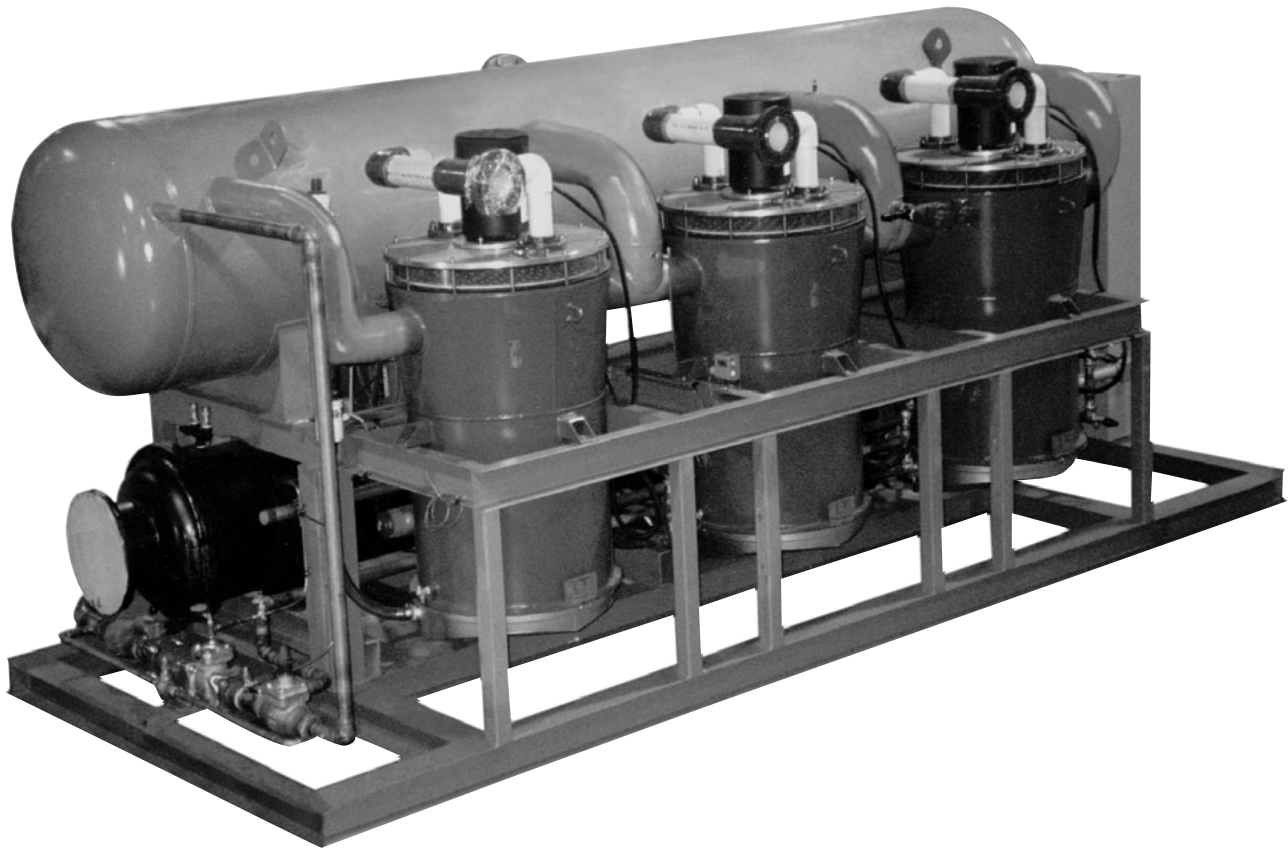


MaximICE®

LIQUID ICE TES SYSTEM ORE-200, 300, & 400 (XL) GRAVITY FEED REFRIGERATION SYSTEM

OWNER'S MANUAL



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MUELLER®

THERMAL STORAGE PRODUCTS

**MaximICE[®] LIQUID ICE TES SYSTEM
ORE-200, 300, & 400 (XL) GRAVITY FEED REFRIGERATION SYSTEM
OWNER'S MANUAL**

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SECTION 1.0 - INTRODUCTION

1.1 General Information

This manual has been prepared to present to the owner and service technician the installation, operation, and maintenance procedures recommended by Paul Mueller Company for the MaximICE® thermal storage system. The installation plans, piping layouts, etc., must be detailed in accordance with local codes. If you are uncertain about any installation or operating procedure outlined in this manual, please contact the Mueller Thermal Storage Department for guidance at 1-800-683-5537 or (417) 831-3000.

1.2 Delivery Inspection

MaximICE evaporators are tested for refrigerant leaks and electrical conductivity at the factory prior to shipment; however, damage can occur during shipment. The unit should be thoroughly inspected upon arrival at the installation site. Any damage noted should be reported immediately to the transportation company so that an authorized transportation representative can examine the unit, determine the extent of the damage, and take the necessary steps to rectify the claim. At the same time, a Paul Mueller Company representative should be notified of any claim made.

1.3 Safety Considerations



Installation, start-up, and service of this equipment pose hazards due to automatic equipment operation, high system pressure, and electrical power service. It is extremely important to consider all aspects of safety when working on or around machinery and high voltage. This equipment will be connected to a high-voltage and/or current power supply which can seriously injure or kill a worker. There is moving equipment which can start automatically and cause serious injury. It is imperative that only qualified service personnel install and service this equipment.

This equipment is designed for use with and contains R-22 hydrochlorofluorocarbon (HCFC). This equipment shall be serviced and disposed of in accordance with the current Ozone Depleting Substance Regulation - Clean Environment Act.

When working on this equipment, observe precautions identified in the literature provided and any tags, stickers, and labels attached to the equipment and any other safety precautions that apply.

- ▲ Follow all applicable safety codes.
- ▲ Wear safety glasses and work gloves.
- ▲ Use care in handling, rigging, and setting bulky equipment.

SECTION 2.0 - THERMAL STORAGE SYSTEM - SYSTEM OVERVIEW

2.1 System Overview

It is very important that each component be properly sized and selected. Extreme care must be taken if individual component(s) are selected and supplied by others. System performance and operation can be compromised if any part of the system is incorrectly sized.

The typical MaximICE System consists of three individual circuits: refrigeration circuit, ice building circuit, and cooling circuit. The actual working system includes an ice storage tank, plate-and-frame heat exchanger, coolant pump(s), temperature control valve, and piping. The following information describes each component of the system, along with its operational function.

2.2 Refrigeration Circuit

The evaporator assembly includes multiple nominal 100-ton evaporators. The evaporator employed in the MaximICE system is a bottom gravity liquid refrigerant feed (vertical shell-in-tube). The evaporator is fabricated and stamped per ASME Code, Section VIII, Division 1, for unfired pressure vessels.

Superheated discharge gas from the compressor enters the condenser, condensing into a saturated liquid. Condensed liquid drains into the expansion device consisting of a low-side float valve controlled by a remote pilot chamber. From the low side float valve flash gas enters the low-pressure receiver (LPR). Liquid is then gravity-fed into the evaporator(s), providing the required refrigeration effect to produce ice slurry. The remote pilot chamber is mounted to allow approximately 6" liquid level in the LPR (see Figure 5). Two-phase refrigerant (vapor/liquid) returns from the evaporator(s) into the LPR. The heavier liquid particles drop to the vessel bottom while the lighter "dry" vapor returns to the compressor suction. Each evaporator assembly shall be equipped with isolation valves and a hot gas line valve for manual thawing of the evaporator(s) in the event of a freeze-up condition.

Inside each evaporator tube is a free-hanging $\frac{3}{8}$ " (9.5 mm) stainless steel rod running the entire tube length. A plastic countercrank holds the whip rod in place, while a small pin is attached to the drive plate. The drive motor coupled to the drive plate rotates the attached whip rod continuously (approximately 800 rpm) during system operation. The drive motor is equipped with a soft-start system to reduce starting torque. A mechanical seal provides a water-tight seal at the drive shaft penetration point, located on the top plate. Glycol solution poured into the evaporator tubes gives up heat to the refrigerant. The whip rod spinning action creates a high agitation rate, increasing solution to the tube surface contact. The end result is highly efficient slurry icemaker.

2.3 Oil Return System

A. R-22 Systems — Any oil that passes through the oil separator will fall out in the low-pressure receiver. The method used to return oil to the compressor involves an oil pump supplying a small amount of liquid/oil mixture from the LPR and feeding the dry suction compressor return. The oil return line is equipped with an oil pump, $\frac{1}{2}$ line, an isolation valve, a strainer, a hand expansion valve, and a sight glass. Controlled by the PLC, the oil pump motor starts 2 minutes after compressor start-up. Adjust hand expansion valve open far enough to allow for proper oil return in order to maintain sufficient oil separator oil level.

NOTE: Several adjustments may be required to ensure proper valve stem position over various operating conditions.

B. R-717 Systems — Oil accumulated in the LPR shall be stored within an oil pot located under the LPR. Typical for the ammonia unit, periodical manual draining of oil reservoir is required. Periodically, oil draining of the evaporator(s) may also be required.

2.4 Expansion Device

A low-side float valve with a pilot chamber is used to expand high-pressure condensed liquid from the condenser to a low-pressure flash gas prior to entering the low side. The purpose of the valve is to maintain a refrigerant liquid level in the flooded evaporators. When the desired operating level in the low pressure receiver (LPR) drops, the float ball in the pilot float valve drops and the float valve opens, gradually reducing the pressure (through the pilot line) on top of the main body valve. The inlet pressure to the valve becomes higher than the pressure on top of the main body valve. This pressure difference overcomes the spring tension and the valve will gradually open, allowing flow through the metering plug. When the level in the LPR rises, the float ball in the pilot valve will rise, closing the pilot valve and gradually equalizing (through the pilot line) the pressure between the top of the main body valve and the inlet pressure, causing the valve to close.

2.5 Condenser

Typically, three types of condensers are used for rejecting heat of refrigeration and the compressor to form high-pressure condensed liquid (air cooled, evaporative cooled, and water cooled). The manufacturer's recommendations should be followed for selecting the proper condenser; however, when determining the system refrigeration capacity (TR) the following method will apply: Use a compressor capacity approximately 15% higher than what is required for ice making. The 15% additional capacity will drive a slightly over-sized condenser selection that allows for mid-chilling operation without increasing compressor discharge pressure.

Some form of minimum head pressure control is required to prevent excessively low discharge pressure during low-ambient conditions. As the discharge pressure decreases, the compressor capacity increases. If the compressor capacity increases too high, the maximum allowable heat flux of the evaporator can be exceeded, causing the evaporator to freeze up.

A. Air-Cooled Condenser

1. **Preferred Method** — Variable frequency drive controlling the condenser fan speed based on discharge pressure is recommended.
2. **Air-Cooled Condenser (Alternate Method)** — Fan cycling based on discharge pressure.

NOTE: Low-ambient temperature in combination with high wind speeds cause fan cycling to be less effective.

B. Evaporative-Cooled Condenser

1. **Preferred Method** — Variable frequency drive controlling the condenser fan speed based on discharge pressure is recommended.
2. **Alternate Method** — Two-speed fan control based on condenser sump water temperature. Air damper actuator based on discharge pressure.

NOTE: On large condensers, dampers are less effective due to air leakage and slow actuator speed needed for high torque actuator requirements for driving the dampers.

C. Water-Cooled Condenser

Preferred Method — Electrically actuated butterfly valve controlled from a 4-20 ma signal based on discharge pressure. Normally, a three-way bypass-type valve arrangement is used and the valve must be mounted on the water outlet side of the condenser.

2.6 Low-Pressure Receiver (LPR)

Normally an LPR providing approximately 100 feet per minute is acceptable for MaximICE systems. Once the diameter is selected, the vessel length is determined, then the vessel is capable of storing the entire refrigerant charge and be slightly below 50% level. The ASME design working pressure is 250 psig.

2.7 Line Sizes

Standard industry pipe size tables are set up in refrigeration tons for typical copper and carbon steel line sizes, based on total pressure drop of equivalent length of pipe. The equivalent length of pipe run is an average means of allowing for pressure loss in valves and fittings. These charts and tables are set up for standard operating conditions (suction condensing temperatures). It may be necessary to size pipe and check velocities for other conditions and equivalent lengths, correction factors must be used to ensure proper line sizes.

2.8 Ice Build Circuit

The ice build circuit consists of an insulated tank (ice storage tank) with necessary fittings for field plumbing. It **must** include an internal water spray system and bottom suction header for “burning” ice uniformly during the melt mode. The ice slurry is pumped to the storage tank, filling the tank from the top down. Once the ice reaches the full ice, a temperature sensing device will cycle the unit off.

2.9 Building Cooling Circuit

The building cooling circuit consists of a plate-and-frame heat exchanger, coolant pumps, and temperature regulating valve. Low-temperature glycol solution is pumped from the bottom of the ice storage tank into the plate-and-frame heat exchanger, and then returned over the ice pile via a spraying system. Warm building load water is then pumped into the heat exchanger and cooled. Depending on the building load temperatures, it may vary from 37°-42°F.

NOTE: The ORE glycol solution loop **must** incorporate a heat exchanger to separate the building process from the ORE solution loop. This reduces the amount of piping which carries the glycol solution, thus minimizing the cost and danger associated with piping leaks. All system fluid piping should be properly insulated.

SECTION 3.0 - INSTALLATION

3.1 Important Note



It is very important in installations where the customer supplies certain components (ice storage tank, heat exchanger, valves, and/or fittings), that the following information and details are addressed. PMC shall not be held responsible for performance on systems constructed, piped, or designed differently than outlined in this manual.

3.2 Equipment Rigging

The MaximICE unit and ice storage tank must be lifted in accordance with industry practice. Lifting lugs and sleeves are not intended to be used for extended periods of time. The evaporator section is designed for four-point top lifting only. Please refer to equipment specifications section for weights.



IMPORTANT: A spreader bar must be employed during the lifting process. Failure to do so will result in equipment damage.

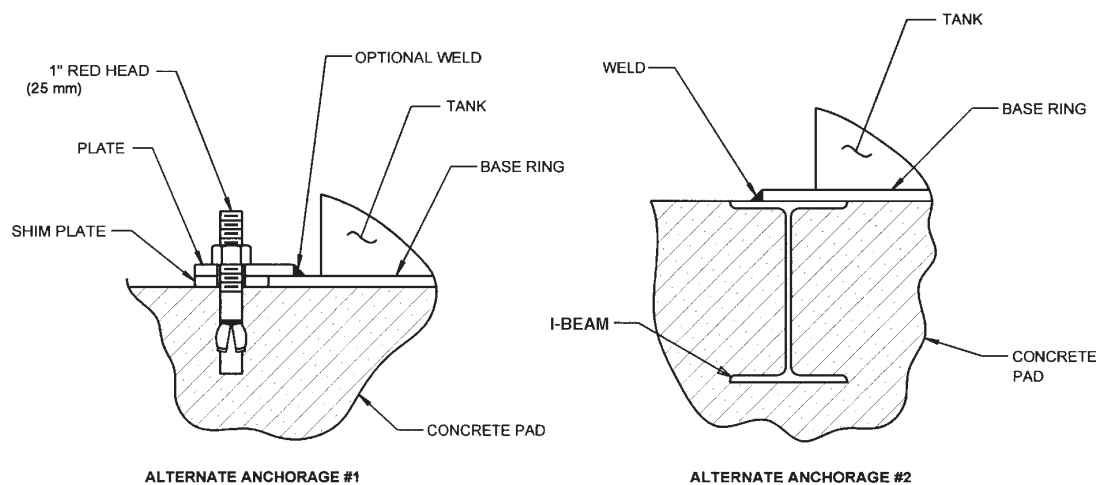
3.3 Foundation

MaximICE units should be anchored to a concrete or structural steel base. Due to the varying conditions across the globe, it is recommended that an architectural engineer be consulted to determine the thickness of the concrete pad or structural steel in accordance with local codes. The concrete pad or structural steel must be level within $\frac{1}{8}$ " (3 mm) to adequately support the refrigeration equipment.

3.4 Anchoring

According to local codes and practices, the refrigeration equipment should be welded or bolted down with appropriately sized hold-down anchor bolts (not furnished with equipment) and are to be securely anchored to the concrete pad by the customer. Refer to Figure 1 below for anchorage details. Polyethylene tank(s) will require tie-down straps. All applicable seismic zone regulations and proper construction practices should be considered in areas designed by the state.

Figure 1 - Anchorage Details



3.5 Serviceability

Accessibility is required for servicing the equipment. A 3' (0.9 m) clearance around the evaporator compartment and a 4' (1.2 m) clearance above the top are required. Review the appropriate submittal drawing for exact required top clearance.

3.6 Shipping Charge

All units are shipped with a dry nitrogen charge (approximately 5 psig/35 kPa) that is required to be bled off prior to installation. Extreme care must be taken while removing flanges or caps when the system is under pressure.

3.7 Remote Refrigeration Piping

The refrigerant connections (suction, liquid) on the evaporator skid are sized based on the compressor unit located within 25' (7.6 m) of equivalent length piping of the ORE skid. For systems with more than the equivalent 100' (30 m), increase pipe size accordingly. When welding refrigerant pipe, an inert gas should be passed through the line at low pressure to prevent scaling and oxidation inside the tubing — dry nitrogen is preferred. Refrigerant lines should be supported and fastened properly.

3.8 Refrigerant Piping Pressure Test

After all lines are connected, the entire system must be leak tested, including the ORE and compressor unit. The complete system should be pressurized to not more than 150 psig (1,000 kPa) using dry nitrogen vapor. The use of an electronic-type leak detector is highly recommended due to its greater sensitivity of small leaks. It is recommended that this pressure be held for a minimum of four hours and then rechecked.

3.9 System Evacuation

Prior to connecting hoses, remove the core from the Schrader fitting. A minimum evacuation to 500 microns and a five-minute hold period is recommended. Proper evacuation processes include vacuum pump oil changes and large-diameter, short-hose connections to both high and low sides of the system.

3.10 Refrigerant Charge

See Section 5.0 for further details.

