



## **INSTALLATION AND OWNER'S MANUAL**

### **INTRODUCTION**

Thank you for selecting the ICE+ Holding Plate Refrigerator/Freezer System. Please take a minute to fill out and mail your Warranty Registration Form along with a copy of your purchase receipt. As an exclusive product of Defender Industries Inc and its dealers, you will find that ICE+ establishes a level of value far beyond that found in the refrigeration systems offered by the retail chain stores. It is designed to provide you with years of quiet, powerful, trouble-free service at a very attractive price. Additionally, ICE+ is one of the few systems available which is truly "dual voltage" and can be powered directly from either AC or DC current. The system comes to you factory tested, pre-charged with refrigerant and ready for immediate installation.

To ensure that your ICE+ operates as efficiently and reliably as possible, it is important that you closely follow the installation and operational instructions in this manual. Failing to do so may result in unsatisfactory operation, premature mechanical failure, injury or death. It is highly recommended that installers read this manual in its entirety before beginning installation. Those who do not feel confident in their ability to closely follow the instructions contained herein are advised to seek qualified professional assistance from a certified refrigeration technician, marine electrician or both.

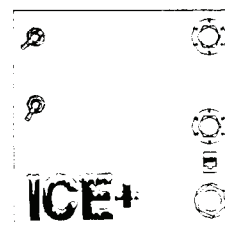
**WARNING: THIS EQUIPMENT CONTAINS PRESSURIZED REFRIGERANT GAS AND HIGH AC LINE VOLTAGE. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SEVERE PHYSICAL INJURY OR DEATH.**

## SHIPPING CHECK LIST

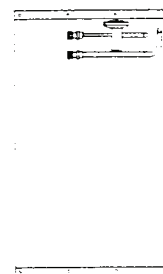
Upon receipt of shipment, verify that you have all of the required components as described below. The exact components needed for any given system will vary according to the box temperatures, number of holding plates, distance between individual components and desired options. If you are going to need additional components, it is recommended that you order and receive them prior to starting your installation. If, after reading this manual, you are unsure of which components you will require, contact Defender Industries for assistance.

### Basic system -

1. **Compressor Unit** - The compressor unit is the heart of every system. Upon receipt of your system check the Compressor Unit over for signs of physical exterior damage such as dents, dings and the presence of oil. The presence of oil would indicate that internal damage had occurred during shipping. In the event such damage is visible, contact Defender Industries (or the dealer from whom the unit was purchased) immediately. NOTE: The interior "rattle" of the compressor is normal and is not a sign of damage.



2. **"System" Holding Plate** - Every ICE+ requires a single "system" holding plate with a permanently attached expansion (or TX) valve. This plate differs from the "additional" holding plates which do not have this valve attached. You will also want to verify that your "System Plate" is a *refrigerator* or *freezer* plate as requested. The back side of the plate will be engraved "REF" or "FRZ" in the upper right hand corner to indicate the type of solution it contains.



NOTE: If you are planning to use both refrigerator and freezer plates in your system, you MUST use a freezer System Plate.

3. **Tubing Line Set** - The standard tubing line set consists of a single 16' length of 3/8" Return (insulated) Tubing and a single 16' length of 3/16" Discharge Tubing. This tubing is pre-charged with refrigerant and comes coiled and capped for shipping and cleanliness. One end of each tube has a larger "quick disconnect" type fitting which attaches to the Compressor Unit and a smaller "one-time connect" fitting which attaches to the holding plate(s). Extension Line Sets are available if required (see Options below).

NOTE: The 3/16" discharge tubing is used only between the Compressor Unit and the System Holding Plate. Tubing used to link up "Additional" Holding Plates will consist only of 3/8" Link tubing.

4. **Water Pump** - The basic system contains one centrifugal (ie. non self-priming) type cooling water pump. The pump is fully submersible and 100% waterproof. A self-priming type pump is available for installations which require it (see Option below).

5. **Control Panel** - The basic system contains one standard Control Panel. An upgraded Control Panel offering additional features is also available (see Options below).

6. **Control Panel Connection Wire** - The basic system includes one 20' wire for connecting the Compressor Unit to the Control Panel.

7. **Temperature Sensor & Expansion Valve Sensor Clamp.**

## Multiple holding plate systems -

Those systems which require the use of multiple holding plates will need the following items for each plate added:

1. **"Additional" Holding Plate** - Available with refrigerator and freezer solutions (choice), these plates differ from the "System" holding plates in that they do not have expansion valves. Depending on the size of your box and the thickness of the insulation, you may need to use one or more of these.

2. **3/8" Link Tubing** - A 3/8" Link Line (2', 3' or 4' ) will be required for each Additional Plate used. It connects the exit of the outlet of the prior plate in the chain to the inlet of the Additional Plate. Depending on the distance, the return line back from the Additional Plate to the Compressor Unit may also have to be extended using a 6' or 12' 3/8" Extension Line.



## Options -

### Pre-charged Line Sets

- \* 3/8" Link (non-insulated, female/female connectors) - 2', 3', 4' lengths.
- \* 3/8" Extension (insulated, male/female connectors) - 6', 12' lengths
- \* 3/16 Extension (non-insulated, male/female connectors) - 6', 12' lengths

