MCS MicroMAG Controller

Installation, Operation & Maintenance Manual

Packaged Air Cooled
Split System Air Cooled
Packaged Water Cooled
Tank & Pump Skids

V 1.0 5-1-20

Drake Refrigeration, Inc. | 2900 Samuel Drive | Bensalem, PA 19020 | 888-289-7299

NOTE

- **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 from Drake, each shipment must be checked against the bill of lading. **Shortages and shipping damage are the responsibility of the shipping 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 used to aid moving equipment, such as to lift via forklift. The shipping skid should not be removed until the equipment is at the 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.

Units with Air-cooled Condensers:

- Care must be taken to ensure an ample supply of fresh, clean air.
- Installing Indoors:
  - When installing 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.
  - Avoid locating multiple units such that the air discharge from one unit feeds into the air intake of another.
- Installing Outdoors
  - For air-cooled units located outdoors AND intended for year-round operation, special attention must be paid to prevailing wind direction during colder weather.
  - If wind is blowing through the condenser, cycling or reducing the speed of the condenser fan may no longer be an effective means of head pressure control. This is normally not a problem with flooding types of head pressure control.

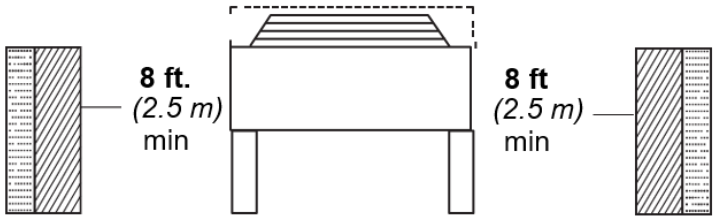
CAUTION: Avoid ALL overhangs above the unit if possible. Failure to provide adequate clearance may cause discharge air to be re-circulated through the condenser!

Units with any 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.

Units with any horizontal-face condensers:

- Allow at least (1) condenser width between the condenser and a single wall.
- If the unit is located with solid walls on more than one side, allow at least (1) condenser width.
- If two or more units are placed side by side, allow at least (2) condenser widths between units.
- For units in pits, the top of the condenser must be level with, or above the top of the pit. In addition, a minimum of **8 feet** (2.5m) is required between the unit and the pit walls.



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 ensure that factory piping is properly brazed, 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 and cause it to not function properly. Horizontal supports must be close enough to prevent sag, which would impose excessive stress on the pipes. 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:

Table 1. Pipe / Tube Support

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)	1/4 – 5/8	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 service for which it is intended. Line sizes should be based on the curves shown in Fig. 1, 2, and 3 on Page 21, and not on connection sizes at the chiller.

- **Chilled Fluid Lines** (See Line Size curves shown in Fig. 1, 2, and 3 on Page 26)

1. Fluid lines should be kept as short and direct as possible.
2. Lines should be sized to ensure low pressure drops in order to minimize pump requirements.
3. Lines must be insulated.
4. Use insulation of sufficient thickness to prevent sweating, which can 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

Packaged Chillers:

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

Water-Cooled Chillers:

- Water-regulating valves for water-cooled condensers are shipped loose with the chiller, and **must be installed in the field.**
- Install on the condenser Leaving Fluid side or on the condenser Return to Fluid Source side.

Split-Systems:

- Split-System chillers 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 overnight.** This is especially important with units that have compressors using polyol ester (POE) oils, due to the hygroscopic 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 accordance with the remote condenser line size table, as shown in Fig. 4 on Page 24. The interconnecting lines must be evacuated. Be sure to install appropriate fittings.

Refrigeration Liquid Line – **Split-Systems only** (See Line Size tables in Fig. 4 on Page 26)

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,
4. the liquid refrigerant may flash.
5. **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.
6. **Brace liquid lines securely to prevent damage to the line from liquid hammer.** Liquid lines are prone to 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, and is a major cause of joint failure.

Refrigeration Discharge Line – **Split-Systems only** (See Line Size tables in Fig. 4 on Page 26)

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.
4. Horizontal lines should be pitched downward in the direction of flow to prevent oil from flowing back to the compressor during an 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 an access valve installed to allow for purging of non-condensable 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. Line pulsation is an inherent characteristic in systems utilizing reciprocating compressors. 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 and to all applicable national and local codes.

Main power wires must be kept a minimum of 12 inches away from all low voltage wiring and controls, such as the microprocessor, temperature sensors, and transducer cables. Power wires can create "noise" that will interfere with the operation of the microprocessor and sensors, such as false readings and nuisance trips.

****All Equipment needs to have its own dedicated power supply**

- Use only copper conductors that are properly sized to handle the load. Always consult the unit's 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. However, 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 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 (fused or non-fused) are optional items when the system is purchased and normally are not factory supplied. They must be field-supplied and field-installed as required by applicable national and local electric codes.

Compressor Oil Charge

- All compressors intended for use with R-134A, R-404A, R-407C, & R-507 are shipped with POE oil.
- For all compressors with an oil sight glass, the proper oil level is between 1/2 to 3/4 up the sightglass.
  - For 8-cylinder compressors, the level should be 1/4 to 1/3 up the sightglass.
- Oil 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: *Too much oil is just as detrimental to a system as not enough oil.*

Low Oil Level

In the absence of a visible oil leak, a 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 blocked oil return
5. Compressor short-cycling

High Oil Level

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 properly working crankcase heater will normally eliminate this problem.

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

Polyolester (POE) Oils: Mobile, Emkarate RL 32CF, EAL ARCTIC 22CC, ICI

Leak Testing

Refrigeration Side

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 can loosen and sometimes break during shipment.

As with electrical connections, gasketed and flared joints may loosen after a short running time. After 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.

Evacuation:

- Connect a deep vacuum pump to both the high side and low side 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.

Troubleshooting:

If a leak is suspected, it must be found and corrected as indicated under the Leak Testing section 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. For small leaks, it is not necessary to re-pressurize the system with refrigerant.

If moisture in the system is the issue, continued evacuation is necessary. Due to the low boiling point of water at very low pressures, the moisture in the system may freeze, especially when using a pump of excessive capacity. An oversized pump can reduce the system pressure so rapidly that freezing will occur, unless special precautions are taken, such as introducing dry nitrogen into the system to maintain pressure or using sun lamps to maintain temperatures above freezing. Attempting to run the vacuum pump after moisture has frozen will greatly prolong the evacuation process, and can possibly damage the pump.

Refrigerant Charging

Once leak testing and evacuation are complete, refrigerant charging may commence. Always refer to the unit nameplate for 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.
  - As much refrigerant as possible should be charged in this manner, since it is the fastest method available.
  - **Never liquid-charge into the low side without taking special precautions as indicated further in this section.**
- Maximize the amount of refrigerant charged by chilling the receiver (when provided) and warming the refrigerant cylinder:
  - Chill receivers by using either liquid or dry ice packed into an insulating blanket which has been wrapped around the receiver.
  - Warm refrigerant cylinders 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 the cylinder pressure rating 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 Fluid" Refrigerants & Azeotropic Blends

- Refrigerants that are pure fluids (such as **R-134A**) as well as Azeotropic blends (such as **R-507**) can be vapor- charged into the low side of the system.
- **Never attempt to vapor-charge into the system high side**. This will result in the refrigerant cylinder becoming charged by the system, rather than the other way around. Cylinders can quickly become over-pressurized, causing them to rupture with resultant injury and property damage.

Zeotropic Blends & Near Azeotropic Blends

- Zeotropic blends such as **R-404A** and **R-407C**, and Near-Azeotropic blends (such as **R-502**) should generally not be vapor-charged due to *fractionation* (see below).

What is fractionation? Fractionation 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. Fractionated blends have a ***reduced capacity*** and become ***less effective*** when returned to the system. This does not present a problem if the entire contents of the refrigerant cylinder are to be used, since it allows all of the refrigerant to boil off and return the mixture to its original proportions. **If all the refrigerant in a cylinder is to be used, vapor-charging is permissible,** but it is generally not a good habit for regular unit servicing and proper operation of chiller.

