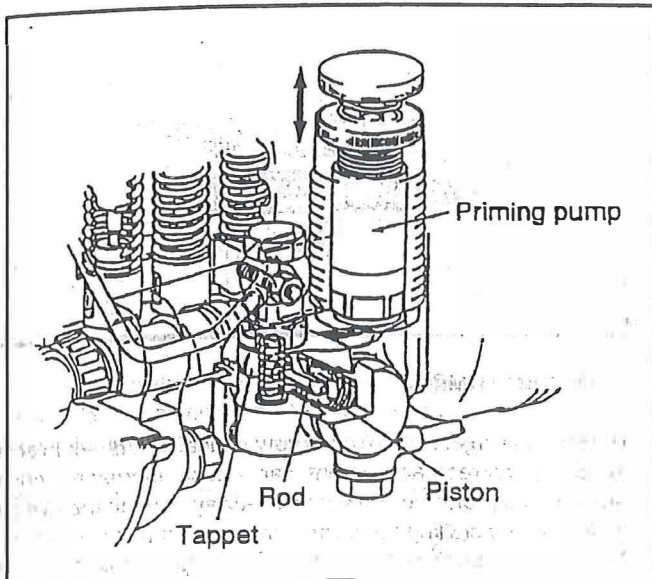
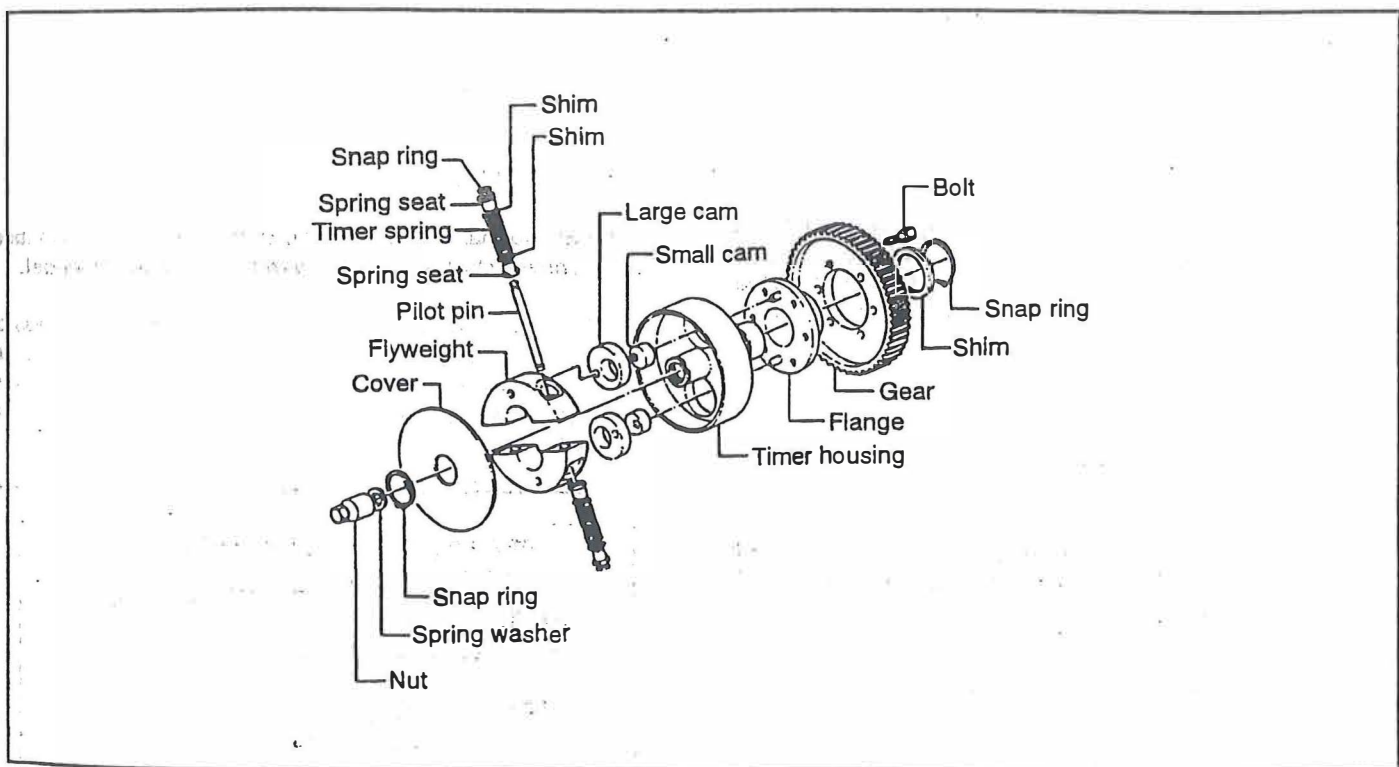


FUEL FEED PUMP DESCRIPTION



The fuel feed pump is a piston type pump installed directly on the injection pump. An additional cam lobe on the camshaft drives the fuel feed pump piston through a tappet and rod. A manual priming pump is provided to prime the system and to bleed air from the system when required.

INJECTION PUMP TIMER COMPONENT ILLUSTRATION



TIMER DESCRIPTION

An eccentric cam type (centrifugal advance) automatic timer, SCDM type, is used on the injection pump. The injection timing

components are located on the front of the injection pump.

