Airconditioning Buying Guide

WHICH SYSTEM ?

There is a great variety of different air conditioning systems on the market. Traditionally, yachts were equipped with so-called "Central Systems" whereby the compressor was located in the engine compartment and the evaporator fitted in the cabin. Such systems can have problems with the copper freon lines connecting the major components.Fractures which are difficult to trace and even more difficult to repair can occur repeatedly. A further draw back is that such designs do not allow removal of the equipment for repair in workshops ashore without breaking into the freon gas circuit. The recent legislation concerning the release of CFC's will discourage the use of these central systems. To overcome "Central System" disadvantages, self-contained air conditioners were developed. These units have all the components required to create cold energy mounted on a common base plate so that the system can be pre-charged and factory tested. The whole unit can then be installed or removed in one piece. This type of equipment lends itself ideally for Sailing Yachts and Motor Cruises from 2O-80ft. Although locating the compressor in the accommodation area can create some noise there are ways of overcoming this problem. Some owners however prefer to have the refrigeration compressor installed away from the accommodation. This has led to the development of so-called water chillers. Here the cold energy is created in a self-contained direct expansion chiller module, is then transferred into a heavily insulated cold water ring main which is run throughout the boat. Cold water can be tapped from this for heat exchange via air handlers which cool the individual cabins. Reverse cycle, self-contained chillers offer the further advantage of allowing modules to be assembled in a variety of combinations either horizontally or in vertical towers. This concept has numerous advantages when it comes to retrofitting, particularly since no specialist refrigeration engineers are required for installation as the freon gas circuits remain sealed. Sophisticated controls are available for any of these air conditioners.

BOAT AIR CONDITIONING

These are direct expansion, seawater-cooled air conditioning systems which cool by removing heat and moisture from the air in the cabin. The heat is absorbed by the refrigerant which flows through sealed pipes and is transferred into the seawater via a condenser. The seawater is discharged overboard. When the refrigerant flow is reversed the opposite cycle takes place, i.e. heat is extracted from the seawater and is used to warm the air flowing through the evaporator pipes. The latest refrigerant gas used in these systems is called R407C which is acceptable under European law.

Air conditioners are generally AC Powered, either 110V/60Hz or 220V/50Hz. The reason being that the compressor power is considerable once larger air conditioners such as several tons are required (12000 BTU = 1 Ton). Despite this there is room for niche products and HFL offer Ocean Cool air conditioners powered by either 12 Volt or 24 Volt. At a capacity of 6000 BTU (1500 Kcal) they offer alternatives when AC is not available or not desirable. With an amperage draw of 40 or 20 amps these air conditioners can be considered if the boat is equipped with a float loader charge facility

or an auxiliary engine is in operation for motoring. A DC-powered air conditioner may be considered for the master cabin when the air conditioner compressor is being controlled via a time switch so that DC consumption is minimised.

