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Cooling / Heating System



The Publisher's Statements on page i of this Owner's Manual apply to this chapter. Please read before proceeding.

This chapter describes the Cruisair heating/cooling system and, briefly, how it works. Instructions are given on basic operations and troubleshooting apparent problems. Major components are identified and located.

Major Topics:

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How it Works

Your VSC 61 Flybridge Yacht is equipped with a Cruisair "Direct Expansion" system (so-called because refrigerant, rather than tempered water, is piped to individual expansion units in the cooled spaces). This is a complete sub-system that includes many items. Unlike home air conditioners, it uses seawater to absorb the heat removed from the vessel.

The seawater pump **A** and pickup **B** are installed below the galley floor. The pump is specially-built to run for days on end, and it is very quiet. A magnetic drive couples the motor to the centrifugal pump, **C**. This pump cannot suck, and is NOT self-priming, so water must flow freely to it (hence its location below the waterline). The system is designed to be self-draining (of seawater) with hoses going uphill, *in* and *out* of the pump until just before the overboard discharge; from that point hoses go constantly downhill. NEVER MOVE THE HOSES. The self-draining design makes it easy to winterize the system if the vessel is out of the water.

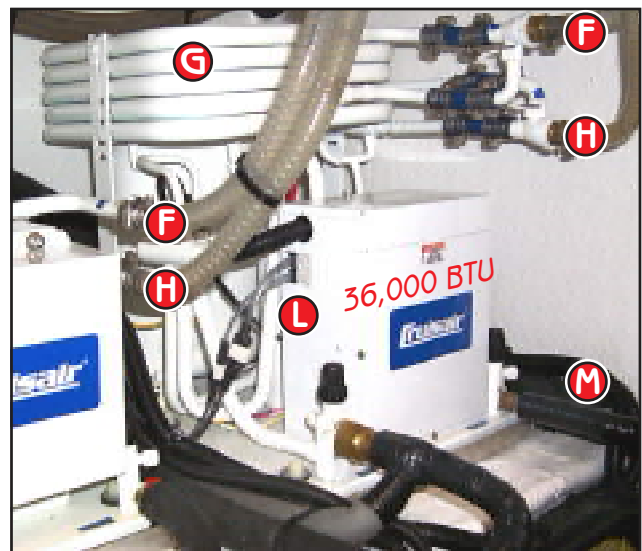
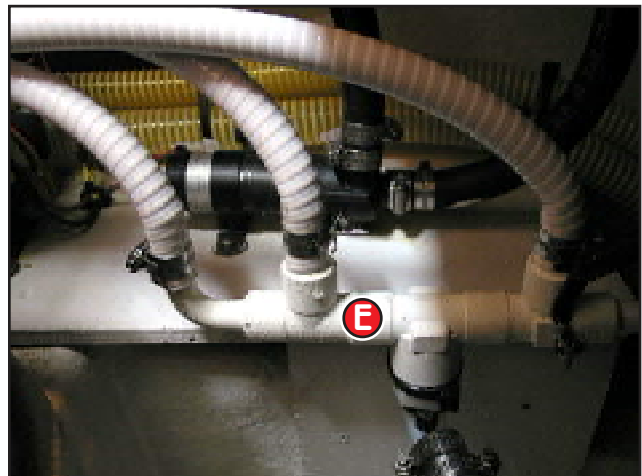
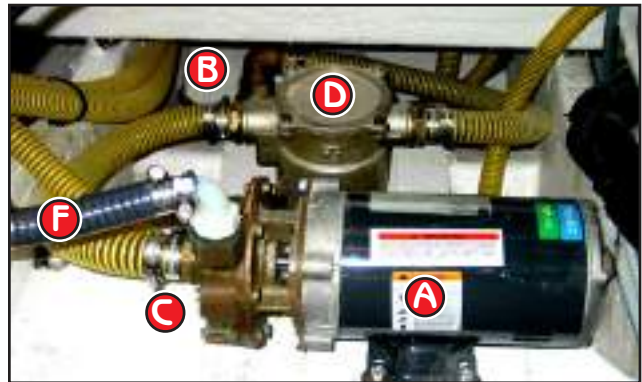
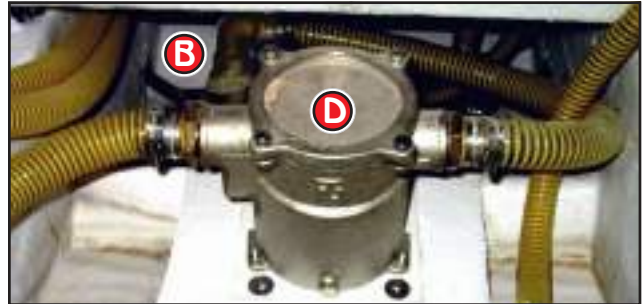
If air is drawn in, the pump can become air locked. This could happen if the vessel is removed from the water – then bleeding of the pump may be needed. Avoid this by closing seacock **B** before lifting the vessel and open it again when the vessel is back in the water.

