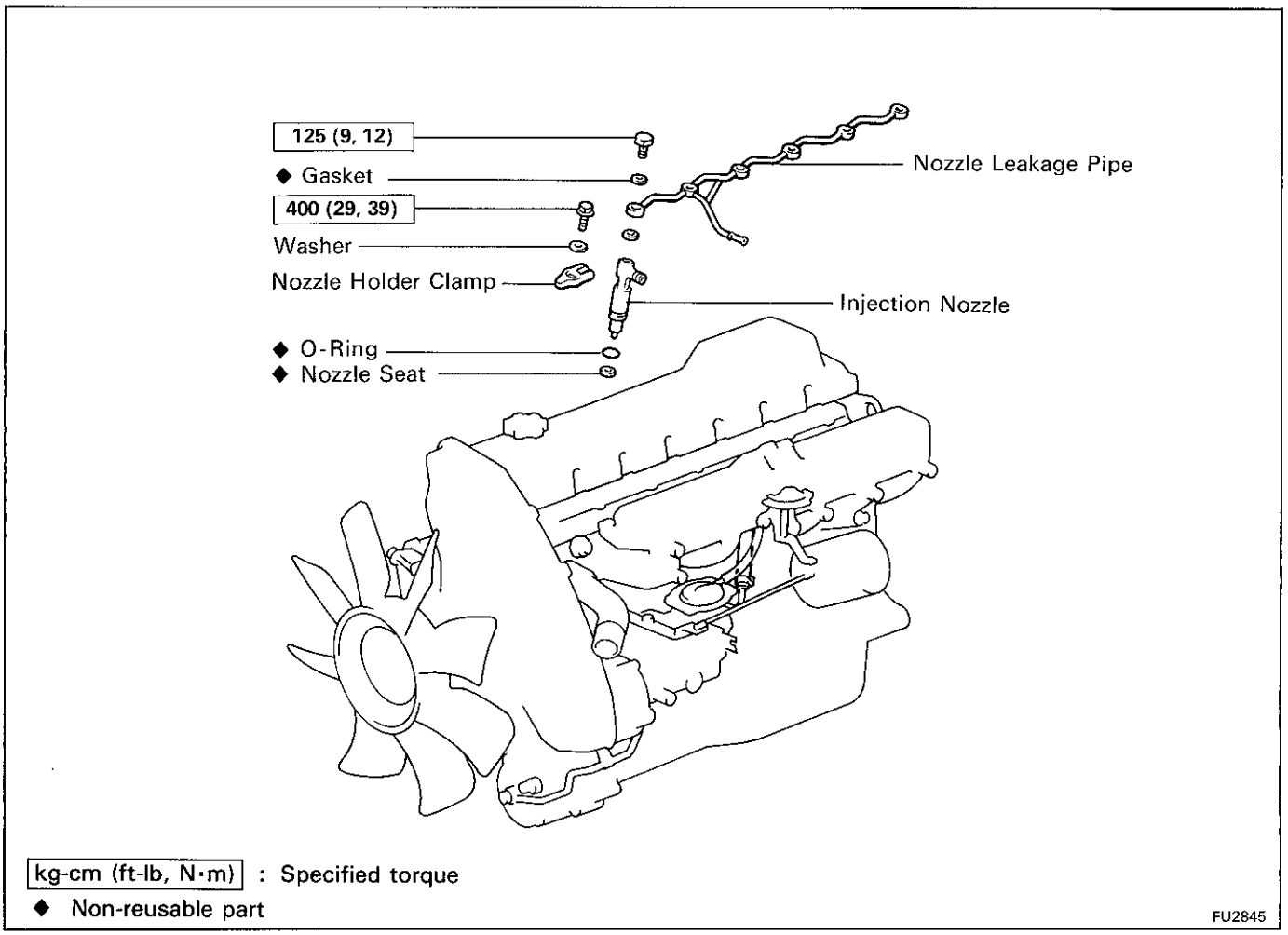
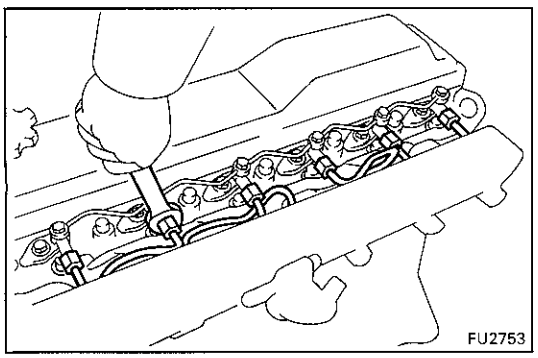
INJECTION NOZZLES (1HD-T)

REMOVAL OF INJECTION NOZZLES

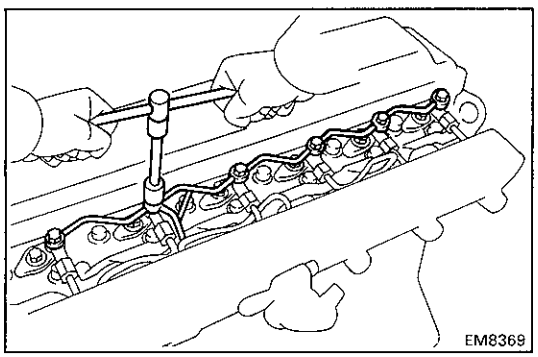




1. **REMOVE INTAKE PIPE**
(See step 6 on page EM-34)

2. **DISCONNECT INJECTION PIPES**

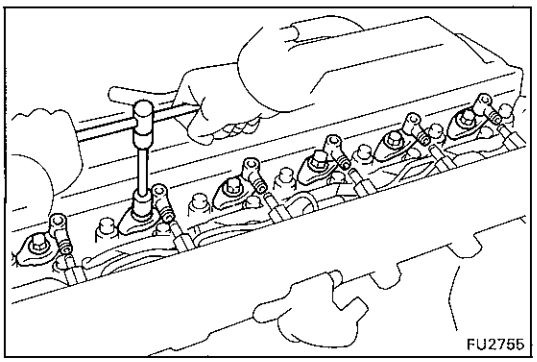
Loosen the union nuts of the six injection pipes from the six injection nozzles.



