

GENERAL INFORMATION

The fuel is drawn out of the fuel tank by means of the feed pump which is built into the fuel injection pump. It then passes through the fuel filter and is fed to the injection pump.

The fuel is pressurized by the feed pump, and this fuel pressure is controlled by the regulating valve which is built into the pump. Then, the fuel is compressed by the plunger and injected from the nozzles at high pressure in accordance with the injection sequence.

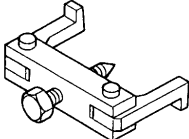
Engine speed (fuel injection amount) control is carried out by means of a centrifugal-type governor using a flyweight.

Fuel injection timing control is carried out by a hydraulic timer. The hydraulic timer operates by the fuel pressure inside the pump chamber. This pressure is controlled by the regulating valve.

SERVICE SPECIFICATIONS

Items	Standard value
Fuel cut solenoid valve coil resistance Ω	8 – 10
Fuel injection initial pressure kPa	14,710 – 15,690

SPECIAL TOOL

Tool	Number	Name	Use
	MH062464	Injection pump sprocket puller	Fuel injection pump sprocket removal

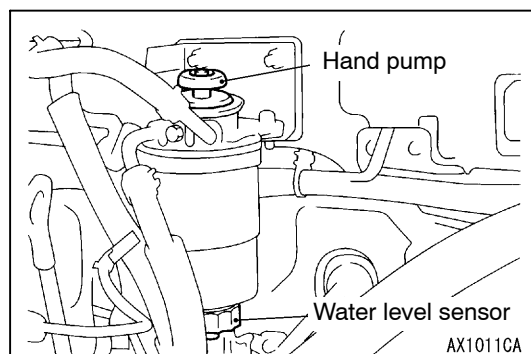
ON-VEHICLE SERVICE

FUEL INJECTION TIMING CHECK AND ADJUSTMENT

Refer to GROUP 11C – On-vehicle Service.

ENGINE IDLE SPEED CHECK AND ADJUSTMENT

Refer to GROUP 11C – On-vehicle Service.



EVACUATION OF WATER FROM FUEL FILTER

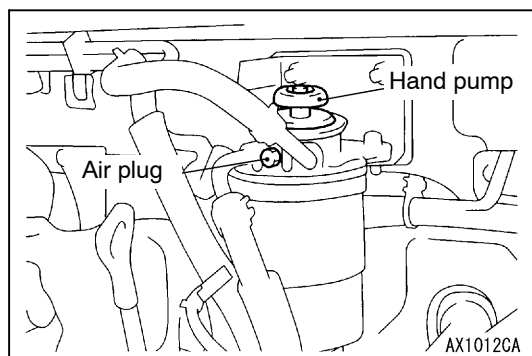
Water is in the filter when fuel filter warning lamp illuminates. Evacuate water by the following procedure.

1. Loosen the water level sensor.
2. After water is evacuated by using a hand pump, tighten the water level sensor to the specified torque.

Tightening torque: 2.5 ± 0.5 N·m

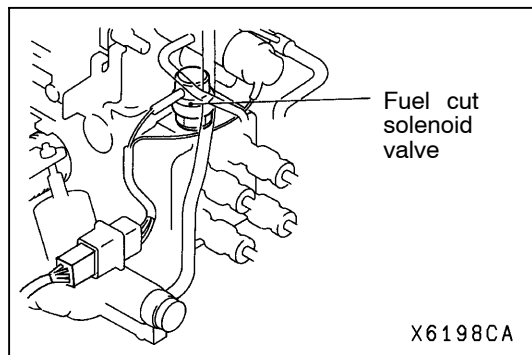
FUEL FILTER CARTRIDGE REPLACEMENT

Refer to GROUP 13E.

