

ENGINE 4H SERIES

SECTION 6C FUEL SYSTEM

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GENERAL DESCRIPTION

Caution

When working on the fuel system, there are several things to keep in mind:

- Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Replace all pipes with the same pipe and fittings that were removed.
- Clean and inspect "O" rings. Replace where required.
- Always relieve the line pressure before servicing any fuel system components.
- Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repair.

Description

Fuel Filters

The Purpose of the fuel filters is to clean the fuel of any dirt particles that can cause wear on the fuel injection nozzle's sliding surface; and to separate any water from the fuel, which is ever-present from the condensation in the fuel tank. The pre-fuel filter (water separator) is located between the fuel tank and the injection pump. The secondary fuel filter is located between the fuel pump and the injection pump.

Pre-Fuel Filter

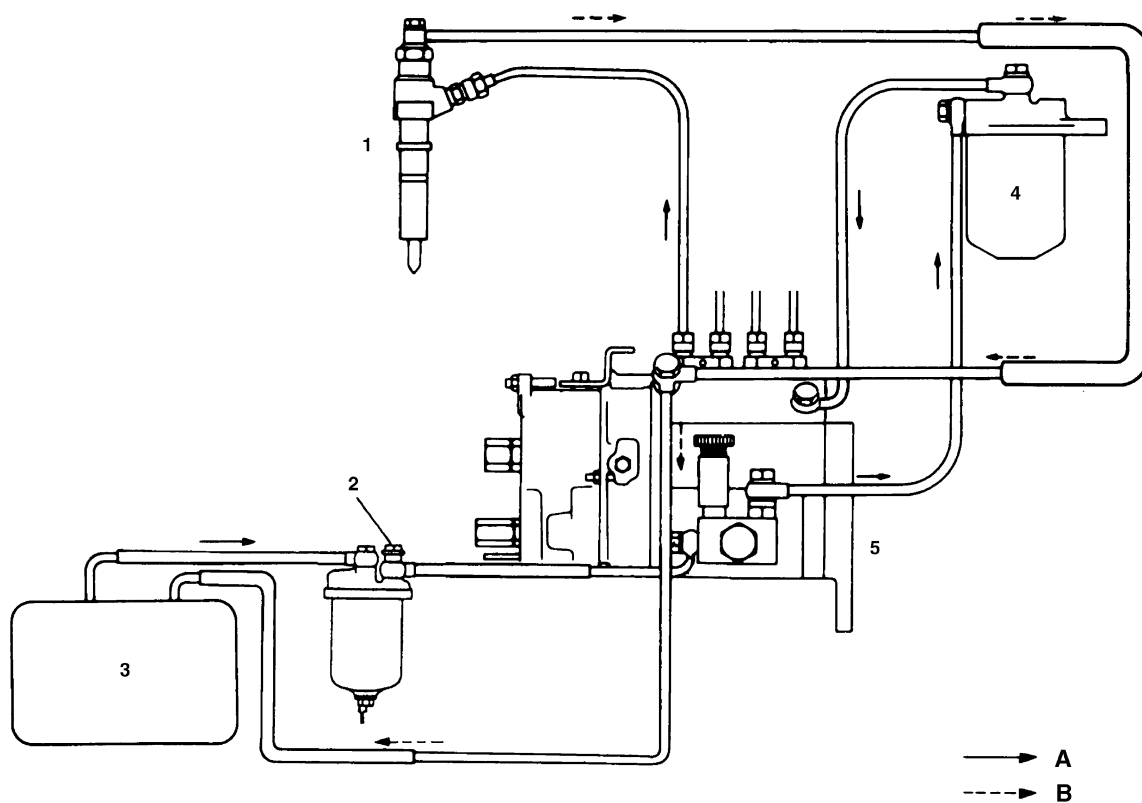
When the condensed water in the pre-fuel filter (water separator) comes to the warning level indicated on its plastic body, drain the fluid immediately from the drain plug located bottom of water separator.

Injection Pump

The fuel injection system includes a fuel tank, fuel hoses and lines, a fuel/water separator, fuel filters, a fuel pump, a Bosch-type in-line fuel injection pump with an internal governor, delivery valves, fuel injection lines and for fuel injection nozzles.

The fuel pump, injection pump and the nozzle are manufactured by Bosch AS corporation, but serviced by Bosch.

Remove the injection pump and governor assembly as a unit to have it serviced. Do not open or break any seals on the pump or the warranty is void. The injection pump has an identification plate attached to the pump body.

Fuel Flow

N6A0817E

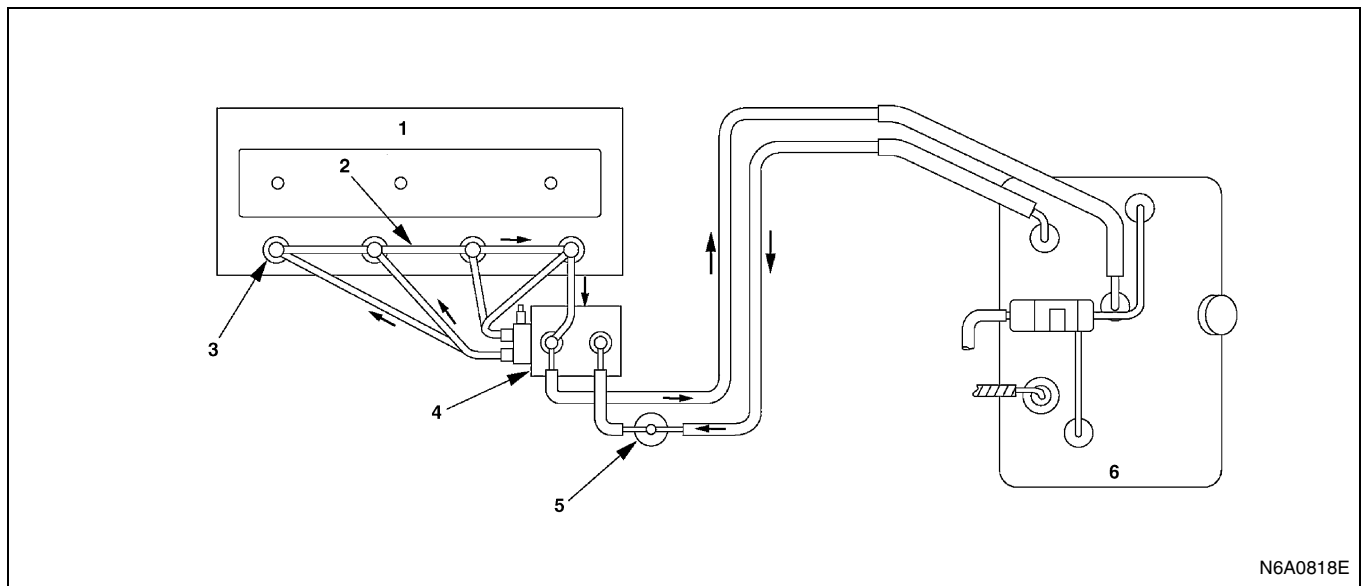
Legend

- A. Feed
- B. Return

- 1. Nozzle
- 2. Water separator

- 3. Fuel tank
- 4. Fuel filter
- 5. Injection pump

4HF1-2

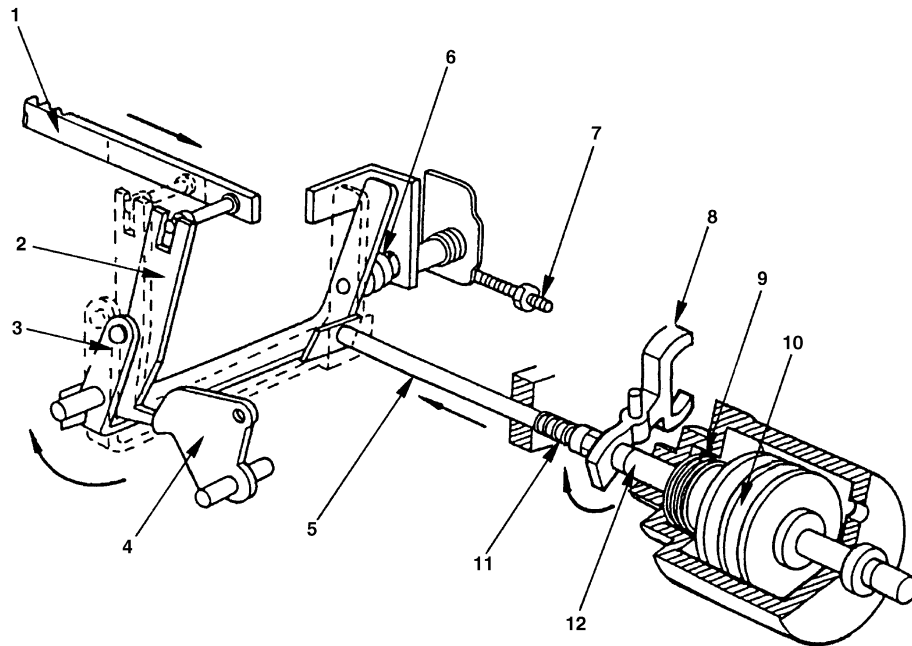
**Legend**

- | | |
|------------------|-----------------------------|
| 1. Engine | 4. Injection pump |
| 2. Leak off pipe | 5. Fuel filter (sedimeater) |
| 3. Nozzle | 6. Fuel tank |

Aneroid Compensator Function

The bellows in the aneroid compensator is provided with an initial set force by the aneroid compensator spring and is compressed by the push rod C. As the atmospheric pressure drops, the bellows begins to expand against the force of the aneroid compensator spring, which in turn causes the push rod B, through the push rod C and the boost compensator lever F, to move to the left.

Then the push rod B comes into contact with the U-shaped lever and, as the expanding bellows overcome the force of the cancel spring installed on the U-shaped lever, causes the U-shaped lever to turn clockwise. Because the bottom of the sensor lever is in touch with the torque cam, the torque cam then works as a pivot on which the top of the sensor lever moves to the right together with the U-shaped lever. At the same time, the control rack, which is hooked on the sensor lever, moves toward the governor to reduce fuel injection.



N6A0819E

Legend

- | | |
|-------------------|-------------------------------|
| 1. Control rack | 7. Full load set screw |
| 2. Sensor lever | 8. Boost compensator lever |
| 3. U-shaped lever | 9. Aneroid compensator spring |
| 4. Torque cam | 10. Bellows |
| 5. Push rod B | 11. Return spring |
| 6. Cancel spring | 12. Push rod C |

Brief Explanation of Emission and Electrical Control System**MITICS (Mechanically Integrated Timing and Injection Control System)****4HE1-TC**

The Mechanically Integrated Timing and Injection rate Control System (MITICS) utilizes mechanical control, in comparison with TICS systems, which utilize electronic control.

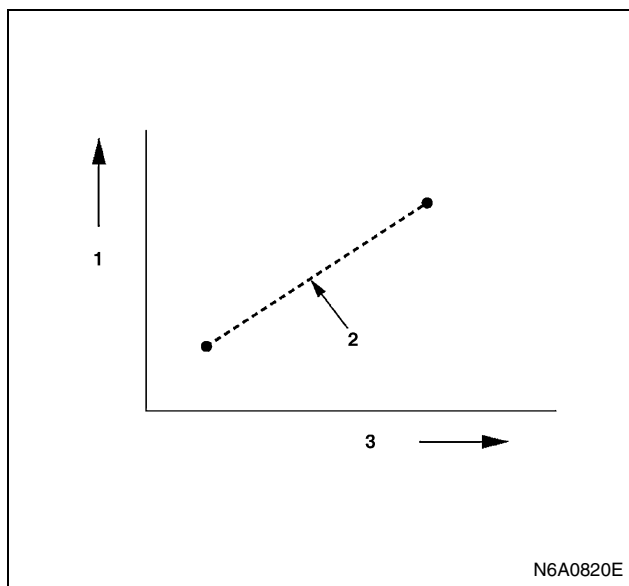
MITICS is equipped with the RLD-M type governor, which contains a pre-stroke control mechanism. With this, pre-stroke position (i.e., beginning of static injection) can be varied to control injection timing and injection rate (i.e., the fuel injection quantity injected from the nozzle per cam angle degree).

This enables high injection rates¹ in the low and medium speed ranges through a short injection interval, thus contributing to higher engine torque and cleaner exhaust.

MITICS was developed in response to the demands of medium sized diesel engines for low cost, low fuel consumption, high output and cleaner emissions.

High injection rates using a short injection interval.

- The speed at which the injection pump plunger rises slows as engine speed decreases and the pressure inside the injection pipe decreases. Because of this, the nozzle spray deteriorates and makes it impossible to obtain the proper fuel - air mixture. To obtain the proper mixture at low and medium speeds, it is necessary to increase the pressure inside the injection pipes using a short injection interval.



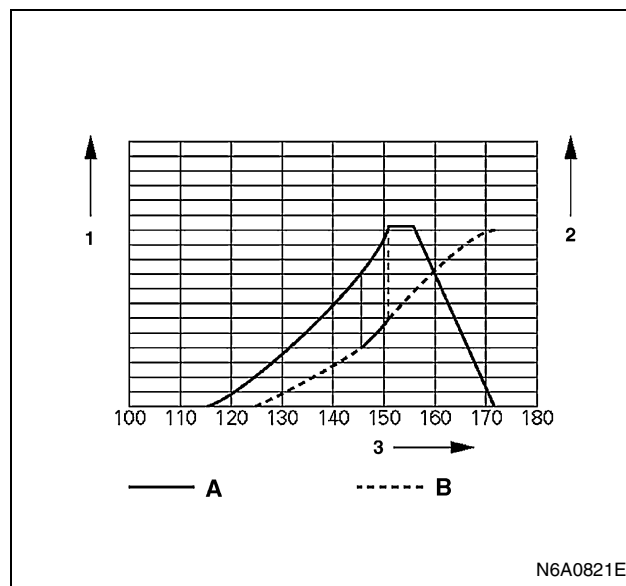
Legend

1. Injection pipe pressure
2. PE-AD type injection pump
3. Engine speed

- The following figure shows plunger speed and cam lift in relation to cam angle. It can be seen from the graph that plunger speed increases together with cam lift.

MITICS varies the beginning of injection position at low and medium speeds so that injection occurs when the plunger speed increases during the latter half of cam lift (shown by the bold line). At high speeds, injection is performed when the plunger speed decreases during the first half of cam lift to prevent an excessive increase in injection pipe pressure.

This enables high pressures at low and medium speeds with a fast plunger speed. Thus, a fine fuel oil spray is injected into the cylinder from the nozzles within a short time to provide the proper mixture for combustion, helping to increase torque and keep exhaust emissions clean.



Legend

- A. Plunger speed
- B. Cam lift
1. Plunger speed (m/sec)
2. Cam lift (mm)
3. Cam angle (degrees)

Governor (Model RLD-M)

4HE1-TC

The RLD-J type governor can be used with the MI, MITICS injection pumps, and was designed to have better control and endurance than the previous RLD type governor.

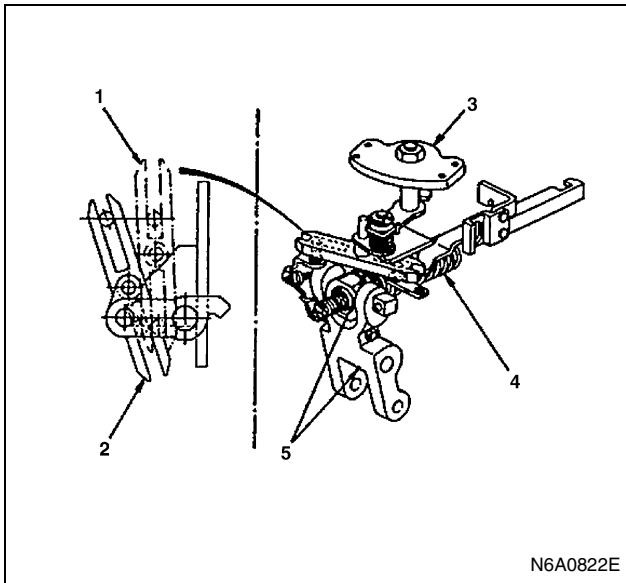
Although the basic construction is identical to that of the RLD type governor, the RLD-M type is larger to match the applicable pumps' larger size.

Features

- Variable speed control governor with decreased lever reaction force

As with the previous RLD type governor, RLD-M governor control is accomplished using the speed control lever to change the fulcrum of the internal link mechanism.

Consequently, as the reaction force of the governor spring does not act directly on the speed control lever, only a very small lever reaction force is exerted on the accelerator pedal.



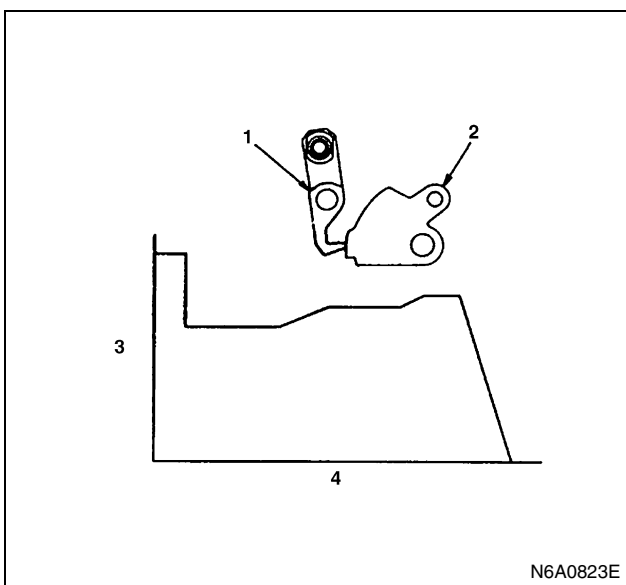
Legend

1. At maximum speed control
2. At idle speed control
3. Speed control lever
4. Governor spring
5. Link mechanism

2. Set torque characteristics through internal torque cam

At full load, the tip of the sensor lever traces the face of the torque cam to determine the full load rack position and control the full load injection quantity.

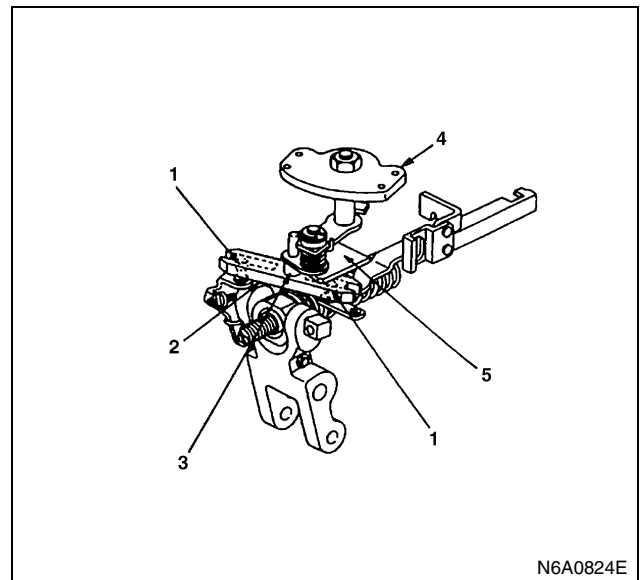
Consequently, the torque characteristics demanded by the engine can be freely set by changing the shape of the torque cam face.



Legend

1. Sensor lever
2. Torque cam
3. Control rack position (mm)
4. Pump speed (r/min)

3. Improved control through internal guide plate
When the speed control lever is operated, the 2nd supporting lever's pin moves along the guide plate. The floating lever connected to the pin thus moves to change the ball joint fulcrum positions. In the intermediate to high speed ranges, the guide plate causes the floating lever to move to increase the lever ratio continuously from 1.1 (idling) — 6 (full speed). This increase in the lever ratio in the intermediate to high speed range improves speed droop.

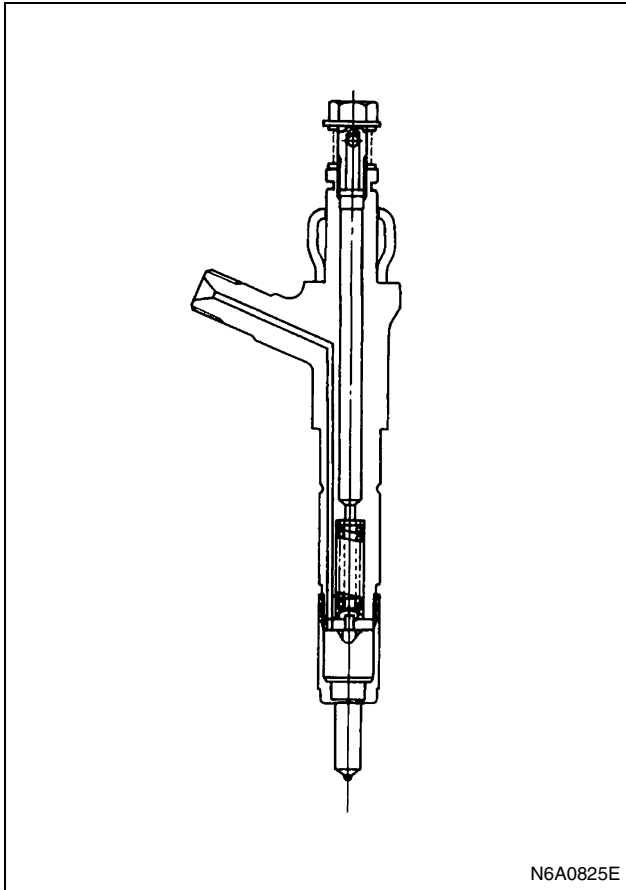


Legend

1. Ball joint
2. Floating lever
3. 2nd supporting lever pin
4. Speed control lever
5. Guide plate

Injection Nozzle

A Bosch hole type injection nozzle is used. It consists of the nozzle body and the needle valve assembly. The injection nozzle assembly sprays pressurized fuel from the injection pump into the combustion chamber through the nozzle body injection orifice.

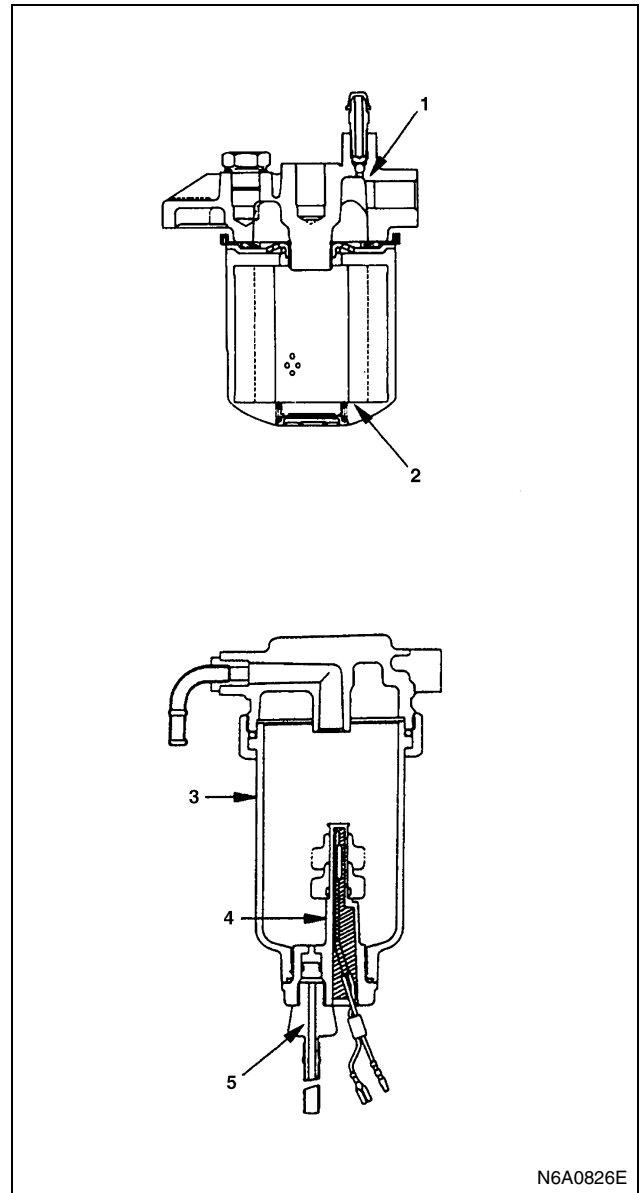


Fuel Filter and Water Separator

A cartridge type fuel filter and a water separator are used along with the in-line type injection pump.

As the inside of the injection pump is lubricated by the fuel which it is pumping, the fuel must be perfectly clean. The fuel filter and the water separator remove water particles and other foreign material from the fuel before it reaches the injection pump.

The water separator has an internal float. When the float reaches the specified level, a warning light comes on to remind you to drain the water from the separator.

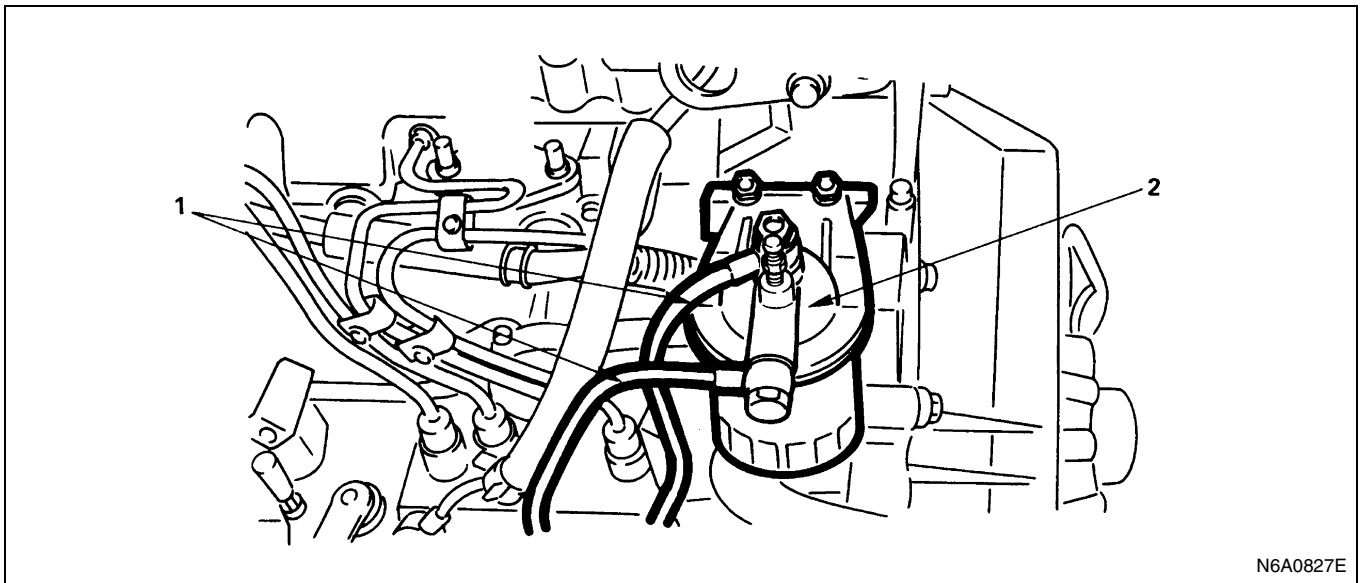


Legend

1. Body assembly
2. Filter cartridge
3. Case
4. Lever sensor
5. Drain plug

FUEL FILTER ASSEMBLY (Except 4HF1-2 model)

Component



Legend

1. Fuel pipe

2. Fuel filter

Removal

Preparation

- Disconnect battery ground cable.
- Tilt the cab

1. Fuel Pipe
2. Fuel Filter Assembly

Installation

1. Fuel Filter Assembly

Tighten:

Fuel filter bracket to 34 N·m (3.5 kg·m / 25 lb·ft)

2. Fuel Pipe

Tighten:

Fuel pipe joint bolt to 23 N·m (2.4 kg·m / 17 lb·ft)

Air Bleeding

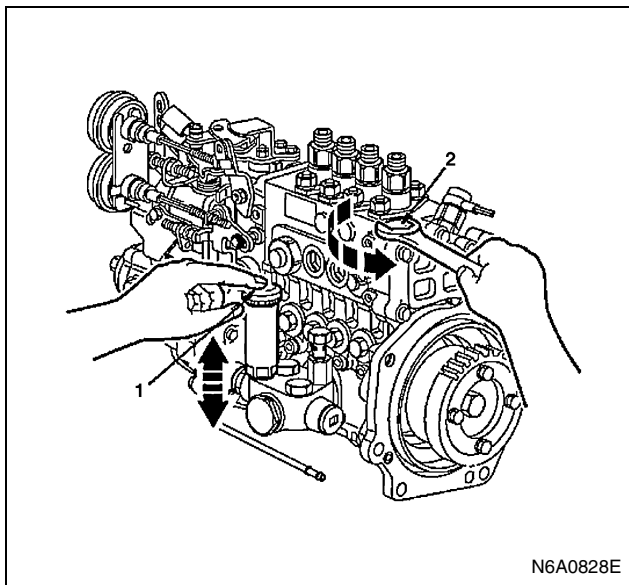
- Loosen the priming pump cap (1).
- Loosen the air bleeding plug. (4HG1-T model only)
- Operate the priming pump.
Pump the primer pump until fuel flow is free of air bubbles. (Except 4HG1-T model)
- Tighten the air bleeding plug. (4HG1-T model only)
- Loosen the bleeding plug.
- Operate the priming pump.
Pump the primer pump until fuel flow is free of air bubbles.
- Tighten the bleeder plug.
- Operate the priming pump.

Pump the primer pump until fuel flow is free of air bubbles. (Except 4HE1-TC model)

- Loosen the bleeding plug on the injection pump (2). (4HE1-TC model only)
- Operate the priming pump.
Pump the primer pump until fuel flow is free of air bubbles. (4HE1-TC model only)
- Tighten the bleeding plug on the injection pump (2). (4HE1-TC model only)
- Lock the priming pump cap (1).

Notice:

Check for fuel leakage from around the injection pump and the fuel filter.

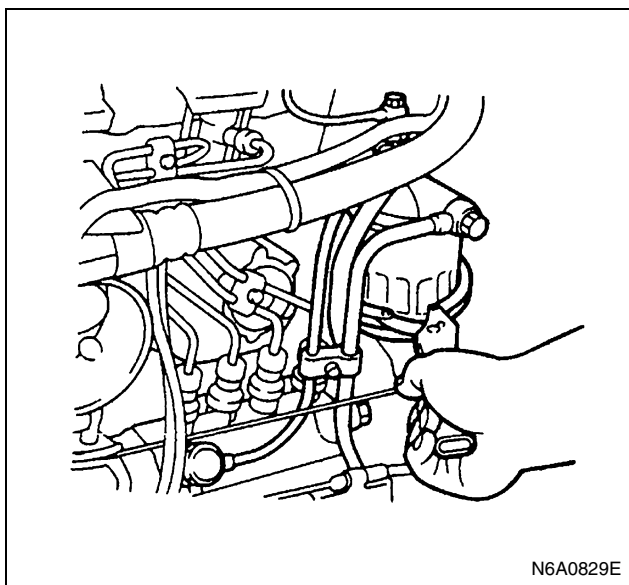


Cartridge Replacement

Removal

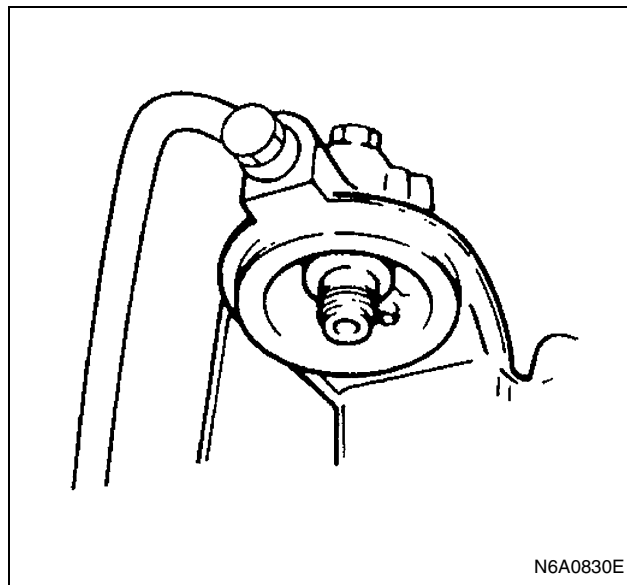
Replacement Procedure

1. Loosen the used fuel filter by turning it counter-clockwise with the filter wrench.

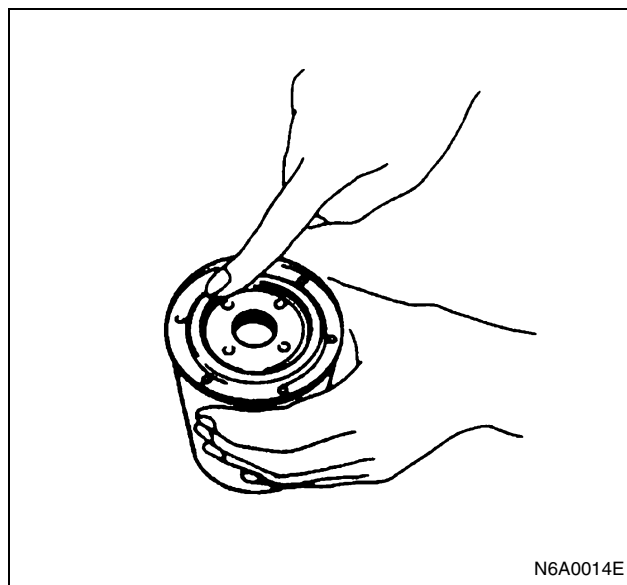


Installation

1. Clean the upper cover fitting face.
This will allow the new fuel filter to seat properly.



2. Apply a light coat of engine oil to the O-ring.
3. Supply fuel to the new fuel filter to facilitate bleeding.
4. Turn in the new fuel filter until the filter O-ring is fitted against the sealing face.
Be very careful to avoid fuel spillage.

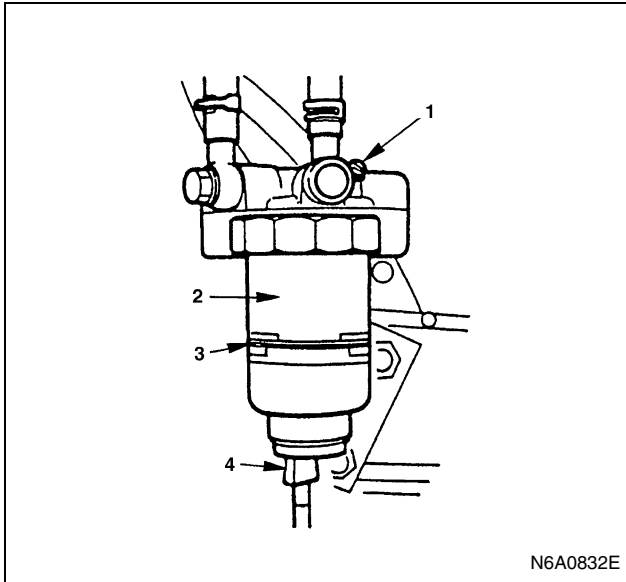


5. Use the filter wrench to turn in the fuel filter an additional 1/3 to 2/3 of a turn.
6. Operate the priming pump to bleed the air from the fuel line.
Refer to "FUEL FILTER ASSEMBLY" for more detailed information.
7. Start the engine.
Crank the engine for ten seconds or until it starts.
If the engine does not start after ten seconds, repeat Step 6.

Draining the Pre-fuel Filter

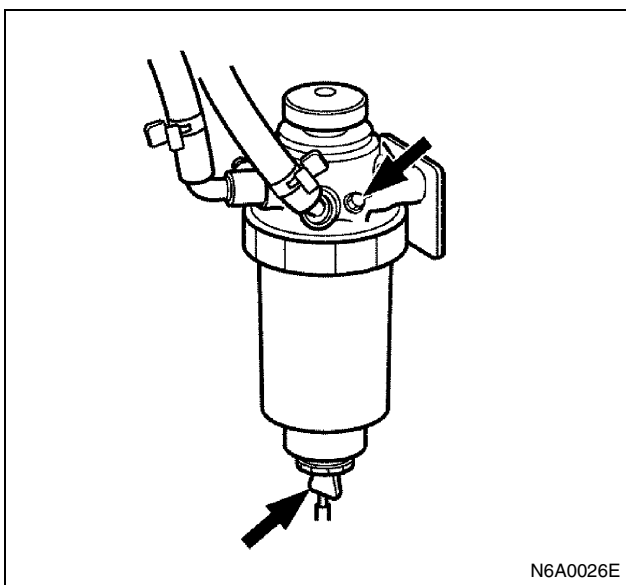
1. Loosen the air bleeding plug and drain plug by turning them counterclockwise.

2. Drain approximately 0.1 liters (3.4 oz) of water.
3. Securely tighten the drain plug.
4. Operate the primer pump on the fuel pump to bleed the fuel system.
5. Tighten the air bleeding plug.