INJECTION PUMP SPECIFICATIONS

Model	In-line Bosch type, A type
Cam lift	9.0 mm / (.3543 in)
Plunger diameter	ϕ 9.5 mm / (.374 in)
Governor type	Centrifugal type
Injection timing adjustment method	Centrifugal type
Nozzle	Multiple hole type
Starting injection pressure	200 kg/cm ² (2845 psi)
Injection order	1-3-4-2
Idle speed	850 \pm 25
Injection timing	BTDC 9°

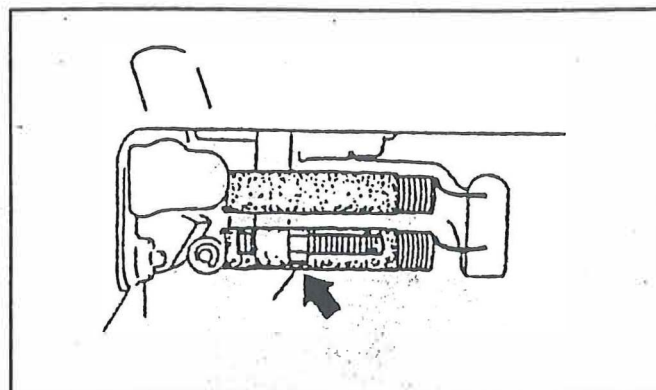
ENGINE IDLE

INSPECTION OF THE ENGINE IDLE

- Apply a piece of reflective tape on the crankshaft pulley or flywheel. (Follow the tachometer manufacturers instructions for surface preparation and installation of the tape.)
- Warm up the engine.
- Check the accelerator cable adjustment at the fuel injection pump. The throttle arm on the fuel injection pump must be allowed to completely return to the idle position with the accelerator pedal in the full up position. The throttle arm on the fuel injection pump must move to the full speed position with the accelerator pedal in the full down position.
- Idle the engine.
- Point the photoelectric tachometer at the tape and check the idle speed.
- Another method that can be used is to set the tachometer (P/N 9125483-58), or equivalent on the fuel injection pipe, to check the idle speed.
Idle speed: 825-875 rpm

ADJUSTMENT OF THE ENGINE IDLE

- If the idle speed is not within the specified range, loosen the idle adjustment bolt lock nut on the top of the injection pump. Turn the bolt to adjust the speed.
- Tighten the lock nut after adjustment.
- Accelerate the engine several times, and verify that the idle speed is within the standard value.
Tightening torque: 1.0-1.4 kgm / (87-122 lbf in)



INJECTION TIMING

NOTE: The injection timing is very critical in a direct injection engine. Incorrect adjustment can cause increased engine noise (knock) and / or power loss. Always check the injection timing after installing the pump, and verify that it is correct. The actual injection timing is 9° BTDC, but the inspection and adjustment must be carried out with the following method.

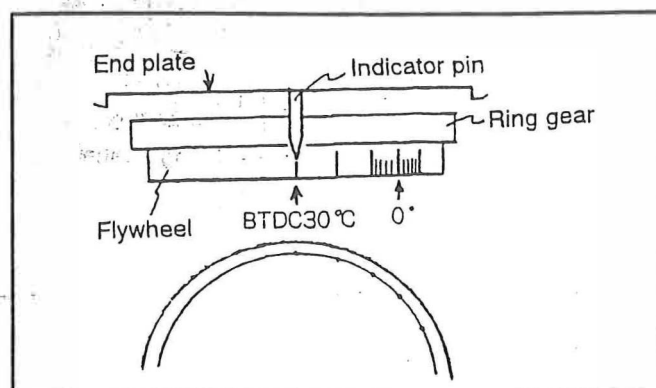
NOTE: Before inspecting the injection timing, verify that the timing marks on the timing gear case and injection pump flange align.

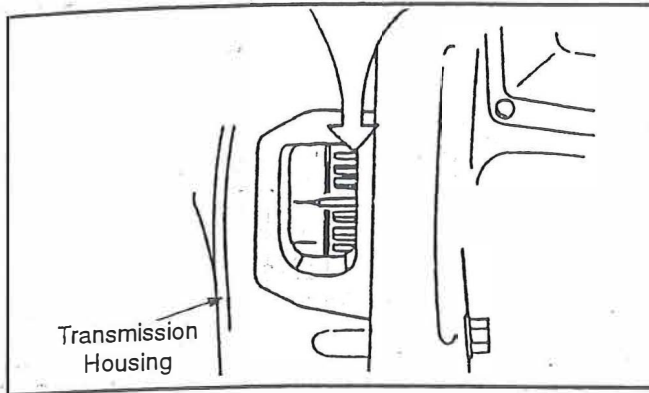
INSPECTION OF THE INJECTION TIMING

- Remove the floor plate.
- Rotate the flywheel forward (CCW), and set the indicator pin to 30° BTDC.

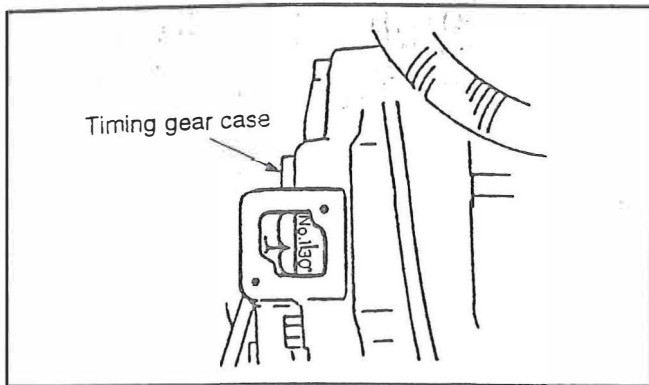
NOTE: Normal engine direction of rotation (forward rotation) is counterclockwise viewed from rear of engine / flywheel.

NOTE: The number 1 cylinder must be on the compression stroke, during this procedure. This can be verified with the use of a compression gauge or by ensuring that both the intake and the exhaust valves are closed with the number 1 piston at Top Dead Center.





3. Remove the cover from the timing gear case on the pump side. Verify that the marks on the case and timer circumference are aligned.

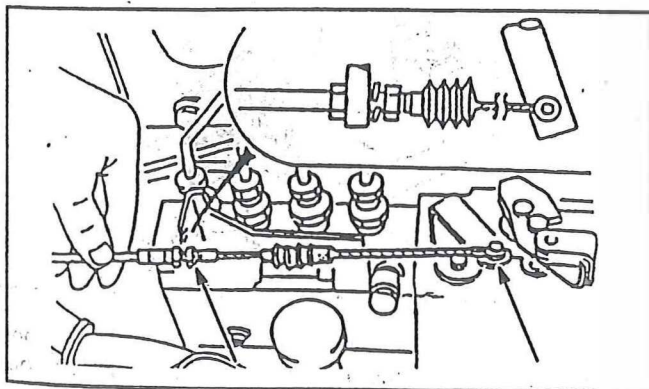


If they match, the number 1 cylinder is set at 30° BTDC, and the injection timing is correct. (Injection pump timing is set at 9° BTDC.)

