

# GROUP 16

# ENGINE ELECTRICAL

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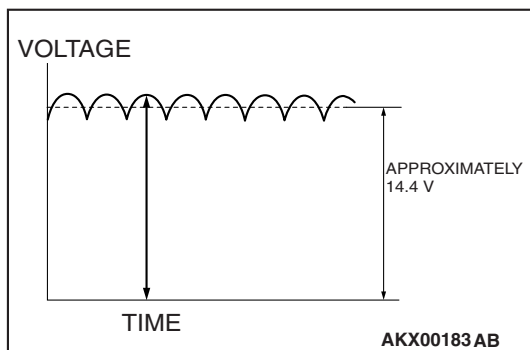
# CHARGING SYSTEM

## GENERAL DESCRIPTION

M1161000100726

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

## OPERATION



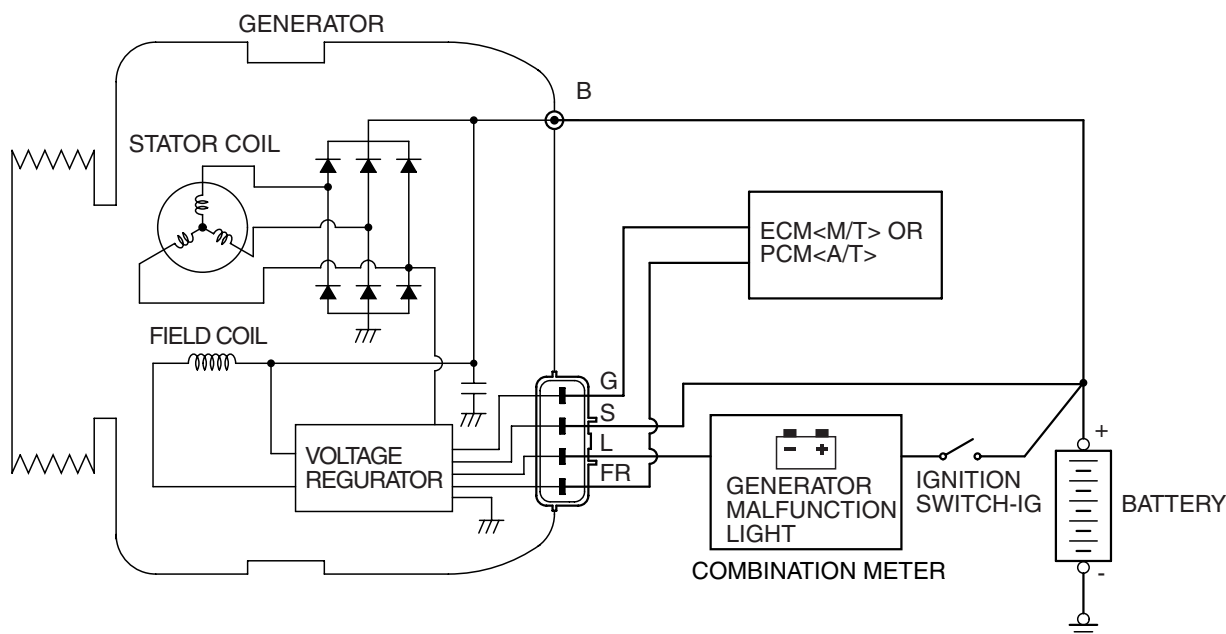
Rotation of the excited field coil generates AC voltage in the stator.  
This alternating current is rectified through diodes to DC voltage having a waveform shown in the illustration above.  
The average output voltage fluctuates slightly with the generator load condition.

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.



AK304842AD

**CHARGING SYSTEM DIAGNOSIS**

M1161000700450

**TROUBLESHOOTING HINTS**

Generator malfunction light dose not go on when the ignition switch is turned to ON, before the engine starts.

- Check the bulb.

Generator malfunction light dose 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.

The generator malfunction light illuminates dimly.

- Check the diode (inside the combination meter) for a short-circuit.

**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-5.)**

**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.00-52.)**

**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-10.)
  - Check for burnt-out generator malfunction light.
  - Check the generator. (Refer to Charging System – Generator Assembly –Inspection P.16-20.)
  - Check the generator malfunction light-related circuits.

---

**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.16-20.](#))

---

**STEP 5.**

**Q: Is an oscilloscope available?**

**YES :** Go to Step 6.

**NO :** Go to Step 7.

---

**STEP 6.**

**Q: Dose the oscilloscope show a normal wave pattern? (Refer to Charging System –On-vehicle Service –Wave Pattern Check Using an Oscilloscope [P.16-11.](#))**

**YES :** Go to Step 7.

**NO :** Check the generator. (Refer to Charging System – Generator Assembly –Inspection [P.16-20.](#))

---

**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.16-8.](#))**

**YES :** Go to Step 9.

**NO :** Check the generator (Refer to Charging System – Generator Assembly –Inspection [P.16-20.](#))

---

**STEP 9.**

**Q: Is the regulated voltage normal? (Refer to Charging System –On-vehicle Service –Regulated Voltage Test [P.16-10.](#))**

**YES :** Go to Step 10.

**NO :** Check the generator (Refer to Charging System – Generator Assembly –Inspection [P.16-20.](#))

## STEP 10.

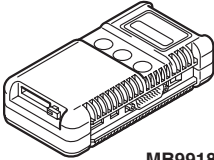
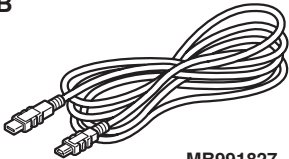
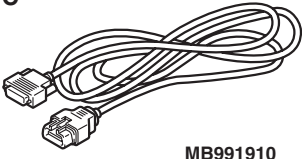
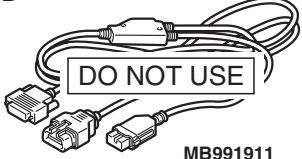
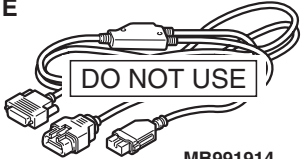
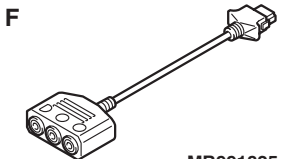
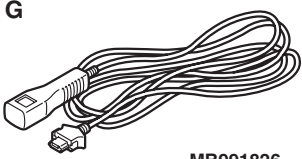
**Q: Is the voltage drop in the generator output line normal?**

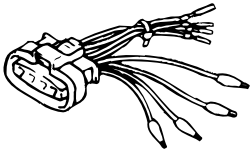
**YES :** Generator is normal. Check other systems.

**NO :** Check the output line.

## SPECIAL TOOL

M1161000600561

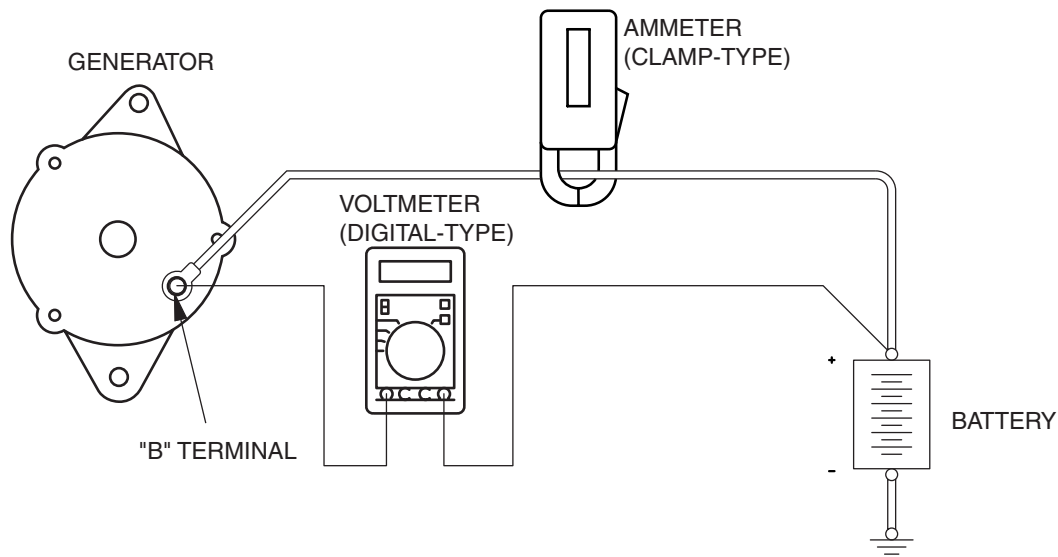
TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
<p>A</p>  <p>MB991824</p>	<p>MB991958 Scan tool (MUT-III sub assembly) A: MB991824 Vehicle communication interface (V.C.I.)</p>	<p>MB991824-KIT <i>NOTE: G: MB991826 MUT-III Trigger Harness is not necessary when pushing V.C.I. ENTER key.</i></p>	<p>Checking of engine speed</p>
<p>B</p>  <p>MB991827</p>	<p>B: MB991827 MUT-III USB cable</p>		<p><b>CAUTION</b> For vehicles with CAN communication, use MUT-III main harness A to send simulated vehicle speed. If you connect MUT-III main harness B instead, the CAN communication does not function correctly.</p>
<p>C</p>  <p>MB991910</p>	<p>C: MB991910 MUT-III main harness A (Vehicles with CAN communication system)</p>		
<p>D</p>  <p>MB991911</p>	<p>D: MB991911 MUT-III main harness B (Vehicles without CAN communication system)</p>		
<p>E</p>  <p>MB991914</p>	<p>E: MB991914 MUT-III main harness C (for Daimler Chrysler models only)</p>		
<p>F</p>  <p>MB991825</p>	<p>F: MB991825 MUT-III measurement adapter</p>		
<p>G</p>  <p>MB991826 MB991958</p>	<p>G: MB991826 MUT-III trigger harness</p>		

TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
	MB991519 Generator harness connector	MIT530 Micrd 530 charging system tester.	Checking of generator ("S" terminal voltage)

## ON-VEHICLE SERVICE

### GENERATOR OUTPUT LINE VOLTAGE DROP TEST

M1161000900788



AK203361AC

#### Required Special Tool:

MB991958: Scan Tool (MUT-III Sub Assembly)

- MB991824: V.C.I.
- MB991827: MUT-III USB Cable
- MB991910: MUT-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, Power Steering Pump and Air Conditioning) (Check) P.00-52.)
- 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 with a range of 0 –150 A to the generator "B" terminal output wire.

*NOTE: The way of disconnecting the generator output wire and of connecting the ammeter is possibly not found the problem that the output current is dropping due to the 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.

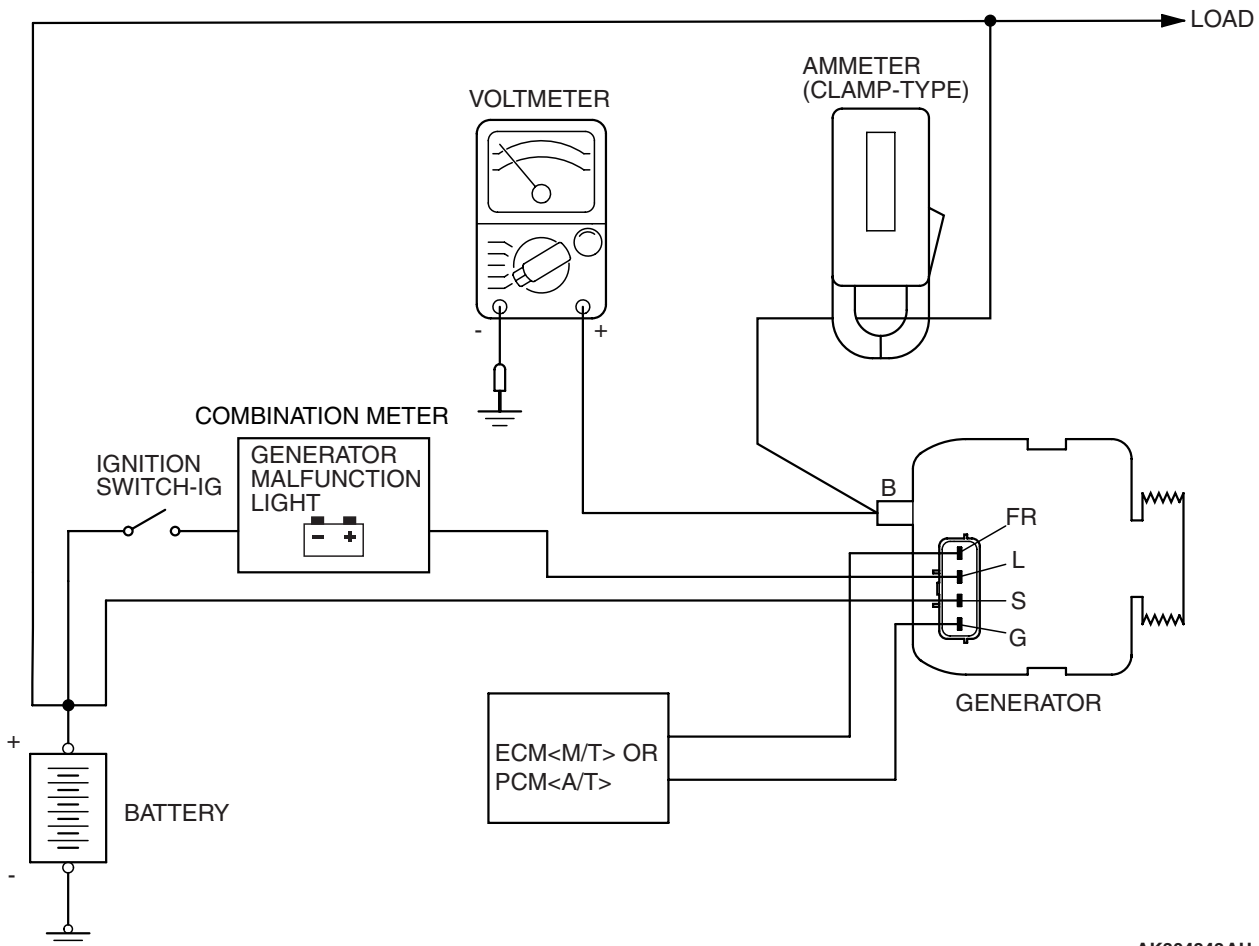
12. After the test, run the engine at idle.
13. Turn off all lights and turn the ignition switch to the "LOCK" (OFF) position.

*NOTE: Vehicles for Canada, the headlight, tail-light, 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**

M1161001000807



AK304843AH



**Required Special Tool:**

MB991958: Scan Tool (MUT-III Sub Assembly)

- MB991824: V.C.I.
- MB991827: MUT-III USB Cable
- MB991910: MUT-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-5.)

*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, Power Steering Pump and Air Conditioning) (Check) P.00-52.)
  - 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.

**⚠ WARNING**

**Never use clips to connect the line. Loose connections (for example, using clips) will lead to a serious accident because of high current.**

4. Connect a clamp-type DC test ammeter with a range of 0 –150 A to the generator "B" terminal 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.*

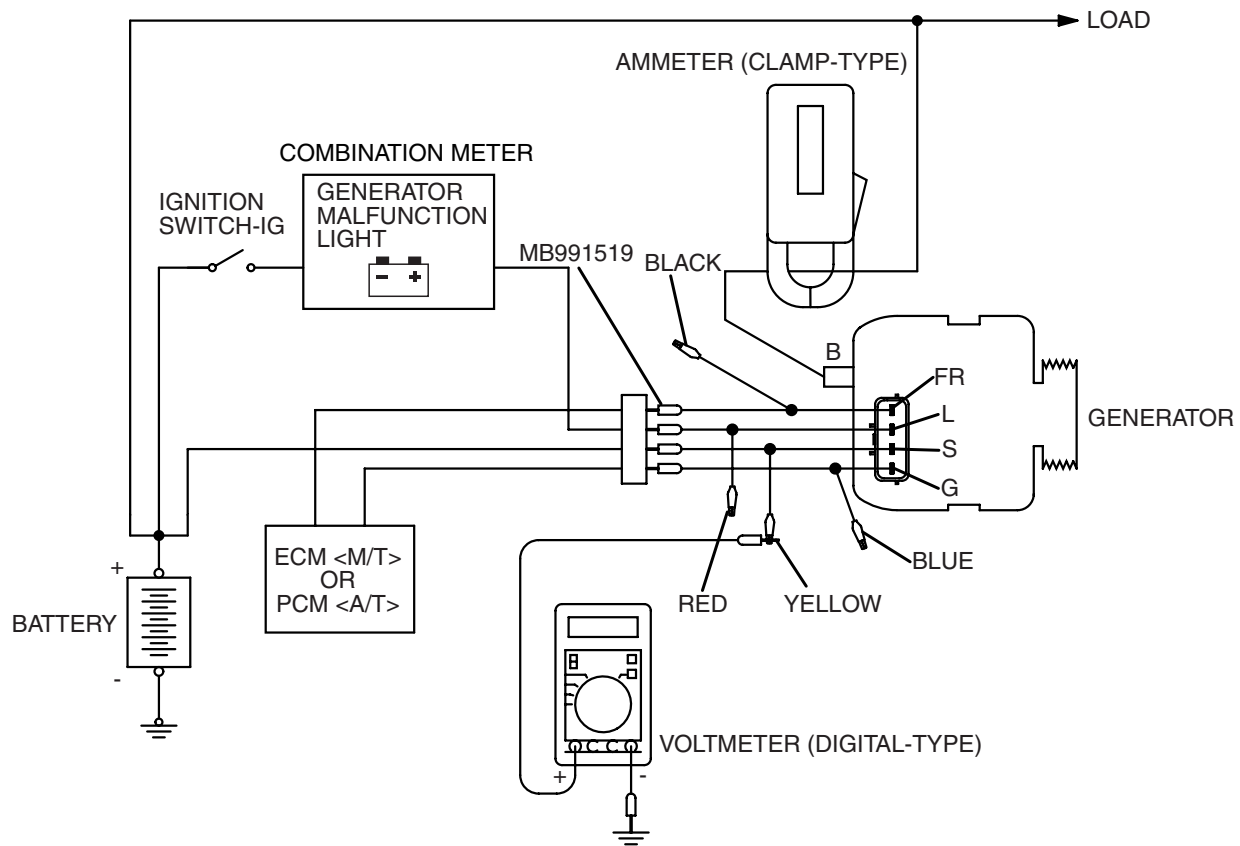
*NOTE: If the electrical load is small while testing, the specified level of current may not be output even though the generator is normal. In such cases, increase the electrical load by leaving the headlights turned on for some time to discharge the battery or by using the lighting system in another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

M1161001100804



AK304844AG

**Required Special Tools:**

- MB991958: Scan Tool (MUT-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: MUT-III USB Cable
  - MB991910: MUT-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-5.)
  - Generator drive belt tension (Refer to GROUP 00, General –Maintenance Service –Drive Belts (For Generator, Power Steering Pump and Air Conditioning) (Check) P.00-52.)

