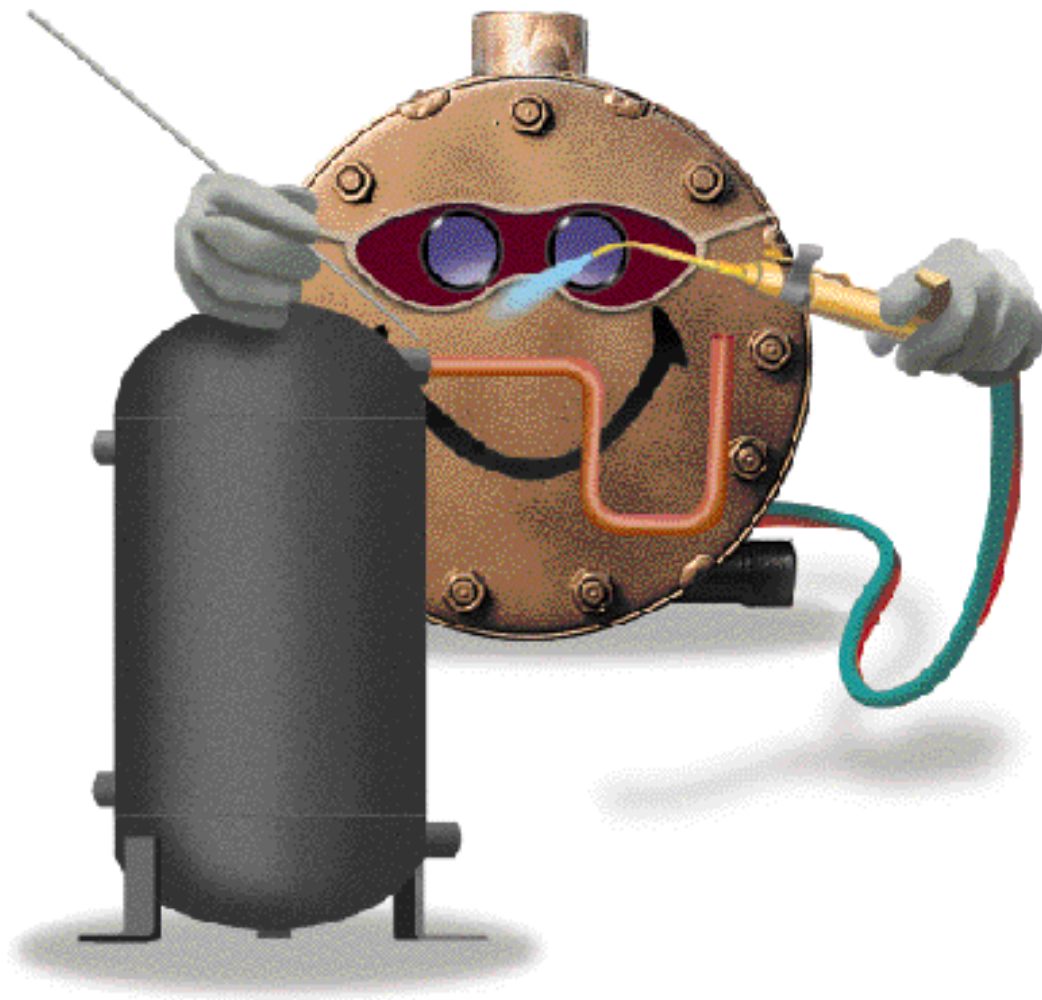


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Service Manual

Installation & Maintenance Procedures



Standard
Refrigeration Company

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CHILLER BARREL INSTALLATION RECOMMENDATIONS

There are many steps involved in installing a new chiller barrel. Following proper procedures will help ensure a long trouble free service life for the chiller. Below is an outline of steps that should be followed. These steps are recommendations only and not a substitute for proper training or experience.

1. Inspect the chiller, any damage should be reported to the wholesaler or the shipping company immediately. This is your responsibility. As with any shipping damage, it is advisable to take a picture of any damage.

2. Use the lifting lug to position the barrel to avoid damaging the insulation. Addition layers or thicker insulation should be used if the unit will be exposed to temperatures in excess of 95 F and 70% relative humidity, or when the leaving water temperature is 32 F or lower. Units should be painted with a good quality latex paint for outdoor installations.

3. Locate the unit allowing adequate room to remove the heads should service ever be necessary. The unit should be within 2 degrees of level and bolted or welded in place.

4. Pipe the water side, the entering water should be on the same end as the refrigerant inlet. Remove plastic plugs that are placed in the pipe couplings on the shell and install steel pipe plugs. A high quality teflon based pipe dope is recommended for sealing water side pipe threads. Note: use care removing these plastic plugs, there are tubes very close to the outside of the shell, poking a screwdriver or awl through the plug could damage a tube. The same is true if you need to retap one of the couplings, threading the tap in too deeply will damage tubes possibly causing a leak.

5. A filter or strainer should be installed on the chiller water inlet if you have silt, particles or other foreign debris in your water. This debris can accumulate in or block water flow through the tubes. This will result in excessive pressure drop with localized areas of high water velocity. You also risk freezing the unit since pockets of stagnant water will accumulate in the unit. Filters and strainers must be maintained on a regular basis.

New piping should be flushed before being connected to the chiller.

6. A flow switch should be installed in the 3/4" NPTF coupling on the water outlet flange or in the outlet pipe immediately after the flange. Provisions may be made to install wells in the outlet piping for a freestat and temperature control sensors (if leaving water is being used for compressor control). Always use new gaskets on flanges and clean flange sealing surfaces.

7. Install the expansion valve or a tee connector if you are using a hot gas bypass valve (Sporlan sells a fitting designed for this)

to into the liquid line fitting. Wrap the expansion valve with a wet rag to protect it while soldering. Use a nitrogen flood and wrap a rag around the steel liquid fitting to protect the insulation from scorching and the head gasket from excessive heat. See soldering note below.

8. Solder the sight glass into the liquid line, using a nitrogen flood and a wet rag to protect the element.

9. Solder the liquid line solenoid in place, using a nitrogen flood and a wet rag to protect the internal components. The solenoid should be installed horizontally with the coil in the 12 o'clock position. Verify that the flow is going in the correct direction through the valve.

10. Solder the liquid line dryer in place using a nitrogen flood and wet rags at both ends. Complete high side piping with connection to condenser outlet.

11. Solder the suction line into the suction fitting, using a nitrogen flood and a wet rag to protect the insulation from scorching and the head gasket from excessive heat. See suction line guidelines below.

12. Connect the expansion valves equalizer line (if used) this can be done by brazing the line directly to a hole punched in the suction line or using the connection that we install on the steel suction fitting. This should only be done after all brazing is done. If you are going to do this you will need to thread a 1/4" NPT to 1/4" SAE adapter into the coupling welded to the steel suction fitting. If the adapter does not thread in easily the coupling should be cleaned out with a 1/4" NPT tap and all shavings should be removed. We recommend using a high quality sealant such as Loctite 554 on the pipe threads.

13. Attach the expansion valve bulb to the suction line. It should be clamped to the copper line using the clamps provided with the valve as close as possible to the steel suction fitting in a horizontal orientation in the 4 or 8 o'clock position. The bulb should be completely and thoroughly wrapped with cork tape, the area of contact should be clean and a thermal transfer gel can be used between the bulb and the suction line.

14. A suction line dryer can be installed at this time and is very helpful after a compressor burnout. We do recommend that the core be removed after 24 hours if the sight glass indicates no moisture and if an acid test shows that the oil condition is satisfactory. Leaving the core in can cause problems later if the pressure drop across the dryer gets too high.

15. Once the entire system has been leak checked you can evacuate it (see service procedure SP13R1), charge it and adjust all settings and controls.

Water Quality and Velocity

Poor water quality can foul a unit to a point that there is a significant reduction in performance or drastically reduce the

service life of a chiller barrel. Corrosive water can attack and destroy the baffles inside a unit, this can cause an 80-90% reduction in performance. Highly corrosive water can also attack the copper tubes creating leaks. We recommend that you take a sample of the water to be run through the unit and have a local laboratory run the Langelier and Ryznar indexes. These are simple tests which will give you an idea of the condition of your water. For more information see Service Bulletin SB12R1. For further information we recommend that you contact a local water treatment professional.

Excessive water velocity will reduce the service life of a chiller barrel. This is the result of excessive water volume or pressure put through the barrel. When you have started the unit you should verify that the pressure drop does not exceed the values published in our catalog for your particular model. When the unit is brand new and clean is the best time to check this since pressure drop will rise slightly as the unit accumulates the normal amount of fouling which is acceptable and expected. Too high of a pressure drop is an indication of excessive water flow or velocity through the unit. This will cause excessive wear on the tubes and can result in premature tube failure. Too low of a pressure drop is an indication of too little water flow. This will cause poor and erratic system performance.

Control Setting Notes

Every year many chillers are needlessly frozen. Freeze-ups can be prevented with properly installed and adjusted controls that are protected from tampering. The two most important controls are the low pressure cut out and the flow switch, both of which should be set up to shut off the compressor should they be tripped. They can be manual or automatic reset. The low pressure cut out should be set to trip slightly above the freezing point of the fluid being circulated through the chiller. An example is a system using R-22 and straight water should be set at 58-59 PSI, this is equal to 32-33 F. You can go to lower settings to minimize nuisance trips, but, this does risk freezing the unit up. The flow switch should be adjusted so that it will trip not only when water flow stops completely, but, when it drops off significantly. A freezestat can be used, however, with the compact high performance TX line of chillers there is a much smaller volume of water in the chiller barrel and it must be set at 39 F for the above example. The best protection is still the low pressure and flow switches.

Always verify settings with an accurate set of gauges through several cycles.

Remember to account for glide with blends such as 407C & 409A.

Correct for altitude by lowering settings by 1/2 a pound for every 1000 feet above sea level.

Suction Line Guidelines

Suction line sizing: This is very important. If suction line diameter is too small you will see excessive pressure drops which can cause a reduction in performance and inadequate compressor cooling. Too large of a diameter can reduce velocities enough that the oil will not remain entrained with the refrigerant and can cause oil to log in the evaporator and suction line. Our suction lines are sized for long piping runs (100') you may want to reduce line diameter one size for shorter runs. Keep the suction line as short and straight as possible and use as few elbows as possible and use long radius elbows where space permits. This will minimize pressure drop and enhance performance. Suction lines should always be insulated.

Oil traps: P-traps are made up with copper elbows and ells to help keep the oil mixed with the refrigerant as it travels to the compressor. Traps may not be necessary when the compressor is mounted below or level with the evaporator, unless you do not have a pumpdown control. In that case you should have an inverted trap to prevent oil from draining into the compressor during the off cycle. Simply pitching the suction line towards the compressor should be adequate when the compressor and evaporator are mounted at the same level. A p-trap should be installed at the base of any suction line with a vertical rise. In long runs a p-trap should be installed for every 20 feet of vertical rise and every 30 feet of horizontal run.

Suction accumulators: P-traps will not prevent large amounts of oil or liquid refrigerant from slugging the compressor. Systems that are prone to liquid damage such as commercial and low temperature systems should use a suction accumulator. This will prevent floodback, slugging and enhance oil return. The accumulator should be installed at the same level as the compressor.

Suction line heat exchangers: These use the suction gas to sub-cool the liquid refrigerant and boil off any liquid in the suction line and to add superheat. This increases system performance and adds a measure of protection for the compressor.

Soldering/Brazing Guidelines

Only AC&R tubing that is plugged and dehydrated should be used for piping the system.

Always use a torch tip that is large enough to bring the metal being soldered up to the appropriate temperature quickly to prevent overheating the work piece.

Whenever possible the component being soldered should be disassembled. This is especially important on ball valves, the seats in these valves are prone to damage from overheating and most are easily disassembled and reassembled.

Always clean both pieces being brazed with sand cloth or a wire brush.

Copper to steel joints: You must use a solder with no less than 45% silver content and the corresponding flux.

Copper to copper joints: You should use a solder with no less than 15% is recommended no flux is needed. Solders with a lower silver content can be used if necessary.

Nitrogen flood: The system should be flooded with nitrogen when soldering to prevent the formation of oxidation on the inside of the copper tubing being brazed. This is done by filling the system with nitrogen and then setting the regulator at 2-4 pounds and letting it flow while you are brazing. There should be an opening large enough to prevent pressure from building up in the system.

Wipe the joints clean with a wet rag when done brazing. Always pressure test with nitrogen when brazing is completed, 150 PSIG is recommended for testing, note: ensure all of the systems components and relief valves are rated for at least that pressure. Big Blu leak reactant by Refrigeration Specialties is recommended for testing these joints.

Welding Repair Notes

If a weld repair is necessary on a chiller you must determine what type of unit it is since different rules apply.

UL: These are smaller units and can be identified by an adhesive label that says "built" in the upper right hand corner followed by a nine digit serial number. You can weld on these as necessary. It is your responsibility to use proper procedures and a qualified welder. You accept all liability for these repairs.

