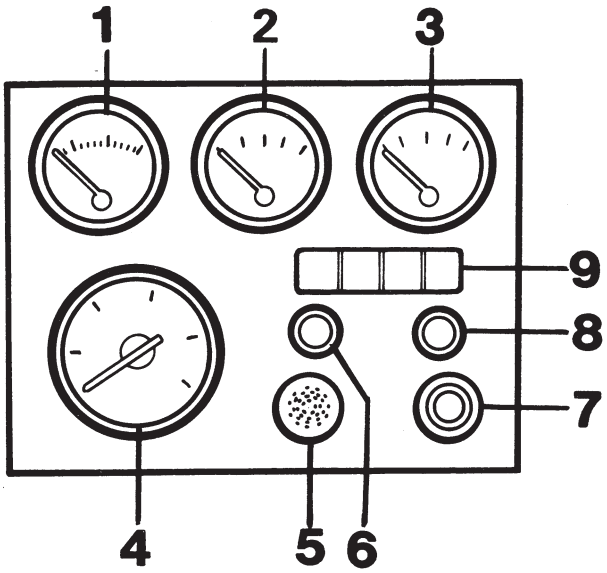
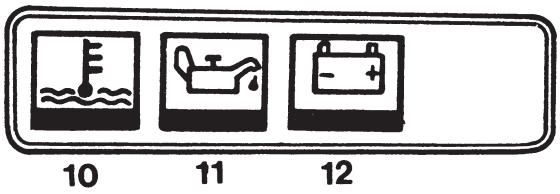
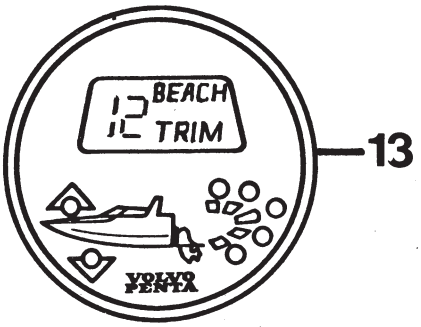
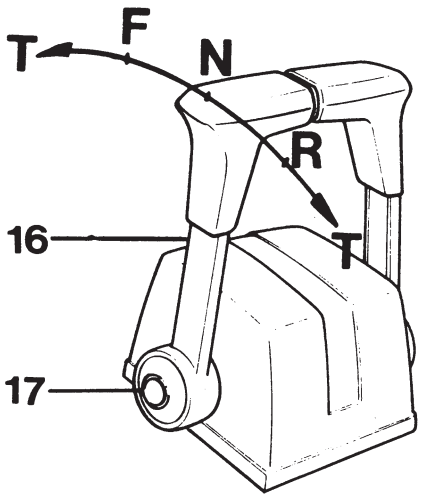
OPERATOR'S MANUAL

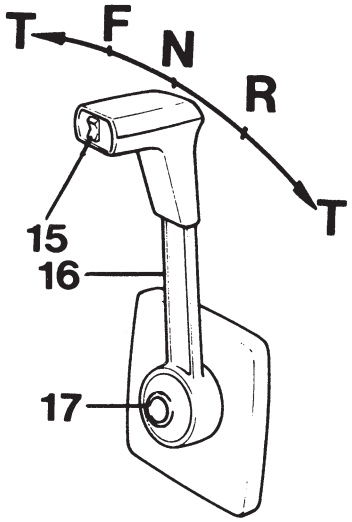
AD31, MD31, TMD31, TAMD31
D41, AD41, TMD41, TAMD41

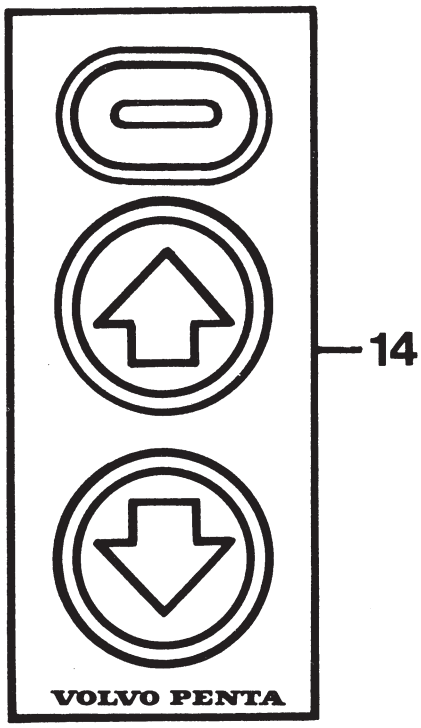












Instruments and controls

1. Temperature gauge for cooling water (fresh water) Normal cooling water temperature 75-90°C (167-194°F)
2. Oil pressure gauge
3. Voltmeter
4. Rev counter – scale 0-5000 r/m, hourcounter
5. Alarm "Low pressure oil" or "Temperature too high"
6. Alarm check
7. Ignition switch
8. Switch for instrument lighting
9. Alarm panel
10. Warning lamp, high temperature
11. Warning lamp, low oil pressure
12. Warning lamp, no charging
13. Instrument for trim angle
14. Operating switch for outdrive "UP", "DOWN"
15. Operating switch for Power Trim
16. Control lever
17. Disengaging device. Push in the button when the control lever is in neutral and move the lever forwards slightly. Release the button. The lever now operates the throttle only. Pull back the lever when you wish to use it for operating the speed and for manœuvring.

N = Neutral
F = Control lever in position for running "Forward"
R = Control lever in position for reversing
T = Engine speed

Contents

IMPORTANT INFORMATION

Stop the engine before opening the hatch to the engine compartment. An engine which is running has rotating and moving parts which are dangerous to touch.

Bear in mind the risk of a fire. All engine fuels are inflammable. Alcohol, methanol or ethanol is sometimes added to fuel, especially to unleaded petrol. These additives shorten the life of rubber and plastic components in the fuel system. Inspect regularly.

The cooling system is filled with liquid and it should be drained when there is risk of frost. The fresh water part of the system can be filled with an anti-freeze mixture or drained. Note that in certain cases a suction action may occur when the sea-water system is being drained. Close all drainage points when the boat is not under constant supervision. Incorrectly performed drainage may cause the boat to become filled with water and sink. When working on the drive in the upper position, lock the drive in position with the special tool available or in some other secure way so that there is no possibility of the drive falling down.

INTRODUCTION

This instruction book provides helpful information for running and maintaining your Volvo Penta products.

The contents herein apply to particular engine specifications. Each engine is supplied from Volvo Penta in accordance with the published specifications. Examine your engine and other components to be able to find them in this book. Read this book carefully before placing the engine in operation. Do not wait until a problem occurs.

WARRANTY

A service and warranty book which states the Volvo Penta International Limited Warranty (all markets except USA) should have been provided by the selling dealer. If you have not received this publication contact the nearest Volvo Penta Importer for a copy.

Some markets provide special or limited warranties as a supplement or replacement for the Volvo Penta International Limited Warranty. Contact the local Volvo Penta Importer to obtain copies of such special warranties if applicable.

For products operating in the USA special limited warranties and warranty documents apply.

WARRANTY CARD

The Warranty Card should be filled out and sent in **by the selling dealer always.** Ensure this has been **done as refusal of warranty** can occur if no proof of **delivery date** can be provided.

VOLVO PENTA SERVICE

Volvo Penta has built up an extensive dealer network to support you with service and parts. These dealers have the necessary training, special tools, test equipment and stocks of parts to provide the quality service. When requesting service or parts always quote the complete product model and serial number from the product serial number plate.

NOTICE: All information, illustrations and specifications contained in this manual are based on the latest production information available at the time of publication. Volvo Penta reserves the right, without prior notice, to revise prices, materials, standard equipment, specifications, models and to discontinue models. Not all models, standard equipment and accessories are available in all countries.

OUR JOINT RESPONSIBILITY

Volvo Penta invest anually considerable development resources to minimize the effects on the environment caused by our products. Examples of this continous work are the improvements in exhaust emissions, sound levels and fuel consumption.

Whether your Volvo Penta engine is used to power a pleasure boat or is used in a commercial application it can, if used incorrectly or maintained insufficiently, disturb or damage the environment.

This Owner´s manual covers several service checks that, if not performed correctly, can cause a deterioration of the engine affecting the environment, its service life and operation economy. Always follow the recommended service intervals and make it a habit to check for anything abnormal each time you use the engine. An example of this is excessive exhaust smoke. Contact an authorised Volvo Penta Service Dealer if you cannot remedy the cause yourself.

Remember that most chemical products used to maintain your boat and engine are harmful to the environment, if used incorrectly. Always dispose correctly of used engine and transmission oil, paint, degreasing agents and washing fluids, etc, so that they cannot harm the environment.

When using your boat, always adjust the speed and distance to prevent the wake or sound level from disturbing wildlife, moored boats, pontoons, etc. Leave the waters and natural harbours in the condition you yourself would like to find them.

We thank you for your choice of Volvo Penta marine engine and we wish to continue to supply you with maintenance and advice to help you get the best possible performance from your engine. Contact your nearest Authorised Volvo Penta Service Dealer for assistance.

We wish you pleasant trips with your boat.

AB VOLVO PENTA
Technical Information

SAFETY NOTICE

The following special warning notes will alert you to possible bodily injury dangers and to important information on safe operation of equipment. Observe them carefully. "Warning" follow notes alone do not eliminate the dangers that they signal. Personal close attention to detail plus common sense operation of equipment are major accident prevention measures.

WARNING: You are warned that personal injuries, damage to property or malfunction of the engine can result from your not following these instructions.

GENERAL INFORMATION

Important information concerning the function of your engine:

FUEL

Use diesel fuel oil of "Autodiesel" quality. Lower fuel quality can cause operational breakdowns.

LUBRICATING OIL

Use only oil with quality CD according to the APi-system. Volvo Penta oil for diesel engines fulfills these quality requirements and can be used to advantage. See "Technical data" for viscosity.

RUNNING IN

A new engine must be run in with due care during the first 20 hours of operation. Therefore, avoid operating the engine under full load during this period. A higher oil consumtion during this running in period is normal. Therefore, check the oil-level in the engine more frequently than normally during this period.

REPLACEMENT PARTS

Warning: Electrical, and fuel system components on Volvo Penta products are designed and manufactured to comply with US coast guard rules and regulations to minimize risks of fire or explosion.

Use of non approved replacement parts, which do not comply to these rules and regulations, could result in a fire or explosion hazard.

When servicing the electrical, and fuel systems insure that parts are properly installed and tightened.

WARRANTY INSPECTION

(Not applicable for US-market)

Is carried out after between 20 and 50 hours' running or within 180 days after delivery by an authorized Volvo Penta dealer.

OIL CHANGE

In conjunction with the guarantee warranty the engine oil and the oil filter should be changed. See also "Inspection and Service".

FULL THROTTLE OPERATING RANGE

When fitting a propeller to a specific boat-engine combination it is sometimes hard to select the proper sized propeller for varying load and weather conditions. Therefore Volvo Penta offers a wide range of propeller sizes and types. In some boats there are advantages to selecting a propeller that limits engine rpm including lower fuel consumptions, lower noise, lower vibration and better propeller efficiency.

Full throttle operating range, pleasure duty light duty

AD31 B: 3700-3900 rpm
MD31A: 3300-3500 rpm
TMD31B: 3600-3900 rpm
TAMD31B: 3700-3900 rpm
D41B:3700-3900 rpm
AD41B: 3700-3900 rpm
TMD41B: 3700-3900 rpm
TAMD41B: 3700-3900 rpm

Full throttle operating range, medium duty

TAMD31B: 3000-3250 rpm
TAMD41B: 3000-3250 rpm

If the boat has been in the water for some time the boat speed and the maximum engine speed can drop as a result of marine growth on the boat hull and the outboard drive. Prevent growth by painting boat hull and outboard drive with "copper free" anti fouling paint.

SAFETY EQUIPMENT

Irrespective of whether the boat is being used for long cruises or short day trips, it should be equipped with safety equipment as suggested below. This list can, of course, be supplemented further according to personal option. Inspect at regular intervals to ensure that there is safety equipment on board and that it is in working order.

LIFE-JACKETS for all on board, approved type.
FIRE EXTINGUISHER, approved type at least one and installed easy to get at.
DISTRESS ROCKETS and matches. Packed watertight.
FIRST AID BOX
TOOLS suitable for the equipment on board.
ON BOARD KIT containing, e.g. an impeller, spare engine parts, etc. (See your dealer for recommended on board kit for your engine).
ANCHOR with line.
RADAR REFLECTOR
RADIO for listening to, e.g. weather reports.
COMPASS which has been corrected for deviation.
BOAT HOOK and **PADDLE**
MOORING ROPES, BUMPERS.
FOG-HORN and **WHISTLE.**
SEA ANCHOR
FLASHLIGHT
EXTRA PROPELLER and **MOUNTING TOOLS.**

NOTICE: USCG regulations, state and federal laws specify equipment and safety requirements that must be complied with to operate boat safely and legally. Consult USCG, state and federal publications for details.

PREPARATIONS BEFORE STARTING

Before starting the engine make sure that:

There is no **FUEL LEAKAGE**
There is no **WATER LEAKAGE** from engine or hull
There is no **OIL LEAKAGE**
There is no **SMELL OF LP-GAS** in the deep cavities of the boat or elsewhere.
The **OIL LEVELS** are correct.
COOLING WATER LEVEL in the expansion tank for the fresh water system is correct. If the expansion tank is empty, cooling system venting must be done after refilling. See instructions under Checks and Service.
The proper **NAUTICAL CHARTS** are on board for the planned voyage.
There is enough **FUEL** on board for the planned voyage.

WARNING: Make sure when filling your fuel tank that there is no open flame on board, e.g. in the galley. Ventilate the boat and run the engine room fan (if fitted) for 4 minutes before starting the engine. Do not fill fuel tank with too much fuel.

If some people are on board for the first time, tell them how to manœver the boat and where to find the life-jackets and fire-extinguishers. Also tell them everything else you think necessary from the point of view of safety. Should something unexpected happen during the voyage, very often it is too late to tell those on board how the safety equipment works.

RUNNING INSTRUCTIONS

STARTING THE ENGINE

1 Switch on the **main battery switch.**

Start the **engine room blower** (if fitted) and allow it to run for at least four minutes before starting the engine.

Lower the drive, if it has been tilted. Make sure there is no obstacle near the propeller.

2 When starting the engine, keep the control in idling/ neutral. The engine is fitted with automatic cold starting.

3 Turn the key to position "1". Temp-oil pressure-charging lamp on.

4 (Not engines in B-version) Turn the key to "2", and keep the pre-heater connected fo approx. 30 seconds. Warm engines do not need pre-heating.

WARNING! Never use starting ether. Danger of explosion!

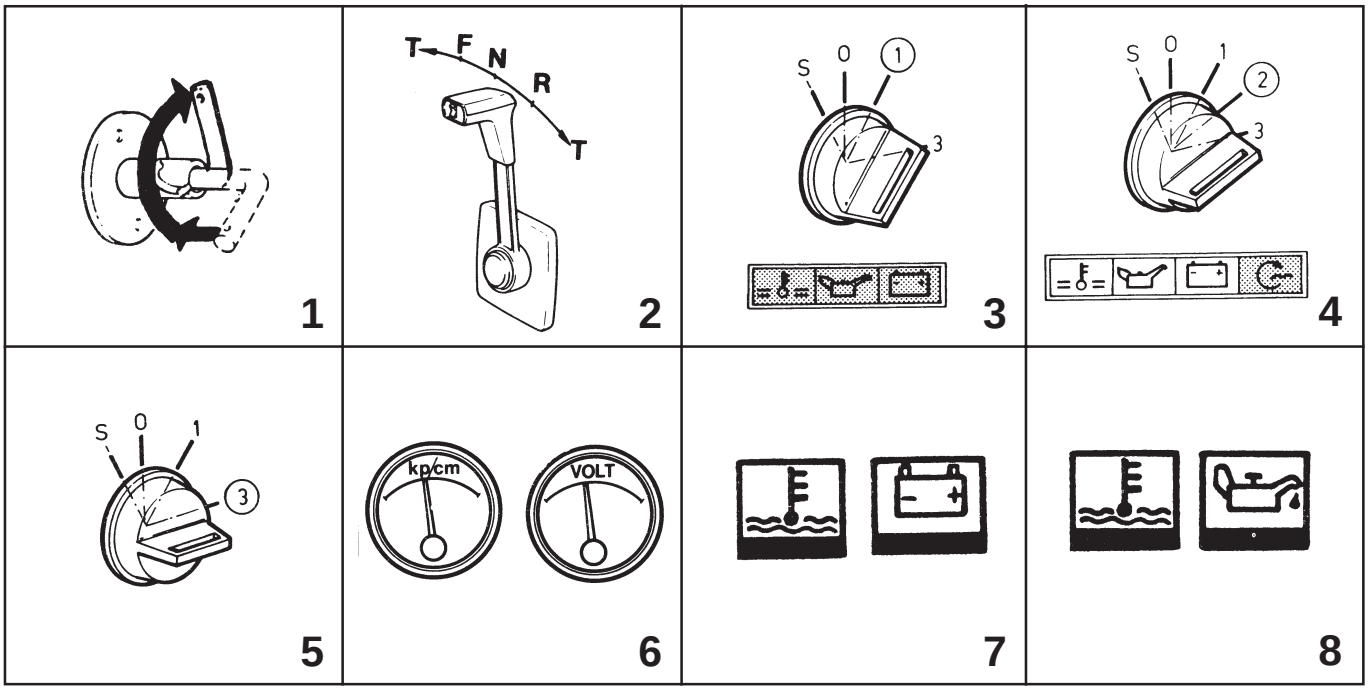
5 "3" Starting position. Key to "1" after starting. Begin in position "0" when restarting.