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 Zeotropic or Near-Azeotropic.

To avoid the problem of fractionation, Zeotropic or Near-Azeotropic refrigerants should be liquid-charged.
Suggested Method:

1. Liquid-charge into the high side.
2. Start compressor.
3. Using a throttle valve, then begin liquid charging into the low side. This ensures that the liquid flashes to vapor before entering the compressor, preventing liquid slug in the compressor on start-up.

**Pure fluid refrigerants and Azeotropes may also be charged in this manner.*

Fractionation is also 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 more significant.** As the blend becomes increasingly fractionated, the system performance can be affected to the point where the outlet water (or glycol) temperature cannot be maintained. **Additionally, the effects of fractionation also become more significant with increased refrigerant glide, meaning these problems become more pronounced with Zeotropes than with Near-Azeotropes.** If leaks are small and corrected early, simply topping off the system with refrigerant is acceptable. **On the other hand, with systems having repeated or large leakages, it may be necessary to completely evacuate and recharge.**

Amount of Refrigerant Required

The amount of refrigerant required to charge a system depends on the specific components used in the chiller and the type and combination of head pressure control(s) used. Refer to the engineering documents packaged with your chiller for the capacity and sizes of the components in your chiller.

A head pressure control or condenser fan control alone does not require any additional refrigerant. However, flooding type head pressure controls may require a significant amount of additional refrigerant. The exact amount is dependent on the condenser coil design, as well as the minimum head pressures required for proper thermal expansion valve (TXV) operation. Using both fan controls and flooding type controls in the same system can significantly reduce the amount of additional refrigerant required.

For 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.

Table 2. Weight Liquid Refrigerant in Copper Tube

Tube O.D. (in)	3/8	1/2	5/8	7/8	1-1/8	1-3/8	1-5/8
R-134A / R-407C (lbs.)	3 .9	7 .4	11 .8	24 .4	41 .6	63 .5	90
R-404A / R-507 (lbs.)	3 .4	6 .4	10 .3	21 .2	36 .1	55	78

CHILLER START-UP

MCS MAGNUM CONTROLLER & KEYPAD (DRAKE OPTIONAL MICROPROCESSOR)

Chillers with MCS Controls can be started via chiller mounted Keypad or Laptop
If using a Laptop for start-up, call Drake Tech Support 215-638-5515

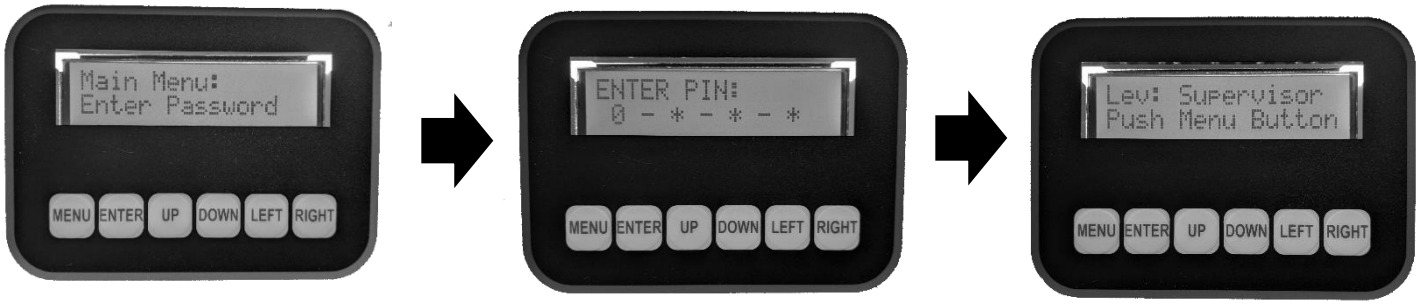
Keypad Controls

1. Press **Menu** to return to the main screen at anytime
2. Press **LEFT / RIGHT** or **UP / DOWN** to navigate the menus and scroll through setting options
3. Press **ENTER** to select a display tab or select a value

Password Authorization

Chillers with MCS controls have authorization levels to allow for changes to operation conditions. For supervisor level access:

1. Scroll **DOWN** to **Password**
2. Press **ENTER** to be prompted for PIN#
3. Use **LEFT / RIGTH** to select what password digit to change
4. Use **UP / DOWN** to select options 1-9 for each password digit
5. Enter **2112** for **Supervisor** access
6. Press **ENTER** to confirm password



Chiller Controls

Installed with each controller is a digital **RUN/STOP** typically tied to Input M-9.
This virtual switch has three settings:

1. **'MANON'** – This input will display **RUN**, allowing the chiller to enable cooling if called for and run on board pumps (if applicable)
2. **'MANOFF'** – This input will display **STOP** and deactivate all chiller **Outputs** or similar external devices
3. **'AUTO'** – Used when an external toggle switch is instead wired to this input – *See wiring diagram for installation reference*

Alarms

Each individual chiller is configurated to the particular design and usage, coming equipped with a custom engineered control configuration. When an unsafe condition occurs, the chiller will display one of two system status

1. **'Alarm'** – Compressors will shut down and will attempt to restart after a specified time. Continual alarms will result in a 'Lockout'
2. **'Lockout'** – All chiller components will stop and will not restart until a manual 'Lockout Rest' has been performed

A full alarm and error manual for this controller can be found on **www.drakechillers.com** under the Tech Support page

INSTALLATION CHECKLIST

Once installation is complete check the following ***prior to startup***

1. Inspect chiller location is **free from overhangs and at least 3 feet from any wall or fence**
2. **Verify power supply** on site and check that incoming voltage matches nameplate voltage and chiller disconnect per national & local codes
3. Inspect all electrical connections in the control panel, microprocessor, and other controls are wired in accordance with the attached diagram. **Tighten any terminal connections loosened during shipping**.
4. Shipping spacers on spring mounted compressors have been removed, the neoprene washers used to properly center the compressor foot on its mounting spring and stud have been properly installed, and the mounting nut and washer is reinstalled so as to allow the compressor to "float."
5. The compressor oil is at the proper level in the oil sightglass (if applicable) --- See **"Compressor Oil Charge"**
6. Confirm the **Pump Overload** settings match the SFA rating on the pump labels (if applicable)
7. **CAUTION: Confirm the chilled fluid side of the system contain either water or an appropriate water/glycol solution before turning on any pump (if applicable)**
    a. Pumps should not be allowed to "**deadhead**," and those using three-phase motors must be checked for proper rotation. Allowing a pump to run dry, deadheaded, or in reverse rotation may all cause damage not covered by warranty.
    b. Check glycol freeze point and log into **Warranty Activation Form** at end of manual.
8. **Open ball valves on the chilled fluid lines to allow water/glycol to circulate through the system.**
    a. 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 unless otherwise specified by Drake Tech Support or Engineering** (if applicable)
    b. **If chiller is not provided with on board pumps, confirm that proper flow through the chiller can be established prior to start-up and ball valves on the process line(s) are open**
9. Bleed tank and lines to remove air trapped in the chilled fluid circuit
    a. **First**, bleed the tank using the boiler drain provided (if applicable)
    b. **Second**, bleed the chilled fluid lines at their high points
    c. **Third**, bleed the system's water flow switch located in the compressor compartment.
        i. **Air trapped in the flow switch lines will trip the switch and prevent the chiller from operating. This will trip the "Low Flow" alarm on the Drake Chiller Controller**
10. **Tighten all Schrader valve cores and refrigerant solenoid bodies**
11. **Confirm all PROPER refrigerant ball valves on receivers or split systems are open** to release the refrigerant into the system and the packing nuts are tight (if applicable)
12. Leak check the refrigerant circuit(s) with an electronic leak detector
13. **Fill out MCS Warranty Activation Form at end of the manual**

COMPRESSOR CHECKLIST

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** must be completed ***prior to startup***

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. However, this does not mean that liquid refrigerant is not present elsewhere in the low side. **To avoid compressor damage on start-up:**
    a. **Hook up refrigerant pressure gauges (see nameplate for refrigerant type).**
    b. **Deactivate the liquid solenoid valve.**
    c. **"Bump" the compressor with the following procedure:**
        i. **Before running the compressor, ensure that the compressor is not in a vacuum.** Running the compressor in a vacuum can quickly cause it to be overworked and burn out the motor.
        ii. *Using a flathead screwdriver with an insulated handle,* "bump" the compressor by pressing the contactor switch for 2 seconds. **Do not repeat**.

