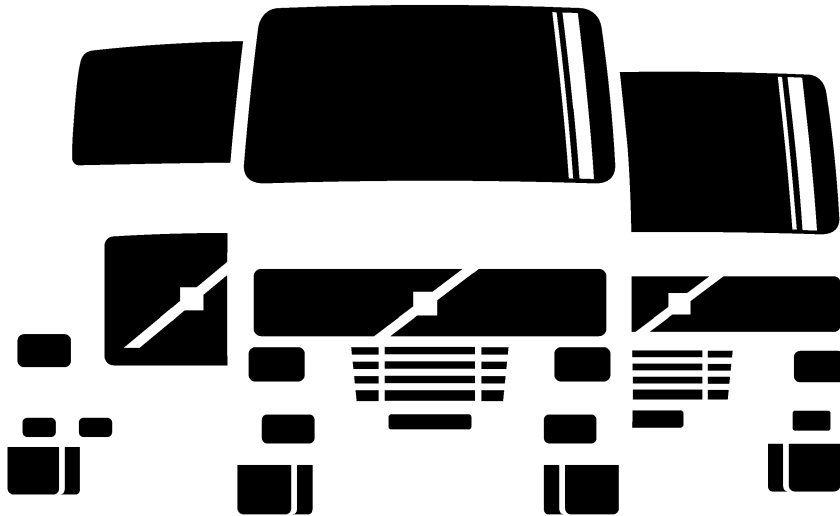


# Service Manual Trucks

Group **230–600**

Fuel System  
D12, D12A, D12B, D12C



# Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to August 2000.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an S.R.T. (Standard Repair Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an S.R.T.

The following levels of observations, cautions and warnings are used in this Service Documentation:

**Note:** Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

**Caution:** Indicates an unsafe practice where damage to the product could occur.

**Warning:** Indicates an unsafe practice where personal injury or severe damage to the product could occur.

**Danger:** Indicates an unsafe practice where serious personal injury or death could occur.

**Volvo Trucks North America, Inc.**  
Greensboro, NC USA

**Order number: PV776-TSP142867**

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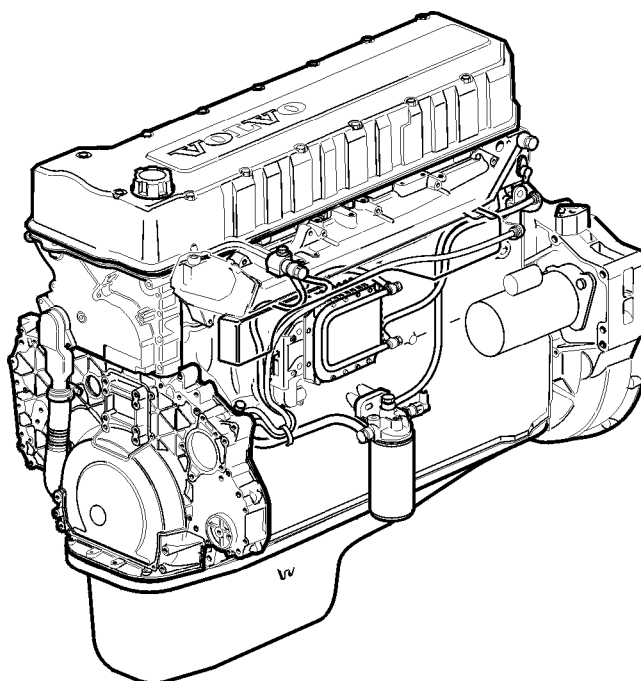
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## **Feedback**

## **Operation Numbers**

# General



W2003244

This information covers the fuel system of the Volvo D12 engine and includes engine versions D12, D12A, D12B, and D12C.



# Specifications

## Fuel System

Component	Nm	ft-lb
Retainer bolt unit injector w/ NEW COPPER SLEEVE		
First tightening Step 1	20 ± 5	15 ± 4
First tightening Step 2	Turn an additional 180 ± 5°	
Loosen the retainer bolt for the unit injector prior to the second tightening.		
Second tightening Step 1	20 ± 5	15 ± 4
Second tightening Step 2	Turn an additional 60 ± 5°	
Component	Nm	ft-lb
Retainer bolt unit injector w/ OLD COPPER SLEEVE		
Step 1	20 ± 5	15 ± 4
Step 2	Turn an additional 60 ± 5°	

## Fuel Supply Pump and Overflow Valve

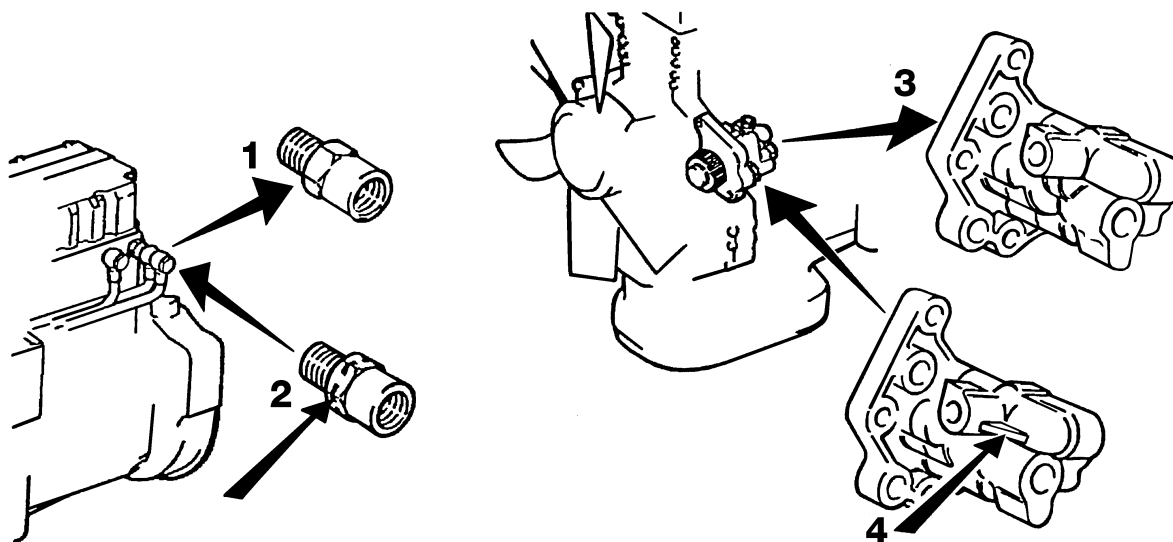
### Fuel Supply Pressure

Engine number .....	up to 98799	from 98800
Minimum supply pressure at full load .....	250 kPa (36 psi)	350 kPa (51 psi)

### Overflow Valve

Engine number .....	up to 98799	from 98800
Opening pressure .....	300-350 kPa (44-51 psi)	340-450 kPa (50-65 psi)

## Identifying 450 kPa (65 psi) Fuel System Components

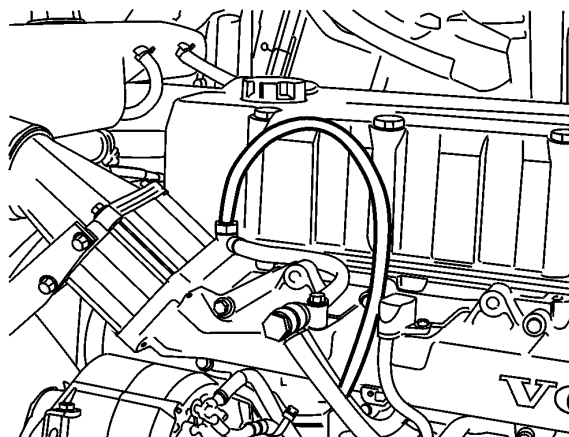


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Fig. 1: Fuel System Components

- 1 350 kPa (51 psi) overflow valve\*
- 2 New 450 kPa (65 psi) overflow valve can be identified by the groove cut into the hex portion of the valve as shown above.\*
- 3 350 kPa (51 psi) fuel pump.
- 4 New 450 kPa (65 psi) fuel pump can be identified by the additional web in the casting as shown above.  
(\*D12A/B location shown.)

**Important:** When changing an overflow valve to the new 450 kPa (65 psi) bar version, the fuel pump must also be changed to the 450 kPa (65 psi) version. However, when changing a fuel supply pump to the 450 kPa (65 psi) version, you are not required to change the overflow valve.



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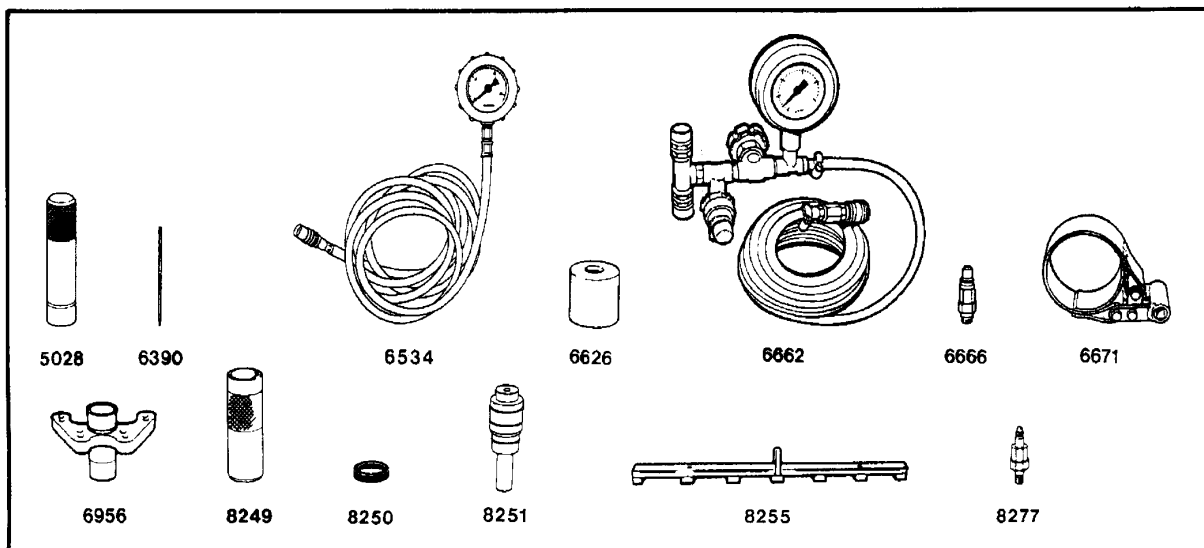
Fig. 2: Overflow valve location, D12C



# Tools

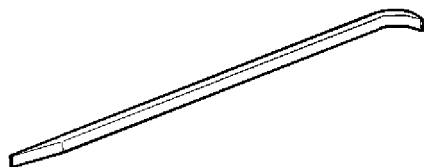
## Special Tools

The following special tools are used to replace or repair components. The tools can be ordered from Volvo Parts North America; please use the specified part number when ordering. Tools with part numbers beginning with "J" are available directly from Kent-Moore (telephone: 1-800-328-6657).



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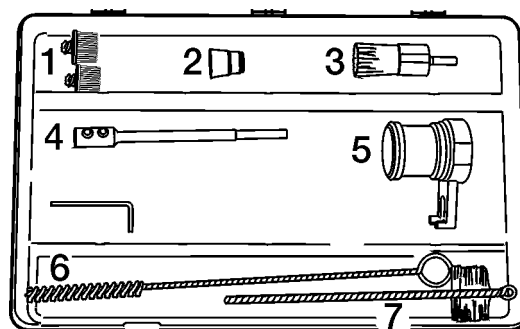
<b>9996390</b>	Drift indicator extension for setting electronic unit injector
<b>9996534</b>	Gauge for checking fuel feed pressure
<b>9996662</b>	Pressure gauge
<b>9996666</b>	Union for checking fuel feed pressure
<b>9996671</b>	Fuel filter removal tool
<b>9996956</b>	Cranking tool for flywheel
<b>9998249</b>	Protective sleeve for electronic unit injector
<b>9998250</b>	Sealing rings for the fuel gallery (2)
<b>9998251</b>	Sealing plug for cylinder head
<b>9998277</b>	Union for draining fuel system
<b>9812546</b>	Cleaning brush
<b>J-41603</b>	Socket
<b>J-41196</b>	Dial indicator



9998511

Lever tool

W0001802

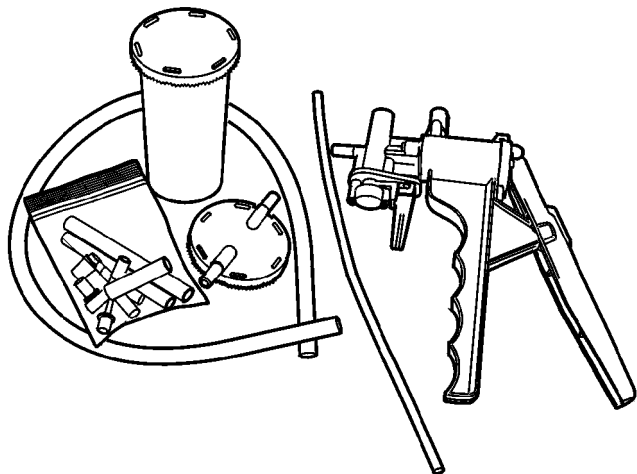


W2003530

9998599

Cleaning kit

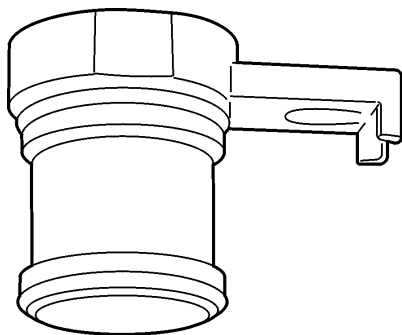
- 1 9808614 — brush
- 2 9808615 — holder
- 3 9808613 — holder
- 4 9808616 — handle
- 5 J-42885-25 — protecting sleeve
- 6 9808617 — brush
- 7 9808618 — brush



J-44515

Fuel vacuum tool

W0001837



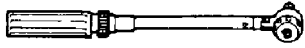
W2003529

J-42885-25

Injector bore protecting sleeve

## Special Equipment

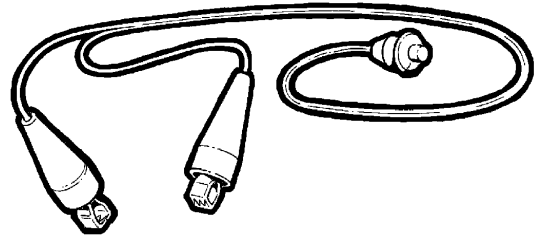
Like the special tools, the following equipment will aid in servicing the D12 engine. When ordering equipment, specify the appropriate number.



W0001840

**1159794**

Torque wrench, 10 – 100 Nm (7 – 70 ft-lb)



W0000399

**MT302A**

SNAP-ON Remote Starter Cable Switch



# Design and Function

## Fuel System

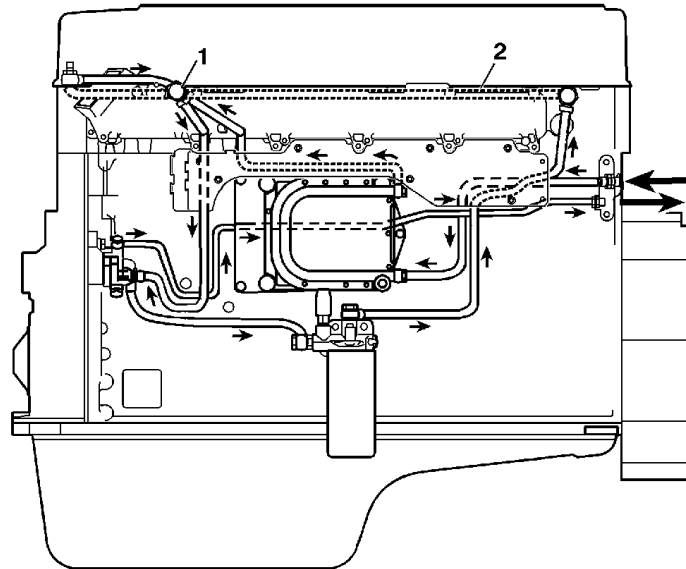


Fig. 3: Fuel system, D12C

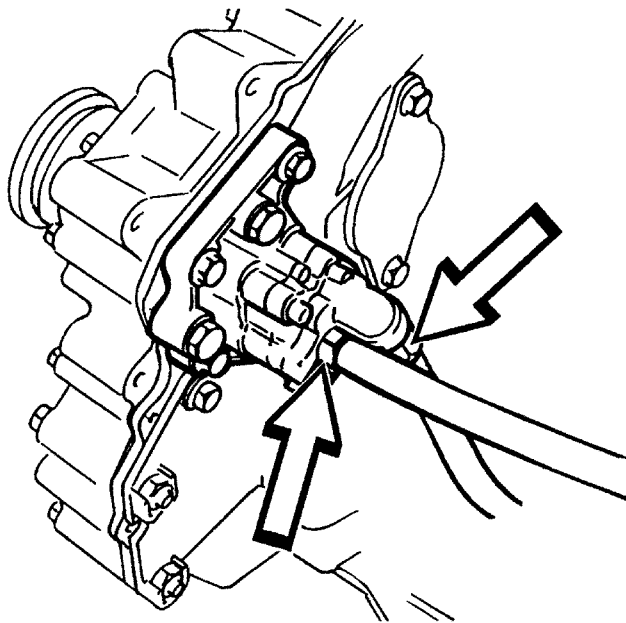
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The Volvo D12 is an electronic engine designed to meet today's high environmental standards. Meeting these standards requires optimum combustion. This demands, among other things, injecting the exact amount of fuel into the combustion chamber under very high pressure, at precisely the correct time, depending on engine speed, load, temperature and other conditions.

Because totally mechanical injection systems cannot meet these demands, the engine is equipped with an electronically controlled injection system. An **engine electronic control unit (EECU)** receives impulses from the accelerator pedal and a number of sensors on the engine. The sensors read signals which govern the injection procedure and send these signals to the EECU. The fuel system has a built-in diagnostic system, which electronically detects and traces any faults in the system.

Each cylinder has four valves. Individual differences always occur between the cylinders in an internal combustion engine. The engine has a cylinder balancing system, the purpose of which is to even out the amounts of fuel between the cylinders. Cylinder balancing takes place with the engine running at idle speed, providing certain preconditions have been met.

## Fuel Line O-Rings

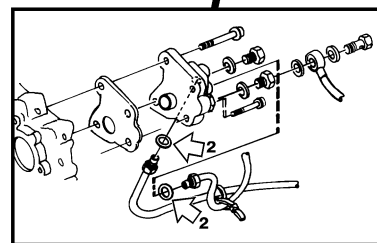
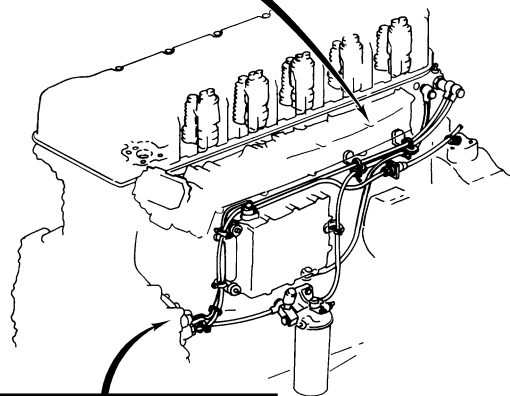
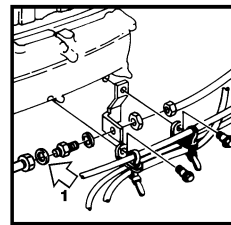


W2002168

Fig. 4: Removing fuel lines

**Always replace the fuel line O-rings when:**

- troubleshooting for fuel aeration and/or
- performing any Service Procedure that requires the removal of VE D12 engine fuel lines.



W2002169

Fig. 5: Fuel line O-ring locations

- 1 976020
- 2 955984

## Unit Injectors

The fuel injection system of the D12 engine uses electronically-governed unit injectors that are electrically activated and mechanically driven via roller rocker arms from the camshaft lobe. They are vertically located in the center between the four valves in the cylinder head for each cylinder.

The electronic unit injector (EUI) combines an injection pump and an injector. An EUI can operate at considerably higher injection pressure than a conventional injector. The EUI consists of three main components:

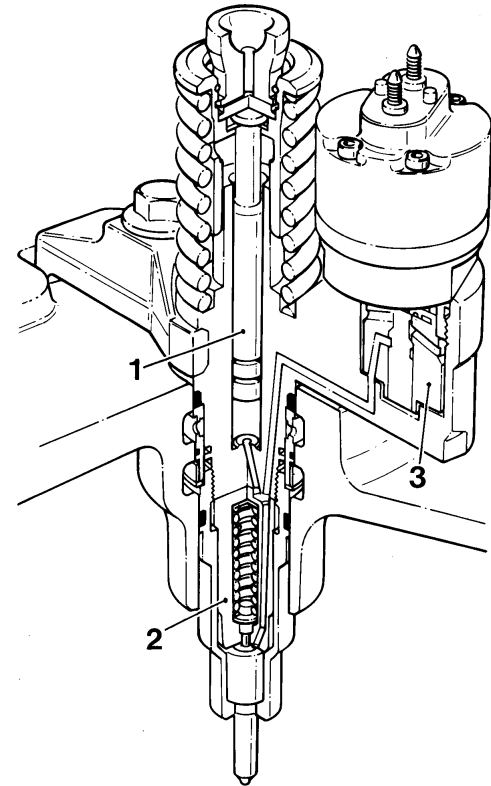
- **Pump** containing a cylinder and piston; this corresponds to the pump assembly in an injection pump.
- **Injector** with nozzle body, nozzle needle and spring.
- **Valve housing** with an electro-magnetically controlled fuel valve.

The upper part of the electronic unit injector, which includes the compression spring and valve housing, lies above the cylinder head.

The center part of the electronic unit injector, where the intake and outlet holes for the fuel are located, lies in the cylinder head fuel gallery. The electronic unit injector takes in fuel directly from the fuel gallery.

The lower part of the EUI is located in a copper sleeve against the bottom of the cylinder head, similar to a standard injector.

The EECU calculates injection timing and the amount of fuel to inject into the cylinder and transmits signals to the electromagnetically controlled fuel valve in the valve housing. The length of the injection time determines the amount of fuel injected into the cylinder.



