



5 Fuel system

5.1 General

Remember the following points while working on fuel supply system:

- While the fuel supply system is working you should cut off battery ground cables anytime except when carrying out tests that need batteries.
- Always prepare dry chemical fire extinguishers (class B) near the work place.
- Replace all removed oil pipes and parts with same ones.

The fuel supply system consists of a fuel tank, water separator, fuel filter, injection pump and fuel injector.

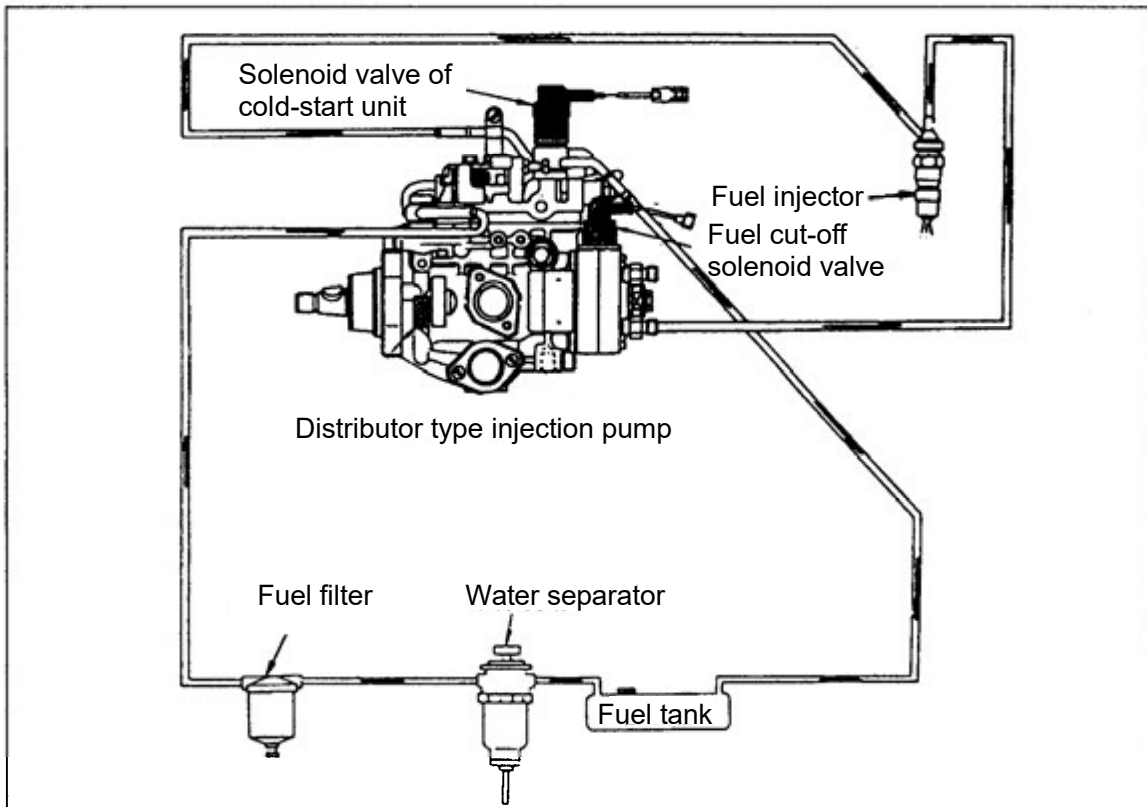
Clean and inspect the O-ring. Replace them if necessary.

Before repairing any part of the fuel supply system, relieve the pressure in pipes.

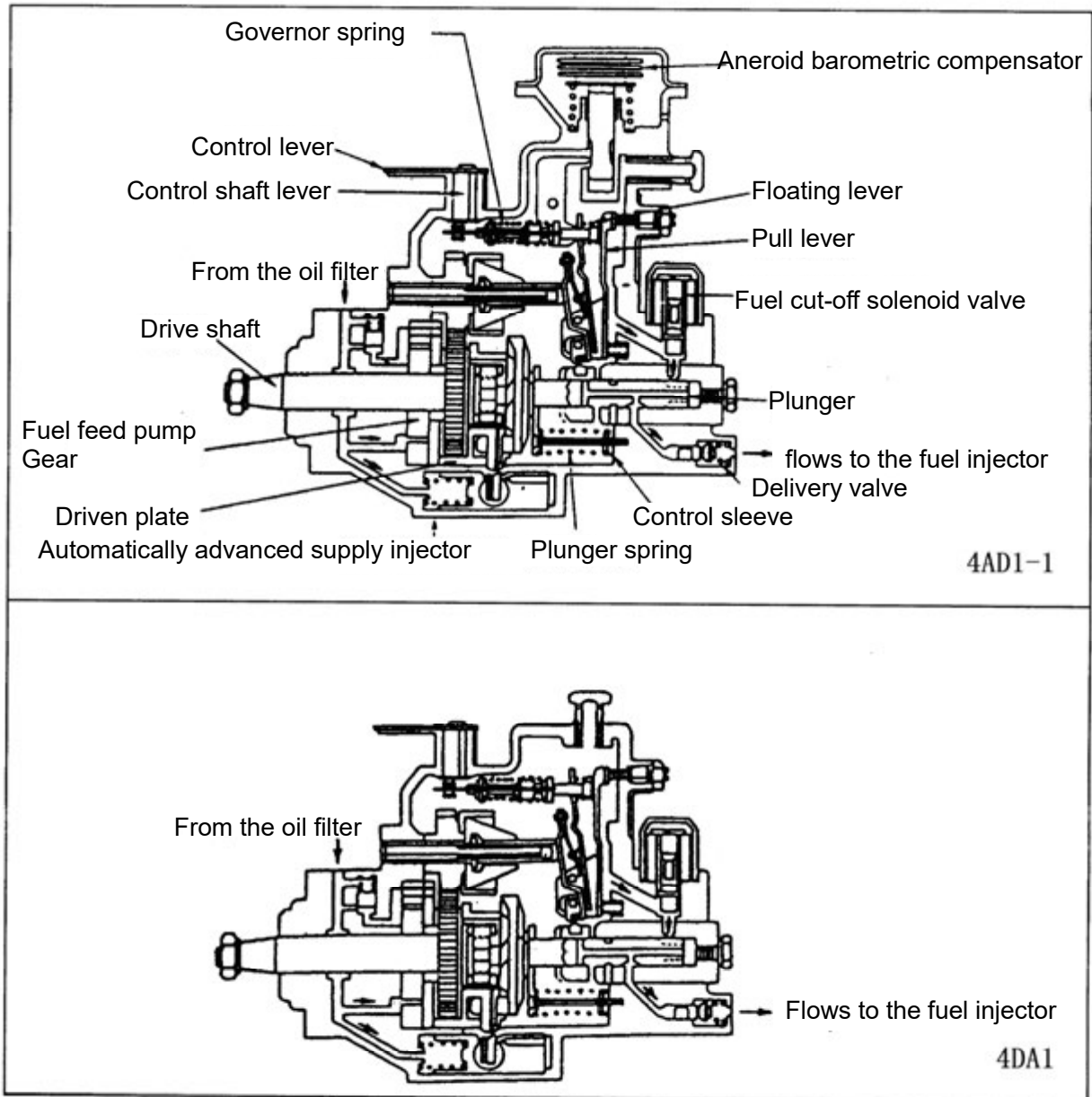
Before repairing the fuel supply system, please read the product manual and consult to repairing drawings.

A certain amount of fuel in the fuel tank flows through water separator and fuel filter – filters off moistures and other foreign bodies in the fuel, and then goes through the injection pump plunger to the fuel injector in the best time, so the engine can work effectively.

