GASOLINE DIRECT INJECTION (GDI) <4G6>

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GENERAL

OUTLINE OF CHANGES

The following service procedures for items which are different from before have been established to correspond to the changes in the 4G64-GDI engine for SPACE WAGON.
Other service procedures are the same as before.

- An integrated-type accelerator pedal position sensor has been adopted.
- A GDI ECO indication lamp has been adopted.
- The fuel feed pipe and fuel return pipe shapes have been changed.

GENERAL SPECIFICATIONS

Items			Specifications
Engine-ECU	Identification model No.	Except vehicles for Germany	E2T72584H1 <M/T> E2T72585H1 <A/T>
		Vehicles for Germany	E2T72586H <M/T> E2T72587H <A/T>

SERVICE SPECIFICATIONS

Items	Standard value
Adjustment voltages (1) and (2) of accelrator pedal position sensor V	0.5 - 0.9
Resistance (1) and (2) of accelerator pedal position sensor kΩ	3.5 - 6.5

TROUBLESHOOTING

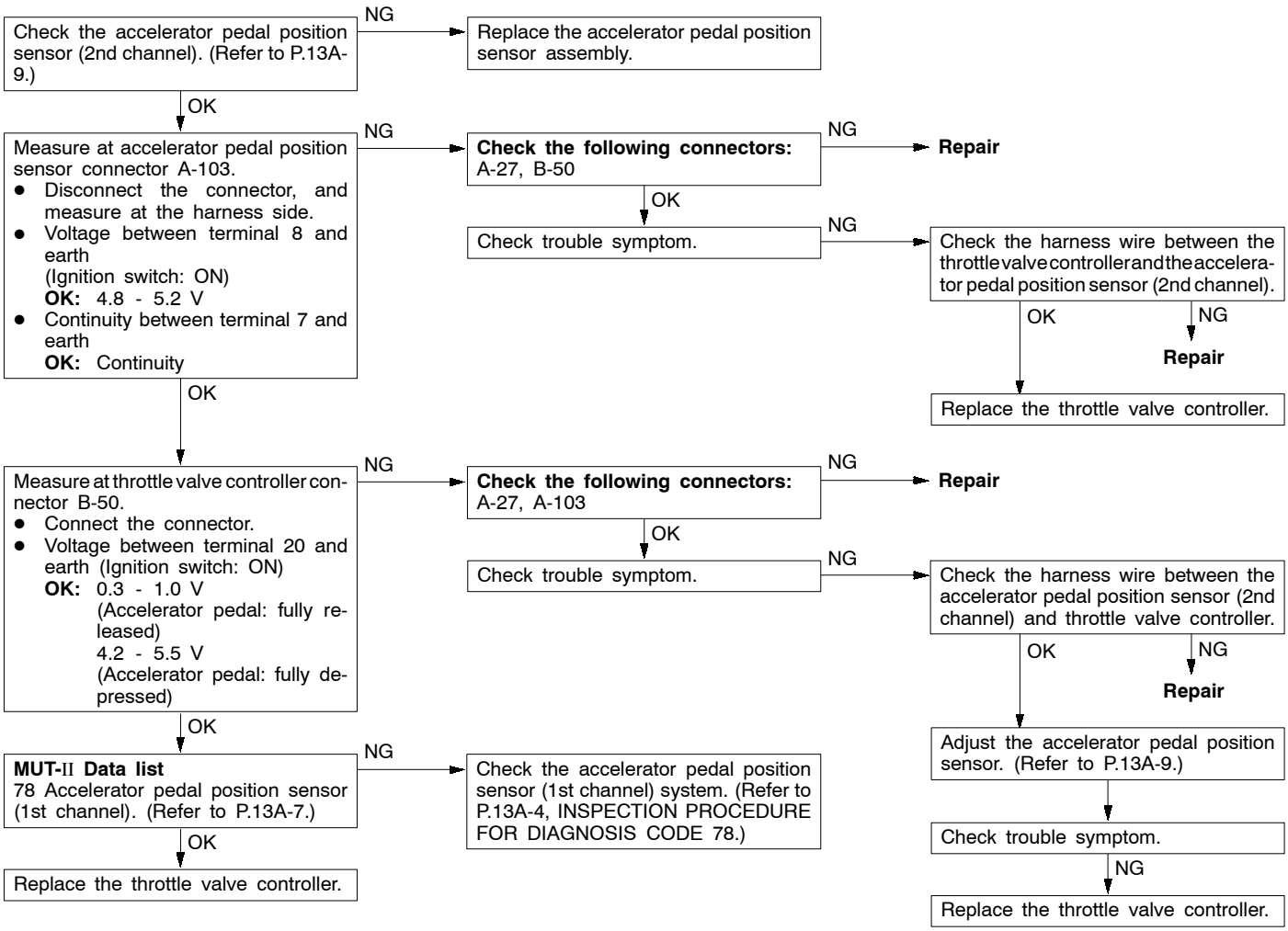
INSPECTION CHART FOR DIAGNOSIS CODES

Diagnosis code Nos.77 and 78 have been changed in line with the adoption of an integrated-type accelerator pedal position sensor. Other items are the same as before.