3. **REMOVE NOZZLE LEAKAGE PIPE**

(a) Disconnect the fuel hose from the nozzle leakage pipe.

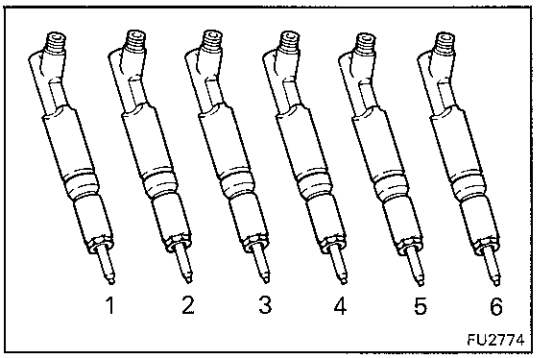
(b) Remove the six hollow bolts, leakage pipe and twelve gaskets.



4. REMOVE INJECTION NOZZLES

(a) Remove the bolt, washer, nozzle holder clamp, injection nozzle and seat.

(b) Remove the O-ring from the injection nozzle.



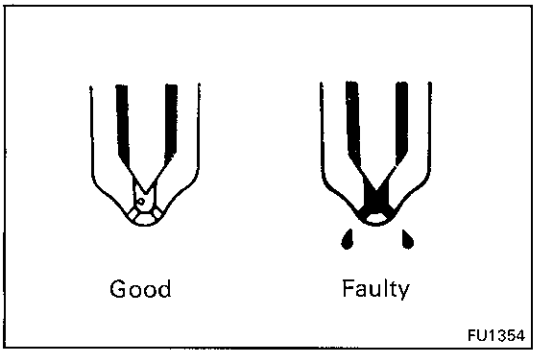
HINT: Arrange the injection nozzles in correct order.

TEST OF INJECTION NOZZLES

1. LEAKAGE TEST

While maintaining pressure at about 10 – 20 kg/cm^2 (142 – 284 psi, 981 – 1,961 kPa) below No.1 opening pressure (adjust by tester handle), check that there is no dripping for 10 seconds from the injection hole or around the retaining nut.

If the nozzle drips within 10 seconds, replace or clean and overhaul the nozzle assembly.

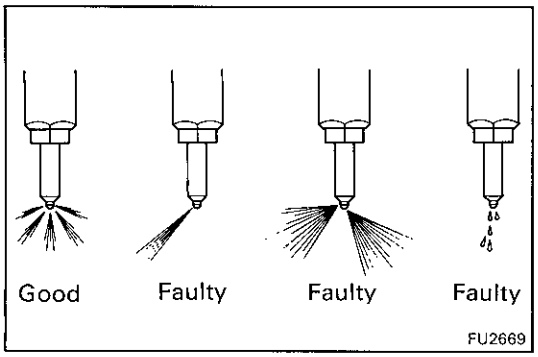


2. SPRAY PATTERN TEST

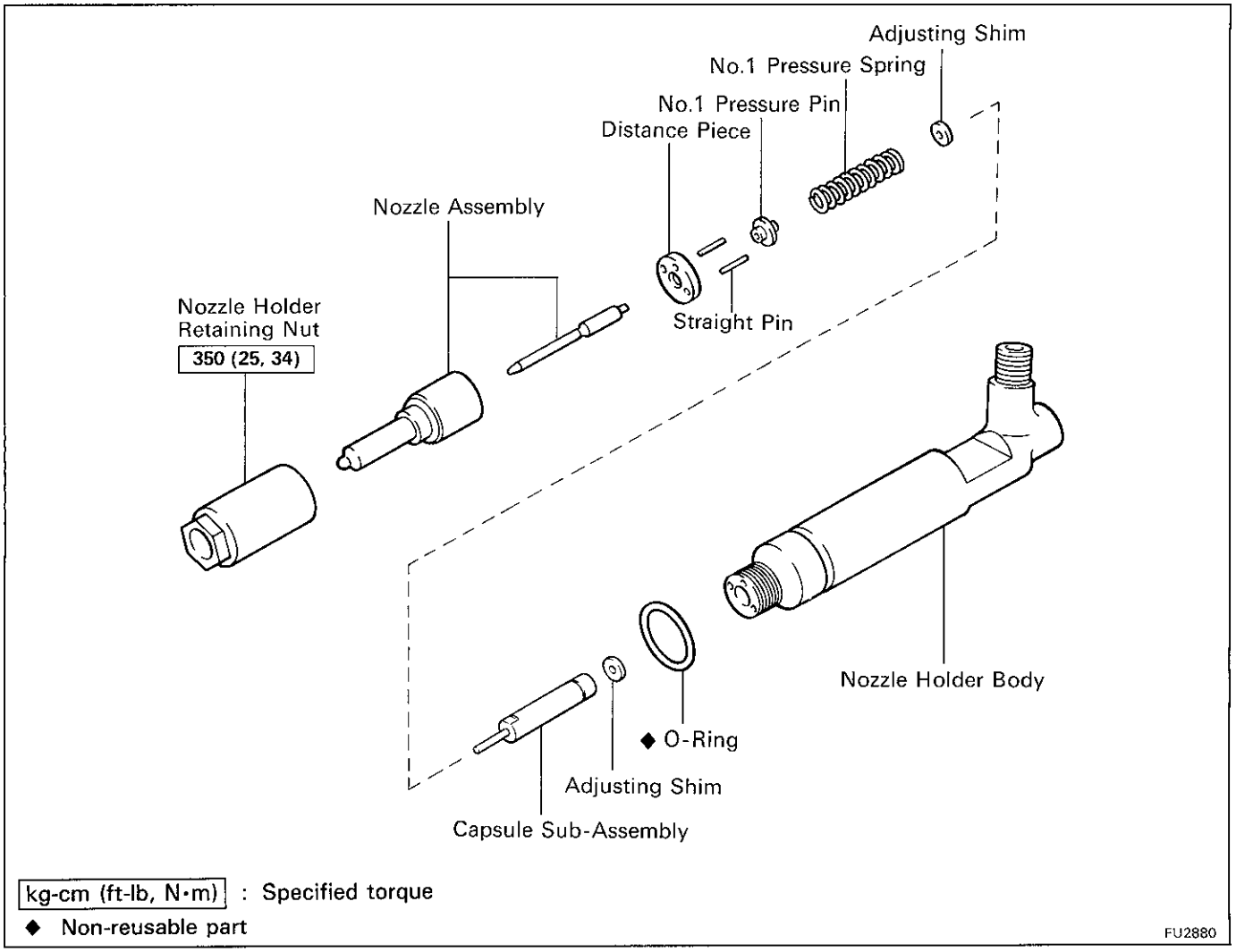
(a) The injection nozzle should shudder at a certain pumping speed between 15 – 60 times (old nozzle) or 30 – 60 times (new nozzle) per minute.