3.11 Electrical

The MaximICE wiring schematic identifies the minimum remote interconnecting field/customer wiring required. All power wiring and grounding must be installed in accordance with all local, state, and national codes. Separate field-supplied breaker/disconnect is required and shall be supplied by others. Article 440 of the NEC requires that the system have “disconnecting means capable of disconnection of air conditioning and refrigeration equipment including motor compressor and controllers from the circuits feeder.” The circuit breaker and/or fused disconnect switch should be selected and located within the NEC guidelines.

3.12 Electrical Specifications: ORE-100 (but not limited to)

PLC: 24 Volts, Inputs DC, Outputs AC, Power Supply 120 volts AC

50 Hertz: Drive Motor 3 Horsepower

200 volts
13.8 amps (± .2)
850 rpm

50 Hertz: Drive Motor 3 Horsepower

380 volts
6.9 amps (± .2)
850 rpm

60 Hertz: Drive Motor 3 Horsepower

230 volts
12.6 amps (± .2)
850 rpm

60 Hertz: Drive Motor 3 Horsepower

460 volts
6.3 amps (± .2)
850 rpm

3.13 Ice Storage Tank - Full Ice Sensor Option

To determine a full ice storage tank condition, a temperature bulb is mounted in the evaporator solution inlet which sends a signal to a digital temperature controller located in the PMC control box. As the amount of ice increases within the storage tank, the glycol percentage increases and lowers the solution freeze point. At approximately 24 to 26°F (-4.4 to -3.3°C) the PLC loses an input from the temperature controller initiating a full ice shutdown.

3.14 Ice Storage Tank - Vent Line

To ensure proper solution flow, a vent system is incorporated. Attach the vent line to the top of the ice storage tank top. The line must be mounted to ensure full draining, with no loops, kinks, or traps.

3.15 Ice Storage Tank - Spraying System

To ensure that the stored liquid ice is burned efficiently and a low-temperature supply solution can be maintained to the cooling loads, spray device(s) must be used to distribute the warm solution over the liquid ice. For field-fabricated storage tanks, spray distribution system should be supplied in sufficient numbers and location, based upon spray pattern, to provide maximum coverage over the liquid ice (approximately 75% coverage). Please consult PMC for field-fabricated storage tank spray distribution systems.

3.16 Glycol Solution Specification

The MaximICE TES system uses a very low concentration of propylene or ethylene glycol solution as the storage medium to promote the growth of the ice crystals.

A. Glycol Solution Concentration Adjustments — A minimum of 8% glycol is recommended to start the ORE. This is done by adding water to your tank (60%), circulating the water, and then adding glycol using a refractometer with a 0-10 scale degrees in brix. Keep checking the freeze depressant chart on the back page of this manual.

B. Glycol Manufacturer-Supplied Information — The following information should be provided to the owner:

- ▲ Manufacturer's name, address, and telephone numbers.
- ▲ Material safety data sheet.
- ▲ Instruction for system cleaning, flushing, and testing of system water prior to charging.
- ▲ Off-season lay-up of equipment.

C. Solution Additives — Prior to filling and charging the storage tank, the interior of the tank and all piping runs should be thoroughly cleaned to remove pipe scale, dirt, and other impurities. The system should also be checked for leaks at this time.



IMPORTANT: It is imperative that these guidelines be followed. Since the concentration in the tank will be 8% (by weight), the additives present in the HVAC-grade inhibited glycol will not be sufficient to protect the system from corrosion and bacterial growth. Dipotassium phosphate (K_2HPO_4) **must** be used as a corrosion inhibitor to protect steel and stainless steel components at a concentration no less than 4,000 ppm as PO_4 (7,350 ppm as dry K_2HPO_4). An azole-type corrosion inhibitor **must** be added to protect copper and brass components. The best choice is halogen-resistant azole like BetzDearborn AZ8104 (10 ppm). Alternatively, one may use tolyl triazole (30 ppm of typical formulation with approximately 20% active ingredient). Anti-foaming agents (such as Dow Corning 1410) may also be added as needed.

To inhibit bacterial growth, add 200 ppm of quaternary amine. Typical quaternary amines are C₁₂ to C₁₈ mixtures of n-alkyl dimethyl benzyl ammonium chloride or n-alkyl dimethyl ethyl benzyl ammonium chloride. Manufacturers include Albemarle Chemical (BQ 451-5), Lonza (Barquat 50-65), and Stepan Company (BTC 818).

Dry ingredients (such as dipotassium phosphate) **must** be dissolved in water prior to addition to the ice slurry tank. A small tank and mixer is convenient for this purpose.

- D. Water Quality** — Water used to make up the glycol solution must meet certain standards of purity. Distilled or de-ionized water is recommended. Levels of chlorides and sulfates should be less than 25 ppm each. Total hardness should be less than 100 ppm expressed as ppm calcium carbonate. If good quality water is unavailable, pre-diluted solutions are available from manufacturers.

Local conditions must always be taken into consideration, particularly when it comes to biofouling and scaling/fouling deposits. A local water-treatment authority should be consulted for guidance in this matter. PMC recommends calling your county or city water department to find out the specification of your local water supply. If the water contains less than 100 ppm of hardness, it can be used to dilute your glycol-based heat transfer fluid. Another option would be to test the water yourself with a HACH test kit.

One word of caution about the common practice of using softeners when filling HVAC systems: resins typically used in these softeners will replace the calcium and magnesium ions with sodium ions. This, in itself, is fine. However, these resins do not sufficiently reduce high concentrations of chloride or sulfate ions. To accomplish the latter, another type of ion exchange resin must be used. Resins that remove calcium and magnesium ions are typically regenerated with a strong brine solution, and the excess sodium chloride is flushed out as waste water. This must be followed by thoroughly flushing the regenerated resin bed with water. Otherwise, an excess of chloride ions will be flushed into the so-called good quality water. Glycol manufacturers recommend using de-mineralized water that has been distilled, de-ionized, or passed through a reverse osmosis (RO) process to remove certain minerals and salts.

Good water quality is typically defined by the following parameters:

- ▲ Less than 50 ppm of calcium
- ▲ Less than 25 ppm of chloride
- ▲ Less than 50 ppm of magnesium
- ▲ Less than 25 ppm of sulfate
- ▲ Less than 100 ppm (6 grains) of total hardness

After combining the proper amounts of water and inhibited glycol, the system should be mixed for a minimum of four hours to achieve uniformity. This can be accomplished with the MaximICE feed and solution pumps or with the cooling load pump. Solution concentration should be verified using a refractometer to measure Refractive Index (RI).

The glycol supplier should be consulted to determine correct RI for the inhibited solution used at the temperature tested. Adjustments to the solution may be necessary to achieve the correct concentration. This should always be done prior to starting the MaximICE system, as the glycol concentration will change as the production of liquid ice begins. An accurate measurement of the concentration of glycol can be accomplished using a hand-held refractometer. This instrument is portable, requires only a few drops of fluid, and needs no adjustment for fluid temperature. PMC recommends that the glycol solution be tested every month (see Maintenance and Service Manual). It is also recommended that the owner test the alkalinity four times per year the first year and annually after that.

- E. Glycol Solution Concentration Adjustments** — It is sometimes necessary to increase or decrease the concentration of the glycol solution in your system to replace fluid lost through leakage or moisture absorbed from the atmosphere. Either adjustment can be carried out in batch or continuous operation.

- F. Procedure for Adjusting Freezing Point of Glycol Fluids** — If the concentration of glycol must be increased, use the formula below to determine the amount of solution to drain and the number of gallons of glycol to add to increase glycol concentration.

$$A = V(D-P)/(100-P)$$

To decrease the glycol concentration, the following formula should be used to determine the volume to drain and replace with high-quality water:

$$A = V(P-D)/P$$

JeffCool® has developed coolants (MSE and MSP) specifically for MaximICE systems. Dilution of JeffCool MSE or MSP should be made using deionized or distilled water. One part MES or MSP mixed with 9 parts water is recommended.

Where:

A = The quantity (in gallons or m³) of glycol to be added to the system to lower the freeze point or the quantity (in gallons or m³) of glycol solution that must be drained from the system to decrease glycol concentration.

V = The total solution capacity of the system in gallons or m³.

D = The volume percent of glycol desired in the system.

P = The volume percent of glycol presently in the system.

3.17 Freeze Protection

Units located outside shall require freeze-up protection (heat tape on all solution lines). A glycol solution is required for the MaximICE system; however, during low ambient conditions (outside temperatures below 27°F or -3°C), the solution may freeze and cause piping damage.

3.18 Insulation

All glycol solution piping should be insulated with 1/2" (12.7 mm) polyfoam/Armaflex to prevent external heat gain. Heat gain and proper insulation practices should be considered for concrete tanks constructed on site.

3.19 ORE Drive Assembly

The drive system is designed with very close tolerances to ensure proper clearance, water sealing, and operation of all drive components extreme caution should be taken during installation.



IMPORTANT: Do not operate drive system without circulating glycol solution.

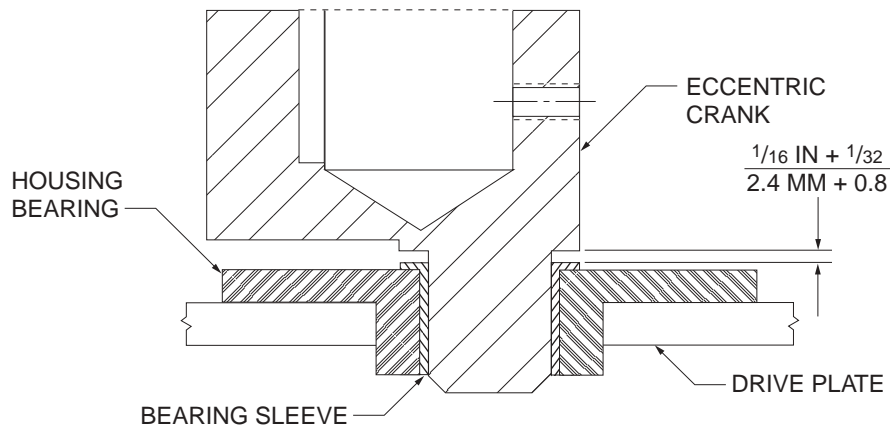
NOTE: Refer to Figures 3 through 6 with the following drive installation steps:

1. Using a flashlight, inspect each tube for any foreign debris.
2. Apply a thin coat of petroleum jelly or white lithium grease on each eccentric crank prior to installing (lower end, top edges).
3. Working clockwise at the alignment mark, place each countercrank in a left-hand/right-hand arrangement. Countercrank type is determined by positioning the drive pin at six o'clock and checking the slot point direction. See Figure 3, "MaximICE ORE-100 Drive Assembly."

NOTE: The ORE-100 has several countercranks that may appear out of sequence. See the appropriate layout drawing for specific alignment.

4. Install each whip rod.
 5. Position all drive pins towards the evaporator top tube sheet alignment mark.
 6. Install lower rubber gasket.
 7. Install drive plate by matching the top tube sheet alignment mark with the drive plate.
- NOTE:** The evaporator top sheet and drive plate are labeled with an alignment mark(s) to ensure proper assembly.
8. Install clear PVC top water chamber.
 9. Install upper rubber gasket.
 10. Install top head.
 11. Install drive motor. Adjustments can be made to the eccentric crank during assembly by rotating the motor fan blades with small screwdriver.
 12. Tighten top plate mounting bolt using a star pattern while tightening bolts.
 13. Adjust motor for approximately $\frac{1}{16}$ " (2.4 mm) clearance between the eccentric crank and drive plate bearing (no pressure on drive plate).

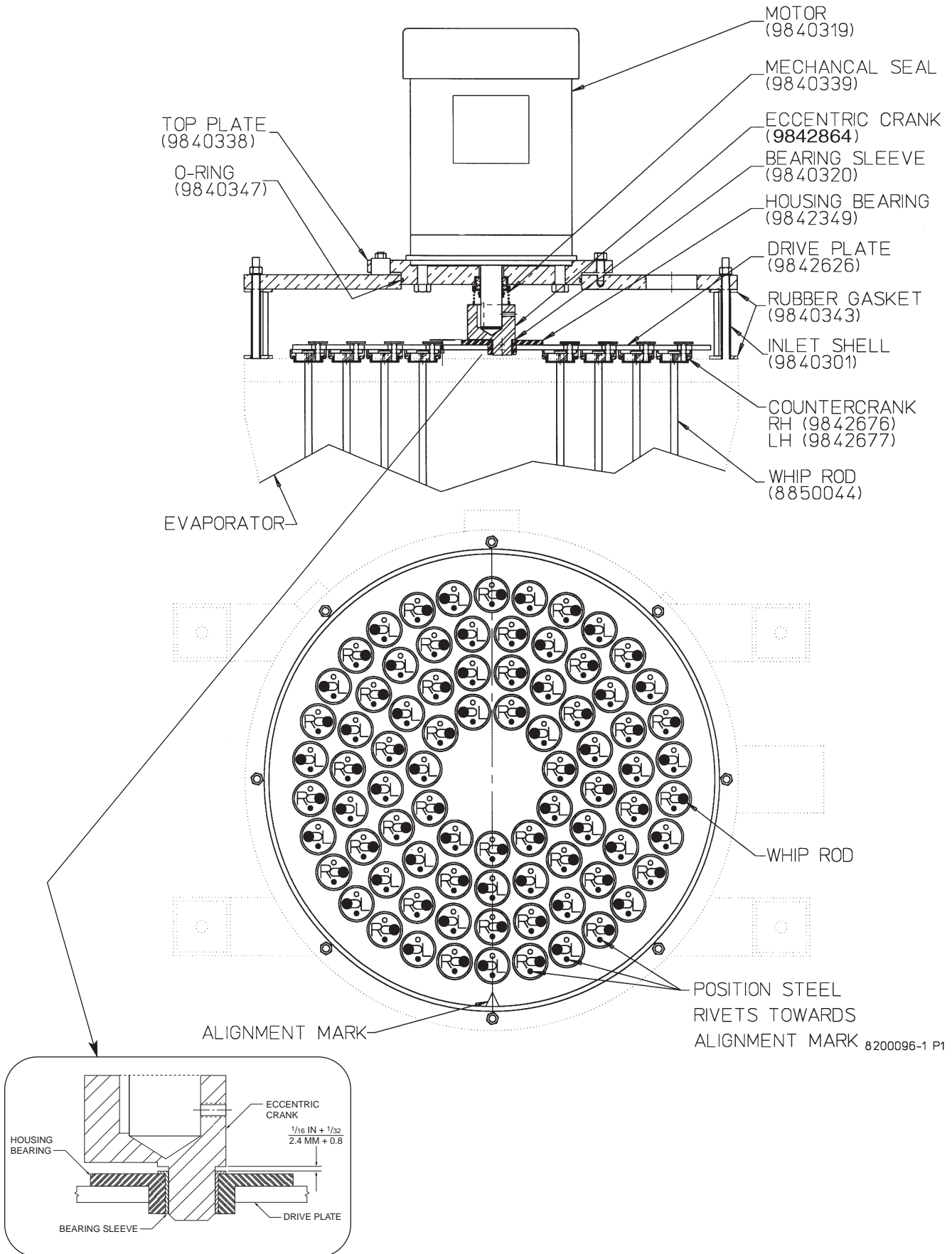
Figure 2 - ORE Drive Assembly Detail



3.20 Gravity Feed System

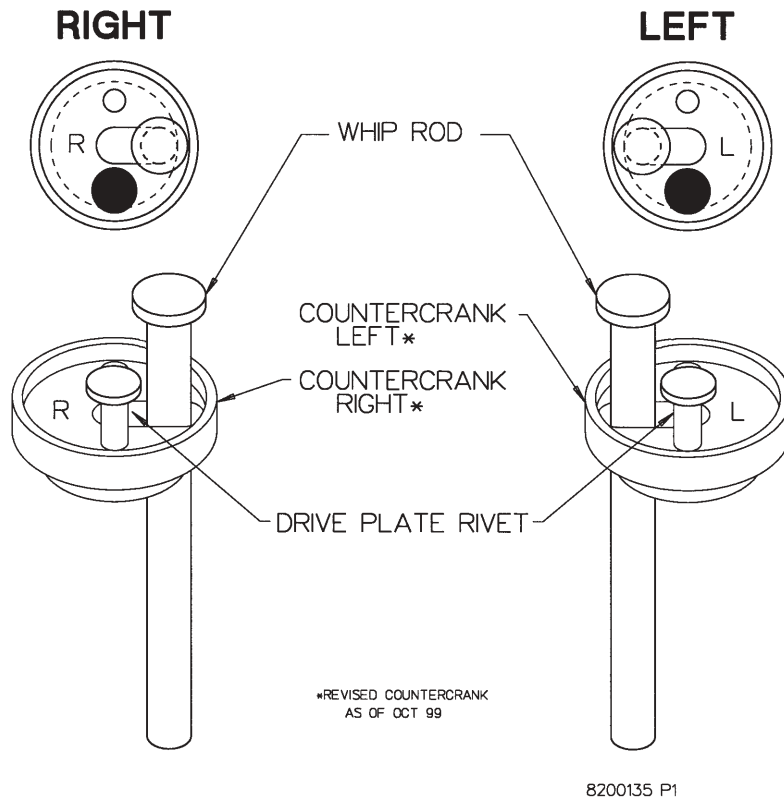
A gravity feed ice-discharge system, with a telescopic-type housing mounted to the evaporator (bottom) that extends into the ice opening, is incorporated for systems where the evaporator is installed on top of the ice storage tank. A watertight seal must be applied once the unit is set in place and the housing is lowered into the opening. The gap (about $\frac{1}{2}$ "/12 mm) can be filled with insulation rope and sealed with a layer of silicone.