- 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 with a range of 0 –150 A 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.*

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

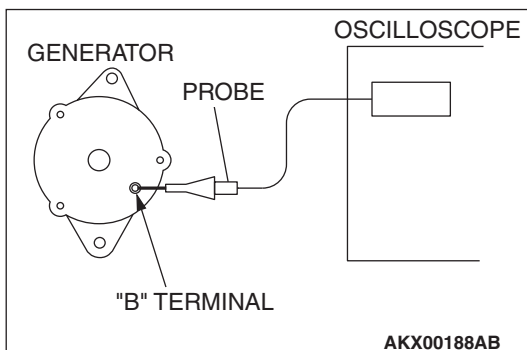
INSPECTION TERMINAL	VOLTAGE REGULATOR AMBIENT TEMPERATURE [° C (° F)]	STANDARD VALUE (V)
Terminal "S"	-20 (-4)	14.2 -15.4
	20 (68)	13.9 -14.9
	60 (140)	13.4 -14.6
	80 (176)	13.1 -14.5

**WAVE PATTERN CHECK USING AN OSCILLOSCOPE**

M1161001200298

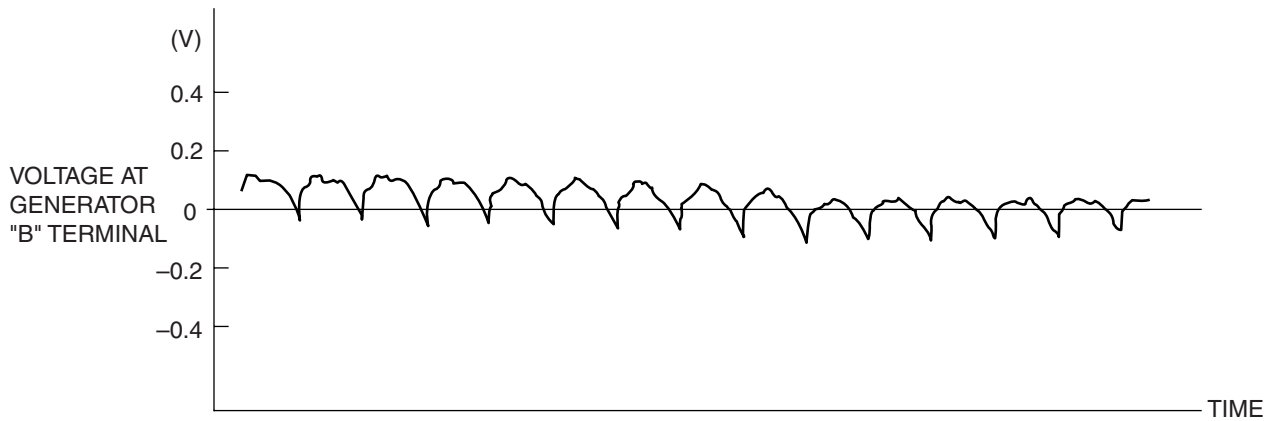
**MEASUREMENT METHOD**

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

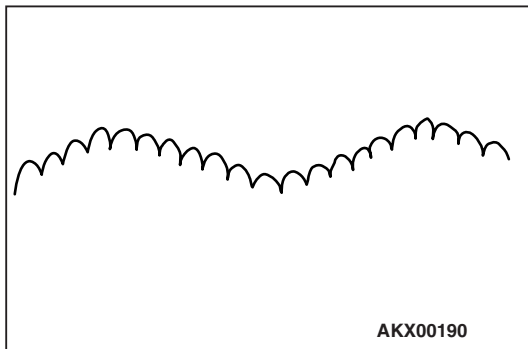


**STANDARD WAVEFORM**

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



AKX00189AB



AKX00190

*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**

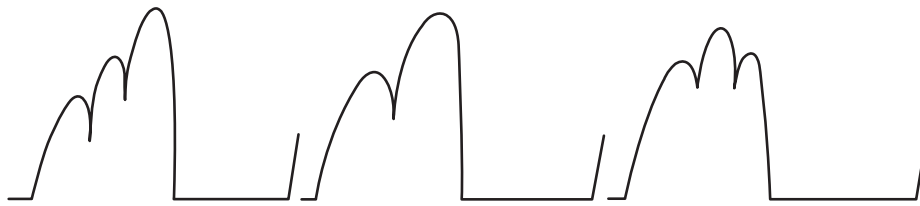
*NOTE: The size of the waveform patterns can differ greatly, depending on the adjustment of the variable knob on the oscilloscope.*

*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



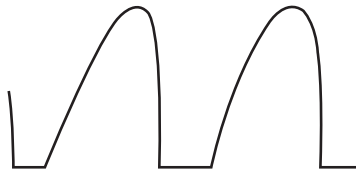
AKX00191

- Example 2  
PROBABLE CAUSE: Short-circuit in diode



AKX00192

- Example 3  
PROBABLE CAUSE: Open circuit in stator coil



AKX00193

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



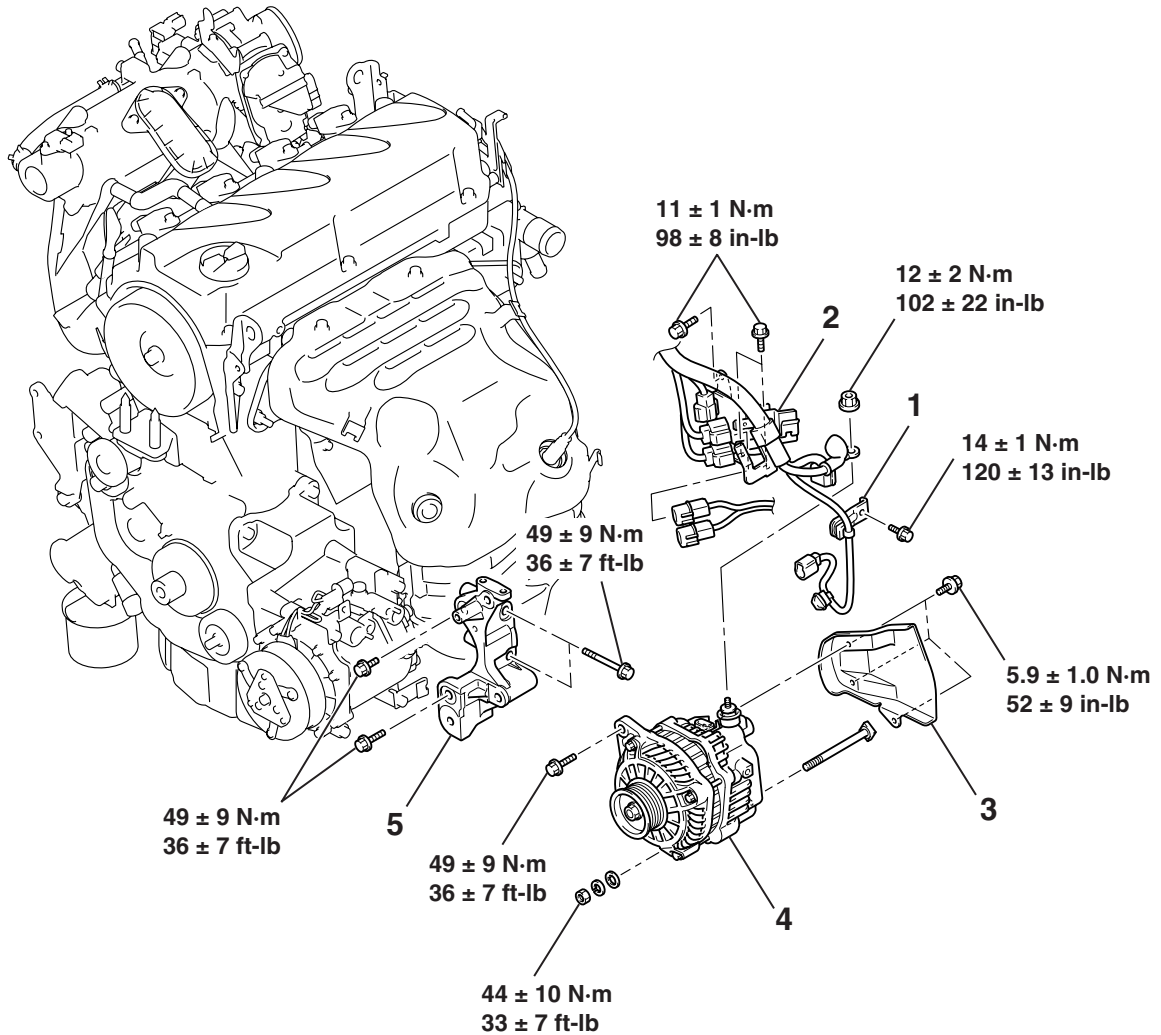
AKX00194

GENERATOR ASSEMBLY

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1161001401165

<p><b>Pre-removal Operation</b></p> <ul style="list-style-type: none"> <li>• Side Under Cover Removal (Refer to GROUP 51, Under Cover P.51-8).</li> <li>• Drive Belt Removal (Refer to GROUP 11A, Crankshaft Pulley P.11A-25).</li> </ul>	<p><b>Post-installation Operation</b></p> <ul style="list-style-type: none"> <li>• Drive Belt Installation (Refer to GROUP 11A, Crankshaft Pulley P.11A-25).</li> <li>• Drive Belt Tension Check (Refer to GROUP 11A, On-vehicle Service –Drive Belt Tension Check P.11A-8).</li> <li>• Side Under Cover Installation (Refer to GROUP 51, Under Cover P.51-8).</li> </ul>
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AC406314AB

**REMOVAL STEPS**

1. HARNESS BRACKET
2. CONNECTOR BRACKET
3. GENERATOR COVER
4. GENERATOR ASSEMBLY

**REMOVAL STEPS (Continued)**

- TIMING BELT LOWER COVER (REFER TO GROUP 11A, TIMING BELT P.11A-50).
- 5. GENERATOR MOUNTING BRACKET

<<A>>

REMOVAL SERVICE POINT

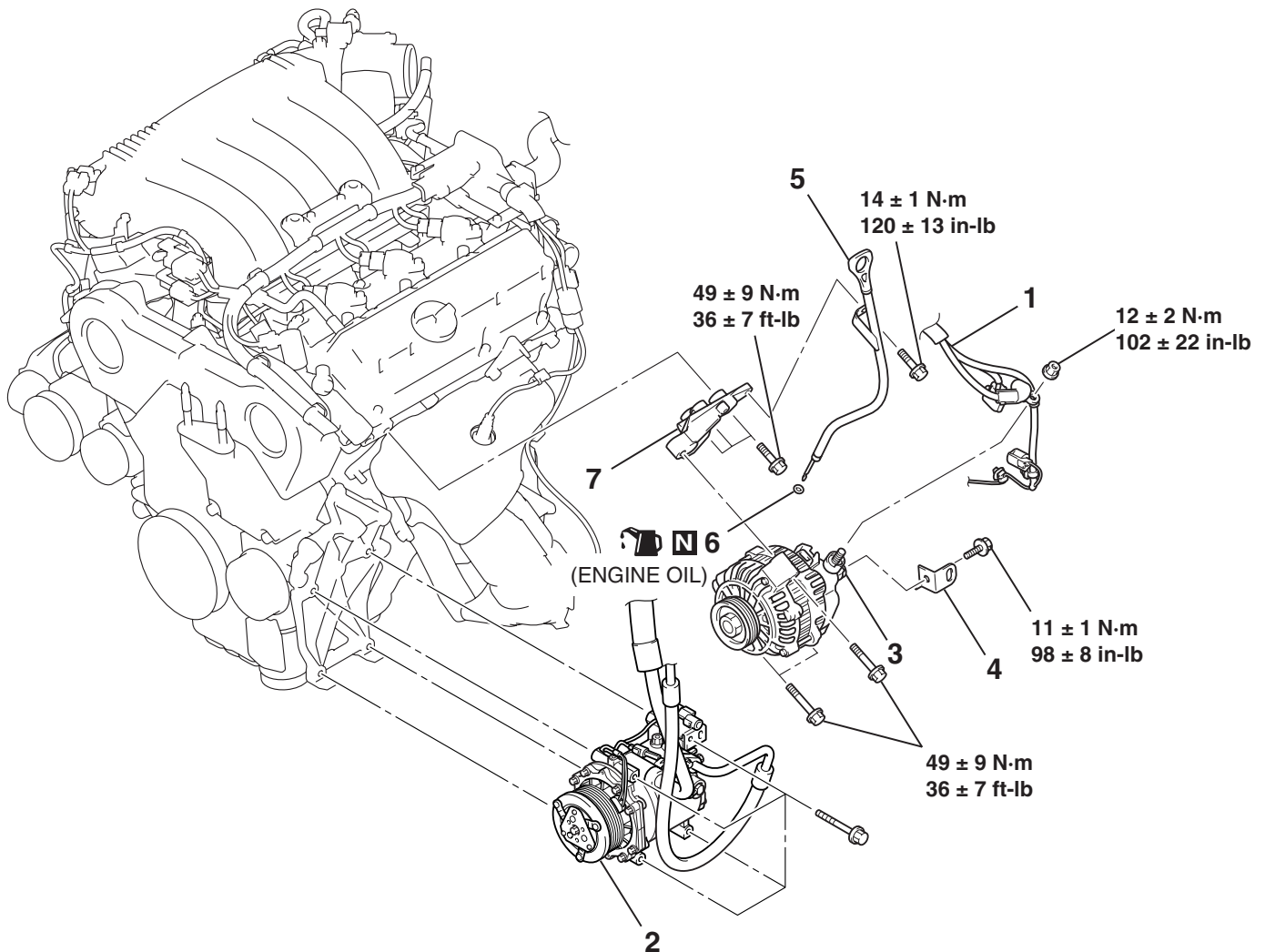
<<A>> GENERATOR ASSEMBLY REMOVAL

Remove the generator assembly from above the vehicle.

REMOVAL AND INSTALLATION <3.8L ENGINE>

M1161001401176

Pre-removal Operation	Post-installation Operation
<ul style="list-style-type: none"> <li>Side Under Cover Removal (Refer to GROUP 51, Under Cover P.51-8).</li> <li>Generator Drive Belt Removal (Refer to GROUP 11C, Timing Belt P.11C-59).</li> </ul>	<ul style="list-style-type: none"> <li>Generator Drive Belt Installation (Refer to GROUP 11C, Timing Belt P.11C-59).</li> <li>Drive Belt Tension Check and Adjustment (Refer to GROUP 11C, On-vehicle Service –Drive Belt Tension Check and Adjustment P.11C-7).</li> <li>Side Under Cover Installation (Refer to GROUP 51, Under Cover P.51-8).</li> </ul>



AC406128AB

REMOVAL STEPS

- <<A>>
- CONTROL WIRING HARNESS CONNECTION
  - A/C COMPRESSOR AND CLUTCH ASSEMBLY
- <<B>> >>A<<
- GENERATOR ASSEMBLY

REMOVAL STEPS (Continued)

- HARNESS BRACKET
- ENGINE OIL DIPSTICK AND DIPSTICK GUIDE
- O-RING
- GENERATOR BRACKET

**REMOVAL SERVICE POINTS****<<A>> A/C COMPRESSOR AND CLUTCH ASSEMBLY REMOVAL**

1. With the hose installed, remove the A/C compressor and clutch assembly from the bracket.
2. After removing the A/C compressor and clutch assembly, secure it with a cord in a location where it does not interfere with generator assembly removal.