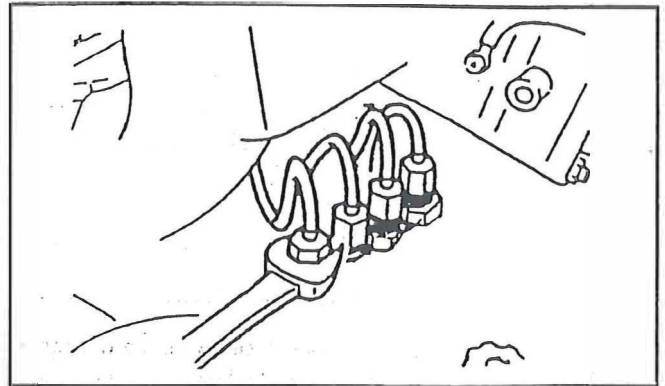
Maximum allowable variation: $\pm 2^\circ$.

ADJUSTMENT OF THE INJECTION TIMING

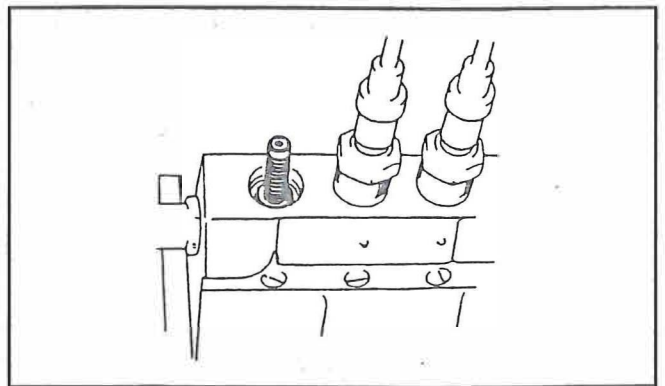
1. Remove the fuel stop cable from the fuel stop bracket and from the fuel stop arm at the fuel injection pump.
2. Remove the fuel stop bracket from the injection pump.



3. Loosen the number 2, 3 and 4 injector fuel lines at the pump side.



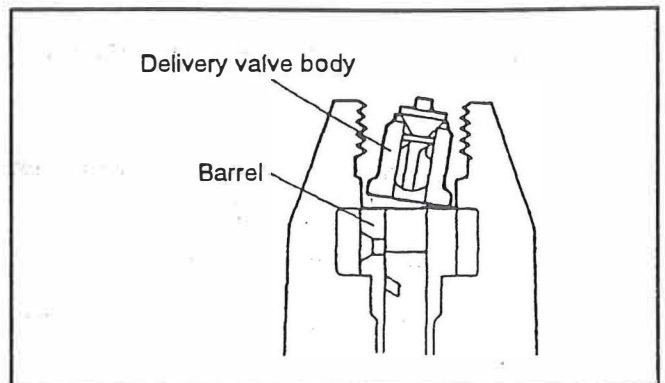
4. Remove the number 1 injector fuel line, and remove the delivery valve holder.



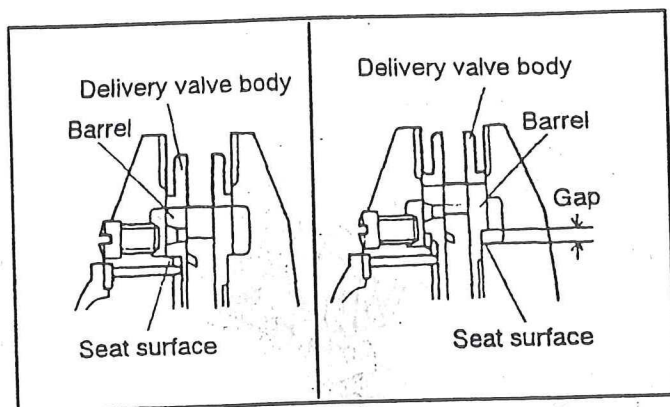
5. Remove the delivery valve stopper and spring.



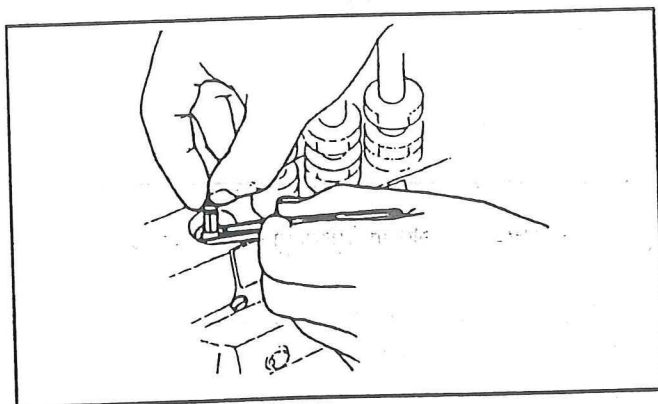
CAUTION: Do not move the delivery valve body when removing the above parts.



6. Position the delivery valve body at an angle to one side in order to break the surface tension between the delivery valve body and the plunger barrel.



CAUTION: Failure to separate the delivery valve body from the plunger barrel as previously described can cause the plunger barrel to lift or float when the delivery valve is removed. If the plunger barrel lifts or floats during removal of the delivery valve body, the plunger barrel can become unseated. A gap will be created between the plunger barrel and the seat. The plunger barrel will not reseat even when the delivery valve holder is reinstalled. A gap between the plunger barrel and the seat will allow diesel fuel to flow into the lubricating oil cavities inside the injection pump. Contamination or dilution of the engine oil will result in injection pump and / or engine failure.



