GLACIER BAY, INC

Installation Manual

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GLACIER BAY REFRIGERATION SYSTEM
INSTALLATION GUIDE

Congratulations on your purchase of the finest marine refrigeration system in the world. Your Glacier Bay system has been carefully engineered to provide you with many years of trouble-free, energy efficient operation. To take full advantage of your system's advanced design it is important that the installation and adjustment procedures outlined in this guide are carefully followed.

Many owners choose to install their new Glacier Bay system themselves rather than hire a professional. One advantage in doing so, in addition to the obvious one of saving money, is that they will increase their familiarity with the system's design and operation. Glacier Bay has kept the owner/installer in mind. Those doing their own installation are likely to find the process easier than they expected with only a minimal number of inexpensive tools required.

Warranty Activation - The Glacier Bay "System Startup Form"

Throughout this manual you will see certain items identified as "***(This is a Prestart Checkout Item)***". This identification denotes that this particular installation point is included in the prestart checklist of the **System Startup Form.** While all high-performance refrigeration systems have very similar installation and startup requirements, it is a fact that installation quality can vary widely from installer to installer. It is in the best interest of the end user, the installer and Glacier Bay to be certain that proper procedures are followed during installation and system start-up. To this end we make the completion and submission of our "System Startup Form" a requirement for warranty activation. ***This form must be completed and returned to us within 30 days of system startup for your warranty to be valid.*** For more information on your warranty, see the **GLACIER BAY, INC. LIMITED THREE YEAR WARRANTY** on the following page.

A Note About Your HFC-134a System

Your Glacier Bay system is designed to use HFC-134a refrigerant gas rather than R-12. The best energy efficiency and overall performance will be obtained by using HFC-134a. However, in an emergency it is possible to substitute a number of other refrigerants in the system without harm. These include CFC-12 (R-12), MP-39 (401a), MP-66 (401b) and various hydrocarbon/HCFC blends such as "Hot-Shot" which are made to mimic the pressures of HFC-134a. Under no circumstances is it permissible to use any of the higher pressure refrigerants such as 409a, 410a, R-22 or R-502. If you must use a substitute refrigerant for any reason and there is doubt about its compatibility, call Glacier Bay. ***Never use a petroleum or PAG oil in your system. Do not assume that any component part designed for use with R-12 or any other refrigerant is interchangeable with your system. Preserve your warranty - use only Glacier Bay components.***

"Modular (M)" vs "Palletized (P)" Systems

Glacier Bay refrigeration systems are available in modular and palletized configurations. These are identified by the letters "M" and "P" following the model name. The information in this manual details the connections to the "modular" unit. However, the manual applies equally to the "palletized" version with the exception that the tubing interconnections between the compressor, condenser, R/A/D assembly and control "T" assembly have already been made at the factory.

GLACIER BAY, INC.
LIMITED THREE YEAR WARRANTY

NOTE: The "System Startup Form" must be completed and returned to us within 30 days of system startup for your warranty to be valid. Failure to submit this form within 30 days of system startup will invalidate all warranty coverage. After completion, the form may be submitted by mail by any one of the following methods:

Mail - send to Glacier Bay, Inc., Attn: Warranty Activation, 2845 Chapman St., Oakland, CA 94601
Fax - send to (510) 437-9200
Internet - submit the form on-line at www.glacierbay.com/warranty_form.htm

Please request an acknowledgment that the form has been received.

Glacier Bay refrigeration systems are warranted with the following conditions:

The warranty covers defects in materials and workmanship for a period of three (3) years from the date of purchase. The warranty is limited to the actual cost of the defective component(s) and does not include coverage for any labor cost incurred in the removal or reinstallation of such component(s). Shipping costs are not included. Warranted components shall be repaired or replaced at the sole discretion of the manufacturer. This warranty does not include failure due to:

- improper installation
- abuse, misuse or improper maintenance
- rust/corrosion due to water exposure

Components expressly excluded from this warranty are:

- motor brushes
- sea water pump

Glacier Bay, Inc. shall not be liable for consequential damages resulting from the use of this product. Coverage for any incidental damage to vessel, equipment or supplies caused, either directly or indirectly, by the failure of any Glacier Bay component is specifically excluded. This warranty is valid only for complete systems and does not include Glacier Bay equipment used in conjunction with components of other manufacturers. The coverage herein described constitutes the whole, no other warranty written or verbal is authorized.

To obtain warranty service:
Return the defective component(s), properly packaged and postage paid to Glacier Bay, Inc., 2845 Chapman St, Oakland, CA 94601. When making a warranty claim be sure to attach a letter detailing the problem encountered. Include evidence of purchase date, place of purchase, model and serial number along with your name address and telephone number.

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THE MOST COMMON INSTALLATION MISTAKES

HEADS UP!
Through years of experience and thousands of installations, we have found the following mistakes to be the ones most commonly made.

Component Location

- Mounting the compressor unit on a "flimsy" base creating noise and vibration.
- Installing the holding plates horizontally on the top of the box causing poor convective circulation.
- Failure to follow the 18" maximum distance rule when mounting the freezer plates.
- Mounting the condenser without regard to future removal of the end cap(s) for cleaning.

Tubing Runs

- Bending the vibration isolators
- Incorrectly connecting the "T's" on the suction line so that oil traps are created
- Using high-temperature braze ("Silfoss" or "Phosbronze") rather than refrigeration-grade soft solder to make the connections. (see chapter exceptions)
- Failure to equalize the 3/8" liquid line lengths between the control "T" assembly and the expansion valves.
- Failure to allow sufficient room to properly mount the expansion valve sensing bulbs.
- Improperly tightened expansion valve sensing bulbs.

Raw Water Connection

- Incorrectly mounting the centrifugal pump by failing to ensure an uphill flow into the pump head.
- Mounting either water pump so low in the bilge that it is exposed to splashing bilge water.
- Using the centrifugal pump on fast boats without a "speed scoop" type through-hull.

Electrical Connections

- Making poor quality connections when lengthening the temperature probe wires.
- Failure to properly connect the "Engine Start Input" wire on ECM control installations.
- Making poor quality "step-down" connections when reducing wire size to enter the control box.
- Forgetting to run the wire between thermostatic controls (or ECM controls) on multi-zone systems.
- Failure to properly "tin" the ends of the wires before inserting them into the control box.

System Startup

- Installer does not understand Glacier Bay's sequential box pull-down (freezer first, then refrigerator, etc) and thinks there is a problem because "the freezer is cooling but the refrigerator isn't".
- Installer overcharges the system by trying to "clear the sight glass" when the holding plates are warm.

CHOOSING LOCATIONS FOR THE MAJOR COMPONENTS

Materials Required

- Assorted stainless steel or bronze wood screws
- Wood block (mounting "T" assembly on ref & frz only)
- Wood blocks and epoxy (if mounting to fiberglass hull)
- Condenser mounting clamps (included in the installation kit)
- Condenser fittings (SCF-6 and/or ECF-6)
- Hose clamps (included in installation kit)
- 3/4" water hose
- "Leak Lock" or similar thread sealant (included in installation kit)

Tools Required

- Marking pencil
- Tape measure
- Flathead screw driver

Introduction

Glacier Bay systems are available in two different component configurations: modular and palletized. The modular configuration offers maximum mounting flexibility since individual components can be placed at any distance from each other without effecting system performance. The palletized unit is compact and faster to install since many of the components come pre-connected. Read through this entire section before beginning to mount your components.

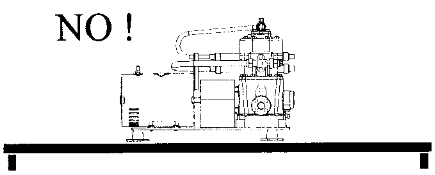
Palletized Systems

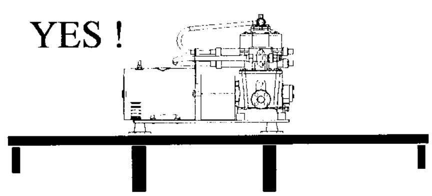
Palletized units have most of the system components mounted on an aluminum base. The only components not pre-mounted are the control "T" assembly (for multi-zone systems), the holding plate(s) and the digital thermostatic control(s). Check the appropriate mounting instructions for these components on pages **IM - 10** and **IM - 12.** When choosing a location for a palletized system, follow the guidelines given for the modular compressor unit. In addition, when positioning the pallet allow sufficient clearance for future servicing. Also the sight glass(es) should be easy to observe.

Compressor Unit

1. All Glacier Bay compressor units must be mounted so that they are level when the boat is at rest. They can be mounted either fore/aft or athwart ships and can operate for extended periods of time at full heel when mounted to be level at rest.

2. Avoid mounting the compressor on flimsy platforms or large surfaces which can amplify noise through vibration. When identifying or building a mounting platform, make certain that it can be very solidly attached directly to the hull. It is best to attach (fiberglass or weld) gussets directly under the compressor itself rather than just supporting the ends. It is generally not a good idea to mount the compressors onto cabin soles without putting additional support underneath. Platforms attached to large bulkheads are certain to be problematic.
(This is a Prestart Checkout Item)





3. Ensure that the area is ventilated particularly if the space is small. Small, unventilated spaces (< 5 cubic feet) do not permit the heat generated by the compressor

unit to be properly dissipated. In these spaces it is important to have a means to permit heated air to flow out of the cabinet. On systems incorporating the Arctic Air option a greater amount of air circulation is required. Spaces larger than 5 cubic feet do not generally need additional ventilation. Engine room locations are permissible so long as the mounting is below the level of the top of the engine.

4. On Traditional belt-driven systems, make sure that the open drive-belt will pose no danger to personnel or stored items.

5. Ensure access to those areas of the compressor unit which will require periodic maintenance. On Traditional belt-driven systems this includes the motor bolts for the adjustment of belt tension. On direct-coupled systems access to the coupling cover plate will permit easy replacement of the coupling pad. On all DC systems the motor brushes should be easily reached.

6. Remember that you are going to have to attach service gauges to the 1/4" ports on the compressor rotolock valves. Allow at least 2" of clearance around them.

7. Mark II compressor units have an oil level sight glass. You won't need to check this frequently but it is a good idea to be able to see it when you want to.

Control Box

1. The control box should be located near the compressor unit to minimize the length of wire running to the drive motor and permit easy access to the manual over-ride toggle switch during servicing.

2. Make sure all toggle switches and the pump fuse are readily accessible. If the box is to be located in a locker or compartment where other items will be stored, make sure that the toggle switches will not be hit as these items are loaded in and out.

3. It will be easier to run the wires into the box if it is positioned to allow the inner panel (the board to which all the relays and terminal blocks are attached) to be removed.

4. Turn all toggle switches to the OFF (down) position until the installation is complete.

Raw Water Pump - Self priming pump installation.

1. Intake water access can be obtained by teeing into almost any existing raw water *intake lines* including head, galley, engine, water maker or deck wash. If the engine intake is used the tee should be made as close to the thru-hull as possible. (See the "Self-Priming" section of the "Running The Water Circuit" chapter for additional detail).

2. Leave room for a suitable seawater strainer. If one does not already exist it will have to be added. The strainer will need to be checked for periodic cleaning so make sure you can get to it.
(This is a Prestart Checkout Item)

3. The self-priming pump may be mounted above or below the waterline.

4. The pump does create vibration when running. Do not mount it to any bulkhead or platform which may amplify pump noise into the cabin interior.
(This is a Prestart Checkout Item)

Raw Water Pump - Non-self priming pump (centrifugal) installation.

1. The centrifugal water pump must be mounted below the waterline and in such a fashion that no air trap ("U" bend) exists between it and the water intake source. Simply mounting it below the waterline does not ensure that it will self-prime. (See the "Centrifugal Pump Installation " section of the Appendix for additional detail.).
(This is a Prestart Checkout Item)

2. Intake water access can be obtained by teeing into almost any existing raw water intake lines including head, galley, engine, water maker or deck wash. Pumps should always be mounted as close to the thru-hull as possible.

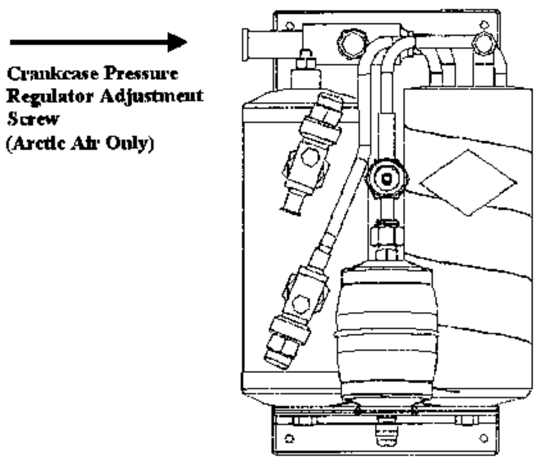
R/A/D (Receiver/Accumulator/Dryer) Assembly

1. The Glacier Bay system is delivered to you with oil held in the compressor crankcase and the receiver on the R/A/D assembly. ***Throughout the shipping and mounting process it is very important that all rotolock valves remain closed*** to prevent loss of oil and contamination from moisture and particulate matter. The valves must not be opened until the system is ready to be leak-checked and charged.

2. The R/A/D assembly must be mounted vertically (standing upright).
(This is a Prestart Checkout Item)

3. Allow sufficient room for connection and soldering of the copper tubing. Allow at least 2" at the bottom of the filter-dryer for the flared 3/8" tubing connection.

4. If your system includes the ARCTIC AIR air conditioning option you will want to allow a minimum of 6" clearance on the left side to permit access to the crankcase pressure regulator adjustment screw.



5. Be certain that you provide enough room to access the rotolock valves with both supporting and tightening wrench.

Condenser

It is strongly recommended that the installer review the "Running The Water Circuit" section of this manual before selecting a location for the condenser

1. The condenser must be mounted vertically (standing upright) with the zinc end down.
(This is a Prestart Checkout Item)

2. The condenser is designed to permit the rubber end caps to be removed to facilitate periodic cleaning. Cleaning is done by removing one end cap (top or bottom) and pushing a 1/4" dowel rod through the passages. To accomplish this without desoldering the tubing (and losing refrigerant) it is necessary to leave a space of 12" on either the top or bottom of the condenser to allow the dowel rod to be inserted.

3. When choosing a location remember that it will be necessary to run a 3/8" copper line from the bottom fitting (nearest zinc) to the R/A/D assembly.

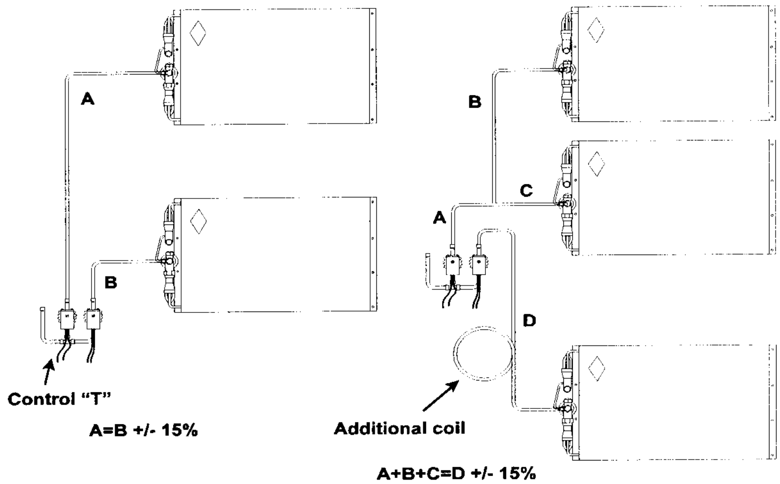
4. To mount the condenser, temporarily clip the mounting brackets onto the condenser body. Position the condenser and mark the bracket locations. Remove brackets and screw them in place. Replace condenser in the mounted brackets (tube connections and zinc facing you) then clip thems fully closed.

Ref/Frz Control "T" Assembly

1. The control "T" assembly may be mounted in any position.

2. Depending on the number of "zones" in your system, your control "T" assembly may, or may not, come to you mounted on a metal backing plate. Larger control "T" assemblies (> 3 zones) which have a backing plate should be screwed to a bulkhead or other suitable mounting surface. Smaller control "T" assemblies which do not have a backing plate may be secured into position using tube mounting connectors (available from most hardware stores) over the tubing. Depending on the mounting location, it is usually necessary to first screw (or epoxy) a wooden mounting block in place to which you may attach the control "T" assembly.

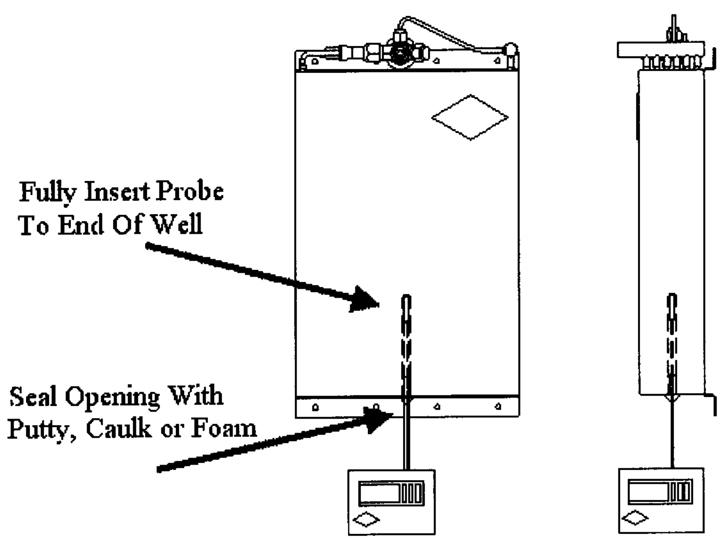
3. The control "T" assembly should be located so that the total length of all 3/8" copper tubing running between it and each "zone" will be equal (+/- 15%) Extra tubing can be coiled to add length to the shorter run.
(This is a Prestart Checkout Item)



Digital Thermostat/ECM Controller

1. The standard digital thermostat or (optional) ECM digital controller may be mounted any distance from the refrigerator/freezer box(es). These controls are of the flush-mount type. For panel (or bulkhead) mounted installations it will be necessary to cut a rectangular hole into which the control is mounted. When such a hole is not desired (or possible), a box can be constructed to hold the control out from the surface.

2. A "well" is provided at the bottom of each holding plate for the temperature probe. The probe must be fully inserted into the well and the hole sealed with putty, caulk or foam. If a single box (ie. "zone") has multiple holding plates, the probe should go into the largest of them. If the holding plates are all the same size, the one nearest the wire entry point can be used.
(This is a Prestart Checkout Item)



3. If you purchased the optional box temperature probes, you should know that they are identical to, and interchangeable with, plate temperature probes. They will just be wired to different connectors on the control. You will want to mount your box temperature probes as near as possible to mid-point in the box. Choosing the "best" location to measure box temperature is always problematic due to a common lack of an out-of-the-way place to secure the probes. Compromises usually have to be made. Probes mounted at the top of the box generally measure temperatures above the "average" while probes mounted at the bottom may read lower than the box average. While you may want to secure the probe wire to the side of the box, make certain that the actual probe itself rests at least 1/2" (12mm) away from the wall and is exposed to free air circulation.
(This is a Prestart Checkout Item)

4. The standard wire length for all temperature probes is 59" (1500 mm). The wire can be lengthened to any distance required with regular marine 18 AWG to 22 AWG wire. When lengthening the wire all connections must be soldered and sealed with glue-lined heat-shrink tubing. Securely fasten the wire inside the box so that it is out of the way and cannot come loose to pull the probe from inside the plate.
(This is a Prestart Checkout Item)

INSTALLATION OF THE HOLDING PLATES

Materials Required

- Stainless steel or bronze wood screws

(For BARRIER Ultra-R™ Boxes)

- BARRIER plate mounts (set) or 1/4" fiberglass sheet and flat-head screws

Tools Required

- Marking pencil
- Tape measure
- Screw driver
- Drill and bit
- Wood blocks to position plate

Refrigeration Plates and Freezer Plates

Refrigeration plates and freezer plates are identical except for the eutectic solution inside and the corresponding temperature rating engraved on the back of the plate. The standard freezer solution (TSS - 8) is rated at -8° F (-22° C) and the refrigeration solution TSS+26 at +26° F (-3° C). These temperature ratings reflect the eutectic point (freeze/thaw temperature) of the solution. The plates are not interchangeable and cannot be used outside their intended functions without an extreme loss in efficiency and holdover.

Note: While the holding plates themselves do not differ except for the eutectic solution, the expansion valves on refrigerator and freezer plates do use different orifices. The size of the orifice is stamped on it in ascending numeric code. For example: The orifice sizes for the freezer plate(s) are commonly #0X. or #00, and #01 or #02 for the refrigerator plates.

Choosing a location

When choosing a location for your holding plate(s) keep the following points in mind:

1. Holding plates may be mounted in any position.

2. The holding plates should be mounted on the side(s) of the box rather than on the top. The higher in the box the better. This is to take advantage of the convection current which occurs when hot air rises. Having the plate(s) located near the top of the box will help maintain even temperatures throughout the box. Although it may seem counter-intuitive, mounting the plate(s) on the top of the box does not make good use of this convection current.

3. In the case of freezer holding plates attention must also be paid to the spacing of the plates and the distance to other areas of the box. To ensure proper freezer temperatures under all conditions, no point in the freezer box should be further than 18" (450mm) from a holding plate.