Fuel flowing schematic diagram



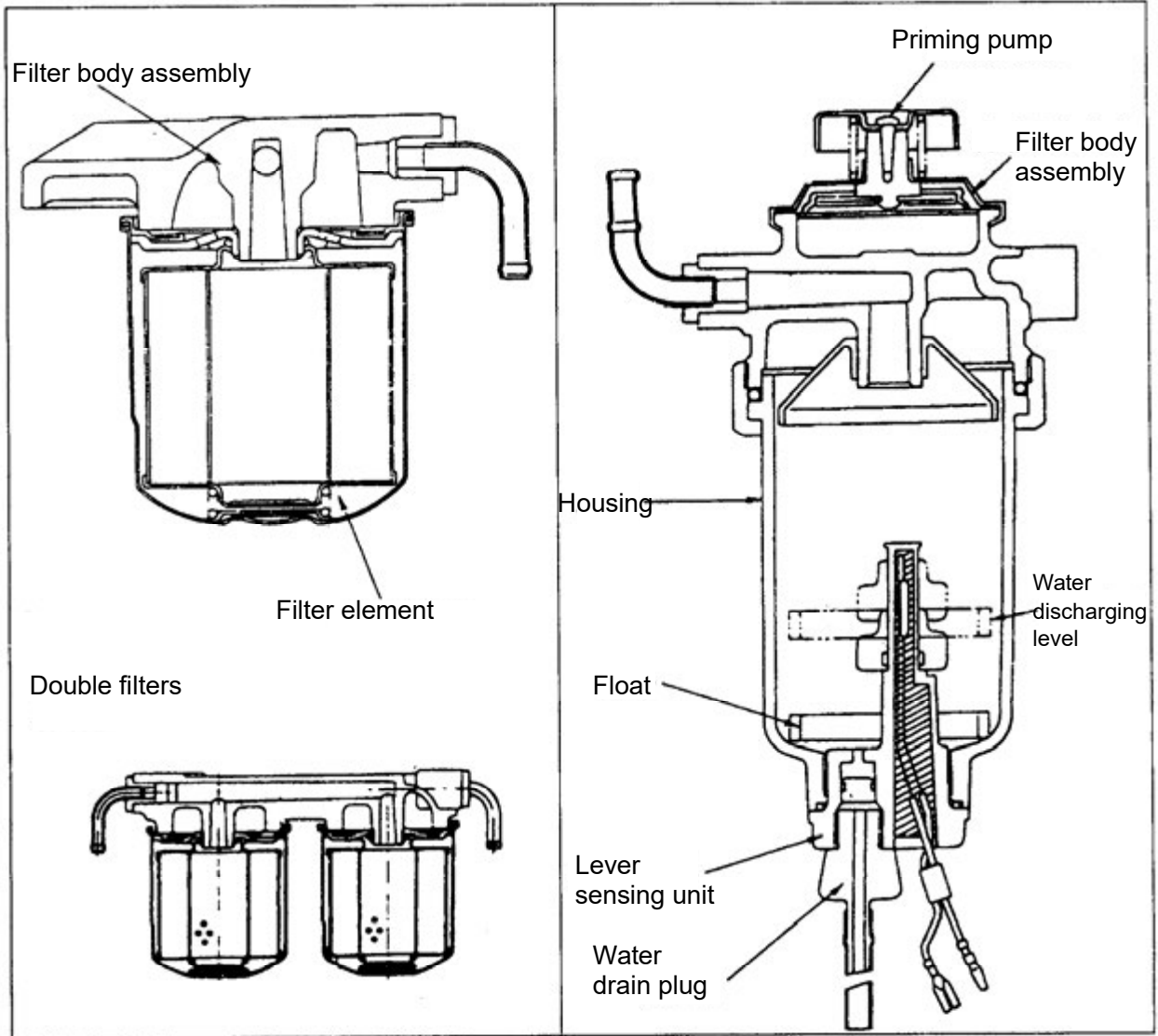
Injection pump



A distributor type injection pump is used. A Reciprocating / Rotating plunger will deliver equal fuel to each fuel injector and this has no relationship with the cylinder number. The governor, automatically advanced supply injector and fuel feed pump are all installed in the injection pump case.

This injection pump features a compact and lighter structure, which works efficiently. Aneroid barometric compensator can be used in vehicles operating in plateau areas and it can regulate the mixing ratio of fuel air.

× Fuel filter and water separator

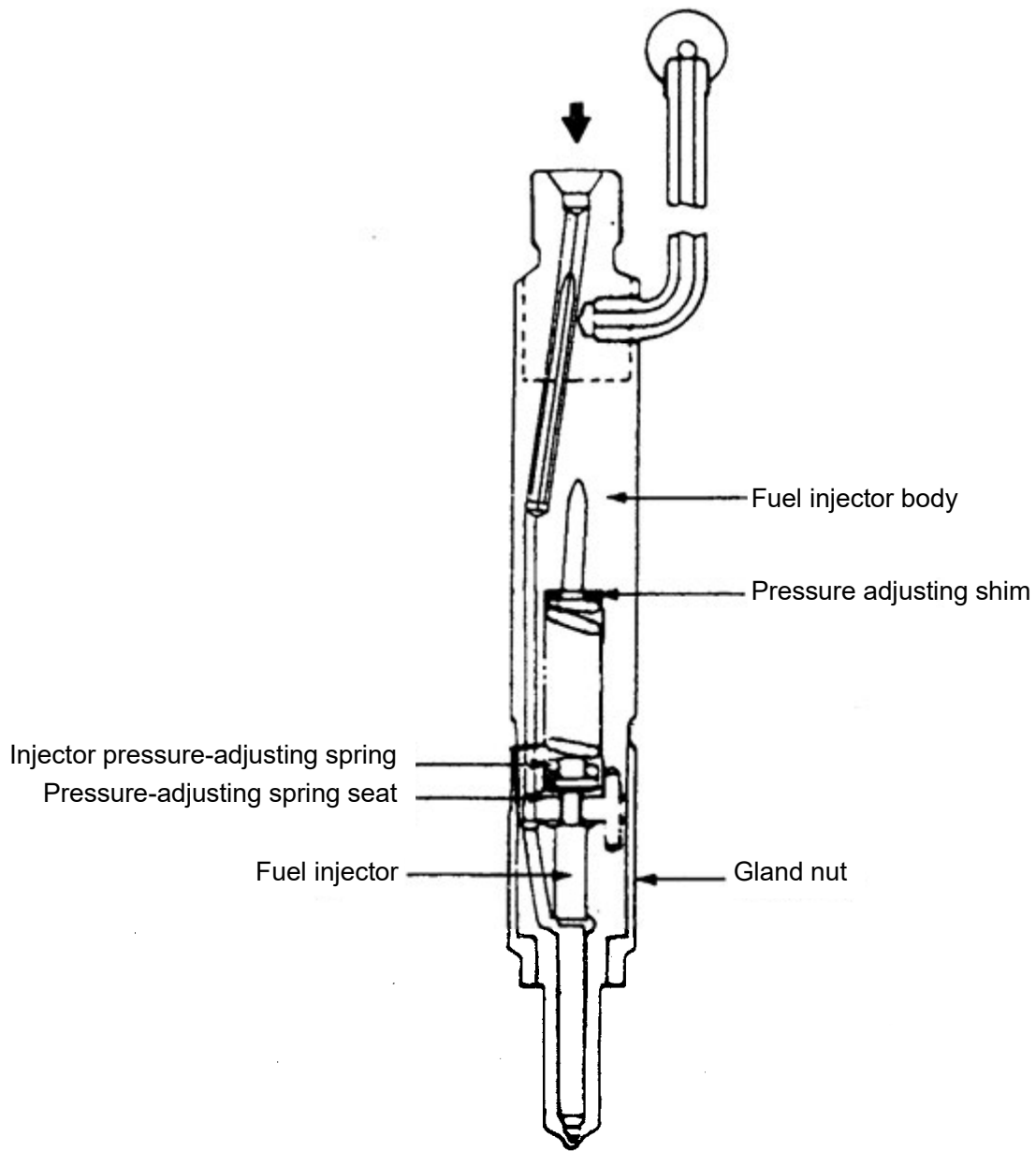


Besides the distributor type injection pump, a filter and water separator is also used. The injection pump inside is lubricated with the flowing fuel. The fuel must be clean. Before the fuel flows into the injection pump, the fuel filter and water separator will filter off moistures and other foreign bodies in the fuel.

There is a float in the water separator. When the float rises up to the specified level, a warning light reminds the workers to discharge water in the water separator.

There is a membrane priming pump installed on the top of the water separator. Use this pump when discharging water and air.

✘ Fuel injector



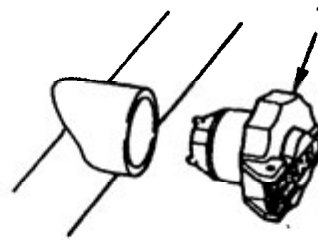
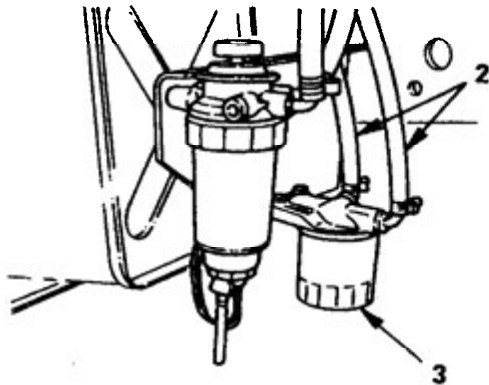
The fuel injector injects high-pressure fuel from the injection pump via an injector nozzle into the combustion chamber.