**Legend**

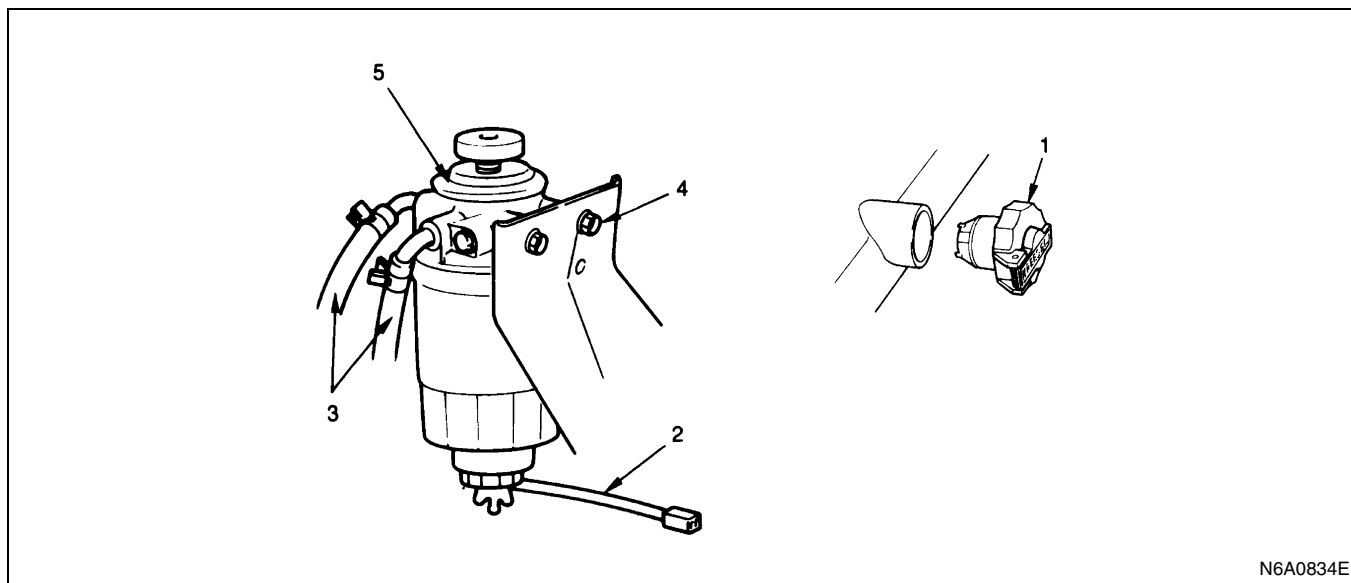
1. Air bleeding plug
2. Pre-fuel filter
3. Drain level
4. Drain plug

6. Start the engine and check to be sure no fuel is leaking from the drain plug.
7. Make sure that the warning light in the instrument panel is off. (Except 4HE1-TC)



FUEL FILTER ASSEMBLY (4HF1-2 model only)

Component



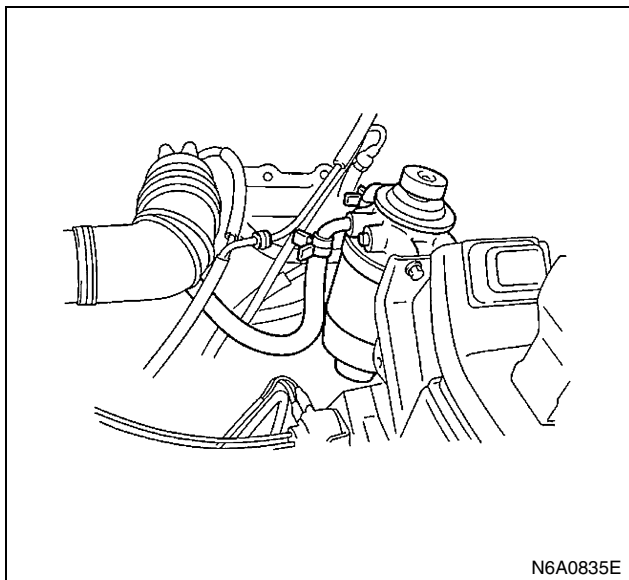
Legend

- | | |
|---------------------------------|--------------------------------|
| 1. Filter cap | 4. Fuel filter installing bolt |
| 2. Lead switch wiring connector | 5. Fuel filter assembly |
| 3. Fuel hoses | |

Removal

Preparation

- Disconnect battery ground cable.
1. Filler cap
 2. Lead switch wiring connector
 3. Fuel hose
 - Draw out inlet and outlet hoses from the fuel filter and cork the hoses to prevent fuel outflow.
 4. Fuel filter installing bolt
 5. Fuel filter assembly



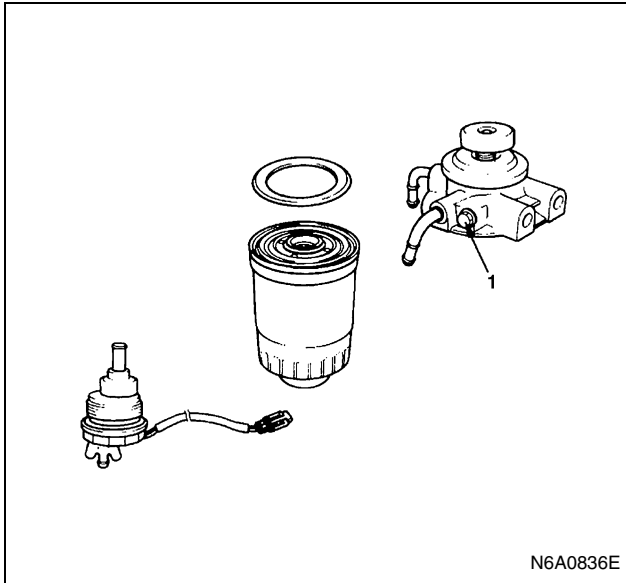
Installation

1. Fuel filter assembly
2. Fuel filter installing bolt
3. Fuel hose
 - Connect the inlet hose and outlet hose.
4. Lead switch wiring connector
5. Filler cap

Cartridge Replacement

Removal

1. Remove the cartridge using a filter wrench.
Special Tool
Filter wrench: 5-8840-0253-0
2. Remove the sedimenter/center.



Legend

1. Air bleeding plug

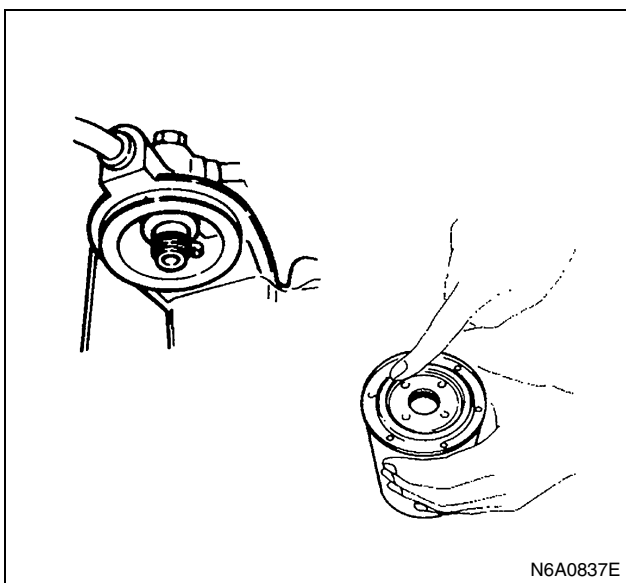
Reassembly

1. Fit the sedimenter/center in a new cartridge.
2. Clean the cartridge mounting surface of the filter body so that the new cartridge can be seated completely.
3. Apply engine oil thinly to the new cartridge O-ring.
4. Fill the new cartridge with light oil to facilitate air bleeding.
5. Tighten the cartridge until the O-ring comes into contact with the sealing surface. Sufficient care should be taken not to spill the light oil.

Give 1/3 to 2/3 of a turn using a filter wrench.

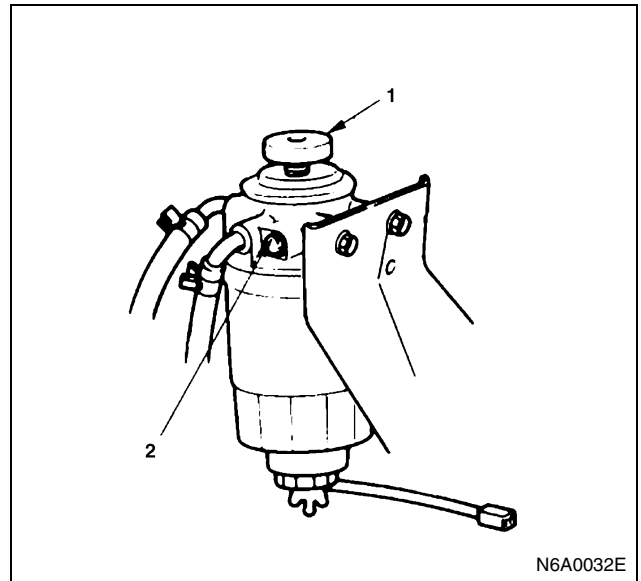
Special Tool

Filter wrench: 5-8840-0253-0



Air Bleeding

1. Actuate the priming pump (1) to send the air in the fuel system to the injection pump.
2. Loosen the sedimenter air bleeding plug (2) and operate the priming pump until no bubbles appear.
3. Tighten the air bleeding plug completely.
4. Try to start the engine. If the engine is not started within 10 seconds, air bleeding should be conducted once again.
5. Check that there is no fuel leak, and then tighten the priming pump completely.



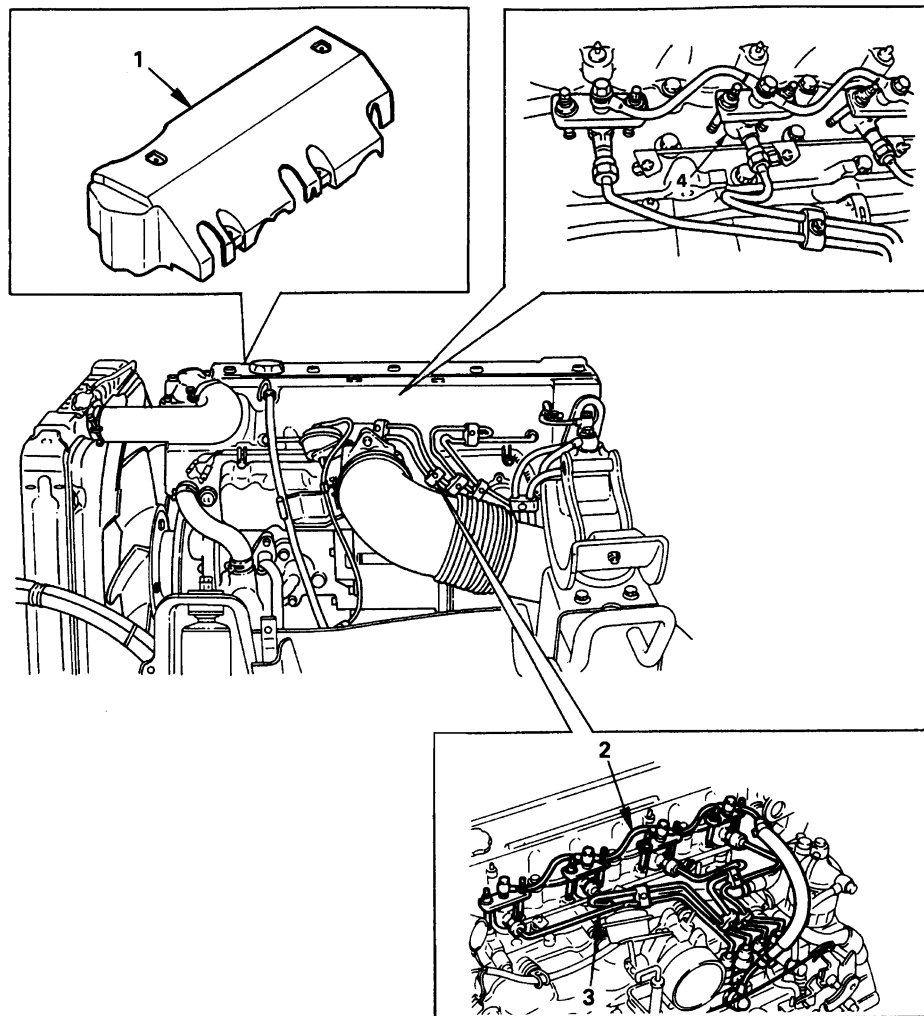
Water Drain

If more than specified has collected, the warning light is lit. Under this condition, follow the following water drain procedure:

1. Place a container (Approximately 0.2 lit (0.18 Imp qt/0.21 US qt) capacity) beneath the drain plug on the separator.
2. Loosen the drain plug and air bleeding plug.
3. After draining, tighten the drain plug.
4. Operate the priming pump several times again and check for fuel leak.
5. Tighten the air bleeding plug.
6. Make sure that the warning light in the instrument panel is off.

INJECTION NOZZLE ASSEMBLY

Component



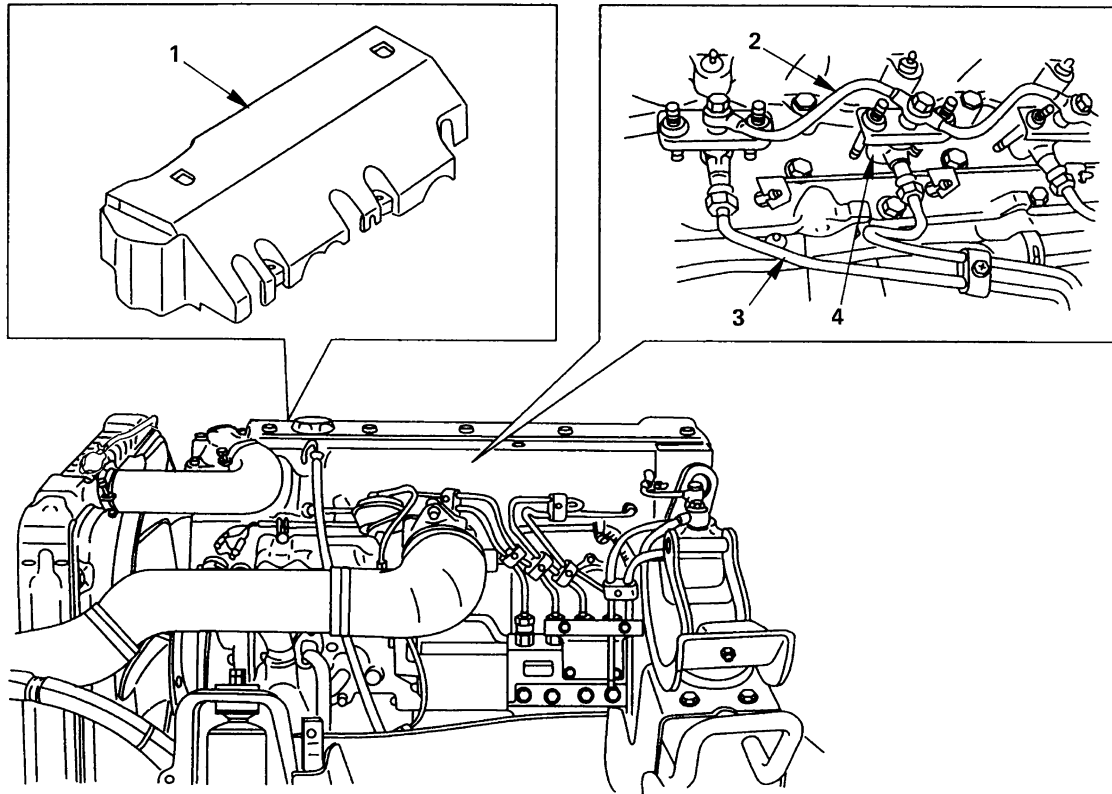
N6A0839E

Legend

- 1. Nozzle cover
- 2. Leak off pipe

- 3. Injection pipe
- 4. Injection nozzle assembly

4HE1-TC (Engine)



N6A0840E

Legend

- | | |
|------------------|------------------------------|
| 1. Nozzle cover | 3. Injection pipe |
| 2. Leak off pipe | 4. Injection nozzle assembly |

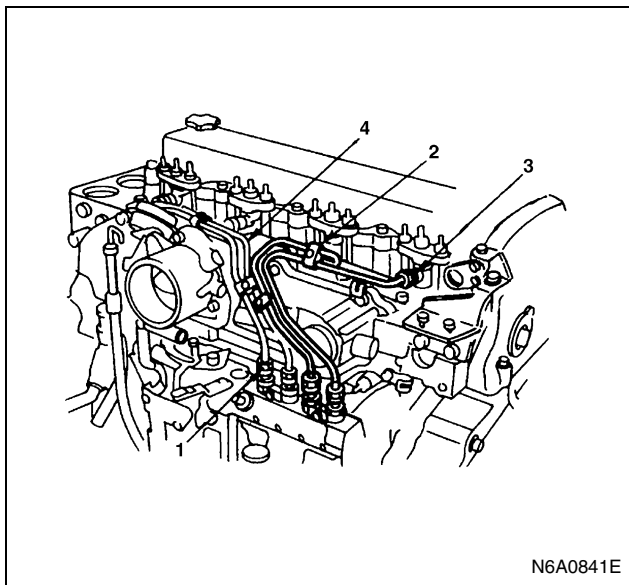
Removal**Preparation**

- Disconnect battery ground cable.
- Tilt the cab.

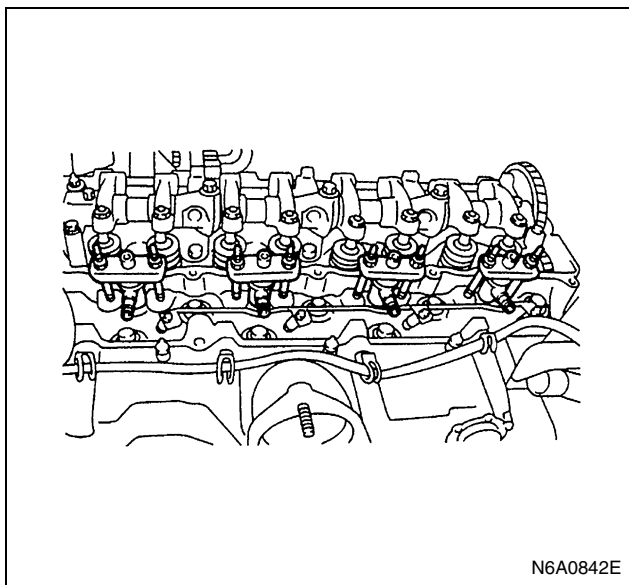
1. Nozzle Cover
2. Leak-Off Pipe
3. Fuel Injection

- 1) Loosen the injection pipe sleeve nuts (1).
Do not apply excessive force to the injection pipes (4).
- 2) Loosen the injection pipes clips (2).
- 3) Remove the injection pipe assembly.

Plug the delivery valve holder ports and nozzle holder (3) ports with caps to prevent the entry of foreign material.



4. Injection Nozzle Assembly
Mark the nozzle holder assemblies fitting positions by tagging each nozzle holder assembly with the cylinder number from which it was removed.



Inspection

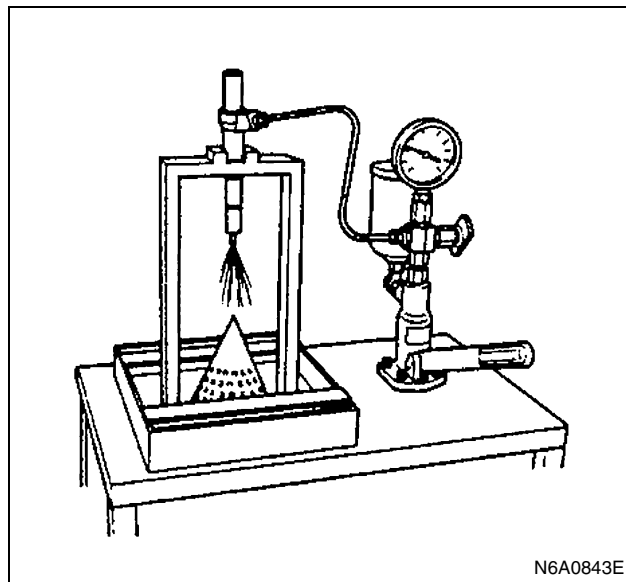
Before disassembling the injection nozzle assembly, check nozzle opening pressure, spray pattern, chatter and oil leakage.

Opening Pressure

Use a nozzle tester to check the injection nozzle opening pressure.

If the opening pressure is above or below the specified value, the injection nozzle must be replaced or adjusted.

Injection Nozzle Opening Pressure		MPa (kg/cm ² /psi)
4HF1/4HF1-2/4HG1		18.1 (185/2,631)
4HE1-TC		21.6 (220/3,128)
4HG1-T	1st	18.1 (185/2,631)
	2nd	21.1 (215/3,057)



Spray Pattern

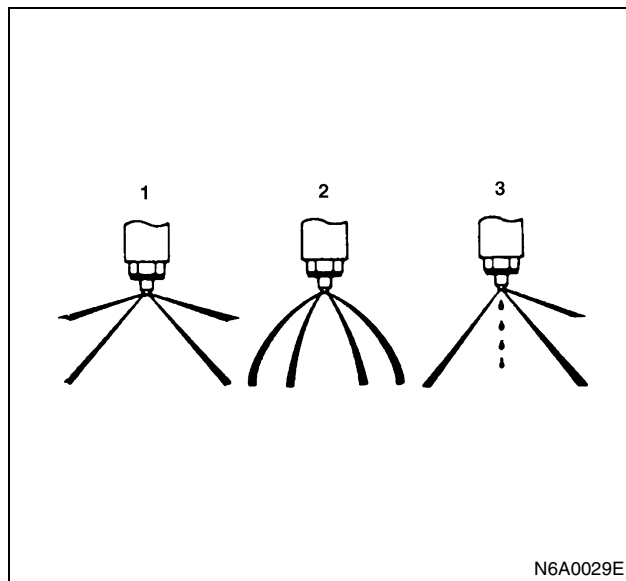
Check the spray pattern

Refer to the illustration.

Spray Condition

- Correct (1)
- Incorrect (Restrictions in orifice) (2)
- Incorrect (Dripping) (3)

If the spray condition is bad, the injection nozzle must be replaced or adjusted.



Leakage

Hold the tester handle to about 2,070 kPa (21 kg/cm²/ 300 psi) below the opening pressure. If no drops of fuel fall from the nozzle tip within 10 seconds, the nozzle is not leaking.

Chatter

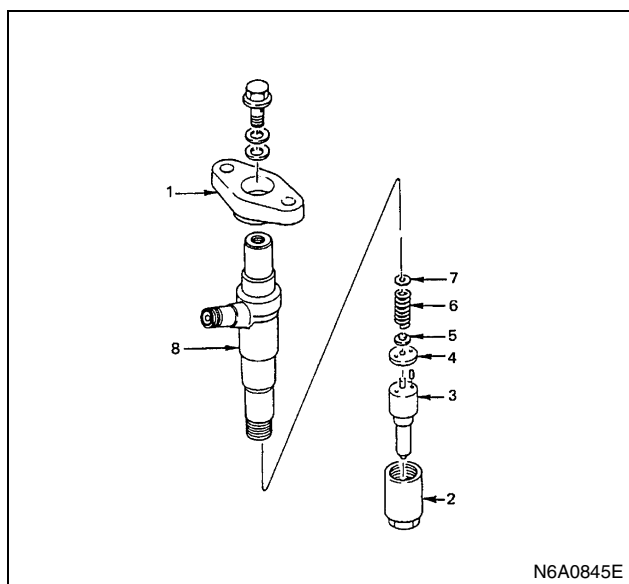
An easily audible chatter at all pump lever speeds should be heard.

WARNING:

TEST FLUID FROM THE INJECTION NOZZLE WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PERSON'S SKIN. KEEP YOUR HANDS AWAY FROM THE INJECTION NOZZLE TESTER AT ALL TIMES.

Disassembly

Clamp the injection nozzle holder in a vice.

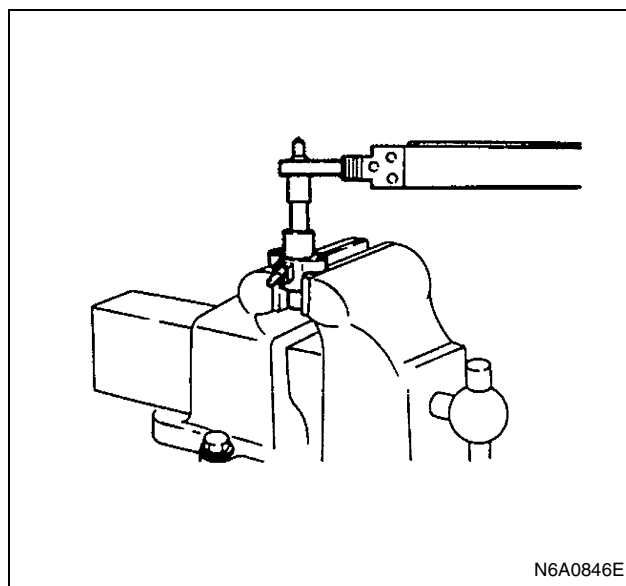


N6A0845E

Legend

1. Flange
2. Retaining nut
3. Injection nozzle
4. Spacer
5. Spring seat
6. Nozzle spring
7. Adjusting shim
8. Nozzle holder body

1. Flange
 2. Retaining Nut
- Use a wrench to remove the injection nozzle retain-er nut.

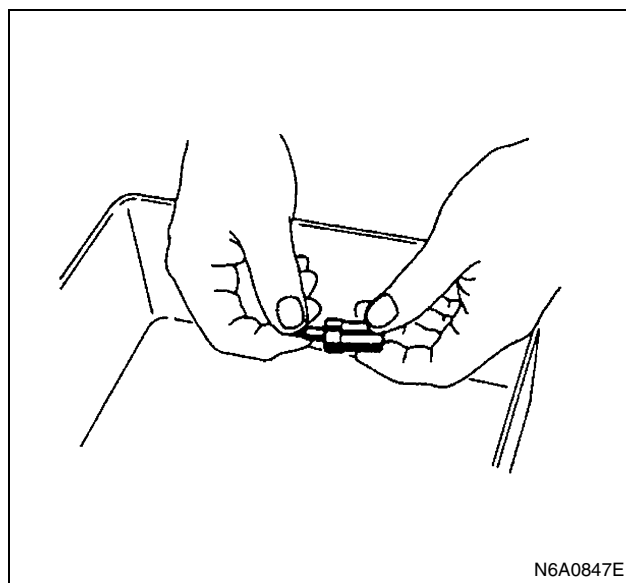


N6A0846E

3. Injection Nozzle
Keep the nozzle along with the needle valve separately to maintain the original nozzle to needle valve combination.
4. Spacer
5. Spring Seat
6. Nozzle Spring
7. Adjusting Shim
Keep the adjusting shims in the original groups to hold the initial shim to nozzle spring combination.
8. Nozzle Holder Body

Caution:

- Wash all the parts removed and arrange them on a cylinder basis, care should be taken not to miss any parts.
- Soak the nozzle assembly in a parts receptacle filled with light oil.
- Care should be taken not to miss shim, if used.

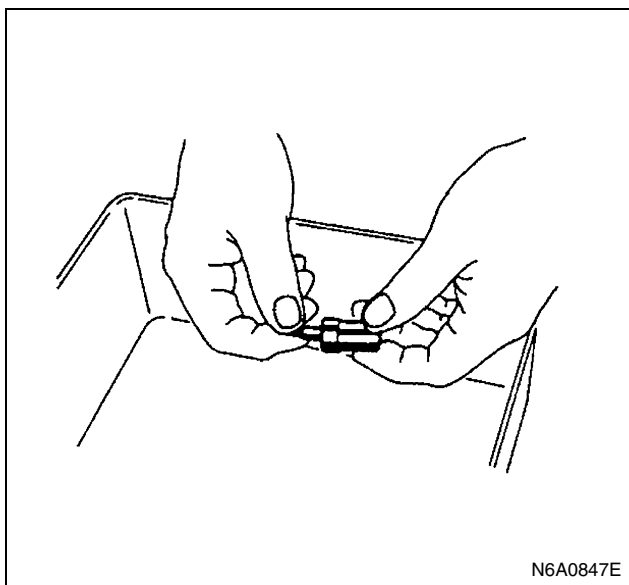


N6A0847E

Inspection

Injection Nozzle Needle

1. Remove the nozzle from the nozzle body.
2. Carefully wash the nozzle needle and the nozzle body in clean diesel fuel.
3. Check that the nozzle needle moves smoothly inside the injection nozzle body.
If the nozzle does not move smoothly, it must be repaired (See "Nozzle Lapping Procedure" below).

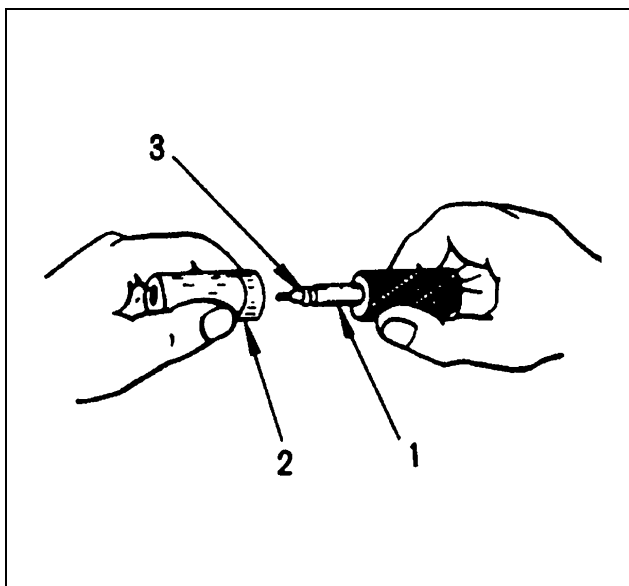


Nozzle Lapping Procedure

1. Lap the nozzle needle (1) and the nozzle body (2) by applying a compound of oxidized chrome and animal oil (3).

Notice:

Do not apply an excessive amount of the oxidized chrome and animal oil compound to the injection needle valve seat area.



2. Carefully wash the needle valve and the nozzle body in clean diesel fuel after lapping.

Nozzle Body and Needle Valve

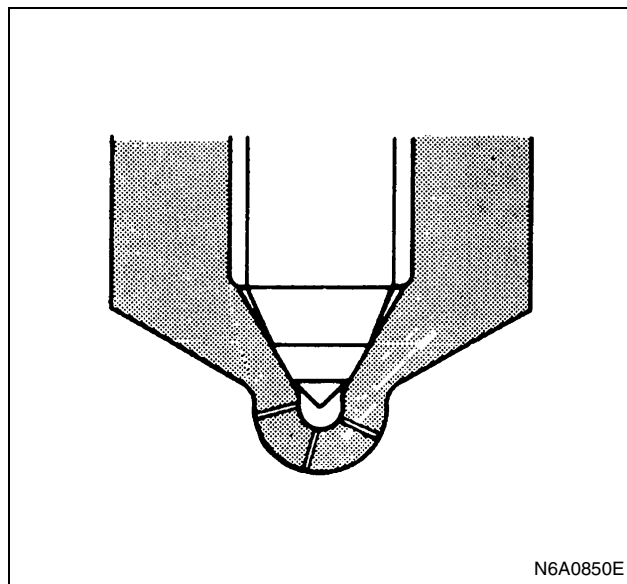
Check the nozzle body and the needle valve for damage and deformation.

The nozzle and body assembly must be replaced if either of these two conditions are discovered during inspection.

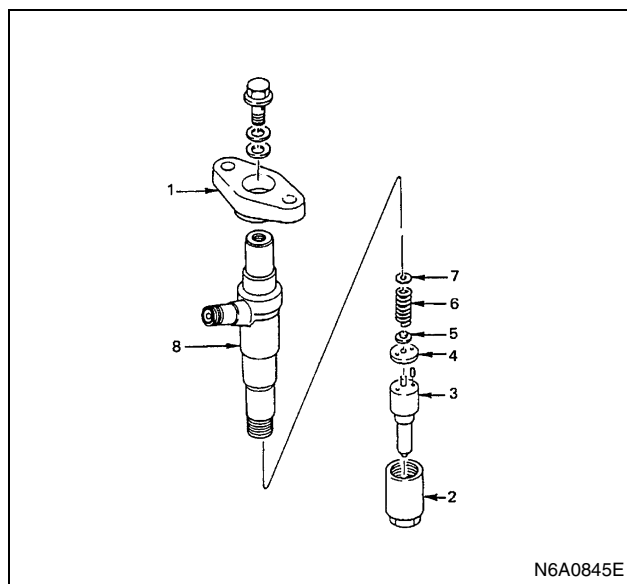
Notice:

New nozzles must be cleaned in a solvent to remove protective coating.

The nozzle body and needle must always be replaced as an assembly.



Reassembly

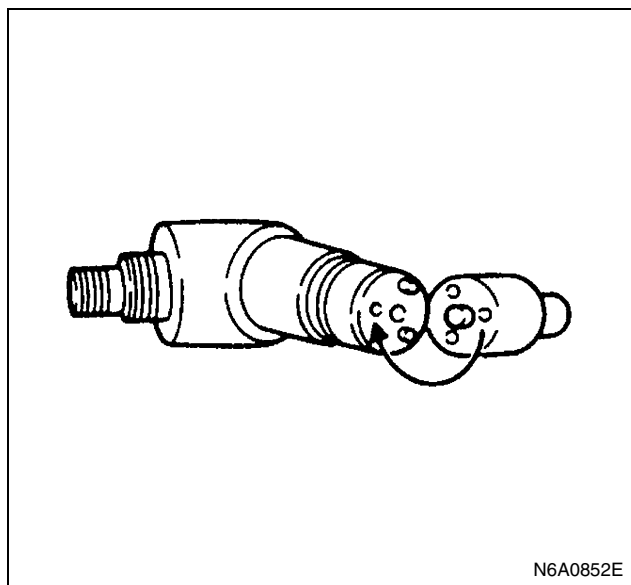


Legend

1. Flange
2. Retaining nut
3. Injection nozzle
4. Spacer
5. Spring seat
6. Nozzle spring
7. Adjusting shim
8. Nozzle holder body

1. Nozzle Holder Body
2. Adjusting Shim
3. Nozzle Spring
4. Spring Seat
5. Spacer
6. Injection Nozzle

Install the nozzle dowel pin with it set to the dowel hose of the nozzle holder body.



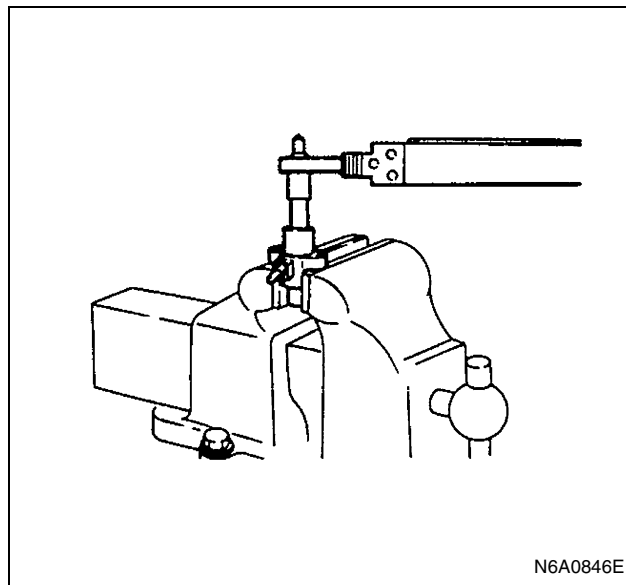
7. Retaining Nut

Clamp the injection nozzle holder in a vice.

Tighten the injection nozzle holder retaining nut to the specified torque.

Tighten:

Injection nozzle holder retaining nut to 34 N·m (3.5 kg·m / 25 lb·ft)



Remove the injection nozzle holder from the vice.

8. Flange

Adjustment of Injection Starting Pressure

After reassemble of the injection nozzle, recheck the opening pressure and spray condition.

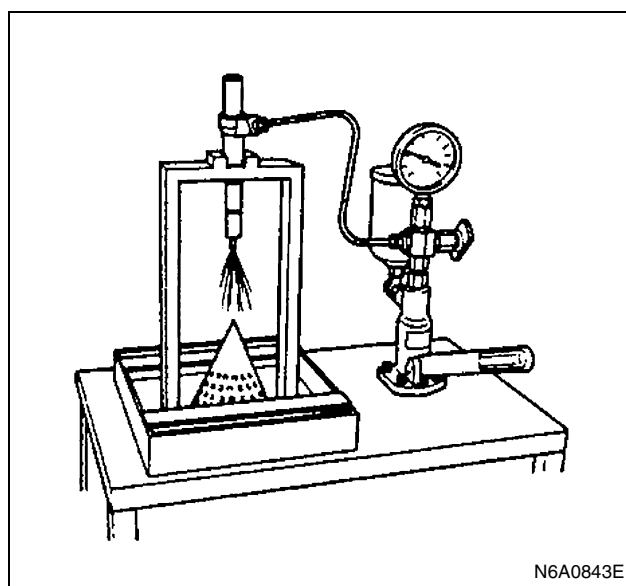
Opening Pressure

Attach the injection nozzle holder to the injection nozzle tester.

Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.

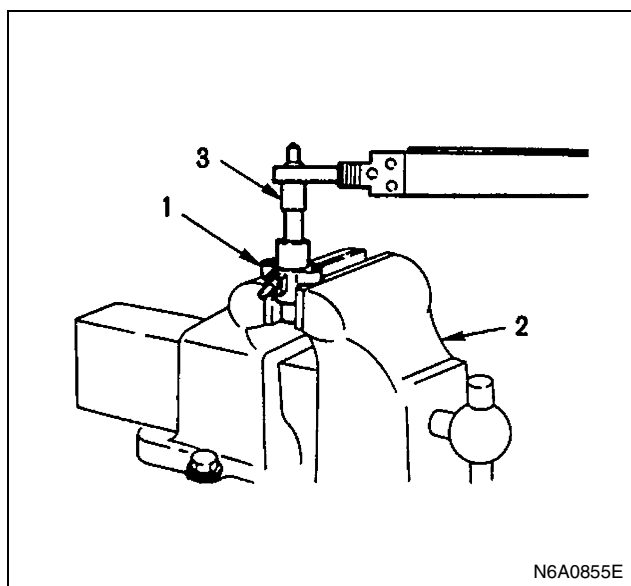
If the injection nozzle does not open at the specified pressure, install or remove the appropriate number of adjusting shims to adjust it.

Injection Nozzle Opening Pressure	MPa (kg/cm ² /psi)
4HF1/4HF1-2/4HG1	18.1 (185/2,631)
4HE1-TC	21.6 (220/3,128)

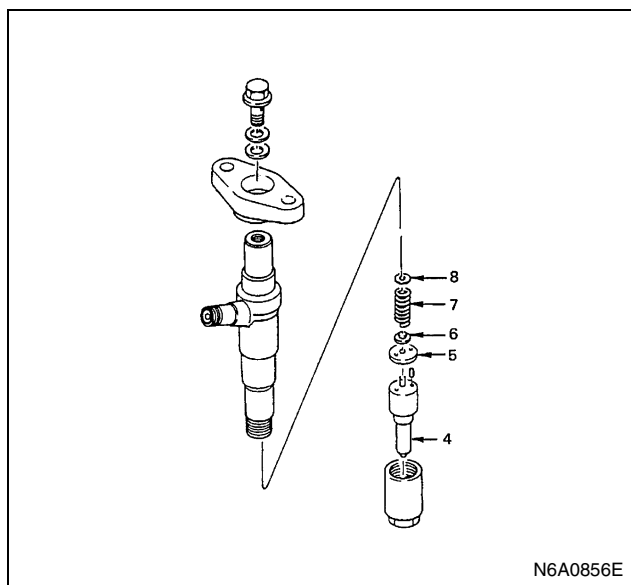


Opening Pressure Adjustment

1. Clamp the injection nozzle holder (1) in a vise (2).
2. Use a wrench to remove the injection nozzle retaining nut (3).



3. Remove the injection nozzle holder from the vise.
4. Remove the injection nozzle (4), the spacer (5), the spring seat (6) the spring (7) and the adjusting shim (8).
5. Install the new adjusting shim, the spring, the spring seat, the spacer, the injection nozzle, and the retaining nut.



6. Clamp the injection nozzle holder in the vise.
7. Tighten the injection nozzle holder retaining nut to the specified torque.

Tighten:

Injection nozzle holder retaining nut to 34 N·m (3.5 kg·m / 25 lb·ft)

8. Remove the injection nozzle holder from the vise.

9. Attach the injection nozzle holder to the injection nozzle tester.
10. Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.

If the injection nozzle does not open at the specified pressure, install or remove the appropriate number or adjusting shims to adjust it.

Removing or installing one shim will increase or decrease the nozzle opening pressure approximately 370 kPa (3.77 kg/cm² / 53.6 psi).

Adjusting Shim Availability		mm (in)
Range		0.5 — 1.5 (0.02 — 0.06)
Increment		0.025 (0.001)
Total Number of Shims		41

Spray Pattern

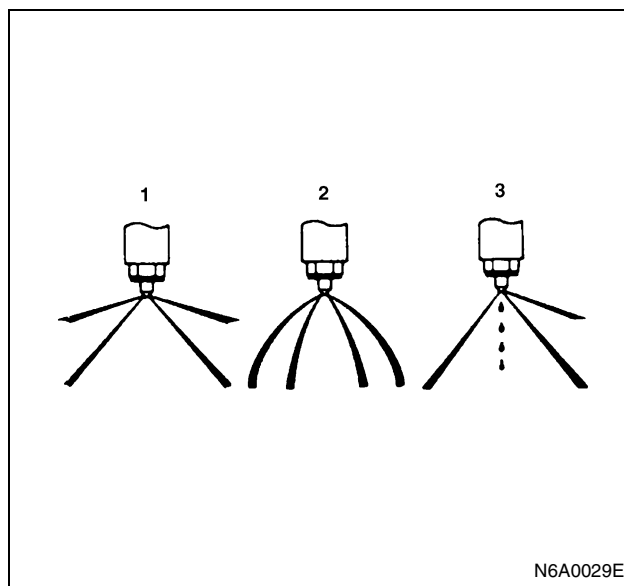
Check the spray condition.

