Workshop Manual

Group 20-26

A
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D3
Work edition

Content

00-0 General

About this Workshop manual

General information

This Service Manual contains technical data, descriptions and maintenance and repair instructions for standard model Volvo Penta products. A list of these products may be found in the section ***Specifications***.

The product designation and the serial number and specification is indicated on the engine decal or type plate. This information must be included in all correspondence regarding the product.

The service manual is produced primarily for the use of Volvo Penta workshops and their qualified personnel. It is assumed that any person using the Service Manual has a fundamental knowledge of the product and is able to carry out mechanical and electrical work to trade standard.

Volvo Penta continually develops its products; we therefore reserve the right to make changes. All information in this manual is based on product data which was available up to the date on which the manual was printed. New working methods and significant changes introduced to the product after this date are communicated in the form of ***Service bulletins***.

Spare Parts

Spare parts for the electrical and fuel systems are subject to various national safety standards. Volvo Penta Original Spare Parts meet these standards. No damage of any kind caused by the use of spare parts not approved by Volvo Penta will be compensated by any warranty undertaking.

Certified engines

When carrying out service and repair on emission-certified engines, it is important to be aware of the following:

Certification means that an engine type has been inspected and approved by the relevant authority. The engine manufacturer guarantees that all engines of the same type are manufactured to correspond to the certified engine.
This places special demands on service and repair work, namely:

- Maintenance and service intervals recommended by Volvo Penta must be complied with.
- Only spare parts approved by Volvo Penta may be used.
- Service on injection pumps, pump settings and injectors must always be carried out by an authorized Volvo Penta workshop.
- The engine must not be converted or modified, except with accessories and service kits which Volvo Penta has approved for the engine.
- No changes to the exhaust pipe and engine air inlet duct installations may be made.
- No warranty seals (where present on the product) may be broken by unauthorized persons.

The general instructions in the Operator's Manual concerning operation, service and maintenance apply.

IMPORTANT!

Neglected or poorly-performed care/service and the use of spare parts not approved by Volvo Penta, will mean that AB Volvo Penta no longer guarantees that the engine conforms to the certified model.

Volvo Penta accepts no responsibility for damage or costs arising as a result of failure to follow the above mentioned standards.

Repair instructions

Introduction

The working methods described in this manual are based on a workshop scenario where the product is mounted in a holding fixture. Maintenance work is often carried out in situ, in which case – if nothing else is indicated – using the same working methods as the workshop.

Warning symbols that occur in the service manual. For significance, refer to ***Safety Information*** .

DANGER!

WARNING!

CAUTION!

IMPORTANT!, **NOTICE!**
are by no means comprehensive since not everything can be foreseen as service work is carried out in the most varied of circumstances. We call attention to risks that may occur due to incorrect handling during work in a well-equipped workshop using working methods and tools tried and tested by us.

The service manual describes work operations carried out with the aid of Volvo Penta Special Tools, where such have been developed. Volvo Penta Special Tools are designed to ensure the safest and most rational working methods possible. It is therefore the responsibility of anyone using tools or working methods other than those we recommend to ensure that no risk of personal injury or mechanical damage is present, or that malfunction can result.

In some cases, special safety regulations and user instructions may be in force for the tools and chemicals mentioned in the Service Manual. These regulations must always be followed, and no special instructions regarding this are to be found in the Service Manual.

By taking these basic precautions and using common sense it will be possible to guard against most elements of risk. A clean workplace and a clean product will eliminate many risks of personal injury and malfunction.

Above all, when working on fuel systems, hydraulic systems, lubrication systems, turbochargers, inlet systems, bearings and seals, it is of the utmost importance that dirt and foreign objects are kept away, as malfunctions or shortened service intervals may otherwise result.

Our mutual responsibility

Each product comprises a large number of interacting systems and components. A deviation from the technical specification may dramatically increase the environmental impact of an otherwise reliable system. It is therefore critical that the stated wear tolerances be adhered to, that systems which can be adjusted be correctly set up and that only Volvo Penta Original Parts are used. The intervals in the care and maintenance schedule must be followed.
Some systems, e.g. fuel systems, often require special expertise and test equipment. A number of components are factory-sealed, for among other things environmental reasons. Warranty-sealed components may not be worked on without authorization to perform such work.

Remember that most chemical products, incorrectly used, are harmful to the environment. Volvo Penta recommends the use of biodegradable degreasers whenever components are cleaned, unless otherwise specified in the Service Manual. When working outdoors, take especial care to ensure that oils and wash residues etc. are correctly properly for destruction.

Tightening torques

Tightening torques for vital fasteners that must be applied using a torque wrench are indicated in the Service Manual, chapter ***Tightening torques*** and in the Manual's work descriptions. All torque indications apply to clean threads, bolt heads and mating faces. Indicated torque data apply to lightly-oiled or dry threads. If lubricants, locking fluids or sealants are required for fasteners, the correct type will be noted in the job description.

Torque, angle tightening

When torque/angle tightening, the fastener is tightened to a specified torque, and tightening then continues through a pre-determined angle.

Example: For 90° angle tightening, the fastener is turned a further 1/4 turn in one sequence, after the specified tightening torque has been achieved.

Lock nuts

Removed locknuts may not be re-used; they must be replaced by new ones, as locking properties are impaired or lost with re-use.
In the case of lock nuts with plastic inserts the tightening torque indicated must be reduced if the nut has the same nut height as a standard, all-metal hexagonal nut.
Reduce the torque by 25% for bolt sizes of 8 mm or larger.
In the case of lock nuts with plastic inserts with a high nut-height (where the all-metal thread is as high as a standard hexagonal nut), the indicated torque applies.

Strength classes

Nuts and bolts are subdivided into different strength classes. The classification is shown by a marking on the bolt head. Markings of a higher number indicate stronger material. For example, a bolt marked 10-9 is stronger than one marked 8-8.

For this reason, it is important that when bolts are removed they are returned to their original locations on re-assembly. When replacing bolts check the applicable ***Spare parts catalogue*** to ensure the correct bolt is used.

Sealing compounds etc.

To ensure service work is correctly carried out it is important that the correct type of sealants and locking fluids are used on joints where such are required.

In each service manual section concerned, the sealants used in product manufacture are indicated. The same sealants, or sealants with equivalent properties, must be used for maintenance work.

Make sure that mating surfaces are dry and free from oil, grease, paint and anti-corrosion agent before applying sealant or locking fluid. Always follow the manufacturer's instructions regarding applicable temperatures, hardening times and such.

Two basic types of compound are used:

RTV preparations (Room Temperature Vulcanizing).
Used most often together with gaskets, e.g. sealing gasket joints, or are brushed on gaskets. RTV sealants are completely visible when the part has been removed. Old RTV sealant must be removed before the component is sealed again. Use denatured alcohol.

Anaerobic agents.
These agents cure (harden) in the absence of air. These preparations are used when two solid components, e.g. two cast components, are fitted together without a gasket. Common uses are also to lock and seal plugs, stud threads, taps, oil pressure monitors etc.

Hardened anaerobic preparations are glassy and for this reason, the preparations are colored to make them visible. Hardened anaerobic preparations are highly resistant to solvents, and old compound cannot be removed. On re-assembly, it is important to carefully degrease and wipe dry components first, before applying new sealant in accordance with the instructions.

Safety regulations for fluorocarbon rubber

Fluorocarbon rubber is a common material in sealing rings for shafts, and in O-rings, for example.

When fluorocarbon rubber is exposed to high temperatures (above 300°C/572°F), hydrofluoric acid can form. This is highly corrosive. Contact with the skin can result in severe chemical burns. Splashes in your eyes can result in chemical wounds. If you breathe in the fumes, your lungs can be permanently damaged.

⚠ WARNING!

Seals must never be cut with a torch, or be burnt afterwards in an uncontrolled manner. Risk for poisonous gases.

⚠ WARNING!

Always use chloroprene rubber gloves (gloves for chemicals handling) and goggles. Handle the removed seal in the same way as corrosive acid. All residue, including ash, can be highly corrosive. Never use compressed air to blow clean.

Put the remains in a plastic container, seal it and apply a warning label. Wash the gloves under running water before removing them.

The following seals are most probably made from fluorocarbon rubber:

Seal rings for the crankshaft, camshaft, idler shafts.

