3. If excessive air is seen in the sight gauge in the fuel return line, install a second sight gauge at the inlet to the fuel transfer pump. If a second sight gauge is not available, move the sight gauge from the fuel return line and install the sight gauge at the inlet to the fuel transfer pump. Observe the fuel flow during engine cranking. Look for air bubbles in the fuel. If the engine starts, check for air in the fuel at varying engine speeds.

   If excessive air is not seen at the inlet to the fuel transfer pump, the air is entering the system after the fuel transfer pump. Refer to the Testing and Adjusting, "Fuel System - Prime".

   If excessive air is seen at the inlet to the fuel transfer pump, air is entering through the suction side of the fuel system.

WARNING

To avoid personal injury, always wear eye and face protection when using pressurized air.

NOTICE

To avoid damage, do not use more than 55 kPa (8 psi) to pressurize the fuel tank.

4. Pressurize the fuel tank to 35 kPa (5 psi). Do not use more than 55 kPa (8 psi) in order to avoid damage to the fuel tank. Check for leaks in the fuel lines between the fuel tank and the fuel transfer pump. Repair any leaks that are found. Check the fuel pressure in order to ensure that the fuel transfer pump is operating properly. For information about checking the fuel pressure, see Testing and Adjusting, "Fuel System Pressure - Test".

5. If the source of the air is not found, disconnect the supply line from the fuel tank and connect an external fuel supply to the inlet of the fuel transfer pump. If this corrects the problem, repair the fuel tank or the stand pipe in the fuel tank.

i01893314

Finding Top Center Position for No. 1 Piston

Table 1

Required Tools		
Part Number	Part Description	Qty
27610211	Crankshaft timing pin	1
27610212	Camshaft timing pin	1

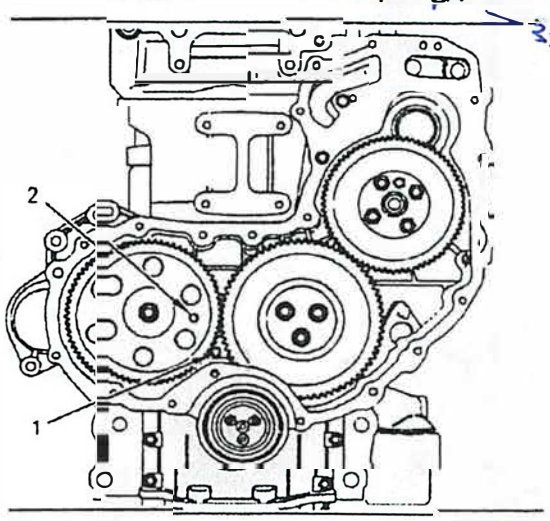

Illustration 17 g00923030

(1) Hole for crankshaft pin
(2) Hole for camshaft pin

1. Remove the valve mechanism cover, the glow plugs, and the cover for the front housing.

Note: The crankshaft timing pin can be inserted with the crankshaft pulley still on the engine.

2. Rotate the crankshaft in the normal direction of the engine until the inlet valve of the No. 4 cylinder has just opened and the exhaust valve of the No. 4 cylinder has not completely closed.

3. Carefully rotate the crankshaft in the normal direction of the engine in order to align the hole in the crankshaft with the hole in the cylinder block and the timing case. Insert the **27610211** Crankshaft Timing Pin fully into the hole in the crankshaft web.

4. Insert the **27610212** Camshaft Timing Pin through the hole in the camshaft gear and into the body of the timing case. The engine is set at the top center position for No. 1 piston.

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4. Remove the plug (1) and the washer from the rear of the fuel injection pump and install **27610248** fuel injection pump timing adapter (2). Install a suitable dial indicator (3) into **27610248** fuel injection pump timing adapter. Set the dial indicator to approximately 3 mm (0.1181 inch).

5. Ensure that the timing pins have been removed from the engine.

6. Rotate the crankshaft counterclockwise when the crankshaft is viewed from the front of the engine. Carefully rotate the crankshaft until the dial indicator (3) indicates that the plunger of the fuel injection pump is at the bottom. Set the dial indicator (3) to zero.

7. Rotate the crankshaft clockwise, until the required lift on the plunger is achieved. Refer to Specifications, "Fuel Injection Pump" for the correct reading.