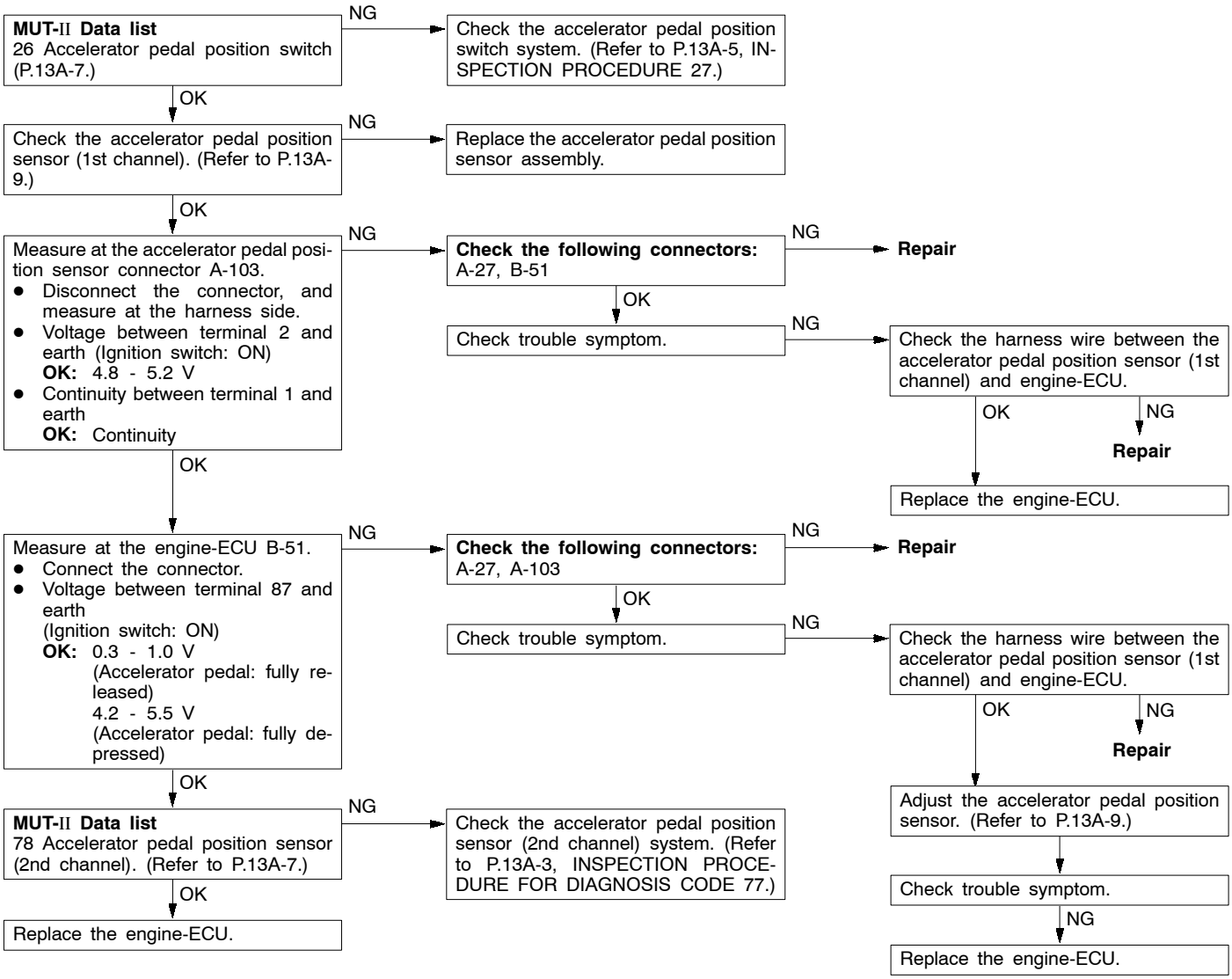
Code No.	Diagnosis item	Reference page
77	Accelerator pedal position sensor (2nd channel) system	13A-3
78	Accelerator pedal position sensor (1st channel) system	13A-4

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code No.77 Accelerator pedal position sensor (2nd channel) system	Probable cause
Range of check ● Accelerator pedal position sensor (1st channel) system is normal. ● Communication between the engine-ECU and throttle valve controller is normal. Set conditions ● Output voltage of accelerator position sensor (2nd channel) system is 0.2 V or less for one second. or ● Output voltage of the accelerator pedal position sensor (1st channel) is 2.5 V or less, and output voltage of the accelerator pedal position sensor (2nd channel) is 4.5 V or more for one second. or ● Difference between the accelerator pedal position sensor output voltages (1st and 2nd channels) exceeds 1.0 V (i.e. when the throttle valve opening angle changes slightly).	● Malfunction of the accelerator pedal position sensor (2nd channel) ● Open circuit or short-circuited harness wire in the accelerator pedal position sensor (2nd channel) system, or poor connector contact ● Malfunction of the throttle valve controller ● Malfunction of the engine-ECU



Code No.78 Accelerator pedal position sensor (1st channel) system	Probable cause
Range of check ● Accelerator pedal position sensor (2nd channel) system is normal. ● Communication between the engine-ECU and throttle valve controller is normal. Set conditions ● Output voltage of accelerator position sensor (1st channel) system is 0.2 V or less for one second. or ● Output voltage of the accelerator pedal position sensor (2nd channel) is 2.5 V or less, and (1st channel) output voltage of the accelerator pedal position sensor is 4.5 V or more for one second. or ● Difference between the accelerator pedal position sensor (1st and 2nd channels) output voltages exceeds 1.0 V (i.e. when the throttle valve opening angle changes slightly). or ● Although the accelerator pedal position switch is on, 1st-channel output voltage of the accelerator pedal position sensor exceeds 1.1 V for one second.	● Malfunction of the accelerator pedal position sensor (1st channel) ● Open circuit or short-circuited harness wire in the accelerator pedal position sensor (1st channel) system, or poor connector contact ● ON-seizure of the accelerator pedal position switch ● Malfunction of the throttle valve controller ● Malfunction of the engine-ECU



INSPECTION CHART FOR TROUBLE SYMPTOMS

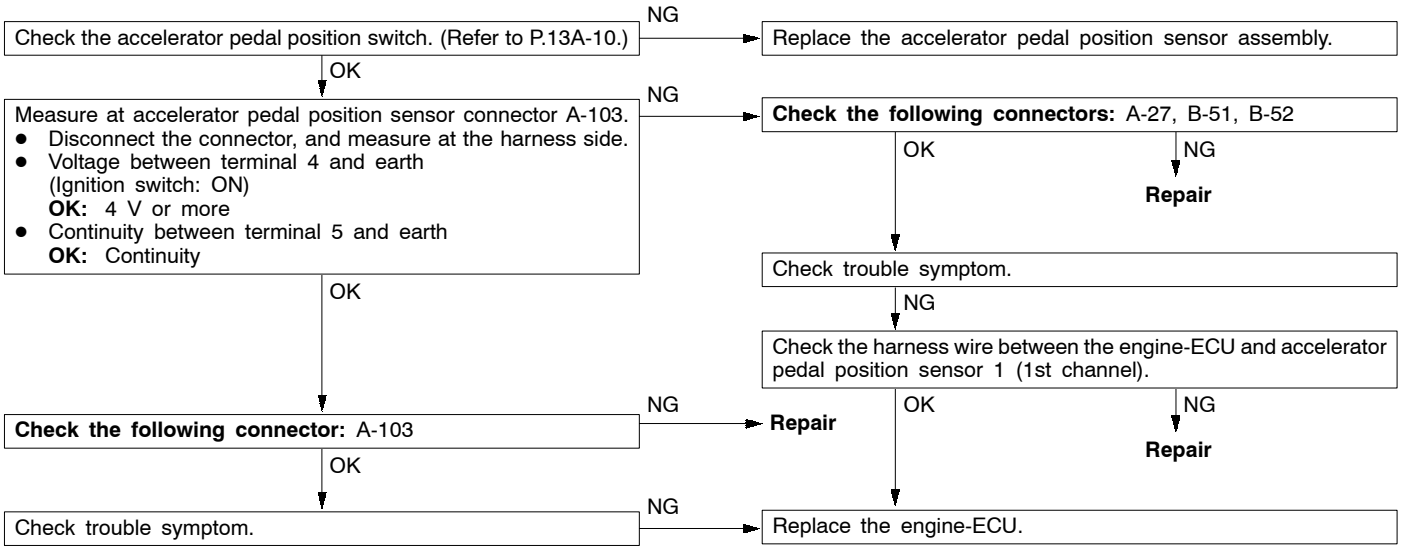
Inspection procedure No.27 has been changed in line with the adoption of an integrated-type accelerator pedal position sensor. Inspection procedure Nos.36 and 37 have been added in line with the adoption of a GDI indication lamp. Other items are the same as before.

