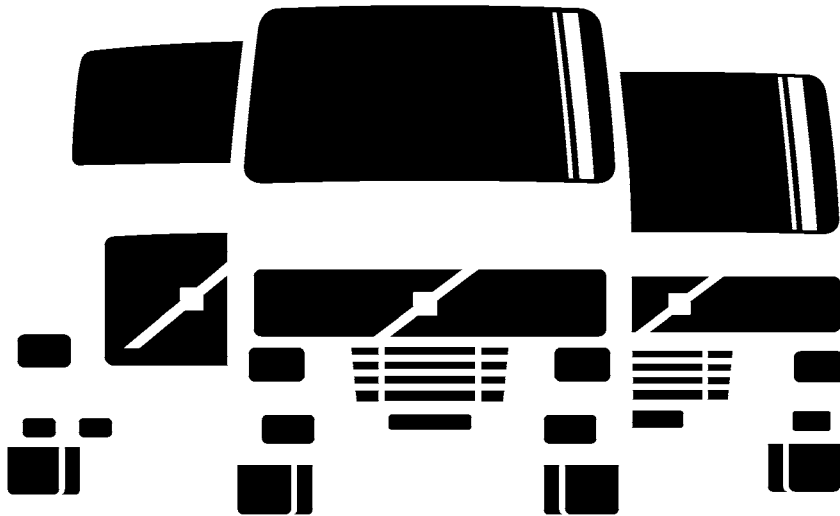


Service Manual Trucks

Group **220–600**

Lubricating and Oil 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-TSP144525

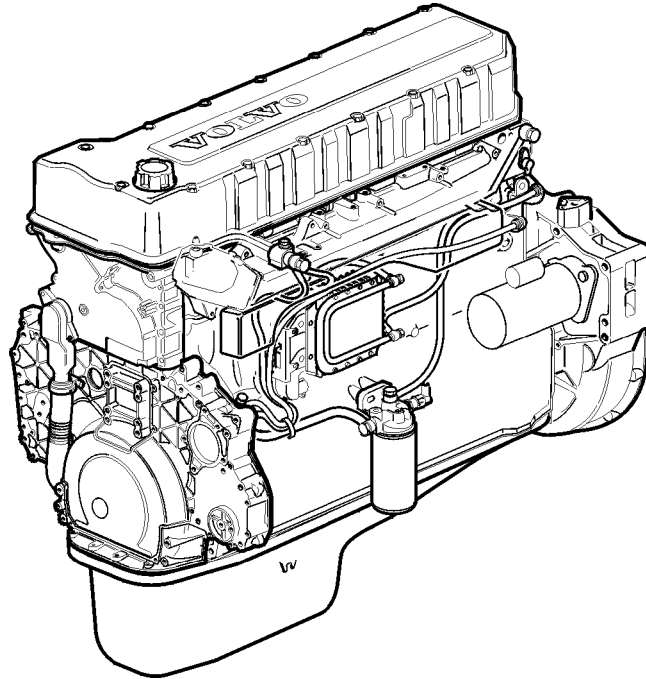
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Contents

General	3
Specifications	5
Torque Chart	5
Tightening Specifications	5
Tools	7
Special Tools	7
Special Equipment	9
Design and Function	11
Lubricating and Oil System	11
General	11
D12, D12A, D12B	12
D12C	13
Oil Valves	14
D12, D12A, D12B	14
D12C	15
Oil Pump	16
Oil Filter	16
Piston Cooling	16
Troubleshooting	17
Lube System Fuel Contamination, Checking	17
Oil Cooler Leak Test, Checking	17
Service Procedures	19
Oil Pan, Installation	19
Lube Oil Pump, Replacement	19
Removal	20
Installation	21
Lube System Pressure, Checking	22
Oil Filter, Replacement	23
Piston Cooling Valve, Replacement	24
Piston Cooling Nozzle, Replacement	25
Oil Pressure Reduction Valve, Replacement	26
Oil Cooler Core, Replacement	28
Removal	28
Installation	29
Oil Cooler Bypass Valve, Replacement	31
Oil System Passages, Cleaning	31
Oil Filter Nipple, Replacement	42
Oil Filter Overflow Valve, Replacement	43
Feedback	
Operation Numbers	

General



W2003244

This information covers the Lubricating and Oil System for the D12, D12A, D12B, and D12C engines.

Specifications

Torque Chart

Part	Torque
Oil cooler element bolts	27 ± 4 Nm (20 ± 3 ft-lb)
Oil cooler element cover bolts	33 ± 4 Nm (24 ± 3 ft-lb)
Oil pump intermediate gear bolts	24 ± 4 Nm (18 ± 3 ft-lb)
Oil pump main bearing bolts	150 ± 20 Nm (111 ± 14 ft-lb)
Oil pump main bearing cap bolts	24 ± 4 Nm (18 ± 3 ft-lb)
Oil strainer bolts	27 ± 4 Nm (20 ± 3 ft-lb)
Delivery pipe union	10 Nm (7.4 ft-lb)
Oil pan bolts	24 ± 4 Nm (18 ± 3 ft-lb)
Piston cooling nozzle bolts	24 ± 4 Nm (18 ± 3 ft-lb)
Oil filter base	40 ± 5 Nm (30 ± 4 ft-lb)

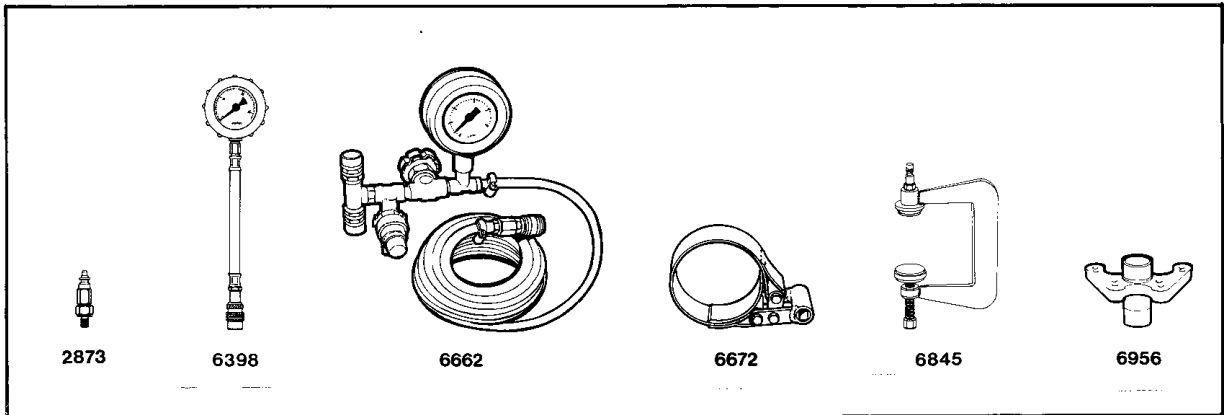
Tightening Specifications

Part	Tighten Until:
Oil filter (full flow)	Seal contacts housing then additional 1/2 - 3/4 turn
Oil filter (bypass)	Seal contacts housing then additional 3/4 -1 turn

Tools

Special Tools

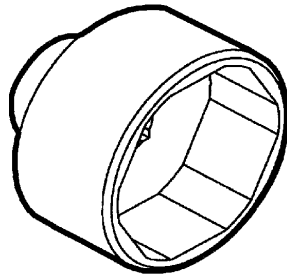
The following special tools are required for work on the VE D12 oil system. Tools are available from Volvo Trucks North America, Inc. parts department. Unless otherwise noted, all tool numbers are preceded by "999". When requesting tools, provide the appropriate part number, for example, 9992873.



- 9992873** Connection union for checking lube oil pressure
- 9996398** Pressure gauge for checking lube oil pressure
- 9996662** Pressure gauge for leak test, oil cooler element

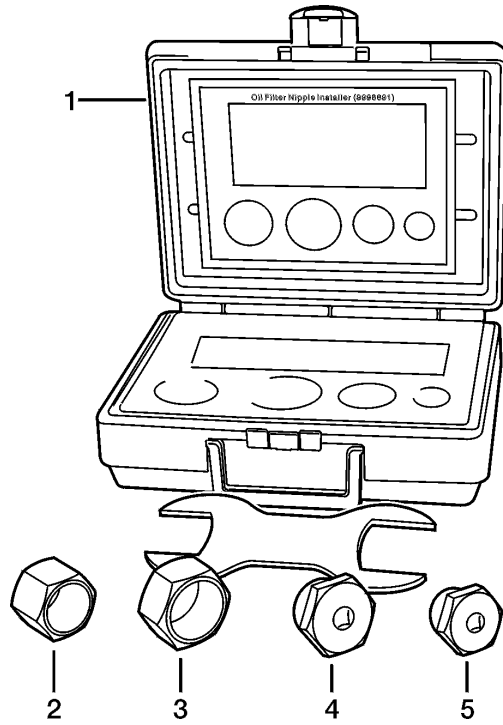
- 9996672** Removal tool for oil filter
- 9996845** C-clamp for leak test, oil cooler element
- 9996956** Cranking tool for flywheel

T2006803



W0001809

J-43051 Reduction valve cap socket



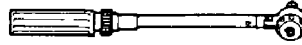
W2003485

9998691 Oil Filter Nipple installation Kit

- 1 9809706
- 2 9809702
- 3 9809703
- 4 9809705
- 5 9809704

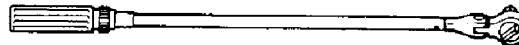
Special Equipment

Like the special tools, the following are available from the parts department of Volvo Trucks North America, Inc.. When requesting tools, provide the appropriate part number.



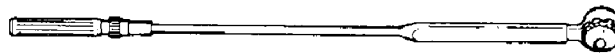
W0001840

1159794 Torque wrench 10–100 Nm (7 – 73 ft-lb)



W0001841

1159795 Torque wrench 40 – 340 Nm (30 – 250 ft-lb)



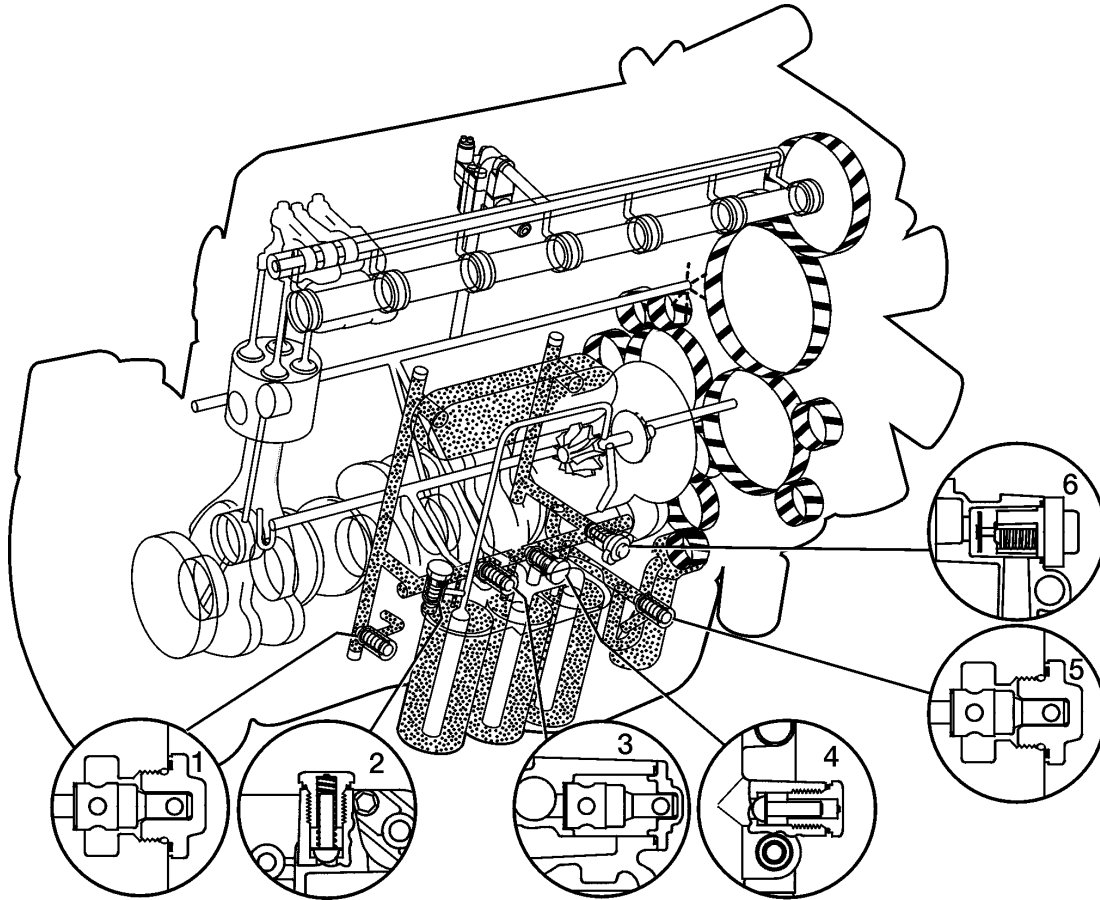
W0001842

1159796 Torque wrench 150 – 800 Nm(110 – 590 ft-lb.)

Design and Function

Lubricating and Oil System

General



W2003516

- 1 Reducing valve
- 2 Overflow valve
- 3 Cooling valve
- 4 Overflow valve
- 5 Safety valve
- 6 Thermostatic valve

The engine has a forced lubrication provided by a gear pump driven by the crankshaft through an intermediate gear. The lubrication system contains two full flow filters and a by-pass filter. The oil flow is adjusted by six valves. Three of these are individual valves and they are identified with color codes to avoid an incorrect installation. This color code may be replaced by a number that represents the valve opening pressure.