Figure 3 - MaximICE ORE-100 Drive Assembly



8200096-1 P1

Figure 4 - ORE Countercrank Assembly



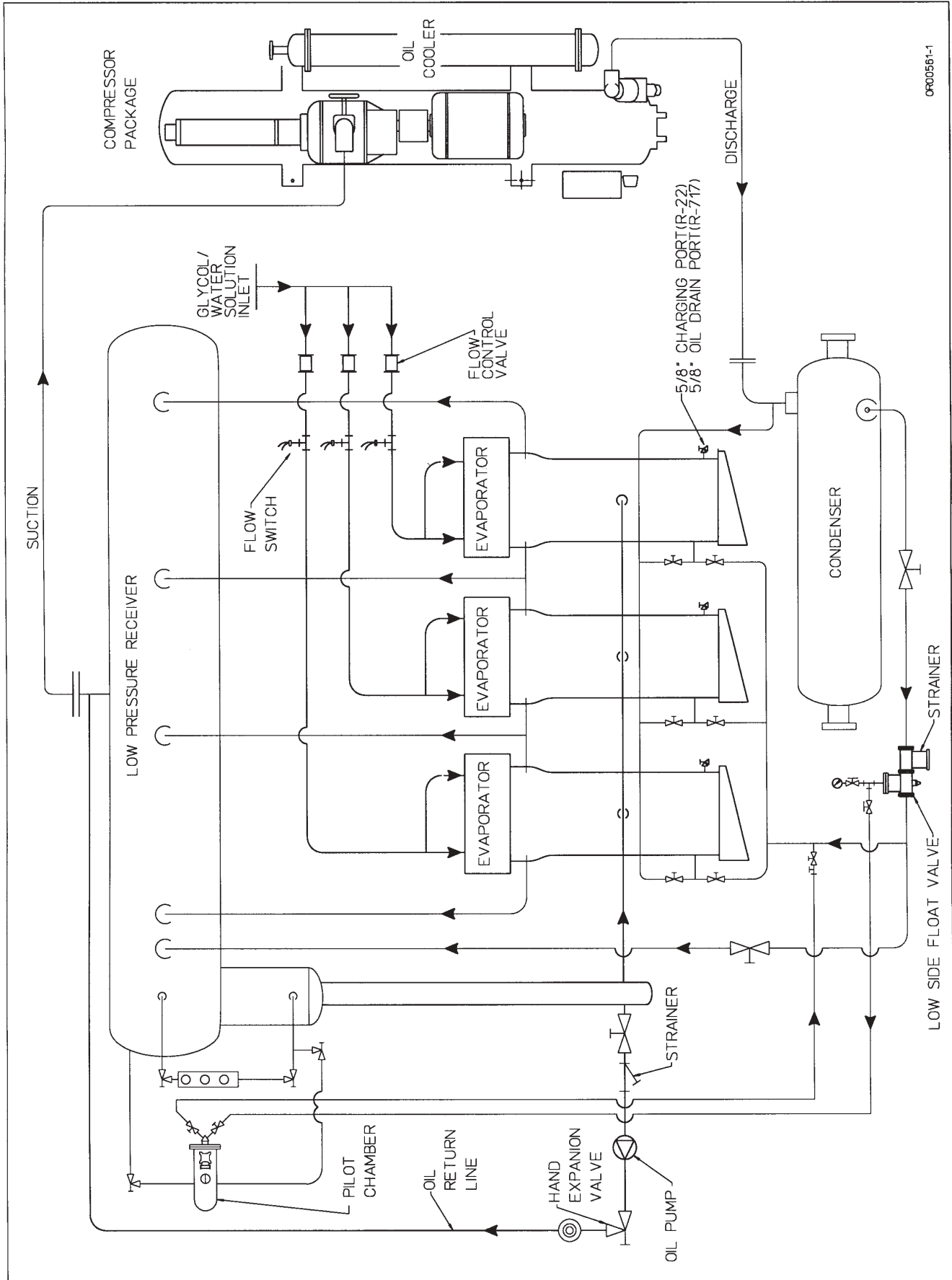
3.21 Packing Material(s)



IMPORTANT: The whip rods are secured in place with cellophane wrap, which must be removed from the bottom of each evaporator. On units with an ice discharge pump option, the outlet manifold ships loose and should be installed after the cellophane wrap.

Figure 5 - Typical ORE-300 (XL) PI & D

TYPICAL ORE-300XL PI&D



0900561-1

SECTION 4.0 - PRE START-UP/INSTALLATION REQUIREMENTS

4.1 Evaporator Unit Drive

The unit must be level within $\frac{1}{8}$ " (3 mm) over the entire length and width of the evaporator compartment (shim and grout as necessary).

The unit must be uniformly supported along the base beams.

The unit must not have restricted access. At least 4' (1.2 m) of clearance is required on all sides of the unit. Service access must be provided for removal of whip rods (approximately 4' or 1.2 m above evaporator compartment). **Do not suspend or support any piping or conduit from this unit.**

This unit contains rotating equipment, thus vibration and sound control may be required for this unit. Where vibration may be transmitted to a structure, all external piping to the unit should be vibration isolated.

4.2 Water Loop/Piping

All piping must be complete and correctly installed.

Water piping shall be flushed and drained prior to final connection to the MaximICE. The flushing procedure shall use an environmentally approved cleaning solution and consist of flushing the piping at not less than 10 ft/sec (3 m/sec) velocity for six hours. The water piping shall then be flushed with clean water to remove any residue.

All exposed exterior water piping shall be heat traced and insulated. The Paul Mueller Company warranty specifically excludes any liability for freezing damage resulting from low ambient temperatures.

The ice storage tank must be cleaned with an approved cleaning solution and rinsed with clean water prior to adding water/glycol solution. The water piping system including the tank shall then be filled with clean water and 8.0% glycol to 70% of the height of the tank. The water/glycol solution should be analyzed by a water-treatment authority and properly treated for oxygen corrosion, scales, algae, and fungus growth. The water should be periodically checked by a water-treatment authority.

Water-cooled condenser water piping shall be cleaned and flushed to remove all debris. The condenser/cooling tower water shall be properly treated. A properly sized strainer should be used on the condenser water supply to the MaximICE. The condenser, condenser water piping, condenser pump, and cooling tower must be properly protected against freeze damage resulting from low ambient temperatures.

Evaporative condensers shall be flushed and properly treated. A proper water-treatment system usually consists of a continuous blow down and chemical feeder. The condenser, condenser water piping, condenser water make-up line, and pump must be properly protected against freeze damage. The Paul Mueller Company warranty specifically excludes any liability for damage resulting from low ambient temperature. **Failure to maintain proper operation of the condenser by allowing fouling will result in decreased MaximICE system performance and operation.**

Water-cooled units may be provided with a condenser water-regulating valve, which is shipped loose for field installation at the outlet side of the condenser.

Remote, evaporatively cooled, air-cooled condenser or cooling towers, when supplied by other than PMC, require head pressure/capacity control. Consult factory for details and minimum requirements.

(If applicable) Water-cooled oil cooler, if installed, shall be connected by the installing contractor to a water source with a maximum water temperature of 85°F (30°C), with the required flow rate shown on the submittal. Supply water piping must be properly protected against freeze damage by the installer.

4.3 Electrical

All power wiring and grounding must be installed in accordance with all local, state, and national codes. All wiring to the MaximICE shall be copper. **Do not use aluminum wire.**

The following control interlocks must be installed prior to operating the unit:

1. **Water flow** — Proof of condenser water flow is required. Either a flow switch or a pressure differential switch can be employed.
2. **For a remote, evaporatively-cooled condenser** — Proof of condenser water pump and fan operation is required.
3. **For a remote, air-cooled condenser** — Proof of operation or signal upon a unit failure is required.

4.4 Refrigerant Piping

The installing contractor shall provide and install all interconnection piping and service valves. All refrigerant (R-22) piping shall be Type L or K hard copper or Schedule 40 steel piping. All piping shall be purged with an inert gas during welding or brazing. Ammonia (R-717) must be piped per ASHRAE 15 latest revision.

A pressure leak test of the complete refrigeration system is required once field piping is complete. The system shall be proven tight at 25 psig (175 kPa) below the lowest setting pressure relief valve.

The entire system must be evacuated to at least 500 microns with a five minute hold period.

The contractor shall provide a charging line from the charging connection on the MaximICE unit to the charging drum(s).

4.5 Start-Up Coordination/Inspection

Upon arrival of PMC authorized start-up personnel at the job site, a start-up coordination meeting will be held and a walk-through inspection of the job site conditions will be conducted. All trades involved in the installation should be represented. This includes, but is not limited to, the general contractor, mechanical contractor, plumbing contractor, tank contractor, and owner's representative. The start-up will not continue until all requirements for correct and safe operation of the MaximICE are satisfied. The installing trades should be available to resolve installation problems as required during the start-up period.

Contractors' personnel and the owner's representative who will be operating and maintaining the unit should be available for training during the entire start-up period.

4.6 Start-Up Policy

MaximICE units require two, three, or four days of start-up assistance depending on the size of equipment. Delays in the start-up caused by failure to comply with any of the following procedures are not the responsibility of PMC. Additionally, start-up time caused by delays, not the responsibility of PMC, must be authorized by customer in advance. Failure to follow these procedures will result in delays and may result in the voiding of the equipment warranty. Contact the Paul Mueller Company Thermal Energy Storage Department if you have any questions pertaining to the installation requirements of this equipment.

SECTION 5.0 - START-UP/REFRIGERANT CHARGING

5.1 Start-Up/Refrigerant Charging

Apply main power at least 12 hours prior to starting unit. This will allow the compressor crankcase ample time to boil off any possible liquid refrigerant within the compressor.

NOTE: Refrigerant charges provided are conservative and will vary due to condenser type and equipment layout. Final charging will be necessary once the system is under a stable operating condition.

Total system compressor and evaporator within 50 feet.

APPROXIMATE REFRIGERANT CHARGE(S)					
Unit	Refrigerant	Charge	Unit	Refrigerant	Charge
ORE-200	R-22	1,500 lbs (680 kg)	ORE-200	R-717	750 lbs (340 kg)
ORE-300	R-22	2,250 lbs (1,020 kg)	ORE-300	R-717	1,125 lbs (510 kg)
ORE-400	R-22	3,000 lbs (1,360 kg)	ORE-400	R-717	1,500 lbs (680 kg)

Liquid refrigerant can be added directly to the evaporator(s) through an angle valve located at the bottom of each evaporator. Approximately 50% of the refrigerant charge can be added without unit operation, until pressure equalization occurs. Once the compressor is started, add the remaining refrigerant charge. Suction pressure may drop during the charging process when the compressor operation begins. The compressor may require manual unloading to prevent compressor low suction pressure failure. On compressor's equipped with a micro processor panel, the suction control point perimeter(s) can be set to allow for automatic slide valve control. A minimum suction pressure can be maintained without causing a compressor failure. Additionally, the evaporator freeze-up protection pressure switch may require a lower adjustment during initial charging. After the completion of the charge, adjust the switch to cut-out at approximately 3 psig below normal suction pressure during full ice-making mode. Normal operating charge during ice making conditions is midway of the second LPR sight glass column.

5.2 Flow Switch Adjustment

To ensure proper flow a heavy-duty flow switch is incorporated in the solution riser pipe midway to the top. This ensures that minimal flow is met and 12 to 20 psid across the flow control valve is met. It will be necessary to remove the cover of the flow switch and adjust the tension spring. First, slowly close the hand valve of the solution to 10 psid across the flow control valve. Adjust the spring so that the switch will trip to the open position. Then, slowly open the solution hand valve and make sure the flow switch closes above the 12 to 20 psid across the flow control valve.

NOTE: Turn clockwise to increase tension and counterclockwise to decrease tension.

5.3 Softstarters Adjustment Introduction

It is best to operate the motor at its full load starting condition to achieve the proper time, torque, and ramp settings. Note that the potentiometers have a turning range of $\frac{3}{4}$ revolution. Forcing the potentiometer beyond this range will damage the unit. Initial settings are set to accommodate most motor conditions.

5.4 Softstarters Acceleration Adjustment

The unit is set at the factory with typical starting characteristics that perform well in most applications. When the system is ready to start, try the initial unit settings. If the motor does not come up to speed, increase the current limit setting. If the motor does not start to turn as soon as desired, raise the starting torque adjustment. The unit has three acceleration adjustments. Adjustment description and procedures are described as follows:

A. Starting Voltage Adjustment/Rotation Check

- ▲ **Factory Setting** — 60% of line voltage
- ▲ **Range** — 0 to 100% of line voltage

Starting voltage adjustment changes the initial starting voltage (torque) level to the motor. Start voltage is increased by rotating the START VOLTAGE potentiometer clockwise. Turn the START VOLTAGE potentiometer fully counterclockwise. Apply power to the SSA and give the START command. Observe that the motor does not rotate. Slowly increase the initial voltage by turning the potentiometer clockwise until the motor shaft just begins to rotate. When the motor shaft begins to rotate, give a STOP command and remove power (both line and control voltage). the minimum effective starting voltage level is set.

NOTE: Use this time to check rotation without full speed operation.

B. Ramp Time Adjustment

- ▲ **Factory Setting** — 10 seconds
- ▲ **Range** — 0 to 60 seconds

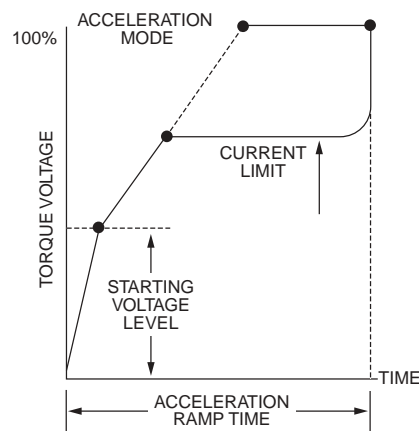
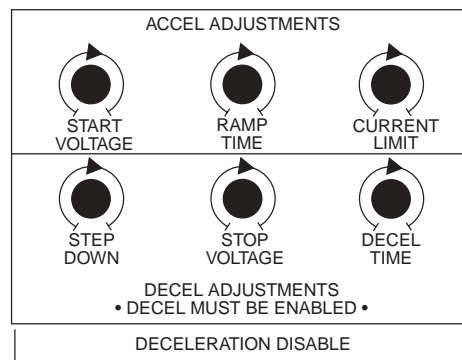
Ramp time adjustment changes the amount of time it takes to reach the current limit point or full voltage if the current limit point was not reached. Acceleration time (ramp) can be increased by rotating the ramp potentiometer in a clockwise direction. The ramp time adjustment is made after the starting torque has been set. Set the ramp potentiometer by slowly rotating it until the desired ramp time is reached. The unit should be stopped and restarted to see if the desired acceleration time has been achieved.

NOTE: Refer to your motor manual for the maximum number of starts allowed by the manufacturer and do not exceed the recommended number.

C. Current Limit Adjustment

- ▲ **Factory Setting** — 350% of unit FLA
- ▲ **Range** — 200 to 500% of unit FLA

The main function of current limit is to cap the peak current. It may also be used to extend the ramping time if desired. The interaction between the voltage ramp and the current limit will allow the soft start to ramp the motor until the maximum current is reached and the current limit feature will hold the current at that level.



The current limit must be set high enough to allow the motor to reach full speed. The factory setting of 350% is a good starting point. Do not set the current limit too low on variable starting loads. This may cause the motor to stall and eventually cause the system overloads to trip. If the motor decelerates or stops during the acceleration period, hit the STOP button immediately. Increase the current limit setting and restart.

NOTE: If the motor does stall, refer to the motor manufacturer's specifications for the proper cooling time.

5.5 Temperature Controller Settings (Love Controller) - Procedure for Temperatures in °F

1. Turn power on to unit.
2. Hold down the ▲ (arrow) and ENTER keys for 5 seconds or until the word **SECr** is displayed.
3. With **SECr** on display, use the ▲ or ▼ keys to change the value to 111 and press the ENTER key.
4. With **SECr 4** on display, press the INDEX key.
5. With **INP** on display, use the ▲ or ▼ keys until **P385** is shown on display and press the ENTER key to store.
6. With **INP P385** on display, press the INDEX key.
7. With **F-C** on display, use the ▲ or ▼ keys until **F** is shown on display and press the ENTER key to store.
8. With **F-C F** on display, press the INDEX key.
9. With **dPt** on display, use the ▲ or ▼ keys until **0.0** is shown on display and press the ENTER key to store.
10. With **dPt 0.0** on display, press the INDEX key.
11. With **InPt** on display, use the ▲ or ▼ keys until **OFF** is shown on display and press the ENTER key to store.
12. With **InPt OFF** on display, press the INDEX key.
13. With **SPL** on display, use the ▲ or ▼ keys until **20** is shown on display and press the ENTER key to store.
14. With **SPL 20** on display, press the INDEX key.
15. With **SPH** on display, use the ▲ or ▼ keys until **60** is shown on display and press the ENTER key to store.
16. With **SPH 60** on display, press the INDEX key.
17. With **SPSt** on display, use the ▲ or ▼ keys until **dir** is shown on display and press the ENTER key to store.
18. With **SPSt dir** on display, press the INDEX key.
19. With **SPLP** on display, use the ▲ or ▼ keys until **Ooff** is shown on display and press the ENTER key to store.

20. With **SPLP Ooff** on display, press the INDEX key.
21. With **AL** on display, use the ▲ or ▼ keys until **Hi** is shown on display and press the ENTER key to store.
22. With **AL Hi** on display, press the INDEX key.
23. With **ALt** on display, use the ▲ or ▼ keys until **AbS** is shown on display and press the ENTER key to store.
24. With **ALt AbS** on display, press the INDEX key.
25. With **ALrE** on display, use the ▲ or ▼ keys until **OnOf** is shown on display and press the ENTER key to store.
26. With **ALrE OnOf** on display, press the INDEX key.
27. With **ALPi** on display, use the ▲ or ▼ keys until **OFF** is shown on display and press the ENTER key to store.
28. With **ALPi OFF** on display, press the INDEX key.
29. With **ALiH** on display, use the ▲ or ▼ keys until **OFF** is shown on display and press the ENTER key to store.
30. With **ALiH OFF** on display, press the INDEX key.
31. With **ALSt** on display, use the ▲ or ▼ keys until **CLOS** is shown on display and press the ENTER key to store.
32. With **ALSt CLOS** on display, press the INDEX key.
33. With **ALLP** on display, use the ▲ or ▼ keys until **O On** is shown on display and press the ENTER key to store.
34. With **ALLP O On** on display, press the INDEX key. A click will be heard and display will show the bulb temperature.
35. Press the INDEX key.
36. With **SP** on display, use the ▲ or ▼ keys to change value to **26** on display and press the ENTER key to store.
37. With **SP 26** on display, press the INDEX key.
38. Press down the ▲ (arrow) and ENTER keys for one second until **ALHi** is displayed.
39. With **ALHi** on display, use the ▲ or ▼ keys to change value to **55** on display and press the ENTER key to store.
40. With **ALHi 55** on display, press the INDEX key.
41. With **CY** on display, use the ▲ or ▼ keys until **OnOF** is shown on display and press the ENTER key to store.
42. With **CY OnOF** on display, press the INDEX key.
43. With **SP_d** on display, use the ▲ or ▼ keys to change value to **2** on display and press the ENTER key to store.

