

MaximICE™

LIQUID ICE TES SYSTEM

ORE-200, 300 & 400

(Liquid Overfeed Refrigeration System)

Owner's Manual
Part No. 9841385
Effective June 1, 1998



MUELLER®
THERMAL STORAGE PRODUCTS

TABLE OF CONTENTS

Section 1.0 Introduction	4
1.1 Delivery Inspection	4
1.2 Safety Considerations	4
Section 2.0 Thermal Storage System - System Overview	5
2.1 Refrigeration Circuit	5
2.2 Drive System	6
2.3 Compressor	6
2.4 Condenser	6
2.5 Low-Pressure Receiver	7
2.6 Line Sizes	8
2.7 Expansion Device	9
2.8 Ice Build Circuit	9
2.9 Building Cooling Circuit	9
Section 3.0 Installation	10
3.1 Equipment Rigging	10
3.2 Foundation	10
3.3 Anchoring	10
3.4 Serviceability	10
3.5 Shipping Charge	10
3.6 Remote Refrigeration Piping	11
3.7 Refrigerant Piping Pressure Test	11
3.8 System Evacuation	11
3.9 Refrigerant Charge	11
3.10 Glycol Solution Piping	11
3.11 Electrical	11
3.12 Electrical Specifications	12
3.13 Ice Storage Tank - Full Ice Sensor	12
3.14 Ice Storage Tank - Vent Line	12

3.15 Ice Storage Tank - Suction Header/Spraying System	13
3.16 Glycol Solution Specification	13
3.17 Freeze Protection	15
3.18 Insulation	15
3.19 ORE Drive Assembly	16
3.20 Gravity Feed System	17
3.21 Pumped Ice Discharge	17
3.22 Packing Material(s)	17

Section 4.0 Pre Start-Up/Installation Requirements18

4.1 Evaporator Unit - Leveling	18
4.2 Water Loop/Piping	18
4.3 Electrical	19
4.4 Refrigerant Piping	20
4.5 Start-Up Coordination/Inspection	20
4.6 Start-Up Policy	20

Section 5.0 Start-Up/Refrigerant Charging21

Section 6.0 Programmable Controller22

6.1 Input	22
6.2 Outputs	22
6.3 Start-Up	23
6.4 Normal Shut Down	23
6.5 Failure - Total System Shutdown with No Delay	23
6.6 Failure - Partial System Shutdown with Delays	24
6.7 Full Ice Tank Shutdown/Monitoring Mode	24

Section 7.0 Maintenance25

7.1 Daily Checks	25
7.2 Preventative Maintenance	25
7.3 Recommended Drive Component(s) Replacement Schedule	25

Section 8.0 Recommended Spare Parts . . . . .	.27
Section 9.0 Troubleshooting Failures . . . . .	.28
9.1 Low-Pressure Evaporator - Freeze-Up . . . . .	.28
9.2 Unit Fails on Vent Switch . . . . .	.29
9.3 Unit Will Not Start . . . . .	.30
9.4 Compressor Operates with High Discharge Pressure . . . . .	.31
9.5 Compressor Operates with Low Suction Pressure . . . . .	.32
9.6 System Will Not Make Ice . . . . .	.33
9.7 Compressor Fails on Motor Overload . . . . .	.34
9.8 System Will Not Cool Building/Process Load . . . . .	.35
9.9 Excessive Evaporator Shell Vibration . . . . .	.36
9.10 Low Compressor Oil Pressure . . . . .	.37
9.11 Compressor Will Not Start . . . . .	.38
9.12 Compressor High Inlet Oil Pressure . . . . .	.39
9.13 Compressor High Oil Filter Differential Pressure . . . . .	.40
9.14 Compressor High Oil Separator Temperature . . . . .	.41
9.15 Compressor High Inlet Oil Temperature . . . . .	.42
9.16 Compressor Low Oil Separator Temperature . . . . .	.43
9.17 Compressor Operating Unloaded . . . . .	.44
9.18 Compressor Will Not Load . . . . .	.45
9.19 Compressor Oil Pump Will Not Start . . . . .	.46
Section 10.0 Start-Up Requirements . . . . .	.47
Section 11.0 Drawings . . . . .	.51
Warranty	

SECTION 1

1.0 Introduction

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 Commercial Refrigeration Department for guidance at 1-800-683-5537.