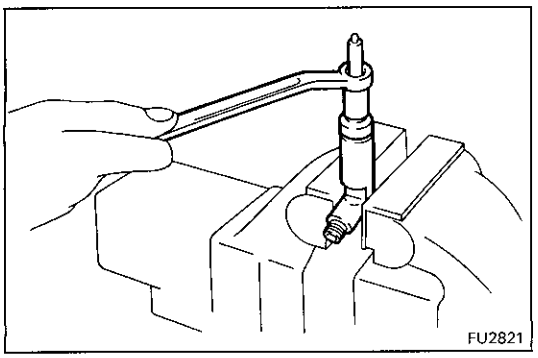
(b) Check the spray pattern during shuddering.

If the spray pattern is not correct during shuddering, the nozzle must be clean or replaced.



COMPONENTS





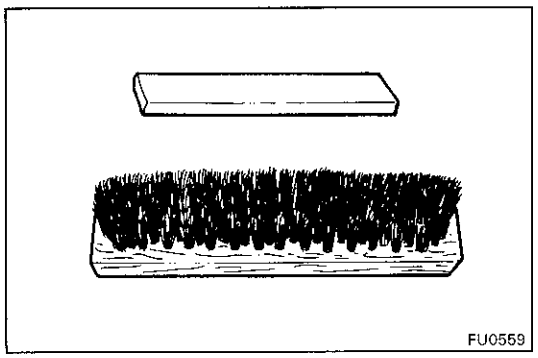
DISASSEMBLY OF INJECTION NOZZLES

DISASSEMBLE INJECTION NOZZLES

(a) Remove the nozzle holder retaining nut.

NOTICE: When disassembling the nozzle, be careful not to drop the inner parts.

(b) Remove the nozzle sub-assembly and distance piece, straight pins, No.1 pressure pin, No.1 pressure spring, adjusting shim, capsule sub-assembly and adjusting shim.

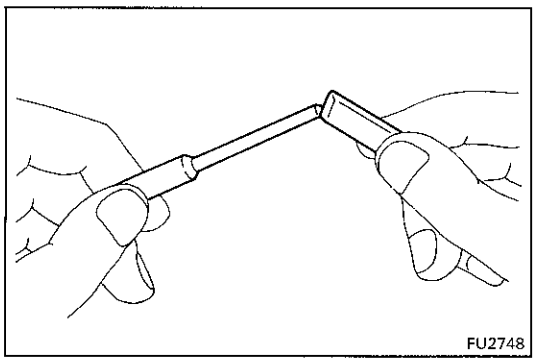


CLEANING AND INSPECTION OF INJECTION NOZZLES

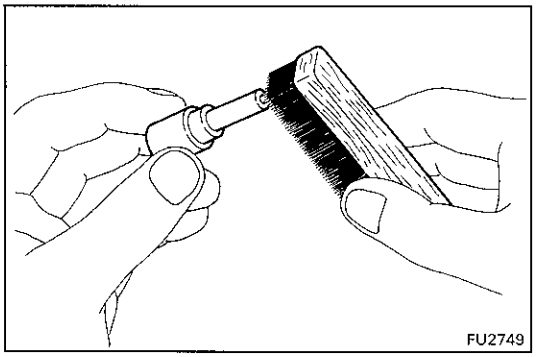
1. NOZZLE CLEANING

(a) To wash the nozzles. Use a wooden stick and brass brush. Wash them in clean diesel fuel.

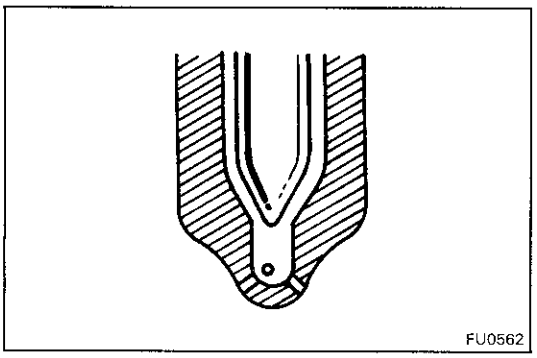
HINT: Do not touch the nozzle mating surfaces with your fingers.



(b) Using a wooden stick, remove the carbon adhering to the nozzle needle tip.



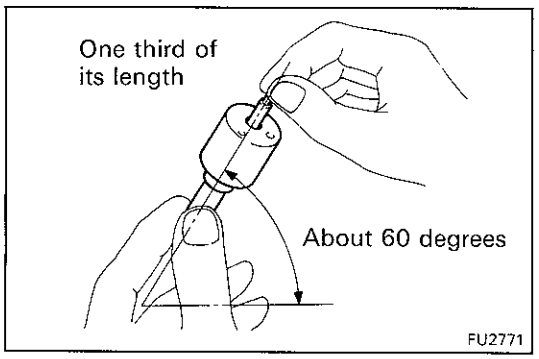
(c) Using a brass brush, remove the carbon from the exterior of the nozzle body (except lapped surface).



