

# **INSTRUCTION BOOK**

**MB21A/MB32A**

**VOLVO  
PENTA**



## Foreword

Before you start using your new Volvo Penta marine engine, we recommend you to read this instruction book carefully. It contains all the instructions you need to run and service your engine in the best possible way. The dependability and the lifetime of your engine and equipment depend to a great extent on how these units are given servicing and maintenance in the future. Always follow closely the instructions included in this book. Volvo Penta has built up a world-wide service organization including service workshops with specially trained personnel at your service. Always contact your nearest Volvo Penta representative should you need advice and also when you require service or spare parts. We are fully convinced that the demands concerning good running economy and outstanding performance you have every right to make on a high-quality product such as this will be more than satisfied and that your Volvo Penta marine engine will serve you faithfully during many pleasant boat trips.

## Guarantee

Every marine engine is accompanied by a warranty certificate which entitles the first purchaser to a guarantee concerning both material and labour. The extent of the guarantee is shown in the warranty certificate and we recommend you to read this carefully.

If our guarantee is to be valid, we make one absolute condition and that is that the checking procedures in the maintenance scheme are carried out and that your engine and its equipment is always looked after in accordance with the instructions in this book. When in doubt, please always contact a Volvo Penta authorized dealer.

In all correspondence with your dealer and also when ordering spare parts, always state the type designation and serial number of the engine and reverse gear, (see 3, 42 Fig. 1, and 3, 42 Fig. 3).

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## PRESENTATION

### MD21A Four cylinder - 75 hp

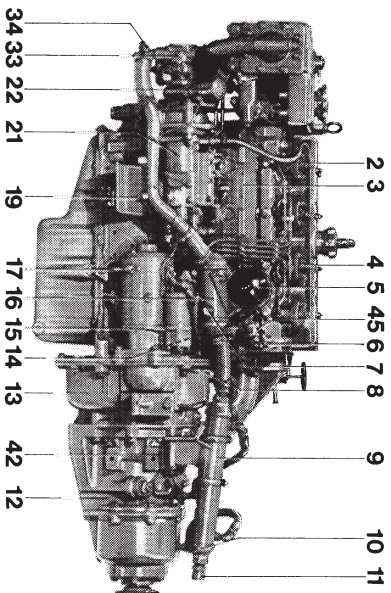


Fig. 1. Port side, MD 21 A with Borg-Warner reverse gear

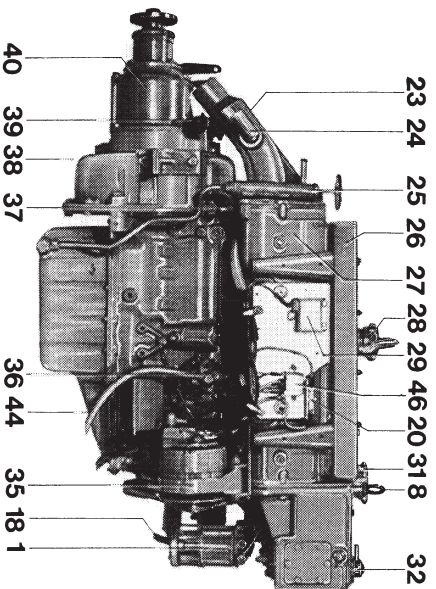


Fig. 2. Starboard, MD 21 A with RB reverse gear

1. Fuel filter with water separator
2. Glow plug
3. Engine type and number
4. Injector
5. Oil filter
6. Sending unit, thermometer
7. Sending unit, oil pressure
8. Lifting eyelet
9. Oil cooler, reverse gear
10. Draining, sea-water
11. Inlet, sea-water
12. Reverse gear, Borg-Warner
13. Flywheel housing
14. Drain cock fresh-water (placed on block)
15. Starter motor
16. Oil cooler, engine
17. Oil dip stick
18. Return pipe to fuel tank
19. Draining, sea-water
20. Fuse box
21. Injection pump
22. Sender, revolution counter
23. Water-cooled exhaust elbow
24. Separate water outlet
25. Oil scavenging pump
26. Air silencer
27. Water-cooled exhaust manifold and inlet pipe
28. Oil-filler cap
29. Charging regulator
30. Hose connection for expansion tank
31. Coolant filler cap
32. Pressure valve
33. Sea-water pump
34. Drain plug, sea-water
35. Alternator (alt. equipment)
36. Feed pump with hand primer
37. Drain cock, sea-water
38. Drain plug, sea-water
39. Inlet sea-water
40. Reverse gear, type RB
41. Alternator
42. Type designation, reverse gear
43. Zink plug (inside cover)
44. Flexible fuel line to feed pump
45. Glow plug circuit resistor
46. Glow plug circuit relay

## PRESENTATION

### MD32A Six cylinder - 106 hp

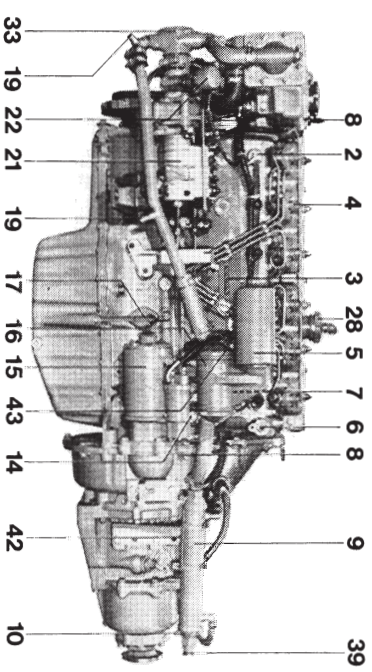


Fig. 3. Port side, MD 32 A with Borg-Warner reverse gear  
Pos. No., see page 2

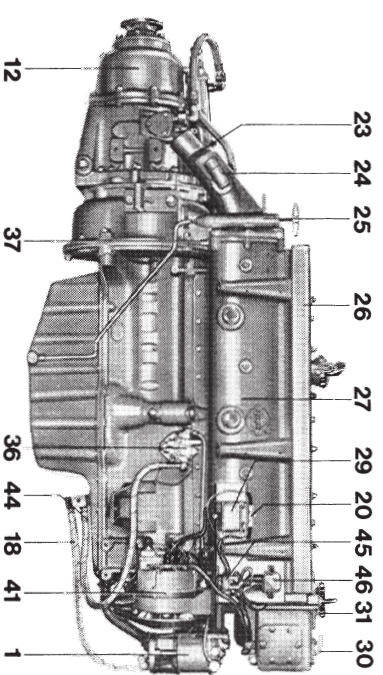


Fig. 4. Starboard side, MD 32 A with Borg-Warner reverse gear  
Pos. No., see page 2

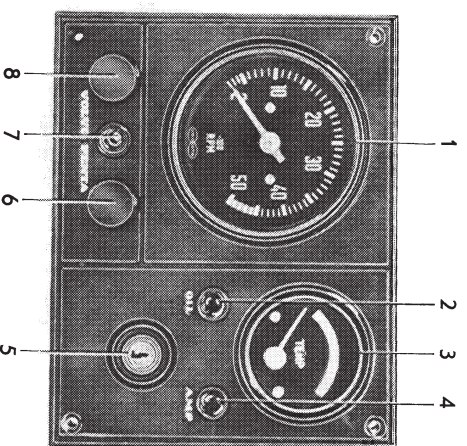


Fig. 6. Instrument panel

1. **Tachometer, graduated 0—5000 r.p.m.**
2. **Warning lamp for oil pressure**  
Red light = stop the engine, insufficient oil pressure
3. **Temperature gauge for cooling water**  
Green field = normal cooling water temperature
4. **Warning lamp for battery charging**  
Red light = low charging
5. **Key switch (see Fig. 7)**
6. **Switch for instrument lighting**
7. **Control lamp, lights when the glow plugs are engage**
8. **Switch for extra equipment**

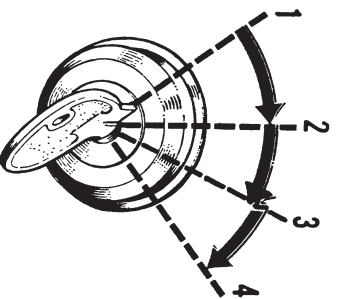


Fig. 7. Key switch

1. Neutral position
2. Engaging position
3. Connection of glow plug
4. Starting position (connection of starter motor)

**Controls**

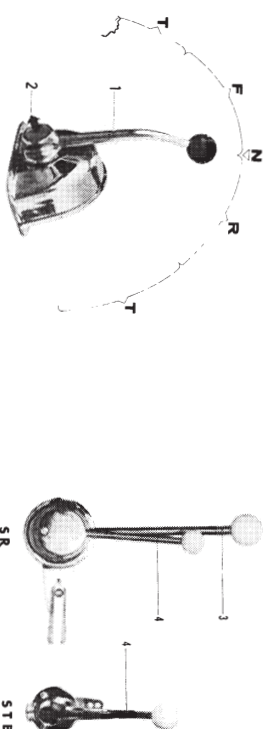


Fig. 8. Controls

MT, combined controls for Borg-Warner reverse gear

SR, controls for RB mechanical reverse gear.  
STB, speed control

1. Control lever
2. Disengaging device (pulled out axially)
3. Gear shift lever
4. Engine speed control

F = Control lever in "Forward" position  
R = Control lever in "Reverse" position  
T = Engine speed  
N = Neutral position

**GENERAL INSTRUCTIONS**

**Fuel and lubricating oil recommendations**

NOTE. Our guarantee only applies on condition that the fuel and lubricating oil recommendations given below are followed.