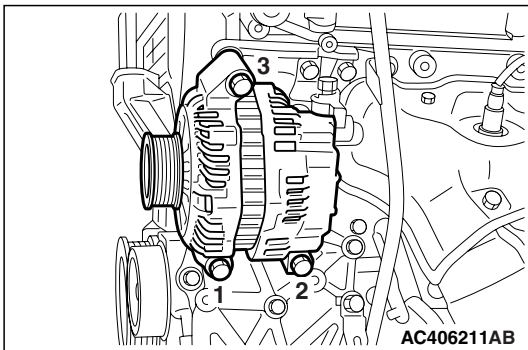
**<<B>> GENERATOR ASSEMBLY REMOVAL**

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

**INSTALLATION SERVICE POINT****>>A<< GENERATOR ASSEMBLY INSTALLATION**

1. Install the generator assembly to the generator bracket.
2. Tighten the generator assembly mounting bolts by hand.
3. Tighten the generator assembly mounting bolts to the specified torque in the order shown.

**Tightening torque:  $49 \pm 9$  N·m ( $36 \pm 7$  ft-lb)**

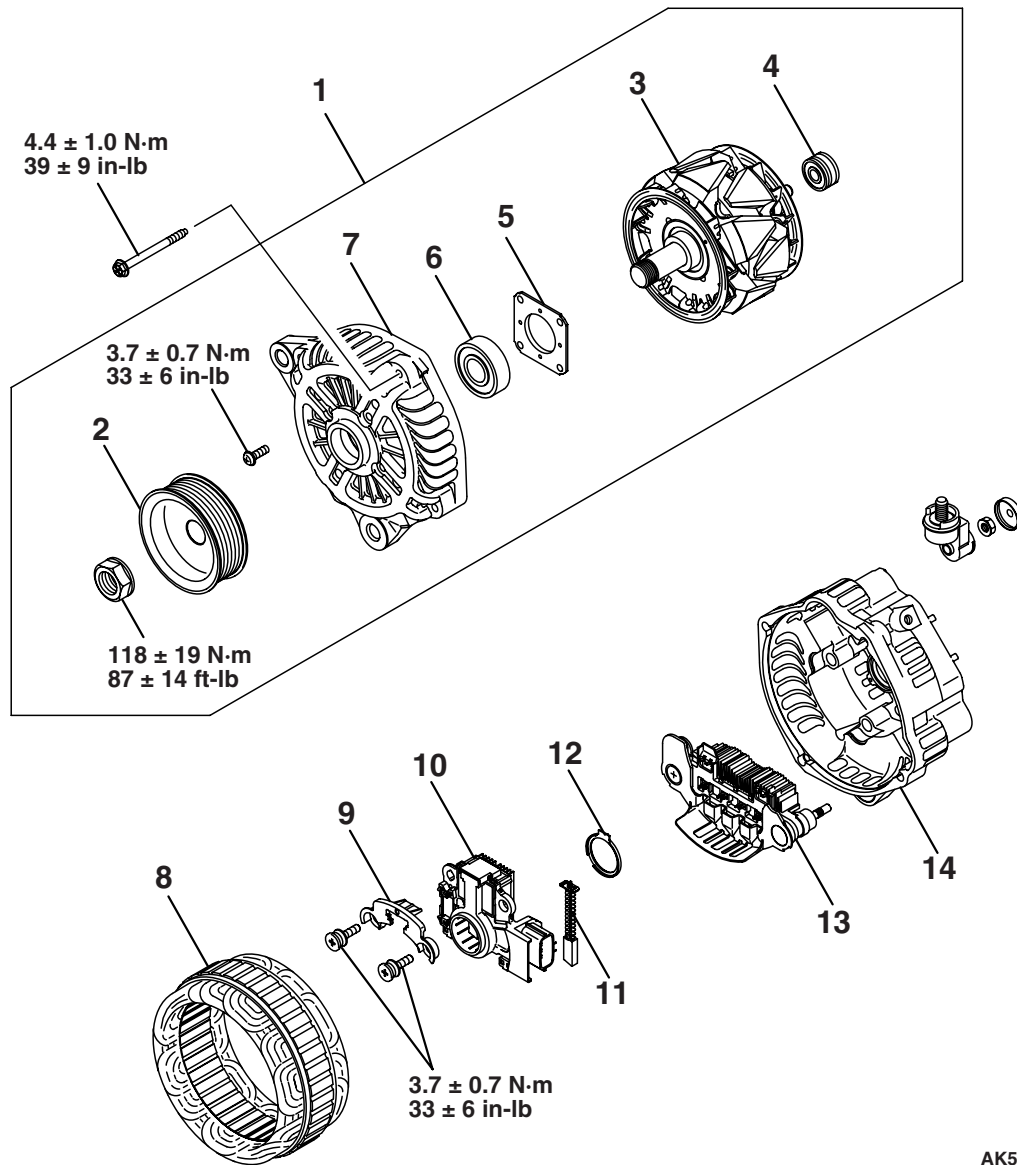




DISASSEMBLY AND ASSEMBLY

M1161001600315

<2.4L ENGINE>

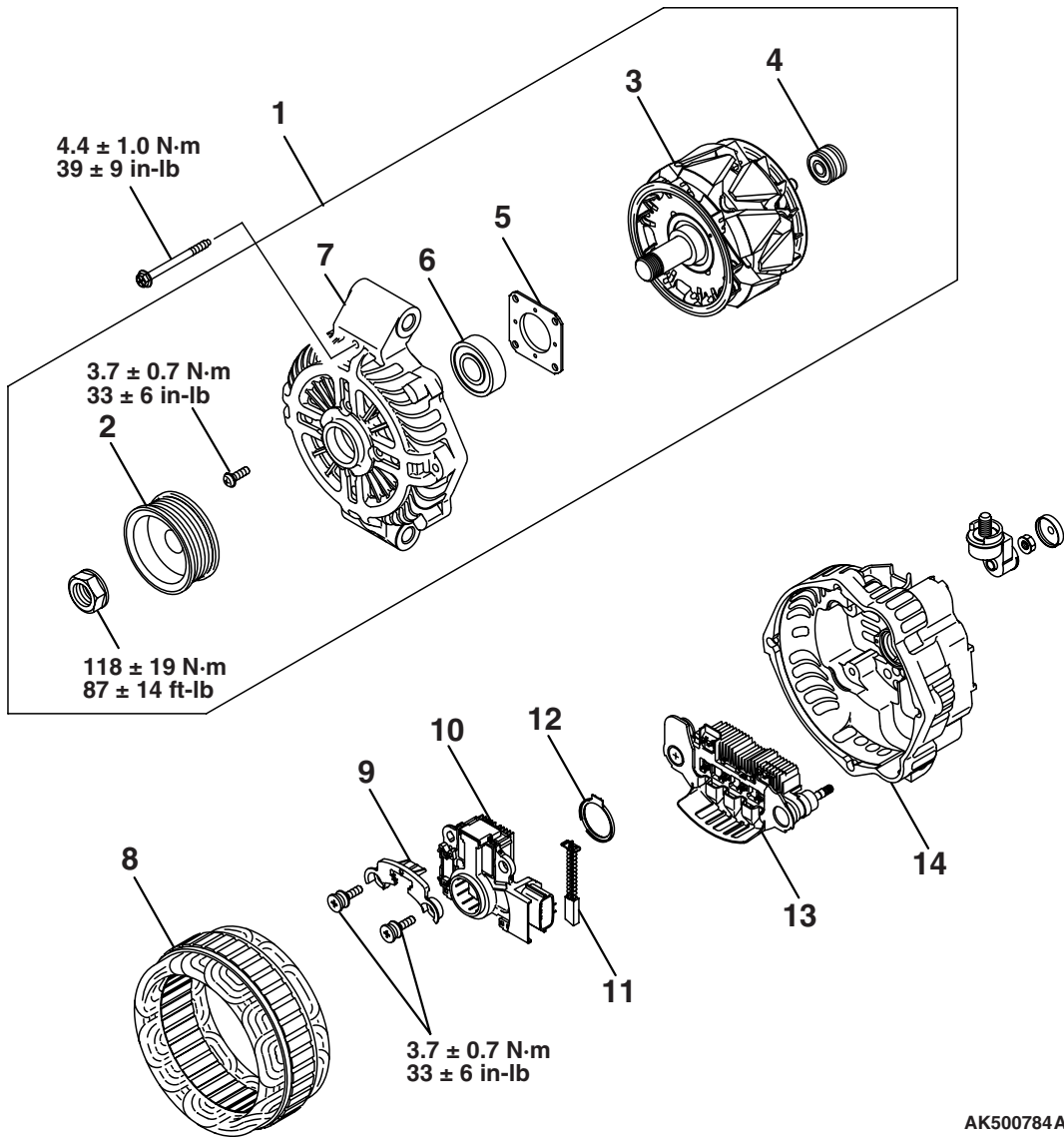


AK500783AB

- DISASSEMBLY STEPS**
- <<A>> 1. FRONT BRACKET ASSEMBLY
  - <<B>> 2. GENERATOR PULLEY
  - >>B<< 3. ROTOR ASSEMBLY
  - 4. REAR BEARING
  - 5. BEARING RETAINER
  - 6. FRONT BEARING
  - 7. FRONT BRACKET

- DISASSEMBLY STEPS (Continued)**
- <<C>> 8. STATOR
  - 9. PLATE
  - >>A<< 10. REGULATOR ASSEMBLY
  - 11. BRUSH
  - 12. SLINGER
  - 13. RECTIFIER
  - 14. REAR BRACKET

<3.8L ENGINE>



AK500784AB

**DISASSEMBLY STEPS**

- <<A>> 1. FRONT BRACKET ASSEMBLY
- <<B>> 2. GENERATOR PULLEY
- >>B<< 3. ROTOR ASSEMBLY
- 4. REAR BEARING
- 5. BEARING RETAINER
- 6. FRONT BEARING
- 7. FRONT BRACKET

**DISASSEMBLY STEPS (Continued)**

- <<C>> 8. STATOR
- 9. PLATE
- >>A<< 10. REGULATOR ASSEMBLY
- 11. BRUSH
- 12. SLINGER
- 13. RECTIFIER
- 14. REAR BRACKET

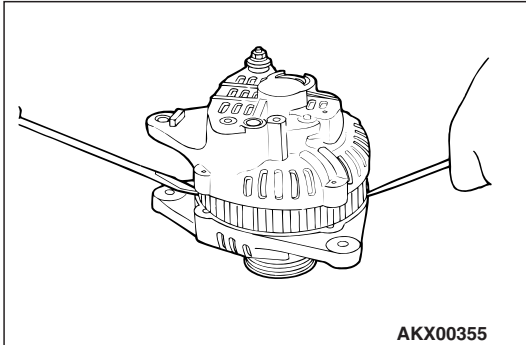
## DISASSEMBLY SERVICE POINTS

### <<A>> FRONT BRACKET ASSEMBLY REMOVAL

**⚠ CAUTION**

Do not insert a screwdriver too deep. The stator coil will be damaged.

Insert a flat-tipped screwdriver between the front bracket assembly and the stator core, and pry it downward to separate the stator and front bracket assembly.

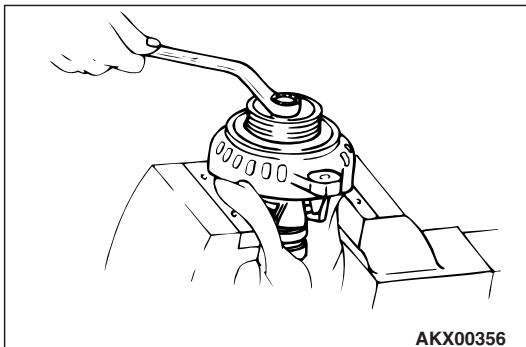


### <<B>> GENERATOR PULLEY REMOVAL

**⚠ CAUTION**

Make sure not to damage the rotor.

Set the pulley upward, clamp the rotor in a vise, and remove the pulley.

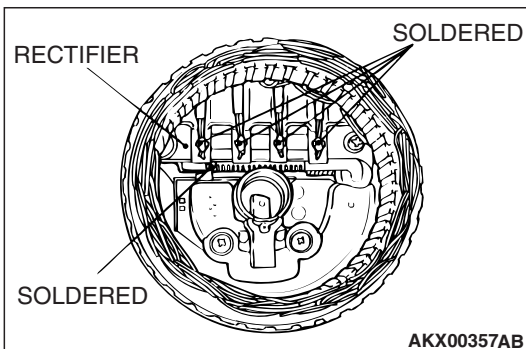


### <<C>> STATOR REMOVAL

**⚠ CAUTION**

- Check that the heat from the soldering iron is not transmitted to the diode for a long time.
- Use care that no undue force is exerted to leads of diodes.

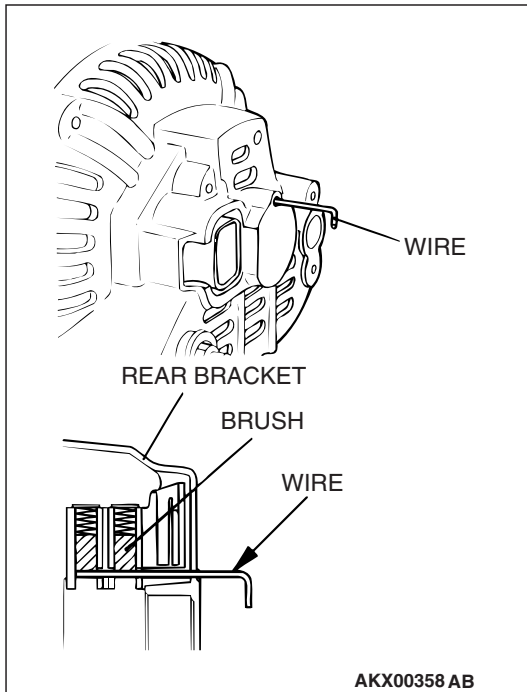
1. Use a soldering iron (180 to 250 W) to unsolder the stator. This work should complete within approximately four seconds to prevent heat from transferring to the diode.
2. When removing the rectifier from the regulator assembly, unsolder the points soldered on the rectifier.



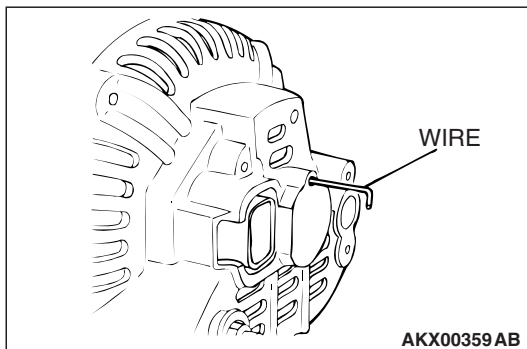
**ASSEMBLY SERVICE POINTS****>>A<< REGULATOR ASSEMBLY INSTALLATION**

After installing the regulator assembly, insert a wire through the hole provided on the rear bracket while pressing down on the brush, and secure the brush.

*NOTE: By inserting a wire, the brush will be secured in place, and the installation of the rotor will be easier.*

**>>B<< ROTOR ASSEMBLY INSTALLATION**

After installing the rotor, remove the wire used to secure the brush.

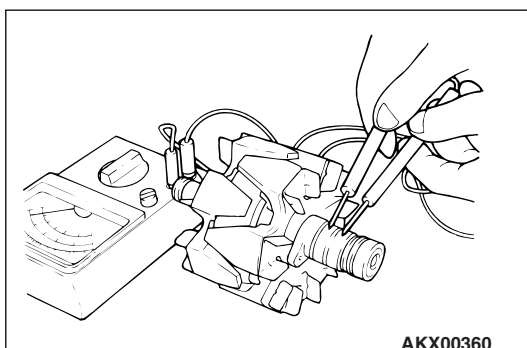
**INSPECTION**

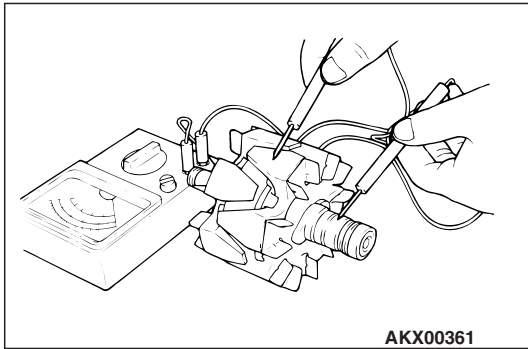
M1161001700282

**ROTOR CHECK**

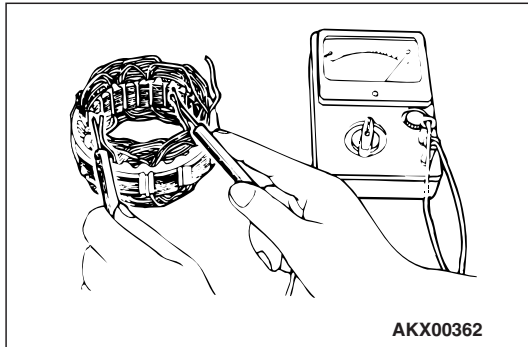
1. Check the continuity between the slip rings of the field coil. If the resistance value is not within the standard value, replace the rotor.

