Special tool

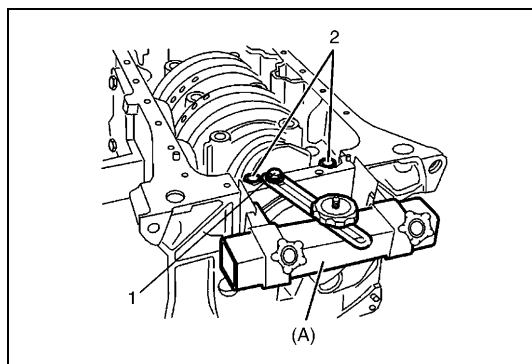
(B): 09913-96510/OUT0000012

- Apply engine oil to special tool (B) and their contact surface on cylinder block.

[A]: View A



- Engage bearing cap & special tools into cylinder block tilting them as shown.
- Straighten bearing cap & special tools out.
- Lower bearing cap & special tools slowly into cylinder block.



- Remove bolt and washer (1) that holds special tool (A) to bearing cap.
- Tighten both bearing cap bolts (2) temporarily.
- Remove special tools sideways.

- k) Check protrusion of bearing cap seals with specified value below.

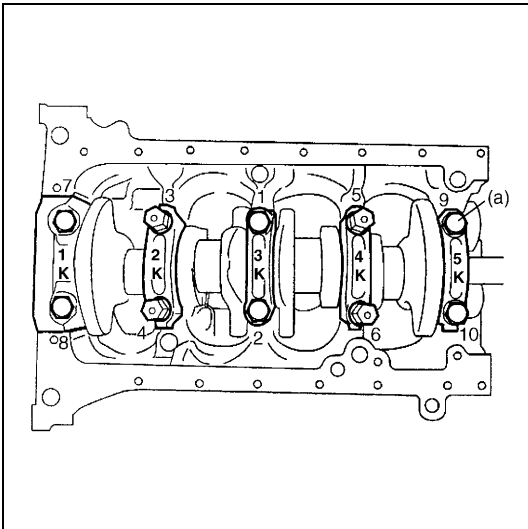
If protrusion is out of specification, repeat step a) through j).

Bearing cap seal protrusion:

Approximately 1.5 mm (0.059 in.)

NOTE:

Bearing cap seal is supplied with correct length, thus it must not be cut.



- 8) Install main bearing caps in the right place as shown figure.
 9) Tighten main bearing cap bolts as follows.
 a) Tighten bolts to 25 N·m (2.5 kg-m, 24.5 lb-ft) according to numerical order in figure.
 b) In the same manner as in step a), retighten them by turning through 60°.

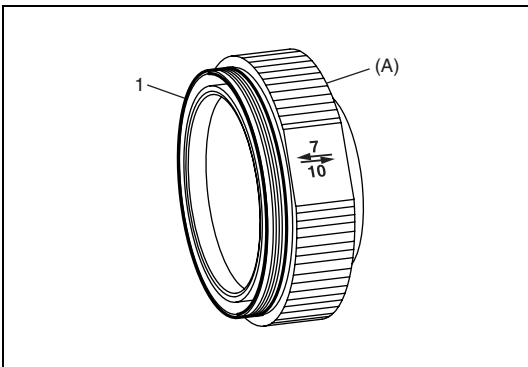
Tightening torque

Crankshaft main bearing cap bolt (a):

25 N·m (2.5 kg-m, 24.5 lb-ft) and extra tightening 60°

NOTE:

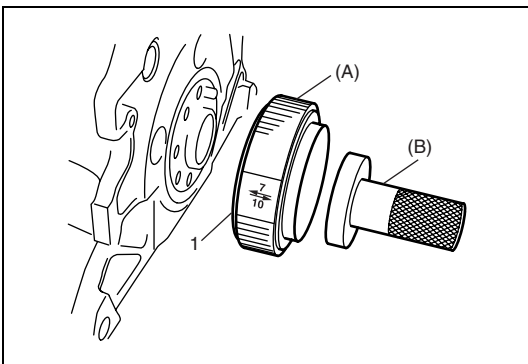
After tightening cap bolts, check to be sure that crankshaft rotates smoothly.



- 10) Set new rear oil seal (1) on special tool as shown figure.

Special tool

(A): 09911-16520/OUT0000011



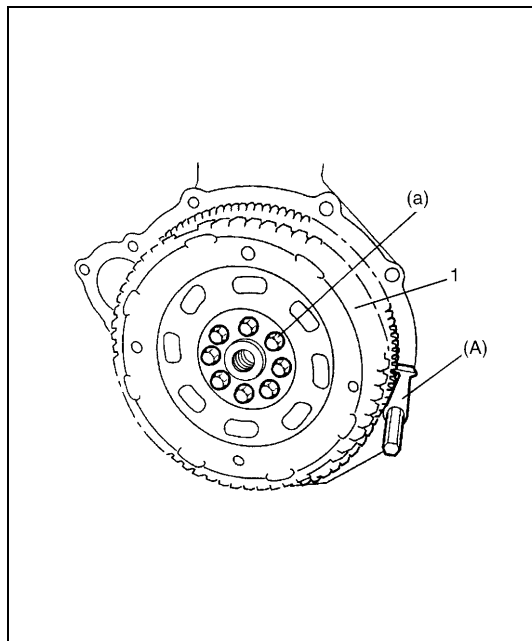
- 11) Install rear oil seal (1) tapping it with plastic hammer until it fully seats.

Special tool

(A): 09911-16520/OUT0000011

(B): 09913-75510

- 12) Remove special tool by turning and pulling it out in direction of engine rotation.
 13) Check that visible lip of rear oil seal faces outside.



- 14) Install flywheel (for M/T model) or drive plate (for A/T model) and CKP (Engine speed) sensor ring.
Using special tool, lock flywheel or drive plate.

CAUTION:

- **Do not use CKP sensor ring (1) to lock crankshaft rotation. This prohibited service may damage CKP sensor ring.**
- **Do not reuse flywheel bolts (for M/T model) or drive plate bolts (for A/T model). Otherwise, engine oil may leak. Be sure to use new bolts with pre-coated adhesive.**

Special tool

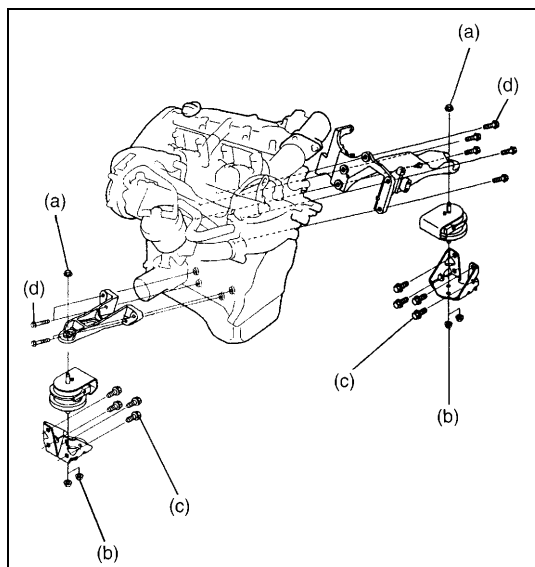
(A): 09924-17811

Tightening torque

Flywheel or drive plate bolt (a):

50 N·m (5.0 kg-m, 36.5 lb-ft)

- 15) Install piston and connecting rod referring to "Piston, Piston Rings, Connecting Rods and Cylinders" in this section.
- 16) Install cylinder head assembly referring to "Valve and Cylinder Head" in this section.
- 17) Install camshafts referring to "Camshafts and Valve Rockers" in this section.
- 18) Install oil pump, oil pump drive sprocket and gasket holder plate referring to "Oil Pump" in this section.
- 19) Install to timing belt, belt tensioner, roller, crankshaft timing sprocket and timing belt cover referring to "Timing Belt and Belt Tensioner" in this section.
- 20) Install cylinder head cover referring to "Cylinder Head Cover" in this section.
- 21) Install exhaust manifold referring to "Exhaust Manifold" in this section.
- 22) Install oil pan and oil pump strainer referring to "Oil Pan and Oil Pump Strainer" in this section.
- 23) Install clutch to flywheel (for M/T model) referring to "Clutch Cover, Clutch Disc and Flywheel" in Section 7C1.



24) Install engine mounting brackets.

Tightening torque

Engine side mounting bracket nuts (a):

55 N·m (5.5 kg-m, 40.0 lb-ft)

Frame side mounting bracket nuts (b):

55 N·m (5.5 kg-m, 40.0 lb-ft)

Frame side mounting bracket bolts (c):

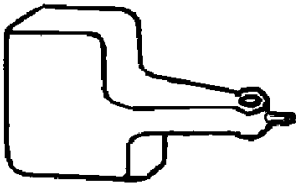
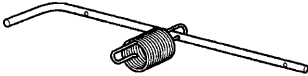
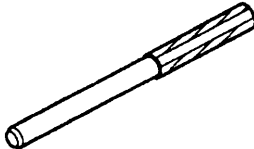
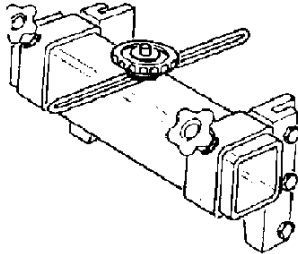
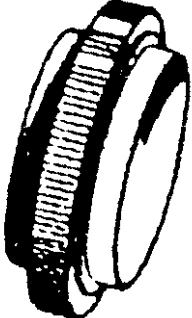
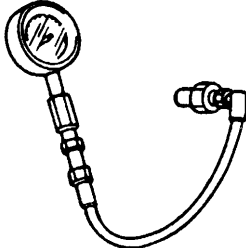
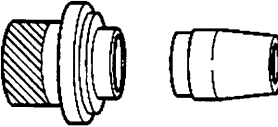
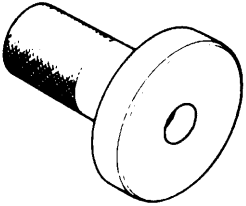
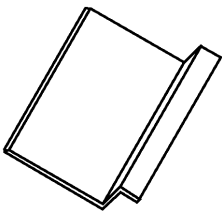
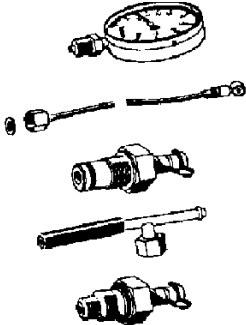
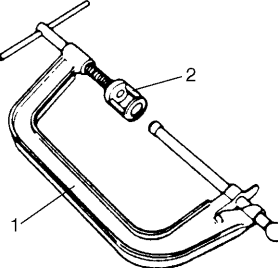
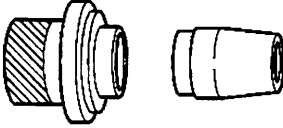
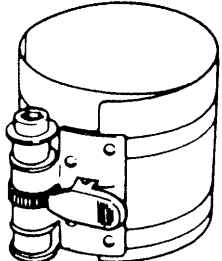
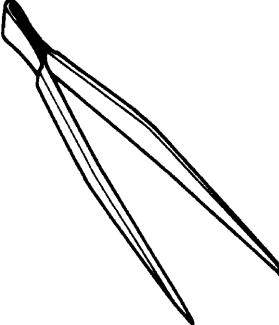
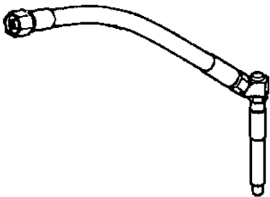
93 N·m (9.3 kg-m, 67.5 lb-ft)

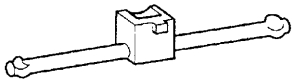
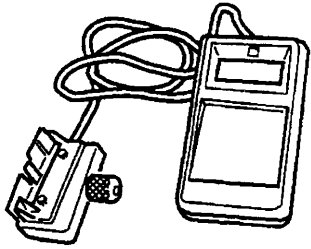
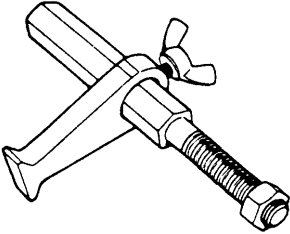
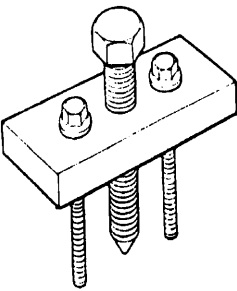
Engine side mounting bracket bolts (d):

40 N·m (4.0 kg-m, 29.0 lb-ft)

25) Install engine assembly to vehicle referring to "Engine Assembly" in this section.

Special Tools

 09910-26510 (OUT0000005) Dial gauge support	 09910-26530 (OUT0000160) TDC rod positioner	 09910-26540 (OUT0000151) Camshaft TDC positioner	 09911-16510 (OUT0000002) Rear oil seal installer
 09911-16520 (OUT0000011) Rear main seal installer	 09912-57820 Compression gauge	 09913-56510 (OUT0000152) Oil seal installer	 09913-75510 Bearing installer
 09913-96510 (OUT0000012) Bearing cap seal support	 09915-76530 (OUT0000057) Oil pressure gauge kit	 1. 09916-14510 Valve lifter 2. 09916-14521 Valve lifter attachment	 09916-51910 (OUT0000132) Fitting, crankshaft oil seal
 09916-77310 Piston ring compressor	 09916-84511 Forceps	 09916-96520 Compression gauge attachment	 09919-46510 (OUT0000110) Clamp pliers

			
09919-56550 (OUT0000141) Tension lever	09919-56560 (OUT0000138) Tension measuring equipment	09924-17811 Flywheel holder	09944-36011 Steering wheel remover

Required Service Materials

Recommended SUZUKI product (Part Number)	Use
Sealant 1207F 99000-31250	• To apply to mating surfaces of cylinder of cylinder block and oil pan. • To apply to mating surfaces of cylinder block and gasket holder plate.
Sealant 1207B 99000-31140	• To apply to mating surface of camshaft housing intake manifold and cylinder head. • To apply mating surfaces of cylinder block and main bearing cap No.1.

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Intercooler outlet and inlet hose clamps	4.5	0.45	3.5
Cylinder head cover bolt	10	1.0	7.5
Engine front hook mounting bolt	50	5.0	36.5
Timing belt cover bolt and nut	10	1.0	7.5
EGR pipe bolt	10	1.0	7.5
EGR cooler bolt No.1	10	1.0	7.5
EGR cooler bolt No.2	23	2.3	16.5
EGR cooler bracket nut	30	3.0	22.0
Strut tower bar bolt	50	5.0	36.5
Air cleaner outlet hose clamp	4.5	0.45	3.5
Turbocharger nut	25	2.5	18.0
Lubrication pipe union bolt	20	2.0	14.5
Turbocharger outlet pipe nut	25	2.5	18.0
Exhaust No.2 pipe bolt	55	5.5	40.0
Oil return pipe bolt	10	1.0	7.5
Exhaust manifold nut	30	3.0	22.0
EGR valve spacer nut	10	1.0	7.5
Roller bolt	45	4.5	32.5
Timing belt tensioner bolt	25	2.5	18.0
Camshaft timing belt pulley bolt	20	2.0	14.5
Crankshaft pulley bolt	a) Tighten 50 N-m (5.0 kg-m, 36.5 lb-ft) b) Tighten 145 N-m (14.5 kg-m, 105 lb-ft)		
Oil pressure switch	32	3.2	23.5
Oil pump strainer bolt	9.0	0.9	6.5
Oil pan bolt	16	1.6	11.5
Drain plug	34	3.4	24.5
Suspension frame bolt	85	8.5	61.5
Oil pump bolt	16	1.6	11.5
Gasket holder plate bolt	15	1.5	11.0
Camshaft housing/intake manifold bolt	10	1.0	7.5
Fuel injector pillar bolt	10	1.0	7.5
Camshaft hub bolt	45	4.5	32.5
Cylinder head bolt	For tightening procedure, refer to "Valves and Cylinder Head" in this section		
Engine bracket bolt No.1	45	4.5	32.5
Engine bracket bolt No.2	20	2.0	14.5
Connecting rod bearing cap nut	a) Tighten 20 N-m (2.0 kg-m, 14.5 lb-ft) b) Tighten by turning through 70°		
Engine side mounting bracket nut	55	5.5	40.0
Crankshaft main bearing cap bolt	a) Tighten 25 N-m (2.5 kg-m, 24.5 lb-ft) b) Tighten by turning through 60°		
Oil jet bolt	10	1.0	7.5
Flywheel or drive plate bolt	50	5.0	36.5
Engine side mounting bracket nut	55	5.5	40.0
Engine side mounting bracket bolt	40	4.0	29.0

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Frame side mounting bracket nut	55	5.5	40.0
Frame side mounting bracket bolt	93	9.3	67.5

SECTION 6B

ENGINE COOLING

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Precautions” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

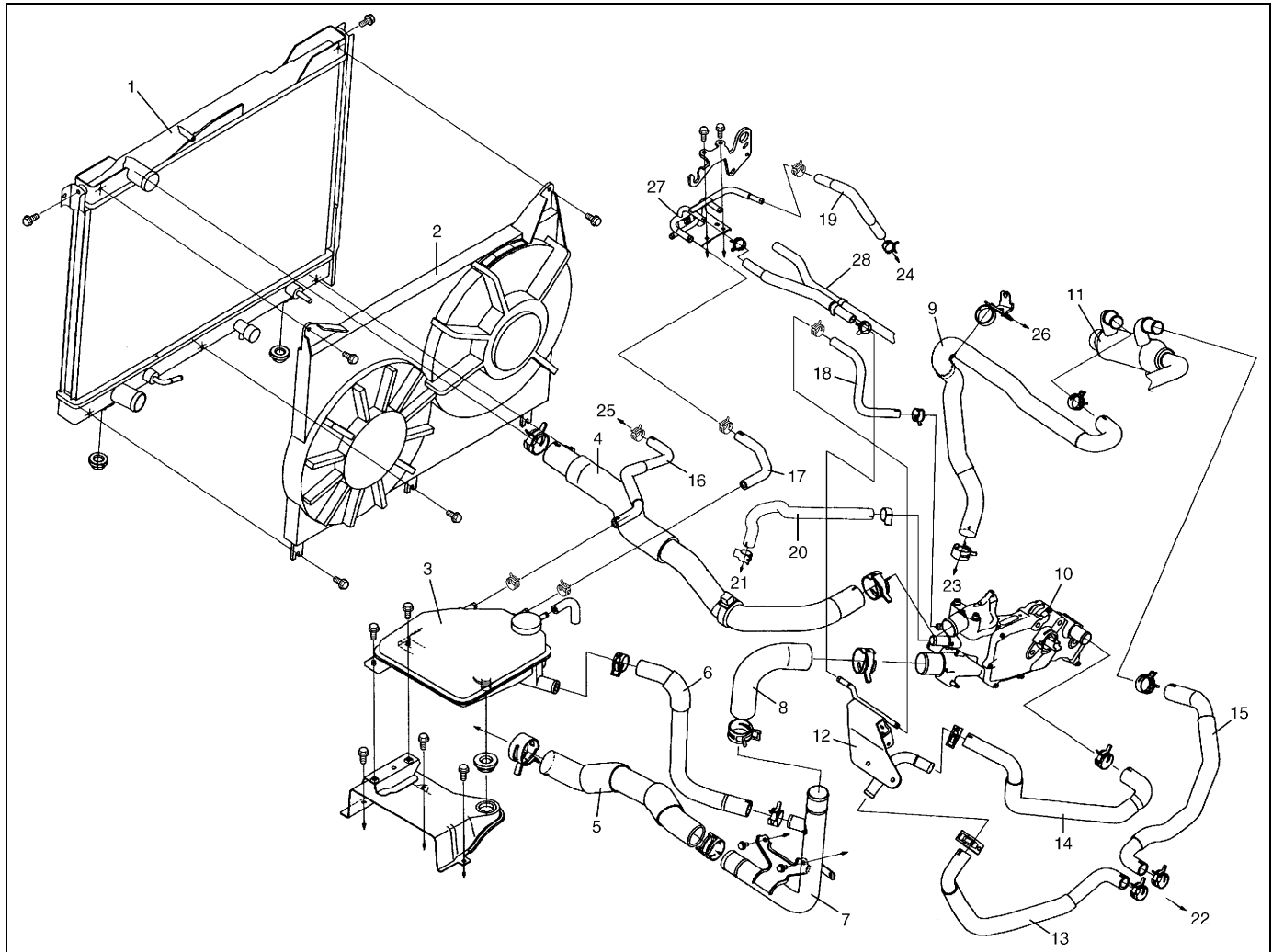
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General Description

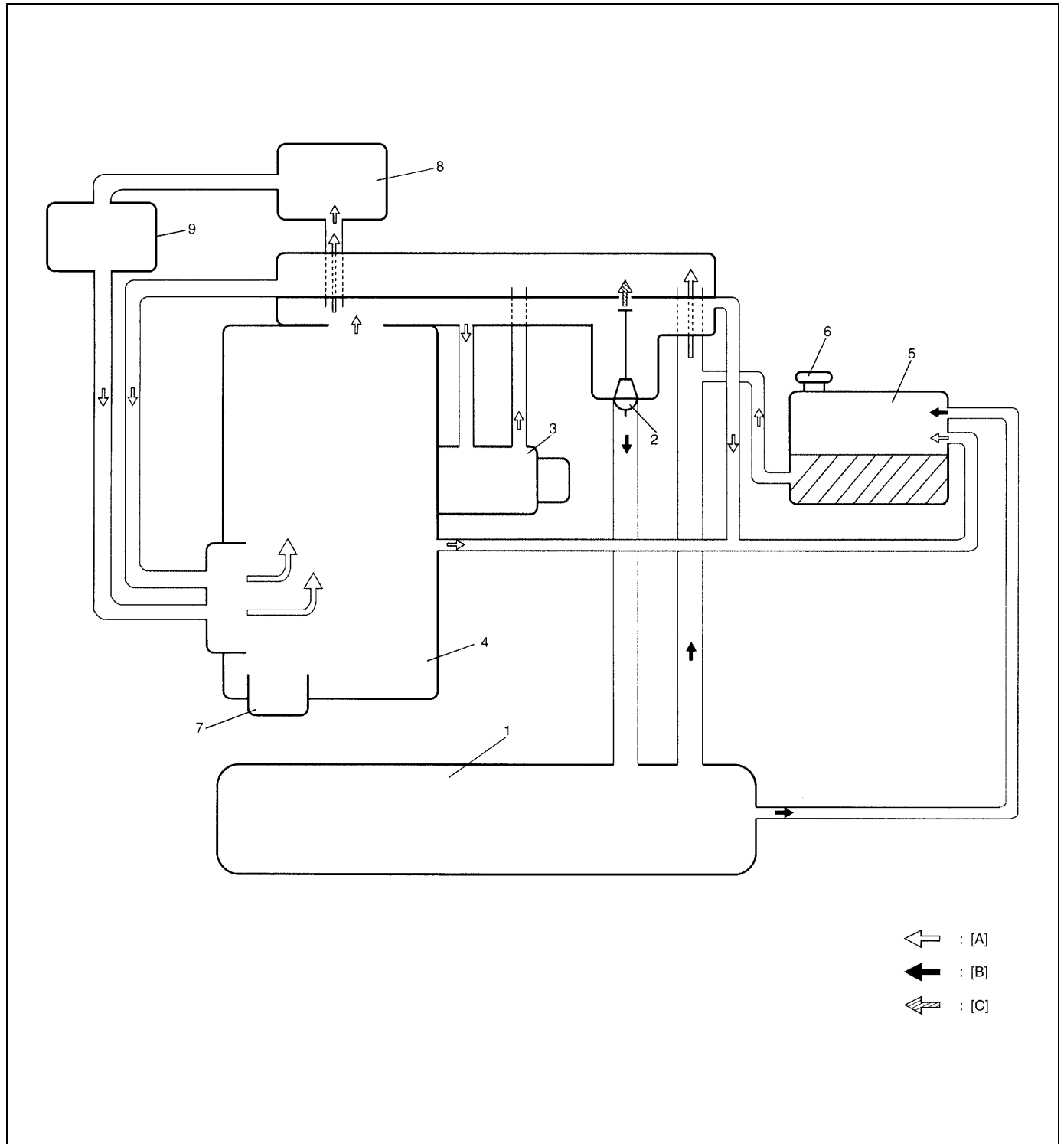
The cooling system consists of the degassing tank cap, radiator, degassing tank, hoses, water pump, cooling fan, thermostat. The radiator is of tube-and-fin type.

Cooling System Component



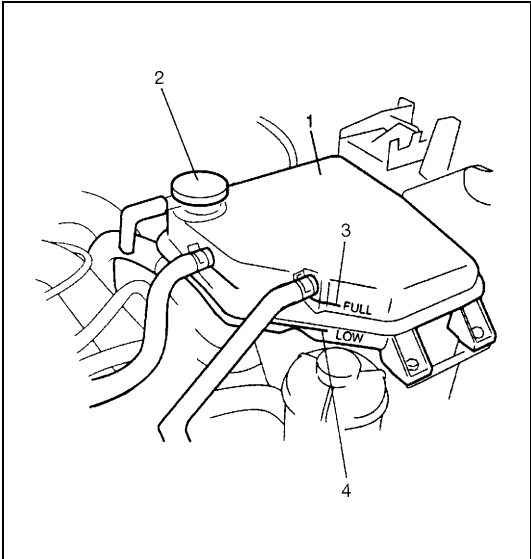
1. Radiator	8. Radiator outlet No.2 hose	15. Heater outlet hose	22. To heater unit
2. Engine cooling fan	9. Heater outlet No.2 hose	16. Vent. hose (radiator to degassing)	23. To water pump
3. Degassing tank	10. Water box	17. Vent. hose (pipe to degassing)	24. To cylinder head
4. Radiator inlet hose	11. EGR cooler	18. Vent. hose (waterbox to pipe) No.1	25. To radiator upper tank
5. Radiator outlet hose	12. Inter cooler bracket	19. Vent. hose (engine to pipe)	26. To timing belt cover
6. Degassing tank outlet hose	13. Heater inlet hose	20. Oil cooler hose	27. Water ventilation pipe
7. Water inlet pipe	14. Water inlet hose (engine to pipe)	21. To oil cooler	28. Vent. hose (waterbox to pipe) No.2

Cooling System Circulation



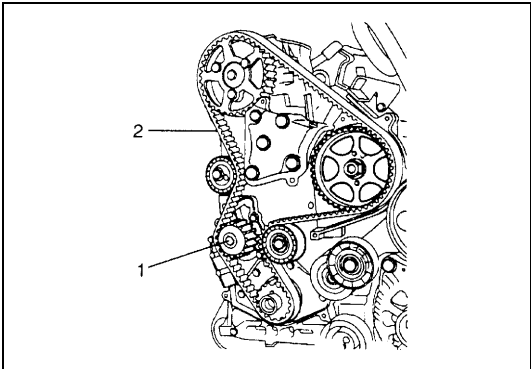
[A] : When thermostat is open and close	1. Radiator	4. Engine	7. Water pump
[B] : When thermostat is open	2. Thermostat	5. Degassing tank	8. Heater
[C] : When thermostat is close	3. Engine oil cooler	6. Degassing tank cap (Radiator cap)	9. EGR cooler

Coolant Degassing Tank



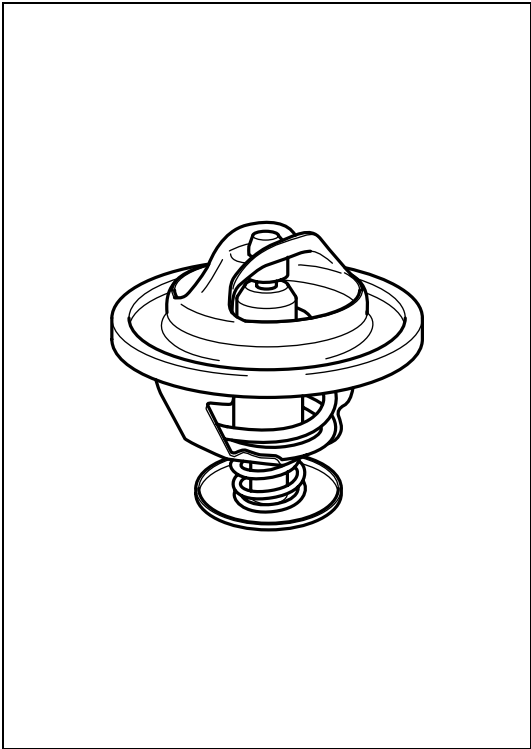
The degassing tank (1) consists of a “see-through” plastic tank, a hose and a degassing tank cap (2). During operation, the coolant circulates inside of the degassing tank constantly. As the coolant warms up and expands, the coolant level in the degassing tank rises. On the other hand, it lowers as the coolant cools down and contracts. When the pressure applied to the inside of the degassing tank constantly exceeds the specified value, the pressure is relieved through the degassing tank cap. Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency. Coolant level should be between “FULL” (3) and “LOW” (4) marks on the degassing tank.

Water Pump



The water pump (1) is driven by timing belt (2). The water pump can not be disassembled.

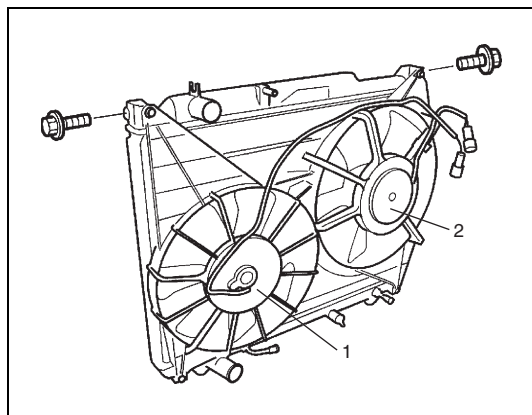
Thermostat



A wax pellet type thermostat is used in the coolant outlet passage to control the flow of engine coolant, to provide fast engine warm up and to regulate coolant temperatures. A wax pellet element is hermetically contained in a metal case, and expands when heated and contracts when cooled. When the pellet is heated and expands, the metal case pushed down the valve to open it. As the pellet is cooled, the contraction allows the spring to close the valve. Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator. At this point, coolant is allowed to circulate only throughout the engine to warm it quickly and evenly. As the engine warms, the pellet expands and the thermostat valve opens, permitting coolant to flow through the radiator.

Thermostat functional spec. ±1.5 °C (2.7 °F)	
Temp. at which valve begins to open	83 °C (181 °F)
Temp. at which valve becomes fully open	95 °C (203 °F)

Cooling Fan



The cooling fan is driven by electric motor, and the motor is activated by ECM (and ECT sensor).

WARNING:

Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the relays with the ignition switch in the “ON” position.

- | |
|-------------------------|
| 1. Radiator fan motor 1 |
| 2. Radiator fan motor 2 |

Coolant

When the system cools down, the coolant is drawn back into the radiator.

The cooling system has been filled at the factory with a quality coolant that is a 50/50 mixture of water and ethylene glycol antifreeze.

This 50/50 mixture coolant solution provides freezing protection to -36°C (-33°F).

- Maintain cooling system freeze protection at -36°C (-33°F) to ensure protection against corrosion and loss of coolant from boiling.

This should be done even if freezing temperatures are not expected.

- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperature lower than -36°C (-33°F).

Anti-freeze proportioning chart:

Freezing temperature	$^{\circ}\text{C}$	-36
	$^{\circ}\text{F}$	-33
Antifreeze/Anticorrosion coolant concentration	%	50
Ratio of compound to cooling water	ltr.	4.75/4.75
	US pt	10.04/10.04
	Imp. pt.	8.36/8.36

Coolant capacity

	Engine, radiator heater and degassing tank etc.
ltr. (US/Imp. pt.)	9.5 (20.1/16.72)

NOTE:

- Alcohol or methanol base coolant or plain water alone should not be used in cooling system at any time as damage to cooling system could occur.
- Coolant must be mixed with demineralized water or distilled water.

Diagnosis

Diagnosis Table

Condition	Possible Cause	Correction
Engine overheats	Not enough coolant	Check coolant level and add as necessary.
	Faulty thermostat	Replace.
	Faulty water pump	Replace.
	Dirty or bent radiator fins	Clean or remedy.
	Coolant leakage on cooling system	Repair.
	Defective cooling fan motor or its circuit	Check and replace as necessary.
	Plugged radiator	Check and replace radiator as necessary.
	Faulty degassing tank cap	Replace.
	Dragging brakes	Adjust brake.
	Slipping clutch	Adjust or replace.

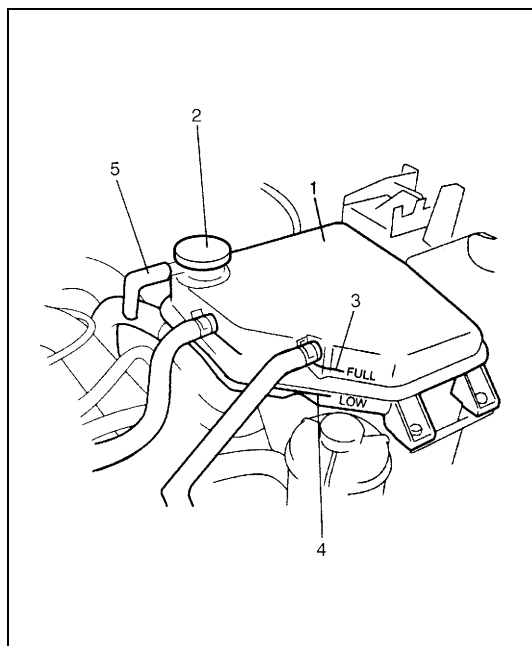
Maintenance

Coolant Level Check

WARNING:

To help avoid danger of being burned, do not remove degassing tank cap while engine and radiator are still hot.

Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.



To check level, lift hood and look at “see-through” degassing tank (1). It is not necessary to remove degassing tank cap (2) to check coolant level.

When engine is cool, check coolant level in degassing tank (1). A normal coolant level should be between “FULL” (3) and “LOW” (4) marks on degassing tank (1).

If coolant level is below “LOW” mark, remove degassing tank cap and add recommended coolant to tank to bring coolant level up to “FULL” mark. Then, install degassing cap, making sure that the ear of cap lines up with degassing tank pipe (5).

NOTE:

If recommended quality antifreeze is used, there is no need to add extra inhibitors or additives that claim to improve system. They may be harmful to proper operation of system, and are unnecessary expense.

Cooling System Service

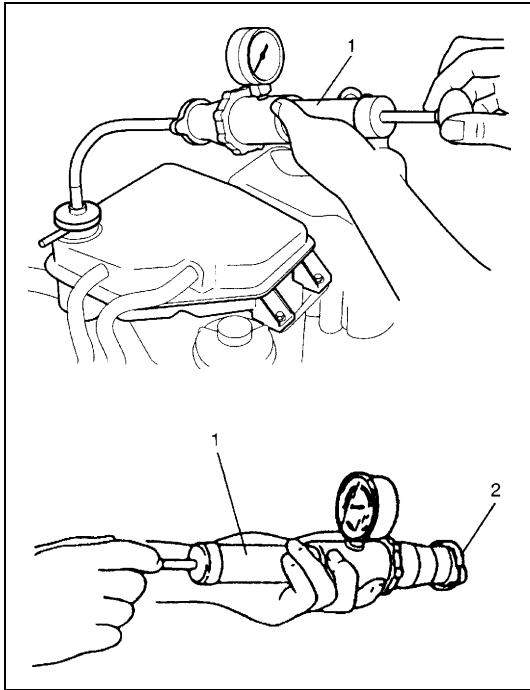
WARNING:

To help avoid danger of being burned, do not remove degassing tank cap while engine and radiator are still hot.

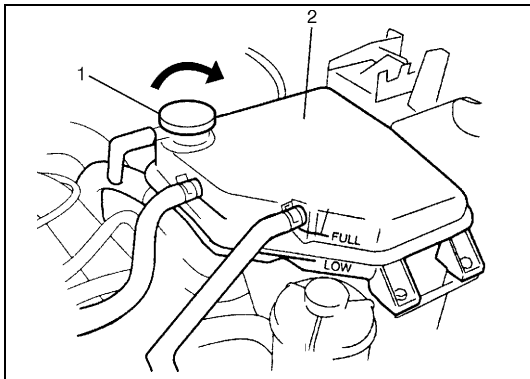
Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

Cooling system should be serviced as follows.

- 1) Check cooling system for leakage or damage.
- 2) Wash degassing tank cap and filler neck with clean water by removing degassing tank cap when engine is cold.
- 3) Check coolant for proper level and freeze protection.



- 4) Using a pressure tester (1), check system and degassing tank cap (2) for proper pressure holding capacity 110 kpa (1.1 kg/cm², 15.6 psi). If replacement of cap is required, use proper cap specified for this vehicle.



- 5) Install degassing tank cap (1) to degassing tank turning it clockwise up to stop.

- 6) Tighten hose clamps and inspect all hoses. Replace hoses whenever cracked, swollen or otherwise deteriorated.
- 7) Clean frontal area of radiator core.

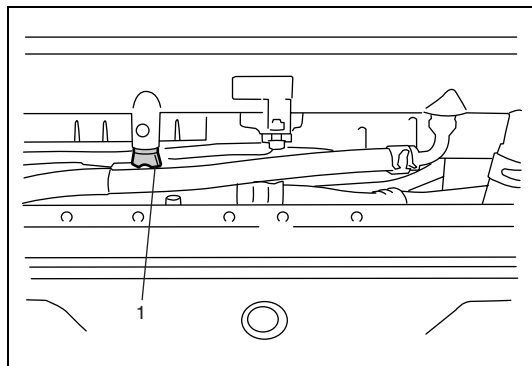
Cooling System Flush

WARNING:

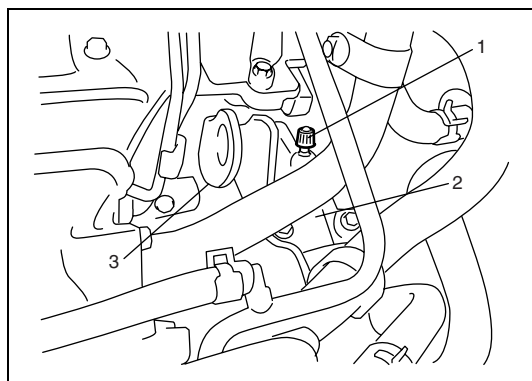
To help avoid danger of being burned, do not remove degassing tank cap while engine and radiator are still hot.

Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

- 1) Remove degassing tank cap turning it counter clockwise when engine is cool.
- 2) With degassing tank cap removed, run engine until upper radiator hose is hot (this shows that thermostat is open and coolant is flowing through system).
- 3) Stop engine, and remove engine under cover.

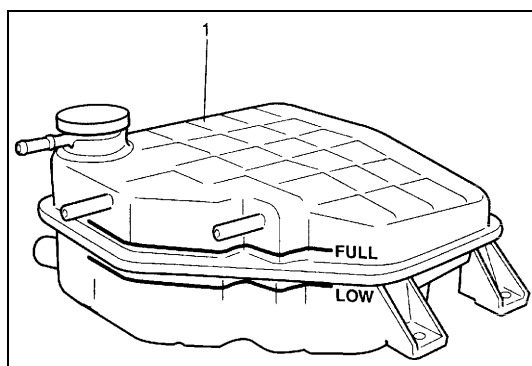


- 4) Stop engine and open radiator drain plug (1) to drain coolant.
- 5) Close drain plug.



- 6) Fill the circuit slowly with water.
- 7) Remove intercooler referring to "Intercooler" in Section 6E3.
- 8) Loosen bleed screw (1) to bleed air and tighten it after confirmation of overflow.

- | |
|---------------------|
| 2. Thermostat cap |
| 3. Engine rear hook |



- 9) Install intercooler referring to "Intercooler" in Section 6E3.
- 10) Run engine until upper radiator hose is hot again.
- 11) Stop engine, and repeat steps 4) and 10) several times until drained liquid is nearly colorless.
- 12) Drain cooling system and then close radiator drain plug tightly.
- 13) Disconnect hoses from degassing tank (1). Remove degassing tank and pour out any fluid. Scrub and clean inside of degassing tank (1) with soap and water. Flush it well with clean water and drain.
Reinstall degassing tank and hose.
- 14) Refill cooling system referring to "Cooling System Refill" in this section.

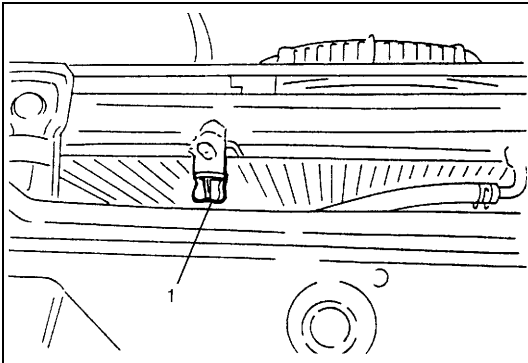
On-Vehicle Service

WARNING:

- Check to make sure that engine coolant temperature is cold before removing any part of cooling system.
- Also be sure to disconnect negative cord from battery terminal before removing any part.

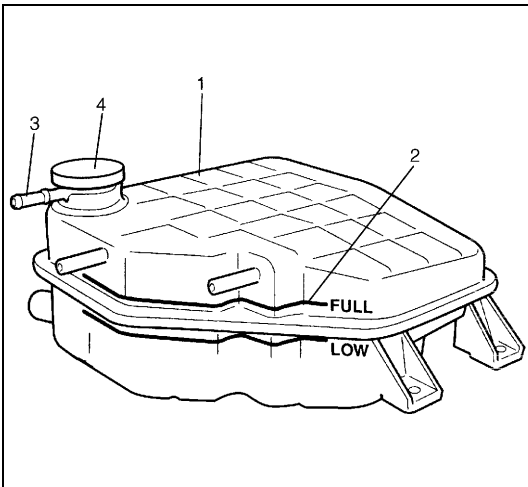
Cooling System Draining

- 1) Remove degassing tank cap.
- 2) Loosen drain plug (1) on radiator to drain coolant.
- 3) After draining coolant, be sure to tighten drain plug securely.



Cooling System Refill

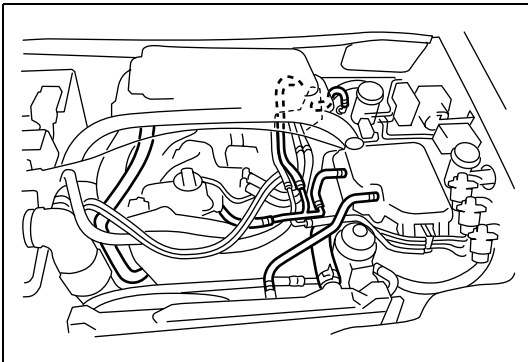
- 1) Add 50/50 mixture of good quality ethylene glycol antifreeze and water to degassing tank (1).
Fill to "FULL" level mark (2).
- 2) Remove intercooler referring to "Intercooler" in Section 6E3.
- 3) Loosen bleed screw to bleed air and tighten it after confirmation of overflow.
- 4) Install intercooler referring to "Intercooler" in Section 6E3.
- 5) Run engine, with degassing tank cap (4) removed, until radiator upper hose is hot.
- 6) With engine idling, add coolant to degassing tank (1) until level reaches "FULL" mark.
Install degassing tank cap (4) turning it clockwise up to stop.



Cooling Water Pipes or Hoses

REMOVAL

- 1) Drain cooling system referring to "Cooling System Draining" in this section.
- 2) To remove these pipes or hoses, loosen clamp on each hose and pull hose end off.



INSTALLATION

Install removed parts in reverse order of removal procedure noting the following.

- Tighten each clamp securely.
- Refill cooling system with proper coolant referring to “Cooling System Refill” in this section.

Thermostat

REMOVAL

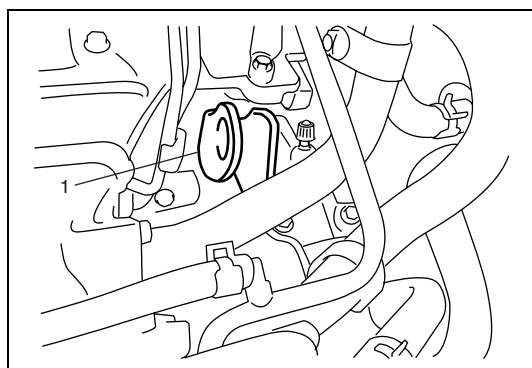
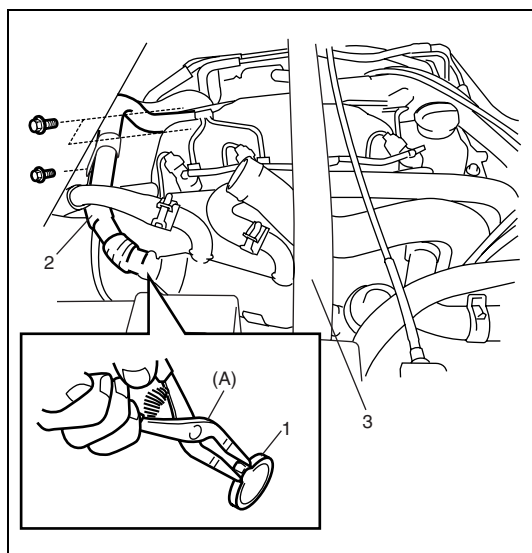
- 1) Remove battery from vehicle.
- 2) Drain cooling system referring to “Cooling System Draining” in this section.
- 3) Remove intercooler referring to “Intercooler” in Section 6E3.
- 4) Remove EGR pipe clamp (1) by using special tool.

Special tool

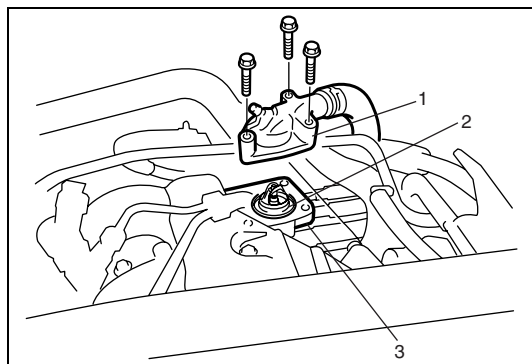
(A): 09919-46510/OUT0000110

- 5) Remove EGR pipe (2).

3. Strut tower bar



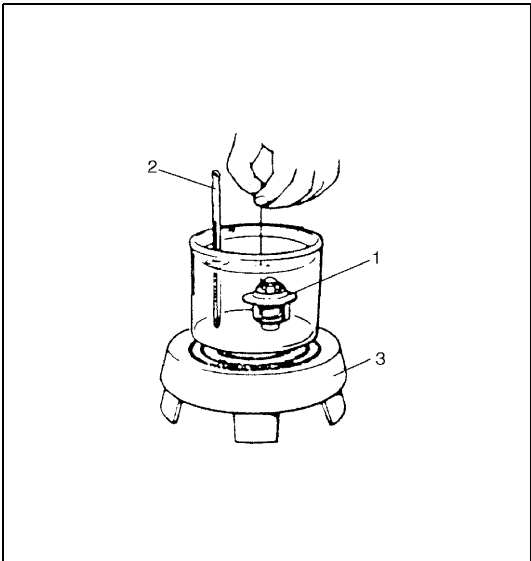
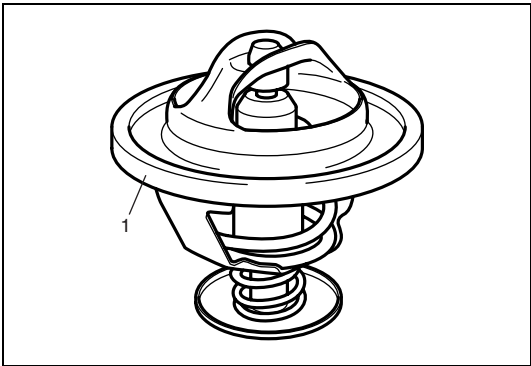
- 6) Remove Engine hunger bracket (1).



- 7) Remove thermostat cap (1) from water box (3).
- 8) Remove thermostat (2) from water box (3).

INSPECTION

- Check to make sure that valve seat is free from foreign matters which would prevent valve from seating tight.
- Check thermostat seal (1) for breakage, deterioration or any other damage.



- Check thermostatic movement of wax pellet as follows:
 - 1) Immerse thermostat (1) in water, and heat water gradually.
 - 2) Check that valve starts to open at specific temperature.
 - 3) If valve starts to open at a temperature substantially below or above specific temperature, thermostat unit should be replaced with a new one. Such a unit, if reused, will bring about overcooling or overheating tendency.

Temp. at which valve begins to open	83 °C (181 °F)
Temp. at which valve becomes fully open	95 °C (203 °F)

2. Thermometer
3. Heater

INSTALLATION

For installation, reverse removal procedure noting the following.

- Tighten EGR pipe bolts to specified torque.

Tightening torque

EGR pipe bolts

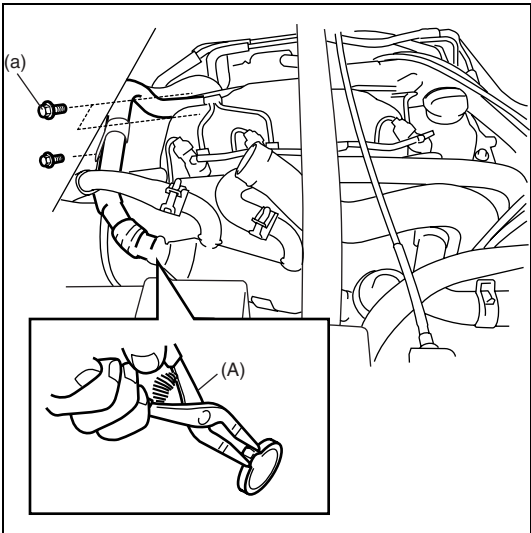
(a): 10 N·m (1.0 Kg-m, 7.0 lb-ft)

- Install new EGR pipe clamp using special tool.

Special tool

(A): 09919-46510/OUT0000110

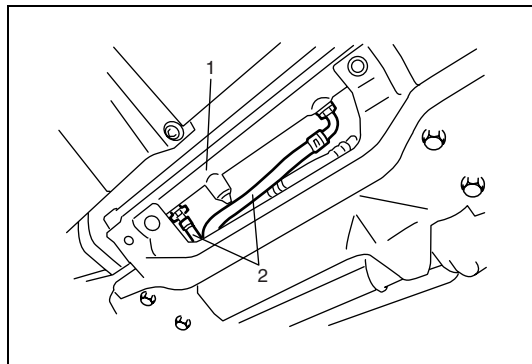
- Refill cooling system referring to “Cooling System Refill” in this section.



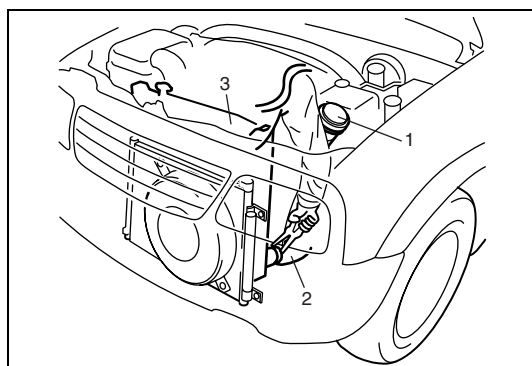
Radiator

REMOVAL

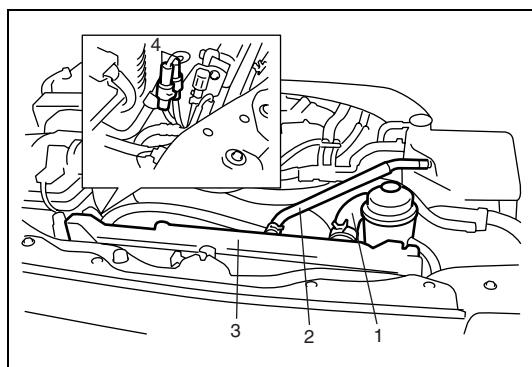
- 1) Disconnect negative (–) cable at battery.
- 2) Drain cooling system referring to “Cooling System” in this section.
- 3) Remove engine under cover.
- 4) When servicing A/T vehicle, place oil pan under radiator (1), and drain A/T fluid disconnecting A/T fluid hoses (2) from radiator.



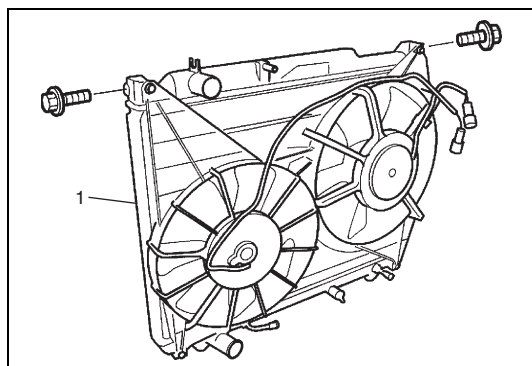
- 5) Detach P/S fluid reservoir (1) and disconnect radiator outlet hose (2) from radiator (3) as shown in figure.



- 6) Disconnect radiator inlet hose (1) and degassing tank hose (2) from radiator (3).
- 7) Remove P/S fluid reservoir bracket.
- 8) Remove P/S high pressure hose clamp.
- 9) Disconnect radiator fan motor couplers (4).



- 10) Remove radiator (1) with radiator fan motor assembly from vehicle.
- 11) Remove radiator fan motor assembly from radiator (1).



INSPECTION

Check radiator for leakage or damage. Straighten bent fins, if any.

CLEANING

Clean frontal area of radiator cores.

INSTALLATION

Reverse removal procedures, noting the following.

- Refill cooling system with proper coolant referring to “Cooling System Refill” in this section.
- After installation, check each joint for leakage.
- With A/T vehicle, check A/T fluid level referring to “Fluid Change” Section 7B1.

Radiator Fan Relay

INSPECTION

Refer to “Radiator Fan Control System” in Section 6E3.

Water Pump

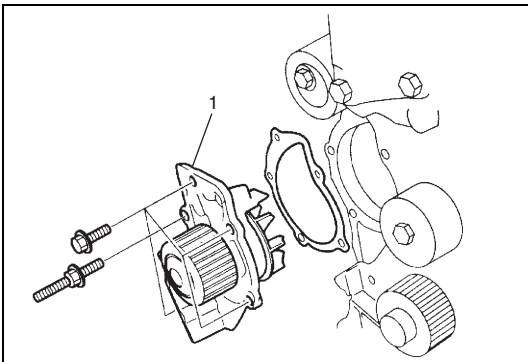
CAUTION:

Do not disassemble water pump.

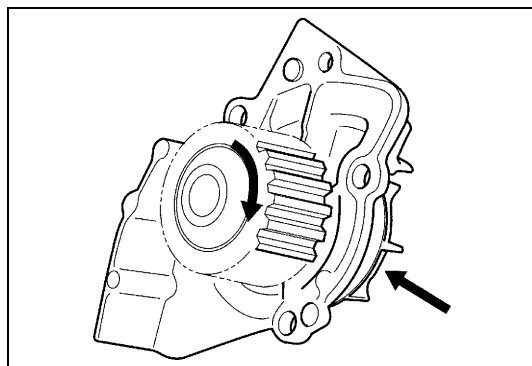
If any repair is required on pump, replace it as assembly.

REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Drain cooling system referring to “Coolant System Draining” in this section.
- 3) Remove timing belt referring to “Timing Belt and Belt Tensioner” in Section 6A3.
- 4) Remove water pump assembly (1).

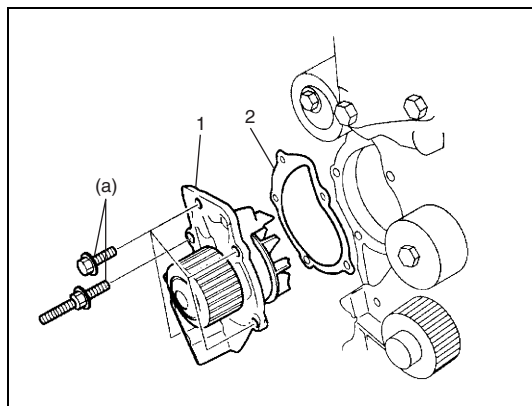


INSPECTION



- Rotate water pump by hand to check for smooth operation. If pump does not rotate smoothly or makes abnormal noise, replace it.
- Inspect water pump impeller for damage. Replace as necessary.

INSTALLATION



- 1) Install new pump gasket (2) to water pump (1).
- 2) Install water pump to cylinder block.

Tightening torque

Water pump bolt (a): 15 N·m (1.5 kg-m, 11.0 lb-ft)

- 3) Install timing belt and timing belt covers referring to "Timing Belt and Belt Tensioner" in Section 6A3.
- 4) Connect negative (–) cable at battery.
- 5) Fill coolant referring to "Coolant System Refill" in this section.
- 6) After installation, check each part for leakage.

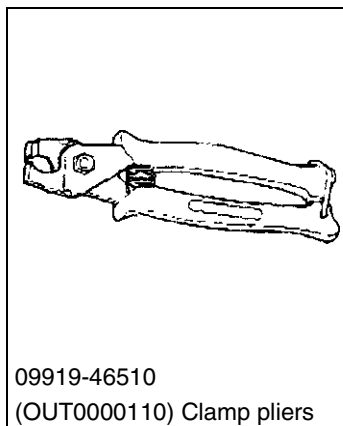
Required Service Materials

Material	Recommended SUZUKI product (Part Number)	Use
Ethylene glycol base coolant (Anti-freeze/Anti-corrosion coolant)	—	Engine cooling system for improving cooling efficiency and for protection against rusting.

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
EGR pipe bolt	10	1.0	7.0
Water pump bolt	15	1.5	11.0

Special Tool



SECTION 6C

ENGINE FUEL

CAUTION:
Be sure to read “Precaution” in Section 6E before disconnecting fuel line or removing fuel system part(s).
Failure to follow “Precaution” could result unneeded fuel system repairs.

CONTENTS

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On-Vehicle Service.....	6C-2	Fuel tank	6C-7
Water Draining of Fuel Filter	6C-2	Fuel Pump and Fuel Level Gauge	6C-8
Air Bleeding of Fuel System	6C-2	Fuel pump	6C-9
Fuel Filter Assembly	6C-2	Fuel level gauge	6C-10
Fuel filter assembly components.....	6C-2	Injection Pump	6C-10
Fuel filter element.....	6C-3	Tightening Torque Specifications	6C-11
Fuel filter assembly	6C-4	Special Tools.....	6C-11
Fuel Tank Assembly	6C-6		

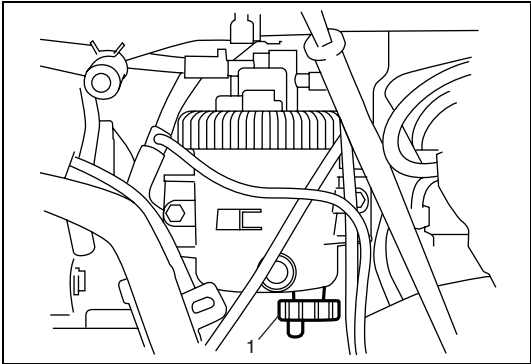
General Description

Fuel System

The main components of the fuel system are fuel tank, fuel pump, high pressure fuel pump, fuel filter and fuel level gauge and it includes fuel feed line, fuel return line and vapor line.

On-Vehicle Service

Water Draining of Fuel Filter



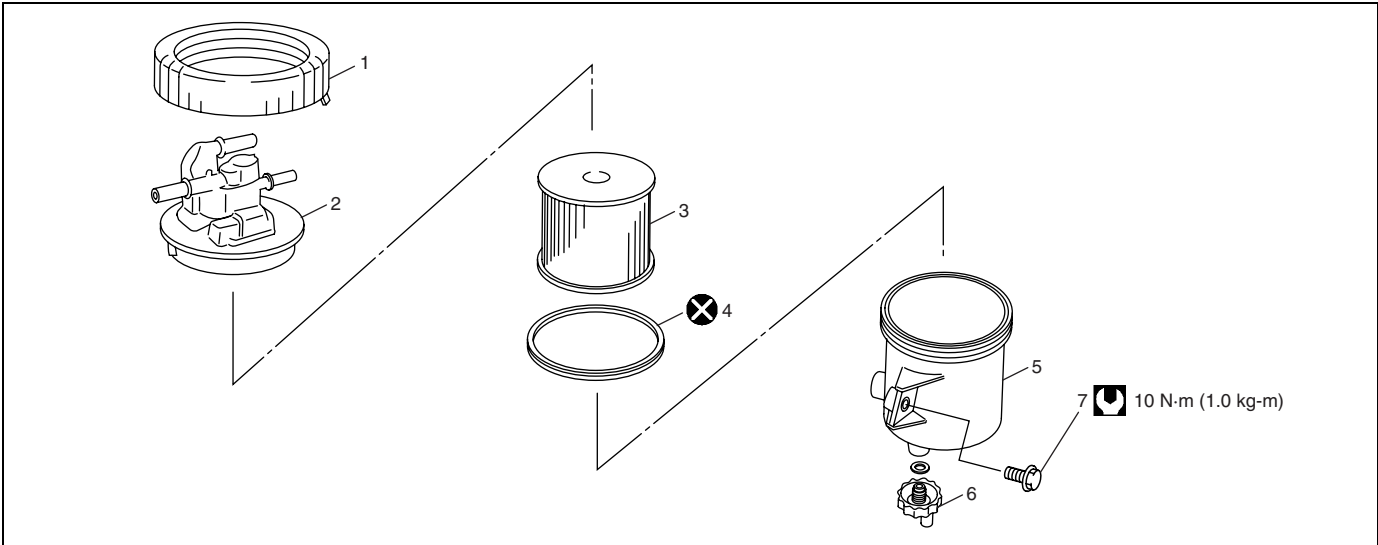
- 1) Disconnect negative cable at battery.
- 2) Remove strut tower bar.
- 3) Place container under bleed screw (1), and drain fuel loosening it.
- 4) Tighten bleed screw.
- 5) Install strut tower bar referring to “Strut Damper” in Section 3D.
- 6) Connect negative cable at battery.

Air Bleeding of Fuel System

Air bleeding must be carried out when fuel system has been disassembled or when vehicle ran out of fuel.
Turn ignition switch ON to operate fuel pump and after about 5 seconds turn it OFF. Repeat this 6 times and then check engine starts.

Fuel Filter Assembly

Fuel filter assembly components

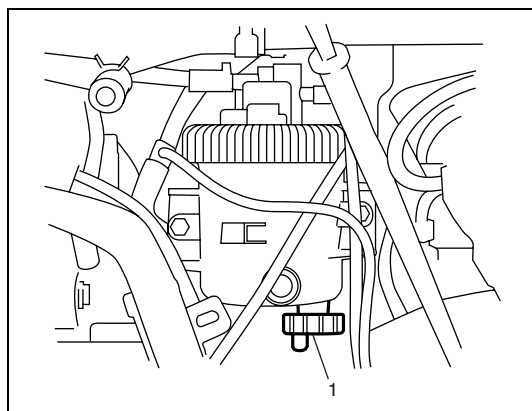


1. Fuel filter fastener	4. Gasket	7. Fuel filter assembly mounting bolt
2. Fuel filter cap incorporate with fuel heater	5. Fuel filter case	 Do not reuse
3. Fuel filter element	6. Bleed screw	 Tightening torque

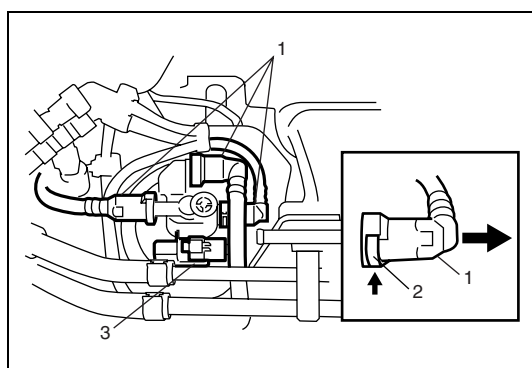
Fuel filter element

REMOVAL

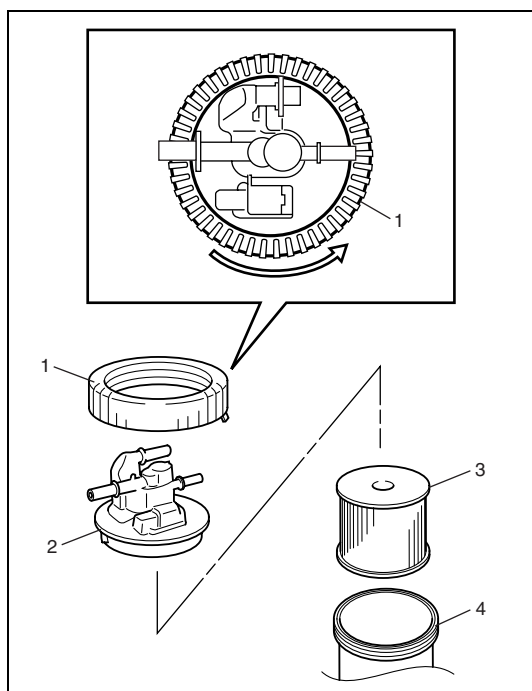
- 1) Disconnect negative cable at battery.
- 2) Place container under bleed screw (1), and drain fuel loosening bleed screw.



- 3) Pull out fuel pipes (1) with pushing lock button (2).
- 4) Disconnect coupler (3) from fuel filter cap.



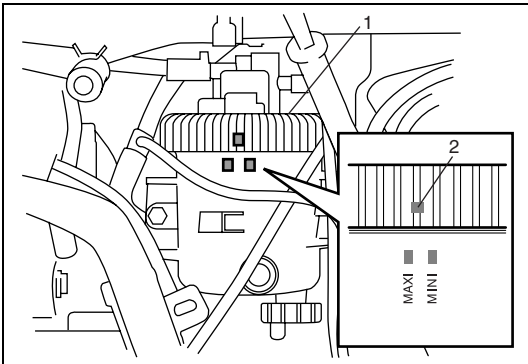
- 5) Turning fuel filter fastener (1) counterclockwise, remove fuel filter fastener (1) from fuel filter case (4).
- 6) Remove fuel filter cap (2) and fuel filter element (3).



INSTALLATION

Reverse removal procedure for installation noting the following.

- Be sure to replace fuel filter element as new one.
- Clean fuel filter case as follows.
 - a) Place container under breed screw, and drain fuel loosing breed screw.
 - b) Tighten breed screw.
 - c) Remove fuel filter case.
 - d) Pour diesel substitute (kerdane, diltine or paraffin) into fuel filter case.
 - e) Clean fuel filter case with brush.
 - f) Dry and wipe out fuel filter case.
- Tighten fuel filter fastener (1) until its match mark (2) becomes between “MAXI” and “MINI”.
- Bleed air in system referring to “Air Bleeding Procedure” in this section.
- Start engine and check that there are no fuel leakage.



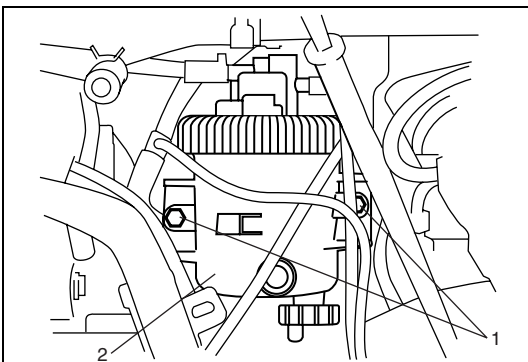
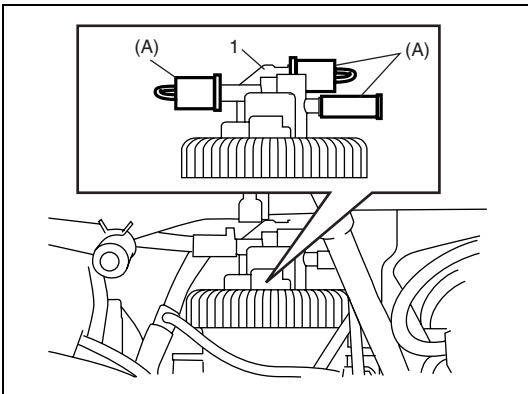
Fuel filter assembly

REMOVAL

- 1) Disconnect fuel pipes and install special tools to fuel filter cap referring to Step 1) through 4) of “Removal” under “Fuel Filter Element” in this section.
- 2) Install special tools to fuel filter cap (1) in order to prevent its internal parts from dust.
For detail, refer to “Precaution” in Section 6E.

Special tool

(A) : 09916-50010



- 3) Remove fuel filter assembly mounting bolts (1).
- 4) Remove fuel filter assembly (2).

INSTALLATION

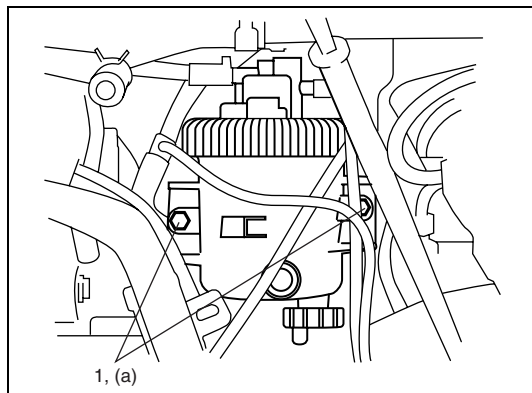
Reverse removal procedure for installation noting the following.

- Tighten fuel filter assembly mounting bolts (1) to specified torque.

Tightening torque

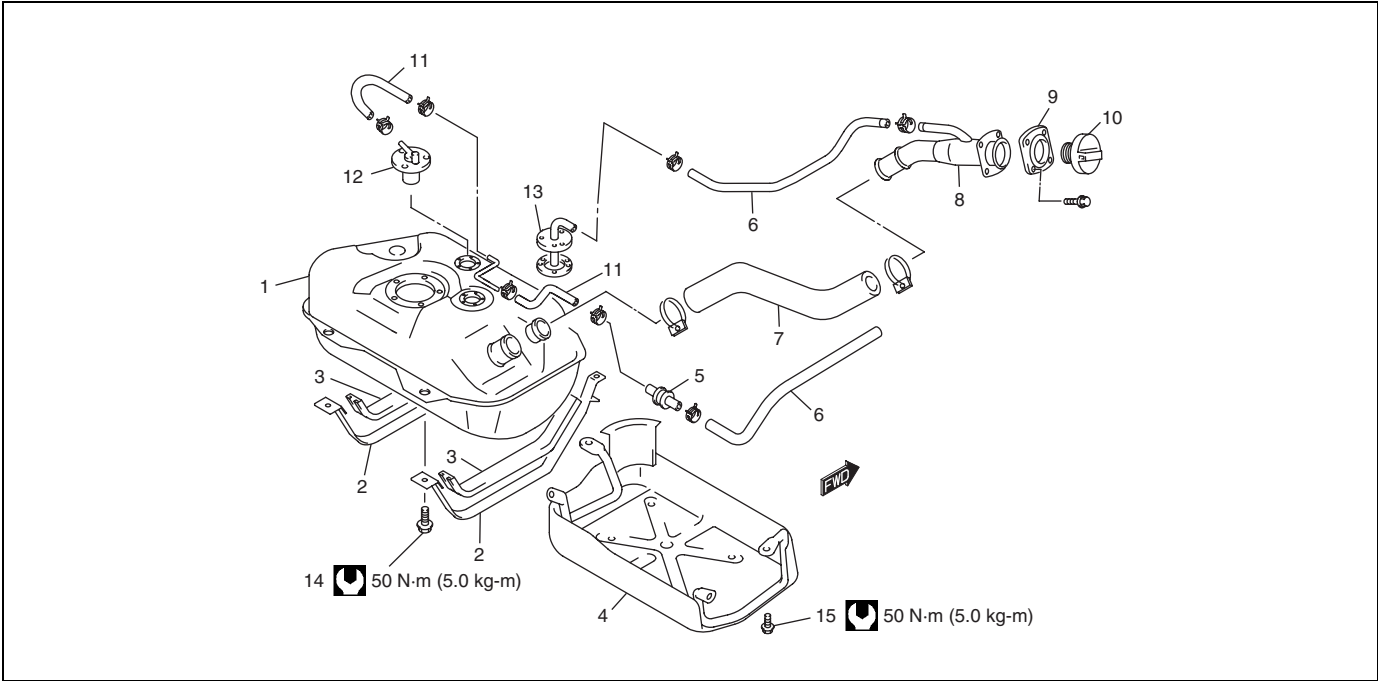
Fuel filter mounting bolt (a) : 10 N·m (1.0 kg-m, 7.0 lb-ft)

- Bleed air in system referring to “Air Bleeding Procedure” in this section.
- Start engine and check that there are no fuel leakage.



Fuel Tank Assembly

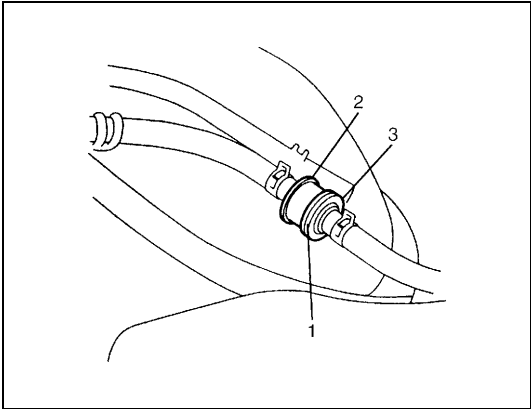
Fuel tank assembly components



1. Fuel tank	5. 2 way check valve	9. Fuel filler packing	13. Fuel tank breather pipe
2. Fuel tank fixer belt	6. Breather hose	10. Fuel filler cap	14. Fuel tank bolt
3. Fixer belt pad	7. Fuel tank filler hose	11. Hose	15. Fuel tank protector bolt
4. Fuel tank protector	8. Fuel filler neck	12. Fuel cut valve	Tightening torque

2-way check valve (tank pressure control valve)

INSPECTION



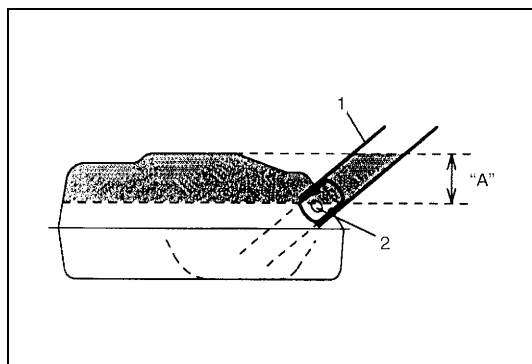
WARNING:
Do not suck air through 2-way check valve.
Fuel vapor inside the valve is harmful.

- 1) Air should pass through 2-way check valve (1) smoothly from fuel tank side (Black side (2) of 2-way check valve) to Orange side (3) when blown hard.
- 2) From Orange side, even when blown softly, air should come out of Black side.
- 3) If air doesn't pass through valve in step 1) or hard blow is required in step 2), replace 2-way check valve.

Fuel tank

REMOVAL

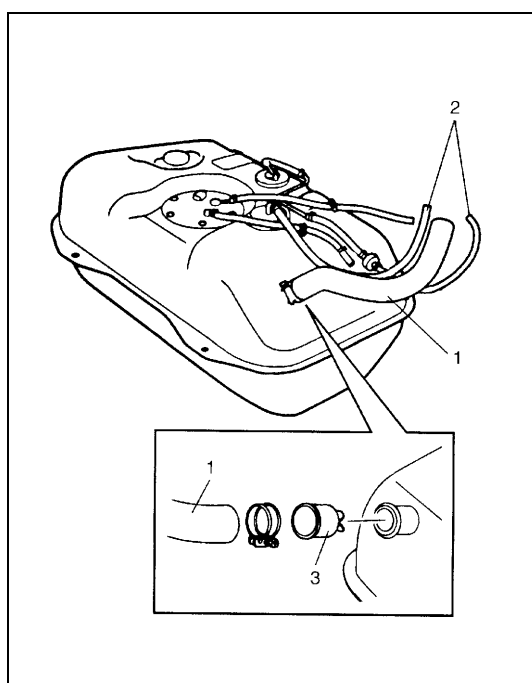
- 1) Disconnect negative cable at battery.
- 2) Remove fuel filler cap.
- 3) Insert hose of a hand operated pump into fuel filler hose (1) and drain fuel in space "A" in the figure (drain fuel through it till fuel stops).



CAUTION:

Do not force hose of a hand operated pump into fuel tank, or inlet valve may be damage.

2. Fuel tank inlet (check) valve



- 4) Disconnect filler hose (1) from fuel tank and breather hoses (2) from fuel filler neck.
- 5) Remove fuel tank inlet valve (3).

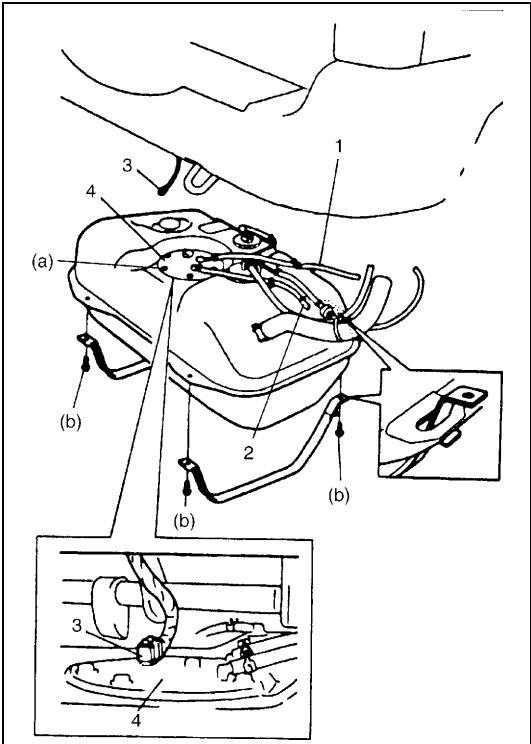
NOTE:

Use care not to damage inlet valve when removing.

- 6) Drain fuel tank by pumping fuel out through fuel tank filler. Use hand operated pump device to drain fuel tank.

CAUTION:

Never drain or store fuel in an open container due to possibility of fire or explosion.



- 7) Disconnect fuel pump inlet hose (1) from fuel pump and fuel return hose (2) from pipes.
- 8) Remove fuel tank protector (if equipped) from vehicle.
- 9) Lower fuel tank gradually while holding it with jack horizontally and pull out coupler (3) at fuel level gauge (4).

INSTALLATION

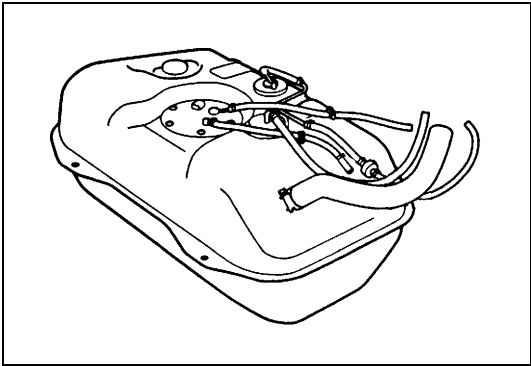
Reverse removal procedure for installation noting the following.

- Tighten each bolt to specified torque.

Tightening torque

Fuel level gauge bolt (a): 5.0 N-m (0.5 kg-m, 3.5 lb-ft)

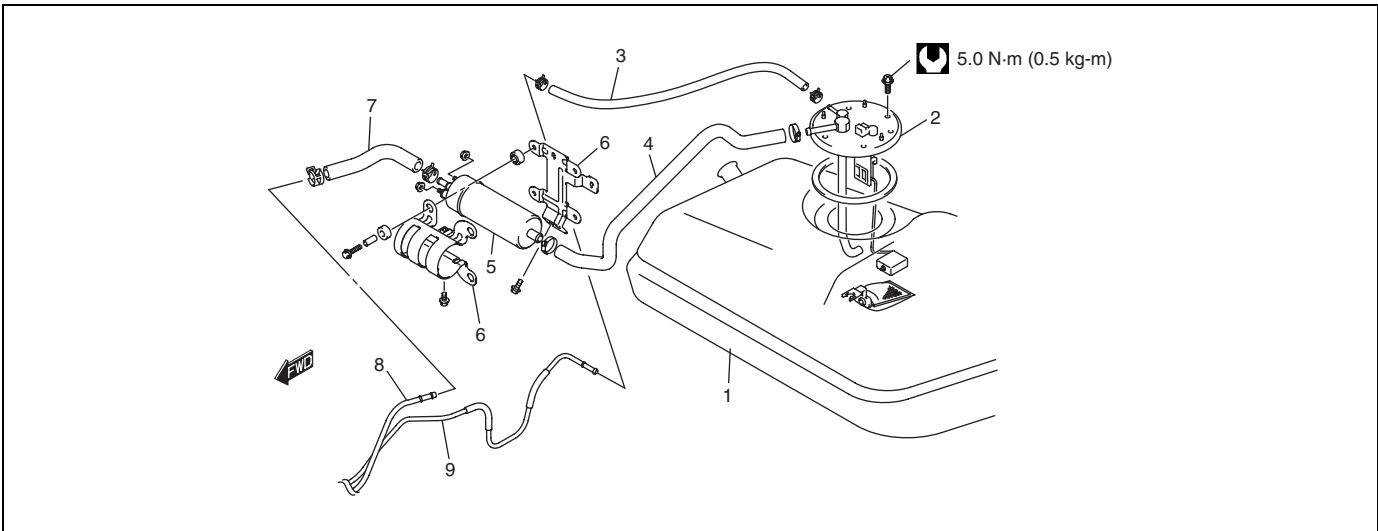
Fuel tank bolt (b): 50 N-m (5.0 kg-m, 36.0 lb-ft)



INSPECTION

After removing fuel tank, check hoses and pipes connected to fuel tank for leaks, loose connections, deterioration or damage. Also check fuel level gauge gaskets for leaks, visually inspect fuel tank for leaks and damage. Replace any damaged or malfunctioned parts.

Fuel Pump and Fuel Level Gauge

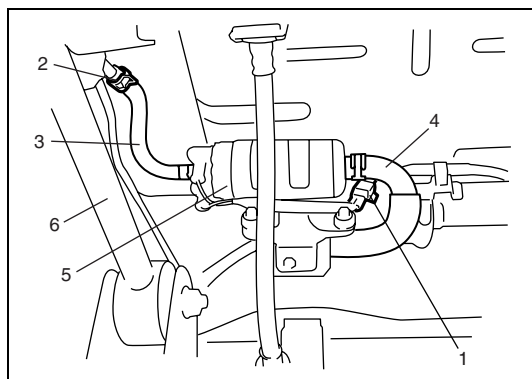


1. Fuel tank	3. Fuel return hose	5. Fuel pump	7. Fuel pump outlet hose	9. Fuel return pipe
2. Fuel level gauge	4. Fuel pump inlet hose	6. Fuel pump bracket	8. Fuel feed pipe	 Tightening torque

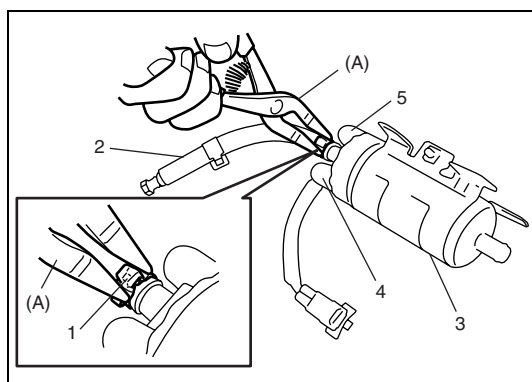
Fuel pump

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Hoist vehicle.
- 3) Disconnect fuel pump wire harness (1).
- 4) Pull outlet hose clamp (2) and disconnect outlet hose (3).
- 5) Disconnect inlet hose (4) from fuel pump (5).
- 6) Remove fuel pump (5).



6. Left side suspension lower arm



- 7) Remove inlet hose clamp (1) using special tool.

Special tool

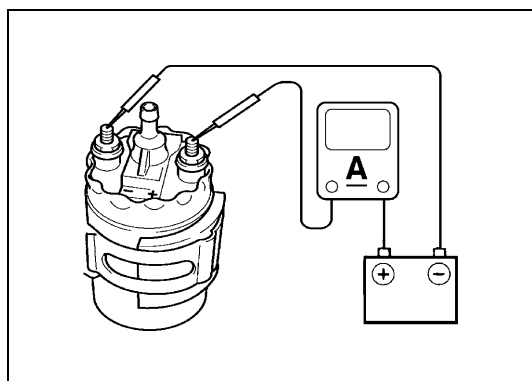
(A) : 09919-46510/OUT 0000110

- 8) Disconnect inlet hose (2) from fuel pump (3).
- 9) Disconnect "BLU/BLK" wire terminal (4) and "BLK" wire terminal.

INSPECTION

Connect battery and ammeter to starter as shown. Check that fuel pump operation and ammeter indicates specified current.

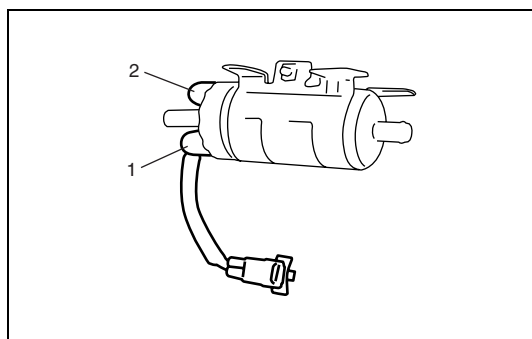
Fuel pump specified current: 8 A MAX. at 12 V

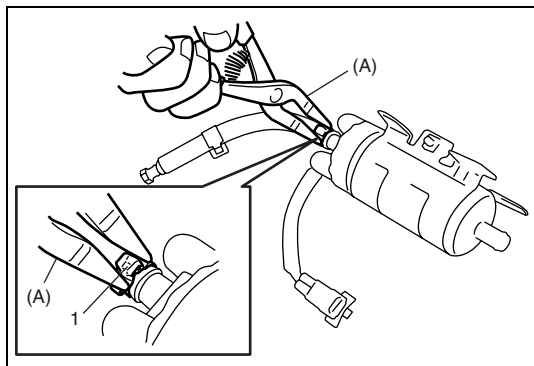


INSTALLATION

Reverse removal procedure for installation noting the following.

- Connect "BLU/BLK" wire terminal (4) and "BLK" wire terminal (2) to fuel pump using nuts securely as shown in figure.

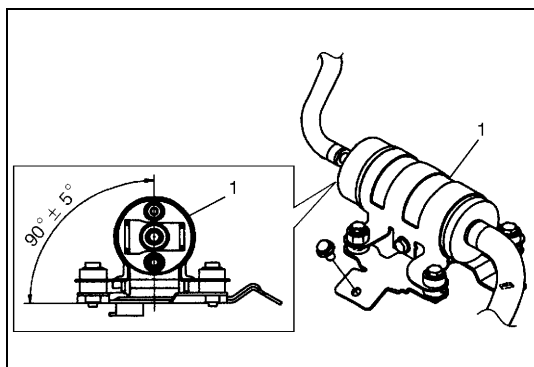




- Install new inlet hose clamp (1) using special tool.

Special tool

(A) : 09919-46510/OUT 0000110



- Be sure to install fuel pump (1) to proper direction as shown.
- Bleed air in system referring to “Air Bleeding Procedure” in this section.
- Start engine and check that there are no fuel leakage.

Fuel level gauge

REMOVAL

- 1) Remove fuel tank referring to “Fuel tank” in this section.
- 2) Remove fuel level gauge (1) from fuel tank.

INSPECTION

Check fuel level gauge (1) for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

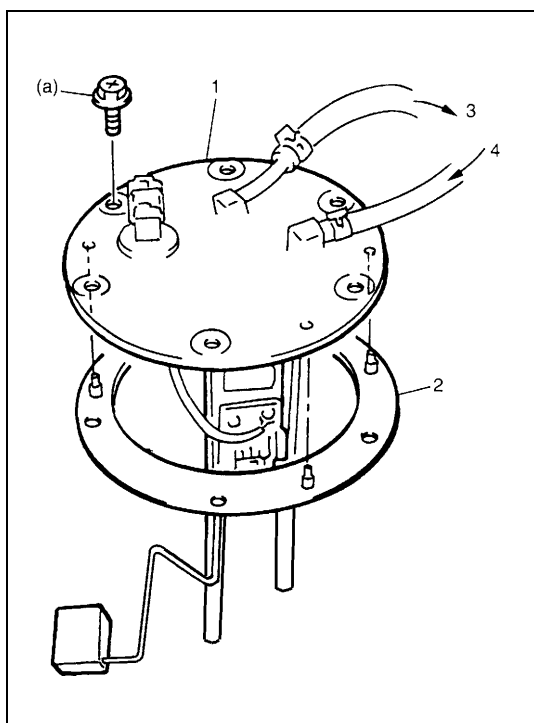
INSTALLATION

Reverse removal procedure for installation noting the following.

- Use new gasket (2).
- Tighten fuel level gauge bolts to specified torque.

Tightening torque

Fuel level gauge bolt (a): 5.0 N·m (0.5 kg-m, 3.5 lb-ft)



3. To supply pump

4. From return pipe

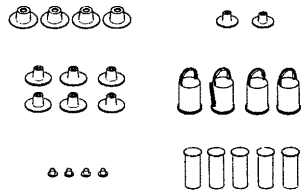
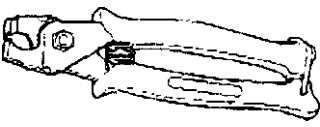
Injection Pump

For removal and installation, refer to “Injection Pump” in Section 6E3.

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Fuel filter mounting bolt	10	1.0	7.0
Fuel tank bolt	50	5.0	36.0
Fuel tank protector bolt	50	5.0	36.0
Fuel level gauge bolt	5	0.5	3.5

Special Tools

	
09916-50010 Fuel system, plug set	09919-46510 (OUT0000110) Clamp pliers

SECTION 6E3

ENGINE AND EMISSION CONTROL SYSTEM (RHW ENGINE)

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

Service information for two types of emission control system, “Other Than EOBD Spec”, and “EOBD Spec”, is provided in this section. To distinguish between “Other Than EOBD Spec” and “EOBD Spec”, refer to “Identification of Emission Control System” in this section.

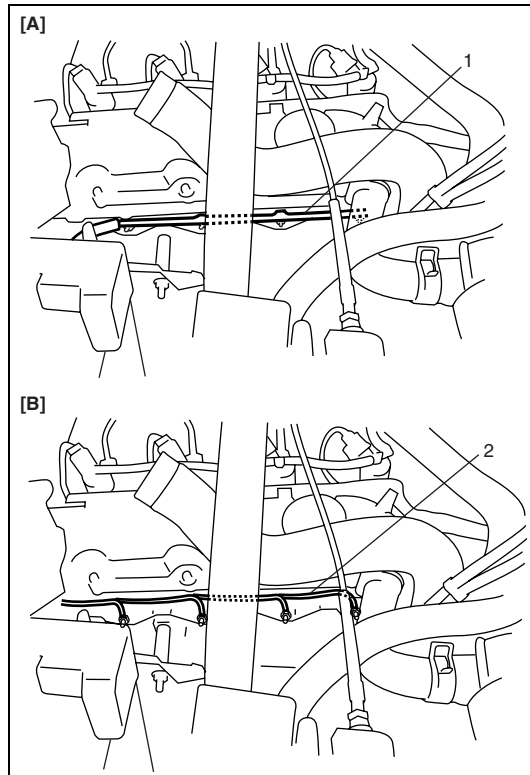
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Pre/post heating relay (control unit)	6E3-50	Special Tools	6E3-57

General Description

Identification of Emission Control System



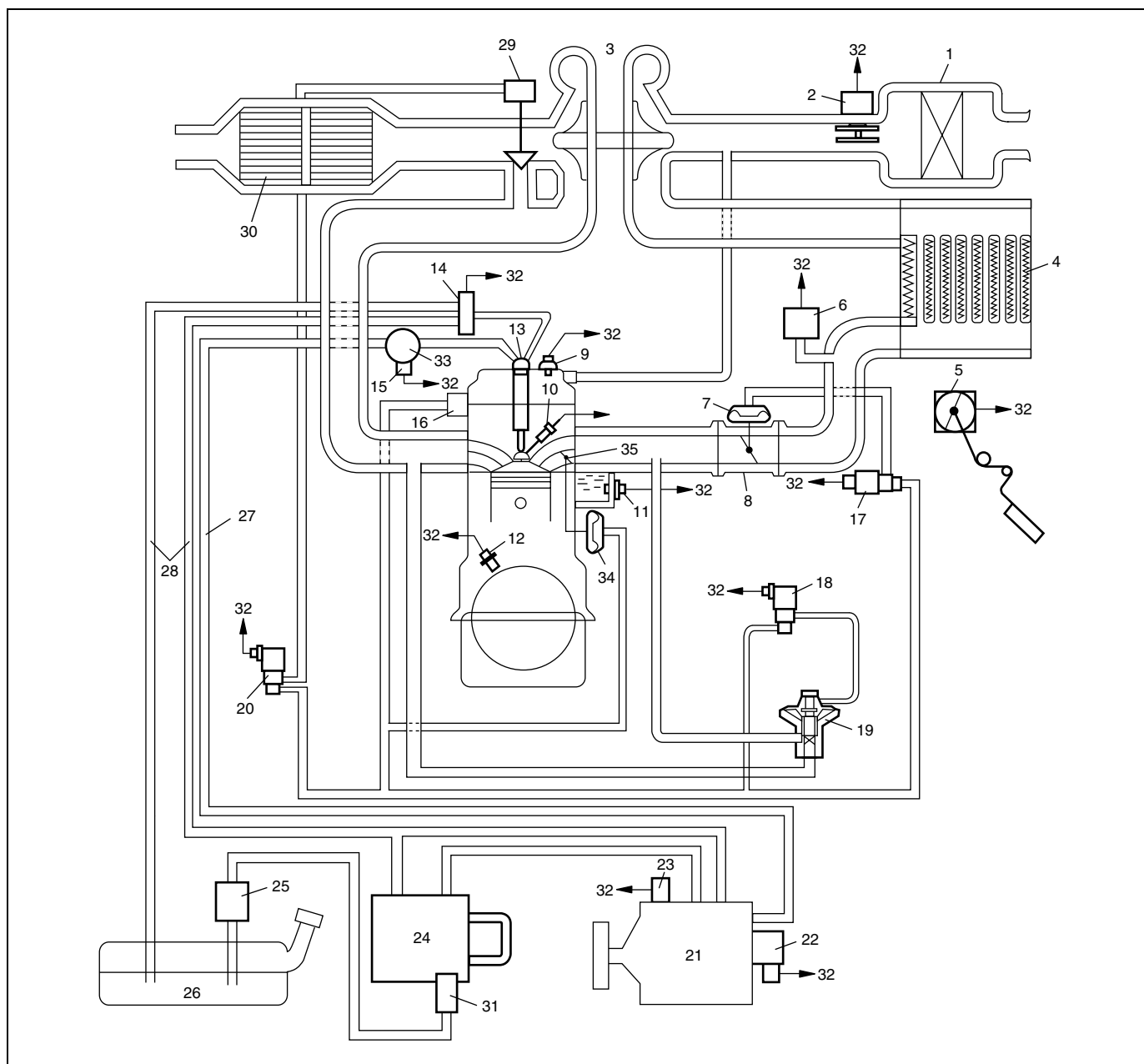
For EOBD spec, the wire harness type power supply line (1) for glow plugs is used.

For other than EOBD spec, the metal plate type power supply line (2) for glow plugs is used.

Identify it by the type of glow plug power supply line.

[A]: Other than EOBD spec
[B]: EOBD spec

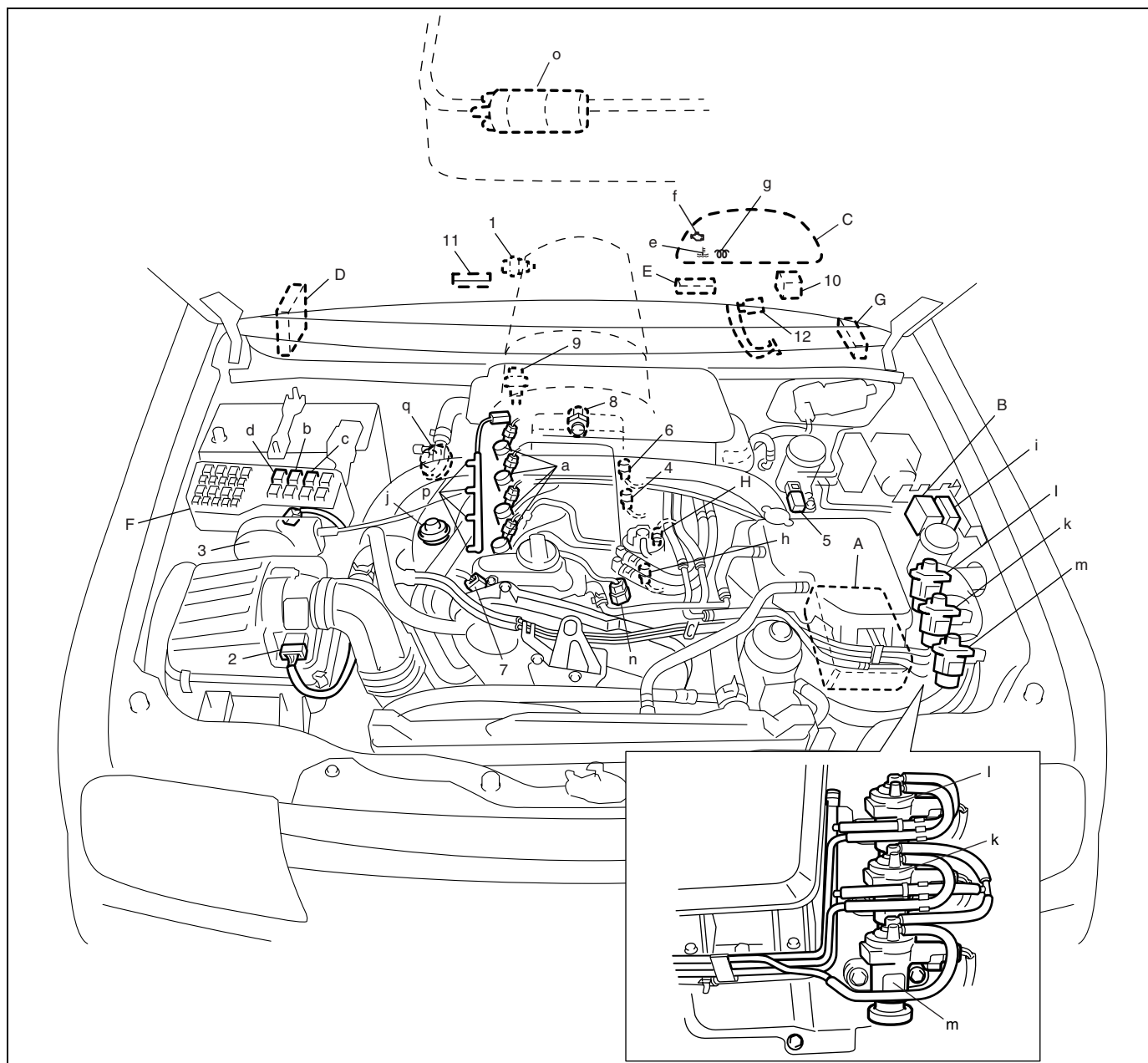
System Diagram



1. Air Cleaner	13. Injector	25. Fuel pump
2. MAF sensor	14. Fuel temperature sensor	26. Fuel tank
3. Turbocharger	15. Fuel pressure sensor	27. Fuel feed line
4. Intercooler	16. Vacuum pump	28. Fuel return line
5. TP sensor (Accelerator stroke sensor)	17. EGR throttle solenoid valve	29. Waste gate actuator
6. Intake air pressure sensor	18. EGR solenoid valve	30. Catalytic converter
7. Throttle valve actuator	19. EGR valve	31. Fuel heater
8. Throttle valve assembly	20. Boost (Turbo) pressure regulator solenoid valve	32. To ECM
9. CMP sensor	21. Injection pump	33. Common rail (High pressure fuel injection rail)
10. Glow plug	22. Fuel pressure regulator	34. Swirl control solenoid valve
11. ECT sensor	23. Injection pump solenoid valve (3rd piston deactivator)	35. Swirl valve
12. CKP sensor (Engine speed sensor)	24. Fuel filter	

Electronic Control System

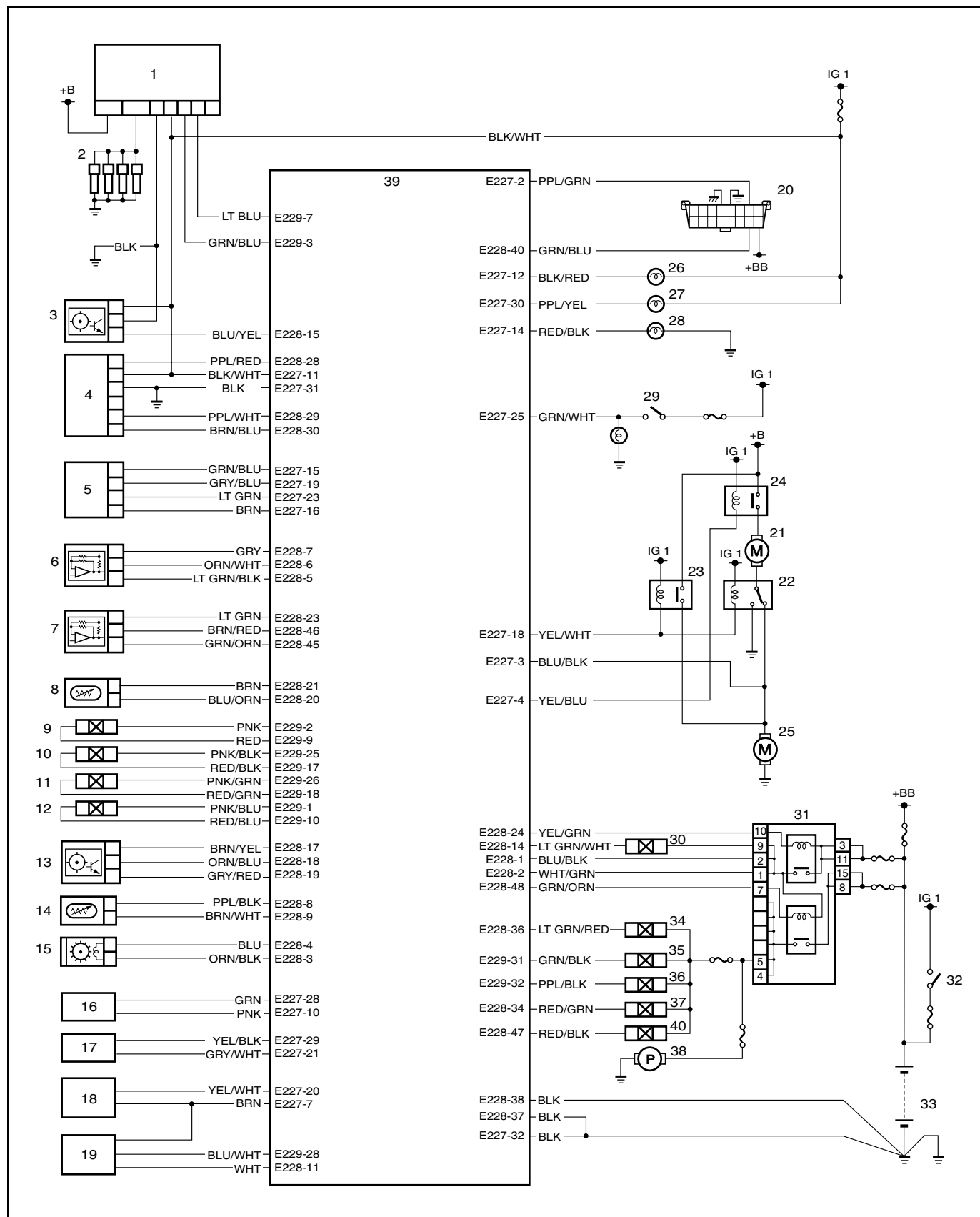
System location diagram



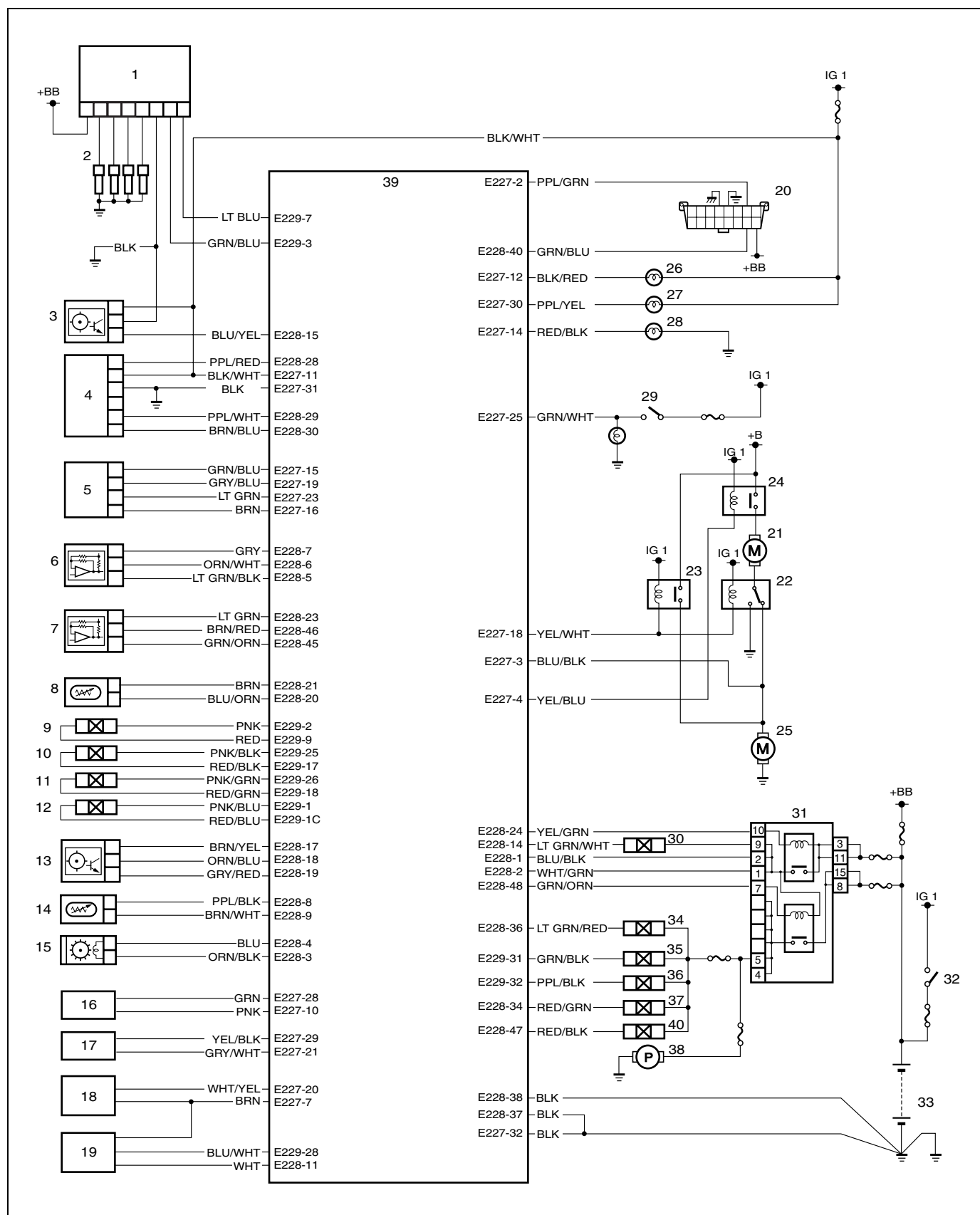
INFORMATION SENSORS	CONTROLLED DEVICES	OTHERS
1. VSS (Installed on transfer)	a: Injector	A: ECM
2. MAF sensor (built-in intake air temp. sensor)	b: Radiator fan relay 1 (High/Low)	B: Pre/post heating relay (control unit)
3. Accelerator stroke sensor	c: Radiator fan relay 2 (High)	C: Combination meter
4. Fuel (rail) pressure sensor	d: Radiator fan relay 3 (Low)	D: TCM
5. Intake air pressure sensor	e: Engine coolant temperature warning lamp	E: Data link connector
6. Fuel temperature sensor	f: Malfunction indicator lamp	F: Main fuse box
7. CMP sensor	g: Glow indicator lamp	G: Fuel box
8. ECT sensor	h: Fuel pressure regulator	H: Fuel heater
9. CKP sensor (Engine speed sensor)	i: Double relay	
10. Immobilizer control module	j: EGR valve	
11. A/C control module	k: EGR solenoid valve	
12. Brake lamp switch	l: Boost (Turbo) pressure regulator solenoid valve	
	m: EGR throttle solenoid valve	
	n: Injection pump solenoid valve (3rd piston deactivator)	
	o: Fuel pump	
	p: Glow plug	
	q: Swirl control solenoid valve	

System wiring diagram

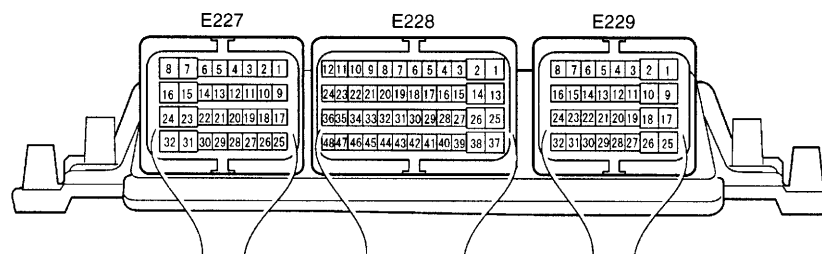
Other than EOBD Spec



EOBD Spec



ECM Connector (Terminal Arrangement Viewed from Harness Side)



1. Pre/post heating relay (control unit)	15. Crankshaft position sensor (Engine speed sensor)	29. Brake lamp switch
2. Glow plug	16. Immobilizer control module	30. Fuel pressure regulator
3. Vehicle speed sensor	17. A/C control module	31. Double relay
4. Mass air flow sensor (built-in intake air temp. sensor)	18. Combination meter	32. Ignition switch
5. Throttle position sensor (Accelerator stroke sensor)	19. Transmission control module (TCM)	33. Battery
6. Fuel (rail) pressure sensor	20. Data link connector	34. EGR solenoid valve
7. Intake air pressure sensor (MAP sensor)	21. Radiator fan motor 1 (Left side)	35. Boost (Turbo) pressure regulator solenoid valve
8. Fuel temperature sensor	22. Radiator fan relay 1 (High/Low)	36. EGR throttle solenoid valve
9. Fuel injector No.1	23. Radiator fan relay 2 (High)	37. Injection pump solenoid valve (3rd piston deactivator)
10. Fuel injector No.2	24. Radiator fan relay 3 (Low)	38. Fuel pump
11. Fuel injector No.3	25. Radiator fan motor 2 (Right side)	39. Engine control module (ECM)
12. Fuel injector No.4	26. Engine coolant temperature warning lamp	40. Swirl control solenoid valve
13. Camshaft position sensor	27. Malfunction indicator lamp	
14. Engine coolant temperature sensor	28. Glow indicator lamp	

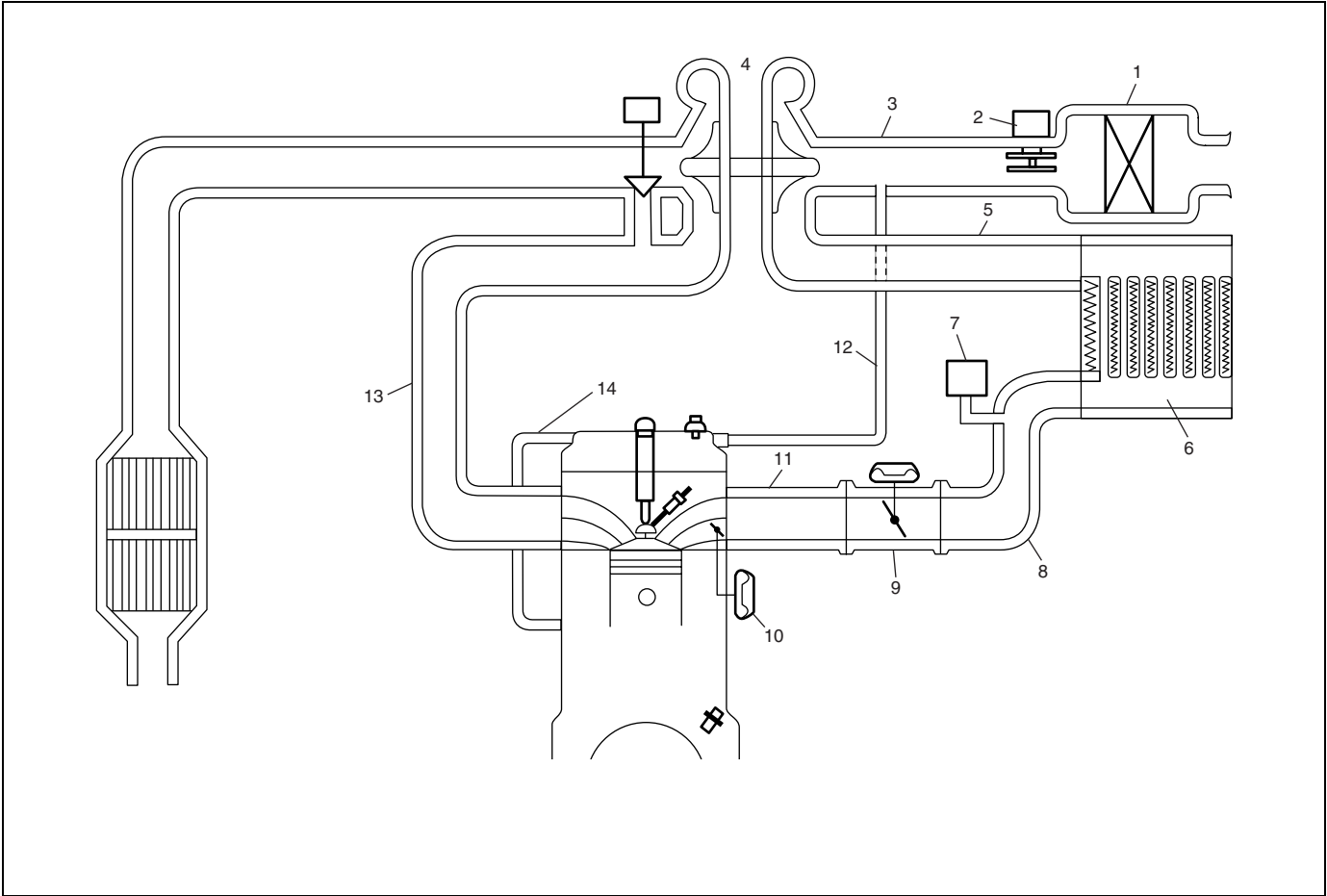
TERMINAL	CIRCUIT		TERMINAL	CIRCUIT		TERMINAL	CIRCUIT	
E227	1	—	E228	7	Ground for fuel pressure sensor	E228	45	Signal for intake air pressure sensor
	2	Data link connector		8	Engine coolant temperature sensor (–)		46	Ground for intake air pressure sensor
	3	Radiator fan state		9	Engine coolant temperature sensor (+)		47	Swirl control solenoid valve
	4	Radiator fan relay (low)		10	—		48	Double relay (Fuel pump relay)
	5	—		11	Engine torque signal (A/T)	E229	1	Fuel injector No.4 (+)
	6	—		12	—		2	Fuel injector No.1 (+)
	7	Engine speed signal (Combination meter)		13	—		3	Pre post heating diagnostic
	8	—		14	Fuel pressure regulator		4	—
	9	—		15	Vehicle speed sensor		5	—
	10	Immobilizer control module signal		16	—		6	—
	11	Power supply for mass air flow sensor		17	Power supply for camshaft position sensor		7	Pre/post heating relay
	12	Engine coolant temperature warning lamp		18	Signal for camshaft position sensor		8	—
	13	—		19	Ground for camshaft position sensor		9	Fuel injector No.1 (–)
	14	Glow indicator lamp		20	Signal for fuel temperature sensor		10	Fuel injector No.4 (–)
	15	Throttle position sensor No.1 (Accelerator stroke sensor)		21	Ground for fuel temperature sensor		11	—
	16	Sensor ground		22	—		12	—
	17	—		23	Power supply for intake air pressure sensor		13	—
	18	Radiator fan relay (high)		24	Double relay (Main relay)		14	—
	19	Throttle position sensor No.2 (Accelerator stroke sensor)		25	—		15	—
	20	Signal for engine coolant temperature sensor		26	—		16	—
	21	Cut off signal for A/C control module		27	—		17	Fuel injector No.2 (–)
	22	—		28	Intake air temperature sensor		18	Fuel injector No.3 (–)
	23	5 V power supply output		29	Mass air flow sensor (+)		19	—
	24	—		30	Mass air flow sensor (–)		20	—
	25	Brake lamp switch		31	—		21	—
	26	—		32	—		22	—
	27	—		33	—		23	—
	28	Immobilizer control module wake-up signal		34	Injection pump solenoid valve (3rd position deactivator)		24	—
	29	A/C control module signal		35	—		25	Fuel injector No.2 (+)
	30	Malfunction indicator lamp		36	ERG solenoid valve		26	Fuel injector No.3 (+)
	31	Ground for mass air flow sensor		37	Ground		27	—
	32	Ground		38	Ground		28	Throttle position signal (A/T)
E228	1	Power source	39	—	29		—	
	2	Double relay (Main relay)	40	Data link connector 12 V	30		—	
	3	Crankshaft position (Engine speed) sensor (–)	41	—	31		Boost (Turbo) pressure regulator solenoid valve	
	4	Crankshaft position (Engine speed) sensor (+)	42	—	32		ERG throttle solenoid valve	
	5	Power supply for fuel pressure sensor	43	—				
	6	Signal for fuel pressure sensor	44	—				

Correspondence Table of Harness Connector

The following harness connector number of this section is corresponding to the following harness connector number of WIRING DIAGRAM MANUAL.

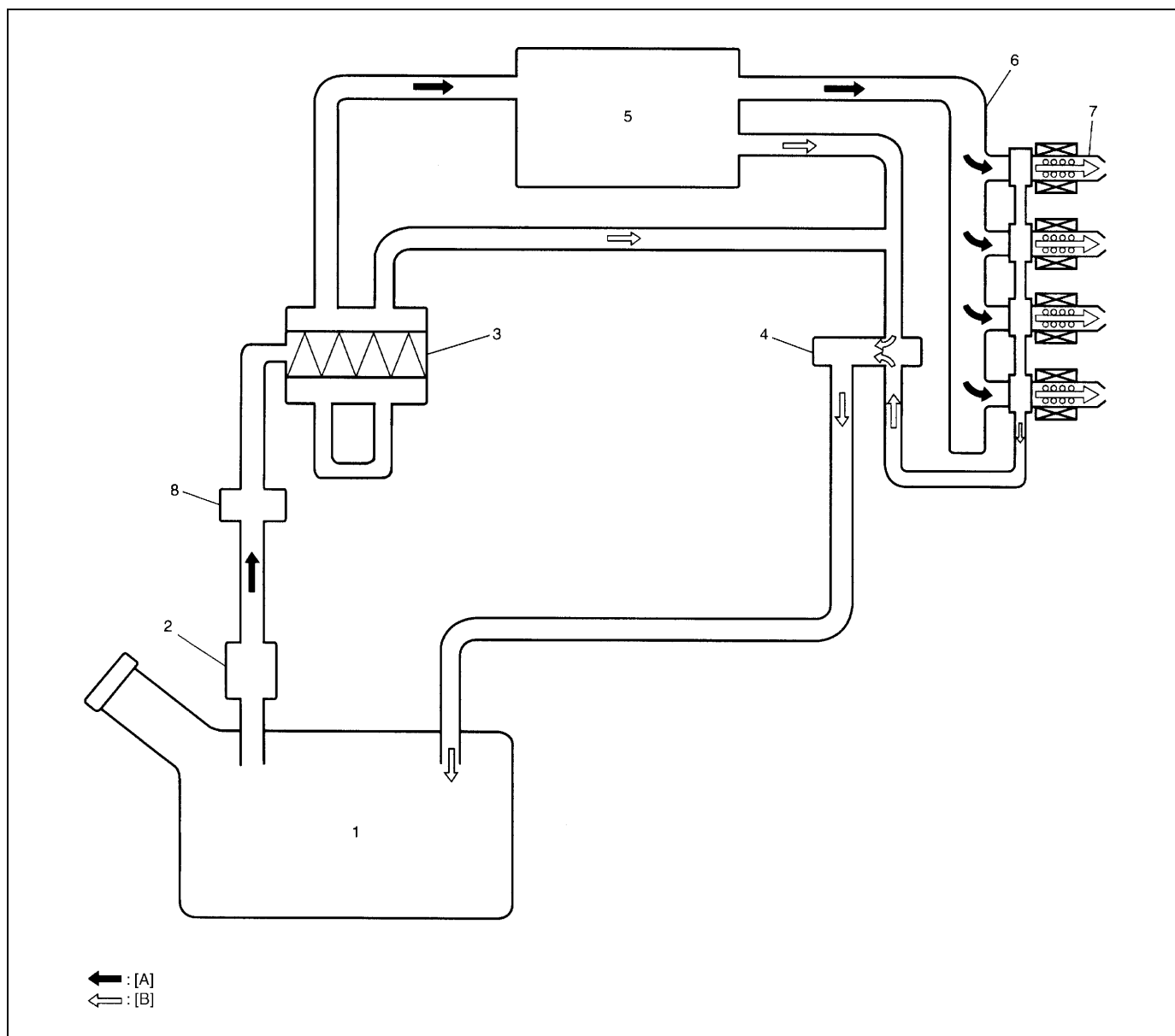
Connector number of this section	Connector number of WIRING DIAGRAM MANUAL
E227	C51-1
E228	C51-2
E229	C51-3

Air Intake System



1. Air cleaner	6. Intercooler	11. Intake manifold / camshaft housing
2. MAF sensor	7. Intake air pressure sensor	12. Breather hose
3. Air cleaner outlet hose	8. Intercooler outlet hose	13. Exhaust manifold
4. Turbocharger	9. EGR throttle valve assembly	14. PCV hose
5. Intercooler inlet hose	10. Swirl control solenoid valve	

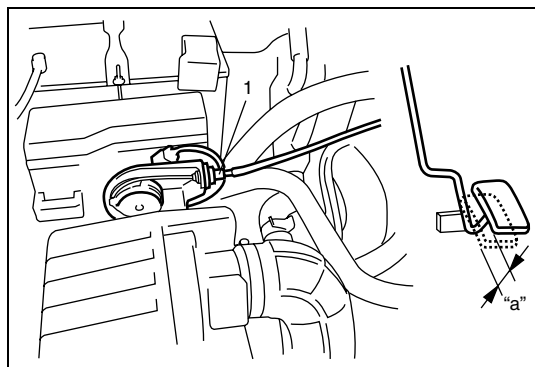
Fuel Delivery System



1. Fuel tank	5. Injection pump	[A]: Fuel feed line
2. Fuel pump	6. Common rail (High pressure fuel injection rail)	[B]: Fuel return line
3. Fuel filter	7. Injector	
4. Fuel temperature sensor	8. Fuel heater	

On-Vehicle Service

Accelerator Cable Adjustment

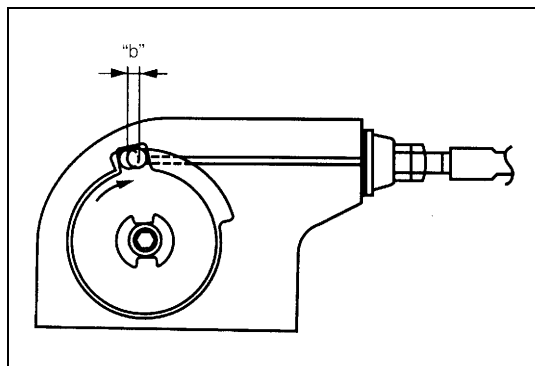


- 1) Check accelerator pedal play which should be within the following specification.

If measured value is out of specification, adjust it to specification with cable adjusting nut (1).

Accelerator pedal play

"a": 2 – 7 mm (0.08 – 0.27 in.)



- 2) With accelerator pedal depressed fully, check clearance between throttle lever and lever stopper (throttle body).

If measured value is out of specification, adjust it to specification by changing height of pedal stopper bolt.

Accelerator cable adjustment clearance (With pedal depressed fully)

"b": 0.5 – 2.0 mm (0.02 – 0.07 in.)

Idle Speed Inspection

- 1) Shift transmission into Neutral (for M/T) or P range (for A/T).
- 2) Start engine and warm it up to normal operating temperature.
- 3) Turn all electrical loads off.
- 4) Using tachometer, verify that idle speed is within specification.

Engine speed: 825 – 875 rpm (M/T)

805 – 855 rpm (A/T)

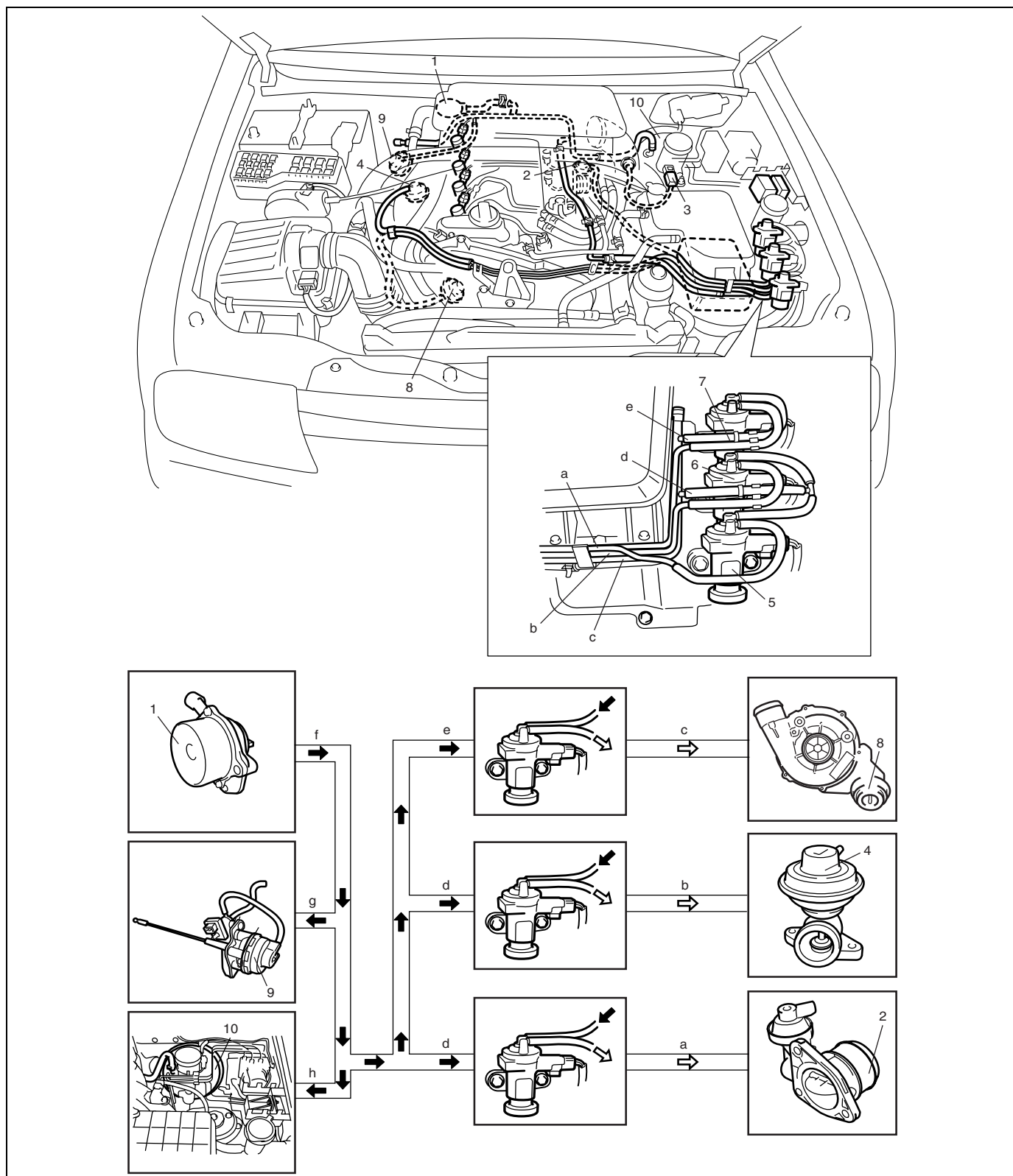
- 5) Operate A/C and verify that engine speed is within specification.