**Fuel quality**

As fuel for operating Diesel engines, the special Diesel fuel oils supplied by well-known oil companies for **rapid Diesel engines should be used "Auto-Diesel"**. Do not use fuel oils of lower quality since these can easily cause damage to the fuel injection pump and injectors.

**Lubricating oil quality**

The modern, rapid marine Diesel engines require high-class lubricating Diesel oils. It is therefore absolutely essential that the correct lubricating oil quality is used. For the engines, only **lubricating Diesel oil of quality "Service DS"** according to the API-system should be used (see table, page 17). This oil contains additives which ensure maximum engine life under various conditions of operation. For reverse gear type **Borg-Warner** transmission oil of type "Automatic Transmission Fluid type A" should be used. For the **RB-reverse gear** use oil of the same quality and viscosity as used for the engine.

## RUNNING THE UNIT

## RUNNING THE UNIT

### Running in

When your marine engine is new, we recommend you to run it with a certain amount of care during the first 20 hours of operation. Never subject the engine to full loading for more than during short periods since it is during this time that the moving parts in the engine wear in together.

When the engine is new or newly reconditioned, it must not be raced immediately after starting. During the first 2 minutes of running the engine warm, the engine speed must not exceed 1000 r.p.m. This also applies in connection with oil changing and oil filter replacement.

### Oil changes

During the running-in period the engine lubricating oil should be changed more frequently than at a later stage. Change the engine oil and the oil filter after 20 hours of operation. See also under "Servicing" points 3 and 5.

### Recommended engine speed

**For our guarantee to apply, it is a condition that the propeller is selected so that the maximum permissible speed is reached with a normally loaded boat.**

**NOTE.** When the boat has been in the water for some considerable time, maximum engine speed can decrease depending on marine growth on the bottom of the boat. Use therefore anti-fouling bottom paint (this must not include copper or mercury). Check and clean the bottom of the boat at regular intervals.

### Pressure boats and other installations in planing boats

Maximum permissible operating engine speed during a short period of time is 4500 r.p.m. for the 4-cylinder engine and 4000 r.p.m. for the 6-cylinder unit. During longer periods of time, so-called "cruising speed", the engine speed should be reduced by at least 200 r.p.m. under maximum operating speed attained.

### Work boats

Maximum permissible operating engine speed for heavy-duty operation in work boats is 3000 r.p.m. During longer periods of time, so-called, "cruising speed", the speed should be reduced by at least 200 r.p.m. under maximum operating speed attained.

### Precautions in case of frost

When there is risk of frost, the sea-water and fresh-water circuits of the cooling system should be drained in order to prevent cracks in the cooling jackets and pipes. It is advisable to add ethylene glycol to the fresh-water cooling system of the engine after which only the sea-water system requires to be drained.\* Only ethylene glycol with inhibitors of a well-known make must be used. Drain cocks on four-cyl. see 10, 14, 19 Fig. 1 and 34, 37, 38 Fig. 2 and Fig. 22. Drain cocks on six-cyl. see 10, 14, 19, Fig. 3 and 37 Fig. 4 and Fig. 23.

Freezing points of ethylene glycol and water mixtures:

Volume % of ethylene glycol	Freezing point
35	-20° C (-4° F)
45	-30° C (-22° F)
50	-35° C (-31° F)

\* Warning! Watch out for sea-water running back into the boat from the intake.

The capacity of the fresh-water system is about 9.5 litres on the four-cyl. and 11.5 litres on six-cyl.

## Running

### Procedure before starting

1. Check the coolant level in the fresh-water system. (See "Servicing", point 10).
2. Check the lubricating oil level in the engine and reverse gear. (See "Servicing", points 1 and 2).
3. Check the fuel level in the tanks and open the cock for the fuel supply to the engine. At the same time, check fuel cocks, pipes and connections for leakage.
4. Check that all drain cocks on the engine are closed. Open the sea-cock for the cooling water intake if one is fitted.
5. Make sure that a fire extinguisher, life vests, anchor, mooring lines and other safety equipment are on board.
6. Switch on the master switch for the electrical system if such is fitted. Pump any water from the boat.

### Starting

1. Move the control lever to the neutral position, and on the MT controls disengage the shift mechanism, see instruction at Fig. 8. Then push the speed control to **full throttle**, and this provides fully satisfactory injection, even during cold weather.
2. Make sure that the stop control is pushed in bottom. The stop lever should rest against its stop on the injection pump, otherwise the output will be reduced.
3. Turn the starting key to the running position (position 2 acc. to Fig. 7). Check that the charging control lamp and oil pressure warning lamp light up.
4. Turn the starting key to position 3, and check that the control lamp,<sup>7</sup> Fig. 6, lights up. Keep the key in this position 40—60 seconds so that the glow plugs are pre-heated (the time varies with the engine temperature).

## RUNNING THE UNIT

## TECHNICAL DESCRIPTION

5. Push in the starting key and turn it to position 4 (see Fig. 7), at which the starter motor is engaged.
6. Release the starting key as soon as the engine has started. The starting key automatically returns to the running position. Move back the speed control immediately when the engine has started to prevent the engines from racing at high speed. Run the engine warm at high idling speed (about 1000 r.p.m.). Do not let the starter motor run for longer periods than 10–15 seconds at a time. If the engine does not start or stops after starting, apply further pre-heating before making a new starting attempt.
7. Check that the control lamps for charging and oil pressure do not light when the engine has started. If the red light comes on — stop the engine immediately and examine the reason.
8. Check the cooling water circulation after starting by observing that the water runs overboard.

### Stopping

1. Move the control lever to the neutral position. Let the engine run at idling speed for a few minutes before stopping it.
2. Pull out the stop control.
3. The starting key to the neutral position.

**NOTE: Never turn off the master switch while the engine is running. This will burn out the charging regulator on engine equipped with alternator.**

4. Switch off the master switch and close the fuel cocks if the boat is to be idle for some considerable time.
5. If there is a risk of frost, drain the cooling system or add anti-freeze (see "Precautions in case of frost", page 7).  
If the unit is to remain idle for more than two weeks, a special procedure must be followed concerning the engine (see under the heading "Procedure if unit is to remain idle", page 27).  
The engine electrical system should also be sprayed regularly with a rust-proofing compound, which provides protection from corrosion and moisture.

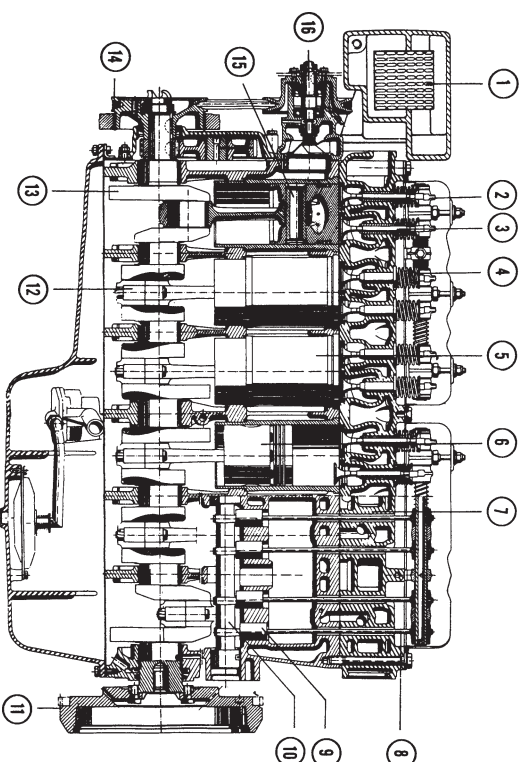


Fig. 9. Cross-section of the 6-cyl. engine

- |                     |                      |
|---------------------|----------------------|
| 1. Heat exchanger   | 9. Valve tappet      |
| 2. Rocker arm       | 10. Camshaft         |
| 3. Valve            | 11. Flywheel         |
| 4. Valve spring     | 12. Connecting rod   |
| 5. Cylinder liner   | 13. Crankshaft       |
| 6. Piston           | 14. Pulley           |
| 7. Cylinder head    | 15. Piston pin       |
| 8. Fresh-water pump | 16. Fresh-water pump |

## TECHNICAL DESCRIPTION

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### Engine unit

The cylinder block is made of cast iron and is integral with the upper part of the crankcase. It is fitted with replaceable, wet-type cylinder liners.

The cylinder head is of light alloy and has replaceable valve seats and guides. Also fitted in the cylinder head are valves, a turbulence chamber with injectors and glow plug.

The crankshaft is made of drop-forged steel and is both statically and dynamically balanced. The crankshaft on the 4-cylinder engine is journalled in five main bearings and on the 6-cylinder unit in seven main bearings. The centre bearing serves as a pilot bearing.

The camshaft and injection pump are gear-driven from the crankshaft. The crankshaft drive and idler gear are made of steel while the pump and camshaft gears are made of cast iron. The camshaft is made of special alloy cast iron.

The connecting rods are of drop-forged steel.

The pistons are made of light alloy and have three compression rings and one oil scraper ring.