44. With **SP_d 2** on display, press the INDEX key.
45. With **rt** on display, use the ▲ or ▼ keys until **OFF** is shown on display and press the ENTER key to store.
46. With **rt OFF** on display, press the INDEX key.
47. With **InPC** on display, use the ▲ or ▼ keys to change value to **0** on display and press the ENTER key to store.
48. With **InPC 0** on display, press the INDEX key.
49. With **FiLt** on display, use the ▲ or ▼ keys to change value to **2** on display and press the ENTER key to store.
50. With **FiLt 2** on display, press the INDEX key. The display will show the bulb temperature.
51. Hold down the ▲ (arrow) and ENTER keys for five seconds or until the word **SECr** is displayed.
52. With **SECr** on display, use ▲ or ▼ keys to change value to **1101** and press the ENTER key.
53. With **SECr 2** on display, wait one minute and the unit will return to temperature readout.

SECTION 6.0 - SEQUENCE OF CONTROL

6.1 General Control Sequence Information

The operation of the MaximICE unit is controlled by a Programmable Logic Controller (PLC), a very reliable, continuous-duty, automatic control device. By observing LED input/output lights, the operational status can be determined, serving as a useful tool during troubleshooting. It is recommended to study the system wiring diagram while matching the proper input/output LED lights with each function. Exhaust all other possible failure causes before assuming a PLC control malfunction. It is highly unlikely that the program is causing a failure.

NOTE: The PLC is equipped with dual, low-voltage 120 CDC and 24 VAC.

The MANUAL/OFF/AUTO switch (located in the control enclosure) facilitates unit operation within the panel. A manual switch reset is required after a system failure shutdown. The MaximICE unit is programmed with a unique system start-up and shutdown sequence unlike common refrigeration equipment. The following information describes a typical system operation sequence.

6.2 Start-Up Sequence

1. Select either MANUAL or AUTO on local 3-position toggle switch.
 - a. MANUAL — System starts immediately.
 - b. AUTO — System starts when remote “enable” signal is received.
2. Slush pump(s) and glycol solution pump(s) are ON (5-minute pre-wash cycle begins).
3. Enable full ice sensor temperature while glycol solution circulates for 5 minutes during pre-wash cycle).
4. End of pre-wash PLC verifies ice storage tank condition (glycol solution temperature). Check to see if high ice condition exists.

If no full ice condition exists the drive motors, condenser, and compressor start-up (oil return pump starts after two minute delay).

5. Start-up sequence complete.

If a full ice condition exists the system shuts down on full ice.

6. 60-minute (typical) delay for start after full ice condition. Unit will automatically start the solution pump(s) and ice slurry pump(s), and check for absence of full ice condition. If full ice exists, the pump(s) shall shutdown and another 60-minute delay will take place, after which the restart process will repeat.

6.3 Shutdown Sequence

1. Shutdown initiated by either selecting OFF on the toggle switch, removing the remote enable signal (if in AUTO), or high ice condition (temperature set point reached) in tank.
2. Compressor, condenser, and oil pump shutdown.
3. After 15-minute delay (wash down cycle), the drive motor, ice slurry pump(s), and glycol solution pump(s) shut down.
4. Shutdown sequence complete.

6.4 Alarm Condition Sequence

If a unit compressor, condenser, or oil pump component failure occurs, the unit will shut down on alarm with a wash down cycle.

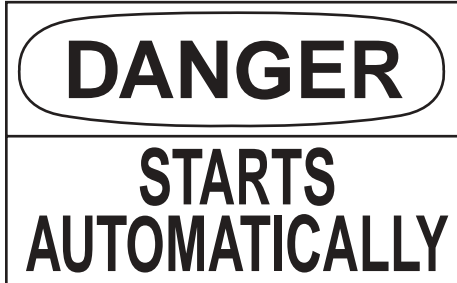
After 15-minute delay, the drive motor, ice slurry pump(s) and glycol solution pump(s) shut down.

If a unit evaporator flow switch, evaporator freeze-up low pressure, drive motor, slush pump, or top/lower vent switch component failure occurs, the unit will shut down on alarm without a wash down cycle.

SECTION 7.0 - SAFETY

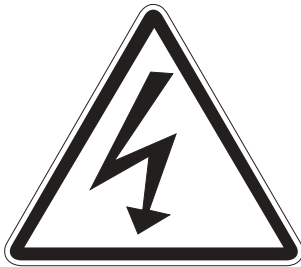
7.1 Label, Danger, "Unit Starts Up Automatically"

The unit is intended to operate automatically and will start at any time. Power must be disconnected and locked-out when servicing the unit.



7.2 Label, Electrical Symbol, Part No. 8820623

Indicates the high voltage electrical components of the system.



7.3 Label, Danger, "High Voltage"

This unit should be serviced by qualified electrical and refrigeration technicians.



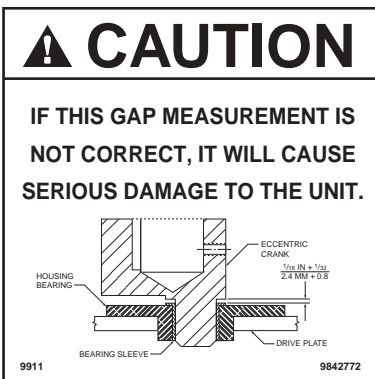
7.4 Label, Caution, "Do Not Run Unit Dry," Part No. 8850229

Major damage will occur if the drive parts are ran without the solution.



7.5 Label, Caution, "This Gap Measurement...", Part No. 9842772

If the bearing gap is not set correctly, it will cause the failure of the drive bearing and the drive plate.



SECTION 8.0 - MAINTENANCE

8.1 General Information

The MaximICE system is designed to be a low-maintenance piece of equipment. Preventive maintenance is the key to a properly operating unit. It is recommended to maintain an inspection log book for tracking the history of operation.

8.2 Daily Checks

1. Inspect the ORE unit for solution leaks and excessive vibrations. Check for proper compressor suction pressure and temperature.
2. Inspect around ice storage tank for solution leaks (piping, fittings, and tank surface).
3. Check for oil spots around condensing unit.
4. Listen to compressor for any noises different than normal. Sound level(s) should be constant.
5. Listen to the ORE. The whip rods should make a sibilant noise (sh...). Rattling noises may indicate one or more frozen tubes.

8.3 Recommended Inspection Procedures

The following points should be inspected when performing preventive maintenance on the MaximICE thermal energy storage system.

A. Drive Component Inspection

1. Turn the ON/AUTO/OFF control switch inside the ORE control panel to the off position. At this time, the liquid line solenoid and the oil return solenoid will close and the unit will pump down.
2. After the pumps and the drive assembly stop, turn the main power off to the unit.
3. Remove the insulation from the inlet shell and set aside.
4. Remove the inlet solution header (this will consist of removing 8 flange bolts and 2 union fittings).
5. On the top plate there will be (12) $\frac{3}{8}$ " nuts. Remove all 12 nuts and the lock washers. (**NOTE:** Do not remove the motor.) If this preventive maintenance is performed on an ORE-100, 200, 300, or 400, and a hoist is not available, the motor may have to be removed due to the weight and the awkwardness of the drive motor and top plate. If you have to remove the motor, the following steps must be followed: There are three $\frac{3}{4}$ " bolts with a lock nut on the bolt. Remove the $\frac{3}{4}$ " bolts from the motor mounting plate, not the adjusting inserts. This will allow the motor to be removed by lifting it along with the motor lifting lugs that are provided with the motor straight up.
6. With the motor and the top plate removed, the drive plate will be visible. Carefully lift the drive plate up and out of the evaporator and set aside.
7. With the drive plate removed, the counter cranks and the tops of the whip rods will be exposed. You will notice they are configured in a left and right format. Refer to Figures 3, 4, or 5 for counter crank arrangement. Randomly pull 8 to 10 counter cranks, along with the whip rods, out of the evaporator for inspection. Look at the counter cranks to see if there is any sign of scoring or frictional wear. If so, refer to the tolerance chart to see if these parts need to be replaced or if they are in specification. Then they can be reinstalled in the evaporator and returned to service.

B. Drive Plate

With the drive plate removed and placed on a flat surface, check all the holes and make sure the holes in the drive plate are round and not elongated. If there are any holes that are out of round, please refer to the tolerance chart to see if the drive plate can be reinstalled or if it needs to be replaced.

Figure 6 - Drive Plate Inspection Criteria

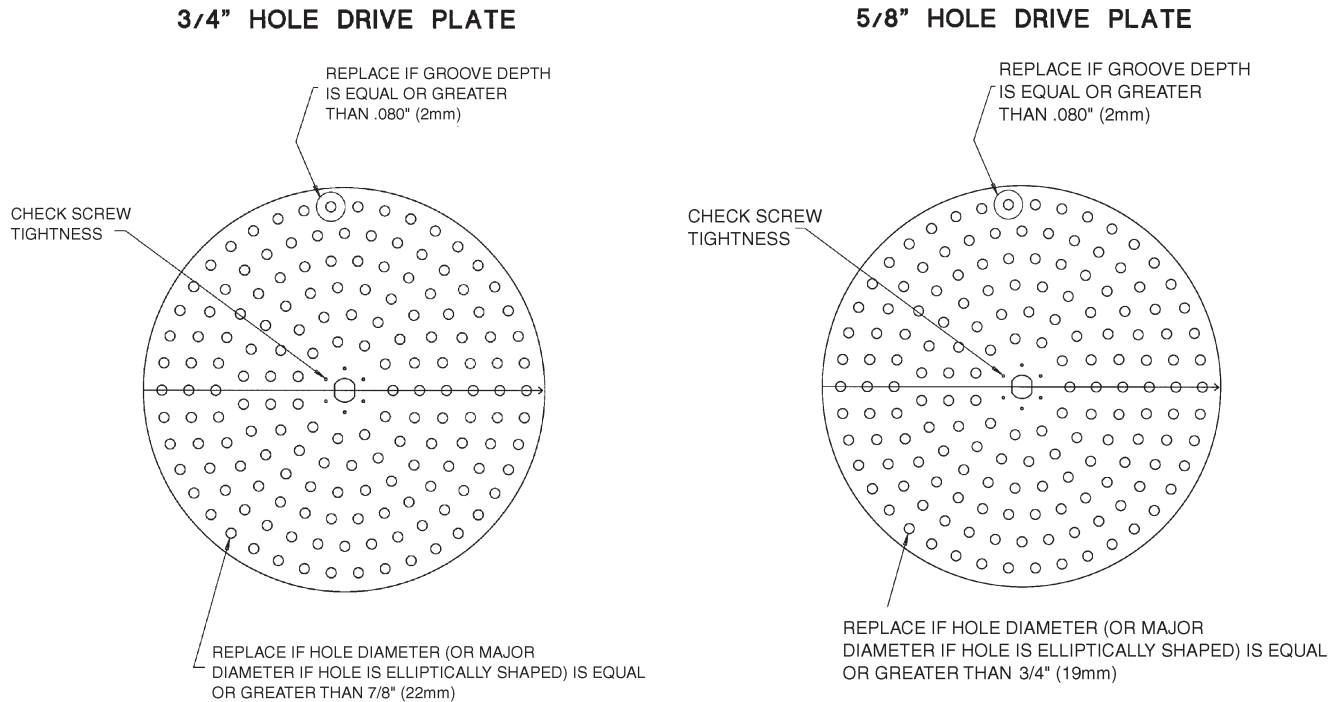


Figure 7 - Countercrank Inspection Criteria

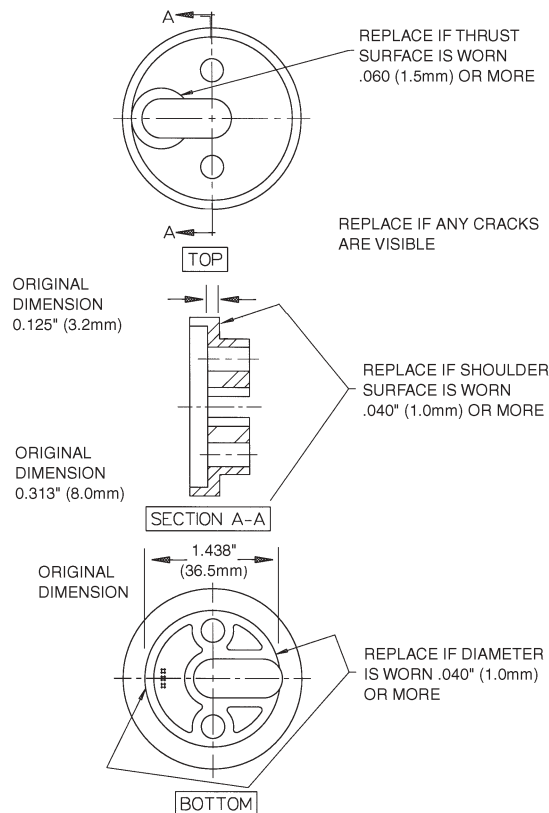
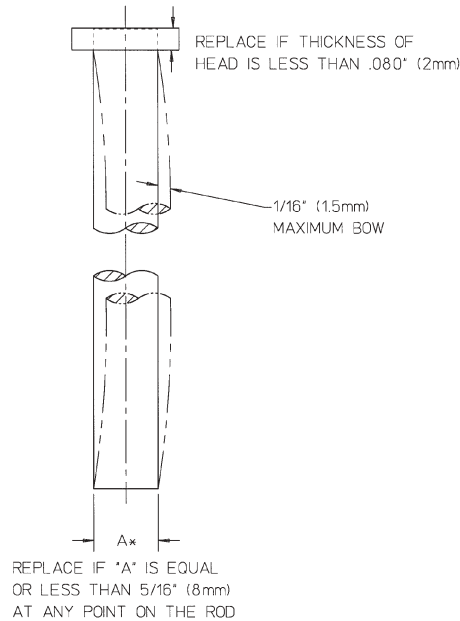


Figure 8 - Whip Rod Inspection Criteria

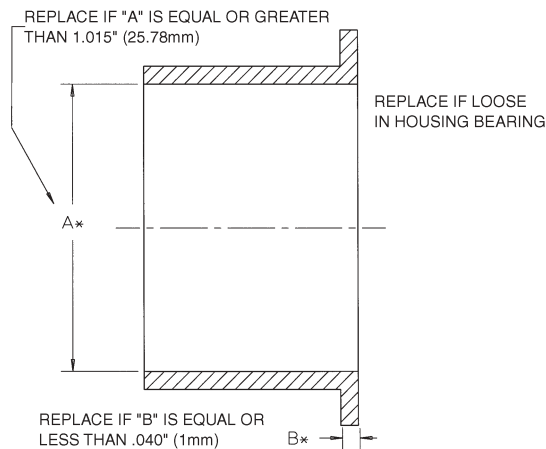
REPLACE IF ANY VISIBLE FLAT SPOTS ON WHIP ROD
 MEASURE BOW WITH FEELER GAUGE IF WHIP ROD WON'T
 ROLL FREELY ON A FLAT SURFACE



C. Drive Plate Bearing Housing

Make sure that there is not any apparent scoring inside the bearing sleeve. Measure the ID of the bearing sleeve and refer to the tolerance chart to see if this part can be reinstalled or needs replacing. The lip on the bearing sleeve should be fully seated into the bearing housing.

Figure 9 - Bearing Sleeve Inspection Criteria



D. Freeze-Up Protection Switch Adjustment

Remove the 2 wires that are connected to the freeze-up protection switch. Shut the angle valve off at the evaporator and remove the hose that is connected to the freeze-up protection switch. (**NOTE:** Loosen the hose fitting very slowly because of the possibility of the presence of liquid in the line.) Using a VOM meter, set the meter to the OHM position. Attach the leads to the NC set of contacts on the freeze-up protection switch. Attach the suction hose from your gauge set (blue hose) to the freeze-up protection switch. Attach your charging hose (yellow hose) to a bottle of pressurized gas, preferably nitrogen. When pressure is applied to the switch it will show you the exact pressure of your suction gauge. The freeze-up protection switch should be set to open at 4 psig (27 kPa) below normal suction pressure.

E. Solution Difference Regulating Valve (Flow Control Valve) - Grisworld

the inlet glycol solution flow should be set to maintain a 12 to 20 psid. There are two gauge ports located on the top of the valve to verify the pounds per square inch difference. If the differential pressure on the inlet of the regulator is not within these parameters, the machine is either not getting enough solution and has the possibility of freeze-up, or, it it exceeds the pressure, the unit will not be running at the designed capacity. A balance ball valve is recommended to be installed in front of the regulating valve, as well as a cut-off valve. Low flow, verify the pump cure. Change to a larger pump if necessary.