Engine speed: 825 – 875 rpm (M/T or A/T)

- 6) If not, refer to troubleshooting "Improper engine idle" under "Engine Diagnosis Table" in Section 6-1.

Air Intake System

Vacuum hose routing diagram



a: To EGR throttle valve	g: To swirl control solenoid valve	5. EGR throttle solenoid valve
b: To EGR valve	h: To brake booster	6. EGR solenoid valve
c: To waste gate actuator	1. Vacuum pump	7. Boost (turbo) pressure regulator solenoid valve
d: To EGR throttle solenoid valve and EGR solenoid valve	2. EGR throttle valve assembly	8. Waste gate actuator (turbocharger)
e: To boost (turbo) pressure regulator solenoid valve	3. Intake air pressure sensor	9. Swirl control solenoid valve
f: To swirl control solenoid valve, brake booster and each solenoid valve	4. EGR valve	10. Brake booster

Throttle valve assembly

Inspection

- 1) Remove intercooler and intercooler outlet hose.
- 2) Connect a vacuum pump gauge (Special Tool) to throttle valve assembly (1).

Special tool

(A): 09917-47910

- 3) Gradually increase vacuum and check for throttle valve (2) operation.

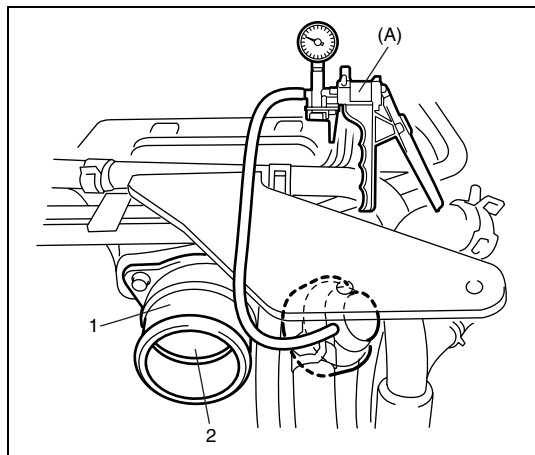
If not as specified, replace throttle valve assembly (1).

Valve operation starting vacuum:

0 – About 10.7 kPa (80 mmHg)

Valve operation completion vacuum:

About 50.6 – 66.5 kPa (380 – 500 mmHg)

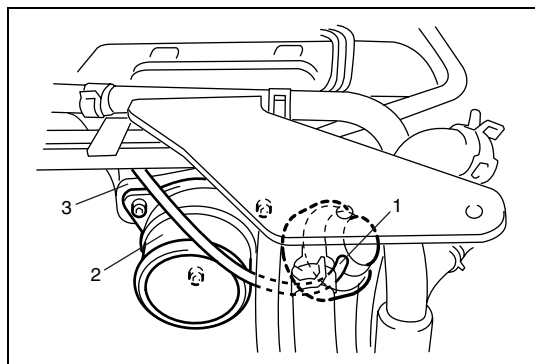


Removal

- 1) Remove intercooler and intercooler outlet hose.
- 2) Disconnect vacuum hose (1) from throttle valve assembly (2).
- 3) Remove throttle valve assembly from intake manifold/camshaft housing (3).

CAUTION:

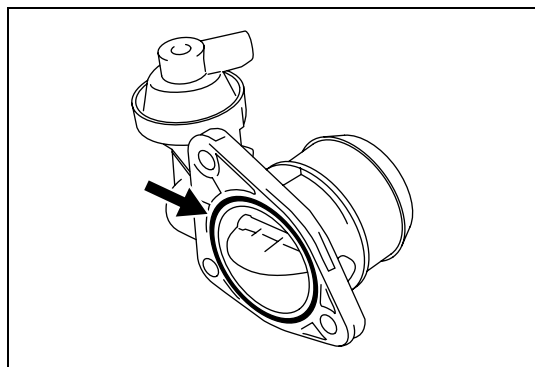
Don't disassemble throttle valve assembly.



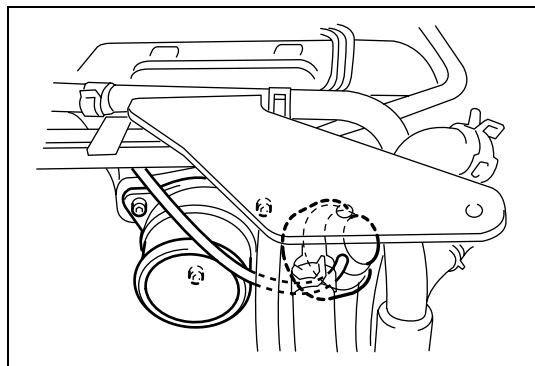
Installation

Reverse removal procedure for installation noting the following.

- Clean mating surfaces of throttle valve assembly and intake manifold/camshaft housing.
- Check O-ring for damage and replace throttle valve assembly if necessary.

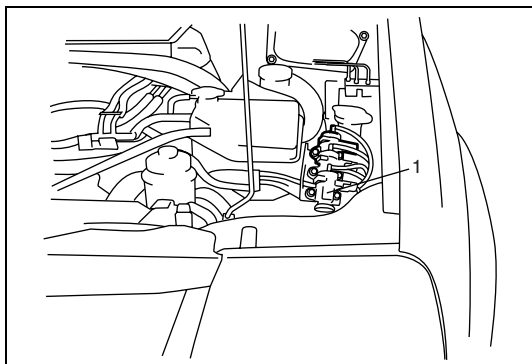


- Connect vacuum hose securely.



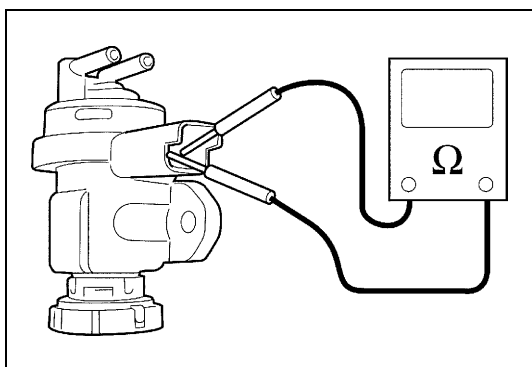
EGR throttle solenoid valve

Removal



- 1) Disconnect negative cable at battery.
- 2) Remove EGR throttle solenoid valve (1) from bracket.
- 3) Disconnect connector from EGR throttle solenoid valve.
- 4) Disconnect vacuum hoses from EGR throttle solenoid valve.

Inspection



Measure resistance between each two terminals.
If resistance is out of specification, replace EGR throttle solenoid valve.

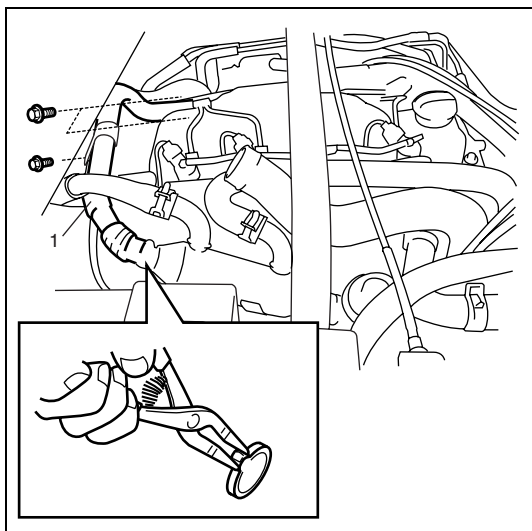
EGR throttle solenoid valve resistance
12 – 18 Ω at 25 °C (77 °F)

Installation

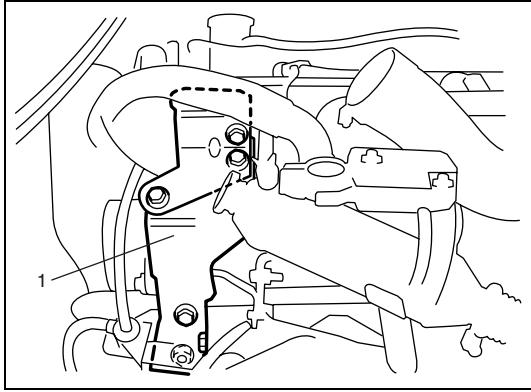
For installation, reverse removal procedure.

Vacuum pump

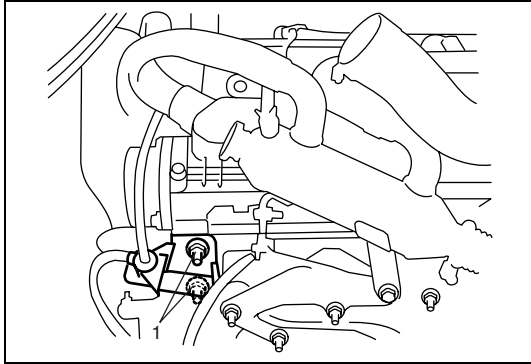
Removal



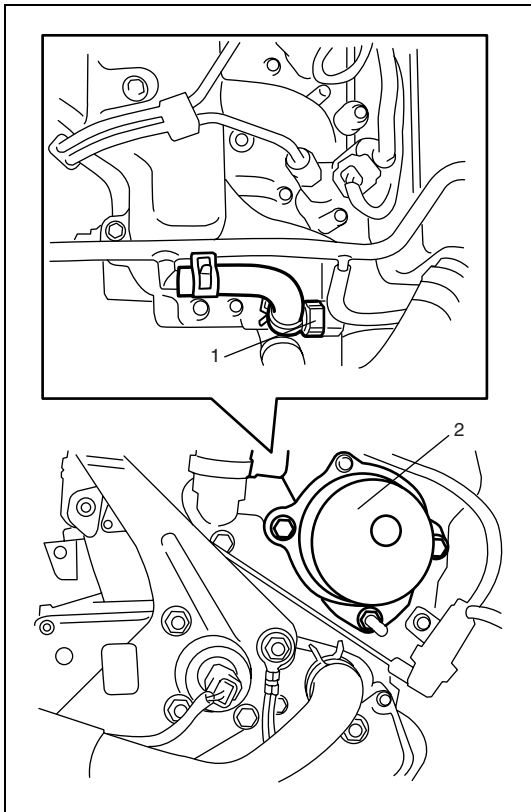
- 1) Remove battery.
- 2) Remove intercooler from intercooler bracket.
- 3) Remove EGR pipe (1) from EGR cooler and intake manifold/camshaft housing.



4) Remove left side intercooler bracket (1).



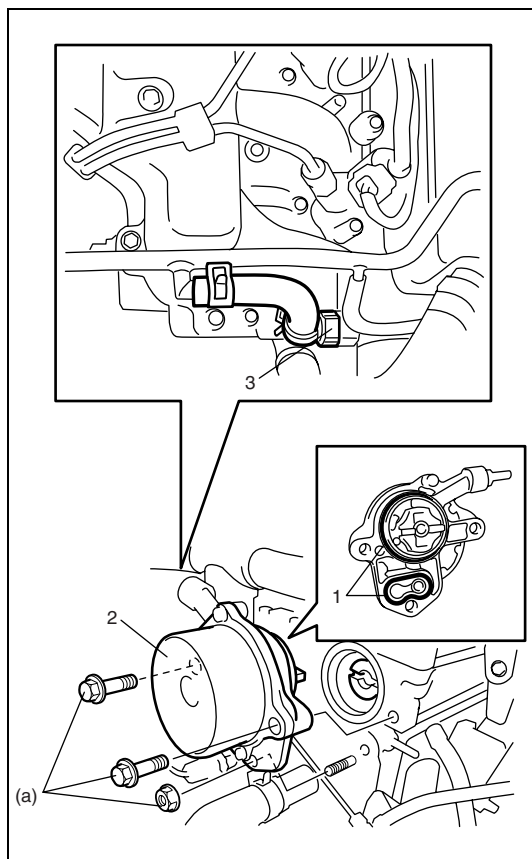
5) Remove swirl control solenoid valve mounting nuts (1).



6) Disconnect vacuum hose (1) from vacuum pump.

7) Remove vacuum pump (2) from cylinder head.

Installation



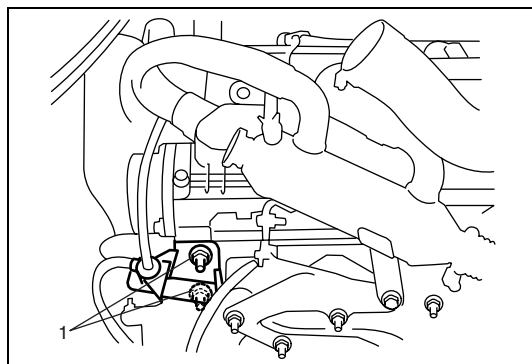
- 1) Install new O-rings (1) to vacuum pump.
- 2) Install vacuum pump (2) to cylinder head.
Fit the dogs of vacuum pump coupling into the slot of camshaft.
- 3) Tighten vacuum pump bolts and nut to specified torque.

Tightening torque

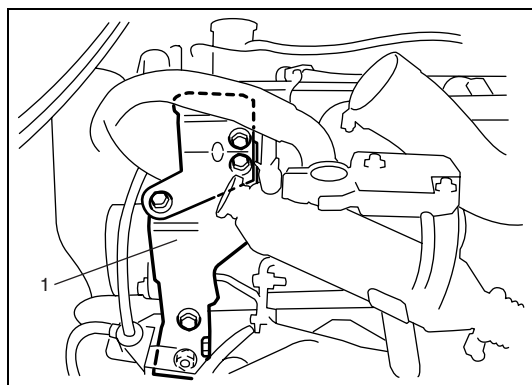
Vacuum pump bolt and nut

(a): 20 N·m (2.0 kg-m, 14.5 lb-ft)

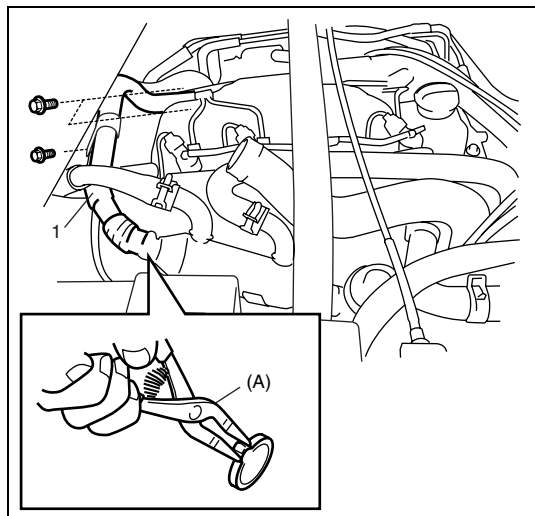
- 4) Connect vacuum hose (3) to vacuum pump.



- 5) Tighten swirl control solenoid valve nuts (1).



- 6) Install left side intercooler bracket (1).



- 7) Install EGR pipe (1) to EGR cooler and intake manifold/camshaft housing.
- 8) Install new EGR pipe clamp by using special tool.

Special tool

(A): 09919-46510/OUT0000110

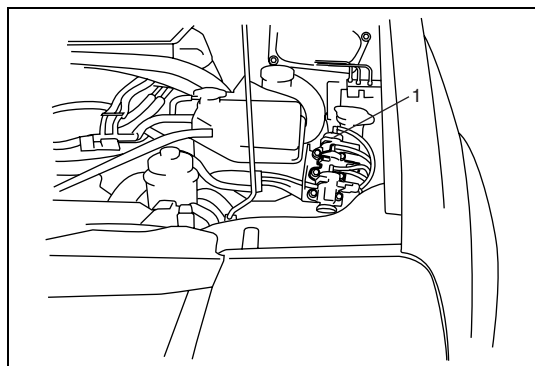
NOTE:

Do not reuse EGR pipe clamp.

- 9) Install intercooler from intercooler bracket.
- 10) Install battery.

Boost pressure regulator solenoid valve

Removal



- 1) Disconnect negative cable at battery.
- 2) Remove boost pressure regulator solenoid valve (1) from bracket.
- 3) Disconnect connector from boost pressure regulator solenoid valve.
- 4) Disconnect vacuum hoses from boost pressure regulator solenoid valve.

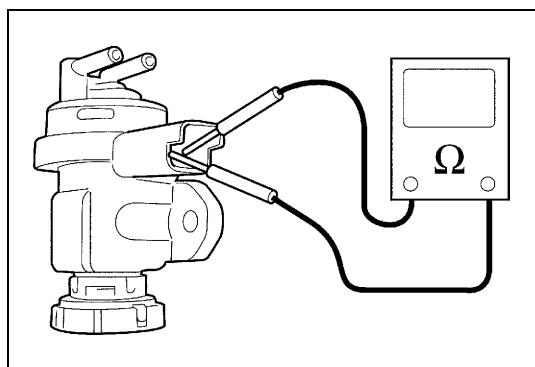
Inspection

Measure resistance between each two terminals.

If resistance is out of specification, replace boost pressure regulator solenoid valve.

Boost pressure regulator solenoid valve resistance

12 – 18 Ω at 25 °C (77 °F)



Installation

For installation, reverse removal procedure.

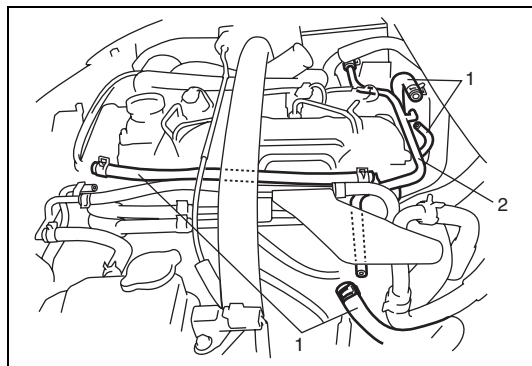
Glow plug

Removal

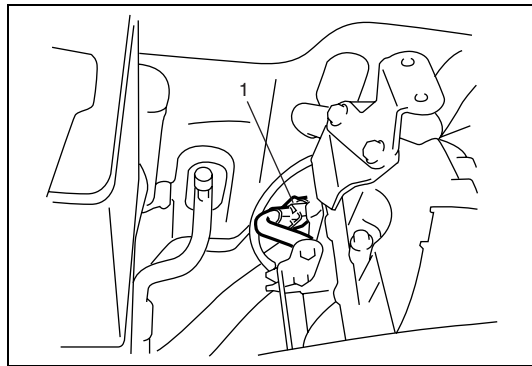
CAUTION:

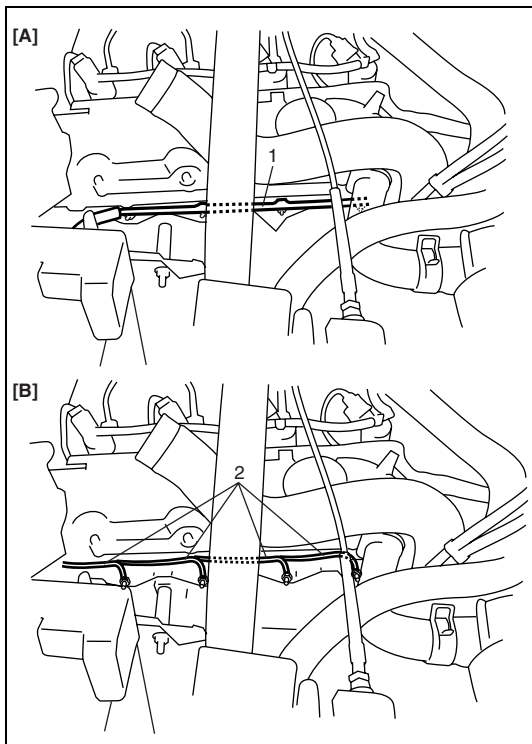
- Do not damage heating section of the glow plug.
- Do not use glow plug that has been dropped.
- When removing glow plug, first loosen it by using a tool so that one or more screw threads remain engaged, then loosen and remove by hand.

- 1) Disconnect negative (–) cable at battery.
- 2) Drain cooling system and tighten drain plug.
- 3) Remove intercooler referring to “Intercooler” in Section 6A3.
- 4) Disconnect vacuum hoses (1) from vacuum pipe.
- 5) Remove vacuum pipe (2) from intercooler bracket.



- 6) Remove EGR valve and EGR cooler referring to “EGR Valve and EGR Cooler” in this section.
- 7) Disconnect glow plug connector (1) (other than EOBD spec only).

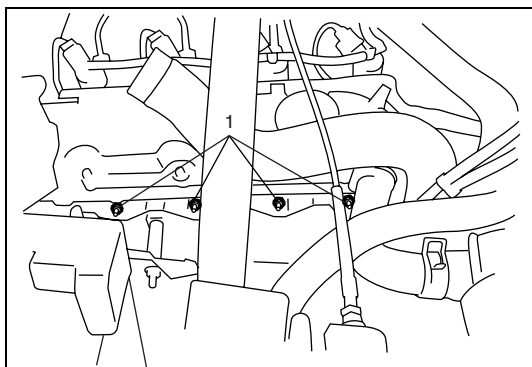




- 8) Remove glow plug metal plate (1) (other than EOBD spec) or glow plug wires (2) (EOBD spec) from glow plugs.

[A]: Other than EOBD spec

[B]: EOBD spec



- 9) Remove glow plugs (1) from cylinder head.

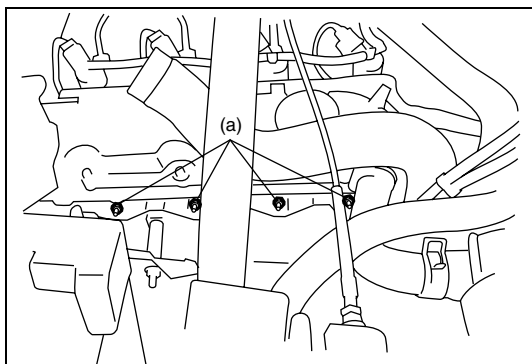
Installation

For installation, reverse removal procedure noting the following.

- Tightening glow plug to specified torque.

Tightening torque

Glow plug (a): 10 N·m (1.0 km-m, 7.5 lb-ft)



- Use new EGR gasket.
- Tighten EGR connection bolts and nuts to specified torque referring to “EGR Valve Component” in this section.
- Connect vacuum hoses securely.
- Refill cooling system referring to “Cooling System Refill” in Section 6B.

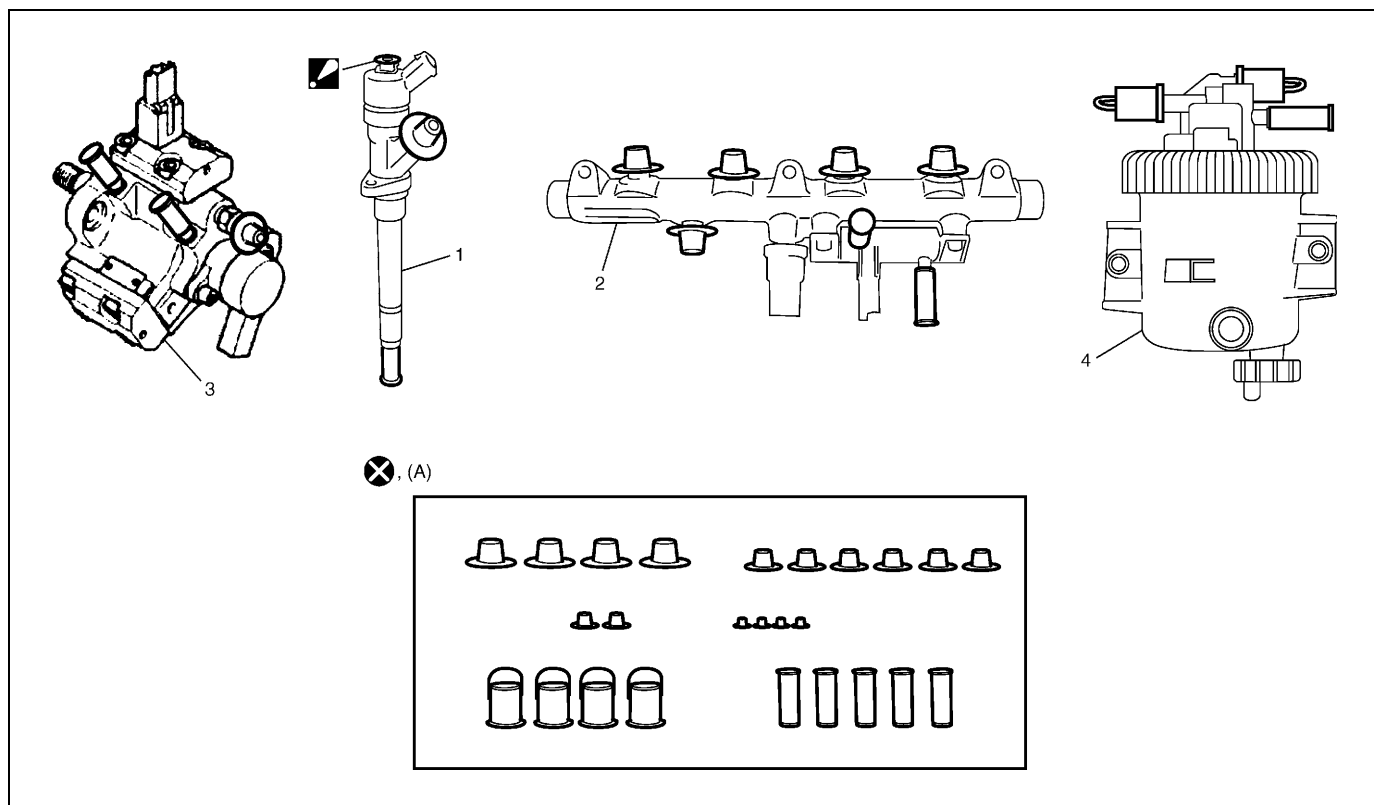
Fuel Delivery System

WARNING:

- Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel. Fuel line spills and leaks are dangerous. Fuel can ignite and cause serious injuries or death and damage.
- Fuel can also irritate skin and eyes. To prevent this, always complete the following "Precautions".

Precautions

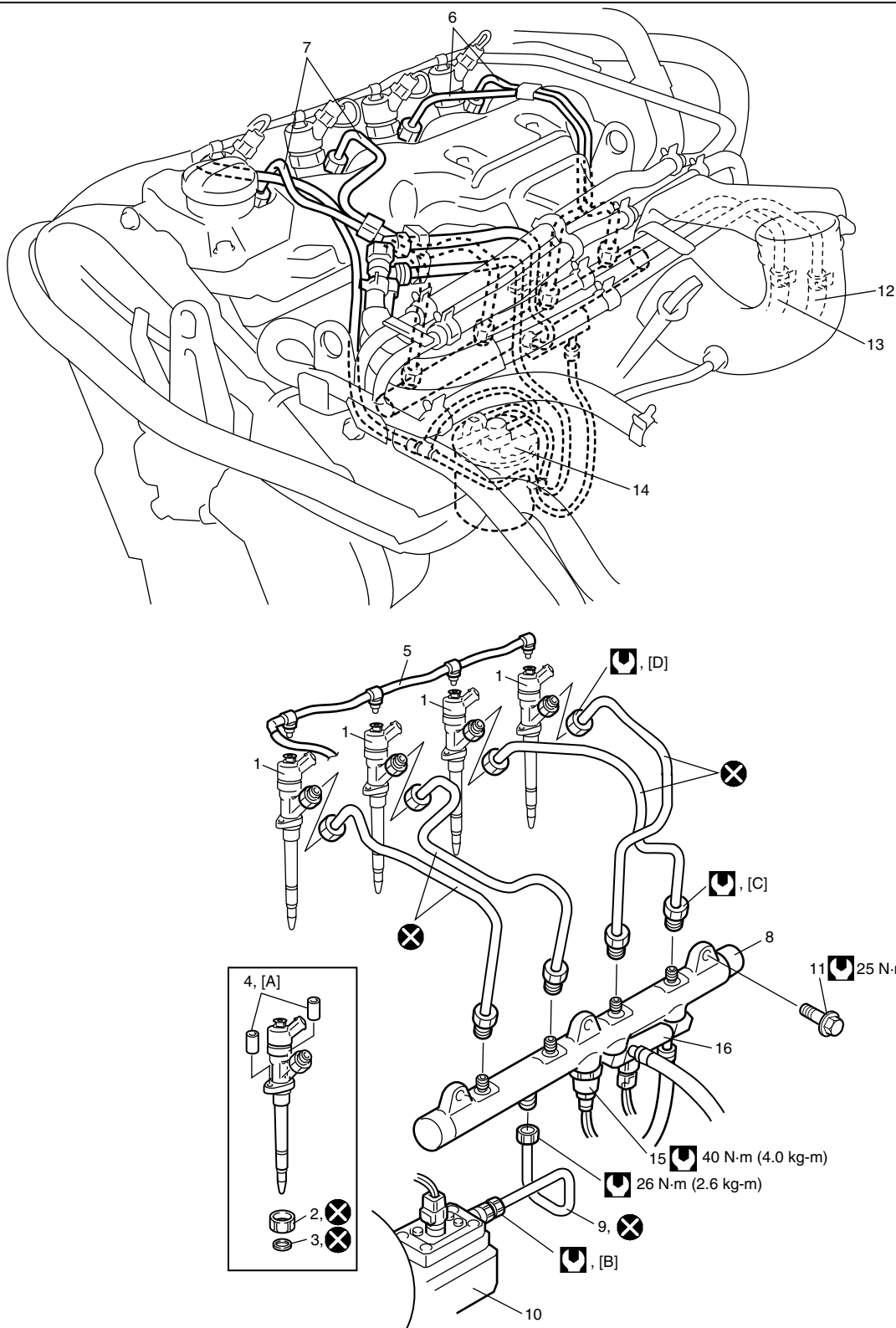
- When disconnecting a fuel hose or pipe, wrap rag around it to protect against fuel leakage. Plug disconnected hose.
- Before disconnecting a fuel hose or pipe, wait 30 seconds or more after engine stop to release pressure in fuel system.
- When disconnecting fuel line from injection pump, injector, delivery pipe and/or fuel filter, install new plug or new cap including in fuel system plug set (special tool) to fittings immediately in order to prevent its internal part from dust.



1. Fuel injector	3. Injection pump	☐ : Use special tool with clip which fixing fuel return hose to injector.
2. Common rail	4. Fuel filter	⊗ : Do not reuse

Special tool

(A): 09916-50010



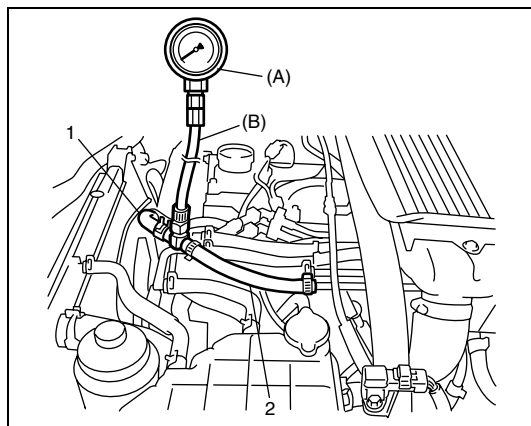
[A]: Tighten fuel injector nut to 4 N·m (0.4 kg-m) and then turn fuel injector nut at 45°	3. Copper seal	9. High pressure supply pipe	15. Fuel pressure sensor
[B]: Tighten union nut to 24 N·m (2.4 kg-m) and then turn tighten union nut to 26 N·m (2.6 kg-m)	4. Nut	10. Injection pump	16. Fuel temperature sensor
[C]: Tighten union nut to 24 N·m (2.4 kg-m) and then turn tighten union nut to 26 N·m (2.6 kg-m)	5. Return hose	11. Bolt	: Tightening torque
[D]: Tighten union nut to 8 N·m (0.8 kg-m) and then turn tighten union nut to 27.5 N·m (2.8 kg-m)	6. High pressure pipe (for No.1 & No.2)	12. Fuel feed hose	: Do not reuse.
1. Fuel injector	7. High pressure pipe (for No.3 & No.4)	13. Fuel return hose	
2. Sealing ring	8. Common rail (high pressure)	14. Fuel filter assembly (including fuel heater)	

Low pressure fuel supply system

Inspection

CAUTION:

A small amount of fuel may be released when fuel feed hose is removed. Place container under the fuel feed hose or fuel feed pipe with a shop cloth so that released fuel is caught in container or absorbed in cloth. Place that cloth in an approved container.



- 1) Disconnect fuel feed hose (1) from fuel feed pipe.
- 2) Connect special tools and hose (2) between fuel feed hose and fuel feed pipe as shown in figure, and clamp hose securely to ensure no leaks occur during checking.

Special tool

(A): 09912-58442

(B): 09912-58432

(C): 09912-56530

- 3) Check that battery voltage is above 11 V.
- 4) Check for the maximum fuel pressure by repeating the following procedure for 5 times.
 - a) Turn ignition switch to ON position for about 5 seconds.
 - b) Turn ignition switch to OFF position.
- 5) Start engine.
- 6) Measure fuel pressure at idling.

If measured specified fuel pressure is not obtained, refer to "Table B-2 Fuel Pressure Inspection" in Section 6-1 and check each possibly defective part. Replace if found defective.
- 7) Make sure that the fuel pressure is decreased after turning the ignition switch to OFF position.

If not decreased, make sure if the fuel pipe is clogged up. If clogged up, replace the original pipe with the new one.

Fuel pressure specification

CONDITION	FUEL PRESSURE
With fuel pump operating and engine stopped (See Step 4))	about 300 kPa 3.0 kg/cm ² , 42.7 psi
At specified idle speed (See Step 6))	about 320 kPa 3.2 kg/cm ² , 45.5 psi
With fuel pump stopped (See Step 7))	0 kPa 0 kg/cm ² , 0 psi

- 8) After checking fuel pressure, remove special tool and hose from fuel feed pipe.
- 9) Connect fuel feed hose and clamp it securely.
- 10) With engine "OFF" and ignition switch "ON", check for fuel leaks.

Fuel Leakage Check

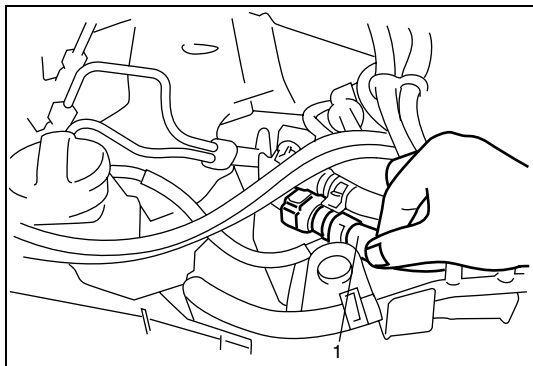
- 1) Turn ignition switch to ON position.
- 2) Check for the fuel leakage in each part, which was serviced.
- 3) Start the engine, and then check for the fuel leakage in each part, which was serviced.
- 4) Run vehicle at 1000 rpm with the 3rd gear, accelerate the vehicle to 3500 rpm with the same gear, and stop the vehicle. Check for the fuel leakage in each part, which was serviced.

Fuel pump

On-Vehicle Inspection

- 1) Check that fuel pump operating sound is heard from fuel pump for 5 seconds and then stop when turning ignition switch to ON position.

If above check result is not satisfactory, advance to "Table B-1 Fuel Pump Circuit Inspection" in Section 6-1.



- 2) Check that fuel pressure is felt at fuel feed hose (1) for about 5 seconds after ignition switch ON.

If fuel pressure is not felt, advance to "Low Pressure Fuel Supply System" in this section.

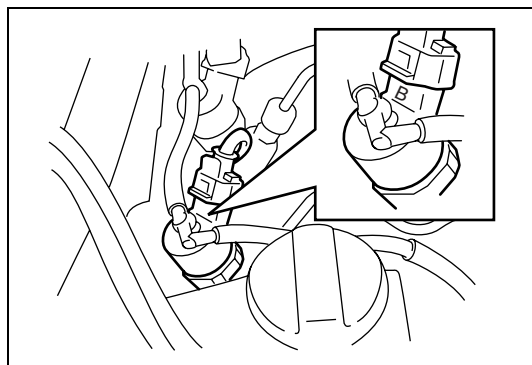
Removal/Inspection/Installation

Refer to "Fuel Pump" in Section 6C.

Fuel heater

Refer to "Fuel Heater" in Section 6C for removal, installation and inspection.

Fuel injector

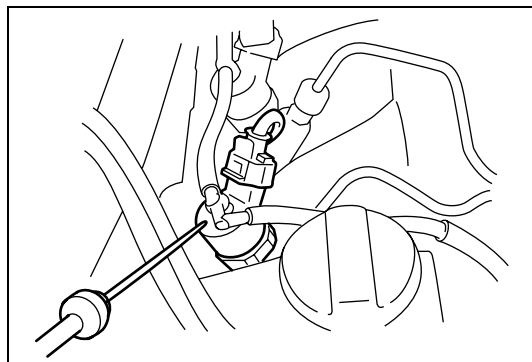


NOTE:

There are three types of the fuel injector type, whose are distinguished as "A", "B" and "C".

The distinction mark is stamped on the near the connector. When replacing the fuel injector(s) with new one(s), make sure that type of new fuel injector(s) is same as the one of the replaced fuel injector(s) because the engine vibration or noise might occur if any fuel injector(s), which is different type, installed onto the engine.

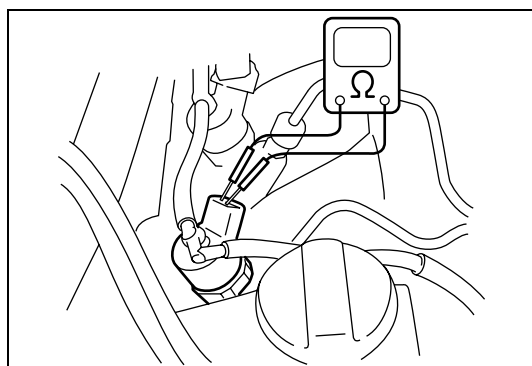
On-Vehicle Inspection



- 1) Using sound scope or such, check operating sound of injector when engine is running or cranking.

Cycle of operating sound should vary according to engine speed.

If no sound or an unusual sound is heard, check injector circuit (wire or coupler) or injector.



- 2) Disconnect coupler from injector, connect ohmmeter between terminals of injector and check resistance.

If resistance is out of specification, replace.

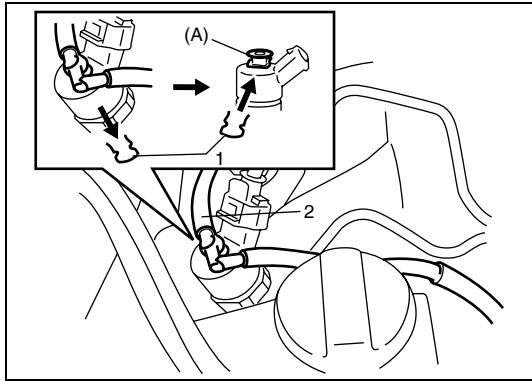
Resistance of injector

0.56 Ω (MAX.) (at 20 °C, 68 °F)

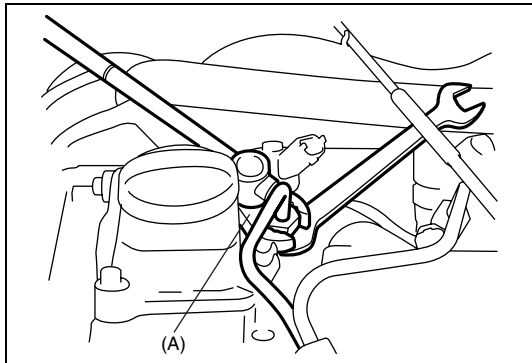
- 3) Connect coupler to injector securely.

Removal

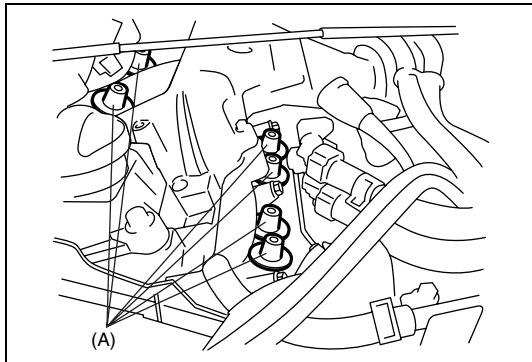
- 1) Disconnect negative (–) cable at battery.
- 2) Remove strut tower bar referring to "Strut Tower Bar" in Section 3D.
- 3) Remove intercooler and intercooler outlet hose.
- 4) Remove fuel filter referring to "Fuel Filter Assembly" in Section 6C.
- 5) Remove fuel filter bracket from cylinder head.



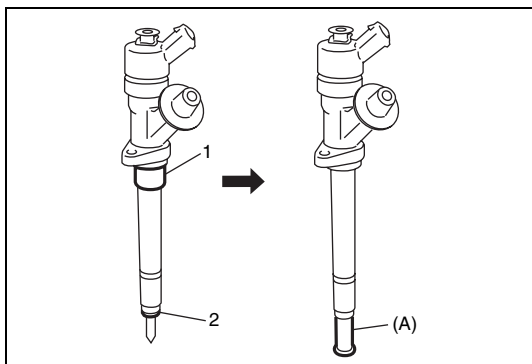
- 6) Remove clip (1), and then disconnect return hose (2) from fuel injector.
- 7) Install special tool to fuel injector as shown in the figure.
Fix special tool using removed clip (1).

Special tool**(A): 09916-50010**

- 8) Remove high pressure pipe.
When loosening union nut of high pressure pipe, holding union nut of fuel injector with wrench as shown.

Special tool**(A): 09950-76510/OUT0000148**

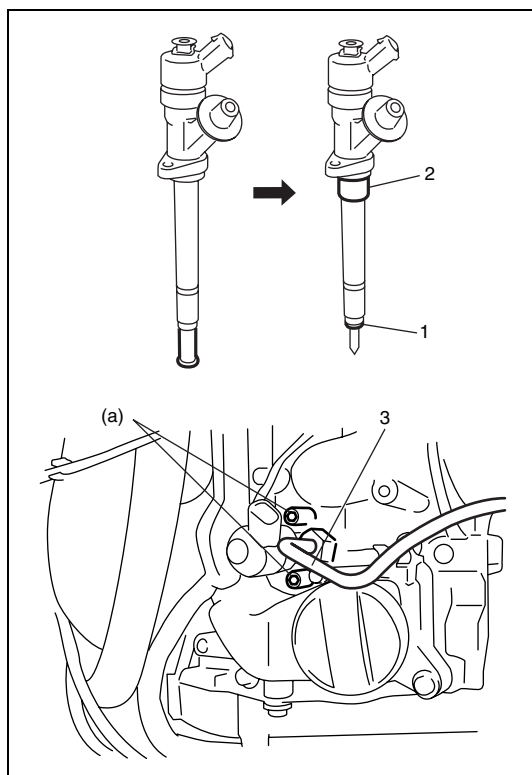
- 9) Install special tool to fuel injector and common rail to prevent them from entering dust.

Special tool**(A): 09916-50010**

- 10) Remove fuel injector from cylinder head.
- 11) Remove sealing ring (1) and copper seal (2), then install special tool from fuel injector.

Special tool**(A): 09916-50010**

Installation



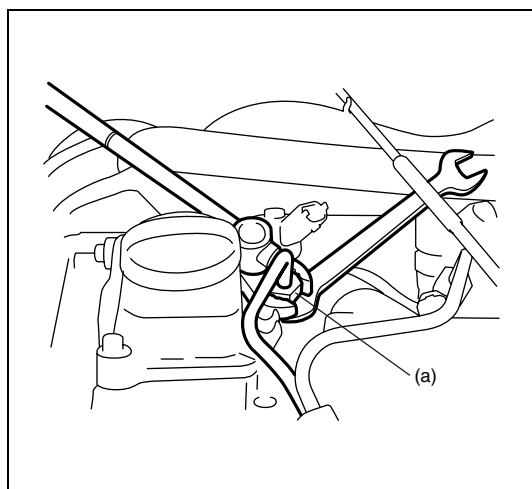
CAUTION:

Do not reuse high pressure pipe (3) because it has the possibility that fuel leaks out.

- 1) Remove special tool from fuel injector and then install new copper seal (1) and new sealing ring (2).
- 2) Install fuel injector to cylinder head.
- 3) Install new high pressure pipe (3) tighten each union nut temporarily by hand.
- 4) Tighten fuel injector nuts in Steps below.
 - a) Tighten fuel injector nuts to 4 N·m (0.4 kg-m, 3.0 lb-ft)
 - b) Tighten fuel injector nuts by turning through 45°

Tightening torque

Fuel injector nut (a): 4 N·m (0.4 kg-m, 3.0 lb-ft) and then turn fuel injector nut at 45°



- 5) Tighten high pressure pipe union nut of fuel injector side to specified torque in Steps below, holding union nut of fuel injector with wrench as shown.
 - a) Tighten high pressure pipe union nut to 8 N·m (0.8 kg-m, 6.0 lb-ft).
 - b) Tighten high pressure pipe union nut to 27.5 N·m (2.8 kg-m, 20.0 lb-ft).

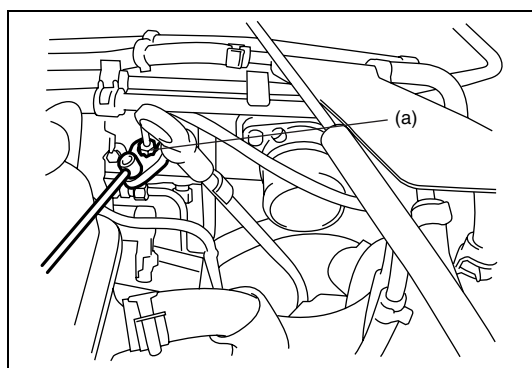
Special tool

(A): 09950-76510/OUT0000148

Tightening torque

High pressure pipe union nut (Fuel injector side)

(a): 27.5 N·m (2.8 kg-m, 20.0 lb-ft)

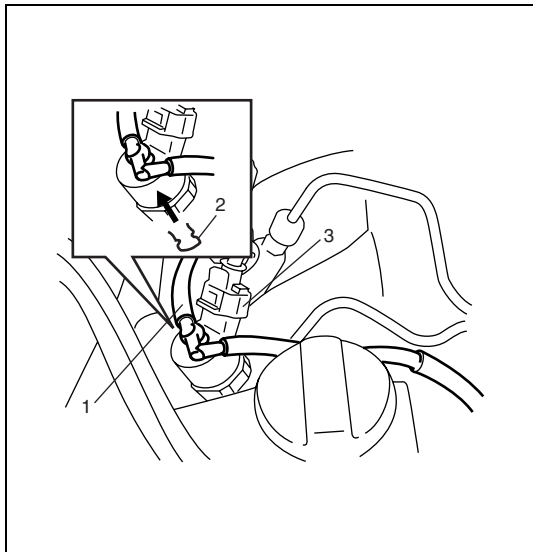


- 6) Tighten high pressure pipe union nut of common rail side in Steps below.
 - a) Tighten high pressure pipe union nut to 24 N·m (2.4 kg-m, 17.5 lb-ft).
 - b) Tighten high pressure pipe union nut to 26 N·m (2.6 kg-m, 19.0 lb-ft).

Tightening torque

High pressure pipe union nut (Common rail side)

(a): 26 N·m (2.6 kg-m, 19.0 lb-ft)



- 7) Connect return hose (1) to fuel injector and then install clip (2) to fuel injector.
- 8) Connect fuel injector connector (3).
- 9) Install fuel filter bracket to cylinder head.
- 10) Install fuel filter to fuel filter bracket referring to "Fuel Filter Assembly" in Section 6C.
- 11) Install intercooler and intercooler outlet hose.
- 12) Install strut tower bar referring to "Strut Tower Bar" in Section 3D.
- 13) Connect negative (–) cable at battery.
In case that the fuel injector(s) was replaced, perform "Registration Data Check" in this section to check the fuel injector type registered to ECM.
- 14) Check fuel leakage referring to "Fuel Leakage Check" in this section.

Common rail (High pressure fuel injection rail)

Removal

- 1) Disconnect negative cable from battery.
- 2) Remove strut tower bar referring to "Strut Tower Bar" in Section 3D.
- 3) Remove intercooler and intercooler outlet hose.
- 4) Remove fuel filter referring to "Fuel Filter Assembly" in Section 6C.
- 5) Remove fuel filter bracket from cylinder head.
- 6) Remove high pressure supply pipe (1) from injection pump and common rail.
When loosening union nut of high pressure supply pipe, holding union nut of injection pump with wrench as shown.

Special tool

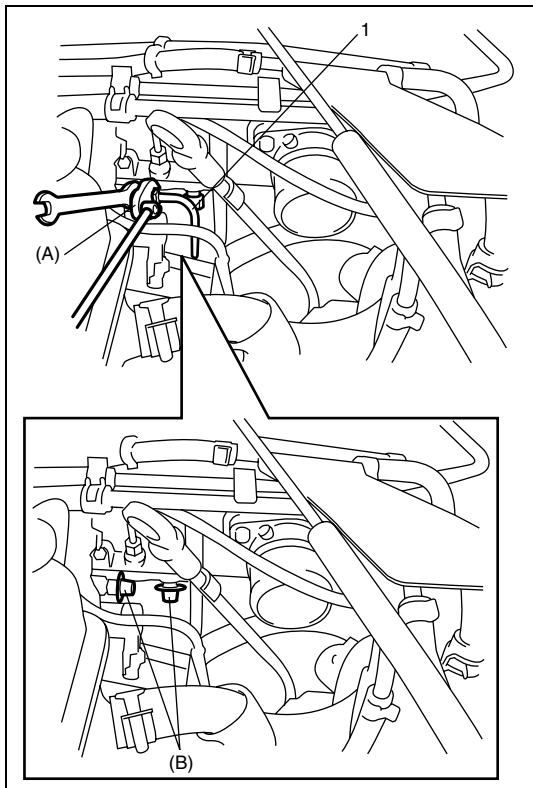
(A): 09950-76510/OUT0000148

- 7) Install special tool to injection pump and common rail to prevent them from entering dust.

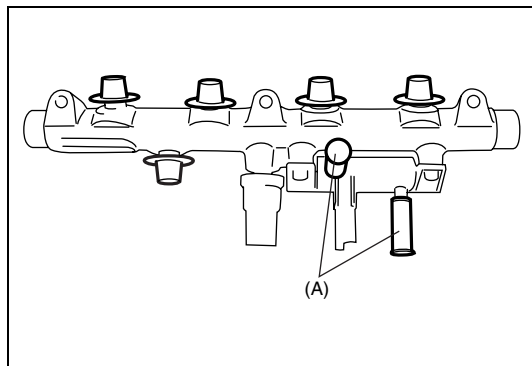
Special tool

(B): 09916-50010

- 8) Remove high pressure pipes from fuel injectors and common rail referring to Step 8) to 9) of "Removal" under "Fuel Injector" in this section.



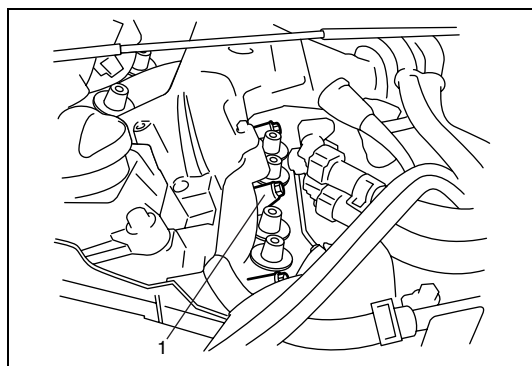
- 9) Disconnect fuel hoses from fuel temperature sensor.



- 10) Install special tool to fuel temperature sensor to prevent them from entering dust.

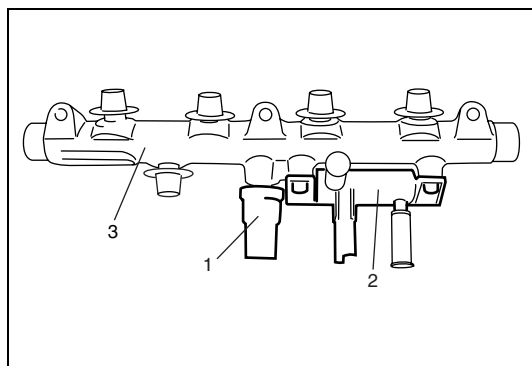
Special tool

(A): 09916-50010



- 11) Disconnect fuel pressure sensor and fuel temperature sensor connectors.

- 12) Remove common rail (1) from cylinder head.



- 13) Remove fuel pressure sensor (1) and fuel temperature sensor (2) from common rail (3).

Installation

CAUTION:

Do not reuse high pressure supply pipe and high pressure pipes because it has the possibility that fuel leaks out.

- 1) Install fuel pressure sensor (2) and fuel temperature sensor (1) to common rail.

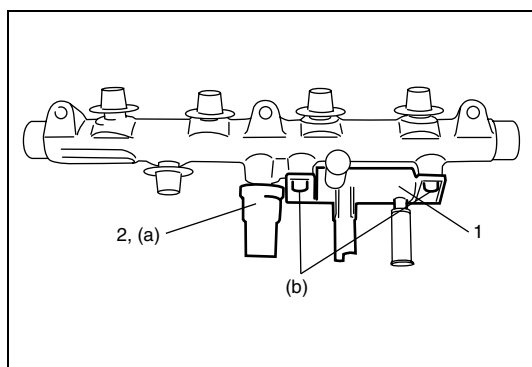
Tightening torque

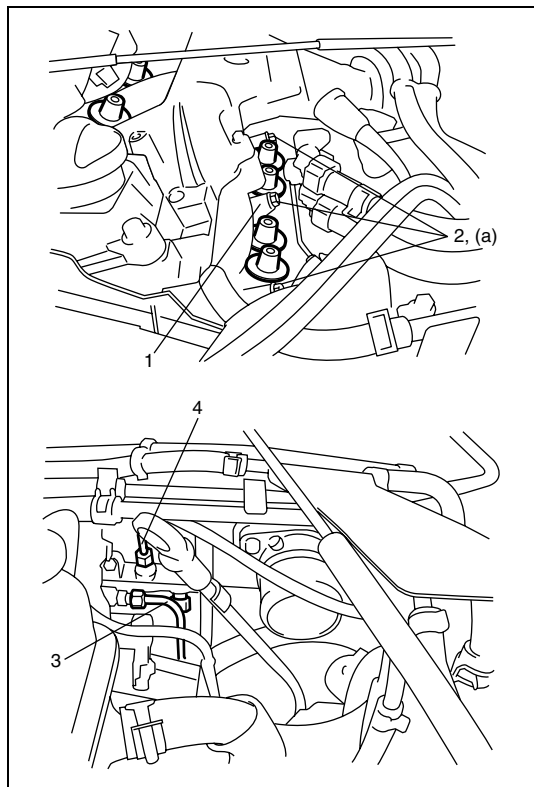
Fuel pressure sensor

(a): 40 N·m (4.0 kg-m, 29.0 lb-ft)

Fuel temperature sensor mounting bolt

(b): 8.5 N·m (0.9 kg-m, 6.5 lb-ft)



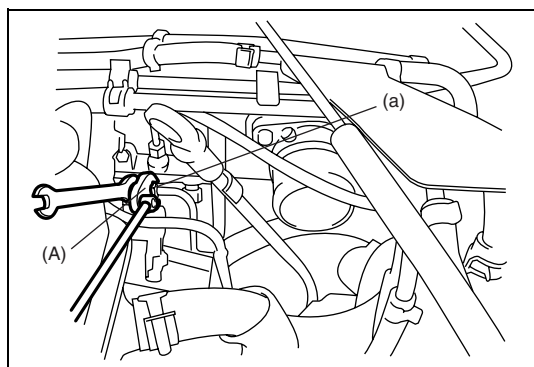


- 2) Install common rail (1) and tighten bolts (2) temporarily by hand.
- 3) Connect fuel pressure sensor and fuel temperature sensor connectors, then remove special tool from common rail, fuel temperature sensor and injection pump.
- 4) Connect fuel hoses to fuel temperature sensor.
- 5) Install new high pressure supply pipe (3) and new high pressure pipes (4), tighten each union nuts temporarily by hand.
- 6) Tighten common rail bolts to specified torque.

Tightening torque

Common rail bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

- 7) Tighten high pressure pipes union nuts to specified torque referring to Step 5) to 6) of "Installation" under "Fuel Injector" in this section.



- 8) Tighten high pressure supply pipe union nut of injection pump side to specified torque, holding union nut of injection pump with wrench as shown.

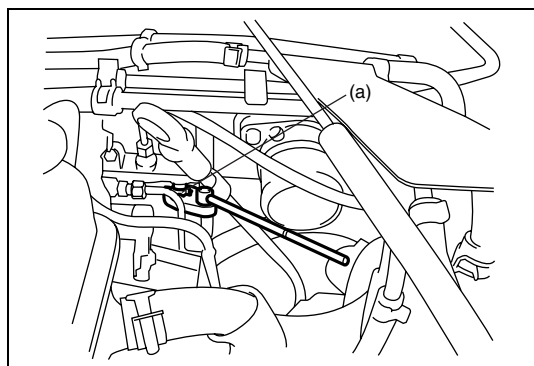
Special tool

(A): 09950-76510/OUT0000148

Tightening torque

High pressure supply pipe union nut (Injection pump side)

(a): 26 N·m (2.6 kg-m, 19.0 lb-ft)



- 9) Tighten high pressure supply pipe union nut of common rail side in Steps below.
 - a) Tighten high pressure supply pipe union nut to 24 N·m (2.4 kg-m, 17.5 lb-ft).
 - b) Tighten high pressure supply pipe union nut to 26 N·m (2.6 kg-m, 19.0 lb-ft).

Tightening torque

High pressure supply pipe union nut (Common rail side)

(a): 26 N·m (2.6 kg-m, 19.0 lb-ft)

- 10) Install fuel filter bracket to cylinder head.
- 11) Install fuel filter referring to "Fuel Filter Assembly" in Section 6C.
- 12) Install intercooler and intercooler outlet hose.
- 13) Install strut tower bar referring to "Strut Tower Bar" in Section 3D.
- 14) Connect negative (–) cable at battery.
- 15) Check fuel leakage referring to "Fuel Leakage Check" in this section.

Injection pump

Removal

- 1) Disconnect negative cable at battery.
- 2) Remove fuel filter referring to “Fuel Filter Assembly” in Section 6C.
- 3) Remove fuel filter bracket from cylinder head.
- 4) Remove timing belt referring to “Timing Belt and Belt Tensioner” in Section 6A3.
- 5) Loosen injection pump pulley nut (1) with pulley locked by using special tool.

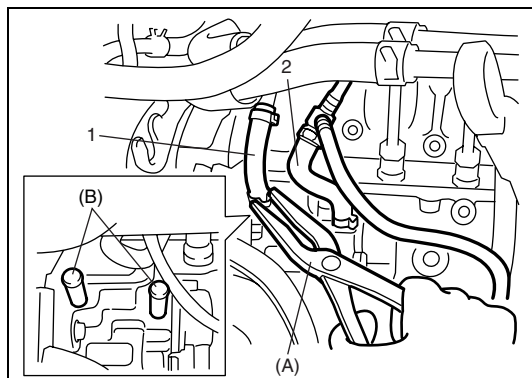
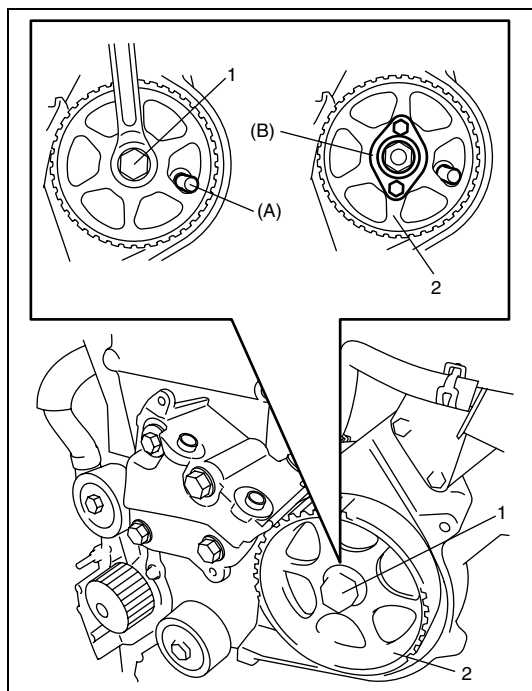
Special tool

(A): 09919-56570/OUT0000157

- 6) Remove injection pump pulley (2) by using special tool.

Special tool

(B): 09919-56580/OUT0000158

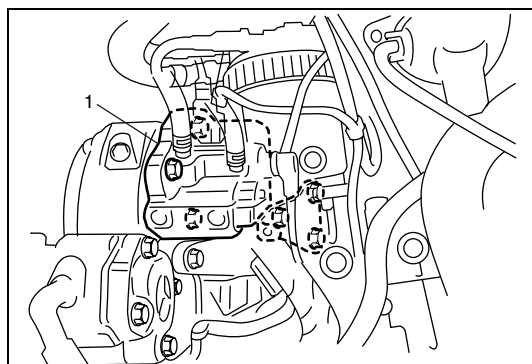


- 7) Disconnect inlet fuel hose (1) and return fuel hose (2), then cap injection pump opening with special tool.

Special tool

(A): 09919-46510/OUT0000110

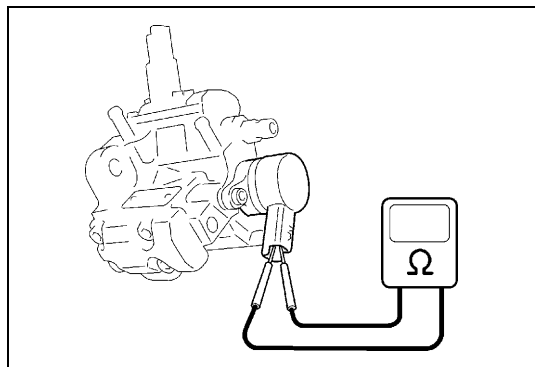
(B): 09916-50010



- 8) Remove high pressure supply pipe referring to Step 6) to 7) of “Removal” under “Common Rail (High Pressure Fuel Injection Rail)” in this section.
- 9) Remove injection pump (1).

Inspection

Fuel Pressure Regulator

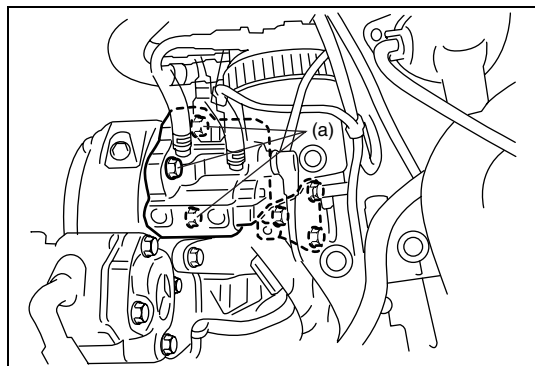


Check resistance between terminals of fuel pressure regulator.
If found faulty, replace injection pump.

Resistance of fuel pressure regulator

2 – 3 Ω

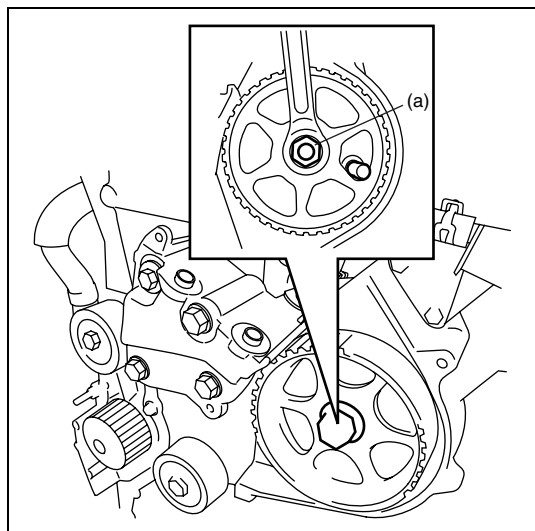
Installation



- 1) Install injection pump.
Tighten injection pump bolts to specified torque.

Tightening torque

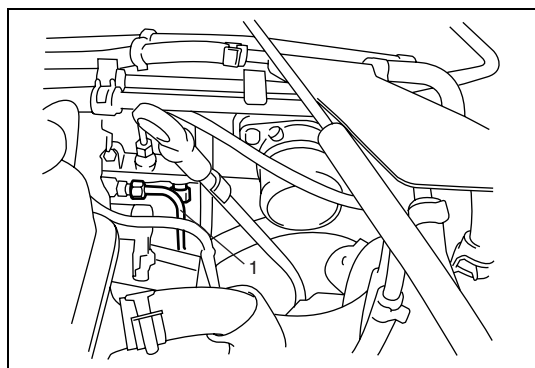
Injection pump bolt (a): 22.5 N·m (2.3 kg-m, 16.5 lb-ft)



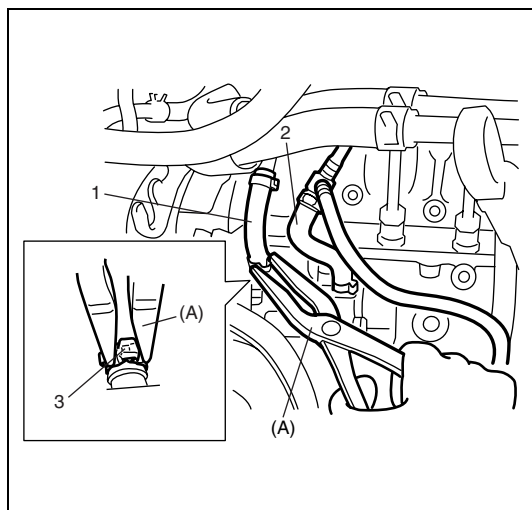
- 2) Install injection pump pulley.
Tighten injection pump pulley nuts to specified torque.

Tightening torque

Injection pump pulley nut (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)



- 3) Remove special tool, then install high pressure supply pipe (1)
to injection pump and common rail.
Tighten each union nuts temporarily by hand.



4) Tighten high pressure supply pipe referring to Step 8) to 9) of “Installation” under “Common Rail (High Pressure Fuel Injection Rail)” in this section.

5) Remove special tool, then connect inlet fuel hose (1) and return fuel hose (2) to injection pump.

6) Install new fuel hose clamps (3) by using special tool.

Special tool

(A): 09919-46510/OUT0000110

7) Install timing belt referring to “Timing Belt and Belt Tensioner” in Section 6A3.

8) Install fuel filter bracket to cylinder head.

9) Install fuel filter referring to “Fuel Filter Assembly” in Section 6C.

10) Connect negative (–) cable at battery.

11) Check fuel leakage referring to “Fuel Leakage Check” in this section.

Electronic Control System

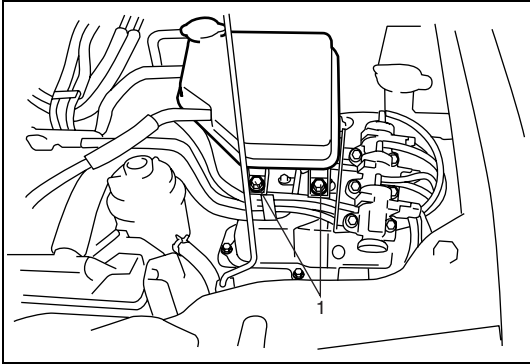
Engine control module (ECM)

CAUTION:

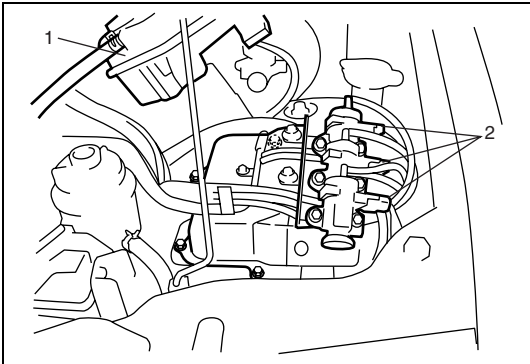
- As ECM consists of precision parts, be careful not to expose it to excessive shock.
- Be careful not to spill coolant from degassing tank when relocating degassing tank to engine side. ECM may be damaged by spill coolant.

Removal

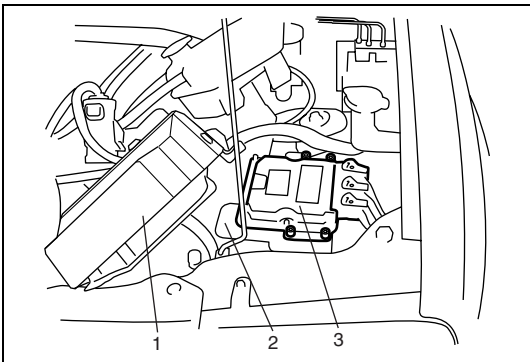
- 1) Disconnect negative cable at battery.
- 2) Remove degassing tank mounting bolts (1).

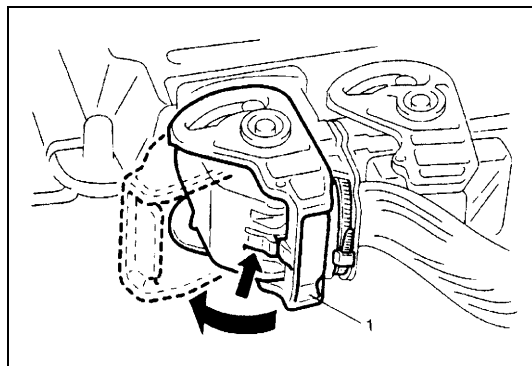


- 3) Relocate degassing tank (1) to engine side away.
- 4) Disconnect solenoid valve connectors (2).
- 5) Remove vacuum pipe mounting bolts.



- 6) Detach ECM cover (1) from ECM bracket (2).
- 7) Remove ECM (3) from ECM bracket (3).





- 8) Disconnect ECM connectors from ECM by pulling off the lock (1).

Installation

NOTE:

If ECM is replaced, register fuel injector type and transmission type into ECM referring to “ECM Registration” in this section.

- 1) Connect connectors to ECM securely.
- 2) Install ECM to bracket.
- 3) Install ECM cover to ECM bracket.
- 4) Install vacuum pipe to ECM bracket.
- 5) Connect solenoid valve connectors.
- 6) Install degassing tank to ECM cover.
- 7) Connect negative cable to battery.

ECM registration

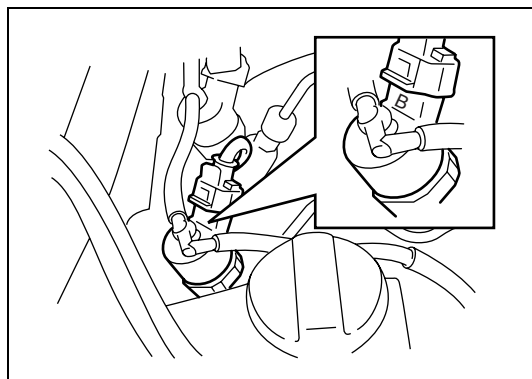
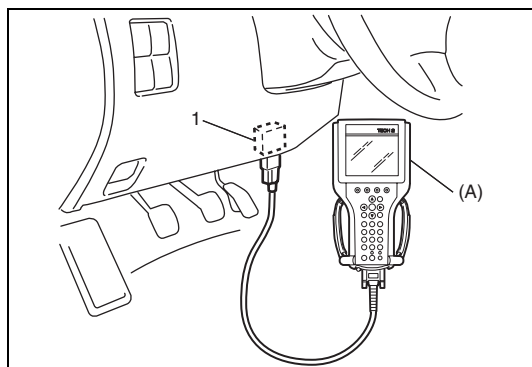
NOTE:

If the registration of the fuel injector type is not performed correctly, engine noise or vibration might occur.

- 1) Connect SUZUKI scan tool to data link connector (DLC) (1) located on under side of instrument panel at driver's seat side.

Special tool

(A): SUZUKI scan tool



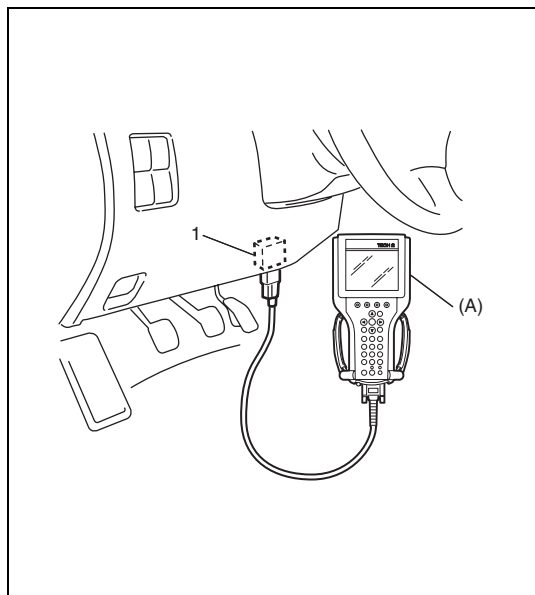
- 2) Check the fuel injector for the type “A”, “B” or “C” stamped on the fuel injector.
- 3) Turn ignition switch to ON position.
- 4) Select “ECM registration” command in SELECT MODE menu of SUZUKI scan tool.
- 5) Follow the instructions indicated on the SUZUKI scan tool.

NOTE:

For further details, refer to the operator's manual for SUZUKI scan tool.

- 6) Check DTC referring to “DTC Check” in this section.
If DTC is displayed on SUZUKI scan tool, go to applicable DTC diag. flow for troubleshooting.
- 7) Clear DTC referring to “DTC Clearance” in this section if any.

Registration data check



- 1) Connect SUZUKI scan tool to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

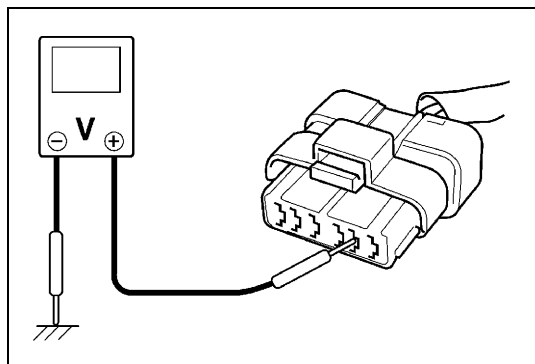
Special tool

(A): SUZUKI scan tool

- 2) Turn ignition switch to ON position.
- 3) Select “ECM registration” command in SELECT MODE menu of SUZUKI scan tool.
- 4) Confirm whether fuel injector type and transmission type installed on correspond to specification displayed on SUZUKI scan tool.
Register fuel injector type and transmission type into ECM referring to “ECM Registration” in this section when it does not correspond.
- 5) Push “EXIT” button of SUZUKI scan tool.

Mass air flow sensor (MAF sensor)

Inspection



NOTE:

Use voltmeter with high-impedance (10 k Ω /V minimum) or digital type voltmeter.

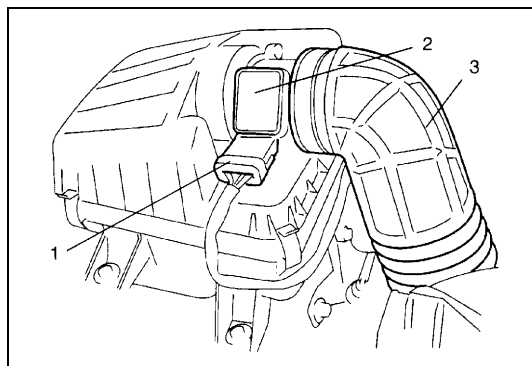
- 1) Connect voltmeter to “BLK/WHT” wire terminal of MAF sensor coupler disconnected and ground.
- 2) Turn ignition switch ON and check that voltage is battery voltage.
If not, check if wire harness is open or connection is poor.

- 3) Connect MAF sensor coupler to MAF sensor.
- 4) Check voltage at MAF sensor output terminal “E228-29” of ECM referring to “Voltage Check” in Section 6-1.

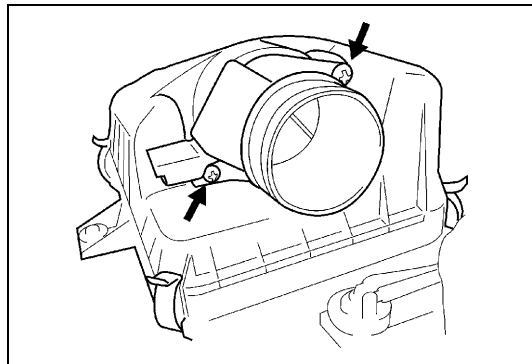
Voltage: About 0.6 V

- 5) Start engine and check that voltage is lower than 5 V and it rises as engine speed increases.
(Reference data: about 2.6 V at specified idle speed)
If check result is not as specified above, cause may lie in wire harness, coupler connection, MAF sensor or ECM.

Removal



- 1) Disconnect negative cable at battery and coupler (1) from MAF sensor (2).
- 2) Remove air cleaner outlet hose (3) from turbocharger and MAF sensor.

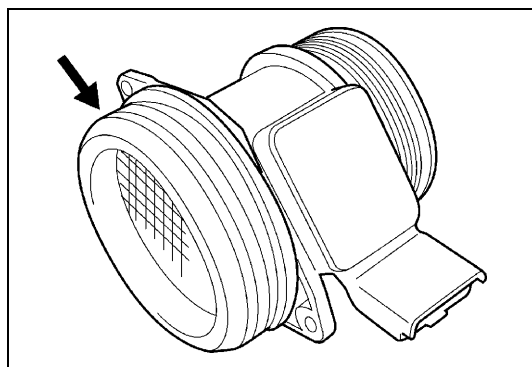


- 3) Remove MAF sensor from air cleaner case.

CAUTION:

- Don't disassemble MAF sensor.
- Do not expose MAF sensor to any shock.
- Do not blow compressed air by using air gun or the like.
- Do not put finger or any other object into MAF sensor. Malfunction may occur.

Installation



- 1) Check MAF sensor seal for deterioration and damage.
- 2) Install MAF sensor to air cleaner case.
- 3) Install air cleaner outlet hose.
- 4) Connect MAF sensor coupler securely.
- 5) Connect battery negative cable to battery.

Throttle position sensor (TP sensor) (accelerator pedal position sensor)

Inspection

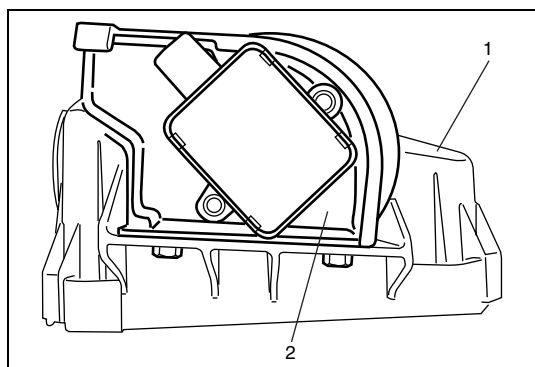
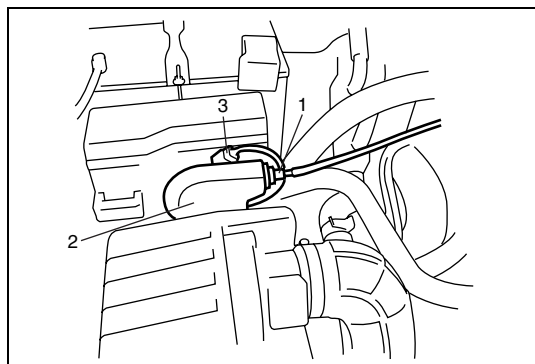
Check throttle position sensor referring to Diag. flow table of each emission control system spec in Section 6-1 as follows.

- Other than EOBD spec
 - “DTC P0121 (P0121) Throttle Position Circuit Range/Performance Problem”
 - “DTC P0221 (P0220) Throttle Position Range/Performance Problem 2”
 - “DTC P0604 (P0120) Throttle Position Sensor Monitoring System Malfunction”
- EOBD spec
 - “DTC P0220 (P0222/P0223/P0224) Pedal Position Sensor “No.1” Circuit (Low/High/Intermittent)”
 - “DTC P0225 (P0224/P0227/P0228/P2137) Pedal Position Sensor “No.2” Circuit (Intermittent/Low/High/Voltage Correlation)”

If malfunction is found, replace throttle position sensor.

Removal

- 1) Disconnect negative cable at battery.
- 2) Disconnect accelerator cable (1) from TP sensor (2).
- 3) Disconnect coupler (3) from TP sensor.
- 4) Disconnect air cleaner outlet hose from MAF sensor.



- 5) Remove air cleaner upper case (1).
- 6) Remove TP sensor (2) from air cleaner upper case.

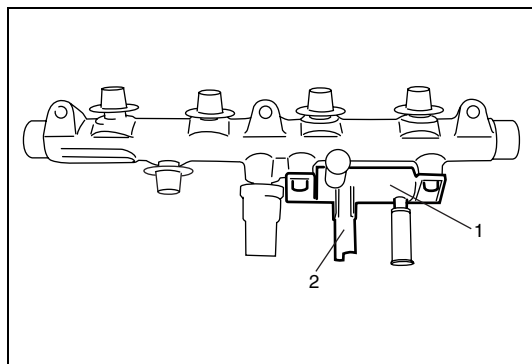
Installation

For installation, reverse removal procedure noting the following. Adjust accelerator cable play to specification referring to “Accelerator Cable Adjustment” in this section.

Fuel temperature sensor assembly

Removal

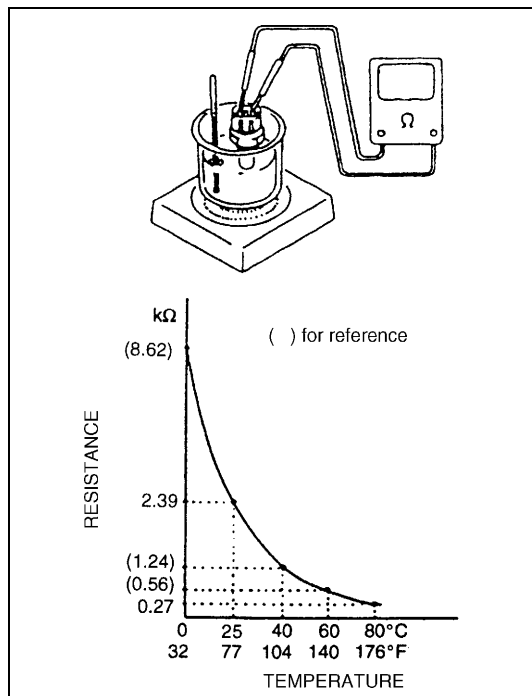
- 1) Disconnect negative cable at battery.
- 2) Remove common rail referring to “Common Rail (High Pressure Fuel Injection Rail)” in this section.
- 3) Remove fuel temperature sensor assembly (1) from common rail.



2. Fuel temperature sensor

Inspection

- 1) Remove fuel temperature sensor from its assembly.
- 2) Place sensor and a thermometer in water. Heat water gradually and verify that resistance between fuel temperature sensor terminals at following temperatures is as specified. If not as specified, replace fuel temperature sensor assembly.



Water temperature °C (°F)	Resistance (kΩ)
-40 (-40)	93.63
-20 (-4)	25.76
0 (32)	8.62
25 (77)	2.39
40 (104)	1.24
60 (140)	0.56
80 (176)	0.27
100 (212)	0.14
120 (248)	0.08

Installation

For installation, reverse removal procedure noting the following.

- Connect each fuel hoses and connectors securely.
- Install common rail referring to “Common Rail (High Pressure Fuel Injection Rail)” in this section.

Fuel (rail) pressure sensor

Removal

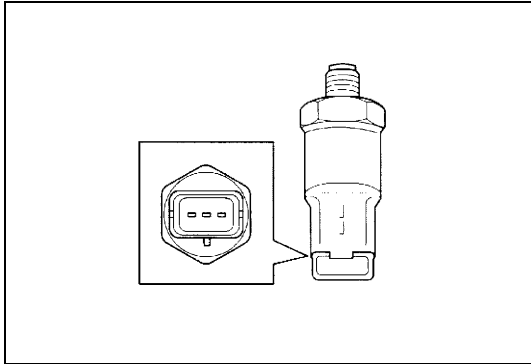
- 1) Disconnect negative cable at battery.
- 2) Remove strut tower bar referring to “Strut Tower Bar” in Section 3D.
- 3) Remove intercooler and intercooler outlet hose.
- 4) Remove fuel filter referring to “Fuel Filter Assembly” in Section 6C.
- 5) Disconnect connector from fuel pressure sensor (1).
- 6) Remove fuel pressure sensor from common rail (2).

Inspection

Inspect the fuel pressure sensor visually for the followings.

- Thread of fuel pressure sensor for deformed.
- Fuel pressure sensor for clogged.
- Terminal of fuel pressure sensor for damaged.

If defective is found, replace fuel pressure sensor.



Installation

Reverse removal procedure for installation noting the following.

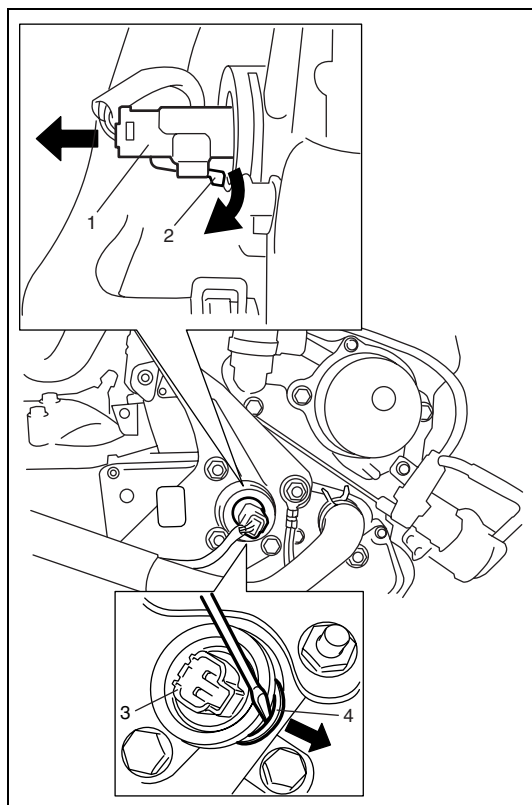
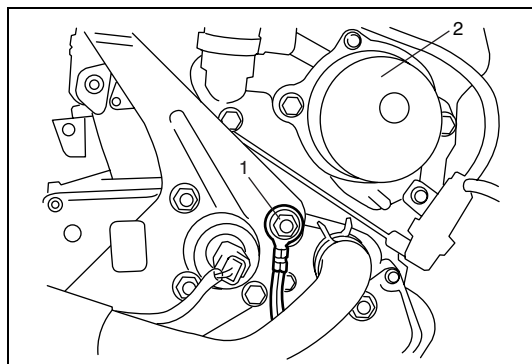
- Connect each fuel hoses and connectors securely.
- Check joints of fuel line for leakage referring to “Fuel Leakage Check” in this section.

Engine coolant temperature sensor (ECT sensor)

Removal

- 1) Remove battery.
- 2) Drain cooling system.
- 3) Remove intercooler from intercooler bracket.
- 4) Remove ground wire mounting nut (1).

2. Vacuum pump

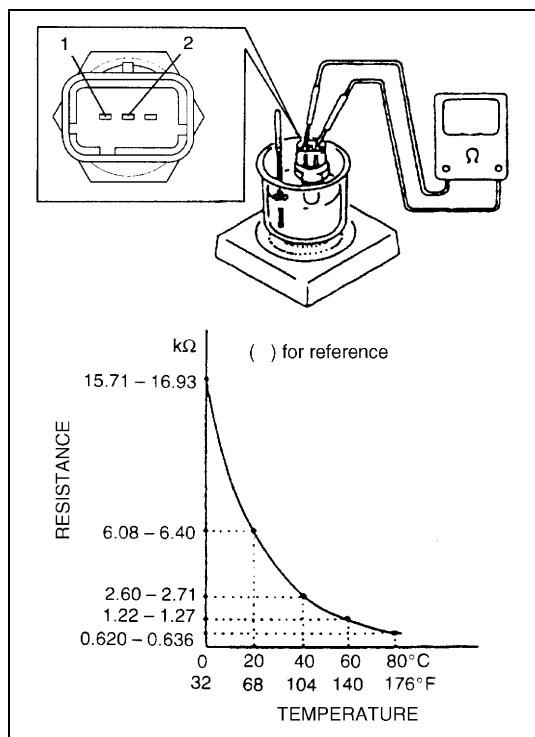


- 5) Disconnect ECT sensor connector (1) with unlocked connector lock.
- 6) Remove ECT sensor (3) from water box by removing clip (4).

Inspection

Immerse temperature sensing part of ECT sensor in water and measure resistance between sensor terminals (1) and (2) while heating water gradually.

If measured resistance doesn't show such characteristic as shown, replace ECT sensor.



Installation

Reverse removal procedure noting the following.

- Clean mating surfaces of sensor and water outlet box.
- Check O-ring for damage and replace ECT sensor if necessary.
- Install ECT sensor and then install ECT sensor clip securely.
- Connect coupler to sensor securely.
- Refill cooling system.

VSS

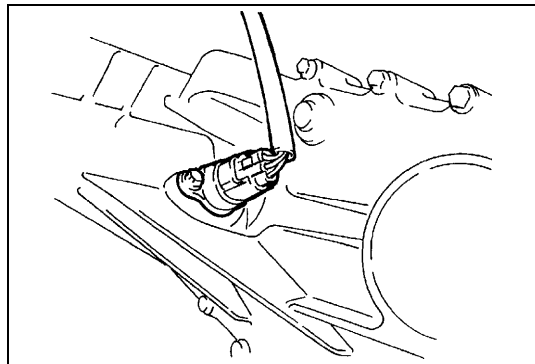
On-Vehicle Inspection

Check VSS referring to “DTC P0500 (P0500) Vehicle Speed Sensor Circuit Malfunction” (other than EOBD spec) or “DTC P0500 (P0500/P0501) Vehicle Speed Sensor (Malfunction/Performance)” (EOBD spec) in Section 6-1.

If malfunction is found, replace.

Removal, Inspection and Installation

Refer to “Speed Sensor” in Section 7D.



Camshaft position sensor (CMP sensor)

On-Vehicle Inspection

Check CMP sensor referring to “DTC P0340 (P0335/P0340) Camshaft Position Sensor Circuit Malfunction” (other than EOBD spec) or “DTC P0340 (P0341/P0343/P0344/P0016) Camshaft Position Sensor Circuit (Performance/High/Intermittent/Crankshaft Position-Camshaft Position Correlation)” (EOBD spec) in Section 6-1.

If malfunction is found, replace.

Air Gap Inspection/Adjustment

- 1) Remove upper timing belt cover.
- 2) Check clearance between CMP sensor (1) and camshaft hub (2), using thickness gauge (3).

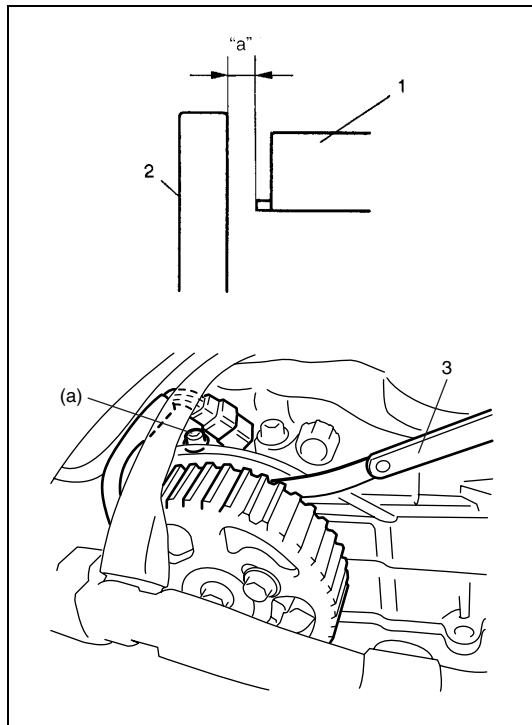
Clearance between CMP sensor and camshaft hub

“a”: 1.2 mm (0.047 in.)

If clearance is out of specification, move the CMP sensor and adjust the clearance.

Tightening torque

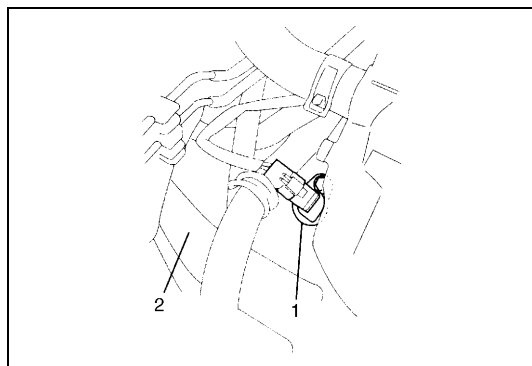
CMP sensor bolt (a): 2 N·m (0.2 kg-m, 2.8 lb-ft)



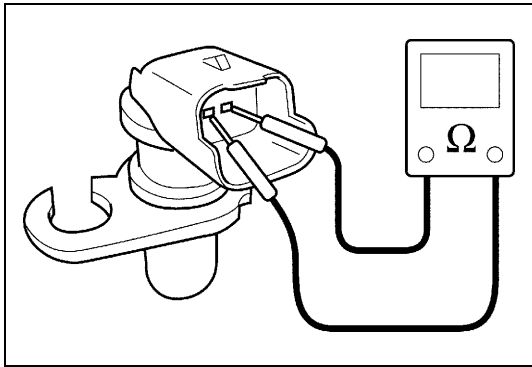
Crankshaft position sensor (engine speed sensor)

Removal

- 1) Remove battery.
- 2) Remove swirl control solenoid valve referring to “Swirl Control Solenoid Valve” in this section.
- 3) Disconnect connector from crankshaft position sensor.
- 4) Remove crankshaft position sensor (1) from transmission case (2).



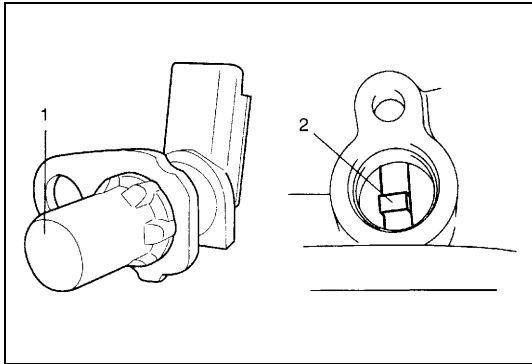
Inspection



- Verify that resistance between terminals of CKP sensor is within specification.

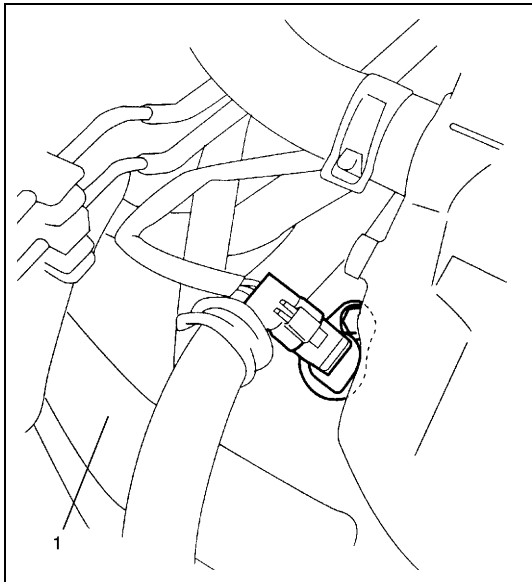
Resistance: 315 – 405 Ω

If not as specified, replace CKP sensor.



- Check to make sure that crankshaft position sensor (1) and sensor rotor tooth (2) is free from any metal particles and damage.

Installation

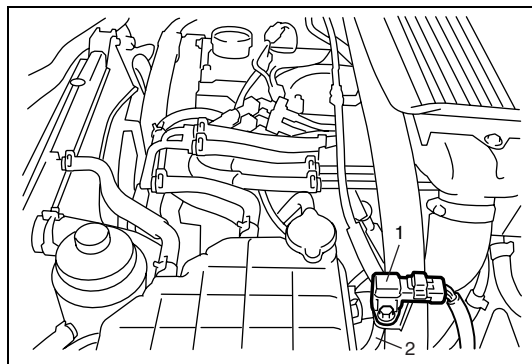


- 1) Install crankshaft position sensor to transmission case (1).
- 2) Tighten crankshaft position sensor mounting bolt.
- 3) Connect connector to it securely.
- 4) Install swirl control valve referring to “Swirl Control Solenoid Valve” in this section.
- 5) Install battery.

Intake air pressure sensor (manifold absolute pressure sensor)

Removal

- 1) Disconnect negative cable at battery.
- 2) Disconnect connector from intake air pressure sensor (1) and then pull off vacuum hose (2).
- 3) Remove intake air pressure sensor from strut tower bar.



Inspection

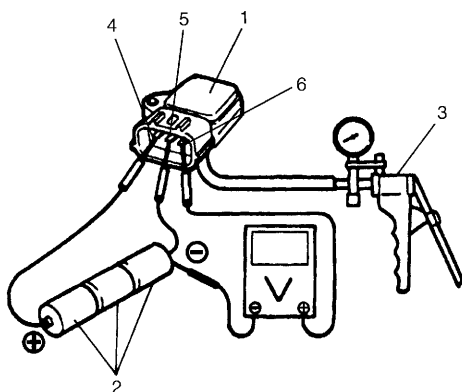
- 1) Arrange 3 new 1.5 V batteries (2) in series and connect its positive terminal to “Vin” (4) terminal of coupler and negative terminal to “Ground” (5) terminal. Then check voltage between “Vout” (6) and “Ground”.

Also, check if voltage reduces when vacuum is slowly applied up to 400 mmHg by using vacuum pump (3).

CAUTION:

As connection to wrong terminal will cause damage to intake air pressure sensor, make absolutely sure to connect properly as shown in the figure.

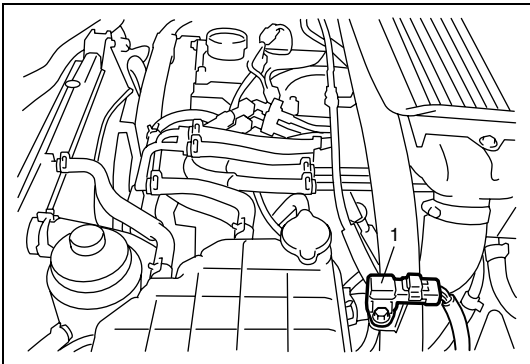
Output voltage (When sensor input voltage is 4.5 – 5.5 V, ambient temp. 20 – 30 °C, 68 – 86 °F)



ALTITUDE (Reference)		BAROMETRIC PRESSURE		OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(kPa)	(V)
0	0	760	100	1.9 – 2.7
2 000	610	707	94	1.8 – 2.6
		Under 707 over 634		
2 001	611	Under 634 over 567	94	1.7 – 2.4
5 000	1 524	Under 567 over 526	85	1.6 – 2.3
5 001	1 525	Under 526 over 500	85	1.5 – 2.2
8 000	2 438	Under 500 over 475	76	1.4 – 2.1
8 001	2 439	Under 475 over 450	76	1.3 – 2.0
10 000	3 048	Under 450 over 425	70	1.2 – 1.9

If check result is not satisfactory, replace intake air pressure sensor (1).

Installation

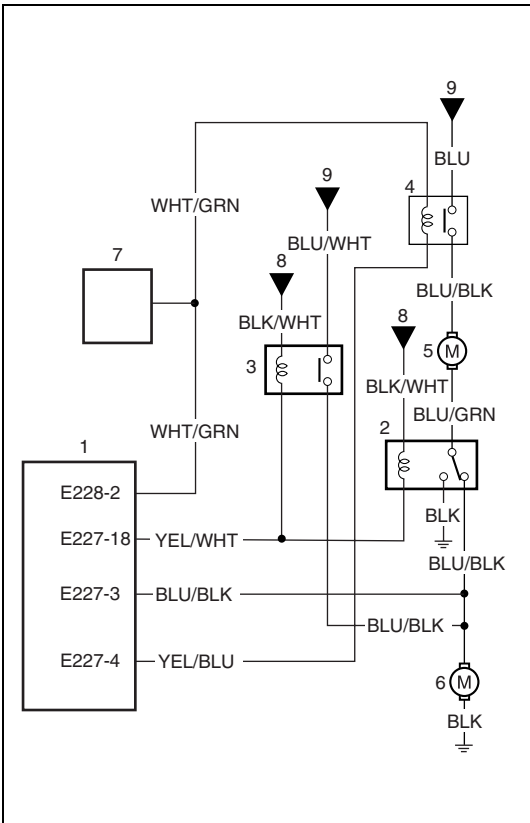


CAUTION:
 Before installing intake air pressure sensor hose, degrease connect part of hose and intercooler outlet hose. Otherwise, hose may become detached and cause turbo system failure.

- 1) Install intake air pressure sensor (1) to strut tower bar.
- 2) Connect connector and hose to intake pressure sensor securely.
- 3) Connect negative cable at battery.

Radiator fan control system

System Inspection



WARNING:
 Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECT sensor with the ignition switch in the “ON” position.

Check system for operation fererring to Diag. flow table of each emission control system spec in Section 6-1 as follows.

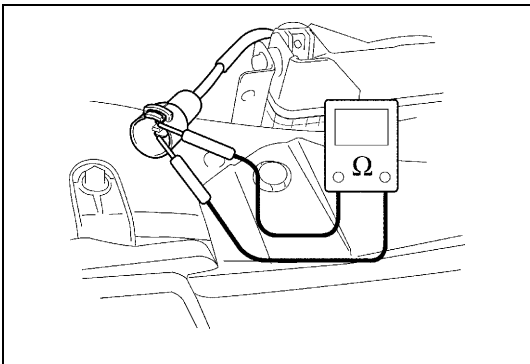
- Other than EOBD spec
 - “DTC P1108 Radiator Fan High Speed Circuit Malfunction”
 - “DTC P1109 Radiator Fan Low Speed Circuit Malfunction”
 - “DTC P1519 Radiator Fan Circuit Malfunction”
- EOBD spec
 - “DTC P0480 Fan 1 Control Circuit”
 - “DTC P0481 Fan 2 Control Circuit”
 - “DTC P0485 Fan Power/Ground Circuit”

If radiator fan fails to operate properly, check relay, radiator fan and electrical circuit.

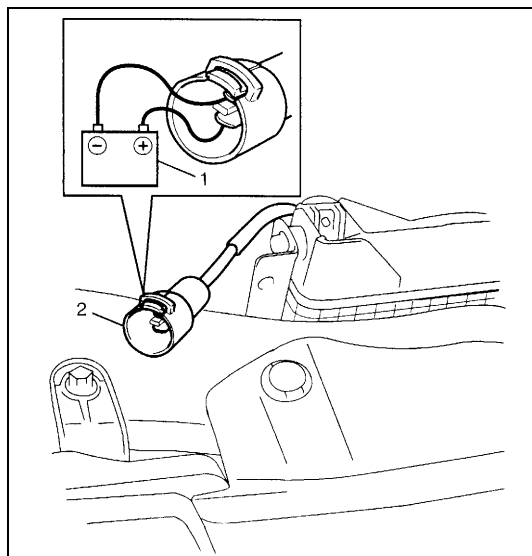
1. ECM	4. Radiator fan relay 3 (Low)	7. Double relay
2. Radiator fan relay 1 (High/low)	5. Radiator fan motor 1	8. From “IG COIL” fuse
3. Radiator fan relay 2 (High)	6. Radiator fan motor 2	9. From main fuse

Radiator fan

Inspection



- 1) Check continuity between each two terminals.
If there is no continuity, replace radiator fan motor.



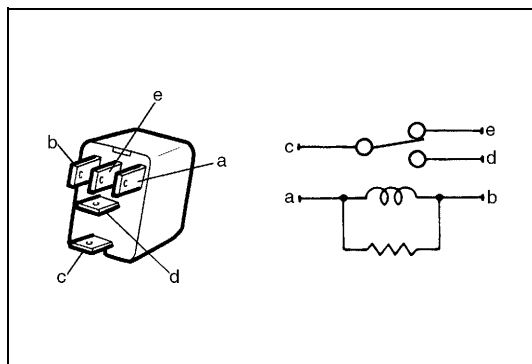
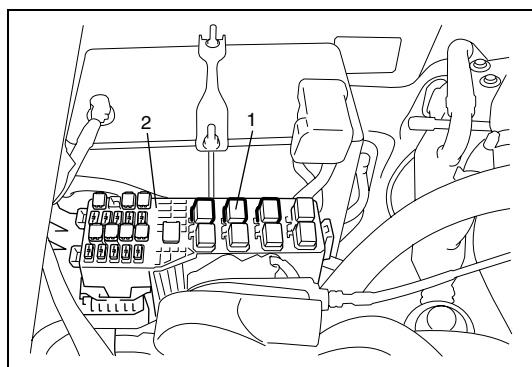
- 2) Connect battery (1) to radiator fan motor coupler (2) (black connector for radiator fan motor 1, white connector for radiator fan motor 2) as shown in figure, then check that the radiator fan motor operates smoothly.

If radiator fan motor does not operate smoothly, replace motor.

Radiator fan relay 1 (high/low)

Inspection

- 1) Disconnect negative cable at battery.
- 2) Remove radiator fan relay 1 (1) from fuse/relay box (2).



- 3) Check that there is no continuity between terminal “c” and “d”.

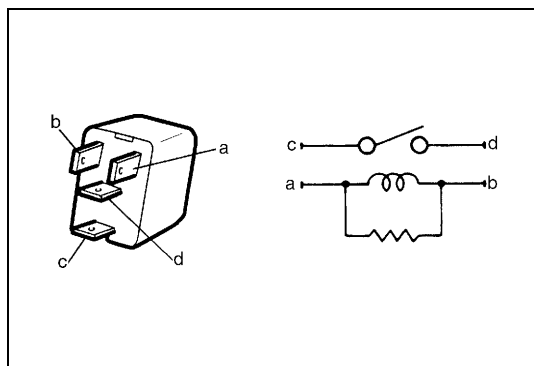
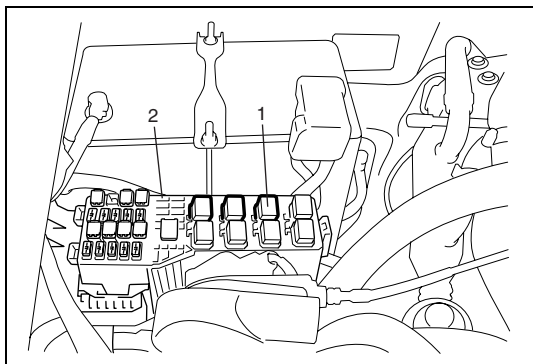
If there is continuity, replace relay.

- 4) Connect battery positive (+) terminal to terminal “b” of relay. Connect battery negative (–) terminal “a” of relay. Check continuity between terminal “c” and “d”. If there is no continuity when relay is connected to the battery, replace relay.

Radiator fan relay 2 (high)

Inspection

- 1) Disconnect negative cable at battery.
- 2) Remove radiator fan relay 2 (1) from fuse/relay box (2).

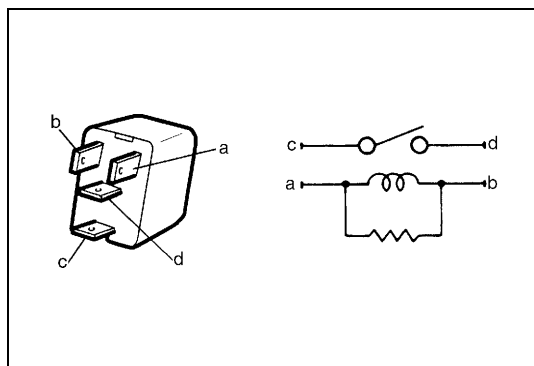
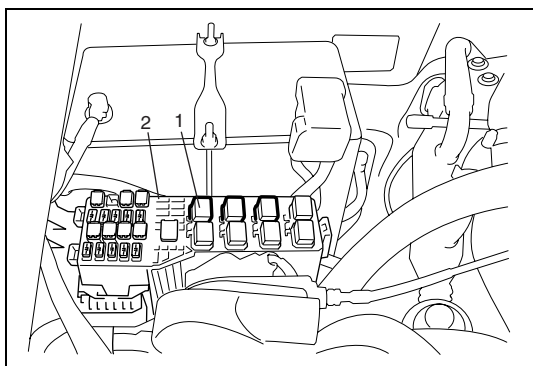


- 3) Check that there is no continuity between terminal "c" and "d".
If there is continuity, replace relay.
- 4) Connect battery positive (+) terminal to terminal "b" of relay.
Connect battery negative (–) terminal "a" of relay.
Check continuity between terminal "c" and "d".
If there is no continuity when relay is connected to the battery, replace relay.

Radiator fan relay 3 (low)

Inspection

- 1) Disconnect negative cable at battery.
- 2) Remove radiator fan relay 3 (1) from fuse/relay box (2).

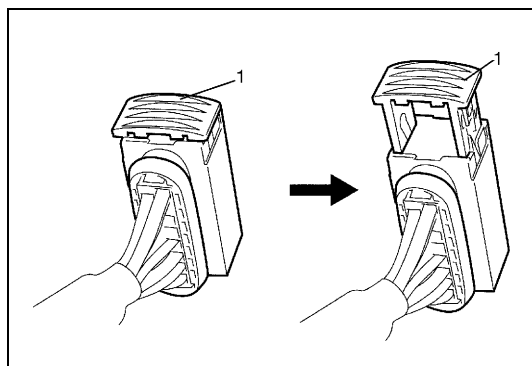
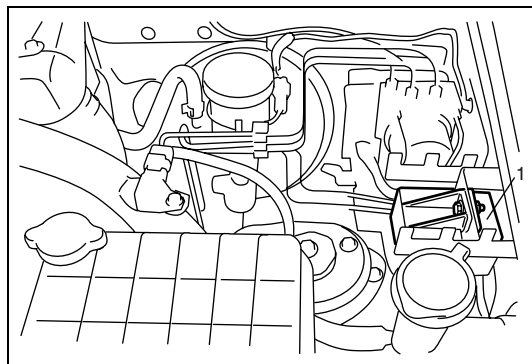


- 3) Check that there is no continuity between terminal "c" and "d".
If there is continuity, replace relay.
- 4) Connect battery positive (+) terminal to terminal "b" of relay.
Connect battery negative (–) terminal "a" of relay.
Check continuity between terminal "c" and "d".
If there is no continuity when relay is connected to the battery, replace relay.

Double relay

Removal

- 1) Disconnect negative cable at battery.
- 2) Remove double relay (1) from bracket.

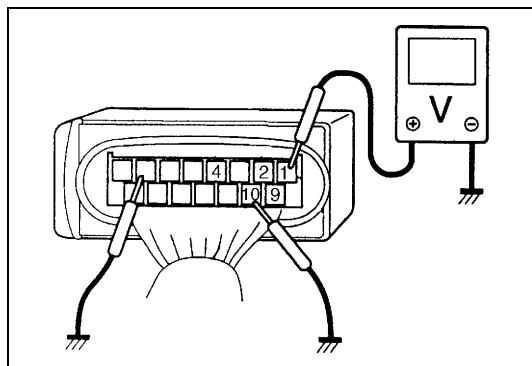
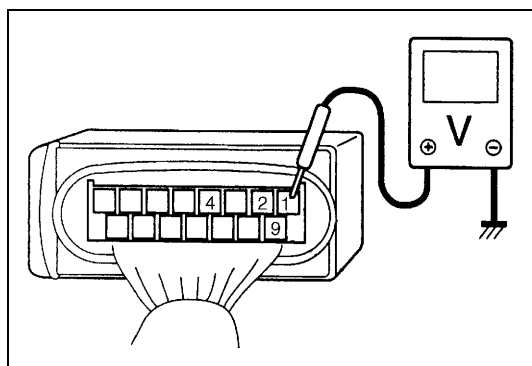


- 3) Disconnect connector from double relay by pulling off lock (1).

Inspection

- 1) Connect connector to double relay.
- 2) Remove "FUEL PUMP" fuse from fuse box.
- 3) Disconnect ECM connector.
- 4) Connect negative cable at battery.
- 5) Check voltage between each terminal and ground.
If not as specified, replace double relay.

Terminal "1", "2", "4" and "9": 0 V



- 6) Using service wire, ground terminal "7" and terminal "10".
- 7) Check voltage between each terminal and ground.
If not as specified, replace double relay.

Terminal "1", "2", "4" and "9": Battery voltage

Installation

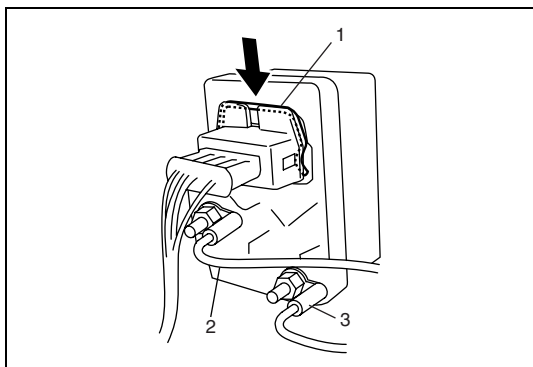
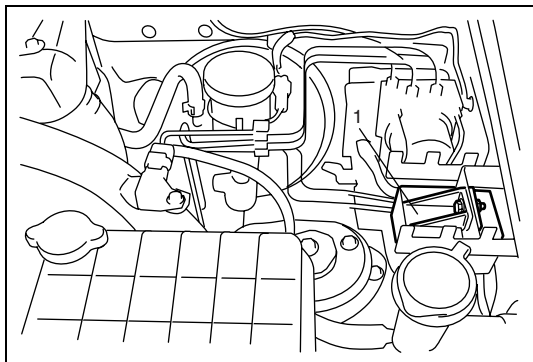
Reverse removal procedure for installation.

Pre/post heating relay (control unit)

Removal

Other than EOBD spec

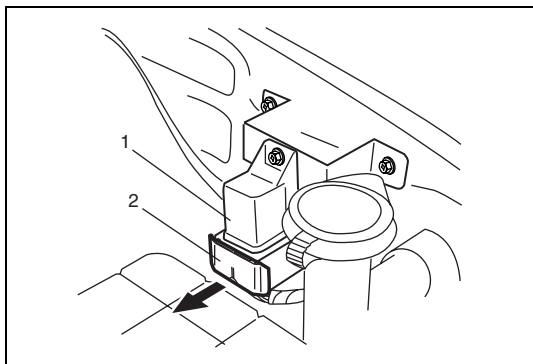
- 1) Disconnect negative cable at battery.
- 2) Remove pre/post heating control unit (1) from bracket by removing the mounting bolt.



- 3) Disconnect connector from pre/post heating control unit by pushing lock (1).
- 4) Disconnect "WHT" wire terminal (2) and "BLK" wire terminal (3) by removing the pre/post heating control unit nuts.

EOBD spec

- 1) Disconnect negative cable at battery.
- 2) Disconnect connector from pre/post heating control unit (1) by pulling off lock lever (2).
- 3) Remove pre/post heating control unit from bracket by removing the mounting bolt.



Installation

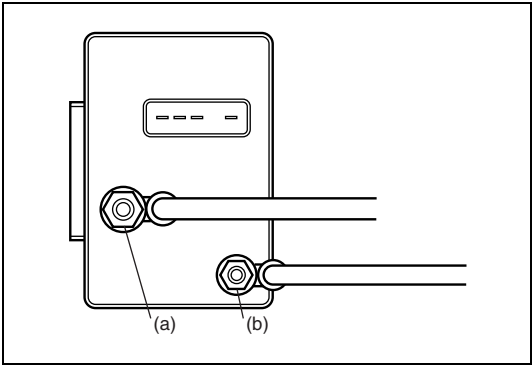
For installation, reverse removal procedure noting the following.

- For other than EOBD spec, tighten pre/post heating control unit nuts to specified torque.

Tightening torque

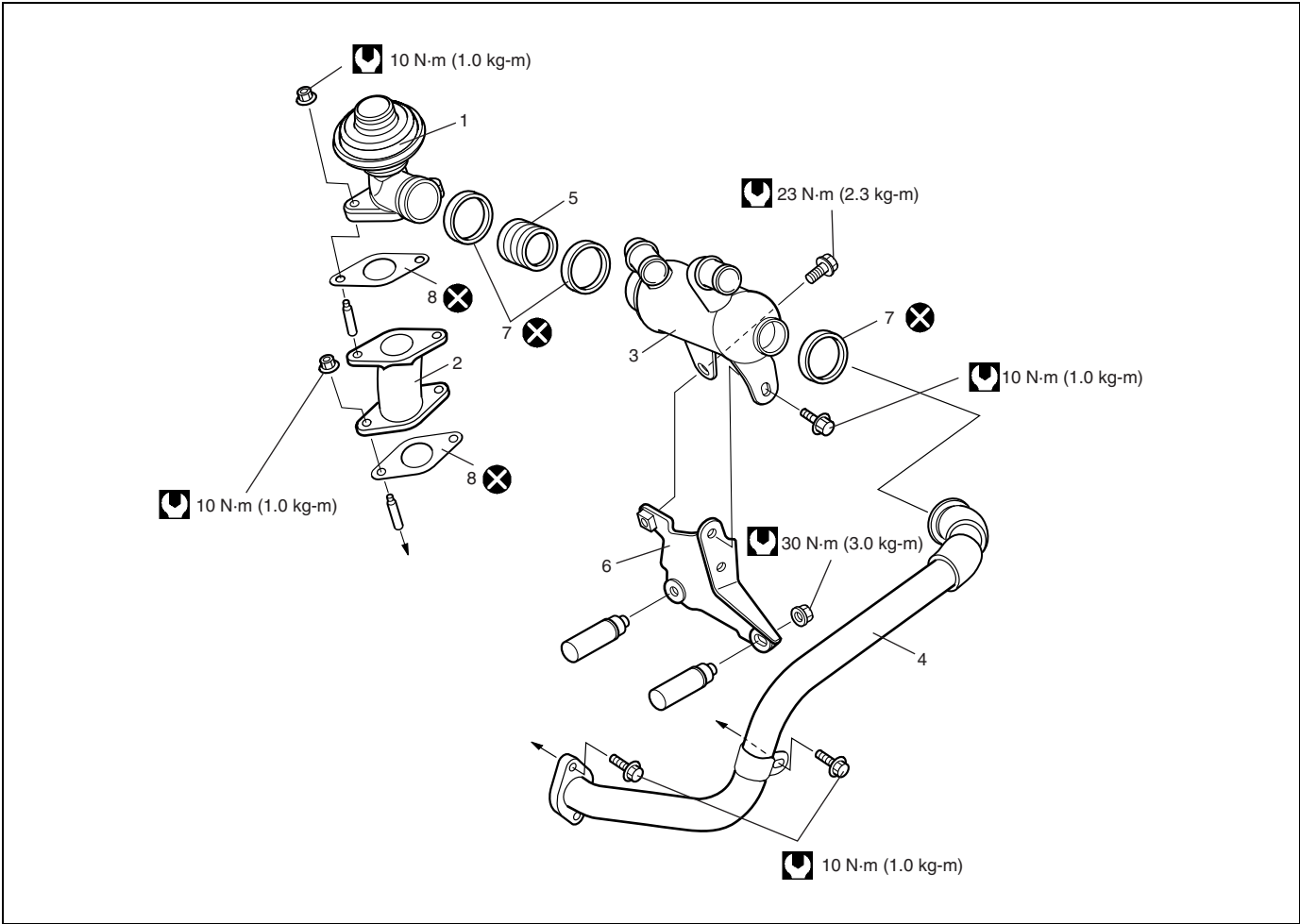
Pre/post heating control unit nut (a): 6.5 N·m (0.65 kg-m, 5.0 lb-ft)

Pre/post heating control unit nut (b): 4.5 N·m (0.45 kg-m, 3.5 lb-ft)



EGR System

EGR valve component

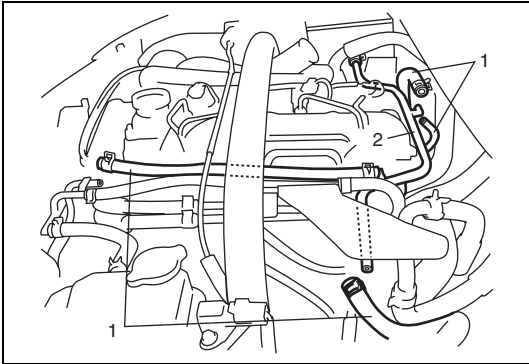


1. EGR valve	3. EGR cooler	5. EGR pipe No.2	7. EGR pipe clamp	 : Tightening torque
2. EGR valve spacer	4. EGR pipe No.1	6. EGR bracket	8. Gasket	 : Do not reuse

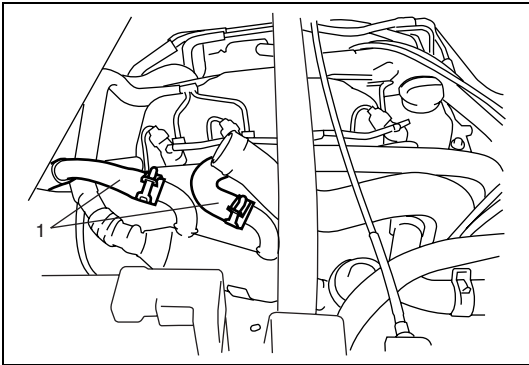
EGR valve and EGR cooler

Removal

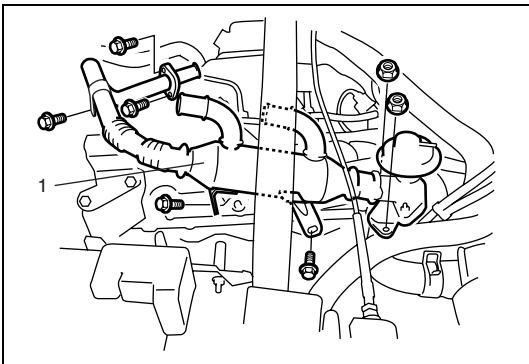
- 1) Disconnect negative (–) cable at battery.
- 2) Drain cooling system and tighten drain plug.
- 3) Remove intercooler from intercooler bracket.
- 4) Disconnect vacuum hoses (1) from vacuum pipe.
- 5) Remove vacuum pipe (2) from intercooler bracket.



- 6) Disconnect EGR cooler hoses (1) from EGR cooler.



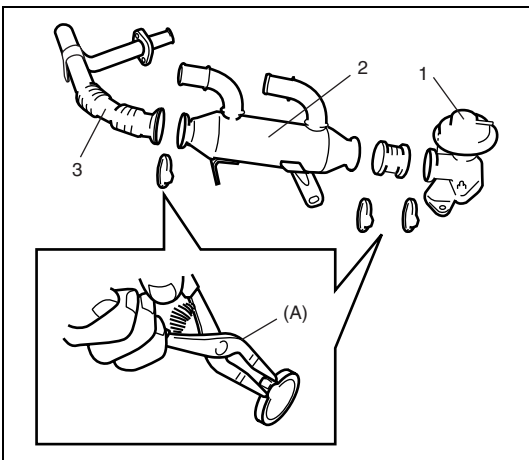
- 7) Remove EGR assembly (1) from exhaust manifold and intake manifold/camshaft housing.

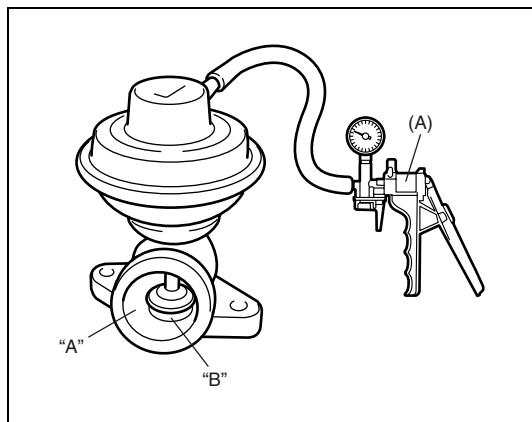


- 8) Remove EGR valve (1) from EGR cooler (2).
- 9) Remove EGR pipe (3) from EGR cooler by using special tool.

Special tool

(A): 09919-46510/OUT0000110





Inspection

- 1) Using a vacuum pump, apply vacuum to diaphragm chamber.

Check EGR valve for operation.

Vacuum less than about 24 kPa (180 mmHg):

EGR valve close

Vacuum about 24 kPa (180 mmHg) or more:

EGR valve open

Special tool

(A): 09917-47910

If not as specified, replace EGR valve.

Installation

For installation, reverse removal procedure noting the following.

- Clean mating surfaces of EGR valve and exhaust manifold.
- Install new EGR pipe clamps (2) by using special tool.

Special tool

(A): 09919-46510/OUT0000110

- Use new gasket (1).
- Tighten EGR valve nuts to specified torque.

Tightening torque

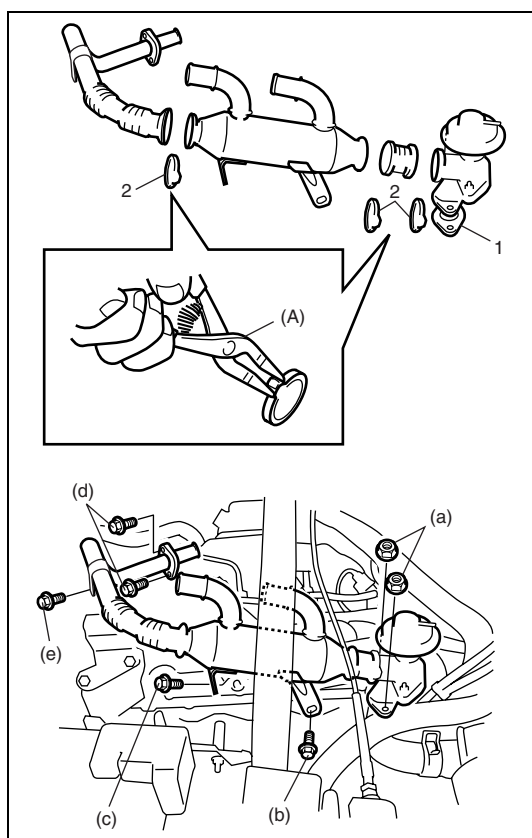
EGR valve nut (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

EGR cooler mounting bolt (b): 23 N·m (2.3 kg-m, 16.5 lb-ft)

EGR cooler mounting bolt (c): 10 N·m (1.0 kg-m, 7.5 lb-ft)

EGR pipe joint bolt (d): 10 N·m (1.0 kg-m, 7.5 lb-ft)

EGR pipe mounting bolt (e): 10 N·m (1.0 kg-m, 7.5 lb-ft)



Vacuum hose

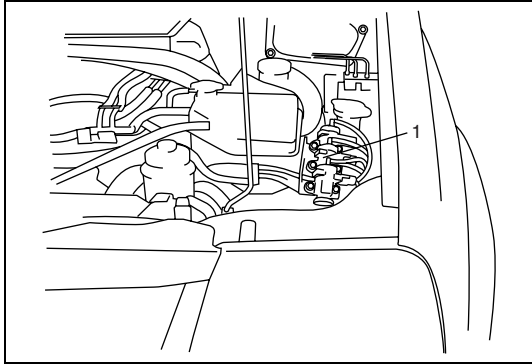
Inspection

Check hose for connection, leakage, clogs and deterioration. Replace as necessary.

EGR solenoid valve

Removal

- 1) Disconnect negative cable at battery.



- 2) Remove EGR solenoid valve (1) from bracket.
- 3) Disconnect connector from EGR solenoid valve (1).
- 4) Disconnect vacuum hoses from EGR solenoid valve.