(d) Check the seat of the nozzle body for burns or corrosion.

(e) Check the nozzle needle tip for damage or corrosion.

If any of these conditions are present, replace the nozzle assembly.

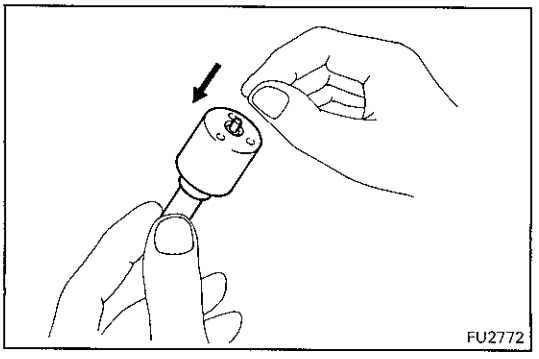


2. INSPECT NOZZLE ASSEMBLY

(a) Wash the nozzle in clean diesel fuel.

HINT: Do not touch the nozzle mating surfaces with your fingers.

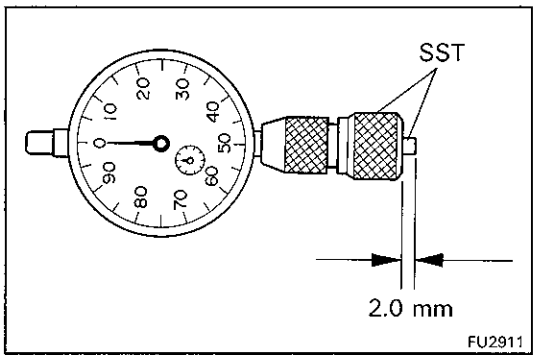
(b) Tilt the nozzle body about 60 degrees and pull the needle out about one third of its length.

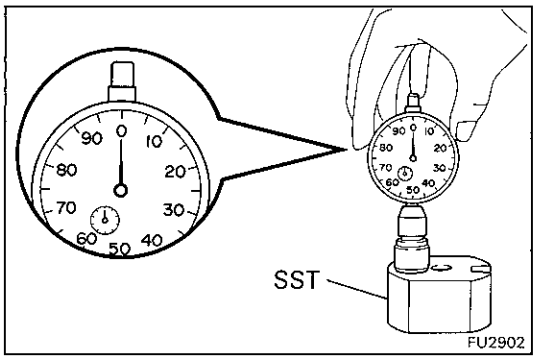


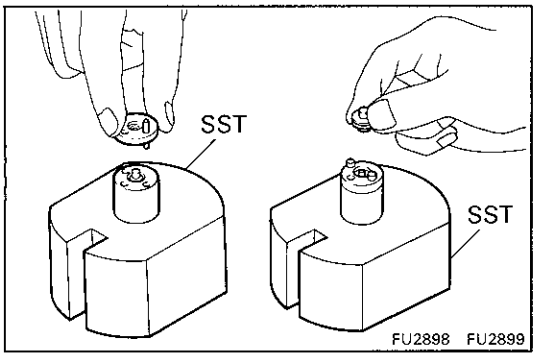
(c) When released, the needle should sink down into the body vent smoothly by its own weight.

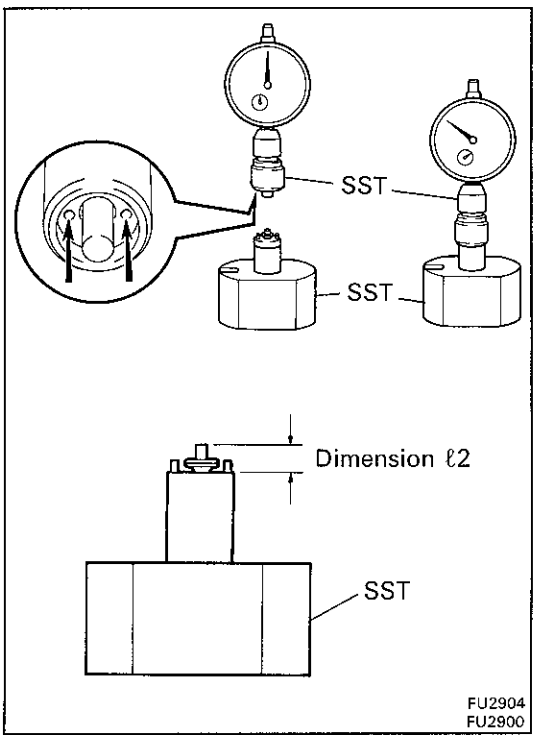
(d) Repeat this test, rotating the needle slightly each time.

If the needle does not sink freely, replace the nozzle assembly.









ASSEMBLY AND ADJUSTMENT OF INJECTION NOZZLES

(See page FU-18)

1. ADJUST PRE-LIFT

NOTICE: Pre-lift adjustment requires great precision, so when performing this operation, make sure everything is clean and that no foreign substances are trapped.

(a) Install the SST to the dial indicator so that the protrusion shown in the illustration is 2.0 mm (0.079 in.) or less.

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(b) Set the dial indicator scale to 0 mm (0 in.) on top of SST or surface plate.

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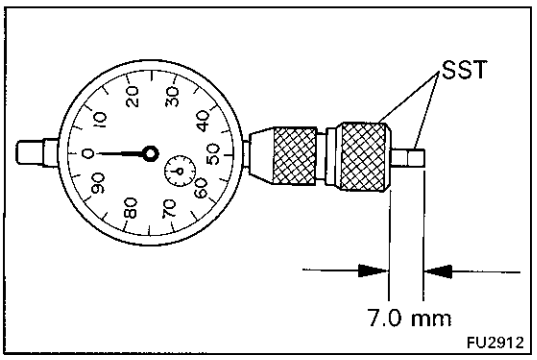
(c) Place the nozzle sub-assembly, distance piece, straight pins and No.1 pressure pin on the SST as shown in the illustration.

