GROUP 16

ENGINE ELECTRICAL

CONTENTS

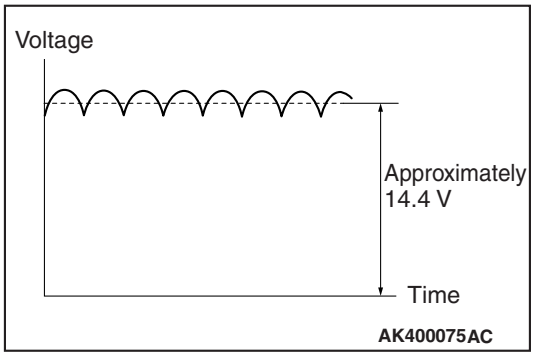
Continued on next page

CHARGING SYSTEM

GENERAL INFORMATION

M1161000101934

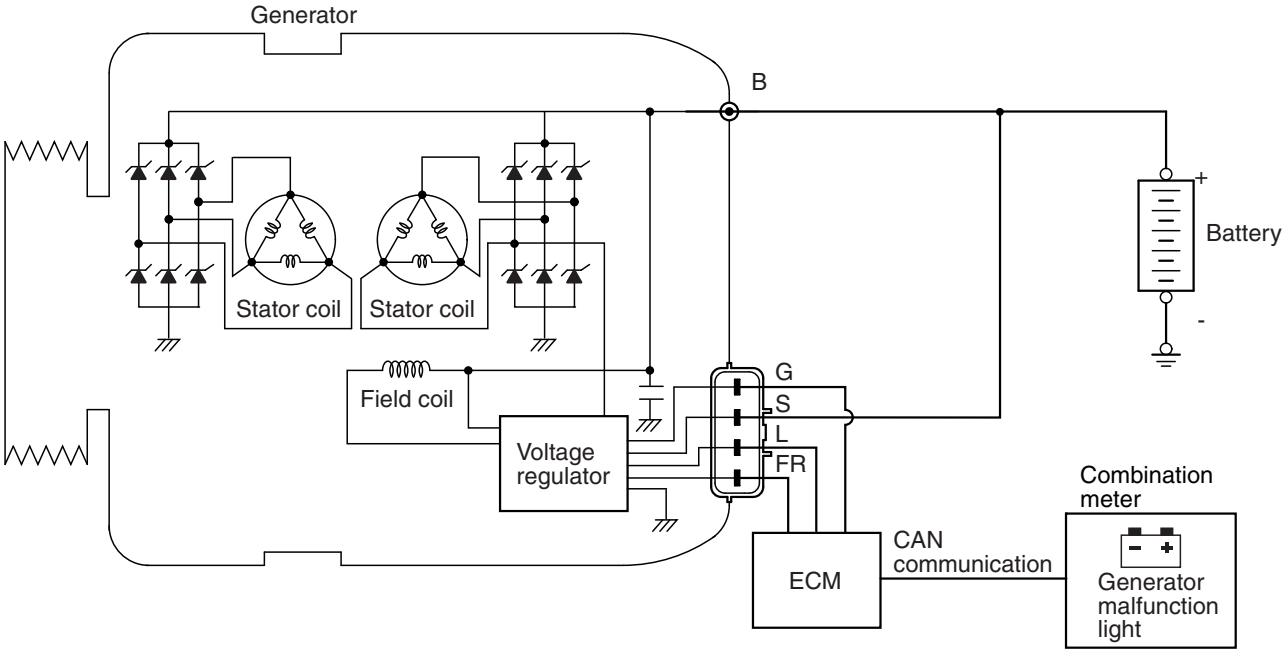
The charging system charges the battery with the generator output to keep the battery charged at a constant level during varying electrical load.



OPERATION

Rotation of the excited field coil generates AC voltage in the stator.
This alternating current is rectified through diodes to DC voltage having a waveform shown in the illustration above.
The average output voltage fluctuates slightly with the generator load condition.
When the ignition switch is turned on, current flows in the field coil and initial excitation of the field coil occurs.
When the stator coil begins to generate power after the engine is started, the field coil is excited by the output current of the stator coil.
The generator output voltage rises as the field current increases and it falls as the field current decreases. When the battery positive voltage (generator S terminal voltage) reaches a regulated voltage of approximately 14.4 V, the field current is cut off.
When the battery positive voltage drops below the regulated voltage, the voltage regulator regulates the output voltage to a constant level by controlling the field current.
In addition, when the field current is constant, the generator output voltage rises as the engine speed increases.

<2.4 L Engine>



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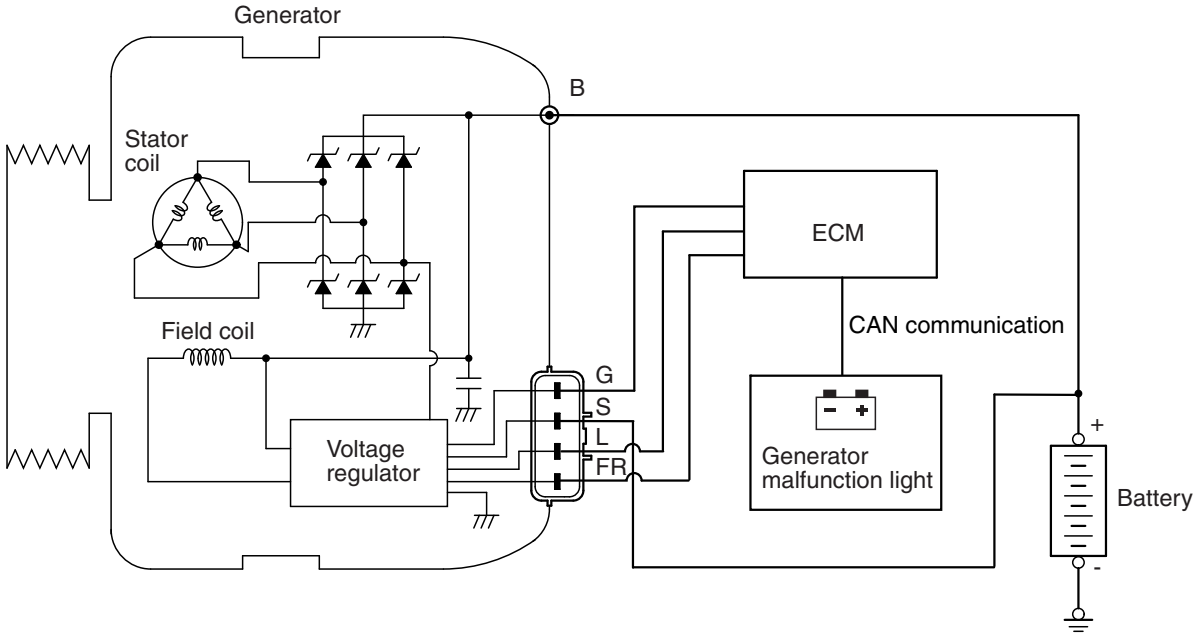
<3.0 L Engine>



AK700032 AB

GENERAL SPECIFICATIONS

M1161000200648

Item	2.4L engine	3.0L engine
Type	Positive battery positive voltage sensing	
Identification number	A2TX0881A	A3TG4491
Part No.	1800A288	1800A141
Rated output V/A	12/130	12/120
Voltage regulator	Electronic built-in type	

SERVICE SPECIFICATIONS

M1161000300861

Item		Standard value	Limit
Regulated voltage (Ambient temperature at voltage regulator)	–20°C (–4°F)	14.2 – 15.4	–
	20°C (68°F)	13.9 – 14.9	–
	60°C (140°F)	13.4 – 14.6	–
	80°C (176°F)	13.1 – 14.5	–
Generator output line voltage drop (at 30 A) V		–	Maximum 0.3
Output current		–	70 % of normal output current
Field coil resistance Ω		Approximately 2 – 5	–
Brush protrusion length mm (in)		–	Minimum 2 (0.08)

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CHARGING SYSTEM DIAGNOSIS

M1161000700546

TROUBLESHOOTING HINTS

Generator malfunction light does not go on when the ignition switch is turned to ON, before the engine starts.
- Check the generator malfunction light.

Generator malfunction light does not switch off after the engine starts.
- Check the IC voltage regulator inside the generator.

Discharged or overcharged battery.
- Check the IC voltage regulator inside the generator.

TROUBLESHOOTING GUIDE

The charging system troubleshooting guide is shown in the following steps.

STEP 1.

Q: Is the battery in good condition? (Refer to GROUP 54A, Chassis Electrical – Battery – On-vehicle Service – Battery Check P.54A-7.)

YES : Go to Step 2.
NO : Charge or replace the battery.

STEP 2.

Q: Is the generator drive belt in good condition? (Refer to GROUP 00, General – Maintenance Service – Drive Belts (For Generator, Power Steering Pump and Air Conditioning) (Check) P.00-74.)

YES : Go to Step 3.
NO : Adjust the belt tension or replace the belt.

STEP 3.

Q: Does the generator malfunction light come on when the ignition switch is turned on?

YES : Go to Step 4.
NO : Check the ignition switch. (Refer to GROUP 54A, Chassis Electrical – Ignition Switch – Ignition Switch – Inspection P.54A-26).
Check the generator malfunction light and its related circuits.
Check the generator. (Refer to Charging System – Generator Assembly – Inspection P.16-25).

STEP 4.

Q: Does the generator malfunction light go out after starting the engine?

YES : Go to Step 5.
NO : Check the generator (Refer to Charging System – Generator Assembly – Inspection P.16-25.)

STEP 5.

Q: Is an oscilloscope available?

YES : Go to Step 6.
NO : Go to Step 7.

STEP 6.

Q: Does the oscilloscope show a normal wave pattern? (Refer to Charging System – On-vehicle Service – Wave Pattern Check Using an Oscilloscope P.16-12.)

YES : Go to Step 7.
NO : Check the generator. (Refer to Charging System – Generator Assembly – Inspection P.16-25.)

STEP 7.

- Engine: 2,500 r/min
- Headlight: ON (high beam)
- Voltage between generator terminal B and the positive battery terminal
  OK: 0.5 V or less
- Voltage between the negative battery terminal and generator body
  OK: 0.5 V or less

Q: Are the generator output line and ground line in good condition?

YES : Go to Step 8.
NO : Check the generator output line and ground line.

STEP 8.

Q: Is the output current normal? (Refer to Charging System – On-vehicle Service – Output Current Test P.16-9.)

YES : Go to Step 9.
NO : Check the generator (Refer to Charging System – Generator Assembly – Inspection P.16-25.)

STEP 9.

Q: Is the regulated voltage normal? (Refer to Charging System – On-vehicle Service – Regulated Voltage Test P.16-11.)

YES : Go to Step 10.
NO : Check the generator (Refer to Charging System – Generator Assembly – Inspection P.16-25.)

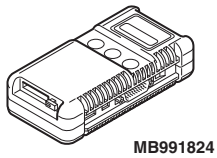
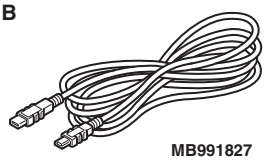
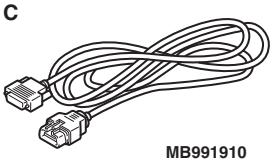
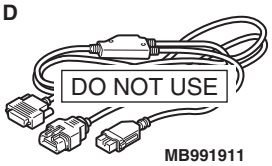
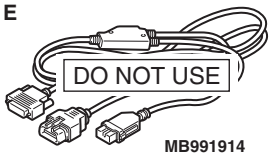
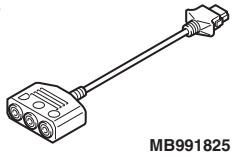
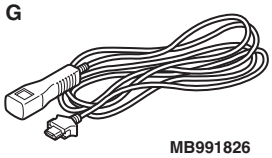
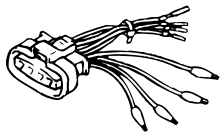
STEP 10.

Q: Is the voltage drop in the generator output line normal?

YES : Generator is normal. Check other systems.
NO : Check the output line.

SPECIAL TOOL

M1161000600787

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
A  MB991824 B  MB991827 C  MB991910 D  MB991911 E  MB991914 F  MB991825 G  MB991826 MB991958	MB991958 Scan tool (M.U.T.-III sub assembly) A: MB991824 Vehicle communication interface (V.C.I.) B: MB991827 M.U.T.-III USB cable C: MB991910 M.U.T.-III main harness A (Vehicles with CAN communication system) D: MB991911 M.U.T.-III main harness B (Vehicles without CAN communication system) E: MB991914 M.U.T.-III main harness C (for Chrysler models only) F: MB991825 M.U.T.-III measurement adapter G: MB991826 M.U.T.-III trigger harness	MB991824-KIT *NOTE: M.U.T.-III Trigger Harness is not necessary when pushing V.C.I. ENTER key.*	Checking of engine speed **⚠ CAUTION** **For vehicles with CAN communication, use M.U.T.-III main harness A to send simulated vehicle speed. If you connect M.U.T.-III main harness B instead, the CAN communication does not function correctly.**
	MB991519 Generator harness connector	MIT530 Micrd 530 charging system tester.	Checking of generator ("S" terminal voltage)

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ON-VEHICLE SERVICE

GENERATOR OUTPUT LINE VOLTAGE DROP TEST

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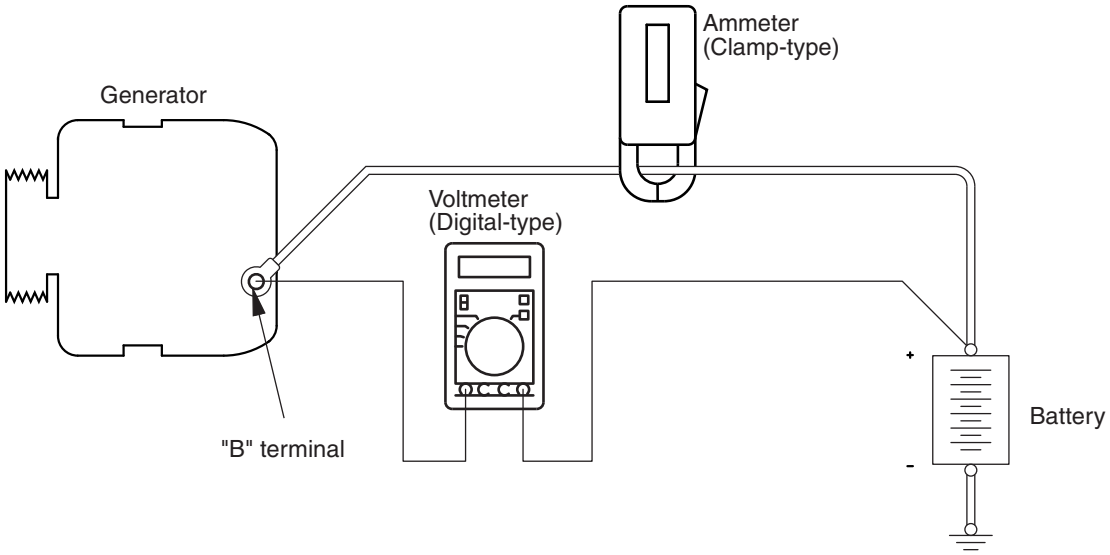


AK700033 AB

Required Special Tool:
MB991958: Scan Tool (M.U.T.-III Sub Assembly)
- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

This test determines whether the wiring from the generator "B" terminal to the positive battery terminal (including the fusible link) is in good condition or not:

⚠ WARNING

Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

1. Always be sure to check the following before the test.
   - Generator installation
   - Generator drive belt tension (Refer to GROUP 00, General – Maintenance Service – Drive Belts (For Generator, Water Pump, Power Steering Oil Pump) (Check Condition) P.00-74.)
   - Fusible link
   - Abnormal noise from the generator while the engine is running.
2. Turn the ignition switch to the "LOCK" (OFF) position.
3. Disconnect the negative battery cable.
4. Connect a clamp-type DC test ammeter to the generator "B" terminal output wire.

   NOTE: Disconnecting the generator output wire and connecting the ammeter may not thoroughly diagnose an alternator output line resistance increase problem because of an insufficient connection between terminal "B" and the output wire.
5. Connect a digital-type voltmeter between the generator "B" terminal and the positive battery terminal. (Connect the positive lead of the voltmeter to the "B" terminal, and then connect the negative lead of the voltmeter to the positive battery cable.)
6. Reconnect the negative battery cable.
7. Connect an engine tachometer or scan tool MB991958.
8. Leave the hood open.
9. Start the engine.

10.With the engine running at 2,500 r/min, turn the headlights and other lights on and off to adjust the generator load so that the value displayed on the ammeter is slightly above 30 A.

Read the voltmeter. Voltage reading at or below limit value means voltage drop between generator and battery is OK.

Limit value: maximum 0.3 V

NOTE:
When the generator output is high and the value displayed on the ammeter does not decrease to 30 A, set the value to 40 A. Read the value displayed on the voltmeter at this time.
In this case the limit value becomes maximum 0.4 V.
Adjust the engine speed by gradually decreasing it until the value displayed on the ammeter is 30 A. Take a reading of the value displayed on the voltmeter at this time.

11.If the value displayed on the voltmeter is above the limit value, there is probably a malfunction in the generator output wire. Check the wiring between the generator "B" terminal and the positive battery terminal (including fusible link).

If a terminal is not sufficiently tight or if the harness has become discolored due to overheating, repair and then test again.

12.After the test, run the engine at idle.

13.Turn off all lights and turn the ignition switch to the "LOCK" (OFF) position.

NOTE: Vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position.

14.Disconnect the engine tachometer or scan tool MB991958.

15.Disconnect the negative battery cable.

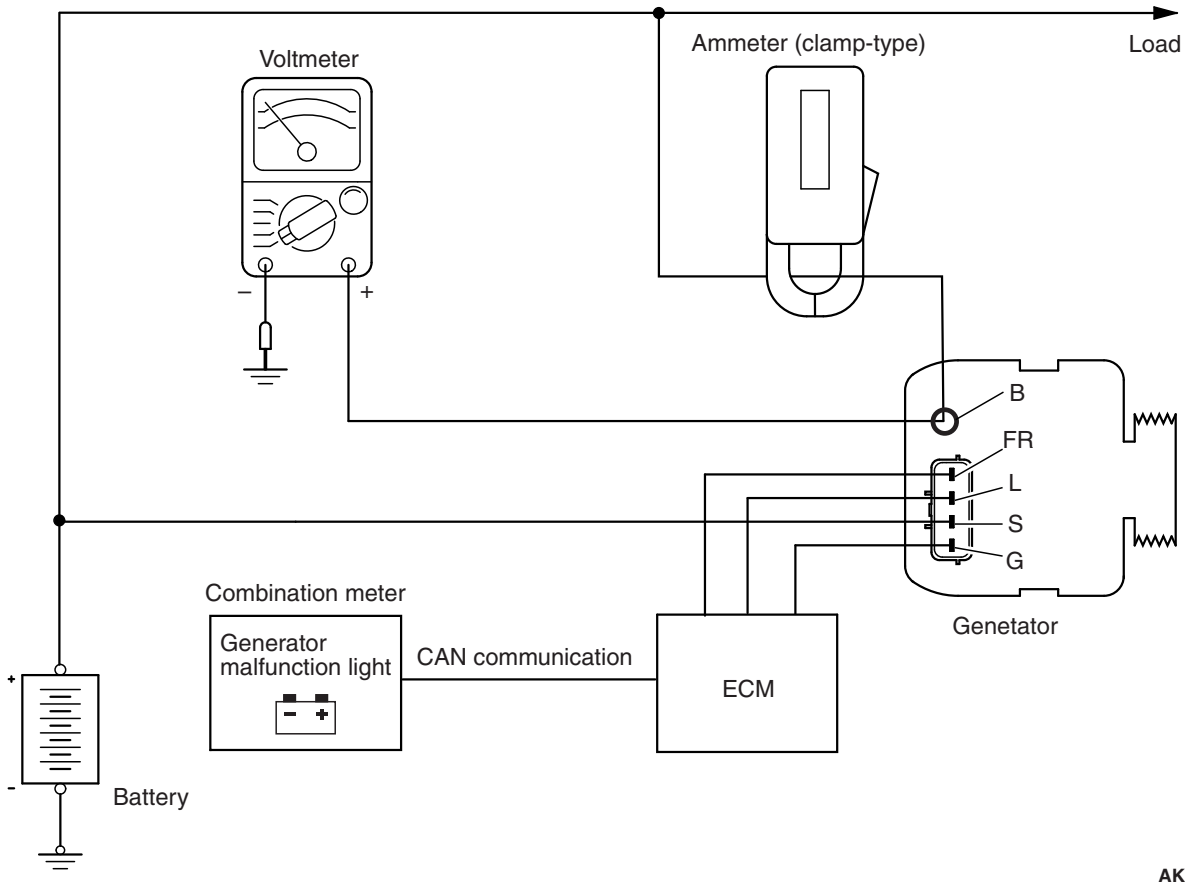
16.Disconnect the ammeter and voltmeter.

