Guidelines for Selecting Air Conditioning For Your Boat

This guideline will provide practical, easy to understand steps to help you select an air conditioning system for your boat. We invite you to review this information, and then call your Cruisair dealer to discuss the system that best fits your needs.

About Boat Air Conditioners

The basic principle of an air conditioner is the movement of heat. In a marine, direct expansion (DX) seawater-cooled air conditioner, heat is transferred from the cabin air to the refrigerant gas, which then releases the heat into the seawater. In reverse cycle heating (heat pump), the refrigerant flow is reversed and heat is extracted from the seawater and discharged into the cabin.

Part of the cooling process, in addition to lowering the air temperature, is the removal of moisture from the air. This lowers the humidity, making the area feel more comfortable and helping to keep the boat dry, reducing mold growth and other moisture related problems.

There are three basic types of Cruisair systems: self-contained units, remote (split gas) systems, and Tempered Water Systems. In selecting the type of system for your boat, many factors must be considered, including: size and layout of boat, required capacity, access for routing necessary tubing/wiring/hoses, location of furnishings, and the storage space you are willing to sacrifice. And of course, cost.

Self-Contained System

Self-contained units are typically the best choice for smaller boats, up to about 40 feet (12m), due to the lower cost of the units and installation. A self-contained air conditioner has all of the major components mounted on a single chassis, which is installed in the living area; usually under a bunk or settee, or in a locker. Cooling only models, as well as reverse-cycle heat pump units, are available.

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Dometic is a customer driven, world-leading provider of innovative leisure products for the caravan, motorhome and marine markets. Dometic offers a complete range of air conditioners, refrigerators, awnings, cookers, sanitation systems, lighting, windows, doors and other equipment that makes leisure life more comfortable away from home.

Dometic also provides refrigerators for specific use in hotel rooms, offices and for storage of medical products and wine. Dometic's products are sold in almost 100 countries and are produced mainly in Dometic's own production facilities around the world. Annual sales amount to approximately 750 MEUR. Dometic has more than 4,400 employees.

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Dometic Cruisair

A single unit can cool each cabin, or can be ducted to 2 or more cabins to save space and cost. A self-contained unit is larger than a remote or Tempered Water air handler, so the space requirement should be considered, and, even though the compressor in a self-contained unit is very quiet, it will be louder than an air handler. Good installation practices can reduce the emitted noise to a level acceptable by most. Self-contained units often require less power than other systems due to the highly efficient rotary compressors.

Remote Systems

Remote systems, also called split gas, have the air conditioning components split between two separate units that are installed in different locations and connected by insulated, copper refrigerant tubing through which the refrigerant travels. The condensing unit, consisting of the compressor, seawater condenser, and electrical components, is mounted in the engine room or other mechanical space. The air handler (also called the cooling/heating unit, or evaporator) includes the evaporator coil and a blower, and is installed in the living area in a similar manner to a self-contained unit. Two air handlers can be connected to one condensing unit so that multiple cabins, or a single large area, can be cooled.

Remote systems are typically found on boats up to 80 feet (24m) in length, only limited by the number of condensing units that can be fit, and by the length of copper tubing between the condensing unit and air handler, which is a maximum of 50 feet (15m).

An installed remote system is typically more expensive than a self-contained unit, not only due to the equipment cost, but also because a remote system must be charged with refrigerant by a certified technician.

Some advantages of a remote system are: less space needed in the living area for the air handlers, quieter because the compressor is in the engine room, and a wide selection of air handler types.

Tempered Water Systems

For larger boats, Cruisair Tempered Water systems (also called chilled water) are available. These consist of a chiller, located in the engine room, that cools (or heats) fresh water, which is pumped through an insulated piping loop, out to air handlers located in the living spaces, where the air is cooled (or heated). There are no limitations on the number of air handlers in a system, or on the distance from the chiller to the air handlers. Other advantages of a TW system include flexible load management and often a reduced peak electrical load.

Subsystems

A complete Cruisair air conditioning system requires multiple subsystems, including the control/switch assembly, the seawater cooling system, and the air distribution system.

Controls: Cruisair has two basic types of controls, rotary-knob switch assemblies and the SMX digital control.