HEATING AS WELL – Straight cool versus reverse cycle

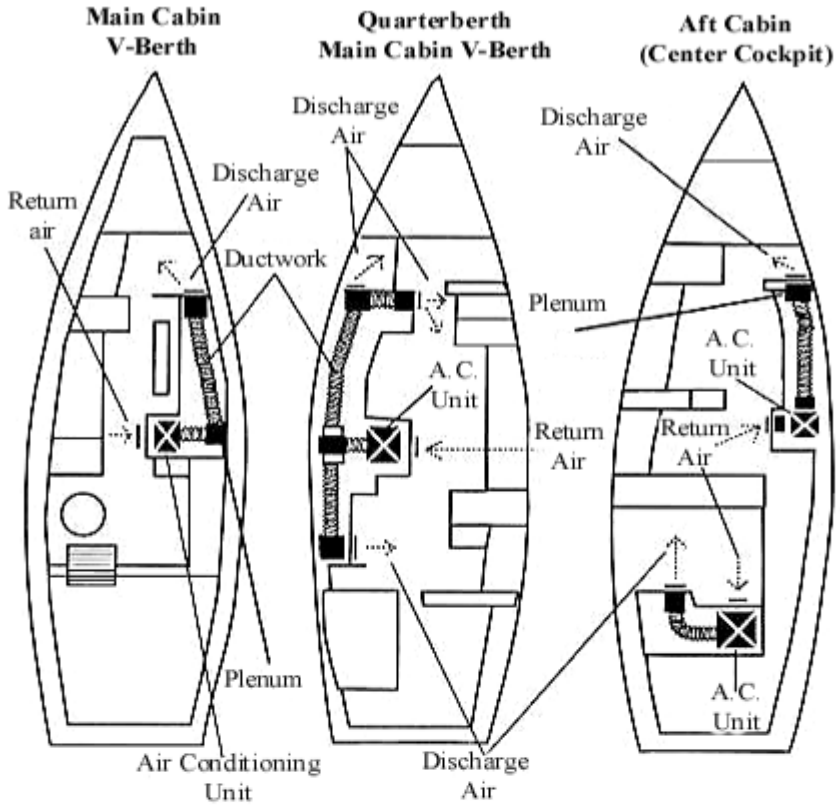
All marine air conditioners can operate as coolers only or, in the case of a reverse cycle machine, the air conditioner can also be used as a heater by converting the latent heat contained in the seawater into warm air. Cabin temperatures of up to 45-48 °C have been recorded with seawater temperatures of as low as l0°C. For details see the relevant efficiency diagram. It is however important that a reverse cycle air conditioner is operated from time to time in the heating mode to ensure that the reversing valve remains operational and does not seize up due to oil solidification.

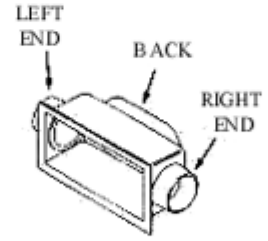
AC OR DC POWERED

Ocean Cool DC Air conditioners are self-contained and are therefore easy to install. They require little attention regarding maintenance. An outstanding feature on these units is their great range of speed control which effectively allows a small unit to cool a much larger area than an equivalent AC powered unit. Whilst engine driven units exist it must be said that they require refrigeration experience with regard to layout installation and maintenance. They are more viable at large BTU capacities since the engine itself is expensive and requires a great deal of attention concerning noise, vibration and installation.

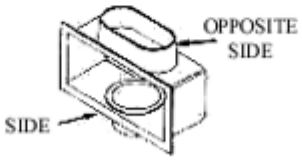
DUCTWORK

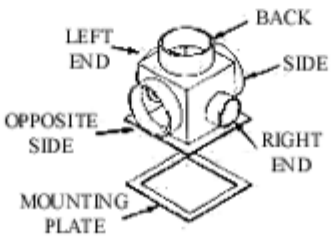
Whilst it is important to select the correct location for the air conditioner, it is even more important to select the correct route and type of ductwork. Most of the air conditioners suggested in the previous paragraph allow the cold air to be pushed through flexible ducting for distribution through a number of outlets. It is important to remember that, to achieve the most efficient heat exchange, cold air has to enter the cabin as high as possible to allow it to fall onto the rising warm air. It is therefore illogical to use heater ducts which normally discharge just above floor level. Ducting can either be insulated or of the flexible non-insulated PVC-type. In areas where duct condensation can drain away to bilges etc., it is easier to use non-insulated ducting. If cold air is routed through voids higher up in the accommodation, or particularly through ceilings, insulated ducting material should be used.





