INSTRUCTION BOOK

AQ130/280, AQ170/280

VOLVO
PENTA

FOREWORD

Before you start using your new Volvo Penta marine engine, we recommend that you read this instruction book carefully. It contains all the information you need to run and service your engine in the best possible way.

Volvo Penta have built up av 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 convinced that the demands concerning good running economy and high performance, which you have every right to make on a quality product such as this, will be more than satisfied and that your engine will serve you faithfully during many pleasant sea trips.

WARRANTY

A warranty certificate is supplied with each engine and it gives information about the warranty to which the customer is entitled, in connection with the remedying of any faults on the product.

The certificate also contains coupons for a delivery inspection and service inspection. These coupons should be completed by the dealer or the boat salesman and sent on to Volvo Penta.

If our warranty is to apply, it is an absolute condition that the engine and equipment should be maintained according to the instructions in this book.

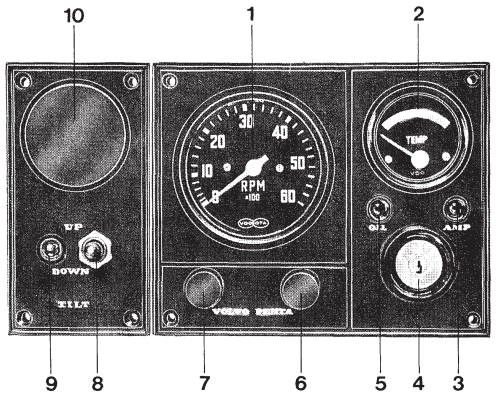
Make sure that your engine type is the same as the one described in this instruction book.

AB VOLVO PENTA
Technical Information Department

CONTENTS

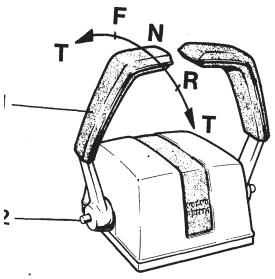
INSTRUMENTATION AND CONTROLS

INSTRUMENT PANEL

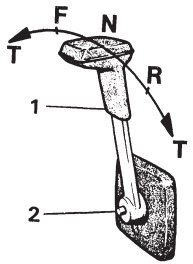


1. **Revolution counter** — graduated 0-6000 rev/min
2. **Temperature gauge for cooling water** Green scale – Normal cooling water temperature
3. **Control lamp for battery charging** Red light — no charging
4. **Key switch with built-in starter**
5. **Warning lamp for oil pressure** Red light — stop engine, insufficient oil pressure
6. **Switch for instrument lighting**
7. **Switch for extra lighting**
8. **Control switch** "Up" — drive up "Down" — drive down
9. **Warning lamp** — Red light indicates disengaged retaining pawl or outboard drive tilted up. Do not start the engine while this lamp is on
10. **Place for extra instruments** (Ø 52 mm) = 2.05 in)

OPERATING CONTROLS



Volvo Penta twin control system



Volvo Penta single control system

N = neutral
F = oprating lever in position for running "forward"
R = operating lever in position for running in "reverse:'
T = throttle

1. **Operating lever**
2. **Disengaging device**

Push in the button when the operating lever is **neutral** and move the lever slightly forwards. Release the button. The lever now only operates the throttle.
Push the button in and **pull the operating lever backwards** to neutral. The operating lever now operates both speed and shifting simultaneously.

GENERAL INFORMATION

Important information concerning the function of your engine:

FUEL

Use only high-octane premium petrol (gasoline) with an octane rating of at least 90 (Research Method). The engine can be run on petrol without lead additives.

LUBRICATING OIL

Only use oil with quality designation SE (MS) according to the API system.

Volvo Penta oil for petrol (gasoline) engines meets these quality demands and should preferably be used. If any other oil is used, see "Technical data" regarding the viscosity.

RUNNING IN

A new marine engine requires careful running-in during the first 20 hours of operation. Avoid, therefore, loading the engine to the full during this period.

SERVICE INSPECTION

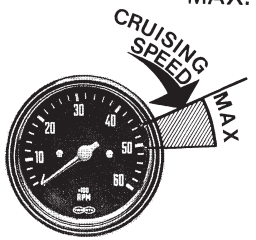
After about 20 hours of operation or at the latest 60 days after delivery you are entitled to a service inspection carried out by a Volvo Penta authorized workshop.

OIL CHANGE

In connection with the service inspection after 20 hours of operation, the oil in the engine and the oil filter should be changed. See further "Checking and Service".

ENGINE SPEED

MAX. SPEED:



AQ130D, 85 rev/s (5100 rev/min)[1]
AQ170C, 83.3 rev/s (5000 rev/min)

Maximum permissible engine speed for longer periods of time, so-called cruising speed is 5–8 rev/sec (300–500 rev/min) under the maximum engine speed reached.

With a correctly chosen propeller size and a boat with normal load, the maximum engine speed should be between 75–85 rev/s (4500–5100 rev/min) respectively 75–83,3 rev/s (4500–5000 rev/min). If this speed cannot be reached there is a risk of overloading the engine. N.B. When the boat has been in the water for some time the speed and the maximum engine speed can decrease due to marine growth on the bottom of the boat and on the outboard drive. Prevent this growth by painting the bottom and the outboard drive with anti-fouling paint, see "Measures when launching".

[1] For light, fast boats above 30 knots 91.7 rev/s (5500 rev/min) applies.

SAFETY EQUIPMENT

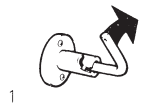
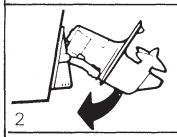
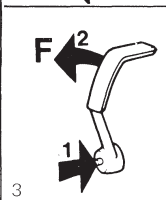
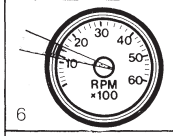
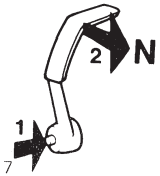
Regardless of whether the boat is to be used for long cruises or short bathing trips it should be equipped with the safety equipment listed below, to which additions can be made according to personal taste. Check at regular intervals that the safety equipment is actually on board and that it is in working order.

LIFE JACKETS for all on board
FIRE EXTINGUISHER, approved, at least one and fitted for easy access
DISTRESS ROCKETS and matches. Packed watertight
FIRST AID BOX
TOOLS which fit the equipment on board
ON-BOARD KIT containing spare parts, e. g. pump impeller etc,
ANCHOR with line
RADAR REFLECTOR
RADIO for listening to, e. g. the weather forecast
COMPASS which is deviated
BOAT HOOK and **PADDLE**
MOORING ROPES
FOG HORN and **WHISTLE**
FLOATING ANCHOR
TORCH
PROPELLER

PREPARATIONS BEFORE STARTING

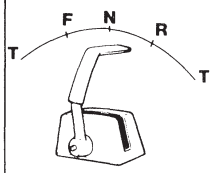
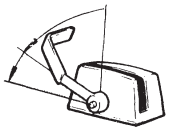
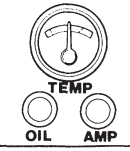
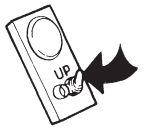
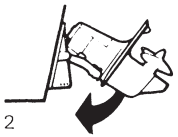
Check:
that there is no **FUEL LEAKAGE**
that there is no **WATER LEAKAGE** from engine or hull
That there is no **OIL LEAKAGE**
that there is no **SMELL OF LP-GAS** in the lower parts of the boat or elsewhere
that the **OIL LEVEL** is correct
that you have up-to-date **NAUTICAL CHARTS** on board for the planned voyage
that there is enough **FUEL** for the planned voyage
When filling fuel, check that there is no naked flame on board, e. g. lighted gas stove in the galley. Before starting the engine ventilate the boat and run the engine compartment fan. Do not fill too much fuel so that it overflows.
If there are people who are on board for the first time, tell them how the boat is manoeuvred and where the life jackets and the fire extinguisher are placed. Also tell them anything else you think necessary from a safety point of view. Should anything unexpected happen during the voyage it is then very often too late to tell the people on board how the safety equipment works.

STARTING THE ENGINE

 1	**Turn on the master switch.** **Start the engine compartment fan** and allow it to run for a few minutes before starting the engine.
 2	**Lower the outboard drive** if it has been tilted up. Make sure that there are no obstacles near the propeller. The warning lamp should be out.
 3	**Release the engine speed control** from the shift control as follows: Push in the red release button (1) when the control lever (2) is in neutral and move the lever slightly forwards. Release the button. The control lever now only operates the engine speed. **In cold weather:** "Pump" a few times with the control lever. N.B. This applies only to a cold engine!
 4	**Turn the ignition key** one step to the right. The control lamp for the charging and the warning lamp for the oil pressure should now be alight and the buzzer (if fitted) should sound. Press the key in and turn it to the right to start the engine. Release the key as soon as the engine has started.
 5	**Immediately after starting check** that the warning lamp for the oil pressure and the control lamp for the charging are out and that the buzzer is silent. If any of the lamps are still alight or the buzzer sounds stop the engine immediately and try to find the cause.
 6	**Run the engine warm** at a fairly rapid idling speed, i. e. 20–25 rev/s (1200–1500 rev/min). When the pointer of the temperature gauge has entered the green scale the boat is ready to move off.
 7	Lower the speed to idling and check that the engine runs smoothly. **Engage the shift control** as follows: Push in the red release button (1) when lever (2) is in neutral. Release the button. The control lever now operates the shift and the engine speed simultanyously.