A flat oil cooler is assembled under a cast aluminum cover in the engine block right side.

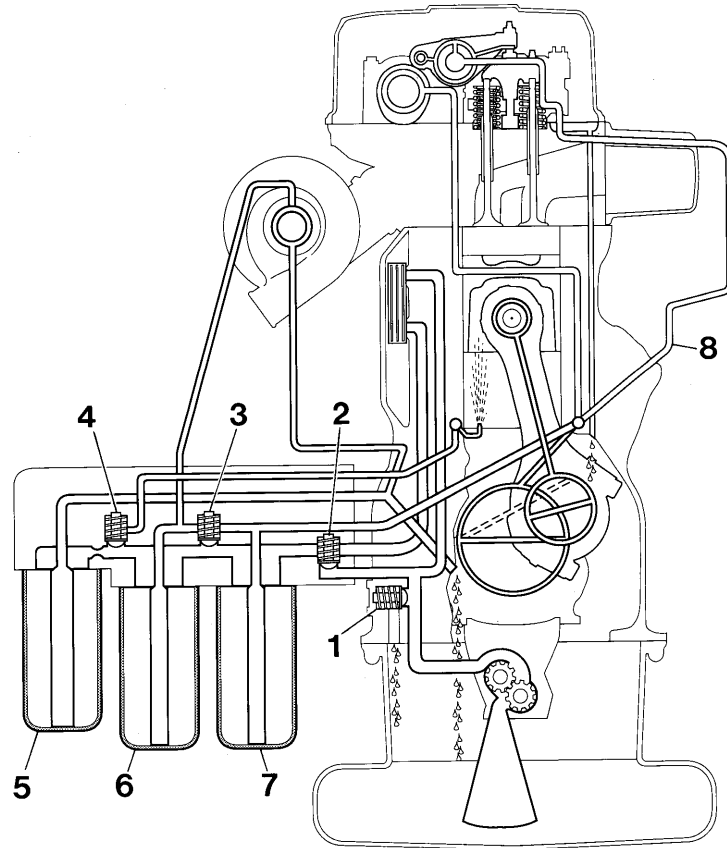
The lubrication oil pump impels the oil towards the two full flow filters and the by-pass filter.

The by-pass filter contains a low oil passageway and a high degree of filtering.

After passing through the full flow filters, the oil moves to the cylinder block, where it is distributed through galleries to engine points in need of lubrication.

The purpose of the lubrication system is to lubricate the engines movable parts in order to keep friction and wearing to a minimum. The oil transports coal and other residues stuck on the cylinder walls after combustion. The oil also functions as a sealer, for the cylinder liners have been projected in such a way that a thin layer of oil is always kept in its walls. This make it easier for the piston rings to seal the combustion chamber. The oil also cool the engine inner and, at the same time, reduces the sounds produced by the engine.

D12, D12A, D12B



T2006823

- 1 Oil pressure regulator valve
- 2 Oil cooler by-pass valve
- 3 Oil filter by-pass valve
- 4 Piston cooling valve
- 5 By-pass filter
- 6 Full-flow filter
- 7 Full-flow filter
- 8 Oil pipe for engine brake (VEB)

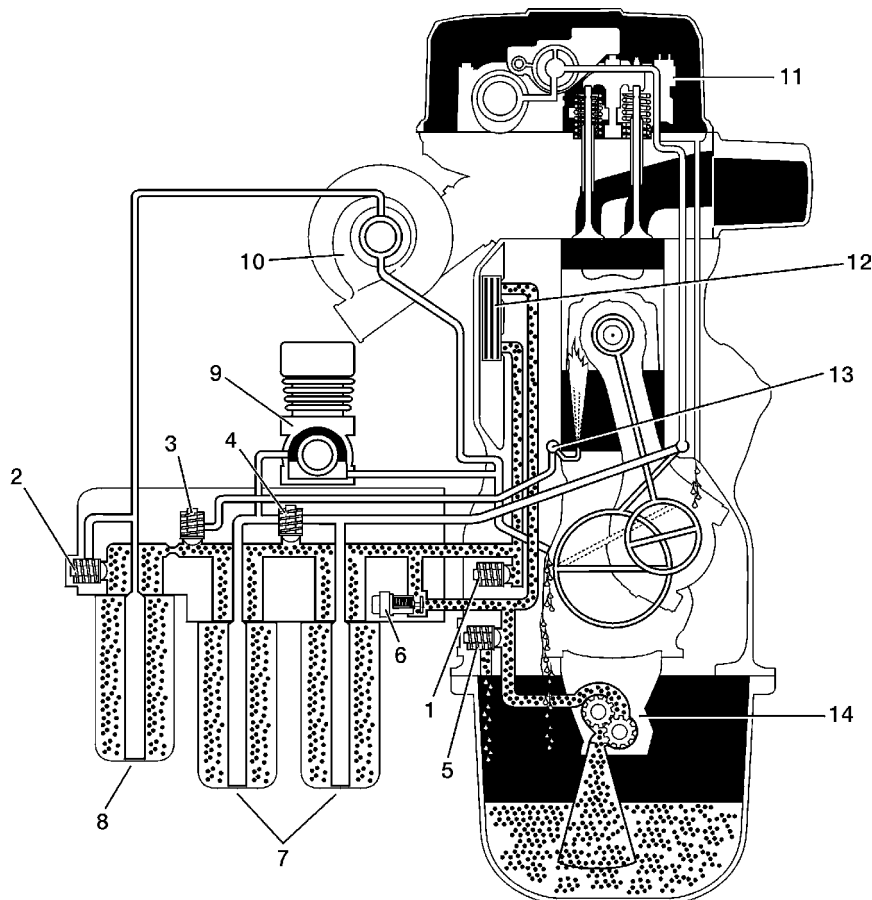
The engine is pressure-lubricated by a gear pump driven by the engine timing gears. The lube oil is cleaned by two full-flow filters and one bypass filter. The flat-type oil cooler is mounted under a cast aluminum cover on the right-hand side of the cylinder block.

The lube oil pump forces the oil to the full-flow filters and the bypass filter. The bypass filter has a low through flow and provides a high degree of filtration. The oil is led from the full-flow filters to the cylinder block where it is distributed by passages to the lubricating points of the engine.

The lubricating system incorporates four valves:

- Oil pressure regulator valve
- Oil cooler bypass valve
- Oil filter bypass valve
- Piston cooling valve

D12C



W2003517

- 1 Reducing valve
- 2 Overflow valve
- 3 Cooling valve
- 4 Overflow valve
- 5 Safety valve
- 6 Thermostatic valve
- 7 Filter

- 8 Filter
- 9 Compressor
- 10 Turbocompressor
- 11 Regulator valve
- 12 Oil cooler
- 13 Pulverizer nozzle
- 14 Oil pump

The oil pump (14) forces the oil through the coolant element in the oil cooler (12) to the filter casing that contains both the full flow filter (7) and the by-pass filter (8). The oil goes then to the gallery in the engine block where it is distributed through the galleries and all the engine lubrication points. A gallery that passes through the engine block and the cylinder head lubricates the

camshaft and the rocker arm mechanisms. In the VEB engines, the oil passes through the regulator valve (11). The compressor (9) is lubricated through an external pipe that comes from the filter casing. The turbocompressor (10) is lubricated through a pipe that comes from the bypass filter.

Valve Functions

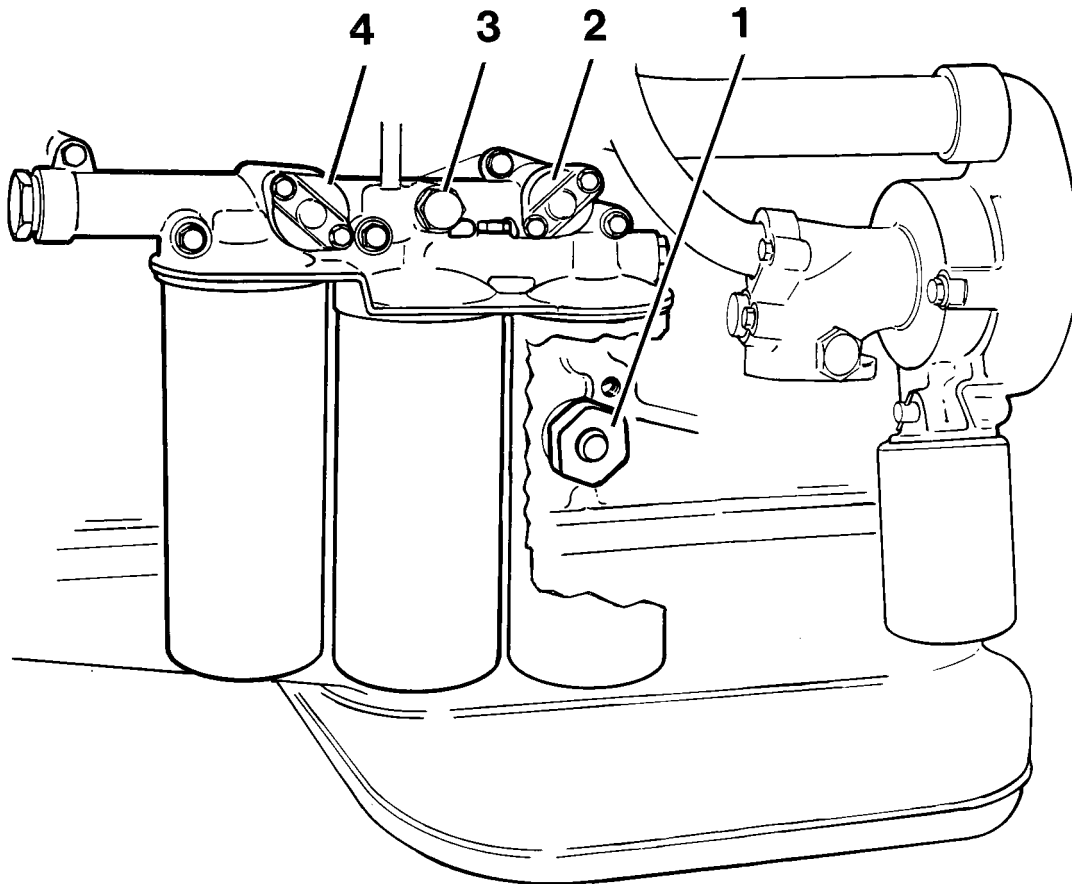
- 1 The reducing valve regulates engine oil pressure letting go the oil excess to the oil sump.
- 2 The filter overflow valve (8) opens up if the filters become clogged, assuring the continuity of the turbocompressor lubrication.
- 3 The piston cooling valve is pressure sensible and opens up as soon as the rotates exceeds idling speed pressure.

The oil is conducted to the longitudinal gallery on the block and pulverized by the pulverizer nozzle (13), one for each piston, on the piston flange bottom side.

- 4 The filter overflow valve (7) opens up if the filters become clogged, assuring the continuity of the engine lubrication.
- 5 The safety valve opens up if the pressure in the lubrication system gets too high.
- 6 The oil cooling thermostatic valve is used to conduct the oil through the outside of the cooler during the engine heating, so that the engine gets a faster lubrication during a cold start and heats faster. This valve is thermostatically controlled and it acts as an oil temperature sensor.

Oil Valves

D12, D12A, D12B



T2006673

- 1 Regulator Valve
- 2 Bypass valve for oil cooler

- 3 Overflow valve for oil filters (bypass)
- 4 Reducing valve

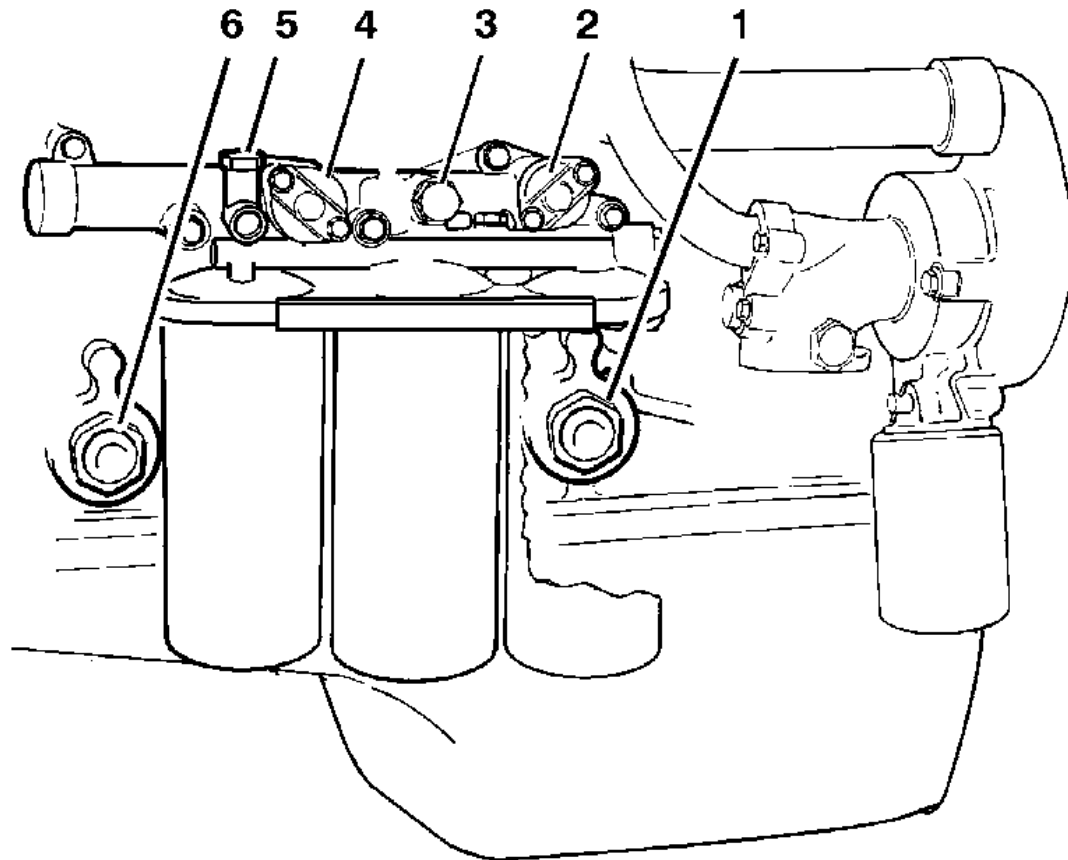
1 Regulator valve — The regulator valve regulates the oil pressure. It does this by opening when the lube oil pressure becomes too high and letting any surplus oil back to the oil pan.