Refer to the illustration.

Spray Condition

- Correct (1)
- Incorrect (Restrictions in orifice) (2)
- Incorrect (Dripping) (3)

If the spray condition is bad, the injection nozzle must be replaced or adjusted.



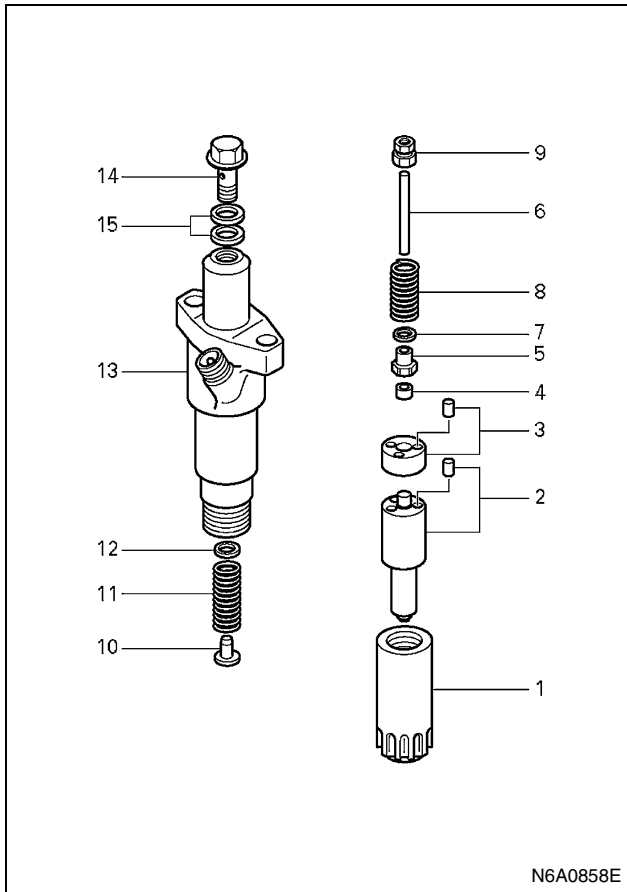
Refer to "Adjustment".

Notice:

Adjust the nozzle in a well ventilated area. Do not inhale oil or spray injected from the nozzle.

Disassembly**4-1 Injection Nozzle (Two spring nozzle holder) (4HG1-T only)**

The two-spring nozzle holder has been developed to reduce NOx (Nitrogen Oxides) and particulates from direct injection diesel engine exhaust.



N6A0858E

Legend

1. Retaining nut
2. Nozzle & pin
3. Spacer & pin
4. Lift piece
5. Spring seat
6. Push rod
7. Shim (Second nozzle opening pressure adjustment)
8. Second spring
9. Collar
10. Spring seat
11. First spring
12. Shim (First nozzle opening pressure adjustment)
13. Nozzle holder body
14. Eye bolt
15. Gasket

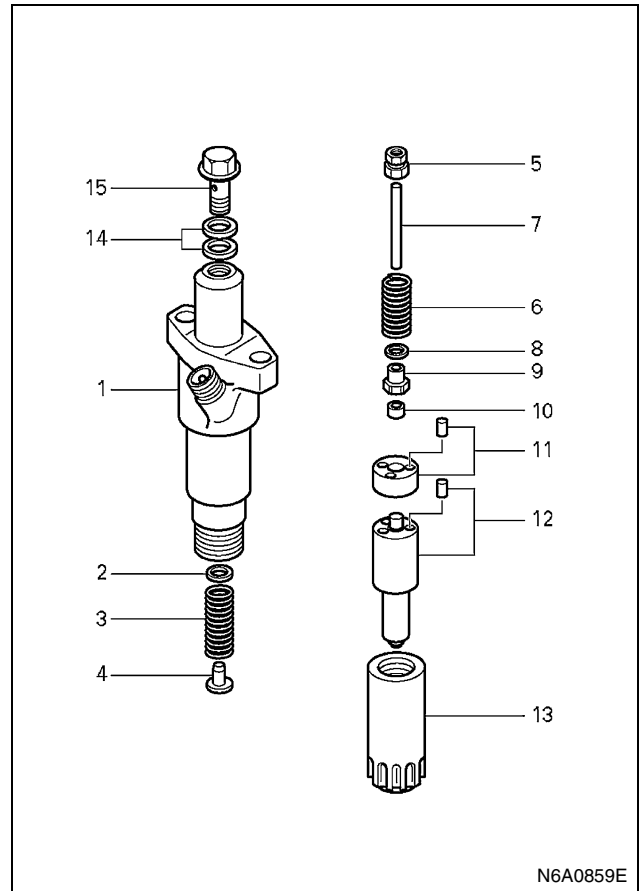
1. Before disassembly remove carbon deposit from nozzle and nozzle holder using a wire brush and wash the outside nozzle holder assembly.

Caution:

Do not touch nozzle holes with the wire brush during cleaning it.

2. Disassemble the nozzle holder assembly to numerical order.

Reassembly and Opening Pressure Adjustment



N6A0859E

Legend

1. Nozzle holder body
2. Shim (First opening pressure adjustment)
3. First spring
4. Spring seat
5. Collar
6. Second spring
7. Push rod
8. Shim (Second opening pressure adjustment)
9. Spring seat
10. Lift piece
11. Spacer & pin
12. Nozzle & pin
13. Retaining nut
14. Gasket
15. Eye bolt

The nozzle holder is adjusted as the components are reassembled in the sequence above.

As adjustment of the two-spring nozzle holder is made in hundredths of a millimeter, clean the parts thoroughly in light oil to completely remove any dirt or foreign matter.

Reassembly and Adjustment Procedure

1. First nozzle opening pressure adjustment
 - Adjust the first nozzle opening pressure using the shim.

6C-22 FUEL SYSTEM

2. Full needle valve lift confirmation
 - Confirm the full needle valve lift in accordance with the closed method.
3. Pre-lift confirmation
 - Confirm pre-lift in accordance with the closed method.
4. Second nozzle opening pressure confirmation
 - Confirm the second nozzle opening pressure in accordance with the closed method.
5. Second nozzle opening pressure adjustment
 - Adjust the second nozzle opening pressure using the shim.
6. Final inspection
 - Confirm the condition of the fuel spray with the nozzle and nozzle holder assembled.

Caution:

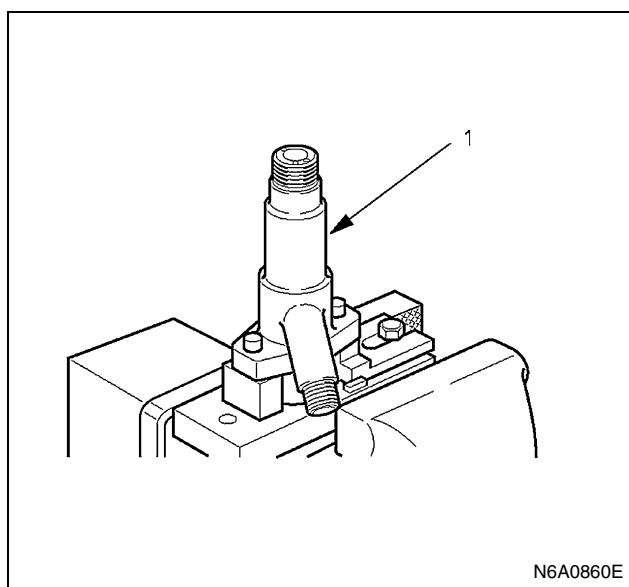
If not as specified, replace the nozzle assembly, lift piece, pins and spacer using the nozzle service kit.

Adjustment Service Data (4HG1-T only)

Nozzle needle valve full-lift		0.30 mm (0.0118 in)
Nozzle needle valve pre-lift		0.04 mm (0.0016 in) at 19.1 MPa (195 kg/cm ² , 2,770 psi)
Nozzle pressure	1st Stage	18.1 MPa (185 kg/cm ² , 2,630 psi)
	2nd Stage	22.1 — 23.0 MPa (225 — 235 kg/cm ² , 3,200 — 3,342 psi) at lift 0.09 mm (0.0035 in) = pre lift + 0.05 mm (0.0020 in)

First nozzle opening pressure adjustment

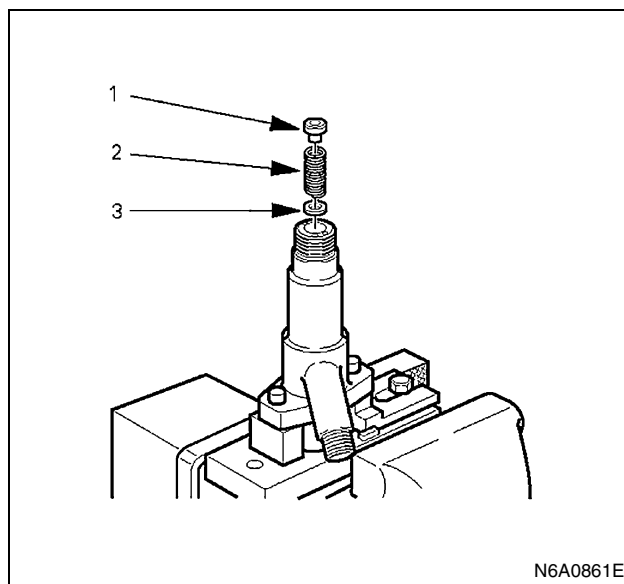
1. Clamp the nozzle holder in a vise.



Legend

1. Nozzle holder body

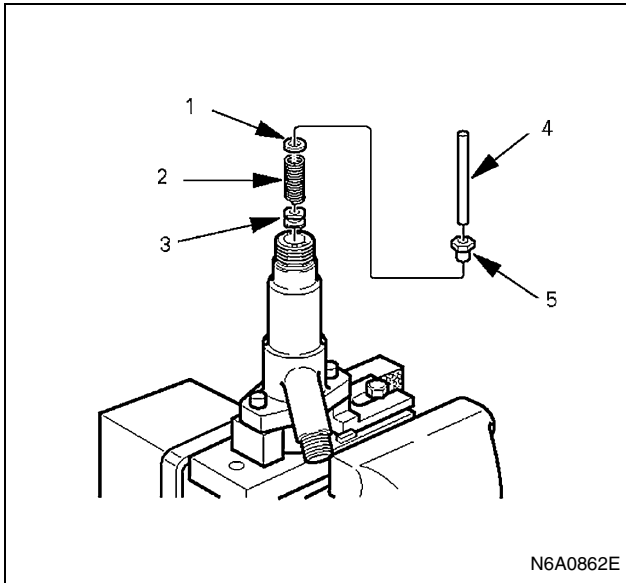
2. Install the shim, first spring and spring seat in the nozzle holder.



Legend

1. Spring seat
2. First spring
3. First nozzle opening pressure adjusting shim

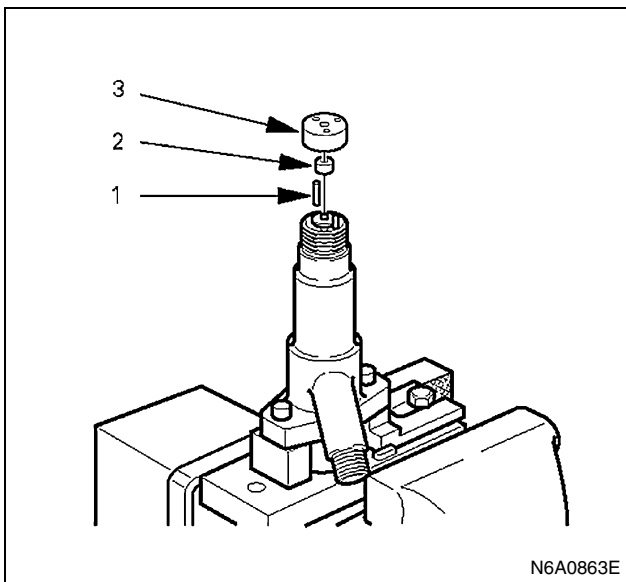
3. Install the collar, second spring, shim, spring seat and push rod in the nozzle holder.



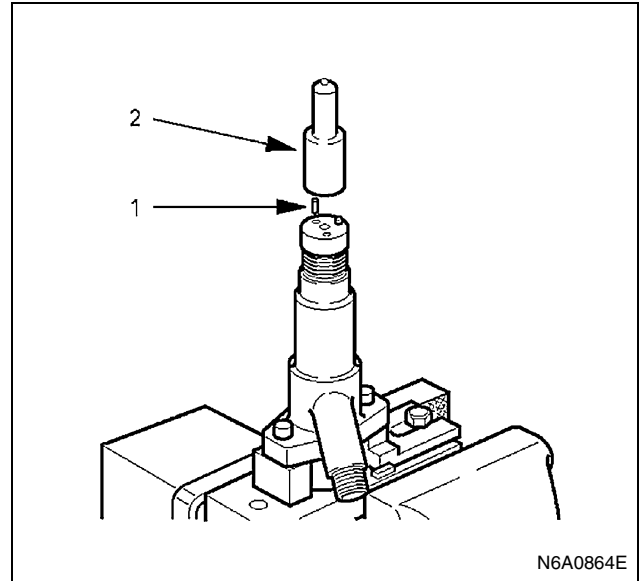
Legend

1. Second nozzle opening pressure adjusting shim
2. Second spring
3. Collar
4. Push rod
5. Spring seat

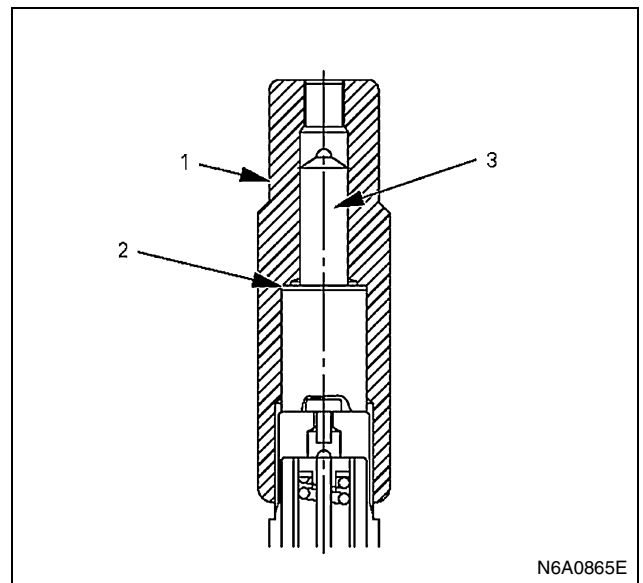
4. Install the pins (1), lift piece (2) and spacer (3) in the nozzle holder.



5. Install the pins (1) in the spacer.
6. Install the nozzle (2) on the spacer.



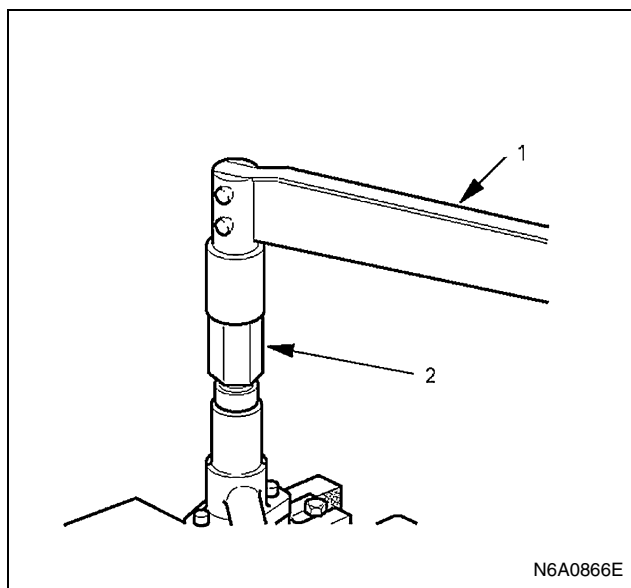
7. Hand-tighten the adjustment retaining nut together with the gasket to the nozzle holder.
Retaining nut: 157892-3200 (* Bosch AS)
Gasket: 157892-5100 (* Bosch AS)
(* Bosch Automotive System Corporation)



Legend

1. Retaining nut (special tool)
2. Gasket
3. Nozzle

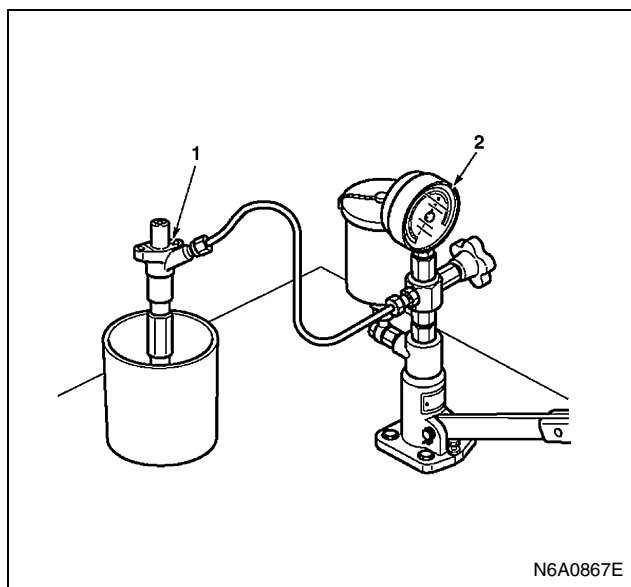
8. Tighten the adjustment retaining nut to the specified torque.
Torque: 29 — 39 N·m (3.0 — 4.0 kg·m/257 — 345 lb·in)



Legend

1. Torque wrench
2. Retaining nut (special tool)

9. Set the nozzle holder (1) to the nozzle tester (2).



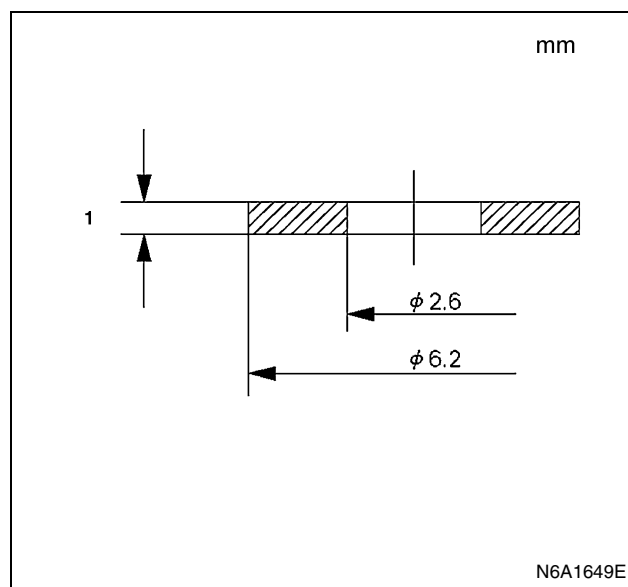
10. Operate the nozzle tester and measure the first nozzle opening pressure.
11. If the first nozzle opening pressure is not as specified, disassemble the nozzle holder and replace the shim until the pressure is as specified.

Caution:

- Use a micrometer to measure shim thickness.
- Use some combination of 3 adjusting shims to adjust the pressure.

- First nozzle opening pressure adjusting shims

Part No. (ISUZU)	Thickness mm (in)
115349-0420	0.40 (0.0157)
115349-0430	0.50 (0.0197)
115349-0440	0.52 (0.0205)
115349-0450	0.54 (0.0213)
115349-0460	0.56 (0.0220)
115349-0470	0.58 (0.0228)
115349-0480	0.60 (0.0236)
115349-0490	0.70 (0.0276)



Legend

1. Thickness

Full Needle Valve Lift Confirmation

1. Install the gasket (1) and plug (2) on the adjustment retaining nut.

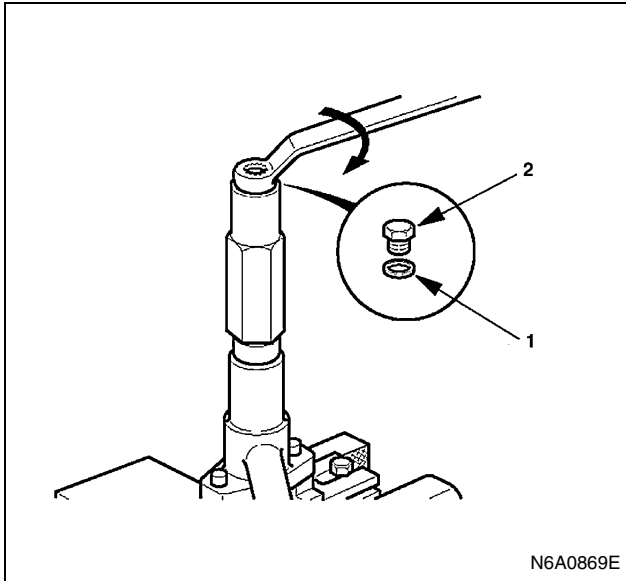
Gasket:

026508-1140 (Bosch AS)

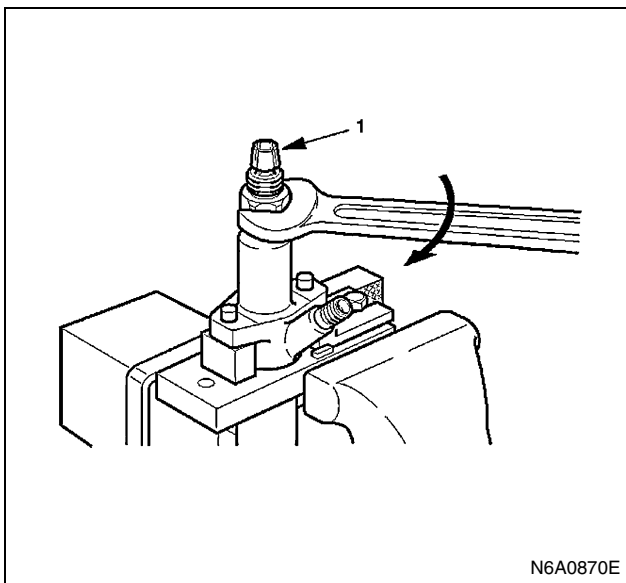
894227-6020 (ISUZU)

Plug:

157892-1600 (Bosch AS)



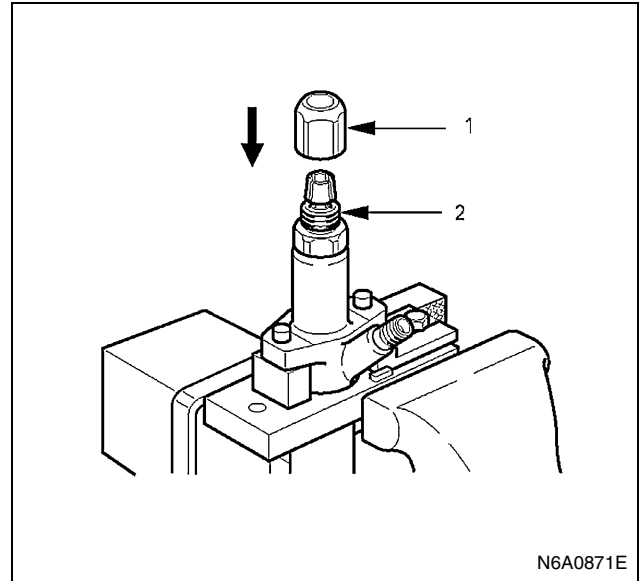
2. Position the nozzle holder with the nozzle facing down and install the dial gauge holder on the nozzle holder.
Dial gauge holder: 157892-5000 (Bosch AS)



Legend

1. Holder (special tool)

3. Install the nut on the dial gauge holder.
Nut: 157892-1000 (Bosch AS)



Legend

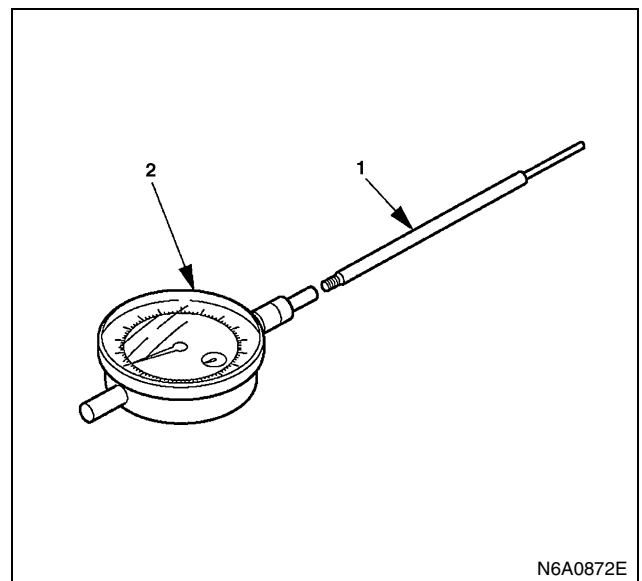
1. Nut (special tool)
2. Holder (special tool)

4. Install the pin (1) to the dial gauge (2).

Notice:

The lengths of the pins do not include the threaded portions.

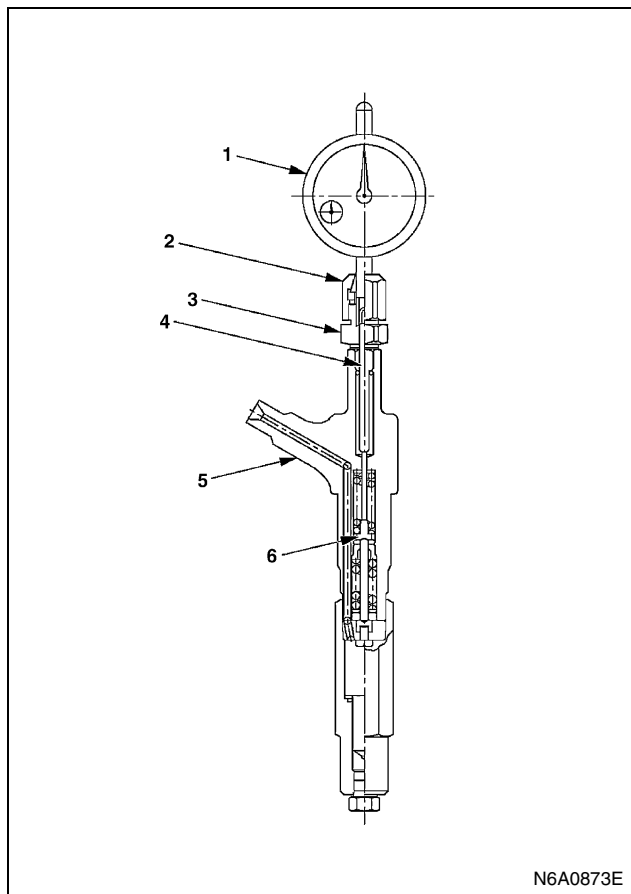
Pin (l=100 mm (3.94 in)):
157892-5200 (Bosch AS)
Dial gauge:
157954-3800 (Bosch AS)
185317-0150 (ISUZU)



5. Secure the dial gauge to the nozzle holder using the nut so that the pin contacts the tip of the first spring seat.

Caution:

- Secure the dial gauge so that a stroke of 2 mm (0.08 in) can be measured.
- Do not over-tighten the nut as the dial gauge shaft may jam. (Confirm from the dial gauge that the shaft moves smoothly.)

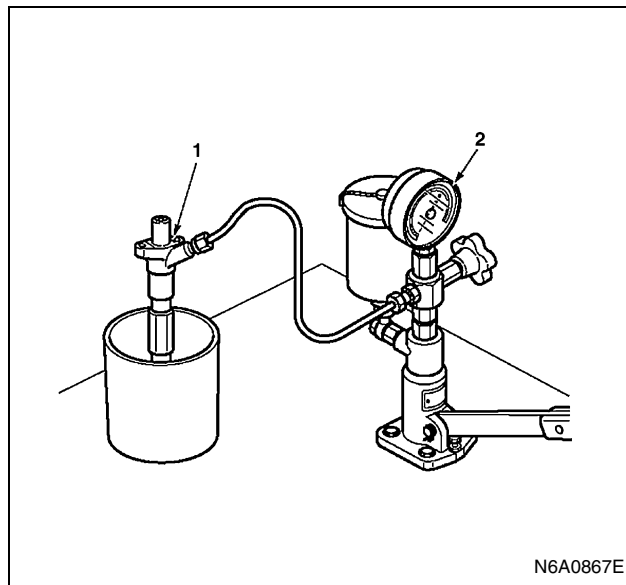


N6A0873E

Legend

1. Dial gauge
2. Nut
3. Holder
4. Pin
5. Nozzle holder
6. First spring seat

6. Set the nozzle holder (1) to the nozzle tester (2) and put needle to zero on the dial gauge.
7. Operate the nozzle tester to bleed any air from inside the retaining nut and to confirm that no fuel leaks.



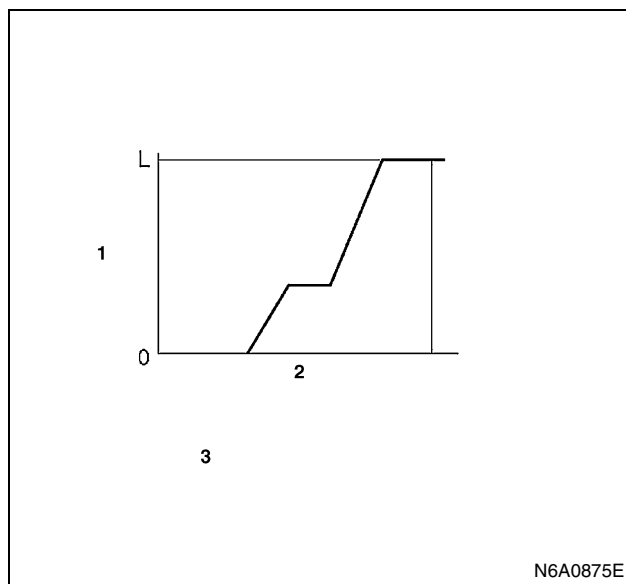
N6A0867E

8. Operate the nozzle tester and increase the in-line pressure to 34.3 — 44.1 MPa (350 — 450 kg/cm² / 4,975 — 6,396 psi) so that the nozzle's needle valve moves through its full lift. Record full lift 'L'. (Read dial gauge)

Nozzle Full Lift	mm (in)
	0.30 (0.0118)

Notice:

The above operation is used to determine whether the nozzle seat is worn and whether the nozzle assembly is in good condition.



N6A0875E

Legend

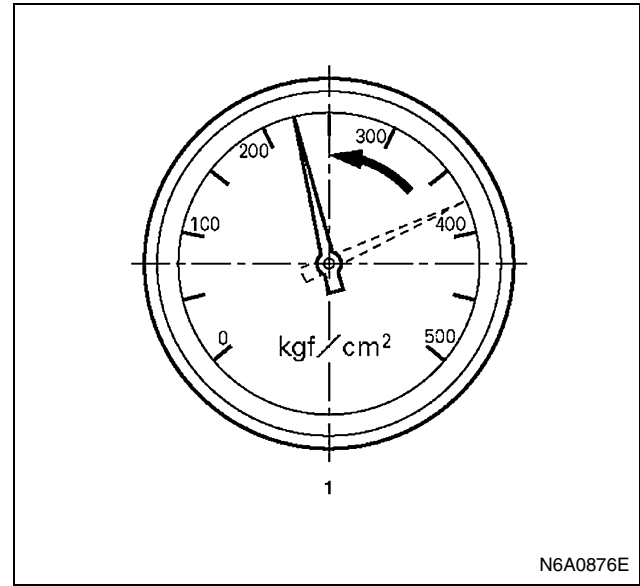
1. Needle valve
2. First nozzle opening pressure 34.3 — 44.1 MPa (350 — 450 kg/cm² / 4,975 — 6,396 psi)
3. In line pressure

Pre-lift Confirmation

- 1. With the needle valve at full lift, release the nozzle tester handle.

Notice:

The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.



Legend

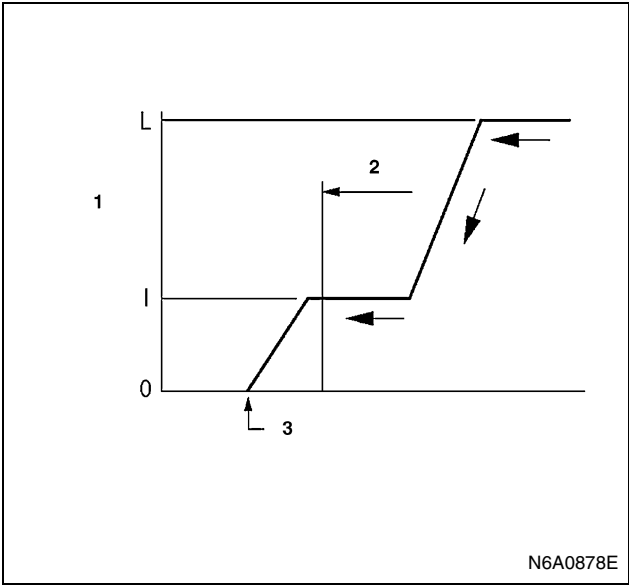
- 1. Pressure gauge

Read the dial gauge at **first nozzle opening pressure + approx 1 MPa (10 kg/cm² / 145 psi)**.

Pre-lift		
Engine	Pressure MPa (kg/cm² / psi)	Lift mm (in)
4HG1-T	19.1 (195/2,770)	0.04 (0.0016)

Notice:

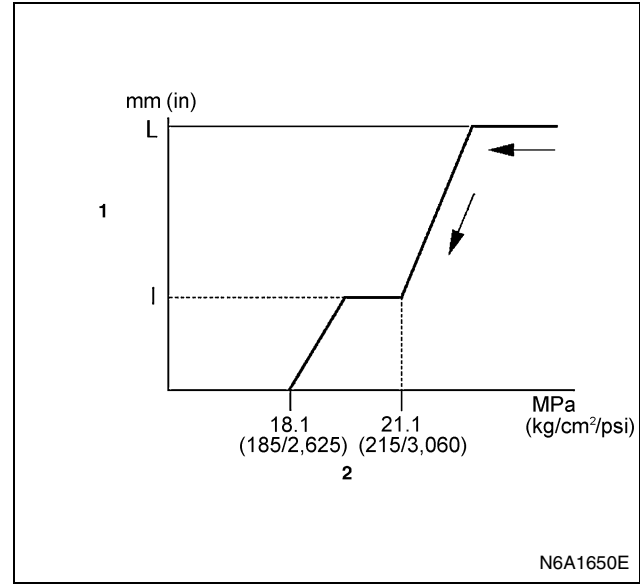
This point can be found while the pressure is decreasing.



Legend

- 1. Needle valve lift
- 2. Measuring point of prelift
- 3. First nozzle opening pressure

- 3. Confirm that pre-lift 'I' is as specified.

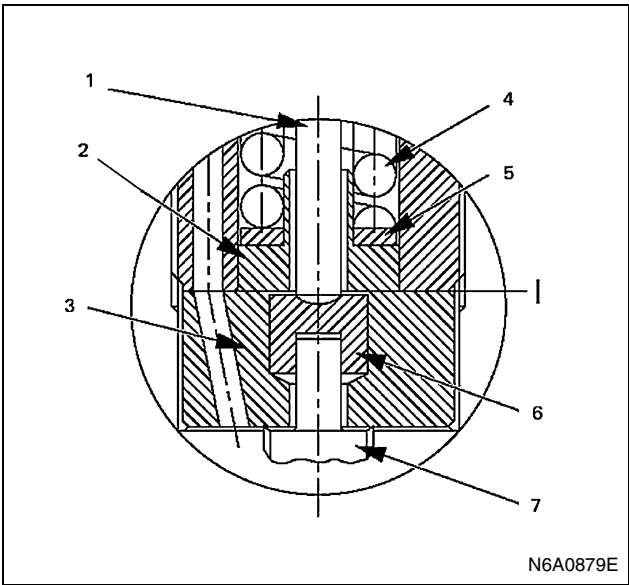


Legend

- 1. Needle valve lift
- 2. In line pressure

- 2. Read the needle valve lift 'I' from the dial gauge indication (once the needle valve has descended when the second spring has stopped operating). Refer to the pre-lift measuring point for 'I'.

Pre-lift measuring point:



Legend

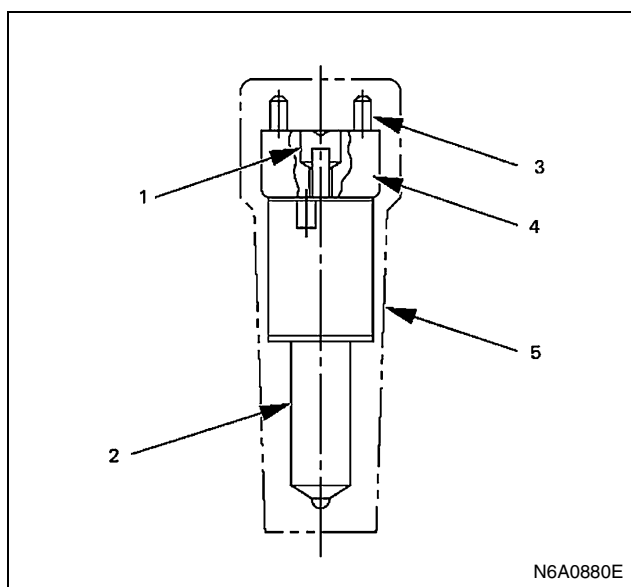
1. Push rod
2. Spring seat
3. Spacer
4. Second spring
5. Adjusting shim
6. Lift piece
7. Needle valve

4. If pre-lift is not as specified, replace the pins, lift piece, spacer and nozzle assembly as a set with the service kit.

Service kit:

4HG1-T

897313-8970

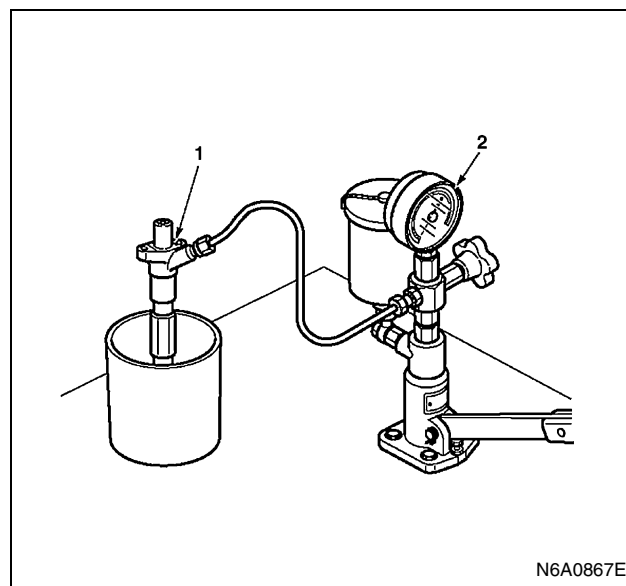


Legend

1. Lift piece
2. Nozzle assembly
3. Pin
4. Spacer
5. Capsule

Second Nozzle Opening Pressure Confirmation

1. After pre-lift confirmation, operate the nozzle tester to increase in-line pressure to 34.3 — 44.1 MPa (350 — 450 kg/cm² / 4,975 — 6,396 psi) so that the nozzle's needle valve moves through its full lift.