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Fig. 6: Electronic unit injector (EUI)

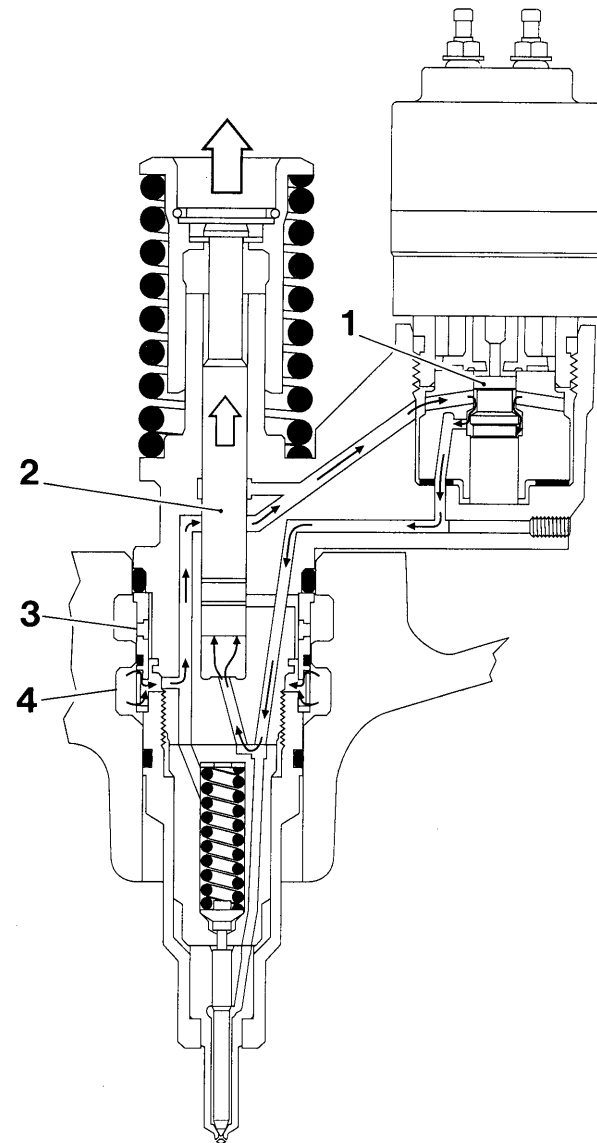
- 1 Pump part
- 2 Injector part
- 3 Valve housing

## Injector Operational Phases

### *Fill Phase*

During the filling phase, the pump plunger (2) is on its way up, the camshaft lobe is passing its highest point, and the rocker arm is on its way toward the camshaft basic circle.

The fuel valve (1) is open, allowing fuel to flow into the EUI from the lower fuel gallery (4). It flows into the cylinder head and the EUI pump cylinder. Filling continues until the pump plunger reaches its upper position.



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Fig. 7: Filling phase

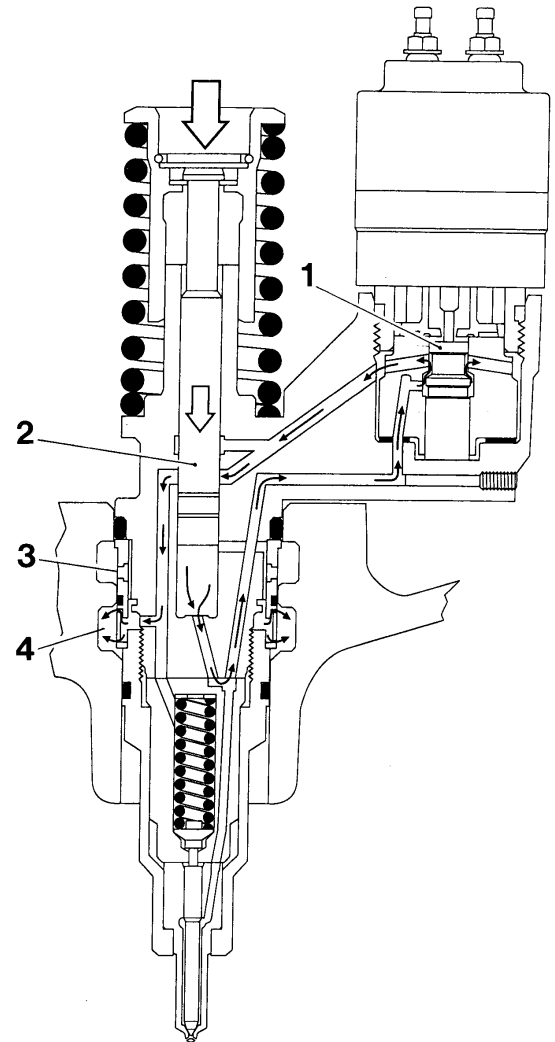
- 1 Fuel valve
- 2 Pump plunger
- 3 Fuel outlet (overflow)
- 4 Fuel gallery (inlet and outlet)



### Spill Phase

The spill phase begins when the camshaft turns to the position at which the camshaft lobe forces the rocker arm to push the pump plunger (2) down.

The fuel can now flow through the fuel valve (1), through the holes in the EUI and out through the fuel gallery (4). The spill phase continues as long as the fuel valve (1) is open.



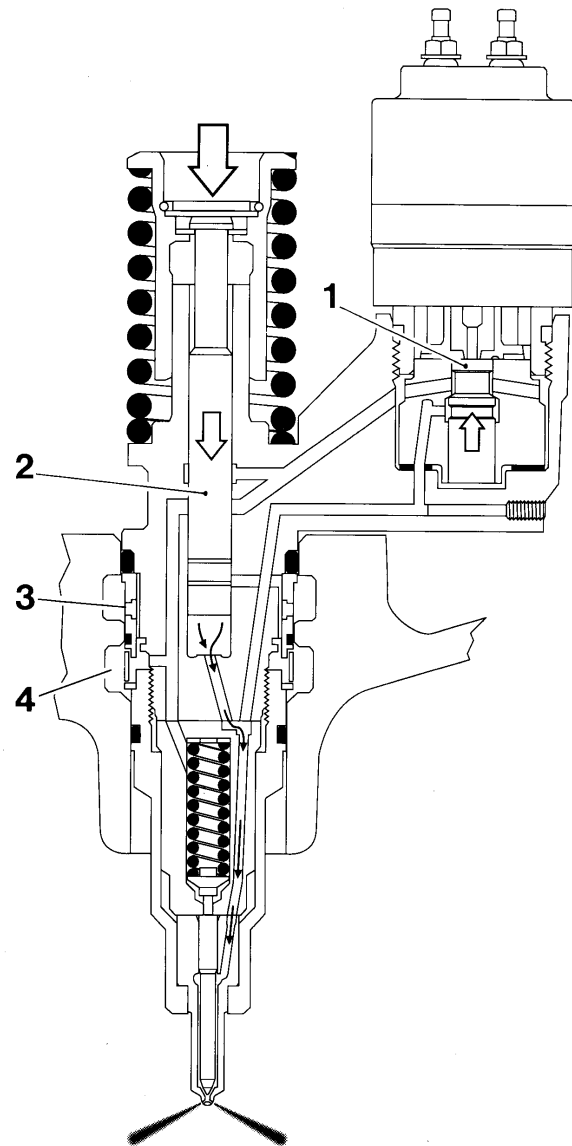
T2006814

Fig. 8: Spill phase

- 1 Fuel valve
- 2 Pump plunger
- 3 Fuel outlet (overflow)
- 4 Fuel gallery (inlet and outlet)

### *Injection Phase*

The injection phase begins when the fuel valve (1) closes. The camshaft lobe and rocker arm continue to press down the pump plunger (2) and injection occurs as the route through the fuel valve closes. The injection phase continues as long as the fuel valve (1) is closed.



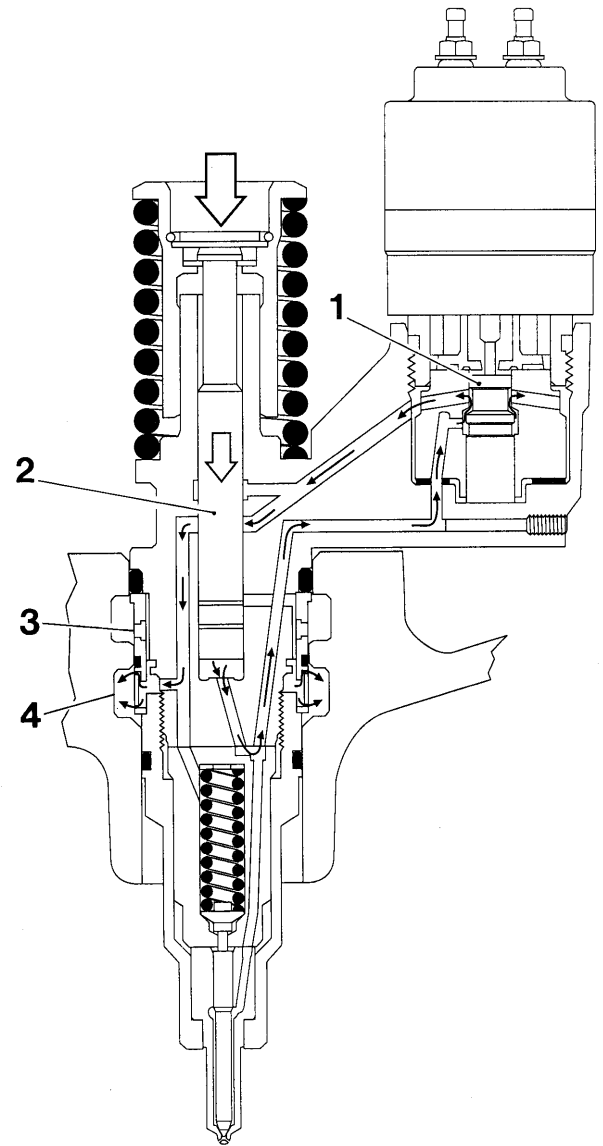
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Fig. 9: Injection phase

- 1 Fuel valve
- 2 Pump plunger
- 3 Fuel outlet (overflow)
- 4 Fuel gallery (inlet and outlet)

### *Pressure Drop Phase*

The injection phase ends when the fuel valve (1) opens and pressure in the EUJ drops below the nozzle opening pressure. The fuel flows through the open fuel valve (1), through the electronic unit injector holes and out through the fuel gallery (4). Note that the fuel valve position (closed or open) determines when the injection phase begins and ends. The time during which the fuel valve is closed determines the amount of fuel injected at each pump stroke.



T2006816

Fig. 10: Pressure drop phase

- 1 Fuel valve
- 2 Pump plunger
- 3 Fuel outlet (overflow)
- 4 Fuel gallery (inlet and outlet)

## D12A

One unit injector is used for the 345, 385, and 425 horsepower variants. The spray angle has been modified. These injectors are **NOT** interchangeable with the D12 injectors.

## D12B

**The unit injectors on the D12B have a longer pump stroke length than earlier injectors on the D12A. They are not interchangeable with other engine versions.**

The engine electronic control unit (EECU) receives signals both from the engine's own sensors and from the vehicle control unit. The EECU then controls the unit injectors and determines the timing of the injection as well as the amount of fuel to be injected into the cylinders.

With the adaptation to the new vehicle electronics, the throttle position sensor signal on the D12B is now linked to the engine control unit via the vehicle control unit.



### CAUTION

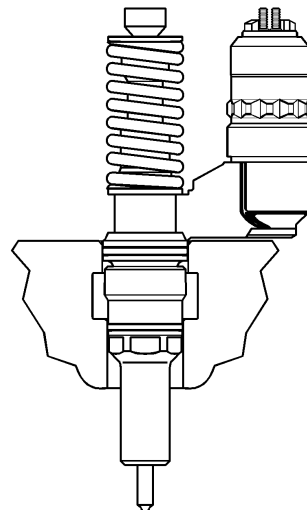
Using incorrect injectors (i.e. D12A injectors in a D12B engine) can cause engine damage and/or poor performance. Injector identification can only be made using the injector part number located on the injector solenoid valve.

## D12C

The D12C has new unit injectors, with 17 mm pump stroke and higher injection pressure. The injector nozzles are new, and have a different orifice pattern.

Unlike the D12A and D12B engines, the D12C cylinder head only has one fuel galley for the unit injectors. This means that only two sealing rings are needed for each unit injector (the D12A and D12B use three rings).

Fuel enters at the rear of the cylinder head and exits out the front.

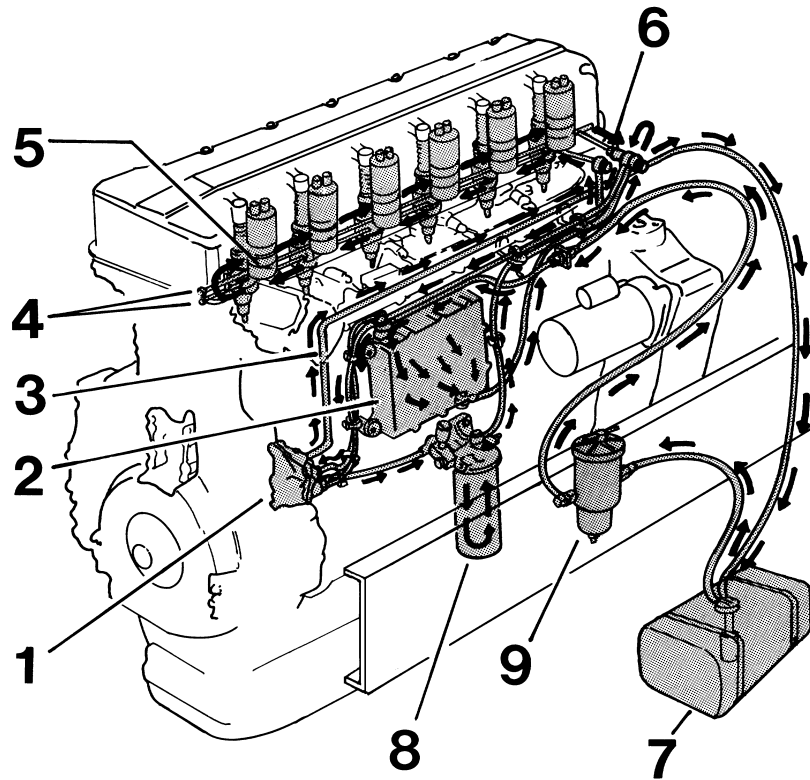


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Fig. 11: Unit Injector, D12C

# Fuel Flow

## D12A



W2000680

Fig. 12: Fuel flow, D12A

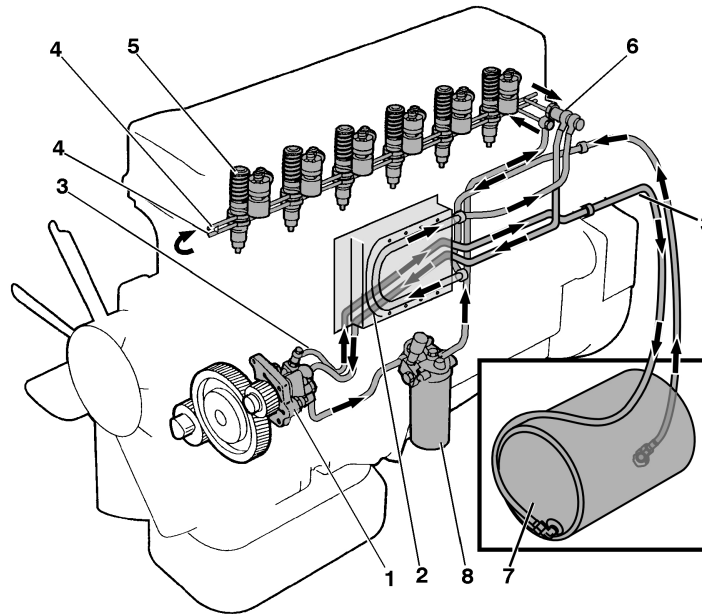
- |                                         |                                  |
|-----------------------------------------|----------------------------------|
| 1 Fuel feed pump                        | 5 Electronic unit injector (EUI) |
| 2 Engine electronic control unit (EECU) | 6 Overflow valve                 |
| 3 Bleed line                            | 7 Fuel tank                      |
| 4 Fuel gallery                          | 8 Fuel filter                    |

The fuel feed pump (1) is mounted on the timing gear plate and driven through a recess in the pump shaft by the engine timing gears. It picks up fuel from the fuel tank (7) through the fuel system EECU (2). Return fuel from the cylinder head is also routed into the fuel feed pump. A bleed line (3) goes from the fuel feed pump back to the fuel tank, and is designed to continuously bleed the system. From the fuel feed pump, fuel first passes through the filter (8) and then into the cylinder head fuel gallery (4). The fuel gallery surrounds the part of the EUI (5) where the fuel holes are placed. The system overflow valve (6) is located in the fuel gallery outlet connection.

Leak-off fuel flows from the EUI back to the fuel gallery, eliminating the need for an external fuel return.

## D12B

Unlike the D12A, the EECU on the D12B is fitted with an external fuel cooling coil.



W2002628

Fig. 13: D12B, Fuel flow

- |               |                 |                  |
|---------------|-----------------|------------------|
| 1 Supply pump | 4 Fuel gallery  | 6 Overflow valve |
| 2 EECU        | 5 Unit injector | 7 Fuel tank      |
| 3 Bleed line  |                 | 8 Fuel filter    |

The fuel system's supply pump (1) is attached to the timing gear plate and is driven via a groove in the pump shaft from the engine's timing gears.

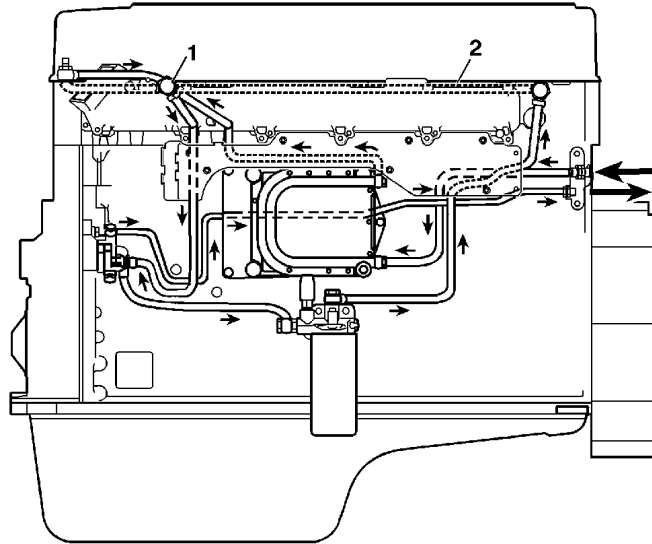
The supply pump pulls fuel from the tank (7) through the EECU's cooling coil, which cools the EECU. The return fuel from the cylinder head is then blended with this fuel and enters the supply pump. From the supply pump (1), a bleed line (3) leads back to the fuel tank to provide continuous venting for the system.

With the bleed line (3) as the only return line to the tank, the only fuel passing through the EECU's cooling coil is the amount consumed by the engine.

From the supply pump (1), the fuel is forced through the fuel filter (8) and then into the cylinder head fuel gallery (4). The fuel gallery is designed so that it surrounds that part of the unit injectors (5) where the fuel holes are located.

The system's overflow valve (6) is located in the fuel gallery's outlet connection. The overflow valve regulates the fuel system's supply pressure. All fuel that exits the overflow valve (leak-off fuel) is then blended with the fuel entering the supply pump.

## D12C



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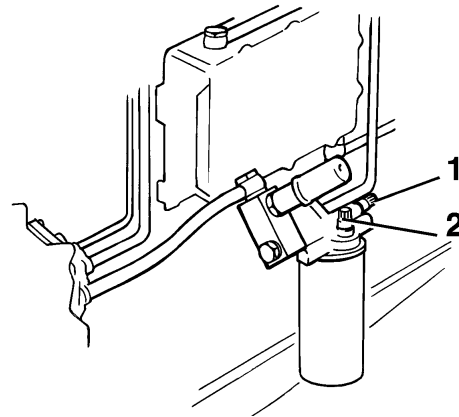
Fig. 14: External fuel line installation and fuel flow, D12C.

- 1 Bypass valve
- 2 Fuel passage in cylinder head

The D12C uses a fuel line through the cylinder head.  
The bypass valve is also located toward the front of the cylinder head.

## Fuel Filter

The system is equipped with a large fuel filter located on the left-hand side of the engine. The filter insert consists of a special corrugated filter paper with a high resistance to water and very good filtering properties. In addition, a fine-gauge net filter on the fuel suction line in the fuel tank separates any possible solid impurities before the fuel is pumped up into the system.



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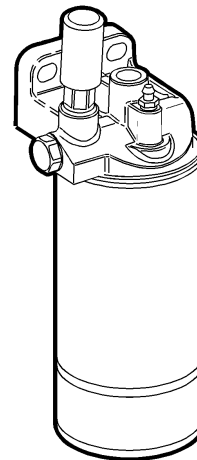
Fig. 15: Fuel filter

- 1 Drain nipple
- 2 Bleed nipple

## D12C

The D12C uses a new fuel filter base, with hand pump mounted directly on the base.

The base has a port for a fuel pressure sensor.



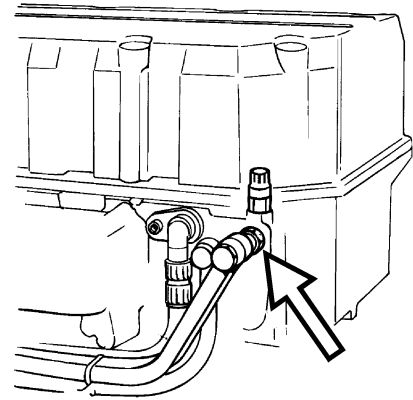
T2012783

Fig. 16: Fuel Filter, D12C



## Overflow Valve

The overflow valve, located in the outlet from the cylinder head fuel gallery, regulates the fuel system feed pressure. Opening pressure is about 345 kPa (50 psi). The high feed pressure ensures that the injectors are filled with fuel.

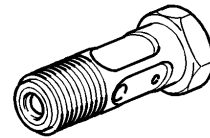


W2000681

Fig. 17: Overflow Valve Location, D12A/B

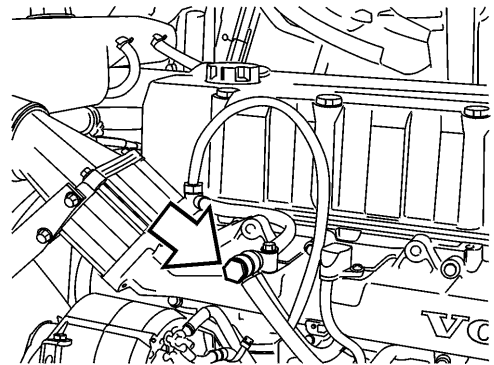
## D12C

The D12C has a new overflow valve. The valve is integrated with the hollow screw in the fuel outlet at the front of the cylinder head.



T2012784

Fig. 18: Overflow Valve, D12C

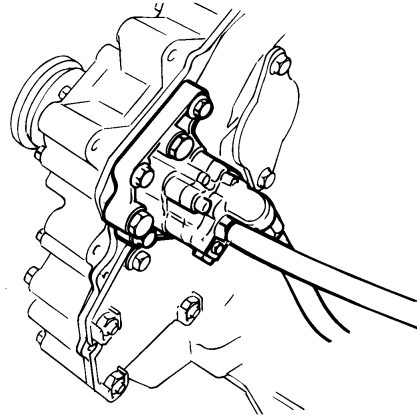


W2003527

Fig. 19: Overflow Valve location, D12C

## Fuel Feed Pump

The capacity of the pump has been adapted to give the correct pressure and flow to the EUI. Filling the EUIs requires relatively high pressure. The flow must be large enough to even out any fuel temperature differences in the cylinder head fuel gallery.