2 Bypass valve for oil cooler — The purpose of the bypass valve is to regulate the oil flow through the oil cooler. When the pressure drop across the oil cooler is low, for example, immediately after starting when oil temperature is low, the overflow valve opens and oil is led past the oil cooler. When oil temperature rises and pressure drops across the oil cooler increases, the bypass valve closes, and oil flows through the oil cooler before being pressed out into the lubrication system. The bypass valve is also available with a built-in thermostat. When the oil temperature is under 105–115° C (221–239° F), the by—pass valve opens and oil is led past the oil cooler and directly out into the lubrication system. At higher oil temperatures, the thermostat closes the by—pass valve and the oil passes through the oil cooler before it is forced out into the lubrication system.

3 By—pass valve for oil filter — If the filters become blocked, the by—pass valve opens guaranteeing lubrication, but with no filtration.

4 Piston cooling valve— The piston cooling valve opens when the engine speed (rpm) has increased to slightly over idling speed. Oil flows through the piston cooling passage to the six piston cooling nozzles which spray oil against the underside of the pistons.

D12C



T2012843

- 1 Safety valve
- 2 Thermostatic valve
- 3 Overflow valve for oil filters (bypass)

- 4 Oil valve for pistons cooling
- 5 Overflow valve for oil filters (bypass)
- 6 Reducing valve

1 Safety valve

The safety valve opens up if the pressure in the lubrication system gets too high, for example, during a cold start in the winter.

2 Thermostatic valve

The thermostatic valve function is to regulate the oil flow through the oil cooler.

When the pressure in the oil cooler is too low, for instance, just after a start with a low oil temperature, the thermostatic valve opens up and the oil passes through near to the oil cooler. When the oil temperature increase and the pressure drop in the oil cooler get higher, the thermostatic valve closes and the oil passes through the cooler before being impelled to the lubrication system.

3 Overflow valve for oil filters (bypass)

The overflow valve opens up if the filters become clogged, assuring the continuity of the lubrication process.

4 Oil valve for pistons cooling

The oil valve for pistons cooling opens up as soon as the rotates exceeds idling speed.

The oil passes through the piston cooling circulation galleries to the six piston cooling oil injectors.

5 Overflow valve for oil filters (bypass)

The overflow valve opens up if the filters become clogged, assuring the continuity of the lubrication process.

6 Reducing valve

The reducing valve regulates oil pressure, opening up when the pressure exceeds the specified value, letting go the oil excess to the engine oil sump.

Oil Pump

The oil pump is a gear pump set in motion by an intermediate gear in the synchronized gearing. The pump is made up of two gears that are turned in a well-sealed casing. When gears turn, the oil is transported between its teeth and the walls of the pump casing. When the teeth are geared, the oil is pumped out and inserted in the lubrication system.

Oil Filter

One of the purposes of the oil lubrication to clean up impurities on the engine lubrication points and on the bearings surface. The oil, then, accumulates dirt that needs to be cleaned up before it goes back to the lubrication points. The oil is roughly filtered while passing through the oil manifold filter. In order to get rid of the dirt particles, the D12C engine lubrication system is equipped with three filters.

The oil filters are made up of replaceable filtering elements.

All the oil coming through the pump passes through the filters before entering the engine.

Piston Cooling


When the engine is running, there usually is a buildup of heat in the piston that, in some cases, needs an extra cooling. The piston cooling is set in motion when the oil pressure gets so high that the piston cooling valve in the cylinder block opens up. The oil is then forced through the engine block drilled galleries into the injection nozzles of piston cooling, one for each piston. The oil is then pulverized on the bottom of the piston.

Troubleshooting

Lube System Fuel Contamination, Checking

1
When fuel contamination is suspected in the lube system, use a high-intensity black-light lamp (Kent-Moore part number J 28428 E) along with a fluorescent additive to locate the point at which fuel is entering the system.

2231-06-05-01 Oil Cooler Leak Test, Checking

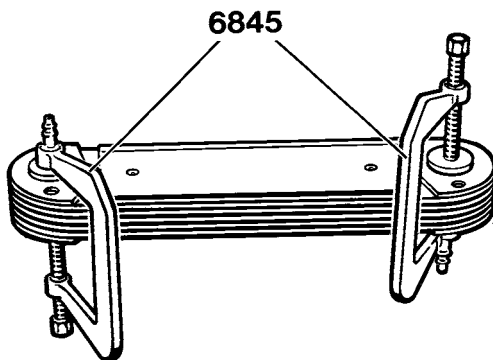

DANGER

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.

Special tools: 9996662, 9996845

1
Flush the coolant side of the oil cooler element with water-soluble degreasing fluid. Wash the oil side of the cooler element with degreasing solvent.

2



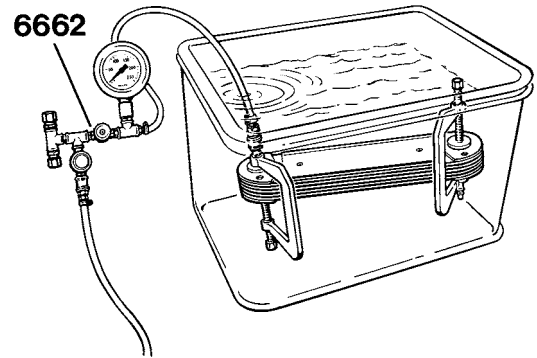
T2006695

Tools 9996845

Install tools 9996845, making sure they are properly seated.

9996845

3



T2006696

Pressure gauge and bath

Make sure the reduction valve knob of pressure gauge 9996662 is fully open and that the pressure gauge is in the "0" position.

9996662
9996845

Connect the pressure gauge needle to 9996845. Lower the oil cooler element into a bath which contains water at 70° C (160° F).

Increase pressure to **250 kPa (35 psi)** using the reduction valve knob. The test period should last for **at least one minute**.

Air bubbles emerging from the oil cooler element indicate a leak and the element should be replaced.

Service Procedures

2171-02-02-01 Oil Pan, Installation

1

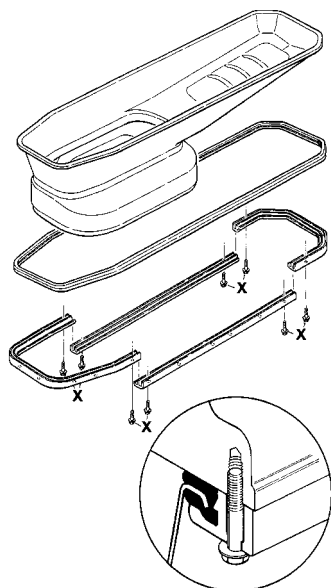


Fig. 1: Oil pan, gasket and rail-D12, D12A, D12B, D12C

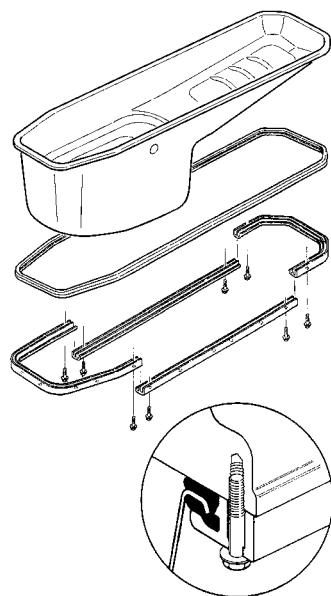


Fig. 2: Oil pan, gasket and rail-D12C

Make sure the gasket is correctly positioned. Then position the oil pan and tighten the bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

Note: Tighten the bolts in the metal rail joints first.

24 ± 4 Nm
(18 ± 3 ft-lb)

2

Fill the engine with the correct amount of oil.

3

Crank the engine with the starter until oil pressure is recorded on the pressure gauge.

4

Apply parking brake. Place the shift lever in neutral.

5

Start the engine, check operation and perform a leak test.

2211-03-02-01 Lube Oil Pump, Replacement

! 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.

! 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

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

(Oil Pan Removed)

Not Included:

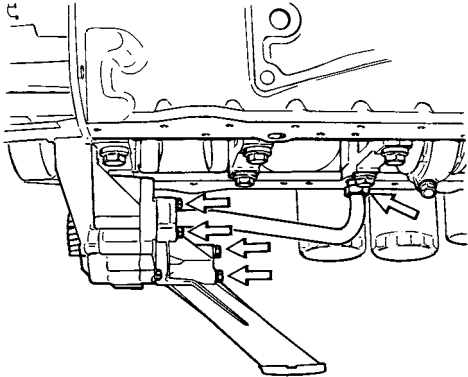
- "Oil Filter, Replacement" page 23

Removal

1
Drain engine oil into suitable container and remove the oil pan.

Note: Dispose of oil according to local and state regulations.

2

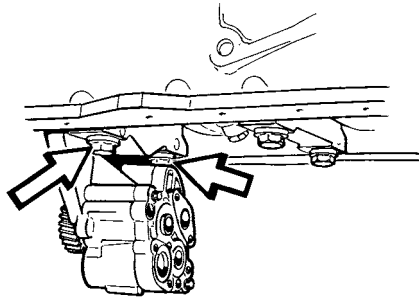


T2006798

Fig. 3: Oil delivery pipe nuts

Remove the oil delivery pipe nut in the cylinder block, and bolts for the oil strainer.

3

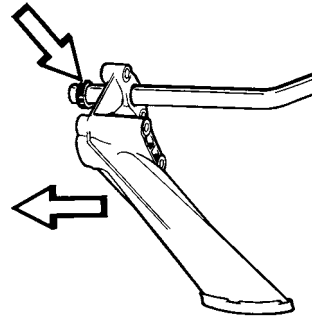


T2006799

Fig. 4: Oil pump bolts

Remove the bolts for the first main bearing cap. Lift out the oil pump together with the main bearing cap.

4

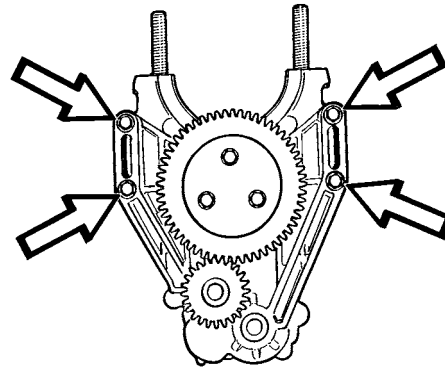


T2006800

Fig. 5: O-ring and oil strainer

Remove the O-ring and oil strainer from the oil delivery pipe.

5

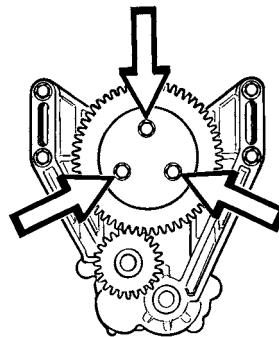


T2006697

Fig. 6: Remove oil pump

Remove the oil pump from the main bearing cap.

6



T2006698

Fig. 7: Intermediate gear

Remove the intermediate gear from the oil pump housing.

7

Clean the oil strainer. Make sure the oil strainer mesh is not damaged.

8
Clean and check the bushings and teeth on the intermediate gear.

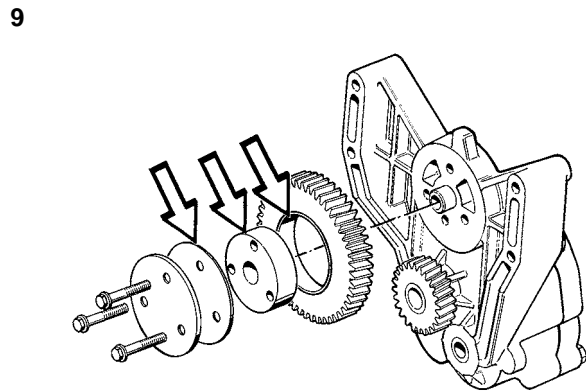


Fig. 8: Intermediate bushing locations

Intermediate bushings with engine oil. 24 ± 4 Nm
Insert the intermediate gear into the new oil pump. Tighten the bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

Installation

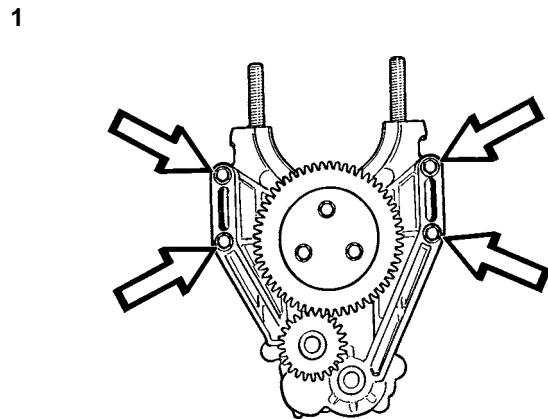


Fig. 9: Mounting oil pump to main bearing cap

Install the new oil pump on the main bearing cap. Tighten the bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

Note: Remember to install the main bearing cap bolts before fastening the pump to the bearing cap.