4DA1 Series generators use hole-type fuel injector. It has five nozzles. The fuel injector consists of injector body and fuel injection nozzle pairs assembly.

The high-pressure fuel coming from the injection pump injects via into the combustion chamber the injector and injector nozzle.



5.2 Fuel filter assembly



Disassembly sequence

1. Fuel filter cap
2. Fuel hose
3. Fuel filter assembly

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.



Disassembly

Preparation:

- Remove battery ground cables.
1. Fuel filter cap
 2. Fuel hose
 - Remove the fuel hose connected to the fuel filter body.
 - Plug hose ends to prevent fuel overflowing.
 3. Fuel filter assembly
 - Loosen the fixing bolt(s) on the fuel filter bracket.



ASSEMBLY

3. Fuel filter assembly
 - Assemble the fuel filter bracket and screw down the fixing bolt(s).
2. Fuel hose
 - Connect the fuel hose to the filter body.

1. Fuel filter cap

- Connect battery ground cables.
- Deliver fuel to the injection pump with a priming pump, and then discharge the air in the fuel supply system.

Fuel filter element

 **Disassembly**



- Remove the filter element with a filter wrench.
- Filter wrench: 1010300FA-9101

 **Assembly**

- Clean the filter element installing surface so that the element can be installed securely.



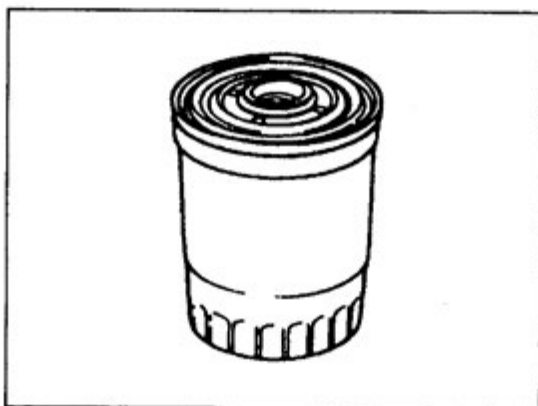
- Coating a thin layer of fresh engine oil on the new element O-ring.
- For discharging air, fill some fuel into the new element.
- Screw on the new element until the filter O-ring sticks to the seal surface seamlessly. Exercise care to avoid fuel flowing out.



- Further screw on the element by $\frac{1}{3}$ - $\frac{2}{3}$ turn with a filter wrench.
- Filter wrench: 1010300FA-9101

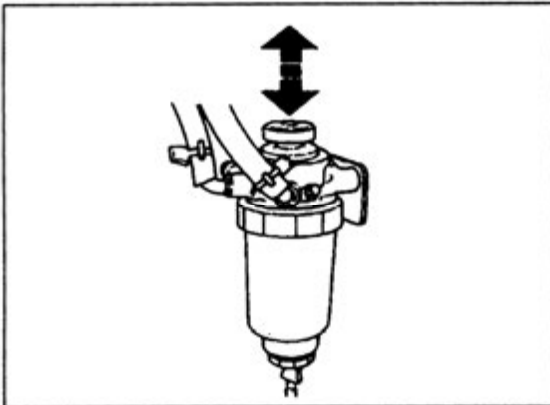
Air bleed

- Squeeze up the air inside fuel supply system to the injection pump by starting the priming pump.
- Loosen injection pump bleeder plug and start the priming pump until the air bleeds totally.





- Tighten the bleeder plug.
- Start the engine. If the engine can't start within 10 seconds, repeat the above air bleed operation.
- Make sure there is no fuel leakage and tighten the priming pump cover.

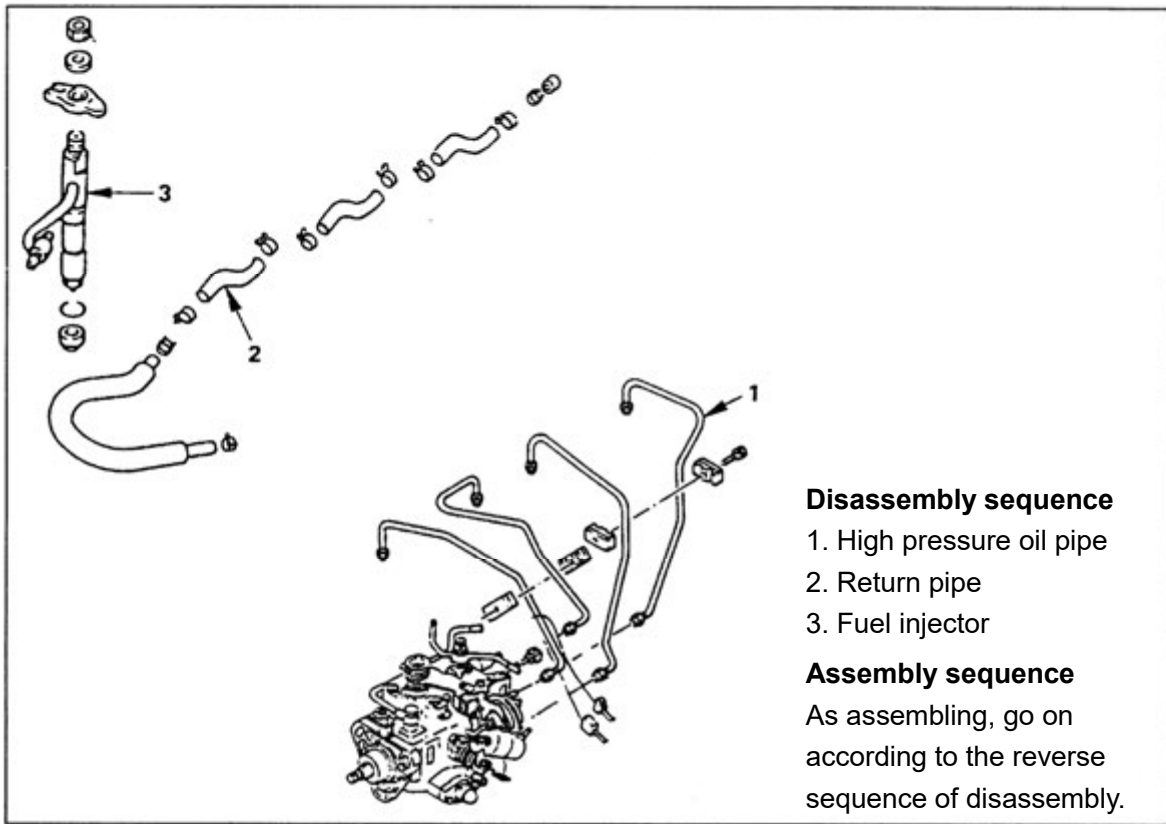


Water drain

- When the water in oil-water separator reaches the specified amount, the warning light will give a signal. Here drain water in the following steps.
- Connect a vinyl hose to the water drain plug.
- Loosen the water drain plug.
- Start the priming pump for several times to drain the water.
- Tighten the plug after draining the water.
- Start the priming pump for several times to check whether there is any fuel leakage.
- Check whether the warning light has gone out.



5.3 Fuel injector



Disassembly sequence

1. High pressure oil pipe
2. Return pipe
3. Fuel injector

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.

Disassembly

Preparation:

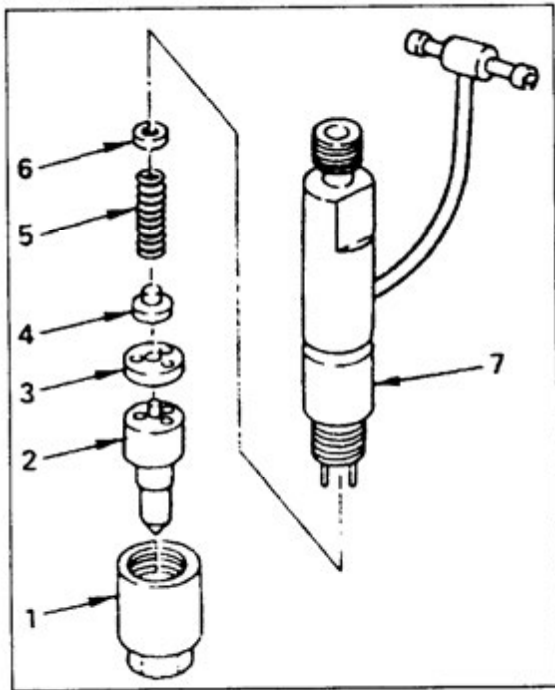
- Remove battery ground cables.
1. High pressure oil pipe
 - Loosen high pressure oil pipe clamp.
 - Loosen the taper nut(s) on the injection pump side.
 - Loosen the taper nut(s) on the fuel injector side and put aside the high pressure oil pipe after disconnecting it.
 2. Return pipe
 3. Fuel injector

Inspection

- Install the fuel injector on the injector tester.

