DRAKE
REFRIGERATION, INC.

Installation, Operation and Maintenance Manual



Packaged air cooled



Split system air cooled



Packaged water cooled

Tank & pump skids

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- **This equipment should only be installed and started by a certified refrigeration mechanic who is familiar with chiller equipment.**

- **Failure to follow accepted refrigeration practices during installation and start-up will void the equipment warranty.**

- **All field piping and wiring must conform to the requirements of the manufacturer as well as all applicable national and local codes.**

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Receiving
When receiving equipment, each shipment must be checked against the bill of lading. **Shortages and shipping damage is the responsibility of the carrier.** Both should be noted on the shipping receipt when the equipment is first received. Hidden damage should be brought to the carrier's attention as soon as it is discovered. In both cases, claims should be filed promptly with the carrier. Do not return damaged equipment to the manufacturer without prior approval.

Uncrating
The shipping skid can be an aid in moving the equipment and should not be removed until the equipment is at the actual point of installation.

Rigging
Fork lifts or dollies are required for moving this equipment. When lifting from above, always use sufficiently long spreader bars to avoid lifting damage. On larger units, where lifting eyes are provided in the base frame, be sure to lift only from the base and use all eyes provided.

Unit Location
Units must be positioned with sufficient clearance on all sides for proper inspection, maintenance and airflow.

Allow at least 3 ft. for access into the compressor compartment. National Electric Code requires a minimum of 3 ft. in front of control panels rated 600V or less. More may be required depending on the peculiarities of the installation such as proximity to other live electrical parts. Local codes may require greater clearance.

On units with air cooled condensers, care must be taken to ensure an ample supply of fresh, clean air. When installing these units indoors, an intake and exhaust air system capable of handling 1000 CFM per compressor horsepower must be supplied at zero static pressure. In all cases, caution must be taken to avoid locating units in restricted spaces where heat build up at the condenser can occur. Locating multiple units so that the air discharge from one blows into the air intake of another must be avoided.

Avoid all overhangs, which may cause discharge air to be re-circulated through the condenser.

On units having vertical face condensers, one condenser height is the minimum distance that the condenser face may be located from a wall or obstruction. When placing (2) of these units side by side so that the condensers face one another, use twice the tallest condenser height as the minimum distance between units.

On units having horizontal face condensers, allow at least one condenser width between the condenser and a single wall. If the unit is located in a well or has solid walls on more than one side allow at least two condenser widths. If two or more units are placed side by side, allow at least two condenser widths between units.

On air cooled units located outdoors and intended for year round operation, special attention must be paid to prevailing wind direction during colder weather. Cycling or reducing the speed of the condenser fan as a means of head pressure control can be totally ineffective when wind is blowing through the condenser. This is normally not a problem with flooding types of head pressure control.

Failure to follow these instructions will cause the unit to run inefficiently and may cause nuisance trips on various safety controls.

Mounting
Units must be installed in a level position, on a firm support. Never use a wooden shipping skid as a permanent base. For ground mounting, a suitably designed concrete slab is recommended. Raising the slab 4 to 6 inches above grade provides some protection from ground water. For roof mounting, a structural analysis by a qualified engineer may be required. The unit should be mounted on suitably sized steel channels or beams. Vibration absorbing pads or springs between the unit and mounting frame are recommended for vibration elimination.

Compressors that are spring mounted, are rigidly secured from the factory to prevent shipping damage. After mounting the unit and prior to startup, the following steps should be taken.

1. Loosen and remove the (4) nuts and washers used to hold the compressor firmly in place.
2. Remove and discard the (4) shipping spacers between the compressor and its mounting base.
3. Install the (4) rubber spacers, provided as loose items, over the compressor mounting stud
4. Reinstall the (4) nuts and washers removed in step 1 above leaving approximately 1/16" space between the nut and washer. This will allow the compressor to "float" on the mounting springs.

Piping – General

All field piping must conform to the requirements of the equipment as well as all applicable national and local codes.

Care has been taken to insure that factory piping is properly braced, and all fittings and gasketed joints are tight. These may loosen or break during shipment & must be checked prior to start-up. All joints, especially threaded and gasketed joints, should be checked again after one to two weeks of operation. Take corrective action as necessary.

All lines must be supported. The distance between supports will vary with the diameter and wall thickness of the pipe or tubing used, the weight of the fluid being carried, as well as the number of valves and fittings in the line. Supports should be provided near changes in direction, at branch lines and particularly near valves. The weight of the tubing must not be carried through the valve body since this may distort the valve to the point where it will not function properly. Horizontal supports must be close enough to prevent sag, which would impose excessive stress. Vertical supports must be close enough to adequately support the weight of the tube as well as to prevent sway caused by blowing wind. As a guide, the following table may be used.

Tube OD – in	3/8 – 7/8	1 1/8	1 3/8 – 1 5/8	2 1/8	2 5/8	3 1/8
Nom pipe size – in		3/4 -1	1-1/4	1-1/2	2	3
Max. span – ft	5	6	7	9	10	12

Chilled Fluid Piping

Various types of pipe may be used, but care must be taken to ensure that the material is compatible with the type of service for which it is intended. Line sizes should be based on the curves shown in figures 1 through 3 in the back of this manual and not on connection sizes at the chiller.

- **Chilled Fluid Lines** (see line size curves shown in figures 1 through 3 in the back of this manual)
  1. Fluid lines should be kept as short and direct as possible.
  2. Lines should be sized for low-pressure drop in order to minimize pump requirements.
  3. Lines must be insulated.
  4. Use insulation of sufficient thickness to prevent sweating which may damage property or present a hazard to personnel.
  5. Piping must be a continuous loop with purge valves at high points.
  6. Expansion tanks are normally not required and their use is dependent on the peculiarities of the job.
  7. A continuous and steady fluid flow through the chiller's heat exchanger is necessary for proper system operation. If the fluid is being used to cool more than (1) process or machine, 3 way valves or bypass circuits may be required.
  8. Field supplied flow controls, meters or gauges may be required for proper operation.
  9. Field supplied strainer or filter is required in the return fluid line at the chiller. The fineness of the strainer mesh, or the filtering medium, used is dependent on local conditions. If no mesh fineness is defined, a mesh fineness of U.S. Mesh 14 to 35 is recommended to protect the chiller. Failure to provide a strainer or filter will void all warranties.

Refrigeration Piping

All packaged chillers leave the factory with the refrigeration side fully piped & charged.

Split systems require interconnecting refrigeration piping between the compressor/evaporator section & the condenser section. **Both sections leave the factory charged with refrigerant. Their combined charge is indicated on the compressor/evaporator data tag**. Additional refrigerant will have to be added in the field due to the interconnecting piping (see "System Refrigerant Charging"). The discharge and liquid lines in both sections have shutoff valves with capped leads. Never uncap these leads without checking the shutoff valves to be sure that they are fully closed and the units are ready for piping. To prevent moisture in the air from condensing inside the tubes, never leave refrigerant lines open when they are not being worked on, especially over night. This is especially important with units that have compressors using POE oils due to the hydroscopic nature of the oil. Copper tubing must be refrigeration grade (ACR). When using high temperature solders, always pass dry nitrogen through the lines to prevent scaling. Interconnecting line size should never be based on the lead sizes at the compressor/evaporator section and the condenser section. For proper system operation, they must be sized in accord with the remote condenser line size table, shown as figure 4, in the back of this manual. The interconnecting lines must be evacuated. Be sure to install appropriate fittings.

Refrigeration Liquid Line – split systems only (see line size tables figure 4 in the back of this manual)

1. Liquid lines should be kept as short and direct as possible.
2. Lines should be sized for low-pressure drop to prevent liquid flashing. The height of liquid risers must be taken into account.
3. Do not run liquid lines through heated spaces. At best, this will result in a loss of subcooling. At worst, the liquid refrigerant may flash.
4. Do not insulate liquid lines. Liquid refrigerant moving through the line will normally be warmer than the surrounding air. Uninsulated lines will allow for some heat exchange between the refrigerant and ambient air. This increased subcooling will result in slightly increased capacities.
5. Brace liquid lines securely to prevent damage to the line due to liquid hammer. Liquid lines have a tendency toward substantial motion when valves are suddenly opened or closed. The bigger and longer the line, the more pronounced the problem. This is caused by the shock of the liquid column impinging on the next closed valve or on the first bend in the line that it encounters is a major cause of joint failure.

Refrigeration Discharge Line – split systems only (see line size tables figure 4 in the back of this manual)

1. Discharge lines should be kept as short and direct as possible.
2. Lines should be sized for low-pressure drop in order to minimize the effect of pressure drop on system capacity.
3. These lines should not be insulated except to prevent injury to personnel who may come in contact with them.
4. Horizontal lines should be pitched downward in the direction of flow to prevent oil from flowing back to the compressor during a off cycle.
5. Vertical lines require a trap at the base of the riser as well as an inverted trap at the top. The Inverted trap should be the highest point in the discharge line and should have a access valve installed to allow for purging of non condensables from the system. For vertical runs greater than 10-12 ft, additional traps should be used at 10-ft. intervals.
6. Systems using unloading compressors may require the use of double risers.
7. Additional line support may be required to prevent transmission of vibration & movement in the line.
8. An inverted trap of sufficient height or a check valve may be required to prevent liquid migration back to the compressor during off cycles. This can be especially important on units using flooding head pressure controls due to their larger refrigerant charge.

Wiring

All field wiring must conform to the requirements of the equipment as well as all applicable national and local codes.