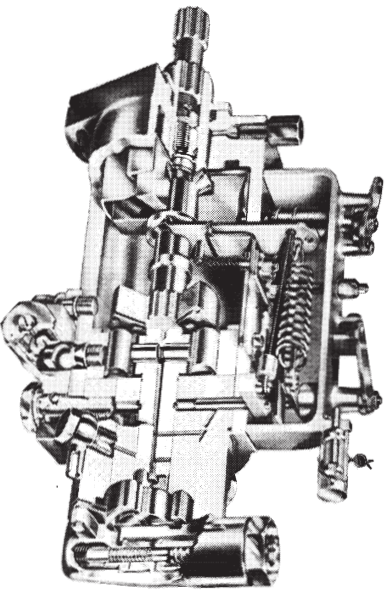


Fig. 10. Cross-section of the fuel injection pump

### Lubricating system

The engine is fitted with a sea-water cooled oil cooler on which an easily replaceable oil filter is fitted. The oil filter is of the full-flow type, which means that all the oil passes through the oil cooler and filter before it continues to the lubricating points in the engine. A built-in relief valve in the oil pump prevents the pressure from reaching excessively high values.

### Fuel system

The fuel system consists of a feed pump with pre-filter, fine filter with water separator, fuel injection pump and injectors as well as fuel lines.

The fuel injection pump, Fig. 10, which is flange mounted, consists principally of a distributor rotor with two plungers working against each other, a distributor housing with transfer pump and a governor. The injection pump is driven by a shaft provided with splines. It is made as a closed fuel-tight unit and does not have any special lubricating system

### Cooling system

The cooling system consists of two separate systems, a fresh-water and sea-water system.

#### Fresh-water system

Coolant circulation is taken care of by a pump mounted on the front of the engine. The pump draws coolant from the lower part of the heat exchanger and forces it into the cylinder block. In the cylinder block the coolant first cools the cylinder liners and then passes to the cylinder head. The coolant then flows through a thermostat to the upper part of the heat exchanger. In the heat exchanger the coolant passes down through a tubular system, where it is cooled down by the sea-water.

As long as the coolant is cold the thermostat keeps the passage to the heat exchanger closed.

The coolant passes instead through a by-pass line directly back to the suction side of the pump. This means that the engine quickly reaches operating temperature and at the same time the engine temperature is prevented from becoming too low during cold weather.

The fresh-water system is provided with an overpressure valve by means of which the boiling point of the water is raised and evaporation is reduced.

#### Sea-water system

The sea-water pump draws cooling water through the engine oil cooler to the sea-water pump. The sea-water pump then forces the water under pressure through the heat exchanger and the exhaust manifold cooling jacket to the exhaust elbow. The outgoing water passes through the exhaust line for cooling at the same time as the exhaust noise is dampened. A part of the cooling water is led through separate outlets.



## TECHNICAL DESCRIPTION

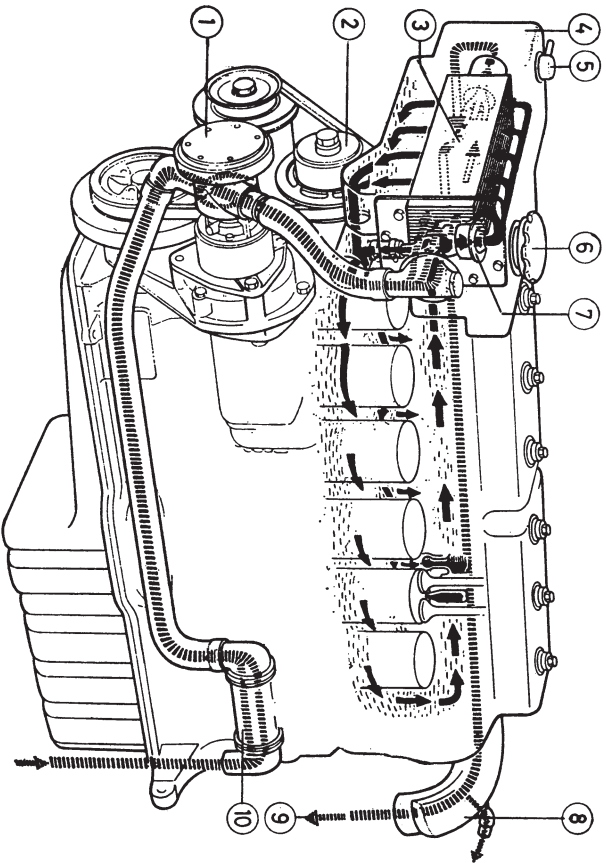


Fig. 11. Cooling system for 6-cyl. engine

- Broken line = sea-water  
 ————— Unbroken line = fresh-water
1. Sea-water pump
  2. Circulation pump, fresh-water
  3. Sea-water inlet to exhaust manifold cooling jacket
  4. Heat exchanger
  5. Overpressure valve
  6. Filler cap
  7. Thermostat
  8. Water-cooled exhaust bend
  9. Outlet, cooling water
  10. Oil cooler

## Reverse and reduction gear

### Volvo Penta RB

Volvo Penta reverse and reduction gear type RB has a built-in reduction gear with ratio 1.91:1. "Forward" or "Reverse" is engaged through self-adjusting cones which are kept in engaged position partly by means of the propeller thrust. In the reverse gear housing there is a cooling jacket for sea-water cooling.

## TECHNICAL DESCRIPTION

### Reverse gear type Borg-Warner

The reverse gear type Borg-Warner has ratio 1.91:1, alternatively 2.1:1 and 2.91:1. It is hydraulically operated and fitted with a separate oil cooler. For running "Forward", the reverse gear is fitted with a multi-disc clutch, the discs of which are held in engaged position by means of oil under pressure. Reversal of the direction of rotation is done through planetary gears which are also engaged hydraulically. The disc assembly requires no adjusting to compensate for any wear.

### Electrical system

The voltage of the electrical system is as standard 12 V and is specially designed for marine operation.

For the 4-cyl. engine the charging current is provided by a current and voltage controlled D.C. generator, while the 6-cyl. engine is provided with an alternator. The alternator has a built-in rectifier which converts alternating current to direct current. The voltage control is taken care of by a transistorized regulator. The D.C. generator or alternator is driven by a V-belt from the crankshaft. The starter motor is a four-pole series motor. Engagement is done by means of a sliding pinion which is controlled by a solenoid fitted on the starter motor which also cuts in the starting current.

The engine is provided with glow plugs, the purpose of which is to warm up the combustion air in the swirl chambers, thereby facilitating starting when the engine is cold. The glow plugs are single-pole and connected in parallel.

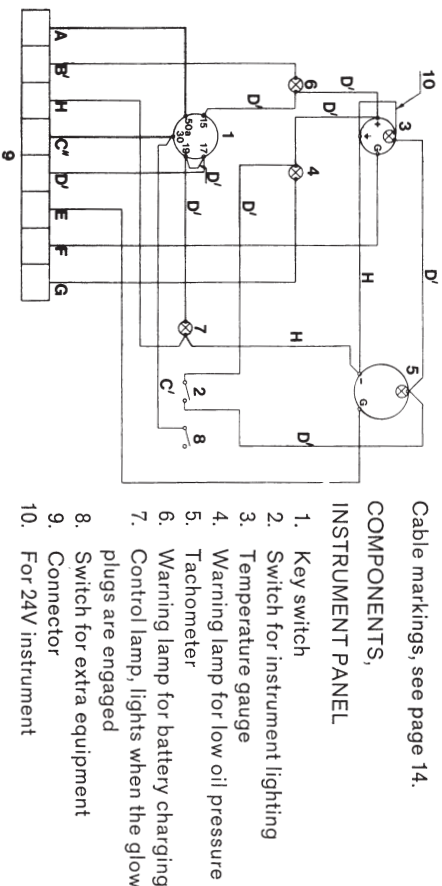


Fig. 12 Wiring diagram for instrument panel, 4-cyl. and 6-cyl. engine

- Cable markings, see page 14.
- COMPONENTS,  
 INSTRUMENT PANEL
1. Key switch
  2. Switch for instrument lighting
  3. Temperature gauge
  4. Warning lamp for low oil pressure
  5. Tachometer
  6. Warning lamp for battery charging
  7. Control lamp, lights when the glow plugs are engaged
  8. Switch for extra equipment
  9. Connector
  10. For 24V instrument

