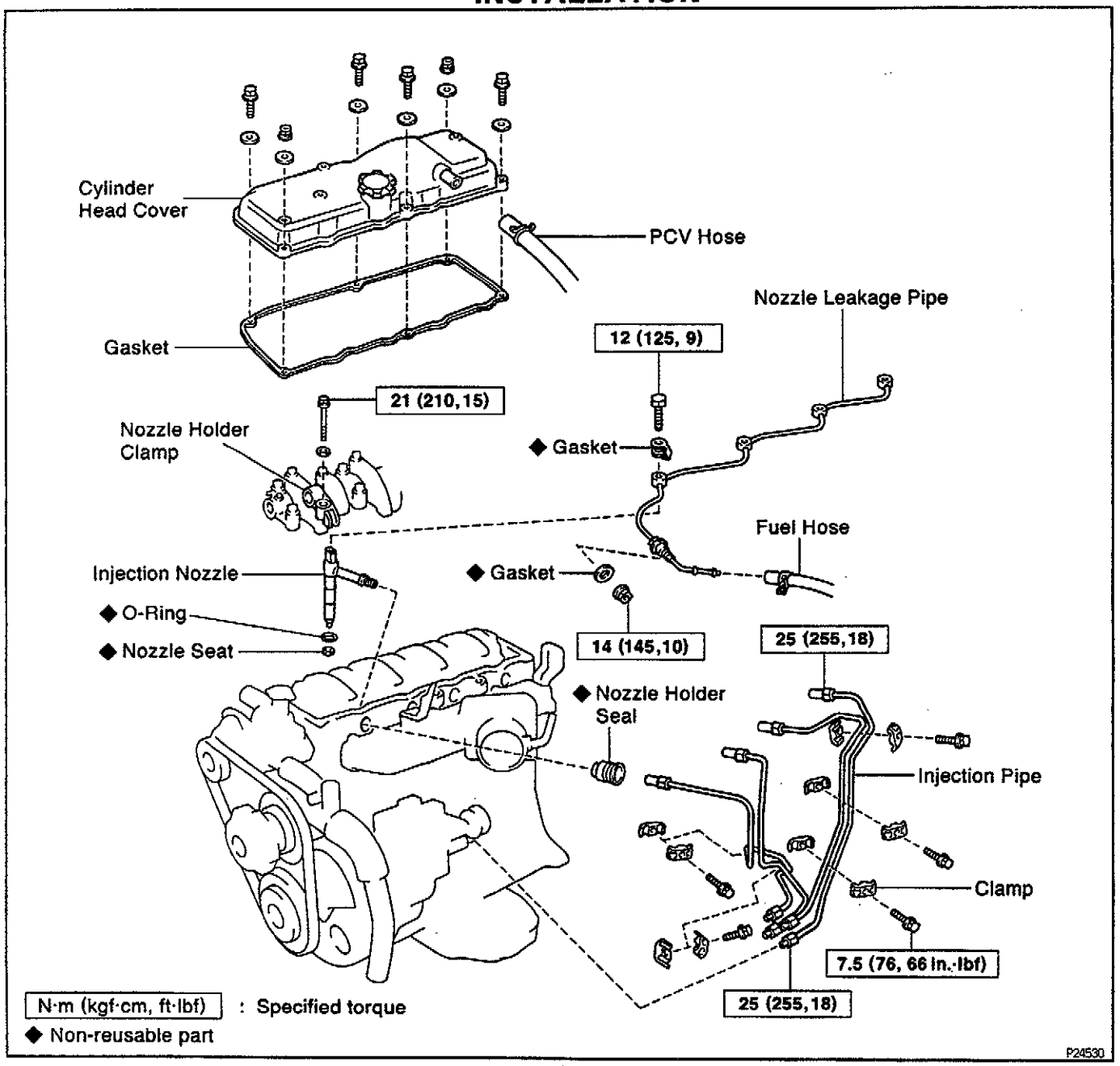
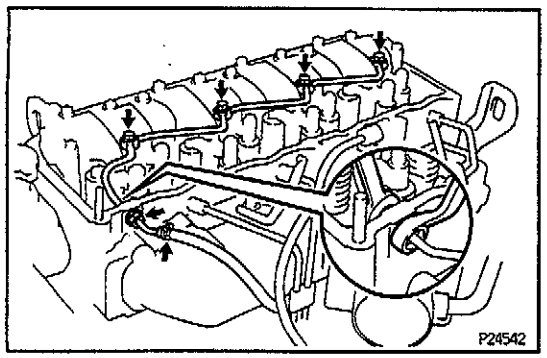
INJECTION NOZZLE (15B–F, 15B–FT)

COMPONENTS FOR REMOVAL AND INSTALLATION



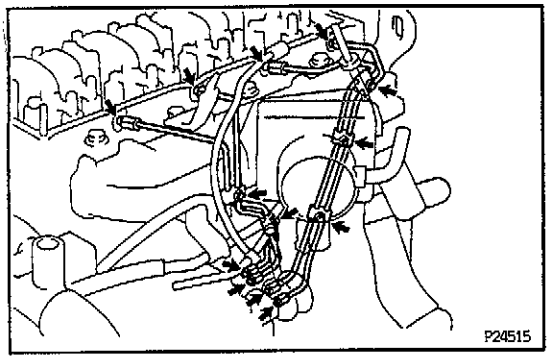


INJECTION NOZZLES REMOVAL

1. **REMOVE CYLINDER HEAD COVER**
2. **REMOVE NOZZLE LEAKAGE PIPE**

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

(b) Remove the nut holding the nozzle leakage pipe to the cylinder head.