Main power wires must be kept a minimum of 12 inches away from the microprocessor, temperature sensors, and transducer cables as they will create "noise" that will interfere with the operation of the microprocessor and sensors by causing false readings and nuisance trips.

Use only copper conductors that are properly sized to handle the load. Always consult the unit electrical nameplate. Since equipment is continuously being updated, do not rely on catalog information unless it has been verified.

Always refer to the unit electrical nameplate for sizing conductors, disconnects and fusing. Units are factory wired so that a single power source can be brought to the unit. This may not always be the case with non standard units. Consult the wiring diagram affixed to the inside of the control panel lid. Additional wiring diagrams are supplied as a separate loose item in the same envelope that contained these instructions.

Electrical connections have been securely tightened at the factory. They may loosen during shipment and again during initial periods of operation. All connections should be checked and tightened as necessary prior to startup and again after the system has been operating for 1 to 2 weeks. To avoid personnel injury, always disconnect power before conducting tightness checks.

Disconnect switches, either fused or non fused, are optional items when the system is purchased and normally are not factory supplied. They must be field supplied and installed as required by applicable national and local electric codes.

Compressor Oil Charge

All compressors intended for use with R134A, R404A, R407C & R507, are shipped with polyolester oil. For all compressors which have an oil sight glass, the proper level is between 1/2 to 3/4 up the sightglass with the exception of 8 cylinder compressors. For these, the level should be 1/4 to 1/3 up the sightglass. These levels should be observed at start-up and when the system is operating. Add or remove oil from the system as necessary to maintain these levels. Always remember that too much oil is just as detrimental to a system as not enough oil.

In the absence of a visible oil leak, low oil level generally indicates one or more of the following problems

1. Oil was not at the proper level to begin with.
2. Refrigerant lines are not properly pitched. This rarely is a problem with factory piping and is usually encountered with field piping on split systems. The usual causes are:
    a. Failure to pitch piping in direction of flow.
    b. Excessively large lines which allow refrigerant velocities to drop below the point where oil remains entrained.
    c. Failure to provide traps in vertical risers
3. Low refrigerant mass flow.
4. A system component such as the suction accumulator having a plugged up oil return.
5. Compressor short cycling.

Excessively high oil levels are generally caused by one or more of the following

1. Oil was not at the proper level to begin with.
2. Oil was simply added to the system due to a low sightglass without looking for the cause.
3. A compressor changeout using a compressor with a full oil charge. Replacement compressors generally contain no oil or have a reduced charge.
4. During long off cycles, liquid refrigerant may migrate to the compressor where it can lay in the crankcase. This gives the impression of high oil levels when the compressor is not running. On starting the compressor, this refrigerant will rapidly boil off as evidenced by violent foaming in the sightglass. This in turn may cause tripping of the oil pressure safety switch. A working crankcase heater will normally eliminate this problem.

The following oils have been approved by Copeland & Bitzer for use with their compressors.

Polyolester Oil: Mobile, EAL ARCTIC 22CC
ICI, Emkarate RL 32CF

Leak Testing

<u>Refrigeration Side</u>

Prior to startup, the entire system must be leak tested. Due to their greater sensitivity, electronic leak detectors are recommended. Carefully leak test both factory and field made joints including condenser coils. Although each unit is factory leak tested, joints do loosen and sometimes break during shipment.

As with electrical connections, gasketed and flared joints may loosen after a short running time. Approximately 1 to 2 weeks after placing a system into operation, return and again leak check the various joints. Tighten or repair as necessary.

Chilled Fluid Side

After initially filling the system with water or a water/glycol solution, turn on all pumps and allow the fluid to circulate. The entire system should be checked for leaks paying special attention to joints and seals. Approximately 1 to 2 weeks after placing a system into operation, return and again leak check the various joints. Tighten or repair as necessary.

Evacuation – Refrigeration Side

Evacuating a system to remove moisture and non condensable gases is necessary if it has been opened to the atmosphere. With split systems, provisions should be made to evacuate the interconnecting discharge and liquid lines prior to opening the shutoff valves provided in each section.

Non condensables trapped in the system will increase condensing pressures above what would be normal for a particular operating condition. This causes the system to run inefficiently and may cause nuisance trips on high pressure. Moisture will chemically react with refrigerant and oil in the system creating acids and sludge, which in turn will corrode the system internally. This problem can be especially severe with POE oils. Proper evacuation will eliminate these problems.

CAUTION: Do not attempt to use the refrigeration compressor to evacuate the system. Do not start the compressor while in a vacuum.

Connect a deep vacuum pump to both high and low sides of the system with copper tube or vacuum hoses. The larger the tube or hose diameter the better. In no case should the inside diameter of the tube or hose be smaller than the vacuum pumps service port. A vacuum gauge capable of showing pressure in microns must be attached. Ordinary charging manifold gauges are not satisfactory! This gauge should be attached to the system as far from the vacuum pump connections as possible. Some gauges of this type may be damaged if exposed to pressures greater than atmospheric. Be sure that the system pressure is below one atmosphere before exposing the gauge to system pressure.

Manually open all service valves and solenoids as required. Operate the vacuum pump until a pressure of 500 microns is attained. Close the vacuum pump service valves so as to isolate the pump from the refrigeration lines being evacuated and turn it off. Perform a vacuum decay test by monitoring system pressure for approximately 1/2 hour. It should not rise more than 250 microns. Rising pressure indicates either a small leak, which was not found during leak testing or moisture in the system.

If a leak is suspected, it must be found and corrected as indicated under leak testing above, before proceeding any further. Ultrasonic leak detectors are available which “listen” for the high frequency sound of gas rushing into or out of a system. With these, it is not necessary to repressurize the system with refrigerant.

If moisture in the system is the problem, continued evacuation is necessary. Due to the low boiling point of water at very low pressures, freezing of moisture may occur, especially when using a pump of excessive capacity. These can reduce system pressure so rapidly that freezing occurs unless special precautions are taken. These precautions include introducing dry nitrogen into the system to maintain pressure or using sun lamps to maintain temperatures above freezing. Simply running the vacuum pump to rid the system of moisture, once it has frozen, will greatly prolong the evacuation process.

Refrigerant Charging

Once leak testing and evacuation are complete, refrigerant charging may commence. Always refer to the unit nameplate as to the type and amount of refrigerant required.

Always use a charging manifold with gauges along with a scale to charge refrigerant into a system.

When initially charging a system that is in a vacuum, liquid refrigerant can be added directly into the high side while the compressor is off. Never liquid charge into the low side without taking special precautions as indicated further on in this section. As much refrigerant as possible should be charged in this manner since it is the fastest method available. Chilling the receiver (when provided) and warming the refrigerant cylinder will maximize the amount of refrigerant charged. Receivers can be chilled by using either liquid or dry ice packed into an insulating blanket which has been wrapped around the receiver. Refrigerant cylinders can be heated using sun lamps or a warm water bath. Do not use a torch or heat gun since these can cause cylinder pressures to increase significantly in a very short time span.

CAUTION: cylinder pressures must be closely monitored whenever a refrigerant cylinder is being heated in ANY manner. Allowing pressures to exceed those for which the cylinder is rated, may result in the cylinder rupturing with related injury and/or property damage.

Once system and tank pressures have equalized, other slower methods must be employed to finish charging the system. The method chosen depends on the refrigerant involved.

"Pure" refrigerants such as R134A as well as Azeotropic blends such as R507 can be vapor charged into the low side. Never attempt to vapor charge into the system high side. This will result in the refrigerant cylinder being charged by the system rather than the other way around. Cylinders can quickly be over pressurized causing them to rupture with resultant injury and property damage.

Zeotropic blends such as R404A and R407C as well as near Azeotropic blends should generally not be vapor charged due to fractionation. This is the process where the most volatile component(s) in the blend begin to boil first thereby leaving higher concentrations of the least volatile component(s) behind. This does not present a problem if the entire contents of the refrigerant cylinder is to be used since at this point all the refrigerant has boiled off returning the mixture to its original proportions. If all the refrigerant in a cylinder is to be used, vapor charging is permissible although it is probably not a good habit to get into. When in doubt as to the type of blend being used, refer to a current pressure – temperature chart. If the saturated temperature column for a particular refrigerant shows distinctly different bubble and dew points, it is either a zeotrop or near azeotrop. These types of refrigerants should be liquid charged as this process prevents fractionation. Once liquid charging into the high side is complete, start the compressor and begin liquid charging the low side. When doing this, a throttling valve must be used to insure that the liquid flashes to vapor before entering the compressor. Pure refrigerants and azeotrops may also be charged in this manner.

Fractionation is a concern with system leaks. The problem is negligible in areas of the system where the refrigerant is in a totally liquid or vapor phase. However if the leak occurs in a heat exchanger where phase changes are normally encountered, the problem can be significant. In these cases, the refrigerant component(s), which are most volatile, will be released first leaving behind high concentrations of the least volatile. This will eventually affect system performance to the point where water or glycol temperature cannot be maintained. The effects of fractionation become more significant with increased refrigerant glide. Therefore the problem is more pronounced with zeotrops than with near azeotrops. If leaks are small and corrected early, simply topping off is acceptable. However with systems having repeated or large leakages it may be necessary to completely evacuate and recharge.

The amount of refrigerant required to charge a system depends on the particular components used to make up the system. In addition, the type and combination of head pressure control being used must be considered. No head pressure control or condenser fan control by itself does not require any additional refrigerant. Flooding types of head pressure control may require a significant amount of additional refrigerant. The exact amount being dependent on the condenser coil design as well as the minimum head pressures required for proper expansion valve operation. Combining fan control and flooding type controls can significantly reduce the amount of additional refrigerant required.