# TECHNICAL DESCRIPTION

# PERIODICAL SERVICING

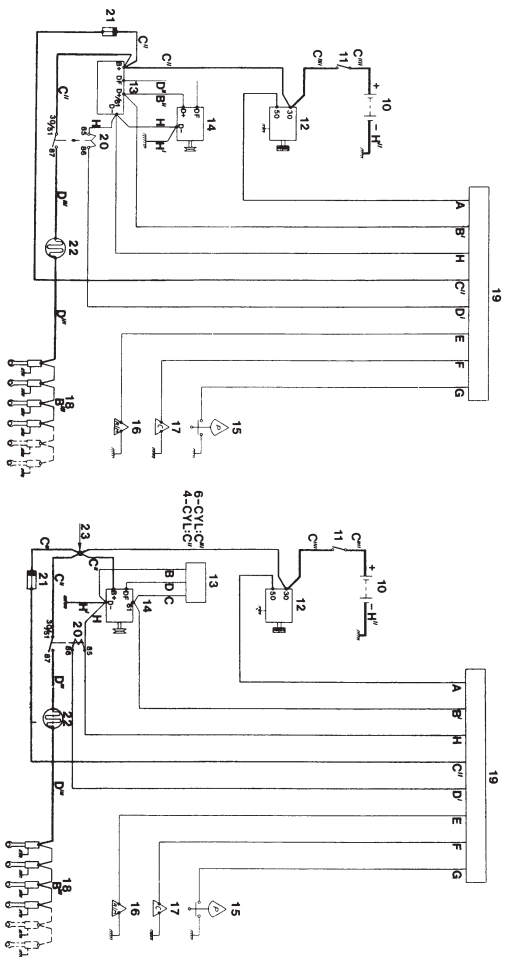


Fig. 13. Wiring diagram, engine

### COMPONENTS

- 10. Battery
- 11. Master switch
- 12. Starter motor
- 13. Charging regulator
- 14. Alternator or generator
- 15. Oil pressure sensor
- 16. Tachometer sender
- 17. Temperature sender
- 18. Glow plugs
- 19. Relay for glow plug current
- 20. Connector
- 21. Fuse
- 22. Control resistance
- 23. Joint

### CABLE MARKINGS

Mark	Colour	mm <sup>2</sup>	AWG
A	White	6	9
B	Black	0,6	19
B'	Black	1,5	15
B''	Black	4	11
B'''	Black	6	9
C	Red	0,6	19
C'	Red	2,5	13
C''	Red	6	9
C'''	Red	10	7
D	Green	0,6	19
D'	Green	1,5	15
D''	Green	2,5	13
D'''	Green	6	9
E	Grey	1,5	15
F	Yellow	1,5	15
G	Brown	1,5	15
H	Blue	1,5	15
H'	Blue	4	11
H''	Blue	50	0

**Warning**  
 Never break the current circuit between the alternator and the battery when the engine is running. This results in the charging regulator diodes being ruined immediately.  
 The master switch must never be switched off until the engine has stopped completely. See also under the heading "Servicing" point 17.

**Maintenance scheme**  
 In the following maintenance scheme, consecutive numbers have been assigned to the servicing procedures, and these numbers refer to detailed descriptions on the following pages. Some of the operations require professional experience and special tools, and should therefore be carried out by authorized service personnel.

See point	Operation	To be carried out:		
		Daily before starting for first time	After <sup>1)</sup> 50 hours running	After <sup>1)</sup> 100 hours running
<b>Periodical servicing</b>				
1	Check oil level in engine .....	●		
2	Check oil level in reverse gear .....	●		
3	Change oil in engine .....		●	●
4	Change oil in reverse gear .....		●	●
5	Change oil filter .....		●	
6	Check V-belt .....		●	
7	Check the water separator in the fuel system .....		●	
8	Change fine filter and clean pre-filter .....			●
9	Vent fuel system .....			3)
10	Check coolant level .....		●	
11	Check anti-corrosion devices .....		●	
12	Check electrolyte level in battery .....		● 2)	
13	Check valve clearances .....			●
<b>General servicing instructions</b>				
14	Check-tighten cylinder head bolts .....	To be carried out according to the intervals given under respective points or when necessary.		
15	Fuel system .....			
16	Cooling system .....			
17	Electrical system .....			
18	Check reverse gear .....			
19	Procedure if the unit is to remain idle .....			

1) Or, once each season if this should occur first.  
 2) Every fourteen days.  
 3) When necessary.



## PERIODICAL SERVICING

## PERIODICAL SERVICING

### 5 Changing the oil filter

**Change the oil filter after every 100 hours running** at the same time as the oil is changed. In the case of a new or reconditioned engine, the oil filter should also be changed after 20 hours running (see "Running-in").

The oil filter is changed as follows:

Screw off the old oil filter (see Fig. 17). If the filter remains firmly in position and cannot be loosened, use a special tensioning tool or pierce the outer part of the filter so that it can be used as a lever. **Remember that oil will spill out.**

Smear oil on the new filter rubber gasket and make sure that the contact surface against the oil cooler is clean. Screw on the filter by hand until it just comes into contact with the contact face on the oil cooler.

Tighten the filter a further half turn but absolutely no more. Start the engine and turn it at idling speed and check that there is no leakage at the filter.

**Always check the oil level after changing the oil filter or changing the engine oil.**

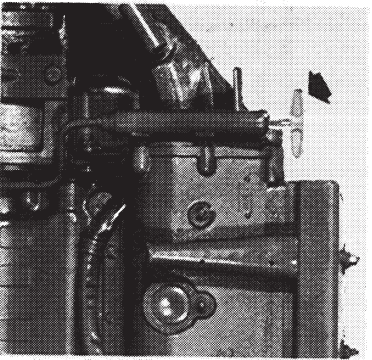


Fig. 16. Oil scavenging pump

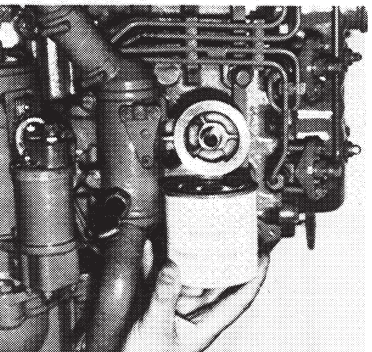


Fig. 17. Changing oil filter

### 6 Checking the V-belt

**Check the tension of the V-belt every 50 hours running.** Due to wear or grease, the belt can start slipping and result in poor generator output and poor cooling water circulation.

If the belt is insufficiently tensioned, loosen the tensioner as well as the screws at the alternator, attaching points. Pull the generator outwards and tighten the screws.

### 4-cyl. engine (fitted with D.C. generator)

The V-belt should be tensioned so hard that it is possible to depress it about 5 mm (1/4") between the generator and crankshaft pulley.

### 6-cyl. engine (fitted with alternator)

The V-belt should be tensioned so hard that it is only just possible to get the pulley to move with a finger on the generator fan blade.

### 7 Checking the water separator in the fuel system

Each day before starting check to see if water has collected in the bottom of the container. If this is the case, the water can be drained through the drain cock (7 Fig. 19). Then vent the system (see point 9).

### 8 Changing the fine filter and cleaning the pre-filter

**The fine filter should be changed after every 100 hours running,** however at least once per season.

Thoroughly clean the entire filter housing externally. Clean the inside of the container also thoroughly (see Fig. 19). Check that the seals are not damaged. Fit a new filter. Vent the fuel system (see point 9).

**The pre-filter should be cleaned after every 100 hours running,** however, at least once per season. Wash the feed pump clean externally and remove the cover (see Fig. 18) and lift up the strainer. Clean the strainer in fuel oil and then refit it. Check the seal and tighten the cover. Vent the fuel system (see point 9).

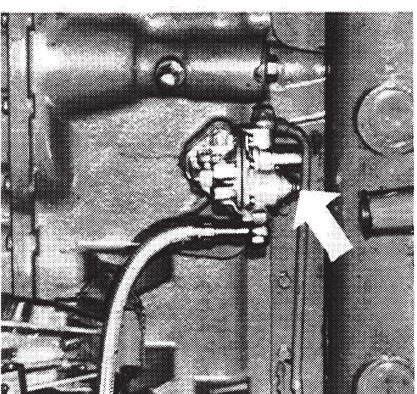


Fig. 18. Cleaning the pre-filter

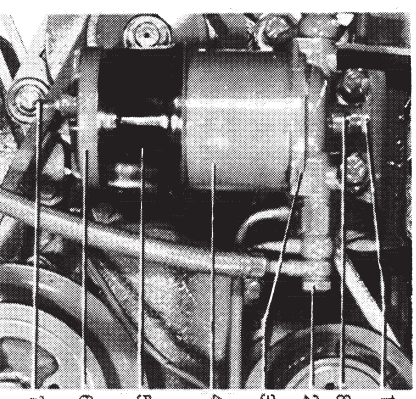


Fig. 19. Fine filter and water separator

1. Venting screw
2. Banjo screw
3. Bracket
4. Fine filter
5. Container
6. Cover
7. Drain cock
8. Center bolt

### 9 Venting the fuel system

Normally the fuel system requires venting only in connection with servicing of the fuel system or after the tank has been run empty.

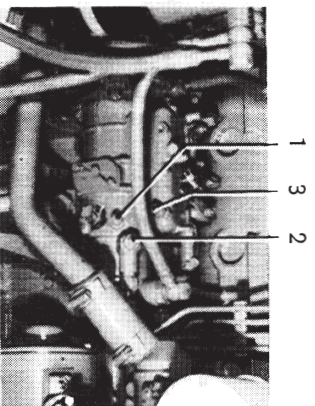


Fig. 20. 4-cyl. engine

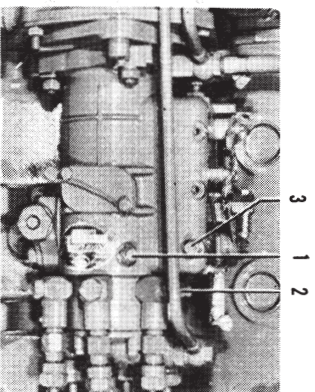


Fig. 21. 6-cyl. engine

**Venting after draining water, changing fine filter and cleaning pre-filter**

Open the venting screw (1, Fig. 19) on the fine filter. Manually pump with the feed pump until fuel without air is obtained. Tighten the venting screw.