2
Clean the main bearing shell and lubricate it with engine oil.

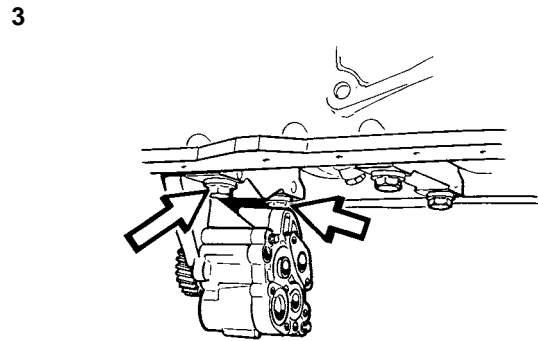


Fig. 10: Installing lube oil pump

Install the lube oil pump, making sure that the teeth in the intermediate gear make contact with the crankshaft drive gear. Tighten the main bearing bolts to 150 ± 20 Nm (111 ± 14 ft-lb). Then turn a further $120^\circ \pm 5^\circ$.

4
Check the oil delivery pipe for cracks in the flange where it contacts the union.

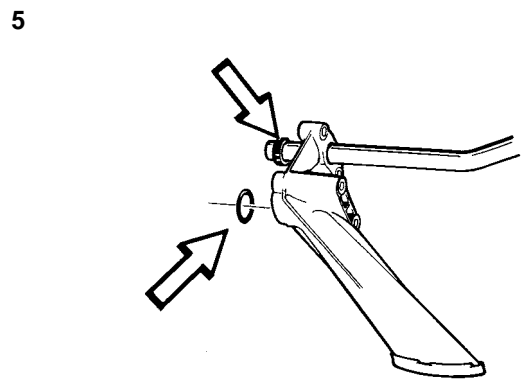
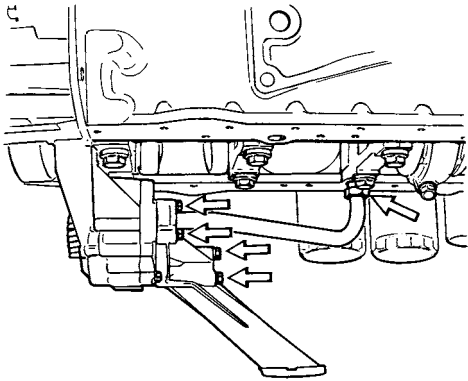


Fig. 11: Oil strainer installation

Place the oil strainer on the oil delivery pipe and install new O-rings.

6

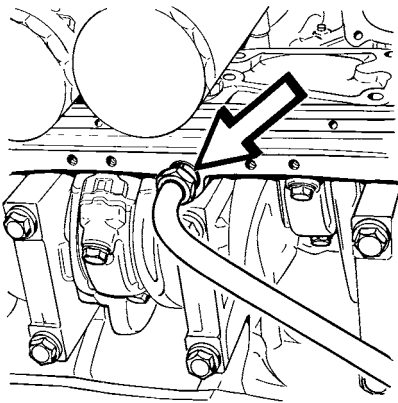


T2006798

Fig. 12: Installing oil strainer and delivery pipe

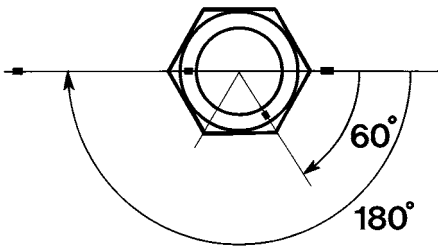
Install the oil strainer and the oil delivery pipe. Tighten the oil strainer to the oil pump to 27 ± 4 Nm (20 ± 3 ft-lb).

7



T2006701

Fig. 13: Oil pipe union installation



T2006825

Fig. 14: Union tightening torque

Tighten the union in the cylinder block until it bottoms at about 10 Nm (7.4 ft-lb).

For a previously installed pipe, tighten the union a further 60° . For a new pipe, tighten the union a further 180° . Make sure the pipe is installed properly.

2211-06-02-01 Lube System Pressure, Checking

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.

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.

Special tools: 9992873, 9996398

1

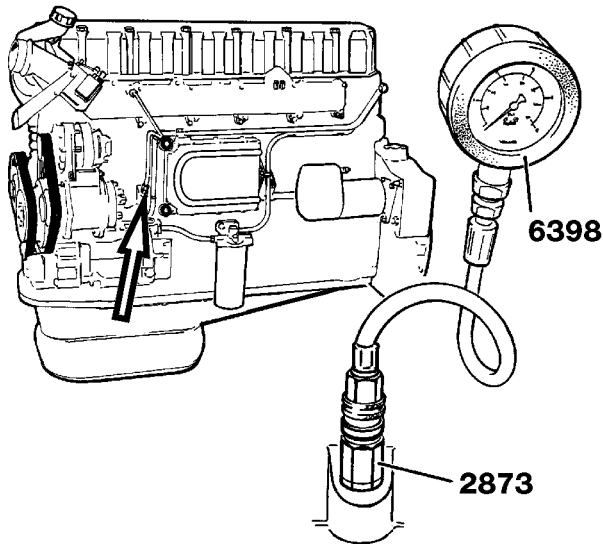
Place shift lever in neutral and apply parking brake.

2

Lubricating oil pressure is checked by connecting a pressure gauge and hose to the oil pressure sender outlet on the left-hand side of the engine.

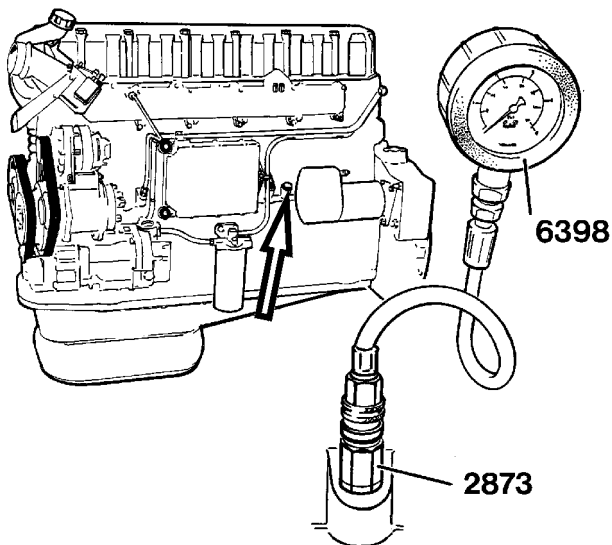
Note: The oil pressure sender is mounted in the cylinder block front outlet. The rear outlet can be plugged or an oil temperature sender may be installed. On some trucks, a hose is connected to the front outlet, and the oil pressure sender is positioned in an attachment on the frame side.

3



W2003484

Fig. 15: Pressure gauge and hose installation-D12C



W2003499

Fig. 16: Pressure gauge and hose installation-D12B

Carefully clean and disconnect the oil pressure sender wiring and remove the sender. Install connect union 9992873 into the engine block and then attach the hose and pressure gauge 9996398. Start the engine; engine oil should be at operating temperature. Take the oil pressure reading at low idle speed and at high idle. At low idle speed, the oil pressure should be 150 kPa (22 psi) minimum. At high idle, it should be 300–550 kPa (45–80 psi).

4

Remove the gauge, hose and union. Reinstall the oil sender and reconnect the sender wiring.

2223-03-02-01 Oil Filter, Replacement

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.

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

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

Special tools: 9996672

1

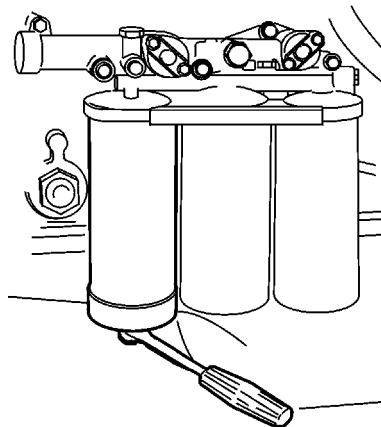


Fig. 17: Replacing oil filters

- 1 Bypass filter
- 2 Full-flow filter
- 3 Full-flow filter

Drain the engine oil into suitable container and clean around the oil filter housing. Remove the filters, using filter tool 9996672.

9996672

Note: Dispose of oil in accordance to local and state regulations.

2
Moisten the seals of the new filters with clean engine oil and screw on the filters by hand until the seals come in contact with the filter housing. Then tighten the full-flow filters a further 1/2–3/4 turn. Tighten the bypass filter 3/4–1 turn after making contact with the filter housing.

1/2–3/4 turn
3/4–1 turn

3
Fill the engine with oil.

4
Crank the engine with the starter until oil pressure is recorded on the pressure gauge.

5
Place shift lever in neutral and apply parking brake.

6
Start the engine and check for leaks around the oil filters.

2229-03-02-02 Piston Cooling Valve, Replacement

! 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.

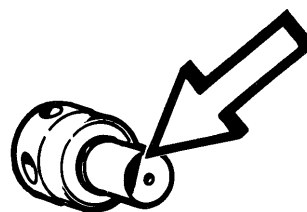
! WARNING

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.

1
Clean the filter housing and remove the cover of the piston cooling valve. Remove the O-ring.

2
Remove the piston cooling valve and clean the valve seat in the filter housing. Make sure to remove the old O-ring from the filter housing.

3



T2006676

Fig. 18: Piston cooling valve

Make sure the color marking on the new piston cooling valve is **orange**.

4

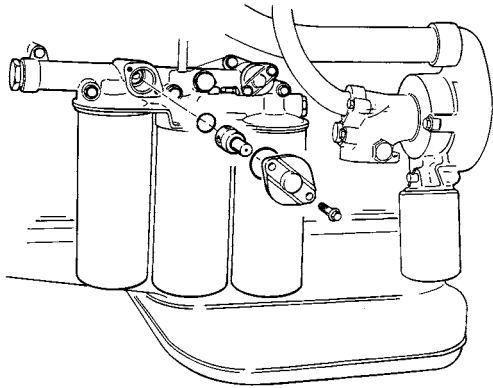


Fig. 19: Inserting valve

T2006684

Insert the new valve in the cover. Place new O-rings on the valve and the filter housing.

5

Install the valve in the filter housing and tighten the cover bolts.

6

Apply parking brake. Place shift lever in neutral.

7

Start the engine and perform a leak test.

2229-03-02-03 Piston Cooling Nozzle, Re- placement



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.



WARNING

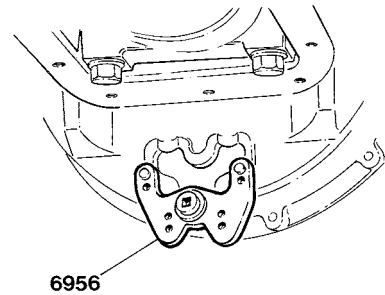
Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

(Oil Pan Removed)

Note: To prevent the piston cooling nozzles from being damaged, always remove them before removing pistons and cylinder liners.

Special tools: 9996956

1



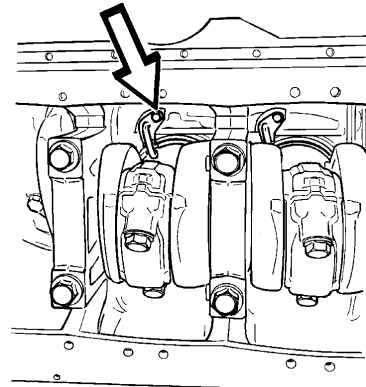
6956

T2006702

Fig. 20: Cranking tool

Remove the inspection cover from the bottom of the flywheel housing and install cranking tool 9996956.

2



T2006685

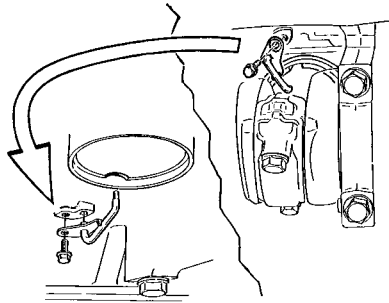
Fig. 21: Piston cooling nozzle

Turn the crankshaft until the piston cooling nozzle to be replaced is easily accessible.

3

Remove the piston cooling nozzle.

4



T2006686

Fig. 22: Installing new piston cooling nozzle

Install new piston cooling nozzle, using a new bolt. Tighten to 24 ± 4 Nm (18 ± 3 ft-lb)

Note: The piston cooling nozzle attachment bolt is coated with a friction-inducing compound. Do not reuse.

Note: Any piston cooling nozzle suspected to be damaged or deformed must be replaced (this even applies to a new nozzle). Always make sure the piston cooling nozzle fits correctly in its hole in the cylinder block and that the attachment plate is flush with the cylinder block.