Unit	DESIGN FLOW RATES	
	GPM	L/Min
ORE-200	490	1,855
ORE-300	735	2,782
ORE-400	980	3,710

Figure 10 - Tube Insert Inspection Criteria

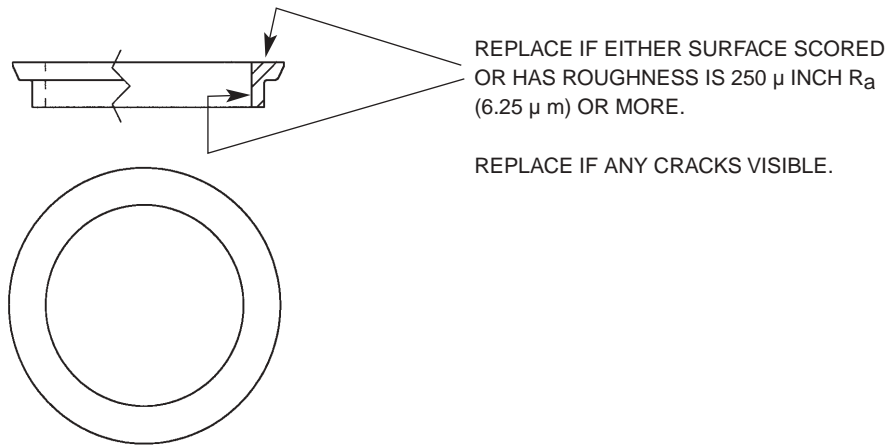
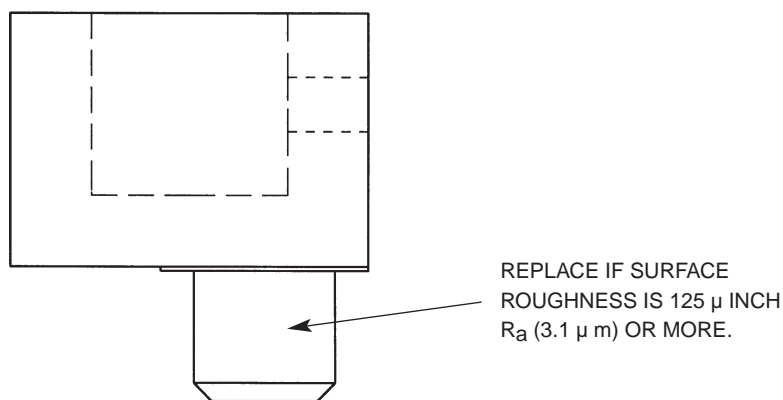


Figure 11 - Eccentric Crank Inspection Criteria



8.4 Recommended Drive Component(s) Replacement Schedule

A. 1,000 Hours —

- a. Disassemble drive assembly.
- b. Inspect wear surfaces.
- c. Apply a thin coating of Petroleum-Gel to all surface wearing drive parts.

B. 8,000 Hours —

- a. Possible replacement of countercranks, drive plate, and flange bearing.
- b. Clean ORE inlet strainer.

NOTE: The above schedule is based on good glycol solution quality and normal wear. Systems with poor water quality and operational difficulties may require more frequent replacement.

8.5 Recommended Monitoring Points

- ▲ Temperatures (°F)
- ▲ Ambient
- ▲ Solution Supply To Process
- ▲ Solution Supply To Evaporator
- ▲ Compressor Discharge
- ▲ Compressor Suction
- ▲ Condenser Liquid Outlet
- ▲ Pressures (psig)
- ▲ Compressor Discharge
- ▲ Condenser Liquid Outlet
- ▲ Drier Core ΔP
- ▲ Evaporator Suction
- ▲ Main Voltage
- ▲ AMPS
- ▲ Compressor Motor
- ▲ Evaporator Drive Motor
- ▲ Evaporator Solution Pump Motor
- ▲ Evaporator Slurry Pump Motor

SECTION 9.0 - RECOMMENDED SPARE PARTS

9.1 Recommended Spare Parts

The following list consists of specialty-type or hard-to-find parts, while most all other parts can be purchased locally.

Paul Mueller Company has the right to improve the design of equipment without notice.

9.2 ORE Common Parts

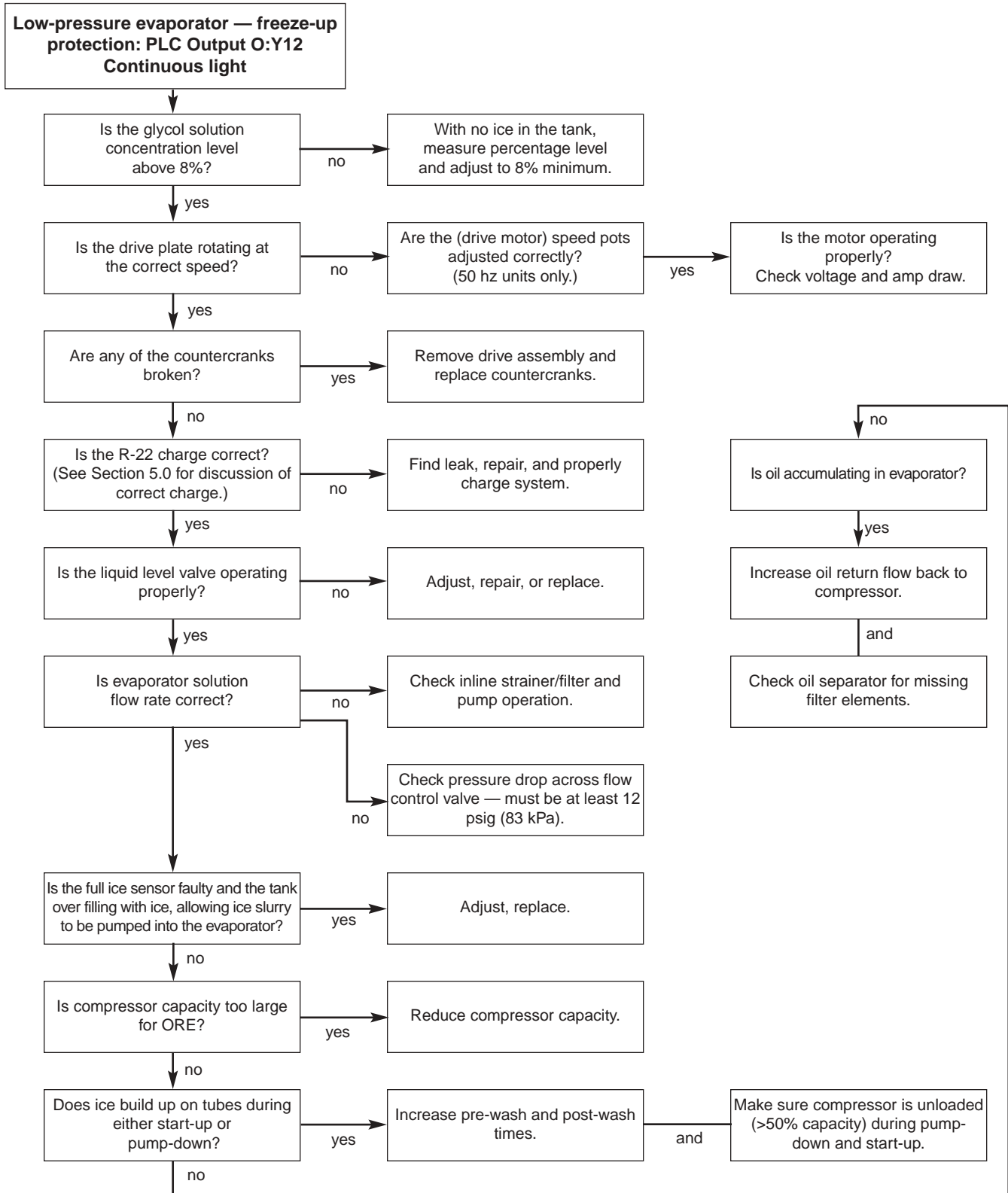
Description	Recommended Qty.	PMC Part No.
Whip Rod	(80) ORE-100	8850044
Counter Crank - Right Hand	(80) ORE-100	9842676
Counter Crank - Left Hand	(80) ORE-100	9842677
Switch Flow Water Inlet	1	9841944
Full Ice Sensor (temperature controller)	1	9840492
Full Ice Sensor (RTD)	1	9840550
Switch Float Vent Line	11	8850091

9.3 ORE-100 Parts

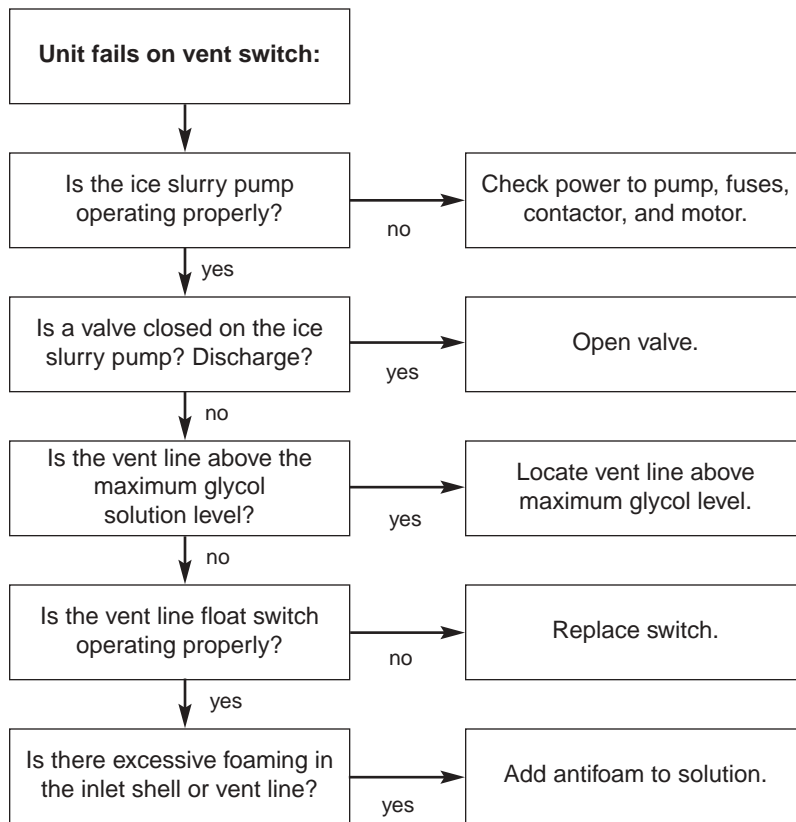
Description	Recommended Qty.	PMC Part No.
Drive Plate	1	9842620
Drive Plate Assembly (plate, housing bearing, bearing sleeve)	1	9842872
Drive Motor Shaft Seal	1	9840666
Housing Bearing	1	9842349
Bearing Sleeve	1	9840320
Crank Eccentric Assembly	1	9842862
Inlet Shell	1	9840854

SECTION 10.0 - TROUBLESHOOTING FAILURES

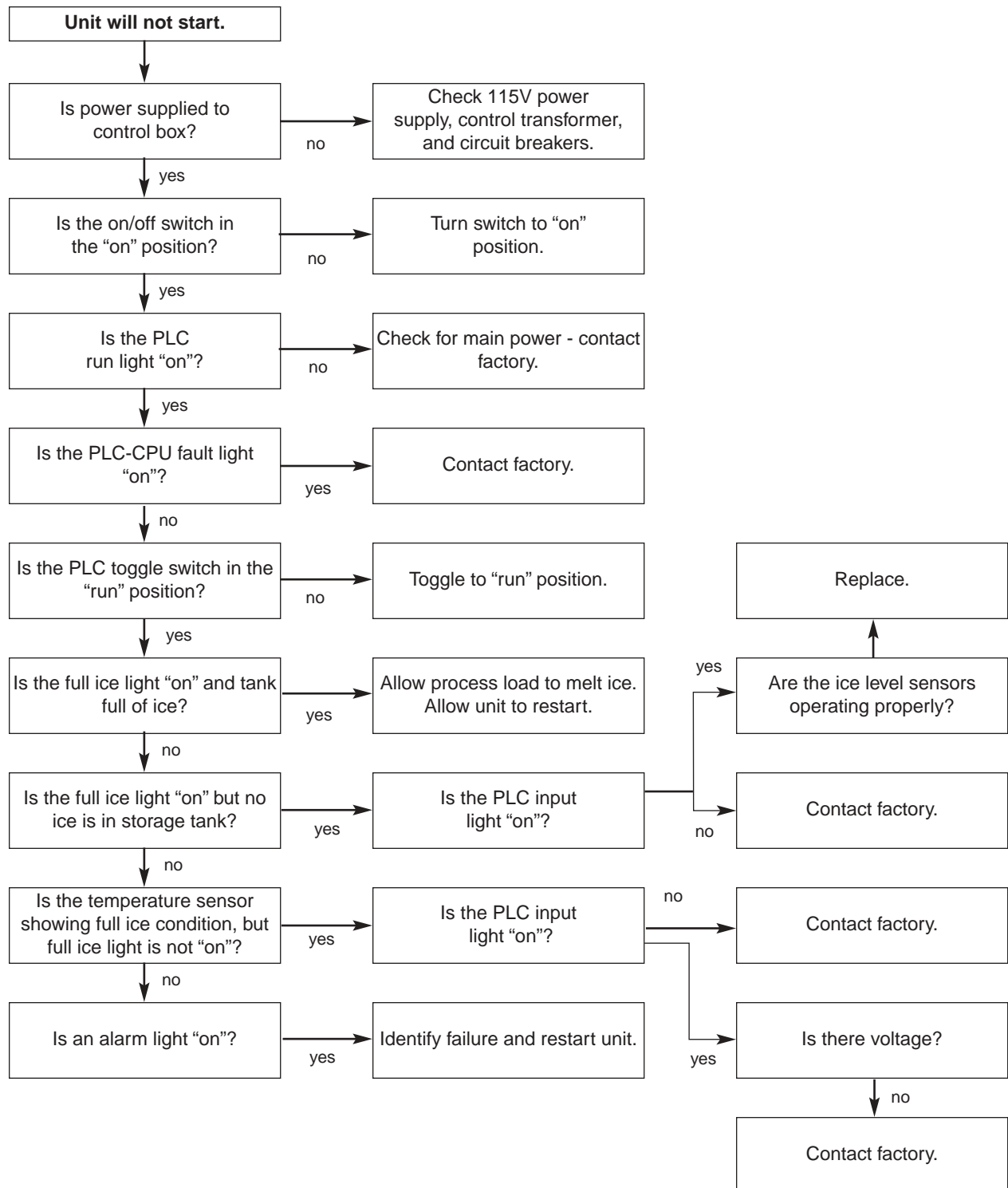
10.1 Troubleshooting Chart 1: Low Pressure Evaporator - Freeze-Up Protection Alarm



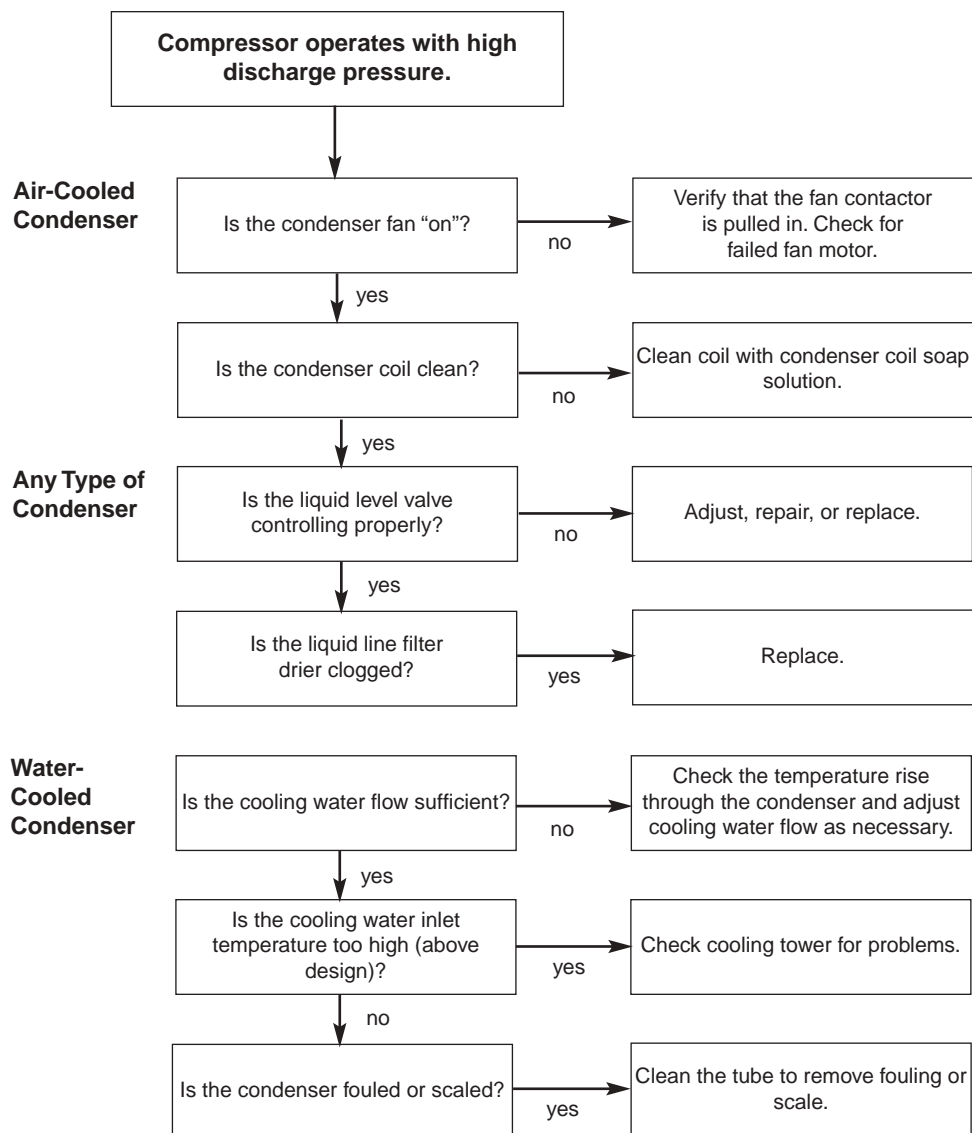
10.2 Troubleshooting Chart 2: Unit Fails on Vent Switch