1.1 Delivery Inspection

Each MaximICE evaporator is tested (operational or electrical test) 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.

1.2 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

2.0 Thermal Storage System - 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 basically consists of three individual circuits: refrigeration circuit, ice building circuit, and cooling circuit. The actual working system includes an ice storage tank, plate-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.

2.1 Refrigeration Circuit

The evaporator assembly includes multiple nominal 100-ton evaporators. The evaporator employed in the MaximICE system is a bottom liquid refrigerant feed (vertical shell-in-tube). The evaporator is fabricated and stamped per ASME Code, Section VIII, Division 1 for unfired pressure vessels. The shell side of the evaporator shall have a design pressure rating of 235 psig to full vacuum and a design temperature rating of -20°F to 125°F with a pressure relief valve set at 235 psig. The tube side of the evaporator shall have a design pressure rating of 10 psig and a design temperature rating of -20°F to 125°F. Each evaporator is equipped with a hand expansion valve for metering the refrigerant flow to each evaporator.

Liquid and vapor (two phase) refrigerant flow exits the evaporator(s) into the wet suction line and returns to the low pressure receiver. Each evaporator assembly shall be equipped with a filter/drier core assembly with isolation valves and a hot gas line valve for manual thawing of the evaporator(s) in the event of a freeze-up condition. The hot gas line size provided in the chart is for the main feed to the evaporator bank. To minimize refrigerant reclaiming during filter/drier replacement, 1/4" tubing and isolation valves are installed to allow hot gas pressurizing and liquid purging into the main wet suction line. The expansion device consists of a Phillips high-side float with pilot chamber to expand high pressure condensed liquid from the condenser to a low-pressure flash gas prior to entering the low-pressure receiver. Some refrigeration systems are equipped and take advantage of the compressor economizer port for subcooling liquid refrigerant. These systems shall have two high-side float valve assemblies with a flash-type economizer vessel. A seal gasket provides an air-tight seal at the drive shaft penetration point located on the top plate.

Glycol solution pouring into the evaporator tubes and gravity is either chilled or an ice slurry is formed. A whip rod spinning inside of each evaporator tube creates a high agitation rate, increasing solution to tube surface contact. The glycol solution/ice slurry collects within the evaporator bottom outlet and is pumped to the ice storage tank. For evaporator assemblies located on top of the ice storage tank, glycol solution/ice slurry discharges from the evaporator bottom and falls into the ice storage tank. See ORE submittal drawings in section 11.0.

2.2 Drive System

Inside each evaporator tube is a free-hanging, 3/8" 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 rods continuously (approximately 800 rpm) during system operation. The drive is equipped with a soft start system to reduce starting internal torque. A seal gasket provides an air-tight seal at the drive shaft penetration point located on the top plate. Solution pours into the evaporator tubes and gravity drains, gives up heat to the refrigerant, producing a boiling effect, pushing liquid/gas out the top wet suction outlets.

2.3 Compressor

PMC standard design consists of a large screw-type compressor package with either a horizontal- or vertical-type oil separator. Typically, an oil separator one size larger than a standard selection is used. This will ensure proper discharge gas/oil separation during high compressor load conditions (chilling duty).

Multiple Compressors—small screw-type compressors and/or reciprocating compressors can be utilized, however, special design consideration for external oil separation and oil management to each compressor must be followed. System details should be reviewed with compressor supplier prior to the package design phase.

Oil Management, Reciprocating-Type Compressors—normally used is an oil float valve located at the bottom of the oil separator—oil flows from the separator and is stored in an oil reservoir. Mounted on the side of each compressor is an oil regulator float, which allows oil to flow into the compressor crankcase whenever the oil level drops - see attached AC&R oil control system diagram.