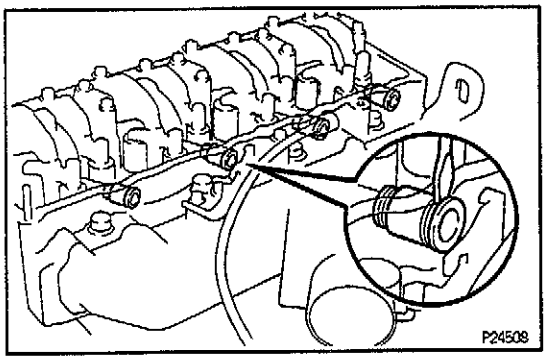


(c) Remove the 4 hollow bolts, 5 gaskets and nozzle leakage pipe.

3. REMOVE INJECTION PIPES

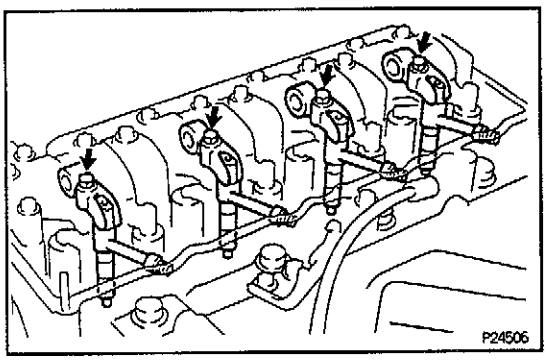
(a) Loosen the union nuts of the 4 injection pipes.

(b) Remove the 5 bolts, 4 injection pipes and clamps.



4. REMOVE NOZZLE HOLDER SEALS

Using a screwdriver, pry out the nozzle holder seals from the cylinder head.



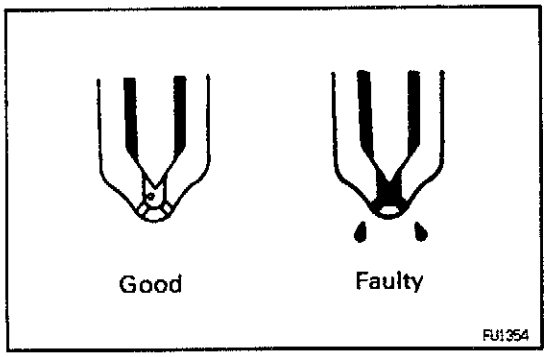
5. REMOVE INJECTION NOZZLES

(a) Remove the bolt holding the nozzle holder clamp to the cylinder head.

(b) Remove the 4 injection nozzles and seats from the cylinder head.

(c) Remove the O—ring from the injection nozzle.

HINT: Arrange the injection nozzles in correct order.

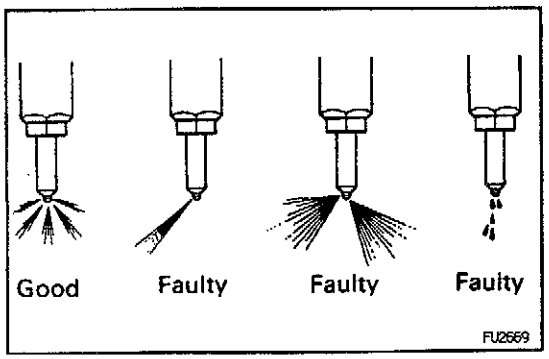


INJECTION NOZZLES TEST

1. LEAKAGE TEST

While maintaining pressure at about 981 — 1,961 kPa (10 — 20 kgf/cm² 142 — 284 psi), below No.1 opening pressure (adjust by tester handle), check that there is not 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