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(d) Install SST holes to the straight pins and measure dimension ℓ2.

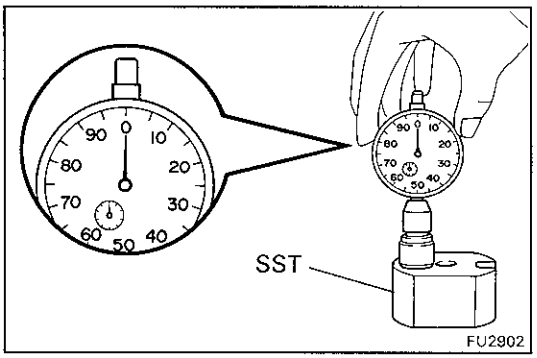
SST 09268-17010

Dimension ℓ2 (Reference): 4.70 mm (0.1850 in.)



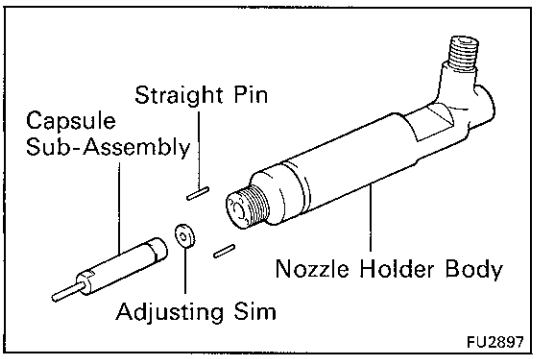
(e) Install SST to the dial indicator so that the protrusion shown in the illustration is 7.0 mm (0.276 in.) or less.

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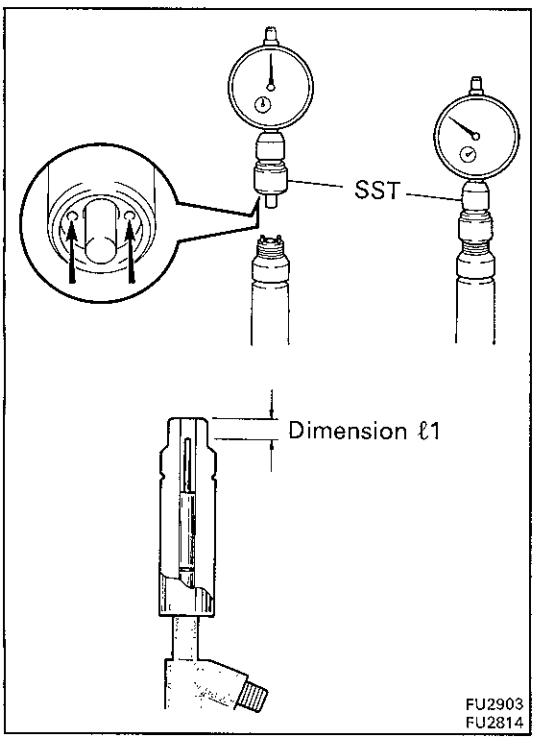


(f) Set the dial indicator scale to 0 mm (0 in.) on top of SST or surface plate.

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(g) Place the adjusting shim, the capsule sub-assembly and straight pins on the nozzle holder body.



(h) Install SST holes to the straight pins and measure dimension ℓ1.

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Dimension ℓ1 (Reference): 4.79 mm (0.1886 in.)

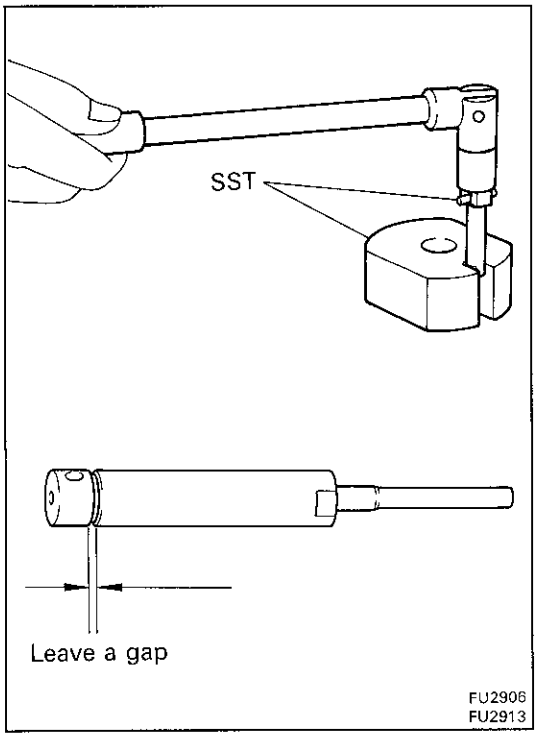
(i) Subtract the dimension ℓ2 from the dimension ℓ1.

Pre-lift: 0.08 — 0.10 mm (0.0031 — 0.0039 in.)

If the pre-lift dimension is not as specified, change the adjusting shim on the top of the capsule sub-assembly.