Oil Management, Small Screw-Type Compressors—most screw compressors are equipped with an oil separator, however, this is not sufficient for total oil separation; an external oil separator is recommended. Additionally, most small screw compressors utilize special oil management and liquid injection systems that are unique to each manufacturer. System details should be reviewed with compressor supplier prior to the package design phase.

2.4 Condenser

Condenser Selection

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 condenser selection which allows for mid-chilling operation without increasing compressor discharge pressure "slightly over sized condenser."

2.4 Condenser (continued)

Compressor Head Pressure Control

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

Air-Cooled Condenser (Preferred Method)

Variable frequency drive controlling the condenser fan speed based off discharge pressure is recommended. **(Alternate Method)** Fan cycling off discharge pressure. **Note:** Low-ambient temperature in combination with high wind speeds causes fan cycling to be less effective.

Evaporative-Cooled Condenser (Preferred Method)

Variable frequency drive controlling the condenser fan speed based off discharge pressure is recommended. **(Alternate Method)** Two-speed fan control based off condenser sump water temperature - air damper actuator based off 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.

Water-Cooled Condenser (Preferred Method)

Electric-actuated butterfly valve controlling off a 4-20 ma signal based off discharge pressure. Normally, a three-way by-pass-type valve arrangement is used; valve must be mounted on the water outlet side of the condenser.

2.5 Low-Pressure Receiver

Low-Pressure Receiver (LPR)

Normally, for the MaximICE system a LPR with a diameter providing approximately 85 feet per minute is acceptable. Once the diameter is selected, the vessel length is determined and the vessel is capable of storing the entire refrigerant charge and be slightly below 50% level. The ASME design working pressure is 250 psig.

During the initial charging, a minimum liquid operating level of 25% of vessel height is required - this will ensure there is enough liquid head in the vessel to establish an adequate NPSH (net positive suction head) and eliminate any vortexing to assure a prime and liquid seal for the refrigerant pump. A high-level cutout switch is required (cut-out point @ 50% vessel height). A vortex eliminator is required in the low-pressure receiver drain line nozzle to the refrigerant pump. The wet suction vapor and return liquid should enter the receiver at least 25% of the vessel diameter above the maximum liquid height. To prevent liquid splashing, common practice is to run the wet suction and liquid together just prior to entering a header inside the vessel. This allows the wet suction/liquid return to fall against each end head. Ideally, all evaporators should be arranged for gravity flow into the wet suction line and a gravity flow into the low pressure receiver, minimizing pressure drop. Normally, the compressor dry suction return connection is made at the top center of the vessel.

2.5 Low-Pressure Receiver (continued)

Refrigerant Pump

Mounted below the low-pressure receiver (center) is the centrifugal refrigerant pump. A hermetically sealed pump is not recommended. The pump is selected for (3 to 1) liquid overfeed - assume a required 15 psig at the evaporator hand expansion valve. The drop leg size should be sized for 3 feet per second. A pressure differential switch (auto-reset type set for 10 psig) is required, which provides a signal to the PLC indicating low pump differential pump pressure.

Oil Return

R-22 systems only - any oil that passes through the oil separator will fall out in the low pressure receiver. The method used to return the oil to the compressor involves tapping off a small amount of liquid/oil mixture from the refrigeration pump discharge and running into the dry suction compressor return. The oil return line is equipped with the following components: 1/2" line, isolation valve, strainer, solenoid valve, hand expansion valve, and sight glass. Ideally, the line can be tapped into the low-pressure receiver compressor dry suction return line nozzle. Controlled by the PLC the solenoid valve energizes (open) two minutes after the compressor starts and shuts off during the off cycle.

2.6 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 maybe necessary to size pipe and check velocities for other conditions and equivalent lengths, correction factors must be used to ensure proper line sizes.