T2006725

Fig. 20: Fuel Feed Pump

## Fuel Feed Pump Replacement

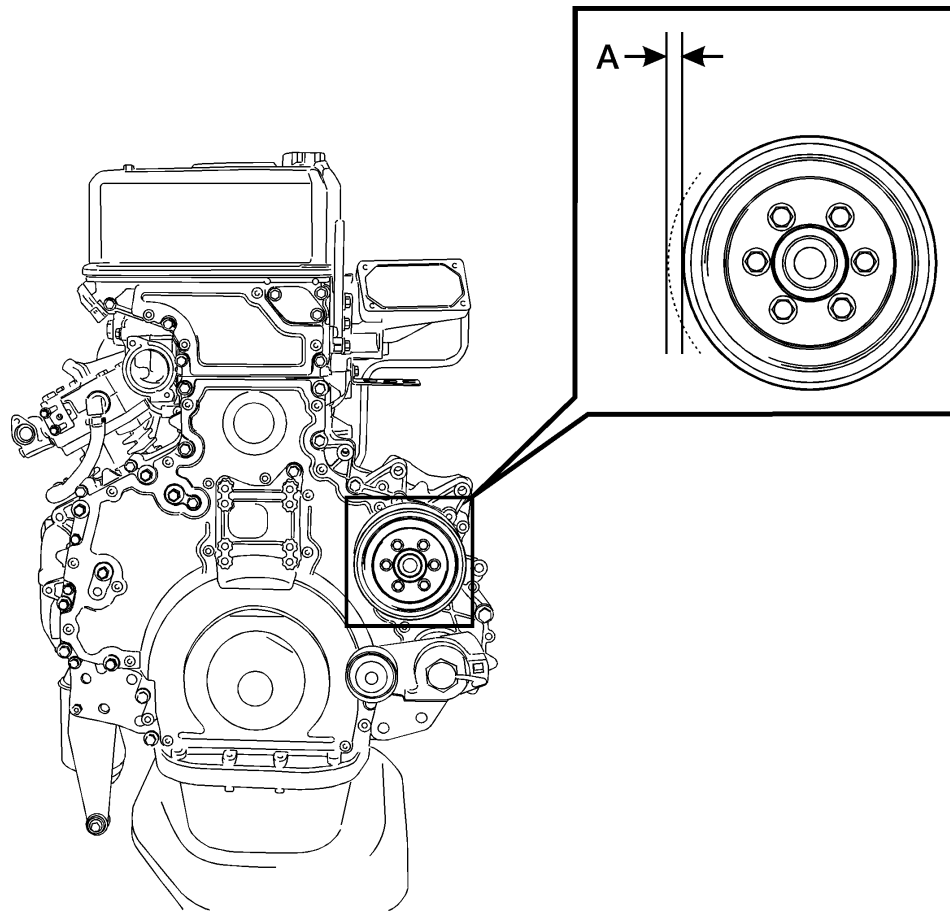


Fig. 21: A = Radial Play

W2002891

When replacing a D12 fuel supply pump for any reason, the accessory drive must also be inspected. There should be no radial or axial play in the accessory drive shaft. Radial play is movement parallel (side to side) to the face of the pulley. Do not confuse with backlash which is measured by turning the pulley. Axial play is movement perpendicular (in and out) to the face of the pulley. Release the tension on the alternator and fan belts before checking. This test is done by simply attempting to move the accessory drive pulley by hand.

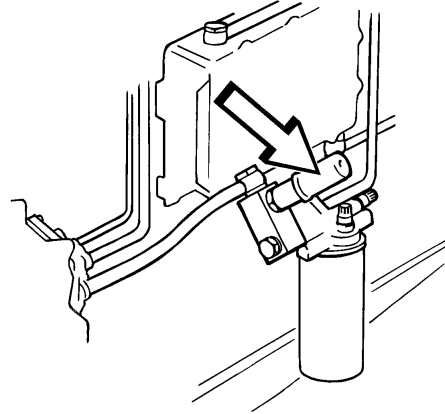


### CAUTION

Radial or axial play in the accessory drive shaft may cause premature failure of the fuel feed pump.

## Hand Primer

The hand primer is situated on the fuel filter bracket. It is used to pump the fuel and bleed the system when the engine is not running.



T2006729

Fig. 22: Hand primer

## Engine Electronic Control Unit (EECU)

The electronic control module is the central part of the injection system. It is located on the left-hand side of the engine. The EECU receives continuous information from the accelerator pedal and from several sensors on the engine. It calculates the amount and the time to inject fuel into the cylinders. Electrical wiring to the EUI fuel valves transmits control signals to the injectors.

The EECU uses the flywheel sensor to monitor engine rotation and engine speed variations during a revolution. This allows the EECU to ensure that each EUI receives exactly the correct amount of fuel. The EECU stores information when a fault occurs or if something in the system is abnormal. Occasional faults are also stored and can be traced at a later stage.

For information about the EECU, EECU sensors, and their functions, refer to:

**Service Information** 280–600  
*Control Systems, D12*

**IMPACT** Function Group: 284  
Information Type: Design and Function  
"Sensors"

# Troubleshooting

## Fuel System, Fault Tracing

Correct fault diagnosis is essential to accurate engine repair. The complex design of the engine (that is, with a cylinder head that covers all the cylinders, overhead gear wheel-driven camshaft, and EUI) makes the cylinder head removal on the D12 a comprehensive work operation. Fault tracing in the fuel system requires thorough knowledge on how the system functions, as one does not have the opportunity as with a conventional fuel system of seeing and checking directly on the engine.

As the EECU receives all the information electronically from the different sensors, the EECU must gather all the information when the engine is started and then check that the information is correct. This means the D12 engine does not start on the first crankshaft revolution, but requires two revolutions in order for the control unit to set the correct values. It is important that the starter motor revolutions are not too slow, as slow starter motor speed is interpreted by the control unit that the crankshaft does not rotate and, as a result, the injector fuel valves do not receive the appropriate signals to release fuel.

The crankshaft must rotate at a minimum of 75 rpm to ensure that the engine starts. To facilitate fault tracing in the fuel system, D12 is equipped with a diagnostic system which makes it possible to localize faults in the fuel system without having to perform extensive dismantling work.

With the fault codes stored in the control unit, it is possible, through the diagnostic system, to quickly establish which fault or faults have occurred.

## Fault Codes

It is important to delete a fault code from the diagnostic system after the fault code has been corrected and **before the truck leaves the workshop. Fault codes remain in the system until they are removed. They do not automatically clear when the fault has been corrected.**

## Unit Injector Troubleshooting

The following information will aid in troubleshooting of Electronic Unit Injector (EUI) fault codes.

## Read and Document Fault Codes

Connect the MPSI tool to the vehicle's diagnostic connector to determine whether any active or inactive fault codes are set. Document all set fault codes below:

Code #	Occurred counts	Active/Inactive	PID	SID	FMI
Description .....					

Code #	Occurred counts	Active/Inactive	PID	SID	FMI
Description .....					

Code #	Occurred counts	Active/Inactive	PID	SID	FMI
Description .....					

Code #	Occurred counts	Active/Inactive	PID	SID	FMI
Description .....					

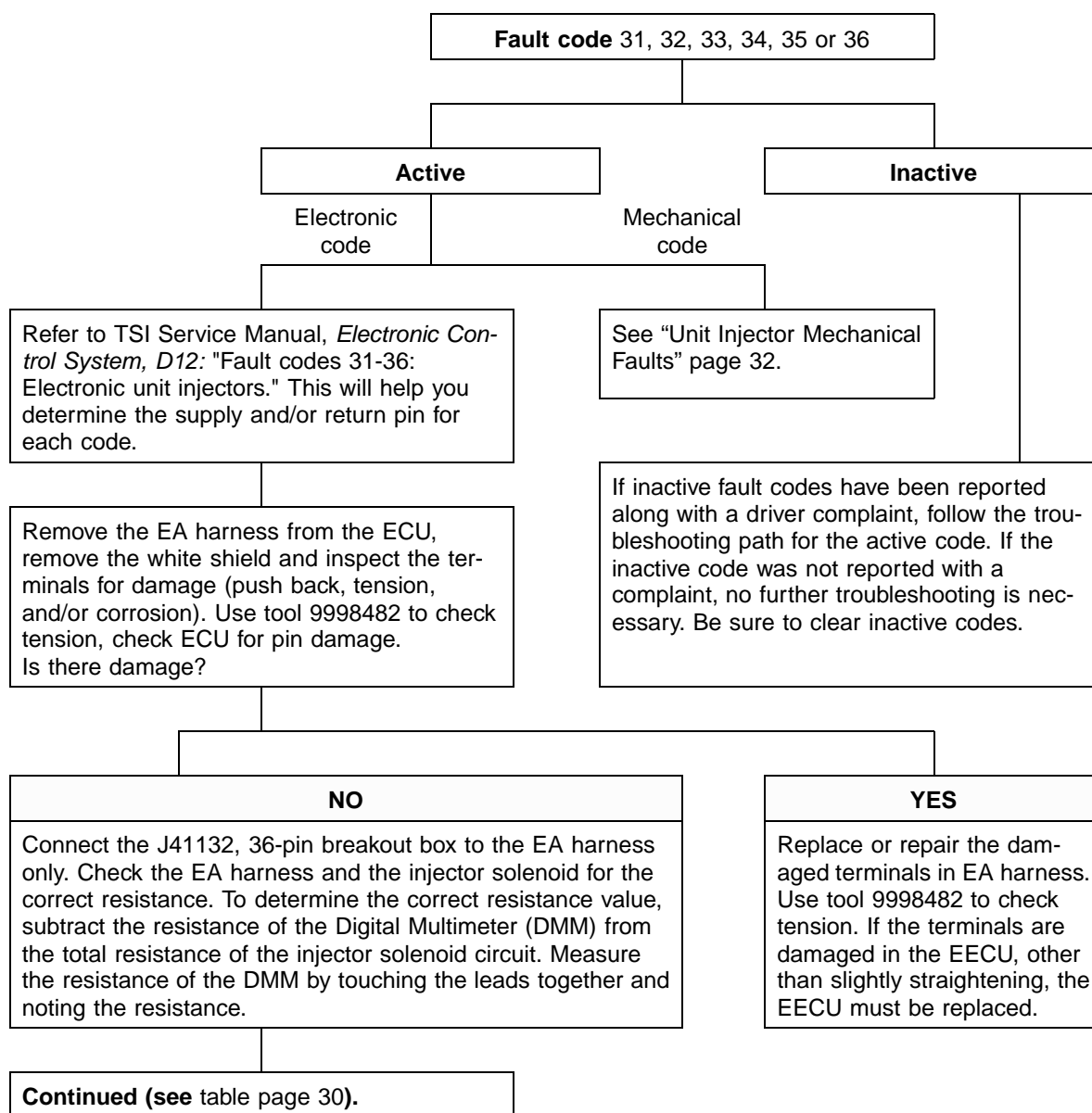
## Troubleshooting Flow Path

### Active fault codes

Troubleshoot the active fault codes first.

### Inactive fault codes with high counts

If inactive fault codes are recorded, follow the troubleshooting path for that same active code. This should be done; however, only when there is a driver complaint in conjunction with the inactive fault code.



Continued from table page 29

Measure the circuit resistance between the injector supply and return pins into the EA harness and note the reading. Subtract the DMM lead resistance from the injector circuit resistance. This will give you the true circuit resistance. Compare to the specifications below.

**Note:** The ECU must **NOT** be connected to the breakout harness during these checks.

Specifications:

* Solenoid circuit to ground .....	OL (open circuit)
* Solenoid circuit resistance .....	1.3-3.5 $\Omega$
* Return circuit to block .....	OL (open circuit)
* Supply circuit to block .....	OL (open circuit)

Record the values.

Remove the valve cover, check the harness to solenoid connection.  
Is connection tight?

**YES**

Remove the supply and return wiring from the injector solenoid and test the solenoid for open or short circuit to ground. Does the solenoid check within specifications?

**NO**

Tighten the connection, re-assemble and check for active code.

**YES**

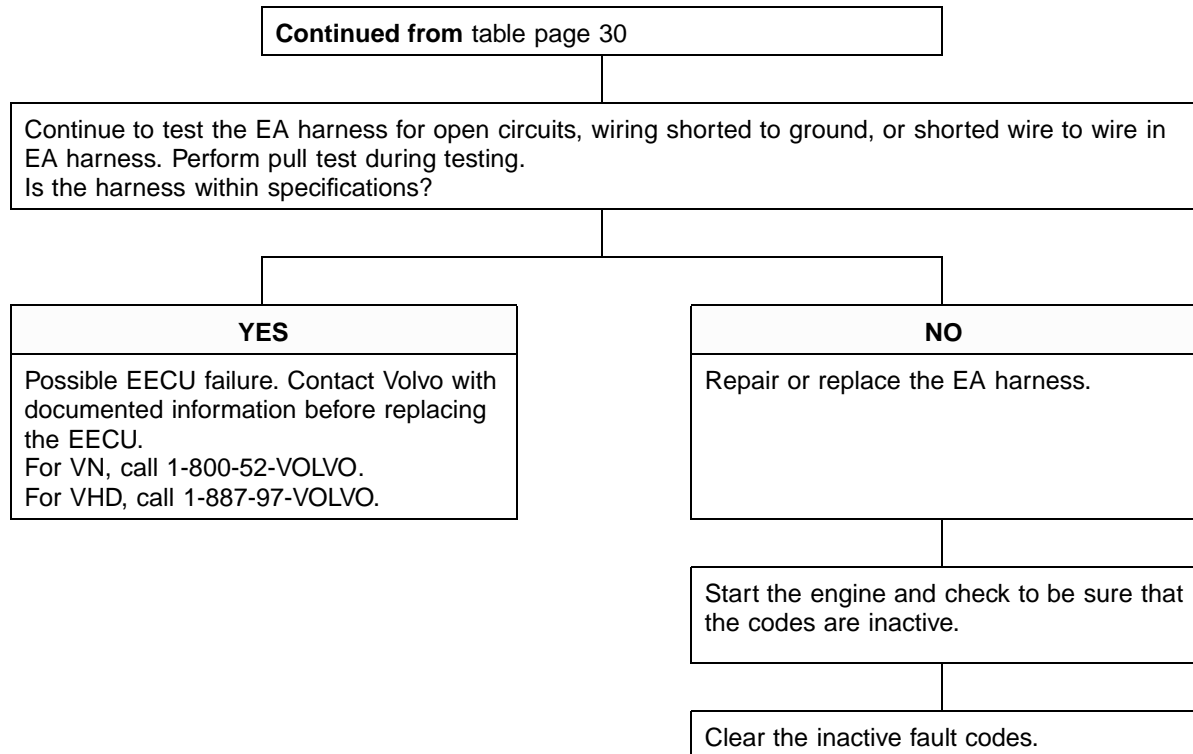
The injector is good. Do **not** replace the injector.

**NO**

Replace the injector.

Continued (see table page 31)





## Unit Injector Mechanical Faults

**Note:** A mechanical fault indicates low performance of that cylinder, not just the injector.

Determine the correct troubleshooting flow path.

Fault codes: 31, 32, 33, 34, 35, 36.

### 1. Active code or misfiring occur immediately after start-up

Cause	Corrective action
<ul style="list-style-type: none"> <li>Incorrect valve or injector adjustment</li> <li>Injector problem</li> <li>Base engine problem</li> </ul>	<ul style="list-style-type: none"> <li>Check the valve and injector adjustment as required.</li> <li>Perform cylinder balancing or manual compression test before replacing the injector; refer to appropriate service literature or diagnostics checklists for information.</li> <li>Visual inspection of the camshaft and high crankcase pressure. Perform cylinder balancing or manual compression test before replacing the injector for piston and valve condition. Repair as required.</li> </ul>

### 2. Active code at normal operating temperature and high idle

Cause	Corrective action
<ul style="list-style-type: none"> <li>Incorrect valve or injector adjustment</li> <li>Poor quality fuel or excessive fuel additives</li> <li>Aeration</li> <li>Injector problem</li> <li>Base engine problem</li> </ul>	<ul style="list-style-type: none"> <li>Check the valve and injector adjustment as required.</li> <li>Test with auxiliary fuel and retest.</li> <li>Check for fuel restriction, air or compression introduced into the fuel system and repair as required.</li> <li>Perform cylinder balancing test or manual compression test. If within specifications, replace injector.</li> <li>Visual inspection of camshaft and high crankcase pressure. Perform cylinder balancing or manual compression test before replacing injector for piston and valve condition. Repair as required.</li> </ul>

### 3. Active code and misfiring at BASE IDLE ONLY

Cause	Corrective action
-------	-------------------

- Incorrect camshaft to crankshaft static timing
- Refer to Camshaft Timing procedure, Group 21.

**If the answer to any of the following is yes, static timing may be the cause of the fault.**

- Have previous repairs been made to the engine that required removing the camshaft?
- Can you clear the fault code, unplug the camshaft sensor, start the engine, and the fault code does not return?
- Can you clear the fault code, start the engine, set the idle above the base idle, and the fault code does not return?

## Locating Air in the Fuel System

Air in the fuel being supplied to the engine can cause a number of problems including hard starting, poor performance, and excessive smoke. Air can enter the fuel system at several points:

- suction side fuel supply lines
- pick-up in the fuel tank
- primary fuel filter
- copper sleeve to injector seat
- injector tip
- fuel supply pump seals

Locating the point of entry can be troublesome and time consuming. A kit has been developed to aid in this process. The kit (J-42753) consists of:

- two fuel line sight glass assemblies
- two transparent hose assemblies
- a clamp
- a washer
- a hollow screw
- copper gaskets
- O-rings

## Determining Whether There is Air in the Fuel



### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



### **DANGER**

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.



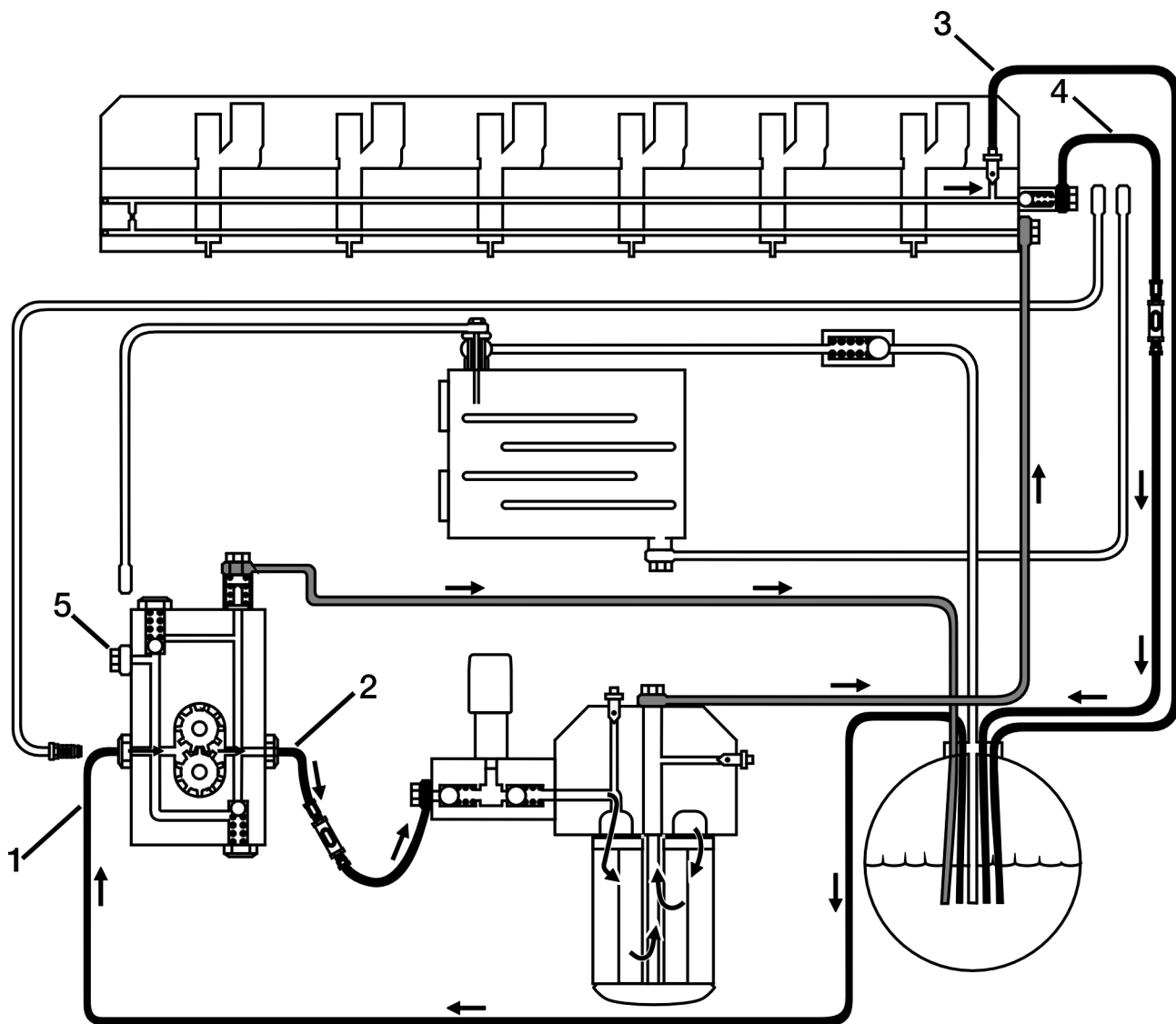
### **WARNING**

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



### **CAUTION**

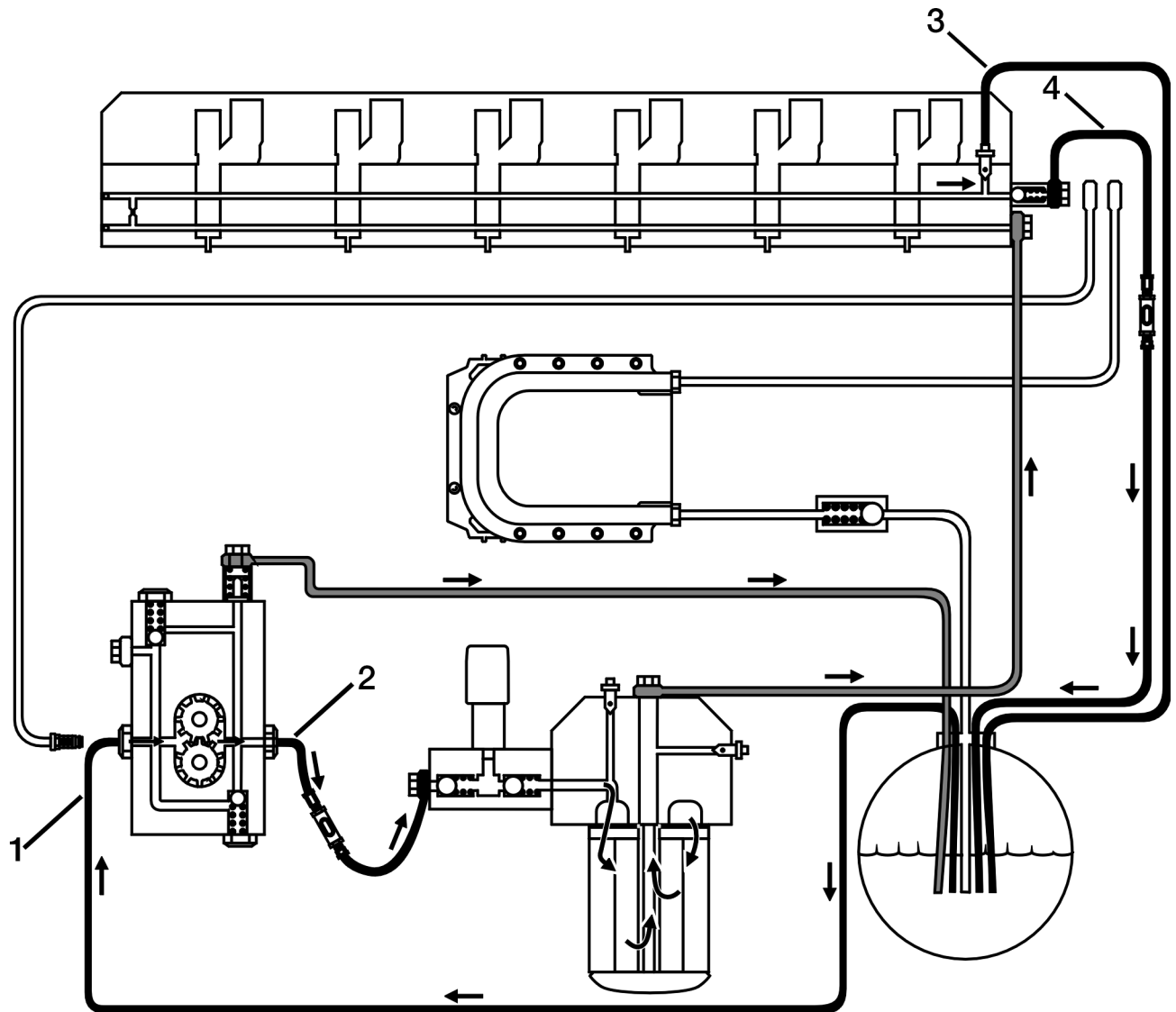
After using the fuel aeration test kit, thoroughly drain all remaining fuel from the test hoses, then install plugs, end caps and washers. This will prevent accidental spillage which could result in fuel contamination.



