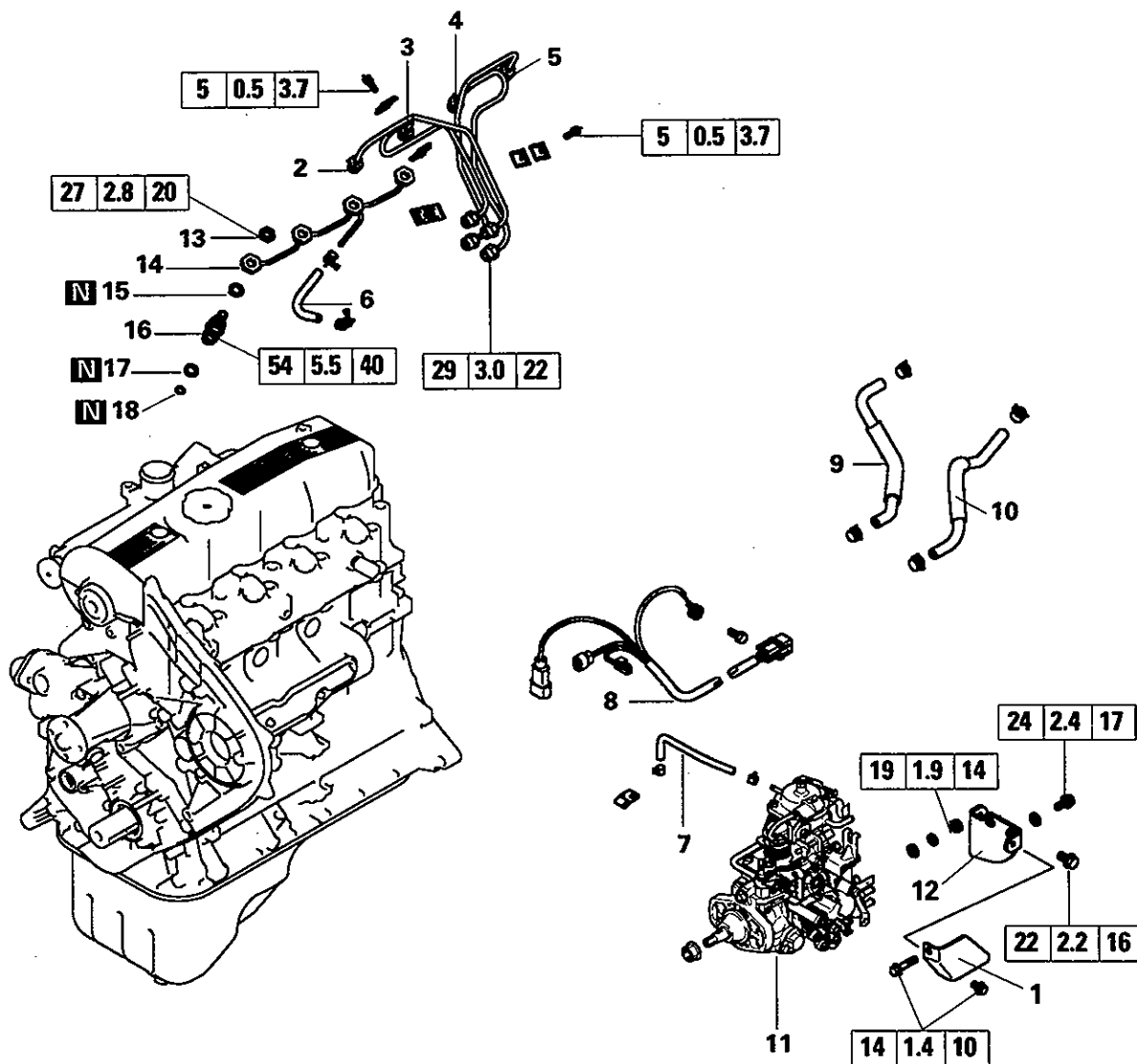


5. FUEL INJECTION PUMP AND INJECTION NOZZLE

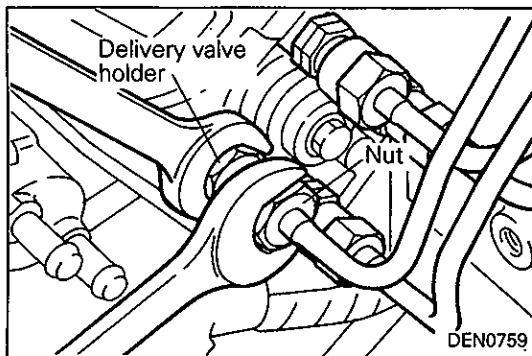
REMOVAL AND INSTALLATION



Removal steps

- | | | | |
|---------|--|---------|----------------------------|
| | 1. Injection pump protector (2000- model L200) | ◀B▶ | 11. Fuel injection pump |
| ◀A▶ ▶D▶ | 2. Injection pipe No. 1 | ◀C▶ ▶C▶ | 12. Injection pump bracket |
| ◀A▶ ▶D▶ | 3. Injection pipe No. 2 | | 13. Fuel return pipe nut |
| ◀A▶ ▶D▶ | 4. Injection pipe No. 3 | | 14. Fuel return pipe |
| ◀A▶ ▶D▶ | 5. Injection pipe No. 4 | ◀D▶ ▶B▶ | 15. Gasket |
| | 6. Fuel hose | ▶A▶ | 16. Injection nozzle |
| | 7. Tube | ▶A▶ | 17. Holder gasket |
| | 8. Injection pump harness assembly | | 18. Nozzle gasket |
| | 9. Water hose } Engines with cold | | |
| | 10. Water hose } start device | | |

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REMOVAL SERVICE POINTS

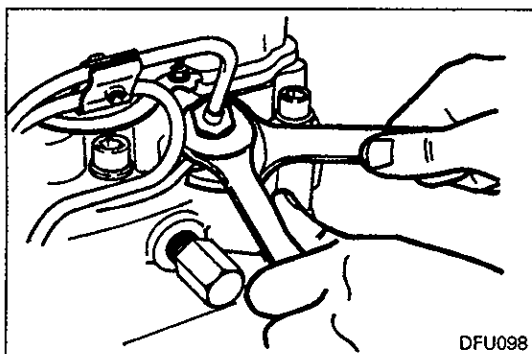
◊A◊ INJECTION PIPE REMOVAL