17.Connect the negative battery cable.

18.Run the engine for 10 minutes at an idle.

OUTPUT CURRENT TEST

M1161001001639



AK700034 AB

Required Special Tool:
MB991958: Scan Tool (M.U.T.-III Sub Assembly)
- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

This test determines whether the generator outputs normal current. For best results, use a charging system tester. If not available, follow the steps below.

⚠ ***WARNING***
Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

1. Before the test, always be sure to check the following.
   - Generator installation
   - Battery (Refer to GROUP 54A, Chassis Electrical – Battery – On-vehicle Service – Battery Check P.54A-7.)

     NOTE: The battery to be used should be slightly discharged. The load in a fully-charged battery will be insufficient and the test may not be able to be carried out correctly.
   - Generator drive belt tension (Refer to GROUP 00, General – Maintenance Service – Drive Belts (For Generator, Water Pump, Power Steering Oil Pump) (Check Condition) P.00-74.)
   - Fusible link
   - Abnormal noise from the generator while the engine is running.
2. Turn the ignition switch to the "LOCK" (OFF) position.
3. Disconnect the negative battery cable.
4. Connect a clamp-type DC test ammeter to the generator "B" terminal output wire.

   NOTE: Disconnecting the generator output wire and connecting the ammeter may not thoroughly diagnose an output current drop problem because of an insufficient connection between terminal "B" and the output wire.
5. Connect a voltmeter with a range of 0 – 20 V between the generator "B" terminal and ground. (Connect the positive lead of the voltmeter to the "B" terminal, and then connect the negative lead of the voltmeter to ground.)
6. Connect the negative battery cable.
7. Connect an engine tachometer or scan tool MB991958.
8. Leave the hood open.
9. Check to be sure that the reading on the voltmeter is equal to the battery positive voltage.

   NOTE: If the voltage is 0 V, the cause is probably an open circuit in the wire or fusible link between the generator "B" terminal and the battery positive terminal or malfunctioning voltmeter.
10. After turning on the headlights, start the engine.

    NOTE: Because the current from the battery will soon drop after the engine is started, step 11 should be carried out as quickly as possible in order to obtain the maximum current output value.
11. Immediately after setting the headlights to high beam and turning the heater blower switch to the highest position, increase the engine speed to 2,500 r/min and read the maximum current output value displayed on the ammeter.

    Limit value: 70 % of nominal current output

    NOTE: For the nominal current output, refer to the Generator Specifications.

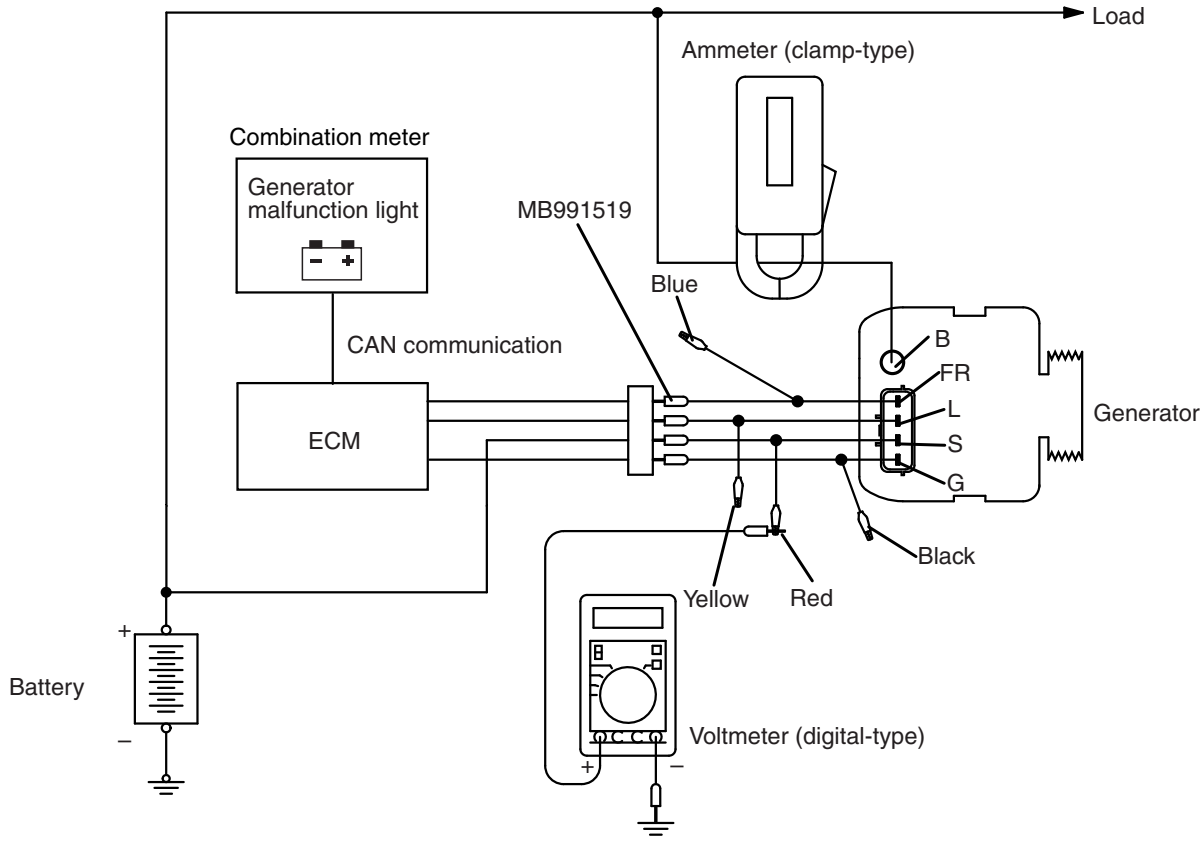
    NOTE: The current output value will depend on the electrical load and the temperature of the generator body.

    NOTE: If the electrical load is small while testing, the specified level of current may not be output even though the generator is normal. In such cases, increase the electrical load by leaving the headlights turned on for some time to discharge the battery or by using the lighting system in another vehicle, and then test again.

    NOTE: The specified level of current also may not be output if the temperature of the generator body or the ambient temperature is too high. In such cases, cool the generator and then test again.
12. The reading on the ammeter should be above the limit value. If the reading is below the limit value and the generator output wire is normal, remove the generator from the engine and check the generator.
13. Run the engine at idle speed after the test.
14. Turn the ignition switch to the "LOCK" (OFF) position.
15. Disconnect the engine tachometer or scan tool MB991958.
16. Disconnect the negative battery cable.
17. Disconnect the ammeter and voltmeter.
18. Connect the negative battery cable.
19. Run the engine for 10 minutes at an idle.

REGULATED VOLTAGE TEST

M1161001102424



AK700035 AB

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: M.U.T.-III USB Cable
  - MB991910: M.U.T.-III Main Harness A
- MB991519: Generator Harness Connector

This test determines whether the voltage regulator is correctly controlling the generator output voltage.

⚠ WARNING

Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

1. Always be sure to check the following before the test:
   - Generator installation
   - Check to be sure that the battery installed in the vehicle is fully charged. (Refer to GROUP 54A, Chassis Electrical – Battery – On-vehicle Service – Battery Check P.54A-7.)
   - Generator drive belt tension (Refer to GROUP 00, General – Maintenance Service – Drive Belts (For Generator, Water Pump, Power Steering Oil Pump) (Check Condition) P.00-74.)
   - Fusible link
   - Abnormal noise from the generator while the engine is running.
2. Turn the ignition switch to the "LOCK" (OFF) position.
3. Disconnect the negative battery cable.
4. Use the special tool (Generator harness connector: MB991519) to connect a digital-type voltmeter between the generator "S" terminal and ground. (Connect the positive lead of the voltmeter to the "S" terminal, and then connect the negative lead of the voltmeter to a secure ground or to the negative battery terminal.)
5. Connect a clamp-type DC test ammeter to the generator "B" terminal output wire.
6. Reconnect the negative battery cable.
7. Connect an engine tachometer, or scan tool MB991958.
8. Turn the ignition switch to the "ON" position and check that the reading on the voltmeter is equal to the battery positive voltage.

   NOTE: If the voltage is 0 V, the cause is probably an open circuit in the wire or fusible link between the generator "S" terminal and the battery positive terminal or malfunctioning voltmeter.

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9. Check to be sure that all lights and accessories are off.
10. Start the engine.

    NOTE: Do not drive the vehicle after the engine starts.
11. Increase the engine speed to 2,500 r/min.
12. Read the value displayed on the voltmeter when the current output by the generator becomes 15 A or less.
13. If the voltage reading conforms to the value in the voltage regulation table, then the voltage regulator is operating normally.

    If the voltage is outside the standard value, there is a malfunction of the voltage regulator or the generator (Refer to the following table).
14. After the test, lower the engine speed to idle.
15. Turn the ignition switch to the "LOCK" (OFF) position.
16. Disconnect the engine tachometer or scan tool MB991958.
17. Disconnect the negative battery cable.
18. Disconnect the ammeter and voltmeter.
19. Remove the special tool (Generator harness connector: MB991519), and return the connector to the original condition.
20. Connect the negative battery cable.
21. Run the engine for 10 minutes at an idle.

VOLTAGE REGULATION TABLE

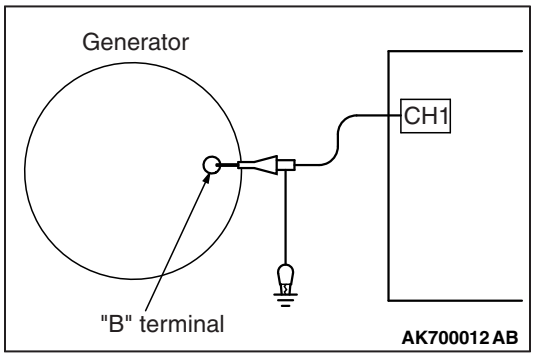
INSPECTION TERMINAL	VOLTAGE REGULATOR AMBIENT TEMPERATURE [°C (°F)]	STANDARD VALUE (V)
Terminal "S"	–20 (–4)	14.2 – 15.4
	20 (68)	13.9 – 14.9
	60 (140)	13.4 – 14.6
	80 (176)	13.1 – 14.5

WAVE PATTERN CHECK USING AN OSCILLOSCOPE

M1161001200793

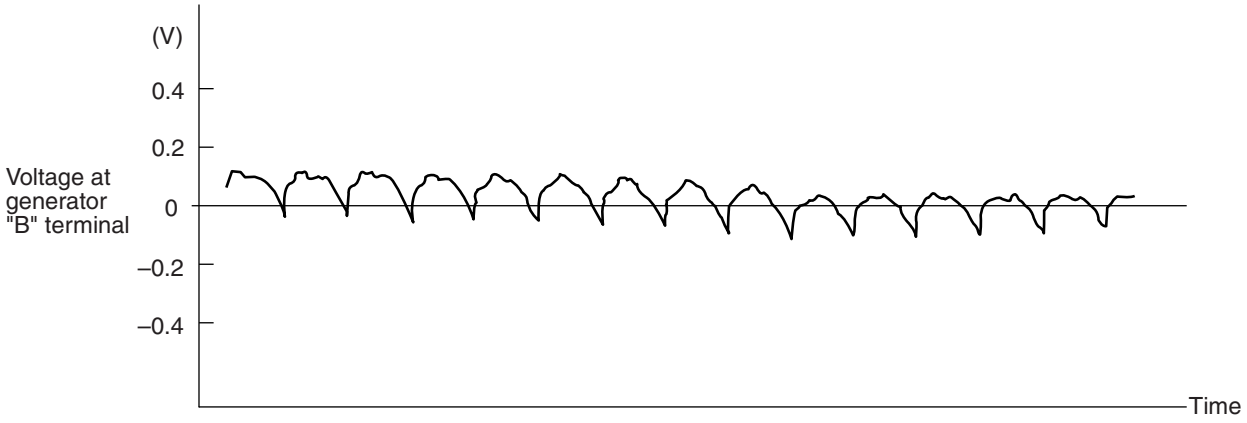
MEASUREMENT METHOD

Connect the oscilloscope special patterns pick-up to the generator "B" terminal.



STANDARD WAVEFORM

Observation Conditions	
FUNCTION	**SPECIAL PATTERNS**
Pattern height	Variable
Variable knob	Adjust while viewing the wave pattern
Pattern selector	Raster
Engine revolutions	Curb idle speed



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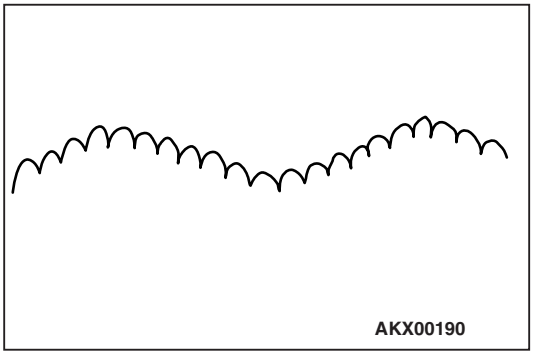

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NOTE: The voltage waveform of the generator "B" terminal can undulate as shown at left. This waveform is produced when the regulator operates according to fluctuations in the generator load (current), and is normal for the generator.
If the ripple height is abnormally high (approximately 2 V or more during idling), the wires between the generator "B" terminal and the battery have broken due to fuse blowing, etc. The generator is usually operating properly.

ABNORMAL WAVEFORMS EXAMPLES

NOTE: The size of the waveform patterns can differ greatly, depending on the adjustment of the variable knob on the oscilloscope.

NOTE: Identification of abnormal waveforms is easier when there is a large output current (regulator is not operating). (Waveforms can be observed when the headlights are illuminated.)

NOTE: Check the conditions of the generator malfunction light (illuminated/not illuminated) also, and carry out a total check.

ABNORMAL WAVEFORMS

- Example 1
  PROBABLE CAUSE: Open circuit in diode

AK700038

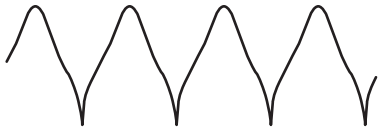
- Example 2
  PROBABLE CAUSE: Short-circuit in diode

AK700039

- Example 3
  PROBABLE CAUSE: Open circuit in stator coil

AK700040

- Example 4
  PROBABLE CAUSE: Short-circuit in stator coil



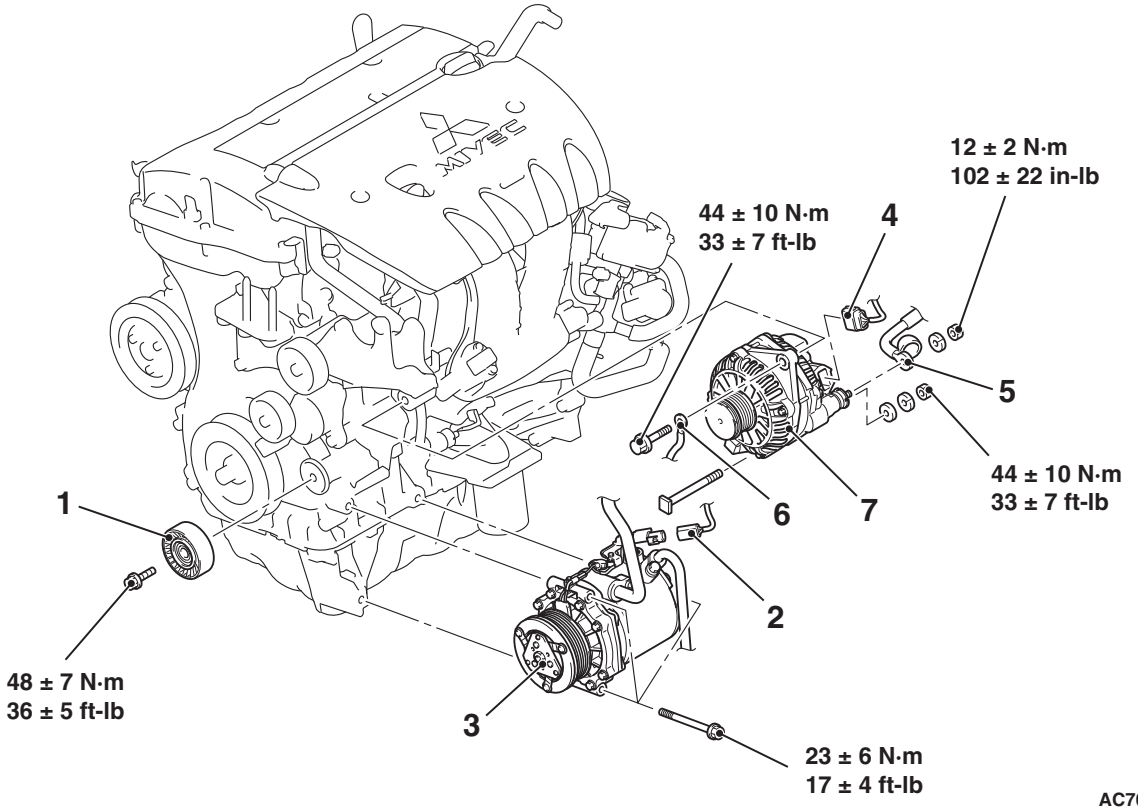
AK700041

GENERATOR ASSEMBLY

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1161001402492

Pre-removal operation	Post-installation operation
• Engine Room Under Cover Front A, B, C Removal (Refer to GROUP 51, Under Cover P.51-22). • Drive Belt Removal (Refer to GROUP 11A, Crankshaft Pulley P.11A-21).	• Drive Belt Installation (Refer to GROUP 11A, Crankshaft Pulley P.11A-21). • Drive Belt Tension Check (Refer to GROUP 11A, On-vehicle Service – Drive Belt Tension Check P.11A-9). • Engine Room Under Cover Front A, B, C Installation (Refer to GROUP 51, Under Cover P.51-22).



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Removal steps

1. Idler pulley
2. A/C compressor connector connection

<<**A**>> >>**B**<< 3. A/C compressor assembly

Removal steps (Continued)

4. Generator connector connection
5. Generator terminal connection

>>**A**<< 6. Grounding cable connection

<<**B**>> 7. Generator assembly

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REMOVAL SERVICE POINTS

<<A>> A/C COMPRESSOR ASSEMBLY REMOVAL

1. Remove the A/C compressor assembly from the A/C compressor bracket with the hose still attached.
2. Place the removed A/C compressor assembly where it will not be a hindrance when removing and installing the generator assembly, and secure it with a cord or wire.

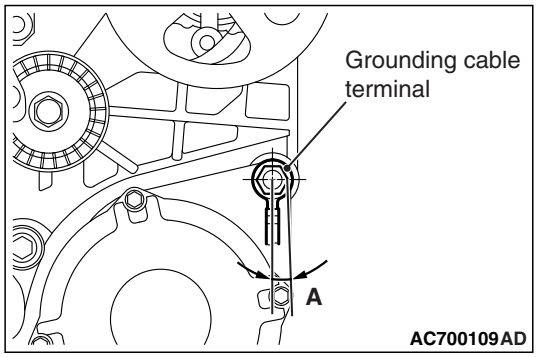
<<B>> GENERATOR ASSEMBLY REMOVAL

Move the A/C compressor assembly to one side, and then remove the generator assembly from under the vehicle.

INSTALLATION SERVICE POINTS

>>A<< GROUNDING CABLE INSTALLATION

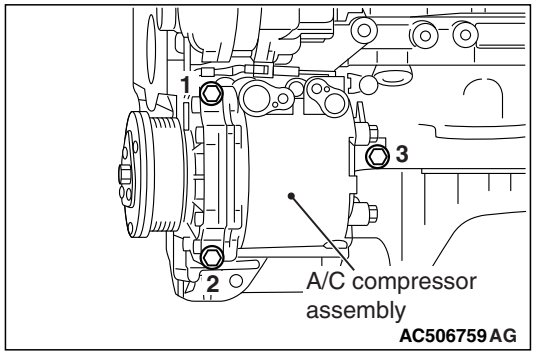
Install the grounding cable within the area marked with A in the illustration.



>>B<< A/C COMPRESSOR ASSEMBLY INSTALLATION

1. Temporarily tighten the A/C compressor assembly to the A/C compressor bracket.
2. In accordance with the tightening order shown in the illustration, tighten the installation bolts for the A/C compressor bracket to the specified torque.