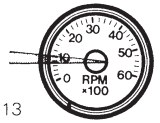
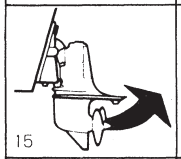
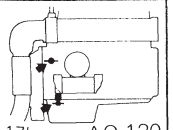
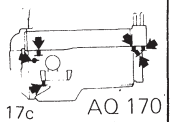
RUNNING INSTRUCTIONS

RUNNING INSTRUCTIONS

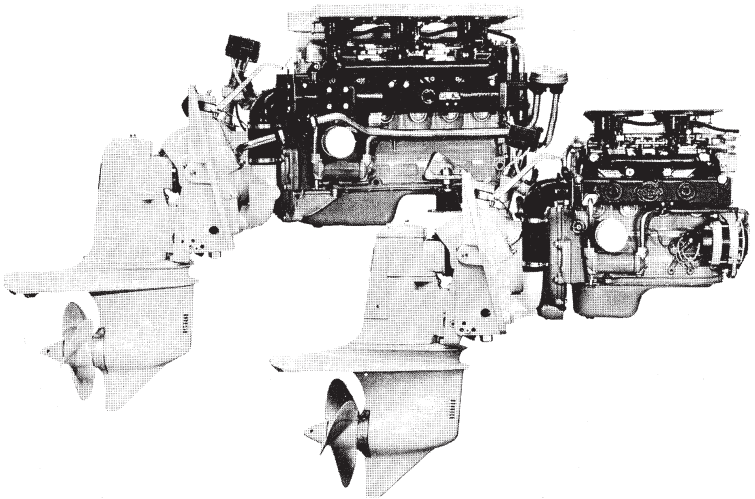
 8	The single control lever actuates both the speed and the power transmission simultaneously. F = Forward R = Reverse N = Neutral T = Throttle
 9	In order to obtain good running economy, the engine should not be run at max. speed for long periods of time. Note that the max. permissible running speed over longer periods, so-called "crusing speed" is 5–8 rev/s (300–500 rev/min) below the maximum reached speed for the boat.
 10	While running check that the engine temperature is normal (pointer within the green scale) and that the lamps for the charging and oil pressure are out. If the temperature becomes too high or any of the lamps light up, immediately stop the engine and try to find the cause of the fault.
 11	**Running in shallow water** If you are uncertain about the depth of the water it is recommended that the speed should be lowered and that the switch for the drive lift is kept in position "Up" for a few seconds. The drive warning lamp will show a red light and the retaining pawl will be disengaged. **N.B. It is now not possible to reverse.**
 12	**Running in reverse** In order to make reversing possible, the drive gear must be down and the control lamp out. **IMPORTANT. Never shift to reverse when the boat is planing.**

RUNNING INSTRUCTIONS

SHUTDOWN PROCEDURE

 13	After running allow the engine to idle for a few minutes with the control lever in neutral.
 14	Stop the engine by turning the key back to the switched-off position.
 15	If the water is shallow at the mooring place and there is a risk that the drive gear can strike the bottom, it should be raced as much as possible. Otherwise there is no need to keep the drive up.
 16	Turn off the master switch. N.B. **The master switch must never be turned off before the engine has stopped.** Before you leave the boat, check that no water leakages have arisen.
 17a	**In cold weather** when there is a risk of freezing, the cooling water should be dráined from the engine.
 17b AQ 130	Draining is done by opening the cocks on the oil cooler and on the cylinder block. AQ170 is provided with cocks also at the front and rear part of the exhaust manifold and at the circulation pump.
 17c AQ 170	Also take off the cover for the seawater pump. N.B. **Close the cocks and tighten the cover before leaving the boat.**

If possible carry out measures which will make it more difficult to steal the boat. Never leave the boat "ready" for running, Fit VOLVO PENTA steering wheel lock.



ENGINE ASSEMBLY

The AQ130D and AQ170C are in-line, seawater cooled, four- resp, six-cylinder marine engines with overhead valves. The cylinder block and cylinder head are made of cast iron. The cylinder bores are drilled directly in the block. The crankshaft is journalled in five respectively seven main bearings.

LUBRICATING SYSTEM

The lubricating system is provided with an oil cooler and a full-flow type oil filter. All oil is cleaned and cooled before it reaches the various lubricating points. The relief valve in the oil pump prevents the pressure from becoming too high.

ELECTRICAL SYSTEM

The electrical system has a voltage of 12 V

The engine is fitted with an alternator with a built-in rectifier. The voltage is controlled by a transistorized regulator. The alternator makes it possible to charge two battery circuits independent of each other if a charging distributor (accessory) is fitted on the alternator.

The main fuse which is easy to change is fitted on the engine. It protects the electric system from damage in the event of overloading.

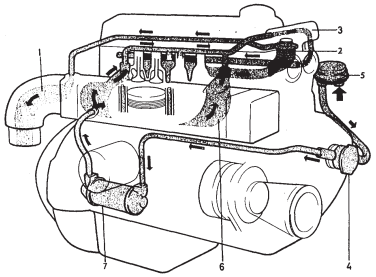
Wiring diagrams for engine and instrument panel are shown on pages 34–35 where also a diagram suggesting how to connect optional equipment is shown.

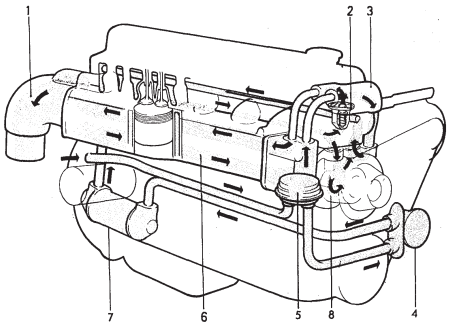
TECHNICAL DESCRIPTION

FUEL SYSTEM

The fuel system comprises fuel pump, two down-draught carburetors for AQ130 and three for AQ170 with flame arresters and intake silencers. The fuel pump which is driven by the camshaft is of the diaphragm type. The carburetors which are provided with anti-flooding devices have fixed jets and an acceleration pump.

COOLING SYSTEM





1. Exhaust elbow
2. Thermostat
3. Distribution housing
4. Seawater pump
5. Seawater filter
6. Water-cooled exhaust manifold
7. Oil cooler
8. Circulation pump

The engine is seawater cooled. The seawater system comprises water filter, thermostat, seawater pump and oil cooler and on AQ170C also a circulation pump.

The seawater pump, which has an impeller made of neoprene rubber, is driven from the camshaft via a rubber drive flange.

The circulation pump (AQ170) is driven by the same V-belt as the alternator.

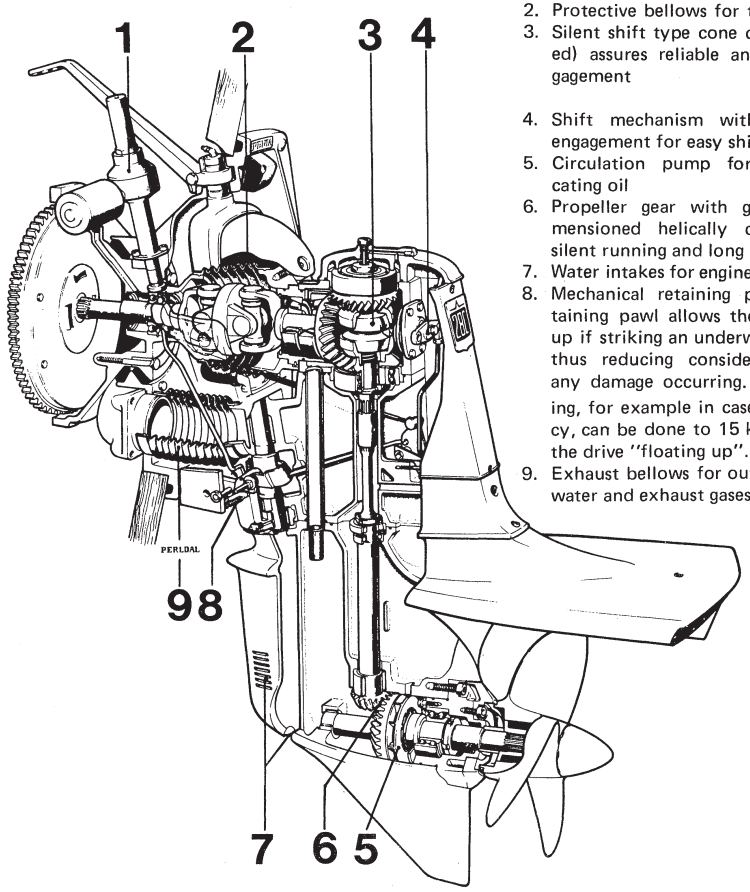
In order to prevent, for example seaweed from entering the cooling passages of the engine, there is an easily cleaned filter fitted. The thermostat controls water circulation and maintains the correct working temperature.