**Venting the entire fuel system**

1. Replace the banjo screw (2, Fig. 19) with a special screw, part. No. 884308 (can be ordered from AB Volvo Penta dealer).
2. Open the venting screws 1, 2 and 3 according to Fig. 20 or 21 and 1, Fig. 19, also disconnect the delivery pipe connections on the injectors.
3. Manually pump with the feed pump until fuel without air is obtained at 1, Fig. 19, then tighten the venting screw. Continue pumping until fuel without air is obtained at 1, Fig. 20, or 21. Tighten the screw.
4. Replace the special screw 884308 with the banjo screw.
5. Move the speed control to full throttle. Turn the engine with the help of the starter motor until fuel without air is obtained at 2, Fig. 20 or 21. Tighten the screw.
6. Turn the engine round as above until fuel without air comes out of all the delivery pipes. Tighten the delivery pipe connections securely.
7. Start the engine. When fuel flows at 3, Fig. 20 or 21, then tighten the screw securely.

**10 Checking the coolant level**

The coolant level in the fresh-water system should be checked every day when starting the engine for the first time. The coolant level should reach up to the marking plate in the heat exchanger. On engines which have a separate mounted expansion tank the coolant level shall be between the max. and min. marks. Always use clean fresh-water.

When there is risk of frost, the fresh-water system should be drained or anti-freeze solution added (see "Precautions in case of frost", page 7).

- 11 Checking the anti-corrosion devices**  
In order to protect the material against corrosion from galvanic currents, there are zinc-electrodes built into the heat exchanger and oil cooler on MD32 (43, Fig. 3). The zinc-electrodes should be removed and checked after every 50 hours running. The location of the zinc plugs, see Figs 22 and 23. On MD32 there is also a zinc plug fitted on the inside of the oil cooler front end. If the zinc-electrodes are coated, the coating should be scraped off. If up to more than 50 % of the original size of the electrode is used, the electrode should be replaced.

When refitting the electrodes it is of the utmost importance that good metallic contact is obtained between the electrode and the material.

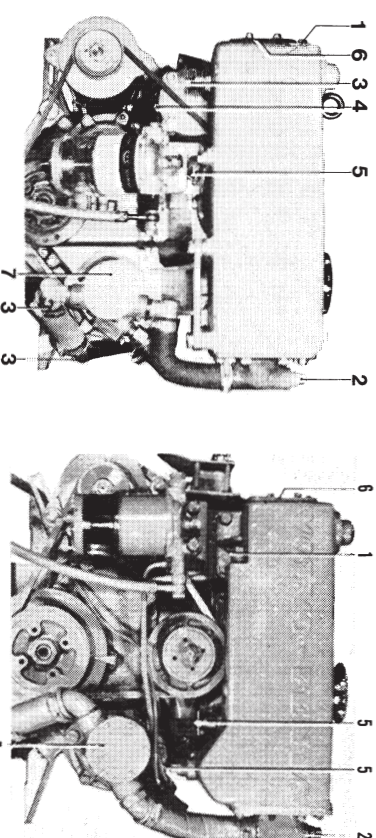


Fig. 22. 4-cyl. engine

Fig. 23. 6-cyl. engine

- |   |  |
|---|--|
| 1. Zink plug, fresh-water                 | 5. Draining, fresh-water                   |
| 2. Zink plug, sea-water                   | 6. Zink plug, sea-water (inside cover)     |
| 3. Draining, sea-water                    | 7. Draining, sea-water (remove pump-cover) |
| 4. Draining, exhaust manifold (sea-water) |  |

**12 Checking the electrolyte level in battery**

The electrolyte level in the battery should be checked at least every 14 days.

The level should be 5–10 mm (1/4"–1/2") over the cell plates. Fill up with distilled water if necessary. Never add too much since the electrolyte can then splash out and cause corrosion damage. Never check the electrolyte level by using a lighted match since the gas formed in the battery cells is extremely explosive.

**13 Checking valve clearances**

The valve clearances should be checked after every 50 hours running or at least once per season. Too small valve clearances can easily cause burned valves and valve seats. When adjusting the valves, the engine should be cold, that is, it must not have been run for at least 6 hours. The valves must not be adjusted when the engine is running. The valve clearances should be:

**Inlet valves:**

0.15 mm (0.006"), designation I according to Figs. 24 and 25.

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### Exhaust valves:

0.25 mm (0.010"), designation E according to Figs. 24 and 25.

The valve clearances are adjusted as follows:

Turn round the engine so that the respective exhaust valve marked I according to the table is fully open.

The valves indicated in the table are then adjusted. **Note No. 1 cylinder nearest the flywheel.** Checking is done by means of a feeler gauge.

	For adjusting valves	Fully open valve
4-cyl. engine	1 3 and E 4	E 1
	1 4 and E 2	E 3
	1 2 and E 1	E 4
	1 1 and E 3	E 2
6-cyl. engine	1 5 and E 3	E 1
	1 3 and E 6	E 5
	1 6 and E 2	E 3
	1 2 and E 4	E 6
	1 4 and E 1	E 2
	1 1 and E 5	E 4

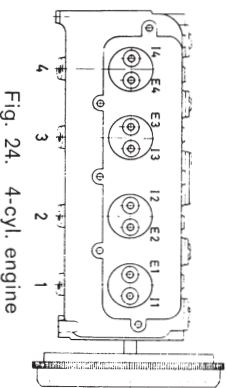


Fig. 24. 4-cyl. engine



Fig. 25. 6-cyl. engine

## General servicing instructions

### 17 Re-tightening the cylinder head bolts

In the case of a new engine or when a reconditioned cylinder head has been fitted, the cylinder head bolts must be re-tightened before starting for the first time. Then re-tightening the bolts again after 20 hours running, **when the engine has been cold**, that is, it must not have been run for at least 6 hours.

A torque wrench must be used to carry out this re-tightening and the work should be done by an authorized workshop. Figs. 26 and 27 show the order in which the bolts should be tightened. See the Technical Data for the tightening torque.

The valve clearances should always be adjusted after the cylinder head bolts have been tightened.

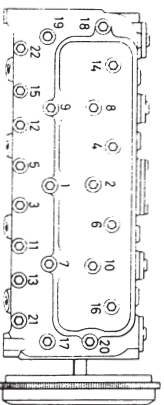


Fig. 26. 4-cyl. engine

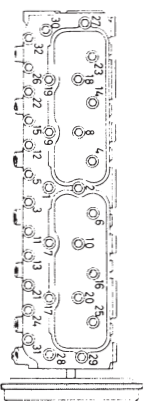


Fig. 27. 6-cyl. engine

### 15 Fuel system

#### Adjusting the idling speed

The idling speed must not exceed the values given in the Technical Data. Please note that no seals must be broken. **All warranty becomes void if seals are broken by other than personnel from authorized Diesel workshops.** The idling speed is adjusted as follows:

1. Run the engine warm until it reaches normal operating temperature. Put the control lever in the neutral position and make sure that the stop control is completely pushed in.
2. Loosen the lock nut, then turn the screw (2; Fig. 28 or 29) so that the correct idling speed is obtained.
3. Re-tighten the lock nut while holding the nut (2) firm.

After a few rapid accelerations, the engine must not stop when the control lever is quickly moved back to the neutral position.

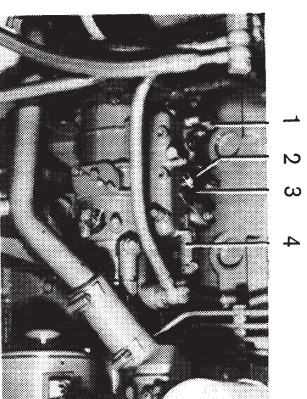


Fig. 28. 4-cyl. engine

1. Connection for stop control
2. Idling screw
3. Connection for throttle control cable

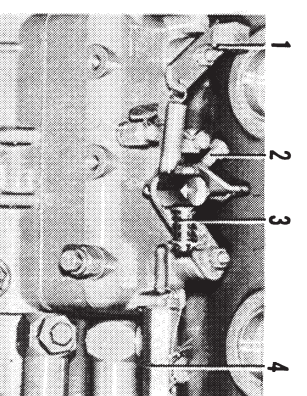


Fig. 29. 6-cyl. engine

4. Screw for max. engine speed (sealed)

### Checking the injectors

All the injectors should be removed once each season and taken to a Diesel workshop for cleaning and a check on operating pressure, leakage and spray pattern.

### Removing

Clean the injector, delivery pipe and cylinder head around the injector. Disconnect the delivery pipe and leak-off oil line from the injector. **NOTE:** Fit protective caps.

**Fitting**

Check that the contact surface against the injector is clean. Push the injector down into position and fit the yoke but do not tighten the nuts. Connect the delivery pipes. Make sure that the pipe flange comes in correct position. If the flange is tightened when incorrectly located, the delivery pipe will break after some time due to the stresses caused. Do not forget to place all the clamps in position — otherwise the delivery pipes will not last long. Tighten the retaining nuts on the yoke. The tightening torque should be 1.5–2.5 kgm (11–18 lb.ft.). Connect the return line

**Connecting the speed cable to the engine**

Check that the control lever of the controls is in neutral position and that the fuel injection pump lever (3, Fig. 28 or 29) is in the idling position. Release the spring "disc" from the lever. Screw on a lock nut and then the "disc" with the spring end in front so far that a tensioning of the spring by 4–5 mm (0.16–0.20") is obtained when the "disc" is refitted in the lever. Tighten the lock nut. Move the control lever fully "Forward" and check that there is optimum operation on the fuel injection pump.

