



OPERATION & INSTALLATION
INSTRUCTIONS

COOL FISH
ENGINE DRIVE CHILLER SYSTEM

C.F. HORTON & CO., INC.
603-868-5720

PLANT LOCATION AND MAIL

148 Old Concord Turnpike
BARRINGTON, NH 03825

USA

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US Patent #4,356,708

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PRODUCT DESCRIPTION

Start up warning

Refrigerated Sea Water (RSW)

The Engine Drive RSW Chiller is a water-cooled refrigeration system that chills circulated sea water from an insulated catch storage tank. A belt driven water pump or electric pump must be operating whenever the Engine Drive Chiller compressor is running. This pump pumps through the condenser and then overboard. Water flow should be observed before operation of the system. If no water is flowing and the engine is running with the system switched on the compressor will stop. Check the water system, pump and sea strainer. The re-set switch for the loss of water (or overcharge) is mounted on the chiller barrel. The re-set button is a soft red button on a green housing next to the low pressure control.

If water is flowing and the compressor switches out after several minutes of operation the low pressure cut out may be operating indicating that the circulation pump on the circulated water side is not on or there is little cooling demand. The low pressure switch will automatically re-set after a few moments. This switch can be adjusted to prevent ice buildup in the barrel.

OPERATION

With 12 (or 24) volts DC switched on to the system, the compressor clutch will engage and cooling will begin. If the system is turned on when the engine is off, the compressor clutch will engage, but no cooling will take place. Normal operating current will be drawn from the battery. The compressor clutch will draw 3 to 3.5 amps per hour at 12 volts 1.5 to 2 amps per hour at 24 volts. (The clutch circuit should be activated when the electric cooling pump is switched on if so fitted.)

ROUTINE INSPECTION:

~ CHECK THE WATER INTAKE STRAINER.

~ CHECK THE REFRIGERANT CHARGE. (SEE CHECKING THE CHARGE SECTION OF THIS MANUAL).

~ ROUTINELY CHECK BELT TENSION ON THE COMPRESSOR AND WATER PUMP (If belt driven is used.)

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INSTALLATION

Installer's care should be stressed. No matter how good SEA FROST equipment is, its performance and life are in the hands of the installer. To insure your work:

1. Read this manual.
2. Reread any aspect you don't understand.
3. Follow Swagelok fitting instructions carefully.
4. Install the RFD last and the same day the system is charged.
5. Spend enough time leak-checking to be sure there are no leaks.
6. Thanks from all of us who have to guarantee your work.

There are two contaminants that will give you problems in a refrigeration system. They are WATER and DIRT. Moisture in the air is always present and cannot be eliminated; water in this case refers to puddles and drops. Dirt is any solid. The installer's habits will be most important in ensuring a trouble-free start-up. We have added a large receiver filter drier (RFD) to trap all dirt and moisture that might get into the system during a careful installation. Moisture in the system is boiled off when the system is evacuated, or it is captured in the desiccant. There is a screen in the expansion valve to prevent dirt from plugging it.

Excess moisture that the RFD can't handle will plug the expansion valve with ice. This ice stops the cycle. The only cure is to discharge the refrigerant, replace the RFD, re-evacuate the system, and recharge it. This remedy takes time and is somewhat costly. Keep the system clean and dry!

TUBE HANDLING

Installation is quite simple. All the copper tube comes to you with the ends capped. Any routing of the tubing must be done with the tube either taped or capped. Cap both tube ends after each cut. (Spare caps have been included).

Work with only one line at a time, and uncap only one end at a time.

TUBE CUTTING

Use only a tube cutter; hacksawing or any other method will introduce chips to the system and also distort the tube, making connections difficult and leak-prone. A miniature cutter is essential for this work. CUT SLOWLY to avoid a ridge on the inside of the tube. We do not recommend reaming or dressing the cut, as it is very easy to get chips of copper in the system that will cause trouble.

TUBE BENDING

Make all but the long sweep bends with a spring bender; one kink and the line must be re-run. Don't add any more fittings than are absolutely necessary. Route all the lines in such a way that they are most direct but out of the way. Always leave several inches of straight undistorted tubing leading to all Swagelok fittings to allow proper connection. Again, keep everything sealed until you are ready to make that connection.