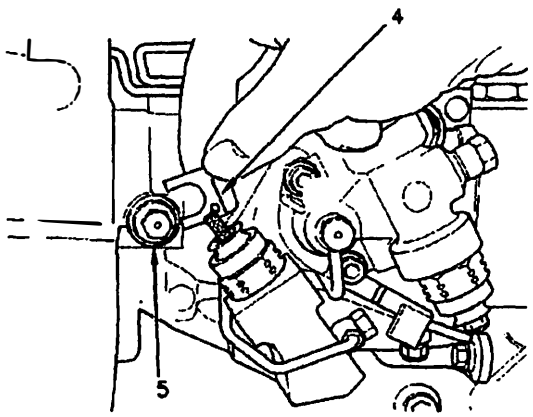

Illustration 22 g00996240

(4) Washer
(5) Locking screw

8. Lock the fuel injection pump shaft.
In order to lock the shaft of the Bosch EPVE fuel injection pump, loosen the locking screw (5) and remove the washer (4). Tighten the locking screw to 31 N·m (23 lb ft). Ensure that the needle of the dial indicator has not moved.

9. Remove the water pump. Refer to Disassembly and Assembly, "Water Pump - Remove and Install"

10. Remove the front cover. Refer to Disassembly and Assembly, "Front Cover - Remove and Install".

11. Remove the fuel injection pump gear. Refer to Disassembly and Assembly, "Fuel Injection pump - Remove".

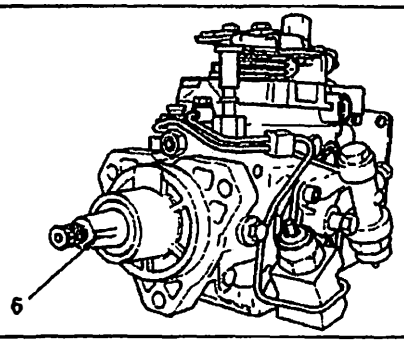

Illustration 23 g00996242

(6) Keyway

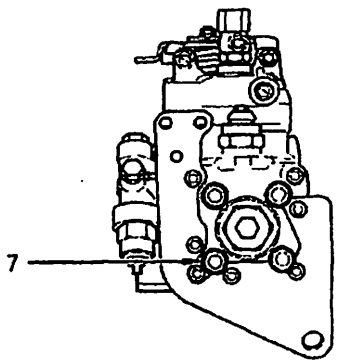

Illustration 24 g00996245

(7) Outlet

Note: A key should not be installed in the keyway (6).

Note: If the fuel injection pump is on the correct stroke, the keyway (6) is toward the outlet (7).

12. Set the number one piston at the top center piston on the compression stroke. Refer to Testing and Adjusting, "Finding Top Center Position for the No. 1 Pistion" for the procedure.

13. Install the fuel injection pump gear. Refer to Disassembly and Assembly, "Fuel Injection pump - Install".

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14. Install the front cover. Refer to Disassembly and Assembly, "Front Cover - Remove and Install".

15. Install the water pump. Refer to Disassembly and Assembly, "Water Pump - Remove and Install".

16. Install a new washer to the plug and install the plug in the back of the fuel injection pump. Refer to Specifications, "Fuel Injection Pump" for the correct torque.

17. Install the rocker shaft. Refer to Disassembly and Assembly, "Rocker Shaft and Pushrods".

18. Install the high pressure fuel lines on the fuel injection pump. Eliminate all air from the fuel system. Refer to Testing and Adjusting, "Fuel System - Prime".

i01944302

Fuel Quality - Test

Use the following procedure to test for problems regarding fuel quality:

1. Determine if water and/or contaminants are present in the fuel. Check the water separator (if equipped). If a water separator is not present, proceed to Step 2. Drain the water separator, if necessary. A full fuel tank minimizes the potential for overnight condensation.

Note: A water separator can appear to be full of fuel when the water separator is actually full of water.

2. Determine if contaminants are present in the fuel. Remove a sample of fuel from the bottom of the fuel tank. Visually inspect the fuel sample for contaminants. The color of the fuel is not necessarily an indication of fuel quality. However, fuel that is black, brown, and/or similar to sludge can be an indication of the growth of bacteria or oil contamination. In cold temperatures, cloudy fuel indicates that the fuel may not be suitable for the operating conditions. Refer to Operation and Maintenance Manual, "Fuel Recommendations" for more information.