On split systems, the size and length of the liquid line between the (2) sections must be considered. The lbs. of refrigerant contained in liquid lines can be estimated from the following table which is based on 100 lineal feet of type "L" copper tube and refrigerant densities corresponding to 90°F saturated liquid.

Tube O.D.	3/8	1/2	5/8	7/8	1 1/8	1 3/8	1 5/8
R134A/R407C	3.9	7.4	11.8	24.4	41.6	63.5	90
R404A/R507	3.4	6.4	10.3	21.2	36.1	55	78

Start-up

General

Once installation is complete, check the following

1. All refrigerant and electrical connections must be tight. Tighten all loose wire terminal connections that may have loosened in shipping.
2. Shipping spacers on spring mounted compressors have been removed, the neoprene washers used to properly center the compressor foot on its mounting spring & stud have been properly installed & the mounting nut & washer is reinstalled so as to allow the compressor to "float".
3. The compressor oil is at the proper level in the oil sightglass (when provided) for the compressor being used. See "Compressor Oil Charge".
4. Check initial settings of thermostats and pressure controls. All adjustable pressure controls and valves will require a final adjustment with the use of a compatible gauge
5. Check the control panel to be sure that all wiring is in accord with the unit wiring diagram.
6. Main power wires must be kept at least 12 inches away from microprocessor as they will create "noise" that can interfere with the operation of the microprocessor and sensors.
7. Verify power supply on site and check the wiring of the control circuit transformer before energizing.
8. Check all three phase motors for proper rotation.

Compressor Precautions

Care must be taken when initially starting a system or when the system has been off for an extended period. At this time, the compressor may contain liquid refrigerant. Simply starting the system and walking away may result in irreparable compressor damage not covered under warranty. To prevent compressor damage, one or more of the following steps may be used.

1. All compressors are supplied with a crankcase heater. It must be activated for 24 hours prior to starting the compressor. Be sure to check that the heater is functional. This can be done by simply touching the compressor in the area of the heater. It should feel warm to the touch. This check should be performed shortly after energizing the heater and again prior to starting the compressor. If the compressor is cold, do not attempt to start it. Locate the source of the problem, correct it and wait 24 hours before starting the compressor.
2. Use a "safe" heat source such as a heat lamp on the compressor crankcase for approximately 1/2 hour before start-up. Never use a torch or heat gun. They can raise system pressures to dangerous levels in a very short time resulting in injury to personnel as well as property damage.
3. After following steps 1 and 2 above, you can be relatively certain that no liquid refrigerant is left in the compressor. This does not mean that liquid refrigerant is not present elsewhere in the low side. To avoid compressor damage on startup, deactivate the liquid solenoid and "bump" the compressor, using the controller "POWER" switch, several times. The first 2 or 3 times the compressor is "bumped", it should not be allowed to run more than 2 or 3 seconds. Increase the run time to 5, 10 and 15 seconds over the next 3 "bumps". This will rapidly reduce low side pressure causing any liquid to boil off quickly. At this point it is usually safe to allow the compressor to run.
4. After starting the compressor, listen for unusual sounds such as knocking. Should they be heard, immediately stop the compressor. Do not restart until the problem is resolved.

While scroll compressors are more tolerant to liquid refrigerant than reciprocating types of compressors, the above precautions should still be observed

Rotational direction is very important with three phase scroll compressors. Running these compressors with reversed rotation will result in damage not covered by warranty. When starting a three phase scroll compressor, refrigerant pressure gauges ***must*** be attached to both the high & low pressure ports provided on the system. With the compressor rotating in the proper direction, system suction pressure should drop and discharge pressure should rise to appropriate levels within a few seconds after the compressor is started. If this is not the case, the compressor is probably running in reversed rotation. Each chiller is computer tested and all three phase motors, (Pumps and compressors) are in proper phase when it leaves the factory. Turn the power off at the main disconnect and reverse any two of the three main power leads and restart. Observe the suction and discharge pressure gauges to verify that the compressor is rotating correctly. If pressures are still not appropriate, some other problem has developed which must be found and corrected prior to running the system.

Procedure

- **Microprocessor controller**
  Note: Each chiller is factory tested on a computer aided test stand. A copy of the test printout is contained in the installation packet. The controller has been factory programmed for your specific cooling requirements. The paragraphs below explain how the controller operates, and how to change the set points.

Refer to the wiring & piping diagrams supplied with the chiller while going through the following procedure.
This control is powered by 24 VAC and provides control of up to two compressors by monitoring water temperature and refrigerant pressures. Compressor control is accomplished via switching 24 VAC to the motor contactor. Run time control parameters are user programmable and, once set and saved, are maintained in non-volatile memory. Please refer to the programming section for more information on this topic. An optional remote display will be available which provides remote display of system parameters.

Main power switch is closed:

- Main power is applied to the controller system transformer (24 VAC). The controller's power supply is now energized and power is supplied to the pressure transmitters but all pumps and compressors remains off until the power switch on the panel is pressed. The control indicators have 3 reds dots illuminated in each display.
- When the power or the system pump buttons are toggled the control will save this status to non-volatile ram. This is done so if power is removed from the control and re-applied it will power up in the last known state. The compressor run times are saved every 12 hrs in non-volatile ram.

Power On: Power switch on control is pressed and held for 5 seconds (Normal operation):

- All the control LED's briefly flash as an indicator test, then the digital displays and the power indicator will illuminate. Any previous alarms are cleared. The top numeric LED will indicate the inlet water temperature and the lower numeric LED will indicate the outlet water temperature. If the control has not been configured the letters "CFG" will appear on the upper 3-digit LED (This is a factory only function).
- The re-circulation pump is energized. There is no status LED for this pump. Any time the power is on, the re-circulation pump is on.
- If the inlet water temperature is above either setpoint plus differential, cooling will be called. After the compressor delay (30 seconds, fixed) the first compressor will energize. The "Compressor 1" green LED illuminates.
- Hot gas relay valves will all be energized 60 seconds after the compressor starts.
- If so equipped, the secondary compressor will energize based on the second setpoint and differential. The same delays outlined for compressor #1 will be observed. To equalize compressor run time, periodically the primary and secondary compressor assignments will switch. The LED will illuminate for the actual compressor in use. Should the setpoints be set such that both compressors could be energized at the same time, a short delay will be imposed on the second compressor to reduce power line inrush to the chiller.
- Once the setpoint is achieved or surpassed the compressor will be de-energized. The hot gas relay will also de-energize but the re-circulation pump will remain energized. The compressor will be available for another call immediately, but will not engage until after the compressor delay time expires.

- When the inlet water setpoint plus differential is again exceeded, the compressor will again energize per the schedule listed above and the cycle will repeat. The compressors are rated for continuous duty and will run continuously if required.

System Pump Control: Momentarily pressing the "pump" switch energizes the system pump relay. The "PUMP" LED illuminates. Momentarily pressing it again turns it off.

Power Off: Press and hold the power switch. After holding the power switch for 5 seconds the compressor(s), the hot gas relays and the re-circulation pump will de-energize. The system pump will also de-energize. All control LED's will turn off and the control will be off except all (and only) the decimal points on the numeric LED's will be on. The pressure transducers will remain powered. The mains disconnect must be used to completely remove control power.

Power Failure: Upon power being restored after a power failure the control will restart and run with the last known user settings. If the control fails to restart it is recommended to remove power for approximately one minute and then re-apply power.

Alarm conditions and indications:

- Temperature Sensor: If the temperature sensor transmits an out of range temperature it will be perceived as bad. "Err" will begin flashing in the upper numeric LED while one of the following will be displayed on the bottom numeric LED: "tSi" for the inlet temperature sensor, and "tSo" for the outlet temperature sensor. The control will de-energize the compressors and hot gas valves and the alarm relay will energize. The re-circulation pump remains energized. The fault is cleared by momentarily pressing the **"**Power**"** switch after the error has been resolved. It will not reset automatically.
- Pressure Sensor: If the voltage received from the pressure sensor(s) is < .4vdc or > 4.6vdc the pressure sensor will be perceived as bad since it's normal operating parameters are .5vdc to 4.5vdc. "Err" will begin flashing in the upper numeric LED while one of the following will be displayed on the bottom numeric LED: "tL1" for compressor 1 low pressure sensor, "tL2" for compressor 2 low pressure sensor, "tH1" for compressor 1 high pressure sensor, and "tH2" for compressor 2 high pressure sensor. The compressor and hot gas valve will be de-energized and the alarm relay will energize. The fault is cleared by momentarily pressing the **"**Power**"** switch after the error has been resolved. It will not reset automatically.
- High pressure: If the outlet pressure exceeds the high pressure setpoint the "Hi Pres" led will illuminate and the "Hi Pres" alarm parameter name will begin flashing in the upper numeric LED. The compressor and hot gas valve will be de-energized and the alarm relay will energize. The parameter value will be displayed in the lower numeric LED. The fault is cleared by momentarily pressing the **"**Power**"** switch after the pressure is less than the set point. Once cleared the control will attempt to function normally. It will not reset automatically.
- Low Pressure: If the outlet pressure is less than the low pressure setpoint for more than 120 seconds, the "Lo Press" red LED will illuminate and the alarm parameter name will begin flashing on the upper numeric LED. The compressor will be de-energized and the alarm relay will energize. The parameter's value will be displayed in the lower numeric LED. The "Lo Press" alarm parameter name will continue to flash until the fault is cleared by momentarily pressing the "Power" switch after the pressure is greater than the setpoint. Once cleared the control will attempt to function normally. It will not reset automatically.
- High Temperature: If the outlet water temperature exceeds the setpoint for 10 seconds the "Hi Temp" LED will illuminate and the "Hi Temp" alarm parameter name will flash on the upper numeric LED, but the control will continue to function normally. The alarm relay is not affected by the High Temperature alarm and does not energize. The parameter name value will be displayed in the lower numeric LED. When the outlet water temperature recovers to below the setpoint the "Hi Temp" LED will turn off. Normal run display will resume.
- Low Temperature: If the outlet water temperature is less than the setpoint the "Lo Temp" LED will illuminate and the "Lo Temp" alarm parameter name will flash on the upper numeric LED. The compressor will be de-energized and the alarm relay energizes. The parameter value will be displayed in the lower numeric LED. When the outlet water temperature recovers to above the set point the "Lo Temp" LED will illuminate steadily. The fault is cleared by momentarily pressing the **"Power"** switch after the temperature is greater than the reset point. Once cleared the control will attempt to function normally. It will not reset automatically.