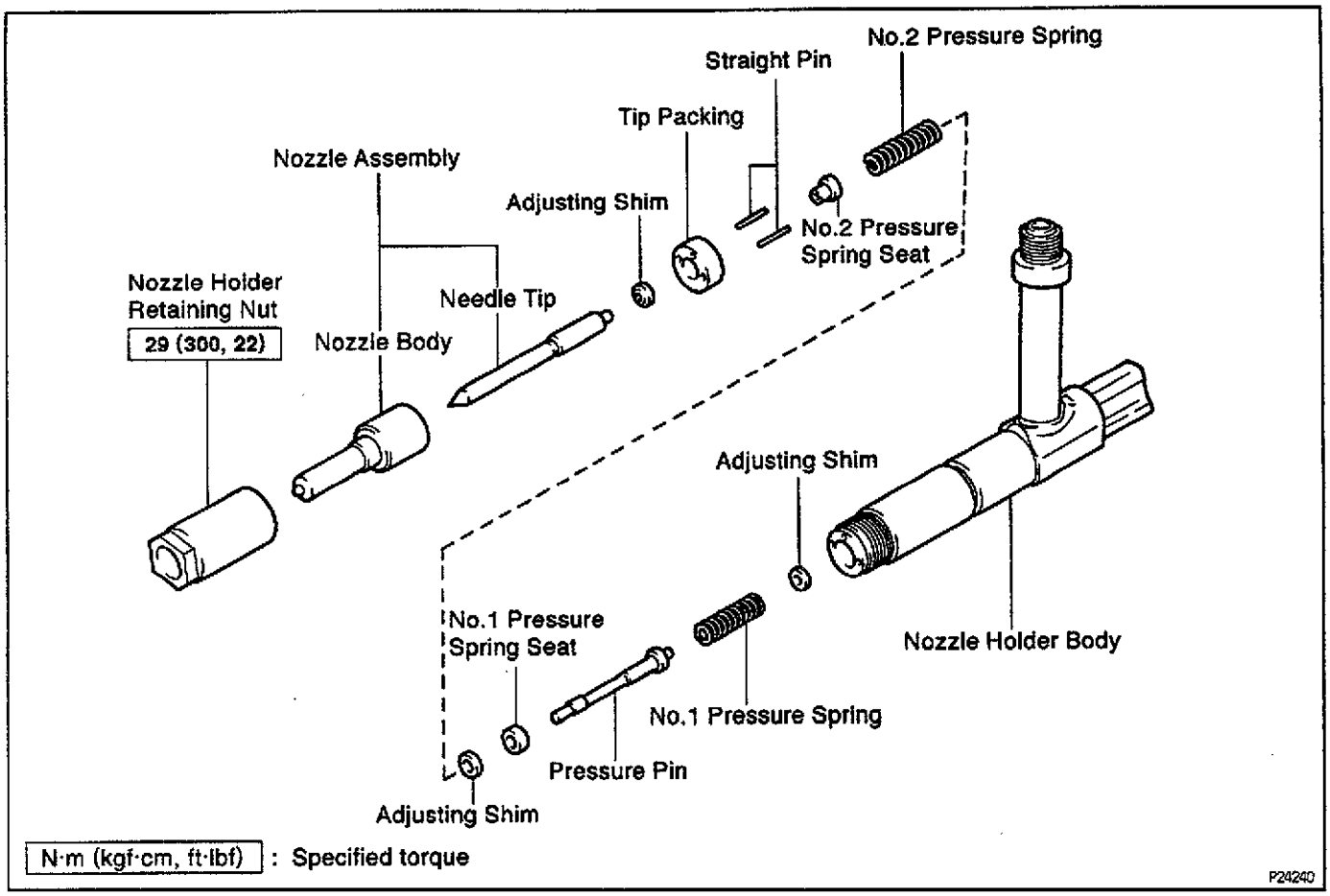
(a) The injection nozzle should shudder at a certain pumping speed between 15 — 60 times (old nozzle) or 30 — 60 times (new nozzle) per minute.

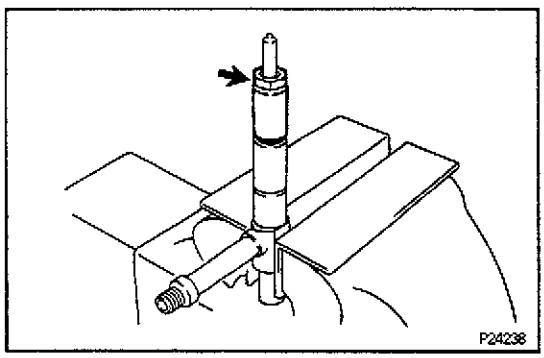
(b) Check the spray pattern during shuddering.

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

EG

COMPONENTS FOR DISASSEMBLY AND ASSEMBLY





INJECTION NOZZLE DISASSEMBLY

DISASSEMBLE INJECTION NOZZLES

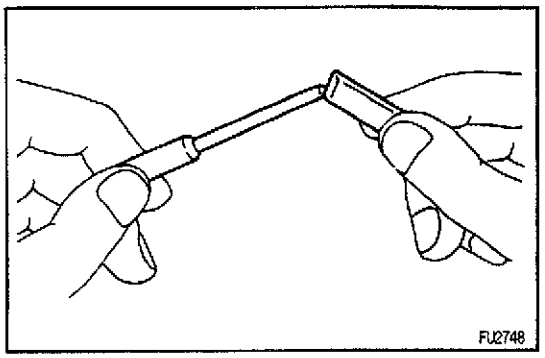
(a) Remove the nozzle holder retaining nut.
NOTICE: When disassembling the nozzle, be careful not to drop the inner parts.

(b) Disassemble the injection nozzle.

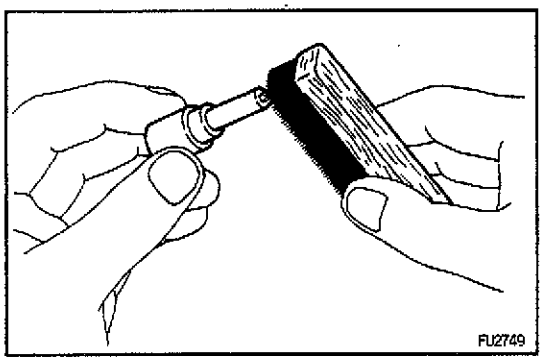
INJECTION NOZZLES CLEANING AND INSPECTION

1. NOZZLE CLEANING

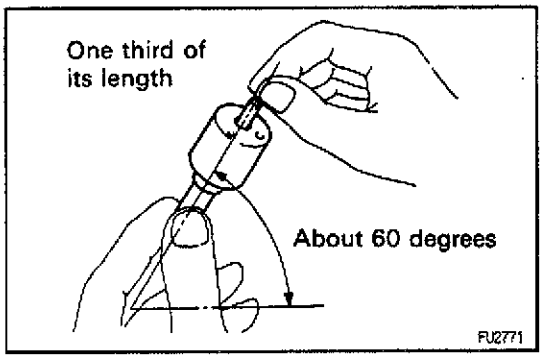
(a) To wash the nozzles, use a wooden stick and brass brush. Wash them in clean diesel fuel.
HINT: Do not touch the nozzle mating surfaces with your fingers.