- (1) When loosening the union nuts on the injection pump, hold delivery valve holder on fuel injection pump head with a wrench to prevent it from rotating along with the union nut.

Caution

- If the injection pipe has been removed, plug the delivery valve holder to prevent foreign matter from entering the injection pump.

- (2) When loosening the union nuts on the injection nozzles, hold hexagon nut of fuel return pipe with a wrench to prevent it from rotating along with the union nut.

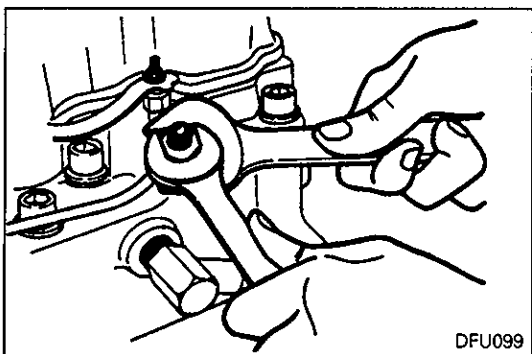


◊B◊ FUEL INJECTION PUMP REMOVAL

- (1) Do not hold the injection pump by the accelerator lever or the fast idle lever. These levers must not be removed.

◊C◊ FUEL RETURN PIPE NUT REMOVAL

- (1) When removing the fuel return pipe nut, hold the hexagon nut of fuel return pipe with a wrench.

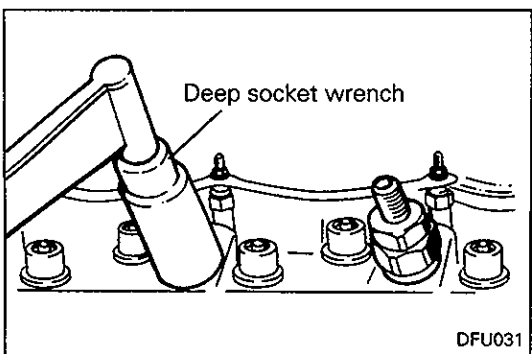


◊D◊ INJECTION NOZZLE REMOVAL

- (1) Write the number of the cylinder on the injection nozzle that has been removed.

