

GROUP 13Aa

MULTIPOINT FUEL INJECTION (MFI)

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GENERAL DESCRIPTION

M1131000100541

The Multiport Fuel Injection System consists of sensors which detect the engine conditions, the POWERTRAIN CONTROL MODULE (PCM) which controls the system based on signals from these sensors, and actuators which operate under the control of the PCM.

The PCM carries out activities such as fuel injection control, idle air control, and ignition timing control. In addition, the PCM is equipped with several diagnostic test modes which simplify troubleshooting when a problem develops.

FUEL INJECTION CONTROL

The injector drive times and injector timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions.

A single injector is mounted at the intake port of each cylinder. Fuel is sent under pressure from the fuel tank to the fuel injectors by the fuel pump, with the pressure being regulated by the fuel pressure regulator. The regulated fuel is distributed to each of the injectors.

Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The firing order is 1-2-3-4-5-6. Each cylinder has a dedicated fuel injector. This is called multiport.

The PCM provides a richer air/fuel mixture by carrying out "open-loop" control when the engine is cold or operating under high load conditions in order to maintain engine performance. In addition, when the engine is under normal operating temperature after warming-up, the PCM controls the air/fuel mixture by using the heated oxygen sensor signal to carry out "closed-loop" control. The closed-loop control achieves the theoretical air/fuel mixture ratio where the catalytic converter can obtain the maximum cleaning performance.

THROTTLE VALVE OPENING CONTROL

This system electrically controls the opening of the throttle valve. The PCM detects the amount of travel of the accelerator pedal via the accelerator pedal position sensor, and controls the actuation of the throttle actuator control motor, which is mounted on the throttle body, in order to attain the target throttle valve opening that has been predetermined in accordance with driving conditions.

IDLE AIR CONTROL

The idle speed is kept at the optimum speed by controlling the amount of air that passes through the throttle valve in accordance with changes in idling conditions and engine load during idling.

The PCM drives the throttle actuator control motor to keep the engine running at the pre-set idle target speed in accordance with the engine coolant temperature and A/C and other electrical load. In addition, when the air conditioning switch is turned off and on while the engine is idling, the throttle actuator control motor adjusts the throttle valve passes through air amount according to the engine load conditions to avoid fluctuations in the engine speed.

IGNITION TIMING CONTROL

The ignition power transistor located in the ignition primary circuit turns ON and OFF to control the primary current flow to the ignition coil. This controls the ignition timing to provide the optimum ignition timing with respect to the engine operating conditions. The ignition timing is determined by the PCM from engine speed, intake air volume, engine coolant temperature, and atmospheric pressure.

DIAGNOSTIC TEST MODE

- When an abnormality is detected in one of the sensors or actuators related to emission control, the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) illuminates to warn the driver.
- When an abnormality is detected in one of the sensors or actuators, a diagnostic trouble code corresponding to the abnormality is stored in the PCM.
- The RAM data inside the PCM that is related to the sensors and actuators can be read with the scan tool. In addition, the actuators can be controlled by scan tool MUT-II (MB991502) under certain circumstances.

OTHER CONTROL FUNCTIONS

- Fuel Pump Control
Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking or running.
- A/C Compressor Clutch Relay Control
Turns the compressor clutch of the A/C ON and OFF.
- Evaporative Emission Purge Control
(Refer to GROUP 17, Emission Control System – Evaporative Emission System – General Description P.17-59.)
- EGR Control
(Refer to GROUP 17, Emission Control System – Exhaust Gas Recirculation (EGR) System - General Description P.17-63.)

MULTIPOINT FUEL INJECTION (MFI) SYSTEM DIAGRAM

SENSE

- ★1 LEFT BANK HEATED OXYGEN SENSOR (FRONT)
- ★2 VOLUME AIRFLOW SENSOR
- ★3 INTAKE AIR TEMPERATURE SENSOR
- ★4 THROTTLE POSITION SENSOR (MAIN/SUB)
- ★5 CAMSHAFT POSITION SENSOR
- ★6 CRANKSHAFT POSITION SENSOR
- ★7 BAROMETRIC PRESSURE SENSOR
- ★8 ENGINE COOLANT TEMPERATURE SENSOR
- ★9 LEFT BANK HEATED OXYGEN SENSOR (REAR)
- ★10 RIGHT BANK HEATED OXYGEN SENSOR (FRONT)
- ★11 RIGHT BANK HEATED OXYGEN SENSOR (REAR)
- ★12 FUEL TANK DIFFERENTIAL PRESSURE SENSOR
- ★13 MANIFOLD DIFFERENTIAL PRESSURE SENSOR
- ★14 FUEL TANK TEMPERATURE SENSOR
- ★15 FUEL LEVEL SENSOR

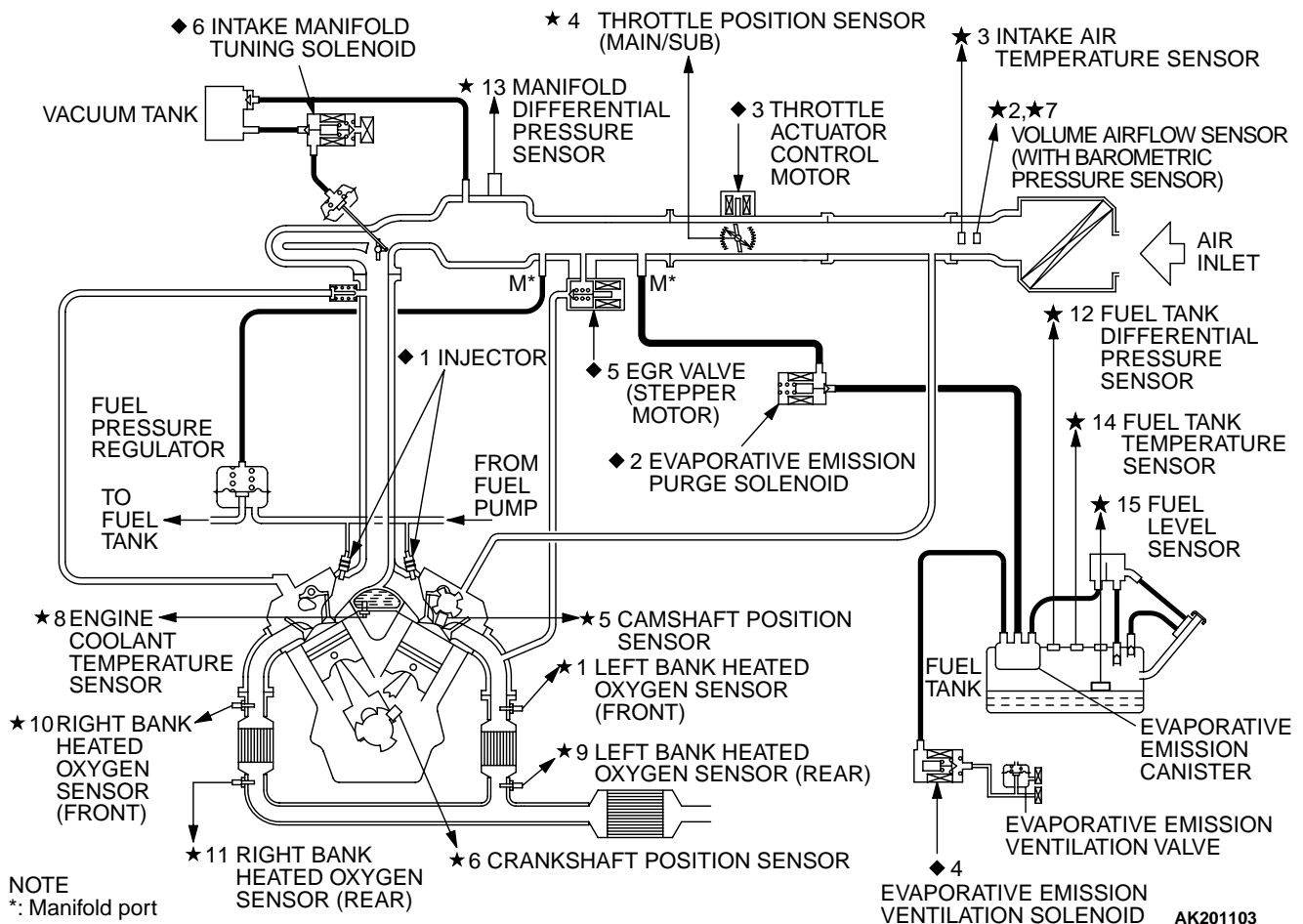
- POWER SUPPLY
- ACCELERATOR PEDAL POSITION SENSOR (MAIN/SUB)
- ACCELERATOR PEDAL POSITION SWITCH
- VEHICLE SPEED SENSOR
- A/C SWITCH 1, 2
- TRANSMISSION RANGE SWITCH
- POWER STEERING PRESSURE SWITCH
- IGNITION SWITCH - ST
- KNOCK SENSOR

DECIDE



ACT

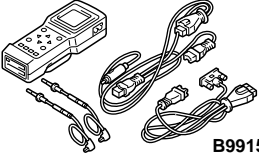

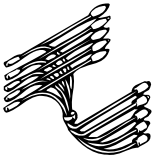



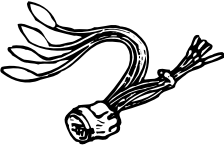
- ◆ 1 INJECTOR
 - ◆ 2 EVAPORATIVE EMISSION PURGE SOLENOID
 - ◆ 3 THROTTLE ACTUATOR CONTROL MOTOR
 - ◆ 4 EVAPORATIVE EMISSION VENTILATION SOLENOID
 - ◆ 5 EGR VALVE (STEPPER MOTOR)
 - ◆ 6 INTAKE MANIFOLD TUNING SOLENOID
-
- FUEL PUMP RELAY
 - MULTIPOINT FUEL INJECTION (MFI) RELAY
 - THROTTLE ACTUATOR CONTROL MOTOR RELAY
 - A/C COMPRESSOR CLUTCH RELAY
 - MALFUNCTION INDICATOR LAMP (SERVICE ENGINE SOON OR CHECK ENGINE LAMP)
 - DIAGNOSTIC OUTPUT
 - IGNITION COIL, IGNITION POWER TRANSISTER

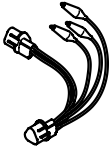

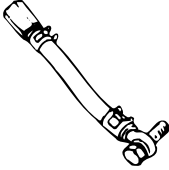



NOTE: For the vacuum routing, refer to GROUP 17, *uum Hose Routing P.17-56.*
Emission Control System – Vacuum Hoses – Vac-

SPECIAL TOOLS

M113100600245

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
 B991502	MB991502 Scan tool <MUT-II>	MB991496-OD	<ul style="list-style-type: none"> • Reading diagnostic trouble code • MFI system inspection • Measurement of fuel pressure
 MB991348	MB991348 Test harness set	MB991348-01	<ul style="list-style-type: none"> • Inspection of throttle position sensor • Inspection using an oscilloscope
 MB991658	MB991658 Test harness SET	Tool not available	<ul style="list-style-type: none"> • Inspection using an oscilloscope • Adjustment of accelerator pedal position sensor
 MB991709	MB991709 Test harness set	MB991709-01	Inspection using an oscilloscope
 MD998474	MD998474 Test harness (8 pin, square)	MD998474-01	Inspection using an oscilloscope
 MD998464	MD998464 Test harness (4 pin, square)	MD998464-01	<ul style="list-style-type: none"> • Inspection of heated oxygen sensor • Inspection using an oscilloscope
 MB991316	MB991316 Test harness (4 pin, square)	Tool not available	Inspection of heated oxygen sensor

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
	MD998478 Test harness (3 pin, triangle)	MD998478-01	Inspection using an oscilloscope
 MB991637	MB991637 Fuel pressure gauge set	Tool not available	Measurement of fuel pressure
	MD998709 Adaptor hose	MIT210196	Measurement of fuel pressure
	MD998742 Hose adaptor	MD998742-01	Measurement of fuel pressure