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

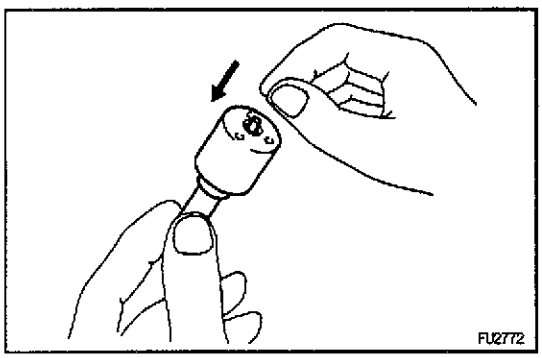


(c) Using a brass brush, remove the carbon from the exterior of the nozzle body (except lapped surface).
(d) Check the seat of the nozzle body for burns or corrosion.
(e) Check the nozzle needle tip for damage or corrosion.
If any of these conditions are present, replace the nozzle assembly.



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.

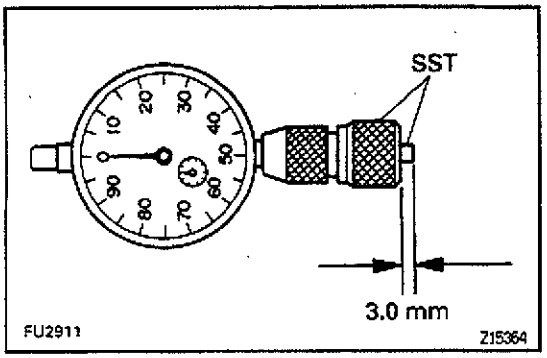


(c) When released, the needle should stick down into the body vent smoothly by its own weight.
(d) Repeat this test, rotating the needle slightly each time.
If the needle does not sink freely, replace the nozzle assembly.

INJECTION NOZZLES ASSEMBLY AND ADJUSTMENT

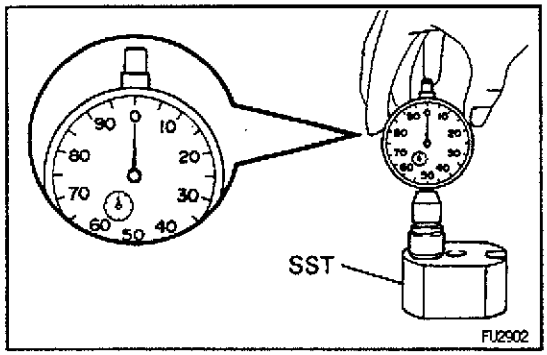
1. ADJUST NEEDLE–LIFT AND PRE–LIFT

NOTICE: Needle–lift and pre–lift adjustment requires great precision, so when doing this operation, make sure everything is clean and that no foreign substances are trapped.

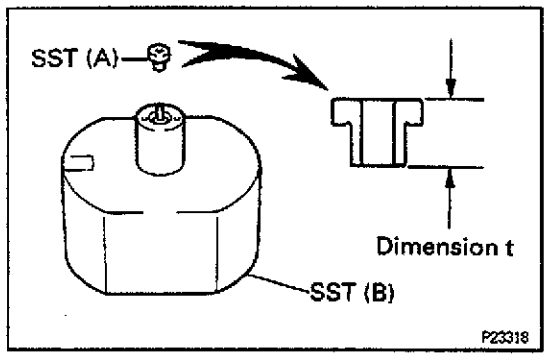


A. Adjust needle–lift

(a) Using SST, install the SST to the dial indicator so that the protrusion shown in the illustration is 3.0 mm (0.118 in.) or less.
SST 09268–17010

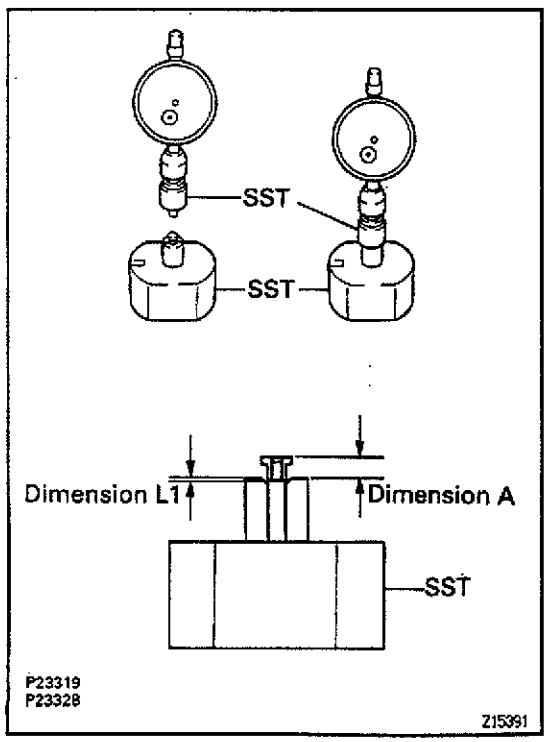


(b) Using SST, set the dial indicator scale to 0 mm (0 in.) on top of the SST or the surface plate.
SST 09268–17010