O-rings, regardless of where they are installed. O-rings for cylinder liner sealing are almost always made of fluorocarbon rubber.

Please note that seals which have not been exposed to high temperature can be handled normally.

03-2 Specifications, Engine

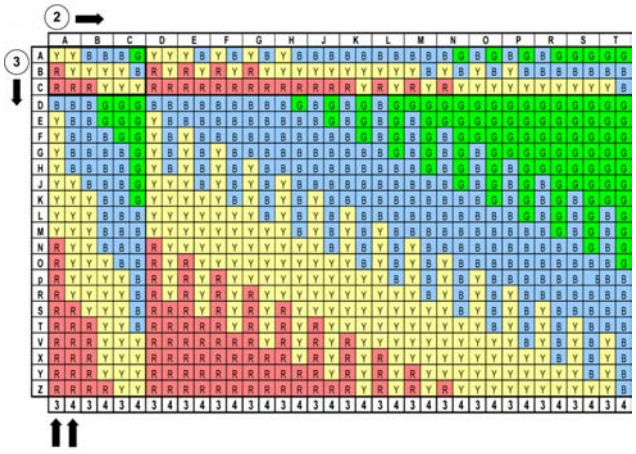
Technical Data

Engine, General

	Inboard					Aquamatic			
	D3-110 I	**D3-150 I**	**D3-170 I**	**D3-200 I**	**D3-220 I**	**D3-140**	**D3-170**	**D3-200**	**D3-220**
No. of cylinders	5								
No. of valves	20								
Displacement	2.4 l (0.63 US gallon)								
Firing sequence	1–2–4–5–3								
Bore	81 mm (3.19")								
Stroke	93.2 mm (3.67")								
Compression ratio	16,5:1								
Idling speed	700 + 50 rpm								
Engine power	81 kW (110 hp)	110 kW (150 hp)	125 kW (170 hp)	147 kW (200 hp)	162 kW (220 hp)	98 kW (133 hp)	119 kW (162 hp)	140 kW (190 hp)	154 kW (209 hp)
High idle	3000 rpm		4000 rpm						
Rating	5								
Transmission	HS25	HS45				SX / DPS		DPS	

Group 21: Engine

Main bearing classes



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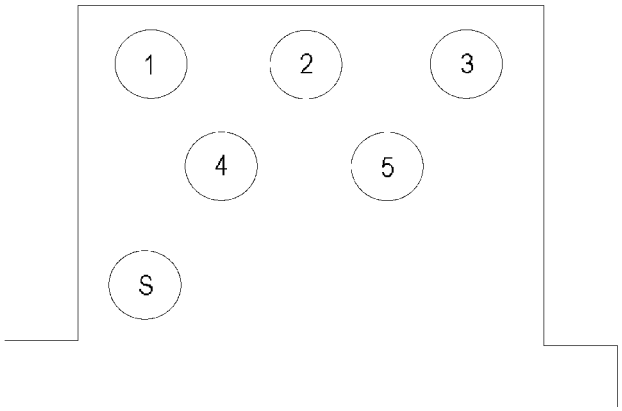
A template for identification is available in the workshop manual as well as an eTool in the Electronic Parts Catalague, this is to make sure that correct bearings are used within the engine overhaul procedure.

Bore

C-marked	81.00–81.01 mm (3.18897-3.18936")
D-marked	81.01–81.02 mm (3.18936-3.18975")
E-marked	81.02–81.03 mm (3.18975-3.19015")

Cylinder head gasket



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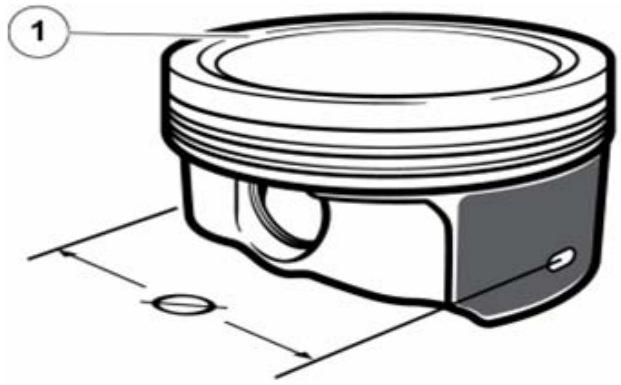
Classification	Hole marking
1	5
2	4, 5
3	3, 4, 5
4	2, 3, 4, 5
5	1, 5
S	Single turbo



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Pistons

Piston class is stamped on top of the piston.

As standard the diameter is measured 12 mm (0.47") above the piston lower end.

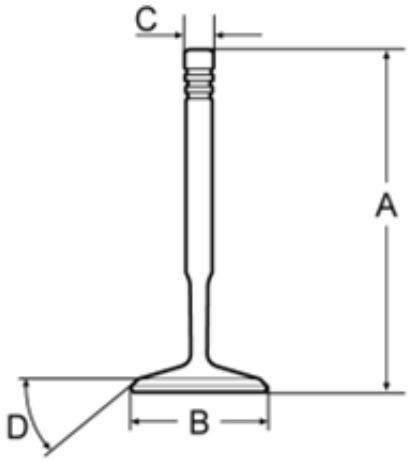
C-marked (1)	80.95–80.96 mm (3.18700-3.18739")
D-marked (1)	80.96–80.97 mm (3.18739-3.18779")
E-marked (1)	80.97–80.98 mm (3.18779-3.18818")

Piston rings

	Height	Clearance
Top ring		
First ring		
Oil ring		

Piston pin

Diameter	24.985-25.0 mm (0.9837-0.9842")
Length	66.0-66.3 mm (2.5984-2.6102")



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Valves

	Inlet	Exhaust
Length (A)	98.1 ±0.07 mm (3.862 ±0.0028")	97.7 ±0.15 mm (3.846 ±0.0059")
Plate diameter (B)	28.0 ±0.1 mm (1.102 ±0.0039")	26.2 ±0.1 mm (1.031 ±0.0039")
Shaft diameter (C)	5.975 ±0.015 mm (0.235 ±0.0006")	5.975 +0/-0.015 mm (0.235 +0/-0.0006")
Valve angle (D)	45.0 ±0.5°	45.0 +0.5/-0°

Crankshaft

Axial clearance*	0.11-0.30 mm (0.0043-0.0118")

* To be measured with the cylinder block assembled.

Con rods

Diameter, big end	53 mm (2.09")
Diameter, small end	30 mm (1.18")
Length between centre of the ends	147 mm (5.79")

Group 22: Lubrication System

Max. oil level with oil filter	6.3 l (1.66 US gallon)
Max. oil level without oil filter	5.8 l (1.53 US gallon)

Oil pressure at	
850 rpm	0.1 MPa (14.5 psi)
4000 rpm	0.35 MPa (50.8 psi)

Max. oil pressure*	0.48 MPa (69.6 psi)

* Safety valve opens.

Group 23: Fuel System

EDC, type	Bosch EDC17
Fuel feed pump, type	Electrical
High pressure pump, type	Bosch CP 4.2
Injectors, type	Bosch CRI 3.2

Group 25: Inlet and Exhaust System

	Inboard					**Aquamatic**			
	D3-110 I	**D3-150 I**	**D3-170 I**	**D3-200 I**	**D3-220 I**	**D3-140**	**D3-170**	**D3-200**	**D3-220**
	Charge air pressure, kPa (psi)								
1200 rpm	128 (18.56)	127 (18.42)	126 (18.27)	126 (18.27)	127 (18.42)	127 (18.42)	126 (18.27)	126 (18.27)	127 (18.42)
2000 rpm	199 (28.86)	229 (33.21)	230 (33.36)	229 (33.21)	230 (33.36)	198 (28.72)	230 (33.36)	229 (33.21)	230 (33.36)
2800 rpm	198 (28.72)	235 (34.08)	249 (36.11)	243 (35.24)	270 (39.16)	206 (39.16)	249 (36.11)	243 (35.24)	270 (39.16)
4000 rpm	–	–	239 (34.66)	250 (36.26)	274 (39.74)	203 (29.44)	239 (34.66)	250 (36.26)	274 (39.74)

Group 26: Cooling System

Thermostat, opens at	80 °C (176 °)
Thermostat, fully open at	94 °C (201.2 °)
Coolant volume, incl. heat exchanger	8,7 l (2.3 US gallon)
Heat exchanger	Seawater cooled
Seawater pump	Rubber impeller

05-1 Safety Instructions


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Safety Information

This Service Manual contains repair instructions, descriptions and technical data for products or product designs from Volvo Penta. Ensure that you are using the correct service manual.