ON-VEHICLE SERVICE

COMPONENT LOCATION

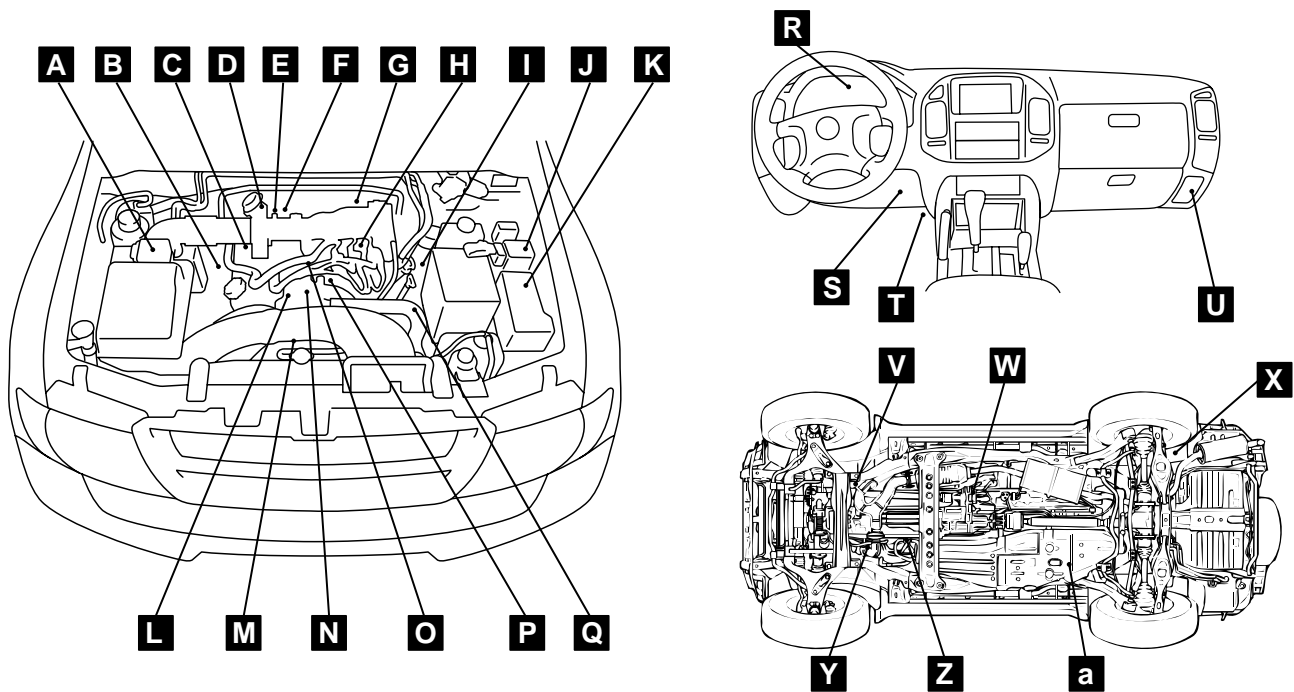
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NAME	SYMBOL	NAME	SYMBOL
Accelerator pedal position sensor (with built-in accelerator pedal position switch)	S	Left bank heated oxygen sensor (front)	I
Air conditioning compressor clutch relay	K	Left bank heated oxygen sensor (rear)	V
Camshaft position sensor	G	Malfunction Indicator Lamp (SERVICE ENGINE SOON or check engine lamp)	R
Crankshaft position sensor	M	Manifold differential pressure sensor	F
Data link connector	T	Multiport fuel injection (MFI) relay	J
EGR valve	D	Powertrain control module	U
Engine coolant temperature sensor	L	Power steering pressure switch	Q
Evaporative emission purge solenoid	E	Right bank heated oxygen sensor (front)	B
Evaporative emission ventilation solenoid	X	Right bank heated oxygen sensor (rear)	Y

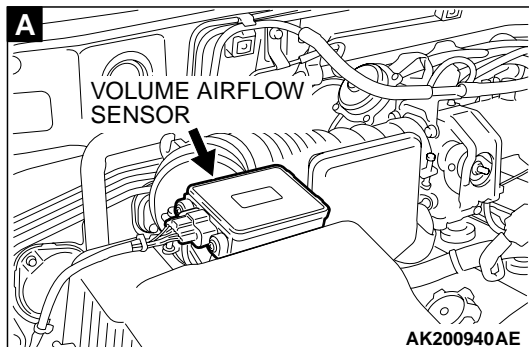
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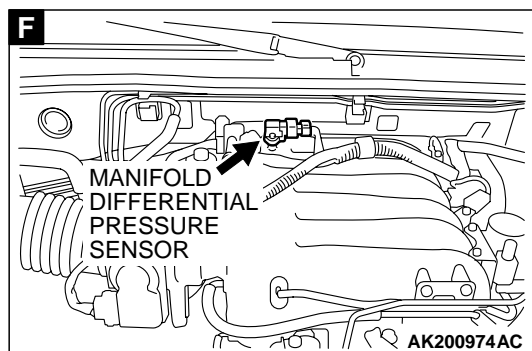
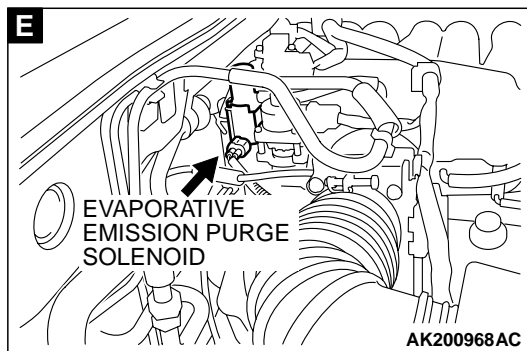
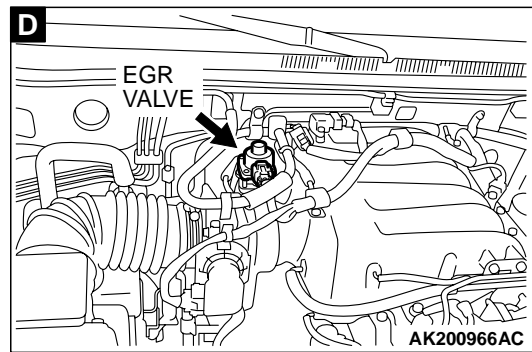
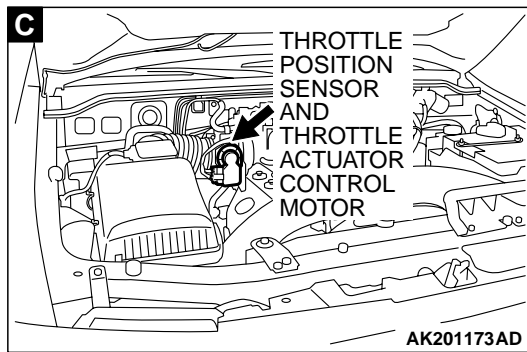
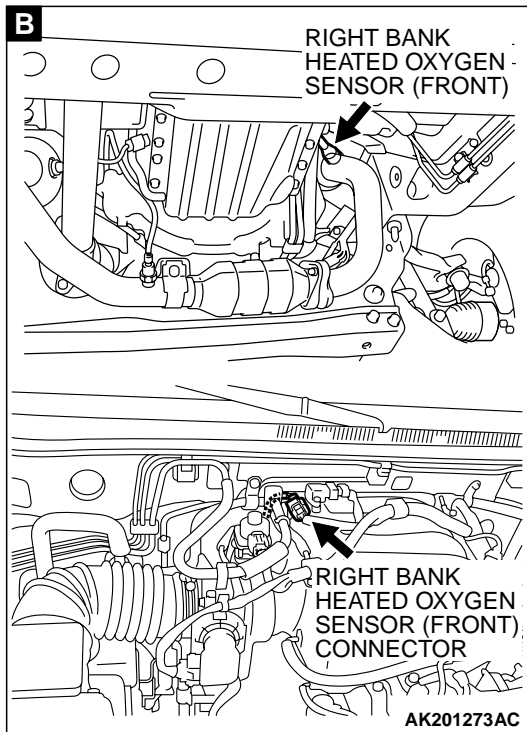
MULTI-PORT FUEL INJECTION (MFI) ON-VEHICLE SERVICE

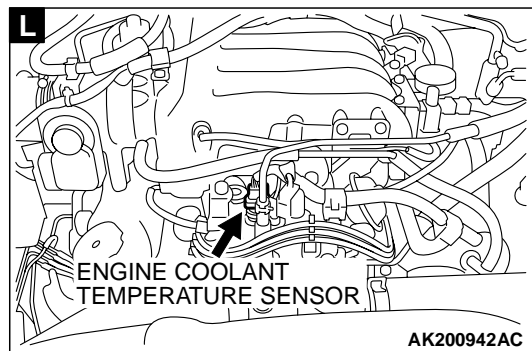
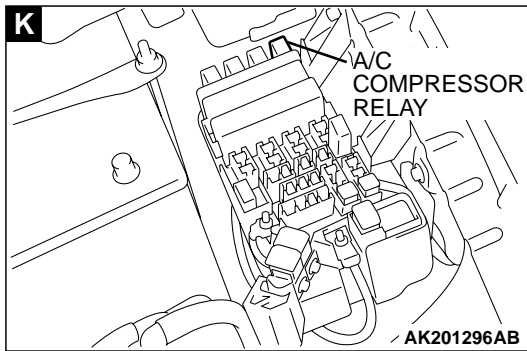
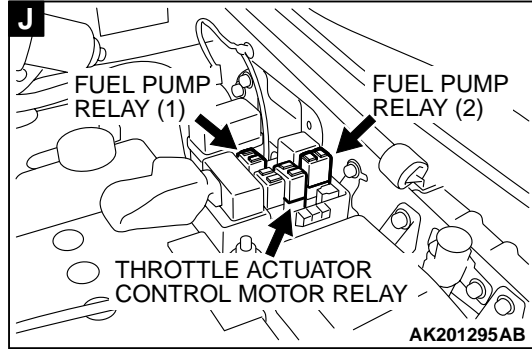
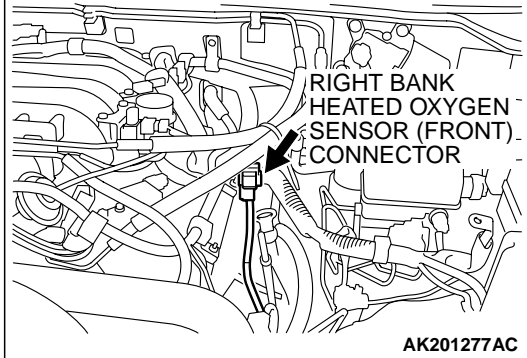
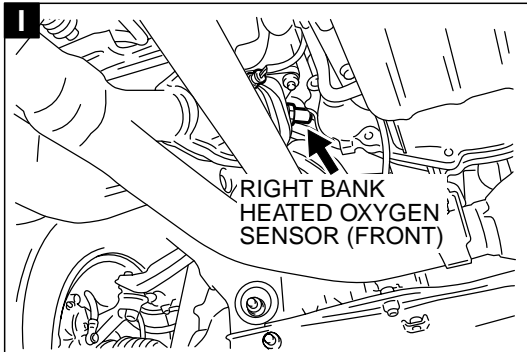
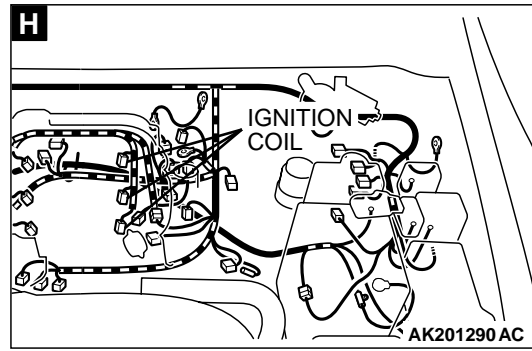
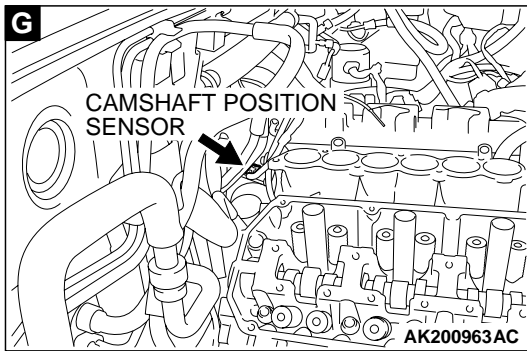
NAME	SYMBOL	NAME	SYMBOL
Fuel level sensor	a	Throttle actuator control motor	C
Fuel pump relay	J	Throttle actuator control motor relay	J
Fuel tank differential pressure sensor	a	Throttle position sensor	C
Fuel tank temperature sensor	a	Transmission range switch	Z
Ignition coil	H	Intake manifold tuning solenoid	P
Injector	O	Vehicle speed sensor	W
Intake manifold tuning solenoid	P	Volume airflow sensor (with built-in intake air temperature sensor and barometric pressure sensor)	A
Knock sensor	N		