The outgoing cooling water always passes the exhaust pipe and the elbow and is then mixed with the exhaust gases of the engine.

TECHNICAL DESCRIPTION

DRIVE 280

The aquamatic outboard drive model 280 is designed in such a way that it provides very low resistance to water flow at high speeds. The drive which can be steered is suspended in a mounting collar which is bolted to the outside of the boat transom and it can be tilted up with the help of an electro-mechanical lifting device.



1. Electro-mechanical lifting device for tilting up the drive.
2. Protective bellows for the drive joint
3. Silent shift type cone clutch (patented) assures reliable and smooth engagement
4. Shift mechanism with power disengagement for easy shifting
5. Circulation pump for drive lubricating oil
6. Propeller gear with generously dimensioned helically cut gears for silent running and long service life
7. Water intakes for engine cooling water
8. Mechanical retaining pawl. The retaining pawl allows the drive to tilt up if striking an underwater obstacle, thus reducing considerably risk of any damage occurring. Rapid reversing, for example in case of emergency, can be done to 15 knots without the drive "floating up".
9. Exhaust bellows for outgoing cooling water and exhaust gases

CHECKS AND SERVICE SCHEME

Checking and service should be carried out regularly according to the intervals given below. Let an authorized Volvo Penta Service Workshop maintain your engine.

CHECK DAILY BEFORE STARTRING that

CHECK every 14 days that

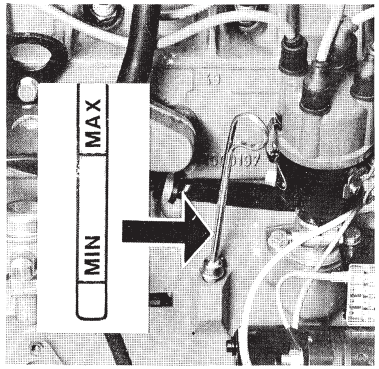
SERVICE EVERY 50 HOURS OF OPERATION

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

MEASURES IN CONNECTION WITH LAYING-UP AND LAUNCHING THE BOAT

CHECK DAILY BEFORE STARTING

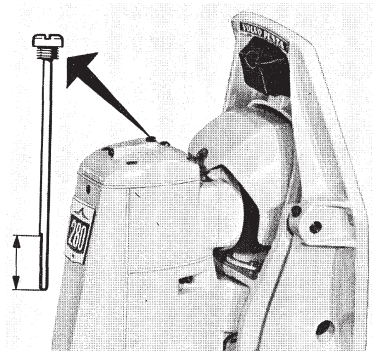
OIL LEVEL IN ENGINE



Check daily before starting for the first time that the oil level stands between the marks on the dipstick. If necessary top up with oil through the filler hole on the valve cover. N.B. Do not fill above the max. mark. Regarding the choice of oil see under "Technical Data".

CHECK every 14 days

OIL LEVEL IN DRIVE



The drive should be fully down when checking the oil level. The oil level should come within the marks on the dipstick. Do not screw the dipstick down when checking. Make sure that water cannot get into the drive when the check is carried out. If necessary top up with oil through the hole for the dipstick. Regarding the choice of oil see under "Technical Data".

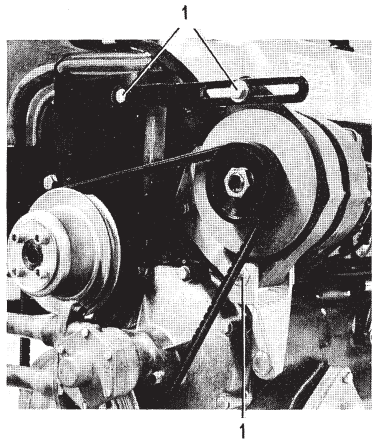
N.B. Pay attention to the O-ring in the groove under the plug on the dipstick.

ELECTROLYTE LEVEL IN BATTERY

The level should stand 5–10 mm (3/16–3/8 in) above the cell plates in the battery. If necessary top up with destilled water. N.B. Observe great care as the elektrolyte is corrosive and the gases which are formed in the battery are explosive.

CHECKS AND SERVICE

BELT TENSION

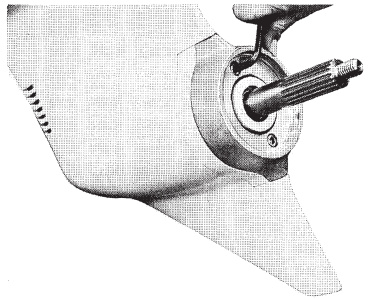


The correct belt tension is essential to maintain full alternator output and on AQ170 also to maintain correct cooling water temperature. The belt should be tensioned so that with the pressure of your thumb it should deflect 5 mm (3/16 in) between the belt pulleys.

The belt can be tensioned after the alternator attaching points (1) have been slackened.

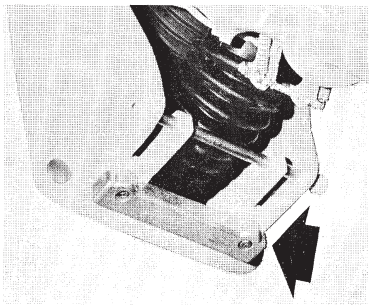
A badly worn or cracked belt should be changed. See under "Checking and changing V-belt".

PROTECTION AGAINST CORROSION



The zinc ring inside the propeller should be changed when about half of the ring has been corroded away. See under "Removing and fitting propeller".

Scrape the contact surface against the propeller housing clean before fitting a new zinc ring.

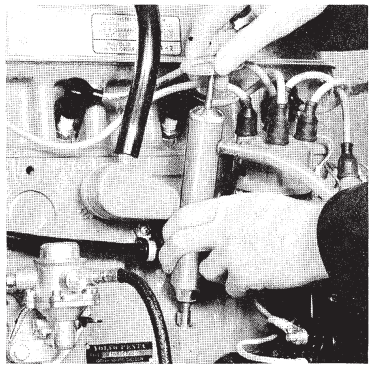


Change the zinc plate under the collar when half of the plate has worn away.

Scrape the contact surface clean before fitting the new zinc plate.

SERVICE EVERY 50 HOURS OF OPERATION

CHANGE OIL IN ENGINE



With a new engine or a reconditioned engine the oil should be changed for the first time after 20 hours of operation and then every 50 hours.

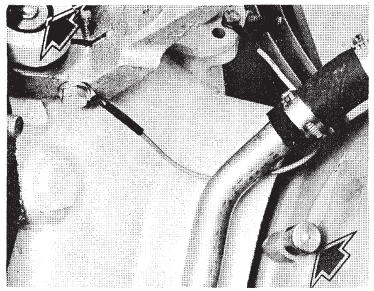
Run the engine until warm. Suck up the oil through the hole for the dipstick.

Fill oil to the correct level. See under "Technical Data" regarding the choice of oil.

N.B. The oil filter should be changed every second time the oil in the engine is changed.

LUBRICATING THE DRIVE AND STEERING SHAFT JOURNALLING

DRIVE SHAFT JOURNALLING

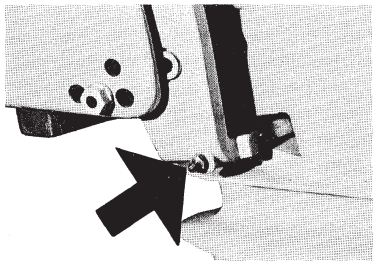


Fill the lubricator for the drive shaft bearing with water-resistant grease and screw it right down.

Grease the upper steering shaft bearing with a grease gun filled with water-resistant grease until grease is squeezed out at the bearing.

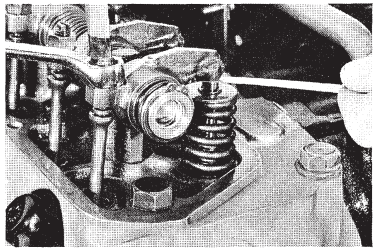
CHECKS AND SERVICE

STEERING SHAFT JOURNALLING



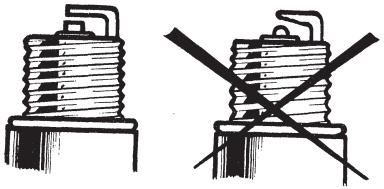
Lubricate the lower steering shaft bearing using a grease gun filled with water-resistant grease until the grease is squeezed out at the bearing.

VALVE CLEARANCE



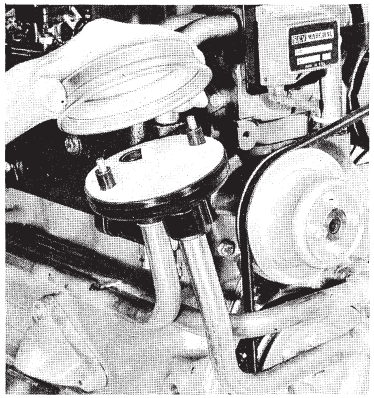
Checking and adjusting the valve clearance should be carried out by an authorized workshop, see under "Valves, Technical Data".