**Standard value: approximately 2 – 5  $\Omega$**



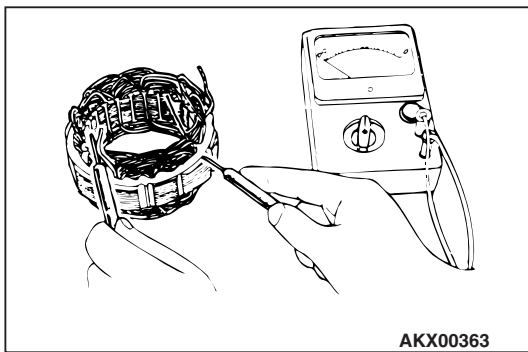


2. Check the continuity between the slip ring and the core. If there is continuity, replace the rotor.

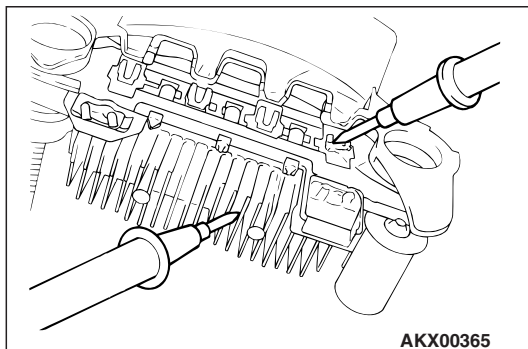


### STATOR CHECK

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

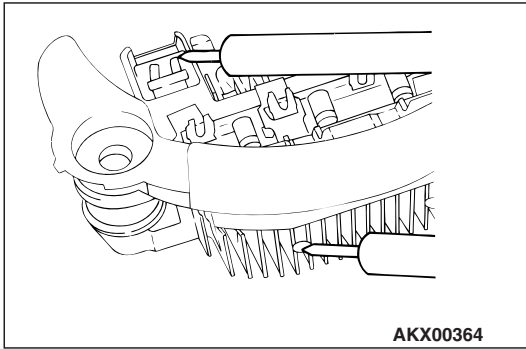


2. Check the continuity between the coil and the core. If there is continuity, replace the stator.



### RECTIFIER CHECK

1. Check the continuity between the positive rectifier and the stator coil lead connection terminal with a tester. If there is continuity between the terminals, the diode is shorted, so replace the rectifier.

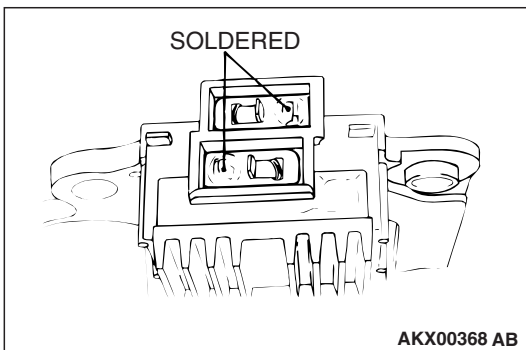
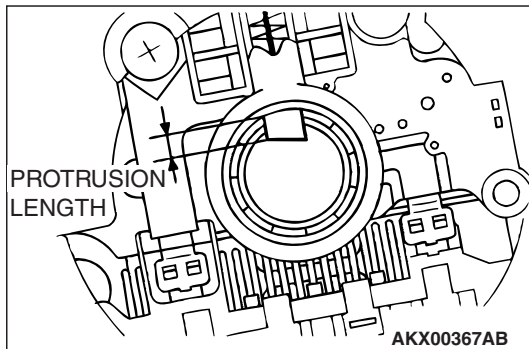


2. Check the continuity between the negative rectifier and the stator coil lead connection terminal with a tester. If there is continuity between the terminals, the diode is grounded, so replace the rectifier.

### BRUSH CHECK

1. Replace the brush if the brush protrusion length shown in the illustration is below the minimum limit value.

**Minimum limit: 2 mm (0.08 inch)**



2. The brush can be removed by unsoldering the brush lead wire.
3. When installing a new brush, push the brush in to the brush holder, and solder the lead wire.

## STARTING SYSTEM

### GENERAL DESCRIPTION

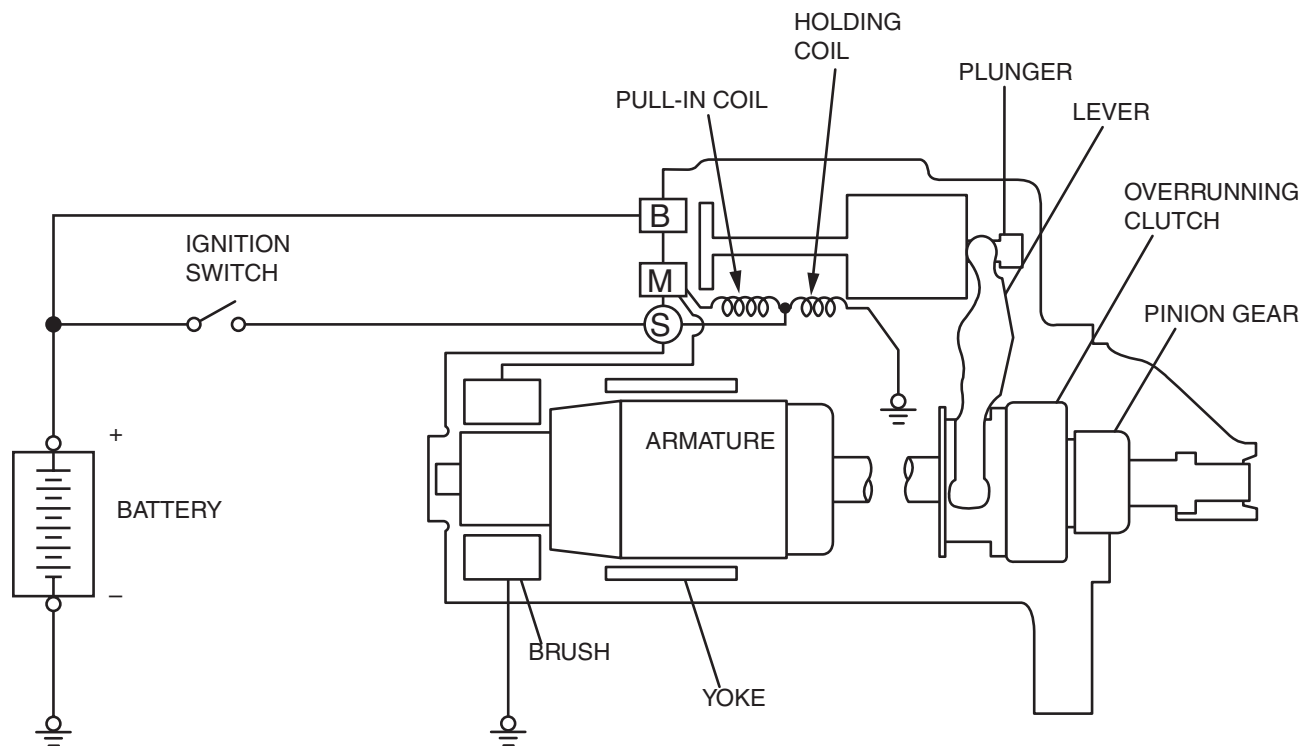
If the ignition switch is turned to the "START" position, current flows in the coil provided inside magnetic switch, attracting the plunger. When the plunger is attracted, the lever connected to the plunger is actuated to engage the starter clutch.

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.

M1162000100451

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.



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### OPERATION

- For models equipped with M/T, the interlock switch contact is switched OFF when the clutch pedal is depressed. When the ignition switch is then switched to the "ST" position, electricity flows to the starter relay and the starter motor, the contact (magnetic switch) of the starter is switched ON and the starter motor is activated.

*NOTE: If the ignition switch is switched to the "ST" position without the clutch pedal being depressed, electricity flows to the starter relay (coil), the interlock switch (contacts) and to ground, with the result that the contacts of the starter relay are switched OFF, and because the power to the starter motor is thereby interrupted, the starter motor is not activated.*

- For models equipped with A/T, when the ignition switch is switched 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.

## STARTING SYSTEM DIAGNOSIS

M1162000700464

### 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-5.](#))**

**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: Does the starter motor operate normally?**

- YES :**
- Check the ignition switch (Refer to GROUP 54A, Chassis Electrical –Ignition Switch –Ignition Switch –Inspection [P.54A-10.](#))
  - Check the starter relay and interlock switch.  
<M/T>
  - Check the transmission range switch. (Refer to GROUP 23A, Automatic Transaxle –On-vehicle Service –Essential Service –Transmission Range Switch Check [P.23A-387.](#)) <A/T>
  - 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.16-20.](#))**

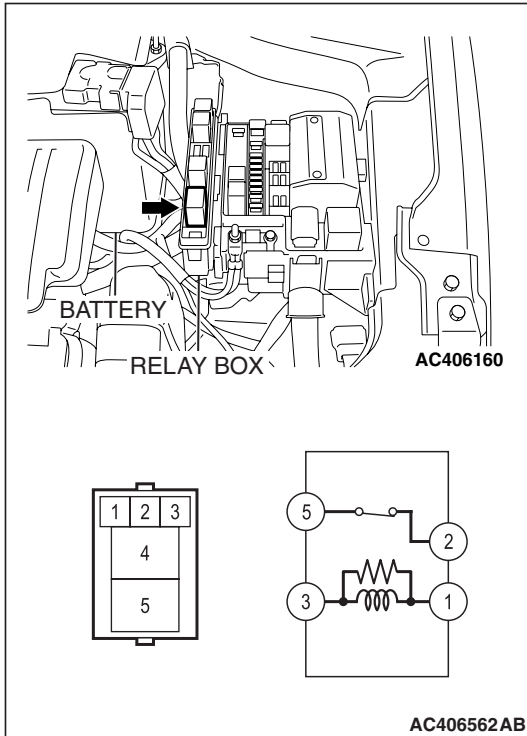
**YES :** Excessive rotational resistance of the engine.

**NO :** Replace the starter motor.

ON-VEHICLE SERVICE

STARTER RELAY CHECK <M/T>

M1162001400295



BATTERY VOLTAGE	TERMINAL NUMBER TO BE CONNECTED TO TESTER	CONTINUITY TEST RESULTS
Not applied	2 – 5	Less than 2 ohms
<ul style="list-style-type: none"> <li>• Connect terminal 3 to the positive battery terminal</li> <li>• Connect terminal 1 to the negative battery terminal</li> </ul>	2 – 5	Open circuit

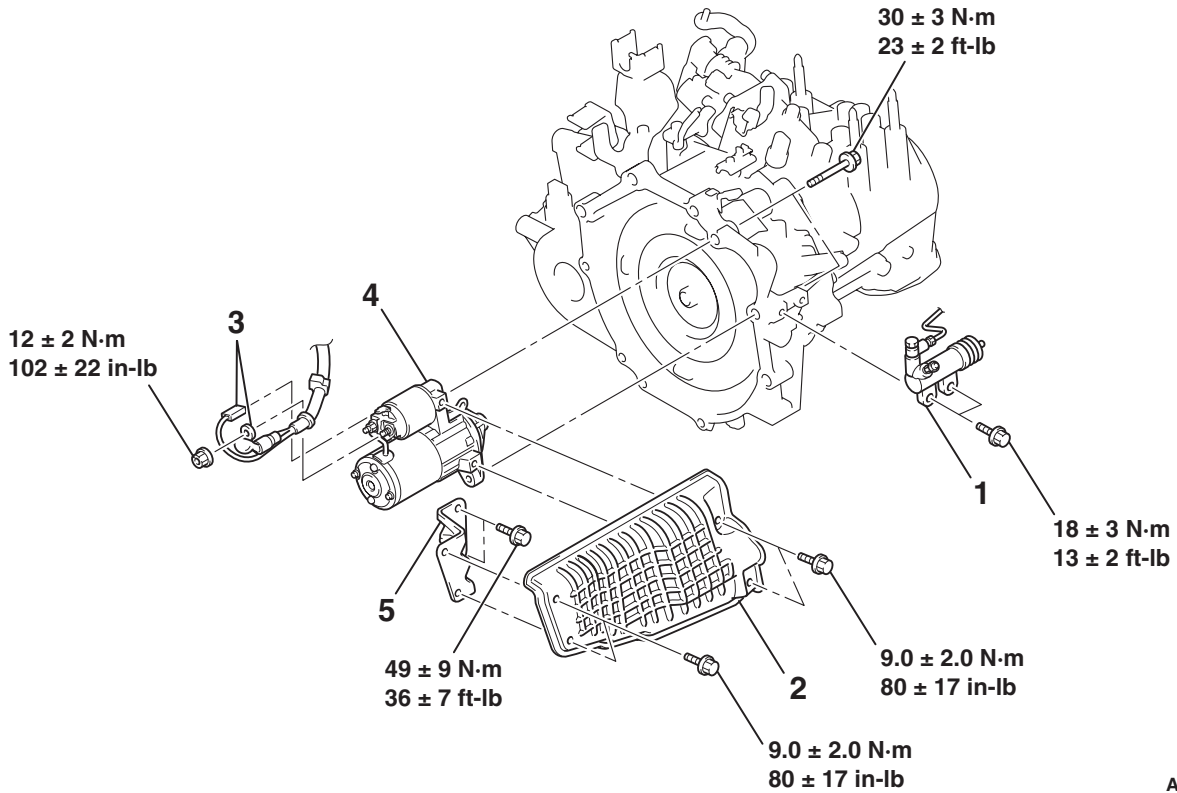
STARTER MOTOR ASSEMBLY

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1162001001126

<M/T>

**Pre-removal and Post-installation Operation**  
Air Cleaner Intake Duct Removal and Installation (Refer to GROUP 15, Air Cleaner P.15-4).



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<<A>>

**REMOVAL STEPS**

1. CLUTCH RELEASE CYLINDER
2. STARTER COVER
3. STARTER CONNECTOR AND TERMINAL

<<C>>

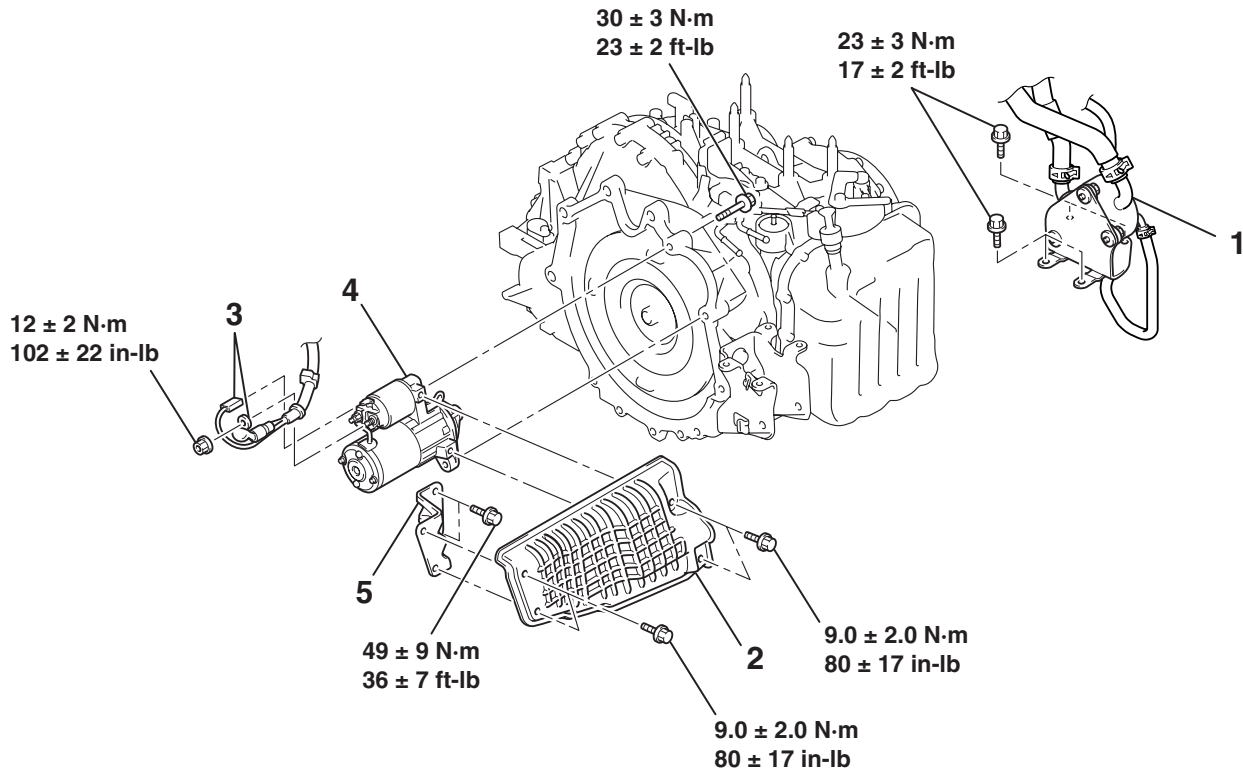
**REMOVAL STEPS (Continued)**

4. STARTER ASSEMBLY
5. STARTER COVER BRACKET

<A/T>

**Pre-removal and Post-installation Operation**

Air Cleaner Removal and Installation (Refer to GROUP 15, Air Cleaner P.15-4).