When the oil pressure is 185kg / cm², check if there is any oil leakage from the head portion of the injector.

Replace them if there is any leakage.



Disassembly

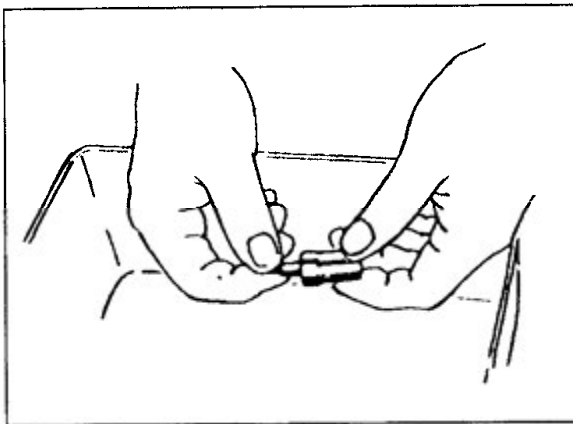
1. Gland nut
2. Fuel injection nozzle pairs
 - 1) Remove injector parts from the injector body.

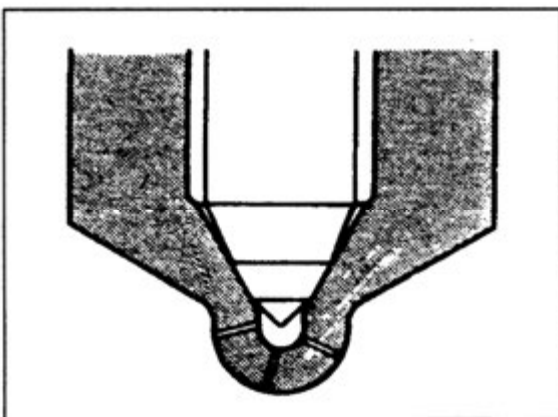
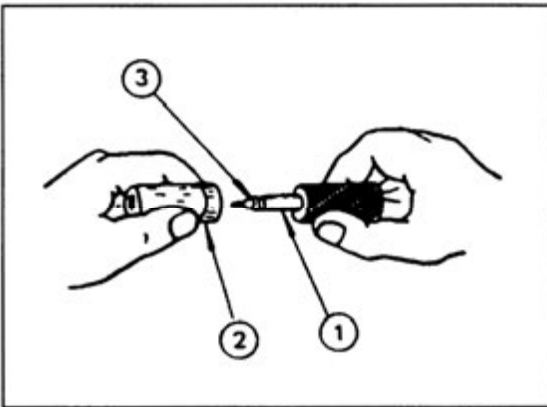
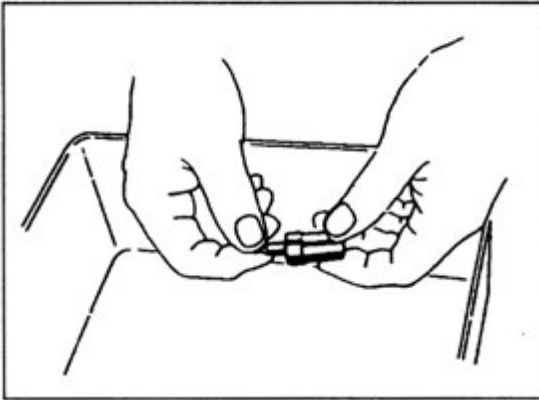
Attach a label to each injector part and the injector body to ensure that they are reassembled to the original positions.

Do not change the assembly of injector parts and the injector body.

- 2) In order to prevent dust entering the injector, put it in a tool pan full of clean diesel oil.

3. Spacer
4. Pressure-adjusting spring seat
5. Pressure-adjusting spring
6. Pressure-adjusting shim
7. Injector body





Inspection and repair

If during inspection it is found that the injector is severely worn or damaged, you have to adjust and repair the injector and replace the worn-out parts.

Inspection on fuel injection nozzle pairs

1. Remove the needle valve from the needle valve body of oil nozzle.
2. Carefully wash the needle valve of oil nozzle and the valve body in clean oil.
3. Check if the needle valve moves smoothly in the needle valve body. If this is not the case, repair the needle valve and needle valve body.



Grinding procedure of fuel injection nozzle pairs

1. Grind the needle valve of oil nozzle ① and needle valve body ② with chrome and animal oil grinding paste.

Notes:

Do not apply excessive chrome and animal oil grinding paste to the needle valve seat joint faces. Too much paste will lead to the severe abrasion of the needle valve and valve cone.

2. Carefully wash the needle valve and the valve body in clean oil after grinding.

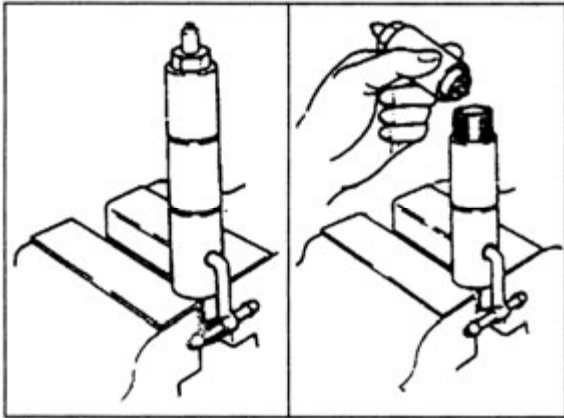
Inspection on the needle valve body of oil nozzle and the needle valve

Check if the needle valve body of oil nozzle and needle valve are damaged and distorted.

If during inspection it is found that the needle valve and valve body are damaged or distorted, replace them.

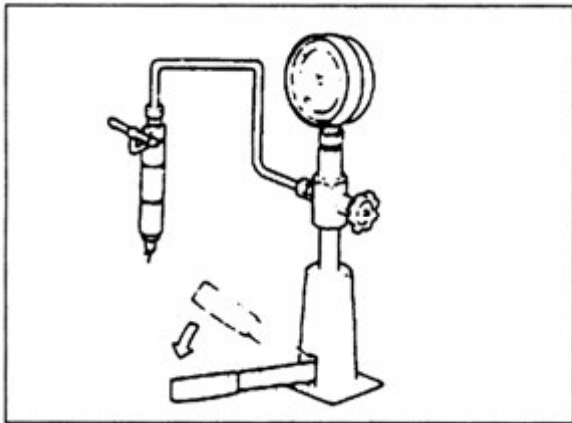
Reassembly

7. Injector body
6. Pressure-adjusting shim
5. Pressure-adjusting spring
4. High pressure spring seat
3. Spacer



2. Fuel injection nozzle pairs
1. Gland nut
Tighten gland nut to the specified torque.

	N·m
	69



Injector adjustment

- 1) Install the fuel injector on the injector tester.
- 2) Pressurize the injector tester to check if the injector opens at the specified pressure.

	MPa
4DA1	19 — 20
4DA1-1	18.6 — 19.6

If the injector doesn't inject oil under the specified pressure, adjust it with suitable adjusting shim according to different pressure classes.

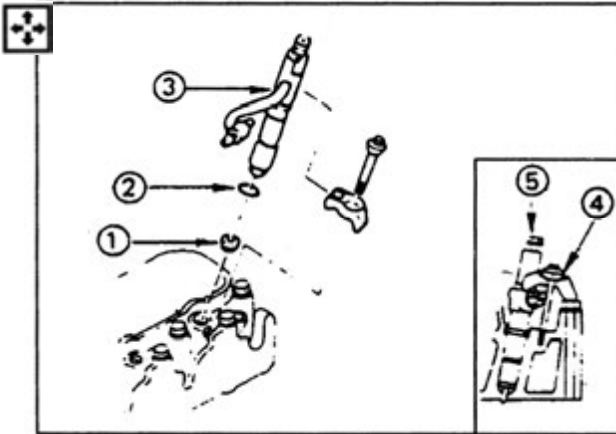
Adjusting shim available		mm
Thickness range	0.50—1.50	
Grading thickness	0.025	
Total no. of adjusting shims	40	

Decrease or increase the thickness of adjusting shims by one grade will increase or reduce the injector opening pressure by 369.46kPa.

Warning:

The testing liquid in the injector is injected under high pressure, so it may burn your skin easily. During testing, your hands should keep away from the injector tester.

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Assembly

3. Fuel injector

- 1) Install the injector gasket ① and O-ring ② onto the injector body ③.

The O-ring should be placed in the injector groove.

- 2) Fill engine oil into the injector body nozzle on the cylinder head.

- 3) Install both the injector body and injector pressure plate onto the cylinder head and tighten to the specified torque.