Seawater supply passes through strainer **D**. Like all such strainers, it must be checked for weeds and debris on a regular schedule. If any of the units do not cool as they should, the strainer is the first place to look for the source of the problem. The rotating impeller in the pump is lubricated by seawater. Thus, if debris blocks the water flow the bearing surfaces will overheat, which may lead to pump failure.

The seawater pump has a manifold **E** feeding three hoses **F** which supply seawater to the 4 condenser units (compressors).

Seawater is pumped through hoses **F** into the double wall coils **G** on top of the condenser. A reciprocating-type compressor compresses R22 refrigerant gas from about 75 psi to 275 psi, making it very hot and dense. It then passes through the double walled coils **G** which envelop the gas pipe with cool seawater. The hot gas warms the seawater, thus giving up heat and becoming cool. The seawater, which is now hot, is pumped through hoses **H** into a manifold then overboard through the starboard engine exhaust. The cooled gas is filtered and dried **L** then pumped in insulated pipes **M** to the various expansion units in the living spaces.

Note:- All items shown are accessed via the hatch in the galley floor.



Salon Deck




Aircon Components

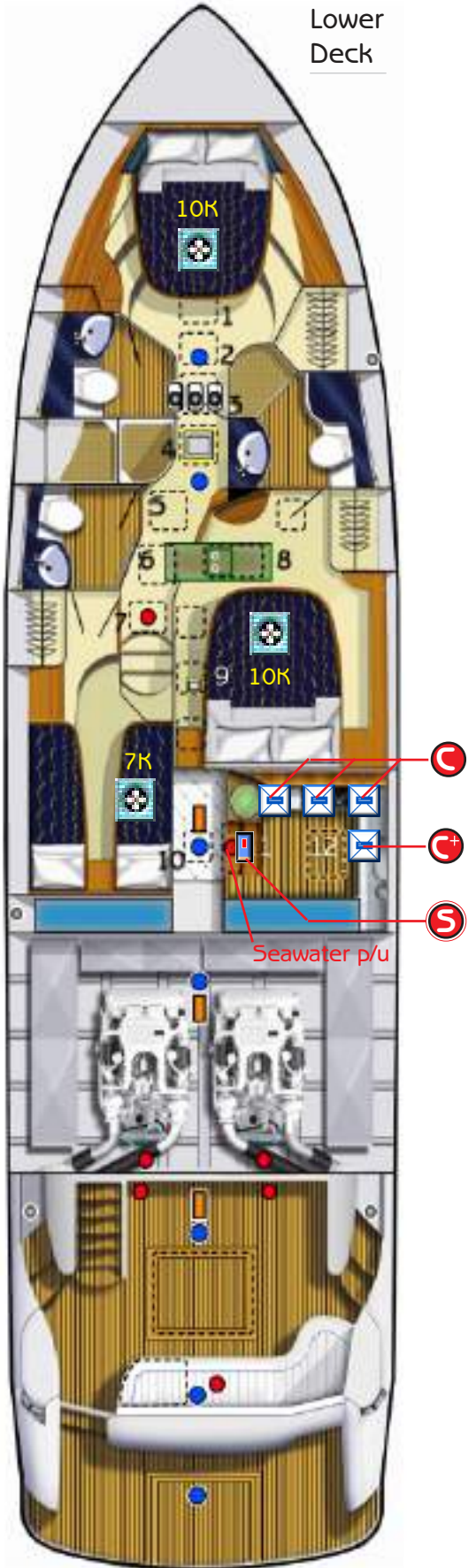
S - Seawater Pump - Draws seawater thru a bottom fitting and strainer and sends it to the four condenser units.