TRANSITION BOXES





SEAWATER PUMP

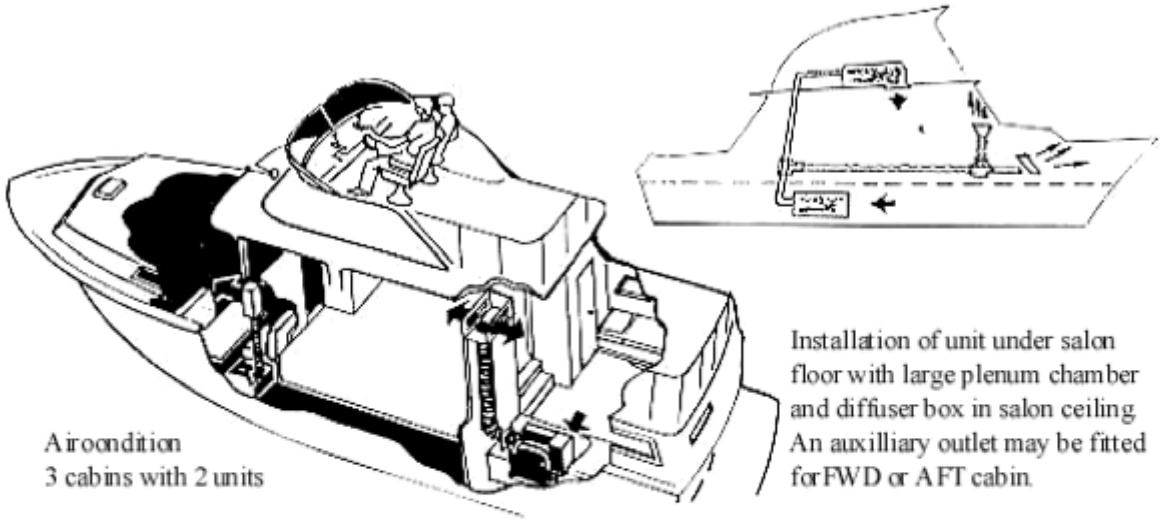
The purpose of the seawater pump is to deliver seawater to the self-contained unit for cooling the refrigerant. The seawater is then discharged overboard. Two main types of seawater pumps are available, all of which are of the non self-priming type. It is for this

reason that seawater pumps have to be mounted below the water line. This is not ideal as the pump motor is powered by 220 volt AC and the bilge water level is often very close to the underside of the floor.As most pumps are made of metal and use metal hose connectors they suffer from corrosion problems and electrolysis. Plastic seawater pumps made from PVC, i.e. with plastic-type heads, are not affected by electrolysis or corrosion but the problem can sill arise when the metal hose connectors are fitted to the pump ports. Care should be taken during fitting as it is easy to create hairline cracks in a pump port thread. This can lead to a substantial crack developing with dramatic results and boats have even sunk as a result. Seawater inlet valves should therefore always be closed after use to avoid this problem. Self-priming seawater pumps, which can be installed away from the bilge, and which are available from HFL, are generally of the impeller type. These used to have a relatively limited life although this is now much improved. However, due to the pump design itself, they are still a little noisy.

LOCATION

Self-contained air conditioners can be located anywhere in lockers, under bunks or settees and in furniture to avoid taking up additional floor space. In some cases the air conditioner may be put into the bilge area. However it is important to ensure that water cannot splash onto the air conditioner when the boat is underway. The air conditioner itself is more commonly installed at floor level allowing for high level air discharge via the ducts as described above. Chiller systems generally have the chiller unit installed in a separate hold or engine compartment with only the air handlers located in the cabins. Air distribution is the same as with self-