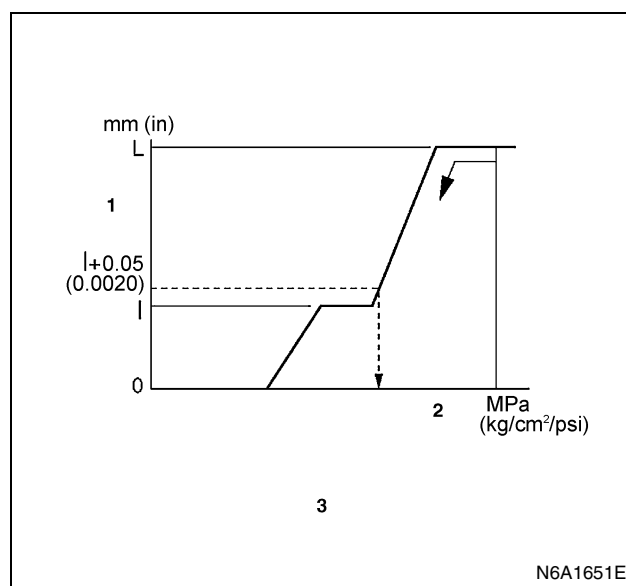
Legend

1. Nozzle holder
2. Nozzle tester

2. Release the nozzle tester handle so that in-line pressure decreases.

Notice:

The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.



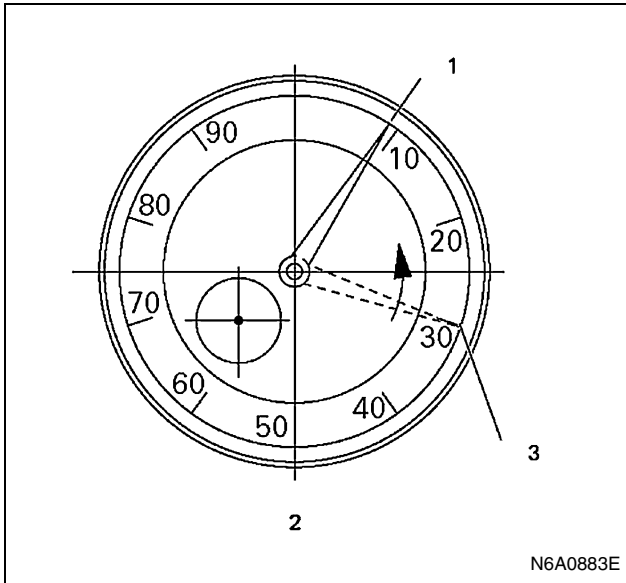
Legend

1. Needle valve lift
2. Second nozzle opening pressure 34.3 — 44.1 MPa (350 — 450 kg/cm² / 4,975 — 6,396 psi)
3. In line pressure

3. Then, read the pressure gauge indication (second nozzle opening pressure) the instant that the dial

gauge indicates the specified needle valve lift (usually pre-lift $l + 0.05$ mm (0.0020 in)).

Second Nozzle Opening Pressure		
	Lift mm (in)	Pressure MPa (kg/cm ² /psi)
4HG1-T	0.09 (0.0035)	22.1 — 23.0 (225 — 235/ 3,200 — 3,342)



Legend

1. When needle valve lift is $l + 0.05$ mm (0.0020 in)
2. Dial gauge
3. Full needle valve lift

Second Nozzle Opening Pressure Adjustment

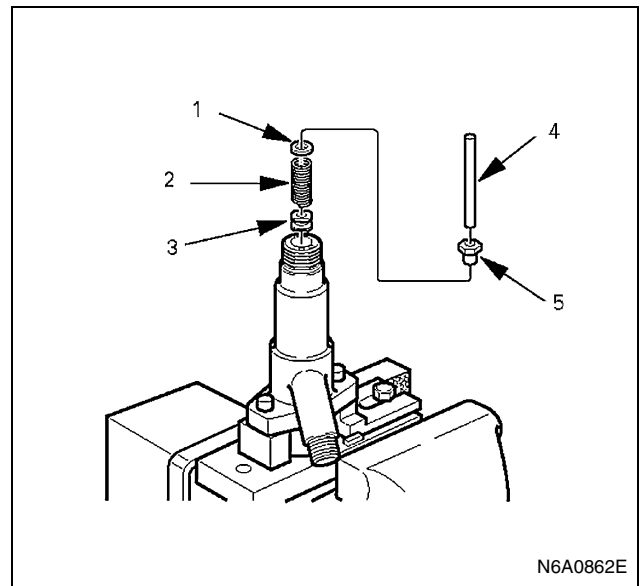
If the second nozzle opening pressure is not as specified, disassemble the nozzle from the nozzle holder and replace the shim until the pressure is as specified.

Caution:

- Because the second opening pressure changes when the first opening pressure changes, the second opening pressure must be adjusted when the first opening pressure changes.
- Use a micrometer to measure shim thickness.
- Use some combination of 3 adjusting shims to adjust the pressure.
- Second nozzle opening pressure adjusting shims

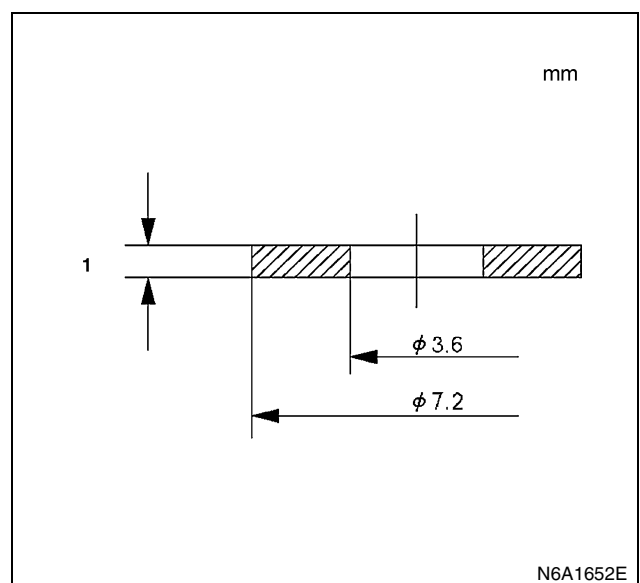
Part No. (ISUZU)	Thickness mm (in)
897116-0290	0.10 (0.0039)
897116-0320	0.20 (0.0079)
897116-0330	0.30 (0.0118)
897116-0340	0.40 (0.0157)
897116-0350	0.50 (0.0197)
897116-0360	0.51 (0.0201)

Part No. (ISUZU)	Thickness mm (in)
897116-0370	0.52 (0.0205)
897116-0380	0.53 (0.0209)
897116-0390	0.54 (0.0213)
897116-0400	0.55 (0.0217)
897116-0410	0.56 (0.0220)
897116-0420	0.57 (0.0224)
897116-0430	0.58 (0.0228)
897116-0440	0.59 (0.0232)



Legend

1. Second nozzle opening pressure adjusting shim
2. Second spring
3. Collar
4. Push rod
5. Spring seat

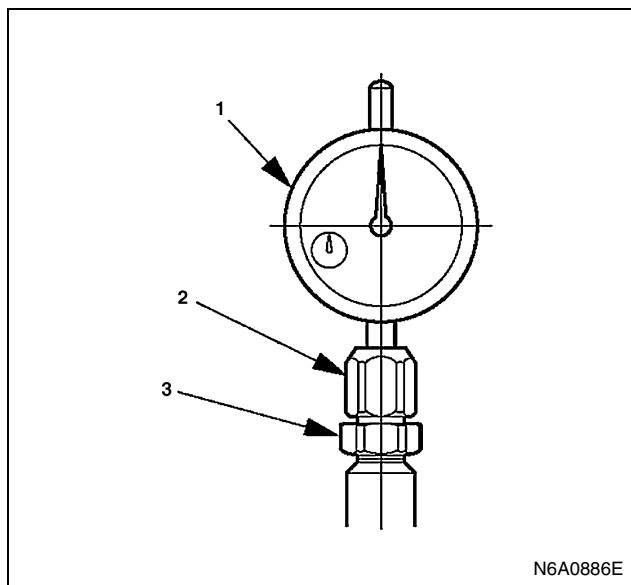


Legend

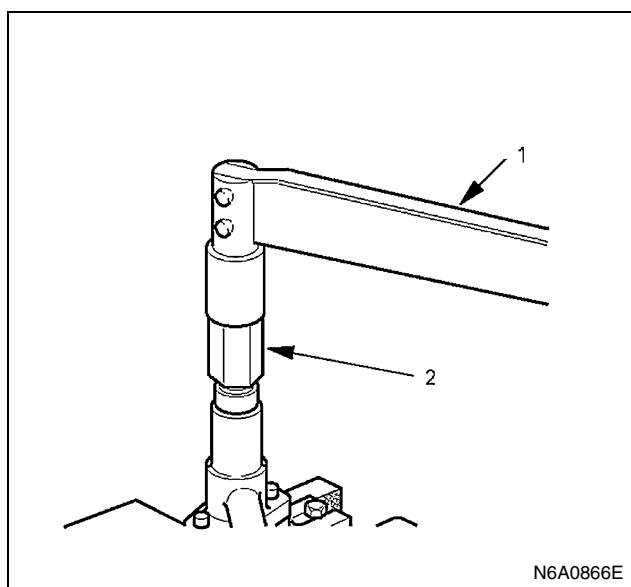
1. Thickness

Final Inspection

1. Remove the dial gauge (1), nut (2) and dial gauge holder (3).



2. Remove the adjustment retaining nut and gasket.
3. Install the original retaining nut, confirm that the pins are inserted fully into the nozzle, and then hand-tighten the retaining nut. Then, tighten the original retaining nut to the specified torque.
Torque: 29 — 39 N·m (3.0 — 4.0 kg·m / 22 — 29 lb·ft)



Legend

1. Torque wrench
2. Retaining nut (special tool)

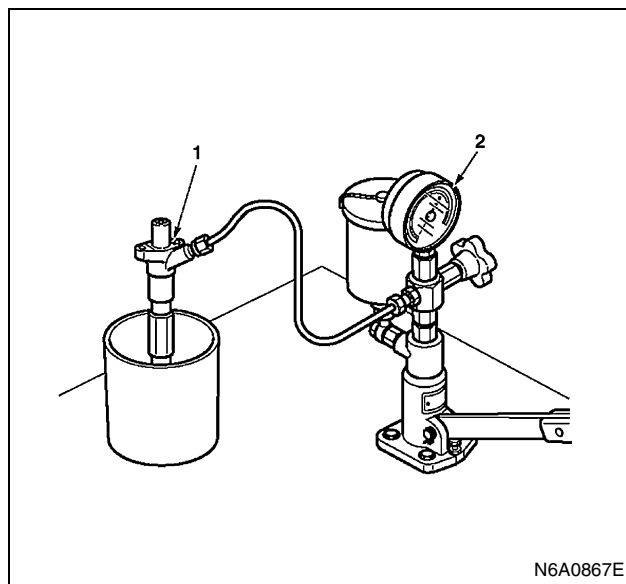
4. Set the nozzle holder (1) to the nozzle tester (2) and check first nozzle opening pressure, spray

condition, seat oil tightness and each part for oil leaks.

5. When replacing the nozzle, replace the nozzle, lift piece, pins and spacer as a set with the nozzle service kit.

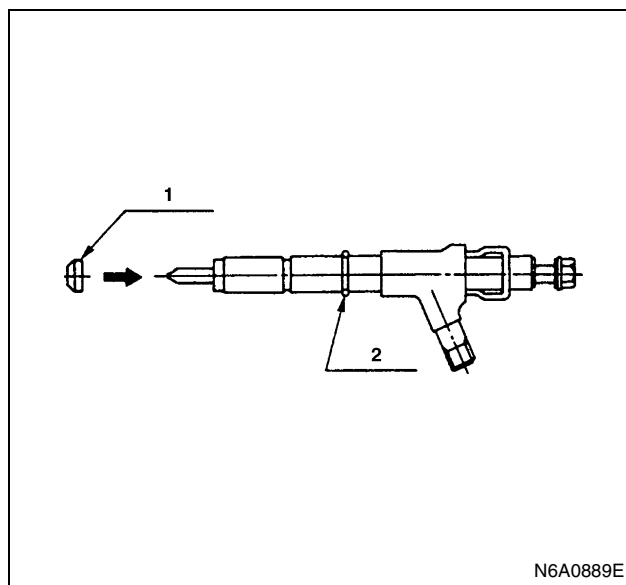
Caution:

Pre-lift will not be as specified if only the nozzle is replaced.



Installation

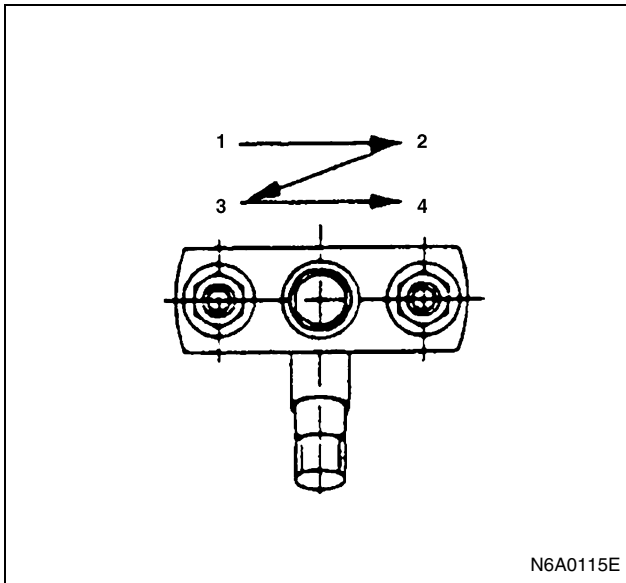
1. Injection Nozzle Assembly
 - 1) Install a new injection nozzle (1) gasket and O-ring (2) to the nozzle holder, and then install the nozzle holder to the cylinder head as shown in the illustration.



- 2) Tighten the nozzle holder flange nuts to the specified torque in the numerical order.

Tighten:

Nozzle holder flange nuts to 19 N·m (1.9 kg·m / 14 lb·ft)



2. Fuel Injection Pipe

- 1) Install the injection pipe assembly and temporarily tighten the injection pipe sleeve nuts.
- 2) Set the clips in the prescribed position shown in the illustration.

Caution:

Make absolutely sure that the clip is correctly positioned. An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

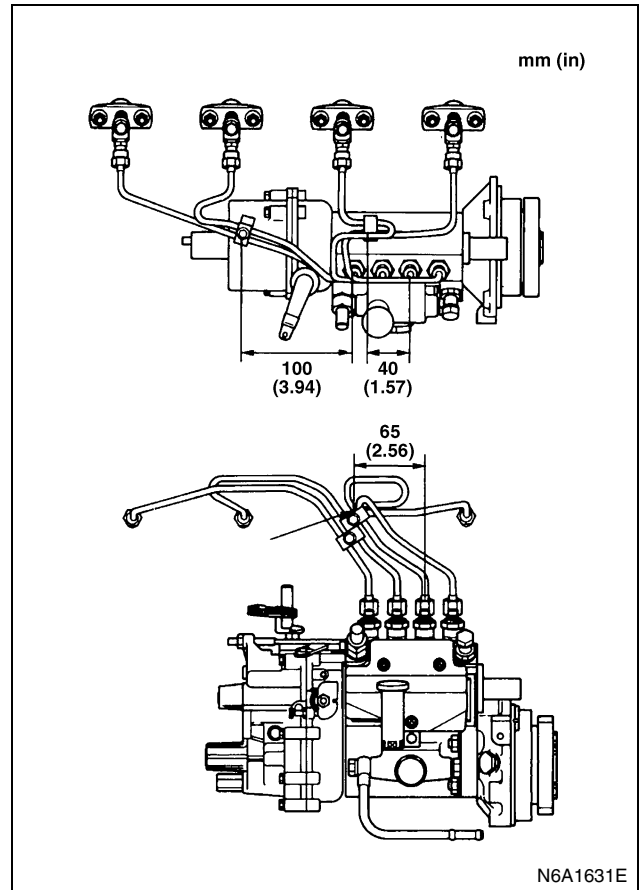
Tighten:

Clip screw to 3 N·m (0.3 kg·m / 26 lb·in)

- 3) Tighten the injection pipe sleeve nuts to the specified torque.

Tighten:

Injection pipe sleeve nut to 29 N·m (3 kg·m / 22 lb·ft)

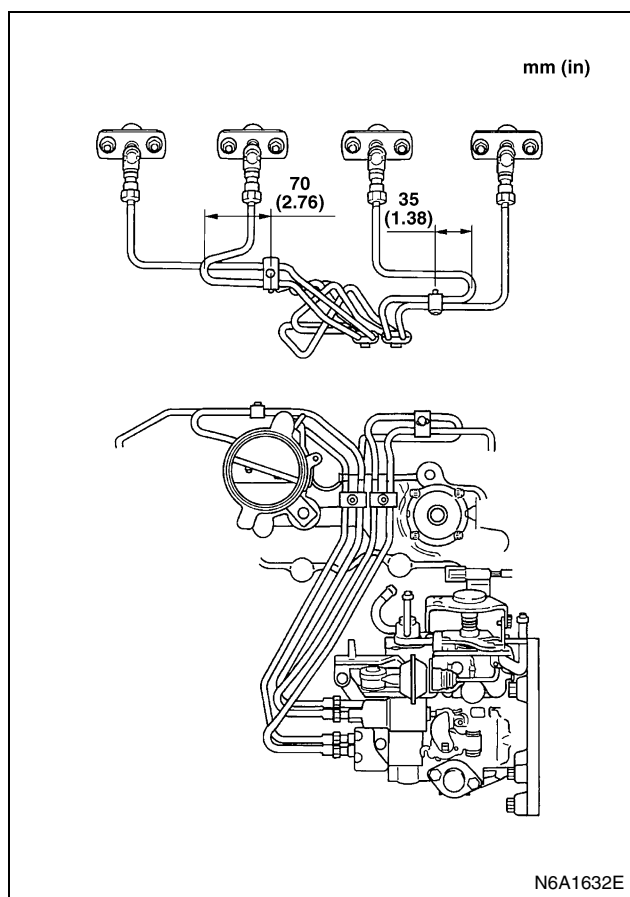


3. Fuel Injection Pipe (4HF1-2 model only)

- 1) Connect Injection Pipe and fix with clips as illustrated.

Tighten:

- Injection pipe to 29 N·m (3.0 kg·m / 22 lb·ft)
- Clip to 3 N·m (0.3 kg·m / 26 lb·in)

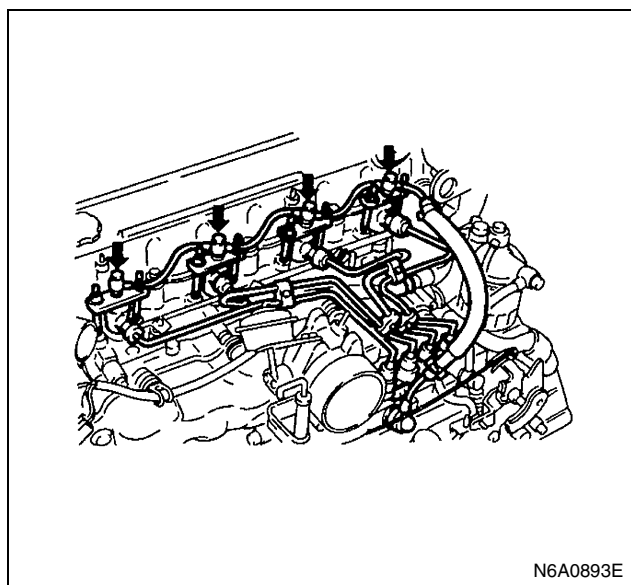


4. Leak Off Pipe

Leak-off pipe joint bolt 13 N·m (1.3 kg·m / 113 lb·in)

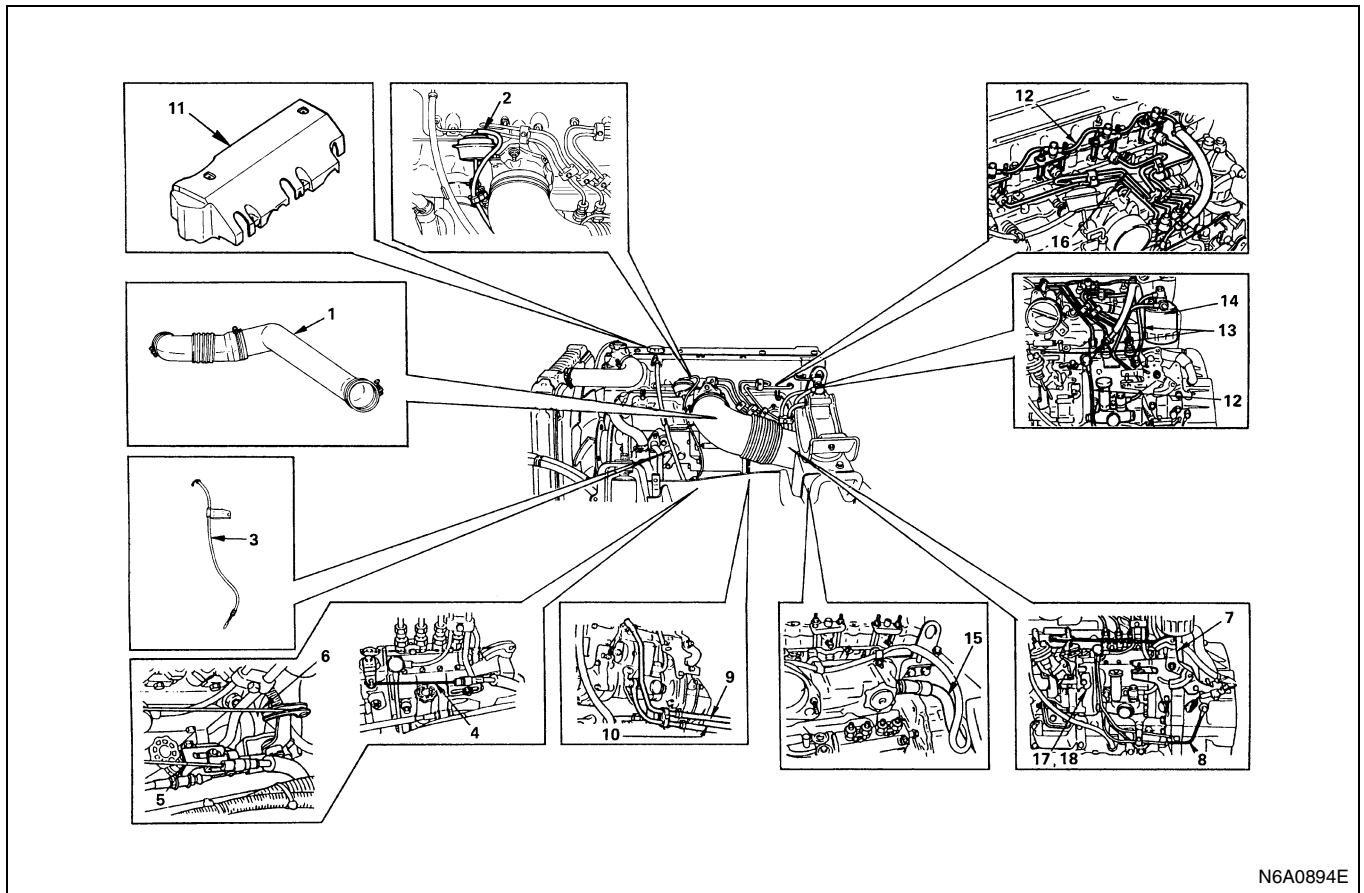
5. Nozzle Cover

- Connect battery ground cable.



INJECTION PUMP ASSEMBLY (Except 4HF1-2 model)

Component



N6A0894E

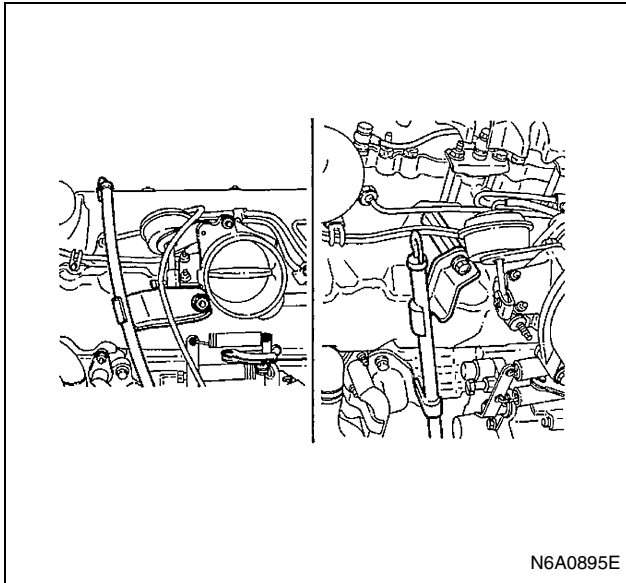
Legend

- | | |
|------------------------------|-----------------------------|
| 1. Intake air duct | 10. Fuel feed hose |
| 2. Vacuum hose | 11. Nozzle cover |
| 3. Oil level guide tube | 12. Leak off pipe |
| 4. Engine stop cable | 13. Fuel pipe |
| 5. Accelerator control cable | 14. Fuel filter assembly |
| 6. Engine control wire | 15. PCV hose |
| 7. Engine control lever | 16. Injection pipe |
| 8. Oil pipe | 17. Injection pump assembly |
| 9. Fuel return hose | 18. Injection rubber spacer |

Removal

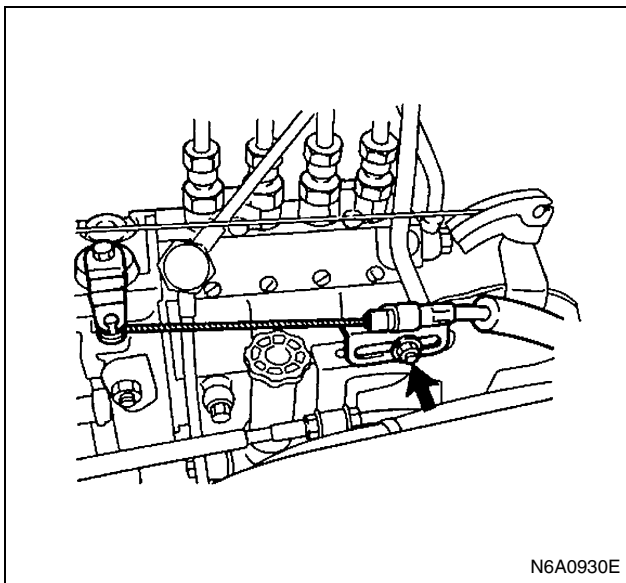
Preparation

- Disconnect the battery ground cable
 - Drain coolant
1. Intake Air Duct
 2. Vacuum Hose
 3. Oil Level Guide Tube
 - Remove the guide tube fixing bolt and pull out the guide tube.

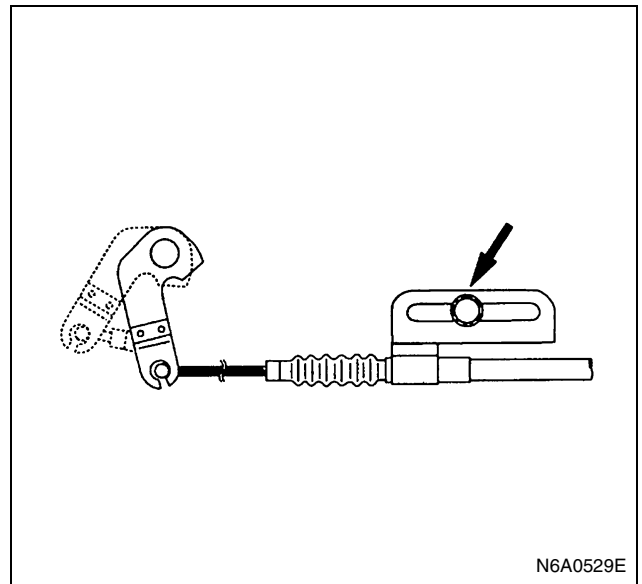


4. Engine Stop Cable

- Loosen the locking nut at bracket and disconnect engine stop cable from the injection pump stop lever.

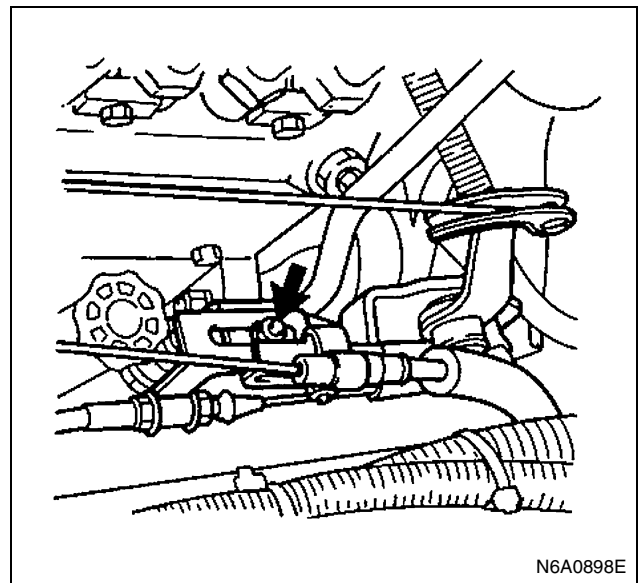


For 4HE1-TC

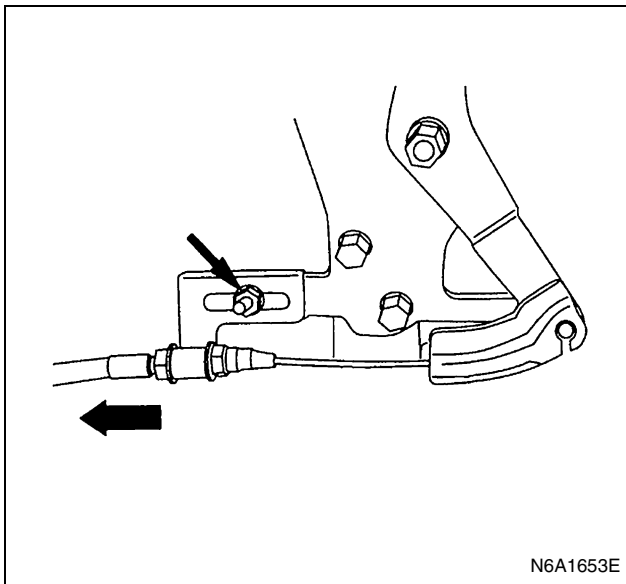


5. Accelerator Control Cable

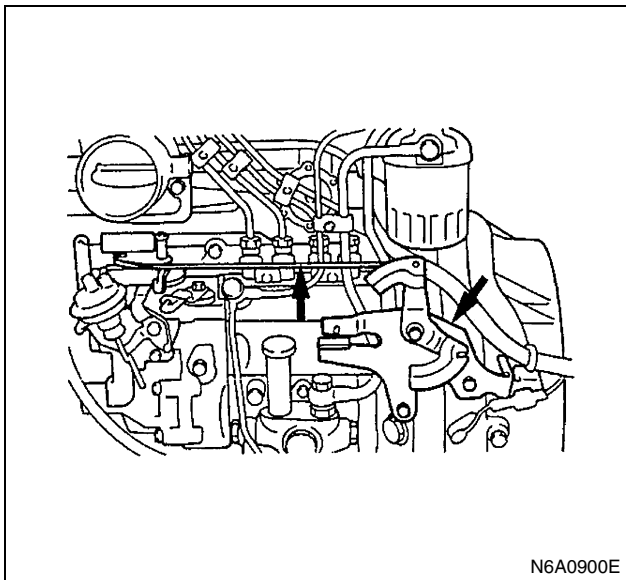
- Loosen the locking nut at bracket and disconnect the accelerator control cable from the injection pump control lever.



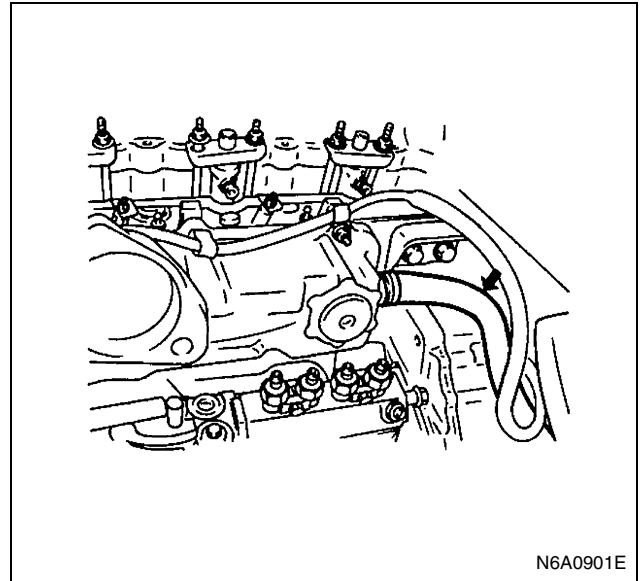
For 4HE1-TC



6. Engine Control Wire
7. Engine Control Lever
8. Oil Pipe
9. Fuel Return Hose
10. Fuel Feed Hose
 - Disconnect fuel hose from injection pump side and take care not to spill and enter dust.
11. Nozzle Cover

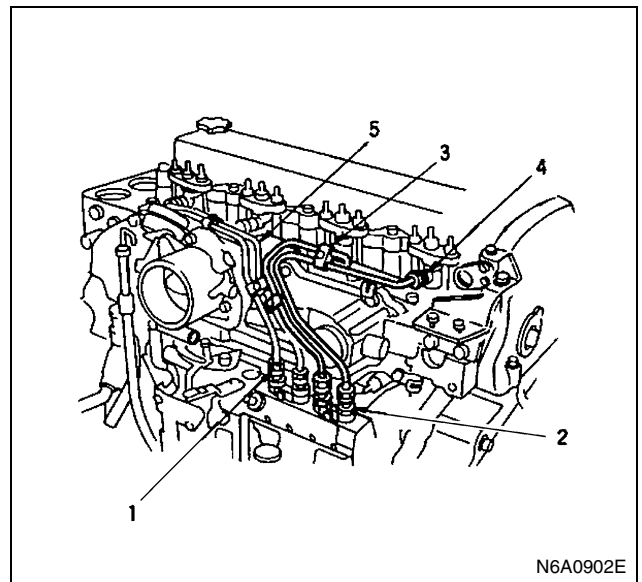


12. Leak-Off Pipe
13. Fuel Pipe
14. Fuel Filter Assembly
15. PCV Hose



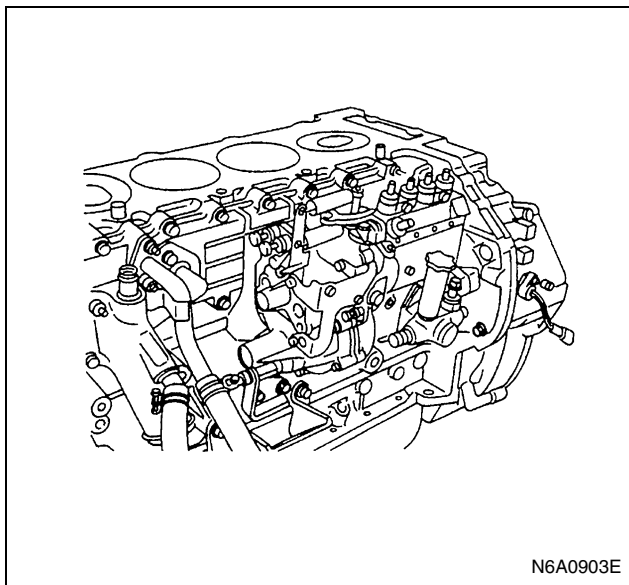
16. Injection Pipe

- Loosen the injection pipe sleeve nuts (1). Do not apply excessive force to the injection pipes (5).
- Loosen the injection pipes clips (3).
- Remove the injection pipe assembly. Plug the delivery valve holder (2) ports and nozzle holder (4) ports with caps to prevent the entry of foreign material.

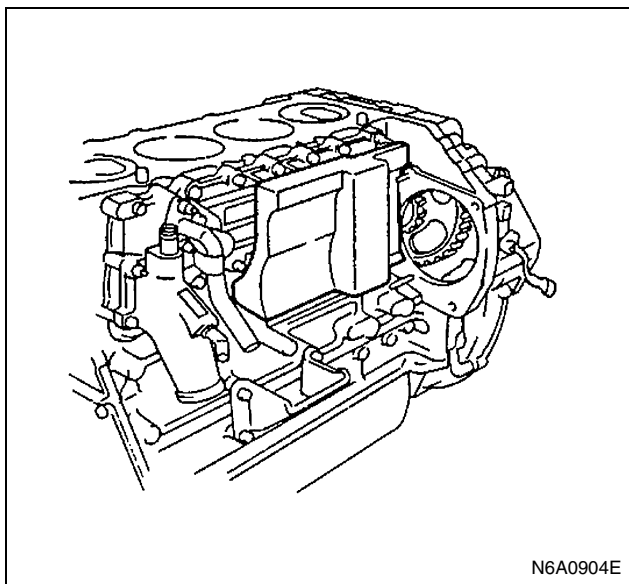


17. Injection Pump Assembly

- 1) Remove the injection pump bracket bolts and the injection pump rear bracket bolts.
- 2) Then remove the injection pump assembly.



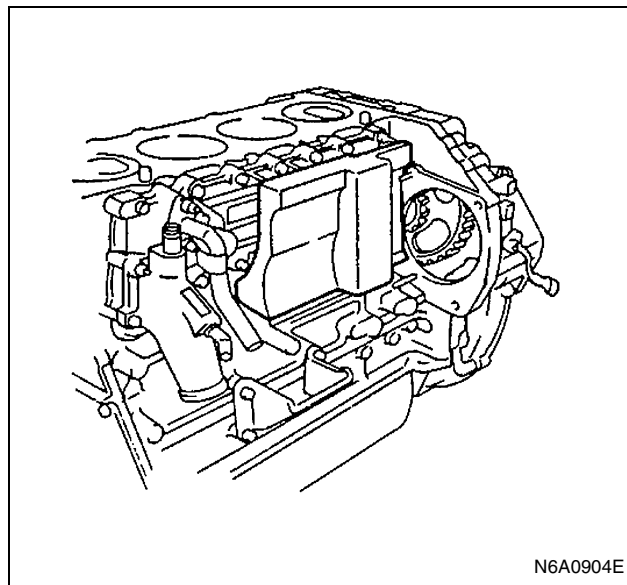
18. Injection Pump Rubber Spacer (For 4HF1/4HG1)



Installation

1. Injection Pump Rubber Spacer

- 1) Stick the rubber spacer to the location indicated in the illustration with pressure sensitive adhesive double coated tape. (4HF1/4HG1 Engine)
- 2) 4HE1-TC (4HE1-XS) EURO-3 engines use a larger rubber spacer than other engines. However, engines destined for Hong Kong do not have a rubber spacer.



2. Injection Pump Assembly

- 1) Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with "13°" line.
- 2) Check the No.1 cylinder intake and exhaust valve rocker arms for any play.