UM & U: These are medium and larger units identified by a steel tag welded to the unit. UM units have a UM symbol in the upper left corner of the tag and says "MFR. SER. NO." followed by a six character serial number with the first being an letter and the remaining five being numbers, across the top. U units have a U symbol in the upper left corner and say "MFR. SER. & NAT'L BD. NO." followed by a six digit number across the top. Any welding done on either of these units must be done by an ASME certified welder that holds an "R" stamp, following proper procedures. An R-1 form must be completed. Welding by an unauthorized welder or removal of the steel tag voids the warranty and the vessel's certification with the National Board. SP21R1

CHILLER BARREL CLEANING INFORMATION

Chiller barrels can build up deposits on the tubes, baffles and sediment inside the chiller. This can lead to a complete or partial blockage which often results in freeze-ups and reduced performance. It is crucial to maintain water quality and keep scale and sediment from accumulating in the unit. Below are guidelines on how to keep the unit clean and how to clean the unit once it is dirty.

Water Quality

Water quality is a complex issue that is best handled by a professional who specializes in water treatment. For more information on water quality see service bulletin SB12R1. Poor quality water can cause corrosion on the inside of the tubesheets, shell or the baffles. Corrosion on the tubesheets can lead to leaks through the tube joints. It can also corrode the shell, perforating it in extreme cases. When the baffles are attacked they no longer direct the water flow and allow it to pass through the unit too quickly, resulting in a serious loss of performance, this can not be repaired. This damage is not reversible, may require replacement of the unit and is not covered under our warranty. Poor quality water can also lead to tube failure and subsequent system damage.

Scale

Excessive hard scale which forms on the tubes will inhibit heat transfer, reducing performance and increasing utility costs. This is caused by hard water with high mineral content. Some scale build up is normal and will help protect the tubes. The only way to remove hard scale is to run acid through the unit. We do not recommend this.

Sediment

Sediment can cause a loss of performance and freeze-ups when it builds up and restricts water flow through the tube bundle. The way to prevent this is to install a strainer or filter the inlet of the chiller barrel. If the water is exposed to airborne particulates, heavy rust or any other source of sediment, you must clean the screen or filter as needed to ensure full water flow through the barrel. To remove accumulated sediment, back flush the unit by reversing the water flow through the unit. To improve the results of this procedure inject low pressure air (25-50 PSIG) through a nozzle into the 3/4" NPTF coupling on the flange that the water is being pumped through, this will help agitate the sediment.

Flow Switches & Water Velocity

It is crucial that a flow switch be installed on the chiller water outlet and inspected for function on a regular basis. It is also important that water velocity through the chiller remains below 5 FPS, higher velocities can result in tube failure. We can calculate the velocity for you if we know the flow in GPM through the barrel. SP22R1

CHILLER BARREL TUBE LEAK TEST PROCEDURE

If you suspect you have a leaking tube or tubes in a chiller you need to verify it. Electronic leak detectors can be used to sense the presence of a leak, but, you need to pinpoint it's location. To do this you can use the procedure below.

1. Remove heads, see chiller gasket replacement procedure (SP10R6).

chiller barrels

2. Shut off water to chiller, drain water side of vessel, close the valves and go to step 3, if there are no valves you will have to split the flanges and install blank flanges.

3. Pressurize the shell with nitrogen to 150 PSIG. NOTE: YOU MUST VERIFY THAT EVERY PART OF THE SYSTEM EXPOSED TO PRESSURE IS RATED TO SAFELY HANDLE THAT PRESSURE, INCLUDING THE CHILLER, PIPING, VALVES, BLANK FLANGES, RELIEF VALVES, AIR BLEEDS, ETC.. Start by leak checking the tube to tubesheet joints by spraying or brushing a leak detecting soap solution on the tubesheet, we recommend Sherlock by Winton for this. Let the bubbles that form when applying pop, then look for a thick white froth around the outside diameter of each tube which indicates a leak. After an hour verify that you still have 150 PSIG, reapply soap, recheck, if no leaks are found go to step 4.

4. There are three methods for checking leaks inside of the tubes. All of these should be done while the pressure applied in step 3 is still on the shell.

Method A. For this method you will need a bubbler. This is easily made by drilling a hole in an appropriate size rubber plug, insert a tube through the hole and insert the other end into a clear glass jar half filled with water. Plug the tubes at one end with rubber plugs and insert the bubbler into each tube at the other end individually and observe the jar for bubbles for 20-30 seconds on each tube. A leaking tube will produce bubbles in the jar. This is the best method.

Method B. Plug the tubes at one end with rubber plugs and form bubbles at the other end using Big Blu leak reactant by Refrigeration Specialties. Watch for bubbles that rapidly expand and pop. It is best to leave the unit open for several hours since refrigerant laden oil will give false indications as the refrigerant boils.

Method C. Plug both ends of the tubes and let the unit sit for 12 hours, leaking tubes will pop one of the plugs out.

5. If leaks are found you must repair, replace or plug leaking tubes. You must also take corrective action to eliminate the conditions that caused the failure. Bulges or blisters on the inside of tubes are caused by ice that formed when the suction pressure drops below the freezing point of the fluid.

SP16R1

FIELD CHILLER BARREL GASKET LEAK TEST PROCEDURE

If you suspect that you have leaking chiller gaskets this must be verified by testing the unit. The steps to check for cross-circuit or external gasket leaks are listed below.

1. The liquid and suction lines must be sealed to isolate the chiller barrel. The liquid line solenoids will seal the liquid lines.

Close the suction valves at the compressor.

2. Install 1/4" SAE fittings (without cores) into the 1/4" pipe thread couplings on the suction fittings. This allows you to use your gauge manifold.

3. Pressure all circuits to 150 PSIG with nitrogen or carbon dioxide. Using a leak reactant such as Big Blu (Refrigeration Technologies (800-869-1407), brush or spray a liberal amount over the entire outside of the gasket and check for indications of a leak. If no leaks are found and you are working on a single circuit a unit you are done, If you are working on a multi-circuit unit move onto the next step. If a leak is found move onto step # 5.

4. On multi-circuit units you can now check for cross-circuit leaks. Pressurize the first circuit to 150 PSIG. Place a hose over the flare fitting on the second circuit (two circuit) and place the other end into a small jar of water. Watch the jar for bubbles for two minutes. If you are working on a two circuit model and no bubbles appear there are no leaks and you may put the unit into service. On three and four circuit units you must pressurize each circuit and check adjacent circuits. In other words, on a four circuit unit, you would pressurize circuit # 1 and check # 2. Pressurize circuit # 2 and check circuits # 1 & 3. Pressurize circuit # 3 and check circuits # 2 & 4. Do this until each circuit has been pressurized. If no leaks are found you may put the unit back into service. If you do find a leak see step # 5. If you can not find a hose and a jar you can form a soap bubble on the opening of the fittings and see if it grows and pops. If it is not leaking the bubble will collapse or it will not grow. Be careful not to get excessive amount of soap in the fitting. Note: refrigerant laden oil can give a false leak indication as the unit warms and the refrigerant boils and expands. If the unit is used you may want to let it sit for 24 hours or until the residual refrigerant boils off. If no leaks are found you may put the unit into service. If you are confident that you have a leak see step # 5.

5. If you verify a leak you should retorque the bolts to the correct torque and retest. If this does not stop the leak you can raise the torque by 10 foot/pounds and retest. If you still have a leak you must replace the gaskets. Contact Standard for gaskets and the appropriate procedure. Only gaskets supplied by Standard should be used, since other materials may not be compatible with all refrigerants and oils.

SP14R1

TUBE PLUGGING PROCEDURE

If you must plug a tube in a chiller or condenser, follow the steps below to ensure the repair is permanent. NOTE: Never plug more than 10% of the tubes in any one refrigerant or water pass.

1. Chiller: If the tube has a blister in it due to a freeze-up, you must work it down before installing the plug. This can be done using a large line up punch. Drive the tapered punch into the

tube using light hammer taps until the punch bottoms in the hole. Work the punch around the inside of the tube and remove it.

Condenser: Remove all scale, deposits and excess epoxy. A tube cleaning brush on an drill works well for this.

2. Select a plug of the proper size and material. If you are not sure which is the correct size, contact one of the suppliers listed below. Plugs can be ordered in one or two piece, either one will work. Measure the inside diameter (ID) of the tube, after cleaning, before you call. If you are making your own plugs measure the ID of the tube to be plugged. The plug should be 3 inches long and taper .010" per inch. The ID you measured will be the diameter in the center of the plug, add .015", this will be the size of the large end, subtract .015" and this will be the size of the small end. In other words, if your tube ID is .570", the plug will run from .555" to .585". The material must be compatible with the tube being plugged. Copper and cupronickel tubes should be plugged with brass, carbon steel with carbon and stainless steel with stainless.

3. When you have the plug ready you must clean the hole. This can be done using Virginia # 10e solvent or acetone. Thoroughly clean the inside of the hole and the plug, allow to solvent evaporate.

4. Apply a thick ring of Loctite 277 to the plug and the ID of the tube. On two piece plugs also put Loctite on the inner hole of the plug and on the drive pin. Loctite 554 or 290 can also be used.

5. Insert the plug in the hole and drive it in using a 2-3 pound hammer. Strike the plug squarely, glancing blows will bend the plug. 3-5 firm blows should seal the plug. Apply pressure and check for leaks. If leaks are found strike again. NOTE: Do not drive plug in any further than necessary to seal the plug, excessive force can cause leaks in adjacent tubes. Let Loctite cure for 1 full hour.

6. Cut off the excess plug only if it will interfere with the installation of the head.

Plug Sources

Cooper Powertools/

Airtools Operator

Springfield, OH

937 323-4981

www.cooperindustries.com

Elliott Tool Technologies, Ltd.

Dayton, OH

800 332-0447 513 253-6133

www.elliotttool.com

Tupros

Springfield, OH

800 872-5340 513 325-5044

www.tupros.com

SP19R2

CHILLER BARREL GASKET CUTTING PROCEDURE

There are times when you will need cut a gasket by hand from sheet material. The material must be a neoprene compatible with refrigerant and oils with a durometer of 70. The gasket material used at Standard is compatible with all refrigerants (except R-123) and refrigerant oils and is available in 1/8", 3/16" & 1/4". Follow the procedure below to hand cut a gasket. Contact the factory for gaskets for units with grooved heads or tubesheets.

1. Cut a disc from suitable material. To obtain the dimensions for this disc you can use the old gasket, if it is in usable condition. If not, you will have to measure on the inside of the head, move 1/4" from the inside of one bolt hole, measure 180 degrees across to the same point on another bolt hole. This is your diameter which must be transferred to a sheet, do this using a large compass. If you do not have a compass, you can make one using a ruler, yard stick, or a straight edge Take a ball point pen and a white paint marker, tape them to the yard stick and use this as your compass. Center the ball point pen and mark your diameter with the paint marker. Two ball point pens can be used if necessary, but lines are much harder to see.

2. Lay material on flat surface, a piece of cardboard on a bench or the floor works well. Using a utility knife with a new blade, make your first cut along the outside diameter mark you have laid out, using light pressure. Follow along the same line, on the second cut the blade will pass through on 1/8" material, 3/16" will take 3 cuts and 1/4" 4. Work your way around the disc cutting 1/4 of the diameter at a time.

3. Once you have a disc you must now lay out the partition webs, if you have a gasket in good condition you can lay it on top of your disc and trace the webs with the paint marker. If you do not have a usable gasket there are two alternatives to transferring the pattern to the disc. In the first method, put a good coat of oil on the head and then holding the gasket very tightly at one edge roll it down over the head and press on the backside of the gasket. Peel the gasket back up without allowing it to slip and you will have a pattern to cut along. In the second method you again hold the gasket, but, now you push firmly on the back of the gasket with your thumbs along the inside diameter of the head and on both sides of the partitions. In both cases you must make sure that the disc does not slip while you are getting the pattern, the lines must be clear before you start cutting. Always make sure that you keep the disc centered when patterning. Both methods can be done with the head in a vertical position, but, are much easier to do with the head laying flat, and should be done with two people.

4. Once you have your pattern cut out the sections of the gasket. Follow the directions in step 2. The difference being when you come to the corners be very careful, one slip and you will be starting over. Always cut away from the corners.