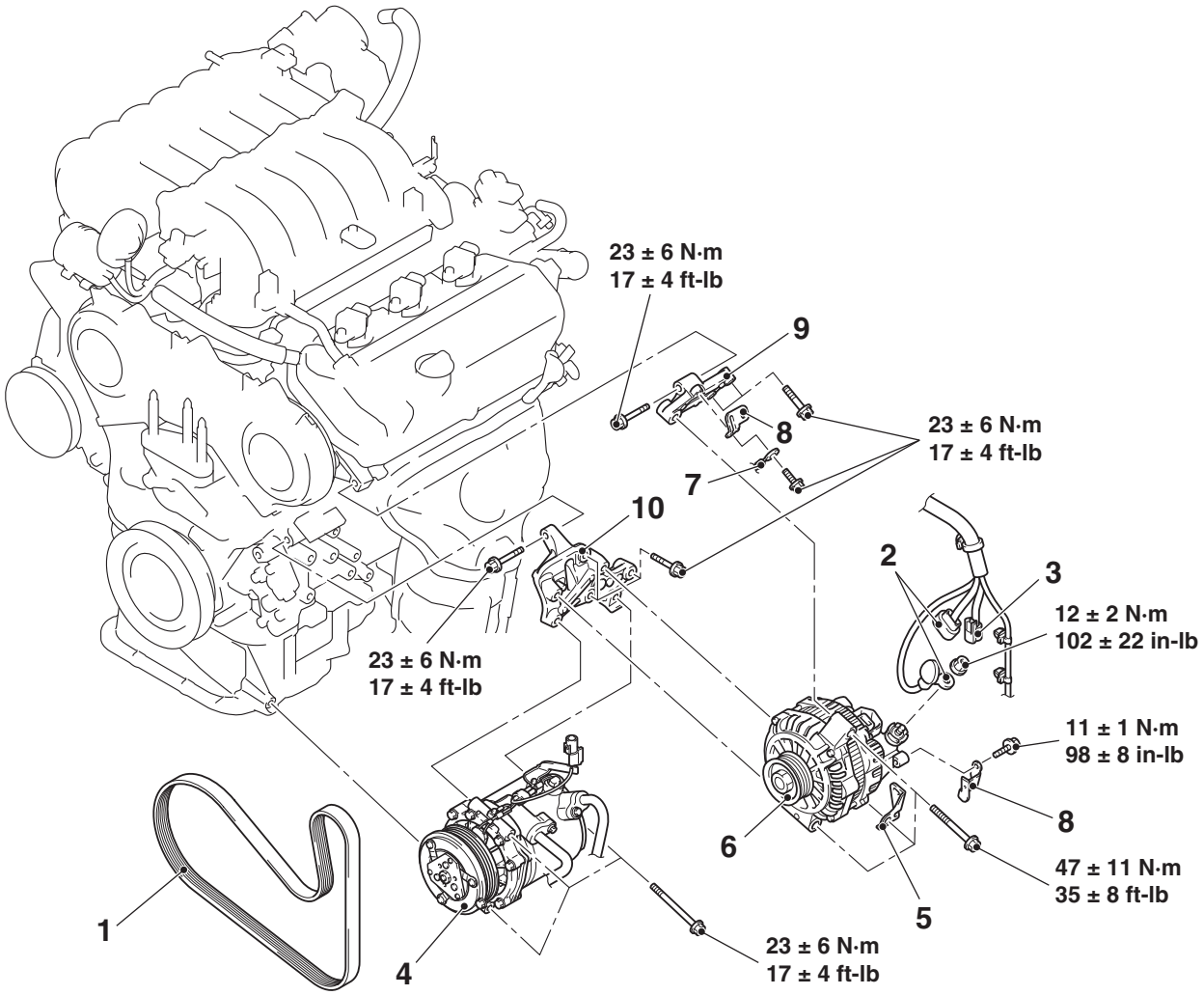
   Tightening torque: 23 ± 6 N·m (17 ± 4 ft-lb)



REMOVAL AND INSTALLATION <3.0L ENGINE>

M1161001402500

Pre-removal operation	Post-installation operation
• Engine Room Under Cover Front Removal (Refer to GROUP 51, Under Cover P.51-22).	• Generator Drive Belt Tension Check (Refer to GROUP 11C, On-vehicle Service – Generator Drive Belt Tension Check P.11C-8). • Engine Room Under Cover Front Installation (Refer to GROUP 51, Under Cover P.51-22).



AC703784AB

Removal steps

<<A>>
1. Generator drive belt
2. Generator connector and terminal connection
3. A/C compressor connector connection

<<B>>
4. A/C compressor assembly

Removal steps (Continued)

<<C>> >>A<<
5. Harness bracket
6. Generator assembly
7. Grounding cable connection
8. Harness bracket
9. Generator upper bracket
10. Generator lower bracket

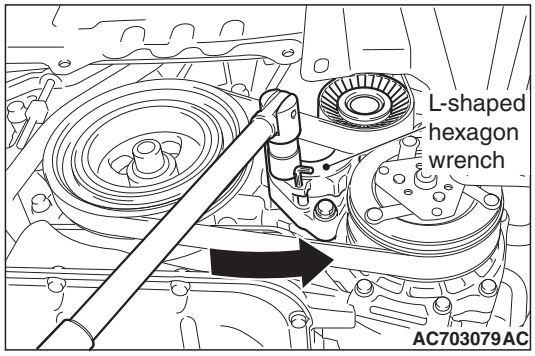
TSB Revision

REMOVAL SERVICE POINTS

<<A>> GENERATOR DRIVE BELT REMOVAL

⚠ CAUTION

When the generator drive belt is reused, draw an arrow indicating the rotating direction on the back of the belt using chalk to install the same direction.



1. Turn the drive belt auto-tensioner to counterclockwise, and insert the L-shaped hexagon wrench to the auto-tensioner hole in order to fix the auto-tensioner.
2. Remove the generator drive belt.

<<B>> A/C COMPRESSOR ASSEMBLY REMOVAL

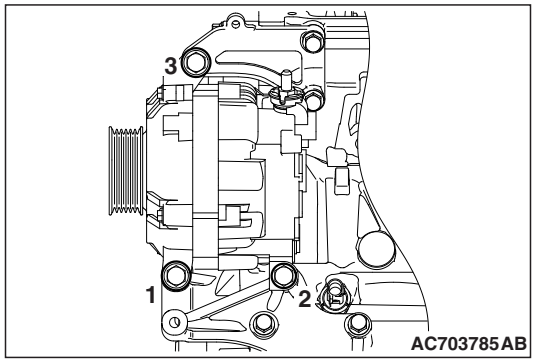
1. Remove the A/C compressor assembly from the A/C compressor bracket with the hose still attached.
2. Place the removed A/C compressor assembly where it will not be a hindrance when removing and installing the generator assembly, and secure it with a cord or wire.

<<C>> GENERATOR ASSEMBLY REMOVAL

Move the A/C compressor assembly to one side, and then remove the generator assembly from under the vehicle.

INSTALLATION SERVICE POINT

>>A<< GENERATOR ASSEMBLY INSTALLATION



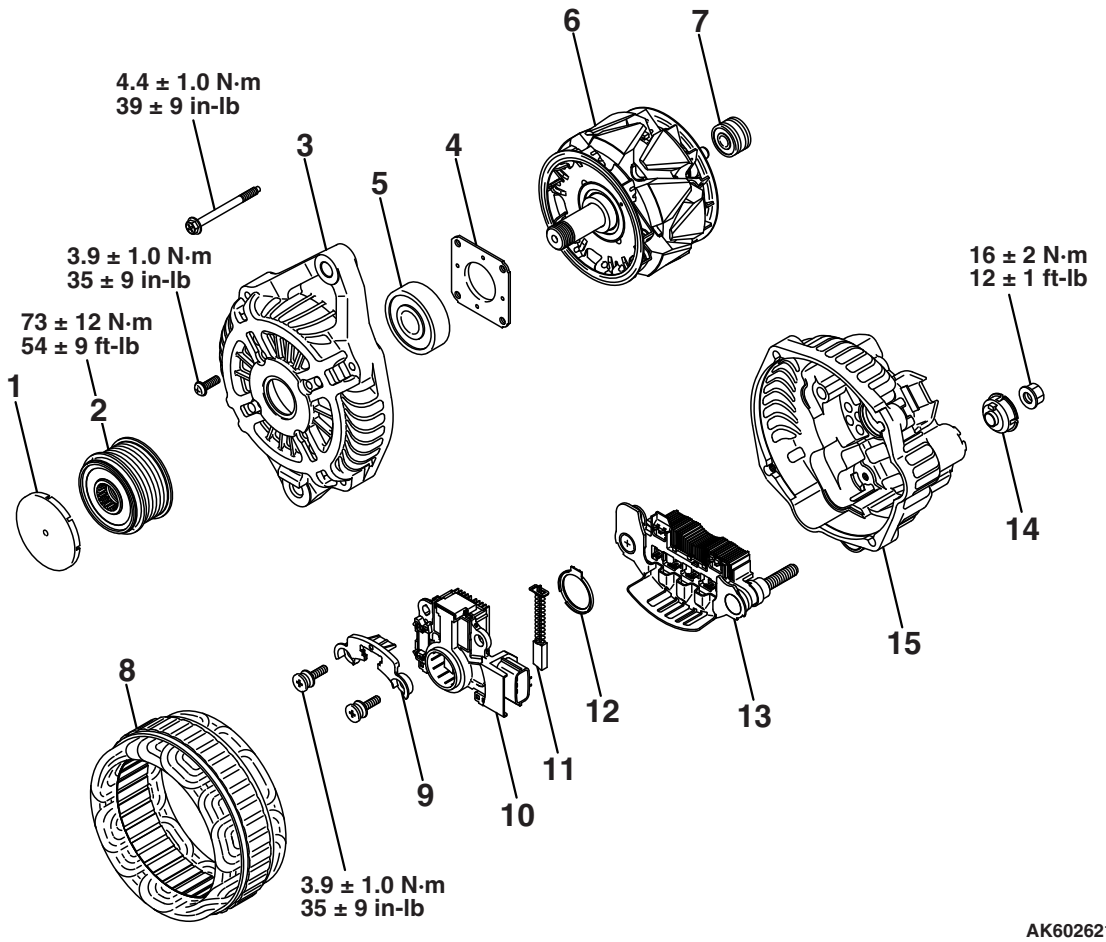
1. Temporarily tighten the generator assembly to the generator bracket.
2. In accordance with the tightening order shown in the illustration, tighten the installation bolts for the generator bracket to the specified torque.

   Tightening torque: 47 ± 11 N·m (35 ± 8 ft-lb)

DISASSEMBLY AND REASSEMBLY

M1161001600520

<2.4L ENGINE>



AK602621AE

Disassembly steps

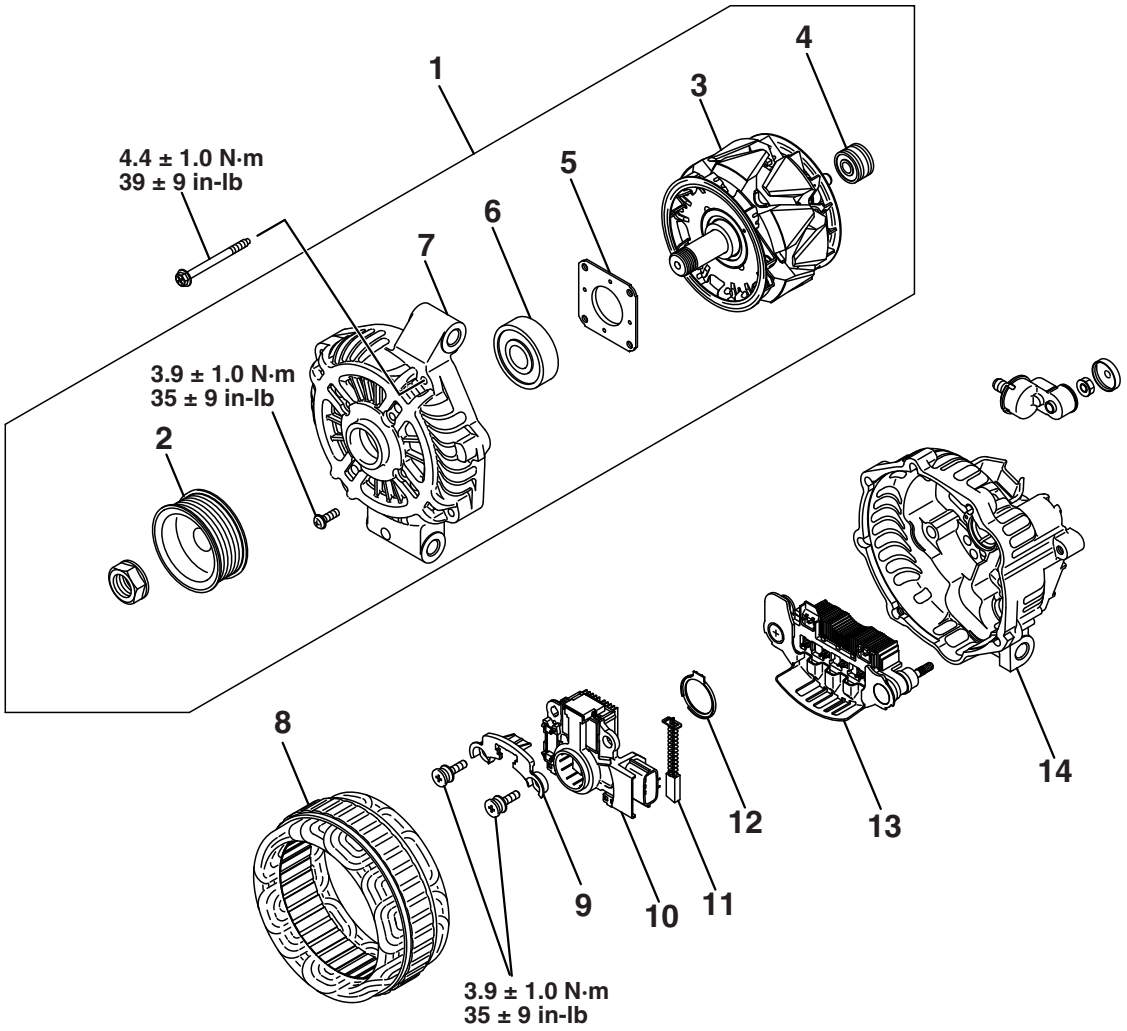
1. Cap
<<**A**>> >>**C**<< 2. Pulley
<<**B**>> >>**B**<< 3. Front bracket
4. Plate
5. Front bearing
6. Rotor
7. Rear bearing
<<**E**>> 8. Stator

Disassembly steps (Continued)

9. Plate
<<**E**>> >>**A**<< 10. Regulator assembly
11. Brush
12. Rubber packing
13. Rectifier
14. Insulator
15. Rear bracket

TSB Revision

<3.0L ENGINE>



AK702167AD

Disassembly steps

<<**C**>> 1. Front bracket assembly
<<**D**>> 2. Alternator pulley
>>**B**<< 3. Rotor
4. Rear bearing
5. Bearing retainer
6. Front bearing
7. Front bracket

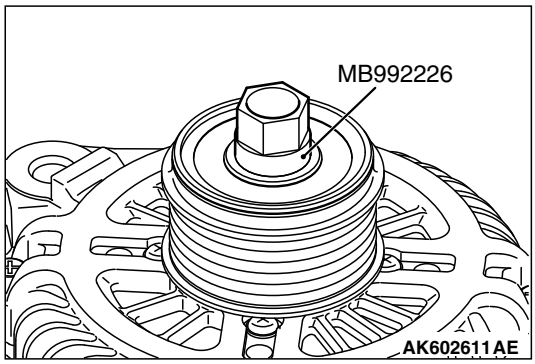
Disassembly steps (Continued)

<<**E**>> 8. Stator
9. Plate
<<**E**>> >>**A**<< 10. Regulator assembly
11. Brush
12. Rubber packing
13. Rectifier
14. Rear bracket

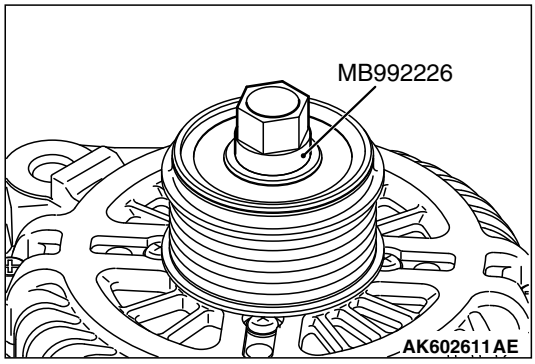
TSB Revision

DISASSEMBLY SERVICE POINTS

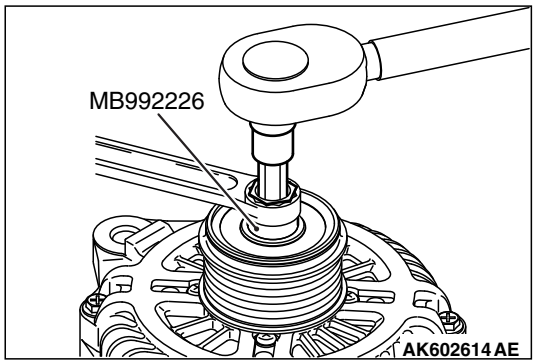
<<A>> PULLEY REMOVAL<2.4L ENGINE>



1. Set the special tool Serration socket (MB992226) to the pulley.

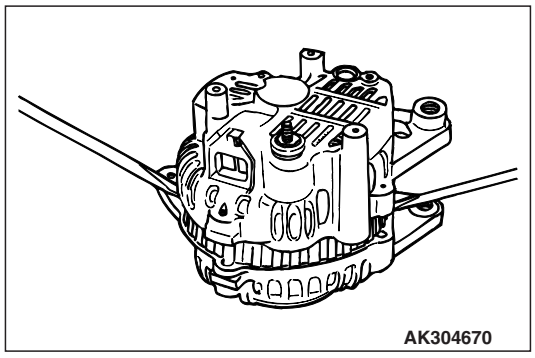


2. Set the closed wrench to the hexagonal area of the special tool Serration socket (MB992226).



3. Insert the hexagonal bit socket having width across flats of 10 mm into the hexagonal area of the rotor shaft.
4. Hold the pulley with the closed wrench. Rotate the rotor shaft clockwise to remove the pulley.

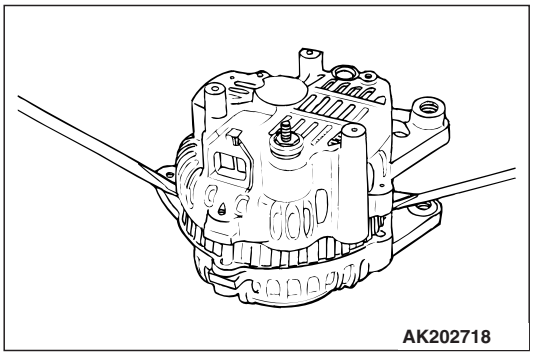
<<B>> FRONT BRACKET REMOVAL<2.4L ENGINE>



⚠ CAUTION
Do not insert the screwdriver blades too deep. Doing so could damage the stator coil.

Insert the blades of screwdrivers between the front bracket and stator core, and pry and separate them with the screwdrivers.

<<C>> FRONT BRACKET ASSEMBLY REMOVAL<3.0L ENGINE>

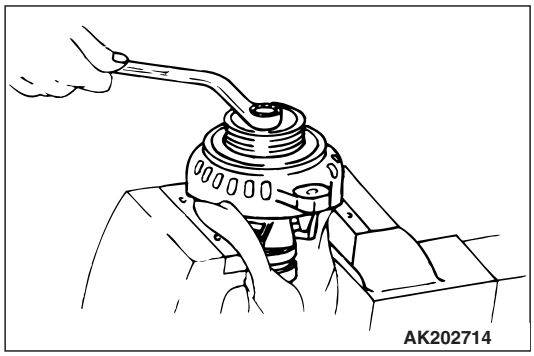

AK202718

⚠ CAUTION

Do not insert the screwdriver blades too deep. Doing so could damage the stator coil.

Insert the blades of screwdrivers between the front bracket assembly and stator core, and pry and separate them with the screwdrivers.

<<D>> ALTERNATOR PULLEY REMOVAL<3.0L ENGINE>

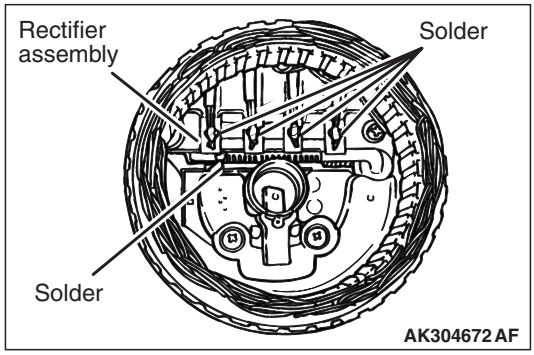

AK202714

⚠ CAUTION

Perform operation carefully not to damage the rotor.