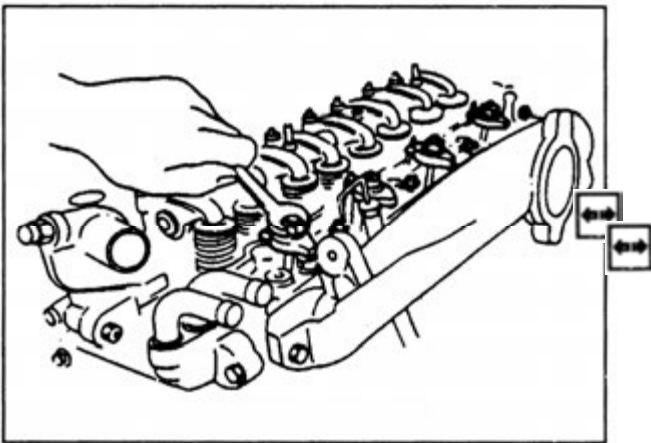
N·m

37

- 4) Tighten the injector body nut and shim ⑤ to the specified torque.

N·m

35

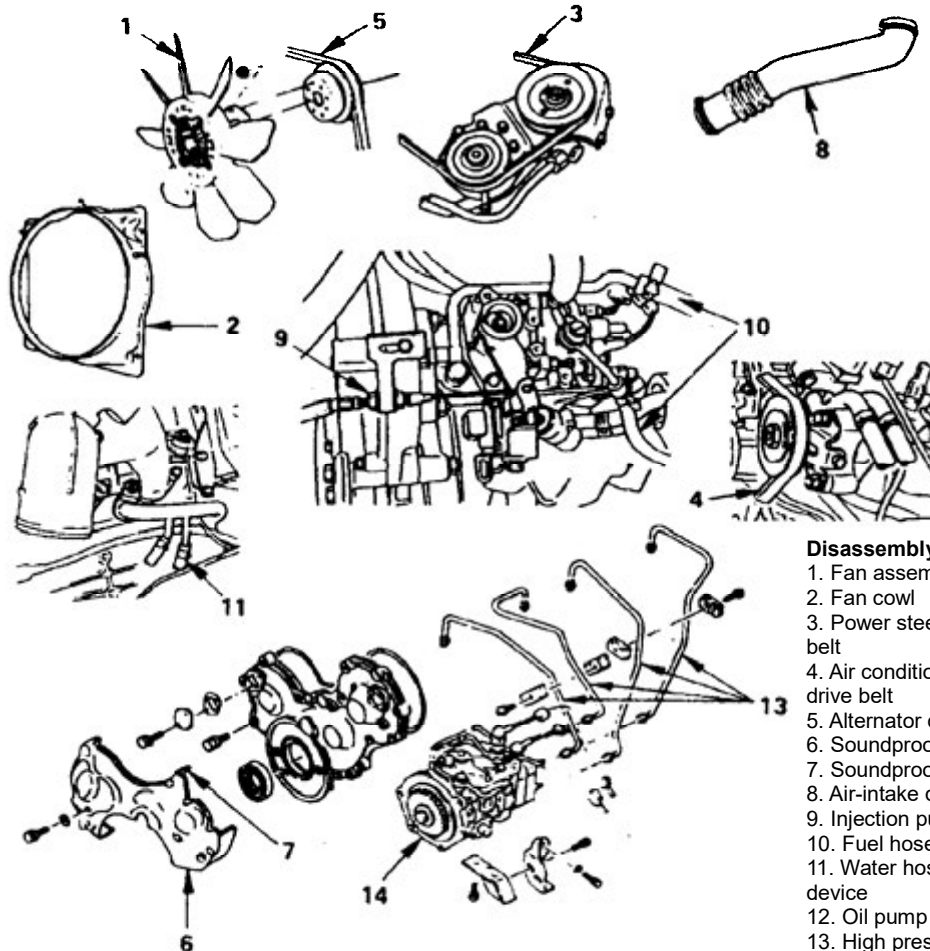


2. Return pipe

1. High pressure oil pipe



5.4 Injection pump assembly



Disassembly sequence

1. Fan assembly
2. Fan cowl
3. Power steering pump drive belt
4. Air conditioning compressor drive belt
5. Alternator drive belt
6. Soundproof cover
7. Soundproof cover gasket
8. Air-intake duct
9. Injection pump control wire
10. Fuel hose
11. Water hose of cold start device
12. Oil pump wire harness
13. High pressure oil pipe

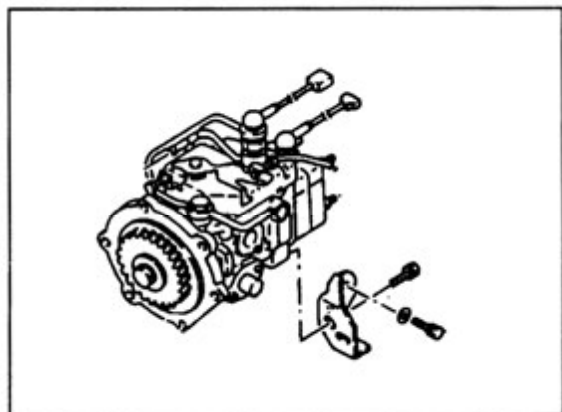
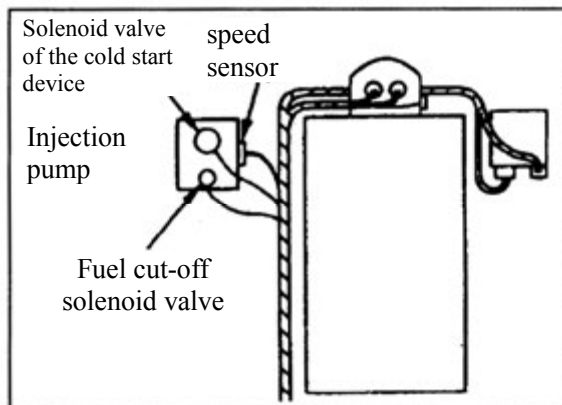
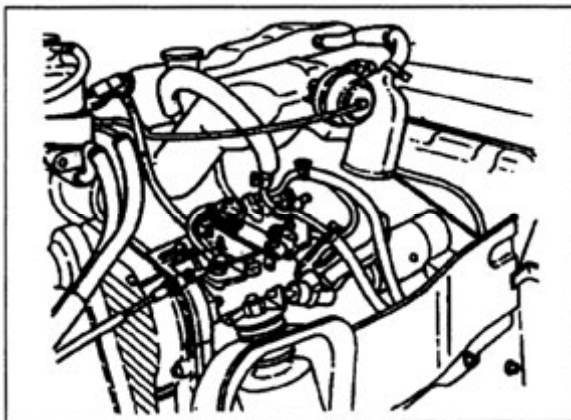
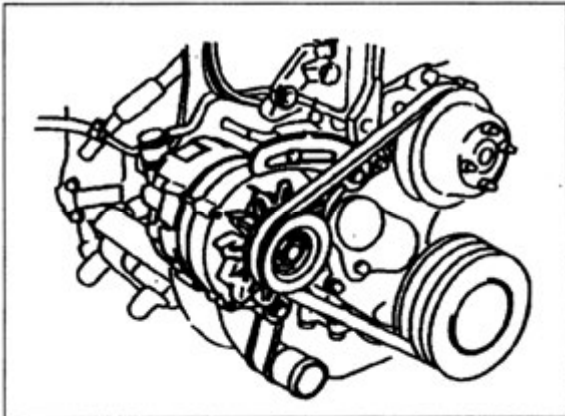
Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.

Disassembly

Preparation:

- Remove battery ground cables.
 - Discharge the coolant.
1. Fan assembly
 - Remove the gland nut(s), fan assembly, collar and fan pulley.
 2. Fan cowl
 3. Power steering pump drive belt
 - Unscrew power steering pump fixing bolt(s) and adjusting bolt(s), then remove the drive belt.



4. Air conditioning compressor drive belt
 - Loosen idler locking nut(s) and adjusting bolt(s) of the air conditioning compressor and then remove the drive belt.
5. Alternator drive belt
 - Unscrew alternator fixing bolt(s) (lower side) and adjusting plate locking bolt(s), then remove the drive belt.
6. Soundproof cover
7. Soundproof cover gasket
8. Air-intake duct
9. Injection pump control wire
 - Remove the control wire bracket bolt(s) and control wire.
10. Fuel hose
 - Disconnect fuel inlet hose and return hose.
11. Water hose of cold start device (CSD)
 - Disconnect the water hose from the injection pump side.
12. Injection pump wire harness
 - Dismount the speed sensor (with a tachometer), solenoid valve of the cold start device (CSD) and the fuel cut-off solenoid valve.
13. High pressure oil pipe
 - Loosen high pressure oil pipe clamp.
 - Remove the taper nut(s) on the injection pump side.
 - Remove taper nut(s) on the fuel injector side and high pressure oil pipe.