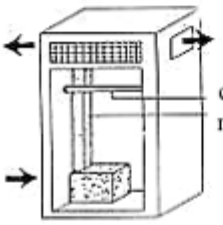
FLYBRIDGE INSTALLATION

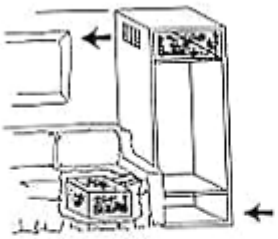


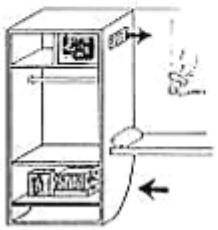
Airoondition
3 cabins with 2 units

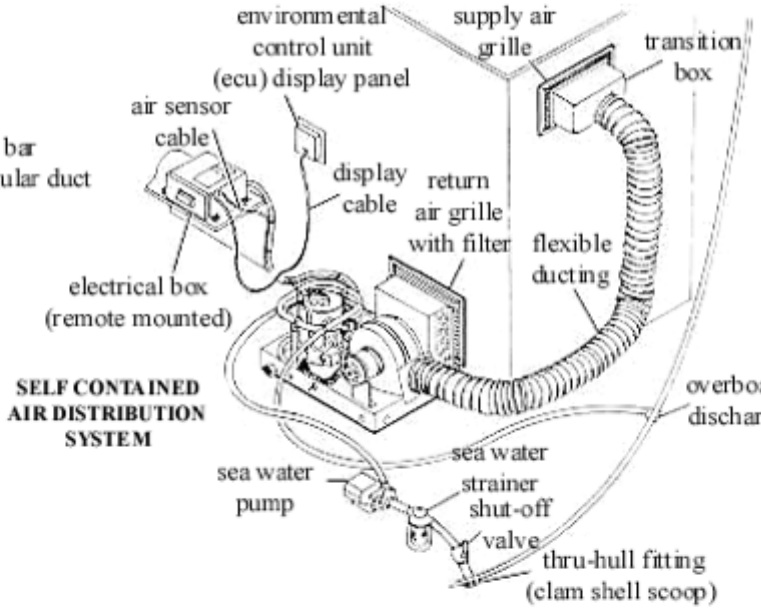
Installation of unit under salon floor with large plenum chamber and diffuser box in salon ceiling An auxilliary outlet may be fitted forFWD or AFT cabin.

HANGING LOCKER

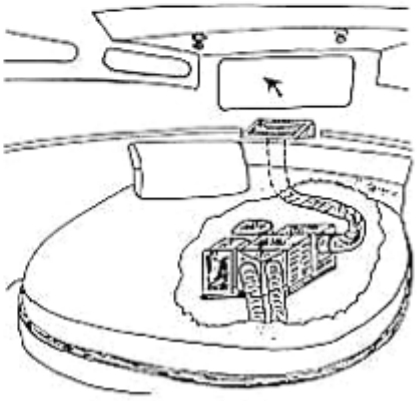








SELF CONTAINED AIR DISTRIBUTION SYSTEM

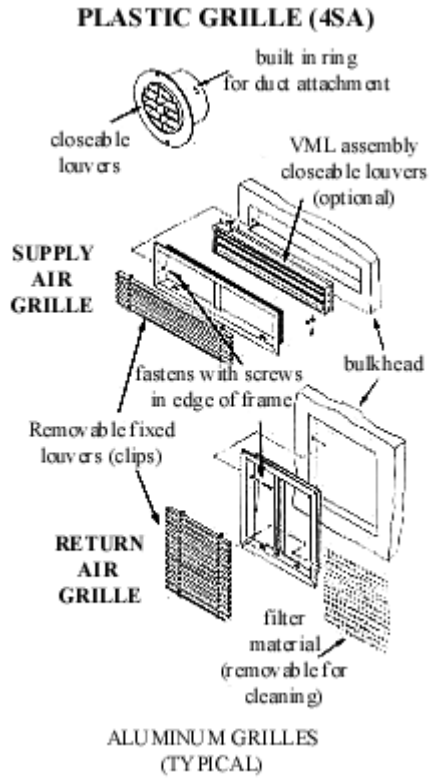


BED

Mount unit under bed. To ensure silent running, use HFL return air aperture system with flexible ducting. Dimension return air box sufficiently large to ensure slow airspeed and good return air filtering. Air outlet box high or alternativaly on 30 degree wedge at middle height.

GRILLES AND LOUVRES

For the cold air to exit, air outlet grilles have to be installed. These are connected to the flexible ducting and should generally be placed as high as possible. If it is not possible to install them at window ledge height it is recommended that they be installed at an angle so that the air is directed towards the centre of the deckhead. Return air grilles should be installed as close to the floor as possible to allow the air to be filtered and enter the airconditioner without restriction. Grille sizes and duct sizes are listed in separate data sheets.