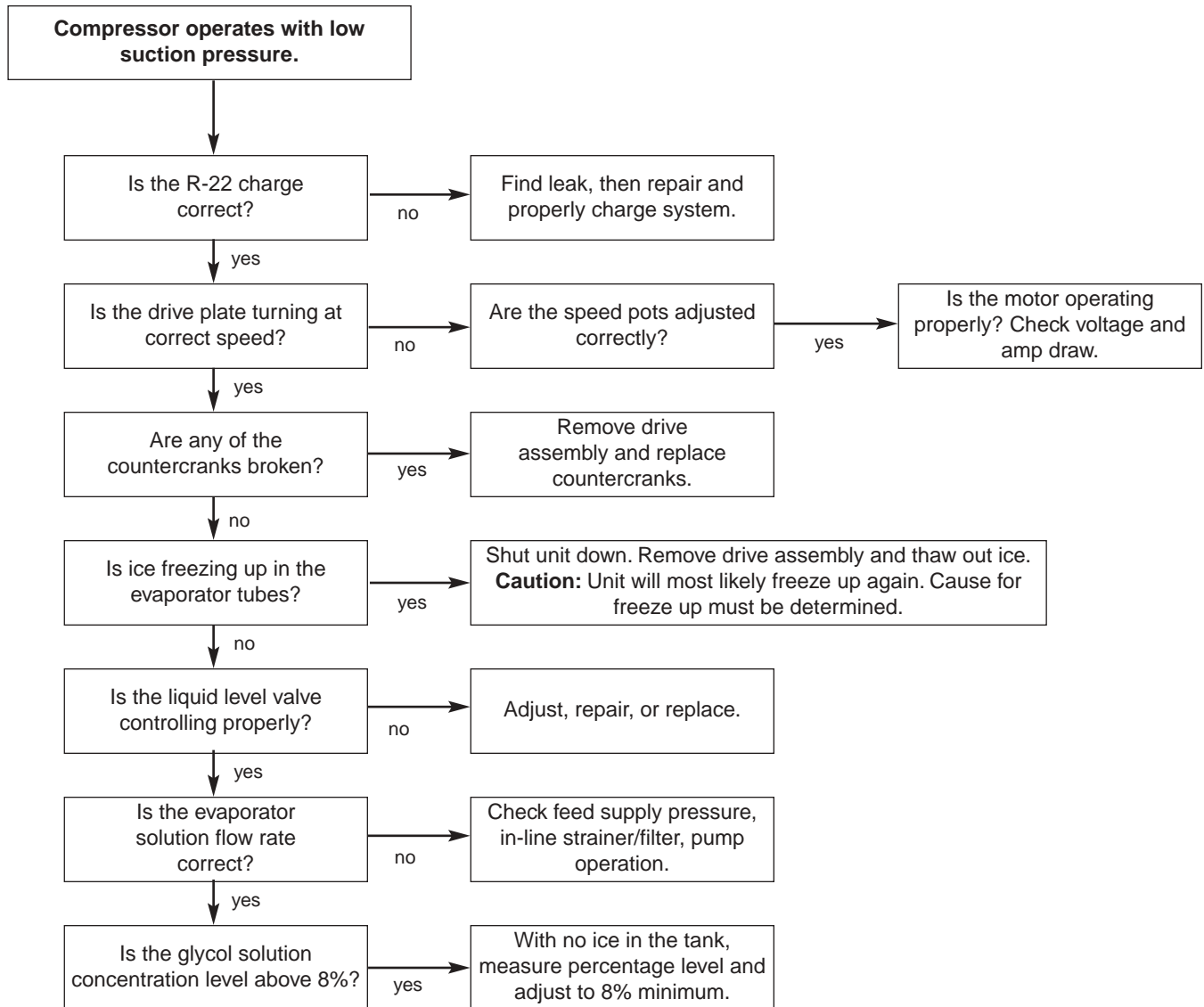
10.3 Troubleshooting Chart 3: Unit Will Not Start



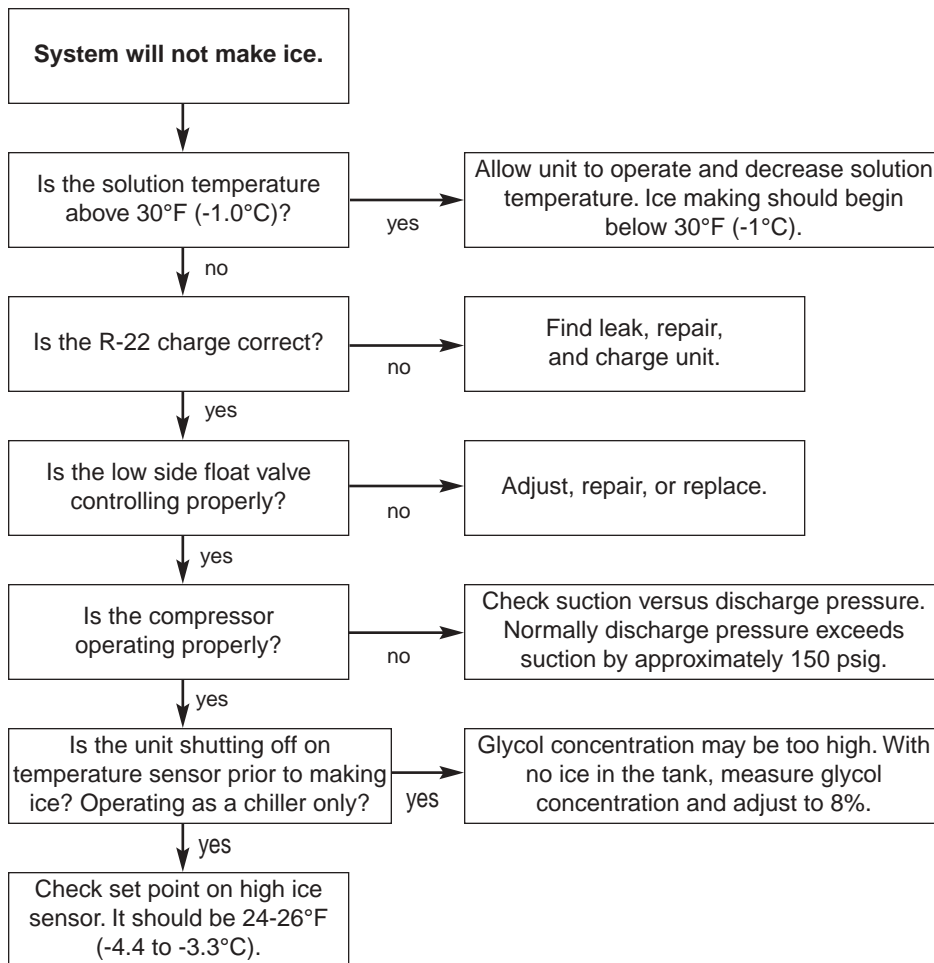
10.4 Troubleshooting Chart 4: Compressor Operates with High Discharge Pressure



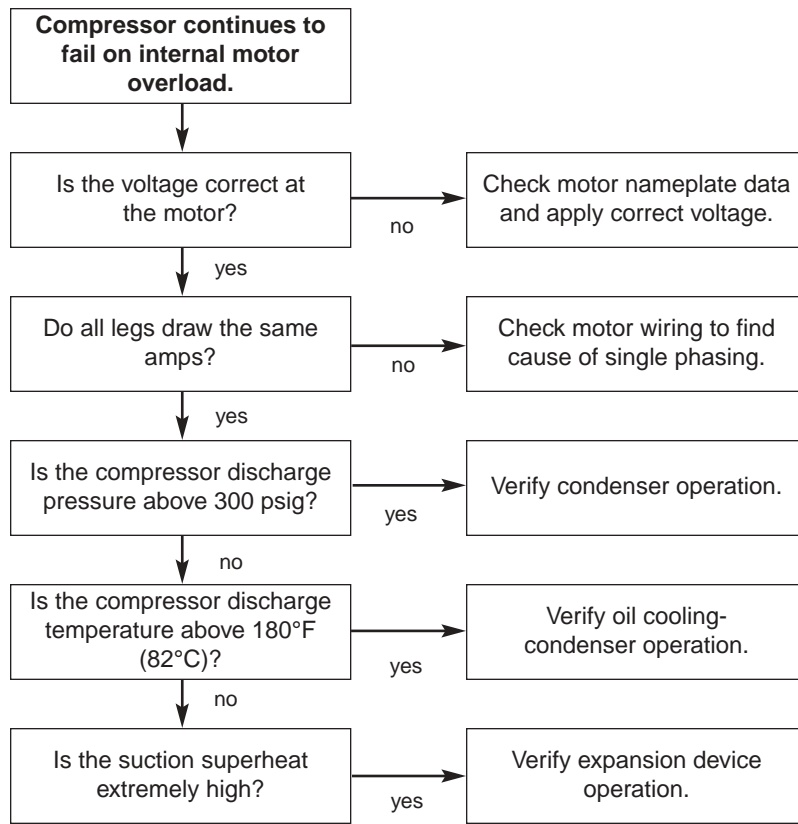
10.5 Troubleshooting Chart 5: Compressor Operates with Low Suction Pressure



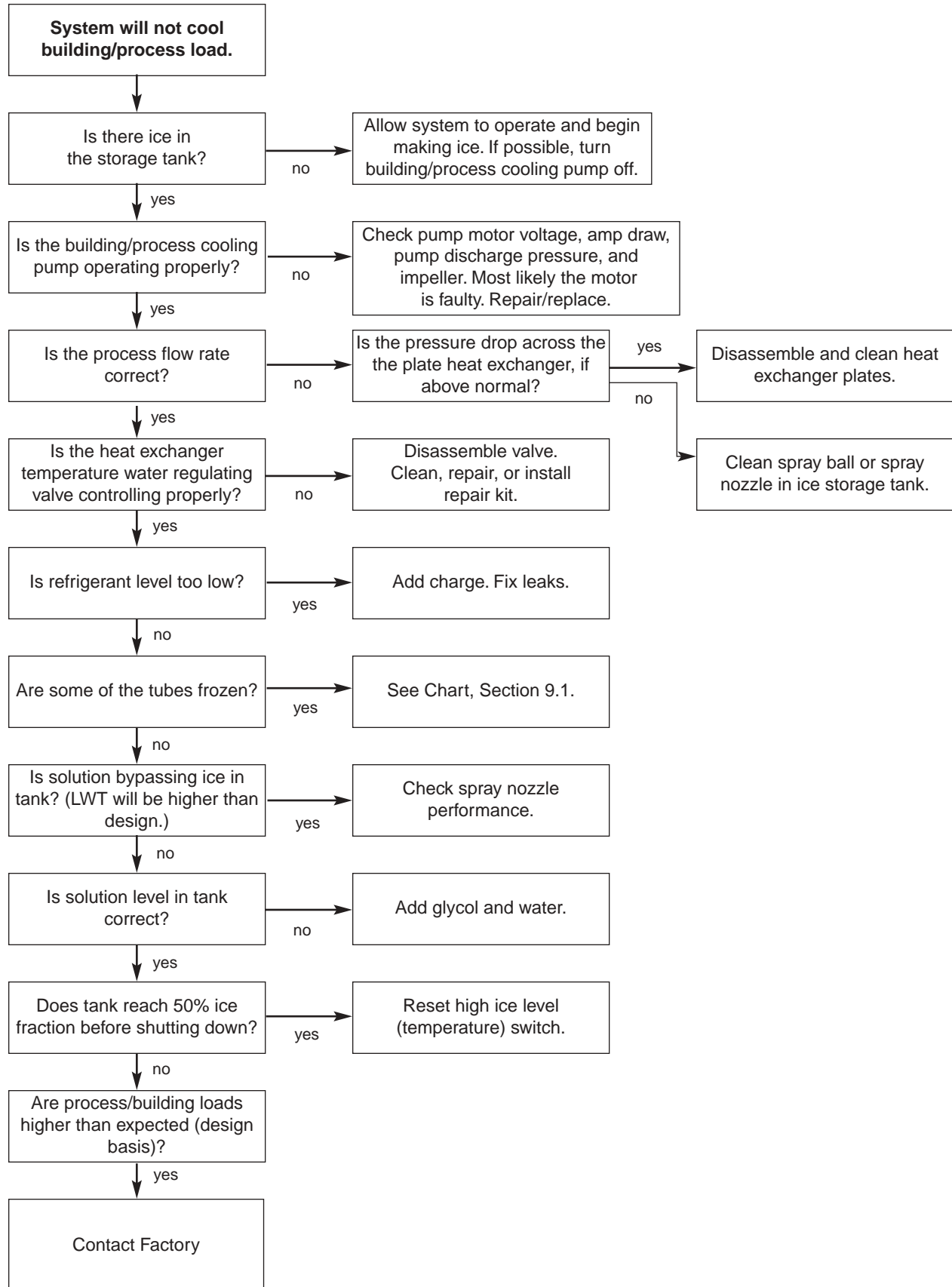
10.6 Troubleshooting Chart 6: System Will Not Make Ice



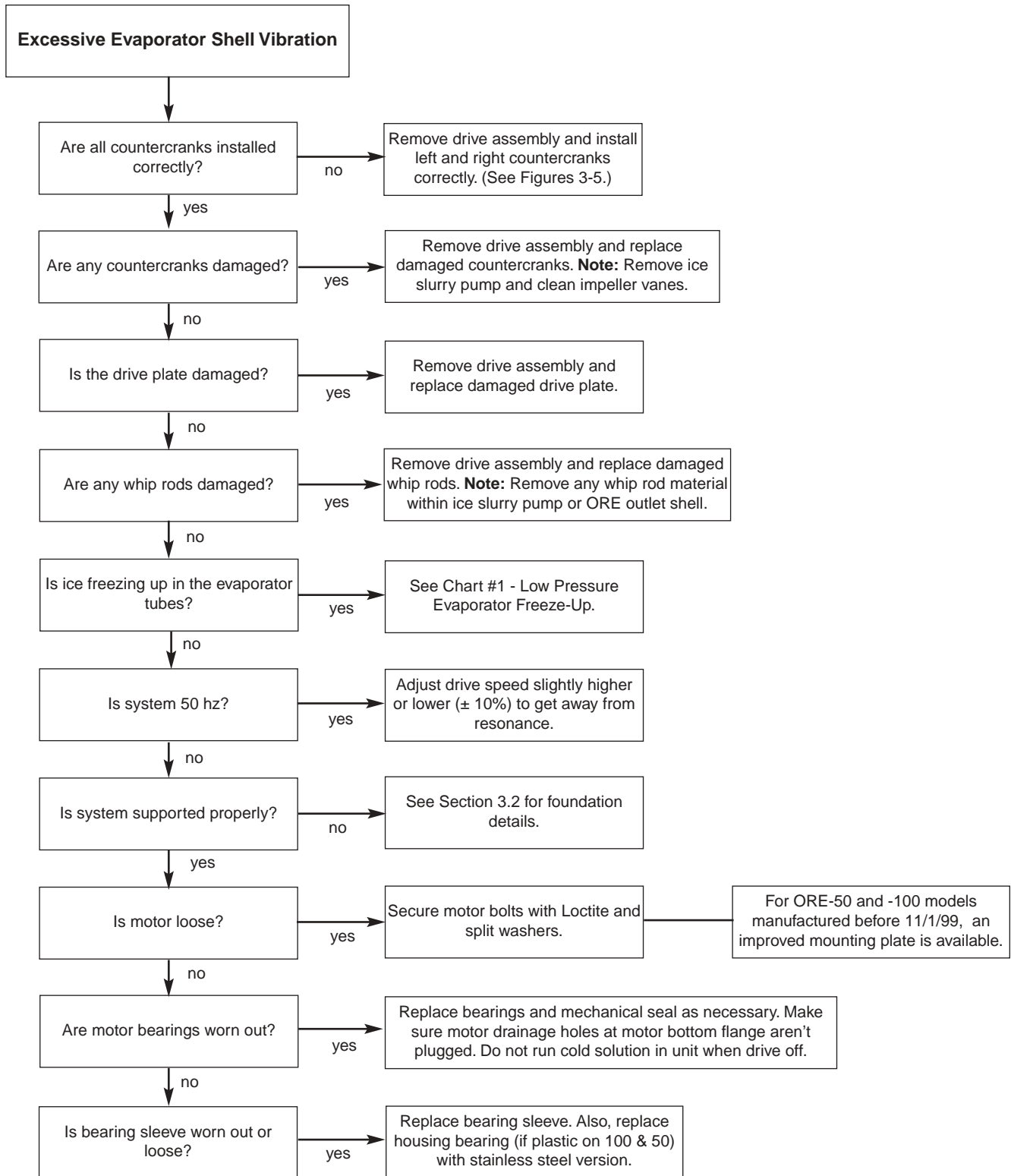
10.7 Troubleshooting Chart 7: Compressor Fails on Motor Overload



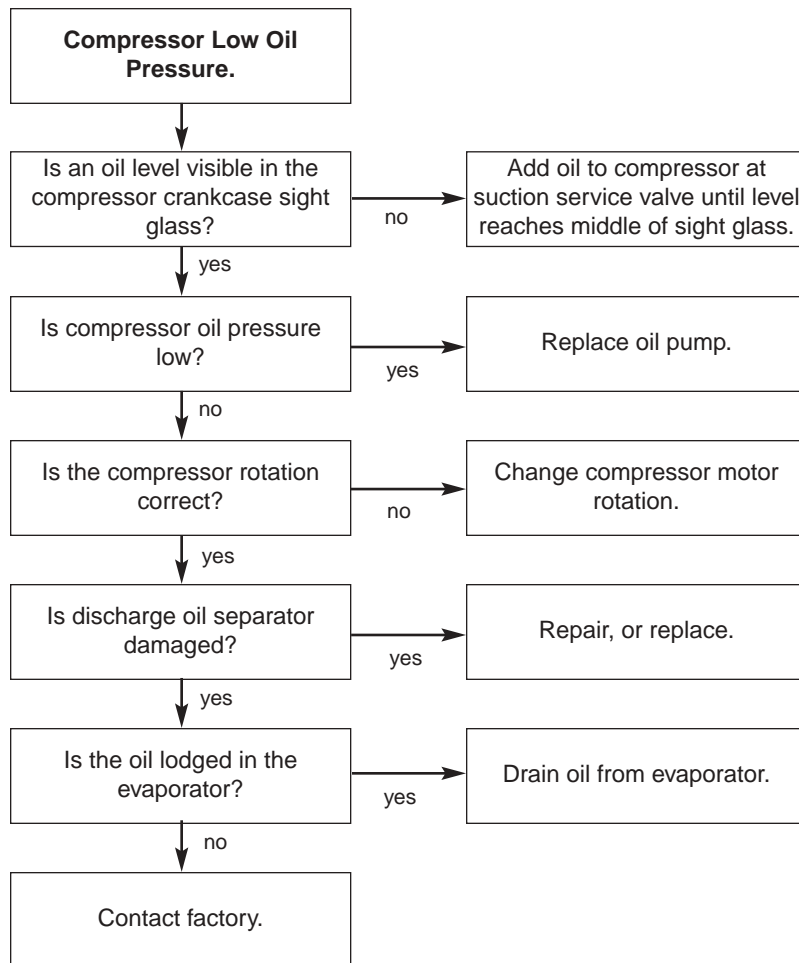
10.8 Troubleshooting Chart 8: System Will Not Cool Building/Process Load