### Additional Holding Plates

- \* Refrigerator
- \* Freezer

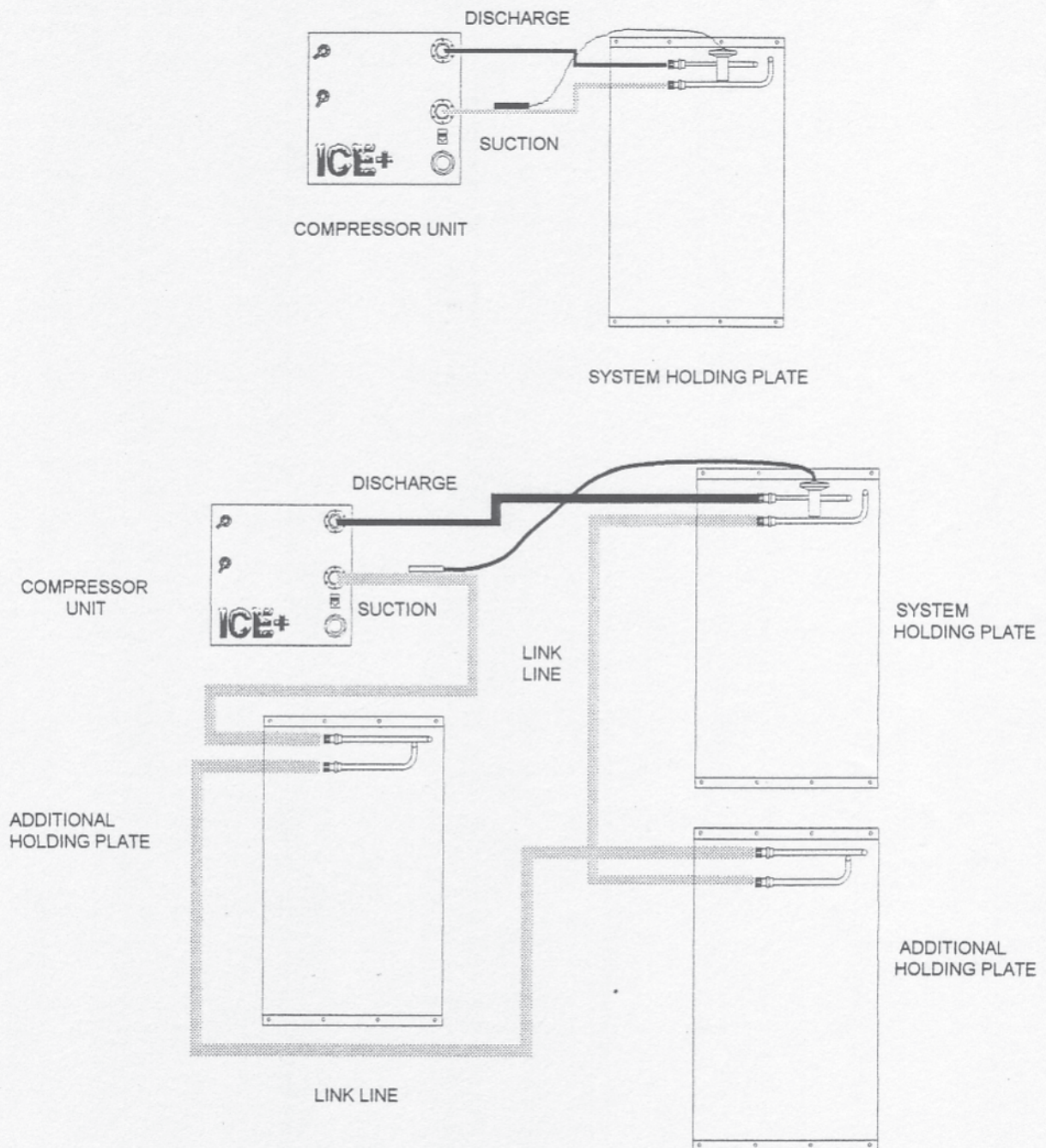
### Controls

- \* Upgraded Control Panel
- \* Control Extension Wire - 6', 12' lengths

### Water Pump

- \* Self-Priming diaphragm pump

## THE BASIC SYSTEM LAYOUT



NOTE: THE EXPANSION VALVE SENSOR BULB IS SHOWN FOR CLARIFICATION. THE BULB SHOULD ACTUALLY BE MOUNTED VERY NEAR THE HOLDING PLATE.

## **MOUNTING THE COMPRESSOR UNIT , HOLDING PLATE(S) AND CONTROL PANEL**

### **Compressor Unit -**

Select the location for the Compressor Unit based on the following qualities:

- a. Level - The Compressor unit must be mounted so that the mounting "feet" are down and it is level when the vessel is not underway.
- b. Dry - Ensure that the area is not exposed to water or condensing moisture.
- c. Ventilated - A modest amount of ventilation is required. An engine room should be considered only if it is exceptionally well ventilated. In any case, the Compressor Unit should be protected from the radiant heat emitted by the engine.
- d. Close To Icebox - The standard line set required that the Compressor Unit be mounted no further than 15' from the System Holding Plate. (extensions can be added)
- e. Direct Tubing Run - The more direct the tubing run to the holding plate(s), the easier the installation will be.
- f. Ease Of Access - You will need clear access to the front of the unit to attach tube wires and water hoses.

Generally, noise is not a consideration due to the very quiet operation of the ICE+.

Once a satisfactory location is selected, use 4 1/4" SS screws through the mounting tabs provided to attach the Compressor Unit to the mounting surface.

### **Thermostatic Control location-**

The Thermostatic Control must be mounted within 20' of the Compressor Unit or you will need to extend the connecting wires supplied. It is generally, not desirable to locate the Control within a refrigerated compartment due to the possibility of moisture accumulation. Therefore, you will need to find a bulkhead or cabinet which will permit the installation of the 2.5" depth (min.) of the Control and wire connection. If such a location does not exist, it may be desirable to build out a small box at a location near the refrigerator.

### **Refrigerator holding plate location -**

The refrigerator holding plate can be mounted horizontally or vertically and at any angle. It should be positioned as high in the box as possible. This high position combined with a central location facilitates good convective air circulation and even temperatures throughout the box. Mounting the holding plate at the far end on a long box may create an unsatisfactory temperature gradient.

It is important that the installer recognize the need to maintain access for the attachment of the tubing line set. In particularly cramped areas, it may be easier to first mount the plate, then temporarily remove it for connection of the tubing. Once the location has been selected, attach the refrigerator holding plate with at least 4 1/4" SS screws in the integral mounting flange. When attaching to thinner substrates use all 8 holes provided.