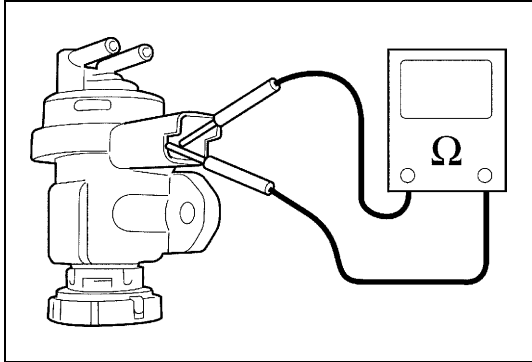
Inspection

Measure resistance between each two terminals.

If resistance is out of specification, replace EGR solenoid valve.

EGR solenoid valve resistance

12 – 18 Ω at 25 °C (77 °F)



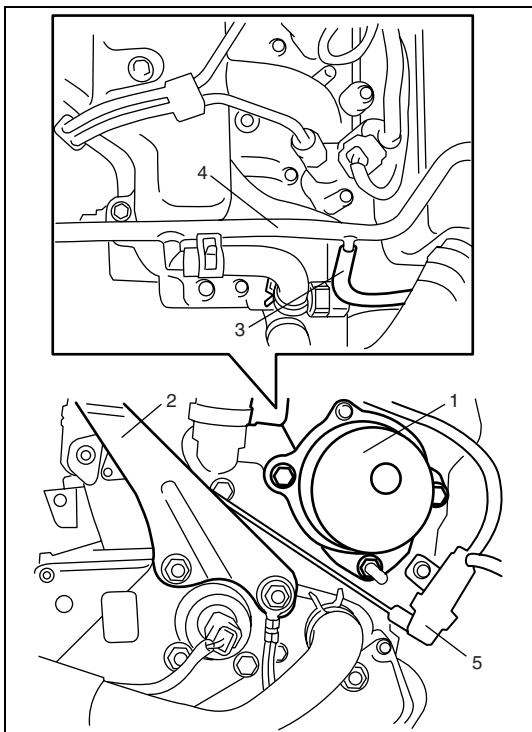
Installation

For installation, reverse removal procedure.

Swirl Control Solenoid Valve

Removal

- 1) Remove battery.
- 2) Remove vacuum pump (1) referring to “Vacuum Pump” in this section.
- 3) Remove EGR pipe bracket (2) from water box.
- 4) Disconnect vacuum hose (3) from vacuum pipe (4).
- 5) Disconnect connector from swirl control solenoid valve.
- 6) Remove swirl control solenoid valve assembly (5) from cylinder head.



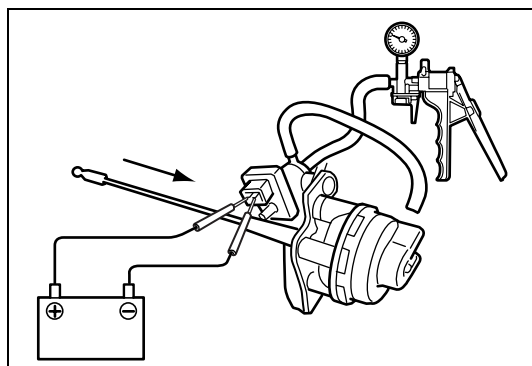
Installation

Reverse removal procedure for installation noting the following.

- Install vacuum pump referring to “Vacuum Pump” in this section.
- Connect connector to swirl control solenoid valve securely.
- Connect vacuum hose securely.

Inspection

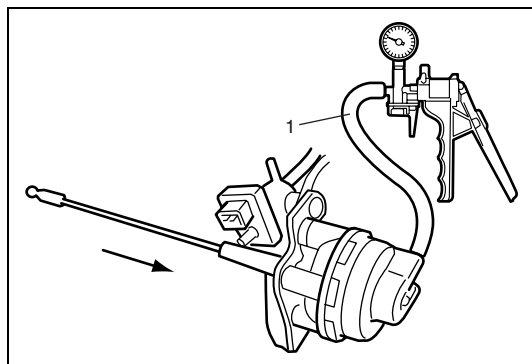
Swirl control solenoid valve



- 1) Connect 12 V battery to swirl control solenoid valve terminals as shown in the figure.
- 2) Check that swirl control solenoid valve opens when battery voltage is added.

If check result is not satisfactory, replace swirl control solenoid valve.

Swirl control actuator



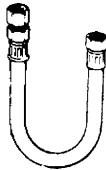
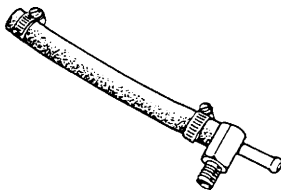
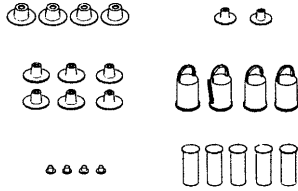
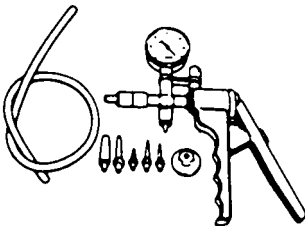
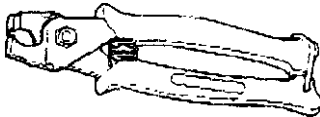
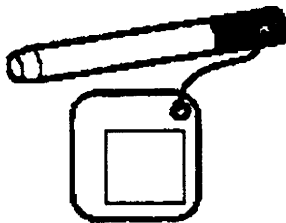
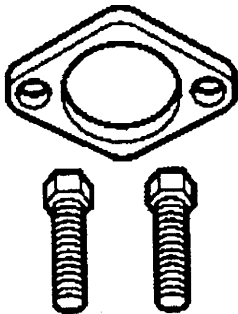
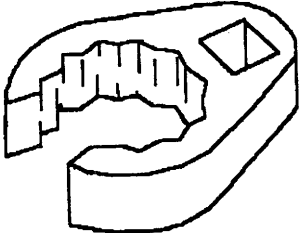
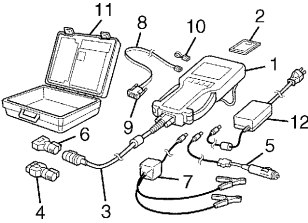
- 1) Disconnect vacuum hose (1) from swirl solenoid valve.
- 2) Using a vacuum pump, apply vacuum to diaphragm chamber.
- 3) Confirm that actuator rod of swirl control valve moves and it keeps the position when vacuum is added.

If check result is not satisfactory, replace swirl control solenoid valve.

Tightening Torque Specifications

Fastening part	Tightening torque		
	N·m	kg-m	lb-ft
Vacuum pump bolt and nut	20	2.0	14.5
Glow plug	10	1.0	7.5
EGR valve nut	10	1.0	7.5
EGR cooler mounting bolt 8 mm	23	2.3	16.5
EGR cooler mounting bolt 6 mm	10	1.0	7.5
EGR pipe joint bolt	10	1.0	7.5
EGR pipe mounting bolt	10	1.0	7.5
Fuel injector nut	4 N·m (0.4 kg-m, 3.0 lb-ft) and then turn to 45° once.		
Fuel injector side high pressure pipe union nut	27.5	2.8	20.0
Common rail side high pressure pipe union nut	26	2.6	19.0
Fuel pressure sensor	40	4.0	29.0
Fuel temperature sensor mounting bolt	8.5	0.9	6.5
Common rail bolt	25	2.5	18.0
Injection pump side high pressure supply pipe union nut	26	2.6	19.0
Common rail side high pressure supply pipe union nut	26	2.6	19.0
Injection pump bolt	22.5	2.3	16.5
Injection pump pulley nut	50	5.0	36.5
CMP sensor bolt	2	0.2	2.8

Special Tools

 09912-58432 Pressure hose	 09912-58442 Pressure gauge	 09912-56530 3 way joint and hose	 09916-50010 Fuel system, plug set
 09917-47910 Vacuum pump gauge	 09919-46510 (OUT0000110) Clamp pliers	 09919-56570 (OUT0000157) Injection pump pulley lock	 09919-56580 (OUT0000158) Injection pump pulley remover
 09950-76510 (OUT0000148) Pipe spanner	 Tech 2 kit (SUZUKI scan tool) (See NOTE)		

NOTE:

This kit includes the following items.

1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable,
6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter,
10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 6G

CRANKING SYSTEM

(2.0 kW Reduction Type)

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

CONTENTS

General Description	6G-2	Inspection.....	*
Cranking Circuit.....	6G-2	Inspection.....	6G-7
Starting Motor Circuit	6G-2	Performance Test	*
Starting Motor.....	6G-3	Performance test.....	6G-10
Diagnosis	6G-4	Specifications.....	6G-11
Unit Repair Overhaul	6G-5	1.2 kW type (1.4 kW type).....	*
Generator	6G-5	0.9 kW type	*
Dismounting and Remounting	*	2.0 kW reduction type	6G-11
Dismounting	6G-5	Required Service Materials	6G-11
Remounting	6G-5	Special Tool.....	*
Disassembly	*	Tightening Torque Specifications	6G-12
Reassembly	*		
Disassembly and reassembly.....	6G-6		

General Description

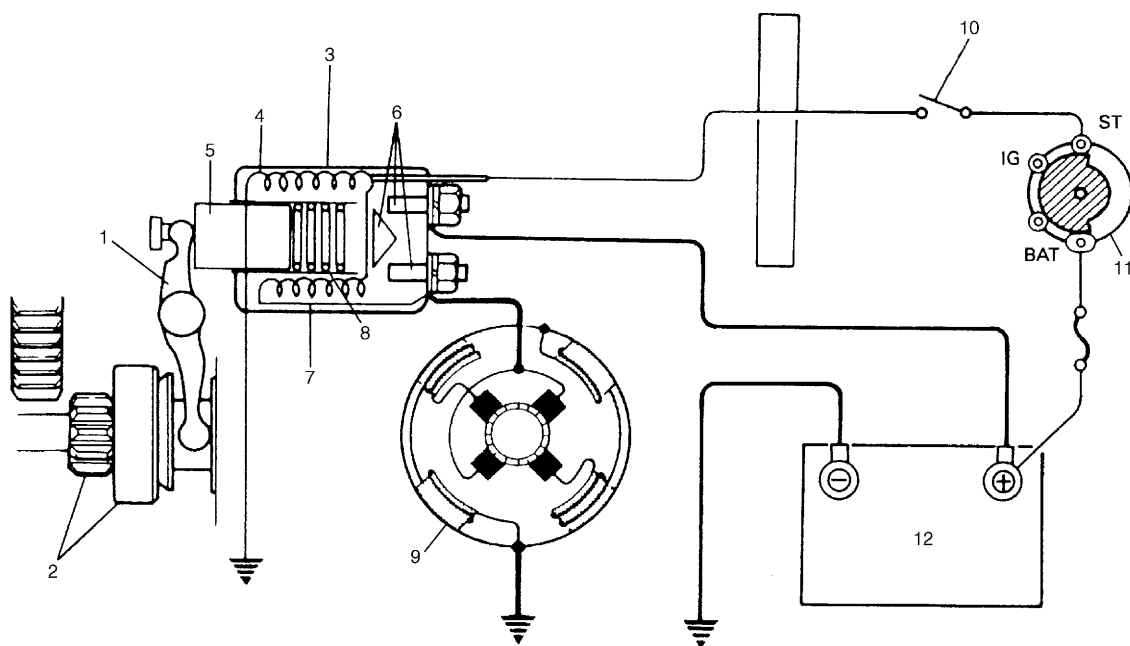
Cranking Circuit

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically.

Only the starting motor will be covered in this section.

Starting Motor Circuit

- The magnetic switch coils are magnetized when the ignition switch is closed.
- The resulting plunger and pinion drive lever movement causes the pinion to engage the engine flywheel gear and the magnetic switch main contacts to close, and cranking takes place.
- When the engine starts, the pinion over-running clutch protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage.

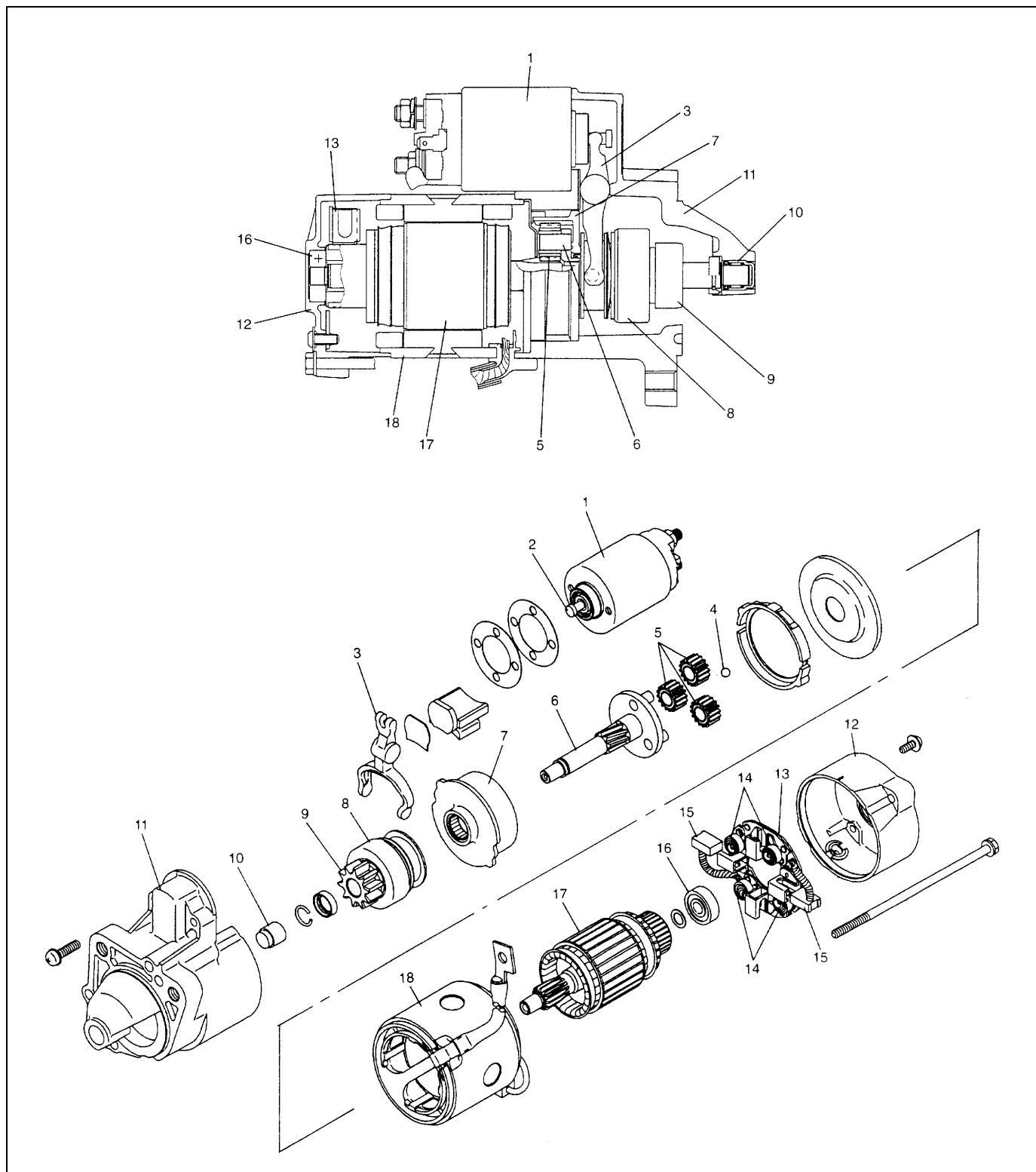


1. Pinion driver lever	5. Plunger	9. Starting motor
2. Pinion and Over running clutch	6. Magnetic switch contacts	10. A/T: Transmission range switch (shift lever switch)
3. Magnetic switch	7. Pull in coil	11. Ignition and Starting motor switch
4. Hold in coil	8. Return spring	12. Battery

Starting Motor

The starting motor consists of parts shown in below.

The magnetic switch assembly and parts in the starting motor are enclosed in the housings so that they will be protected against possible dirt and water splash.



1. Magnetic switch	6. Planetary carrier shaft	11. Front housing	16. Bearing
2. Plunger	7. Internal gear	12. Rear bracket	17. Armature
3. Lever	8. Over-running clutch	13. Brush holder	18. Yoke
4. Ball	9. Pinion gear	14. Brush spring	
5. Planetary gear	10. Bush	15. Brush	

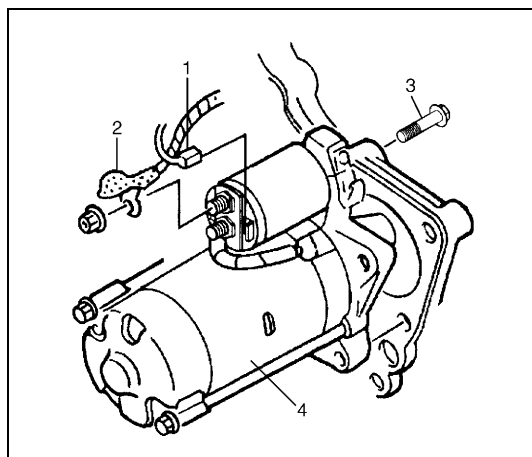
Diagnosis

Condition	Possible Cause	Correction
Motor not running	Operating sound of magnetic switch heard	
	Battery run down	Recharge battery.
	Battery voltage too low due to battery deterioration	Replace battery.
	Loose battery cable connections	Retighten.
	Burnt main contact point, or poor contacting action of magnetic switch	Replace magnetic switch.
	Brushes are seating poorly or worn down	Repair or replace.
	Weakened brush spring	Replace.
	Burnt commutator	Replace armature.
	Poor grounding of field coil	Repair.
	Layer short-circuit of armature	Replace.
	Crankshaft rotation obstructed	Repair.
Starting motor running but too slow (small torque)	If battery and wiring are satisfactory, inspect starting motor	
	Insufficient contact of magnetic switch main contacts	Replace magnetic switch.
	Layer short-circuit of armature	Replace.
	Disconnected, burnt or worn commutator	Repair commutator or replace armature.
	Poor grounding of field coil	Repair.
	Worn brushes	Replace brush.
	Weakened brush springs	Replace spring.
	Burnt or abnormally worn end bush	Replace bush.

Unit Repair Overhaul

Generator

Dismounting



- 1) Disconnect negative cable at battery.
- 2) Remove strut tower bar.
- 3) Disconnect magnetic switch lead wire ("S" terminal) (1) and battery cable (2) from starting motor terminal ("B" terminal).
- 4) Drain coolant.
- 5) Hoist vehicle.
- 6) Remove water outlet pipe mounting bolts from left side engine mounting.
- 7) Disconnect radiator outlet hose No.1 from water outlet box.
- 8) Remove starting motor mount bolts (3) and remove starting motor (4).

Remounting

Reverse dismounting procedure to install starting motor, noting the following points.

- Tighten starting motor mount bolt and battery cable nut.

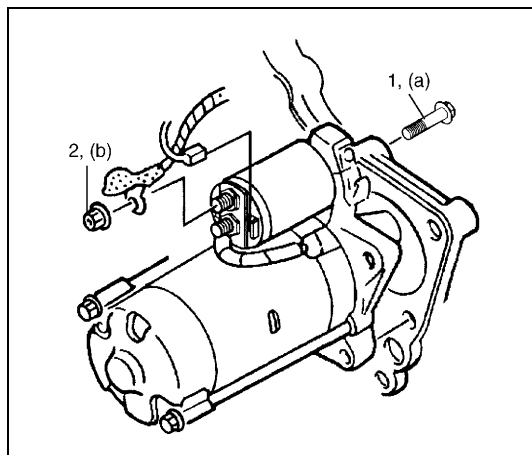
Tightening torque

Starting motor mount bolt

(a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

Battery cable nut

(b): 11 N·m (1.1 kg-m, 8.0 lb-ft)

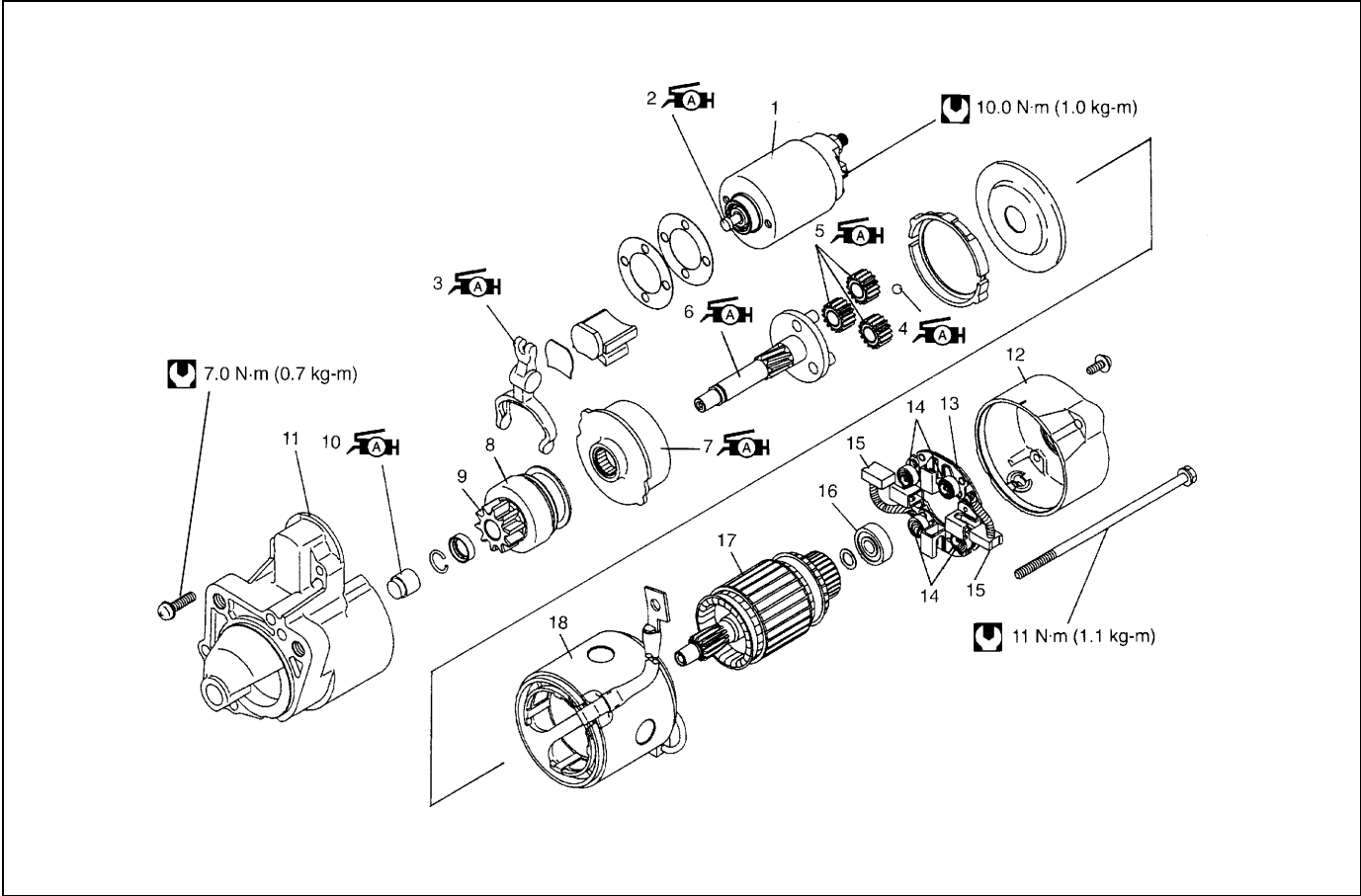


- Refill cooling system with proper coolant referring to "Coolant" and "Cooling System Flush and Refill" in Section 6B.

Disassembly and reassembly

NOTE:

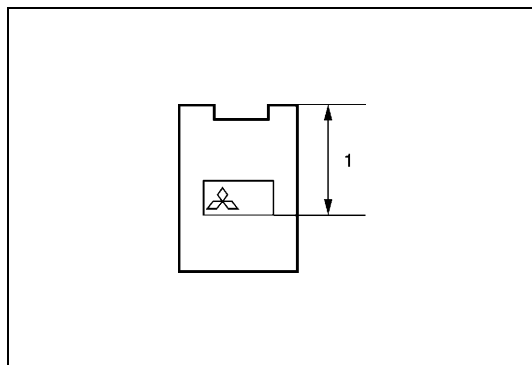
- Disassemble in order shown in figure.
- For reassembly, reverse disassembly procedure.
- Tighten bolt and nut to specified torque.
- Upon completion of reassembly, carry out “Performance Test” later in this section.



1. Magnetic switch	8. Over-running clutch	15. Brush
2. Plunger	9. Pinion gear	16. Bearing
3. Pinion drive lever	10. Front bush	17. Armature
4. Ball	11. Front housing	18. Yoke
5. Planetary gear	12. Rear bracket	Apply grease (99000-25010)
6. Planetary carrier shaft	13. Brush holder	Tightening torque
7. Internal gear	14. Brush spring	

Inspection

BRUSH



- Check brushes for wear.
Measure length of brushes and if below limit, replace brush.

Brush length

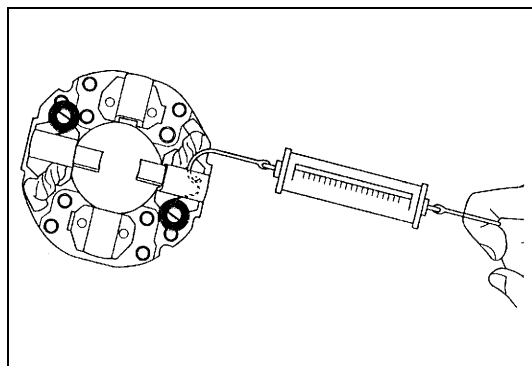
Standard	18.0 mm (0.71 in.)
Limit	11.0 mm (0.43 in.)

1. Wear limit

- Install brushes to each brush holder and check for smooth movement.

SPRING

Inspect brush springs for wear, damage or other abnormal conditions. Replace if necessary.

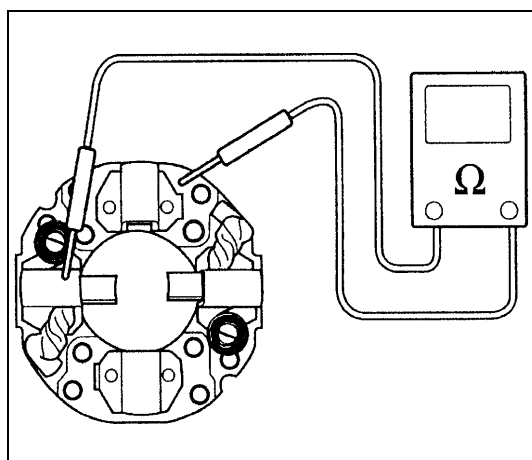


Brush spring tension

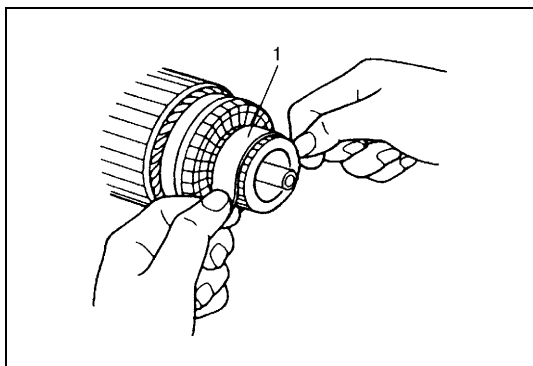
Standard	3.1 kg (6.8 lb)
Limit	1.5 kg (3.3 lb)

BRUSH HOLDER

- Check movement of brush in brush holder. If brush movement within brush holder is sluggish, check brush holder for distortion and sliding faces for contamination. Clean or correct as necessary.
- Check for continuity between insulated brush holder and brush holder plate. Replace brush and brush holder if there is continuity.

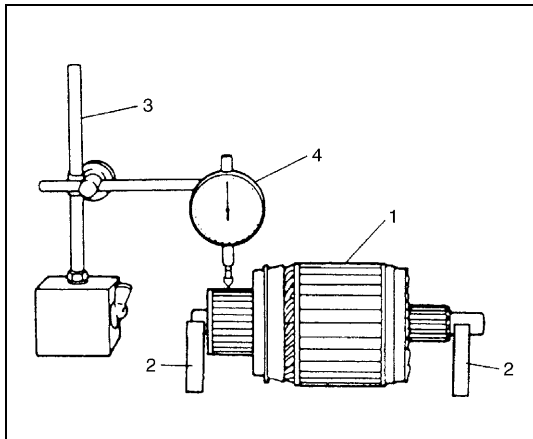


ARMATURE



- Inspect commutator for dirt or burn. Correct with sandpaper or lathe, if necessary.

1. Sandpaper (#300~400)



- Check commutator for uneven wear with armature (1) supported on V-blocks (2). If deflection of dial gauge (4) pointer exceeds limit, repair or replace.

NOTE:

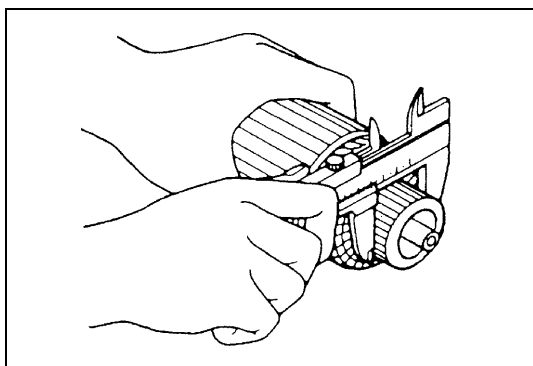
Below specification presupposes that armature is free from bend. Bent armature must be replaced.

Commutator out of round

Standard: 0.05 mm (0.002 in.) or less

Limit: 0.1 mm (0.004 in.)

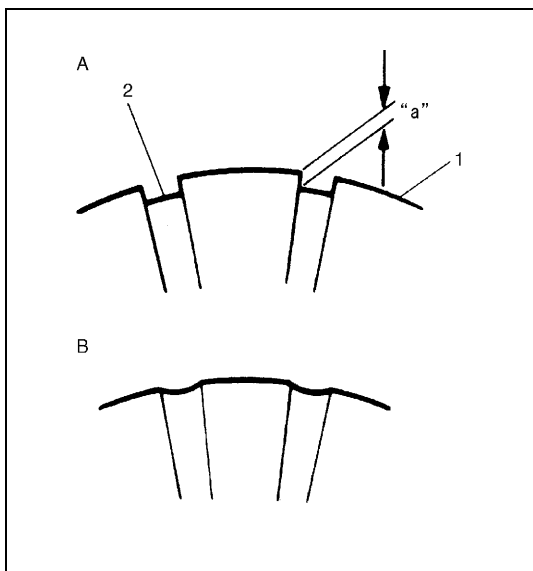
3. Magnetic stand



- Inspect commutator for wear. If diameter is below limit, replace armature.

Commutator outside diameter

Limit: 31.4 mm (1.24 in.)



- Inspect commutator for insulator (2) depth. Correct or replace if below limit.

Commutator insulator depth "a"

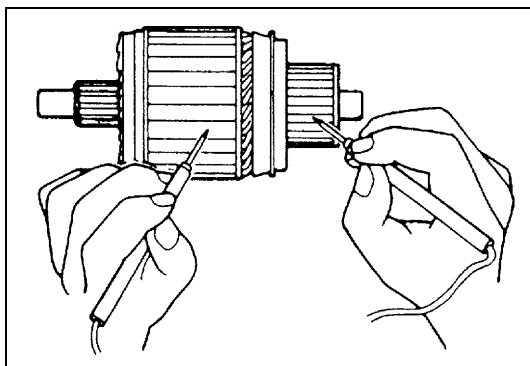
Standard: 0.5 – 0.8 mm (0.02 – 0.031 in.)

A: Correct

B: Incorrect

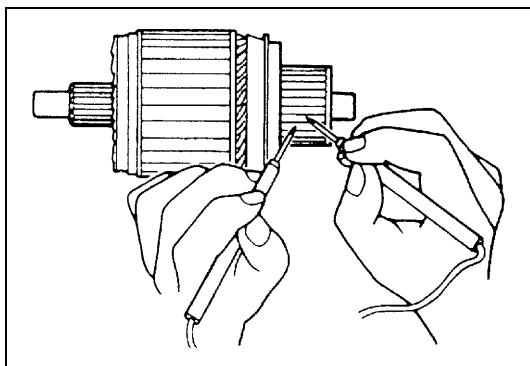
1. Commutator segment

Ground Test



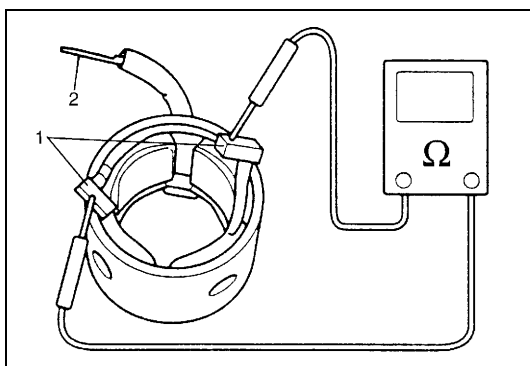
Check commutator and armature core. If there is continuity, armature is grounded and must be replaced.

Open Circuit Test

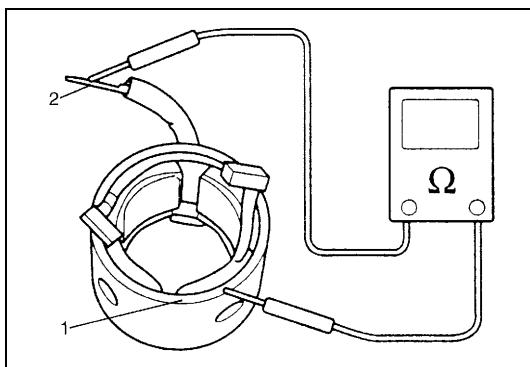


Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and armature must be replaced.

FIELD COIL



- Check for continuity between brushes (1) and between connector (2) and brush (1). Replace field coil if there is continuity.



- Check for continuity between connector (2) and yoke (1). Replace field coil if there is continuity.

Performance test

CAUTION:

Each test must be performed within 3 – 5 seconds to avoid coil from burning.

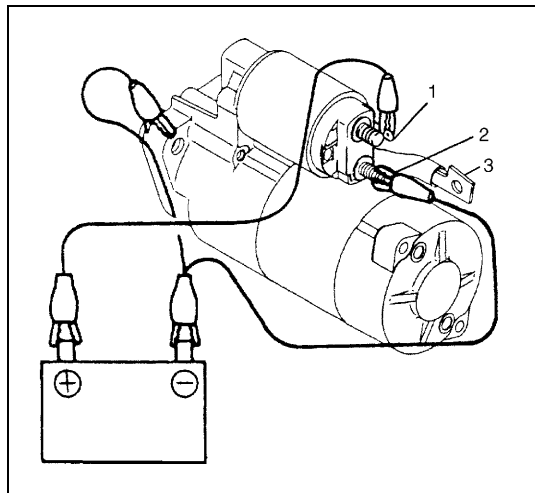
PULL-IN TEST

Connect battery to magnetic switch as shown. Check that plunger and pinion move outward. If plunger and pinion don't move, replace magnetic switch.

NOTE:

Before testing, disconnect lead wire from terminal "M".

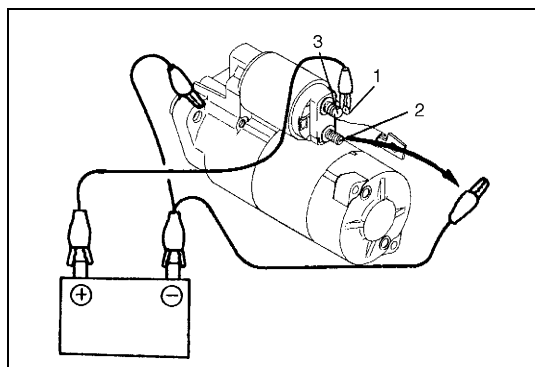
1. Terminal "S"
2. Terminal "M"
3. Lead wire (switch to motor)



HOLD-IN TEST

While connected as above with plunger out, disconnect negative lead from terminal "M". Check that plunger and pinion remain out. If plunger and pinion return inward, replace magnetic switch.

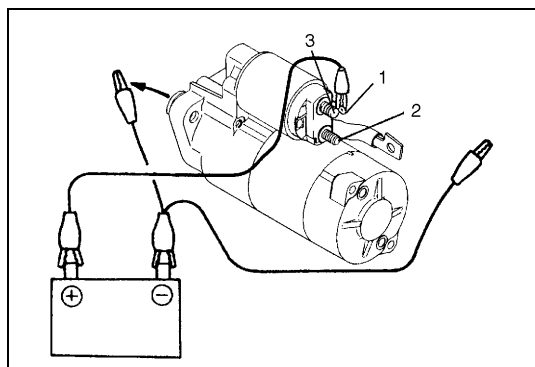
1. Terminal "S"
2. Terminal "M"
3. Terminal "B"



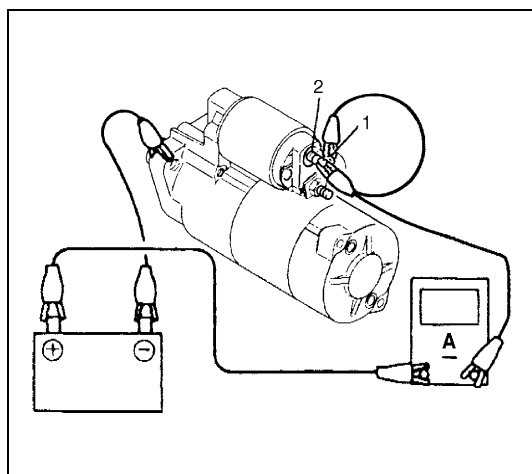
PLUNGER AND PINION TEST

Disconnect negative lead from switch body. Check that plunger and pinion return inward. If plunger and pinion don't return, disassemble and inspect starting motor.

1. Terminal "S"
2. Terminal "M"
3. Terminal "B"



NO-LOAD PERFORMANCE TEST



- Connect battery and ammeter to starter as shown.
- Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

Specified current: 130 A MAX. at 11 V

NOTE:

Use wires as thick as possible and tighten each terminal fully.

1. Terminal "S"
2. Terminal "B"

Specifications

2.0 kW reduction type

Voltage		12 volts	
Output		2.0 kW	
Rating		30 seconds	
Direction of rotation		Clockwise as viewed from pinion side	
Brush length		18.0 mm (0.71 in.)	
Number of pinion teeth		10	
Performance		Condition	Guarantee
Around at 20 °C (68 °F)	No load characteristic	11.0 V	130 A maximum 3,600 rpm minimum
	Load characteristic	7.7 V 400 A	10.6 N·m (1.06 kg-m, 7.67 lb-ft) minimum 1,280 rpm minimum
	Locked characteristic	3.0 V	1,000 A maximum 29.4 N·m (2.94 kg-m, 21.3 lb-ft) minimum
	Magnetic switch operating voltage		8 volts maximum

Required Service Materials

Material	Recommended SUZUKI product	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Front bush • Plunger • Pinion drive lever • Internal gear • Planetary carrier shaft • Planetary gear • Ball

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Starting motor mounting bolt	45	4.5	32.5
“B” terminal nut	11	1.1	8
Magnetic switch screw	7	0.7	5.0
Starting motor housing screw	11	1.1	8

SECTION 6H

CHARGING SYSTEM

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

CONTENTS

General Description	*		
Battery	*	Remounting	*
Carrier and hold-down	*	Generator	6H-2
Electrolyte freezing	*	Generator belt	6H-2
Sulfation	*	Unit Repair Overhaul	6H-4
Built-in indicator (If equipped)	*	Generator	6H-4
Care of battery	*	Dismounting	*
Generator	*	Remounting	*
Diagnosis	*	Disassembly [60 A type]	*
Battery	*	Disassembly [70 A and 80 A types]	*
Common causes of failure	*	Inspection [60 A type]	*
Visual inspection	*	Inspection [70 A and 80 A types]	*
Hydrometer test	*	Replace brush	*
Generator	*	Reassembly [60 A type]	*
Undercharged battery	*	Reassembly [70 A and 80 A types]	*
Overcharged battery	*	Specifications	6H-7
On-Vehicle Service	6H-2	Battery	*
Battery	*	Generator	6H-7
Jump starting in case of emergency	*	Tightening Torque Specifications	6H-7
Dismounting	*	Special Tools	6H-7
Handling	*		

On-Vehicle Service

Generator

Generator belt

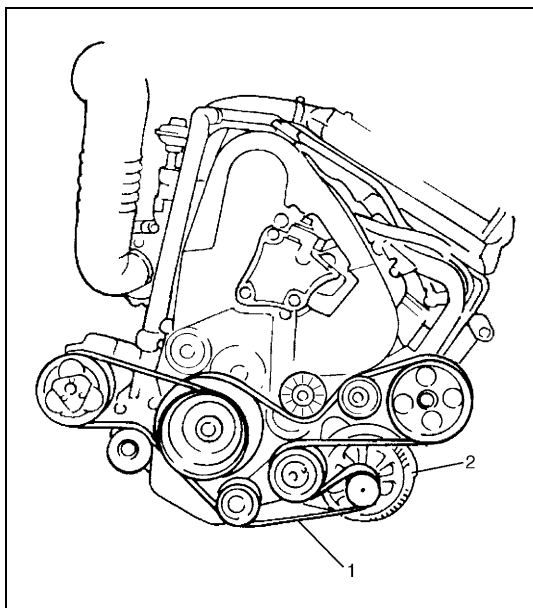
WARNING:

Disconnect negative cable at battery before inspection, removing and installing Generator belt.

INSPECTION

- Verify that belt engages with pulley groove correctly.
- Visually check for wear and damage on belt and pulley contact surface and damage on pulley.

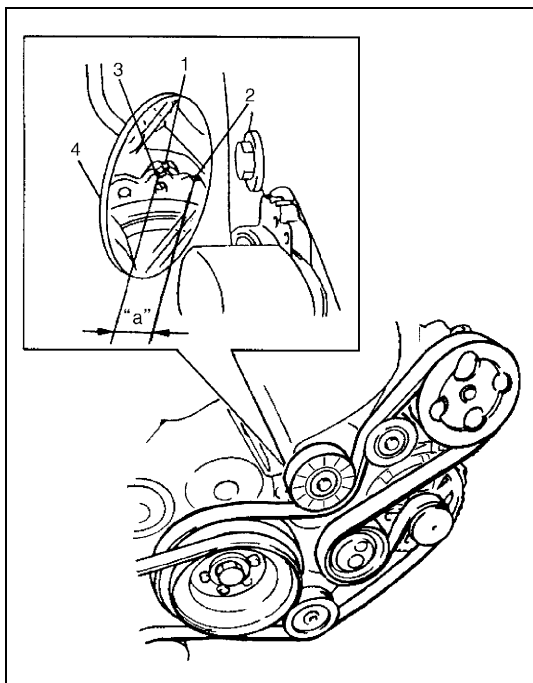
- | |
|-------------------|
| 1. Generator belt |
| 2. Generator |

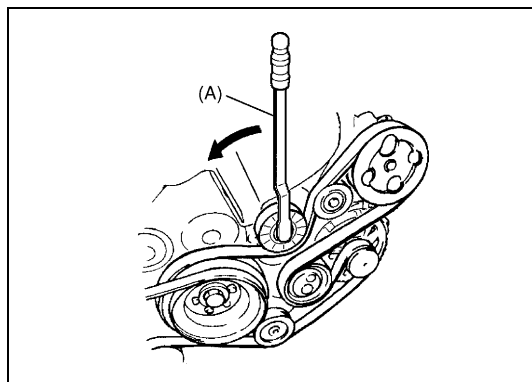


- Inspect belt for cracks, cuts, deformation, wear and cleanliness using mirror under enough lighting. If any defect exists, replace.

- Check that belt wear check mark (1) (tension indicator) is within range "a" using mirror (4) under enough lighting. If wear check mark (1) is aligned with maximum wear mark (2) or out of range "a", replace generator belt with a new one.

- | |
|-------------------|
| 3. Zero wear mark |
|-------------------|

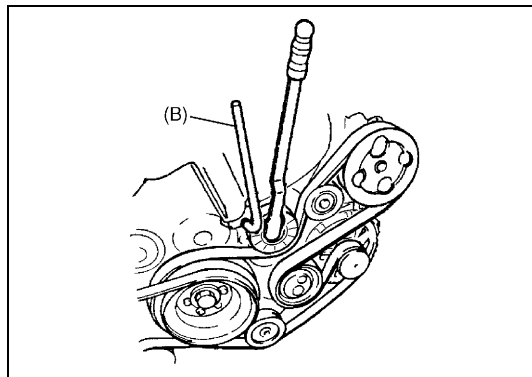


REMOVAL

- 1) Using special tool (A) for dynamic roller tensioner, turn dynamic roller tensioner counterclockwise to loosen it.

Special tool

(A): 09919-56610/OUT0000143

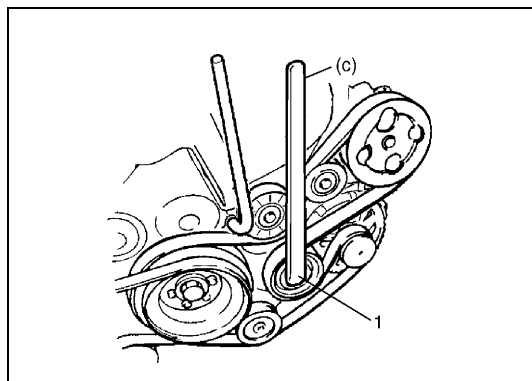


- 2) With dynamic roller tensioner holes aligned by turning dynamic roller tensioner, insert special tool (B) into them.

Special tool

(B): 09919-56590/OUT0000142

1. Zero wear mark
2. Maximum wear mark

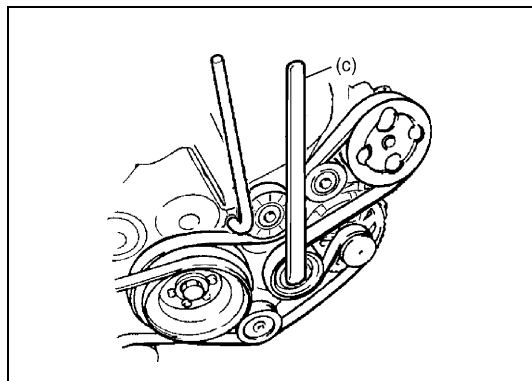


- 3) Loosen roller tensioner bolt (1) using special tool (C).

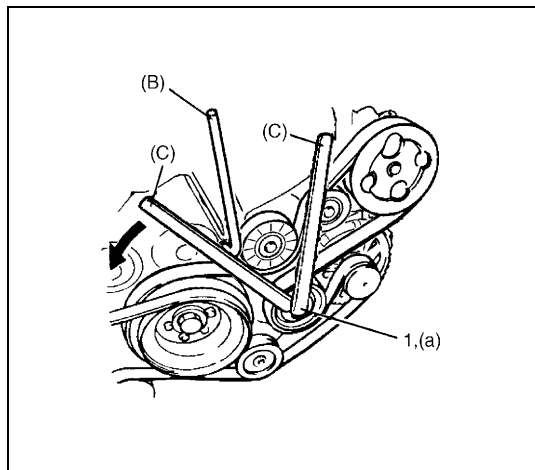
Special tool

(C): 09919-56620

- 4) Remove generator belt.

INSTALLATION

- 1) Using special tool (C) for roller tensioner, turn roller tensioner clockwise to loosen it.
- 2) While holding the tensioner, install generator belt.



- 3) Using special tool (C), turn roller tensioner counterclockwise to until special tool (B) becomes free. With roller tensioner kept in that state, fix it by tightening roller tensioner bolt (1) to specified torque.

Special tool

(B): 09919-56590/OUT0000142

(C): 09919-56620

Tightening torque

Roller tension bolt

(a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

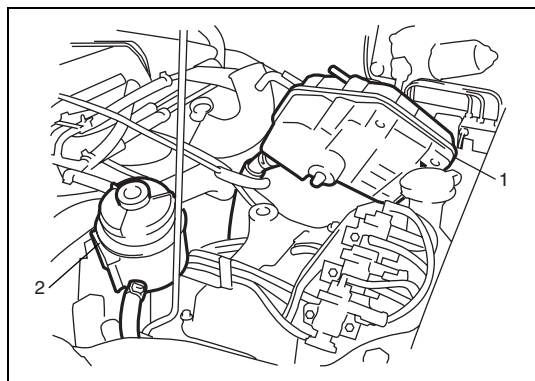
- 4) Remove special tool (B) and (C), turn crankshaft pulley 4 revolutions.
- 5) Using special tool (B), check that dynamic roller tensioner holes are aligned. If they are not aligned, repeat step 3) to 5).

Unit Repair Overhaul

Generator

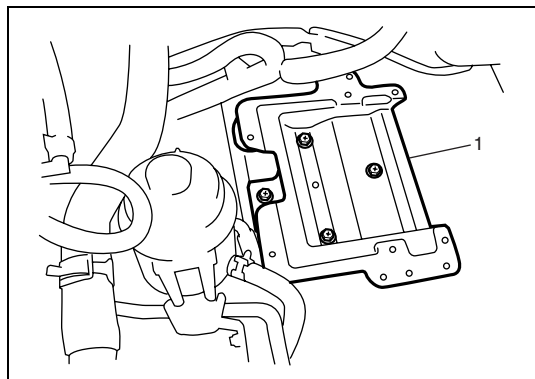
DISMOUNTING

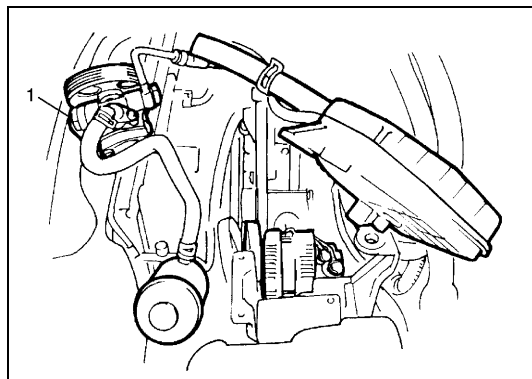
- 1) Disconnect negative (–) cable at battery.
- 2) Drain engine oil and remove engine oil element.
- 3) Detach degassing tank (1) and P/S pump reservoir (2).



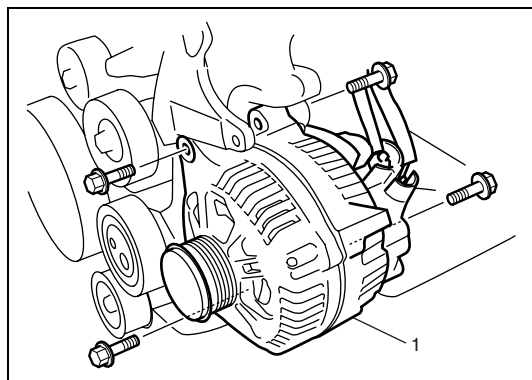
- 4) Remove ECM, referring to “Engine Control Module (ECM)” in Section 6A3.

- 5) Remove ECM bracket (1).





6) Detach P/S pump (1) from P/S pump bracket.



7) Remove Generator (1).

REMountING

Install removed parts in reverse order of dismounting procedure, noting the following.

- Tighten generator bolts and “B” terminal outer nut.

Tightening torque

Generator upper bolt

(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

Generator lower bolt

(b): 48 N·m (4.8 kg-m, 35.0 lb-ft)

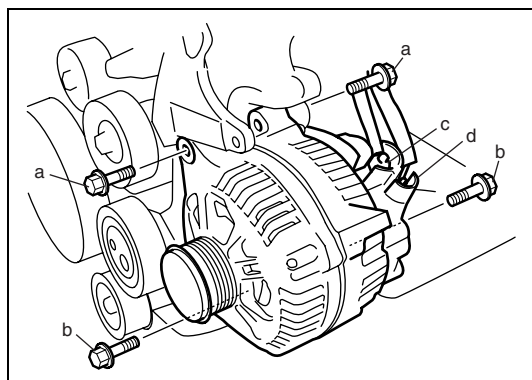
“B” terminal outer nut

(c): 16 N·m (1.6 kg-m, 11.5 lb-ft)

“L” terminal outer nut

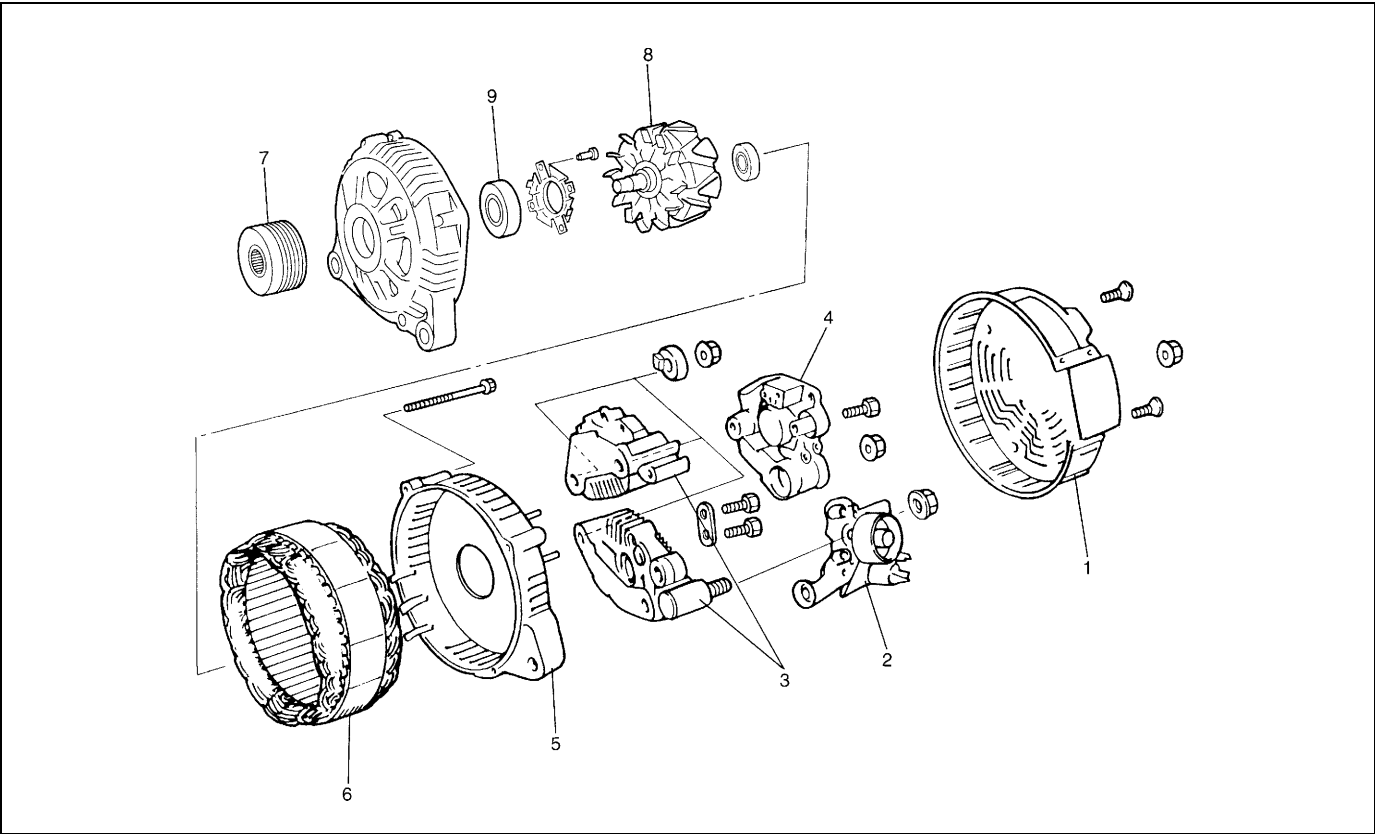
(d): 6 N·m (0.6 kg-m, 4.5 lb-ft)

- Install engine oil filter and refill engine oil referring to “Engine Oil and Oil Filter Change” in Section 0B.

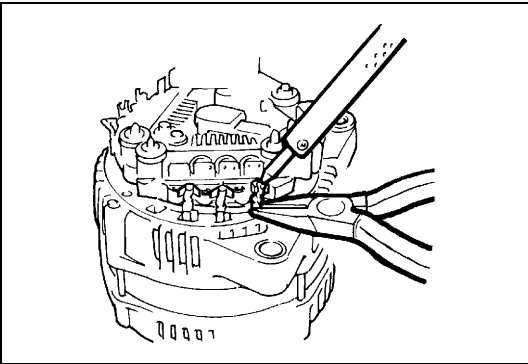


DISASSEMBLY AND REASSEMBLY

- Disassemble in numerical order shown in figure below and note the following.
- For reassembly, reverse disassembly procedure.



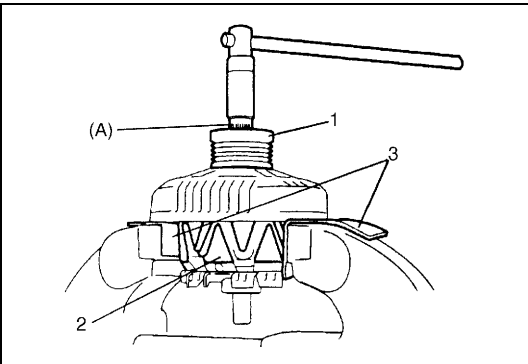
1. Rear cover	4. Regulator	7. Pulley
2. D+ contact with capacitor	5. Cover	8. Rotor
3. Rectifier	6. Stator	9. Front bearing



- When removing stator lead wire from rectifier, carry out soldering quickly.

CAUTION:
Overheating can damage semiconductor components such as regulator and rectifier.

NOTE:
Hold lead wire with pliers during soldering to prevent applying heat to rectifier.



- Hold rotor (2) with soft jawed vise (3) and remove pulley (1) by using special tool.

Special tool
(A): 09932-96510

Specifications

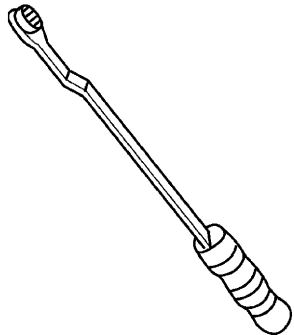
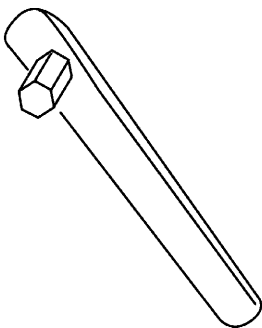
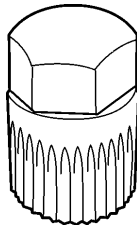
Generator

Type	150 A type
Rated voltage	12 V
Nominal output	150 A

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Roller tension bolt	45	4.5	32.5
Generator upper bolt	23	2.3	17.0
Generator lower bolt	48	4.8	35.0
“B” terminal outer nut	16	1.6	11.5
“L” terminal outer nut	6	0.6	4.5

Special Tools

 09919-56610/OUT0000143 Belt tension lever	 09919-56590/OUT0000142 Belt tensioner pin	 09919-56620 Belt tension adjuster wrench	 09932-96510 Pulley remover attachment

SECTION 6K

EXHAUST SYSTEM

CONTENTS

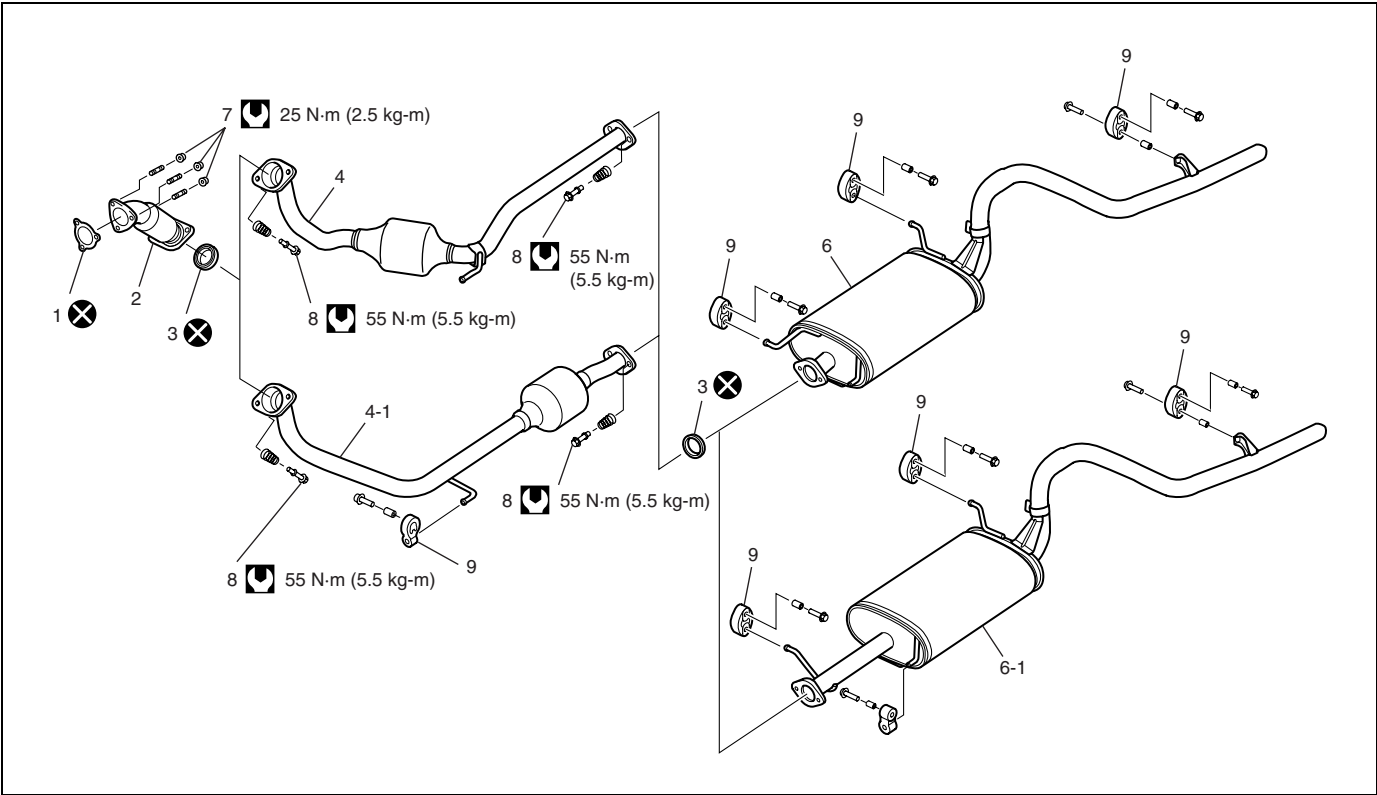
General Description	6K-2	On-Vehicle Service	6K-4
Exhaust System Components	6K-2	Exhaust Manifold	6K-4
Maintenance	6K-3	Muffler	6K-4

General Description

The exhaust system consists of an exhaust manifold, a turbo charger, a turbocharger outlet pipe, an exhaust No.1 pipe, an exhaust No.2 pipe, a muffler and seal, gaskets and etc., and the exhaust No.1 and No.2 pipe has the catalytic converter for oxidation.

The catalytic converter for oxidation is an emission control device added to the exhaust system to lower the levels of Hydrocarbon (HC) and Carbon Monoxide (CO) pollutants in the exhaust gas.

Exhaust System Components



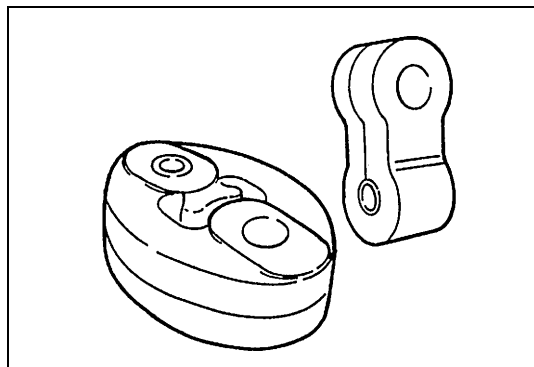
1. Exhaust pipe gasket	5. Blank	9. Mounting
2. Exhaust No.1 pipe	6. Muffler for 3door model	 Tightening torque
3. Exhaust pipe seal ring	6-1. Muffler for 5door model	 Do not reuse
4. Exhaust No.2 pipe for M/T model	7. Exhaust No.1 pipe nut	
4-1. Exhaust No.2 pipe for A/T model	8. Exhaust pipe bolt	

Maintenance

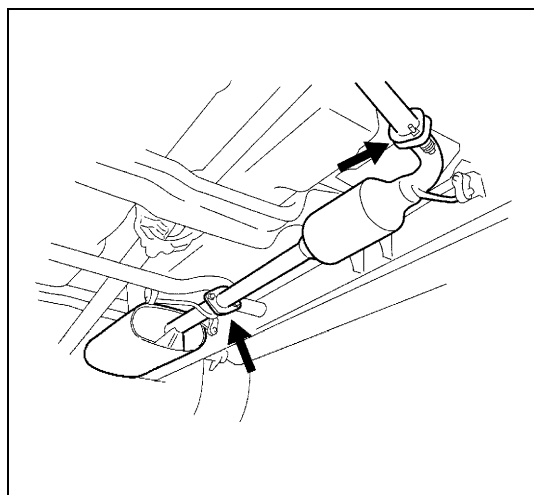
WARNING:

To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

At every interval of periodic maintenance service, and when vehicle is raised for other service, check exhaust system as follows:



- Check rubber mountings for damage, deterioration, and out of position.



- Check exhaust system for leakage, loose connection, dent and damage.
If bolts or nuts are loosened, tighten them to specified torque.
Refer to "Exhaust System Components" in this section for torque data.
- Check nearby body areas damaged, missing, mispositioned part, open seam, hole connection or any other defect which could permit exhaust fumes to seep into vehicle.
- Make sure that exhaust system components have enough clearance from underbody to avoid overheating and possible damage to passenger compartment carpet.
- Any defect should be fixed at once.

On-Vehicle Service

WARNING:

To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

Exhaust Manifold

Refer to “Turbocharger” in Section 6E3 for removal and installation procedures. Before installation, check gasket and seal for deterioration or damage. Replace them as necessary.

Muffler

CAUTION:

As exhaust No.2 pipe has catalytic converter in it, it should not be exposed to any impulse. Be careful not to drop it or hit it against something.

- Tighten bolts and nuts to specified torque when reassembling. Refer to “Exhaust System Components” in this section for location of bolts and nuts.
- After installation, start engine and check each joint of exhaust system for leakage.

SECTION 7A2

7A2

MANUAL TRANSMISSION (TYPE 3)

CONTENTS

General Description	7A2-2	Back Up Light Switch	7A2-4
System Description	7A2-2	Engine Rear Mounting	7A2-4
Diagnosis	7A2-2	Dismounting of Transmission Unit	7A2-4
On-Vehicle Service.....	7A2-3	Remounting of Transmission Unit.....	7A2-6
Transmission Gear Oil	7A2-3	Unit Repair.....	7A2-8
Transmission Shift Control Lever	7A2-4	Tightening Torque Specifications	7A2-8

General Description

System Description

The manual transmission consists of the input shaft, main shaft, countershaft and reverse idle gear shaft which are installed in the die-cast aluminum alloy and cast-iron cases. This transmission provides five forward speeds and one reverse speed.

The 1st, 2nd and 3rd speeds are for speed reduction drive, 4th speed is for direct drive and 5th speed is for over drive.

The low speed (1st and 2nd) synchronizer is mounted on middle of the main shaft and engaged with the main shaft 1st or 2nd gear. The high speed (3rd and 4th) synchronizer is mounted on forefront of the main shaft and engaged with the main shaft 3rd gear or input shaft. The 5th speed synchronizer is mounted on the countershaft and engaged with the countershaft 5th gear. The 5th speed synchronizer is also equipped with the prevention device from gear cracking noise when shifting gear into the reverse gear. The triple cone synchronizer mechanism is provided to the 1st, 2nd and 3rd gear synchromesh devices for high performance of shifting into the 1st, 2nd and 3rd gear.

The gear shift lever case is located at the upper behind the transmission case and has a cam which prevents direct gear shifting from the 5th speed gear into the reverse gear.

As the die-cast aluminum alloy and cast-iron cases are sealed with liquid type gasket, it is necessary to use genuine sealant or its equivalent on its mating surface when reassembling them. Also, the case fastening bolts must be tightened to specified torque by means of the torque wrench and tightening over or below the specified torque should be avoided.

Diagnosis

Condition	Possible Cause	Correction
Gear slipping out of mesh	Worn shift fork shaft	Replace
	Worn shift fork or synchronizer sleeve	Replace
	Weak or damaged locating spring	Replace
	Worn bearings on input shaft or main shaft	Replace
	Worn chamfered tooth on sleeve or gear	Replace sleeve and gear
	Missing or disengagement of circlip(s)	Install or replace
Gears refusing to dis-engage	Weakened or broken synchronizer spring	Replace
	Distorted shift shaft or shift fork	Replace
Hard shifting	Improper clutch pedal free travel	Adjust
	Distorted or broken clutch disc	Replace
	Damaged clutch pressure plate	Replace clutch cover
	Worn synchronizer ring	Replace
	Worn chamfered tooth on sleeve or gear	Replace sleeve and gear
	Distorted shift shaft	Replace
Noise	Inadequate or insufficient lubricant	Replenish
	Damaged or worn bearing(s)	Replace
	Damaged or worn gear(s)	Replace
	Damaged or worn synchronizer ring	Replace
	Damaged or worn chamfered tooth on sleeve or gear	Replace

On-Vehicle Service

Transmission Gear Oil

INSPECTION AND CHANGE

- 1) Before changing or inspecting oil, be sure to stop engine and lift vehicle horizontally.
- 2) With vehicle lifted up, check oil level and leakage. If leakage exists, correct or repair it.
- 3) Drain old oil removing drain plug (1).

NOTE:

- Do not drain transmission oil from plug (4).
- Whenever vehicle is hoisted for any service work other than oil change, check for oil leakage.
- If water or rust is mixed in drained oil, be sure to check breather hose and boot of transmission.

- 4) Fill new specified oil as shown by specified amount (up to level hole).

NOTE:

It is highly recommended to use SAE 75W-90 gear oil.

Gear Oil Specification

Oil grade: API GL-4

Viscosity: SAE 75W-85, 75W-90 or 80W-90

Oil Capacity:

2.7 liters (5.8/4.8 US/Imp. pt)

- 5) Torque drain plug (1) and level/filler plug (2) as specified.

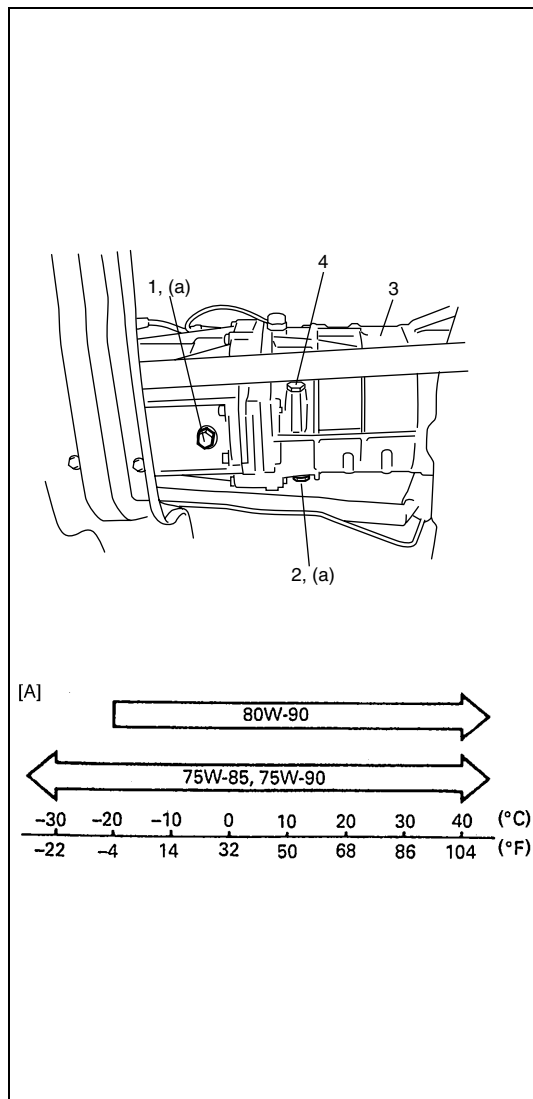
CAUTION:

Transmission oil must not be poured through gear shift control lever part.

Tightening torque

Transmission oil filler/level and drain plugs

(a): 37 N·m (3.7 kg-m, 27.0 lb-ft)



[A]: Viscosity chart SAE

Transmission Shift Control Lever

Refer to “Transmission Shift Control Lever” in Section 7A of the Service Manual mentioned in “Foreword” of this manual.

Back Up Light Switch

Refer to “Back Up Light Switch” in Section 7A of the Service Manual mentioned in “Foreword” of this manual.

Engine Rear Mounting

When replacement of mounting parts are necessary, torque bolts as specified below.

Tightening torque

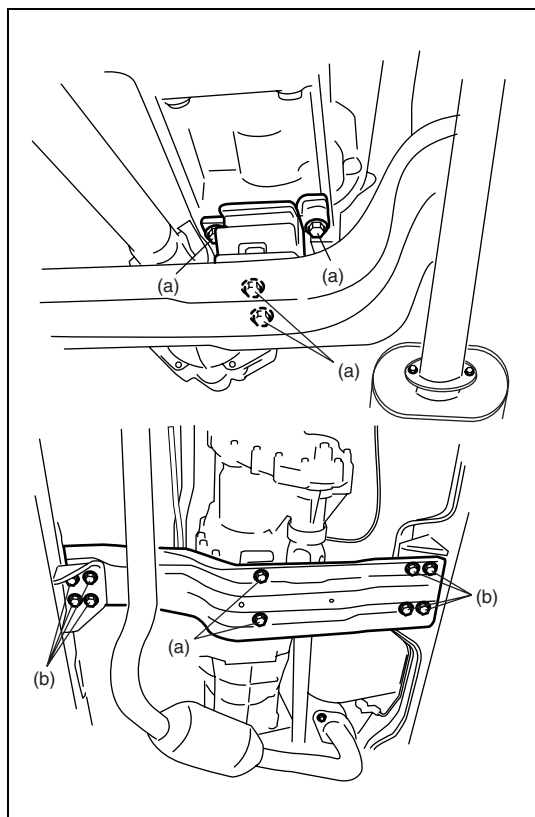
Engine rear mounting bolts

(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Engine rear mounting member bolts

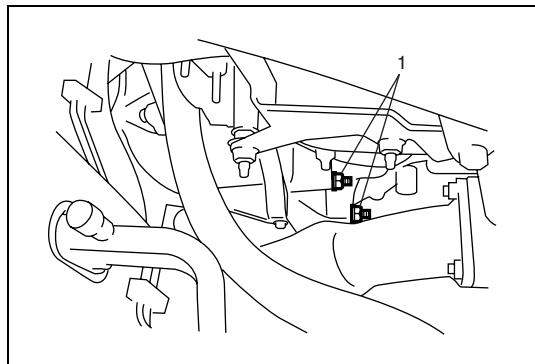
(b): 55 N·m (5.5 kg-m, 40.0 lb-ft)

1.	Engine rear mounting member
2.	Engine rear mounting

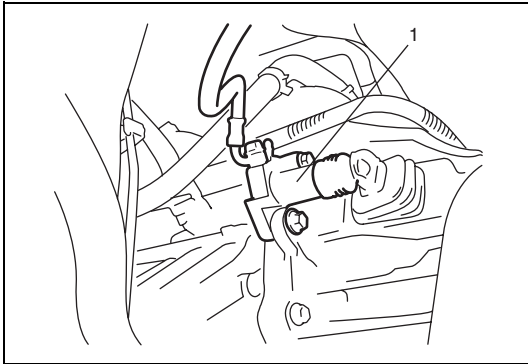
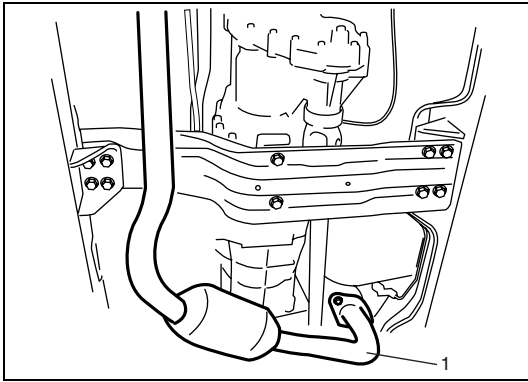


Dismounting of Transmission Unit

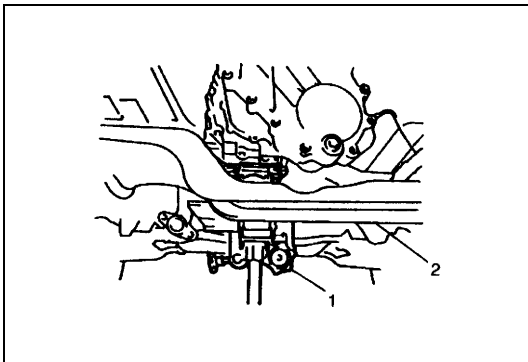
- 1) Remove battery.
- 2) Detach fuse/relay box, remove strut tower bar.
- 3) Remove CKP sensor from clutch housing referring to “CKP Sensor” in Section 6E3.
- 4) Remove starting motor bolts.
- 5) Remove transmission to engine nuts (1).



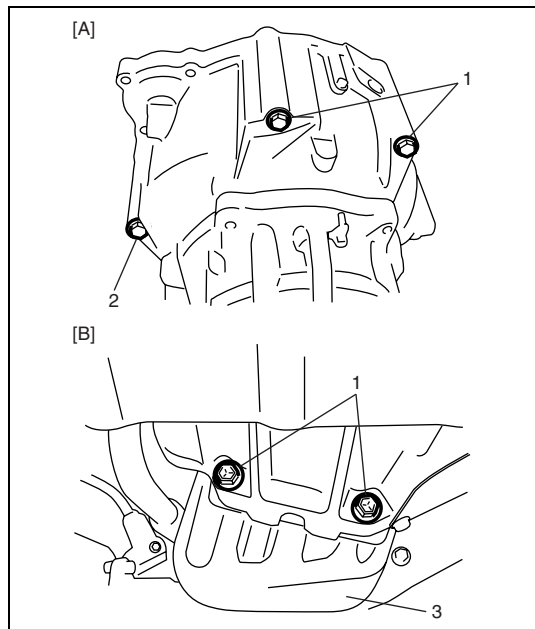
- 6) Remove transmission shift control lever referring to "Transmission Shift Control Lever" in Section 7A of the Service Manual mentioned in "Foreword" of this manual.
- 7) Remove transfer shift control lever referring to "Transfer Shift Control Lever" in Section 7D of the Service Manual mentioned in "Foreword" of this manual.
- 8) Hoist vehicle.
- 9) Drain transmission gear oil referring to "Transmission Gear Oil" in this section.
- 10) Drain transfer gear oil referring to "Transfer Gear Oil" in Section 7D of the Service Manual mentioned in "Foreword" of this manual.
- 11) Remove propeller shafts referring to "Propeller Shaft" in Section 4B of the Service Manual mentioned in "Foreword" of this manual.
- 12) Remove exhaust No.2 pipe (1).



- 13) Remove clutch operating cylinder (1) from transmission. It is not necessary to disconnect clutch hose from operating cylinder.



- 14) Apply transmission jack (1) and remove engine rear mounting member (2) taking off its bolts.
- 15) Lower the transmission jack (1) slowly.
- 16) Disconnect couplers from 4WD switch, back up light switch and speed sensor assembly and release their harness from clamps.



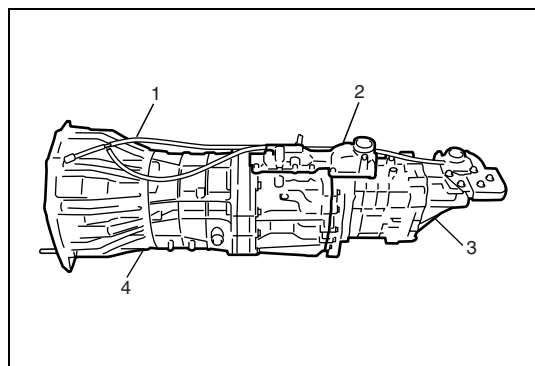
17) Remove transmission fastening bolts (1 and 2).

[A] : Upper side
[B] : Lower side
3. Oil pan

NOTE:

If bolt (2) cannot be removed, loosen it only completely.

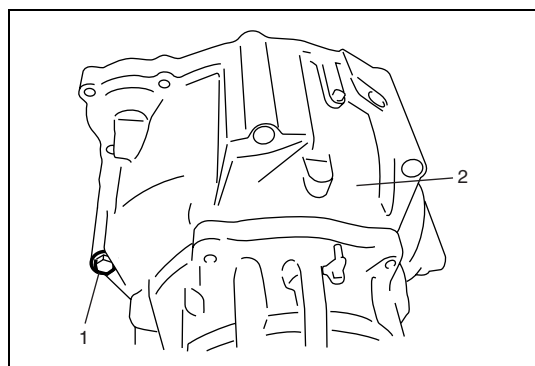
18) Move rearward transmission and transfer assemblies placed on jack and then lower them.



19) Remove breather hoses (1).

20) Separate gear shift lever case (2) and transfer assembly (3) from transmission assembly (4).

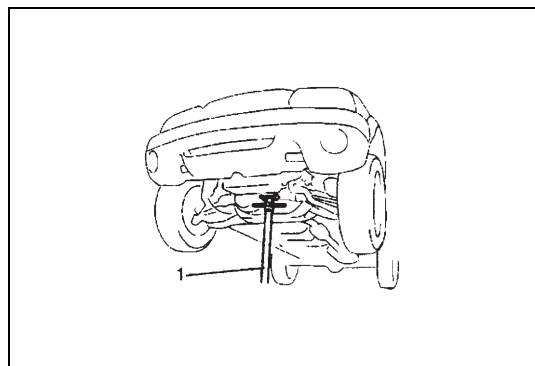
Remounting of Transmission Unit

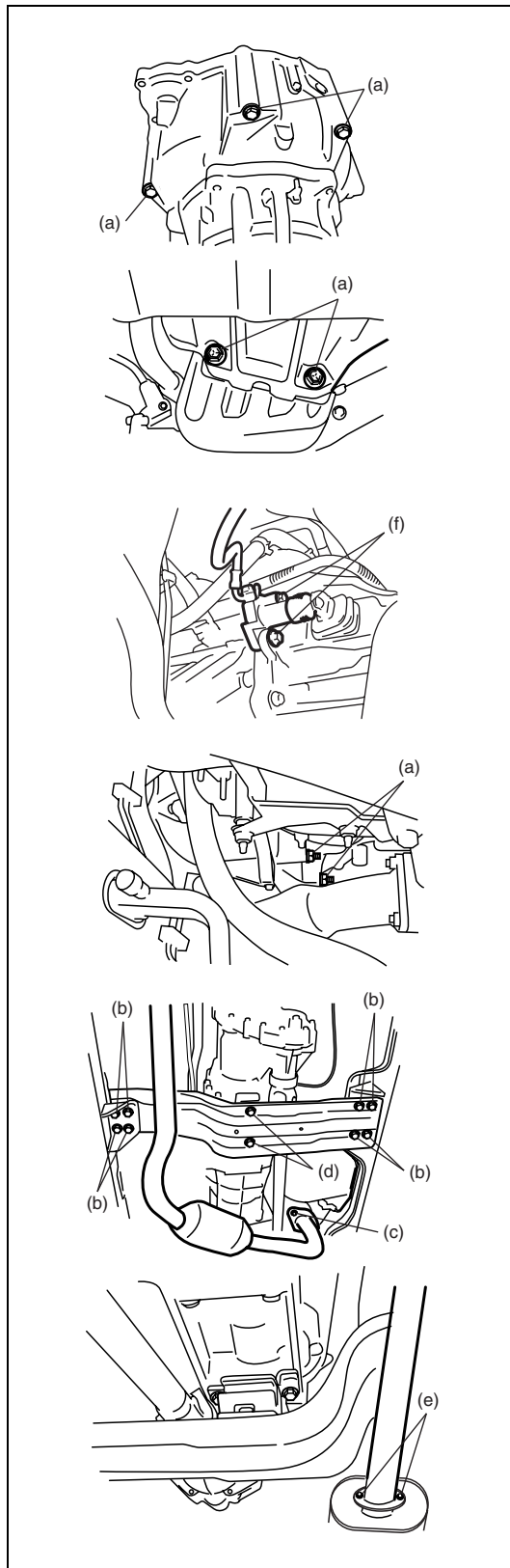


1) Set transmission fastening bolt (1) to transmission assembly (2) as shown beforehand, if transmission fastening bolt (1) could not be removed at step 16) of "Dismounting of Transmission Unit" in this section.

2) Reverse dismounting procedure for remounting noting the following.

- Slant the rear of the engine down, using support device (1) and install transmission to engine.





- Use specified torques as given below.

Tightening torque

Transmission to engine bolts and nuts

(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Engine rear mounting member bolts

(b): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Turbocharger outlet pipe to exhaust No.2 pipe bolt

(c): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Engine rear mounting bolts

(d): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Exhaust No.2 pipe to muffler bolts or nuts

(e): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Clutch operating cylinder bolts

(f): 50 N·m (5.0 kg-m, 36.5 lb-ft)

- Set each clamp for wiring and hoses securely.
- Set clamp for shift control lever boots securely.
- Fill gear oil to transmission and transfer as specified referring to "Transmission Gear Oil" in this section and "Transfer Gear Oil" in Section 7D of the Service Manual mentioned in "Foreword" of this manual.
- Install propeller shafts referring to "Propeller Shaft" in Section 4B of the Service Manual mentioned in "Foreword" of this manual.
- Install strut tower bar referring to "Strut Damper" in Section 3D of the Service Manual mentioned in "Foreword" of this manual.
- Install battery and check function of engine, clutch, transmission and transfer.

Unit Repair

Refer to the same section of “Unit Repair Manual” mentioned in “Foreword” of this manual.

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Transmission oil filler/level and drain plugs	37	3.7	27.0
Transmission to engine bolts and nuts	55	5.5	40.0
Engine rear mounting member bolts	55	5.5	40.0
Turbocharger outlet pipe to exhaust No.2 pipe bolts	50	5.0	36.5
Exhaust No.2 pipe to muffler bolts or nuts	50	5.0	36.5
Engine rear mounting bolts	55	5.5	40.0
Clutch operating cylinder bolts	50	5.0	36.5

SECTION 7B1

7B1

AUTOMATIC TRANSMISSION (4 A/T)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

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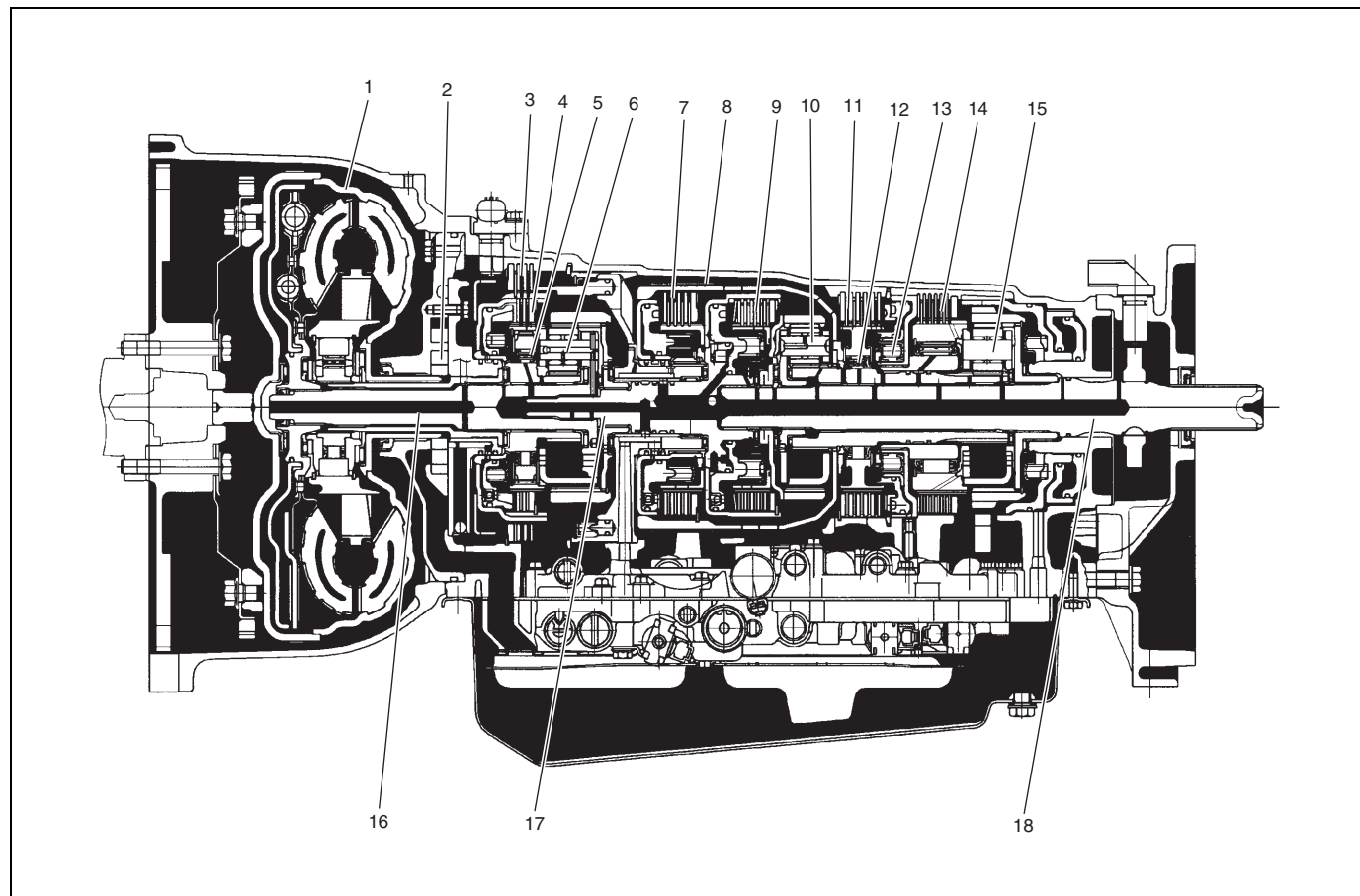
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General Description

This automatic transmission is a full automatic type with 3-speed plus overdrive (O/D).

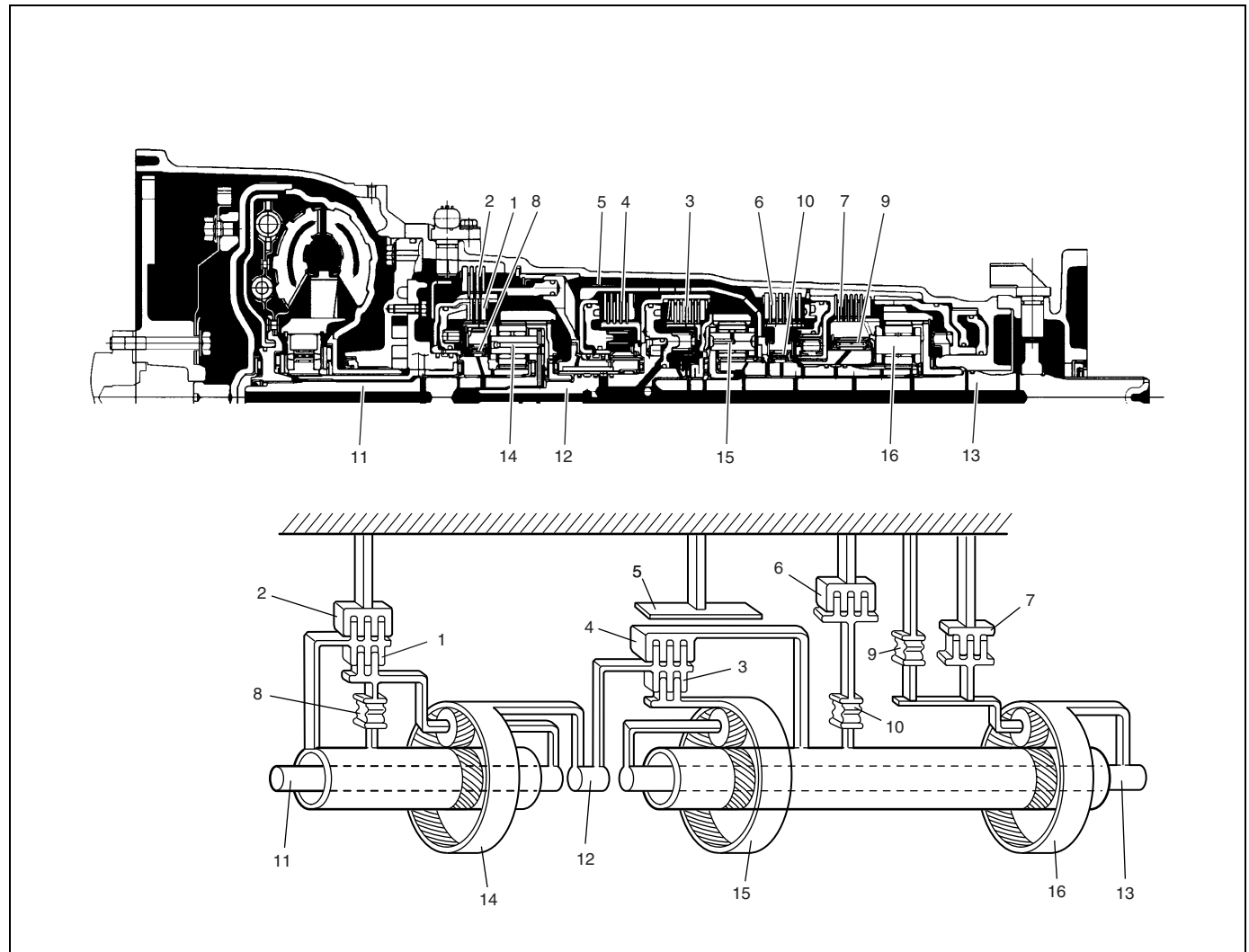
The torque converter is a 3-element, 1-step and 2-phase type and is equipped with an electronically controlled lock-up mechanism. The gear shift device consists of 3 sets of planetary gear units, 3 disc type clutches, 3 disc type brakes, 1 band type brake and 3 one-way clutches. The gear shift is done by selecting one of 6 positions ("P", "R", "N", "D", "2" and "L") of the select lever installed on the floor. On the shift knob, there is an overdrive (O/D) off switch which prevents shift-up to the overdrive mode. The optimum line pressure of fluid is obtained based on throttle pressure of fluid. The throttle pressure of fluid which corresponds to engine load (engine torque) is adjusted by the electronically controlled linear solenoid.



1. Torque converter	6. O/D planetary gear	11. 2nd brake	16. O/D input shaft
2. Oil pump	7. Direct clutch	12. One-way No. 3 clutch	17. Intermediate shaft
3. O/D brake	8. 2nd coast brake	13. One-way No. 2 clutch	18. Output shaft
4. O/D clutch	9. Forward clutch	14. Reverse brake	
5. One-way No.1 clutch	10. Front planetary gear	15. Rear planetary gear	

Item			Specifications
Torque con- verter	Type		3-element, 1-step, 2-phase type (with TCC (lock-up) mechanism)
	Stall torque ratio		1.75 ± 0.1
Oil pump	Type		Trochoid type oil pump
	Drive system		Engine driven
Gear change device	Type		Forward 4-step, reverse 1-step planetary gear type
	Shift position		“P” range Gear in neutral, output shaft fixed, engine start “R” range Reverse “N” range Gear in neutral, engine start “D” range Forward 1st ↔ 2nd ↔ 3rd ↔ 4th (O/D) (O/D ON) automatic gear change “D” range Forward 1st ↔ 2nd ↔ 3rd (O/D OFF) automatic gear change “2” range Forward 1st ↔ 2nd ← 3rd automatic gear change “L” range Forward 1st ← 2nd reduction, and fixed at 1st gear
	Gear ratio	1st (low gear)	2.804
		2nd (second gear)	1.531
		3rd (top gear)	1.000
		4th (overdrive gear)	0.705
		Reverse (reverse gear)	2.393
	Control elements		Wet type multi-disc clutch . . . 3 sets Wet type multi-disc brake. . . . 3 sets Band type brake. 1 set One-way clutch 3 sets
	Transfer		Hi : 1.000 Lo : 1.816 (4WD model only)
	Final gear reduction ratio (Differential)		4.300
Lubrication	Lubrication system		Forced feed system by oil pump
Cooling	Cooling system		Radiator assisted cooling (water-cooled)
Fluid used			An equivalent of DEXRON®III

Clutch/Brake Functions



1. O/D clutch	5. 2nd coast brake	9. One-way No. 2 clutch	13. Output shaft
2. O/D brake	6. 2nd brake	10. One-way No. 3 clutch	14. O/D planetary gear
3. Forward clutch	7. Reverse brake	11. O/D input shaft	15. Front planetary gear
4. Direct clutch	8. One-way No.1 clutch	12. Intermediate shaft	16. Rear planetary gear

Part Name	Function
O/D clutch	Meshes overdrive carrier incorporated with overdrive input shaft and overdrive sun gear.
O/D brake	Fixes overdrive sun gear.
One-way No.1 clutch	Meshes overdrive carrier and overdrive sun gear only when driven by engine.
Forward clutch	Meshes forward clutch input shaft and front planetary carrier.
Direct clutch	Meshes forward clutch input shaft with front sun gear and rear sun gear.
Second coast brake	Fixes front sun gear and rear sun gear.
Second brake	Fixes outer race of one-way No.3 clutch, to prevent front sun gear and rear sun gear from turning counterclockwise (reverse direction of engine input rotation direction).
Reverse brake	Fixes rear planetary carrier.
One-way No.3 clutch	Prevents front sun gear and rear sun gear from turning counterclockwise only when second brake is at work.
One-way No.2 clutch	Prevents rear planetary carrier from turning counterclockwise.

Table of Component Operation

	Solenoid valve-A (No.1)	Solenoid valve-B (No.2)	TCC solenoid valve	O/D clutch	Forward clutch	Direct clutch	O/D brake	Second coast brake	Second brake	Reverse brake	One-way No.1 clutch	One-way No.3 clutch	One-way No.2 clutch
P	○	×	×	○	×	×	×	×	×	×	×	×	×
R (Rev<9 km/h)	○	×	×	○	×	○	×	×	×	○	○	×	×
R (Rev≥9 km/h)	○	○	×	○	×	×	×	×	×	×	○	×	×
N	○	×	×	○	×	×	×	×	×	×	×	×	×
D	1st	○	×	○	○	×	×	×	×	×	○	×	○×
	2nd	○	○	○	○	×	×	×	○	×	○	○×	×
	3rd	×	○	(○)	○	○	×	×	○	×	○	×	×
	4th	×	×	(○)	○	○	○	×	○	×	×	×	×
2	1st	○	×	○	○	×	×	×	×	×	○	×	○×
	2nd	○	○	○	○	×	×	○	○	×	○	○	×
	3rd	×	○	○	○	○	×	×	○	×	○	×	×
L	1st	○	×	○	○	×	×	×	×	○	○	×	○
	2nd	○	○	○	○	×	×	○	○	×	○	○	×

○ : ON

× : OFF

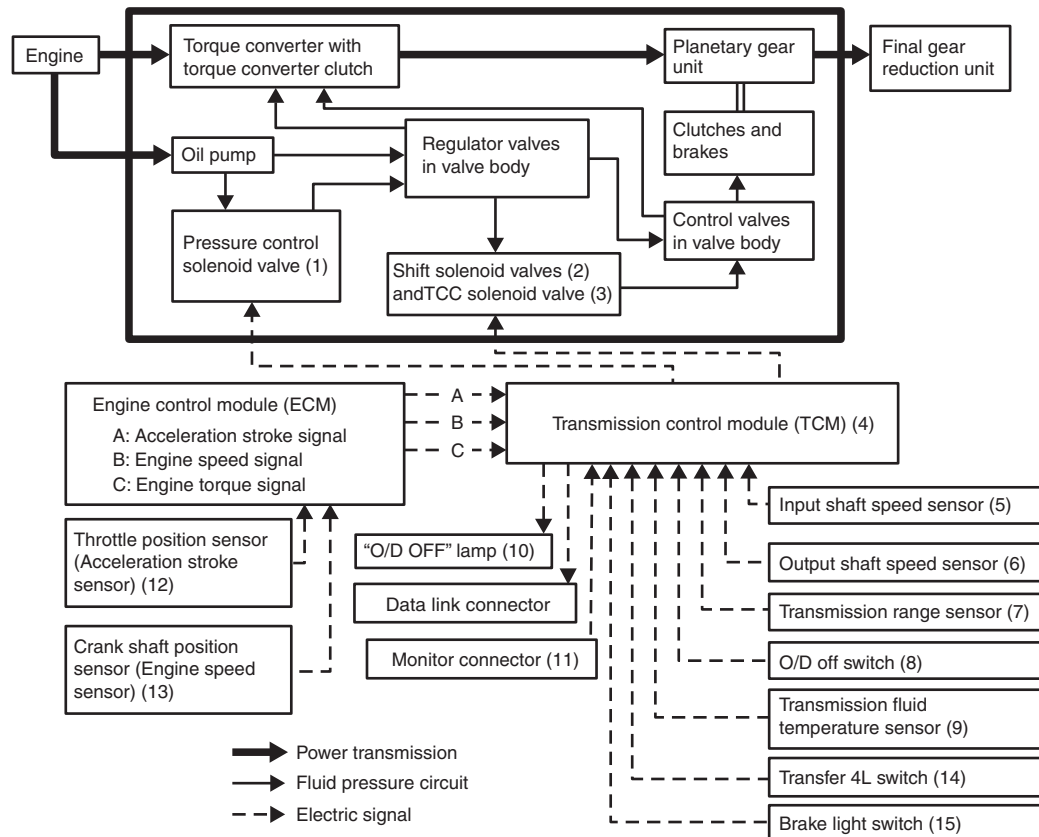
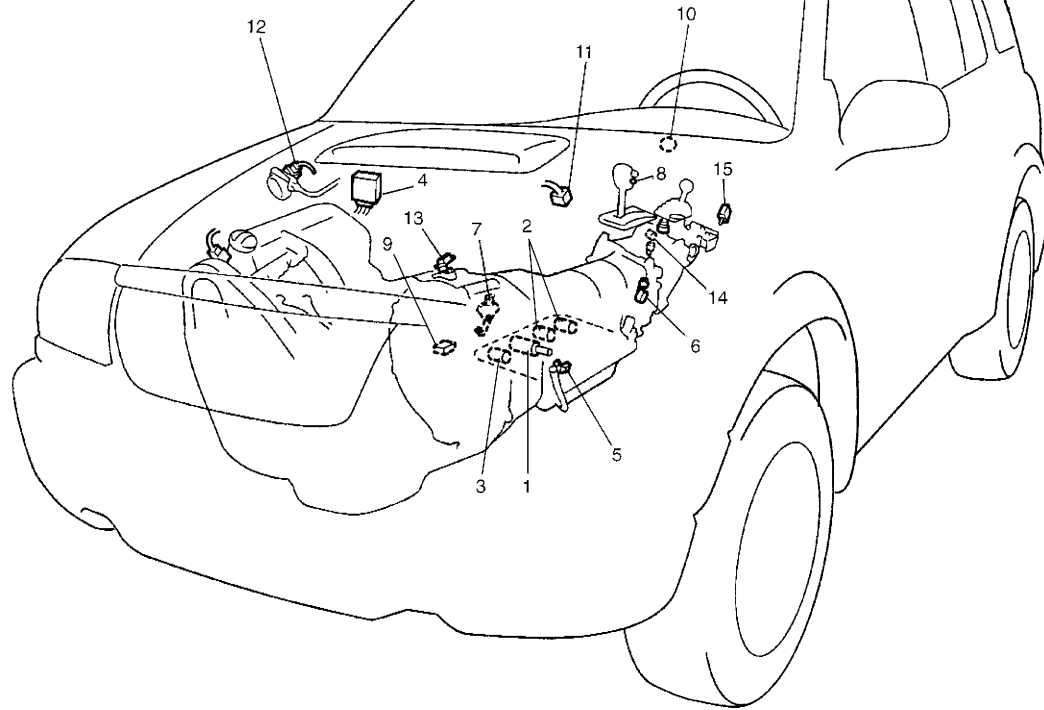
(○) : ON when TCC is in lock-up condition

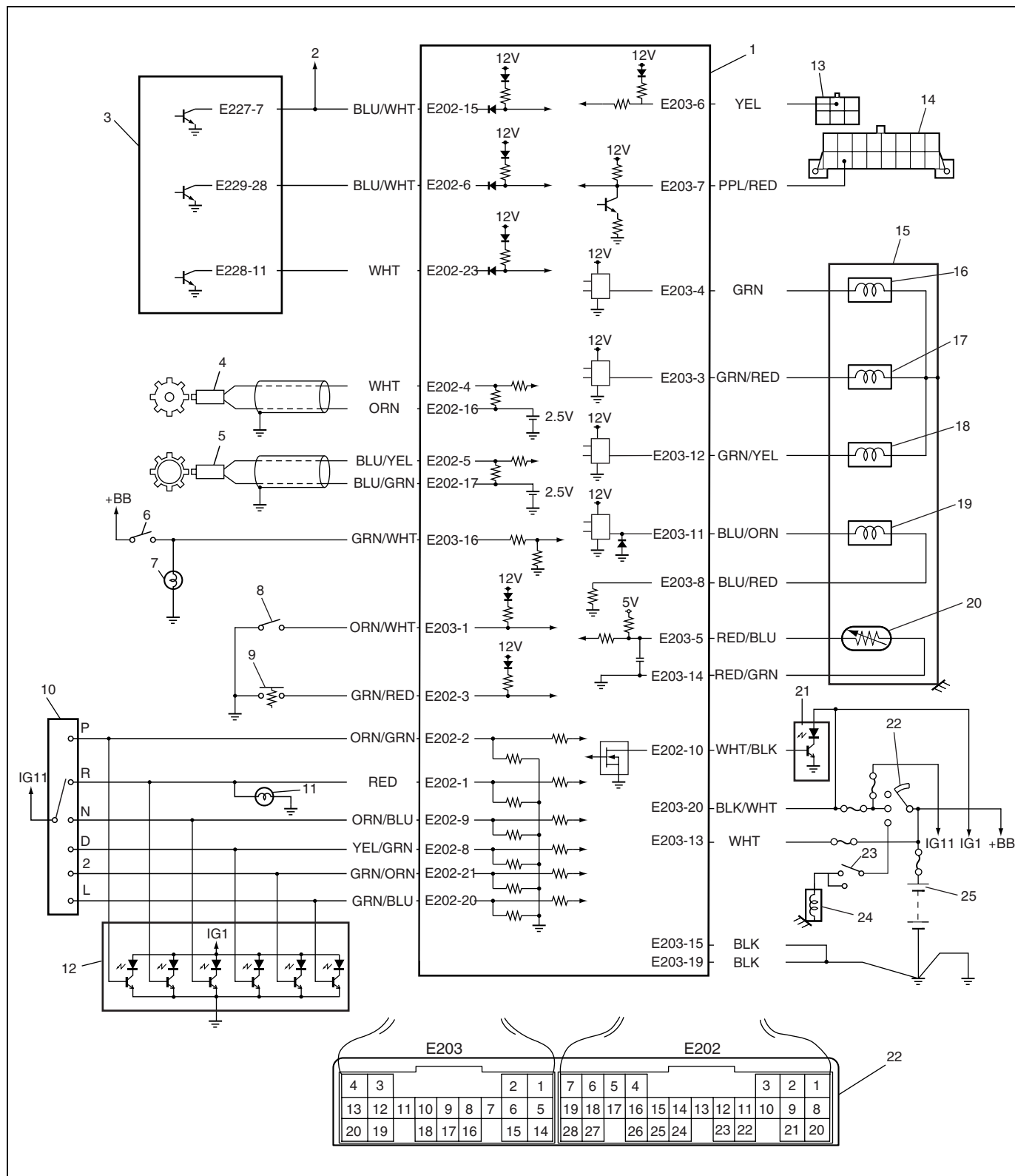
○ × : ON when vehicle is accelerating

: OFF when vehicle is coasting

Electronic Shift Control System

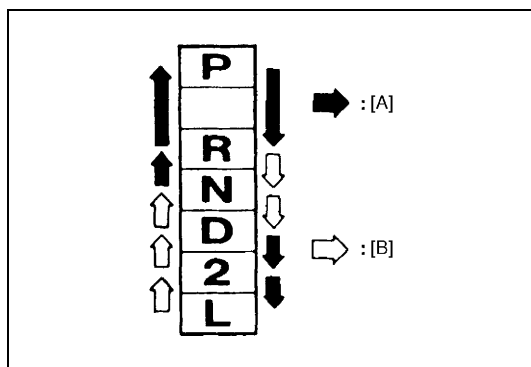
The gear ratio change in "D", "2" or "L" range and torque converter clutch operation are controlled by Transmission Control Module (TCM).





1. TCM	8. 4WD low switch	15. A/T	22. Ignition switch
2. To tachometer	9. O/D off switch	16. Shift solenoid-A (Shift solenoid No.1)	23. Inhibitor switch (In transmission range sensor)
3. ECM	10. Transmission range sensor	17. Shift solenoid-B (Shift solenoid No.2)	24. Starter relay
4. Output shaft speed sensor	11. Backup lamp	18. TCC (Lock-up) solenoid	25. Battery
5. Input shaft speed sensor	12. Shift indicator	19. Pressure control solenoid	26. Terminal arrangement of TCM coupler (Viewed from harness side)
6. Brake light switch	13. Monitor connector	20. Transmission fluid temp. sensor	
7. Brake light	14. Data link connector (DLC)	21. "O/D OFF" lamp	

Change mechanism



The same select pattern shift lever is used as the floor type and frequently used “N” and “D” ranges are made selectable freely.

[A] : Shift the select lever with its button pushed in.

[B] : Shift the select lever without pushing its button.

Operation of shift solenoids and TCC solenoid

RANGE		D				2		L	N	R		P
GEAR		1st	2nd	3rd	4th (O/D)	1st	2nd	1st	Neu-tral	Rev (>9 km/h)	Rev (≤9 km/h)	–
SOLENOIDS	Shift solenoid-A (NO.1)	○	○	×	×	○	○	○	(–)	×	○	○
	Shift solenoid-B (NO.2)	×	○	○	×	×	○	×	(–)	○	×	×
	TCC solenoid valve	×	×	(○)	(○)	×	×	×	×	×	×	×

○ : ON (Turn power on)

×

(○) : ON only when TCC is in lock-up condition

(–) : Gear is at neutral position regardless of solenoid status

	Valve status	
	Turn power ON	Turn power OFF
Shift solenoid-A (NO.1)	Open	Close
Shift solenoid-B (NO.2)	Open	Close
TCC solenoid	Close	Open

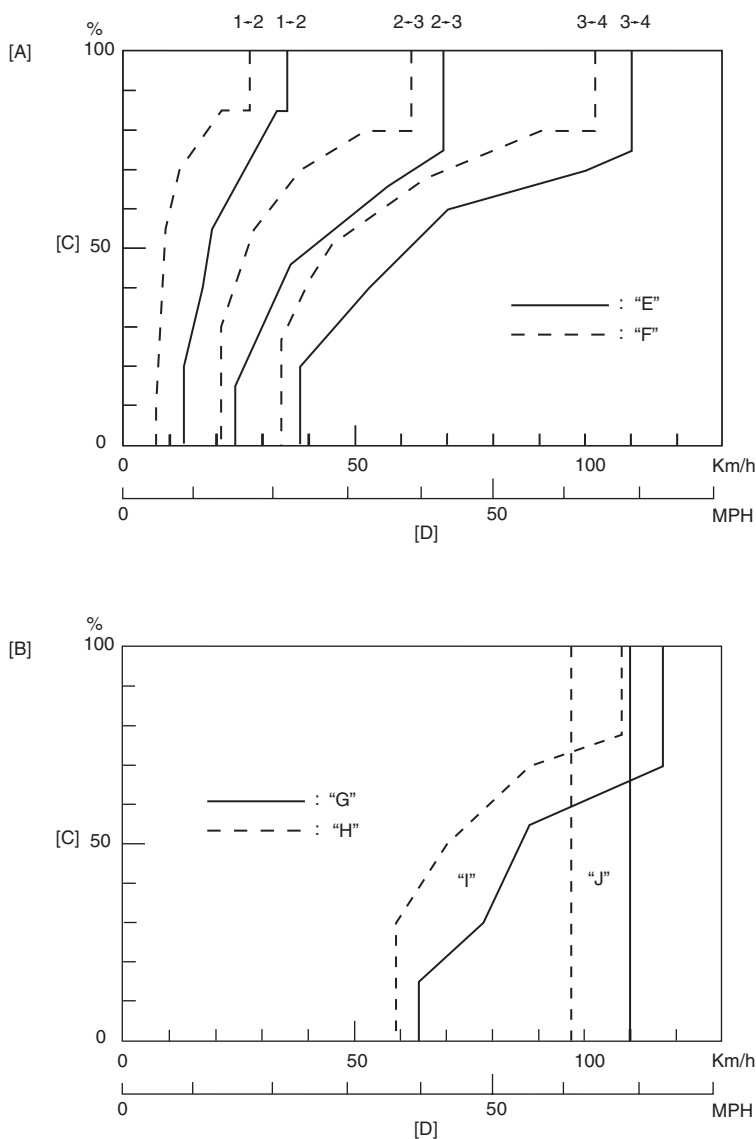
AUTOMATIC GEAR SHIFT DIAGRAM

Automatic shift schedule as a result of shift control is shown below. In case that select lever is shifted to L at a higher than 35 km/h or 22 mile/h speed, 2nd or 3rd gear is operated and then down shifts to 1st at a speed lower than that. No up shift is available in L.

Likewise, when the select lever is shifted to 2 at a higher than 69 km/h (43 mile/h) speed, 3rd gear is operated and then down shifts to 2nd at a speed lower than that.

			Shift					
			1 → 2	2 → 3	3 → 4	4 → 3	3 → 2	2 → 1
Throttle opening	Full throttle	km/h (mile/h)	35 (22)	69 (43)	110 (69)	102 (64)	62 (39)	27 (17)
	Closed throttle	km/h (mile/h)	13 (8)	24 (15)	38 (24)	34 (21)	21 (13)	7 (4)

GEAR SHIFT DIAGRAM [A] AND TCC LOCK-UP DIAGRAM [B]



[C] : Throttle valve opening	[G] : TCC ON
[D] : Vehicle speed	[H] : TCC OFF
[E] : Up shift	[I] : 4th gear
[F] : Down shift	[J] : 3rd gear

Diagnosis

This vehicle is equipped with an electronic transmission control system, which controls the automatic shift up and shift down timing, TCC operation, etc. suitably to vehicle driving conditions.

TCM has an On-Board Diagnostic system which detects a malfunction in this system and abnormality of those parts. When diagnosing a trouble in the transmission including this system, be sure to have full understanding of the outline of "On-Board Diagnostic System" and each item in "Precaution in Diagnosing Trouble" and execute diagnosis according to "Automatic Transmission Diagnostic Flow Table" to obtain correct result smoothly.

On-Board Diagnostic System

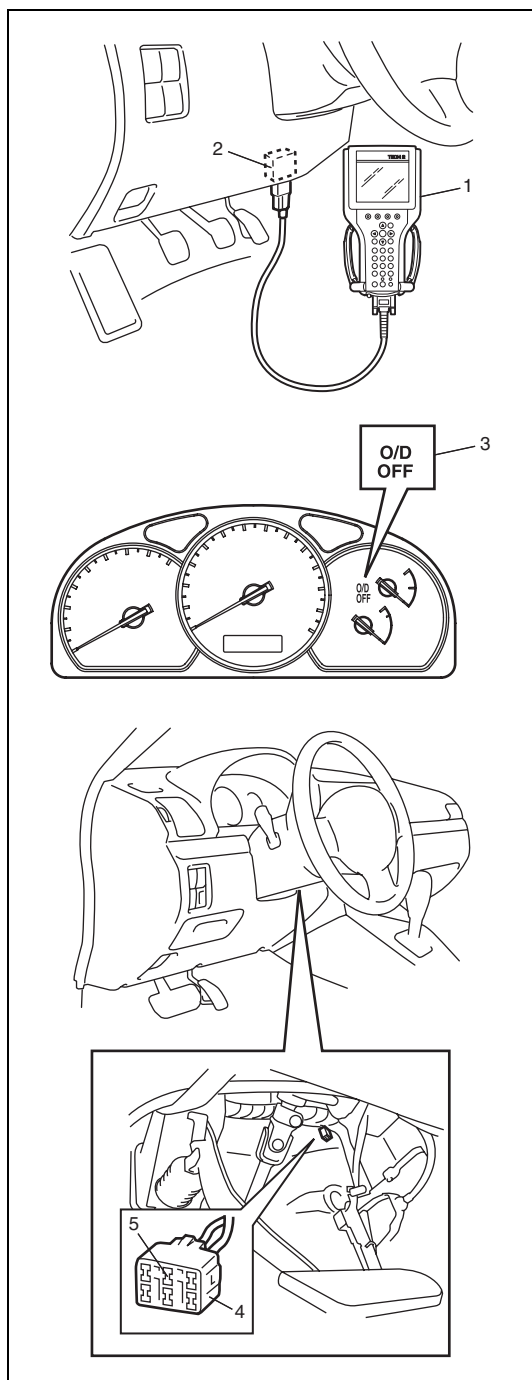
For automatic transmission control system, TCM has the following functions.

- When TCM detects a malfunction in A/T control system while the engine is running, it flashes "O/D OFF" lamp (3) and stores the malfunction area in its memory.
- It is possible to communicate with TCM through DLC (2) by using SUZUKI scan tool (1). (Diagnostic information can be accessed by using a scan tool (1).)
- It is also possible to output by flashing of "O/D OFF" lamp (3) with diagnosis switch terminal (5) of monitor connector (4) grounded.

If no DTC is stored in TCM memory, DTC No.12 is outputted repeatedly.

If one or more DTCs are stored in TCM memory, they are outputted three times per one code starting from smallest code number in increasing order.

After all DTCs are outputted, they are outputted again in the same manner.



Precaution in Diagnosing Trouble

- Don't disconnect couplers from TCM, battery cable from battery, TCM ground wire harness from engine or main fuse before checking DTC stored in TCM memory. Such disconnection will clear memorized information in TCM memory.
- Using SUZUKI scan tool, the diagnostic information stored in TCM memory can be checked and cleared as well. Before its use, be sure to read Operator's (Instruction) Manual supplied with it carefully to have good understanding of its functions and usage.
- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before inspection and observe what is written there.
- TCM replacement
When substituting a known-good TCM, check for the following condition.
Neglecting this check may result in damage to a good TCM.
 - All relays and actuators have resistance of specified value.

Automatic Transmission Diagnostic Flow Table

Refer to the following items for the details of each step.

Step	Action	Yes	No
1	Customer Complaint Analysis 1) Perform customer complaint analysis. Was customer complaint analysis performed according to instruction?	Go to Step 2.	Perform customer complaint analysis.
2	Diagnostic Trouble Code (DTC) Check, Record and Clearance 1) Check for DTC Is there any DTC(s)?	Print DTC or write them down and clear them by referring to "DTC Clearance" in this section. Go to Step 3.	Go to Step 4.
3	Visual Inspection 1) Perform visual inspection. Is there any faulty condition?	Repair or replace malfunction part. Go to Step 11.	Go to Step 5.
4	Visual Inspection 1) Perform visual inspection. Is there any faulty condition?		Go to Step 8.
5	Trouble Symptom Confirmation 1) Confirm trouble symptom. Is trouble symptom identified?	Go to Step 6.	Go to Step 7.
6	Rechecking and Recording of DTC 1) Recheck for DTC referring to "DTC Check" in this section. Is there any DTC(s)?	Go to Step 9.	Go to Step 8.
7	Rechecking and Recording of DTC 1) Recheck for DTC referring to "DTC Check" in this section. Is there any DTC(s)?	Go to Step 9.	Go to Step 10.
8	Automatic Transmission Basic Inspection and Trouble Diagnosis Table 1) Check and repair according to "A/T Basic Check" and "Trouble Diagnosis Table" in this section. Are check and repair completed?	Go to Step 11.	Check and repair malfunction part(s). Go to Step 11.
9	Troubleshooting for DTC 1) Check and repair according to applicable DTC Diagnostic Flow Table. Are check and repair completed?		
10	Check for Intermittent Problems 1) Check for intermittent problems. Is there any faulty condition?	Repair or replace malfunction part(s). Go to Step 11.	Go to Step 11.
11	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test. Is there any problem symptom, DTC or abnormal condition?	Go to Step 6.	End.

STEP 1. CUSTOMER COMPLAINT ANALYSIS

Record details of the problem (failure, complaint) and how it occurred as described by the customer.

For this purpose, use of such an inspection form as shown in the following page as an example will facilitate collecting information to the point required for proper analysis and diagnosis.

STEP 2. DIAGNOSTIC TROUBLE CODE (DTC) CHECK, RECORD AND CLEARANCE

First, referring to “DTC Check” in this section, check DTC. If DTC exists, print or write down DTC and then clear it by referring to “DTC Clearance” in this section. DTC indicates malfunction in the system but it is not possible to know from it whether the malfunction is occurring now or it occurred in the past and normal condition has been restored. In order to know that, check symptom in question according to Step 5 and then recheck DTC according to Step 6.

Diagnosing a trouble based on the DTC in this step only or failure to clear the DTC in this step may result in a faulty diagnosis, trouble diagnosis of a normal circuit or difficulty in troubleshooting which is otherwise unnecessary.

STEP 3 and STEP 4. VISUAL INSPECTION

As a preliminary step, be sure to perform visual check of the items that support proper function of the A/T and engine referring to “Visual Inspection” in this section.

STEP 5. TROUBLE SYMPTOM CONFIRMATION

Check trouble symptoms based on information obtained in Step 1 “CUSTOMER COMPLAINT ANALYSIS” and Step 2 “DTC Check”.

Also, recheck DTC according to “DTC Confirmation Procedure” described in each “DTC FLOW TABLE”.

STEP 6 and STEP 7. RECHECKING AND RECORDING OF DTC

Refer to “DTC Check” in this section for checking procedure.

STEP 8. A/T BASIC CHECK AND TROUBLE DIAGNOSIS TABLE

Perform A/T basic check according to “A/T Basic Check” in this section first. When the end of the flow table has been reached, check the parts of the system suspected as a possible cause referring to “Trouble Diagnosis Table” in this section and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or A/T basic check) and repair or replace faulty parts, if any.

STEP 9. DIAGNOSTIC TROUBLE CODE FLOW TABLE

Based on the DTC indicated in Step 6 and 7 and referring to “Diagnostic Trouble Code Table” in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, TCM or other part and repair or replace faulty parts.

STEP 10. CHECK FOR INTERMITTENT PROBLEM

Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to “Intermittent and Poor Connection” in Section 0A and related circuit of DTC recorded in Step 2.

STEP 11. FINAL CONFIRMATION TEST

Confirm that the problem symptom has gone and the A/T is free from any abnormal conditions.

If what has been repaired is related to the malfunction DTC, clear the DTC once, set conditions under which DTC was detected and A/T and/or vehicle was repaired and confirm that no DTC is indicated.

Customer Problem Inspection Form (Example)

User name:	Model:	VIN:	
Date of issue:	Date of Reg:	Date of problem:	Mileage:
PROBLEM SYMPTOMS			
☐ Engine does not start ☐ Vehicle does not move (forward, rearward) ☐ No lock-up (TCC clutch operation) ☐ Shift point too high or too low ☐ Excessive gear change shock		☐ Engine stops ☐ Transmission does not shift (1st, 2nd, 3rd, 4th, Rev) gear ☐ Automatic shift does not occur ☐ Transmission slipping in (1st, 2nd, 3rd, 4th, Rev) gear ☐ Other:	
VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS			
Environmental Condition			
Weather	☐ Fair/ ☐ Cloudy/ ☐ Rain/ ☐ Snow/ ☐ Always/ ☐ Other ()		
Temperature	☐ Hot/ ☐ Warm/ ☐ Cool/ ☐ Cold/ ☐ (°C °F)/ ☐ Always		
Frequency	☐ Always/ ☐ Sometimes/ ☐ (times/ day, month)/ ☐ Only Once		
Road	☐ Urban/ ☐ Suburb/ ☐ Highway/ ☐ Mountainous (uphill/downhill)/ ☐ Paved road/ ☐ Gravel/ ☐ Other ()		
Vehicle Condition			
Transmission range	☐ (P, R, N, D, 2, L) range/ ☐ (→) range		
Transmission temp.	☐ Cold/ ☐ Warming up phase/ ☐ Warmed up		
Vehicle	☐ At stop/ ☐ During driving (constant speed/accelerating/decelerating/ right hand corner/left hand corner)/ ☐ Other ()/ ☐ Speed (km/h mile/h)		
Engine	☐ Speed (r/min)/ ☐ Throttle opening (idle/about %/full)		
Brake	☐ Apply/ ☐ Not apply		
O/D off switch	☐ ON/ ☐ OFF		
Diagnostic trouble code	First check : ☐ No code ☐ Malfunction code () Second check : ☐ No code ☐ Malfunction code ()		

NOTE:

The above form is a standard sample. It should be modified according to conditions characteristic of each market.

“O/D OFF” Lamp Check

- 1) Turn ignition switch ON.
- 2) Check that “O/D OFF” lamp lights for about 2 – 4 sec. and then goes OFF.

If anything faulty is found, advance to “Table B-1: “O/D OFF” Lamp Circuit Check (“O/D OFF” Lamp Doesn’t Light at Ignition Switch ON)” or “Table B-2: “O/D OFF” Lamp Circuit Check (“O/D OFF” Lamp Comes ON Steadily)” in this section.

Diagnostic Trouble Code (DTC) Check

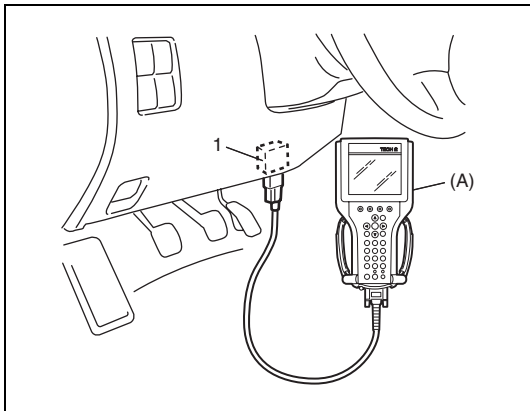
[CHECK DTC USING SUZUKI SCAN TOOL]

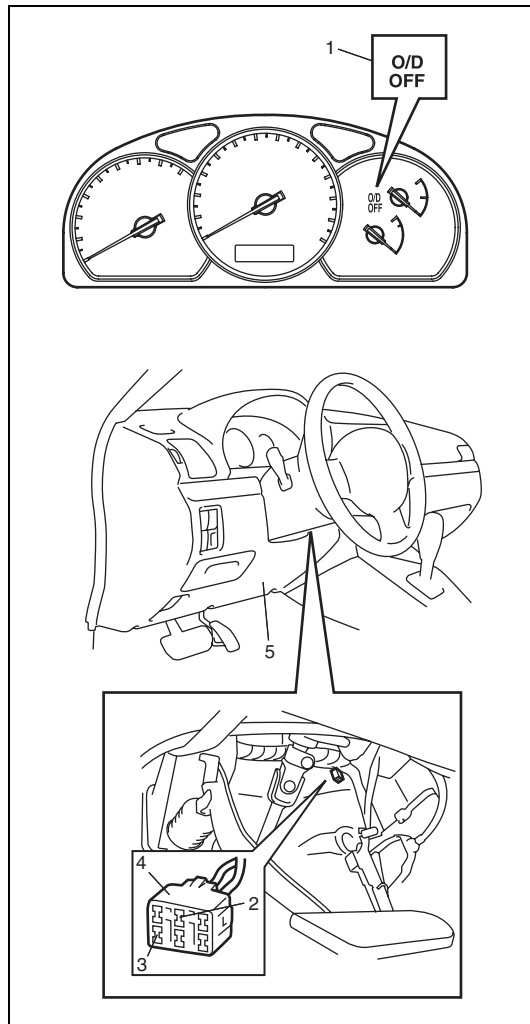
- 1) Turn ignition switch OFF.
- 2) Connect SUZUKI scan tool to data link connector (DLC) (1).