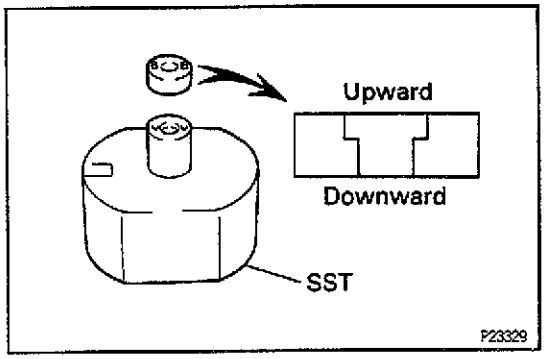
(c) Using a micrometer, measure dimension t of the SST (A).
SST(A) 09268–17020

(d) Place the nozzle assembly and SST (A) on the SST (B) as shown in the illustration.
SST(A) 09268–17020
(B) 09268–17010

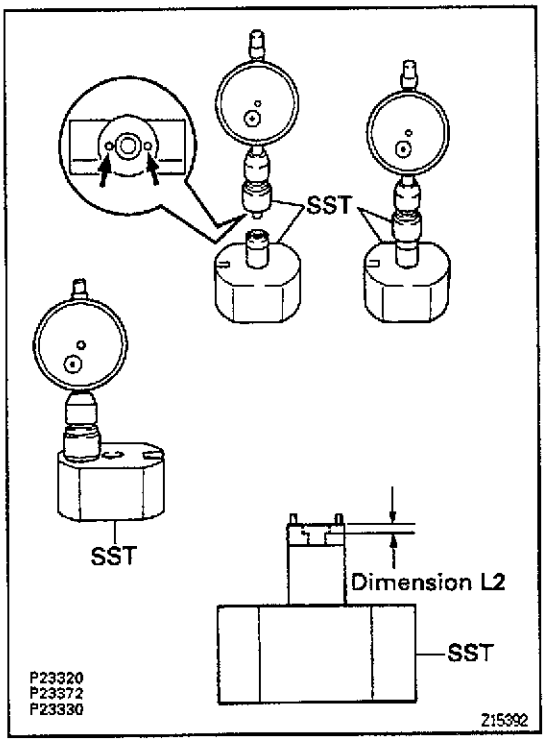


(e) Using SST, set the SST above the nozzle, and measure dimension A.
SST 09268–17010
Dimension L1 = t – A

(f) Remove the SST and needle tip from the nozzle body.
SST 09268–17020

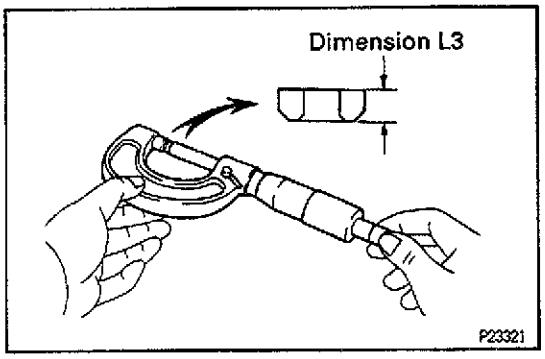


(g) Place the tip packing and straight pins on the nozzle body as shown in the illustration.
NOTICE: Position the tip packing on top of the nozzle body in the direction shown in the illustration.



(h) Install SST holes to the straight pins, and set dial indicator scale to 0 mm (0 in.) on top of the nozzle assembly.
SST 09268–17010

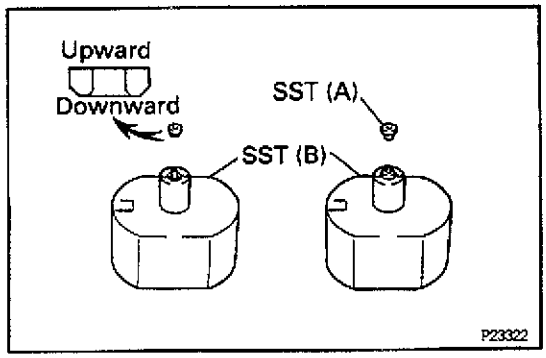
(i) Using SST, set the dial indicator above the SST or the surface plate, and measure dimension L2.
SST 09268–17010



(j) Using a micrometer, measure dimension L3 of the adjusting shim.
Needle–lift = (L1 + L2) – L3
Needle–lift: 0.23 – 0.28 mm (0.0091 – 0.0110 in.)
If the needle – lift dimension is not as specified, change the adjusting shim.
Adjusting shim thickness mm (in.):

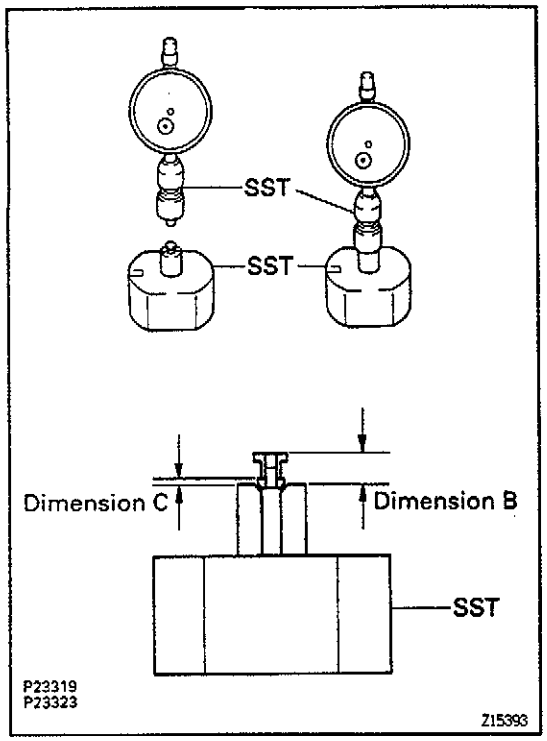
1.900 (0.0748)	1.950 (0.0768)	2.000 (0.0787)
1.925 (0.0758)	1.975 (0.0778)	–

HINT: If the shim is made thicker, the needle–lift is decreased.

