



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 to call your Cruisair dealer to discuss the system that best fits your needs.

About Boat Air Conditioners

A direct-expansion seawater-cooled air conditioning system cools your boat by removing heat and humidity from the cabin. The heat is absorbed by the refrigerant which flows through sealed tubes. It is then given off to raw seawater which is pumped through the system and discharged overboard. When the refrigerant flow is reversed, the opposite is true. Heat is extracted from the seawater and is used to warm the air flowing into the living area.

There are three basic types of Cruisair systems. Each has a particular group or size boat where it is best suited. In selecting the type and system to use, many factors must be considered, including capacity needed, access for routing necessary tubes, wires, and hoses, location of furnishings, and the storage space you are willing to sacrifice.

Self-Contained Systems

The self-contained system is normally considered the best choice for a smaller vessel where it is impractical to route copper refrigerant tubes, and there is no space for an air conditioner unit in the engine compartment. These systems are typically found in boats up to about 40 feet and are available in either cooling only, or in a reverse cycle heat pump unit. In a self-contained system, all of the major components are mounted on a single chassis, which is installed inside the living area. Installation requires only locating the unit, routing water hoses to and from it, and connecting a flexible duct to the discharge grill. The noise level expected for this type system is minimal as the unit is normally installed under a seat or bunk, and extra insulation can be added if desired.

Remote Condensing Systems

The second type of system is the remote condensing unit, which has the compressor, condenser and other mechanical components mounted on a chassis and installed in the engine or equipment room. The cooling/heating unit (evaporator and fan) is mounted in the living area, with copper refrigerant lines connecting the two components. Normally this type of system is found on boats up to 75 feet in length. A remote system offers more flexibility in that the cooling unit can be selected to take advantage of the limited space available in the living area and provide the most effective use of the capacity of the system. This system also allows the motor noise of the compressor to be moved to the engine room and out of the living area. The installation is more involved, as the copper tubes must be insulated, routed, and flared on each end to provide a leak proof connection. It is recommended that the condensing unit and cooling unit be located within 50 feet of each other to prevent an undesirable pressure drop in the refrigerant tubes. The remote system requires evacuation of the refrigerant circuit and charging in the field with refrigerant during the installation. Therefore a qualified, EPA certified technician is needed to complete the installation.

Tempered Water Systems

For boats 75 feet and above Cruisair offers a family of the tempered water systems. The length of the plumbing circuit is virtually unlimited, providing the proper diameter piping is used. Also, fewer larger units weigh less and present a lighter electrical load than many smaller DX systems. The tempered water system is also reverse cycle to provide heating as well as cooling. A tempering unit, installed in the engine room, chills or heats water which is circulated through the hoses to air handlers in the living areas. This unit is charged with refrigerant at the factory and the installation does not require the presence of a certified air conditioning technician.

There are other subassemblies, including the seawater cooling subsystem, the air distribution subsystem, and the user control/switch assembly, which make up the complete Cruisair air conditioning system. We will describe each briefly.

Seawater Cooling Subassembly

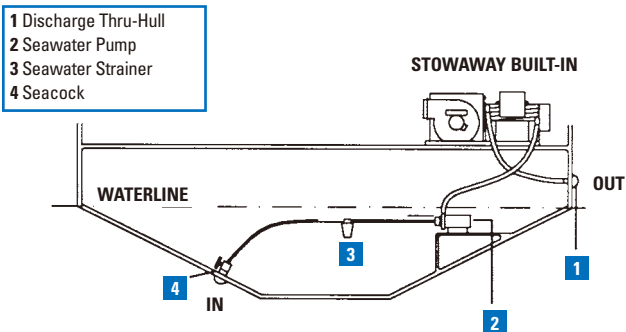
The cooling water circuit consists of a scoop thru-hull fitting, water shut-off valve or seacock, strainer, seawater pump, water hose and overboard thru-hull fitting. If more than one Cruisair system is using a single seawater pump, a water manifold and pump relay are also needed.

Either a centrifugal or self priming pump may be used with a Cruisair system. Normally, we recommend a magnetically

driven centrifugal pump for quiet and efficient operation. Centrifugal pumps are not self-priming and must be mounted in a location which is below the water-line at all times. For shallow-draft boats, on which it is about impossible to mount the pump below the water line, a self-priming pump must be used. It is vitally important, whenever you are using a centrifugal-type seawater pump, that the seawater plumbing system be self-draining to avoid air-locks. This means that seawater hoses must be routed continuously uphill, with no traps, from the inlet thru-hull to a single high point, which is normally the condensing unit outlet. The overboard discharge fitting should be 3-5 inches above the waterline.

Seawater hoses should be at least single-braided. Any good-quality automotive-type heater hose works well. Note that non-reinforced plastic hoses should never be used. A typical seawater plumbing system is shown in **Figure 1**. A cleanable seawater strainer must be placed in the seawater line between the seacock and the pump.