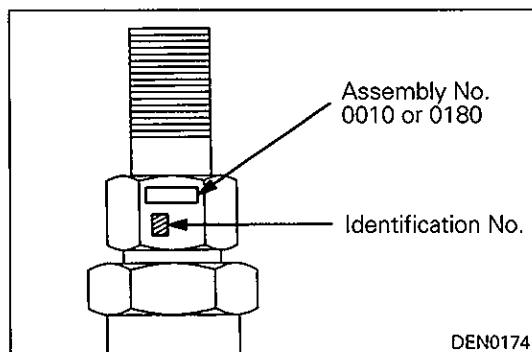
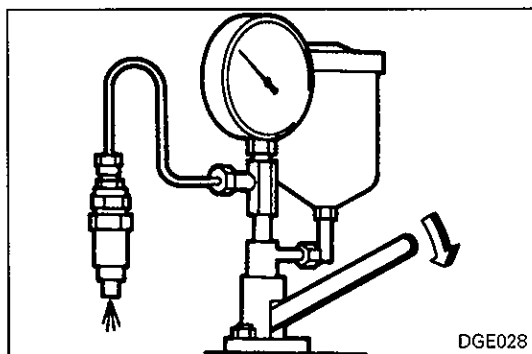
Caution

- Cover the opening with an appropriate cap to prevent entry of dust, water and foreign material into the fuel passage and combustion chamber.



INSPECTION**INJECTION NOZZLE****Warning**

- When testing injection nozzles, do not expose your hands or any other parts of your body to the injector spray. Working pressure can cause the fuel oil to penetrate the skin. Do not smoke or work near heaters or other fire hazards. Have a fire extinguisher handy.

**Breaking Pressure Test**

- (1) Install the injection nozzle to the nozzle tester.
- (2) Operate the lever of the nozzle tester to inject fuel oil two or three times and bleed air from the nozzle.
- (3) Slowly push down the nozzle tester lever.
- (4) Monitor the pressure indicated when the injection nozzle starts operation. Be sure that a pressure of standard value is indicated.

Standard value:

<Assembly No. "0010">

11,770 – 12,750 kPa

(120 – 130 kg/cm², 1,707 – 1,849 psi)

<Assembly No. "0180">

14,700 – 15,690 kPa

(150 – 160 kg/cm², 2,133 – 2,276 psi)

NOTE

The assembly number is stamped at the position shown in the illustration.

- (5) If necessary, adjust the pressure by replacing the shims in accordance with INJECTION NOZZLE HOLDER.

NOTE

1. There are 10 shims for adjustment, with thickness in the range 0.10 – 0.80 mm (0.0039 – 0.0315 in.)
2. When the shim thickness is increased by 0.1 mm (0.039 in.), the fuel injection initial pressure increases by 2,350 kPa (24 kg/cm², 341 psi).

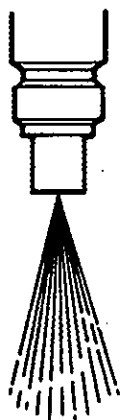
SPRAY TEST

- (1) Move the nozzle tester lever with a fast and short stroke (four to six strokes per second) to make sure that the sprays from the nozzle are uniform and have good patterns.

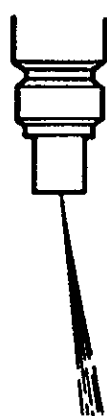
The spray patterns shown at left indicate that the nozzle is defective.

Assembly No.	Identification No.	Spray angle (deg.)
0010	1	0
	None	15
0180	None	10