W2003008

Fig. 23: D12, D12A Fuel System Diagram with Fuel Line Kit Installed

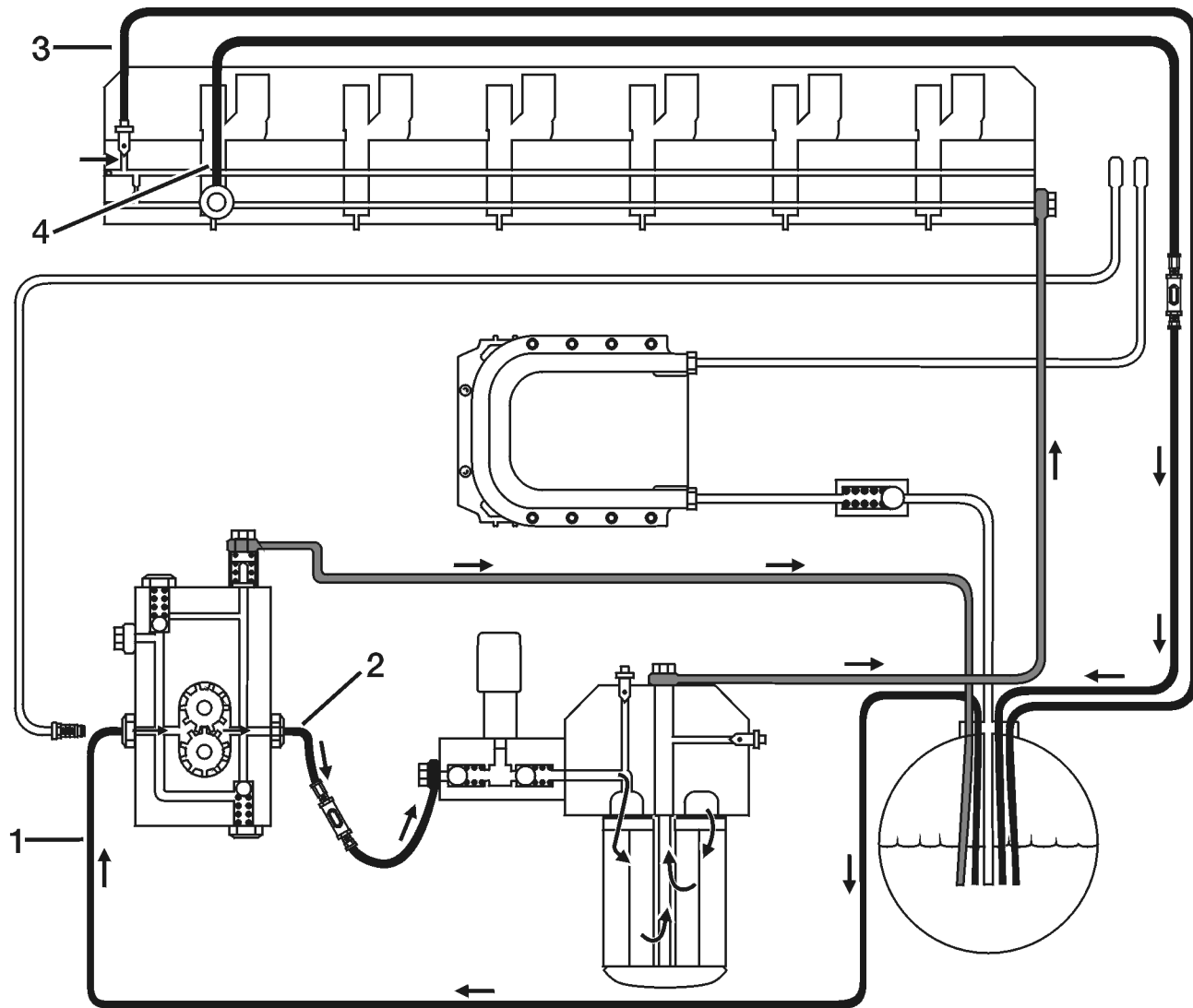
- 1 3/8 in. I.D. Transparent Suction Hose/Alternate Fuel Supply
- 2 Sight Glass Hose Assembly (S)
- 3 3/16 in. I.D. Transparent Hose
- 4 Sight Glass Hose Assembly (R)
- 5 Vent Line Port Washer (949873)



W2003009

Fig. 24: D12B Fuel System Diagram with Fuel Line Kit Installed

- 1 3/8 in. I.D. Transparent Suction Hose/Alternate Fuel Supply
- 2 Sight Glass Hose Assembly (S)
- 3 3/16 in. I.D. Transparent Hose
- 4 Sight Glass Hose Assembly (R)



W2003500

Fig. 25: D12C Fuel System Diagram with Fuel Line Kit Installed

- 1 3/8 in. I.D. Transparent Suction Hose/Alternate Fuel Supply
- 2 Sight Glass Hose Assembly (S)
- 3 3/16 in. I.D. Transparent Hose
- 4 Sight Glass Hose Assembly (R)



**Note:** The numbers within parentheses in the following steps correspond to the accompanying figures:

- D12, D12A** See Fig. 23: D12, D12A Fuel System Diagram with Fuel Line Kit Installed, page 37
- D12B** See Fig. 24: D12B Fuel System Diagram with Fuel Line Kit Installed, page 38
- D12C** See Fig. 25: D12C Fuel System Diagram with Fuel Line Kit Installed, page 39

### 1

Connect the 3/16 in. I.D. transparent hose (3) to the bleed nipple located at the rear of the cylinder head and secure onto the bleed nipple with the clamp provided in the fuel line kit. Route the line back to the fuel tank and secure to prevent it from moving out of the tank. Open the bleed nipple 1 1/2 turns and pump the hand primer pump until the transparent hose is free of air. If the fuel system can be bled free of air continue to step 3.

### 2

If air continues to exist in the fuel, check the following:

- that there is ample fuel in both tanks.
- connections from the fuel tank to the fuel supply pump for suction leaks.
- fuel/water separator for restrictions, suction side leaks or an incorrect micron element.
- that the hand primer pump is capable of pumping fuel.
- the fuel supply pump seal for failure.

### 3

Close the fuel bleed nipple and start the engine.

**Note:** It may be necessary to continue to pump the hand primer during cranking to start the engine. If the engine does not start then the fuel system is most likely filling with air during cranking; skip to step 5.

### 4

Once the engine starts, open the fuel bleed nipple, located at the rear of the cylinder head, 1 1/2 turns with the transparent hose connected. Monitor for air in the fuel for 3 to 5 minutes. If air is present continue to step 5, if not then there is a possibility that air is entering the fuel system only under loaded conditions. If it is suspected that air is entering under loaded conditions continue to step 5. If not, stop here, no further testing is required.

### 5

If the engine would not start in step 3, continues aeration during cranking, or if air is noted in the transparent hose while the engine is running then install the following hoses and sight glasses to determine where the air is entering the fuel system.

### 6

Install sight glass hose assembly (2) between the outlet port of the fuel supply pump and the fuel filter.

### 7

Remove the fuel supply (suction) line from the fuel supply pump and install the alternate transparent fuel supply line (1) and route back to the fuel tank.

### 8

Remove the two fuel lines at the overflow valve and install sight glass assembly (4) onto the overflow valve using hollow screw (941686) from the kit, and route the line to the fuel tank.

### 9

**Remove** the transparent hose (3) from the bleed nipple at the rear of the cylinder head to the fuel tank and close the bleed nipple. Secure all three lines to prevent them from moving out of the fuel inside the tank.

**Note:** For engines equipped with the small line located between the fuel supply pump and the top of the engine electronic control unit (EECU), this line must be disconnected from the fuel supply pump and the port from which the line was removed (5) must be plugged using two copper gaskets and washer (949873) supplied in the fuel line kit.

**10**

Using the hand primer pump attempt to purge all air from the fuel system and start the engine.

**Note:** Purging time may vary.

**11**

Repeat the conditions in which aeration was previously noted or test under loaded conditions, i.e. dyno test.

**12**

Monitor the two sight glasses and transparent hose for aeration allowing 3 to 5 minutes for the sight glasses to clear.

**Note:** Shining a flashlight into the **backside** of the sight glass will improve visibility.

**13**

If no air is noted in either sight glass and air was noted in previous steps, the air entry is most likely in the suction lines between the fuel supply pump and the fuel tank including the primary fuel filter, copper washers, O-rings and pick-up inside of the fuel tanks.

**14**

If air is noted in sight glass (2) between the fuel supply pump and fuel filter, and the alternate fuel supply is supplying the fuel supply pump with a good flow of air free fuel, the problem is most likely in the fuel pump seals.

**Note:** The fuel in sight glass (2) is under pressure. This compresses the air bubbles and they will appear to be small.

**15**

If air is noted in the sight glass (4), at the rear of the cylinder head, but not in sight glass (2) at the outlet of the fuel supply pump (with no engine load), the problem is most likely within the cylinder head, i.e. copper sleeve to injector seat or injector tip leakage. See "Determining which Cylinder is Introducing Air into the Fuel" page 41.

**Note:** Sight glass (4) will show small bubbles due to the turbulence created by the opening and closing of the overflow valve. To determine whether normal or abnormal aeration is occurring, use the transparent hose (3) at the bleed nipple at the rear of the cylinder head. Open the bleed nipple 1 1/2 turns and monitor for air. If the line is clear then the aeration in the sight glass (4) is normal. If the transparent hose indicates aeration then the aeration in sight glass (4) is abnormal.

**16**

If air is noted only under loaded conditions, remove all six injectors and inspect the copper sleeve to the injector seat for signs of leakage.

## Determining which Cylinder is Introducing Air into the Fuel



### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.



### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



### CAUTION

After using the fuel aeration test kit, thoroughly drain all remaining fuel from the test hoses, then install plugs, end caps and washers. This will prevent accidental spillage which could result in fuel contamination.

**Note:** The numbers within parentheses in the following steps correspond to the accompanying figures:

- D12, D12A** See Fig. 23: D12, D12A Fuel System Diagram with Fuel Line Kit Installed, page 37
- D12B** See Fig. 24: D12B Fuel System Diagram with Fuel Line Kit Installed, page 38
- D12C** See Fig. 25: D12C Fuel System Diagram with Fuel Line Kit Installed, page 39

#### 1

Disconnect the two fuel lines from the overflow valve at the rear of the cylinder head and install the sight glass (4) and line assembly onto the overflow valve using hollow screw (941686), from the kit, and route into the fuel tank. Tie down the line to prevent it from moving out of the tank.

#### 2

Remove the fuel supply line from the fuel supply pump and install the alternate fuel supply line onto the feed pump. Route the line back to the fuel tank. Tie down the line to prevent it from moving out of the fuel level inside the tank.

**Note:** For engines equipped with the small line located between the fuel supply pump and the top of the engine electronic control unit (EECU), this line must be disconnected from the fuel supply pump. The port from which the line was removed (5) must be plugged using two copper gaskets and washer (949873) supplied in the fuel line kit.

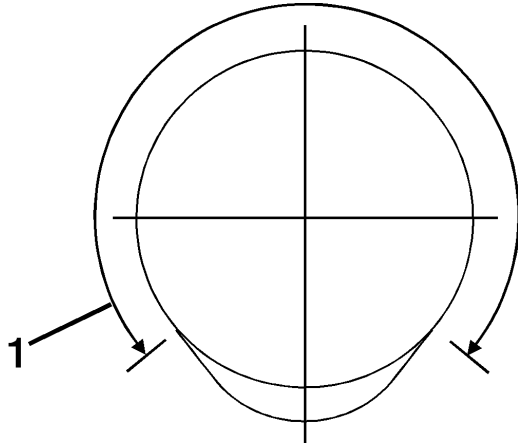
#### 3

Start the engine and allow 3 minutes for the sight glass to clear. Take note of the air present in the fuel sight glass (4).

#### 4

Stop the engine and remove the valve cover.

5



W2003027

Fig. 26: 1 base circle of camshaft

Rotate the engine by hand until the rocker arm for the intake valve for number 1 cylinder is on the base circle of the cam, (in other words, in position to be adjusted). Turn the adjusting screw down (clockwise) until all clearance has been removed then turn it down an additional 1/4 turn (90°). Install the valve cover and secure with 4 nuts.

**CAUTION**

Do not turn the adjusting screw down more than 1/4 turn (90°) after all clearance has been removed. Engine damage will result.

6

Using the hand primer pump, purge all air from the fuel system.

**CAUTION**

Run the engine only at idle speed with no load for this test. High engine speed or load could cause engine damage.

7

Restart the engine and monitor the sight glass (4) in the rear of the cylinder head. If the air that was noted in step 3 is gone then the problem is most likely in the number 1 cylinder (injector tip or injector to copper sleeve seat). Remove the number 1 injector and inspect the injector to the copper sleeve seat. If the seat appears to be OK, replace the injector and perform the test again.

8

If the air that was noted in step 3 is not gone, stop the engine, remove the valve cover, back out (counterclockwise) the adjusting screw for the intake valve at the number 1 cylinder 1/2 round (180°), and repeat the procedure (starting with step 5) on the number 2 cylinder.

9

Continue the procedure until the cylinder that is introducing air into the fuel system has been determined.

10

When the cylinder that is introducing air into the fuel system has been located, remove that injector and inspect the injector to copper sleeve seat. If the seat appears to be O.K., replace the injector and perform the test again. If the seat and injector O-rings show signs of combustion leakage, clean the injector and replace the injector copper sleeve. Reinstall the injector with new O-rings and adjust all valves and injectors.

11

Start the engine and monitor the sight glass for air. If no air is present then stop. If air is present then test again as required.

# Service Procedures

## General Work Practices



### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



### DANGER

The D12 engine uses high voltage (up to 90 V) to the electronic unit injectors. Do not come in contact with the injector terminals while the engine is running as there could be as much as 90V going to the electronic injectors. Contact may result in electrical shock. Personal injury or death can occur.



### CAUTION

Extreme cleanliness must be observed when working on the fuel system and the **Volvo Engine Brake (VEB)**. Always clean the engine before beginning repairs. To prevent dirt from entering the fuel system, install protective plugs whenever connections are removed. Store components in sealed plastic bags (when feasible) until they are to be reinstalled. The same procedures apply for VEB components. The oil channels for the VEB control system should also be plugged. Dirt in the fuel system and in the VEB system can affect engine operation.

**Note:** After removing or replacing any EUI, or after adjusting preload, start the engine and allow it to reach normal operation temperature. Then let the engine idle for an additional five minutes. This will enable the ECM (through the cylinder-balancing system) to set the correct amount of fuel for delivery to the EUI. No power-consuming components, for example, a PTO should be engaged. The exhaust pressure governor must not be activated. (Remove wire **636K** from the solenoid valve and apply the parking brake to ensure that the truck cannot move.) When the engine runs evenly at idle speed, the cylinder-balancing function has been carried out.

**Note:** If the engine is turned over with the starter motor (for example, when adjusting the valves) the fuse for the engine control system (**B6**) must first be removed and the ignition key must be in the **OFF** position in order to eliminate any risk of the engine starting unintentionally. Also check that the gear lever is in neutral and the parking brake is applied.

- Never remove the EECU connectors or any other electrical wires from the sensors while the engine is running. The ignition key must be in the **OFF** position and the engine stopped.
- Never turn the battery master switch **OFF** or disconnect the battery cables while the engine is running.
- When performing electric welding work on the truck, the EECU connectors must be disconnected from the EECU.

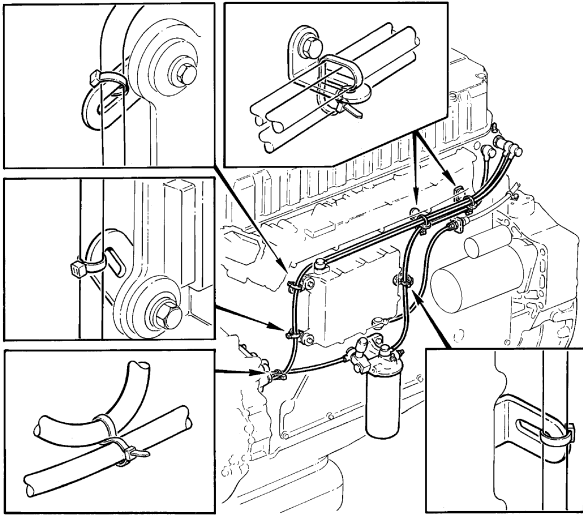
**Note:** Before disconnecting the connectors, the key switch must be turned to the **OFF** position.

- When oven-drying spray-paint work, any ECUs must be removed from the truck. The maximum allowable drying temperature, with the control unit in the vehicle, is 80°C (176°F).
- Use only batteries for auxiliary starting. Using a starting unit can induce peak voltages that can damage the electronic components.
- When charging batteries with a rapid charger, battery cables must be disconnected. (Normal trickle charging does not require this procedure.)
- If a connector is removed, make sure it is reinstalled correctly and is not covered with oil or other fluids which can result in a poor connection.
- For maintenance intervals, refer to:

**Service Bulletin** 175-001  
*Oil and Filter Change Intervals*

**IMPACT** Function Group 175  
Information Type: Maintenance  
*Engine Maintenance*

## Clamping the Fuel Lines



W2000684

Fig. 27: Fuel line routing and securing

To avoid damage and operational disturbances in the fuel system, the fuel lines should be rerouted and secured with plastic cable ties.

**Note:** Always check the fuel lines for cuts, abrasions, chafing or leakage. Diesel fuel that comes in contact with a hot surface can start a fire.

**Note:** Refer to Service Bulletin, Group 23, for oil-cooler thermostat plate leak repair.

**Note:** Refer to Service Bulletin, Group 23, for accessory drive pulley information.

**Note:** Refer to Service Bulletin, Group 23, for fuel line information.

## Turning the Engine Over with the Starter Motor

1

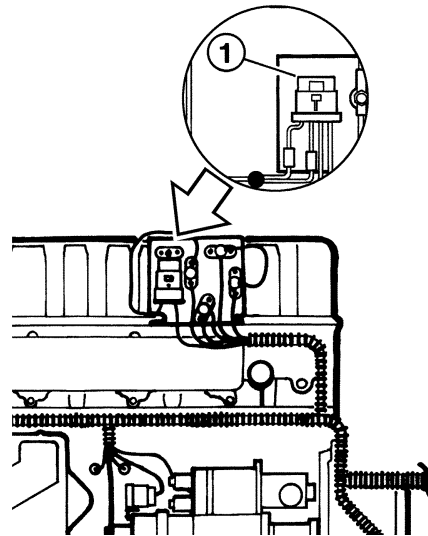


**DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

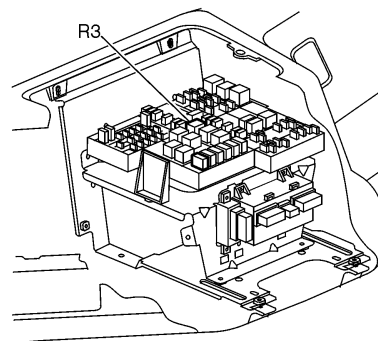
Apply the parking brake, block the wheels, and place the gear lever in neutral. Make sure that the ignition key is in the **OFF** position.

2



W3000459

Fig. 28: EECU power supply relay, D12A/B



W5001141

Fig. 29: R3 relay location (TEC Panel), D12C

For D12/A/B only, disconnect the EECU power supply relay (1); for D12C (and later versions of D12B), disconnect the R3 relay (located in the TEC panel).

3

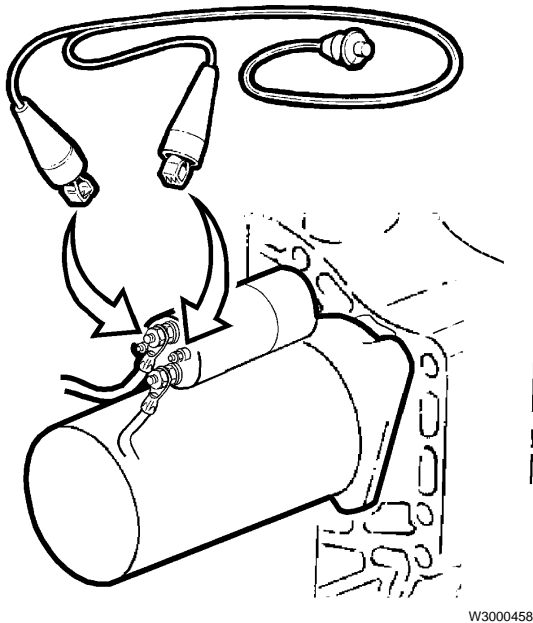


Fig. 30: Remote starter switch and wiring

Connect a switch between the battery positive (+) and the positive (+) connection on the starter solenoid.