NOTE: In all cases, ensure that the tubing will not need to be bent at a radius tighter than 1.75" for 3/8" tubing and 1.00" radius for 3/16" tubing. For reference, a typical coffee cup is approximately 1.75" radius.

### **Freezer holding plate location -**

Selecting the best location for the freezer plate(s) is similar to that for the refrigerator plate. As with the refrigerator plate, the freezer plate(s) can be positioned either horizontally or vertically. However, when choosing a location particular attention must be paid to ensure that all food stored in the box maintains fairly close proximity to at least one plate. The importance of this cannot be overemphasized. Remember, food has excellent insulating qualities. When a freezer box is loaded to the top, heat coming in through the box walls must first conduct its way through the nearest food before eventually being absorbed by the holding plate. If the heat is forced to travel through too much food, the food will rise unacceptably in temperature and thaw out. While every box is different, the general rule-of-thumb is that stored frozen food should never be more than 16" from any holding plate.

### **A word about "spillover" configurations -**

For those who may not be familiar with the term, a "spillover" configuration refers to the indirect cooling of a separate compartment to refrigerator temperatures by "spilling over" cold air from the freezer. In a spillover system all holding plates are mounted in the freezer compartment and holes are made in the box divider to permit the transfer of air between the two compartments. Frequently a manual shutter or thermostatically operated fan assists in the regulation of the temperature of the warmer refrigerator box.

In our experience, such configurations are as common as are their dissatisfied users. Contrary to popular belief, the creation of a functional spillover system often requires more, rather than fewer, holding plates. This is due to the fact that freezer plates are less efficient at removing heat than are refrigerator plates. For this reason we recommend against them unless only the smallest of refrigerators is required. You will be much better off insulating the separation between the two compartments completely and using separate refrigerator and freezer holding plates.

## **CONNECTING THE COPPER TUBING**

NOTE: THE CONNECTORS WHICH COUPLE THE COMPRESSOR UNIT TO THE SYSTEM LINE SETS ARE OF THE "QUICK DISCONNECT TYPE" AND CAN BE DISCONNECTED WITHOUT LOSS OF REFRIGERANT. THE SMALLER CONNECTORS USED THROUGHOUT THE REMAINDER OF THE SYSTEM ARE PRE-CHARGED FOR ONE-TIME CONNECTION ONLY. ONCE CONNECTED THEY CANNOT BE DISCONNECTED WITHOUT LOSS OF THE COMPLETE REFRIGERANT CHARGE.

The ICE+ system uses two types of fittings, "quick disconnect" which may be safely disconnected without loss of the refrigerant charge and, "one-time connect" which once connected, cannot be disconnected without loss of refrigerant. The "quick connect" fittings allow the owner to easily remove the Compressor Unit for service should it ever be required. The use of "one-time" connect fittings in the remainder of the system reduce bulk and prevent the excessive pressure drops which could result from using too many quick disconnect type fittings.

### **General planning -**

While planning your tubing connections, it is helpful to keep the following facts in mind:

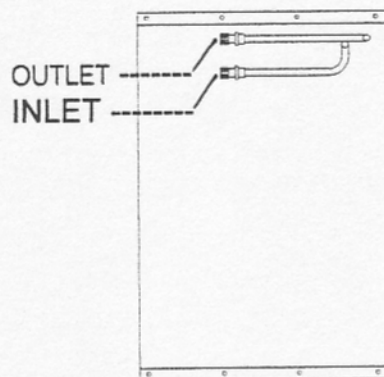
- a. The Compressor Unit and all Holding Plates use only male connectors.

b. The small diameter (3/16") Discharge Tubing is used only to connect the Compressor Unit Refrigerant Out (ie. discharge) to the System Holding Plate expansion valve. This line has female fittings at both ends, one is a "quick disconnect" and the other a "one-time" connect type.

c. The insulated 3/8" diameter Return Tubing is used only to connect the outlet of the System holding plate (in a single plate system) or the last plate in the series (in a multiple plate system) to the Compressor Unit Refrigerant In (ie. suction). This line has female fittings at both ends, one a "quick disconnect" and the other a "one-time" connect type.

d. Multiple plate systems are connected in series (ie. "daisy chained") so that the outlet of the "System Plate" is connected to the inlet of the "Additional Plate". In three or four plate systems, the outlet of each Additional Plate is connected to the inlet of the next plate.

e. If you are installing an Additional Plate it is important to differentiate between the plate INLET and OUTLET. This ensures that the flow direction of the refrigerant will be correct. The INLET and OUTLET connection for the Additional Plate are identified in the illustration below.



f. A non-insulated 3/8" Link Line of the appropriate length is used to provide the connection between plates in a multiple plate system. This line has female "one-time connect" fittings at both ends.

g. In systems using both refrigerator and freezer plates, the "System Plate" must be a freezer plate. The outlet of this plate must be connected to other freezer plates (if present) before continuing on the refrigerator plate(s). In this way the freezer plate(s) receive refrigerant before the refrigerator plate(s).

h. In the event that the standard line set is not long enough (ie. the compressor must be placed further than 16' from the holding plates), use the optional "Extension Lines" to lengthen them. Extension Lines have one male and one female "one-time connect" fitting.

i. It will be necessary to attach the "sensing bulb" of the expansion valve to the 3/8" Return Line after it exits the last holding plate in the series. The capillary tube which connects this bulb to the expansion valve is 30" in length. This means that the Return Line will have to pass well within 30" of the expansion valve of the System Plate.

#### Uncoiling the tubing -

Do not uncoil tubing until required. All copper tubing "work hardens". Once straightened from its coil and bent, it will be much easier to "kink" if bent again. This is particularly true of the larger 3/8" diameter tubing. Therefore, it is necessary to plan your tubing run carefully so as to ensure that, once bent, the tubing will not have to be straightened for a second attempt.