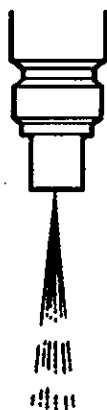
A. Excessive spray angle



B. Defected spray



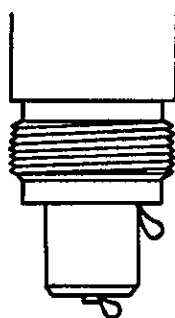
C. Interrupted spray



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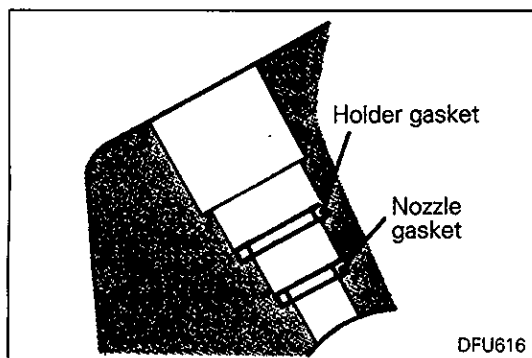


DFU0070

- (2) Be sure that the nozzle has no drip.
(3) Repair or replace the defective injection nozzle.

Leakage Test

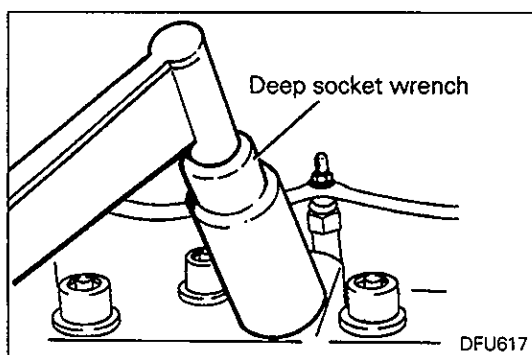
- (1) Slowly push down the nozzle tester lever until the nozzle pressure (pressure gauge reading) reaches a pressure of 1,960 kPa (20 kg/cm², 284 psi) lower than the nozzle breaking pressure and hold the pressure for approx. 10 seconds. Make sure that no fuel oil leaks from the nozzle tip during this period.
- (2) Disassemble the defective injection nozzle and replace the nozzle tip or replace the nozzle holder assembly.



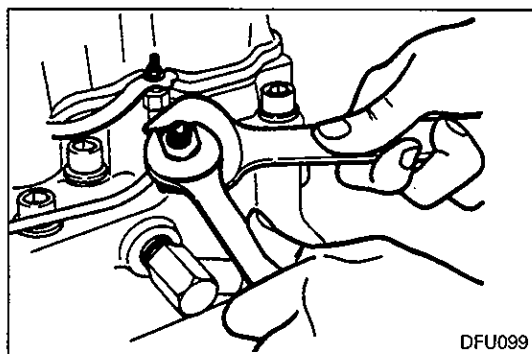
INSTALLATION SERVICE POINTS

◆A◆ NOZZLE GASKET / HOLDER GASKET INSTALLATION

- (1) Clean nozzle holder installation area of the cylinder head.
- (2) Fit a new nozzle gasket and holder gasket into the nozzle holder hole in the cylinder head.

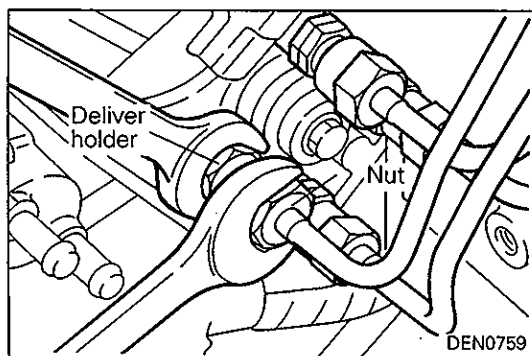


◆B◆ INJECTION NOZZLE INSTALLATION



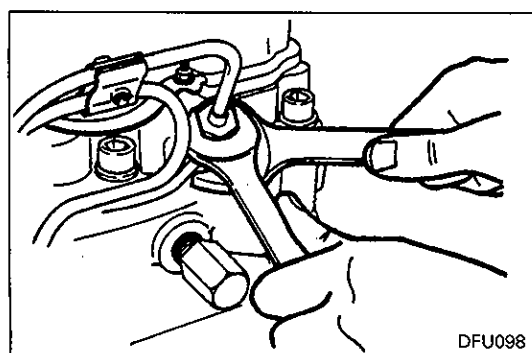
◆C◆ FUEL RETURN PIPE NUT INSTALLATION

- (1) While holding the fuel hexagon nut of fuel return pipe with a wrench, tighten the fuel return pipe nut to the specified torque.