- Water Flow: If the water flow drops below the point required to keep the flow switch closed, the “Lo Flow” alarm parameter name will flash on both numeric LED’s and the control will de-energize the compressors and hot gas valves. The re-circulation pump remains energized. It will reset automatically.

Review Mode: A review (read only) mode is available which will display the program variables and settings. The control will continue to run normally during the review mode. Use the UP or DN key to step through each parameter. There are six (6) additional parameters viewable; “Hi1”, “Hi2”, “Lo1”, “Lo2” (actual pressure readings) which appear first in the list, and “Hr1” and “Hr2” (compressor hours) which appear after the “LtA” setpoint. There is no “Upd” function in review mode. To exit the Review mode, momentarily press the “Set” key. There is no timeout to automatically exit the review mode.
Note: In the event of an alarm the Review mode will terminate and the control and alarm settings will be active.

Programming:

Press and hold both the “UP” and “DN” switches for 3 seconds to enter programming mode from the run mode. Control will continue to operate while changes are made using the existing parameters. The parameter name will be displayed on the upper numeric LED and the parameter value will be displayed on the lower numeric LED. Use the UP/DN keys to change the value, use the “Set” to keep that value and advance to the next parameter. The last parameter is “Upd”, which will save the settings to memory and make them the active the control parameters when the “Set” key is pressed. This also exits the programming mode. If no keys are pressed after 30 seconds in any programming display, the programming mode is aborted and any changes are discarded. The following are the parameters and the order of display:

“dEG”	degrees F or degrees C
“tC”	Select whether inlet or outlet temperature control (limits: in or out)
“SP1”	temperature setpoint for compressor 1 (limits: -40 to +120)
“SP2”	temperature setpoint for compressor 2 (limits: -40 to +120) (requires dual compressor model)
“dF1”	temperature differential #1 (limits: 1 to 10)
“dF2”	temperature differential #2 (limits: 1 to 10) (requires dual compressor model)
“HP1”	high pressure setpoint #1 (limits: 200 to 490 psi)
“HP2”	high pressure setpoint for compressor 2 (limits: 200 to 490 psi) (requires dual compressor model)
“LP1”	low pressure setpoint #1 (limits: 1 to 100 psi)
“LP2”	low pressure setpoint for compressor 2 (limits: 1 to 100 psi) (requires dual compressor model)
“HtA”	high temperature outlet water alarm (limits: max setpoint + max differential +2)
“LtA”	low temperature outlet water alarm (limits: min setpoint – 2)
“Upd”	update settings to permanent memory, exit programming mode to active mode.

Note: In the event of an alarm the programming mode will terminate and the control and alarm settings will be active. Any new settings will be discarded.

Initial Setup (factory setup):

Press and hold the “UP” and “PUMP” switches for more 3 seconds to enter factory mode from the run mode or setup mode. If the control is unconfigured this mode will appear automatically and the factory default configuration will be loaded.

- The upper display shows “CFG”. Press the “Set” key and the configuration menu will begin. The name of the parameter being set will appear in the top LED and the value will appear in the lower LED. Use the “UP” and “DN” keys to change the value to the desired setting. Once at the desired setting, press the “Set” key to move to the next parameter. Repeat the sequence to set all parameters. There are extra parameters in the factory menu. The last parameter is “Upd”, which will save the changes when the “Set” key is again pressed. Due to the nature of the possible changes, there is no timeout from this mode. The values will be saved and the control will begin operation using the new parameters after a few seconds. These are the parameters:

“dEG”	degrees F or degrees C

"CP-"	number of compressors, 1 or 2
"tC"	Select whether inlet or outlet temperature control (limits: in or out)
"SP1"	Temperature setpoint #1 (limits: -40 to +120)
"SP2"	Temperature setpoint #2 (limits: -40 to +120) (requires dual compressor model)
"dF1"	Temperature differential #1 (limits: 1 to 10)
"dF2"	Temperature differential #2 (limits: 1 to 10) (requires dual compressor model)
"HP1"	high pressure setpoint #1 (limits: 200 to 490 psi)
"HP2"	high pressure setpoint for compressor 2 (limits: 200 to 490 psi) (requires dual compressor model)
"LP1"	low pressure setpoint #1 (limits: 1 to 100 psi)
"LP2"	low pressure setpoint for compressor 2 (limits: 1 to 100 psi) (requires dual compressor model)
"HtA"	high temperature outlet water alarm (limits: max setpoint + max differential +2)
"LtA"	low temperature outlet water alarm (limits: min setpoint – 2)
"Hr1"	compressor 1 hours (in 100 hr increments), either keep value or reset to zero (toggle)
"Hr2"	compressor 2 hours (in 100 hr increments), either keep value or reset to zero (toggle, requires dual compressor model)
"Upd"	update settings to permanent memory, exit programming mode to active mode.

Note: Due to the nature of the changes possible in the factory mode, the control is taken off line while in this mode.

Drake Remote Display Unit Operation:

- 24vac as well as serial communication is connected through a cat 5 patch cable from the drake chiller controller to the drake remote display unit.
- "STD" or "OPT" modes
- remote display unit mimics all led's, display and errors on the drake chiller controller
- independent review mode can be used and is the same as the chiller controller's review mode

Initial Programming of the Remote Display Unit:

- For initial programming of the remote display unit, you must have first set up the drake chiller controller as above and then have connected the two through a cat 5 patch cable. Power on the drake chiller controller then must be turned on, which in turn will turn the remote display unit on. Enter into factory setup mode on the remote display unit by holding "UP" and "PUMP" for more then 3 seconds. You will now have to enter the correct password to enter into factory setup mode. You will see "PAS" on the top display and "000" on the bottom display. By pressing the "UP" or "DN" key you will see the first digit on the left increment or decrement. When you are at the desired number, press the set key. A degree symbol will now replace the number you have just entered. You may now enter the second digit from the left, then press set, then the third and set. If you have entered the correct password, you will now be in factory setup mode. If not, "BAD" "PAS" will be displayed and the unit will go back to run mode. To try again you must reenter into factory setup mode. The table below shows the parameters that you will be able to access at this point. The 15th parameter ("rdu") is only available in factory setup mode of the remote display unit. All other parameters are the same as the chiller controllers.

"dEG"	degrees F or degrees C
"CP-"	number of compressors, 1 or 2
"tC"	Select whether inlet or outlet temperature control (limits: in or out)
"SP1"	Temperature setpoint #1 (limits: -40 to +120)
"SP2"	Temperature setpoint #2 (limits: -40 to +120) (requires dual compressor model)
"dF1"	Temperature differential #1 (limits: 1 to 10)
"dF2"	Temperature differential #2 (limits: 1 to 10) (requires dual compressor model)
"HP1"	high pressure setpoint #1 (limits: 200 to 490 psi)
"HP2"	high pressure setpoint for compressor 2 (limits: 200 to 490 psi) (requires dual compressor model)
"LP1"	low pressure setpoint #1 (limits: 1 to 100 psi)
"LP2"	low pressure setpoint for compressor 2 (limits: 1 to 100 psi) (requires dual compressor model)
"HtA"	high temperature outlet water alarm (limits: max setpoint + max differential +2)
"LtA"	low temperature outlet water alarm (limits: min setpoint – 2)
"Hr1"	compressor 1 hours (in 100 hr increments), either keep value or reset to zero (toggle)

"Hr2"	compressor 2 hours (in 100 hr increments), either keep value or reset to zero (toggle, requires dual compressor model)
"rdu"	Remote display unit – "Std" or "Opt" ("Std" is default)
"Upd"	update settings to permanent memory, exit programming mode to active mode.

RDU – Std Mode:

- only enter factory setup if you are authorized and know the password
- entering setup mode is disabled
- power button's only function is when momentarily pressed during an error to clear the error on both units
- set button is used to place the remote unit in/out review mode
- up button is used to silence the buzzer for 10 minutes while in an alarm.
- system pump button is disabled

RDU – Opt Mode:

- only enter factory setup if you are authorized and know the password
- entering setup mode is enabled
- power button is used to power on/off the remote unit and the chiller controller, also when momentarily pressed during an error it will clear the error on both units
- set button is used to place the remote unit in/out review mode
- up button is used to silence the buzzer for 10 minutes while in an alarm.
- system pump button is enabled and will turn the system pump on/off on the chiller controller

Run Mode:

- While the drake chiller controller is in normal operating run mode, the remote display unit will display whatever the controller is displaying as well as turn on/off whatever led's are on, on the drake chiller controller.