Trouble symptom		Inspection procedure No.	Reference page
GDI ECO indication lamp system	GDI ECO indication lamp does not illuminate.	36	13A-6
	GDI ECO indication lamp remains on and does not go off.	37	13A-6

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

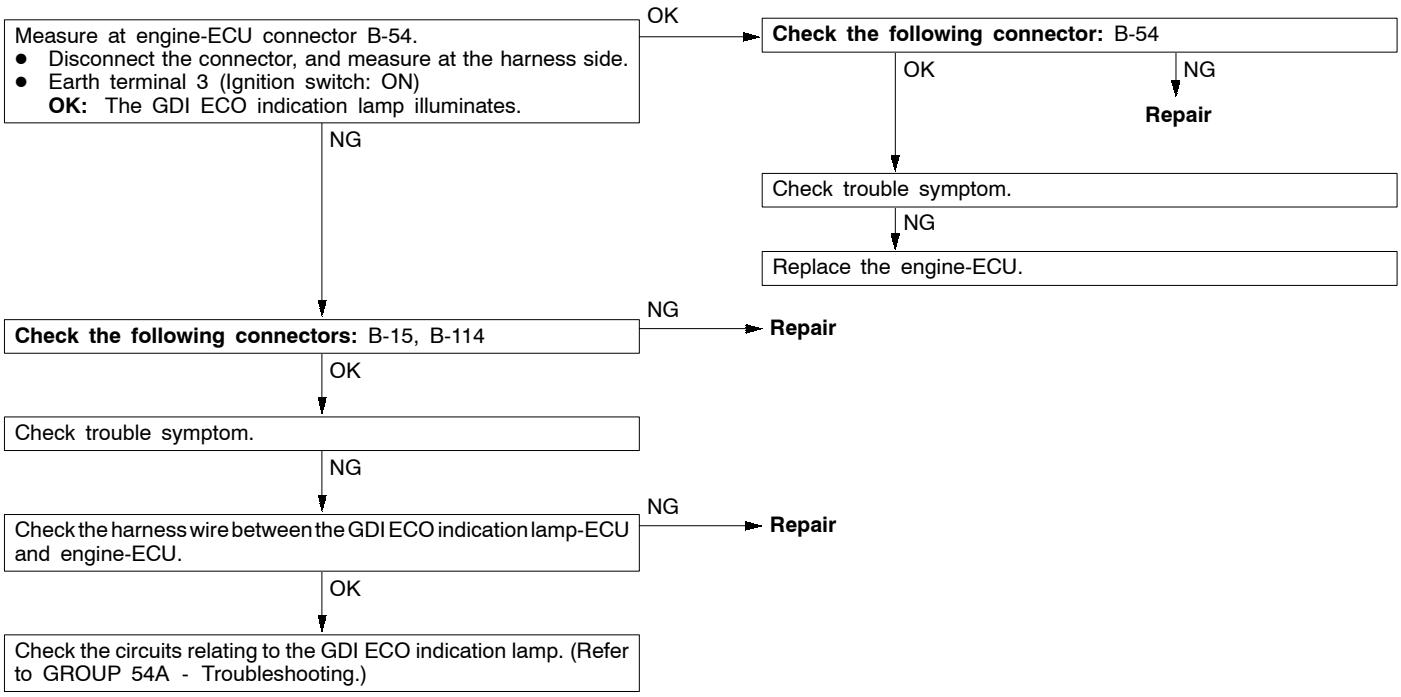
INSPECTION PROCEDURE 27

Accelerator pedal position switch system	Probable cause
The accelerator pedal position switch detects that the accelerator pedal is fully closed, and sends a signal to the engine-ECU. The engine-ECU controls idle speed, based on this signal.	• Maladjustment of the accelerator cable • Maladjustment of the accelerator pedal position switch • Open circuit or short-circuited harness wire in the accelerator pedal position switch system, or poor connector contact • Malfunction of the engine-ECU



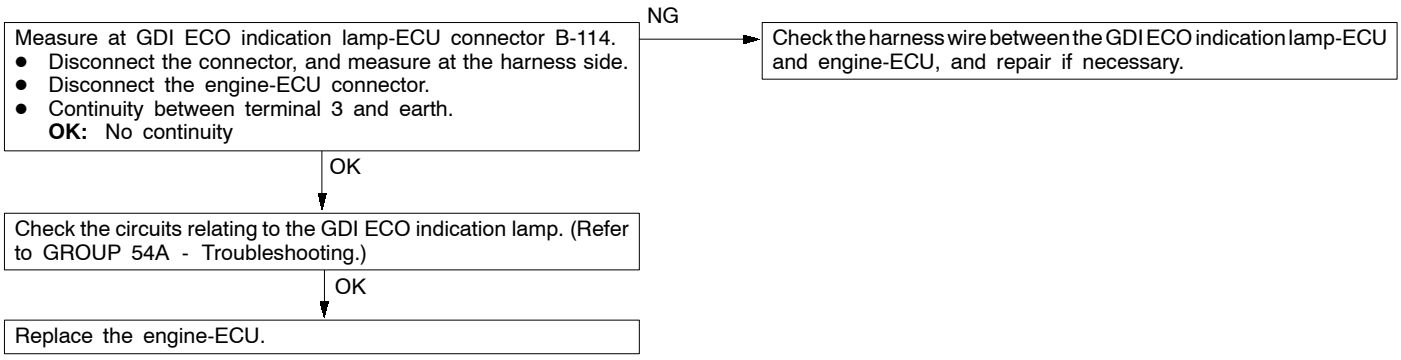
INSPECTION PROCEDURE 36

GDI ECO indication lamp does not illuminate.	Probable cause
If the GDI ECO indication lamp does not illuminate after turning switch, the causes listed in the right column are suspected.	• Burned-out GDI ECO indication lamp bulb • Open circuit or short-circuited harness wire in the GDI ECO indication lamp circuit • Malfunction of the engine-ECU • Malfunction of the GDI ECO indication lamp-ECU



INSPECTION PROCEDURE 37

GDI ECO indication lamp remains illuminated and does not go off.	Probable cause
If the GDI ECO indication lamp does not go off during high load operation, the causes listed in the right column are suspected.	• Short circuit between the GDI ECO indication lamp and engine-ECU • Malfunction of the engine-ECU • Malfunction of the GDI ECO indication lamp-ECU



DATA LIST REFERENCE TABLE

Caution
When shifting the select lever to D range, the brakes should be applied so that vehicle does not move forward.