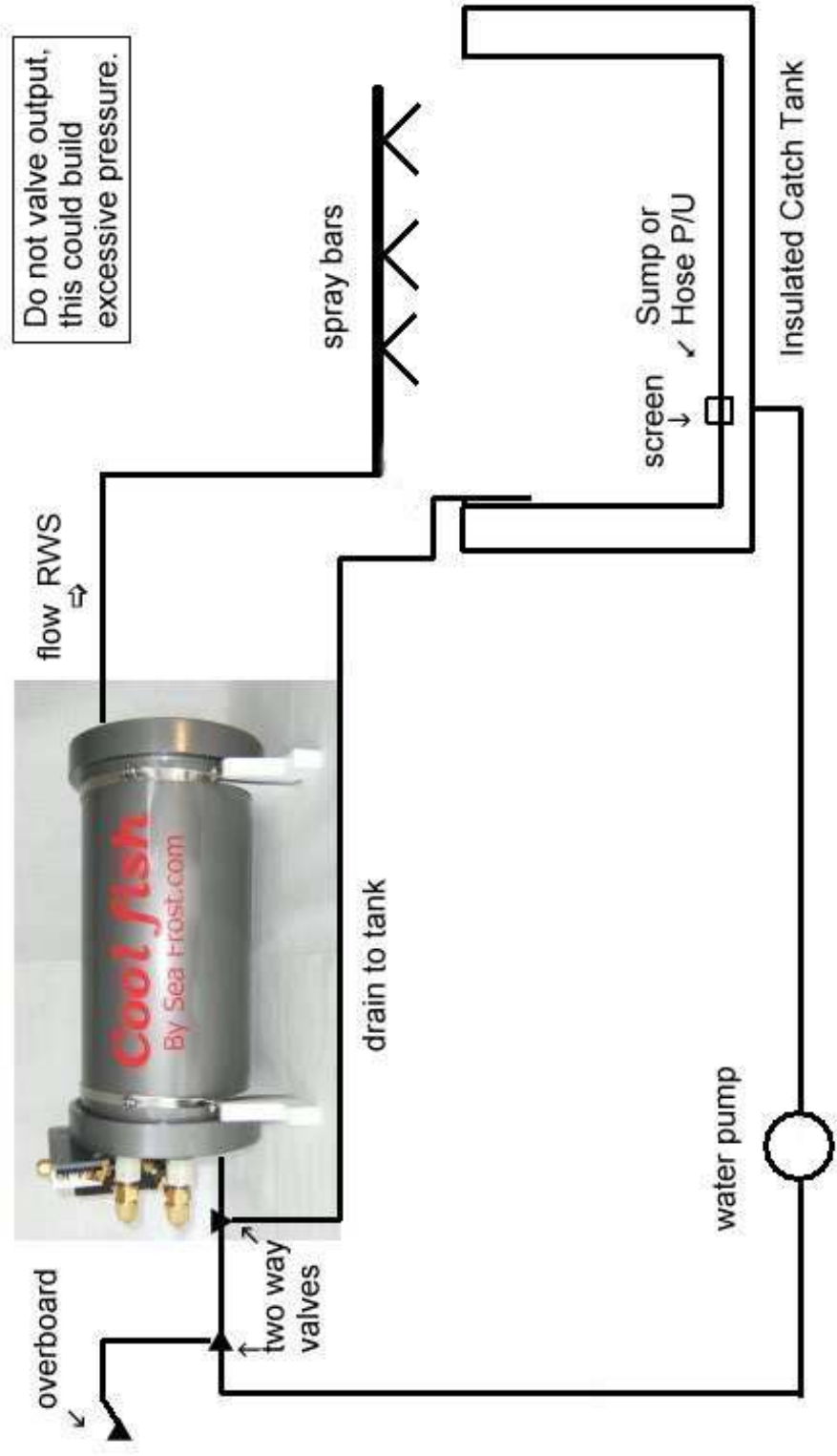
FIT RFD LAST

The RFD (receiver, filter, drier) and condenser assembly should be the last component to be opened and fitted; the day the system is charged.

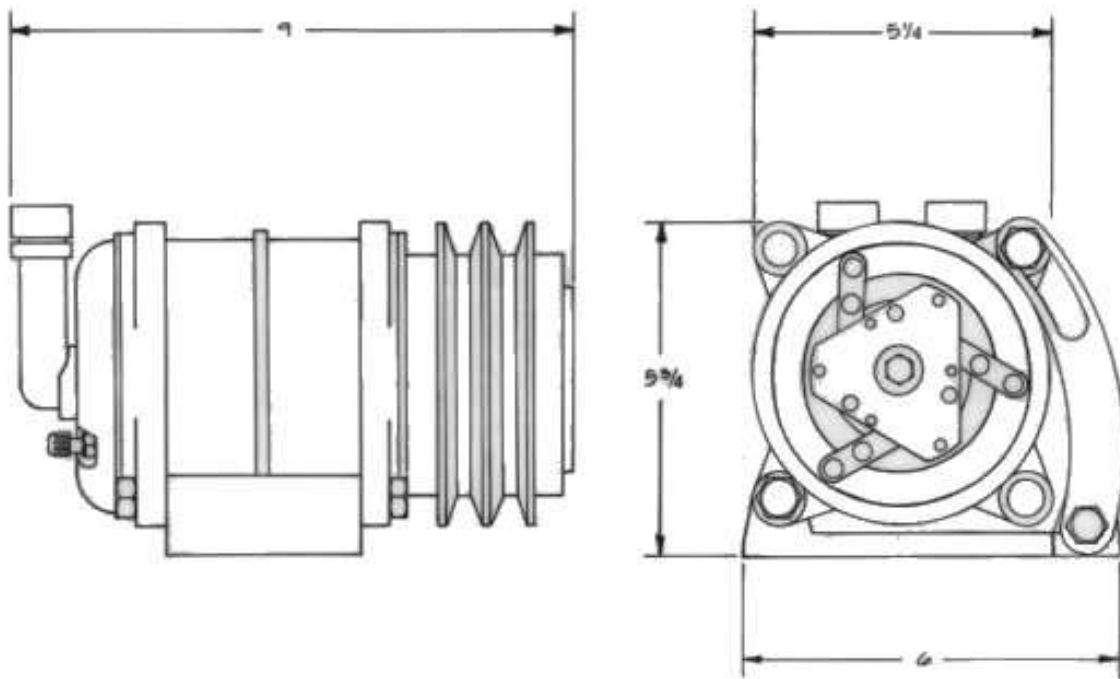
INSTALLING THE CHILLED WATER ASSEMBLY

Mount the chilled water assembly horizontally. The brine (fluid to be chilled) inlet connection is at the bottom. The chilled output is at the top. This displaces the air that could be trapped in the barrel. Water fittings may be reduced as long as flow rates are maintained. The RSW pump should be protected from fish parts and debris by a screen. RSW can be dumped back into the tank with one outlet or dispersed anyway desired. If spray bars are used the spray bar jets should be cleanable. (RSW will foam with organic material in it. This makes a cool blanket over the catch.) A valve should be fitted before the inlet to the barrel to allow the catch tank to be pumped overboard and cleaned etc. If the circulation pump is centrifugal the Cool fish barrel will drain when the pump stops provided it is installed above the tank. A drain valve back to the tank can be fitted on impellor pump systems. Do not fit a shut off valve on the outflow of the barrel. Do not exceed 10 PSI maximum pressure for the barrel.

Refrigerated Sea Water Circuit



THE COMPRESSOR



FITTING THE COMPRESSOR TO THE BASE BRACKET

WARNING: FAILURE TO FOLLOW THESE DIRECTIONS WILL CAUSE IRREPARABLE DAMAGE TO THE COMPRESSOR AND VOID ANY CLAIMS.

The compressor base has been matched to the compressor before shipment. If the parts have been miss-matched, the compressor base bracket might need to be lightly filed or sanded to properly fit between the mounting "ears" of the compressor. It must be a perfect fit with no force required to slide the bracket onto the compressor and yet have **zero clearance** between the two parts. Forcing the compressor on to the bracket will spread the ears cracking the compressor case. Extra space will allow the hinge bolt to work and if tightened, break the compressor ears.

In determining the compressor location for custom brackets and off engine mounting of the compressor consider all of the following:

COMPRESSOR POSTURE

❖ When mounted, the compressor **must not lay over more than 45 degrees from vertical**. The port fittings, the clutch coil wire, and the ground screw indicate the top of the compressor.

- ❖ Allow clearance for the compressor hose assemblies and belt adjustment if the compressor is mounted under the engine.
- ❖ An optional low profile head is available that requires little top clearance and allows the hoses to exit straight back.
- ❖ We recommend that the compressor be driven by it's own belt.
- ❖ A single hi-power "A" belt is all that is required to drive the compressor.
- ❖ The compressor should be driven by a pulley 5 to 7 inches in diameter. The compressor speed ratio should not exceed the crankshaft speed of the engine. This ratio will give proper cooling at a fast idle and also allow operation at cruising RPM's.
- ❖ The compressor will draw up to five horsepower. It should be ruggedly bolted.
- ❖ The extra pulley on the compressor may be used to drive a pump or alternator.
- ❖ The compressor may be mounted to a fabricated bracket that is bolted to the engine.
- ❖ A jackshaft may be used to drive the compressor.
- ❖ The compressor may rotate in either direction.

COMPRESSOR BELTS

Various belts are available with an "A" section (1/2"). Specify a high power belt. Fractional horsepower belts will stretch and wear rapidly. Cogged belts and Kevlar strand reinforced belts are available but not essential.

Belt length is measured on the back edge of a belt. An easy way to get a belt size is to wrap masking tape around the pulleys with the compressor in the loose position. Break the tape in one place and peel it off. Measure the tape to get the belt length. When the belt size is determined record the brand and part number. Each belt manufacture has a different sizing.