Read the safety information below and the service manual section ***About this Workshop manual*** and ***Repair instructions*** carefully before repair and service work is begun.

This symbol is used in the service manual and on the product, to call attention to the fact that this is safety information. Always read such information very carefully.
Safety texts in the manual have the following order of priority:

DANGER!
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING!
Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION!
Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

IMPORTANT!
Is used to draw your attention to something that may cause minor damage or a minor malfunction to the product or property.

NOTICE! Is used to draw your attention to important information that will facilitate the work or operation in progress.

This symbol is used on our products in certain cases and refers to important information in the instruction book. Make sure that warning and information symbols on the engine are clearly visible and legible. Replace symbols which have been damaged or painted over.

A compilation of safety precautions that must be taken and risks which must be paid attention to is presented in the following pages.

Immobilize the engine by turning off the power supply to the engine at the main switch (switches) and lock it (them) in the off position before starting work. Post a warning notice at the main circuit breaker.

As a rule, all service operations must be carried out with the engine stopped. However, some work, such as adjustments, will require the engine to be running. Approaching an engine which is running is a safety risk. Bear in mind that loose clothing or long hair can fasten in rotating parts and cause serious personal injury.

Be aware of hot surfaces (exhaust pipes, turbos, charge air pipes, starting heaters etc.) and hot fluids in pipes and hoses on an engine that is running or has just stopped.
If work is done adjacent to a running engine, a careless movement or a dropped tool may in the worst case lead to personal injury.

Ensure that the warning symbols or information decals on the product are always clearly visible. Replace decals which have been damaged or painted over.

Avoid getting oil on your skin! Protracted or repeated exposure to oil can cause skin to become dry. Irritation, dryness, eczema and other skin problems may then result. From a health standpoint, used oil is more dangerous than new. Use protective gloves and avoid oil-soaked clothes and rags. Wash regularly, especially before eating. Use suitable barrier creams to counteract drying out of the skin and to aid dirt removal.

Stop the engine and turn off the electrical supply at the main switch(es) before carrying out work on the electrical system.

Avoid opening the coolant filling cap when the engine is hot. Steam or hot coolant can spray out and system pressure will be lost. Open the filler cap slowly, and release the pressure in the cooling system if the filler cap or valve has to be opened, or if a plug or coolant hose has to be removed when the engine is hot.

Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before any work is begun. Never start or operate the engine with the oil filler cap removed, because of the risk of oil ejection.

Never start the engine without installing the air filter. The rotating compressor turbine in the turbocharger can cause severe injury. Foreign objects entering the intake ducts can also cause mechanical damage. Install all protective covers before the engine is started.

Only start the engine in a well-ventilated space. When running in a confined space, exhaust fumes and crankcase gases must be led away from the engine bay or workshop area.

The majority of chemicals e.g. engine and transmission oils, glycol, gasoline, and diesel oil, together with chemicals for workshop use such as degreasing agents, paints and solvents, are injurious to health. Carefully read the instructions on the product packaging! Always follow a product's safety directions, e.g. use of protective mask, glasses, gloves etc. Ensure that other personnel are not exposed to substances that are injurious to health. Ensure good ventilation. Handle used and leftover chemicals in the prescribed manner.

Clutch adjustments must be carried out with the engine stopped.

Always use protective glasses or goggles when carrying out work where a risk of splinters, grinding sparks, splashes from acid or other chemicals is present. Your eyes are extremely sensitive; injury may cause blindness!

Never use start gas or similar products as a starting aid. They may cause an explosion in the inlet manifold. Danger of personal injury.

All fuels, as well as many chemicals, are flammable. Do not allow open flames or sparks in their vicinity. Gasoline, some thinners, and hydrogen gas from batteries are extremely flammable and explosive when mixed with air in the correct proportions. **No Smoking!** Ensure that the work area is well ventilated and take the necessary safety precautions before welding or grinding work is begun. Always ensure that there are fire extinguishers close at hand in the work area.

Batteries must never be exposed to open flames or electric sparks. Never smoke in the vicinity of the batteries; they generate hydrogen gas when charged, which is explosive when mixed with air. This gas is easily ignited and highly explosive. A spark, which can be caused by incorrect battery connection, is sufficient to cause a battery to explode and cause damage.

Do not touch the connections during start attempts. Sparking hazard! Do not lean over batteries.

Never transpose the positive (+) and negative (-) battery posts when installing batteries. Such a transposition can result in serious damage to electrical equipment. Refer to the wiring diagram.
Always use protective goggles when charging and handling the batteries. Battery electrolyte contains sulfuric acid which is highly corrosive. Should the battery electrolyte come into contact with unprotected skin, wash it off immediately using soap and copious amounts of water. If you get battery acid in your eyes, flush at once with copious amounts of water and seek medical assistance immediately.

Never start the engine with the valve cover removed. There is a risk of personal injury.

Stop the engine before working on the cooling system.
Marine engines: Close the sea cock / cooling water inlet valve before work on the cooling system is begun.

Make sure that oil, fuel-soaked rags, and used fuel and oil filters are stored in a safe manner. Rags soaked in oil can spontaneously ignite under certain circumstances. Used fuel and oil filters are environmentally hazardous waste and must be handed to an approved waste management facility for destruction, as must any used lubrication oil, contaminated fuel, paint residue, solvents, degreasers and wash residue.

Never work alone when removing heavy components, even when using lifting devices such as locking tackle lifts. When using a lifting device, two people are usually required to do the work - one to take care of the lifting device and the other to ensure that components are lifted clear and not damaged during the lifting operations.

The existing lugs on the engine should be used for lifting. Always check that the lifting equipment used is in good condition and has the load capacity to lift the engine (engine weight including gearbox or extra equipment). For safe handling and to avoid damaging components fitted to the top of the engine, the engine must be lifted with a correctly adjusted lifting boom. All chains or wires must run parallel to each other and as perpendicular to the engine as possible. If other equipment attached to the engine has altered its center of gravity, special lifting devices may be needed to obtain the correct balance for safe handling. Never perform any work on an engine that is only suspended from the lifting equipment.

The components in the electrical and fuel systems on Volvo Penta products are designed and manufactured to minimize the risk of fire and explosion. The engine must not be run in areas where there are explosive materials.

Only use fuels and lubricating oils recommended by Volvo Penta. Refer to the Operator's Manual for the product in question. Use of fuels that are of a lower grade may damage the engine, the injection pump and the injectors. On a diesel engine, low grade fuel can cause the control rod to bind and the engine to over-rev, with the risk of engine damage and personal injury as a result. Low fuel and oil grades may result in high service, maintenance and repair costs.

Fuel delivery pipes must not be bent or straightened under any circumstances. Cracks may occur. Damaged pipes must be replaced.

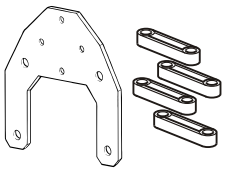
Exercise extreme caution when leak-detecting on the fuel system and testing the fuel injector nozzles. Use eye protection. The jet from a fuel nozzle has very high pressure and great penetration power. Fuel can force its way deep into body tissue and cause severe injury. There is a risk of blood poisoning (septicemia).

Never use a high-pressure washer for cleaning the engine.
Pay attention to the following when using a high-pressure washer on components other than the actual engine: Never direct the water jet at seals, rubber hoses or electrical components.

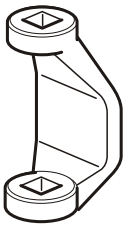
08-2 Special Service Tools

Special tools

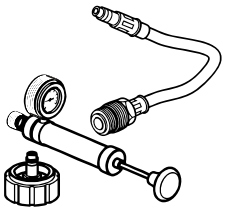
The following special tools are used when working on the engine. The tools can be ordered from AB Volvo Penta by specifying the number indicated.