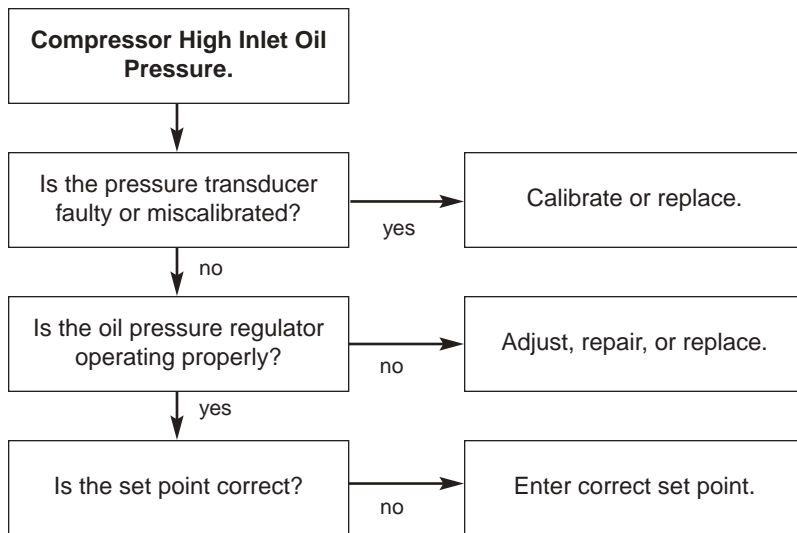
10.9 Troubleshooting Chart 9: Excessive Evaporator Shell Vibration



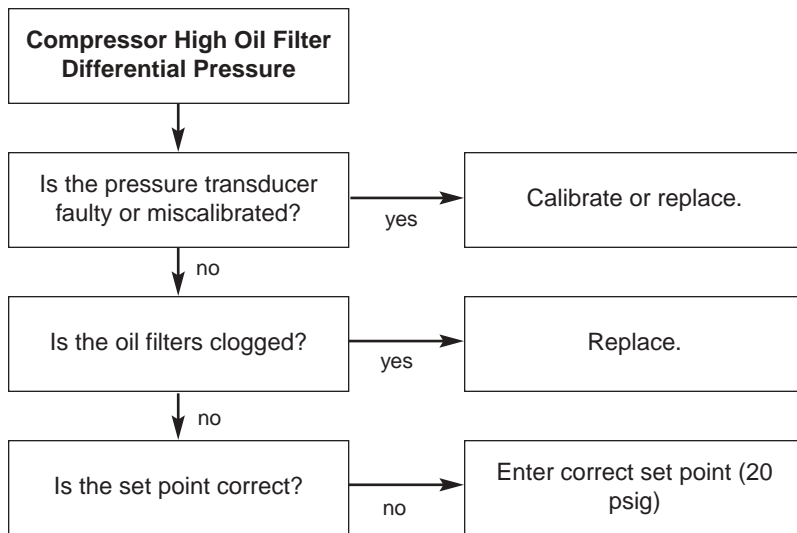
10.10 Troubleshooting Chart 10: Compressor Fails on Low Oil Pressure



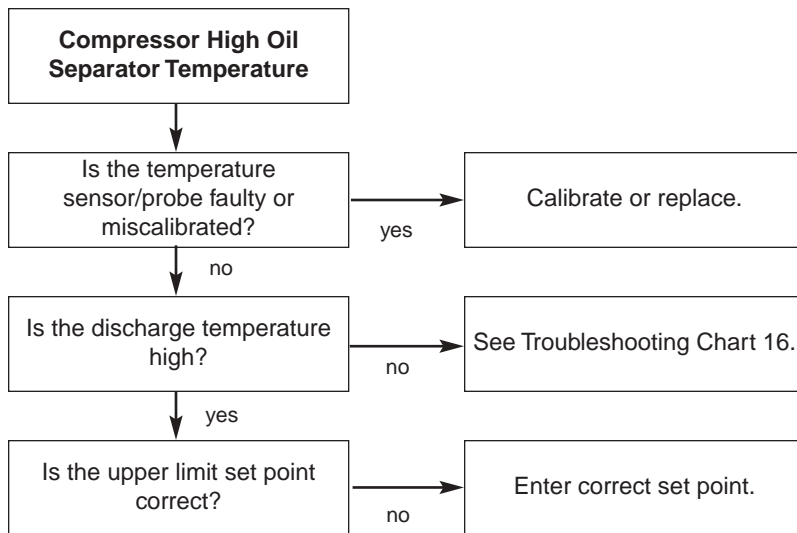
10.11 Troubleshooting Chart 11: Compressor High Inlet Oil Pressure



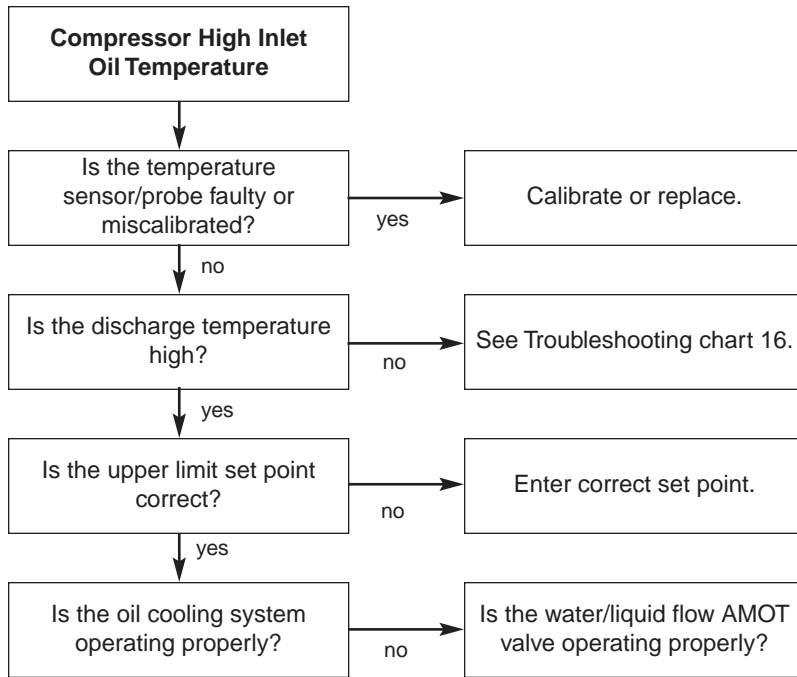
10.12 Troubleshooting Chart 12: Compressor High Oil Filter Differential Pressure



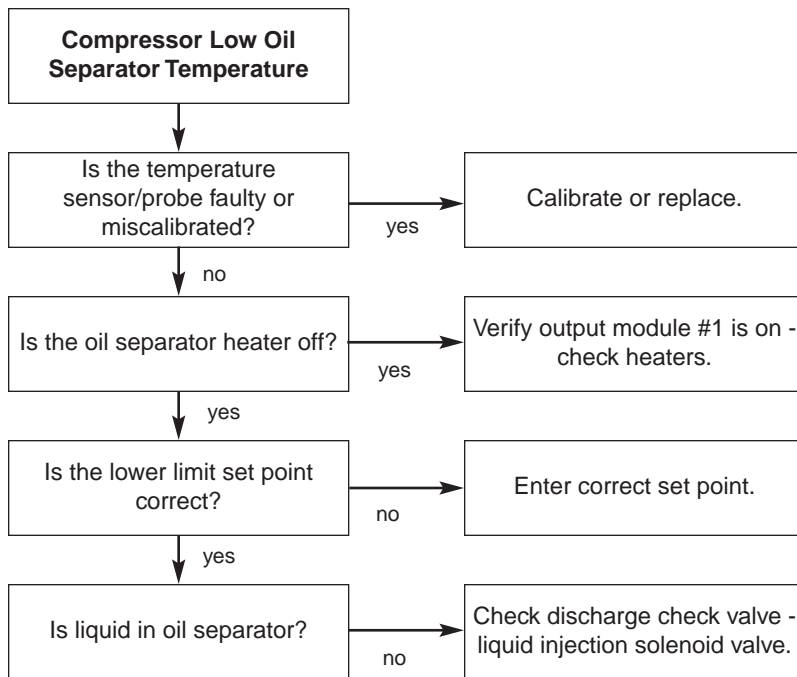
10.13 Troubleshooting Chart 13: Compressor High Oil Separator Temperature



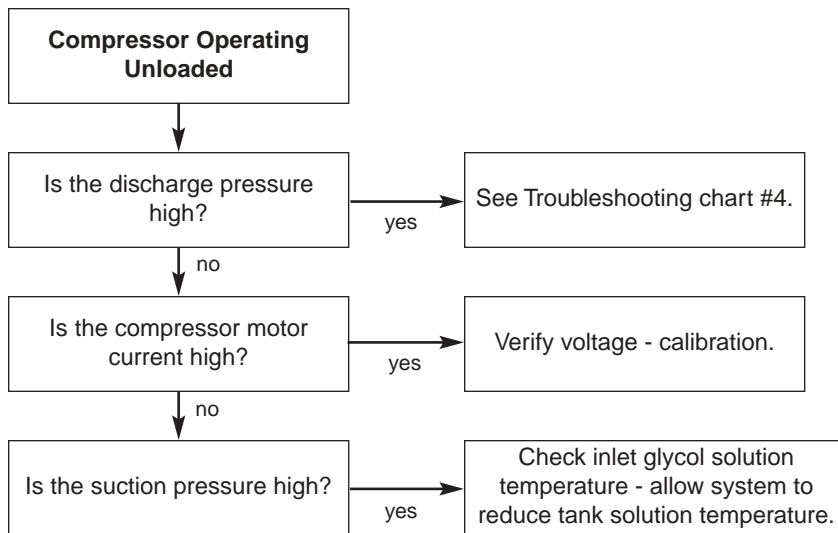
10.14 Troubleshooting Chart 14: Compressor High Inlet Oil Temperature



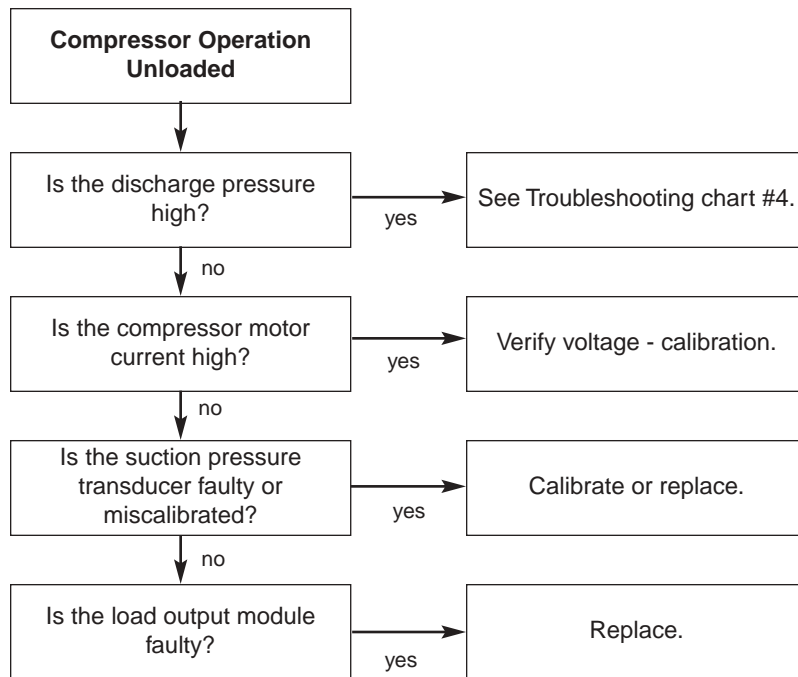
10.15 Troubleshooting Chart 15: Compressor Low Oil Separator Temperature



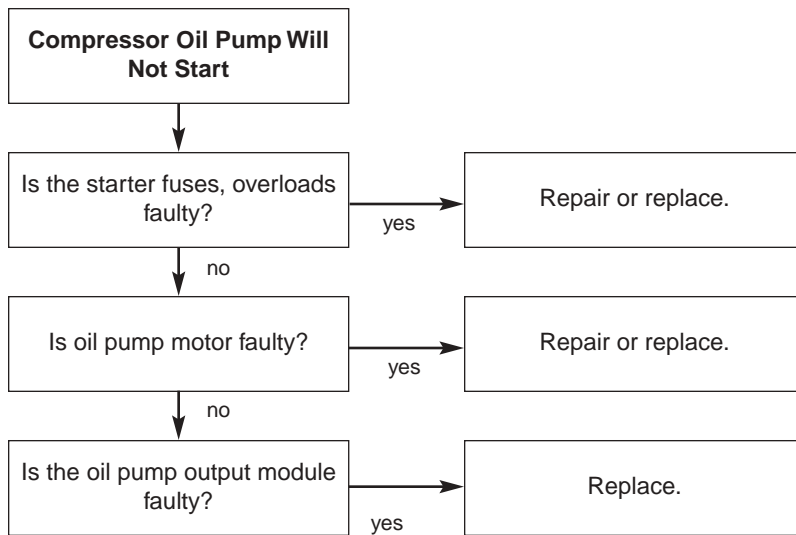
10.16 Troubleshooting Chart 16: Compressor Operating Unloaded



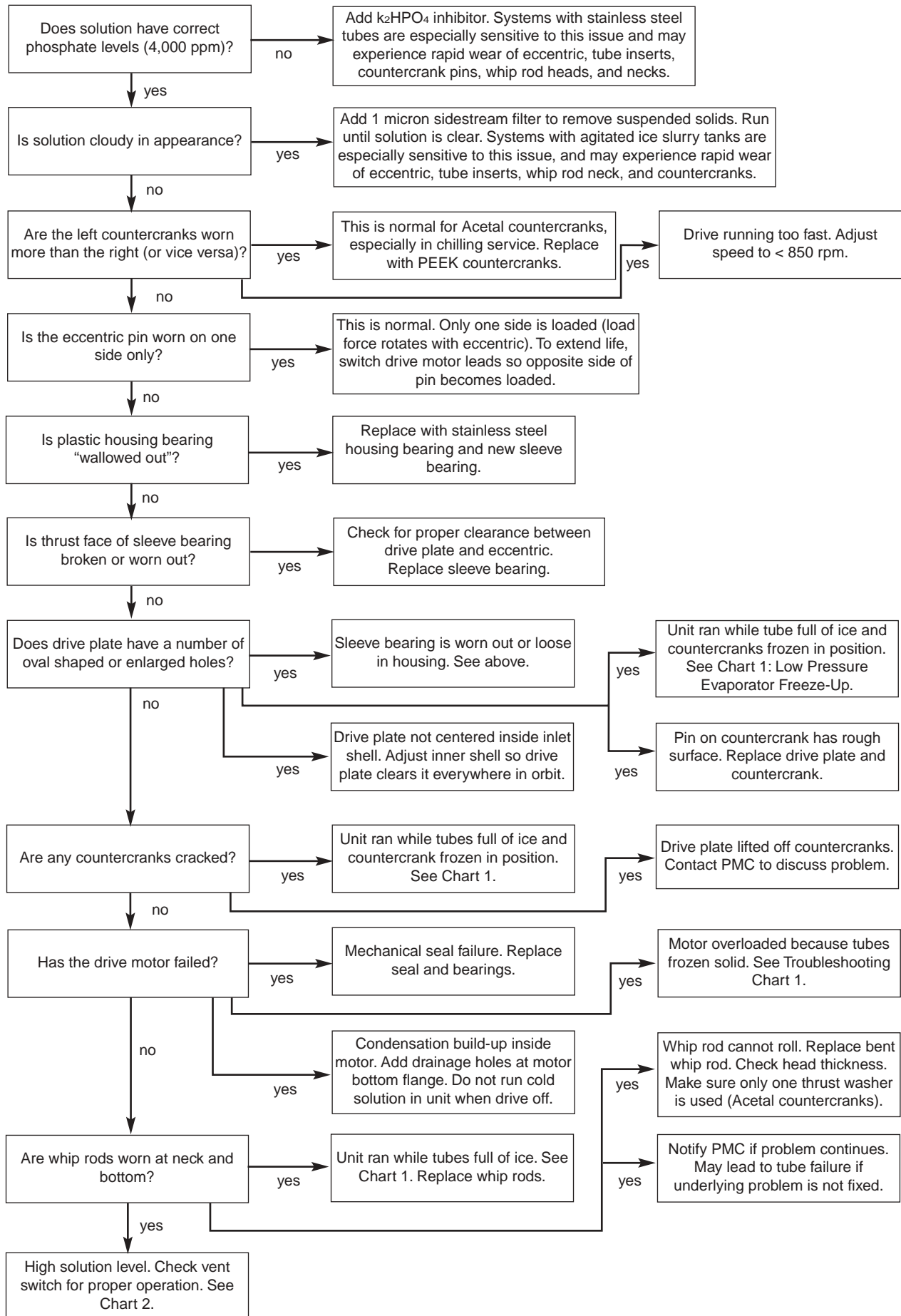
10.17 Troubleshooting Chart 17: Compressor Will Not Load



10.18 Troubleshooting Chart 18: Compressor Oil Pump Will Not Start



10.19 Troubleshooting Chart 19: Excessive Wear



SECTION 11.0 - START-UP REQUIREMENTS

11.1 MaximICE® Start-Up Request Form

Prior to requesting start-up, verify that all the following items are complete. Only PMC-qualified start-up personnel shall be authorized for start-up. Unauthorized start-up of equipment will result in immediate void of warranty.