Adjusting shim thickness		mm (in.)
0.700 (0.0276)	1.310 (0.0516)	1.520 (0.0598)
0.750 (0.0295)	1.320 (0.0520)	1.530 (0.0602)
0.800 (0.0315)	1.330 (0.0524)	1.540 (0.0606)
0.850 (0.0335)	1.340 (0.0528)	1.550 (0.0610)
0.900 (0.0354)	1.350 (0.0531)	1.560 (0.0614)
0.950 (0.0374)	1.360 (0.0535)	1.570 (0.0618)
0.975 (0.0384)	1.370 (0.0539)	1.580 (0.0622)
1.000 (0.0394)	1.380 (0.0543)	1.590 (0.0626)
1.025 (0.0404)	1.390 (0.0547)	1.600 (0.0630)
1.050 (0.0413)	1.400 (0.0551)	1.610 (0.0634)
1.075 (0.0423)	1.410 (0.0555)	1.620 (0.0638)
1.100 (0.0433)	1.420 (0.0559)	1.630 (0.0641)
1.125 (0.0443)	1.430 (0.0563)	1.640 (0.0646)
1.150 (0.0453)	1.440 (0.0567)	1.650 (0.0650)
1.175 (0.0463)	1.450 (0.0571)	1.660 (0.0654)
1.200 (0.0472)	1.460 (0.0575)	1.670 (0.0657)
1.225 (0.0482)	1.470 (0.0579)	1.680 (0.0661)
1.250 (0.0492)	1.480 (0.0583)	1.690 (0.0665)
1.280 (0.0504)	1.490 (0.0587)	1.700 (0.0669)
1.290 (0.0508)	1.500 (0.0591)	1.750 (0.0689)
1.300 (0.0512)	1.510 (0.0594)	1.800 (0.0709)

HINT: If the shim is made thicker, the pre-lift is decreased.

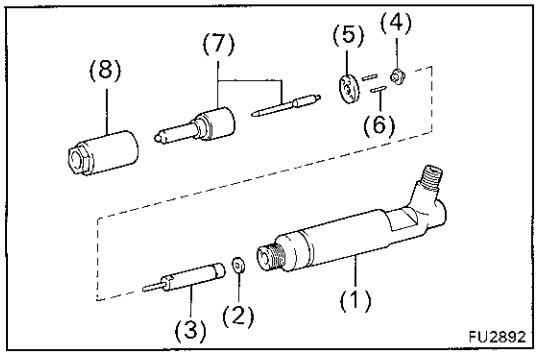


2. CHECK NO.2 OPENING PRESSURE

(a) Loosen by one or two turns the plug screw of the capsule sub-assembly with SST.

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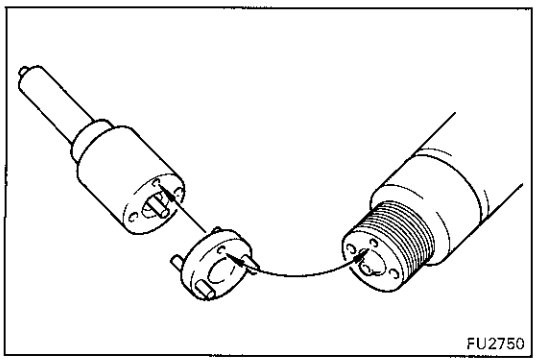
HINT: When the plug screw is loosened by one or two turns, the pre-lift from installation in the nozzle holder becomes 0 mm (0 in.).



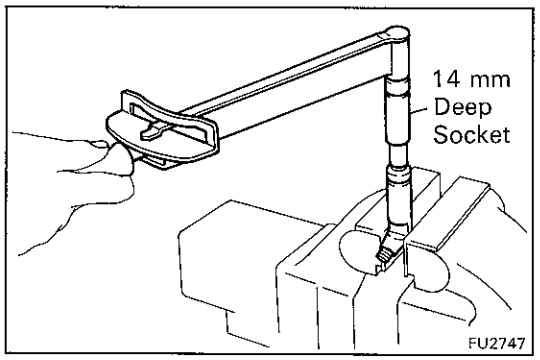
(b) Assemble the following parts:

(1) Nozzle holder body
(2) Adjusting shim selected in step 1 above
(3) Capsule sub-assembly in the condition from step 2 (a)
(4) No.1 pressure pin
(5) Distance piece
(6) Straight pins
(7) Nozzle sub-assembly
(8) Retaining nut

NOTICE: Do not assemble the No.1 pressure spring and the adjusting shim for adjustment of the No.1 opening pressure.



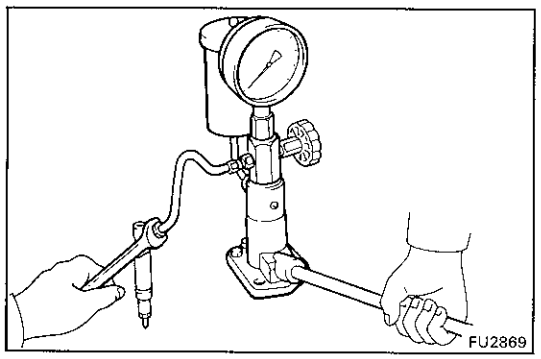
HINT: Align the holes of the nozzle body, distance piece and nozzle holder body.



(c) Using a 14 mm deep socket wrench, torque the retaining nut.

Torque: 350 kg-cm (25 ft-lb, 34 N·m)

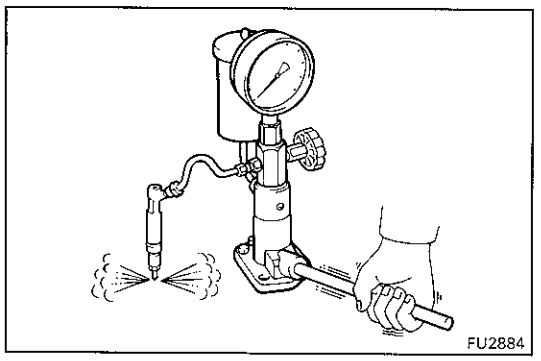
NOTICE: Over torquing could cause nozzle deformation and needle adhesion or other defects.



(d) Install the injection nozzle to the injection nozzle hand tester and bleed air from the union nut.

CAUTION: Do not place your finger over the nozzle injection hole.

(e) Pump the tester handle a few times as fast as possible to discharge the carbon from the injection hole.



(f) Pump the tester handle slowly and observe the pressure gauge.