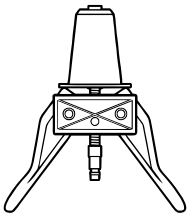
885224 Fixture



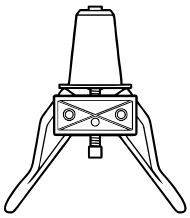
885490 Sleeve



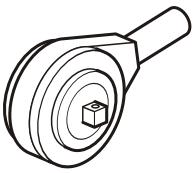
885531 Pressure testing kit



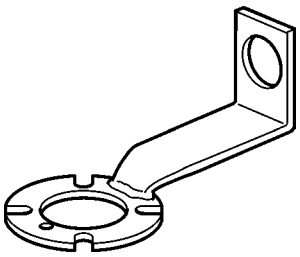
885536 Plug



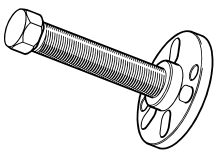
885539 Plug



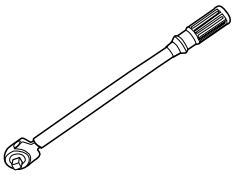
885633 Torque multiplier



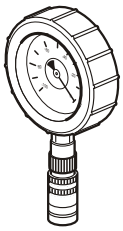
885819 Counterhold



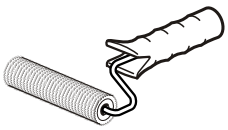
885820 Puller



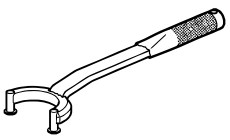
1158688 Torque wrench



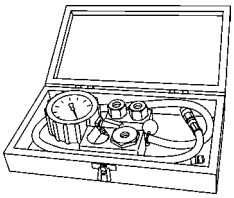
9990150 Manometer



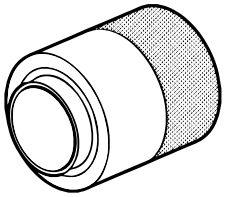
9992767 Roller



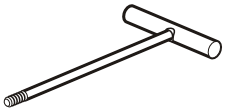
9995199 Drift



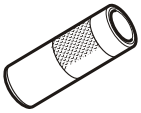
9995270 Pressure gauge



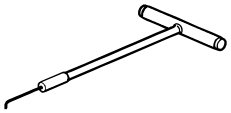
9995455 Mounting tool



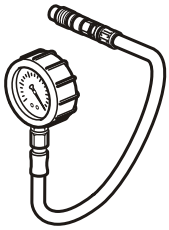
9995746 Puller



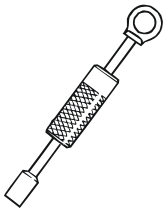
9995747 Protective sleeve



9995919 Extractor

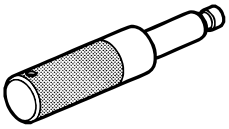


9996398 Manometer

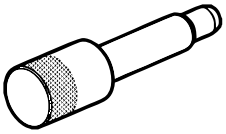


9996400 Slide hammer

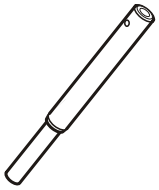
9996666 Nipple



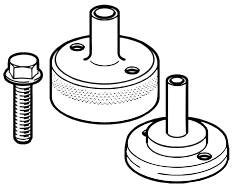
9997005 Rotation tool



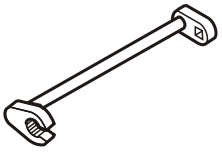
9997007 Lock pin



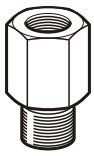
9997009 Brush



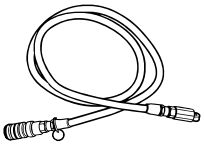
9997174 Mounting tool



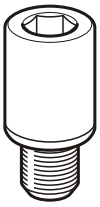
9997217 Wrench



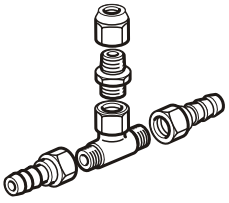
9998007 Adapter



9998493 Hose



21427201 Guide sleeve



21433378 Nipple

20-0 Engine Information, General

Lifting the Engine, Actions

Before lifting the engine

Boat removed from the water

1 Turn the main switch off. Undo the battery connections to the engine.

2 Disconnect the harness terminals for the secondary fuel filter and the trim pump. Undo the throttle cable from the engine control unit. Remove the box containing the engine control unit from the bulkhead. Remove the ground cable from the shield.

3 Remove the seawater connection.

4 Remove the exhaust pipe (baffle).

5 **Aquamatic only**
Drain the power steering system hydraulic oil via the drain valve under the system oil cooler. Undo the hydraulic connections on the steering cylinder. Remove the power steering oil reservoir.

6 Close the fuel taps. Remove the fuel connections.

7 Disconnect the drive at the shield (if an AQ is fitted) or disconnect the propeller shaft at the reverse gear (inboard).

8 Undo the engine mounts from the beds and the flywheel housing. Lift out the engine.

Actions after lifting the engine

1 Clean the engine.

IMPORTANT!
Do not use a power washer. There is a risk that the engine components are subjected to waterlogging.

2 Pump out the engine oil (as necessary).

Actions before working in boat

1 Switch off the current at the main switch and check that the engine is without power.

2 Clean the outside of the engine.

NOTICE! Make sure that wash residue is collected for disposal and does not inadvertently end up in the environment.

3 The work includes the following actions on the cooling system: Close the sea cocks and drain the coolant from the seawater and fresh water systems.

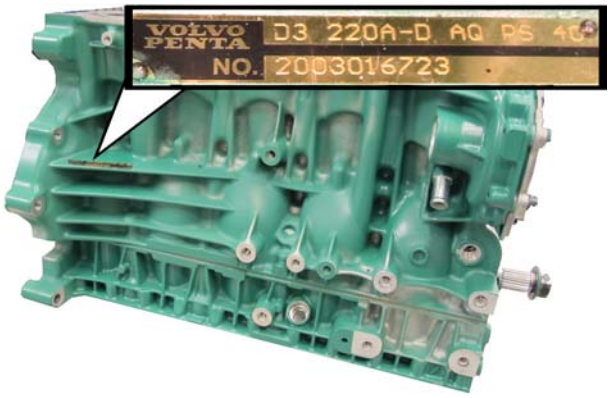
IMPORTANT!
Make sure that all seawater inlets are securely closed so that water cannot enter the boat during removal of cooling system sub-components.

Model Identification

There are two ways in which to identify an engine.

- A decal on the engine cover (cold side).

P0010766

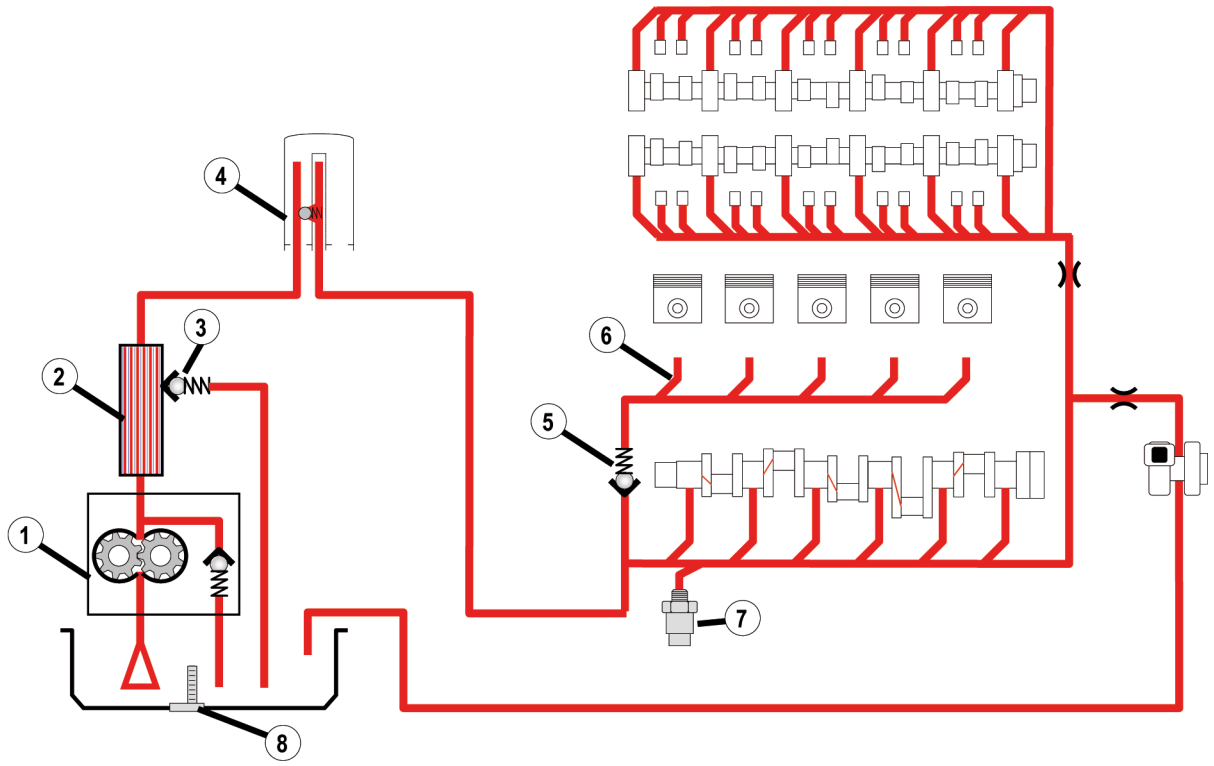


P0010767

- An identification plate riveted to the back of the engine block (hot side).