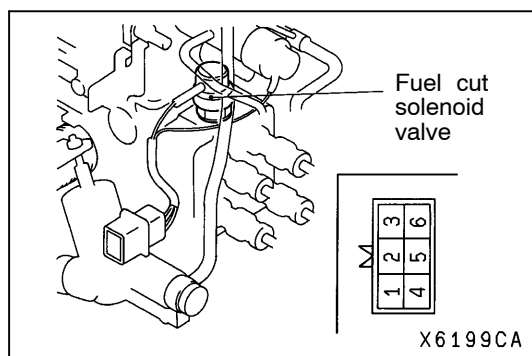
**EVACUATION OF AIR FROM FUEL LINE**

When the following service work(s) is done, refill the fuel tank and then evacuate air from the fuel line.

- Fuel hose is removed
 - Fuel filter is replaced
 - Fuel injection nozzle is removed
 - If necessary for access, fuel is drained from the fuel tank.
1. Loosen the fuel filter air plug.
 2. Cover the circumference of the air plug hole with cloth and use a manual pump repeatedly until no bubbles come out of the plug hole, then tighten the air plug to the specified torque.
- Tightening torque: $6.0 \pm 1.0 \text{ N}\cdot\text{m}$**
3. Repeat until the hand pump operation becomes stiff.

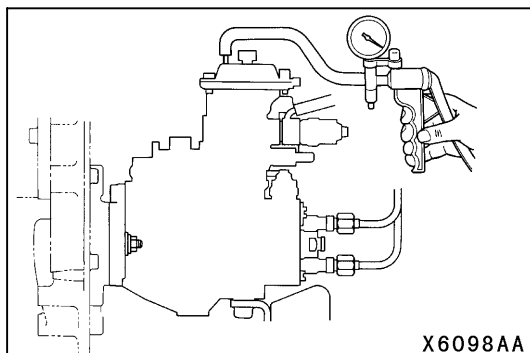
**FUEL INJECTION PUMP CHECK****FUEL CUT SOLENOID VALVE OPERATION CHECK**

When a sound scope is held against the fuel cut solenoid valve and the ignition switch is turned to "ON", check that the sound of the valve operating can be heard.

**FUEL CUT SOLENOID VALVE COIL RESISTANCE CHECK**

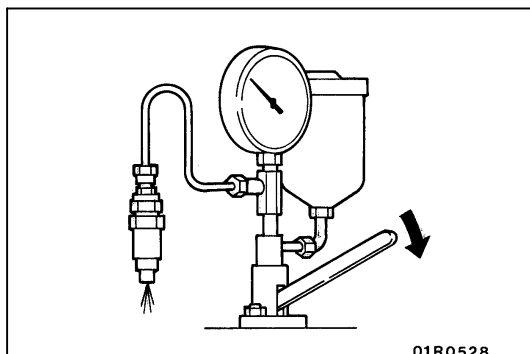
Measure the resistance between the fuel cut solenoid valve terminals 1 and 5.

Standard value: $8 - 10 \Omega$



BOOST COMPENSATOR CHECK

1. Connect a hand pump (pressurization type) to the nipple of the boost compensator.
2. Apply 30 kPa of pressure and check to be sure that the pressure is maintained.



INJECTION NOZZLE CHECK AND ADJUSTMENT

Caution

Never touch the injection spray that is injected from the nozzle.

FUEL INJECTION INITIAL PRESSURE CHECK

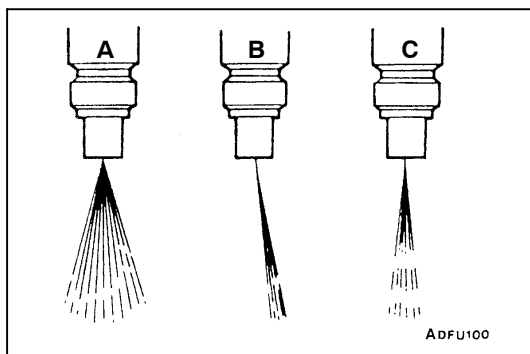
1. Install the injection nozzle to a nozzle tester.
2. Move the lever of the nozzle tester 2 – 3 times to inject fuel and to bleed the air.
3. Gently press down the lever of the nozzle tester, and take a reading of the indication value on the pressure gauge at the point where the needle slowly rises and then suddenly drops.