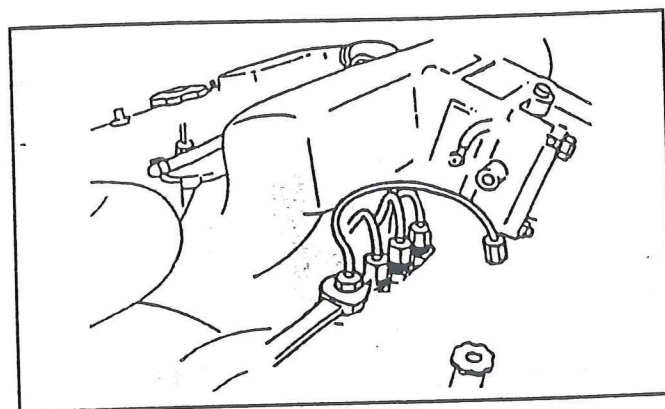
7. Hold down the flat washer with tweezers, and remove the delivery valve.



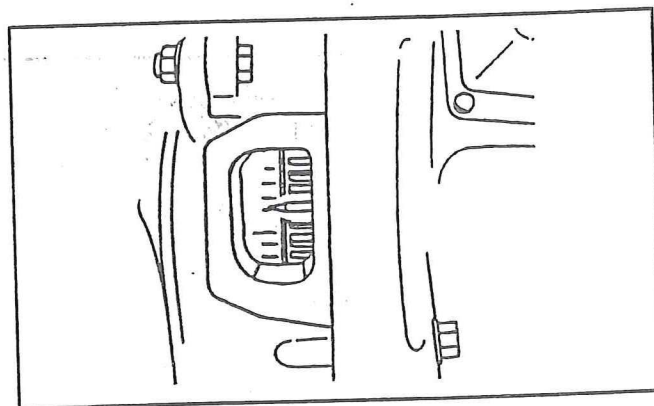
CAUTION: Do not touch the finished surfaces on the delivery valve during this procedure.

8. Reinstall the delivery valve holder.
9. Reinstall the number 1 injector fuel line to the delivery valve holder side.

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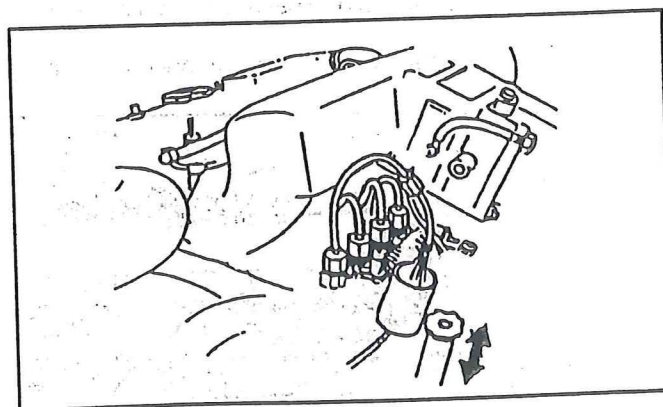


The opposite end of the fuel line must face out as shown in the illustration.



10. Rotate the flywheel forward (CCW), and set it 12° to 13° in front of the injection timing mark 9° BTDC. (21° to 22° BTDC).

NOTE: The number 1 cylinder must be on the compression stroke, during this procedure. This can be verified with the use of a compression gauge or by ensuring that both the intake and the exhaust valves are closed with the number 1 piston at Top Dead Center.



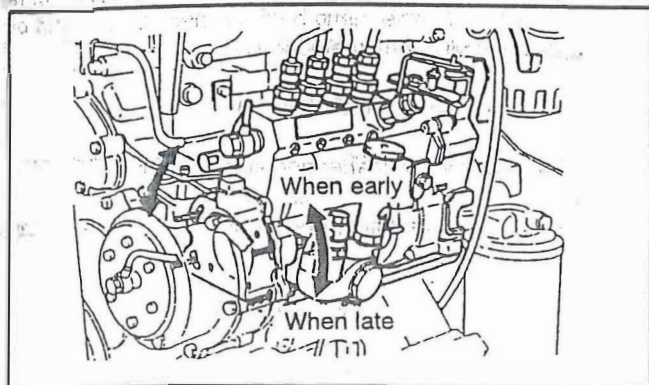
11. Place a container below the open end of the number 1 injector fuel line. Pump the priming pump, and verify that fuel flows out.

12. Slowly, manually (by hand) rotate the flywheel forward (CCW) while pumping the priming pump, and verify that the fuel flow stops at 9° BTDC.

13. To adjust the injection timing, loosen the four injection pump mounting nuts and the governor bracket. Turn the pump unit to the position where the fuel flow stops.

When early – Turn right (looking from fan)

When late – Turn left (looking from fan)

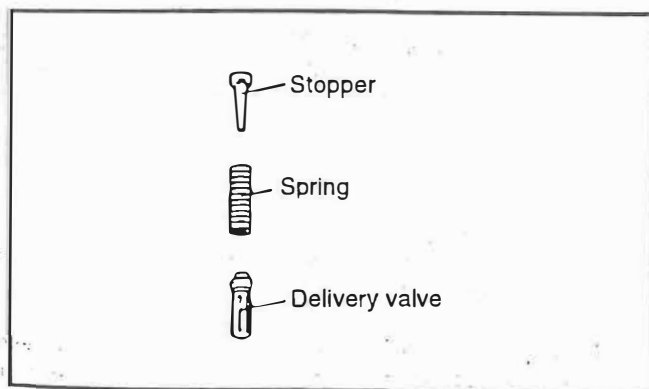


14. Tighten the nuts after adjustment.

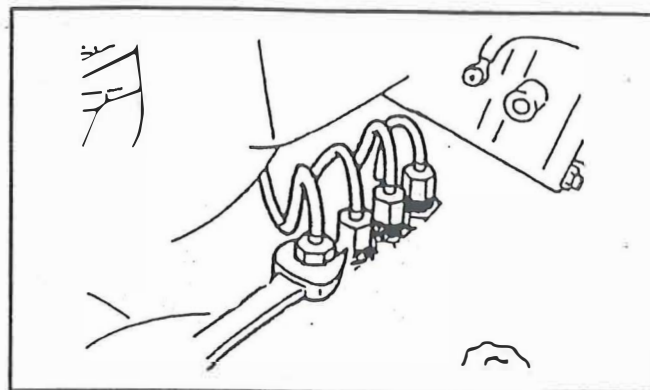
Tightening torque: 3.5-4.0 kgm / (35-25 lbf ft)