SPARK PLUGS



Check the electrode gap and adjust if necessary. If the spark plugs are damaged or worn, the edges of the electrodes rounded, they should be changed and replaced by plugs with the same data. See under "Technical Data".

SEA-WATER FILTER



Remove the two brass nuts. Insert a screwdriver in the clamp on the cover and lever up the cover. Note there is a risk of water getting into the boat. Lift up and clean the filter. Then position the filter with the broader stud upwards, put on the cover and tighten the nuts.

Start the engine and check that the filter is not leaking and that the engine temperature is normal.

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

OIL FILTER

The oil filter should be changed for the first time after 20 hours of operation and then every second time the oil is changed. Screw off and discard the oil filter. Try to avoid oil spillage.

Apply some oil to the rubber gasket of the new filter and check that the contact surface on the engine is clean and screw the filter on **by hand** until it just touches the contact surface. Then tighten the filter a further **half turn, but not more.**

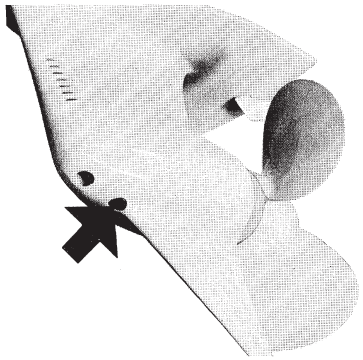
N.B. Use only a genuine oil filter with a diameter of 92 mm (3.62 in).

Start the engine and run it at idling speed and check that the oil pressure warning lamp goes out immediately.

Check the oil level and that there is no oil leakage at the filter.

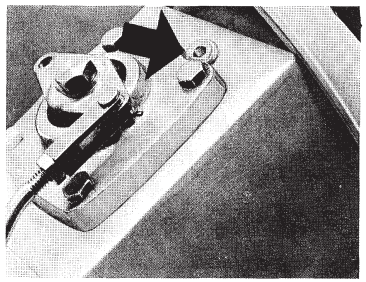
CHECKS AND SERVICE

OIL CHANGE IN DRIVE



Draining

Remove the oil dipstick. Tilt up the drive and remove the plug under the propeller shaft housing and allow the oil to run out. Refit the plug together with its O-ring.

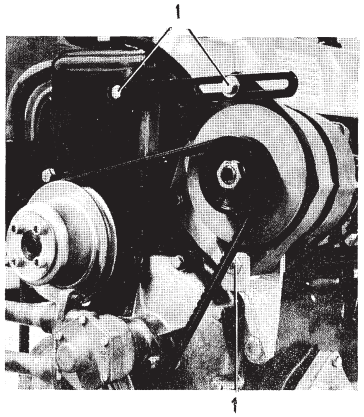


Filling

Remove the filler plug and fill with oil. Regarding the choice of oil and capacity, see under "Technical Data". Fit the plug together with the O-ring. Lower the drive and check the oil level with the dipstick which must not be screwed down when checking. Top up to the correct level through the hole for the dipstick. If the level is too high, oil must be drained off until it is down to the correct level. Fit the dipstick together with its O-ring.

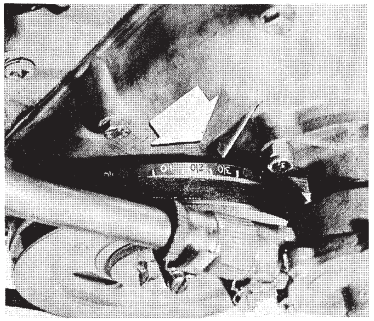
Check that there is no oil leakage at the draining plug.

CHECK THE ALTERNATOR DRIVE BELT



Carefully check the belt and if there are any indications of wear or cracks fit a new belt. Slacken the bolts at the attaching points of the alternator so that the belt can be taken off. On AQ 170 you also must remove the flange for the pipes on the sea-water pump. Wipe the belt grooves in the pulleys clean before the new belt is fitted. Tension the belt so that it can be deflected only 5 mm (3/16 in) between the belt pulleys. After a couple of hours of operation check the belt tension again and if necessary adjust.

IGNITION SYSTEM



All adjustments to the engine ignition system should be handed over to an authorized workshop which has the necessary equipment for this kind of work. The ignition system is sensitive and faulty handling can easily cause serious damage.

The distributor should be checked in a test bench. The ignition timing is checked by means of a stroboscope. Regarding the setting values, see under "Technical Data".

The check should be done once every season.

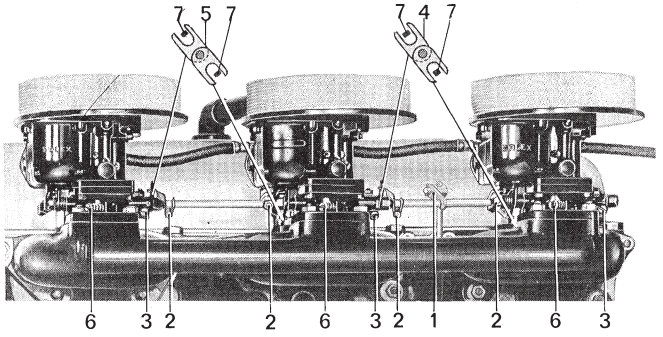
Lubricate the distributor with a few drops of engine oil in the drive shaft lubricating wick under the rotor.

CARBURETORS

Correctly adjusted carburetors are necessary to ensure smooth running and good fuel economy. Therefore ask an authorized workshop to check the adjustment sometime during the season.

SYNCHRONIZING AND ADJUSTING THE IDLING

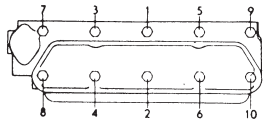
1. Remove the intake silencer and disconnect the control cable "dice" from the control lever (1).
2. Slacken the clamp nut for **one** lever (2) so that the lever can move on the intermediate shaft. On the six-cylinder engine slacken one lever on each intermediate shaft.
3. Screw out all idling screws (3) so far that they just touch (without pressing against) the carburetor housing lug. Then screw them in exactly 3/4 of a turn.
4. Adjust and lock lever (2) on the intermediate shaft in such a position that **both** levers (2) **simultanecusly** actuate the throttle levers of the carburetors. On the six-cylinder engines the lever on the front intermediate shaft should be adjusted first.



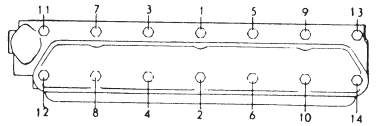
Down-draft carburetors (AQ 170C)

5. Adjust the position of the "dice" on the control cable so that the pins (7) on the levers (2) are **centrally located** in the gap on the throttle levers (4), when the "dice" is connected to the control lever. Connect the "dice" to the control lever and lock it. On the six-cylinder engine, then adjust levers (2) between the **rear** and **intermediate** carburetors, so that there is a small gap between the levers and the pins (see 5, 7).
6. Screw in the air screws (6) fully and then unscrew them 1 1/4 turns.
7. Fit the intake silencer and start the engine and run it until warm, i. e. normal working temperature.
8. Check the idling speed of the engine, see under "Technical Data". If necessary, adjust the idling screw (3) exactly the same amount on each carburetor.

CHECK-TIGHTENING THE CYLINDER HEAD BOLTS



Four-cylinder engine



Six-cylinder engine

Before starting a new or reconditioned engine for the first time, check-tighten the bolts **with a torque wrench.** Check tighten the bolts again after 20 hours of operation.

If the bolts have been removed they should be tightened in two stages.

The sequence in which the bolts should be tightened is shown in the adjacent figure.

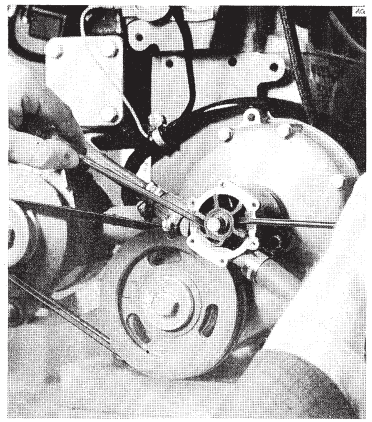
Regarding the tightening torque, see under "Technical Data".

The valve clearance should always be checked after the cylinder head bolts have been tightened.

CHECKING THE COOLING SYSTEM

The cooling system functions normally when the pointer of the temperature gauge is within the green scale. Too hight a temperature may be due to the following: clogged seawater filter, defective pump impeller or defective drive flange in the seawater pump, leakages, clogged oil cooler, slipping or broken belt for the circulation pump (AQ170), faulty thermostat or faulty instrument or faulty instrument sender unit. **Note the risk of water getting into the boat** when working with the cooling system. Regarding "clogged seawater filter", see page 16.