Design and Function

Group 22: Lubrication System



P0012383

The oil pump (**1**) is of the rotor (duo centric) type with a flow capacity of 69 l/min (18.2 US gallon/min) at 4000 rpm and an oil temperature of 100 °C (212 °F), at a pressure of 3 bar (43.5 psi).

The oil pump cannot be repaired but must be exchanged if it becomes defective. The pump inner rotor is spline driven directly from the crankshaft. The pump has an internal safety valve that opens at 8 bar (116.0 psi).

Oil flows from the pump to the water-cooled oil cooler (**2**) located on the right side of the oil sump.

The relief valve (**3**) is located after the oil cooler and maintains oil pressure at a maximum of 5.5 bar (79.8 psi).

Cooled oil is then fed to the oil filter (**4**) via an integral pipe in the lower crankcase/engine bed.

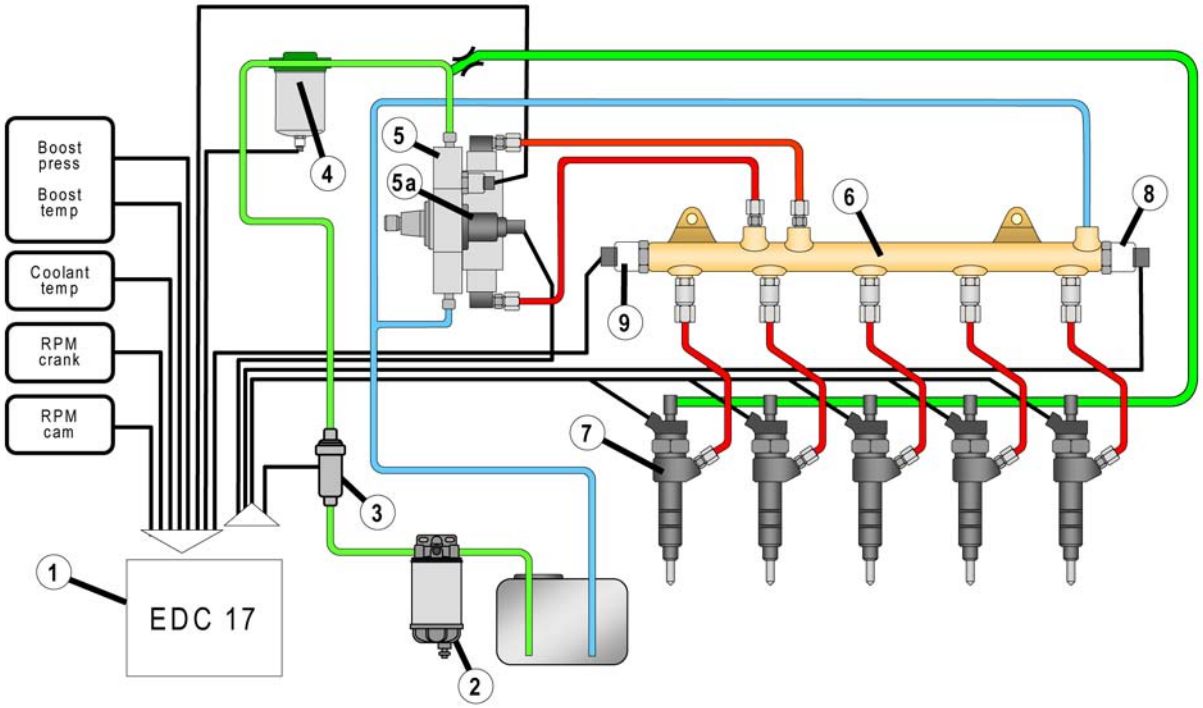
Oil from the filter is distributed to the connecting rod bearings via ducts in the main gallery.

Oil is also distributed to the pistons via piston cooling nozzles (**6**) below the side gallery.

Pressure is regulated by a valve (**5**) that opens at 1.35 bar (19.6 psi). Oil is led up to the cylinder head, the hydraulic valve lifter roller bearings and the camshaft via a vertical duct at the front of the block.
An oil pressure sensor (**7**) is located in the cylinder block - engine bed for monitoring.

A combined oil level/temperature sensor (**8**) is installed in the bottom of the oil sump.

Group 23: Fuel System



P0012207

⚠ CAUTION!

Never disconnect a fuel line or component after the fuel pump to bleed. The fuel is under very high pressure and can penetrate the skin.

Do not try to measure any pressure without checking the workshop manual!

The electrical feed pump (**3**) is controlled by the EDC 17 (**1**) . Fuel is sucked from the fuel tank through the pre-filter to the feed pump, the feed pump increases the fuel feed pressure to approx 4 bars (p-norm 3,8 – 4,2 bar).

The fuel is then pumped through the fine filter (**4**) before it enter the High Pressure pump (**5**).

A magnetic proportional valve is mounted in the Hp pump to regulate the expected output pressure to the fuel rail (**6**).

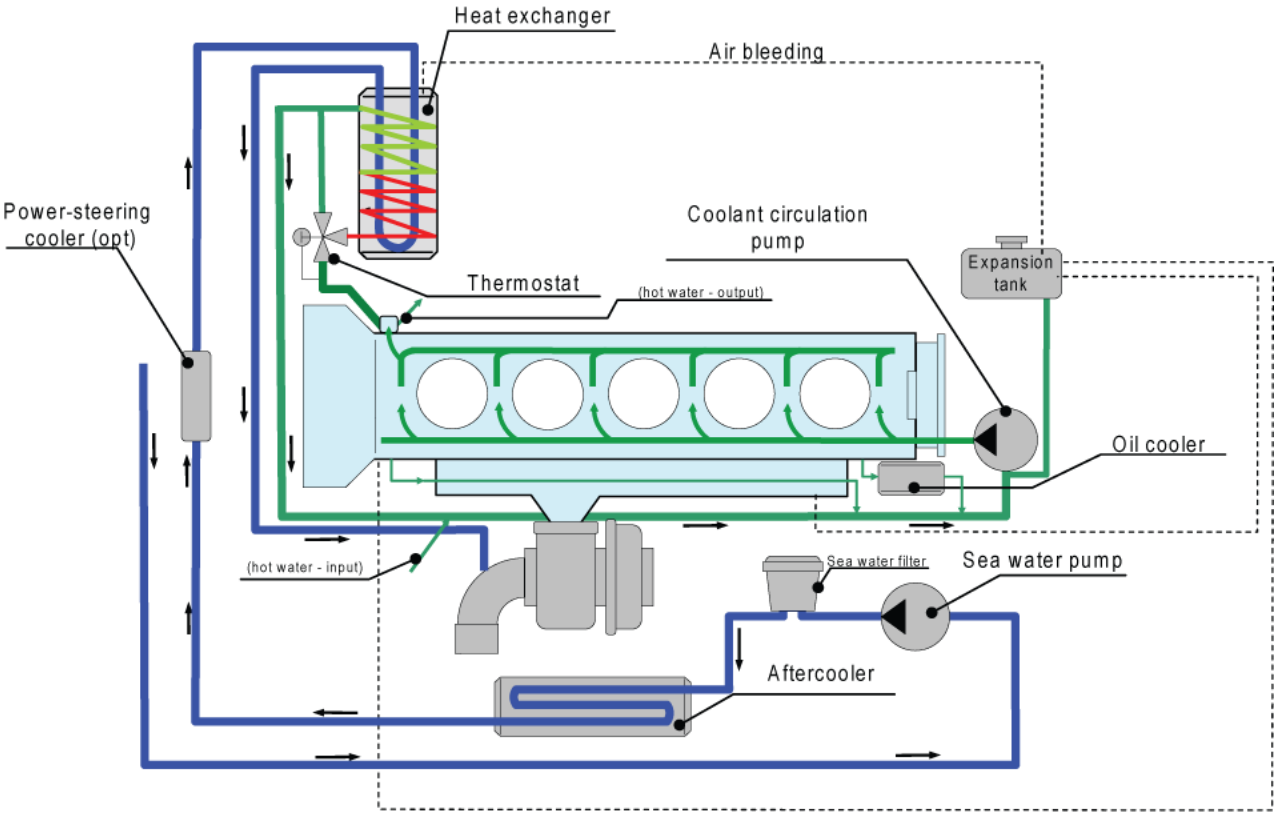
The fuel rail is equipped with one fuel pressure sensor (**9**) and one Pressure Control Valve (**8**)*.