Standard value: 14,710 – 15,690 kPa

4. If the fuel injection initial pressure is outside the standard value, disassembly the nozzle holder to clean it, and then change the thickness of the shim to adjust the fuel injection initial pressure.

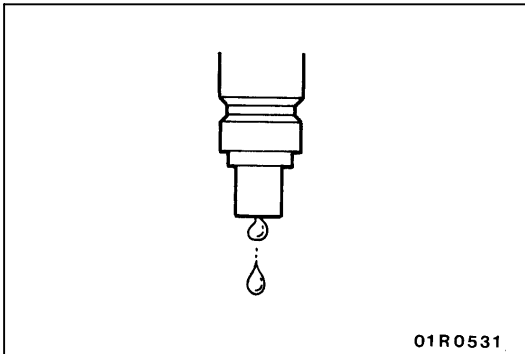
NOTE

- (1) For disassembly, reassembly and adjustment of the nozzle holder, refer to P.13C-8.
- (2) When the shim thickness is increased by 0.1 mm, the fuel injection initial pressure increases by approx. 1,177 – 2,157 kPa.

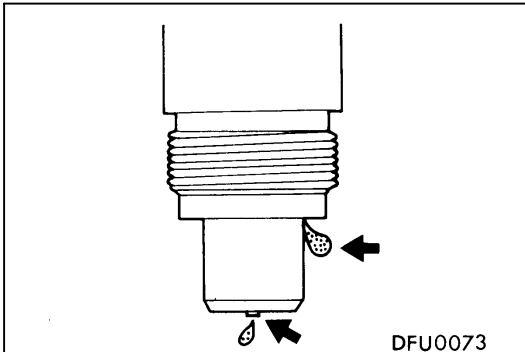


INJECTION SPRAY CONDITION CHECK

1. Move the lever of the nozzle tester rapidly (4 – 6 times per second) to eject the fuel continuously. Check to be sure that the injection spray comes out evenly in a straight, thin line (injection spray angle is 0 °). The injection spray patterns shown in the illustration at left are wrong.
 - A. Injection angle is too large
 - B. Bias
 - C. Intermittent fuel injection



2. Check to be sure that no fuel drips after injection is completed.
3. If there are any drips, disassemble the nozzle, clean it and reinspect, or replace the nozzle.



NOZZLE FUEL-TIGHT CHECK

1. Gently raise the lever of the nozzle tester until the pressure inside the nozzle (value displayed on pressure gauge) becomes 12,749 – 13,729 kPa, and check to be sure that there are no fuel leaks from the nozzle within 10 seconds.
2. If there are any leaks, disassemble the nozzle, clean it and re-inspect, or replace the nozzle.