### **Drilling holes -**

In most cases the Discharge Line and Return Line connecting to the Compressor Unit can be easily routed through a single 2" diameter hole. Link Lines run through box dividing walls require only a 1" diameter hole. Care should be taken that tubing does not rest directly against sharp edges, particularly those of stainless steel lines ice boxes. Once the tubing is connected to the correct components any gap remaining should be sealed tight with spray foam sealant (available from Defender and many hardware stores) or insulated "barrier putty" (available from wholesale refrigeration suppliers).

### **Positioning the tubing -**

Before making connections, bend and position all tubing runs so that the fittings line up easily. Properly bent tubing will not place a "spring action" strain on the holding plate connections. It should be possible to begin screwing the connections together using only your fingers. If you need to use a wrench to start the connections it isn't lined up and may cross-thread the fittings.

If you are using more than one holding plate - This is the time to double check that you are connecting the "OUTLET" from the System Plate to the "INLET" of the Additional Plate.

**WARNING: REVERSING THE FLOW DIRECTION THROUGH THE ADDITIONAL HOLDING PLATES WILL VOID THE WARRANTY AND MAY DESTROY THE COMPRESSOR UNIT. ALWAYS ENSURE THAT THE GAS ENTERS THE "INLET" AND EXITS THE "OUTLET".**

### **Making Connections -**

**IMPORTANT:** Complete all connections to, and between, holding plates before making the final connections to the Compressor Unit.

Before making your connections be sure to have the appropriate sized wrenches at the ready. You will need two 5/8" and one 13/16" open end wrenches to assemble the "one-time connect" fittings. To make the final connection of the "quick disconnect" fittings to the compressor you will need a 1 5/16" or large adjustable.

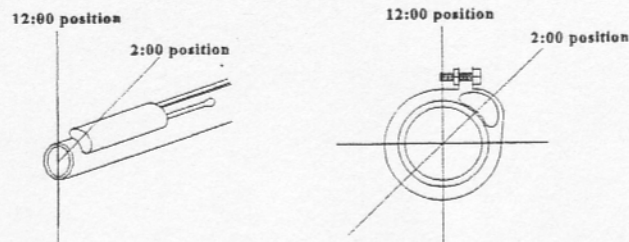
#### **For "one-time connect" fittings -**

Remove the protective plastic caps from the fittings. Closely examine each end to make sure no dirt, moisture or other contamination is present. Also, careful check the inside of the male connector to verify the presence of a rubber "O" ring. When satisfied that everything is clean and complete, screw the fitting together as tightly as possible with your fingers. Using the wrenches, continue to screw the two fittings together to complete the connection. Once you have started tightening the connection with your wrenches - **DO NOT STOP UNTIL IT IS TIGHT.** The final connection should be firm, but not excessively tight - about 12 ft-lbs.

#### **For "quick disconnect" fittings -**

Follow the guidelines given above for the "one-time connect" fittings. These fittings have metal protective covers. Be sure to save these caps for future use in the event that your Compressor Unit should ever need to be shipped for service. The correct torque for these fittings is 35 ft-lbs.

## Mounting the expansion valve sensing bulb -



The expansion valve sensing bulb is connected to the expansion valve on the System Holding Plate by a 30" capillary tube. The temperature of this bulb regulates the flow of refrigerant through the expansion valve by sensing the temperature of the Return Line leading back to the Compressor Unit. It is important that it is properly positioned and firmly attached if efficient system operation is to be achieved.

The bulb should be tightly secured (using the clamping band provided or a stainless steel hose clamp) to the top half of a horizontal run of the Return Line, close to the outlet of the last holding plate. Remember, the Return Line is the 3/8" tube which connects the outlet of the holding plate (or last holding plate in a multi-plate system) to the "Refrigerant In" (suction) of the Compressor Unit.

This connection is always made inside the ice box. The bulb should be clamped tight enough so as not to be easily twisted on the tube by hand. However, if you are using a hose clamp be careful not to clamp so tight as to distort the bulb or tubing.

## THE COOLING WATER CIRCUIT

### WARNING - SHOCK HAZARD!!!

THE SEA WATER PUMP OPERATES ON AC LINE VOLTAGE AT ALL TIMES AND PRESENTS A POTENTIAL SHOCK HAZARD IF WET AND/OR IMPROPERLY CONNECTED. FOLLOW MOUNTING AND CONNECTION INSTRUCTIONS PRECISELY.

The sea water pump used to circulate cooling water through your ICE+ system is a simple and trouble-free device when properly installed. While the installation is not difficult, there are a number of issues which must be addressed. As mentioned in the warning above, the pump is driven by 110v AC current and, therefore, presents a potential for electric shock. This hazard is present primarily at the electrical connections. The water pump itself is epoxy encapsulated and 100% submersible. This section presents the information you'll need through a Q&A and graphic format.

### Installing The Centrifugal Water Pump

Question: If I mount my pump under the water line will it self-prime?

Answer: A location below the water line is one, but by no means the only, requirement for a centrifugal pump to prime. A good rule of thumb is to remember that if an air bubble was to enter the through-hull, it must leave through the pump discharge unhindered. This requires a continuous, smooth uphill run all the way into the head of the pump.

Question: Do I need a water scoop (ie. "speed scoop") on my through-hull when using a centrifugal pump?

Answer: Water scoops are a good idea but they are not always necessary. On fast monohulls and catamarans they may be required to ensure that the pump continues to operate at high vessel speed.

Question: Do I have to discharge water above the water line?

Answer: No. As long as the pump head is (a) below the discharge port and, (b) does not have the discharge hose "dipping" below the level of the water pump.

Question: Can I share a through-hull with another pump?