This process will rapidly reduce low side pressure, causing any remaining liquid to boil off quickly. After this process is complete, it is usually safe to allow the compressor to run.

After starting the compressor, listen for unusual sounds such as knocking, shaking, or rattling. **Should these noises be heard, immediately stop the unit.** Do not restart until the problem is resolved.

- **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 and 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 before it leaves the factory, and all three-phase motors (i.e. pumps and compressors) have been set in the proper phase.
- **Turn off the power at the main disconnect, 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.

START-UP PROCEDURE

Before following the steps below, confirm:

- **Supervisor level access has been entered --- See "Password Authorization"**
- **Installation and Compressor Checklist have been completed**
- **The process source is able to provide an adequate load to the chiller**

Following factory start-up procedures, the sequence of operations follow:

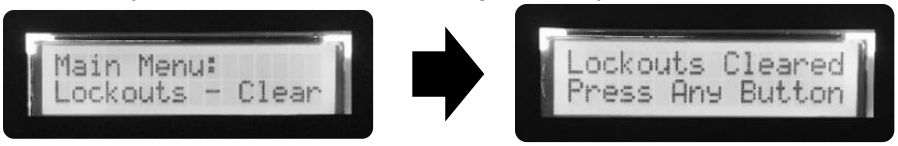
1. Confirm chiller **RUN/STOP** is set to '**STOP'**
2. Clear **Lockouts** and **Alarms**
3. Test **Output** functions
4. Verify pump function and proper phase
5. Establish and confirm evaporator flow
6. Turn chiller **RUN/STOP** to '**RUN'**
7. Allow heat load to increase **FLUID OUT** temp
8. **Enable Circuit #1**
9. **Monitor Circuit #1**
10. **Disable Circuit #1** and test remain Circuit(s)
11. Return Circuit(s) to '**AUTO'** when finished
12. Continue to adjust for normal operating condition

Confirm Chiller RUN/STOP is set to 'MANOFF'

1. Press **MENU** to return to the **Main Menu** screen
   a. Scroll **DOWN** to **Inputs SI** and press **ENTER** to open the **Inputs SI** tab
   b. Scroll **DOWN** to **RUN/STOP** (M-9) and press **ENTER** to select **'DI MANOFF'** so it displays **STOP**

Clear Lockouts & Alarms

2. Press **MENU** to return to the **Main Menu** screen
   a. Scroll **DOWN** to **Lockouts - Clear**
   b. Hit **ENTER** to perform a **'Lockout Reset'** and confirm
   c. This should only have to be done once during a start-up



If lockouts persist, refer to full MicroMAG Error/Alarms Manual for troubleshooting

Test Output Functions

3. Test individual component function **-except compressor(s) & pump(s)-** from the **Outputs RO** tab with the following steps:
   a. Scroll **DOWN** to component relay (solenoids, receiver heaters, fan motors, etc.)
   b. Press **ENTER** to change status from **'AUTO'** to **'MANON'** to send power to the components
   c. Ensure the components are operating correctly
      - For solenoids, use of a magnetic solenoid rotation tester is recommended
   d. Return component relay(s) to **'AUTO'** and confirm change when finished testing
   e. **Compressor relay(s) (COMP) should be set to 'MANOFF' when finishing this step**

CAUTION: Never **'MANON'** a compressor. This bypasses all safety logic and can cause unsafe discharge pressure, damaging the compressor and/or ruining the chiller. Only ever **BUMP** a compressor **ONCE** as described on Pg. 11

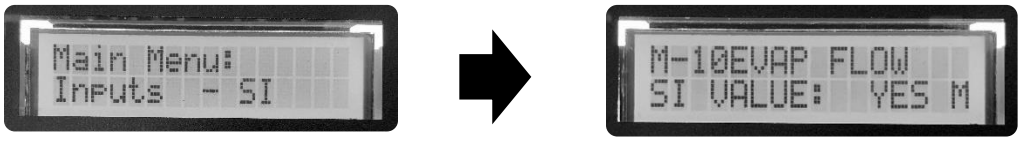
NOTE: If any Chiller components are not energizing during testing, confirm that when turned to **'MANON'** there is a +24VAC reading between the **NO** and **GND** relay output on the control board.
If not, test to see if there is +24VAC reading between the **COM** and **GND** relay output on the control board. If so, the 5A on-board relay fuse may have a loose connection or needs replacing

Verify Pump Function & Proper Phase

4. Press **MENU** to return to the **Main Menu** screen
    a. Scroll **DOWN** to **Outputs RO** and press **ENTER** to open the **Outputs RO** tab
    b. Scroll **DOWN** to pump relay(s) and press **ENTER** to set to **'MANON'** and confirm change.
    c. Confirm correct phase and proper rotation **–** *rotational direction shown in impeller housing*

Establish & Confirm Evaporator Flow

5. Press **MENU** to return to the **Main Menu** screen
    a. Scroll **DOWN** to **Inputs SI** and press **ENTER** to open the **Inputs SI** tab
    b. Scroll **DOWN** to **EVAP FLOW** (M-10)
    c. This will be reading **'YES'** if **Step #4** was completed and there is fluid moving through the evaporator
        - **For chillers <u>with</u> provided pumps, do not allow the pump to continuously run if flow is not established or a grinding sound can be heard from the pump**
        - **For chillers <u>without</u> provided pumps, ensure process side is instead providing flow and all ball valves in the process lines are open**
    d. When flow is confirmed, return pump **Output(s)** to **'AUTO'**

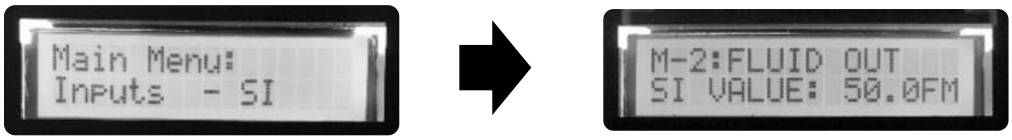


Turn Chiller RUN/STOP to 'MANON'

6. Press **MENU** to return to the **Main Menu** screen
    a. Scroll **DOWN** to **Inputs SI** and press **ENTER** to open the **Inputs SI** tab
    b. Scroll **DOWN** to **RUN/STOP** (M-9)
    c. Press **ENTER** to set it to **'DI MANON'** and so it displays **RUN**
    d. **Pumps should begin to run and circulate fluid through the chiller**

Allow Heat Load to Increase FLUID IN/OUT Temps

7. Press **MENU** to return to the **Main Menu** screen
    a. Scroll **DOWN** to **Status** and press **ENTER** to open the **Status** tab
    b. Allow the heat load to bring **FLUID IN/OUT** temperature at least 10ºF above **FLUID TARGET** value



Allow Heat Load to Increase FLUID IN/OUT Temps

8. Press **MENU** to return to the **Main Menu** screen
    a. Scroll **DOWN** to **Outputs RO** and press **ENTER** to open the **Outputs RO** tab
    b. Press **ENTER** to set **COMP 1** to **'AUTO'** and confirm change
    c. **Compressor #1 should begin to run after a short delay** if temperatures are above setpoint
        - If compressors don't begin to run after a short delay, confirm the **FLUID TARGET** value in **Setpoints** is accurate for your operating conditions