NOTE
1.*1: When the accelerator pedal position sensor (1st channel) output is 500 - 900 mV, the accelerator pedal position switch should normally change from ON to OFF. If this does not happen, adjust the accelerator pedal position sensor.
2.*2: Check if the difference in output between *2 and *3 is 4 V or more.

Item No.	Check items	Requirements		Normal condition	Inspection procedure No.	Reference page
26	Accelerator pedal position switch	Ignition switch: ON (Depress and release the accelerator pedal several times)	Release the accelerator pedal.	ON	Procedure No.27	13A-5
			Depress the accelerator pedal slightly.	OFF		
77	Accelerator pedal position sensor (2nd channel)	Ignition switch: ON	Release the accelerator pedal.	300 - 1,000 mV*2	Code No.77	13A-3
			Depress the accelerator pedal gradually.	Increases in response to the pedal depression stroke.		
			Depress the accelerator pedal fully.	4,200 - 5,500 mV*3		
78	Accelerator pedal position sensor (1st channel)*1	Ignition switch: ON	Release the accelerator pedal.	300 - 1,000 mV*2	Code No.78	13A-4
			Depress the accelerator pedal gradually.	Increases in response to the pedal depression stroke.		
			Depress the accelerator pedal fully.	4,200 - 5,500 mV*3		

CHECK AT THE ENGINE-ECU TERMINALS

TERMINAL VOLTAGE CHECK CHART

Engine-ECU Connector Terminal Arrangement

Terminal No.	Check items	Check requirements (engine condition)		Normal condition
3	GDI ECO indication lamp	Engine: idling		0 - 3 mV
		Engine: When the accelerator pedal is suddenly depressed while the engine is idling		System voltage
57	Accelerator pedal position switch	Ignition switch: ON	Release the accelerator pedal.	0 - 1 V
			Depress the accelerator pedal slightly.	4 V or more
81	Power supply to accelerator pedal position sensor (1st channel)	Ignition switch: ON		4.5 - 5.5 V
87	Accelerator pedal position sensor (1st channel)	Ignition switch: ON	Release the accelerator pedal.	0.3 - 1.0 V*1
			Depress the accelerator pedal fully.	4.2 - 5.5 V*2

NOTE
Check if the difference in output between *1 and *2 is 4 V or more.

Engine-ECU Connector Terminal Arrangement

Terminal No.	Check items	Standard value, Normal condition (Check requirements)
57-53	Accelerator pedal position switch	Continuity (when the accelerator pedal is released)
		No continuity (when the accelerator pedal is slightly depressed)

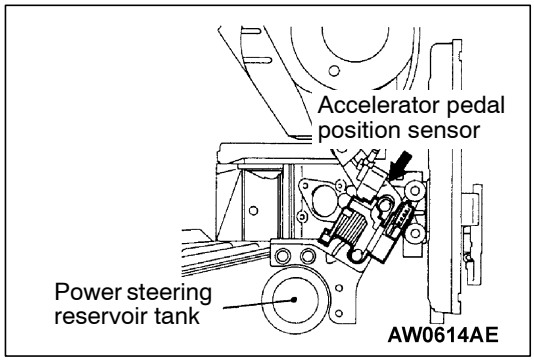
CHECK AT THE THROTTLE VALVE CONTROLLER TERMINALS

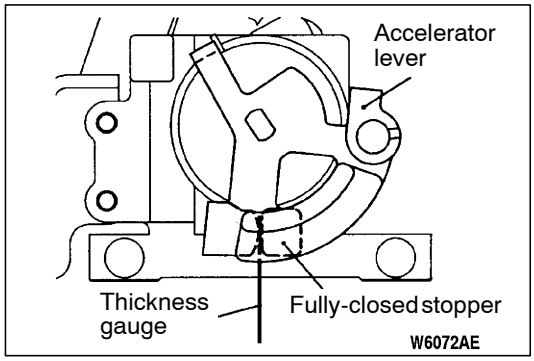
TERMINAL VOLTAGE CHECK CHART

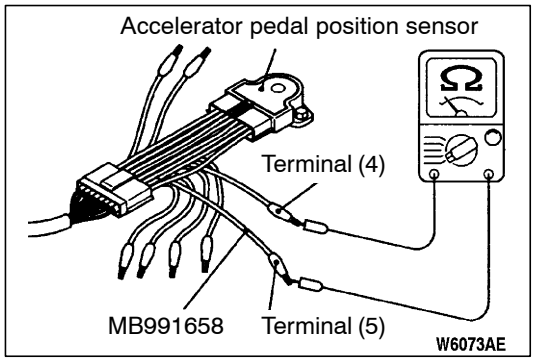
Throttle Valve Controller Connector Terminal Arrangement

Terminal No.	Check items	Requirements		Normal value
20	Accelerator pedal position sensor (2nd channel)	Ignition switch: ON	Release the accelerator pedal.	0.3 - 1.0 V*1
			Depress the accelerator pedal fully.	4.5 - 5.5 V*2

NOTE
Check if the difference in output between *1 and *2 is 4 V or more.







ON-VEHICLE SERVICE

1. ACCELERATOR PEDAL POSITION SWITCH AND ACCELERATOR PEDAL POSITION SENSOR ADJUSTMENT

Caution

(1) The accelerator pedal position sensor is adjusted correctly at the time of shipment from the factory, and so it should not normally be moved.

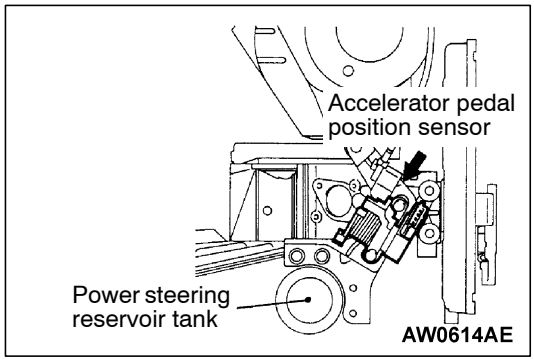
(2) If adjustment does become necessary, use the following procedure.