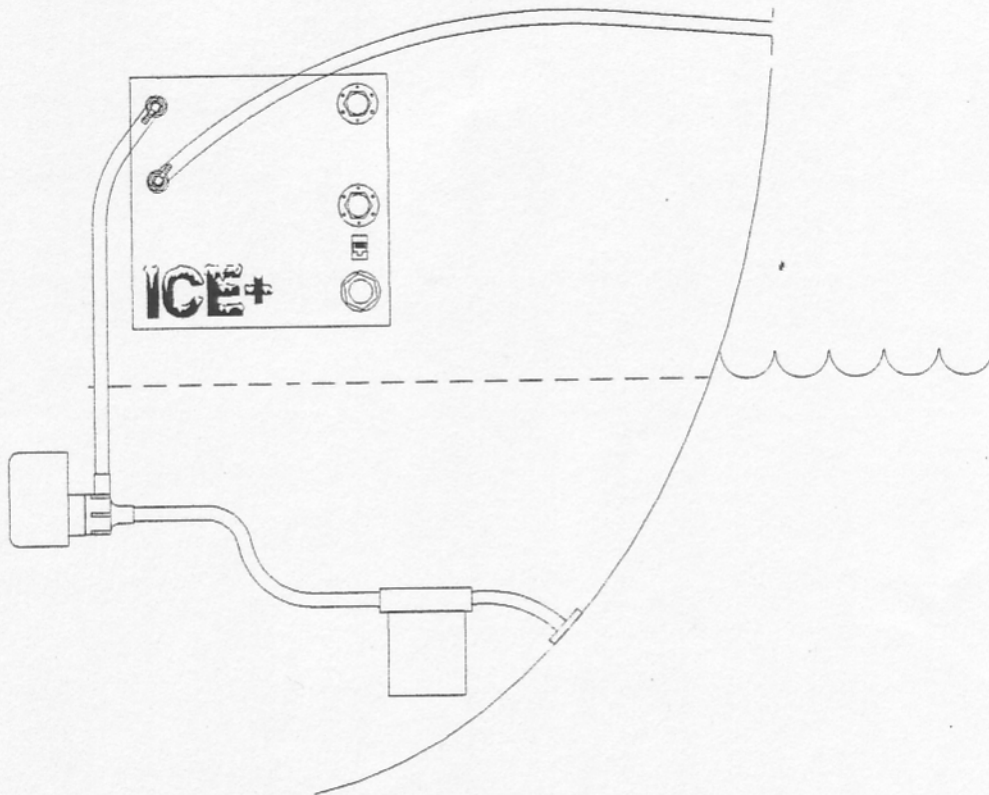
Answer: On merchant vessels this system is used all the time. The way they accomplish it is by using sea strainers that are massively over-sized (often unrealistic on a sailing boat), using one-way "check" valves on the pump discharge line or, discharging below the waterline. The potential problem stems from the fact that a centrifugal pump at rest permits water to flow in both directions. This can cause the other pumps on the circuit to suck in air thus losing their own prime. In any event, only low-flow through-hulls such as toilet intakes, cockpit drains or the galley sea water pump should be considered as a multiple intake source.

Question: Why does my pump work well at the dock but not when I am under way?

Answer: Sometimes boats prime well in the vertical plane but not on a heel. Some hull shapes and speeds can also stop flow by inducing suction (ie. Venturi effect). This is where the movement of the vessel through the water creates a suction on the through-hull thus taking the prime from the pump (This can be alleviated with speed scoop).

## An ideal installation:

As illustrated in the drawing, the cooling water enters the vessel via it's own *through-hull* located deep on the hull. The incoming water then rises to the *sea strainer* and continues smoothly uphill to the inlet of the water pump. (The through-hull, sea strainer and pump are positioned so as to remain under the water line and continue this uphill sloping attitude at all angles of heel.) The *discharge outlet* of the pump points upwards with the *connecting hose* continuing to rise smoothly into the *Condenser Unit inlet*. From the *Condenser Unit outlet*, the *connecting hose* then continues to a *discharge through-hull* located above the water line and above the level of the water pump.



## Connecting the hoses -

The pump is supplied with 1/2" fittings. This larger size hose is advantageous for the inlet side of the pump. However, the outlet (discharge) must be reduced down to accommodate the 1/4" ID hose required by the Compressor Unit. Using a hose of larger or smaller diameter between the pump discharge and Compressor Unit can cause priming and circulation problems. Therefore, it is recommended that the hose is reduce down to 1/4" immediately after the pump discharge (reducing fitting is provided). Use small SS hose clamps to secure the hose to the pump and Compressor Unit fittings.

**WARNING: MANY SMALL TUBE FITTINGS ARE MADE OF BRASS - NOT BRONZE. NEVER USE BRASS FITTINGS IN A SEA WATER CIRCUIT. USE ONLY PLASTIC OR BRONZE.**

## CONNECTING THE ELECTRICAL SYSTEM AND CONTROL

### WARNING - SHOCK HAZARD!!!

AC LINE VOLTAGE IS PRESENT WHENEVER EITHER AC OR DC POWER IS CONNECTED TO THE ICE+ COMPRESSOR UNIT. FOLLOW MOUNTING AND WIRING INSTRUCTIONS PRECISELY. DO NOT OPEN HOUSING OR TOUCH ANY EXPOSED WIRING WHEN AC OR DC CURRENT IS SUPPLIED.

### WARNING - FIRE HAZARD!!!

AS WITH ALL ELECTRICALLY POWERED DEVICES, IMPROPERLY SIZED AND/OR CORRODED WIRE AND INCORRECT CONNECTING PROCEDURE CAN CAUSE FIRE. THESE DANGERS ARE PARTICULARLY PRESENT WITH HIGH AMPERAGE DC POWERED EQUIPMENT. INSTALLERS NOT FAMILIAR WITH APPROVED MARINE WIRING TECHNIQUES ARE DIRECTED TO REFERENCE THE PUBLISHED GUIDELINES OF THE AMERICAN BOAT AND YACHT COUNCIL (ABYC).