CONDENSER / RECEIVER FILTER DRYER (RFD)

- ❖ Install the condenser close to the water pump and the compressor.
- ❖ Mount the CONDENSER / RFD assembly component to a suitable platform.

- ❖ Water should enter the lower 5/8" tube and exit overboard above the waterline from the upper one.
- ❖ THE RFD IS FITTED WITH A SIGHT GLASS. THIS GLASS MUST BE VISIBLE FOR CHARGING AND SERVICING THE SYSTEM. It can be viewed from the top at up to a 45-degree angle but not from the bottom or side. Be sure the sight glass is easily visible!
- ❖ The CONDENSER / RFD should be connected only after all the lines are run and all other fittings are made. See below.

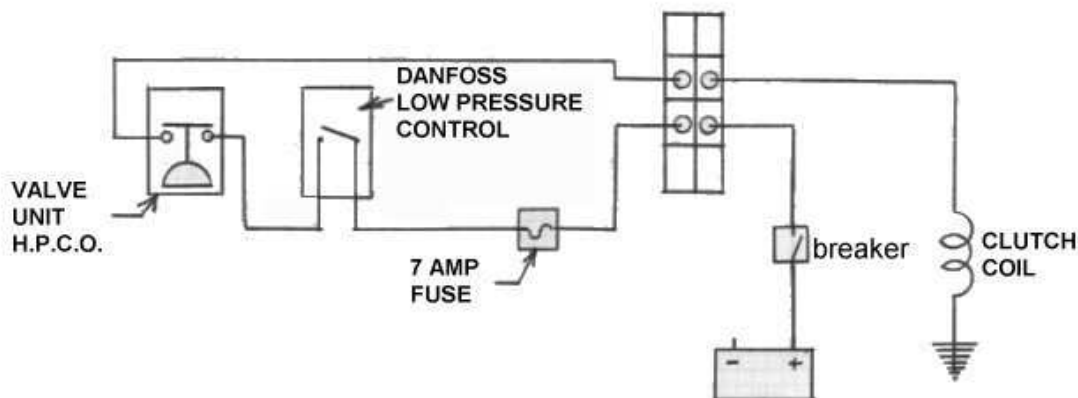
DO NOT OPEN THE RFD UNTIL ALL THE OTHER CONNECTIONS HAVE BEEN MADE AND YOU ARE READY TO COMMISSION THE SYSTEM.

Because the RFD contains desiccant to absorb moisture and the absorption is limited, it is important to make the connections after all other connections are made. Leaving the RFD installed on a partially open system may reduce its capacity by allowing it to absorb moisture in free air before the system is sealed. See "Work Habits."

DC WIRING (12 or 24 Volt Systems)

Battery power should be protected with a circuit breaker within 30 inches of the wire connection to the battery power. If the system is using an electric water pump for the cooling water to the condenser the pump and the compressor should be on the same breaker. Size the wire and breaker for the pump load plus the compressor clutch load.

Compressor Control Wiring



NOTES ON SWAGelok FITTINGS

Swagelok fittings come to you completely assembled, finger-tight. (Pieces a,b, and c in Drawing #1 are already together). They are ready for immediate use.

Disassembly before use can result in dirt and foreign material getting into the fitting and causing leaks. If disassembly is necessary, reassemble per drawing.

This is a double ferrule system. The most serious installation problem encountered with SEA FROST is the incorrect assembly of these fittings. Be absolutely sure that you assemble all fittings as in Drawing #1.

To ease assembly slacken the fitting nut slightly before assembly. Then re tighten with fingers before tightening with a wrench. (This is to avoid cross threading.)

Step 1. Always leave two inches of straight, undistorted tubing leading to all Swagelok fittings to allow proper connection.

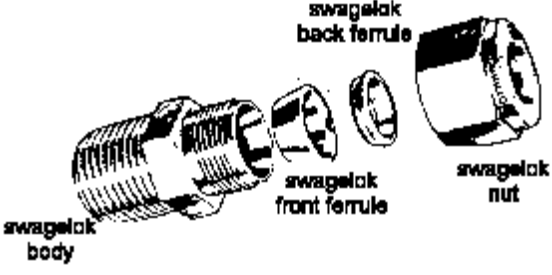
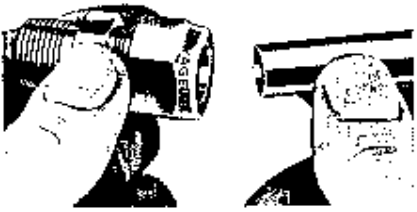
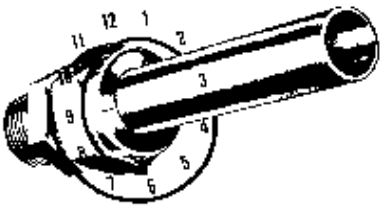
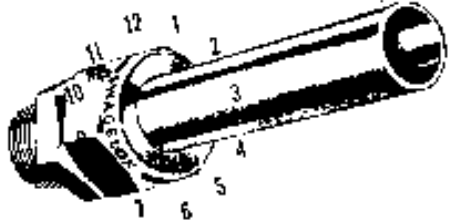
Step 2. Prior to inserting 1/2" tubing into the Swagelok tube fitting, make a pencil mark 1" from end of tube. Prior to inserting 3/8" tubing, make a pencil mark 3/4" from the end of the tube. With 1/4" tubing make a mark 5/8" from the end.

Step 3. Insert clean, smooth tubing with the pencil mark into the Swagelok tube fitting. You can be sure the tube is resting firmly on the shoulder of the fitting when the pencil mark is flush with the nut. This mark will also indicate that the tube has not moved before tightening. (As the fitting is tightened the space from the pencil mark to the shoulder will increase.)

Step 4. Tighten the Swagelok nut to a wrench snug* position. Scribe the nut with a pencil at the 6:00 o'clock position (see drawing #1, step # 2).

* Wrench snug is the first point in the assembly tightening when the tube cannot be pulled from the fitting, (i.e. when the ferrules tighten enough to contact the tubing).

Step 5. Now, while holding the fitting body with a back-up wrench, tighten the nut one-and-one-quarter turns ($1+1/4$). To do so, watch the scribe mark, make one complete revolution, and continue to the 9:00 o'clock position. (See drawing #1, step #3).

<p>DRAWING 1</p>	
	<p>STEP 1</p> <p>Simply insert the tubing into the SWAGELOK tube fitting. Make sure that the tubing rest firmly on the shoulder of the fitting and that the nut is wrench snug.</p>
<p>STEP 2</p> <p>Before tightening the SWAGELOK nut, scribe the nut at the six o'clock position.</p>	
	<p>STEP 3</p> <p>Now, while holding the fitting body steady with a backup wrench, tighten the nut 1 1/4 turns. Watch the scribe mark, make one complete revolution and continue to the 9 o'clock position. By scribing the nut at the 6 o'clock position as it appears to you, there will be no doubt as to the starting position. When tightened 1 1/4 turns to the 9 o'clock position you can easily see that the fitting has been properly installed.</p>

SWAGELOK FITTINGS ARE TO BE TIGHTENED TO A TORQUE SPEC, NOT INFINITE TIGHTNESS. BE SURE YOUR STARTING POINT IS WRENCH SNUG. A DISTORTED TUBE MIGHT GIVE A FALSE STARTING POINT.