TURBO WARNING: Do not race the engine immediately after starting. Cold oil flows less rapidly and will not reach all necessary parts immediately.

6 Check immediately after starting that the **oil pressure gauge** and the **voltmeter** show normal values and that **the alarm** is quiet. If abnormal values are shown and the alarm sounds, the engine must be stopped immediately and the cause investigated.

7 Temp. and ammeter lamp on (no acoustic alarm) = charging fault.

8 Temp. or oil lamp and acoustic alarm on = temp. too high or oil pressure too low. Find cause of fault.



9 Run the engine warm, keeping the control in idling/ neutral.

WARNING: Do not shift into gear if engine speed is above 800 r.p.m.

RUNNING INSTRUCTIONS

10 The single control lever operates both the speed and the drive shaft. (Please see under 17 on page 1).

F = Forwards
R = Reverse
N = Neutral
T = Engine speed
(Volvo Penta controls only)

11 To obtain good operating economy the engine should not be run at maximum speed for long periods.

When under sail, the control lever should be in the neutral position if the propeller is a fixed propeller. If the propeller is a folding propeller the control lever should be in the reverse position. Start the engine and run it for five minutes every ten hours when on long-distance cruises.

12 Check that the engine temperature is normal when running (75-90°C) (167-194°F) and that the instruments for charging and oil pressure show normal values. If abnormal values are shown the engine must be stopped immediately and the cause investigated.

POWER TRIM

The Power Trim function makes it possible to trim the boat´s planing angle while running so that it can be optimised for different sea, load and speed conditions.

When trimming, the electro-hydraulic system changes the drive´s vertical angle in relation to the boat´s hull. In this way the bow of the boat can be raised or lowered until the desired running angle is reached. Correct use of the Power Trim gives the following advantages:

- faster acceleration to the planing position
- improved maneuverability and more comfortable ride in choppy seas
- improved fuel economy

The Power Trim is also used to raise or lower the drive when winching the boat out of the water onto a trailer, when launching from a trailer, and when running in shallow waters.

The Power Trim instrument

LCD display

13 Shows the current figure within the measurement range. This figure corresponds to the drive´s angle in relation to a vertical line (boat laying still)

14 TRIM lights when the drive is within the range:

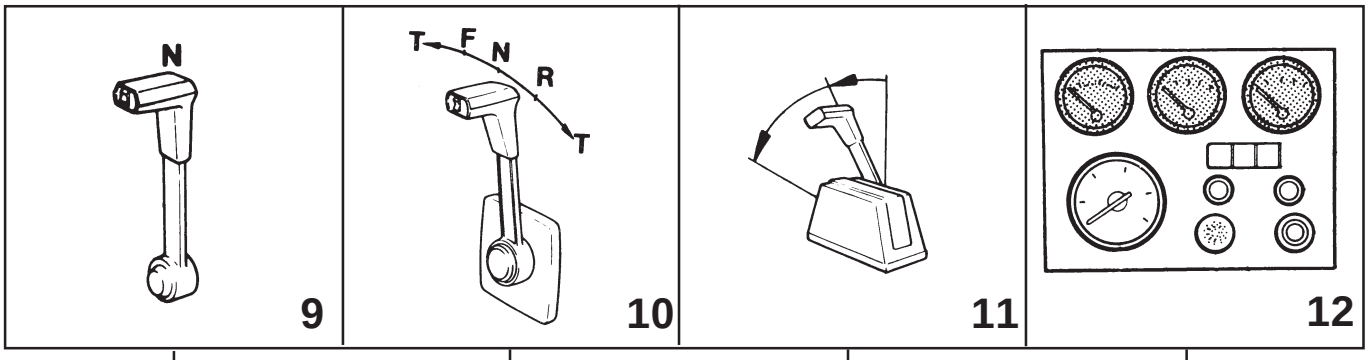
– DP: max trimmed in up to 5.
– SP: max trimmed in up to 12.

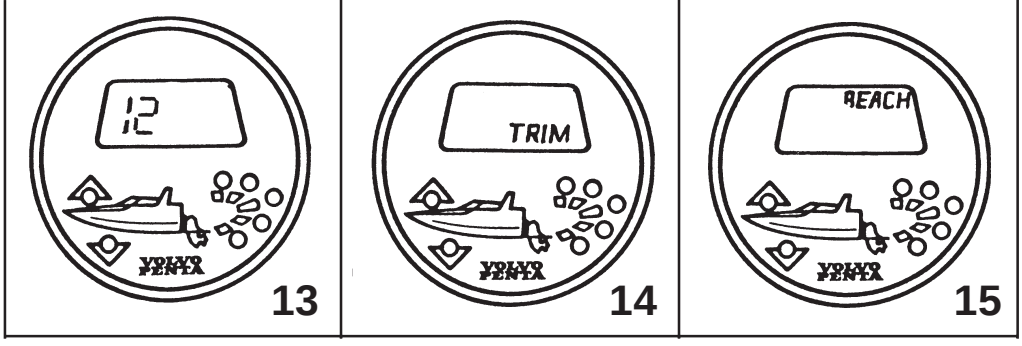
The drive must be within the TRIM range when running, except for the conditions described in point 15.

15 BEACH lights when the drive is within the range:

– DP: between 6 and 40.
– SP: between 12 and 40

THE BEACH range is used where shallow waters are suspected or when running is shallow waters at reduced speed, when launching or winching from a trailer ramp and when the boat is beached.





LEDs

16 Flashing red light when the drive is trimmed above 40. Otherwise out.

17 Steady red light when the drive is in the range:

- DP: between 5 and 40. Otherwise out.
- SP: between 12 and 40. Otherwise out.

18 Steady green light when the drive is in the range:

- DP: between 2 and 5. Otherwise out.
- SP: between 2 and 12. Otherwise out.

19 Steady green light when the drive is in the range between 0 and 2. Otherwise out.

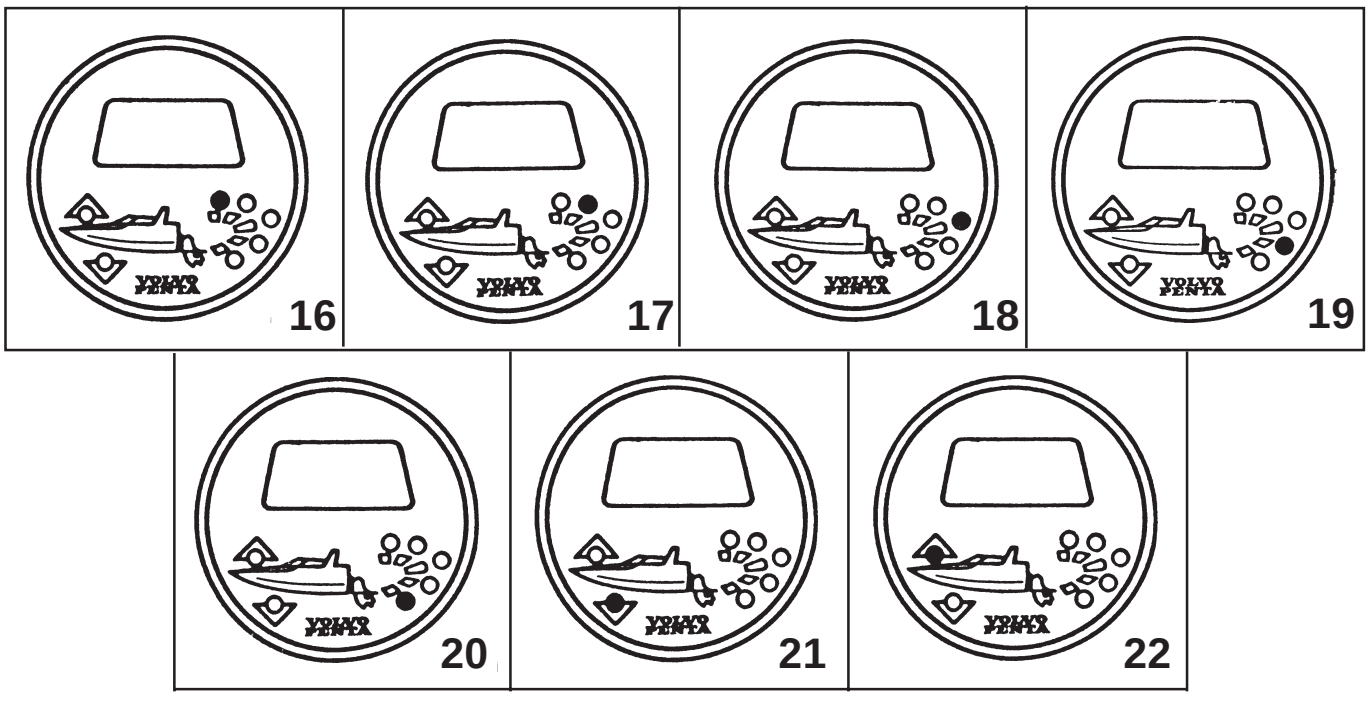
20 Steady green light when the drive is in the maximum trimmed in position up to 0. Otherwise out.

21 Steady yellow light when the drive is in the maximum trimmed-in position up to 0. Flashes when the drive is trimmed down within the trim range (the bow is lowered). Otherwise out.

22 Steady yellow light when the drive is in the range:

- DP: between 2 and 5.
- SP: between 2 and 12.

Flashes when the drive is trimmed up within the trim range (the bow is raised). Otherwise out.



Power Trim controls

23 The Power Trim function can be controlled either from a separate control panel (1) or from a switch built into the controls for the boat (2).

Control panel (Volvo Penta accessory)

When the button is pressed in, the bow of the boat will be raised. This function is locked when the upper limit of the TRIM range is reached.

The bow of the boat is lowered when this button is pressed in.

To be able to trim the drive up in the BEACH range, the red button (bypasses the lock) and the button for trimming up must be pressed in simultaneously.

Switch in the controls (Volvo Penta accessory)

By pressing the switch´s (2) upper or lower half, the boat´s bow can be raised or lowered. To be able to trim within the BEACH range, a separate switch in the instrument panel (bypasses the lock function) must be pressed simultaneously.

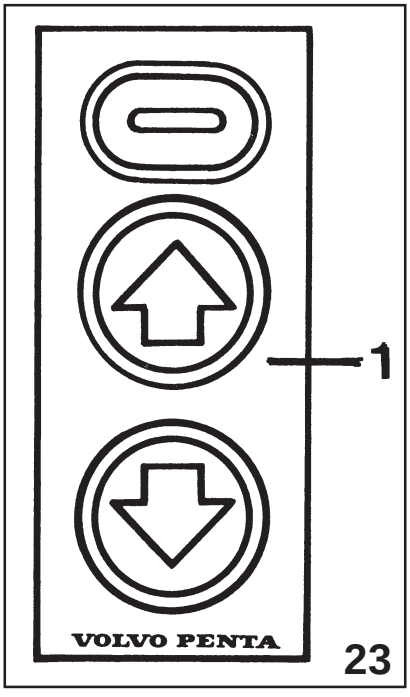
Hold function BEACH

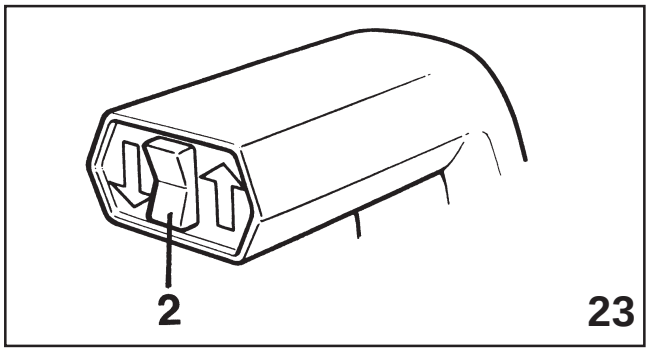
Boats with separately mounted switches for the bypassing of the BEACH function can also be equipped with a hold function.

Trimming into and within the BEACH range is done as follows:

Press the button for bypassing the BEACH lock. The warning lamp now comes on confirming that the hold function for bypass is now activated. The drive can now be trimmed "single-handed" within the BEACH range.

The hold function remains in operation as long as the drive is within the BEACH range. When the drive is lowered into the TRIM range, the lock function for BEACH is reactivated and the warning light goes out.





Running with Power Trim

Every boat has its own unique running characteristics. These are also affected by other external factors such as the wind and sea, how the boat is loaded and how the load is distributed, etc. We therefore recommend that you, after you have become familiar with your boat, test to find the most suitable trim angles for different running conditions. Note such things as: how fast does the boat start planing, at which trim angle does the boat feel most comfortable to control, and so on. When the boat feels well balanced and easily steered this usually indicates that the trim angle is correct. Check by running with the same engine speed and adjust the trim angle up and down slightly. The boat is most easily operated when the engine speed is at its highest. Therefore, you can achieve improved fuel economy by reducing the engine speed a little but still maintain the same speed.

At start

24 Trim in the drive. The bow will be pressed down which gives a better run and steering characteristics at speeds below the planing threshold. The boat will also reach planing speed quicker.

At planing speed (Trim range)

25 Gradually trim out the drive until the running position, where the boat feels comfortable and stable, is reached.

For choppy and rough seas (Trim range)

26 Trim the drive so that the bow is lowered. This will give a more comfortable ride.

For side winds (Trim range)

27 If the boat has a twin installation, the drives can be trimmed in to different trim angles. One can then compensate for side winds or uneven load distribution, which cause the boat to list when running.

Running in shallow waters (Beach range)

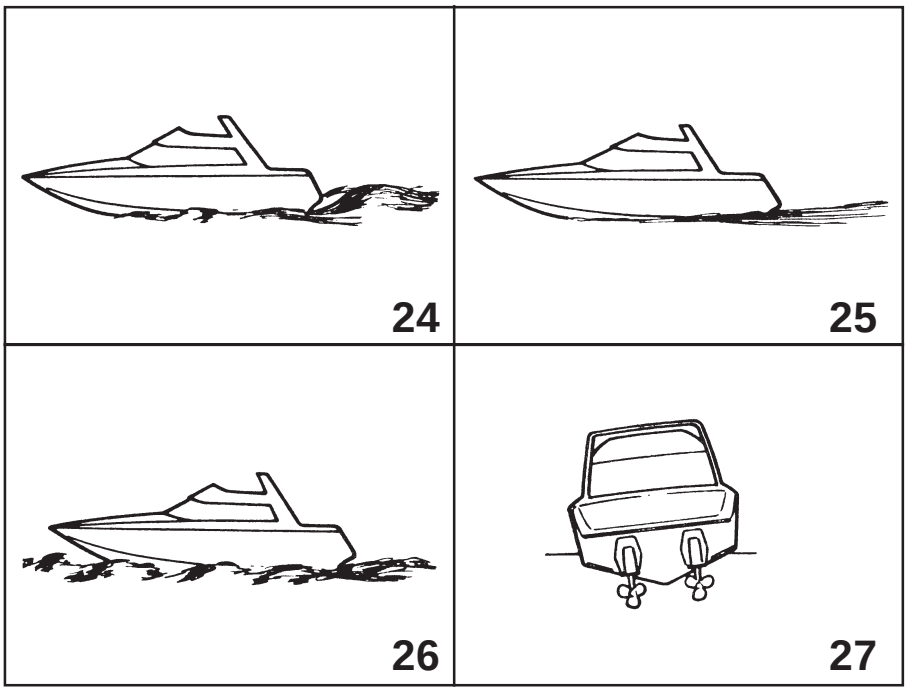
If you are uncertain of the water depth you should reduce speed and trim the drive up into the BEACH range. The drive can be trimmed up to maximum 40 in BEACH; thereafter BEACH and the LCD display go out.

