

# SEA FROST®

## 12 Volt Refrigeration Systems



**Sea Frost's line of BD Direct Evaporator Systems** (BD, BDxp and BDxpx subzero freezing unit) feature an advanced design that operates on 12- or 24-volt D.C. power. They are perfect for well insulated refrigerator boxes. The systems consist of two components—a remotely located compressor and rugged, half-inch thick polished stainless steel cold plate(s)—connected by pre-charged copper lines. These plates offer the highest resistance to damage and corrosion and can be mounted on a shelf, wall or ceiling. Water-cooled units are also fitted with a remote water pump. Optional ice-making trays are available for wall-mounted installations.

**BD systems** are factory pre-charged and require no special tools for installation. Popular **Danfoss®** hermetic compressors are used in all systems. These electronically-controlled, variable speed compressors feature state of the art efficiency. Compressor choice is determined by plate size and the insulation quality of the refrigerator box.

**BD compressors** are enclosed in an aluminum, powder-coated cabinet with a brushless D.C. fan and efficient, air-cooled, oversized copper and aluminum finned condenser. **Ducted air** creates high efficiency and allows for installation in confined locations. Water cooling can be added as an option.

**Sea Frost's BD systems** are well-suited for boats with adequate battery banks and charging equipment. Thermostatic operation maintains the cold plate at even temperatures. The thin direct evaporator cold plate requires minimal box space. Dockside, the system operates through the boat's battery charger.

**Options** include custom plate sizes, custom line lengths, 2-plate freezer systems, freezer bin, remote thermostat, electronic control, air and water cooling and ice-making tray kits.

# Compressor Information

## BD

All BD systems feature ducted air cooling. The four-inch round intake vent is ducted to the cabin to allow the compressor to draw in ambient temperature air. This air is then forced through the compressor box to cool the electronics and pass through the oversized air cooled condenser. Exhausted air exits through the back side of the cabinet ensuring efficient performance even in tropical climates.



Back of compressor showing air exhaust

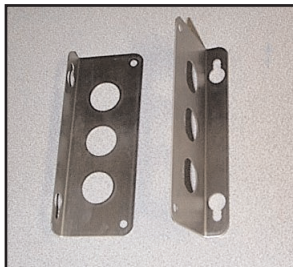


BD compressor with cover removed

BD and BDxp units come pre-charged with R-134a refrigerant. The copper lines from the cold plate connect to the compressor with brass Aeroquip<sup>®</sup> connectors which are self-sealing and may be disconnected without loss of refrigerant.

The compressor is fitted with SAE-style R-134a service ports.

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Stainless steel bulkhead brackets are available for mounting the BD compressor cabinet to a vertical wall.

### Compressor dimensions:

Height: 7.5 inches

Width: 15 inches (includes 4-inch air duct)

Depth: 9 inches

Weight: 19 lbs.

*Typical installation requires 1.5 inches behind the compressor, and room for vent hose.*

## BDxp

The BDxp has approximately 30% greater cooling capacity than the BD and should be used in larger refrigerator and some freezer applications.

The BDxp also has an AEO (Adaptive Energy Optimizing) feature. This feature senses the amount of cooling needed and adjusts compressor speed accordingly.



The BDxp may be fitted with a speed control in order to manage power draw. Air cooling is standard; optional air and water cooling is available. Housing size/weight are identical to the BD.

## Water Cooled Option

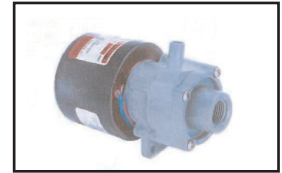


BD air/ water cooled,  
left end view  
(Uses 3/8" hose)

The water cooling option, added to the air-cooled system, incorporates a copper-nickel tube-in-tube condenser. A remote pump, selected by a switch on the cabinet, operates with the compressor and fan.

Water cooling should be used in engine room or other confined installations.

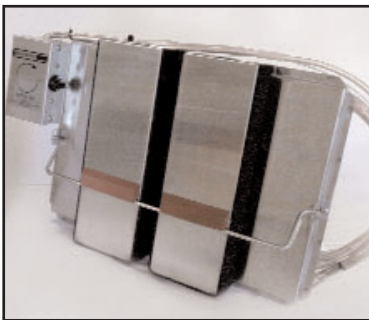
This type of condenser utilizes the scrubbing effect of water and is far more efficient than static water cooling.