CHECKING AND REPLACING THE IMPELLER

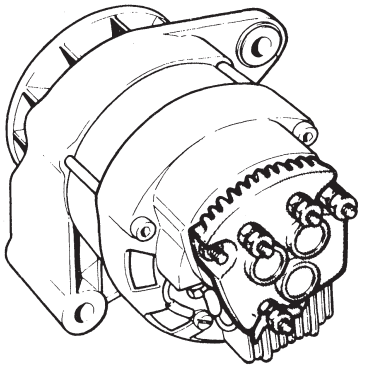


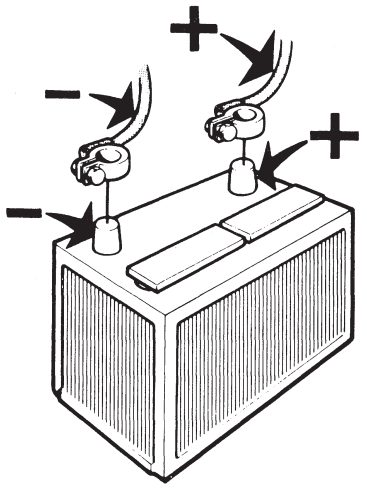
The pump impeller can become damaged due to, for example, shortage of seawater. Remove the cover from the water pump. Inspect the pump impeller and if damaged fit a new one. **On AQ130:** Pull the shaft out slightly and screw out the bolt retaining the pump impeller. Press against the shaft end and prise the impeller gently off the shaft using two screwdrivers. **On AQ170:** The impeller is secured by means of a key. Press against the shaft end and prise off the impeller by means of two screwdrivers. The impeller is fitted on splines. Take care not to damage the pump housing. N.B. If the shaft has slipped out from the pump housing it should be turned round carefully at the same time as it is pushed in again in order not to damage the sealing ring.

The drive flange is defective if it is possible to turn the pump impeller and shaft when these are in their correct working position. Remove the pump in order to fit a new drive flange.

CHECKS AND SERVICE

ELECTRICAL SYSTEM





ALTERNATOR

The engine is provided with an alternator. It is important that the following instructions are observed in order that the alternator and the regulator can function without interference.

1. **The master switch must not be turned off until the engine has stopped.**

   Otherwise the charging regulator can be destroyed.

2. **The battery terminals must not be reversed.** One terminal is provided with a plus sign and the other with a minus sign. The negative terminal should be connected to the cylinder block. The cable shoes should be greased and well tightened.

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

   Fit a Volvo Penta charging distributor (accessory) to the alternator when more than one battery is connected.

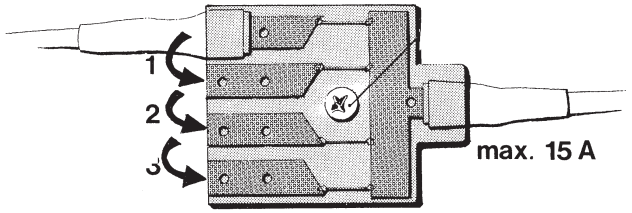
4. In the event of starting with the aid of a spare battery, proceed as follows:

   Leave the ordinary battery connected. Connect the spare battery to the ordinary battery with **plus** to **plus** and **minus** to **minus**. When the engine has started, disconnect 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.
6. Disconnect both battery cables before doing any work on the alternator equipment.
7. Before carrying out any electrical welding on the engine or installation parts, disconnect the charging regulator cables at the alternator and insulate them.
8. Check the belt tension and the cable connections regularly.

Changing the fuse

A fusebox is fitted next to the starter motor. In case of overloading the fuse breaks the electric circuit. Remedy any faults and close the electric circuit by moving the cable to the next terminal for any of the spare fuses.



Overhauling the starter motor and alternator

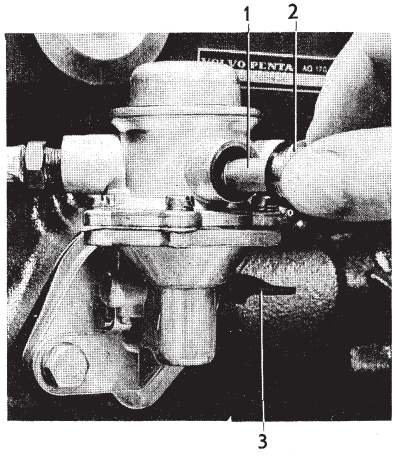
Any work to be done on the starter motor and the alternator should be handed over to an authorized workshop. Checking of the electrical components should be done in connection with a general inspection of the engine.

BATTERY

Checking the state of charge

The state of charge of the battery should be checked at least once during every season. The state of charge is done with the help of a hydrometer which shows the specific gravity of the electrolyte. The specific gravity varies with the state of charge, see "Technical Data".

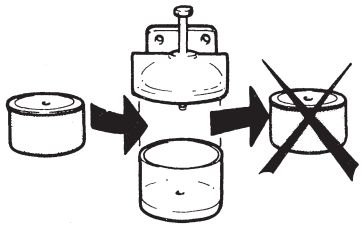
FUEL SYSTEM



FUEL FILTER

The fuel pump on the engine has a built-in strainer (1) which becomes accessible when plug (2) is removed. When fitting the cleaned strainer check that the gasket under the plug is in good condition. Pump up fuel to the carburetor by means of the hand priming pump (3). **Immediately after starting the engine check that there is no leakage.**

CHECKS AND SERVICE



Extra fuel filter

If an extra fuel filter with a water trap is fitted any water should be drained off through the plug in the bottom of the filter.

The filter element should be changed at least once during the season.

N.B. Take care to avoid any fuel spillage when working on the fuel system. Always wipe up spilled fuel and ventilate well before starting the engine!

Pump up fuel by means of the hand priming pump or by running the starter motor.

MEASURES IN CONNECTION WITH LAYING-UP AND LAUNCHING THE BOAT

INHIBITING THE ENGINE AND DRIVE

BRIEF INTERRUPTION IN OPERATION WITH BOAT IN WATER

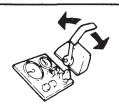
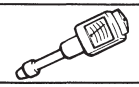
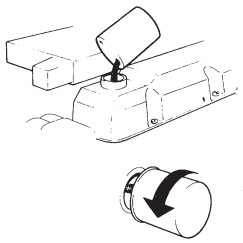
In order to prevent corrosion damage to the engine it should be run warm at least every fourteen days while the boat is afloat. If the boat is not to be used for over a month, a long-term inhibiting should be carried out.

LONG-TERM INHIBITING

Before the engine is treated according to inhibiting scheme (I) and (II) an authorized workshop should test the engine and the equipment. It is recommended that a compression test is made to determine the condition of the engine.

Inhibiting Scheme (I)

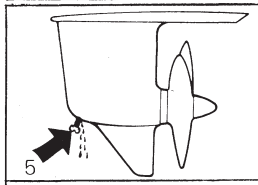
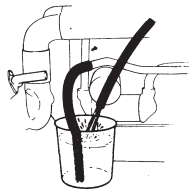
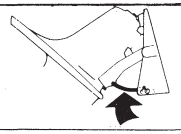
Carried out with boat in water

1 	Run the engine until warm. Make sure that all the instruments show normal readings. Check the function of the control lever.
2 	Make a compression test on the engine. Regarding the compression pressure, see under "Technical Data".
3 	Pump all oil out of the engine. Use an oil scavenging pump.
4 	Change the oil filter. Fill the engine to correct level with Volvo Penta oil which also contains rust-proofing properties. Now the engine is ready for operation with this oil next season. If the boat is to be laid up for a period longer than the normal winter period, rust-proofing oil should be used. It should be Esso Rustban 623, Shell Ensis Oil or equivalent. In this case the oil filter should be changed when the boat is launched. Run the engine for approximately five minutes and check the oil pressure and that there are no leakages.

LAYING-UP AND LAUNCHING

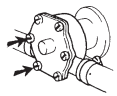
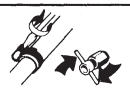
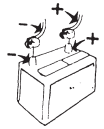
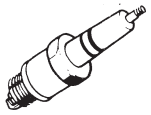
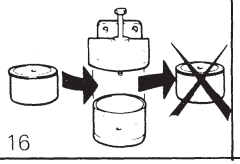
Inhibiting Scheme (II)

Carried out with boat on land

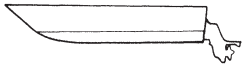
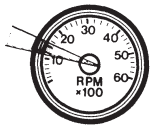
5 	Carefully remove the oil drain plug at the bottom of the drive and allow a few drops of oil to run out. Check that the oil is clean and not discoloured. Then fill the drive fully with oil. N.B. When launching reduce the amount of oil to correct level. No other inhibiting of the drive is required.
6 	Drain the cooling water from the engine seawater system. The position of the cocks are shown at 17 page 7. Make sure that the water runs out as impurities may clog the cocks. Then close the cocks.
7a 	Disconnect the suction line for the seawater system between the cooling water pipe and the mounting collar (AQ170) and at the seawater pump (AQ130) respectively. Fit a hose and immerse the free end of the hose in a bucket of fresh water. Run the engine at idling speed for a few minutes in order to flush through with fresh water, making sure that there is enough fresh water in the bucket. Make sure that the discharged water at the exhaust outlet and at the extra cooling water outlet on AQ170 is not spoiling anything nearby. N.B. Do not let the propeller rotate. Drain all the water from the seawater system.
7b 	Make a mixture of rust-proofing, consisting of 10 litres (2 1/4 Impgal, 2 5/8 USgal) of fresh water and 1 litres (1/2 Impgal, 1/2 USgal) of rust-proofing oil of the emulsifying type. N.B. Mix the oil into the water. Immerse the hose in the rust-proofing mixture. Start the engine and let it idle until the mixture is used up. N.B. The water pump must not be allowed to work without water. Use for example Esso Cutwell 40, Shell Donax C or equivalent. As an alternative an anti-freeze mixture containing 30% glycol can be used. Drain the rust-proofing mixture if it is not of the anti-freeze type. Loosen the cover slightly on the seawater pump to allow the water to drain off. Then close all draining cocks.
8 	When the boat is to be transported by land, e. g. on a trailer, the drive must be tilted up fully and locked in this position. A locking clamp is supplied and should be fitted as shown in the illustration.