SP15R1

chiller barrels

CHILLER BARREL GASKET REPLACEMENT PROCEDURE

1. Ensure that all refrigerant has been recovered and that the vessel has been isolated. There is no need to drain the barrel.
 2. Carefully remove insulation to expose bolt heads, cut carefully and mark position of insulation so that it can be reused.
 3. Cut or unsweat liquid and suction lines as necessary for removal of heads. Measure line sizes and get slip couplings.
 4. Put witness marks at 12 O'Clock on the tubesheet and on the head to ensure proper alignment during reassembly. Support head and remove all but two bolts, carefully remove final two bolts, be careful that head does not slip down or swing out. CAUTION: HEADS ARE VERY HEAVY, HANDLE WITH EXTREME CARE!
 5. Once head is secured where you can safely work on it, peel off old gasket. Scrape the remaining gasket material and adhesive from the head, be careful not to gouge the head. A wire brush on an electric grinder works well for removing the old adhesive. Clean gasket surfaces on the head and tubesheet with acetone or Virginia # 10e solvent and clean rags. Clean gasket with solvent until the surface is shiny black, allow to dry.
 6. After that you ensure that you have the correct gaskets, apply a thin (.010"-.015") uniform coat of Armstrong 520 or Rubatex R-27780 adhesive to the head and one side only of the gasket.
 7. Carefully place gasket on head, this is best done with two people since the gasket should not be moved once it has been placed. Ensure that the gasket's webs are centered on the partitions. Allow the adhesive to cure for at least one full hour. Cut out unused dividers from the gasket after curing.
 8. Guide head into place (remember to put couplings on liquid and suction lines) be careful not to disturb gasket. Tighten bolts until gasket is just touching the tubesheet all the way around.
 9. Torque bolts in a criss-cross pattern to value A, then value B and value C, (if applicable see chart). Torque once more to the final value once more. DO NOT TIGHTEN THE BOLTS ANY FURTHER!
 10. Rebraze all connections, use 45% or higher silver content solder and the proper flux for steel to copper joints and 15% for copper to copper. Charge evaporator to 150 PSIG with nitrogen and check for leaks using a leak reactant such as Big Blu. If a gasket leak is found, torque the bolts 10 ft/lbs higher and recheck. Evacuate to 1500 microns, break the vacuum with nitrogen and evacuate to 500 microns. You can now recharge and start the chiller.
 11. Reinsulate, you can use the left over adhesive for this.
- SP10R7

CHILLER BARREL GASKET REPLACEMENT PROCEDURE FOR GROOVED HEADS/TUBESHEETS

1. Ensure that all refrigerant has been recovered and that the vessel has been isolated. There is no need to drain the barrel.
 2. Carefully remove insulation to expose bolt heads, cut carefully and mark position of insulation so that it can be reused.
 3. Cut or unsweat liquid and suction lines as necessary for removal of heads. Measure line sizes and get slip couplings.
 4. Put witness marks at 12 O'Clock on the tubesheet and on the head to ensure proper alignment during reassembly. Support head and remove all but two bolts, carefully remove final two bolts, be careful that head does not slip down or swing out. CAUTION: HEADS ARE VERY HEAVY, HANDLE WITH EXTREME CARE!
 5. Once head is secured where you can safely work on it, peel off old gasket. Scrape the remaining adhesive from the head, a 1/4" wood chisel works well for this, be careful not to gouge head. Remaining adhesive can be removed using 3M or CRC automotive brake cleaner. On TX25s and smaller use just the solvent. Clean tubesheet with brake cleaner. Clean gasket with solvent until the surface is shiny black, allow to dry.
 6. Verify that you have the correct gaskets. Cut out any unused gasket dividers, cut along the lines of the webs and the inside diameter of the gasket so there is no overhang on the groove. Apply a thin (.010"-.015") uniform coat of Armstrong 520 or Rubatex R-27780 adhesive in the groove of the head and one side of the gasket. Carefully place the gasket into the groove, start from the outside at the top and bottom and work towards the center, then the partitions on the side. Once the gasket is in place run a small flat blade screwdriver between the wall of the groove and the gasket to make sure that the gasket is seated in the groove. If the gasket is not fully seated it will probably leak. Allow adhesive to cure one full hour.
 7. Guide head into place and align it with the tubesheet, this is critical and the head must remain aligned and fully supported until all bolts are completely tightened. Be careful not to disturb gasket. Tighten bolts until gasket is just touching the tubesheet all the way around. Torque bolts in a criss-cross pattern to value A, then value B and value C, (if applicable see chart). Torque once more to the final value once more. DO NOT TIGHTEN BOLTS ANY FURTHER!
 8. Rebraze all connections. Charge evaporator to 150 PSIG with nitrogen and check for leaks using a leak reactant such as Big Blu. If a gasket leak is found, torque the bolts 10 ft/lbs higher and recheck. Evacuate to 1500 microns, break the vacuum with nitrogen and evacuate to 500 microns. You can now recharge and start the chiller. Reinsulate, you can use the left over adhesive for this.
- SP12R2

MODELS	Front	Rear	Single	Dual	Quad
TX 2	2865	2865	Fig. A	NA	NA
TX 3	2865	2865	Fig. A	NA	NA
TX 5	2872	2872	Fig. A	NA	NA
TX 6	2872	2872	Fig. A	NA	NA
TX 7.5	2872	2872	Fig. A	NA	NA
TX 10	2872	2872	Fig. A	Fig. C	NA
TX 12	2889	2889	Fig. A	Fig. C	NA
TX 15	2889	2889	Fig. A	Fig. C	NA
TX 20	2889	2889	Fig. A	Fig. C	NA
TX 25	2889	2889	Fig. A	Fig. C	NA
TXB 30	2227	2227	Fig. A	Fig. C	NA
TXB 40	2227	2227	Fig. A	Fig. C	NA
TXB 50	2236	2236	Fig. A	Fig. C	NA
TXB 60	2236	2236	Fig. A	Fig. C	NA
TXB 75	2236	2236	Fig. A	Fig. C	NA
TXB 100	2245	2245	Fig. A	Fig. C	NA
TXB 120	2254	2254	Fig. A	Fig. C	NA
FSX 5	2522	2553	Fig. A	NA	NA
FSX 10	2218	2218	Fig. A	Fig. C	NA
FSX 15	2218	2218	Fig. A	Fig. C	NA
FSX 20	2227	2227	Fig. B	Fig. D	NA
FSX 25	2227	2227	Fig. B	Fig. D	NA
FSX 30	2227	2227	Fig. B	Fig. D	NA
FSX 40	2236	2236	Fig. B	Fig. D	NA
FSX 50	2236	2236	Fig. B	Fig. D	NA
FSX 60	2245	2245	Fig. B	Fig. D	NA
FSX 75	2245	2245	Fig. B	Fig. D	NA
FSX 100	2245	2245	Fig. A	Fig. C	NA
FSX 120	2254	2254	Fig. A	Fig. C	NA
FSX 150	2263	2263	Fig. A	Fig. C	NA
FSX 200	1679	1679	Fig. A	Fig. C	NA
FSX 250	1688	1688	NA	Fig. C	Fig. E
FSX 300	1688	1688	NA	Fig. C	Fig. E
FSX 350	2290	2290	NA	Fig. C	Fig. E
FSX 500	2739	2739	NA	NA	Fig. E
FSX 600	2739	2739	NA	NA	Fig. E
FSX 800	2739	2739	NA	NA	Fig. E

torque chart

Figure A
Single Circuit
Dual Pass

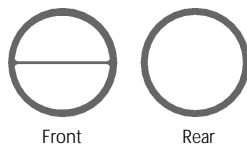


Figure B
Single Circuit
Four Pass

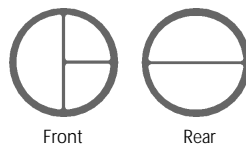


Figure C
Dual Circuit
Dual Pass

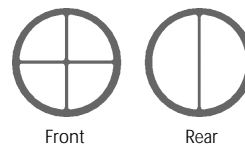


Figure D
Dual Circuit
Four Pass

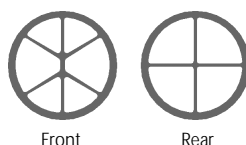
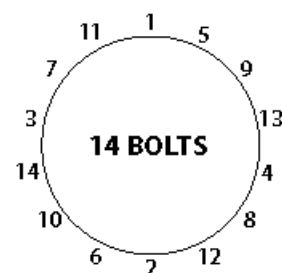
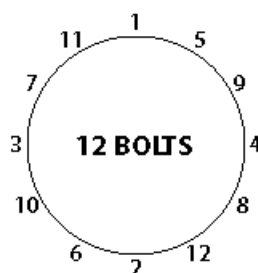
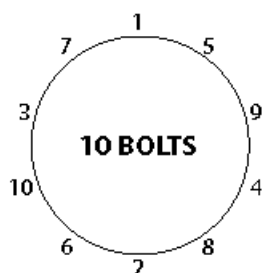
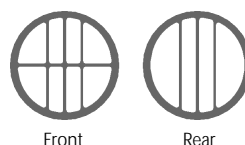


Figure E
Quad Circuit
Dual Pass



There are numerous bolt patterns used on our chillers. Illustrated above are three common configurations. If the unit that you are working on does not match one of these use the written instructions below.

1. Start at a top bolt or 12 o'clock, torque bolt.
2. Move 180 degrees to a bottom bolt or 6 o'clock, torque bolt.
3. Move 90 degrees to a bolt at 9 o'clock, torque bolt.
4. Move 180 degrees to a bolt at 3 o'clock, torque bolt.
5. Go back to the top and move clockwise one bolt and start the sequence over. Continue using the steps outlined above, using the torque steps listed in the chart at the right.

Chiller Head Torque Information

Bolt Diameter	Wrench Size	Torque Step 1*	Torque Step 2*	Torque Step 3*
1/4"	3/16" ALLEN	5	10	NA
3/8"	5/16" ALLEN or 9/16" HEX	15	30	NA
1/2"	3/4" HEX**	30	50	70
5/8"	15/16" HEX**	35	70	120
3/4"	1-1/8" HEX**	40	90	140

* All torque values are expressed in foot pounds.

** Units designed for low temperature operation (-20 degrees Fahrenheit and lower) will use B7 or B7M bolts. These bolts may have larger heads as follows:
1/2" bolt = 7/8" hex, 5/8" = 1-1/16" and 3/4" = 1-1/4".

CONDENSER INSTALLATION GUIDELINES

There are many steps involved in installing a new water cooled condenser. Following the proper procedures will help ensure a long trouble free service life for the condenser. Below is an outline of steps that should be followed. These steps are recommendations only and not a substitute for proper training and experience.

1. Inspect the condenser, any damage should be reported to the wholesaler or shipping company immediately. This is your responsibility. As with any shipping damage it is advisable to take a picture of any damage. As hard as we try to prevent it the refrigerant fittings sometimes get dinged. These can be repaired quickly with the cautious use of a hammer and a drift. There are some condensers in the 15-20 horsepower range that may make a "rattling tube" sound when handled, this is not a problem and will go away when the unit is installed and running.

2. Install the condenser using our universal brackets or factory installed brackets. Condensers should always be securely mounted.

3. Pipe up the refrigerant side of the condenser, use a solder with 45% or higher silver content and the proper flux for copper to steel joints. In some cases it will necessary to install a vibration isolator in the refrigerant inlet line to insulate the condenser from compressor vibration, a discharge muffler is advisable when the compressor is very close to the compressor. You should use a nitrogen flood to prevent the formation of oxidation on the inside of the copper lines and steel fittings while brazing. This is done by filling the unit with nitrogen and setting the regulator at 2-4 PSIG and letting it flow while you are brazing. There must be an opening to prevent pressure from building up inside unit.

4. Install a relief valve in the fitting provided. Verify the rating on the valve is not higher than the maximum allowable working pressure (M.A.W.P.) specified on our tag. A quality sealant such as Loctite 554 should be used to seal the relief valve and any other pipe thread joints on the refrigerant side of the unit.

5. Pressure test all refrigerant connections by pressurizing the condenser to 150 PSIG. Big Blu leak reactant is good for this purpose. Evacuate the condenser (see service procedure SP13R1).

6. Pipe the water side using unions, since water cooled condensers need to be cleaned occasionally this makes removing the heads easier. Dielectric unions should be installed if galvanic corrosion is a concern. The water regulating valve should be carefully sized and must be installed on the inlet side to prevent water hammers which can cause damaging vibrations. A high quality teflon based pipe dope is recommended for all water connections. If you have water leaks at the gaskets tighten the nuts holding the heads on.

7. To check the water flow start the system and measure the pressure drop across the inlet and outlet. Compare this to the data published in our catalog. This is best done when the unit is new since fouling, which is normal and acceptable, will cause a slight increase in pressure drop. Excessive pressure drop indicates too much water flow which will shorten the service life of the unit.

8. Make sure that you are not sending any abrasives such as sand or silt through the unit, this is particularly a concern when you are using river water. Install or maintain a filter or strainer if debris or sediment is a problem. Also ensure that you are not entraining air or gas in the water inlet at the pick-up point, this will cause cavitation which will lead to premature failure.

9. If you have followed the above mentioned guidelines and when you start the unit it makes a rattling noise the source of the vibration is probably the water side. You may need to install vibration dampeners in the water piping.

Selection Guidelines

There are many things to consider when selecting a condenser, criteria such as performance and pumpdown capacity is covered in our condenser catalog. Below are factors that affect longevity.

Size: The use of too small of a condenser will force you to run an excessive amount of water through it to maintain head pressure. This will cause premature failure through impingement corrosion or cavitation. The small amount of money that you may save by buying a smaller condenser will be lost since damage caused by impingement corrosion will not be covered under warranty.