**Connecting the stop control**

Check that the stop control lever (1, Fig. 28 or 29) lies against its stop on the fuel injection pump and that the control is pushed in. Then screw securely the control wire in the "dice" on the lever.

**16 Cooling system**

The cooling systems should be checked at regular intervals or at least once each season concerning leakage, blockage, etc.

In order to function effectively, the cooling systems must be clean and all passages in the engine and heat exchanger must be free from deposits and impurities. To keep the cooling systems clean, they should be flushed regularly with fresh-water. This cleaning should preferably be carried out in connection with laying up. For draining off the coolant, see page 7 under "Precautions in case of frost".

The temperature gauge for the cooling water has a measured area in green which corresponds to the normal cooling water temperature of the engine. When the cooling water temperature is abnormal, the cooling system should be examined immediately.

Excessive temperature can be due among other things to closed water intakes, broken impeller in the sea-water pump, defective pump carrier, blockage in the engine cooling passages or oil cooler and faults in the thermostat and instruments. The end cover of the oil cooler can be removed so that the oil cooler tubes are accessible for cleaning. To avoid water penetration, close the bottom cock.

**Changing impeller in the sea-water pump**

The pump impeller is made of neoprene rubber which can be damaged if the sea-water inlet becomes blocked. When replacing the impeller proceed as follows:

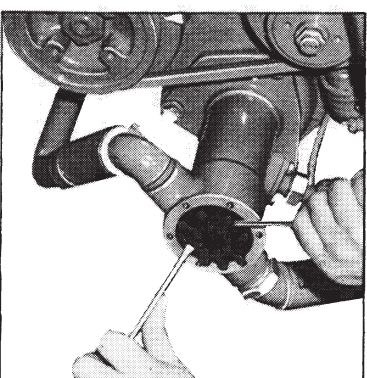


Fig. 30 Changing impeller

Close the bottom cock. Remove the cover on the sea-water pump. Insert two screwdrivers and force out the impeller by exerting leverage on the pump housing as shown in Fig. 30. Place some form of protection under the screwdrivers. Remove any pieces of the impeller that may be left in the housing. Fit the new impeller and cover. Then open the bottom cock. Make sure that there is always a spare impeller on board.

**NOTE. A new genuine gasket must be used.**

**17 Electrical system****Checking state of charge of battery**

The state of charge of the battery should be checked at least once each season. This is done by using a hydrometer showing the specific gravity of the electrolyte, which varies with the state of charge (see "Technical Data").

**Cable connections and cables**

At regular intervals check that all the cable connections are tightened and that none of the electric cables is damaged.

**NOTE.** This is particularly important when the engine is fitted with an alternator. The battery cable ends and terminal bolts should be well-tightened and coated with terminal bolt grease or vaseline.

**Starter motor and generator**

All work on the starter motor and generator should be carried out by an authorized service workshop. Inspection and control should be carried out when the engine is given a general overhaul.

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### Warning

The following applies to engines fitted with alternator.

If the alternator and its regulator are to function perfectly, it is extremely important that the following instructions are followed:

1. Never break the circuit between the alternator and the battery while the engine is running. This causes a short-circuit in the regulator which is immediately ruined.  
**The master switch must never be switched off before the engine has completely stopped.**
2. Never confuse the battery poles with one another. The poles are stamped with a plus and a minus sign respectively. The minus pole must always be connected to the engine block.  
In the case of a twin engine installation, neither of the batteries must be disconnected while either of the engines is running.
3. Should it be necessary to start by using a spare battery, do this in the following way:  
Let the ordinary battery remain connected in circuit. Connect the spare battery to the ordinary battery, plus to plus and minus to minus. When the engine starts, disconnect the spare battery but never break the circuit to the ordinary battery.
4. Never use a rapid charger while the generator is connected to the battery.
5. Always disconnect both battery cables before carrying out any work on the generator equipment.
6. If electric welding work is to be carried out on the engine or installation unit, disconnect the charging regulator cables at the generator and insulate.
7. Check the V-belt tension and cable connections at regular intervals.

### Checking the glow plugs

Remove the glow plugs once each season, and clean from carbon deposits. Lubricate the threads with graphite which will facilitate removing the plugs in the future.

### Fault-tracing table

Engine	Control resistance	Glow plug
Easily started	Dark red or yellow	In good condition
Difficult to start	Glow only slightly or not at all	Faults in one or more plugs
Does not start	Is incandescent and in a melting condition	Short-circuit in the electrical system or plugs

### Control measures

If the control resistance of the glow plug during preheating is darker or lighter than normally and if there are starting difficulties, check the glow plugs individually after removing the connection cable and the current carrying bar between the positive poles of the glow plugs.

Connect up a bulb between the positive pole of the battery and the positive pole of the glow plug. If the lamp lights, then the plug is in good condition. Check all the glow plugs and replace those that are faulty with new ones.

Always have spare glow plugs on board.

### 18 Checking reverse gears

#### Reverse gear type RB

The reverse gear should be checked regularly for oil leakage, abnormal noise level or excessive operating temperature. Once every season the reverse gear cooling jacket should also be cleaned.

If the remote control for the RB reverse gear is fitted, it must not be installed so that there is a constant pressure on the control components of the reverse gear. When the reverse gear is engaged in "Forward" or "Reverse", the remote control should be fully unloaded so that the propeller pressure can keep the cones in the reverse gear in the engaged position.

#### Reverse gear type Borg-Warner

The disc assembly for running "Forward" and "Reverse" is operated hydraulically. In order for the disc assembly not to slip, it is a condition that the correct control pressure is supplied by the built-in oil pump. Check once every season by means of a pressure gauge that the oil pressure is between 8.5–10 kg/cm<sup>2</sup> (120–145 lb/sq.in.).

The reverse gear oil cooler should be pressure-tested once every season for leakage.

### 19 Procedure if unit is to remain idle

#### Idle period with boat afloat

In the case of an idle period of less than one month with the boat afloat, the engine should be started and run warm after 14 days at least to prevent corrosion damage to the internal parts of the engine.

If the engine is to remain idle for a longer period than one month, then the engine should be inhibited, see "Procedure before and after laying up".

Protect the engine and equipment from external corrosion damage by regularly spraying unpainted surfaces and electrical components with corrosion and moisture protective spray.



We also recommend that the cylinders are sprayed through the injector holes in the case of long intervals of idleness.

If the engine has not been used for a long time, check that the bottom of the boat is free from marine growths and also check to see whether the zinc electrodes need replacing (see point 11).

#### Procedure before laying up

Before the boat is taken up on land for laying up, it is advisable to let an authorized service workshop test the condition of the engine by carrying out a compression test on the engine.

Prepare the engine for laying up before the boat is lifted out of the water as follows:

1. Run the engine warm to its normal operating temperature. Stop the engine and pump all the lubricating oil out of the engine and reverse gear.
  2. Fill the engine and reverse gear with rustproofing oil up to the lower mark on the dipstick. Suitable rustproofing oils are Esso Rustban 623, Shell Ensis oil 20 (or another corresponding make), intended for internal protection of combustion engines.
  3. Inhibit the engine **fresh-water system** according to the following alternatives:
    - a. Drain the fresh-water system completely. See under "Precautions in case of frost" page 7, for location of the drain cocks. Mix about 6 litres of fresh-water and 6 litres ethylene glycol of a well-known make. The ethylene glycol should contain the anti-corrosion additives and be intended for combustion engines. Shut the drain cocks and then fill the mixture in the fresh-water system.
    - b. Drain the fresh-water system completely and then shut all cocks. Mix about 10 litres (8.8 Imp. qts. = 10.5 US qts.) water with 1 litre (0.9 Imp. qts. = 1 US qts.) emulsifying rustproofing oil, for example Esso Cutwell 40, Shell Donax C or another corresponding make.
- NOTE: The rustproofing oil should be added to the water, and not vice versa.
- Mix the emulsion well and fill the emulsion into the fresh-water system.
- NOTE**
- Alternative 3a. provides fully satisfactory protection against frost and corrosion, so that the mixture should not be drained off during the period the boat is laid up. Alternative 3b. does not provide protection against frost, so that the emulsion should be drained off when the procedure according to point 6d. has been completed.
4. Drain off the fuel oil in the fuel filter. Disconnect the feed pump flexible fuel line at the connection. Place the hose in a can containing 1/3rd rustproofing oil (Esso Rustban 623 or similar) and 2/3rds fuel oil.
  5. Vent the fuel system (see "Servicing" point 9) and start the engine. Allow it to run at rapid idle (approx. 1000 r.p.m.) for about 15 minutes.