4. Be sure to allow room to access to the expansion valve and suction side connection fittings.

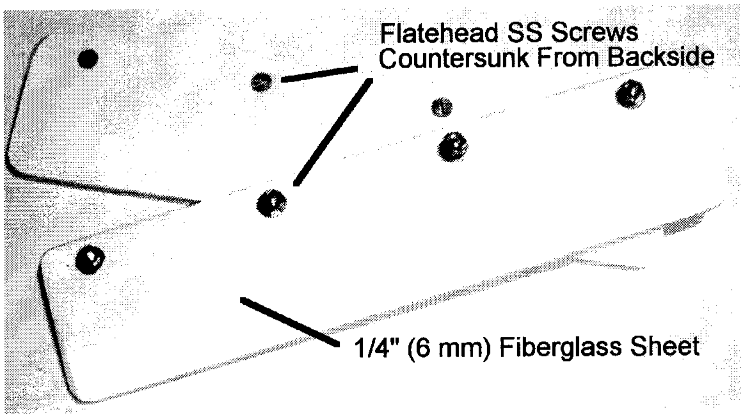
Install Holding Plate(s) - With Standard Foam Insulation

Position all holding plate(s) and support them in place with suitable wooden blocks. After ensuring that all positioning is correct, use a pencil to mark the location of all eight holes in each holding plate mounting flange. Remove the plates and pre-drill the screw holes with a suitable size bit. Re-install the holding plate(s) using at least four (4) bronze or stainless steel screws on #1 and #2 plates and eight (8) on #3 and #4 plates.

Install Holding Plate(s) - With BARRIER Ultra-R™ Vacuum Insulation

If your box is equipped with BARRIER Ultra-R™ vacuum insulation panels you must not drill or screw through the interior fiberglass liner. To mount the holding plate it is therefore necessary to devise another method of attachment. One method is to bond (with fiberglass and epoxy) strips of wood to the inside of the box and screw into the wood rather than the fiberglass liner. The disadvantage of this method is that the thickness of the wood causes the holding plate to protrude further into the box space.

An alternative method is to construct (or purchase from Glacier Bay), holding plate mounting brackets. These brackets are constructed by countersinking flat-head stainless steel screws into a 1/4" thick strip of pultruded (or pressure-molded) fiberglass sheet. By epoxying this sheet to the fiberglass liner, the plates can then be attached directly to the screws extending from the surface. Don't forget to thoroughly sand the mounting brackets and the area on the liner where they will be attached to promote good adhesion of the epoxy.



Leave the expansion valve capillary tube and sensing bulb neatly coiled until after the copper tubing is run.

RUNNING THE WATER CIRCUIT

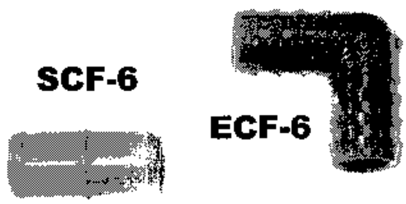
At the time of purchase, the installer must choose between a positive displacement (self-priming) and a centrifugal (non self-priming) type water pump. The type of pump selected will be determined by the type of vessel and the mounting options which are available to the installer. Generally speaking, cruising mono-hulls with deep bilges will want to take advantage of the quiet operation and high flow rate of the centrifugal pump. Light displacement mono-hulls and multi-hulls, which may have priming problems with a centrifugal pump, will require the self-priming power of the positive displacement pump. While both pumps work equally well in the proper application, their installation requirements are very different. This section will provide guidelines for installing the water circuit using either type of pump.

General Information

1. The recommended through-hull size for both pumps is 3/4"
2. Pumps should be mounted horizontally or with the head facing downwards - never with the head up.
3. Protect pumps from exterior water exposure.
4. Choose your sea strainer carefully. If you are using a centrifugal pump, make sure that the strainer is of a type which not trap air and create an air-lock. Positive displacement pumps are sensitive to particulate matter. Avoid using sea strainers with too coarse a filter mesh.

Condenser - Water line connections

1. Insert the appropriate condenser water line fittings (SCF-6 and/or ECF-6) into the rubber ends of the condenser and tighten them in place with the hose clamps provided.

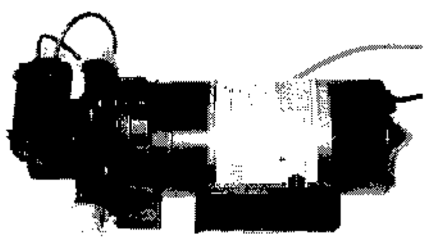


2. Run 3/4" rubber hose from the raw water pump discharge to the bottom water line fitting. ***Raw water from the pump must enter at the bottom of the condenser and discharge from the top. (This is a Prestart Checkout Item)***

3. The raw water discharge line (from the top fitting) may be teed into almost any existing through-hull exit lines including galley sink drains and cockpit drains. Choosing a discharge through-hull below the water line will minimize noise when the unit is running but may, under certain conditions, cause priming problems with a centrifugal pump.

Positive Displacement Pump (Self-priming)

The positive displacement pump provided with the Glacier Bay system is a multi-chamber diaphragm type. This pump is fully self-priming which means it can be mounted above the water line and without concern of air traps forming in the intake line. Nevertheless, as with other water pumps, it is primarily designed to push rather than pull. For this reason it is always a good policy to mount the pump near the through-hull.



Centrifugal Pump (Non self-priming)

Because the centrifugal pump cannot pump air it does not have the ability to "prime" itself. It is therefore important that the pump be installed in such a way as to ensure that the pump head is always flooded. Contrary to popular belief, it is not enough to simply install the pump below the water line. Review the "Non-self Priming Pump (Centrifugal) Installation" in the Choosing Locations for the Major Components section and the "Centrifugal Pump Installation" in the Appendix of this manual.

RUNNING THE COPPER TUBING

Materials Required

- 3/8", 1/2" and 5/8" soft copper refrigeration tubing
- Harris "Stay-Brite #8" solder
- Compatible flux such as Harris "Stay-Clean"
- Assorted solder fittings (as required, see installation kit)
- "Leak-Lock" refrigeration flare sealant (see installation kit)
- Bronze vibration isolators (pre-installed or see installation kit)
- 5/8" ID neoprene tube insulation

Tools Required

- Drill with assorted bits and/or hole saws
- Marking pencil
- Tape measure
- Tubing cutter
- Tube flaring tool
- #11 X-acto knife (or similar)
- Assorted wrenches - open end and adjustable
- 3/8", 1/2" and 5/8" spring or lever type (preferred) tube benders

Tube connection basics

Now that you have installed all the major components you are ready to make your copper tubing runs. Running the copper tubing correctly is key to achieving not only a professional-looking installation, but one that permits your system to operate efficiently and reliably for many years. Be sure to read and understand this section BEFORE starting to bend your tubing. Once you do get started, patience (and extra tubing) is the key to success. Remember that once the tubing is bent it "work hardens" and will resist any further manipulation. If tubing is improperly bent or kinked during installation you will be far better off to remove it and start again with new tubing than to try to "make do" with the old piece.

Glacier Bay systems are designed to be installed using soldered connections. Soldering is both faster and more reliable then flare and compression connections. Additionally, soldered connections permit the tubing to be run more tightly next to corners and surfaces since no wrench access is required. (Surfaces can be temporarily protected from heat with a wet rag.) A very limited number of "flare" connections are maintained to enable the filter/dryer and expansion valve(s) to be easily replaced in the field should the need ever arise. Installers are cautioned to:

1. Use only Harris Stay-Brite #8 solder on all connections. DO NOT USE ANY SOLDER/BRAZE WHICH REQUIRES THE USE OF AN ACETYLENE TORCH. An acetylene torch should never be used to install a Glacier Bay system. (Exception - Canadian and some European jurisdictions require the use of high temperature braze materials)
(This is a Prestart Checkout Item)

2. Never add flare or compression ("Swagelok") fittings in the middle of tubing runs. Experience has shown that these often start leaking over time and can end up being a headache for years to come.
(This is a Prestart Checkout Item)

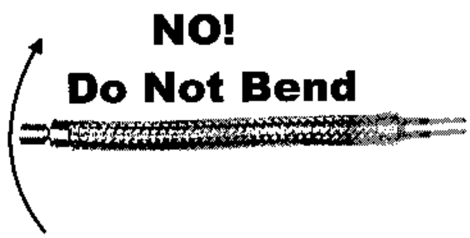
3. Read and follow instructions on making "T" connections to ensure that no oil-traps are created.
(This is a Prestart Checkout Item)

Vibration Isolators

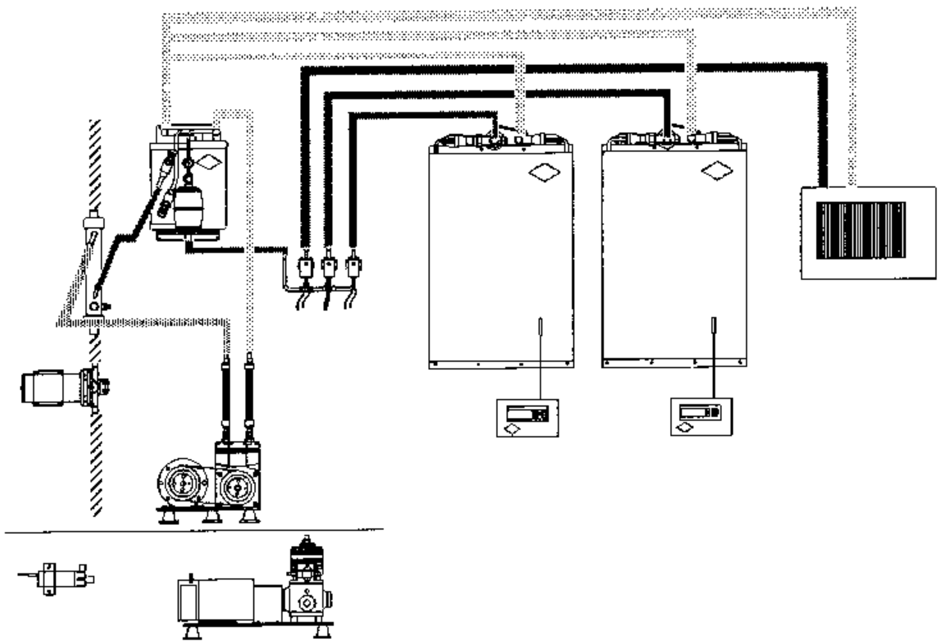
The Glacier Bay compressor unit uses bronze vibration isolators (VBI's) to isolate compressor vibration from the rest of the copper tubing. This type of isolator has been used for over fifty years in heavy-duty industrial applications. The VBI's are comprised of corrugated bronze tubing covered with a wire mesh for abrasion protection. They do not contain rubber hose. Unlike rubber hose (which slowly leaks refrigerant out and moisture in), these VBI's are completely impervious to moisture and refrigerant penetration. Properly installed, the VBI's will last the life of the system. However, two precautions must be taken during installation.

1. VBI's must ***NEVER*** be bent. They are intended for vibration isolation only and are not a substitute for bent tubing or an elbow fitting. ***(This is a Prestart Checkout Item)***

2. Care should be taken to solidly secure the tube just after the VBI to prevent the buildup of a harmonic "resonance" which could magnify the vibration.



TYPICAL THREE-ZONE SYSTEM LAYOUT



Tubing sizes

All tubing used in the installation should be clean/dehydrated soft copper refrigeration tubing. This tubing is available from any refrigeration equipment supplier and most industrial supply houses or directly from Glacier Bay. Do not use copper tubing designed for fuel or water - there is a difference. Copper fittings from the local plumbing store can be used but will be referred to as one size smaller than the refrigeration fittings (ie. a 5/8" refrigeration fitting is a 1/2" plumbing fitting).

Refrigeration tubing is sized by the outside diameter. Installation of your Glacier Bay system requires the use of three sizes of copper tubing - 3/8", 1/2" and 5/8".

O.D.	Tubing Function	Pressure	From	To
1/2"	Discharge - Gas	High	Compressor	Condenser
3/8"	Discharge - Liquid	High	Condenser	R/A/D
3/8"	Discharge - Liquid	High	R/A/D	Control "T"
3/8"	Discharge - Liquid	High	Control "T"	Exp. Valve
5/8"	Suction - Gas	Low	Holding Plate	R/A/D
5/8"	Suction - Gas	Low	R/A/D	Compressor

Tubing Run #1 (Compressor Discharge to Condenser)
(This run is not required on "palletized" systems)
Required tubing size - 1/2"

1. Your compressor comes from the factory with the bronze vibration isolators already attached to the compressor. You will notice that one of these is smaller in diameter than the other (1/2" ID and 5/8" ID). The smaller of these is the *discharge* line on the compressor.

2. At the open end of the isolator is a 1/2" female stub into which you can insert and solder your 1/2" tube.

3. Bend and fit the copper tubing to run between this fitting and the *top* connection on the condenser.

Tubing Run #2 (Condenser to R/A/D Assembly - Receiver)
(This run is not required on "palletized" systems)
Required tubing size - 3/8"

1. Bend and fit the copper tubing to run between the *bottom* fitting on the condenser and the *top* receiver rotolock valve on the R/A/D assembly.

Tubing Run #3 (R/A/D Assembly - Dryer to Control "T" or Expansion Valve)
Required tubing size - 3/8"

Note: On systems utilizing multiple zones (ie. such as separate refrigeration and freezer plates) this run will terminate at the control "T" assembly. On refrigeration only systems this run will terminate at the holding plate expansion valve.

1. (For multi-zone installations)
Bend and fit the copper tubing to run between the 3/8" flare fitting on the R/A/D assembly (at the filter/dryer) and the inlet (common) fitting on the control "T" assembly. If you are using the standard solder fittings package, you will need wrap the control "T" assembly in a very wet rag to protect it from heat during soldering.

2. (For single-zone installations)
Bend and fit the copper tubing to run between the 3/8" flare fitting on the R/A/D assembly (at the bottom of the filter/dryer) and the 3/8" flare fitting on the holding plate expansion valve. If you are connecting to

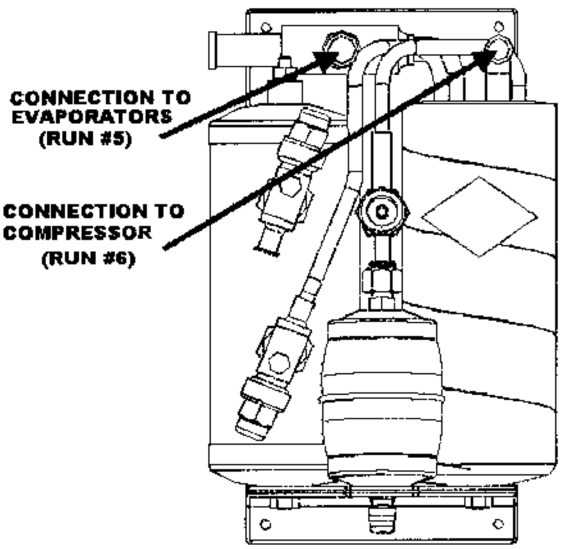
multiple holding plates you will need to create a split in this run to feed both plates in parallel using a "union tee" fitting. Be certain that the removable expansion valve orifice is in place before attempting to connect the flare nut.

Tubing Run #4 (Multi-zone systems, Control "T" Assembly to Expansion Valve(s))
Required tubing size - 3/8"

1. Bend and fit the copper tubing to run between the compression fittings on the control "T" assembly and the 3/8" flare to compression fitting on the expansion valve(s). If you are connecting to multiple holding plates in the same box you will need to create a split in this run using a "union T" fitting (holding plates in parallel). Be certain that the wet rag is placed so as to protect the valve body from excessive heat during soldering. If you are connecting to multiple holding plates in any box you will need to create a split in this run to feed both plates in parallel using a "union T" fitting. Be certain that the removable expansion valve orifice is in place before attempting to connect the flare nut.

2. Clearly label which valve has been routed to the freezer and which valve has been routed to the refrigerator.

Tubing Run #5 (Holding Plate to R/A/D Assembly - Accumulator)
Required tubing size - 5/8"



NOTE: On multi-zone systems it will be necessary to "T" the holding plate suction side connections into a common 5/8" tube to run to the R/A/D assembly. It is imperative that a minimum of 6" of tubing is used between the exit of any plate and a "T" connection. This distance is required to ensure accurate superheat (see the "Attach the Expansion Valve Sensing Bulb" section below and the Appendix for additional detail) ***(This is a Prestart Checkout Item)***

1. Bend and fit the copper tubing to run between ***The left hand side (as viewed from the front) fitting on the R/A/D - accumulator*** and the 5/8" suction fitting of the holding plate(s).

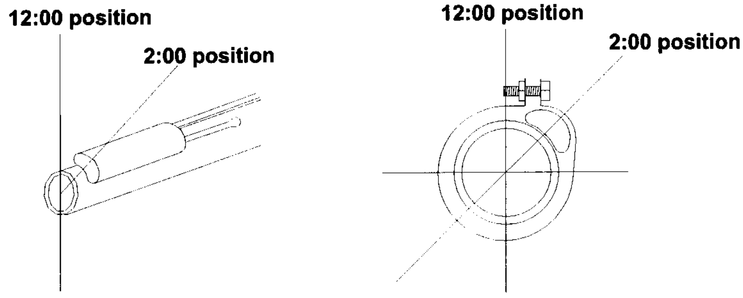
2. Verify that the run connection is made to the correct fitting on the R/A/D assembly - accumulator. *Connecting this run to the wrong (ie. right hand) connection will cause severe compressor damage and void the warranty.*

Tubing Run #6 (R/A/D Assembly - Accumulator to Compressor Suction)
(This run is not required on "palletized" systems)
Required tubing size - 5/8"

1. Attach a 5/8" elbow fitting to the end of the remaining bronze vibration isolator at the compressor.

2. Bend and fit the copper tubing to run between *the right hand fitting on the R/A/D - accumulator* and the fitting on the compressor suction bronze vibration isolator.
(This is a Prestart Checkout Item)

Attaching the Expansion Valve Sensing Bulb
Carefully uncoil the expansion valve capillary tube and sensing bulb so that it can be secured to the suction line exiting the plate. Use the perforated metal strap provided or a small hose clamp to secure the bulb to *a horizontal run of the 5/8" suction tubing at the 10:00 or 2:00 position.* Do not use nylon "wire ties" as they do not provide sufficient clamping pressure.



Be sure that the bulb rests flat on the tube to ensure good thermal contact between the bulb and suction line. When properly attached the bulb should be tight enough to be difficult to twist by hand.
(This is a Prestart Checkout Item)

Insulate the suction lines
The suction (return) lines from the holding plate to the R/A/D assembly and, to a lesser extent, from the R/A/D assembly to the compressor will sweat in humid weather unless they are insulated. All 5/8" suction (return) lines outside the box should be covered with a "slip on" neoprene foam pipe insulation to prevent unwanted condensation. It is not necessary to insulate the 3/8" liquid lines. Slip-on foam tube insulation can be purchased from some hardware stores and all plumbing and refrigeration equipment supply stores. This insulation is also available with a split for installation on existing tubing runs.

When installing the insulation DO NOT LEAVE gaps between sections. Insulation sleeves should be bonded (and sealed) together with rubber cement. Leaving gaps, cracks or other openings in the insulation will cause condensate (water) to collect along the length of the tube and run out these openings in surprisingly large quantity.

MAKING THE ELECTRICAL CONNECTIONS

Materials Required

- Tinned copper wire
- Rosin core solder
- Heat shrink tubing
- Cable ties w/screws

Tools Required

- Screw driver
- Wire cutters/strippers
- Soldering iron
- Lighter or heat gun

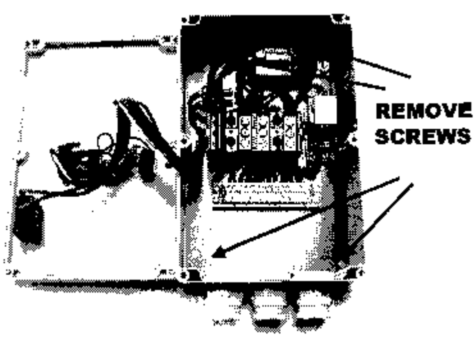
Introduction

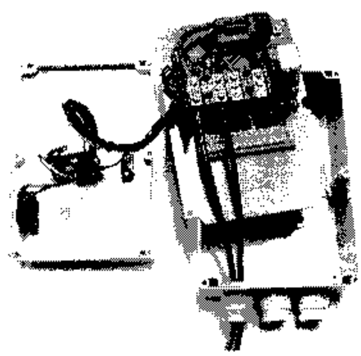
With all components mounted and the copper tubing run, it is now time to make the electrical connections. Included in this manual is the wiring schematic for your particular system configuration. All wire sizes are given in "American Wire Gage" (AWG) and are typically sized for 15' (or less) run lengths. Longer runs (always use the combined length of the positive and negative wire) will require heavier wire. Installers outside the US are reminded that this is not the same as metric wire sizes which are given in mm (see the "Appendix" of this manual for additional detail). To retain the reliability inherent in your Glacier Bay system it is important that all connections are done in proper fashion using a high strand count 100% tinned marine-grade wire.
(This is a Prestart Checkout Item)

Wiring the Control Box

When wiring the control box it is important to ensure that all wires are fully inserted into their proper terminal locations. Because strands from frayed wires can create electrical shorts and poor contacts, it is advisable that all wires be "tinned" with solder before inserting them into the terminal block. Additionally, tinned wire is less prone to corrosion and less likely to loosen up over time.
(This is a Prestart Checkout Item)

In most installations, connecting the wires to the control box is much easier if the component mounting plate is first removed from the housing. This provides a clearer view of the terminal I.D. #s and allows more room to manipulate the wire.