CAUTION! Maximum engine speed when running in the BEACH range is 1000 r/min. Remember that the boat's manoeuvering characteristics are impaired with the drive trimmed up to BEACH. Always reduce speed before raising the drive to BEACH.

When trailing

When the drive's angle exceeds 40, the LCD display in the trim instrument goes out and the LED (16) starts to flash with a red light, which indicates that the drive is in the lift range. Power Trim has an automatic lift stop which breaks the current to the hydraulic pump when the drive has been lifted to its maximum and has reached the transportation position. The stop is reset automatically when the drive is trimmed down.

CAUTION! The engine must never be run while the drive is in the lift range.



MANOVERING ASTERN

28 Running astern can be carried out with the drive raised to maximum position of 40.

WARNING: Never shift into reverse when the boat is planing or at engine speeds above 800 r.p.m.

SHUTDOWN PROCEDURE

29 After stopping the boat, allow the engine to idle for a minute or so at idling speed with the control lever in the neutral position to avoid subsequent coolant boiling and engine thermal stresses. This is particularly important if the engine has been run at high speed.

30 Stop the engine. Turn the key to the stop position (S) and hold it there until the engine has stopped.

EMERGENCY STOP: Turn the lever (1), point 65 backwards.

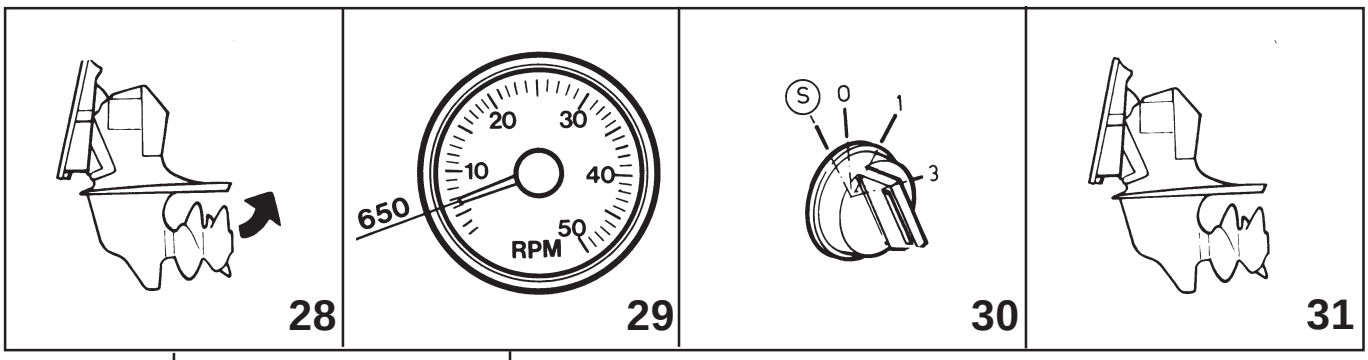
31 To prevent overgrowth on the trim cylinders' piston rod the drive gear should be trimmed in to maximum, if the boat is to lie unused in water for a longer period. How quickly overgrowth will take place depends on water conditions and the time of the year.

Pay attention to the depth of water. On no condition, e.g. during low water, should the drive gear risk touching the bottom.

32 Switch off the main battery switch!

WARNING: The mainswitch must never be switched off before the engine has stopped.

Before leaving the boat, check that no leakages have occured.



IF RISK OF FROST

33 **If there is a risk of freezing, an anti-freeze mixture must be filled to the engine´s fresh water system.**

WARNING! Watch out for seawater entering the boat.

The sea water system is drained by removing the hose from the shield and plugging the shield with a plug as described by Volvo Penta (1) (contact your nearest dealer). Also remove the hose (2) from the sea water filter and empty the hose of all water. The oil cooler is drained through the cock (3). Remove the plug (4) in the aftercooler. Remove also the hose (5) from the heat exchanger. Remove the cover from the sea water pump. If the engine is equipped with servo steering, the oil cooler for this must also be drained.

Reverse gear MS4B: Close the bottom cock and remove the hose on the starboard side from the lower connection.

Reverse gear HS 1A: Close the bottom cock and remove the hose on the oil cooler's portside.

CAUTION! Close the cocks, tighten the pump´s cover and fit the hose before leaving the boat.

NOTE! Do not forget to fit the hose to the shield before starting the engine.

CHECK DAILY BEFORE STARTING

OIL LEVEL IN ENGINE

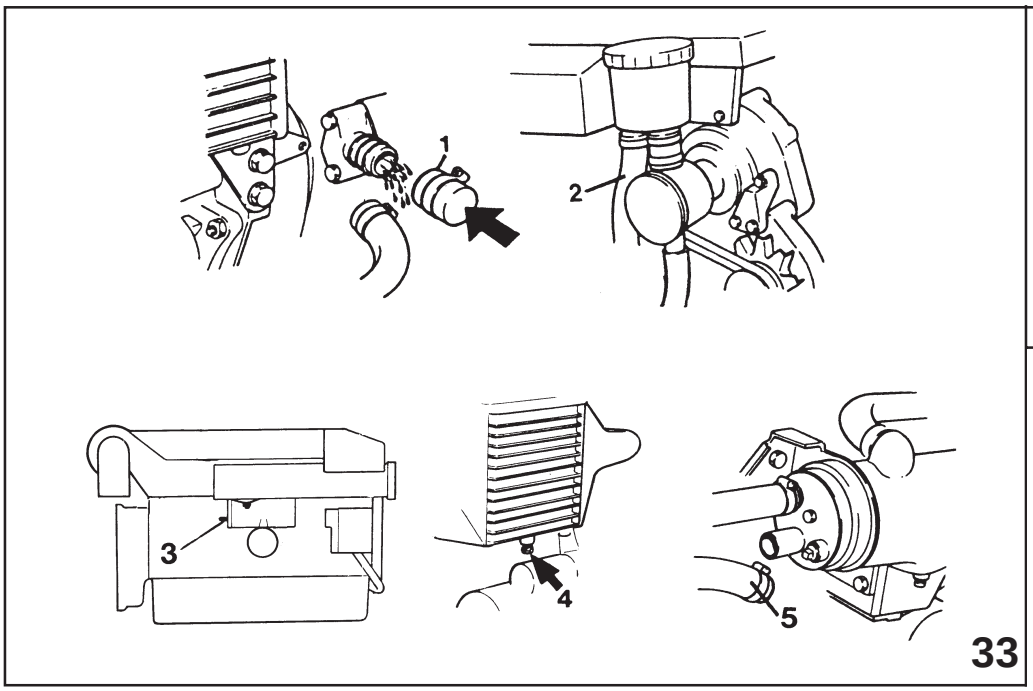
34 Check the oil level daily before starting and make sure that the oil level is within the marked field on the dipstick. Fill with oil when necessary through the oil filler. NOTE! Do not exceed the maximum mark. See "Technical Data" for choice of oil.

COOLANT

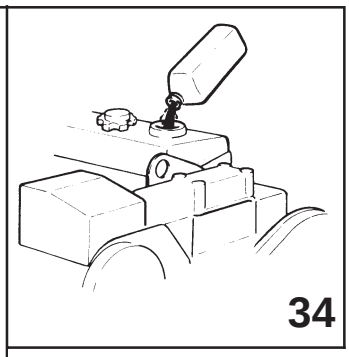
The cooling system is to be filled with a corrosion-protective anti-freeze mixture, 50% anti-freeze and 50% fresh water. Alternatively a mixture of fresh water with about 1 litre corrosion protective additive. (Volvo Penta accessory).

If there is a risk of freezing, an anti-freeze mixture must be filled or the system must be drained after each use. Regarding draining of fresh water and sea water system, see "Shutdown Procedure".

Fresh water system should be drained and flushed once per year. (See lay-up procedure).



33


34

Level of Coolant in Thermostat Housing

35 Before starting the engine for the first time on any day, check that the thermostat housing is filled with coolant. If necessary, replenish to bring the level up to the hole in the filler pipe. Then start the engine, and replenish if necessary with the engine running.

Level of Coolant in Expansion Chamber (MD31)

36 Before starting the engine for the first time on any day, check that the coolant level is between the MAX and MIN marks. I f necessary, replenish with fresh water or anti-freeze corrosion protection mixture to bring the level up between the marks.

WARNING: Top up using only a 50/50 mix of water and anti-freeze.

WARNING: Closed fresh water system is under pressure. If pressure cap is removed when the engine is at operating, temperature, turn cap to first stop and allow pressure to escape before completely removing cap.

CHECK EVERY 14 DAYS

OIL LEVEL IN REVERSE GEAR MS4B

37 Check the oil level using the oil dipstick (1). The oil level should be between the marks on the dipstick. NOTE! The dipstick must **not** be screwed down when checking the oil level. Top-up if necessary through the oil filler hole (2). Use the same type of oil as already in the reverse gear. See "Technical Data".

OIL LEVEL IN THE REVERSE GEAR MODEL HS 1A

38 Use the oil dipstick (1) to check the lubricating oil level. The oil level should be within the marks on the oil dipstick. **NOTE!** When measuring the oil level, Do **not** tighten the oil dipstick! Top up when necessary. Use the same type of oil as already in the reverse gear. See under "Technical Data"!

OIL LEVEL IN REVERSE GEAR PRM

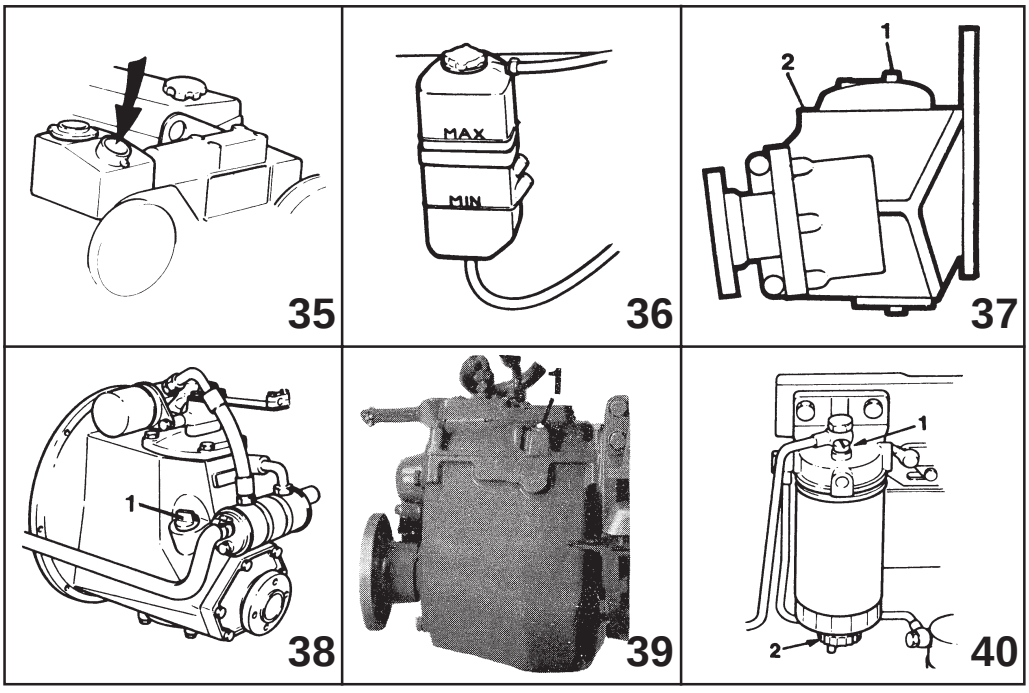
39 Use the dipstick (1) to check the oil level. The level should be between the MAX and MIN marks on the dipstick. NOTE: Screw the dipstick in when checking the oil level. If necessary, replenish with the same brand of oil as that already in the reverse gear. Please see "Technical Data".

Draining the water from the fuel filter

40 Open the venting screw (1) approx. 3 turns. Then open the drain screw (2) and drain the fuel/water into a suitable container. Tighten the drain screw and vent the fuel system. See "Venting the fuel system".

ELECTROLYTE LEVEL IN BATTERY

The level should be 5-10mm (3/16"-3/8") above the cell plates in the battery. If necessary, top-up with distilled water.



ELECTROLYTE LEVEL IN BATTERY

The level should be 5-10 mm (3/16"-3/8") above the cell plates in the battery. If necessary, top-up with distilled vater.

WARNING: Some maintenance free batteries have special inspection instrustions which should be followed.

BELT TENSION

The V-belt must be properly tensioned in order to get full alternator output and correct cooling water temperature.

WARNING: Belts too tight will cause short belt life and may damage alternator and/or water pump bearings, belts too loose may jump off pulleys or slip, causing short belt life. The V-belts are properly tensioned when it is possible to depress them 10 mm (3/8") midway between the pulleys.

CORROSION PROTECTION - OUTDRIVE/SHIELD

41 Replace the zinc ring when it has been worn down by 50%.

Replacement with magnesium ring is recommended for boats mainly used in fresh water.

DP drives with stainless steel propellers (Accessory) shall have two zinc plates fitted to the shield.

These are to be fitted with two bolts part No. 963701-8 and two spacer sleeves 854486-8.

WARNING: Make sure that the contact surface on the drive is clean before installing the new ring.

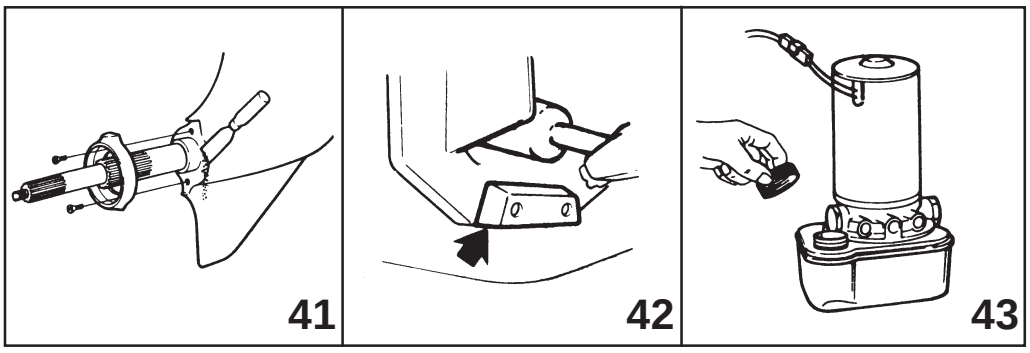
42 Replace the zinc plate under the transom shield when it has been worn down by 50%.

WARNING: Make sure that the contact surface on the shield is clean before installing the new plate.

Check zinc plugs as necessary but at least twice per season.

OIL LEVEL IN THE HYDRAULIC PUMP (POWER TRIM)

43 Trim the drive inwards as far as possible. Remove the screw and check pump oil level. The oil level must be between MAX and MIN on the plastic reservoir. Top up if necessary. For choice of oil see "Technical Data". Take great care when checking the oil level that no foreign particles enter the system.



SERVICE EVERY 50 HOURS OF OPERATION

SEA-WATER FILTER AD31, 41 ONLY

When there is risk of clogging the filter, check after 25 hours or as necessary.

44 When checking and cleaning the waterfilter unscrew the cover (1) and remove the sealing-plate (2). Then lift out the insert (3). Shake the insert and rinse it. The insert can be refitted in one way only. Check that the seal on the insert is undamaged. Reinstall the sealing-plate and tighten the cover. Check for water leakage after the engine has been started.

WARNING! Watch out for seawater entering the boat when working with the seawater filter.

ON INBOARD APPLICATIONS

WARNING: Volvo Penta recommends use of a properly installed sea strainer or raw water filter to provide engine with an unrestricted flow of filtered cooling water. Regular inspection and cleaning of this strainer is required. Operation in areas where seaweed, sea grass, sand etc. or other foreign matter might block intake of filter require more frequent maintenance.

LUBRICATING THE PRIMARY SHAFT AND STEERING SHAFT JOURNAL

Grease the fitting with a grease-gun until grease is forced out at the journals. Use water-resistant grease.

45 1 - Upper fitting

46 2 - Lower fitting

SERVICE EVERY 100 HOURS OF OPERATION OR AT LEAST ONCE PER SEASON

CHANGE OIL IN ENGINE

47 The oil is to be changed in new or reconditioned engines after the first 20 hours of operation and then after 100 hours of operation.