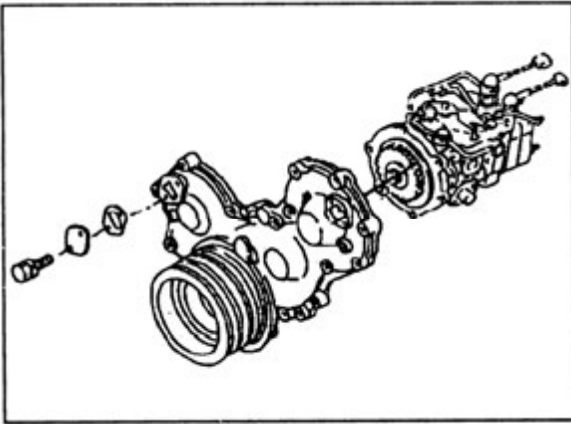


Caution:

- Plug the holes in injector body and delivery valve body to prevent foreign bodies falling in.
14. Injection pump assembly
 - Loosen injection pump fixing nut(s).
 - Unscrew the adjusting and locking bolts in the injection pump rear bracket.
 - Unscrew the generator side fixing bolt(s). Take out the injection pump from the engine backside.

Notes:

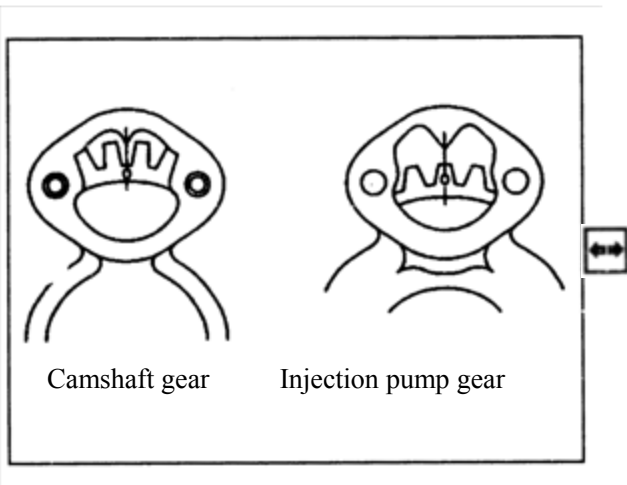
- Cover holes in injection pump delivery valve body with a cap (or equivalents) to prevent foreign bodies falling into the valve.



Assembly

14. Injection pump assembly

1. Mount inspection hole covers on the camshaft timing gear side of the timing gear chamber and the timing gear side of the injection pump.
2. Turn the crankshaft clockwise and check whether the II °C mark on the crankshaft pulley is aligned with the index. Place the piston of the first cylinder on the top dead center of the compression stroke.
3. Observe and check if the scale on the timing gear mark "O" is aligned with the hole index via the inspection hole on crankshaft timing gear side.
4. Align the injection pump gear mark "O" with the inspection hole index and install the injection pump assembly.
 - Screw on the injection pump fixing bolts and tighten them to the specified torque.

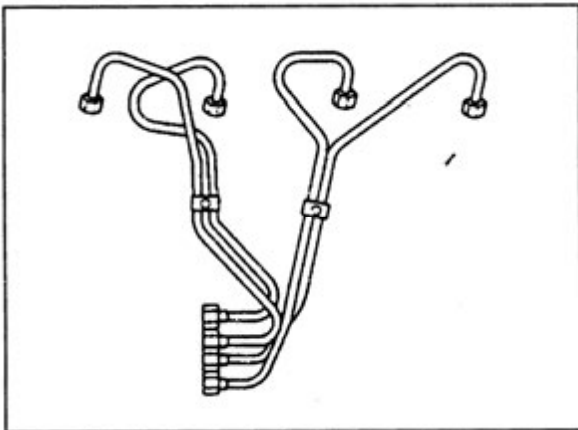


Injection pump fixing bolt torque	N·m
25	

13. High pressure oil pipe

- Connect the high pressure oil pipes to the injection pump side and fuel injector side and screw down these pipes.
- Install the oil pipe fixing clips in the original positions.

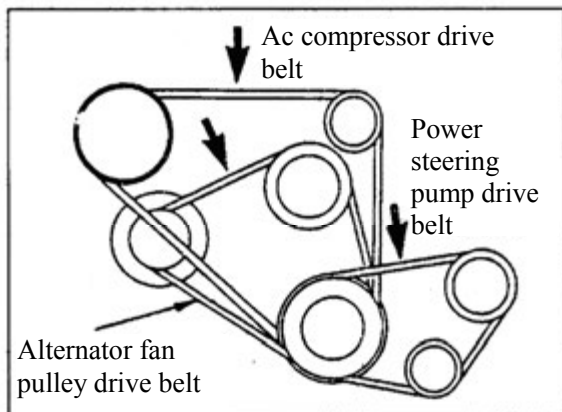
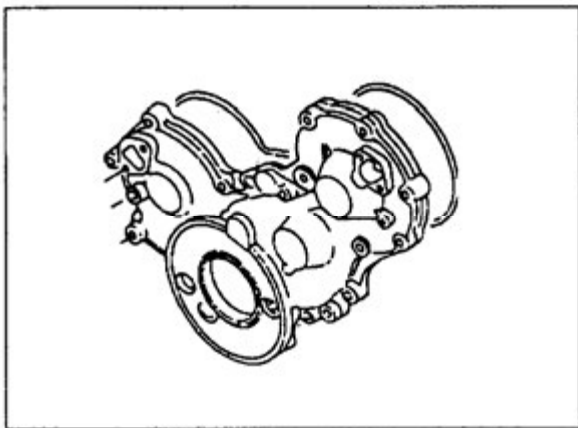
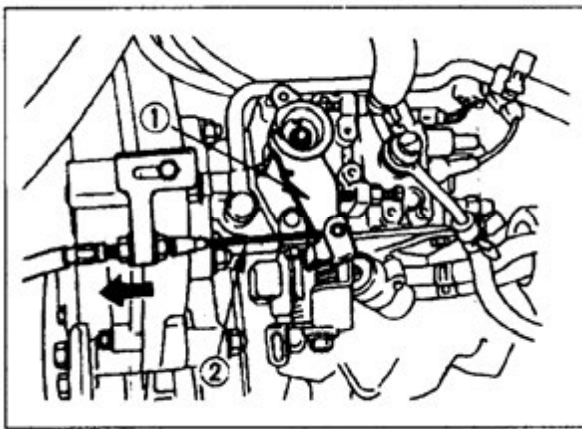
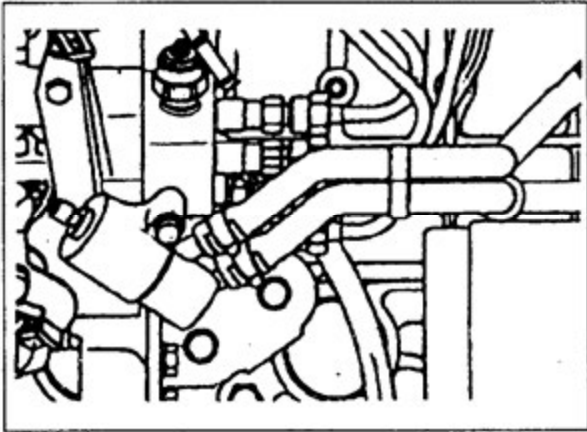
N·m
30



12. Injection pump wire harness

- Fix the injection pump wire harness and connect it to the switch.

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11. Water hose of cold start device
 - Connect the water hose of cold start device and tighten the fixing clip(s).

10. Fuel hose
 - Connect the fuel inlet hose and return hose.
 - Connect the defuelling hose(s).

9. Injection pump control wire
 - 1) Connect the control wire rope to the engine control lever.
 - 2) Place the throttle lever in fully cut-off position and pull tight the control wire towards the arrow direction to prevent it being slack.
 - 3) Tighten the throttle wire bracket bolt(s).

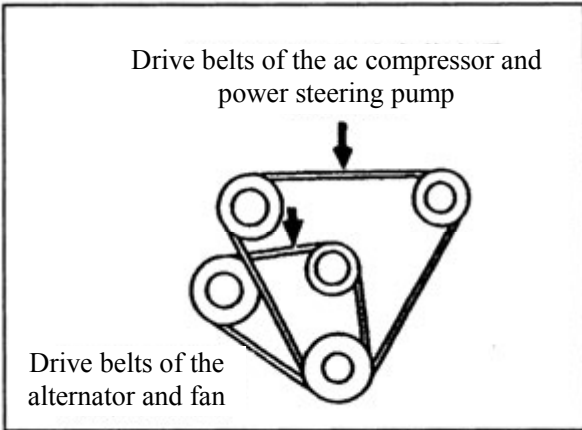
8. Air-intake duct
7. Soundproof cover gasket
6. Soundproof cover

5. Alternator drive belt
 - Mount the alternator drive belt and adjust the belt tension.
 - Apply a force of 100N to the middle part of the drive belt.