* When making all connections, USE TWO WRENCHES. Don't allow the fittings to turn or twist when tightening.

RECONNECTING PRE-SWAGED FITTINGS

Connections can be disconnected and re tightened many times.

When reconnecting, insert the tubing with pre-swaged ferrules into the fitting until the front ferrule seats in the fitting. Tighten the nut by hand. After tightening to wrench snug, rotate the nut about one-quarter turn with a wrench.

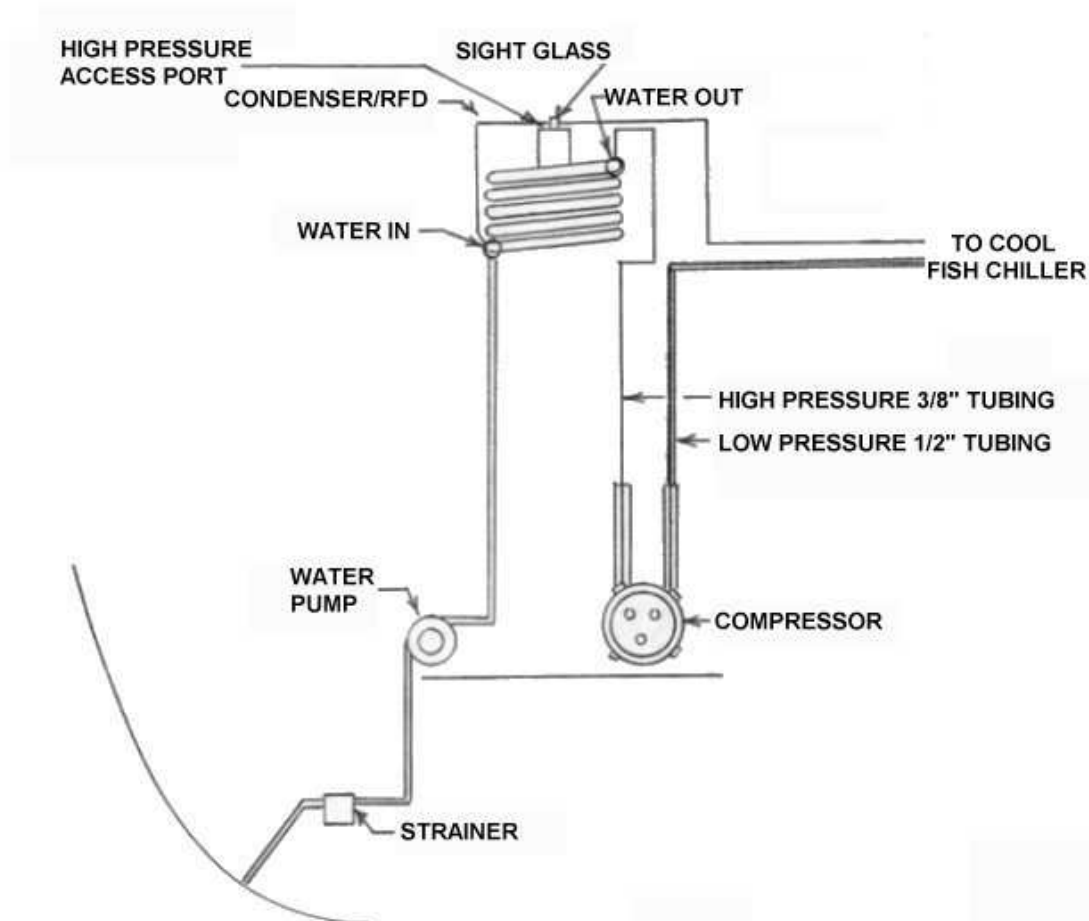
A port connector fitting as is on the condenser is considered pre-swaged.

SWAGELOK PERFORMANCE

Swagelok fittings have built-in spring interaction between the ferrules. This compensates for temperature changes and allows the fittings to be reconnected many times. As the fitting is tightened, a burnishing occurs between the body of the fitting and the ferrules and between the ferrules and the tube. This action provides the tightest connection available.

RUNNING THE LINES

See the schematic diagram. Prior to making up connections see "Swagelok Fittings" and "Hose-to-compressor Fittings" texts.



PLANNING

- 1) The hose assemblies connecting the compressor to the copper tubing allow for movement of the compressor after installation to enable work on and around the engine without having to disconnect the system. Leave some slack in the hoses and have both hoses directed the same way to allow compressor movement as necessary for access to anticipated repair areas.
- 2) Keep tube runs as short as possible. The suction (return) line should be as direct as possible with a minimum number of bends.

3) Helpful tools.

~ Coil spring-type tube benders are available for 3/8"-1/2" O.D. tube. These springs are slid over the tube. The bend is formed in the spring, and then the spring is removed by unscrewing.

~ Mini tube cutter: "IMP" by Gould Imperial requires less than 1 1/2" radius clearance for the cut.

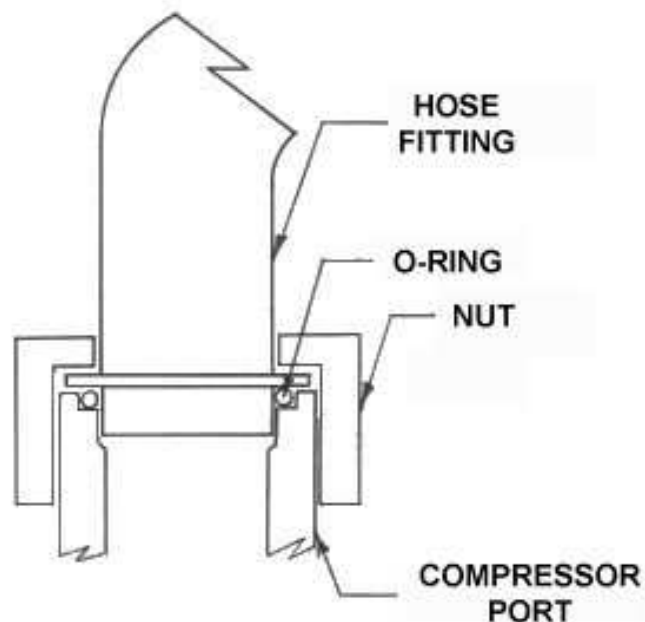
LINE CONNECTION PLAN

The compressor hose with the smaller elbow fitting, attaches to the discharge side of the compressor. The other end of the hose has a 3/8" Swagelok fitting. A 3/8" tube goes from the hose to the top of the condenser. From the RFD, 1/4" tube goes to V/U on the chiller assembly. The return line from the V/U 1/2" tube returns to the Swagelok-to-hose fitting. The compressor hose then returns to the compressor.

HOSE TO COMPRESSOR FITTINGS

REMOVE THE PLASTIC CAPS FROM COMPRESSOR PORTS.