Monitor Circuit #1

9. Press **MENU** to return to the **Main Menu** screen
    a. Scroll **DOWN** to **Status** and press **ENTER** to open the **Status** tab
    b. Scroll **UP**/**DOWN** to view **COMP 1** and **LEFT/RIGHT** to view pressures and temperatures
        - **Run the circuit for 1-2 minutes and monitor for unsafe discharge and suction temperatures**
        - **FLUID OUT** temperatures should begin to decrease as the chiller runs
        - **Fill out Log Sheets – Motor/Elements/Etc. & Pressure/Temperature Chart**

NOTE: Chiller pressures and temperatures will be adjusted for normal operation in the following **Operational Checklist**

Disable Circuit #1 & Test Remaining Circuit(s)

a. Press **MENU** to return to the **Main Menu** screen
    i. Scroll **DOWN** to **Inputs SI** and press **ENTER** to open the **Inputs SI** tab
    ii. Scroll **DOWN** to **RUN/STOP** (M-9)
    iii. Press **ENTER** to set it to **'DI MANOFF'** and confirm change
    iv. Wait for **COMP 1** to pump-down and turn off

b. Repeat **Steps #2-9** using **COMP 2** for **Step #8** to test **Circuit #2**

11. Confirm all **Outputs -including compressor(s)-** are in **'AUTO'** when done testing the unit.
12. **Fill out MCS Warranty Activation Form at the end of the manual and continue to Operational Checklist**

- **Any questions with this process call Drake Tech Support 215-638-5515**
- **With the chiller now running, continue through the Operational Check to finalize start-up and adjust for normal operation conditions**
- **For electrical and mechanical component information, see following sections**

OPERATIONAL CHECKLST

After installation and stat-up, follow all of these steps to set up chiller for normal operating conditions

1. **Attach refrigerant pressure gauges to the high and low side of the system**. **When letting the chiller run, confirm these pressure readings match those displayed in the INPUTS tab of the controller**. If displayed pressure readings are inaccurate consult Drake Tech support for troubleshooting or replacement transducers.

2. **With a typical heat load on the process side, turn the Run/Stop switch to 'RUN' and allow the system to operate for 4 – 5 minutes.** Check refrigerant pressures, fluid temperatures to ensure that all readings are in line with what could be expected at present fluid temperatures, ambient temperatures, and chiller application.
   i. **Keep in mind that pressure-limiting expansion valves are used to limit low side pressures for most chillers, regardless of fluid temperature.**
   ii. ***Typical Standard Chiller* - Low Side Pressure Limit**: Equivalent of 55°F
   iii. ***Low Temp Operation Chiller* - Low Side Pressure Range**: Equivalent of -5° to 0°F.

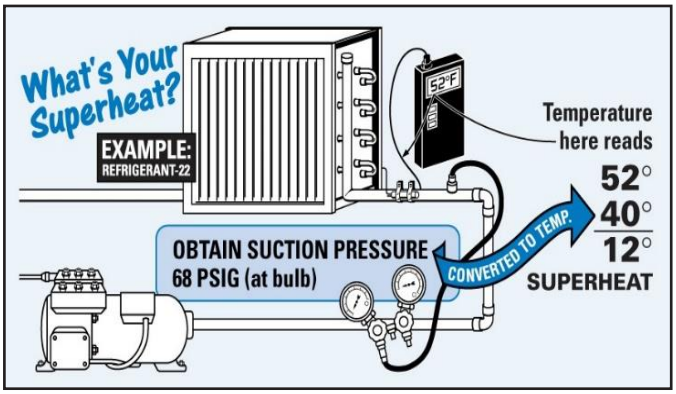
3. **If chiller is equipped with Low Ambient Head Pressure Control valve(s), adjustment may be needed to build sufficient discharge head pressure**. Chillers come equipped with Sporlan fixed OROA or an adjustable combination of ORD/ORI valves. With all fans running, set the adjustable ORI valve to maintain the following minimum discharge pressures:

   - R407C – 225-235psi
   - R404A – 250psi

   NOTE: When setting the ORI valve, low ambient operating conditions often require adjustment during winter weather conditions. If ambient is below 0°F during start-up, only 50% of the fans may be running.

4. **For the evaporator to operate at maximum efficiency, a superheat of 15-20°F at the compressor is required to be verified by the start-up technician, and adjusted if necessary.**

5. To ensure that liquid refrigerant does not return to the compressor during the running cycle, maintaining proper superheat at the compressor suction inlet is critical. ***Superheat readings can be found under the STATUS window on the controller.*** To confirm these readings are accurate, Drake requires a manual superheat reading by the start-up technician.



Manual Superheat Reading:

1. Measure the temperature and pressure 6 inches from the compressor suction valve.
2. Convert the temperature using a P-T chart.
3. Subtract this conversion from the measured temperature.
4. The resulting number is the superheat at the compressor.

6. **Ensure that the system recirculation pump has proper flow.** 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 fluid 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 flow 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 & will lock out the unit and, in some cases, may damage the system.

7. **Chillers using integral recirculation tanks**: The ball valve installed on the discharge side of the tank recirculation pump is factory-set to maintain an approximate 5°F TD across the evaporator. The handle is then removed & wrapped to the valve with zip ties. Under most circumstances, no readjustment is necessary.

8. **Systems using an external chilled fluid recirculation tank**: It may be necessary to leave the system pump off and isolate the chiller from the process until the fluid inside the tank reached the desired temperature.

9. **Check compressor oil sightglass to ensure it is clear and free of refrigerant or any other contaminants.**
   If there is refrigerant bubbling in the oil sightglass, it can usually be boiled off by **slowly increasing then decreasing the superheat or the following:**
   1. Locate the oil return ball valve and restrict oil flow using a refrigeration wrench (if applicable)
   2. Monitor and with for bubbling in the sightglass to disappear
   3. Slowly open oil return ball valve and monitor oil sightglass level

10. **Check the liquid line sight glass to make sure it is clear with steady liquid.**
   - **NOTE: A slightly bubbling sightglass does not necessarily mean the system is undercharged. Take this into account when installing/servicing the unit**.

   Small amounts of bubbling may result from the following:
   1. Cool weather operation without head pressure control.
   2. Locating the sightglass close to the condenser outlet.

11. **Check status of moisture indicator:**
   - **GREEN** – Normal Operation
   - **LIGHT RED** – 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.
   - **BRIGHT YELLOW** – Large amounts of moisture in the system. 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.

12. **Check with Gauge or Thermometer**
   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. See the units piping diagram(s) and wiring diagram(s) for more information.
   Refer to System Controls -- Electrical & System Controls – Mechanical for description & settings.
   1. **Condenser Fan Control**
   2. **Evaporator Heat Tape Controls**
   3. **Low Ambient Receiver Heat Tape Controls**
   4. **Hot Gas Bypass Valve & Solenoid**
   5. **Low Ambient Head Pressure Control**
   6. **Electronic Expansion Valve**
   7. **Condenser Water Regulating Valve**
   8. **Compressor Unloader Solenoids**

13. **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.**

14. **Once the system has operated for 1-2 hours without any sign of problems, it may be left operating overnight. 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 the ambient temperature falls below 70°F.