Clamp the rotor in a vise with the pulley facing up to remove the pulley.

<<E>> STATOR / REGULATOR ASSEMBLY REMOVAL



AK304672 AF

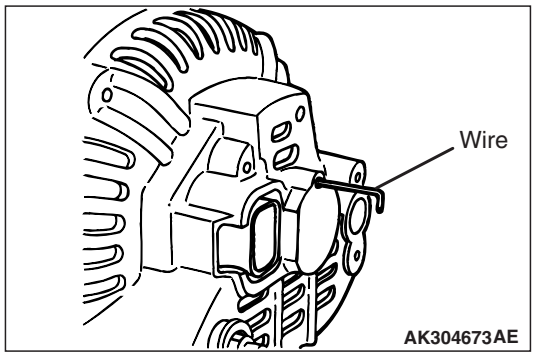
⚠ CAUTION

- **Use a 180 – 250 W soldering iron, and finish unsoldering within four seconds. Diodes will be damaged by heat if unsoldering time is too long.**
- **Avoid applying undue force to the diode leads.**

1. Unsolder the stator leads from the main diode of the rectifier assembly when the stator is removed.
2. When removing the rectifier assembly from the regulator assembly, undo the soldered points on the rectifier assembly.

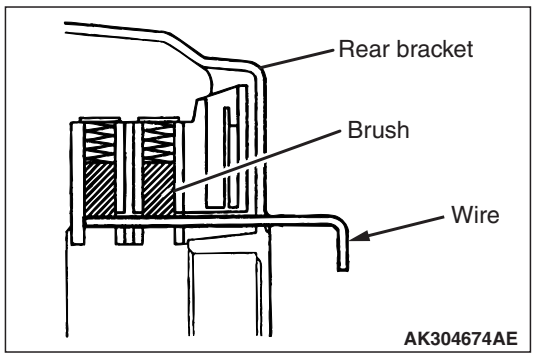
REASSEMBLY SERVICE POINTS

>>A<< REGULATOR ASSEMBLY INSTALLATION

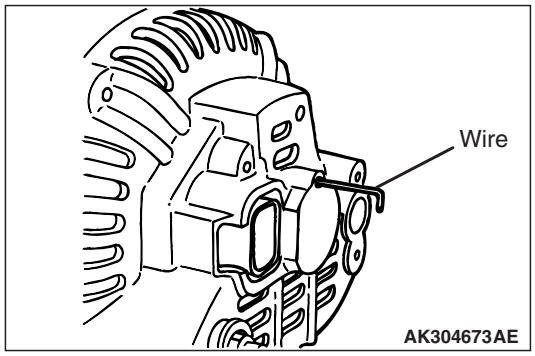


After installing the regulator assembly, insert a piece of wire through the hole in the rear bracket while pressing the brush to keep the brush against movement.

NOTE: Holding the brush with the wire facilities installation of the rotor.



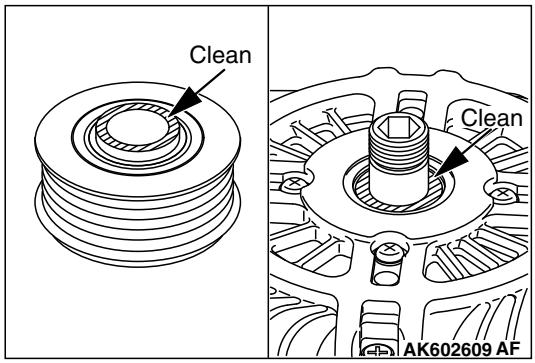
>>B<< ROTOR INSTALLATION

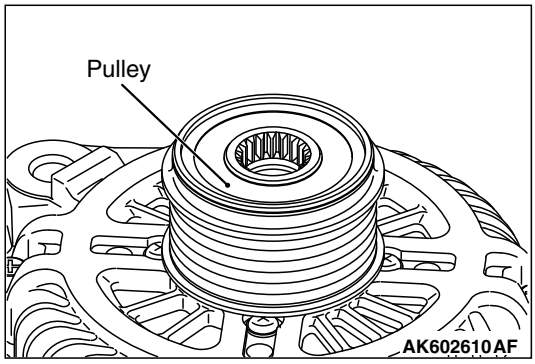


Remove the brush holding wire after the rotor has been installed.

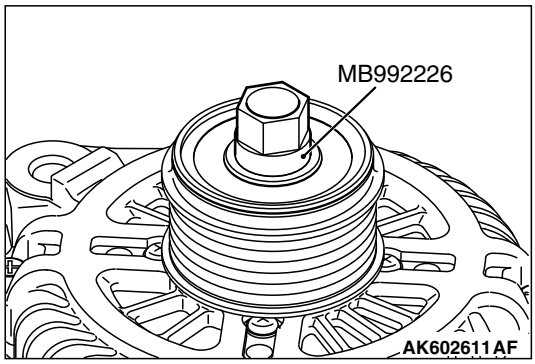
>>C<< PULLEY INSTALLATION<2.4L ENGINE>

1. Clean the inner race of the front bearing and that of the pulley.
2. Screws the inner race of the pulley until it touches the inner race of the front bearing.

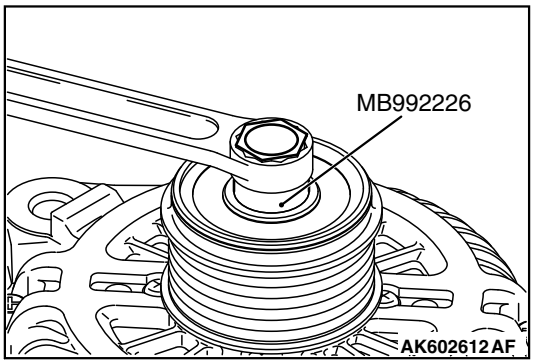


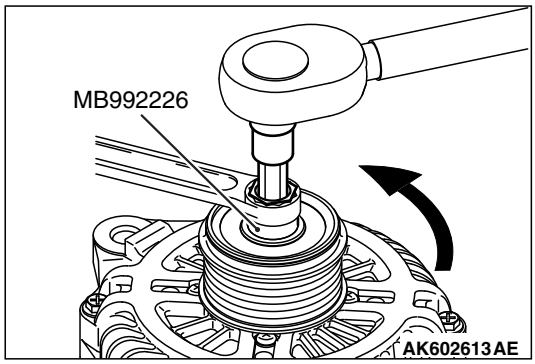


3. Set the special tool Serration socket (MB992226) to the pulley.



4. Set the closed wrench to the hexagonal area of the special tool Serration socket (MB992226).



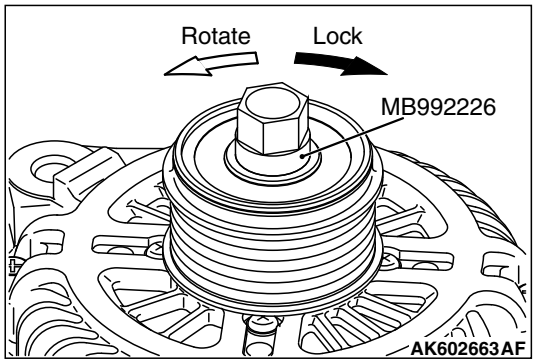


5. Insert the hexagonal bit socket having width across flats of 10 mm into the hexagonal area of the rotor shaft.
6. Hold the pulley with the closed wrench.
   Rotate the hexagonal bit socket counterclockwise to tighten it to the specified torque of 73 ± 12 N·m (54 ± 9 ft-lb).

INSPECTION

M1161001700442

PULLEY<2.4L ENGINE>

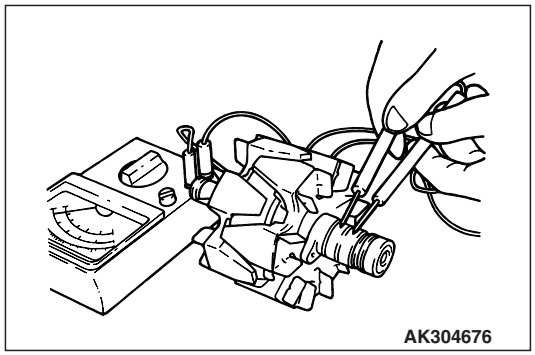


Lock the pulley when rotating it clockwise. Check that the pulley rotates smoothly when rotating it counterclockwise.

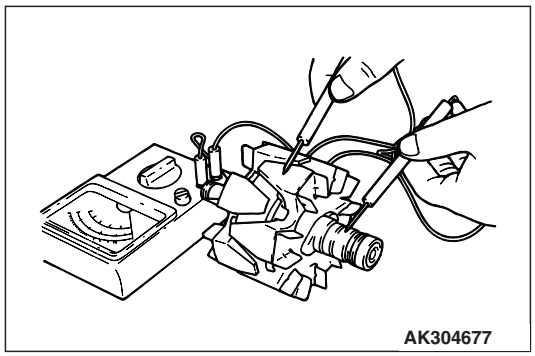
⚠ CAUTION

Locking the one-way clutch might cause the damaged drive belt and an abnormal noise.

ROTOR

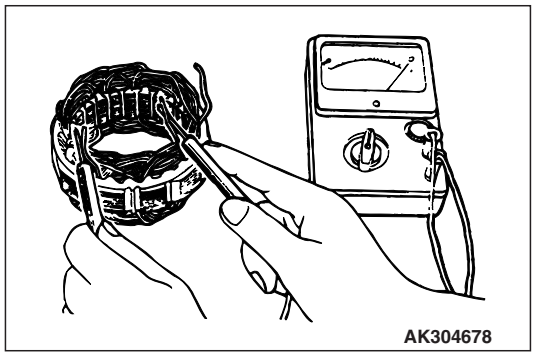


1. Measure the resistance between the two slip rings of the rotor coil to check the continuity between them.
   Replace the rotor if the resistance is not within the standard value range.
   Standard value: 2.1 – 2.4 Ω
2. Check the continuity between the slip rings and core.

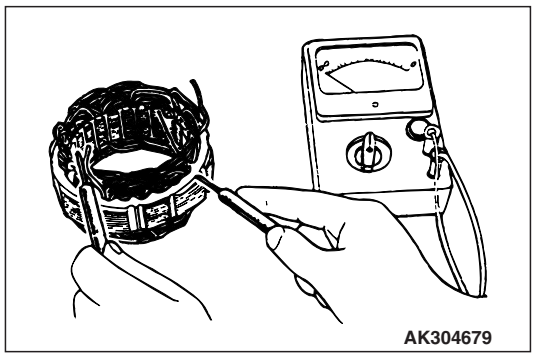


3. If continuity is present, replace the rotor.

STATOR

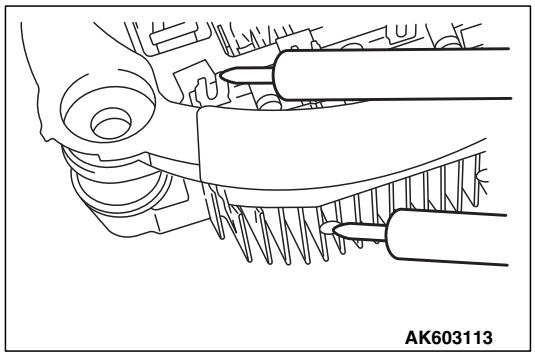


1. Check the continuity between coil leads.
   If there is no continuity, replace the stator.

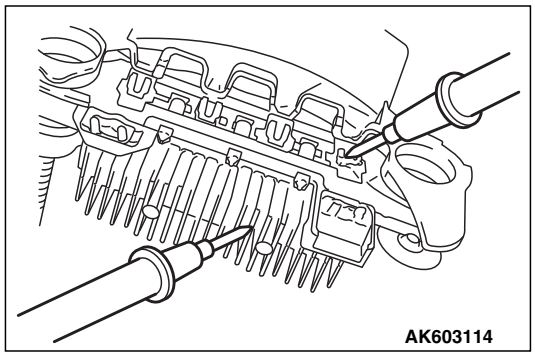


2. Check the continuity between coil and core.
   If there is continuity, replace the stator.

RECTIFIER ASSEMBLY

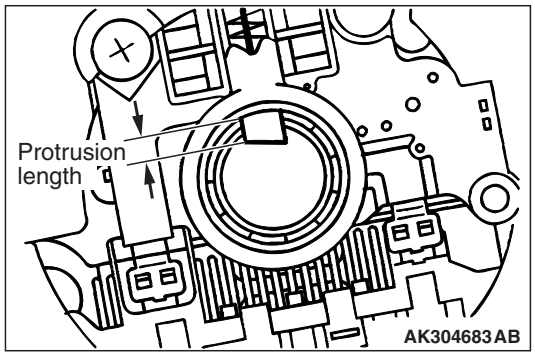


1. Check the condition of the (+) heat sink by checking the continuity between the (+) heat sink and each of the stator coil lead connecting terminals.
   If the continuity is present for both terminals, or if no continuity is present for both terminals, the diode is shorted. Replace the rectifier assembly.

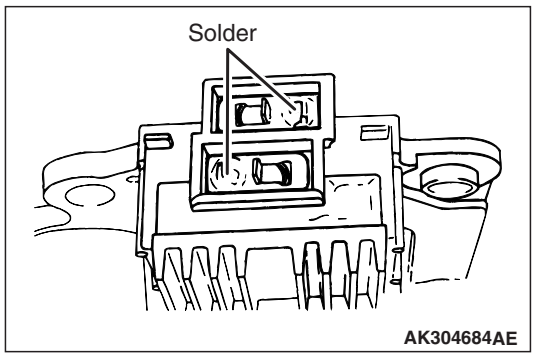


2. Check the condition of the (–) heat sink by checking the continuity between the (–) heat sink and each of the stator coil lead connecting terminals.
   If the continuity is present for both terminals, or if no continuity is present for both terminals, the diode is shorted. Replace the rectifier assembly.

BRUSH



1. Measure the length of the protrusion of the brush. Replace the brush if the protrusion length is shorter than the limit.
   Limit: 2 mm (0.08 inch) minimum
2. Unsolder the lead of the brush. The brush will come out, becoming ready for removal.



3. Install a new brush by pushing it into the holder as shown in the drawing and soldering the lead.

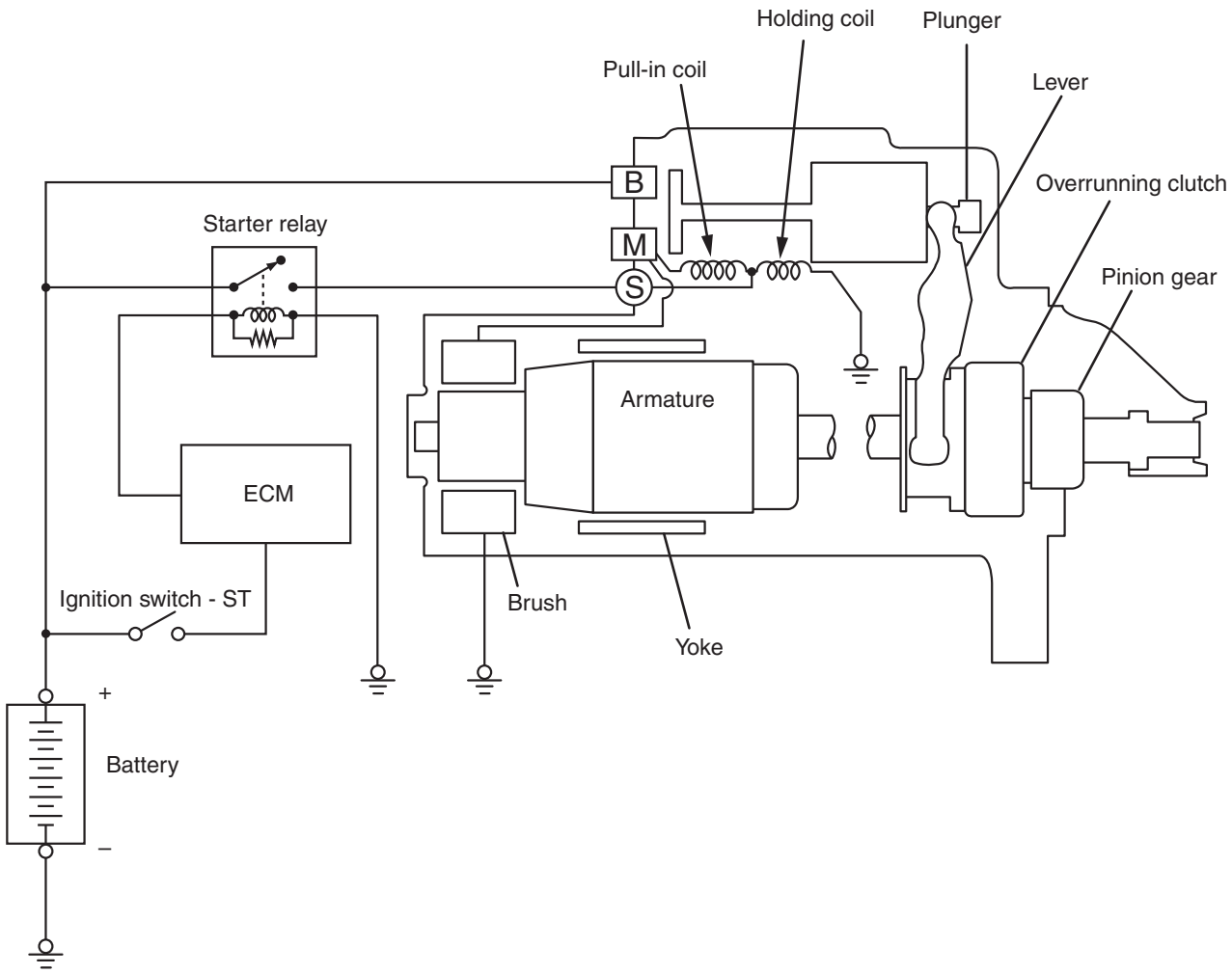
STARTING SYSTEM

GENERAL INFORMATION

M1162000100859

If the ignition switch is turned to the "START" position, current flows in the coil provided inside magnetic switch, attracting the plunger. When the plunger is attracted, the lever connected to the plunger is actuated to engage the starter clutch.
On the other hand, attracting the plunger will turn on the magnetic switch, allowing the "B" terminal and "M" terminal to conduct. Thus, current flows to engage the starter motor.

When the ignition switch is returned to the "ON" position after starting the engine, the starter clutch is disengaged from the ring gear.
An overrunning clutch is provided between the pinion and the armature shaft, to prevent damage to the starter.



AK603513 AC

OPERATION

For models equipped with A/T, when the ignition switch is turned to the "ST" position while the selector lever is at the "P" or "N" position, the contact (magnetic switch) of the starter is switched ON and the starter motor is activated.

GENERAL SPECIFICATIONS

M1162000200124

Item	2.4L engine	3.0L engine
Type	Reduction drive with planetary gear	
Identification number	M000T21571	M000T23471
Part No.	1810A011	1810A184
Rated output kW/V	1.4/12	
Number of pinion teeth	8	

TSB Revision

SERVICE SPECIFICATIONS

M1162000300626

ITEMS		STANDARD VALUE	LIMIT
Free running characteristics	Terminal voltage V	11	–
	Current A	90	–
	Speed r/min	2,400 or more	–
Pinion gap mm (in)		0.5 – 2.0 (0.02 – 0.07)	–
Commutator run-out mm (in)		0.05 (0.002)	Minimum 0.1 (0.004)
Commutator diameter mm (in)		29.4 (1.16)	Minimum 28.8 (1.13)
Undercut depth mm (in)		0.5 (0.02)	Minimum 0.2 (0.008)

STARTING SYSTEM DIAGNOSIS

M1162000700505

TROUBLESHOOTING HINTS

The starter motor does not operate at all.

⚠ ***WARNING***
Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

- Check the starter (coil).
- Check for poor contact at the battery terminals and starter.
- Check the transmission range switch.

The starter motor doesn't stop

- Check the starter (magnetic switch).

TROUBLESHOOTING GUIDE

The starting system troubleshooting guide is shown in the following steps.

⚠ ***WARNING***
Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

STEP 1.

Q: Is the battery in good condition? (Refer to GROUP 54A, Chassis Electrical – Battery – On-vehicle Service – Battery Check P.54A-7.)

YES : Go to Step 2.
NO : Charge or replace the battery.

STEP 2.

- Disconnect the starter motor S (solenoid) terminal connector.
- Using a jumper wire, apply battery positive voltage to the starter motor S (solenoid) terminal.
- Check the engine condition.
  OK: Turns normally

Q: Dose the starter motor operate normally?