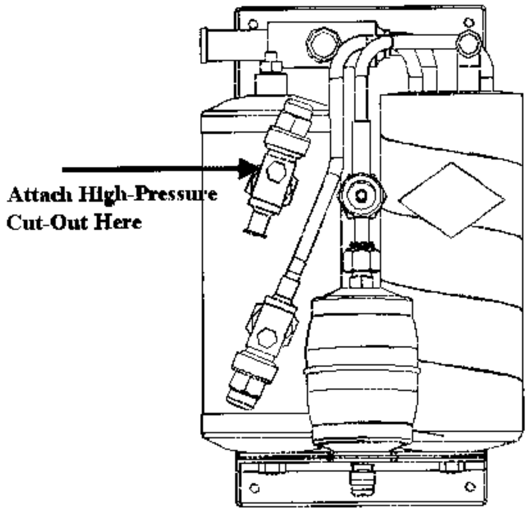
NOTE: The maximum size wire which can be accommodated by the terminal block is #4 AWG. If your system requires the use of heavier gage wire, you will need to "step-down" to #4 just before entering the control box.

Extending the Temperature Probe wire

The temperature probes used to monitor the holding plate and box are identical and interchangeable. The probes come with a 59" (150cm) length of wire attached. This can be extended to any length using #18 AWG tinned wire. If the wire is extended, the connections MUST be soldered and sealed with heat shrink tubing.

Attaching The High Pressure Cut-Out

The high pressure cut-out switch is a a green plastic switch with a 1/4" female flare at one end and two black wires at the other. To attach it, remove the "acorn nut" service port cap from the top rotolock valve on the receiver and screw it into place. To ensure a good seal, dab a very small amount of "Leak-Lock" thread sealant onto the 1/4" male flare. The switch should be tightened carefully but snugly.

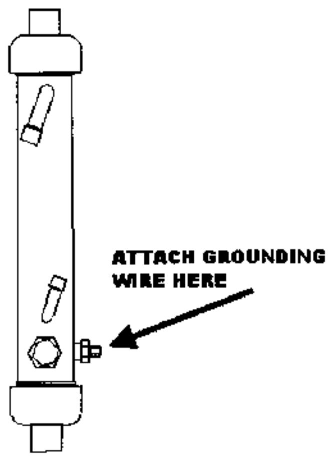


The High-Pressure Cut-Out

Condenser Grounding

You will notice that the condenser has a stud and nut in place for the attachment of a bonding wire. If your vessel uses a through-hull bonding system, the condenser should be included in it. If you do not have a bonding wire, run a separate wire to connect the condenser stud to the engine ground.

(This is a Prestart Checkout Item)



Engine-Drive Signal Input (ECM Controllers only)

The optional ECM controller provides an automatic holding plate "top-off" mode of operation whenever extra power is available. This system *does not* operate from a change in voltage but, rather, from a distinct and separate input. All systems which include the ECM controllers option require that an additional wire be run to notify the system that the auxiliary engine has been started and that additional power is available. This wire should be taken from a location which is "HOT" with a positive DC current only when the engine (and/or generator) is running. The key start switch is one obvious choice. Alternately, on some engines it may be possible to use the oil pressure safety system, however, this must be of the "make on pressure rise" type. The current load on this wire is very low with a draw of only a few milliamps.

On some vessels it may be desirable to also connect this wire to a toggle switch (for manual activation) and/or to the generator or other secondary power source. When activating the "engine-drive" mode from several different sources (such as both and engine and generator), be sure to use a diode in each wire to prevent back-feeding the other input devices.

Maximum Current Draw for Individual Components

The wiring diagram and accompanying text information for your system (included in this manual) provides recommended wire sizes and circuit breaker capacities for your system configuration. The wire sizes given are suitable for a 15' (4.6 meter) "round trip" length. In certain installations the wire lengths to certain component parts may exceed this. If this is the case in your installation find the maximum current draw from the list below and use the wire sizing table shown in the "System Installation basics chapter at the beginning of this manual to identify the correct wire size. Remember, the wire length is always considered to be the total distance from the power source to the device and back again. The table below gives the current draws which should be considered when sizing the wire runs. The DC is rated at 12 volts and the AC at 110 volts. Multiply by .5 for 24v and 220v.
(This is a Prestart Checkout Item)

- 1/2 hp Trad. Comp. (DC) - 60 amps
- MARK II Comp. (DC) - 60 amps
- Whisper Jet Comp. (DC) - 100 amps
- Whisper Jet Comp. (AC) - 10 amps
- 2 hp Rapid Chill Comp. (AC) - 30 amps
- Solenoid Coil (ea) - 2 amps
- Water Pump (DC) - 10 amps
- Arctic Air Fan (ea) - 2 amps

CHARGING THE SYSTEM

Warning - the Clean Air Act of the United States and similar laws in many other countries require that any person servicing a refrigeration system be licensed in the use of a certified recovery device and that such a device be on location at all times during the service call. Failure to comply may result in fines up to $50,000.00 per incident. Some of the procedures described herein may need to be modified to meet the requirements of these governing laws. It is the installer/technician's responsibility to comply.

Materials Required

- HFC -134a Refrigerant gas

Tools Required

- 1/4" square or open-end wrench
- Refrigeration service gauge set
- Refrigeration vacuum pump
- Electronic leak detector (recommended)
- Liquid soap (bubble detector) & brush
- High pressure nitrogen tank with 200 psi regulator
- Certified recovery device and HFC-134a tank
- Refrigerant weighing scale (optional)

Introduction - Certification And The Law

The refrigerant used in your system, HFC-134a, is considered "environmentally friendly" due to its zero ozone depletion rate and has become the world-wide defacto standard replacement gas for CFC-12 in many applications. However, while HFC-134a does not deplete the ozone level, it can contribute to global warming if released indiscriminately into the air. For this reason most countries regulate its use and require that it be "recovered" in the same way as the ozone depleting gases.

What this means to the owner-installer is that you cannot legally charge, refill or otherwise service the refrigerant carrying portion your refrigeration system without a certification. For some owner-installers, this does not present an immediate problem since (as you will see in this section) it is often a good idea to have a professional evacuate, leak-check and charge the newly installed system anyway. On the other hand, some owners would like the option of doing it all themselves and would like to be able to freely purchase refrigeration gas and service equipment. If you fall into this category, we suggest that you consider getting yourself "certified". To do so requires that you take a brief (usually 1-2 hours) review class and a certification test which immediately follows. Most people, even those with no refrigeration background, pass the test with little problem. For information on classes and test dates in your area, contact your local professional refrigeration supply outlets. The certification you are seeking is the 608 certification. There is a 609 certification (even easier) available, however, this certification applies only to car air conditioning systems and does not legally permit you to work on any system installed on a boat.

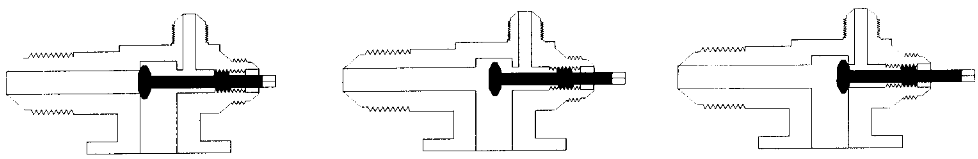
Note: When hiring a "professional" to work on your system you should verify that they are working under a 608 certification. Although there is no legal risk to you, there is good reason to be highly skeptical of any marine refrigeration service person working under a 609 certification.

Opening the Compressor and Receiver Rotolock Valves
As mentioned in the early part of this manual, the Glacier Bay system is delivered to you with a charge of oil held in the compressor crankcase and the receiver on the R/A/D assembly. Throughout the shipping and mounting process the rotolock valves have been closed to prevent loss of oil and contamination from moisture and particulate matter. The initial oil charge is adequate for most systems. There is no need to add additional oil at the time of charging even though a small amount of the oil may be lost during the system evacuation. However, owners and installers are cautioned to follow the oil checking procedures outlined in the "Owner's Manual" following the first few hours of operation.

Wait until you are ready to begin leak-checking (see below) before you open the valves. If the process is delayed for any reason, close the valves tightly. This prevents moisture laden air from contaminating the oil.

Note: The normal operating positions for all rotolock valves except the one to which the HP cut-out is connected is the "back seated" (ie. fully open) position The valve to which the HP cut-out is attached must first be turned counter-clockwise to the "back-seated" position then given 3/4 turn clockwise to the "service" position. The valve with the HP cut-out must remain in this "service" position during operation. This opens the pressure path to the HP cut-out and allows it to be pressurized. Failure to properly install the HP cut-out can result in exposive component failure and serious injury.
(This is a Prestart Checkout Item)

The diagram below shows a cut-away view of a rotolock valve in the three operational positions:



Front seated **Service** **Back seated**

Leak Checking the System
No matter how much care is taken when running the copper tubing, chances are good that there will be one or more "leaks" which will need to be repaired before the system can be evacuated and charged. Many installers simply put on the vacuum pump and check to see if the system holds a vacuum for a period of time. This technique is strongly discouraged for the following reasons:

1. When the system is at full vacuum there is only a 15 psi pressure differential with the ambient air. Such a low differential makes detection of small leaks very difficult.

2. When leaks are present air and moisture from the outside are circulated through the system.

3. If a leak is detected, there is no way to identify its origin.

4. Newly soldered joints often have a coating of flux left filling pinholes. This can act as a "one-way" valve preventing leaks on suction but permitting them upon pressurization.

A much more thorough check can be made by using pressurized nitrogen to elevate the internal pressure above the normal operating system pressure. Since nitrogen cannot be detected by electronic refrigerant leak detectors, a mixture of liquid soap and water is brushed on every joint and a visual inspection is made for "bubbles". For more on this procedure see the "Leak Checking" section in the Appendix of this manual.
(This is a Charge/Startup Item)

When adding nitrogen to the system be sure to add it to the *high pressure and low pressure sides simultaneously*. Do not pressurize the low pressure side alone. The total system pressure should be slowly elevated to 200 psi. Under no condition should test pressure exceed 250 psi. **WARNING: NEVER USE OXYGEN TO PRESSURIZE A REFRIGERATION SYSTEM. EXPLOSION AND INJURY OR DEATH MAY RESULT.**

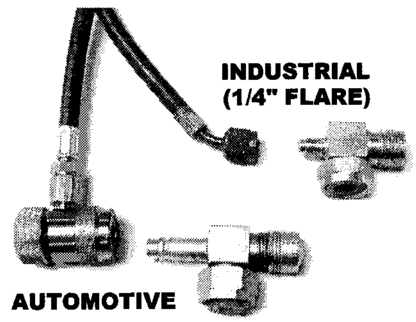
Evacuating the System

Once the system has been thoroughly leak checked, it is time to evacuate the system. This process removes not only air (and residual nitrogen) from the system, but moisture as well. It is important to use a high-quality refrigeration vacuum pump and to ensure that the pump has clean, fresh oil. Old and/or contaminated oil in a vacuum pump prevents the pump from achieving the high level of vacuum required to properly dehydrate the system.

(This is a Charge/Startup Item)

Refrigerant Connection Types

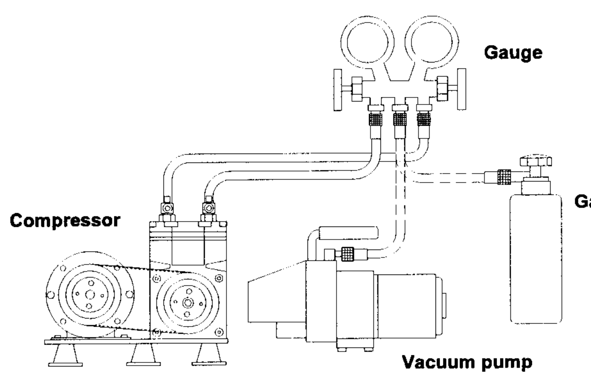
HFC-134a refrigerant gas bottles and gauge sets are available with two different types of fittings - "industrial" and "automotive". The gas itself is identical, only the fittings themselves are different. Your Glacier Bay system uses the "industrial" type fitting. This fitting is a 1/4" male flare and is identical to those used for many years with all CFC (R-12) and HCFC (R-22) type refrigerants. As a result, you do not need to use a special "134a" gauge set when charging your system. When purchasing refrigerant cans, be sure that they have the "industrial" 1/4" male flare fitting or purchase an "automotive to 1/4" flare" adapter.



Getting Started

Step 1 - Connect the gauge set.

Remove the covers from the compressor rotolock valves and use a 1/4"square wrench to turn the valves first counter-clockwise to the "back-seated" position then clock-wise 1 full turn to the "service" position. Remove the service port caps and screw the gauge set into place. Remember that the RED hose connects to the discharge valve and the BLUE hose to the suction valve. The center hose (which can be WHITE, YELLOW or BLACK) is connected to the vacuum pump.



Step 2 - Evacuating the system.

Fully open both valves on the gauge set and vacuum pump, and turn on the vacuum pump. You should see the needles on both gauges quickly pull below "0". With continued evacuating, the suction gauge should soon indicate 29 - 30 inches. Failure to reach this vacuum indicates either a defective vacuum pump or a severe system leak.

Note: Systems which have been previously leak checked with elevated nitrogen pressure may require that the vacuum pump be run for several hours before the system pressure will stabilize at 29 - 30 inches. This is caused by the oil in the system absorbing the nitrogen which then 'boils off' as vacuum is applied. (see "Leak Checking" in the Appendix of this manual for additional detail)
(This is a Charge/Startup Item)

To completely dehydrate the system the vacuum pump must be left running for an extended period of time. How long depends on the ambient temperature since heat tends to "boil off" moisture more quickly. The following table assumes use of a high-quality two-stage vacuum pump.

Ambient Temperature	Recommended Evacuation Time
90° F / 32° C	1 Hour
80° F / 27° C	1 Hour
70° F / 21° C	2 Hours
65° F / 18° C	6 Hours
60° F / 15° C	24 Hours
50° F / 10° C	48 Hours

If a system must be evacuated at temperatures below 50° F/10° C it will be necessary to heat up the tubing and components. Use a safe and gentle heat source such as incandescent lamps and/or electric room heaters.
(This is a Charge/Startup Item)

Step 3 - Disconnect the vacuum pump and attach the refrigerant cylinder.
Close both valves on the gauge set and turn off the vacuum pump. Disconnect the center hose from the vacuum pump. (Check the gauge to see that the system is still in a full vacuum. If not, you did not properly close the gauge set valves and steps #1 and #2 must be repeated.) Attach the center hose to the refrigerant cylinder and loosen it slightly at the gauge set connection. Holding the refrigerant cylinder upright, crack the cylinder valve to purge air from the hose then tighten all connections.

Step 4 - Fill with an initial charge.
Open both valves on the gauge set. Then, while holding the refrigerant cylinder upright, fully open the refrigerant cylinder valve. Allow the pressure to equalize (NOTE: If you are using small 16 oz cans, shake the refrigerant cylinder to see if any liquid remains. If not, close all gauge and cylinder valves and remove the empty cylinder. Attach a full refrigerant cylinder to the white hose and purge it as before and repeat step 4 until the system pressure is equal to the cylinder pressure and liquid remains in the cylinder.) ***(This is a Prestart Checkout Item)***

Step 5 - Checking for leaks
Even if no leaks were detected previously, all connections should be thoroughly checked once again. The preferred method for leak detection in a charged system is with the use of an electronic detection device made especially for HFC-134a. *Old style leak detectors designed for use with CFC or HCFC refrigerants will not work with HFC-134a.* If an electronic leak detector is not available, satisfactory results can be obtained by carefully brushing all connections with soapy water and looking for bubble formation.

Step 6 - Starting the system.
Note: The Glacier Bay control system does not permit the simultaneous operation of multiple boxes or "zones". When both the refrigerator and freezer are warm and "calling for cooling", the freezer will take priority and cool down first. The separate refrigerator plate(s) will only begin cooling after the freezer has been satisfied. Operation of the manual override switch will activate the freezer only on multi-zone systems. The manual override switch is intended as an aid for servicing the system and can be used to force the compressor on when (and only when) all other controls are switched off. The manual override switch is not intended for use at any other time and could cause compressor damage if used in while other system controls are turned on.

The initial charge of refrigerant filled in step 4 is certain to be less than the total charge you will ultimately need. However, the final charge amount cannot be determined until the system is cold and the holding plates are partially frozen. It will therefore be necessary to activate the compressor and cool the system down. While it will be operating at less than optimum efficiency, the initial charge should be enough to allow the system to cool itself. However, it will be necessary to "top off" the charge once the plates get cold.

Note: If you have a scale, you can "weigh in" the total correct charge of 4 lbs of refrigerant directly into the low-pressure side of the system.

Use the manual override switch on the control box to turn on the compressor. (Before turning on the compressor close both valves on the gauge set and the valve on the refrigerant cylinder.) Because of the large amount of oil which had been added to the receiver, the system will appear to be "clogged" when it is first started (ie. the suction pressure will be very low and the system will not cool). After a period of time (generally 5 to 15 minutes) the freezer plate(s) will begin to feel cool to the touch. Continue running the compressor until the freezer plate(s) cool to 30°F (-1°C) or lower. If necessary, add more refrigerant to enable the plate to begin cooling down.

Step 7 - Topping off the system charge.
With the holding plate(s) cooled to 30°F (-1°C) or lower, and the compressor still running, look at the sight glass on the R/A/D assembly. You should see liquid refrigerant splashing past. (The term "bubbles" is often used but is misleading). This indicates that the system is still undercharged. At this point you will want to add enough refrigerant to totally clear the sight glass. To do this, open the gauge set valve on the low pressure (suction) side only.

Note: During normal operation of a properly charged system, it is generally possible to see liquid splashing in the sight glass for the first few minutes of operation. It is only after the plate(s) has cooled down that the sight glass should fill up and clear. A sight glass which clears very quickly after the compressor starts (particularly if the box and plates are at room temperature) often indicates an overcharged condition.

WARNING: WHEN THE COMPRESSOR IS RUNNING ALL CHARGING MUST BE DONE THROUGH THE SUCTION SIDE - ATTEMPTING TO CHARGE THROUGH THE HIGH PRESSURE (DISCHARGE) SIDE MAY RESULT IN EXPLOSION OF THE REFRIGERANT CYLINDER AND SEVERE INJURY.

With the gauge set low pressure valve fully open, watch the suction gauge and slowly open the gas cylinder valve. You will immediately see the suction side pressure begin to rise. Use the gas cylinder valve to maintain the suction pressure at 35 - 40 psi. *Note: If the cylinder gets very cold you can speed up the charging process by setting the cylinder in a pan of warm water.*
(This is a Charge/Startup Item)

Watch the sight glass closely and close the gas valve completely as soon as it clears. Allow the system to continue operating for a few more minutes as you monitor the charge status through the sight glass. If bubbles should appear, add more refrigerant until it clears. (Should you need to change cylinders at any point during the operation, do not stop the compressor. Close the low pressure gauge set valve and the refrigerant cylinder valve. Disconnect the empty cylinder and attach a full one. *Remember to purge the white or center hose*. Re-open the low pressure gauge set valve and continue filling the system.

Step 8 - Removing the gauge set.
The system in now fully charged. Close the gauge set and cylinder valves. Before removing the gauge set the compressor rotolock valves must be fully back-seated (counter-clockwise). SLOWLY loosen the three hoses allowing time for the pressurized refrigerant to bleed off be fore making the final disconnect. Replace the protective caps on the rotolock service ports.

CONCLUSION
Now that you have successfully completed the installation of your system, you will want to refer to the Owner's Manual for further information on fine tuning the system to obtain maximum performance, performing routine maintenance and trouble shooting.

Remember, the maximum charge is 4 lbs of refrigerant for standard systems utilizing a single R/A/D assembly.

Many service technicians will just keep adding refrigerant in an attempt to "clear the sight glass" without regard to the temperature of the holding plates. If this is done when the holding plates are warm, it may result in a severely overcharged system.

INSTALLATION OF THE ARCTIC AIR OPTION

Introduction
This is your guide to installing the ARCTIC AIR air conditioning option package to your Glacier Bay refrigeration system.

The addition of ARCTIC AIR to your system allows your refrigeration system components to automatically serve "double duty" as an efficient air conditioner for the 22-23 (average) hours per day when they aren't needed for refrigeration. Because of our innovative thermal storage technology and outstanding efficiency, a Glacier Bay refrigeration system generally needs to run only about 1/2 to 2 hours per day to handle your boat's refrigeration needs. This means that the compressor and other major components of the system are "off" up to 97% of the day. It is during this "off" time that the ARCTIC AIR option automatically puts the refrigeration system back to work to provide air conditioning for the cabin.

Far from just a convenient add-on, the ARCTIC AIR system is a powerful, reliable and unusually efficient air conditioning system. Additionally, the exclusive "tunable" blowers permit the output of a multiple-blower ARCTIC AIR system to be controlled with an accuracy only matched by the largest and most expensive "liquid chiller" type systems.

LOCATING THE BLOWER UNIT(S)

The ARCTIC AIR blower units are designed primarily to be used in non-ducted type installations. However, where required, a limited amount of ducting can be used to route either the intake or discharge (fan reversed) air flow.