#### Procedure after laying up

6. Rust-proof the **sea-water system** as follows:

- a. Drain all the cooling water from the **sea-water system** of the engine and reverse gear. The location of the engine drain cocks is shown under "Precautions in case of frost", page 7. Then shut all the drain cocks.
  - b. Mix about 20 litres (17.6 Imp. qts. = 21.0 US qts.) with about 2 litres (1.76 Imp. qts. = 2.1 US qts.) of emulsifying rustproofing oil in accordance with the same procedure described under point 3b.
  - c. Disconnect the sea-water system's suction line from the water intake and extend possibly the hose so that it reaches down to the bottom of the can containing the rustproofing mixture.
  - d. Insert the suction hose down into the bottom of the can and start the engine. Do not let the speed exceed the idling speed. The capacity of the sea-water pump is very great and for this reason the 20 litres of rustproofing mixture in the can will be sucked up within about a minute.
- NOTE: The pump must not be run without water since this can damage the impeller.
- e. Drain off all the water from the engine and reverse gear sea-water system and any water remaining in the exhaust line. If the fresh-water system has been inhibited according to point 3b., it should be drained completely.
  - f. Drain the sea-water pump by slackening the cover on the bottom of the pump. Remove the impeller for winter storage (see "Servicing" point 16).
  7. Remove the injectors and spray in about 2 centilitres (1/4 pint) of rustproofing oil into each cylinder. Use rustproofing oil according to point 2. Turn the engine round several turns. **Watch out for oil splash.** Refit the injectors (see point 15).
- The engine must not then be cranked until the boat is ready for launching again. Attach a tag which clearly indicates that the oil and cooling water have been drained and also the date on which the engine was inhibited.
8. Clean the engine externally with white spirit or similar and touch up any scraped-off spots with paint. Protect all the unpainted parts as well as the electrical system by spraying them with anti-rust and anti-moisture spray.
  9. Remove the battery and hand it in to a charging station. It must be maintained in a good state of charge in order not to be ruined.

#### Procedure before launching

1. Shut the drain cocks and fill up the fresh-water system with clean fresh-water. It is suitable to add about 2 dl (2/3 fl. oz.) emulsifying anti-rust oil as corrosion protection according to 3b. Alternatively the fresh-water system can be filled with ethylene glycol containing corrosion inhibiting additives (see mixture table on page 7).
2. Drain the anti-rust oil from the engine and reverse gear and fit a new oil filter. Fill the engine and reverse gear with lubricating oil. (See "Servicing" point 3, 4, 5.

**SERVICING**

3. Fit the impeller in the cooling water pump, see "Servicing" point 16, and connect as well as check-tighten all hoses and hose clamps.
4. Clean the engine and reverse gear externally from anti-rust oil.
5. Take on board a fully charged battery and connect up the battery cables. **NOTE:** Do not get the cables mixed up (see "Servicing Instructions" on page 26). The negative pole stud should be connected to the earthed cable on the engine.
6. Remove the glow plugs and the injectors. Inspect the glow plugs for possible carbon deposits. Turn round the engine so that any remaining anti-rust oil is blown out. **NOTE:** Watch out for oil splash.
7. Fit the injectors and the glow plugs (see point 15 and 17).
8. Fit a new fine filter (see point 8). Shut all the drain cocks for the cooling water. Open the water inlet cock. Launch the boat and fill with fuel and vent the fuel system (see point 9).
9. Start the engine but do not let the engine speed exceed 1000 r.p.m. during the first two minutes. Check for leakage of water, oil, air, exhaust gases and fuel. Adjust if necessary. Check the tightness of oil sump and timing gear casing bolts as well as manifold flange nuts. Check the manoeuvring controls.
10. **Contact an authorized Volvo Penta service workshop and let it carry out the servicing on the engine and reverse gear according to the instructions given in the maintenance scheme.**

**FAULT-TRACING SCHEME****Tracing faults in case of running interruptions**

The fault-tracing scheme below includes only the more usual reasons for faulty operation. With the help of the instructions in this book it is usually possible to trace most of the causes mentioned below. In case of doubt always contact the nearest Volvo Penta service workshop.

Follow the instructions in the servicing scheme — this ensures best running reliability.

Engine does not start	Engine stops	Engine does not attain top speed with full speed control	Engine runs roughly or vibrates abnormally	Engine overheats	FAULT-TRACING SCHEME	Remarks See page
×					Battery discharged, broken cables, defective glow plugs, defective starter motor	25-27
×					Fuel tank empty, fuel cock closed	-
×	×	×	×		Air in the fuel system	20
×	×	×	×		Blocked fuel filters, defective feed pump	19
		×	×		Defective injectors	23-24
	×	×			Speed- and stop controls or idling screw incorrectly adjusted	24
		×			Marine growths and fouling on boat bottom	6
		×			Boat abnormally loaded	-
			×		Propeller damaged	-
		×			Defective revolution counter	-
				×	Blocked cooling water intake, oil cooler, cooling jackets, defective thermostat	24-25
				×	Poor tension on drive belt for coolant pump	18

## TECHNICAL DATA

## TECHNICAL DATA

### General

Type designation	MD 21 A	MD 82 A
Engine designation	Indenor XDP 4/90	Indenor XDP 6/90
Type	4-stroke Diesel engine with swirl chambers	4-stroke Diesel engine with swirl chambers
Number of cylinders	4	6
Valve system	Overhead valves	Overhead valves
Max. output, pleasure boats, SAE	75 h.p. at 4500 r.p.m.	106 h.p. at 4000 r.p.m.
Max. output, other installations in planing boats, SAE	—	94 h.p. at 4000 r.p.m.
Max. output, work boats, SMMT	51 h.p. at 3000 r.p.m.	75 h.p. at 3000 r.p.m.
Max. intermittent torque	13.2 kgm (95 lb.ft.) at 2000 r.p.m.	20.6 kgm (156 lb.ft.) at 2000 r.p.m.
Bore	90 mm (3.543")	90 mm (3.543")
Stroke	83 mm (3.268")	83 mm (3.268")
Displacement	2.11 litres (129 cu.in.)	3.17 litres (199 cu.in.)
Compression ratio	22:1:1	22:1:1
Compression pressure cold engine (at starter motor speed <sup>1)</sup> )	24–27 kg/cm <sup>2</sup> (520–600 lb./sq.in.)	24–27 kg/cm <sup>2</sup> (498–570 lb./sq.in.)
Order of injection, cylinder no. 1 nearest the flywheel	1–3–4–2	1–5–3–6–2–4
Direction of rotation, viewed from forward end of engine	Clockwise	Clockwise
Cylinder liners	Wet-type, replaceable	Wet-type, replaceable
Max. engine inclination	18°	18°
Weight of engine with RB reverse gear	about 275 kg (605 lb.)	—
Weight of engine with Borg-Warner reverse gear	about 310 kg (685 lb.)	360 kg (795 lb.)

### Engine speed

#### Pleasure boats and other installations in planing boats

Max. permissible operating speed during a short period of time	4500 r.p.m. <sup>1)</sup>	4000 r.p.m. <sup>1)</sup>
Max. speed, without load on engine	4850 r.p.m.	4350 r.p.m.
Idling speed	650 r.p.m.	650 r.p.m.

#### Work boats

Max. operating speed	3000 r.p.m. <sup>1)</sup>	3000 r.p.m. <sup>1)</sup>
Max. speed, without load on engine	3400 r.p.m.	3400 r.p.m.
Idling speed	650 r.p.m.	650 r.p.m.

### Valves

Valve clearances, cold engine	0.15 mm (0.006")	0.15 mm (0.006")
Inlet valves	0.25 mm (0.010")	0.25 mm (0.010")
Exhaust valves	0.25 mm (0.010")	0.25 mm (0.010")

- <sup>1)</sup> When cruising the max. engine speed should be reduced by 200 r.p.m. under maximum operating speed attained.
- <sup>2)</sup> Moto Meter instrument with nipple no 67.

### Lubricating system

Engine	MD21A	MD82A
Oil grade	Service DS	Service DS
Oil viscosity	SAE 30	SAE 30
Oil capacity including oil filter <sup>3)</sup>	SAE 20/20 W	SAE 20/20 W
Oil capacity	approx. 5.5 litres (4.8 Imp. qts. = 5.8 US qts.)	approx. 8 litres (7.0 Imp. qts. = approx. 8.4 US qts.)
Volvo Penta RB reverse gear		
Oil quality	"Service DS"	"Service DS"
Viscosity	same as in engine	same as in engine
Oil capacity	about 0.5 litre (1 pint)	about 0.5 litre (1 pint)
Borg-Warner reverse gear		
Oil grade	Automatic Transmission Fluid, type A <sup>4)</sup>	Automatic Transmission Fluid, type A <sup>4)</sup>
Oil capacity	about 3 litres (2.6 Imp. qts. = approx. 3.2 US qts.)	about 3 litres (2.6 Imp. qts. = approx. 3.2 US qts.)