Review Mode:

- While the drake chiller controller is in normal run mode (no alarms, not in setup) a review mode is available which will display the program variables and settings of the drake chiller controller. The control will continue to run normally during the review mode. Use the UP or DN key to step through each parameter. To exit the Review mode, momentarily press the "Set" key. There is no timeout to automatically exit the review mode.

Note: In the event of an alarm the Review mode will terminate and the control and alarm settings will be active.

Offline Mode:

- In the event that the drake remote display unit has power, but is not receiving serial information from the drake chiller controller, it will display "OFF" on the top display and "Lne" on the bottom display. This indicates that the chiller controller has power, but is not communicating to the remote. More then likely a wiring issue.

Alarms:

Alarms are shown exactly as they are shown on the chiller controller. The remote display unit will also sound a buzzer at 50% duration while the alarm is active. If during this time the "up" key is pressed, the buzzer will be silenced for 10 minutes while still in the same alarm. If another different alarm occurs within those 10 minutes then the buzzer would sound again. If after 10 minutes of silence the error still exists the buzzer will sound again. If applicable to the particular alarm, momentarily pressing the power key will clear the error and silence the buzzer. Alarm relay on the drake remote display unit will function the same as the drake chiller controller.

OPERATIONAL CHECK

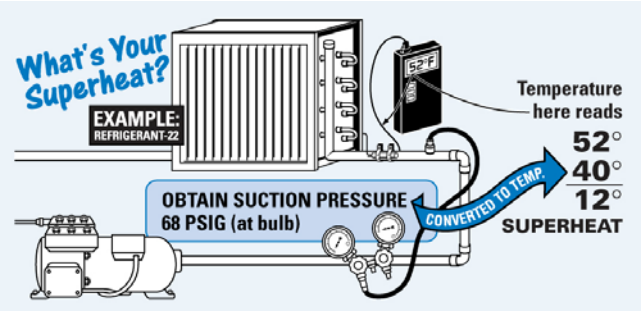
- ***CAUTION (When pumps are provided)***: The chilled fluid side of the system must contain either water or a water/glycol solution before turning on any pump. Pumps should not be allowed to "deadhead" & those using three phase motors must be checked for proper rotation. Allowing a pump to run dry, deadheaded or in reverse rotation may cause damage not covered by warranty.

- With the pumps running & all valves open, check the chilled fluid circuit. Please note that the ball valve on the discharge side of the tank recirculation pump has been factory set for the proper evaporator flow rate & the handle removed. Do not readjust at this time. Bleed the tank using the boiler drain provided (does not apply to open vented tanks), followed by the chilled fluid lines at their high points. Finally bleed the systems water flow switch located in the compressor compartment. Air trapped in the flow switch lines will trip the switch and prevent the chiller from operating. This will show as "Low Flow" on the controller.

- Attach thermocouples to the evaporators entering & leaving water lines as well as the suction line as close to the expansion valves feeler bulb as possible. Always disconnect electrical power before replacing fuses. The refrigeration circuit may now be turned on, by replacing the compressor fuses, if they had been removed. Refer to "System Controls, Electrical" for details concerning thermostat adjustments. Be sure that the compressor precautions previously discussed have been followed.

- Allow the system to operate for 1 – 2 minutes. Check refrigerant pressures, water temperatures etc. to be sure that all readings are in line with what could be expected at present water temperatures, ambient etc. Keep in mind that pressure limiting expansion valves are used so low side pressures should not exceed the equivalent of approximately 55°F on most chillers regardless of water temperature. Chillers built for low temperature operation have pressure limits with equivalent temperatures in the range of -5° to 0°F.

- For the evaporator to operate at maximum efficiency, a superheat of 8-12°F at the evaporator is required to be verified by the start-up technician, and adjusted if necessary. This is done by measuring the temperature and pressure at the exit of the evaporator. The pressure is then converted to a temperature by use of a P-T chart and subtracted from the measured temperature. This resulting number is the superheat at the evaporator.



- In order to assure that liquid refrigerant does not return to the compressor during the running cycle, attention must be given to maintaining proper superheat at the compressor suction inlet. Drake recommends a minimum of 20°F superheat to prevent liquid refrigerant flood back and this must be verified by the start-up technician and adjusted if necessary. This is done by measuring the temperature and pressure 6 inches from the compressor suction valve. The pressure is then converted to a temperature by use of a P-T chart and subtracted from the measured temperature. This resulting number is the superheat at the compressor.

- Check the liquid line sight glass to make sure it is clear. A slightly bubbling sightglass does not necessarily mean short of charge. Cool weather operation without head pressure controls or locating the sightglass close to the condenser outlet may result in some bubbling & should be taken into account.

- The moisture indicator should be green. A chartreuse indicator means that there is a small amount of moisture in the system. This can usually be removed by the filter drier & does not necessarily indicate a serious problem. The indicator should be monitored over the next few days & corrective action taken as required. A bright yellow indicator means larger amounts of moisture & can be indicative of a serious problem. Do not rely on the filter drier under these circumstances & do not run the refrigeration equipment until the problem is resolved.

- On chillers using integral storage tanks, the ball valve on the discharge side of the tank recirculation pump is factory set to maintain an approximate 5° TD across the evaporator. The handle is than removed & tie wrapped to the valve. Under most circumstances, no readjustment is necessary.

- All systems require a system circulation pump to move the chilled fluid between the chiller & whatever machinery, process etc. is being cooled. Care must be taken to ensure that water flow rates are in line with the requirements of the system being cooled. Flow meters and/or regulators may be required. Flow rates can be adjusted using ball valves on the discharge side of the pump. Never adjust flows from the intake side of a pump. Always remember that if the machinery, process etc. is not being properly cooled, the problem is normally flow rates that are either too high or too low. Do NOT attempt to solve the problem by simply lowering the thermostat setting. This is normally not a solution & may damage the system.

- On systems using a chilled fluid storage tank, it may be necessary to leave the system pump off until the fluid inside the tank reaches the desired temperature.

The following adjustable controls & valves must be checked with an appropriate gauge and/or thermometer. Many are optional items, which may not be included in your system. Refer to System Controls Electrical & Mechanical for description & settings.

1. Condenser Fan Control
2. Evaporator Heat Tape Freeze Protection Thermostat
3. Discharge Bypass Valve
4. Head Pressure Control Valves
5. Thermostatic Expansion Valves
6. Water Regulating Valve
7. Compressor Unloading Pressure Switch

- Do not leave the system unattended until normal operating conditions have been reached & the compressor oil level has been adjusted to maintain the proper level.

- Once the system has operated for 2 or 3 hours without any sign of problems, it may be left operating over night. The following day, recheck the system as follows.
  1. Check both high & low side pressures. If they are not within appropriate ranges, determine the cause & correct.
  2. Check sightglass for signs that additional refrigerant is required. Before adding any refrigerant, leak check the entire system correcting any leaks that may be found.
  3. Check compressor oil level where appropriate. Add or remove oil as necessary.
  4. Check evaporator superheat and readjust expansion valve as required.
  5. Check voltage & amperage at the compressor power terminals. Voltage must be within ±10% of the nominal as indicated on the unit nameplate. If it is outside of this limit, contact the local power company. If amperage is excessive, the cause must be determined & corrective action taken. With a three phase line, the load must be balanced at each phase.
  6. Check all safety & operating controller settings in the review mode for proper settings & operation.
  7. Check all head pressure controls for proper operation. This may not be possible during warm weather & it will be necessary to wait until ambient fall below 70°F.

System Controls, Electrical

One or more wiring diagrams are supplied on the inside of the control panel lid as well as in the envelope that contained these instructions. These should be referred to while reading these instructions.

Catalog listed chillers can be built for operation on the following electric services. Not all models however are available for every electric service shown below.

Designation	Electric Service	Designation	Electric Service
S2	208-230/1/60	S6	220/1/50
T3	208-230/3/60	T7	200/3/50
T4	460/3/60	T9	380/3/50
T5	575/3/60		

- Regardless of which electric service is ordered, the system control circuit operates on 24 VAC. This is accomplished through a step down transformer located in the control panel.

- All parts mounted in the control panel are clearly labeled. Unless otherwise shown on the wiring diagram, all control panels contain a main terminal block intended for single point electrical connection.

- **Compressor Unloading Pressure Switch:** Optional component normally mounted in the compressor compartment. It senses compressor suction pressure & will deactivate banks of compressor cylinders in response to a drop in suction pressure, due to low load conditions.

- **Condenser Fan Control, Ambient temperature Switch:** Optional component normally mounted on the back of the control panel in the compressor compartment. It senses ambient temperature and will de-energize fan motors when the temperature drops below the control setting. The de-energized motor will be re-energized when ambient temperature rises to a predetermined level.

- **Condenser Fan Control, Variable Speed:** Optional component normally mounted on the back of the control panel in the compressor compartment. The feeler bulb is connected to the liquid line piping at the outlet of the condenser coil. It will begin to modulate fan speed when the sensed temperature drops to 100°F & will proportionally reduce fan speed until the temperature reaches 70°F at which point power to the motor is cut off. As the temperature rises, the motor will restart at full speed and than modulate to the appropriate RPM. Caution – the power wiring to the fan motor(s) must be derived from the same two-phase lines as those, which are wired to the primary side of the control circuit transformer.

- **Fusing:** The condenser fan motor, as well as the control circuit, are fused using class R dual element time delay cartridge fuses. Replacing these with non time delay fuses of the same amperage rating may result in nuisance trips. Non time delay fuses with a higher amperage ratings may not fit in the block provided.