15. Mark the pump flange and pump body.

16. Reassemble the delivery valve, spring and stopper.



17. Tighten the delivery valve holder to the specified torque.
Tightening torque: 4.0-4.5 kgm / (29-33 lbf ft)

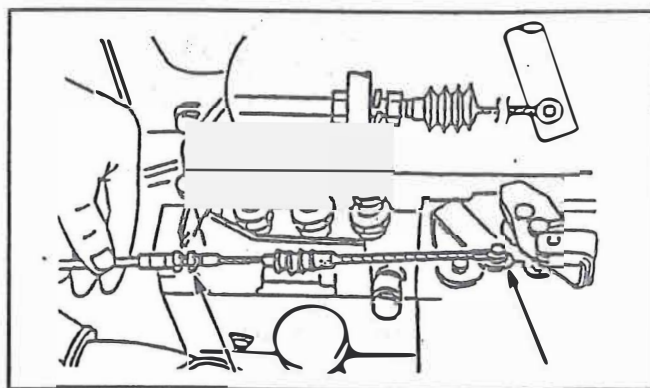


18. Install the number 1 injector fuel line.

Tightening torque: 2.5-3.0 kgm / (19-22 lbf ft)

19. Tighten the number 2, 3 and 4 injector fuel lines (pump side).

Tightening torque: 2.5-3.0 kgm / (19-22 lbf ft)



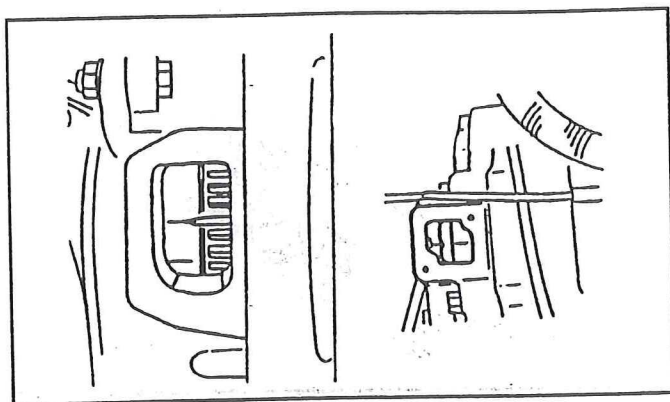
20. Install the fuel stop bracket.

21. Install the fuel stop cable to the fuel stop arm.

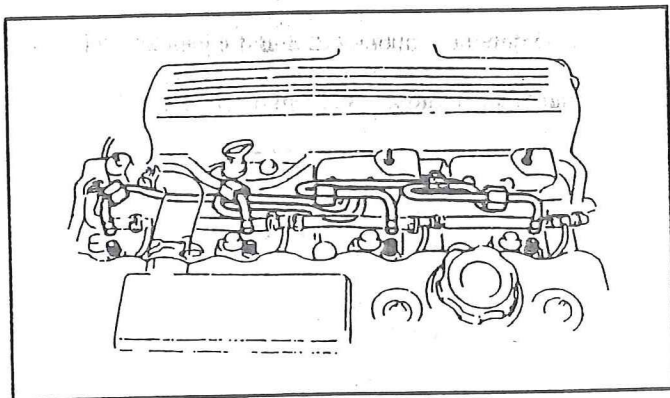
22. Turn the ignition switch on to energize the fuel stop motor. Pull the fuel stop cable housing to extend the fuel stop cable completely. Install the cable housing on the fuel stop bracket. Check the adjustment of the fuel stop cable. See: "**FUEL STOP CABLE INSPECTION AND ADJUSTMENT**".

23. Install the cover on the timing gear case.

24. Bleed the air from the fuel system. See: "**BLEEDING AIR FROM THE FUEL SYSTEM**" for the complete procedure.



25. Loosen the four flare nuts for the injection pipes.



26. Crank the engine. Verify that no air and only fuel is discharged from the injector fuel lines.
27. Install the injection pipe flare nuts.
Tightening torque: 2.5-3.0 kgm / (19-22 lbf ft)
28. Start the engine, and verify there are no fuel leaks.

INJECTION PUMP REMOVAL / REPLACEMENT / INSTALLATION

FUEL INJECTION PUMP ASSEMBLY REMOVAL



WARNING: The fuel injection pump is heavy. Be sure that all lifting devices (hoists, cables, chains, slings etc.) are suitable and of adequate capacity to lift the fuel injection pump. The fuel injection pump can weigh approximately 17 kg (38 lb).



CAUTION: Servicing of the internal components of the injection pump is not recommended except by an authorized service facility. Special tools and testing equipment are required to service the pump's internal parts.

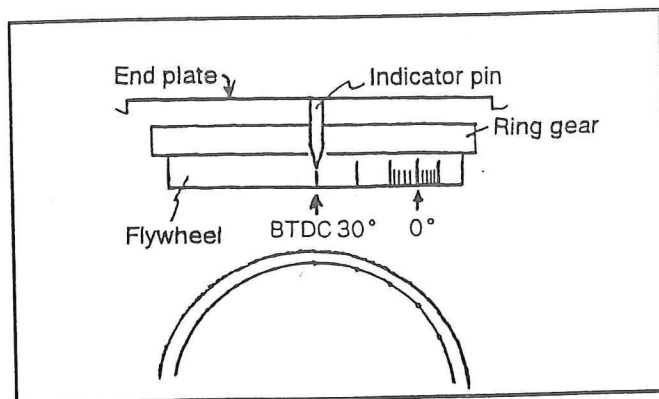


CAUTION: Prior to removing the fuel injection pump it is necessary to align the flywheel and injection pump timing marks. This is necessary to ensure the correct injection pump timing at reinstallation.



CAUTION: Always place a suitable container below the pump before removal. Fuel and oil will spill during the operation.

1. Remove the battery's minus (-) cable.
2. Remove the air cleaner and air cleaner hose.
3. Remove the fuel filter from the air cleaner bracket. (Vehicle side)
4. Remove the accelerator cable and fuel stop cable.
5. Remove the air cleaner bracket and fuel stop motor bracket.