Special tool

(A): SUZUKI scan tool

- 3) Turn ignition switch ON.
- 4) Read DTC according to instructions displayed on SUZUKI scan tool and print it down. Refer to SUZUKI scan tool operator’s manual for further details.
- 5) After completing DTC check, turn ignition switch OFF and disconnect SUZUKI scan tool from data link connector (DLC) (1).



[CHECK DTC WITHOUT USING SUZUKI SCAN TOOL]

- 1) Turn ignition switch ON and make sure that "O/D OFF" lamp (1) is OFF in combination meter (with O/D off switch OFF).
- 2) Turn ignition switch OFF.
- 3) Remove steering column hole cover (5).
- 4) Using service wire, ground diagnosis switch terminal (2) of monitor connector (4).
- 5) Turn ignition switch ON.
- 6) Read DTC from flashing pattern of "O/D OFF" lamp (1).
- 7) After completing DTC check, turn ignition switch OFF and disconnect service wire from monitor connector (4).

3. Ground terminal

Diagnostic Trouble Code Clearance

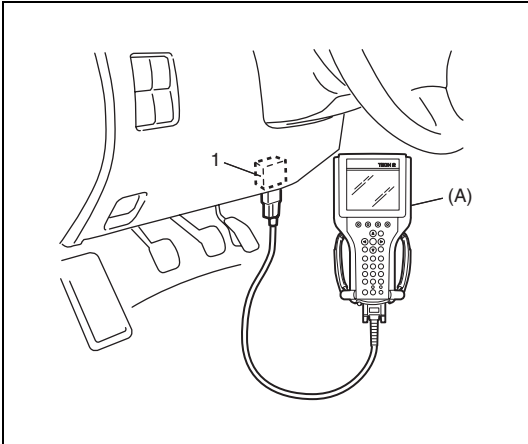
[CLEAR DTC USING SUZUKI SCAN TOOL]

- 1) Turn ignition switch OFF.
- 2) Connect SUZUKI scan tool to data link connector (DLC) (1) located in underside of instrument panel at driver's seat side.

Special tool

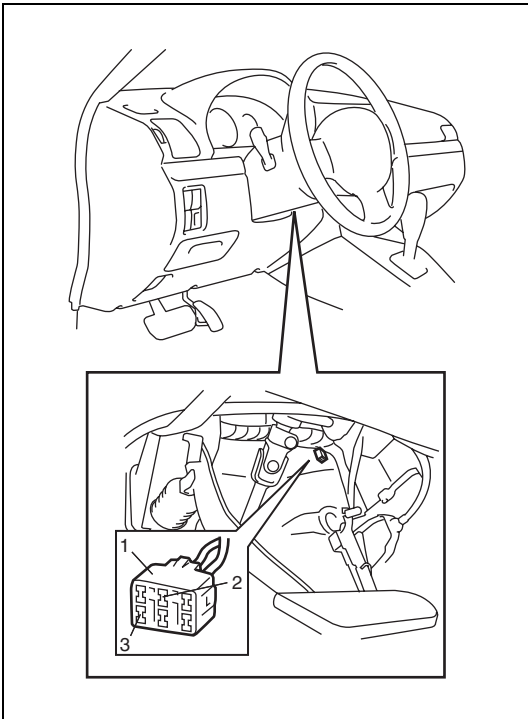
(A): SUZUKI scan tool

- 3) Turn ignition switch ON.
- 4) Erase DTC according to instructions displayed on SUZUKI scan tool. Refer to SUZUKI scan tool operator's manual for further details.
- 5) After completing erasing, turn ignition switch OFF and disconnect SUZUKI scan tool from data link connector (DLC) (1).



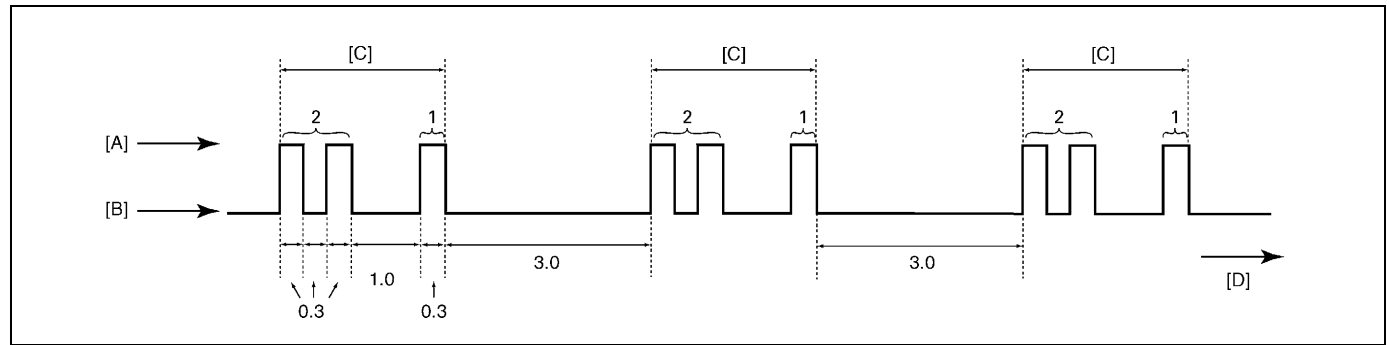
[CLEAR DTC WITHOUT USING SUZUKI SCAN TOOL]

- 1) Turn ignition switch ON.
- 2) After 6 seconds or more, repeat connecting and disconnecting diagnosis switch terminal (2) and ground terminal (3) of monitor connector (1) 5 times at about 1 second interval within 10 seconds, using service wire.
- 3) Perform "DTC Check" in this section and confirm that only DTC No.12 (normal DTC) is displayed. If not, repeat Step 1) and 2) and check again.



Diagnostic Trouble Code Table

EXAMPLE: When Shift Solenoid-B Electrical (Code No.21) Is Set



[A] : "O/D OFF" lamp is turned ON	[C] : Code No.21
[B] : "O/D OFF" lamp is turned OFF	[D] : Time (Sec.)

DTC		"O/D OFF" Lamp Flashing of DTC (Not using scan tool)	Detecting Items	Detecting Condition (DTC will set when detecting)
Using scan tool	Not using scan tool			
—	12		Normal	—
P0705	34		Transmission range sensor circuit malfunc- tion	- No sensor signal is inputted. - or 2 or more signals are inputted simultaneously.
P0710	36		Transmission fluid tem- perature sensor circuit	Sensor output voltage is too high (Circuit open or shorted power cir- cuit)
	38			Sensor output voltage is too low (Circuit shorted to ground)
P0715	37		Input/Turbine speed sensor circuit	No sensor signal is inputted although output shaft speed sensor signal is inputted.
P0720	31		Output speed sensor circuit	No sensor signal is inputted although input shaft speed sensor signal is inputted.
P0725	35		Engine speed input cir- cuit	No sensor signal is inputted although input shaft speed sensor signal is inputted.
P0743	25		Torque converter clutch circuit electrical	Voltage of TCC solenoid terminal is too high although TCM commands TCC solenoid to turn OFF.
	26			Voltage of TCC solenoid terminal is too low although TCM commands TCC solenoid to turn ON.
P0748	41		Pressure control sole- noid electrical	No electric flow is detected in pres- sure solenoid circuit.
	42			Too much electric flow is detected in pressure control solenoid circuit.

DTC		“O/D OFF” Lamp Flashing of DTC (Not using scan tool)	Detecting Items	Detecting Condition (DTC will set when detecting)
Using scan tool	Not using scan tool			
P0753	21		Shift solenoid-A (No.1) electrical	Voltage of shift solenoid terminal is too high although TCM commands shift solenoid to turn OFF.
	22			Voltage of shift solenoid terminal is too low although TCM commands shift solenoid to turn ON.
P0758	23		Shift solenoid-B (No.2) electrical	Voltage of shift solenoid terminal is too high although TCM commands shift solenoid to turn OFF.
	24			Voltage of shift solenoid terminal is too low although TCM commands shift solenoid to turn ON.
P1700	32		Acceleration stroke sig- nal input malfunction	Too short low signal of pulse signal from ECM to TCM continues to be out of specification.
	33			Too long low signal of pulse signal from ECM to TCM continues to be out of specification.
P1702	52		Internal malfunction of TCM	Calculation of current data stored in TCM is not correct comparing with pre-stored checking data in TCM.
P1730	64		Engine torque signal cir- cuit malfunction	Too short or too long low signal of pulse signal from ECM to TCM continues to be out of specification.

Fail Safe Table

This function is provided by the safe mechanism that assures safe driveability even when the solenoid valve, sensor or its circuit fails.

The table below shows the fail safe function for each fail condition of solenoid, solenoid or its circuit.

DTC No.		Trouble Area	Fail Safe Operation
P0705	34	Transmission range sensor or its circuit	- In case of circuit open, selected range is set as "D" range. - In case of circuit short (In case that 2 or more sensor signals are inputted), selected range is set in following priority order. D>2>L>R>N>P - Reverse control operation, which inhibits reverse driving at "R" range while vehicle runs forward at more than 11 km/h (7 mile/h), is inhibited.
P0710	36 38	Transmission fluid temperature sensor or its circuit	- Lock-up function is inhibited to operate. - Line pressure control which defuses shift shock is inhibited.
P0715	37	Input shaft speed sensor or its circuit	- Maximum value of line pressure is outputted. - Lock-up function is inhibited to operate. - Line pressure control which defuses shift shock is inhibited.
P0720	31	Output speed sensor or its circuit	- Maximum value of line pressure is outputted. 4th gear (O/D) shift-up function is inhibited to operate. - Lock-up function is inhibited to operate. - Line pressure control which defuse shift shock is inhibited. - Reverse control operation, which inhibits reverse driving at "R" range while vehicle runs forward at more than 11 km/h (7 mile/h), is inhibited.
P0725	35	Engine speed input circuit or ECM	- Maximum value of line pressure is outputted. - Lock-up function is inhibited to operate.
P0743	25 26	TCC solenoid valve or its circuit	- Lock-up function is inhibited to operate. - When TCC solenoid circuit is shorted to power circuit and vehicle speed is less than 10 km/h (6 mile/h), gear position is fixed in 1st gear for prevention of engine stall. - Up shift to 4th gear is inhibited when A/T fluid temperature is 140 °C (284 °F) or higher.
P0748	41 42	Pressure control solenoid valve or its circuit	- Lock-up function is inhibited to operate. - Line pressure control which defuses select shock is inhibited. - Power supply to shift solenoid, TCC solenoid and pressure control solenoid is cut.
P0753	21 22	Shift solenoid-A valve or its circuit	- Lock-up function is inhibited to operate. - Line pressure control which defuses select shock is inhibited. - Power supply to shift solenoid, TCC solenoid and pressure control solenoid is cut.
P0758	23 24	Shift solenoid-B valve or its circuit	
P1700	32 33	Throttle position (TP) sensor or its circuit	- Maximum value of line pressure is outputted. - Line pressure control which defuses shift shock is inhibited. - Throttle position which is used for A/T control (Shift schedule etc.) is supposed to be 0%. - Lock-up function is inhibited to operate.
P1702	52	TCM	Power supply to shift solenoid, TCC solenoid and pressure control solenoid is cut.
P1730	64	Engine torque signal circuit or ECM	- Maximum value of line pressure is outputted. - Lock-up function is inhibited to operate.

Shift solenoid fail safe table

Select lever position	Normal	Gear position to be fixed
D	1	O/D
	2	
	3	
	O/D	
2	1	3
	2	
	3	
L	1	1
	2	

Visual Inspection

Visually check the following parts and systems.

INSPECTION ITEM	REFERRING SECTION
• A/T fluid - - - - - level, leakage, color • A/T fluid hoses - - - - - disconnection, looseness, deterioration • Accelerator cable - - - - - play, installation • A/T select cable - - - - - installation, operation • Engine oil - - - - - level, leakage • Engine coolant - - - - - level, leakage • Battery - - - - - fluid level, corrosion of terminal • Connectors of electric wire harness - - - - - disconnection, friction • Fuses - - - - - burning • Parts - - - - - installation, damage • Bolt - - - - - looseness • Other parts that can be checked visually • Also check the following items at engine start, if possible. – “O/D OFF” lamp - - - - - Operation – Malfunction indicator lamp - - - - - Operation – Charge warning lamp - - - - - Operation – Engine oil pressure warning lamp - - - - - Operation – Other parts that can be checked visually	SECTION 0B SECTION 7B1 SECTION 6E3 SECTION 7B1 SECTION 0B SECTION 0B SECTION 6 SECTION 8 SECTION 7B1 SECTION 6 SECTION 6H SECTION 8 (SECTION 6A3 for pressure check)

A/T Basic Check

This inspection is important for troubleshooting when TCM has detected no DTC and no abnormality has been noted in visual inspection. Follow flow table carefully.

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Perform "Road Test" in this section. Is it OK?	Go to Step 3.	Proceed to "Road Test" in this section.
3	Perform "Manual Road Test" in this section. Is it OK?	Go to Step 4.	Proceed to "Manual Road Test" in this section.
4	Perform "Engine Brake Test" in this section. Is it OK?	Go to Step 5.	Proceed to "Engine Brake Test" in this section.
5	Perform "Stall Test" in this section. Is it OK?	Go to Step 6.	Proceed to "Stall Test" in this section.
6	Perform "Time Lag Test" in this section. Is it OK?	Go to Step 7.	Proceed to "Time Lag Test" in this section.
7	Perform "Line Pressure Test" in this section. Is it OK?	Go to Step 8.	Proceed to "Line Pressure Test" in this section.
8	Proceed to "Trouble Diagnosis Table 1" in this section. Is trouble identified?	Repair or replace defective parts.	Go to Step 9.
9	Proceed to "Trouble Diagnosis Table 2" in this section. Is trouble identified?	Repair or replace defective parts.	Proceed to "Trouble Diagnosis Table 3" in this section.

Trouble Diagnosis Table 1

ELECTRICAL REPAIR

Condition	Possible Cause	Correction
Poor 1 → 2 shift and 2 → 1 shift	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Transmission range sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	Output shaft speed sensor circuit faulty	
	Shift solenoid-B valve circuit faulty	
	TCM	Inspect referring to “DTC FLOW TABLE” of P0705, P0720, P0748, P0753, P0758, P1700 and P1702 in this section. If NG, replace.
Poor 2 → 3 shift and 3 → 2 shift	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Transmission range sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	Output shaft speed sensor circuit faulty	
	Shift solenoid-A valve circuit faulty	
	TCM	Inspect referring to “DTC FLOW TABLE” of P0705, P0720, P0743, P0748, P0753, P0758, P1700 and P1702 in this section. If NG, replace.
Poor 3 → O/D shift and O/D → 3 shift	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Transmission range sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	Output shaft speed sensor circuit faulty	
	O/D off switch circuit faulty	Refer to “DIAGNOSTIC FLOW TABLE A-1” in this section.
	4WD low switch circuit faulty	
	TCM	Inspect referring to “DTC FLOW TABLE” of P0705, P0720, P0743, P0748, P0753, P0758, P1700 and P1702 in this section. If NG, replace.
Incorrect gear shift point	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Transmission range sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	Output shaft speed sensor circuit faulty	
	Pressure control solenoid valve circuit faulty	
	TCM	Inspect referring to “DTC FLOW TABLE” of P0705, P0720, P0743, P0748, P0753, P0758, P1700 and P1702 in this section. If NG, replace.
TCC (lock-up) system does not operate	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Transmission range sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	Output shaft speed sensor circuit faulty	
	TCC solenoid valve circuit faulty	
	Transmission fluid temperature sensor circuit faulty	
	Brake light switch circuit faulty	
	TCM	Inspect referring to “DTC FLOW TABLE” of P0710, P0715, P0720, P0743 and P1700 in this section. If NG, replace.

Condition	Possible Cause	Correction
Higher or lower stall speed	Pressure control solenoid valve circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	TCM	Inspect referring to "DTC FLOW TABLE" of P0748 in this section. If NG, replace.
Higher or lower line pressure	Pressure control solenoid valve circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	TCM	Inspect referring to "DTC FLOW TABLE" of P0748 in this section. If NG, replace.
Excessive shock at "N" → "D"	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Transmission fluid temperature sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	Pressure control solenoid valve circuit faulty	
	TCM	Inspect referring to "DTC FLOW TABLE" of P0710, P0715, P0720, P0725, P0748, P0753, P0758, P1700 and P1730 in this section. If NG, replace.
Excessive shock at "N" → "R"	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Transmission fluid temperature sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	TCM	Inspect referring to "DTC FLOW TABLE" of P0710, P0715, P0720, P0725, P0748, P0753, P0758, P1700 and P1730 in this section. If NG, replace.
Excessive shock at shift up and down	Acceleration stroke sensor circuit faulty	Inspect circuit for open, short and intermittent trouble referring to Section 6. If NG, repair.
	Output shaft speed sensor circuit faulty	Inspect circuit for open, short and intermittent trouble. If NG, repair.
	Input shaft speed sensor circuit faulty	
	Transmission fluid temperature sensor circuit faulty	
	Pressure control solenoid valve circuit faulty	
	TCM	Inspect referring to "DTC FLOW TABLE" of P0710, P0715, P0720, P0725, P0748, P0753, P0758, P1700 and P1730 in this section. If NG, replace.

Trouble Diagnosis Table 2

ON-VEHICLE REPAIR

Condition	Possible Cause	Correction
Unable to run in all range	Faulty valve body component	Replace valve body assembly.
Poor 1 → 2 shift, excessive shock or slippage	Engine abnormal condition	Inspect and repair engine.
	Malfunction of acceleration stroke sensor	Inspect. If NG, replace.
	Malfunction of transmission range sensor	
	Malfunction of transmission fluid temperature sensor	
	Malfunction of output shaft speed sensor	
	Malfunction of input shaft speed sensor	
	Malfunction of shift solenoid-B valve circuit	
	Malfunction of pressure control solenoid	Inspect. If NG, replace valve body assembly.
Poor 2 → 3 shift, excessive shock or slippage	Faulty valve body component	Replace valve body assembly.
	Engine abnormal condition	Inspect and repair engine.
	Malfunction of acceleration stroke sensor	Inspect. If NG, replace.
	Malfunction of transmission range sensor	
	Malfunction of transmission fluid temperature sensor	
	Malfunction of output shaft speed sensor	
	Malfunction of input shaft speed sensor	
	Malfunction of shift solenoid-A valve circuit	
Poor 3 → O/D shift, excessive shock or slippage	Malfunction of pressure control solenoid	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Engine abnormal condition	Inspect and repair engine.
	Malfunction of acceleration stroke sensor	Inspect. If NG, replace.
	Malfunction of transmission range sensor	
	Malfunction of transmission fluid temperature sensor	
	Malfunction of output shaft speed sensor	
	Malfunction of input shaft speed sensor	
Incorrect shift point	Malfunction of pressure control solenoid	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Engine abnormal condition	Inspect and repair engine.
	Malfunction of acceleration stroke sensor	Inspect. If NG, replace.
	Malfunction of transmission range sensor	
	Malfunction of output shaft speed sensor	Inspect. If NG, replace valve body assembly.
	Malfunction of pressure control solenoid	

Condition	Possible Cause	Correction
TCC (lock-up) system does not operate	Malfunction of acceleration stroke sensor	Inspect. If NG, replace.
	Malfunction of transmission range sensor	
	Malfunction of output shaft speed sensor	
	Malfunction of transmission fluid temperature sensor	
	Malfunction of TCC solenoid valve	
	Malfunction of brake light switch	
	Faulty valve body component	Replace valve body assembly.
Excessive “N” → “D” or “N” → “R”	Faulty valve body component	Replace valve body assembly.

Trouble Diagnosis Table 3

OFF-VEHICLE REPAIR

Condition	Possible Cause	Correction
Unable to run in all ranges	Faulty oil pump	Inspect. If NG, replace.
	Seized or broken planetary gear	
	Damaged drive plate	
	Faulty torque converter	Replace.
Poor 1 → 2 shift, excessive shock or slippage	Faulty 2nd brake	Inspect. If NG, replace.
	Faulty one-way No.3 clutch	
	Faulty torque converter	
Poor 2 → 3 shift, excessive shock or slippage	Faulty direct clutch	Inspect. If NG, replace.
	Faulty torque converter	
Poor 3 → O/D shift, excessive shock or slippage	Faulty O/D brake	Inspect. If NG, replace.
	Faulty torque converter	
TCC (lock-up) system does not operate	Faulty torque converter	Replace.
Excessive “N” → “D” time lag	Clogged oil strainer	Replace.
	Faulty oil pump	Inspect. If NG, replace.
	Faulty forward clutch	
	Faulty one-way No.1 clutch	
	Faulty one-way No.2 clutch	
	Leakage from “D” range fluid pressure circuit	Replace valve body assembly.
Excessive “N” → “R” time lag	Clogged oil strainer	Replace.
	Faulty oil pump	Inspect. If NG, replace.
	Faulty direct clutch	
	Faulty reverse brake	
	Faulty one-way No.1 clutch	
	Leakage from “R” range fluid pressure circuit	Replace valve body assembly.
Poor engine brake in downshift to “2” range	Faulty second coast brake	Inspect. If NG, replace.
Poor engine brake in downshift to “L” range	Faulty reverse brake	Inspect. If NG, replace.

ROAD TEST

This test is to check if upshift and downshift take place at specified speed while actually driving vehicle on a level road.

WARNING:

- Carry out test in very little traffic area to prevent an accident.
- Test requires 2 persons, a driver and a tester.

- 1) Warm up engine.
- 2) With engine running at idle, shift select lever to "D".
- 3) Accelerate vehicle speed by depressing accelerator pedal gradually.
- 4) While driving in "D" range, check if gear shift and lock-up occur properly as shown in "Automatic Gear Shift Diagram" in this section.

TROUBLESHOOTING

Condition	Possible Cause	Correction
Unable to run in all ranges	Faulty valve body component	Replace valve body assembly.
	Faulty oil pump	Inspect. If NG, replace.
	Seized or broken planetary gear	
	Damaged drive plate	
	Faulty torque convertor	Replace.
1 → 2 up shift fails to occur	Malfunction of shaft solenoid-B valve	Inspect. If NG, replace.
	Malfunction of acceleration stroke sensor	
	Malfunction of transmission range sensor	
	Malfunction of output shaft speed sensor	
	Faulty valve body component	Replace valve body assembly.
	Faulty 2nd brake	Inspect. If NG, replace.
	Faulty one-way No.3 clutch	
2 → 3 up shift fails to occur	Malfunction of shift solenoid-A valve	Inspect. If NG, replace.
	Malfunction of acceleration stroke sensor	
	Malfunction of transmission range sensor	
	Malfunction of output shaft speed sensor	
	Faulty valve body component	Replace valve body assembly.
	Faulty direct clutch	Inspect. If NG, replace.
3 → O/D up shift fails to occur	Malfunction of acceleration stroke sensor	Inspect. If NG, replace.
	Malfunction of transmission range sensor	
	Malfunction of output shaft speed sensor	
	Faulty valve body component	Replace valve body assembly.
	Faulty O/D brake	Inspect. If NG, replace.
Gear shift point is incorrect	Malfunction of acceleration stroke sensor	Inspect. If NG, replace.
	Malfunction of transmission range sensor	
	Malfunction of output shaft speed sensor	
	Malfunction of pressure control solenoid valve	

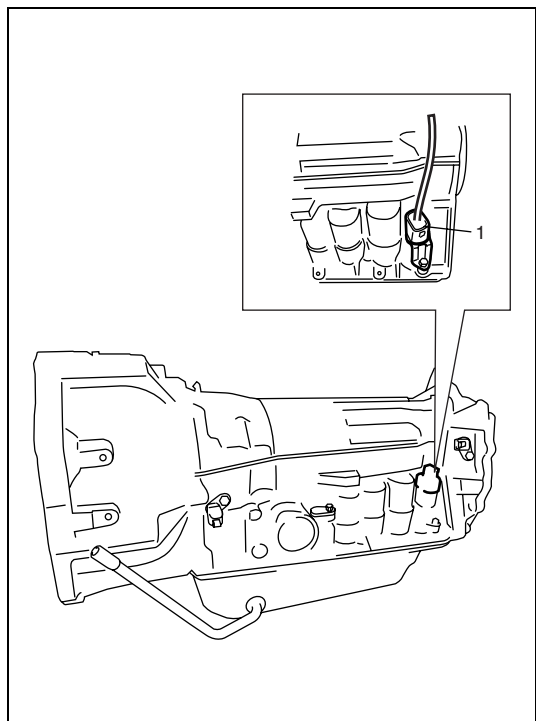
Condition	Possible Cause	Correction
TCC (lock-up) function does not operate	Malfunction of TCC solenoid valve	Inspect. If NG, replace.
	Malfunction of acceleration stroke sensor	
	Malfunction of transmission range sensor	
	Malfunction of output shaft speed sensor	
	Malfunction of transmission fluid temperature sensor	
	Malfunction of brake light switch	
	Faulty valve body component	Replace valve body assembly.
	Faulty torque converter	Replace.

MANUAL ROAD TEST

This test is to check the gear being used in “L”, “2” or “D” range when driven with gear shift control system unoperated. Test drive vehicle on a level road.

NOTE:

Before this test, check diagnostic trouble code (DTC).



WARNING:

To avoid danger of being burned, do not touch hot exhaust system when disconnecting or reconnecting shift solenoid coupler (1).

- 1) Disconnect shift solenoid connector (1) on transmission.
- 2) With select lever in “P” range, start engine and warm it up.
- 3) With select lever in “L” range, start vehicle and accelerate to 20 km/h (12.5 mile/h). Check in this state that 1st gear is being used.
- 4) At 20 km/h (12.5 mile/h), shift select lever to “2” range and accelerate to 40 km/h (25 mile/h). Check in this state that 3rd gear is being used.
- 5) At 40 km/h (25 mile/h), shift select lever to “D” range and check that O/D gear is used when speed is higher than 40 km/h (25 mile/h).
- 6) After above checks, stop vehicle then engine, and connect shift solenoids coupler (1) with ignition switch OFF.
- 7) Clear DTC with scan tool.

TROUBLESHOOTING

Condition	Possible Cause	Correction
Selected gear is not correct	Defective valve body component	Replace valve body assembly.
	Defective clutch or brake	Inspect clutch and brake. If any part is found faulty, replace it.

Engine Brake Test

WARNING:

Before this test, make sure that there is no vehicle behind so as to prevent rear-end collision.

- 1) While driving vehicle in 3rd gear of “D” range, shift select lever down to “2” range and check if engine brake operates.
- 2) In the same way as in Step 1, check engine brake for operation when select lever is shifted down to “L” range.
- 3) If engine brake fails to operate in above tests, possible causes for such failure are as follows. Check each part which is suspected to be the cause.

TROUBLESHOOTING

Condition	Possible Cause	Correction
Failure to operate when shifted down to “2” range	Defective second coast brake	Replace.
Failure to operate when shifted down to “L” range	Defective reverse brake	Replace.

Stall Test

This test is to check overall performance of automatic transmission and engine by measuring stall speed at “D” and “R” ranges. Be sure to perform this test only when transmission fluid is at normal operating temperature and its level is between FULL and LOW marks.

CAUTION:

- **Do not run engine at stall more than 5 seconds continuously, for fluid temperature may rise excessively high.**
- **After performing stall test, be sure to leave engine running at idle for longer than 60 seconds before another stall test.**

- 1) Apply parking brake and block wheels.
- 2) Install tachometer.
- 3) Start engine with select lever shifted to “P” range.
- 4) Depress brake pedal fully range.
- 5) Shift select lever to “D” and depress accelerator pedal fully while watching tachometer. Read engine rpm quickly when it has become constant (stall speed).
- 6) Release accelerator pedal immediately after stall speed is checked.
- 7) In the same way, check stall speed in “R” range.
- 8) Stall speed should be within the following specification.

Stall speed:

2,250 - 2,550 rpm

TROUBLESHOOTING

Condition	Possible Cause	Correction
Lower than standard level	Engine output torque failure faulty	Inspect and repair engine.
	Defective one-way clutch of torque converter	Replace.
Higher than standard level in “D” range	Defective pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Primary regulator valve (Low line pressure)	Replace valve body assembly.
	Slippery forward clutch	Replace.
	Defective one-way No.2 clutch	Replace.
	Leakage from “D” range fluid pressure circuit	Replace valve body assembly.
Higher than standard level in “R” range	Defective pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Defective primary regulator valve (Low line pressure)	Replace valve body assembly.
	Slippery direct clutch	Replace.
	Slippery reverse brake	Replace.
	Leakage from “R” range fluid pressure circuit	Replace valve body assembly.
High than standard level in both “D” and “R” ranges	Defective pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Defective primary regulator valve (Low line pressure)	Replace valve body assembly.
	Clogged oil strainer	Wash strainer.
	Defective O/D clutch and one-way No.1 clutch	Replace.
	Malfunction of oil pump	Replace.
	Leakage from fluid pressure circuit	Replace valve body assembly.

Time Lag Test

This test is to check conditions of clutch, reverse brake and fluid pressure. "Time lag" means time elapsed since select lever is shifted with engine idling till shock is felt.

- 1) With chocks placed before and behind front and rear wheels respectively, depress brake pedal.
- 2) Start engine.
- 3) With stop watch ready, shift select lever from "N" to "D" range and measure time from that moment till shock is felt.
- 4) Similarly measure time lag by shifting select lever from "N" to "R" range.

Specification for time lag:

"N" → "D"	Less than 1.0 sec.
"N" → "R"	Less than 1.4 sec.

NOTE:

- When repeating this test, be sure to wait at least one minute after select lever is shifted back to "N" range.
- Engine should be warmed up fully for this test.

TROUBLESHOOTING

Condition	Possible Cause	Correction
"N" → "D" time lag exceeds specification	Defective pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Defective primary regulator valve (Low line pressure)	Replace valve body assembly.
	Clogged oil strainer	Wash strainer.
	Defective oil pump	Inspect. If NG, replace.
	Leakage from "D" range fluid pressure circuit	Replace valve body assembly.
	Defective forward clutch	Replace.
	Defective one-way No.2 clutch	Replace.
"N" → "R" time lag exceeds specification	Defective pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Defective primary regulator valve (Low line pressure)	Replace valve body assembly.
	Defective oil pump	Inspect. If NG, replace.
	Clogged oil strainer	Wash strainer.
	Leakage from "R" range fluid pressure circuit	Replace valve body assembly.
	Defective direct clutch	Replace.
	Defective reverse brake	Replace.

Line Pressure Test

Purpose of this test is to check operating conditions of each part by measuring fluid pressure in fluid pressure line. Line pressure test requires the following conditions.

- Automatic fluid is at normal operating temperature (70 to 80 °C/158 – 176 °F).
- Fluid is filled to proper level (between FULL HOT and LOW HOT on dipstick).
- Air conditioner switch is turned OFF.

1) Apply parking brake securely and place chocks against wheels.

2) Attach oil pressure gauge to fluid pressure check plug bolt (1) hole in transmission case.

2. Transmission identification number plate

Special tool

(A): 09925-37811

CAUTION:

After attaching oil pressure gauge, check that no fluid leakage exists.

3) Depress foot brake fully, run engine at idle and stall.

4) Check fluid pressure in “D” and “R” ranges. Measured values should be as specified below.

CAUTION:

Do not continue running engine at stall speed longer than 5 seconds.

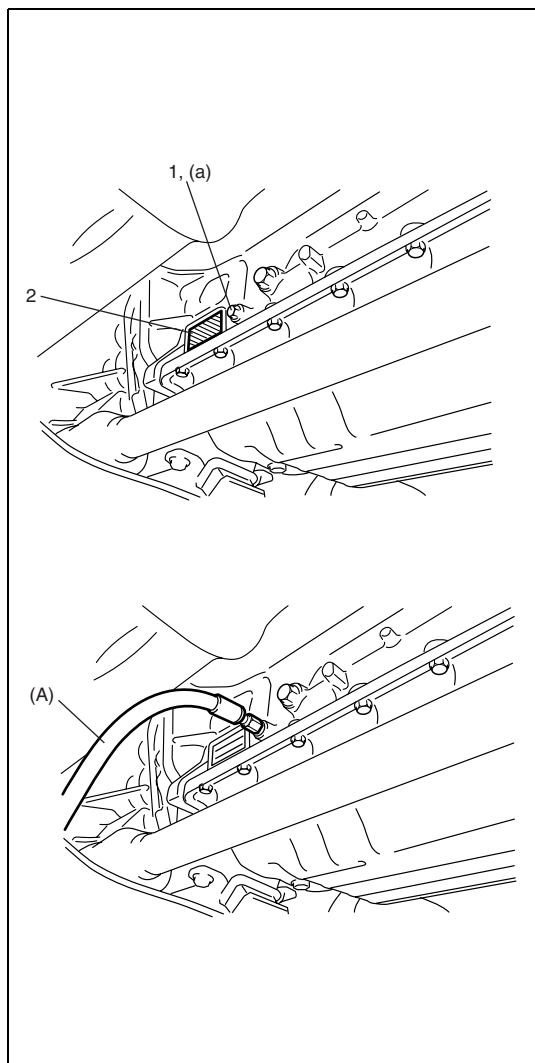
	“D” range	“R” range
Idle speed	4.0 – 4.6 kg/cm ² 57 – 65 psi	7.7 – 8.7 kg/cm ² 109 – 124 psi
Stall speed	9.1 – 10.5 kg/cm ² 129 – 150 psi	12.5 – 15.9 kg/cm ² 177 – 226 psi

5) If check result is OK, disconnect special tool, then tighten fluid pressure check plug bolt to specified torque.

Tightening torque

Fluid pressure check plug bolt

(a): 7.5 N·m (0.75 kg-m, 5.5 lb-ft)



TROUBLESHOOTING

Condition	Possible Cause	Correction
Higher than standard level in each range	Defective pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
	Defective primary regulator valve	Replace valve body assembly.
Lower than standard level in each range	Defective pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
	Defective primary regulator valve	Replace valve body assembly.
	Clogged oil strainer	Wash strainer.
	Defective oil pump	Inspect. If NG, replace.
	Leakage from fluid pressure circuit	Overhaul or replace valve body assembly.
	Defective O/D clutch and one way No.1 clutch	Replace.
Lower than standard level only in “D” range	Leakage from “D” range fluid pressure circuit	Overhaul or replace valve body assembly.
	Defective forward clutch	Replace.
Lower than standard level only in “R” range	Leakage from “R” range fluid pressure circuit	Overhaul or replace valve body assembly.
	Defective direct clutch	Replace.
	Defective reverse brake	Replace.

“P” Range Test

- 1) Stop vehicle on a slope of 5 degrees or more, shift select lever to “P” range and at the same time apply parking brake.
- 2) After stopping engine, depress brake pedal and release parking brake.
- 3) Then, release brake pedal gradually and check that vehicle remains stationary.
- 4) Depress brake pedal and shift select lever to “N” range.
- 5) Then, release brake pedal gradually and check that vehicle moves.

WARNING:

Before this test, check to make sure no one is around vehicle or down on a slope and keep watchful for safety during test.

Table A-1: No Gear Shift to O/D

SYSTEM DESCRIPTION

TCM does not shift to O/D gear under any of the following conditions.

- O/D off switch is ON. ("O/D OFF" lamp ON.)
- 4WD low switch is ON.
- Output shaft speed sensor is in faulty condition. (P0720)

TROUBLESHOOTING

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and tester, on a level road.

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check DTC. Is DTC P0720 detected?	Go to "DTC P0720 (DTC No.31) Output Speed Sensor Circuit Malfunction" in this section to repair and retry.	Go to Step 3.
3	Perform running test under the following conditions and check voltage between terminal E203-4 of TCM connector and ground, terminal E203-3 of TCM connector and ground. • O/D off switch is OFF. • Selector lever is in "D" range. • Transfer lever is in "2H" position. • Drive vehicle with 4th gear condition referring to "Automatic Gear Shift Diagram" in this section. Is each terminal voltage 0 – 1 V?	Faulty shift solenoid valve, circuit or transmission.	"GRN" or "GRN/RED" circuit shorted to power circuit. If wire is OK, go to Step 4.
4	"O/D" off switch signal inspection. With ignition switch ON, check voltage between terminal E202-3 of TCM connector and ground. O/D off switch OFF : 10 – 14 V O/D off switch ON : 0 – 1 V Is check result as specified?	Go to Step 5.	Faulty O/D off switch or its circuit. If OK, substitute a known-good TCM and recheck.
5	4WD low switch signal inspection. With ignition switch ON, check voltage between terminal E202-1 of TCM connector and ground. Transfer gear position "4L" or "N": 0 – 1 V Transfer gear position "2H" or "4H": 10 – 14 V Is check result as specified?	Substitute a known-good TCM and recheck.	Faulty 4WD low switch or its circuit. If OK, substitute a known-good TCM and recheck.

Table A-2: No Lock-Up Occurs

SYSTEM DESCRIPTION

TCM turns TCC solenoid OFF under any of the following conditions.

- Brake light switch is ON.
- 4WD low switch is ON.
- Transmission fluid temperature sensor circuit is in faulty condition. (P0710)
- Input shaft speed sensor is in faulty condition. (P0715)
- Output shaft speed sensor is in faulty condition. (P0720)
- TCC (lock-up) system circuit is in faulty condition. (P0743)
- Pressure control solenoid circuit is in faulty condition. (P0748)
- Shift solenoid circuit is in faulty condition. (P0753/P0758)
- Acceleration stroke signal circuit is in faulty condition. (P1700)

TROUBLESHOOTING

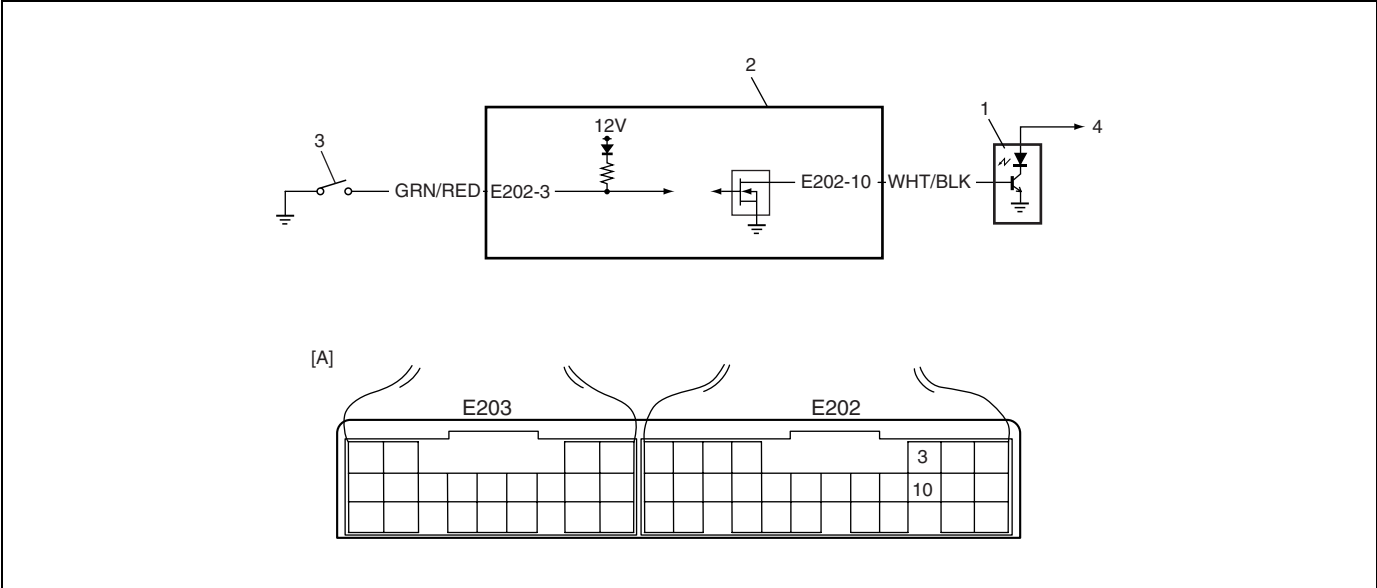
WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and tester, on a level road.

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check DTC. Is DTC P0710, P0715, P0720, P0743, P0748, P0753, P0758 or P1700 detected?	Go to applicable DTC diagnosis flow table to repair and retry.	Go to Step 3.
3	Perform running test under the following conditions and check voltage between terminal E203-12 of TCM connector and ground. • Selector lever is in "D" range. • Transfer lever is in "2H" position. • Brake pedal is released. • Drive vehicle with TCC ON condition referring to "Automatic Gear Shift Diagram" in this section. Is terminal voltage 10 – 14 V?	Faulty TCC solenoid valve, circuit or transmission.	Go to Step 4.
4	Brake light switch signal inspection. With ignition switch ON, check voltage between terminal E202-16 of TCM connector and ground. Brake pedal is released: 0 – 1 V Brake pedal is depressed: 10 – 14 V Is check result as specified?	Go to Step 5.	Maladjusted brake light switch, faulty brake light switch or its circuit. If OK, substitute a known-good TCM and recheck.
5	4WD low switch signal inspection. With ignition switch ON, check voltage between terminal E202-1 of TCM connector and ground. Transfer gear position "4L" or "N": 0 – 1 V Transfer gear position "2H" or "4H": 10 – 14 V Is check result as specified?	Substitute a known-good TCM and recheck.	Faulty 4WD low switch or its circuit. If OK, substitute a known-good TCM and recheck.

Table B-1: “O/D OFF” Lamp Circuit Check (“O/D OFF” Lamp Doesn’t Light at Ignition Switch On)

WIRING DIAGRAM



1. “O/D OFF” lamp	4. To ignition switch
2. TCM	[A] : Terminal arrangement of TCM connector (viewed from harness side)
3. O/D off switch	

TROUBLESHOOTING

Step	Action	Yes	No
1	“O/D OFF” lamp circuit check: 1) With ignition switch OFF, disconnect couplers from TCM. 2) Using service wire, connect E202-10 terminal of disconnected TCM harness side connector and ground. Does “O/D OFF” light turn ON at ignition switch ON?	Poor E202-10 terminal connection. If OK, substitute a know-good TCM and recheck.	Bulb burned out or faulty “WHT/BLK” or “BLK/WHT” wire.

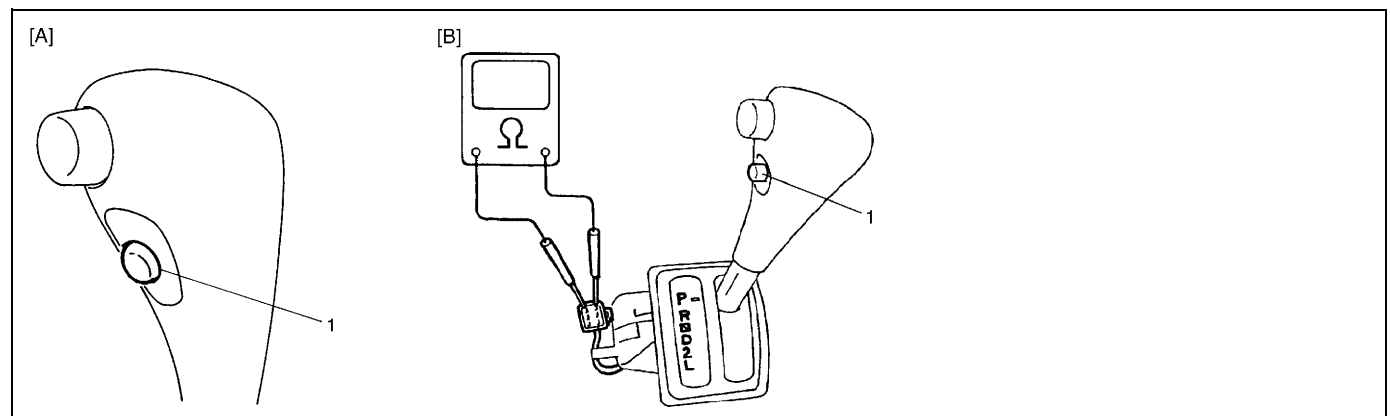
Table B-2: “O/D OFF” Lamp Circuit Check (“O/D OFF” Lamp Comes On Steadily)

WIRING DIAGRAM

Refer to “Table B-1: “O/D OFF” Lamp Circuit Check (“O/D OFF” Lamp Doesn’t Light at Ignition Switch ON)” in this section.

TROUBLESHOOTING

Step	Action	Yes	No
1	Check “O/D OFF” switch status. 1) Press “O/D OFF” switch button (1) at ignition switch ON. Does “O/D OFF” lamp come ON steadily?	Go to Step 2.	System is OK.
2	“O/D OFF” light circuit check: 1) Turn ignition switch OFF, disconnect couplers from TCM. 2) Turn ignition switch to ON position. Does “O/D OFF” lamp come ON steadily?	“WHT/BLK” wire shorted to ground circuit. If OK, replace combination meter.	Go to Step 3.
3	“O/D OFF” light circuit check: 1) Turn ignition switch to OFF position. 2) Disconnect “O/D OFF” switch connector. 3) Check continuity between “YEL/RED” wire terminal of disconnected “O/D OFF” switch connector and body ground. Is it infinity?	Go to Step 4.	“YEL/RED” wire shorted to ground circuit.
4	Check “O/D OFF” switch for operation: 1) With ignition switch OFF, remove console box. 2) Disconnect “O/D OFF” switch connector. 3) Check continuity between switch terminals under each of following conditions. “O/D OFF” switch operation With “O/D OFF” switch button (1) released: No continuity With “O/D OFF” switch button (1) pressed: Continuity Is check result satisfactory?	Substitute a known-good TCM and recheck.	Replace knob assembly.



[A]: Fig. for Step 1

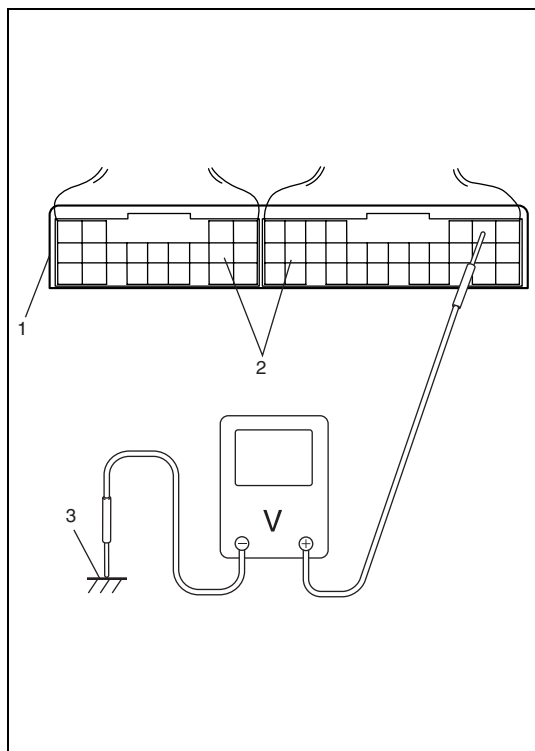
[B]: Fig. for Step 4

Inspection of TCM and Its Circuits

TCM and its circuits can be checked at TCM wiring connectors by measuring voltage and resistance.

CAUTION:

TCM cannot be checked by itself, it is strictly prohibited to connect voltmeter or ohmmeter to TCM with connector disconnected from it.



INSPECTION

- 1) Remove TCM (1) from vehicle referring to "Transmission Control Module (TCM)" in this section.
- 2) Connect TCM connectors (2) to TCM.
- 3) Check voltage at each terminal of connectors connected.

NOTE:

- As each terminal voltage is affected by battery voltage, confirm that it is 11 V or more when ignition switch is ON.
- Pulse signal cannot be measured by voltmeter. It can be measured by duty meter or oscilloscope.

3. Body ground

Connector : E202

Terminal Number	Wire Color	Circuit	Normal Voltage	Condition
1	RED	"R" position signal for transmission range switch	10 – 14 V	Ignition switch turned ON, select lever shifted at "R" range.
			0 – 2 V	Ignition switch turned ON, select lever shifted at other than "R" range.
2	ORN/GRN	"P" position signal for transmission range switch	10 – 14 V	Ignition switch turned ON, select lever shifted at "P" range.
			0 – 2 V	Ignition switch turned ON, select lever shifted at other than "P" range.
3	YEL/RED	"O/D" switch signal for selector switch	0 – 2 V	Ignition switch turned ON, O/D OFF switch at O/D OFF.
			10 – 14 V	Ignition switch turned ON, O/D OFF switch at O/D ON.
4	WHT	Output shaft speed sensor signal (+)	2 – 3 V	Ignition switch turned ON.
5	BLU/YEL	Input shaft speed sensor signal (+)	2 – 3 V	Ignition switch turned ON.
6	BLU/WHT	Throttle position sensor (Accelerator stroke sensor) signal	0 – 1 V ↑ ↓ 10 – 14 V	Ignition switch turned ON (Output signal is 100 Hz active low duty pulse. Duty ratio varies as throttle valve is opened gradually.) Throttle opening 0% = 5 – 10% ON duty Throttle opening 100% = 80 – 90% ON duty
7	–	–	–	–
8	YEL/GRN	"D" position signal for transmission range switch	10 – 14 V	Ignition switch turned ON, select lever shifted at "D" range.
			0 – 2 V	Ignition switch turned ON, select lever shifted at other than "D" range.
9	ORN/BLU	"N" position signal for transmission range switch	10 – 14 V	Ignition switch turned ON, select lever shifted at "N" range.
			0 – 2 V	Ignition switch turned ON, select lever shifted at other than "N" range.
10	WHT/BLK	"O/D OFF" lamp signal	0 – 2 V	Ignition switch turned ON, O/D OFF switch at O/D OFF.
			10 – 14 V	Ignition switch turned ON, O/D OFF switch at O/D ON.
11	–	–	–	–
12	–	–	–	–
13	–	–	–	–
14	–	–	–	–

Terminal Number	Wire Color	Circuit	Normal Voltage	Condition
15	BRN	Engine speed signal	0 – 1 V ↑ ↓ 10 – 14 V	While engine running. (Output signal is pulse. Pulse frequency varies depending on engine speed.) (3000r/min=100Hz)
16	ORN	Output shaft speed sensor signal (–)	2 – 3 V	Ignition switch turned ON.
17	BLU/GRN	Input shaft speed sensor signal (–)	2 – 3 V	Ignition switch turned ON.
18	–	–	–	–
19	–	–	–	–
20	GRN/BLU	“L” position signal for transmission range switch	10 – 14 V	Ignition switch turned ON, select lever shifted at “L” range.
			0 – 2 V	Ignition switch turned ON, select lever shifted at other than “L” range.
21	GRN/ORN	“2” position signal for transmission range switch	10 – 14 V	Ignition switch turned ON, select lever shifted at “2” range.
			0 – 2 V	Ignition switch turned ON, select lever shifted at other than “2” range.
22	–	–	–	–
23	WHT	Engine torque signal	0 – 1 V ↑ ↓ 10 – 14 V	Ignition switch turned ON (Output signal is 100 Hz active low duty pulse. Duty ratio varies depending on engine output torque.) Engine torque –100Nm=2 – 9% ON duty Engine torque 300Nm=92 – 98% ON duty
24	–	–	–	–
25	–	–	–	–
26	–	–	–	–
27	–	–	–	–
28	–	–	–	–

Connector : E203

Terminal Number	Wire Color	Circuit	Normal Voltage	Condition
1	ORN/WHT	4WD low switch signal	0 – 2 V	Ignition switch turned ON, select lever at 4WD low position.
2	–	–	–	–
3	GRN/RED	Shift solenoid valve-B (Shift solenoid No.2)	0 – 2 V	Ignition switch turned ON, select lever at “P” range.
4	GRN/RED	Shift solenoid valve-A (Shift solenoid No.1)	10 – 14 V	Ignition switch turned ON, select lever at “P” range.
5	RED/BLU	Transmission fluid temperature sensor signal	3.2 – 3.8 V	Ignition switch turned ON, fluid temperature is 60 °C (140 °F).
6	YEL	Diagnosis switch	10 – 14 V	Ignition switch turned ON.
7	PPL/RED	Data link connector	10 – 14 V	Ignition switch turned ON.
8	BLU/RED	Pressure control solenoid valve (ground)	0.6 – 1.0 V	Ignition switch turned ON.
9	–	–	–	–
10	–	–	–	–
11	BLU/ORN	Pressure control solenoid valve (+)	Voltage varies depending on throttle opening. (Output signal is duty pulse.)	
12	GRN/YEL	TCC (lock-up) solenoid valve	0 – 2 V	Ignition switch turned ON.
13	WHT	Power source for back-up	10 – 14 V	Constantly.
14	RED/GRN	Transmission fluid temperature sensor signal (ground)	0 – 2 V	Ignition switch turned ON.
15	BLK	Ground	0 – 2 V	Ignition switch turned ON.
16	GRN/WHT	Brake light switch	10 – 14 V	Ignition switch turned ON, brake pedal depressed.
			0 – 2 V	Ignition switch turned ON, brake pedal released.
17	–	–	–	–
18	–	–	–	–
19	BLK	Ground	0 – 2 V	Ignition switch turned ON.
20	BLK/WHT	Power source	10 – 14 V	Ignition switch turned ON.

Wire Harness and Connectors

Refer to Section 8A (“WIRING DIAGRAM” manual).

Scan Tool Data

As the data values given below are standard values estimated on the basis of values obtained from the normally operating vehicles by using a scan tool when the vehicle is under the following conditions, use them as reference values. Even when the vehicle is in good condition, there may be cases where the checked value does not fall within each specified data range. Therefore, judgment as abnormal should not be made by the those detected by TCM and output from TCM as commands and there may be cases where the automatic transaxle or actuator is not operating in the condition as indicated by the scan tool.

- Apply parking brake and block wheels.
- Ignition switch ON.
- Turn OFF air conditioner (if equipped).
- Apply no load to power steering (if equipped). (Don't turn it)
- Turn OFF all electric loads (except ignition).

Scan Tool Data	Standards	Condition
GEAR POSITION	1st	Vehicle stop when select lever in D, 2 or L range
	P or N/R	When select lever in P, N or R range
ENGINE SPEED	Specified idle speed	At specified idle speed in P range
INPUT SHAFT REV	0 RPM	Vehicle stop at specified idle speed in D range
	Specified idle speed	At specified idle speed in P range
OUTPUT SHAFT REV	0 RPM	Vehicle stop
BATTERY VOLTAGE	10 – 14 V	Engine stop
ATF TEMP	70 – 80 °C	–
SHIFT SOL #1	ON	Vehicle stop
SHIFT SOL #2	OFF	Vehicle stop
TCC SOL	OFF	Vehicle stop
PRESS CONT SOL	100 %	Throttle valve at idle position engine stop
ENGINE TORQUE	Display of engine torque	–
VEHICLE SPEED	0 Km/h, 0 MPH	Vehicle stop
O/D OFF SWITCH	ON	“O/D OFF” switch ON
	OFF	“O/D OFF” switch OFF
TRANS RANGE	P	When select lever in P range
THROTTLE POS	0 – 1.0 %	Throttle valve at idle position with engine running
	90 – 100 %	Throttle valve fully open
BRAKE SWITCH	ON	Brake pedal depressed
	OFF	Brake pedal released
4WD LOW SW	ON	Transfer lever at 4L
	OFF	Transfer lever at 4H or 2H

Scan Tool Data Definition

GEAR POSITION (R/P or N/1/2/3/4):

This parameter indicates the current gear position. It is computed by the throttle position coming from ECM and vehicle speed.

ENGINE SPEED (RPM):

Engine speed is obtained by computing the CKP signal from ECM and it is used for trouble diagnosis of the AT system and fail-safe control.

INPUT SHAFT REV (RPM):

Input shaft revolution is computed based on pulse signal from input shaft speed sensor in the transmission.

OUTPUT SHAFT REV (RPM):

Output shaft revolution is computed based on pulse signal from output shaft speed sensor in the transmission.

BATTERY VOLTAGE (VOLTS):

Battery voltage is an analog input signal read by TCM.

ATF TEMP (°C, °F):

This parameter is decided by signal from transmission fluid temperature sensor in the transmission.

SHIFT SOL #1, SHIFT SOL #2 (ON, OFF):

Shift solenoid is used for shifting the transmission up and down. It is turned ON or OFF by a signal from TCM. Gear position is decided by combination of ON or OFF.

TCC SOL (ON, OFF):

TCC solenoid is used for the TCC control mode. It is turned ON or OFF by a signal from TCM.

PRESSURE CONT SOL (%):

Pressure control solenoid is used for the shift change control in the transmission. It is operated by timing pulses coming from TCM.

ENGINE TORQUE (N·m):

Engine torque value at the engine crankshaft output is transmitted from ECM.

VEHICLE SPEED (Km/h, MPH):

Vehicle speed is a TCM internal parameter. It is computed by timing pulses coming from the vehicle speed sensor for A/T. Vehicle speed is used for the solenoid control in TCM.

O/D OFF SWITCH (ON, OFF):

O/D OFF switch is used for the over drive control. When this signal is ON, the gear position is not shifted to 4th.

TRANS RANGE (P/R/N/D/2/L/FAIL):

Transmission range is fed to TCM from the transmission range switch. This signal indicates when the gear is shifted to each range.

THROTTLE POS (%):

Throttle position is a TCM internal parameter. It is computed by duty signal coming from ECM. Throttle position is used for the shift solenoid control in TCM.

BRAKE SWITCH (ON, OFF):

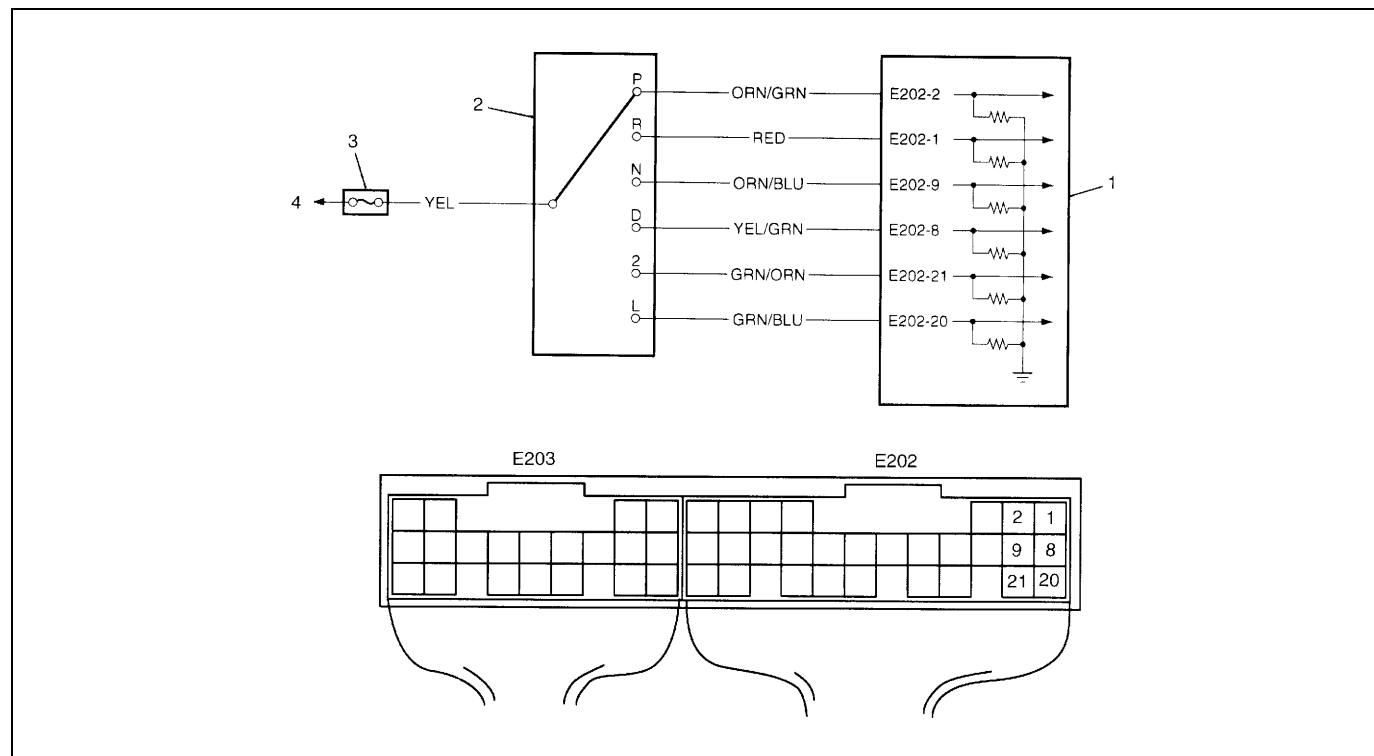
This switch signal informs TCM whether the brake is active or not.

4WD LOW SW (ON, OFF):

4WD-L signal is fed to TCM from the 4WD-L switch. This switch signal is used for timing of shift change.

DTC P0705 (DTC NO.34) Transmission Range Sensor (Switch) Circuit Malfunction

WIRING DIAGRAM



1. TCM	3. Fuse box
2. Transmission range sensor (switch)	4. To ignition

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
- Transmission range sensor (switch) signal (P, R, N, D, 2 or L) is not inputted for 30 sec. at more than 30 km/h (19 mile/h) vehicle speed and more than 1500 rpm engine speed. - Multiple signals are inputted simultaneously for 10 sec.	- Transmission range sensor (switch) maladjusted - Transmission range sensor (switch) or its circuit - TCM

DTC CONFIRMATION PROCEDURE

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

- Connect scan tool to DLC with ignition switch OFF.
- Clear DTC in TCM memory by using scan tool and start engine.
- Shift A/T select lever to each of L, 2, D, N, R and P ranges for 20 seconds each.
- Increase vehicle speed to about 40 km/h (25 mile/h) and engine speed to 1500 rpm or more in D range.
- Keep driving above vehicle speed for 40 seconds.
- Release accelerator pedal, decrease vehicle speed and stop vehicle.
- Check DTC.

TROUBLESHOOTING

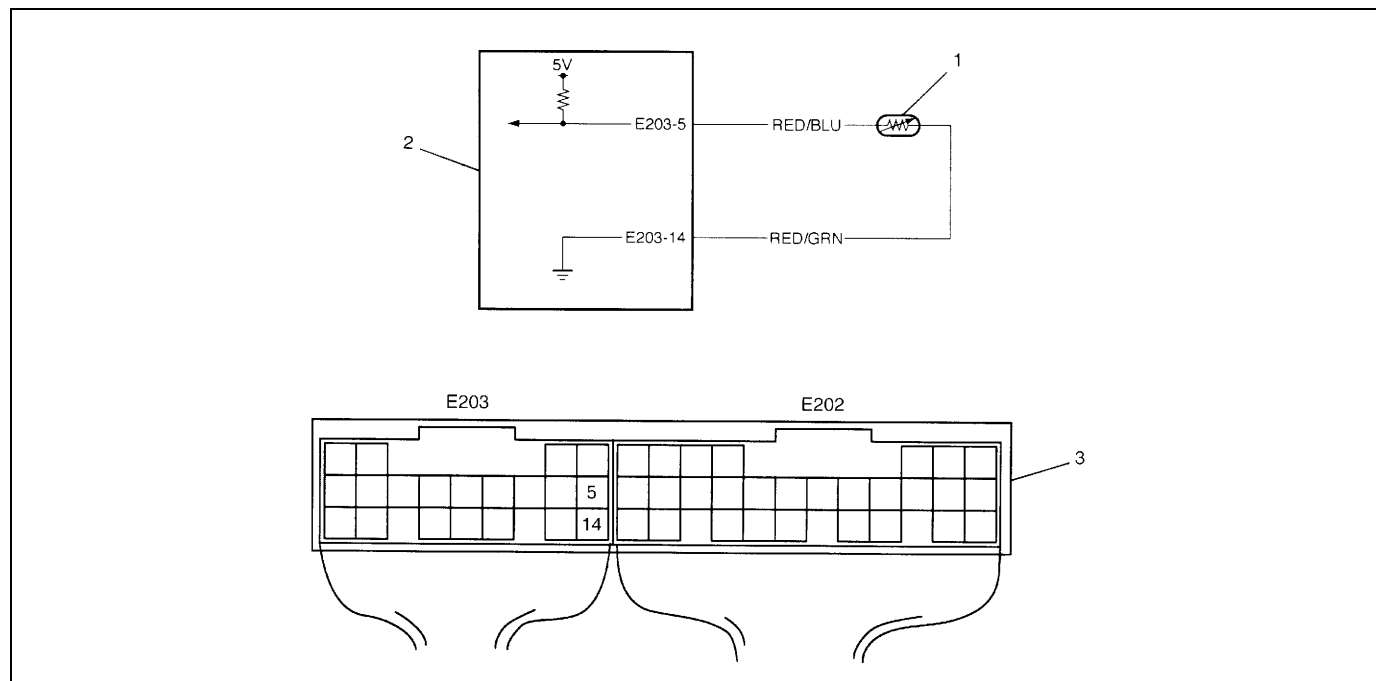
Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Do you have SUZUKI scan tool?	Go to Step 3.	Go to Step 4.
3	Check transmission range sensor (switch) circuit for operation. Check by using SUZUKI scan tool: 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and check transmission range signal (P, R, N, D, 2 or L) on display when shifting select lever to each range. Is applicable range indicated? Are check results satisfactory?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 5.
4	Check transmission range sensor (switch) circuit for operation. Check without using SUZUKI scan tool: 1) Turn ignition switch ON. 2) Check voltage at terminals E202-1, E202-2, E202-8, E202-9, E202-20 and E202-21 respectively with select lever shifted to each range. Taking terminal E202-21 as an example, is battery voltage indicated only when select lever is shifted to "2" range and 0 V for other ranges as shown in the figure. Check voltage at other terminals likewise, referring to the figure. Are check results satisfactory?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 5.
5	Check transmission range sensor (switch) for installation position. 1) Shift select lever to "N" range. 2) Check that "N" reference line on sensor and center line on shaft are aligned. Are they aligned?	Go to Step 6.	Adjust transmission range sensor (switch) and recheck.
6	Check select cable for adjustment referring to "Select Cable Adjustment" in this section. Is it adjusted correctly?	Go to Step 7.	Adjust select cable and recheck.
7	Check transmission range sensor (switch) referring to "Transmission Range Sensor (Switch)" in this section. Are check results satisfactory?	"YEL", "ORN/GRN", "RED", "ORN/BLU", "YEL/GRN", "GRN/ORN" or "GRN/BLU" circuit open or short. If wires and connections are OK, substitute a known-good TCM and recheck.	Replace transmission range sensor.

Fig. for Step 3

		Terminal					
		E202-2	E202-1	E202-9	E202-8	E202-21	E202-20
Select lever position	P	10 – 14 V	0 V	0 V	0 V	0 V	0 V
	R	0 V	10 – 14 V	0 V	0 V	0 V	0 V
	N	0 V	0 V	10 – 14 V	0 V	0 V	0 V
	D	0 V	0 V	0 V	10 – 14 V	0 V	0 V
	2	0 V	0 V	0 V	0 V	10 – 14 V	0 V
	L	0 V	0 V	0 V	0 V	0 V	10 – 14 V

DTC P0710 (DTC NO.36/38) Transmission Fluid Temperature Sensor Circuit Malfunction

WIRING DIAGRAM



- | |
|---|
| 1. Transmission fluid temperature sensor |
| 2. TCM |
| 3. Terminal arrangement of TCM connector (viewed from harness side) |

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
- Transmission fluid temperature sensor output voltage is continuously too high in "R", "D", "2" or "L" range for 15 minutes after engine is started. - Transmission fluid temperature sensor output voltage is too low for 5 minutes continuously.	- Transmission fluid temperature sensor or its circuit - TCM

DTC CONFIRMATION PROCEDURE

WARNING:

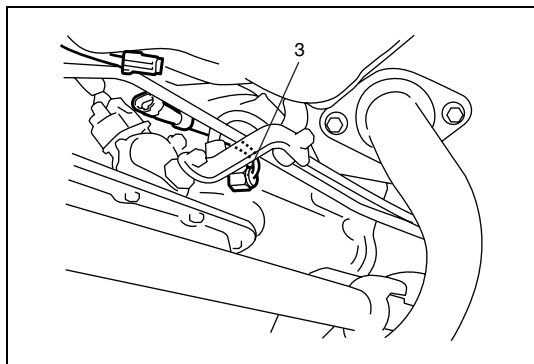
- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Start engine and drive vehicle for 25 minutes or more.
- 4) Stop vehicle and check DTC by using scan tool.

TROUBLESHOOTING

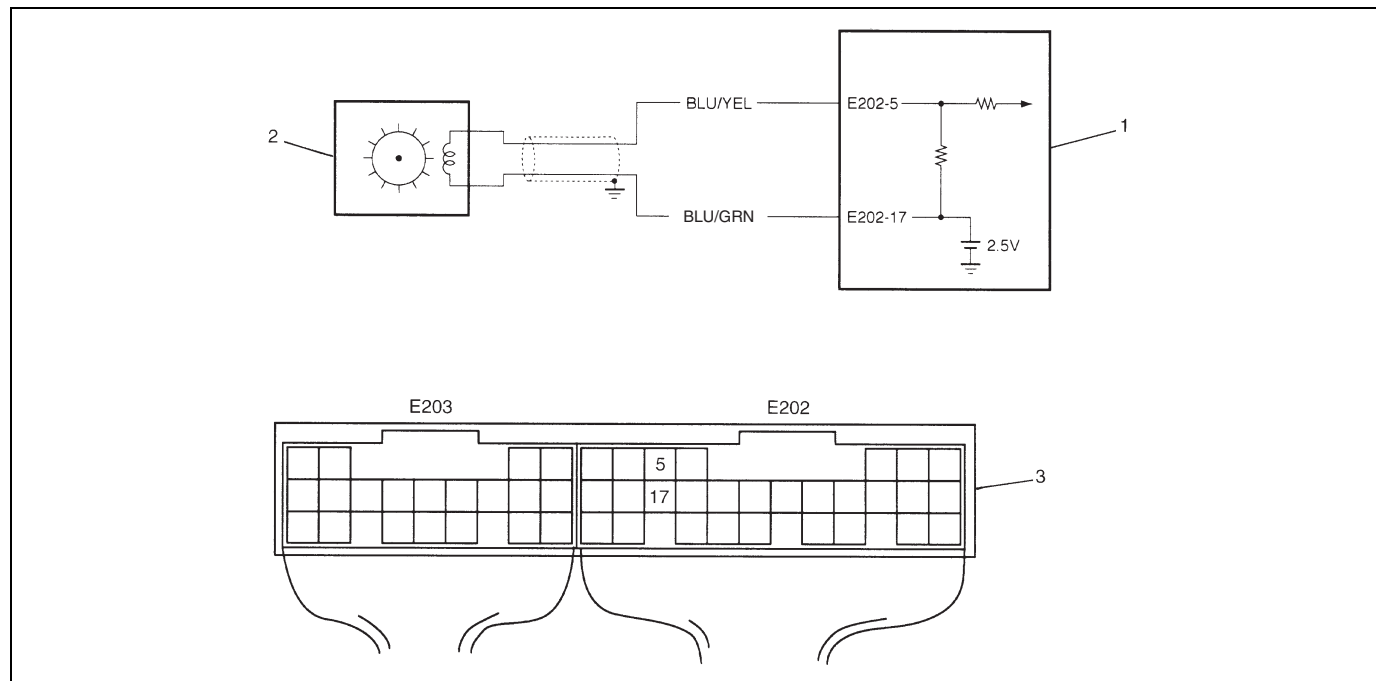
Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check transmission fluid temperature sensor circuit. 1) Turn ignition switch OFF and disconnect TCM connectors. 2) Check for proper connection to output transmission fluid temperature sensor at terminal E203-5 and E203-14. 3) If OK, check resistance between terminal E203-5 and E203-14 of disconnected harness side TCM connector. Is it Approx. 12 kΩ (at 20 °C (68 °F))? Resistance of transmission fluid temperature sensor Reference: Approx. 12 kΩ (at 20 °C (68 °F)) Approx. 1.7 kΩ (at 80 °C (176 °F))	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Go to Step 3.
3	Check transmission fluid temperature sensor resistance. 1) With ignition switch OFF, disconnect transmission fluid temperature sensor connector. 2) Check resistance transmission fluid temperature sensor connector. Is it Approx. 12 kΩ (at 20 °C (68 °F))? Resistance of transmission fluid temperature sensor Reference: Approx. 12 kΩ (at 20 °C (68 °F)) Approx. 1.7 kΩ (at 80 °C (176 °F))	"RED/BLU" or "RED/GRN" circuit open, shorted each other, intermittent trouble or faulty TCM. If wire and connection are OK, substitute a known-good TCM and recheck.	Faulty transmission fluid temperature sensor.

[A] : Fig. for Step 3



DTC P0715 (DTC NO.37) Input/Turbine Speed Sensor Circuit Malfunction

WIRING DIAGRAM



1. TCM
2. Input shaft speed sensor
3. Terminal arrangement of TCM connector (viewed from harness side)

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
The following condition is detected for one minute continuously in the period between ignition switch ON and OFF. - No pulse signal out of input shaft speed sensor is inputted although 12 pulses out of output shaft speed sensor are inputted. - and - Transmission range sensor signal is detected as "D", "2" or "L" range. - and - Gear position is not 4th. - and - Output shaft revolution is more than 775 rpm.	- Input shaft speed sensor or its circuit - TCM

DTC CONFIRMATION PROCEDURE

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

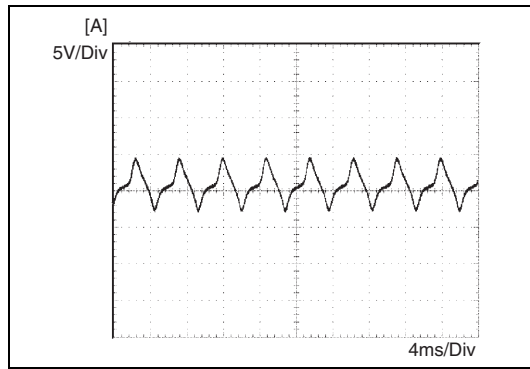
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC by using scan tool.
- 3) Start engine and turn O/D off switch ON.
- 4) Shift select lever to D range.
- 5) Start vehicle and keep vehicle speed at 50 km/h (31 mile/h) with 3rd gear in D range for 60 sec. or more.
- 6) Stop vehicle.
- 7) Check DTC.

TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Input shaft speed sensor circuit check: 1) With ignition switch OFF, disconnect TCM connectors. 2) Check for proper connection to input shaft speed sensor at E202-5 and E202-17 terminals. 3) If OK, check resistance of sensor circuit. Input shaft speed sensor resistance: Resistance between E202-5 and E202-17: 560 – 680 Ω (at 20 °C (68 °F)) Resistance between E202-5/E202-17 and ground: 1 MΩ or more Are check results satisfactory?	Go to Step 4.	Go to Step 3.
3	Input shaft speed sensor check: 1) With ignition switch OFF, disconnect input shaft speed sensor connector. 2) Check for proper connection to input shaft speed sensor at each terminal. 3) If OK, then check resistance of input shaft speed sensor. Are measured values as specified in Step 2?	"BLU/YEL" or "BLU/GRN" wire open or shorted to ground.	Replace input shaft speed sensor.
4	Check visually input speed shaft sensor and overdrive clutch drum for the followings. • No damage • No foreign material attached • Correct installation Are they in good condition?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Clean, repair or replace.

REFERENCE

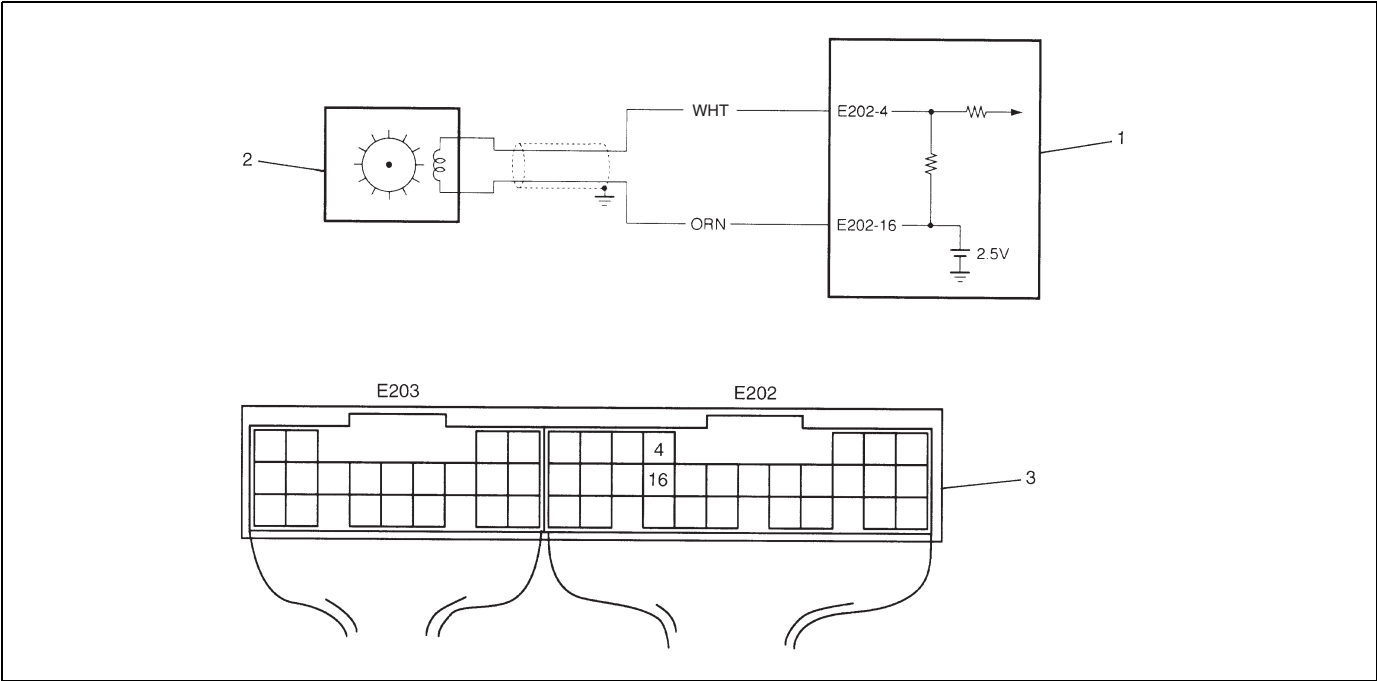
Connect oscilloscope between E202-5 (+) and E202-17 (-) of TCM connector connected to TCM and check input shaft speed sensor signal.



[A] : Oscilloscope waveforms at specified idle speed in "P" range

DTC P0720 (DTC NO.31) Output Speed Sensor Circuit Malfunction

WIRING DIAGRAM



1. TCM
2. Output shaft speed sensor
3. Terminal arrangement of TCM connector (viewed from harness side)

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
[When gear position is 1st, 2nd or 3rd gear] The following condition is detected for five hundred times continuously in the period between ignition switch ON and OFF. - No pulse signal out of output shaft speed sensor is inputted although 45 pulses out of input shaft speed sensor are inputted. - and - Transmission range sensor signal is detected as "D", "2" or "L" range. - and - Vehicle speed is more than 5 km/h (3 mile). [When gear position is 4th gear] - Detected (calculated) output shaft revolution is 0 rpm and 1500 rpm or more less than last detected (calculated) revolution. - and - Transmission range sensor signal is detected as "D", "2" or "L" range. - and - Vehicle speed is more than 5 km/h (3 mile).	- Output shaft speed sensor or its circuit - TCM

DTC CONFIRMATION PROCEDURE

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Start engine, warm it up to normal operating temperature and shift transfer lever to "2H" or "4H" range.
- 4) Drive vehicle at 50 km/h (31 mile/h) or more with 3rd gear in "D" range for longer than 60 sec. and at 60 km/h (38 mile/h) or more with 4th gear for about 10 sec.
- 5) Stop vehicle and check DTC by using scan tool.

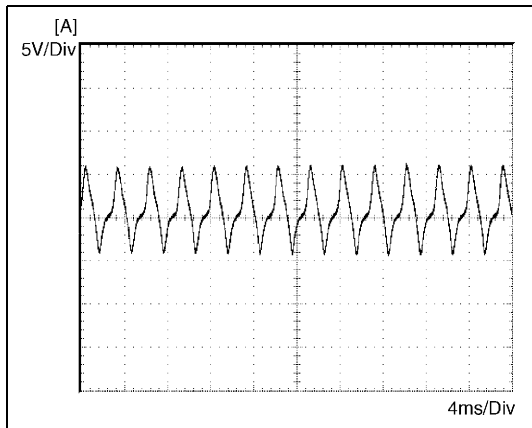
TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Output shaft speed sensor circuit check: 1) Remove TCM cover. 2) With ignition switch OFF, disconnect TCM connectors. 3) Check for proper connection to output shaft speed sensor at E202-4 and E202-16 terminals. 4) If OK, check resistance of sensor circuit. Resistance between E202-4 and E202-16: 560 – 680 Ω (at 20 °C (68 °F)) Resistance between E202-4/E202-16 and ground: 1 MΩ or more Are check results satisfactory?	Go to Step 4.	Go to Step 3.
3	Output shaft speed sensor check: 1) With ignition switch OFF, disconnect output shaft speed sensor connector. 2) Check for proper connection to output shaft speed sensor at each terminal. 3) If OK, then check resistance of output shaft speed sensor. Are measured values as specified in Step 2?	"ORN" or "WHT" wire open or shorted to ground.	Replace output shaft speed sensor.
4	Check visually output shaft speed sensor and sensor rotor for the followings. • No damage • No foreign material attached • Correct installation Are they in good condition?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Clean, repair or replace.

REFERENCE

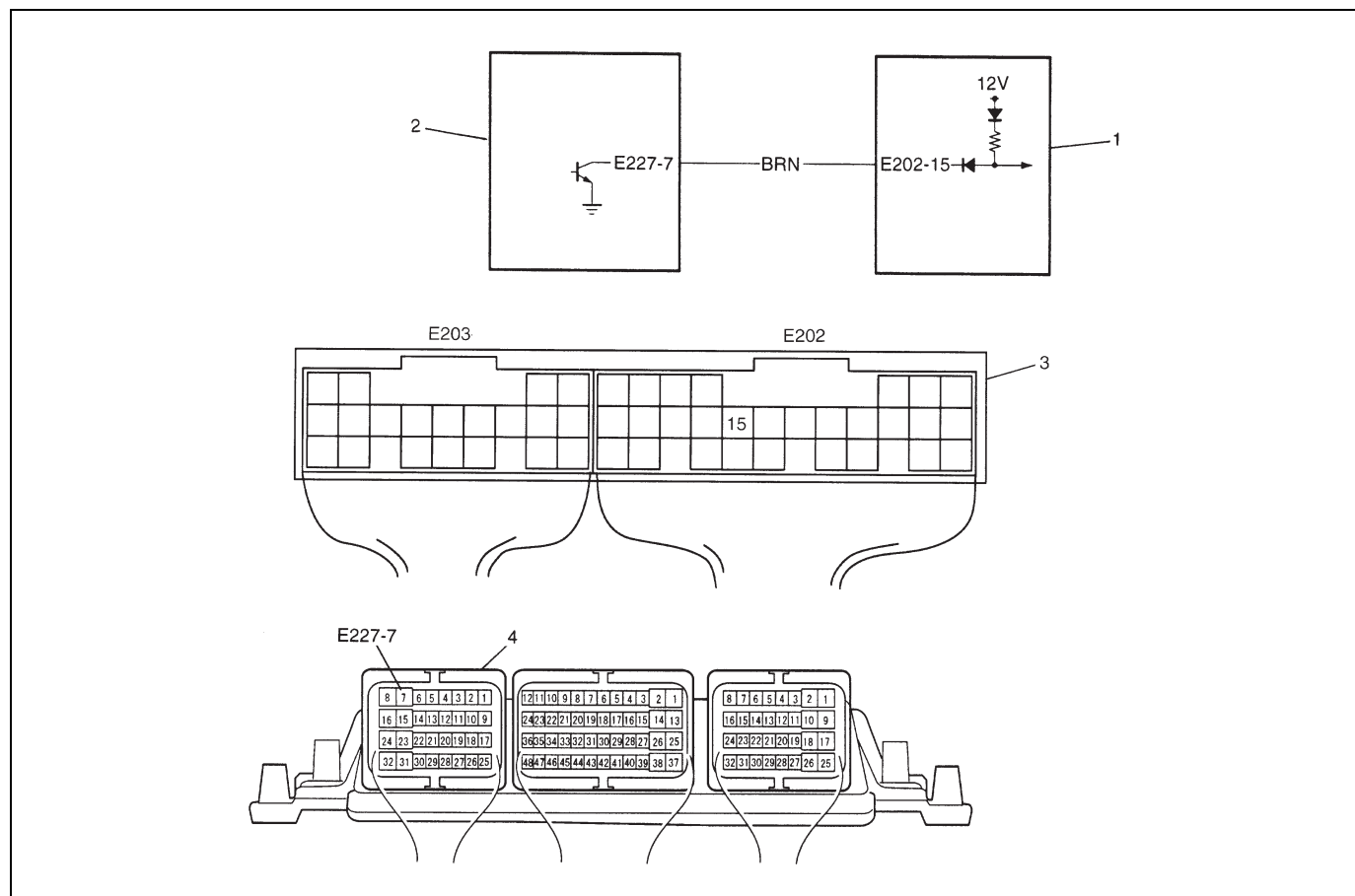
Connect oscilloscope between “E202-4” (+) and “E202-16” (–) of TCM connector connected to TCM and check output shaft speed sensor signal.

[A] : Oscilloscope waveforms at about 40 km/h (25 mile/h)



DTC P0725 (DTC NO.35) Engine Speed Input Circuit Malfunction

WIRING DIAGRAM



1. TCM	3. Terminal arrangement of TCM connector (viewed from harness side)
2. ECM	4. Terminal arrangement of ECM connector (viewed from harness side)

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
No engine speed signal is inputted although input shaft speed sensor signals indicate 2000 rpm or more for five seconds (other than 4th gear).	- Engine speed input circuit - TCM - ECM

DTC CONFIRMATION PROCEDURE

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

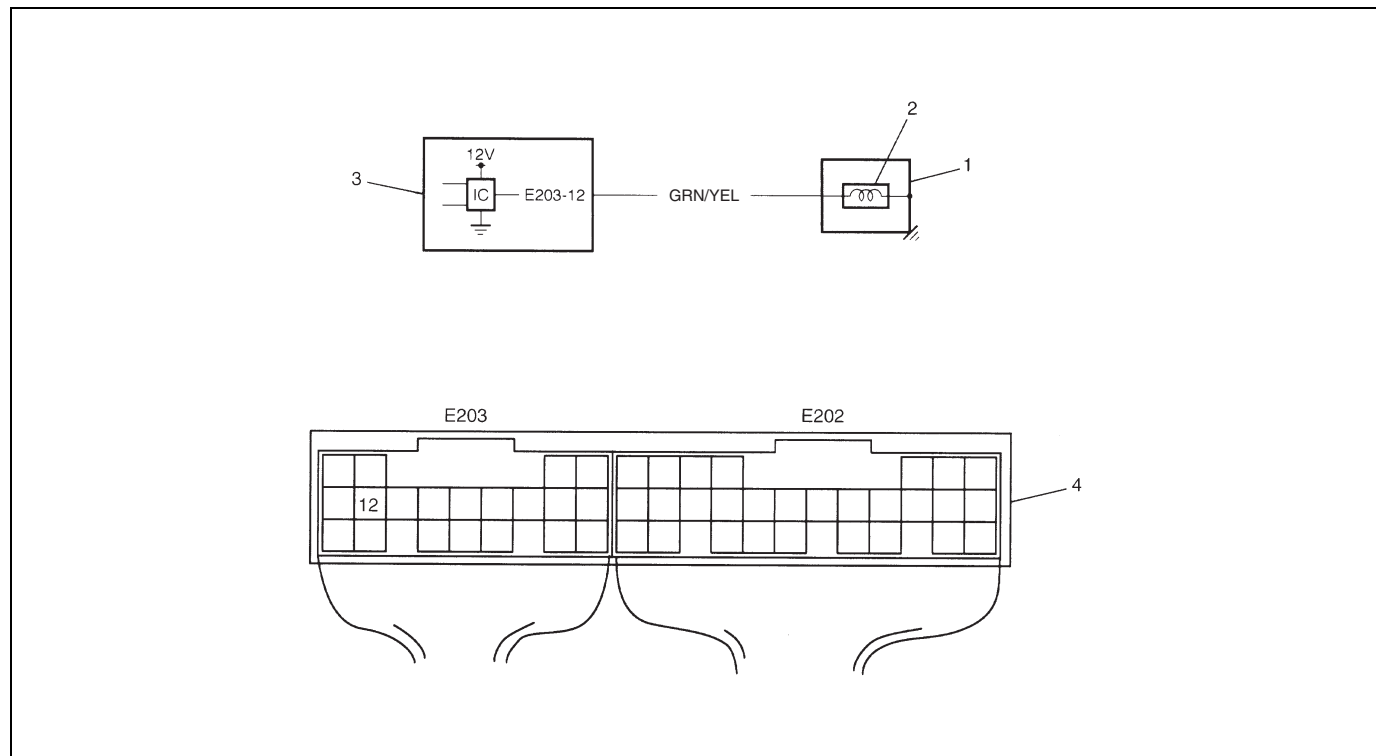
- Connect scan tool to DLC with ignition switch OFF.
- Clear DTC in TCM memory by using scan tool.
- Start engine and O/D off switch is turned OFF.
- Shift selector lever in "D" range and drive vehicle, keeping vehicle speed of about 65 km/h (41 mile/h) at 3rd gear for 10 second.
- Stop vehicle and check DTC by using scan tool.

TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check engine speed input circuit. 1) Turn ignition switch OFF and disconnect TCM and ECM connectors. 2) Check for proper connection of TCM connector at "E202-15" wire and ECM connector at "E227-7" wire terminals. 3) If OK, measure resistance between terminal "E202-15" of disconnected harnesses side TCM connector and terminal "E227-7" of disconnected harness side ECM connector. Is resistance 1Ω or less?	Go to Step 3.	"BRN" circuit open.
3	Check engine speed input circuit. Measure between terminal "E202-15" of disconnected harness side TCM connector and ground. Is it infinity?	Go to Step 4.	"BRN" circuit shorted to ground.
4	Check TCM terminal voltage. 1) With ignition switch OFF, connect TCM connector. 2) Turn ignition switch ON. 3) Measure voltage between terminal "E227-7" of disconnected harness side ECM connector and ground. Is it 10 – 14 V?	Intermittent trouble, faulty TCM or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM or ECM and recheck.	Substitute a known-good TCM and recheck.

DTC P0743 (DTC NO.25/26) TCC (Lock-Up) System Electrical

WIRING DIAGRAM



1. A/T	3. TCM
2. TCC (Lock-up) solenoid	4. Terminal arrangement of TCM connector (viewed from harness side)

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
The following condition is detected 8 times of gear change continuously. Voltage at terminal E203-12 of TCM is too high while TCC solenoid OFF is commanded or too low while TCC solenoid ON is commanded.	- TCC (lock-up) solenoid valve or its circuit - TCM

DTC CONFIRMATION PROCEDURE

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

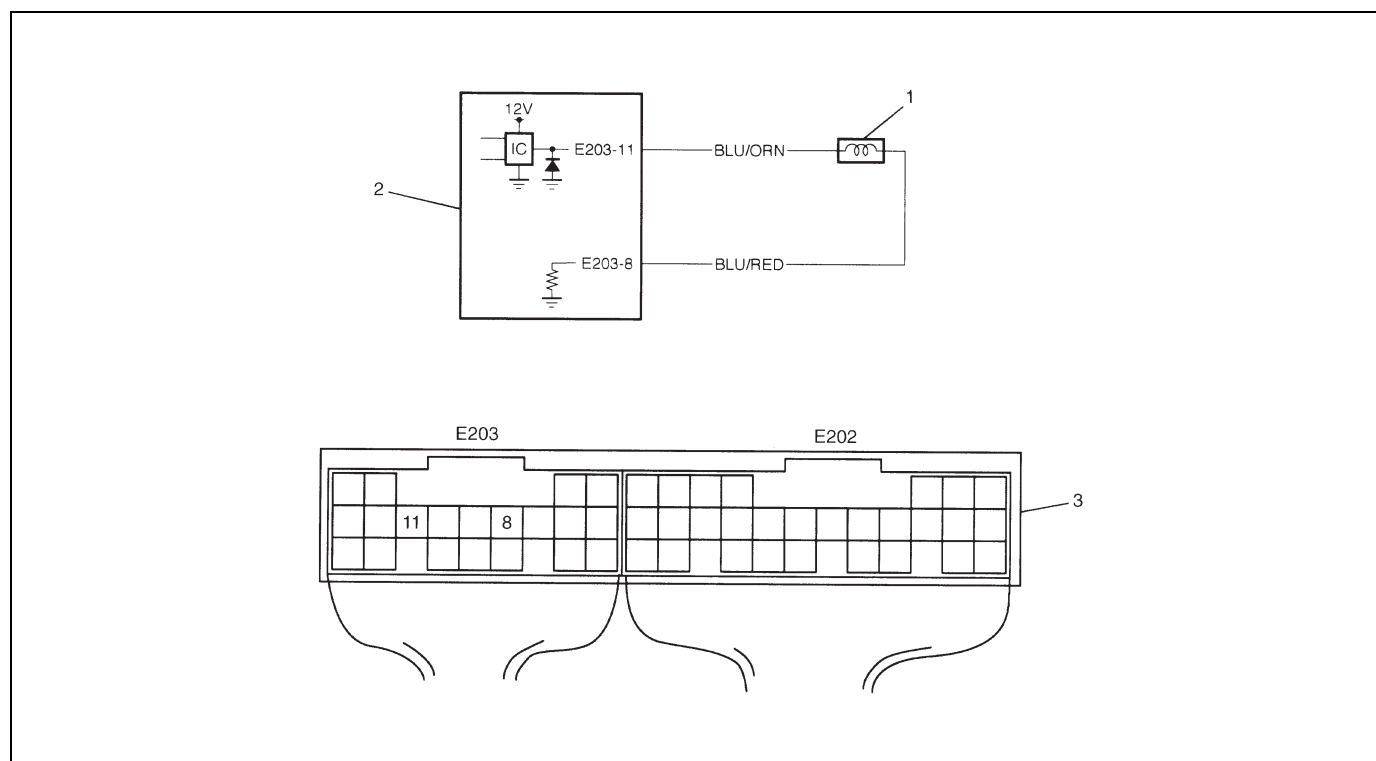
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Start engine, warm it up to normal operating temperature and shift transfer lever to "2H" or "4H" range.
- 4) Shift selector lever in "D" range and start vehicle.
- 5) Increase vehicle speed to about 80 km/h (50 mile/h) in 4th gear and in "D" range.
- 6) Release accelerator pedal, decrease vehicle speed and stop vehicle.
- 7) Repeat step 4) to step 6) one time.
- 8) Check DTC by using scan tool.

TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check TCC solenoid circuit for short. 1) Turn ignition switch OFF and disconnect TCM connectors. 2) Check for proper connection to TCM at terminal E203-12. 3) If OK, then turn ignition switch ON and measure voltage between terminal E203-12 of disconnected TCM harness side connector and ground. Is it about 0 V?	Go to Step 3.	"GRN/ORN" circuit shorted to power circuit.
3	Check TCC solenoid circuit for open or short. 1) Turn ignition switch OFF. 2) Measure resistance between terminal E203-12 of disconnected TCM harness side connector and ground. Is it 11 –15 Ω ? (at 20 °C (68 °F))?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	"GRN/ORN" circuit open or shorted to ground. If wire and connections are OK, replace TCC solenoid.

DTC P0748 (DTC NO.41/42) Pressure Control Solenoid Electrical

WIRING DIAGRAM



- | |
|---|
| 1. Pressure control solenoid valve |
| 2. TCM |
| 3. Terminal arrangement of TCM connector (viewed from harness side) |

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
- Pressure control solenoid output voltage is too high comparing with TCM command value. - or - Pressure control solenoid output voltage is too low comparing with TCM command value.	- Pressure control solenoid valve - Pressure control solenoid valve circuit - TCM

DTC CONFIRMATION PROCEDURE

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

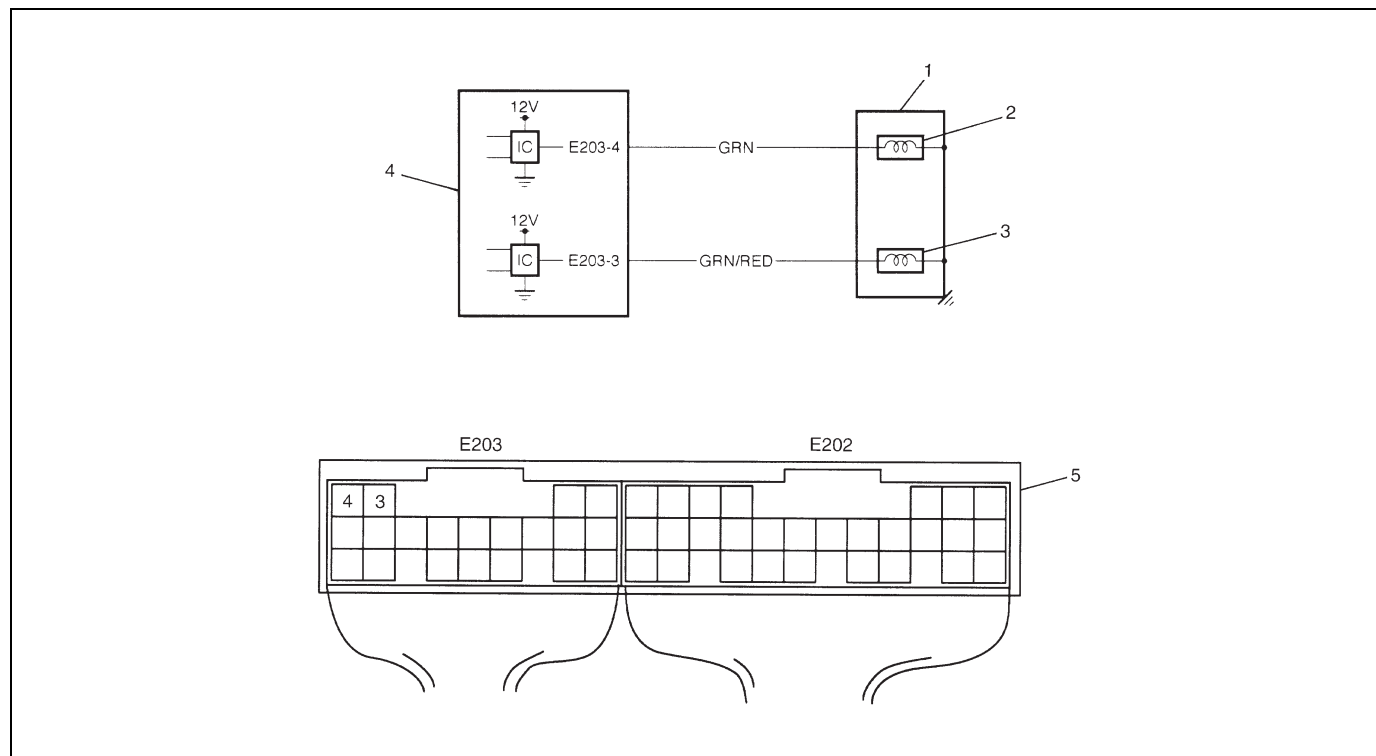
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Start engine and shift select lever in "D" range.
- 4) Start vehicle and increase vehicle speed to about 60 km/h in "D" range.
- 5) Keep driving at above vehicle speed for 30 second.
- 6) Stop vehicle and check DTC by using scan tool.

TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check pressure control solenoid circuit for short. 1) Turn ignition switch OFF and disconnect TCM connectors. 2) Check for proper connection to TCM at terminals E203-11 and E203-8. 3) If OK, measure voltage between terminal E203-8 of disconnected harness side TCM connectors and ground. Is it about 0 V?	Go to Step 3.	"BLU/ORN" or "BLU/RED" circuit shorted to power circuit.
3	Check pressure control solenoid circuit for short. Measure resistance between terminal E203-11 or disconnected harness side TCM connector and ground. Is it infinity?	Go to Step 4.	"BLU/ORN" or "BLU/RED" circuit shorted to ground.
4	Check pressure control solenoid circuit for short. Measure resistance between terminal E203-8 and "E203-11" of disconnected harness side TCM connector. Is it 3.3 – 3.7 Ω (20 °C (68 °F))?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM or ECM and recheck.	Faulty pressure control solenoid valve. Replace valve body assembly.

DTC P0753 (DTC NO.21/22)/ P0758 (DTC NO.23/24) Shift Solenoid-A/ Shift Solenoid-B Electrical

WIRING DIAGRAM



1. A/T	4. TCM
2. Shift solenoid-A	5. Terminal arrangement of TCM connector (viewed from harness side)
3. Shift solenoid-B	

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
DTC P0753: The following condition is detected 8 times of gear change continuously. Voltage at terminal E203-4 of TCM is too high while shift solenoid OFF is commanded or too low while shift solenoid ON is commanded	- Shift solenoid valve-A or its circuit - TCM
DTC P0758: The following condition is detected 8 times of gear change continuously. Voltage at terminal E203-3 of TCM is too high while shift solenoid OFF is commanded or too low while shift solenoid ON is commanded	- Shift solenoid valve-B or its circuit - TCM

DTC CONFIRMATION PROCEDURE

WARNING:

- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.
- Road test should be carried out with 2 persons, a driver and a tester, on a level road.

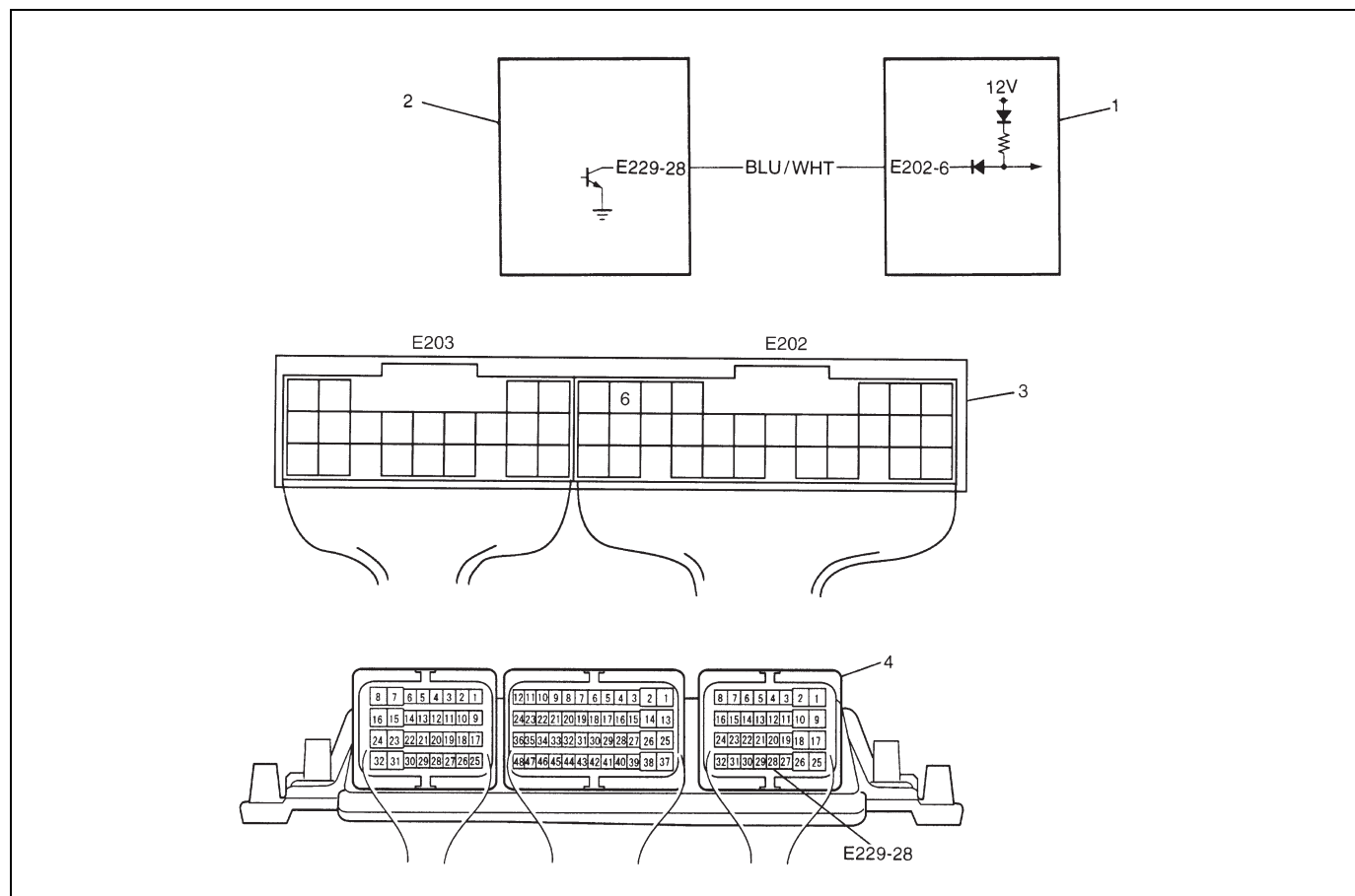
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Start engine and shift transfer lever to "2H" or "4H" range.
- 4) Shift select lever in "D" range and start vehicle.
- 5) Increase vehicle speed to about 80 km/h (50 mile/h) with 4th gear in "D" range.
- 6) Release accelerator pedal, decrease vehicle speed and stop vehicle.
- 7) Repeat step 4) to step 6) five times.
- 8) Check DTC by using scan tool.

TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check shift solenoid circuit for short. 1) Turn ignition switch OFF and disconnect TCM connectors. 2) Check for proper connection to TCM at terminal E202-3 or E203-4. 3) If OK, then turn ignition switch ON and measure voltage between terminal E203-3 or E203-4 of disconnected harness side TCM connector and ground. Is it about 0 V?	Go to Step 3.	"GRN" or "GRN/RED" circuit shorted to power circuit.
3	Check shift solenoid circuit for open or short. 1) Turn ignition switch OFF. 2) Measure resistance between terminal E203-3 or E203-4 of disconnected harness side TCM connector and ground. Is it 11 – 15 Ω (at 20 °C (68 °F))?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	"GRN" or "GRN/RED" circuit open or shorted to ground. If wire and connections are OK, replace malfunction shift solenoid.

DTC P1700 (DTC NO.32/33) Acceleration Stroke Signal Input Malfunction

WIRING DIAGRAM



1. TCM	3. Terminal arrangement of TCM connector (viewed from harness side)
2. ECM	4. Terminal arrangement of ECM connector (viewed from harness side)

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
- Continuous time of low voltage acceleration stroke signal is too long. - or - Continuous time of low voltage acceleration stroke signal is too short. - or - No acceleration stroke signal is inputted from ECM.	- Acceleration stroke signal circuit from ECM to TCM open or short. - Throttle position sensor (acceleration stroke sensor) or its circuit malfunctioning. - TCM - ECM

DTC CONFIRMATION PROCEDURE

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Start engine and keep on idling for 20 seconds.
- 4) Stop engine and check DTC by using scan tool.

TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Is there DTC related to throttle position sensor (P0121, P0221)?	Go to corresponding DTC Flow Table in Section 6.	Go to Step 3.
3	Check acceleration stroke signal input circuit for open. 1) Turn ignition switch OFF and disconnect TCM and ECM connectors. 2) Check for proper connection to TCM connector at "E202-6" wire and ECM connector at "E229-28" wire terminals. 3) If OK, measure resistance between terminal "E202-6" of disconnected harness side TCM connector and terminal "E229-28" of disconnected harness side ECM connector. Is resistance 1Ω or less?	Go to Step 4.	"BLU/WHT" circuit open.
4	Check acceleration stroke signal input circuit for short. Measure between terminal E202-6 of disconnected harness side TCM connector and ground. Is it infinity?	Go to Step 5.	"BLU/WHT" circuit shorted to ground.
5	Check acceleration stroke signal input circuit for short to power circuit. 1) With ignition switch OFF, connect ECM connector. 2) Turn ignition switch ON. 3) Measure voltage between terminal E202-6 of disconnected harness side TCM connector and ground. Is it about 0 V?	Go to Step 6.	"BLU/WHT" circuit shorted to power circuit.
6	Check TCM terminal voltage. 1) With ignition switch OFF, connect TCM connector and disconnect ECM connector. 2) Turn ignition switch ON. 3) Measure voltage between terminal "E229-28" of disconnected harness side ECM connector and ground. Is it 10 – 14 V?	Intermittent trouble, faulty TCM or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM or ECM and recheck.	Substitute a known-good TCM and recheck.

DTC P1702 (DTC NO.52) Internal Malfunction of TCM

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
Calculations of current data stored in TCM is not correct comparing with pre-stored checking data in TCM.	• TCM

DTC CONFIRMATION PROCEDURE

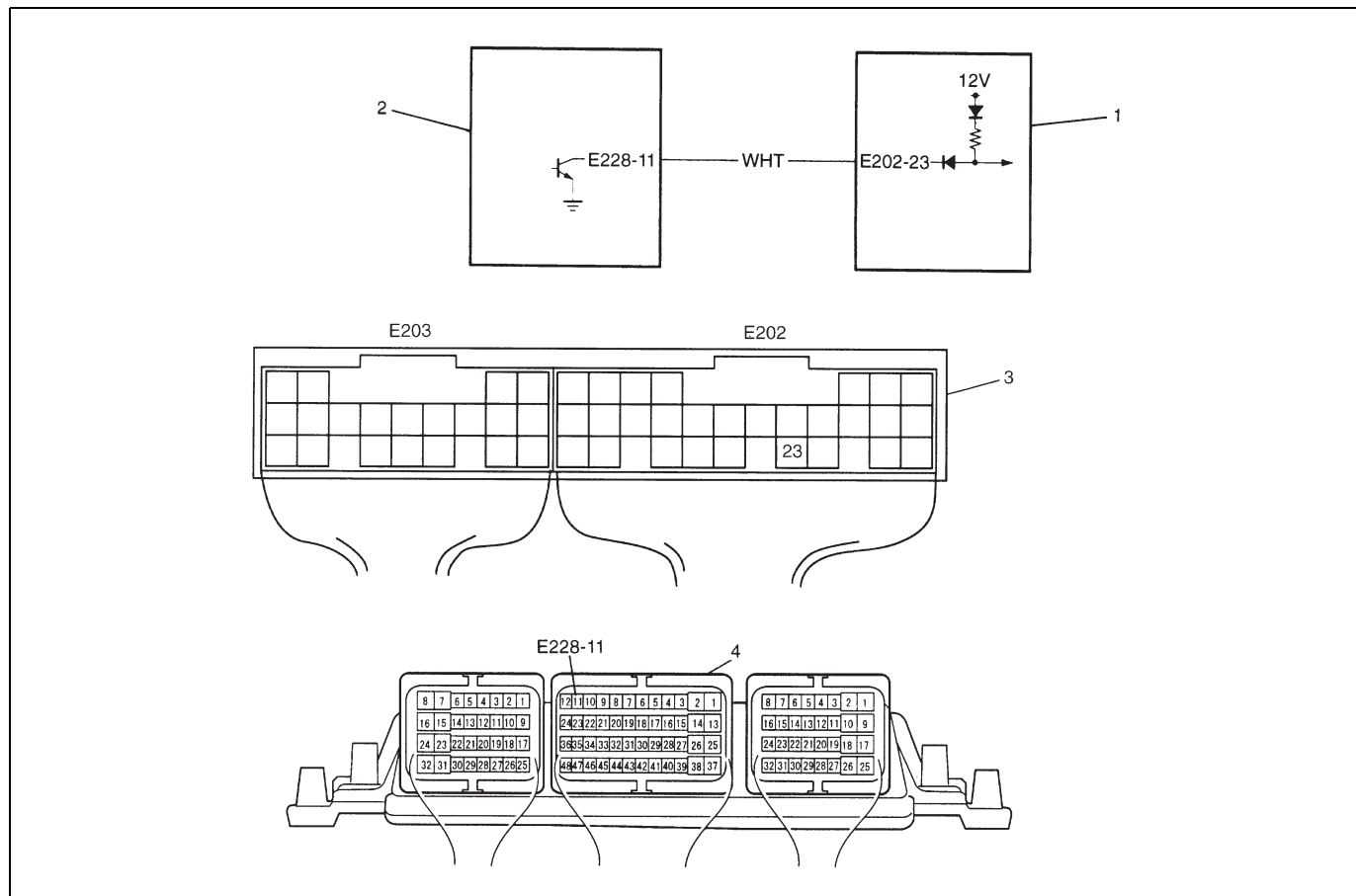
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Turn ignition switch ON, and OFF.
- 4) Check DTC by using scan tool.

TROUBLESHOOTING

Step	Action	Yes	No
1	Is DTC P1702 outputted after performing DTC confirmation procedure?	Faulty TCM	Could be a temporary malfunction of TCM.

DTC P1730 (DTC NO.64) Engine Torque Signal Circuit Malfunction

WIRING DIAGRAM



1. TCM	3. Terminal arrangement of TCM connector (viewed from harness side)
2. ECM	4. Terminal arrangement of ECM connector (viewed from harness side)

DTC DETECTING CONDITION AND TROUBLE AREA

DTC DETECTING CONDITION	TROUBLE AREA
- Continuous time of low voltage engine torque signal is too long. - or - Continuous time of low voltage engine torque signal is too short. - or - No engine torque signal is inputted from ECM.	- Engine torque signal circuit - TCM - ECM

DTC CONFIRMATION PROCEDURE

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Clear DTC in TCM memory by using scan tool.
- 3) Start engine and keep on idling for 10 seconds.
- 4) Stop engine and check DTC by using scan tool.

TROUBLESHOOTING

Step	Action	Yes	No
1	Was "Automatic Transmission Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transmission Diagnostic Flow Table" in this section.
2	Check engine torque signal circuit for open. 1) Turn ignition switch OFF and disconnect TCM and ECM connectors. 2) Check for proper connection to TCM connector at "E202-23" wire and ECM connector at "E228-11" wire terminals. 3) If OK, measure resistance between terminal "E202-23" of disconnected harnesses side TCM connector and terminal "E228-11" of disconnected harness side ECM connector. Is resistance 1Ω or less?	Go to Step 3.	"WHT" circuit open.
3	Check engine torque signal circuit for short. Measure between terminal "E202-23" of disconnected harness side TCM connector and ground. Is it infinity?	Go to Step 4.	"WHT" circuit shorted to ground.
4	Check engine torque signal circuit for short to power circuit. 1) With ignition switch OFF, connect ECM connector to ECM. 2) Turn ignition switch ON. 3) Measure voltage between terminal "E202-23" of disconnected harness side TCM connector and ground. Is it about 0 V?	Go to Step 5.	"WHT" circuit shorted to power circuit.
5	Check TCM terminal voltage. 1) With ignition switch OFF, connect TCM connector and disconnect ECM connector. 2) Turn ignition switch ON. 3) Measure voltage between terminal "E228-11" of disconnected harness side ECM connector and ground. Is it 10 – 14 V?	Intermittent trouble, faulty TCM or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM or ECM and recheck.	Substitute a known-good TCM and recheck.

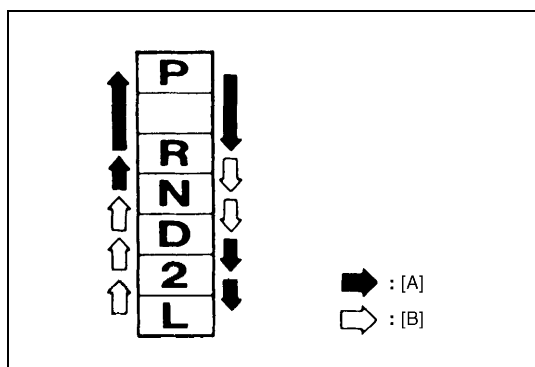
On-Vehicle Service

Maintenance Service

Fluid level

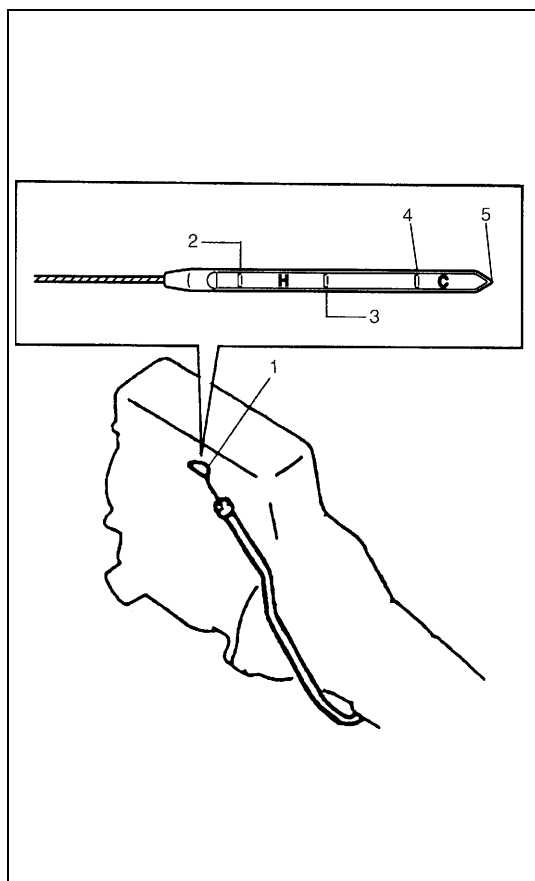
LEVEL CHECK AT NORMAL OPERATING TEMPERATURE

- 1) Stop vehicle and place it level.
- 2) Apply parking brake and place chocks against wheels.
- 3) With select lever at P range, start engine.
- 4) Warm up engine till A/T fluid temperature reaches normal operating temperature (70 – 80 °C (158 – 176 °F)). As a guide to check fluid temperature, warm up engine to normal operating temperature.
- 5) Keep engine idling and shift select slowly to “L” and back to “P” range.



[A]: Shift select lever with its button pushed in.

[B]: Shift select lever without pushing its button.



- 6) With engine idling, pull out dipstick (1), wipe it off with a clean cloth and put it back into place.
- 7) Pull out dipstick (1) again and check fluid level indicated on it. Fluid level should be between FULL HOT and LOW HOT. If it is below LOW HOT, add equivalent of DEXRON®-III up to FULL HOT.

A/T fluid specification

Equivalent of DEXRON®-III

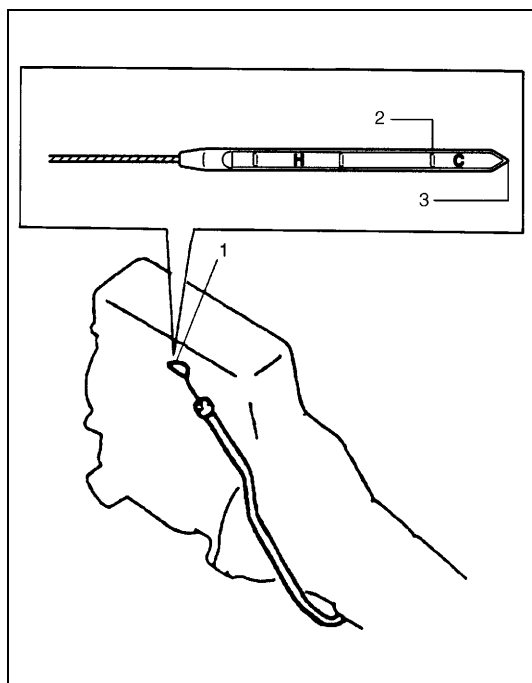
NOTE:

- **DO NOT RACE ENGINE** while checking fluid level, even after engine is started.
- **DO NOT OVERFILL.** Overfilling can causes foaming and loss of fluid through breather. Then slippage and transmission failure can result.
- Bringing fluid level from LOW HOT to FULL HOT requires 0.3 liters (0.64/0.53 US/Imp. pt.).
- If vehicle was driven under high load such as pulling a trailer, fluid level should be checked about half an hour after it is stopped.

2. "FULL HOT"	4. "FULL COLD"
3. "LOW HOT"	5. "LOW COLD"

LEVEL CHECK AT ROOM TEMPERATURE

The fluid level check at room temperature performed after repair or fluid change before test driving is just preparation for level check of normal operating temperature. The checking procedure itself is the same as that described in "Level Check at Normal Operating Temperature" under "Fluid Level" in this section. If the fluid level is between FULL COLD and LOW COLD, proceed to test drive. And when the fluid temperature has reached the normal operating temperature, check fluid level again and adjust it as necessary.



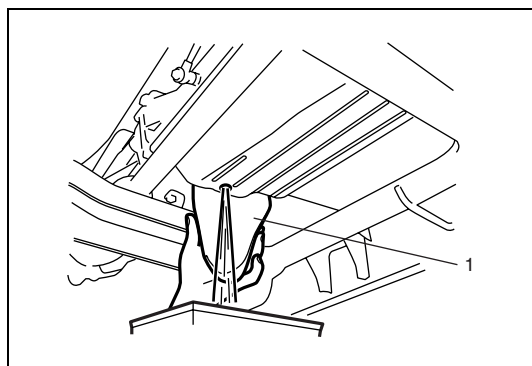
1. Dipstick
2. "FULL COLD"
3. "LOW COLD"

Fluid change

- 1) Lift up vehicle.
- 2) When engine is cool, remove drain plug from oil pan and drain A/T fluid using oil gutter (1).
- 3) Install drain plug.

Tightening torque

A/T fluid drain plug: 20 N·m (2.0 kg·m, 14.5 lb·ft)



- 4) Lower vehicle and fill proper amount of specified fluid.
- 5) Check fluid level referring to "Level Check Normal Operating Temperature" under "Fluid Level" in this section.

A/T fluid specification

Equivalent of DEXRON®-III

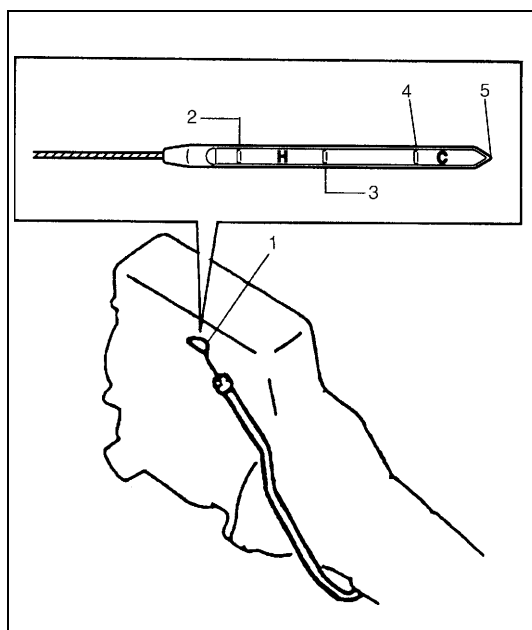
A/T fluid capacity reference value

When draining from drain plug hole:

Approx. 4.0 liters (8.45/7.04 US/Imp. pt.)

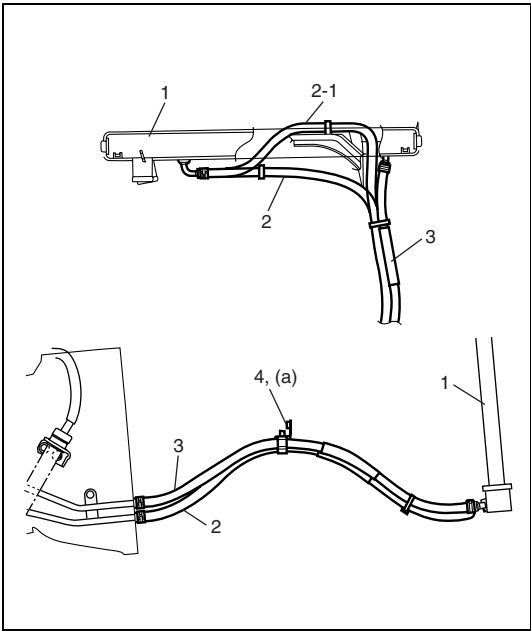
When overhauling:

Approx. 9.0 liters (19.02/15.84 US/Imp. pt.)



1. Dipstick	4. "FULL COLD"
2. "FULL HOT"	5. "LOW COLD"
3. "LOW HOT"	

Oil Cooler Hoses



When replacing them, make sure to note the followings.

- to replace clamps at the same time
- to insert hose as far as bulge of pipe
- to clamp hose securely

Tightening torque

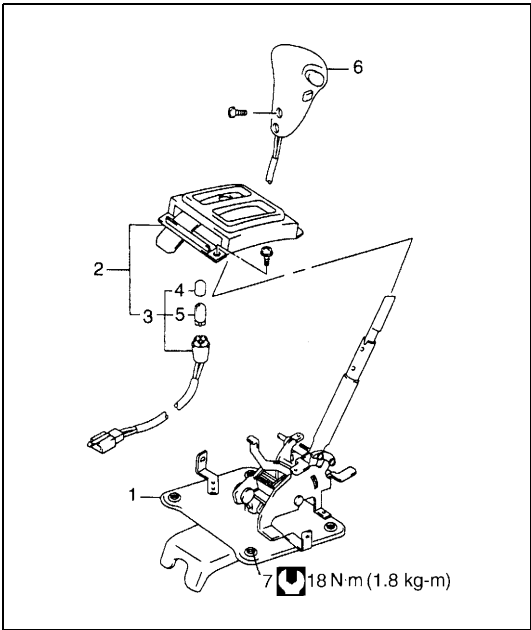
Oil hose clamp bracket bolt

(a): 23 N·m (2.3 kg·m, 17.0 lb·ft)

1. Radiator	3. Outlet hose
2. Inlet hose	4. Oil hose clamp bracket bolt
2-1. Inlet hose for left hand steering vehicle	

Manual Selector Assembly

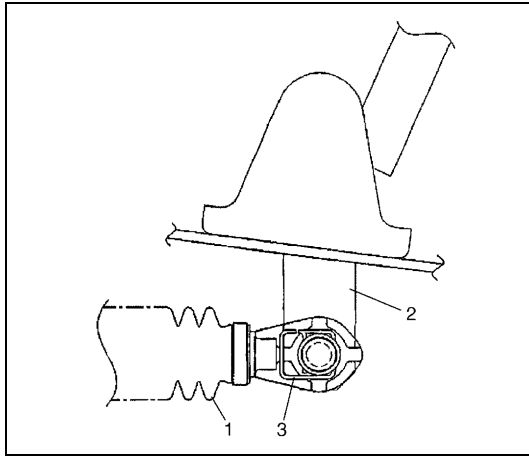
COMPONENTS



1. Manual lever assembly	5. Bulb
2. Select indicator assembly	6. Knob assembly
3. Illumination lamp assembly	7. Manual selector assembly mounting bolt
4. Bulb filter	 Tightening torque

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove console box.
- 3) Disconnect connector for illumination lamp and O/D off switch.
- 4) Remove manual selector assembly mounting bolts.



- 5) Disconnect select cable (1) from manual selector assembly (2) expanding select cable clip (3).

INSTALLATION

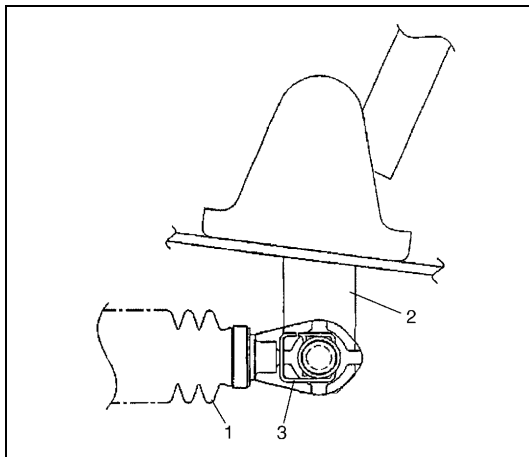
Reverse removal procedure to install manual selector assembly noting the following instructions.