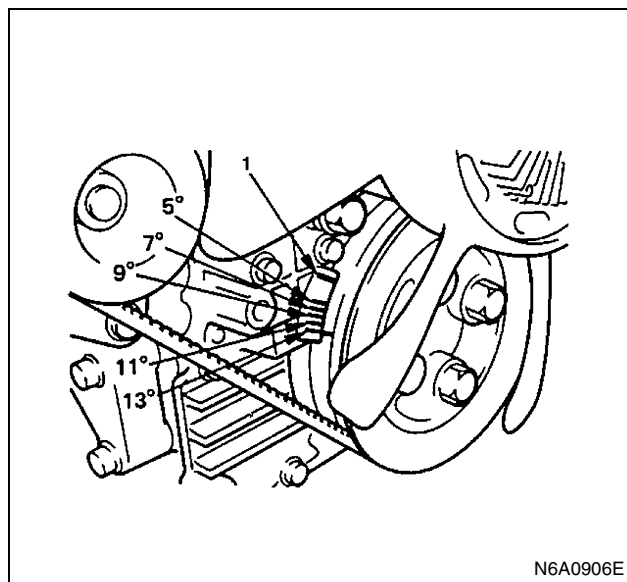
If the No.1 cylinder intake and exhaust valve rocker arms are depressed the No.4 piston is at on the compression stroke.

Rotate the crankshaft one full turn (360 degrees) and realign the crankshaft damper pulley timing mark with the "13°" line.

Notice:

BTDC 13° to be aligned with here is an angle at which the injection pump is installed, and has nothing to do with the injection timing.

- Remove the inspection hole plug from the cylinder body.
- Install the O-ring to the injection pump bracket.



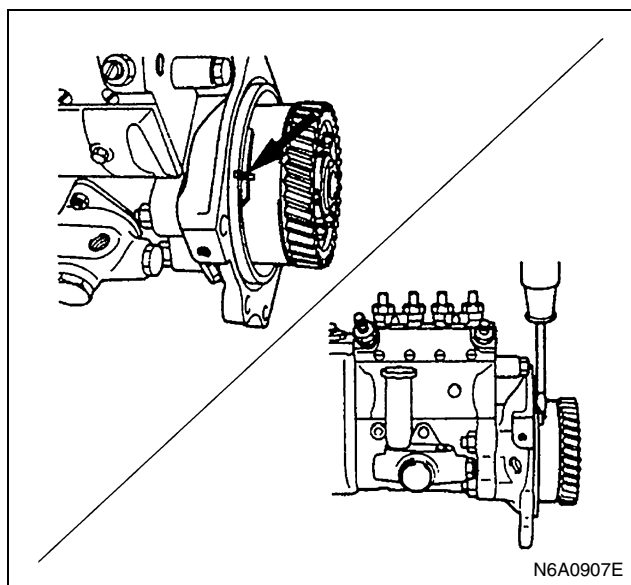
Legend

1. TDC

- 3) Align the injection pump bracket slit with the timer slit.
- 4) Install the injection pump assembly to the cylinder body.

Notice:

When the injection pump has a poor gear engagement while installing the assembly to the cylinder body, insert a screwdriver into the slit on the time peripheral with the pump bracket slit used as a guide, and move it up and down to get it into forcibly.

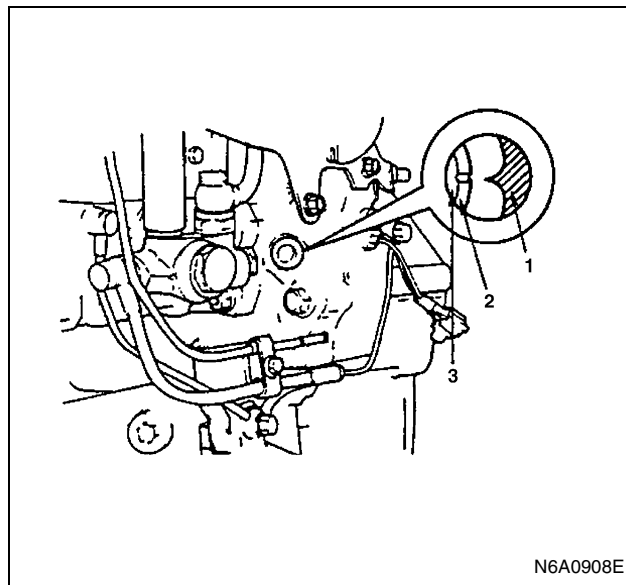


- 5) After installing the injection pump, the injection timing can be checked through the timing check hole provided at the injection pump bracket.

Set the No.1 cylinder to the BTDC (injection timing of engine mode) on the compression stroke. When the pointer of the timing check hole comes in line with the mark on the timer periphery of the injection pump as shown in the illustration, the injection timing is normal.

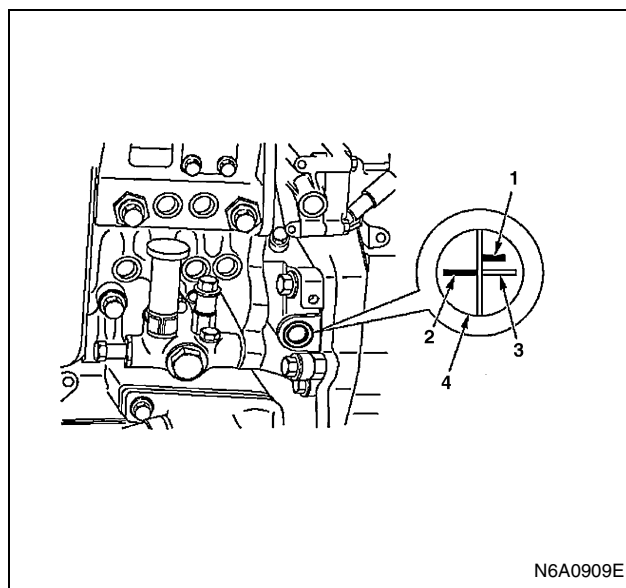
After completion of the injection timing check, tighten the check hole plug to the specified torque.

Injection Timing		deg
4HF1: 4HE1-TC (4HE1-XS, XN)	BTDC 8	
4HG1	BTDC 9	
4HG1-T	BTDC 7 BTDC 9 (For Colombia)	
4HE1-TC (4HE1-XS)	BTDC 9 (Spec EURO3)	

**Legend**

1. Pointer
2. Timer outside mark
3. Timing check hole

For 4HE1-TC

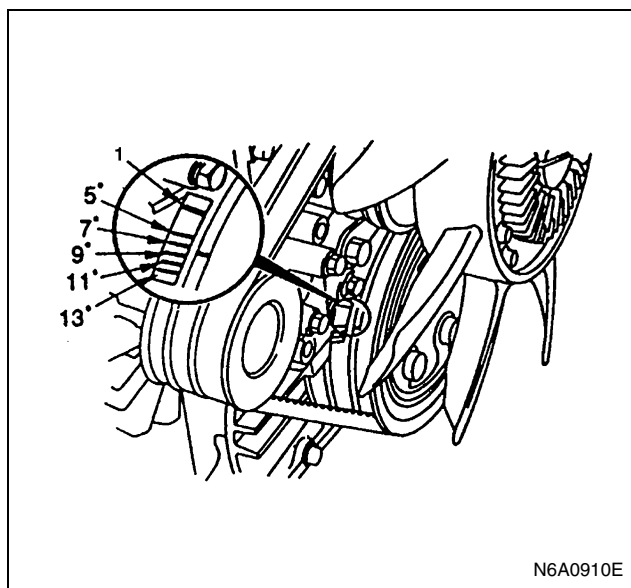
**Legend**

1. 8° mark
2. Pointer
3. 13° mark
4. Timing check hole

- 6) Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with "8°" (98EPA) or "9°" (Spec EURO3) line.

Notice:

Position in its normal rotating direction. (for 4HE1-TC only)

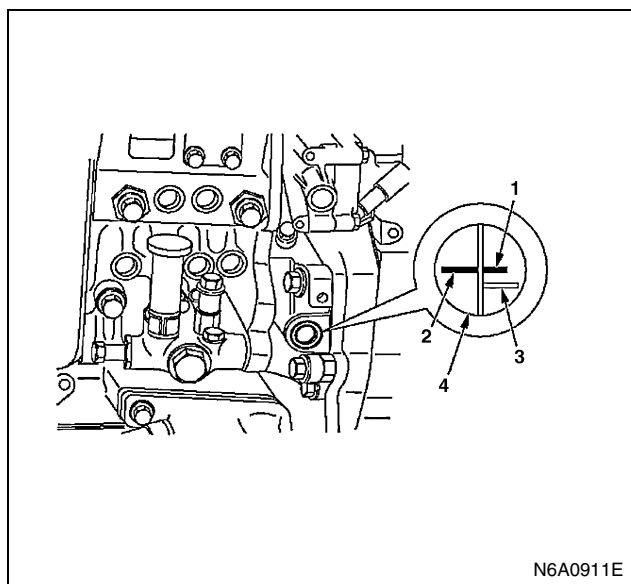
**Legend**

1. TDC

- 7) Adjust injection pump downward so that the "8°" (98EPA) or "9°" (Spec EURO3) comes to position in the timing check hole. (for 4HE1-TC only)

Notice:

Whenever the injection pump is replaced, be sure to adjust the injection timing. For the details of the adjustment, refer to the "SECTION 00 SERVICING: INJECTION TIMING INSPECTION AND ADJUSTMENT".

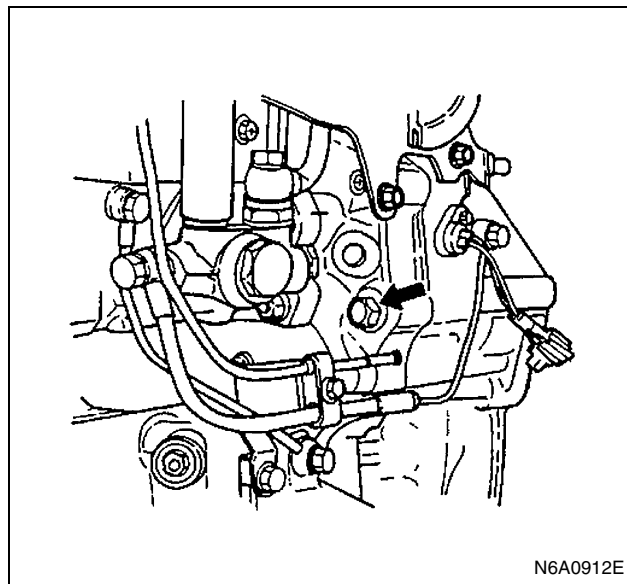
**Legend**

1. 8° mark
2. Pointer
3. 13° mark
4. Timing check hole

- 8) Tighten the injection pump bracket nuts and bolts to the specified torque.

Tighten:

Injection pump bracket nut and bolt to 48 N·m (4.9 kg·m / 35 lb·ft)



- 9) Install the injection pump rear bracket.

Tighten:

Injection pump rear bracket bolt to 48 N·m (4.9 kg·m / 35 lb·ft)

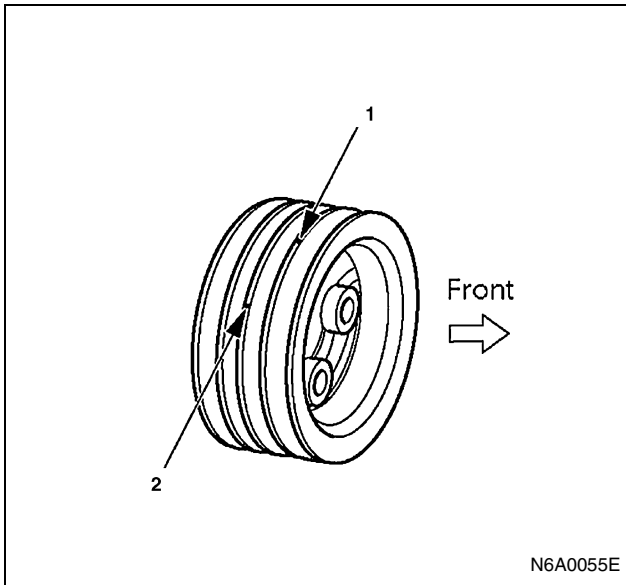
- 10) Install the inspection hole plug.

Tighten:

Inspection hole plug to 48 N·m (4.9 kg·m / 35 lb·ft)

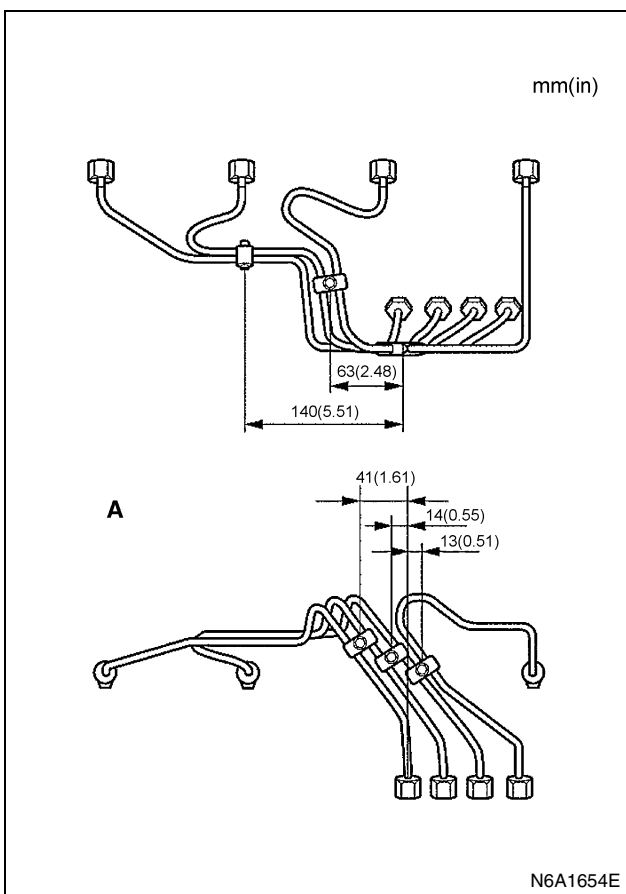
Notice:

In case the crank pulley has two marks as illustrated, (1) BTDC 49° mark on the second crest and (2) TDC mark on the third crest (as viewed from the front side), be sure to set at the mark (2). (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.) The mark (1) is used when installing the injection pump for 4HF1-2.



3. Fuel Injection Pipe

- 1) Install the injection pipe assembly and temporarily tighten the injection pipe sleeve nuts.
- 2) Set the clips in the prescribed position shown in the illustration.



Legend

A. 4HG1-T

An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

Tighten:

Clip screw to 3 N·m (0.3 kg·m / 26 lb·in)

- 3) Tighten the injection pipe sleeve nuts to the specified torque.

Tighten:

Injection pipe sleeve nut to 29 N·m (3 kg·m / 22 lb·ft)

4. PCV Hose
5. Fuel Filter

Tighten:

Fuel filter bracket bolt to 34 N·m (3.5 kg·m / 25 lb·ft)

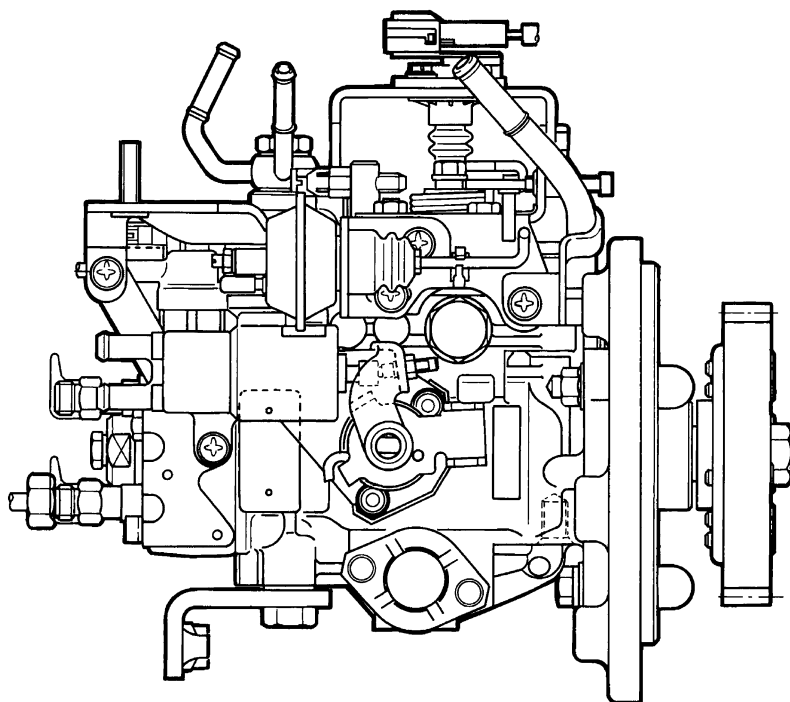
6. Fuel Pipe
7. Leak Off Pipe
8. Nozzle Cover
9. Fuel Feed Hose
10. Fuel Return Hose
11. Oil Pipe
12. Engine Control Lever
13. Engine Control Wire
14. Accelerator Control Cable
15. Engine Stop Cable
16. Oil Level Guide Tube
17. Vacuum Hose
18. Intake Air Duct

Caution:

Make absolutely sure that the clip is correctly positioned.

INJECTION PUMP ASSEMBLY (4HF1-2 model only)

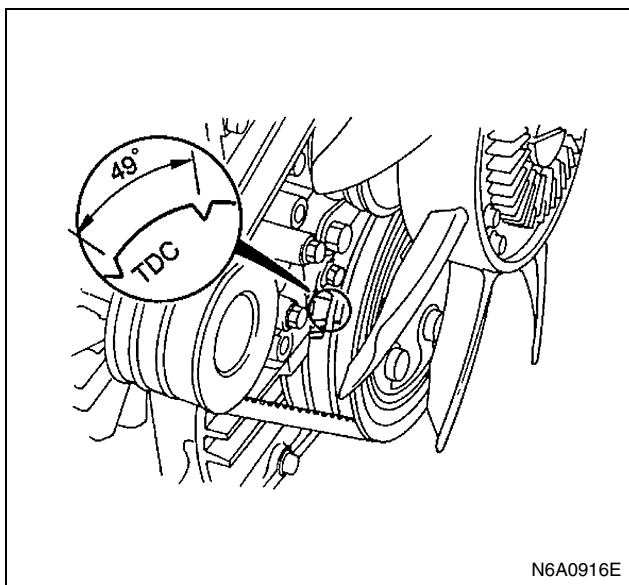
Component



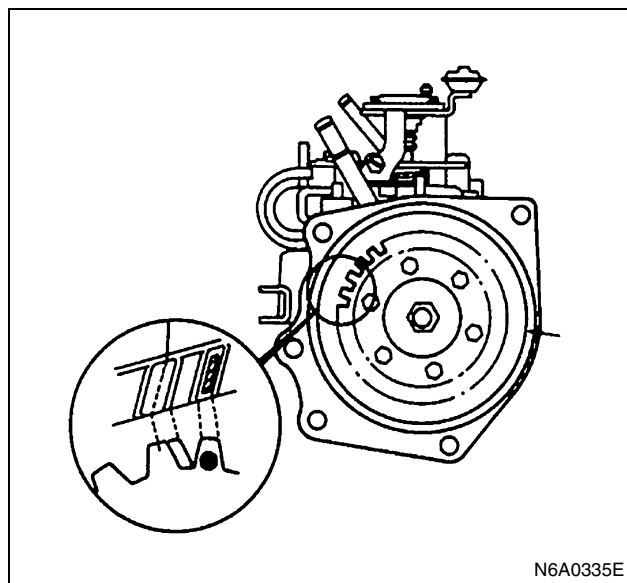
N6A0915E

Installation

1. Turn the crankshaft to set No. 1 cylinder to 49° before TDC in its compression stroke. (49° is a pump assembling angle, not related to injection timing.)
4. Align the pump bracket mark with the tooth (under side of the pump) just before the • (Z) marked tooth.
5. Insert the pump using the block side of stud bolt as a guide.



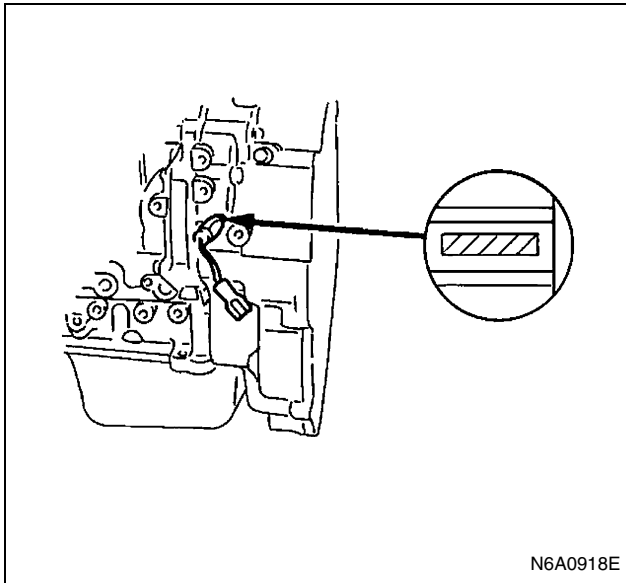
N6A0916E



N6A0335E

2. Install O-ring to the injection pump.
3. Apply paint on the • (Z) marked side of the injection pump gear.
6. After installing the injection pump, remove the tachometer sensor from the housing, and make sure

that the painted gear is at the center of the sensor mounting hole.



7. Tighten injection pump clamping bolt and nut to specified torque:

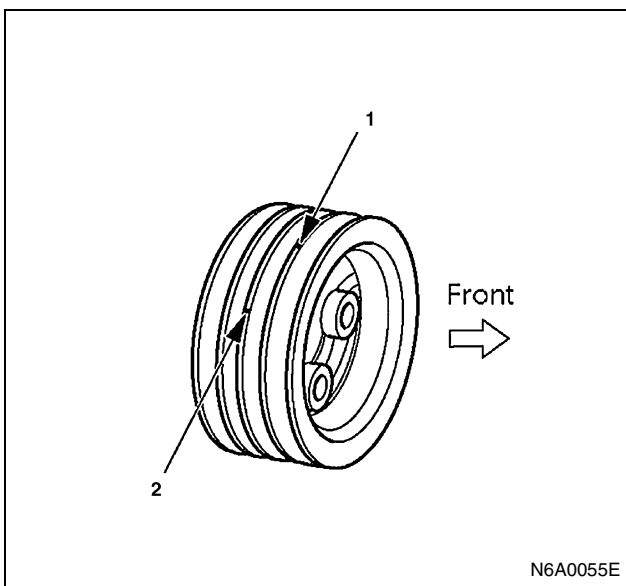
Tighten:

- Bolt to 48 N·m (4.9 kg·m / 35 lb·ft)
- Nut to 24 N·m (2.4 kg·m / 17 lb·ft)

8. With reference to Injection Timing Check & Adjustment, set No. 1 Cylinder to 12° before its TDC.

Notice:

In case the crank pulley has two marks as illustrated, (1) BTDC 49° mark on the second crest and TDC mark on the third crest (as viewed from the front side), be sure to set at the mark (2). (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.)

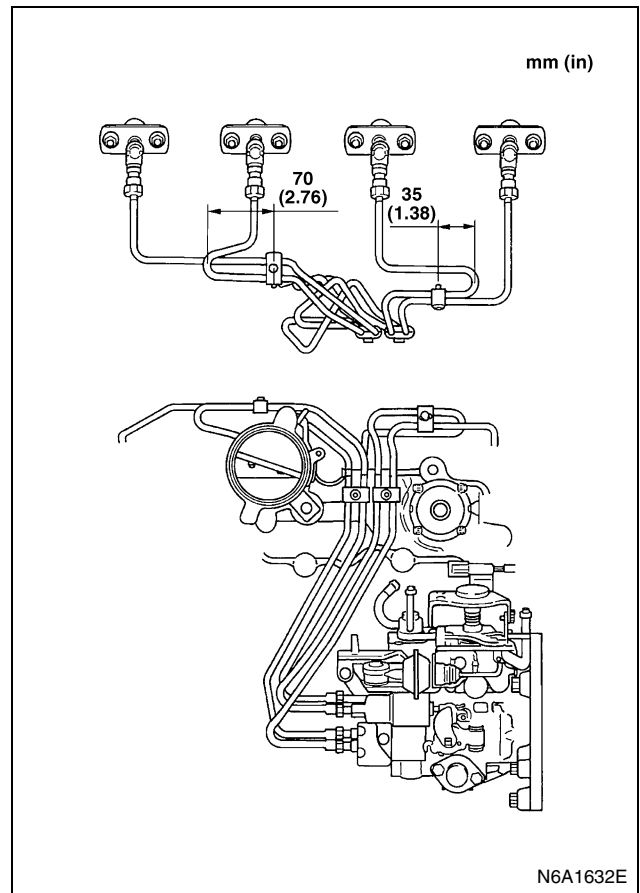


9. Injection Pipe (4HF1-2 model only)

- 1) Connect Injection Pipe and fix with clips as illustrated.

Tighten:

- Injection pipe to 29 N·m (3.0 kg·m / 22 lb·ft)
- Clip to 3 N·m (0.3 kg·m / 26 lb·in)

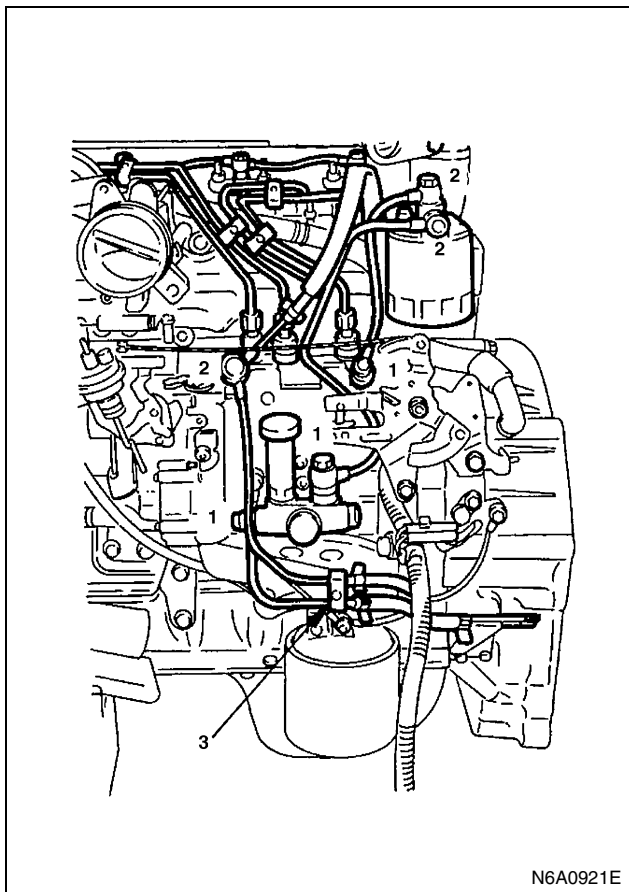


10. Fuel Pipe

Do not apply excessive force to the fuel pipe.

Tighten:

- Fuel pipe joint bolt (1) to 41 N·m (4.2 kg·m / 30 lb·ft)
- Fuel pipe joint bolt (2) to 23 N·m (2.3 kg·m / 17 lb·ft)
- Clip screw to 4 N·m (0.4 kg·m / 35 lb·in)



N6A0921E

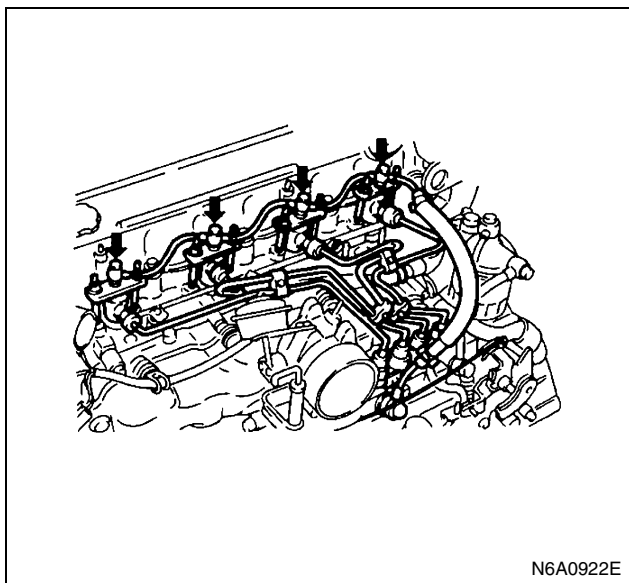
Legend

1. Fuel pipe joint bolt
2. Fuel pipe joint bolt
3. Clip

11. Leak Off Pipe

Tighten:

Leak-off pipe joint bolt to 13 N·m (1.3 kg·m / 9.6 lb·ft)



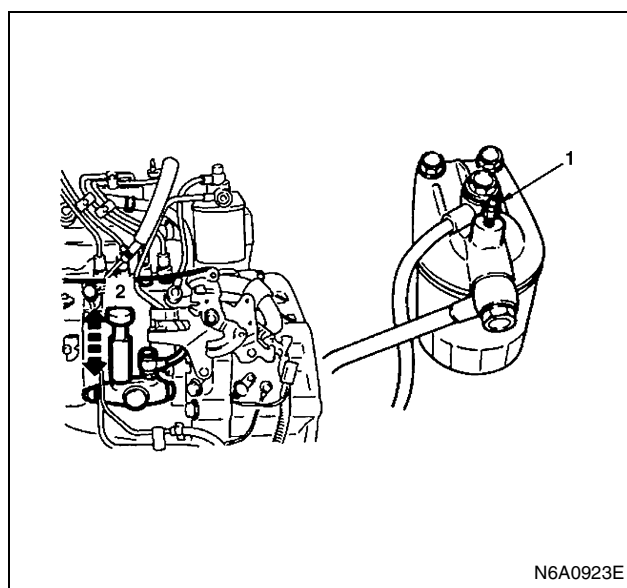
N6A0922E

12. Nozzle Cover
13. Fuel Feed Hose

14. Fuel Return Hose

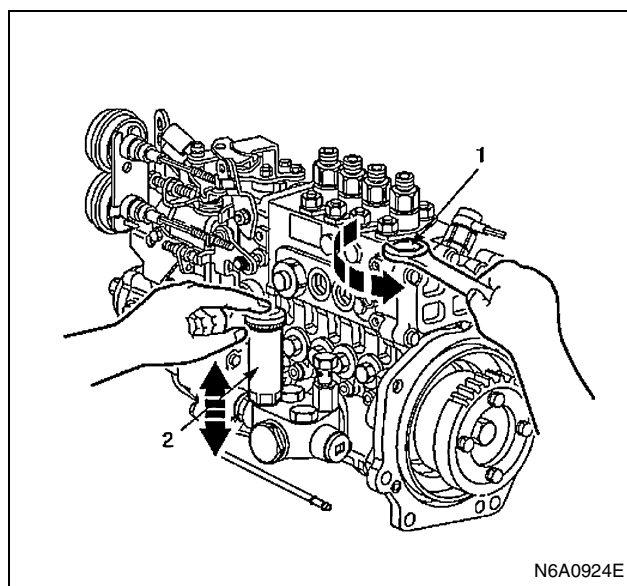
15. Air Bleeding

- 1) Loosen the priming pump cap (2) at the side of the injection pump.
- 2) Loosen the bleeder valve (1) at the top of the fuel filter.
- 3) Operate the priming pump to bleed the air from the injection pump.
- 4) Retighten the bleeder valve (1).
- 5) Operate the priming pump.
Check for fuel leakage from around the injection pump and the fuel filter.
- 6) Lock the priming pump cap (2) to the injection pump.



N6A0923E

For 4HE1-TC

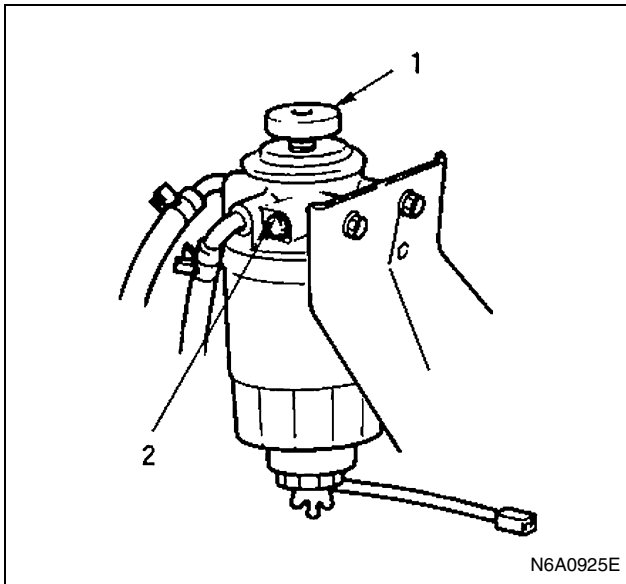


N6A0924E

16. Air Bleeding (4HF1-2 model only)

- 1) Actuate the priming pump (1) to send the air in the fuel system to the injection pump.

- 2) Loosen the sedimenter air bleeding plug (2) and operate the priming pump until no bubbles appear.

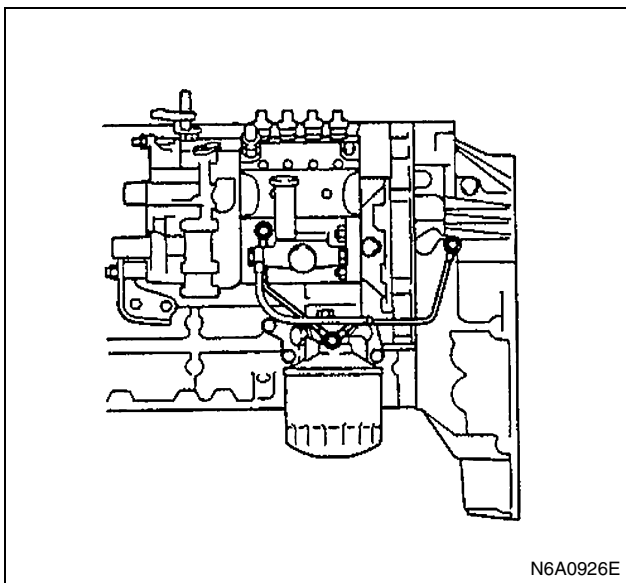


- 3) Tighten the air bleeding plug completely.
- 4) Try to start the engine. If the engine is not started within 10 seconds, air bleeding should be conducted once again.
- 5) Check that there is not fuel leak, and then tighten the priming pump completely.

17. Oil Pipe

Tighten:

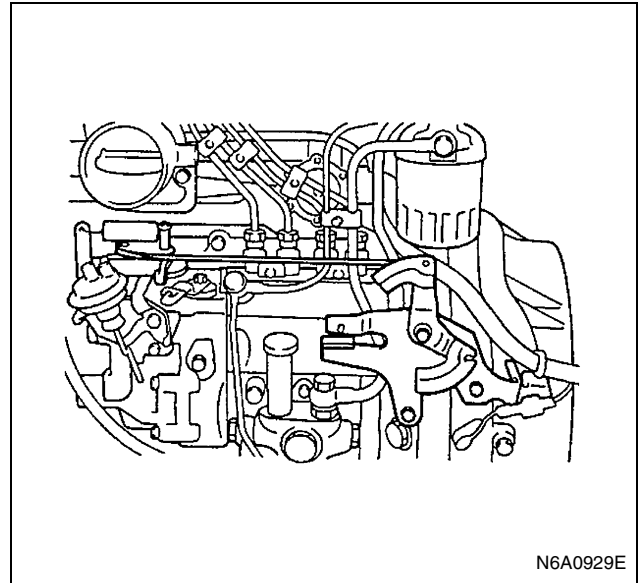
Oil pipe joint bolt to 17 N·m (1.7 kg·m / 12 lb·ft)



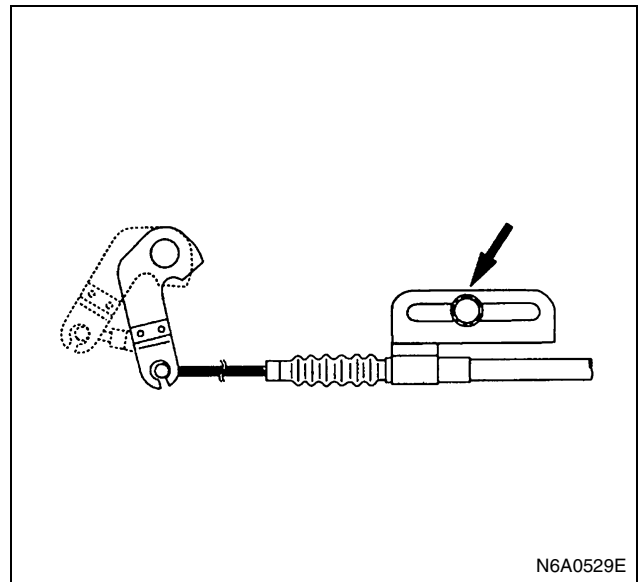
18. Engine Control Lever Assembly

Tighten:

Engine control lever bolt to 24 N·m (2.4 kg·m / 17 lb·ft)



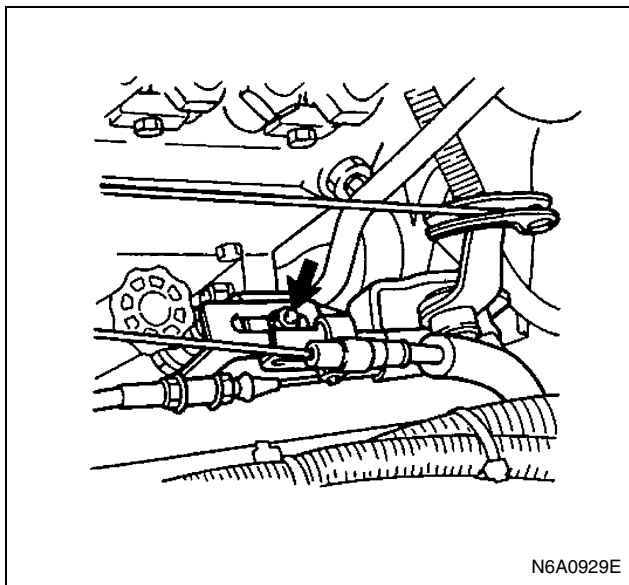
For 4HE1-TC



19. Engine Control Wire

20. Accelerator Control Cable

- 1) Check to see if the idling control knob is turned to the extreme left.
- 2) Attach the tip end of the cable to the engine control lever.
- 3) Pull the outer cable toward the front side of the vehicle, and provide the engine control wire and the inner cable with an appropriate play before fastening the clamp with a nut.

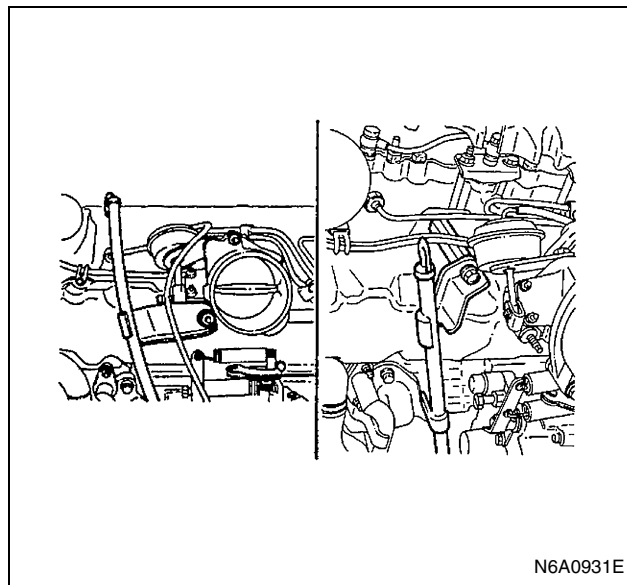


N6A0929E

- 4) Check to see if the injection pump control lever is at the idling position (with the lever in touch with the stopper bolt).