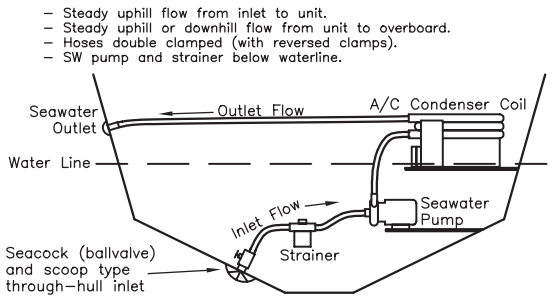
A rotary-knob switch is a manual control with 2 or 3 knobs to provide mode of operation, thermostat, and variable fan speed control. Reverse-cycle models have automatic changeover between heating and cooling.

The SMX control system is a microprocessor system with many advanced functions, including: automatic fan speed control, fault display, and a dehumidification (absent) program. With SMX, you have a choice of 3 different keypads/displays to match the boat interior: SMXII AB, SMXir, and SMXht.

Seawater System: The seawater cooling system consists of an inlet through-hull fitting, seacock (water valve), strainer, pump, and overboard discharge fitting all connected by hose or piping. If multiple air conditioning units are served by a single seawater pump, then a pump relay and water manifold are required.

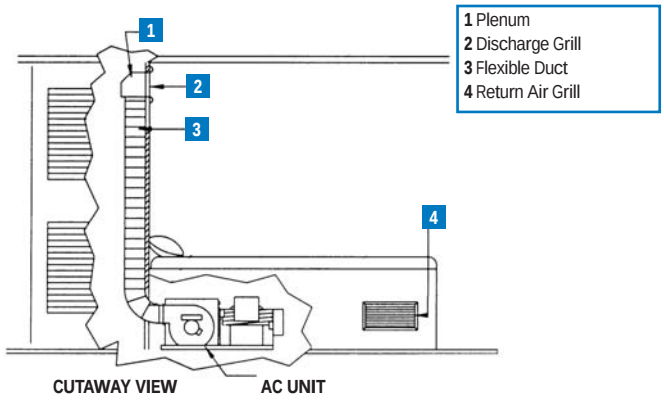
Cruisair recommends a centrifugal seawater pump for efficient, quiet operation and long life. Centrifugal pumps are not self-priming and must be mounted below the water-line. It is important that the seawater plumbing be “self-draining”, meaning that if the boat is lifted all water in the piping will drain out. An air conditioning system plumbed this way will have no air locks which could disrupt the flow of seawater. For shallow-draft boats where it is impossible to mount the pump below the water-line, a self-priming pump must be used. Figure 1 shows a typical seawater system.

Figure 1: Typical Seawater Plumbing System



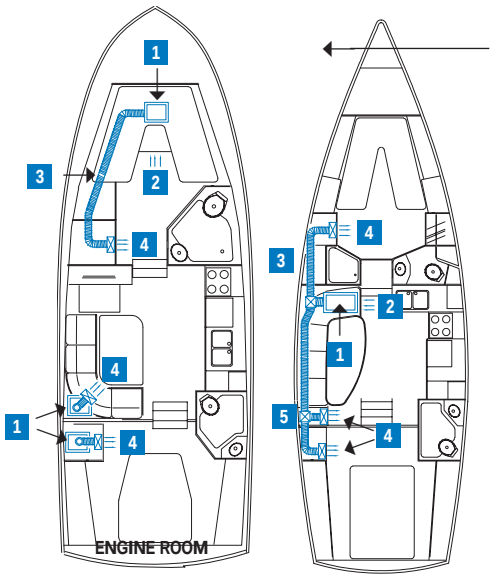
Air Distribution Systems: Cabin air is drawn into the self-contained unit or air handler through a return air grill. It is then cooled or warmed and blown back into the cabin through a ducting system. The air should be discharged high in the cabin and away from the return air grill to ensure good circulation. Plenums (transition boxes) can be installed in the ducting to allow multiple discharge grills, in one or more cabins. Insulated duct is recommended to prevent secondary condensation. An air filter, located on the cooling unit or on the return air grill, must be cleaned regularly. Figures 2 and 3 show typical ducting installations.

Figure 2: Typical Duct installation Beneath a Settee



1 Plenum
2 Discharge Grill
3 Flexible Duct
4 Return Air Grill

Figure 3: Comparison of typical remote and self-contained systems



1 Self-contained Unit or Airhandler
2 Return Air
3 Ducting
4 Discharge Plenum and Grill
5 Transition Box (Plenum)

Specifying Guidelines

Now that we know what components are needed to complete a Cruisair system and have an idea of the type of system that is needed, we can proceed in selecting the items for each particular application.