C - Reverse Cycle Direct Expansion Condensers - These 4 units compress refrigerant, causing it to release heat, which is transferred to seawater flowing thru and then discharged overboard (via port engine exhaust). Compressed refrigerant goes to evaporator units in the cabins to provide cooling. A reverse cycle valve enables the system to heat cabins as well.

C+ is 36,000 BTU;
others **C** are 7-10k BTU.
All 4 condensers are under the galley floor.

 **Evaporator Units** - These 6 units receive the compressed refrigerant and quickly decompress it through a heat exchanger coil, thus taking up heat from the cabin air. Thus the air is cooled, and the now hot refrigerant circulates back to the condenser units where the acquired heat is transferred to seawater during re-compression.

Lower Deck



Compressors

The four compressors and the seawater pump are under hatch #13 in the galley, **A**. To gain access to this, and also the water system, lift hatch **A** and put it safely aside. Then remove the large white plastic storage bin filling the hatch space. Lift it up and also put it safely aside.

All of the equipment is now visible. The compressors are on shelves, but other components are on the floor. Space here is very limited so great care must be taken not to stand on or move any equipment. While you *can* access the strainer from here, it is easier to check it for weeds via the lift-up stair **B** (hatch #12) near the washer. To operate the thru-hull valve, lift up the small hatch (#11) in front of the washer.

Check for water leaks around the seawater hoses and hose clamps. Although double clamped, the hose softens over time and leakage is possible. An integral drip pan under each compressor drains to a small grey water sump under hatch #10 in the starboard cabin – from there the condensate is pumped overboard.

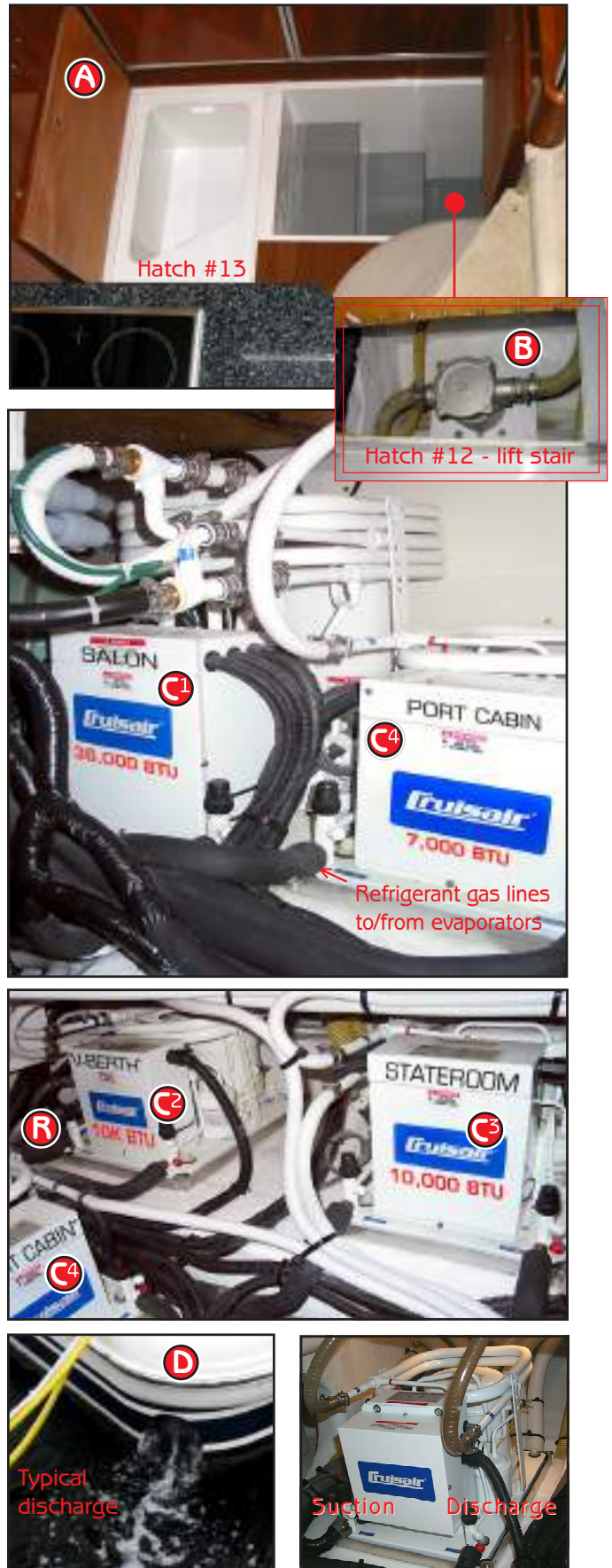
Total rated system capacity is 63,000 BTU. Compressor ratings are:

- One 36,000 BTU unit **C¹** supplies three 12,000 BTU evaporators in the Salon and dinette.
- One 10,000 BTU unit **C²** supplies a 10,000 BTU evaporator in the forward cabin
- Another 10,000 BTU unit **C³** supplies a 10,000 BTU evaporator in the starboard cabin.
- One 7,000 BTU unit **C⁴** supplies the evaporator in the port cabin.

There are six evaporator units (see next page) throughout the vessel. Each has expansion valves which allow the high pressure refrigerant gas to expand, causing a sudden drop in pressure and a resulting drop in its temperature to below freezing. The cold refrigerant then goes through the coils of a type of radiator as a blower moves air across the coils, cooling the air very quickly. A reverse cycle valve is installed to reverse the process, and thus deliver warm air.

The system operates effectively, cooling well in seawater up to 80°F and heating well in seawater down to 42°F.

Photo **D** shows typical discharge from the compressors when the system is running. Knowing "normal", you can judge if the seawater filter is restricted by weeds etc. When the seawater pump is running all four compressors have seawater flowing through them, whether they are operating or not. This is a free flow system and water must flow when the seawater pump is running. A hose from each compressor goes along the side of the hull and ends in a manifold. A single hose from there discharges into the starboard engine exhaust tube.



Evaporators and Blowers

The six evaporators (expansion units) **A** are located in spaces that are normally an enclosed compartment, and usually not far from a floor level air return grille **R**. The photos here show typical installations of evaporator units – under beds or couches, and under the bridge stairs.

A boat is more commonly used in hot weather so the prime need is for air conditioning. Chilled air is forced up to outlets near the ceiling **C**. Being cold, the conditioned air falls and circulates to the ground where the suction of the return air **R** pulls it back in to the evaporator to be re-cooled and recycled back to the ceiling area.

Evaporators have an integral blower **B** to suck in air through a grille **R**, a filter screen **F**, and then into the evaporator unit **A**. Within the unit, cooled (or heated) refrigerant gas goes into an expansion valve behind the evaporator, it deploys through the coils and returns to the suction side of the condensing unit (compressor) to start a new cycle.

In cooling mode, the temperature of incoming air is lowered about 20°F as it blows over the chilled evaporator coils. The chilled air is blown into an insulated pipe **E** and discharged via an outlet duct **C** to cool the vessel.

In reverse cycle cold floor-level air is heated, the evaporators warm the air, and blow out outlet duct(s) **C**.

Sensors **S** monitor return air temperature; do not move them.

Below each evaporator, an integral pan catches dripping condensate. It drains to the grey water box from where it discharges overboard. This is why it's essential to have on the SHOWER DISCHARGE PUMP breaker if the A/C is operating.

Behind every return air duct there is a filter, either inside the duct or attached to the evaporator unit. Filters quickly collect dust, and it gradually blocks off air flow, resulting in very little air coming from the outlet.