Figure 1: Typical Seawater Plumbing System



Air Distribution Subassembly

A combination of plenums and/or built-in or flexible ducts are used to carry air from the blower on the pull through evaporators, (self contained units are of this type) to one or more discharge grills. Some type of insulating material may be needed to avoid secondary condensation depending on the material used to build the duct. A return-air grill is situated near the evaporator unit, permitting the cabin air to be drawn into the unit. Draw through units come with a lint screen mounted in front of the coil, so a separate air filter is not necessary in the return-air path.

On blow through units a filter must be installed on the return air grill or somewhere in the return air path. Blow through units are normally used for direct discharge without ductwork.

Electrical System

Although most Cruisair systems are operated on 115V or 230V, 60 HZ, single-phase power, they will operate at 50 HZ with certain restrictions. Equipment designed for operation at 50 HZ only is available on special request. Discuss this with your Cruisair dealer or with the factory, if you need help.

Electrical connections are made via color-coded wiring harnesses or with pre-wired plugs, depending on the models.

Control/Switches

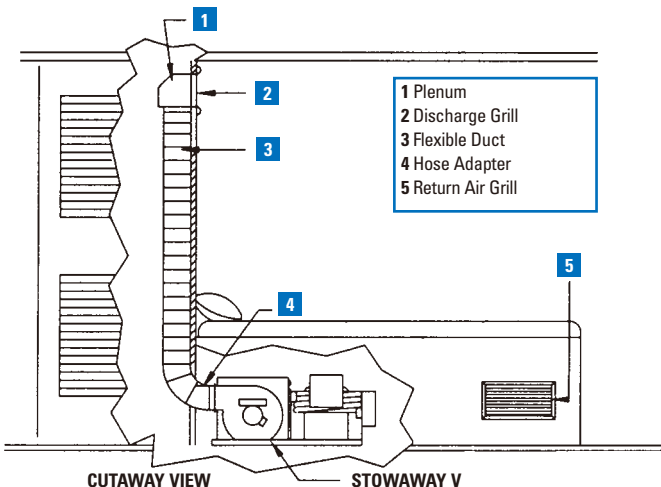
Cruisair provides two basic types of controls which are compatible with all three types of air conditioning systems. They are the rotary knob switch assemblies and the SMX-series computer-based controls. Both provide automatic changeover when used with a reverse cycle heat pump system.

The rotary knob control is a manual control which provides for operating the system fan only for air circulation and for air conditioning operation. It also has a variable fan speed control and a manual thermostat for selecting the desired temperature.

The SMX series control is an advanced microprocessor-based system, with more than 20 user-programmable functions including automatic dehumidification for extended periods of time when the boat is unoccupied. There are three displays that work with SMX II systems: SMX II AB, SMXir, and SMXht.

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

Figure 2: Typical Duct Installation Beneath a Settee



Specifying Guidelines

Step 1 How Much Capacity is needed?

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, which are situated partly below and partly above the deck, and
- (3) any above-deck compartments, such as an enclosed flybridge.

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. 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. Once you have measured all the living spaces, have determined the deck you are considering, and decided what climate you will be boating in, use the factors in **Figure 4** to determine the total capacity needed for your boat.

Step 2 How Many To Best Handle My Boat?

The layout of your boat will dictate not only the number of systems you will need to effectively cool your boat but also will determine the location of the systems. If you have an aft stateroom, it may be desirable to put a separate unit there, along with a larger unit for the salon and forward areas. You should check with your Cruisair dealer for specific guidance.

Step 3 Where Do I Install the System?

Self-contained units should be installed low with the discharge air ducted to one or more discharge grills located as high as possible in the area being conditioned. The same criteria holds true for the evaporator portion of the remote condensing unit system. It is not necessary that the coil be placed directly behind the return air grill but an unobstructed path must be provided for the air to get to the coil. Survey your boat and identify possible locations. Then use the dimensions shown on the various specification sheets to determine whether the unit will fit there. Provide room on all sides of the equipment for service and air circulation.

The remote condensing unit should be located in the engine or equipment room with ample room on all sides for servicing if required. Some Cruisair units, both StowAway and remote, have a detachable electrical boxes, which can be remotely mounted to save space if there is not sufficient clearance.

The seawater pump must be installed low in the hull of the boat in a location where the inlet is always below the water line in order to provide a constant flooded inlet. The plumbing should be constant uphill through the condenser of the unit and then dip down and overboard.