YES :
- Check the ignition switch (Refer to GROUP 54A, Chassis Electrical – Ignition Switch – Ignition Switch – Inspection P.54A-26.)
- Check the transmission range switch. (Refer to GROUP 23A, CVT – On-vehicle Service – Essential Service – Transmission Range Switch Continuity Check P.23A-143.) <2.4L> (Refer to GROUP 23C, Automatic Transaxle – On-vehicle Service – Essential Service – Transmission Range Switch Check P.23C-269.) <3.0L>
- Check the line between the battery and starter motor S (solenoid) terminal.

NO : Go to Step 3.

STEP 3.

- Check the cable between starter B (battery) terminal and battery positive terminal for connection and continuity.

Q: Is the starter cable in good condition?

YES : Go to Step 4.
NO : Repair or replace the cable.

STEP 4.

- Check the connection and the continuity of the cable between the starter motor body and the negative battery terminal.

Q: Is the ground line in good condition?

YES : Go to Step 5.
NO : Repair or replace the cable.

STEP 5.

Q: Is the starter motor in good condition? (Refer to Starting System – Starter Motor Assembly – Inspection P.16-34.)

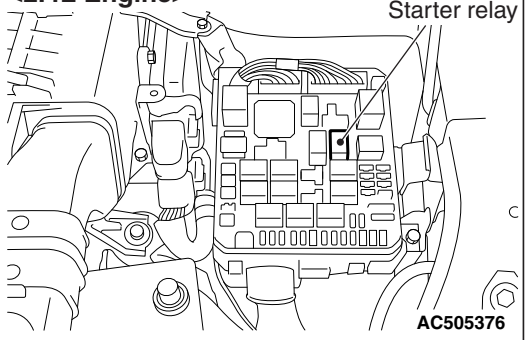
YES : Excessive rotational resistance of the engine.
NO : Replace the starter motor.

ON-VEHICLE SERVICE

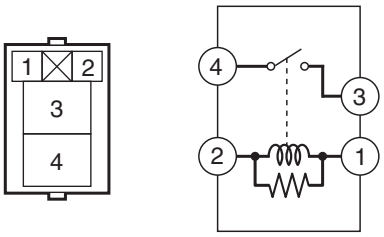
STARTER RELAY CHECK

M1162001400875

<2.4L Engine>

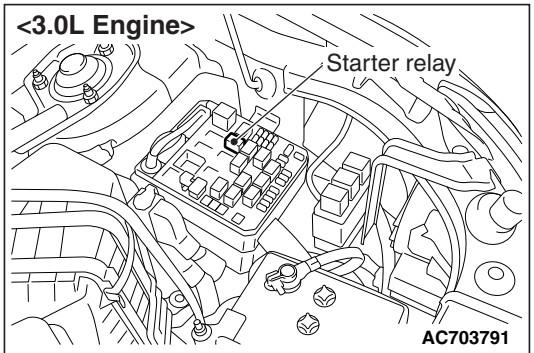


AC505376

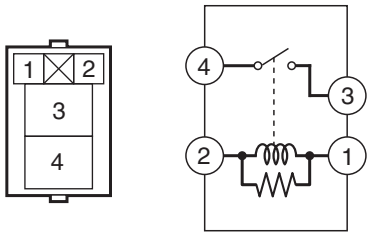


AC506970AI

<3.0L Engine>



AC703791



AC703792AC

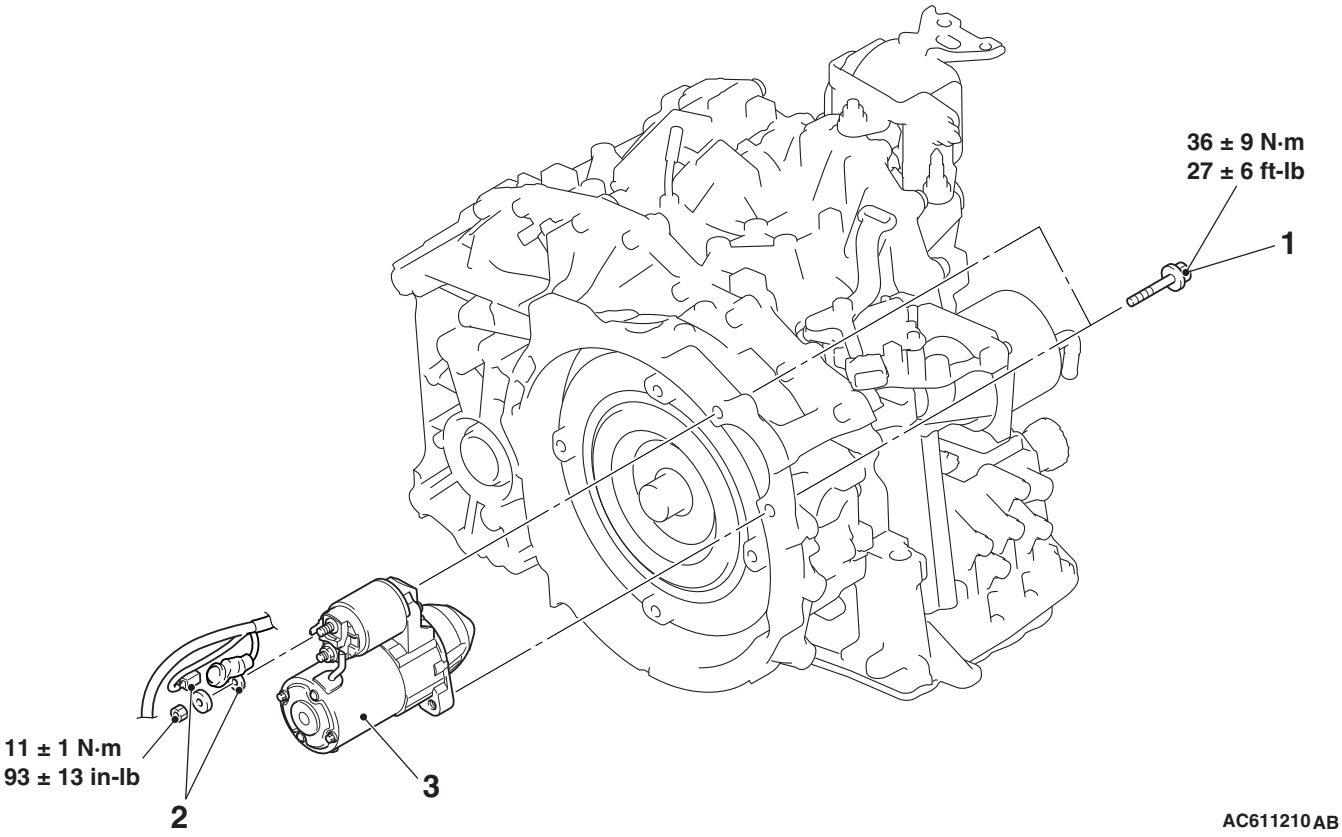
Battery voltage	Terminal number to be connected to tester	Continuity test results
Not applied	3 – 4	Open circuit
Connect terminal 2 to battery (+) terminal. Connect terminal 1 to battery (–) terminal.	3 – 4	Continuity (less than 2 ohms)

STARTER MOTOR ASSEMBLY INSPECTION

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1162001002345

Pre-removal operation	Post-installation operation
• Air Cleaner Intake Duct and Air Cleaner Intake Hose Removal (Refer to GROUP 15, Air Cleaner <2.4L Engine>P.15-4). • Battery and Battery Tray Removal (Refer to GROUP 54A, Battery P.54A-11). • Engine Room Under Cover Front A, B Removal (Refer to GROUP 51, Under Cover P.51-22).	• Engine Room Under Cover Front A, B Installation (Refer to GROUP 51, Under Cover P.51-22). • Battery and Battery Tray Installation (Refer to GROUP 54A, Battery P.54A-11). • Air Cleaner Intake Duct and Air Cleaner Intake Hose Installation (Refer to GROUP 15, Air Cleaner <2.4L Engine>P.15-4).



Removal steps
- Emission vacuum hose and brake booster vacuum hose connection (Refer to GROUP 15, Intake Manifold <2.4L Engine>P.15-9).
- Throttle body stay (Refer to GROUP 13A, Throttle Body P.13A-885).

<<A>>

<<A>>

Removal steps (Continued)
1. Starter mounting bolts
2. Starter connector and terminal connection
3. Starter assembly

REMOVAL SERVICE POINT

<<A>> STARTER CONNECTOR AND TERMINAL/STARTER ASSEMBLY REMOVAL

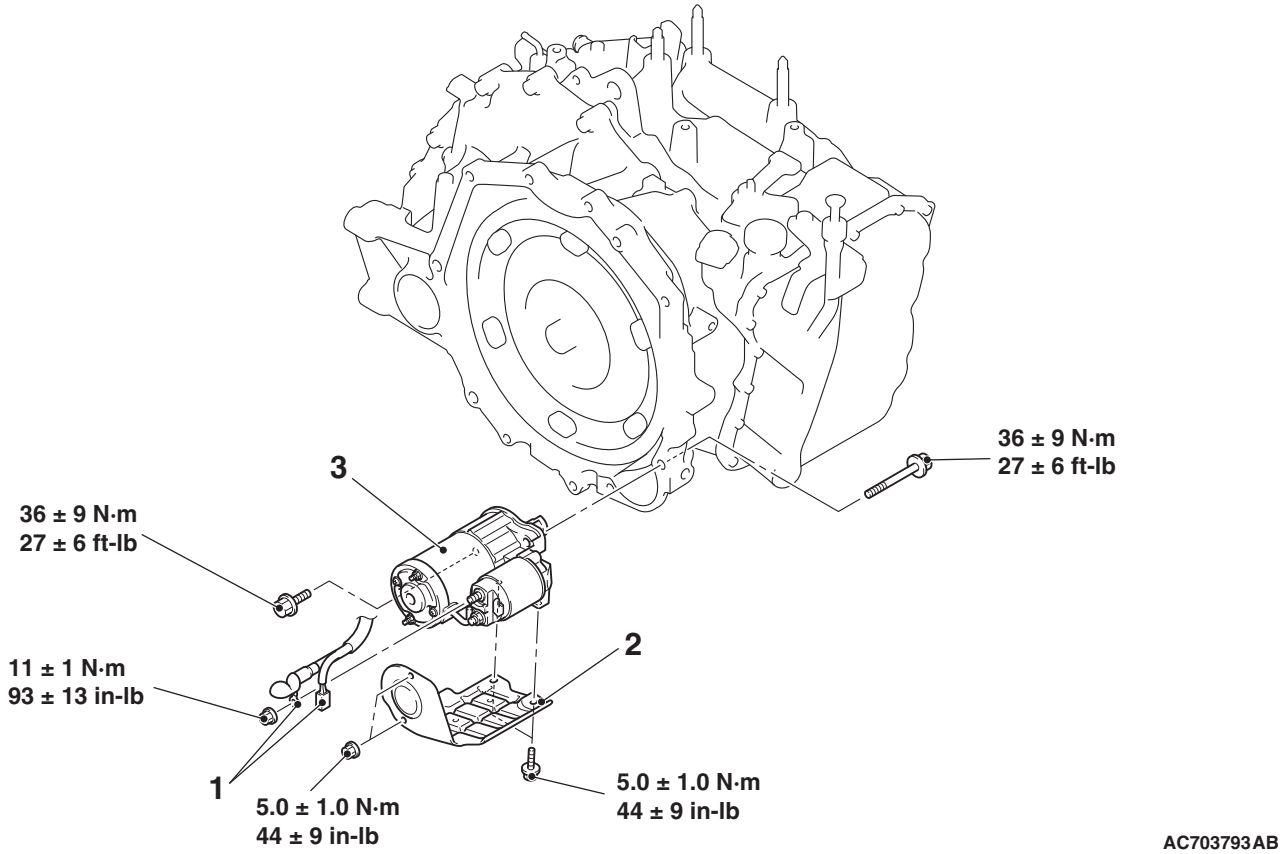
1. Slide the starter assembly, and disconnect the starter connector and terminal.
2. Remove the starter assembly from the lower front of the engine.

TSB Revision

REMOVAL AND INSTALLATION <3.0L ENGINE>

M1162001002594

Pre-removal and Post-installation Operation
- Engine Room Under Cover Front Removal and Installation (Refer to GROUP 51, Under Cover P.51-22).



Removal steps
1. Starter connector and terminal connection

<<A>>

Removal steps (Continued)
2. Starter cover
3. Starter assembly

REMOVAL SERVICE POINT

<<A>> STARTER ASSEMBLY REMOVAL

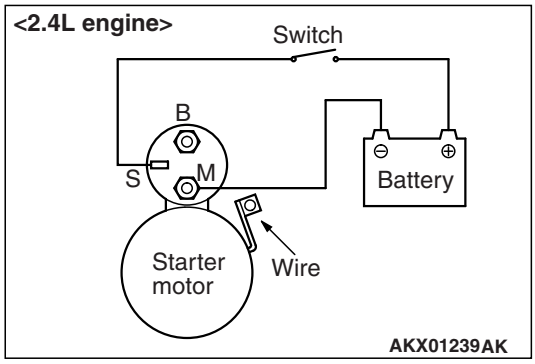
Remove the starter assembly from under the vehicle.

TSB Revision

INSPECTION

M1162001100830

PINION GAP ADJUSTMENT

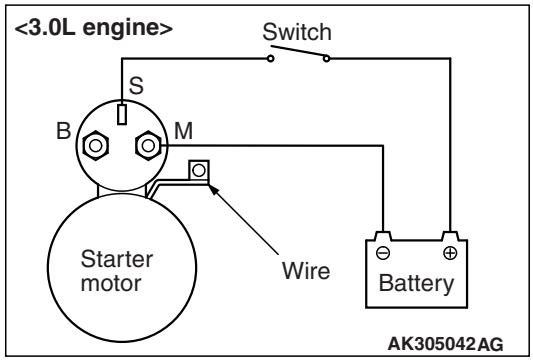


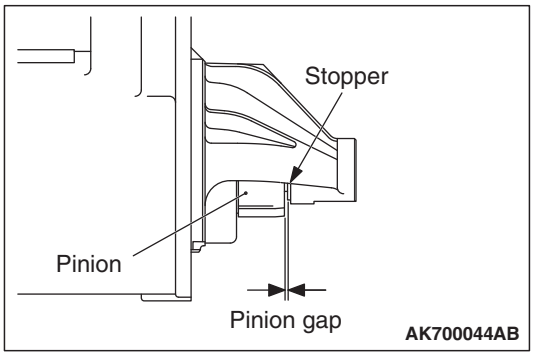
1. Disconnect the lead wire from the M-terminal of the magnetic switch.
2. Connect a 12-volt battery between the S-terminal and M-terminal.

⚠ CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

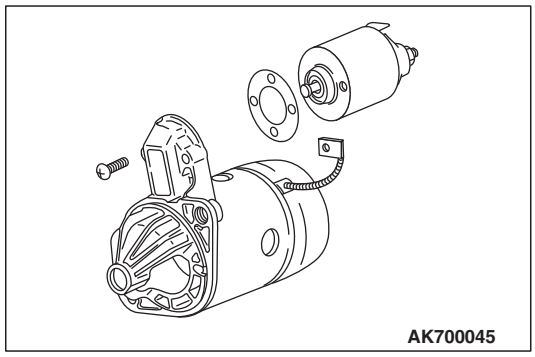
3. Set the switch to "ON", and the pinion will move out.





4. Check the pinion-to-stopper clearance (pinion gap) with a feeler gauge.

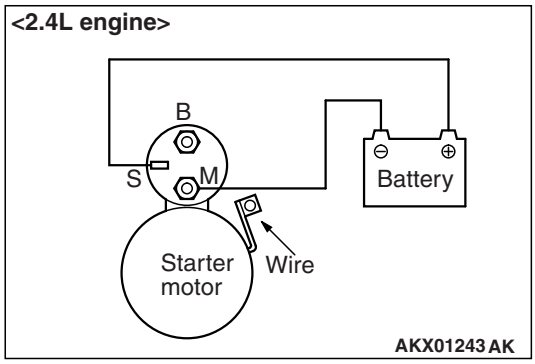
   Standard value: 0.5 – 2.0 mm (0.02 – 0.07 inch)



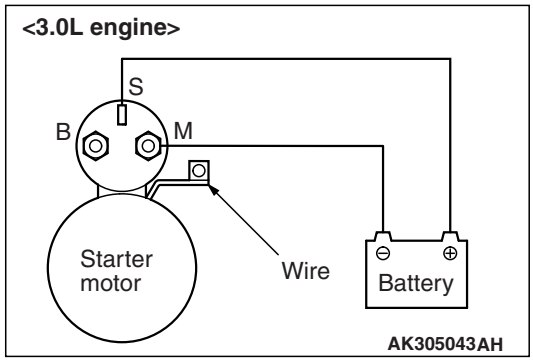
5. If the pinion gap is out of specification, adjust by adding or removing gasket(s) between the magnetic switch and front bracket.

MAGNETIC SWITCH PULL-IN TEST

<2.4L engine>



<3.0L engine>



1. Disconnect the field coil wire from the M-terminal of the magnetic switch.

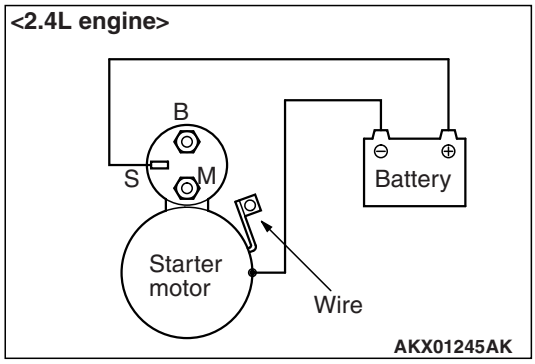
⚠ CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

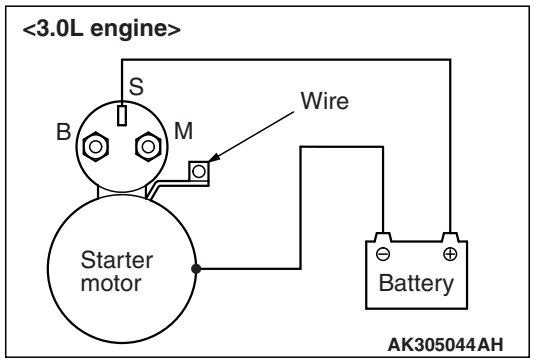
2. Connect a 12-volt battery between the S-terminal and M-terminal.
3. If the pinion moves out, the pull-in coil is good. If it doesn't, replace the magnetic switch.

MAGNETIC SWITCH HOLD-IN TEST

<2.4L engine>



<3.0L engine>

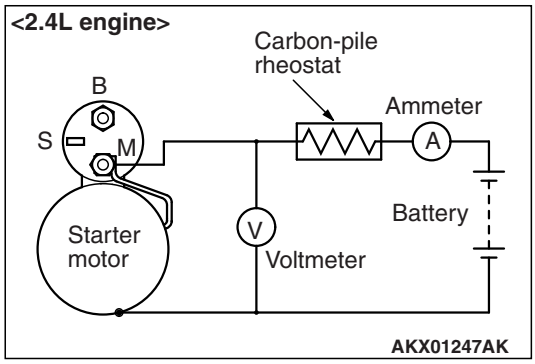


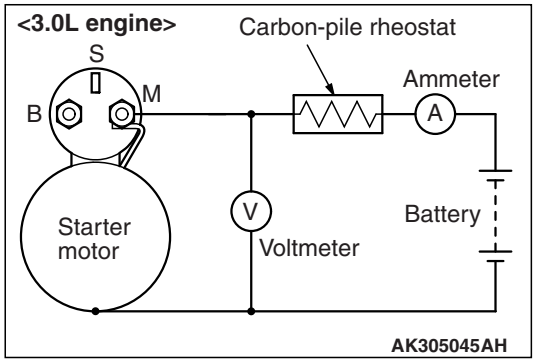
1. Disconnect the field coil wire from the M-terminal of the magnetic switch.

⚠ CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

2. Connect a 12-volt battery between the S-terminal and body.
3. Manually pull out the pinion as far as the pinion stopper position.
4. If the pinion remains out, everything is operating properly. If the pinion moves in, the hold-in circuit is open. Replace the magnetic switch.