INJECTION PUMP AND NOZZLE

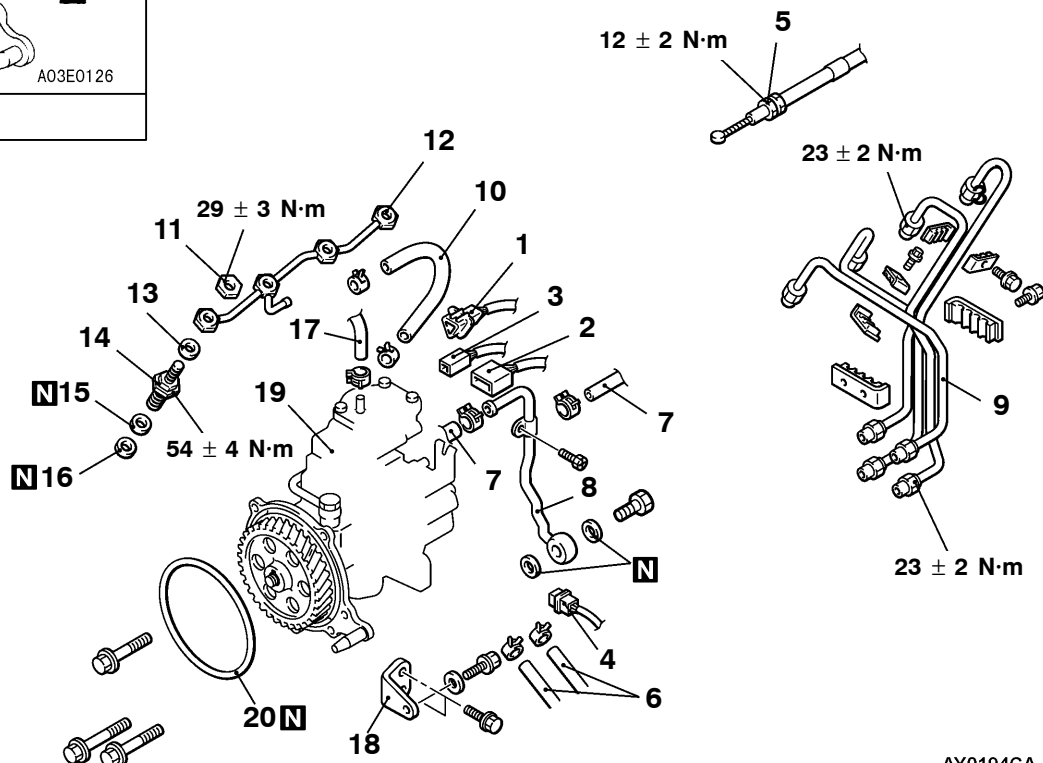
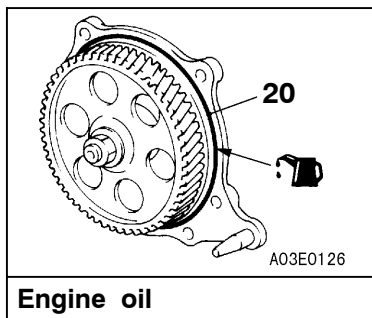
REMOVAL AND INSTALLATION

Pre-removal Operation

- Engine Coolant Draining
(Refer to GROUP 14 – On-vehicle Service.)
- Intercooler Hose Removal (Refer to GROUP 15.)
- Battery and Battery Tray Removal

Post-installation Operation

- Battery and Battery Tray Installation
- Intercooler Hose Installation (Refer to GROUP 15.)
- Air Bleeding from Fuel Line (Refer to P.13C-3.)
- Engine Coolant Supplying
(Refer to GROUP 14 – On-vehicle Service.)
- Injection Timing Checking and Adjustment
(Refer to GROUP 11C – On-vehicle Service.)
- Accelerator Cable Adjustment
(Refer to GROUP 17 – On-vehicle Service.)
- Lever Position Sensor Adjustment <A/T>
(Refer to GROUP 17.)



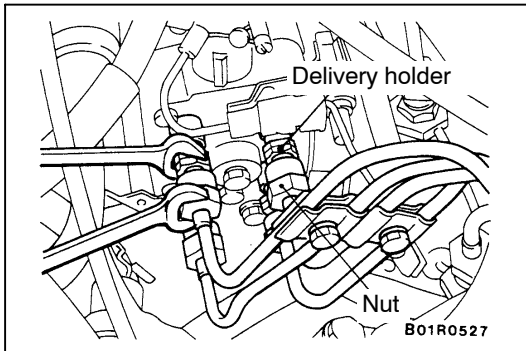
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Removal steps