4

Do not run the starter for more than 15 seconds at any one time. However, if the starter is run for 15 seconds or longer, wait at least one minute before reusing the starter motor.

## 2309-06-02-03

### Fuel System Pressure, Checking

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

#### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

#### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

#### WARNING

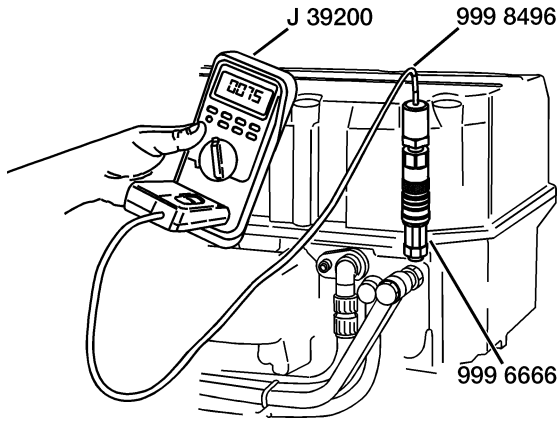
Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

#### WARNING

Do not work near the fan with the engine running or the ignition in the ON position. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured.

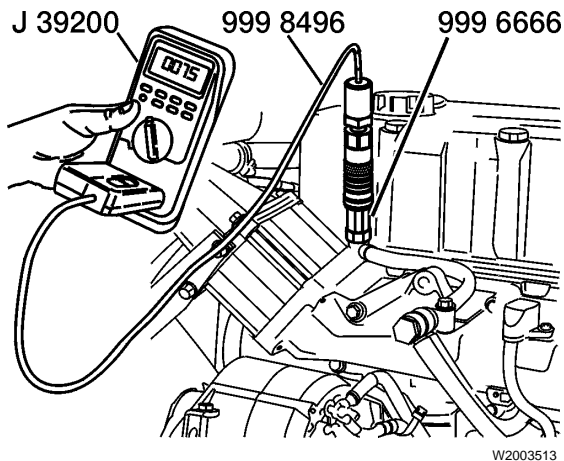
*Special tools:* 9996666, 9998496, J-39200

1



W2002209

Fig. 31: Bleed nipple, D12A/B



W2003513

Fig. 32: Bleed nipple, D12C

Remove the bleed nipple at the rear of the head on the D12A/B, or at the front of the head on the D12C; install adapter 9996666 and pressure transducer 9998496.

Connect the transducer to multimeter J-39200.

9996666  
9998496  
J-39200

**Note:** The pressure transducer measurement scale is in kPa.

2

**DANGER**

When operating a vehicle on streets and highways, during a data collection procedure, it is mandatory to have a second person drive while a technician collects the data.

Monitor fuel pressure under full load, i.e. Dyno test or road test with load.

3

Compare measurements with specifications found in "Fuel Supply Pump and Overflow Valve" page 5.

**Note:** If measurements are found to be within specifications, no further testing is required. However, if measurements do not meet specifications, refer to the Diagnostics Checklist B, "Fuel System."



## 2309-11-03-01 Fuel System, Draining

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.



### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.



### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



### WARNING

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.



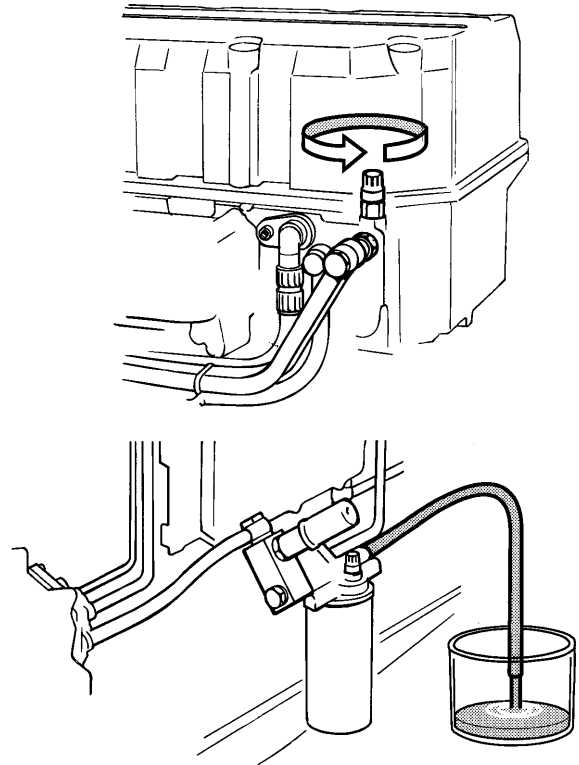
### WARNING

Make sure that gauge pressure never exceeds 50 kPa (7.25 psi). Excessive pressure may cause personal injury.

**Note:** Before using, check the function of pressure gauge 6662 by attaching it to an air supply and setting the pressure to 50 kPa (7.25 psi) with the regulator valve.

**Special tools:** 9996662, 9998277

1



T2006719

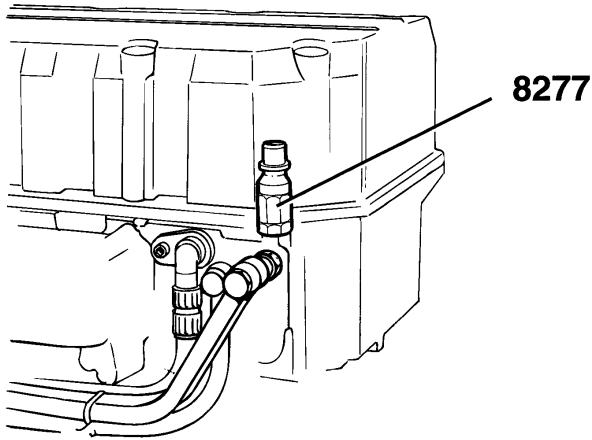
Fig. 33: Draining the fuel system (D12A/B bleed nipple location shown)

Carefully clean around the cylinder head bleed nipple and the fuel filter bracket drain union located on the right side of the filter housing.

2

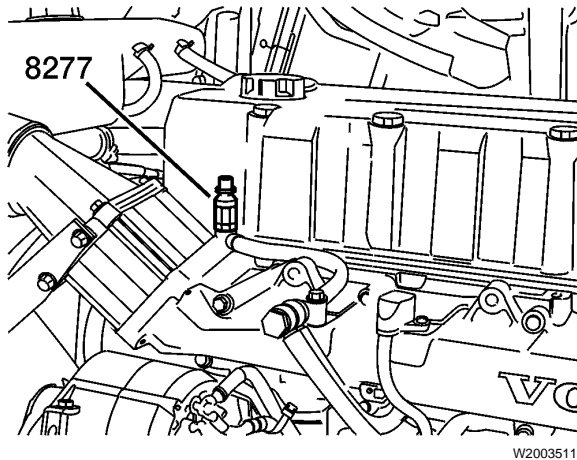
Connect a 7.9 mm (5/16 in.) drain hose and open the fuel filter bracket drain union. Remove the bleed nipple from the cylinder head.

3



T2006715

Fig. 34: Tool installation, D12A/B



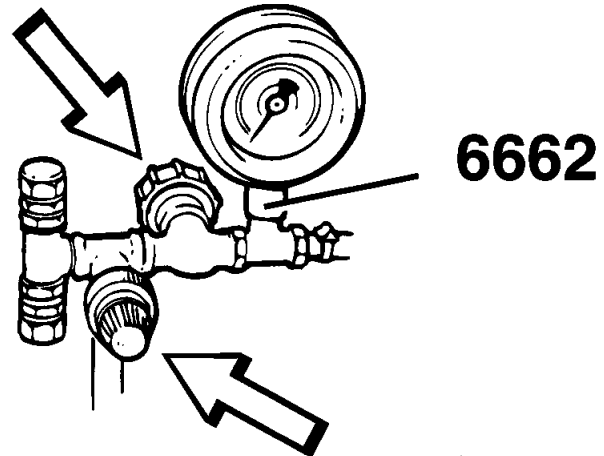
W2003511

Fig. 35: Tool installation, D12C

When the fuel has completely drained out of the cylinder head, install union 9998277 into the bleed nipple hole.

9998277

4



T2006716

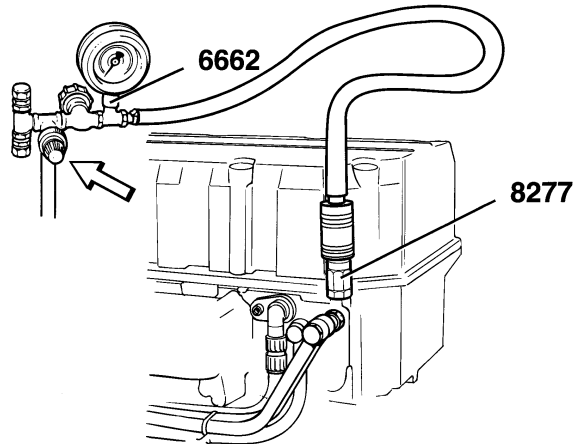
Check the pressure gauge assembly

- 1 Reduction valve
- 2 Air supply shut-off

Make sure the reduction valve knob is completely open (rotate counterclockwise). Open the shut-off tap. Connect pressure gauge 9996662 assembly to the shop air supply.

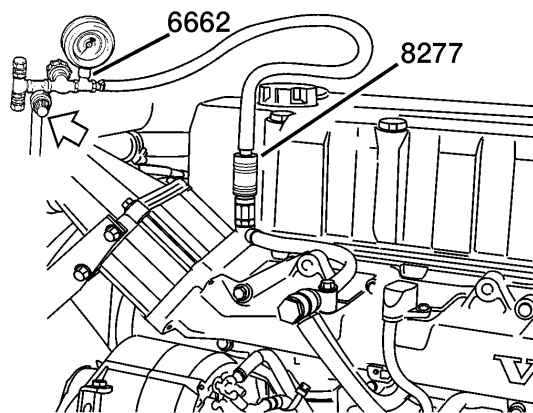
9996662

5



T2006717

Fig. 36: Pressure gauge assembly connected to union, D12A/B

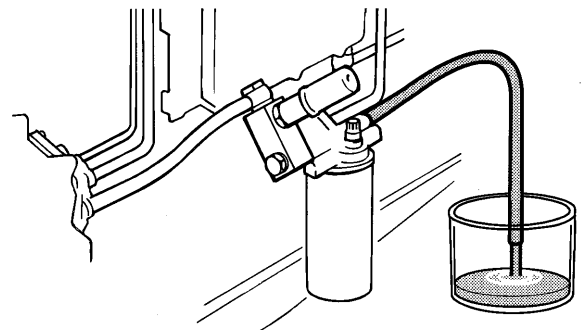
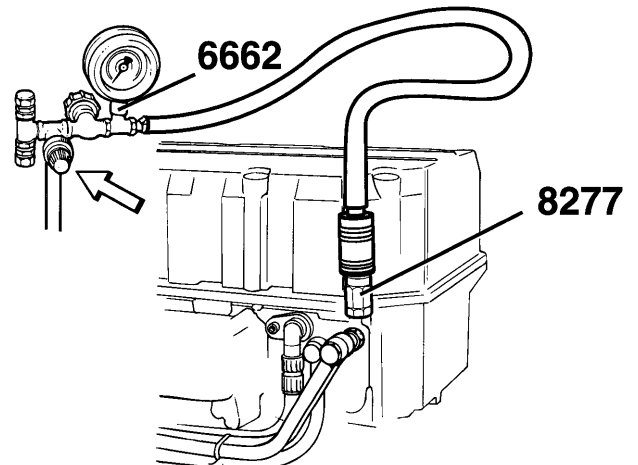


W2003512

Fig. 37: Pressure gauge assembly connected to union, D12C

Check that the pressure gauge indicator is at "0" (zero) and connect the gauge to union 9998277.

6



T2006718

Fig. 38: Draining the remainder of the fuel, D12A/B

Blow the remaining fuel out of the cylinder head by carefully increasing the pressure with the knob on the pressure gauge reduction valve. **DO NOT EXCEED 50 kPa (7.25 psi).**

7

When all fuel has been drained:

- Remove the pressure gauge assembly, union and the drain hose.
- Reinstall the bleed nipple and the protective cap onto the cylinder head. Do not replace the nipple, as the original nipple is fitted to the seating in the cylinder head. A new nipple can result in leakage.
- Tighten the drain union on the fuel filter bracket and install the protective cap.

## 2309-05-03-01

### Fuel System, Bleeding

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

#### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

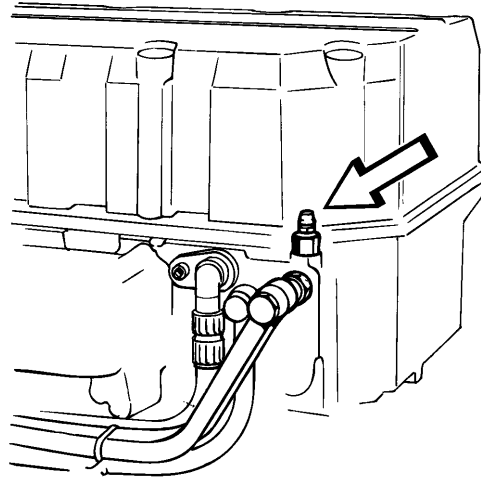
#### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

#### WARNING

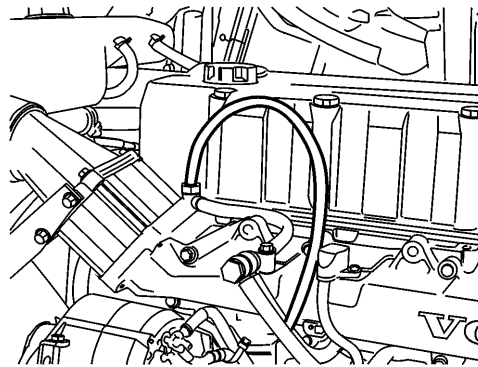
Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

1



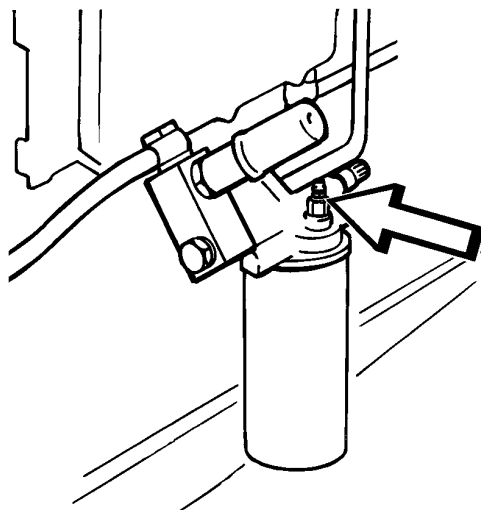
T2006713

Fig. 39: Cylinder head bleed nipple, D12A/B location



W2003394

Fig. 40: Cylinder head bleed nipple, D12C location

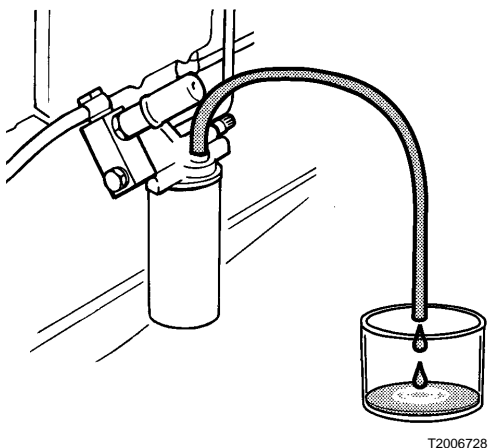


T2006712

Fig. 41: Fuel filter bleed nipple

Clean around the bleed nipples on the fuel filter housing and cylinder head.

2



T2006728

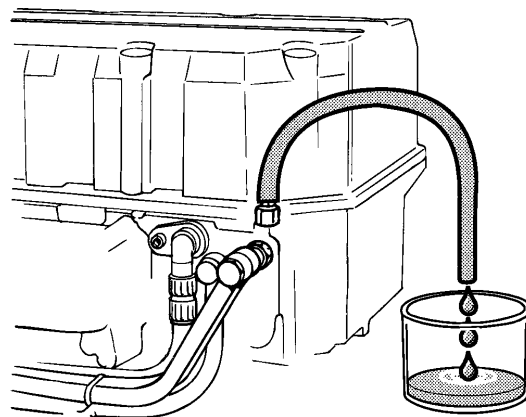
Fig. 42: Installing bleed line

Connect a transparent plastic hose to the fuel filter housing bleed nipple. Open the bleed nipple and pump the hand primer until clean fuel runs out of the hose. Tighten the bleed nipple while fuel is still running out.

3

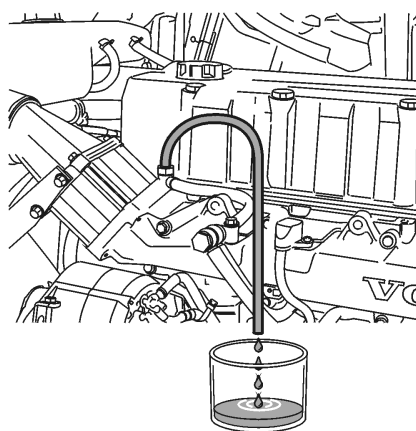
Remove the hose and install the protection plug on the bleed nipple.

4



T2006711

Fig. 43: Bleeding the cylinder head, D12A/B



W2003510

Fig. 44: Bleeding the cylinder head, D12C

Move the hose over to the cylinder-head bleed nipple and bleed the system in the same way as with the fuel filter housing.

5

Apply parking brake and place gear lever into neutral.

6

Start the engine and allow it to run at fast idle, or with the PTO engaged, for about five minutes to remove air from the system. Check for leaks.

## 2331-03-02-01 Fuel Feed Pump, Replacement

### D12, D12A, D12B

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### **DANGER**

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

#### **WARNING**

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

#### **WARNING**

Do not work near the fan with the engine running or the ignition in the ON position. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured.

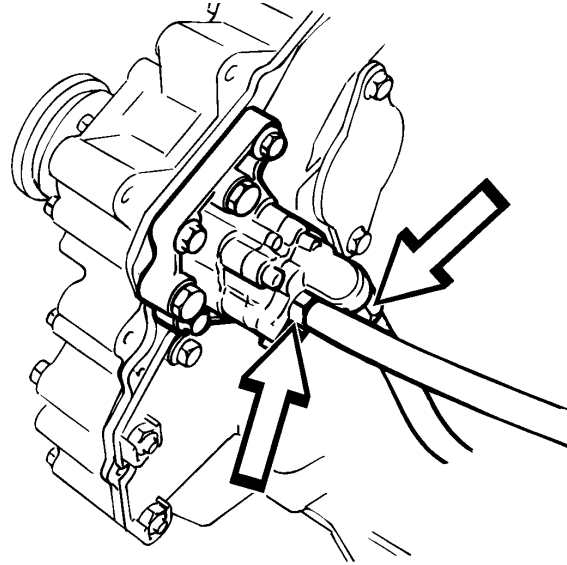
#### **WARNING**

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

**1**

Clean the area around the fuel feed pump area and remove the bleed line.

**2**

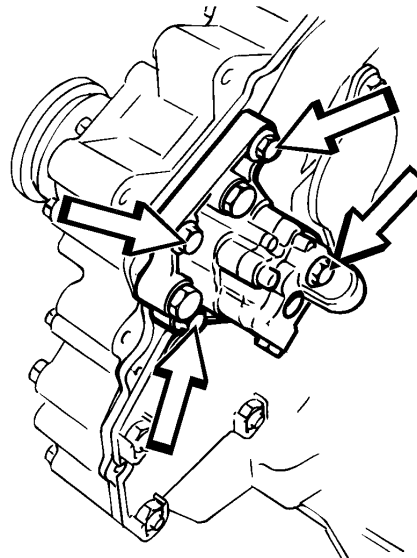


T2006724

Fig. 45: Removing fuel line

Remove the plastic straps securing the fuel line on the ECM and cylinder block. Remove the lines at the unions from the fuel feed pump, as indicated by arrows in figure Fig. 46: Removing fuel pump, page 52.

**3**



T2006723

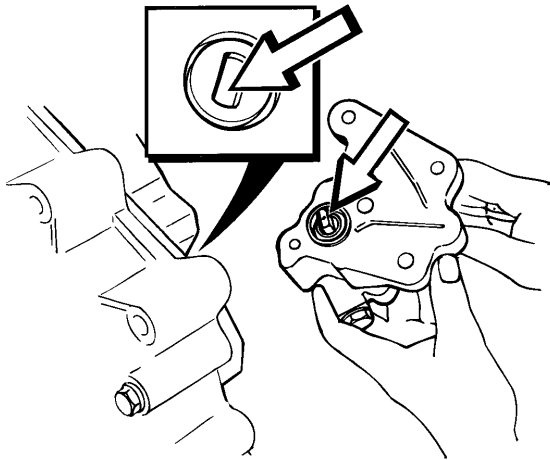
Fig. 46: Removing fuel pump

Remove the bolts indicated by arrows in figure Fig. 46: Removing fuel pump, page 52 and lift out the fuel-feed pump.

**4**

Clean the contact surface on the timing gear plate.

5



T2006722

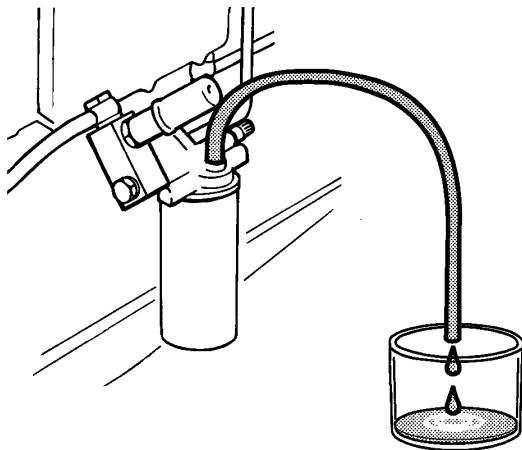
Fig. 47: Install fuel-feed pump

Check to make sure that the fuel-feed pump drive engages in the drive slot. Install a new gasket and tighten the fuel-feed pump mounting bolts.

6

Connect the fuel lines and the bleed line. Use new sealing washers. Secure the fuel lines with plastic tie straps.

7



T2006728

Fig. 48: Bleeding fuel system

Bleed the fuel system at the fuel filter as shown in illustration, Fig. 48: Bleeding fuel system, page 53. See also "Fuel System, Bleeding" page 50.

8

Apply parking brake and place gear lever into neutral.