Material: Few applications have ideal water. Tower systems can be treated. If you are using city, well, or river water you can not economically treat your water and if the water quality is poor you can quickly damage a unit. We recommend the Langelier and Ryznar indexes to assess your water quality. These are simple tests that can be done by a local laboratory at a reasonable cost. Give them a sample of the water that will be run through the unit. This will give you an idea if your water is corrosive, balanced or scale forming and help you decide if you need to treat your water or go to a cupronickel or stainless steel unit. Damage to a misapplied unit is covered under warranty.

Water Quality & Velocity

As mentioned in the above section water quality can affect the service life of a condenser. It is your responsibility to make sure that you are the water you are using is compatible with the condenser, or you must select a unit to handle harsh water conditions or treat the water. Again, as mentioned above excessive velocity will shorten the service life off a condenser. Velocities must be below 8 feet per second (FPS) in units

condensers

with copper and cupronickel tubes and below 12 FPS for stainless steel. Additionally, stainless units risk biological fouling if operated below 5 FPS. Too low of a velocity in any unit will provide poor performance. All values in our catalog are within these ranges.

Frozen Condensers

We receive many condensers that have been frozen. This commonly occurs when a large amount of refrigerant is lost out of a condenser quickly. The most frequent cause is the relief valve opening due to excessive head pressure. This is caused by high water temperature or the shut down of water flow to the condenser. Other causes are mistakenly removing refrigerant from an idle unit or accidental breakage of a liquid line. Pumps should be on circuits that will not be shut off while the compressor is running and lines should be protected from accidental damage. Freeze ups are also caused by not completely draining a condenser that is exposed to low air temperatures. The only way to be certain that a unit is completely drained is to loosen the nuts holding the heads on and pulling the head and gasket away from the tubesheet. Simply removing a drain plug does not ensure that all of the water will be drained from the unit. Freeze ups are not covered under warranty.

Welding Repair Notes

If a weld repair is necessary on a chiller you must determine what type of unit it is since different rules apply. You must also determine whether or not the part that you need to repair is a code part. Most condenser water plates are not code items and you may weld on them as necessary. The exception to this would be a "UM" or "U" condenser that has a tube side rating on the steel tag, such as our HP line of condensers. Heads on these units are code parts.

UL: These are smaller units and can be identified by an adhesive label that says "built" in the upper right corner followed by a nine digit serial number. You can weld on these as necessary. It is your responsibility to use proper procedures and a qualified welder. You accept all liability for these repairs.

UM & U: These are medium and larger units identified by a steel tag welded to the unit. The UM units have a UM symbol in the upper left corner of the tag and says "MFR. SER. NO." followed by a six character serial number with the first being a letter and the remaining five being numbers. The U units have a U symbol in the upper left corner and say "MFR. SER. & NAT'L BD. NO." followed by a six digit number across the top. Any welding done on either of these units must be done by an ASME certified welder that holds an "R" stamp, following proper procedures. An R-1 form must be completed. Welding by an unauthorized welder or removal of the steel tag voids the warranty and the vessel's certification with the National Board. SP23R1

CONDENSER CLEANING INFORMATION

As condensers, run, deposits accumulate in the tubes, inhibiting heat transfer. This raises head pressure and utility costs. With good water, condensers can run for years without cleaning, but, poor quality water can build up enough deposits to cause a drop in performance in a very short time. Below is information that will help you clean your condenser. The importance of controlling water quality and proper condenser maintenance can not be overstated.

Soft deposits

Soft deposits are really biological growth in the form of mud, slime and algae resulting from the use of river water or poorly controlled tower water. This is best cleaned using a pneumatic tube cleaning gun which forces plugs down the tubes. Some have a brush between two rubber plugs and others are specially designed plugs which scrape the tube walls as they travel down the tube.

Scale

Scale is minerals that have been deposited on the inside of the tubes resulting from the use of water with high alkalinity. These deposits are harder to clean and require special equipment. These systems utilize a flexible shaft which rotates a brush as it is fed down the tube, they can also simultaneously flush out the tubes with water. There is a wide variety of brushes and tools available that attach to the shaft to clean both soft and hard deposits.

Corrosion

If you find evidence of corrosion or pitting in the tubes, on the tubesheets or water plates some investigation is in order. This can be caused by poor water quality, inadequate or excessive velocity. The investigation should begin by taking a water sample to a local lab and having them run the Langelier and Ryznar indexes (see service bulletin SB12R1). If the water quality is found to be bad it should be corrected immediately and you should repair the damage to the condenser if possible. You should then check the water velocity through the unit. Check the flow in GPM through the unit and call us, we will calculate the velocity. Velocity through units with copper and 90/10 cupronickel tubes should not exceed 8 FPS. Stainless steel is acceptable for velocities up to 12 FPS, but, must not drop below 5 FPS or biological fouling can occur.

Acid Cleaning

We do not recommend acid cleaning, since if it is not done perfectly and fully neutralized it can do severe damage.

Sources for Cleaning Equipment

Goodway Technologies
Stamford, CT
800 243-7932
www.goodway.com
SP24R1

Thomas C. Wilson
Long Island City, NY
800 230-2636
www.tcwilson.com

CONDENSER TUBE LEAK TEST PROCEDURE

If you suspect that you have a leak in a condenser you need to verify this. Electronic leak detectors can not be used to verify a leak. Using an electronic leak detector with heavily chlorinated water will give false indications of a leak.

1. Shut system down and turn off water to the condenser and remove the water plates (see condenser gasket replacement procedures).

2. Put a pressure gauge on the high side of the system and check the pressure, you want 150 PSIG. If pressure is higher, that is fine, if it is lower, you will have to raise it. This is best done using a heat lamp. If the unit has already been removed from the system, securely plug all fittings and pressurize with nitrogen. Once you have reached 150 PSIG start by leak checking the tube to tubesheet joints by spraying or brushing a leak detecting soap solution on the tubesheet, we recommend Sherlock by Winton for this. If you have corrosion on the tubesheet clean it with a wire brush before leak checking. Let the bubbles that form when applying pop and then look for a thick white froth around the outside diameter of each tube which indicates a leak. After an hour verify that you still have 150 PSIG, reapply soap, recheck, if no leaks are found go to step 3.

3. There are three methods for checking leaks inside of the tubes. All of these should be done with the 150 PSIG still on the unit.

Method A. For this method you will need a bubbler. This is easily made by drilling a hole in an appropriate size rubber plug, insert a tube through the hole and insert the other end into a clear glass jar half filled with water. Plug the tubes at one end with rubber plugs and insert the bubbler into each tube at the other end individually and observe the jar for bubbles for 20-30 seconds on each tube. A leaking tube will produce bubbles in the jar. This is the best method.

Method B. Plug the tubes at one end with rubber plugs and form bubbles at the other end using Big Blue leak detecting solution by Refrigeration Technologies (800-869-1407). Watch for bubbles that rapidly expand and pop.

Method C. Plug both ends of the tubes and let unit sit for 12 hours, leaking tubes will pop one of the plugs out.

4. If leaks are found you must repair, replace or plug leaking

tubes. You must also take corrective action to eliminate the conditions that caused the failure. Large leaks coming from inside of a tube can be an indication that the unit was frozen. This can be caused by low ambient temperature or the loss or removal of gas from the unit which lowers the refrigerant pressure below the freezing point, which freezes the water and ruptures the tube from the inside out. SP17R1

TUBE PLUGGING PROCEDURE

If you must plug a tube in a chiller or condenser, follow the steps below to ensure the repair is permanent. NOTE: Never plug more than 10% of the tubes in any one refrigerant or water pass.

1. Chiller: If the tube has a blister in it due to a freeze-up, you must work it down before installing the plug. This can be done using a large line up punch. Drive the tapered punch into the tube using light hammer taps until the punch bottoms in the hole. Work the punch around the inside of the tube and remove it.

Condenser: Remove all scale, deposits and excess epoxy. A tube cleaning brush on an drill works well for this.

2. Select a plug of the proper size and material. If you are not sure which is the correct size, contact one of the suppliers listed below. Plugs can be ordered in one or two piece, either one will work. Measure the inside diameter (ID) of the tube, after cleaning, before you call. If you are making your own plugs measure the ID of the tube to be plugged. The plug should be 3 inches long and taper .010" per inch. The ID you measured will be the diameter in the center of the plug, add .015", this will be the size of the large end, subtract .015" and this will be the size of the small end. In other words, if your tube ID is .570", the plug will run from .555" to .585". The material must be compatible with the tube being plugged. Copper and cupronickel tubes should be plugged with brass, carbon steel with carbon and stainless steel with stainless.

3. When you have the plug ready you must clean the hole. This can be done using Virginia # 10e solvent or acetone. Thoroughly clean the inside of the hole and the plug, allow to solvent evaporate.

4. Apply a thick ring of Loctite 277 to the plug and the ID of the tube. On two piece plugs also put Loctite on the inner hole of the plug and on the drive pin. Loctite 554 or 290 can also be used.

5. Insert the plug in the hole and drive it in using a 2-3 pound hammer. Strike the plug squarely, glancing blows will bend the plug. 3-5 firm blows should seal the plug. Apply pressure and check for leaks. If leaks are found strike again. NOTE: Do not drive plug in any further than necessary to seal the plug, excessive force can cause leaks in adjacent tubes. Let Loctite cure for 1 full hour.

condensers

6. Cut off the excess plug only if it will interfere with the installation of the head.

Plug Sources

Cooper Powertools/
Airtools Operator
Springfield, OH
937 323-4981
www.cooperindustries.com

Elliott Tool Technologies, Ltd.
Dayton, OH
800 332-0447 513 253-6133
www.elliotttool.com

Tupros
Springfield, OH
800 872-5340 513 325-5044
www.tupros.com

SP19R2

MARINE SHELL & TUBE SEASONAL MAINTENANCE PROCEDURE

It is important to remember that a sea water environment is hostile and unpredictable. Waters found in Houston Harbor are not the same as those found in the Pacific Northwest.

The presence of salt will do much to accelerate the rate of deterioration of a heat exchanger. Cupronickel is used primarily to protect against that possibility.

Moreover, sea water is not simply salt water. There are also particulate contaminations such as sand, mud, and dirt; there can be marine life which can end up in the tubes, die and cause highly corrosive by-products. And there are numerous chemicals from processing plants present in rivers that feed into the sea.

Each of these contaminants has its own effect on condensers. Sand, for example, will cause erosion of the tubes and tubesheets. If velocity is not sufficient, biological material lays in the tubes and deteriorates into by-products, such as ammonia, which is highly corrosive to copper bearing alloys.

This causes what is known as under-deposit corrosion. High sulfur content can cause rapid deterioration, because sulfur is highly corrosive to copper bearing materials. Phosphorous compounds in sea water can cause embrittlement by combining with the nickel in cupronickel and forming nickel-phosphides.

Finally, free electric current which is a common characteristic of many boats can cause condenser deterioration.

To control these problems, Standard has added an epoxy coat to the cupronickel tubesheets, giving tubesheet surfaces and tube joints protection against chemical attack and sand.

Sacrificial Zinc Plates

A sacrificial zinc plate, which used to be included on all Standard MS units, is no longer necessary, due to advancements in Standard's manufacturing process. Optional zinc

plates to be added between the rear gasket and the endplate, are available from the factory.

NOTE: Units with zinc plates require a different rear endplate and set of studs than units without zinc plates.

If you are adding a zinc plate in the field remember to order the appropriate endplate and stud set.

With regular maintenance of the epoxy coating on the tubesheet, your shell and tube marine condenser should give you many, many years of fine service.

Seasonal Procedure

1. At the end of each fishing season, every six months, or whenever the condenser would stagnate for over 36 hours, water should be drained from the condensers. Stagnant water left in a heat exchanger for long periods of time can cause deoxidization of the water, greatly increasing the level of corrosion in any given heat exchanger.
2. Every six months or at the end of the fishing season, the tubesheets should be brushed clean and a fresh coat of epoxy should be used to protect its surface (Epo-Lux #154 by Steelcote or equivalent, is recommended). Epoxy should be allowed to cure completely. A gasket should be added to give protection for the upcoming season's activities.
3. Water plates should be put back on the condenser and torqued to 25 ft-lb on each bolt.

SHELL AND TUBE CONDENSER GASKET REPLACEMENT PROCEDURE

1. Before starting work ensure that you have the correct gaskets.

In most cases this can be done by comparing the gaskets that you have on hand with the illustration in the appropriate catalog. On most condensers the gasket part number will be stamped into the top of the circumferential weld on each end.