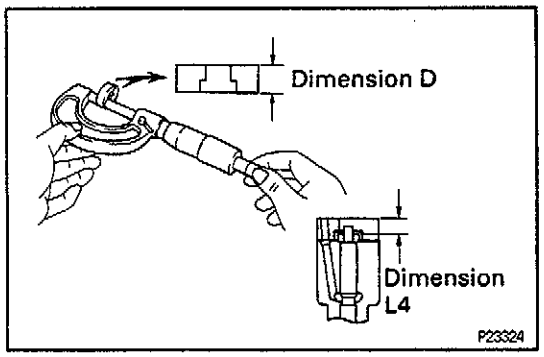


B. Adjust pre–lift
(See steps (a) to (c) in step A)

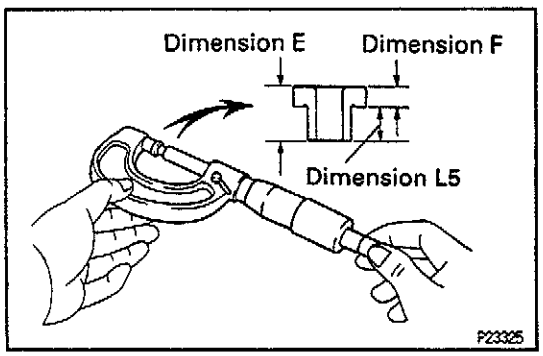
(a) Using SST, place the nozzle assembly, the adjusting shim selected step A and SST (A) on the SST (B) as shown in the illustration.
SST(A) 09268–17020
(B) 09268–17010



(b) Using SST, set the SST above the nozzle, and measure dimension B.
SST 09268–17010
t ..... Dimension of the SST (A) (See step (c) in step A)
Dimension C = B – t



(c) Using a micrometer, measure dimension D of the tip packing.
Dimension L4 = D – C



(d) Using a micrometer, measure dimension E and F of the No.2 pressure spring seat.
Dimension L5 = E – F
Pre–lift = L4 – L5
Pre–lift: 0.10 – 0.12 mm (0.0039 – 0.0047 in.)
If the pre–lift dimension is not as specified, change the adjusting No.2 pressure spring seat.
Adjusting spring seat thickness **mm (in.)**
15B–F:

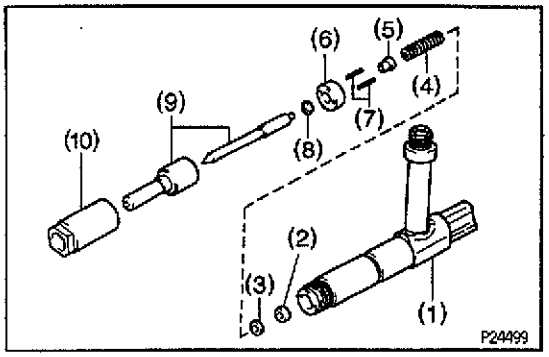
1.950 (0.0768)	3.120 (0.1228)	3.210 (0.1264)
1.975 (0.0778)	3.150 (0.1240)	3.240 (0.1276)
3.090 (0.1217)	3.180 (0.1252)	3.270 (0.1287)

15B–FT:

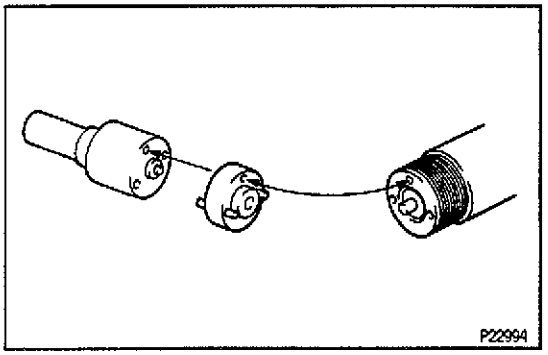
1.900 (0.0748)	0.01 (0.0004) increments from 3.15 (0.1240) to 3.28 (0.1291)
1.975 (0.0778)	
0.01 (0.0004) increments from 3.07 (0.1209) to 3.12 (0.1228)	–

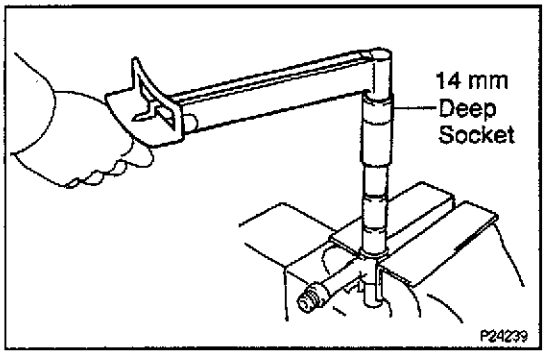
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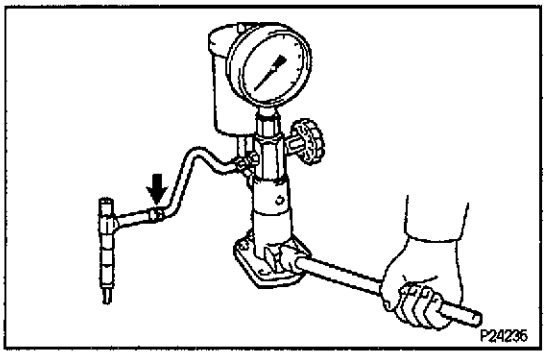
HINT: If the shim is made thicker, the pre–lift is decreased.