AC306713AB

<<B>>

**REMOVAL STEPS**

1. ATF WARMER (TRANSMISSION FLUID COOLER) AND BRACKET ASSEMBLY
2. STARTER COVER

<<D>>

**REMOVAL STEPS (Continued)**

3. STARTER CONNECTOR AND TERMINAL
4. STARTER ASSEMBLY
5. STARTER COVER BRACKET

**REMOVAL SERVICE POINTS**

**<<A>> CLUTCH RELEASE CYLINDER REMOVAL**

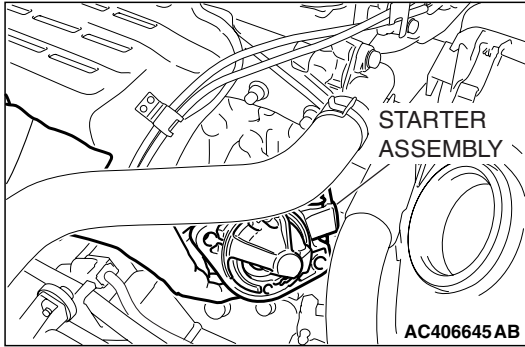
With the pipe installed, remove the clutch release cylinder from the transaxle assembly.

**<<B>> ATF WARMER (TRANSMISSION FLUID COOLER) AND BRACKET ASSEMBLY REMOVAL**

With the hose installed, remove the ATF warmer (transmission fluid cooler) and bracket assembly from the transmission case front roll stopper bracket.

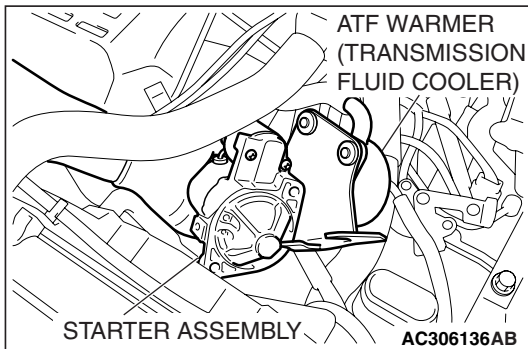
**<<C>> STARTER ASSEMBLY <M/T> REMOVAL**

Remove the starter assembly from above vehicle.



**<<D>> STARTER ASSEMBLY <A/T> REMOVAL**

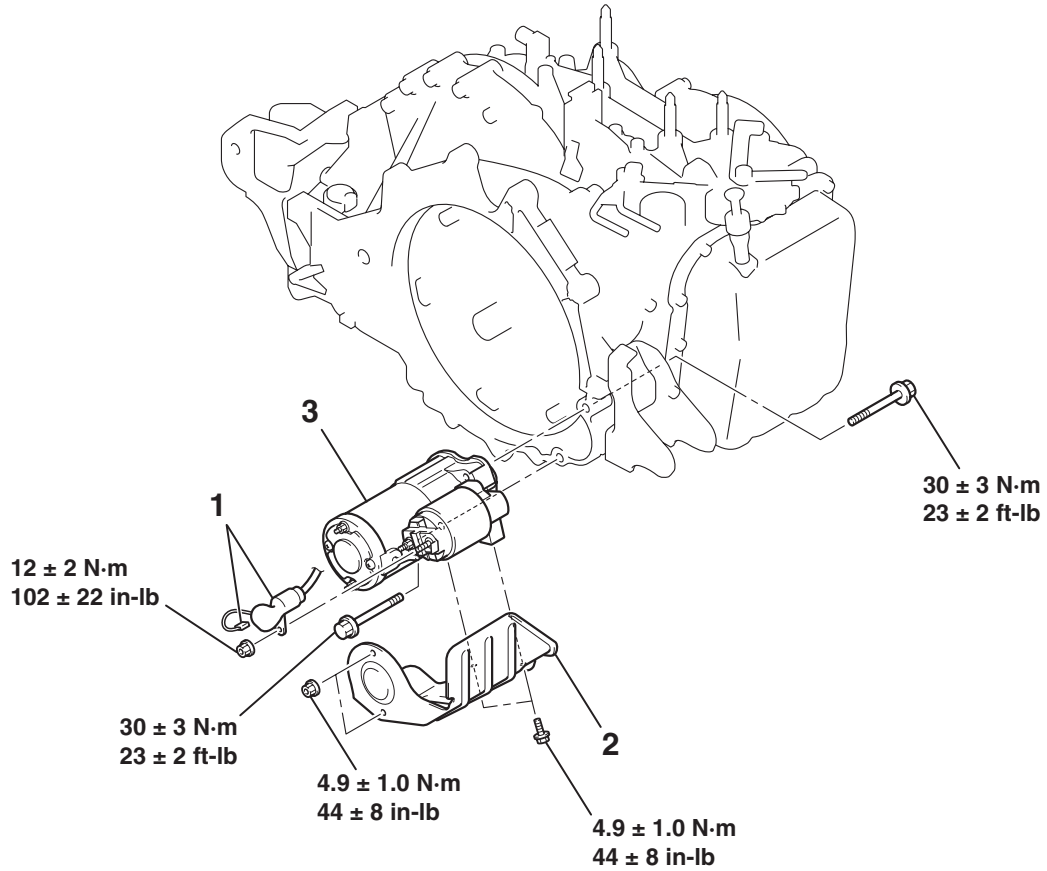
Remove the starter assembly from the side of ATF warmer (transmission fluid cooler).



REMOVAL AND INSTALLATION <3.8L ENGINE>

M1162001001137

**Pre-removal and Post-installation Operation**  
Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-8).



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**REMOVAL STEPS**

1. STARTER CONNECTOR AND TERMINAL

<<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.

INSPECTION

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**

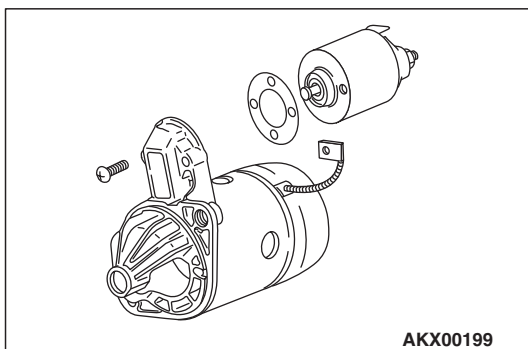
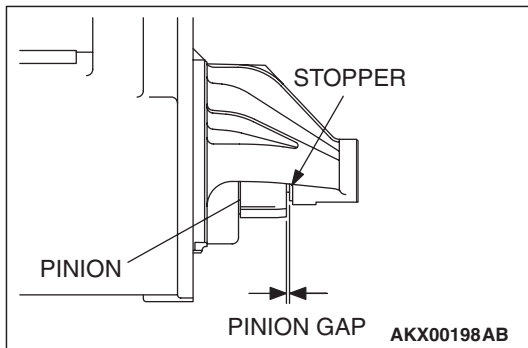
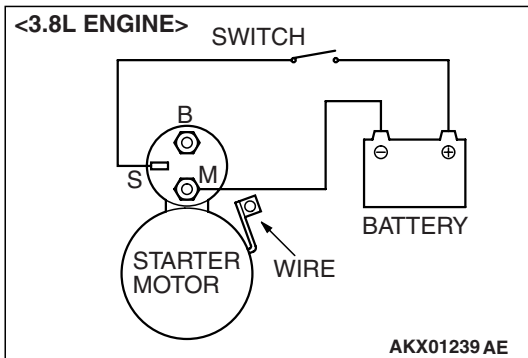
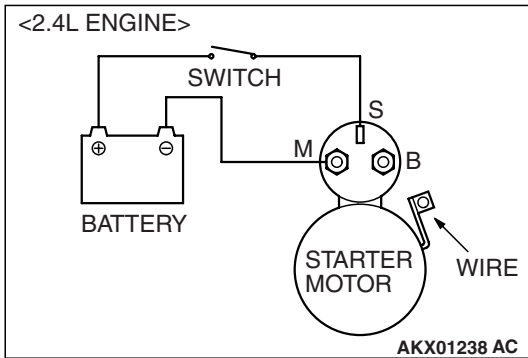
This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

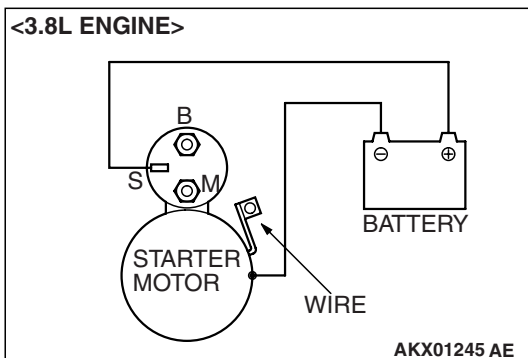
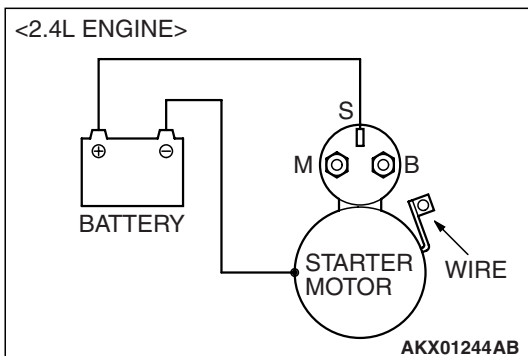
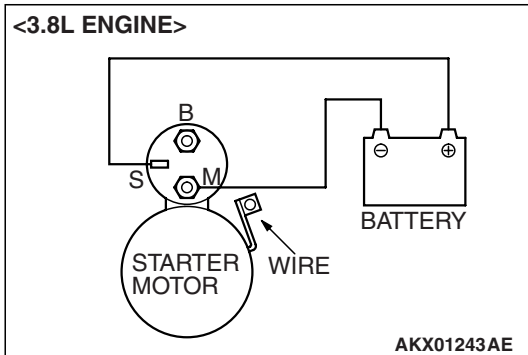
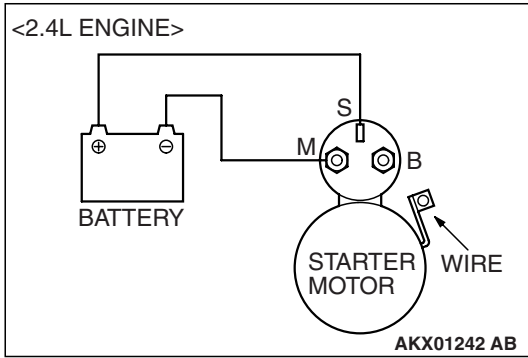
3. Set the switch to "ON", and the pinion will move out.

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

1. Disconnect the lead 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

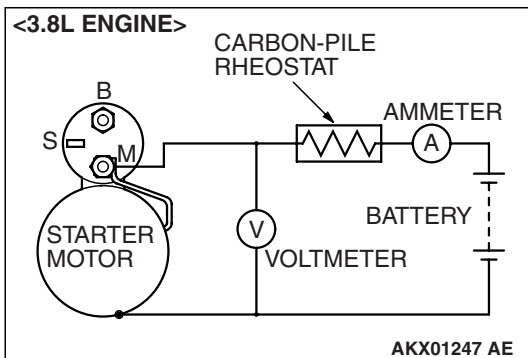
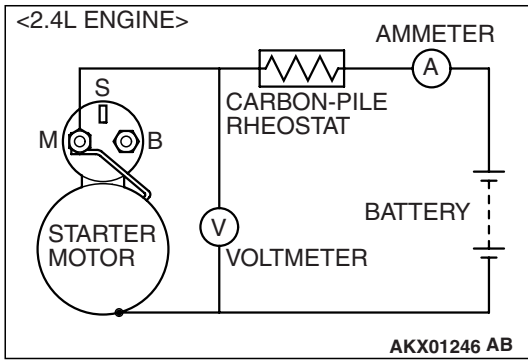
1. Disconnect the lead wire from the M-terminal of the magnetic switch.

### ⚠ 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 the rheostat 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 on 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 lead wire from the M-terminal of the magnetic switch.

**CAUTION**

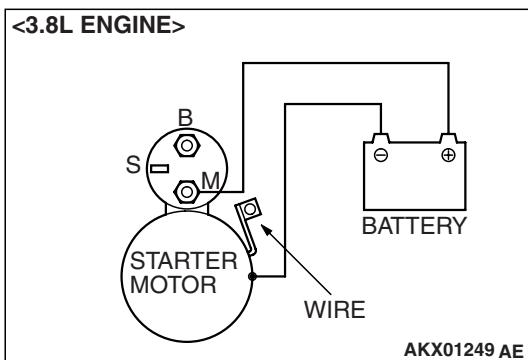
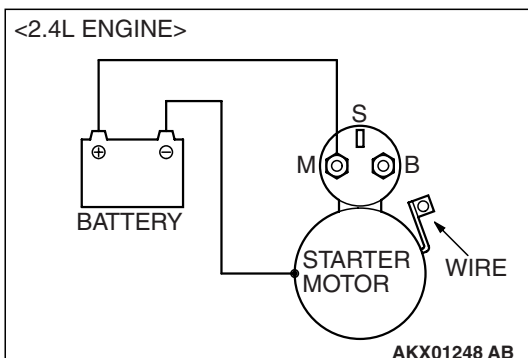
**This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.**

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

**WARNING**

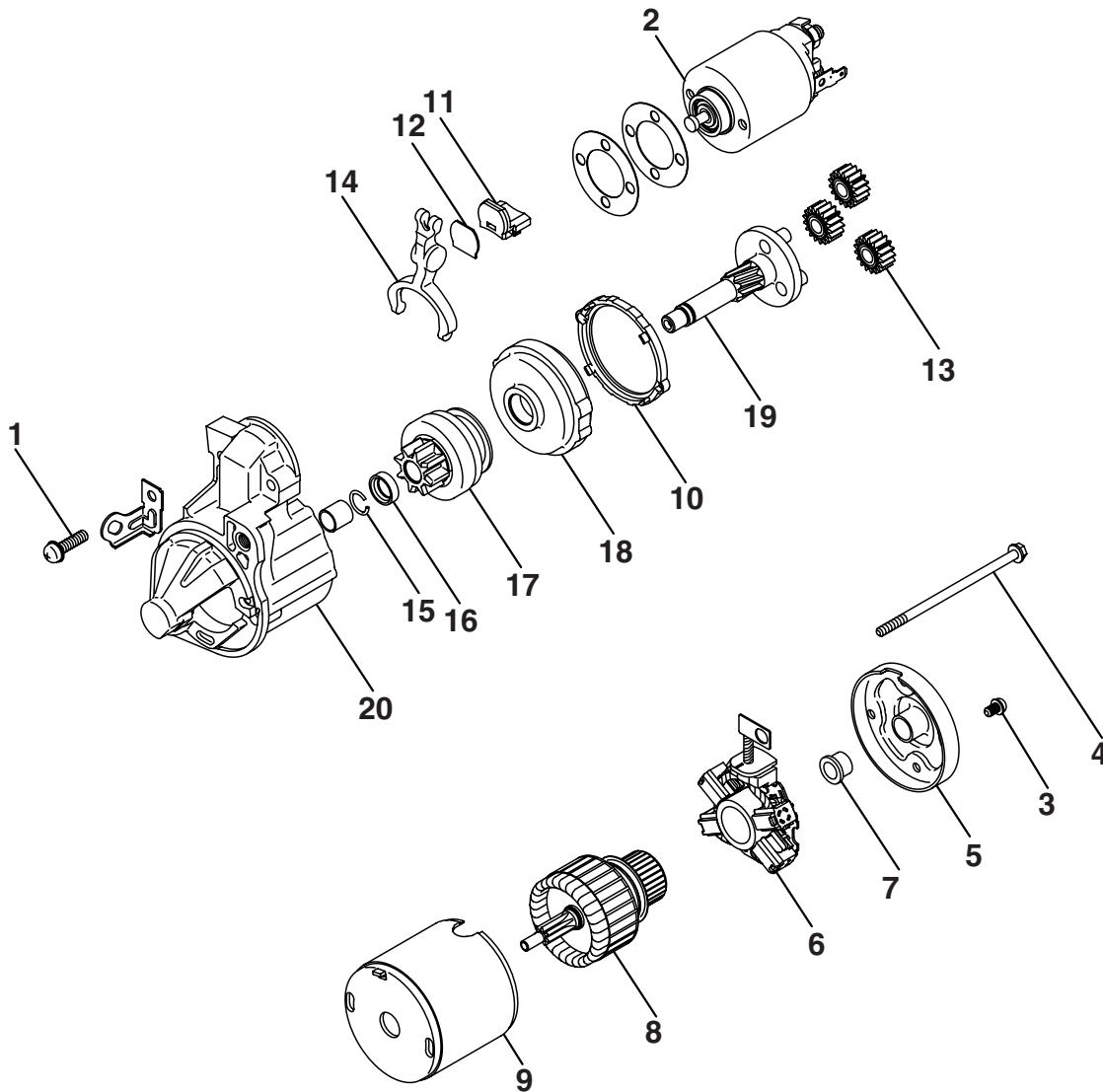
**Be careful not to get your fingers caught when pulling out the pinion.**

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 ASSEMBLY

M1162001200376



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**DISASSEMBLY STEPS**

1. SCREW
2. MAGNETIC SWITCH
3. SCREW
4. SCREW
5. REAR BRACKET
6. BRUSH
7. REAR BEARING
8. ARMATURE
9. YOKE ASSEMBLY
10. PACKING A

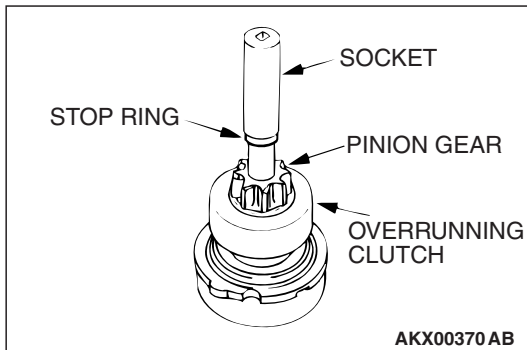
<<A>> >>A<<  
<<A>> >>A<<

**DISASSEMBLY STEPS**

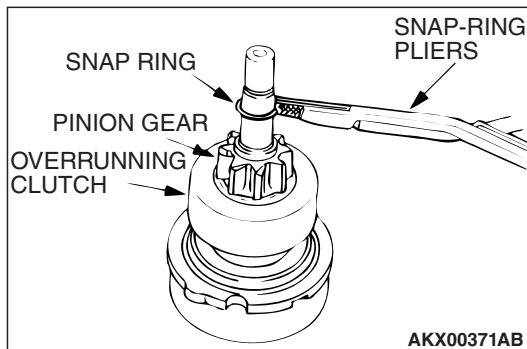
11. PACKING B
12. PLATE
13. PLANETARY GEAR
14. LEVER
15. SNAP RING
16. STOP RING
17. OVERRUNNING CLUTCH
18. INTERNAL GEAR
19. PLANETARY GEAR HOLDER
20. FRONT BRACKET

## DISASSEMBLY SERVICE POINTS

### <<A>> SNAP RING AND STOP RING REMOVAL



1. Press a long socket wrench of appropriate size to the stop ring. Then tap the socket wrench to remove the stop ring to the pinion gear side.