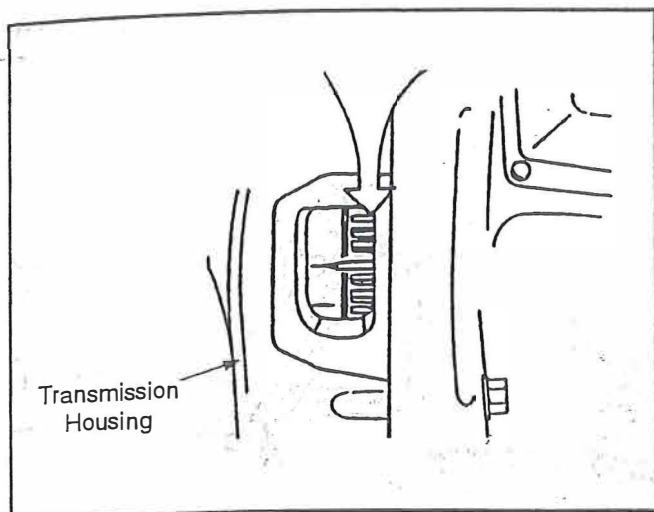


6. Remove the floor plate and rotate the flywheel forward. Set the number 1 cylinder (indicator pin) to 30° BTDC.

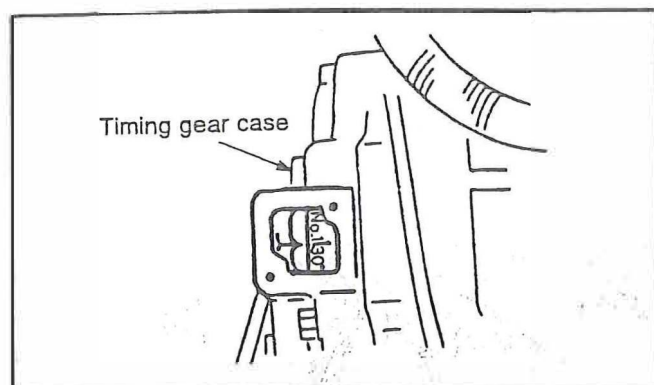
NOTE: The number 1 cylinder must be on the compression stroke, during this procedure. This can be verified with the use of a compression gauge or by ensuring that both the intake and the exhaust valves are closed with the number 1 piston at Top Dead Center.

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7. Remove the access cover on the timing gear case (located on the pump side). Verify that the markings on the timer circumference and the peep hole notch match. (30° BTDC)
Maximum allowable variation: $\pm 2^\circ$.



NOTE: If the markings do not match, the number 4 cylinder instead of the number 1 cylinder, may be set at 30° BTDC. Repeat the procedure starting from step number 6.

8. Remove the fuel injection pump with the procedure shown on the following page.



WARNING: The fuel injection pump is heavy. Be sure that all lifting devices (hoists, cables, chains, slings etc.) are suitable and of adequate capacity to lift the fuel injection pump. The fuel injection pump can weigh approximately 17 kg (38 lb).

Remove the injection pipe, fuel pipe and oil pipe, etc. Remove the injection pump and timing gear case installation bolts and nuts, and then, remove the injection pump assembly.

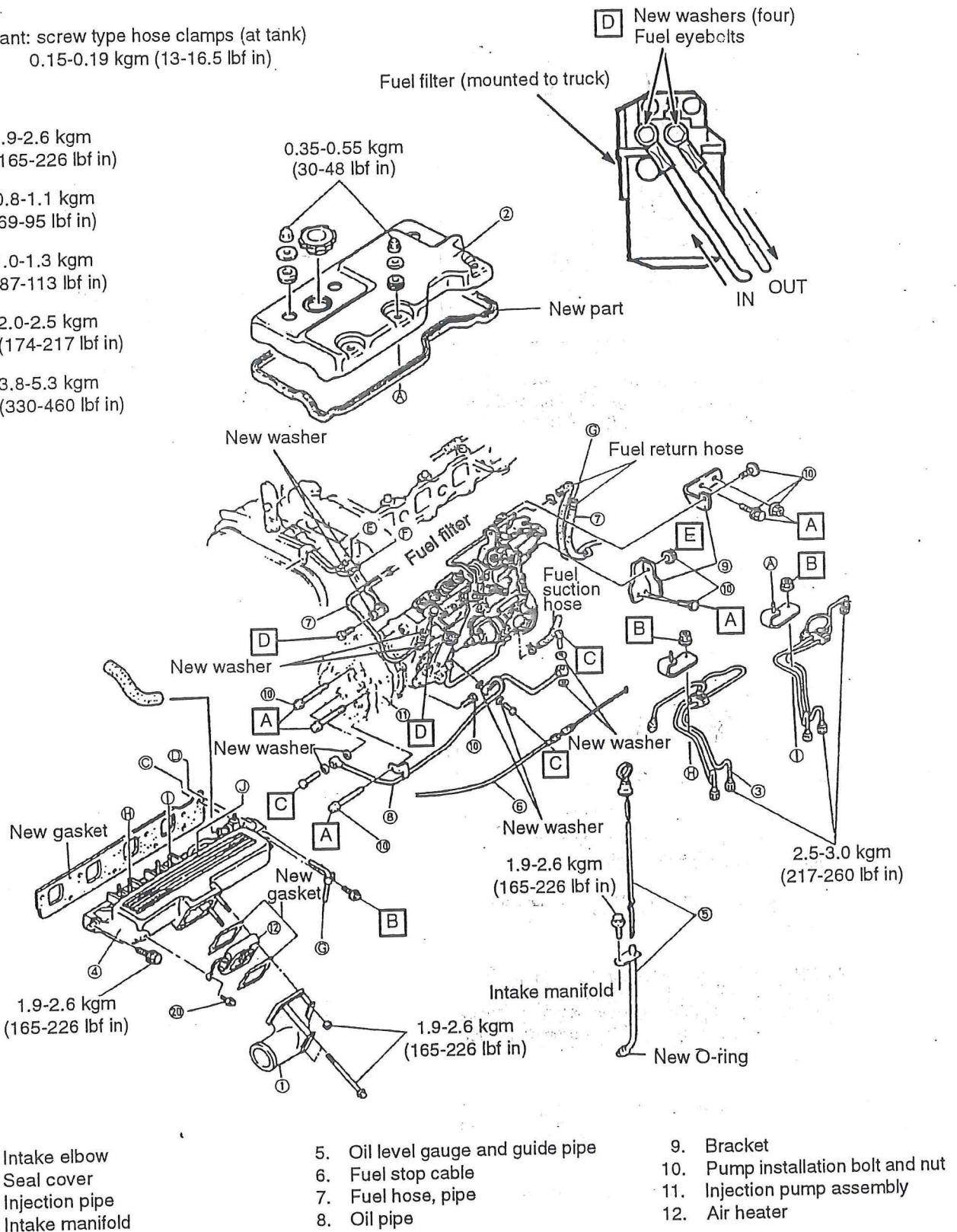
NOTE: Cover the intake manifold and injector fuel lines so that foreign matter cannot enter.