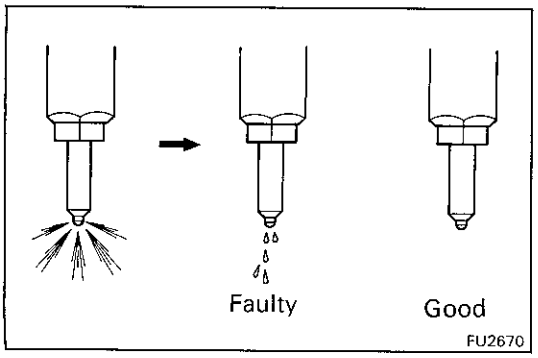
(g) Read the pressure gauge just as the injection pressure begins to drop.

No.2 opening pressure (Inspection pressure):
132 – 138 kg/cm^2
(1,877 – 1,963 psi, 12,945 – 13,533 kPa)

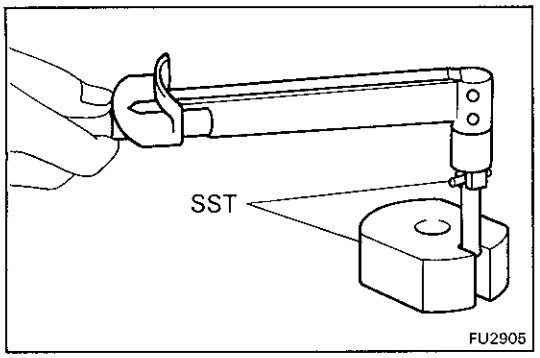
HINT: Proper nozzle operation can be determined by a swishing sound.

If the opening pressure is not as specified, replace the capsule sub-assembly.

HINT: The No.2 opening pressure is already adjusted for the new capsule sub-assembly.



(h) There should be no dripping after injection.



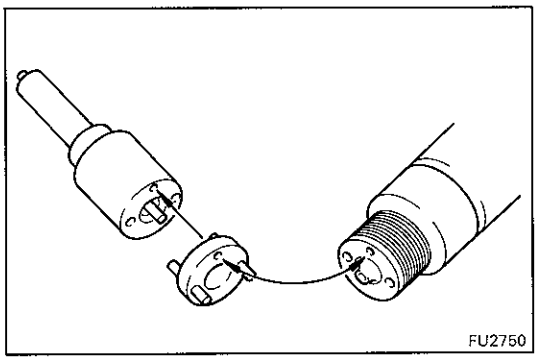
(i) After checking the No.2 opening pressure, remove the capsule sub-assembly and tighten the plug screw with SST.

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Torque: 25 kg-cm (21 in.-lb, 2.5 N·m)

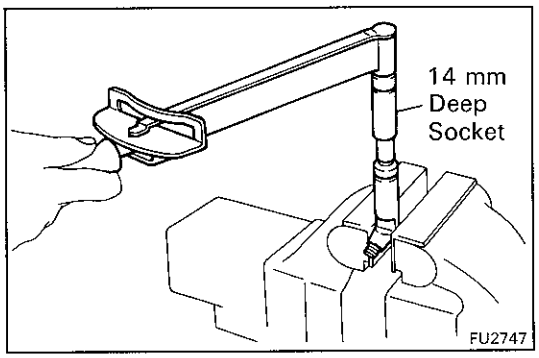
3. ADJUST NO.1 OPENING PRESSURE

(a) Assemble the nozzle holder body, adjusting shim selected in step 1, the capsule sub- assembly, adjusting shim for adjustment of No.1 opening pressure, No.1 pressure spring, No.1 pressure pin, distance piece, straight pins and the nozzle sub-assembly, and finger tighten the retaining nut.



HINT:

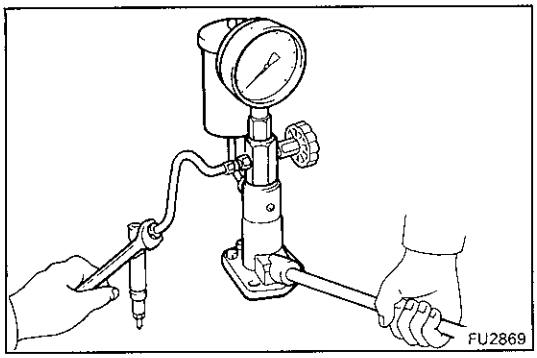
- Align the holes of the nozzle body, distance piece and nozzle holder body.
- When the thickness of the originally used adjusting shim is not known, use a shim 1.5 mm (0.59 in.) thick instead.



(b) Using a 14 mm deep socket wrench, torque the retaining nut.

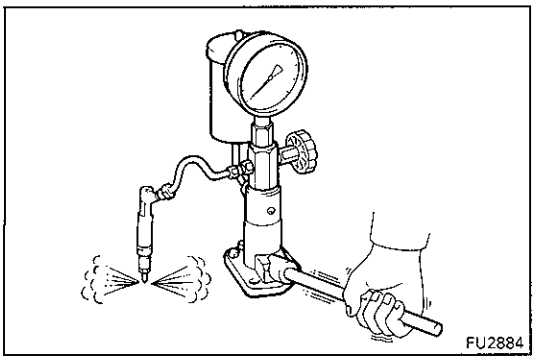
Torque: 350 kg-cm (25 ft-lb, 34 N·m)

NOTICE: Over torquing could cause nozzle deformation and needle adhesion or other defects.



(c) Install the injection nozzle to the injection nozzle hand tester and bleed air from the union nut.

CAUTION: Do not place your finger over the nozzle injection hole.



(d) Pump the tester handle slowly and observe the pressure gauge.

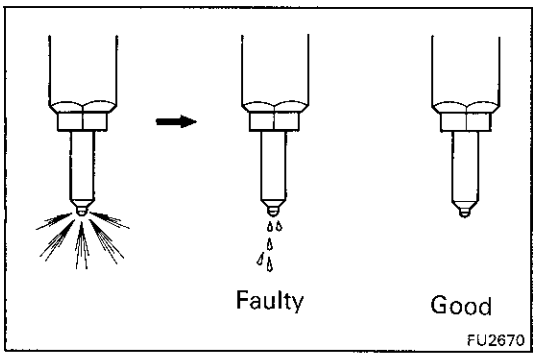
(e) Read the pressure gauge just as the injection pressure begins to drop.