- Make sure that select cable clip (3) holds select cable (1) on manual selector assembly (2) securely.
- Tighten manual selector assembly mounting bolts to specified torque.

Tightening torque

Manual selector assembly mounting bolts:

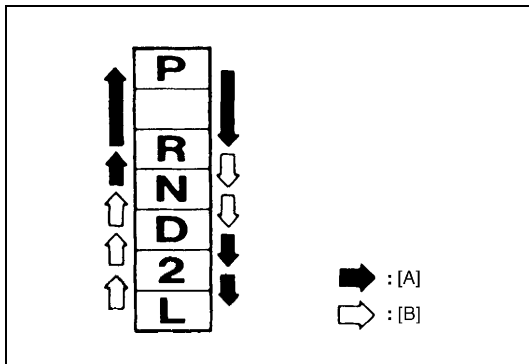
18 N·m (1.8 kg-m, 13.5 lb-ft)



INSPECTION

Check select lever for smooth and clear-cut movement and position indicator for correct indication.

For operation of select lever, refer to the figure.

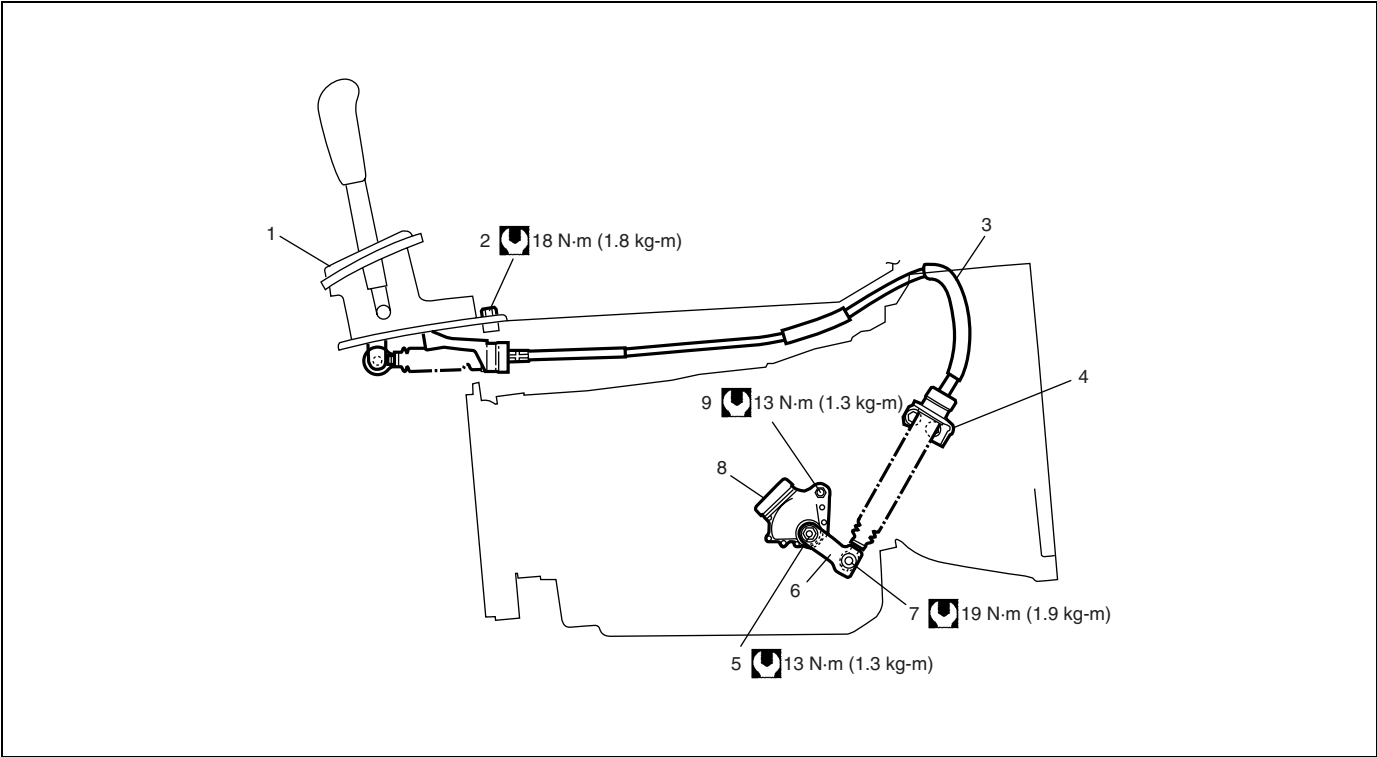


[A]: Shift select lever with its button pushed in.

[B]: Shift select lever without pushing its button.

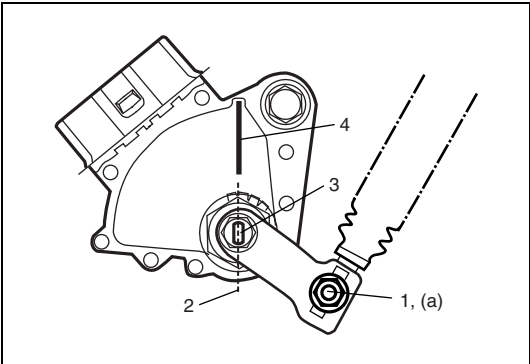
Select Cable

LOCATION



1. Manual selector assembly	5. Manual select lever nut	9. Transmission range sensor bolt
2. Manual selector assembly mounting bolt	6. Manual select lever	Tightening torque
3. Select cable	7. Select cable end nut	
4. Select cable bracket	8. Transmission range sensor	

ADJUSTMENT



- 1) Loosen select cable end nut (1).
- 2) Shift selector lever to "N".
- 3) Align center line (2) on manual shift shaft (3) to "N" reference line (4) as shown in figure.
- 4) Tighten select cable end nut (1) to specified torque.

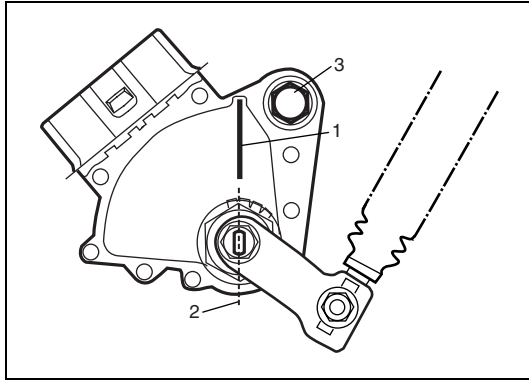
Tightening torque

Select cable end nut (a): 19 N-m (1.9 kg-m, 14.0 lb-ft)

- 5) After select cable was installed, check for the following.
 - Push vehicle with select lever shifted to "P".
Vehicle should not move.
 - Vehicle can not be driven in "N".
 - Vehicle can be driven in "D", "2", and "L".
 - Vehicle can be backed in "R".

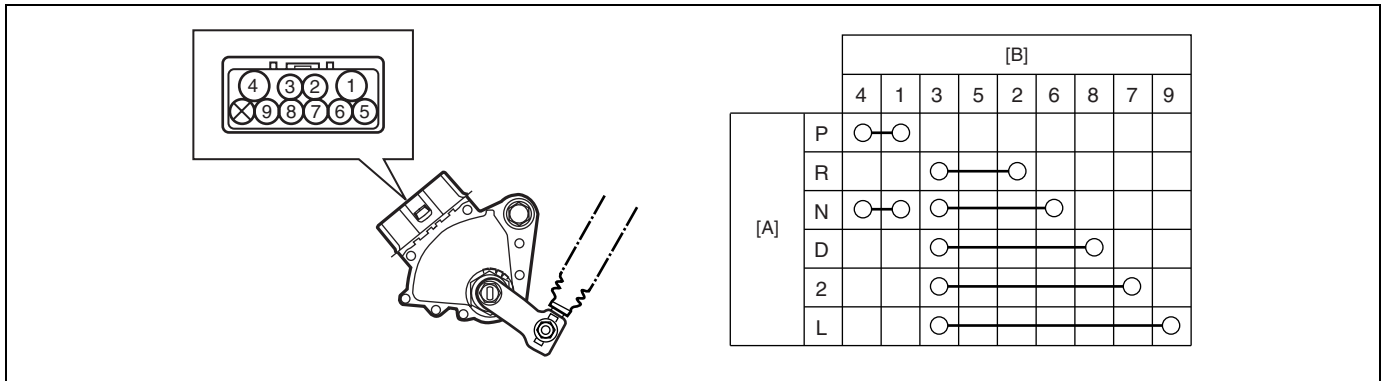
Transmission Range Sensor (Switch)

INSPECTION AND ADJUSTMENT



- 1) Shift select lever to "N" range.
- 2) Check that center line on manual shift shaft (2) and "N" reference line (1) on sensor are aligned. If not, loosen sensor bolt (3) and align them.
- 3) Check that engine starts in "N" and "P" ranges but it doesn't start in "D", "2", "L" or "R" range. Also, check that back-up lamp lights in "R" range.

If faulty condition cannot be corrected by adjustment, disconnect transmission range sensor connector and check that continuity exists as shown by moving select lever.

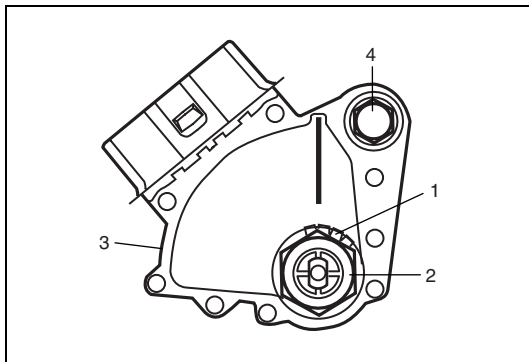
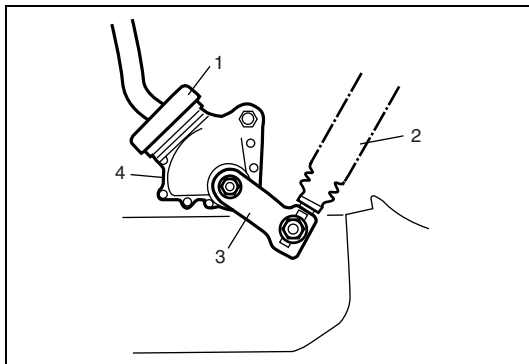


[A]: Sensor position

[B]: Terminal No.

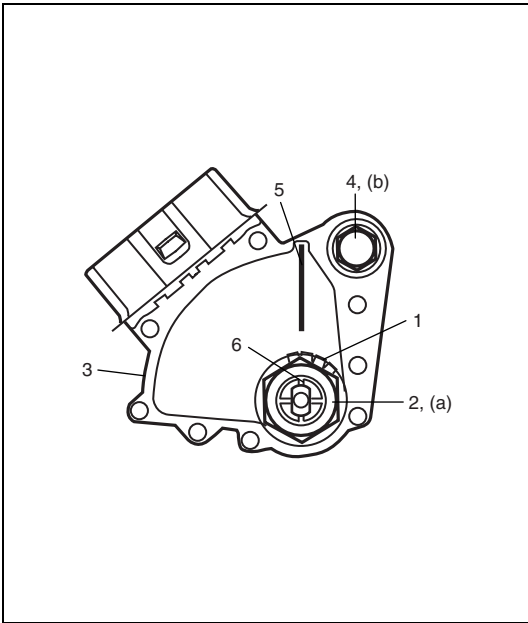
REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Hoist vehicle.
- 3) Disconnect transmission range sensor connector (1).
- 4) Disconnect select cable (2) from manual select lever (3).
- 5) Remove manual select lever (3) from transmission range sensor (4).



- 6) Unbend bend parts of lock washer (1), then remove manual shift shaft nut (2), lock washer (1) and grommet.
- 7) Remove transmission range sensor (3) by removing sensor bolt (4).

INSTALLATION



- 1) Install transmission range sensor (3) and tighten sensor bolt (4) temporarily.
- 2) Install grommet, lock washer (1) and manual shift shaft nut (2). Tighten nut to specified torque. After tightening it, bend claws of lock washer (1).

Tightening torque

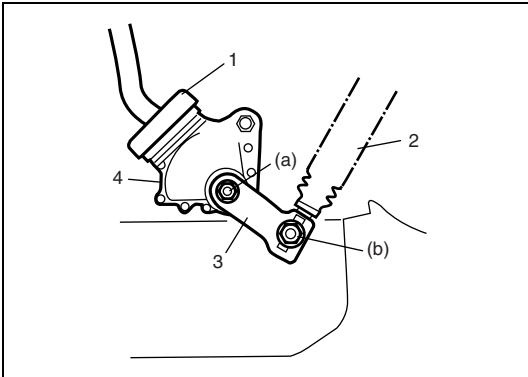
Manual shift shaft nut (a): 7 N·m (7.0 kg-m, 5.0 lb-ft)

- 3) After turning manual shift shaft fully counterclockwise, turn it clockwise by 2 notches and set it to "N" range.
- 4) With "N" reference line (5) on range sensor and shaft center (6) aligned, tighten transmission range sensor bolt (4) to specified torque.

Tightening torque

Transmission range sensor bolt

(b): 13 N·m (1.3 kg-m, 9.5 lb-ft)



- 5) Install manual select lever (3) to transmission range sensor (4). Tighten nut to specified torque.

Tightening torque

Manual select lever nut

(a): 13 N·m (1.3 kg-m, 9.5 lb-ft)

- 6) Connect select cable (2) to manual select lever (3). Tighten select cable end nut to specified torque referring to "Adjustment" of "Select Cable" in this section.
- 7) Connect transmission range sensor connector (1).
- 8) Lower hoist.
- 9) Connect negative cable at battery.

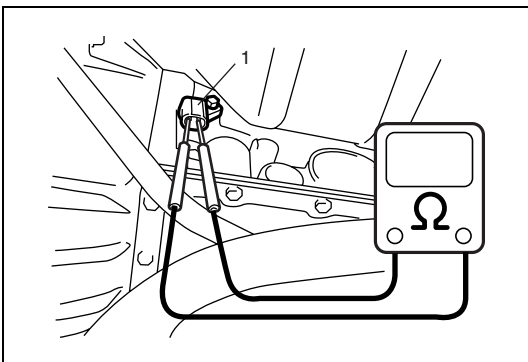
Input Shaft Speed Sensor

INSPECTION

- 1) Disconnect negative cable at battery.
- 2) Hoist vehicle.
- 3) Disconnect input shaft speed sensor connector.
- 4) Check input shaft speed sensor (1) for resistance between terminals of sensor.

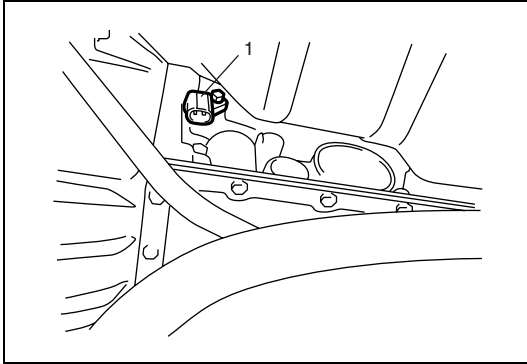
Input shaft speed sensor resistance

560 – 680 Ω (at 20 °C, 68 °F)



REMOVAL

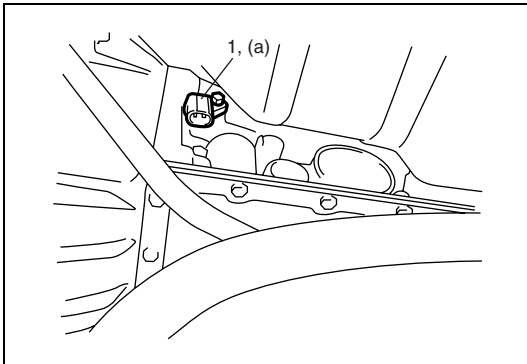
- 1) Disconnect negative cable at battery.
- 2) Hoist vehicle.
- 3) Disconnect input shaft speed sensor connector.
- 4) Remove input shaft speed sensor (1) from transmission.

**INSTALLATION**

- 1) Check that sensor is free from any metal particles and damage.
- 2) Apply A/T fluid to O-ring and then install input shaft speed sensor (1) to transmission. Tighten sensor bolt to specified torque.

Tightening torque**Input shaft speed sensor bolt**

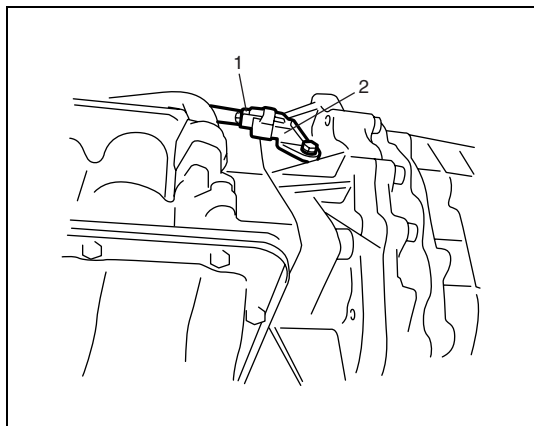
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)



- 3) Connect input shaft speed sensor connector.
- 4) Lower hoist.
- 5) Connect negative cable at battery.

Output Shaft Speed Sensor**REMOVAL**

- 1) Disconnect negative cable at battery.
- 2) Remove transfer shift lever referring to Step 2) to 4) of "Dis-mounting" under "Automatic Transmission assembly (with Transfer)" in this section.
- 3) Hoist vehicle.
- 4) Remove exhaust No.2 pipe.
- 5) Disconnect propeller shafts from differential flanges referring to "Propeller Shafts" in Section 4B.



- 6) To facilitate work, increase clearance between transmission and floor panel according to procedure described below.
- a) Support transmission with jack and lower transmission 2 – 3 cm (1 in.).

CAUTION:

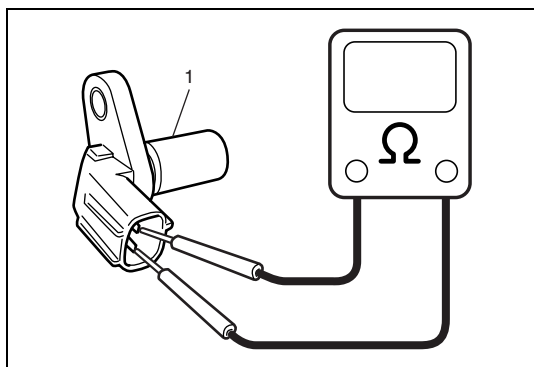
**Do not lower transmission more than instructed value.
That may cause trouble to engine or transmission.**

- b) Disconnect output shaft speed sensor connector (1) and then remove output shaft speed sensor (2) from transmission.

INSPECTION

Check output shaft speed sensor (1) for resistance between terminals of sensor.

Output shaft speed sensor resistance
560 – 680 Ω (at 20 °C, 68 °F)

**INSTALLATION**

Reverse removal procedure for installation noting the followings.

- Check that sensor is free from any metal particles and damage.
- Apply A/T fluid to O-ring and then install input shaft speed sensor (1) to transmission. Tighten sensor bolt to specified torque.

Tightening torque

Input shaft speed sensor bolt

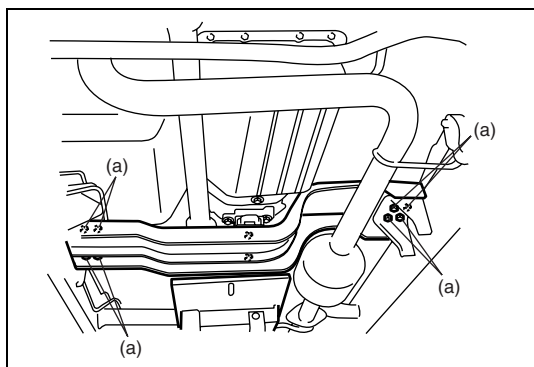
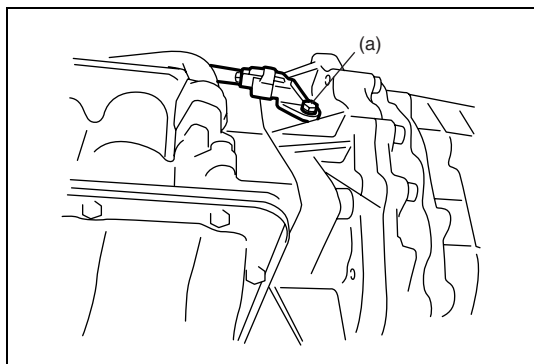
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

- Tighten rear mounting member bolts to specified torque.

Tightening torque

Rear mounting member bolt

(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)

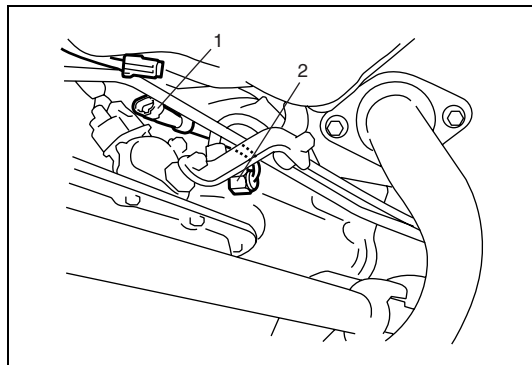


- Connect propeller shaft referring to “Propeller Shaft” in Section 4B.
- Install exhaust No.2 pipe referring to “Exhaust System Components” in Section 6K.

A/T Fluid Temperature Sensor

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Hoist vehicle.
- 3) Disconnect A/T fluid temperature sensor connector (1).
- 4) Remove A/T fluid temperature sensor (2) from transmission.



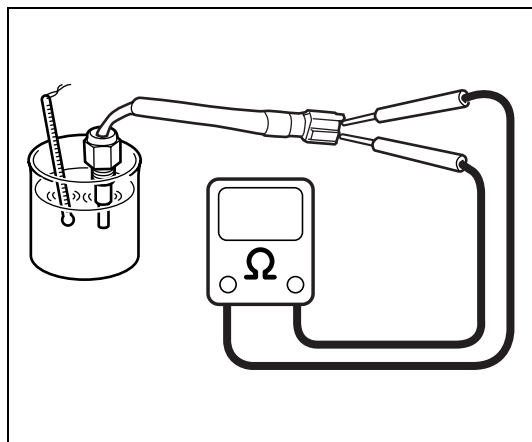
INSPECTION

Immerse temperature sensing part of A/T fluid temperature sensor in water. Check A/T fluid temperature sensor for resistance between terminals of sensor. Thus make sure its resistance decreases as temperature rises.

A/T fluid temperature sensor resistance

Temperature	Resistance
20 °C (68 °F)	Approx. 12 kΩ
80 °C (176 °F)	Approx. 1.7 kΩ

1. A/T fluid temperature sensor connector



INSTALLATION

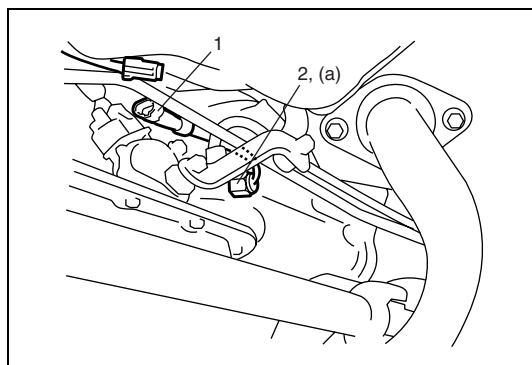
- 1) Apply A/T fluid to O-ring, install A/T fluid temperature sensor (2) to transmission. Tighten sensor to specified torque.

Tightening torque

A/T fluid temperature sensor

(a): 14.7 N·m (1.5 kg-m, 11.0 lb-ft)

- 2) Connect A/T fluid temperature sensor connector (1).



- 3) Lower hoist.
- 4) Connect negative cable at battery.

O/D Off Switch

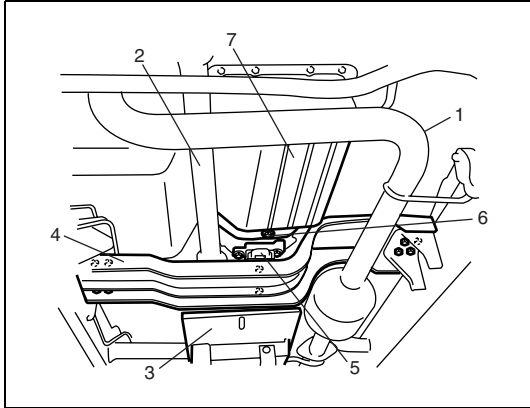
INSPECTION

Check O/D off switch for operation referring to Step 4 of "Diagnostic Flow Table B-2" in this section.

If malfunction is found, replace.

Solenoid Valves (Shift Solenoid Valves, TCC Solenoid Valve and Pressure Control Solenoid Valve)

REMOVAL



- 1) Disconnect negative cable from battery.
- 2) Pull out fluid level gauge and lift up vehicle.
- 3) Remove exhaust No.2 pipe (1).
- 4) Disconnect front propeller shaft (2) from front differential.
- 5) Apply transmission jack (3) under transfer and take off rear mounting member (4).
- 6) Remove engine rear mounting (5).
- 7) Remove drain plug (6) and drain A/T fluid.
- 8) Install drain plug (6).

Tightening torque

A/T fluid drain plug (a): 20 N·m (2.0 kg-m, 14.5 lb-ft)

- 9) Remove A/T oil pan (7).
- 10) Disconnect shift solenoid-A valve, shift solenoid-B valve, TCC solenoid valve and pressure control solenoid valve connectors referring to "Unit Disassembly" in this section.
- 11) Remove shift solenoid-A valve, shift solenoid-B valve, TCC solenoid valve and pressure control solenoid valve referring to "Unit Disassembly" in this section.

INSPECTION

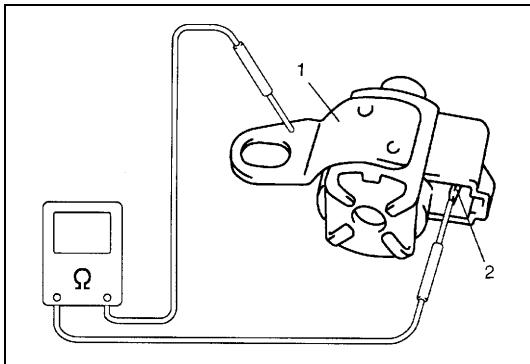
Solenoid Valves (Shift Solenoid Valves and TCC Solenoid Valve)

Resistance Check

Measure resistance between terminal (2) and solenoid valve body. If resistance is out of specification, replace solenoid valve.

Shift solenoid valve and TCC solenoid valve resistance
Standard: 11 – 15 Ω (at 20 °C (68 °F))

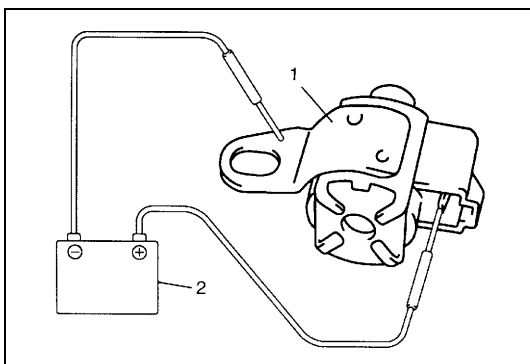
1. Shift solenoid or TCC solenoid valve

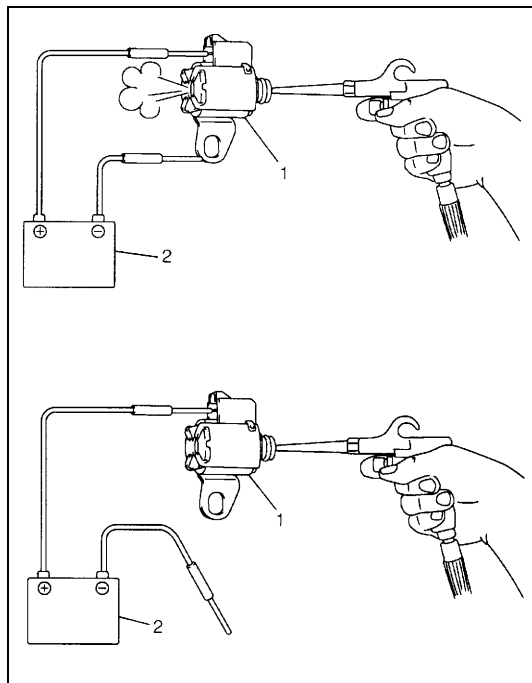


Operation Check

- With solenoid connected to battery (2) as shown in the figure, check that solenoid valve is actuated with click sound.

1. Shift solenoid or TCC solenoid valve

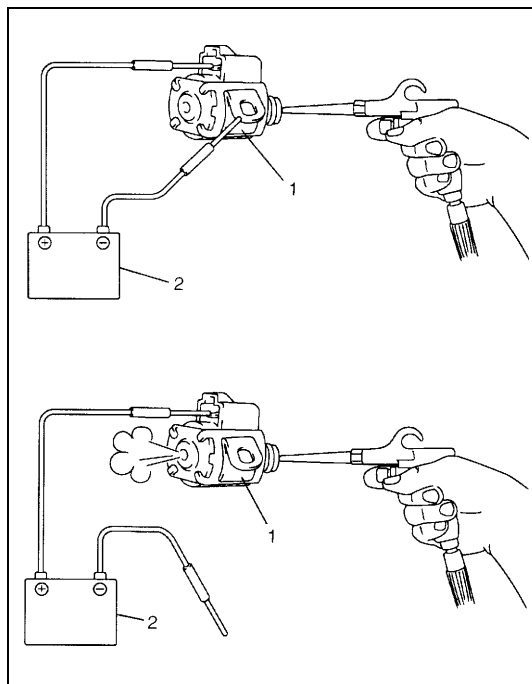




- With shift solenoid valve (1) connected to battery (2), confirm that shift solenoid valve is open by blowing air (50 – 200 kpa, 0.5 – 2.0 kg/cm², 7 – 28.5 psi) into solenoid valve as shown in the figure.
- With shift solenoid valve (1) not connected to battery (2), confirm that shift solenoid valve is closed by blowing air (50 – 200 kpa, 0.5 – 2.0 kg/cm², 7 – 28.5 psi) into solenoid valve as shown in the figure.

CAUTION:

Do not insert air gun against strainer installed on inlet of solenoid valve too deeply, when blowing air into solenoid valve. If not, the strainer will be damaged.



- With TCC solenoid valve (1) connected to battery (2), confirm that shift solenoid valve is closed by blowing air (50 – 200 kpa, 0.5 – 2.0 kg/cm², 7 – 28.5 psi) into solenoid valve as shown in the figure.
- With TCC solenoid valve (1) not connected to battery (2), confirm that TCC solenoid valve is open by blowing air (50 – 200 kpa, 0.5 – 2.0 kg/cm², 7 – 28.5 psi) into solenoid valve as shown in the figure.

CAUTION:

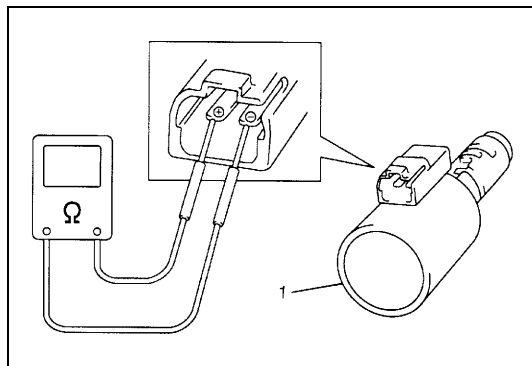
Do not insert air gun against strainer installed on inlet of solenoid valve too deeply, when blowing air into solenoid valve. If not, the strainer will be damaged.

Pressure Control Solenoid Valve**Resistance Check**

Measure resistance between pressure control solenoid valve (1) terminals. If resistance is out of specification, replace valve body assembly.

Pressure control solenoid valve resistance

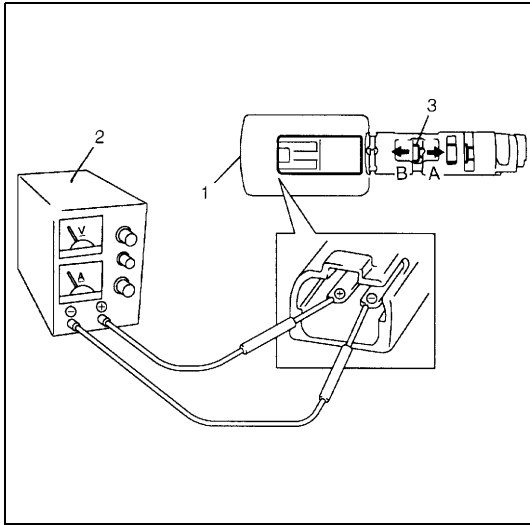
Standard: 5.0 – 5.6 Ω (at 20 °C (68 °F))



Operation Check

Check pressure control solenoid valve (1) operation in either of the following methods.

[Using regulated DC power supply]

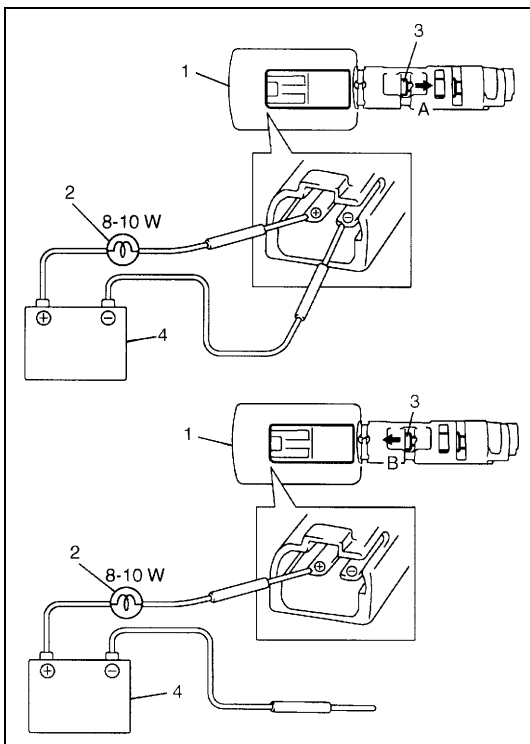


- 1) Connect pressure control solenoid valve (1) with regulated DC power supply (2) as shown in the figure.
- 2) Turn regulated DC power supply switch ON, increase voltage of power supply keeping current within 1.0 A.
- 3) Check that valve (3) moves gradually in arrow "A" direction as voltage increases.
- 4) Check that valve (3) moves in arrow "B" direction as voltage decreases.
- 5) Turn power supply switch OFF.

CAUTION:

Do not feed current 1.0 A or more, or pressure control solenoid will be burned out.

[Not using regulated DC power supply]



- 1) Connect pressure control solenoid valve (1) to battery (4) setting 8 – 10 W bulb (2) in between as shown in the figure.
- 2) Check that valve (3) moves in arrow "A" direction.
- 3) Disconnect pressure control solenoid valve (1) from battery (4) and check that valve (3) moves in arrow "B" direction as shown in the figure.

CAUTION:

Set 8 – 10 W bulb in between, or pressure control solenoid valve will be burned out.

INSTALLATION

Reverse removal procedure to install solenoid valves, noting the following points.

- For details of solenoid valves and their connectors installation, refer to "Unit Disassembly" in this section. Use new O-ring.
- For details of A/T oil pan installation, refer to "Unit Disassembly" in this section.
- Tighten universal joint flange bolts & nuts, engine rear mounting bolts, exhaust pipe bolts & nuts and rear mount member bolts.

- Fill A/T fluid and check fluid level according to procedure described in “Fluid Change” in this section.
- Check for fluid leakage after warming up A/T.

Throttle Position Sensor

INSPECTION

Refer to “DTC P0121 (DTC P0120) TP Circuit Range/Performance Problem”, “DTC P0221 (DTC P0220) TP Range/Performance Problem” and “DTC P0604 (DTC P0120) TP Sensor Monitoring System Malfunction” in Section 6-1.

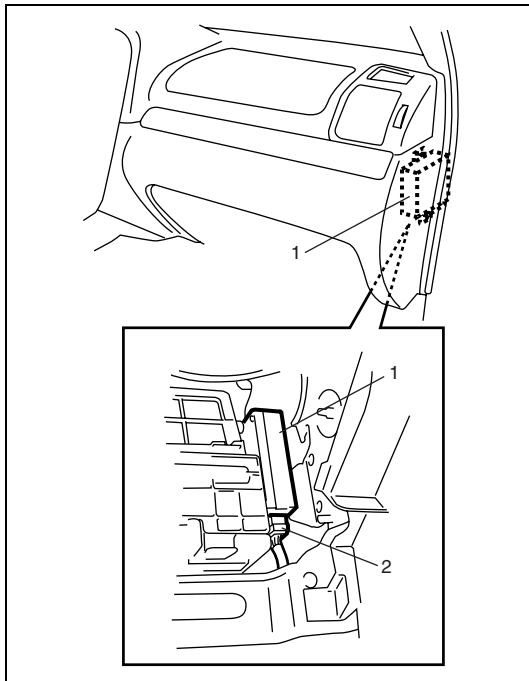
Transmission Control Module (TCM)

CAUTION:

TCM consists of highly precise parts, so when handling it, be careful not to expose it to excessive shock.

REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Disable air bag system.
Refer to “Disabling Air Bag System” in Section 10B.
- 3) Remove glove box.
- 4) Disconnect couplers (2) from TCM (1).
- 5) Loosen screws and remove TCM (1).



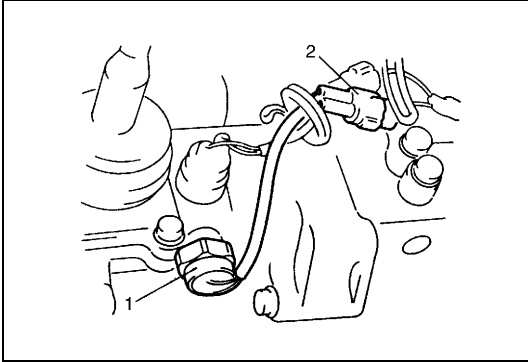
INSTALLATION

Reverse removal procedure noting the following points.

- Connect TCM couplers securely.
- Be sure to enable air bag system after TCM is back in place.
Refer to “Enabling Air Bag System” in Section 10B.

4WD LOW Switch

INSPECTION



- 1) Disconnect negative cable (–) at battery.
- 2) Hoist vehicle.
- 3) Disconnect 4WD LOW switch coupler (2).
- 4) Check continuity between 4WD LOW switch (1) terminals.
There should be continuity when transfer lever is shifted to 4L position and it should be infinity when transfer lever is shifted to 4H or 2H position.
If not, replace 4WD LOW switch (1).
- 5) Connect 4WD LOW switch coupler (2).
- 6) Lower hoist and connect negative (–) cable.

Oil Cooler Pipes

REMOVAL

- 1) Lift up vehicle.
- 2) Make sure to wash dirt off from around pipe joints.
- 3) When engine is cool, loosen oil cooler pipe union bolts with oil outlet union locked and remove oil cooler pipes (1) from oil outlet unions and hoses.

NOTE:

To avoid fluid leakage, plug open ends of oil outlet unions and hoses right after they are disconnected.

INSTALLATION

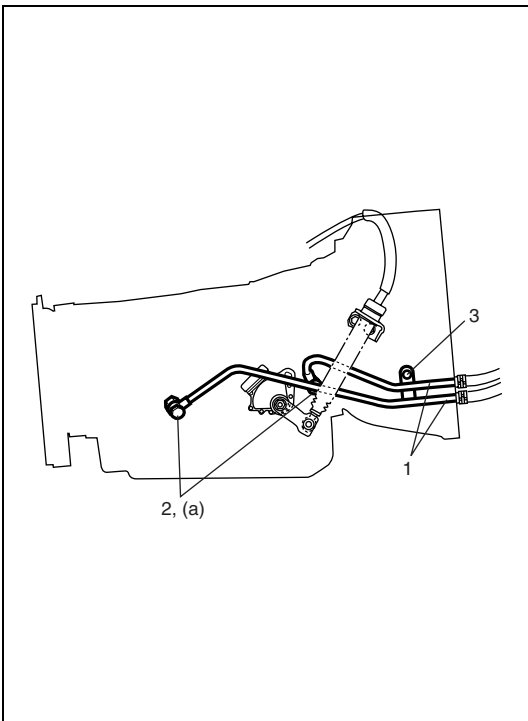
- 1) Use new union gaskets and connect oil cooler pipes to oil outlet unions.
- 2) Connect hoses to pipes and clamp them securely.
- 3) Tighten union bolts (2) to specified torque with oil outlet union locked.

Tightening torque

Oil cooler pipe union bolts

(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

- 4) Tighten pipe clamp bolt (3) securely.
- 5) Check A/T fluid level according to procedure described in “Maintenance Service” in this section.
- 6) Check for fluid leakage after warming up A/T.

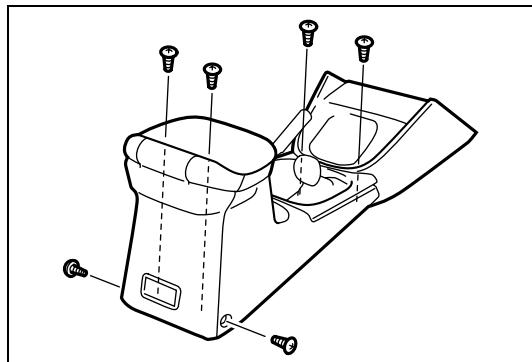


Automatic Transmission Assembly (with Transfer)

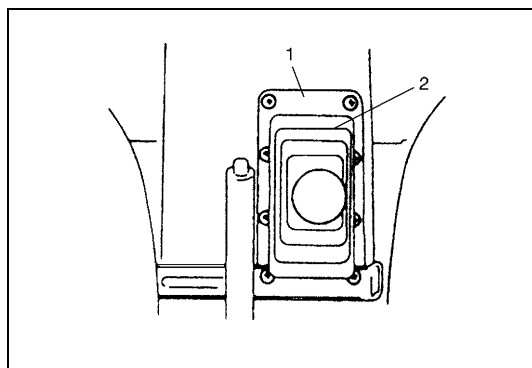
DISMOUNTING

Vehicle Compartment

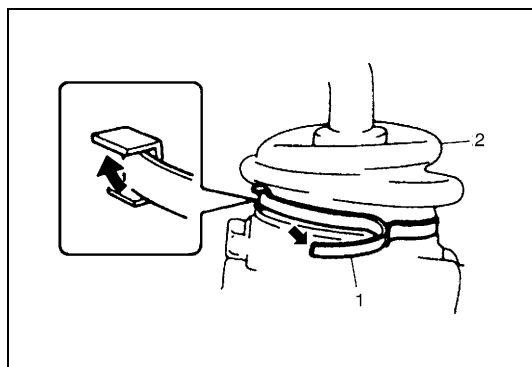
- 1) Disconnect negative cable at battery.
- 2) Remove console box.



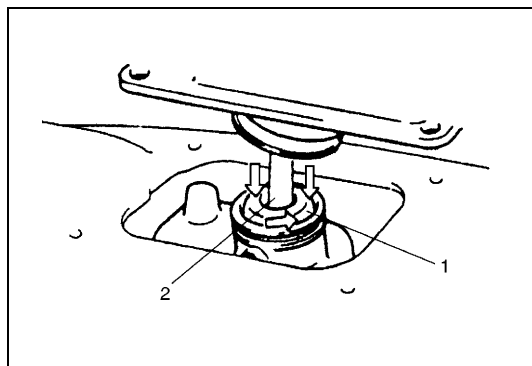
- 3) Detach boot cover (1) and boot No.2 (2).



- 4) Remove boot clamp (1) and then remove boot No.1 (2) from transfer gear shift lever case.

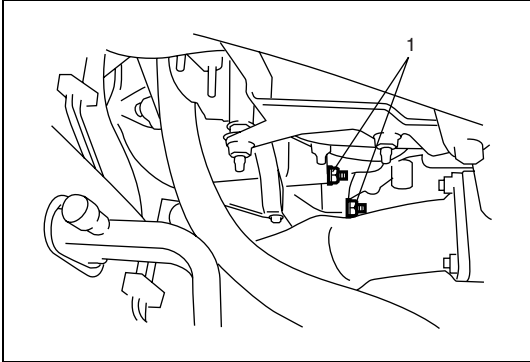


- 5) With transfer shift control case cover (1) pushed down with fingers, turn it counterclockwise and take out shift control lever (2).



In Engine Room

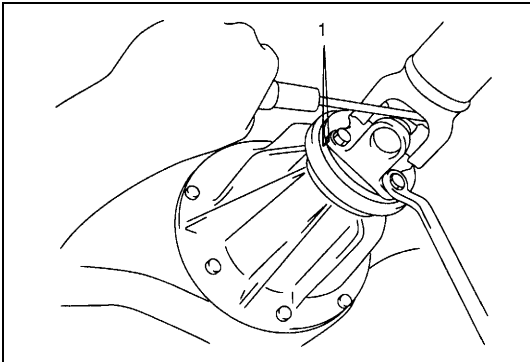
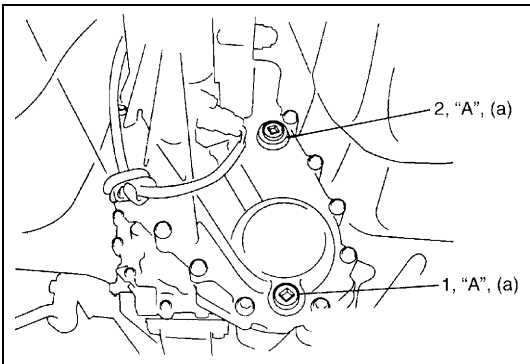
- 1) Remove battery.
- 2) Detach fuse/relay box and remove strut tower bar.
- 3) Remove CKP sensor from torque converter housing referring to "CKP sensor" in Section 6E3.
- 4) Remove starter motor bolts.
- 5) Remove nuts (1) fixing transmission to engine.



On Lift

- 1) Drain transfer oil.

1. Drain plug
2. Level and filler plug



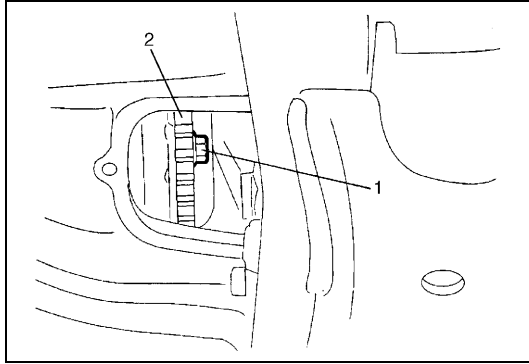
- 2) Before removing propeller shaft, give match marks (1) on joint flange and propeller shaft as shown in the figure.
- 3) Remove universal joint flange bolts and take out rear propeller shaft.

- 4) Likewise, take out front propeller shaft.
- 5) Remove nut from the end of select cable and bracket to set cable free.
- 6) Remove select cable bracket by removing its 2 bolts.
- 7) Remove exhaust No.2 pipe.
- 8) Remove stabilizer bar mount bush bracket bolts.
- 9) Unclamp and disconnect oil cooler hoses from pipes.

NOTE:

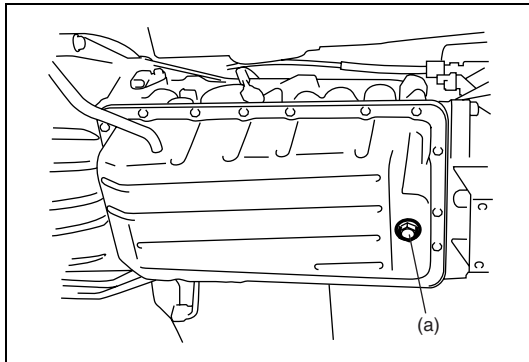
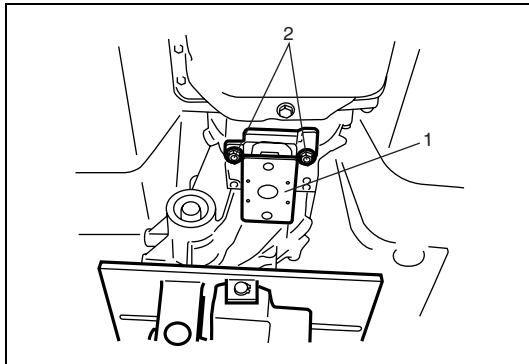
To avoid leakage of transmission fluid, plug open ends of oil cooler pipes and hoses right after they are disconnected.

- 10) Remove torque converter housing cover.
- 11) Remove engine under cover.
- 12) Holding crankshaft pulley bolt stationary with wrench, remove torque converter mounting bolts (1) with wrench.

**CAUTION:**

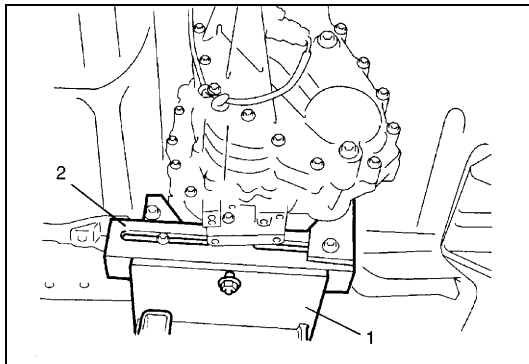
Do not use CKP sensor ring (2) to lock drive plate when loosening bolts.

- 13) Apply transmission jack and take off rear mounting member by removing its bolts.
- 14) Remove rear mounting (1) by removing its bolts (2).

**NOTE:**

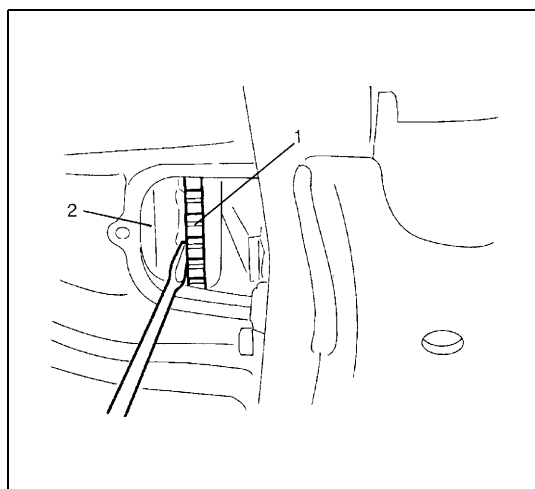
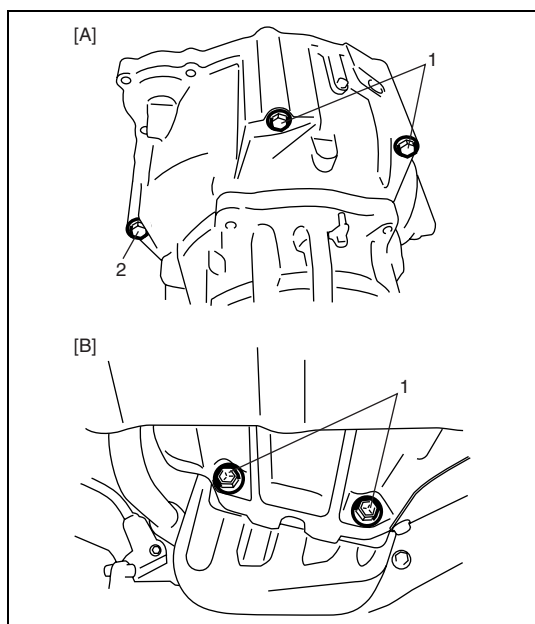
If automatic transmission is overhauled later on, draining A/T fluid at this point will facilitate work.

1. Drain plug



- 15) Lower transmission jack slowly. Remove it from transmission, then install auxiliary arm (2) to transmission jack (1).
- 16) Raise transmission jack until it contacts transmission.

- 17) Disconnect connectors from VSS, output shaft speed sensor, input shaft speed sensor, transmission range sensor, shift & TCC solenoid valves, A/T fluid temperature sensor, 4WD low switch and 4WD switch, and release their wire harnesses from clamps.



- 18) Remove breather hose and harness clamp mounting bolt from transmission.
- 19) Remove mass damper from transfer.
- 20) Remove bolts (1) fixing engine to transmission and loosen bolt (2) which can not removed due to interference with vehicle body.

- 21) With transmission assembly held up on jack, move them to the rear and lower them including torque converter.
As necessary, insert a rod into the gap between CKP sensor rotor (1) and torque converter (2), then separate CKP sensor rotor (1) from torque converter (2).

WARNING:

Transmission assembly may tilt rearward on jack. It is recommended to use an auxiliary arm of jack for the purpose of safety.

[A]: Transmission upper side

[B]: Transmission lower side

After Dismounting**WARNING:**

Be sure to keep transmission and transfer assembly horizontal throughout the work. Should they be tilted, torque converter may fall off and cause personal injury and A/T fluid may flow out.

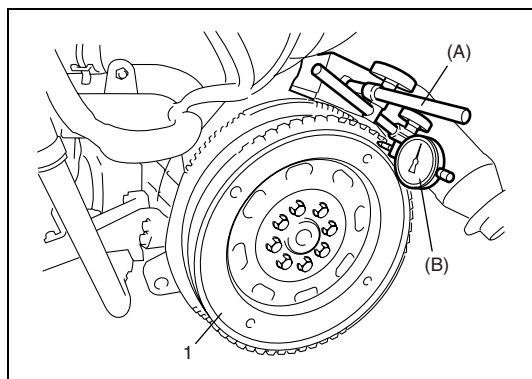
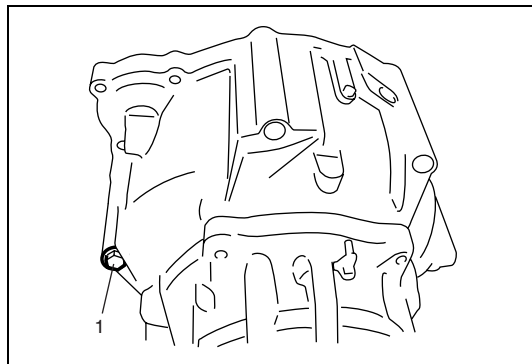
- 1) Remove transfer by removing its bolts.

REMountING**WARNING:**

When moving transmission assembly with torque converter equipped in it, be sure to keep it horizontal. Tilting it with its front facing down may allow converter to fall off, thereby an injury may result.

Reverse dismounting procedure for remounting noting the following points.

- When installing transmission and transfer to engine, lift the front of engine about 10 cm (3.94 in) by using hoist.
- Fit transmission assembly to engine cylinder block with bolt (1) inserted to transmission. After fitting, bolt (1) can not be installed.



- Check drive plate (1) for runout by using magnetic stand and dial gauge.
If runout is not within specification or ring gear is damaged, replace drive plate.

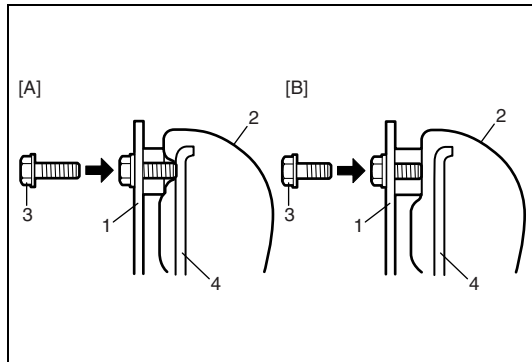
Drive plate runout limit
0.2 mm (0.0079 in.)

Special tool

(A): 09900-20606

(B): 09900-20701

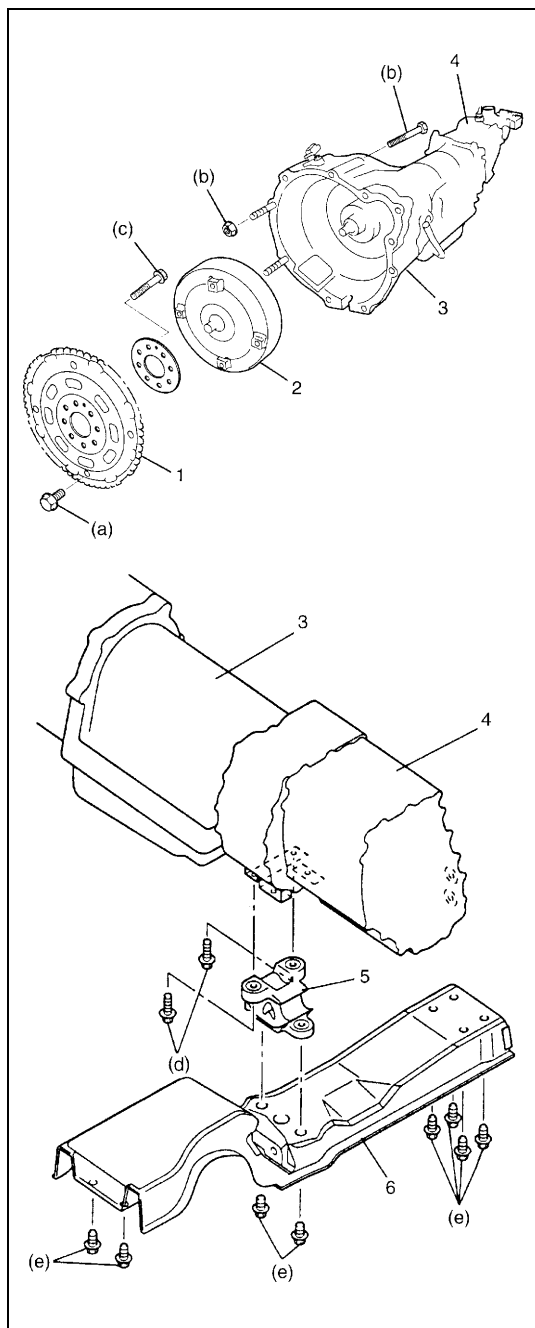
- Install torque converter (2) to drive plate (1) by using torque converter mounting bolt (3) of correct length.



[A]: Incorrect length bolt

[B]: Correct length bolt

4. TCC



- Tighten bolts and nuts to specified torque.

Tightening torque

Torque converter mounting bolts

(a): 65 N·m (6.5 kg-m, 47.0 lb-ft)

Transmission to engine bolts and nuts

(b): 61 N·m (6.1 kg-m, 44.0 lb-ft)

Drive plate bolts

(c): 50 N·m (5.0 kg-m, 36.5 lb-ft)

Engine rear mounting bolts

(d): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Engine rear mounting member bolts

(e): 55 N·m (5.5 kg-m, 40.0 lb-ft)

Torque converter housing cover bolts:

10 N·m (1.0 kg-m, 7.5 lb-ft)

Exhaust No.2 pipe to turbocharger outlet pipe bolts:

55 N·m (5.5 kg-m, 40.0 lb-ft)

Muffler to exhaust No.2 pipe bolts or nuts:

55 N·m (5.5 kg-m, 40.0 lb-ft)

Front propeller shaft universal joint flange bolts:

50 N·m (5.0 kg-m, 36.5 lb-ft)

Rear propeller shaft universal joint flange bolts:

55 N·m (5.5 kg-m, 40.0 lb-ft)

Stabilizer bar mount bush bracket bolts:

23 N·m (2.3 kg-m, 17.0 lb-ft)

Strut tower bar bolts:

50 N·m (5.0 kg-m, 36.5 lb-ft)

1. Drive plate	4. Transfer
2. Torque converter	5. Engine rear mounting
3. Automatic transmission	6. Engine rear mounting member

- Clamp wire harness and hoses securely.
- Refer to "Select Cable" in this section for adjusting procedure of select cable.
- Follow fluid level check procedure for refilling automatic transmission fluid and adjusting its level.
- Install battery, and confirm that engine and transmission function acceptably.
- When remounting drive plate, use specified bolts.

Unit Repair

When repairing automatic transmission, it is necessary to conduct the on-vehicle test to investigate where the cause of the trouble lies first.

Then whether overhaul should be done or not is determined. If the transmission is disassembled without such preliminary procedure, not only the cause of the trouble would be unknown, but also a secondary trouble may occur and often time would be wasted.

Precautions

As the automatic transmission consists of high precision components, the following cautions should be strictly observed when handling its parts in disassembly and reassembly.

- Disassembling valve body assembly is prohibited in principle. However, a few parts can be disassembled. When disassembling valve body component parts, confirm whether these parts are allowed to disassemble or not referring to "Valve Body Assembly" in this section.
- Make sure to wash dirt off from the transmission so that no such dirt will enter the transmission during dismounting and remounting.
- Select a clean place free from dust and dirt for overhauling.
- Place a rubber mat on the work bench to protect parts from damage.
- Work gloves or shop cloth should not be used. (Use nylon cloth or paper towel.)
- When separating the case joint, do not pry with a screwdriver or such but tap with a plastic hammer lightly.
- Make sure to wash dirt off from the transmission so that no such dirt will enter the transmission during disassembly and reassembly.
- Wash the disassembled parts in ATF (Automatic Transmission Fluid) or kerosene (using care not to allow ATF or kerosene to get on your face, etc.) and confirm that each fluid passage is not clogged by blowing air into it. But use ATF to wash the disc, resin washers and rubber parts.
- Replace each gasket, oil seal and O-ring with a new one.
- Apply ATF to sliding or rotating parts before reassembly.
- A new disc should be soaked in ATF at least 15 minutes before use.

Part Inspection and Correction Table

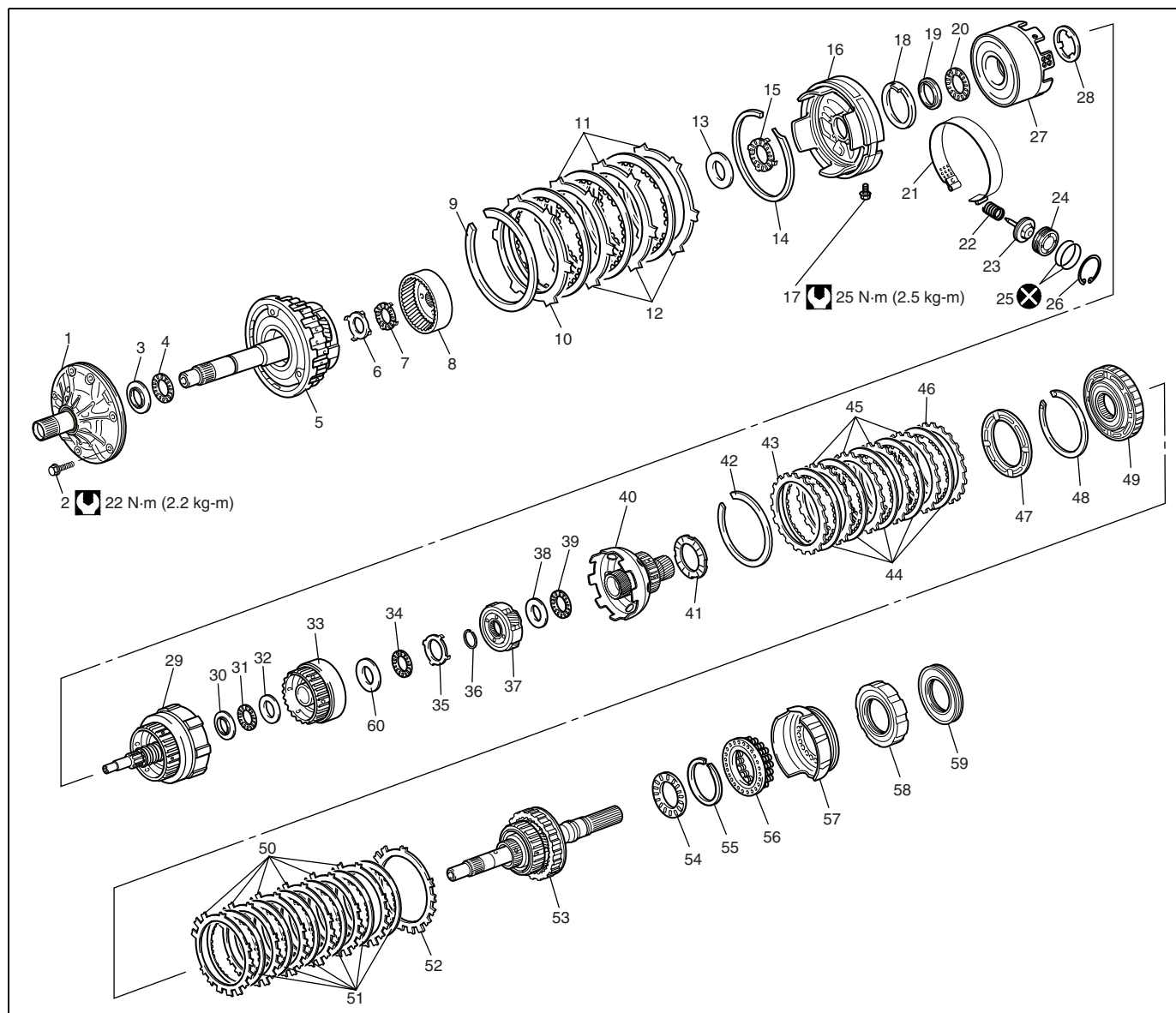
Part	Inspect for	Correction
Casted part, machined part	Small flaw, burr	Remove with oil stone.
	Deep or grooved flaw	Replace part.
	Clogged fluid passage	Clean with air or wire.
	Flaw on installing surface, residual gasket	Remove with oil stone or replace part.
	Crack	Replace part.
Bearing	Unsmooth rotation	Replace.
	Streak, pitting, flaw, crack	Replace.
Bushing, thrust washer	Flaw, burr, wear, burning	Replace.
Oil seal, gasket	Flawed or hardened seal ring	Replace.
	Worn seal ring on its periphery or side	Replace.
	Piston seal ring, oil seal, gasket, etc.	Replace.
Gear	Flaw, burr	Replace.
	Worn gear tooth	Replace.
Splined part	Burr, flaw, torsion	Correct with oil stone or replace.
Snap ring	Wear, flaw, distortion	Replace.
	No interference	Replace.
Thread	Burr	Replace.
	Damage	Replace.
Spring	Settling, sign of burning	Replace.
Clutch disc, brake disc	Wear, burning, distortion, damaged claw	Replace.
Clutch plate, brake plate	Wear, burning, distortion, damaged claw	Replace.
Sealing surface (where lip contacts)	Flaw, rough surface, stepped wear, foreign material	Replace.

Unit Disassembly

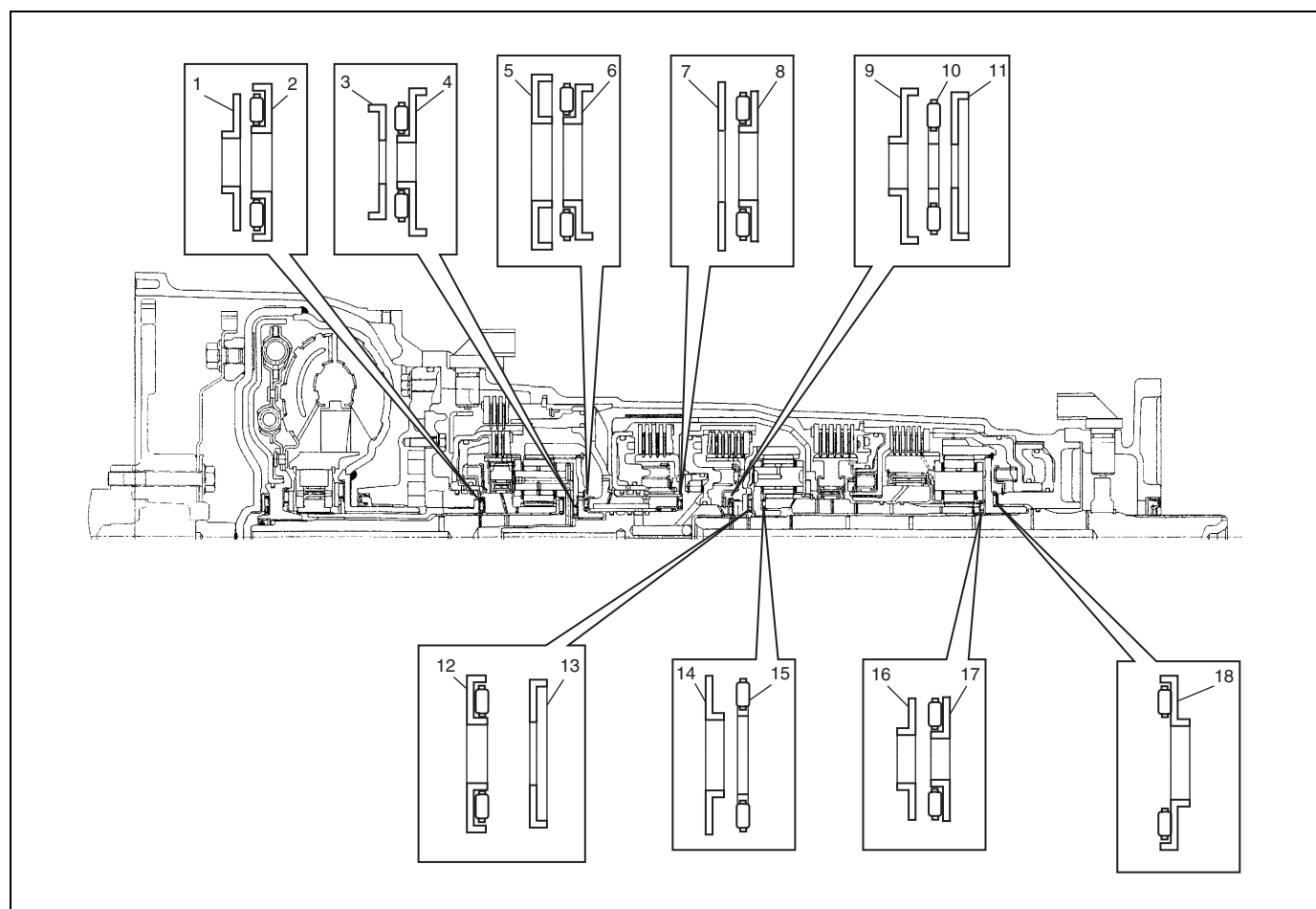
CAUTION:

- Keep component parts in group for each subassembly and avoid mixing them up.
- Clean all parts with cleaning solvent thoroughly and air dry them.
- Use kerosene or automatic transmission fluid as cleaning solvent.
- Do not use wiping cloths or rags to clean or dry parts.
- All oil passages should be blown out and checked to make sure that they are not obstructed.
- Keep face and eyes away from solvent spray while air blowing parts.
- Check mating surface for irregularities and remove them, if any, and clean it again.
- Soak new clutch discs and brake discs in transmission fluid for at least 15 minutes before assembly.
- Replace all gaskets and O-rings with new ones.
- Apply automatic transmission fluid to all O-rings.
- When installing seal ring, be careful so that it is not expanded excessively, extruded or caught.
- Replace oil seals that are removed and apply grease to their lips.
- Before installing, be sure to apply automatic transmission fluid to sliding, rolling and thrusting surface of all component parts. Also after installation, make sure to check each part for proper operation.
- Always use torque wrench when tightening bolts.

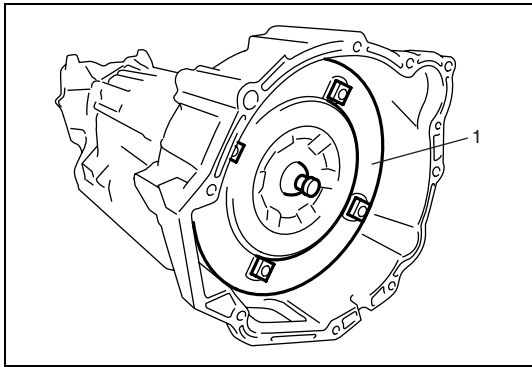
COMPONENTS



1. Oil pump assembly	22. Spring	43. Forward brake flange
2. Oil pump bolt	23. 2nd coast brake piston assembly	44. Forward brake disc
3. O/D thrust bearing No.1 race	24. 2nd coast brake piston cap	45. Forward brake No.1 plate
4. O/D thrust No.1 bearing	25. O-ring	46. Forward brake No.2 plate
5. O/D clutch assembly and O/D planetary gear assembly	26. Snap ring	47. Forward brake sleeve
6. O/D thrust bearing No.2 race	27. Direct clutch assembly	48. Snap ring
7. O/D thrust No.2 bearing	28. Forward clutch thrust washer	49. Forward brake drum
8. O/D planetary ring gear	29. Forward clutch assembly	50. Reverse brake plate
9. Snap ring	30. Input shaft rear thrust bearing front race	51. Reverse brake disc
10. O/D brake flange	31. Input shaft rear thrust bearing	52. Reverse brake flange
11. O/D brake disc	32. Input shaft rear thrust bearing rear race	53. Rear planetary carrier assembly and output shaft
12. O/D brake plate	33. Front planetary ring gear	54. Rear planetary thrust bearing
13. O/D thrust bearing No.3 race	34. Front ring gear thrust bearing	55. Snap ring
14. Snap ring	35. Front ring gear thrust bearing rear race	56. Reverse brake return spring
15. O/D thrust No.3 bearing	36. Snap ring	57. Reverse brake No.1 piston
16. O/D case	37. Front planetary carrier assembly	58. Reverse brake piston sleeve
17. O/D case bolt	38. Front planetary thrust bearing race	59. Reverse brake No.2 piston
18. Direct clutch thrust washer	39. Front planetary thrust bearing	60. Front ring gear thrust bearing front race
19. Input shaft front thrust bearing race	40. Input sun gear drum, sun gear and one-way No.3 clutch	 Tightening torque
20. Input shaft thrust bearing	41. Forward brake return thrust washer	 Do not reuse.
21. 2nd coast brake band	42. Snap ring	

BEARING AND RACE INSTALLATION DIAGRAM**Bearing and race dimensions**

No.	Bearing and race	Inner diameter	Outer diameter
1	O/D thrust bearing No.1 race	28.45 mm (1.120 in.)	47.20 mm (1.858 in.)
2	O/D thrust No.1 bearing	29.20 mm (1.150 in.)	50.20 mm (1.976 in.)
3	O/D thrust bearing No.2 race	24.70 mm (0.972 in.)	41.80 mm (1.646 in.)
4	O/D thrust No.2 bearing	24.20 mm (0.953 in.)	47.80 mm (1.882 in.)
5	O/D thrust bearing No.3 race	37.20 mm (1.465 in.)	58.80 mm (2.315 in.)
6	O/D thrust No.3 bearing	33.80 mm (1.331 in.)	50.00 mm (1.969 in.)
7	Input shaft front thrust bearing race	36.80 mm (1.449 in.)	50.90 mm (2.004 in.)
8	Input shaft front thrust bearing	33.70 mm (1.327 in.)	47.60 mm (1.874 in.)
9	Input shaft rear thrust bearing front race	26.00 mm (1.024 in.)	48.90 mm (1.925 in.)
10	Input shaft rear thrust bearing	26.00 mm (1.024 in.)	46.75 mm (1.841 in.)
11	Input shaft rear thrust bearing rear race	26.80 mm (1.055 in.)	47.02 mm (1.851 in.)
12	Front ring gear thrust bearing	35.00 mm (1.378 in.)	53.75 mm (2.116 in.)
13	Front ring gear thrust bearing rear race	34.30 mm (1.350 in.)	47.30 mm (1.862 in.)
14	Front planetary thrust bearing race	33.70 mm (1.327 in.)	47.60 mm (1.874 in.)
15	Front planetary thrust bearing	35.50 mm (1.398 in.)	47.70 mm (1.878 in.)
16	Sun gear thrust bearing race	28.50 mm (1.122 in.)	44.20 mm (1.740 in.)
17	Sun gear thrust bearing	27.70 mm (1.091 in.)	44.20 mm (1.740 in.)
18	Rear planetary thrust bearing	39.38 mm (1.550 in.)	58.10 mm (2.287 in.)

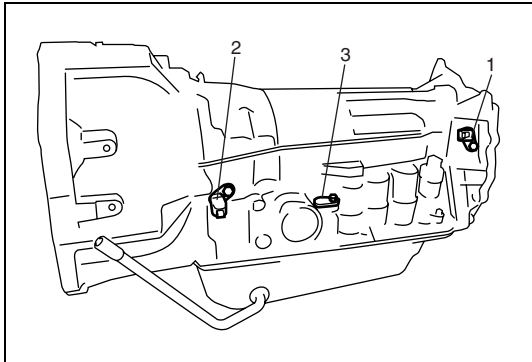
DISASSEMBLY

- 1) Pull out torque converter (1) from transmission.

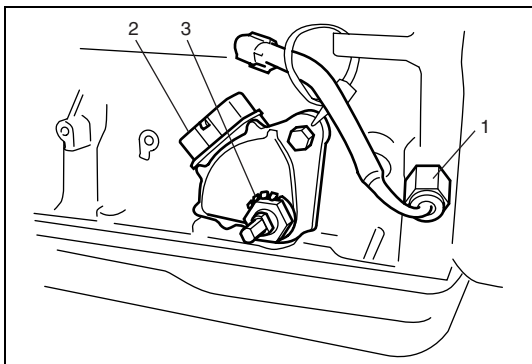
CAUTION:

Remove torque converter as much straight as possible. Leaning it may cause damage to oil seal lip.

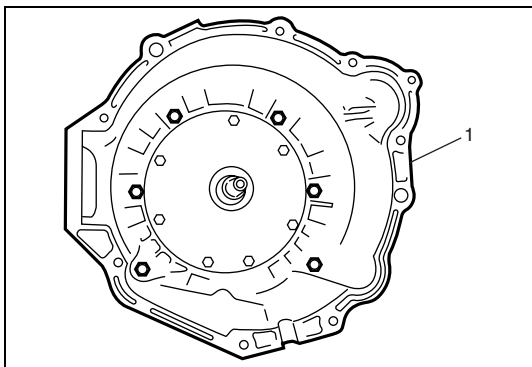
- 2) Remove breather hose from transmission.



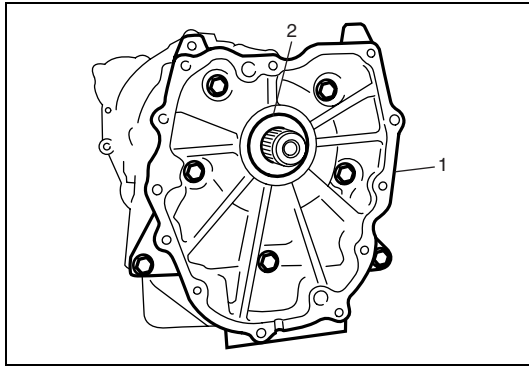
- 3) Remove output shaft speed sensor (1), input shaft speed sensor (2) and transmission case plug (3).



- 4) Remove A/T fluid temperature sensor (1).
- 5) Remove manual select lever from transmission range sensor (2).
- 6) Unbend bent parts of lock washer (3), and then remove manual shift shaft nut, lock washer and grommet.
- 7) Remove transmission range sensor (2) by removing sensor bolt.



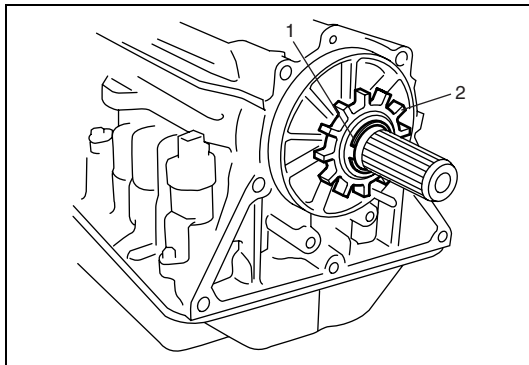
- 8) Remove converter housing (1) by removing 6 bolts.



9) Remove adapter case (1) by removing 7 bolts.

CAUTION:

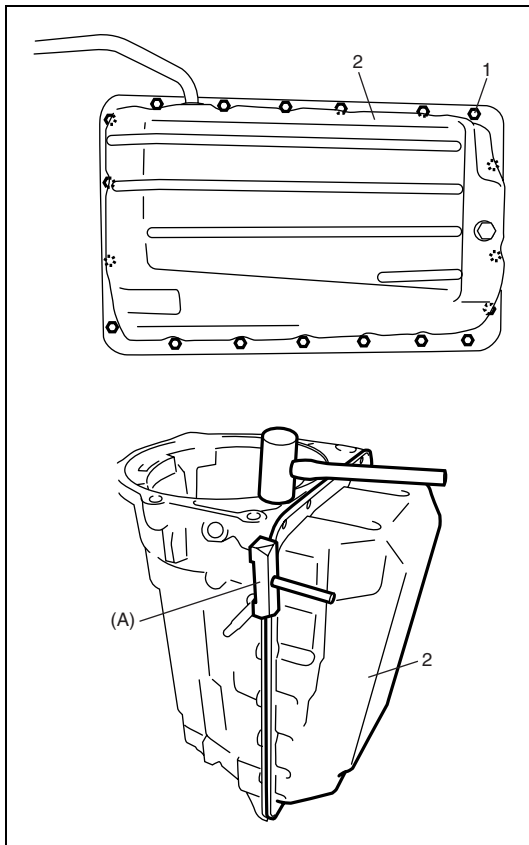
Use care not to cause damage to adapter case oil seal (2).



10) Remove C-ring (1) and then remove speed sensor rotor (2).

NOTE:

Use care not to loose rotor stop key.



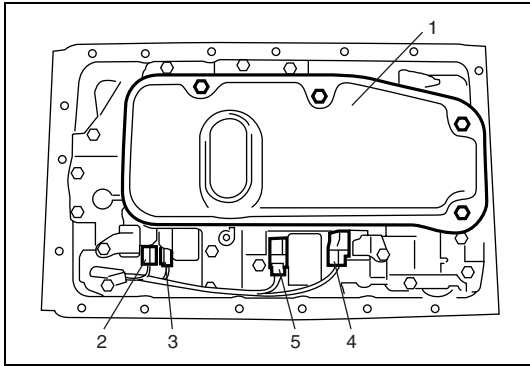
11) Remove oil pan (2) using special tool and plastic hammer.

CAUTION:

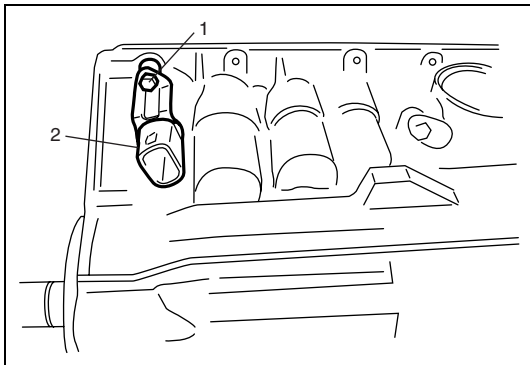
- Hold oil pan with transfer side down to prevent foreign material in oil pan from entering valve body.
- If iron powder is found, it is possible that bearing, gear or clutch plate is worn.

Special tool

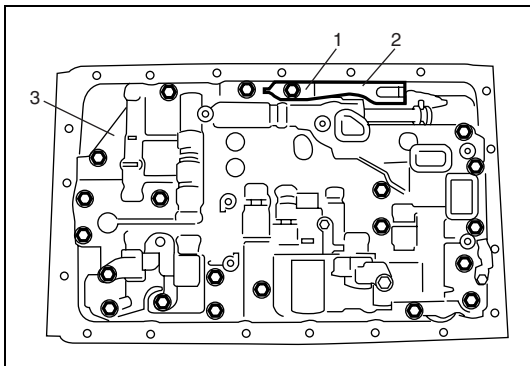
(A): 09921-96510



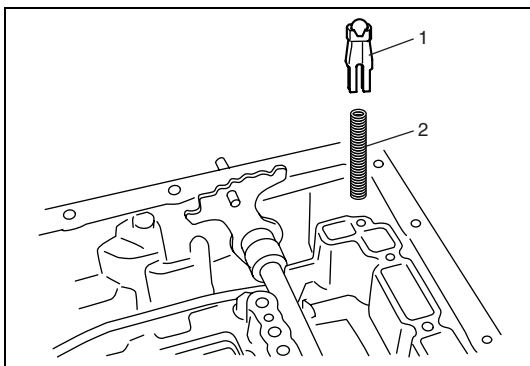
- 12) Remove oil strainer (1) from valve body assembly.
- 13) Disconnect connectors from shift solenoid-A (2), shift solenoid-B (3), TCC solenoid (4) and pressure control solenoid (5).



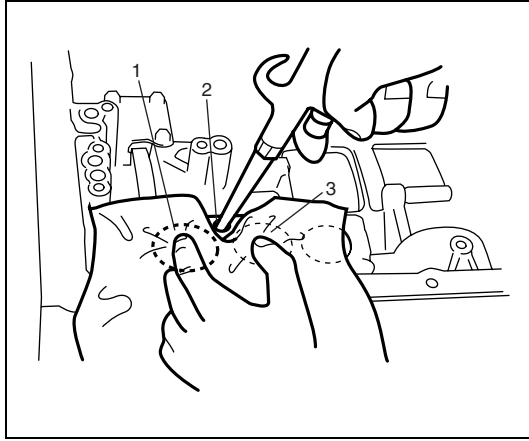
- 14) After removing bolt (1), pull out solenoid wire harness connector (2) from transmission case.



- 15) Remove spring plate (1) and manual shift lever spring (2).
- 16) Remove valve body assembly (3) by removing 20 bolts.



- 17) Remove check ball body (1) and spring (2).

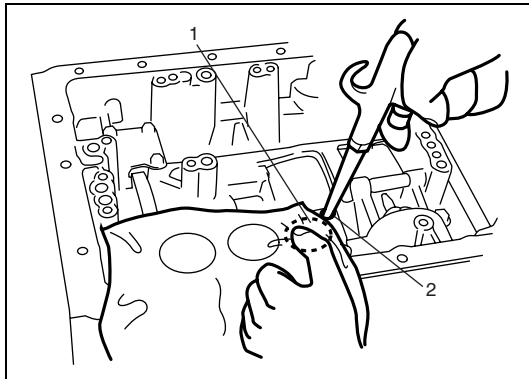


- 18) Remove forward brake and direct clutch accumulator pistons (1) and (3) by blowing compressed air (lower than 392 kPa, 4.0 kg/cm², 57 psi) into oil hole (2).

NOTE:

Cover accumulator piston (1) with shop cloth while blowing because A/T fluid will spatter.

- 19) Remove forward brake accumulator piston spring (Yellow) from transmission case.
20) Remove direct clutch accumulator piston springs (Pink and Pink/White) from transmission case.

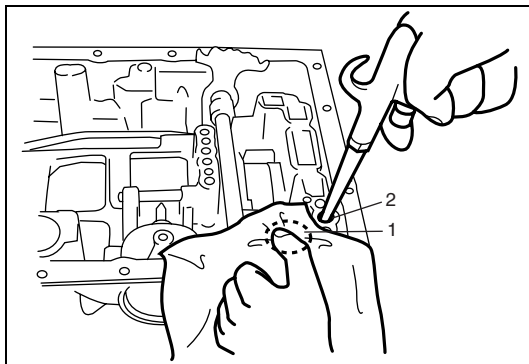


- 21) Remove forward clutch accumulator piston (1) by blowing compressed air (lower than 392 kPa, 4.0 kg/cm², 57 psi) into hole (2).

NOTE:

Cover accumulator piston (1) with shop cloth while blowing because A/T fluid will spatter.

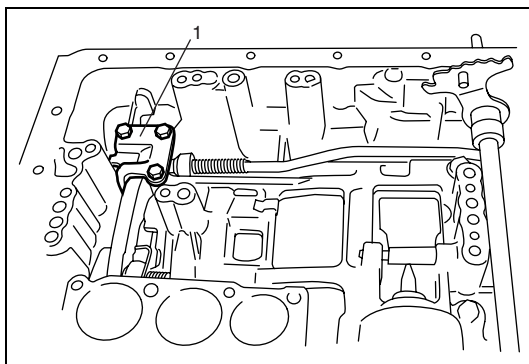
- 22) Remove forward clutch accumulator piston (1) by blowing air into hole (2).



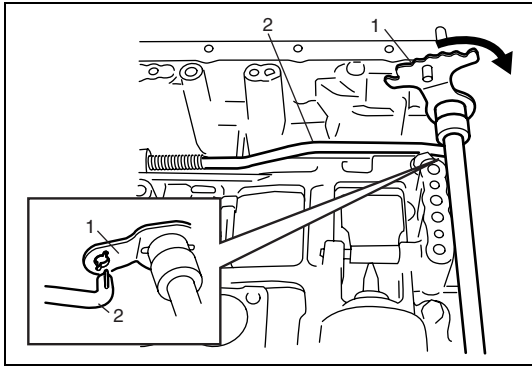
- 23) Remove O/D clutch accumulator piston springs (Orange and Yellow) from O/D clutch accumulator piston.
24) Remove O/D clutch accumulator piston (1) by blowing compressed air (lower than 392 kPa, 4.0 kg/cm², 57 psi) into hole (2).

NOTE:

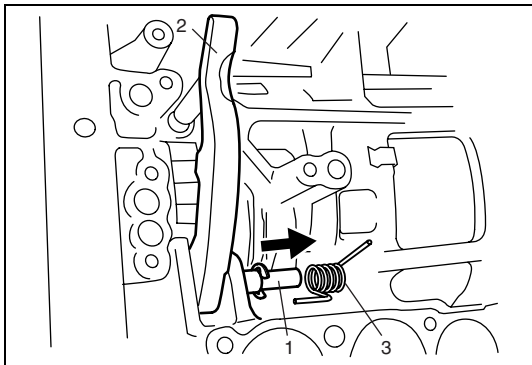
Cover accumulator piston (1) with shop cloth while blowing because A/T fluid will spatter.



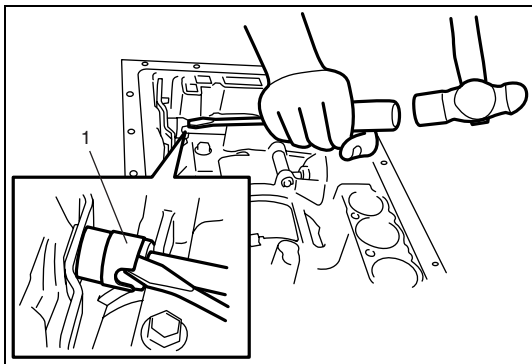
- 25) Remove parking pawl bracket (1).



26) Remove parking lock rod (2) from manual shift lever (1).

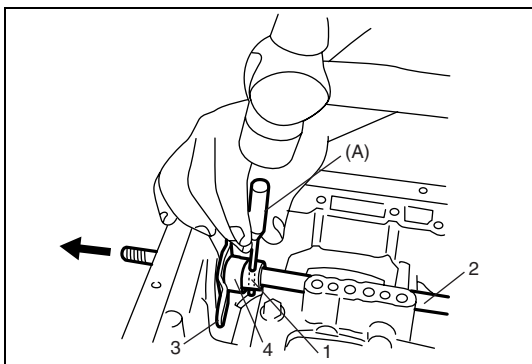


27) Pull out parking pawl pin (1) to oil pump side and then remove parking lock pawl (2) and parking pawl spring (3).



28) Remove manual shift shaft and lever as follows.

a) Undo caulking of sleeve cover (1) by using flat end rod or the like and hammer.

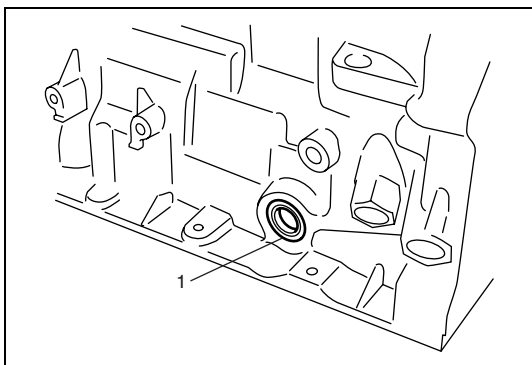


b) Drive out manual shift lever pin (1) by using special tool and hammer.

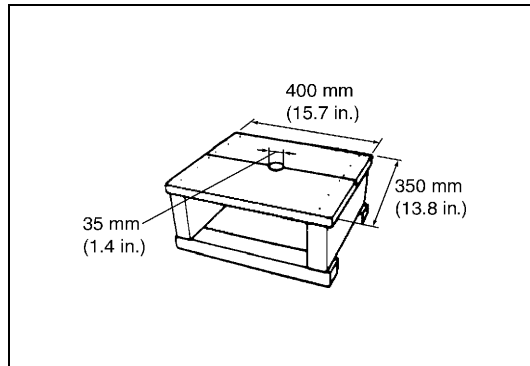
Special tool

(A): 09922-89810

c) Pull out manual shift shaft (2) from transmission case, and then remove manual shift lever (3) and sleeve cover (4).



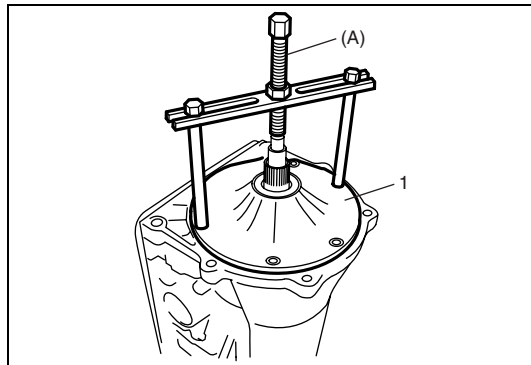
29) Remove manual shift shaft oil seals (1) from transmission case.



30) Place transmission on the stand facing oil pump upward.

NOTE:

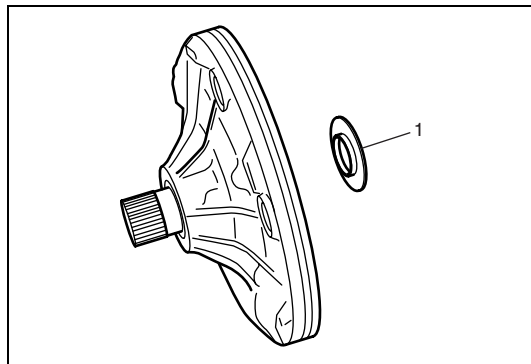
- To prevent transmission case from getting damaged, protect its contacting surface with stand by using shop cloth or the like.
- A stand of such size as shown in the figure will facilitate work.



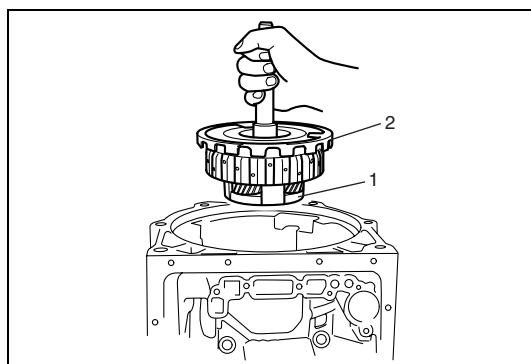
31) After removing oil pump bolts, remove oil pump assembly (1) by using special tool.

Special tool

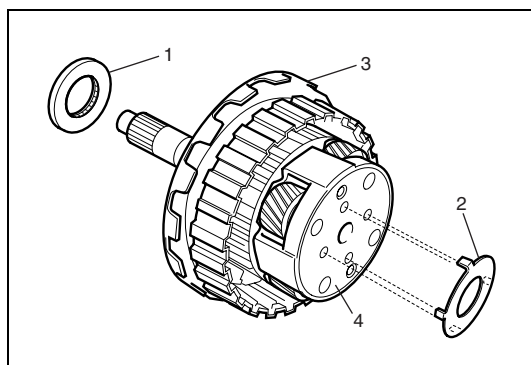
(A): 09918-48211



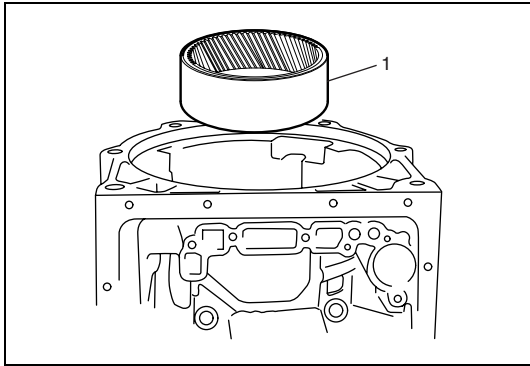
32) Remove O/D thrust bearing No.1 race (1) from oil pump assembly.



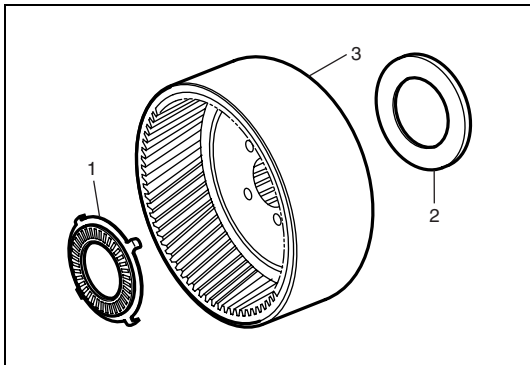
33) Remove O/D planetary gear assembly (1), O/D clutch assembly (2) and one-way No.1 clutch assembly from transmission case.



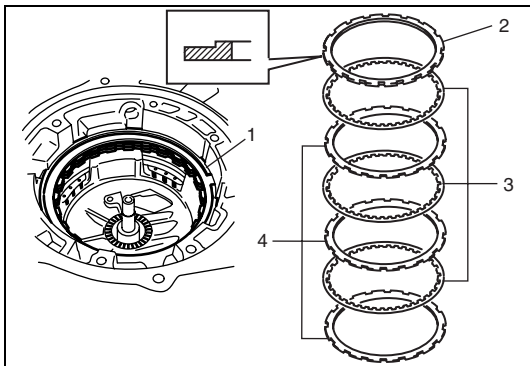
34) Remove O/D thrust No.1 bearing (1) and O/D thrust bearing No.2 race (2) from O/D clutch assembly (3) and O/D planetary gear assembly (4).



35) Remove O/D planetary ring gear (1) from transmission case.



36) Remove O/D thrust No.2 bearing (1) and O/D thrust bearing No.3 race (2) from O/D planetary ring gear (3).

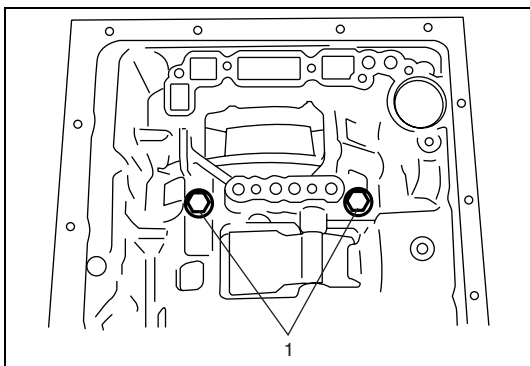


37) Remove snap ring (1) by using flat end rod or the like.

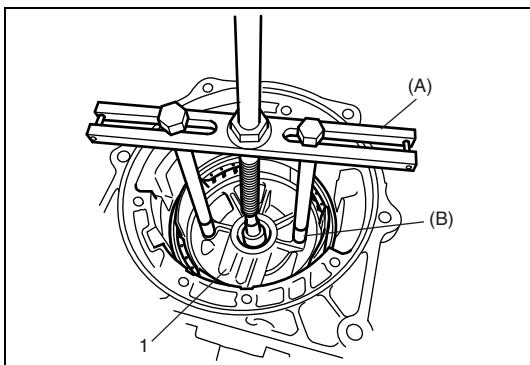
CAUTION:

Use care not to cause damage to transmission case when removing snap ring.

38) Remove O/D brake flange (2), O/D brake discs (3) and O/D brake plates (4).



39) Remove 2 bolts (1) of O/D case assembly from transmission case.

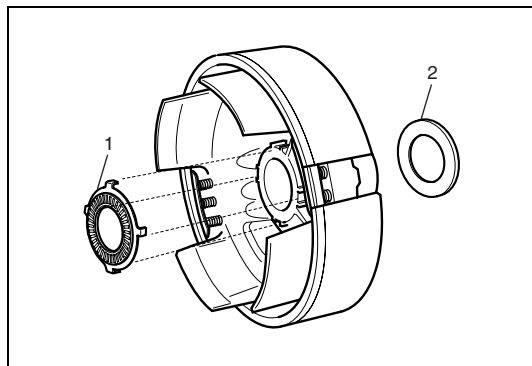


40) Remove snap ring and then remove O/D case assembly (1) by using special tools.

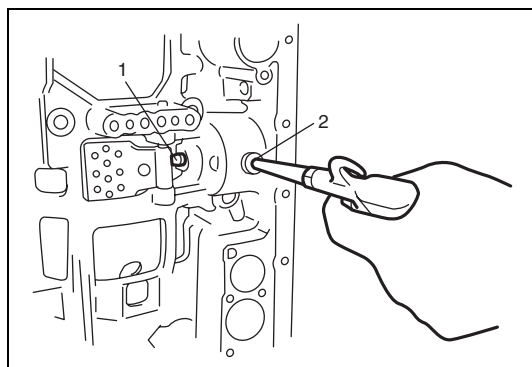
Special tool

(A): 09918-48211

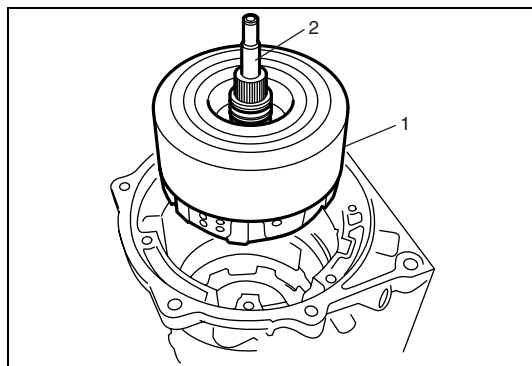
(B): 09918-48220



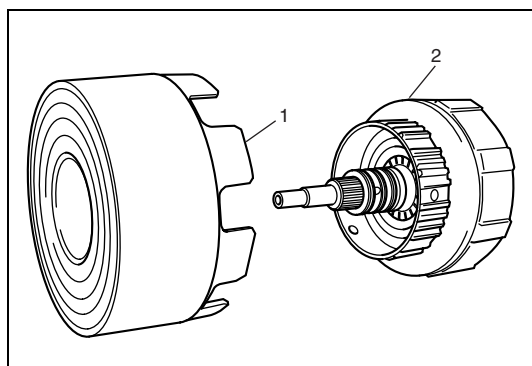
- 41) Remove O/D thrust No.3 bearing (1) and input shaft front thrust bearing race (2) from O/D case assembly.



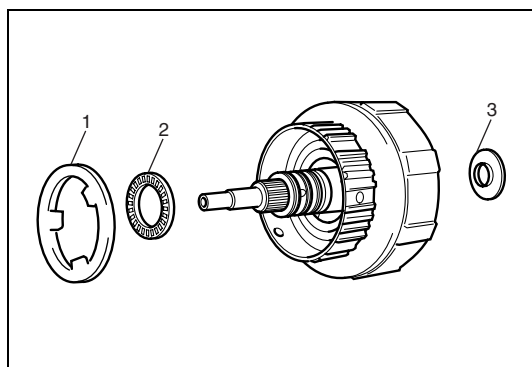
- 42) Remove 2nd coast brake piston cap snap ring.
43) Remove 2nd coast brake piston cap and 2nd coast brake piston assembly (1) and spring by blowing air into oil hole (2).



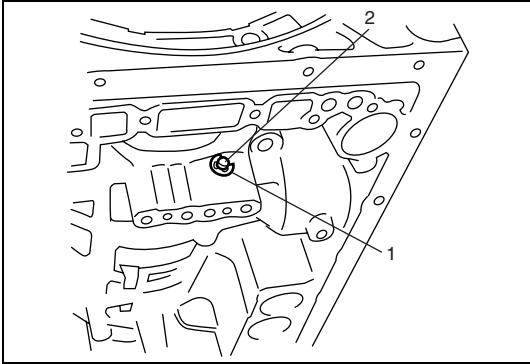
- 44) Remove direct clutch assembly (1) with forward clutch assembly (2) from transmission case.



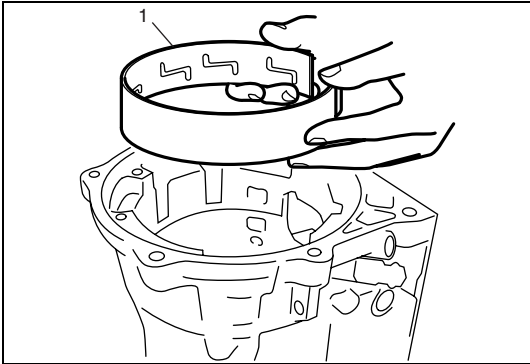
- 45) Remove direct clutch assembly (1) from forward clutch assembly (2).



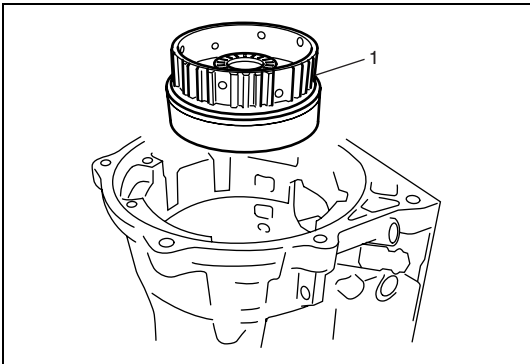
- 46) Remove forward clutch thrust washer (1), input shaft front thrust bearing (2) and input shaft rear thrust bearing (3) from forward clutch assembly.



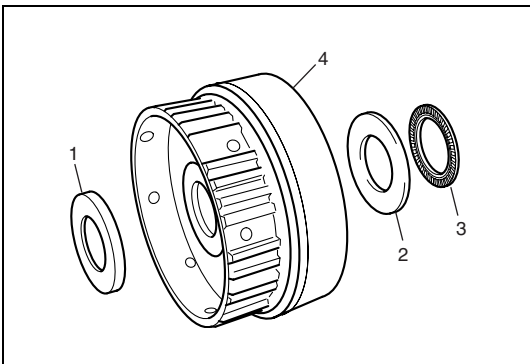
47) Remove E-ring (1) and 2nd coast brake pin (2).



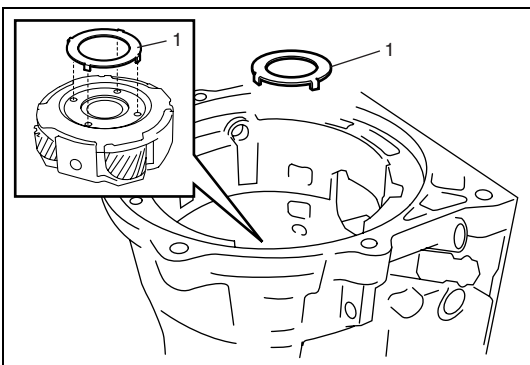
48) Remove 2nd coast brake band (1) from transmission case.



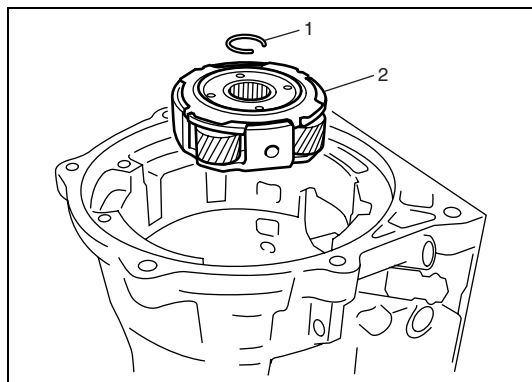
49) Remove front planetary ring gear (1) from transmission case.



50) Remove input shaft rear thrust bearing rear race (1), front ring gear thrust bearing front race (2) and front ring gear thrust bearing (3) from front planetary ring gear (4).



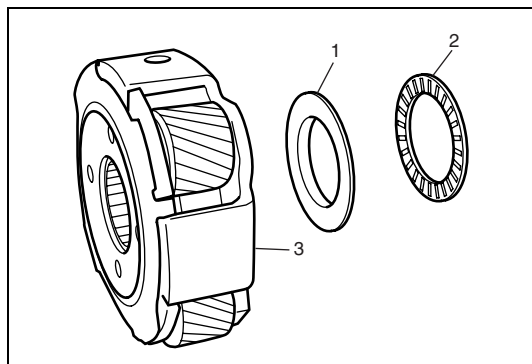
51) Remove front ring gear thrust bearing rear race (1) from front planetary carrier assembly.



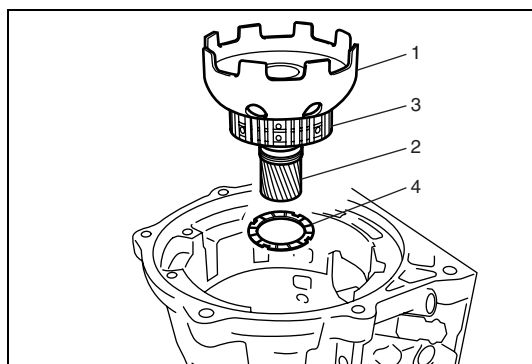
52) Place wooden block or the like under output shaft and hold it.

53) Remove snap ring (1).

54) Remove front planetary carrier assembly (2) from transmission case.

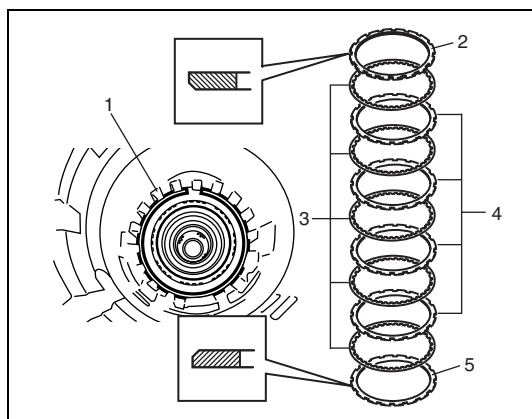


55) Remove front planetary thrust bearing race (1) and front planetary thrust bearing (2) from front planetary carrier assembly (3).



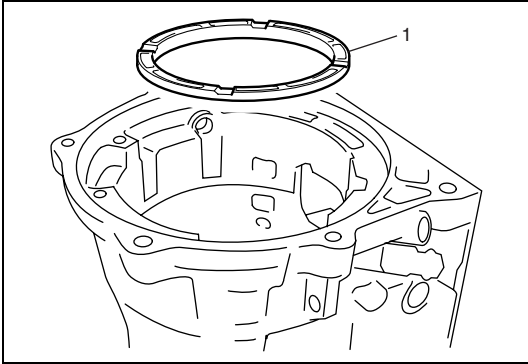
56) Remove input sun gear drum (1), sun gear (2) and one-way No.3 clutch (3) all together from transmission case.

57) Remove forward brake return thrust washer (4) from forward brake return spring retainer.

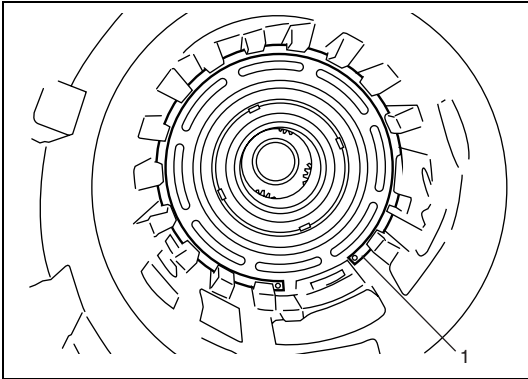


58) Remove snap ring (1).

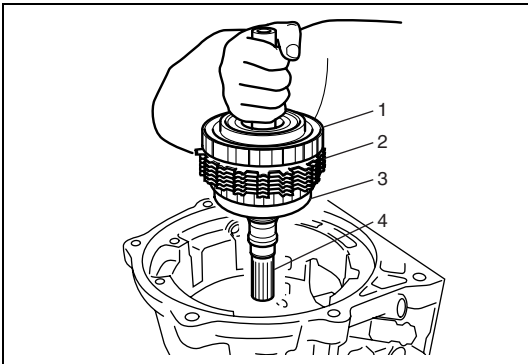
59) Remove forward brake flange (2), forward brake discs (3), forward brake No.1 plates (4) and forward brake No.2 plate (5) from transmission case.



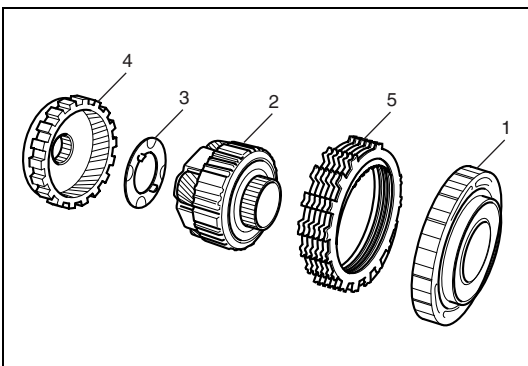
60) Remove forward brake sleeve (1) from transmission case.



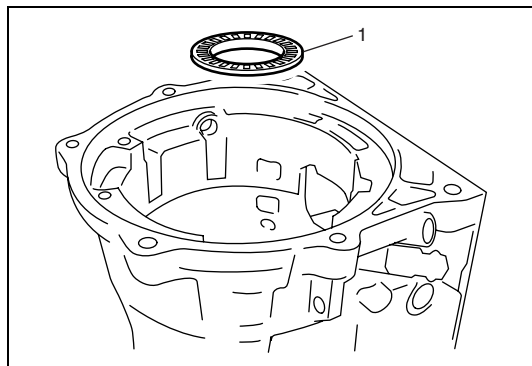
61) Remove snap ring (1).



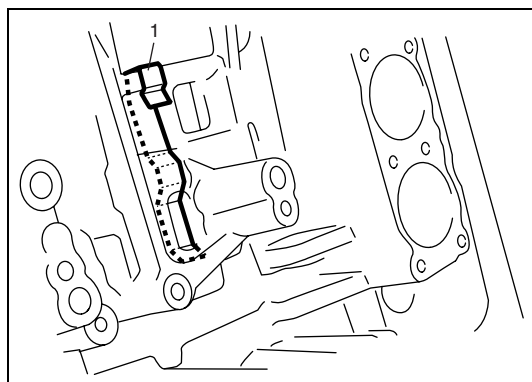
62) Remove forward brake drum assembly (1), reverse brake disc/plate/flange (2), rear planetary carrier assembly, rear planetary ring gear (3) and output shaft (4) from transmission case.



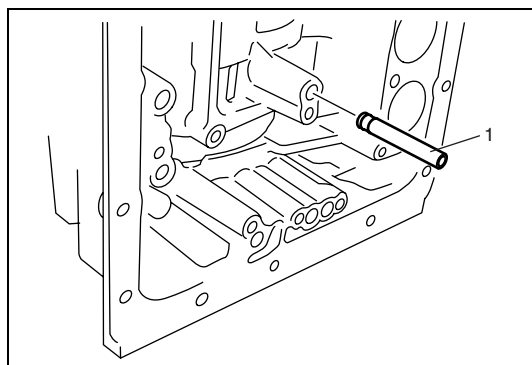
63) Disassemble forward brake drum assembly (1), reverse brake disc/plate/flange (5), rear planetary carrier assembly (2), rear planetary rear thrust washer (3) and rear planetary ring gear (4) from output shaft.



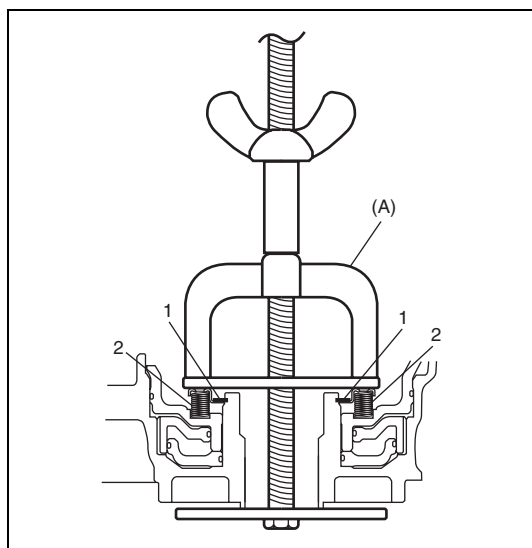
- 64) Remove rear planetary thrust bearing (1) from transmission case.



- 65) Remove forward clutch/reverse brake guide spring (1) from transmission case.



- 66) Remove reverse brake drum gasket (1) from transmission case.



- 67) Compress reverse brake return spring (2) by using special tool and then remove snap ring (1).

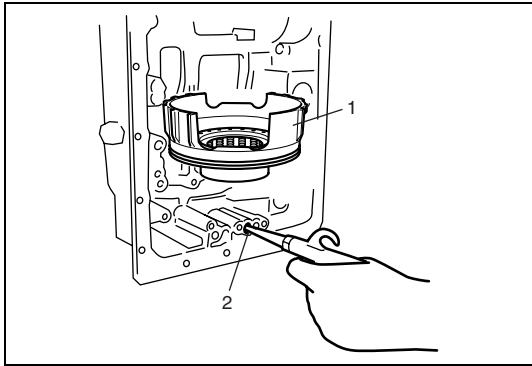
CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

Special tool

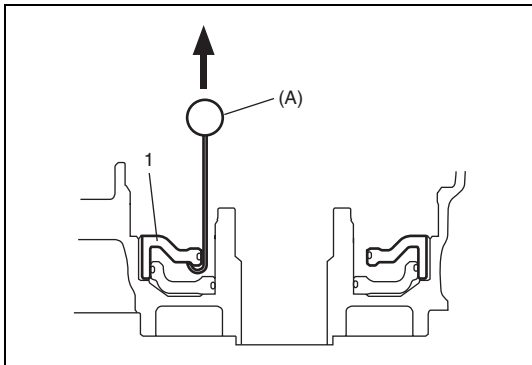
(A): 09922-86010

- 68) Remove reverse brake return spring (2).



69) Remove reverse brake No.1 piston (1) by blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (2) of transmission case.

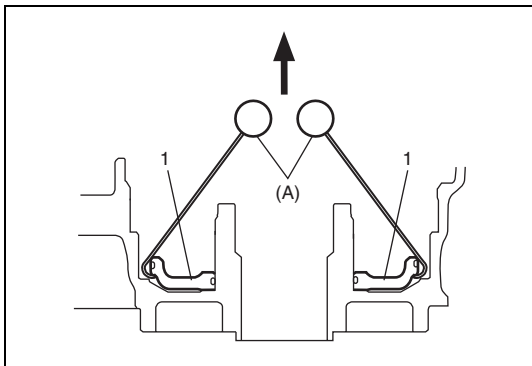
70) Remove O-ring from reverse brake No.1 piston (1).



71) Remove reverse brake piston sleeve (1) by using special tool.

Special tool

(A): 09920-20310



72) Remove reverse brake No.2 piston (1) by using special tools.

Special tool

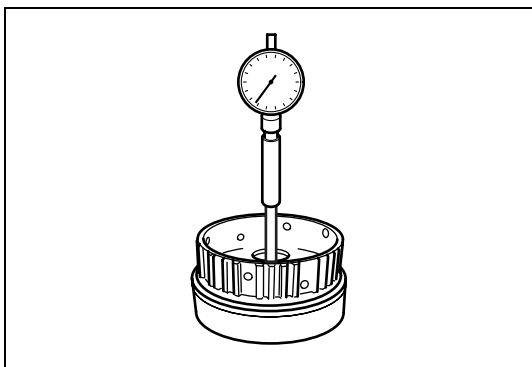
(A): 09920-20310

INSPECTION

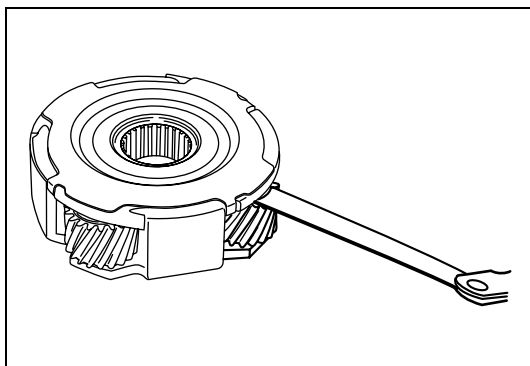
Front planetary ring gear

Measure inner diameter of front planetary ring gear bushing. If inside diameter exceeds limit, replace front planetary ring gear.

**Front planetary ring gear bushing inner diameter limit
24.08 mm (0.948 in.)**



Front planetary carrier assembly



Measure planetary pinion gear thrust clearance by using thickness gauge.

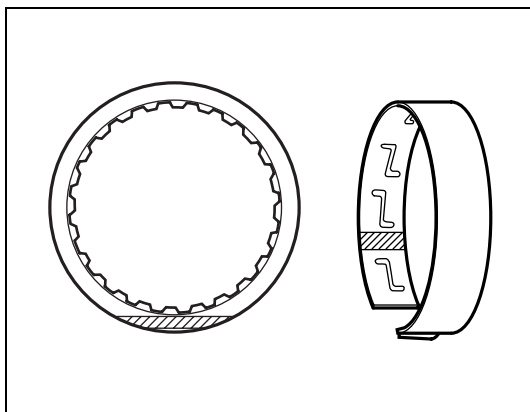
If clearance exceeds limit, replace front planetary carrier assembly.

Front planetary gear thrust clearance

Standard: 0.20 – 0.60 mm (0.0079 – 0.0236 in.)

Limit: 0.65 mm (0.0255 in.)

Clutch discs, clutch plates or brake band

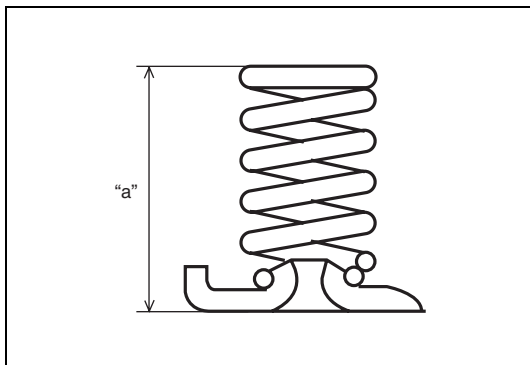


Check that sliding surfaces of discs, plates or band are not worn or burnt. If necessary, replace them.

NOTE:

- If disc or band lining is exfoliated, discolored or worn excessively, replace all discs or band.
- Even if only a part of printed numbers is corroded, replace all discs or band.
- Before assembling new discs or band, soak them in A/T fluid for at least 15 minutes.

Reverse brake return spring

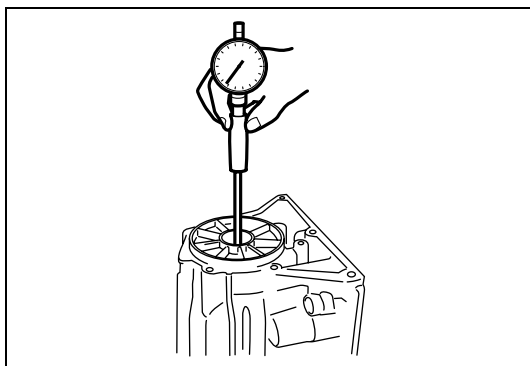


Measure free length of reverse brake return spring together with spring seat.

Reverse brake return spring free length

“a”: 12.9 mm (0.507 in.)

Transmission case



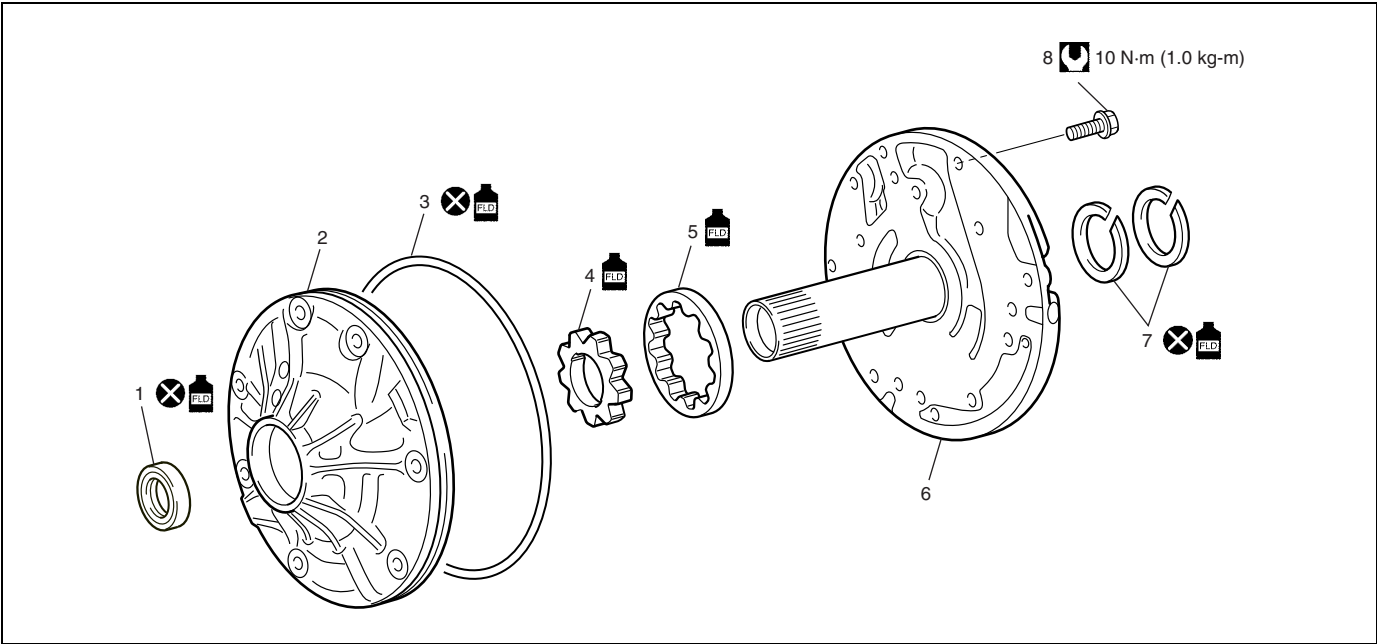
Measure inner diameter of transmission case rear bushing. If inner diameter exceeds limit, replace transmission case.

Transmission case rear bushing inner diameter limit
38.19 mm (1.5035 in.)

Subassembly

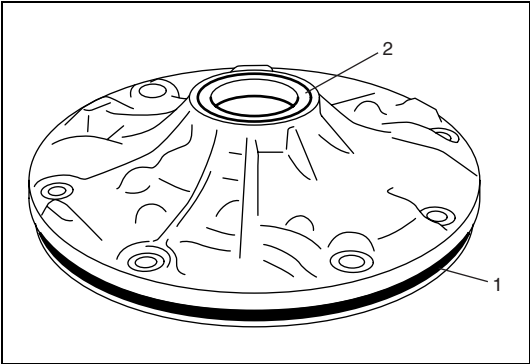
Oil pump assembly

COMPONENTS



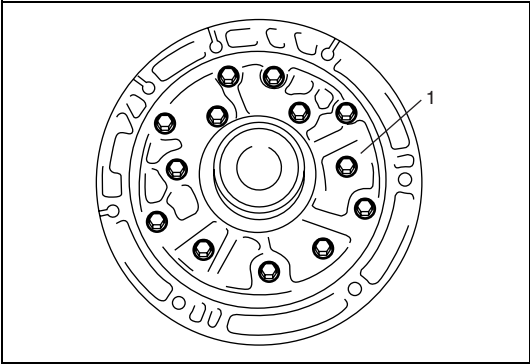
1. Oil pump body oil seal	3. Oil pump cover O-ring	5. Driven gear	7. Stator shaft seal	Tightening torque	Apply A/T fluid
2. Oil pump body	4. Drive gear	6. Stator shaft assembly	8. Oil pump cover bolt	Do not reuse.	