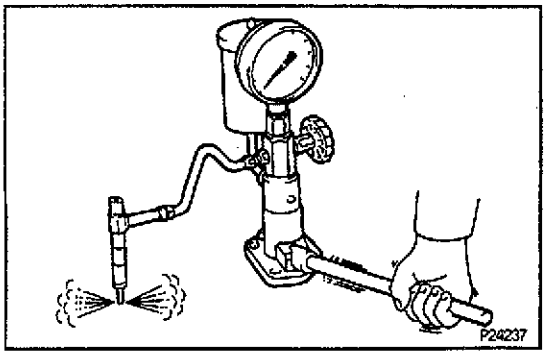


EG









2. CHECK NO.2 OPENING PRESSURE

(a) Assemble these parts:
(1) Nozzle holder body
(2) No.1 pressure spring seat
(3) Adjusting shim
(4) No.2 pressure spring
(5) SST
(6) Tip packing
(7) Straight pins
(8) Adjusting shim selected in step 1. A above
(9) Nozzle assembly
(10) Retaining nut
SST 09268–17020

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

HINT: Align the holes of the nozzle body, tip packing and nozzle holder body.

(b) Using a 14 mm deep socket wrench, torque the retaining nut.
Torque: 29 N·m (300 kgf·cm, 22 ft·lbf)
NOTICE: Over torquing could cause the nozzle deformation and the 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 a few times as fast as possible to discharge the carbon from the injection hole.

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

(f) Read the pressure gauge just as the injection pressure begins to drop.
No.2 opening pressure (Inspection pressure):
15B–F:
19,520 – 20,500 kPa
(200 – 210 kgf/cm², 2,830 – 2,970 psi)
15B–FT:
18,530 – 19,520 kPa
(190 – 200 kgf/cm², 2,690 – 2,830 psi)

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

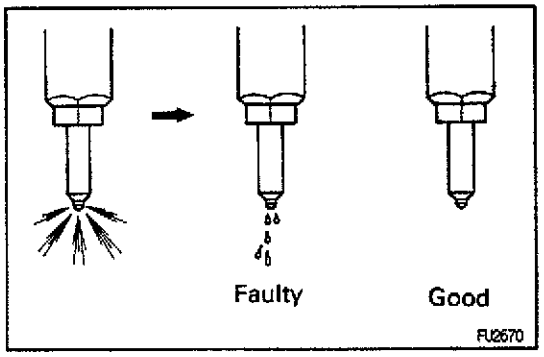
If the opening pressure is not as specified, disassemble the nozzle and change the adjusting shim on the top of the No.2 pressure spring.

Adjusting shim thickness:

- 0.050 mm (0.0020 in.) increments from 0.700 mm (0.0276 in.) to 0.950 mm (0.0374 in.)
- 0.025 mm (0.0010 in.) increments from 0.975 mm (0.0384 in.) to 1.800 mm (0.0709 in.)
- 0.050 mm (0.0020 in.) increments from 1.850 mm (0.0728 in.) to 2.150 mm (0.0846 in.)

HINT:

- Varying the adjusting shim thickness by 0.025 mm (0.0010 in.) changes the injection pressure by about 470 kPa (3.8 kgf/cm², 54 psi).
- Only one adjusting shim should be used.



(g) There should be no dripping after injection.

(h) After checking the No.2 opening pressure, disassemble the nozzle.

3. ADJUST NO.1 OPENING PRESSURE

(a) Assemble the nozzle holder body, adjusting shim for adjustment of No.1 opening pressure, No.1 pressure spring, No.1 pressure pin, No.1 pressure spring seat, adjusting shim selected in step 2 above, No.2 pressure spring, No.2 pressure spring seat selected in step 1. B, tip packing, straight pins, adjusting shim selected in step 1. A and nozzle assembly, and finger tighten the retaining nut.

HINT:

- Align the holes of the nozzle body, the distance piece and the 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) Read the pressure gauge just as the injection pressure begins to drop.

(See steps (b) to (f) in step 2 above)

No.1 opening pressure:

15B–F:

16,670 – 17,650 kPa

(170 – 180 kgf/cm², 2,420 – 2,560 psi)

15B–FT:

17,650 – 18,630 kPa

(180 – 190 kgf/cm², 2,560 – 2,700 psi)

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.