To install a tube "O" ring fitting on the compressor, inspect the hose ends to be sure they are clean and free from burrs. Apply a drop of oil to the backside of the nut. This will lubricate the nut to allow proper tightening. Install the proper "O" ring on the hose fitting. Uncap the compressor port, removing the nylon cap and rubber insert plug. Insert the correct fitting in the compressor port. Tighten the nut wrench snug. Using a back up wrench on the compressor port, tighten one quarter of a turn more. This fitting should feel tighter than a SWAGELOK. The elbow should not rotate when tightening is complete.



INSULATING THE ½" RETURN LINE

Insulating should be the last step after leak testing because it will cover fittings that must be leak-checked. On long uninterrupted lengths of tubing the insulation can be slipped over the tube before attaching Swagelok fittings. Insulation should be installed only on dry lines.

The suction return line is cold and will attract moisture (as frost) when running. The suction return line includes all the exposed 1/2" tubing and the larger fittings and hose. The 1/4" line can be bundled with the 1/2" line if they run together.

INSTALL THE INSULATION IN A MANNER THAT WILL NOT TRAP WATER AROUND A LOW POINT. Trapping salty bilge water in the insulation will reduce the operating life of tubing and fittings. If the insulation is split and wrapped over the tube, install it with the split side down.

Closed cell foam is provided to insert the tube into, or to split and wrap onto the tubes that are impossible to feed into the insulation. The foam wrap should be taped with vinyl electrician's tape.

TIE WRAPS

Tie wraps should be used to support the wiring, tubing, and insulation. Do not crush the insulation, as it will sweat where it is compressed.

DISPLACING OIL IN NEWLY INSTALLED COMPRESSOR

The compressor is shipped with the proper amount of oil for the system. **THE OIL MUST BE DISPLACED FROM THE CYLINDERS BEFORE THE COMPRESSOR MAY BE TURNED BY THE BOAT'S ENGINE.** After completing all the connections, turn the outer face of the compressor drive disk for at least five turns by hand.

ASSEMBLY INSPECTION CHECK LIST

- [] 1. Check the lines to be sure they are properly routed. Check to see that the compressor discharge connects to the top of the condenser and the water line enters the bottom.
- [] 2. Check that the RFD sight glass can be seen.
- [] 3. Check **all** the connections with wrenches to be sure they have been made up. Refresh your knowledge by re-reading the Swagelok instructions.
- [] 4. Check the pulley and compressor bolts for tightness.
- [] 5. Check to make sure the compressor is mounted in an upright position.
- [] 6. Check the panel wiring by engaging the switch. The compressor clutch should click.
- [] 7. Check the neatness of the installation; sufficient service access; secure wiring, tubing, and hoses supported to prevent damage and chafing.
- [] 8. Check the service access. The service access ports must allow attachment of the gauge hoses.
- [] 9. Check (after leak checking and testing) that the return line is properly insulated.
- [] 10. Spin the compressor drive disk to displace oil from the compressor cylinders. See: Displacing the Compressor oil.

REFRIGERANT HANDLING AND SAFETY

Do not proceed with any aspect of a procedure if you do not fully understand the procedure and know what results to expect. Understand fully that pressure exists in refrigeration systems. Be careful.

REFRIGERANT

SEA FROST is charged with REFRIGERANT-404a. R-404a is a chemical compound of three refrigerants, HFC-125, HFC-143a, HFC-134a. It is almost odorless. Its boiling point is -50 degrees F. at sea level. R-404a is heavier than air and its label and container color is orange. It must be charged as liquid to avoid separating the blend, fractionating.

GENERAL SAFETY THIS IS IMPORTANT. READ THIS!

R-404a is safe if handled properly. Avoid breathing vapors and prolonged skin exposure. Avoid using in areas of open flames. The vapor is heavier than air and may reduce oxygen available for breathing. Use with sufficient ventilation to keep exposure below recommended limits. Liquid R-404a will freeze skin. It's especially dangerous to the irreparable tissues of the eyes.

--WEAR EYE PROTECTION--

Do not pressurize an empty system with R-404a without first evacuating the system with a vacuum pump.

DANGER! NEVER OPERATE A SYSTEM WITH THE HIGH SIDE (DISCHARGE) OPEN TO THE REFRIGERANT SUPPLY. PRESSURIZATION OF THE REFRIGERANT SUPPLY COULD CAUSE IT TO BURST.

WARNING. When charging or working on the system with the engine running, watch for MOVING BELTS AND PULLEYS. Loose clothes and long hair can pull you into a belt. PLEASE BE CAREFUL.

DO NOT CONNECT OR DISCONNECT GAUGES TO A SYSTEM WHILE THE COMPRESSOR IS OPERATING.

PROCEDURES FOR WORKING WITH R-404a

- 1) A new uncharged system must be evacuated before adding R-404a.
- 2) An R-404a system must only be pressurized with R-404a or nitrogen.
- 3) Only service tools dedicated to R-404a are to be used. No parts, tubing, fittings, receivers, driers, service gauges, or any refrigerant carrying components may be fitted to a R-404a system from a used system or from a CFC based system. Damage caused by the use of parts not supplied by Sea Frost for a R-404a system will cancel all claims against Sea Frost.
- 4) No oil is to be added to the engine drive system but the PAG oil supplied by Sea Frost, labeled and capped for engine drive use. **No oil is to be added to a system without prior consultation with Sea Frost. Some parts when replaced can remove oil. Only then should make up oil be added.**
- 5) The oils used in R-404a systems are extremely moisture sensitive (hygroscopic). Do not leave any tube end or component connection open to the air while assembling the system. Be sure to use only new, capped copper tubing and be sure to cap the copper coil after cutting it.

ACCESS TO THE SYSTEM ~ SERVICE ACCESS PORTS

The access ports are on the end of the hoses attached to the compressor. The low-pressure (blue) port and high-pressure (red) port. These ports are the service access to the system and are of different sizes. To access these ports the proper connecting valve must be used.

Be sure the plastic port caps are installed tightly after charging or service. The caps are to seal the ports. Without the caps the ports may leak.

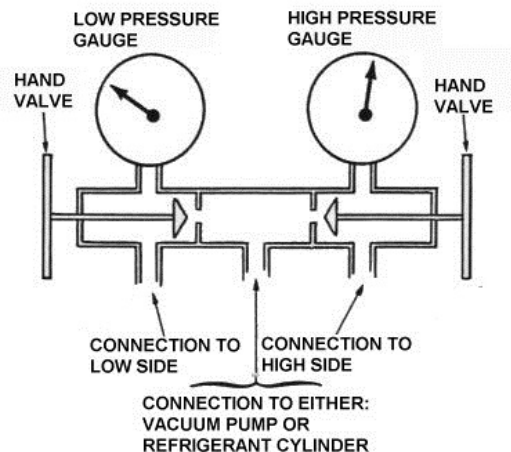
NOTE: THIS SYSTEM IS CHARGED WITH R-404a. IT MUST BE CHARGED WITH R-404a ONLY. ONLY DEDICATED R-404a GAUGES AND EQUIPMENT ARE TO BE USED. ANY CONTAMINATION FROM CFC BASED REFRIGERANTS WILL DESTROY THIS SYSTEM.