5
Remove the cranking tool and reinstall the inspection cover on the flywheel casing.

2229-03-02-04 Oil Pressure Reduction Valve, Replacement

! DANGER

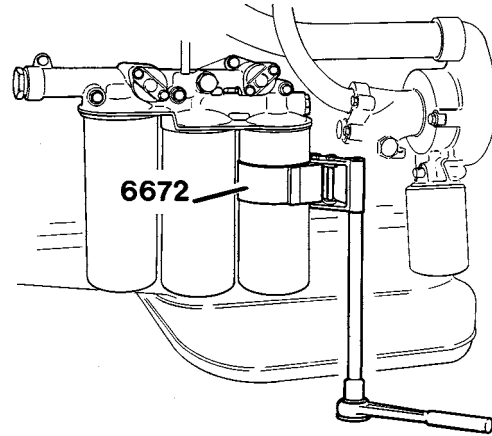
Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

! 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.

Special tools: 9996672

1



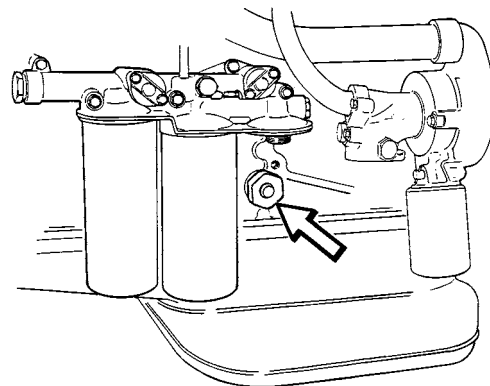
T2006797

Fig. 23: Removing oil filter

Drain the engine oil into a suitable container and clean around the oil filter housing. Remove the front oil filter, using filter removal tool 9996672 or equivalent.

Note: Dispose of oil in accordance to local and state regulations.

2



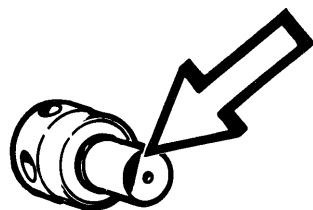
T2006675

Fig. 24: Plug location on engine

Clean around the plug on the cylinder block. Unfasten the plug and remove the regulator valve.

3
Clean the regulator valve seat and make sure to remove the old O-ring.

4

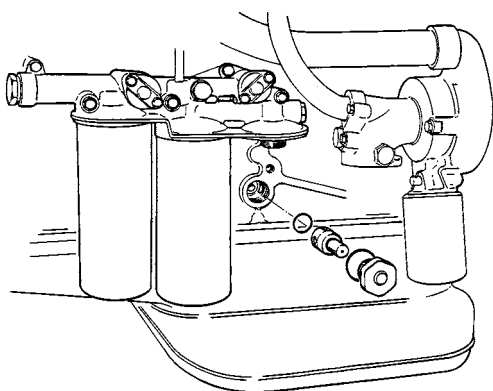


T2006676

Fig. 25: Regulator valve

Check that the color marking on the new regulator valve is **brown**.

5



T2006677

Fig. 26: Inserting regulator valve in plug

Insert the regulator valve in the plug. Place new O-rings on the valve and plug. Install the plug into the cylinder block.

6

Install a new oil filter. Moisten the seal of the new filter with engine oil and screw on the filter by hand until the seal is in contact with the filter housing. Then tighten the filter a further $\frac{1}{2} - \frac{3}{4}$ turn.

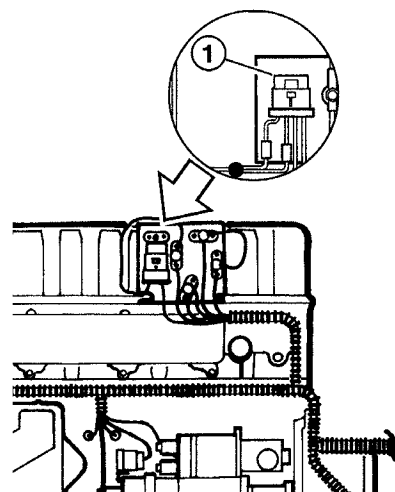
7

Fill the engine with oil.

8

Place the shift lever in neutral and apply parking brake.

9

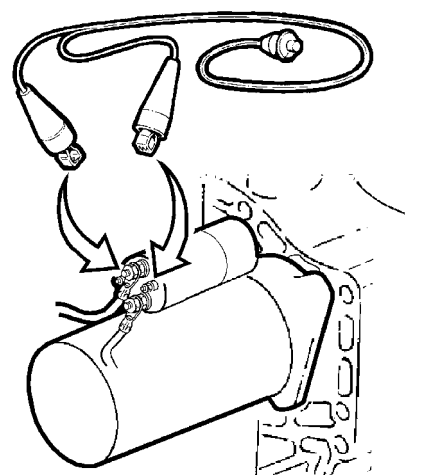


W3000459

Fig. 27: ECM relay location

Remove the ECM relay from engine valve cover.

10



W3000458

Fig. 28: Connections for remote starter cable

Connect a remote starter switch cable (Snap-On® MT302A or equivalent) between the battery (+) and the positive connection (+) on the starter motor solenoid. Crank the engine with the starter until oil pressure is recorded by the pressure gauge.

Note: Do not run the starter any longer than 15 seconds at one time. Allow the starter to cool before re-running the starter motor.

11

Remove remote starter cable and replace the ECM relay after completion.

12

Start the engine and perform an operation and leak check.

2232-03-02-01 Oil Cooler Core, Replacement

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.

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.

(Coolant Drained, Air Compressor Removed.)

Not Included:

- “Oil Cooler Leak Test, Checking” page 17

Note: Radiator and cooling system must be properly cleaned and flushed in the event of a suspected oil cooler failure. Refer to:

Service Manual 260–600
Cooling System, VE D12–D12C

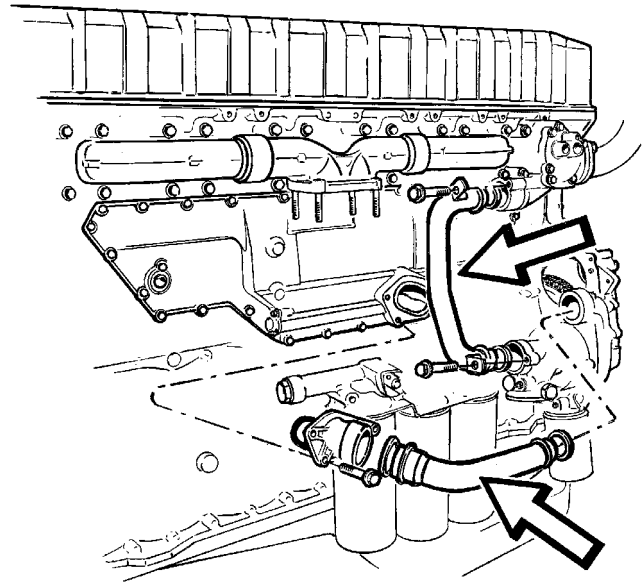
IMPACT Function Group 2619
Information Type: Repair
“Cooling System”

Removal

1

Remove the turbocharger. Plug turbo oil lines and outlet openings to prevent contamination. Install cover on turbo intake and exhaust openings to prevent foreign material from possibly becoming lodged in turbine wheels.

2



T2006687

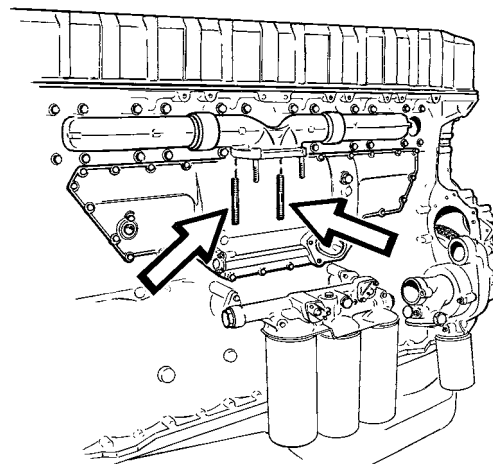
Fig. 29: Removing pipes

Remove the pipes between the thermostat housing and the coolant pump, and between the coolant pump and the oil cooler cover.

3

Remove the thermostat housing.

4

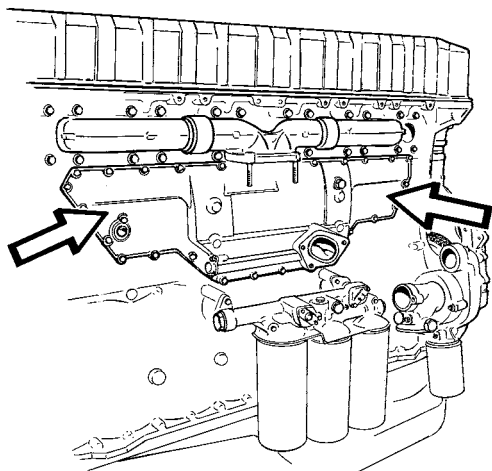


T2006688

Fig. 30: Inner stud bolts

Remove the turbocharger inner mounting stud from the exhaust manifold.

5

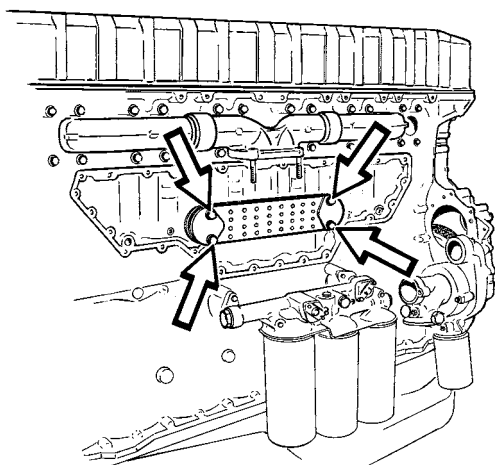


T2006689

Fig. 31: Oil cooler element cover

Remove the oil cooler element cover.

6



T2006690

Fig. 32: Removing oil cooler element

Remove the oil cooler element.

7

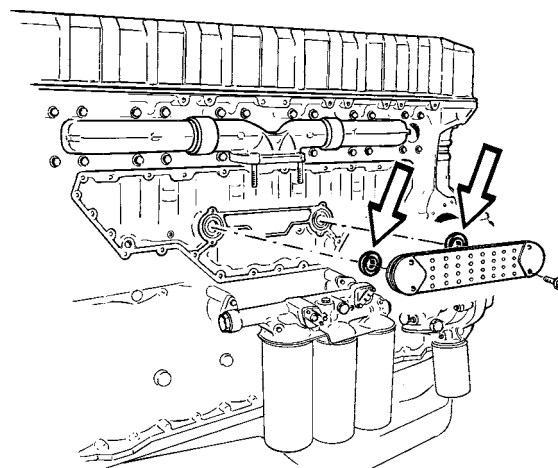
Remove the oil cooler element O-rings and the gasket in the cover. Clean the contact surfaces of the cylinder block and cover.

8

If a leak test on the oil cooler element is desired, see "Oil Cooler Leak Test, Checking" page 17.

Installation

1

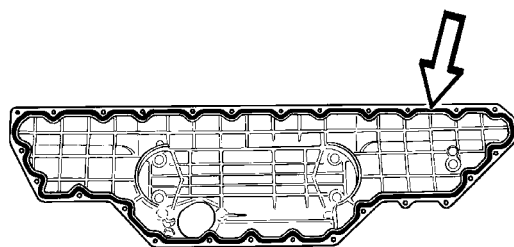


T2006691

Fig. 33: Oil cooler O-rings

Clean and place new O-rings in the cylinder block. Install the oil cooler element and tighten the bolts to 27 ± 4 Nm (20 ± 3 ft-lb).

2



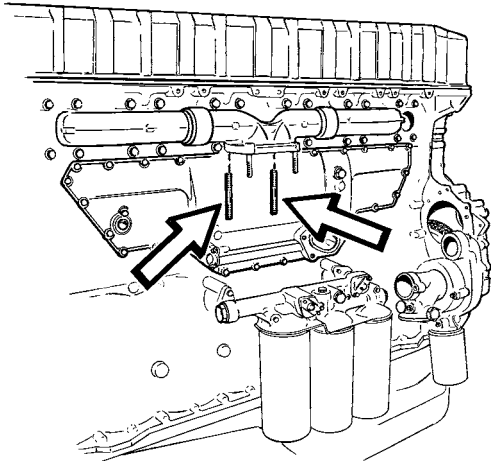
T2006692

Fig. 34: Gasket inserted

Insert a new gasket in the cover. Replace and tighten the cover. Tighten the bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

Note: Tighten the oil cooler cover bolts evenly and in several steps to avoid damaging the oil cooler cover.

3

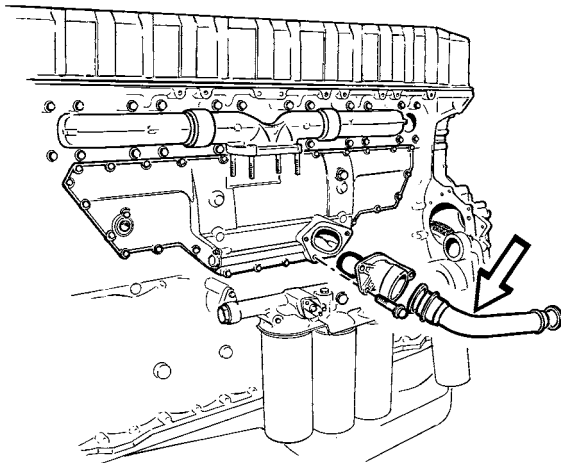


T2006688

Fig. 35: Inner turbo mounting stud

Install the two inner stud bolts for the turbocharger.