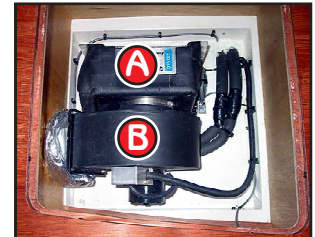
It is absolutely necessary to keep return air filters clean. Cleaning of the filters should be scheduled – remove and clean them every 2 or 3 weeks when the vessel is in use. Vacuum then rinse in warm water. Let dry before refitting.



F

Not cooling?

A buildup of dust is the most common cause of poor cooling performance. Inspect and clean often.



Conditioned air outlets and returns

Photos above show typical locations of outlets/inlets that facilitate circulation of heated or cooled air in the living spaces. **C** is outlet; **R** is return.



Do not run the A/C without dust filters in place. Dust will clog up the evaporator coils and major work will be needed to remove it.

Operating the System

The four condensing units share a common seawater input fed by the seawater pump. This pump starts when any A/C breaker is switched on.

To distribute air more evenly, evaporating units in some cases have more than one outlet. Similarly, toilets are supplied with air ducted from a unit in the adjoining cabin.

Procedure

Switch on breakers **Q** to **T**, or only the ones needed. Selecting any of the units powers up the system. The seawater pump starts automatically and seawater flows through all four condensers, even if only one is selected. Also, the SMX controls become active. After starting the system, check voltage under load, and check that overboard discharge at the starboard exhaust is normal.

Note:- The panel switches are **CIRCUIT BREAKERS**, and if overloaded through low AC voltage they may trip.

SMX II controls

On system start-up: If the individual SMX II controls were not switched off, they assume the settings of the last time they were used.

Indicator lights show compressor mode: **COOLING** or **HEATING**.

The setpoint indicator lights when temperature is reached.

Press **SET** key to display current setpoint (the temperature you wish to maintain). To change setpoint, use the **UP** and **DOWN** keys and select the temperature required.

To select automatic changeover from heat to cool, press **HEAT** and **COOL** both at the same time.

To switch the system off, push the **OFF** key.

It is best to leave fan speed in automatic, unless you wish to run the fans only without the compressor running. In automatic, when the compressor is running, as the setpoint is reached fan speed slows down. Once the compressor cycles off, the fan runs in slow speed. **AUTO** fan is strongly recommended.

For further information consult your Cruisair Direct Expansion Users Guide and the SMX Series Control System guide.

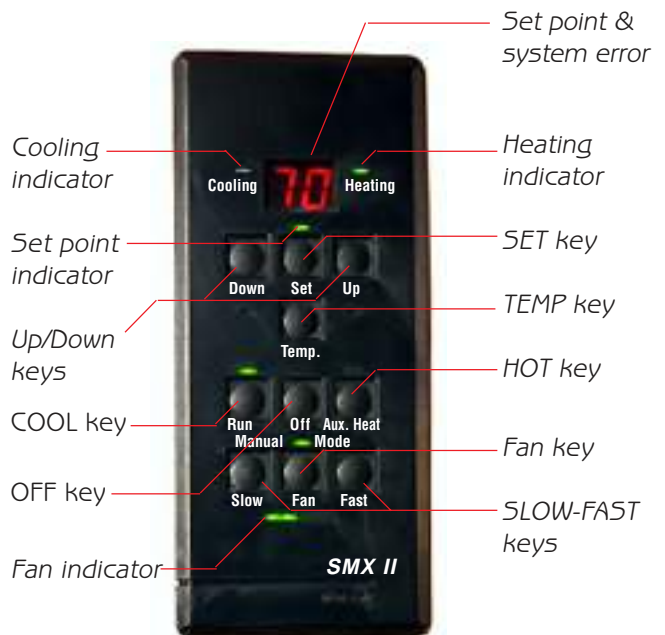
Electrical load management

If shore power voltage is low power can be conserved by running only the compressor serving the area you are in. The cooktop and the A/C are the biggest users of power.