RETURN AIR APERTURE SYSTEMS

In some cases it is necessary to return the air from two or even three cabins. The air is guided through so called return air apertures and ducted to the airconditioner from which it is distributed back into the cabins. For these applications HFL offer components which make the installation easy and efficient. The return air apertures also ensure that the bilge smell cannot enter the cooling air circuit.

ENCLOSURES

Sometimes it is necessary to mount the air conditioner in a glass fibre enclosure, particularly when the unit is mounted below the floor and is subject to bilge water splashing. Such GRP enclosures also help to reduce noise and lend themselves to be used within the return air aperture system. Noise can be reduced by using soft hush covers with a lead lining. These are placed over the compressor and can be extremely effective.

CONTROLS

A variety of controls are on offer, from simple 3-knob controls consisting of system switch, speed controller and thermostat to sophisticated environmental control units, i.e. programmers which allow high and low temperatures to be set and can include many other features. The HFL ECU pack offers a total programme selection of some 64 different options including such features as electrical diagnosis for voltage and current, 6-step variable speed control and many others

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RELAY BOX

Single seawater pump with relay box or several pumps ? For multi air conditioner installations owners can choose between a large single seawater pump with a relay box to control the signal from each control panel, or separate seawater pumps for each air conditioner. The latter requires increased plumbing. Since the seawater pump is the part most vulnerable to corrosion, electrolysis and other damage, it is generally thought to be more satisfactory to use one seawater pump per air conditioner in an installation with up to four air conditioners. In an installation with a greater number of units an arrangement with single pumps and relay boxes is generally preferred. With such installations owners should be prepared to keep a spare seawater pump and relay box on board.

HOW MANY BTU'S OR Kcal – How much air conditioning?

Firstly decide on the areas to be air conditioned, then calculate their volume. To obtain the cooling capacity required multiply the cabin volume by specific multipliers as follows:-

Volume in m^3

m^3 x 612 = BTU for area above deck

m^3 x 504 = BTU for area below deck

4 BTU = 1 Kcal

Volume in cu.ft

cu. ft X 17 = BTU for area above deck

cu. ft x 14 = BTU for area below deck

For vessels operating in areas with ambient temperatures above 30ºC add up to a further 20%. In areas with high sea water temperature, i.e. above 25ºC, add a further 20% since the air conditioner will also have to remove large quantities of radiated surface heat entering the boat via the hull. BTU's (British Thermal Units) represent the amount of energy required in order to heat or cool a given area. This energy potential can also be expressed in Kcal (kilo calories). Approximately four BTU's equal one Kcal.

The table shows the relationship between BTU's and cabin area in SqFt. It also includes the effects of the location of the cabin board. Below deck areas are generally well insulated and have limited window area which effect heat/cold losses greatly. Resulting from this chart and assuming that the equipment is installed properly using the correctly sited seawater pump, Room temperatures for cool of between 16-22ºC should be achieved. Calculate 3.5 Gallons of seawater per minute per self-contained unit. This applies for air conditioning units from 6-16000 BTU's

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ELECTRICAL DEMAND

The electrical consumption depends on the size of the air conditioner. The larger the compressor, the larger the amperage required. The voltage may be either 110 volt for a 60Hz system or 220 volt for a 50Hz system. In most cases the power is single phase. The operating current is generally indicated on the manufacturers plate. This however, does not state the starting current. Hermetically-sealed AC compresssors, have a high starting current requirement although this is generally reduced via capacitors etc. to a manageable level of approx 3-5 times the running current. Larger ratios between starting and running current should not be considered for pleasure craft air conditioner applications. Such heavy starting currents would create overload problems for either the shore supply or smaller generators. The starting current generally applies only for a shore period, say 300-400 milliseconds but as soon as the compressor is running the current drops back to normal level. It is important that the correct circuit breaker is selected and when doing so the running current for the seawater pump also has to be taken into account since the compressor and seawater pump often run simultaneously.