2. Make sure that the water supply to the condenser is shut off.
3. If the unit is equipped with a drain plug in the either head remove it to drain the unit and piping. NOTE: some water will remain in the unit below the level of the drain plug. To remove the remaining water and on units with no drain plugs you will have to remove the rear head to completely drain the unit. To do this remove the nuts and pull the bottom of the head away from the vessel. If the head does not come away from the unit easily, tap the edge of the head with a hammer and large flat blade screwdriver. Once you open up a gap insert the screwdriver between the head and the tubesheet and turn the screwdriver to separate them. Use care not to scratch the gasket surface.
4. Disconnect the piping from the front head. Removing as much piping as possible will make removal and replacement of the head easier. Remove the nuts and follow the instructions

in step three if the head does not come off by hand. NOTE: some of the studs may back out when you try to remove the nuts, simply note which hole it came from and put it back in the same one during reassembly. NOTE: the water regulating valve should always be installed on the water inlet to prevent water hammers.

5. The gaskets will remain on the unit. Note the position of the gasket and use a large flat blade screwdriver to separate it from the tubesheet. Work your way around the gasket pulling it off a little bit at a time. Be careful not to scratch the gasket surface on the tubesheet.

6. If the factory applied marine epoxy on the tubesheets or water plates is damaged or corroded it should be touched up with a suitable substitute. Follow label instructions for application.

7. Install the new gaskets over the studs, push them on by hand a little bit at a time, do not force them with a tool or hammer.

8. Install the water plates and torque nuts in a criss-cross pattern to values shown in illustration.

9. Repipe front head and turn water back on check for leaks after water pressure has been on for at least 5 minutes. If a leak is found retorque in the same criss-cross pattern 5 ft/lbs higher.

SP11R1

TUBE-IN-TUBE CONDENSER GASKET REPLACEMENT PROCEDURE

1. Before starting work ensure that you have the correct gaskets.

In most cases this can be done by comparing the gaskets that you have on hand with the illustration in the appropriate catalog.

2. Make sure that the water supply to the condenser is shut off.

3. ELT, SWT & TNT: Remove all nuts from u-bolts, remove cross bars and remove end plates. Note which side gasket came off each side since they are different. NOTE: Some water will drain from unit.

4. KHX: Disconnect the piping from the front head. Removing as much piping as possible will make removal and replacement of the head easier. Remove nuts and bolts and remove end plates. Note which gasket came off each side since they are different. Peel off old gasket. NOTE: Some water will drain from unit.

5. If the factory applied marine epoxy on the tubesheets or water plates is damaged or corroded it should be touched up with a suitable substitute. Follow label instructions for application.

6. ELT, SWT & TNT: Place gaskets into end plates, ensure that the gaskets are installed on the correct side, put end plate against tubesheet and slide cross bars over u-bolts and hand tighten nuts.

KHX: Pass bolts through end plates and gaskets and guide head into place, ensure that gaskets are installed on the correct side. Hand tighten nuts.

7. ELT, SWT & TNT: Run down all nuts by hand and torque to value A, then value B. Move from the center bolts to the outer ones.

KHX: Run down all bolts by hand tighten one bolt at top, one bolt at bottom, one bolt on right side, on bolt on left side. Follow same sequence and torque bolts to value A and then value B. A wrench must be used on the nut to ensure accurate torque readings.

8. KHX: Repipe front head.

9. Turn water back on check for leaks after water pressure has been on for at least 5 minutes. If a leak is found retorque in the same torque sequence 5 ft/lbs higher.

NOTE: THE WATER REGULATING VALVE SHOULD ALWAYS BE INSTALLED ON THE INLET SIDE OF A CONDENSER. THIS WILL PREVENT VIOLENT WATER HAMMERS THAT CAN OCCUR WHEN WATER VALVES SLAM SHUT UNDER CERTAIN CONDITIONS.

SP18R1

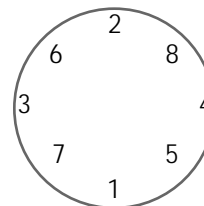
torque chart

Condenser Endplate Torque

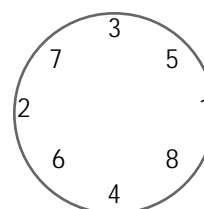
	Torque Step 1	Torque Step 2	Torque Step 3
SST*, HSE*, CA, and MSE with 1/2"-20 brass nuts (Not HP units)	15	30	NA
HP with 1/2"-20 brass nuts	15	35	NA
HP with 1/2"-20 steel nuts	CONTACT FACTORY		
ELT, TNT, SWT w/ 1/4"-20 nuts	4	8	NA
ELT, SWT with 5/16"-18 nuts	7	15	NA
KHX with 5/16"-24 nuts & bolts	7	15	NA

* For 150 ton & larger HSEs, 126 ton & larger SSTs and all AMCs use head bolt torque chart.

Sample torque sequence for SST, HSE, CA and MSE.
Use criss-cross pattern for all bolt configurations



Step 1
15 ft-lbs.



Step 2
30 ft-lbs.

Condenser Head Bolt Torque

Bolt Diameter	Wrench Size	Torque Step 1	Torque Step 2	Torque Step 3
3/8"	9/16" HEX	15	30	NA
1/2"	3/4" HEX	30	50	70
5/8"	15/16" HEX	35	70	120
3/4"	1-1/8" HEX	40	90	140

Always tighten bolts in a criss-cross sequence, i.e. start at the top, go to the bottom, then left and then right. Go to the top again and move one bolt clockwise and start sequence again.

All Torque values are expressed in foot/pounds.

Tighten the head bolts following the torque pattern sequence shown to the final torque in two steps.

gaskets & endplates cross reference

Condenser	Front Gasket GASKET—	Rear Gasket GASKET—	Front Endplate ENDPL—	Rear Endplate ENDPL—
SST 75A	3156	346	4304	30
*SST 75	337	346	49	30
SST 100A	3163	3149	5040	5026
*SST 100	175	184	67	58
*SST 150	175	184	67	58
SST 200A	3101	3170	4230	76
*SST 200	193	201	85	76
SST 300A	3101	3170	4230	76
*SST 300	193	201	85	76
SST 500A	3118	2584	4254	4047
*SST 500	210	229	120	21
SST 750A	3118	2584	4254	4047
*SST 750	210	229	12	21
SST 755A	3118	2584	4254	4047
*SST 755	238	247	12	21
SST 1000A	1723	2953	2678	4047
*SST 1000	238	247	12	21
SST 1500A	1723	2953	2263	4047
*SST 1501	2977	2584	175	4047
SST 1555A	2591	2984	4261	4180
*SST 1555	256	265	193	184
SST 2005A	2591	2984	4278	4180
*SST 2005	256	265	148	184
SST 2026A	2591	2984	4278	4180
*SST 2026	256	265	148	184
SST 2505A	2591	2984	4292	4180
*SST 2505	256	265	148	184
SST 2527A	2591	2984	4292	4180
*SST 2527	256	265	148	184
SST 3005A	2591	2984	4292	4180
*SST 3005	256	265	148	184
SST 3028A	2591	2984	4292	4180
*SST 3028	256	265	148	184
*SST 30-460M	166	111	166	157
SST 3505A	2591	2984	4292	4180
*SST 35-520M	166	111	201	157
SST 4005A	111	120	210	238
*SST 40-610M	111	120	210	238
SST 4505A	111	120	210	238
*SST 45-680M	111	120	210	238
SST 5005A	111	120	247	238
*SST 50-760M	111	120	210	238
SST 5505A	111	120	247	238
*SST 55-850M	111	120	210	238
SST 6005A	111	120	247	238
*SST 60-940M	111	120	247	238
SST 7005A	111	120	247	238
*SST 70-1060M	111	120	247	238
SST 8005A	111	120	247	238
*SST 80-1200M	111	120	247	238
SST 100-1408A	120	120	2245	2245
*SST 100-1500M	111	120	247	238
SST 120-1408A	120	120	2245	2245
*SST 126-1905M	120	120	3994	3994

Condenser	Front Gasket GASKET—	Rear Gasket GASKET—	Front Endplate ENDPL—	Rear Endplate ENDPL—
SST 150-1410A	120	120	2245	2245
*SST 150-2250M	2254	2254	'H1039	'H1039
SST 200-1412A	120	120	4335	4335
*SST 200-3000M	2263	2263	'H1048	'H1048
*SST 250-3750M	1679	1679	'H1057	'H1057
*SST 300-4500M	1688	1688	'H1066	'H1066
*SST 350-5250M	1688	1688	'H1066	'H1066
*SST 400-6000M	2290	2290	'H1921	'H1921
*SST 500-7500M	2290	2290	'H1921	'H1921
HSE 2	337	346	49	30
HSE 3	175	184	67	724
HSE 5	1066	1057	1499	724
HSE 7	1066	1057	706	724
HSE 10	1066	1057	706	724
HSE 15	445	247	2227	21
HSE 20A	1723	2953	2227	4047
*HSE 20	1723	1732	2227	21
HSE 25A	1723	2953	2227	4047
*HSE 25	1723	1732	2227	21
HSE 30A	1741	2984	2236	4180
*HSE 30	1741	1750	2236	4180
HSE 40A	1741	2984	2236	4180
*HSE 40	1741	1750	2236	4180
HSE 50A	1741	2984	2236	4180
*HSE 50	1741	1750	2236	4180
HSE 60	111	120	247	238
HSE 70	111	120	247	238
HSE 80	111	120	247	238
HSE 100	120	120	2245	2245
HSE 125	120	120	2245	2245
HSE 150	2254	2254	'H1039	'H1039
HSE 200	2263	2263	'H1048	'H1048
HSE 250	1679	1679	'H1057	'H1057
HSE 300	1688	1688	'H1066	'H1066
HSE 350	1688	1688	'H1066	'H1066
HSE 400	2290	2290	'H1921	'H1921
HSE 450	2290	2290	'H1921	'H1921
HSE 500	2290	2290	'H1921	'H1921
▲HP 10	1471	1471	2065	2074
▲HP 15	1471	1471	2092	2083
▲HP 20	1471	1471	2092	2083
▲HP 30	1462	1462	2119	2100
▲HP 40	1462	1462	2119	2100
▲HP 50	1480	1480	2137	2128
▲HP 60	1480	1480	2137	2128
▲HP 80	1499	1499	2155	2146
◊CA 050	355	364	2876	2885
◊CA 075	238	247	2911	2902
◊CA 100	238	247	2911	2902
CA 150	256	265	2920	2948
CA 200	445	247	2894	2902
CA 300	373	265	2939	2948

* Indicates that model is obsolete and no longer manufactured. • H prefix indicates 'Head' (flange) style endplate.

▲ In addition to listed gaskets, all HP condensers require gasket 1697 for use with front endplate.

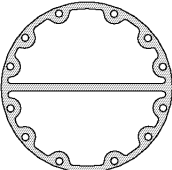
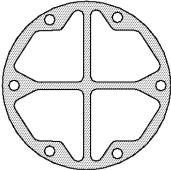

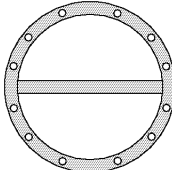
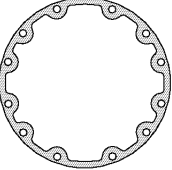
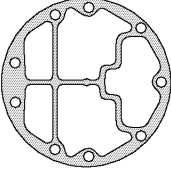

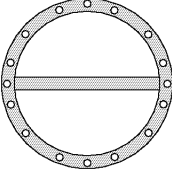
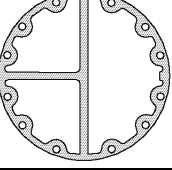
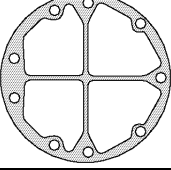

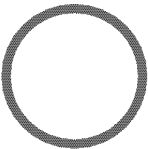
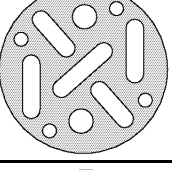
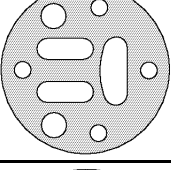

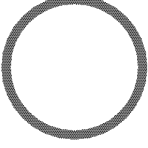
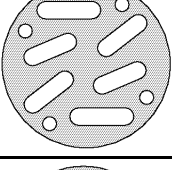
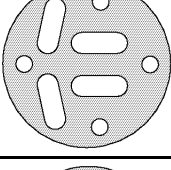

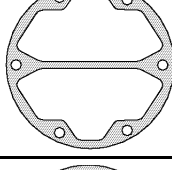
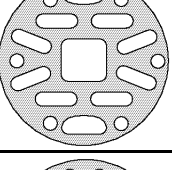
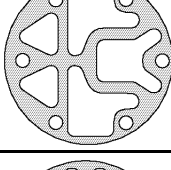