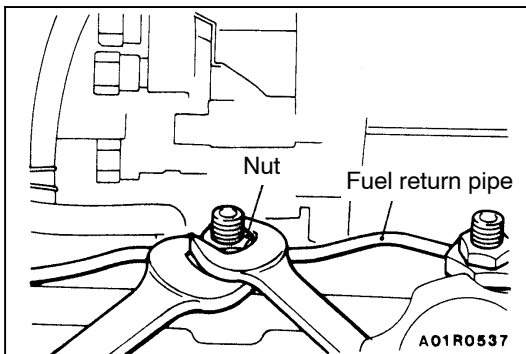
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|---|---------|-------------------------------|
| 1. Lever (throttle) position sensor connector <A/T> | ◀B▶ | 9. Injection pipe |
| 2. Fuel cut valve controller connector <Vehicles with immobilizer system> | ◀C▶ | 10. Fuel return hose |
| 3. Lever position switch connector <A/C (A/T)> | ◀C▶ | 11. Nut |
| 4. Fuel injection pump wiring harness and front wiring harness connection | ◀D▶ | 12. Fuel return pipe |
| 5. Accelerator cable connection | ▶B▶ | 13. Fuel return pipe gasket |
| 6. Fuel hose connection | ▶B▶ | 14. Injection nozzle assembly |
| 7. Water hose connection <Vehicles with EGR> | ◀E▶ ▶A▶ | 15. Holder gasket |
| ▶C▶ 8. Water pipe | | 16. Nozzle gasket |
| | | 17. Boost hose connection |
| | | 18. Stay |
| | | 19. Injection pump assembly |
| | | 20. O-ring |

REMOVAL SERVICE POINTS**◀A▶ WATER HOSE <Vehicles with EGR>
DISCONNECTION**

After making mating marks on the hose and the hose clamp, disconnect the hose.

**◀B▶ INJECTION PIPE DISCONNECTION**

When loosening nuts at both ends of injection pipe, hold the delivery holder (for pump side) and the injection nozzle assembly (for nozzle side) with wrench and loosen nut.

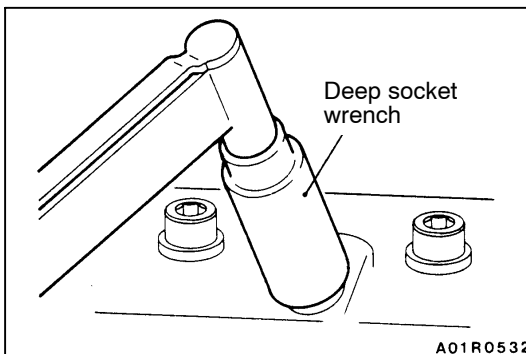
**◀C▶ NUT/FUEL RETURN PIPE REMOVAL**

1. While using a spanner or similar tool to hold the hexagonal nut of the fuel return pipe, remove the nut.

Caution

If an attempt is made to loosen the nut without first holding the fuel return pipe, the pipe may be broken or otherwise damaged.

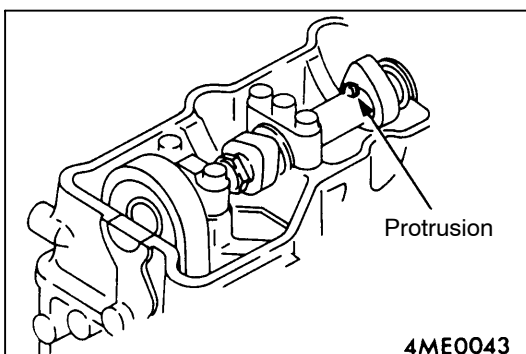
2. Disconnect the fuel return pipe.

**◀D▶ INJECTION NOZZLE ASSEMBLY REMOVAL**

Using a deep socket wrench, remove the injection nozzle assembly.