15. **Complete MCS Warranty Activation Form at end of the manual**

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	Electrical Service (VAC/Phase/Hz)	Designation	Electrical Service (VAC/Phase/Hz)
S2	208-230/1/60	S6	220/1/50
T3	208-230/3/60	T7	200/3/50
T4	460/3/60	T8	380-400/3/60
T5	575/3/60	T9	380/3/50

- **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.**

- **Microprocessor Controller:**
  - The heart of the chiller, mounted on the chiller panel with an external keypad, the microcontroller monitors all chiller inputs and stages compressors, condensers, and chilled fluid pumps via a Drake programed configuration file.
    i. **When using plain water, never set the Chilled Fluid IN or OUT setpoint less than +50°F/+40°F** (respectively) unless the chiller has been approved to operate at a lower temperature from Drake.
    ii. When colder temperatures are required, a glycol/water solution can be used. The setpoints can then be lowered below +50°F/+40°F. The lowest setting is dependent on the type and concentration of glycol used.
  - Failure to do follow these guidelines may result in heat exchanger freeze-up and rupture, which in turn will destroy the refrigeration circuit. **This type of failure will void any warranty on the equipment.**

- **Compressor Unloading Pressure Switch:** Optional component, normally mounted in the compressor compartment.
  - 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, Discharge Pressure Switch:** Depending on the configuration of the unit's controls, a fan cycling pressure switch may be installed on a Schrader port along the discharge line of each compressor circuit. The switch interrupts the control circuit voltage energizing or de-energizing the condenser fan motor contactor
  - When discharge pressures rise above 275PSI the switch will close, energizing the condenser fan contactor while the compressor is running. If pressures drop below 210PSI during operation, the switch will open, de-energizing the condenser fan contactor

- **Fusing:** Condenser fan motor(s), control circuit transformers, and included pumps 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 higher amperage ratings may not fit in the fuse block provided.

- **Overload Relay:** Chiller recirculation and system pumps included with the chiller have additional overload rely protection. Set to the motor nameplate FLA value via an adjustable dial, these devices will open during high current condition, and will need a manual reset to provide power to the pump motor.

- **Heat Tape Freeze Protection:** Optional item, consisting of low wattage (5 Watts/ft) 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. Typical setting for the thermostat: 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** – Normal Operation
    - **RED** – Indicates Problem
    - Wiring for the indicators varies depending on their use. Refer to wiring diagrams.
    - If dry contacts are ordered with any indicator, a DPDT relay is included in the control panel. The relay coil is wired in parallel with its 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.
- **Switch, Disconnect**: *(Optional Component)*
    - **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."
    - *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.*
- **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.
- **Transformer(s):**
    - The control circuit transformer is used to step down the system voltage to 24VAC used to power the control circuit.
        i. Additional transformers may be used to power selected components as shown on the wiring diagram. On systems intended for use on 208-230V electric service, the transformer leaves the factory wired for 230V on the Primary side.
        ii. 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 safety device used to sense flow through the evaporator. It is a heat dissipation flow sensor typically mounted to the water inlet of the evaporator and wired to the electrical control box.
    - **If flow rates drop for any reason, the flow switch will shut down the unit completely until flow is restored.**

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**: A 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.
    - **Valves typically 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 for water chilling systems 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 glycol concentration used and the desired target temperature.

  To set the valve, the following procedure should be used:
    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. This will be indicated by a hissing sound and/or an accompanying temperature rise at the outlet.
    4. Note the evaporator pressure when the valve open. 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:** Systems with these valve(s) use a combination of Sporlan ORD/ORI valves.
    - The ORI 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:** Systems with these valve(s) use a Sporlan OROA valve, which is factory set to maintain a set discharge pressure depending on the refrigerant.
    - R-404A, R-407C, R-507: 225 PSIG discharge pressure
    - R-134: 100 PSIG discharge pressure.

- **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.** Typically energized via adjustable time delay tied to compressor relay

- **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, Drake recommends a superheat of 10° - 15°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 will decrease superheat and slightly increase the valve capacity. Keep in mind that superheat cannot be adjusted when the system is operating well above setpoint.

- **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.
    - **All water regulating valves should be installed on the leaving fluid condenser outlet.**

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
GENERAL WARRANTY

These Terms and Conditions of Sale and the General Warranty outline below ("Agreement") shall apply to any goods and services supplied by Drake Refrigeration, Inc. ("Seller"). The customer ("Buyer") shall be deemed to have full knowledge of this Agreement.

1. **ORDERS-** All orders received are subject to acceptance and approval by the Seller. Orders must identify the quantity, model / part number, applicable price, the requested delivery date and the ship to information for goods being purchased. 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 the Buyer's release is accepted by the Seller. Orders may not be canceled or rescheduled without the Sellers approval and confirmation. Cancellations will require a verbal notice followed by a written notice and 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. A restocking fee may apply.

2. **PRICES-** All prices for goods and services, whether specified in the Seller's price list, written quotation or acknowledgment, are subject to change without notice. Prices invoiced will be those in effect at the time of order. Unless otherwise expressly stated, all prices are exclusive of transportation and insurance costs, duties and all taxes.

3. **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.

4. **TAXES-** Prices do not include Local, State, Provincial or Federal sales, use, excise, or similar taxes. Any such charges will be added to the invoice at the time of shipment.

5. **TERMS OF PAYMENT-** Credit is a privilege and all orders will be shipped C.I.A. unless prior arrangements have been made with the credit department. Direct all inquiries for information to the credit manager. All goods are sold FOB factory suitably packaged or crated for domestic shipment. Export shipments are subject to anadditional packing charge. Terms to buyers of satisfactory credit are-NET 30 DAYS FROM DATE OF INVOICE. No shipments for accounts with balances 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.

6. **DELIVERY-** Delivery date(s) are approximate and not guaranteed. For goods manufactured to order, approximately 4 to12 weeks depending on the workload and unit ordered. Larger Tonnage units will have longer lead times.

7. **FREIGHT/SHIPPING**- All shipments will be forwarded FOB, Bensalem, Pa.

   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.

8. **RETURN GOODS-** No goods should be returned to the Seller without prior written authorization. All approved returns whether new and unused or for warranty consideration must be packaged in accordance with methods designed to handle the normal rigors of transportation and handling. Each item in a return must have an approved return authorization number clearly marked on the goods. Return transportation will be at the Buyers expense. New items returned that are inspected and found to be "OK" will be subject to a **restocking fee.** Used Goods under warranty returned to Seller will be tested at Drake and those components deemed functional may be returned to the Buyer with no credit provided.

9. **WARRANTY LIABILITY-** The Seller's liability shall be limited to honoring the Seller's published manufacturer's warranty only with respect to defective goods, provided the Buyer provides written notice within the warranty period. Neither party shall be liable for any delay or failure in performance (other than failure with respect to payment obligations) due to acts beyond their control including, but not limited to, acts of God, war, warlike conditions, blockade, pandemics, embargoes, riots, governmental restriction, labor disturbances, resultant disruption in supplies, transportation or loading facilities, wrecks, epidemics, quarantine, fire, flood, earthquake, explosion or any other causes beyond its reasonable control.

10. **GENERAL WARRANTY-** Subject to the terms and conditions hereof, the Seller warrants all products manufactured by the Seller, including service parts, to be free from defects in material or workmanship, under normal use and application for a period of thirteen (13) months from the original ship date or twelve months from date of installation, whichever comes first. Service parts furnished as replacements for an in-warranty situation automatically acquire only the unexpired portion of the warranty applied to the original product. The parts to be replaced must be made available, when requested by the Seller. Reasonable proof of the original installation date or ship date of the product must be presented in order to establish the effective date of the warranty. Any labor, materials, refrigerant, transportation, freight, crane or any other charges incurred in connection with the performance of this warranty will be the responsibility of the Buyer at the current rates and prices then in effect. This warranty may be transferred to a subsequent owner of the product.

All warranty labor must be PRE-APPROVED exclusively by Drake Refrigeration Inc. prior to beginning any warranty repair work. Drake must pre-approve the service technician's labor rate and all warranty labor is specified as only one service technician. All warranty repairs are to be completed within a reasonable amount of time (fair to all parties) for the service rendered. Refrigerant reimbursement will be provided when a warranty issue causes a loss of refrigerant to the system and will be reimbursed at a fair rate to all parties. If deemed necessary, Drake reserves the right to bring back a piece of equipment to the Drake facility (2900 Samuel Drive, Bensalem, Pa 19020) for warranty repair.