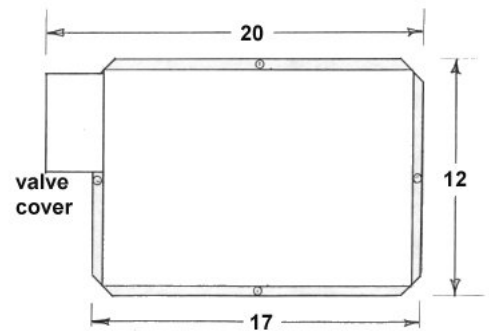
Brushless, submersible,  
magnetic-drive,  
BD water pump

## Plate Sizing for Refrigerators

BD systems use thin (half-inch), stainless steel cold plates, available in many sizes. These direct evaporator plates provide excellent thermal conductivity for cooling efficiency. They're mounted on stand-offs to allow air to flow on both sides.



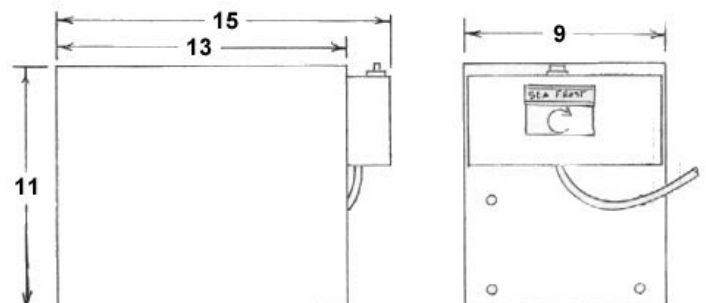
Refrigerators require a single plate which should be mounted as high as possible in your insulated box. Approximately 20% of the wall area should be covered. Contact us for plate sizing.



## Stainless Steel Freezer Bin

For a small freezer within a refrigerator, the stainless steel freezer bin is ideal. Two walls of the Freezer Bin are double sided direct evaporator cold plates which freeze the bin on the inside, creating a small freezer, and refrigerate the cabinet.

The bin should be mounted high in the box, either vertically or horizontally, and operates best in a relatively small, well insulated cabinet. The standard built-in thermostat regulates the compressor to maintain constant temperatures. Other options include a remote thermostat, and a remote electronic thermostat /thermometer, bin lid, hinged latching stainless steel door and ice making tray kit. Custom widths are also available up to 12 inches.



### Bin dimensions:

Height: 11 inches; Width: 9 inches

Weight: 22 lbs.; Freezer volume: .6 cubic feet

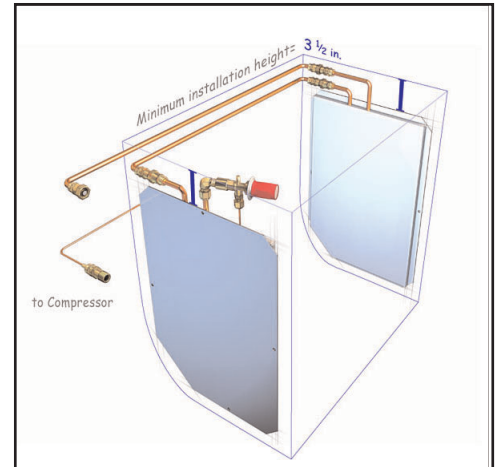
# Freezers

Consider the freezer as an additional system with its own compressor and controls. This is the best way to achieve deep freeze temperatures.

## Plate Sizing

It is necessary to have more plate area in a freezer to get air temperatures close to plate temperatures. Freezers require two plates in series, mounted on opposite walls of the same box to create a sandwiching effect. This helps eliminate problems with air flow in a full box. 60% of the wall area should be covered.

In series systems, a small copper line from the compressor runs to the first plate where an expansion valve is mounted. An inter-connector jumper connects the first plate to the second plate; a return line connects the second plate to the compressor.



Two plate freezer format

## The BDxpx A/W Super Cold Freezer

The BDxpx A/W is our highest capacity BD 12- or 24-volt system and is ideally suited for the largest refrigerators or for freezer applications requiring subzero freezing. The BDxpx A/W is coupled with stainless steel direct evaporator plates that can be custom sized for optimum performance.

Ducted air and selectable water-cooling give the BDxpx A/W excellent efficiency and allow maximum capacity operation in all installations.

The BDxpx A/W is fitted with a Danfoss® variable speed brushless hermetic compressor and like the BDxp has the AEO (Adaptive Energy Optimizing) feature which adjusts compressor speed based on cooling need. Additional options include manual speed control. All systems come pre-charged with refrigerant R-404a. Housing size/weight are identical to the BD and BDxp.

## Ice-making Kits



Vertical ice tray kit

Ice making trays are an option. Ice can be made with both refrigerator and freezer applications. The trays are specially made to expand when the water freezes to ice. The ice trays hang on the vertical sides of the cold plate in surface contact. Removing the frozen trays from the cold plate and allowing them to melt slightly will allow the cubes to be harvested and stored for later use.