The new Piezo injectors (**7**) are supplied from the fuel rail. One big difference compared to previous systems is that the injectors have fuel pressure on the leak-off side.

*The PCV valve replaces the old security relief valve and it's main function is to stabilise the hp pressure in the fuel rail.
It controls and manages the pressure together with the M-prop valve especially at engine deceleration.
The PCV valve is fully open when it is not energised (No Current).

This type of system is called Coupled Pressure Control (CPC).

Group 26: Cooling System



P0011256

The engine is fresh water cooled and Volvo type 90 coolant must be used. The turbocharger is not water cooled but has instead a protective cover to prevent turbocharger heat from presenting a hazard.
The oil is cooled by an oil cooler located at the lower, front right on the oil pan.

Oil temperature is maintained at the correct level by means of an oil thermostat. Refer to *Group 22: Lubrication System page 19*.
The engine has a power steering (accessory) cooler at the rear.

Seawater circuit

Seawater is drawn in by the seawater pump on the right side of the engine and lead through a seawater filter before reaching the charge air cooler. After the charge air cooler it passes the power steering (accessory) cooler at the rear of the engine. The water is then led to the heat exchanger on the left side of the engine.
Finally, seawater passes through the exhaust elbow where it cools exhaust gases and is discharged.

Freshwater circuit

Coolant enters the engine at the front and cools the engine block via transverse channels. The coolant is discharged at the left rear. If coolant is still cold it passes the thermostat directly back to the circulating pump and enters the engine block again. The oil cooler is located parallel with the main return line and does not have a separate thermostat on the water side. Refer to oil cooling in *Group 22: Lubrication System page 19*.

The exhaust manifold has its own connection at the rear right where coolant is led through the exhaust manifold and on to the main return line.
If the coolant is too hot the thermostat opens and coolant is led through the heat exchanger where it is cooled. It is then drawn into the circulating pump and returns to the engine block. There is an expansion tank at the front of the engine where expanded coolant and air are collected.
The engine has three venting points: 1. Heat exchanger, 2. Cylinder Head (rear) and 3. Exhaust Manifold.

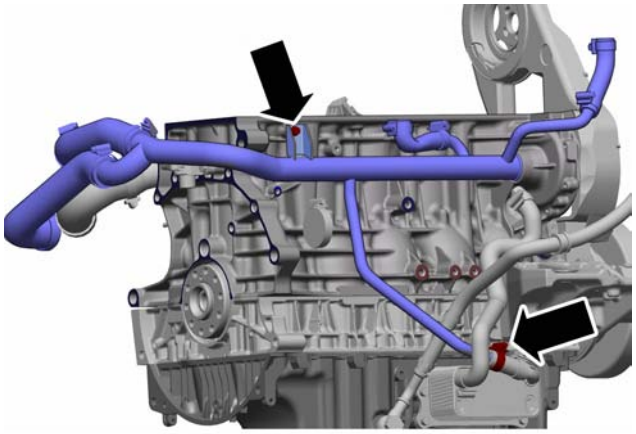
21-0 Engine Complete, General

Engine, Overhaul

Tools:
885224 Fixture
885820 Puller
9995746 Puller

Removal

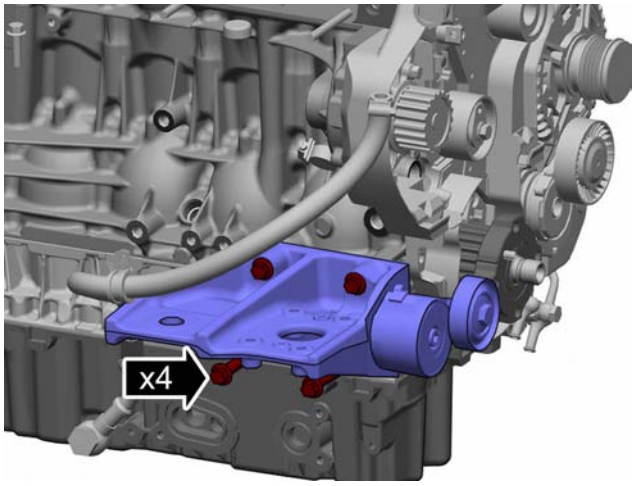
Remove the cylinder head according to *Cylinder Head, Change page 42*.
Remove the rear crankshaft seal according to: *Crankshaft Seal, Change (rear) page 76*.



P0014642

1 Remove the coolant pipe.

2 Remove the oil cooler according to *Oil Cooler, Replace page 87*.



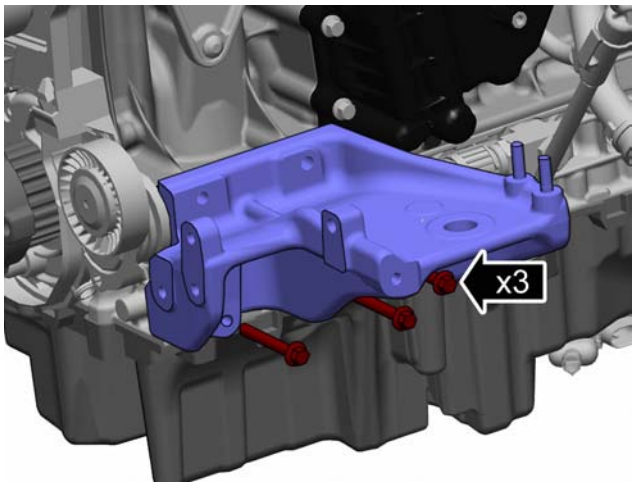
P0014643

3 Remove the engine mount on the engine hot side.
Tightening torque: M10, 60 Nm (44.3 lbf.ft.)

4 Remove the alternator according to *32-1, Alternator, Change*.

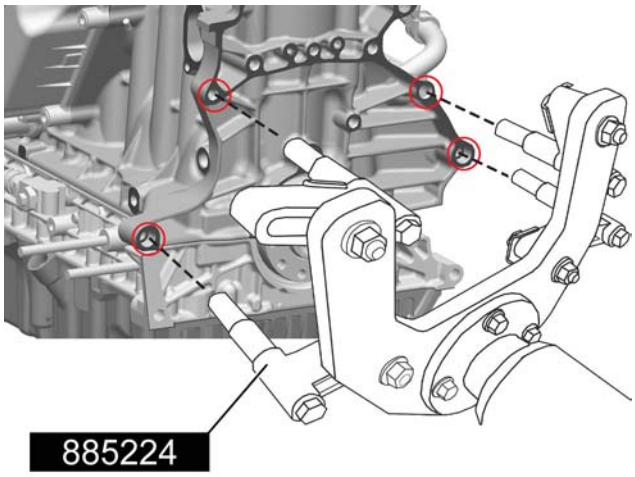
5 Remove the wire harness:

- Flywheel sensor
- B+ cable, starter motor-alternator
- Coolant temperature sensor
- Ground
- Oil level sensor
- Oil pressure sensor
- Attachment, oil trap