NOTE: Do not crank the engine after removing the pump.

INJECTION PUMP ASSEMBLY AND TORQUE VALUE ILLUSTRATION

Important: screw type hose clamps (at tank)
0.15-0.19 kgm (13-16.5 lbf in)

- A** 1.9-2.6 kgm
(165-226 lbf in)
- B** 0.8-1.1 kgm
(69-95 lbf in)
- C** 1.0-1.3 kgm
(87-113 lbf in)
- D** 2.0-2.5 kgm
(174-217 lbf in)
- E** 3.8-5.3 kgm
(330-460 lbf in)



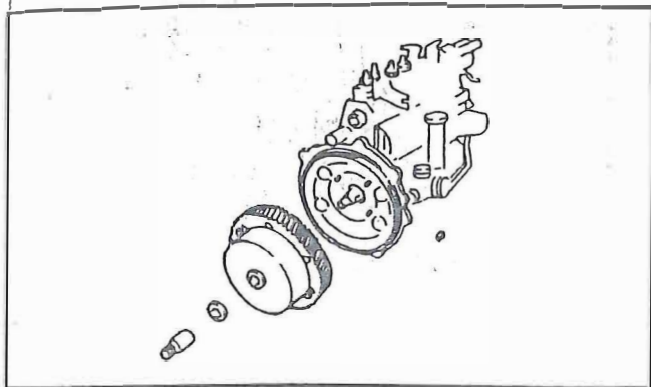
INJECTION PUMP REPLACEMENT



WARNING: The fuel injection pump is heavy. Be sure that all lifting devices (hoists, cables, chains, slings etc.) are suitable and of adequate capacity to lift the fuel injection pump. The fuel injection pump can weigh approximately 17 kg (38 lb).

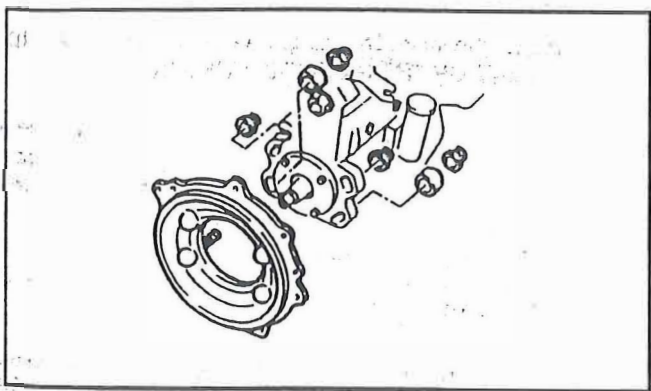
NOTE: Always use a protector over the jaws of the vice as shown in the illustration.

1. Clamp the injection pump timer in the vice, and remove the timer fastening bolt.



2. Remove the timer and gear assembly from the pump assembly.

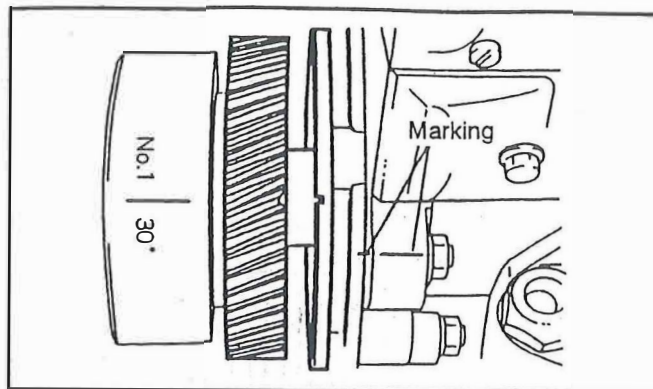
3. Remove the woodruff key from the pump shaft.



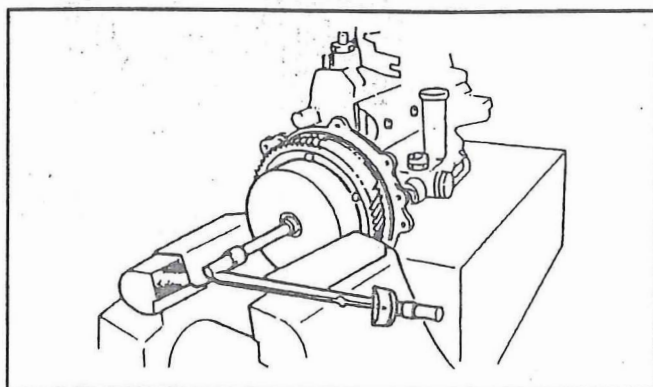
4. Remove the flange plate.

5. Clamp the replacement injection pump in the vice. Install the flange plate. Align the marks on the pump and flange plate. Tighten the four nuts to the specified torque.