Physical location
There are two theories on the placement of AC blowers on board. Conventional wisdom points out that, since hot air rises, it is usually desirable to try to mount the blower (intake and discharge) as high in the boat as possible. However, some experienced installers point out that most boats have a great deal of natural air circulation at the top of the cabin and the blowers placed high become very inefficient. In our experience there is truth in both of these positions and it really comes down to the layout of the particular vessel. Many times an "ideal" position simply isn't possible due to space limitations. While many owners prefer to adapt existing cabinets and storage spaces, don't rule out the construction of custom enclosures for your system. This can expand your options when it comes to blower placement.

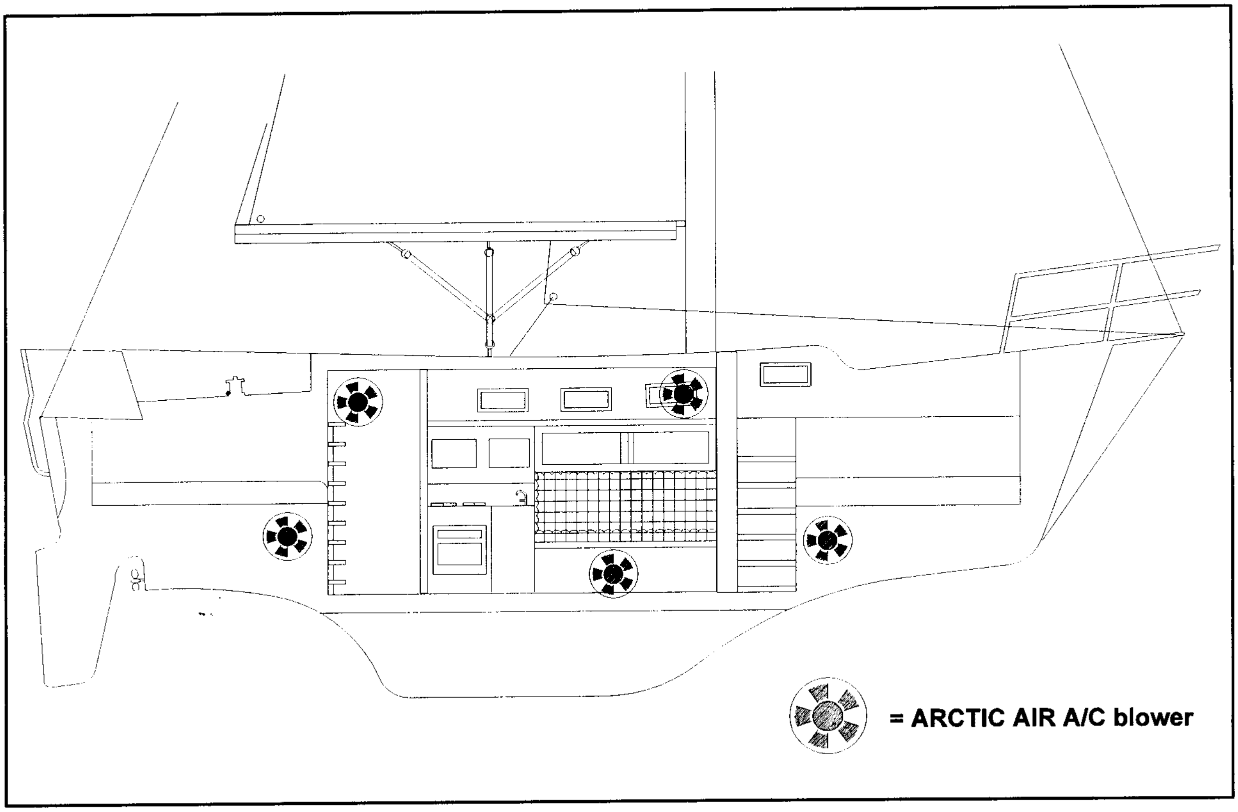
The illustration one the following page suggests some possible locations on a typical vessel. Remember to consider the following items when choosing your location:

1. Tubing runs - You will want to route your copper tubing in an aesthetically pleasing manner.

2. Blower adjustment access - The blowers on multi-blower systems have an access cover (square with four screws) on the top left side (as viewed from the front). Allow at least 5" clearance to access the adjustment under this plate. Note that the blowers on single blower systems do not have or require this adjustment.

3. Condensate drain - Condensation can produce several quarts of water per hour. Most owners of fiberglass vessels route the condensate tubes directly into the bilge. Some owners, particularly those with wooden and metal boats, will want to use a separate, easily emptied container.

4. Air throw - ARCTIC AIR blowers have an average air throw of 12 ft. in most non-ducted installations. The standard discharge grills allow this flow to be directed (up and/or down) for optimum circulation.



TYPICAL PLACEMENT LOCATIONS FOR A/C BLOWERS

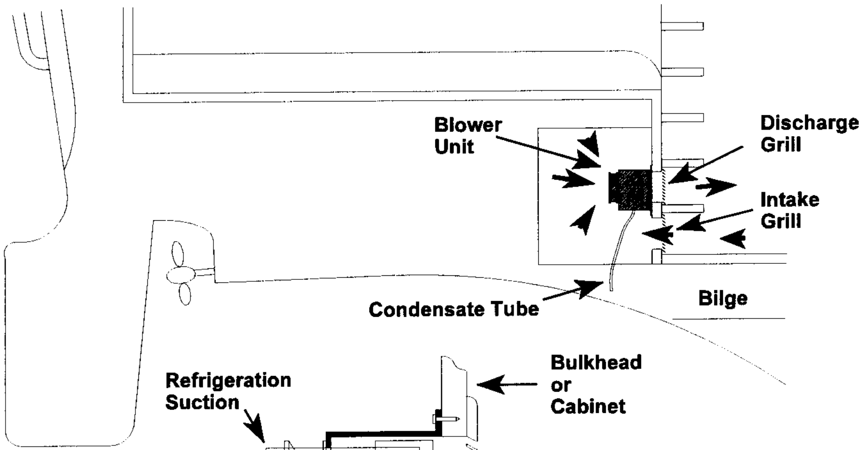
Ducted vs Non-ducted Installation

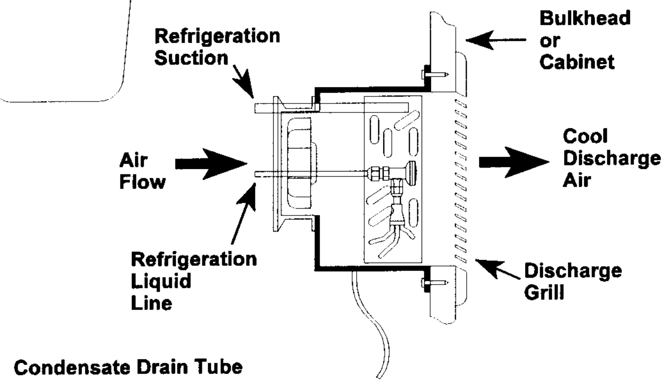
In their standard configuration ARCTIC AIR blower units intake air through the back of the fan and blow it through the evaporator coil before discharging it out the front of the unit. In this configuration the unit is ready for direct discharge past the discharge grill into a cooled room. The air intake may be ducted or non-ducted as required. Since even a short length of ducting can significantly reduce air flow (and cooling capacity) a non-ducted installation is always preferred when possible.

If the need arises, it is possible to reverse the air flow direction of the unit by removing the fans and flipping them (do not try to reverse the current to the fans). Air is now pulled in the front of the unit and passes over the evaporator coil before being discharged out the back. In this configuration ducting can be added to the fan and the discharge routed to remote locations if desired.

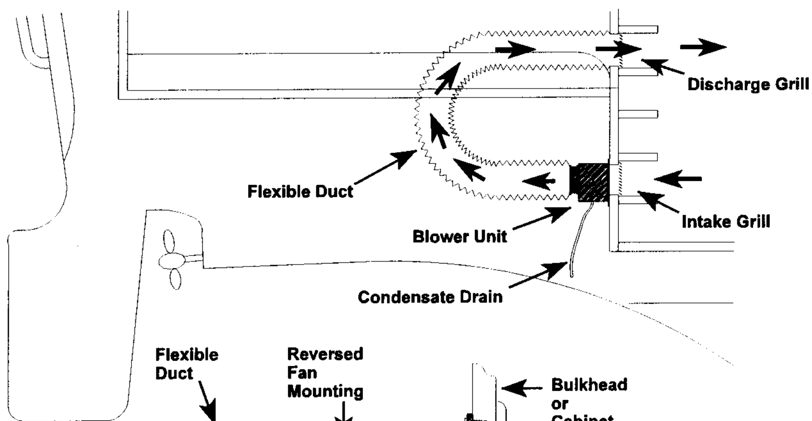
The illustrations on the following page give general ideas for how the blower unit may be installed in ducted and non-ducted applications. Obviously, this is just a guideline as every boat and requirement is different. With a little ingenuity, you'll find the ARCTIC AIR blowers to be very flexible and permit many mounting options.

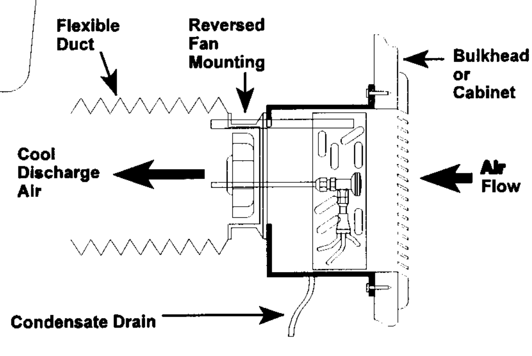
TYPICAL NON-DUCTED INSTALLATION





TYPICAL DUCTED INSTALLATION





RUNNING THE COPPER TUBING

Like your Glacier Bay holding plates, the ARCTIC AIR blower units are connected to the compressor components by two copper tubes, a 3/8" liquid supply line and a 5/8" suction line.

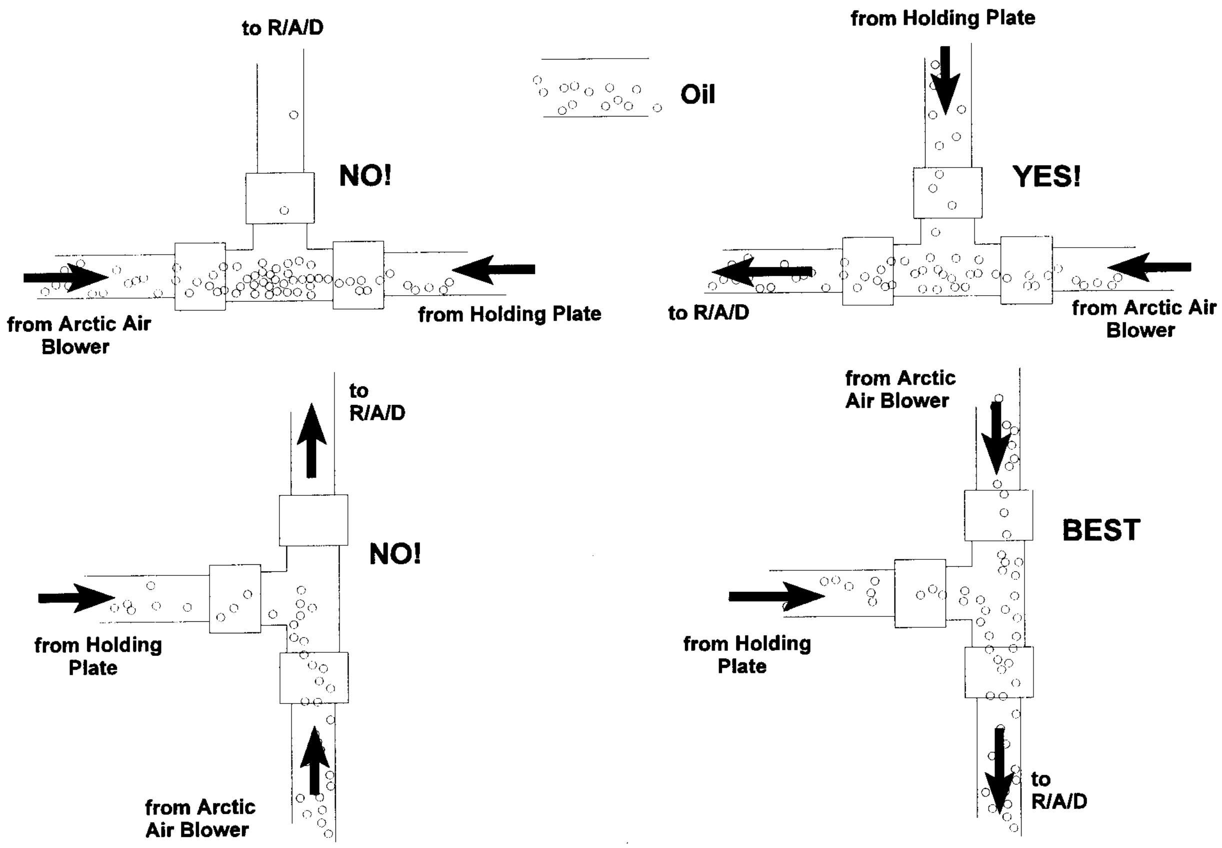
3/8" liquid supply line

The 3/8" liquid line will be run directly from the solenoid valve assembly and connected to the small line at the back of the blower unit. If you are using two blower units which will operate simultaneously you will need to split this supply line with a 3/8" "T" connector and feed both blowers in parallel. On multiple zone systems, each zone (comprised of one or more blowers) will be fed from a separate solenoid valve.

5/8" suction line

The 5/8" suction line is run from all blower units and "T"'d into the suction line coming from the holding plates. This connection may be made at any point between the holding plate and the R/A/D assembly.

IMPORTANT: Care and consideration must be given to the detail of how this "T" connection is made. If improperly connected the line can act as an "oil separator" and eventually starve the compressor of oil causing it to fail prematurely. Use the following illustrations as guidelines for making your "T" and refer to the Appendix of this manual for additional information.
(This is a Prestart Checkout Item)



ADJUSTING THE CRANKCASE PRESSURE REGULATOR

Materials Required
- None

Tools Required
- Amp meter sufficient for motor capacity
- 1/4" Allen wrench

Background
All Glacier Bay systems (engine driven systems excluded) which incorporate the ARCTIC AIR option include a Crankcase Pressure Regulator (CPR) pre-attached to the "inlet" side of the R/A/D assembly. The purpose of this regulator is to prevent overloading of the compressor motor under exceptionally high-load conditions. Such high-load conditions can exist when the air temperature and humidity levels are unusually high and/or when multiple air conditioning evaporators are simultaneously activated. When a potential overload condition exists, the CPR engages to "throttle back" the suction side pressure thus reducing the load on the compressor and motor. Under normal conditions the regulator (when properly adjusted) acts invisibly and has no effect on system operation.

Setting The Crankcase Pressure Regulator
Note: The regulator can only be accurately set under extremely high-load conditions. If the procedure was initially done in cool weather it should be repeated again when ambient air temperature is 80⁰ F (27⁰ C) or higher.

To make the adjustment, a maximum load is placed on the system and the current consumption of the compressor motor is monitored. The adjustment screw is turned so that the compressor current draw does not exceed the maximum permissible. This procedure is executed as follows:

1. Attach a ***reliable and accurate*** amp meter to the compressor motor. For vessels equipped with such a meter as part of a battery monitoring system, be sure all other loads are turned off.

2. Remove the brass cap adjusting screw cover from the end of the CPR

3. Use the toggle switches on the Control Box to turn off the refrigerator and freezer (down position).

4. Turn the compressor power on and turn the switches to run all blowers simultaneously.

5. Read the current consumption and use the 1/4" Allen wrench to adjust the input current to the level designated for your system in the "Maximum Current Draws" table on the following page.

Turning the Allen screw in (clockwise) will increase the current, adjusting it out (counter-clockwise) will decrease the current.
(This is a Charge/Startup Item)

Maximum Current Draws when setting the Crankcase Pressure Regulator

System		Voltage		Current	(excludes water pump)
1/2 HP	Traditional	12	vdc	41	Amps
"	"	24	vdc	21	"
1 HP	"	12	vdc	80	"
"	"	24	vdc	40	"
"	"	110	vac	14.0	"
"	"	220	vac	7.0	"
MARK II	Direct Drive	12	vdc	41	Amps
"	"	24	vdc	21	"
Whisper Jet	"	12	vdc	80	"
"	"	24	vdc	40	"
"	"	110	vac	14.0	"
"	"	220	vac	7.0	"
Rapid-Chill	"	110	vac	19.4	"
"	"	220	vac	9.7	"

NOTE: All AC currents are given for single-phase. For three-phase systems consult factory.

SETTING BLOWER CAPACITY
(Multiple Blower Systems Only)

Materials Required
- None

Tools Required
- Phillips head screw driver
- 1/4" Hex socket (Allen) wrench

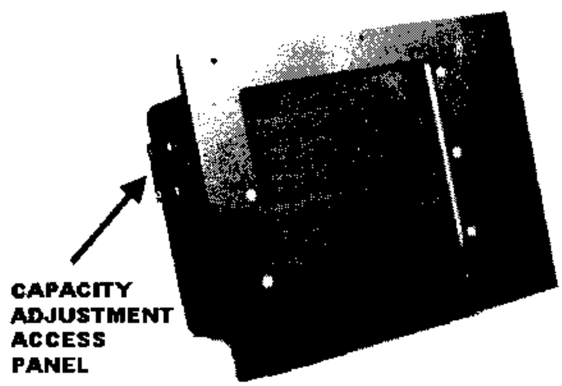
Background
A unique and exclusive feature of the ARCTIC AIR system is the ability to adjust the output of individual blowers. This provides the owner with the means to accurately distribute the total capacity of the system and focus greater or lesser cooling power where it is most needed. For example;

A small and large cabin contain one "A" size blower and one "B" size blower. These blowers combined with a Whisper Jet compressor unit would provide a total output of 16,000 BTU/HR. However, due to the different sizes of the cabins, it may well be desirable to adjust the blowers so that the larger cabin (using the "B" blower) receives a greater portion of the available cooling power (say, 12,000 BTU/HR) while the smaller cabin (using the "A" blower) receives the remainder (4,000 BTU/HR). Similarly, the total available air conditioning power from the compressor can be divided to provide dissimilar capacities from identically sized blowers so long as the maximum capacity of any one blower is not exceeded. Exceeding the maximum capacity of a blower will cause it to frost up. The maximum capacity that can be put through an "A" size blower is 8,000 BTU/HR and 16,000 BTU/HR for a "B" size blower.

Once adjusted, the blowers will remain at the set capacity even if other blowers (on separate "zones") are shut down. This flexibility also permits powerful multi-zone systems to operate only one or two zones without fear of frosting up the blower coil.

Adjusting The Blowers

To adjust the capacity of each blower:



1. Remove the square cover plate (4 screws) from the top left-side rear corner of the blower housing.
2. Using your fingers, unscrew the round brass adjustment screw cover plate just inside the housing. NOTE: This plate and the adjustment screw beneath it, are identical to that of the CPR discussed above.
3. With the system running, use a 1/4" hex socket (Allen) wrench to turn the adjustment screw and change the capacity of the blower. Turn the adjustment screw in (clockwise) to reduce the capacity of the blower and out (counter- clockwise) to increase the capacity of the blower.
4. Replace the two cover plates.

After adjusting all blowers, run the system on a single "zone" at a time to ensure that no single blower is so cold as to begin frosting up. If frost does begin to form on any blower, re-adjust it to a reduced capacity.

Introduction
The unit controls are designed so that the refrigerator and freezer always have "priority" over air conditioning. If either the refrigerator or freezer should require cooling while the air conditioner is activated the A/C will automatically switch off while the refrigerator/freezer holdover-plates are re-frozen. Once cooling is no longer needed by the refrigerator, the unit automatically returns to air conditioning duty.

Note: For convenience, the ARCTIC AIR controls permit the blowers to be turned off and on directly at the control itself. Because of this configuration, there is no "toggle" switch provided on the Glacier Bay control box as there is for the refrigerator and freezer zones.

Standard Control - Timer
The standard control is a mechanical timer. Cruisers on a strict energy "diet" find that this control allows them to closely monitor the amount of energy devoted to air conditioning. The timer control does not respond to air temperature. To activate ARCTIC AIR simply turn the knob to the number of hours you wish to run the system. For continuous operation, turn the knob to the "hold" setting.

Optional Digital Thermostat
The optional digital thermostat controls air conditioner operation based on the ambient air temperature. The choice of sensor location is important in obtaining an accurate average cabin air temperature. By extending the wires running between the sensor and the control, the sensor may be located anywhere in the cabin. The best location is often found to be near the ARCTIC AIR intake grill. Setting the digital thermostat is identical to that of the standard thermostat on the refrigerator/freezer system. A description of the control programming procedure can be found in the Glacier Bay Operations Manual.

GLACIER BAY, INC

Installation Manual

(APPENDIX)

A recent survey of commercial (non marine) refrigeration and air conditioning system failures (which occur during the manufacturer's warranty period) found that over 92% could be traced directly to poor installation procedures and practices. Our experience suggests that the problem of poor installation quality is, if anything, even greater in the marine industry. This section will provide basic information common to the installation of all holding plate refrigeration systems including your new Glacier Bay unit. The recommendations made are based on published professional guidelines, in-situ testing and common sense. Owners hiring professional installers are encouraged to review the procedures outlined with the person they hire. It bears remembering that an installer with "20 years of experience" may actually have 1 year of experience 20 times!

Refrigerant Handling Precautions

As with any refrigerant gas, certain safety precautions should be followed when handling HFC-134a. Bare skin exposed to liquid refrigerant may suffer severe frostbite. Additionally, although HFC-134a is non-toxic it is heavier than air and therefore displaces oxygen. Always provide proper ventilation when working in enclosed areas.