2. After removing the snap ring (by using snap-ring pliers), remove the stop ring and the overrunning clutch.

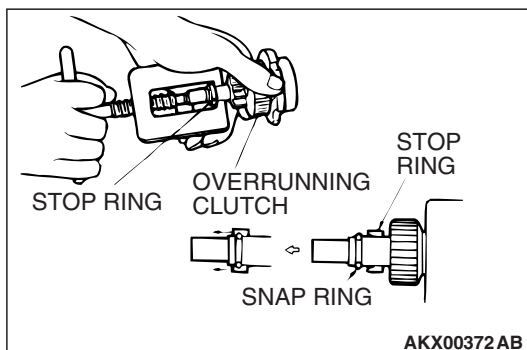
### STARTER MOTOR PART CLEANING

1. Do not immerse parts in cleaning solvent. Immersing the yoke and field coil assembly and/or armature will damage insulation. Wipe these parts with a shop towel only.
2. Do not immerse the drive unit in cleaning solvent. Overrunning clutch is pre-lubricated at the factory and solvent will wash lubrication from the clutch.
3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a shop towel.

### ASSEMBLY SERVICE POINT

### >>A<< STOP RING AND SNAP RING INSTALLATION

Using a suitable pulling tool, pull the overrunning clutch stop ring over the snap ring.



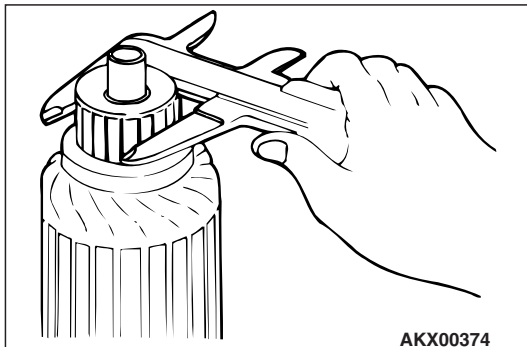
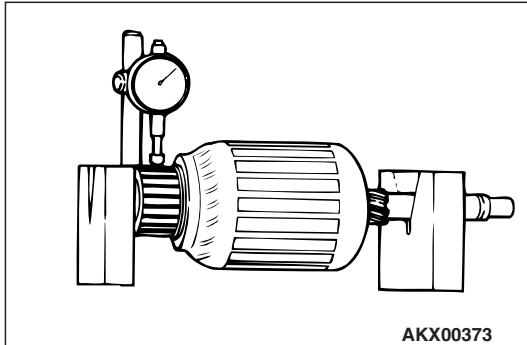
## INSPECTION

## COMMUTATOR CHECK

1. Place the armature on a pair of V-blocks, and check the deflection by using a dial gauge.

**Standard value: 0.05 mm (0.002 inch)**

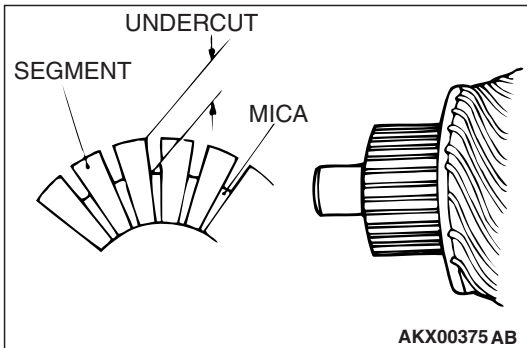
**Limit: 0.1 mm (0.004 inch)**



2. Check the outer diameter of the commutator.

**Standard value: 29.4 mm (1.16 inches)**

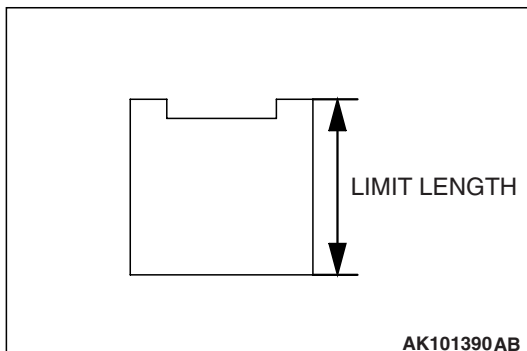
**Minimum limit: 28.8 mm (1.13 inches)**



3. Check the depth of the undercut between segments.

**Standard value: 0.5 mm (0.02 inch)**

**Minimum limit: 0.2 mm (0.008 inch)**



## BRUSH CHECK

1. Check the brush for roughness of the surface that contacts the commutator and check the brush length. Replace the brush holder if this measurement exceeds the limit.

**Minimum limit:**

**7.0 mm (0.28 inch)**

2. If the contacting surface has been corrected or the brush has been replaced, correct the contacting surface by winding sandpaper around the commutator.

### OVERRUNNING CLUTCH CHECK

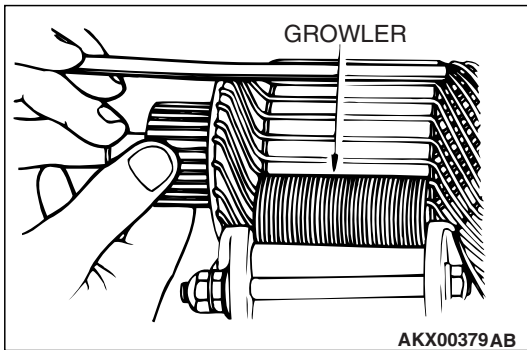


1. While holding the clutch housing, rotate the pinion. The drive pinion should rotate smoothly in one direction, but should not rotate in the opposite direction. If the clutch does not function properly, replace the overrunning clutch assembly.
2. Inspect the pinion for wear or burrs. If the pinion is worn or burred, replace the overrunning clutch assembly. If the pinion is damaged, also inspect the ring gear for wear or burrs.

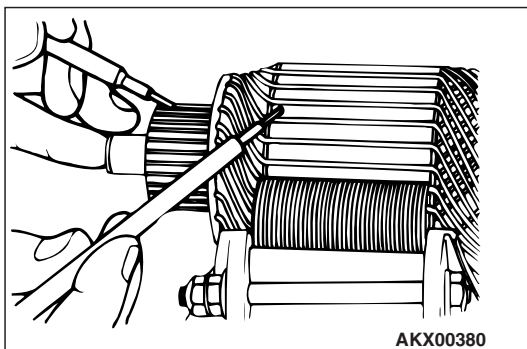
### FRONT AND REAR BRACKET BUSHING CHECK

Inspect the bushing for wear or burrs. If the bushing is worn or burred, replace the front bracket assembly or rear bracket assembly.

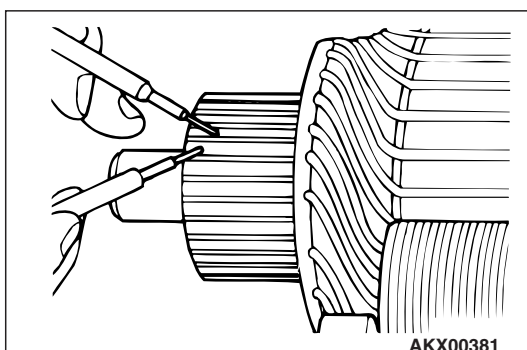
### ARMATURE CHECK



1. Check that the armature coil is not grounded.
2. Place the armature in a growler.
3. Hold a thin steel blade parallel and just above while rotating the armature slowly in the growler. A shorted armature will cause a blade to vibrate and be attracted to the core. Replace the shorted armature.



4. Check the insulation between the armature coil cores and the commutator segments. They are normal if there is no continuity.



5. Check for continuity between the segments. The condition is normal if there is continuity.

## IGNITION SYSTEM

## GENERAL DESCRIPTION

## &lt;2.4L ENGINE&gt;

This system is provided with four ignition coils with built-in ignition power transistors for each of the cylinders.

Interruption of the primary current flowing in the primary side of ignition coil generates a high voltage in the secondary side of ignition coil.

The engine control module (ECM) or powertrain control module (PCM) controls the four ignition power transistors to turn them 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.

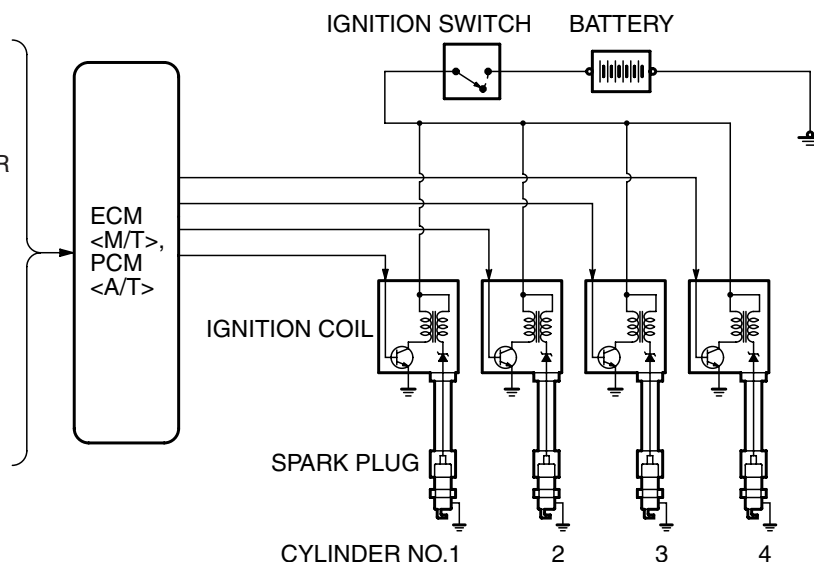
M1163000100595

The ECM or PCM determines which ignition coil should be controlled by means of the signals from the camshaft position sensor which is incorporated in the camshaft and from the crankshaft position sensor which is incorporated in the crankshaft.

It also detects the crankshaft position to provide ignition at the most appropriate timing in response to the engine operation conditions.

When the engine is cold or operated at high altitudes, the ignition timing is slightly advanced to provide optimum performance.

MASS AIRFLOW SENSOR  
INTAKE AIR TEMPERATURE SENSOR  
ENGINE COOLANT TEMPERATURE SENSOR  
CAMSHAFT POSITION SENSOR  
CRANKSHAFT POSITION SENSOR  
VEHICLE SPEED SENSOR <M/T>  
TRANSMISSION RANGE SWITCH <A/T>  
IGNITION SWITCH-ST  
KNOCK SENSOR



AK304112AC

## &lt;3.8L ENGINE&gt;

This system is provided with six ignition coils with built-in ignition power transistors for each of the cylinders.

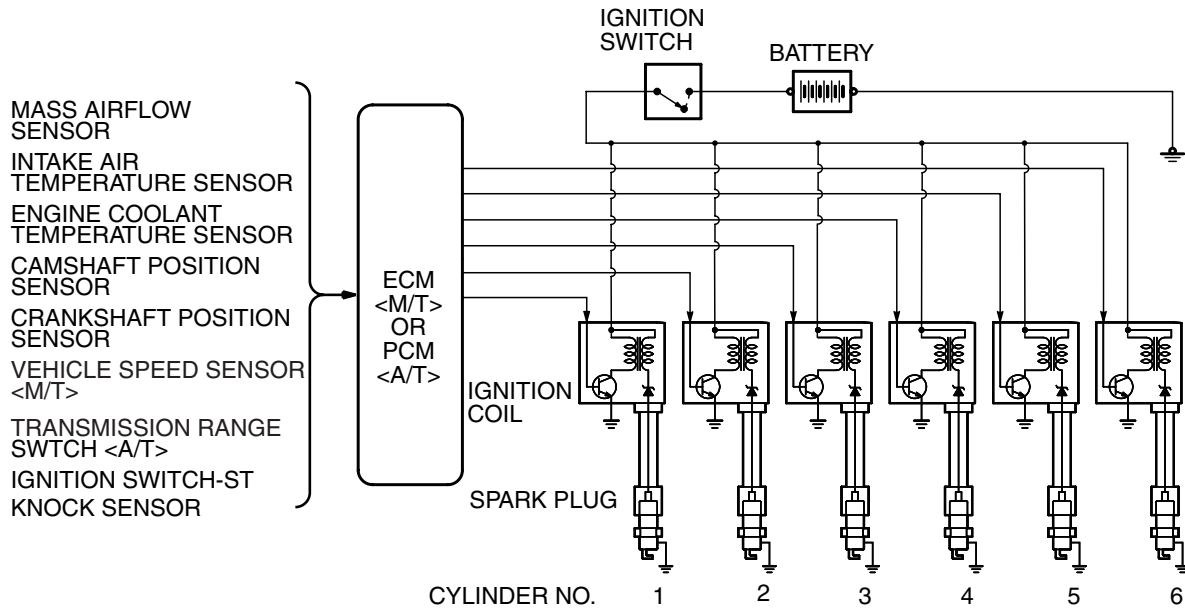
Interruption of the primary current flowing in the primary side of ignition coil generates a high voltage in the secondary side of ignition coil.

The engine control module (ECM) or powertrain control module (PCM) controls the three ignition power transistors to turn them 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 1-2-3-4-5-6.

The ECM or PCM determines which ignition coil should be controlled by means of the signals from the camshaft position sensor which is incorporated in the camshaft and from the crankshaft position sensor which is incorporated in the crankshaft.

It also detects the crankshaft position to provide ignition at the most appropriate timing in response to the engine operation conditions.

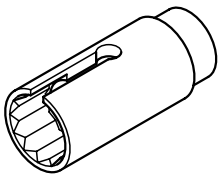
When the engine is cold or operated at high altitudes, the ignition timing is slightly advanced to provide optimum performance.



AK400831AD

## SPECIAL TOOL

M1163000600396

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
	MD998773 Knock sensor wrench	MD998773-01	Knock sensor removal and installation

## ON-VEHICLE SERVICE

### KNOCK CONTROL SYSTEM CHECK

M1163001800241

Check the knock sensor circuit if diagnostic trouble code, No. P0325 is shown.

#### <2.4L ENGINE>

Refer to GROUP 13A, Multiport Fuel Injection (MFI) <2.4L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures –DTC P0325 : Knock Sensor Circuit [P.13A-551](#).

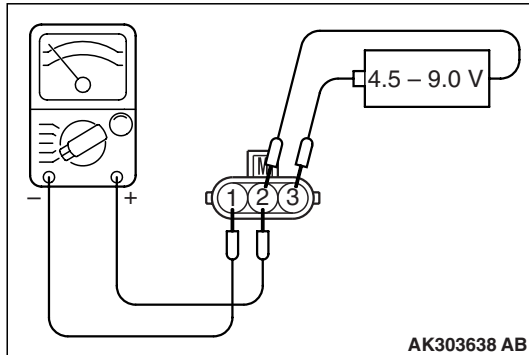
#### <3.8L ENGINE>

Refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.8L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures –DTC P0325 : Knock Sensor Circuit [P.13B-589](#).

**IGNITION COIL CHECK**

M1163001200584

Check by the following procedure, and replace the coil if there is a malfunction.

**PRIMARY COIL AND IGNITION POWER  
TRANSISTOR CONTINUITY CHECK**

*NOTE: An analog-type ohmmeter should be used.*

*NOTE: Connect the negative probe of the ohmmeter to terminal 1.*

**⚠ CAUTION**

**This test must be performed quickly (in less than 10 seconds) to prevent coil from burning and ignition power transistor from breaking.**

1. Connect and disconnect 4.5 – 9.0 V battery between terminal No. 2 and No. 3, and observe the ohmmeter whether there is continuity or not.
2. If results do not agree with the table below, replace the primary coil and ignition power transistor assembly.