- **Heat Tape Freeze Protection:** Optional item consisting of low wattage (5 watts per foot) heat tape wrapped around the heat exchanger below the insulation and operated by a thermostat wired to close on temperature drop. The thermostat bulb is strapped to the bottom of the water line leaving the heat exchanger. A typical setting for the thermostat would be 35°F.

- **Indicator lights with or without dry contacts**: Optional component(s). Indicator lights are externally visible and normally mounted adjacent to the control panel. Green is used to indicate proper operation while red is used to indicate a problem. Wiring for the indicators vary depending on their use. Refer to wiring diagrams. If dry contacts are ordered with the any indicator, a DPDT relay is included in the control panel. The relay coil is wired in parallel with it corresponding indicator. The controller has relay terminals that can be connected to a remote audible or visual alarm should the controller fault and shut down the chiller. Reference the wiring diagram for the location of these terminals for field connection.
  12 FLA 60 LRA 125 VAC
  6 FLA 35 LRA 250/277 VAC
  15 A 277 VAC RES
  1/2 HP 125/250 VAC

- **Switch, Disconnect**: Not provided as a standard item but offered as a factory option. It is generally the responsibility of the installer to provide and mount a fused or non-fused disconnect switch as per national and local electric codes. This is a safety device and should not be used as an on-off switch. Throwing this switch to the off position will remove all power from the system including the compressor crankcase heater. This may result in irreparable damage to the compressor when restarting. See “start-up”.

- **Switch, Oil Pressure:** A safety device that senses compressor crankcase pressure. It is used with all compressors which have a positive displacement oil pump and is located in the compressor compartment. These switches contain a non-adjustable timing circuit, which allows the crankcase pressure to come up to a predetermined minimum before shutting down the compressor. The length of the time delay is dependent on the particular compressor.

- **Microprocessor controller:** Temperature controller mounted on the chiller panel, which senses the temperature of the chilled fluid returning to the chiller. It’s range is -30° to +220°F, with a adjustable differential of 1° to 30°F. With plain water, never set the thermostat lower than +42°F unless the chiller has been specifically built to operate at a lower temperature. Failure to do this may result in heat exchanger freezeup and rupture which in turn will destroy the refrigeration circuit. This type of failure will void any warranty on the equipment. When colder temperatures are required, a glycol/water solution can be used. The thermostat can then be lowered below +42°F. The lowest setting is dependent on the type and concentration of glycol used.

- **Transformer(s):** The control circuit transformer is used to step down the system voltage to 24 VAC used to power the control circuit. Additional transformers may be used to power selected components as shown on the wiring diagram. Systems intended for use on 208-230V electric service, the transformer leaves the factory wired for 230V on the primary side. Some transformers must be rewired when used on a 208V network. Always check the wiring of the transformer primary circuit before energizing.

- **Water Flow Switch**: A differential pressure switch normally mounted on the back of the control panel in the compressor compartment. A safety device used to sense flow through the heat exchanger. It is adjustable from 1 to 25 psid and will shut down all refrigeration if flow rates drop for any reason.

System Controls, Mechanical
One or more piping diagrams are supplied in the envelope that contained these instructions. These should be referred to while reading these instructions.

- **Discharge Bypass Valve**: An modulating control valve which opens on a decrease in suction pressure and can be set to automatically maintain a desired minimum evaporating pressure regardless of the evaporator load. The valves normally used have an adjustment range of 0 – 80 psig. Other ranges are available and may be used depending on application. The valve is factory set to maintain a minimum evaporating temperature of 34°F for most applications. Do not reset to a lower pressure when chilling ordinary water unless specially designed heat exchangers are employed. For applications using glycol solutions, this valve can be safely reset to maintain a lower minimum pressure. The exact setting will be dependent on the type and concentration of glycol used. To reset the valve, the following procedure should be followed.

  1. Remove the cap and insert a 5/16 allen wrench into the adjusting screw. Turning this screw clockwise will increase the setting and counter clockwise will lower the setting.
  2. A high evaporator load is initially required to raise the evaporator pressure above the desired setting.
  3. Slowly decrease the load until the regulating valve begins to open. A hissing sound and/or an accompanying temperature rise at the outlet connection will indicate that the valve has opened.
  4. Note the evaporator pressure when the valve opens. This is the current pressure setting of the valve.
  5. Turn the adjusting screw as required and repeat steps 2 through 4 to determine the new valve setting.
  6. Repeat this procedure until the valve is set at the proper pressure for the service required.

- **Head Pressure Control Valve – adjustable:** This system uses a combination of Sporlan ORD/ORI valves. The ODI valve is adjustable over a range and is located in the liquid line between the condenser and receiver. Due to its wide adjusting range, it can be used with most commonly used refrigerants. The valve will throttle and restrict the flow of liquid refrigerant from the condenser. Adjusting the valve is done by removing the cover over the adjusting screw and turning it clockwise to raise pressure and counter clockwise to reduce pressure. The ORD valve is a non-adjustable pressure differential check valve located in a bypass line between the systems discharge line and the receiver inlet. As the ORI valve restricts flow from the condenser, it creates a pressure differential across the ORD valve. This allows the ORD valve to bypass hot gas directly into the receiver, warming the liquid refrigerant and thereby maintaining a constant pressure at the expansion valve.

- **Head Pressure Control Valve – non adjustable:** This system uses a Sporlan OROA valve which is factory set to maintain 225 psig discharge pressure with R404A, R407C and R507. The valve used with R134A is set to maintain 100 psig. It does this by limiting the flow of liquid refrigerant from the condenser, thus flooding it, while regulating the flow of hot gas around the condenser to the receiver so as to maintain a constant pressure at the expansion valve.

- **Solenoid, Liquid:** Electrically operated (energize to open) valve used to control the flow of liquid refrigerant to the expansion valve.

- **Solenoid, Hot Gas:** Electrically operated (energize to open) valve used to control the flow of discharge gas to the discharge bypass valve.

- **Thermostatic Expansion Valve:** A modulating valve used to meter refrigerant into the evaporator in response to the imposed load. It does this by maintaining a constant superheat of the refrigerant vapor at the suction outlet of the evaporator. The lower the superheat, the more efficiently the evaporator is operating. From a practical standpoint, we recommend a superheat of 8° - 10°F at the evaporator. To adjust superheat, remove nut covering the adjusting stem. Turning the stem clockwise will increase superheat and slightly decrease the valve capacity. Turning the stem counter clockwise has the opposite effect. Keep in mind that superheat cannot be adjusted when the system is in a pulldown mode.

- **Water Regulating Valve:** An optional modulating type valve used with water-cooled condensers to maintain a constant head pressure. The valve senses discharge pressure and modulates the flow of water through the condenser in response to this pressure. Turning the adjusting stem on top of the valve will increase or decrease the systems discharge pressure.

Warranty Repairs
All in-warranty repairs must be performed by competent refrigeration mechanics that are familiar with this type of equipment. Prior to the commencement of the work, factory authorization is required. Billing for parts and labor will not be considered without this authorization.

See Terms and Conditions of Sales on next page…

TERMS AND CONDITIONS OF SALE

ORDER PROCEDURES- All equipment-requiring options are manufactured to order after receipt of customer purchase order. Some of the standard units are stocked and available for shipping generally within three working days.

DELIVERY REQUIREMENTS-Indicate at time order is placed.
STANDARD DELIVERY-Manufactured to order, approximately in 2-3 weeks (Weeks to ship will vary due to workload,) Shipping inquiries will be estimated to the "week ending."
EXTENDED DELIVERY- manufactured to order and shipped as per requested, when applicable, within the weeks required.
PRIORITY DELIVERY- Manufactured to order in 3-10 working days. Must have factory authorization in advance.
QUOTATIONS-All quotations in writing automatically expire thirty (30) days from the date of quotation and may be terminated by notice within that period. All oral quotations automatically expire five (5) days from date of quotation and are subject to change without notice. All orders are subject to approval at the factory by and authorized employee of the Seller. Orders are accepted under the Seller's terms, conditions, and price information as of the date of the Seller's factory acknowledgment of the order. Orders, originally entered, and then "held" for future release will be subjected to the Seller's terms, conditions, and price information as of the date Buyer's release is accepted by the Seller.

CANCELLATIONS- The buyer may not cancel an order except upon a verbal notice followed by a written notice and on payment of a reasonable and proper sum to compensate for expenses incurred in the engineering and manufacturing of said order to the date of cancellation.

TERMS OF PAYMENT- Credit is a privilege and all orders will be shipped C.O.D. unless prior arrangements have been made with the credit department. Direct all inquires for information to the credit manager. All goods are sold FOB factory suitably packed or crated for domestic shipment. Export shipments are subject to additional packing charge.

Terms to buyers of satisfactory credit are-NET 30 DAYS FROM DATE OF INVOICE. NO CASH DISCOUNT ALLOWED. No shipments for accounts 45 days outstanding. Shipments made only after receipt of payment on all outstanding invoices. For special orders, a down payment or deposit may be required.

SALES TAXES- Sales or use taxes required by law to be collected or paid by seller be in addition to prices quoted unless appropriate tax exemption certificate is furnished.

SHIPPING- All shipments will be forwarded FOB, PHILADELPHIA, PA.

1.) Prepaid only when open accounts terms are applicable to shipment.

2.) Collect on all other accounts.
3.) Insurance will be automatically added to UPS shipped valued in excess of $100.00
4.) All COD shipment will include the appropriate COD charges, when applicable.

DAMAGED FREIGHT- The consignee (buyer) is responsible for filing a freight claim with the delivering carrier should freight damages occur. Damages in shipment are not considered the responsibility of the factory. An inspection should be made at the time of delivery for any visible sign of mishandling by the carrier. Damages MUST be noted on the delivery receipt and a request for an inspection should be made immediately by the freight company adjuster. All packaging MUST be retained for the INSPECTION of the carrier or claim may be denied.