Drive belt deflection	mm
8—10	

- Screw on the fixing bolt and tighten it to the specified torque.

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Generator fixing bolt torque N·m

37.5

Adjusting plate fixing bolt torque N·m

25

4. Air conditioning compressor drive belt
- Mount the ac compressor drive belt and adjust the belt tension.
 - Apply a force of 100N to the middle part of the drive belt.力。

Drive belt deflection mm

8—10

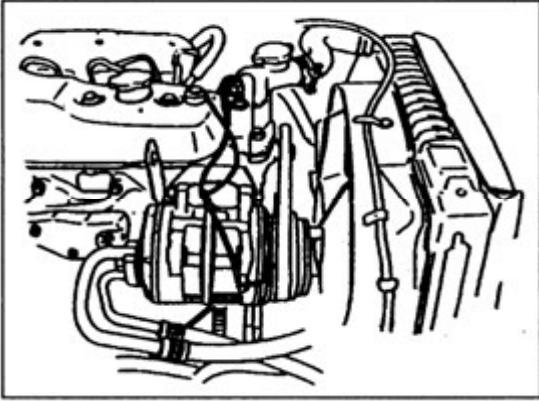
- Tighten the idler locking nut to the specified torque.
- N·m
-
- 27

3. Power steering pump drive belt
- Mount the power steering pump drive belt and adjust the belt tension.
 - Apply a force of 100N to the middle part of the drive belt.力。

Drive belt deflection mm

8—10

- Tighten the idler locking nut to the specified torque.
- N·m
-
- 27

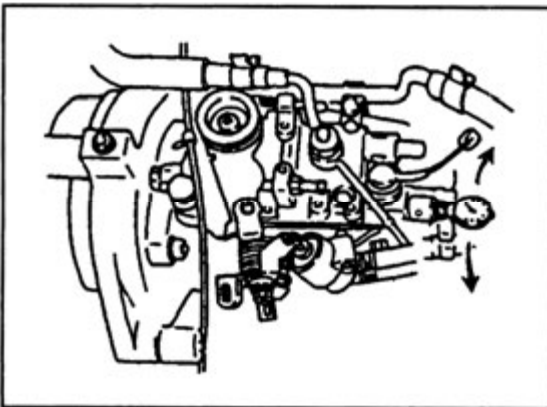
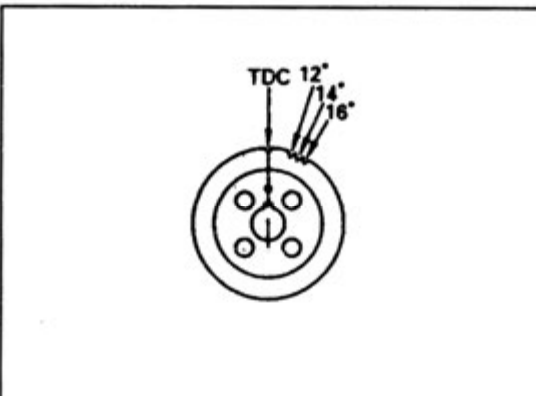
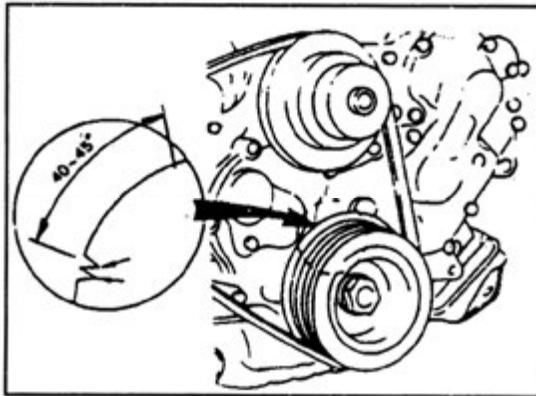
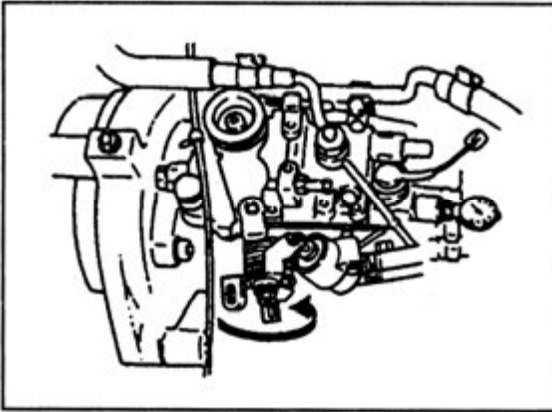


2. Fan cowl
 - Install the fan cowl and storage tank hose.
1. Fan assembly
 - Fix the fan pulley, collar and fan assembly onto the water pump in sequence, and tighten them to the specified torque.

N·m

12.5

- Connect battery ground cables.
- Fill in coolant.



Fuel supply and timing adjustment

- Place the piston of the first cylinder on the top dead center.
- Remove the top plug of the injection pump distributor.
- Dismantle wax type cold start device with screwdriver hand lever.
- Mount a dial indicator and pre-elevate to 1 mm.



Measuring instrument: 1100300FA—9101

- Place the top dead center mark on the crankshaft damper pulley at a position 30°-45° to the index.
- Place the dial indicator at the “0” position.
- Turn the crankshaft left and right slightly and observe if the dial indicator is still at the “0” position.
- Turn the crankshaft in normal direction and read out the dial gauge readings in the following cases.



4DA1 16° to the top dead center (before)

4DA1-1 12° to the top dead center (before)

Dial indicator readings mm

4DA1	1.60
4DA1-1	1.50

If the readings are improper, unscrew the injection pump fixing nut and the bracket adjusting bolt. Adjust the readings by changing the injection pump mounting position. When the dial gauge readings change to the specified values, tighten the fixing nut and bolt to the specified torques.

Injection pump fixing nut torque N·m

25

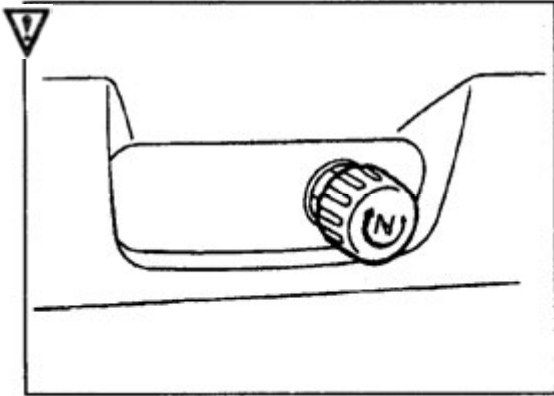
Adjusting Bolt torque N·m

25

- Tighten the top plug of the injection pump distributor to the specified torque after removing the measuring instrument.

N·m

35



Caution:

- While mounting the top plug of the injection pump distributor, you should use a new copper gasket.
- Connect the high pressure oil pressure.
- Fix the oil pipe clamp.

Carry out idle speed inspection and adjustment

- 1) Pull the parking brake lever and lock the drive wheel (s).
- 2) Set the transmission gear to neutral shift.
- 3) Start the engine and operate it at idle speed until the water temperature rises to 70°-80°.
- 4) Reverse the idle control knob. Remove the control wire from the injection pump control lever.
- 5) Install the engine tachometer.
- 6) Check the idle speed.

If the idle speed exceeds the specified limit, correct it.

Specified value (r / min) = 700-800

- 1) Unscrew the locking nut of the idle speed adjusting bolt.
- 2) Turn the idle speed adjusting bolt and adjust the idle speed to the specified value.
- 3) Tighten the locking nut and adjusting bolt.
- 4) Check the control wire tension and pull tight this wire if necessary.