THE SELLER REMAINS THE FINAL AUTHORITY FOR ADJUDICATION OF ALL WARRANTY CLAIMS. ONLY THE SELLER MAY MAKE ANY COMMITMENT FINANCIAL OR OTHERWISE TO THE BUYER REGARDING THE FINAL ACCEPTABILITY OF ANY PARTICULAR CLAIM.

THIS WARRANTY DOES NOT COVER-(a) Damages caused by accident, abuse, negligence, misuse, riot, war, fire, flood, or Acts of God (b) damages caused by operating the product in a corrosive atmosphere (c) damages caused by any unauthorized alteration or repair of the system affecting the product's reliability or performance (d) damages caused by improper matching or application of the product or the product's components (e) damages caused by failing to provide routine and proper maintenance or service to the product (f) product loss (g) expenses incurred for the erecting, disconnecting, or dismantling the product (h) parts used in connection with normal maintenance, such as filters or belts (i) products no longer at the site of the original installation (j) products installed or operated other than in accordance with the printed instructions, with the local installation or building codes and with good trade practices (k) products lost or stolen.

11. **IN WARRANTY SERVICE PARTS-** In warranty service parts will need to be purchased and 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.

COMPRESSORS – GENERAL WARRANTY- Compressors that fail in-warranty are to be returned to the Seller for review.

All compressors shipped either in-warranty or out-of-warranty will be shipped freight collect or prepaid and charged via the most economical means as determined by the Seller. At no time will warranty compressors be shipped free of charge. No credit will be issued for compressor shipping charges, core allowances or administration fees. If the Seller requires the return of the failed compressor, the compressor must be shipped freight prepaid to the location specified by the Seller. No credit will be issued for compressor shipping charges, core allowances, administration fees or other charges resulting from the return of the compressor.

COMPRESSORS – OPTIONAL EXTENDED WARRANTY- Subject to the foregoing General Warranty, the Seller offers a non-transferable optional 4 Year Extended Compressor Warranty.

To obtain credit for a compressor that failed under the Extended Warranty contract, the Buyer must provide proof of purchase that the replacement compressor was obtained through Drake or an authorized distributor of the compressor manufacturer. The Seller reserves the right to request a failed compressor be shipped freight prepaid to a compressor manufacturer's authorized Distributor or the Seller's designated location for a tear down analysis in order to identify the cause of the failure. At no time will warranty compressors be shipped free of charge. No credit will be issued for compressor shipping charges, core allowances or administration fees. All Extended Warranty claims submitted to the Seller will be valued at the Seller's cost.

COMPRESSOR WARRANTY REIMBURSEMENT

In the event that a compressor fails within the warranty period the Buyer MUST contact the Seller with all of the details at drakeservice@drakechillers.com prior to purchasing a replacement compressor.

THE PRICE OF THE REPLACEMENT COMPRESSOR MUST BE PRE-APPROVED BY THE SELLER PRIOR TO PURCHASE. FAILING TO FOLLOW THIS PROCESS WILL IMPACT THE OUTCOME OF THE WARRANTY CLAIM.

The Seller's support team will provide direction on how to proceed with the claim within two business days. The Buyer may be instructed to purchase a replacement compressor from the Seller. All warranty claims submitted to the Seller must be processed via the Seller. For warranty consideration, a copy of the invoice/receipt for the replacement compressor and the actual compressor must be returned to the Seller regardless of where the compressor was purchased. The Seller will issue a warranty credit for the lesser value of; the price of the replacement compressor if it was purchased through the Seller or the price of the compressor when purchased through a distributor. No credit will be issued for compressor shipping charges, core allowances, brokerage fees, import duties or other charges resulting from the administration of this warranty.

12. **GOVERNING LAW AND VENUE** This agreement shall be interpreted, construed, and governed according to the internal laws (and not the law of conflicts) of the Commonwealth of Pennsylvania. All disputes hereunder shall be brought in state courts located in Philadelphia or Bucks County or the federal district courts for the Eastern District of Pennsylvania.

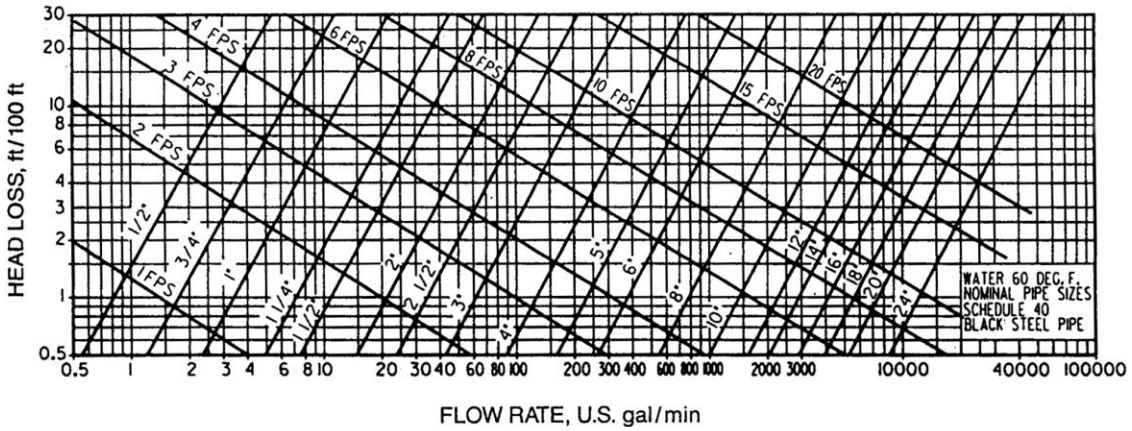


Fig. 1 Friction Loss for Water in Copper Steel Pipe (Schedule 40)

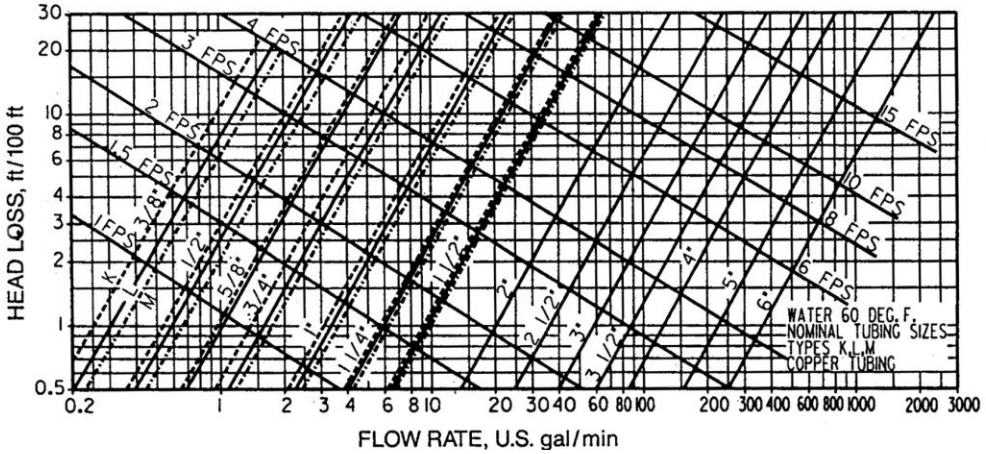


Fig. 2 Friction Loss for Water in Copper Tubing (Types K, L, M)