21. Engine Stop Cable

- 1) Attach the end tip of the cable to the engine stop lever.
- 2) Pull the cable toward the rear side of the vehicle, and fasten the clamp with a nut at the position where the lever stops.

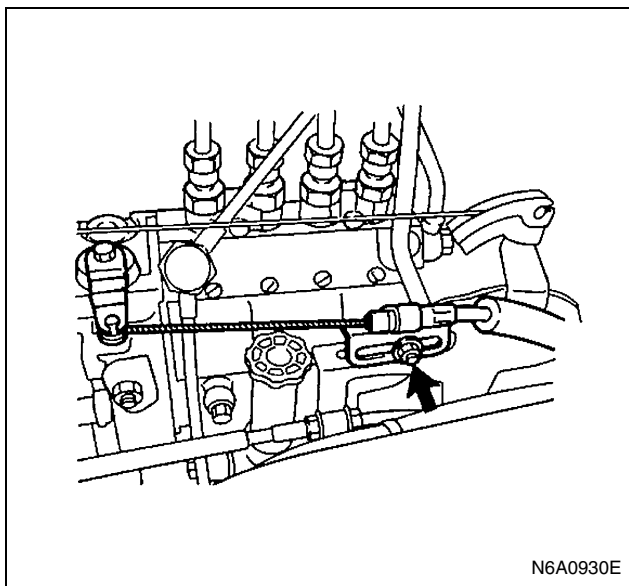


N6A0931E

23. Vacuum Hose

24. Intake Air Duct

- Pour coolant into radiator.
- Connect battery ground cable.
- Start engine and check for oil and fuel leakage carefully.



N6A0930E

22. Oil Level Gauge Guide Tube

- 1) Install the O-rings to the guide tube lower portion and insert the guide tube completely to the cylinder body.
- 2) Tighten the guide tube bolt to the specified torque.

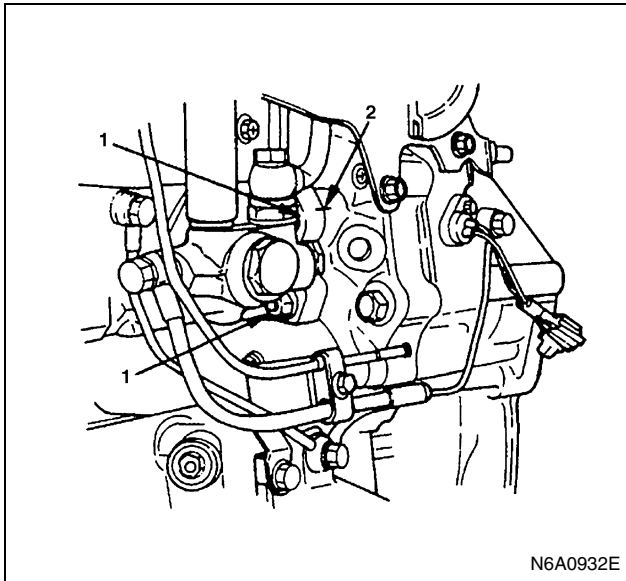
Tighten:

Guide tube bolt to 13 N·m (1.3 kg·m / 9.6 lb·ft)

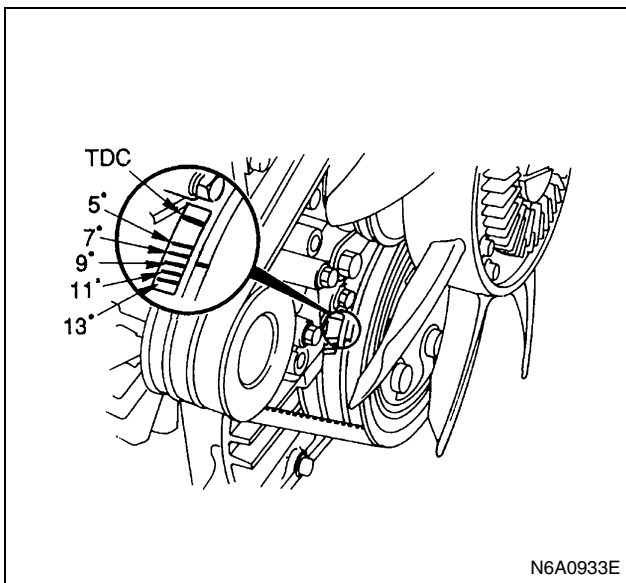
INJECTION TIMING ADJUSTMENT

Injection Pump Notched Line Inspection

1. Check the injection pump bracket nuts (1) for looseness.
Tighten as required.
2. Check that the notched lines (2) on the injection pump bracket and the timing gear case are aligned.
If the notched lines are not aligned, the injection timing must be checked.



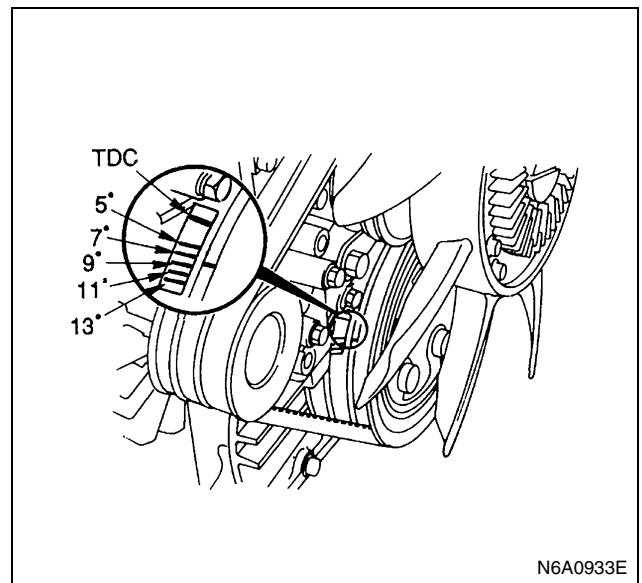
3. Same time, check injection timing on the crank damper pulley. If the injection timing aligned with incorrect, the injection timing must be readjusted.



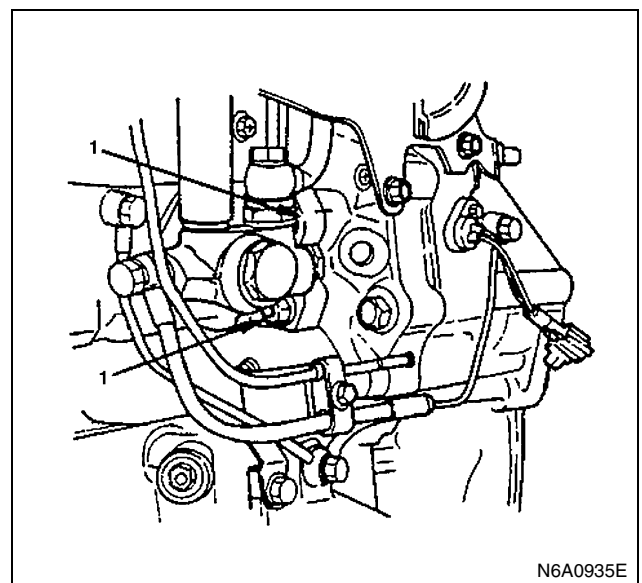
Injection Timing Adjustment (Except 4HF1-2 model)

1. Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with the injection timing of each engine mode mark in the illustration.

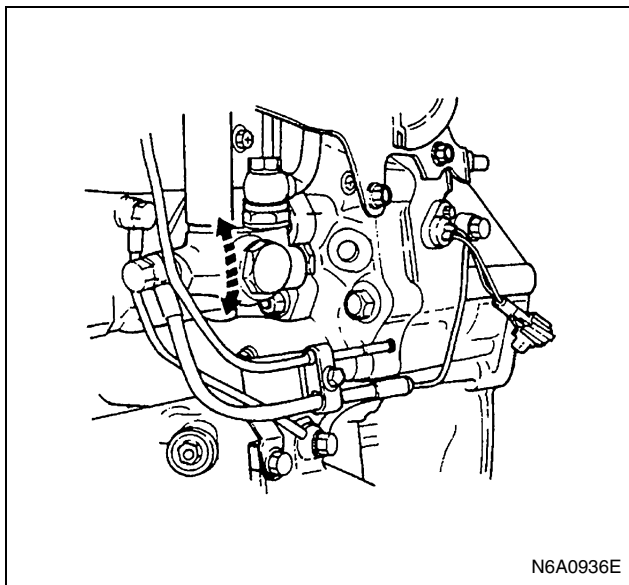
Injection Timing		deg
4HF1 4HE1-TC (4HE1-XS)		BTDC 8
4HG1		BTDC 9
4HG1-T		BTDC 7 BTDC 9 (For Colombia)
4HE1-TC (4HE1-XS)		BTDC 9 (Spec EURO3)



2. Remove the two foam rubbers.
3. Loosen the four injection pump fixing nuts (1).
This will allow the pump to pivot.
Do not bend or scratch the fuel pipe.



4. Align the notched line between the injection pump bracket and the timing gear case.
Make sure that the timing mark on the crank damper pulley is aligned with correct injection timing.



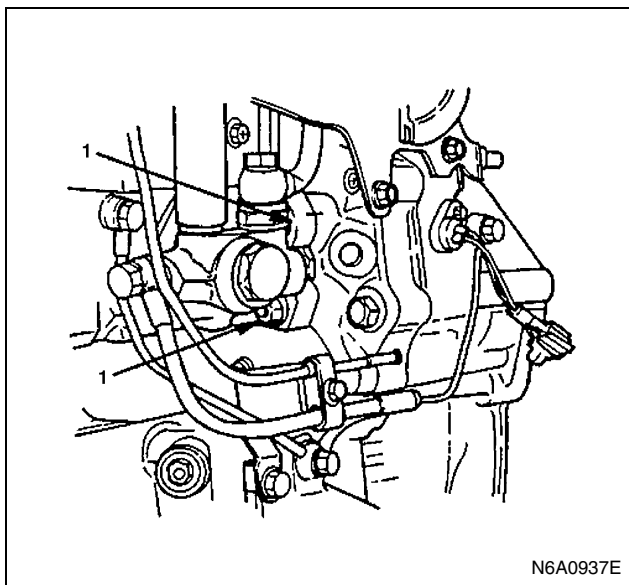
5. Tighten the injection pump fixing nuts (1) to the specified torque.

Tighten:

Injection pump fixing nut to 25 N·m (2.6 kg·m / 19 lb·ft)

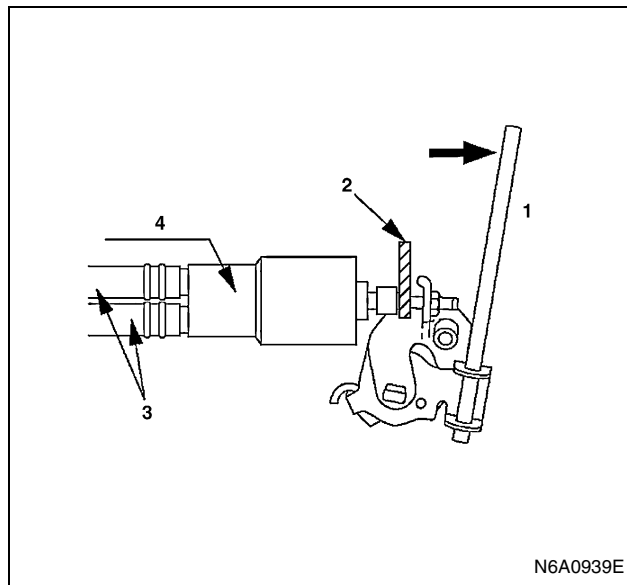
Notice:

If there are two marks on the crank pulley, the front side of mark is for setting BTDC 49° and the rear side of mark is for setting TDC.



Injection Timing Check (4HF1-2 model only)

1. Set No. 1 Cylinder to the TDC in the compression stroke.
2. Disconnect Injection Pipe.
3. Put down Wax CSD lever, insert a spacer 10 — 12 mm (0.39 — 0.47 in) thick between the plunger and adjust bolt, and cancel the Wax CSD.



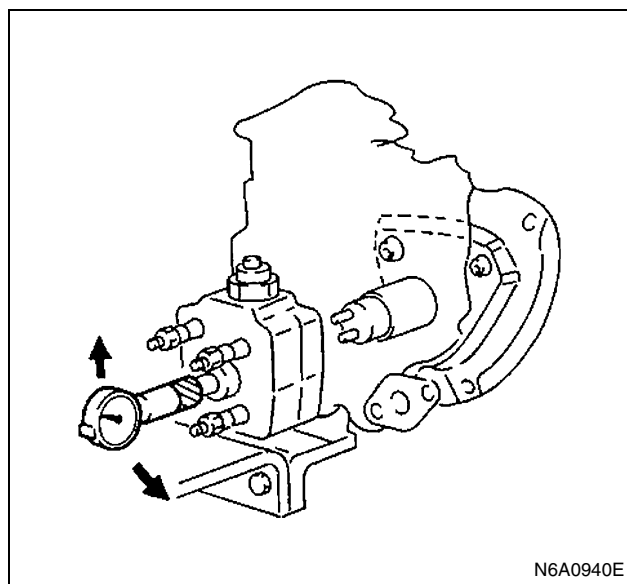
Legend

1. Lever
2. Spacer
3. Water hose
4. Wax CSD

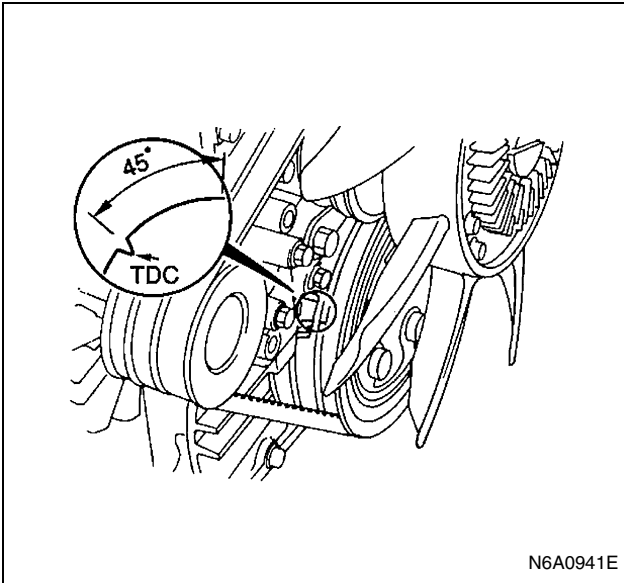
4. Remove the pump rear plug, connect a dial gage and set the lift at 1 mm (0.039 in).

Special Tool

Measuring device: 5-9940-0145-0



5. Set the crankshaft damper pulley TDC mark to the pointer or 45° before TDC.

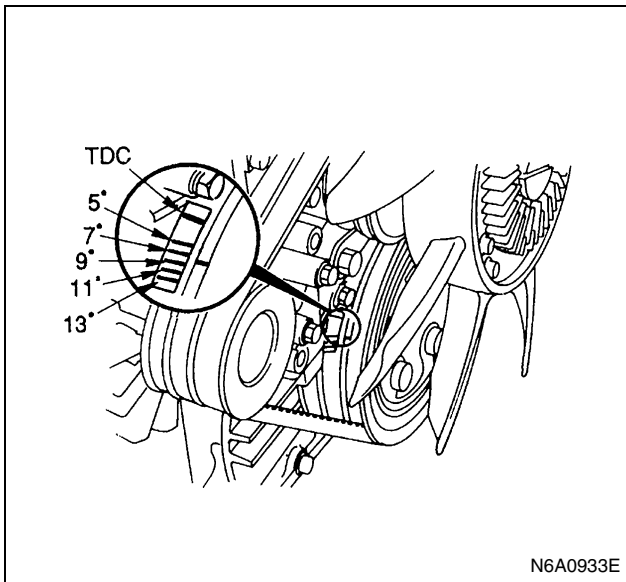


6. Set the dial gage to the "0" position.
7. Turn the crankshaft leftwise and rightwise a little and make sure that the needle stays in the "0" position.
8. Turn the crankshaft in the normal direction and read the measuring device's indication at the 12° before TDC position.

Notice:

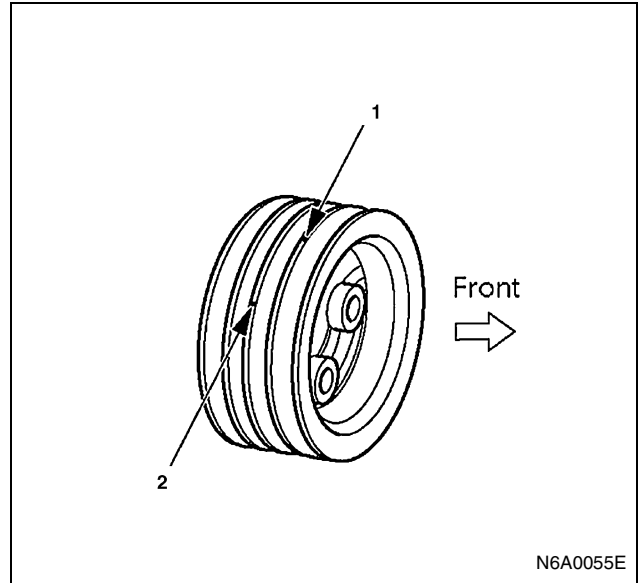
As there is no 12° mark, set midway between the 11° and 13° marks.

Standard value: 0.5 mm (0.0197 in)



Notice:

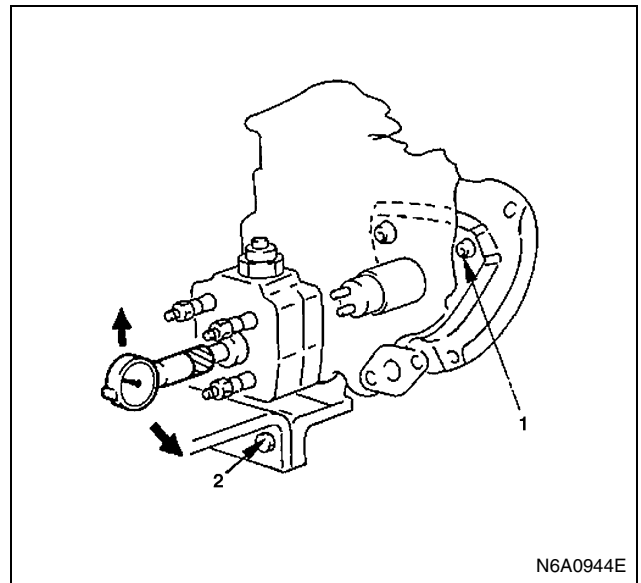
In case the crank pulley has two marks as illustrated, (1) BTDC 49° mark on the second crest and (2) TDC mark on the third crest (as viewed from the front side), be sure to set at the mark (2). (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.) The mark (1) is used when installing the injection pump for 4HF1-2.



Injection Timing Adjustment (4HF1-2 model only)

If injection timing is out of the specified range, follow the following procedure for adjustment:

1. Loosen injection pump fixing nuts (1) and bracket bolt (2).



2. Adjust the mounting angle of injection pump:
 - If injection timing is too fast, bring the injection pump closer to the engine.
 - If injection timing is too slow, put the injection pump more distant from the engine.
3. When the dial gage has indicated the specified value, tighten the fixing nuts and bolt to specified torque.

Tighten:

- Nut to 24 N·m (2.4 kg·m / 17 lb·ft)
- Bolt to 48 N·m (4.9 kg·m / 35 lb·ft)

6C-48 FUEL SYSTEM

4. Disconnect the dial gage, install and tighten the plug to specified torque. (Make sure of a copper washer being attached to the plug)

Tighten:

Plug to 17 N·m (1.7 kg·m / 12 lb·ft)

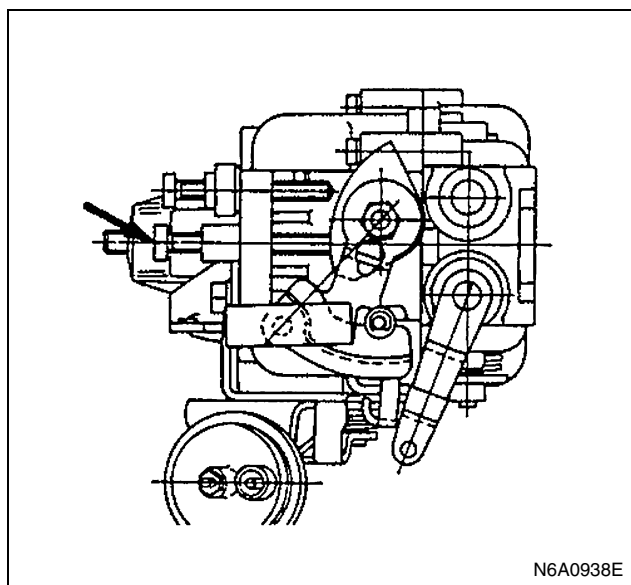
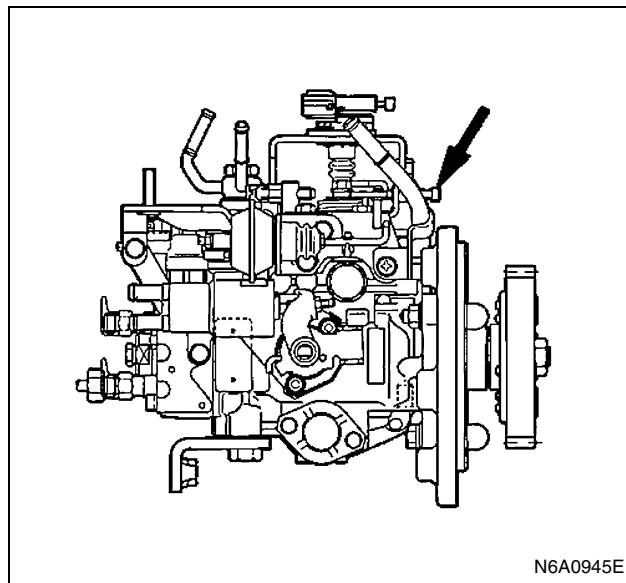
5. Release the wax CSD and connect the injection pipe.

Tighten:

Pipe sleeve nut to 29 N·m (3.0 kg·m / 22 lb·ft)

Idling Speed Adjustment (Except 4HF1-2 model)

1. Idling Rotation Check
 - 1) Idle the engine.
 - 2) Measure the number of the idling rotations with a tachometer.
 - 3) When the number of the idling rotations is outside the specified value, adjust it with the idling adjust bolt (arrow-marked).



Number of idling rotations:

550 — 600 rpm

(4HE1-TC)

775 — 825 rpm

Idling Speed Check & Adjustment (4HF1-2 model only)

1. Warm up the engine.
2. Measure idling speed by means of tachometer.
3. If idling speed is out of the standard, adjust with an idling adjust bolt (indicated by arrow mark).
Idling speed: 575 — 625 rpm

- ## Injection Volume Adjustment (4HF1 Engine)

Injection Volume and Governor Performance Diagram

Identification Numbers : 101401-7070/101401-7060

[4HF1 Engine]

Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm (0.1614 ± 0.0020 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 30'$) Plungers are numbered from the Governor side

Tapet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.
 : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

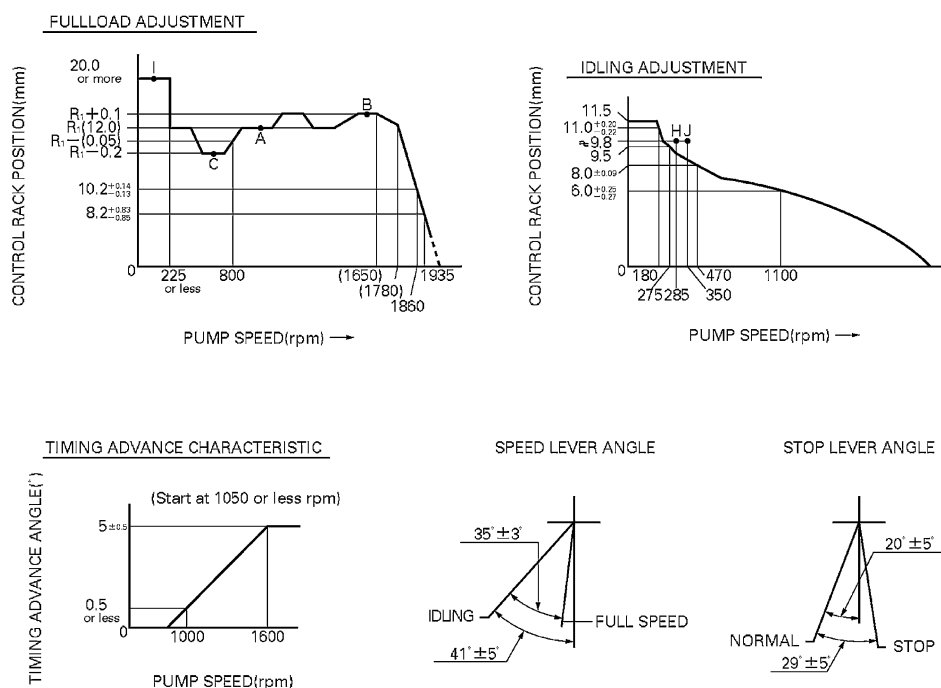
Injection Volume

Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	960	61 ± 1.6	± 4	Basic
H	285	16 ± 1.3	± 10.0	
A	960	61 ± 1	—	Basic
B	1,600	$(62) \pm 2$	—	
C	500	$(60.5) \pm 2$	—	
I	150	$(82)^{+16}_{-0}$	—	

Timing Advance Specification

Pump Speed (r.p.m.)	1,050 or less	1,000	1,600 or more
Degree for Angle of Lead (deg.)	Start	0.5 or less	Finish 5 ± 0.5

Governor Adjustment



Injection Volume and Governor Performance Diagram

Identification Numbers : 101401-7090

[4HF1 Engine]

Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm (0.1614 ± 0.0020 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 30'$) Plungers are numbered from the Governor side

Tappet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.
 : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

Injection Volume

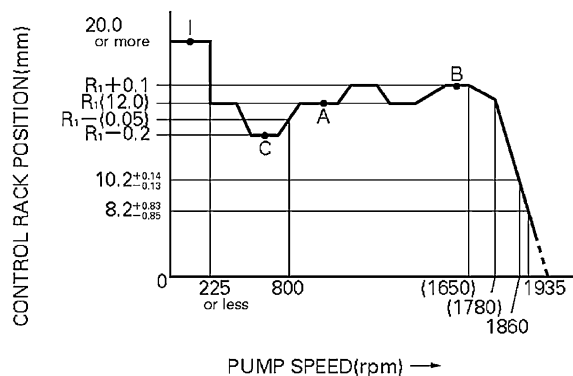
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	960	61 ± 1.6	± 4	Basic
H	285	16 ± 1.3	± 10.0	
A	960	61 ± 1	—	Basic
B	1,600	$(62) \pm 2$	—	
C	500	$(60.5) \pm 2$	—	
I	150	$(82)^{+16}_{-0}$	—	

Timing Advance Specification

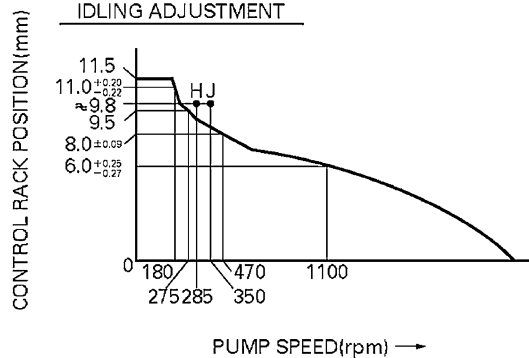
Pump Speed (r.p.m.)	1,050 or less	1,000	1,600 or more
Degree for Angle of Lead (deg.)	Start	0.5 or less	Finish 5 ± 0.5

Governor Adjustment

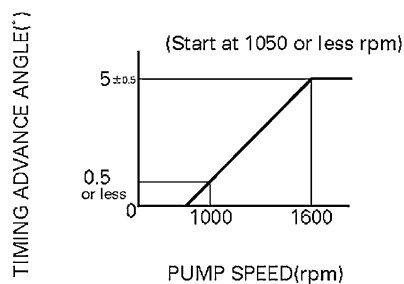
FULLLOAD ADJUSTMENT



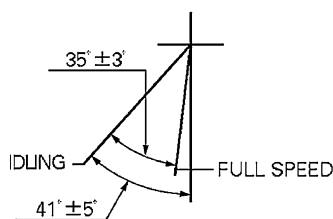
IDLING ADJUSTMENT



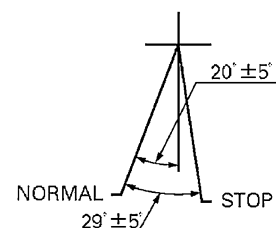
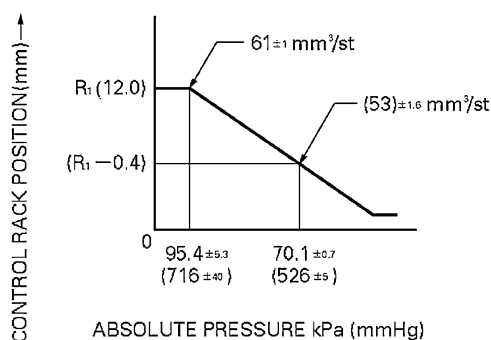
TIMING ADVANCE CHARACTERISTIC



SPEED LEVER ANGLE



STOP LEVER ANGLE

ANEROID COMPENSATOR PERFORMANCE
(CONTROL LEVER FULL SET POSITION 960 r/min)

Injection Volume and Governor Performance Diagram

Identification Numbers : 101401-7311

[4HF1 Engine]

Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm (0.1614 ± 0.0020 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 30'$) Plungers are numbered from the Governor side

Tappet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.

: Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

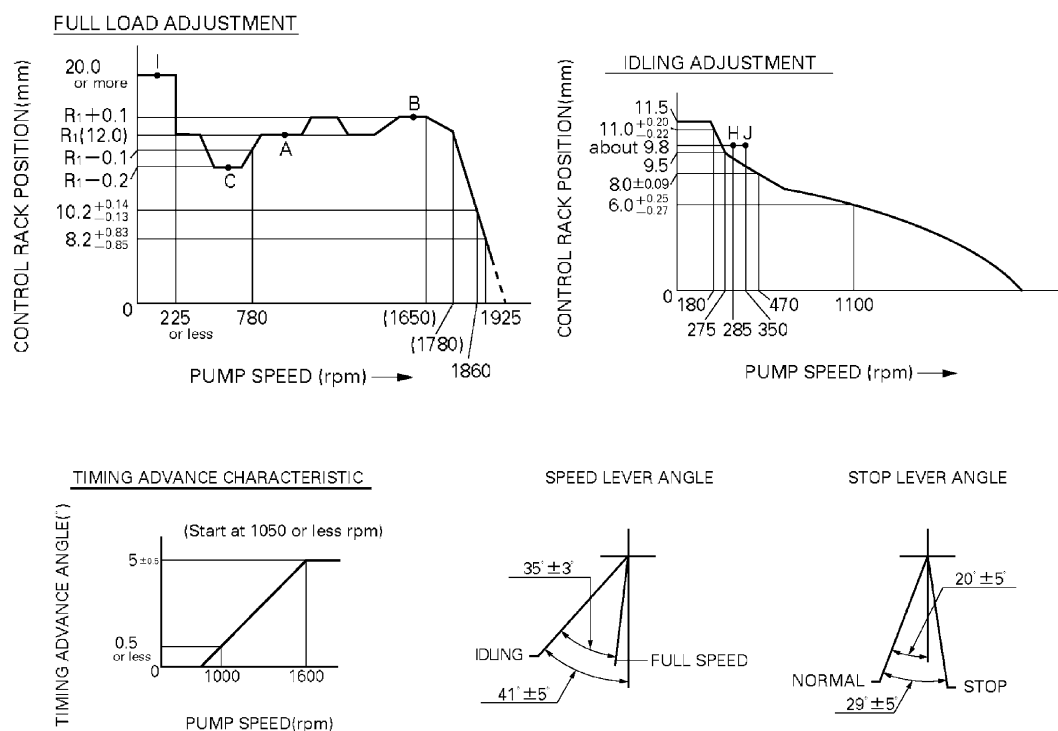
Injection Volume

Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	960	61 ± 1.6	± 4	Basic
H	285	16 ± 1.3	± 10.0	
A	960	65 ± 1	—	Basic
B	1,600	$(62) \pm 2$	—	
C	500	$(63.5) \pm 2$	—	
I	150	$(82)^{+16}_{-0}$	—	

Timing Advance Specification

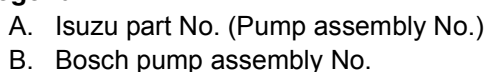
Pump Speed (r.p.m.)	1,000	1,600 or more
Degree for Angle of Lead (deg.)	0.5 or less	Finish 5 ± 0.5

Governor Adjustment



4HF1-2 (Bosch distributor type)

Use the data following the injection pump identification number to adjust the injection volume.



Injection Volume and Governor Performance Diagram

Identification Numbers : 104742-1630

[4HF1-2 Engine]

Pre-stroke : No. 1 plunger 0.45 ± 0.05 mm (0.0177 ± 0.0020 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 30'$) Plungers are numbered from the Governor side

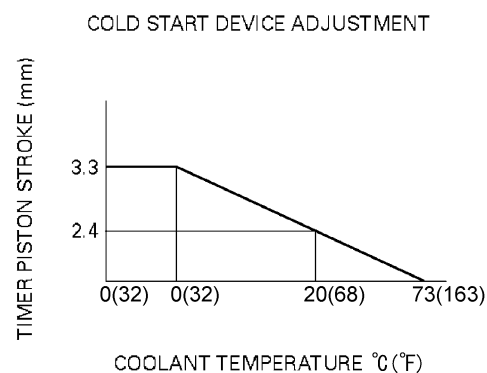
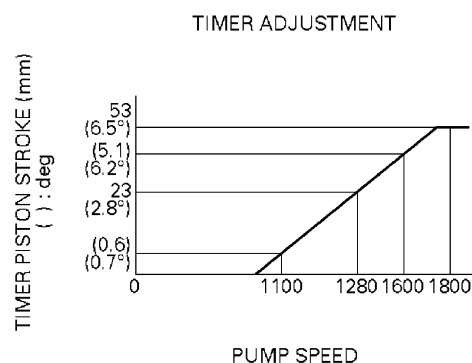
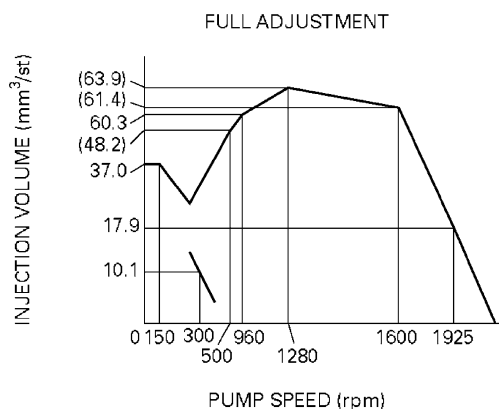
Injection volume

Pump speed (rpm)	Injection volume (mm ³ /strokes)	Uneven amplitude (mm ³ /strokes)	Oil temperature (°C (°F))	Remarks
500	48.2 ± 4.5	—	48 ± 2 (118 ± 36)	
960	60.3 ± 1.0	5.0	50 ± 2 (122 ± 36)	Basic
1280	63.9 ± 3.5	—	50 ± 2 (122 ± 36)	
1600	61.4 ± 4.5	—	50 ± 2 (122 ± 36)	
1925	17.9 ± 3.0	5.5	50 ± 2 (122 ± 36)	Basic
300	10.1 ± 2.0	2.0	48 ± 2 (118 ± 36)	Basic
150	37.0 ± 10	—	48 ± 2 (118 ± 36)	

Timing Advance Specification

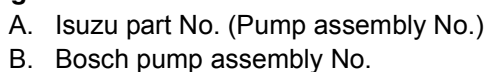
Pump Speed (r.p.m.)	1,100	1,280	1,600	1,800
Degree for Angle of Lead (deg.)	0.7	2.8	6.2	Finish 6.5

Governor Adjustment (4HF1-2)



4HG1 Engine

Use the data following the injection pump identification number to adjust the injection volume.



Injection Volume and Governor Performance Diagram

Identification Numbers : 101401-7430/101401-7440

[4HG1 Engine]

Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm (0.1614 ± 0.0020 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 30'$) Plungers are numbered from the Governor side

Tappet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.
 : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

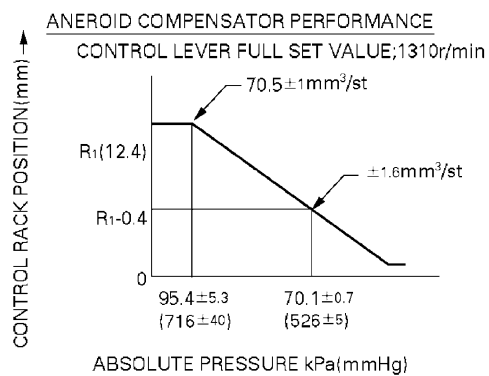
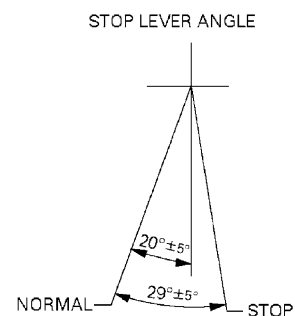
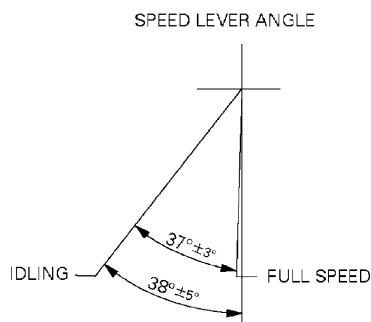
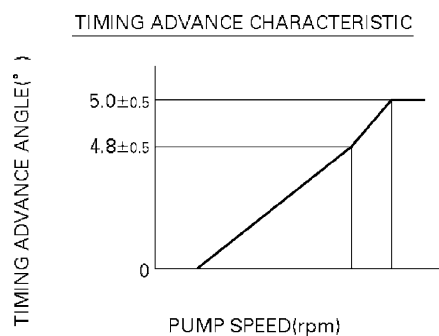
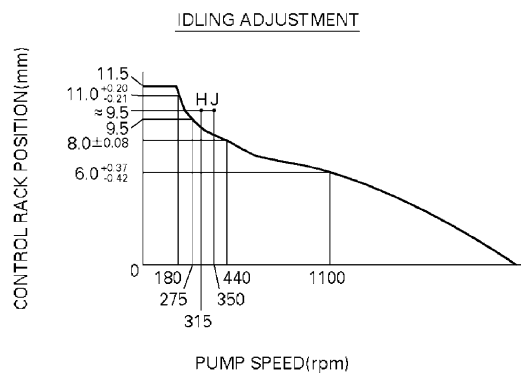
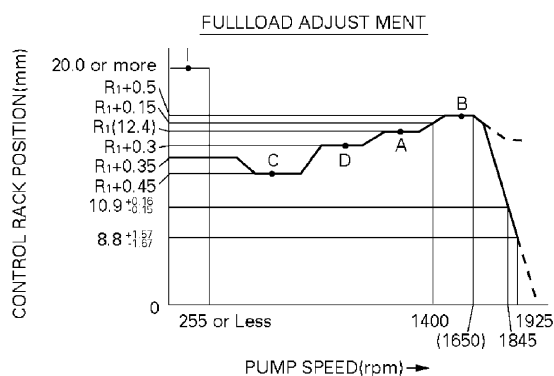
Injection Volume

Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	1,310	70.5 ± 1.6	± 4	Basic
H	315	10 ± 1.3	± 10.0	
A	1,310	70.5 ± 1	—	Basic
B	1,600	$(75.5) \pm 2$	—	
C	520	$(64) \pm 2$	—	
D	960	$(70.5)^{+2}_{-0}$	—	
I	150	$(95)^{+16}_{-0}$	—	

Timing Advance Specification

Pump Speed (r.p.m.)	1,050 or less	1,000	1,600 or more
Degree for Angle of Lead (deg.)	Start	0.5 or less	Finish 5 ± 0.5

Governor Adjustment



- A. Isuzu part No. (Pump assembly No.)
B. Bosch pump assembly No.