The ICE+ system is designed to be "hard wired" into the supply circuit. The elimination of terminal type connectors minimizes the potential for future problems due to corrosion and the build-up of resistance. When planning your connections, it is easiest to think of the wire bundle in distinct and separate groups according to their function. You will find the following wires:

| Function          | Color       | Identifier                         |
|-------------------|-------------|------------------------------------|
| AC IN - Hot       | Black       | Stripped Wire - 16 awg             |
| AC IN - Neutral   | White       | " " - " "                          |
| AC IN - Ground    | Green       | " " - " "                          |
| DC IN - Positive  | Red         | Stripped Wire - 8 awg              |
| DC IN - Negative  | Black       | " " - " "                          |
| WATER PUMP        |             |                                    |
| Neutral & Hot     | Purple (x2) | Spade Terminal Connector           |
| Ground            | Green       | " " "                              |
| TEMPERATURE PROBE | Red         | Bullet Terminal Connector - female |
|                   | Black       | " " " - male                       |

### General -

NOTE: Per ABYC recommendations, the AC ground circuit and DC negative are connected internally.

Use only 100% tinned marine-grade wire for connections.

Solder all "stripped wire" connections with a rosin core (electronics-grade, non-acidic) flux. Apply sufficient heat to ensure thorough penetration of the connection.

Fully insert all "spade" and "bullet" connectors.

Seal all connections (soldered and terminal) with adhesive-lined heat shrink tubing.

### **AC circuit -**

The AC circuit provides power to the system while it is in "AC mode". A separate and dedicated breaker on the AC distribution panel should be assigned to refrigerator system duty.

While running from AC the current draw will be very modest at < 2 amps @ 115vac. However, there is startup surge which needs to be considered. Our recommendation is that a breaker of no more than 10 amps capacity be used. Supply wire should be size according to the length run, #14 awg will accommodate a one way distance of 20'.

NOTE: Installers are cautioned to verify the correct polarity of their AC system and the integrity of the grounding circuit. If unsure, contact a qualified marine electrician.

### **DC circuit -**

The DC circuit provides power to the compressor while it is in "DC mode" and a smaller amount of current to the control circuitry in both AC and DC modes. Therefore, the DC circuit must be on anytime the system is running. A separate and dedicated breaker on the DC distribution panel should be assigned to refrigerator system duty. This breaker can be used as the main "on/off" switch for the system.

While running directly from the batteries, the DC current draw will average 16 amps @ 12vdc. There is also a substantial momentary (1 sec) startup surge of approximately 125 amps which needs to be considered. The wire size and circuit breaker selected need to accommodate this surge without excessive (>3%) voltage drop.

Supply wire should be size according to the length run, #2 awg will accommodate a round trip distance (ie. supply to Compressor Unit and back) of 30'. The recommended breaker size is 50 amps.

NOTE: Undersized wire and/or poor connections in the DC circuit are the single largest source of problems with the ICE+ system. Remember that the DC distribution panels of many vessels are supplied with undersize wire. They may also have corrosion or poorly made connections which cause loss of voltage and potential fire. It does no good to run #2 gauge wire from a distribution panel which itself is fed with #8.

### **Water Pump and Temperature Probe Wires -**

The water pump and temperature probe wires are equipped with spade and bullet connectors. These connectors not only identify the circuits but make it difficult to connect them improperly. However, should it be necessary to lengthen the wires, it may be desirable to remove the connectors, then strip and solder the extended wire into place. Whether or not the supplied connectors are used, all connections must be sealed with adhesive-lined heat shrink tubing.

Temperature probe wires can be lengthened using common tinned marine 18 awg wire.

NOTE: The temperature probe is polarity sensitive, the water pump is not.

CAUTION: The water pump wires transmit 115vac current, even when the compressor is in the DC mode of operation. Do not touch bare wires when connected to any power source AC or DC.

### **Control Panel Cable -**

The Control Panel Cable supplied with your system is 20' in length and incorporates telephone type RJ-45 connectors at each end. To connect this wire simply plug into the outlet on the front of the Compressor Unit and the back of the Control Panel. If this wire needs to be lengthened you make purchase an extension cable from

Defender Industries or try contacting a local computer or electronics supplier who may be able to make a custom one for you.

### **Selecting the Temperature Probe Location -**

All holding plates have a "well" on the bottom for insertion of the Temperature Probe. Generally, in multiple plate systems it is best to place the probe on the last holding plate in the series. If this does not seem to give satisfactory results, try moving it to plates further up the line.

## **NORMAL OPERATION AND MAINTENANCE**

Once properly installed and "tuned in", your ICE+ system is designed to be as simple and maintenance-free as your home refrigerator. Simply set the desired temperature on the Control Panel and ICE+ handles the rest.

### **AC/DC Mode -**

The ICE+ system automatically switches to "AC mode" whenever 115 volts is present on the AC wires. However, while in AC mode the unit continues to draw a small amount (<2 amps) of current from the DC circuit to power the control board and logic circuit. It is not possible to run the system without applying this small amount of DC current.

When 115v is not applied to the AC circuit, ICE+ defaults to DC operation. The unit will fail to start and give an audible "LOW VOLTAGE" signal whenever battery voltage drops below acceptable levels. The charge level which trips the low voltage signal will vary according to each individual installation (due to differing line losses) but will always be short of a complete discharge. Remember, the unit can only detect the level of voltage which is reaching it. This is rarely, if ever the same as the voltage reading on your monitoring meter.

### **Audible Alarm Signals -**

The Control Panel will emit three distinct audible alarms to notify you of your system status.

**1. Two "Beeps", one time only** - This signal occurs whenever DC voltage is applied following a shut down. It tells you that the board is receiving the input power and has initiated the control logic circuitry. Failure to give this signal upon DC power up tells you that the board has not received energy (ie. wiring problem) or has not initialized (ie. defective control board).

**2. Three "Beeps", 35 second delay then repeat** - The rapidity of the "beeps" in this signal is the same as those on initial power up (above). It indicates that DC or AC (depending on mode of operation) voltage is being received at the Compressor Unit however the voltage drops below an acceptable level when subjected to the surge current required to start the compressor. Generally, the water pump will continue to operate during the 35 second delay between triple beeps.

**3. Three "Beeps", 6 second delay then repeat** - This signal is the same as that above except that the delay between repeating the sequence is much shorter. It indicates that the internal power supply has failed. The water pump will not operate during the 6 second delay between triple beeps.