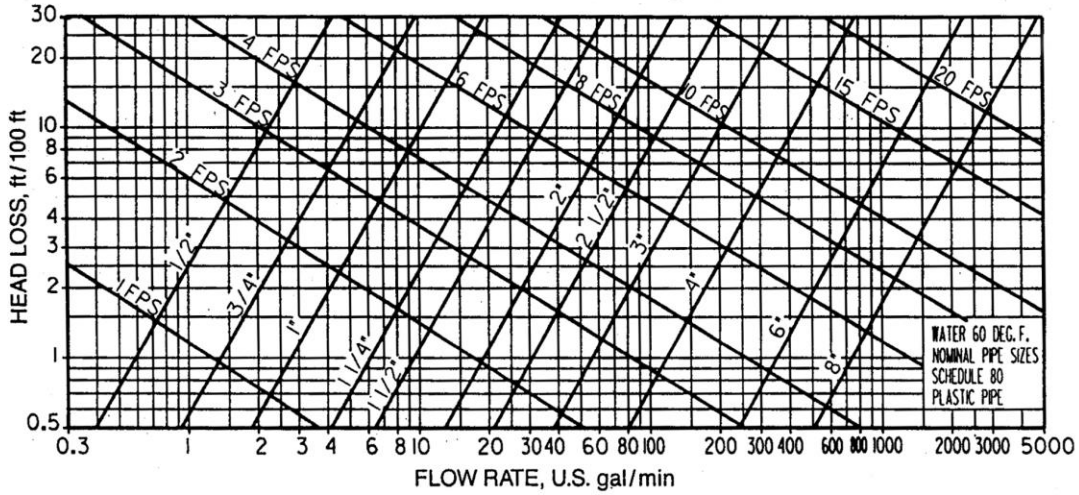


Fig. 3 Friction Loss for Water in Plastic Pipe (Schedule 80)

RECOMMENDED REMOTE CONDENSER LINE SIZES

Net Evaporator Capacity BTUs	Total Equivalent Length FEET	R-134a		R-407		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	3/8	7/8	3/8
	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

Fig. 4 Remote Condenser Line Sizes

Drake Refrigeration Chiller Preventative Maintenance Schedule

Type of PM: Quarterly:_____ Annual:_____

Site or Building Name:_____

Technician Name:_____ Date:_____

Chiller Model #:_____ Chiller Serial #:_____

	Initial	Quarterly	Annually
1. Review Chiller Logs		x	
2. Clean Condenser Coils-Fin			x
3. Flush Evaporator			x
4. Flush Condenser-Coaxial			x
5. Test Compressor Oil			x
6a. Change Compressor Oil, Recips			x
6b. Change Compressor Oil, Scroll			x
6c. Change Compressor Oil, Screw			x
7. Check Oil Filters		x	
8. Change Oil Filters			x
9. Check Y-Strainers		x	
10. Check Pump Gaskets/Seals		x	
11. Check for Leaks		x	
12. Tighten All Electric		x	
13. Check Overloads		x	
14. Check Contactors		x	
15. Check VFD'S		x	
16. Check Chiller Operation		x	
17. Complete PM Checklist		x	

# Drake Refrigeration Inc. # MCS Warranty Activation Form	**Issue Date** 3-21-12 **Supersedes** 8-1-00	**File Name** **3T. ACTIVATION. FORM**
Schedule Type: Drake Chiller Start-Up & PM Checklist		**Page: 1 of 6**

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. # .				

INSTALLATION CHECKLIST

- ☐ Inspect chiller location is **free from overhangs and at least 3 feet from any wall or fence**.
- ☐ Inspect incoming voltage matches nameplate voltage, and chiller disconnect per national and local codes.
- ☐ Tighten all electrical connections in the control panel, microprocessor and other controls that may have loosened during shipping
- ☐ Confirm that chiller has power supplied for **24 hours** and the disconnect switch is turned **ON**. Inspect installation of equipment mounting, piping, and wiring for completion
- ☐ Inspect distilled water loop is full of fluid. **If Applicable**. **N/A if not**
- ☐ **Open ball valves on the chilled fluid lines and process line(s)**
- ☐ Inspect chiller fluid lines/tank full and bled of all air.
- ☐ **Check the glycol freeze point and log into the chart below.**
- ☐ For indoor heat exchangers, inspect disconnect is in OFF position. **If Applicable**. **N/A if not**
- ☐ Inspect chiller piping and pump housing for any fluid leaks (Slight seal leak might occur until pump seal burn time is complete)
- ☐ Inspect pump overload settings - this should match the SFA rating on the pump labels. **If Applicable**. **N/A if not.**
- ☐ Tighten all Schrader valve cores and solenoid bodies.
- ☐ Open indicated refrigerant ball valves to release the refrigerant into the system and tighten receiver valve packing nut. **If Applicable. N/A if not.**
- ☐ Leak check the refrigerant circuit with an electronic leak detector.

START-UP PROCEDURE (Via Keypad)

- ☐ Go to the **Password** tab and enter the **2112** password for **Supervisor** level access
- ☐ Confirm that the **RUN/STOP** is set to **'MAN OFF'**
- ☐ Perform a **'Lockout Reset'** from the display **Main Menu**
- ☐ Test individual component function **-except compressor(s) & pump(s)-** from the **Outputs** tab
  - Solenoid(s)
  - Condenser fan motor(s)
  - Receiver/Evaporator heater(s)
- ☐ Return all **Outputs** to **'AUTO'** – **Compressor relay(s) should be set to 'MANOFF'**

Completion Date:	Service Provider:	Material/tool reference

- ☐ From the **Outputs** tab, turn on the pumps to **'MANON'** to circulate fluid in the system. **If Applicable. N/A if not**
- ☐ From the **Inputs tab**, verify fluid is circulating through the evaporator and the flow sensor is reading correctly. **Return pumps to 'AUTO' when finished. If Applicable. N/A if not**
  - **Do not allow the pumps to run without proper flow or if a grinding sound can be heard**
- ☐ Turn the **RUN/STOP** to **'MAN ON'** to start the chiller and run the pumps
- ☐ Allow the pumps to run and bring the **'FLUID OUT'** up to 10ºF above setpoint value
- ☐ From the **Outputs** tab, set **COMP 1** to **'AUTO'**
- ☐ Monitor pressure and temperature readings and verify pressure readings with correct refrigerant pressure gauges
- ☐ Measure amperage and voltage readings while the unit is running
- ☐ **Fill out Log Sheets – Motor/Elements/Etc. & Pressure/Temperature Chart**
- ☐ Inspect fan cycling pressure control function to maintain min-designed head pressure of 230-250 psi
- ☐ Disable Circuit #1 and test chiller Circuit #2 by repeating previous steps. **If Applicable. N/A if not**
- ☐ **After testing all chiller circuits, confirm the RUN/STOP is set to 'MAN ON'**
  - If an external switch has been wired to this input, instead set to **'AUTO'**
- ☐ Confirm every **Output** is set to **'AUTO'** **-including compressors-** when done testing

START-UP PROCEDURE (Via Laptop)

- ☐ Refer to detailed start-up procedures in IO&M Manual for full walk through
- ☐ Bring Windows based computer with the latest version of MCS Connect downloaded https://mcscontrols.com/ - Download **AUTH CODE** version to enable program changes
- ☐ Bring one of two cables for laptop to MCS connection
  - RS-485 to USB cable included with chiller --- MicroMAG & MAGNUM Controller
  - Cross-over Ethernet cable --- MAGNUM Controller only
- ☐ Through MCS Connect, choose ***Local Serial*** is using RS-485 cable and ***Ethernet*** if using Cross-over cable
- ☐ Once connected, the chiller model number will show up on laptop
  - If chiller is not displaying on laptop, refer to www.drakechillers.com for a more complete walkthrough on using **MCS Connect**
- ☐ Click on the **VIEW ONLY** tab and enter the **2112** password for **Supervisor** level access
- ☐ Confirm that the **RUN/STOP** is set to **'MAN OFF'**
- ☐ Perform a **'Lockout Reset'** from the display **Main Menu**
- ☐ Test individual component function **-except compressor(s) & pump(s)-** from the **Outputs** tab
  - Solenoid(s)
  - Condenser fan motor(s)
  - Receiver/Evaporator heater(s)
- ☐ Return all **Outputs** to **'AUTO'** – **Compressor relay(s) should be set to 'MANOFF'**
- ☐ From the **Outputs** tab, turn on the pumps to **'MANON'** to circulate fluid in the system. **If Applicable. N/A if not**