4



T2006693

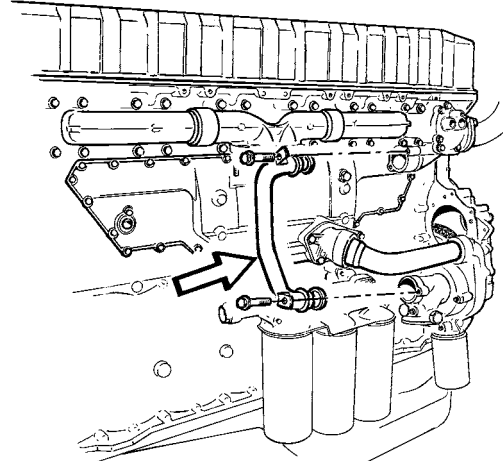
Fig. 36: Installing pipe

Install the pipe between the coolant pump and the oil cooler cover. Replace the gasket between the cover and pipe connection. Use new O-rings.

5

Replace the thermostat housing, using a new gasket.

6



T2006694

Fig. 37: Installing pipe

Install the pipe between the thermostat housing and the coolant pump. Use new O-rings.

7

Replace the turbocharger. Use a new mounting gasket.

8

Replace the air compressor. Use a new mounting gasket.

9

Fill with coolant. Use only a concentrated coolant that meets or exceeds ASTM D4985 specifications. The recommended coolant is monoethylene glycol (MEG) based or monopropylene glycol (MPG) based anti-freeze.

10

Fill the engine with oil.

11

Pre-lube the turbo unit with engine oil. Add two ounces of engine oil through turbo lube line opening before connecting the lube line. This will ensure turbo has sufficient lubricant at start up.

Note: It is very important to make sure there is an adequate oil supply to the turbo before starting the engine.

12

Apply parking brake and place shift lever in neutral.

13

Start the engine and perform operation and leak tests.

2239-03-02-02 Oil Cooler Bypass Valve, Replacement

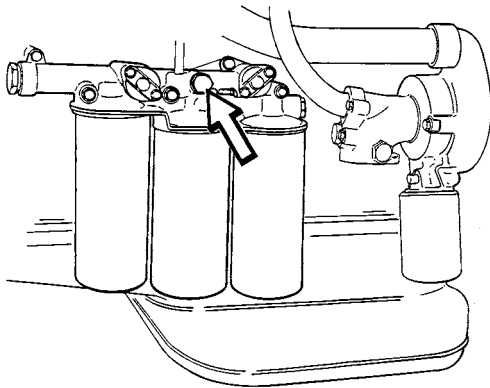
DANGER

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.

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.

1



T2006681

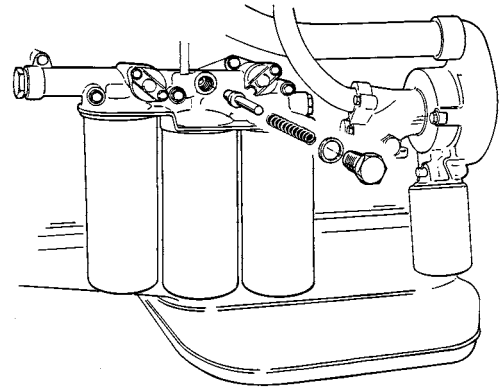
Fig. 38: Installed Plug

Clean around the oil filter housing and remove the plug. Remove the cone and spring.

2

Clean and check the valve seat. If the valve seat shows signs of corrosion, replace the oil filter housing.

3



T2006682

Fig. 39: Inserting cone and spring

Insert the new cone and spring along with a new O-ring. Install and tighten the plug.

4

Apply parking brake and place shift lever in neutral.

5

Start the engine and perform a leak test.

2209-11-02-01 Oil System Passages, Cleaning

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.

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

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

1
Drain coolant into suitable container.

Note: Dispose of coolant in accordance to local and state regulations.

2
Note: Before flushing the passage you must remove the turbocharger. Refer to:

Service Manual 250–600
Intake and Exhaust Systems, D12, D12A, D12B, D12C

IPMPACT Function Group
Information Type: Repair
"Turbocharger"

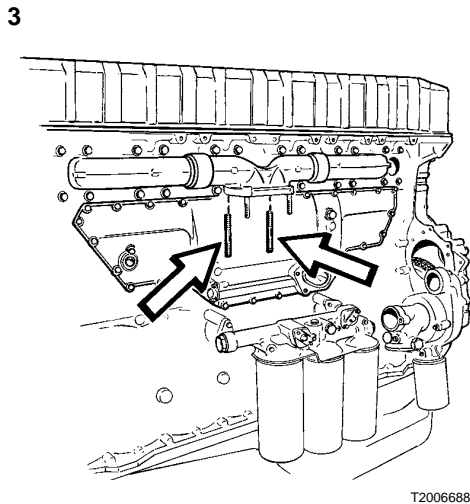


Fig. 40: Turbo mounting studs

Remove the inner 2 turbo mounting studs.

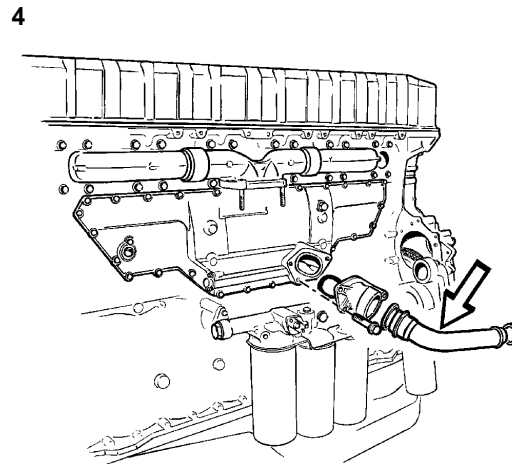


Fig. 41: Water pump discharge pipe

Remove the 3 bolts fastening the water pump discharge pipe to the oil cooler cover. Unplug the Volvo Engine Brake (VEB) temperature sensor (if equipped) and remove the pipe.

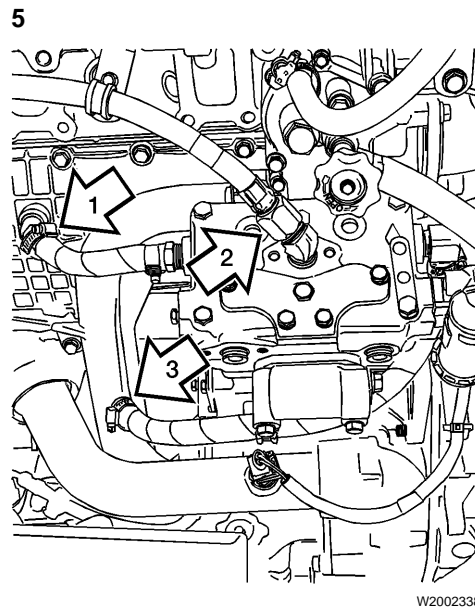


Fig. 42: Air compressor disconnect

- 1) coolant supply hose
- 2) air compressor discharge line
- 3) coolant return hose

Disconnect the air compressor coolant supply hose (1) from the oil cooler cover.

6
Disconnect the air compressor discharge line (2) from the air compressor.

- 7
Disconnect the air compressor coolant return hose (3) from the bypass pipe.

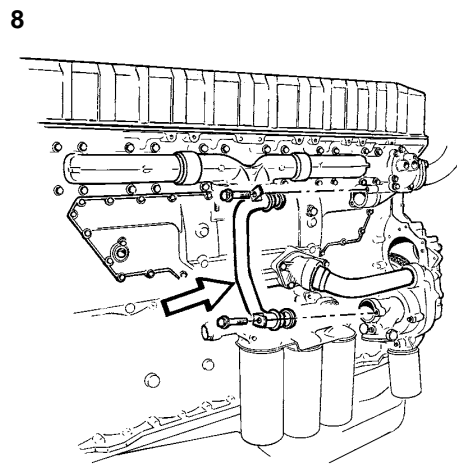


Fig. 43: Remove bypass pipe

Remove the bolts fastening the bypass pipe and remove pipe.

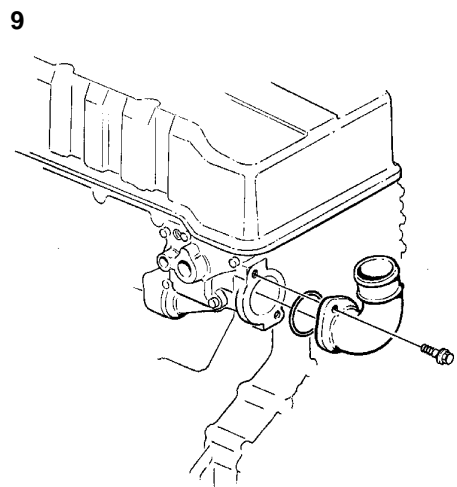


Fig. 44: Remove radiator hose neck

Disconnect the wiring harness from the cam sensor and remove the 2 bolts fastening the upper radiator hose neck to the thermostat housing. Move the neck and the upper radiator hose to the side.

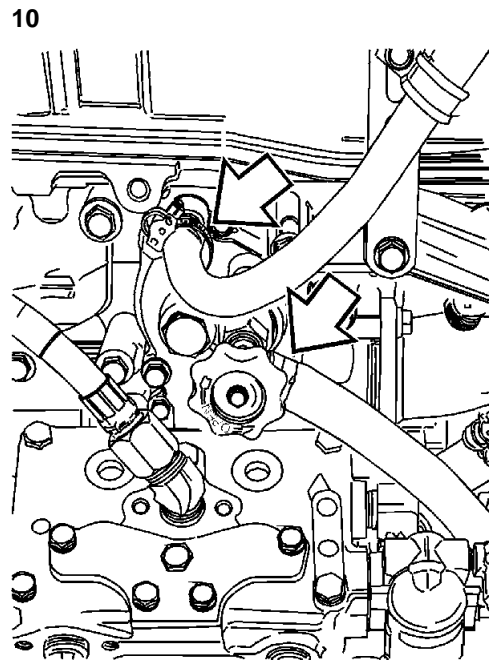


Fig. 45: Thermostat housing hoses

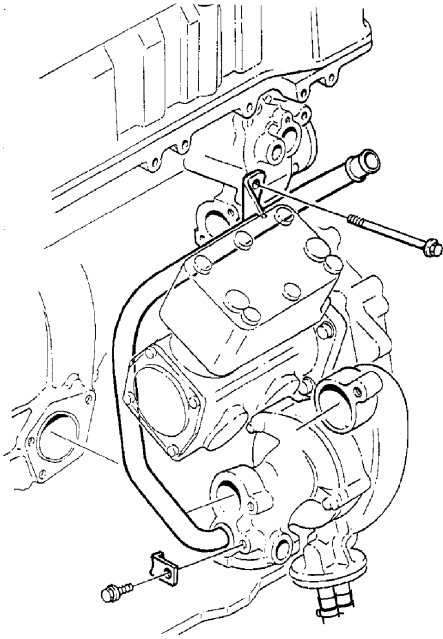
Remove the 2 hoses from the thermostat housing (the heater hose and the bleed hose).

- 11
Remove the lower right front exhaust manifold bolt.

- 12
For Bendix Air Compressors: Remove the 4 bolts fastening the outer cover of the thermostat housing. Remove the 3 bolts mounting the thermostat housing to the head. Separate the outer cover from the thermostat housing and remove both separately.

Note: For Volvo (Knorr) Air Compressors: Remove the compressor mounting bolts and rotate the compressor for clearance.

13



W2002343

Fig. 46: Expansion tank pipe

Remove the 2 bolts fastening the water pump to the expansion tank pipe. Move the pipe to the side.

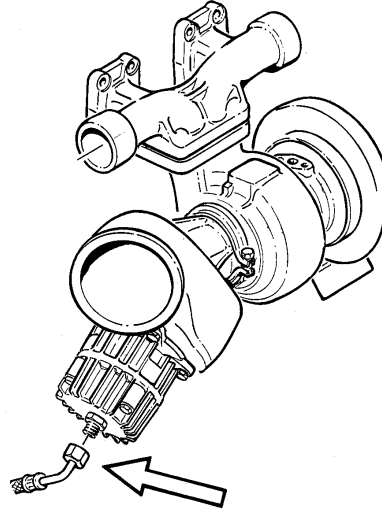
14

Disconnect the wire to the block heater (if equipped with block heater).

15

Remove the bolt fastening the transmission cooler water pipe to the oil cooler cover and move the pipe to the side (if equipped with transmission oil cooler).

16



T2006942

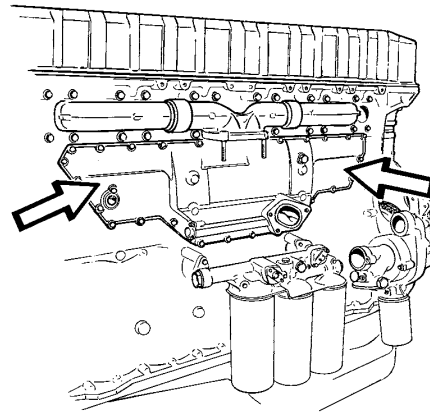
Fig. 47: Remove air supply line

Disconnect the Exhaust Pressure Governor (EPG) air supply line.