**4. Multiple rapid (30ms) "Beeps", delay between repeat is variable** - This signal is similar to the low voltage signal above but with longer beeps. Also, unlike the voltage signal, the compressor may actually run to several minutes before repeating. This indicates that the high pressure safety switch has activated due to insufficient water cooling. This is typically caused by a clogged sea water strainer or water line, or a failed water pump.

**5. Five "Beeps", 1 second delay then repeat** - This indicates a an over temperature condition of the Compressor Unit. This is an external condition (not caused by loss of cooling water) that may result from exposure to too much engine heat or insufficient ventilation.

### **Optional Upgraded Control Operation-**

Those users who have purchased the Upgraded Control (optional) will find that their control provides the same audible signals as the standard unit (described above). Additionally, the Upgraded Control provides this information visually in the form of a multi-color led and continuously indicates holding plate temperature via an illuminated bar graph.

With this control, all audible signals will be accompanied by the indicator light flashing red in time with the audible signal.

The illuminated bar graph tracks the temperature of the holding plate in 5 degree increments. All bars illuminated indicate a plate temperature of 50°F while no illuminated bars indicate a plate temperature of 0 degrees or less. Between these temperatures two illuminated bars = 10 degrees F, etc. Although box temperature is not displayed directly (plate temperature is), the box temperature will typically maintain a constant differential (usually about 10 degrees) with that of the plate.

The ICE+ Warranty Registration Card provides an area to identify yourself as an owner of the Upgraded Control. This information allows us to notify you of any future software changes which will permit your control to diagnose additional system performance and faults.

### **Defrosting -**

While routine maintenance is limited, periodic defrosting of the holding plate(s) will be necessary. Although systems vary, most plates should be defrosted when ice buildup exceeds 3/8". Excessive frost buildup makes it difficult for the system to remove the heat from the box. As a result, you will find that the box temperature will begin to rise as the frost layer grows. Compensating by adjusting the thermostat lower will simply make the system consume more energy than is necessary. The time intervals between defrosting will depend on use, climate and above all else - the quality of the seal on your access door.

To defrost the system, simply shut off the power until the plate thaws.

### **Winterizing -**

Winterizing the ICE+ couldn't be easier.

For dry storage - Simply turn on the system and allow to run dry for about two minutes after the boat has been pulled out of the water to flush remaining water overboard.

For in-the-water storage - Close the sea-cock and remove the intake hose to the water pump. Run the unit dry for about two minutes to flush remaining water overboard.

## TROUBLE SHOOTING

If you are having trouble with your system, you may get an indication of the problem from the audible signals described under the "OPERATION" section of this manual.

1. **Problem** - The system is connected up but nothing happens when I try to turn it on.  
**Solution** - Check the DC power to the Compressor Unit and the electrical connection to the Control Panel.
2. **Problem** - The system initializes (Beep, Beep) but does not turn on.  
**Solution** - Check that the thermostat is turned up to a midpoint or higher. Also check the electrical connections to the Temperature Probe and Control Panel.
3. **Problem** - The refrigerator is consistently too cold compared to freezer (multiple plate systems only).  
**Solution** - Relocate the expansion valve sensor bulb to the inlet side of the refrigerator plate.
4. **Problem** - The refrigerator is consistently too warm compared with the freezer.  
**Solution** - Relocate the temperature probe further away from the refrigerator holding plate.
5. **Problem** - The system keeps cycling and the audible alarm tells me that the voltage is too low (alarm #2) whenever I'm in DC mode, however my batteries are at 12.5 volts  
**Solution** - Check to see if the system works normally in AC mode. If it does, than the problem is most likely with your vessel's DC circuit. Resting voltage readings do not accurately reflect the voltage which is being seen by the Compressor Unit during a start-up surge. Your wire may be too small, connections making poor contact or the battery bank too small or in poor condition. Use a fast-reacting digital volt meter to test the actual voltage drop in the DC circuit by measuring the voltage directly at the DC wire connections to the Compressor Unit during a start-up surge.
6. **Problem** - The system keeps cycling and the audible alarm tells me that the voltage is too low (alarm #2) whenever I'm in AC mode, however my monitor shows 110+ volts.  
**Solution** - Check to see if the system works normally in DC mode. If it does, than the problem is most likely with your vessel's (or dock's) AC circuit. Resting voltage readings do not accurately reflect the voltage which is being seen by the Compressor Unit during a start-up surge. Your wire may be too small, connections making poor contact or supply from your dock inadequate. Use a fast-reacting digital volt meter to test the actual voltage drop in the AC circuit by measuring the voltage directly at the AC wire connections to the Compressor Unit during a start-up surge.
7. **Problem** - The system will operate normally most the time but occasionally give the low voltage (alarm #2) signal even though the AC and DC power are at the same level they have always been. If the unit is shut down for 3+ hours it then starts and runs normally for while before the problem arises again.  
**Solution** - The low voltage monitoring circuit is giving a false reading due to over-heating. Increasing the supply fresh cool air to the Compressor Unit should solve the problem. If it persists, it may be necessary to relocate the Compressor Unit to a better ventilated area of the boat.
8. **Problem** - The system is giving me alarm signal # 3 indicating a failure of the internal power supply.  
**Solution** - Return the Compressor Unit to the service facility for factory repair.
9. **Problem** - The system operates normally sometimes but gives the #4 alarm at others indicating insufficient cooling water.  
**Solution** - Most likely the water pump is intaking air and loosing prime. Verify that the flow of cooling water out the discharge is at least 10 fl. oz/min.. If it is not, identify the source of the restriction and correct. If it is, the high-pressure safety cut-out may be defective.
10. **Problem** - Water pump doesn't "self-prime".  
**Solution** - Refer to the pump installation guidelines elsewhere in this manual.