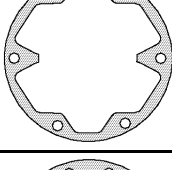
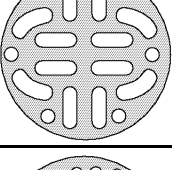
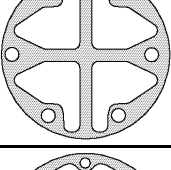
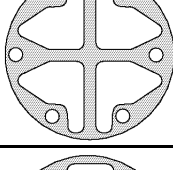
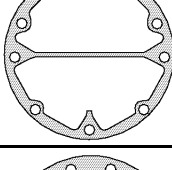
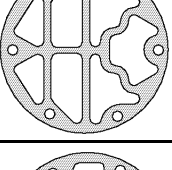
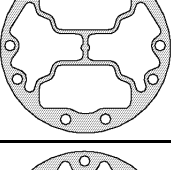
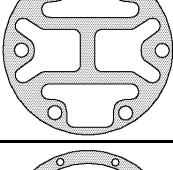
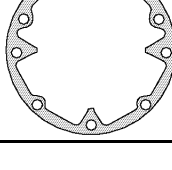
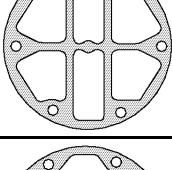
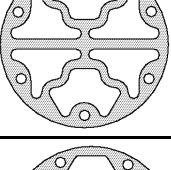
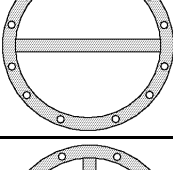
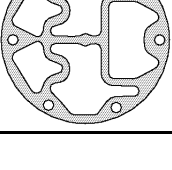
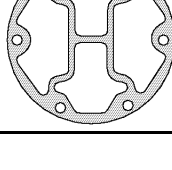
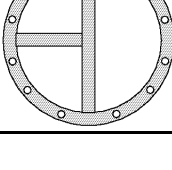
gaskets & endplates cross reference

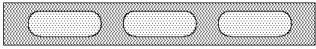
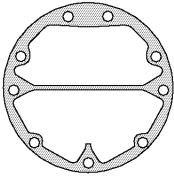

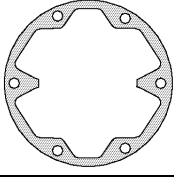
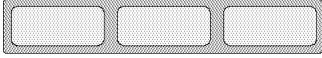
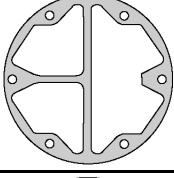

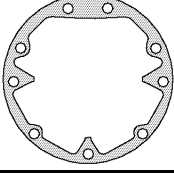
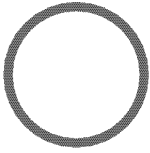
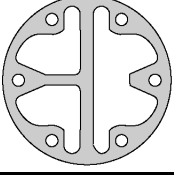
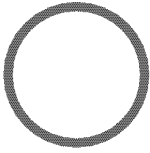
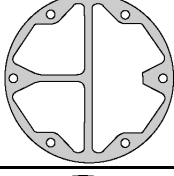
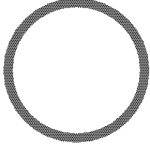
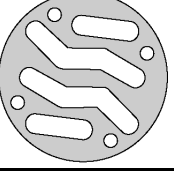
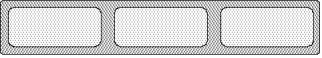
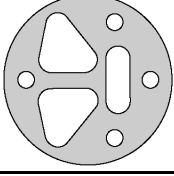
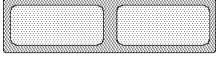
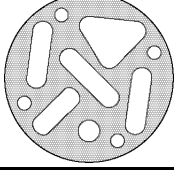
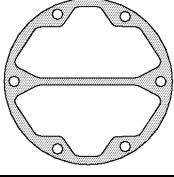
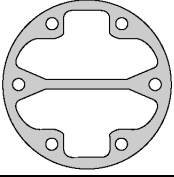
Condenser	Front Gasket GASKE—	Rear Gasket GASKE—	Front Endplate ENDPL—	Rear Endplate ENDPL—
MSE 100	3163	3149	5107	300
MSE 200	3163	3149	5107	300
MSE 300	355	364	2452	337
MSE 500	355	364	2452	337
MSE 750	1066	1057	5071	5088
MSE 1005	1061	1057	5071	5088
MSE 1500	445	2584	5095	4104
MSE 2005	1723	2953	5095	4104
MSE 2505	1723	2953	5095	4104
MSE 3006	1723	2953	5288	4104
MSE 3305	1741	2984	5121	5114
MSE 4005	1741	2984	5121	5114
MSE 4505	1741	2984	5121	5114
MSE 5005	1741	2984	5121	5114
MSE 6505	111	120	2542	5233
MSE 7505	111	120	2542	5233
MSE 100Hp	4092	4092	120	120
MSE 120Hp	4092	4092	120	120
*MS 100	175	184	328	300
*MS 150	175	184	328	300
*MS 200	355	364	2452	337
*MS 300	355	364	2452	337
*MS 500	382	229	2461	355
*MS 750	382	229	3334	355
*MS 755	445	247	3334	355
*MS 1000	445	247	3334	355
*MS 1500	445	247	2489	355
*MS 1501	1723	2953	2489	4104
*MS 1555	373	265	2498	373
*MS 2005	373	265	2506	373
*MS 2026	373	265	2506	373
*MS 2505	373	265	2506	373
*MS 2527	373	265	2506	373
*MS 3005	373	265	2506	373
*MS 3028	373	265	2506	373
*MS 30 460M	166	111	2524	2597
*MS 35 520M	166	111	2524	2597
*MS 40 610M	111	120	2533	2605
*MS 45 680M	111	120	2533	2605
*MS 50 760M	111	120	2533	2605
*MS 55 850M	111	120	2533	2605
*MS 60 940M	111	120	2533	2605
*MS 70 1060M	111	120	2542	2605
*MS 80 1200M	111	120	2542	2605
*MS 100 1500M	111	120	2542	2605
*MS 120 1901M	120	120	4092	4092
*MS 125 1900M	111	120	2542	2605
(MSE Units with Zinc Anode)				
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*MS 150Z	175	184	328	4454
*MS 200Z	355	364	2452	4461
*MS 300Z	355	364	2452	4461
*MS 500Z	382	229	2461	4478
*MS 750Z	382	229	3334	4478
*MS 755Z	445	247	3334	4478
*MS 1000Z	445	247	3334	4478
*MS 1501Z	1723	2953	2489	4485
*MS 1555Z	373	265	2498	4492
*MS 2005Z	373	265	2506	4492
*MS 2026Z	373	265	2506	4492
*MS 2505Z	373	265	2506	4492
*MS 2527Z	373	265	2506	4492
*MS 3005Z	373	265	2506	4492
*MS 3028Z	373	265	2506	4492

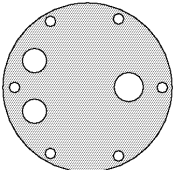
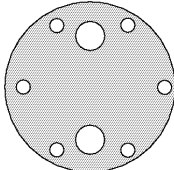
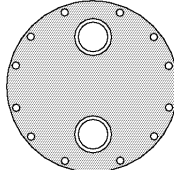
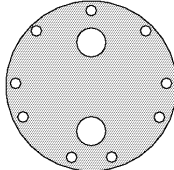
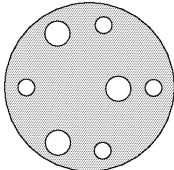
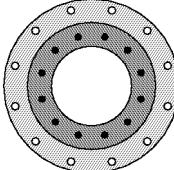
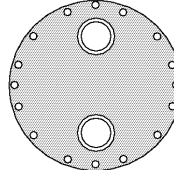
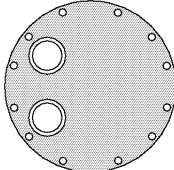
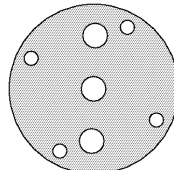
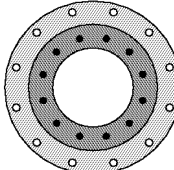
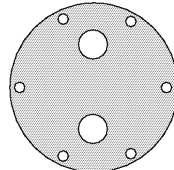
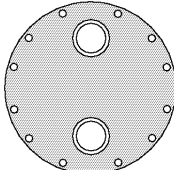
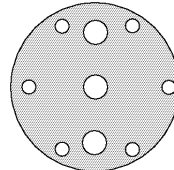
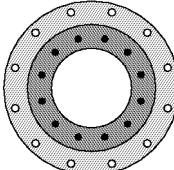
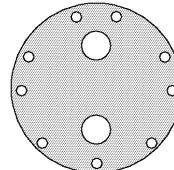
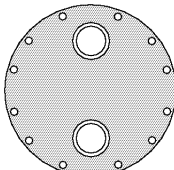
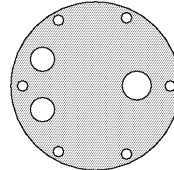
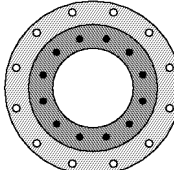
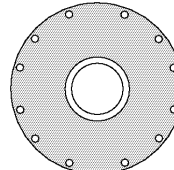
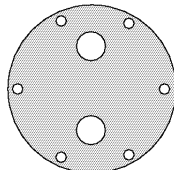
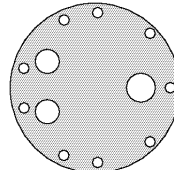
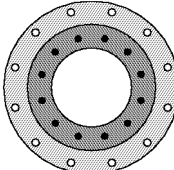
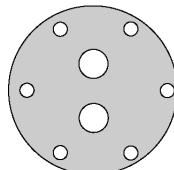
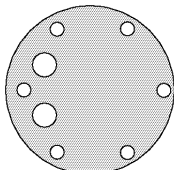
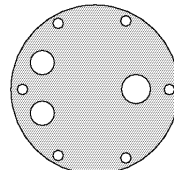
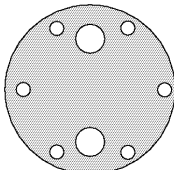
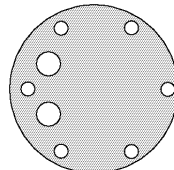
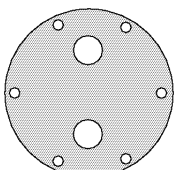
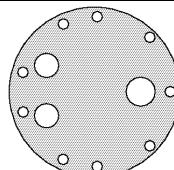
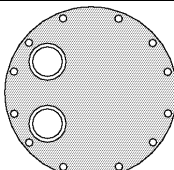
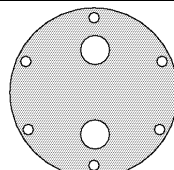
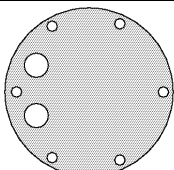
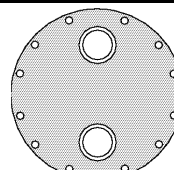
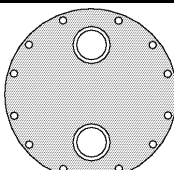
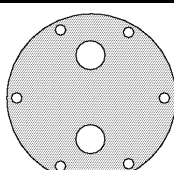
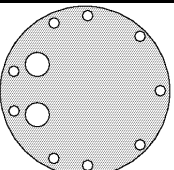
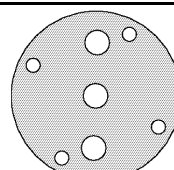
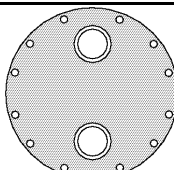
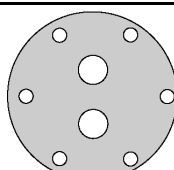
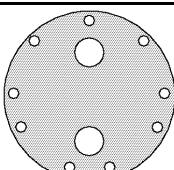
Condenser	Front Gasket GASKE—	Rear Gasket GASKE—	Front Endplate ENDPL—	Rear Endplate ENDPL—
*SM 3	355	364	2452	337
*SM 5	445	247	3956	355
*SM 7	445	247	3334	355
*SM 10	445	247	3334	355
*SM 15	445	247	2489	355
*SM 20	445	247	3918	355
*SM 21S	373	265	2506	373
*SM 25	445	247	3918	355
*SM 26S	166	111	2524	2597
*SM 30	445	247	3918	355
*SM 31S	166	111	2524	2597
*SM 35	373	265	3901	373
*SM 36S	166	111	2524	2597
*SM 40	373	265	3901	373
*SM 50	111	120	2533	2605
*SM 60	111	120	3868	2605
*SM 70	111	120	2542	2605
ELT 50	2092	2100	3046	3064
ELT 75	2092	2100	3046	3064
ELT 100	2092	2100	3046	3064
ELT 150	2092	2100	3046	3064
ELT 200	2092	2092	3424	3424
ELT 300	2191	2209	3262	3280
ELT 500	2191	2209	3262	3280
ELT 800	2461	2470	3475	3482
ELT 1000	2461	2470	3475	3482
TNT 50	2074	2083	2993	3028
TNT 75	2074	2083	2993	3028
TNT 100	2074	2083	2993	3028
TNT 150	2092	2100	3046	3064
TNT 200	2092	2100	3046	3064
KH 1 1/2X	698A	698B	1840	1796
KH 2X	698A	698B	1840	1796
KH 3X	698A	698B	1840	1796
KH 5X	706A	706B	1859	1813
KH 7 1/2X	724A	724B	1868	1831
KH 10X	724A	724B	1868	1831
*SWT 50	2092	2092	4061	4061
*SWT 75	2092	2092	4061	4061
*SWT 100	2092	2092	4061	4061
*SWT 150	2092	2092	4061	4061
*SWT 200	2191	2191	4078	4078
*SWT 300	2191	2191	4078	4078
*SWT 500	2191	2191	4078	4078