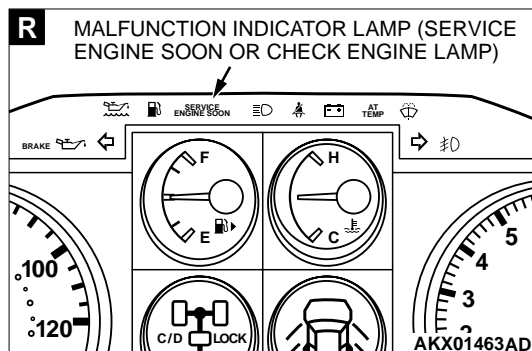
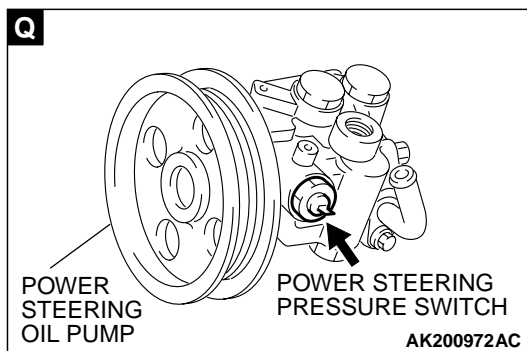
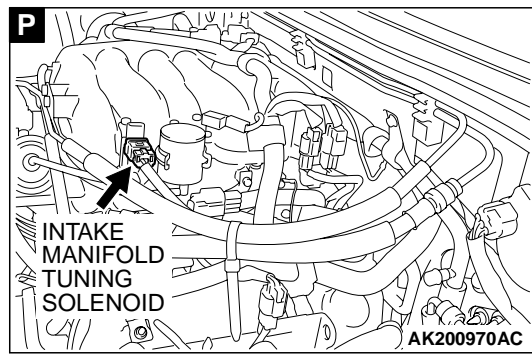
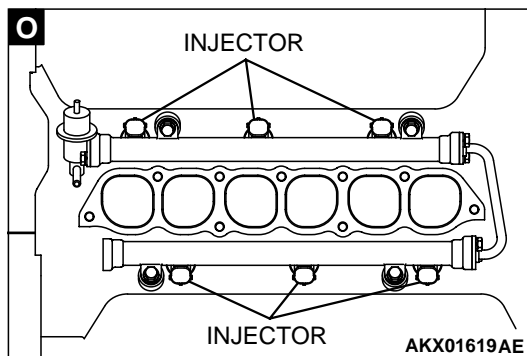
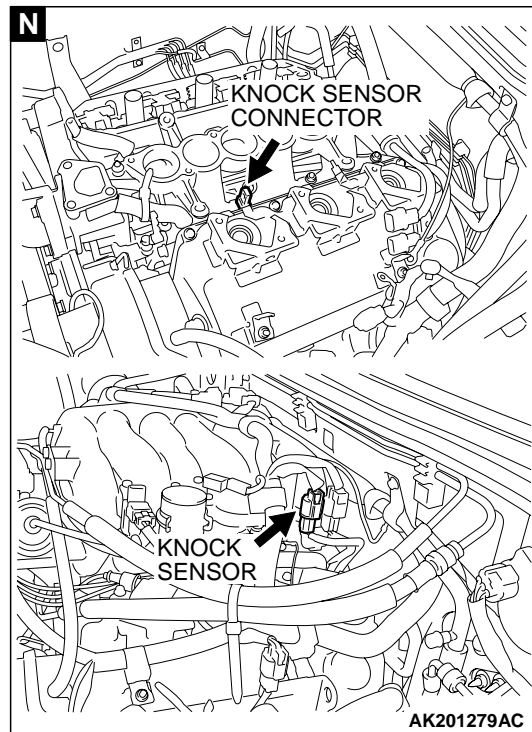
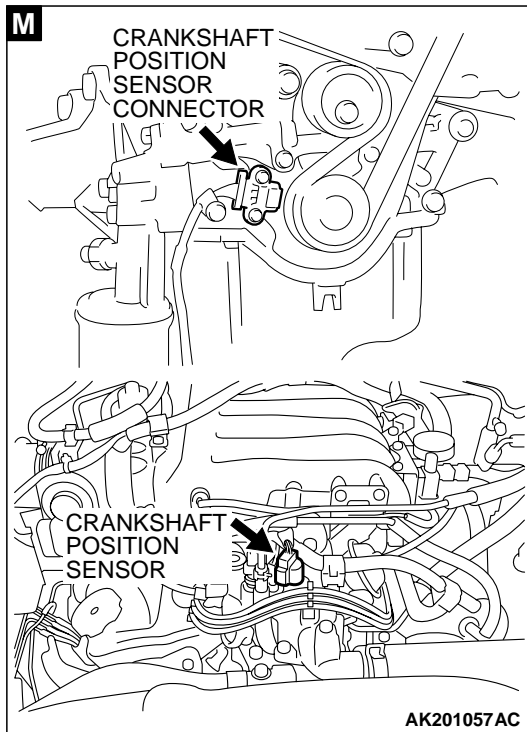


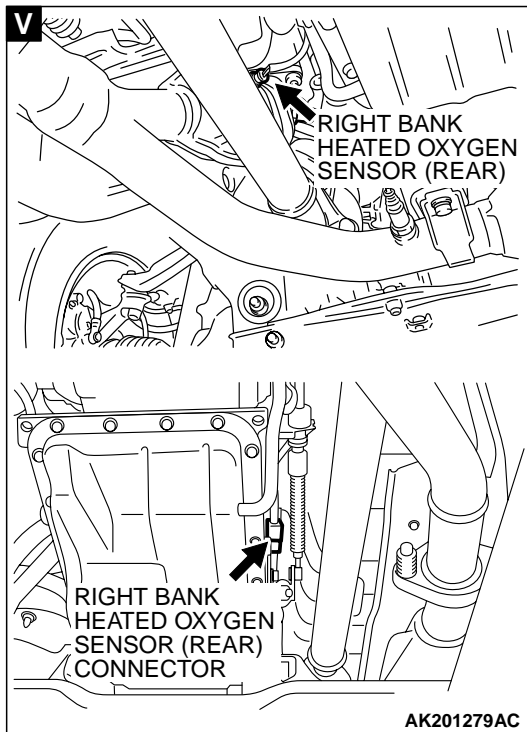
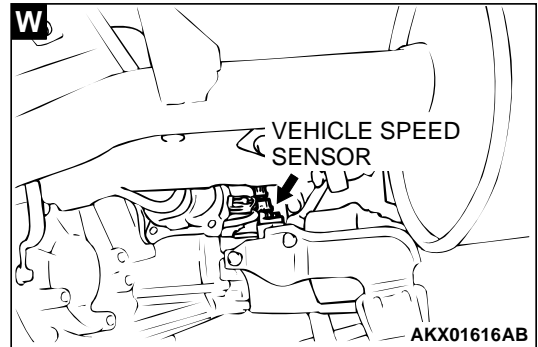
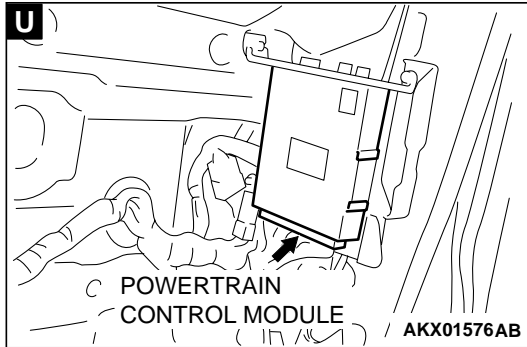
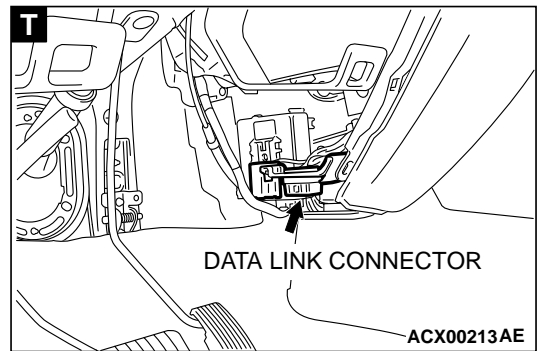
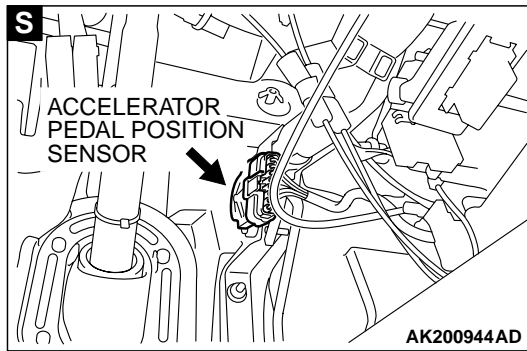
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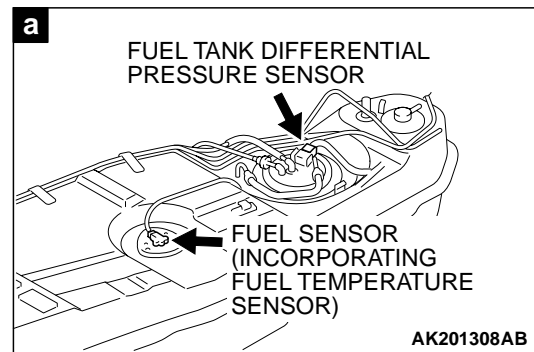
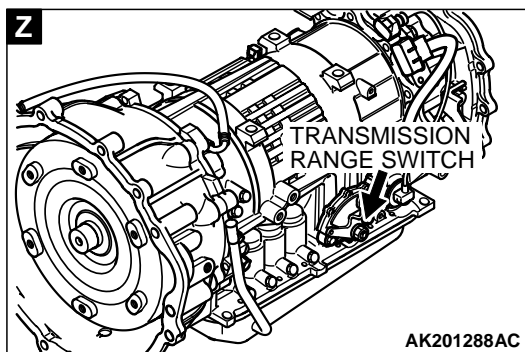
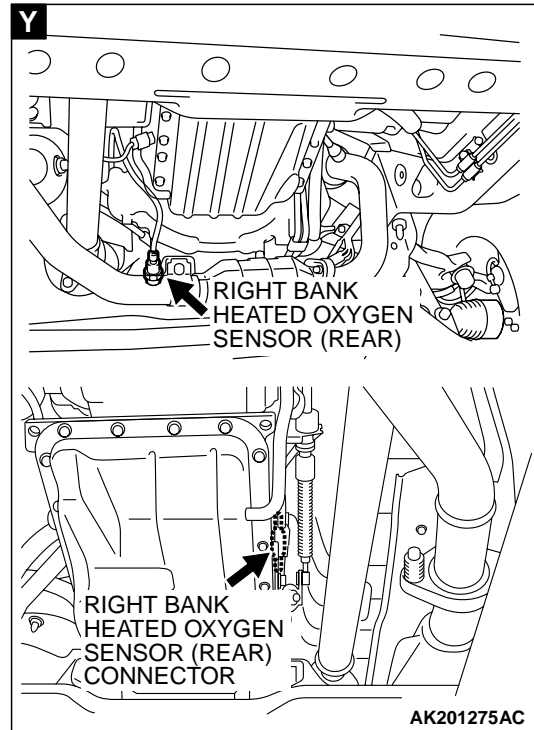
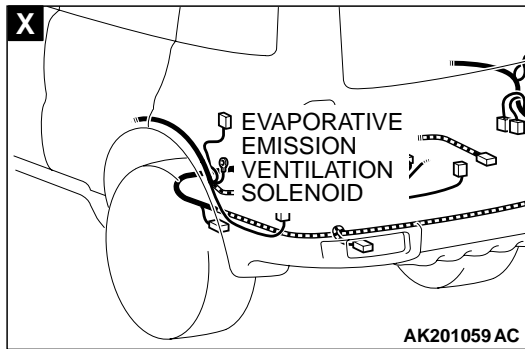