Injection Volume and Governor Performance Diagram

Identification Numbers : 101401-7452

[4HG1-T Engine]

Pre-stroke : No. 1 plunger 3.8 ± 0.05 mm (0.1496 ± 0.0020 in)Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 30'$) Plungers are numbered from the Governor side

Tappet clearance : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

: Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.

Injection Volume

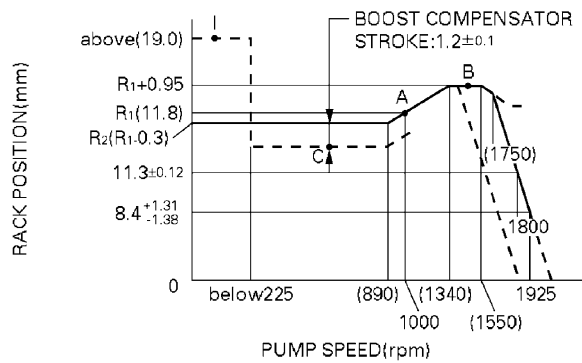
Adjusting point	Rack Position (mm (in))	Pump Speed (rpm)	Injection q'ty (cm ³ /1000strokes)	Max var bet. cyl. (%)	Fixed	Remarks
	11.5 (0.4528)	1000	73.5 ± 1.6	± 4	Rack	Basic
H	Approx. 8.9 (0.3504)	315	(Measure) ± 1.3	± 10	Rack	
A	R1 (11.5 (0.4528))	1000	73.5 ± 1	—	Lever	Basic Boost press. kPa (mmHg/psi) Above 62.0 (465/8.99)
B	R1 +1.0 (0.0394)	1500	(78.5) ± 2	—	Lever	Lever Boost press. kPa (mmHg/psi) Above 62.0 (465/8.99)
C	R2 -0.8 (0.0315)	500	(66.5) ± 2	—	Lever	Boost press. 0
I	—	150	(Measure) ± 16	—	Lever	Boost press. 0 Confirm that the timing of is advanced $1^\circ \pm 30'$ from A.

Timing Advance Specification

Pump speed (rpm)	Below (N1 + 50)	N1	N3
Advance angle (°)	Start	Below 0.5	Finish 4.0 ± 0.5

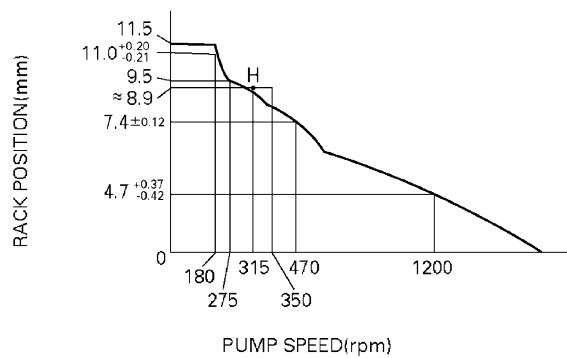
Governor Adjustment (4HG1-T)

FULL LOAD ADJUSTMENT

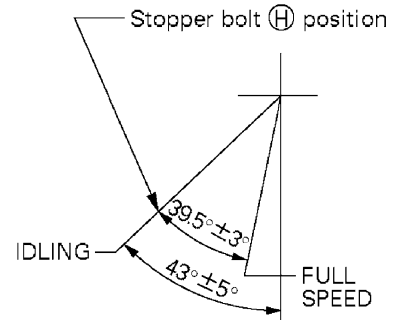


Confirm that $V_{ist} = 2.97 \pm 0.28$ at $N = 1500$, $R = R + 0.95$ at rack sensor voltage 5 ± 0.01 V.

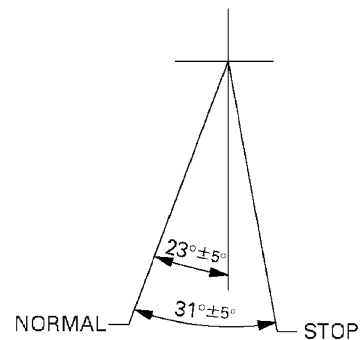
IDLING ADJUSTMENT



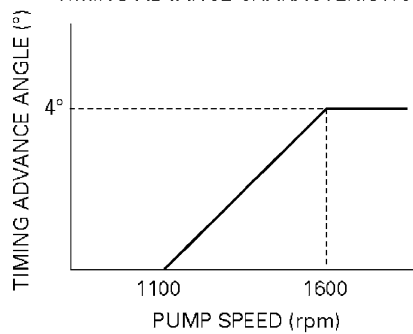
SPEED LEVER ANGLE



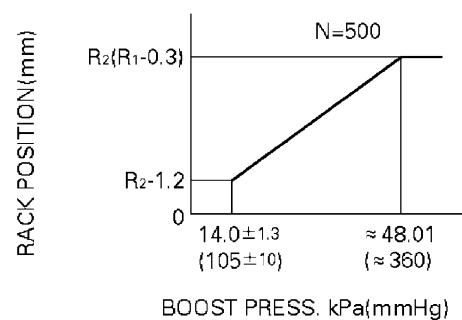
STOP LEVER ANGLE



TIMING ADVANCE CHARACTERISTIC



BOOST COMPENSATOR ADJUSTMENT



4HE1-TC Engine

Identification Plate and Number

1-1-1/P
 ASST NO. A

Valve Holder (Highten to
 27.1kg) (18.1kg) (18.1kg)

Minus (to Bottom of Connection
 4-4.5mm - kg

ZEXEL

PUMP NO. 101040-8510
 NP-PE31A95C412RS2000
 (LICENCE BOSCH)

A. Isuzu part No. (Pump assembly No.)
B. Bosch pump assembly No.

Injection Volume and Governor Performance Diagram

Identification Numbers : 107492-1110

[4HE1-TC Engine]

Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm (0.1575 ± 0.0012 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 15'$) Plungers are numbered from the Governor side

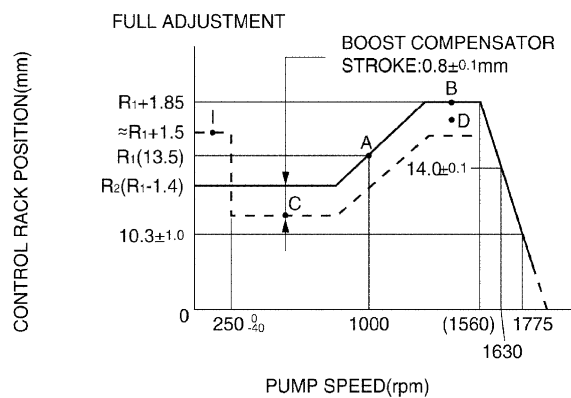
Tappet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.
 : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

Injection Volume

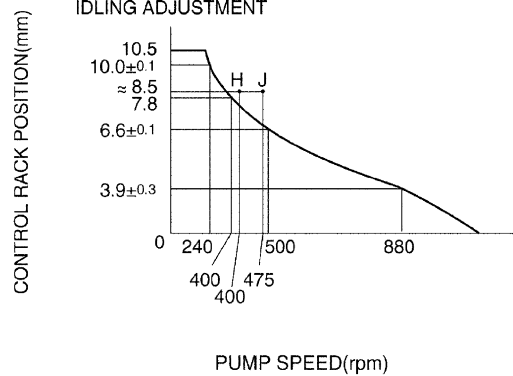
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/ 1000 strokes)	Variance (%)	Remarks
	1,000	82.5 ± 1.6	± 4	Basic
H	400	19 ± 1.5	± 14	
Z	500	—	—	
A	1,000	82.5 ± 1	—	Basic
B	1,450	92.5 ± 2	—	
C	500	67	—	
D	1,450	89.5	—	
I	150	220	—	

Governor Adjustment

GOVERNOR PERFORMANCE

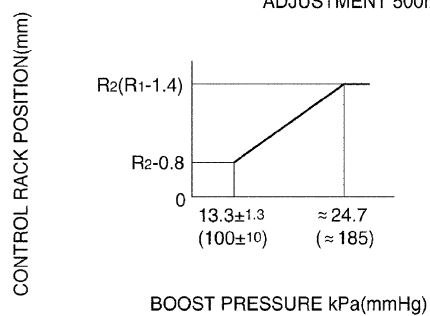


IDLING ADJUSTMENT



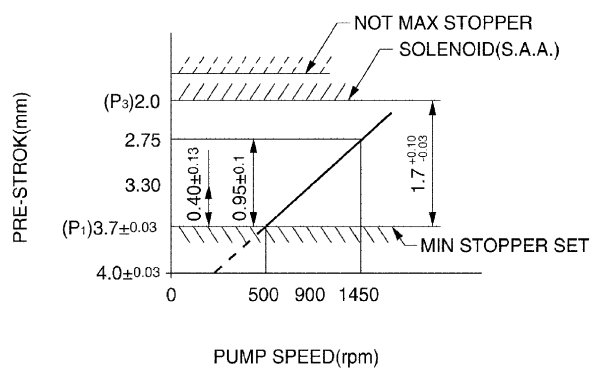
BOOST COMPENSATOR PERFORMANCE

ADJUSTMENT 500r/min

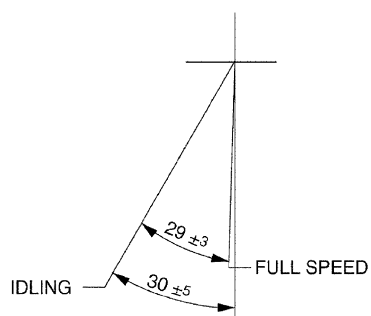


PRE-STROK PERFORMANCE

FULL SPEED LEVER SET



SPEED LEVER ANGLE



Injection Volume and Governor Performance Diagram

Identification Numbers : 107492-1023 / 107492-1100

[4HE1-TC Engine]

Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm (0.1575 ± 0.0012 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 15'$) Plungers are numbered from the Governor side

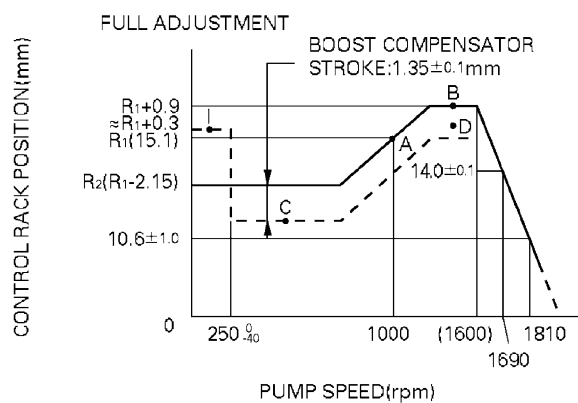
Tappet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.
 : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

Injection Volume

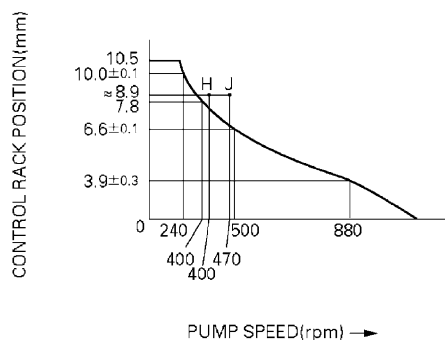
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/ 1000 strokes)	Variance (%)	Remarks
	1,000	107.5 ± 1.6	± 4	Basic
H	400	22 ± 1.5	± 10.0	
Z	510	—	—	Basic
A	1,000	107.5 ± 1	—	
B	1,200	112.5 ± 2	—	
C	500	(78)	—	
D	1,200	(103)	—	
I	150	(235)	—	

Governor Adjustment

GOVERNOR PERFORMANCE

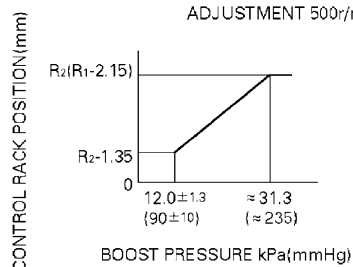


IDLING ADJUSTMENT

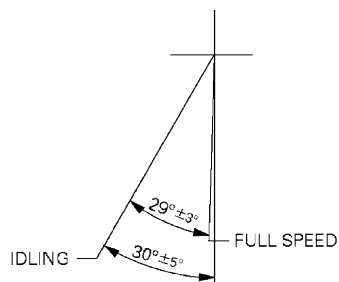


BOOST COMPENSATOR PERFORMANCE

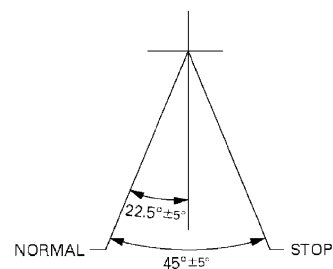
ADJUSTMENT 500r/min



SPEED LEVER ANGLE

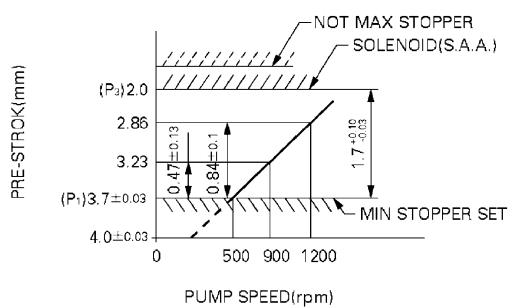


STOP LEVER ANGLE



PRE-STROKE PERFORMANCE

FULL SPEED



Injection Volume and Governor Performance Diagram

Identification Numbers : 107492-1062 / 107492-1120 / 897212-9350 (ISUZU NO.)

[4HE1-TC Engine]

Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm (0.1575 ± 0.0012 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 15'$) Plungers are numbered from the Governor side

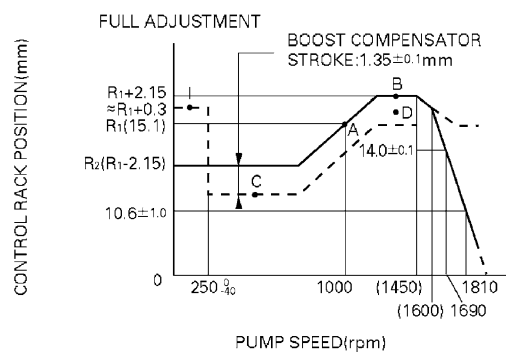
Tappet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.
 : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

Injection Volume

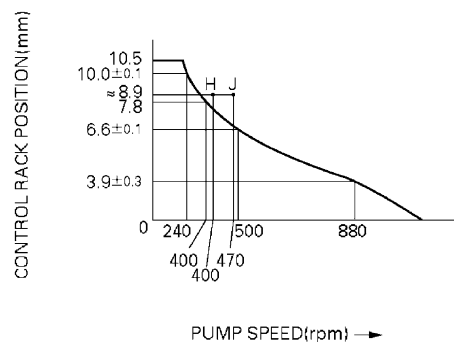
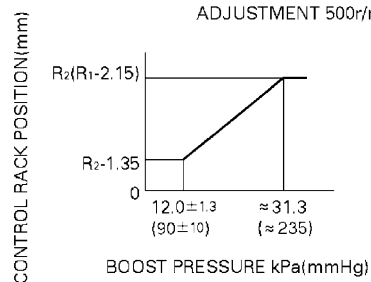
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/ 1000 strokes)	Variance (%)	Remarks
	1,000	107.5 ± 1.6	± 4	Basic
H	400	22 ± 1.5	± 14	
Z	510	—	—	Basic
A	1,000	107.5 ± 1	—	
B	1,400	121.5 ± 2	—	
C	500	78	—	
D	1,400	103	—	
I	150	235	—	

Governor Adjustment

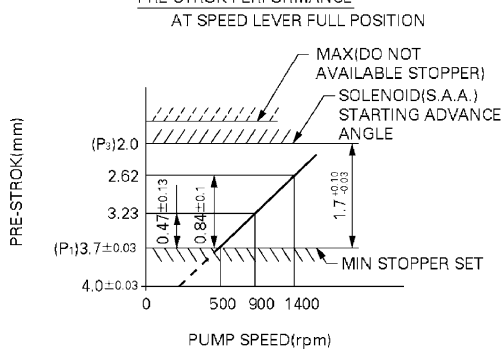
GOVERNOR PERFORMANCE



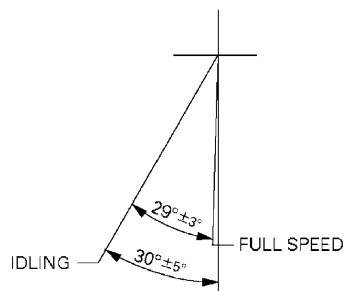
IDLING ADJUSTMENT

BOOST COMPENSATOR PERFORMANCE
ADJUSTMENT 500r/min

PRE-STROKE PERFORMANCE



SPEED LEVER ANGLE



Injection Volume and Governor Performance Diagram

Identification Numbers : 10749-1032 / 107492-1130

[4HE1-TC Engine]

Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm (0.1575 ± 0.0012 in)

Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 15'$) Plungers are numbered from the Governor side

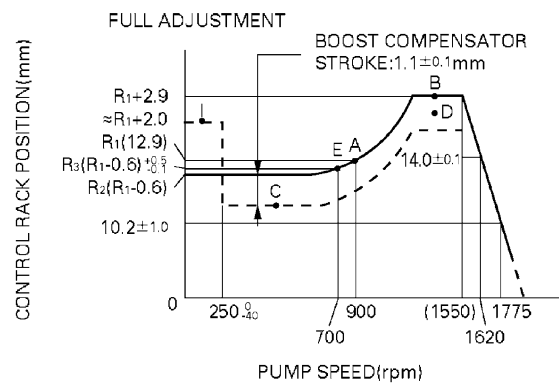
Tappet clearance : Bolt adjustment type : More than 0.3 mm (0.0118 in) for all cylinders.
 : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

Injection Volume

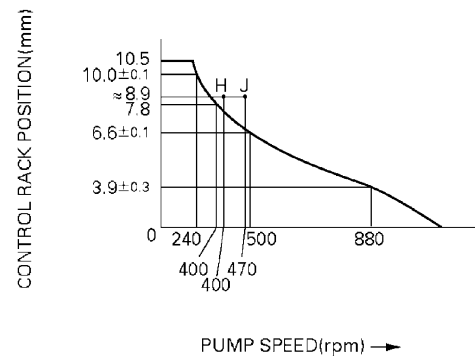
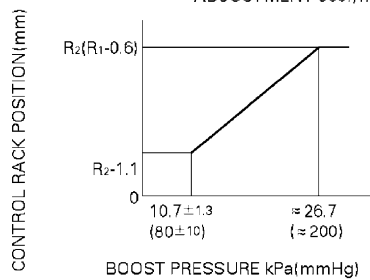
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/ 1000 strokes)	Variance (%)	Remarks
	900	78 ± 1.6	± 4	Basic
H	400	19 ± 1.5	± 14	
Z	500	—	—	Basic
A	900	78 ± 1	—	
B	1,450	89.5 ± 2	—	
C	500	67.5	—	
D	1,450	91.5	—	
E	700	78	—	
I	150	220	—	

Governor Adjustment

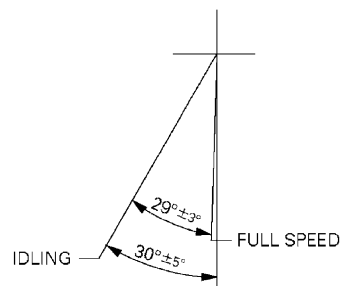
GOVERNOR PERFORMANCE



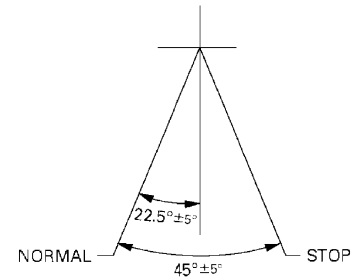
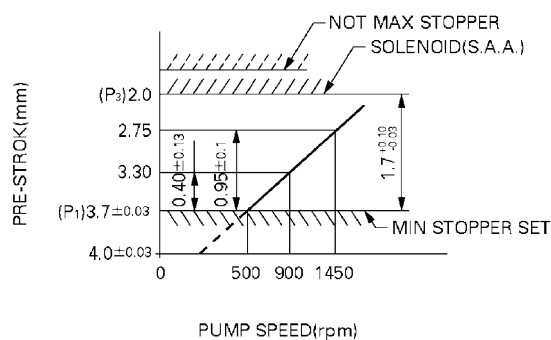
IDLING ADJUSTMENT

BOOST COMPENSATOR PERFORMANCE
ADJUSTMENT 500r/min

SPEED LEVER ANGLE



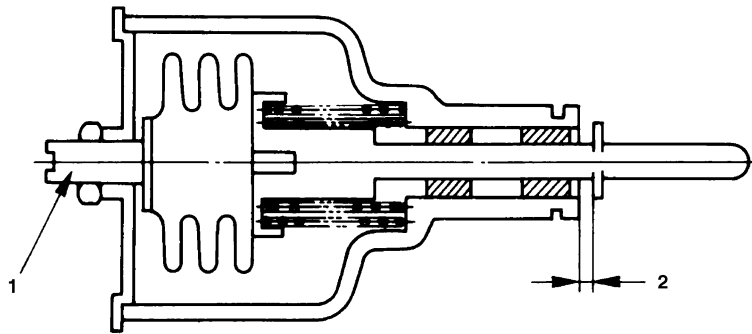
STOP LEVER ANGLE

PRE-STROKE PERFORMANCE
FULL SPEED LEVER SET

ANEROID COMPENSATOR ADJUSTMENT

Component

Adjust the aneroid kit



N6A0961E

Legend

1. Setting screw
2. Between 1.4 — 1.7 mm (0.055 — 0.067 in) at sea level (adjust by setting screw)

INJECTION VOLUME ADJUSTMENT

4HE1-TC (4HE1-XS) Engine for EURO3

Test Condition

Item	Condition
Injection nozzle and holder assembly	Bosch AS Part No.: 105118-6831
Injection nozzle	Bosch AS Part No.: 105017-2930
Nozzle holder	Bosch AS Part No.: 105048-4430
Injection nozzle opening pressure MPa (kg/cm ² / psi)	20.7 (211 / 3,000)
Injection line dimensions	
Inside diameter mm (in)	3.0 (0.118)
Outside diameter mm (in)	8.0 (0.315)
Length mm (in)	600 (23.6)
Fuel delivery pressure kPa (kg/cm ² / psi)	254.9 (2.6 / 36.97)
Test fuel	SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature °C (°F)	40 — 45 (104 — 113)
Identification numbers	107492-1162 897225-4322 (ISUZU No.)

Injection Timing

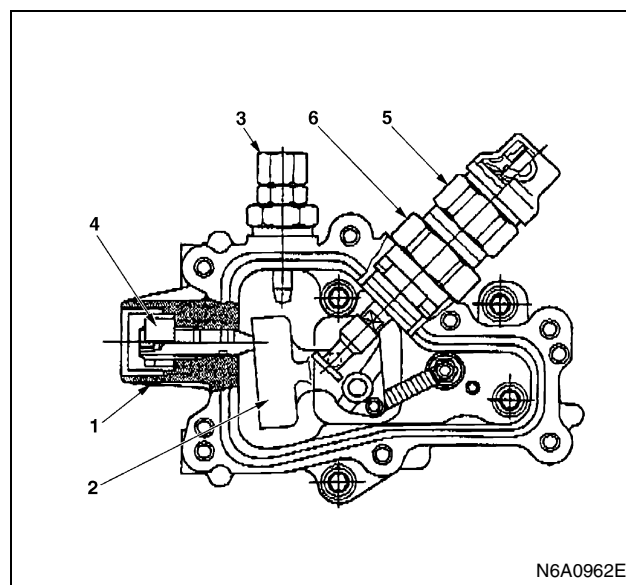
- Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm (0.1575 ± 0.0012 in)
- Injection order : 1 — 3 — 4 — 2 (interval $90^\circ \pm 15'$) Plungers are numbered from the Governor side
- Tappet clearance : Shim adjustment type : Manually rotate the camshaft 2 — 3 times and confirm that it rotates smoothly.

Injection Timing Adjustment

(Refer to the MITICS Repair and Maintenance Service Manual for adjustment details.)

Adjustment Preparation

1. Install setscrew (3) (P/N 157927-2820), screw (4) (P/N 157927-3321) and solenoid switch (5) into housing (1).
 - 1) Screw in setscrew (3) until the counterweight contacts the housing's pressfitted stopper pin.
 - 2) Tighten screw (4) until clearance between screw (4) and counterweight (2) is 1 — 2 mm (0.04 — 0.08 in).
 - 3) Tighten solenoid switch (5) until clearance between solenoid switch and counterweight (2)'s pin is 1 — 2 mm (0.04 — 0.08 in), then tighten locknut (6).



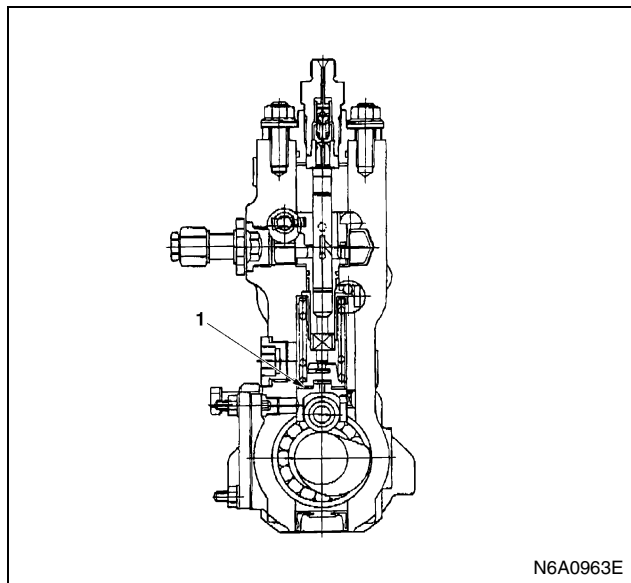
2. Install starting advance mechanism's cover.
3. Position control rack in full position.
4. Set power supply voltage to manual controller at 12V.

Pre-stroke adjustment

Adjust No.1 cylinder's start of static injection using the shim (1).

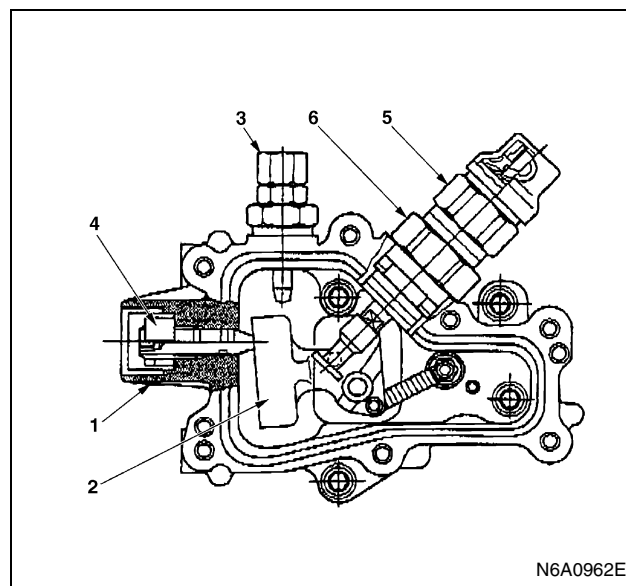
Individual cylinder's injection order adjustment

Adjust difference between each cylinder's injection angle based on that of the No.1 cylinder using the shim (1).

**Measuring pre-stroke output voltage**

1. Install the measuring device (P/N 105782-6420).
2. Remove the setscrew (3) (P/N 157927-2820) and install the air bleeder bolt.
3. Screw in screw (4) (P/N 157927-3321) and measure the No 1 cylinder's output voltage for pre-stroke lift values in the table below.

Adjusting point confirmation point	Pre-stroke (mm (in))	Output voltage (actual)	Remarks
a	3.70 (0.1457)	a1	+ tolerance
	3.44 (0.1354)	a2	- tolerance
b	3.24 (0.1276)	b1	+ tolerance
	3.04 (0.1197)	b2	- tolerance
(calculate form each specification)			

**Advice**

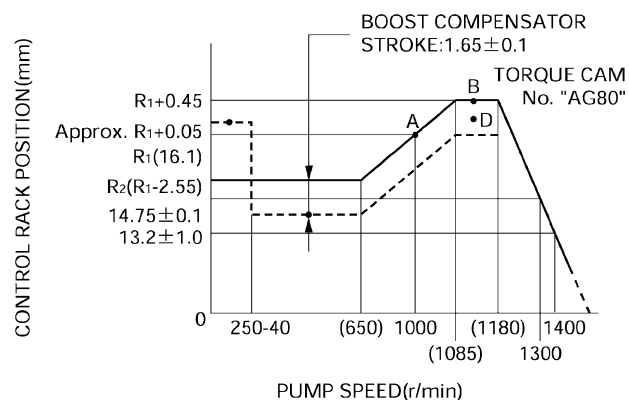
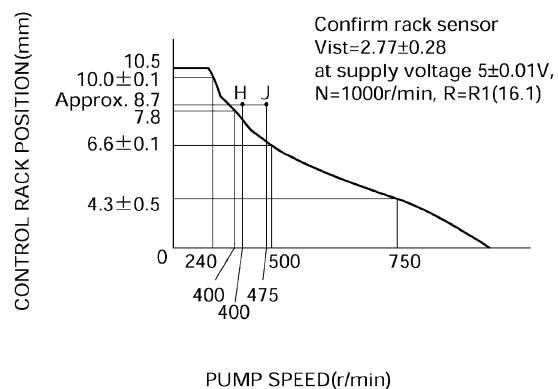
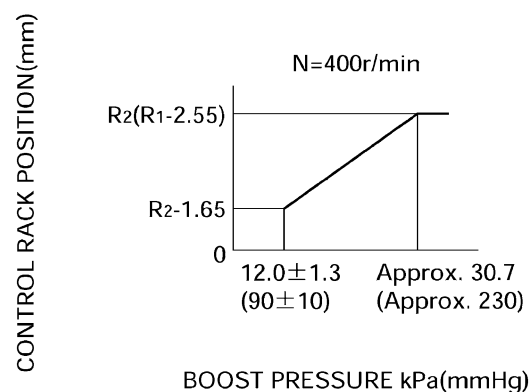
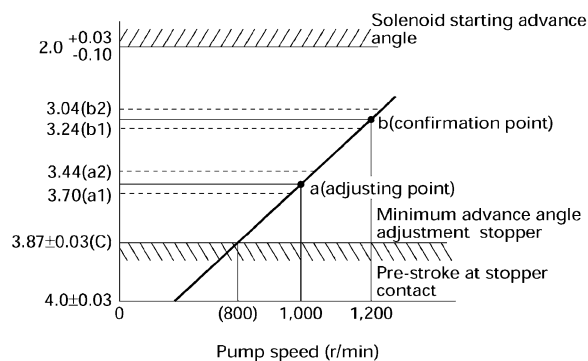
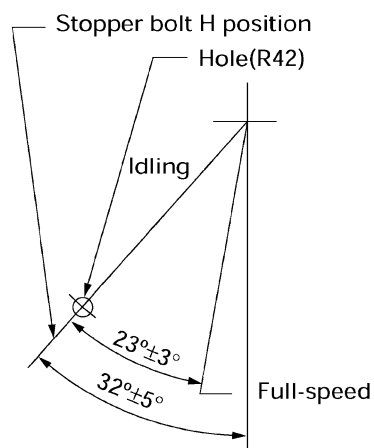
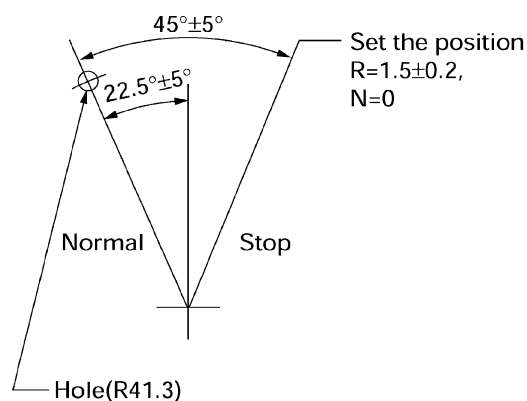
If measuring device (P/N 105782-6420) is removed, the output voltage (a1, a2) should be remeasured.

Minimum advance angle adjustment stopper adjustment

1. Remove the screw (4) (P/N 157927-3321) and install minimum advance angle adjustment stopper.
2. Screw in minimum advance angle adjustment stopper until No 1 cylinder's pre-stroke is 3.84 — 3.90 mm (0.1512 — 0.1535 in). Then, tighten locknut to specified torque.
3. Measure the output voltage (c) at this time.

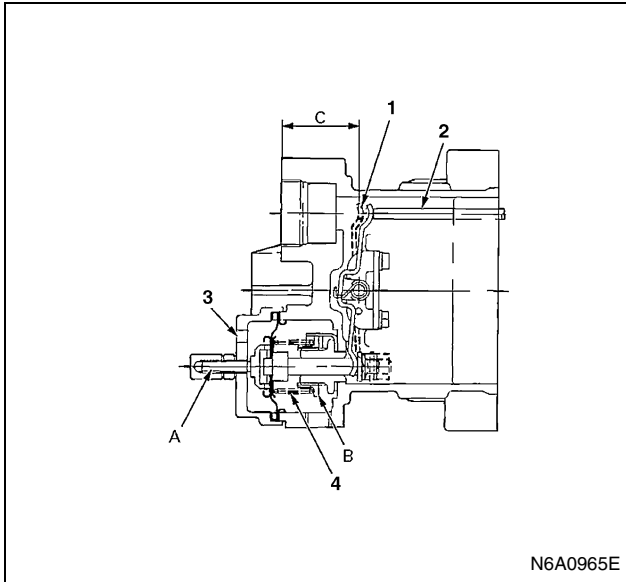
Solenoid switch adjustment

1. Apply 24 V voltage to solenoid switch (5).
2. Loosen solenoid switch (5) until No 1 cylinder's pre-stroke is 1.90 — 2.03 mm (0.0748 — 0.0799 in), then tighten the locknut to the specified torque.
3. Confirm solenoid switch operates at 14.5 — 0.1 V.

Governor Adjustment**Governor adjustment**FULL ROAD ADJUSTMENTIDLING ADJUSTMENTBOOST COMPENSATOR PERFORMANCEPre-stroke (Pre-stroke output voltage)Speed control lever angleStop lever angle

Boost compensator adjustment

1. Select a push rod so (C) = 37.5 ± 0.5 mm (1.48 ± 0.02 in) at full boost pressure. ((C) is the distance from the end face of the housing to top of the lever.)
2. Adjust the boost compensator stroke using screw (A). (0 boost pressure position adjustment)
Adjust the beginning of boost compensator operation by adjusting the notch adjusting nut (B).

**Legend**

1. Top of lever
2. Push rod
3. Boost pressure inlet
4. Boost compensator spring

Timing cam adjustment (Timing cam No: 510)

1. Hold speed control lever against full speed stopper bolt.
2. Supply boost pressure of at least 44.0 kPa (330 mmHg/6.38 psi)
3. Operate pump at the timing cam adjusting point (point a table below: $N_p = 1,000$ r/min).
4. Perform timing cam adjustment so output voltage is within range of a1 — a2 actually measured for pore-stroke output voltage during injection timing adjustment in 3 — 4.

Adjusting point	Pre-stroke (mm (in))	Output voltage (actual)	Remarks
a	3.70 (0.1457)	a1	+ tolerance
	3.44 (0.1354)	a2	– tolerance

5. Operate the pump at the timing cam confirmation point.
(point b in table below: $N_p = 1,200$ r/min)

6. Confirm that the pre-stroke output voltage is within the range b1 — b2.

Confirmation point	Pre-stroke (mm (in))	Output voltage (actual)	Remarks
b	3.24 (0.1276)	b1	+ tolerance
	3.04 (0.1197)	b2	– tolerance

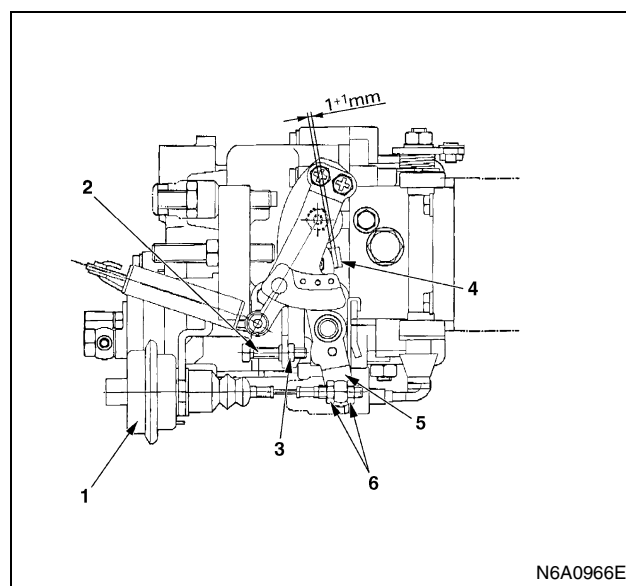
Injection Quantity

Adjust- ing point	Rack position (mm (in))	Pump speed (r/min)	Injection q'ty (cm ³ /1,000 strokes)	Max. variation between cylinders	Fixed	Pre-stroke at adjust- ment	Remarks	
—	16.1 (0.6339)	1,000	124±1.6	±4	Rack	a1 — a2 (v)	Basic	Cylinder variation adjust- ment standard
Z	8.7±0.5 (0.3425± 0.0197)	585	14±1.5	±14	Rack	c (v)		Cylinder variation adjust- ment standard
A	R1 (16.1 (0.6339))	1,000	124±1	—	Lever	a1 — a2 (v)	Basic	Boost press. kPa (mmHg/ psi) Above 44.0 (330/6.38)
B	R1+0.45 (0.0177)	1,150	123.5±2	—	Lever	Measure		Boost press. kPa (mmHg/ psi) Above 44.0 (330/6.38)
D*	16.15±0.1 (0.6358± 0.0039)	1,150	—	—	Lever	Measure		Boost press. kPa (mmHg/ psi) Above 44.0 (330/6.38) Negative press. kPa (mmHg/psi) 53.3 (400/7.73)

D*: Aneroid compensator actuator adjustment point

FICD Adjustment

1. Stop the injection pump.
2. Hold speed control lever against idling stopper bolt.
3. Adjust clearance between FICD actuator lever and speed control lever to approx. 1+1 mm (0.0394+0.0394 in).
4. Loosen nut (3) and fully tighten FICD set bolt (2).
5. Apply 53.3 kPa (400 mmHg/7.73 psi) negative pressure to the actuator (1) and set the pump speed at 450 r/min.
6. Gradually loosen set bolt (2) then fix bolt using nut when the rack position is 8.1±0.1 mm (0.3189±0.0039 in).
7. Apply above negative pressure several times and confirm FICD actuator is operating properly and clearance between FICD actuator lever and speed control lever.