Step 1 Required Capacity

Divide your boat into three basic load areas:
(1) Below Deck – cabins where the hull slopes inward toward the keel and there are minimal port lights and hatches
(2) Mid Deck – areas on the main deck with small or shaded windows
(3) Above Deck – areas with large glass surfaces and direct sunlight

Measure the length and width of each room to be conditioned to determine the square footage. It is assumed that your boat has average headroom of about 6-1/2 ft. (2m) and you have an average amount of furniture. If one end of the compartment is narrower than the other, take your measurement in the middle.

Fill in the chart below with your measurements; then multiply the length by width to get the area of each. Next, determine which load factors to use from the table in figure 4, and multiply the area of each cabin by the load factor to determine the required air conditioner capacity.

Load Calculation Table

Cabin	Length (ft)	Width (ft)	Area (sq ft)	Factor	Capacity (BTU/hr)

Figure 4: Load Factors (BTU/hr per ft ²)

Climate	Below Deck	Mid Deck	Above Deck
Temperate	60	90	120
Tropical	80	120	150

Temperate: 95°F (35°C) air, 85°F (35°C) water, moderate humidity
Tropical: 105°F (41°C) air, 95°F (35°C) water, high humidity

Step 2 Number of Units

The number of air conditioners and their locations will be determined by the size and layout of your boat, and the space limitations for ducting and plumbing. The typical maximum ducting run is 15 ft (4.5m), but if there are many bends then the overall length must be reduced to ensure good airflow.
Also consider which areas require independent thermostat control, and which cabins will be served by ducting or a secondary air handler (where the only temperature control is by reducing airflow with an adjustable grill or fan speed control).

Refer to figure 3 for some suggestions. You should check with your Cruisair dealer for specific guidance.

Step 3 Location

As in step 2, the location of the units will be determined by your boat layout. Check the appropriate specification sheet for unit sizes, and make sure that there is sufficient space to service the unit and remove if necessary.

The self-contained unit or air handler must have an open return air path, and be located such that the discharge ducting can be routed to a high point in the cabin. The return air grill does not need to be directly in front of the unit, in fact, the system will be less noisy if there is an indirect path for the return air to follow. Most units have blowers that rotate which will allow routing the discharge duct in the most direct path to reduce restrictions.

Step 4 Seawater Components

It is normally recommended that you use one pump of adequate capacity for all of the air conditioning systems on board. The rule of thumb is to have 250 gallons per hour (4gpm) of water per ton of air conditioning (one ton is 12,000 BTU/hr). If more than one Cruisair system shares a common pump, you will also need a pump relay and manifold.
The table below shows recommended seawater flow rates and minimum inlet (through-hull) for a system of a given capacity.

Your dealer can give you more guidance.

System Capacity (BTU/hr)	Seawater Flow Rate (gph)	Inlet Size
5-12,000	250	1/2”
16-24,000	500	3/4”
30-48,000	1000	1”

Step 5 Duct and Grill Sizing

See the table below for recommended duct and grill sizing. Your Cruisair dealer can help with duct transition boxes and sizing of branch ducting, as well as with the large selection of grills available, some of which include aluminum, plastic, and many species of wood.

Capacity (BTU/hr)	Duct (in)	Return Air Grill (sq in)	Discharge Grill (sq in)
5,000	4"	60	30
7,000	5"	80	45
10,000	6"	100	60
12,000	6"	130	70
16,000	7"	160	80
18,000	7"	200	100

Electrical Requirements

All Cruisair marine air conditioners run on AC (alternating current) power. Most units are available in 3 different power configurations: 115V 60hz, 230V 60hz, and 230V 50hz. Larger units are also available with 3-phase compressors.

Some 60hz units can run at 50hz, but not all. Please check the spec sheets or with your Cruisair dealer if you have a particular requirement for international cruising.

The specification sheets will show the running current for the unit. Sometimes both cooling and heating amperages are shown.

To select the circuit breaker for the unit, multiply the running (heat) amps by 2.5 then chose the next size breaker. If the seawater pump is wired with the unit (not on a pump relay), then add in the pump amps before multiplying by 2.5. Wire sizing should be done per ABYC requirements.

If running on a generator, make sure that it can handle the large starting inrush current of the compressor. The best solution is to take the spec sheets to the generator supplier and ask for their help.