Caution

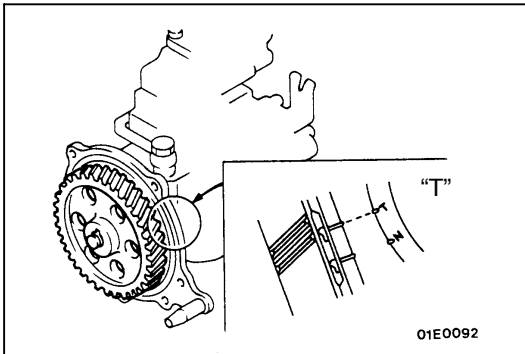
1. Make a mark on the removed injection nozzle assembly (the cylinder No.).
2. Use a cap to prevent foreign material, etc. from entering the injection nozzle hole.

**◀E▶ FUEL INJECTION PUMP REMOVAL**

Align the notch of the crankshaft pulley with the "0" timing mark to set the No.1 cylinder to the compression top dead centre position.

NOTE

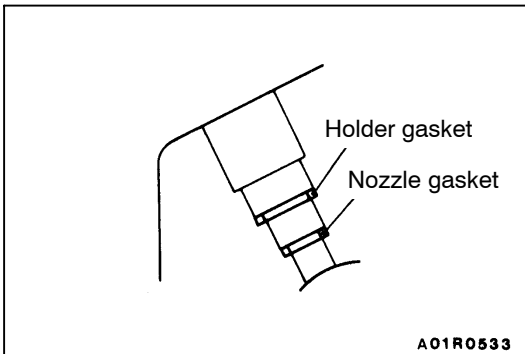
If the protrusion on the camshaft points directly upwards when the filler cap removed, the No.1 cylinder will be at the compression top dead centre position.



INSTALLATION SERVICE POINTS

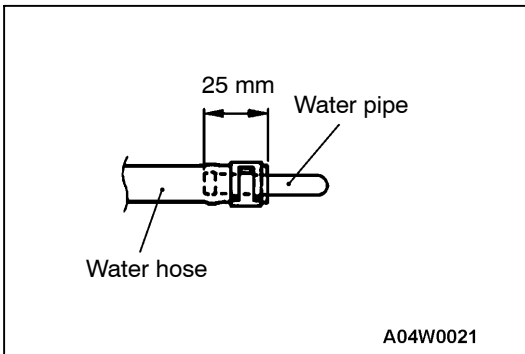
►A◄ INJECTION PUMP INSTALLATION

Check that the No.1 cylinder is at the compression top dead centre position and aligning the notch of the injection pump gear with the “T” mating marks on the flange plate, and then install the injection pump to the timing gear case.



►B◄ NOZZLE GASKET/HOLDER GASKET INSTALLATION

Clean the cylinder head's injection nozzle hole, and insert a new gasket.