At elevated temperatures the vapor pressure of HFC-134a exceeds that of R-12. Never refill R-12 containers with HFC-134a or subject any container to temperatures exceeding 120 dgr. F (50 dgr. C.).

HFC-134a produces hazardous byproducts if exposed to open flame or heating elements. The presence of these by-products will be apparent by a very acrid odor. ***Never use a flame type leak detector with HFC-134a.***

Making Connections - Soldered

There is little doubt that soldering connections is the preferred method among experienced refrigeration system installers. Once the technique is developed, soldering is both fast and extremely reliable. If you are not confident in your soldering ability, buy 10 or so extra fittings of various sizes from the hardware store and practice your technique. To ensure good solder connections observe the following recommendations:

- De-burr the ends of the tubing in the same manner described for flared connections so that refrigerant will flow smoothly through it. Ensure that the mating surfaces are clean and free of oxidation by cleaning them with steel wool before applying flux.

- To prevent flux from entering the system, always apply flux to the outside of the male half of the connection only - never the female half.

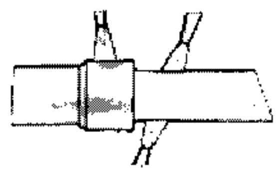
- Use the proper solder and flux. DO NOT USE HIGH TEMPERATURE BRAZE MATERIALS.* Also, avoid using solder from a plumbing supply store as these alloys are not designed to withstand the operating pressures of your refrigeration system. The recommended solder is manufactured by the Harris Company and is called "Stay-Brite #8". The compatible paste flux for copper to copper connections is called "Stay-Clean". (JW Harris Company, 800-773-4533, Intl 937-778-8515 or www.jwharris.com) Alternate solders can be used but must contain 2% to 4% silver and/or nickel. These make considerably stronger joints than do common "50/50" and "95/5" solders. Fluxes should be of the non-acid paste type. Do not use liquid acid-based fluxes. (*Exception - Canadian and some European jurisdictions require the use of high temperature braze materials)
  (This is a Prestart Checkout Item)

- All soldering should be done with a propane torch. DO NOT USE ACETYLENE*. Protect surrounding cabinetry and sensitive components from heat damage by covering them with a wet (not just moist) heavy cotton rag. Be sure to cover everything near the joint to be soldered as proper soldering technique requires that the joint be heated all the way around. To protect overhead areas (such as the top of the ice box) place a wet rag behind a piece of sheet metal which can, in turn, then be wedged into place. (*Exception - Canadian and some European jurisdictions require the use of high temperature braze materials)

Soldering Technique
Caution - Do not overheat the joint as too much heat will burn the flux. If the flux burns, the joint must be disassembled and thoroughly cleaned or it will be impossible to solder. The flux itself is a good temperature guide. Heat the tube until the flux passes the "bubbling" temperature range and becomes completely fluid and transparent.

1. Start heating the tube, first applying the flame at a point just adjacent to the fitting. Work the flame alternately around the tube and fitting until both reach soldering temperature (as indicated by the flux becoming clear and fluid) before applying the solder.

2. Move the flame to the fitting and apply solder with a "wiping action" directly on the connection to ensure that it flows evenly into the joint. The molten solder should be spread evenly around the entire fitting. Do not keep adding solder and heat in an attempt to "fill the joint" as this can allow liquid solder to flow into the system. (Indeed, we have seen solenoid valves completely filled with solder by well intended installers trying to ensure a good connection.) A properly soldered joint requires very little solder.



3. Sweep the flame back and forth along the axis of assembled joint...tube and fitting...to achieve uniform heat in both parts.

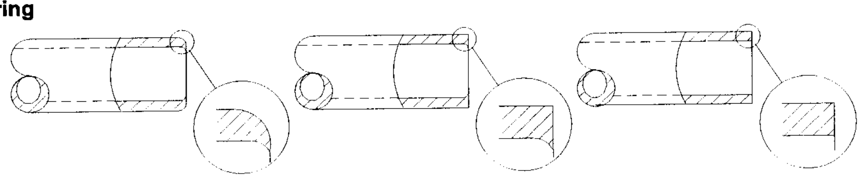
4. After the joint is soldered, with the tube still warm, throughly clean joint of all excess flux using water and a rag.

Making Connections - Flare Fittings
The number of flared tubing connections in your system is intentionally limited by design. Flare connections are far more likely to leak than a properly soldered one. However, the fact remains that the most readily available "after-market" refrigeration components use flare connections rather than solder. Therefore, to ensure that replacements can be readily obtained when traveling, Glacier Bay systems use refrigeration industry standard 45^0 flare fittings on the expansion valve(s), filter/dryer and compressor. The installer is forewarned that these connections can be more difficult and troublesome than those made by solder. To make a reliable leak-free flare fitting, closely follow the instruction given below.

1. Carefully prepare the cut end of the tubing. Ensure that the end is straight and square with the tube.

2. Use a reamer or #11 X-Acto knife to smoothly remove the burr from the inside and end of the tube. Be extra careful to keep shavings out of the tube.

De-burring

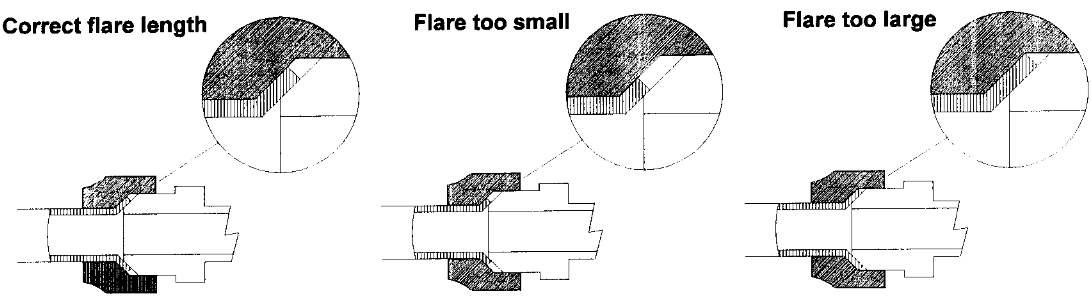


3. Place the flare nut (use refrigeration grade only) on the tube with the open threaded end facing the end to be flared.

4. Observe the die of the 45° flaring tool and note the depth of the flare machined into the tool. To ensure the proper size of your finished flare, clamp the die to the tube so that it protrudes beyond the surface of the die 1/3rd farther again than the depth of the machined flare.

5. Couple the flaring spinner to the die and slowly screw it down far enough to just barely complete formation of the flare. *Do not over tighten!*

6. Examine the finished flare closely. It should be even, smooth and polished on the inside with no signs of cracking around the edge. Now slide the nut over the flare to check for sizing. A properly sized flare will easily clear the threads of the nut and will seat securely. A flare which is too small will "pinch-off" when tightened, while one that is too large will leak.



7. Immediately before attaching the flare to the component, apply a small amount of "Leak-Lock" sealant (the blue tube provided in the installation kit) to both sides of the flare. The sealant on the face of the flare will help ensure a leak free connection while that between the back side of the flare and the flare nut itself acts as a lubricant to prevent galling and twisting of the soft copper as the nut is tightened.
(This is a Prestart Checkout Item)

Connecting Suction (Return) Lines

It is important to carefully plan the plumbing of the suction (return) lines from the evaporator(s). This is particularly true when the system uses more than one evaporator. Improperly run lines can create "oil traps" which starve the compressor of oil causing premature failure. Another important part of planning your tubing run is to ensure that you have left sufficient room to accommodate correct placement of the expansion valve sensing bulbs.

The (suction) return line "T" connections

All refrigeration systems circulate droplets of oil with the flow of refrigerant gas though the system. When routing the 5/8" (suction) return lines, care and consideration must be given to the detail of how

"T" connections (used to connect multiple plates to a single return line) are made. If improperly installed, a "T" can act as an "oil separator" and eventually starve the compressor of oil causing it to wear out quickly and possibly fail altogether. Also, poorly run return lines can transfer a large quantity of oil into a single evaporator (ie. holding plate) causing it to become "oil logged" resulting in a substantial loss in efficiency. Use the following illustrations as guidelines for making your "T". It shows how the oil droplets (indicated by the circles) have a tendency to flow downhill even though the gas flow (indicated by the arrows) may be flowing the other direction. The goal in configuring you "T" connection is to take advantage of this fact to move the oil out of the holding plate(s) and toward the R/A/D assembly.

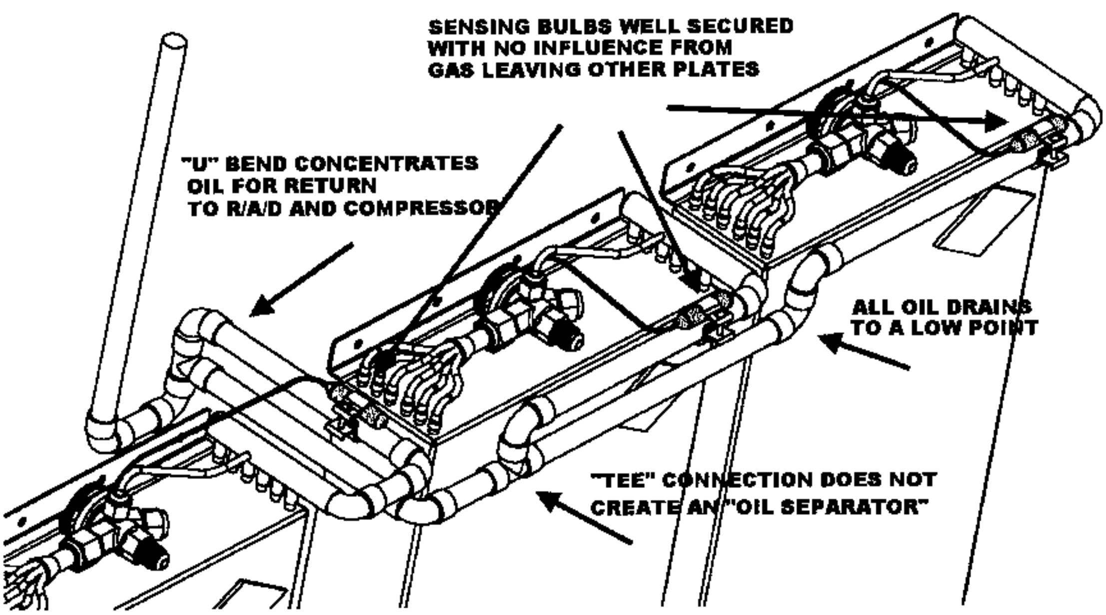
Expansion Valve Sensing Bulb Placement

A second consideration has to be given to expansion valve sensing bulb attachment. Space must be made in the area immediately after the holding plate for this bulb to be securely attached to the tube (see Attaching the expansion valve sensing bulb below). This location must not be less that 2" (50mm) from a "T" connection and made in such a way that gas flowing from another plate will not effect the temperature it reads. From proper operation it is imperative that each sensing bulb only responds to the temperature of the gas exiting that holding plate and not other plates "down stream".

(This is a Prestart Checkout Item)

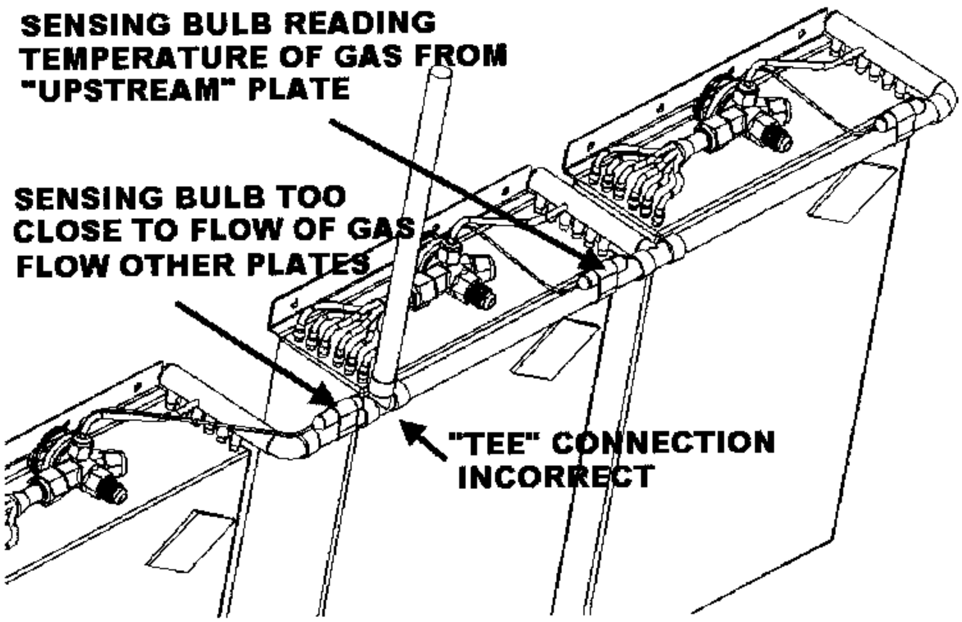
The following illustration shows a well-routed return line connecting three holding plates.

Ideal Tubing Layout

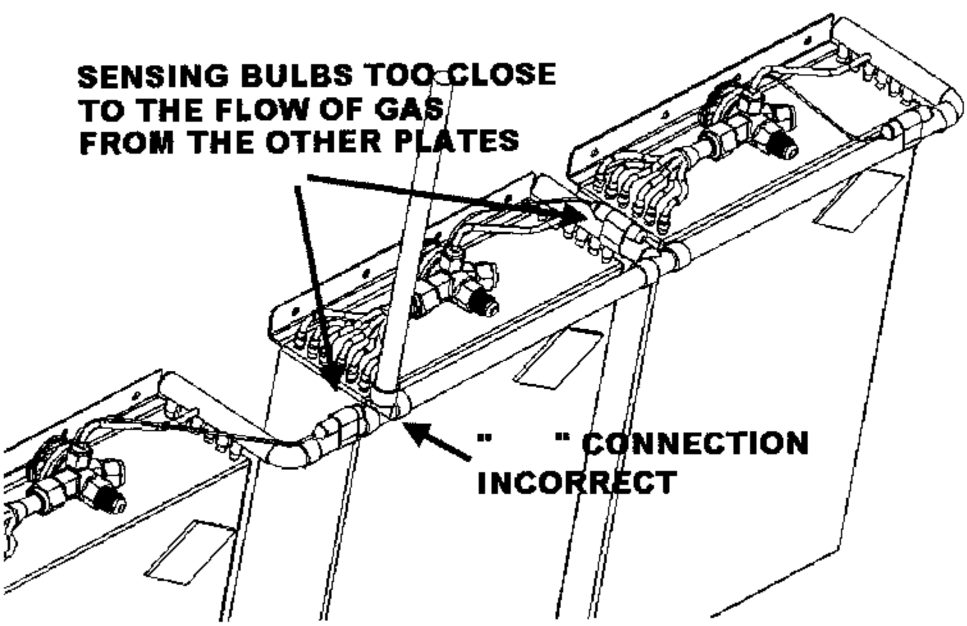


The next two illustrations show a similar plate layout with poorly run tubing.

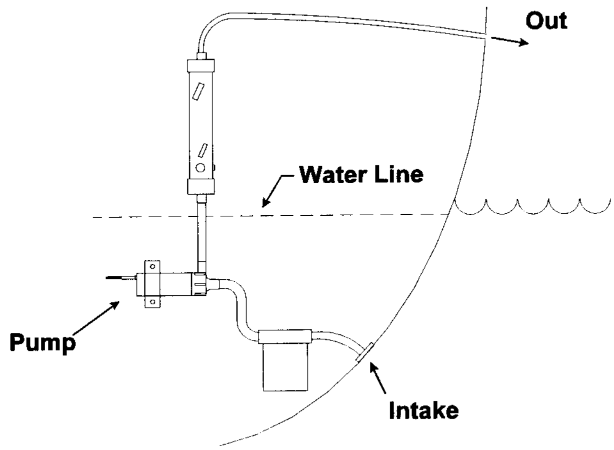
Bad Tubing Layout (example #1)



Bad Tubing Layout (example #2)



Centrifugal Pump Installation



As illustrated in the drawing, the cooling water enters the vessel via its 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 outlet, the connecting hose then continues to a discharge through-hull located above the water line and above the level of the water pump. By studying the diagram carefully it can be seen that it is also necessary to have the connecting hose between the inlet through-hull and the pump situated so as to create an "uphill" run into the pump head. This ensures that no air pockets can be created in the inlet line thereby obstructing water flow.

Centrifugal Pump Q&A

The following answers provided to commonly asked questions may further clarify what factors ensure a good centrifugal pump installation.

Q: ***If I mount my pump under the water line will it self-prime?***
A: Not necessarily. A location below the water line is just one of the requirements for a centrifugal pump to prime. You must also be sure there are no air traps between the through-hull and the head of the pump. A good rule of thumb is to remember that if an air bubble was to enter the through-hull, it must be able to travel straight into the pump head unhindered.

Q: ***Do I need a "speed scoop" on my through-hull when using a centrifugal pump?***
A: Speed scoops are a good idea but they are not always necessary. On fast monohulls and catamarans they are usually required to ensure that the pump continues to operate at high speed. On full-keel cruising boats with very deep intake through-hulls, they can often be eliminated.

Q: ***Do I have to discharge water above the water line?***
A: No. As long as the pump head is below the discharge port and, the discharge hose does not "dip" below the level of the water pump.

Q: ***Can I share an intake through-hull with another pump?***
A: Generally - Yes. However, there are some precautions to take. Choose a through-hull that is shared with a low-flow application such at a head or galley raw-water intake. Also, if the second device does not terminate below the waterline (such as an air conditioning system that discharges above the waterline) then you may need to add a one-way "check" valve to the discharge line of that system.

Q: ***What causes a pump to work well at the dock but not under way?***
A: Sometimes pumps prime well when the boat is upright but not on a heel. Additionally, 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 problem can be alleviated with a speed scoop type through-hull fitting.

Basic Electrical Wiring
Closely follow the wiring schematic and written identifications of the wiring connections which are included in this manual. In planning your wiring remember:

1. Use only 100% tinned stranded copper wire of the recommended AWG size.

2. Always use the recommended size circuit breaker on the main power line.

3. Butt splices should be soldered and sealed with heat shrink tubing.

4. The ends of high power DC cables should be soldered to prevent damage from the connection block screw.

5. Cable runs to the smaller connection block need not be soldered although insertion into the connector is often easier if they are.

6. When making connections to the terminal block, be sure to tighten the clamping screws firmly. (All high-power connections should also be rechecked for tightness at regular intervals)

Wire Size
In addition to using the right type of wire, it is also important to use the correct wire size. While this is important for both AC and DC systems, it is in high-current DC systems that installers tend to underestimate the size of wire needed. Refer to the tables on the following pages for a general reference when selecting a wire size as a function of length and current. The Glacier Bay wiring diagram calls out wire size by AWG gages. AWG is used in the United States while Metric diameter is used in the rest of the world. For convenience, an AWG - Metric conversion table is also provided.

REQUIRED WIRE SIZE BY RUN LENGTH & CURRENT (AWG)

AMPS	WIRE LENGTH - SOURCE TO LOAD AND RETURN FEET (METERS)						
	10 (3.0)	20 (6.1)	30 (9.1)	40 (12.2)	50 (15.2)	60 (18.3)	70 (21.3)
5	18	14	12	10	10	10	8
10	14	10	10	8	6	6	6
15	12	10	8	6	4	4	2
20	10	8	6	6	4	4	2
30	10	6	4	4	2	2	1
40	8	6	4	2	2	1	1/0
50	6	4	2	2	1	1/0	2/0
60	6	4	2	1	1/0	2/0	3/0
70	6	2	1	1/0	2/0	3/0	3/0
80	6	2	1	1/0	3/0	3/0	4/0

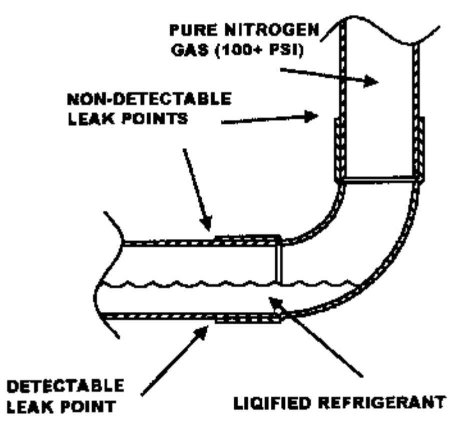
AWG TO METRIC WIRE SIZES

AWG	METRIC (MM)	AWG	METRIC (MM)
0000 (4/0)	11.7	8	3.3
000 (3/0)	10.4	9	2.9
00 (2/0)	9.2	10	2.6
0 (1/0)	8.3	11	2.3
1	7.3	12	2.1
2	6.5	13	1.8
3	5.8	14	1.6
4	5.2	15	1.5
5	4.6	16	1.4
6	4.1	17	1.2
7	3.7	18	1.0

Leak Checking
There exists a surprisingly large amount of confusion over the seemingly simple process of checking a system for leaks. This confusion is generated by a lack of understanding of the physical processes which significantly affect the two most common methods of performing leak checks.
(This is a Charge/Startup Item)

Method #1
In this method a small amount of HFC-134a, R-22 or other refrigerant gas is added to the system. To raise the internal pressure and make small leaks more apparent, a "back-charge" of nitrogen gas is added to elevate the internal tubing pressure to 150 - 250 PSI. An electronic refrigerant "sniffer" is then used to search for leaks around the joints and connections.