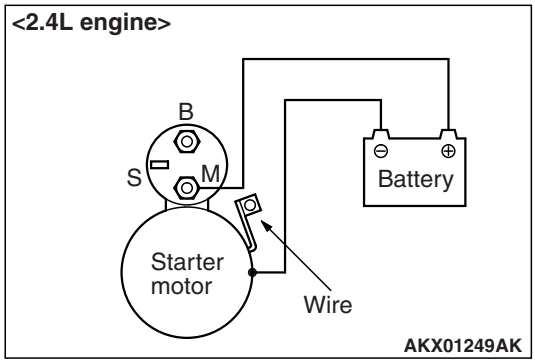


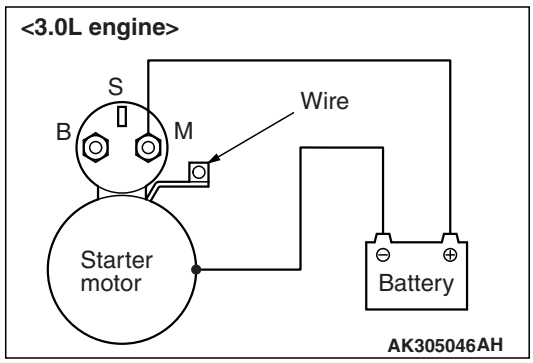


FREE RUNNING TEST

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to the starter motor as follows:
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostat in series between the positive battery terminal and starter motor terminal.
3. Connect a voltmeter (15-volt scale) across the starter motor.
4. Rotate carbon pile to full-resistance position.
5. Connect the battery cable from the negative battery terminal to the starter motor body.
6. Adjust the rheostat until the battery positive voltage shown by the voltmeter is 11 V.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

   Current: maximum 90 Amps





MAGNETIC SWITCH RETURN TEST

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.

⚠ CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

2. Connect a 12-volt battery between the M-terminal and body.

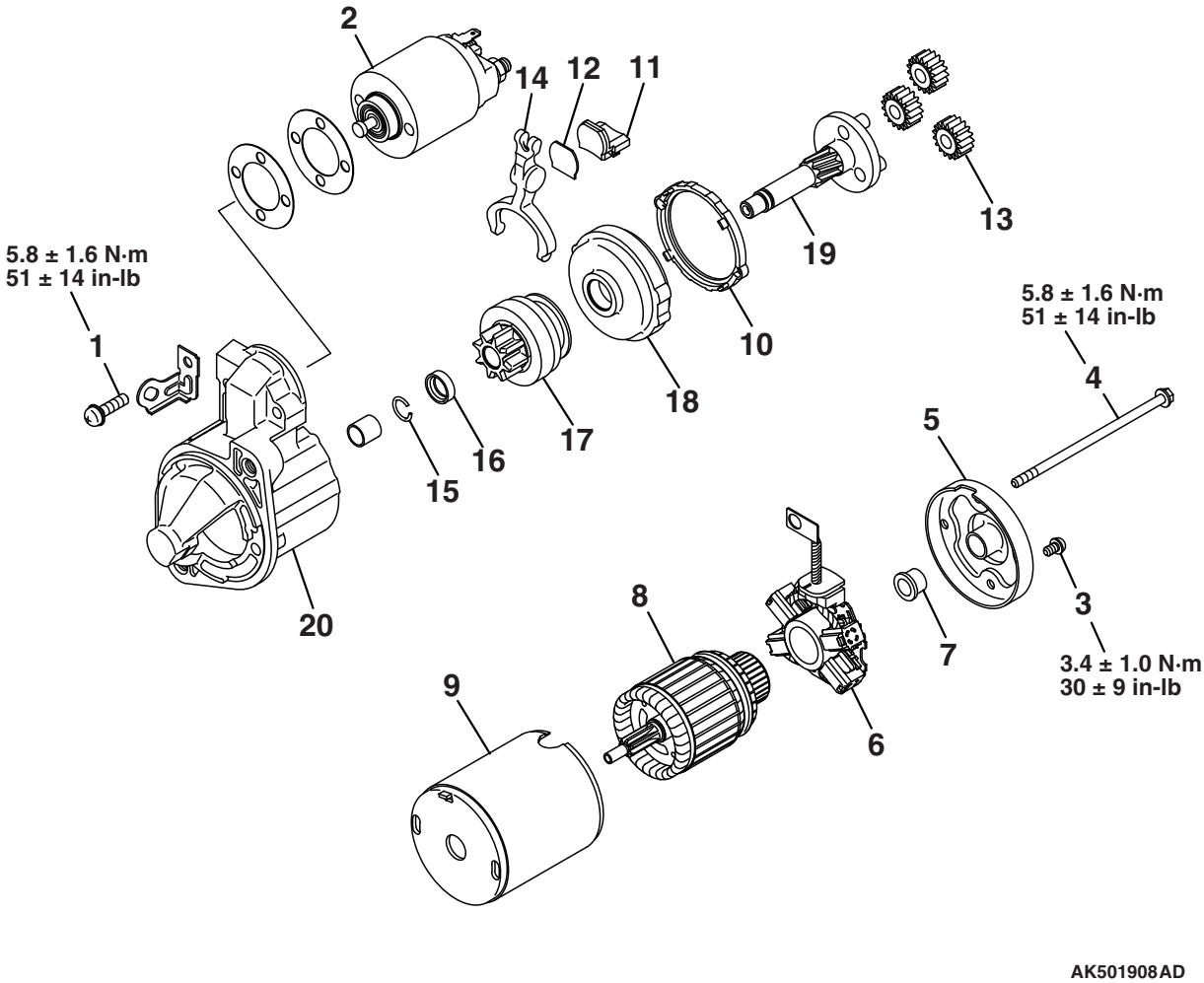
⚠ WARNING

Be careful not to get your fingers caught when pulling out the pinion.

3. Pull the pinion out and release. If the pinion quickly returns to its original position, everything is operating properly. If it doesn't, replace the magnetic switch.

DISASSEMBLY AND REASSEMBLY

M1162001200600



AK501908AD

Disassembly steps

1. Screw
<<A>> 2. Magnetic switch
3. Screw
4. Bolt
5. Rear bracket
6. Brush holder
7. Rear bearing
8. Armature
9. Yoke assembly
10. Packing A

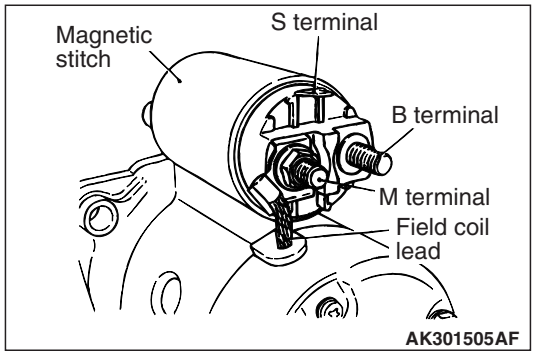
Disassembly steps (Continued)

11. Packing B
12. Plate
13. Planetary gear
14. Lever
<<B>> >>A<< 15. Snap ring
<<B>> >>A<< 16. Stop ring
17. Overrunning clutch
18. Internal gear
19. Planetary gear shaft
20. Front bracket

TSB Revision

DISASSEMBLY SERVICE POINTS

<<A>> MAGNETIC SWITCH REMOVAL

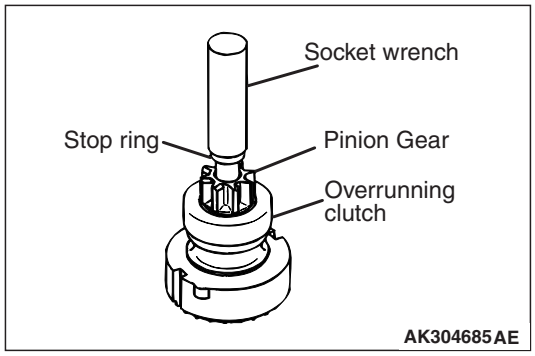


⚠ CAUTION

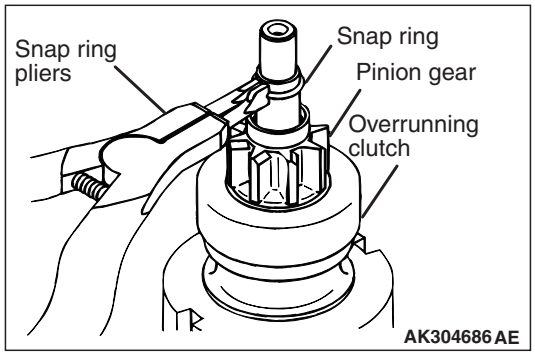
Do not clamp the yoke assembly with a vise.

Disconnect the lead from the M terminal of the magnetic switch.

<<B>> SNAP RING/STOP RING REMOVAL



1. Apply a long socket wrench of an appropriate size to the stop ring and strike the wrench to drive out the stop ring toward the pinion gear side.



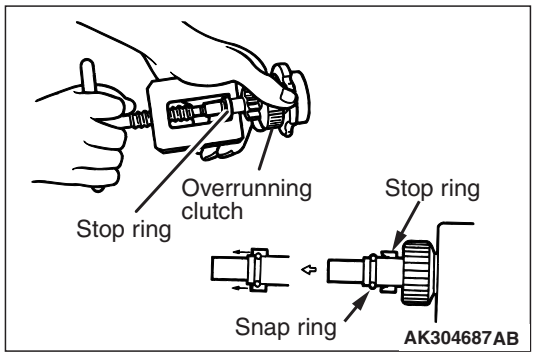
2. Remove the snap ring with snap ring pliers, then remove the stop ring and overrunning clutch.

STARTER MOTOR PARTS CLEANING

1. Never clean in a solvent such starter motor parts as the magnetic switch, brush holder, and armature. If they are soaked in a solvent, their insulation could be impaired. When these parts require cleaning, wipe off contamination with cloth.
2. Never soak the drive unit in a solvent. If it is washed in a solvent, the grease having been packed in the overrunning clutch at the factory will be washed out. Wipe the drive unit with cloth if it requires cleaning.

REASSEMBLY SERVICE POINTS

>>A<< STOP RING/SNAP RING INSTALLATION

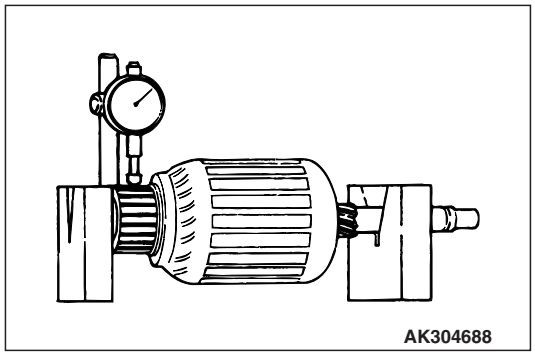


Use a suitable puller to pull the stop ring until it gets over the snap ring.

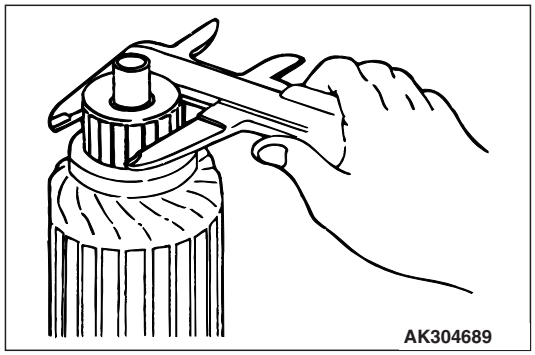
INSPECTION

M1162001300469

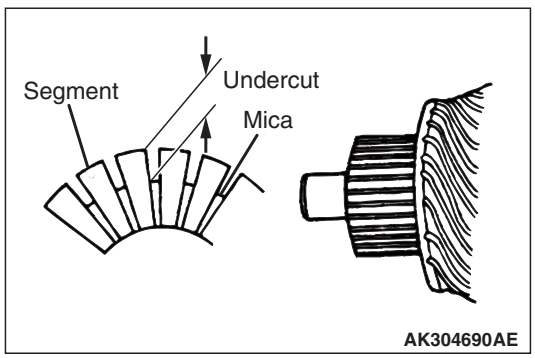
COMMUTATOR



1. Support the armature with a pair of V block and turn it to measure the runout of the surface not rubbed by the brushes using a dial gauge.
   Standard value: 0.05 mm (0.002 inch) or less
   Limit: 0.1 mm (0.004 inch)

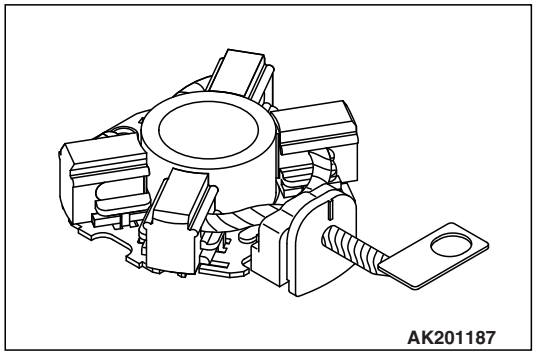


2. Measure the diameter of the commutator.
   Standard value: 29.4 mm (1.157 inch)
   Limit: 28.8 mm (1.134 inch)



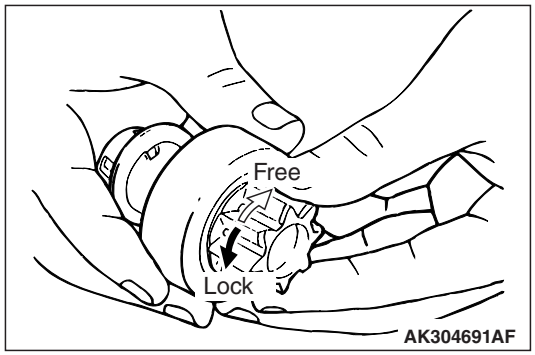
3. Measure the depth of the undercut between segments.
   Standard value: 0.5 mm (0.002 inch)
   Limit: 0.2 mm (0.008 inch)

BRUSH HOLDER


AK201187

Push the brush into the brush holder to make sure that the spring is working on the brush.
If the spring is not working, replace the brush holder.

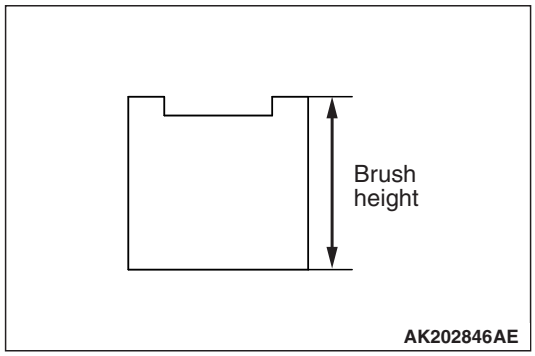
OVERRUNNING CLUTCH



AK304691AF

1. Make sure that the pinion cannot be turned counterclockwise and can be turned clockwise freely.
2. Check the pinion for abnormal ware and damage.

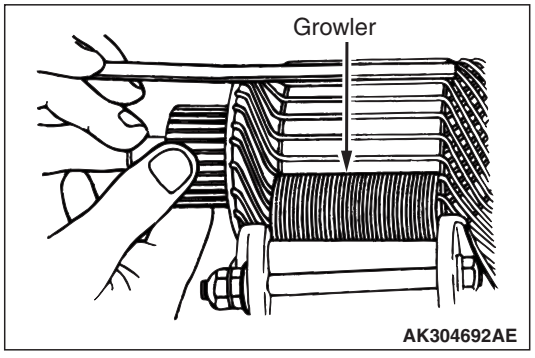
BRUSHES



AK202846AE

1. Check the commutator contacting surface of each brush for abnormal roughness. Also check the height of the brush. Replace the brush holder if the height is lower than the limit.
   Limit: 7.0 mm (0.28 inch)
2. When the contact surface of the brush is rectified or the brush holder is replaced, recondition the contact surface with sandpaper wrapped around the commutator.

ARMATURE COIL

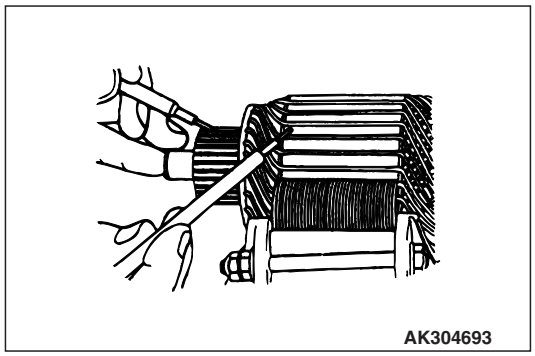


AK304692AE

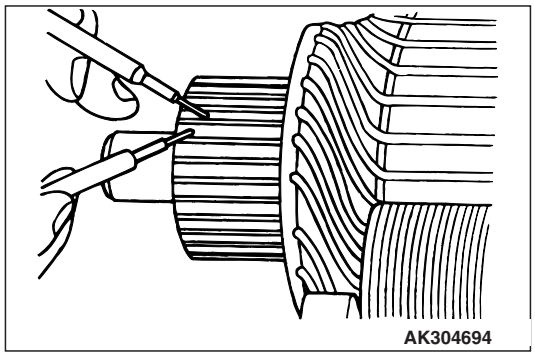
1. Check the armature coil for short circuit as follows.
2. Set the armature in a growler.

⚠ CAUTION
Clean the surface of the armature thoroughly before performing the test.

3. While holding a thin strip of iron against the armature in parallel with its axis, turn the armature slowly. The armature is normal if the iron strip is not attracted to the armature or it does not vibrate.


AK304693

4. Check the insulation between commutator segments and armature coils. The armature coils are properly insulated if no continuity is present.


AK304694

5. Check continuity between a segment and another. There is no open circuit in the tested coil if there is continuity.

IGNITION SYSTEM

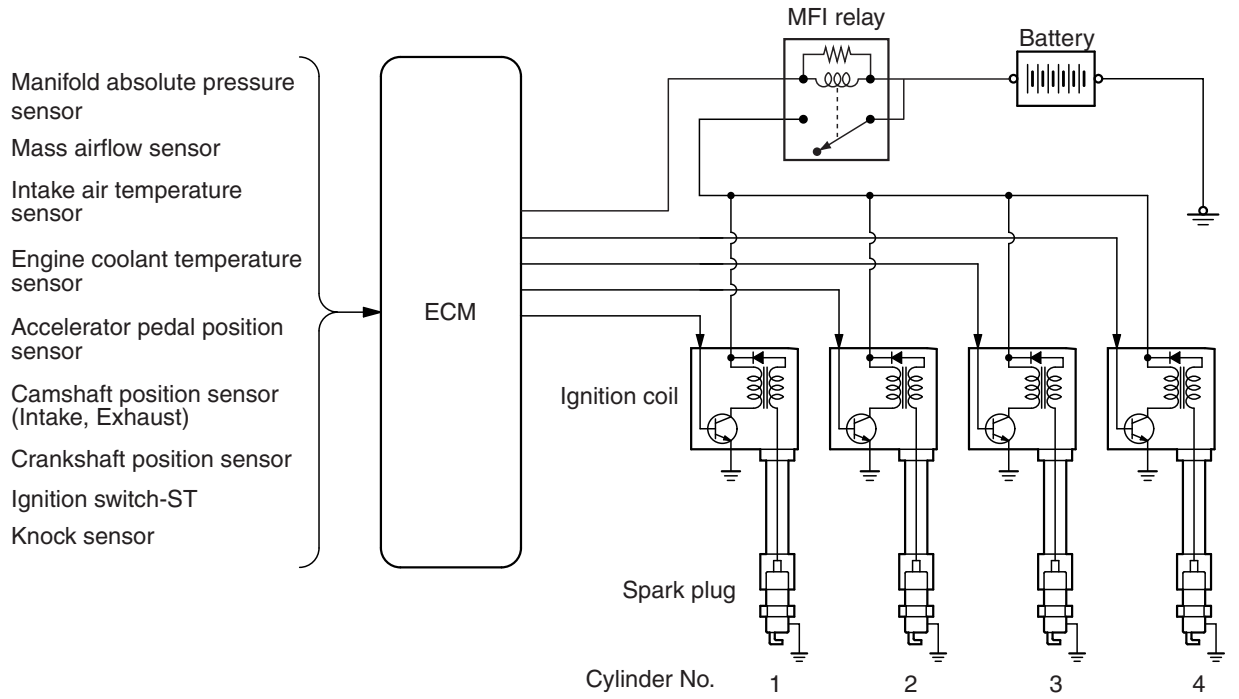
GENERAL INFORMATION

M1163000101048

This system is equipped with four <2.4L> or six <3.0L> ignition coils with built-in power transistors for each of the cylinders.
Interruption of the primary current flowing in the primary side of an ignition coil generates a high voltage in the secondary side of ignition coil. The high voltage thus generated is applied to the spark plugs to generate sparks. The engine control module (ECM) turns the power transistors inside the ignition coils alternately on and off.This causes the primary currents in the ignition coils to be alternately interrupted and allowed to flow to fire the cylinders in the order 1-3-4-2 <2.4L> or 1-2-3-4-5-6 <3.0L>.
The ECM determines which ignition coil should be controlled by means of the signals from the camshaft position sensor and the crank angle sensor. It also detects the crankshaft position, in order to provide ignition at the most appropriate timing in response to the engine operation conditions.
When the engine is cold or running at high altitudes, the ignition timing is slightly advanced to provide optimum performance. Furthermore, if knocking occurs, the ignition timing is gradually retarded until knocking ceases.