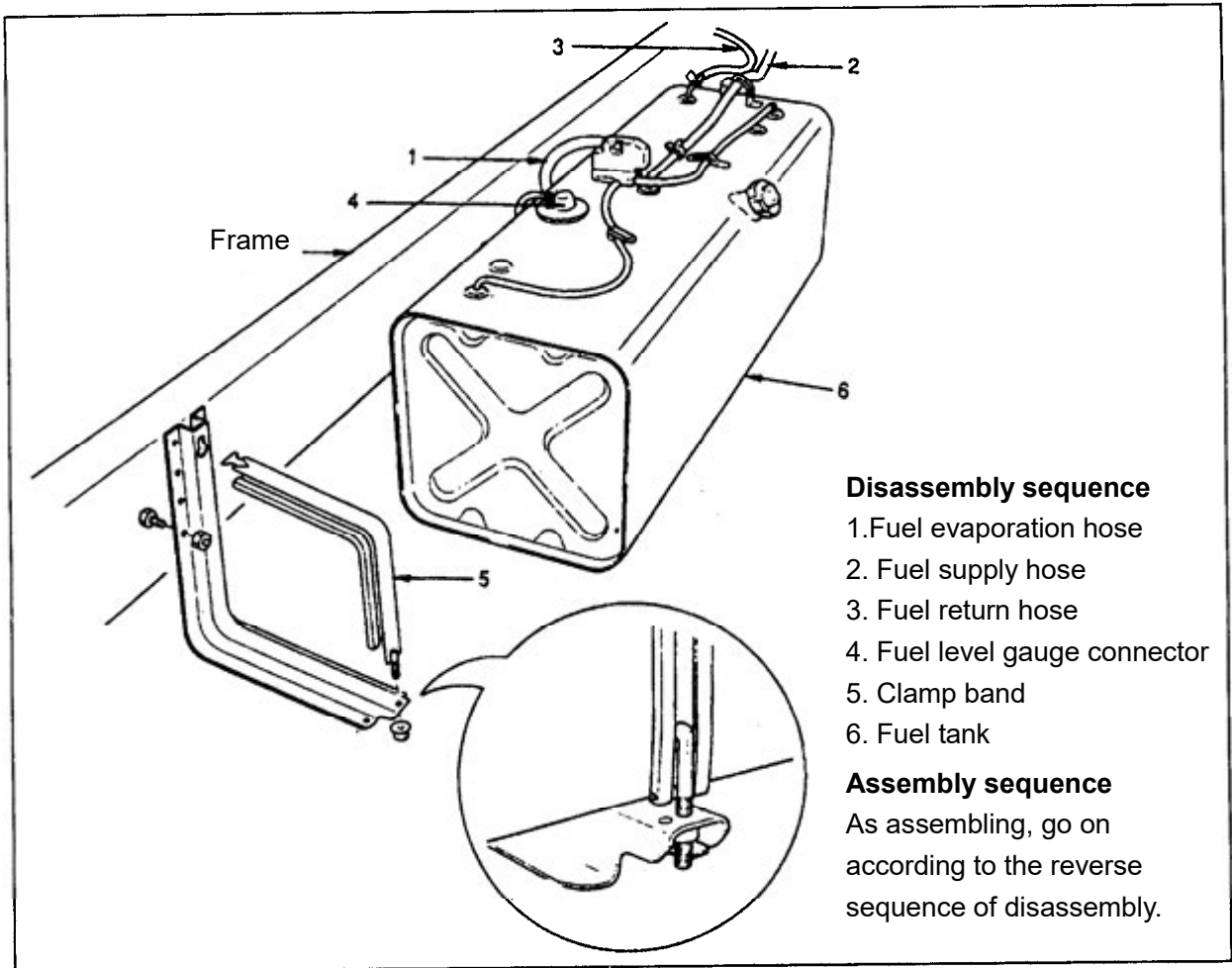
5.5 Fuel system related parameters

Test conditions

Items	Conditions	
Model	4DA1	4DA1-1
Fuel injector		
Injector type	KBAL—P001	KBAL—P001
Fuel injection nozzle pairs	DSL153P009	DLLA153P034
Injector opening pressure (Mpa)	19 — 20	18.6 — 19.6
Size of high pressure oil pipe		
Inner diameter	1.6	
Outer diameter	6.5	
Length	430	
Feeding pressure (kPa)	19.61	
Test fuel	SAE standard test diesel oil (SAE967D)	
	ISO standard test diesel oil (ISO4113)	
Test fuel temperature °C	48—52	



5.6 Fuel tank



Disassembly sequence

1. Fuel evaporation hose
2. Fuel supply hose
3. Fuel return hose
4. Fuel level gauge connector
5. Clamp band
6. Fuel tank

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.

Disassembly

Preparation:

- Remove battery ground cables.
- Open the fuel filter cap
- Drain oil via the oil drain plug
- Tighten the oil drain plug to the specified torque after draining the oil.

N·m

29

1. Fuel evaporation hose
2. Fuel supply hose
3. Fuel return hose
 - Plug hose ends to prevent the fuel flowing out. Fasten the hose to the frame with plugged end upward.

- 4. Fuel lever gauge connector
 - Remove the fuel lever gauge connector.
- 5. Clamp band
 - Loosen the fixing nut of the fuel tank clamp band. Draw out the clamp band from one end of the frame.
- 6. Fuel tank
 - Withdraw the fuel tank.

Note:

If it is impossible to withdraw the fuel tank, remove the bracket and pull out the fuel tank downwards..



Assembly

- 6. Fuel tank
 - Note:
 - If the bracket is removed while pulling out the fuel tank, mount it to the frame and tighten it to the specified torque.

N·m

55

- While mounting the fuel tank to the bracket, you have to place a piece of cushion on the bracket.

- 5. Clamp band
 - Tighten the clamp band nuts to the specified torque.

N·m

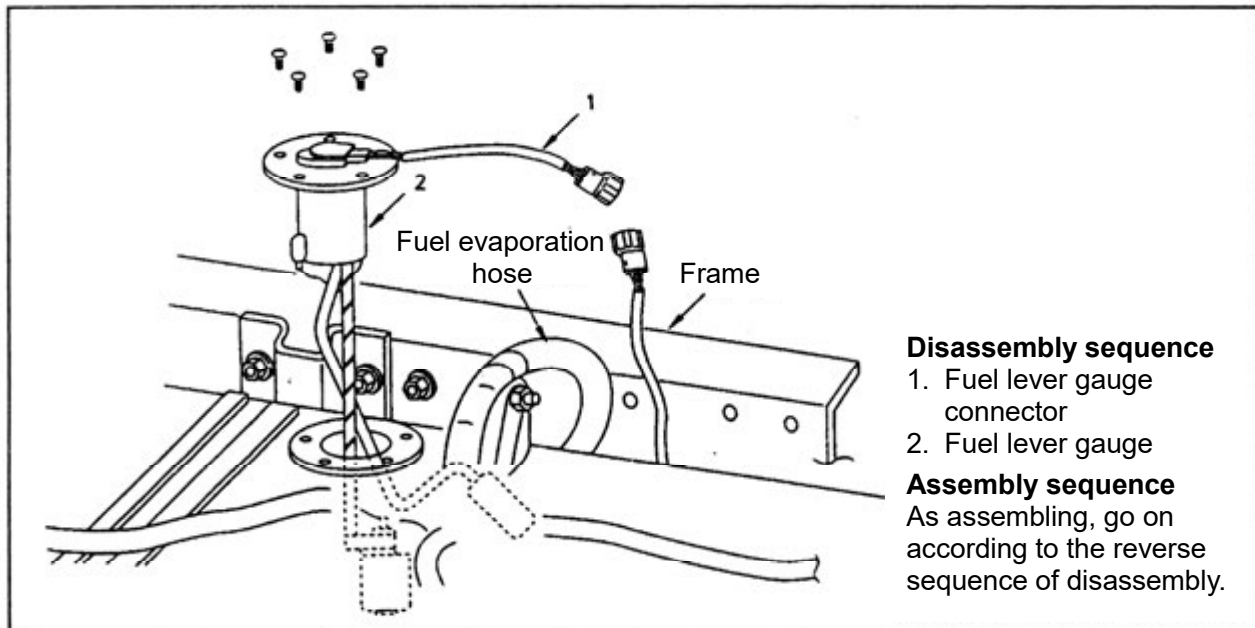
12



- 4. Fuel lever gauge connector
 - Connect the fuel lever gauge connector.
- 3. Fuel return hose
- 2. Fuel supply hose
 - Insert the hose into the oil pipe with insert depth above 25mm.
- 1. Fuel evaporation hose
 - Feed fuel into the fuel tank.
 - Connect battery ground cables.



5.7 Fuel lever gauge



Disassembly

Preparation:

- Remove battery ground cables.
1. Fuel lever gauge connector
 - Remove the connector from the fuel lever gauge.
 2. Fuel lever gauge
 - Unscrew the fuel lever gauge fixing bolt (s) and remove the gauge.

Note:

- After removing the fuel lever gauge, plug the tank port with cotton waste to prevent dirt falling into the tank.

Assembly

2. Fuel lever gauge
1. Fuel lever gauge connector
 - Connect the wire connector to the fuel lever gauge