RETURNED GOODS- All returned goods must be authorized in advance. Only new and unused equipment will be considered for return. All items must be sent freight prepaid and include a packing slip. Equipment built to order is not subject to return for credit. Items returned that are inspected and found to be "OK" will be subject to a 25% restocking charge. Goods must be securely packed to arrive at the factory without damage. Any cost incurred by the factory to put equipment in first class condition will be charged to the buyer.

IN WARRANTY SERVICE PARTS- In warranty service parts will be invoiced pending receipt of the replaced parts previously authorized for return. After inspection of the replaced part at the factory, credit will be issued against the replacement parts providing the part was returned freight prepaid and that the part was free from abuse or misuse.

EQUIPMENT PARTS WARRANTY-DRAKE REFRIGERATION, INC. WARRANTS TO THE ORIGINAL OWNER OF THE UNIT THAT THE EQUIPMENT WILL BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE YEAR FROM THE EFFECTIVE DATE OF THE WARRANTY.
The effective date of this warranty is thirty days after shipment from the factory. The company's obligation under this warranty is limited to the repair or replacement, at its factory, of any part that shows evidence of being defective in material and workmanship and are deemed so by Drake Refrigeration, Inc., during the one year period. No obligation for labor required to replace the defective parts not for freight or Drake Refrigeration, Inc assumes mailing costs to return or to secure the part.
THE COMPRESSOR ONLY WILL BE WARRANTED FOR AN ADDITIONAL FOUR YEARS (TOTAL FIVE YEARS) FROM THE EFFECTIVE DATE OF THE WARRANTY PROVIDED THE EXTENDED WARRANTY IS PURCHASED WITHIN THIRTY DAYS FROM THE EFFECTIVE DATE. The compressor warranty obligates Drake Refrigeration, Inc., to replace FOB the factory, the compressor with a comparable compressor with equal capacity, free of charge. Drake Refrigeration, Inc. assumes no responsibility for refrigerant accessories, labor, or freight to or from the factory. Defective parts will be replaced provided notice of such defect was given by the original owner within the warranty period. Drake Refrigeration, Inc. reserves the right to replace in warranty defective parts from its factory. The warranty does not cover the cost to parts substituted by field service for original equipment parts not authorized by Drake Refrigeration, Inc. Any unauthorized substitution voids the warranty.
THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES. IN NO CASE WILL ANY CLAIM FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES BE APPROVED. THIS WARRANTY DOES NOT APPLY TO THE UNIT OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO DAMAGE DUE TO TRANSPORTATION,

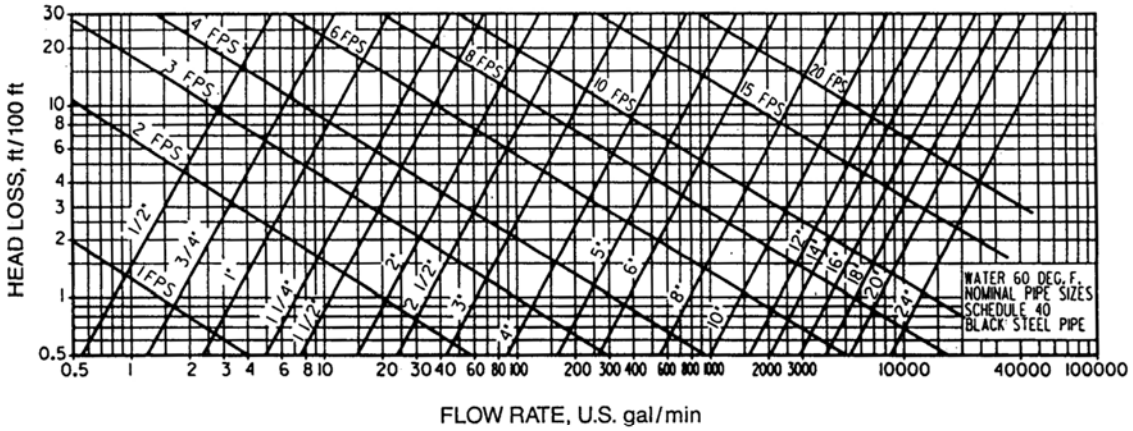


Fig. 1 Friction Loss for Water in Commercial Steel Pipe (Schedule 40)

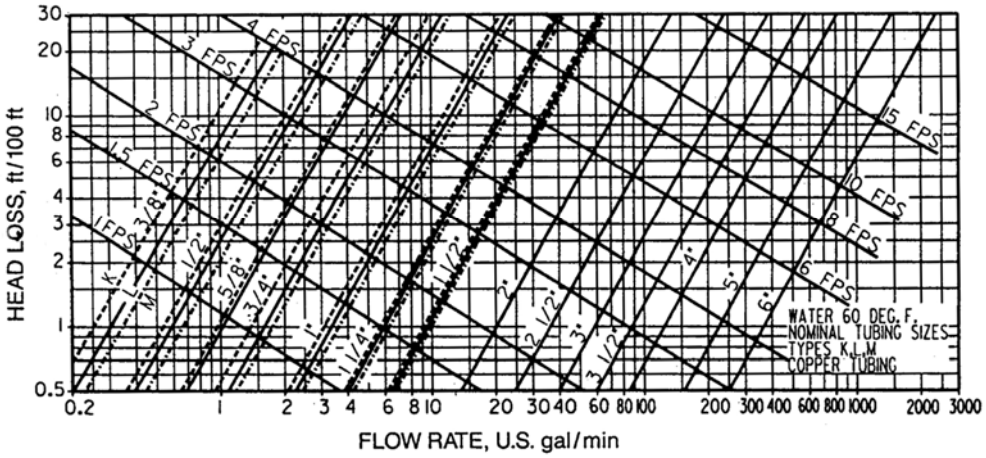


Fig. 2 Friction Loss for Water in Copper Tubing (Types K, L, M)

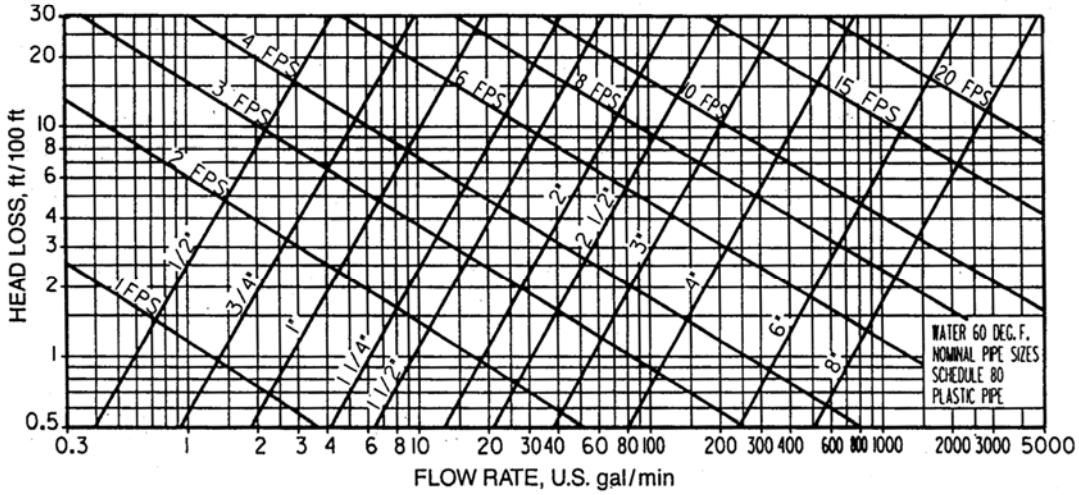


Fig. 3 Friction Loss for Water in Plastic Pipe (Schedule 80)