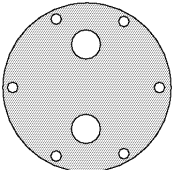
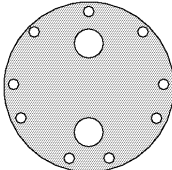
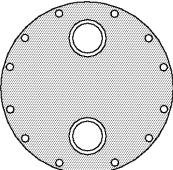
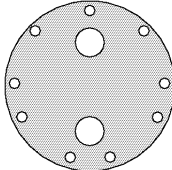
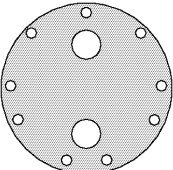
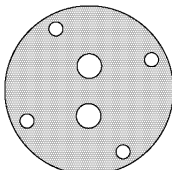
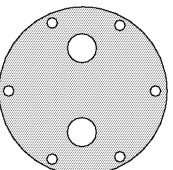
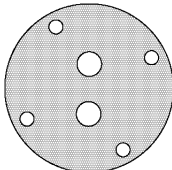
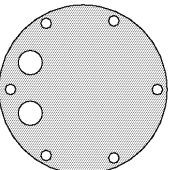
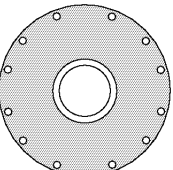
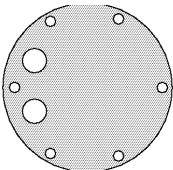
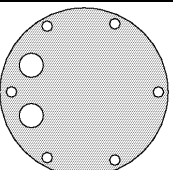
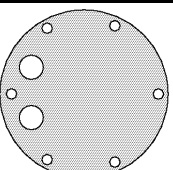
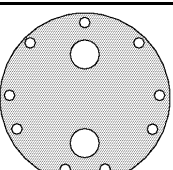
* Indicates that model is obsolete and no longer manufactured.

◊ The unit requires two sets of gaskets.

111 12 3/4" Dia. 12 Studs 	247 8 5/8" Dia. 6 Studs 	698A 	1480 12 3/4" Dia. 12 Studs 
120 12 3/4" Dia. 12 Studs 	256 10 3/4" Dia. 9 Studs 	698B 	1499 14" Dia. 12 Studs 
166 12 3/4" Dia. 12 Studs 	265 10 3/4" Dia. 9 Studs 	706A 	1679 19 11/16" Dia. 
175 6" Dia. 4 Studs 	337 5" Dia. 4 Studs 	706B 	1688 21 11/16" Dia. 
184 6" Dia. 4 Studs 	346 5" Dia. 4 Studs 	724A 	1723 8 5/8" Dia. 6 Studs 
193 6 5/8" Dia. 6 Studs 	355 6 5/8" Dia. 6 Studs 	724B 	1732 8 5/8" Dia. 6 Studs 
201 6 5/8" Dia. 6 Studs 	364 6 5/8" Dia. 6 Studs 	1057 6 5/8" Dia. 6 Studs 	1741 10 3/4" Dia. 9 Studs 
210 8 5/8" Dia. 6 Studs 	373 10 3/4" Dia. 9 Studs 	1066 6 5/8" Dia. 6 Studs 	1750 10 3/4" Dia. 9 Studs 
229 8 5/8" Dia. 6 Studs 	382 8 5/8" Dia. 6 Studs 	1462 10 3/4" Dia. 12 Studs 	2074 tube-in-tube gasket No picture available
238 8 5/8" Dia. 6 Studs 	445 8 5/8" Dia. 6 Studs 	1471 8 5/8" Dia. 12 Studs 	2083 tube-in-tube gasket No picture available

2092 1 3/16" x 9 1/16" 	2591 10 3/4" Dia. 9 Studs 		
2100 1 3/16" x 6 5/16" 	2953 8 5/8" Dia. 6 Studs 		
2191 2 9/16" x 15 3/4" Dia. 	2977 8 5/8" Dia. 6 Studs 		
2209 2 9/16" x 15 3/4" Dia. 	2984 10 3/4" Dia. 9 Studs 		
2254 14 11/16" Dia. 	3101 6 5/8" Dia. 6 Studs 		
2263 16 11/16" Dia. 	3118 8 5/8" Dia. 6 Studs 		
2290 25" Dia. 	3149 6" Dia. 4 Studs 		
2461 3 1/4" x 20 1/4" Dia. 	3156 5" Dia. 4 Studs 		
2470 3 1/4" x 13 1/2" Dia. 	3163 6" Dia. 4 Studs 		
2584 8 5/8" Dia. 6 Studs 	3170 6 5/8" Dia. 6 Studs 		

<p>12</p> <p>8 1/2" Dia. 6 Studs</p> 	<p>706</p> <p>6 5/8" Dia. 6 Studs</p> 	<p>2137</p> <p>12 3/4" Dia. 12 Studs</p> 	<p>2506</p> <p>10 3/4" Dia. 9 Studs</p> 
<p>49</p> <p>5" Dia. 4 Studs</p> 	<p>H1039</p> <p>17 7/8" Dia.</p> 	<p>2155</p> <p>14" Dia. 16 Studs</p> 	<p>2524</p> <p>12 3/4" Dia. 12 Studs</p> 
<p>67</p> <p>6" Dia. 4 Studs</p> 	<p>H1048</p> <p>19 7/8" Dia.</p> 	<p>2227</p> <p>8 5/8" Dia. 6 Studs</p> 	<p>2533</p> <p>12 3/4" Dia. 12 Studs</p> 
<p>85</p> <p>6 5/8" Dia. 6 Studs</p> 	<p>H1057</p> <p>22" Dia.</p> 	<p>2236</p> <p>10 3/4" Dia. 9 Studs</p> 	<p>2542</p> <p>12 3/4" Dia. 12 Studs</p> 
<p>120</p> <p>8 5/8" Dia. 6 Studs</p> 	<p>H1066</p> <p>24" Dia.</p> 	<p>2245</p> <p>12 3/4" Dia. 12 Studs</p> 	<p>2678</p> <p>8 5/8" Dia. 6 Studs</p> 
<p>148</p> <p>10 3/4" Dia. 9 Studs</p> 	<p>H1921</p> <p>28" Dia.</p> 	<p>2263</p> <p>8 5/8" Dia. 6 Studs</p> 	<p>2876</p> <p>6 5/8" Dia. 6 Studs</p> 
<p>175</p> <p>8 5/8" Dia. 6 Studs</p> 	<p>1499</p> <p>6 5/8" Dia. 6 Studs</p> 	<p>2452</p> <p>6 5/8" Dia. 6 Studs</p> 	<p>2894</p> <p>8 5/8" Dia. 6 Studs</p> 
<p>193</p> <p>10 3/4" Dia. 9 Studs</p> 	<p>2065</p> <p>8 5/8" Dia. 12 Studs</p> 	<p>2461</p> <p>8 5/8" Dia. 6 Studs</p> 	<p>2911</p> <p>8 5/8" Dia. 6 Studs</p> 
<p>247</p> <p>12 3/4" Dia. 12 Studs</p> 	<p>2092</p> <p>8 5/8" Dia. 12 Studs</p> 	<p>2470</p> <p>8 5/8" Dia. 6 Studs</p> 	<p>2920</p> <p>10 3/4" Dia. 9 Studs</p> 
<p>328</p> <p>6" Dia. 4 Studs</p> 	<p>2119</p> <p>10 3/4" Dia. 12 Studs</p> 	<p>2489</p> <p>8 5/8" Dia. 6 Studs</p> 	<p>2939</p> <p>10 3/4" Dia. 9 Studs</p> 

3334 8 5/8" Dia. 6 Studs 	4278 10 3/4" Dia. 9 Studs 		
3868 12 3/4" Dia. 12 Studs 	4292 10 3/4" Dia. 9 Studs 		
3901 10 3/4" Dia. 9 Studs 	4328 6" Dia. 4 Studs 		
3918 8 5/8" Dia. 6 Studs 	5040 6" Dia. 4 Studs 		
3956 8 5/8" Dia. 6 Studs 			
4092 12 3/4" Dia. 12 Studs 			
4230 6 5/8" Dia. 6 Studs 			
4247 8 5/8" Dia. 6 Studs 			
4254 8 5/8" Dia. 6 Studs 			
4261 10 3/4" Dia. 9 Studs 			

SIGHT GLASS

REPLACEMENT PROCEDURE

If a sight glass is leaking or broken and needs to be replaced follow the instructions below to ensure a permanent repair.

1. Ensure that all refrigerant is recovered and the unit is isolated.
2. Remove old sight glass, if you are going to reuse it, you must remove all of the old sealant from the threads with a wire brush. You will have the most success if you use a new sight glass.
3. You must also clean the threads in the coupling, use a wire brush, dental pick or a tap to do this. When using a tap do not cut the threads any deeper, just use it to clean them. Keep as much residue of the old sealant out of the unit as possible.
4. Clean the threads in the coupling and on the sight glass with Loctite # 7649 primer (PN 21348), Virginia # 10e solvent, acetone, lacquer thinner or automotive brake cleaner such as CRC Brakleen part # 05088. Clean as many times as necessary to remove all oil and moisture. Allow solvent to evaporate fully before proceeding.
5. Apply Loctite # 554 thread sealant (PN 55441), put 3-4 drops on the first 2 threads in the coupling and a heavy ring around the sight glass covering the 1st 4 threads.
6. Thread the sight glass into the coupling by hand as far as possible and torque to value specified in table below, wipe off excess sealant from threads.
7. Allow sealant to cure at least 1 full hour before putting unit back in service, the longer you let it cure the stronger the bond.
8. Evacuate properly prior to putting system back into operation.

Sight Glass Torque Specifications

NPT size	Standard part #	torque in foot/pounds
3/8"	NA	30
1/2"	SG04	40
3/4"	SG06	45
1"	SG08	55
1-1/4"	SG10	65
1-1/2"	NA	75
2"	GLASS193	100
SP20R3		

LIQUID LEVEL INDICATOR MAINTENANCE

Location

Units require a factory installed flange. Available for 8 5/8 OD and larger horizontal receivers only.

Normal location is on the side, centered between the liquid inlet and outlet connections. Other locations may be provided if specified. Note that at least six inches are required between centers of adjacent units, and also between a unit and the liquid outlet pickup tube.

These can be mounted in the center of either end, provided the respective inlet or outlet fitting is moved to 1 1/2 tank diameters from that end.

A sketch must accompany orders for other than standard location.

Description

Liquid Level Indicator

Model part numbers vary depending on vessel OD.

The dial reads percent of pumpdown capacity of the receiver: when the pointer indicates 100%, the receiver is 80% full of liquid.

Pounds of refrigerant can be determined by taking the indicated percentage of the specified pumpdown capacity of the receiver.

Liquid Level Alarm Switches

Model part number: INDIC58A

Single pole single throw.

Contacts close on decrease of liquid level at 20% pumpdown.

Switch Duty AC

Max. Volts 120/240

Max. Amps 1 (inductive)

Max. Watts 75/150

Note: limited electrical capacity of switches.

Operation

Movement of the seamless aluminum float rotates a magnet on the inner side of the solid aluminum alloy head. The indicator pointer, or switch contacts, are on the outer side and are operated by a small magnet which follows the position of the inner magnet. There is no connection, except the magnetic field, between the inside and outside. Internal gears and bearings are stainless steel.

In case of external damage, the indicator dial or switch cartridge may be replaced from outside so the refrigerant charge is not disturbed.

receiver accessories

The seal between the mounting flange and the gauge head is a gasket which is suitable for halocarbon refrigerants. These units should not be used with any other liquids unless compatibility of the seal and metals has been checked and approved by Standard.

Installation

Liquid level indicators are an inexpensive, effective means of gauging the refrigerant level in a horizontal receiver. However care must be exercised to properly install the unit to prevent leaks and insure its proper operation.

The receiver must be level, especially if the indicator is at one end. Check with a level. The indicator flange face should be vertical.

Any projections on the face of the flange caused by shipping or handling must be removed to ensure the gasket seats properly. A very light film of refrigerant oil, or a light grease may be used if desired. Do not use a heavy sealing compound, or anything that sets hard.

Install as follows (see Note for 8 5/8 and 9 3/4 OD units). Hold head up and float end toward flange. Start float into flange. Swing head down and in at same time (wiggle slightly to check against binding).

When all the way in, check to be sure float is free by rotating head slightly each way. Indicator pointer swings with float. Alarm makes no sound, but a slight jar can be felt when the float swings to the upper and lower stops.

Keep the head snug against the gasket and rotate it to right side up. Note the upper lug holding the dial, or switch, is rounded, the bottom one is square.