GAUGES

Gauges must be used in the evacuation and charging. They will provide information on the operation of the system when troubleshooting.

A gauge sets consist of two gauges installed in a manifold with two hand wheel valves and hoses to connect the gauges to the system. The left gauge (blue) is a compound device; it indicates pressure and also vacuum. The right gauge (red) indicates pressure

only. The hand wheels open a center port (yellow) to the left or right side respectively. Operation of the hand wheels is only necessary when moving refrigerant or evacuating. With the hand wheels closed, the gauges read the pressures of the connection points. At the end of the red and blue service hoses are 404a connecting valves.



R-404a SERVICE PORT ACCESS FITTINGS

The R-404a service ports are standard 1/4" flare fittings with core valves. Hose ends must have depressor fittings.

CONNECTING GAUGES TO AN UNCHARGED SYSTEM

To connect these fittings to the access service ports; remove the protective sealing caps from the ports. Connect the blue hose to the larger elbow fitting. Connect the red service hose to the smaller elbow fitting.

Control of refrigerant and vacuum is by the manifold hand wheels.

TO INSTALL GAUGES ON A CHARGED SYSTEM, with the system off, attach the connecting valves to the access service ports. Proceed to "Venting the Gauge Set".

VENTING THE GAUGE SET

If the gauge set is not fitted with sealing valves or has not been purged with refrigerant, vent the hoses at the manifold body by opening the hand wheels to an open center hose for a few seconds allowing some of the system refrigerant to purge the hoses of air.

DISCONNECTING GAUGES

Allow the system to rest for 20 minutes before disconnecting the hoses.

Disconnecting the gauge set on a static system may be done by disconnecting them from the access ports. Recap the access ports.

Adding charge to a working system should be done through the suction side (blue). (See "Safety") The center hose is connected to the refrigerant supply. Be sure to vent the hoses at the manifold to displace any air that might be in them. Keep your gauges clean. Inspect the rubber gaskets and core depressors on the hose ends. Leak-check the gauge hose connections.

VENTING THE CHARGE HOSE

To avoid pulling air or other contaminants into the system, it is necessary to vent the air from the hose that is used to carry 404a to the system. To vent the hose, open the supply valve on the refrigerant cylinder with the cylinder upright (vapor) then loosen the center hose fitting at the manifold. After several seconds of venting tighten the hose end fitting. Be sure to invert the cylinder for charging.

R-404a Refrigerant must be charged as liquid only to prevent the three components in the mix from fractionating.

COMMISSIONING PROCEDURE

EVACUATION WITH A VACUUM PUMP

Evacuation removes air, readying the system for charging.

Connect a gauge set to the service ports. Connect the gauge center hose to a high vacuum pump. Start the pump and slowly open the low side/suction gauge hand wheel. As the vacuum drops below 20 inches open both high and low side hand wheels fully.

EVACUATION LEAK TEST

Evacuate the system to the best vacuum (lowest pressure). As the gauge reaches this low pressure close the valves on the manifold. Observe the vacuum gauge and be sure the pressure remains constant for 5 minutes. If the pressure rises rapidly check all the connections again. Re-evacuate to the lowest pressure and test by holding a vacuum

with the gauges closed. Be sure the system will hold this vacuum. Proceed by opening the valves and continuing the evacuation process for 30 minutes more. A micron gauge can be used to measure vacuum. Proper dehydration and evacuation should be in the range of 200 to 500 microns.

The "Evacuation Leak Check" is a preliminary check and is not to be considered a system leak check.

NEW SYSTEM CHARGING

INTRODUCING INITIAL CHARGE

After the evacuation leak test and vacuum pump down, shut off the manifold valves, disconnect the center hose from the pump and connect it to the refrigerant supply. Vent the hose from refrigerant supply to the manifold. Invert the R-404a refrigerant supply, to supply liquid. Weigh in the refrigerant. The compressor is off. Charge will be drawn in the low side port by the vacuum in the system. If the pressure equalizes before the full charge is drawn in it will be necessary to start the compressor after the following step in pressure leak checking to finish installing the weighed charge. Always keep charging pressure as low as possible to control the rate of charging.

LEAK CHECKING

Leak checking is a very important step, which should be done with diligence. A leak will cripple this system. Please take the time needed to be sure all connections are tight. Check every connection even the ones that were pre-made in manufacture.

LEAK CHECKING A CHARGED SYSTEM - ABOUT PRESSURES

Refrigerant in a saturated condition, part liquid and part vapor will exert a pressure that is a function of its temperature. The higher the temperature, the higher the pressure will be.

Avoid leak checking in cold weather or on a cold system. Never leak check the low side connections with the compressor running. A refrigerant leak will show with moderate pressure. A leak is not a function of pressure. Pressure is only required to aid in detection.

There are two ways to leak-check a pressurized system:

1. Soap bubbles (a solution of dish soap and water works well).
2. R-404a Electronic leak detector (probe senses the presence of refrigerant molecules. We recommend both procedures.

TO CHECK WITH BUBBLES

Soap each connection and observe all sides of the connection with a strong light and a mirror. A leak will blow bubbles. Without careful examination and plenty of pressure this test is not reliable.

TO CHECK WITH AN ELECTRONIC DETECTOR

Use a detector designed for R-404a. Slowly trace the area with the probe. Refrigerant is heavier than air, therefore trace below the fitting. Most units can be calibrated to home in on a leak. (See detector instructions). We use and recommend electronic detection. Detectors can accurately detect leaks as low as 1/2 oz loss per year. This sensitivity exceeds S.A.E. leak specifications. Be sure to test the operation of the detector before and after you leak check the system.

IF A LEAK IS DETECTED

Try tightening the fitting nut slightly. (See Swagelok fitting instructions.) If the leak is not stopped, it is possible that the fitting was incorrectly assembled. Discharge the refrigerant, and then disassemble the connection for inspection. After reassembly, proceed with a leak check.

SPECIAL NOTES

- ❖ Be aware that propellants and solvents in sprays and foams may upset electronic detectors.
- ❖ To confirm a leak detected with a detector use bubbles and be sure it is a leak and not some erroneous vapor that is upsetting the machine.
- ❖ Electronic detectors do not function below 40.F.
- ❖ A good leak detector is able to pick up leaks as low as 1/2 oz per year.

NEW SYSTEM CHARGING

- 1) Continue by opening the discharge hand wheel valve with the refrigerant supply inverted to introduce more refrigerant. The system is designed for 24 ounces of refrigerant. Install as much of the total charge as possible by this method. Close the discharge hand wheel.
- 2) Turn the compressor drive disk several times by hand to displace oil in newly

installed compressor.

- 3) With the engine running, switch on and operate the compressor at 1000 to 1200 rpm.
- 4) The sight glass will show a stream of foam, indicating a partial charge. Install the balance of the total charge by opening the suction hand wheel with the refrigerant supply in the vapor position. The new system charge should be 24 ounces.
- 5) When the sight glass runs clear, top off with approximately 4 oz.
- 6) On a new system, turn off the compressor for several minutes after charging, and then restart it. Run the compressor at slow speed (under 1200 rpm) with several on/off compressor operations. (Allow several 5 minute "off" periods between 5 minute operating periods). This distributes the oil.
- 7) When observation and test operation have been complete and the system is resting at the lowest pressure, remove the gauges. Recap the access ports.
- 8) Recheck all the connection points for leaks.
- 9) Insulate any low side connections and tubing left exposed for leak checking.