### Fuel system

Injection pump, make and designation	CAV ROTO-DIESEL DPA	CAV ROTO-DIESEL DPA
Fine filter, make and designation	CAV/DES 583-6100	CAV/DES 583-6100
Timing, injection begins	19° B.T.D.C.	19° B.T.D.C.
Injectors	RKB 3S S 5118	RKB 3S S 5246
Injector nozzles	RDN-12SD-6517	RDN OSD 21
Injector opening pressure	130 ± 5 kg/cm <sup>2</sup> (1850 ± 70 lb./sq.in.)	120 ± 5 kg/cm <sup>2</sup> (1700 ± 70 lb./sq.in.)
Marking on injection pump data plates	R-34-42-490-4/90-4850	R-34-62-091-6/90-4350
Pleasure boats	—	R-34-62-091-6/90-D4350
Other installations in planing boats	R-34-42-490-4/90-3400	R-34-62-091-6/90-3400
Other installations	—	R-34-62-091-6/90-3400

### Cooling system

Capacity, fresh-water system, including heat exchanger	about 9.5 litres (8.5 Imp. qts. = 10 US qts.)	about 11.5 litres (10 Imp. qts. = 12.5 US qts.)
Thermostat begins to open at	68–72° C (154–162° F)	68–72° C (154–162° F)

### Electrical system

Voltage	12 V	12 V
Generator output	240 W	—
Alternator output	—	450 W
Starter motor output	1.8 h.p.	3 h.p.
Battery capacity, standard	114 Ah	114 Ah
Battery electrolyte specific gravity:		
Fully charged battery	1.275–1.285	1.275–1.285
Battery to be re-charged at	1.230	1.230
Glow plugs, Bosch	KE/GSA 10/1	KE/GSA 10/1

- <sup>3)</sup> The oil capacity varies depending on the engine inclination.
- <sup>4)</sup> Esso Automatic Transmission Fluid 55, Shell Donax T6 or corresponding.

# TECHNICAL DATA

## Reverse gear

Mechanical reverse gear  
 Type .....  
 Direction of rotation for .....  
 Reduction ratio, "Forward" .....  
 Hydraulic reverse gear  
 Type .....  
 Reduction ratio .....  
 " " .....  
 " " .....

Volvo Penta RB  
 Left-hand propeller  
 1.91: 1  
 Borg-Warner AS 70 CR  
 2.1:1 (left-hand propeller)  
 1.91: 1 (right-hand propeller)  
 2.91: 1 (left-hand propeller)

## Tightening torques

Cylinder head bolts (cold engine) .....  
 Injector retaining nuts .....  
 Glow plugs .....

6.5-7.5 kgm (47-54 lb. ft.)  
 1.5-2.5 kgm (11-18 lb. ft.)  
 4-5 kgm (29-36 lb. ft.)

## Personal Information

Name .....  
 Address .....  
 Phone .....  
**Nearest Volvo Penta Dealer**  
 Name .....  
 Address .....  
 Phone .....

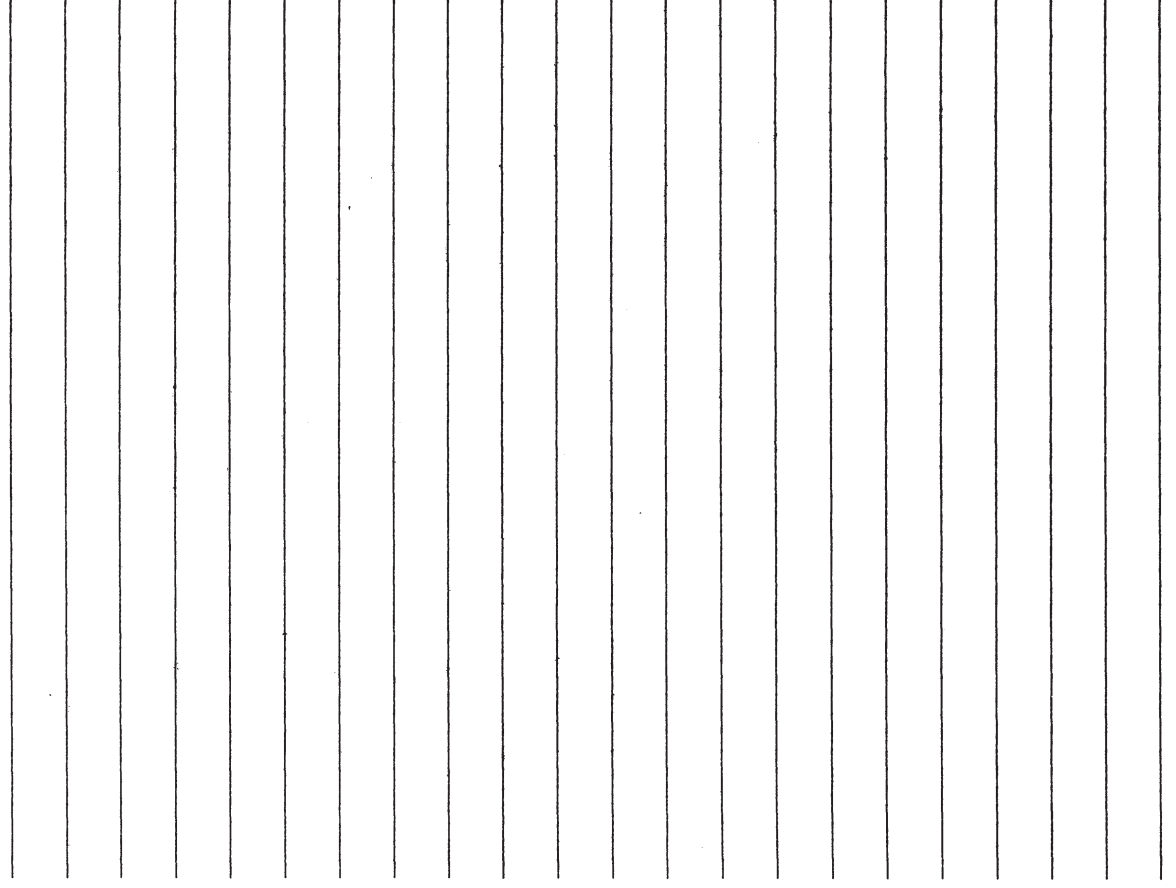
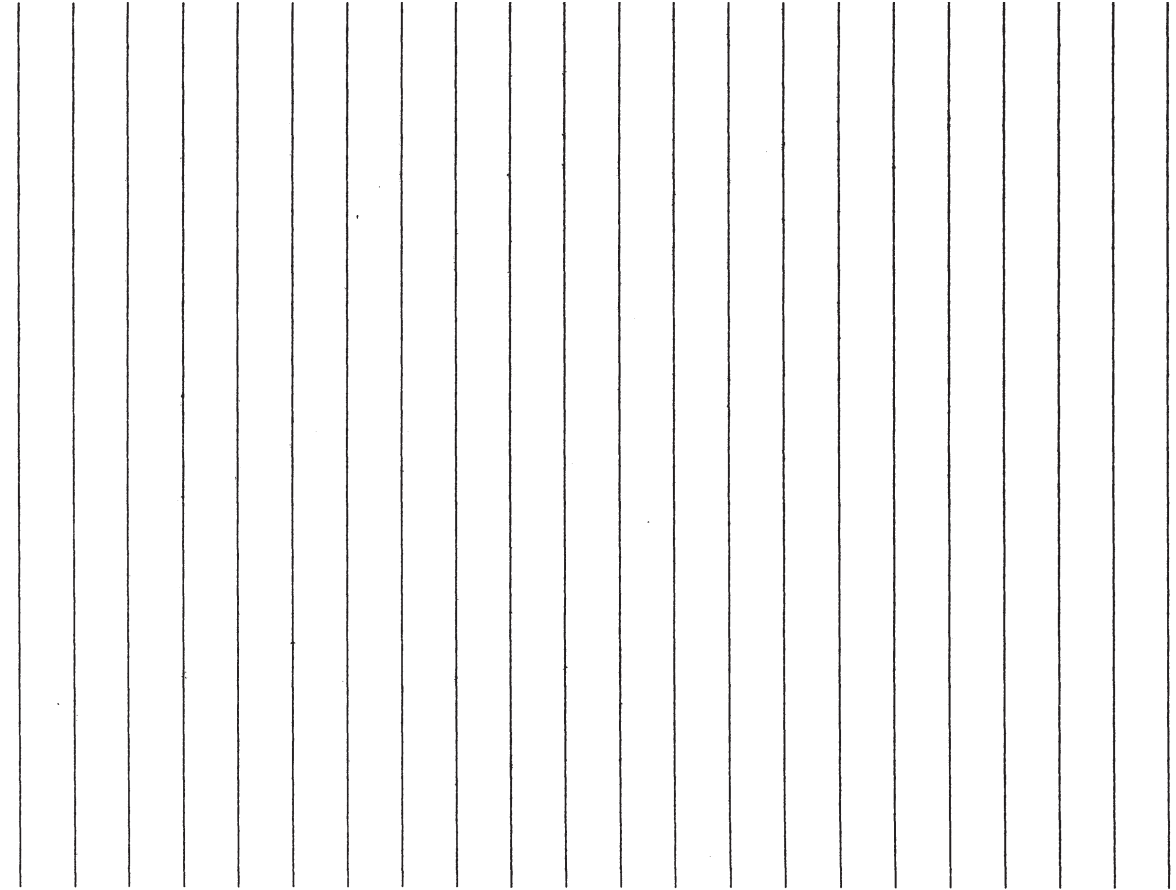
## Technical Information

Engine type .....  
 Serial number, engine .....  
 Reverse gear type ..... Ratio .....  
 Serial number, reverse gear .....  
 Number, ignition key .....  
 Propeller size .....  
 .....

The specifications and constructional details given in this instruction book are not binding.  
 We reserve the right to make modifications without previous notice.

**Technical Information Department**  
**AB VOLVO PENTA**







# **VOLVO PENTA**

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