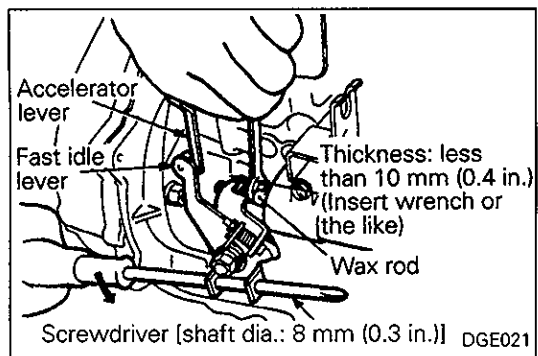


◆D◆ INJECTION PIPE INSTALLATION

- (1) When tightening the injection pipe nuts, hold the delivery valve holder with a spanner in order to prevent it from rotating along with the nut.



- (2) When tightening the injection pipe nuts, hold the hexagon nut of return pipe with a spanner in order to prevent it from rotating along with the nut.



INJECTION TIMING ADJUSTMENT

- (1) Release the fast idle mechanism.
 - (a) Insert a screwdriver [shaft dia.: 8 mm (0.3 in.)] into the holes at the bottom of the fast idle lever and turn the lever in the direction of the arrow as shown.

Caution

- In order to prevent weakening of the spring, do not turn the lever any more than necessary.

- (b) Insert a wrench or similar tool [thickness approx. 10 mm (0.4 in.)] between the wax rod and the adjusting screw.

Caution

- Do not turn the adjusting screw.

- (c) Remove the screwdriver.
- (2) Loosen (but do not remove) two nuts and two bolts holding the injection pump.
- (3) Loosen (but do not remove) the 4 nuts on the injection pump side which hold the injection pipes.

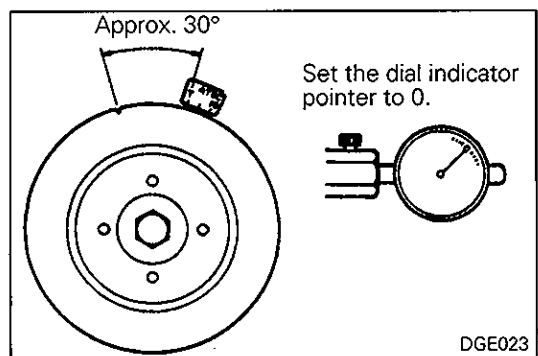
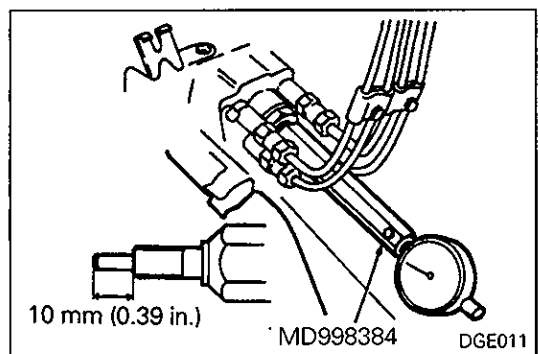
Caution

- When loosening the nuts, hold the delivery valve holder with a wrench to prevent it from turning along with the nut.

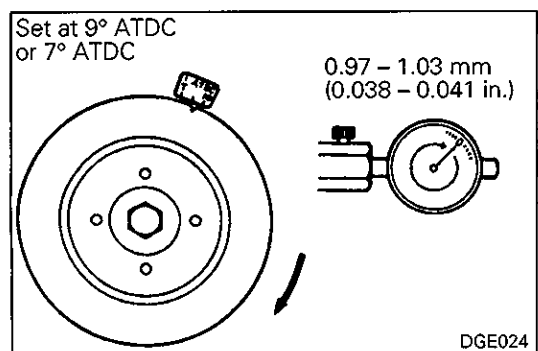
- (4) Remove the plug from the rear of injection pump, and attach the special tool and dial indicator.

Caution

- Before installing the adapter, make sure that the push rod projects 10 mm (0.39 in.). Push rod projection can be adjusted by means of the interior nut.