READING THE SIGHT GLASS




A clear sight glass is required when the compressor is operating. To determine the meaning of "clear", notice the appearance of the RFD sight glass when the system is at rest with the compressor off. This is a "clear" glass.

SPECIAL WARNING: A clear sight glass can also indicate a completely EMPTY system. Anytime the compressor is started, white foam should appear in the sight glass indicating that refrigerant is present. This foam may disappear quite quickly, but IF NO FOAM IS EVIDENT and the system is not cooling, the system is empty. DO NOT OPERATE THE SYSTEM in this empty condition. Operation in this mode will ruin the compressor. Turn off the main breaker to the Control Panel or remove the compressor drive belt to prevent operation until system can be properly leak tested and recharged.

Fast moving white foam with the compressor operating indicates an insufficient charge level. Watch closely for a transition from foam to total liquid, (indicated by a clear sight glass). This transition point can be missed if proper attention is not given. Also, IT IS POSSIBLE for the sight glass to show large bubbles even when the charge is sufficient, so it is important to differentiate between "foam" and "bubbles". The foam condition has velocity and direction; the bubbles are large, temporary, and nearly stationary. Do not try to chase away these larger bubbles with more refrigerant: overcharging will then occur. Air in the system may give a false sight glass reading, which could lead to overcharging. If in doubt, discharge a suspected overcharged system to continuous

foam (see "DISCHARGING THE SYSTEM") and slowly add refrigerant to clear the glass. **MONITOR THE SIGHT GLASS CONTINUALLY** since the glass will not indicate when the system is overcharged.

In a warm system upon start-up the sight glass may take several minutes to clear. A cold system, in cold water, may show a clear glass within seconds of start-up.

RFD SIGHT GLASS DETAIL		
		
Clear or empty	Stationary bubbles	Foam (low charge)

PROPER CHARGE AMOUNT

THE ENGINE DRIVE SYSTEM IS DESIGNED TO HOLD 24 to 30 OUNCES. THIS IS THE **MAXIMUM CHARGE**. The sight glass must clear by the time the return line (suction/large diameter hose) goes below 32 degrees F.

GENERAL INFORMATION

OPERATING PRESSURES will vary with rpm, water temperature, and water flow. Generally, the discharge pressure will peak when the unit first starts. Increasing pressure indicates an overcharge or no water flow. The suction pressure will drop to the 40 PSI rapidly. Suction pressure will drop more rapidly when the seawater is cold. A deep vacuum indicates the V/U is frozen or plugged. Failure to "pull down" indicates the V/U is malfunctioning or flooding.

The compressor case may feel warm. The V/U has been operated prior to shipment. There are no field superheat adjustments.

The condensing pressure (temperature) should be 15 to 20 degrees F. above the water temperature. The suction pressure (temperature) should be 5 to 10 degrees F. below the chiller brine output.

The low pressure control must be set to maintain the lowest pressure without freezing the coils in the barrel.

SPECIAL NOTE

R-404 refrigerant must be handled properly. If you do not have proper gauges, a charging scale or dial a charge cylinder, be careful to avoid over charge. Refrigerant condensing temperature should be between 15 and 25 degrees F. above water temperature. Refer to the R-404a pressure temperature charts.

CHECKING THE REFRIGERANT CHARGE ~ PERIODIC INSPECTION

Checking the refrigerant charge must be incorporated into a routine maintenance schedule.

- 1) Locate the RFD (receiver filter drier). It is a blue metal can about 10 inches high and 3 inches in diameter, with brass fittings connecting it to copper tubing. The RFD has a sight glass for viewing the flow of the refrigerant.
- 2) Start the boat's engine. Check to be sure the cooling water is pumping.
- 3) Locate the SEA FROST Control Panel. With the compressor running at a fast idle (900 to 1200 rpm), and while looking into the sight glass in the RFD, have a helper turn the unit, starting the compressor. The engine might load. An empty system will put very little load on the engine.
- 4) MONITOR THE SIGHT GLASS CONTINUALLY. If the sight glass does not show the presence of refrigerant within a minute of operation the system is empty. TURN OFF THE COMPRESSOR and follow the procedure in the "TROUBLE SHOOTING" section.
- 5) If the white foam is evident watch closely for the transition to clear. If the glass indicates insufficient charge level, additional charge will be needed. Turn off the compressor to avoid damage from loss of lubrication from a low charge.

DISCHARGING THE SYSTEM

Follow all regulations for handling refrigerants.

Before the connections or components can be disassembled, the refrigerant must be discharged. Connect a gauge set to the suction access port. Slowly vent the refrigerant, (keeping the pressure under 20 psi.) into an approved reclaiming system. Do not loosen any connections until the system shows 10" vacuum for 10 minutes.

Discharging an overcharged system; discharge into a recovery machine at the same 20 psi rate for a minute at a time. Be sure the gauge hand wheel is off before starting the compressor.

TROUBLESHOOTING

The most common problems that can occur in a SEA FROST Engine Drive Cool Fish Chiller System are:

- 1) Loss of refrigerant charge resulting from leaks.
- 2) Moisture or dirt plugging the valve.
- 3) Compressor malfunction due to loss of refrigerant charge.
- 4) High-pressure switch disconnecting due to overcharge or lack of water flow.
- 5) Improper setting of the low pressure cut out.

STEP 1. Gather information as to the nature of the problem before operating the system. A leak often leaves a trace of oil. Inspect fittings, hoses, and tubing for wear, corrosion, and chafe. **Do not operate the compressor until the trouble is corrected.**

The high pressure switch is manually re-set after over pressure is detected.

High pressure switch disconnecting is indicated by the compressor turning off after a minute or two when starting a warm system. It will also disconnect if the cooling water is not flowing. Determine the condition by checking the water flow from the discharge through hull. Make sure the pump is operating at full flow. If the water flow is not at fault discharge some refrigerant (see section, "DISCHARGING THE SYSTEM." The compressor should not be operated during discharging. This is a trial and error procedure until the compressor stays on without tripping. Check the sight glass for proper charge. Be sure the sight glass still clears.

For further troubleshooting attach purged gauges to access ports or observe the temperature of the lines.

With gauges attached:

❖ If the pressure readings are over 40 PSI (In 60 degree F weather) with the compressor off, proceed to check charge level via sight glass and charge if needed. If lower than 50 PSI The system could be low or almost empty. CHARGE LOSS INDICATES A LEAK THAT MUST BE CORRECTED.

STEP 2. If the system continues to operate improperly after Step 1, check for moisture or dirt plugging the valve. Run the system, observing closely the gauge readings and discharge air temperature, noting the following.

❖ If system is warm upon start-up a DIRT-PLUGGED Valve will show an immediate deep vacuum reading on suction side. Consult SEA FROST for cleaning techniques.