Problem with Method #1
At a typical ambient temperature, say 80° F (27° C), HFC-134a liquefies at any pressure above 87 PSI (R-22 is slightly higher). As the nitrogen is added to the system the pressure increases above the liquefaction point of the refrigerant. The refrigerant gas turns to liquid, separates from the nitrogen and flows to the low points in the tubing. Since refrigerant "sniffers" are not sensitive to nitrogen, leaks which are located at the high points (above the level of the liquified refrigerant) cannot be detected.



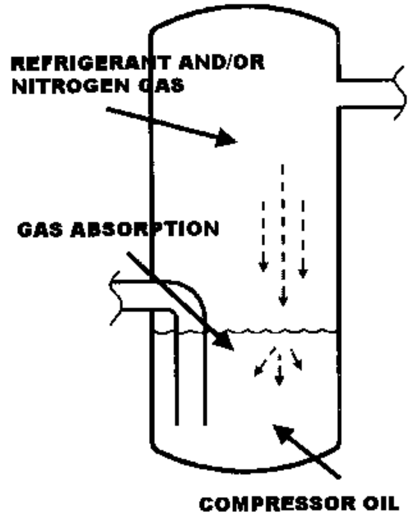
Solution for Method #1
Elevating the pressure in a system above that which would be obtained with refrigerant alone can be helpful in locating leaks. However, the only reliable way to identify leaks in a system which is "back-charged" with nitrogen is to use a soapy bubble solution.

Method #2

This method often used in conjunction with method #1 (described above) but may also be used with refrigerant alone. The idea here is to attach a gauge set to the system and add refrigerant, nitrogen (or both) to the system to raise the internal pressure. A note is taken of what that pressure is. The system is left for a period of time (possibly overnight) and the gauges are then checked to see if the pressure has dropped.

Problem with Method #2

The fact is, that the pressure indicated on the gauges will always drop. While the technicians know this, they generally do not know why. What they will try to do is make a "best guess" as to whether the amount of the drop is severe enough to indicate a leak. Where is the gas going? Indeed, the gas may be lost through a leak. However, it also goes someplace else that is simply impossible for the technician to accurately quantify - into the compressor oil. As the system pressure increases the gas is slowly absorbed by the compressor oil which comes pre-charged in virtually all systems. This is analogous to the carbon dioxide gas which is absorbed into the liquid in a can of soda. As the gas is absorbed, the pressure in the system falls. How much gas will be absorbed and how long it will take varies widely depending on the type and quantity of compressor oil, systems pressure and temperature. The bottom line is, the system pressure is going to fall and there is no way of knowing if it is caused by absorption or a small leak.

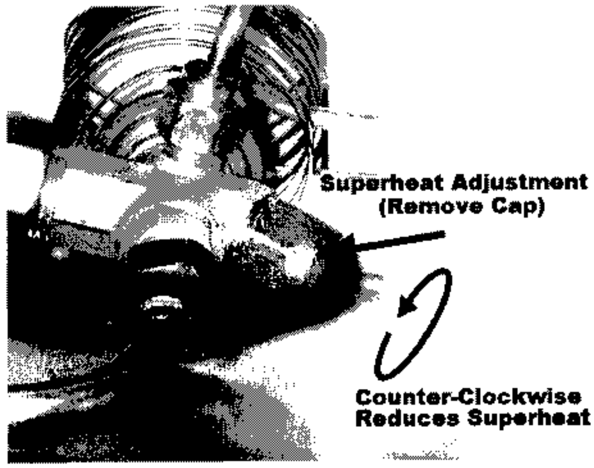


Note: A variation on this same problem occurs when the technician tries to evacuate the system. As the pressure is reduced (by the vacuum pump) the gas which has been absorbed by the oil now begins to boil off (just at the carbon dioxide comes out of your soda when you open the top). This greatly extends the time it takes pull the system pressure down to an acceptable level (29" mercury) and gives the technician the impression that he may be pulling air into the system through a leak.

Solution for Method #2

Monitoring pressure drop can be helpful in identifying leaks - particularly large ones. With proper procedures and equipment it can also be used to indicate moderate leaks. In practical terms it is not helpful when the leaks are very small. To use this method effectively requires that the systems pressure be "topped-off" several times and time given to permit the pressure to completely stabilize. This may take as long as 24 hours. Also, the standard hoses found on refrigeration gauge sets are not designed to hold long-term pressure and are quite "permeable". To eliminate this variable it is necessary to use only special "high-vacuum" rated refrigerant hoses.

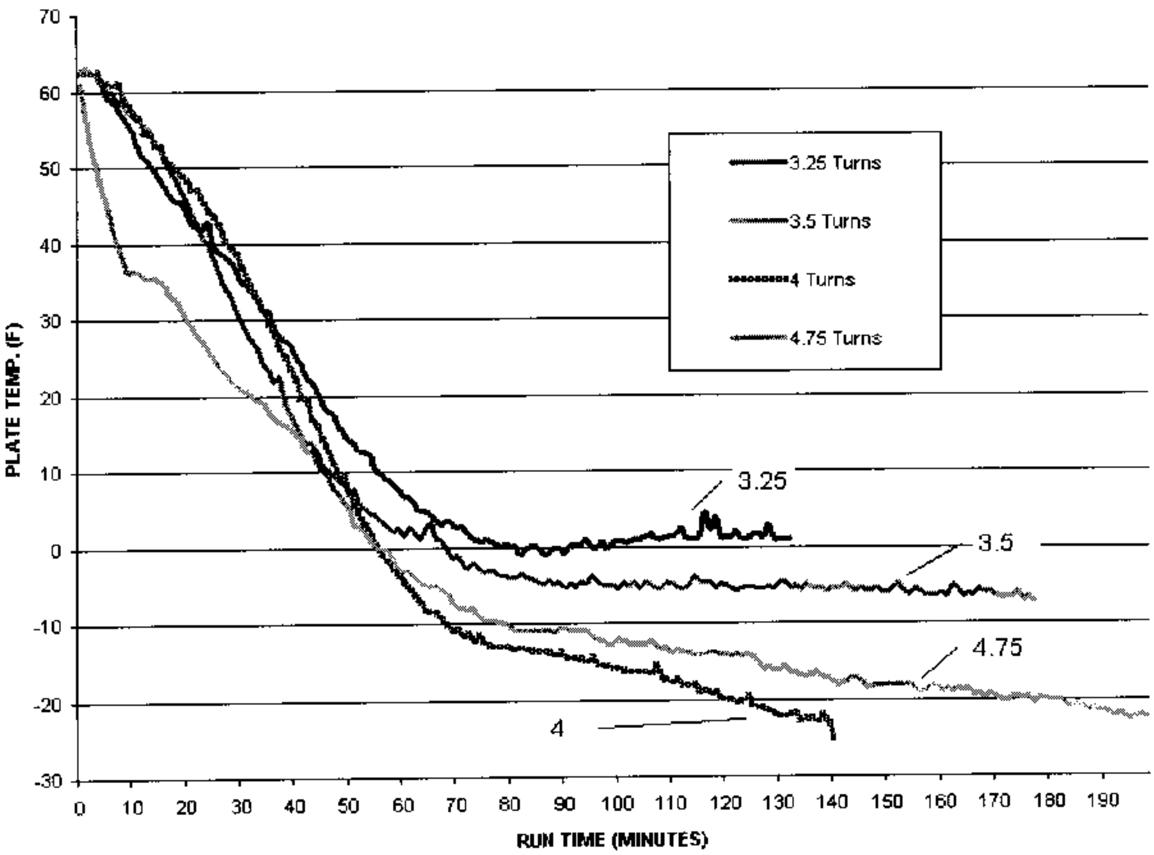
Adjusting Superheat



"Superheat" is the term used to describe the difference between the *vapor point* (ie. temperature at which the refrigerant evaporates at a given pressure) and the actual temperature of the refrigerant exiting the evaporator coil. The "superheat"is regulated by the Thermostatic Expansion Valve (TXV). An adjustment on the valve compares the pressure (and, subsequently, temperature) within the evaporator tubing (inside the holding plate) to the temperature of the tubing at the point where it exits the plate (as measured by the expansion valve sensing bulb).The TXV constantly compares the temperature of the evaporator coil inside the plate with the temperature outside the plate. It then automatically adjusts (opening and closing) to meter in just the right amount of refrigerant for any heatload condition.

By turning an adjustment screw at the back of the TXV, you are telling the valve to maintain a particular temperature difference between the Inside of the evaporator coil and the temperature outside the plate. This adjustment is very sensitive and must be "tuned" to each system and installation to obtain optimum performance.
(This is a Charge/Startup Item)

The chart below is taken from a Whisper Jet compressor unit freezing down a single #3 freezer holding plate and shows the dramatic effect of very small changes in the superheat adjustment screw.



The number of "turns" (chart legend) refers to the number of turns "in" (ie. "clockwise") when starting with the adjustment screw turned completely "out" (ie. turned counter-clockwise until it stops). *The factory default setting is 3.5 turns "in" (ie. clockwise) from the fully counter-clockwise position.*

Things to Notice About The Chart:

- Higher numbers (ie. more "turns") means higher superheat. Higher superheat puts less refrigerant into the evaporator.
- The TXV manufacturer's default setting of 3.5 turns would not permit the holding plate to get colder than -8^0 F.
- Decreasing the superheat (adding more refrigerant) by .25 turns (to 3.25) made the problem much worse.
- Increasing the superheat (reducing the amount of refrigerant) by .5 turns (to 4 turns) greatly improved the performance and allowed the plate to quickly freeze down.
- Increasing the superheat further (to 4.75 turns) reduced the performance substantially but still allowed the plate to freeze down (over a much longer time).

Setting The Superheat On Your System

Note: The superheat adjustment on the freezer plate(s) is much more sensitive than on the refrigerator plates. The refrigerator generally gives satisfactory performance over a much wider adjustment range.

The preceding chart is provided as a general example of how various superheat settings effect a system. In this particular system, 4 turns in was the ideal adjustment setting for the freezer valve - your optimum setting is likely to be different.

Below, two methods are described for setting the superheat on your TX valves. *Method #1 - Observation,* **is intended for freezer plate only** does not require gauges or a separate thermometer. It gives very accurate results but is somewhat time-consuming. *Method #2 - Direct Measurement* can be used for both refrigerator and freezer TXV adjustment and is the method most often used by refrigeration servicemen since it gives acceptable results and is faster than Method #1.

Warning: Do not attempt to adjust the superheat based on the "frost line" of the suction return tubing. Contrary to what you may have heard from confused technicians, the "frostline" is largely irrelevant. Generally, if a Glacier Bay system develops frost on the suction line between the R/A/D assembly and the compressor, it is a good indicator that the superheat setting (on at least one TXV in a multi-plate zone) is too low. Beyond that, accurate adjustment cannot be made based on the length of the frostline.

Multiple Plates In One Zone

Many systems have two (or more) holding plates in single zone. Whenever there are multiple plates pulling-down at the same time (ie. same "zone") it is desirable to adjust only one TXV at a time. To do this, turn the superheat adjustment screw fully "IN" (ie. clockwise - maximum superheat) on the plate(s) that you are NOT adjusting - DO NOT FORCE THE SCREW. This will ensure that the setting of this valve(s) does not interfere with the valve you are attempting to adjust. Also, if you are using Method #1 - you must move the thermostat/ECM temperature probe into the well of the plate being adjusted. Be sure the probe is properly sealed to ensure an accurate reading (see the Installation Manual). After the first valve is adjusted, carefully count the number of turns it takes to get back to the fully out (counter-clockwise) "stop". Write that number down so the valve can be reset to the correct place after the other valves are adjusted. Now, turn the screw all the way "IN" and proceed to the next valve adjustment. After all valves are adjusted, reset them to the correct position by turning them the correct number of turns "IN" from the fully "OUT" (stop) position.

To Adjust The Superheat, You Will Need The Following Tools:

1. Refrigerant gauge set (Method #2 only)
2. 19mm socket or wrench (Method #1 & #2)
3. Flathead screw driver (Method #1 & #2)
4. Temperature/Pressure table for HFC-134a (Method #2 only, located elsewhere in this Manual)
5. Accurate surface reading thermometer (Method #2 only)

Method #1 - Observation (Freezer Plates only)
This method is based on the idea that the "optimum" superheat setting for freezer plates is usually the least superheat (ie. most refrigerant) that can be set while still permitting the plate to freeze down very cold (typically -20^0 to -25^0 F). As can be seen in the chart (presented above), too little superheat prevents the plate from ever reaching the correct temperature while too much superheat requires the compressor to run excessively long to attain a low temperature.

Therefore, the idea is to intentionally set the super heat too low (thus preventing the plate from freezing all the way down), then slowly increase the superheat to the point where the plate temperature begins coming down as it should. To use Method #1:

- Select the TXV/plate to be adjusted. Remove the cap covering the superheat adjustment screw.
- Make sure the thermostat/ECM temperature probe is in the plate well and properly sealed
- Make sure the TXV sensing bulb is securely clamped using the strap provided or a metal hose clamp (no nylon wire ties).
- Turn the adjustment screw fully counter-clockwise (out) until it stops. Then turn it clockwise (in) exactly three (3) turns.
- Turn on the compressor and let it run. Allow the plate to reach its lowest temperature. The temperature is likely to be higher than that desired and fluctuate within a narrow temperature range (see previous chart). Allow it stabilize at this temperature for 15-30 minutes.
- With the compressor still running, turn the superheat adjustment screw "IN" (clockwise) 1/4 turn. Allow the system run until the temperature again reaches its minimum. *Very Important - The system must run for a minimum of 15 minutes before making any further adjustment.*
- Repeat the previous step adjusting the screw IN 1/4 turn at a time and allowing the temperature to fully stabilize at its minimum temperature (or 15 minutes - whichever is longer) after each adjustment. (Do not make further adjustment if the plate temperature is continuing to fall) Repeat the process until the plate reaches -20^0 to -25^0 F.

Note: The temperature of you plate may actually RISE as you begin to make your 1/4 turn adjustments in - this is OK. Simply continue to make the adjustments being sure to wait at least 15 minutes. At a critical adjustment, the temperature will begin falling.

Method #2 - Direct Measurement
This method involves the actual measurement and calculation of the superheat. It is highly accurate with the right tools but can be very misleading if the wrong thermometer or an inaccurate pressure gauge is used. This method is suitable for both refrigerator and freezer plates.

Measuring Superheat

The adjustment process should be started when the holding plate is approximately 1/2 frozen. If the plate is fully thawed, allow the system to partially freeze down before taking your measurements.

Step 1- Ensure that the sensing bulb for the thermostat is firmly clamped to the suction line on a horizontal tubing run at the 10:00 or 2:00 position.

Step 2 - Remove the protective cap covering the superheat adjustment screw.

Step 3 - Connect the refrigerant gauge set and purge. Only the suction side need be connected. It is a good idea to re-calibrate your gauge to "0" before connection.

Step 4 - Securely attach the thermometer probe to the suction line immediately after the manifold elbow and fitting.

Step 5 - Start compressor and allow the system to run at least 10 minutes to stabilize.

Step 6 - Determine suction line pressure drop.

The suction side pressure you are reading at the compressor includes line losses as the refrigerant gas makes its way back to the compressor. To accurately determine the superheat we need to know the suction pressure *at the evaporator*. Therefore, we need to determine, and then add back in, any additional pressure drop which occurs between the evaporator and the compressor. Fortunately, this loss can be easily seen on the pressure gauge as an immediate "jump" at the moment the compressor is turned off. Typically, line pressure drop will only amount to 1 or 2 psi. However, with long tubing runs it may be higher. Manually turn the compressor off and on a couple of times to determine the pressure drop in your system. Once determined, leave the compressor running.

Step 7 - Determine the evaporator temperature.

Do this by reading your suction pressure displayed on the gauge and adding back in the line pressure drop. Use your temperature/pressure table to determine the actual evaporator temperature. For example: gauge reading (10 psig) + line loss (2 psi) = 12 psig. The temperature/pressure table tells us that HFC-134a has a vapor point (evaporator temperature) of 10° F at 12 psig. Therefore, the system evaporator temperature is 10° F.

Step 8 - Measure evaporator exit temperature.

Use your surface reading thermometer to read the temperature of the suction line at the holding plate exit point. For example: 18° F.

Step 9 - Calculate superheat.

Evaporator exit temperature (18° F) - evaporator temperature (10° F) = 8° F superheat.

Changing Superheat

To change the superheat setting, turn the flathead adjustment screw *clockwise to increase* the superheat, *counter-clockwise to decrease*. Adjust the screw no more than 1/4 turn at a time and allow the at least 15 minutes running before re-measuring. Large adjustments and fine-tuning must sometimes be done over several "pull-down" cycles because of the amount of compressor run time required to stabilize the system after each adjustment.

Superheat Adjustment Q&A

Q- *New laws enforce a world-wide requirement that only properly licensed service technicians (complete with recovery equipment "on-site" at all times) may perform certain operations. Does the adjustment of superheat fall into this category?*

A - Method #1 described above does not require a license, Method #2 does. These laws apply anytime it is necessary to "break into the refrigerant stream". Unless you have permanently mounted gauges, you will need to connect them into place to follow Method #2. By doing so, you then fall under the regulations. In the US, fines up to $50,000 are now being regularly issued.

Q - *If the "frostline" is irrelevant as you say, why does my refrigeration serviceman always talk about it when referring to superheat settings?*

A - Unfortunately, in spite of the fact that proper superheat adjustment in vital to the efficient operation of any refrigeration system, most marine servicemen have only a vague understanding of it. Many do know, however, that severely low superheat can cause physical damage to the compressor (don't worry - your Glacier Bay system is protected from such damage). An easy "rule-of-thumb" which ensures that the superheat is not set so low as to cause such damage is to adjust it until the "frost-line" is some distance from the compressor. While this practice does safeguard the compressor from damage it often, particularly in the case of freezer plates, gives in a superheat setting which is much too high. The result is inefficient operation and excessive compressor run time.

Q - *Does under and/or overcharging effect superheat?*

A - Yes and No. In the case of capillary tube systems (typically low-cost direct expansion systems), superheat adjustment in the field is accomplished entirely by the amount of the charge. However, in expansion valve systems (including all Glacier Bay systems), the superheat would only change (increase) in the case of very severe under-charging. Over-charging does cause other problems but never changes the superheat in an expansion valve system.

Q - *Since the superheat setting has very little latitude for error, how do I know that the gauge and thermometer are accurate enough for Method #2?*

A - Most analog (dial type) refrigeration gauges are surprisingly accurate if they have not been abused and have been re-calibrated to "0" before pressure is applied. Thermometers, even very expensive ones, can be problematic. If possible, try to cross-check with another thermometer or two *at the temperatures you expect to be reading.*

Q - *I have a gauge set with a temperature scale for HFC-134a, can I use that instead of the temperature/pressure table?*

A - No. It isn't going to be accurate enough. Use the one provided in the Glacier Bay Installation Manual Appendix or on the Glacier Bay website.

The Temperature/Pressure Table for HFC-134a

Pressure is given in PSIG (gauge) and the temperature in degrees F.
To convert PSIG to "Bar" multiply by .06895
To convert °F to °C subtract 32 then divide by 1.8

Pressure [psig]	Temp [F]	Pressure [psig]	Temp [F]	Pressure [psig]	Temp [F]
(22")	-62.38	27	31.10	65	65.71
(20")	-55.02	28	32.27	66	66.43
(18")	-48.85	29	33.43	67	67.14
(16")	-43.50	30	34.56	68	67.85
(14")	-38.76	31	35.68	69	68.55
(12")	-34.49	32	36.77	70	69.24
(10")	-30.60	33	37.85	75	72.62
(8")	-27.02	34	38.91	80	75.86
(6")	-23.70	35	39.96	85	78.98
(4")	-20.59	36	40.99	90	81.97
(2")	-17.67	37	42.00	95	84.87
0	-14.92	38	43.00	100	87.66
1	-12.31	39	43.98	105	90.37
2	-9.83	40	44.95	110	92.99
3	-7.47	41	45.91	115	95.53
4	-5.21	42	46.85	120	98.00
5	-3.04	43	47.78	125	100.4
6	-0.95	44	48.70	130	102.7
7	1.05	45	49.61	135	105.0
8	2.99	46	50.51	140	107.2
9	4.86	47	51.39	145	109.4
10	6.67	48	52.26	150	111.5
11	8.42	49	53.13	155	113.6
12	10.12	50	53.98	160	115.6
13	11.77	51	54.82	165	117.6
14	13.38	52	55.65	170	119.6
15	14.94	53	56.48	175	121.5
16	16.46	54	57.29	180	123.3
17	17.95	55	58.10	185	125.2
18	19.40	56	58.89	190	126.9
19	20.81	57	59.68	195	128.7
20	22.19	58	60.46	200	130.4
21	23.55	59	61.23	205	132.1
22	24.87	60	62.00	210	133.8
23	26.16	61	62.75	215	135.5
24	27.43	62	63.50	220	137.1
25	28.68	63	64.24	225	138.7
26	29.90	64	64.98	230	140.2

GLACIER BAY, INC

Operation Manual

SYSTEM CONTROLS AND OPERATION

Every installation is different. Your Glacier Bay system is delivered to you with the controls pre-adjusted to "approximate" settings. These settings will generally give acceptable results but are not optimized to achieve maximum efficiency. Optimizing control settings can only be done but monitoring the system operation for an extended period of time. Therefore, it is the responsibility of the owner to optimize these settings.