THROTTLE BODY CLEANING

M1131001000246

1. Start the engine and warm it up until the coolant is heated to 80°C (176°F) or higher. Stop the engine.
2. Remove the air intake hose from the throttle body.
3. Spray cleaning solvent into the valve through the throttle body intake port and leave it for approximately five minutes.
4. Start the engine, rev it several times and then idle it for about one minute. If the idling speed becomes unstable (or if the engine stalls) due to the bypass passage being plugged, slightly open the throttle valve to keep the engine running.
5. If the throttle valve deposits are not removed, repeat steps 3 and 4.
6. Unplug the bypass passage inlet.
7. Attach the air intake hose.
8. Use scan tool MB991502 to erase any diagnostic trouble code.

ACCELERATOR PEDAL POSITION SENSOR
ADJUSTMENT

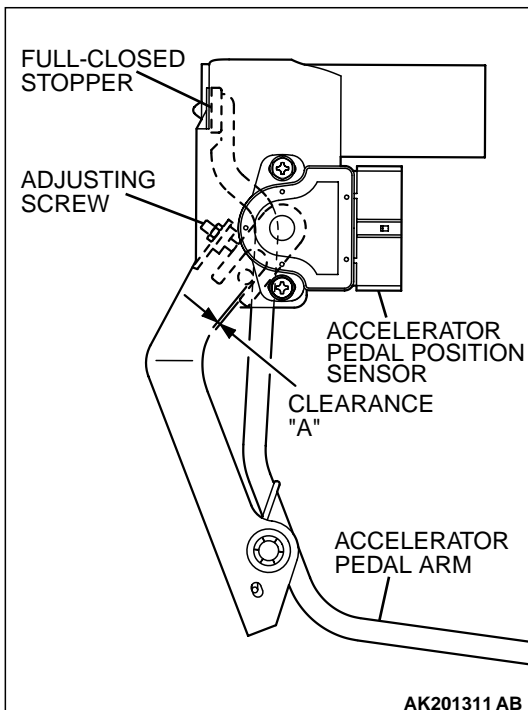
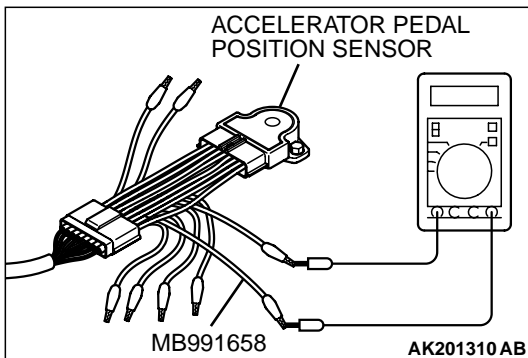
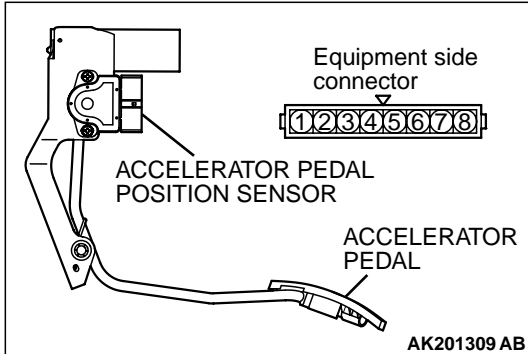
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Required Special Tools:

- MB991658: Test Harness Set

CAUTION

1. The accelerator pedal position sensor should not be moved unnecessarily; it has been precisely adjusted by the manufacture. If the adjustment is disturbed for any reason, readjust as follows.
2. If the adjustment is disturbed for any reason, readjust as follows.



1. Remove the accelerator pedal complete.
2. Connect the scan tool MB991502 to the data link connector. If the scan tool MB991502 is not used, carry out the following steps.
 - (1) Disconnect the accelerator pedal position sensor connector, and connect the special tool (test harness: MB991658) to that connector. (Be careful not to confuse the terminal numbers.)
 - (2) Connect a digital voltmeter between accelerator pedal position sensor connector terminal No. 3 accelerator pedal position sensor (main) output and terminal No. 3 accelerator pedal position sensor (main) earth.
3. Loosen the accelerator pedal position sensor mounting bolts, and hold the accelerator pedal position sensor temporary.
4. Check that the accelerator pedal arm touches the full-closed stopper.
5. Adjust the pedal arm by the adjusting screw so that clearance "A" (see the illustration) is 0.5 – 0.93 mm (0.020 – 0.037 in).
6. Hold the adjusting screw with the lock nut.
7. Turn the ignition switch to the ON position. (but do not start the engine.)
8. Turn the accelerator pedal position sensor until the output from accelerator pedal position sensor (main) satisfies the standard value.

Standard value: 0.905 – 1.165 volts
9. Tighten the accelerator pedal position sensor mounting bolts securely.
10. Install the accelerator pedal complete.

FUEL PRESSURE TEST

Required Special Tools:

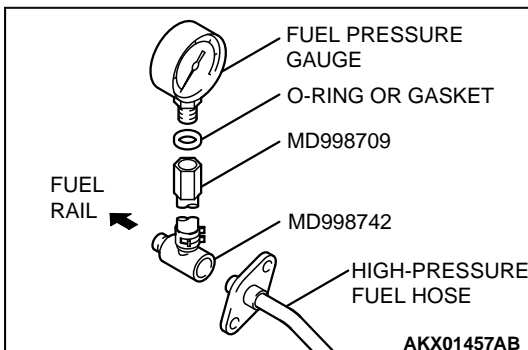
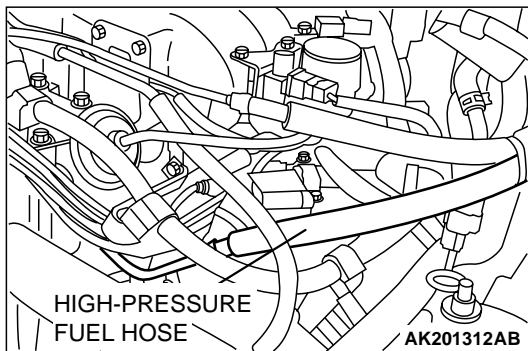
- MB991502: Scan Tool (MUT-II)
- MB991637: Fuel Pressure Gauge Set
- MD998709: Adaptor Hose
- MD998742: Hose Adaptor

1. Release residual pressure from the fuel line to prevent fuel spray. (Refer to [P.13Aa-15.](#))

⚠ WARNING

To prevent a fire, cover the hose connection with shop towels to prevent splashing of fuel that could be caused by some residual pressure in the fuel pipe line.

2. Disconnect the fuel high-pressure hose at the fuel rail side.
3. Assemble the fuel pressure measurement tools as follows.

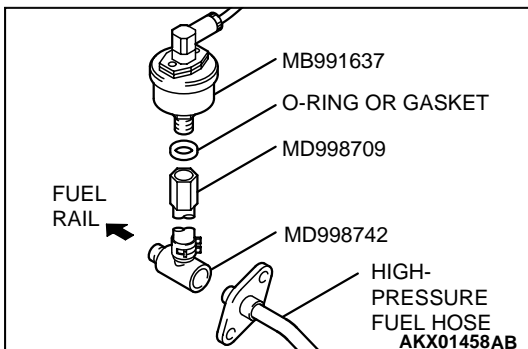


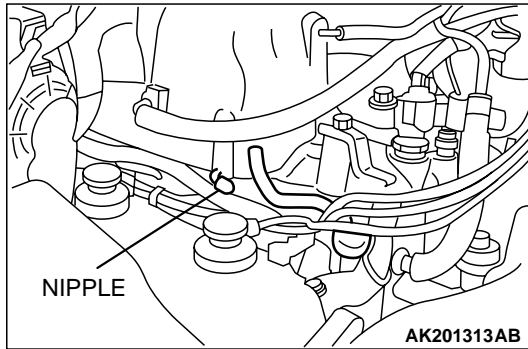
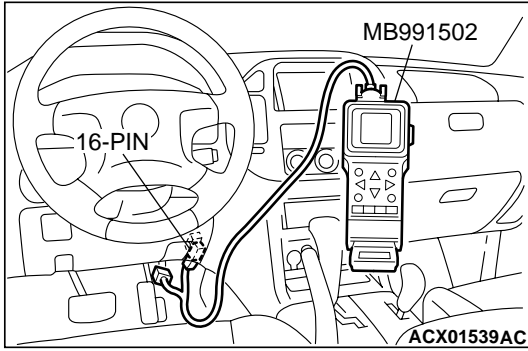
<When using the fuel pressure gauge>

1. Remove the union joint and bolt from special tool MD998709 (adapter hose) and instead attach special tool MD998742 (hose adapter) to the adapter hose.
2. Place a suitable O-ring or gasket on the assembled special tools MD998709 and MD998742 and install the fuel pressure gauge.
3. Install the assembled fuel pressure measurement tools between the fuel rail and fuel high-pressure hose.

<When using special tool MB991637 (fuel pressure gauge set)>

1. Remove the union joint and bolt from special tool MD998709 (adapter hose) and instead attach special tool MD998742 (hose adapter) to the adapter hose.
2. Install special tool MB991637 (fuel pressure gauge set) into assembled special tools MD998709 and MD998742 via a gasket.
3. Install the assembled fuel pressure measurement tools between the fuel rail and fuel high-pressure hose.





CAUTION

To prevent damage to scan tool MB991502, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.

4. Connect scan tool MB991502 to the data link connector.
5. Use Actuator test 07 to drive the fuel pump. Check that there is no fuel leaking from any section when the fuel pump is operating.
6. Stop the fuel pump.
7. Start the engine and run at idle.
8. Measure fuel pressure while the engine is running at idle.

Standard value: Approximately 270 kPa (38 psi) at curb idle

9. Disconnect the vacuum hose (blue stripe) from the fuel pressure regulator and measure the fuel pressure with the hose end closed with your finger.

Standard value: 330 – 350 kPa (47 – 50 psi) at curb idle

10. Check to see that fuel pressure at idle does not drop even after the engine has been revved several times.
11. Revving the engine repeatedly, hold the fuel return hose lightly with your fingers to feel that fuel pressure is present in the return hose.

NOTE: If the fuel flow rate is low, there will be no fuel pressure in the return hose.