❖ A MOISTURE-PLUGGED VALVE is indicated by a deep vacuum reading on the suction side after 1 to 5 minutes of operation from warm, FOLLOWED BY any combination of these symptoms:

- ❖ The temperature at the compressor discharge fitting and the copper tube at the top of the condenser drops from hot to warm.
- ❖ The temperature of the suction line from the V/U increases.
- ❖ Moisture enters either through suction side leaks or during initial installation and will freeze at the V/U, reducing or eliminating cooling activity. Turning off the system and allowing the V/U to warm to above freezing, and then restarting, may temporarily solve the problem. If not, change the RFD as follows.

STEP 3. To change a saturated RFD, allow the system to warm to ambient temperature, thereby preventing moisture from condensing in the system. See "Discharging the System."

" **WARNING:** BEFORE DISASSEMBLY OF ANY PART IN THIS SYSTEM BE SURE CHARGE IS COMPLETELY DISCHARGED.

With a backup wrench holding the brass body of the Swagelok fittings, loosen and back off the nuts. The tubing may be pulled out of the fittings. Remove the RFD. Replace only with an identical unit by size and color. Replace only with an identical unit by size and color: THE SEAFROST RFD is a drier and also a receiver/filter

The DESICCANT and the oil in the Sea Frost RFD are special to this system and R-404a. Installation of the wrong part or oil may destroy the system.

NOTE: This system contains a measured amount of lubricating oil. Be sure the RFD being installed is a blue SEA FROST Engine Drive 404a RFD. Record all component exchanges in the on-board owner's manual.

Follow the "remake" instructions for Swagelok fittings. Once Swaged the fittings should only be tighten in slight amounts to stop leakage. Overturning the Swagelok fittings will ruin the seal and spring action the fitting uses to compensate for vibration and temperature changes.

Reminder: To ensure removal of system moisture use a high vacuum pump, and evacuate the system with the highest possible ambient temperature.

Recharge. Refer to "New System Charging".

MOISTURE IS A SYMPTOM. Carefully leak check the low side of the system if moisture becomes a problem. Moisture leaks in!

STEP 4

Check that the low-pressure cutout is set to limit compressor operation when the RSW circulated temperature gets below 27 degrees. The normal operation of the cutout will disconnect the compressor until the temperature of the cooling coil rises by 5 to 10 degrees. The setting will be affected by the RPM of the compressor and the seawater temperature passing through the condenser. The colder the water the more efficient the compressor will be. It will pull lower faster.

CoolFish Engine Drive Specifications:	
Engine Drive compressor rotation:	Either direction
Compressor RPM Requirement:	Minimum speed for operation 1200. Maximum RPM at cruising RPM 3500.
Clutch draw:	3 amps for 12 volts 1.5 amps for 24 volts
Condensing water flow required:	3 GPM up to 60 degree F. water 5 GPM Tropical conditions
Chiller RSW flow:	5 GPM
Chiller Barrel Maximum Pressure:	10 PSI
Refrigerant:	R-404a
Maximum Charge:	24 Oz.
Leak Check Pressure:	200 PSI Maximum
Operating High Pressure / temperature:	15 to 20 Degrees F. Above seawater temperature
High Pressure Cutout (automatic reset):	325 PSI
Low Pressure Cutout:	Suggested set point 30 PSI = 17 to 20 degree F. evaporator
Performance cooling 30 gallons at 1200 RPM:	

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EASTERN TIME

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e-mail:sales@seafrost.com

ADJUSTING THE LOW PRESSURE CUT OUT

The Cool Fish RSW Barrel is fitted with an adjustable low pressure cut out control. In normal operation this device will switch off the compressor when the circulated seawater temperature drops. The control will turn the compressor back on after the coil and expansion valve warm up. The control needs to be set to avoid icing the cooling coils. Icing reduces capacity and possible damages the components. The control will only operate when the circulated water stops or the water is super cold.

There are two adjustments on the Danfoss K1 control. The cut out point is the range adjustment. This is the left hand scale and is adjusted with the left screw after removing the locking plate. Adjust this to turn off the compressor before the out flow water temperature goes below 28 degrees F.

Do not attempt to adjust the large slotted screw to the right of the locking plate.

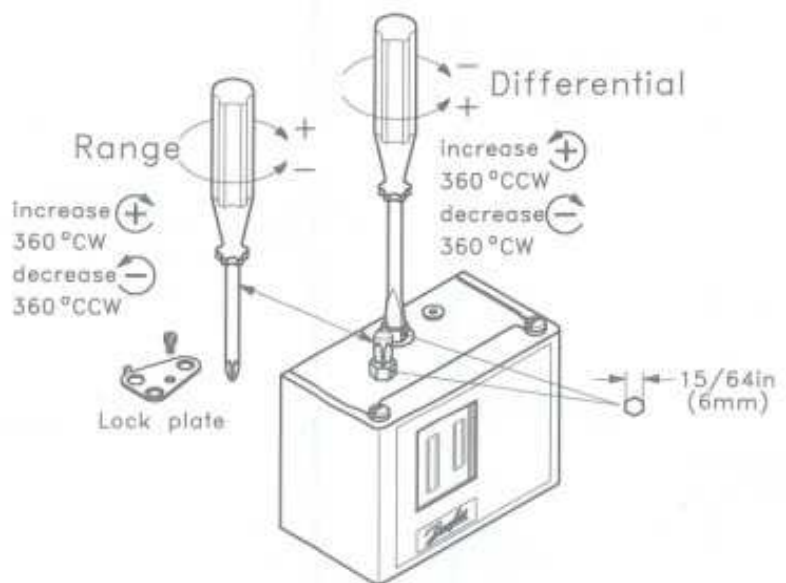
The cut in or turn on point is warmer and should allow the coil to defrost with the water flowing through the barrel. Leave this adjustment at the supplied setting.

The control is measuring refrigerant pressure.

Factory settings:

Engine Drive Compressor
(R-404a refrigerant)
Range 30 PSI
Differential 15 PSI

Danfoss Cut out K1
Normally closed switch.
Wired on terminals 1 and 4





Forane® 404A

Technical Specifications

Pressure Temperature Properties



Temp (deg F)	Pressure (PSIG)	Temp (deg F)	Pressure (PSIG)	Temp (deg F)	Pressure (PSIG)	Temp (deg F)	Pressure (PSIG)	Temp (deg F)	Pressure (PSIG)
-50	0.6	5	38.6	60	125.3	115	290.9		
-45	2.7	10	44.0	65	136.6	120	311.1		
-40	5.0	15	49.9	70	148.6	125	332.3		
-35	7.6	20	56.2	75	161.2	130	354.5		
-30	10.4	25	63.0	80	174.6	135	377.8		
-25	13.4	30	70.3	85	188.8	140	402.2		
-20	16.8	35	78.1	90	203.7	145	427.7		
-15	20.5	40	86.4	95	219.4	150	454.4		
-10	24.5	45	95.2	100	235.9				
-5	28.8	50	104.7	105	253.4				
0	33.5	55	114.7	110	271.7				