Install screws finger tight, then, tighten screws evenly to a final torque of 10-12 ft-lbs. There should be an equal clearance space between the indicator body and the flange face when the required torque is reached.

Note

The 8 5/8 and 9 3/4 OD indicators should be started differently, or the float rod may be bent. Hold the unit with the stem horizontal and parallel to the tank, with the head to the right of the flange (upper stop will keep the float from dropping). Swinging the head from right to left and in. Check float travel with head about two inches out from the flange, then rotate to right side up and insert the rest of the way.

General Specifications

Gasket: neoprene flat gasket fits current indicator & alarm adapter on units manufactured after 1972 (Part Number: Gaske-995)

See Liquid Level Gasket replacement Procedure for more information.

Temperature

Operating temperature range + 150°F. and -30°F.

Humidity

Exposed portion should be painted for marine applications.

Tank pressure

28" vacuum 0 to 500 psi.

Burst pressure

Gasket will unseat at approximately 2,500 psi.

External pressure

Normal atmosphere to 30,000 feet.

LIQUIDLEVEL INDICATOR- ALARM MAINTENANCE

Model part number: INDIC-210A

Application

This indicator-alarm with selectable low-level point is designed for use in applications where low liquid level protection is desirable. It provides a relay circuit that closes at one of five user selectable levels of from 10 to 50%. This relay circuit can be used to drive a variety of applications from alarms to pumps. The indicator-alarm also provides a direct, visual indication of the liquid level in the tank.

Description

This liquid level indicator-alarm features a four bolt brass head that accommodates the direct attachment of the 4" steel junction box. Other indicator-alarm components are of either stainless steel or aluminum. All of these metals are fully compatible with common refrigerants and lubricants.

The indicator-alarm float is magnetically coupled to the indicator-alarm sender. This provides a static seal for no-leak reliability and allows the sender to be replaced if necessary without evacuating the tank.

Each indicator-alarm uses highly reliable and accurate, three wire, voltage divider technology to send the level signal to the level alarm, relay circuitry. The voltage divider uses thick film element in conjunction with a multi-fingered contact to ensure accuracy and reliability. The connector built into the indicator-alarm mates with a standard Packard automotive type, rubber sealed connector for easy installation and reliable connections.

The case and integral crystal of the indicator-alarm are made of polycarbonate.

The case halves are ultrasonically welded together to obtain a hermetic seal.

General Specifications

Temperature

Operating temperature range +158°F. and -4°F.

Working pressure

410 psi.

Power Rating

5 amps, 240 volts ac maximum.

Voltage Input

110 or 220 volts ac.

LIQUID LEVEL INDICATOR GASKET REPLACEMENT PROCEDURE

If you have need to replace the liquid level indicator (LLI) or LLI block off plate gasket follow the procedure outlined below.

1. Recover all refrigerant. You must ensure that all pressure is relieved prior to removing the indicator or plate.
2. Remove the 4 bolts and remove the indicator. You will have to work the head around to get the float out. It is okay to deflect the rod slightly, but, do not bend it.
3. Clean the flange and indicator gasket surfaces with a solvent such a Virginia # 10e. Also clean the gasket until it has a shiny black appearance. Allow all three parts to dry.
4. Place gasket on the indicator and work it back into place. Seat the indicator gasket in the groove machined into the flange.
5. Torque the bolts 30 in/lb in a criss cross pattern and then 60 in/lb.
6. Pressurize the receiver with nitrogen and test with a leak reactant such as Big Blu (Refrigeration Technologies (800-869-1407). If you see a leak identify if it is coming through a porosity in the casting or the gasket. If it is the indicator replace the indicator. If it is the gasket tighten the bolts again and retest.

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EVACUATION PROCEDURE

Any time you install a new refrigeration component or open a system, you must properly evacuate it. The following steps will help to insure that the system is dry and free from non-condensables. If the system has been flooded due to a freeze-up of a chiller or condenser follow the dehydration instructions.

Sporlan has a good written procedure for clean up after a compressor burn out.

Evacuation

1. Pressure test all connections by pressurizing with nitrogen to 150 PSIG and using leak reactant, Big Blu is good for this. NOTE: remember when testing with nitrogen, that it is a non condensable and will accumulate in the condenser and raise head pressure if it leaks past valves.
2. After you have verified there are no leaks, vent the nitrogen and evacuate to 5000 microns. Use a micron gauge, a gauge manifold is not accurate enough.
3. Break vacuum with nitrogen, pressurize to 50 PSIG and vent.
4. Evacuate to 500 microns and isolate the unit and micron gauge. Note the initial reading and observe the gauge for 20 minutes. The reading should not rise more than 50 microns on a new system and 100 microns on a used system in that time. Any decay above that level is an indication of non condensables still in the system or a leak. Once the system holds to no more than 600 microns for 20 minutes break the vacuum with refrigerant. Remove the vacuum pump. The system is now ready for charging.

Evacuation Tips

1. Use a large enough vacuum pump, 1 CFM per 7 tons is a rule of thumb. Always start with fresh oil in the vacuum pump. Keep open containers of oil tightly capped since it is very hygroscopic. Change the oil as soon as it shows signs of moisture in it. Keep the gas ballast valve open until the vacuum is down to 29" of vacuum or 25,000 microns, then close.
2. Use a gauge manifold with a 3/8" vacuum line. Connect the 3/8" hose to the vacuum pump and the 2) 1/4" lines to the system.
3. Whenever possible remove the cores from the 1/4" SAE fittings that you are connecting your hoses to. If you have done this you should also remove the core depressors from your hoses. The fewer restrictions there are in the path that the vacuum will be pulled through the faster the vacuum will come down.
4. Low temperatures make it harder to pull a vacuum, water boils at 101 degrees F at 27.95" of vacuum but at 53 F you must pull the vacuum down to 29.53" or 10,000 microns and at 1 degrees F water boils at 29.88" or 1,000 microns. Isolating a

chiller and raising the temperature will make the evacuation go much faster. This can be done by draining the unit and letting it warm up or by running warm fluid through it.

5. If you are evacuating the compressor crankcase make sure that the crankcase heater is on. Change compressor oil as needed.
6. Replace dryer or cores anytime you open a system.
7. You can expect to pull 1" less of a vacuum per 1000' of elevation above sea level.

Dehydration

1. If the failure was in a chiller, blow the tubes out with nitrogen or compressed air when the repair is done, the tubes are internally enhanced or "rifled" and will hold large amounts of water and oil. Any time spent removing fluids from the tubes before replacing the heads will result in a huge reduction in evacuation time. The condenser is more difficult to dehydrate if it has been flooded. It is usually worth the time and effort to cut the copper tubing coming from the refrigerant outlet to drain the unit. To speed this up you can blow nitrogen or compressed air through the safety fitting on the top. Repair the liquid line later with a coupling.
2. Once you have removed the bulk of fluid from the system and you have it all sealed up you can start pulling vacuum. We strongly recommend the use of a cold trap. A cold trap is a vessel that goes between the vessel or system being evacuated and the vacuum pump. It holds dry ice and has a chamber which the air being removed passes through, this causes the moisture to condense inside it, preventing it from reaching the vacuum pump and contaminating the oil. This speeds the process by eliminating oil changes and allowing the pump to run overnight unattended.
3. Although, you may have reached a good vacuum, you may still have moisture trapped in parts of the system such as suction oil traps. You will have to use dryers to remove the last traces of moisture. It is a good idea to install an oversize liquid line dryer and a suction line drier with replaceable cores to speed up the dehydration process. Use cores with a high water capacity. Remember to remove the cores from the suction line dryer once the clean up is complete or you may have performance problems due to high pressure drop across the drier later. Also replace the liquid line dryer.
4. Change compressor oil prior to starting system back up. The system should be run for 24 hours and then checked with an acid test kit. Change oil and cores until oil shows no residual acid.
5. Replace the sight glass if the moisture indicating element has been saturated with fluid.

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Size of Vessel	Construction and Certification generally acceptable, furnished unless otherwise specified
Under six inches ID	UL Listing
Six inches or greater ID, but less than 1.5 cubic feet net internal volume	ASME Code Construction with UM Certification and UL Recognition
Six inches or greater ID, with over 1.5 cubic feet net internal volume	ASME Code Construction with National Board Certification

Notes

UL Listing may be obtained for a vessel, typical samples of which can withstand five times the marked working pressure without failure. Initial tests are made at Underwriters Laboratory and reexamination tests are made under UL supervision, at the manufacturer's plant.

ASME Code Construction is the same whether UM or National Board certified. Essentially, the vessel must have a calculated design strength capable of withstanding (a) $1\frac{1}{2}$ times the working pressure without static deformation at any point, and (b) five times the working pressure without failure, based on the least thickness and the lowest tensile strength within the tolerances, with the poorest weld likely to occur, all happening simultaneously. Certain details of construction must be observed, and chemical and physical test certification for all material must be on file. Welding procedures, equipment, and personnel must be qualified by performance tests.

UM Certification means that the manufacturer's personnel have performed the necessary inspection and tests. The letters UM appear in the ASME cloverleaf stamp on the tag. Only when requested, a certificate (Form U-3) is furnished, signed by the manufacturer.

UL Recognition of these vessels. Their testing, and reexamination procedure is identical to that for listing. This recognition requirement comes about because UL takes the position that someone other than the manufacturer should check the construction. The recognition list is not published—as is the listing—the records are kept by UL and generally used only when granting listing to an assembly that includes the vessel.

National Board Certification means that in addition to ASME construction, an independent, licensed inspector has witnessed the final tests of the vessel, has observed that construction and procedure details were all as required and checked the mil test reports for the material used. A certificate (Form U-1 or U-1A) is furnished, describing the vessel, materials, construction, and tests, signed by both the manufacturer and the inspector.

The letter U appears in the ASME cloverleaf stamp on the tag. We recommend referring to Nat. Bd., rather than U-stamp, to avoid confusion between U and UM.

Underwriters Lab will automatically accept a National Board certified vessel when listing an assembly, because it has been inspected by an independent agent, to specifications more strict than their own.

A National Board certified vessel is accepted by all state and municipal codes in the United States. Most other countries will accept them also.

Certain government or military requirements essentially parallel the ASME code, but may specify approval and/or certification by inspectors from a government agency in addition to, or in place of ASME code, or UL requirements.



warranty

Liability and Limitations

All products are thoroughly inspected and tested before leaving the factory, and are guaranteed against defects in material and workmanship to the extent expressly provided in this Paragraph. If it is proven to Standard/Stanref satisfaction that any part of any such product was defective when shipped from the factory, and such part is returned to Standard's factory in Melrose Park, Illinois or Stanref's factory in Bury St. Edmunds within twelve months of date of shipment thereof, transportation prepaid, Standard/Stanref shall either furnish a replacement part or repair such part (whichever Standard/Stanref may elect) free of charge and shall return such replacement part or repaired part to Purchaser, transportation prepaid. The foregoing shall not apply and Standard/Stanref shall have no obligation under this Paragraph with respect to any part or product which Standard/Stanref determines was subject to abuse, misuse, or improper installation or application. EXCEPT AS EXPRESSLY PROVIDED ABOVE, STANDARD/STANREF MAKES NO GUARANTEE OR WARRANTY EXPRESS OR IMPLIED WITH RESPECT TO ANY PRODUCTS SOLD HEREUNDER OR ANY PART OF ANY SUCH PRODUCT, INCLUDING (WITHOUT LIMITING THE GENERALITY OF THE FOREGOING) WARRANTIES OF MERCHANTABILITY AND WARRANTIES OF FITNESS OR SUITABILITY FOR ANY PARTICULAR PURPOSE, and Standard/Stanref shall have no other liability whatsoever with respect to such products or parts including (without limitation) any liability for indirect, consequential or resultant damages whether based upon breach of warranty, negligence or any other ground, it being understood that replacement or repair of defective parts as herein provided shall be Purchaser's sole and exclusive remedy.

Changes and Improvements

Changes and improvements may be made at any time in Standard and Stanref products, but Standard Refrigeration Company and/or Stanref International PLC shall be under no obligation to incorporate same in, or substitute the same for any products previously sold to any customer.

Merchandise Returned for Credit

No merchandise will be accepted for credit unless authority of the factory has been first obtained. Only merchandise of current design, in their original individual cartons will be considered for return—and if returned, a handling charge of 12% of the original net purchase price, plus transportation, will be made. No provision is made for the return of merchandise of special nature, and orders for special merchandise are not subject to cancellation.

Engineering Assistance

For assistance in the design, specification or use of Standard products, please contact your nearest sales representative or our office headquarters in Melrose Park, Illinois. In the United Kingdom contact Stanref International in Bury St. Edmunds, England.

Engineering specifications in this catalog are current as of the printing date, but are subject to future design changes. Consult factory for latest specification data before ordering.

Product performance is based on ARI standards and nominal operating conditions. Standard Refrigeration Company is not responsible for product failure in nonconforming applications. For assistance, please consult the factory.