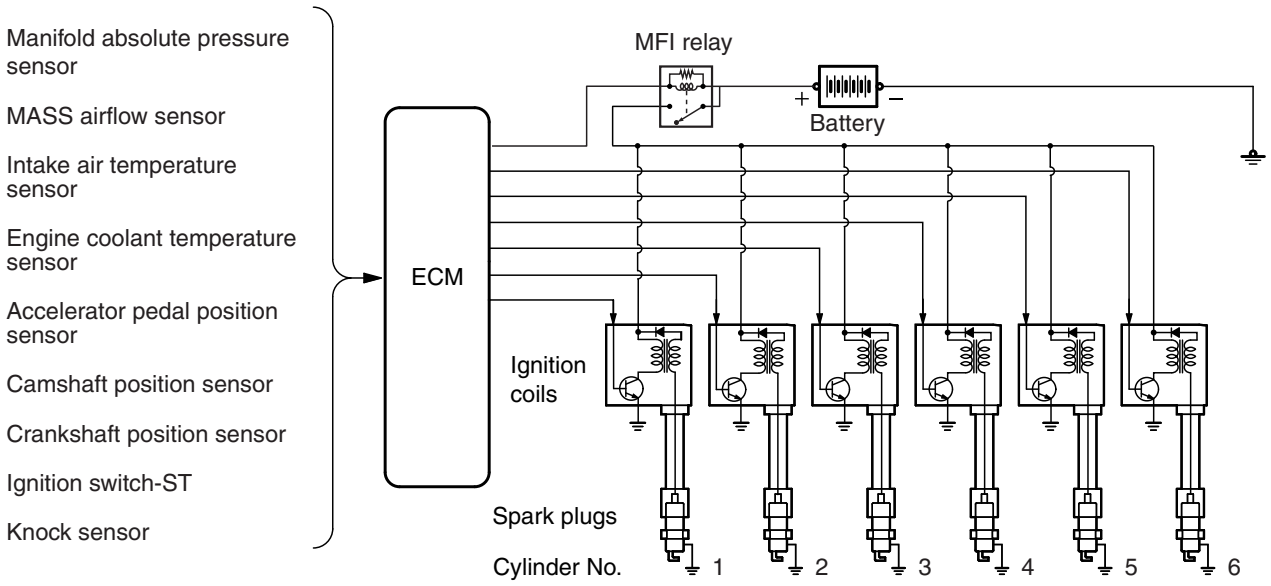
SYSTEM DIAGRAM

<2.4L>



AK503331AI

<3.0L>



AK603514AD

TSB Revision

GENERAL SPECIFICATIONS

M1163000200172

Item	2.4L engine	3.0L engine
Ignition Coil		
Type	Molded 4 coil	Molded 6 coil
Spark Plugs		
NGK	DIFR5C11	ILKR7B-8
DENSO	–	SXU22HDR8

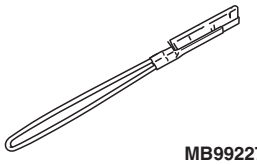
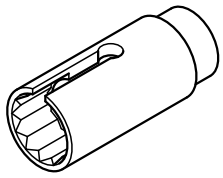
SERVICE SPECIFICATIONS

M1163000301525

Item		Standard value	Limit
Spark plug gap mm (in)	2.4L engine	1.0 – 1.1 (0.039 – 0.043)	1.3 (0.051)
	3.0L engine	0.7 – 0.8 (0.028 – 0.031)	0.95 (0.037)

SPECIAL TOOL

M1163000600567

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
 MB992273	MB992273 Spark plug brush	–	Cleaning spark plug
	MD998773 Knock sensor wrench	MD998773-01	Knock sensor removal and installation

ON-VEHICLE SERVICE

KNOCK CONTROL SYSTEM CHECK

M1163001800326

Check the knock sensor circuit if diagnostic trouble code, No. P0326, P0327, P0328, P0331, P0332 or P0333 is shown.

Refer to GROUP 13A, Multiport Fuel Injection (MFI) <2.4L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Chart P.13A-49. <2.4L>

Refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.0L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Chart P.13B-50. <3.0L>

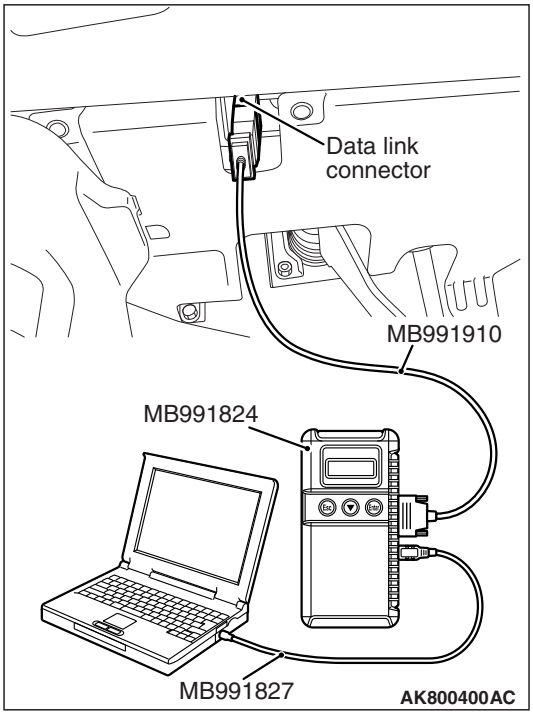
IGNITION COIL CHECK

M1163001201190

Required Special Tool:
MB991958: Scan Tool (M.U.T-III Sub Assembly)
- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

⚠ CAUTION
To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

NOTE: It is impossible to carry out an easy check using a circuit tester because a diode and so on are integrated into the inside circuit of this ignition coil. Accordingly, check the ignition coil in the following procedure.



1. Make sure the diagnosis codes are not stored using scan tool MB991958. If stored, record the code No. Carry out the troubleshooting for the stored codes and solve the problems even if not related to the ignition.
2. Disconnect the injector connectors on all of the cylinders.
3. Disconnect the ignition coil connector.
4. Remove the ignition coil and install a good spark plug to the ignition coil.
5. Connect the ignition coil connector.
6. Ground the side electrode of the spark plug and crank the engine.
7. Check that spark is produced between the electrodes of the spark plug.
8. If the spark plug has weak spark or no spark, carry out the same check using a good ignition coil. If there is strong spark on this check with a good ignition coil, it becomes clear there is a problem with the ignition coil. Replace the ignition coil with a new one. If there is no spark on this check with a good ignition coil, there is probably a problem with the ignition circuit. Check the ignition circuit.
9. Using scan tool MB991958, make sure whether the diagnosis codes are stored due to the check, or not. Except the codes stored in Step 1, clear the codes all together if they are present. And then, carry out the troubleshooting about the codes recorded.
10. Select "Mode $0A" from "Special Function" of Scan tool MB991958. Check whether the permanent-DTC (PDTC) is stored or not. <3.0 L Engine>
    If stored, clear the PDTC. (Refer to GROUP 13B – Multiport Fuel Injection (MFI) <3.0 L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Function P.13B-11)

⚠ CAUTION
To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

11. Disconnect scan tool MB991958 to the data link connector.

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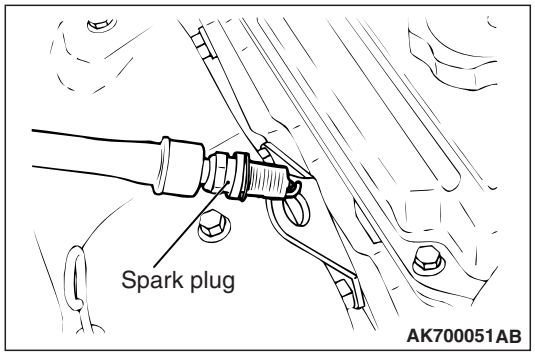
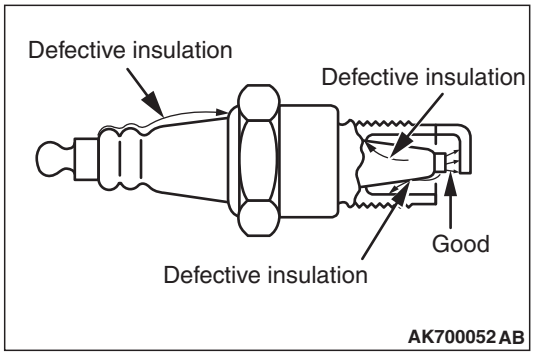
SPARK PLUG TEST

M1163001500198



1. Remove the spark plug and connect to the ignition coil.



2. Ground the spark plug outer electrode (body), and crank the engine.
   Check that there is an electrical discharge between the electrodes at this time.

SPARK PLUG CHECK AND CLEANING

M1163004302735

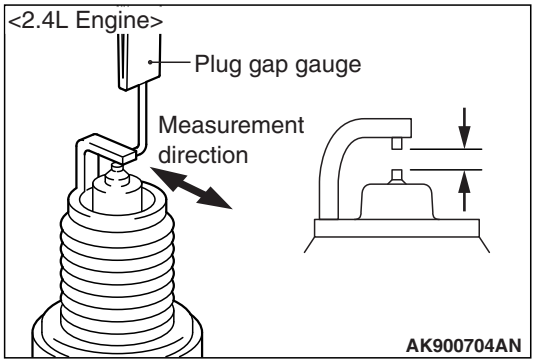
Required Special Tool
MB992273: Spark Plug Brush

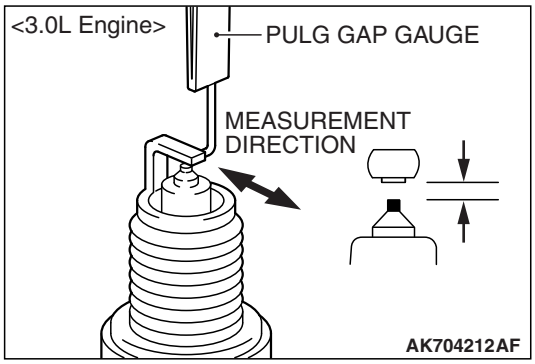
⚠ CAUTION

- **Never attempt to adjust the gap of the iridium plug.**
- **Do not attempt to clean the iridium plug using a wire brush because it may result in damage to the electrode. When the iridium plug is cleaned, use a plug cleaner, sand blast type, or special tool MB992273.**

NOTE: Obey the maintenance interval of the vehicle for the spark plug replacement. If the plug gap and insulation resistance are normal, check the plug state and clean it if necessary.

SPARK PLUG GAP CHECK



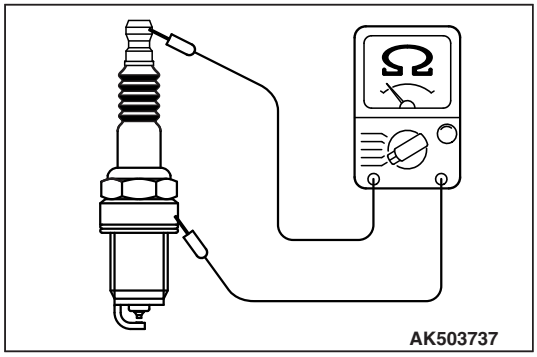


Check the plug gap with the wire type plug gauge. Replace it if the limit is exceeded.

Standard value:
1.0 – 1.1 mm (0.039 – 0.043 inch) <2.4L Engine>
0.7 – 0.8 mm (0.028 – 0.031 inch) <3.0L Engine>

Limit:
1.3 mm (0.051 inch) <2.4L Engine>
0.95 mm (0.037 inch) <3.0L Engine>

SPARK PLUG INSULATION RESISTANCE CHECK



1. Measure the insulation resistance of the spark plug. If the insulation resistance of the spark plug is under the limited value, clean the spark plug (Refer to P.16-46).
2. After cleaning, measure the insulation resistance again. Replace the plug unless it is within the limited value.

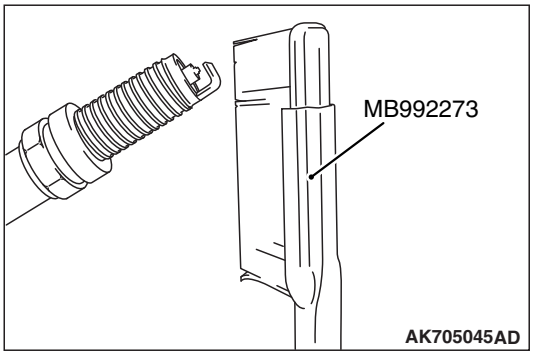
Limit: Minimum 10 MΩ

SPARK PLUG CLEANING

NOTE: Using a sand blast type plug cleaner, is recommended for the spark plug cleaning.

<When a sand blast type plug cleaner is used>

Cleaning must be carried out within 20 seconds to protect the electrode.



<When special tool MB992273 is used>

1. Sufficiently apply the brake cleaner to the plug end.

   NOTE: Repeatedly applying the brake cleaner is acceptable during the cleaning.
2. Using special tool MB992273, intensively clean the electrode for 1 to 2 minutes.

   NOTE: Even if using strong force, the electrode is not damaged.

   NOTE: In case of insufficient cleaning, it is permissible to take longer than 2 minutes for cleaning.
3. After the cleaning, sufficiently remove and then dry both of the carbon and the brake cleaner on the plug, using a waste cloth or air blowing.

CAMSHAFT POSITION SENSOR CHECK

M1163004400822

Refer to GROUP 13A, Multiport Fuel Injection (MFI) <2.4L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures – DTC P0340: Camshaft Position Sensor Circuit P.13A-381. <2.4L>
Refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.0L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures – DTC P0340: Camshaft Position Sensor Circuit P.13B-452. <3.0L>

CRANKSHAFT POSITION SENSOR CHECK

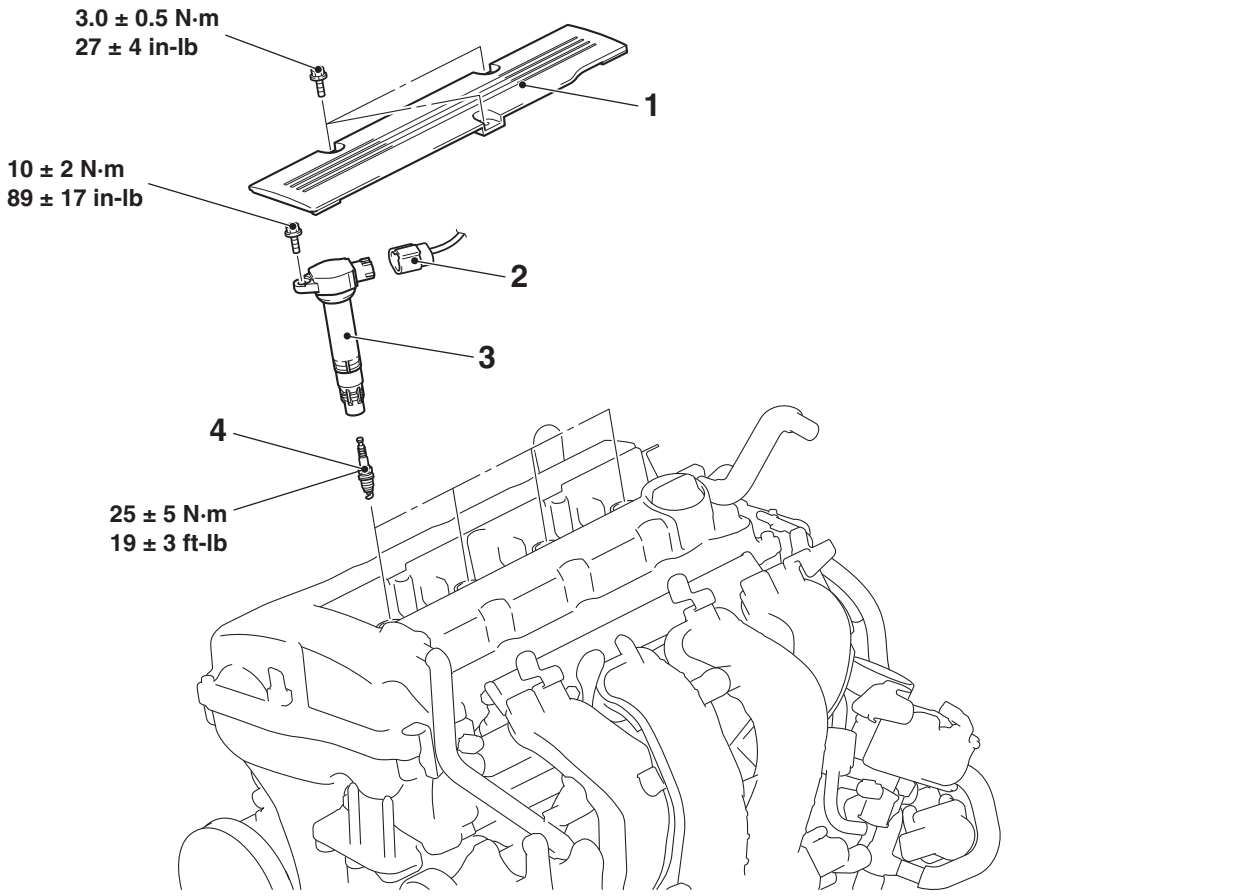
M1163004500874

Refer to GROUP 13A, Multiport Fuel Injection (MFI) <2.4L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures – DTC P0335: Crankshaft Position Sensor Circuit P.13A-372. <2.4L>
Refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.0L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures – DTC P0335: Crankshaft Position Sensor Circuit P.13B-445. <3.0L>

IGNITION COIL

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1163004001504



AC506572AC

Removal steps

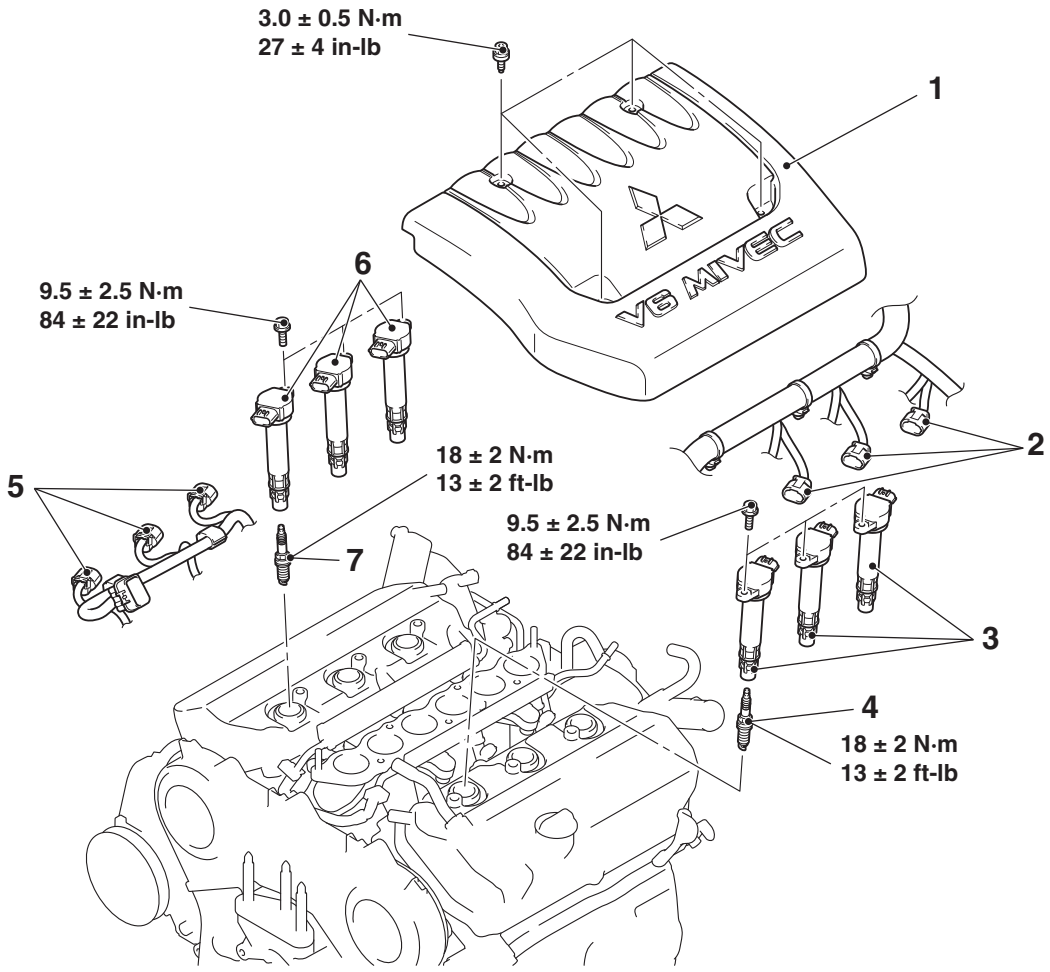
1. Cylinder head cover center cover
2. Ignition coil connector connection

Removal steps (Continued)

3. Ignition coil
4. Spark plug

REMOVAL AND INSTALLATION <3.0L ENGINE>

M1163004001496



AC703803AB

Removal steps

1. Engine cover
2. Ignition coil connector connection (Left bank)
3. Ignition coil (Left bank)
4. Spark plug (Left bank)

Removal steps (Continued)

- Intake manifold plenum (Refer to GROUP 15, Intake Manifold Plenum P.15-6).