N6A0966E

Legend

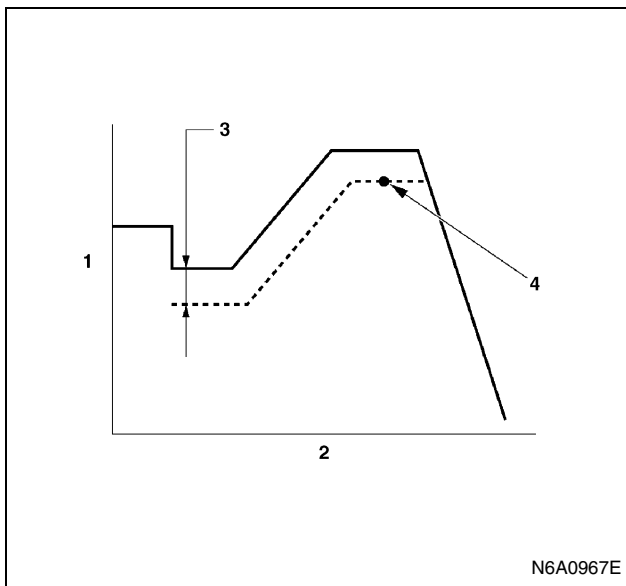
1. Actuator
2. Set bolt
3. Nut
4. Speed control lever
5. FICD actuator lever
6. Tightening torque 5 — 7 N·m (0.5 — 0.7 kg·m/
3.7 — 5.2 lb·ft)

Aneroid Compensator Actuator Adjustment (Injection Quantity Decrease)

Notice:

Set this actuator after adjusting the full rack position.

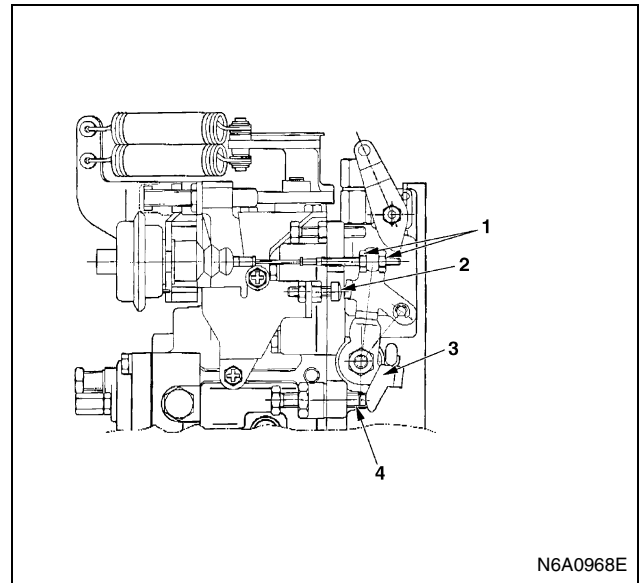
1. Stop injection pump.
2. Adjust wire nut so full load set lever contacts full load set bolt and aneroid compensator actuator wire is not loose. Then, fix the nut.
3. Apply 53.3 kPa (400 mmHg/7.73 psi) negative pressure to aneroid compensator, set pump speed at 1,150 r/min.



Legend

1. Rack position (mm)
2. Pump speed (r/min)
3. Stroke
4. Injection quantity decrease adjustment point

4. Apply at least 44.0 kPa (330 mmHg/6.38 psi) boost pressure to the boost compensator.
5. After operating full load set lever, adjust aneroid compensator set bolt so control rack position is 16.15 ± 0.1 mm (0.6358 ± 0.0039 in) and fuel injection quantity is as specified. Then, fix the set bolt.

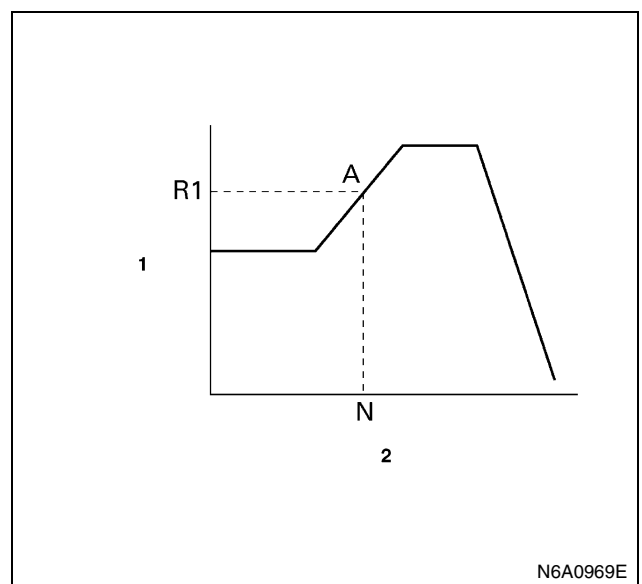


Legend

1. Nut
2. Set bolt
3. Full load set lever
4. Full load set bolt

Rack Sensor Adjustment

1. Before removing rack position measuring device, apply at least 44.0 kPa (330 mmHg/6.38 psi) boost pressure and confirm rack position is $R1 = 16.1$ mm and fuel injection quantity is 124 ± 1 mm³/st at $N = 1,000$ r/min.



Legend

1. Rack position (mm)
2. Pump speed (r/min)

2. Remove the rack position measuring device.
3. Attach the rack sensor core to the control rack.

6C-78 FUEL SYSTEM

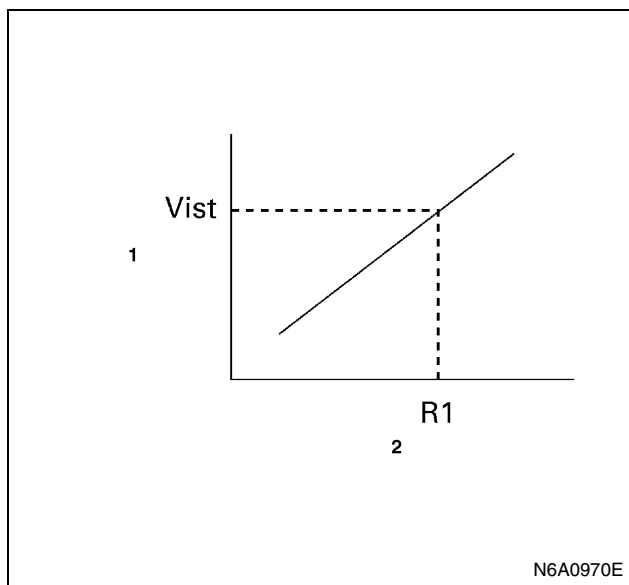
At this time, hold control rack using a spanner (to prevent the rack from bending).

Specified torque: 3.4 — 4.9 N·m (0.35 — 0.5 kg·m/2.5 — 3.6 lb·ft)

4. While pulling stop lever, install rack sensor to rack sensor core.
5. Tighten the two flange fixing screws.

Specified torque: 6.9 — 8.8 N·m (0.7 — 0.9 kg·m/5.1 — 6.5 lb·ft)

6. Connect the rack sensor wire harness to constant voltage power supply and digital voltmeter.
7. Turn constant voltage power supply power switch ON and set it to DC $5 \pm 0.01V$.
8. Apply at least 44.0 kPa (330 mmHg/6.38 psi) boost pressure, set pump speed at $N = 1,000$ r/min, and hold speed control lever against the full speed stopper bolt.
9. Confirm the rack sensor output voltage from the digital voltmeter. ($V_{ist} = 2.77 \pm 0.28V$)
10. Confirm that the voltage changes when the speed control lever is moved to the idle and full sides.

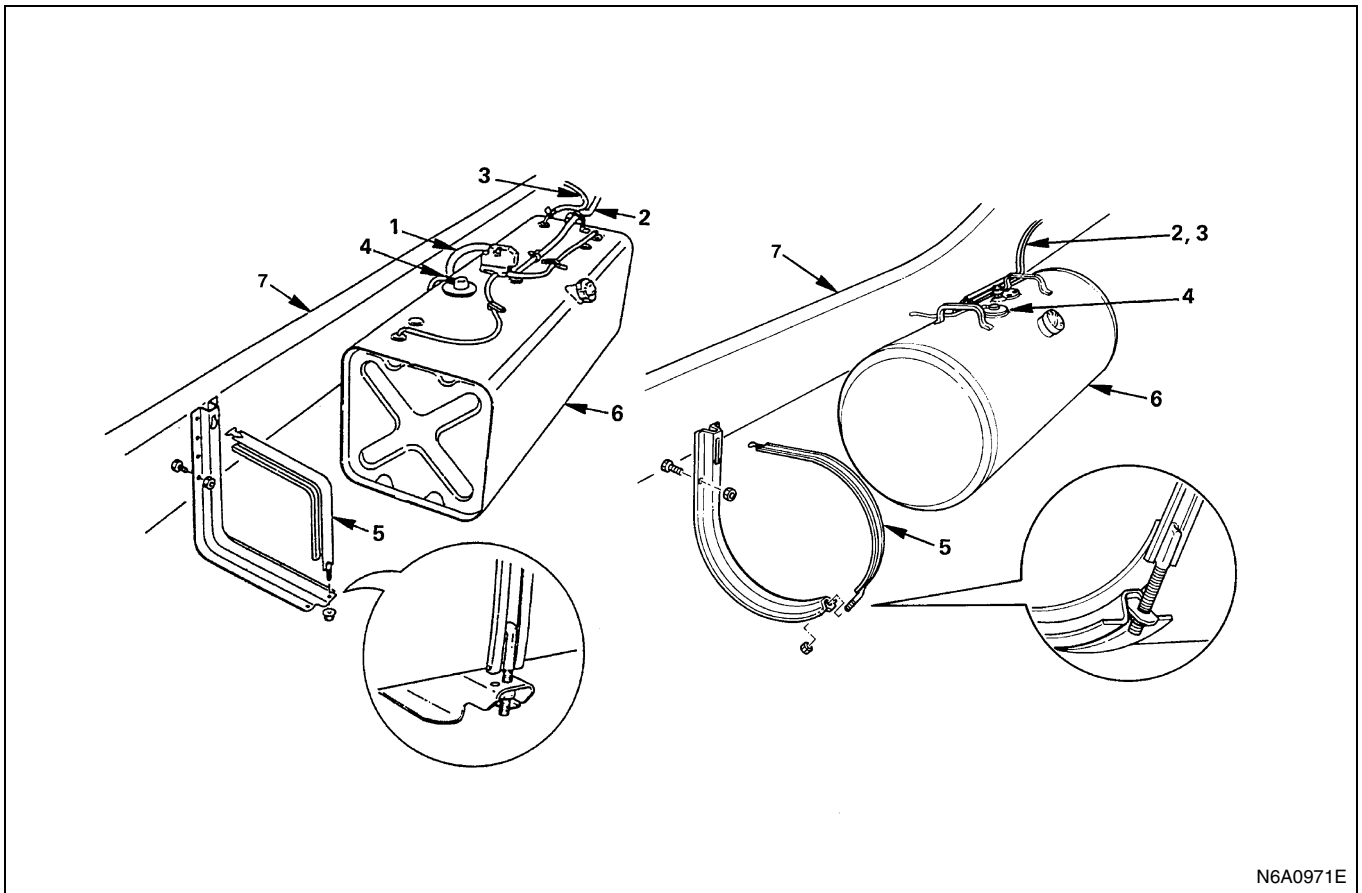


Legend

1. Sensor output voltage (V)
 2. Rack position (mm)
-

FUEL TANK

Component



N6A0971E

Legend

- | | |
|------------------------------|--------------|
| 1. Evapo fuel hose | 5. Band |
| 2. Fuel feed hose | 6. Fuel tank |
| 3. Fuel return hose | 7. Frame |
| 4. Fuel gauge unit connector | |

Removal

Preparation

- Disconnect the battery ground cable.
- Loosen the fuel filler cap.
- Drain fuel from drain plug.
- After the drain fuel, tighten the drain plug to the specified torque.

Tighten:

Drain plug to 29 N·m (3 kg·m / 22 lb·ft)

1. Evapo Fuel Hose
2. Fuel Feed Hose
3. Fuel Return Hose
 - Plugging the return hose to prevent fuel from getting spilt, tie it to the fame with the plugged end up.
4. Fuel Gauge Unit Connector

5. Band
 - Remove the nut of the fuel tank fixing band, and then remove the band end on the frame side.
6. Fuel Tank
 - Pull out the fuel tank to the outside.

Notice:

When it is not possible to pull out the fuel tank, remove the bracket and then draw out the fuel tank downward.

Installation

1. Fuel Tank

Notice:

When the bracket was removed to take off the fuel tank, install the bracket to the frame and tighten it to the specified torque.

6C-80 FUEL SYSTEM

Tighten:

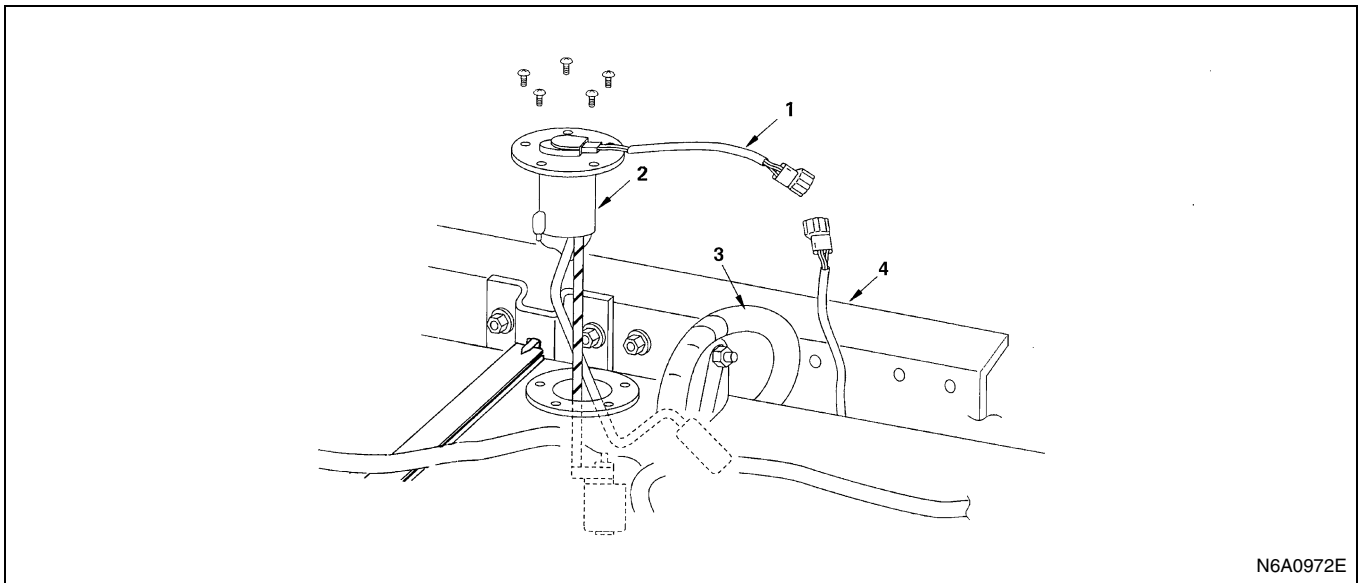
Fuel tank bracket to 55 N·m (5.6 kg·m / 41 lb·ft)

Also, when mounting the fuel tank to the bracket, place the packing section attached to the fuel tank securely on the bracket.

2. Band
 - Tighten the band to 12 N·m (1.2 kg·m / 104 lb·in)
3. Fuel Gauge Unit Connector
 - Connect the fuel gauge unit connector.
4. Fuel Return Hose
5. Fuel Feed Hose
 - Set the hose to the pipe more than 25 mm (0.98 in) deep.
6. Evapo Fuel Hose
 - Fill the fuel to the fuel tank.
 - Connect battery ground cable.

FUEL GAUGE UNIT

Component



Legend

- | | |
|------------------------------|--------------------|
| 1. Fuel gauge unit connector | 3. Evapo fuel hose |
| 2. Fuel gauge unit | 4. Frame |

Removal

Preparation

Disconnect the Battery ground cable.

1. Fuel Gauge Unit Connector
 - Disconnect the fuel gauge unit connector from the fuel gauge unit.
2. Fuel Gauge Unit
 - Remove the fuel gauge unit fixing screw and fuel gauge unit.

Notice:

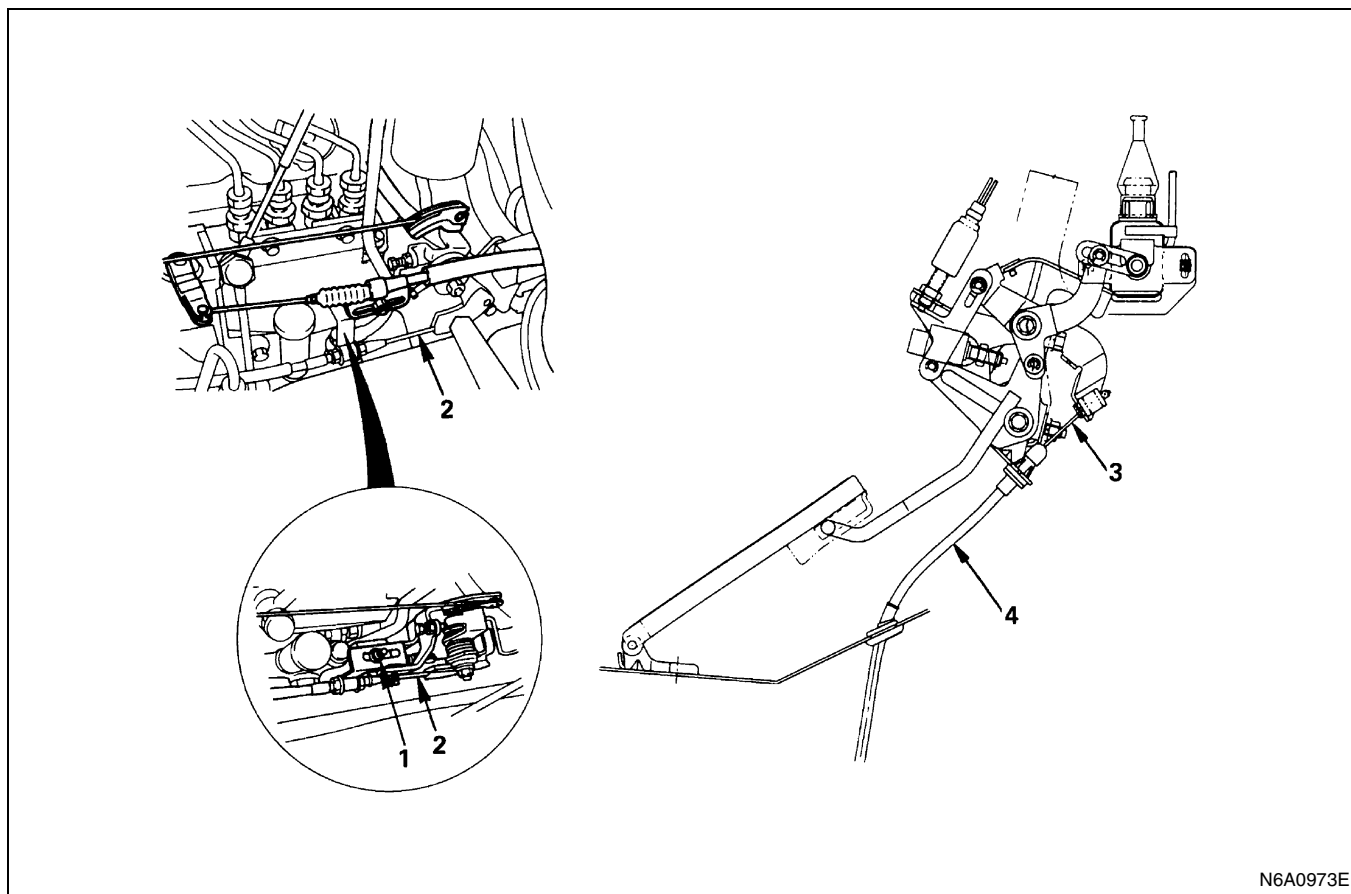
After removing fuel gauge unit, cover fuel tank with waste to prevent any dust entering

Installation

1. Fuel Gauge Unit
2. Fuel Gauge Unit Connector
 - Connect the wiring connector to the fuel gauge unit.

ACCELERATOR CONTROL CABLE

Component



Legend

- | | |
|---|--|
| 1. Adjust nut | 3. Accelerator control wire (Accelerator pedal side) |
| 2. Accelerator control wire (Injection pump side) | 4. Accelerator control cable |

Removal

1. Adjust Nut
 - Loosen the adjust nut on the cable bracket mounted.
2. Accelerator Control Wire (Injection pump side)
 - Remove the control wire from injection pump control lever.
3. Accelerator Control Wire (Accelerator pedal side)
 - Remove the Accelerator control wire from accelerator pedal.
4. Accelerator Control Cable
 - Pull out the wire to the chassis side through the grommet hole of the floor board, and remove the control cable.

Inspection

Check the following items, and replace the control cable if any abnormality is found.

- The control cable should move smoothly.

- The control cable should not be bent or kinked.
- The control cable should be free of damage and corrosion.

Installation

1. Accelerator Control Cable
 - Take care that the core wire of the cable does not get damaged or indented.
 - Put the cable through the grommet hole from under the floor.
 - Set the groove of the grommet securely into the floor panel.
2. Accelerator Control Wire (Accelerator Pedal side)
 - Connect the accelerator control wire to Accelerator pedal.
3. Cable Clips
 - Install the cable clip to chassis frame.
 - Tighten the cable clips to 16 N·m (1.6 kg·m / 12 lb·ft)
4. Accelerator Control Wire

5. Adjust Nut

- Attach the end tip of the wire to the engine control lever.
- Pull the outer cable gently toward the front of the vehicle, and provide the engine control wire and the accelerator control wire an appropriate play before fastening the clamp with a nut.

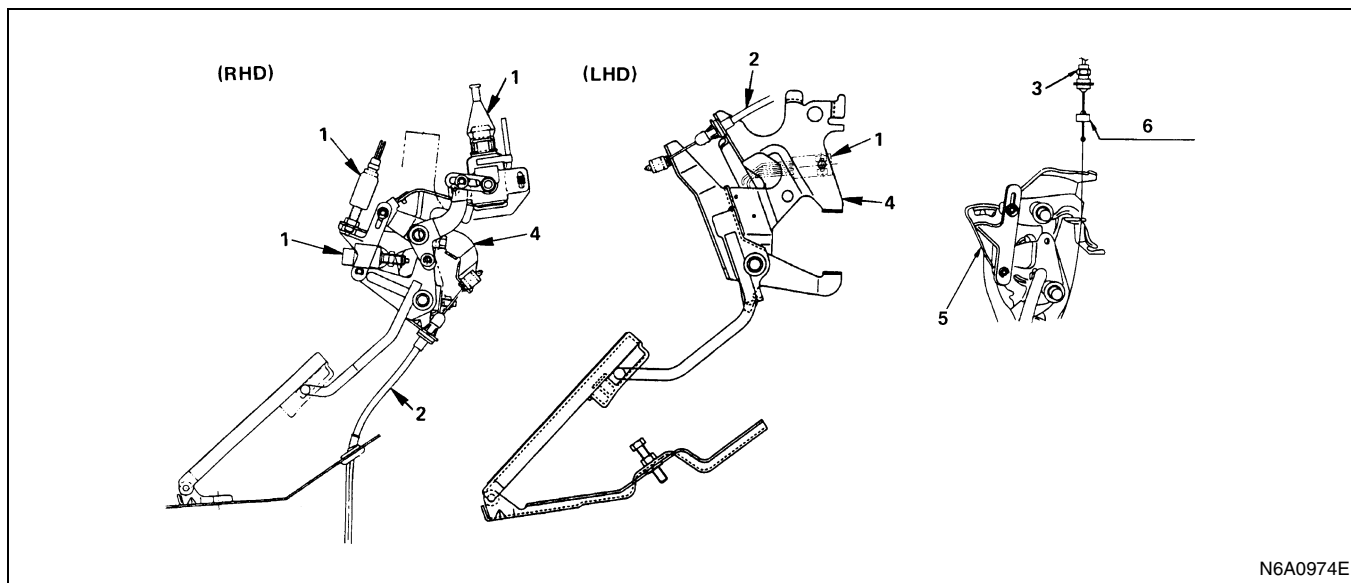
Tighten:

Nut to 8 N·m (0.8 kg·m /69 lb·in)

- Check to see if the injection pump lever is at the idle position (with the lever in touch with the stopper bolt).
- Connect the battery ground cable.
- Check to see if the accelerator pedal fully is in the range of 5 — 10 mm (0.2 — 0.4 in) above the pedal pad.
- Press down on the accelerator pedal fully, and check to see if the engine rotates at the maximum speed with the linkage in the smooth operation.
- In the operating range of the accelerator pedal, check to see if the accelerator pedal and the injection pump lever return without fail to the original positions.

ACCELERATOR PEDAL

Component



Legend

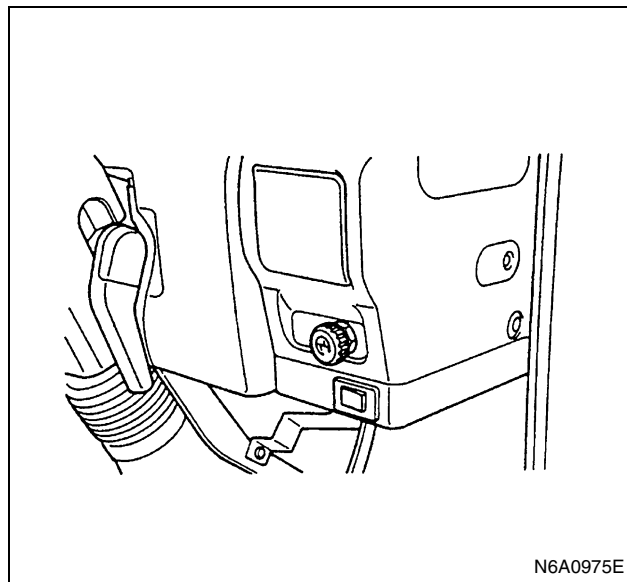
- | | |
|------------------------------|-------------------------------|
| 1. Switch connector | 4. Accelerator pedal assembly |
| 2. Accelerator control cable | 5. Accelerator pedal bracket |
| 3. Idling control cable | 6. Wire guide |

Removal

1. Switch Connector
2. Accelerator Control Cable.
 - Remove control cable from Accelerator pedal bracket.
3. Idling Control Cable
 - Remove control cable from accelerator pedal bracket.
4. Accelerator Pedal Assembly
 - Remove accelerator pedal assembly from brake pedal bracket.

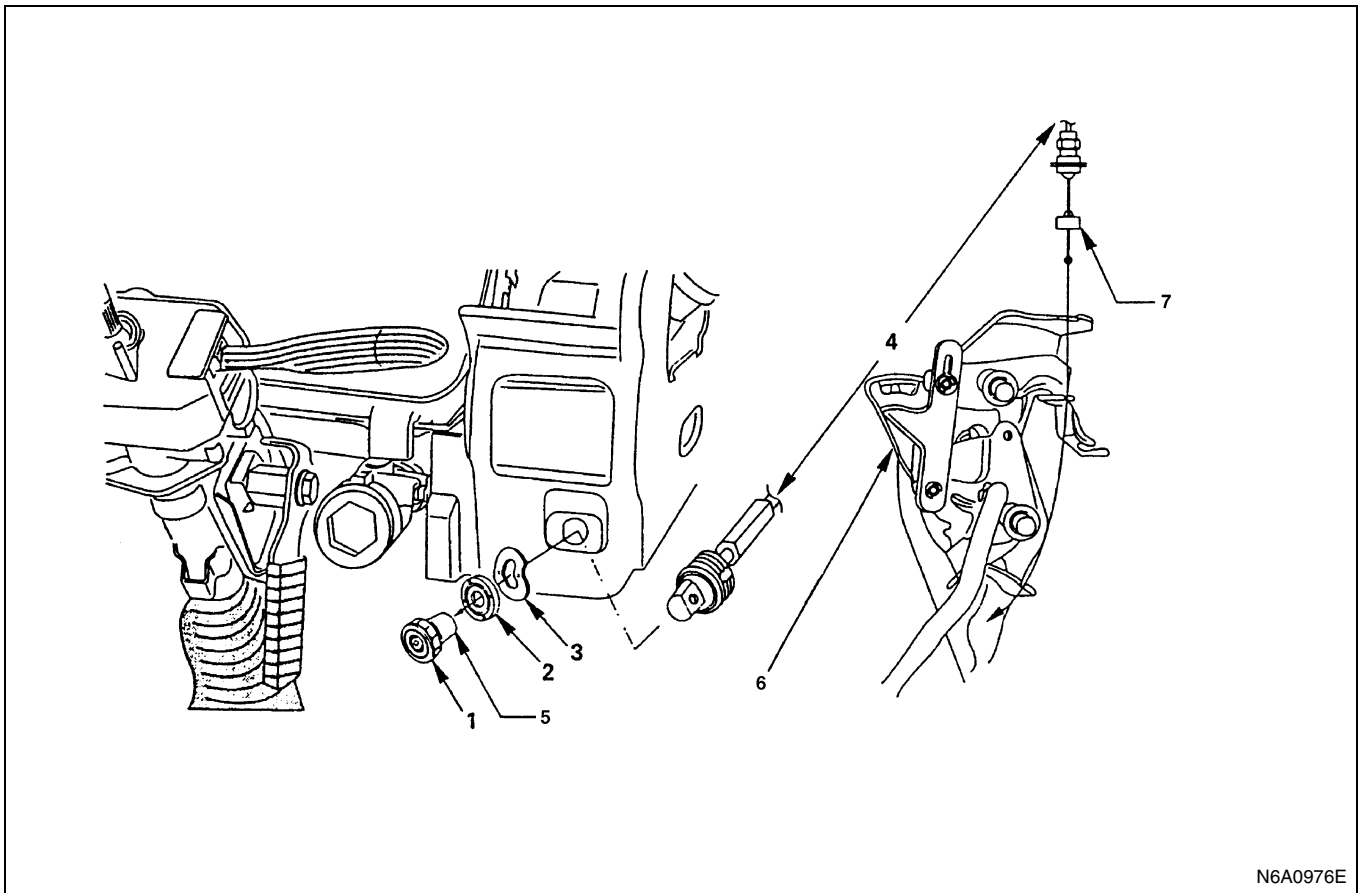
Installation

1. Accelerator Pedal Assembly
 - Apply grease to the sliding portion, and install it to the brake pedal bracket.
2. Idling Control Cable
 - Install the idling control cable to the lever of the accelerator pedal bracket.
3. Accelerator Control Cable
 - After confirming that the idling control knob is turned fully to the left, install the accelerator control cable.
4. Switch Connector



IDLING CONTROL CABLE

Component



N6A0976E

Legend

- | | |
|-----------------------------|------------------------------|
| 1. Idling control knob | 5. Screw |
| 2. Idling control cable nut | 6. Accelerator pedal bracket |
| 3. Wave washer | 7. Wire guide |
| 4. Idling control cable | |

Removal

1. Idling Control Knob
 - Loosen the idling control knob screw and remove the knob from cable.
2. Idling Control Cable Nut
3. Wave Washer
4. Idling Control Cable
 - Remove control cable from accelerator pedal bracket.

- Insert the idling control cable into the specified hole of the instrument panel.
- Install the washer to the cable, and tighten it with a nut.

4. Idling Control Knob
 - Insert the idling control knob into the cable, and tighten the screw.

Inspection:

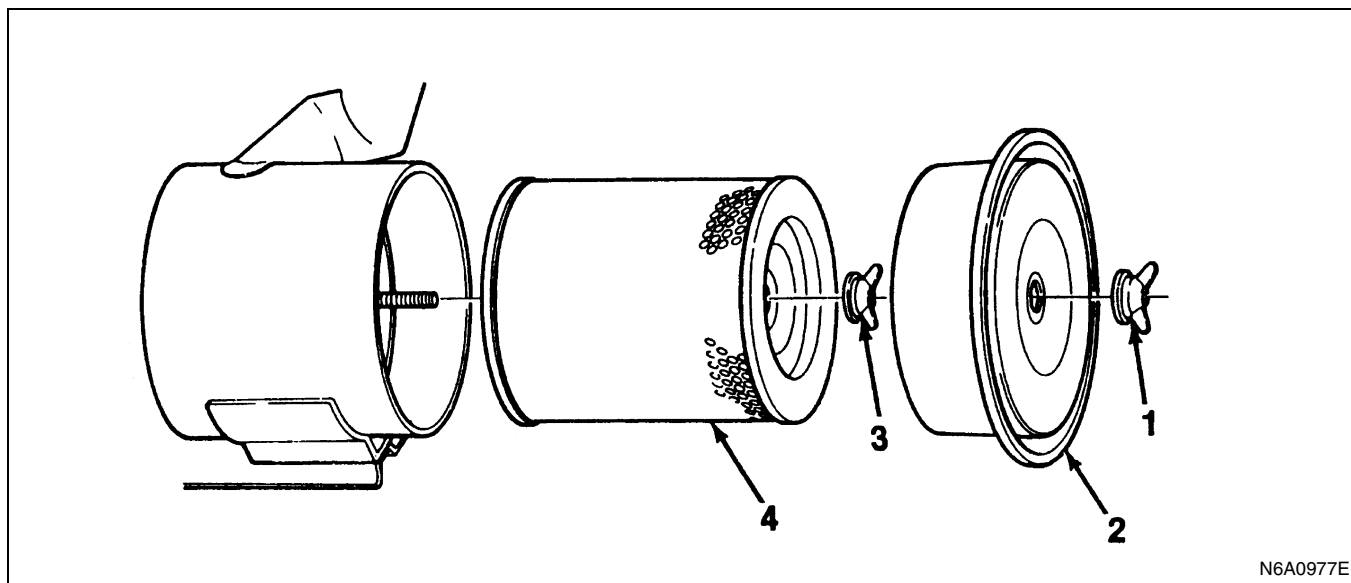
- With the idling control knob not in use, check to see if the injection pump lever is at the idle position (with the lever in contact with the stopper bolt).
- With the idling control knob turned fully to the right, check to see if the number of the engine idling rotations gets to 1,500 rpm or more.

Installation

1. Idling Control Cable
 - Install control cable to Accelerator pedal bracket.
2. Wave Washer
3. Idling Control Cable Nut

AIR CLEANER ELEMENT

Component



Legend

- | | |
|-------------------|------------------------|
| 1. Cover wing nut | 3. Filter wing nut |
| 2. End cover | 4. Air cleaner element |

Removal

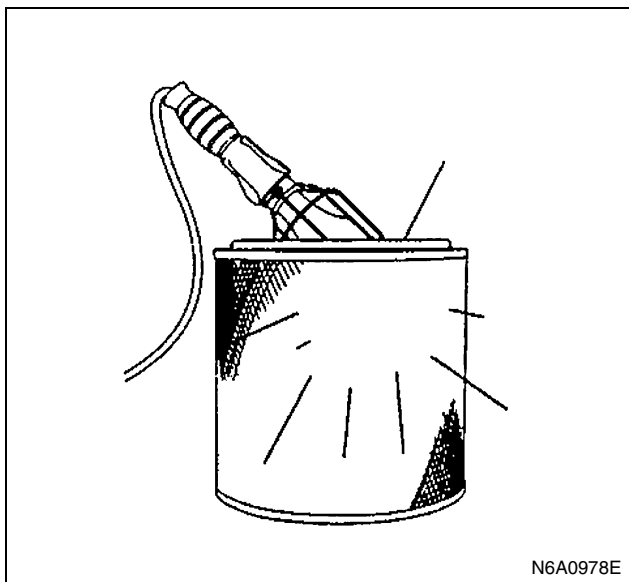
1. Cover Wing Nut
2. End Cover
3. Filter Wing Nut
4. Air Cleaner Element

Clean

- Wipe out the inside of the Air cleaner assembly
- Wipe off the Cover

Inspection

- The air filter with a light for fears or holes.



Cleaning Method

Dust Fouled Element

Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure	kPa (kg/cm ² /psi)
392 — 490	(4 — 5/57 — 71)

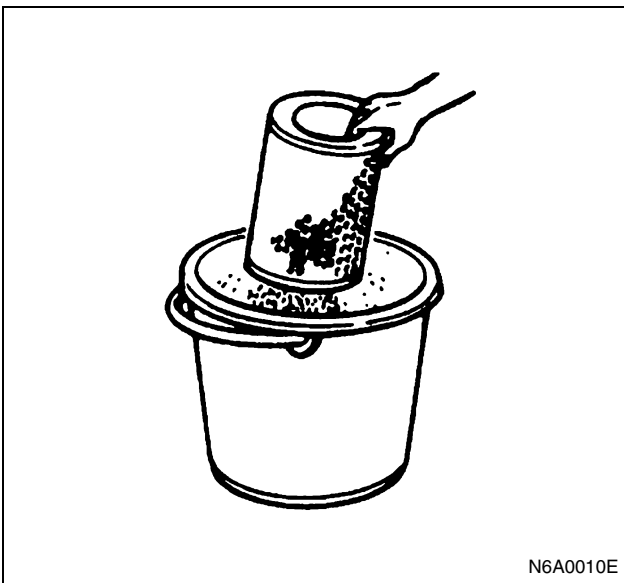
Caution:

Do not bang the element against another object in an attempt to clean it. Damage to the element will result.



Carbon and Dust Fouled Element

1. Prepare a cleaning solution of Isuzu Genuine Element Cleaner (Donaldson D1400) diluted with water.
2. Submerge the element in the solution for twenty minutes.



3. Remove the element from the solution and rinse it well with running water.
Water pressure must not exceed 274 kPa (2.8 kg/cm²/40 psi)

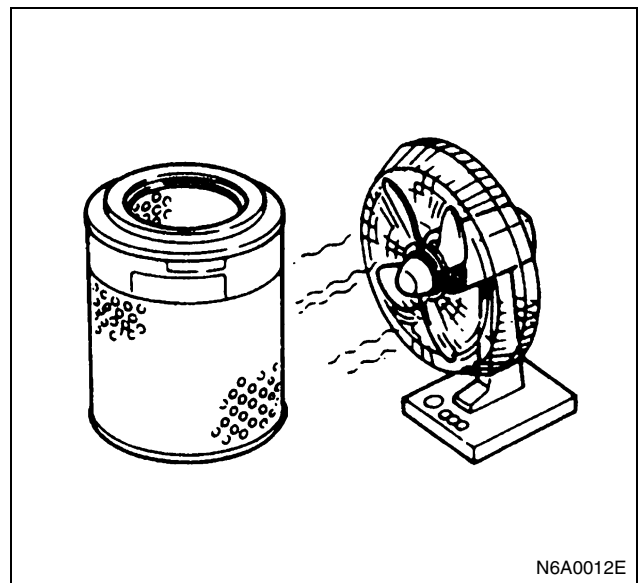


4. Dry the element in a well ventilated area.
An electric fan will hasten drying.

Notice:

Do not use compressed air or an open flame to dry the element quickly. Damage to the element will result.

It will usually take two or three days for the element to dry completely. Therefore, it is a good idea to have a spare on hand to use in the interim.



Installation

1. Air Cleaner Element
2. Filter Wing Nut
3. End Cover
4. Cover Wing Nut

