

Which Thermostat?

A thermostat senses the temperature of the evaporator plate or the air inside the box and tells the compressor when to turn on and off. Two types are available from Frigoboat. Both are designed to keep box temperatures within 2 degrees Fahrenheit of the set point.

MECHANICAL THERMOSTAT

Mechanical Thermostats operate on the principle that gas in a sealed tube expands and contracts with temperature. One end of the tube is attached to the evaporator, and the pressure expands or contracts bellows within the thermostat, which act on a switch to open or close the thermostat. The setting is made on a knob graduated 0 through 7. The Mechanical Thermostat must be mounted at a location within the scope of the tube, which is 5' long. This tube cannot be lengthened or shortened, dictating that the thermostat must usually be mounted within the box itself, which is typically a humid environment. Consequently, Mechanical Thermostats have a short life span. They are designated as either Refrigerator (white housing), or Freezer (blue housing). When using a B or H evaporator, the Refrigerator Thermostat is used.

DIGITAL THERMOSTAT/THERMOMETER

The Digital units utilize a sensor mounted within the box where it picks up average air temperature and sends it to a remote digital display. The display and keypad allow the user to monitor box temperatures as well as set the desired box temperature and range (differential). Very accurate and steady temperatures can be achieved without the guesswork associated with Mechanical Thermostats. The digital read-out of box temperature is a convenient and popular feature.

Two versions are available; the "Carel" and the "Coastal", and both models have the same size display and keypad, with the Coastal being the lowest cost but with fewer features. For most installations the Coastal represents very good value for money, as the extra features found on the Carel are rarely accessed. Both models require a dedicated 12v or 24v power supply and are supplied together with sensors (10' for the Coastal, 20' for the Carel), and a stainless steel bezel to aid mounting into a vertical bulkhead.



Why Vary The Compressor Speed?

The Danfoss compressors that Frigoboat uses have variable speed capability. The slower the compressor runs, the more efficient it is, and the faster it runs the more cooling power it delivers. So ideally the compressor should run at the fastest speed initially to cool the box down and then run as slow as possible to maintain temperatures. There should be a provision for the speed to be adjusted manually or automatically when warm goods are put in the box and/or when external conditions change. In addition, the highest load on the electronics (and highest risk of failure) happens during the first few minutes of start-up with the compressor running at maximum speed. As a safeguard, the compressor should be started in a slower speed, where there is less strain on the electronics, and then gradually increased to maximum.

DO I NEED A SPEED CONTROL?

No, you don't need it, but it makes the system far more efficient as well as providing much-needed protection for the electronics. *NOTE: Pumped-water cooled systems and those using holding plates should be set to run only at maximum speed.*

WHAT ARE THE OPTIONS?

1. **Fixed speed:** Speed set at lowest speed (2000 RPM). Non-adjustable. Standard on Frigoboat's smallest capacity systems.
2. **Variable speed, manually adjusted:** User-adjustable speed selection from 2000 RPM to 3500 RPM. Standard on most Frigoboat systems.
3. **AEO (Adaptive Energy Optimization):** Speed adjusted automatically to achieve 30-minute compressor run time. Ramp start from mid-speed on start-up for electronic protection. No remote panel. Option on all Frigoboat Systems.
4. ~~SSC (Smart Speed Control): Speed adjusted automatically to achieve longer run times than with AEO and hence more efficiency. Manual over-ride and speed selection available. Remote panel shows speed that compressor is set to from the six available, and whether compressor is running or idle. Remote panel also has diagnostic LED to assist in troubleshooting. Ramp start from mid-speed on start-up for electronic protection. Option on all Frigoboat systems.~~

**SMART SPEED CONTROL
NO LONGER AVAILABLE**

You'll Find Frigoboat On The Coolest Boats In The World.

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Island Packet
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Kanter
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MARINE REFRIGERATION

GET THE COLD FACTS ON MARINE REFRIGERATION

Frigoboat marine refrigeration systems are the most dependable, quiet and efficient systems for keeping your perishables fresh and your beverages cold. Here is your guide to choosing the very best refrigeration components for your boat.



- "Best Choice" rating by *Practical Sailor* magazine*
- Highest efficiency – lowest power draw
- Over 15,000 Keel Cooled units installed during the past 12 years

- Preferred by premier powerboat and sailboat builders
- Superior performance in tropical conditions
- Modular design for large and small refrigerators and freezers

* "Fridge Chill-Off" Test in June 2009 Issue. Reprints available upon request.