<When using the MUT-II>

(1) Connect the MUT-II to the diagnosis connector.
(2) Remove the two accelerator pedal position sensor assembly mounting bolts, and then insert a thickness gauge with a thickness of 0.60 mm in between the accelerator lever and the fully-closed stopper.
(3) Turn the ignition switch to ON (without starting the engine).
(4) Loosen the accelerator pedal position sensor mounting bolt, and then turn the accelerator pedal position sensor anti-clockwise as far as it will go.
(5) Check that the idle switch turns on at this time.
(6) Turn the accelerator pedal position sensor clockwise until the point is found where the idle switch turns off. Securely tighten the accelerator pedal position sensor mounting bolt at this point.
(7) Check that the accelerator pedal position sensor (1st channel) output at this time is within the standard value range.

Standard value: 0.5 - 0.9 V

(8) Turn the ignition switch to the LOCK (OFF) position.
(9) Remove the thickness gauge and then install the accelerator pedal position sensor assembly.
(10) Remove the MUT-II.

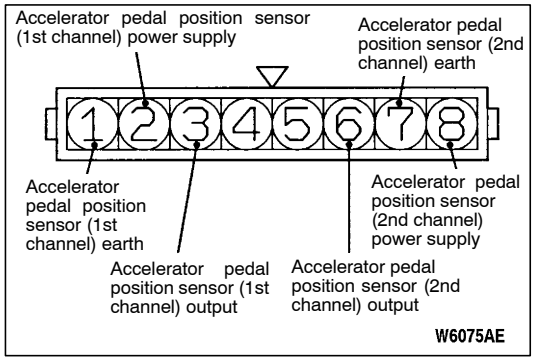


2. ACCELERATOR PEDAL POSITION SENSOR CHECK

(1) Disconnect the accelerator pedal position sensor connector.

(2) Measure the resistance between accelerator pedal position sensor connector terminal (1) [accelerator pedal position sensor (1st channel) earth] and terminal (2) [accelerator pedal position sensor (1st channel) power supply], and between terminal (7) [accelerator pedal position sensor (2nd channel) earth] and terminal (8) [accelerator pedal position sensor (2nd channel) power supply].

Standard value: 0.5 - 0.9 kΩ



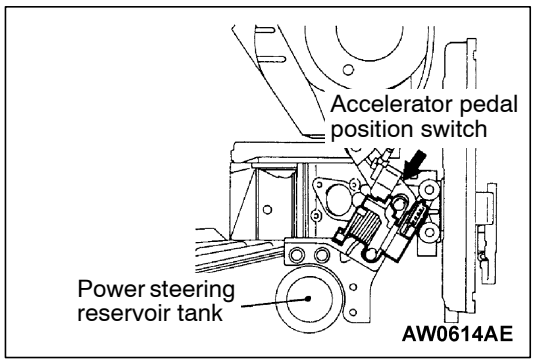
(3) Measure the resistance between accelerator pedal position sensor connector terminal (2) [accelerator pedal position sensor (1st channel) power supply] and terminal (3) [accelerator pedal position sensor (1st channel) output], and between terminal (8) [accelerator pedal position sensor (2nd channel) power supply] and terminal (6) [accelerator pedal position sensor (2nd channel) output].

Normal condition:

When accelerator pedal is gently depressed	Changes comparatively smoothly in proportion to the accelerator pedal depression amount

(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.13A-9.)



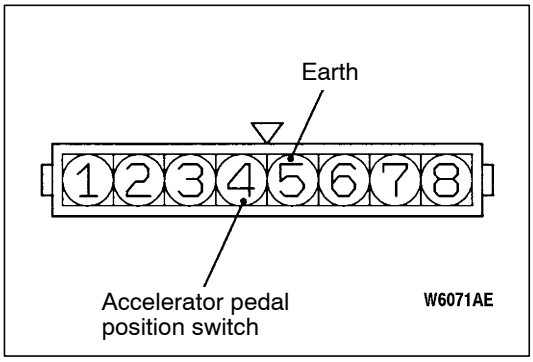
3. ACCELERATOR PEDAL POSITION SWITCH CHECK

(1) Disconnect the accelerator pedal position sensor connector.

(2) Check the continuity between accelerator pedal position sensor connector terminal (4) (accelerator pedal position switch) and terminal (5) (earth).

Normal condition:

Accelerator pedal	Continuity
Depressed	No continuity
Released	Continuity



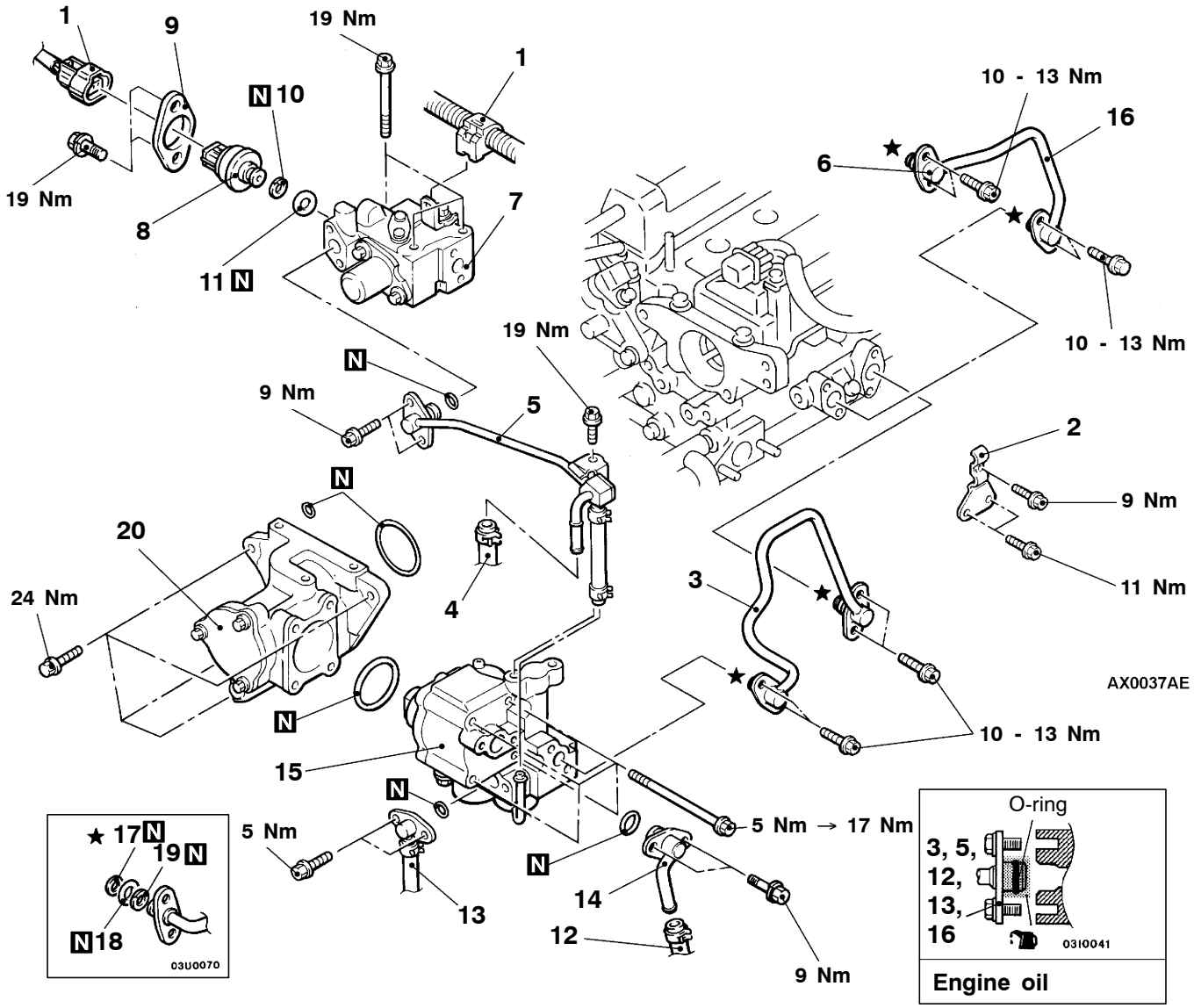
(3) If there is a malfunction, replace the accelerator pedal position sensor.