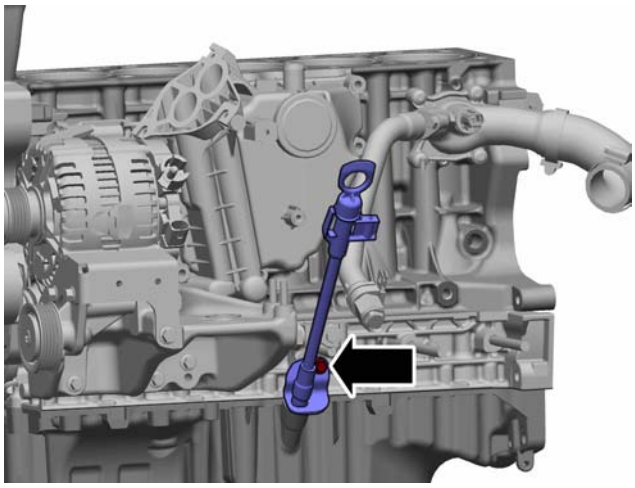
P0014644

6 Remove the engine mount on the engine cold side.
Tightening torque: M8, 30 Nm (22.1 lbf.ft.)



P0014645

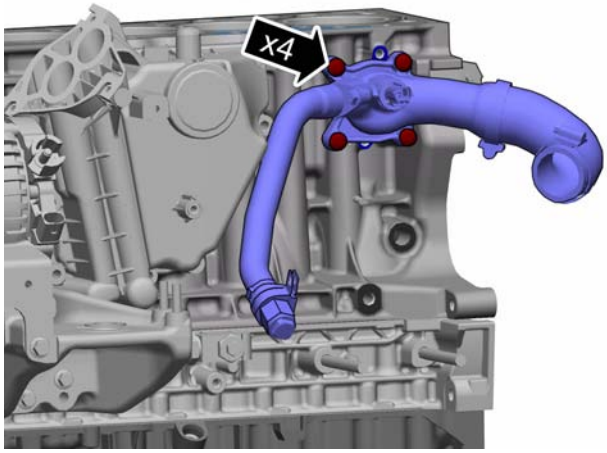
7 Fit the attachment. Use 885224 Fixture.
Place the engine in a stand.



P0014646

8 Remove the oil dipstick.

9 Remove the oil pressure sensor according to *Oil pressure sensor, replace page 146*.



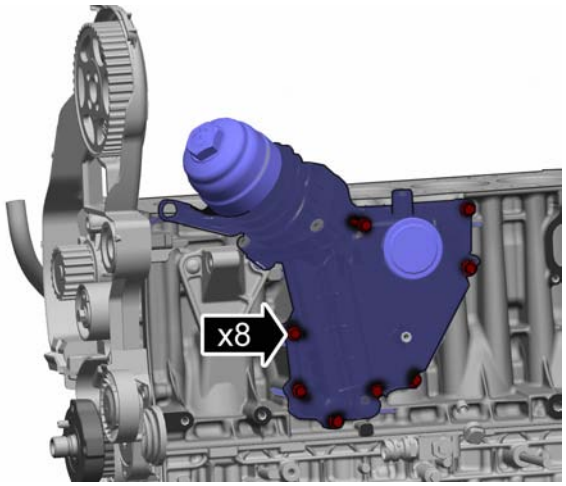
P0014647

10 Remove the distributing pipe.

Early model
When installing the early model with O-ring sealant (part # 1161059) must be applied to the flat surface between the O-ring and the duct.

Late model
When installing the late model with flat gasket, sealant must not be applied.

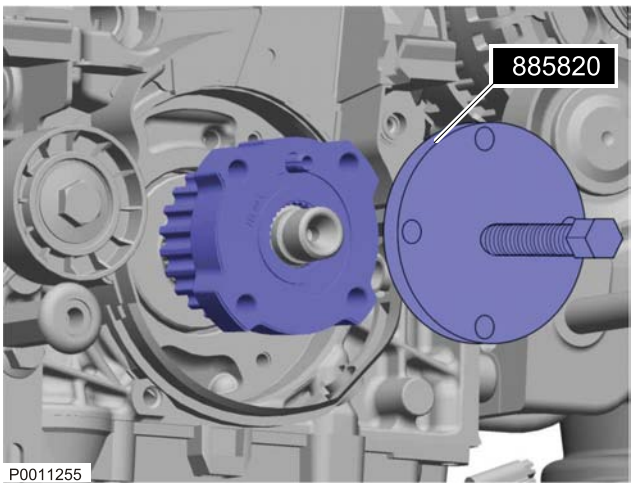
Tightening torque: M7, 17 Nm (12.5 lbf.ft.)



P0014648

11 **NOTICE!** Be prepared to gather up fluids.

Remove the crank case ventilation oil trap.
Tightening torque: M6, 10 Nm (7.4 lbf.ft.)

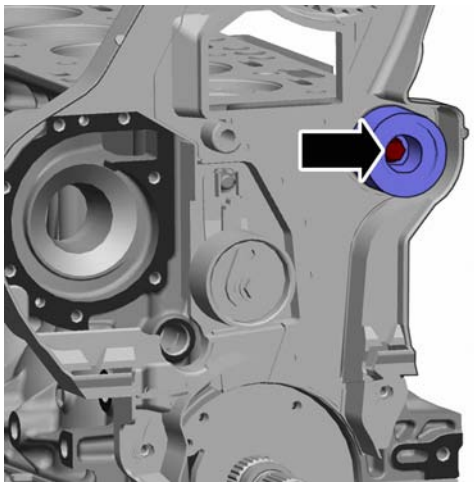


P0011255

12 Remove the timing gear. Use 885820 Puller.

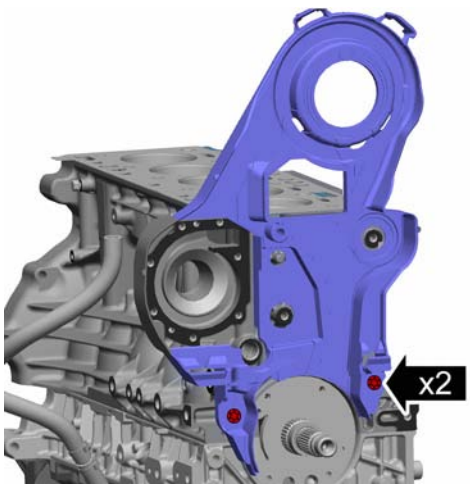
13 Remove the oil pump according to *Lubrication Oil Pump, Change page 85*.