9

Start the engine. Allow it to run at fast idle, or with the PTO engaged, for about five minutes to remove air from the system. Check for leaks.

## 2331-03-02-01 Fuel Feed Pump, Replacement D12C

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

### WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

### WARNING

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

### WARNING

Do not work near the fan with the engine running or the ignition in the ON position. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured.

## Types

There are two types of feed pump on the D12C engine:

1

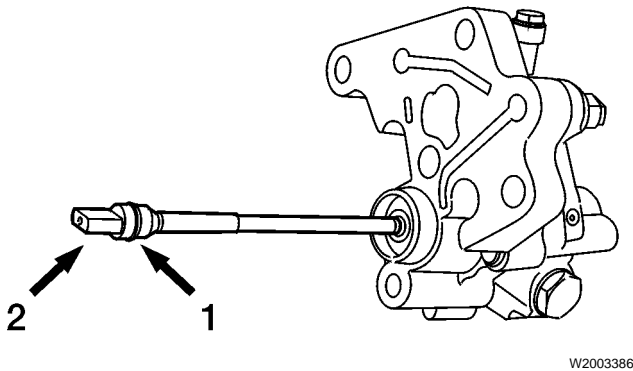


Fig. 49: Feed pump, type 1 (older version, with long drive shaft).

- 1 Seal
- 2 Shaft journal

2

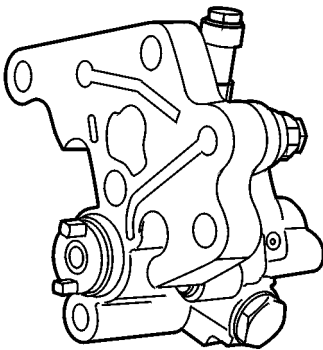


Fig. 50: Feed pump, type 2 (newer version, available with one or two drive heads; available on newer and replacement engines).

Feed pumps as spare parts are available in both versions.

**Note:** Both types of feed pumps are interchangeable, i.e. feed pump type 1 can be replaced with feed pump type 2 and vice versa.

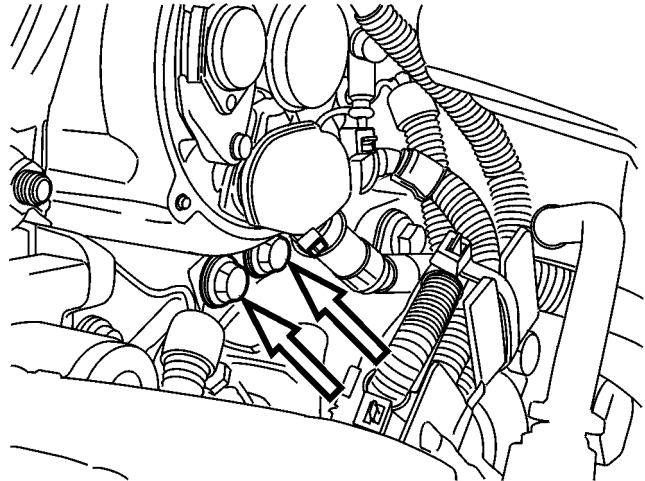


## CAUTION

When replacing feed pump **Type 1**, great care must be taken with the long drive shaft. Any damage to the drive shaft can damage the feed pump; if it is installed on the engine, serious engine damage can result.

## Removal

1



Cut the plastic clamps for the cabling and remove the bracket under the alternator.

2

Carefully clean round the feed pump and the fuel connections.

3

Remove all fuel pipes from the feed pump.

4

Remove the hold-down bolts for the feed pump. Carefully pull the drive shaft from the drive exhaust and remove the pump from the engine.

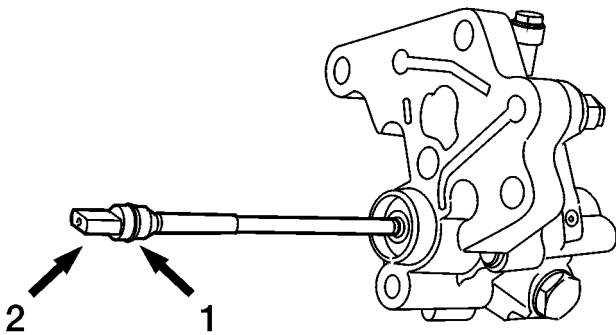
5

Clean the sealing surface on timing gears plate. Check that the gasket for the feed pump is in good condition. If necessary, replace with new gasket.



## Installation

1



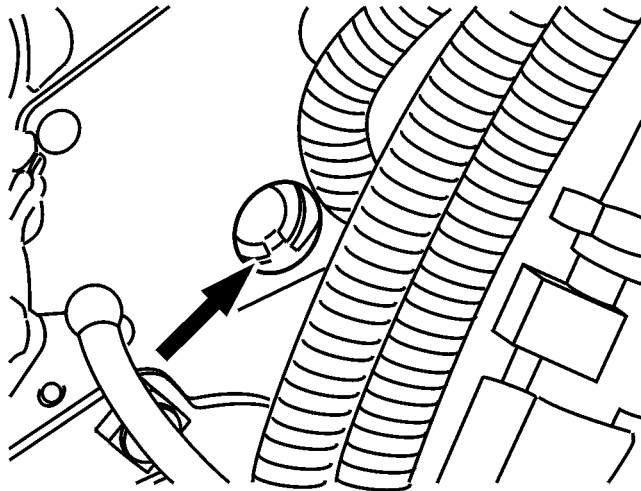
W2003386

Fig. 51: Feed Pump Type 1

- 1 Seal
- 2 Shaft journal

**(Feed Pump Type 1 only:)** Check that the seal (1) is in good condition and correctly positioned. Also check that the shaft journal (2) is lubricated with graphite grease.

2



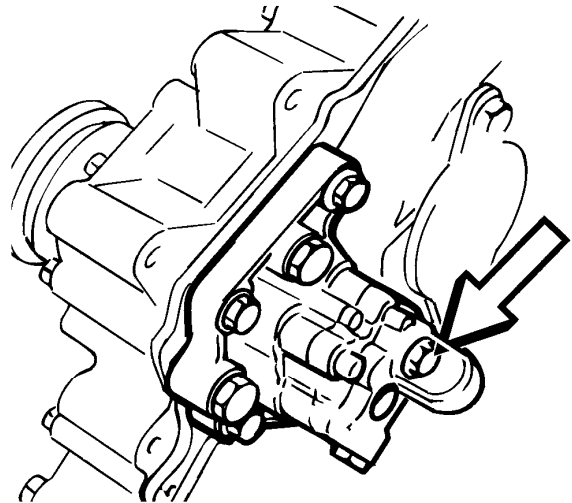
W2003387

Fig. 52: Feed pump drive shaft groove

Check that the feed pump's drive installs in the groove on the feed pump's drive shaft.

The groove in the shaft shows which position the feed pump's shaft journal should have when installing ( applies to both type 1 and 2).

3



T2014660

Fig. 53: M8-bolt with sealant

Install the seal on the feed pump and install the feed pump on the engine.

### CAUTION

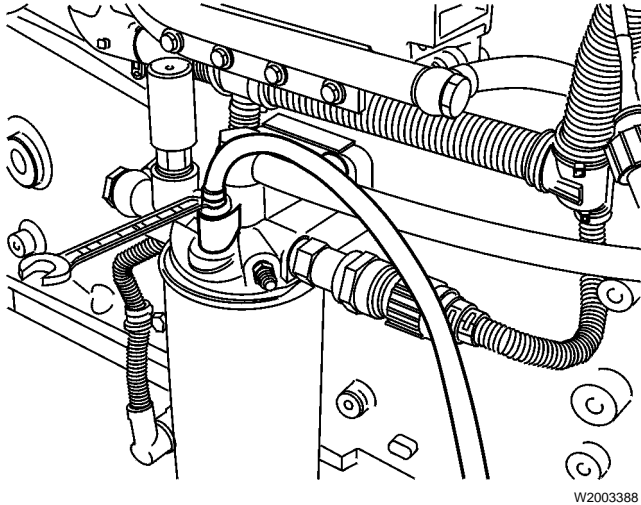
(Feed Pump Type 2:) Observe great care with the feed pump's drive shaft. Damage to the feed pump's drive shaft can permanently damage the engine.

**Note.** The M8-bolt should be reinstalled with sealant to seal any oil leakage. Do **not** install the old bolt without sealant or leakage can occur.

4

Check the seals on the fuel lines. The sealing washers for the return line should always be replaced. Replace other seals if necessary. Install the fuel lines on the feed pump.

5



Vent the fuel system.

6

Start the engine and run it at high revs (**approx. 800 – 1000 rpm**) for **approx. 10 min.** to evacuate any remaining air in the fuel system.

800 – 1000  
rpm  
approx. 10  
min

7

Conduct leakage check.

8

Check that no fault codes exist.

## 2331-03-02-02

### Hand-Primer Pump, Replacement

**Note:** Before beginning this service procedure, please review “General Work Practices” page 43.



#### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



#### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.



#### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



#### WARNING

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

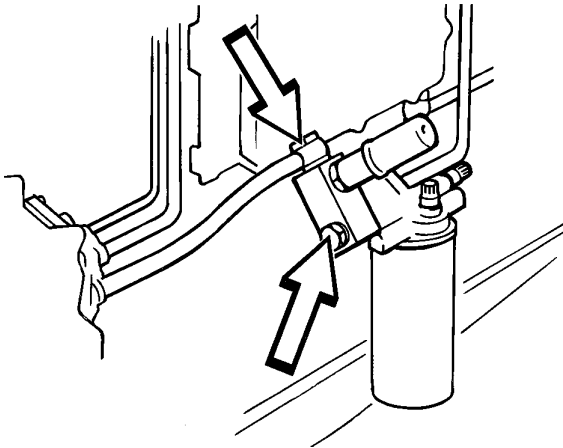
1

Open the fuel tank cap to release any pressure in the fuel tank.

2

Clean around the hand-primer fuel fittings.

3



T2006720

Fig. 54: Removing hand-primer pump

Remove the hand-primer pump fuel lines at the unions.

4

Remove the hand-primer pump mounting bolts.

5

Install the new hand-primer pump using new sealing washers.

6

Reconnect the mounting bolts and fuel lines.

7

Bleed the fuel system (see "Fuel System, Bleeding" page 50).

8

Apply parking brake and place the gear lever into neutral.

9

Start the engine. Allow it to run at fast idle, or with the PTO engaged, for about five minutes to remove air from the system and check for leaks.

## 2334-03-02-01 Fuel Filter, Replacement

### Prerequisite:

- Container for fuel under filter.

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

### WARNING

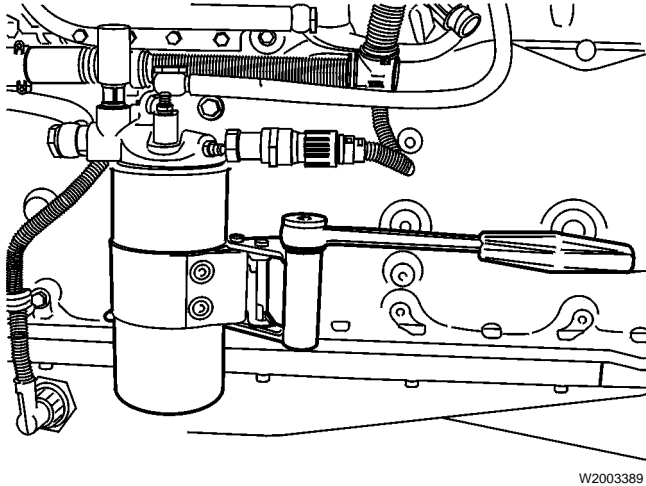
Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

### Special tools: 9996671

1

Clean the area around the fuel filter area.

2



Remove the fuel filter.

3

Clean the sealing surface, making sure that there is no residual gasket.

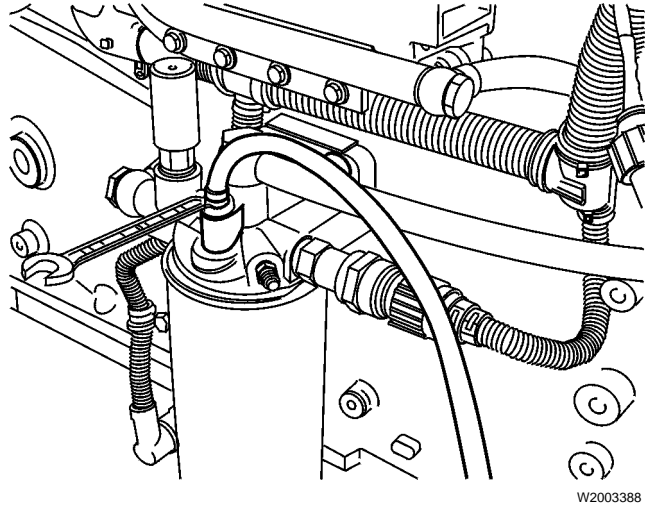
4

Install the new fuel filter, following the instructions on the filter.

**CAUTION**

Do not fill the new fuel filter with fuel before installing. Doing so may allow foreign objects to get into the fuel, and can cause the injectors to malfunction.

5



Bleed (vent) the fuel system at the fuel filter. Connect a transparent plastic hose to the bleed nipple. Open the bleed nipple and pump the hand primer until clean fuel runs out of the hose. Tighten the bleed nipple while fuel is still running out (see "Fuel System, Bleeding" page 50).

6

Remove the hose and reinstall the protection plug on the bleed nipple.

7

Apply parking brake and shift lever into neutral.

8

Start the engine. Allow it to run at fast idle, or with the PTO engaged, for about 10 minutes to evacuate any residual air in the fuel system.

## 2339-06-02-02 Overflow Valve, Checking

### D12, D12A, D12B

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.



#### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



#### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.



#### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

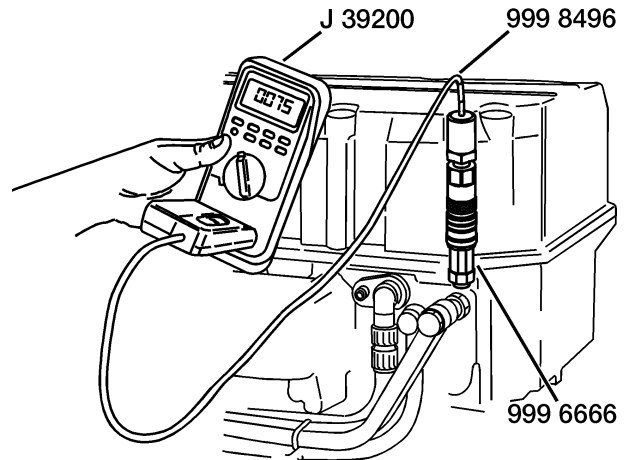


#### WARNING

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

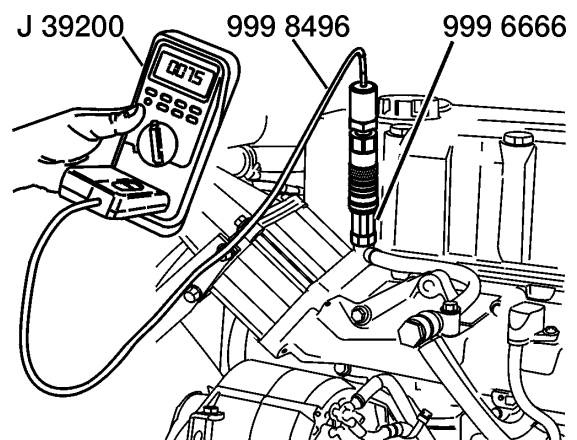
**Special tools:** 9996666, 9998496, J-39200

1



W2002209

Fig. 55: Bleed nipple, D12A/B



W2003513

Fig. 56: Bleed nipple, D12C

Remove the bleed nipple at the rear of the head, install adapter 9996666 and pressure transducer 9998496. Connect the transducer to the multimeter J-39200.

**Note:** The pressure transducer measurement scale is in kPa.

2

Slowly pump the hand pump while monitoring the fuel pressure. The pressure should rise to a point determined by the opening of the overflow valve then drop quickly. Recheck several times to get an accurate reading.

**3**

The opening pressure should correspond to specifications found in “Fuel Supply Pump and Overflow Valve” page 5.

**Note:** If the overflow valve opens at a pressure that is less than that given in the specification, low fuel pressure will result. The valve must be replaced.

**4**

Replace the valve if necessary.

**2339-03-02-02****Overflow Valve, Replacement****D12, D12A, D12B**

**Note:** Before beginning this service procedure, please review “General Work Practices” page 43.

**DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

**DANGER**

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

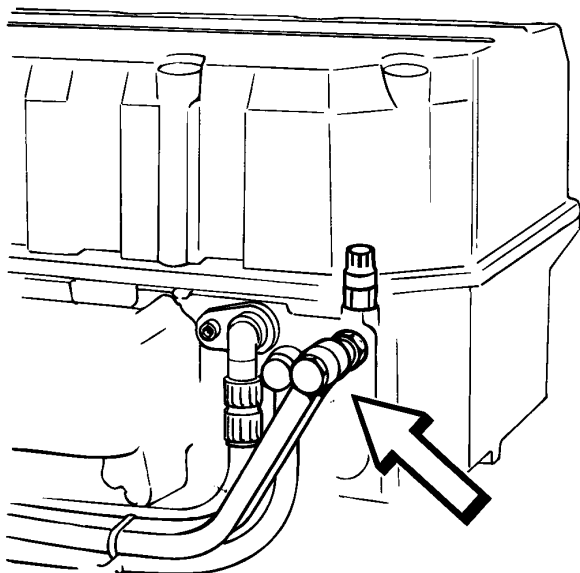
**WARNING**

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

**WARNING**

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

1

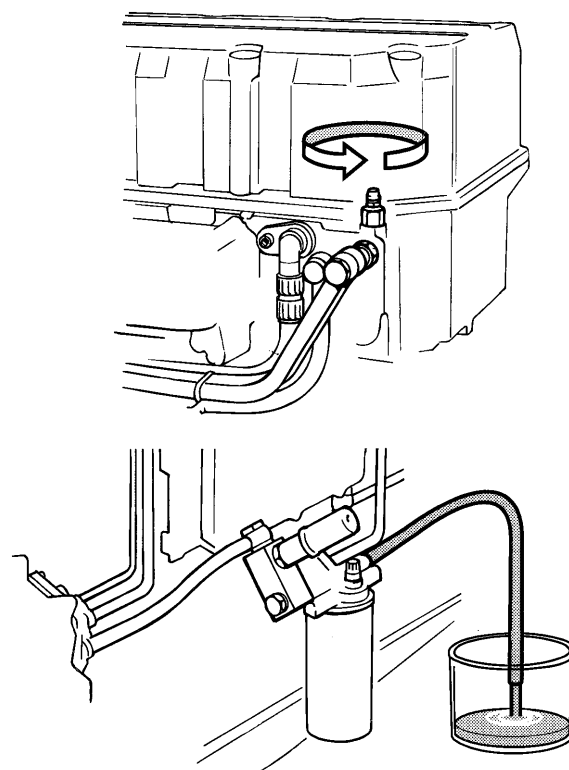


T2006730

Overflow valve

Carefully clean the area around the overflow valve area.

2

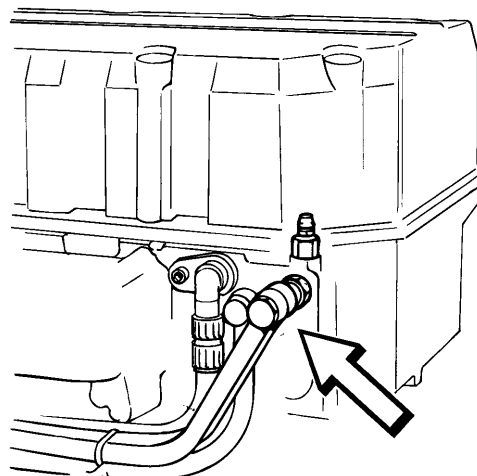


T2006710

Draining fuel

Drain the fuel by connecting a hose to the fuel filter housing drain nipple. Remove the protection plug and open the bleed nipple on the cylinder head. Route the fuel from the fuel filter housing into a suitable container.

3



T2006714

Removing fuel lines

Remove the fuel line from the overflow valve.

**4**

Remove the overflow valve.

**5**

Clean the contact surface on the cylinder head and install a new overflow valve. Use a new sealing washer.

**6**

Reconnect the fuel line. Use new sealing washer.

**7**

Bleed the fuel system.

**8**

Apply parking brake and place the gear lever into neutral.

**9**

Start the engine and allow it to run at fast idle, or with the PTO engaged, for about ten minutes to remove air from the system.

**10**

Perform leak and operation checks.

## 2339-03-02-02

### Overflow Valve, Replacement

#### D12C

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.



#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



#### **DANGER**

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.



#### **WARNING**

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



#### **WARNING**

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

**1**

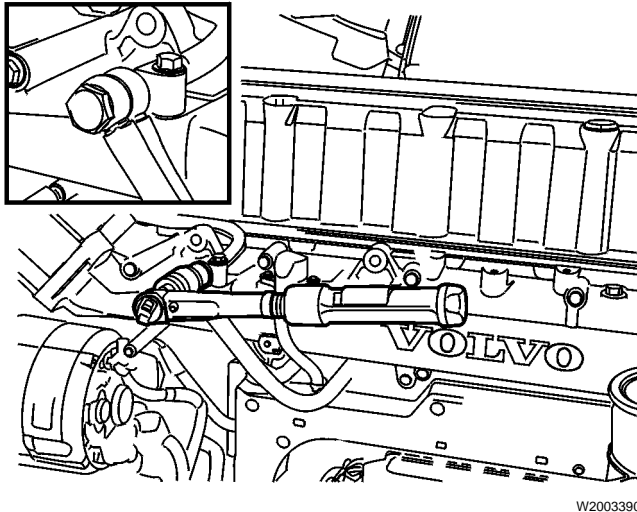
Remove the overflow valve from the intake pipe.

**2**

Clean the sealing surfaces.



3



W2003390

Install a new overflow valve with new copper washers and tighten the overflow valve to  $55 \pm 5$  Nm ( $40 \pm 4$  ft-lb).