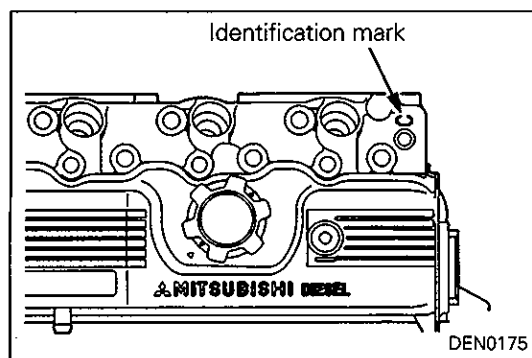
- (5) Set the notch on the crank pulley at approximately 30° BTDC of the compression stroke of the No. 1 cylinder. With the notch in this position, set the dial indicator at zero. Turn the crank pulley slightly in both directions to make sure that the dial indicator pointer does not deviate from the zero position. If the pointer deviates, the notch position is not correct. Readjust it to 30° BTDC.



- (6) Turn the crankshaft clockwise to bring the notch on the pulley to 9° ATDC or 7° ATDC and check to be sure that the dial indicator reading is within the standard value range.

Standard value:

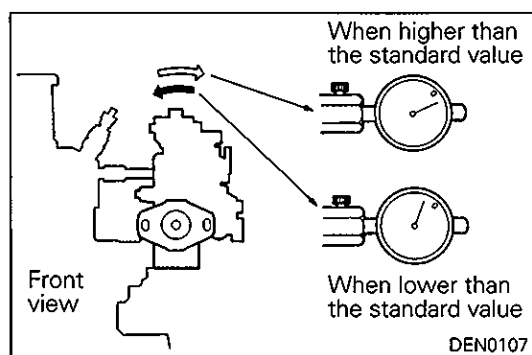
0.97 - 1.03 mm (0.038 - 0.041 in.)



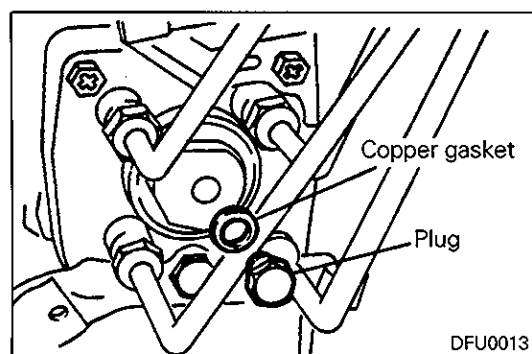
NOTE

The injection timing can be known from the identification mark stamped on the cylinder head at the position shown in the illustration.

Identification mark	Injection timing
A or B	7° ATDC
C or D	9° ATDC



- (7) If dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until the reading is within the standard value range. Then, temporarily tighten the injection pump nuts and bolts.
- (8) Repeat Steps (5) and (6) to make sure that the adjustment has been correctly performed.
- (9) Tighten the injection pump mounting bolts and nuts to the specified torque.
- (10) Remove the dial indicator and the special tool.