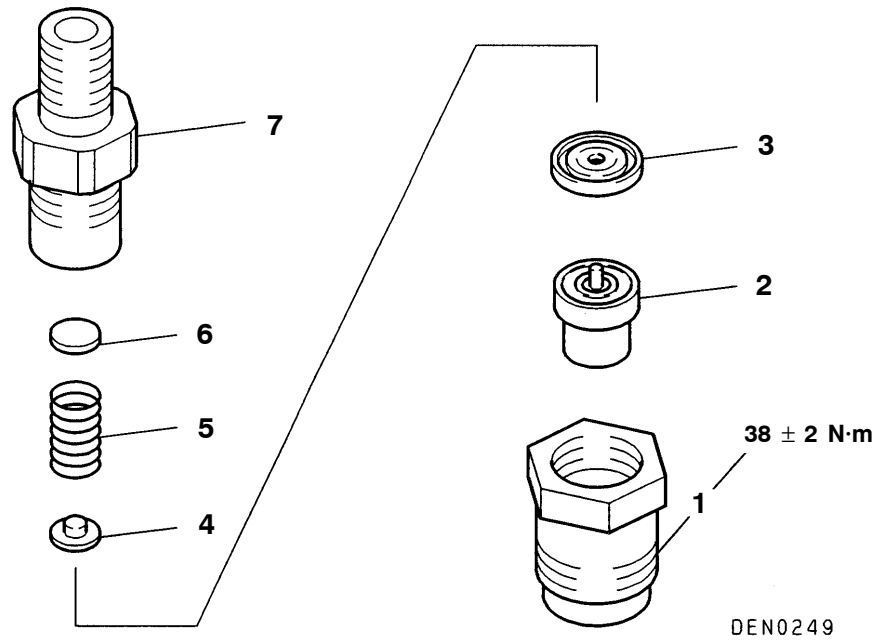


►C◄ WATER HOSE AND WATER PIPE <Vehicles with EGR> CONNECTION

1. Connect the water hose to the water pipe so that it matches the dimension shown in the illustration.
2. To reuse the hose, align the mating marks that were made during removal, and then install the hose clamp.

DISASSEMBLY AND REASSEMBLY

INJECTION NOZZLE

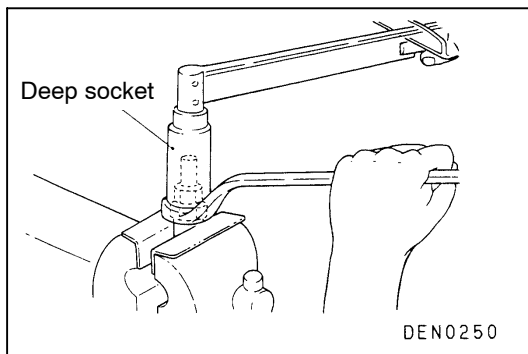


Disassembly steps



1. Retaining nut
2. Nozzle tip
3. Distance piece
4. Retaining pin

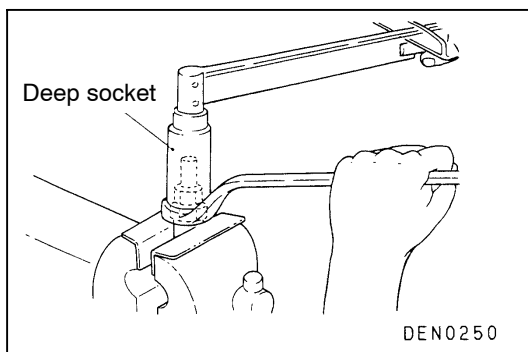
5. Pressure spring
6. Shim
7. Nozzle holder body



DISASSEMBLY SERVICE POINT

◀▶ RETAINING NUT REMOVAL

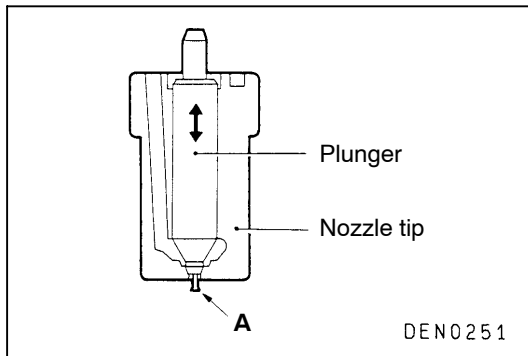
1. Lightly clamp the retaining nut in a vise with soft jaws.
2. Hold the retaining nut with a box wrench, and loosen the nozzle holder body using a deep socket.



REASSEMBLY SERVICE POINT

▶◀ RETAINING NUT INSTALLATION

1. Finger-tighten the nozzle holder body.
2. Lightly clamp the retaining nut in a vise with soft jaws.
3. While holding the retaining nut with a box wrench, tighten the nozzle holder body to the specified torque with a deep socket.



INSPECTION

NOZZLE TIP

1. Check the nozzle tip for carbon deposits. Scrape off carbon deposits with a piece of wood and clean each part with petrol. After cleaning, keep parts submerged in diesel fuel. Take particular care to protect the nozzle tip needle valve from damage.
2. While the nozzle tip is submerged in diesel fuel, check that the needle valve slides smoothly. If the needle valve does not slide smoothly, replace the nozzle tip.