Aircon / Heating Breakers

Activate condensers selectively by breakers **Q** to **T**. They also power the vessel's six evaporators.



SMX II Keypad

In addition to providing all the controls necessary for climate control in the living spaces, the SMX units also display error codes (please reference your SMX manual for details). System faults are displayed as a code on these SMX controls. For example, it will show if the sea water strainer is partially blocked with weeds.

Troubleshooting the System

One of the advantages of a direct expansion system is its simplicity. It depends simply on:

- an unobstructed supply of seawater,
- correct voltage,
- free flowing air supply to the return air grilles, and
- unobstructed air discharge ducts.

Any one of these items that is not up to par will give you a problem.

If the air conditioner is running in weedy water, the strainer can quickly fill with weeds. Don't neglect to regularly check the A/C strainer for weeds, sea urchins and other debris. If anything gets through the strainer it can slow down the magnetic drive to the pump. However, the strainer will not stop sand, and that may damage the seawater pump. Over time, sand in the water can erode the double wall pipe above the compressor.

Also be aware that suction at the thru-hull may attract plastic junk in the water, preventing seawater getting to the pump. Get to know the normal appearance of discharge from the compressors through the engine exhaust so you can tell if flow is reduced.

Do NOT obstruct the return air grilles with furniture, cushions or newspapers. If air cannot get through obviously the air in the cabin cannot be cooled or heated.

The same thing happens if the air filter screen behind the return air grille is not cleaned – very quickly dust builds up, starving the system of free flowing air. You should check screens every two weeks if the vessel is in constant use, monthly if not.

Check the dock voltage, if it is low, below 205 volts, you should be selective in how many units you run or, if cooling, set them at a higher temperature.

If you leave the system on when you are away for a few days, arrange for someone to check that it is operating properly (and leave the SHOWER DISCHARGE PUMP on).

These are very simple checks – if they are done the system will perform as designed, and maintain a constant pleasant temperature throughout the vessel.



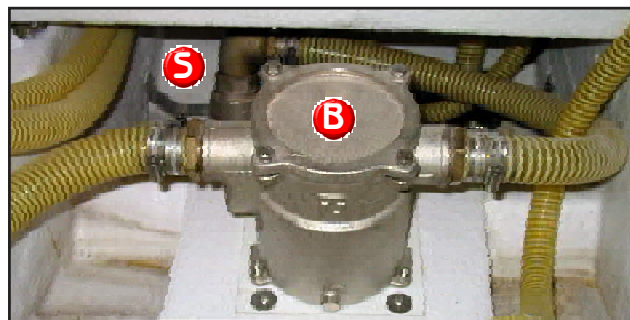
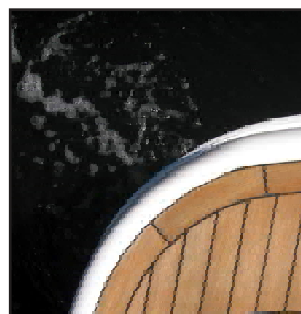
Check voltage and load – 240 volts

Reduce load if a A/C breaker. With an Iso-Boost transformer and 100 amp service, low voltage should not be a problem, but you may be unable to switch on all units. Remember as voltage decreases amperage increases.

The SMX units also display error codes (see SMX manual for details). System fault codes are displayed if, for example, compressors are overheating because the seawater strainer is partially blocked with weeds.

To clean the seawater strainer. . .

- Switch off ALL breakers for the A/C system.
- Close seacock **S**. Have a dish handy to dump seawater and debris from the strainer into it.
- Loosen the four bolts holding the cap **B**. Seawater will come out. Avoid getting seawater into the compartment by having an absorbent cloth around the cap. Ease up and remove bolts and cap.
- Remove the internal screen. Clean out all weeds and other debris.
- Replace the screen and cap, tighten down the nuts.
- Open the seacock **S**; the strainer should quickly fill with seawater. Check the cap for leaks. If OK, switch the system on.
- Check again to ensure there are no leaks.
- Check that discharge flow is normal.



Regularly check the A/C strainer for weeds and other debris. Remember – this is below the waterline! So shut the seacock.