## **General -**

It cannot be overemphasized that most problems with the ICE+ system can be traced to poor and/or inadequate supply voltage. Voltage drop can occur anywhere in your electrical system where undersized wire or poor connections exist. Also, voltage drop in the DC system also occurs naturally as batteries give up their charge. This is particularly true when high surge currents are required. The "deep cycle" type batteries used on boats are designed to provide small amounts of current over a long period of time. They must be large and in good condition to give the high surges required by engine starters, anchor windlasses, etc without suffering excessive current drops. After only moderate levels of discharge small battery banks (less than 250 amp-hrs), and even larger banks as they age, may have difficulty providing the high surge current required to start the ICE+.

Remember, if you suspect inadequate voltage, you must measure at the Compressor Unit during the starting surge with a fast-reacting digital volt-meter. Your vessel's meters and monitoring system will not tell you what you need to know.

## **1 YEAR LIMITED WARRANTY**

**WARNING: THE PURCHASER MUST HAVE RETURNED THE WARRANTY REGISTRATION CARD ALONG WITH A COPY OF THEIR SALES RECEIPT WITHIN 30 DAYS OF PURCHASE TO VALIDATE THIS WARRANTY. PURCHASERS FAILING TO REGISTER THEIR PURCHASE WITHIN 30 DAYS FORFEIT ALL WARRANTY RIGHTS.**

The seller warrants this product, if installed and used in accordance with all applicable instructions, to be free from defects in material and workmanship for a period of one year from the date of initial purchase. If the product should prove defective in material or workmanship within this period, Seller will repair or replace the product, at its sole discretion. Service under this Warranty can be obtained by returning, postage paid, that portion of the product which is found to be defective to: Glacier Bay, Inc. Attn: ICE+ Warranty, 1011 Claremont St. San Mateo, CA 94402. Do not return any equipment for any warranty claim without first contacting Glacier Bay, Inc. at (415) 578-0871 for return authorization. Sender will be billed for all return shipping charges. Additionally, service charges may be applied to warranty repairs when expedited service is required.

Specifically excluded from this warranty is the cost associated with the removal or reinstallation of defective product. Additionally, this warranty does not apply to normal wear or damages resulting from misuse, improper installation, abuse, accident, water exposure or neglect. Seller makes no express warranties or warranties of merchantability or fitness for application. Any and all warranties are limited in duration to the warranty period set forth above; and this warranty expressly excludes all incidental and consequential damages. (This warranty gives you specific legal rights, and you may have other rights which vary from state to state).

## HOW TO OBTAIN REPAIRS

NOTE: THE COMPRESSOR UNIT MAY BE SAFELY AND LEGALLY DISCONNECTED FROM ITS TUBING WITHOUT LOSS OF REFRIGERANT. ALL OTHER CONNECTORS USED THROUGHOUT THE ICE+ SYSTEM ARE PRE-CHARGED FOR 1-TIME CONNECTION ONLY. ONCE CONNECTED THEY CANNOT BE DISCONNECTED WITH LOSS OF THE COMPLETE REFRIGERANT CHARGE. ACCORDING TO U.S. AND INTERNATIONAL LAW, ONLY CERTIFIED REFRIGERATION TECHNICIANS USING THE PROPER RECOVERY EQUIPMENT MAY DISCONNECT THESE LINES. NON-CERTIFIED PERSONS WHO ATTEMPT TO DISCONNECT THE LINES ARE LIABLE FOR A FINE OF UP TO \$50,000 PER INCIDENT WHETHER OR NOT RELEASE OF REFRIGERANT OCCURS.

Your ICE+ system is designed to be factory serviced as many of the internal components do not lend themselves to repair by traditionally trained marine refrigeration servicemen. For your protection and convenience, the manufacturer provides a single fee "flat-rate" repair service\* for most repairs.

In the event that service Compressor Unit is needed, it will be a simple matter to disconnect the tubes and return the unit for repair. If it is necessary to break into other parts of the refrigerant circuit (to exchange a holding plate or expansion valve for example), a certified technician (marine system experience is not required) will have to be retained to recover the refrigerant and disconnect the fittings. Upon return of the repaired system, the certified technician will also be required to evacuate and recharge the system.\*\* Under most conditions these service calls should not take more than 1 hour each.

Once the refrigerant lines have been disconnected, immediately and securely cap them off to prevent damage and contamination. Safely box the defective component (foam-in-place packaging is recommended) and return to:

Please include a written description of the problem encountered. Do not return copper tubing. To obtain the current repair flat-rate charge and/or status of a system being repaired call ( ) No technical assistance can be given at this number. For technical assistance contact Defender Industries at phone (860) 701-3400, fax (860) 701-3424 or e-mail [ALANCE@defender.com](mailto:ALANCE@defender.com).

\* Equipment which has been serviced by outside technicians, dropped, water damaged, abused or delivered with refrigerant lines uncapped may fall outside the flat-rate schedule.

\*\* Equipment can be restored to a pre-charged condition (eliminating the need for a return visit by the service technician) if all holding plates are returned along with the Compressor Unit. It will be necessary to purchase and run new copper lines. The additional charge for this service depends on the number of holding plates involved.

## ADDITIONAL INFORMATION FOR REFRIGERATION SERVICE PROFESSIONALS

|                                               |                                                  |
|-----------------------------------------------|--------------------------------------------------|
| Refrigerant -                                 | HFC-134a                                         |
| System Capacity -                             | 11 fl oz.                                        |
| Refrigerant Connections -                     | HFC-134a Industrial w/Schrader (1/4" male flare) |
| Oil -                                         | Castrol Icematic SW10                            |
| High Pressure Cut-Out -                       | 300 psi                                          |
| High Pressure Cut-In -                        | 200 psi                                          |
| Minimum Cooling Water Flow -                  | 10 fl oz/min.                                    |
| TX Valve Superheat -                          | Factory Set (non-adjustable)                     |
| Maximum Internal Case Operating Temperature - | 130 degrees F                                    |
| Temperature Probe Resistance -                | Cannot be reliably measured with an Ohm meter    |