Run the engine until it is hot. Suck up the oil through the tube for oil drain pump (1).

Fill up with oil to the correct level. See "Technical Data" for choice of oil.

OIL FILTER

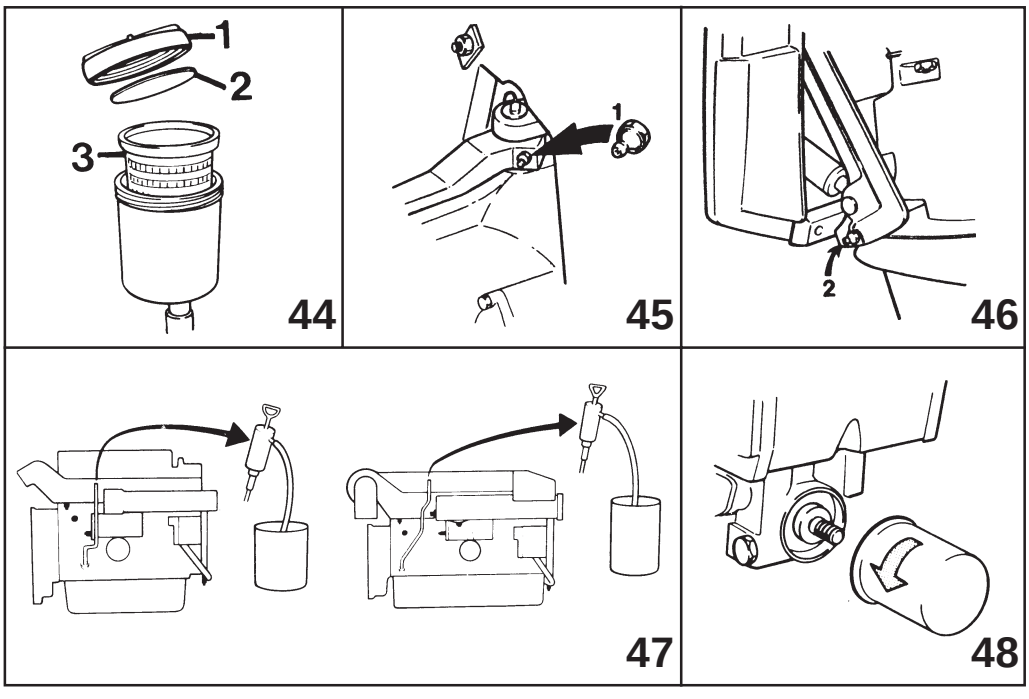
48 The oil filter is to be changed the first time after 20 hours of operation and then after every 100 hours of operation. Screw off the old filter. If the oil filter is difficult to unscrew, there is a special tool which can be used. Alternatively a screwdriver can be driven through the outer section of the filter and then used as a lever. **CAUTION:** Be careful not to spill oil.

Coat the rubber seal of the new filter with oil. Check the contact surface on the engine and screw on the filer **by hand** until it touches the contact surface. Turn the filter a further **half turn, not more.**

Note! Use only genuine Volvo Penta oil filters.

Start the engine, run at idling and check immediately that the oil pressure-gauge shows normal values.

Check the oil-level and check also for leakage around the filter.



SERVICE EVERY 200 HOURS OF OPERATION OR AT LEAST ONCE PER SEASON

OIL CHANGE IN DRIVE

Draining

49 Remove the oil dipstick. Tilt the drive. Remove the plug under the propeller gear housing and let the oil run out. Refit the plug with its O-ring.

Filling

50 Remove the drive cover and the oil filler plug with its O-ring. Fill up with oil. Concerning quality and capacity see Technical Data. Refit the plug together with its O-ring. Lower the drive.

Check the oil with the dipstick, which must **not** be screwed down when measuring the oil level. Fill up to the correct level through the dipstick hole. If the oil level is too high, the oil must be drained to the correct level. Reinstall the dipstick together with its O-ring. Reinstall the drive cover.

WARNING! Check that the drain-plug is not leaking.

OIL CHANGE IN REVERSE GEAR MS4B

51 Use the oil suction pump and suck up the oil through the hole for the oil dipstick (1).

The reverse gear should be filled to the upper mark on the dipstick, through the oil filler hole (2).

OIL CHANGE IN REVERSE GEAR HS1A

52 Use the oil scavenging pump and suck up oil through the oil dipstick hole (1). Replace the oil filter (2).

Fill up with oil to the upper mark on the oil dipstick. Then start the engine and run it for a few minutes at a speed of minimum 1500 rpm to fill the engine oil cooler with lubricating oil. Stop the engine and check the oil level. Top up when necessary.

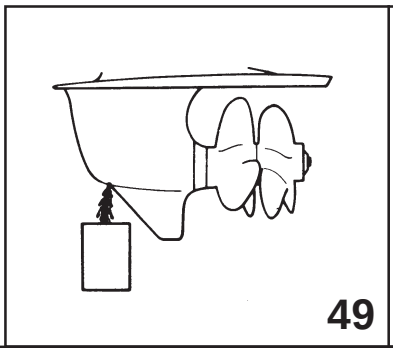
OIL CHANGE IN REVERSE GEAR PRM

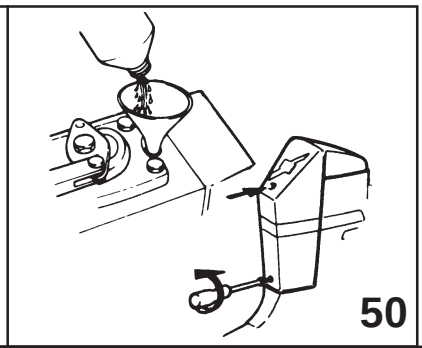
53 Use the oil suction pump and suck up the oil through the hole for the oil dipstick (1).

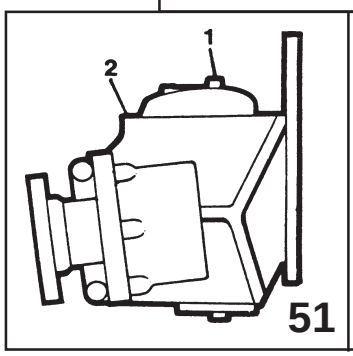
The reverse gear should be filled to the upper mark on the dipstick. Then start the engine and run it for a few minutes at idling speed in order to fill the reverse gear oil cooler with oil. Stop the engine and check the oil level. Top-up if necessary.

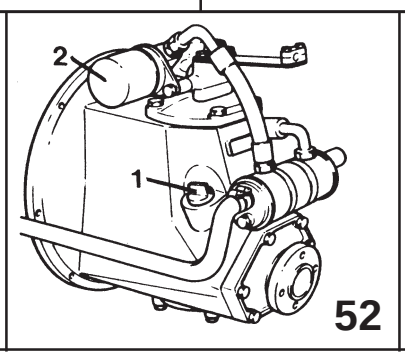
CHECKING THE VALVE CLEARENCE

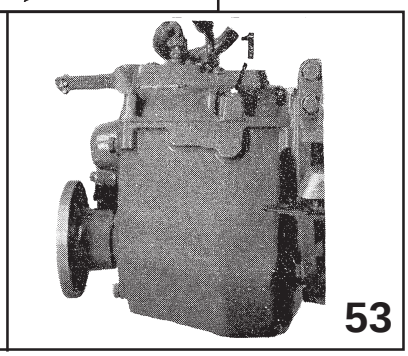
Checking and adjusting the valve clearance should be carried out by an authorized Volvo Penta Dealer. See "Valve Clearence Value" under "Technical Data".











CHECKING AND REPLACEMENT OF V-BELTS

54 Check the belts thoroughly for wear and cracks. Any indication of such and the belts must be replaced. Loosen the alternator mounting bolts 1, 2 and 3 and slip off the belts. Clean the belt grooves on the pulleys before fitting the new belts. Tension the belts in such a way that they can be depressed 10 mm (3/8") between the pulleys. After a few hours of running recheck the belt tension and adjust if necessary. The most accurate belt tension can be objected if belt is adjusted while warm and flexible after engine has been run. Replace belts once per year using only genuine Volvo Penta belts.

CHANGING THE AIRFILTER

55 The airfilter must be replaced every 200 hours of operation or once each season. Change the filter and refit reversed order. Be careful so that no dirt enters the housing.

WARNING: Never remove air cleaner filter while engine is running. Serious injury or engine damage may result.

TURBOCHARGER,

Check airtube and connections for leakage

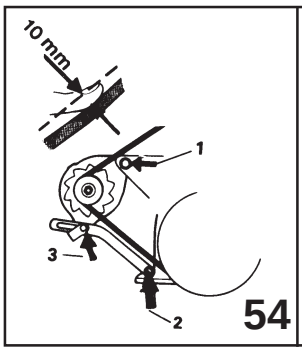
Check the air-tube when the engine is running. Whistling or hissing sounds are signs of leakage. Leakage can also be detected by brushing soapwater on suspected spots on the pressure-side between the turbo-charger and the engine. Tighten hoseclamps or replace the air-tube if necessary. If there are problems with the turbocharger contact an authorized Volvo Penta dealer.

CHECKING THE COOLING SYSTEM

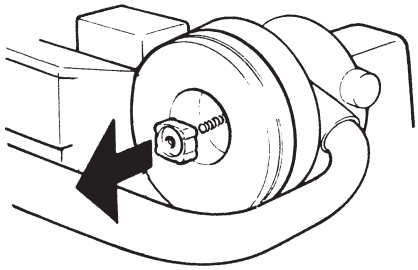
WARNING: Do not top up with water only. Water by itself reduces the rust protection and antifreeze qualities of the coolant and has a low boiling point. It can also cause damage to the engine if it should freeze. Drain and flush system once per year.

The cooling system functions normally when the needle of the temperature gauge is between 75-90°C (165-194°F). If the temperature is too high this can be caused by the following: blocked sea water intake, blocked seawater filter, defective pump impeller or carrier in the seawater pump, air in the freshwater system, coolant leakage, blocked oil cooler, too low coolant level, slipping or broken drive belt for the circulation pump, blocked heat exchanger, faulty thermostat or instrument and temperature sender. **WARNING: Watch out for water entering into boat** during all work with the cooling system.

WARNING: The cooling system must always be kept filled to correct level. If it is not kept filled, there can be high internal engine temperature resulting in damage.



54


55

CHECKING AND REPLACING THE IMPELLER

56 The impeller can be damaged, mostly because of lack of water in the pump due to blocked intake or because of inproper winter storage. To check, remove the cover.

WARNING: Watch out for water entering into boat.

Inspect the impeller. If the impeller is damaged, it must be replaced. Pull out the impeller using a polygrip pliers. Do not damage the housing. The carrier is defective if it is possible to turn the impeller and the shaft. A new carrier can be fitted after the pump has been removed.

ELECTRICAL SYSTEM

CAUTIONS FOR ALTERNATOR!

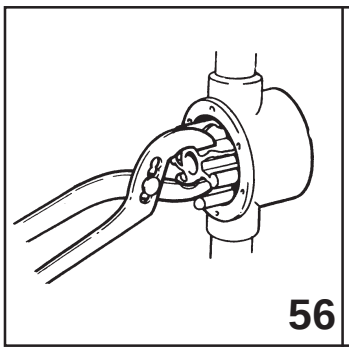
The engine is equipped with an alternator. If the alternator and the regulator are to function without interference, it is important that the following instructions are observed:

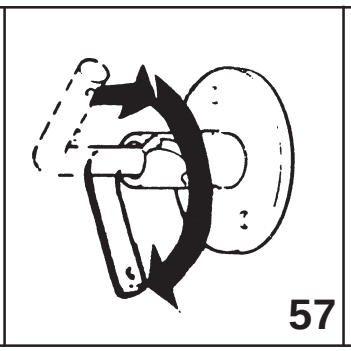
57
1. **The main battery switch must not be switched off until the engine has stopped.** Never disconnect battery cables or wiring in the charging system when the engine is running. Disconnecting any part of the charging circuit when engine is running will result in failure of the volage regulator and serious damage to the alternator.
2. **Battery terminals polarity must never be mixed up, as it will cause damage or equipment failure.** The battery terminals have a plus and a minus sign respectively. The cable from the minus terminal is connected to the engine block. The cable clamps must be well tightened and then greased.

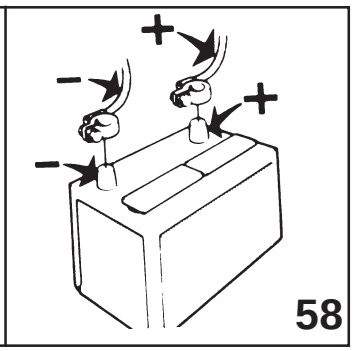
58
3. **Do not switch the charging circuits while the engine is running.**

   Install a Volvo Penta charging distributor (accessory) to the alternator when more than one battery is connected.
4. In the event the engine has to be started with the help of a spare battery, proceed as follows:

   Let the ordinary battery remain connected. Connect the spare battery to the battery with plus to plus and minus to minus. When the engine has started, remove the spare battery but under no circumstances may the circuit to the ordinary battery be broken.
5. Do not use a rapid charger when the alternator is connected to the battery. Never use a rapid charger as a booster to provide starting voltage.
6. Disconnect both battery cables before doing any work on the alternator or electrical system.
7. Before carrying out any electrical welding on the engine or boat components, disconnect the charging regulator cables at the alternator and insulate the cable ends.
8. Check the belt tension and the cable connections regularly.


56


57



58

Re-set button for circuit breaker (fuse)

59 The engine is equipped with an automatic circuit breaker which breaks the electrical system when overloaded. The automatic fuse has a re-set button (1). Always investigate the reason for the overload.

Fuses in the electrical system (Power Trim)

60 The electrical system for Power Trim has a 55A fuse at the starter motor and a 5A fuse at the control.

Checking of starter motor and alternator

Let a Volvo Penta dealer do all checking and repairs of the starter motor and the alternator. All inspection and testing should be carried out in connection with a general inspection of the engine.

BATTERY

WARNING: To prevent possible explosion, never expose battery to open flame or electrical spark. Do not smoke near battery. Batteries generate hydrogen gas which is flammable and explosive. Battery fluid contains sulfuric acid.

Do not allow battery fluid to contact eyes, skin or painted surface. If contact occures, flush affected area immediately with water. Obtain medical attention if eyes are affected.

Checking the state of charge

The battery will be maintained in top operating condition only by regular routine inspection and maintenance. When not in use, the battery will discharge slowly.

ELECTROLYTE LEVEL

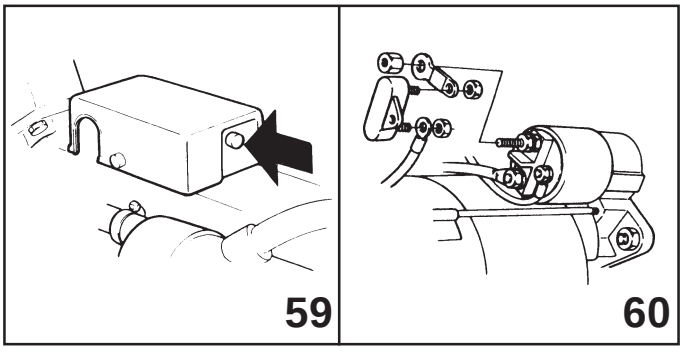
Electrolyte is checked every 14 days or 25 hours. The correct level is approximately 5 to 10 mm (3/16"-3/8") above the battery plates. Add distilled water to bring to proper level, do not overfill. After adding water, battery should be charged for at least 30 minutes by running the engine at high idle. This will ensure proper mixing of distilled water and electrolyte.

SPECIFIC GRAVITY

The electrical capacity of a battery is directly proportional to the specific gravity of the electrolyte and is checked with a hydrometer. A fully charged battery has a specific gravity reading of 1.260 plus. 15 or minus. 005 at 80°F. Additionally reading from cell to cell must not vary more than technical specification for battery. As specific gravity of electrolyte varies with temperature, the temperature at the time of testing must be known and the hydrometer reading corrected with the temperature correction chart included with a hydrometer. Specific gravity should be tested at least once per season. (See "Technical Data").

ROUTINE CLEANING

Batteries should be kept clean and dry. Battery connections must be clean and tight. A light film of grease applied to the battery connections will help to minimize corrosion.



COLD WEATHER!

WARNING: During cold weather, batteries must be charged immediately after adding distilled water. Water floating on top of battery cells will freeze, damaging the battery (see electrolyte level above). Battery capacity is considerably reduced at low temperatures. When stored outside in cold climate it will be necessary to provide a means of keeping batteries warm. If necessary remove batteries and store inside.