## 2371-03-02-02

### Unit Injector, Replacement (One)

Not Included:

- "Unit Injector, Adjustment" page 67

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

#### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

#### WARNING

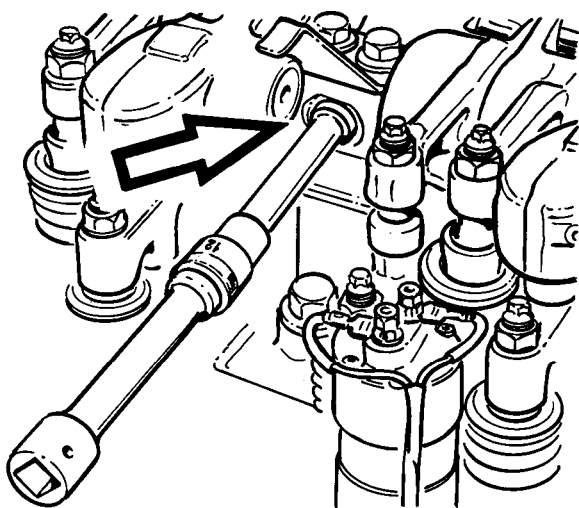
**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

#### WARNING

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

*Special tools:* 9998249, 9998511, 9998599, J-44515

1

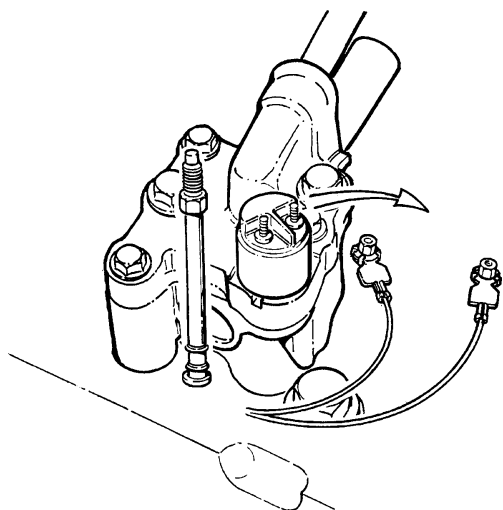


T2009070

**Prerequisites:**

- Valve cover removed.
- Control valve removed.
- Pipe removed between control valve and rocker arm shaft.

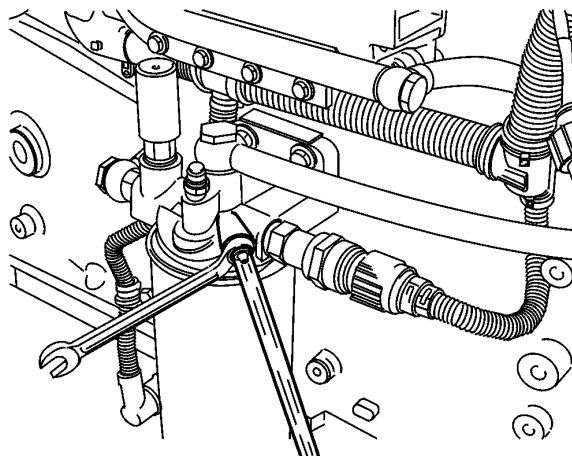
2



T2008812

Release the rocker arm bridge as per the specifications.

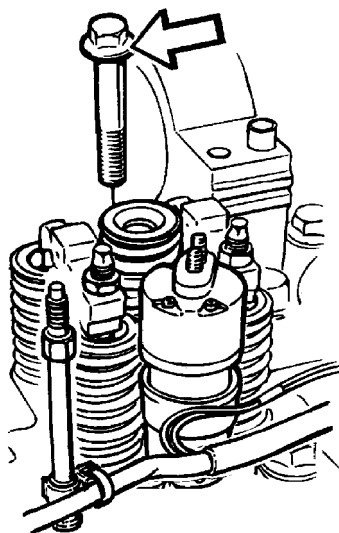
3



W2003391

Drain the fuel out of the system to prevent fuel running down into the cylinder when a unit injector is dismantled.

4



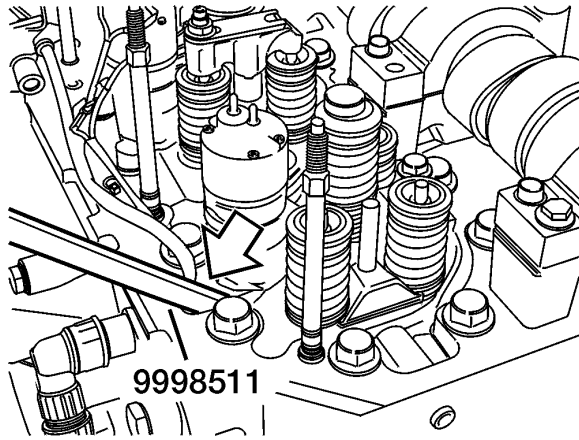
T2008956

Remove the injector hold-down bolt.

5

Clean very carefully round the unit injector to be changed.

6

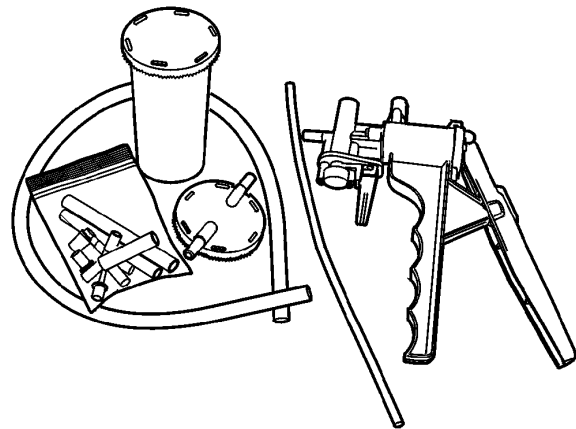


Remove the electrical cables from the unit injector and the bolt for the unit injector's attachment yoke.  
Remove the unit injector with tool 9998511.

W2003392

9998511

7



W0001837

Fig. 57: Vacuum pump J-44515

Remove fuel from the top of the piston using vacuum pump J-44515.

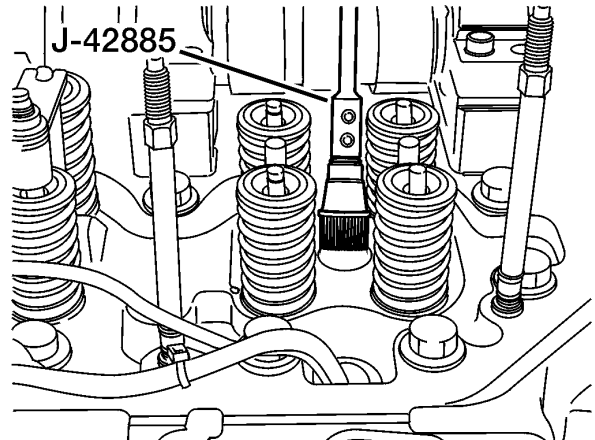
J-44515

8

Install protective sleeve J-42885-25 on the unit injector.

J-42885-25

9



W2003393

Fig. 58: Cleaning the copper sleeve

Install cleaning sleeve 9998580 in the injector well and carefully clean the copper sleeve.

9998580

9998251

Leave cleaning sleeve 9998580 on the cylinder head until the dirt is removed from the injector well.

**Note:** If the unit injector is not installed immediately, install the protective plug 9998251 in the cylinder head.

10

Check the sealing rings on the unit injector. Install the unit injector and centre it between the valve springs. Tighten with a torque as per the specifications.

**11**

Connect the electric cables to the injector.

$1.4 \pm 0.1$  Nm  
( $3.5 \pm 0.88$  in-lb)

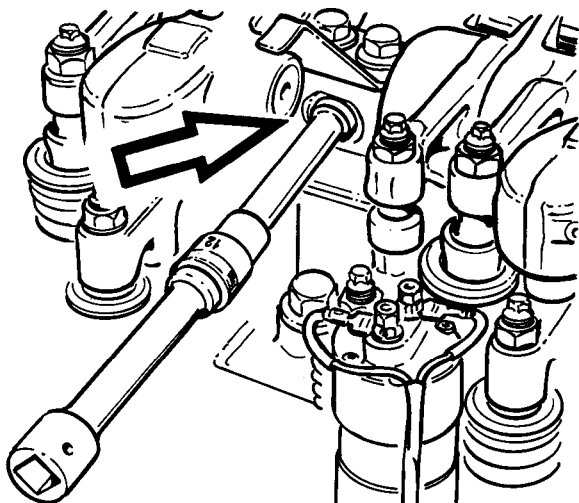
**Note:** Tighten the nuts with a torque of  $1.4 \pm 0.1$  Nm ( $3.5 \pm 0.88$  in-lb).

**CAUTION**

Do not overtorque. This will break the stud.

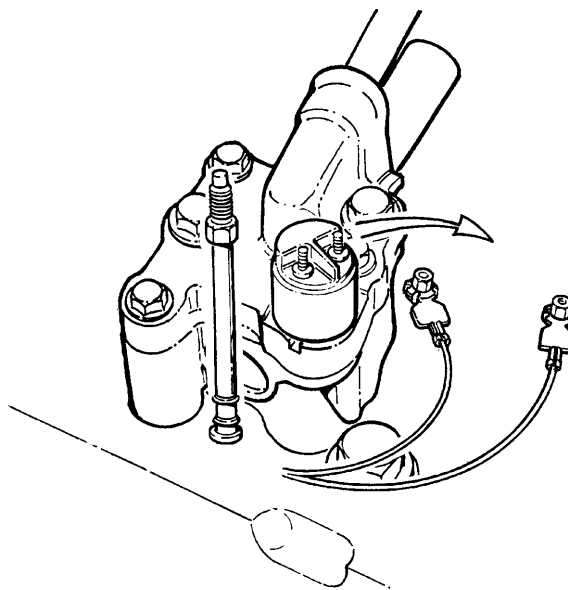
**12**

Install the rocker arm bridge and tighten with a torque as per the specifications.

**13**

T2009070

Install the pipe between the rocker arm shaft and control valve.

**14**

T2008812

Install the control valve.

**15**

Connect the cables on the solenoid valve.

$1.4 \pm 0.1$  Nm  
( $3.5 \pm 0.88$  in-lb)

**Note:** Tighten the nuts with a torque of  $1.4 \pm 0.1$  Nm ( $3.5 \pm 0.88$  in-lb).

**CAUTION**

Do not overtorque. This will break the stud.

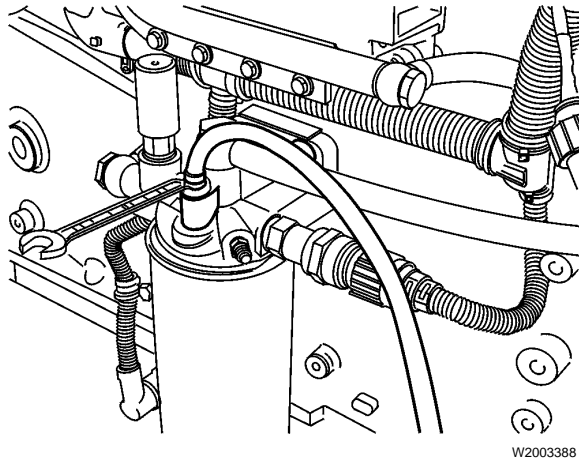
**16**

Adjust the valves.

**17**

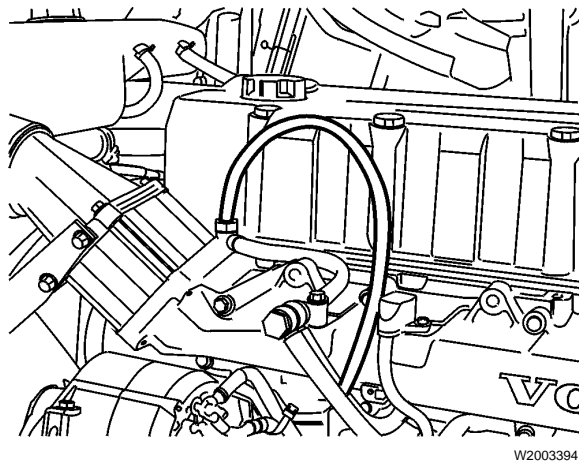
Install the valve cover and tighten according to the tightening schedule in the specifications.

18



Vent the fuel system at the fuel filter.

19



Vent the fuel system on the cylinder head.

20

Start the engine and run for approx. 10 minutes to evacuate any residual air in the fuel system.

21

Check that the engine has reached normal working temperature and then run for another 5 minutes.

22

Check to make sure the fuel system is operating properly. Check for leaks.

## 2371-05-02-01 Unit Injector, Adjustment

(Adjusting pre-load)

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

**WARNING**

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

**WARNING**

Do not work near the fan with the engine running or the ignition in the ON position. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured.

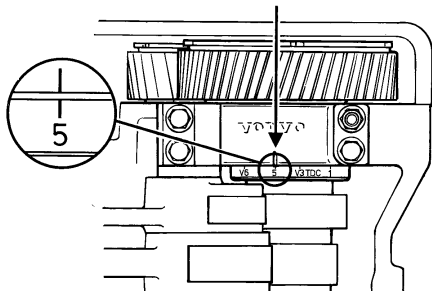
**CAUTION**

Observe the greatest possible cleanliness when working on the cylinder head. Dirt particles in the fuel and oil channels can cause the unit injectors to malfunction, and can cause the VEB (if equipped) to fail.

*Special tools: 9996956*

**Unit Injector, Adjusting Pre-load**

1



T2006935

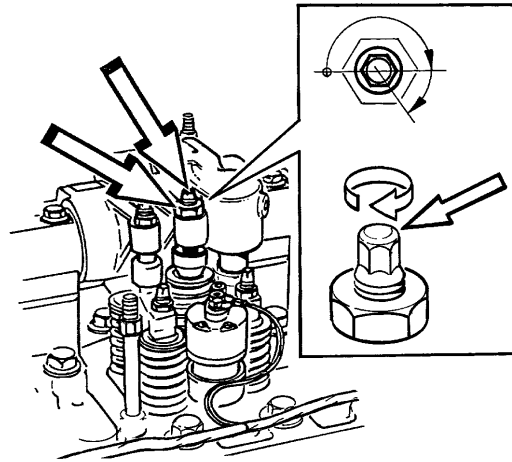
Check that the camshaft line marking for adjusting the intake valves and unit injector are opposite the marking on the bearing cap, tolerance  $\pm 2$  mm (alternatively between the marks). Check, via the number marking on the camshaft on which cylinder unit injector pre-loading is to be adjusted.

**Important:** If tool 6956 is used to crank the flywheel, make sure that the tool is removed if the engine is to be turned over with the starter motor.

2

Loosen the adjustment screw and adjust the unit injector rocker arm to zero clearance against the camshaft. Tighten the adjustment screw one full turn and then loosen again. Then return the rocker arm to zero clearance.

3



T2008845

Preload the unit injector by screwing down the adjustment screw **3–4 flats**, (180° - 240°). Torque-tighten the lock nut according to the specifications.

**3–4 flats**  
(180° - 240°)

## 2379-03-02-02

### Unit Injector Copper Sleeve, Replacement

**Note:** Before beginning this service procedure, please review "General Work Practices" page 43.

#### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### DANGER

Do not service any part of the fuel system while smoking or in the presence of flames, sparks, or hot surfaces. Failure to follow these precautions can result in fire, which can cause serious injury or death.

#### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

#### WARNING

Fuel, oil, or coolant leaked/spilled onto hot surfaces or electrical components can cause a fire. Clean up spills immediately.

#### WARNING

Do not work near the fan with the engine running or the ignition in the ON position. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured.

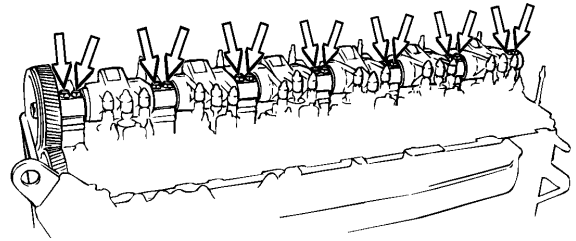
### Removal

1

Connect a drain hose 9996049 to the engine coolant drain nipple and drain the coolant into a suitable container.

9996049

2



T2006777

Remove the rocker arm bridge bolts.

**Note:** Loosen the bolts in three equal stages to avoid bending the rocker arm shaft.

3

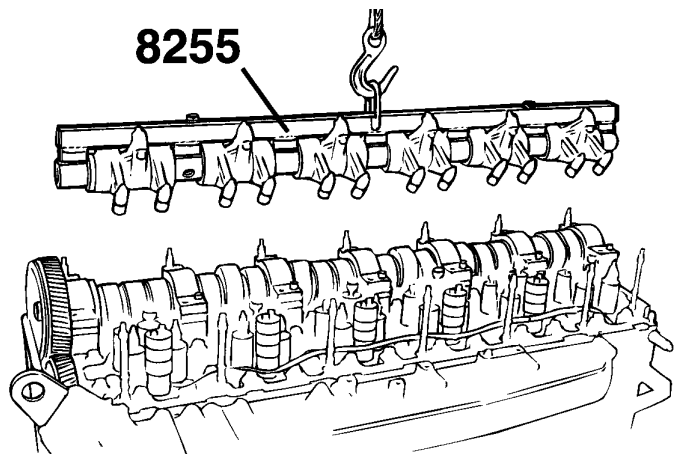
#### CAUTION

Failure to remove the control valve before removing the rocker arm bridge may result in damage to the control valve and/or the pipe.

If the engine is equipped with a VEB (Volvo Engine Brake), remove the control valve and the pipe. Plug the ports and place the valve in a plastic bag to prevent it from being subjected to dirt and contamination. To facilitate removal, remove the valve cover stud bolt.

**Note:** On engines equipped with a VEB (Volvo Engine Brake), secure the rocker arm plungers with rubber bands so that the plungers do not fall out of the rocker arms.

4



T2006776

Lift the rocker arm bridge using lifting tool 9998255.

9998255

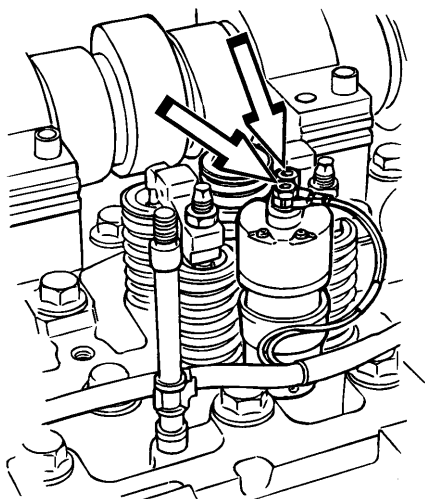
5

Drain the fuel from the cylinder head. Refer to the procedure, "Fuel System Draining," the service manual 210-600, Basic Engine D12.

6

Carefully clean around the electronic unit injector (EUI) to be removed.

7



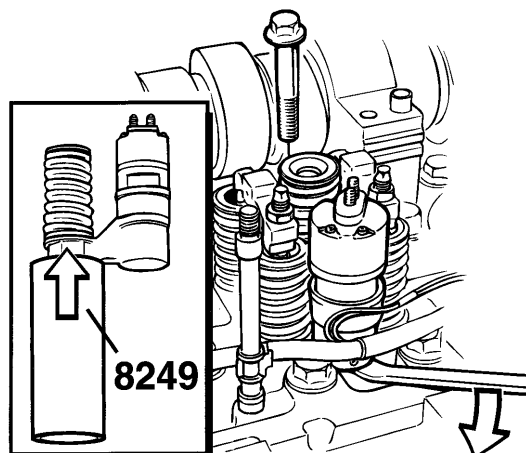
T2006709

Disconnect the electrical wires from the EUI.

**CAUTION**

Pay close attention to the wire terminals. If one breaks, remove the broken pieces. Failure to do so may result in pieces falling into the cylinder, which can cause component damage.

8

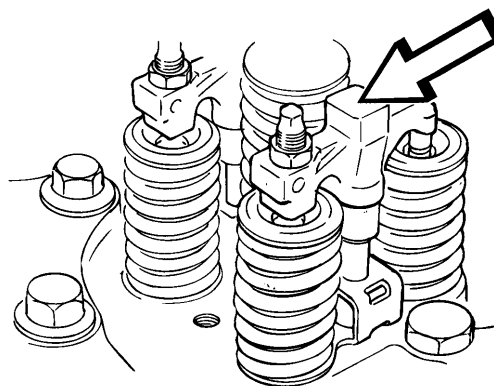


T2006708

9998249

Remove the EUI and check that no dirt enters the injector well in the cylinder head. Install a dust cover on the EUI, and install protective plug 9998249 in the injector well in the cylinder head.

9



T2007050

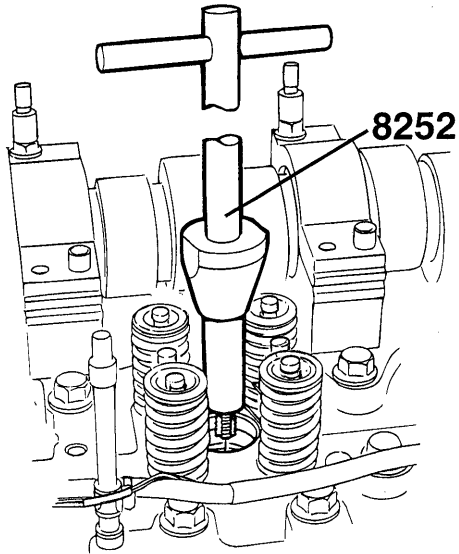
Remove the valve bridges at the copper sleeve that is to be changed, and make note of location for reassembly.

10

Make sure that the piston corresponding to the copper sleeve being removed is in the down position.



11



T2007157

**(This step is for D12C only)** Check whether the copper sleeve has an 8 mm or 9 mm hole in the tip. Install the 8 mm tap in tool 9998252 and try threading the copper sleeve. If it turns too easily, replace the 8 mm tap with the 9 mm tap and continue with the procedure.

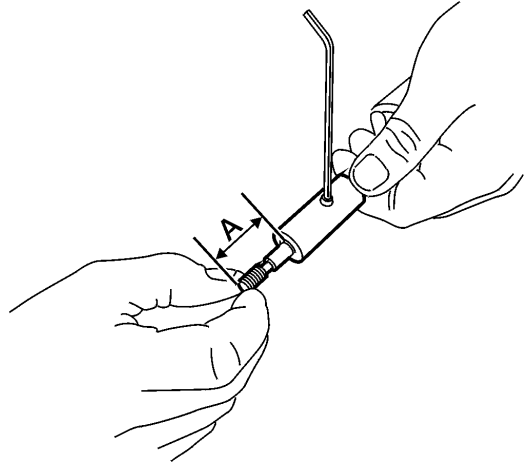
12

Using tool 9998252 turn tap approximately 1/4 of a turn, then back off at least a full turn to remove shavings. Turn forward again until you feel tension, then repeat this step. Continue until the tap has passed through the bottom of the copper sleeve.

9998252

**Note:** Apply grease to the tap to prevent shavings from falling down into the cylinder.

13



W2003433

Using the Allen wrench, loosen the Allen set-screw on the extractor tool 9998253.

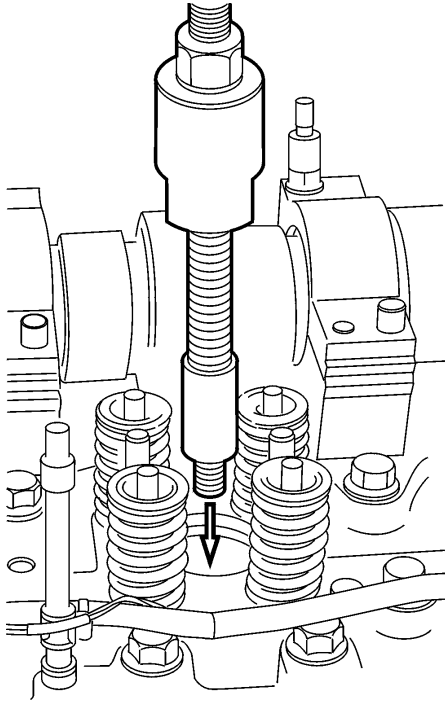
14

Adjust the bolt in the end of the tool until the bolt extends approximately 22 mm (0.875 in.) beyond the end of the tool(A).