DISASSEMBLY

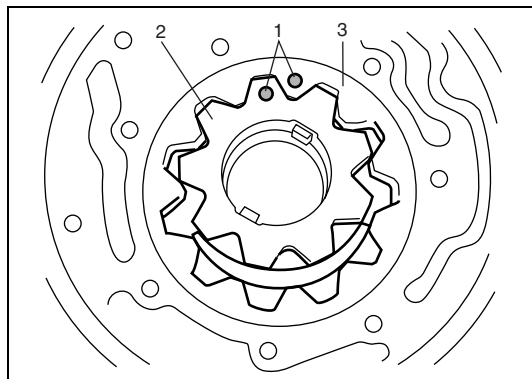


- 1) Remove oil pump body oil seal (2) from oil pump body by using flat end rod or the like.

CAUTION:
 Be careful not to damage bushing and oil pump body.

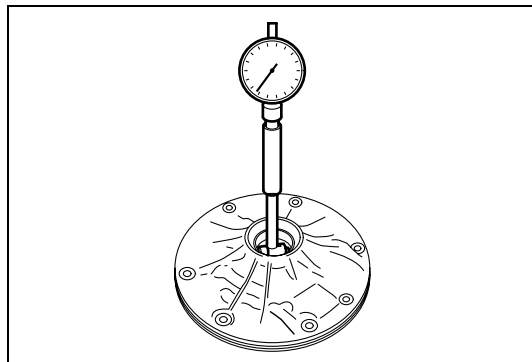


- 2) Remove stator shaft assembly (1) from oil pump body by removing 13 bolts.



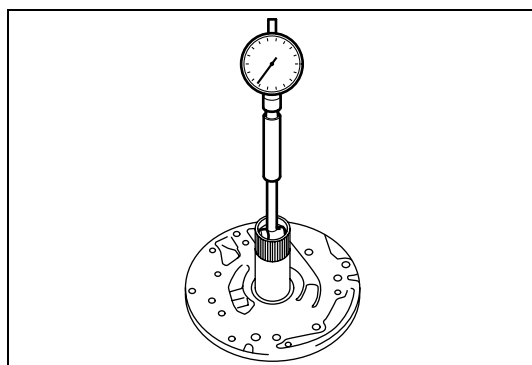
- 3) Give marks (1) on drive gear (2) and driven gear (3) by using water proof paint.
- 4) Remove drive gear (2) and driven gear (3) from oil pump body.

INSPECTION



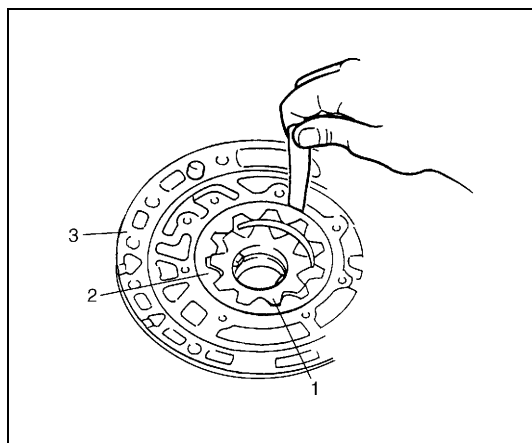
- Measure inner diameter of oil pump body bushing.
If inner diameter exceeds limit, replace oil pump body.

Oil pump body bushing inner diameter limit
38.19 mm (1.5035 in.)



- Measure inner diameter of stator shaft bushing.
If inner diameter exceeds limit, replace stator shaft assembly.

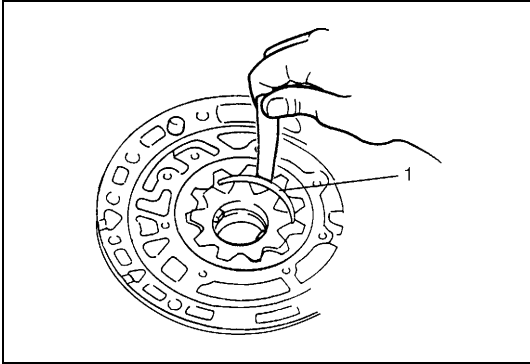
Stator shaft bushing inner diameter limit
Torque converter side: 21.58 mm (0.8496 in.)
Output shaft side: 27.08 mm (1.0661 in.)



- Check body clearance of driven gear.
Push driven gear (2) to one side of oil pump body (3). Using a feeler gauge, measure clearance between driven gear (2) and body (3).
If clearance exceeds standard value, replace oil pump assembly.

Clearance between driven gear and body
Standard: 0.07 – 0.15 mm (0.00276 – 0.0059 in.)
Limit: 0.20 mm (0.0078 in.)

1. Drive gear

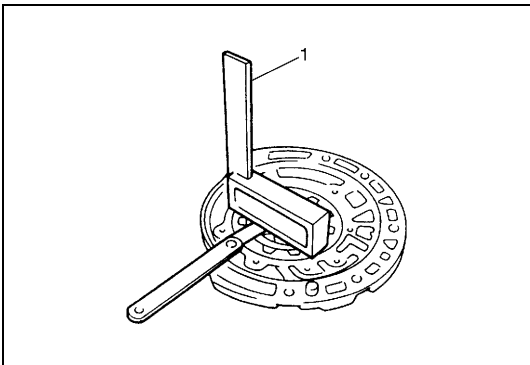


- Check tip clearance of driven gear.
Measure radial clearance between gear tooth tip and crescent (1).
If clearance exceeds standard value, replace oil pump assembly.

Tip clearance between driven gear and crescent

Standard: 0.004 – 0.248 mm (0.0002 – 0.0097 in.)

Limit: 0.300 mm (0.012 in.)



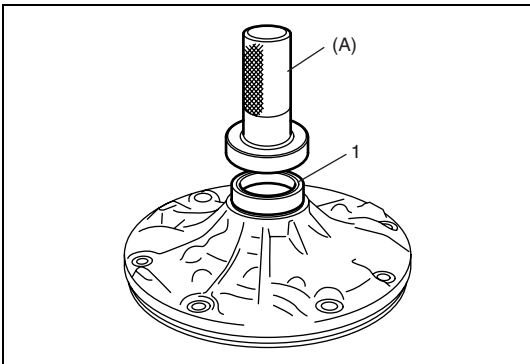
- Check side clearance of both gears.
Using a straightedge (1) and a feeler gauge, measure side clearance between gears and pump body.
If clearance exceeds standard value, replace oil pump assembly.

Side clearance between gears and oil pump body

Standard: 0.02 – 0.05 mm (0.0008 – 0.0019 in.)

Limit: 0.1 mm (0.004 in.)

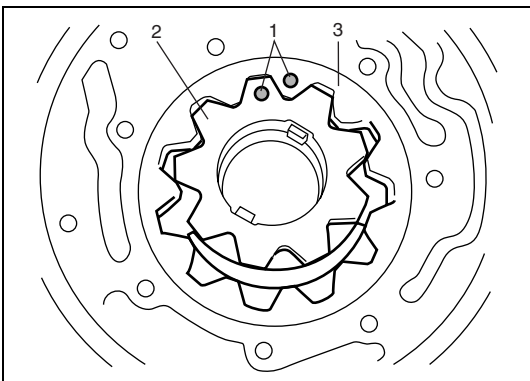
ASSEMBLY



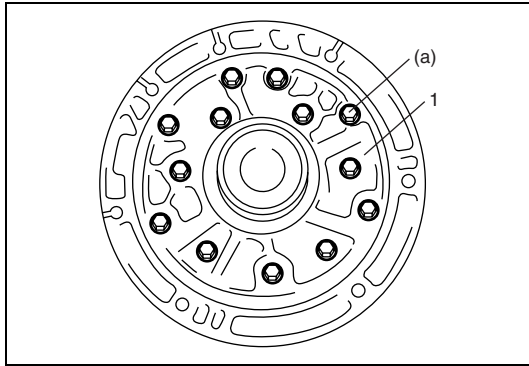
- 1) Press-fit new oil pump body oil seal (1) to oil pump body till its end face is flush with oil pump body end face, using special tool.

Special tool

(A): 09913-75520



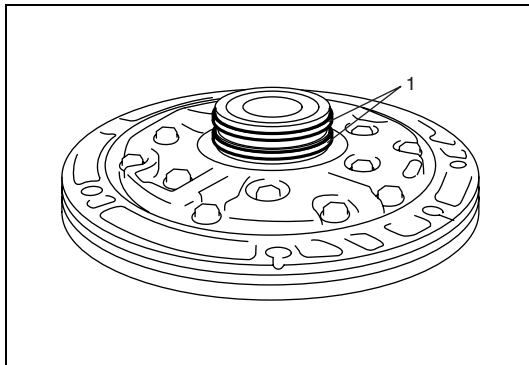
- 2) Install drive gear (2) and driven gear (3) to oil pump body aligning marks and directing marked surface (1) toward stator shaft assembly side. Apply A/T fluid to gears and oil pump body.



- 3) Install stator shaft assembly (1) to oil pump. Tighten 13 bolts to specified torque.

Tightening torque

Oil pump cover bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



- 4) Apply A/T fluid to new stator shaft seals (1).
 5) Squeeze ends of seals together with wrap distance 8 mm (0.314 in.) or less and then install new stator shaft seals (1) to stator shaft groove.

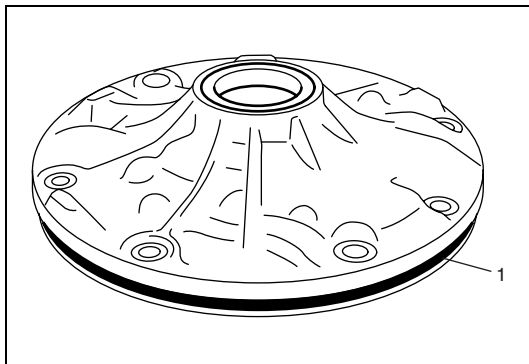
CAUTION:

Do not spread seal ends excessively.

- 6) Check that seals rotate smoothly.
 7) Check that drive gear and driven gear rotate smoothly by turning drive gear with two flat end rods or the like.

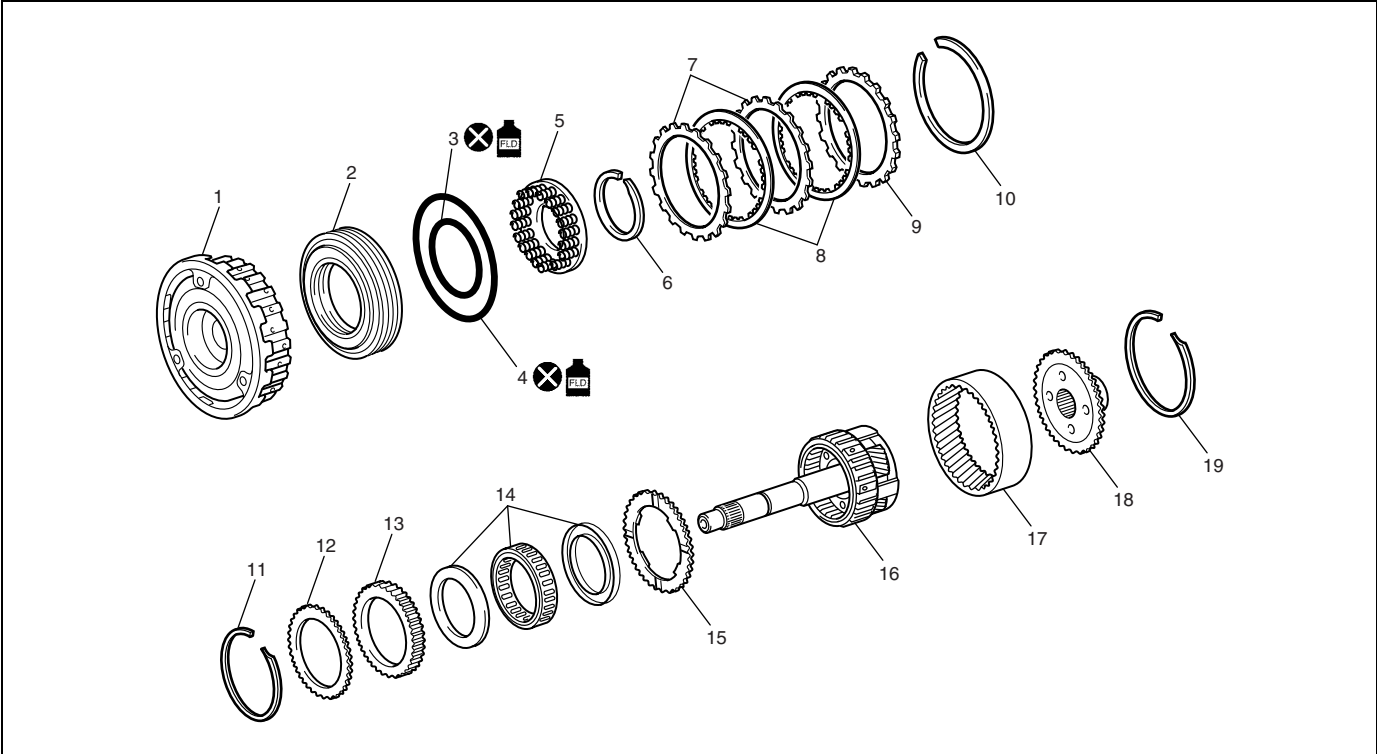
CAUTION:

Be careful not to damage oil pump body oil seal.



- 8) Apply A/T fluid to new O-ring and then install oil pump cover O-ring (1) to oil pump body.

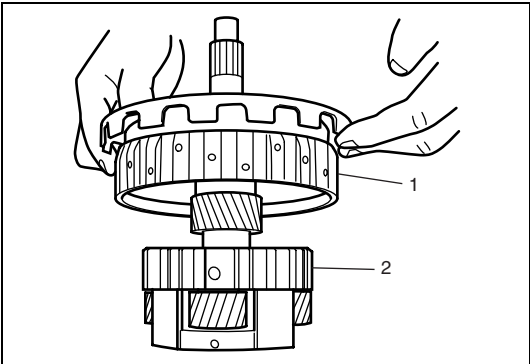
O/D clutch assembly and O/D planetary gear assembly
COMPONENTS



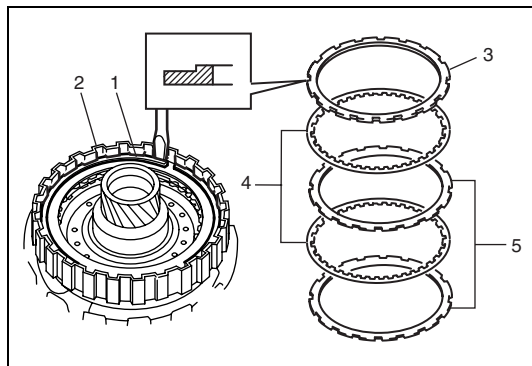
1. O/D clutch drum	7. O/D clutch plate	13. One-way No.1 clutch outer race	19. Snap ring
2. O/D clutch piston	8. O/D clutch disc	14. One-way No.1 clutch	⊗ Do not reuse.
3. Inner O-ring	9. O/D clutch flange	15. O/D planetary thrust washer	FLD Apply A/T fluid
4. Outer O-ring	10. Snap ring	16. O/D planetary gear assembly	
5. O/D clutch return spring	11. Snap ring	17. O/D ring gear	
6. Snap ring	12. One-way No.1 clutch retainer	18. O/D ring gear flange	

DISASSEMBLY

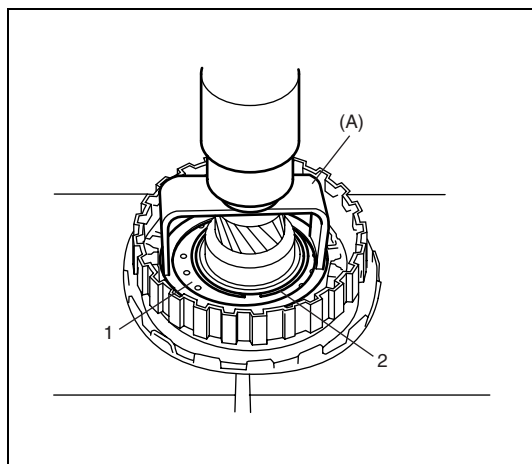
O/D Clutch Assembly



- 1) Remove O/D clutch drum (1) from O/D planetary gear assembly (2).



- 2) Remove snap ring (1) by using flat end rod or the like.
- 3) Remove O/D clutch flange (3), 2 O/D clutch discs (2) and 2 O/D clutch plates (5) from O/D clutch drum (2).



- 4) Compress O/D clutch return spring (1) by using special tool and hydraulic press, and then remove snap ring (2).

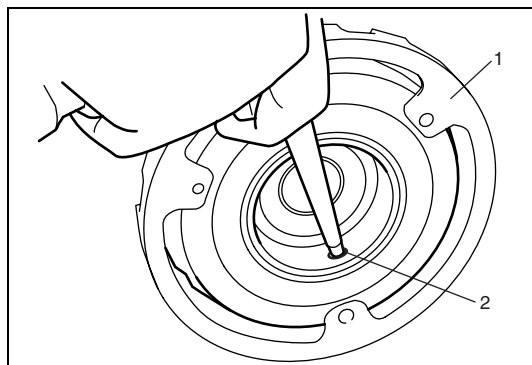
CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

Special tool

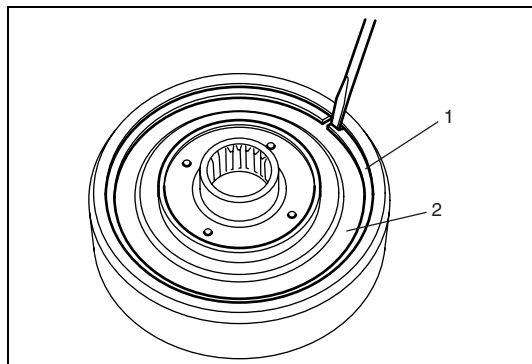
(A): 09926-96010

- 5) Remove O/D clutch return spring (1).



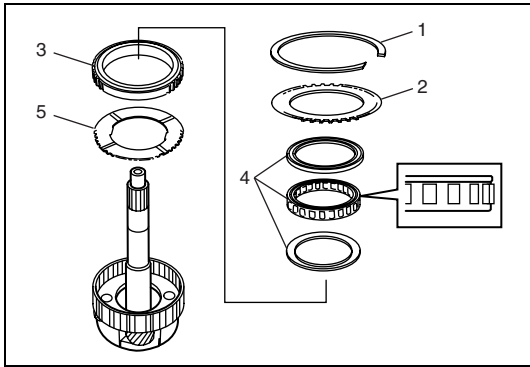
- 6) Remove O/D clutch piston from O/D clutch drum (1) by blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (2) of O/D clutch drum (1) as shown in figure.
- 7) Remove inner and outer O-rings from O/D clutch piston.

O/D Ring Gear



- 1) Remove snap ring (1) by using flat end rod or the like.
- 2) Remove O/D ring gear flange (2) from O/D ring gear.

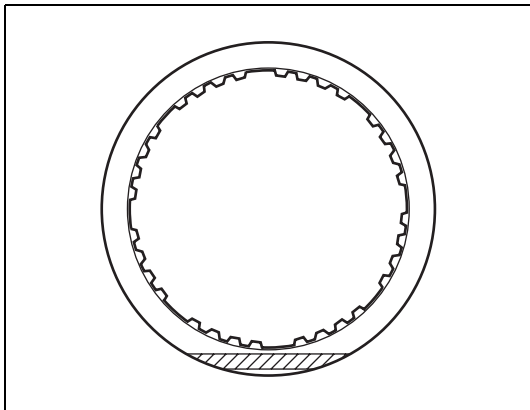
O/D Planetary Gear Assembly



- 1) Remove snap ring (1) by using flat end rod or the like.
- 2) Remove one-way No.1 clutch retainer (2), one-way No.1 clutch outer race (3) with one-way No.1 clutch (4) and O/D planetary thrust washer (5).

INSPECTION

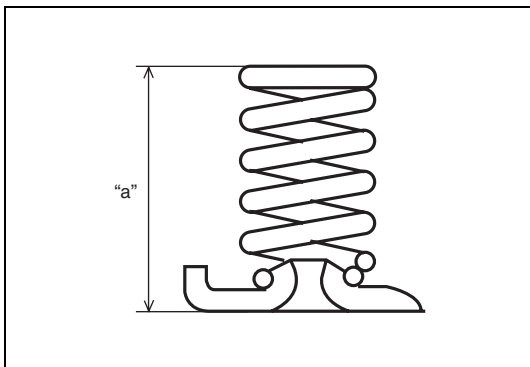
O/D Clutch Assembly



- Check that sliding surfaces of discs, plate and flange are not worn or burnt. If necessary, replace them.

NOTE:

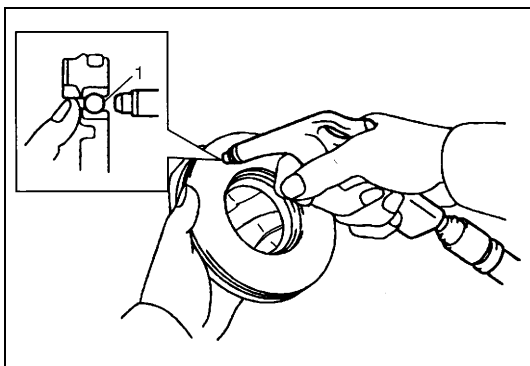
- If disc lining is exfoliated, discolored or worn excessively, replace all discs.
- Even if only a part of printed numbers is corroded, replace all discs.
- Before assembling new discs, soak them in A/T fluid for at least 15 minutes.



- Measure free length of O/D clutch return spring together with spring seat.

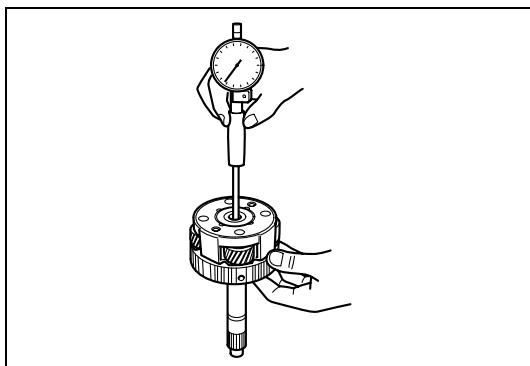
O/D clutch return spring free length

“a”: 15.8 mm (0.622 in.)



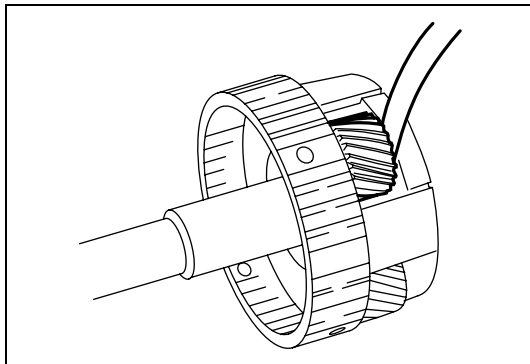
- Shake O/D clutch piston lightly and check that check ball (1) is not stuck. Check that valve does not have leaks by applying low-pressure compressed air.

O/D Planetary Gear Assembly



- Measure inner diameter of O/D planetary gear assembly bushing.
If inner diameter exceeds limit, replace O/D planetary gear assembly.

O/D planetary gear assembly bushing inner diameter limit
11.27 mm (0.443 in.)

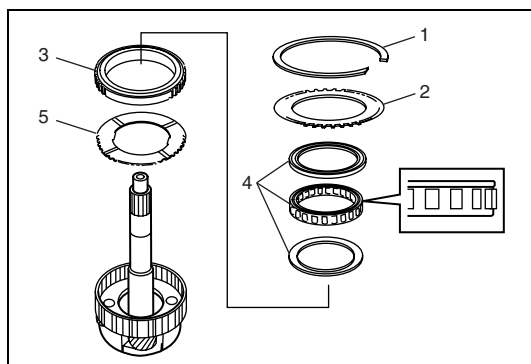


- Measure planetary pinion gear thrust clearance by using thickness gauge.
If clearance exceeds limit, replace O/D planetary gear assembly.

O/D planetary gear thrust clearance
Standard: 0.20 – 0.60 mm (0.0079 – 0.0236 in.)
Limit: 0.65 mm (0.0255 in.)

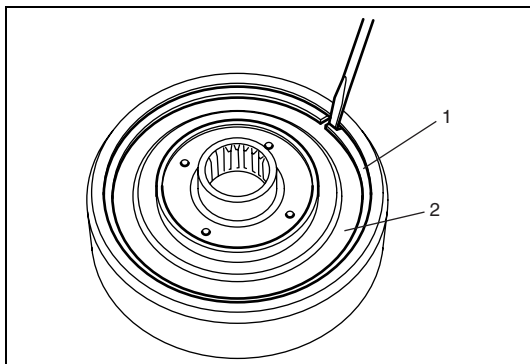
ASSEMBLY

O/D Planetary Gear Assembly

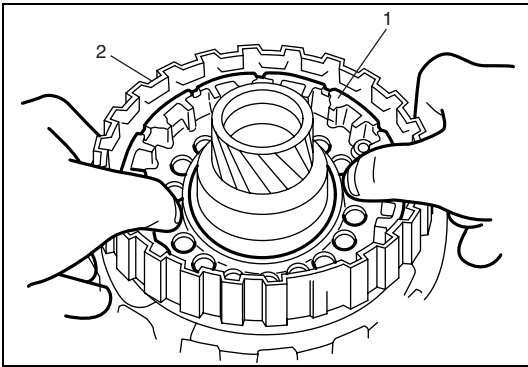


- 1) Install O/D planetary thrust washer (5) with groove to one-way No.1 clutch side.
- 2) Install one-way clutch No.1 (4) into one-way No.1 clutch outer race (3) with flange side of one-way No.1 clutch directed to torque converter side.
- 3) Install one-way No.1 clutch with one-way No.1 clutch outer race to O/D planetary gear assembly.
- 4) Install one-way No.1 clutch retainer (2).
- 5) Install snap ring (1) by using flat end rod or the like.

O/D Ring Gear



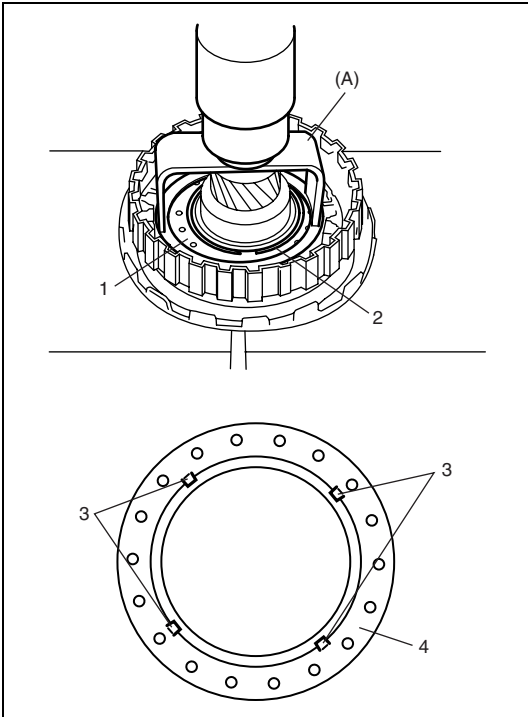
- 1) Install O/D ring gear flange (2) to O/D ring gear.
- 2) Install snap ring (1) by using flat end rod or the like.

O/D Clutch Assembly

- 1) Apply A/T fluid to new inner O-ring and new outer O-ring, and then install them to O/D clutch piston.
- 2) Press-fit O/D clutch piston (1) into O/D clutch drum (2) by hands.

CAUTION:

Do not twist or deviate O-rings during installation.



- 3) Place O/D clutch return spring (1) onto O/D clutch piston.
- 4) Compress O/D clutch return spring (1) by using special tool and hydraulic press.

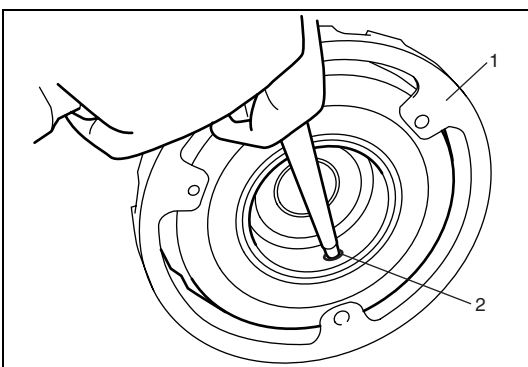
CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

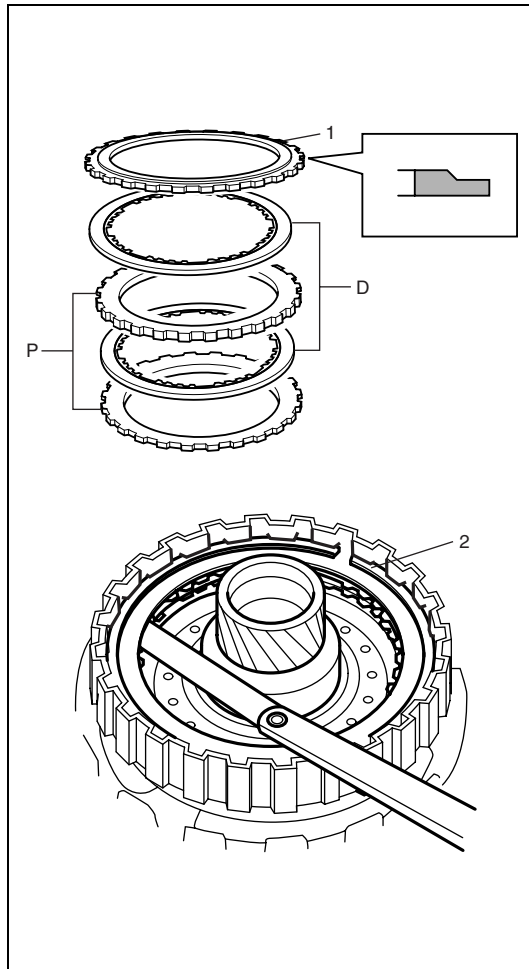
Special tool

(A): 09926-96010

- 5) Install snap ring (2) making sure not to align snap ring end gap with claw (3) of O/D clutch return spring retainer (4).



- 6) Make sure that O/D clutch piston moves smoothly when applying and not applying low-pressure compressed air into oil hole (2) of O/D clutch drum (1).



- 7) Install O/D clutch plates "P" and O/D clutch discs "D" in the following order.
P – D – P – D
- 8) Install O/D clutch flange (1) with flat end facing to clutch disc side.
- 9) Install snap ring (2) by using flat end rod or the like.
- 10) Measure O/D clutch piston stroke by using thickness gauge.

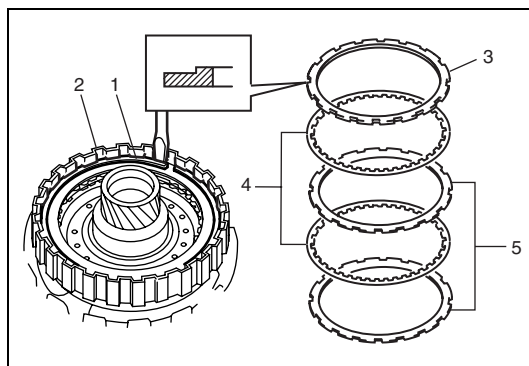
O/D clutch piston stroke

Standard: 1.85 – 2.15 mm (0.0729 – 0.0846 in.)

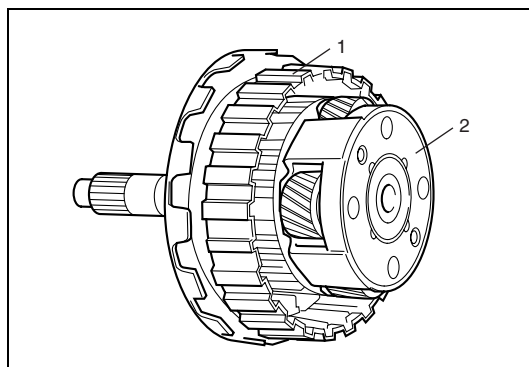
If piston stroke is out of specification, select another O/D clutch flange with suitable thickness from the list below and replace it.

Available O/D clutch flange thickness

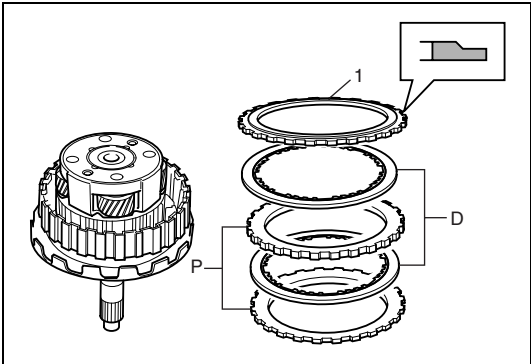
Identification No.	Thickness	Identification No.	Thickness
06	3.6 mm (0.142 in.)	02	3.2 mm (0.126 in.)
05	3.5 mm (0.138 in.)	01	3.1 mm (0.122 in.)
04	3.4 mm (0.134 in.)		
03	3.3 mm (0.130 in.)		



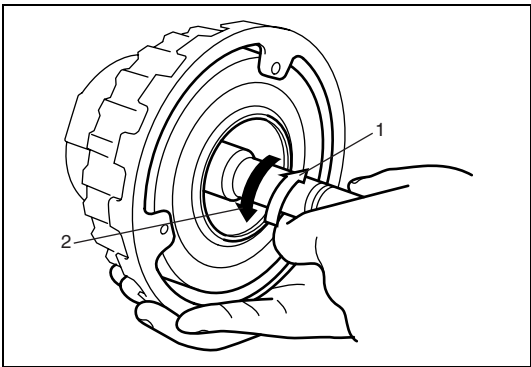
- 11) Remove snap ring (1) by using flat end rod or the like.
- 12) Remove O/D clutch flange (3), 2 O/D clutch discs (4) and 2 O/D clutch plates (5) from O/D clutch drum (2).



- 13) Install O/D clutch drum (1) to O/D planetary gear assembly (2) securely.



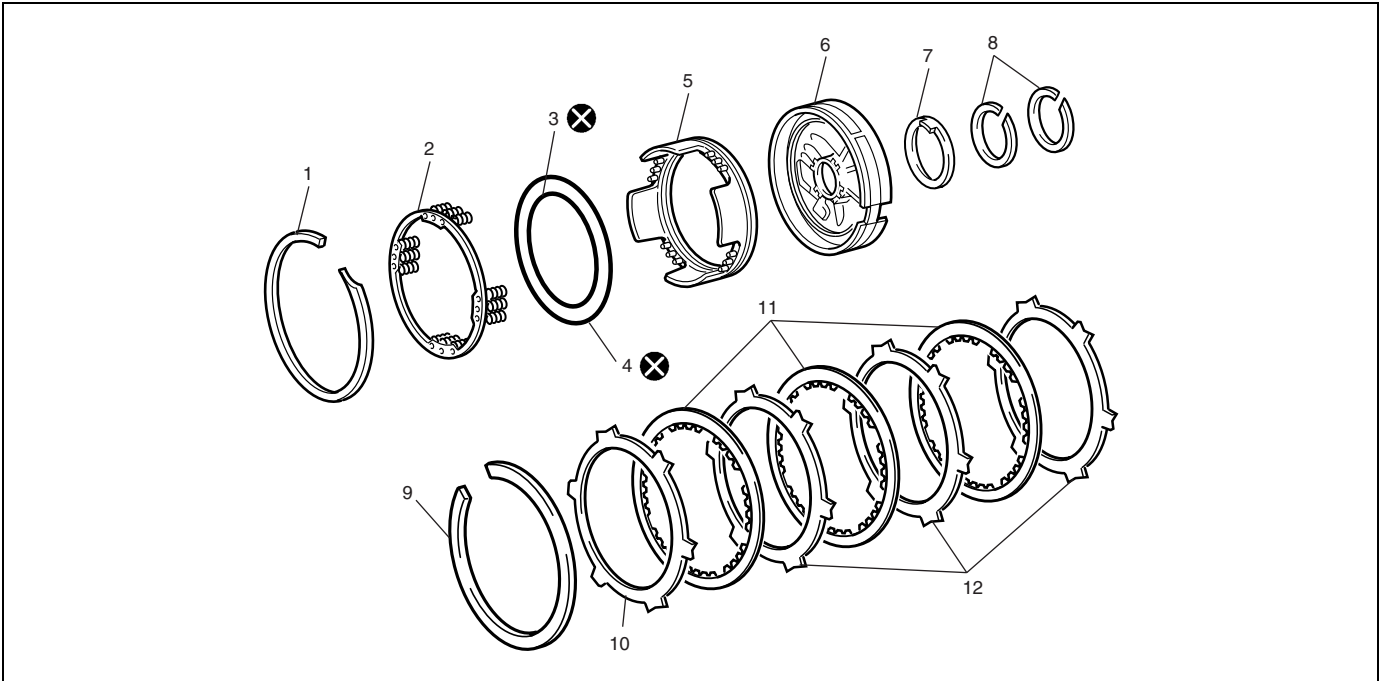
- 14) Install O/D clutch plates “P” and O/D clutch discs “D” in the following order.
P – D – P – D
- 15) Install selected O/D clutch flange (1) with flat end facing to clutch disc side.
- 16) Install snap ring by using flat end rod or the like.



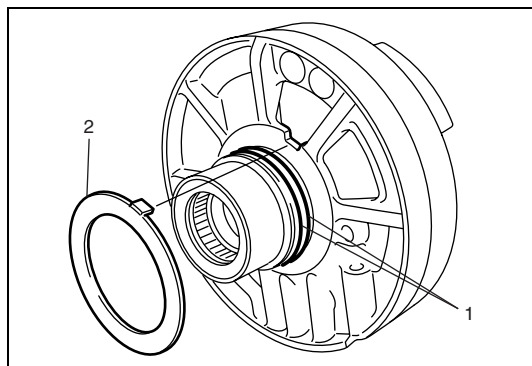
- 17) Hold O/D clutch drum and turn O/D planetary gear assembly. Check that O/D planetary gear assembly can be turned freely (1) clockwise and locked (2) counterclockwise.

O/D brake assembly

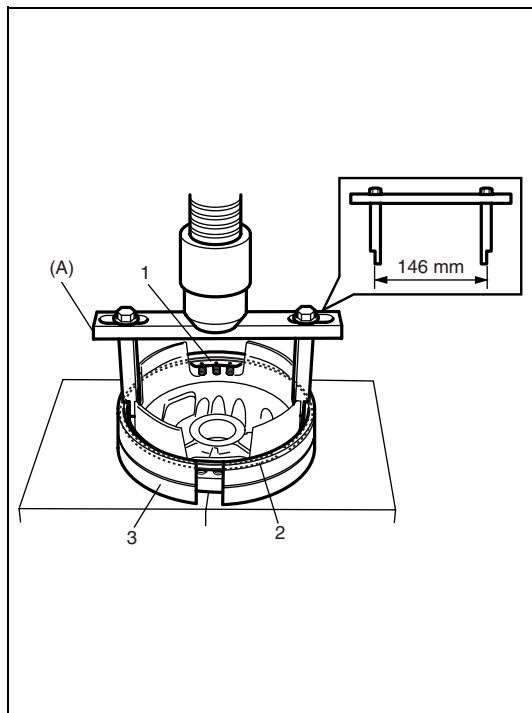
COMPONENTS



1. Snap ring	5. O/D brake piston	9. Snap ring	Do not reuse.
2. O/D brake return spring	6. O/D case	10. O/D brake flange	Apply A/T fluid
3. Inner O-ring	7. Direct clutch thrust washer	11. O/D brake disc	
4. Outer O-ring	8. O/D case seal	12. O/D brake plate	

DISASSEMBLY

- 1) Remove O/D case seals (1) and direct clutch thrust washer (2).



- 2) Remove O/D brake return spring (1) from O/D case (3) as follows.

CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

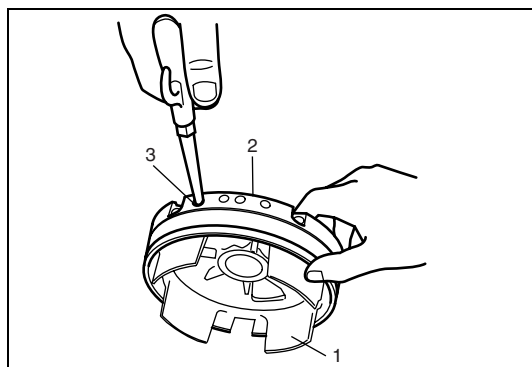
- a) Set special tool to O/D brake return spring.
- b) Compress return spring by using special tool and hydraulic press.
- c) Remove snap ring and then return spring.

NOTE:

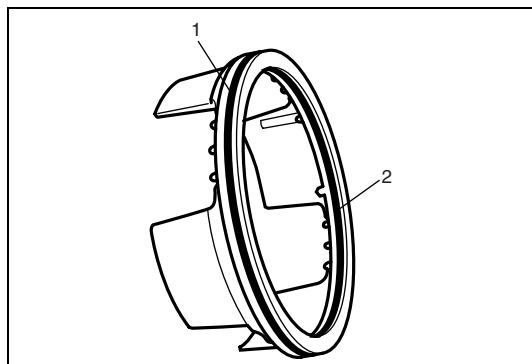
Set special tool to 146 mm (5.748 in.) in width as shown in figure.

Special tool

(A): 09941-51010

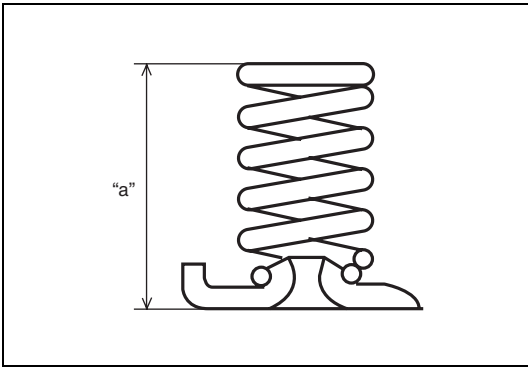


- 3) Remove O/D brake piston (1) from O/D case (2) by blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (3) of O/D case (2) as shown in figure.



- 4) Remove outer O-ring (1) and inner O-ring (2) from O/D brake piston.

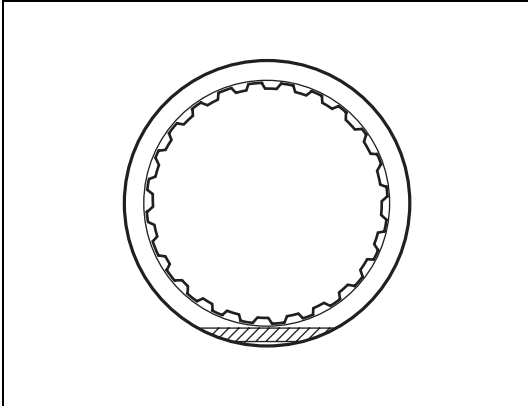
INSPECTION



- Measure free length of O/D brake return spring together with spring seat.

O/D brake return spring free length

“a”: 17.03 mm (0.670 in.)

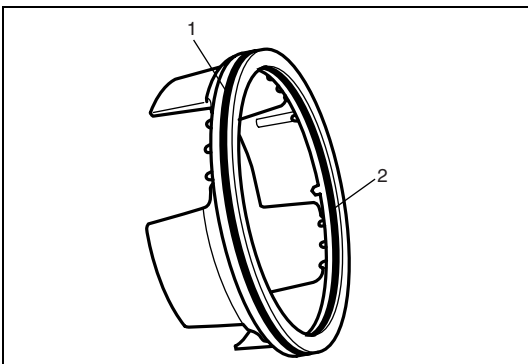


- Check that sliding surfaces of discs, plate and flange are not worn or burnt. If necessary, replace them.

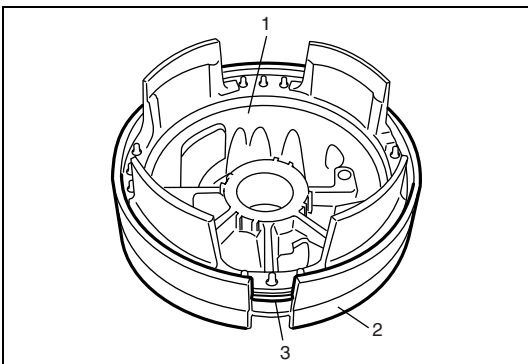
NOTE:

- If disc lining is exfoliated, discolored or worn excessively, replace all discs.
- Even if only a part of printed numbers is corroded, replace all discs.
- Before assembling new discs, soak them in A/T fluid for at least 15 minutes.

ASSEMBLY



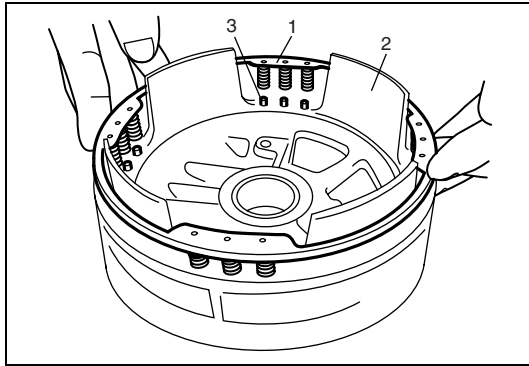
- 1) Apply A/T fluid to new outer O-ring (1) and new inner O-ring (2), and then install O-rings to O/D brake piston.



- 2) Align O/D brake piston (1) and notch of O/D case (3) as shown in figure and then press O/D brake piston (1) into O/D case subassembly (2) by hands.

CAUTION:

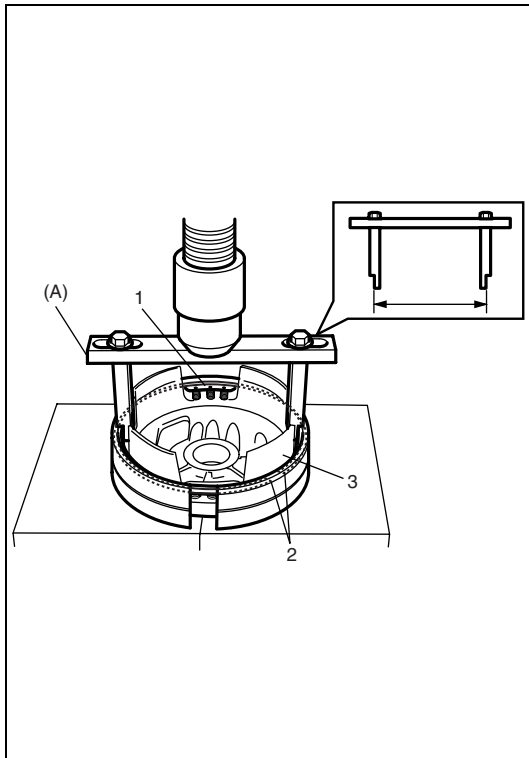
Do not twist or deviate O-rings during installation.



3) Place O/D brake return spring (1) onto O/D brake piston (2).

NOTE:

Make sure that O/D brake return spring is inserted in O/D brake piston return spring boss (3).



4) Install O/D brake return spring (1) to O/D case as follows.

CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

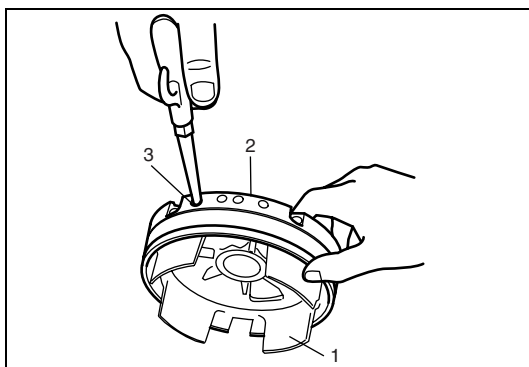
- Set special tool to O/D brake return spring.
- Compress return spring by using special tool and hydraulic press.
- Install snap ring by using flat end rod or the like making sure not to align snap ring end gap (2) with cutout portion of O/D brake piston (3).

NOTE:

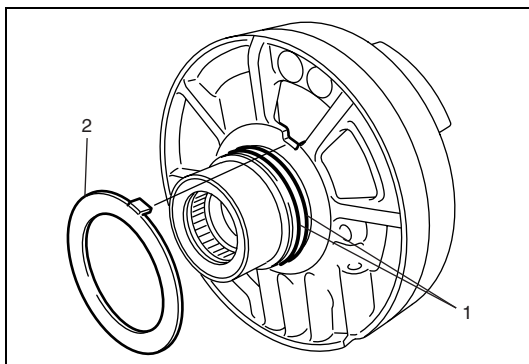
Set special tool to 146 mm (5.748 in.) in width as shown in figure.

Special tool

(A): 09941-51010

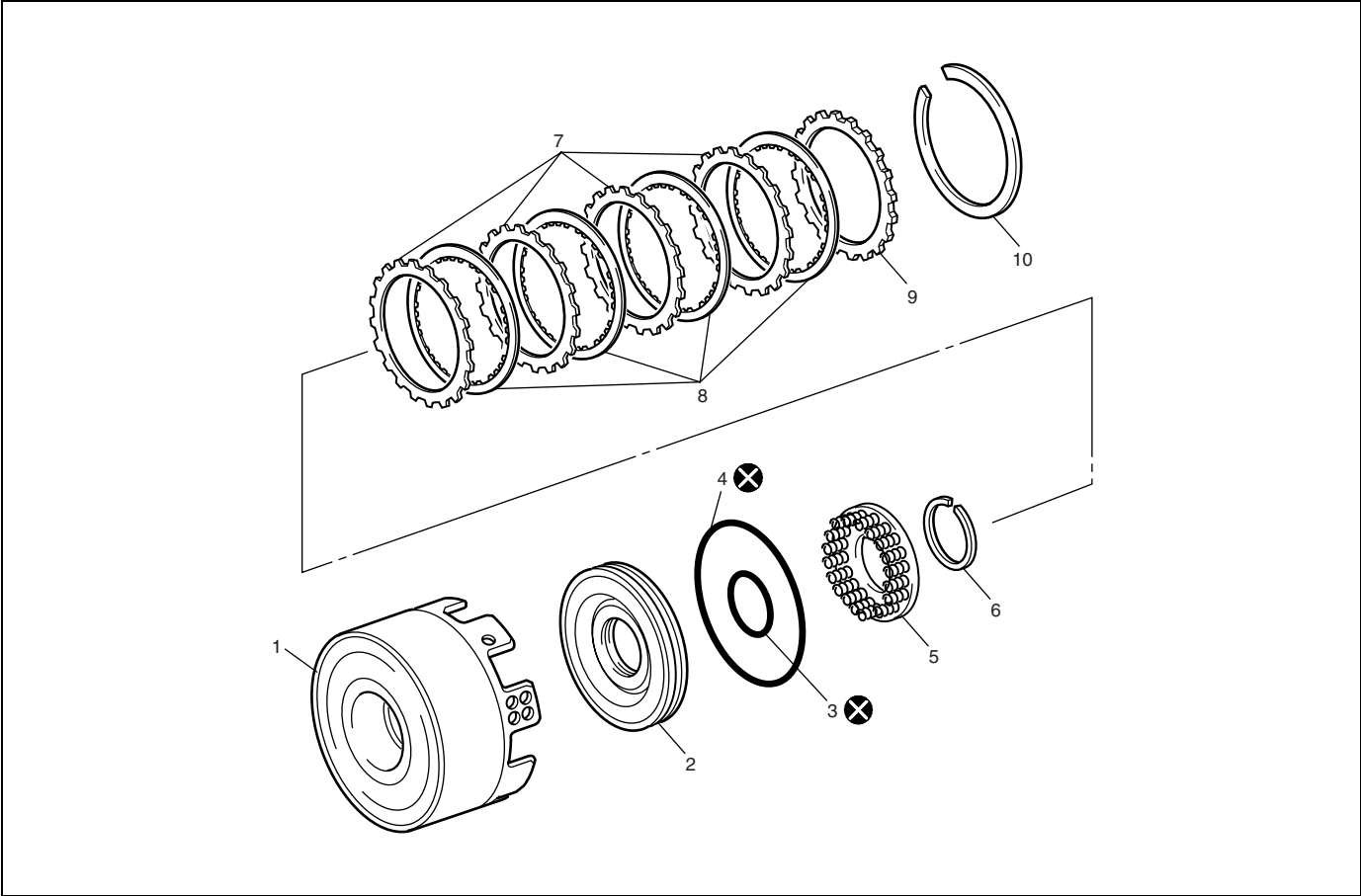


5) Make sure O/D brake piston (1) moves smoothly when blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (3) of O/D case (2) as shown in figure.



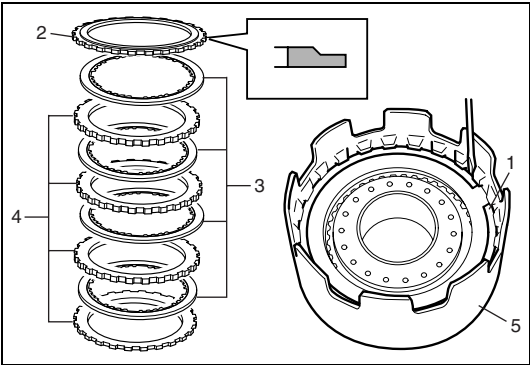
6) Install new O/D case seals (1) and direct clutch thrust washer (2).

Direct clutch assembly
 COMPONENTS

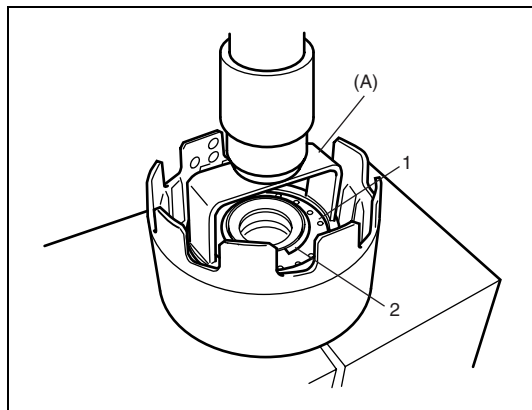


1. Direct clutch drum	5. Direct clutch return spring	9. Direct clutch flange
2. Direct clutch piston	6. Snap ring	10. Snap ring
3. Inner O-ring	7. Direct clutch plate	⊗ Do not reuse.
4. Outer O-ring	8. Direct clutch disc	🛢️ Apply A/T fluid

DISASSEMBLY



- 1) Remove snap ring (1) by using flat end rod or the like.
- 2) Remove direct clutch flange (2), 4 direct clutch discs (3) and 4 direct clutch plates (4) from direct clutch drum (5).



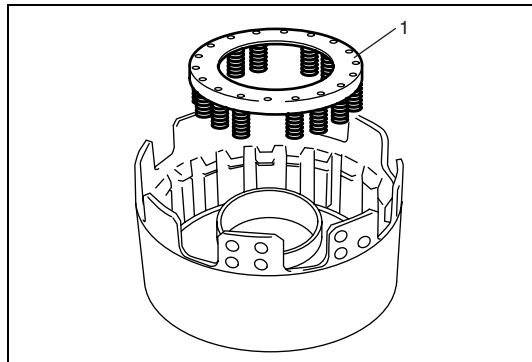
- 3) Compress direct clutch return spring (1) by using special tool and hydraulic press, and then remove snap ring (2).

CAUTION:

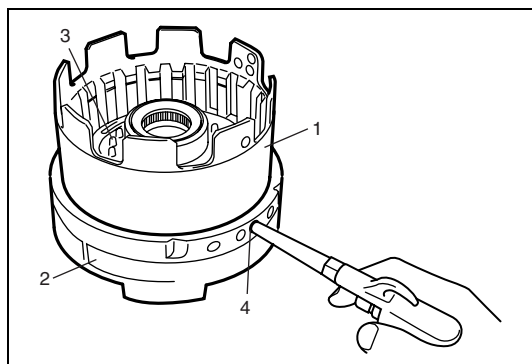
Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

Special tool

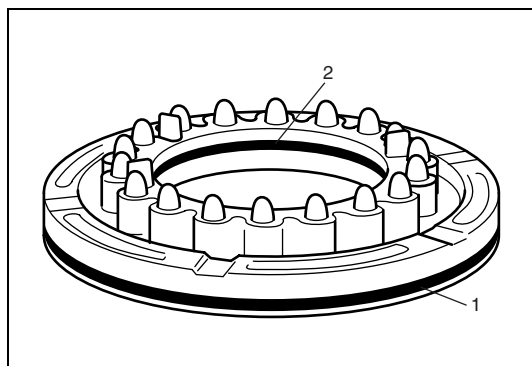
(A): 09926-96010



- 4) Remove direct clutch return spring (1).

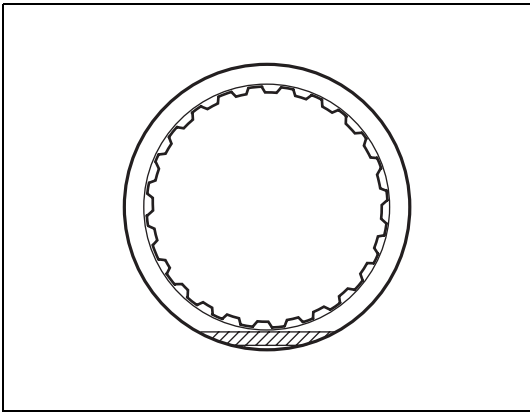


- 5) Place direct clutch drum (1) onto O/D case (2).
 6) Remove direct clutch piston (3) from direct clutch drum (1) by blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (4) of direct clutch drum (1) as shown in figure.



- 7) Remove inner O-ring (1) and outer O-ring (2) from direct clutch piston.

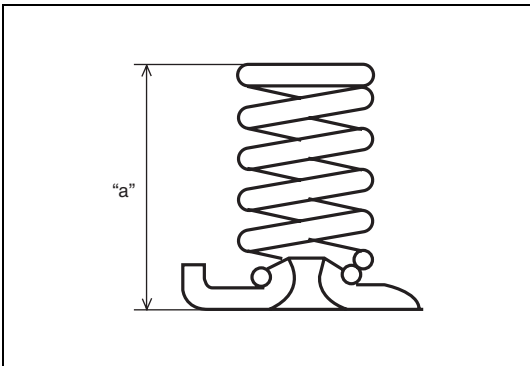
INSPECTION



- Check that sliding surfaces of discs, plate and flange are not worn or burnt. If necessary, replace them.

NOTE:

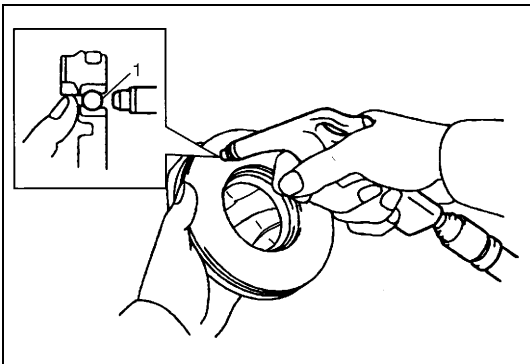
- If disc lining is exfoliated, discolored or worn excessively, replace all discs.
- Even if only a part of printed numbers is corroded, replace all discs.
- Before assembling new discs, soak them in A/T fluid for at least 15 minutes.



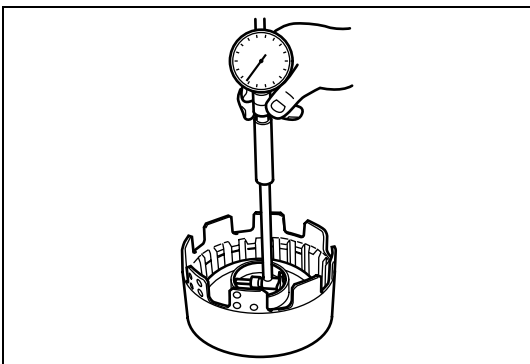
- Measure free length of direct clutch return spring together with spring seat.

Direct clutch return spring free length

"a": 21.32 mm (0.839 in.)



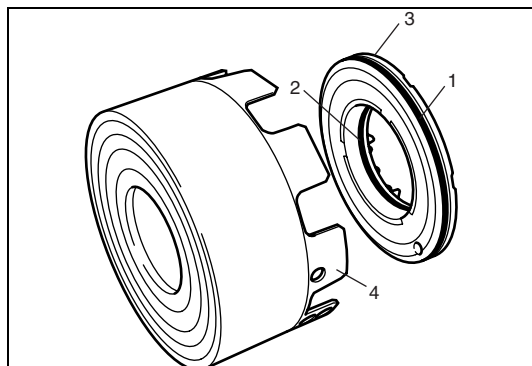
- Shake direct clutch piston lightly and check that check ball (1) is not stuck. Check that valve does not have leaks by blowing low-pressure compressed air.



- Measure inner diameter of direct clutch drum bushing. If inner diameter exceeds limit, replace direct clutch drum.

Direct clutch drum bushing inner diameter limit

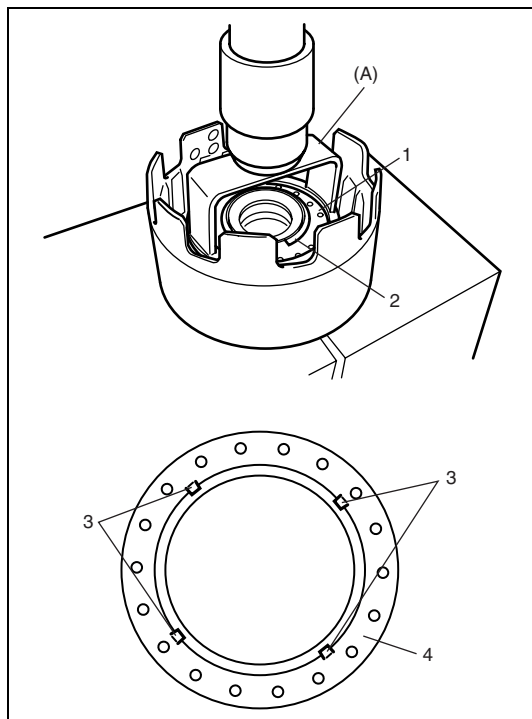
53.99 mm (2.1255 in.)

ASSEMBLY

- 1) Apply A/T fluid to new outer O-ring (1) and new inner O-ring (2), and then install them to direct clutch piston (3).
- 2) Press-fit direct clutch piston (3) into direct clutch drum (4) by hands.

CAUTION:

Do not twist or deviate O-rings during installation.



- 3) Place direct clutch return spring (1) onto direct clutch piston.
- 4) Compress direct clutch return spring (1) by using special tool and hydraulic press.

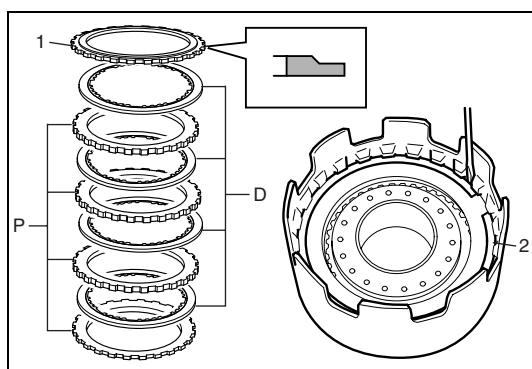
CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

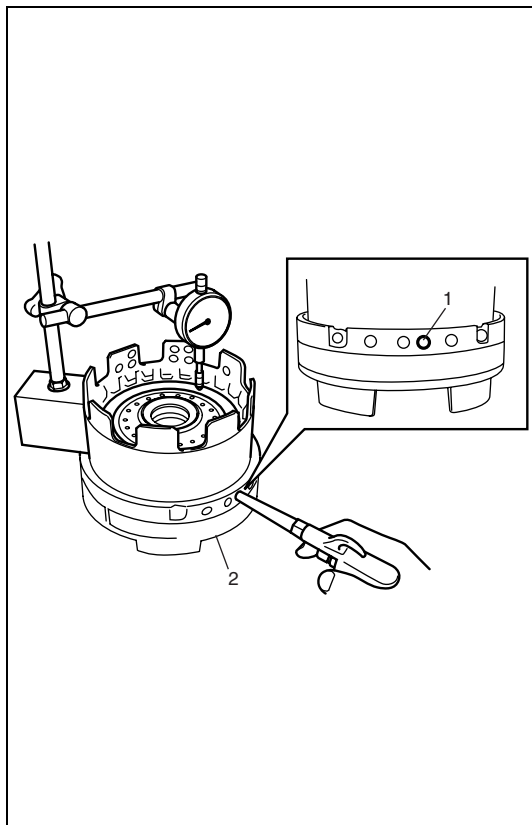
Special tool

(A): 09926-96010

- 5) Install snap ring (2) making sure not to align snap ring end gap with claw (3) of direct clutch return spring retainer (4).



- 6) Install direct clutch plates "P" and direct clutch discs "D" in following order.
P – D – P – D – P – D – P – D
- 7) Install direct clutch flange (1) with flat end facing to clutch disc side.
- 8) Install snap ring (2) by using flat end rod or the like being sure not to align snap ring end gap with cut portion of direct clutch drum.



- 9) Measure direct clutch piston stroke by blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (1) of direct clutch drum (2) as shown in figure.

Direct clutch piston stroke

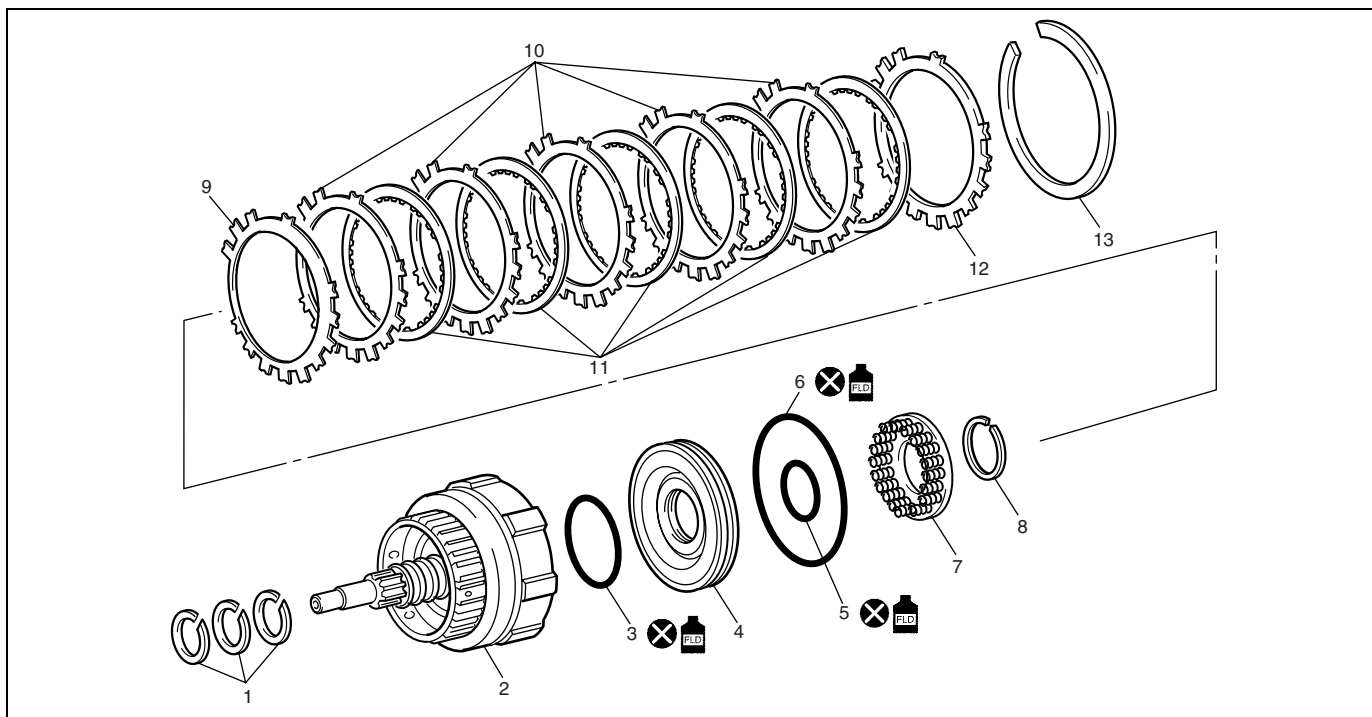
0.30 – 0.60 mm (0.012 – 0.023 in.)

If piston stroke is out of specification, select another direct clutch flange with suitable thickness from the list below and replace.

Available direct clutch flange thickness

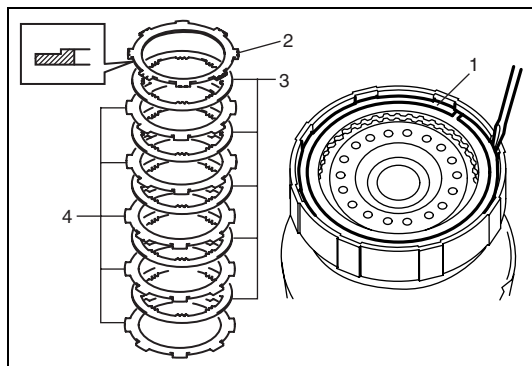
Identification No.	Thickness	Identification No.	Thickness
53	3.3 mm (0.130 in.)	57	3.7 mm (0.146 in.)
54	3.4 mm (0.134 in.)	58	3.8 mm (0.150 in.)
55	3.5 mm (0.138 in.)	60	4.0 mm (0.157 in.)
56	3.6 mm (0.142 in.)	62	4.2 mm (0.165 in.)

Forward clutch assembly COMPONENTS

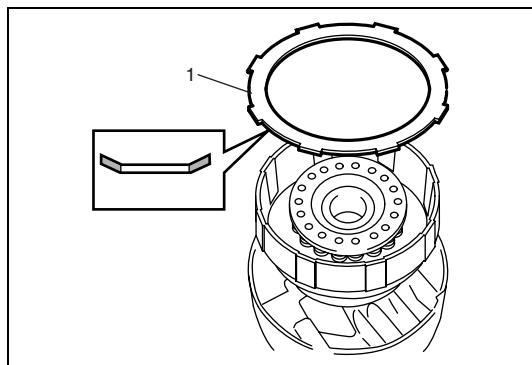


1. Input shaft seal	5. Inner O-ring	9. Forward clutch cushion plate	13. Snap ring
2. Forward clutch drum	6. Outer O-ring	10. Forward clutch plate	⊗ Do not reuse.
3. O-ring	7. Forward clutch return spring	11. Forward clutch disc	⚙ Apply A/T fluid
4. Forward clutch piston	8. Snap ring	12. Forward clutch flange	

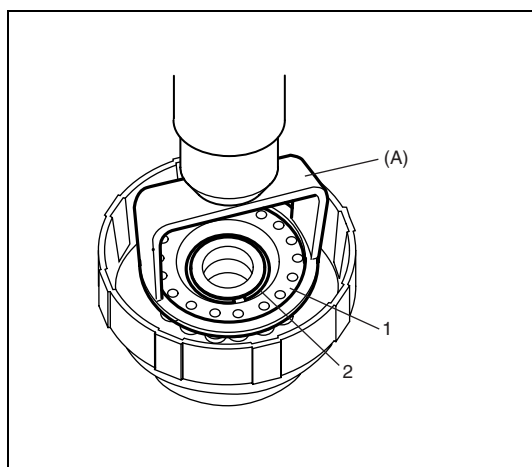
DISASSEMBLY



- 1) Remove snap ring (1) by using flat end rod or the like.
- 2) Remove forward clutch flange (2), 5 forward clutch discs (3) and 5 forward clutch plates (4).



- 3) Remove forward clutch cushion plate (1).



- 4) Compress forward clutch return spring (1) by using special tool and hydraulic press, and then remove snap ring (2).

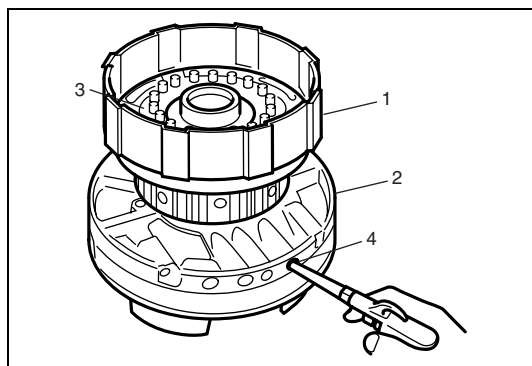
CAUTION:

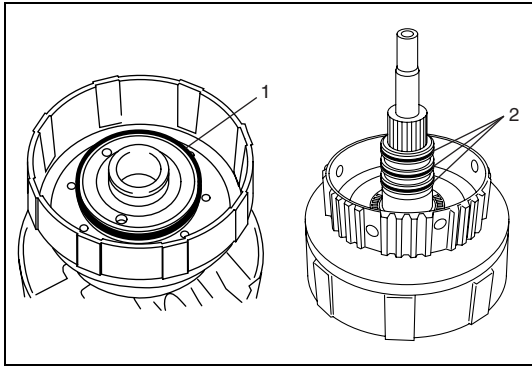
Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

Special tool

(A): 09926-96010

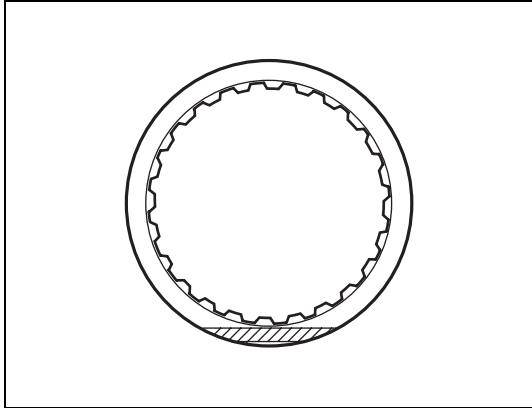
- 5) Remove forward clutch return spring (1).
- 6) Place forward clutch drum (3) onto O/D case (2).
- 7) Remove forward clutch piston (1) from forward clutch drum (1) by blowing compressed air (196 kPa, 2.0 kg/cm², 28.5 psi) into oil hole (4) of O/D case (2) as shown in figure.





8) Remove O-ring (1) and seals (2) from forward clutch drum.

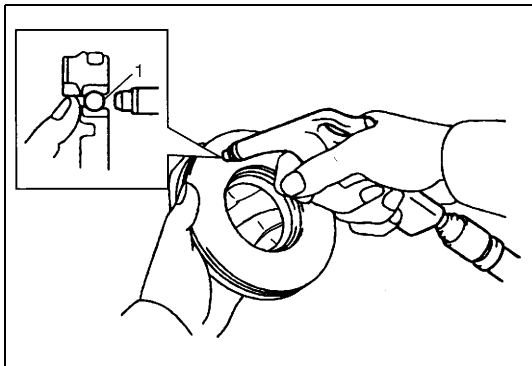
INSPECTION



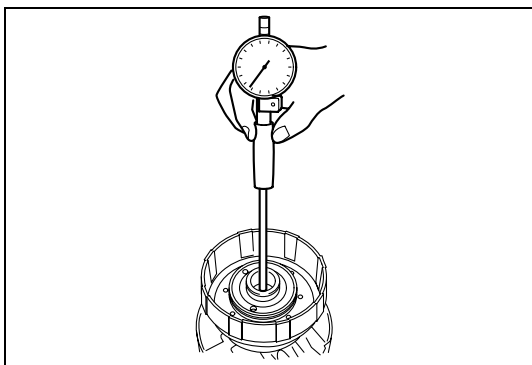
- Check that sliding surfaces of discs, plate and flange are not worn or burnt. If necessary, replace them.

NOTE:

- If disc lining is exfoliated, discolored or worn excessively, replace all discs.
- Even if only a part of printed numbers is corroded, replace all discs.
- Before assembling new discs, soak them in A/T fluid for at least 15 minutes.

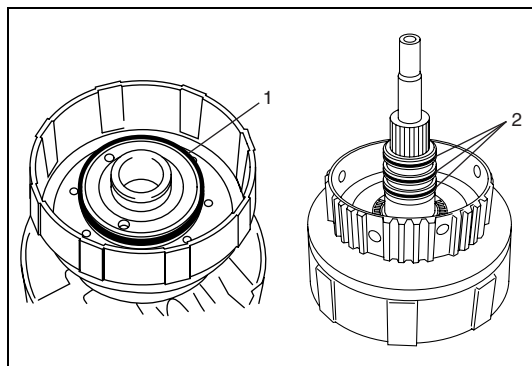


- Shake forward clutch piston lightly and check that check ball (1) is not stuck. Check that valve does not have leaks by blowing low-pressure compressed air.



- Measure inner diameter of forward clutch drum bushing. If inner diameter exceeds limit, replace forward clutch drum.

**Forward clutch drum bushing inner diameter limit
24.08 mm (0.948 in.)**

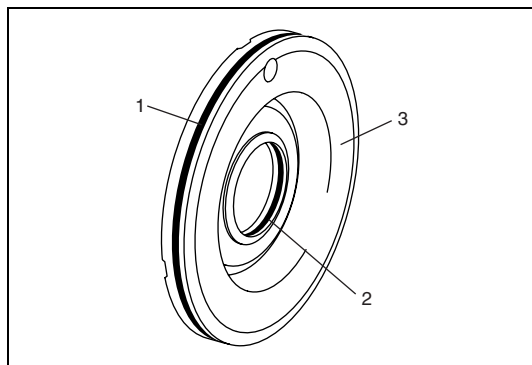
ASSEMBLY

- 1) Apply A/T fluid to new O-ring (1) and new seals (2).
- 2) Squeeze ends of seals together with wrap distance 8 mm (0.314 in.) or less and then install new seals to forward clutch drum groove.

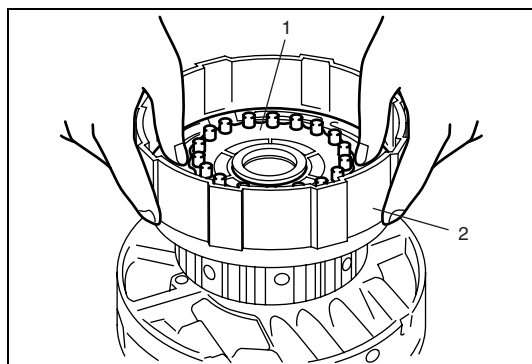
CAUTION:

Do not spread seal ends excessively.

- 3) Check seals rotate smoothly.



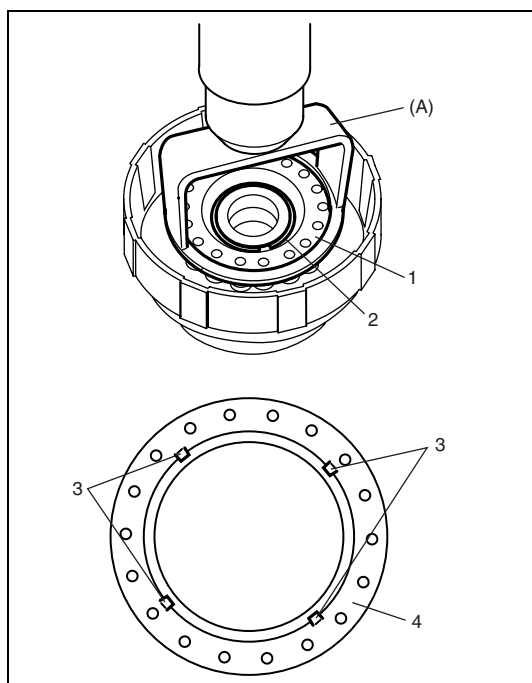
- 4) Apply A/T fluid to new outer O-ring (1) and new inner O-ring (2), and then install them to forward clutch piston (3).



- 5) Press-fit forward clutch piston (1) into forward clutch drum (2) by hands.

CAUTION:

Do not twist or deviate O-rings during installation.



- 6) Place forward clutch return spring (1) onto forward clutch piston.
- 7) Compress forward clutch return spring (1) by using special tool and hydraulic press.

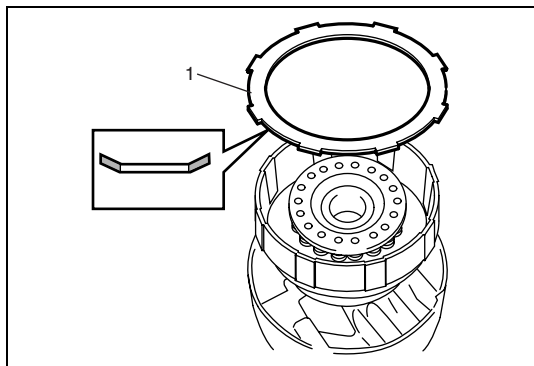
CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

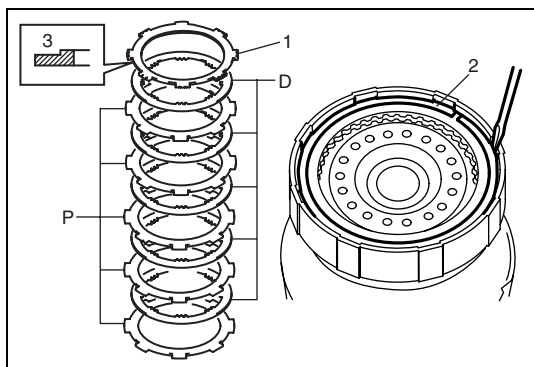
Special tool

(A): 09926-96010

- 8) Install snap ring (2) making sure not to align snap ring end gap with claw (3) of forward clutch return spring retainer (4).



9) Install forward clutch cushion plate (1) in correct direction.

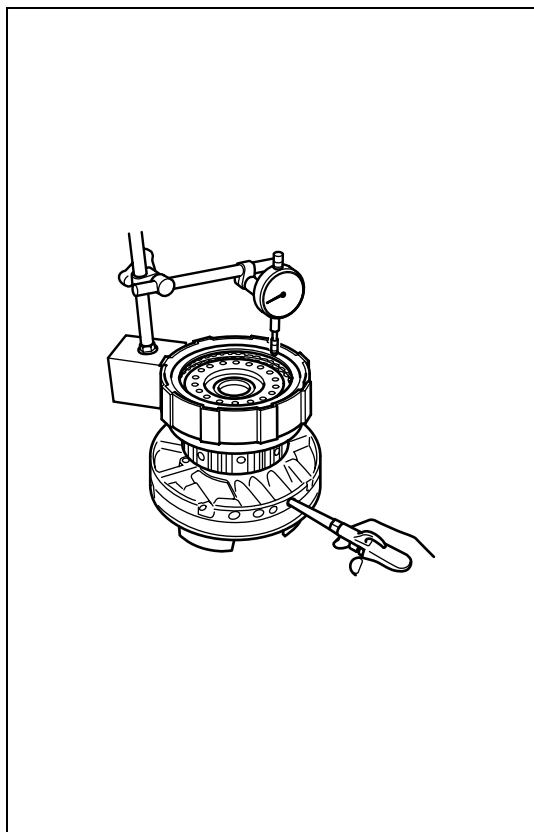


10) Install forward clutch plates “P” and forward clutch discs “D” in the following order.

P – D – P – D – P – D – P – D – P – D

11) Install forward clutch flange (1) facing flat end surface (3) to clutch disc side.

12) Install snap ring (2) by using flat end rod or the like making sure not to align snap ring end gap with cut portion of forward clutch drum.



13) Measure forward clutch piston stroke by blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (1) of forward clutch drum (2) as shown in figure.

Direct clutch piston stroke

0.50 – 0.90 mm (0.020 – 0.035 in.)

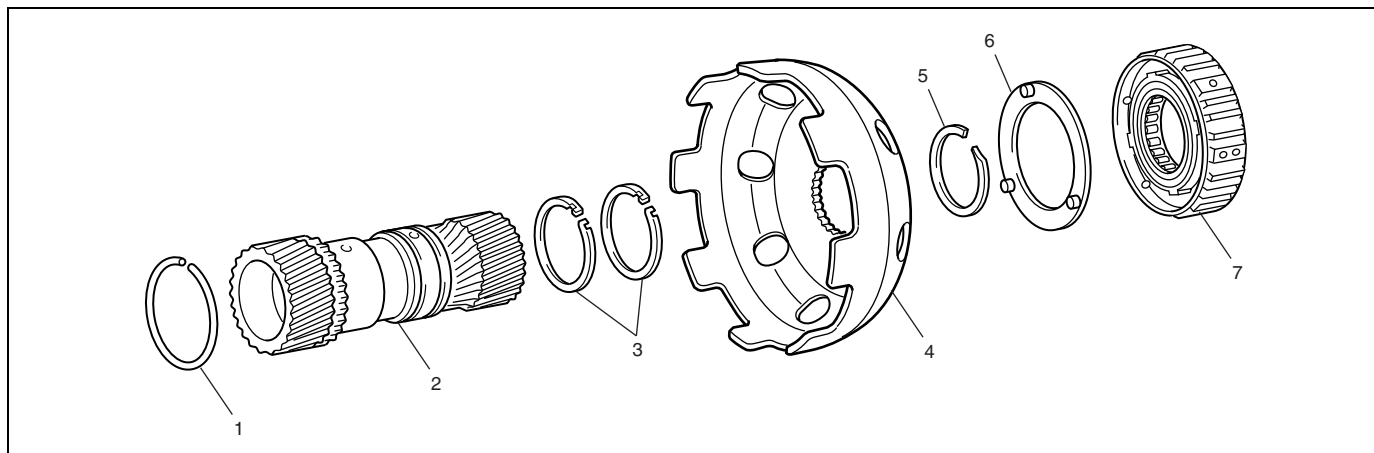
If piston stroke is out of specification, select another forward clutch flange with suitable thickness from the list below and replace.

Available forward clutch flange thickness

Identification No.	Thickness	Identification No.	Thickness
90	3.0 mm (0.118 in.)	94	3.8 mm (0.150 in.)
91	3.2 mm (0.126 in.)	95	4.0 mm (0.157 in.)
92	3.4 mm (0.134 in.)	96	4.2 mm (0.165 in.)
93	3.6 mm (0.142 in.)	97	4.4 mm (0.173 in.)

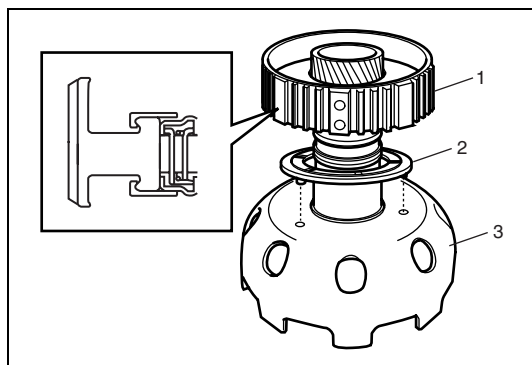
Sun gear and one-way No.3 clutch assembly

COMPONENTS

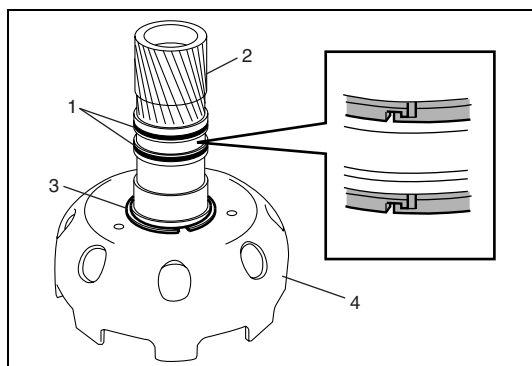


1. Snap ring	5. Snap ring
2. Sun gear	6. One-way No.3 clutch thrust washer
3. Seal	7. One-way No.3 clutch assembly
4. Sun gear input drum	

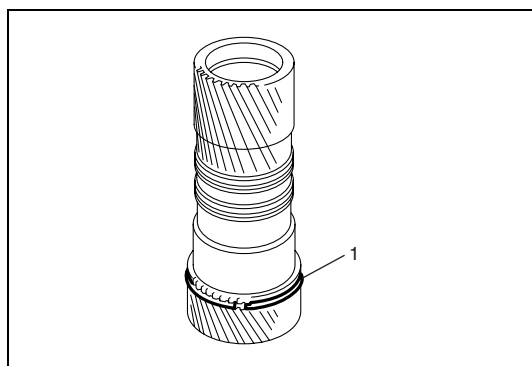
DISASSEMBLY



- 1) Remove one-way No.3 clutch assembly (1) and one-way No.3 clutch thrust washer (2) from sun gear input drum (3).

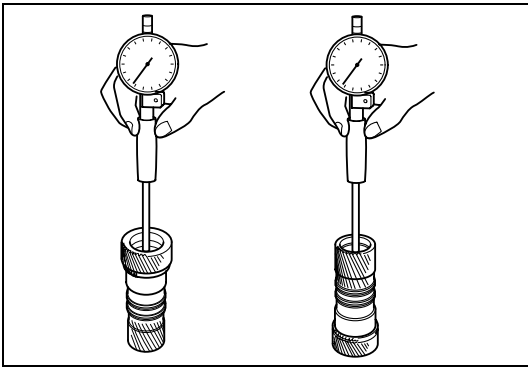


- 2) Remove seals (1) from sun gear (2).
- 3) After removing snap ring (3), remove sun gear (2) from sun gear input drum (4).



- 4) Remove snap ring (1) from sun gear by using flat end rod or the like.

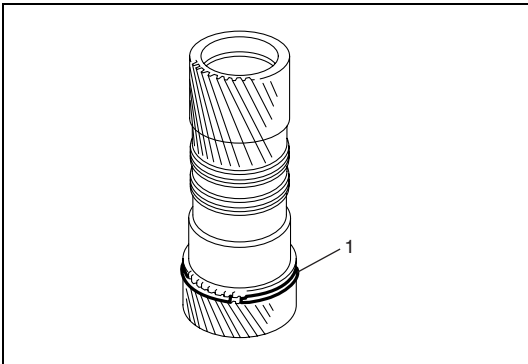
INSPECTION



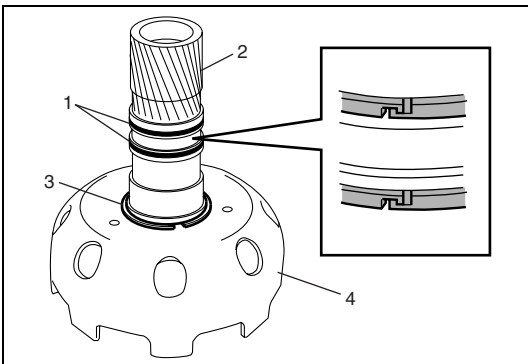
- Measure inner diameter of sun gear bushing.
If inner diameter exceeds limit, replace sun gear.

Sun gear bushing inner diameter limit
27.08 mm (1.066 in.)

ASSEMBLY



- 1) Install snap ring (1) to sun gear by using flat end rod or the like.



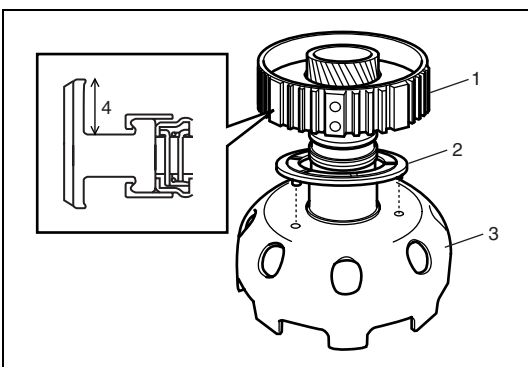
- 2) Install sun gear (2) to sun gear input drum (4) by installing snap ring (3).

- 3) After applying A/T fluid to new seals (1), install them to sun gear (2).

CAUTION:

Do not spread seal ends excessively.

- 4) Check that seals rotate smoothly.

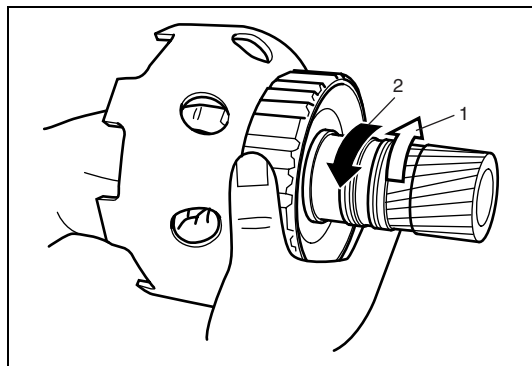


- 5) Install one-way No.3 clutch thrust washer (2) to sun gear input drum (3).

NOTE:

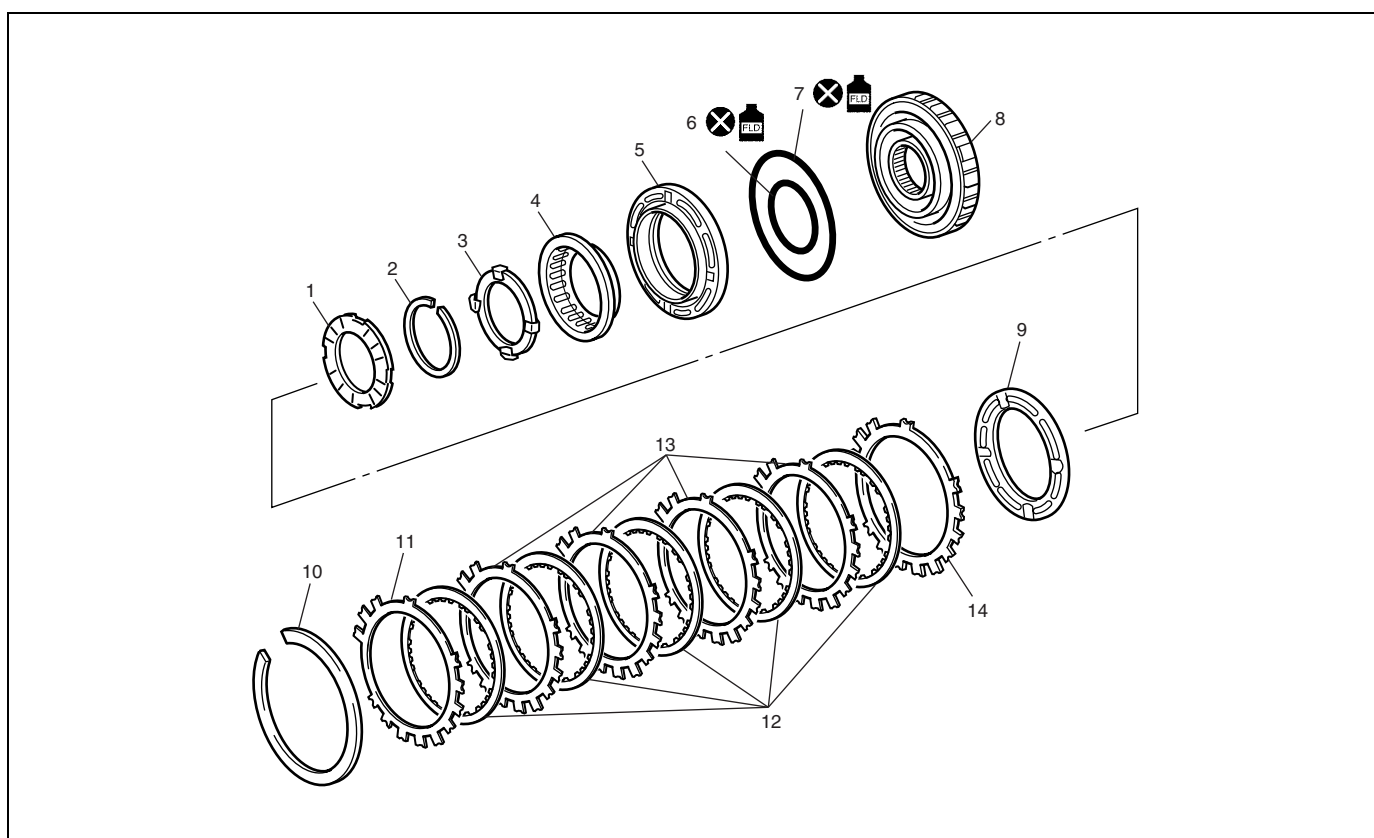
Make sure that tab shapes of thrust washer fit into holes of sun gear input drum.

- 6) Install one-way No.3 clutch assembly (1) to sun gear input drum (3) directing deeper side upward (4).



- 7) Hold sun gear and turn one-way No.3 clutch assembly. Check that one-way No.3 clutch assembly can be turned freely (1) clockwise and locked (2) when turned counter-clockwise.

Forward brake assembly COMPONENTS



1. Forward brake return thrust washer	5. Forward brake piston	9. Forward brake sleeve	13. Forward brake No.1 plate
2. Snap ring	6. Inner O-ring	10. Snap ring	14. Forward brake No.2 plate
3. Forward brake return spring retainer	7. Outer O-ring	11. Forward brake flange	⊗ Do not reuse.
4. Forward brake return spring	8. Forward brake drum	12. Forward brake disc	⚙ Apply A/T fluid

DISASSEMBLY

- 1) Compress forward brake return spring (1) by using special tool and hydraulic press, and then remove snap ring (2).

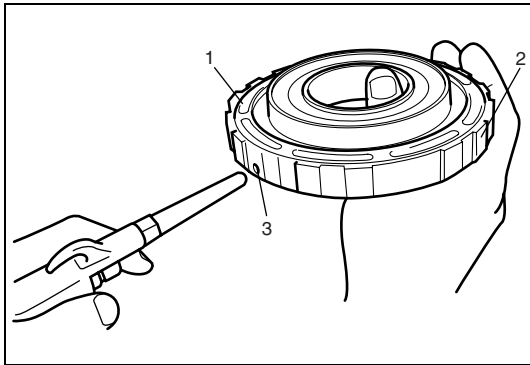
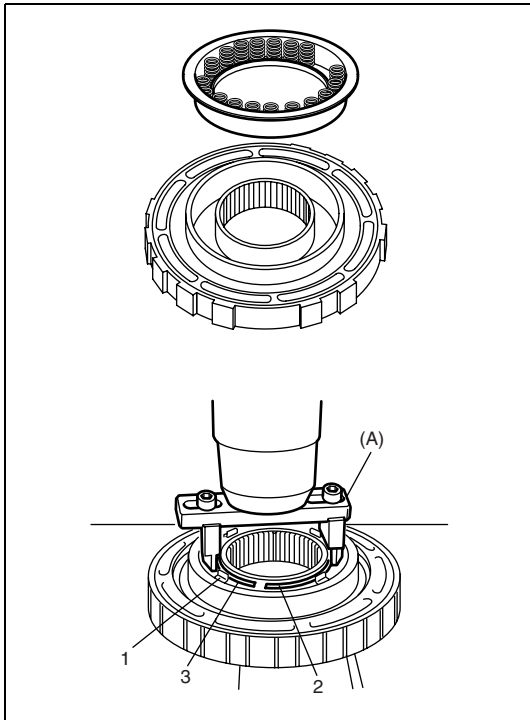
CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

Special tool

(A): 09926-96520

- 2) Remove forward brake return spring retainer (3) and forward brake return spring (1).



- 3) Remove forward brake piston (1) from forward brake drum (2) by blowing low pressure compressed air into oil hole (3) of forward brake drum (2) as shown in figure.

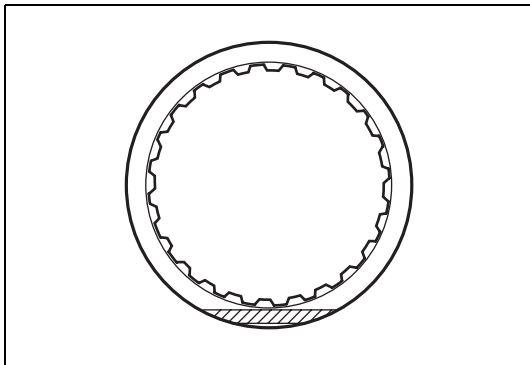
- 4) Remove inner and outer O-rings from forward brake piston.

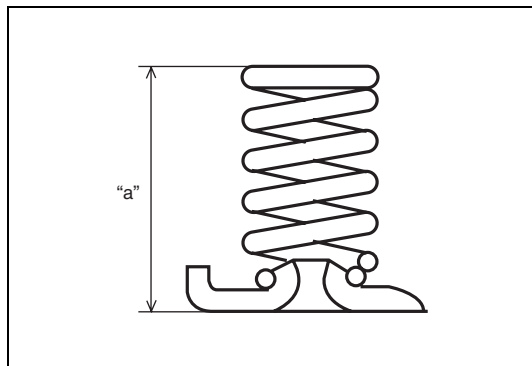
INSPECTION

- Check that sliding surfaces of discs, plate and flange are not worn or burnt. If necessary, replace them.

NOTE:

- If disc lining is exfoliated, discolored or worn excessively, replace all discs.
- Even if only a part of printed numbers is corroded, replace all discs.
- Before assembling new discs, soak them in A/T fluid for at least 15 minutes.



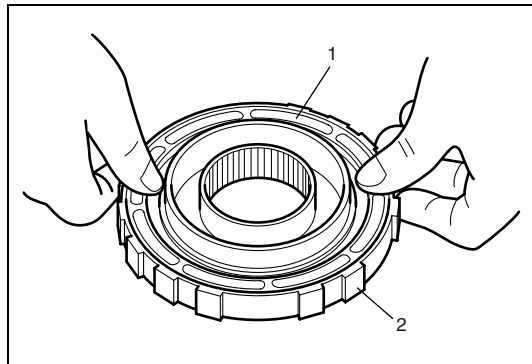


- Measure free length of forward brake return spring including spring seat.

Forward brake return spring free length

“a”: 16.05 mm (0.6318 in.)

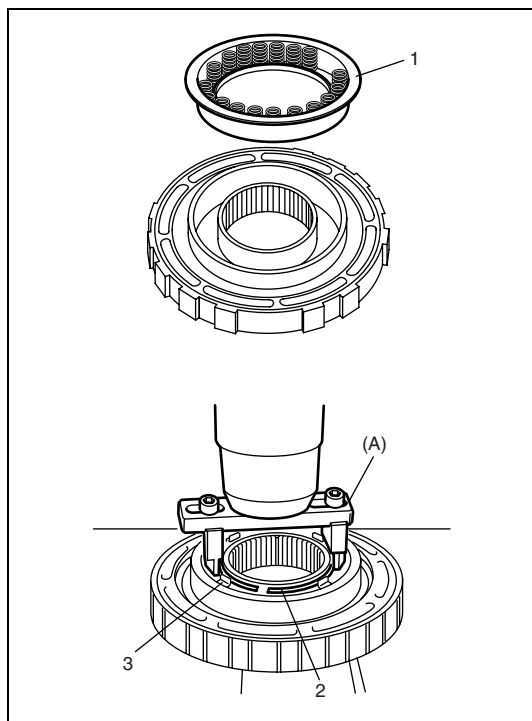
ASSEMBLY



- 1) After applying A/T fluid to new O-rings, install them to forward brake piston.
- 2) Press-fit forward brake piston (1) into forward brake drum (2) by hands.

CAUTION:

Do not twist or deviate O-rings during installation.



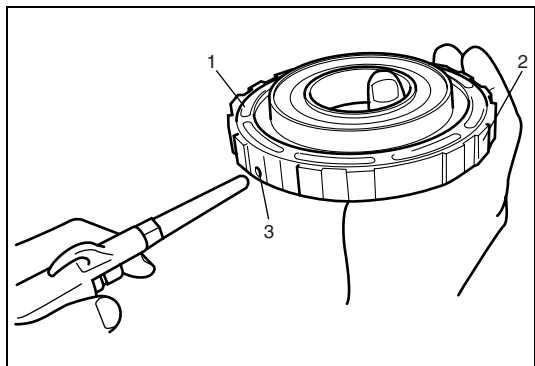
- 3) Put forward brake return spring (1) and forward brake return spring retainer (3) on forward brake piston.
- 4) Compress forward brake return spring (1) by using special tool and hydraulic press, and then install snap ring (2).

CAUTION:

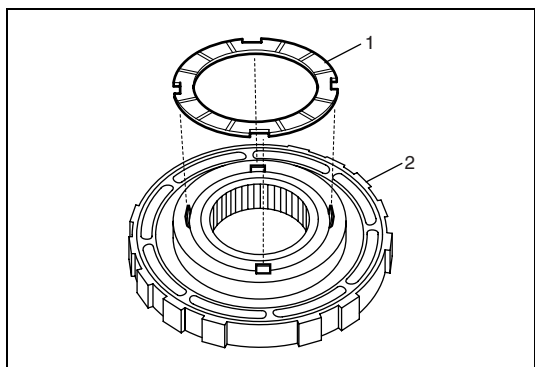
Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

Special tool

(A): 09926-96520



- 5) Make sure that forward brake piston (1) moves smoothly when blowing and not blowing low pressure compressed air into oil hole (3) of forward brake drum (2) as shown figure.

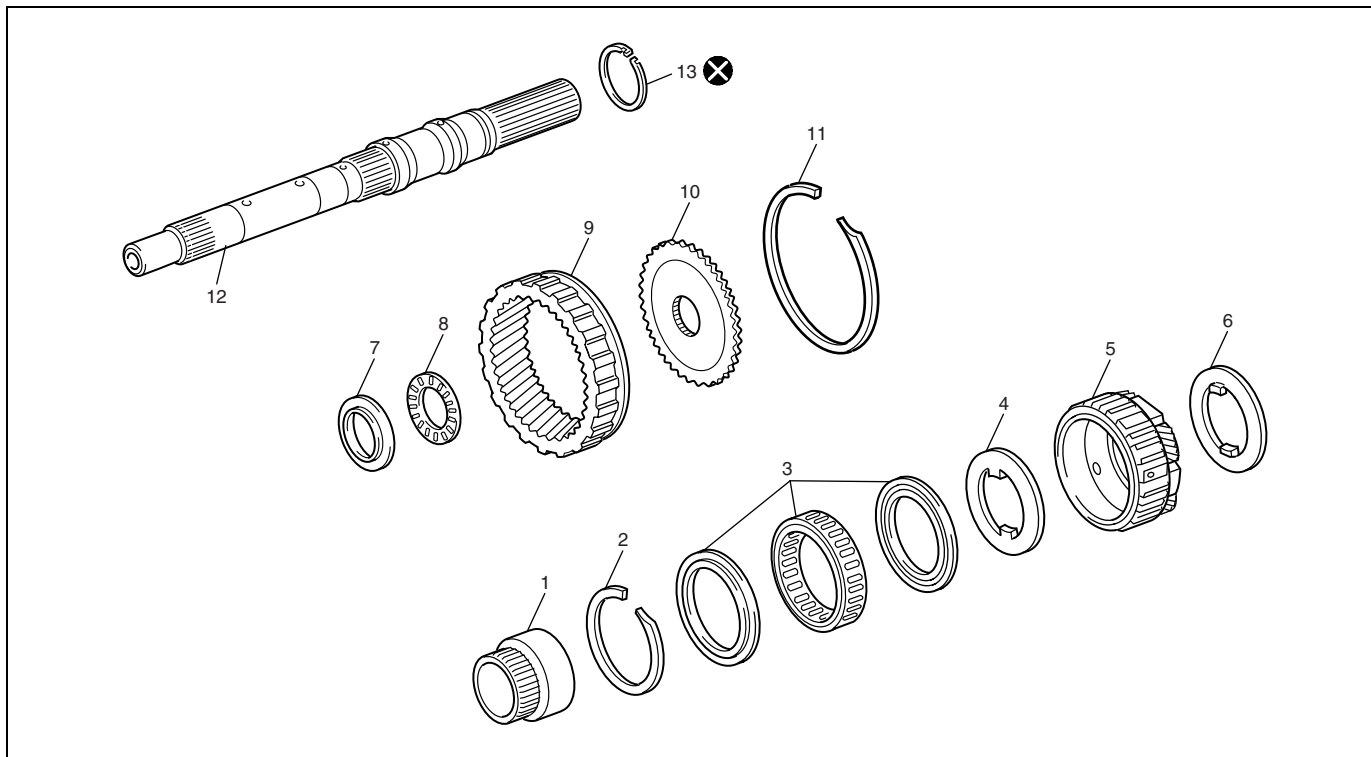


- 6) Fit thrust washer (1) to forward brake assembly (2) with petroleum jelly so that washer does not fall off when assembling A/T unit.

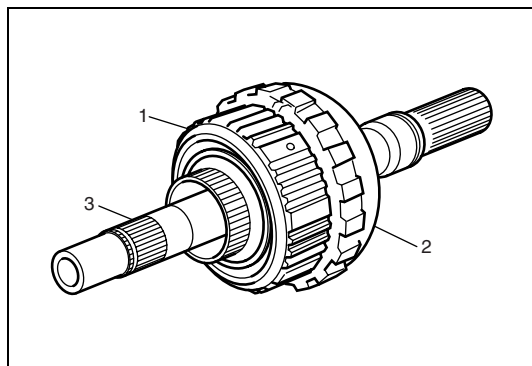
NOTE:

Make sure that cutout portions of thrust washer fit into teeth of forward brake return spring retainer.

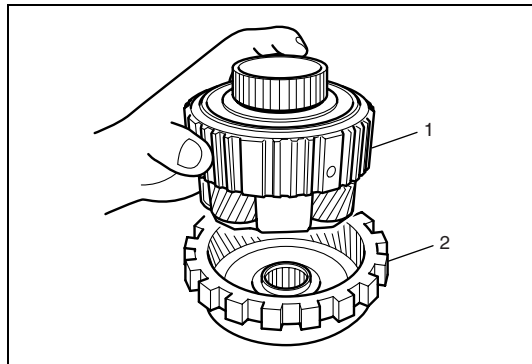
Rear planetary gear carrier assembly and output shaft COMPONENTS



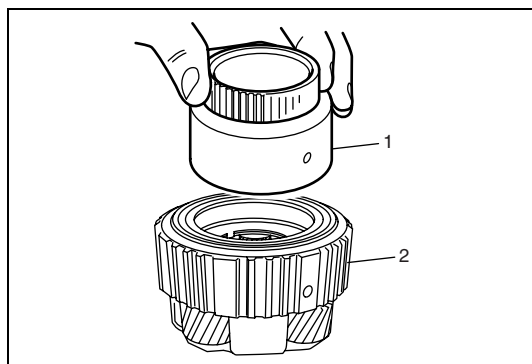
1. One-way No.2 clutch inner race	5. Rear planetary carrier assembly	9. Rear planetary ring gear	13. Seal
2. Snap ring	6. Rear planetary rear thrust washer	10. Rear planetary ring gear flange	⊗ Do not reuse.
3. One-way No.2 clutch	7. Sun gear thrust bearing race	11. Snap ring	
4. Rear planetary front thrust washer	8. Sun gear thrust bearing	12. Output shaft	

DISASSEMBLY

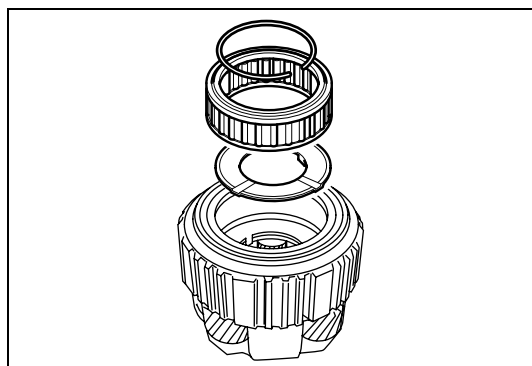
- 1) Remove rear planetary carrier assembly (1) with rear planetary ring gear (2) from output shaft (3).



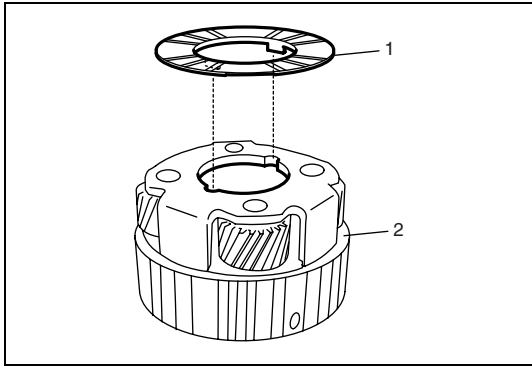
- 2) Remove rear planetary carrier assembly (1) from rear planetary ring gear (2).



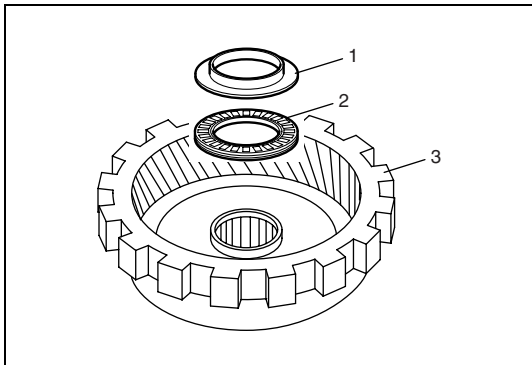
- 3) Remove one-way No.2 clutch inner race (1) from rear planetary carrier assembly (2).



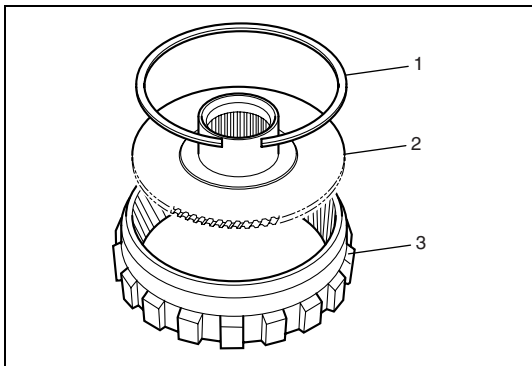
- 4) After removing snap ring (1), remove one-way No.2 clutch (2) and rear planetary front thrust washer (3) from rear planetary carrier assembly (4).



- 5) Remove rear planetary rear thrust washer (1) from rear planetary carrier assembly (2).



- 6) Remove sun gear thrust bearing race (1) and sun gear thrust bearing (2) from rear planetary ring gear (3).



- 7) After removing snap ring (1), remove rear planetary ring gear flange (2) from rear planetary ring gear (3).

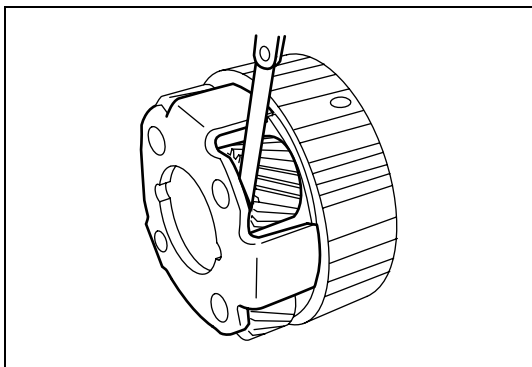
INSPECTION

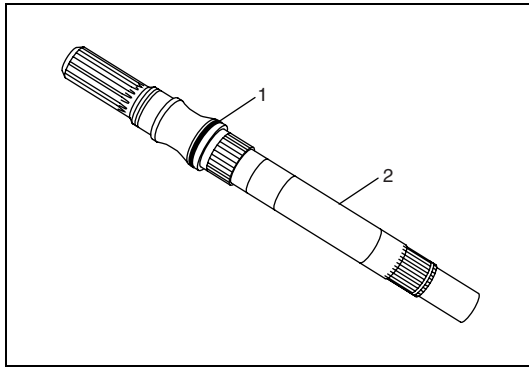
- Measure planetary pinion gear thrust clearance by using thickness gauge.
If clearance exceeds limit, replace rear planetary gear carrier assembly.

Rear planetary gear thrust clearance

Standard: 0.20 – 0.60 mm (0.0079 – 0.0236 in.)

Limit: 0.65 mm (0.0255 in.)



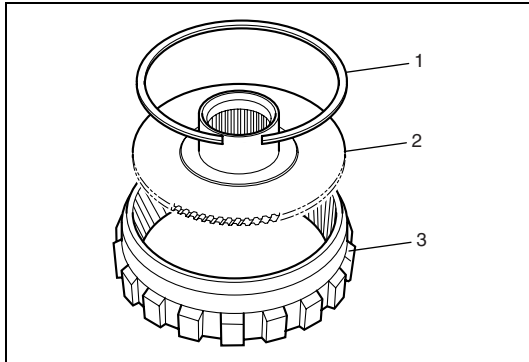
ASSEMBLY

- 1) After applying A/T fluid to new seal (1), install it to output shaft (2).

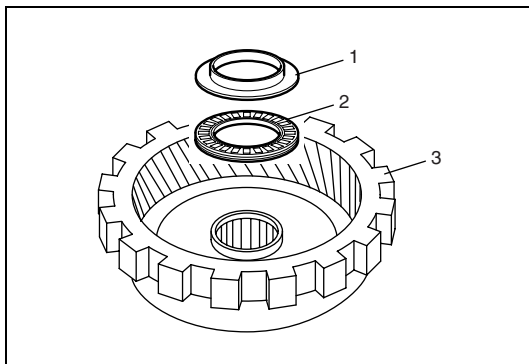
CAUTION:

Do not spread seal ends excessively.

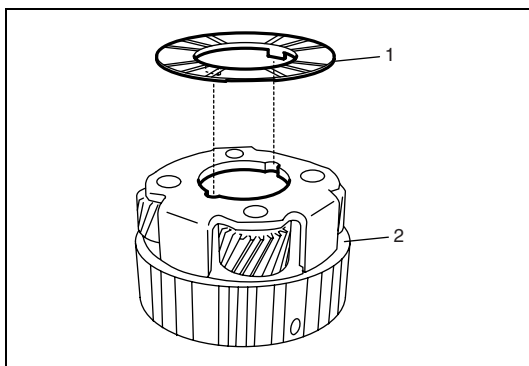
- 2) Check that seal rotates smoothly.



- 3) Install rear planetary ring gear flange (2) to rear planetary ring gear (3) by installing snap ring (1).



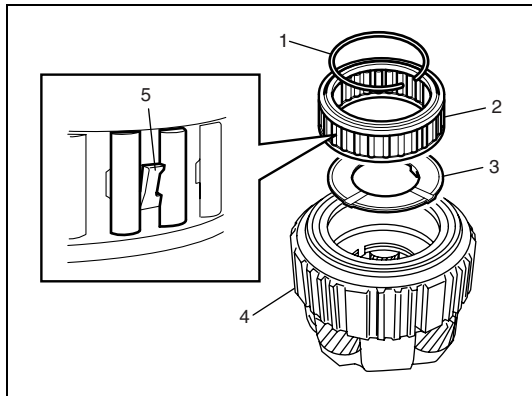
- 4) Apply petroleum jelly to sun gear thrust bearing race (1) and sun gear thrust bearing (2), and then install them to rear planetary ring gear (3).



- 5) Apply petroleum jelly to rear planetary rear thrust washer (1), and then install it to rear planetary carrier assembly (2).

NOTE:

Make sure that tab shapes of thrust washer fit into cutout portions of rear planetary carrier assembly.

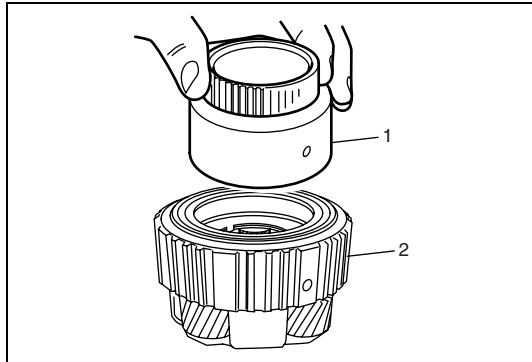


- 6) Apply petroleum jelly to rear planetary front thrust washer (3), and then install it to rear planetary carrier assembly (4).

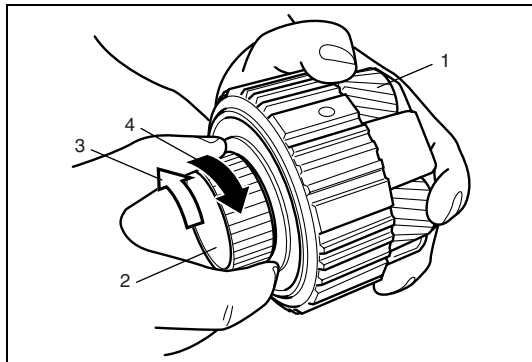
NOTE:

Make sure that tab shapes of thrust washer fit into cutout portions of rear planetary gear carrier assembly.

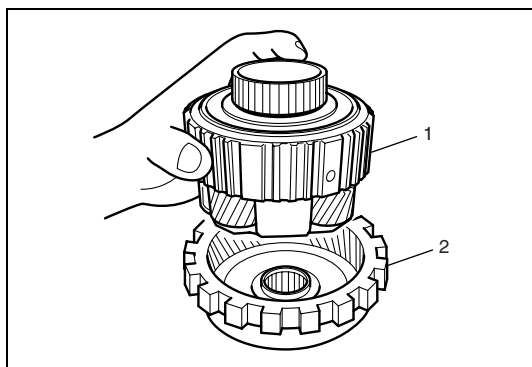
- 7) Install one-way No.2 clutch (2) to rear planetary gear carrier assembly (4) directing open ends of guides (5) on one-way No.2 clutch to snap ring side.
- 8) Install snap ring (1) by using flat end rod or the like.



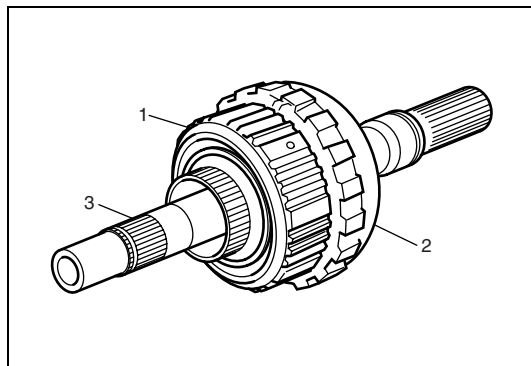
- 9) While turning one-way No.2 clutch inner race (1) counterclockwise, install it to rear planetary carrier assembly (2).



- 10) Hold rear planetary carrier assembly (1), and turn one-way No.2 clutch inner race (2).
Check that one-way No.2 clutch inner race (2) can be turned freely (3) counterclockwise and locked (4) when turned clockwise.

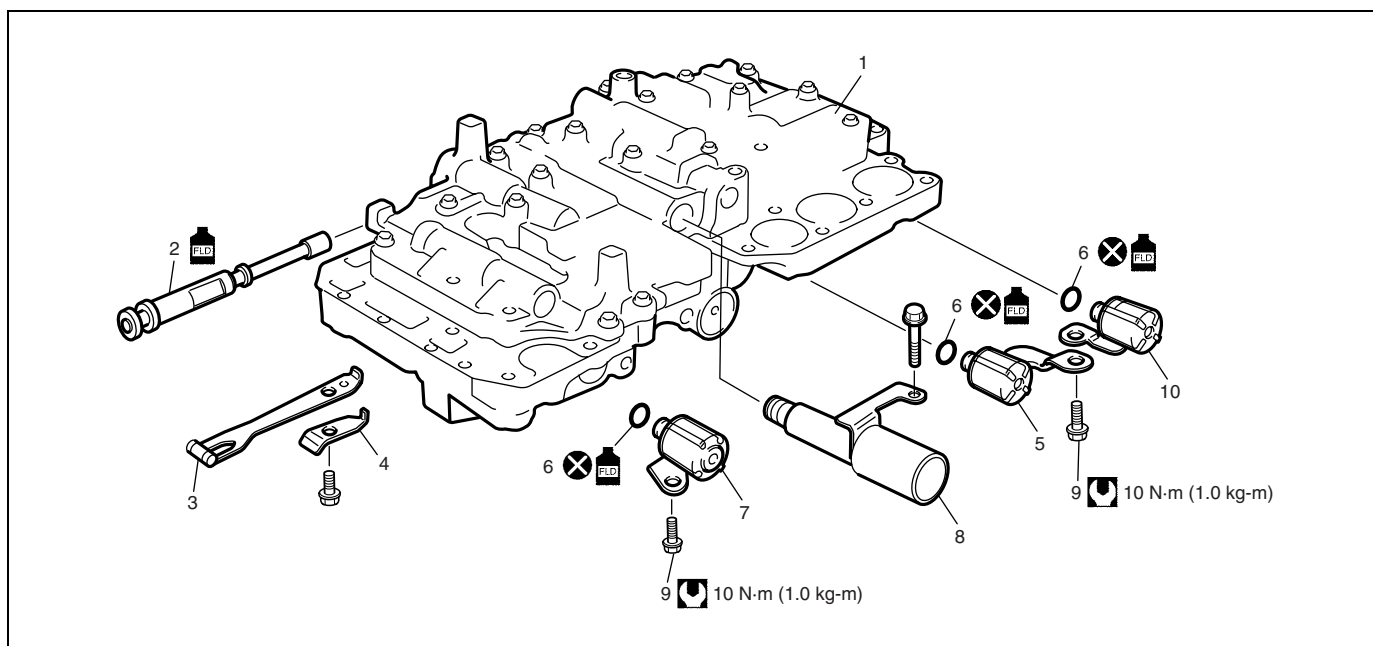


- 11) Install rear planetary carrier assembly (1) to rear planetary ring gear (2).



12) Install rear planetary carrier assembly (1) with rear planetary ring gear (2) to output shaft (3).

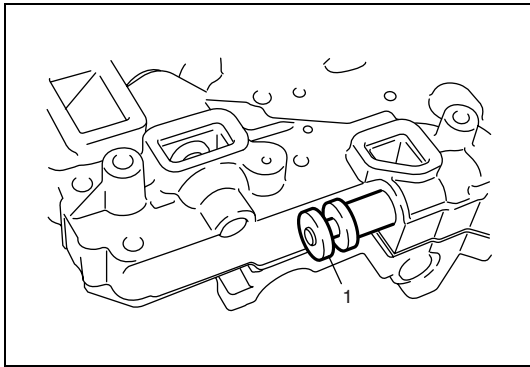
Valve body assembly COMPONENTS



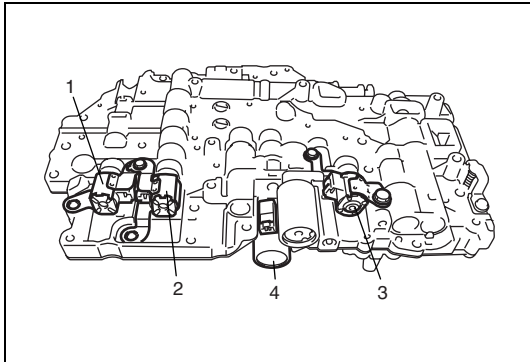
1. Valve body assembly	6. O-ring	Apply A/T fluid
2. Manual valve	7. TCC (lock-up) solenoid valve	Tightening torque.
3. Detent spring	8. Pressure control solenoid valve	Do not reuse.
4. Detent spring plate	9. Solenoid valve bolt	
5. Shift solenoid-B (No.2) valve	10. Shift solenoid-A (No.1) valve	

NOTE:

When replacing pressure control solenoid valve (8), it is strictly required to replace it together with valve body assembly (1) as a set.

DISASSEMBLY

1) Remove manual valve (1).



- 2) Remove shift solenoid-A (No.1) valve (1) and shift solenoid-B (No.2) valve (2).
- 3) Remove TCC solenoid valve (3) and pressure control solenoid valve (4).

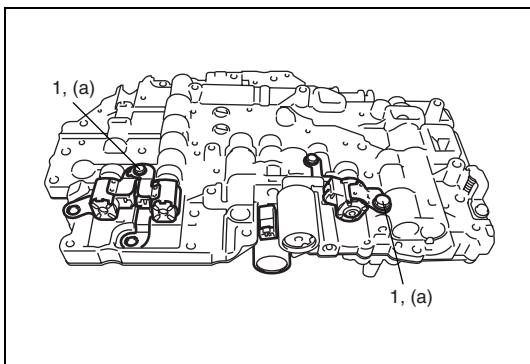
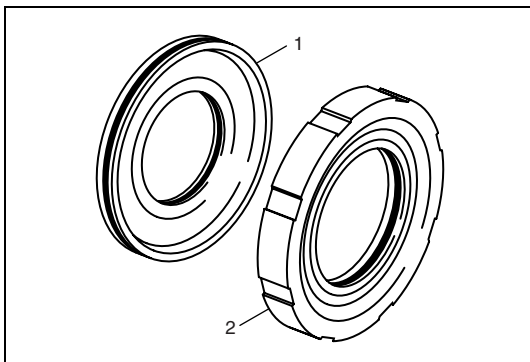
ASSEMBLY

Reverse disassembling procedure noting the following points.