14 Remove the seawater pump according to *Seawater Pump, Change page 133*.



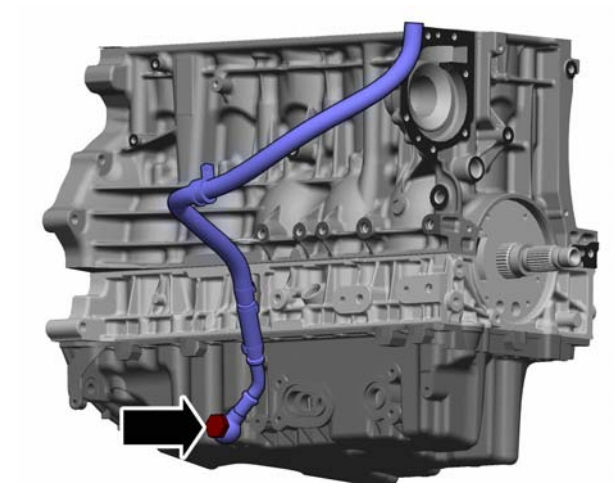
P0014649

15 Remove the camshaft belt idler wheel.
Tightening torque: M8, 24 Nm (17.7 lbf.ft.)



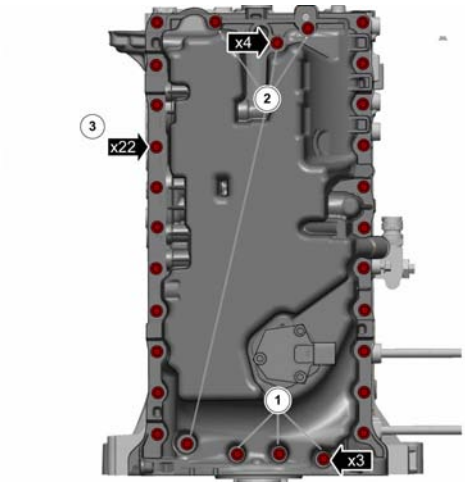
P0014650

16 Remove the belt guard.
Tightening torque: M6, 10 Nm (7.4 lbf.ft.)



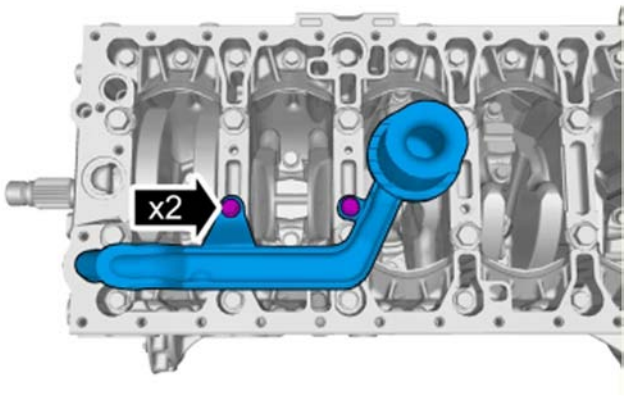
P0014651

17 Remove the crank case ventilation return hose.
Tightening torque: 38 Nm (28.0 lbf.ft.)



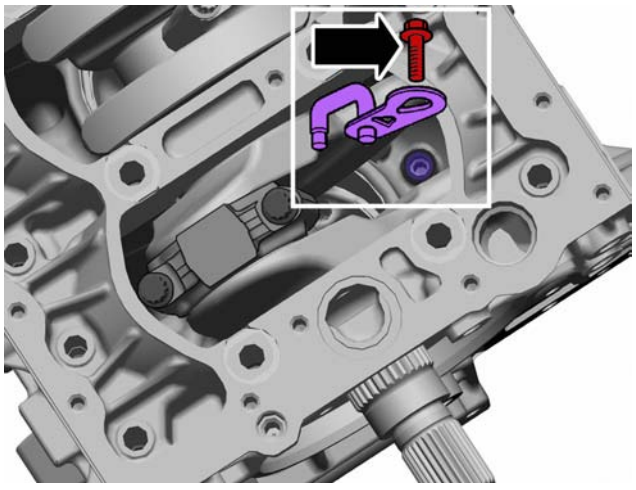
P0014652

18 Remove the oil sump.



P0014653

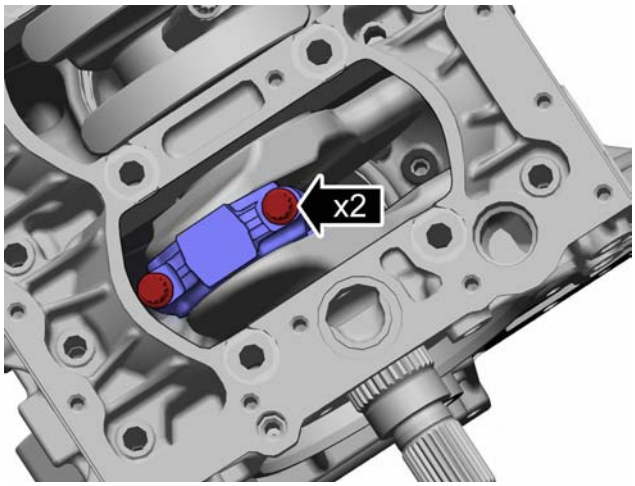
19 Remove the suction strainer.



P0014654

20 Rotate cylinder # 1 piston so that the piston cooling nozzle is accessible.
Remove cylinder # 1 piston cooling nozzle.

21 Repeat the above procedure for cylinders 2-5.



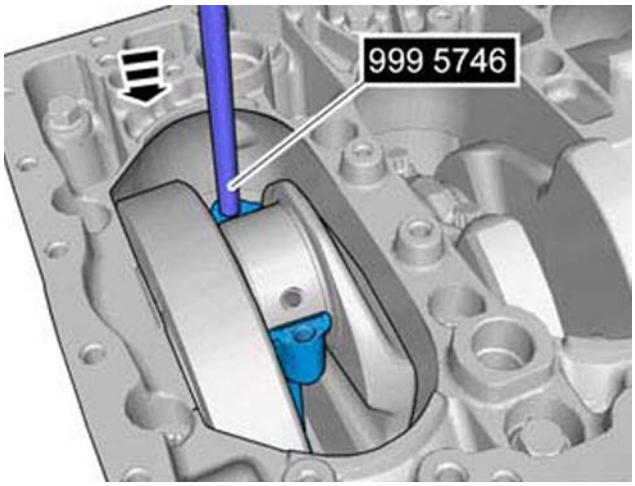
P0014655

22 **NOTICE!** Put the bearing caps with their respective connecting rods after removal.

IMPORTANT!
Take care with contact surfaces.

IMPORTANT!
Note component locations before removal.

Rotate cylinder # 1 piston so that the bearing cap is accessible.
Remove the bearing cap from the cylinder # 1 connecting rod.



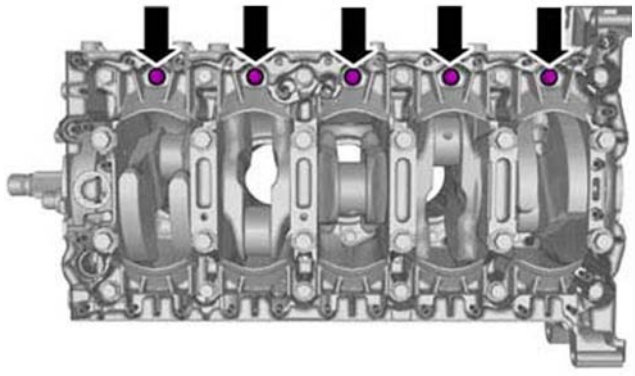
P0014656

23 **IMPORTANT!**
Take care with contact surfaces.

Remove the piston together with the connecting rod. Use 9995746 Puller.

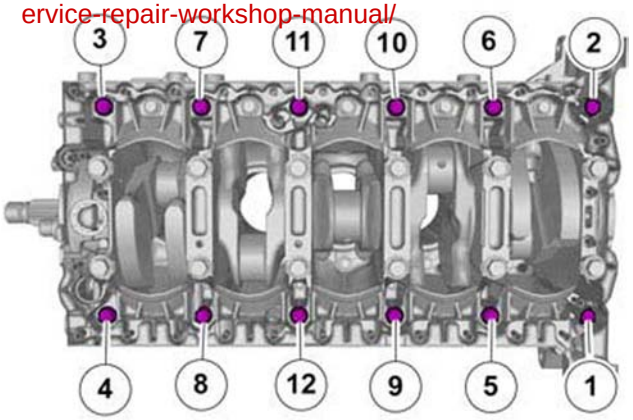
24 Repeat the above procedure for cylinders 2-5.

25 Remove the bolts.



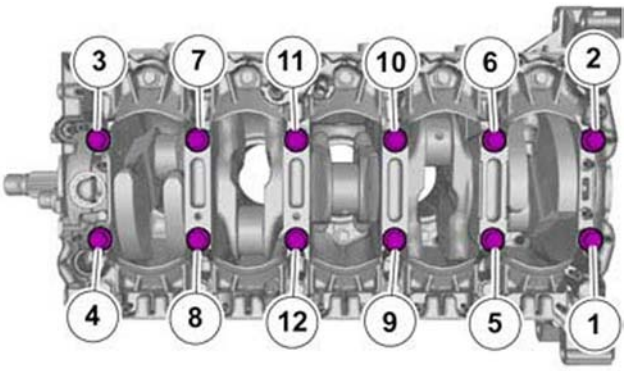
P0014657

26 Remove the bolts.



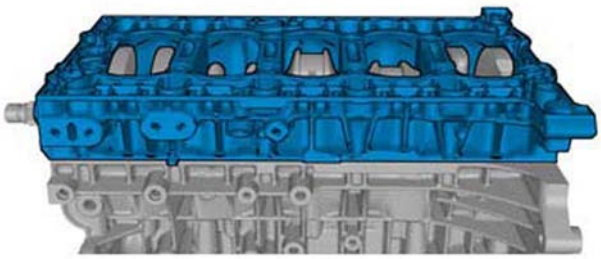
P0014658

27 Remove the bolts.



P0014659

28 Remove the intermediate section.



P0014660