FUEL SYSTEM

WARNING: Observe the greatest cleanliness when handling the fuel system. Try to avoid fuel spill. Dispose the spilled fuel properly. Observe all water pullution laws.

CHANGING FUEL FILTER

61 The fuel filter should be changed at least **once each season.**

Unscrew the fuel filter. Try to avoid fuel spill. The fine filter and container are of throw-away type and therefore a new filter has to be installed.

Check that the contact surface in the cover is clean and that the filter-gasket is faultless. Screw on the new filter by hand until the gasket touches the cover. Then tighten a further half turn. Vent the fuel system, start the engine and check for leakage.

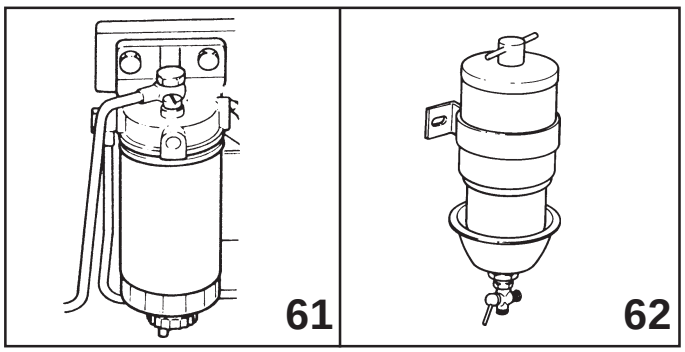
EXTRA FUEL FILTER

62 If an extra fuel filter with water separator is fitted, check the transparent bowl to see if there is any water in the fuel. If necessary, drain the filter into a suitable container via the cock in the bottom of the bowl. **CAUTION!** All water must be removed daily. Water in fuel system can damage fuel injection pump and/or injectors. Try to avoid fuel spill. Pump prime the filter and vent the system. The fuel filter element should be changed at least once each season.

INJECTORS

All work on the engine fuel injectors must be carried out by an authorized dealer. Check the opening pressure, spray pattern and also check for leakage every 600 hours of operation.

WARNING: Carbon monoxide is a poisonous colorless and odorless gas which is present in al wexhaust gases. If you ever smell exhaust fumes inside the boat make sure all compartments are ventilated and have your engine insoected by your dealer immediatley.



VENTING OF THE FUEL SYSTEM

To enable the engine to start, the fuel system must be vented after carrying out any of the following:

- Change of fine filter
- If the fuel tank has been run empty
- When installing the injection pump
- If fuel system has been repaired
- If leakage or if work has been carried out on fuel pipes
- After long periods of no running.
- Venting is carried out as follows. For component location on engine see Engine Component Guide.

63 Open venting screw on the fuel filter about 4 turns. Watch out for fuel spill. Use rags around the vent opening.

Note: It is not necessary to remove screw totally as there is a built in venting channel in bleed screw.

64 Pump up the fuel by using the hand primer until fuel, free from air bubbles flows out. Close venting screw. NOTE: If the pump action is poor, turn the engine so that the cam driving the pump changes position.

65 If the fuel injection pump has been removed or when starting up a new engine for the first time the fuel injection pump must always be vented.

Use the hand primer and pump for about half a minute. During this procedure the injection pump is automatically vented.

66 Loosen the injector's delivery pipe nuts, and put the speed control lever in the full speed position. Turn the engine using the starter motor until fuel flows out of the delivery pipes. Watch out for fuel spill. Use rags around the venting location. Tighten delivery pipe nuts and start the engine.

SERVICE IN CONNECTION WITH LAYING-UP AND LAUNCING THE BOAT

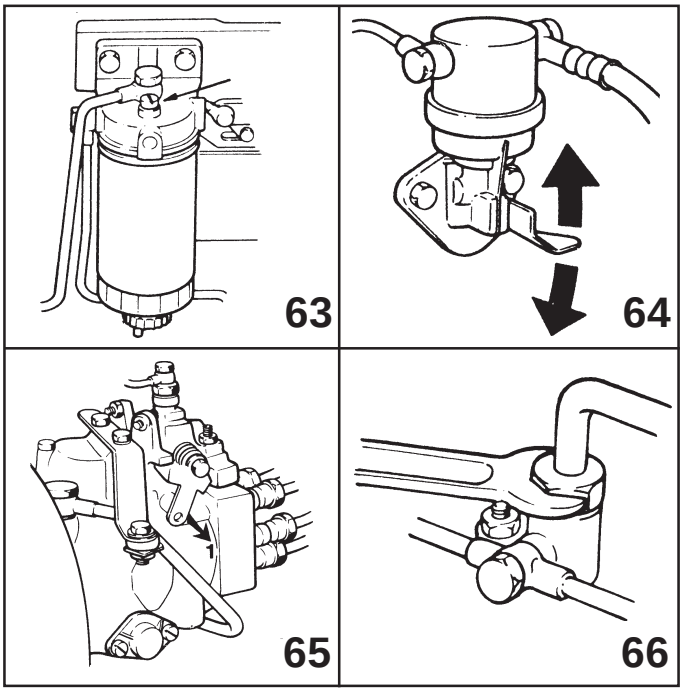
INHIBITING

IDLE ENGINE FOR BRIEF PERIODS WITH BOAT IN WATER

In order to prevent damage to the engine caused by corrosion, the engine should be run warm at least every 30 days as long as the boat is in the water. If the boat is not to be used over three month, long-term inhibiting should be carried out.

INHIBITING WHEN LAYING UP FOR THE WINTER

An authorized dealer should test and inspect the engine and equipment before inhibiting the engine for a long period. It is advisable to test the compression to find out the condition of the engine. If anything is not in good condition let the shop repair it now.



CARRIED OUT WITH THE BOAT IN WATER

67 Change the fuel filter. Pump fuel and vent the system. See "Venting the fuel system". Check the fuel hoses as well as the complete fuel system for leakages. If an extra fuel filter is fitted, this filter cartridge must also be changed.

68 Start the engine after venting and allow it to run at high idle until warm. Stop the engine.

69 Pump out all oil from the engine. (If reverse gear is fitted, the oil in this must also be changed).

Use an oil suction pump or electric type pump designed for this job.

70 Change the oil filter. Fill up the engine (and reverse gear if fitted) to the correct level with Volvo Penta diesel engine oil, which also has corrosion protective properties. The engine is now ready to run on this oil next season. For long term inhibiting, exceeding normal winter laying-up, preservative oil must be used. In this case the oil filter shall not be replaced until launching.

71 Change the air-filter.

CARRIED OUT WITH THE BOAT ON LAND

72 Loosen the hose on the seawater system suction line. (If reverse gear is fitted loosen the hose between the seawater intake and the seawater pump). Connect a hose to the suction line on the engine and put the free end into a container with freshwater. Arrange for refilling of the container. Run the engine at fast idle for a few minutes.

WARNING: The impeller must not be allowed to run dry. Drain the seawater system.

FRESH-WATER SYSTEM

Inhibiting can be carried out according to 2 alternatives.

Alt 1. In case the fresh-water system is already filled with a mixture of ethylene glycol, which is also corrosion protective, the freezing point of the mixture should be checked.

Alt 2. If the system is filled with fresh water and a corrosion protective mixture, this must be changed once each season.

WARNING: There is no protection against freezing and it is therefore recommended that the system be drained now and refilled when launching boat.

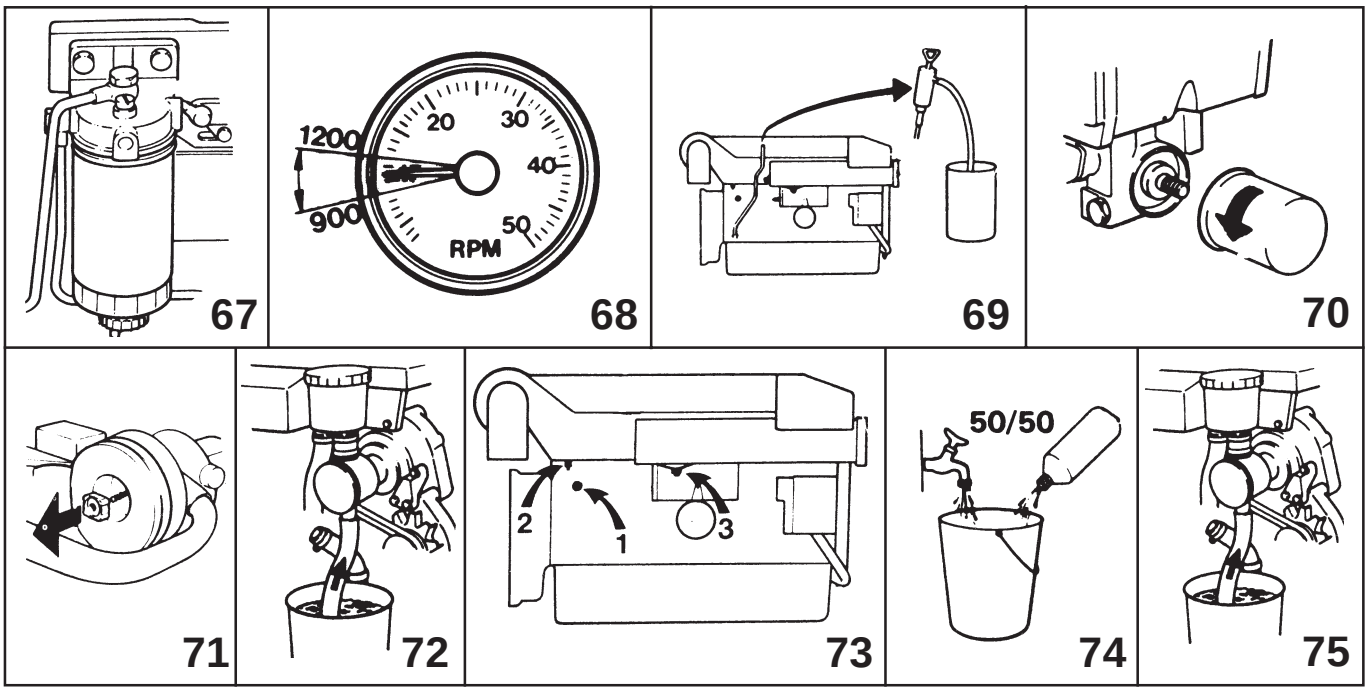
73 If the **freshwater system** is filled with coolant wich does not contain antifreeze, drain it through the cock on the engine block (1), the cock on the exhaust manifold (2) and the cock on the heat exchanger (3). You should also unfasten the cap of the expansion tank so that the coolant runs out faster. If the system is filled with a mixture containing antifreeze it does not need draining.

SEAWATER SYSTEM

74 Mix a 50% mixture of fresh water and corrosion-protective anti-freeze.

75 Put the end of the hose into the anti-freeze mixture. Arrange collection of the outgoing mixture. Start the engine and let run idle until the mixture is finished. Check that nothing behind the exhaust outlet, and the seawater system will be sprayed by anti-freeze.

WARNING: The water pump must not be allowed to run dry.



76 There is no need to drain off this combined anti-corrosion and anti-freezing mixture. If inhibiting is done with emulsifying oils, there is no protection against freezing, and the seawater system must therefore be drained off. Check that the water runs out, since dirt can block the cocks. Then close all cocks. Remove the cover from the seawater pump. Remove the impeller and clean it and leave out during lay-up.

77 Drain and refill outdrive with approved oil. Check the oil. If the oil is discoloured, contact an authorized workshop. The outdrive is now ready to run on this oil next season.

Further inhibiting of the outdrive is not necessary. Remove the propeller (propellers) and coat the shaft with rust-proofing oil.

78 Clean the outside of engine, and outdrive or reverse gear. Touch-up any bare patches in the paintwork with Volvo Penta original paint. Spray the components of the electrical system, and all the control components with anti-moisture spray. All engine control linkages should be inspected for wear, properly adjusted and protected from corrosion.

79 A fully changed battery can remain onboard. But it is recommended that you store battery in a manner that protects it from freezing.

80 Drain off any water or sediment from fuel tanks. Top up all fuel tanks to prevent condensation during storage period.

81 If the engine has a vacuum valve it must be taken apart twice a season or whenever leaks occur.

Remove the entire valve from the bulkhead where it is fitted.

Loosen the valve cover and remove the gasket and diaphragm and clean out any deposits. Deformed diaphragms must be replaced.

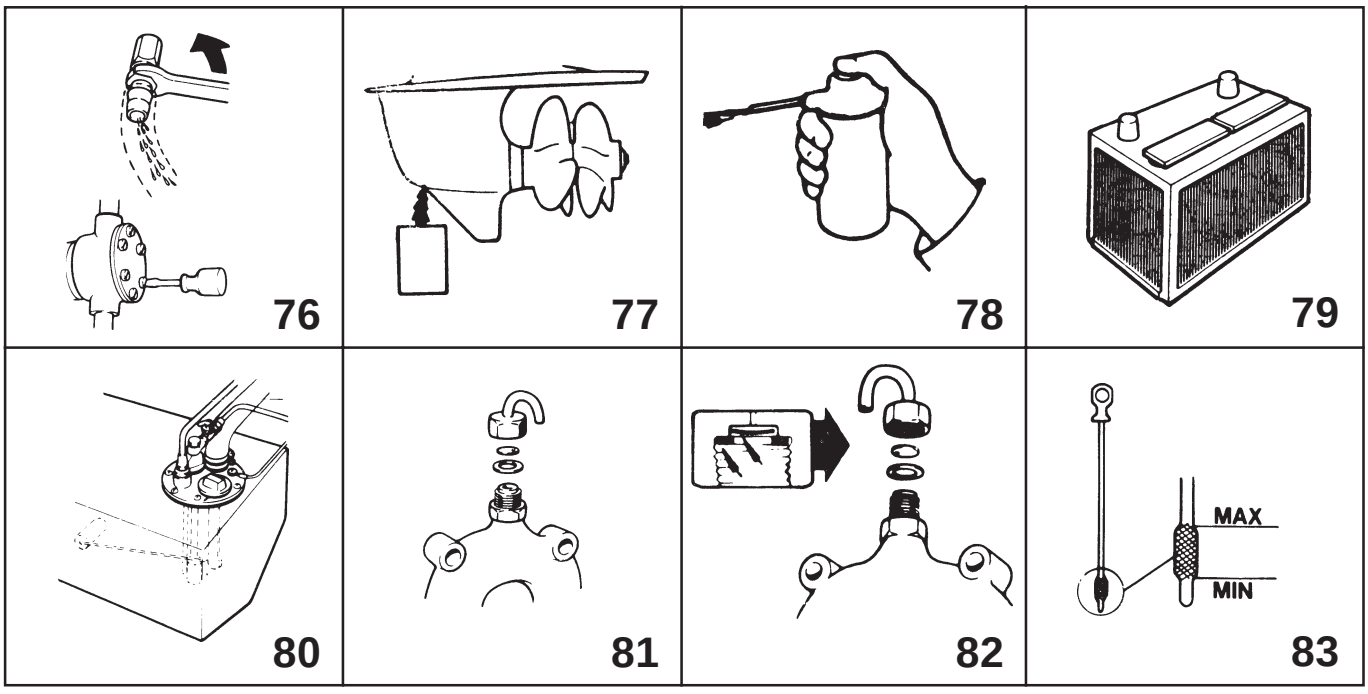
Installation should be done with the valve upside down.

82 Place the diaphragm in the cover. Ensure that the entire diaphragm is placed in the right location. The diaphragm must not be trapped by the gasket. Insert the gasket and screw on the cover. **CAUTION!** Tighten torque 2 Nm (1.47 ft.lbs). If the cover is tightened too hard the valve will stop working.

MEASURES IN CONNECTION WITH LAUNCHING

83 If Volvo Penta oil has been used during lay up only the level needs to be checked.

If another type of inhibiting oil has been used, both the oil and the filter must be changed. See under "Service every 100 hours of operation".



84 Check the drive oil level. If it is too high, it must be lowered by draining. If it is too low, top-up through the hole for the oil dipstick. NOTE! The dipstick must not be screwed down when checking the oil level. Check also the oil level in the hydraulic pump (Power Trim).

85 Check the tightening of all hose-clamps. Check that all drain-cocks are closed and tight. Clean the engine and drive on the outside. Check the exhaust-hoses. Install the impeller.

86 Fill-up the freshwater system to the correct level. Fill up through the filler hole on top of the expansion tank with a 50% mixture of freshwater and rust-proofing ethylene glycol or additive.