Each vertical tray kit includes two vertical trays and splines, mounting rod and clips.



# Installation and Use

The insulated cabinet is a big factor in the success or failure of a refrigeration system. Heat leaks into a chilled box and must be removed on a continuous basis. Energy usage or compressor amp draw is based on the amount of cooling needed (heat leaking in). This energy usage is based on box size, insulation type and thickness, and physical climate. Heat travels into the cabinet from all directions so it's important to have a well insulated top and a lid with good air seals. Cold air flows like water. All drains need to be plugged to prevent losing cold air.

Temperatures are lower at the bottom of a refrigerated box. Mounting a cold plate at the top cools the warmer air and the box more evenly. Fans can help even out the temperature as well.

Air is the medium that transfers the cooling from the cold plate to the food. Vented shelves, grating and baskets should be used to aid air flow around food. This is important in a freezer. Packing a boat refrigerator may require putting the lettuce at one end away from the cold plate and the beer and milk at the bottom or near the plate. Frost build up on cold plates will reduce the efficiency of the system. This frost is a product of humid conditions and wet products being refrigerated.

## Technical Data\*

	<b>BD</b>	<b>BDxp</b>	<b>BDxpx (-30°F.)</b>
Voltage	12 volts	12 volts	12 volts
Fuse size	15 amps	30 amps	30 amps
Maximum amp draw (air 90° F.)	5.6 amps	7.7 amps	8.5 amps
Draw@ medium speed	3.4 amps	5.4 amps	6.7 amps
Draw @ low speed	2.6 amps	4.5 amps	5.1 amps
BTUs @ max speed (ASHRE) (evaporator -10° F.)	250 BTUs	363 BTUs	354 BTUs (evaporator -30° F.)
Water pump (optional)	1 amp	1 amp	1 amp

\* For 24 volt operation, divide all amperage figures by half.

## Energy Conversion Estimates

*Compressor efficiency is about 3.5 to 4 BTU per watt in tropical climates. The BD compressors are variable speed; at low speeds there is low amp draw but a low cooling rate. Higher compressor speed results in more cooling but more amp draw as well. Amp draw is therefore directly related to the amount of cooling being produced and is not the way to compare system performance.*

A 2.3 cubic foot (16" x 16" x 16") box with 3" of 2 lb. density foam insulation used as a refrigerator in the tropics will use 25 amp-hours @ 12 volts per day.

An 8 cubic foot (24" x 24" x 24") box with 3" of 2 lb. density foam insulation used as a refrigerator in the tropics will use 57 amp-hours @ 12 volts per day.

A 15.6 cubic foot (30" x 30" x 30") box with 4" of 2 lb. density foam insulation used as a refrigerator in the tropics will use 68 amp-hours @ 12 volts per day.

# Thermostats and Controls



The **optional Remote Thermostat** is panel mounted. This control allows adjusting the temperature or switching on/off of the BD without having to open the box. The thermostat must be mounted within 50 inches of the cold plate.

**Remote Thermostat dimensions:**  
Height: 3.5 inches; Width: 3.15 inches

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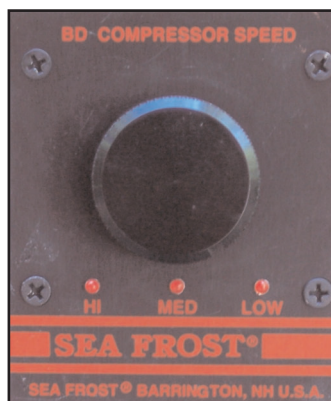
The **Electronic Thermostat/Thermometer Control (ETT)** accurately controls the cold plate temperature as well as displaying the interior cabinet temperature. LEDs indicate *standby* and *run* conditions.



The ETT offers accurate operating settings. The programmable differential increases efficiency. Fitted with wired sensors, the ETT control may be installed any distance from the refrigerator cabinet. It requires 2.5 inches behind its mounting panel. When ordering, specify 12- or 24-volt.

**Electronic Thermostat/Thermometer (ETT) dimensions:**  
Height: 3.5 inches; Width: 4.6 inches

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The **BD Speed Control** can be added to any BD system to change the compressor speed. Speed can be adjusted for cooler weather and will reduce cycling of the compressor. Slowing the compressor reduces the cooling rate, lowering amp draw and reducing battery wear. This also allows energy draw to be matched to solar panels or windmill output. LEDs indicate the compressor operation and speed.

The BD speed control should be used with the standard thermostat or with the ETT.