Purchaser: _____

Address: _____

Contact Person: _____

Telephone No.: _____

Facsimile No.: _____

Unit Model: _____

Unit Serial No.: _____

Installation Location: _____

Address: _____

11.2 MaximICE Evaporator Unit

- ▲ Equipment must be inspected for any damage that may have occurred during shipping. If damage is found, a claim should be made against the trucking company.
- ▲ Check the packing slip or bill of lading to ensure that all accessory parts called for in the sales order are included.
- ▲ The unit must be level to within 1/8" (3 mm) over the length and width.
- ▲ All remote piping must be cleaned.
- ▲ All pumps must be secured (vertical shaft pumps should be properly protected and aligned).
- ▲ Control wiring connected between the ORE and the condensing unit.
- ▲ All shipping material removed from the inlet shell and the bottom of the evaporator.

11.3 Refrigerant Piping

- ▲ All remote refrigerant piping must be installed in accordance with the approved piping practice (ANSI/ASME).
- ▲ All piping must be properly supported.
- ▲ Pressure test complete system for leak (including PMC equipment).
- ▲ Complete system evacuated.
- ▲ Full refrigerant charge (provided by others) to be on-site at start-up.

11.4 Water Piping

- ▲ (If required) strainer installed.
- ▲ Check for water leaks.
- ▲ All flow controls checked and calibrated.
- ▲ (Water-cooled condenser) install water regulating valve on the condenser outlet.
- ▲ (Oil cooler) water piping installed.
- ▲ Check water loop design control.
- ▲ Freeze protection installed on all applicable piping.

11.5 Electrical (see Figure 12)

- ▲ Adequate power supply to unit.
- ▲ Three-phase and control wiring completed to the unit and any remote equipment.
- ▲ All wiring and grounding conforms to national, state, and local electrical codes.
- ▲ (High voltage systems) megohmmeter test main wiring circuit complete to compressor motor.
- ▲ All wire is copper (no aluminum wiring).

11.6 Installing Contractor Shall Furnish The Following

- ▲ All materials and labor necessary to assist in the installation/start-up.
- ▲ A refrigeration service mechanic to assist PMC start-up personnel during start-up for necessary training in the operation of the unit. This training is essential in performing in-warranty labor incumbent upon contractor and/or end user.

11.7 Compressor Package

- ▲ Check compressor/motor alignment and align as necessary to within $\pm.004$ " (0.1 mm) angular/parallel.
- ▲ Check oil pump/motor alignment and align as necessary to within $\pm.004$ " (0.1 mm) angular/parallel.

Figure 12 - Electrical Schematic, Drawing No. 8800454 (Attached)

LEGEND

DISCONNECT

CIRCUIT BREAKER

LIMIT
 NORMALLY OPEN / NORMALLY CLOSED
 HELD CLOSED / HELD OPEN

LIQUID LEVEL
 NORMALLY OPEN / NORMALLY CLOSED

PRESSURE
 NORMALLY OPEN / NORMALLY CLOSED

TEMPERATURE
 CLOSE ON RISING TEMP / OPEN ON RISING TEMP

FLOW (WATER)
 NORMALLY OPEN / NORMALLY CLOSED

SELECTOR
 2-POSITION

CONNECTIONS
 NOT CONNECTED / CONNECTED / TERMINAL BLOCKS / GROUND

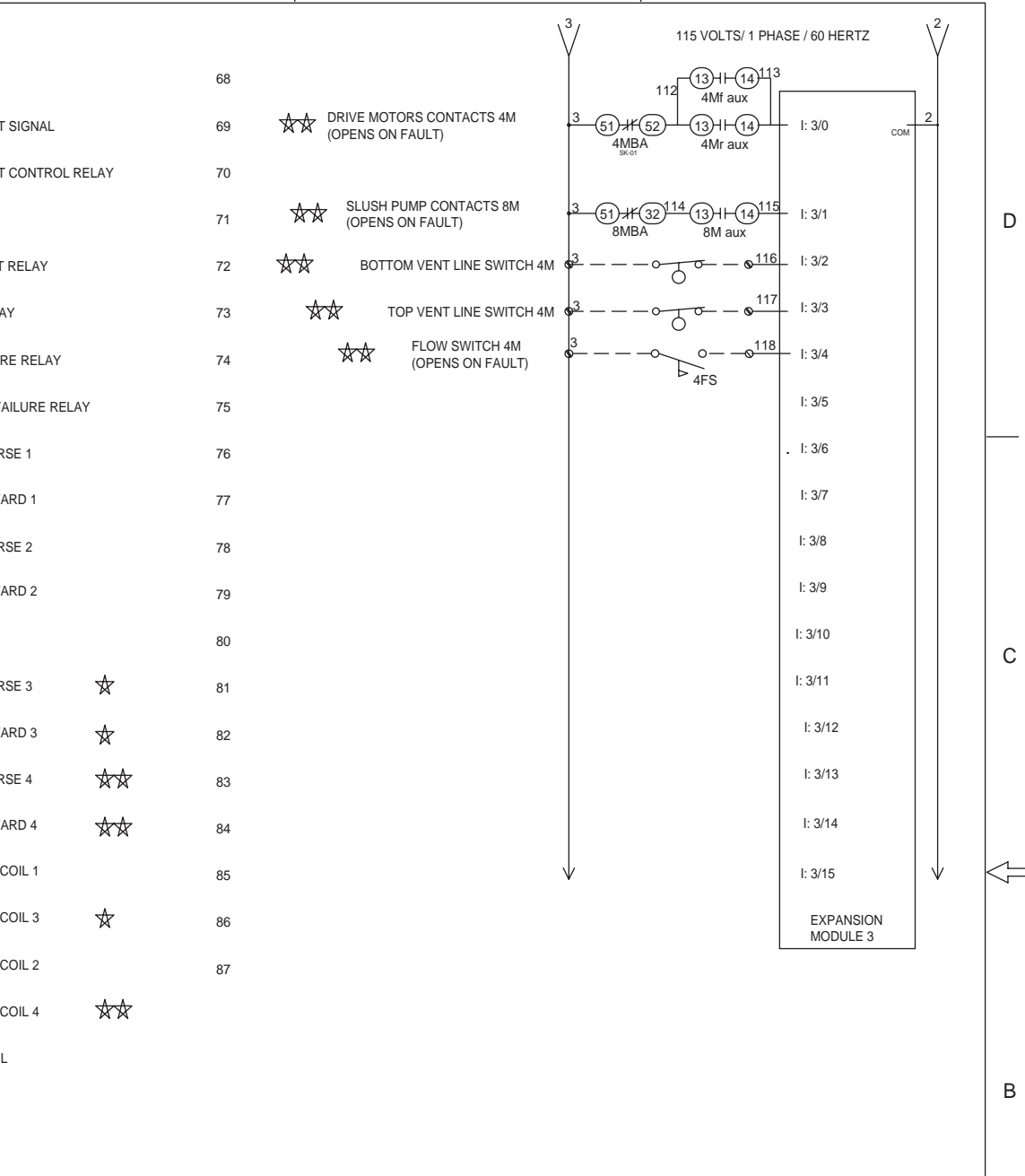
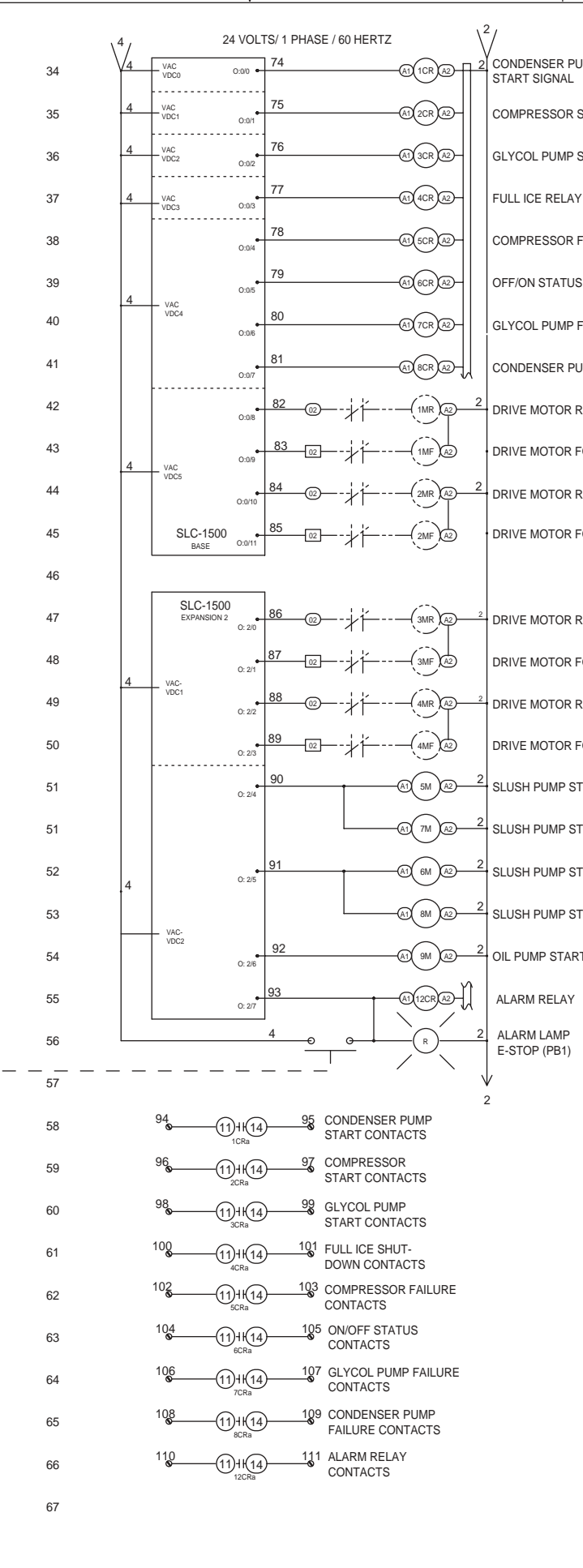
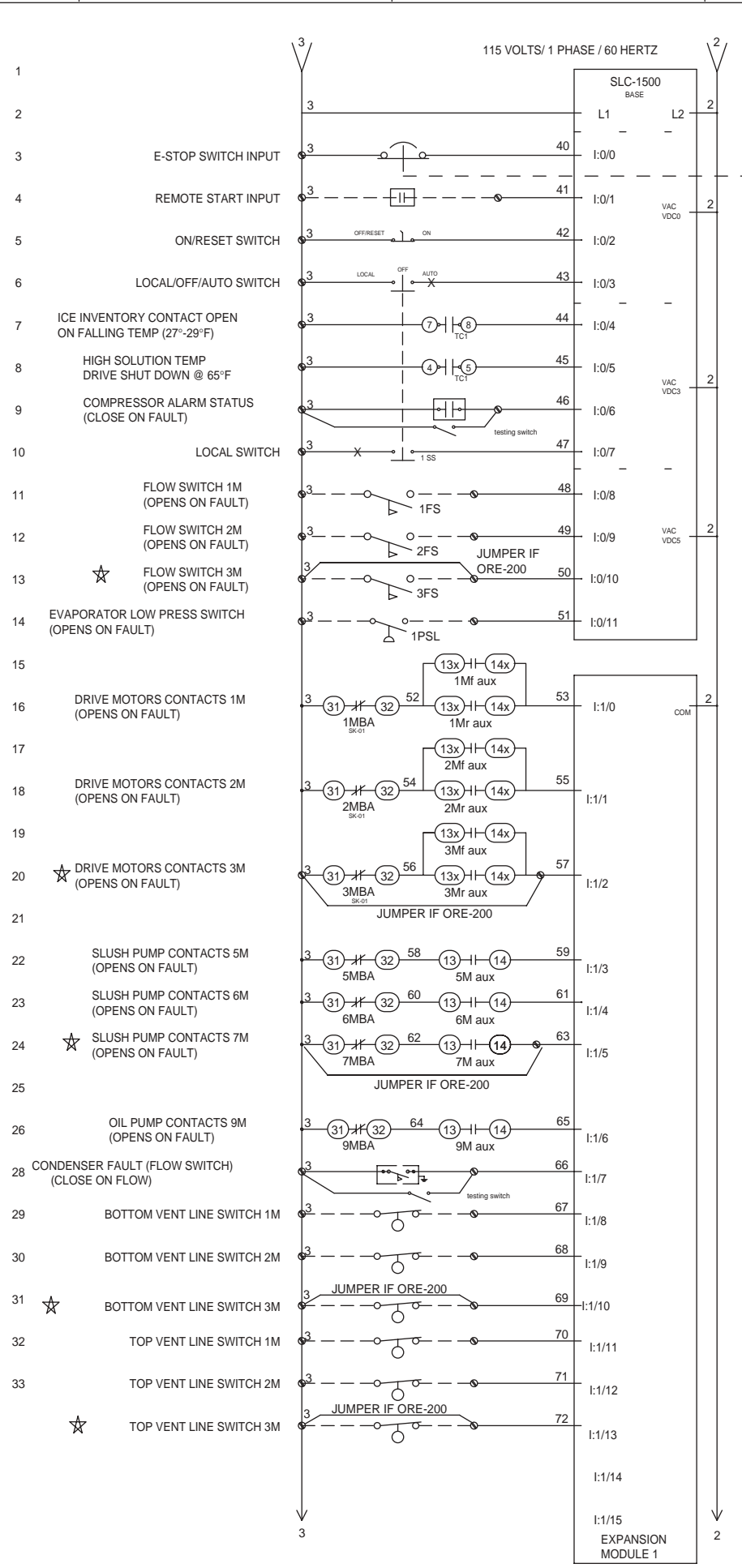
CONTACTS
 DELAY ON ENERGIZED TIMER / DELAY ON DE-ENERGIZED TIMER / RELAY, TIMER, ETC. / THERMAL OVERLOAD

COILS
 THERMAL OVERLOAD ELEMENT / CONTROL CIRCUIT TRANSFORMER

MOTORS
 3 PHASE MOTOR / 1 PHASE MOTOR

MISC
 HEATING ELEMENT / PILOT LIGHT / SHIELDED CABLE / FUSE / THERMOCOUPLE / 2 WIRE RTD / 3 WIRE RTD

SEPIA FROM DWG. NO.



WIRE CHART

2	16 WHT
3,40-72,113-118	16 RED
4, 74-93	16 BLUE
94-111	14 YELLOW

☆ ORE-300XL ADDER

☆ & ☆☆ ORE-400XL ADDER

ALL MATERIALS OR COMPONENT PARTS CALLED OUT ON THIS DRAWING SHALL BE AS SPECIFIED OR APPROVED EQUAL.

DRAWN BY P. GARNIER DATE 12-20-00	SALES ORDER MODEL(S) MaximiCE	 P. O. BOX 828 / SPRINGFIELD, MISSOURI 65801-0828, U.S.A.
REVIEWED BY DATE	SCALE NTS	
TITLE SCHEMATIC 1 PHASE	DRAWING NO. 8200454	D

SECTION 12.0 - WARRANTY

WARRANTY

Mueller® MaximICE® for Thermal Storage

One-Year Parts Warranty

Paul Mueller Company (*hereinafter referred to as Company*) will repair or (or at the *Company's* option) replace any part or portion of a Mueller MaximICE Evaporator Assembly found to be defective in workmanship or material under normal use, service, and installation procedures, for a period of one (1) year from date of installation by the original purchaser/user or eighteen (18) months from the date of shipment from the *Company* factory, whichever occurs first. This Warranty covers replacement of parts or repair of the equipment only. This warranty does not cover consumable products or parts such as refrigerant, driers, glass, or rubber components (See General Provisions.)

Claim Procedure for One-Year Parts Warranty

All defective parts covered by the one-year parts warranty must be returned to Paul Mueller Company with an attached Returned Goods Tag (O-209) and with transportation cost prepaid. Current instructions for return procedures, provided by the Thermal Storage Products Service Department, must be followed to receive warranty.

General Provisions

This warranty does not cover items such as: refrigerant, transportation, mileage, freight, product loss, cost of substitutions, or labor and parts charged by others. Replacement and/or repair of certain components not manufactured by the *Company* will be handled by authorized service stations designated by the manufacturer of the component. Transportation and inspection cost incurred by the *Company* will be charged to the purchaser/user if returned material is not found to be defective. The above will constitute the *Company's* total responsibility. The above warranties will not apply in the event of abuse; negligence; improper installation procedures; alterations by unauthorized service; damage by flood, fire, windstorm, lightning; or acts of God. Oral statements made by employees or representatives of the *Company*, will not constitute warranties. The above warranties apply only to the original purchaser/user and original installation location and are not transferable.

MUELLER®

THERMAL STORAGE PRODUCTS

Paul Mueller Company

P.O. Box 828 • Springfield, Missouri 65801-0828, U.S.A.
Telephone: (417) 831-3000 • Facsimile: (417) 831-6906

SECTION 13.0 - FREEZE DEPRESSANT CHART

Degree Brix Reading	Ethylene Volume %	Freeze Point °F	Propylene Volume %	Freeze Point °F
4	5.6	29.9	4.2	29.6
4.25	6	29.8	4.5	29.3
4.5	6.4	29.7	4.7	29.2
4.75	6.7	29.6	5	29.1
5	7.1	29.4	5.2	29
5.25	7.5	29.2	5.5	28.8
5.5	7.9	29.1	5.9	28.7
5.75	8.3	28.9	6.2	28.5
6	8.7	28.8	6.5	28.4
6.25	9.1	28.6	6.8	28.2
6.5	9.4	28.4	7.2	28.1
6.75	9.8	28.3	7.5	27.9
7	10.1	28.1	7.8	27.8
7.25	10.5	28	8.1	27.6
7.5	11	27.8	8.4	27.5
7.75	11.4	27.6	8.7	27.3
8	11.8	27.5	9	27.2
8.25	12.2	27.3	9.3	26.9
8.5	12.6	27.2	9.7	26.9
8.75	13	27	10	26.7
9	13.4	26.8	10.3	26.6
9.25	13.8	26.7	10.7	26.4
9.5	14.2	26.5	11	26.3
9.75	14.6	26.4	11.4	26.1
10	15	26.2	11.7	26

MUELLER®

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Phone: (417) 831-3000 • 1-800-MUELLER • Fax: (417) 831-6906
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(3/03) Part No. 9842861