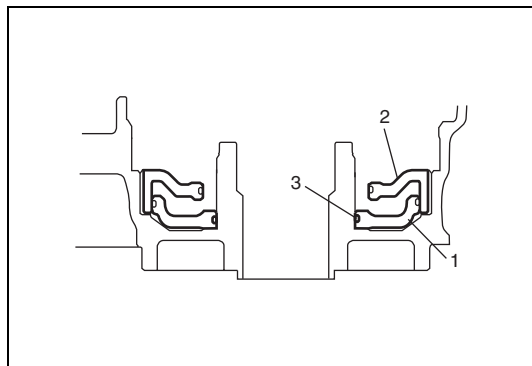
- Use new O-ring for shift solenoid valves and TCC solenoid valve.
- Tighten solenoid bolts (1) to specified torque.

Tightening torque

Solenoid valve bolts (a): 10 N·m (1.0 kg·m, 7.5 lb·ft)

**Unit Assembly****ASSEMBLY**

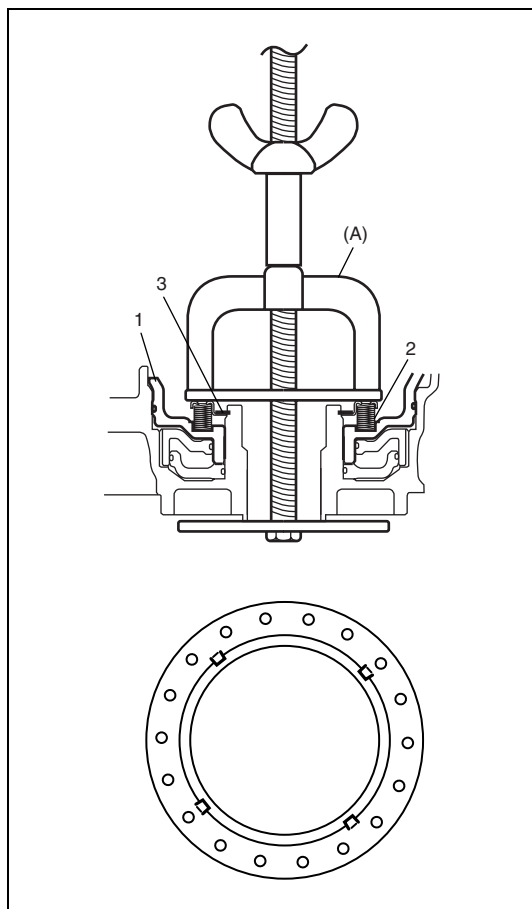
- 1) After applying A/T fluid to new O-rings, install them to reverse brake No.2 piston (1) and reverse brake piston sleeve (2).
- 2) Install reverse brake No.2 piston (1) to reverse brake piston sleeve (2).



- 3) Install reverse brake No.2 piston (1) with reverse brake piston sleeve (2) to transmission case.

CAUTION:

Be careful not to damage O-ring (3).



- 4) After applying A/T fluid to new O-ring, install it to reverse brake No.1 piston (1).
 5) Install reverse brake No.1 piston (1) in transmission case.
 6) Place reverse brake return spring (2) on reverse brake No.1 piston (1).
 7) Place snap ring (3) on reverse brake return spring retainer and compress reverse brake return spring (2) by using special tool.

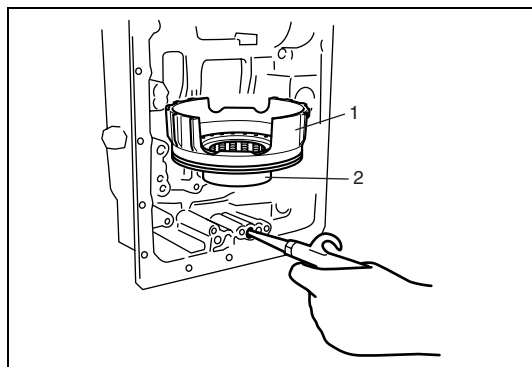
CAUTION:

Stop compressing when spring seat is pushed down to 1 – 2 mm (0.039 – 0.078 in.) lower than snap ring groove, so as to prevent spring seat from being deformed.

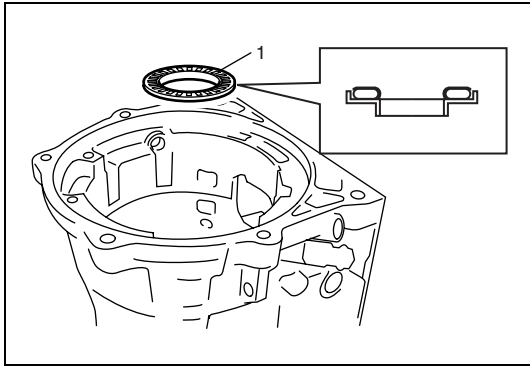
Special tool

(A): 09922-86010

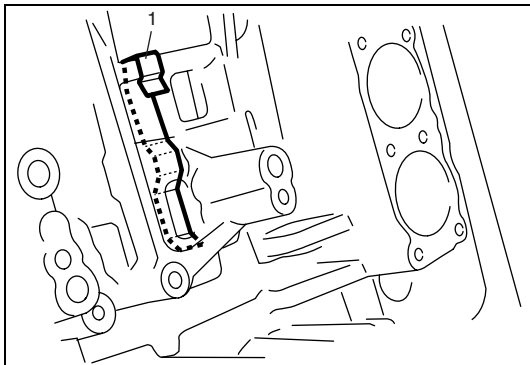
- 8) Install snap ring (3) making sure not to align snap ring end gap with claw of reverse brake return spring retainer.



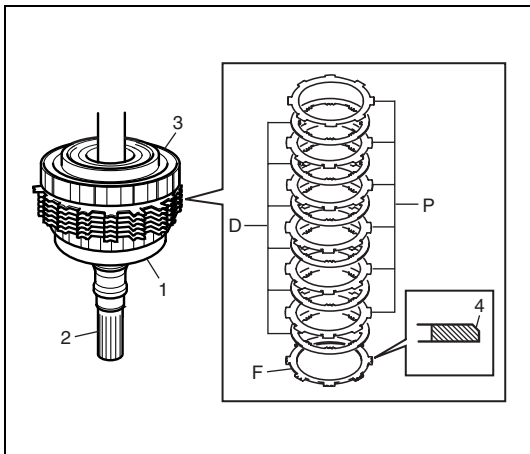
- 9) Make sure that reverse brake No.1 piston (1) and reverse brake No.2 piston (1) move smoothly when blowing and not blowing low pressure compressed air into oil hole of transmission case.



- 10) After applying A/T fluid to rear planetary thrust bearing (1), install it to transmission case.



- 11) Install forward clutch/reverse brake guide spring (1) to transmission case.

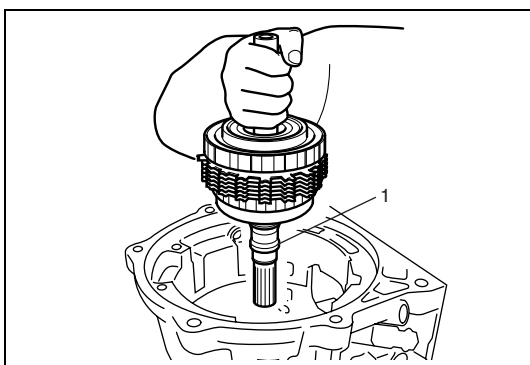


- 12) Install rear planetary gear assembly and rear planetary ring gear (1) to output shaft (2) referring to "Rear Planetary Carrier Assembly" in this section.

- 13) Install reverse brake flange "F" with chamfering side (4) facing to reverse brake disc side, reverse brake discs "D" and reverse brake plates "P" to rear planetary gear assembly in following order.

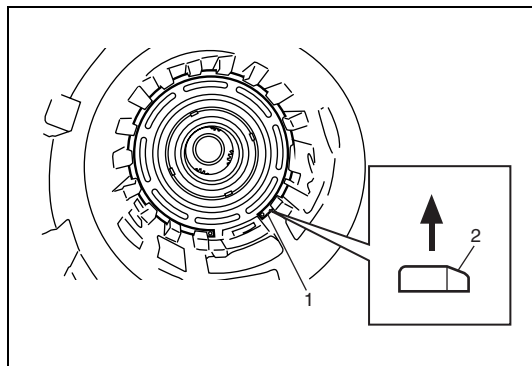
F - D - P - D - P - D - P - D - P - D - P - D - P

- 14) Align teeth of reverse brake flange and reverse brake plates.
15) Face snap ring toward torque converter side and install forward brake drum assembly (3) to rear planetary gear assembly.

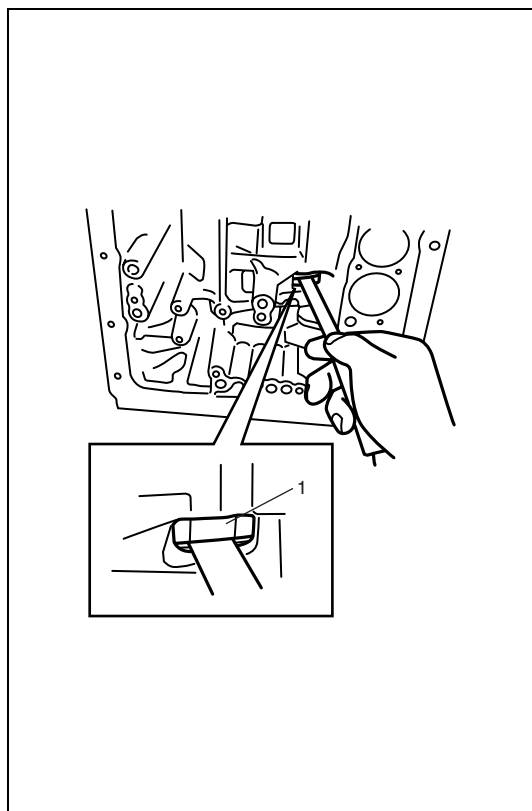


- 16) Install assembled output shaft (1) to transmission case while aligned teeth fit in grooves in transmission case facing oil hole of forward brake drum toward valve body side.

- 17) Place wooden block or the like under output shaft and hold it.



18) Install snap ring (1) facing round edge side (2) upward.



19) Measure clearance between reverse brake plate (1) and forward brake drum by using thickness gauge.

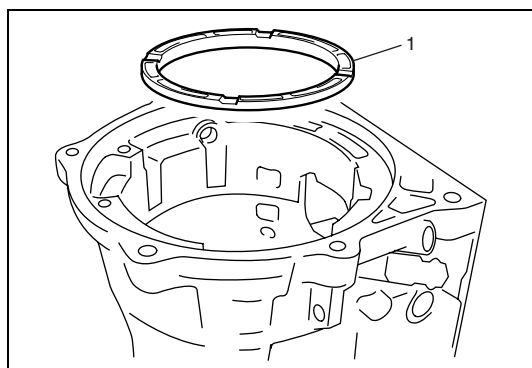
If clearance is out of specification, select another reverse brake flange with suitable thickness from the list below and replace it.

Clearance between reverse brake plate and forward brake drum

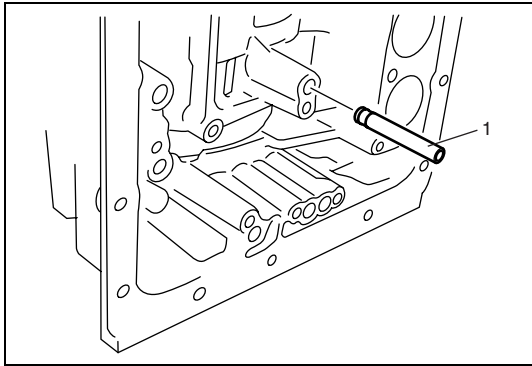
Standard: 0.60 – 1.12 mm (0.0237 – 0.0440 in.)

Available reverse brake flange thickness

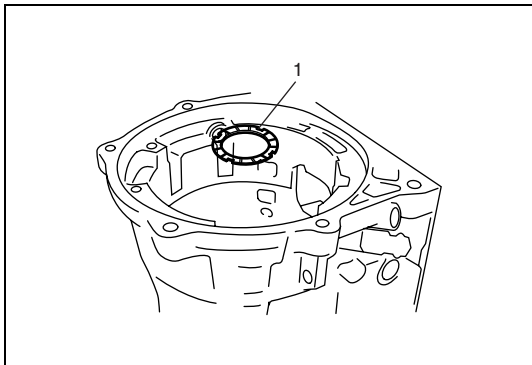
Identification No.	Thickness	Identification No.	Thickness
67	5.4 mm (0.213 in.)	52	4.6 mm (0.181 in.)
66	5.2 mm (0.205 in.)	53	4.4 mm (0.173 in.)
50	5.0 mm (0.197 in.)	54	4.2 mm (0.165 in.)
51	4.8 mm (0.189 in.)	55	4.0 mm (0.157 in.)



20) Install forward brake sleeve (1) onto forward brake piston.



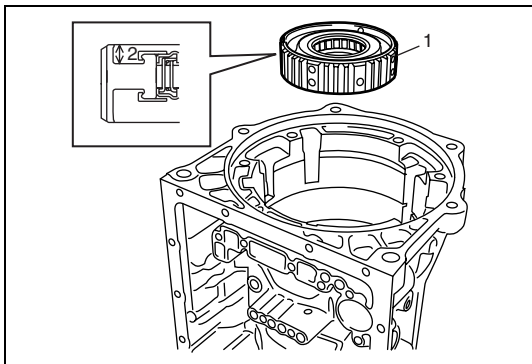
- 21) After applying A/T fluid to new reverse brake drum gasket (1), install it to transmission case.



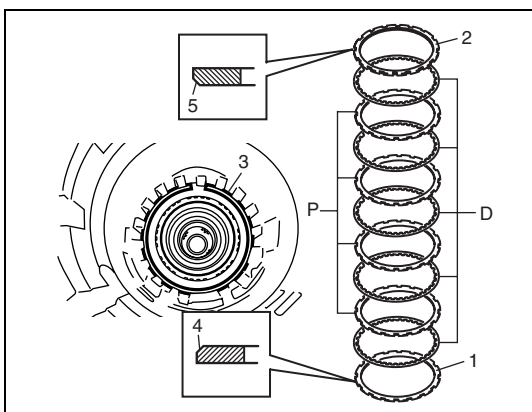
- 22) Install forward brake return thrust washer (1) onto forward brake return spring retainer.

NOTE:

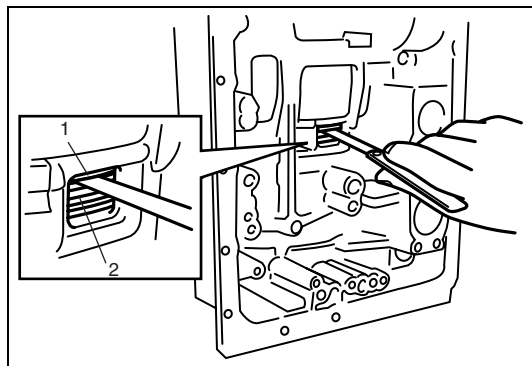
Make sure that cutout portions of thrust washer fit into teeth of forward brake return spring retainer.



- 23) Install one-way No.3 clutch (1) directing shallower side upward (2).

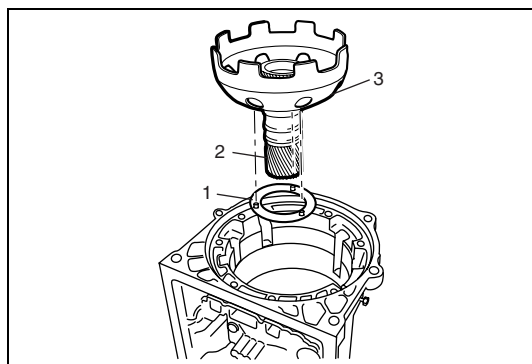


- 24) Install forward brake No.2 plate (1.8 mm, 0.071 in. thickness) (1) with chamfering side (4) of plate facing to forward brake disc side.
- 25) Install forward brake discs "D" and forward brake plates "P" in following order.
D – P – D – P – D – P – D – P – D – P
- 26) Install forward brake flange (2) with chamfering side (5) of flange facing to forward brake disc side.
- 27) Install snap ring (3).

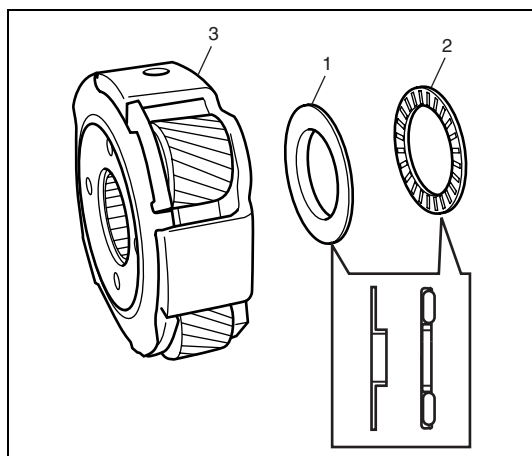


- 28) Measure clearance between snap ring (1) and forward brake flange (2) by using thickness gauge.
If clearance is out of specification, check them for installation.

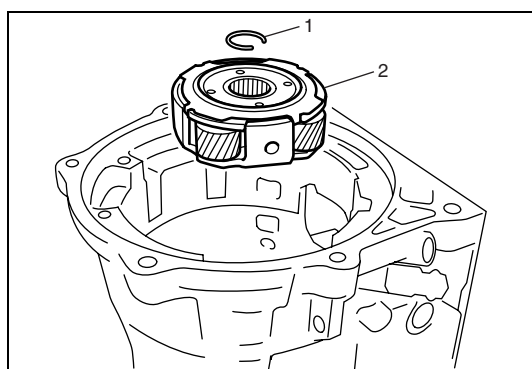
Clearance between snap ring and forward brake flange
Standard: 0.62 – 1.98 mm (0.0244 – 0.0779 in.)



- 29) Install one-way No.3 thrust washer (1) to sun gear input drum (3) securely after applying petroleum jelly so that washer does not fall off.
30) Install sun gear (2) with sun gear input drum (3) into one-way No.3 clutch by turning sun gear (2) clockwise.

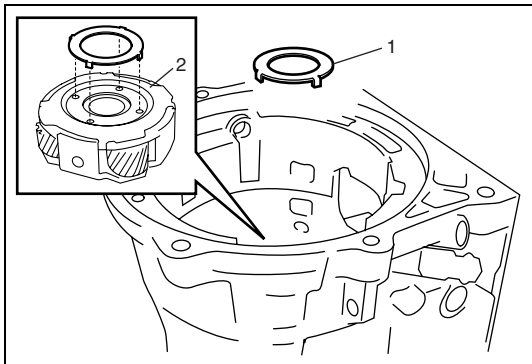


- 31) After applying petroleum jelly to front planetary thrust bearing race (1) and front planetary thrust bearing (2), install them to front planetary carrier assembly (3).



- 32) Install front planetary carrier assembly (2) to sun gear input drum
33) Install snap ring (1).

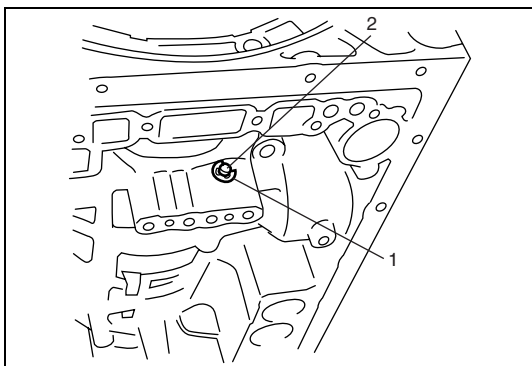
- 34) Remove wooden block or the like under output shaft.



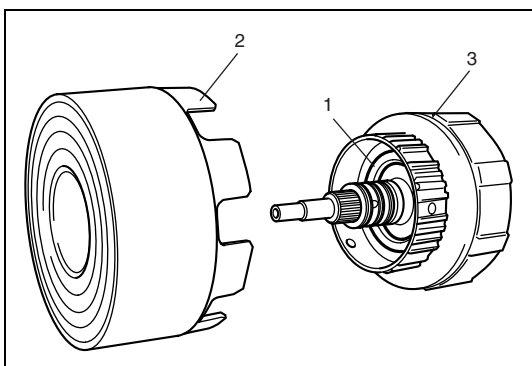
35) After applying petroleum jelly to front ring gear thrust bearing rear race (1), install it to front planetary carrier assembly (2).



36) Install 2nd coast brake band (1) to transmission case.

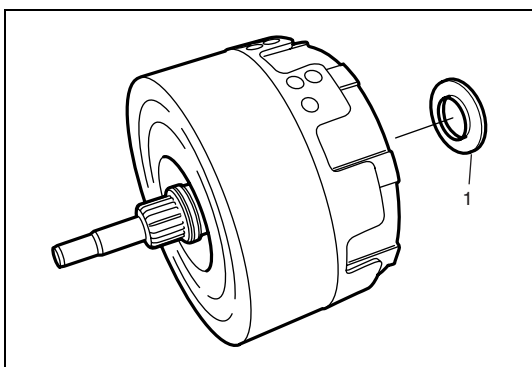


37) Install 2nd coast brake pin (2) and fix with E-ring (1).

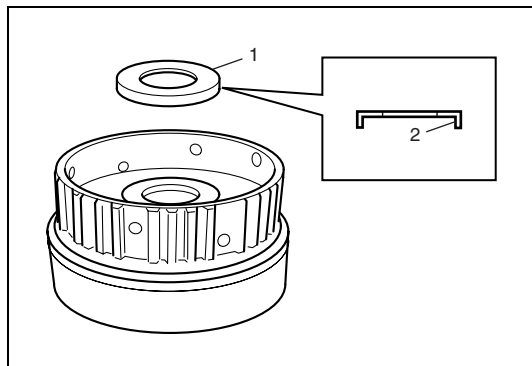


38) Install forward clutch thrust washer (1) to forward clutch assembly.

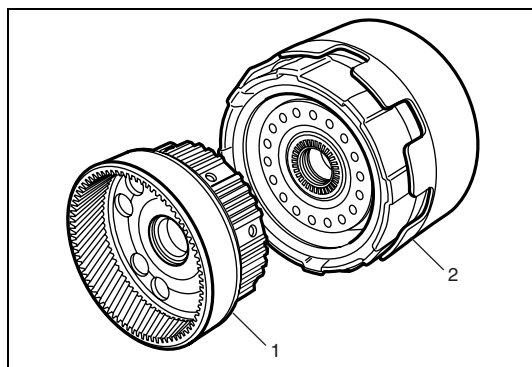
39) Install direct clutch assembly (2) to forward clutch assembly (3).



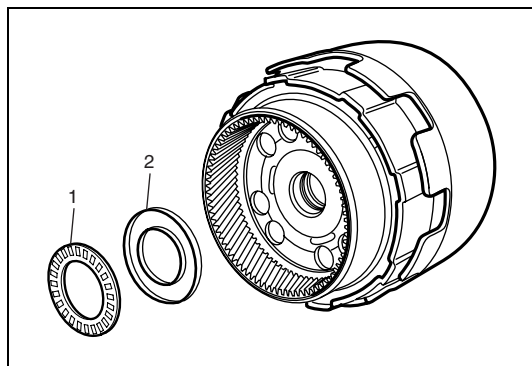
40) After applying petroleum jelly to input shaft rear thrust bearing (1), install them to forward clutch assembly.



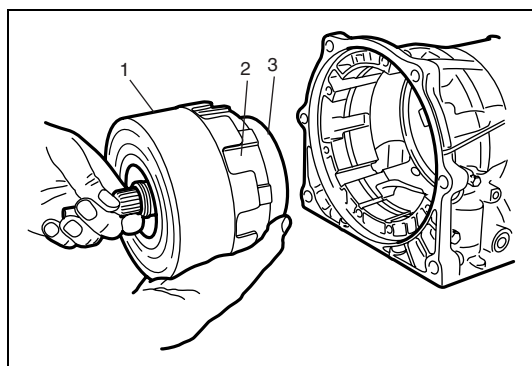
- 41) After applying petroleum jelly to input shaft rear thrust bearing rear race (1), install it to front planetary ring gear facing rim side (2) of washer downward.



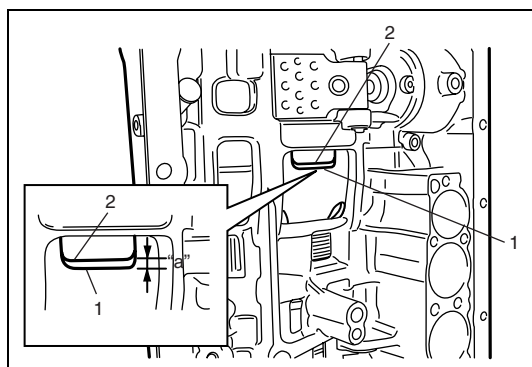
- 42) Align teeth of forward clutch discs and install front planetary ring gear (1) to forward clutch assembly (2).



- 43) After applying petroleum jelly to front ring gear thrust bearing (1) and front ring gear thrust bearing front race (2), install them to front planetary ring gear.



- 44) Install assembled direct clutch assembly (1), forward clutch assembly (2) and front planetary ring gear (3) as a unit to transmission case.

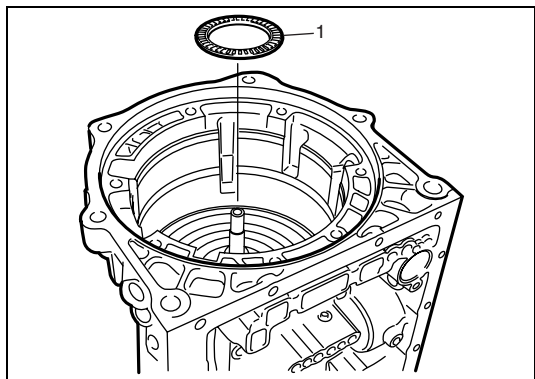


- 45) Measure distance between sun gear input drum (1) and direct clutch drum (2).

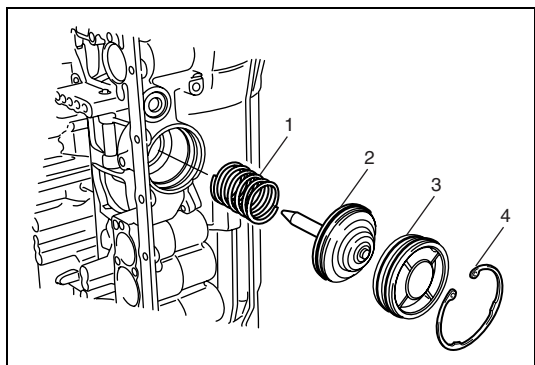
If distance is out of specification, check them for installation.

Distance between sun gear input drum and direct clutch drum

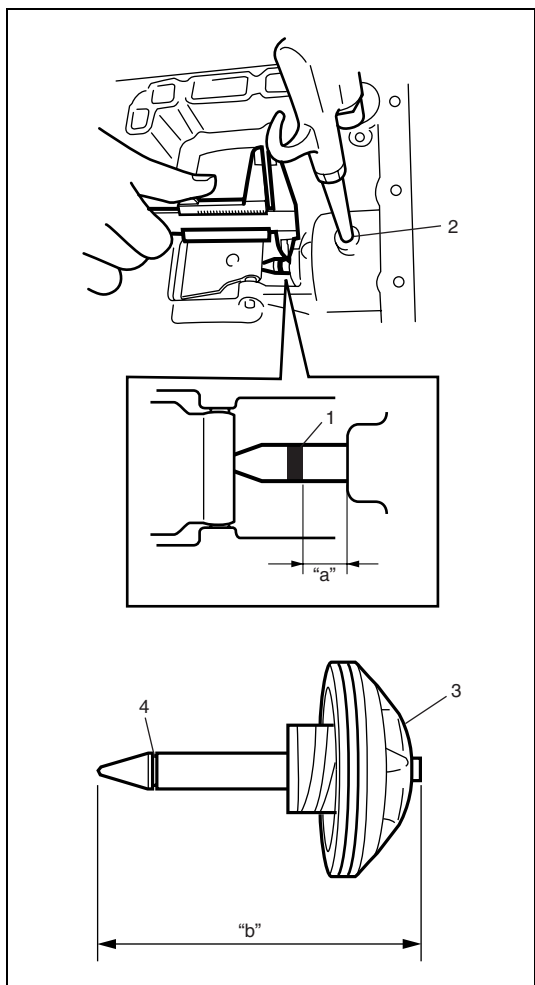
"a": 1.8 – 4.8 mm (0.071 – 0.188 in.)



- 46) After applying petroleum jelly to input shaft front thrust bearing (1), install it to forward clutch.



- 47) After applying A/T fluid to O-rings, install spring (1), 2nd coast brake piston assembly (2) and 2nd coast brake piston assembly cover (3) by installing snap ring (4).



- 48) Measure 2nd coast brake piston stroke as follows.
- Place a mark (1) on piston rod with waterproof pen.
 - Measure piston stroke while blowing compressed air (392 kPa, 4.0 kg/cm², 57 psi) into oil hole (2).

2nd coast brake piston stroke

“a”: 1.5 – 3.0 mm (0.059 – 0.118 in.)

- If stroke is more than specification, select another 2nd coast brake piston assembly (3) with suitable length from the list below and replace.

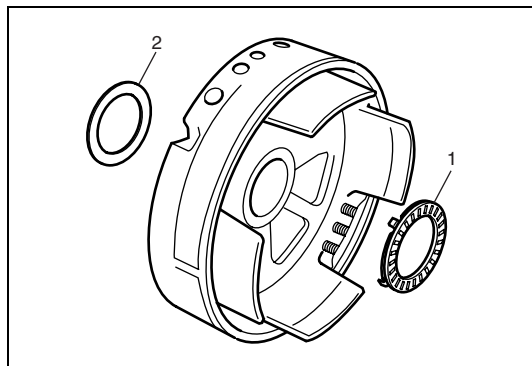
NOTE:

There are two kinds of 2nd coast brake piston assembly and those are distinguished by the number of piston rod groove (4).

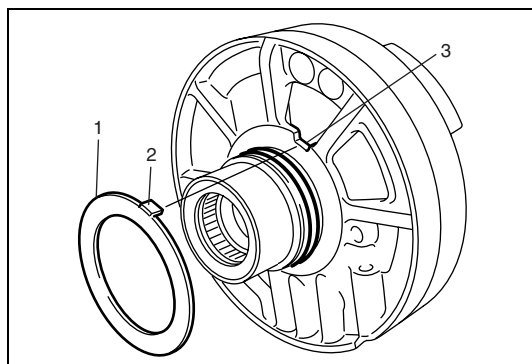
Available 2nd coast brake piston rod length “b”

Piston rod groove	Piston rod length
0	78.40 mm (3.087 in.)
1	79.90 mm (3.146 in.)

- If stroke is still more than specification, replace 2nd coast brake band with a new one.



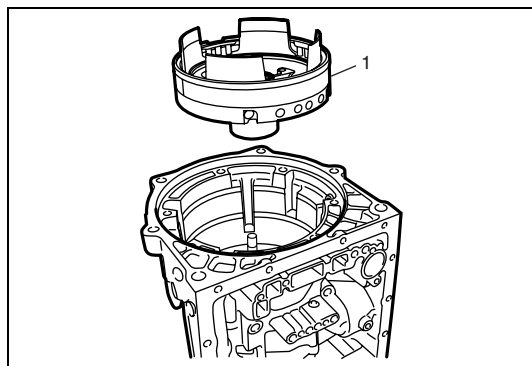
- 49) After applying petroleum jelly to O/D thrust No.3 thrust bearing (1) and input shaft front thrust bearing race (2), install them to O/D case assembly.



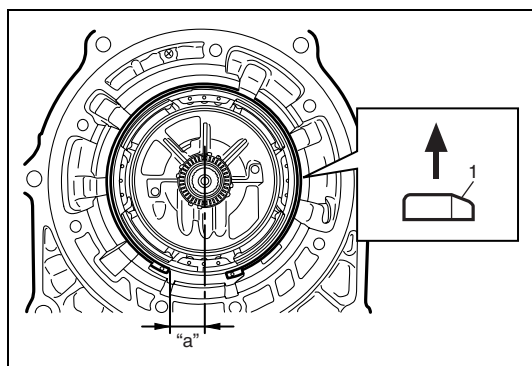
- 50) Install direct clutch thrust washer (1) to O/D case assembly.

NOTE:

Make sure that tab (2) of thrust washer fits into notch (3) of O/D case assembly.



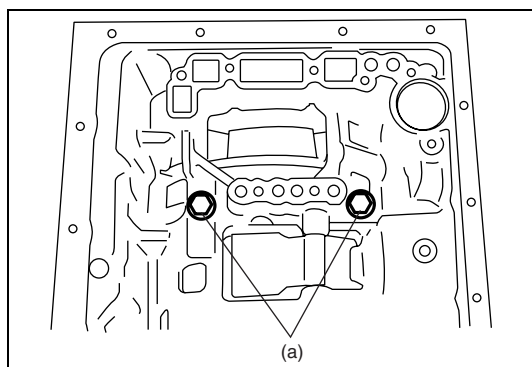
- 51) Install O/D case assembly (1) to transmission case aligning bolt holes of O/D case with bolt holes of transmission case, and then tighten O/D case bolts temporarily.



- 52) Install snap ring facing round edge (1) upward and positioning its end gap as specified below.

Snap ring installation position

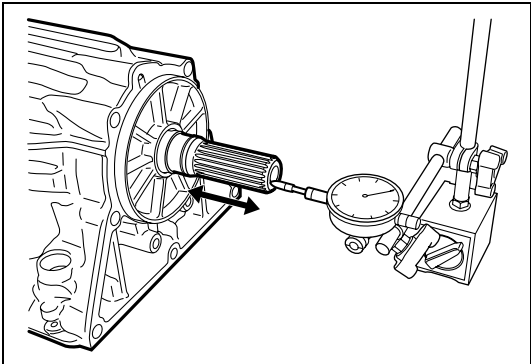
"a": 24 mm (0.94 in.)



- 53) Tighten O/D case bolts to specified torque.

Tightening torque

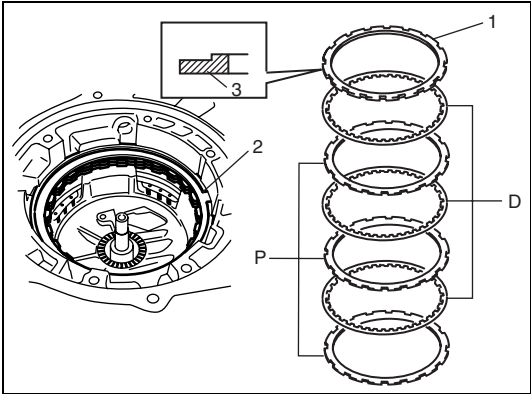
O/D case bolt (a): 25 N·m (2.5 kg·m, 18.0 lb·ft)



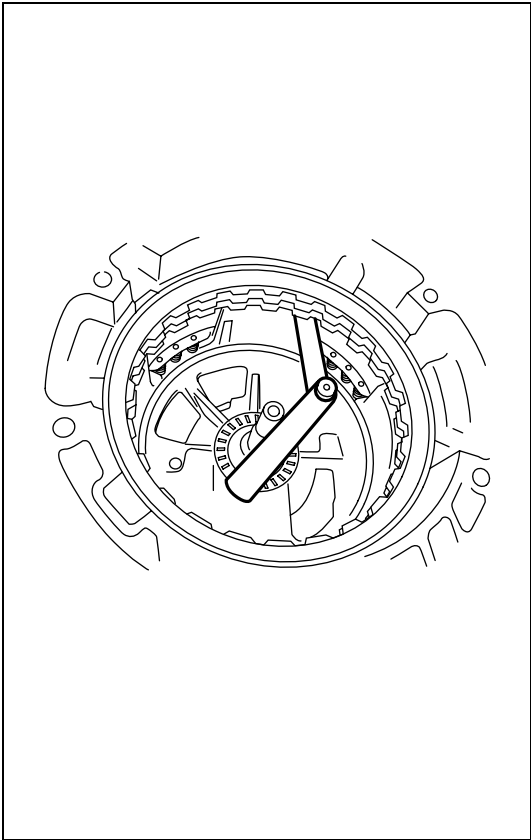
- 54) Measure end play of output shaft.
 If end play is out of specification, check it for installation.

Output shaft end play
0.30 – 1.04 mm (0.0119 – 0.0409 in.)

- 55) Check that output shaft rotates smoothly.



- 56) Install O/D brake plates “P” and O/D brake discs “D” in following order.
 P – D – P – D – P – D
- 57) Install O/D brake flange (1) with flat side (3) of flange facing to O/D brake disc side.
- 58) Install snap ring (2).

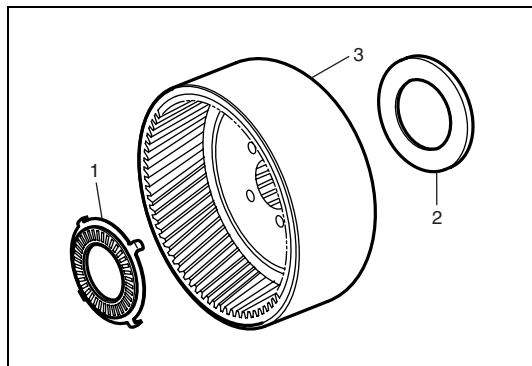


- 59) Measure O/D brake piston stroke between O/D brake piston and O/D brake plate by using thickness gauge.
 If piston stroke is less than specification, parts may have been assembled incorrectly, so check and reassemble them again. If piston stroke is more than specification, select another O/D brake flange with suitable thickness from the list below and replace it.

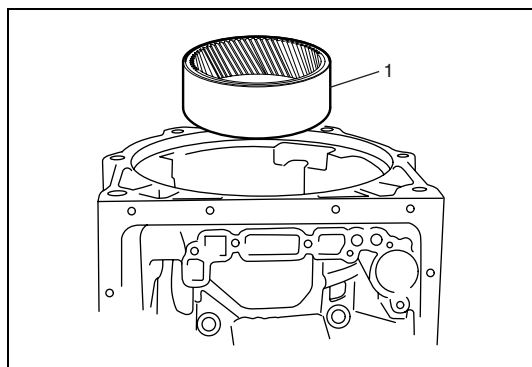
O/D brake piston stroke
1.32 – 1.62 mm (0.052 – 0.0637 in.)

Available O/D brake flange thickness

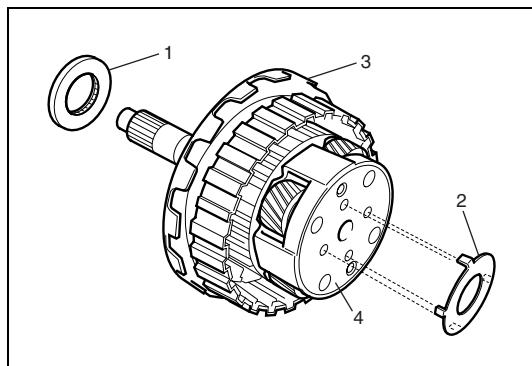
Identification No.	Thickness	Identification No.	Thickness
33	3.3 mm (0.130 in.)	38	3.8 mm (0.150 in.)
35	3.5 mm (0.138 in.)	39	3.9 mm (0.154 in.)
36	3.6 mm (0.142 in.)	40	4.0 mm (0.157 in.)
37	3.7 mm (0.146 in.)		



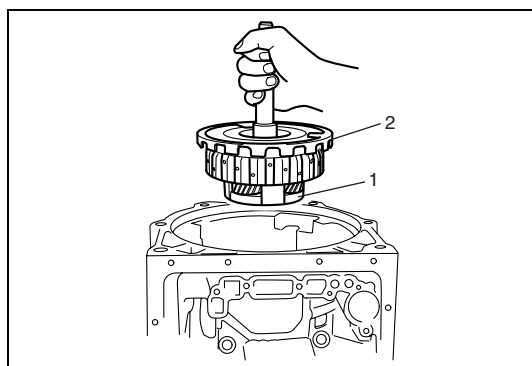
- 60) After applying petroleum jelly to O/D thrust No.2 bearing (1) and O/D thrust bearing No.3 race (2), install them to O/D planetary ring gear (3).



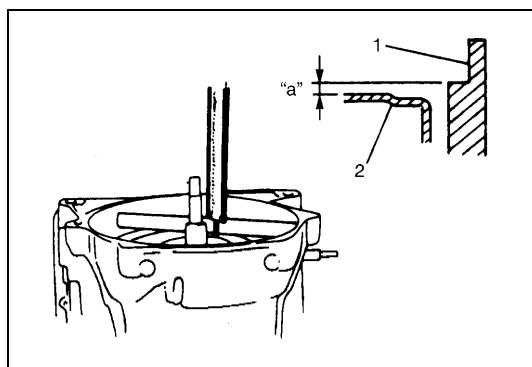
- 61) Install O/D planetary ring gear (1) to transmission case.



- 62) After applying petroleum jelly to O/D thrust No.1 bearing (1) and O/D thrust bearing No.2 race (2), install them to O/D clutch assembly (3) and O/D planetary gear assembly (4).



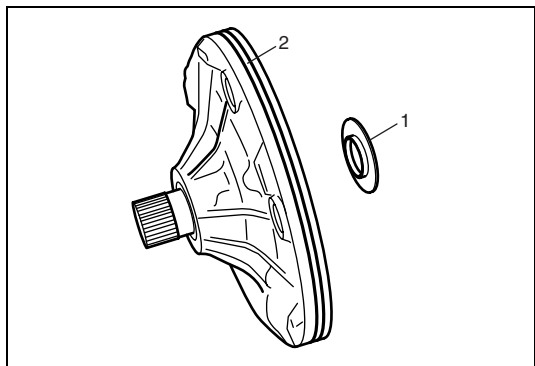
- 63) Install O/D planetary gear assembly (1), O/D clutch assembly (2) and one-way No.1 clutch assembly to transmission case.



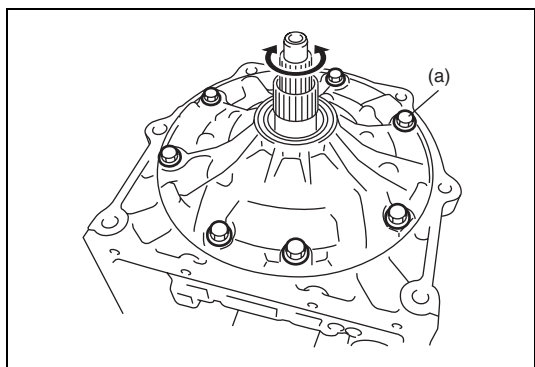
- 64) Check height difference between transmission case (1) and O/D clutch drum (2) by measuring as shown in the figure. If measured value is out of specification, check them for installation.

Standard height difference between transmission case and O/D clutch drum

"a": 15.5 – 16.5 mm (0.611 – 0.649 in.)



- 65) After applying petroleum jelly to O/D thrust bearing No.1 race (1), install it to oil pump assembly.
- 66) After applying A/T fluid to new O-ring (2), install it to oil pump assembly.

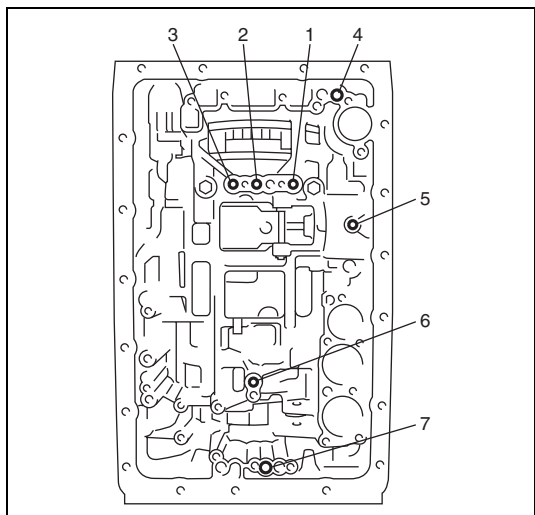


- 67) Install oil pump assembly aligning bolt holes in transmission case with oil pump assembly.
Tighten oil pump bolts by certain amount of torque at each time one after another till specified torque is attained.

Tightening torque

Oil pump bolt (a): 22 N·m (2.2 kg-m, 16.0 lb-ft)

- 68) Make sure input shaft rotates smoothly.

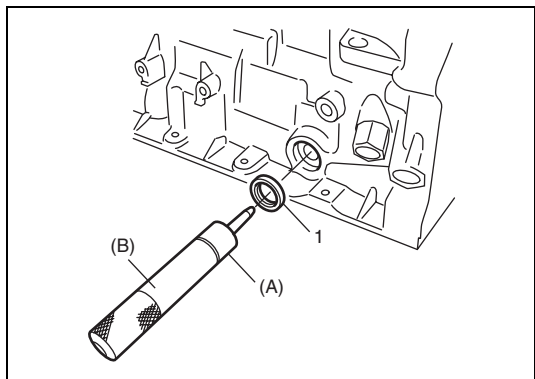


- 69) Blow compressed air into oil holes indicated in the figure.
If there is no sound, disassemble and check installation condition of parts.

NOTE:

When inspecting O/D clutch, check that O/D clutch accumulator piston hole is closed.

1. O/D brake	5. 2nd coast brake
2. Direct clutch	6. Forward brake
3. Forward clutch	7. Reverse brake
4. O/D clutch	

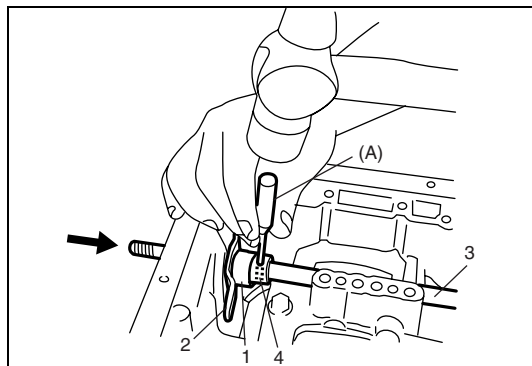


- 70) Install manual shift shaft oil seals (1) to transmission case by using special tools.

Special tool

(A): 09917-98221

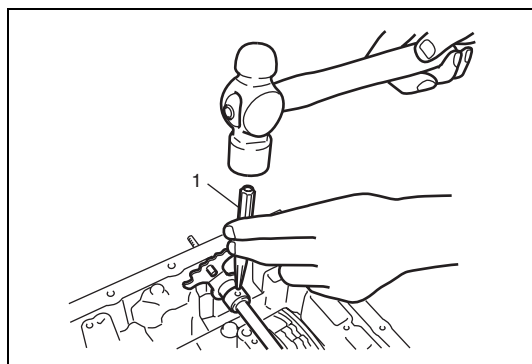
(B): 09916-57330



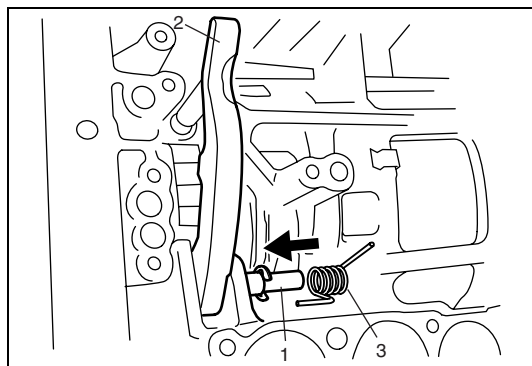
- 71) Install new sleeve cover (1) to manual shift lever (2).
- 72) Install manual shift shaft (3) to transmission case through manual shift lever.
- 73) Drive in manual shift lever pin (4) by using special tool and hammer.

Special tool

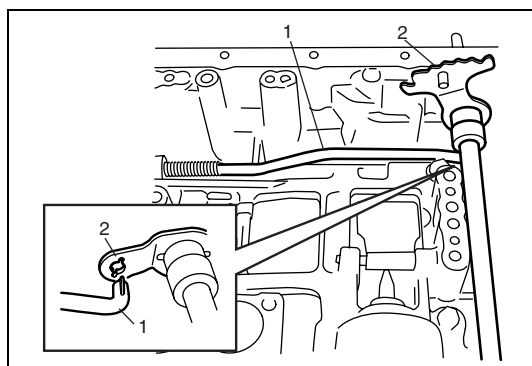
(A): 09922-85811



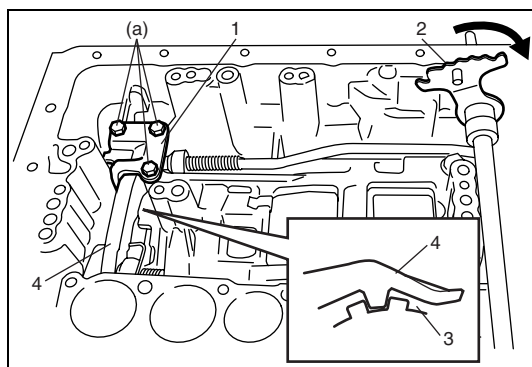
- 74) Align hole in sleeve cover with dent in manual shift lever and caulk securely with pin punch (1). Then check that manual shift shaft turns smoothly.



- 75) Install parking lock pawl (2), parking pawl pin (1) and parking pawl spring (3).



- 76) Connect parking lock rod (1) to manual shift lever (2).



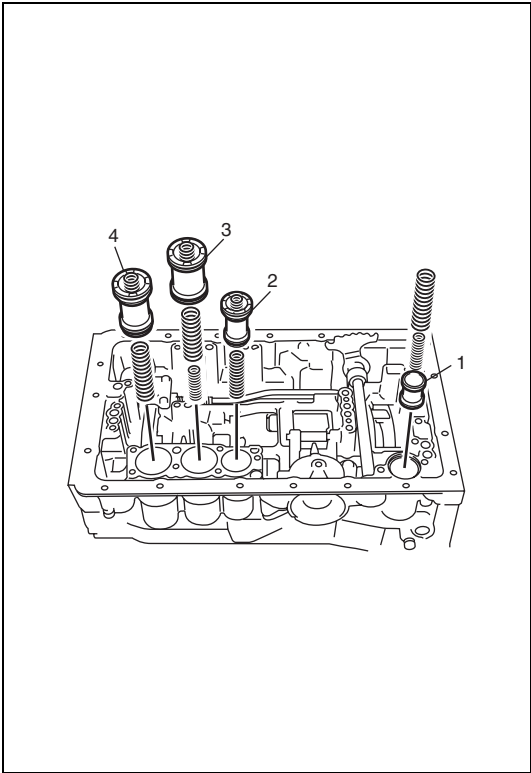
- 77) Install parking pawl bracket (1).
Tighten bolts to specified torque.

Tightening torque

Parking pawl bracket bolt

(a): 7.4 N·m (0.74 kg-m, 5.5 lb-ft)

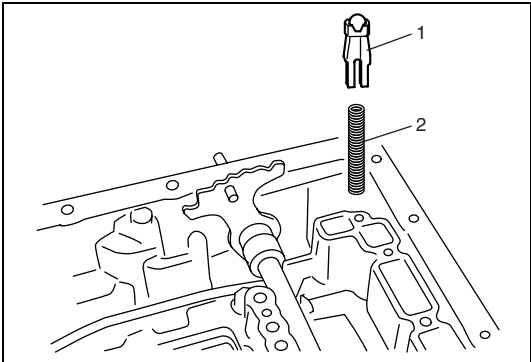
- 78) Turn manual shift lever (2) to "P" position, confirm that rear planetary ring gear (3) is correctly locked up by parking lock pawl (4).



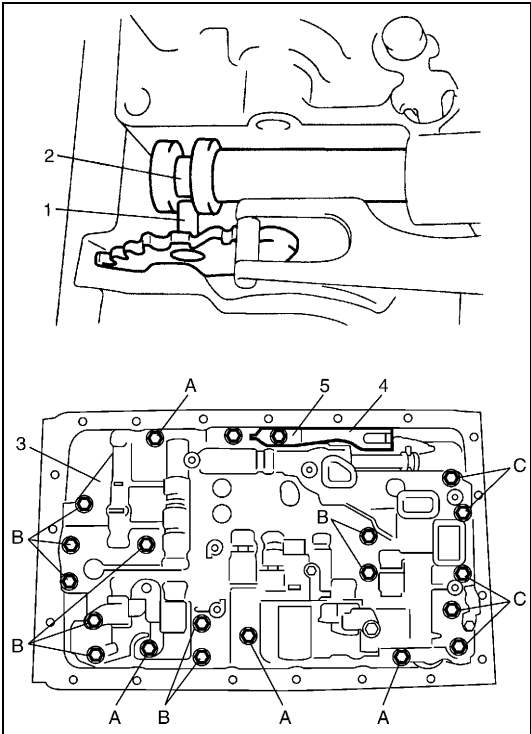
- 79) After applying A/T fluid to new O-rings, install them to accumulator pistons.
- 80) Install springs to transmission case.

Accumulator piston spring specification

Accumulator spring		Free length	Outside diameter	Identification painting
O/D clutch accumulator (1)	Inner	46.0 mm (1.811 in.)	14.02 mm (0.552 in.)	Yellow
	Outer	74.6 mm (2.937 in.)	20.9 mm (0.823 in.)	Orange
Forward clutch accumulator (2)		63.6 mm (2.504 in.)	16.0 mm (0.630 in.)	Red
Direct clutch accumulator (3)	Inner	42.1 mm (1.657 in.)	14.7 mm (0.579 in.)	Pink
	Outer	64.0 mm (2.520 in.)	20.2 mm (0.795 in.)	White/Pink
Forward brake accumulator (4)		70.5 mm (2.776 in.)	19.7 mm (0.776 in.)	Green



- 81) Install spring (2) and check ball body (1) to transmission case.



- 82) After confirming that accumulator piston is pushed all the way down, match pin (1) of manual shift lever with groove in manual valve (2).
- 83) Install valve body assembly (3) by using bolts noting their length shown below.

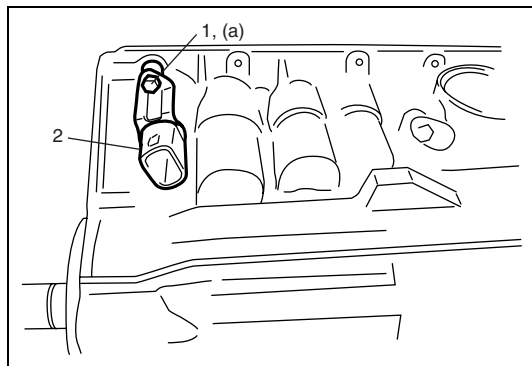
Tightening torque

Valve body bolt (a): 10 N·m (1.0 kg·m, 7.5 lb·ft)

Valve body bolt length

Bolt	Length	Pieces
A	23 mm (0.91 in.)	4
B	28 mm (1.10 in.)	10
C	36 mm (1.42 in.)	6

- 84) Install manual shift lever spring (4) and spring plate (5).

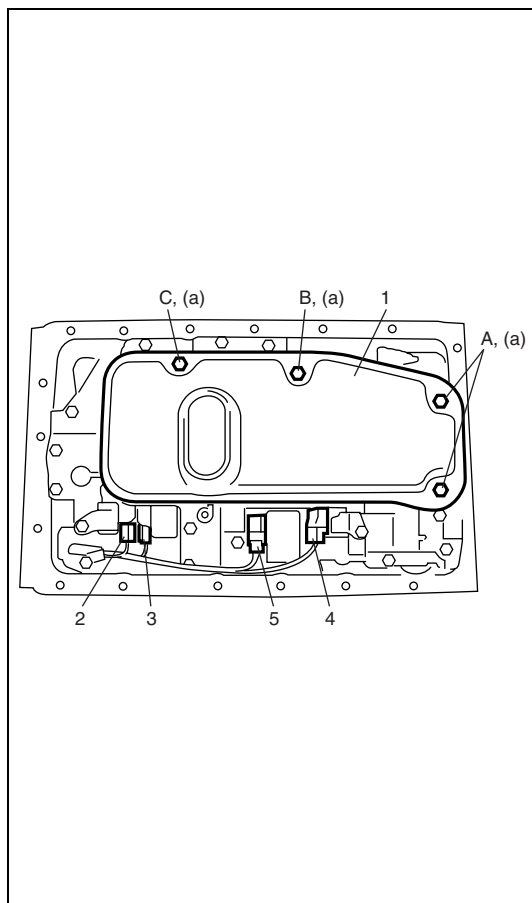


- 85) After applying A/T fluid to O-ring, install solenoid wire harness connector (2).

Tighten stopper plate bolt (1) to specified torque.

Tightening torque

Stopper plate bolt (a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)



- 86) Connect shift solenoid-A (No.1) connector (2), shift solenoid-B (No.2) connector (3), TCC solenoid connector (4) and pressure control solenoid connector (5) to each solenoid valve.

Shift solenoid valve connector and harness color

Solenoid valve	Connector color	Harness color
Shift solenoid-A (No.1)	White	White
Shift solenoid-B (No.2)	Black	Black
TCC solenoid	Black	Yellow
Pressure control solenoid	Black	Green and Orange

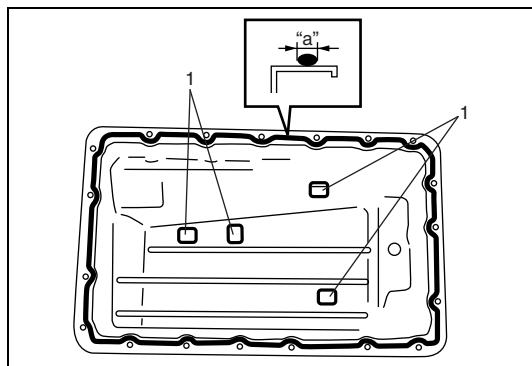
- 87) Install oil strainer (1) to valve body assembly. Tighten bolts to specified torque.

Oil strainer bolt length

Bolt	Length
A	14 mm (0.55 in.)
B	20 mm (0.79 in.)
C	23 mm (0.91 in.)

Tightening torque

Oil strainer bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



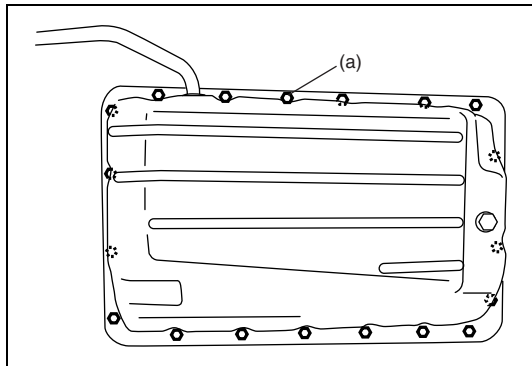
- 88) Install magnets (1) to oil pan.

- 89) Apply sealant continuously to oil pan mating surface as shown in figure.

“A” Sealant: 99000-31230

Sealant amount for oil pan

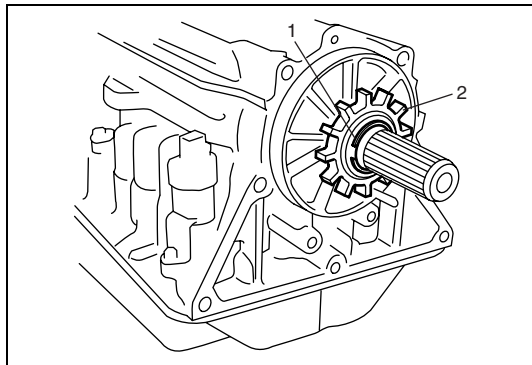
Width “a”: 2 – 3 mm (0.08 – 0.11 in.)



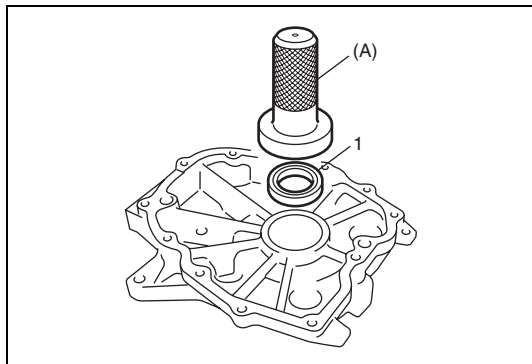
- 90) Install oil pan to transmission case.
Tighten bolts to specified torque.

Tightening torque

Oil pan bolt (a): 7.4 N·m (0.74 kg-m, 5.5 lb-ft)



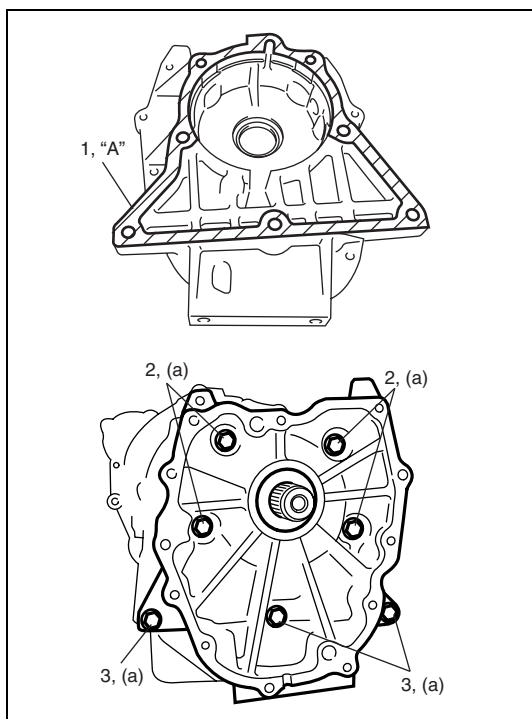
- 91) With key attached to output shaft, install speed sensor rotor (2) by aligning key groove with key and install C-ring (1).



- 92) If oil seal was removed, install new one (1) to adapter case by using special tool and hammer.

Special tool

(A): 09913-75520



- 93) Apply sealant continuously to adapter case (1) mating surface as shown in figure.

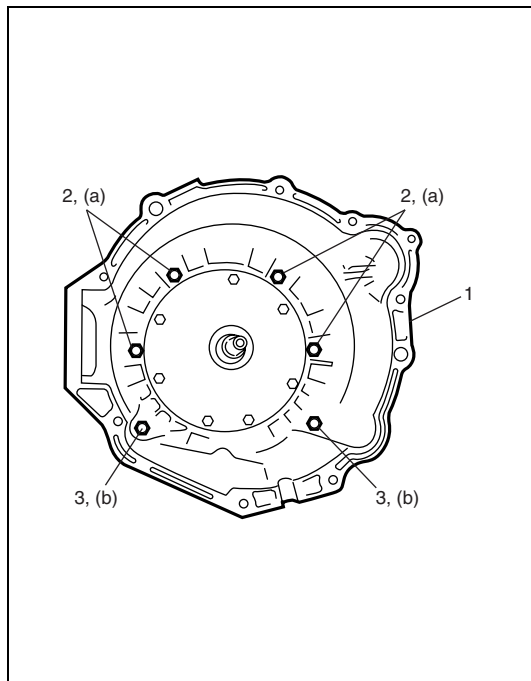
“A” Sealant: 99000-31230

- 94) Install adapter case (1) to transmission case.
Tighten bolts to specified torque.

Tightening torque

Adapter case bolt (a): 34 N·m (3.4 kg-m, 24.5 lb-ft)

2. Adapter case bolt 50 mm (1.969 in.)
3. Adapter case bolt 40 mm (1.575 in.)



- 95) Clean threads of converter housing bolts and bolt holes of transmission case, install converter housing (1) to transmission case.

- 96) Tighten bolts to specified torque.

NOTE:

Make sure to use new converter housing bolts (2) and (3).

Tightening torque

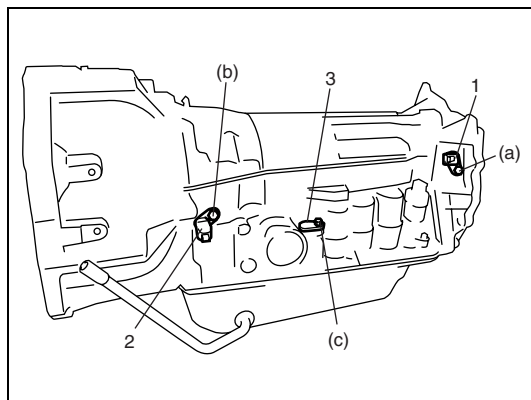
Converter housing bolt M10

(a): 34 N·m (3.4 kg-m, 24.5 lb-ft)

Converter housing bolt M12

(b): 57 N·m (5.7 kg-m, 41.5 lb-ft)

2. Converter housing bolt M10
3. Converter housing bolt M12



- 97) Install output shaft speed sensor (1), input shaft speed sensor (2) and transmission case plug (3).

Tighten bolts to specified torque.

Tightening torque

Output shaft speed sensor bolt

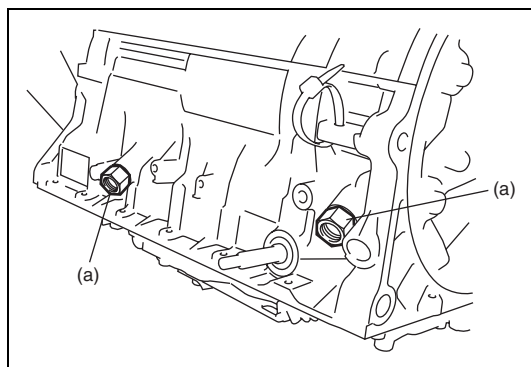
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

Input shaft speed sensor bolt

(b): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

Transmission case plug

(c): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)



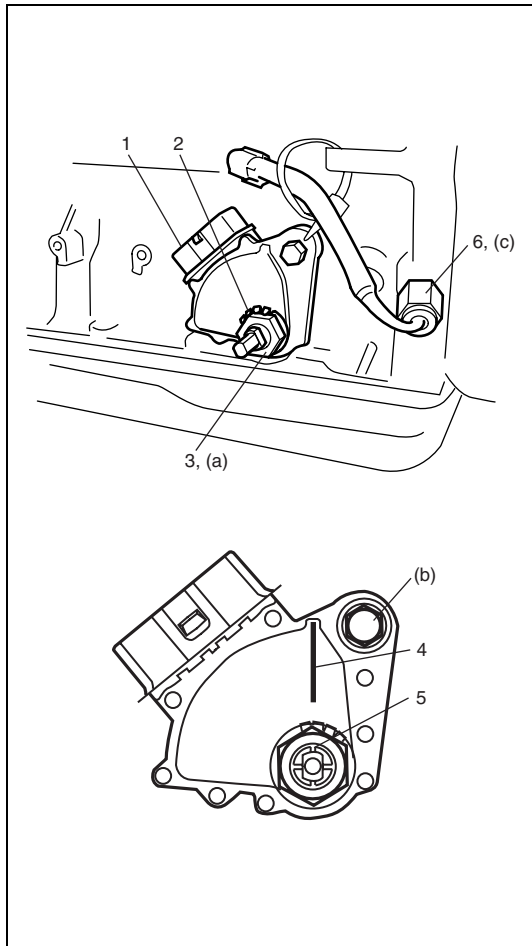
- 98) Apply A/T fluid to O-rings, install oil pipe unions, if removed.

Tighten unions to specified torque.

Tightening torque

Oil pipe union

(a): 29 N·m (2.9 kg-m, 21.0 lb-ft)



99) Install transmission range sensor (1) and tighten sensor bolt temporarily.

100) Install grommet, lock washer (2) and manual shift shaft nut (3).

Tighten nut to specified torque. After tightening it, bend claws of lock washer.

Tightening torque

Manual shift shaft nut

(a): 7 N·m (7.0 kg-m, 5.0 lb-ft)

101) After turning manual shift shaft fully counterclockwise, turn it clockwise by 2 notches and set it to "N" range.

102) With neutral reference line (4) and groove (5) in transmission range sensor aligned, tighten transmission range sensor bolt to specified torque.

Tightening torque

Transmission range sensor bolt

(b): 13 N·m (1.3 kg-m, 9.5 lb-ft)

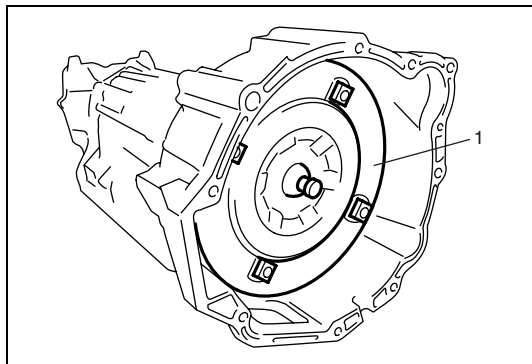
103) Apply A/T fluid to O-ring and install A/T fluid temperature sensor (6).

Tighten A/T fluid temperature sensor to specified torque.

Tightening torque

A/T fluid temperature sensor

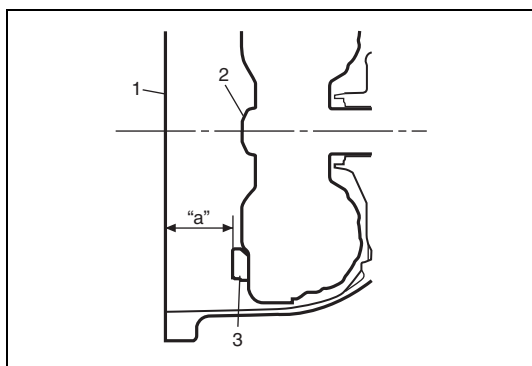
(c): 14.7 N·m (1.5 kg-m, 11.0 lb-ft)



104) Install torque converter (1) to input shaft.

CAUTION:

Install torque converter, using care not to damage oil seal lip of oil pump.



105) Confirm that torque converter is fully fitted in transmission.

Confirmation can be done by measuring dimension between end surface of converter housing (1) and drive plate installation seat (3).

Torque converter installing position

"a": 56.4 mm (2.22 in.)

106) Check that torque converter turns smoothly and feeds grease to centerpiece (2) of torque converter.

107) Connect breather hose to transmission case.

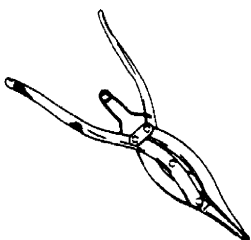
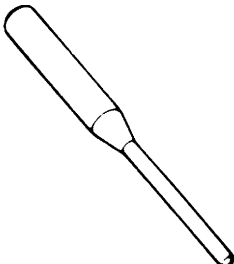
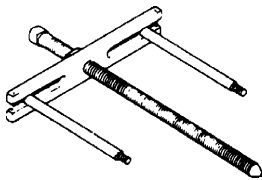
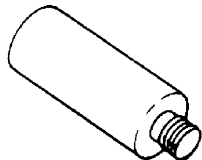
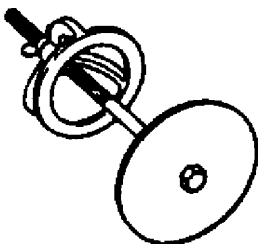
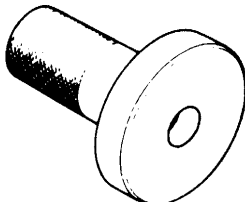
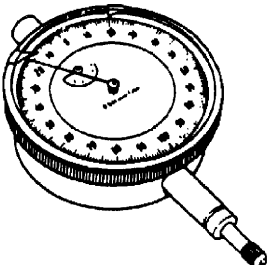
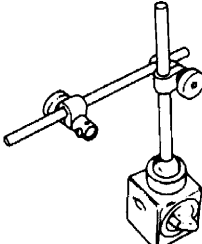
Tightening Torque Specifications

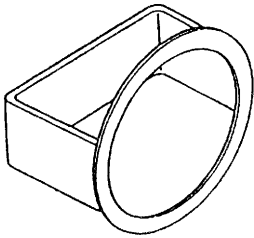
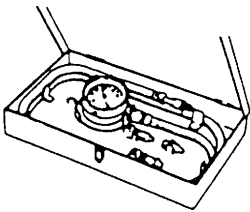
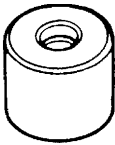
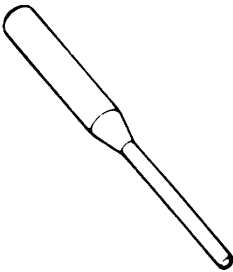
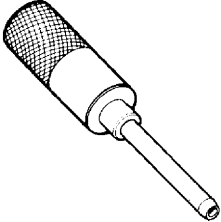
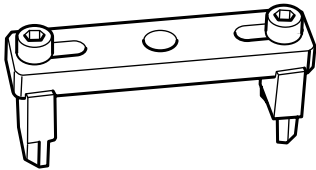
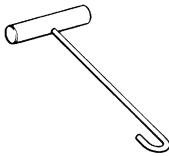
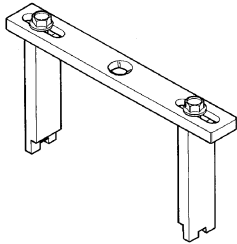
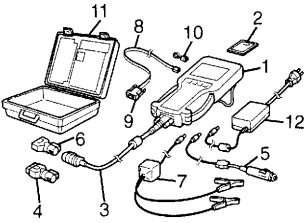
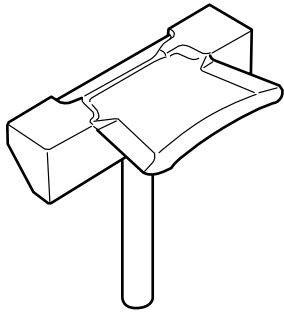
Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
A/T fluid drain plug	20	2.0	14.5
Oil hose clamp bracket bolt	23	2.3	17.0
Manual selector assembly mounting bolt	18	1.8	13.5
Manual select lever nut	13	1.3	9.5
Select cable end nut	19	1.9	14.0
Transmission range sensor bolt	13	1.3	9.5
Manual shift shaft nut	7	0.7	5.0
Input shaft speed sensor bolt	5.5	0.55	4.0
Output shaft speed sensor bolt	5.5	0.55	4.0
Rear mounting member bolt	55	5.5	40.0
Front propeller shaft universal joint flange bolt	50	5.0	36.5
Rear propeller shaft universal joint flange bolt	55	5.5	40.0
Exhaust No.2 pipe to turbocharger outlet pipe bolt	55	5.5	40.0
Muffler to exhaust No.2 pipe bolt or nut	55	5.5	40.0
A/T fluid temperature sensor	14.7	1.5	11.0
Oil cooler pipe union bolt	25	2.5	18.0
Torque converter mounting bolt	65	6.5	47.0
Transmission to engine bolt and nut	61	6.1	44.0
Drive plate bolt	50	5.0	36.5
Engine rear mounting bolt	55	5.5	40.0
Engine rear mounting member bolt	55	5.5	40.0
Stabilizer bar mount bush bracket bolt	23	2.3	17.0
Oil pump cover bolt	10	1.0	7.5
Shift solenoid-A (No.1) valve bolt	10	1.0	7.5
Shift solenoid-B (No.2) valve bolt	10	1.0	7.5
TCC (lock-up) solenoid valve bolt	10	1.0	7.5
O/D case bolt	25	2.5	18.0
Oil pump bolt	22	2.2	16.0
Parking pawl bracket bolt	7.4	0.74	5.5
Valve body bolt	10	1.0	7.5
Stopper plate bolt	5.5	0.55	4.0
Oil strainer bolt	10	1.0	7.5
Oil pan bolt	7.4	0.74	5.5
Adapter case bolt	34	3.4	24.5
Converter housing bolt M10	34	3.4	24.5
Converter housing bolt M12	57	5.7	41.5
Transmission case plug	5.5	0.55	4.0
Oil pipe union	29	2.9	21.0
Strut tower bar bolt	50	5.0	36.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
A/T fluid	Refer to Section 0B	- Automatic transmission - Parts lubrication when installing - Solenoid valve O-ring - A/T fluid temperature sensor O-ring
Lithium grease	SUZUKI SUPER GREASE C (99000-25030)	- Retaining parts in place when assembling - Oil seal lips - Oil pump O-ring
	SUZUKI SUPER GREASE A (99000-25010)	Cable ends
Sealant	SUZUKI BOND NO.1216B (99000-31230)	- Mating surface of adapter case - Mating surface of oil pan

Special Tool

 09920-76010 Snap ring opener	 09922-89810 Spring pin remover	 09918-48211 Oil pump remover	 09918-48220 Oil pump remover attachment (M8)
 09922-86010 Clutch piston compressor	 09913-75520 Bearing installer	 09900-20607 Dial gauge	 09900-20701 Magnetic stand

 09926-96010 Clutch spring compressor	 09925-37811-001 Oil pressure gauge	 09917-98221 Valve stem seal installer	 09922-85811 Spring pin remover
 09916-57330 Valve guide installer	 09926-96520 Spring compressor	 09920-20310 Clutch spring hook	 09941-51010 Lock ring wrench
 Tech 2 kit (SUZUKI scan tool) See MOTE below.	 09921-96510 Oil pan seal cutter		

NOTE:

This kit includes the following items and substitutes for the Tech 1 kit.

1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 7C1

CLUTCH

7C1

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

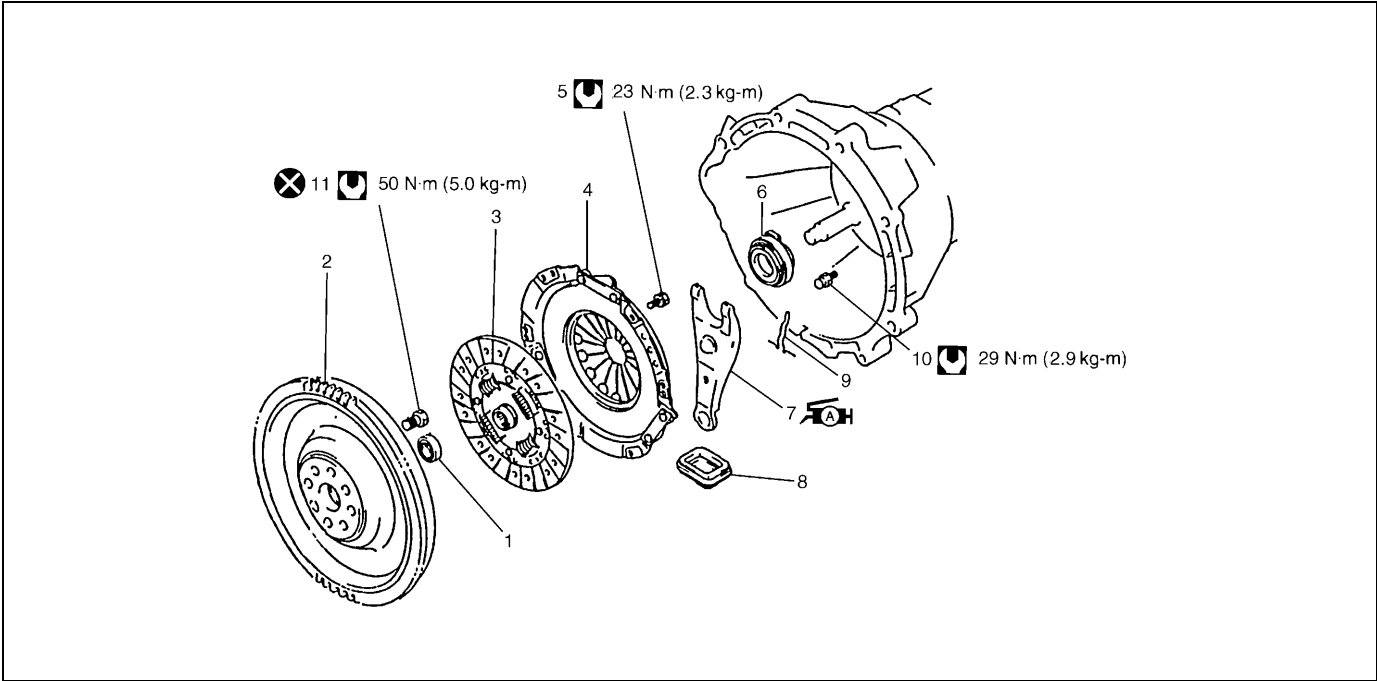
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Clutch Pedal Free Travel	*	Special Tool	7C1-6
Clutch Fluid Pipe and Hose	*		
Clutch Master Cylinder	*		

Unit Pepair

Clutch Cover, Clutch Disc and Flywheel

COMPONENTS

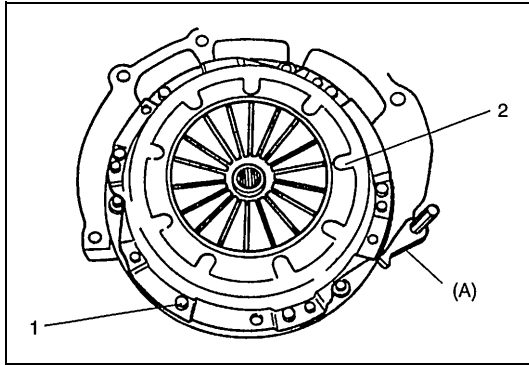


1. Input shaft bearing	6. Release bearing	11. Flywheel bolt
2. Flywheel	7. Clutch release fork Apply grease 99000-25010 to contact part with release bearing	Tightening torque
3. Clutch disc	8. Boot	Do not reuse.
4. Clutch cover	9. Clip	
5. Bolt	10. Clutch release fork support Apply grease 99000-25010 to contact part with clutch release fork	

DISMOUNTING/REMOUNTING

Refer to “Dismounting/Remounting of Transmission Unit” in Section 7A2.

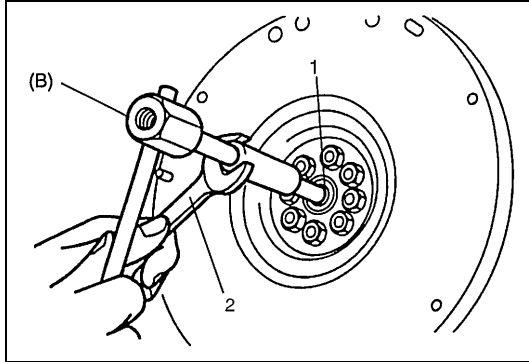
REMOVAL



- 1) Hold flywheel stationary with special tool (A) and remove clutch cover bolts (1), clutch cover (2) and clutch disc.

Special tool

(A): 09924-17810



- 2) Pull out input shaft bearing (1) by using special tool (B) and wrench (2).

Special tool

(B): 09923-73210

- 3) Remove release bearing and release fork.

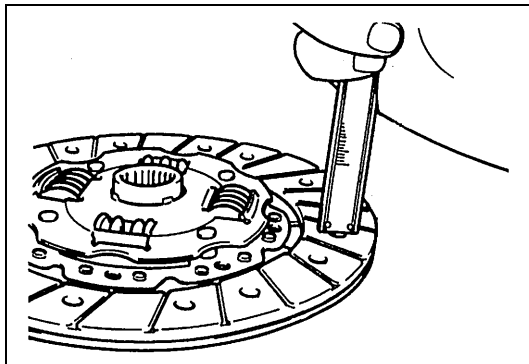
INSPECTION

Input Shaft Bearing and Release Bearing

Check bearing for smooth rotation and replace it if abnormality is found.

Clutch Disc

Measure depth of rivet head depression, i.e. distance between rivet head and facing surface. If depression is found to have reached service limit at any of holes, replace disc assembly.



Rivet head depth

Standard: 1.6 mm (0.06 in.)

Service limit: 0.5 mm (0.02 in.)

Clutch Cover

- 1) Check diaphragm spring for abnormal wear or damage.
- 2) Inspect pressure plate for wear or heat spots.
- 3) If abnormality is found, replace it as assembly. Do not disassemble it into diaphragm and pressure plate.

Flywheel

Check surface contacting clutch disc for abnormal wear or heat spots. Replace or repair as required.

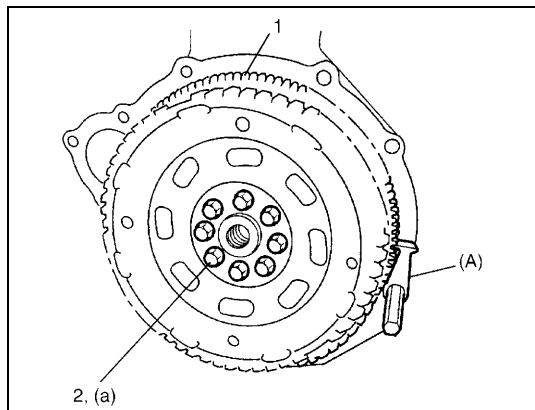
INSTALLATION

CAUTION:

Do not reuse flywheel bolts. Otherwise, engine oil may leak. Be sure to use new bolts with pre-coated adhesive.

NOTE:

Before assembling, make sure that flywheel surface and pressure plate surface have been cleaned and dried thoroughly.



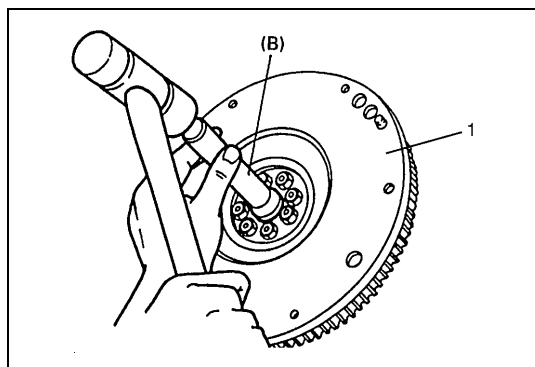
- 1) Install flywheel (1) to crankshaft and tighten new bolts (2) to specified torque.

Special tool

(A): 09924-17810

Tightening torque

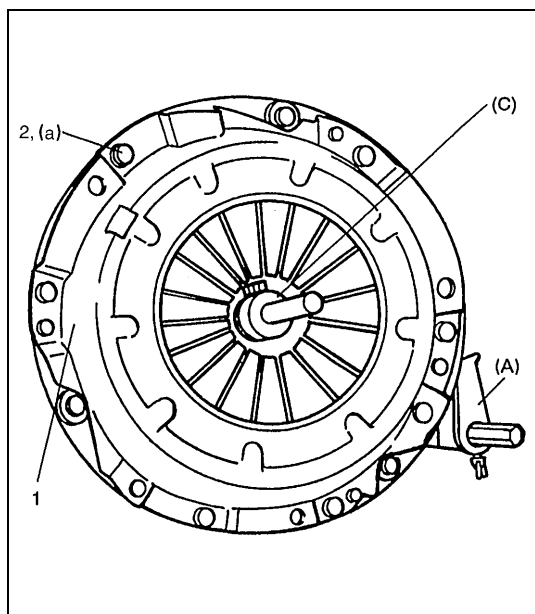
Flywheel bolt (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)



- 2) Using special tool (B), install input shaft bearing to flywheel (1).

Special tool

(B): 09925-98210



- 3) Aligning clutch disc to flywheel center by using special tool (C), install clutch cover (1) and bolts (2). Then tighten bolts to specification.

NOTE:

- While tightening clutch cover bolts (2), compress clutch disc with special tool (C) by hand so that disc centered.
- Tighten cover bolts little by little evenly in diagonal order.

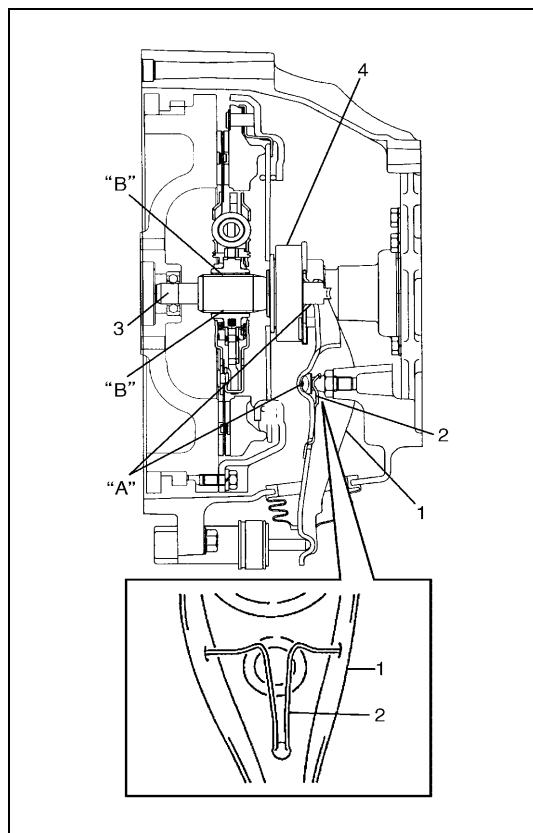
Special tool

(A): 09924-17810

(C): 09923-36320

Tightening torque

Clutch cover bolt (a): 23 N·m (2.3 kg-m, 16.5 lb-ft)



4) Install clip (2) to release fork (1), and apply grease to release fork (1).

Then install release fork (1) and release bearing (4) as shown in figure.

“A”: Grease 99000-25010

5) Slightly apply grease to spline of input shaft (3). Then join transmission assembly with engine referring to “Remounting of Transmission” in Section 7A2.

“B”: Grease 99000-25210

NOTE:

Insert transmission input shaft (3) to clutch disc turning crankshaft pulley with wrench so that splines mesh.

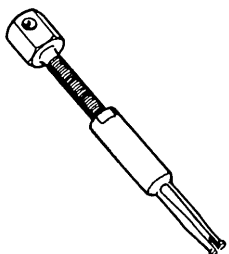
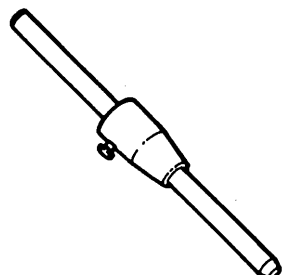
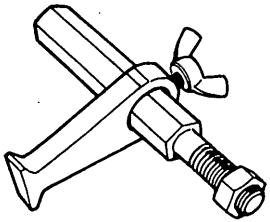
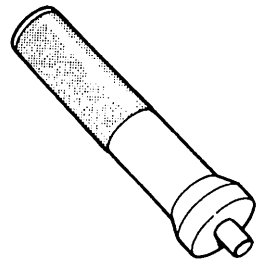
Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Flare nut	16	1.6	11.5
Master cylinder nut	13	1.3	9.5
Lock nut	18	1.8	13.0
Flywheel bolts	50	5.0	36.5
Flywheel bolts (J20, H25 and H27 engines)	70	7.0	50.5
Clutch cover bolts	23	2.3	16.5
Clutch release fork support	29	2.9	21.0
Clutch hose union bolt	23	2.3	16.5
Clutch operating cylinder bolt	50	5.0	36.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Clutch master cylinder clevis pin. • Release fork. • Push rod tip of clutch operating cylinder.
	SUZUKI SUPER GREASE I (99000-25210)	Input shaft spline front end.
Clutch fluid (Brake fluid)	DOT3 or SAE J1703	• Clutch reservoir.
		• Clutch master cylinder.
		• Clutch operating cylinder.
Sealant	SUZUKI BOND No.1215 (99000-31110)	Flywheel bolts

Special Tool

 09923-73210 Bearing remover	 09923-36320 Clutch center guide	 09924-17810 Flywheel holder	 09925-98210 Input shaft bearing installer

SECTION 7E

DIFFERENTIAL (FRONT)

7E

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

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General Description

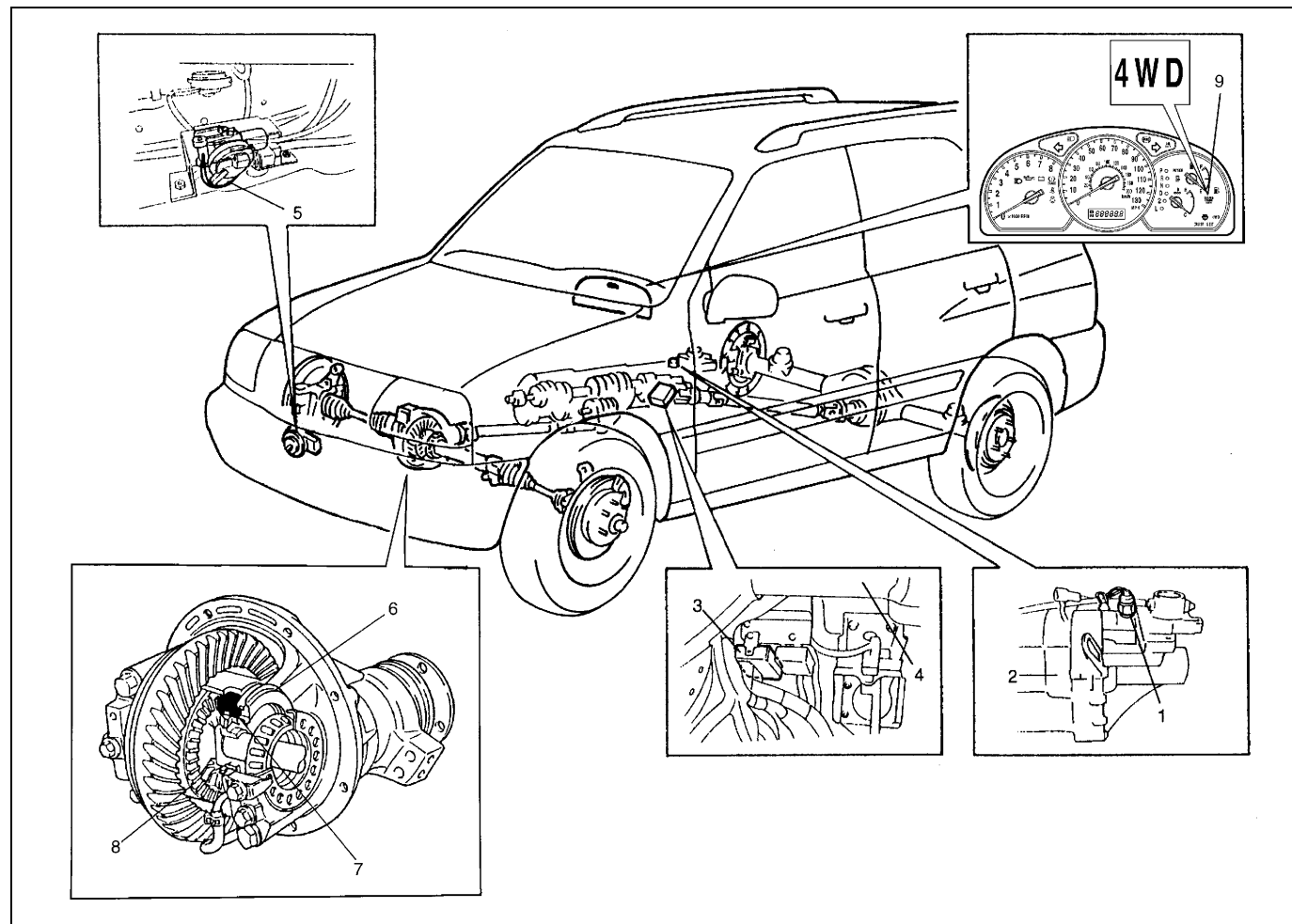
The differential assembly using a hypoid bevel pinion and gear is installed to the front axle.

4WD control system controls drive force to be transmitted to front axles or not. The reduction ratio varies depending on transmission or engine type.

The differential assembly is decisive in that the drive power is concentrated there. Therefore, use of genuine parts and specified torque is compulsory. Further, because of sliding tooth meshing with high pressure between bevel pinion and gear, it is mandatory to lubricate them by hypoid gear oil.

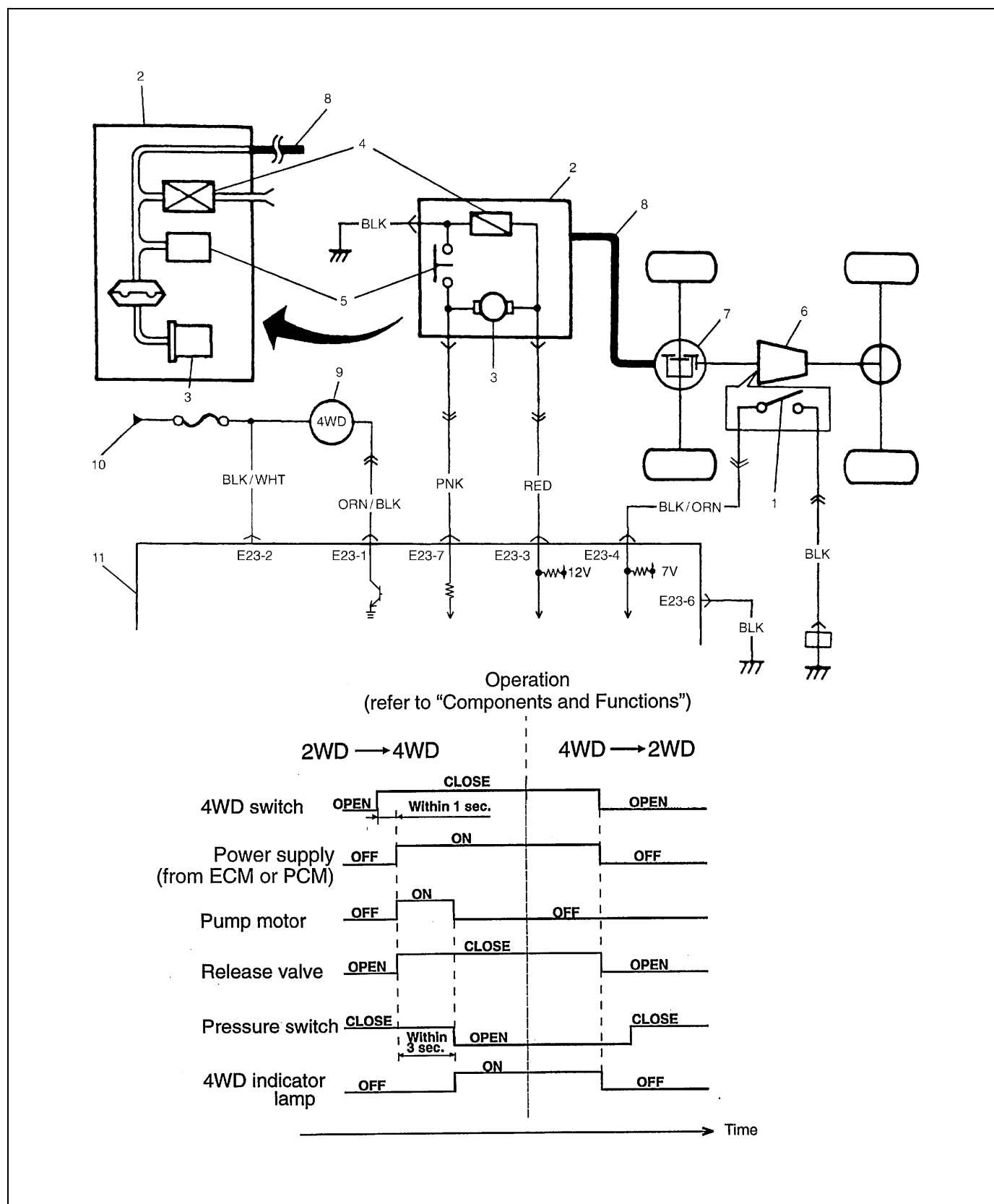
4WD Control System

When the 4WD switch is turned ON by shifting the transfer shift lever, 4WD controller actuates (energizes) the air pump assembly. Then positive pressure is sent from the air pump assembly to the actuator installed to the differential case and causes the axle lock clutch and the free axle hub in the differential case to be engaged, resulting in the 4WD mode. Only when running in the 4WD mode, front axles are joined to differential case, and they become free when 2WD mode is used (or when transfer shift lever is shifted to N position), thereby reducing the power loss.



1. 4WD switch	4. Steering support member	7. Axle lock clutch
2. Transfer	5. Air pump assembly	8. Free axle hub
3. 4WD controller	6. Actuator	9. 4WD indicator lamp

System circuit and operation



1. 4WD switch	4. Release valve	7. Front differential	10. To ignition switch
2. Air pump assembly	5. Pressure switch	8. Air hose and pipe	11. 4WD controller
3. Pump motor	6. Transfer	9. 4WD indicator lamp	

Components and functions

Component	Function
4WD switch	When the transfer shift lever is shifted to 4L or 4H position, this switch turns ON and causes the 4WD control system to turn ON, unless it is shifted to N or 2H within 1 second.
4WD controller	When the 4WD switch turns ON [unless it turns OFF within 1 second], this controller actuates the air pump assembly. If the pressure in the air pump assembly fails to increase higher than the set level even after the pump motor has run more than 10 seconds, this controller stops the motor to protect the air pump assembly.
Air pump assembly • Pump motor • Release valve • Pressure switch	The air pump assembly consists of a pump motor, release valve and a pressure switch. Pump motor : Produces positive pressure which actuates the actuator. Release valve : Closes when transfer shift lever is shifted to 4H or 4L so that the positive pressure is applied to the actuator, and opens when N or 2H to release the pressure to the atmosphere. Pressure switch : Turns ON and OFF depending on the pressure level in the pump assembly (whether higher or lower than the set pressure level). 4WD controller detects the pressure level through this switch.
Differential case assembly • Free axle hub • Axle lock clutch • Actuator	The free axle hub, axle lock clutch and actuator are installed in the differential left case. The positive pressure produced in the air pump assembly is applied to the actuator which then pushes the axle lock clutch to be engaged with the free axle hub. In this state, the drive force is transmitted to the front axle, resulting in the 4WD mode. When the actuator is free from the positive pressure [when it is under the atmospheric pressure], the axle lock clutch is pushed back by the return spring force and cannot be engaged with the free axle hub, resulting in the 2WD mode.
"4WD" indicator lamp	It lights up when 4WD control system is in the 4WD mode.

Diagnosis

Diagnosis Table

Differential assembly

Condition	Possible Cause	Correction
Gear noise	Deteriorated or water mixed lubricant	Repair and replenish.
	Inadequate or insufficient lubricant	Repair and replenish.
	Maladjusted backlash between bevel pinion and gear	Adjust.
	Improper tooth contact in the mesh between bevel pinion and gear	Adjust or replace.
	Loose bevel gear securing bolts	Replace or retighten.
	Damaged side gear(s) or side pinion(s)	Replace.
Bearing noise	(Constant noise) Deteriorated or water mixed lubricant	Repair and replenish.
	(Constant noise) Inadequate or insufficient lubricant	Repair and replenish.
	(Noise while coasting) Damaged bearing(s) of bevel pinion	Replace.
	(Noise while turning) Damaged diff. side bearing(s) or axle bearing(s)	Replace.
Oil leakage	Worn or damaged oil seal	Replace.
	Excessive oil	Adjust oil level.
	Loose differential carrier bolts	Replace or retighten.
2WD/4WD switching error	Defective actuator	Replace.
	Abnormality in 4WD control system	Inspect referring to "4WD control system diagnostic flow table".

4WD control system diagnostic flow table

Before performing the trouble diagnosis, check that the transfer and front differential are in good condition.

[NOTES ON SYSTEM CIRCUIT INSPECTION]

- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before circuit inspection and observe what is written there.
- For system circuit, refer to the figure of "System circuit and operation" in this section.
- For terminal arrangement, refer to "4WD Control Circuit Inspection" in this section.

Step	Action	Yes	No
1	Inspect 4WD control system for air leakage and operation referring to "4WD control system" under "Inspection" in this section. Is the result OK?	Go to step 2.	Inspect for air leakage from air hoses. If OK, go to Step 3.

Step	Action	Yes	No
2	Inspect actuator for air leakage and operation referring to "Actuator" under "Inspection" in this section. Is the result OK?	4WD control system and actuator are OK. Recheck transfer and front differential.	Inspect for air leakage from air hoses. If OK, inspect differential assembly referring to Section 7E in UNIT REPAIR MANUAL.
3	Inspect air pump assembly for air leakage and operation referring to "Air pump assembly" under "Inspection" in this section. Is the result OK?	Go to step 4.	Replace air pump assembly.
4	Check ground circuit. 1) Disconnect connector from 4WD controller with ignition switch OFF. 2) Check for proper connection to 4WD controller at all terminal. 3) If OK, check continuity between terminal E23-6 and body ground. Is there continuity between terminal E23-6 and body ground?	Go to step 5.	"BLK" wire is open.
5	Check power circuit. 1) Disconnect connector from 4WD controller. 2) Turn ignition switch ON. 3) Check voltage between terminal E23-2 and ground. Is it 10 – 14 V?	Go to step 6.	"BLK/WHT" circuit is open or short.
6	Check 4WD switch circuit. 1) Connect coupler to 4WD controller. 2) Turn ignition switch ON and check voltage between terminal E23-4 and ground. Transfer lever is in "N" or "2H": 6 – 8 V Transfer lever is in "4L" or "4H": 0 – 1 V Is the result OK?	Go to step 7.	Check 4WD switch (referring to "4WD switch and back up light switch inspection" under "Switches")., "BLK/ORN" and "BLK" circuit of 4WD switch. If OK, substitute a known-good 4WD controller and recheck.
7	Check 4WD controller. 1) Turn ignition switch ON. 2) Check voltage between terminal E23-3 and ground. Transfer lever is in "N" or "2H": 0 – 1 V Transfer lever is in "4L" or "4H": 10 – 14 V (1 second after transfer lever is shifted to "4H" or "4L".) Is the result OK?	Go to step 8.	Substitute a known-good 4WD controller and recheck.

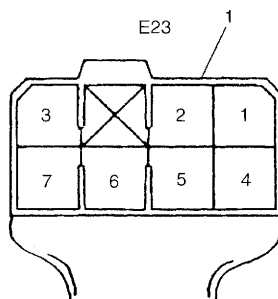
Step	Action	Yes	No
8	Check 4WD controller. 1) Check for proper connection to air pump assembly at all terminals. 2) Turn ignition switch ON. 3) Check voltage between terminal E23-7 and ground. Transfer lever is in "N" or "2H": 0 – 1 V Transfer lever is in "4L" or "4H": 10 – 14 V (4 seconds after transfer lever is shifted to "4H" or "4L".) Is the result OK?	Go to step 9.	Substitute a known-good 4WD controller and recheck.
9	Check 4WD indicator lamp circuit. 1) Turn ignition switch ON. 2) Check voltage between terminal E23-1 and ground. Transfer lever is in "N" or "2H": 10 – 14 V Transfer lever is in "4L" or "4H": 0 – 1 V (4 seconds after transfer lever is shifted to "4H" or "4L".) Is the result OK?	Substitute a known-good 4WD controller and recheck.	Check "ORN/BLK" circuit (including indicator lamp and combination meter). If OK, substitute a known-good 4WD controller and recheck.

4WD Control Circuit Inspection

Voltage check

Check for input or output voltage (voltage between each circuit and body ground) of 4WD controller with 4WD controller connector connected and ignition switch turned ON.

TERMI- NAL	CIRCUIT	WIRE COLOR	NORMAL VOLT- AGE	CONDITION
E23-1	4WD indicator lamp	ORN/BLK	10 – 14 V	Transfer shift lever: 2H or N
			0 – 1 V	4 seconds after transfer shift lever shifted to 4H or 4L
E23-2	Ignition switch	BLK/WHT	10 – 14 V	Ignition switch: ON
E23-3	Air pump assembly (Pump motor and release valve)	RED	0 – 1 V	Transfer shift lever: 2H or N
			10 – 14 V	1 seconds after transfer shift lever shifted to 4H or 4L
E23-4	4WD switch	BLK/ORN	6 – 8 V	Transfer shift lever: 2H or N
			0 – 1 V	Transfer shift lever: 4H or 4L
E23-6	Ground	BLK	0 – 1 V	–
E23-7	Air pump assembly (pressure switch)	PNK	0 – 1 V	Transfer shift lever: 2H or N
			10 – 14 V	4 seconds after transfer shift lever shifted to 4H or 4L



1. 4WD controller connector terminal arrangement

On-Vehicle Service

Maintenance Service

NOTE:

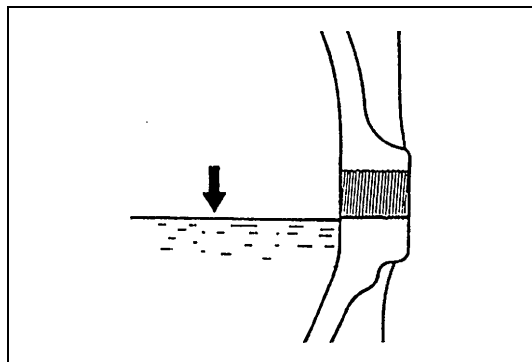
- When having driven through water, check immediately if water has entered (if so, oil is cloudy). Water mixed oil must be changed at once.
- Whenever vehicle is hoisted for any other service work than oil change, also be sure to check for oil leakage and status of breather hoses.

Gear oil change

NOTE:

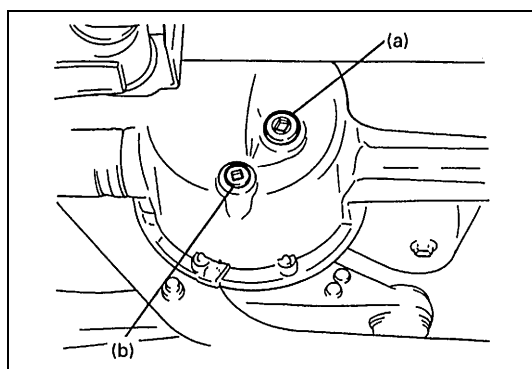
- Hypoid gear oil must be used for differential.
- It is highly recommended to use SAE 75W-90 (API GL-4) viscosity.

1) Before oil change or inspection, be sure to stop engine and lift up vehicle horizontally.



2) Check for oil level and leakage. If leakage is found, find the cause of the leakage and fix it.

3) Drain old oil and pour proper amount of gear oil as specified as shown (roughly up to level hole).



4) Apply sealant to thread of differential oil drain plug (b) and torque plugs to specification.

Sealant 99000-31110

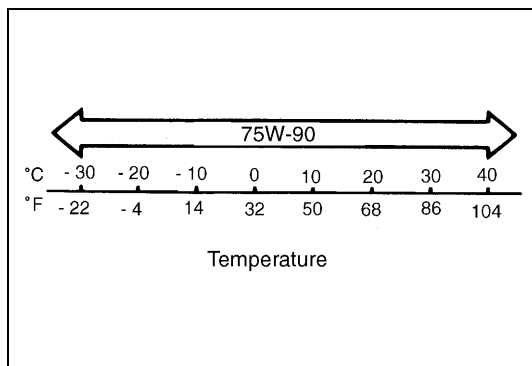
Tightening torque

Differential oil level/filler plug

(a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)

Differential oil drain plug

(b) : 23 N·m (2.3 kg-m, 17.0 lb-ft)



Specified gear oil :

Hypoid gear oil API GL-4

SAE 75W-90

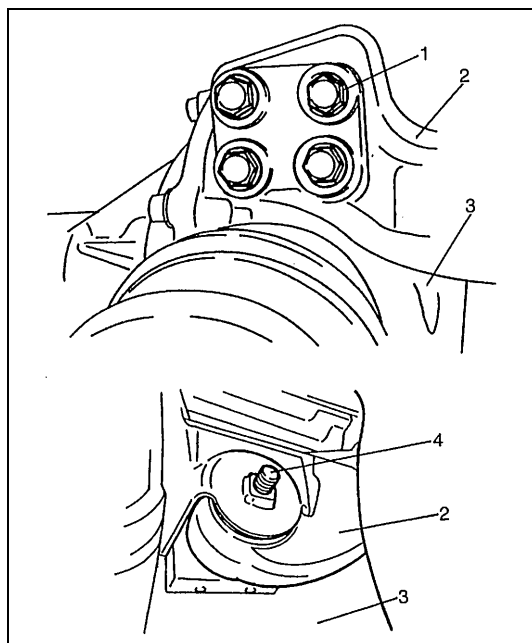
For oil viscosity, refer to left chart.

Oil capacity :

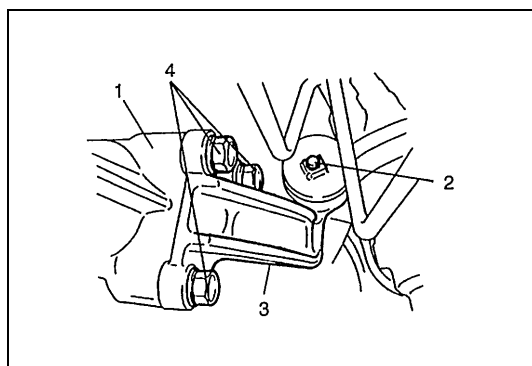
1.1 liter (2.3/1.9 US pt/Imp. pt)

Removal and Installation

Differential mountings

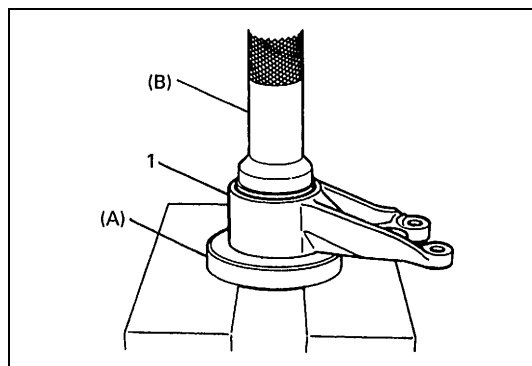


- 1) Lift up vehicle and turn steering wheel all the way to the right.
- 2) Separate mounting bracket R (2) from differential housing (3) by removing mounting bracket bolts (1) from its lower part.
- 3) Remove mounting bracket R (2) by removing mounting front bolt (4) from its upper part.



- 4) Remove mounting bracket L (3) from differential housing (1) by removing upper and lower mounting bracket bolts (4).

2. Front mounting bolt



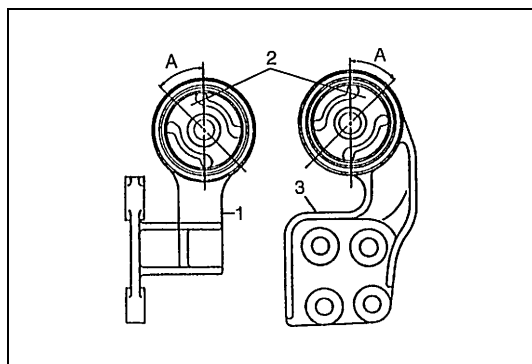
- 5) Check conditions of each bush. If it is damaged or deteriorated, drive it out with special tools and hydraulic press for replacement.

Special tool

(A) : 09951-26010

(B) : 09951-16080

1. Mounting bracket



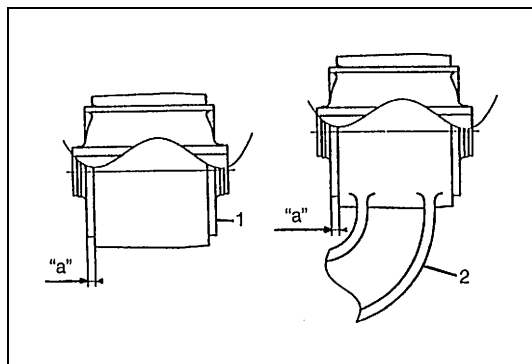
- 6) Position slit in each bush as shown when press-fitting it.

1. Mounting bracket L

2. Bush

3. Mounting bracket R

A : Slit alignment 45°

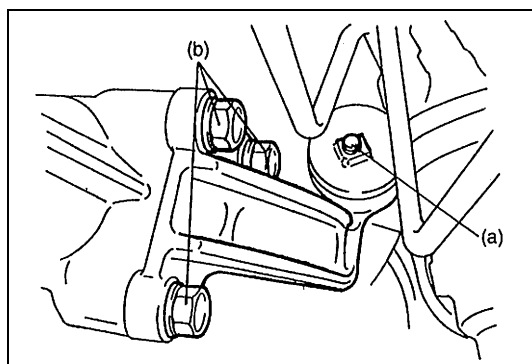


- 7) Position each bush to bracket as shown.

Length "a" : 3.0 mm (0.12 in.)

1. Mounting bracket R

2. Mounting bracket L

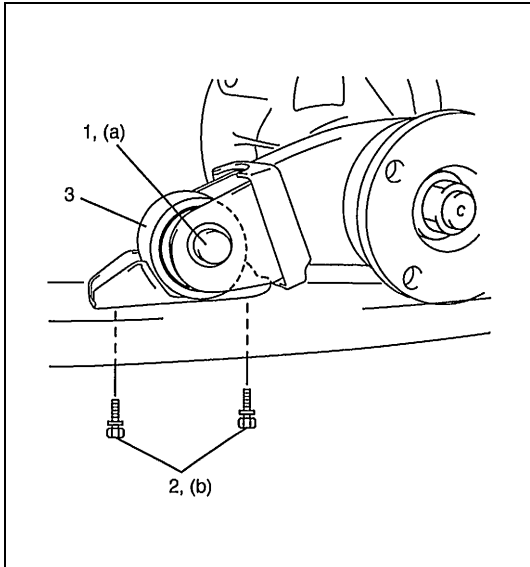


- 8) Use following torque for reinstallation.

Tightening torque

Mounting front bolt (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

Mounting bracket bolts (b) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

Rear mounting (for front differential carrier)

- 1) Lift up vehicle and remove rear mounting bracket (3) by removing rear mounting bolt (1) and rear mounting bracket bolts (2).
- 2) Check mounting rubber for damage or deterioration and replace as necessary.
- 3) Tighten rear mounting bolts (1) and rear mounting bracket bolts (2) to specified torque for reinstallation.

Tightening torque

Rear mounting bolt (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

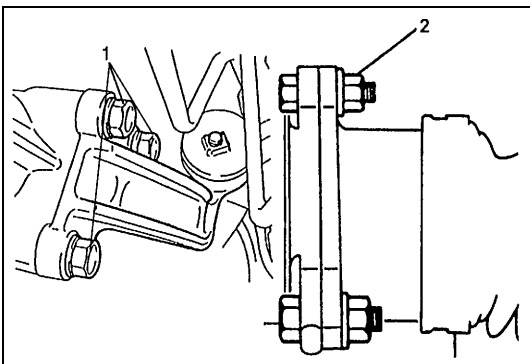
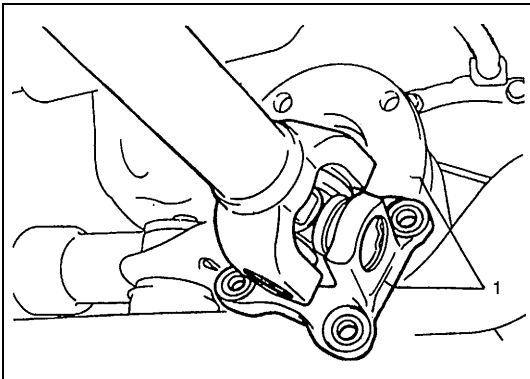
**Rear mounting bracket bolts (b) :
60 N·m (6.0 kg-m, 43.5 lb-ft)**

Dismounting

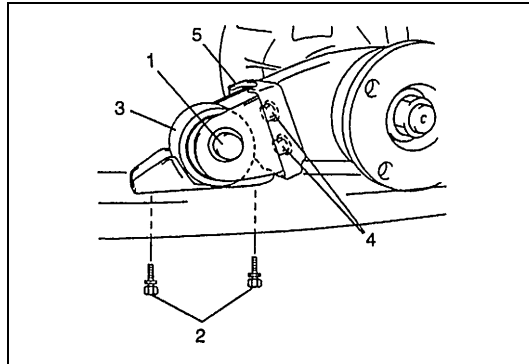
- 1) Lift up vehicle and drain oil.
- 2) Disconnect air hose and breather hose from differential housing.
- 3) Before removing propeller shaft, give match marks (1) on joint flange and propeller shaft as shown.
- 4) Remove propeller shaft flange by removing its 4 bolts and suspend propeller shaft with cord or the like.

NOTE:

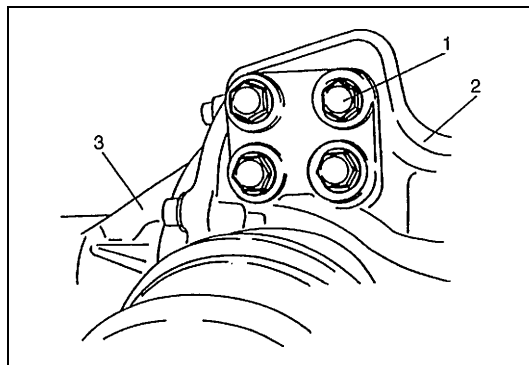
In case of pulling out propeller shaft, transfer oil must be drained before pulling out.



- 5) Remove mounting bracket bolts (1) for left mounting bracket and flange bolts and nuts (2) for drive shaft flange to set left side of differential free.

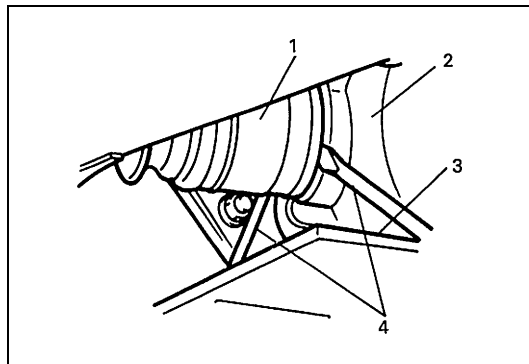


- 6) Remove rear mounting bolt (1), rear mounting bracket bolts (2) and rear mounting bracket (3).
- 7) Remove rear mounting bracket No.2 bolts (4) and rear mounting bracket No.2 (5).



- 8) With differential housing assembly held with transmission jack, remove mounting bracket bolts (1) on right end of differential housing (3).

2. Mounting bracket R



- 9) Using two large screwdrivers (4) as levers, pull out right side drive shaft joint (1) from differential housing (2) and dismount differential housing assembly from vehicle by using transmission jack (3).

CAUTION:

During above work, use care not to damage drive shaft boot and oil seal.

Remounting

For remounting, reverse dismounting procedure and use following tightening torque.

Tightening torque

Propeller shaft flange bolts

(a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

Front drive shaft flange bolts

(b) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

Mounting bracket bolts

(c) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

Rear mounting bracket bolts

(d) : 60 N·m (6.0 kg-m, 43.5 lb-ft)

Rear mounting bolt

(e) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

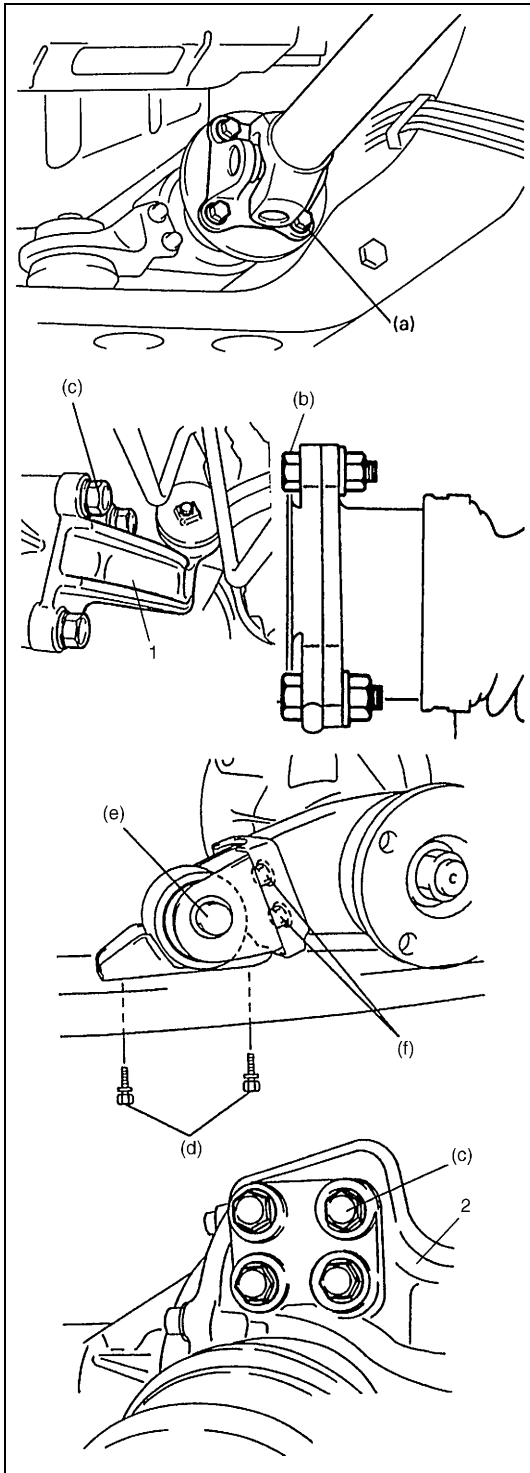
Rear mounting bracket No.2 bolts

(f) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

After tightening all fasteners properly, fill hypoid gear oil as specified and check tightening of plugs with specification.

1. Mounting bracket L

2. Mounting bracket R



Unit Repair

Refer to the same section of “Unit Repair Manual” mentioned in FOREWORD of this manual.

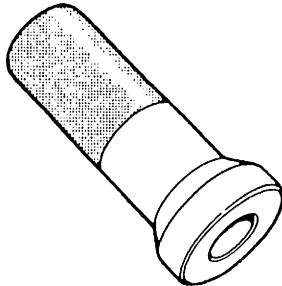
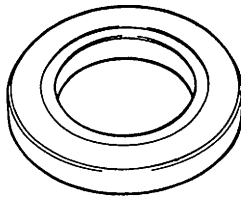
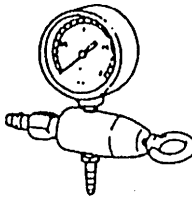
Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Differential oil level/filler plug	23	2.3	17.0
Differential oil drain plug	23	2.3	17.0
Mounting front bolts	85	8.5	61.5
Mounting bracket bolts	50	5.0	36.5
Front drive shaft flange bolts	50	5.0	36.5
Propeller shaft flange bolts	50	5.0	36.5
Pump assembly bolts	13	1.3	9.5
Rear mounting bolt	85	8.5	61.5
Rear mounting bracket bolts	60	6.0	43.5
Rear mounting bracket No.2 bolts	85	8.5	61.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Sealant	SUZUKI BOND NO. 1215 (99000-31110)	Front differential drain plug

Special Tool

 09951-16080 Bearing installer	 09951-26010 Bush remover plate	 09918-18110 Air pressure regulator 09367-04002 3-way joint

SECTION 7F

DIFFERENTIAL (REAR)

CONTENTS

7F

General Description	7F-2	Sub-Assembly Adjustment and	
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On-vehicle Service	7F-3	Differential carrier	7F-9
Maintenance Service	7F-4	Differential case	7F-9
Changing oil	7F-4	Differential side bearing	7F-11
Rear Differential Assembly	7F-5	Drive bevel pinion	7F-12
Dismounting	7F-5	Assembling Unit	7F-16
Remounting	7F-5	Tightening Torque Specification	7F-19
Unit Repair	7F-6	Required Service Material	7F-19
Disassembling Unit	7F-6	Special Tool	7F-20
Component Inspection	7F-9		

General Description

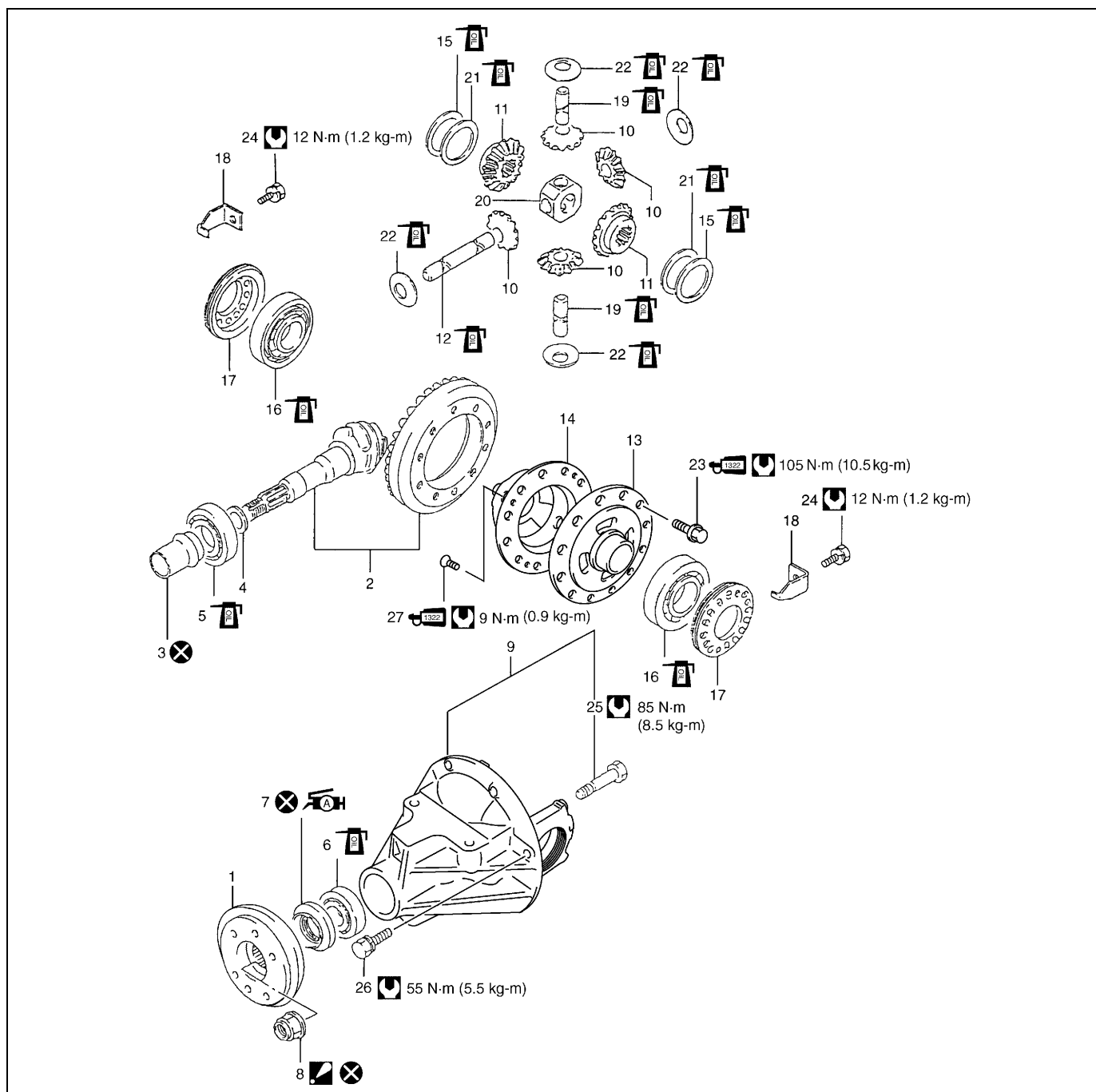
The differential assembly using a hypoid bevel pinion and gear is installed to the rear axle. It is set in the conventional type axle housing.