87 If the drive has been dismantled and the rack-and-pinion that controls the drive´s trimming angle have come out of alignment, the pinion should be turned until the marked tooth (notched) is visible. Mount the rack so that the first tooth gap engages with the marked tooth.

88 Check carefully bellows for damage and also check the tightening of all hose clamps. NOTE! The junction bellow and hose clips should be replaced every other year. Have the bellows checked and replaced by an authorized Volvo Penta dealer.

Note how the hoseclamps tightening screws are oriented on the right hand picture.

WARNING: Never work on the bellows or the drive´s hydraulics without first locking the drive in position in such a way that there is no possibility of it falling down. if the drive falls it can cause servere injuries.

You can use Volvo Penta special tool no. 885143-8 to ensure that the drive cannot fall down while you are working on it. Proceed as follows:

Trim the drive down to 0. Remove the cotter pin (1) and tap out the cylinder bolts.

CAUTION! Secure the drive so that it does not swing out when the last trim cylinder bolt is tapped out.

The drive can now be tilted by hand to the completely raised position. Hold the drive steady in this position and place the tool (2) on the starboard side as shown in the figure.

NOTE: Do not overload the tool by standing on the drive while it is in the upper position.

89 Check the torque on the Allen-bolts which attached the steeringhelmet to the drive. Tightening torque - see "Technical Data".

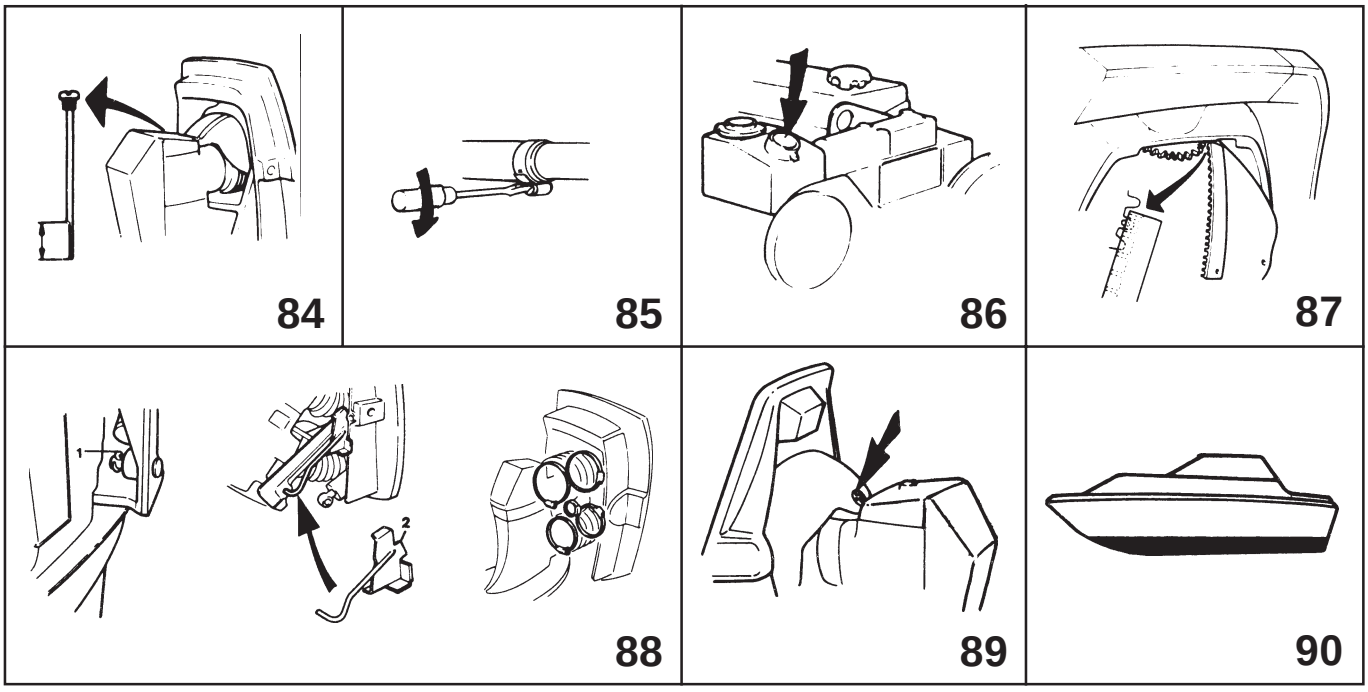
90 Examine the paintwork on the outboard drive. Touch up any blemishes with genuine Volvo Penta paint. Then paint the drive with Volvo Penta anti-fouling paint.

Paint the bottom of the boat with anti-fouling paint.

These anti-overgrowth paints often include tin "TBT" as an active component. On markets where tin based paints are not permitted the drive gear should be teflon treated instead. Use a teflon agent which is free from copper and tin. NOTE! These pure teflon agents are not antigrowth paints; however, the teflon treated surface is so slippery that it is difficult for overgrowths to retain a grip, and the surface is therefore easy to wash clean.

WARNING: The drive gear´s zinc anodes must not be painted or teflon treated. Make sure that there is good metallic contact between the anodes and the drive gear.

Use a pure tin based bottom paint which does not contain copper. On markets where tin based "TBT" paints are not permitted a copper based paint should be used instead. The finished painted surface should have a maximum of 20 g pure copper per m^2. Do not paint closer to the shield/drive gear than 10 mm.



91 Check that the batteries are fully charged. Smear the terminals with pole grease. Connect the battery cables.

WARNING: Do not reverse the polarity. Tighten the cable terminals firmly.

92 If the boat is equipped with a propeller shaft seal of rubber, the following procedure should be observed after launching:

Vent the tubular sleeve and seal by pressing them together and pressing the seal down against the shaft until water emerges. Then press about 1 cm^3 of water resistant grease into the seal.

WARNING: The propeller shaft seal must be replaced after 500 hours or 5 years.

93 Start the engine. (Please see page 4). Check and make sure there is no fuel, water or exhaust gas leakage in the boat. Check also that all steering and control functions are in order.

When necessary, contact an authorized Volvo-Penta dealer. Let them service your engine and drive or reverse gear according to the instructions given in the servicing shedule.

Propellers, SP

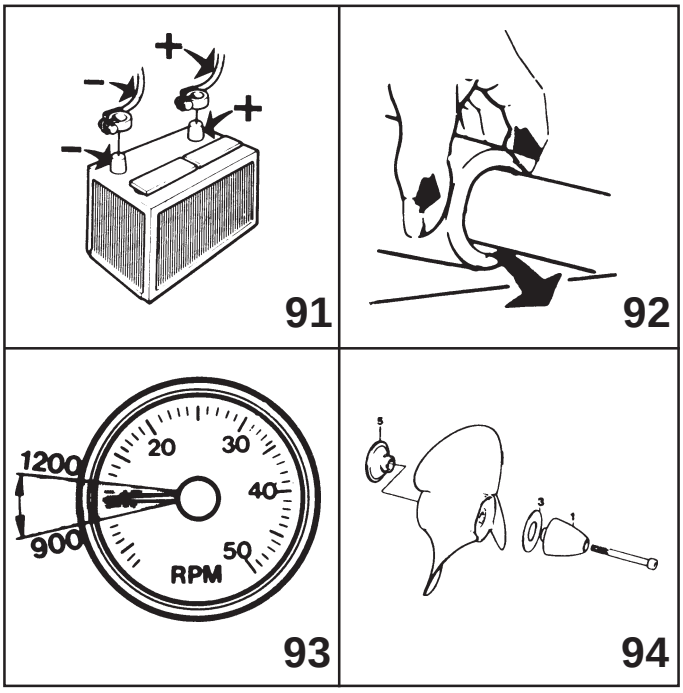
94 The propeller is locked onto the shaft by a bolt and a propeller cone. Remove the bolt and pull off the cone. Pull off the propeller. Note! On the inside of the propeller, there is a spacer sleeve and a deflector ring. Damaged propellers must always be replaced.

1. Apply a thin caot of grease to the propeller shaft.
2. Fit the deflector ring (5).
3. Fit the propeller.
4. Fit the plastic washer (3).
5. Fit and tighten the propeller cone (1).
6. Fit and tighten the center bolt.

WARNING: Engine must be off when changing propeller. Handle fish line cutter and drop carefully as they have sharp edges and may cause injury.

ADJUSTING COURSE DEVIATION

Checkj for deviation in course by releasing the steering wheel when the boat is planning and observe its course. If the boat veers to port or starboard the outdrive trim tab should be adjusted as follows: If, e.g., the boat veers to port, the trim tab under the caviation plate on the drive must be loosened and turned so that the reat edge of the trim tab is positioned slightly to port. Lock the trim tab slightly to port and lock the trim tab in this position. Testrun the boat. Adjust the trim tab further if the boat still tends to veer.



INSTALLING DP PROPELLERS

CAUTION! Before installing the propellers: Switch off the ignition key.

95

INSTALL THE PROPELLERS AS FOLLOWS:

Put the gear in forward.

Installing the forward propeller

Apply grease to both propeller shafts.

Install: Line cutter (1)
Propeller (2)
Tab washer (3)
Nut (4)

Tighten the nut (4) using tool 885127-1 to a torque of 50-75 Nm (5-7.5 kpm/37 lbf tf). Bend in **one** of the tab washer's tabs into a recess in the nut.

Install the rear propeller

Put the gear in reverse.

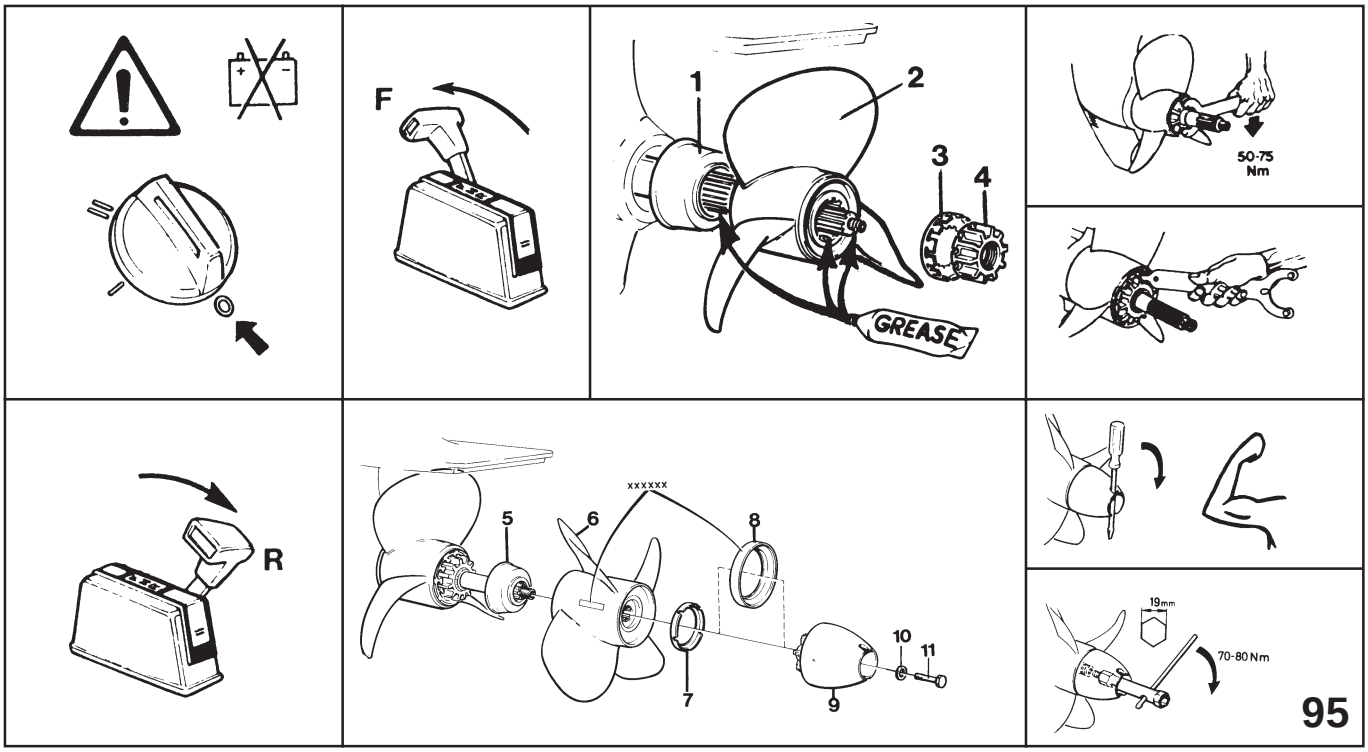
Install: Line cutter (5)
Propeller (6)
Plastic washer (7)
Spacer ring (8)*
Propeller cone (9)
Washer (10)

Tighten the propeller cone. Tighten the screw (11) in the propeller shaft to a torque of 70–80 Nm (7–8 kpm)

Put the gear in neutral before starting the engine.

* Spacer ring (8) intended only for propellers series marked: 852 233, 852 237, 852 241, 852 245, 852 249, 852 253, 852 261, 852 265, 852 269, 852 273.

For earlier executions we refer to the Installation Instruction, which you'll find in the sterndrive- and propeller kits.



FAULT TRACING SCHEME

Tracing faults when having interruptions in operation

The fault tracing scheme given below lists only the most usual of faults that give rise to interruptions in operation.

With the help of the instructions given in this handbook, the owner can generally remedy most of the faluts listed below. When in doubt, always contact the nearest Volvo Penta service workshop.

Follow the maintenance scheme's recommendations - it helps provide trouble-free running.

Engine will not start	Engine stops	Engine does not attain top speed at full throttle	Engine runs unevenly or vibrates abnormally	Engine overheats	Probable cause
●					Main switch not on, flat battery, brake in electric circles or main fuse.
●	●				Empty fuel tank, closed fuel cock, blocked fuel filter.
●	●		●		Water, air or impurities in fuel.
		●	●		Defective injector(s).
		●			Boat abnormally loaded. Marine growth on boat bottom.
		●			Blocked air-filter. Turbocharger faulty.
			●		Damaged propeller.
				●	Blockage in cooling water intake, water filter, defective impeller or thermostat, wrong level in fresh-water system, air in the fresh-water system.

MAINTENANCE SCHEME INSTALLATIONS IN COMMERCIAL USE, WITH DRIVE SP, DP

In addition to these brief instructions, the Instruction Book's detailed instructions must be followed carefully. This also applies to the equipment components as well as for the running-in of the engine.

Please note, however, that the service intervals for commercial use differ from the ones in the Instruction Book.

Daily
- Visual inspection of drive and propellers.
  Damaged propellers are to be replaced.

Monthly
- Check zinc anodes on drive and transom shield.
  If anodes are badly corroded, they are to be replaced.

Every six months:
- Replace zinc anodes.
  Check non-return valve (the rubber flap at the exhaust outlet).

Yearly
- Check painted surfaces for damaged paint or corrosion damages.
  Clean and paint if necessary.
- Replace bellows for universal joint and exhaust.
- Replace bellow between exhaust manifold and exhaust line.

The first 2–5 hours
- Run in the engine with low power output.
- At the end of the period, change oil in engine and drive.
  (Make sure the drive is properly drained).

Every 125th hour
- Change oil (**Note:** Use recommended oil quality!)
- Lubricate steering bushings in transom shield.
- Check oil level in servo pump (on engine).
- Check tightening torque, in particular the following:
  - Lower gear housing and intermediate housing.
  - Upper gear housing and intermediate housing.
  - Drive and helmet.
  - Steering servo pump and bracket.
  - Bracket and transom shield
- Check for abnormal play in steering.
- Tighten hose clamps.
- Check universal joint bellow for water leakage.

Every 500th hour
- Check suspension bushings.
- Check steering bushings and seal in transom shield.
- Lubricate steering bearing in steering fork.
- Check control cable, cubes and control.
- Check earth connection.
- Check oil level in trim pump.
- Check for possible oil leakage from servo cylinder or hoses.
- Check wear/play on push-pull cable.
- Lubricate bearing on primary shaft.
- Check for possible play in holes for suspension axles in the shield.
- Check propeller shafts for straightness.
- Check gear mechanism for function and wear.

Every 1000th hour
- Replace drive with an exchange unit or rebuild the drive totally.
- Exchange remote control cables and cubes.
- Check exhaust line for corrosion damages.
- Check rubber bellow between exhaust manifold and exhaust pipe.
- Check cooling water hose and connection on the inside of the transom shield.
- Check hydraulic hoses for leakage and wear. (On the outside of the transom shield.)

Other service routines may be necessary if the way the products are used diverts considerably from VP's application classes or if gear changes are unusally frequent. (More than 20 manoeuvres per hour on average.)