12. If any of fuel pressure measured in steps 8 to 11 is out of specification, troubleshoot and repair according to the table below.

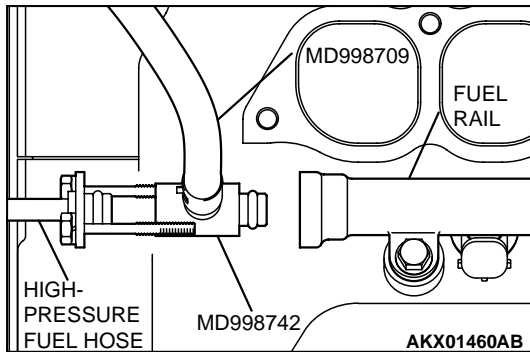
SYMPTOM	PROBABLE CAUSE	REMEDY
<ul style="list-style-type: none"> • Fuel pressure too low • Fuel pressure drops after racing • No fuel pressure in fuel return hose 	Clogged fuel filter	Replace fuel filter
	Fuel leaking to return side due to poor fuel regulator valve seating or settled spring	Replace fuel pressure regulator
	Low fuel pump delivery pressure	Replace fuel pump
Fuel pressure too high	Binding valve in fuel pressure regulator	Replace fuel pressure regulator
	Clogged fuel return hose or pipe	Clean or replace hose or pipe
Same fuel pressure when vacuum hose is connected and when disconnected	Damaged vacuum hose or clogged nipple	Replace vacuum hose or clean nipple
	Defective fuel pressure regulator	Replace fuel pressure regulator

13. Stop the engine and observe fuel pressure gauge reading. It is normal if the reading does not drop within two minutes. If it does, observe the rate of drop and troubleshoot and repair according to the table below. Start, then stop the engine.

- (1) Squeeze the fuel return line closed to confirm leak-down occurs from defective fuel pressure regulator.

- (2) Squeeze the fuel supply line closed to confirm leak-down occurs from defective fuel pump check valve.
- (3) If pressure continues to drop with both fuel lines squeezed closed, injector(s) are leaking.

SYMPTOM	PROBABLE CAUSE	REMEDY
Fuel pressure drops gradually after engine is stopped	Leaky injector	Replace injector
	Leaky fuel regulator valve seat	Replace fuel pressure regulator
Fuel pressure drops sharply immediately after engine is stopped	Check valve in fuel pump is held open	Replace fuel pump



14. Release residual pressure from the fuel pipe line. (Refer to P.13Aa-15.)

⚠ WARNING

Cover the hose connection with shop towels to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.

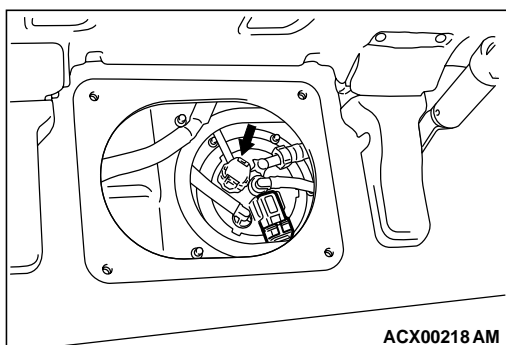
15. Remove the fuel pressure gauge, and special tools MD998709, MD998742 and MB991637 from the fuel rail.
16. Replace the O-ring at the end of the fuel high-pressure hose with a new one.
17. Fit the fuel high-pressure hose into the fuel rail and tighten the bolts to specified torque.
Tightening torque: 4.9 ± 1.0 N·m (43 ± 8 in-lb)
18. Check for fuel leaks.
 - (1) Use scan tool MB991502 to operate the fuel pump.
 - (2) Check the fuel line for leaks and repair as needed.
19. Disconnect scan tool MB991502.

**FUEL PUMP CONNECTOR DISCONNECTION
(HOW TO REDUCE PRESSURIZED FUEL LINES)**

M1131000900451

When removing the fuel pipe, hose, etc., release fuel pressure to prevent fuel splay.

1. Turn the ignition switch to the "LOCK" (OFF) position.
2. Fold down the second seat.
3. Remove the service hole cover (upper) and packing.
4. Remove the service hole cover (lower) and packing.
5. Disconnect fuel pump module connector.
6. Start the engine and let it run until it stops naturally. Turn the ignition switch to the "LOCK" (OFF) position.
7. Connect the fuel pump module connector.



FUEL PUMP OPERATION CHECK

M1131002000476

Required Special Tool:

MB991502: Scan Tool (MUT-II)

⚠ CAUTION

To prevent damage to scan tool MB991502, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.

1. Check the operation of the fuel pump by using scan tool MB991502 (MUT-II) to force-drive the fuel pump.
2. If the fuel pump will not operate, check by using the following procedure, and if it is normal, check the drive circuit.

(1) Turn the ignition switch to the "LOCK" (OFF) position.

(2) Remove fuel pump relay (2).

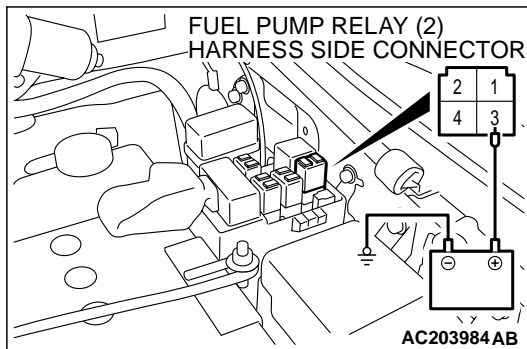
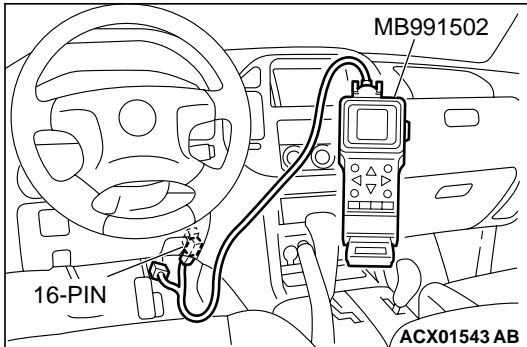
Connect terminal number 3 of the harness-side connector to the battery.

Check if the fuel pump operation sound can be heard at this time.

NOTE: As the fuel pump is an in-tank type, the fuel pump sound is hard to hear, so remove the fuel filler cap and check from the tank inlet.

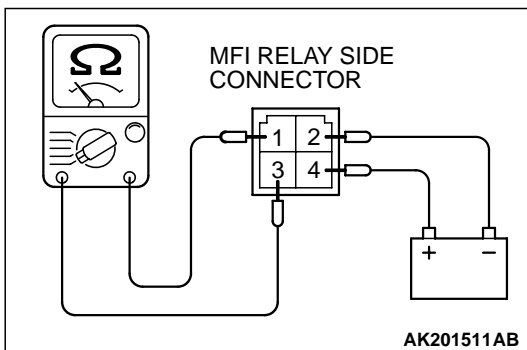
(3) Check the fuel pressure by pinching the fuel hose with the fingertips.

(4) Install fuel pump relay (2).



MULTIPOINT FUEL INJECTION (MFI) RELAY, THROTTLE ACTUATOR CONTROL MOTOR RELAY AND FUEL PUMP RELAY CONTINUITY CHECK

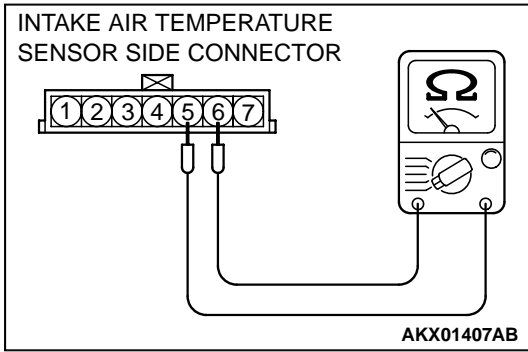
M1131052000017



BATTERY VOLTAGE	BATTERY POWER SUPPLY TERMINAL	SPECIFIED CONDITION
Supplied	2-4	1-3
Not supplied	-	2-4

INTAKE AIR TEMPERATURE SENSOR CHECK

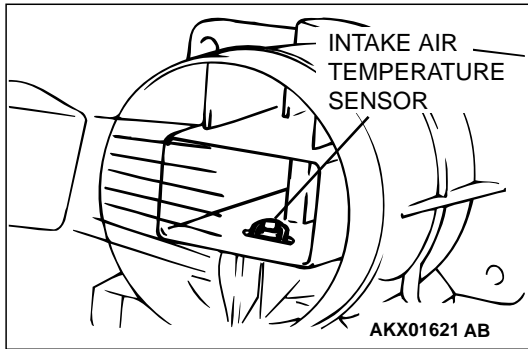
M1131002800159



1. Disconnect the volume air flow sensor connectors.
2. Measure resistance between terminals 5 and 6.

Standard value:

- 13 – 17 kΩ [at -20°C (-4°F)]
- 5.3 – 6.7 kΩ [at 0°C (32°F)]
- 2.3 – 3.0 kΩ [at 20°C (68°F)]
- 1.0 – 1.5 kΩ [at 40°C (104°F)]
- 0.56 – 0.76 kΩ [at 60°C (140°F)]
- 0.30 – 0.42 kΩ [at 80°C (176°F)]



3. If not within specifications, replace the volume air flow sensor.
4. Measure resistance while heating the sensor using a hair dryer.

Normal condition:

TEMPERATURE	RESISTANCE (kΩ)
Higher	Smaller

5. If resistance does not decrease as heat increases, replace the volume air flow sensor assembly.

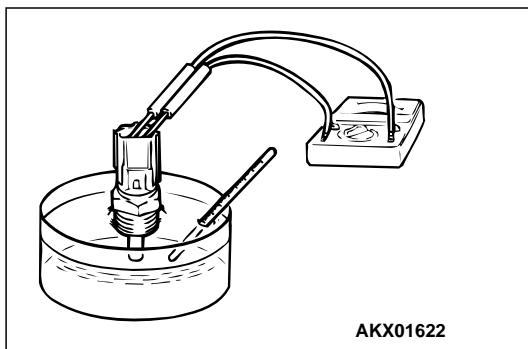
ENGINE COOLANT TEMPERATURE SENSOR CHECK

M1131003100153

CAUTION

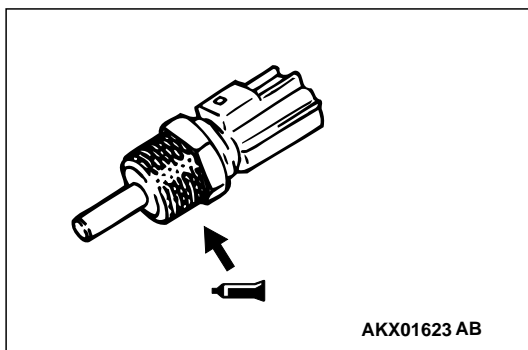
Be careful not to touch the connector (resin section) with the tool when removing and installing.

1. Drain engine coolant, then remove the engine coolant temperature sensor.
2. With the temperature sensing portion of engine coolant temperature sensor immersed in hot water, check the resistance.