<b>4.5 – 9.0 V POWER SUPPLY BETWEEN 2 – 3</b>	<b>CONTINUITY BETWEEN 1 – 2</b>
Current flowing	Yes
Current not flowing	No

**SECONDARY COIL CHECK**

*NOTE: It is impossible to check the secondary coil through the continuity check as a diode is integrated in the secondary coil circuit of this ignition coil. Accordingly, check the secondary coil in the following procedure.*

1. Disconnect the ignition coil connector.
2. Remove the ignition coil and install a new spark plug to the ignition coil.
3. Connect the ignition coil connector.
4. Ground the side electrode of the spark plug and crank the engine.
5. Check that spark is produced between the electrodes of the spark plug.
6. If no spark plug is produced, replace the ignition coil with a new one and recheck.

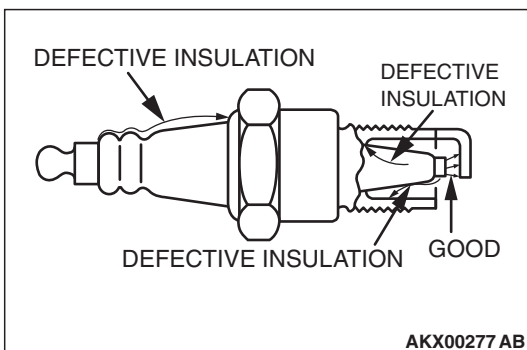
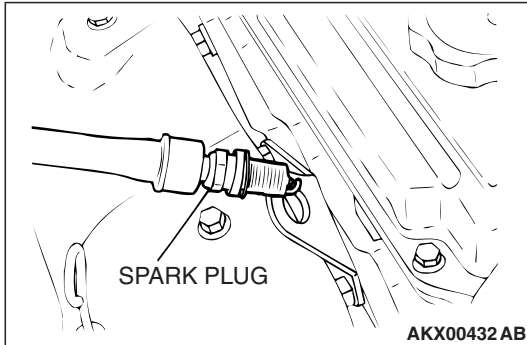


- If spark is produced with the new ignition coil, replace the old one as it is faulty. If no spark is produced again, the ignition circuit is suspected as faulty. Check the ignition circuit.

### SPARK PLUG TEST

M1163001500176

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



- 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

M1163004300698

#### **CAUTION**

- Do not attempt to adjust the gap of the iridium plug.
- Cleaning of the iridium plug may result in damage to the iridium tips. Therefore, if carbon deposits must be removed, use a plug cleaner and complete cleaning within 20 seconds to protect the electrode. Do not use a wire brush.

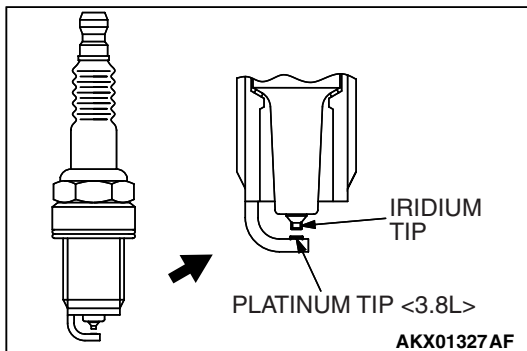
Check the plug gap and replace if the limit is exceeded.

**Standard value: 0.7 – 0.8 mm (0.028 – 0.031 inch)**

**Limit:**

**1.2 mm (0.047 inch) <2.4L Engine>**

**0.95mm (0.037 inch) <3.8L Engine>**



### CAMSHAFT POSITION SENSOR CHECK

M1163004400457

#### <2.4L ENGINE>

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-578](#).

**<3.8L ENGINE>**

Refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.8L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures – DTC P0340 : Camshaft Position Sensor Circuit [P.13B-619](#).

**CRANKSHAFT POSITION SENSOR CHECK**

M1163004500517

**<2.4L ENGINE>**

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-559](#).

**<3.8L ENGINE>**

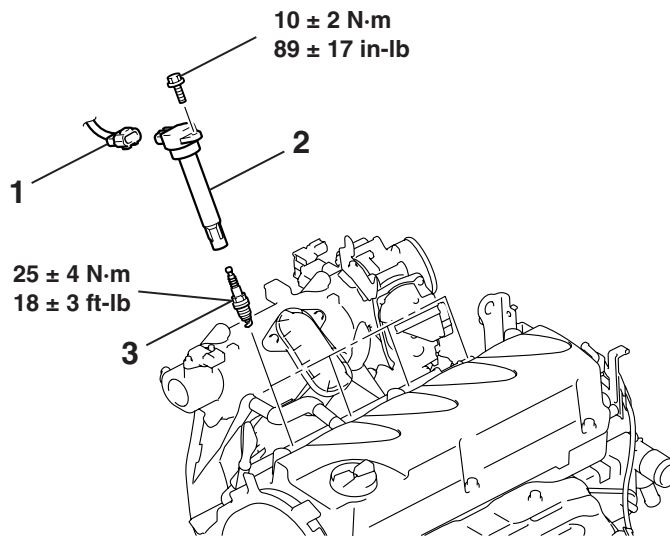
Refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.8L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Diagnostic Trouble Code Procedures –DTC P0335 : Crankshaft Position Sensor Circuit [P.13B-597](#).

**IGNITION COIL****REMOVAL AND INSTALLATION <2.4L ENGINE>**

M1163004000835

**Pre-removal and Post-installation Operation**

Air Cleaner Resonator Removal and Installation (Refer to GROUP 15, Air Cleaner [P.15-4](#)).



AC406315AB

**REMOVAL STEPS**

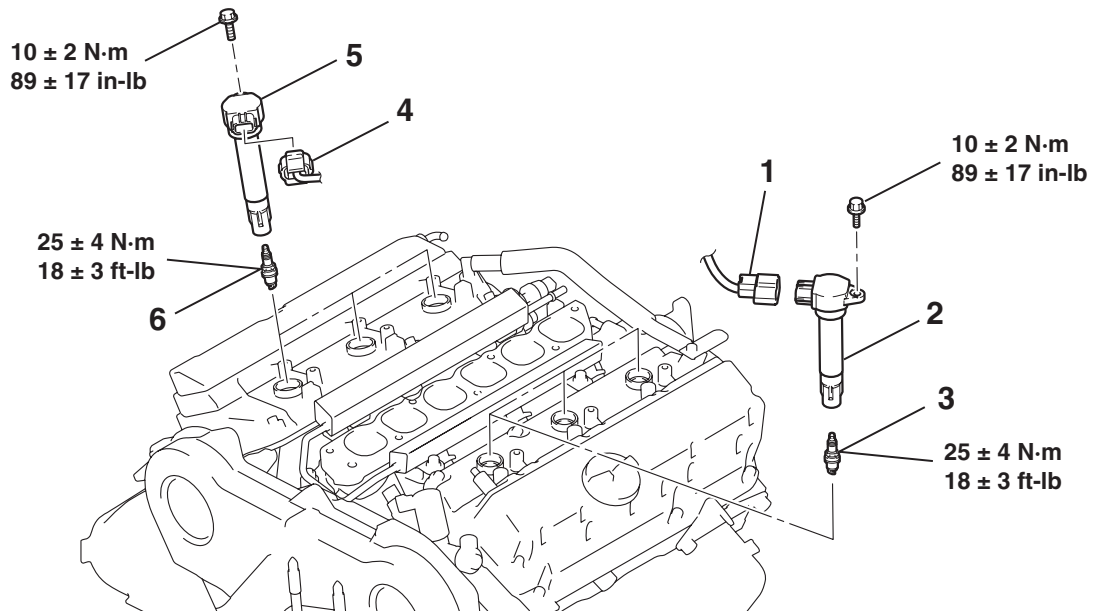
1. IGNITION COIL CONNECTORS

**REMOVAL STEPS (Continued)**

2. IGNITION COILS
3. SPARK PLUGS

REMOVAL AND INSTALLATION <3.8L ENGINE>

M1163004000846



AC406130AB

**REMOVAL STEPS (LEFT BANK)**

- ENGINE COVER (REFER TO GROUP 11C, ENGINE ASSEMBLY [P.11C-22](#)).
- 1. IGNITION COIL CONNECTORS
- 2. IGNITION COILS
- 3. SPARK PLUGS

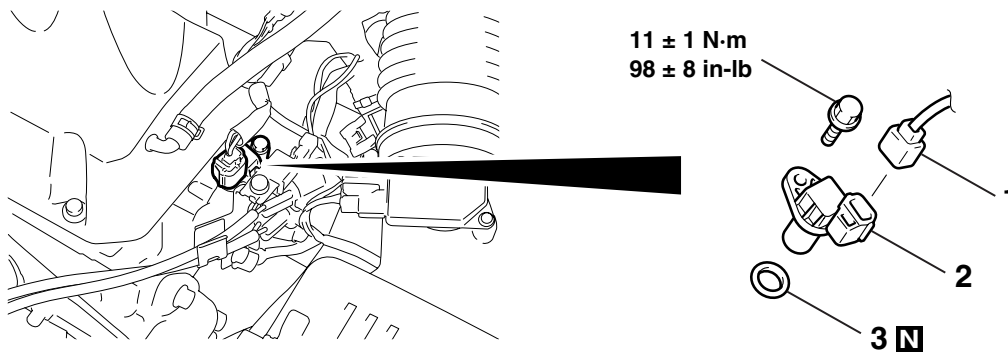
**REMOVAL STEPS (RIGHT BANK)**

- INTAKE MANIFOLD PLENUM (REFER TO GROUP 15, INTAKE MANIFOLD PLENUM [P.15-7](#)).
- 4. IGNITION COIL CONNECTORS
- 5. IGNITION COILS
- 6. SPARK PLUGS

CAMSHAFT POSITION SENSOR

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1163003400755



**REMOVAL STEPS**

1. CAMSHAFT POSITION SENSOR CONNECTOR

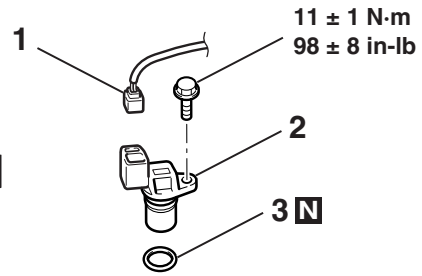
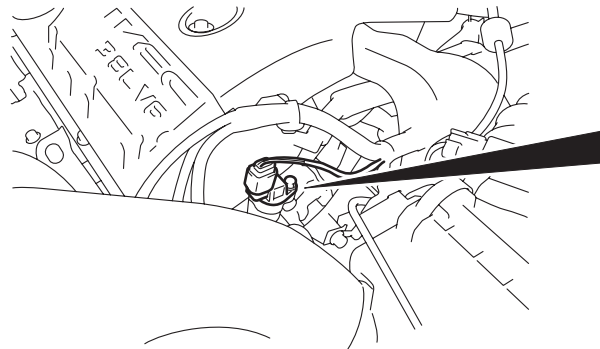
**REMOVAL STEPS (Continued)**

2. CAMSHAFT POSITION SENSOR
3. O-RING

AC406585AB

REMOVAL AND INSTALLATION <3.8L ENGINE>

M1163003400766



AC406131AB

**REMOVAL STEPS**

1. CAMSHAFT POSITION SENSOR CONNECTOR

**REMOVAL STEPS (Continued)**

2. CAMSHAFT POSITION SENSOR
3. O-RING

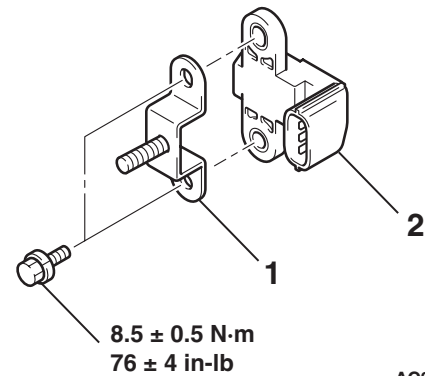
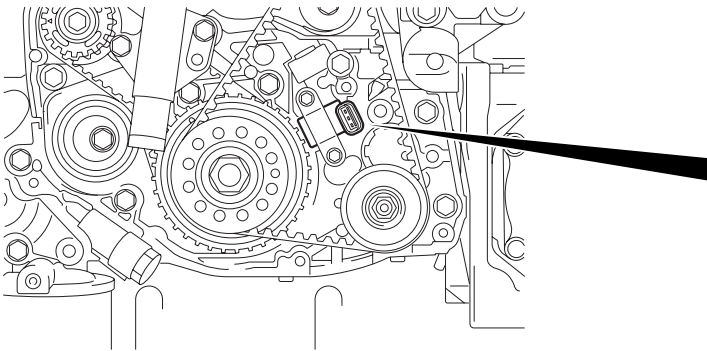
CRANKSHAFT POSITION SENSOR

REMOVAL AND INSTALLATION <2.4L ENGINE>

M1163003500707

**Pre-removal and Post-installation Operation**

Timing Belt Lower Cover Removal and Installation (Refer to GROUP 11A, Timing Belt P.11A-50).



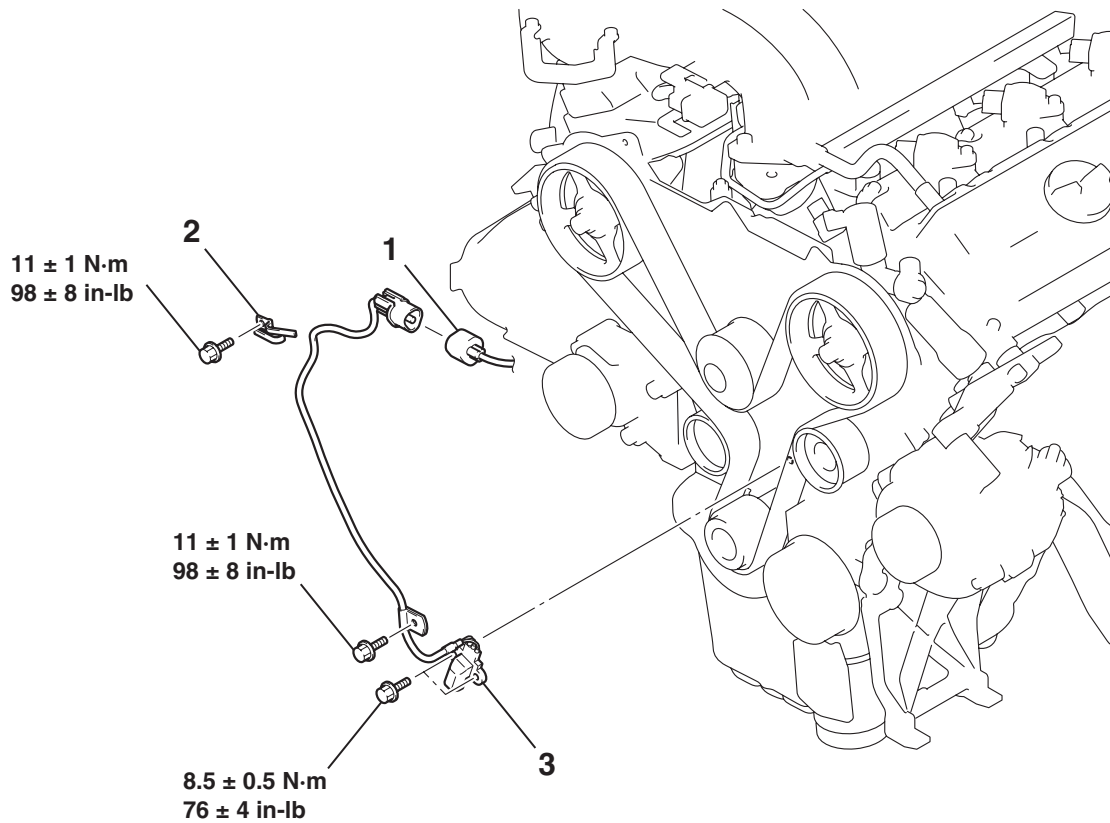
AC305391AC

**REMOVAL STEPS**

1. TIMING BELT LOWER COVER BRACKET
2. CRANKSHAFT POSITION SENSOR

REMOVAL AND INSTALLATION <3.8L ENGINE>

M1163003500718



AC406132AB

**REMOVAL STEPS**

1. CRANKSHAFT POSITION SENSOR CONNECTOR
- >>B<< 2. CLIP

**REMOVAL STEPS (Continued)**

- TIMING BELT LOWER COVER (REFER TO GROUP 11C, TIMING BELT P.11C-59).
- >>A<< 3. CRANKSHAFT POSITION SENSOR

**INSTALLATION SERVICE POINTS**

**>>A<< CRANKSHAFT POSITION SENSOR INSTALLATION**

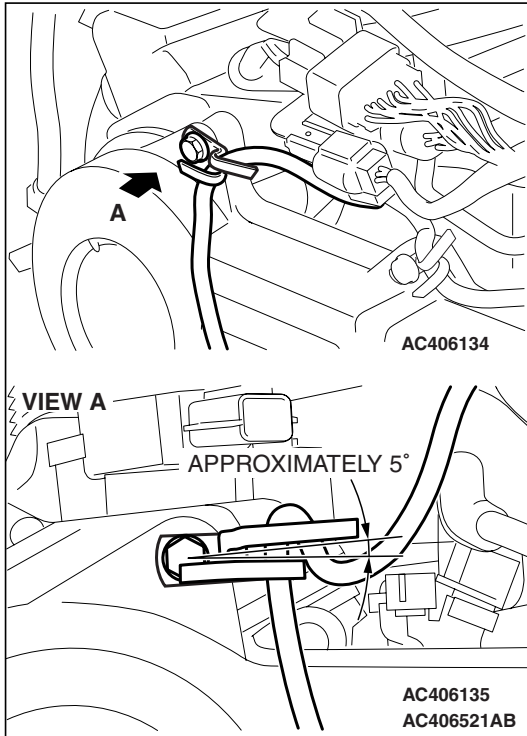
1. Install the crankshaft position sensor to the cylinder block front case.
2. Tighten the crankshaft position sensor mounting bolts by hand.
3. Tighten the crankshaft position sensor mounting bolts to the specified torque.