RESTRICTIONS:
- This Maintenance Scheme is valid for:
  - AQAD41 Medium Duty (165 hp/3600 rpm)
  - AQAD41 Light Duty (200 hp/3800 rpm)
- At the most 1"-extension may be used commercially.
- If the water is heavily polluted, it is necessary to pay attention to corrosion and abnormal consumption of zinc anodes.
- Long running periods in neutral should be avoided. The gear should be in the forward position at least five minutes continuosly every running hour.
- DP-D 2.30:1 may not be used commercially.
- DP-D 1.95:1 may only be used commercially together with AQAD31.

Technical data

Type designation	AD31B MD31A TMD31B TAMD31B	D41B AD41B TMD41B TAMD41B
Output, see sales literature		
Idling speed, (r/m)	650-750	600-700
Bore/Stroke, mm (inch)	92,0/90,0(3,6/3,54)	92,0/90,0(3,6/3,54)
Displacement (lit)	2,39 (1,46 in^3)	3,59 (220 in^3)
Firing order	1-3-4-2	1-5-3-6-2-4
Direction rotation (viewed from front)	Clockwise	Clockwise
Max, forwards incl.	4°	4°
Max rearwards incl underway	15°	15°
Max sidewards incl. underway	20°	20°
Clearence, cold engine inlet mm (in)	0,40 (0,016)	0,40 (0,016)
outlet mm (in)	0,40 (0,016)	0,40 (0,016)

Lubrication system

Engine, oil capacity, (lit) excl filter	8,5 (9qts)	10,5 (11,0 qts)
(lit) incl filter	9,0 (9,5qts)	11,0 (11,5 qts)
At 15° rearwards inclin., (lit) excl filter	9,0 (9,5qts)	11,0 (11,5 qts)
(lit) incl filter	9,5 (10,0 qts)	11,5 (12,0 qts)
Oil quality (API)	CD	CD
Viscosity	SAE 15W/40	SAE 15W/40
Oil pressure - engine hot,		
idling kp/cm^2 (lbs/in^2)	1,5 (21)	1,5 (21)
max revs kp/cm^2 (lbs/in^2)	4,2-5,0 (59-71)	4,2-5,0 (59-71)
Drive SP		
Oil capacity dm^3 (lit)	2,6 (2 2/3 qts)	2,6 (2 2/3 qts)
Oil quality, viscosity	Same as engine	Same as engine
Oil volume between max. and min.	0,15 (1/6 qt)	0,15 (1/6 qt)
Oil volume Power Trim (lit)	1,0 (1,0 qt)	1,0 (1,0 qt)
Oil quality, viscosity	Same as engine or ATF	Same as engine or ATF
Drive DP		
Oil capacity dm^3 (lit)	2,7(2,8 qts)	2,7(2,8 qts)
Oil quality, viscosity	VP Part No. 1141572-6	
Oil volume between max. and min.	0,15 (1/6 qt)	0,15 (1/6 qt)
Oil volume Power Trim (lit)	1,0 (1,0 qt)	1,0 (1,0 qt)
Oil quality, viscosity	Same as engine or ATF	Same as engine or ATF
Reverse gear MS4B		
Oil volume (lit)	1,7 (1,8 qts)	1,7 (1,8 qts)
Oil quality	VP Part No. 1141572-6	
Reverse gear HS 1A		
Oil volume dm^3 (lit), incl oil cooler and oil filter	–	3,3
Oil quality, viscosity	–	Same as engine
Reverse gear PRM302, oil volume (lit)	2,5	–
Reverse gear PRM402, oil volume (lit)	3,25	3,25
Oil quality, viscosity	Same as engine	Same as engine

Cooling system

Thermostats open/fully open at	81°C/94°C (178°F/201°F)	81°C/94°C (178°F/201°F)
Fresh water system, capacity, lit	13 (13,5 qts)	19 (20,0 qts)
Normal temperature	75-90°C (167-194°F)	75-90°C (167-194°F)

Electrical system

System voltage, V	12	12
Battery capacity, starter motor max Ah	140	140
Battery electrolyte spec. grav.:		
Charging to be carried out at g/cm³	1,230	1,230
Fully charged battery, g/cm³	1,275-1,285	1,275-1,285
Alternator rating max	14V 50A	14V 50A
Starter motor rating, hp (kW)	3,4 (2,3)	3,4 (2,3)

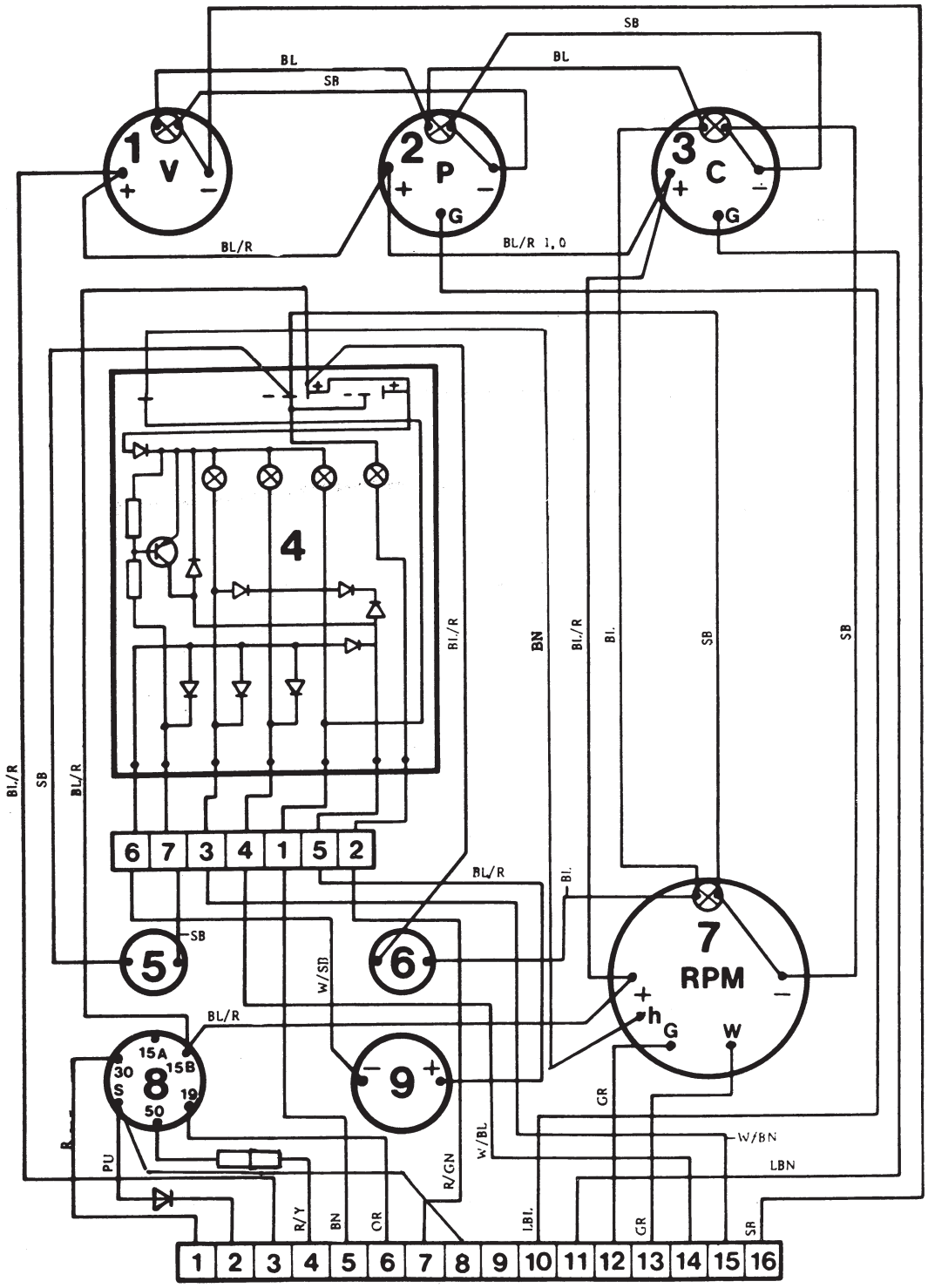
Tightening torques

Steering Helmet Allen bolt	3,5 kpm (35 Nm) 25 ft lbs	3,5 kpm (35 Nm) 25 ft lbs

Transmission ratios	Pleasure duty	Light duty	Medium duty
MD 31	MS4B 1.91:1, 2.6:1	MS4B 1.91:1, 2.6:1	MS4B 1.91:1, 2.6:1
TMD31	MS4B 1.91:1, 2.6:1	MS4B 1.91:1, 2.6:1	–
TAMD31	MS4B 1.91:1, 2.6:1	MS4B 1.91:1, 2.6:1	PRM302 1.9:1; 2.9:1 PRM402 3.95:1
AD31	SP 1.61:1 DP 2.3:1	SP 1.61:1 DP 2.3:1	–
TMD41	MS4B 1.91:1, 2.6:1	MS4B 1.91:1, 2.6:1	–
TAMD41	MS4B 1.91:1, 2.6:1	MS4B 1.91:1, 2.6:1	PRM402 1.9:1;2.9:1 PRM402 3.95:1
D41	SP 1.61:1 DP 1.95:1, 1.78:1	SP 1.61:1 DP 1.95:1, 1.78:1	–
AD41	SP 1.61:1 DP 1.95:1, 1.78:1	SP 1.61:1 DP 1.78:1, 1.95:1	SP 1.61:1 DP 1.78:1

Engine weights	Kg	lbs
MD31/MS4B	360	792
TMD31/MS4B	375	825
TAMD31/MS4B	385	847
AD31/DP	440	968
AD31/SP	433	952
TMD41/MS4B	455	1000
D41/SP	503	1105
D41/DP	510	1122
TAMD41/MS4B	465	1023
AD41/SP	513	1128
AD41/DP	520	1144

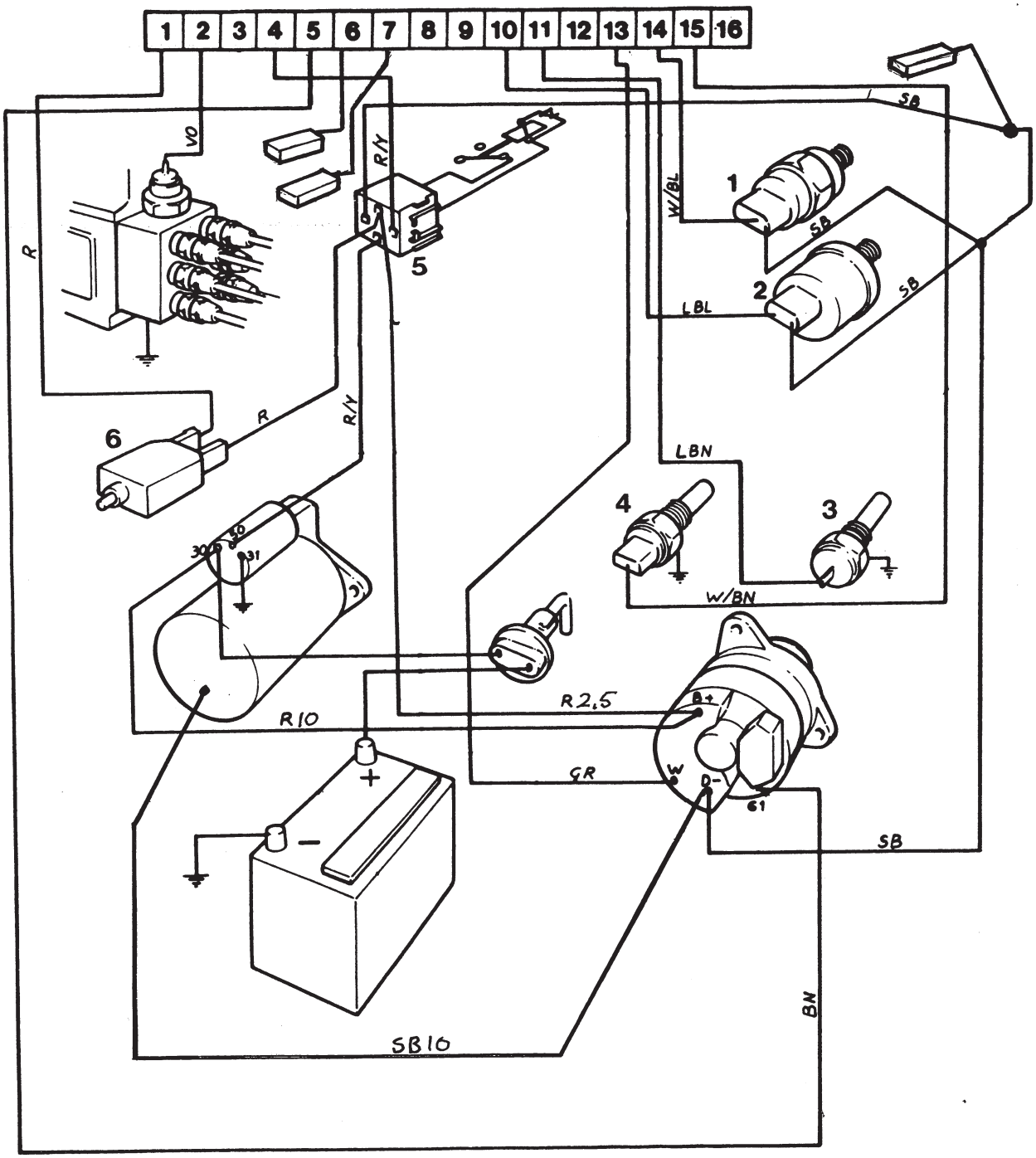
Electrical Wiring Diagram



Instrument panel

1. Voltmeter
2. Oil pressure gauge
3. Coolant temperature gauge
4. Printed circuit card
5. Push button
6. Switch for instrument lighting
7. Rev. counter
8. Key switch
9. Alarm

Electrical Wiring Diagram (12V)



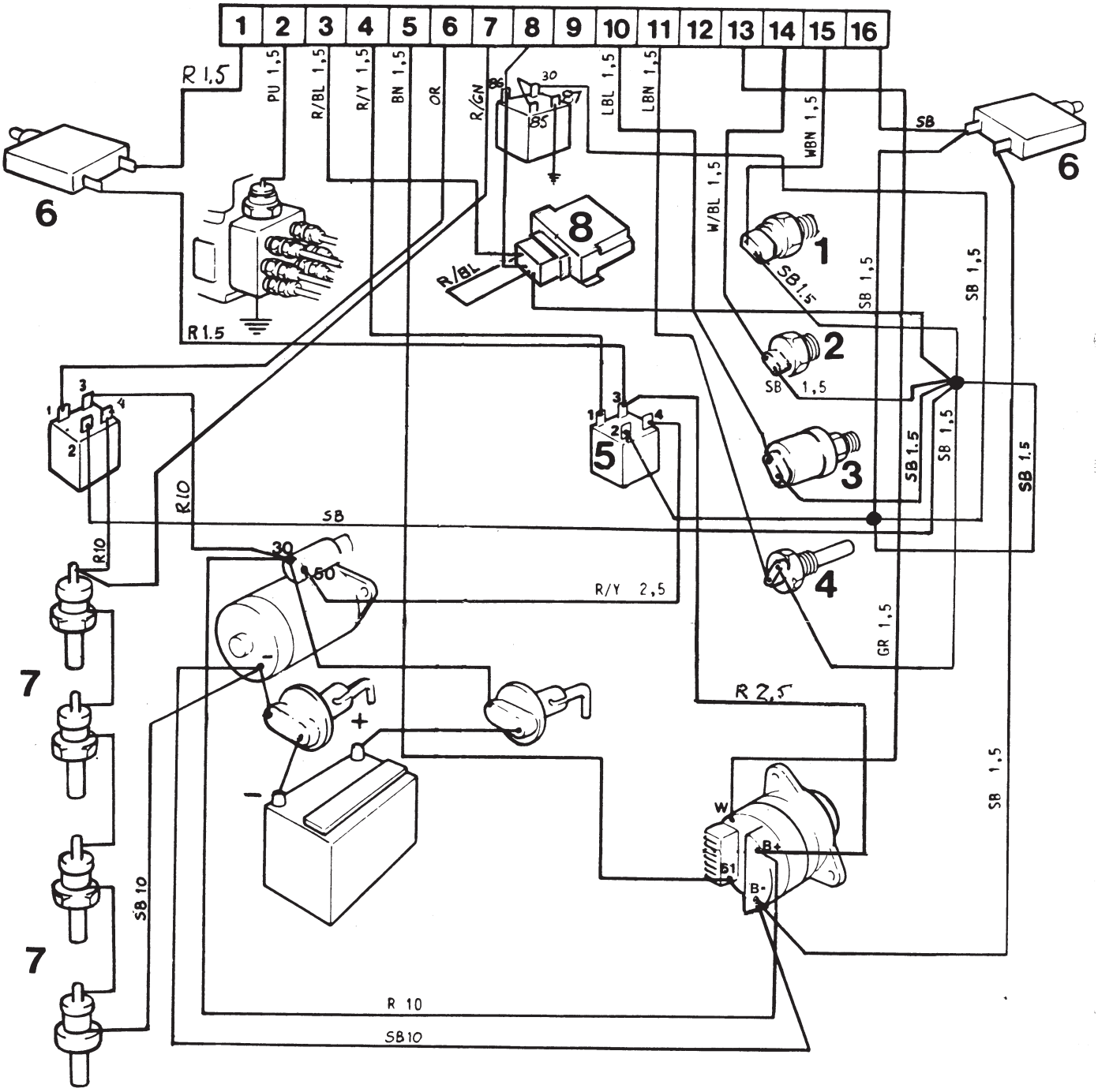
Engine

1. Oil pressure check
2. Oil pressure sender
3. Coolant temperature sender
4. Coolant temperature check
5. Relay
6. Fuse

Wire colour

GR	= Grey
SB	= Black
BN	= Brown
LBN	= Light brown
R	= Red
PU	= Purple
GN	= Green
Y	= Yellow
W	= White
BL	= Blue
LBL	= Light blue