The differential assembly is decisive in that the drive power is concentrated there. Therefore, use of genuine parts and specified torque is compulsory. Further, because of sliding tooth meshing with high pressure between bevel pinion and gear, it is mandatory to lubricate them by hypoid gear oil.

Diagnosis

Condition	Possible Cause	Correction
Gear noise	Deteriorated or water mixed lubricant	Repair and replenish.
	Inadequate or insufficient lubricant	Repair and replenish.
	Maladjusted backlash between drive bevel pinion and gear	Adjust as prescribed.
	Improper tooth contact in the mesh between drive bevel pinion and gear	Adjust or replace.
	Loose drive bevel gear securing bolts	Replace or retighten.
	Damaged differential gear(s) or differential pinion(s)	Replace.
Bearing noise	(Constant noise) Deteriorated or water mixed lubricant	Repair and replenish.
	(Constant noise) Inadequate or insufficient lubricant	Repair and replenish.
	(Noise while coasting) Damaged bearing(s) of drive bevel pinion	Replace.
	(Noise while turning) Damaged differential side bearing(s) or axle bearing(s)	Replace.
Oil leakage	Clogged breather plug	Clean.
	Worn or damaged oil seal	Replace.
	Excessive oil	Adjust oil level.

On-vehicle Service



1. Universal joint flange	10. Differential pinion	19. Pinion shaft No.2	⊗ : Do not reuse.
2. Hypoid gear set	11. Differential gear	20. Pinion joint	⌚ : Tightening torque
3. Bevel pinion spacer	12. Pinion shaft No.1	21. Spring washer	🛢️ : Apply differential oil.
4. Shim	13. Differential left case	22. Washer	
5. Rear bearing	14. Differential right case	23. Bevel gear bolt: Apply thread lock cement 99000-32110 to thread part of bolt.	
6. Front bearing	15. Thrust washer	24. Bolt	
7. Oil seal: Apply grease 99000-25010 to oil seal lip.	16. Differential side bearing	25. Bolt	
8. Flange nut: After tightening nut so as rotation torque of bevel pinion shaft to be in specified value, caulk nut securely.	17. Bearing adjuster	26. Bolt	
9. Differential carrier assembly	18. Lock plate	27. Differential case screw: Apply thread lock cement 99000-32110 to thread part of bolt.	

Maintenance Service

NOTE:

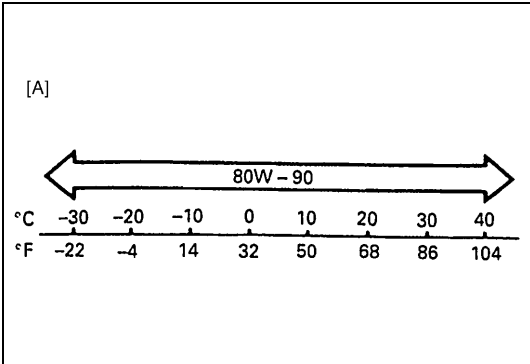
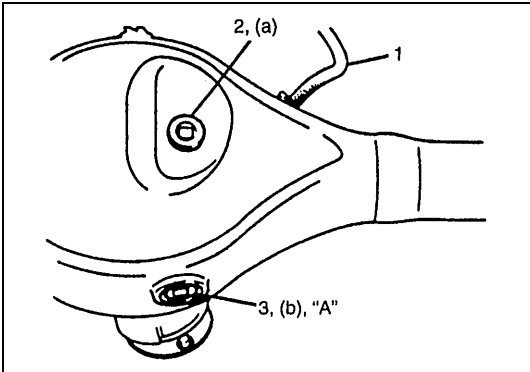
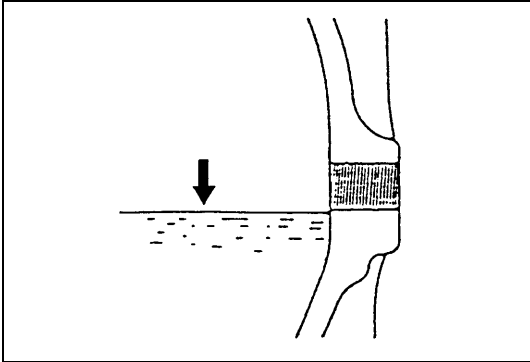
- When having driven through water, check immediately if water has entered (if so, oil is cloudy). Water mixed oil must be changed at once.
- Whenever vehicle is hoisted for any other service work than oil change, also be sure to check for oil leakage and status of breather hoses.

Changing oil

NOTE:

- Hypoid gear oil must be used for differential.
- It is highly recommended to use SAE 80W-90 viscosity.

- 1) Before oil change or inspection, be sure to stop engine and lift up vehicle horizontally.
- 2) Check oil level and existence of leakage. If leakage is found, correct its cause.
- 3) Drain old oil and pour proper amount of gear oil as specified (roughly up to level hole).



- 4) Torque drain (3) and level/filler plugs (2) to specification.

“A”: Sealant 99000-31110

Tightening torque

Differential oil level/filler plug

(a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

Differential oil drain plug

(b): 28 N·m (2.8 kg-m, 20.5 lb-ft)

1. Breather hose

Specified gear oil :

Hypoid gear oil API GL-5 SAE 80W-90

For oil viscosity, refer to the chart at the left.

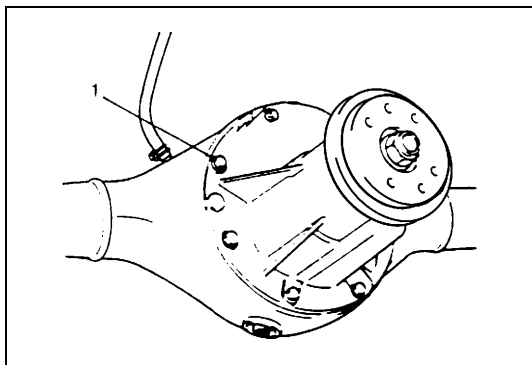
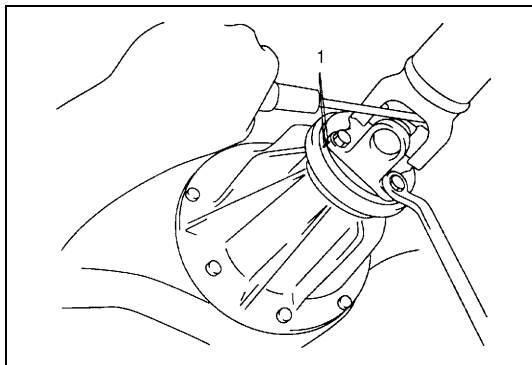
Oil capacity: 2.4 liters (5.1/4.2 US/lmp. pt.)

[A]: Viscosity chart SAE

Rear Differential Assembly

Dismounting

- 1) Lift up vehicle and drain oil from rear differential housing.
- 2) Remove rear brake drums and pull out right and left rear axle shafts. (Refer to "Rear Axle Shaft" in Section 3E.)
- 3) Before removing propeller shaft, give match marks (1) on joint flange and propeller shaft as shown.
- 4) Remove propeller shaft by removing its flange bolts.

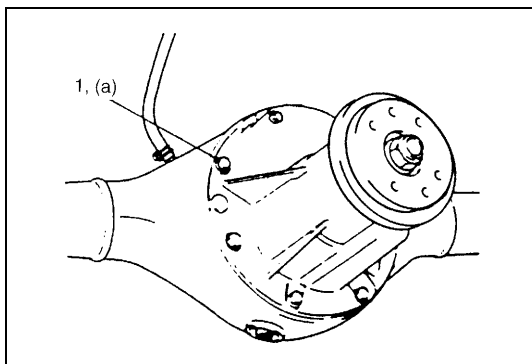
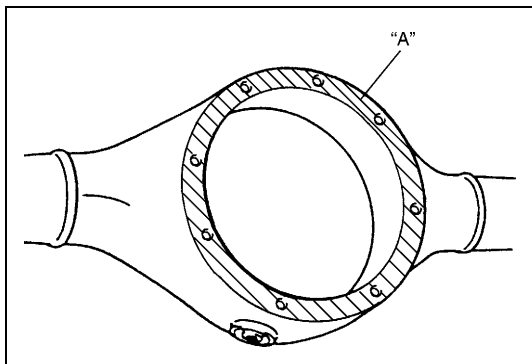


- 5) Remove differential assembly by removing its 8 fastening bolts (1).

Remounting

- 1) Clean mating surfaces of rear axle and differential assembly and apply sealant to axle side evenly.

"A": Sealant 99000-31110

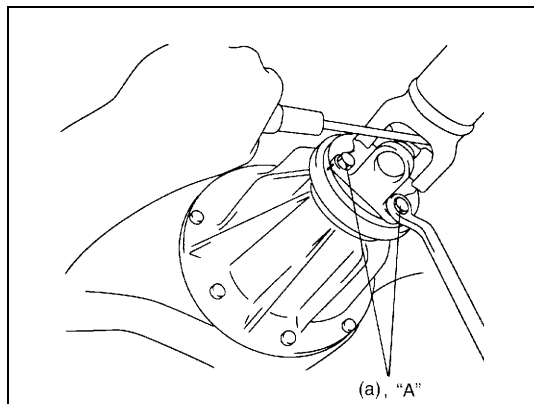


- 2) Install differential assembly to axle and fix it with bolts (1) tightened to specified torque.

Tightening torque

Differential carrier bolts

(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)



- 3) Install propeller shaft to joint flange aligning match marks and torque flange bolts to specification. Apply thread lock cement to thread part of bolt if reused.

“A”: Cement 99000-32110

Tightening torque

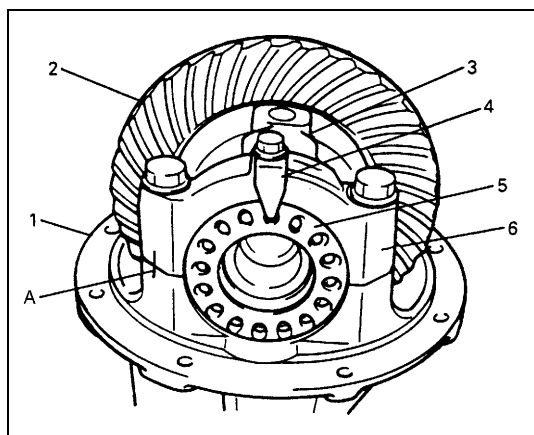
Propeller shaft flange bolts

(a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

- 4) Install right and left rear axle shafts and drums.
(Refer to “Rear Axle” in Section 3E and “Rear Brake Drum” in Section 5.)
- 5) Install wheels.
- 6) Fill hypoid gear oil as specified and tighten plug to specification.
- 7) Lower lift.

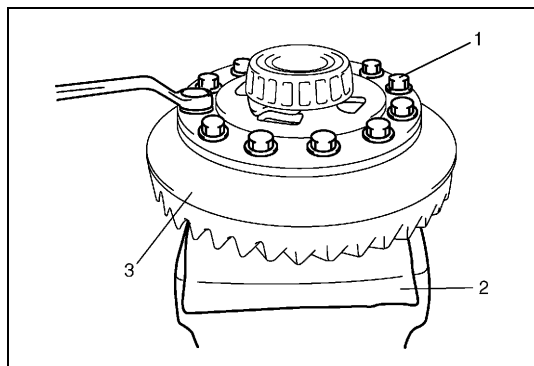
Unit Repair

Disassembling Unit

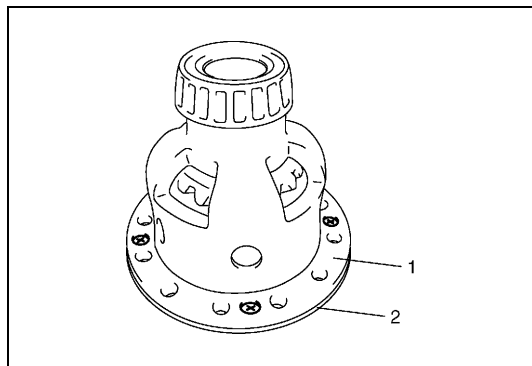


- 1) Hold differential assembly securely and put identification marks on differential side bearing caps (6).
- 2) Take off differential side bearing lock plates (4) and differential side bearing caps (6) by removing their bolts and then take out bearing adjusters (5), side bearing outer races and drive bevel gear with differential case.

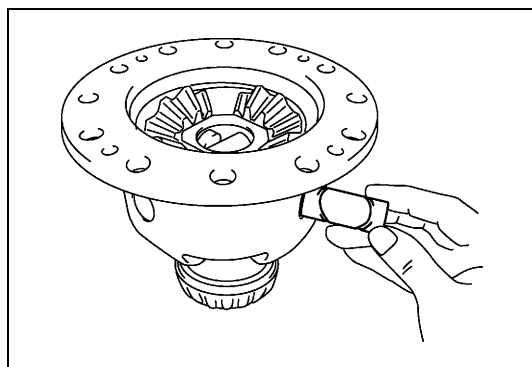
1.	Differential carrier
2.	Drive bevel gear assembly
3.	Differential case
A:	Identification mark



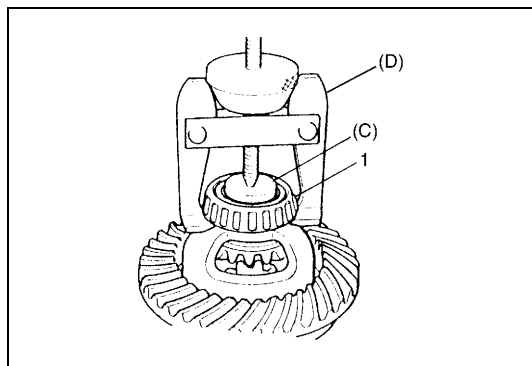
- 3) Remove drive bevel gear (hypoid gear), differential gears, differential pinions and pinion shafts.
 - a) With aluminum plates (2) placed on vise first, grip differential case with it and remove drive bevel gear (hypoid gear) (3) by removing its bolts (1).



- b) Remove differential left case (2) from differential right case (1).



- c) Remove pinion shafts, differential gears, washers, differential pinions, spring washers, thrust washers.

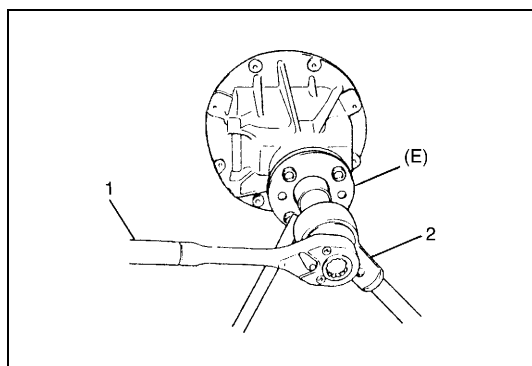


- 4) Using special tools, pull out differential side bearings (1).

Special tool

(C): 09913-85230

(D): 09913-61510



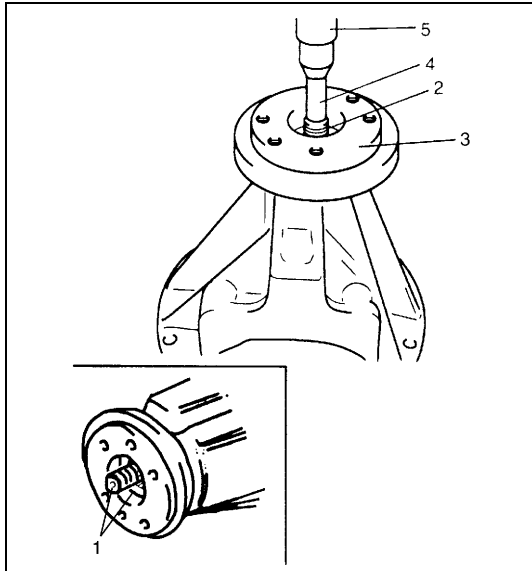
- 5) Remove drive bevel pinion (hypoid gear) assembly.

- a) Hold universal joint flange with special tool and then remove flange nut by using power wrench (4 – 10 magnification) (2).

Special tool

(E): 09922-66021

1. Socket wrench



- b) Make mating marks (1) on drive bevel pinion and companion flange.

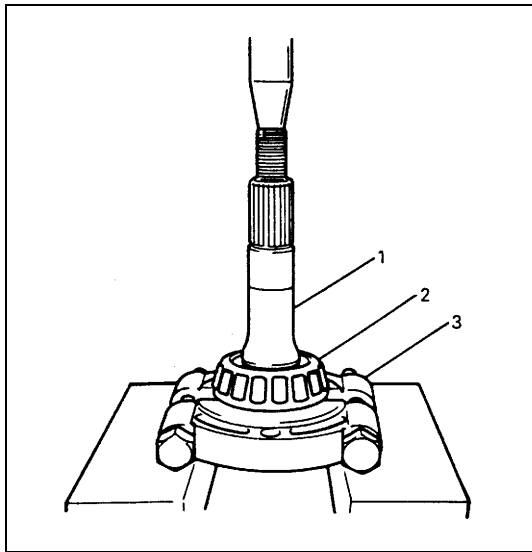
CAUTION:

Don't make mating mark on the coupling surface of the flange.

- c) Press drive bevel pinion (2) by using rod (4) (approx. 22 mm (0.866 in.) in diameter) and press (5) then remove drive bevel pinion (2) and companion flange (3).

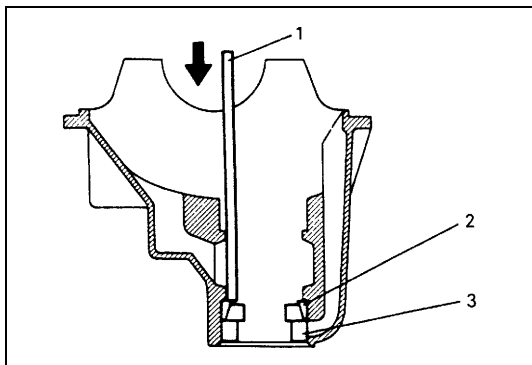
CAUTION:

Do not drop drive bevel pinion by holding its gear part by hand from beneath.

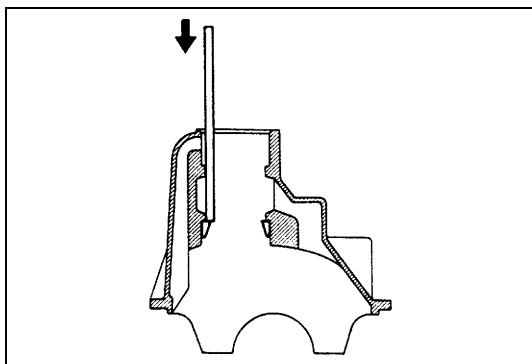


- d) Remove drive bevel pinion rear bearing (2) by using bearing puller (3) and press.

1. Drive bevel pinion



- 6) Using a hammer and brass bar (1), drive out front bearing outer race with bearing (2) and oil seal (3).



- 7) Drive out rear bearing outer race in the same way as in the Step 6).

Component Inspection

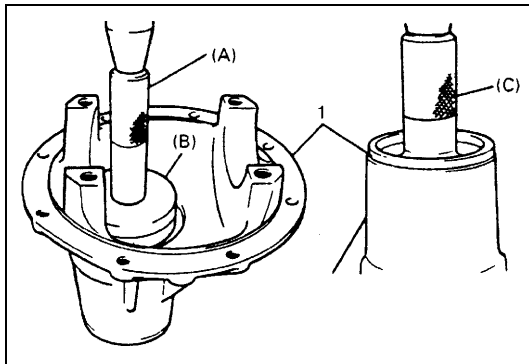
- Check companion flange for wear or damage.
- Check bearings for wear or discoloration.
- Check differential carrier for cracks.
- Check drive bevel pinion and drive bevel gear for wear or cracks.
- Check differential gears, pinions and pinion shafts for wear or damage.
- Check differential gear spline for wear or damage.

Sub-Assembly Adjustment and Reassembly

Judging from faulty conditions noted before disassembly and what is found through visual check of bearing and gear tooth etc. after disassembly, prepare replacing parts and proceed to reassembly according to procedures as described below.

CAUTION:

- Drive bevel gear and pinion must be replaced as a set when either replacement becomes necessary.
- When replacing taper roller bearing, replace as inner race & outer race assembly.



Differential carrier

For press-fitting drive bevel pinion bearing outer races, use special tools as shown in the figure.

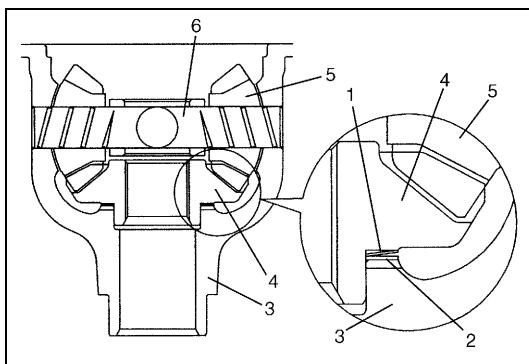
Special tool

(A): 09924-74510

(B): 09926-68310

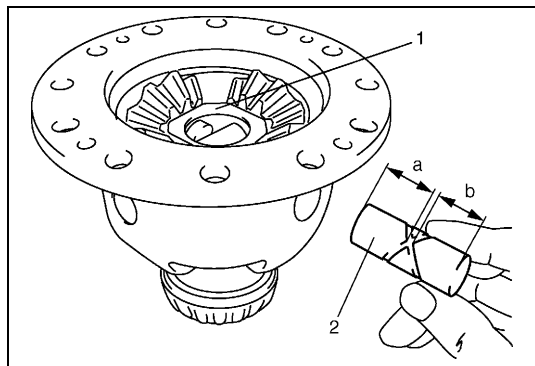
(C): 09913-75510

1. Differential carrier



Differential case

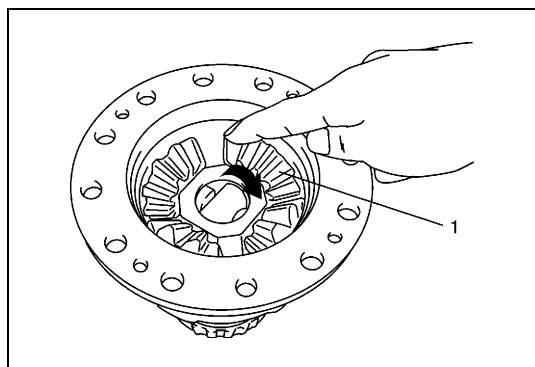
- 1) After applying differential oil to differential gear (4), pinions (5), pinion shafts (6), thrust washer (2) and spring washer (1), install them in differential right case (3). For correct installing direction of thrust washer (2) and spring washer (1), refer to the figure.



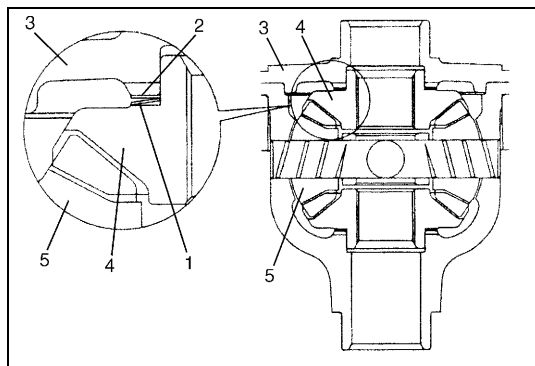
- 2) When installing pinion shaft No.2 (2) (shorter) into differential case and pinion, insert its "a" side into pinion joint (1).

NOTE:

"a" is longer than "b". ("a" > "b")



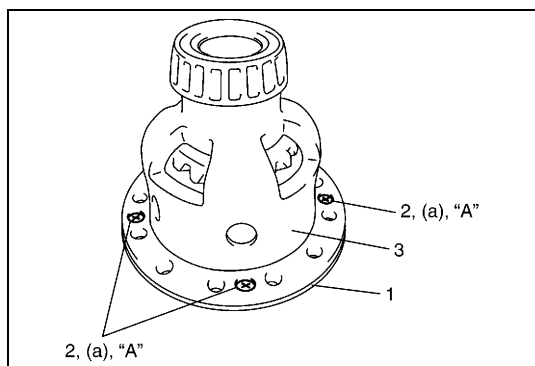
- 3) Check differential pinion gear (1) for smooth rotation.



- 4) In the same manner as described in Step 1), install thrust washer (2), spring washer (1) and differential gear (4).

3. Differential left case

5. Differential pinion



- 5) Install differential left case (1) and then tighten screws (2) to specified torque.

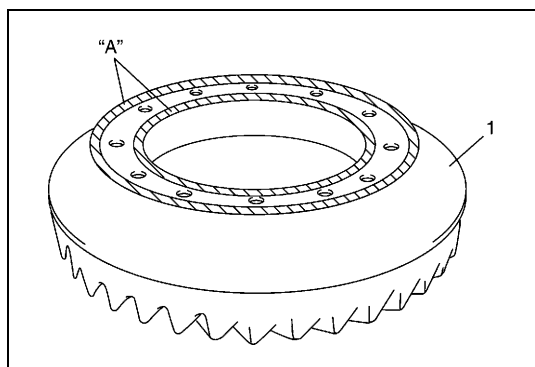
"A": Cement 99000-32110

Tightening torque

Differential case screw

(a): 9 N·m (0.9 kg-m, 6.5 lb-ft)

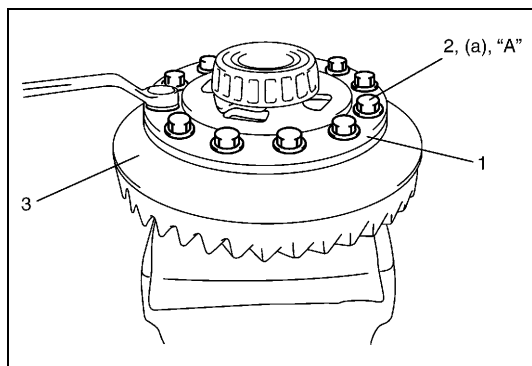
3. Differential right case



- 6) Clean and degrease mating surface of drive bevel gear (hypoid gear) (1).

- 7) Apply thread lock cement to hatched part of drive bevel gear (1) as shown in the figure.

"A": Cement 99000-32110



- 8) Put drive bevel gear (3) on differential case (1) and fasten them with bolts (2) by tightening them to specified torque. Use thread lock cement for bolts (2).

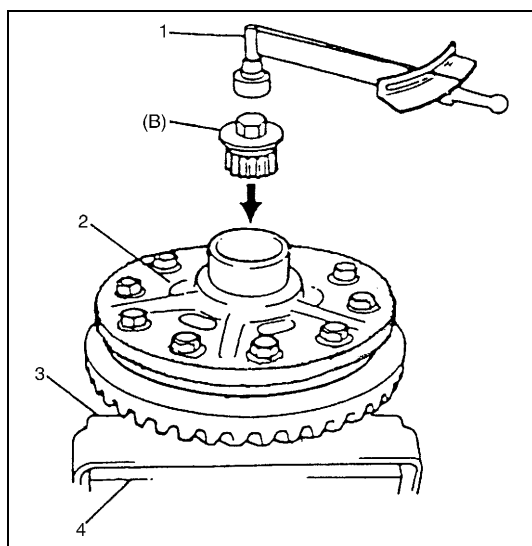
CAUTION:

Use of any other bolts than that specified is prohibited.

“A”: Cement 99000-32110

Tightening torque

Bevel gear bolts (a): 105 N·m (10.5 kg-m, 76.0 lb-ft)



- 9) Install special tool to differential case assembly (2) and check that preload is within specification below. If preload exceeds specified value, check if foreign matter is caught or gear is damaged.

Special tool

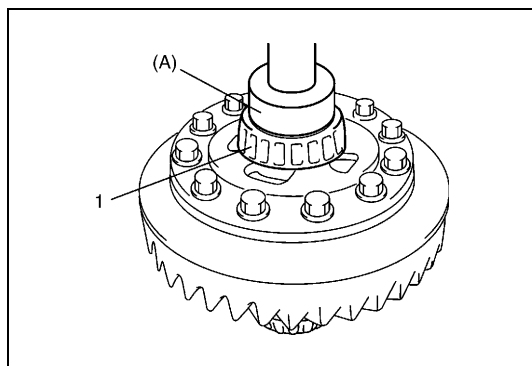
(B): 09928-06510

Side gear preload

: Max. 2.5 N·m (0.25 kg-m, 1.8 lb-ft)

1.	Torque wrench
3.	Aluminum plate
4.	Vise

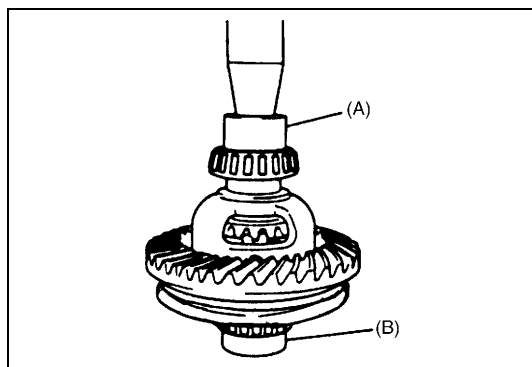
Differential side bearing



- 1) Press-fit side bearing (1) with special tool and press.

Special tool

(A): 09944-66020



- 2) Hold bearing press-fitted in Step 1) with holder and press-fit side bearing on the other side.

NOTE:

Be sure to use bearing holder for the purpose of protecting lower bearing.

Special tool

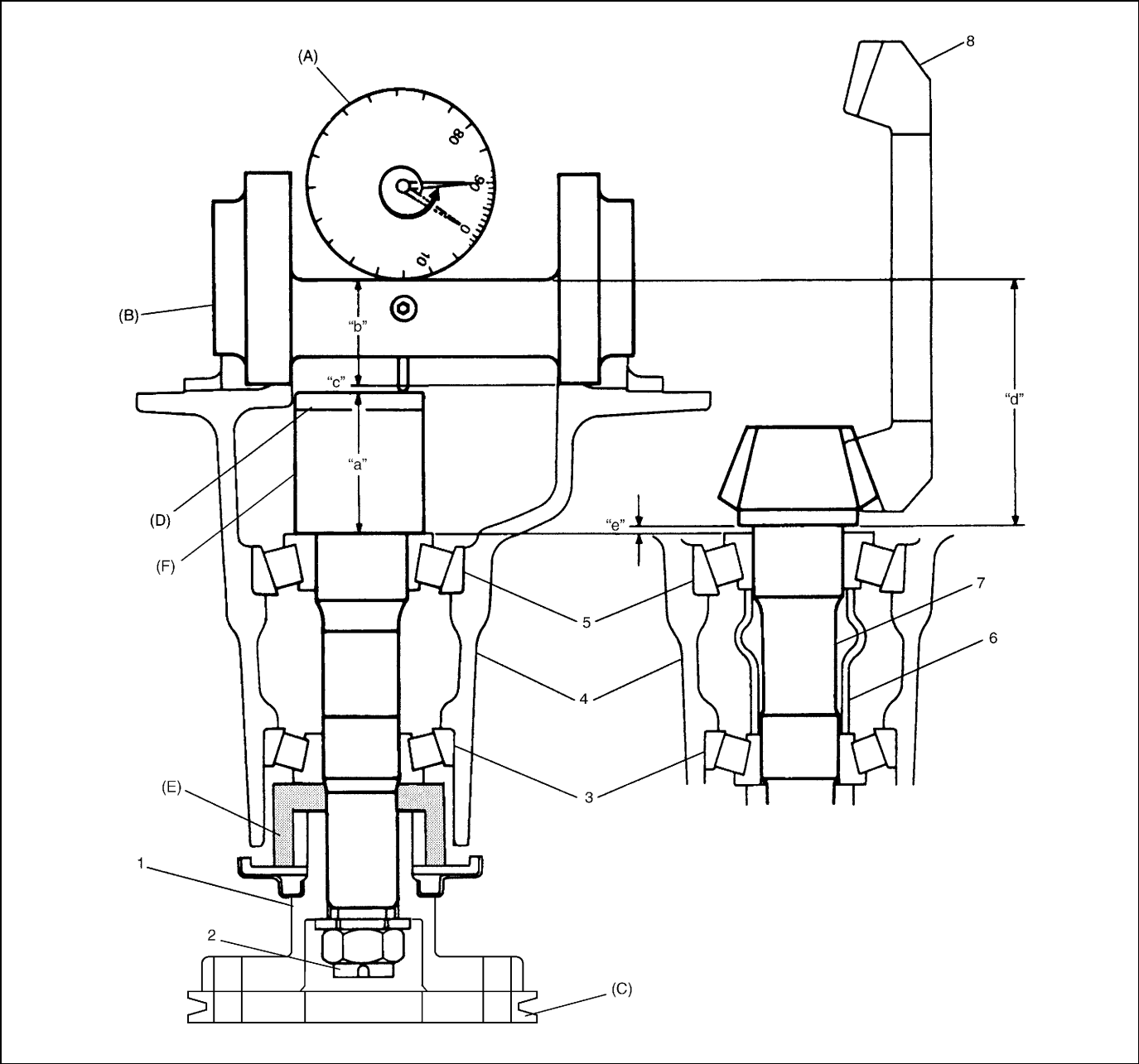
(A): 09944-66020

(B): 09951-16060

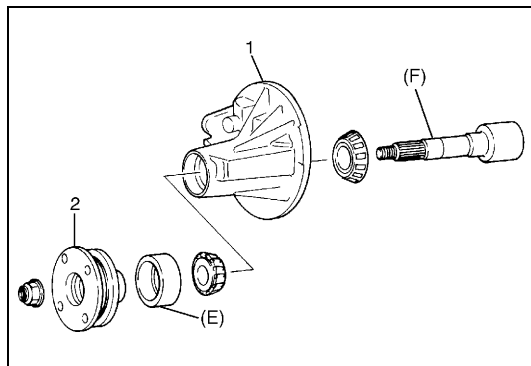
Drive bevel pinion

To engage drive bevel pinion and gear correctly, it is pre-required to install drive bevel pinion to differential carrier properly by using adjusting shim as described on the followings. Shown below is relative positions of drive bevel pinion, differential carrier and mounting dummy.

- (A): 09900-20606
- (B): 09926-78320
- (C): 09922-75222
- (D): 09922-76570
- (E): 09951-46010
- (F): 09926-78311-002



1. Universal Joint flange (P/No. 27110-60A00)	5. Rear bearing	"a": Pinion dummy height + Attachment height	"d": Drive bevel pinion mounting distance 110.00 mm/4.3307 in.
2. Nut	6. Spacer	"b": Axle dummy radius	"e": Shim size for mounting distance adjustment (= "c")
3. Front bearing	7. Drive bevel pinion	"a" + "b": Mounting dummy size 110.00 mm/4.3307 in.	
4. Differential carrier	8. Drive bevel gear	"c": Measured dimension	



- 1) Install special tools with bearings and universal joint flange (2) to differential carrier (1).

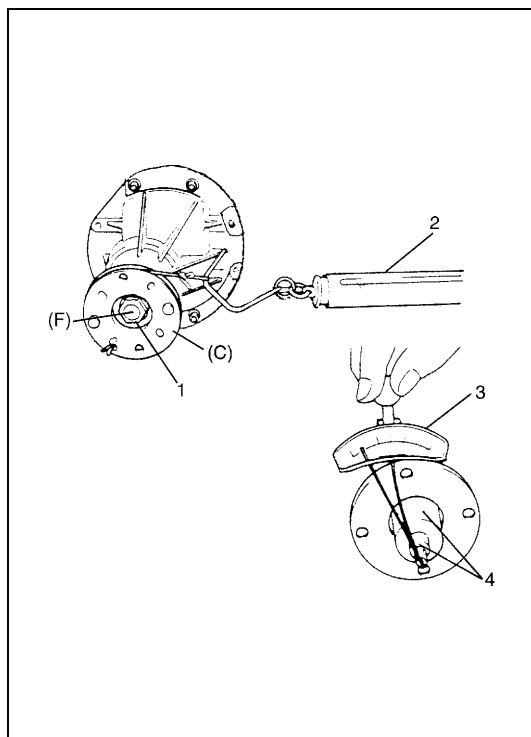
NOTE:

This installation requires no spacer or oil seal.

Special tool

(E): 09951-46010

(F): 09926-78311-002



- 2) Tighten flange nut (1) so that specified bearing preload is obtained.

NOTE:

- Before taking measurement with spring balance (2) or torque wrench (3), check for rotation by hand and apply small amount of differential oil to bearings.
- On measuring preload, rotate the drive bevel pinion about 1 rotation per 2 seconds.

Special tool

(C): 09922-75222

(F): 09926-78311-002

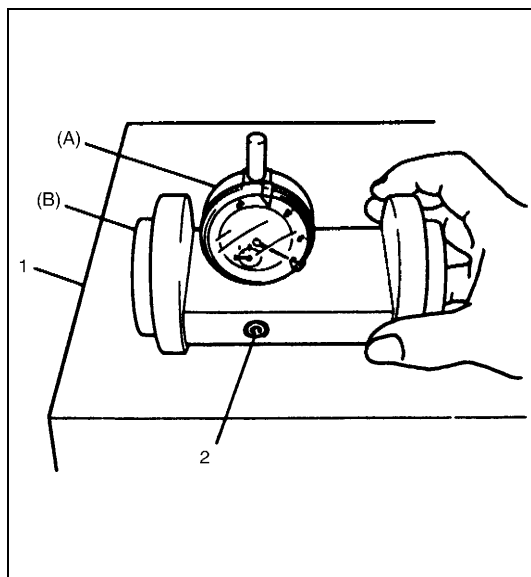
Pinion bearing preload:

0.9 – 1.7 N·m (9.0 – 17.0 kg·cm, 7.8 – 14.7 lb-in.)

Spring measure reading with special tool:

18 – 34 N (1.8 – 3.4 kg, 4.0 – 7.5 lb)

4. Socket with adapter



- 3) Set dial gauge to mounting dummy and make 0 (zero) adjustment on surface plate (1).

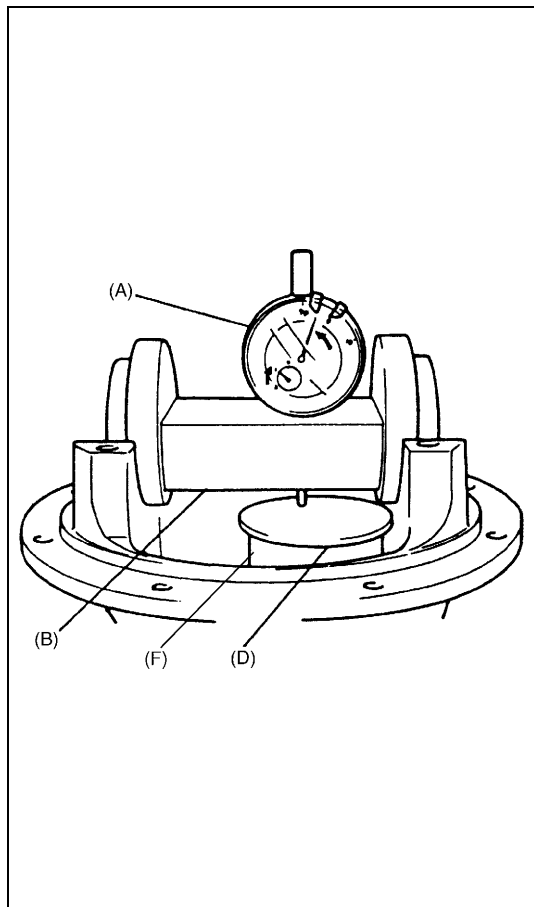
NOTE:

- When setting dial gauge to mounting dummy, tighten screw (2) lightly. Be careful not to overtighten it, which will cause damage to dial gauge.
- With dial gauge set, turn dummy back and force by hand a couple of times and attain accurate 0 (zero) adjustment.
- It is desirable that short pointer indicates beyond 2 mm when long one is at 0 (zero).

Special tool

(A): 09900-20606

(B): 09926-78320



- 4) Place zero-adjusted mounting dummy and dial gauge set on pinion mounting dummy and take measurement between zero position and extended dial gauge measuring tip.

NOTE:

- Repeat turning back and force of dummy and measure distance as far as top surface of pinion dummy accurately.
- When dial gauge measuring tip extends from 0 (zero) position, pointer turns counterclockwise.
- Measured value may exceed 1 mm. Therefore, it is also necessary to know reading of short pointer.

Special tool

(A): 09900-20606

(B): 09926-78320

(D): 09922-76570

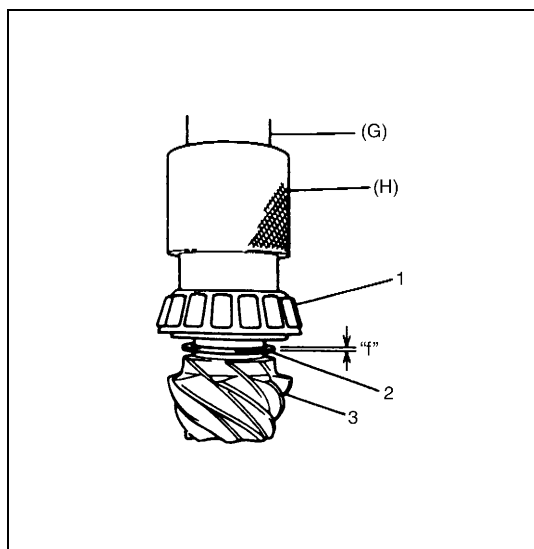
(F): 09926-78311-002

- 5) Obtain adjusting shim thickness by using measured value by dial gauge in previous step.

Necessary
shim thickness
"e"

=

Dial gauge
measured
value "c"



- 6) Select adjusting shim(s) (2) closest to calculated value from among following available sizes and put it in place and then press-fit rear bearing (1).

Calculated value "f":

Closest value to "e" (refer to Step 5.)

Special tool

(G): 09925-18011

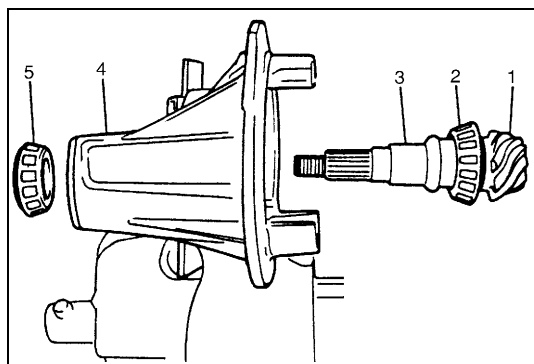
(H): 09927-66010

Available shim thickness:

1.12, 1.15, 1.18, 1.21, 1.24, 1.27, 1.30 and 0.3 mm

(0.044, 0.045, 0.046, 0.047, 0.048, 0.049, 0.050 and 0.012 in.)

3. Drive bevel pinion



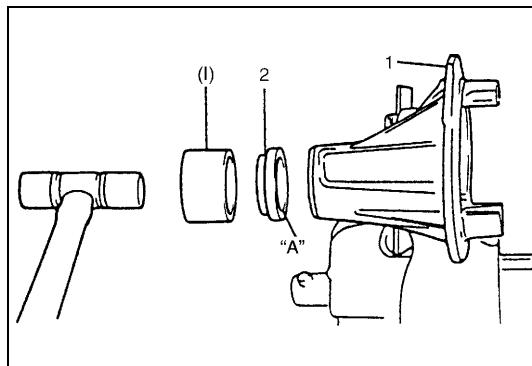
- 7) With new pinion spacer (3) inserted as shown in the figure, install front bearing (5) to differential carrier (4).

NOTE:

- Make sure to use new spacer for reinstallation.
- Apply differential oil to bearings.

1. Drive bevel pinion

2. Rear bearing

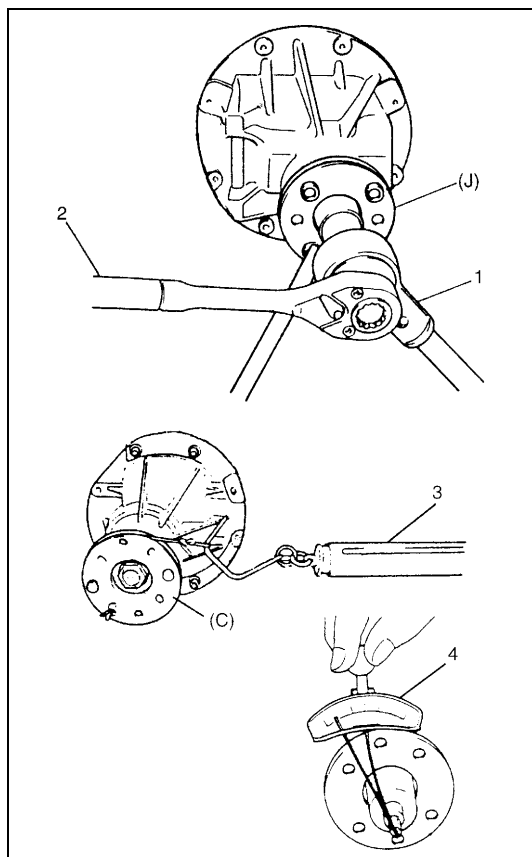


- 8) Using special tool and plastic hammer, drive oil seal (2) into differential carrier (1) till it becomes flush with carrier end. Then apply grease "A" to oil seal lip.

"A": Grease 99000-25010

Special tool

(I): 09951-18210



- 9) While tightening flange nut gradually with special tool and power wrench (4 – 10 magnification) (1), set preload of pinion to specification.

NOTE:

- Before taking measurement with spring balance (3) or torque wrench (4), check for smooth rotation by hand.
- On measuring preload, rotate the drive bevel pinion about 1 rotation per 2 seconds.
- Be sure to tighten gradually and carefully till specified starting torque is obtained. Turning back overtightened flange nuts should be avoided.

Pinion bearing preload:

0.9 – 1.7 N·m (9.0 – 17.0 kg·cm, 7.8 – 14.7 lb-in.)

Spring measure reading with special tool:

16 – 30 N (1.6 – 3.0 kg, 3.5 – 6.6 lb)

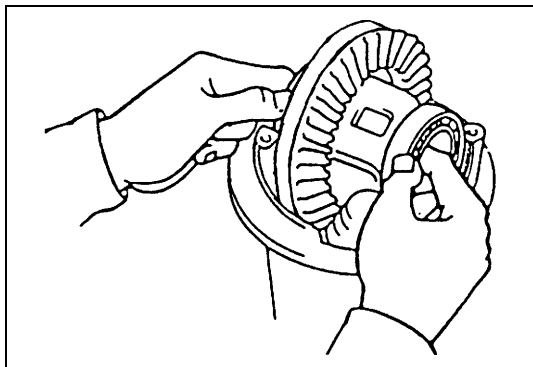
Special tool

(C): 09922-75222

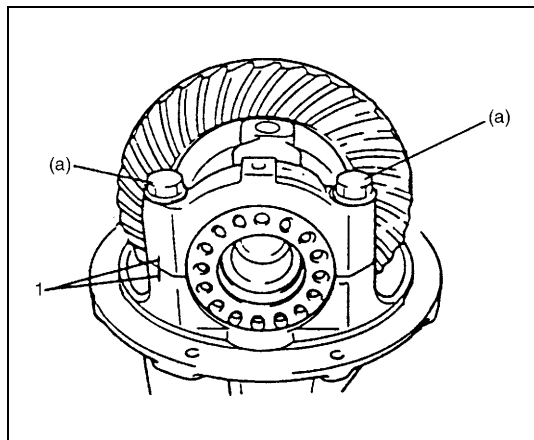
(J): 09922-66021

2. Socket wrench

Assembling Unit



- 1) Place bearing outer races on their respective bearings.
Used left and right outer races are not interchangeable.
- 2) Install case assembly in carrier.
- 3) Install side bearing adjusters on their respective carrier, making sure adjuster are threaded properly.



- 4) Align match marks (1) on cap and carrier. Screw in 2 side bearing cap bolts 2 or 3 turns and press down bearing cap by hand.

NOTE:

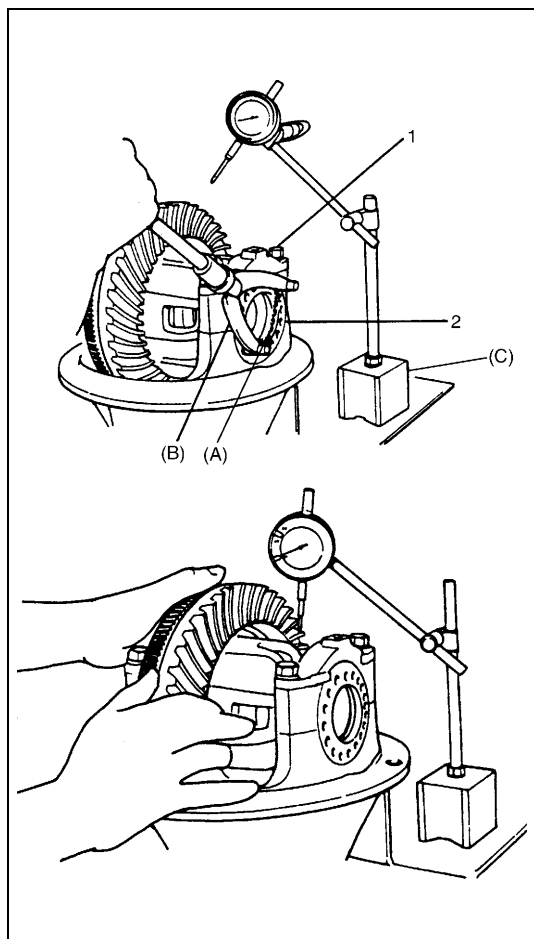
If bearing cap does not fit tightly on carrier, side bearing adjuster is not threaded properly. Reinstall adjuster.

- 5) Tighten cap bolts (provisional torque).

Tightening torque

Bearing cap bolt (Provisional torque)

(a): 15 N·m (1.5 kg-m, 11.0 lb-ft)



- 6) Tighten both bearing adjusters (2) so as to obtain specified gear backlash and at the same time, obtain preload of side bearing.

NOTE:

- Be sure to apply measuring tip of dial gauge at right angles to convex side of tooth.
- As a practical measure the following would be recommended to obtain specified backlash and side bearing preload at the same time.
 - Obtain specified backlash by turning both adjusters inward lightly.
 - Tighten both adjusters further by one notch at a time.
- Measure at least 4 points on drive bevel gear periphery.

Standard backlash:

0.13 – 0.18 mm (0.005 – 0.007 in.)

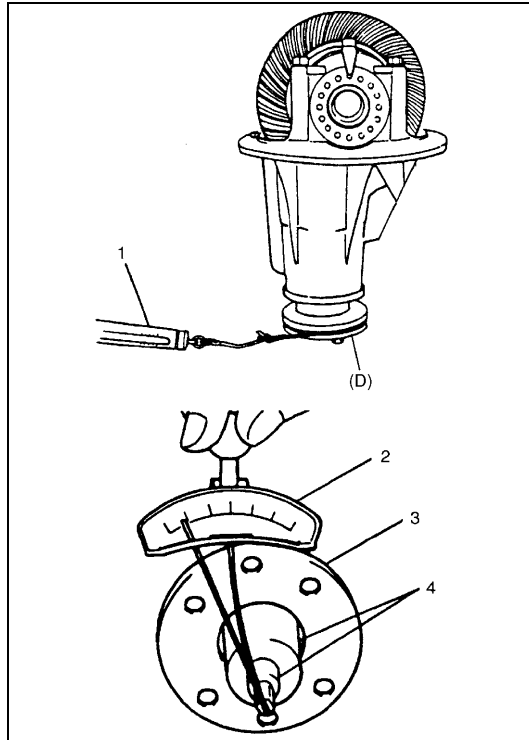
Special tool

(A): 09930-40120

(B): 09930-40113

(C): 09900-20701

1. Bearing cap bolt



- 7) Measure preload of pinion bearing with spring balance (1) or torque wrench (2) and check composite preload of pinion bearing and side bearing.

NOTE:

- Before taking measurement with spring balance (1) or torque wrench (2), check for smooth rotation by hand.
- On measuring preload, rotate the drive bevel pinion about 1 rotation per 2 seconds.

Composite preload of pinion bearing and side bearing:
1.1 – 2.0 N·m (11.0 – 20.0 kg-cm, 9.5 – 17.4 lb-in.)

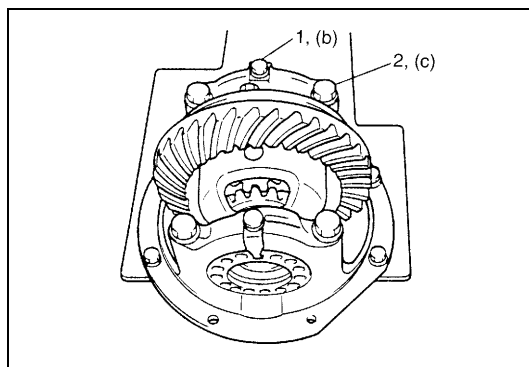
Spring measure reading with special tool:
19.5 – 35.5 N (1.95 – 3.55 kg, 4.30 – 7.83 lb)

Special tool

(D): 09922-75222

3. Universal joint flange

4. Socket with adapter



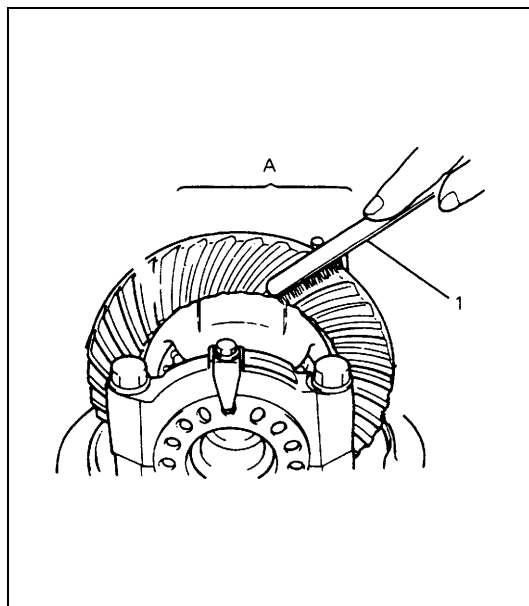
- 8) Torque bearing cap bolts (2) to specification and install bearing lock plates.

Tightening torque

Lock plate bolt (b): 12 N·m (1.2 kg-m, 9.0 lb-ft)

Bearing cap bolt (c): 85 N·m (8.5 kg-m, 61.5 lb-ft)

1. Lock plate bolt



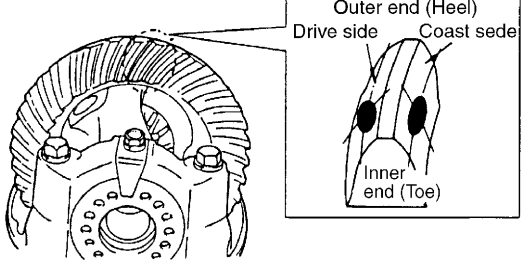
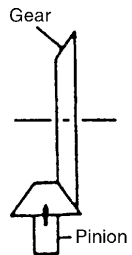
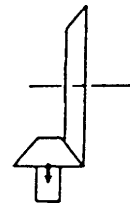
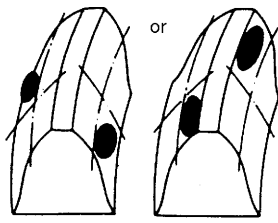
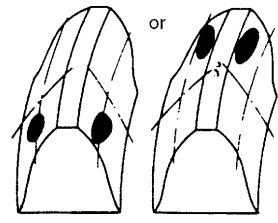
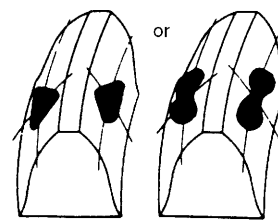
- 9) As final step, check gear tooth contact as follows.

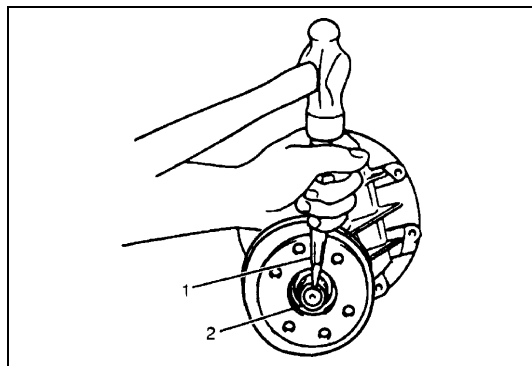
- After cleaning 10 drive bevel gear teeth, paint them with gear marking compound evenly by using brush (1) or sponge etc.
- Turn gear to bring its painted part in mesh with drive bevel pinion and turn it back and forth by hand to repeat their contact.
- Bring painted part up and check contact pattern, referring to following chart. If contact pattern is not normal, readjust or replace as necessary according to instruction in chart.

NOTE:

Be careful not to turn drive bevel gear more than one full revolution, for it will hinder accurate check.

"A": Paint gear marking compound evenly

TOOTH CONTACT PATTERN	DIAGNOSIS AND REMEDY
	NORMAL
	HIGH CONTACT Pinion is positioned too far from the center of drive bevel gear. 1) Increase thickness of pinion height adjusting shim and position pinion closer to gear center. 2) Adjust drive bevel gear backlash to specification. 
	LOW CONTACT Pinion is positioned too close to the center of drive bevel gear. 1) Decrease thickness of pinion height adjusting shim and position pinion farther from gear center. 2) Adjust drive bevel gear backlash to specification. 
	If adjustment is impossible, replace differential carrier.
	1) Check seating of bevel gear or differential case. (Check bevel gear for runout) 2) If adjustment is impossible, replace drive bevel gear & pinion set or differential carrier.
	Replace drive bevel gear & pinion set or differential case.



- 10) Upon completion of gear tooth contact check in Step 9), caulk flange nut (2) with caulking tool (1) and hammer.

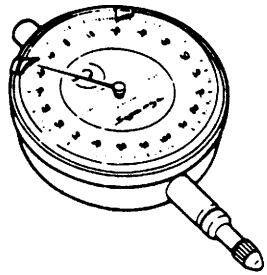
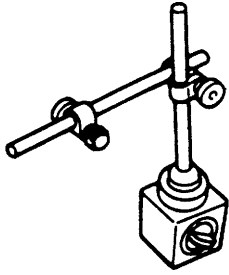
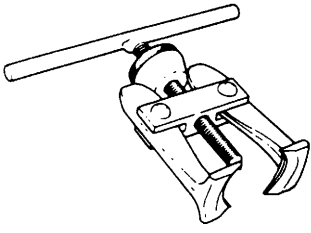
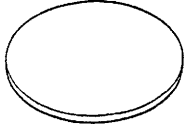
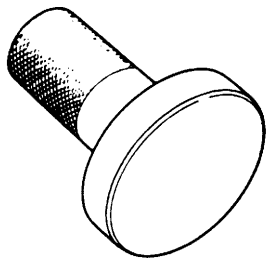
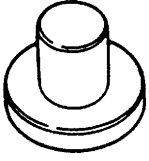
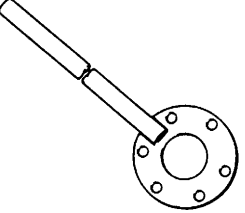
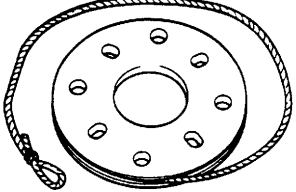
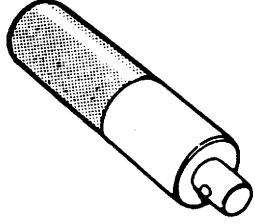
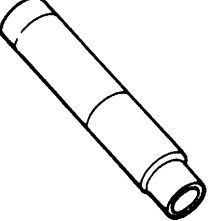
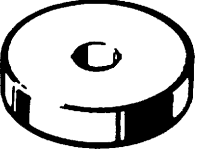
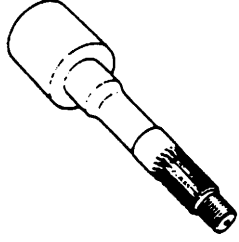
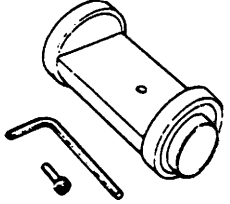
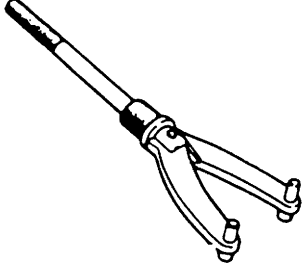
Tightening Torque Specification

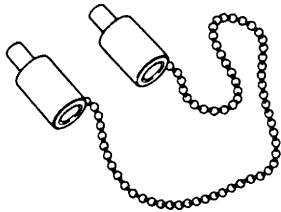
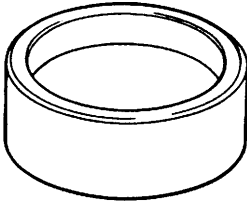
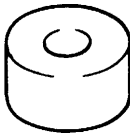
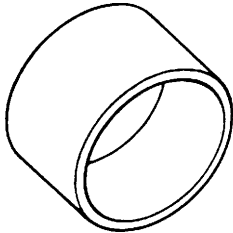
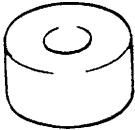
Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Differential oil level/filler plug	50	5.0	36.5
Differential oil drain plug	28	2.8	20.5
Propeller shaft flange bolts	50	5.0	36.5
Differential carrier bolts	55	5.5	40.0
Bevel gear bolts	105	10.5	76.0
Bearing cap bolts	85	8.5	61.5
Lock plate bolts	12	1.2	9.0
Differential case screws	9	0.9	6.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Thread lock cement	THREAD LOCK CEMENT SUPER 1322 (99000-32110)	• Bevel gear bolts • Differential case bolts • Bevel gear mating surface • Propeller shaft flange bolt
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	Oil seal lips
Sealant	SUZUKI BOND NO.1215 (99000-31110)	• Rear differential drain plug • Mating surface of differential housing • Mating surface of rear axle housing

Special Tool

 09900-20606 Dial gauge	 09900-20701 Magnetic stand	 09913-61510 Bearing puller	 09922-76570 Attachment
 09913-75510 Bearing installer	 09913-85230 Bearing removing jig	 09922-66021 Flange holder	 09922-75222 Preload checking tool
 09924-74510 Installer attachment	 09925-18011 Bearing installer	 09926-68310 Bearing installer	 09926-78311-002 Pinion mounting dummy (See NOTE.)
 09926-78320 Mounting dummy	 09927-66010/J-23082-01 Oil pump aligner	 09928-06510 Differential torque checking tool	 09930-40113 Rotor holder

 09930-40120 Attachment	 09944-66020 Bearing installer	 09951-16060 Lower arm bush remover	 09951-18210 Oil seal remover & installer No.2
 09951-46010 Drive shaft oil seal installer			

NOTE:

This tool (09926-78311-002) is one of components for 09926-78311.

SECTION 8C

INSTRUMENTATION/DRIVER INFORMATION

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

NOTE:

For the items with asterisk (*) in the “CONTENTS” below, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

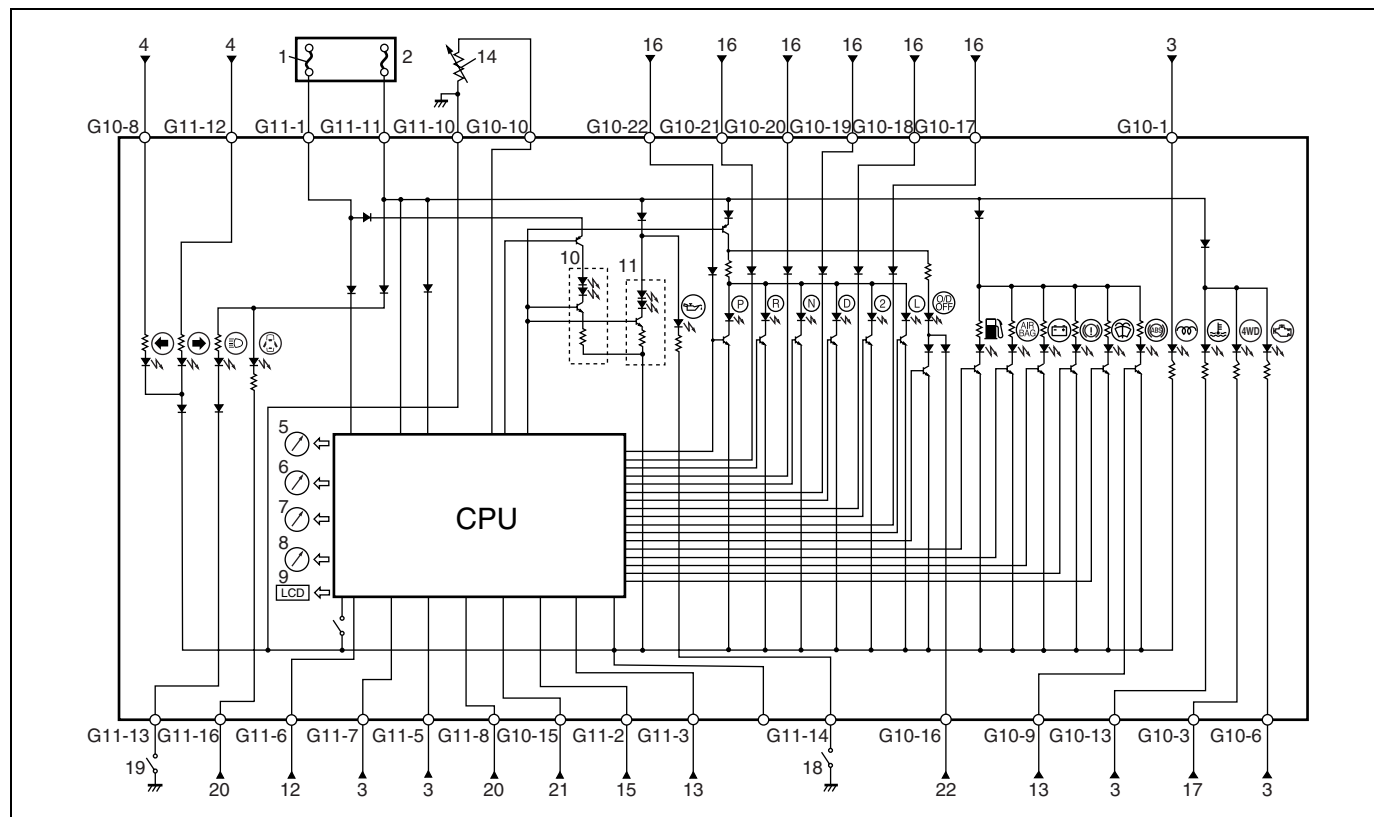
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Engine Oil Pressure Indicator	*	Radio assembly	*
A/T Selector Position Indicator	*	Front speaker	*
Charge Warning Indicator Lamp	*	Sub woofer speaker	*
O/D OFF Indicator Lamp	*	Remote audio control switch	*
POWER Indicator Lamp	*	Tightening Torque Specification	*

General Description

Combination Meter

Combination meter internal circuits and couplers

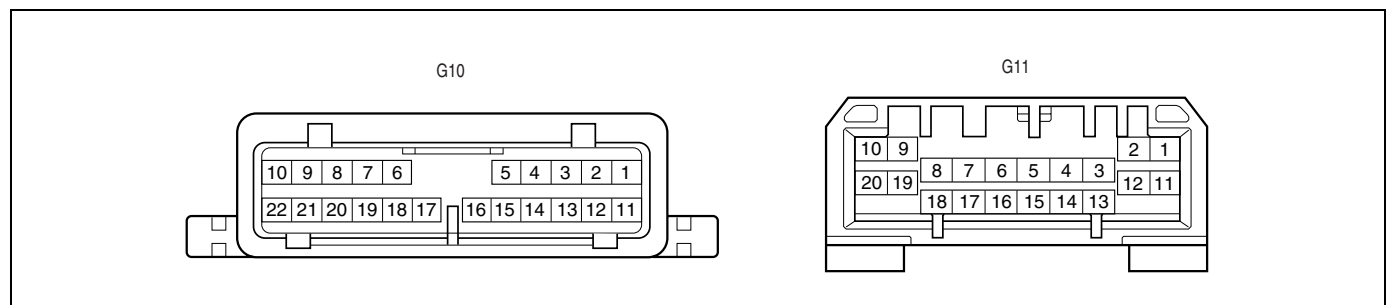


1. RADIO DOME fuse	7. Fuel meter	13. To ABS control module	19. To lighting switch
2. METER fuse	8. Engine coolant temperature meter	14. Fuel level gauge	20. To BCM
3. To ECM	9. ODO-TRIP meter	15. To SDM	21. To data link connector
4. To turn signal relay	10. Back light	16. To transmission range sensor	22. To TCM
5. Tachometer	11. Meter pointer	17. To 4WD controller	
6. Speedometer	12. To VSS	18. Oil pressure switch	

COMBINATION METER TERMINAL ARRANGEMENT TABLE

Terminal	Wire Color	Circuit
G10-1	RED/BLK	To ECM (Glow indicator control signal)
G10-2	—	—
G10-3	ORN/BLK	To 4WD controller (4WD indicator control signal)
G10-4	—	—
G10-5	—	—
G10-6	PPL/YEL	To ECM (MIL indicator control signal)
G10-7	—	—
G10-8	GRN/YEL	To combination switch (Turn R signal indicator control signal)
G10-9	BLU/ORN	To ABS control module (ABS indicator control signal)
G10-10	BLU/WHT	To fuel level gauge
G10-11	—	—
G10-12	—	—
G10-13	BLK/RED	To ECM (Engine coolant temperature warning indicator control signal)
G10-14	—	—
G10-15	PPL/RED	To data link connector

Terminal	Wire Color	Circuit
G10-16	WHT/BLK	To TCM (O/D OFF indicator control signal)
G10-17	GRN/BLU	To transmission range sensor ("L" range indicator control signal)
G10-18	GRN/ORN	To transmission range sensor ("2" range indicator control signal)
G10-19	YEL/GRN	To transmission range sensor ("D" range indicator control signal)
G10-20	ORN/BLU	To transmission range sensor ("N" range indicator control signal)
G10-21	RED	To transmission range sensor ("R" range indicator control signal)
G10-22	ORN/GRN	To transmission range sensor ("P" range indicator control signal)
G11-1	WHT	To "RADIO DOME" fuse
G11-2	BLU	To SDM (AIR BAG indicator control signal)
G11-3	ORN	To ABS control module (EBD warning indicator control signal)
G11-4	—	—
G11-5	YEL/WHT	To ECM (Engine coolant temperature meter signal)
G11-6	BLU/YEL	To VSS (Speedometer signal)
G11-7	BRN	To ECM (Tachometer signal)
G11-8	YEL	To BCM (brake fluid level, parking brake, charge warning, washer level indicator and light switch cognition signal)
G11-9	—	—
G11-10	BLK/YEL	To fuel level gauge ground
G11-11	BLK/WHT	To "METER" fuse
G11-12	GRN/RED	To combination switch (Turn L signal indicator control signal)
G11-13	RED	To combination switch (High beam indicator control signal)
G11-14	YEL/BLK	To oil pressure switch
G11-15	—	—
G11-16	BLK/RED	To door switch
G11-17	—	—
G11-18	—	—
G11-19	—	—
G11-20	—	—



On-Vehicle Service

Fuel Meter/Fuel Gauge Unit

Fuel level gauge

INSPECTION

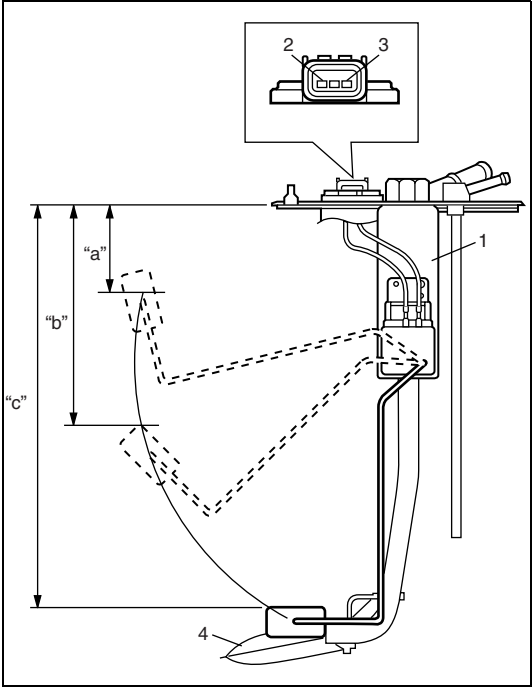
Remove fuel level gauge referring to “Fuel Level Gauge” in Section 6C of this manual.

Using an ohmmeter, confirm that resistance of level gauge unit changes with change of float position.

Fuel level gauge specification

	Float Position		Fuel Meter Position	Resistance (Ω)
	Short Body Vehicle	Long Body Vehicle		
“a”	90.1 mm (3.55 in.)	55 mm (2.17 in.)	F	17 – 19
“b”	157.2 mm (6.19 in.)	139.6 mm (5.50 in.)	1/2	62 – 68
“c”	254.9 mm (10.04 in.)	254.9 mm (10.04 in.)	E	111 – 113

If measured valve is out of specification, replace fuel lever gauge.



1. Fuel level gauge
2. Fuel level gauge (+) terminal
3. Fuel level gauge (-) terminal
4. Float

Engine Coolant Temperature (ECT) Sensor

REMOVAL, INSPECTION AND INSTALLATION

Refer to “Engine Coolant Temperature (ECT) Sensor” in Section 6E3.

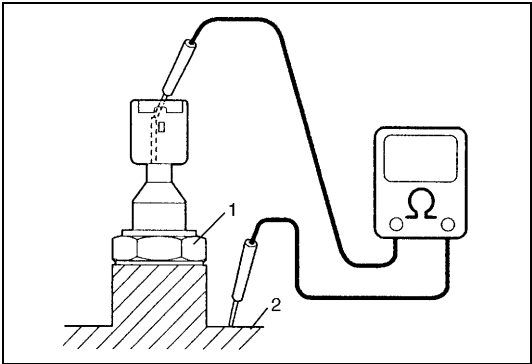
Oil Pressure Switch

REMOVAL AND INSTALLATION

Refer to “Oil Pressure Switch” in Section 6A3 of this manual for details.

INSPECTION

Check oil pressure switch (1) for continuity using an ohmmeter. If check result is not satisfactory, replace oil pressure switch.



During Engine Running	No continuity ($\infty \Omega$)
At Engine Stop	Continuity (0Ω)

2. Cylinder block

SECTION 8G

IMMOBILIZER CONTROL SYSTEM

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

8G

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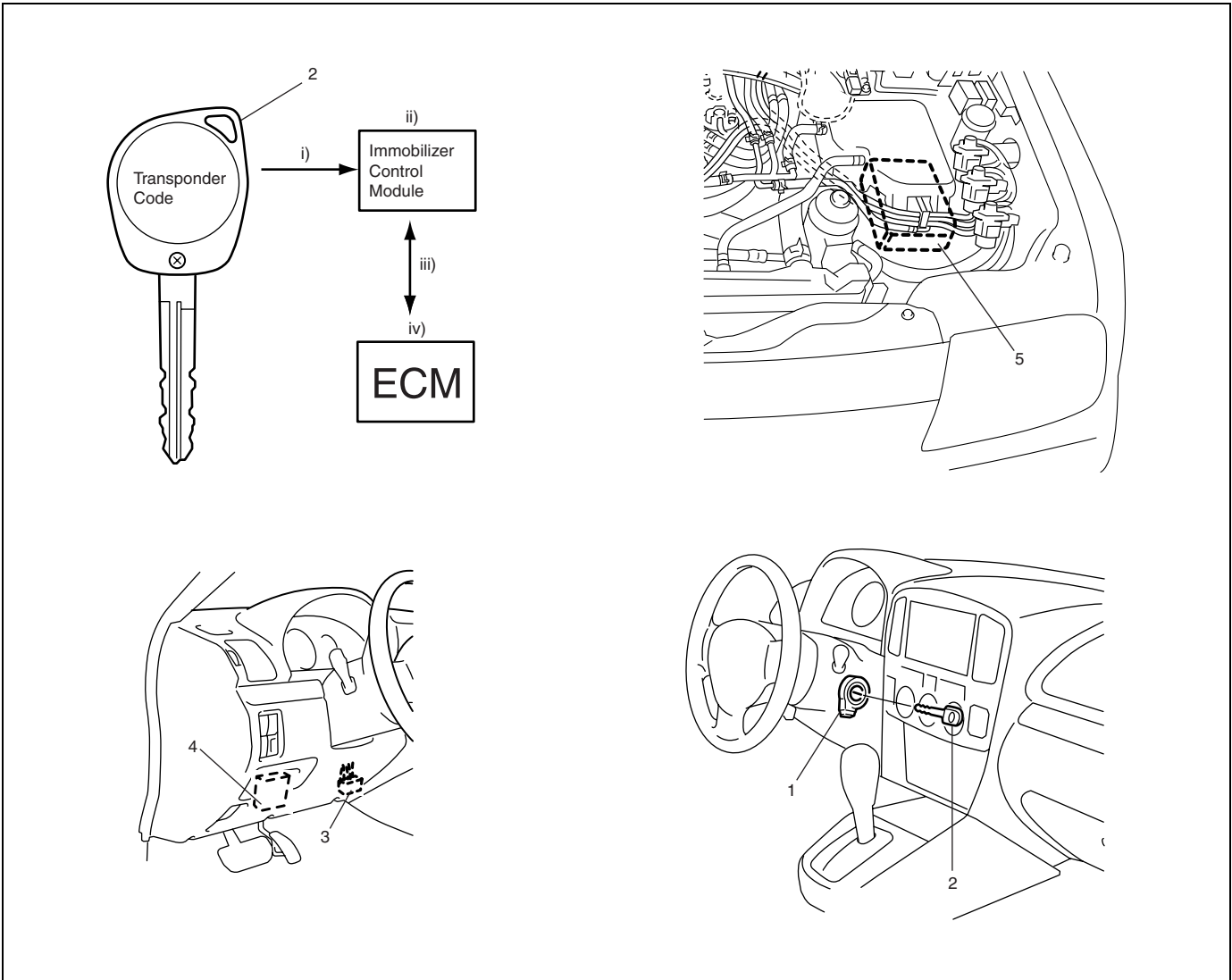
General Description

The immobilizer control system is designed to prevent vehicle burglar and consists of following components.

- Engine Control Module (ECM)
- Immobilizer Control Module
- Ignition key (with built-in transponder)
- Coil antenna

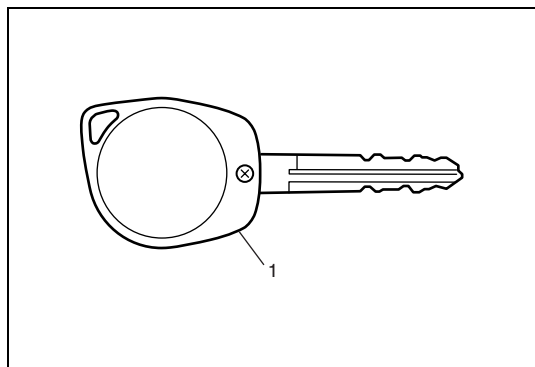
Operation of this system is as follows.

- Each ignition key has its own Transponder code stored in memory. When the ignition switch is turned ON, Immobilizer Control Module tries to read the Transponder code through the coil antenna installed to the steering lock assembly.
- Immobilizer Control Module compares the Transponder code read in (i) and that registered in Immobilizer Control Module and checks if they match.
- When it is confirmed that two Transponder codes match in Step (ii), Immobilizer Control Module and ECM check if ECU codes registered in them respectively match.
- Only when it is confirmed that ECU codes match, engine can be started (immobilizer system unlocked). If Transponder codes in Step (ii) or ECU codes in Step (iii) do not match, ECM will stop operation of the injectors.



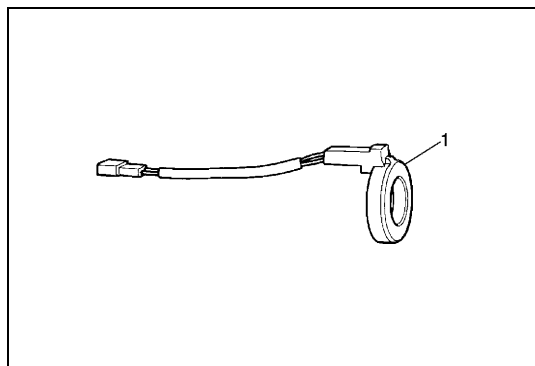
1. Coil antenna	4. Immobilizer Control Module
2. Ignition key	5. ECM
3. Data link connector (DLC)	

Ignition Key



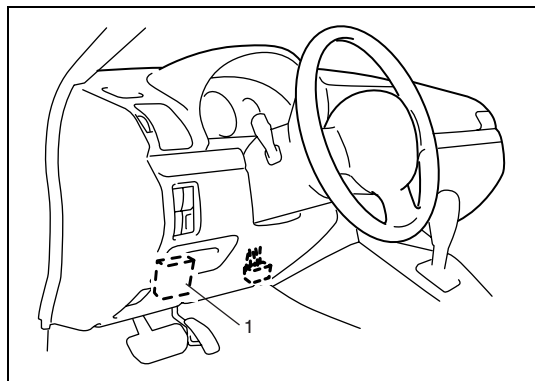
The ignition key (1) for the immobilizer control system has a built-in transponder. Each transponder in the key has an each transmitting code (Transponder code). The code will be transmitted from the key via the coil antenna to Immobilizer Control Module when the ignition switch is turned ON.

Coil Antenna



The coil antenna (1) is installed to the steering lock assembly. As it is energized by Immobilizer Control Module, it transmits the transponder code of the ignition key to Immobilizer Control Module.

Immobilizer Control Module



Immobilizer Control Module (1) is installed to the underside of the instrument panel at the driver's seat side.

As main functions, Immobilizer Control Module checks matching not only between the Transponder Code transmitted from the ignition key and that registered in Immobilizer Control Module (Up to four different Transponder codes can be registered.) but also between the ECU code transmitted from ECM and that registered in Immobilizer Control Module. In addition, it has an on-board diagnostic system (self-diagnosis function) which is described in the following page.

ECM

ECM checks matching of ECU code transmitted from Immobilizer Control Module and ECU code registered in ECM. After confirmation of ECU codes, ECM is ready to start engine.

On-board Diagnostic System (Self-diagnosis Function)

Immobilizer Control Module diagnoses troubles which may occur in the area including the following parts when the ignition switch is ON. It indicates the diagnosis result on SUZUKI scan tool.

- Ignition key (Transponder code)
- Coil antenna
- Serial data circuit between Immobilizer Control Module and ECM
- Immobilizer Control Module (Transponder code or ECU code)
- ECM (ECU code)

Diagnosis

Immobilizer Control Module have on-board diagnostic system (self-diagnosis function) as described previously. Investigate where the trouble is by referring to “Immobilizer Control System Diagnostic Flow Table” and “Diagnostic Trouble Code Table” in this section.

Precautions in Diagnosing Troubles

Precautions in identifying diagnostic trouble code

Immobilizer Control Module

Take a note of diagnostic trouble code indicated first.

Note on system circuit inspection

Refer to “Precautions for Electrical Circuit Service” and “Intermittents and Poor Connection” in Section 0A.

Precautions after Replacing ECM or Immobilizer Control Module

- When ECM was replaced the ECM codes must be registered in ECM and Immobilizer Control Module by performing procedure described in “Procedure after ECM Replacement” in this section. If it is not registered, ECM would not function as Immobilizer Control System and accurate trouble diagnosis would not be assured.
- When Immobilizer Control Module was replaced, including when replaced because rechecking by using a known-good Immobilizer Control Module was necessary during trouble diagnosis, the Transponder code and ECM code must be registered in Immobilizer Control Module by performing procedure described in “Procedure after Immobilizer Control Module Replacement” in this section. If they are not registered, the engine would not start and accurate trouble diagnosis would not be assured.

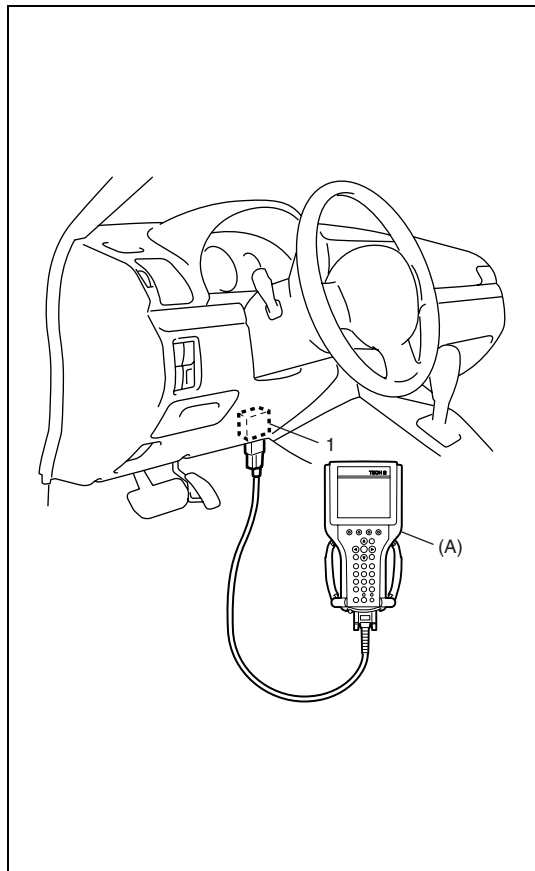
Immobilizer Control System Diagnostic Flow Table

NOTE:

After replacing with Immobilizer Control Module and/or ECM, register Transponder code and ECU code according to “Procedure after Immobilizer Control Module Replacement” or “Procedure after ECM Replacement”. Otherwise, Immobilizer control system will not be in operation.

Step	Action	Yes	No
1	Turn ignition switch to start engine. Does engine run?	Immobilizer control system is in good condition.	Go to Step 2.
2	Check DTC stored in Immobilizer Control Module referring to “Diagnostic Trouble Code (DTC) Check” in this section. Are there DTC Nos 13 and/or 14?	Go to flow table for DTC No.	Go to Step 3.
3	Is there DTC No.12?	Go to flow table for DTC No.	Go to Step 4.
4	Are there DTC Nos 11 and/or 31?	Go to flow table for DTC No.	Go to Step 5.
5	Are there DTC No.41, 42 or 43?	Go to flow table for DTC No.	Substitute a known-good Immobilizer Control Module. Then, perform “Procedure after Immobilizer Control Module Replacement” in this section.
6	Turn ignition switch to start engine. Does engine run?	Immobilizer control system is in good condition.	Go to “Engine Diagnosis Table” in Section 6-1.

Diagnostic Trouble Code (DTC) Check (Immobilizer Control Module)



- 1) Turn ignition switch OFF.
- 2) After setting program card to SUZUKI scan tool, connect it to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

Special tool

(A): SUZUKI scan tool

- 3) Turn ignition switch OFF for 10 seconds and then ON.

NOTE:

When the ignition switch is turned off and then on again within 10 seconds, DTC41 is stored in the Immobilizer Control Module.

- 4) Read DTC stored in Immobilizer Control Module according to instructions displayed on SUZUKI scan tool.
If SUZUKI scan tool indicates "ECU NO RESPONSE", go to "Diagnostic Flow Table A".

NOTE:

For operation procedure of SUZUKI scan tool, refer to operator's manual for SUZUKI scan tool.

- 5) After completing the check, turn ignition switch OFF and disconnect SUZUKI scan tool from data link connector (DLC).

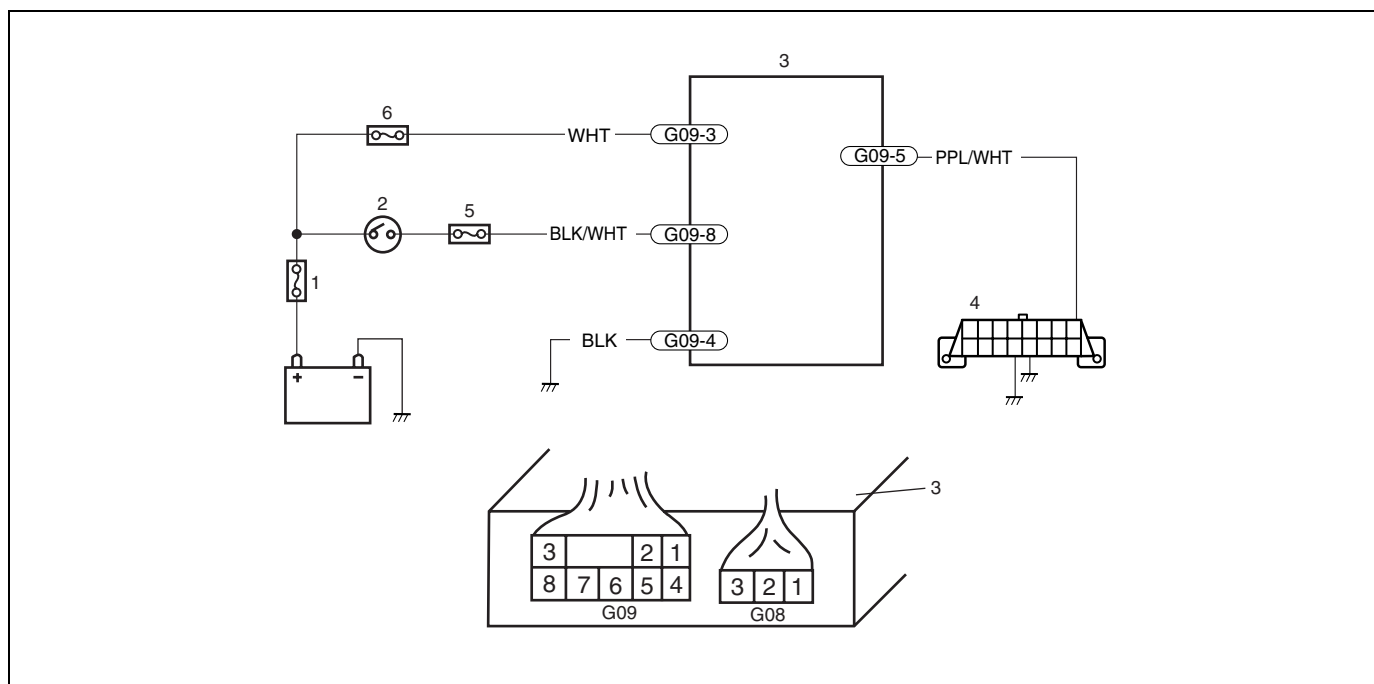
Diagnostic Trouble Code Table

IMMOBILIZER CONTROL MODULE

DIAGNOSTIC TROUBLE CODE NO.	DTC DESCRIPTION	DIAGNOSIS
NO DTC	—	This code appears when none of the other codes are identified.
11	Transponder code not matched	Diagnose trouble according to "Immobilizer Control System Diagnostic Flow Table" corresponding to each code No.
12	Fault in Immobilizer Control Module	
13	No transponder code transmitted from ignition key	
14	Coil antenna circuit malfunction	
31	Transponder code not registered	
41	ECM not registered	
42	Serial data circuit (between Immobilizer Control Module and ECM)	
43	ECU code not matched	

NOTE:

- When the ignition switch is turned off and then on again within 10 seconds, DTC 41 is stored in the Immobilizer Control Module.
- If any DTC other than DTC 41 is stored in the Immobilizer Control Module, the immobilizer system is locked (engine unable to start).

Table A – Scan Tool Can Not Communicate with Immobilizer Control Module

1. Main fuse	4. Data link connector (DLC)
2. Ignition switch	5. "IG METER" fuse
3. Immobilizer Control Module	6. "DOME" fuse

NOTE:

Before inspection, make sure if SUZUKI scan tool is free from any malfunction and if correct PC card is used. Also, make sure if SUZUKI scan tool is properly connected to DLC.

INSPECTION:

Step	Action	Yes	No
1	Check voltage between G09-8 terminal and body ground with ignition switch ON. Is it 10 – 14 V?	Go to Step 2.	• "BLK/WHT" wire open • "IG METER" fuse broken
2	Check voltage between G09-3 terminal and body ground. Is it 10 – 14 V?	Go to Step 3.	• "WHT" wire open • "DOME" fuse broken
3	Is there continuity between G09-4 terminal and body ground?	Go to Step 4.	"BLK" wire open
4	Check voltage between "PPL/WHT" wire terminal of DLC and body ground with ignition switch ON. Is it 4 – 5 V?	• Poor G09-8, G09-3, G09-4 or G09-5 connection. If connection and line are OK, substitute a known-good Immobilizer Control Module and recheck.	"PPL/WHT" wire open

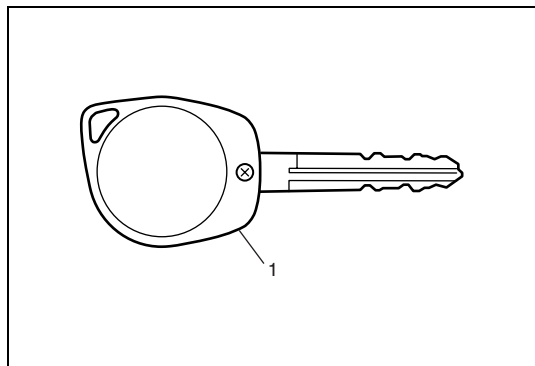
DTC11 Transponder Code Not Matched**DTC31 Transponder Code Not Registered****DESCRIPTION:**

Immobilizer Control Module checks if Transponder code transmitted from ignition key and that registered in Immobilizer Control Module match when ignition switch is ON. If they do not, DTC 11 and 31 are set.

INSPECTION:

Step	Action	Yes	No
1	Was "Immobilizer Control System Diagnostic Flow Table" performed?	Go to Step 2.	Go to "Immobilizer Control System Diagnostic Flow Table".
2	Check that knob shape of ignition key being used is the same as shown in Fig. 1. Is it ignition key with built-in transponder (1)?	Register ignition key in Immobilizer Control Module according to the procedure described in "How to Register Ignition Key". Then, go to Step 3.	Replace ignition key.
3	Read DTC according to "Diagnostic Trouble Code Check" section. Does SUZUKI scan tool indicate DTC 11 and/or 31 again?	Replace ignition key.	Go to "Immobilizer Control System Diagnostic Flow Table".

Fig. 1 for Step 2



DTC12 Fault in Immobilizer Control Module

DESCRIPTION:

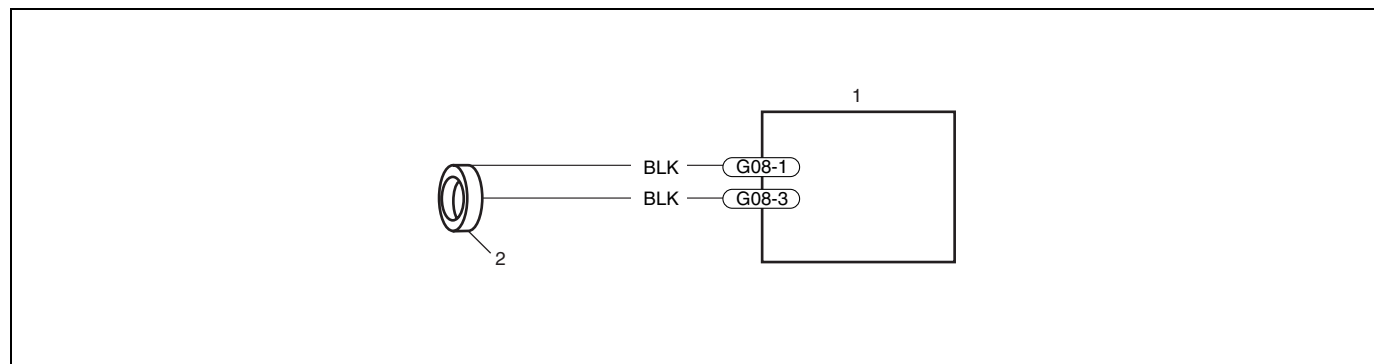
This DTC is set when an internal fault is detected in Immobilizer Control Module.

INSPECTION:

Step	Action	Yes	No
1	Was "Immobilizer Control System Diagnostic Flow Table" performed?	Go to Step 2.	Go to "Immobilizer Control System Diagnostic Flow Table".
2	1) Ignition switch OFF. 2) Disconnect connectors from Immobilizer Control Module. 3) Check for proper connection to Immobilizer Control Module at all terminals. Are they in good condition?	Substitute a known-good Immobilizer Control Module and recheck.	Repair or replace

DTC13 No Transponder Code Transmitted from Ignition Key

DTC14 Coil Antenna Circuit Malfunction



- | |
|-------------------------------|
| 1. Immobilizer Control Module |
| 2. Coil antenna |

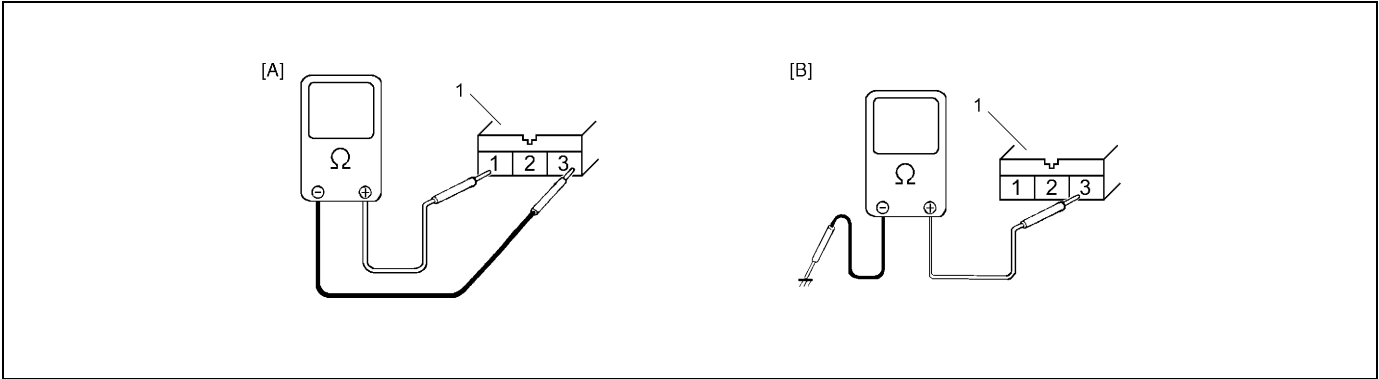
DESCRIPTION:

Immobilizer Control Module energizes the coil antenna when the ignition switch is ON and reads Transponder code from the ignition key. When Immobilizer Control Module cannot read Transponder code from the ignition key even when the coil antenna is energized, DTC 13 and 14 are set.

INSPECTION:

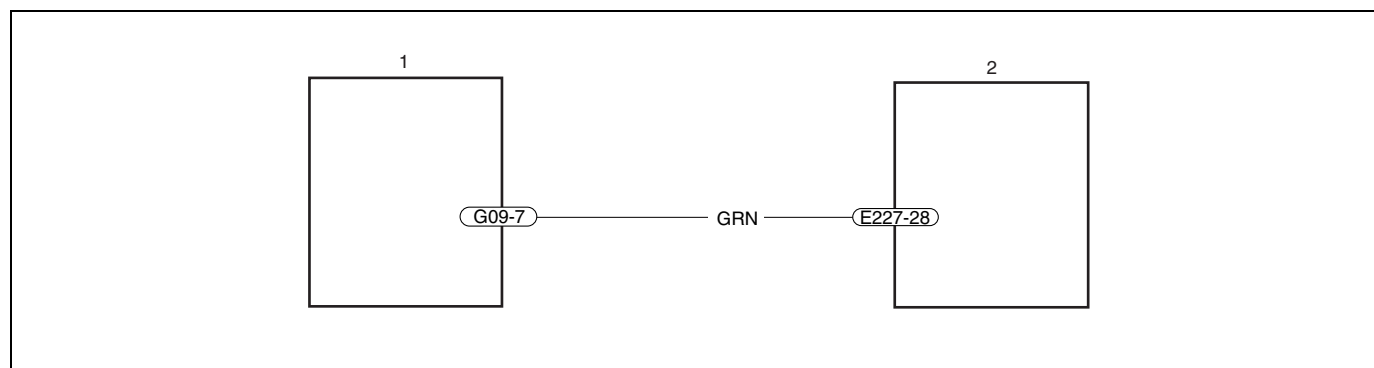
Step	Action	Yes	No
1	Was “Immobilizer Control System Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Immobilizer Control System Diagnostic Flow Table”.
2	1) Disconnect coil antenna coupler with ignition switch turned OFF. 2) Is there continuity between coil antenna coupler terminals G08-1 and G08-3? (See Fig. 1)	Go to Step 3.	Coil antenna open.
3	Measure resistance between terminals of coil antenna coupler and body ground. (See Fig. 2) Is it ∞ (infinity) Ω?	Go to Step 4.	Coil antenna shorted to ground.
4	Poor G08-1 or G08-3 connection. 1) If connections are OK, substitute a known-good coil antenna. 2) Is DTC 13 and/or 14 also indicated with ignition switch turned ON?	Substitute a known-good Immobilizer Control Module and recheck.	Faulty coil antenna.

[A] Fig. 1 for Step 2 / [B] Fig. 2 for Step 3



1. Coil antenna coupler

DTC41 ECM Not Registered



1. ECM

2. Immobilizer Control Module

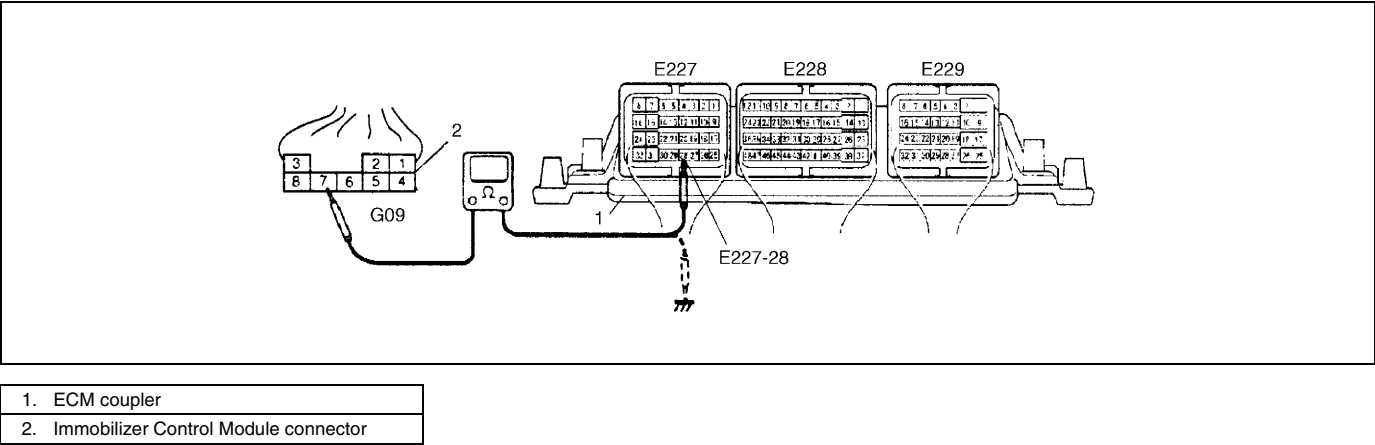
DESCRIPTION:

Immobilizer Control Module checks whether immobilizer control system is locked with ignition switch OFF. If the system is unlocked, DTC 41 is set.

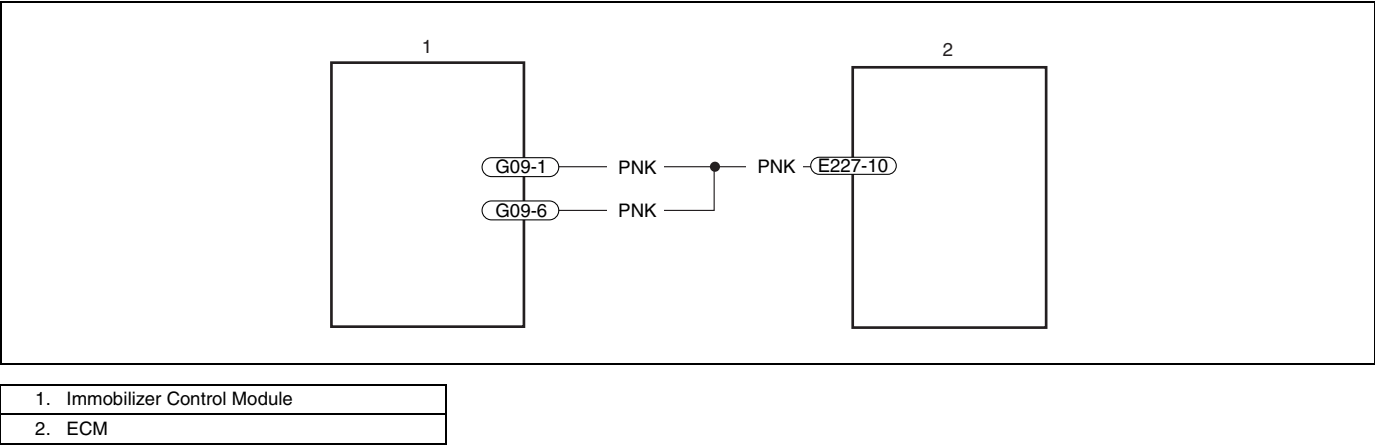
INSPECTION:

Step	Action	Yes	No
1	Was "Immobilizer Control System Diagnostic Flow Table" performed?	Go to Step 2.	Go to "Immobilizer Control System Diagnostic Flow Table".
2	1) Disconnect ECM coupler. 2) Disconnect coupler at Immobilizer Control Module. 3) Is there continuity between G09-7 of Immobilizer Control Module coupler and E227-28 in coupler of ECM? See Fig. 1.	Go to Step 3.	"GRN" wire open or, Poor G09-7 terminal connection.
3	1) Check resistance between G09-7 of Immobilizer Control Module coupler and body ground. See Fig.1. Is it infinity (∞)?	Poor G09-7 and E227-28 terminal connection. If all above are OK, register ECU code in ECM according to "Procedure after ECM Replacement" section. And then go to Step 4.	"GRN" wire shorted to ground.
4	1) Read DTC according to "Diagnostic Trouble Code Check" section. Does SUZUKI scan tool indicate DTC 41 again?	Substitute a known-good ECM and recheck.	Go to "Immobilizer Control System Diagnostic Flow Table".

Fig. 1 for Step 2 and 3



DTC42 Serial Data Circuit Malfunction (Between Immobilizer Control Module and ECM)



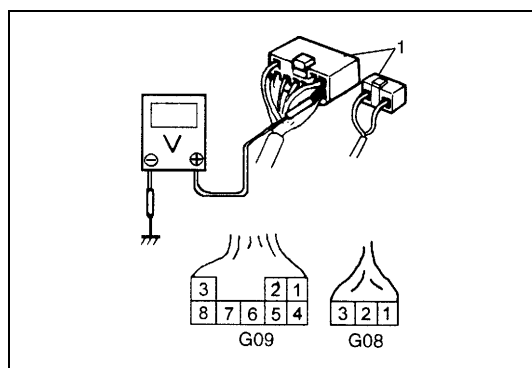
DESCRIPTION:

If ECU code is not transmitted from ECM, Immobilizer Control Module sets DTC42.

INSPECTION:

Step	Action	Yes	No
1	Was "Immobilizer Control System Diagnostic Flow Table" performed?	Go to Step 2.	Go to "Immobilizer Control System Diagnostic Flow Table".
2	1) Disconnect coupler at Immobilizer Control Module. 2) Check for proper connection to Immobilizer Control Module at each terminal. If OK, check voltage between coupler terminal below and body ground with ignition switch ON. See Fig.1. • G09-6 and body ground • G09-1 and body ground Are they 10 – 14 V?	Substitute a known-good Immobilizer Control Module and recheck.	• "PNK" wire open shorted to ground. or • Poor C51-36 or E227-10 terminal connection. If all above are OK, substitute a known-good ECM and recheck.

Fig. 1 for Step 2



1. Immobilizer Control Module coupler

DTC43 ECU Code Not Matched**DESCRIPTION:**

Immobilizer Control Module and ECM check if ECU codes registered in them respectively match. If the codes do not match, Immobilizer Control Module sets DTC 43.

INSPECTION:

Step	Action	Yes	No
1	Was "Immobilizer Control System Diagnostic Flow Table" performed?	Go to Step 2.	Go to "Immobilizer Control System Diagnostic Flow Table".
2	1) Register ECU code in Immobilizer Control Module according to "Procedure after Immobilizer Control Module Replacement" section. 2) Read DTC according to "Diagnostic Trouble Code Check" section. Does SUZUKI scan tool indicate DTC 43 again?	Faulty ECM.	Go to "Immobilizer Control System Diagnostic Flow Table".

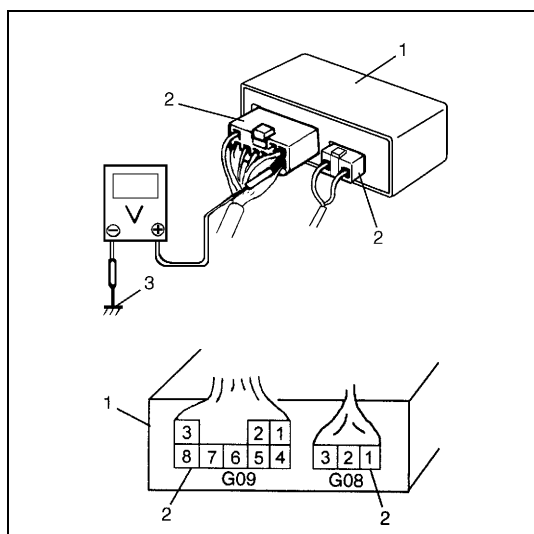
Inspection of Immobilizer Control Module and Its Circuit

Immobilizer Control Module and its circuit can be checked at Immobilizer Control Module wiring coupler by measuring voltage and resistance. Described here is only inspection of Immobilizer Control Module.

CAUTION:

Immobilizer Control Module cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to Immobilizer Control Module with coupler disconnected from it.

VOLTAGE CHECK



- 1) Remove Immobilizer Control Module (1) from body with ignition switch OFF referring to “Immobilizer Control Module” in this section.
- 2) Connect Immobilizer Control Module couplers (2) to Immobilizer Control Module (1).
- 3) Check voltage at each terminal of couplers connected.

NOTE:

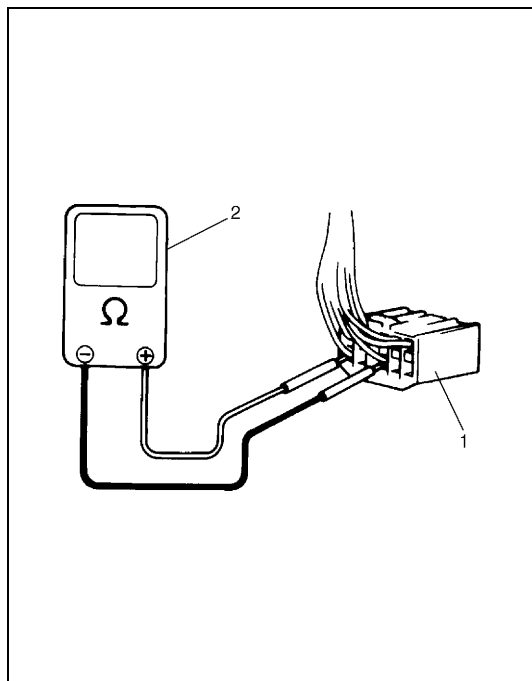
As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON.

3. Body ground

Terminal	Circuit	Normal Voltage	Condition
G08-1	Coil antenna +	0 V	Ignition switch ON
G08-2	—	—	—
G08-3	Coil antenna –	0 V	Ignition switch ON
G09-1	Serial data line between ECM and Immobilizer Control Module	10 – 14 V	Ignition switch ON and OFF
G09-2	—	—	—
G09-3	Power supply	10 – 14 V	Ignition switch ON and OFF
G09-4	GND	—	—
G09-5	Serial data line between SUZUKI scan tool and Immobilizer Control Module	4 – 5 V	Ignition switch ON and OFF
G09-6	Serial data line between ECM and Immobilizer Control Module	10 – 14 V	Ignition switch ON and OFF
G09-7	Power control of ECM	0 V	Ignition switch ON and OFF
G09-8	Ignition signal	0 V	Ignition switch OFF
		10 – 14 V	Ignition switch ON

NOTE:

When measuring voltage at G08-1 and G08-3 terminals with ignition switch turned ON, be sure to turn ignition switch ON before connecting positive probe of voltmeter to G08-1 or G08-3 terminal. If it is not turned ON first, DTC13 (Diagnostic Trouble Code 13) may be indicated.

RESISTANCE CHECK

- 1) Disconnect Immobilizer Control Module coupler from Immobilizer Control Module with ignition switch OFF.

CAUTION:

Do not touch terminals of Immobilizer Control Module itself or connect voltmeter or ohmmeter.

- 2) Check resistance between each terminal of coupler disconnected.

CAUTION:

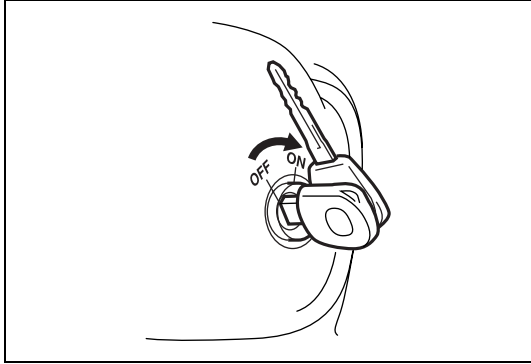
- Be sure to connect ohmmeter probe from wire harness side of coupler.
- Be sure to turn OFF ignition switch for this check.
- Resistance in table below represents that when parts temperature is 20 °C (68 °F).

- | |
|--|
| 1. Immobilizer Control Module coupler disconnected |
| 2. Ohmmeter |

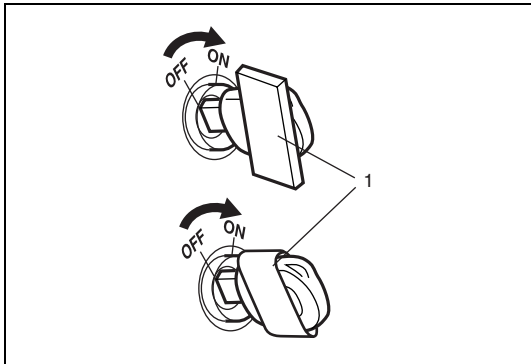
Terminal	Circuit	Normal Resistance	Condition
G08-1 – G08-3	Coil antenna	Continuity	—

On-Vehicle Service

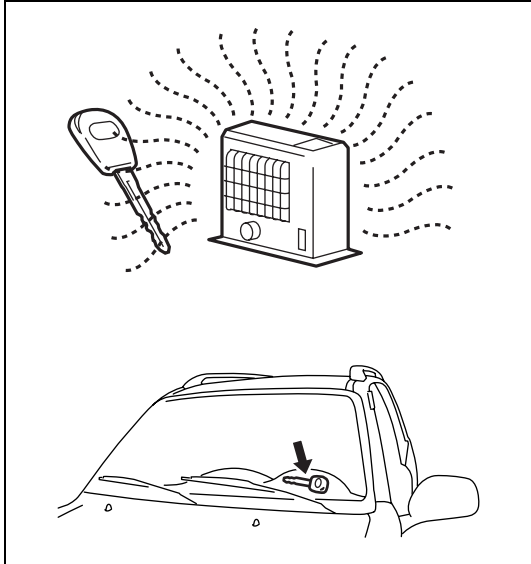
Precautions in Handling Immobilizer Control System



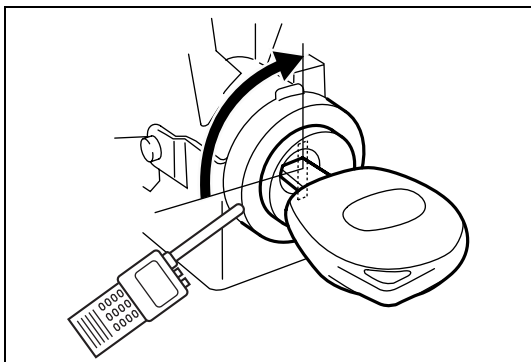
- Don't turn ON ignition switch with ignition key for immobilizer control system put together with another one or placed quite close to another one. Or the system may detect abnormal condition and prevent engine from starting.



- Do not turn ON ignition switch by using ignition key with any type of metal wound (1) around its grip or in contact with it. Or the system may detect abnormal condition and prevent engine from starting.



- Do not leave ignition key where high temperature is anticipated. High temperature will cause transponder in ignition key to be abnormal or damaged.

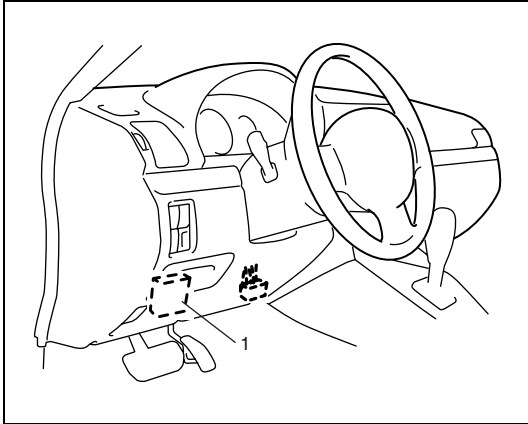


- Do not turn ON ignition switch with a radio antenna placed near coil antenna or its harness to Immobilizer Control Module. Or the system may detect abnormal condition and prevent engine from starting.

Immobilizer Control Module

REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Remove steering column hole cover.
- 3) Disconnect couplers.
- 4) Remove Immobilizer Control Module (1).



INSTALLATION

Reverse removal procedure for installation.

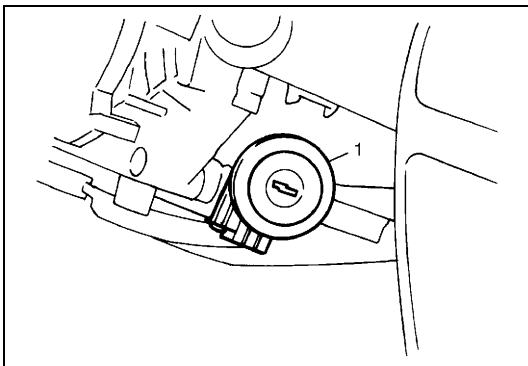
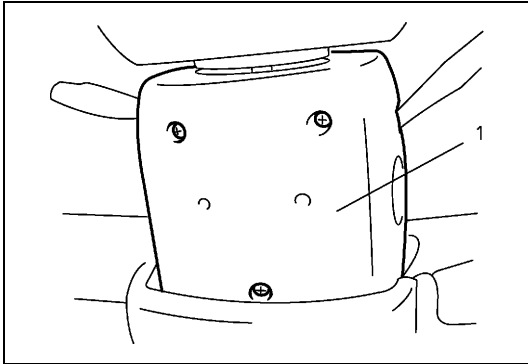
NOTE:

After replacing Immobilizer Control Module, be sure to register Transponder code and ECU code in Immobilizer Control Module by performing procedure described in “Procedure after Immobilizer Control Module Replacement”.

Coil Antenna

REMOVAL

- 1) Disconnect negative (–) cable at battery.
- 2) Remove steering column upper and lower cover (1) by removing three screws.
- 3) Remove steering column hole cover.



- 4) Remove coil antenna (1).

INSTALLATION

For installation, reverse removal procedure.

How to Register Ignition Key

Register the ignition key with a built-in transponder in Immobilizer Control Module by using the following procedure.

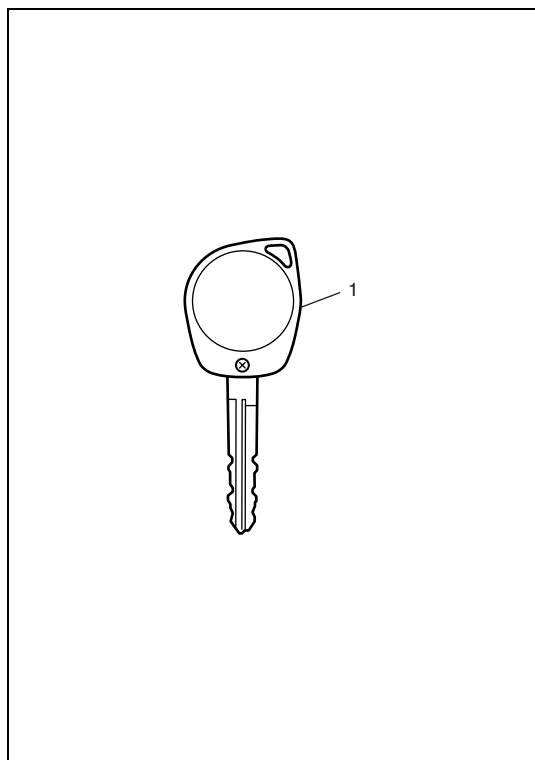
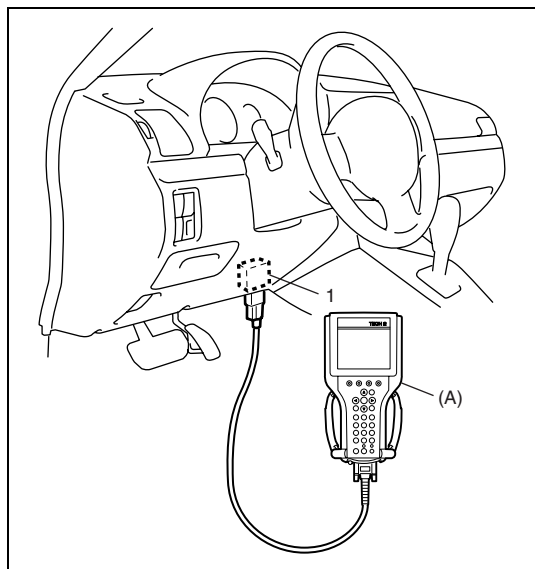
- 1) Prepare SUZUKI scan tool.
- 2) With ignition switch OFF, connect SUZUKI scan tool to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

Special tool

(A): SUZUKI scan tool

NOTE:

For operation procedure of SUZUKI scan tool, refer to operator's manual for SUZUKI scan tool.



- 3) Prepare ignition key with a built-in transponder (1). And then turn ignition switch ON by using it.
- 4) Number of Transponder codes for ignition key with a built-in transponder that can be registered in Immobilizer Control Module is limited to four. If needed, clear all Transponder codes for ignition key with a built-in transponder that have been registered in Immobilizer Control Module by using SUZUKI scan tool.

NOTE:

When clearing Transponder code(s) while no DTC is stored in the immobilizer control module, the immobilizer system remains unlocked. The immobilizer system changes into the locked state if the ignition switch is turned off for 10 seconds or longer and then turned on.

- 5) Using SUZUKI scan tool, register Transponder code in Immobilizer Control Module.
- 6) Make sure that no DTC is displayed on SUZUKI scan tool after ignition switch is turned OFF for 10 seconds or more and then ON.
- 7) If any other Transponder code for ignition key with a built-in transponder needs to be registered, repeat above Steps 3), 5) and 6).

NOTE:

- Up to four Transponder codes for ignition key with a built-in transponder can be registered.
- It is not possible to register the Transponder code which is already registered in Immobilizer Control Module.

Procedure after Immobilizer Control Module Replacement

When Immobilizer Control Module was replaced, including when replaced because rechecking by using a known-good Immobilizer Control Module was necessary during trouble diagnosis, register Transponder code and ECU code in Immobilizer Control Module by performing following procedure.

- 1) Perform Steps 1) and 2) described in “How to Register Ignition Key” in this section.
- 2) Prepare ignition key with a built-in transponder. And then turn ignition switch ON by using it.
- 3) Using SUZUKI scan tool, clear all transponder codes registered in Immobilizer Control Module.

NOTE:

When clearing Transponder code(s) while no DTC is stored in the immobilizer control module, the immobilizer system remains unlocked. The immobilizer system changes into the locked state if the ignition switch is turned off for 10 seconds or longer and then turned on.

- 4) Using SUZUKI scan tool, register Transponder code in Immobilizer Control Module.
- 5) Using SUZUKI scan tool, register ECU code in Immobilizer Control Module.

CAUTION:

In the process of the code registration, SUZUKI scan tool requires VIN to be entered. When entering VIN, make sure to follow the procedure described in operator's manual for SUZUKI scan tool. Incorrect VIN will cause the immobilizer system to be locked (engine does not start up).

- 6) Make sure that no DTC is displayed on SUZUKI scan tool after ignition switch is turned OFF for 10 seconds or more and then ON.
- 7) If any other Transponder code for ignition key with a built-in transponder needs to be registered, repeat above Steps 2), 4) and 6).

NOTE:

- Up to four Transponder codes for ignition key with a built-in transponder can be registered.
- It is not possible to register the Transponder code which is already registered in Immobilizer Control Module.

Procedure after ECM Replacement

CAUTION:

After replacing the ECM with a new one whose ECU code has not been registered, be sure to register it according to the following procedure. Without registration, the immobilizer system does not operate properly.

NOTE:

- ECU code can be registered to the ECM only once.
- If both Immobilizer Control Module and ECM are replaced at the same time, execute “Procedure after Immobilizer Control Module Replacement” first and then “Procedure after ECM Replacement”.

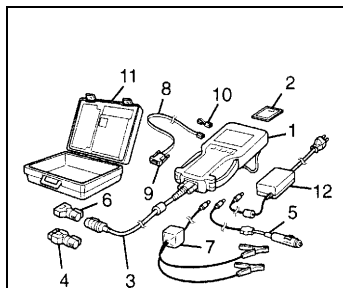
When ECM was replaced, register ECU code in ECM by performing following procedure.

- 1) Perform Steps 1) and 2) described in “How to Register Ignition Key” in this section, and then turn ignition switch ON.
- 2) Using SUZUKI scan tool, register ECU code in ECM.

NOTE:

- Turn on and off the ignition switch according to the instructions that appear on the screen of SUZUKI scan tool.
 - It takes 1 minute (max) until registration of ECU code to the ECM is completed.
- 3) Make sure that no DTC is displayed on SUZUKI scan tool after ignition switch is turned OFF for 10 seconds or more and then ON.

Special Tools



Tech 2 kit (SUZUKI scan tool)
See NOTE below.

NOTE:

This kit includes the following items.

1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

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