**Tightening torque: 8.5 ± 0.5 N· m (76 ± 4 in-lb)**

## &gt;&gt;B&lt;&lt; CLIP INSTALLATION

1. Install the clip to the the timing belt front upper cover as shown.
2. Tighten the clip mounting bolt to the specified torque.

**Tightening torque:  $11 \pm 1$  N·m ( $98 \pm 8$  in-lb)**



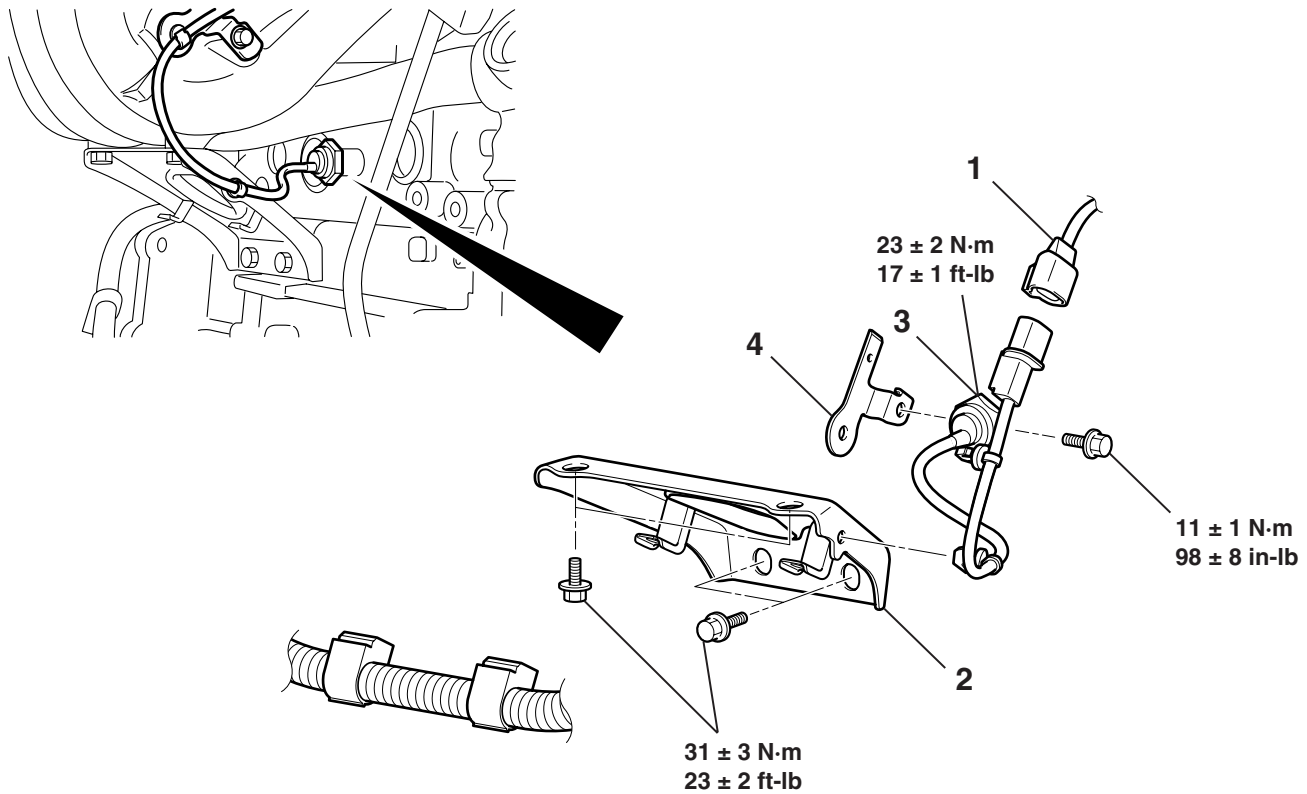
## KNOCK SENSOR

### REMOVAL AND INSTALLATION <2.4L ENGINE>

M1163002800954

**⚠ CAUTION**

When the knock sensor replacement is performed, use scan tool MB991958 to initialize the learning value (Refer to GROUP 00, Initialization Procedure for Learning Value in MFI Engine P.00-30).



AC302234  
AC305130AC

**REMOVAL STEPS**

1. KNOCK SENSOR CONNECTOR
2. INTAKE MANIFOLD STAY

<<A>> >>A<<

**REMOVAL STEPS (Continued)**

3. KNOCK SENSOR
4. KNOCK SENSOR CONNECTOR BRACKET

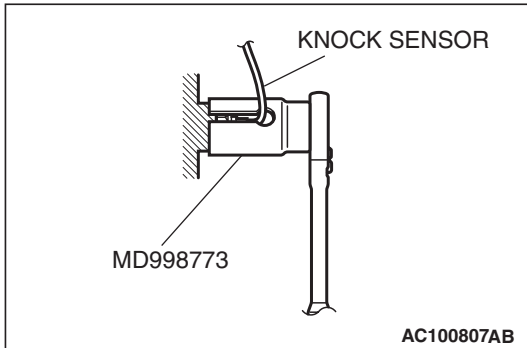
**Required Special Tool:**

MD998773: Knock Sensor Wrench

REMOVAL SERVICE POINT

<<A>> KNOCK SENSOR REMOVAL

Use special tool MD998773 to remove the knock sensor.

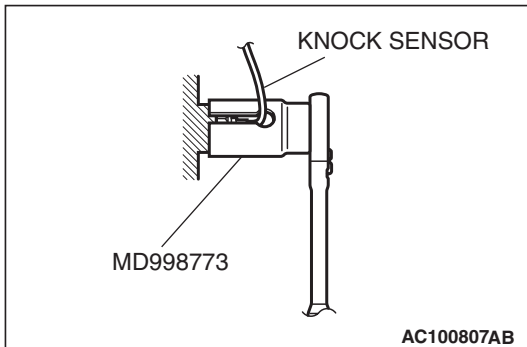


INSTALLATION SERVICE POINT

>>A<< KNOCK SENSOR INSTALLATION

Use special tool MD998773 to tighten the knock sensor to the specified torque in the same manner as removal.

**Tightening torque: 23 ± 2 N·m (17 ± 1 ft-lb)**

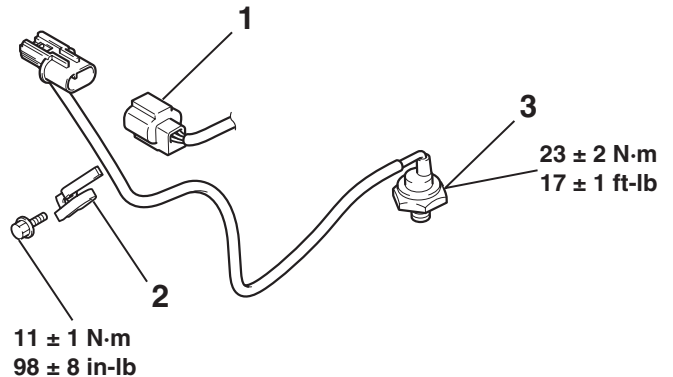


REMOVAL AND INSTALLATION <3.8L ENGINE>

M1163002800965

**CAUTION**

When the knock sensor replacement is performed, use scan tool MB991958 to initialize the learning value (Refer to GROUP 00, Initialization Procedure for Learning Value in MFI Engine P.00-30).



AC406133AB

REMOVAL STEPS

- >>B<<
1. KNOCK SENSOR CONNECTOR
  2. CLIP



**REMOVAL STEPS (Continued)**

- INTAKE MANIFOLD (REFER TO GROUP 15, INTAKE MANIFOLD P.15-14).

<<A>> >>A<< 3. KNOCK SENSOR

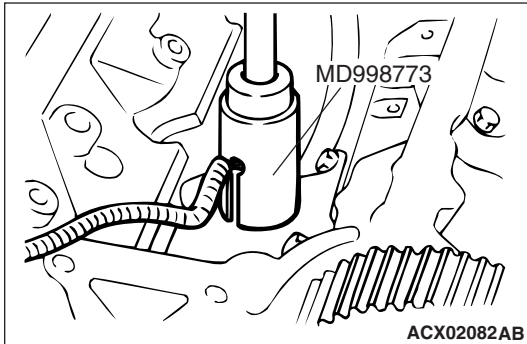
**Required Special Tool:**

MD998773: Knock Sensor Wrench

**REMOVAL SERVICE POINT**

**<<A>> KNOCK SENSOR REMOVAL**

Use special tool MD998773 to remove the knock sensor.

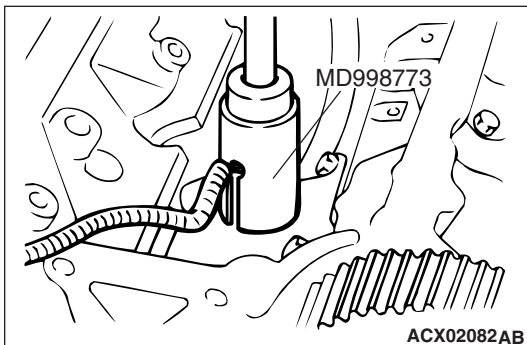


**INSTALLATION SERVICE POINTS**

**>>A<< KNOCK SENSOR INSTALLATION**

Use special tool MD998773 to tighten the knock sensor to the specified torque in the same manner as removal.

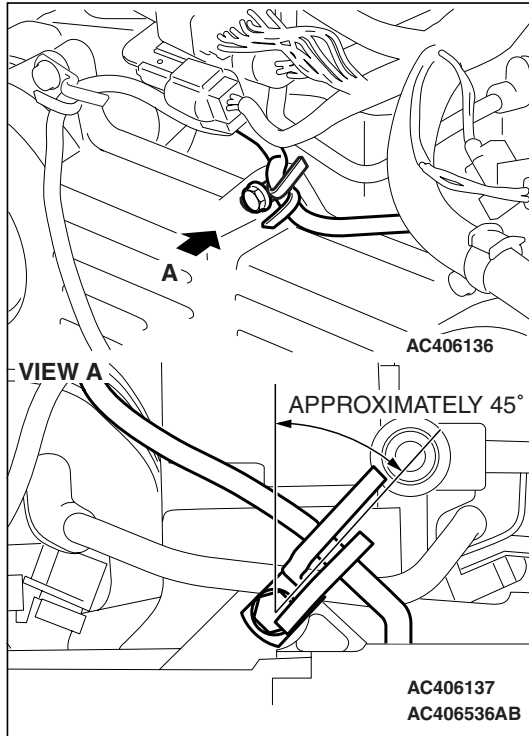
**Tightening torque:  $23 \pm 2$  N·m ( $17 \pm 1$  ft-lb)**



>>B<< CLIP INSTALLATION

1. Install the clip to the the timing belt front upper cover as shown.
2. Tighten the clip mounting bolt to the specified torque.

**Tightening torque: 11 ± 1 N· m (98 ± 8 ft-lb)**



**SPECIFICATIONS**

**FASTENER TIGHTENING SPECIFICATIONS**

M1161002100573

**<2.4L ENGINE>**

ITEM	SPECIFICATION
<b>Charging system</b>	
Connector bracket bolt	11 ± 1 N· m (98 ± 8 in-lb)
Generator bolt	49 ± 9 N· m (36 ± 7 ft-lb)
Generator cover bolt	5.9 ± 1.0 N· m (52 ± 9 in-lb)
Generator mounting bracket bolt	49 ± 9 N· m (36 ± 7 ft-lb)
Generator nut	44 ± 10 N· m (33 ± 7 ft-lb)
Generator terminal nut	12 ± 2 N· m (102 ± 22 in-lb)
Harness bracket bolt	14 ± 1 N· m (120 ± 13 in-lb)
<b>Ignition system</b>	
Camshaft position sensor bolt	11 ± 1 N· m (98 ± 8 in-lb)
Crankshaft position sensor bolt	8.5 ± 0.5 N· m (76 ± 4 in-lb)
Ignition coil bolt	10 ± 2 N· m (89 ± 17 in-lb)
Intake manifold stay bolt	31 ± 3 N· m (23 ± 2 ft-lb)
Knock sensor	23 ± 2 N· m (17 ± 1 ft-lb)
Knock sensor connector bracket bolt	11 ± 1 N· m (98 ± 8 in-lb)
Spark plug	25 ± 4 N· m (18 ± 3 ft-lb)

<b>ITEM</b>	<b>SPECIFICATION</b>
<b>Starting system</b>	
ATF warmer (transmission fluid cooler) bracket bolt <A/T>	23 ± 3 N· m (17 ± 2 ft-lb)
Clutch release cylinder bolt	18 ± 3 N· m (13 ± 2 ft-lb)
Starter bolt	30 ± 3 N· m (23 ± 2 ft-lb)
Starter cover bolt	9.0 ± 2.0 N· m (80 ± 17 in-lb)
Starter cover bracket bolt	49 ± 9 N· m (36 ± 7 ft-lb)
Starter terminal nut	12 ± 2 N· m (102 ± 22 in-lb)

**<3.8L ENGINE>**

<b>ITEM</b>	<b>SPECIFICATION</b>
<b>Charging system</b>	
Control wiring harness nut	12 ± 2 N· m (102 ± 22 in-lb)
Engine oil dipstick and dipstick guide bolt	14 ± 1 N· m (120 ± 13 in-lb)
Generator bolt	49 ± 9 N· m (36 ± 7 ft-lb)
Generator bracket bolt	49 ± 9 N· m (36 ± 7 ft-lb)
Harness bracket bolt	11 ± 1 N· m (98 ± 8 in-lb)
<b>Ignition system</b>	
Camshaft position sensor bolt	11 ± 1 N· m (98 ± 8 in-lb)
Crankshaft position sensor bolt	8.5 ± 0.5 N· m (76 ± 4 in-lb)
Crankshaft position sensor clamp bolt	11 ± 1 N· m (98 ± 8 in-lb)
Crankshaft position sensor clip bolt	11 ± 1 N· m (98 ± 8 in-lb)
Ignition coil bolt	10 ± 2 N· m (89 ± 17 in-lb)
Knock sensor	23 ± 2 N· m (17 ± 1 ft-lb)
Knock sensor clip bolt	11 ± 1 N· m (98 ± 8 in-lb)
Spark plug	25 ± 4 N· m (18 ± 3 ft-lb)
<b>Starting system</b>	
Starter bolt	30 ± 3 N· m (23 ± 2 ft-lb)
Starter cover bolt	4.9 ± 1.0 N· m (44 ± 8 in-lb)
Starter cover nut	4.9 ± 1.0 N· m (44 ± 8 in-lb)
Starter terminal nut	12 ± 2 N· m (102 ± 22 in-lb)

## GENERAL SPECIFICATIONS

M1161000200433

## &lt;2.4L ENGINE&gt;

ITEMS	SPECIFICATIONS
<b>Generator</b>	
Type	Positive battery positive voltage sensing
Identification number	A3TG2192ZC
Part No.	MN183451
Rated output V/A	12/110
Voltage regulator	Electronic built-in type
<b>Starter Motor</b>	
Type	Reduction drive with planetary gear
Identification number	M0T20672ZC
Part No.	1810A001
Rated output kW/V	1.4/12
No. of pinion teeth	8
<b>Ignition Coil</b>	
Type	Molded 4 coil
<b>Spark plugs</b>	
NGK	LZFR6AI

## &lt;3.8L ENGINE&gt;

ITEMS	SPECIFICATIONS
<b>Generator</b>	
Type	Positive battery positive voltage sensing
Identification number	A3TG2491ZC
Part No.	MN176256
Rated output V/A	12/110
Voltage regulator	Electronic built-in type
<b>Starter Motor</b>	
Type	Reduction drive with planetary gear
Identification number	M0T20571ZC
Part No.	MR994145
Rated output kW/V	1.4/12
Number of pinion teeth	8
<b>Ignition Coil</b>	
Type	Molded 6 coil
<b>Spark Plugs</b>	
NGK	IFR6B-K

**SERVICE SPECIFICATIONS**

M1161000300571

ITEMS		STANDARD VALUE	LIMIT
<b>Generator</b>			
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)
<b>Starter motor</b>			
Free running characteristics	Terminal voltage V	11	–
	Current A	90	–
	Speed r/min	2,000 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)
<b>Ignition parts</b>			
Spark plug gap mm (in)	2.4L Engine	0.7 – 0.8 (0.028 – 0.031)	1.2 (0.047)
	3.8L Engine	0.7 – 0.8 (0.028 – 0.031)	0.95 (0.037)

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## NOTES