RECOMMENDED REMOTE CONDENSER LINE SIZES

Net Evaporator Capacity BTUs	Total Equivalent Length FEET	R-134a		R-407c		R507 & R-404A	
		Discharge Line (O.D.)	Liquid Line (O.D.)	Discharge Line (O.D.)	Liquid Line (O.D.)	Discharge Line (O.D.)	Liquid Line (O.D.)
3000	50	3/8	3/8	3/8	3/8	3/8	3/8
	100	1/2	3/8	3/8	3/8	3/8	3/8
6000	50	1/2	3/8	3/8	3/8	1/2	3/8
	100	1/2	3/8	1/2	3/8	1/2	3/8
9000	50	5/8	3/8	1/2	3/8	1/2	3/8
	100	5/8	3/8	1/2	3/8	5/8	3/8
12000	50	5/8	3/8	1/2	3/8	1/2	3/8
	100	7/8	3/8	5/8	3/8	5/8	3/8
18000	50	7/8	3/8	1/2	3/8	5/8	3/8
	100	7/8	1/2	5/8	3/8	5/8	1/2
24000	50	7/8	1/2	5/8	5/8	7/8	5/8
	100	7/8	1/2	5/8	1/2	7/8	1/2
36000	50	7/8	1/2	7/8	1/2	7/8	1/2
	100	1 1/8	5/8	7/8	1/2	7/8	1/2
48000	50	1 1/8	1/2	7/8	1/2	7/8	1/2
	100	1 1/8	5/8	7/8	1/2	1 1/8	5/8
60000	50	1 1/8	1/2	7/8	1/2	7/8	1/2
	100	1 3/8	5/8	7/8	5/8	1 1/8	5/8
72000	50	1 1/8	5/8	7/8	1/2	1 1/8	5/8
	100	1 3/8	7/8	1 1/8	5/8	1 1/8	5/8
90000	50	1 3/8	5/8	7/8	5/8	1 1/8	5/8
	100	1 3/8	7/8	1 1/8	5/8	1 3/8	7/8
120000	50	1 3/8	7/8	1 1/8	5/8	1 1/8	5/8
	100	1 5/8	7/8	1 1/8	7/8	1 3/8	7/8
180000	50	1 5/8	7/8	1 3/8	7/8	1 3/8	7/8
	100	2 1/8	1 1/8	1 3/8	7/8	1 5/8	7/8
240000	50	1 5/8	7/8	1 5/8	7/8	1 5/8	7/8
	100	2 1/8	1 1/8	1 5/8	7/8	1 5/8	1 1/8
300000	50	2 1/8	1 1/8	1 5/8	7/8	1 5/8	1 1/8
	100	2 1/8	1 1/8	1 5/8	1 1/8	2 1/8	1 1/8
360000	50	2 1/8	1 1/8	1 5/8	7/8	2 1/8	1 1/8
	100	2 5/8	1 3/8	2 1/8	1 1/8	2 1/8	1 3/8
480000	50	2 1/8	1 1/8	2 1/8	1 1/8	2 1/8	1 1/8
	100	2 5/8	1 3/8	2 1/8	1 1/8	2 1/8	1 3/8
600000	50	2 5/8	1 3/8	2 1/8	1 1/8	2 1/8	1 3/8
	100	3 1/8	1 5/8	2 1/8	1 3/8	2 5/8	1 5/8
720000	50	2 5/8	1 3/8	2 1/8	1 3/8	2 1/8	1 5/8
	100	3 1/8	1 5/8	2 5/8	1 3/8	2 5/8	1 5/8
840000	50	2 5/8	1 3/8	2 1/8	1 3/8	2 5/8	1 5/8
	100	3 1/8	1 5/8	2 5/8	1 5/8	2 5/8	2 1/8
960000	50	3 1/8	1 3/8	2 5/8	1 3/8	2 5/8	1 5/8
	100	3 1/8	2 1/8	2 5/8	1 5/8	3 1/8	2 1/8
1080000	50	3 1/8	1 5/8	2 5/8	1 3/8	2 5/8	2 1/8
	100	3 5/8	2 1/8	2 5/8	1 5/8	3 1/8	2 1/8
1200000	50	3 1/8	1 5/8	2 5/8	1 5/8	2 5/8	2 1/8
	100	3 5/8	2 1/8	3 1/8	1 5/8	3 1/8	2 1/8
1440000	50	3 1/8	1 5/8	2 5/8	1 5/8	3 1/8	2 1/8
	100	3 5/8	2 1/8	3 1/8	2 1/8	3 5/8	2 5/8
1680000	50	3 5/8	2 1/8	2 5/8	1 5/8	3 1/8	2 1/8
	100	4 1/8	2 1/8	3 1/8	2 1/8	3 5/8	2 5/8

	Issue Date 2-1-07 Supersedes 8-1-00	File Name Wa.form. Rev.2

Drake Refrigeration Inc.
Warranty Activation Form

Schedule Type: Drake Chiller start-up & pm checklist | Page: 1 of 3

Start Up/PM Date:				
Site Name:			Site Contact:	
Address:			Phone Number:	
City:	State:	Zip:	Email Address:	
Manufacturer:	**Drake Refrigeration Inc**		Service Company Name:	
Model #:			Service Company Phone:	
Serial #:			Startup Technician:	
Seg. # .				

Visual Inspection

- ☐ **Inspect incoming voltage matches nameplate voltage, and chiller disconnect per local codes.**
- ☐ Inspect installation of equipment mounting, piping, and wiring for completion.
- ☐ Inspect chiller location is **free from overhangs and at least 3 feet from any wall or fence**.
- ☐ Inspect chiller fluid level is full and free of air.
- ☐ Inspect chiller piping and pump housing for any fluid leaks.
  (Slight seal leak may occur until pump seal burn in time is complete.)
- ☐ Tighten all Rotolock Valves, Schrader valve cores, and Liquid line solenoid body.
- ☐ Backseat receiver rotolock valves to release the refrigerant into the system. (If applicable)
- ☐ Tighten receiver valve packing nut (if applicable)
- ☐ Leak check the refrigerant circuit with an electronic leak detector.
- ☐ Inspect chiller name plate voltage matches the voltage supplied to the chiller.
- ☐ Tighten all electrical connections in the control panel, microprocessor and other controls.
- ☐ Inspect that a filter or Y strainer is installed in the return line of the chiller. Note if not installed.
- ☐ Measure the glycol freeze point and log into the chart below. (If applicable)

Chiller Operation

- ☐ Refer to the chiller operation manual page 11 to start the chiller.
- ☐ Inspect compressor rotation.
- ☐ Inspect chiller pump rotation.
- ☐ Press the Sys pump button to turn on the system pump. (If applicable)
- ☐ Inspect system pump rotation. (If applicable)
- ☐ Inspect chiller pump overload setting. (This should match the SFA rating on the pump label)
- ☐ Inspect system pump overload setting. (This should match the SFA rating on the pump label)
- ☐ Inspect controller set points.
- ☐ Inspect and test Flow differential pressure switch for proper operation (adjust if necessary)
- ☐ Adjust flow of glycol loop using ball valve to verify a 10F delta “T” on microprocessor display.
- ☐ Inspect Condenser fan operation. (if applicable)
- ☐ Inspect Condenser water regulation valve operation. (if applicable)
- ☐ Inspect Fan Cycle setting at 63°F.
- ☐ Install service gauge set and inspect microprocessor pressure readings. (Microprocessor pressures reasonably match technicians gauge set)
- ☐ Inspect indoor remote display panel operation. (If applicable)

Motors, Elements

Completion Date:	Service Provider: (1)	Material/tool reference

☐ Complete log sheet

Compressors

☐ Complete compressor log sheet

Microprocessor Setting

☐ Complete microprocessor table

Final checklist

☐ Remove all tools and debris from the equipment.
☐ Replace all service caps and tighten.
☐ Replace Receiver valve stem caps and tighten. (If applicable)
☐ Replace all chiller manuals and documentation into the electrical panel.
☐ Install & secure all access panels and hardware.
☐ Review start up documents with the customer
☐ Give a copy of the start up documents to the customer
☐ Fax or email a copy of the start up documents to Drake
(215) 638-5518 or tbartlett@drakechillers.com

Log Sheet (Motors, Elements, etc.)

ID Information		Amp Readings				Voltage Readings			
Motor/Element Name	**HP**	**L1**	**L2**	**L3**	***NP**	**L1**	**L2**	**L3**	
Compressor									=To Ground
Condenser fan #1									=Between lines
Condenser Fan #2									
Chiller glycol pump									
Indoor water Pump									
Receiver Heater									
Liquid Solenoid									

*NP=Name Plate

Compressor Log Sheet

Comp #	Suct Press	Disch Press	Super Heat		Oil Level	Outdoor Ambient Temp F.	LWT. °F	EWT. °F	LP Cut	HP Cut
1										
2										
3										

LWT= Leaving Water temp / EWT= Entering LP-Test low pressure cutout HP-Test high pressure cutout
Heat Ops-Test crankcase heater operation Unload Ops-Test unloader operation

Glycol Freeze Point :
Micro Flash Version : **(this will be displayed at power up)**

***Microprocessor Table** (for settings)*

Completion Date:	Service Provider: (1)	Material/tool reference

Drake Refrigeration Inc.
Warranty Activation Form

item	Setting	*item*	Setting
dEG		TC	
CP			
SP1		SP2	
DF1		DF2	
HP1		HP2	
LP1		LP2	
HTA		LTA	
HR1		HR2	

Visit Notes

Completion Date:	Service Provider: (1)	Material/tool reference

WARRANTY LABOR ALLOWANCES

MUST BE APPROVED TO RECEIVE COMPENSATION

Service Category	Task Description	Man Hours
Electrical	Replace HOST micro-processor controller	1.00
	Replace REMOTE micro-processor controller	1.00
	Replace High or Low pressure controller transducer with cable	1.00
	Replace compressor or fan contactor	1.00
	Replace pump motor contactor/overload and calibrate to SF amps	1.00
	Replace differential flow safety	1.00
	Replace compressor crank case heater (insert or band)	1.00
	Replace receiver heater Scroll system	2.50
	Replace receiver heater Semi-Hermetic system	3.50
	Replace evaporator heater (Brazed Plate)	2.00
	Replace evaporator heater (Shell and Tube)	2.50
	Replace condenser fan motor	1.00
	Replace refrigerant solenoid coil	1.00
	Replace flooded condenser heater controller	1.00
Refrigeration	Replace compressor (Scroll)	6.00
	Replace compressor semi-hermetic	8.00
	Replace TXV standard	3.00
	Replace liquid line solenoid valve standard	5.00
	Replace liquid line solenoid flooded condenser	2.00
	Replace head master valve	5.00
Fluid Systems	Replace Recirculation pump	3.00
	Replace System pump	3.00
	Replace Pump Seal on Recirc or System	2.00
	Replace tank level sight glass lenses	1.00
Leak Repairs	Refrigeration piping braze joint (15% silfos)	4.00
	Fluid piping braze joint (95/5 solder)	2.00
	Pipe to fitting joint repair (Refrigeration or Fluid)	2.00
	Fluid pipe to Braze Plate evaporator	3.00
	Fluid pipe to shell and tube evaporator	3.00

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