LAYING-UP AND LAUNCHING

MEASURES IN CONNECTION WITH LAUNCHING

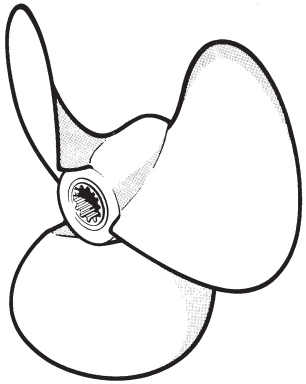
9 	If the Volvo Penta oil has been used in the engine, check only the oil level. If an inhibiting oil has been used, both the oil and filter should be changed. See under "Service every 50 hours of operation".
10 	Check the oil level in the drive. If the oil level is too high it should be lowered by draining off some oil. If too low, top up through the hole for the dipstick. N.B. The dipstick must not be screwed down when checking the oil level.
11 	Secure the cover for the cooling water pump together with a genuine spare gasket. Connect the cooling water hose to the pipe on the mounting collar (AQ170) and to the seawater pump (AQ130) respectively.
12 	Check to make sure that the hose clamps are tight. Check that all drain cocks are closed. Clean the engine and the drive externally.
13 	Carefully check the bellows for damage and check-tighten the hose clamps. If the drive has been removed, make sure when fitting that the bellows and clamps are positioned correctly. Adjust the retaining pawl, see page 29.
14 	Install the battery or batteries which should have been fully charged beforehand. Apply a special type of grease to the cable shoes and connect them to the battery terminals. N.B. Do not reverse the polarity. Tighten the cable shoes properly.
15 	Remove the spark plugs. Crank the engine a few turns in order to blow out any oil from the top of the pistons, making sure that nothing is being soiled by the oil splashing out. N.B. The drive must be fully down. Fit new spark plugs. See under "Technical Data".
16 	If an extra fuel filter is fitted change the filter element. Pump up fuel by cranking the engine with the starter motor or by pumping with the hand priming pump until fuel reaches the carburetor. Make sure that there are no leakages.

LAYING-UP AND LAUNCHING

17 	Inspect the paintwork on the outboard drive. Touch up any damaged spots with genuine Volvo Penta paint. Then paint the drive with Volvo Penta anti-fouling paint. N.B. Anti-fouling paint containing copper must not be used, since this can cause corrosion damage to the drive. Launch the boat when the paint has dried.
18 	Start the engine. See instructions on page 5. Run the engine until warm with the drive engaged if this is possible. Check that there is no leakage of fuel, water or exhaust gases. Also make sure that the manoeuvering controls are correct.
19 	When necessary, contact an authorized Volvo Penta workshop. Let them service your engine and drive according to the instructions given in the servicing scheme.

PROPELLERS

SELECTING THE RIGHT PROPELLER



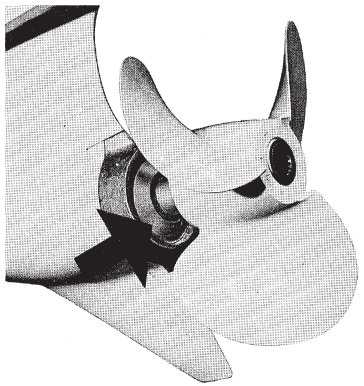
The correct propeller has been selected when the engine maximum speed is reached with a normal load in the boat.

A left-hand rotating propeller should be used with single installation, as with this direction of rotation there is less tendency for the boat to gyre.

With a twin installation, the port drive should be adjusted for the left-hand rotating propeller and the starboard drive for a right-hand rotating propeller.

When changing propellers, make sure that you get a genuine Volvo Penta propeller of the same size as the old one. The size is punched on the propeller hub. Sizes are given in inches, e. g. 15 x 17, where 15 stands for the diameter and 17 for the pitch.

REMOVING AND INSTALLING A PROPELLER



After the boat has been laid up the propeller should be removed and the propeller shaft coated with rust-proofing oil.

The propeller is locked with a toothed lock washer and by a propeller cone. Bend up the teeth and screw off the cone. Pull off the propeller. N.B. Inside the propeller there is a spacer sleeve and deflector ring.

A damaged propeller should be changed.

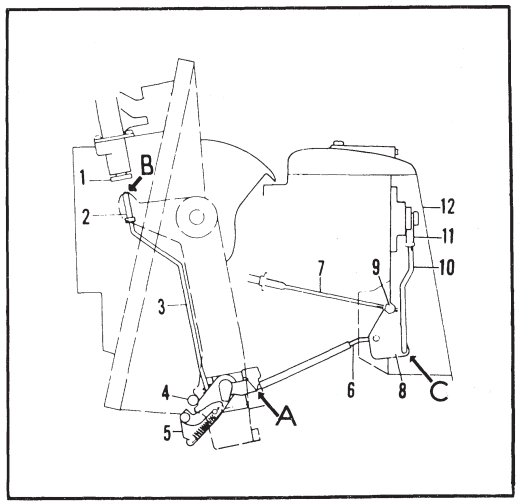
Before fitting a propeller, coat the propeller shaft with molycote (molybdenum disulphide grease) or rust-proofing oil to prevent the propeller from sticking on the shaft.

When fitting the propeller first put on the spacer sleeve. Position the propeller and fit the lock washer and tighten the propeller cone. If the teeth of the lock washer do not correspond with the recess in the cone, slacken the cone and move the lock washer on spline on the shaft. Bend down all the teeth.

TRIMMING THE DRIVE

ADJUSTING THE RETAINING PAWL

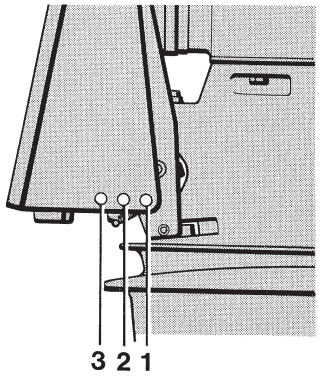
Check once during the season and when necessary adjust the position of the locking rod against the retaining pawl (A) and also the position of the push rod (see B) for lift disengagement of the retaining pawl. Adjustment is done as follows:



1. Remove the protective cover (12). Move the control lever to neutral.
2. Disconnect the gear control cable "dice" (9) and yoke (11).
3. Slacken the lock nut for yoke (11). Adjust the yoke so that after having been connected to the lever it gives push rod (6) a position where it reaches the clamp of the retaining pawl at "A" without pressing. Secure yoke (11) with the lock nut.
4. Adjust "dice" (9) so that it can easily be moved into the hole on the shift yoke. Move the control lever to the "forward" position and check that the corner "C" does not come against the housing. Fit the cover (12).
5. **Press the drive forwards against the adjusting pin.** Check the position of rod (3). Its upper part (2) should be flush with the yoke at "B" to enable lift (1) to disengage the retaining pawl when tilting up the drive. Adjust the upper part (2) of the rod after the lock nuts have been slackened.

TRIMMING THE DRIVE

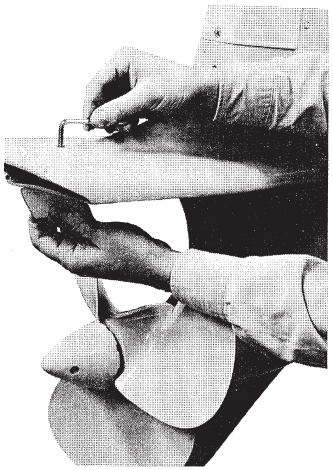
THE TRIM OF THE BOAT



The mounting collar adjusting pin has three alternative holes which determine the trimming angle of the drive. The adjusting pin should be fitted as follows:

Hole 1. When the boat has a tendency to over-planning, fore end too deep.
Hole 2. Normal position.
Hole 3. When the boat has a tendency to heavy planing (heavy stern).

ADJUSTING COARSE DEVIATION



Check for course deviation by releasing the wheel when the boat is planing in observing its course. If the boat, for example veers to port, the trim tab under the cavitation plate on the drive should be loosened and its rear edge moved slightly to port and locked in that position. Test-run the boat and adjust the trim tab further if the boat still tends to veer.