3. If fuel quality is still suspected as a possible cause of problems regarding engine performance, disconnect the fuel inlet line, and temporarily operate the engine from a separate source of fuel that is known to be good. This will determine if the problem is caused by fuel quality. If fuel quality is determined to be the problem, drain the fuel system and replace the fuel filters. Engine performance can be affected by the following characteristics:

- Cetane number of the fuel
- Air in the fuel
- Other fuel characteristics

i01958110

Fuel System - Prime

If air enters the fuel system, the air must be purged before the engine can be started. Air can enter the fuel system when the following events occur:

- The fuel tank is empty or the tank has been partially drained during normal operation.
- The low pressure fuel lines are disconnected.
- A leak exists in the low pressure fuel system during engine operation.
- The fuel filter or the fuel pump is replaced.
- The high pressure fuel lines are disconnected.

Delphi DP210

The Delphi fuel pump will eliminate the air from the fuel system automatically. Position the starting switch to the RUN position for three minutes. Air in the fuel and the fuel lines will be purged from the system.

Bosch EVPE

The Bosch EPVE fuel pump will not eliminate air automatically from the fuel system. the following procedure must be used.

- Remove the valve mechanism cover.
- Turn the start switch to the RUN position for three minutes. Then return the start switch to the OFF position.
- Loosen the high pressure lines at the fuel injectors.
- Operate the starting motor until fuel free from air comes from the connections.
- Tighten the connections for the fuel injectors. Refer to Specifications, "Fuel injection Lines".
- Operate the engine and check for leaks.
- Fit the valve mechanism cover.

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5. Rotate the crankshaft clockwise, until the crankshaft timing pin can be pushed into the hole in the crankshaft web.

6. With the engine set at the Top Center Position for the No. 1 piston, check the reading on the dial indicator (3). Refer to Specifications, "Fuel Injection Pump" for the correct reading for the plunger.

7. If the fuel injection pump timing is correct remove the dial indicator (3). Remove **27610248** fuel injection pump timing adapter from the fuel injection pump. Install a new washer to the plug and install the plug in the back of the fuel injection pump. Refer to Specifications, "Fuel Injection Pump" for the correct torque

8. Install the high pressure fuel lines on the fuel injection pump. Eliminate all air from the fuel system. Refer to Testing and Adjusting, "Fuel System - Prime".

9. If the fuel injection pump timing is incorrect, refer to Testing and Adjusting, "Fuel Injection Pump Timing - Adjust".

i01912949

Fuel Injection Pump Timing - Adjust

Delphi DP210 Series Fuel Injection Pump

The Delphi DP210 Series fuel injection pump must be serviced by an authorized Delphi technician. For repair information, contact your Perkins dealer or your Perkins distributor. The internal adjustment for the pump timing is tamper proof. High idle and low idle of the fuel injection pump are factory set. Idle adjustments can not be made to the fuel pump.

Bosch EPVE Fuel Injection Pump

Note: The Bosch EPVE fuel injection pump is only installed on the 1104 engine.

Table 3

Required Tools		
Part Number	**Part Description**	**Qty**
27610248	Bosch EPVE fuel injection pump timing adapter	1

Note: This procedure must only be carried out by a person with the correct training.

Note: Do not rotate the fuel injection pump if the fuel injection pump shaft is locked.

1. Set the number one piston at the top center on the compression stroke. Refer to Testing and Adjusting, "Finding Top Center Position for the No. 1 Pistion" for the procedure.

2. Remove the rocker shaft. Refer to Disassembly and Assembly, "Rocker Shaft and Pushrods"

3. Remove the high pressure fuel lines from the fuel injection pump.

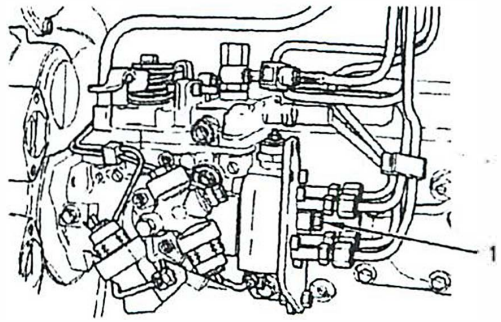

Illustration 20 g00996226

(1) Plug

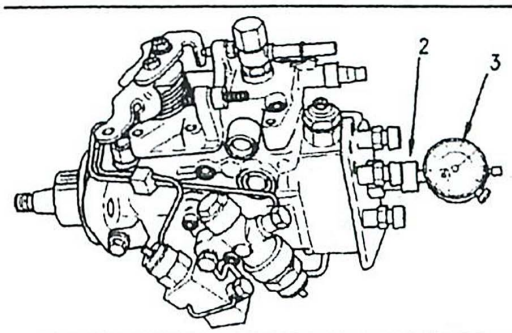

Illustration 21 g00996227

(2) Bosch EPVE fuel injection timing adapter
(3) Dial indicator

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