INJECTION NOZZLE (1HD–FTE)

COMPONENTS

- EGR Pipe
- Oil Filler Cap
- Intake Pipe Assembly
- Nozzle Leakage Pipe
- No.2 Cylinder Head Cover
- No.1 Cylinder Head Cover
- Nozzle Holder Seal
- Nozzle Seat
- Injection Nozzle
- Gasket
- O-Ring
- Clamp
- Vacuum Hose

N·m (kgf·cm, ft·lbf) : Specified torque
* Non-reusable part
N·m (kgf·cm, ft·lbf) : Specified torque
REMOVAL

1. REMOVE INTAKE PIPE (See page EM-77)
2. REMOVE NO.1 AND NO.2 CYLINDER HEAD COVERS
   (See page EM-77)

3. REMOVE NO.1 NOZZLE LEAKAGE PIPE
   (a) Disconnect the fuel return hose from the No.1 nozzle
       leakage pipe.
   (b) Remove the nut holding the No.1 nozzle leakage pipe to
       the cylinder head.
   (c) Remove the 6 hollow bolts, 7 gaskets and No.1 nozzle
       leakage pipe.

4. REMOVE INJECTION PIPES
   (a) Remove the bolt holding the No.3 nozzle leakage pipe to
       the intake manifold.
   (b) Remove the 4 nuts and 2 clamps from the intake manifold.
   (c) Remove the bolt, nut and clamp.
   (d) Loosen the 6 union nuts of the injection pipes from the in-
       jection nozzles.
   (e) Loosen the 6 union nuts of the injection pipes from the in-
       jection pump.
   (f) Remove the 6 injection pipes.
   (g) Remove the 2 clamps.
5. **REMOVE NOZZLE HOLDER SEALS**
Using a screwdriver, pry out the nozzle holder seals from the cylinder head.

6. **REMOVE INJECTION NOZZLES**
   
   (a) Remove the bolt and washer holding the nozzle holder clamp to the cylinder head.
   
   (b) Remove the 6 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.
DISASSEMBLY

DISASSEMBLE INJECTION NOZZLES

(a) Remove the nozzle holder retaining nut.

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

(b) Disassemble the injection nozzle.
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.
ADJUSTMENT

1. CHECK NO.2 OPENING PRESSURE

(a) Assemble these parts:
   (1) Nozzle holder body
   (2) No.1 pressure spring seat
   (3) No.1 pressure spring washer (Adjusting shim)
   (4) No.2 pressure spring
   (5) SST
   (6) Tip packing
   (7) Straight pins
   (8) No.3 pressure spring washer
   (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: 29.4 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):**

- 33,539 – 35,500 kPa
- (342 – 362 kgf/cm², 4,864 – 5,149 psi)

**HINT:**
- Proper nozzle operation can be determined by a swishing sound.
- With the SST installation, the inspection adjusting valve of No.2 opening pressure has become higher than 27,459 kPa (280 kgf-cm, 3,982 psi).

If the opening pressure is not as specified, disassemble the nozzle and change the No.1 pressure spring washer (adjusting shim).

**No.1 pressure spring washer (adjusting shim) thickness:**

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<thead>
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<th>mm (in.)</th>
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<td>0.700 (0.0276)</td>
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<td>1.625 (0.0640)</td>
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<tr>
<td>0.750 (0.0295)</td>
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**HINT:**
- Varying the adjusting shim thickness by 0.025 mm (0.0010 in.) changes the injection pressure by about 373 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.

2. ADJUST NO.1 OPENING PRESSURE

(a) Assemble the nozzle holder body, No.2 pressure spring washer (adjusting shim) for adjustment of No.1 opening pressure, No.1 pressure spring, pressure pin, No.1 pressure spring seat, No.1 pressure spring washer (adjusting shim) selected in step 1 above, No.2 pressure spring, No.2 pressure spring seat, tip packing, straight pins, No.3 pressure spring washer 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 original 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 1 above)

No.1 opening pressure:
17,162 – 18,142 kpa
(175 – 185 kgf/cm², 2,489 – 2,631 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 No.2 pressure spring washer (adjusting shim).
No.2 pressure spring washer (adjusting shim) thickness:

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- Varying the adjusting shim thickness by 0.025 mm (0.0010 in.) changes the injection pressure by about 373 kpa (3.8 kgf/cm², 54 psi).
- Only one adjusting shim should be used.
- There should be no dripping after injection.
  (c) See step (g) in step 1 above)
REASSEMBLY

ASSEMBLY INJECTION NOZZLE HOLDER

(a) Assemble the nozzle holder body, No.2 pressure spring washer (adjusting shim), No.1 pressure spring, pressure pin, No.1 pressure spring seat, No.1 pressure spring washer (adjusting shim), No.2 pressure spring, No.2 pressure spring seat, tip packing, straight pins, No.3 pressure spring washer 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 original 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: 29.4 N·m (300 kgf·cm, 22 ft·lbf)**

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

1. INSTALL INJECTION NOZZLES
(a) Install a new O-ring to the injection nozzle.
(b) Place 6 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: 25 N-m (255 kgf-cm, 18 ft-lbf)
(d) Inspect the valve clearance. (See page EM–9)

2. INSTALL NOZZLE HOLDER SEALS
Install the 6 new nozzle holder seals to the cylinder head with your hand.

3. INSTALL INJECTION PIPES
(a) Place the 2 clamps on the intake manifold.
(b) Attach the 6 injection pipes to the injection nozzle and injection pump.
(c) Tighten the 6 union nuts to the injection pump.
Torque: 24.5 N-m (250 kgf-cm, 18 ft-lbf)
(d) Tighten the 6 union nuts to the injection nozzle.
Torque: 24.5 N-m (250 kgf-cm, 18 ft-lbf)
(e) Install the 2 clamps with the 2 nuts.
Torque: 6.4 N·m (65 kgf·cm, 56 in.-lbf)

(f) Install the clamp with the bolt and nut.
Torque: 6.4 N·m (65 kgf·cm, 56 in.-lbf)

(g) Install the No.3 nozzle leakage pipe with the bolt.
Torque: 19.6 N·m (200 kgf·cm, 15 ft-lbf)

4. **INSTALL NO.1 NOZZLE LEAKAGE PIPE**

   (a) Install the 7 new gaskets, No.1 nozzle leakage pipe to the cylinder head, injection nozzle with the 6 hollow screw and nut.
   Torque:
   Hollow screw: 11.3 N·m (115 kgf·cm, 8 ft-lbf)
   Nut: 19 N·m (186 kgf·cm, 14 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 No.1 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 No.1 nozzle leakage pipe.

5. **INSTALL NO.1 AND NO.2 CYLINDER HEAD COVERS**

   (See page EM–94)

6. **INSTALL INTAKE PIPE** (See page EM–94)

7. **START ENGINE AND CHECK FOR FUEL LEAKAGE**