FAULT TRACING SCHEME

TRACING FAULTS WITH INTERRUPTIONS IN OPERATION

The fault tracing scheme below includes only the more common causes of faulty operation. With the help of the instructions given in this book it is usually possible to remedy most of the faults listed below. When in doubt, always contact the nearest Volvo Penta workshop.

Follow the instructions in the servicing scheme – this assures the best running reliabilty.

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	See
●					Master switch not turned on, flat battery, broken electric cables or main fuse burnt out	page 22
●	●				Fuel tank empty, fuel cock closed, fuel filter blocked	page 22, 23
●	●		●		Water or impurities in fuel	page 23
●	●	●	●		Defective spark plugs	page 15
●					Burnt ignition breaker points, moisture on distributor and spark plug cables	
	●		●		Idling speed not correctly adjusted	page 18
		●			Defective revolution counter	
		●			Boat abnormally loaded	
		●			Marine growths and fouling on the boat bottom and outboard drive	page 27
			●		Propeller damaged	page 28
				●	Blocked cooling water intake, seawater filter, defective pump impeller or thermostat	page 16, 20

TECHNICAL DATA

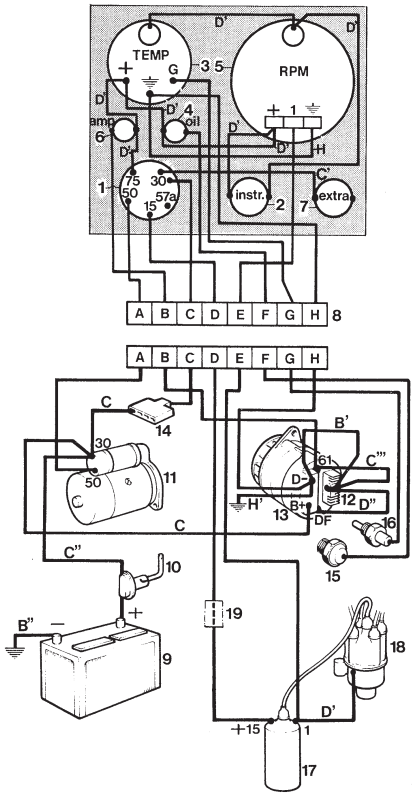
Technical Data

	AQ130D/2800	AQ170C/280C
General		
Engine designation	AQ130D/280D	AQ170C/280C
Operation	4-stroke carburetor engine with overhead valves	
Outboard drive, model	280D	280C
Reduction ratio	2.15:1	1.89:1
Number of cylinders	4	6
Max. output [1] kW at 91.7 rev/s (5500 rev/min)	81	
Max. output [1] kW at 83.3 rev/s (5000 rev/min)		118
Max. operating speed rev/s (rev/min)	91.7 (5500)	82.2 (5000)
Max. cruising speed rev/s (rev/min)	5–8 (300–500 below max. speed reached)	
Cylinder bore, mm (in)	88.90 (3.50)	
Stroke, mm (in)	80 (3.15)	
Capacity, dm^3 (in^3)	1.986 (122)	2.979 (181)
Compression pressure kgf/cm^2 (lbf/in^2) (starter motor speed)	12–14 (170–200)	10–12 (140–170)
Idling speed rev/s (rev/min) approx.	15 (900)	
Direction of rotation seen from the crankshaft pulley	clockwise	
Engine weight including drive, approx. kg (lb)	245 (540)	320 (705)
Valves		
Valve clearance, warm or cold engine		
Inlet valve, mm (in)	0.50–0.55 (0.020–0.022)	
Exhaust valves, mm (in)	0.50–0.55 (0.020–0.022)	
Lubricating system		
Engine		
Oil capacity, dm^3 = litres (Imp. qts. = US qts.), excl. filter	3.25 (2 3/4–3 1/4)	5.2 (4 3/4–5 1/2)
incl. filter	3.75 (3 1/4–4)	6.0 (5 1/4–6 1/2)
Oil quality	Multigrade Oil Service SE	
Viscosity	SAE 10W/40[2]	
Outboard drive		
Oil quality/viscosity	Same as for the engine	
Oil capacity, dm^3 (Imp. quarts/US quarts	2.6 (2.3–2.7)	
Oil capacity between max. and min. marks on dipstick, dm^3 (Imp. pint) approx.	0.15 (0.25)	
Cooling system		
Thermostat, begins to open at, °C (°F)	54 (129)	
Fuel system		
Fuel quality	Min. 90 octane (Research Method) (the engine can be run on petrol (gasoline) without lead additives)	
Carburetor, Solex	44 PAI	44 PAI
Number	2	3

[1] Flywheel output according to DIN 6270 Leistung B.
[2] Volvo Penta Multigrade oil.

	AQ130D/280D	AQ170C/280C
Ignition system		
Firing order	1-3-4-2	1-5-3-6-2-4
Ignition distributor, Bosch type	0231 178 011	0231 311 002
Basic setting, B.T.D.C.	8°	12°
Stroboscope setting 50 rev/s (3000 rev/min)	25–27°	32–34°
Cam angle	62±3°	40±3°
Spark plug, Bosch type	W225T35 (or corresponding type)	
Electrode gap, spark plug, mm (in)	0.7–0.8 (0.028–0.032)	
Electrical system		
Voltage, V	12	
Battery capacity, standard, Ah	60	
Battery electrolyte specific gravity		
Fully charged battery	1.275–1.285	
Recharge at	1.230	
Alternator		
Type	Alternating current	
Output max.	450 W (35 A)	
Starter motor output, hp	1	

Tightening torques	Nm	kpm	lb. ft
Cylinder head bolts	90	9	65
Spark plugs	40	4	30
Clamp ring, flywheel housing	35	3.5	25



INSTRUMENT PANEL

List of components

1. Key switch with starter contact
2. Instrument panel light switch
3. Temperature gauge
4. "Low oil pressure" warning lamp
5. Revolution counter
6. Battery charging warning lamp
7. Extra switch
8. Connector

Cable colour key

Marking	Colour	mm²	AWG
A	Ivory	6	9
B	Black	1.5	15
B'	Black	0.6	19
C	Red	6	9
C'	Red	2.5	13
C''	Red	35	1
D	Green	2.5	13
D'	Green	1.5	15
D''	Green	0.6	19
E	Grey	1.5	15
F	Yellow	1.5	15
G	Brown	1.5	15
H	Blue	1.5	15
H'	Blue	4	11

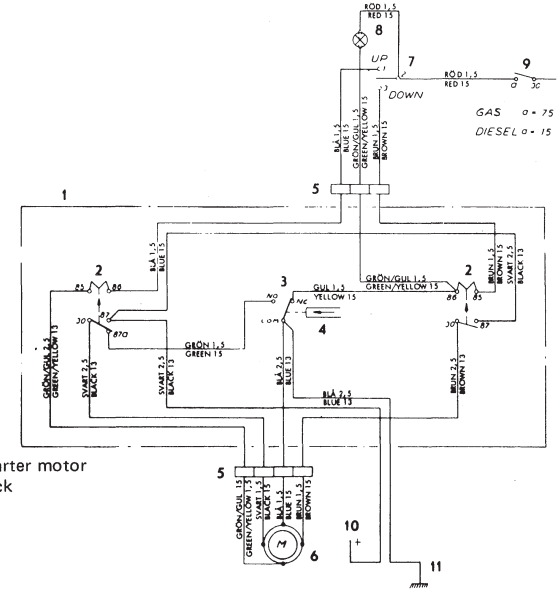
ENGINE

List of components

9. Battery
10. Master switch
11. Starter motor
12. Charging regulator
13. Alternator
14. Fuse
15. Oil pressure sender
16. Temperature sender
17. Ignition coil
18. Ignition distributor
19. Series resistance (AQ170)

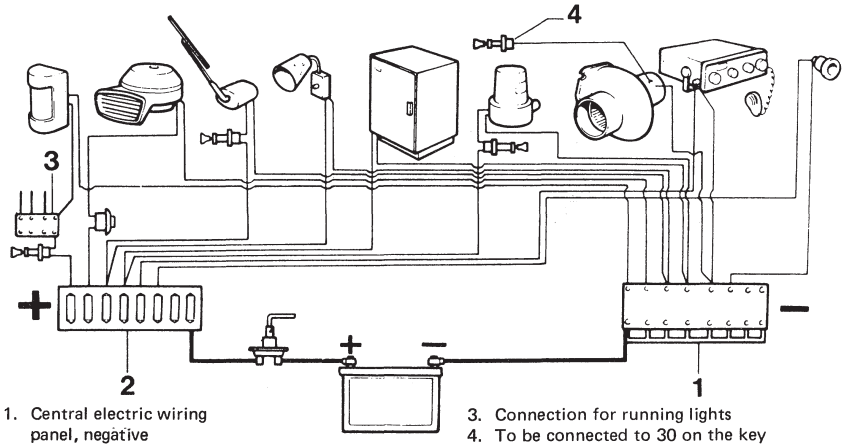
WIRING DIAGRAM

LIFT



1. Relay box
2. Relay
3. End position switch
4. Push rod, retaining pawl
5. Connector
6. Electric motor
7. Manoeuver switch
8. Warning lamp
9. Key switch
10. Connected to 30 (+) on starter motor
11. Connected to cylinder block