Standard value:

- 14 – 17 kΩ [at -20°C (-4°F)]
- 5.1 – 6.5 kΩ [at 0°C (32°F)]
- 2.1 – 2.7 kΩ [at 20°C (68°F)]
- 0.9 – 1.3 kΩ [at 40°C (104°F)]
- 0.48 – 0.68 kΩ [at 60°C (140°F)]
- 0.26 – 0.36 kΩ [at 80°C (176°F)]

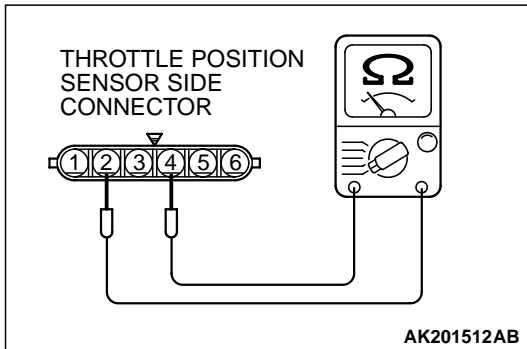
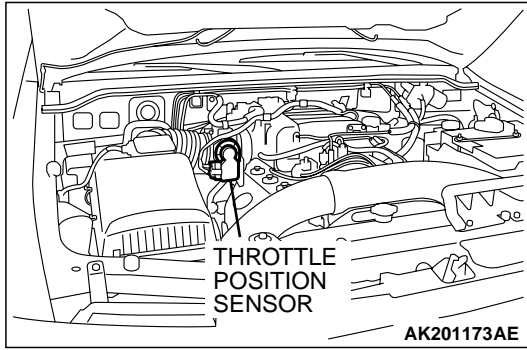


3. If resistance deviates from the standard value greatly, replace the sensor.
4. Apply 3M™ AAD part number 8731 or equivalent to threaded portion.
5. Install the engine coolant temperature sensor and tighten it to the specified torque.

Tightening torque: 29 ± 10 N·m (22 ± 7 ft-lb)

THROTTLE POSITION SENSOR CHECK

M1131003200291



1. Disconnect the throttle position sensor connector.

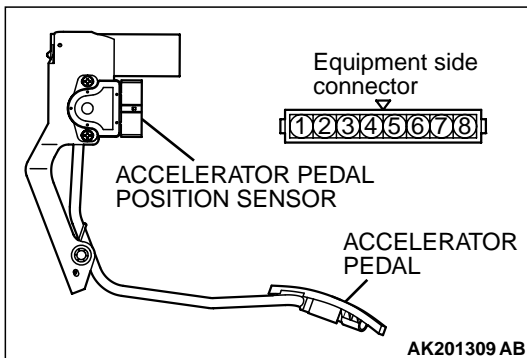
2. Measure the resistance between the throttle position sensor side connector terminal No. 2 (sensor power supply) and terminal No. 4 (sensor ground).

Standard value: 2.0 – 4.0 kilohms [at 20°C (68°F)]

3. If resistance is outside the standard value, replace the throttle body assembly.

ACCELERATOR PEDAL POSITION SENSOR CHECK

M1131003400024



1. Disconnect the accelerator pedal position sensor connector.
2. Measure the resistance between accelerator pedal position sensor connector terminal No. 1 [accelerator pedal position sensor (main) earth] and terminal No. 2 [accelerator pedal position sensor (main) power supply], and between terminal No.7 [accelerator pedal position sensor (sub) earth] and terminal No. 8 [accelerator pedal position sensor (sub) power supply].

Standard value: 3.5 – 6.5 kilohms

3. Measure the resistance between accelerator pedal position sensor connector terminal No. 2 [accelerator pedal position sensor (main) power supply] and terminal No. 3 [accelerator pedal position sensor (main) output]; and between terminal No.8 [accelerator pedal position sensor (sub) power supply] and terminal No. 6 [accelerator pedal position sensor (sub) output].

Normal condition:

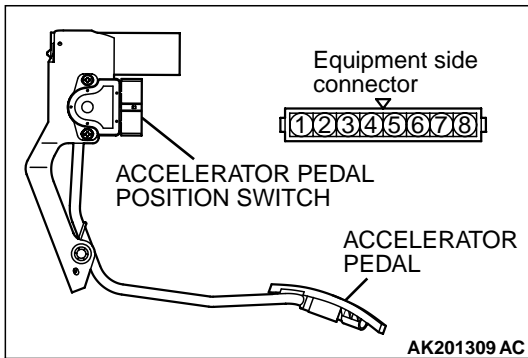
When accelerator pedal is gently depressed	Changes comparatively smoothly in proportion to the accelerator pedal depression amount.
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4. If the measured values are outside the standard value range, or if the resistance does not change smoothly, replace the accelerator pedal position sensor.

NOTE: After replacement, adjust the accelerator pedal position sensor. (Refer to P.13Aa-12.)

ACCELERATOR PEDAL POSITION SWITCH CHECK

M1131052500012



1. Disconnect the accelerator pedal position sensor connector.
2. Check continuity between terminal No. 4 (accelerator pedal position switch) and No. 5 (sensor earth) of the connector.

Normal condition:

Accelerator pedal	Continuity
Depressed	No continuity
Released	Continuity (0 kΩ)

3. If defective, replace the accelerator pedal position sensor assembly.

NOTE: After replacement, adjust the accelerator pedal position sensor. (Refer to P.13Aa-12.)

HEATED OXYGEN SENSOR CHECK

M1131005000323

Required Special Tools:

- MB991316: Test Harness Set
- MD998464: Test Harness

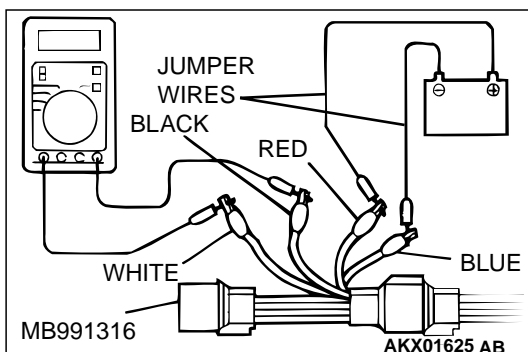
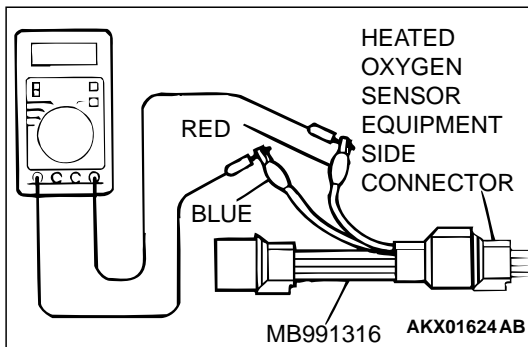
<Left bank heated oxygen sensor (front)>

1. Using scan tool MB991502, observe HO₂S reading. If values are unsatisfactory, or if a scan tool is not available, use the following procedure:
 - (1) Disconnect the heated oxygen sensor connector and connect special tool MB991316 to the connector on the heated oxygen sensor side.
 - (2) Make sure that there is continuity [4.5-8.0 kilohms at 20°C (68°F)] between terminal No. 1 (red clip of special tool) and terminal No. 3 (blue clip of special tool) on the heated oxygen sensor connector
 - (3) If there is no continuity, replace the heated oxygen sensor.
 - (4) Warm up the engine until engine coolant is 80°C (176°F) or higher.

⚠ CAUTION

Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.

- (5) Use the jumper wires to connect terminal No. 1 (red clip) of the heated oxygen sensor connector to the positive battery terminal and terminal No. 3 (blue clip) to the negative battery terminal.
 - (6) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
2. While repeatedly revving the engine, measure the heated oxygen sensor output voltage.



Standard value:

ENGINE	HEATED OXYGEN SENSOR OUTPUT VOLTAGE	REMARKS
When revving engine	0.6 – 1.0 V	If you make the air/fuel ratio rich by revving the engine repeatedly, a normal heated oxygen sensor will output a voltage of 0.6 – 1.0 V.

3. If the sensor is defective, replace the heated oxygen sensor.

NOTE: For removal and installation of the heated oxygen sensor, refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-13.

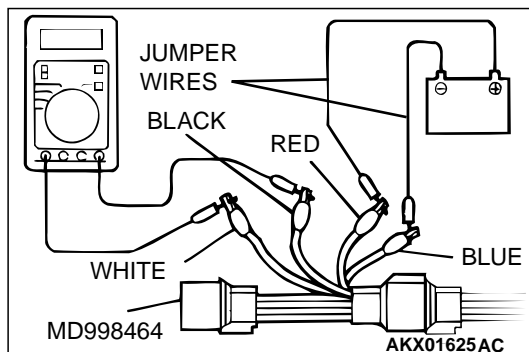
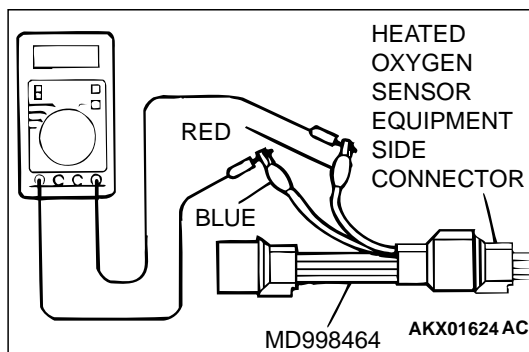
<Right bank heated oxygen sensor (front)>

- Using scan tool MB991502, observe HO₂S reading. If values are unsatisfactory, or if a scan tool is not available, use the following procedure:
 - Disconnect the heated oxygen sensor connector and connect special tool MD998464 to the connector on the heated oxygen sensor side.
 - Make sure that there is continuity [4.5-8.0 kilohms at 20°C (68°F)] between terminal No. 1 (red clip of special tool) and terminal No. 3 (blue clip of special tool) on the heated oxygen sensor connector
 - If there is no continuity, replace the heated oxygen sensor.
 - Warm up the engine until engine coolant is 80°C (176°F) or higher.

CAUTION

Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.

- Use the jumper wires to connect terminal No. 1 (red clip) of the heated oxygen sensor connector to the positive battery terminal and terminal No. 3 (blue clip) to the negative battery terminal.
 - Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
2. While repeatedly revving the engine, measure the heated oxygen sensor output voltage.



Standard value:

ENGINE	HEATED OXYGEN SENSOR OUTPUT VOLTAGE	REMARKS
When revving engine	0.6 – 1.0 V	If you make the air/fuel ratio rich by revving the engine repeatedly, a normal heated oxygen sensor will output a voltage of 0.6 – 1.0 V.

3. If the sensor is defective, replace the heated oxygen sensor.

NOTE: For removal and installation of the heated oxygen sensor, refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-13.

<Left bank heated oxygen sensor (rear)>

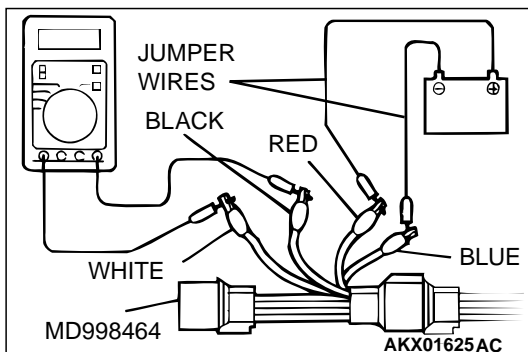
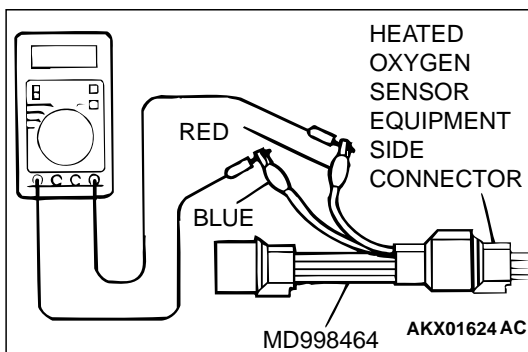
1. Using scan tool MB991502, observe HO₂S reading. If values are unsatisfactory, or if a scan tool is not available, use the following procedure:

- (1) Disconnect the heated oxygen sensor connector and connect special tool MD998464 to the connector on the heated oxygen sensor side.
- (2) Make sure that there is continuity [11 - 18 kilohms at 20°C (68°F)] between terminal No. 1 (red clip of special tool) and terminal No. 3 (blue clip of special tool) on the heated oxygen sensor connector
- (3) If there is no continuity, replace the heated oxygen sensor.
- (4) Warm up the engine until engine coolant is 80°C (176°F) or higher.