NOTE
After replacement, adjust the accelerator pedal position sensor. (Refer to P.13A-9.)

FUEL PUMP (HIGH PRESSURE) AND FUEL PRESSURE REGULATOR (HIGH PRESSURE)

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Prevention of fuel discharge <before removal only>
- Engine Cover Removal and Installation
- Air Cleaner Assembly Removal and Installation
- Fuel Leak Check <after installation only>



Fuel pressure regulator (High pressure) removal steps

1. Harness connector and clamp
4. Fuel return hose connection
▶C◀ 5. Low-pressure fuel pipe
▶C◀ 6. Fuel return pipe connection
7. Fuel pressure regulator (high pressure) assembly
◀A▶ ▶G◀ 8. Fuel pressure sensor
◀A▶ ▶G◀ 9. Flange
▶F◀ 10. O-ring
▶F◀ 11. Back-up ring
▶B◀ 17. Back-up ring A
▶B◀ 18. O-ring
▶B◀ 19. Back-up ring

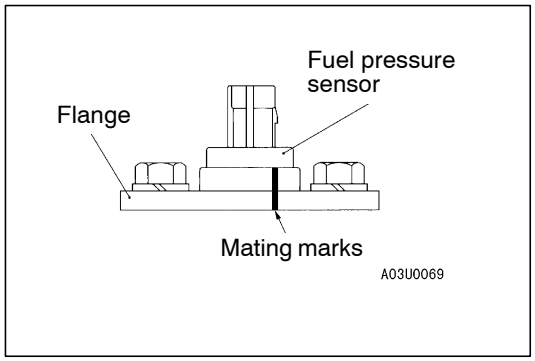
Fuel pump (High pressure) removal steps

- Intake manifold removal (Refer to GROUP 15.)

2. Fuel pipe clamp
▶C◀ 3. Fuel feed pipe
▶C◀ 5. Low-pressure fuel pipe
12. Fuel return hose connection
▶E◀ 13. Fuel pressure hose connection
14. Fuel nipple assembly
▶D◀ 15. Fuel pump (high pressure)
▶B◀ 17. Back-up ring A
▶B◀ 18. O-ring
▶B◀ 19. Back-up ring

Pump camshaft case removal steps

7. Fuel pressure regulator (high pressure) assembly
▶D◀ 15. Fuel pump (high pressure)
▶C◀ 16. Fuel return pipe
▶B◀ 17. Back-up ring A
▶B◀ 18. O-ring
▶B◀ 19. Back-up ring
▶A◀ 20. Pump camshaft case

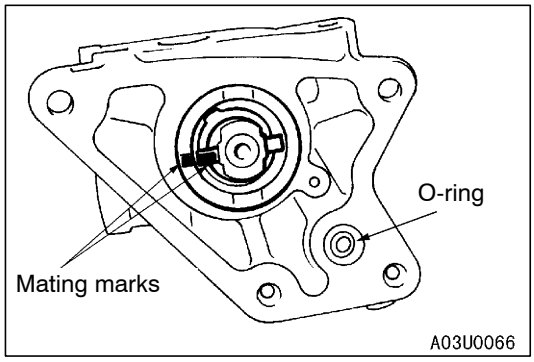


REMOVAL SERVICE POINT

◀A▶ FLANGE/FUEL PRESSURE SENSOR REMOVAL

If reusing the fuel pressure sensor, make the mating marks on the sensor and the flange before removing the flange.

NOTE
The flange will be bent when it is installed to the engine. Because of this, the sealing condition and installation condition of the fuel pressure sensor will be maintained in good condition. Therefore, the mating marks should be made in order to install the flange in the original condition. If replacing the fuel pressure sensor with a new part, the sensor and flange should be replaced together.

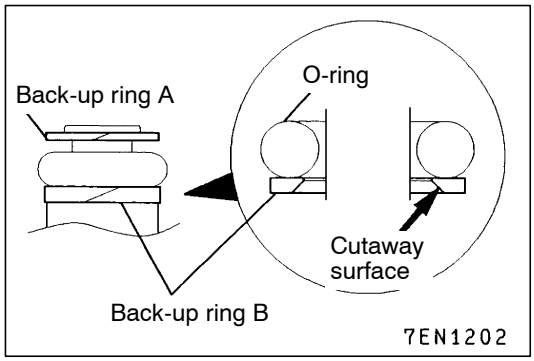


INSTALLATION SERVICE POINTS

▶A◀ PUMP CAMSHAFT CASE ASSEMBLY INSTALLATION

1. Set the No.1 cylinder to the compression top dead centre position.
2. Align the mating mark on the housing of the pump camshaft case assembly with the mating mark on the coupling, and then install the pump camshaft case assembly to the engine.

Caution
Take care not to drop the O-ring.