Completion Date:	Service Provider:	Material/tool reference

- ☐ From the **Inputs tab**, verify fluid is circulating through the evaporator and the flow sensor is reading correctly
  - **Do not allow the pumps to run without proper flow or if a grinding sound can be heard**
- ☐ Turn the **RUN/STOP** to **'MAN ON'** to start the chiller and run the pumps
- ☐ Allow the pumps to run and bring the **'FLUID OUT'** up to 10ºF above setpoint value
- ☐ From the **Outputs** tab, set **COMP 1** to **'AUTO'**
- ☐ Le the unit run for 1 – 2 minutes and monitor for unsafe discharge and suction pressures
- ☐ Measure amperage and voltage readings while the unit is running
- ☐ **Fill out Log Sheets – Motor/Elements/Etc. & Pressure/Temperature Chart**
- ☐ Disable Circuit #1 and test chiller Circuit #2 by repeating previous steps. **If Applicable. N/A if not**
- ☐ Confirm every **Output** is set to **'AUTO'** **-including compressors-** when done testing

OPERATIONAL CHECKLIST

- ☐ **Confirm the process is able to provide the designed heat load for the chiller**
- ☐ Attach proper refrigerant pressure gauges to the high and low side of the system
- ☐ Turn the **Run/Stop** switch to **'RUN'** and allow the unit to run 4 – 5 minutes
- ☐ Monitor low and high side pressure as the chiller approaches operating conditions and compare to values on the chiller display
- ☐ Adjust ORI valve to maintain the designed discharge head pressure with all fans running. Low ambient operating conditions may require additional adjustment. **If Applicable. N/A if not**
  - R407C – 235-240psi
  - R404A – 250psi
- ☐ Inspect fan cycling pressure control function to maintain min-designed head pressure of 230-250 psi
- ☐ Check superheats and adjust TXV as necessary to acquire an 8-20°F superheat at the compressor
- ☐ Confirm process pump is providing designed flow through the process lines and throttle discharge ball valve if necessary
  - **Never adjust flow on the intake side of a pump**
- ☐ Confirm liquid line sightglass is clear and steady with liquid
- ☐ Check status of moisture indicator and monitor if required
- ☐ Allow the system to run for 2 – 3 hours and regularly check

FINAL CHECKLIST

- ☐ Remove all tool and debris from installation site
- ☐ Replace ad tighten all service caps and receiver valve stem caps. **If Applicable. N/A if not**
- ☐ Replace all chiller manuals and documentation into the electrical panel.
- ☐ Install & secure all access panels and hardware.
- ☐ Review and deliver 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 drakeservice@drakechillers.com

Completion Date:	Service Provider:	Material/tool reference

Glycol % and Freeze Point :

Log Sheet: MOTORS, ELEMENTS, ECT.									
ID Information		Amp Readings				Voltage Readings			
Motor/Element Name	**% Load**	**L1**	**L2**	**L3**	***NP**	**L1-L2**	**L1-L3**	**L2-L3**	***NP**
Digital Compressor									
Compressor 2									
Condenser Fan 1									
Condenser Fan 2									
Condenser Fan 3									
Condenser Fan 4									
Chiller Recirc Pump									
Process Fluid Pump									
Receiver Heater 1									
Receiver Heater 2									
Liquid Solenoid 1									
Liquid Solenoid 2									

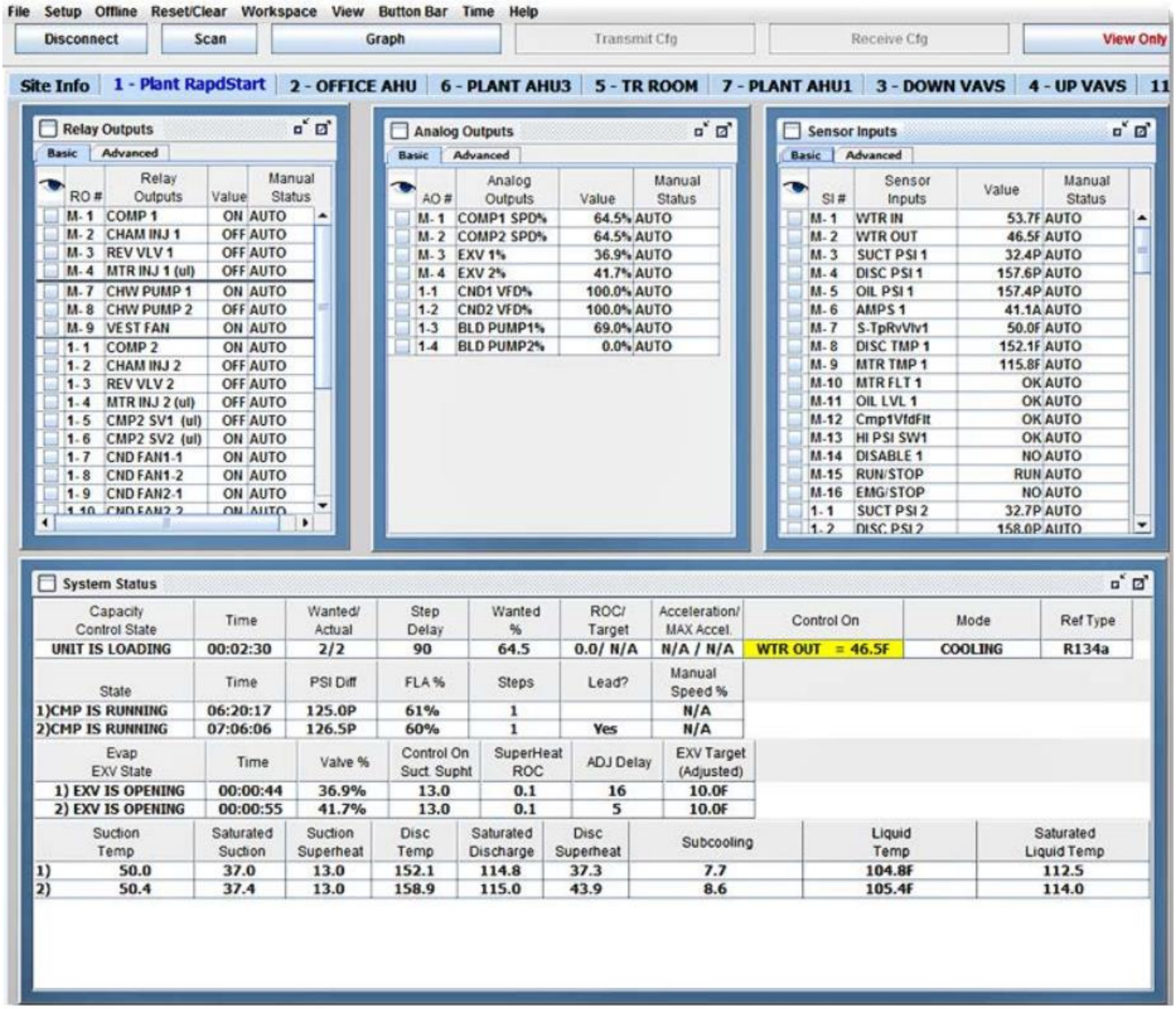
*NP=Name Plate

Log Sheet: PRESSURES AND TEMPERATURES								
INPUTS	**VALUES* 1**	**VALUES* 2**	**VALUES* 3**	**VALUES* 4**	**VALUES* 5**	**VALUES* 6**	**VALUES* 7**	**VALUES* 8**
SUCT1								
DISCH1								
SUCT2								
DISCH2								
FLUID IN								
FLUID OUT								
AMBIENT								

*Values - taken

Completion Date:	Service Provider:	Material/tool reference

MCS STATUS SCREEN



Completion Date:	Service Provider:	Material/tool reference

Notes:

Completion Date:	Service Provider:	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

Notes

2900 Samuel Drive Bensalem, PA 19020
888-289-7299 | 215-638-5515
www.drakechillers.com

Intertek
3046941

Manufactured with pride in the USA.