CAUTION

Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.

- (5) Use the jumper wires to connect terminal No. 1 (red clip) of the heated oxygen sensor connector to the positive battery terminal and terminal No. 3 (blue clip) to the negative battery terminal.
 - (6) Connect a digital voltage meter between terminal 2 (black clip) and terminal No. 4 (white clip).
2. While repeatedly revving the engine, measure the heated oxygen sensor output voltage.



Standard value:

ENGINE	HEATED OXYGEN SENSOR OUTPUT VOLTAGE	REMARKS
When revving engine	0.6 – 1.0 V	If you make the air/fuel ratio rich by revving the engine repeatedly, a normal heated oxygen sensor will output a voltage of 0.6 – 1.0 V.

3. If the sensor is defective, replace the heated oxygen sensor.
NOTE: For removal and installation of the heated oxygen sensor, refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-13.

<Right bank heated oxygen sensor (rear)>

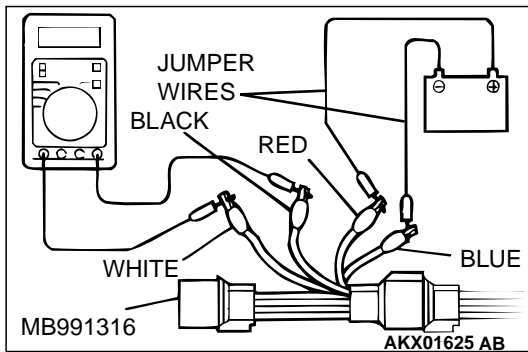
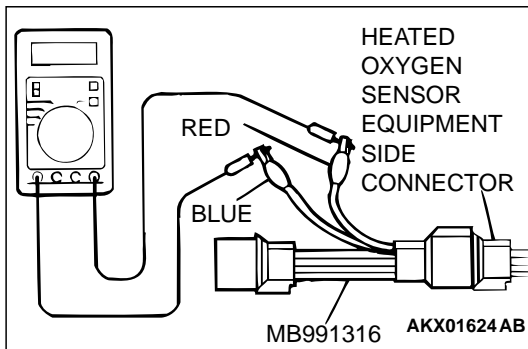
1. Using scan tool MB991502, observe HO₂S reading. If values are unsatisfactory, or if Scan tool is not available, use the following procedure:

- (1) Disconnect the heated oxygen sensor connector and connect special tool MB991316 to the connector on the heated oxygen sensor side.
- (2) Make sure that there is continuity [11-18 kilohms at 20°C (68°F)] between terminal No. 1 (red clip of special tool) and terminal No. 3 (blue clip of special tool) on the heated oxygen sensor connector
- (3) If there is no continuity, replace the heated oxygen sensor.
- (4) Warm up the engine until engine coolant is 80°C (176°F) or higher.

CAUTION

Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.

- (5) Use the jumper wires to connect terminal No. 1 (red clip) of the heated oxygen sensor connector to the positive battery terminal and terminal No. 3 (blue clip) to the negative battery terminal.
 - (6) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
2. While repeatedly revving the engine, measure the heated oxygen sensor output voltage.



Standard value:

ENGINE	HEATED OXYGEN SENSOR OUTPUT VOLTAGE	REMARKS
When revving engine	0.6 – 1.0 V	If you make the air/fuel ratio rich by revving the engine repeatedly, a normal heated oxygen sensor will output a voltage of 0.6 – 1.0 V.

3. If the sensor is defective, replace the heated oxygen sensor.

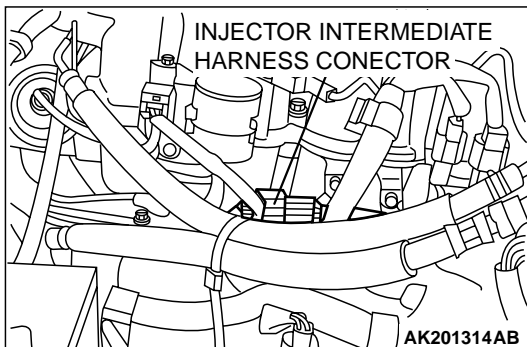
NOTE: For removal and installation of the heated oxygen sensor, refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-13.

INJECTOR CHECK

M1131005200219

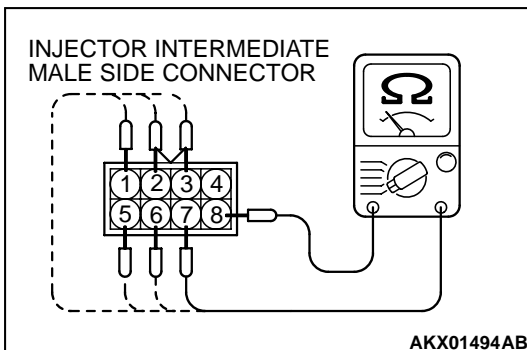
Measurement of Resistance between Terminals

1. Disconnect the injector intermediate connector.



2. Measure the resistor between the injector intermediate male side connector terminals.

Standard value:



INJECTOR NO.	MEASUREMENT TERMINAL	RESISTANCE
NO. 1	8 – 3	13 – 16 kΩ [20°C (68°F)]
NO. 2	8 – 2	
NO. 3	8 – 1	
NO. 4	8 – 7	
NO. 5	8 – 6	
NO. 6	8 – 5	

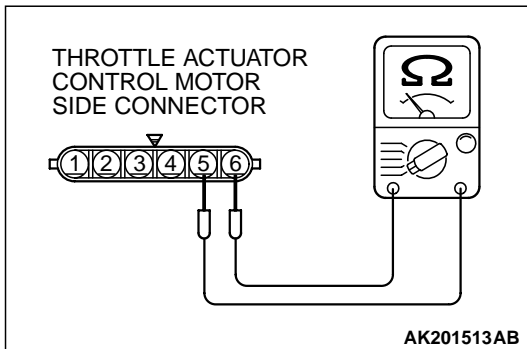
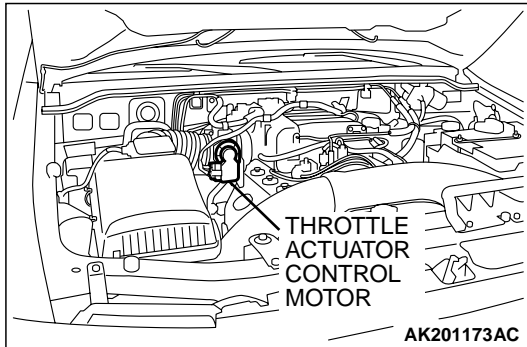
3. Connect the injector intermediate connector.

**THROTTLE ACTUATOR CONTROL MOTOR
CHECK**

M1131051000014

<Operation Inspection>

1. Disconnect the air intake hose from the throttle body.
2. Set the ignition switch to the ON position.
3. Operate the accelerator pedal and confirm that the throttle valve is opening and closing accordingly.

**<Checking the Terminal Resistance>**

1. Disconnect the throttle position sensor connector.
2. Measure the resistance between terminal No. 5 and No. 6.
Standard value 0.3 – 100 ohms [at 20°C (68°F)]
3. If resistance is outside the standard value, replace the throttle body assembly.

**EVAPORATIVE EMISSION PURGE SOLENOID
CHECK**

M1131005600024

Refer to GROUP 17, Emission Control System – Evaporative Emission Control System – Evaporative Emission Purge Solenoid Check [P.17-62](#).

EGR VALVE CHECK

M1131051500019

Refer to GROUP 17, Emission Control System – Exhaust Gas Recirculation (EGR) System – EGR Valve Check. [P.17-64](#)

INTAKE MANIFOLD TUNING SOLENOID CHECK

M1131006500031

Refer to GROUP 15, Intake and Exhaust System – On-vehicle Service – Intake Manifold Tuning Solenoid Check [P.15-4](#).

INJECTOR

REMOVAL AND INSTALLATION

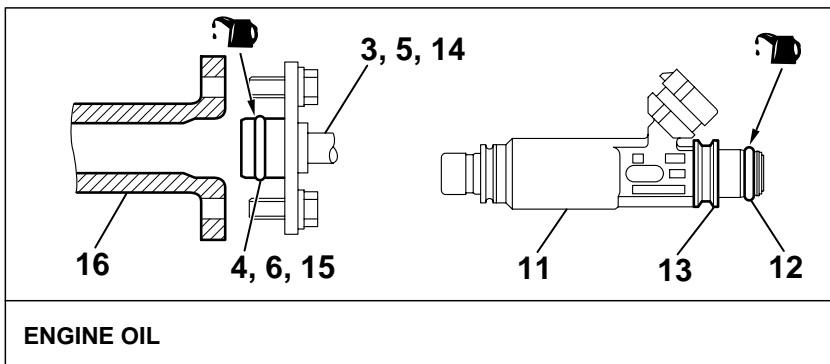
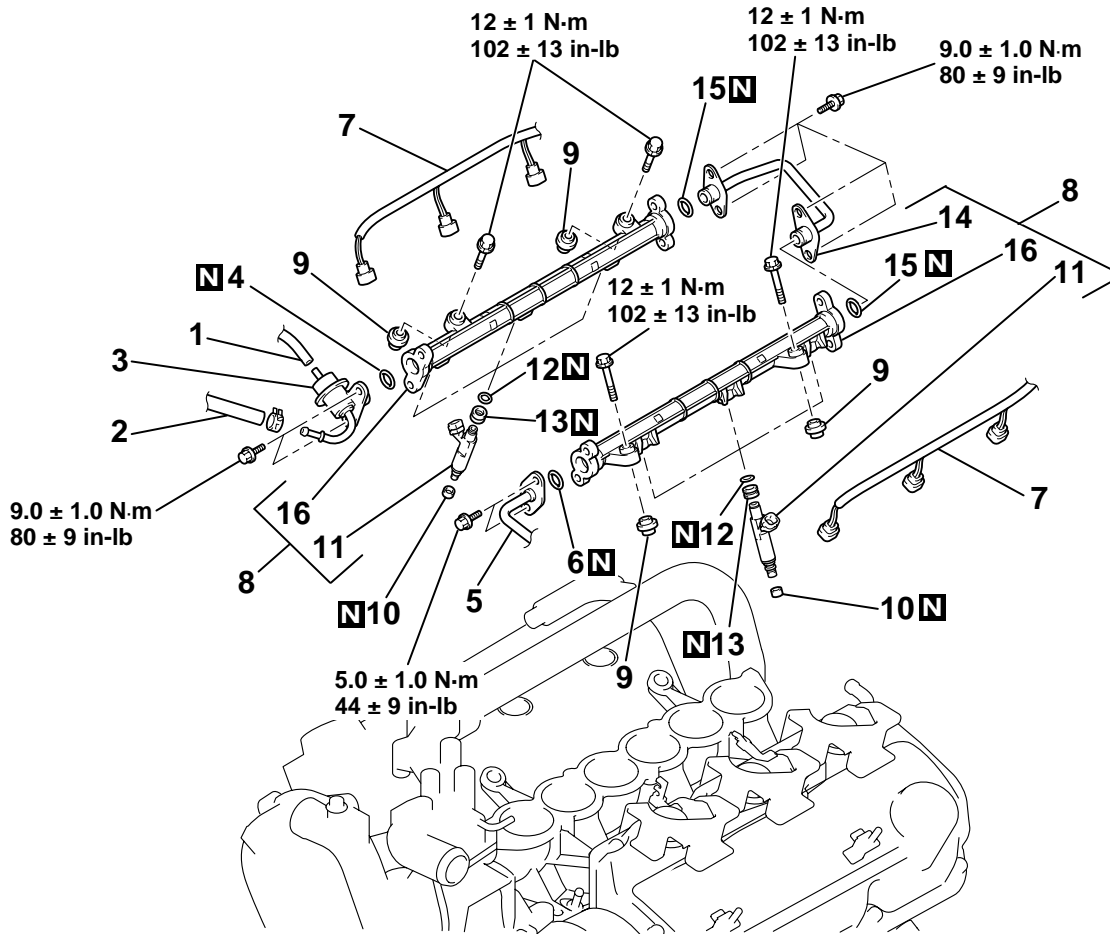
M1131007100434

Pre-removal Operation

- Fuel Line Pressure Reduction (Refer to P.13Aa-15).
- Intake Manifold Plenum Removal (Refer to GROUP15 P.15-7).