EG

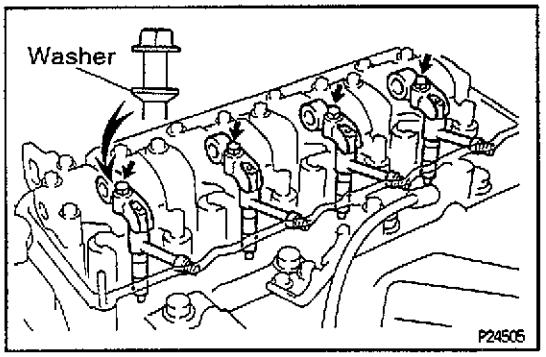
Adjusting shim thickness:

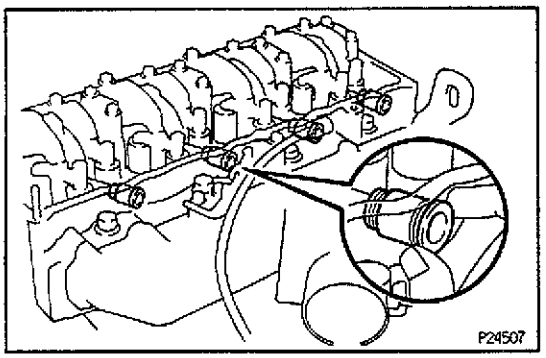
- 0.025 mm (0.0010 in.) increments from 0.800 mm (0.0315 in.) to 1.280 mm (0.0504 in.)
- 0.010 mm (0.0004 in.) increments from 1.290 mm (0.0508 in.) to 1.310 mm (0.0516 in.)
- 0.025 mm (0.0010 in.) increments from 1.325 mm (0.0522 in.) to 2.000 mm (0.0787 in.)
- 0.025 mm (0.0010 in.) increments from 2.050 mm (0.0807 in.) to 2.200 mm (0.0866 in.)

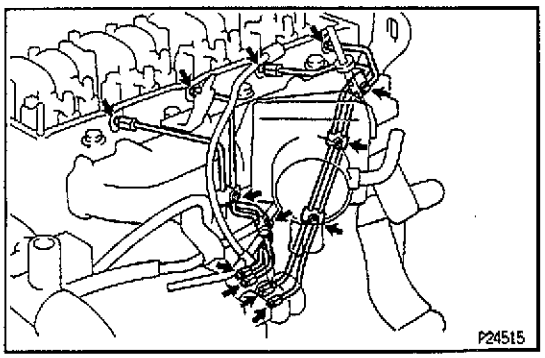
HINT:

- Varying the adjusting shim thickness by 0.025 mm (0.0010 in.) changes the injection pressure by about 470 kPa (3.8 kgf/cm², 54 psi).
- Only one adjusting shim should be used.

(c) There should be no dripping after injection.
(See step (g) in step 2 above)







INJECTION NOZZLES INSTALLATION

1. **INSTALL INJECTION NOZZLES**

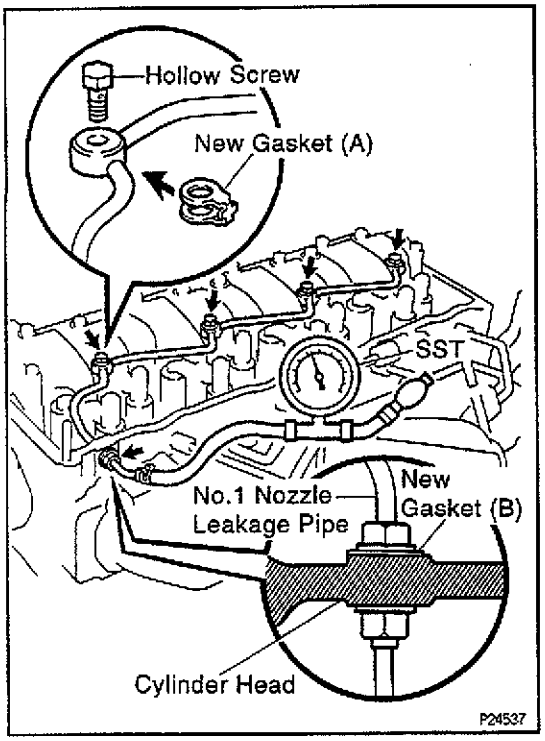
(a) Install a new O–ring to the injection nozzle.
(b) Place 4 new nozzle seats into the injection nozzle holes of the cylinder head.
(c) Install the injection nozzles with the nozzle holder clamp, washer and bolt to the cylinder head.
Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)
(d) Inspect the valve clearance.
(See steps 2 to 4 in valve clearance inspection and adjustment)

2. **INSTALL NOZZLE HOLDER SEALS**

Install the 4 new nozzle holder seals to the cylinder head with your hand.

3. **INSTALL INJECTION PIPES**

(a) Place the 2 lower clamps in position of the intake manifold.
(b) Install the 4 injection pipes. Torque the union nuts.
Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)
(c) Secure the injection pipes with the clamps and bolts.
Torque: 7.5 N·m (76 kgf·cm, 66 in.·lbf)



4. INSTALL NOZZLE LEAKAGE PIPE

(a) Install the 5 new gaskets, nozzle leakage pipe to the cylinder head, injection nozzle with the 4 hollow screw and nut.

Torque:

Hollow screw: 12 N·m (125 kgf·cm, 9 ft·lbf)

Nut: 14 N·m (145 kgf·cm, 10 ft·lbf)

NOTICE: Install the gasket (A) so that its connecting part is between the pipe as shown in the illustration.

(b) Using SST (turbocharger pressure gauge), apply the SST to the fuel return side of the nozzle leakage pipe, and maintain 49 kPa (0.5 kgf/cm², 7.1 psi) of pressure for 10 seconds to check that there are no leaks.

SST 09992—00241

(c) Connect the fuel return hose to the nozzle leakage pipe.

5. INSTALL CYLINDER HEAD COVER

6. START ENGINE AND CHECK FOR FUEL LEAKAGE