15

Tighten the Allen set-screw and make sure that the screw is seated against the flat part of the extractor bolt.

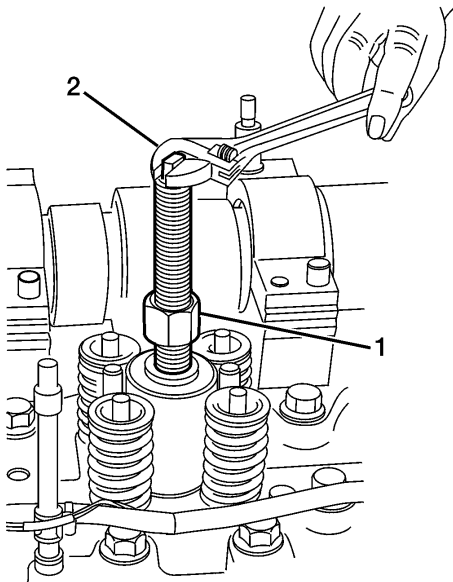
16



W2003434

Install the extractor tool into the copper sleeve and hand tighten until it bottoms out in the sleeve.

17

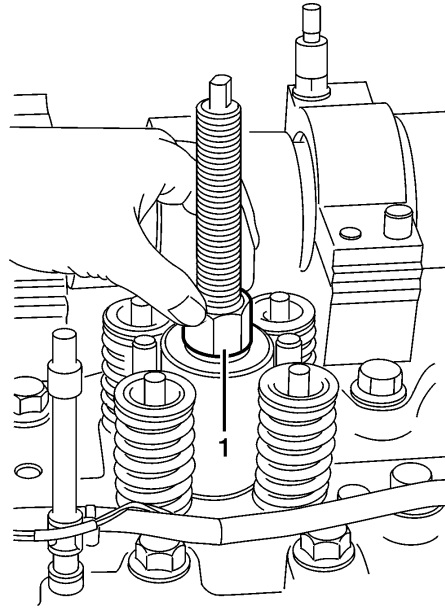


W2003435

Back off the retaining nut (1) and turn the extractor bolt (2) so that the threaded end passes completely through the copper sleeve tip.

**Note:** If the threaded end does not pass completely through the copper sleeve, the tip of the sleeve may break off as it is removed.

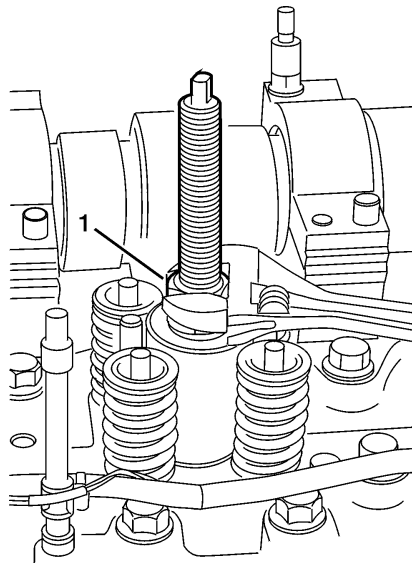
18



W2003436

Hand turn the retaining nut clockwise (1) until it is firmly seated against the bottom of the extracting cup.

19



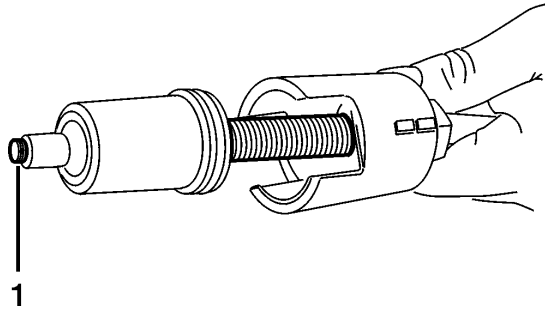
W2003437

**CAUTION**

Do not use air tools to remove the copper sleeve. Use of air tools can damage engine components.

Using a wrench, turn the retaining nut (1) clockwise until the copper sleeve is removed.

20



W2003438

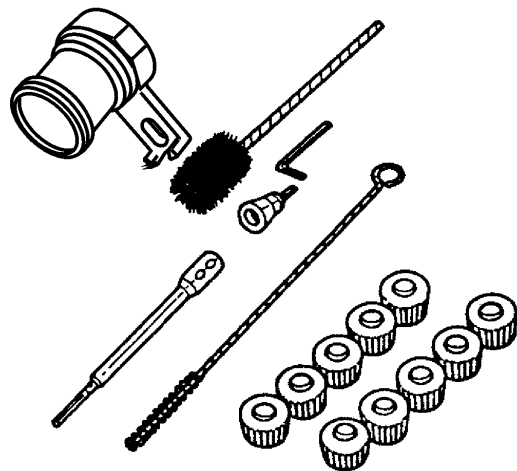
**CAUTION**

Pieces of the copper sleeve that fall into the cylinder can seriously damage the piston and/or turbocharger.

When the sleeve is removed, the extractor tool should be extended beyond the copper sleeve at least 3 mm (0.125 in); see (1). If it is not, check to make sure that a piece of the copper sleeve has not broken off and fallen into the cylinder.

**Cleaning the Copper Sleeve Bore**

21



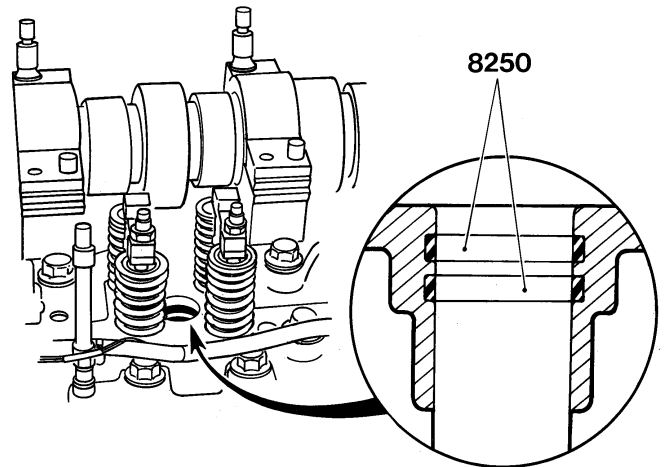
W2003537

Fig. 59: Cleaning kit J-42885

When replacing the injector copper sleeves in the cylinder head, it is important that the sleeve bore in the head is free from any carbon deposits and any other residue (i.e. pieces of the O-ring, etc.) before installing the new sleeve. Use the cleaning kit J-42885 in the following steps.

J-42885

22

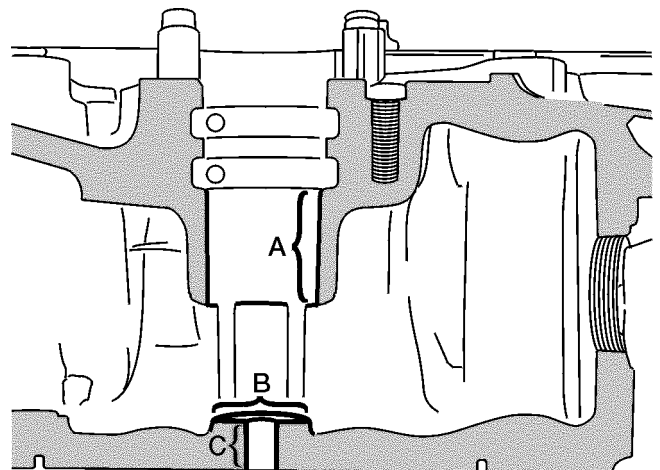


T2006821

Install the 2 sealing clamps 9998250 in the cylinder head fuel gallery.

9998250

23



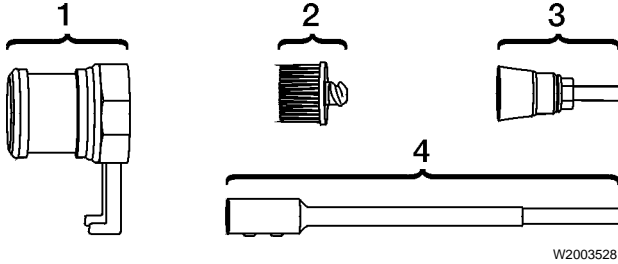
W2003148

**WARNING**

Wear safety glasses while using cleaning brushes or compressed air. Failure to do so could cause eye injury from flying debris.

Use the "7/16 in. diameter" brush inside bore (C). Move the brush up and down while turning it at the same time.

J-42885

**24**

Place the injector bore sleeve protector into injector bore. Assemble the Roloc® brush (2), the holder (3), and the extension (4). Install the assembly into a drill and clean the sleeve seal (B); see illustration page 73.

J-42885

**25**

Install the 1.5 in. diameter brush into the drill and clean bore (A); see illustration page 73.

J-42885

**26**

Use the chip vacuum PT-2900 to remove all debris from the copper sleeve bore.

PT-2900

**27**

Inspect the copper sleeve bore for any remaining debris. Pay close attention to the O-ring area of the bore for any remaining pieces of the O-ring that may require scraping with a pocket knife to remove. Reclean if needed.

**28**

Remove the 2 sealing clamps 9998250 from the cylinder head fuel gallery, and remove any remaining debris using chip vacuum PT-2900.

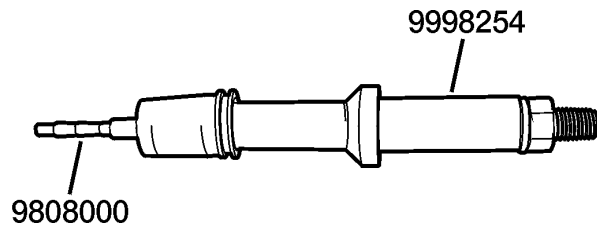
9998250  
PT-2900

## Installation

**1**

T2007088

Lubricate the new sealing ring with engine oil and install it on the new copper sleeve.  
Lubricate the sealing ring again with engine oil.

**2**

9808000

W2003176

Install the copper sleeve on the flaring tool 9998254, and lubricate the flaring pin 9808000 with engine oil. Thread the flaring tool 9998000 to the flaring tool 9998254 until it bottoms. Then, loosen the flaring pin approximately 180°.

9998254  
9808000

**Note:** Failure to loosen the flaring tool 180° can result in the pin being twisted or broken.

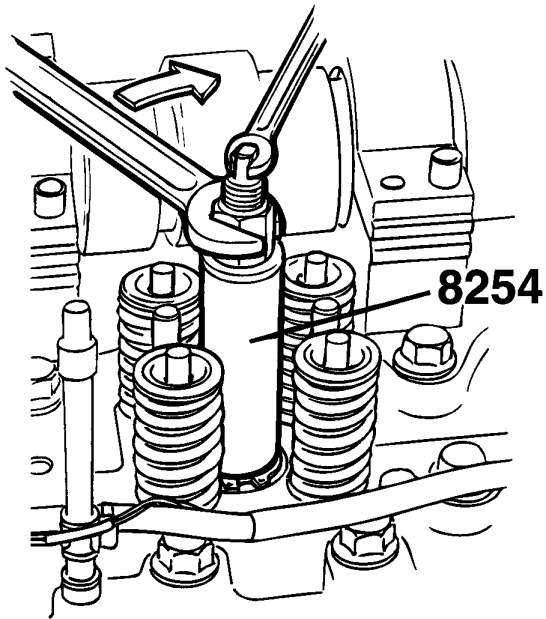
**3**

Check that the piston is not at T.D.C. (if the piston is at T.D.C., the flywheel must be turned). Carefully tap down the copper sleeve until it bottoms out against the sleeve seal in the cylinder head.

**4**

Install and tighten the retainer for the electronic unit injector.

5

T2007089  
9998254

Flare the copper sleeve. Do this by turning the nut while counterholding the spindle until the flaring pin, 9998254 has been completely pulled through the copper sleeve.

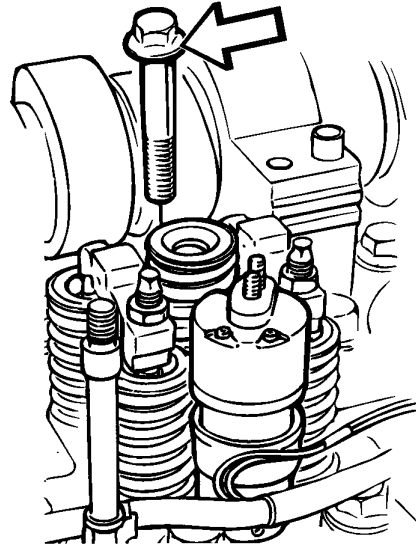
**Note:** Failure to counterhold the spindle will result in a twisted or broken flaring pin.

6

Remove the flaring tool 9998254 and pin 9808000.

9998254  
9808000

7



T2006707

Install the new sealing rings on the electronic unit injector (EUI). Lubricate the sealing rings with grease and install the electronic unit injector.

8

**CAUTION**

Remove all oil from the injector retainer bolt holes to prevent a hydraulic lock that may result in damage to the cylinder head.

Tighten the electronic unit injector.

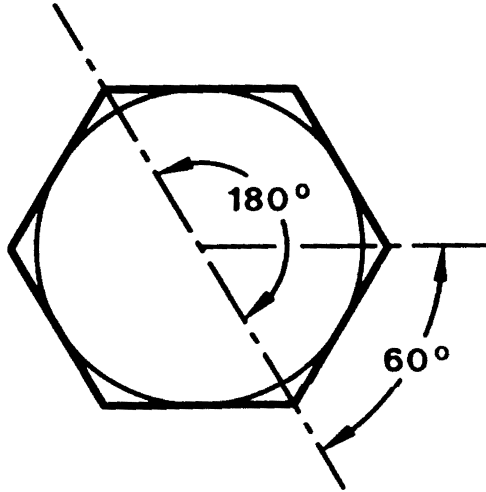
**New Copper Sleeve:**

9

Tighten retainer bolt to a torque of 20 ± 5 Nm (15 ± 4 ft-lb).

20 ± 5 Nm  
(15 ± 4 ft-lb)

10



Turn the retainer bolt an additional  $180 \pm 5^\circ$ .

W2003181  
 $180 \pm 5^\circ$

11

Loosen the retainer bolt for the unit injector prior to the second tightening.

12

Tighten bolt to a torque of  $20 \pm 5$  Nm ( $15 \pm 4$  ft-lb).

$20 \pm 5$  Nm  
( $15 \pm 4$  ft-lb)

13

Turn the retainer bolt an additional  $60^\circ \pm 5^\circ$ .

$60^\circ \pm 5^\circ$

### Old Copper Sleeve:

14

Tighten the retainer bolt to a torque of  $20 \pm 5$  Nm ( $15 \pm 4$  ft-lb).

$20 \pm 5$  Nm  
( $15 \pm 4$  ft-lb)

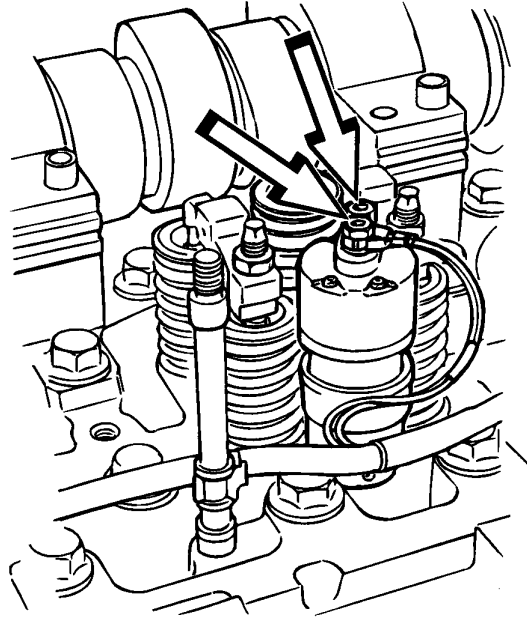
**Note:** If the injector is not to be installed at once, install a protective plug in the cylinder head.

15

Turn the retainer bolt an additional  $60 \pm 5^\circ$ .

$60 \pm 5^\circ$

16



T2006709

Connect the electronic unit injector (EUI) electrical wires and tighten the nut to a torque of 1.4 Nm (1 ft-lb). The EUI electrical wires should be routed to the outside of the valve cover bolts.

1.4 Nm  
(1 ft-lb)  
 $33 \pm 4$  Nm  
( $24 \pm 3$  ft-lb)

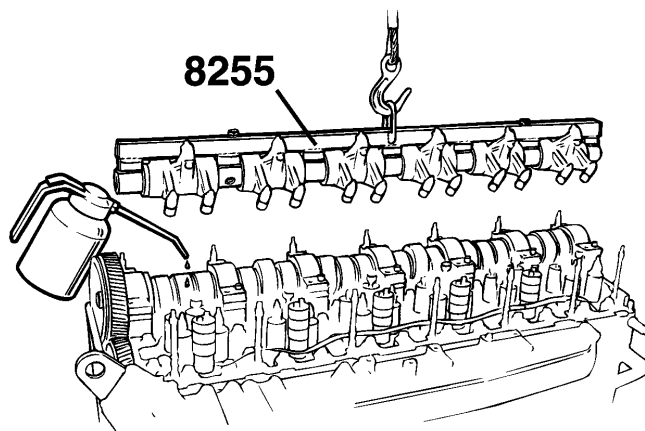
Pay close attention to the cable holders. If one breaks, remove the broken pieces to prevent clogging or damage to any components.

**Note:** Be careful not to pinch the EUI wiring cable harness when installing the valve cover.

**Note:** Hold the wires while tightening. If the screw gets damaged, the complete electronic unit injector must be replaced.

**Note:** Applies to engines equipped with VEB (Volvo Engine Brake). The VEB control valve should be reinstalled at this time. Reconnect sliding valve and pipe into the rocker arm shaft as a unit. Apply Loctite® 242 to threads and tighten the bolts to a torque of  $33 \pm 4$  Nm ( $24 \pm 3$  ft-lb).

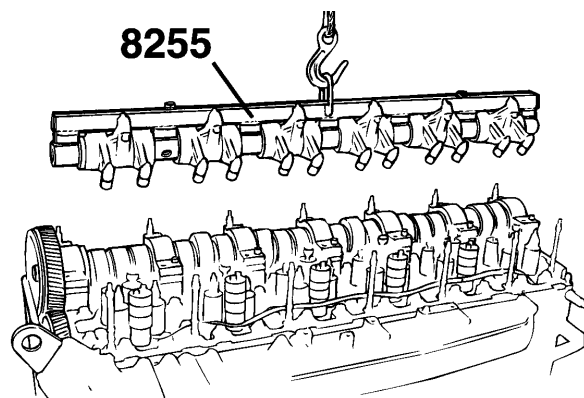
17



Coat the valve bridges and camshaft lobes with engine oil.

T2006820

18



T2006776

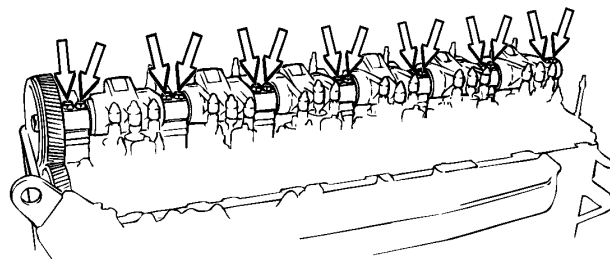
**CAUTION**

Remove all oil from the rocker arm bridge bolt holes to prevent a hydraulic lock that may result in damage to the cylinder head.

Install the rocker arm bridge, using lifting tool 9998255.

9998255

19

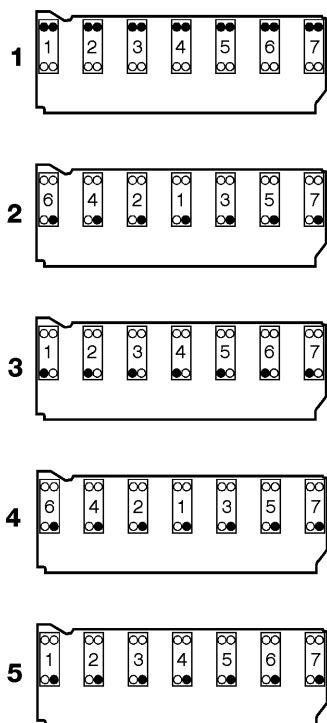


T2006777

Install all rocker arm shaft bolts, making sure they are hand tight before continuing.

**Note:** When reinstalling a rocker arm shaft which has been removed or loosened, only the bolts which hold the rocker arm shaft should be tightened.

## 20



W2003520

Fig. 60: Bearing caps and camshaft/rocker shaft, tightening sequence

## D12C:

- 1  $15 \pm 5$  Nm ( $11 \pm 4$  ft-lb);  $+90 \pm 5^\circ$
- 2  $60 \pm 5$  Nm ( $44 \pm 4$  ft-lb)
- 3  $15 \pm 5$  Nm ( $11 \pm 4$  ft-lb);  $+120 \pm 5^\circ$
- 4  $60 \pm 5$  Nm ( $44 \pm 4$  ft-lb); loosen to 0 Nm (0 ft-lb)
- 5  $15 \pm 5$  Nm ( $11 \pm 4$  ft-lb);  $+120 \pm 5^\circ$

## D12, D12A, D12B:

- 1  $15 \pm 5$  Nm ( $11 \pm 4$  ft-lb);  $+90 \pm 5^\circ$
- 2 45 Nm (33 ft-lb)
- 3  $15 \pm 5$  Nm ( $11 \pm 4$  ft-lb);  $+90 \pm 5^\circ$
- 4 45 Nm (33 ft-lb); loosen to 0 Nm (0 ft-lb)
- 5  $15 \pm 5$  Nm ( $11 \pm 4$  ft-lb);  $+90 \pm 5^\circ$

Gradually tighten the bolts so that the rocker arm shaft does not bend or warp. Tighten the shaft until it lies against the camshaft lobes, then torque tighten using the 5-step torque sequence shown.

## 21

Adjust the valves and the electronic unit injector (EUI).



## Feedback

One of our objectives is that workshop personnel should have access to correct and appropriate service manuals where it concerns fault tracing, repairs and maintenance of Volvo trucks.

**In order to maintain the high standards of our literature, your opinions and experience when using this manual would be greatly appreciated.**

**If you have any comments or suggestions, make a copy of this page, write down your comments and send them to us, either via telefax or mailing directly to the address listed below.**

**To**

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**Greensboro, NC 27402-6115**

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## Comments/proposals

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**Concerns Service Manual:** .....



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# **VOLVO**

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