Tightening torque: 3.5-4.0 kgm / (35-25 lbf ft)



6. Insert the woodruff key into the pump shaft. Install the timer and gear assembly on the pump shaft.



7. Temporarily tighten the timer retaining bolt. Clamp the timer in the vice, and tighten the bolt to the specified torque.
Tightening torque: 6.0-7.0 kgm / (43-51 lbf ft)

INJECTION PUMP INSTALLATION AND SETUP

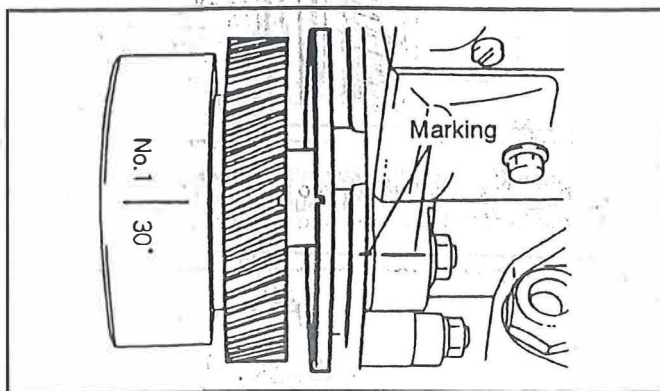
1. Installation is the reverse of removal. Install the fuel injection pump by using the removal procedures in reverse. The following **NOTES**, and **PROCEDURES** must be followed during installation.

NOTE: The injection pump timing must be adjusted after the injection pump is installed. The injection timing is very critical in a direct injection engine. Incorrect adjustment can cause increased engine noise (knock) and / or power loss. Always check the injection timing after installing the pump, and verify that it is correct. See: "INSPECTION AND ADJUSTMENT OF THE INJECTION TIMING".

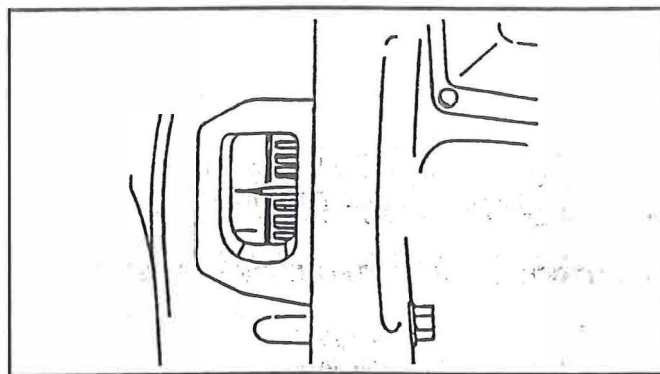
NOTE: The air must be bled from the fuel system after the injection pump is installed. See: "BLEEDING AIR FROM THE FUEL SYSTEM".

NOTE: The engine idle speed must be adjusted after the injection pump is installed. See: **"INSPECTION AND ADJUSTMENT OF THE ENGINE IDLE"**.

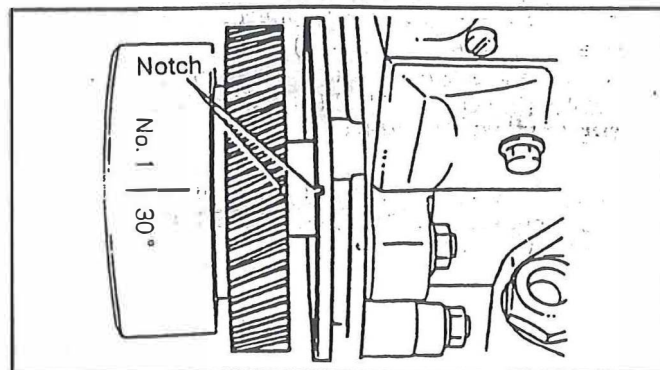
NOTE: Before installing the injection pump or inspecting the injection timing, verify that the timing marks on the injection pump case and injection pump flange are aligned.



2. Using the flywheel indicator pin, verify that number 1 cylinder is at the 30° BTDC position on the flywheel side before assembling the injection pump.



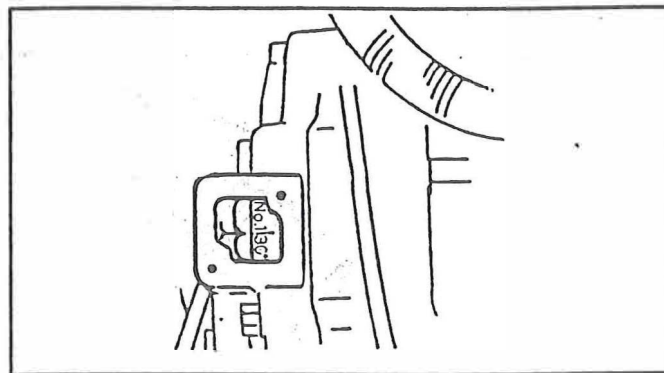
3. Install a new O-ring on the injection pump housing plate. Align the notches on the flange plate and gears. Install the injection pump into the timing gear case.



NOTE: Helical gears are used. Take care to prevent misalignment during installation into the timing gear case. The pump timer 30° BTDC mark must align with the timing gear case pointer, when the pump is installed in the timing gear case.

4. Install the timing gear case bolts and hand tighten to draw the pump flange against the timing gear case. Verify that the mark on the pump timer circumference aligns with the timing gear case pointer. Check alignment through the timing gear case access hole.

Maximum allowable variation: $\pm 2^\circ$.



5. Tighten the timing gear case bolts.

Tightening torque: 1.9-2.6 kgm / (165-225 lbf in)

6. Install the injector fuel lines. Install the remaining fuel lines. Complete installation by referring to the **"INJECTION PUMP REMOVAL PROCEDURE"** and reinstalling the remaining parts in the reverse order of removal.

7. Adjust the injection timing. See: **"INSPECTION AND ADJUSTMENT OF THE INJECTION TIMING"**.

8. Install the accelerator cable and fuel stop cable. Check the accelerator cable adjustment at the fuel injection pump. The throttle arm on the fuel injection pump must be allowed to completely return to the idle position with the accelerator pedal in the full up position. The throttle arm on the fuel injection pump must move to the full speed position with the accelerator pedal in the full down position.

9. Install the air cleaner bracket and stop motor bracket. Adjust the fuel stop cable. See: **"FUEL STOP CABLE INSPECTION AND ADJUSTMENT"** for adjustment procedures on the fuel stop cable.

10. Install the fuel filter and air cleaner.