"Our production and sales team love your system and found it to be user friendly and an absolute winner. From all the Catalina team

here, "Thanks for sending good, easy to install units. Keep up the good work."

—Bob DeFilippo,
Materials
Manager,
Catalina Yachts





A complete keel cooled plus air cooled system

Which Condensing Unit?

Frigoboat utilizes the highly regarded Danfoss BD 35 and BD 50 high-efficiency, variable speed compressors. While the BD 50 has more capacity, it is slightly less efficient. Please refer to the Frigoboat Product Matrix to determine which size compressor is best for your box size and application.



"We've cruised our custom 43-foot Downeast-styled powerboat from Canada to the Bahamas, and after nearly ten-years of service our Frigoboat keel-cooled refrigerator and freezer have never failed us. Best of all, they're so efficient our solar panels easily provide enough power to run them. As a result, we have no need of a generator even when on the hook for weeks."

—George Sass, *MV SAWDUST*

Which Evaporator?

WHAT IS AN "EVAPORATOR"?

This item is installed inside the insulated cabinet. Liquid R134a refrigerant is forced through it, evaporating (or boiling) at around -25 degrees Fahrenheit and absorbing heat from the surrounding air thereby lowering the temperature inside the box. Looking at Frigoboat's aluminum "Flat Plate" evaporators, you can see the channels through which the refrigerant travels.

WHAT TYPE OF EVAPORATOR SHOULD I USE?

All Frigoboat evaporators start life as a thin, flat sheet. Bent to conform to the contours of the box, they are mounted high in the box on stand-offs. A Flat Plate evaporator will keep the area at either refrigerator or freezer temperatures, depending on the design, application, and thermostat. Frigoboat designates these evaporators as "F", for "Flat", with five sizes available. Two "F" models have a stainless steel cover added to one side for applications where exceptionally rugged use is expected. "Bin" (B), and "Horizontal" (H) evaporators are also available in various sizes. These are Flat Plate evaporators formed to make an enclosed area, with a floor or end piece added. The B models mount on a vertical wall, while the H models have a plastic door and mount to the ceiling of the box. The interiors of B and H models function as freezer compartments, while keeping the rest of the box at refrigerator temperatures.

WHAT SIZE EVAPORATOR SHOULD I USE?

If the box is all refrigerator or all freezer, a Flat (F) evaporator is used. For a freezer, install the largest plate that it is practical. For a refrigerator, consult the specifications to see which size evaporator is required. If you plan to have a Spillover system with two adjoining boxes separated by an insulated barrier, halve the refrigerator volume, add it to the freezer volume and treat the box as all freezer. The plate will be mounted in the freezer section, and a Spillover device controlled by a thermostat is installed in the barrier to deliver cold air to the refer section. If you plan on using a B or H evaporator, consult the specifications to see which size model is best. If you install a larger B or H model than recommended, you may have to cover some of the evaporator surface with stick-on insulation to force the system to run longer. This will ensure that the contents of the freezer stay frozen.



"Threads" Keel Cooler



"Studs" Keel Cooler



Keel Cooler with Zincs



"Bare Bones" Keel Cooler. Black plexiglass represents boat's hull.

"The keel cooler concept is great - you get the benefits of a water cooling circuit without having to winterize the unit, or do any maintenance in fact, and without the energy losses of a water pump. The Smart Speed Controller (SSC) is another excellent Frigoboat innovation that improves the overall efficiency of the system. We have found with properly insulated iceboxes that the refrigerant holds a very even temperature and ice cream remains rock hard in the freezer."

—Nigel Calder, *Marine Journalist, Author and World Cruiser*

Which Keel Cooler?

Frigoboat offers two styles of Keel Coolers, "Studs" and "Threads" that differ in how they are secured inside the hull. Each can be ordered with or without sacrificial zincs and are constructed of galvanically compatible sintered bronze, brass, and cupro-nickel.

"THREADS" MODEL

The "Threads" model is similar to a regular through-hull fitting. Its threaded, 1.5 inch diameter shaft passes through the hull, and a nut is threaded onto the shaft and tightened. This requires a large wrench and enough clearance for the wrench to swing. It also requires a helper to restrain the unit from rotating on the outside of the vessel as the nut is tightened.

"STUDS" MODEL

The "Studs" model is identical to the "Threads" model on the outside of the hull. It also has a shaft that requires a 1.5 inch diameter hole. Two threaded studs protrude through the top, and four different sized collars accommodate differing thickness of hulls. The appropriate one is slipped around the shaft and two metal bars are dropped down onto the studs followed by washers and nuts, which are tightened using a socket wrench. No help is needed for the installation, as the unit will not rotate as the nuts are being tightened. Once installed, there is no difference in strength or integrity between the "Studs" and "Threads" models, and the superior bonding power of modern sealants ensures peace of mind.