Introduction

Before undertaking adjustment of the controls, it is important to recognize that your Glacier Bay holding plate system works very differently from a common "non-holding plate" system such as your home refrigerator. In your home refrigerator, the compressor is turned on and off based on the temperature of the air in the box. In your Glacier Bay system, the compressor is turned on and off based on the state of the holding plate (ie. frozen or thawed). The temperature of the air in the box is determined indirectly at the time the system is designed by the eutectic temperature and physical size of the holding plates.

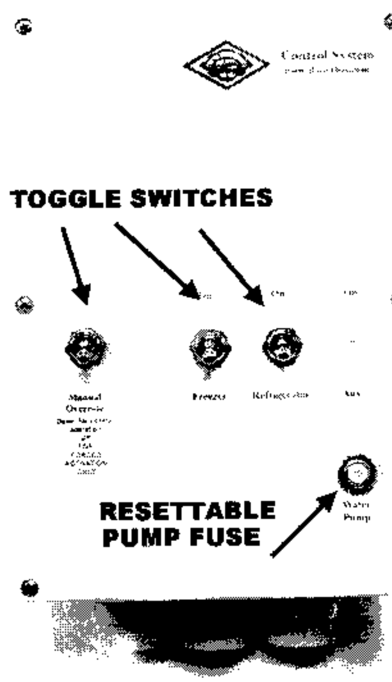
While this may seem a minor distinction at first glance, it is important that the owner does not attempt to adjust the controls to achieve a particular box air temperature. ***In a properly adjusted system, the compressor runs just long enough to freeze the holding plate(s) completely solid then turns off until the plate(s) is completely thawed.*** The control system is improperly adjusted if the compressor turns off before the plate(s) is 100% frozen or, if it continues to run after it is 100% frozen. Similarly, the control system is maladjusted if it turns on before the plate(s) is 100% thawed or, fails to turn on after it is 100% thawed.

An incorrectly adjusted system will often operate fine and maintain very acceptable box temperatures. However, it will generally use more energy that one which is properly adjusted.

Basic Operation

The Glacier Bay control system consists of the control box, digital thermostat(s) and high-pressure cut-out.

Note: In multi-zone systems (ie. separate refrigerator and freezer compartments), the zones do not pull-down simultaneously. Instead, the individual zones operate sequentially by priority with the freezer plates freezing first and the refrigerator afterward.



Toggle switches are provided on the control box to enable the operator to turn individual zones on and off. For example, if all of the food in the freezer is used up but you wish to continue to run the refrigerator, simply move the toggle switch labeled "Freezer" to the down position. The refrigerator will continue to operate normally but the freezer will be allowed to warm up thereby saving a considerable amount of energy.

By flipping the switches UP and DOWN it is possible to activate and de-activate either box independently of the other. To shut down a box, move the toggle switch to the DOWN position. The digital display for this box will go dark.

The toggle labeled "Manual Override" will override the thermostat(s) and force the compressor on at any time. This is useful in service and maintenance work. When the switch is activated, only one box will pull down. This will be the refrigerator in a single zone system and the freezer in a multi-zone system.

WARNING: The manual over-ride switch is for service and backup use only. Do not use it to manually "top-off" holding plates. For normal operation the manual override switch is DOWN and all other switches are UP.

The manual override switch is provided *solely as an aid to the service technician and in the event that the freezer thermostat should fail.* When activated (ie. moved to the UP position), this switch overrides the freezer thermostat and forces the compressor to come on and the freezer solenoid valve to open. When activated, the compressor will run (and the freezer pull-down) continuously. If the refrigerator happens to be "calling for cooling" at the same time, then both refrigerator and freezer boxes may cool simultaneously. If operated for an extended period of time this can cause oil loss to the compressor and eventual failure. *Do not operate the refrigerator and freezer simultaneously unless your system is specifically designed to do so.*

When all switches are in the "OFF" position (ie. toggle switch is "down") the compressor will not be turned on even when the temperature of the plate has risen. This may serve as a safety mechanism when working on or near the compressor unit

The System Control Box - Fuses

There are two (2) 10 amp fuses in the control box. The sea water pump fuse is of the manually re-settable type and is visible on the face of the box. The second fuse is housed in an "in-line" holder and is located inside the box. This fuse provides safety to the control circuitry current.

A failure of the water pump fuse will result in the pump shutting down, which in turn, will cause the HP cut-out to trip (see trouble shooting). A failure of the in-line fuse will cause the control circuitry to lose power and the entire system to shut down immediately.

The High-Pressure (H-P) Cut-Out

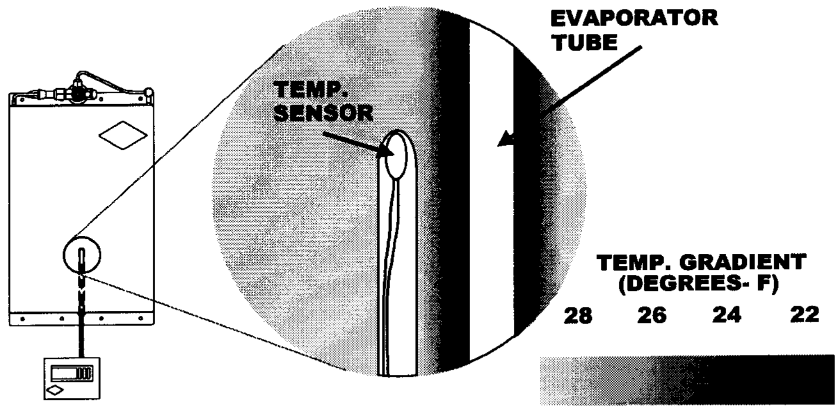
The H-P cut-out is a safety switch which automatically shuts down the system in an over-pressure (above 200 psi) situation. Generally, an over-pressure condition occurs due to loss of cooling water from a failure of sea water pump or loss-of-prime (centrifugal type pumps only). However, the H-P cut-out will also trip if the system has been severely overcharged with refrigerant, if air was accidentally introduced into the system during service or (in older systems) the condenser has not been cleaned.

Note: If the H-P cut-out activates, the system will typically run for a minute or two then shut off for 5-15 minutes then repeat the cycle until the problem is corrected. Each time the system shuts off the digital displays on all controllers will go dark.

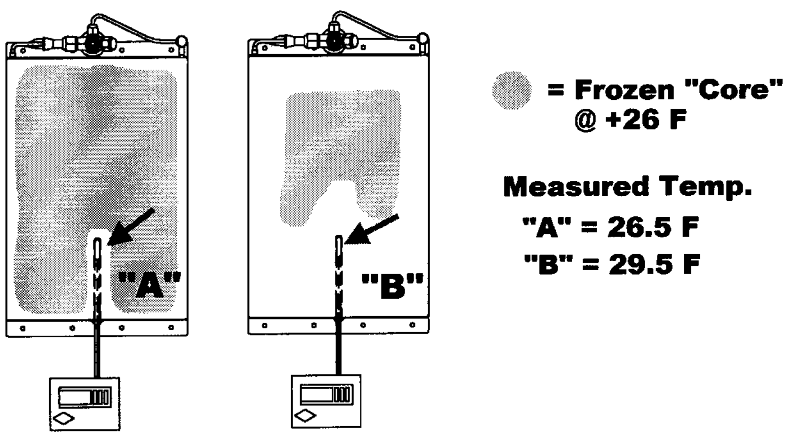
Determining the state (frozen or thawed) of the Holding Plate

The Glacier Bay system uses a true eutectic holding solution in the holding plates. The term "true eutectic" means that the solution freezes and thaws at a single temperature (For example, water at 32° F/0° C for example). Our TSS +26 refrigerator solution changes state at +26° F (-3° C). Our TSS -8 freezer solution changes state at -8° F (-22° C). Knowing that, one would think that it would be a simple matter to know if the plate is frozen or thawed by simply measuring whether the plate temperature is above or below the eutectic point (ie. at 31^0 F water is frozen and at 33^0 F it is thawed). Indeed, this would be true if it were possible to measure the exact temperature of the eutectic solution. Unfortunately, this is not possible.

When the compressor is running (and the holding plate is freezing down) the temperature probe is actually reading a combination of the eutectic solution temperature and the (much colder) evaporator coils inside the holding plate. Consequently, the holding plate temperature measured while the compressor is running will always be *colder* than the eutectic solution itself.. Exactly how much colder varies several degrees between different systems and installations.



Once the compressor stops running (and the plate starts thawing out), another measurement error is introduced. Since we are only able to measure temperature from the outside of the plate, the surface temperature of the plate will slowly rise during the thawing period even though the temperature of the core remains constant. This is because the heat entering the plate from the outside creates a fully melted layer of solution which acts as an insulator to slow heat ingress into the frozen "core". The temperature difference (between the exterior surface and the core) will vary between systems and installations.



Given these measurement variances, it is apparent that the correct compressor "turn on" and "turn off" temperatures will be some number of degrees above and below the eutectic point of the holding plate solution. It is also apparent that the precise number of degrees will vary from system to system and from installation to installation.

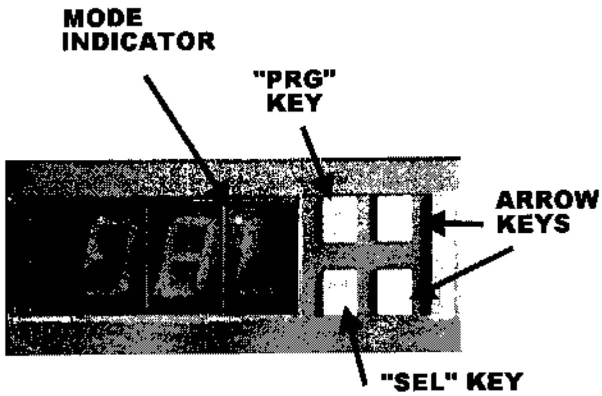
Therefore, the purpose of this section is to describe a method which can be used to determine the exact freeze and thaw points for every system and installation.

A Control Overview

The Glacier Bay system is available with two different controls - the "standard thermostat" and the (optional) "ECM controller". The two controls are virtually identical in appearance and are programmed in the same way. The only difference is that the ECM Control offers a second level programming which becomes active whenever the engine and/or generator is started. If you do not know which type of control you have, you will need to look at the back side of the control to find out.

STANDARD THERMOSTAT **ECM CONTROLLER**

The front face of the controls are identical and feature a green LED digital display, programming keys and mode indicator light. Additionally, a second temperature probe can be added to either type of control to display the "box temperature" as well as the (normal) holding plate temperature.



Functions

Mode Indicator - Standard thermostat - Blinks once when it has reached the programmed upper temperature limit.

ECM controller - Blinks once when it has reached the first programmed upper temperature limit (i.e. "engine-drive mode") and twice when if has reached the second programmed upper temperature limit (i.e. "standard mode").

"SEL" Key - Enters the programming mode for the "set point" setting.
(The "set point" is the temperature at which the compressor turns "OFF")

"PRG" Key - Enters the programming mode for the "differential" setting.
(The "differential" + "setpoint" is the temperature at which the compressor turns "ON")

"Arrow" Keys - Used to scroll numbers and input numbers.

Adjusting "setpoint" and "differential" on the Standard Thermostat and ECM Controller
(This is a Charge/Startup Item)

To alter the **"setpoint"** (ie. The compressor turns <u>OFF</u> at this temperature)

- Press and hold down the "SEL" Key until "St 1" is displayed - then release the Key.
- The number flashing is the current differential setting. To change it, use the Arrow Keys to scroll to the desired number.
- Press "SEL" then "PRG" to retain the new setting.

- NOTE For ECM controllers - After entering the "St 1" setpoint parameter and pressing the "SEL" key, you will be prompted to also enter the "St2" setpoint. After entering it, simply press the "SEL" Key again then press the "PRG Key to retain both settings. *The setpoint for both "St 1" and "St 2" should always be entered as the same number.*

- The factory default setting for "St 1" and "St 2" is -16 for the freezer and +22 for the refrigerator

To alter the **"differential"** setting (ie. The compressor turns <u>ON</u> at the "differential + setpoint")

- Press and hold down the "PRG" Key until "P 1" is displayed then release the Key.
- Press the "SEL" Key to display the current differential setting.
- Use the ARROW Keys to scroll to the desired number.
- Press "SEL" then "PRG" to retain the new setting
- Note For ECM controllers - After entering the new "P 1" differential parameter and pressing the "SEL" Key, you may use the ARROW Keys to scroll to the "P 2" parameter. Once "P 2" is displayed, you may enter this parameter by pressing "SEL". After both "P 1" and "P 2" have been entered, press "PRG" to retain the new settings. *Remember that the "P 1" setting is active in normal mode and the "P 2" setting is active in "engine-drive" mode. Therefore, "P 1" will always be a larger number than "P 2".*
- The factory default setting for "P 1" is +16 for the freezer and +8 for the refrigerator. The factory default setting For "P 2" (ECM only) is +12 for the freezer and +4 for the refrigerator.

Optimizing Settings For Maximum Efficiency
This section will describe two different methods for optimizing the control settings - compressor run time and charting the cycle . The first method, Compressor Run Time, uses an estimated compressor run time to determine the correct "setpoint" (ie. turn-off temperature). The "differential" (turn-on temperature) is held at 0^0 F (-18^0 C) for the freezer and 32^0 F (0^0 C) for the refrigerator. This method is fast and fairly accurate so long as the system itself is operating at maximum efficiency (ie. correct superheat adjustment, correct charge, etc.). The second method takes more time but is also more accurate. It involves "charting" the temperature of the plate as it thaws. By analyzing the chart created, a determination can be made for both the "setpoint" and "differential" settings.

Method #1 - Adjusting the settings based on compressor run time
The basic idea behind this approach is that by knowing how much heat has to be removed (ie. the number and size of holding plates) and knowing how quickly the compressor removes that heat (ie. the model of the compressor), we can determine how long the compressor will need to run to completely freeze down the holding plate(s). After running the compressor the proper length of time to freeze the plate(s), a note is made of the minimum temperature achieved (based on the temperature shown on the digital display).

This temperature is then programmed into the control as the "setpoint" (ie. turn-off temperature). The "differential" setting is then programmed in as the difference between the "setpoint" temperature and +32° F (0° C) for the refrigerator or +10° F (-12° C) for the freezer).

To adjust the settings based on compressor run time start with warm plates (ie. above 35° F), then:

- 1. Calculate what your compressor run time should be for each box (ie. "zone") based on the information below (see "How long should your system run?" below)
- 2. Adjust the "setpoint" on all controls extremely low so that the system will continue to run and not shut off prematurely. (-30° F for example)
- 3. Use the toggle switches on the control Box to cool only one box at a time (be sure the manual over-ride switch is in the down/off position).
- 4. Turn the compressor on and watch the temperature displayed on the control. Start "timing" when the temperature falls to 32° F (for a refrigerator) and/or 10° F (for a freezer).
- 5. Continue to run the compressor for the correct period of time for that box (as determined from the table).
- 6. After the correct time has elapsed, note the temperature displayed on the control. This is the new "setpoint" setting (Note: on ECM controls is the setting for "normal" mode - "St 1").
- 7. After entering the new "setpoint", determine the correct "differential" setting and enter it. The correct "differential" setting is the difference) between the new "setpoint" temperature and +32° F (0° C) for the refrigerator or +10° F (-12° C for the freezer).

How Long Should Your System Run?
Your system run time is determined by (a) the model of your compressor, (b) the size and quantity of holding plates and, (c) the type of box (ie. refrigerator or freezer). The ambient temperature (heat load) is irrelevant as this only changes the "holdover time" (ie. the time between compressor cycles). Compressor run time is determined individually for each box. To calculate your run time for a particular box:

- 1. Add up the total capacity of the holding plate(s) in the box (be sure to differentiate between refrigerator and freezer capacity).
- 2. Divide the total plate capacity (from #1 above) by the capacity of your compressor unit (again - be sure to differentiate between refrigerator and freezer capacity).
- 3. The resulting number is the total number of hours your compressor will need to run (for minutes, multiply by 60).

Holding Plate and Compressor Unit Capacities

Holding Plate	Ref.	Frz.		Compressor Unit	Ref.	Frz.
#1 (11" x 16")*	1790	1325		Traditional 1/2 hp	3400	2200
#2 (11" x 20")*	2390	1765		MK II	3750	2400
#3 (13" x 24")*	3530	2610		Whisper Jet	5900	3800
#4 (15" x 19")*	3055	2260		Rapid Chill	10250	6600

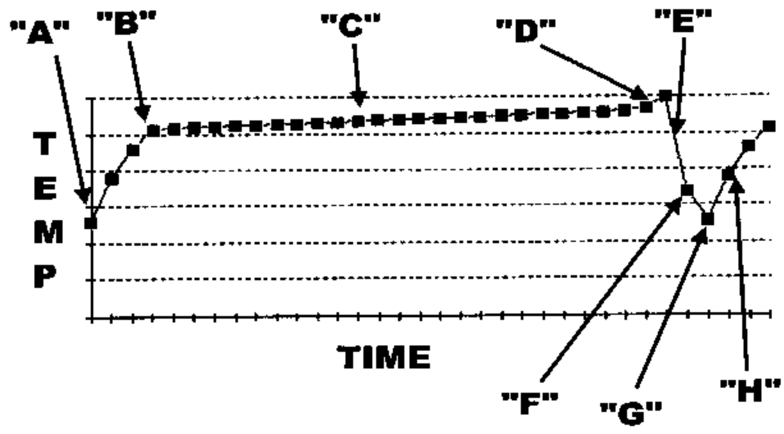
* Holding plate size include the expansion valve.

For example:
To determine how long a MKII compressor should run to freeze down two #3 holding plates in a freezer, add up the total capacity of the holding plates (2610 + 2610 = 5220) and divide the result by the compressor capacity (5220 / 2400 = 2.175). Therefore, the correct sun time for a MKII compressor freezing down two #3 freezer holding plate is 2.175 hours or 2 hours 10 minutes.

Method #2 - Charting The Cycle
For most cruisers the tuning method outlined above will be perfectly adequate. However, for those technically minded individuals who want to delve more deeply into the principles behind "precision tuning", we suggest charting the plate cycle. There is no better way to get a picture of exactly what is going on with the freeze/thaw cycle then to chart it. The easiest way to accomplish this is by using a chart recording thermometer. These machines will draw charts very similar to the ones shown below, allowing you to see exactly the results of your changes. If such a device is not available to you, a diligent individual can get similar results by manually graphing the temperature displayed on the control every 15 minutes.

The following charts are all taken from a single installed system. They demonstrate the charting process and show the results of incorrect settings. The temperatures on the chart begin at the moment the compressor is turned off and cover a complete thaw and re-freeze cycle in 15 minute increments.. *Remember, the actual temperatures are not as important as is the shape of the curve.*

Chart # 1 -
The "Ideal" Chart.



"A"- Compressor OFF - temperature of frozen eutectic solution rises.

"B" - Eutectic point reached - thaw starts.

"C" - Thaw continues - surface temperature rises.

"D" - Eutectic thawed - temperature rise rate increases.

"E" - Compressor turns on - plate surface temperature rapidly drops (little to no eutectic freezing occurs).

"F" - Compressor continues to run - eutectic solution begins to freeze and the rate of temperature change slows down.

"G" - Compressor turns off.

"H" - Surface temperature rapidly rises back to the solution eutectic point.

The Effect Of Mis-Adjustment
The following charts show what happens when the "setpoint" and/or "differential" are incorrectly set.

Chart #2
"Setpoint" Too High

This chart is perhaps the most confusing because the "shape" for the graph is virtually identical to what you would expect from a properly adjusted system. However, the holdover time is very short because the plate was not cooled sufficiently to freeze 100% of the eutectic solution.

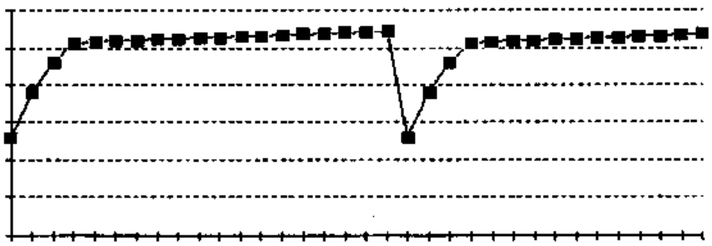


Chart #3
"Setpoint" Too Low

Here the low "setpoint" gives the correct holdover time (compare to Chart #1) but causes the compressor to run for much longer than is required to completely freeze the eutectic solution. The result is excessive energy consumption.

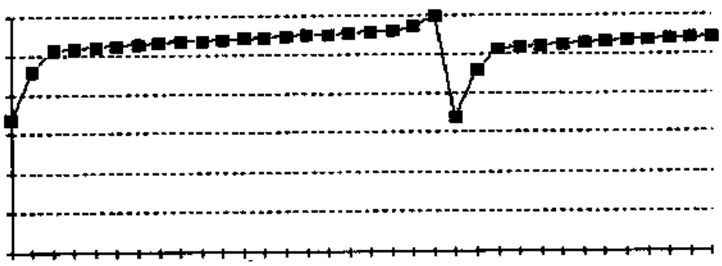


Chart #4
"Differential" Too High

In this chart, the compressor has run the correct period of time (thus providing maximum holdover) and completely frozen the eutectic (ie. "setpoint" is correct). However, the "differential" is too high and permits the plate (and box) to warm up too much.