▶B◀ BACK-UP RING B/O-RING/BACK-UP RING A INSTALLATION

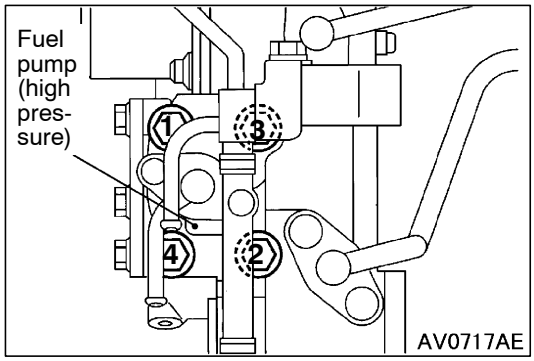
Install the back-up rings and the O-ring as shown in the illustration.

Caution
1. **Install the back-up ring B facing its cutaway surface toward the opposite side of the O-ring as shown in the illustration.**
2. **Confirm the outer diameter of the back-up ring A. Take care not to install the back-up ring for the fuel pressure sensor by mistake. (Outer diameter of the back-up ring A: 14.8 mm)**

▶C◀ FUEL RETURN PIPE/LOW-PRESSURE FUEL PIPE/FUEL FEED PIPE INSTALLATION

Apply a small amount of fresh engine oil to the O-ring.

Caution
Take care not to let any of the engine oil get inside the fuel pump (high pressure), fuel pressure regulator (high pressure) or the delivery pipe assembly.



▶D◀ FUEL PUMP (HIGH PRESSURE) INSTALLATION

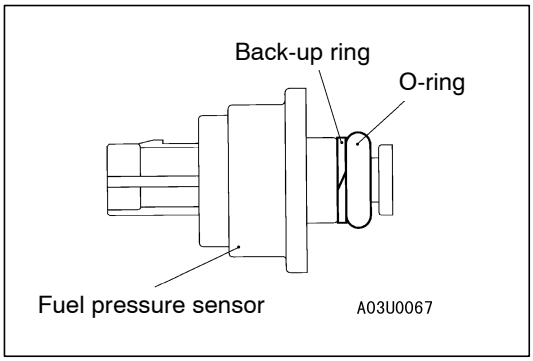
Use a torque wrench with a precision of 0.5 Nm to tighten the fuel pump mounting bolts according to the following procedure.
1. Tighten the bolts to 5 Nm in the order shown in the illustration.
2. Tighten the bolts to 17 Nm in the order shown in the illustration. The overall difference in tightening torque between the four bolts should be within 2 Nm.

▶E◀ HIGH-PRESSURE FUEL HOSE INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

   Caution
   Take care not to let any of the engine oil get inside the fuel pump (high pressure).

2. While being careful not to damage the O-ring, turn the high-pressure fuel hose to the left and right and connect it to the fuel pump (high pressure). After connecting, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the cause may be that the O-ring is getting caught. Disconnect the hose, check the O-ring for damage and re-connect the hose to the fuel pump (high pressure) and then re-check.



▶F◀ BACK-UP RING/O-RING INSTALLATION

Install the back-up ring and the O-ring as shown in the illustration.

Caution
Take care not to install the back-up ring A for the injector, fuel feed pipe or fuel return pipe by mistake. (Outer diameter of the back-up ring for the fuel pressure sensor: 15.1 mm)

▶G◀ FUEL PRESSURE SENSOR/FLANGE INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

   Caution
   Take care not to let any of the engine oil get inside the fuel pressure regulator (high pressure) assembly.

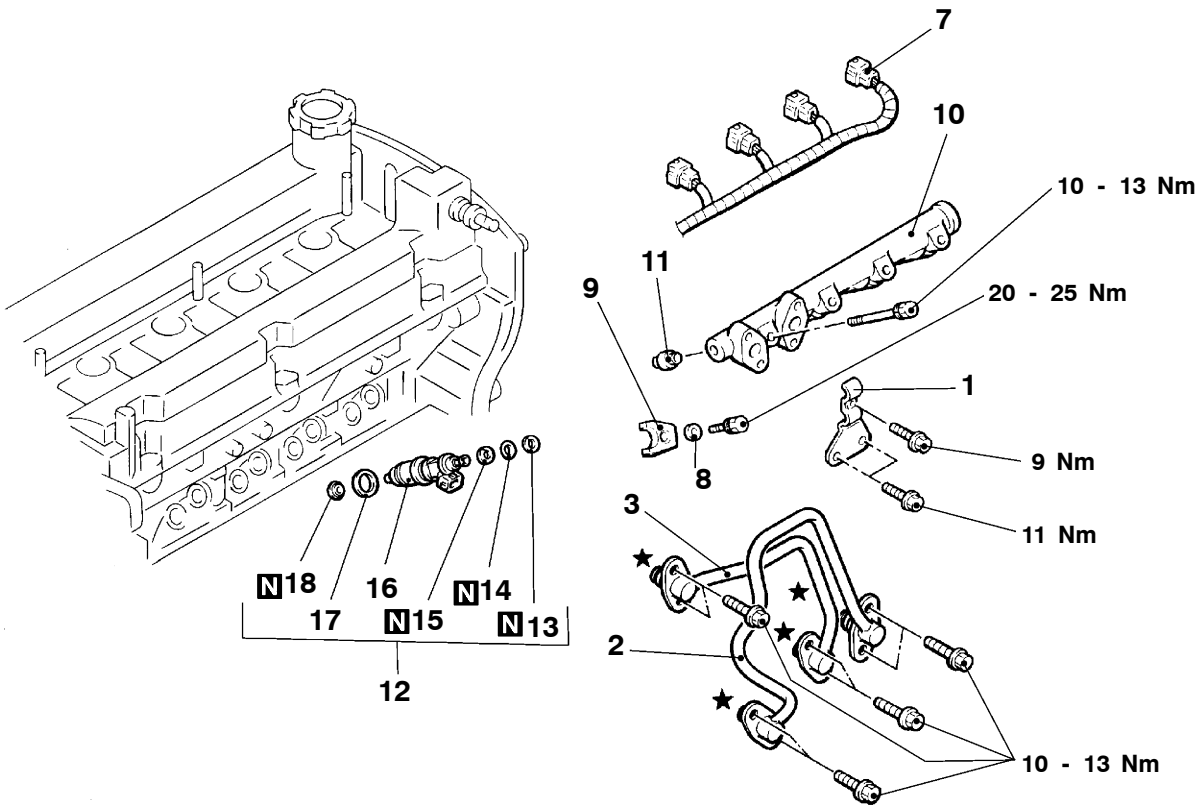
2. Align the mating marks which were made at the time of removal, and then install the fuel pressure sensor and flange to the fuel pressure regulator (high pressure) assembly.