ZINCS OR NO ZINCS?

Both Keel Coolers are available with or without sacrificial zincs. A "Z" is added to the Part Number with zincs. In the "Z" models there are two, circular zincs recessed into the bottom, flush with the surface. An electrical connection must be made between the Keel Cooler and the battery negative. In doing so, the Keel Cooler is often connected

electrically to the boat's sacrificial zinc that is protecting the other underwater metal fittings. In this case, a Keel Cooler with zincs is not necessary. If a "Z" model is used in a situation where zincs are not required, it may result in excessive zinc loss from the Keel Cooler zincs, as these will tend to take over the job previously performed by the boat's zinc.

If the boat does not have a bonding system and/or employs non-metallic underwater fittings it would be advisable to use a Keel Cooler with zincs. Ultimately the choice of whether to use a Keel Cooler with or without zincs rests with the purchaser. If in doubt, consult a marine corrosion specialist.

NEW FOR 2009 – "BARE BONES" KEEL COOLER

This is a threads model without zincs and with no sintered bronze, resulting in a significant cost reduction over the sintered ground plate models. An exposed cupro nickel condensing tube is secured by a plastic restrainer, and components are faired to provide smooth water flow and maximum protection.

INSULATED CABINETS

Frigoboat offers a wide selection of high quality stainless steel, insulated cabinets that meet the highest standards of the marine industry. Many sizes and configurations of these stylish, elegant units are in stock for immediate delivery. Please visit www.frigoboat.com for more details.

AIR COOLED

Paris 35, Capri 35 and Capri 50

Air cooling compressors are less expensive and easier to install than water cooling units, but they are also less efficient. They work by forcing cool air across the condenser using a fan. The air, which picks up heat as it passes through, needs to be expelled into a different area. The Capri and Paris units feature a duct ring on the condenser discharge for adding a flexible duct so that heated air is discharged to a remote area. The fan can be reversed to draw cool air through the duct ring, enabling the compressor to be installed in an engine room or other hot, poorly vented area. A Keel Cooler can be added later to an air-cooled Frigoboat system if cruising plans change.

WATER COOLED WITH PUMP

W35 and W50

For use in tropical climates, water cooling refrigeration systems are best. For all freezer systems, water cooling is highly recommended. Seawater typically stays at a lower temperature than the air inside the boat in tropical areas, but utilizing it normally involves installing a pump. The gains in efficiency must outweigh the added power requirement. The pump that Frigoboat specifies adds approx. 1 amp (at 12v) to the total system current draw, but one pump can be used to support up to three water cooled systems. As with any system using pumped seawater as a cooling medium, there is the concern of clogged strainers and/or pump failures.

KEEL COOLED

K35 and K50

The Keel Cooler is the logical step up from a pump-fed water cooled system, as now the condenser is outside the vessel, and instead of pumping water into the boat and back out over the side, the refrigerant is taken outside the boat where it is cooled, and then returned. The only moving part of this system is the compressor, making the Keel Cooler system the quietest, most reliable and most efficient system of all. Some boat owners may be concerned with "putting another hole in the boat", but the Keel Cooler itself is simply a tough and sturdy plug, and there is no water coming onboard. The water stays where it belongs – outside the boat!

KEEL COOLED PLUS AIR COOLED

Occasionally, long-range cruisers may want to operate a Keel Cooled system when hauled out for repairs. If the haul-out is for one or two days, a hose can be rigged to drip water onto the Keel Cooler. For longer stays on the hard, a simple solution is to install a Keel Cooler system with an air cooled condensing unit instead of a K35 or K50. The fan on the air cooled unit is wired with a switch, and the fan is used when the vessel is hauled out. This simple solution is gaining popularity in cruising circles, where a little extra initial outlay buys considerable peace of mind.

Get More Cold Facts at
www.frigoboat.com



B evaporator



H evaporator



F evaporator



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—Nigel Calder, *Marine Journalist, Author and World Cruiser*



Capri 50



W50

"We've been pleasantly surprised at the capacity and efficiency of the system. We have two freezers aboard Wind Horse, six and seven cubic feet each. We are using your keel coolers (no circulating pump). The system is at least as efficient as the best of the holding plate systems we've installed in the past, and possibly more efficient. Your system is much easier to install and significantly less expensive."

—Steve Dashew, *Yacht Designer, Boat Builder, Author and World Cruiser*