5. Ignition coil connector connection (Right bank)
6. Ignition coil (Right bank)
7. Spark plug (Right bank)

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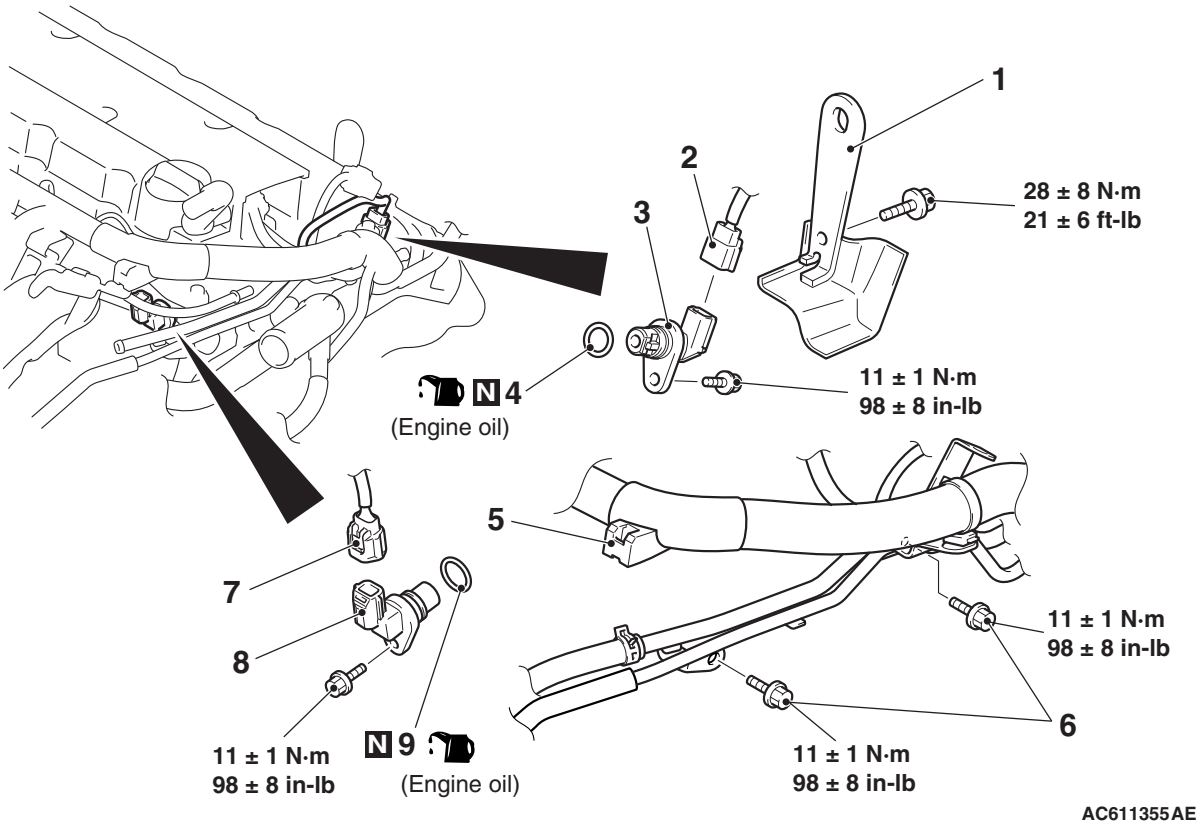
CAMSHAFT POSITION SENSOR

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1163003401402



Removal steps <Exhaust side>

1. Engine hanger
2. Exhaust camshaft position sensor connector connection
3. Exhaust camshaft position sensor
4. O-ring

Removal steps <Intake side>

- Air cleaner cover and air cleaner intake hose (Refer to GROUP 15, Air Cleaner <2.4L Engine>P.15-4).

5. Control harness clamp
6. Emission vacuum hose and pipe assembly mounting bolt
7. Intake camshaft position sensor connector connection
8. Intake camshaft position sensor
9. O-ring

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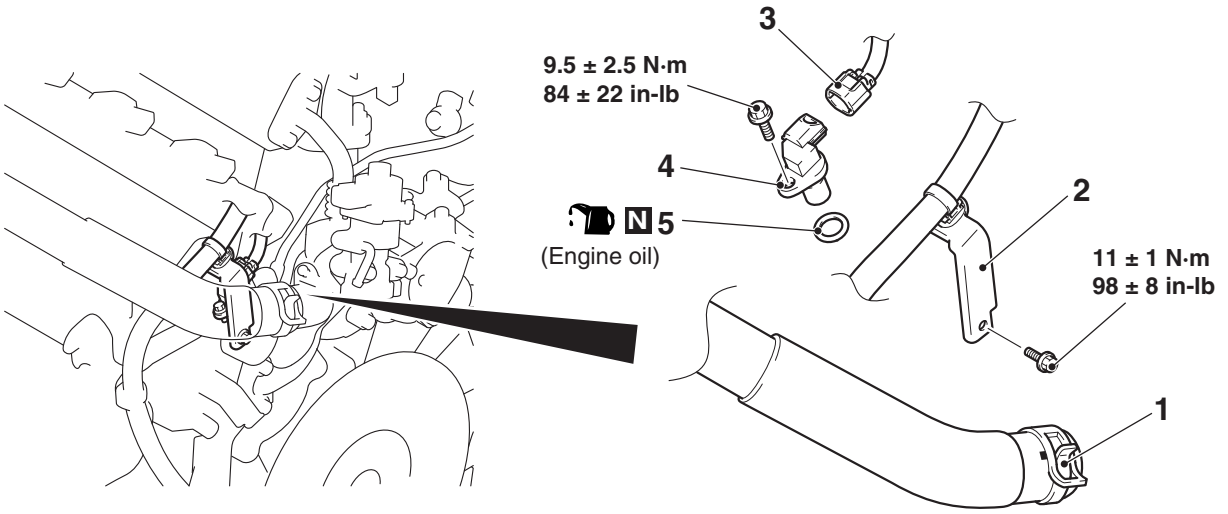
REMOVAL AND INSTALLATION <3.0L ENGINE>

M1163003401606

Pre-removal Operation	Post-installation Operation
• Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Change P.14-26). • Battery and Battery Tray Removal (Refer to GROUP 54A, Battery P.54A-11).	• Battery and Battery Tray Installation (Refer to GROUP 54A, Battery P.54A-11). • Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Change P.14-26).



Removal steps

<<A>> >>A<< 1. Radiator upper hose connection
2. Harness bracket
3. Camshaft position sensor connector connection

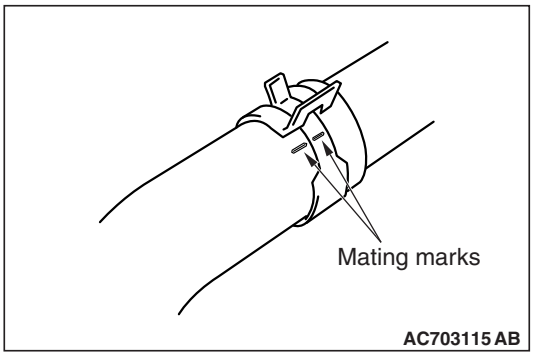
Removal steps (Continued)

4. Camshaft position sensor
5. O-ring

REMOVAL SERVICE POINT

<<A>> RADIATOR UPPER HOSE DISCONNECTION

Make mating marks on the radiator upper hose and the hose clamp. Disconnect the radiator upper hose.



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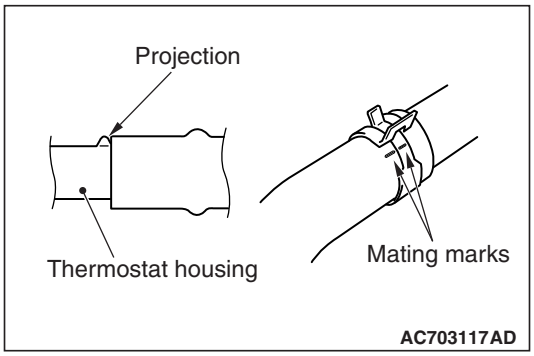
INSTALLATION SERVICE POINT

>>A<< RADIATOR UPPER HOSE CONNECTION



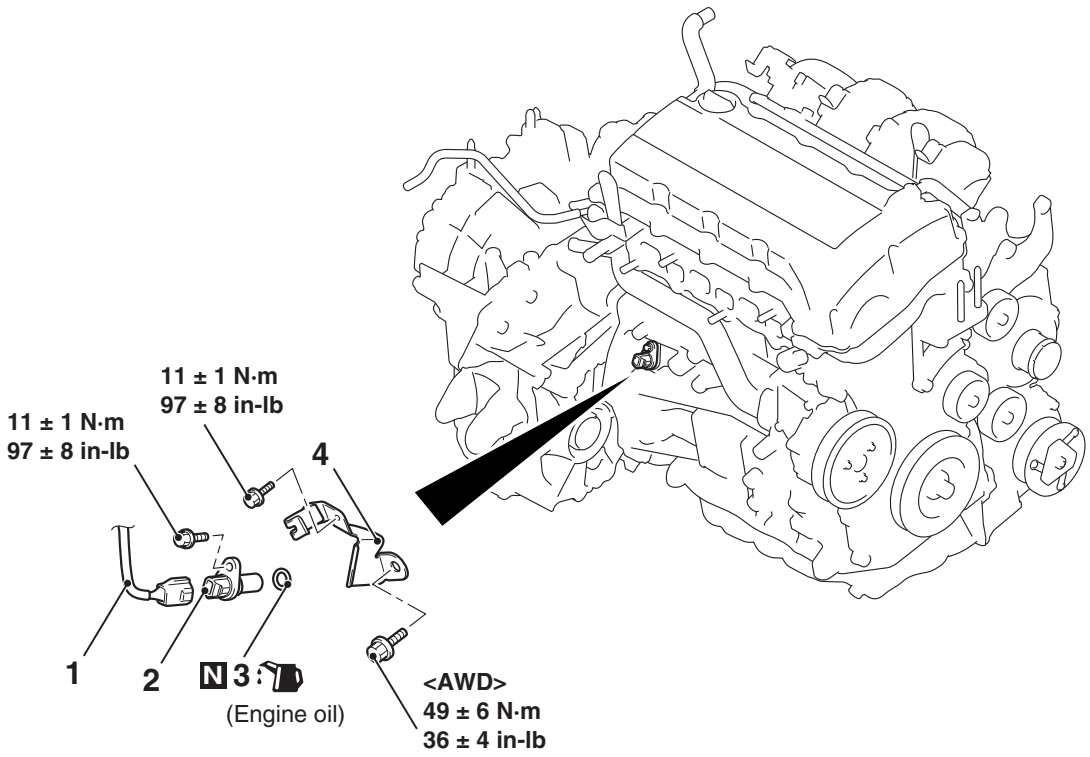
1. Insert radiator upper hose as far as the projection of the thermostat housing.
2. Align the mating marks on the radiator upper hose and hose clamp, and then connect the radiator upper hose.

CRANKSHAFT POSITION SENSOR

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1163004801696

Pre-removal and post-installation operation
- Air Cleaner Assembly Removal and Installation (Refer to GROUP 15, Air Cleaner P.15-4).



Removal steps
1. Crankshaft position sensor connector connection
2. Crankshaft position sensor
3. O-ring

Removal steps (Continued)
- Exhaust manifold bracket (Refer to GROUP 15, Exhaust Manifold P.15-15) <FWD>.
4. Crankshaft position sensor cover

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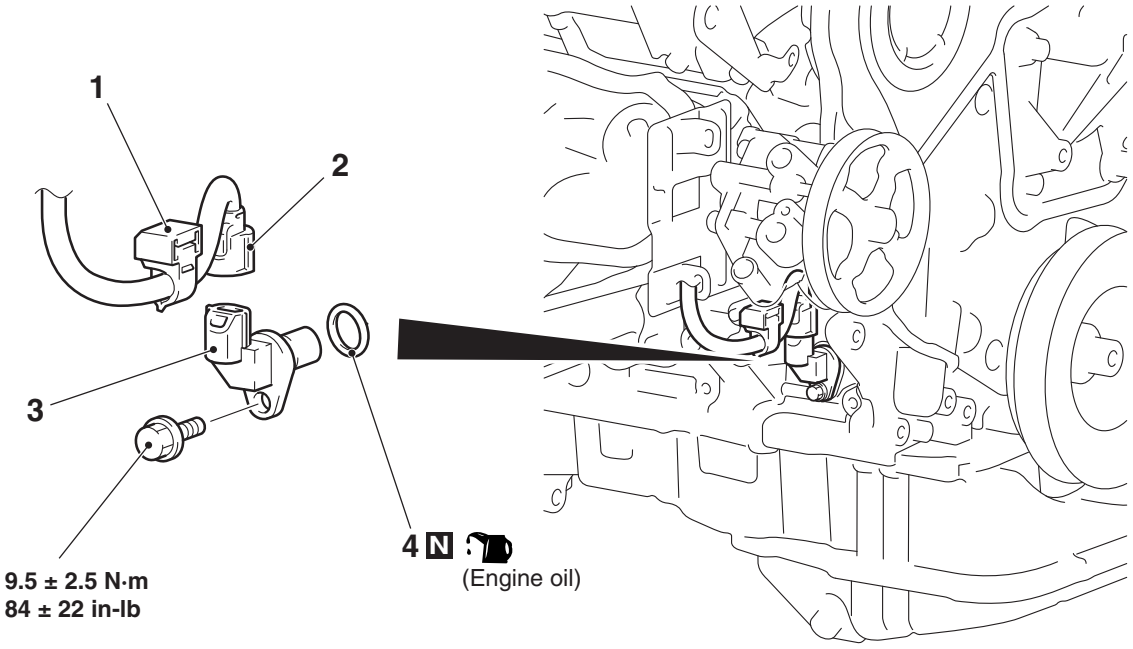
REMOVAL AND INSTALLATION <3.0L ENGINE>

M1163003500923

Pre-removal operation	Post-installation operation
• Engine Room Side Cover (RH) Removal (Refer to GROUP 51 – Under Cover P.51-22). • Driveshaft Assembly (RH) Removal <Vehicles with S-AWC> (Refer to GROUP 26 – Driveshaft Assembly P.26-23).	• Driveshaft Assembly (RH) Installation <Vehicles with S-AWC> (Refer to GROUP 26 – Driveshaft Assembly P.26-23). • Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover P.51-22).



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Removal steps
1. Harness clamp
2. Crankshaft position sensor connector connection

Removal steps (Continued)
3. Crankshaft position sensor
4. O-ring

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KNOCK SENSOR

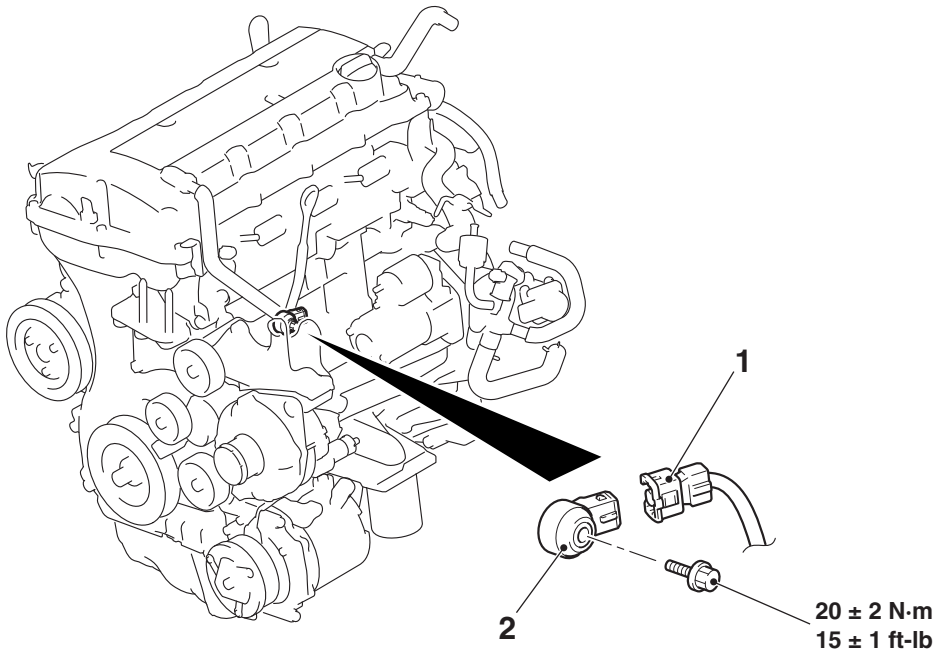
REMOVAL AND INSTALLATION <2.4L ENGINE>

M1163002801894

⚠ CAUTION

- **When the knock sensor replacement is performed, use scan tool MB991958 to initialize the learning value (Refer to GROUP 00, Precautions Before Service – Initialization Procedure for Learning Value in MFI Engine P.00-53).**
- **Do not drop or hit the knock sensor against other components. Internal damage may result, and the knock sensor will need to be replaced.**

Pre-removal and post-installation operation
- Intake Manifold Assembly Removal and Installation (Refer to GROUP 15, Intake Manifold <2.4L Engine>P.15-9).



AC506683AB

Removal steps
1. Knock sensor connector connection
2. Knock sensor

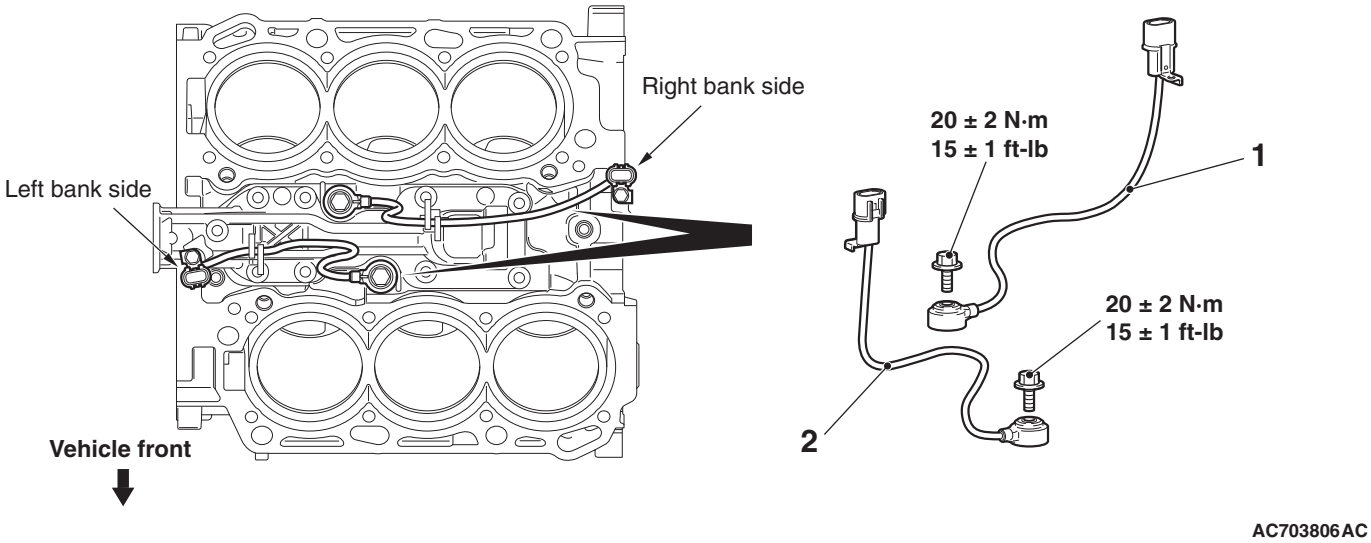
REMOVAL AND INSTALLATION <3.0L ENGINE>

M1163002801883

⚠ CAUTION

- **When the knock sensor replacement is performed, use scan tool MB991958 to initialize the learning value (Refer to GROUP 00, Precautions Before Service – Initialization Procedure for Learning Value in MFI Engine P.00-53).**
- **Do not drop or hit the knock sensor against other components. Internal damage may result, and the knock sensor will need to be replaced.**

Pre-removal and Post-installation Operation
- Intake Manifold Removal and Installation (Refer to GROUP 15, Intake Manifold <3.0L Engine>P.15-11).



AC703806AC

Removal steps
1. Right bank knock sensor
2. Left bank knock sensor

NOTES