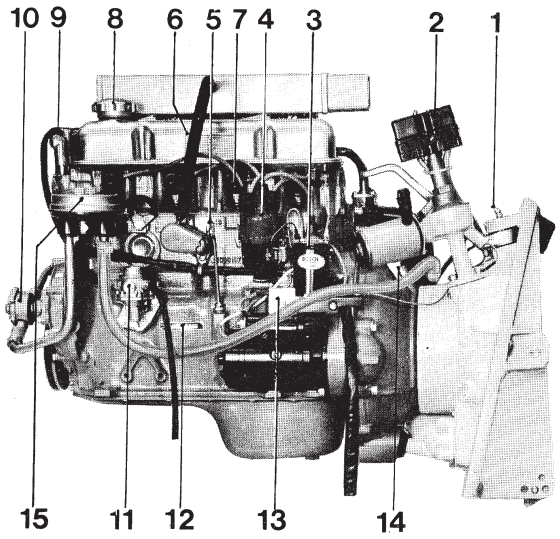
PROPOSED WIRING FOR OPTIONAL EQUIPMENT

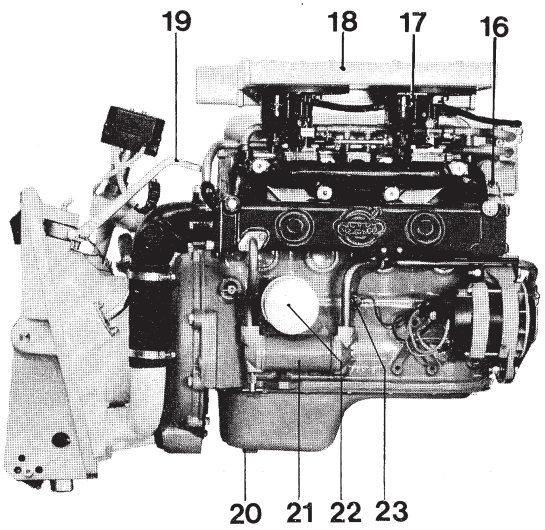


1. Central electric wiring panel, negative
2. Central electric wiring panel, positive and fuses
3. Connection for running lights
4. To be connected to 30 on the key switch

ENGINE COMPONENT GUIDE

ENGINE AQ 130 D

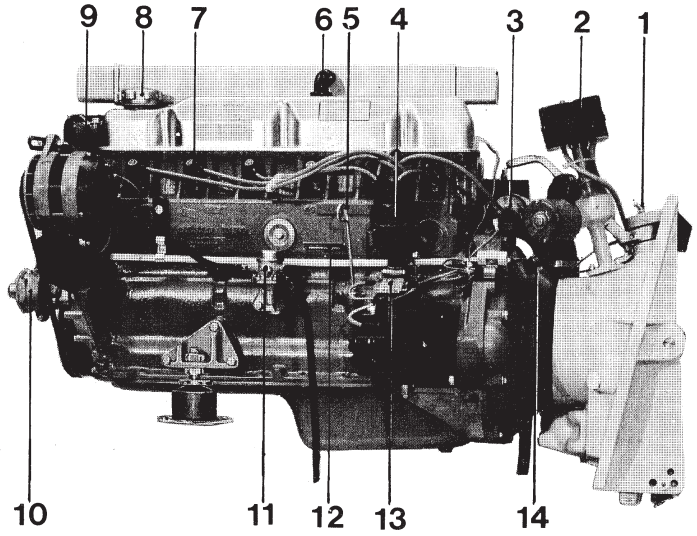


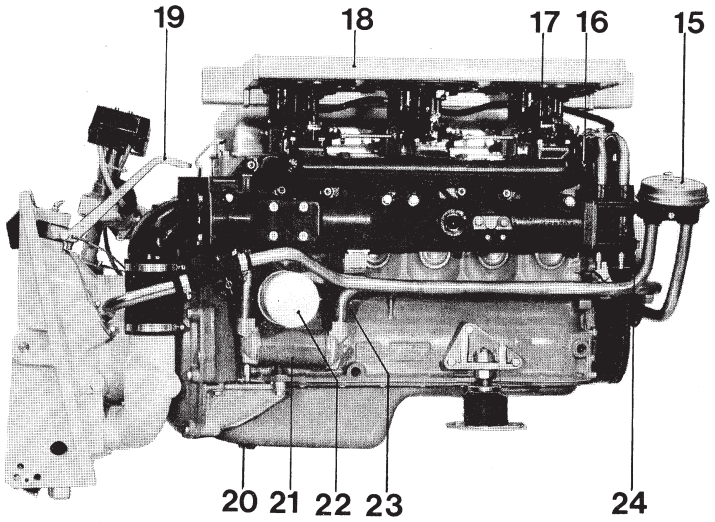


1. Grease nipple, upper steering shaft bearing
2. Electrical lift for drive
3. Ignition coil
4. Distributor
5. Oil dipstick
6. Enclosed crankcase breather
7. Spark plug
8. Oil filler, engine
9. Water distribution housing with thermostat
10. Seawater pump
11. Fuel pump
12. Type designation plate with engine number
13. Fusebox
14. Lubricator, drive shaft bearing
15. Seawater filter
16. Temperature sender
17. Carburetor
18. Intake silencer and flame arrester
19. Steering arm
20. Oil drain plug
21. Oil cooler
22. Lubricating oil filter
23. Oil pressure sender
24. Circulation pump

ENGINE COMPONENT GUIDE

ENGINE AQ 170 C

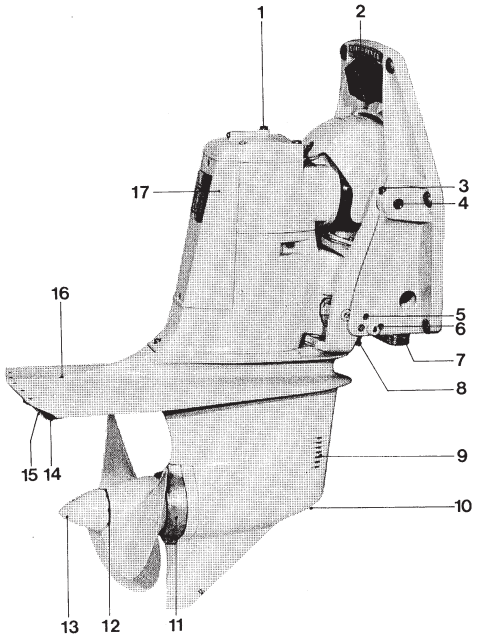




Regarding the list of components see page 36.

DRIVE COMPONENT GUIDE

DRIVE 280



1. Oil dipstick
2. Damping block
3. Lock bolt for suspension pin
4. Suspension pin
5. Holes for support clamp
6. Adjusting pin in middle position
7. Zinc plate
8. Retaining pawl
9. Upper water intake
10. Lower water intake
11. Zinc ring
12. Lock washer
13. Propeller cone
14. Exhaust and cooling water outlet
15. Trim tab
16. Lock bolt for trim tab
17. Shift mechanism under casing

ON-BOARD DATA

LOA= metres (ft.), beam= metres (ft.), draught= metres (ft.), height above waterline= metres (ft.), displacement= metres (ft.). Fuel tank capacity= litres (Imp. gals.= US gals.) Water tank capacity= litres (Imp.gals. = US gals.). Battery capacity, stnd. circuit= Ah. Battery capacity, opt. equipment circuit= Ah.

The lighting bulbs have the following wattage:

Instrument =	W	Port/starboard lights =	W
Cabin =	W	Stern lights =	W
Galley =	W	Masthead lights =	W
Toilet =	W	Searchlight =	W
Compass =	W	Cockpit =	W

The tool kits and spare parts sets consist of the following:

_____

_____

_____

_____

_____

Checks and service have been carried out according to below:

50 hour intervals	100 hour intervals
date_____/_____ –by_____	date_____/_____ –by_____
date_____/_____ –by_____	date_____/_____ –by_____
date_____/_____ –by_____	date_____/_____ –by_____
date_____/_____ –by_____	date_____/_____ –by_____
date_____/_____ –by_____	date_____/_____ –by_____
date_____/_____ –by_____	date_____/_____ –by_____
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date_____/_____ –by_____	date_____/_____ –by_____
date_____/_____ –by_____	date_____/_____ –by_____

INDEX, ALPHABETICAL ORDER

Notes:

Personal Information

Name . . . . . .

Address . . . . . .

Phone . . . . . .

Nearest Volvo Penta Dealer

Name . . . . . .

Address . . . . . .

Phone . . . . . .

Technical Information

Engine type . . . . . .

Serial number, engine . . . . . .

Drive . . . . . Ratio . . . . . .

Drive serial number, PZ . . . . . .

Propeller size . . . . . .

. . . . . .

. . . . . .

VOLVO
PENTA

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