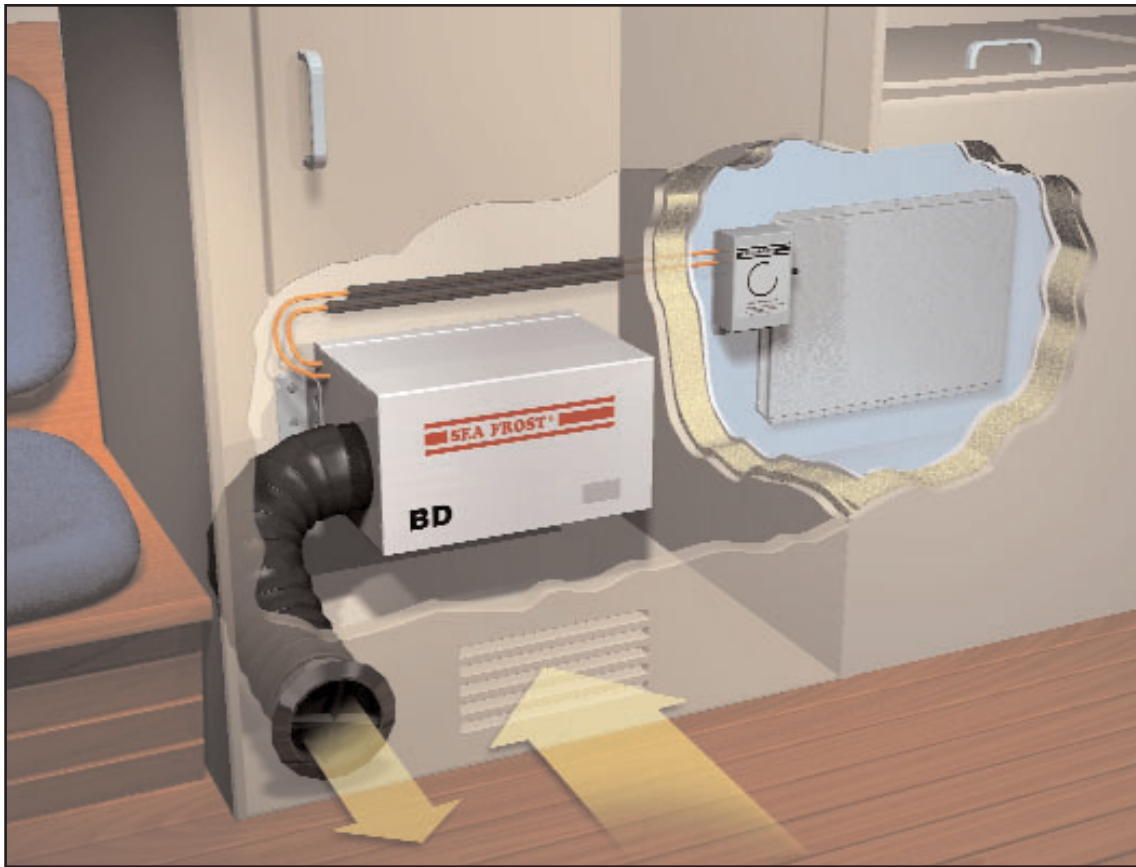
**BD Speed Control dimensions:**  
Height: 3.5 inches; Width: 3.15 inches

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The **BD Speed Control/Thermostat** combines the Remote Thermostat with a speed control. The thermostat must be mounted within 50 inches of the cold plate.

**BD Speed Control/Thermostat dimensions:**  
Height: 3.5 inches; Width: 4.6 inches



## Diagram of an Air Cooled Installation

Ducted air cooling creates the highest efficiency and allows installation in confined areas such as a sail locker, or under a cabinet or seat. The ducting eliminates recirculation of the cooling air. The air temperature increase is minimal (2° to 3° F.). Air flow can be reversed.

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## What Our Customers Have to say . . .

*"My wife and I just finished a two-month cruise to Maine and back. The Sea Frost Bin system was wonderful! At one point we went two full weeks without touching shore. We had plenty of room in the icebox and were able to keep some items frozen for practically the whole trip. We were also able to make our own ice. . . I don't know how we ever did without refrigeration before. . ."* — A. Ames

*"I just finished installing the new BD refrigeration unit I ordered earlier this year. I have to tell you that I am pleasantly surprised at the thought and engineering that went into this system. It installed in under four hours and was very straight forward. Once I turned the unit on it exceeded my expectations in how fast it brought the box temperatures down."* — B. Hughes

*"We use our boat every weekend and used to schlep ice to keep things cool and unfortunately wet! The BD 12-volt refrigeration system works magnificently! Cold milk, juice, soda and beer have transformed our boat into a yacht. What decadence."* — D. and S. Richmond

## Sea Frost

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