No.1 opening pressure: 180 – 190 kg/cm^2 (2,560 – 2,702 psi) (17,652 – 18,633 kPa)

HINT: Proper nozzle operation can be determined by a swishing sound.

If the opening pressure is not as specified, disassemble the nozzle and change the adjusting shim on the top of the No.1 pressure spring.

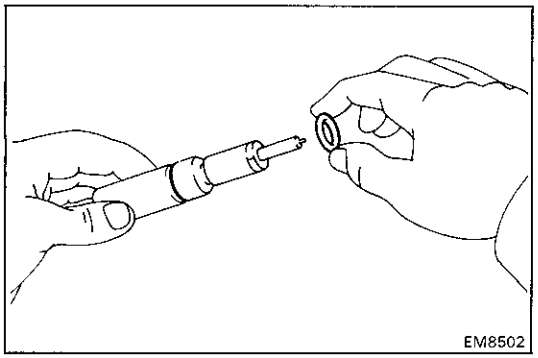
Adjusting shim thickness		mm (in.)
0.700 (0.0276)	1.310 (0.0516)	1.520 (0.0598)
0.750 (0.0295)	1.320 (0.0520)	1.530 (0.0602)
0.800 (0.0315)	1.330 (0.0524)	1.540 (0.0606)
0.850 (0.0335)	1.340 (0.0528)	1.550 (0.0610)
0.900 (0.0354)	1.350 (0.0531)	1.560 (0.0614)
0.950 (0.0374)	1.360 (0.0535)	1.570 (0.0618)
0.975 (0.0384)	1.370 (0.0539)	1.580 (0.0622)
1.000 (0.0394)	1.380 (0.0543)	1.590 (0.0626)
1.025 (0.0404)	1.390 (0.0547)	1.600 (0.0630)
1.050 (0.0413)	1.400 (0.0551)	1.610 (0.0634)
1.075 (0.0423)	1.410 (0.0555)	1.620 (0.0638)
1.100 (0.0433)	1.420 (0.0559)	1.630 (0.0641)
1.125 (0.0443)	1.430 (0.0563)	1.640 (0.0646)
1.150 (0.0453)	1.440 (0.0567)	1.650 (0.0650)
1.175 (0.0463)	1.450 (0.0571)	1.660 (0.0654)
1.200 (0.0472)	1.460 (0.0575)	1.670 (0.0657)
1.225 (0.0482)	1.470 (0.0579)	1.680 (0.0661)
1.250 (0.0492)	1.480 (0.0583)	1.690 (0.0665)
1.280 (0.0504)	1.490 (0.0587)	1.700 (0.0669)
1.290 (0.0508)	1.500 (0.0591)	1.750 (0.0689)
1.300 (0.0512)	1.510 (0.0594)	1.800 (0.0709)



HINT:

- Varying the adjusting shim thickness by 0.01 mm (0.0004 in.) changes the injection pressure by about 1.5 kg/cm^2 (21 psi, 147 kPa).
- Only one adjusting shim should be used.

(f) There should be no dripping after injection.

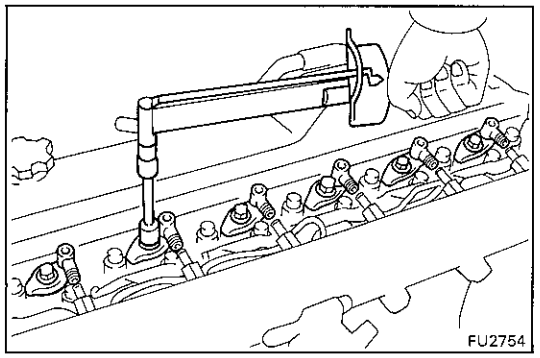


INSTALLATION OF INJECTION NOZZLES

(See page FU-17)

1. INSTALL INJECTION NOZZLES

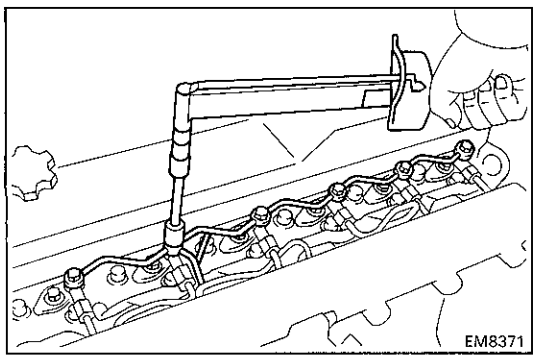
(a) Install a new O-ring to the injection nozzle.



(b) Install new nozzle seats into the injection nozzle hole of the cylinder head.

(c) Install the injection nozzles with the washer, nozzle holder clamp and bolt.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)

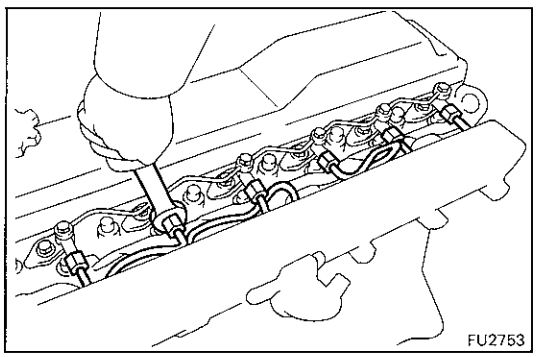


2. INSTALL NOZZLE LEAKAGE PIPE

(a) Install new gaskets and the leakage pipe with the hollow bolts.

Torque: 125 kg-cm (9 ft-lb, 12 N·m)

(b) Connect the fuel hose to the return pipe.



3. CONNECT INJECTION PIPES

Connect the injection pipes to injection nozzle.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

4. INSTALL INTAKE PIPE

(See step 3 on page EM-38)

5. START ENGINE AND CHECK FOR FUEL LEAKS