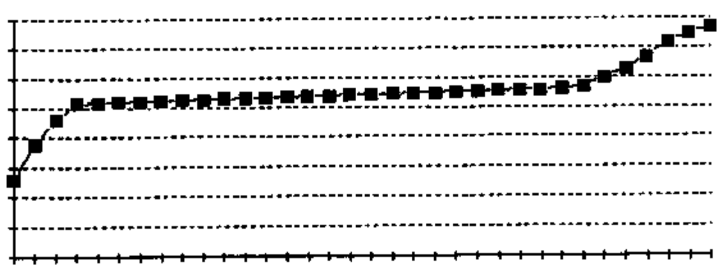
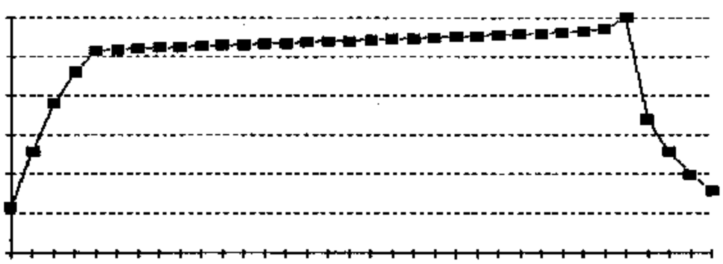


Chart #5"
Differential" Too Low

In this chart the "setpoint" is correct (ie. the eutectic solution is freezing all the way). However, the low "differential" does not permit the solution to thaw completely before the compressor comes back on. The result is a short holdover time..



ECM Controller
The ECM controller replaces the standard thermostat and is very similar in appearance and operation. The difference is that the ECM controller regulates the system operation based on two set of parameters rather than just one. This feature enables the control system to know when the engine and/or generator is running and use the additional power being generated to "top-off" the holding plate without over-cooling it.

The ECM controller recognizes the presence of additional power (ie. a running auxiliary or generator) when a positive DC current is applied to the proper terminal in the Control Box via the key switch or oil pressure switch. *It does not respond to a rise in buss voltage.* Therefore, it is not activated by a shore-power charger, wind generator or solar panels. During normal operation the system is governed by the values programmed in the first set of parameters. When the engine is started, the system begins operating from the second set of parameters.

Programming the ECM is identical to the digital thermostat. However, as you program you will notice that two *"setpoints"* (St1, St 2) and two "differentials" (P 1, P 2) are given rather than one. The first "setpoint" (St 1) and *"differential"* (P 1) are active in the "normal" mode and control the system when the engine (or generator) is not running. The second set of parameters (St 2 and P 2) take over whenever the engine or generator is started and control the system in "engine-drive" mode.

ECM Control Settings
Always set both "setpoints" (St 1 and St 2) to the same value since this determines the ultimate freeze-down temperature which is the same in any mode. Use one of the methods described above for determining the correct setting for "St 1" then simply set "St 2" to the same value.

After determining the correct value for the "P 2" differential setting (again, use one of the above methods), you will want to set the value of the second "differential" (P2) to be several degrees lower than that of the first (P1). By doing so, you will instruct the compressor to start sooner when the engine is running than it does under normal operation. This allows the system to "top off" a partially thawed holding plate whenever the engine or generator is started.

The ECM Status Indicator Light
As the Holding Plate temperature rises, the indicator light will begin blinking with single flashes when the value programmed into the second set of parameters (a lower "differential" setting) is reached. At this point the box is "calling for cooling" and the compressor will activate only if the engine is started. As the plate warms further it eventually reaches the higher values programed into the first set of parameters. The indicator light then begins blinking in double flashes and the compressor activates in normal mode.

Box Temperature Monitor
The standard thermostat and ECM controller come with a single temperature probe and provide a continuous display of the holding plate temperature by which they control the system operation. Either control may be equipped with the optional box temperature monitor. This option provides a second temperature probe which monitors the air temperature of the box in addition to the plate temperature. Digital thermostats and ECM controllers equipped with this option will continuously display the box temperature. The holding plate temperature can be displayed by pressing the down "ARROW" key.

Checking the Oil in Your Compressor
WARNING: The procedure described in this chapter requires a type 608 certification if performed in U.S. territory. Outside the U.S. other restrictions apply.

Unlike an internal combustion engine, your refrigeration compressor does not consume oil. It does, however, distribute the oil throughout the system during the first few hours of operation. Eventually, the oil level of the compressor stabilizes and usually requires no further attention for the life of the system. After installation of a new system it is a good idea to keep an eye on the compressor oil level until you are confident that it is stable. This is particularly true it the ARCTIC AIR air conditioning option is installed. In general, it is recommended that the oil level of newly installed systems be checked at the following intervals:

First Check (all systems) - 4 hours of accumulated compressor run time
Second Check (all systems) - 12 hours of accumulated compressor run time

If additional oil was required at the second check additional checks should be made at 8 hour intervals until no further oil is required.

Note: Recommended Oil for all Compressors is MOBIL EAL ARCTIC 32

Glacier Bay refrigeration systems use three different types of compressors. Each one requires a different method of checking the oil level. Please find the method which is suitable to your system.

FOR MODELS: All Belt-Driven (ie. Traditional), Engine Drive, RAPID-CHILL direct drive.

- 1. Isolate the system charge by closing off the compressor rotolock valves (ie. turn them entirely in - clockwise).
- 2. Remove either one of the oil filler plugs located in the middle on both sides of the compressor.
- 3. Make a "dip stick" (a nylon cable tie works well) to determine the depth of oil in the crankcase.
- 4. Anything greater than 1.25" is fine. If the oil level is BELOW 1.25" add oil directly to the crankcase to a level just below the filler hole (approximately 15 oz.)

You don't need to evacuate the compressor. Just slightly loosen the suction rotolock and purge the air from the crankcase before tightening the fill plug.

FOR MODEL: Whisper Jet

- 1. Isolate the system charge by closing off the compressor rotolock valves (ie. turn them entirely in - clockwise).
- 2. Remove the oil filler/level plug located in the middle of the right side (facing crankshaft) of the compressor.
- 3. Make a "dip stick" (a nylon cable tie works well) to determine how far below the filler plug level the oil is.
- 4. Add sufficient oil to bring it up to plug level if it is more than .25" (1/4") below the plug..

You don't need to evacuate the compressor. Just slightly loosen the suction rotolock and purge the air from the crankcase before tightening the fill plug.

FOR MODELS: MARK II

An oil level sight glass is provided on the right side (as viewed from the crankshaft) of this compressor for convenient inspection. The proper oil level is between the bottom and mid-point of the sight glass when the compressor is not running. The oil level must be visible in the sight glass or it is too low. To add oil:

- 1. Isolate the system charge by closing off the compressor rotolock valves (ie. turn them entirely in - clockwise).
- 2. Remove the oil filler/level plug located in the middle of the right side (facing crankshaft) of the compressor just above the oil level sight glass.
- 4. Add sufficient oil to bring the level up to the mid-point of the sight glass.

You don't need to evacuate the compressor. Just slightly loosen the suction rotolock and purge the air from the crankcase before tightening the fill plug.

After replacing the oil fill plugs, fully open both rotolock valves before starting the compressor.

Topping Off The Refrigerant Charge

WARNING: The procedure described in this chapter requires a type 608 certification if performed in U.S. territory. Outside the U.S. other restrictions apply.

If your system is well-installed and proper procedures are followed during extended shut-downs (see below), your system charge will only rarely need to be "topped up". All "open" type (ie. non-hermetic) compressors, such as that used in your Glacier Bay system inevitably have a low level of refrigerant leakage (a small price to pay for their superior energy efficiency). Therefore, a system which needs to have the refrigerant charge "topped up" once every three to five years would be typical. More often than that and you will want to search your system for a bad solder or flare connection. *Note: Failing to isolate the compressor by shutting the rotolock valves (see "Winterizing and Extended Storage" below) during a system shut-down of 3 or more months will often cause a loss of refrigerant out the front seal of the compressor (see "About The Front Seal")*

Refer to the "Charging The System" (page IM - 24 of the Installation Manual) for instructions on hooking up the gauge set and adding refrigerant to the system.

Does Your System need To Be "Topped Up"

Identifying the correct charge level in your system is done by looking at the "sight glass", NOT by pressure! The pressures (high and low side) will only change if the charge is severely over or under charged. A moderate loss of refrigerant (1-2 lbs) could be seen in the sight glass but would not change the pressures.

Note: If your system incorporates the ARCTIC AIR air conditioning option, only use the sight glass while the holding plates (refrigerator or freezer) are cooling down. The system will often appear "undercharged" (according to the sight glass) when running the air conditioning blowers.

Undercharged System - Your system is undercharged if either (a) flowing refrigerant is visible in the sight glass for more that 10 minutes after the compressor starts running during a normal "pull-down" cycle, or, (b) no refrigerant at all is visible in the sight glass (ie "100% empty" - this only applies if absolutely no cooling is taking place).

Correctly Charged System - Your system is correctly charged if (a) flowing refrigerant is visible in the sight glass less than 10 minutes after the compressor starts running then "clears" (ie completely fills up) during a normal "pull-down" cycle, or, (b) no refrigerant at all is visible in the sight glass at any time while the compressor is running (ie "100% full" - this only applies if the system IS NOT tripping the high-pressure cut-out switch - otherwise see "overcharged").

Overcharged System - Your system is overcharged if no refrigerant at all is visible in the sight glass at any time while the compressor is running (ie "100% full") and the system IS tripping the high-pressure cut-out switch.

Note: Always use a flashlight when looking at the sight glass. Flowing refrigerant is clear in color and can be very hard to see. A 100% "full" and 100% "empty" sight glass looks identical - even to professionals. If no refrigerant can be seen flowing through the sight glass (ie. completely clear) and there is any cooling at all occurring, then the glass is 100% "full".

Winterizing And Extended Storage

To ensure a trouble-free startup in the Spring, two special precautions should be taken whenever shutting your system down for the winter or any period exceeding 3 months. These are:

Prepare the cooling water circuit

Thoroughly drain any cooling water remaining in the water pump and the condenser. This is often most easily accomplished by shutting off the sea cock(s) and removing the hose from the pump and the bottom of the condenser. If possible, it is also a good idea to rinse the entire water circuit out with fresh water. This is also a good time to clean the condenser and inspect the zinc.

Isolate the Refrigerant Charge

TURN THE MAIN CIRCUIT BREAKER OFF. Tightly close (ie. "front seat") both compressor rotolock valves. The idea here it to isolate the refrigerant charge into various portions of the system to prevent total loss of the refrigerant in the event of a leak. Such leaks may often occur at the compressor crankshaft seal when the system is not run for several months. *Be sure to put a RED LABEL on the main circuit breaker to remind everyone that the valves MUST be open prior to starting the compressor. Failure to open the valves before starting the compressor can cause serious damage to the internal compressor valves and connecting rods*.

Routine Maintenance

Although your Glacier Bay system does not require much maintenance, there are a few things you can do to help ensure a long and trouble-free life.

Defrosting

The holding plate on your system will naturally and unavoidably accumulate frost. How often they will need to be defrosted depends on many factors but particularly the quality of your door/lid seals. While some installations may go for six months between defrost cycles, others will need to defrost every two weeks. Chances are you will be somewhere in between. You will know you need to defrost when (a) the air temperature in the box rises unacceptably, or, (b) there's no longer any room left for food. Contrary to popular belief, frost buildup does not cause a holding plate system to use more energy. If fact, the reverse it true. However, the air temperature in the box will rise as the frost thickness increases. This is because the frost has an insulating effect and prevents heat from being absorbed into the holding plate. Defrosting of the holding plates can be expedited by:

- Scraping with a *plastic* scraper
- Pouring on hot water
- Blowing with a hair dryer or heat gun

Do not use metal tools to scrape or chip ice from the plate.

Condenser - Cleaning

One of the many unique features of your Glacier Bay system is the ability to remove the condenser end caps to facilitate cleaning and demineralization. How often such cleaning is necessary depends on the temperature and mineral content of the cooling water as well as the type of cooling duty (ie. refrigerator, freezer or air conditioning). As mineral deposits build inside the condenser, heat exchange with the passing water becomes more difficult. The result is a high head (ie. discharge) pressure and reduced efficiency. It is a good idea to remove the ends caps and inspect annually. To clean the condenser:

- Remove the upper end cap by loosening the hose clamp and sliding it off.
- Remove the zinc.
- Pass a 3/16" wooden dowel rod, tube brush or length of copper tubing through each water passage tube. Do not use steel rod or wire at this can damage the water passage tube.
- Minerals scraped from the inside of the tubing will fall into the bottom cap and be rinsed through when the pump is activated.
- Replace end cap and tighten the hose clamp.

Condenser - Zinc

As an added protection against corrosion, the condenser incorporates a sacrificial zinc anode. As with other zincs on the vessel, the life expectancy of this anode depends on the amount and intensity of stray electrical currents in the area. It is recommended that the zinc be inspected every six months until experience is gained. The zinc is of the "pencil type" with a length of 2" and a diameter of 1/2". The holder plug diameter is a 3/8" pipe thread. These are a standard zinc size and are available from most marine suppliers or directly from Glacier Bay.

Adjusting the Drive Belt (Traditional)
All "Traditional" Glacier Bay models use a cogged belt drive. These belts typically stretch less and require less frequent adjusting than do common "V" belts. New systems usually require an initial re-adjustment after 30 - 40 hours of operation. The need for tensioning becomes apparent with an increase in the noise level. An easy way to check for correct tensioning is, with the compressor running, to apply downward pressure to the middle of the drive belt with the handle-end of a screwdriver. If the belt noise is reduced when pressure is applied, the belt is too loose and should be tightened.

To tension the belt:

- 1. Loosen the four bolts which hold the motor down.
- 2. Slide the motor outward as far as possible.
- 3. Sight down from the top to ensure that the motor shaft is parallel with the compressor crankshaft (and the edge of the base plate).
- 4. Tighten the outer (ie. furthest from the compressor) and rear-most nut.
- 5. Use a large (1"+) open end wrench to lever between the compressor and motor base. Do not try to lever on the motor body as you will not be able to get the belt tight enough.
- 6. While maintaining tension with the wrench, tighten the front outer nut.
- 7. Remove the wrench and tighten the remaining nuts.
- 8. Re-check motor alignment and belt tension.

Replacing the Coupling Pad (Direct-drive)
All Glacier Bay direct-drive models utilize a special coupling to connect the motor to the compressor shaft. This drive coupling incorporates an elastomeric "pad" which cushions and isolates the pulsating compressor shaft rotation from that of the motor. These pads are quite long-lived but, eventually, may need to be replaced. It would become apparent that replacement were required if the coupling were to become noisy. To replace the coupling pad:

1. Unbolt the coupling guard from the base plate.
2. Unbolt the motor from the base plate.
3. Pull the motor straight back and away.
4. Remove the elastomeric pad from its coupling half.
5. Line up the four coupling "pins" with the holes in the new pad and slide the motor back into place.
6. Very carefully align the motor shaft with the compressor crankshaft.*
7. Replace and tighten the motor mounting bolts.

** Note: Careful realignment of the motor and compressor critically effect the life of the new coupling pad. The maximum permissible misalignment is 1.5° (one point five degrees).*

Maintenance Schedule

1 Week

1. Check compressor oil level.
2. Check system refrigerant charge.
3. Examine connections for signs of leaking (ie. presence of oil).

1 Month

1. Check compressor oil level.
2. Check system refrigerant charge.
3. Tighten all high-current wire connections.
4. Check drive-belt tension (Traditional only).
5. Clean sea strainer.
6. Examine connections for signs of leaking (ie. presence of oil).

6 Months

1. Check compressor oil level.
2. Check system refrigerant charge.
3. Tighten all high-current wire connections.
4. Check condenser zinc.
5. Clean sea strainer.
6. Examine connections for signs of leaking (ie. presence of oil).

Annually

1. Check system refrigerant charge.
2. Tighten all high-current wire connections.
3. Check condenser zinc.
4. Clean condenser.
5. Check drive-belt tension (Traditional systems only).
6. Replace coupling pad (Direct-Coupled systems only).
7. Check motor brushes (DC systems only).
8. Clean sea strainer (as needed).
9. Examine connections for signs of leaking (ie. presence of oil).

Additional Standard Thermostat and ECM Control Settings

The Glacier Bay digital controls offer many hundreds of programming options, the vast majority of which have no application in any particular system. Generally, it is only the "setpoint" and differential" setting (previously described) that the system operator needs to be familiar with. While they may not be required, the following pages offer a description of how to modify other, less often used, control settings.

To access these settings, one must first force the control into a "Special Programming Mode". To enter this mode and re-program individual parameters:

- Press "PRG" and "SEL" simultaneously until "0" appears (it will start flashing).
- Use the "ARROW" keys to scroll to "77".
- Press "SEL". "C 0" will now appear and begin flashing.
- Use the "ARROW" keys to scroll to the desired parameter (as identified below).
- When the parameter is displayed, press "SEL" to show the currently programmed setting.
- Use the "ARROW" keys to alter the parameter setting.
- Press "SEL" first, then "PRG" to retain the new setting.

Parameter "C 13" - Probe Display (Default = "0" with one Probe, "1" w/optional Box Probe)

For use only when the optional box temperature probe is added, select either "0" to display the Plate Probe or, "1" to display the box probe. In both cases, pressing the down "ARROW" key displays the other probe value.

Parameter "P 14" - Calibration Offset (Default ="0.0")

Introduces an error offset to the temperature probe.

Parameter "C 17" - Probe response time (Default = "5")

Changes probe response time for noise filtering

Parameter "C 18" - Display Units ⁰C or ⁰F (Default = "1")

Changes units to degrees Centigrade ("0") or Fahrenheit ("1"). Don't forget, the "setpoint" and differential" values must also be programmed appropriately.

Parameter "P 25" - Low Alarm Limit (Default = "-50")

An audible alarm is sounded if the temperature falls to this limit.

Parameter "P 26" - High Alarm Limit (Default = "90")

An audible alarm sounds if the temperature rises to this limit.

Parameter "P 27"- Alarm Hysteresis (Default = "2")

Audible alarm hysteresis (differential).

Parameter "P 28" - Alarm Delay (Default = "60 min.")

Time at the alarm limit before the audible alarm is sounded.

Re-programming to Factory Default Settings

Occasionally, it becomes desirable to completely reset the controls to their factory defaults and start your tuning from a "clean slate". This might be the case if someone unfamiliar with the correct programming procedure has been changing settings at random. Because of the large number of settings which could have potentially been changed, it is likely to be easier to re-set everything to known values and then change only what you need.

Re-programming the controls is a three-step process. The first step is to "clear the settings", the second step is to "set the mode" and the third step is to "program in values" to particular parameters. The first step - "clearing the settings" - is the same for all Glacier Bay thermostats and ECM controllers. To clear the settings:

- Turn off the power to the control (display goes dark).
- Turn on power to the control while holding down "PRG".

Your control settings will now be clear. The temperature will be displayed in ^{0}C but the control will not function properly. The next step is to "set the mode". The procedure for this step is the same for all controls but the numbers are different. To set the mode:

- With power on to the control (display illuminated), press "PRG" and "SEL" simultaneously until "0" is displayed (it will start flashing).
- Use the ARROW" keys to scroll to "22".
- Press "SEL" (The display should now show "C 0").
- Press "SEL" to show the currently programmed setting.
- Use the "ARROW" keys to alter the parameter setting. (set to "9" for ECM controllers, set to "1" for all standard refrigerator/freezer thermostats and ARCTIC AIR thermostats).
- Press "SEL" first, then "PRG" to retain the new setting.
- Turn off the power to the control (very important).

Turn the power back on to the control. The "mode" is now correctly set.

For standard refrigerator/freezer thermostats or ARCTIC AIR thermostats - use the procedure described under the above section, "Additional Standard Thermostat and ECM Control Settings" to:

- Change "C 18" from "0" to "1" (if you want your control to display the temperature in ^{0}F rather than ^{0}C.).
- Change "C 13" from "0" to "1" (only if you have the optional box temperature probe connected).

Use the procedures described on page OM - 5 of the "Operation Manual" to set the appropriate "setpoint" and "differential".

For ECM thermostats - use the procedure described under the above section, "Additional Standard Thermostat and ECM Control Settings" to:

- Change "C 18" from "0" to "1" (if you want your control to display the temperature in ^{0}F rather than ^{0}C.).
- Change "C 13" from "0" to "1" (only if you have the optional box temperature probe connected).
- Change "C 33" to "1" (parameter MUST be "1").
- Change "C 36" to "100" (parameter MUST be "100").
- Change "C 37" to "-100" (parameter MUST be "-100").

Use the procedures described on page OM - 5 of the "Operation Manual" to set the appropriate "setpoint" and "differential".

Control Error Codes

There are five possible error codes which will be displayed to indicate specific FAULT conditions. They are:

"Er0" - The primary temperature probe (ie. plate probe) has either a "short" or "open" circuit. Check the wiring. The temperature probe should read 10k ohms @ 25^0 C (77^0 F).

"Er1" - Same as "Er0" except it applies to the secondary temperature probe (ie. box probe) if it is attached. Otherwise, same as "Er0".

"Er2" - Memory Error. Follow the procedures outlined in "Re-programming to Factory Default Settings" (Page OM -16 and OM - 17) of the Operation Manual. If this does not resolve the problem the control must be replaced.

"Er4" - High alarm. Audible alarm sounds. The temperature has exceeded the value set in parameter "P 26" for a period of time exceeding the value of "P 28".

"Er5" - Low alarm. Audible alarm sounds. The temperature has fallen below the value set in parameter "P 25" for a period of time exceeding the value of "P 28".