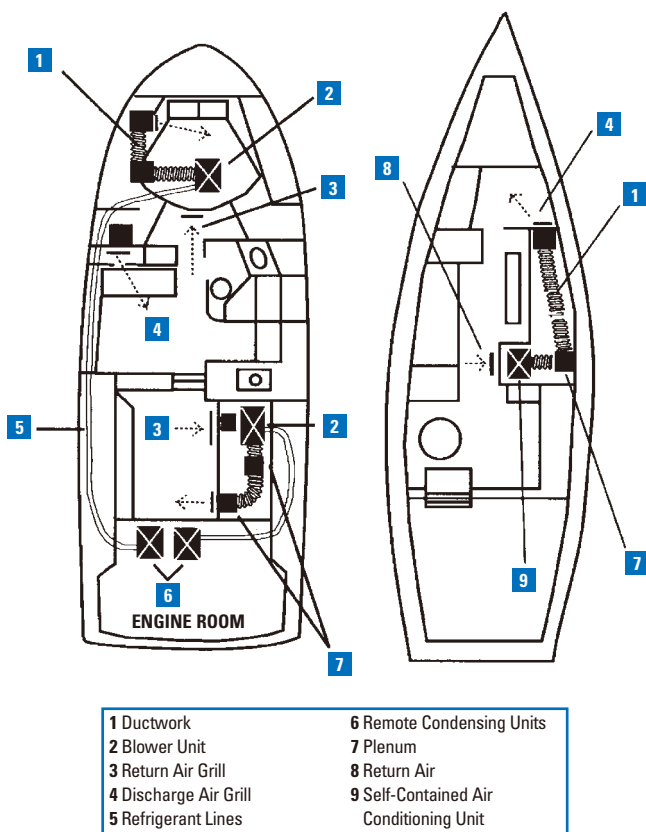
Step 4 Which Seawater Components Do I Use?

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 of water per ton of air conditioning. A ton is 12,000 BTU's per hour. If more than one Cruisair system shares a common pump, you will also need a pump relay. Your dealer can give you more guidance in this area. Use the table in **Figure 6** to determine the proper size pump and peripheral fittings for most typical systems.

Step 5 Which Ducts and Grills Are Needed?

There is a wide selection of grill sizes and shapes, as well as materials of construction. You should check with your dealer to select the best grills to match your boat's interior. The table below will give you recommended minimum grill areas and duct sizes. Your dealer can also make recommendations for the most appropriate routing of the duct.

Figure 3: Comparison of a typical remote condensing and a self-contained system



Worksheet

The formula to determine the total capacity needed for your boat is:
 Capacity (BTU/Hr) = Area (Sq. Ft.) x Factor (BTU's per Sq. Ft.)

Figure 4: Temperate & Tropical Factors (for formula)

	Below Deck	Mid Deck	Above Deck
Temperate Climate (BTU/sq ft)	60	90	120
Tropical Climate (BTU/sq ft)	90	120	150

Figure 5: Temperate & Tropical Definitions

Typical Climate Definitions	Max. Air Temp	Water Temp	Humidity
Temperate	95°	80°	Moderate
Tropical	110°	100°	High

Figure 6: Component Specification Guidelines

Capacity BTU/hr	Min. Pump Capacity (GPH)	Duct Size (in)	Return Air Grill (sq in)	Discharge Grill (sq in)
7,000	250	5	80	50
10,000	250	6	100	60
12,000	250	6	120	70
16,000	500	7	140	80

Step 6 Electrical Requirements

The chart below provides recommended circuit breaker sizes and electrical wiring for your system. There is an amperage surge when the compressor cycles on, and you must allow for this surge.

Figure 7: Recommended Wiring and Breaker Sizes

Capacity BTU/hr	Voltage (VAC)	Running Amps	Wire Gauge	Breaker Amperage
7,000	115	10.6	14	15
	230	505	14	10
10,000	115	14.3	12	20
	230	7.5	14	15
12,000	115	14.9	12	20
	230	7.9	14	15
16,000	115	17.3	10	30
	230	8.3	12	20

Use the worksheet below to list the components you will need for your boat. Then take it to your Cruisair dealer to make final equipment selections.

Area to be cooled

StowAway Capacity _____ BTU

Condensing Unit Capacity _____ BTU

Evaporator #1 Capacity _____ BTU

Evaporator #2 Capacity _____ BTU

Pump Capacity _____ GPH

RA Grill Min. Area _____ sq in

Supply Grill Min. Area _____ sq in

Insulated Duct Diameter _____ in

Length _____ ft

Electrical Voltage _____ VAC

Frequency _____ HZ

Wire _____ guage

Breaker _____ amps

Pump Relay Needed Yes _____ No _____

Dometic Environmental Corporation

P.O. Box 15299 • Richmond, VA 23227-0699 USA

Phone: 804-746-1313 • Facsimile: 804-746-7248

2000 N. Andrews Ave. Ext. • Pompano Beach, FL 33069-1497 USA

Phone: 954-973-2477 • Facsimile: 954-979-4414

For Sales and Service calls Within Europe and the Middle East,
please contact: +44 (0) 870 330 6101

Email: sales@cruisair.com • Website: www.cruisair.com



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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.