Electrical Wiring Diagram (24V)



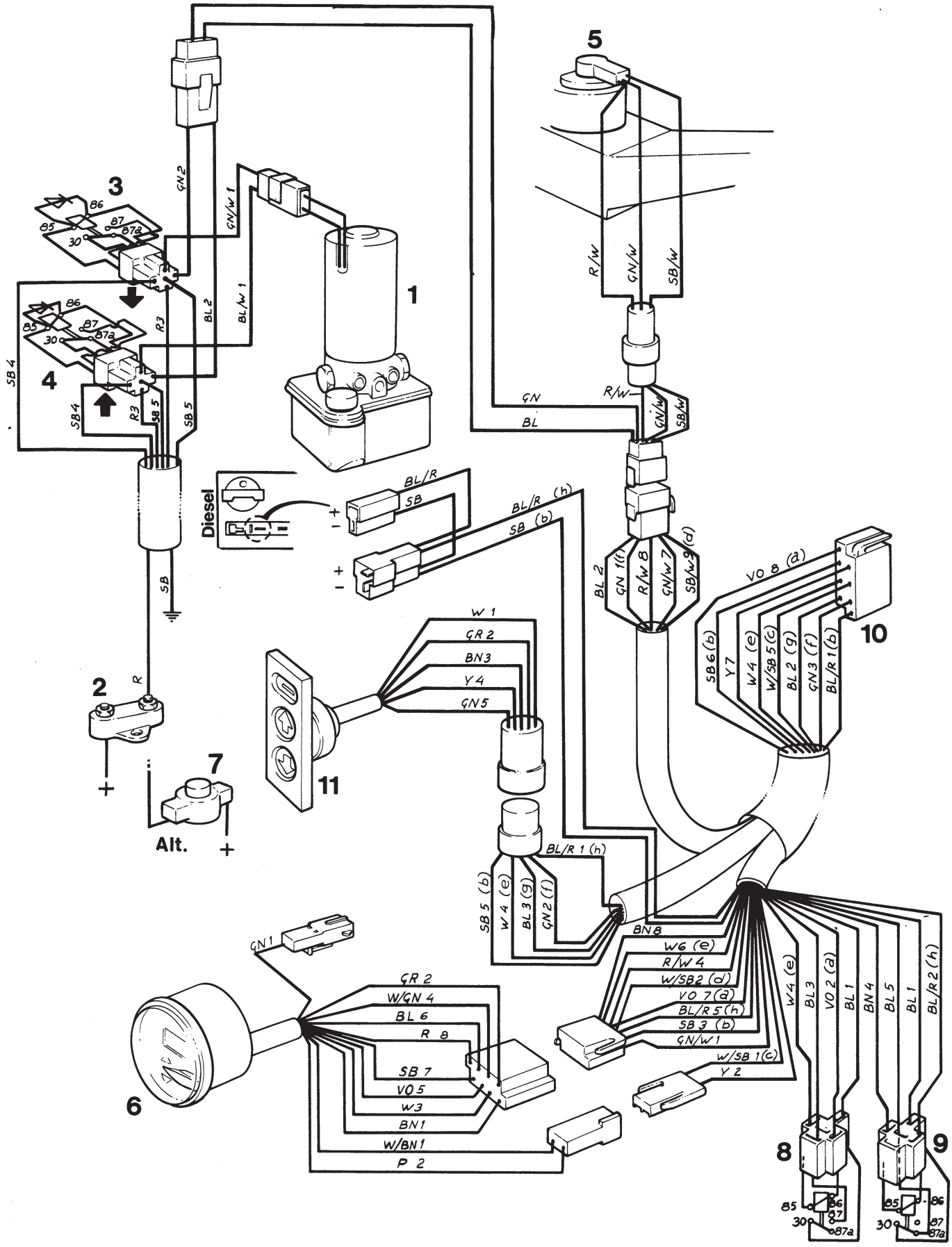
Engine

1. Coolant temperature check
2. Oil pressure check
3. Oil pressure sender
4. Coolant temperature sender
5. Relay
6. Fuse
7. Preheating (Accessorie)
8. Emergency stop engine (Accessorie)

Wire colour

GR	= Grey
SB	= Black
BN	= Brown
LBN	= Light brown
R	= Red
PU	= Purple
GN	= Green
Y	= Yellow
W	= White
BL	= Blue
LBL	= Light blue

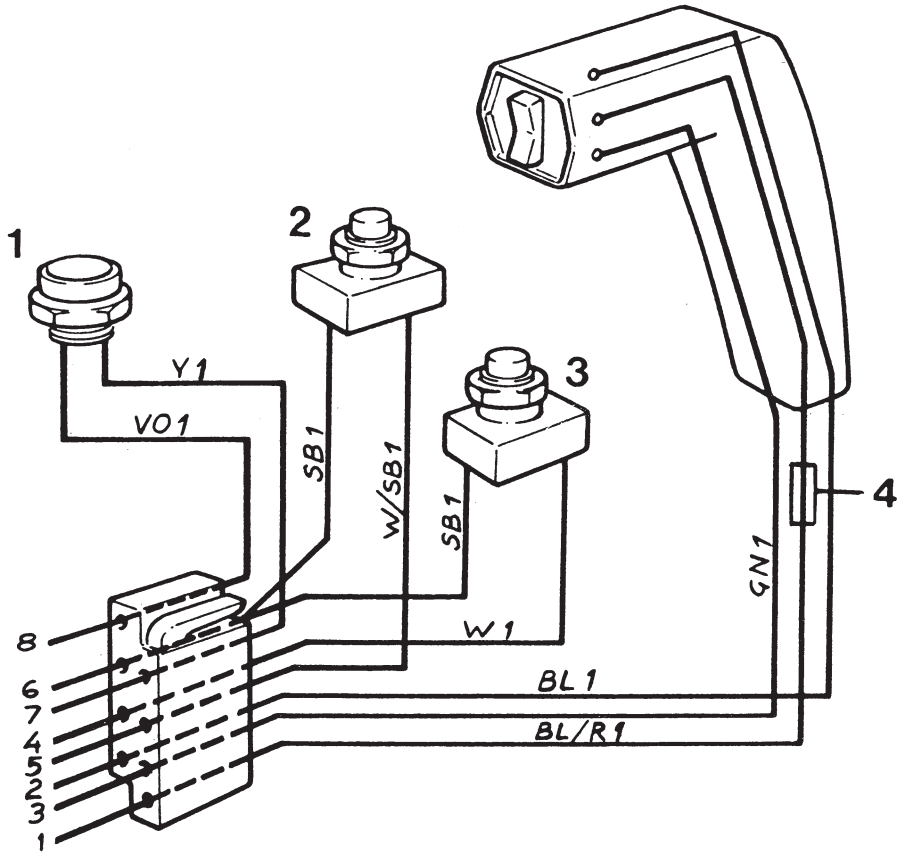
Wiring diagram, Power Trim



1. Oilpump
2. Fuse
3. Relay, down
4. Relay, up
5. Trimsender
6. Triminstrument
7. Button (Beach range)
8. Relay (By-pass)
9. Relay (Tils stop)
10. Connection, trim-control
11. Trimcontrol (Accessory)

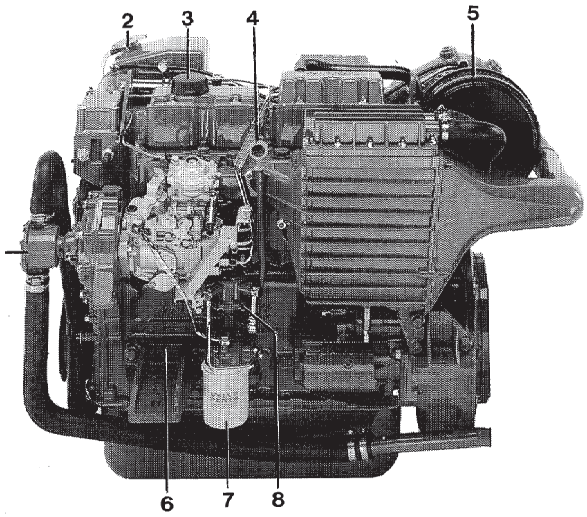
Example:
(a) ‹ › (a) means that these cables are connected

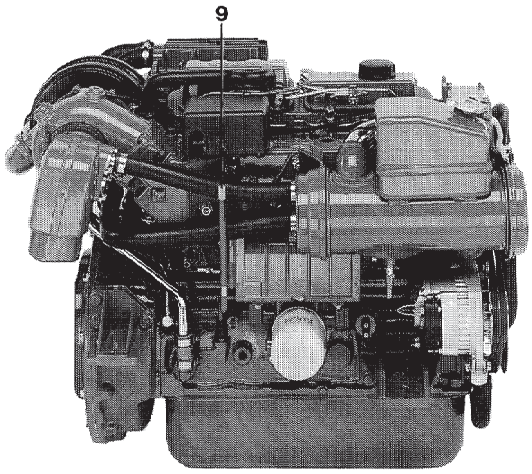
Wiring diagram, Control and switches



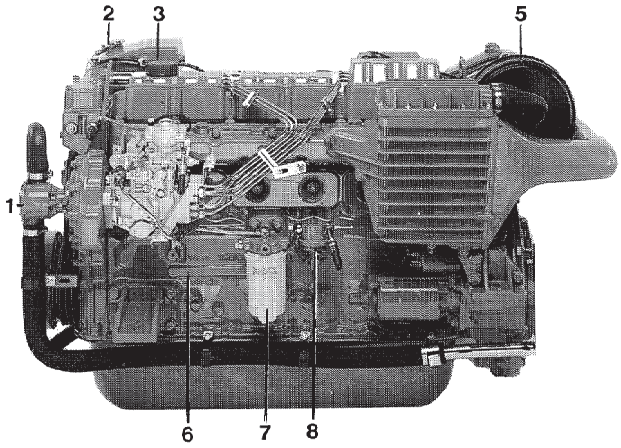
1. Bulb (hold function beach)
2. Button (hold function beach)
3. Button (by-pass)
4. Fuse (5A)

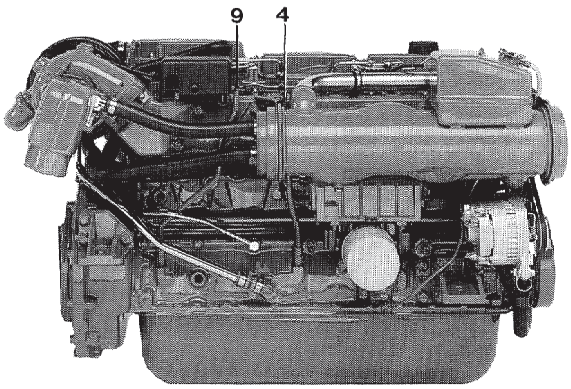
D31





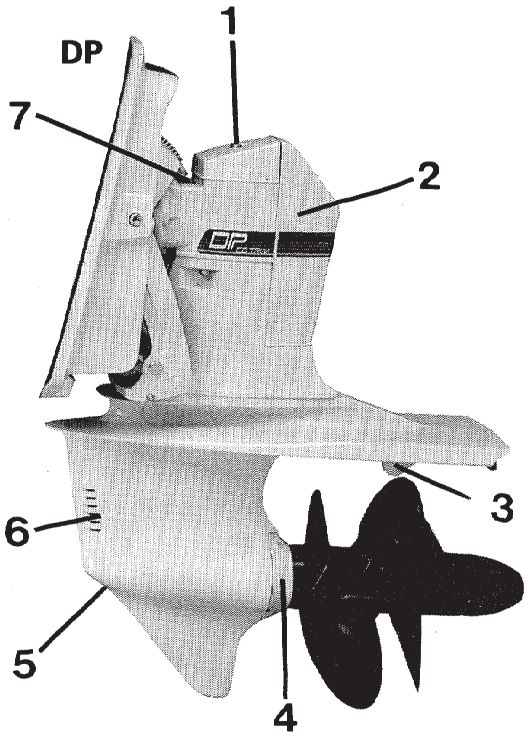
D41

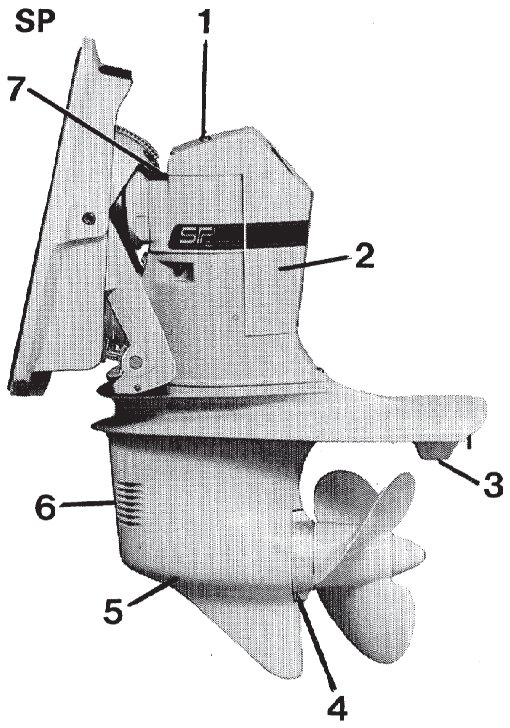




Engine component guide

1. Sea water pump
2. Fresh water filler
3. Enigne oil filler
4. Oil dipstick
5. Air filter
6. Engine serial number
7. Fuel filter
8. Feed pump
9. Pipe for oil bilge pump





Drive SP, Drive DP

1. Oil dipstick
2. Shift mechanism cover
3. Trim tab
4. Zinc-ring
5. Oil draining
6. Cooling water intake
7. Serial number

Reverse gear, MS4B

1. Oil dipstick
2. Oil filling

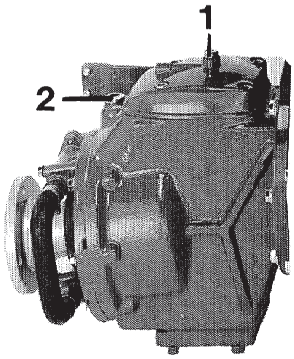
Reverse gear, PRM

1. Oil dipstick, oil filling

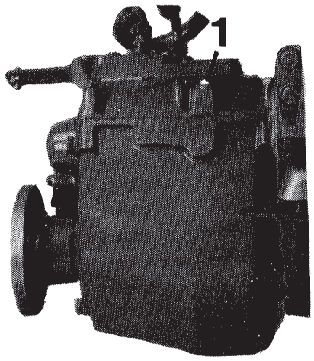
Reverse gear, HS 1A

1. Oil dipstick, oil filling

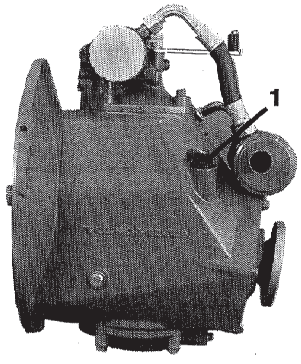
MS4B



PRM



HS 1A



7746337 English 09-1992