Post-installation Operation

- Intake Manifold Plenum Installation (Refer to GROUP 15 P.15-7).
- Fuel Leakage Inspection



ENGINE OIL

AC203985AB

REMOVAL STEPS

1. VACUUM HOSE
2. FUEL RETURN HOSE CONNECTION
- >>A<< 3. FUEL PRESSURE REGULATOR
4. O-RING
- >>A<< 5. FUEL HIGH-PRESSURE HOSE CONNECTION

<<A>>

REMOVAL STEPS (Continued)

6. O-RING
7. INJECTOR CONNECTORS
8. FUEL INJECTORS, FUEL PIPE AND FUEL RAILS ASSEMBLY
9. INSULATORS
10. INSULATORS
- >>A<< 11. INJECTORS

REMOVAL STEPS (Continued)

- >>A<<
12. O-RINGS
 13. GROMMETS
 14. FUEL PIPE
 15. O-RINGS
 16. FUEL RAILS

REMOVAL SERVICE POINT**<<A>> FUEL INJECTORS, FUEL PIPE AND FUEL RAILS
ASSEMBLY REMOVAL**** CAUTION**

Do not drop the injector.

INSTALLATION SERVICE POINT**>>A<< FUEL PIPE/INJECTORS/FUEL PRESSURE REGU-
LATOR/FUEL HIGH-PRESSURE HOSE INSTALLATION**** CAUTION**

Do not let the engine oil get into the fuel rail. Or the injectors will be damaged.

1. Apply a drop of new engine oil to the O-rings.
2. Turn the fuel pipe to the right and left to install to the fuel rails. Repeat for injectors, fuel pressure regulator and fuel high-pressure hose.
Be careful not to damage the O-ring. After installing, check that the item turns smoothly.
3. If it does not turn smoothly, the O-ring may be trapped, remove the item, re-install it into the fuel rails and check again.
4. Tighten the fuel pipe, fuel high-pressure hose and fuel pressure regulator to the specified torque.

Tightening torque:

9.0 ± 1.0 N·m (80 ± 9 in-lb) <Fuel pipe and fuel pressure regulator>

5.0 ± 1.0 N·m (44 ± 9 in-lb) <Fuel-high pressure hose>

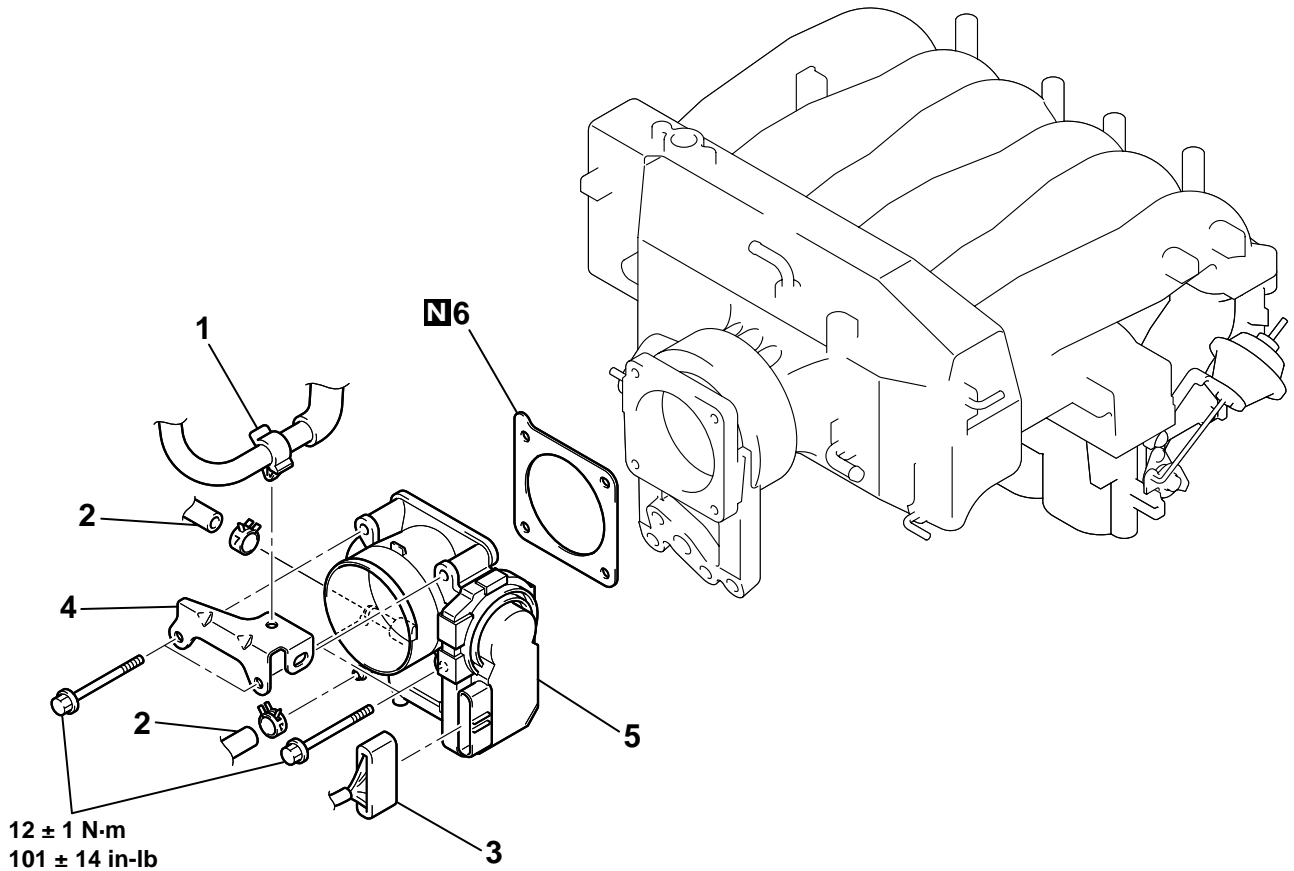
THROTTLE BODY ASSEMBLY

REMOVAL AND INSTALLATION

M1131007700403

Pre-removal and Post-installation Operation

- Engine Coolant Draining and Refilling (Refer to GROUP 00, Maintenance Service P.00-44).
- Intake Air Duct and Air Cleaner Housing Cover Assembly Removal and Installation (Refer to GROUP 15, Air Cleaner P.15-6).



AC203986AB

REMOVAL STEPS

1. PURGE HOSE CLIP CONNECTION
2. WATER HOSES CONNECTION
3. THROTTLE POSITION SENSOR CONNECTOR

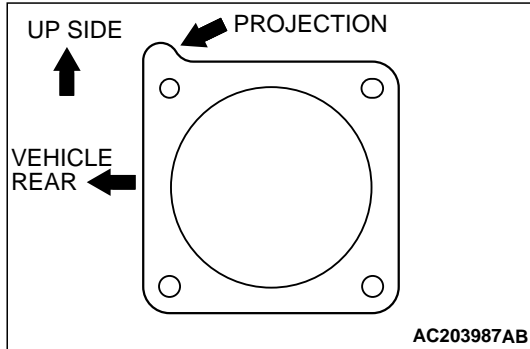
REMOVAL STEPS (Continued)

- >>A<<
4. PURGE HOSE BRACKET
 5. THROTTLE BODY
 6. THROTTLE BODY GASKET

INSTALLATION SERVICE POINT**>>A<< THROTTLE BODY GASKET INSTALLATION****⚠ CAUTION**

Poor idling may result if the throttle body gasket is installed incorrectly.

Install the throttle body gasket as shown in the illustration.



SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

M1131011600421

ITEM	SPECIFICATION
Engine coolant temperature sensor	29 ± 10 N·m (22 ± 7 ft-lb)
Fuel pipe attaching bolts	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Fuel pressure regulator attaching bolts	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Fuel rail mounting bolts	12 ± 1 N·m (102 ± 13 in-lb)
Fuel high-pressure hose attaching bolts	5.0 ± 1.0 N·m (44 ± 9 in-lb)
Throttle body mounting bolts	13 ± 2 N·m (115 ± 18 in-lb)

GENERAL SPECIFICATIONS

M1131000200429

ITEMS		SPECIFICATIONS
Throttle body	Throttle bore mm (in.)	65 (2.56)
	Throttle position sensor	Hall element type
	Throttle actuator control motor	DC motor type, having brushes
Powertrain control module (PCM)	Identification model No.	E6T38374
Sensors	Volume airflow sensor	Karman vortex type
	Barometric pressure sensor	Semiconductor type
	Intake air temperature sensor	Thermistor type
	Engine coolant temperature sensor	Thermistor type
	Heated oxygen sensor	Zirconia type
	Accelerator pedal position sensor	Variable resistor type
	Accelerator pedal position switch	Contact switch type
	Transmission range switch	Contact switch type
	Camshaft position sensor	Electromagnetic resistance element type
	Crankshaft position sensor	Hall element type
	Knock sensor	Piezoelectric type
	Power steering pressure switch	Contact switch type
	Manifold differential pressure sensor	Semiconductor type
Actuators	Multipoint fuel injection (MFI) relay	Contact switch type
	Fuel pump relay	Contact switch type
	Throttle actuator control motor relay	Contact switch type
	Injector type and number	Electromagnetic type, 6
	Injector identification mark	GDH305
	EGR valve	Stepper motor type
	Evaporative emission purge solenoid	Duty cycle type solenoid valve
Fuel pressure regulator	Regulator pressure kPa (psi)	335 (47.6)

SERVICE SPECIFICATIONS

M1131000300330

ITEMS		STANDARD VALUE
Accelerator pedal position sensor adjusting voltage mV		0.905 – 1.165
Basic idle speed r/min		700 ± 50
Fuel pressure kPa (psi)	Vacuum hose disconnected	330 – 350 (47 – 50) at curb idle
	Vacuum hose connected	Approximately 270 (38) at curb idle
Intake air temperature sensor resistance kΩ	-20°C (-4°F)	13 – 17
	0°C (32°F)	5.3 – 6.7
	20°C (68°F)	2.3 – 3.0
	40°C (104°F)	1.0 – 1.5
	60°C (140°F)	0.56 – 0.76
	80°C (176°F)	0.30 – 0.42
Engine coolant temperature sensor resistance kΩ	-20°C (-4°F)	14 – 17
	0°C (32°F)	5.1 – 6.5
	20°C (68°F)	2.1 – 2.7
	40°C (104°F)	0.9 – 1.3
	60°C (140°F)	0.48 – 0.68
	80°C (176°F)	0.26 – 0.36
Throttle position sensor resistance kΩ		2.0 – 4.0
Accelerator pedal position sensor (main, sub) resistance kΩ		3.5 – 6.5
Heated oxygen sensor output voltage V		0.6 – 1.0
Heated oxygen sensor heater resistance Ω	HO ₂ S (front)	4.5 – 8.0
	HO ₂ S (rear)	11 – 18
Injector coil resistance Ω		13 – 16 [at 20°C (68°F)]
Throttle actuator control motor coil resistance Ω		0.3 – 100 [at 20°C (68°F)]

SEALANT AND ADHESIVE

M1131000500022

ITEM	SPECIFIED SEALANT
Engine coolant temperature sensor threaded portion	3M™ AAD part number 8731 or equivalent