When replacing the nozzle tip, completely wash off the anticorrosive oil from the new nozzle tip with clean diesel fuel before using it.

3. Check plunger tip "A" for deformation and breakage. If "A" is damaged or broken, replace it.

DISTANCE PIECE

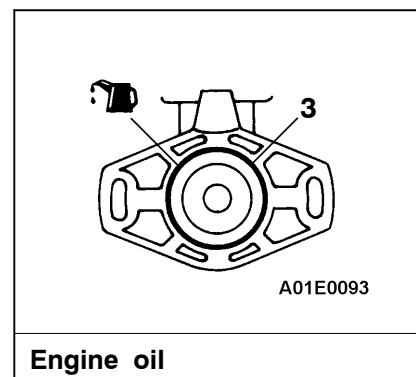
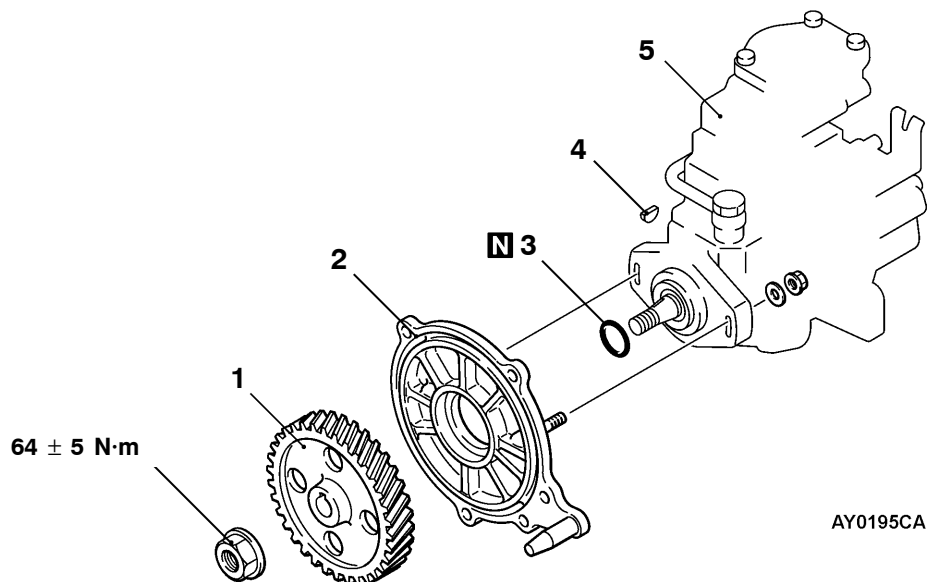
Check the surface in contact with the nozzle holder body by using minium.

PRESSURE SPRING

Check spring for weakness and breakage.

DISASSEMBLY AND ASSEMBLY

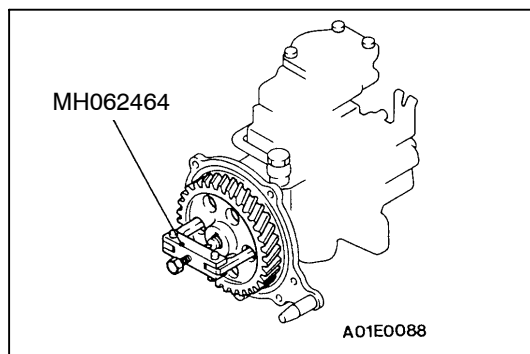
INJECTION PUMP



Disassembly steps



1. Injection pump gear
2. Flange plate
3. O-ring
4. Key
5. Injection pump



REMOVAL SERVICE POINT

◀▶ INJECTION PUMP GEAR REMOVAL

Use the special tool to remove the injection pump gear.