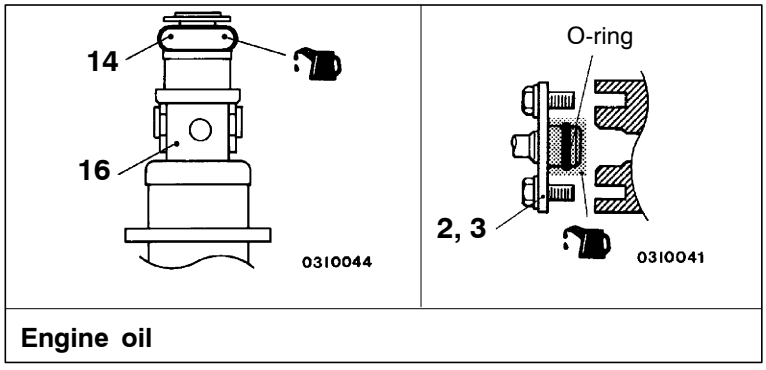
   Caution
   If replacing the fuel pressure sensor with a new part, the sensor and flange should be replaced together.

INJECTOR

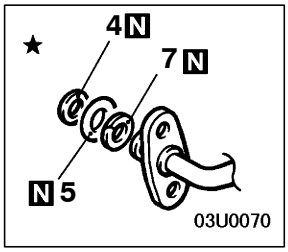
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Prevention of fuel discharge <before removal only>
- Engine Cover Removal and Installation
- Air Cleaner Assembly Removal and Installation
- Intake Manifold Removal and Installation
- Fuel Leak Check <after installation only>





Engine oil



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Removal steps

1. Fuel pipe clamp
2. ▶D◀ Fuel feed pipe
3. ▶D◀ Fuel return pipe
4. ▶C◀ Back-up ring A
5. ▶C◀ O-ring
6. ▶C◀ Back-up ring B
7. ◀A▶ Injector harness connector
8. Washer
9. Injector holder
10. ◀B▶ ▶B◀ Delivery pipe assembly
11. Insulator
12. ◀B▶ ▶B◀ Fuel injector assembly
13. Back-up ring
14. O-ring
15. Back-up ring
16. Fuel injector
17. Gasket
18. ▶A◀ Corrugated washer

REMOVAL SERVICE POINTS

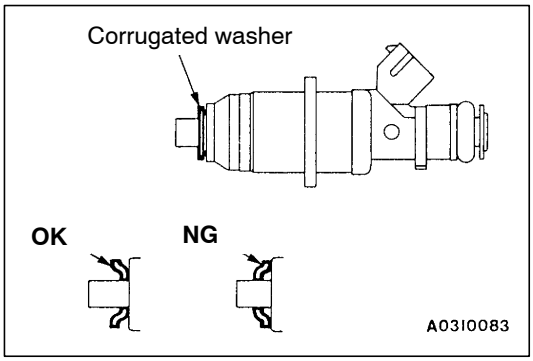
◀A▶ INJECTOR HARNESS CONNECTOR DISCONNECTION

Caution
Disconnect the battery (-) cable from its terminal before carrying out this operation.

◀B▶ DELIVERY PIPE ASSEMBLY/FUEL INJECTOR ASSEMBLY REMOVAL

Remove the delivery pipe assembly with the fuel injector assembly still attached.

Caution
Be careful not to drop the fuel injector assembly when removing the delivery pipe assembly.



INSTALLATION SERVICE POINTS

▶A◀ CORRUGATED WASHER INSTALLATION

Caution
1. **The corrugated washer should always be replaced with a new part.**
2. **There should be no scratches or foreign particles on the corrugated washer mounting surface of the injector.**
3. **Be careful not to mistake the corrugated washer installation direction.**

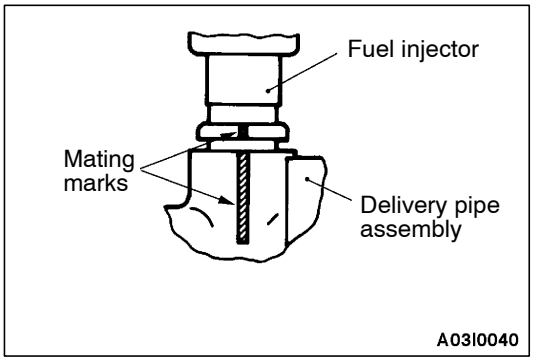
▶B◀ FUEL INJECTOR ASSEMBLY/DELIVERY PIPE ASSEMBLY INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

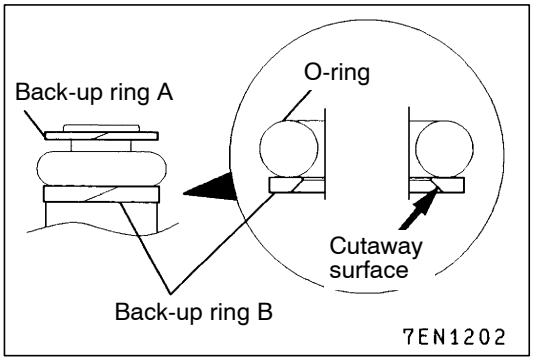
   Caution
   Take care not to let any of the engine oil get inside the delivery pipe assembly.

2. While being careful not to damage the O-ring, turn the fuel injector assembly to the left and right and connect it to the delivery pipe assembly. After connecting, check that the fuel injector turns smoothly.

3. If the fuel injector does not turn smoothly, the cause may be that the O-ring is getting caught. Remove the fuel injector, check the O-ring for damage and re-connect the fuel injector to the delivery pipe assembly and then re-check.



4. Align the mating marks on the delivery pipe assembly and the fuel injector, and then install the delivery pipe assembly with the injector assembly still attached.



▶C◀ BACK-UP RING B/O-RING/BACK-UP RING A INSTALLATION

Install the back-up rings and the O-ring as shown in the illustration.

Caution

1. **Install the back-up ring B facing its cutaway surface toward the opposite side of the O-ring as shown in the illustration.**
2. **Confirm the outer diameter of the back-up ring A. Take care not to install the back-up ring for the fuel pressure sensor by mistake. (Outer diameter of the back-up ring A: 14.8 mm)**

▶D◀ FUEL RETURN PIPE/FUEL FEED PIPE INSTALLATION

Apply a small amount of fresh engine oil to the O-ring.

Caution

Take care not to let any of the engine oil get inside the fuel pump (high pressure), fuel pressure regulator (high pressure) and delivery pipe.