17

Remove the clamp fastening the exhaust pipe to the EPG and remove the EPG and centering ring.

18

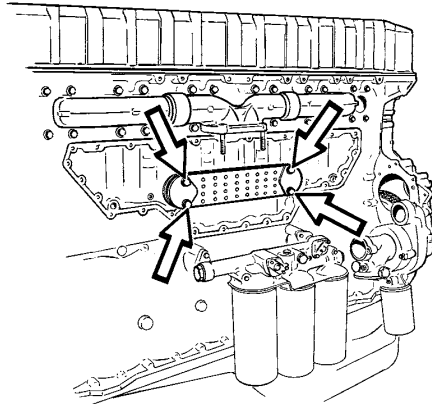


T2006689

Fig. 48: Remove oil cooler cover

Remove all of the 27 bolts fastening the oil cooler cover and remove the cover.

19



T2006690

Fig. 49: Oil cooler element

Remove the 4 bolts fastening the oil cooler element to the engine block and remove the element.

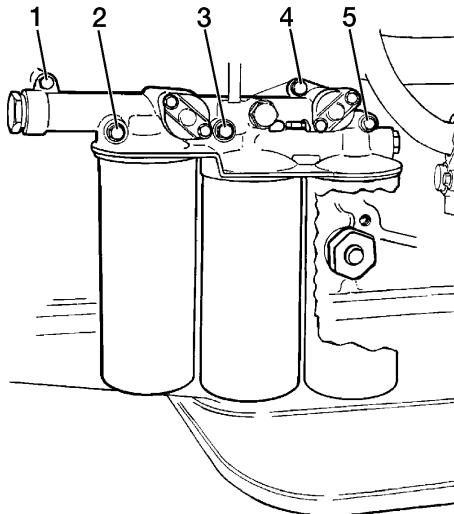
20

Remove the turbo oil return line from the block.

21

Disconnect the lower charge air cooler pipe and remove.

22

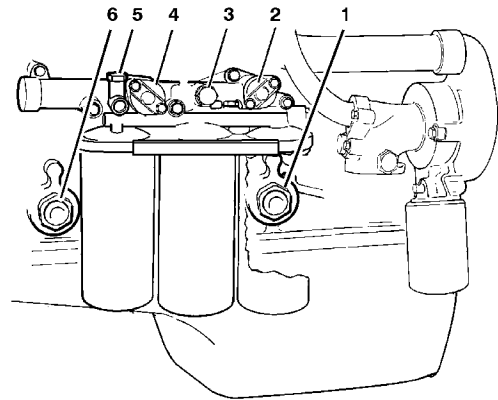


W2002340

Fig. 50: Oil filter base removal

Remove the 5 bolts fastening the oil filter base to the block, and remove the base.

23



T2012843

Fig. 51: Reduction valves

Remove the oil reduction valves (1) and (6).

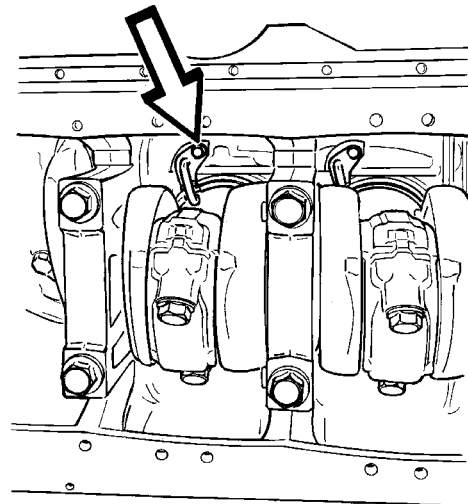
24

Remove the oil pan.

25

Remove the oil pump pick-up and delivery pipe assembly.

26



T2006685

Fig. 52: Remove piston cooling jets

Remove all 6 piston cooling jets.

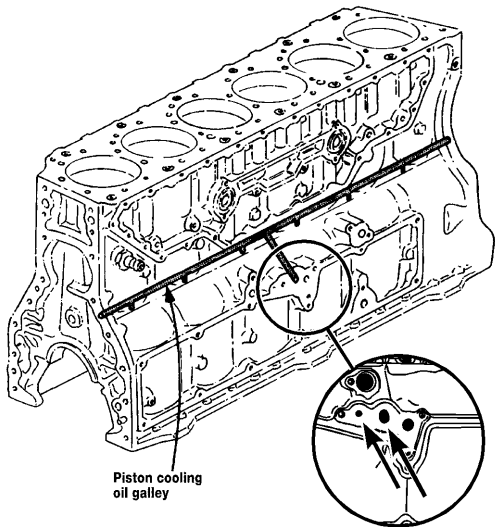
27

Inspect the pistons and liners from the bottom side for damage due to metal contamination.

28

Position the catch pan under the engine.

29



W2002426

Fig. 53: Piston cooling oil galley

! WARNING

Most solvents are flammable, stay away from open flame and observe extreme caution when using these so as to prevent fire.

! WARNING

Always wear eye protection and protective gloves when working with solvent. Exposure to eyes and/or bare skin will cause burns.

Flush out the piston cooling oil galley using **clean** solvent and a siphon type spray gun. Flush from the top side and also up from the bottom.

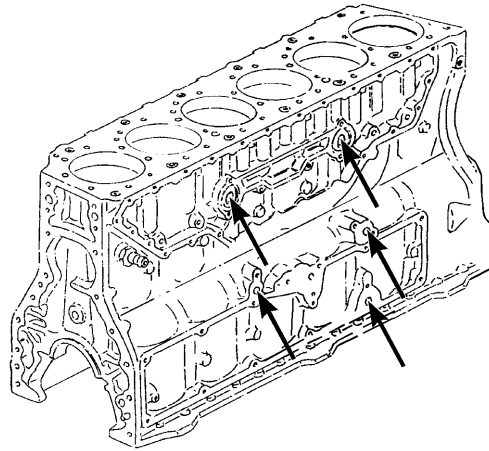
Note: Do not attempt to remove metal contaminants using shop air only.

Note: **Clean** solvent must also be used whenever flushing is required.

30

Flush out the oil reduction valve galley from the side and underside of the block.

31



W2002427

Fig. 54: Oil cooler element oil galleys

Flush out both oil cooler element oil galleys.

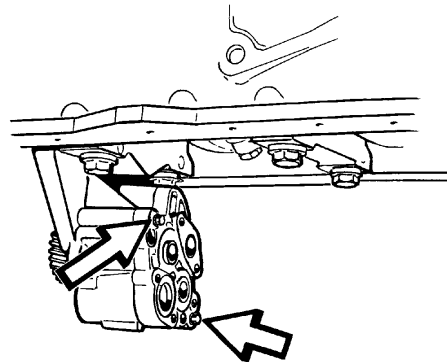
32

! WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

Blow dry all flushed oil galleys with compressed air.

33



W2002341

Fig. 55: Oil pump cover removal

Remove the rear cover of the oil pump.

34


Flush out the oil pump and inspect the pump housing and gears for damage. Replace if needed.

35
Pre-lube and install the rear cover on the oil pump. Torque bolts 27 ± 4 Nm (20 ± 3 ft-lb).

36
Flush out all piston cooling jets and install with new bolts. Torque to 24 ± 4 Nm (18 ± 3 ft-lb).

Note: The piston cooling jet attachment bolt is coated with a friction inducing compound. Do not reuse bolts.

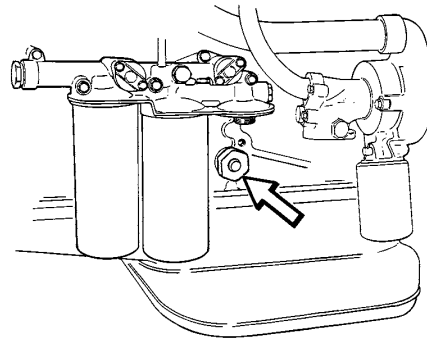
37

 WARNING
Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

Flush out and blow dry the oil pipe pick-up and delivery pipe assembly. Inspect the screen for trapped metal chips.

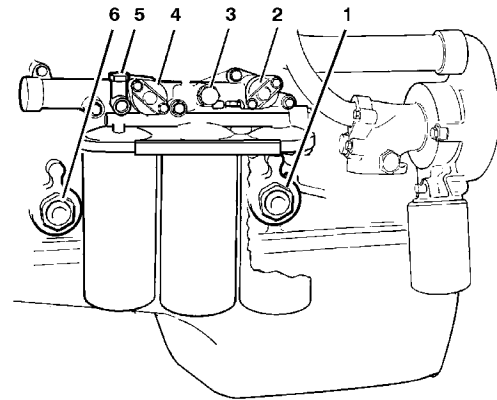
38
Install the oil pump pick-up and delivery pipe assembly with new O-rings. Torque for delivery pipe to block union 10 Nm (7.4 ft-lb) plus an additional 60° for a used pipe, 180° for a new pipe. Torque for strainer to oil pump bolts 27 ± 4 Nm (20 ± 3 ft-lb).

39



T2006675

Fig. 56: D12, D12A, D12B Engines



T2012843

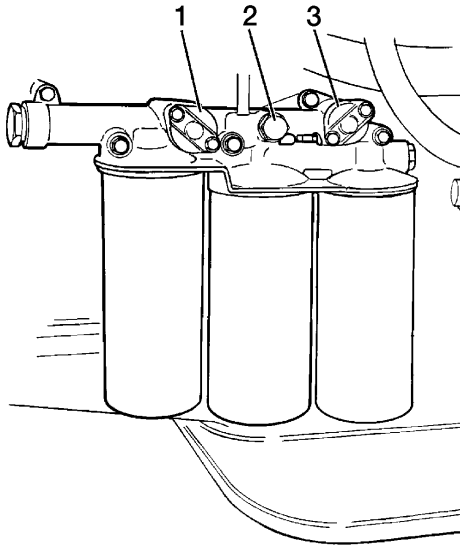
Fig. 57: D12C Engine

Flush and blow dry the reduction valve and inspect for damage or trapped debris.

40
Install the oil reduction valve with a new O-ring on the valve as well as the cover. Torque the cover to 50 Nm (37 ft-lb).

41
Remove oil filters and clean the exterior of the filter base.

42



W2002342

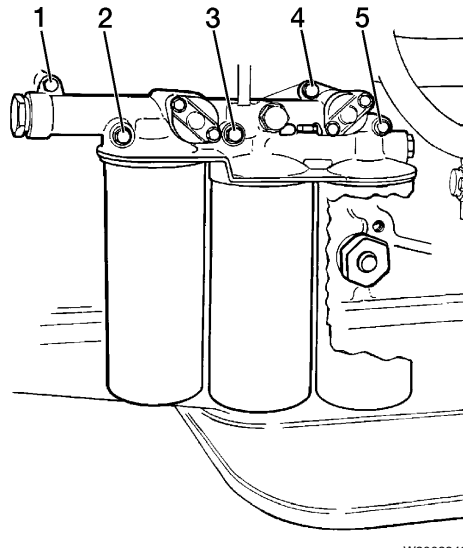
Fig. 58: Remove the piston cooling valves

- 1) piston cooling valve
- 2) overflow valve, oil filter
- 3) overflow valve, oil cooler

Remove the piston cooling valve (1) and the 2 overflow valves (2)(3). Flush out and blow dry the filter housing valve ports and valves.

43
Install the 2 overflow valves (2)(3) and the piston cooling valve (1). Torque the bolts to 10 ± 2 Nm (7 ± 1 ft-lb). Torque the plug to 55 ± 5 Nm (41 ± 4 ft-lb).

44



W2002340

Fig. 59: Torquing the mounting bolts

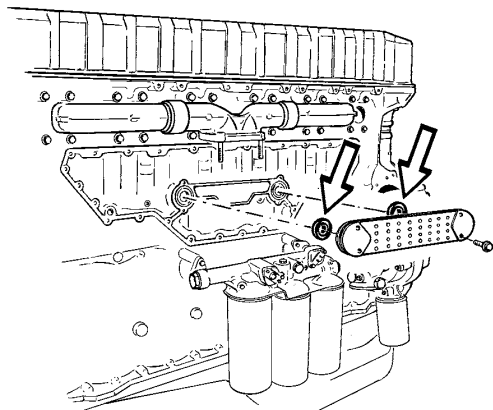
Attach the oil filter base to the block with a new gasket. Torque the mounting bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

45
Install new oil filters.

46
Install the oil pan.

47
Install new engine oil.

48



T2006691

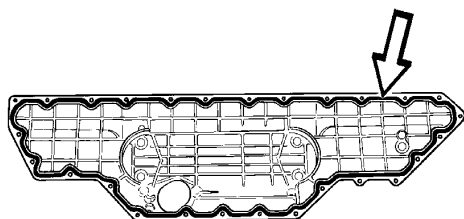
Fig. 60: Oil cooler element

Install a new oil cooler element with new seals. Torque bolts to 27 ± 4 Nm (20 ± 3 ft-lb).

27 ± 4 Nm
(20 ± 3 ft-lb)

Note: Once inside the oil cooler element, metal contamination cannot be flushed out. If this happens, replace the element.