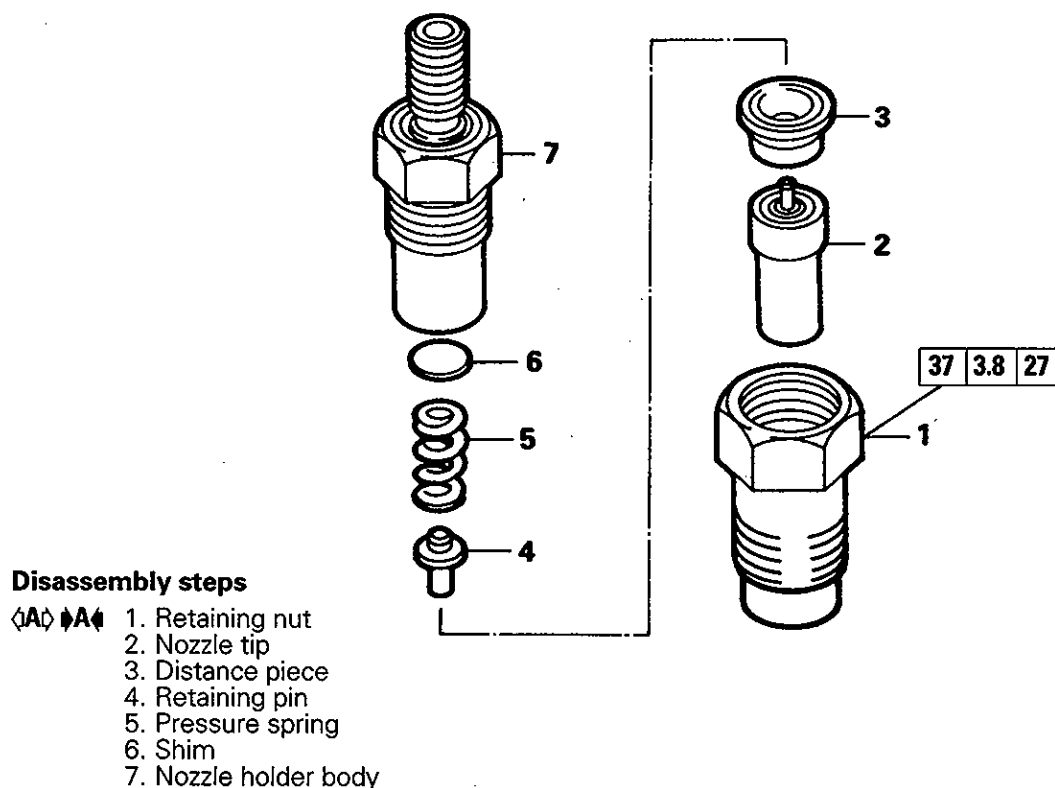


- (11) install new copper gasket and plug, then tighten the plug to specified torque.

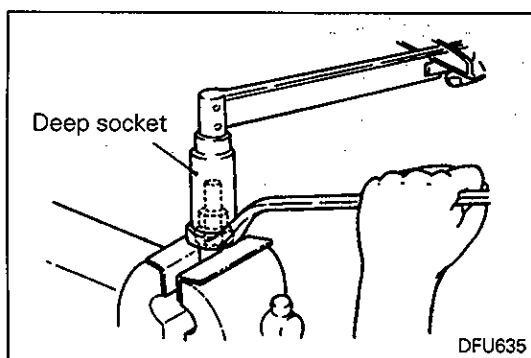
NOTES

6. INJECTION NOZZLE HOLDER

DISASSEMBLY AND REASSEMBLY



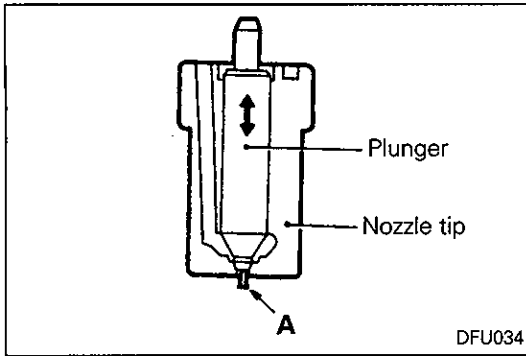
DFU634



DISASSEMBLY SERVICE POINT

⚡⚡ RETAINING NUT DISASSEMBLY

- (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.



INSPECTION

NOZZLE TIP

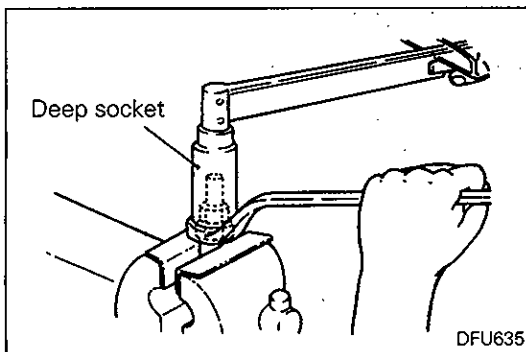
- (1) Check the nozzle tip for carbon deposits. Scrape off carbon deposits with a piece of wood and clean each part with petrol. After cleaning, keep parts submerged in diesel fuel. Take particular care to protect the nozzle tip needle valve from damage.
- (2) While the nozzle tip is submerged in diesel 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

- (1) Check the surface in contact with the nozzle holder body by using minimum.

PRESSURE SPRING

- (1) Check spring for weakness and breakage.



REASSEMBLY SERVICE POINT

RETAINING NUT REASSEMBLY

- (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.