49

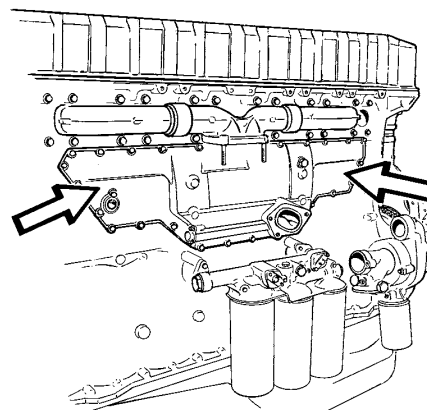


T2006692

Fig. 61: Oil cooler element

Clean the oil cooler element cover and mounting gasket surface of the block.

50



T2006689

Fig. 62: Element cover gaskets

Install the cover with a new gasket. Torque bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

24 ± 4 Nm
(18 ± 3 ft-lb)

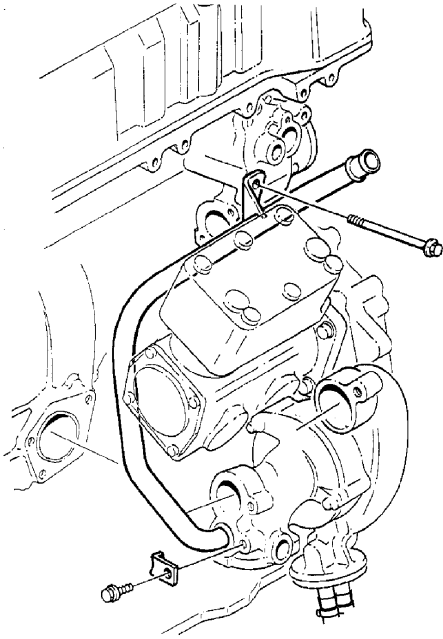
51

Connect the block heater (if equipped).

52

Install the transmission water cooler pipe to the cover with a new seal (if equipped).

53



W2002343

Fig. 63: Water pump installation

Install the water pump to the expansion tank water pipe with a new seal. Install retaining clamp and bolt assembly.

54

Clean all gasket surfaces on the thermostat housing.

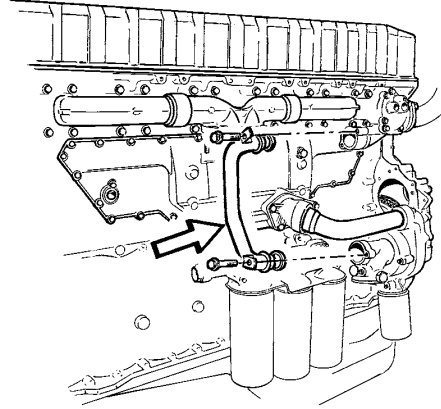
55

Install the thermostat housing with a new seal. Torque the 4 M6 bolts to 10 ± 1.5 Nm (7.4 ± 1 ft-lb), and the 3 M8 bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

For Volvo (Knorr) Air Compressor: re-align the compressor with mounting bolts and tighten to 85 ± 15 Nm (63 ± 11 ft-lb).

10 ± 1.5 Nm
(7.4 ± 1 ft-lb)
 24 ± 4 Nm
(17.7 ± 3 ft-lb)
Knorr:
 85 ± 15 Nm
(63 ± 11 ft-lb)

56

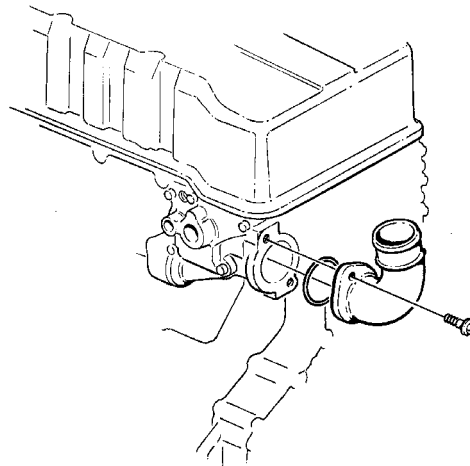


T2006694

Fig. 64: Installing the bypass pipe

Install the bypass pipe using a new seal and gasket.

57

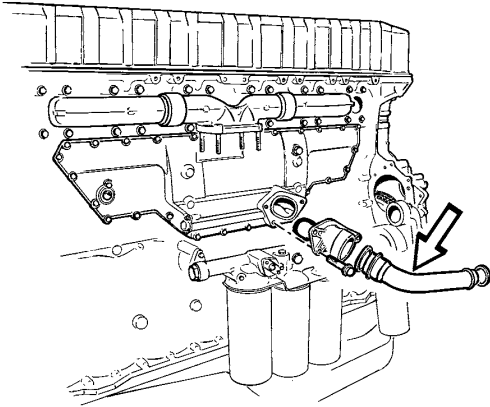


T2007234

Fig. 65: Radiator hose for thermostat housing

Install the top radiator hose neck to the thermostat housing using a new O-ring. Connect the cam sensor wiring harness.

58



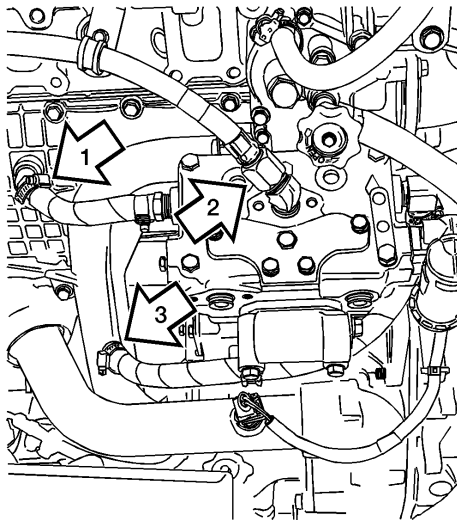
T2006693

Fig. 66: Installing the water pump

Clean and install the water pump to the oil cooler cover pipe using a new gasket and seal. Connect the VEB temperature sensor wiring harness. Torque the 3 mounting bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

24 ± 4 Nm
(18 ± 3 ft-lb)

59



W2002338

Fig. 67: Hoses for the air compressor

Connect the air compressor coolant supply hose (1) to the oil cooler cover. Hand-tighten the hose clamp.

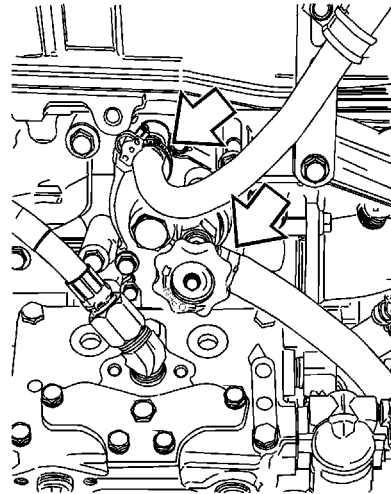
60

Connect the air compressor discharge line (2) to the air compressor.

61

Connect the air compressor coolant return hose (3) to the bypass pipe. Hand-tighten clamp.

62



W2002339

Fig. 68: Hoses to the thermostat housing

Connect the 2 hoses (heater and bleed hoses) to the thermostat housing. Hand-tighten the hose clamps.

63

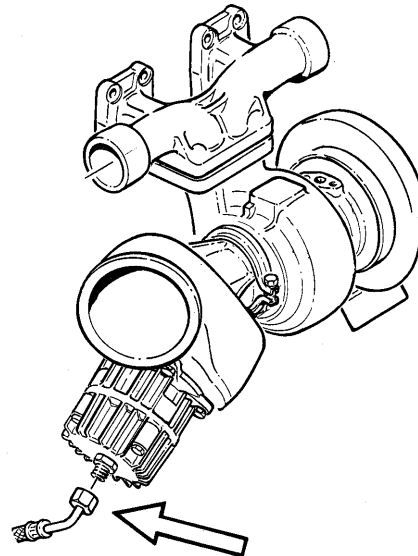
Install the lower right exhaust manifold bolt and torque to 47 ± 8 Nm (35 ± 6 ft-lb).

47 ± 8 Nm
(35 ± 6 ft-lb)

64

Add coolant and inspect for leaks.

65



T2006942

Fig. 69: Connecting the EPG air line

Position the centering ring and EPG against the exhaust pipe. Hand-tighten the clamp bolt only. Connect the EPG air line.

66

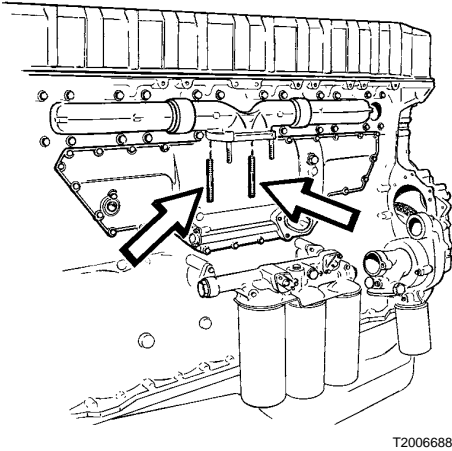


Fig. 70: Turbocharger mounting studs

Install the turbocharger mounting studs.

67

Install the turbocharger, see;

Service Manual 250–600
Intake and Exhaust Systems, D12, D12A, D12B, D12C

IPMPACT Function Group
Information Type: Repair
"Turbocharger"

68

Tighten the EPG to exhaust pipe clamp. Torque the clamp bolt to $60 \pm 10 \text{ Nm}$ ($44 \pm 7 \text{ ft-lb}$).

69

Start the engine, check for proper operation, and inspect for leaks.

2229-03-02-06 Oil Filter Nipple, Replacement

1

Remove oil filters.

2

If the oil filter nipples are loose remove them.

3

Clean the filter base with appropriate cleaning solution.

4

Use an air gun to blow the dirt out of the oil filter base threads.

5

Install thread lock 577 on the nipple threads.

6

Thread the nipple back into the oil filter base by hand until it stops.

7

Thread the nipple installer into the nipple.

8

Use the nipple installer wrench, 9998691, to hold the outer nut.

9

Using a torque wrench on the jam nut, torque the nut to $40 \text{ nm} \pm 5$ ($30 \pm 4 \text{ ft-lb}$). Remove the torque wrench.

10

Use a pull bar to loosen the jam nut with the wrench holding the outer nut.

11

Remove the nipple installer from the filter base.

12

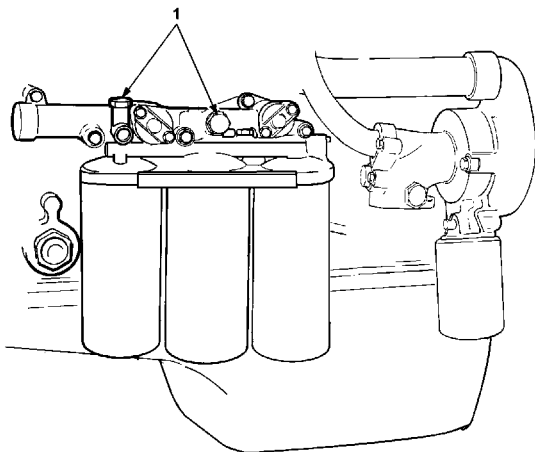
Let the locktite set up for about 5 minutes before putting the filter back on.

13

Moisten the o-ring on the oil filter with clean engine oil. Put the filter in place and torque to $15 \text{ nm} \pm 5$ ($10 \pm 3 \text{ ft-lb}$).

2229-03-02-01 Oil Filter Overflow Valve, Re- placement

1



C2000653

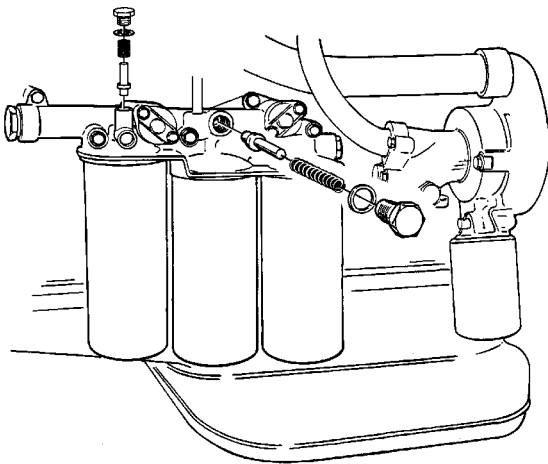
Overflow valve (bypass)

Clean oil filters bracket and remove valves caps (1).
Remove valves needles and springs.

2

Clean and check valve seats. If valve seat is corroded, oil filters bracket must be changed.

3



C2000646

Fig. 71: Valve needles and springs

Assemble new valve needles and springs.
Assemble and tighten cap. Use a new seal ring.

4

Start engine and check for leaks.

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.

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Comments/proposals

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Concerns Service Manual:

Operation Numbers

2171-02-02-01	Oil Pan, Installation	19
2209-11-02-01	Oil System Passages, Cleaning	31
2211-03-02-01	Lube Oil Pump, Replacement	19
2211-06-02-01	Lube System Pressure, Checking	22
2223-03-02-01	Oil Filter, Replacement	23
2229-03-02-01	Oil Filter Overflow Valve, Replacement	43
2229-03-02-02	Piston Cooling Valve, Replacement	24
2229-03-02-03	Piston Cooling Nozzle, Replacement	25
2229-03-02-04	Oil Pressure Reduction Valve, Replacement	26
2229-03-02-06	Oil Filter Nipple, Replacement	42
2231-06-05-01	Oil Cooler Leak Test, Checking	17
2232-03-02-01	Oil Cooler Core, Replacement	28
2239-03-02-02	Oil Cooler Bypass Valve, Replacement	31

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