The following table can be used as a guide for selecting line sizes. Line sizes are based on a self contained refrigeration system with less than 100' of equivalent pipe length, operating at 20°F saturated suction and 100°F saturated condensing temperature. Great care should be taken when selecting the Wet Suction Return line - when in doubt PMC recommends to increase pipe to the next size larger. This will ensure minimum suction line pressure drop.

2.6 Line Sizes (continued)

Compressor Tons	Wet Evap. Main Suction Return (Inches)	Dry Comp. Return Suction (Inches)	Comp. Discharge (Inches)	Hot Gas to Evaporators(s) (Inches)	Cond. Liquid Out (Inches)	Liq. From R-22 Pump (Inches)	Liquid to LPR (Inches)	LPR Drop Leg (Inches)
115	5	4	4	2	4	2.5	2	6
154	5	5	4	2.5	4	3	2	6
193	6	5	5	3	4	3	2.5	8
223	6	5	5	3	5	3	2.5	8
261	8	6	5	4	6	3	3	8
297	8	6	5	4	6	3	3.5	8
345	8	8	6	4	6	4	3.5	8
389	10	8	6	4	6	4	3.5	10
428	10	8	6	4	8	4	4	10
484	10	8	6	4	8	4	4	10
545	10	8	8	4	8	4	4	12
614	12	10	8	4	8	4	4	12
695	12	10	8	4	8	5	4	12
786	12	10	8	4	10	5	5	12
870	12	10	10	5	10	6	5	12
960	14	10	10	5	10	6	5	14
1084	14	12	10	5	10	8	5	14
1314	16	12	12	5	12	8	5	16

2.7 Expansion Device

High Side Float—A Phillips high-side float with pilot chamber is recommended to expand high pressure condensed liquid from the condenser to a low-pressure flash gas prior to entering the low pressure receiver. Assume sewer drain flow for selecting the liquid drain line from the condenser to high-side float valve. Other means of expansion are accepted, however, a review of the control should be conducted by PMC prior to design phase.

2.8 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

Consists of a plate-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-frame heat exchanger and returned over the ice pile via a spraying system. Warm building load water is then pumped into the heat exchanger and cooled, and depending on the building temperatures may vary from 37°F to 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 - minimizing the cost and danger associated with piping leaks. All system fluid piping should be properly insulated.

SECTION 3

3.0 Installation

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/details are addressed. PMC shall not be held responsible for performance on systems constructed, piped, or designed differently than outlined in this manual.

3.1 Equipment Rigging

The MaximICE unit and ice storage tank must be lifted in accordance with industry practice. The evaporator skid is equipped with lifting sleeves at each end which must be used during the rigging process. Lifting lugs and sleeves are not intended to be used for extended periods of time. **Caution:** It is recommended to use a spreader bar during rigging to prevent possible damage to upper frame member(s).

3.2 Foundation

According to applicable codes, the equipment must be mounted level on a support pad. The unit must be level within .125" over the entire length and width of the evaporator compartment (shim and grout as necessary).

3.3 Anchoring

According to local practices, the unit should be welded or bolted down (Polyethylene tank(s) will require tie-down straps). All applicable seismic zone regulations and proper construction practices should be considered in areas designated by the state.

3.4 Serviceability

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

3.5 Shipping Charge

All units are shipped with a dry nitrogen charge (approximately 5 psig) 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.

3.6 Remote Refrigeration Piping

Reference Section 2.6 for the appropriate line size. When welding, an inert gas should be passed through the line at low pressure to prevent scaling and oxidation inside the tubing - dry nitrogen is preferred. Use suitable silver solder alloy on all refrigerant tubing. Refrigerant lines should be supported/fastened properly. The evaporator skid is equipped with the following connections: wet suction shall be shipped with a 150-pound slip-on-type matting/blind flanges. The wet suction shall also include a high-performance-type butterfly valve and shall be shipped loose for field installation. Both the refrigerant liquid feed and manual hot gas defrost lines are equipped with an isolation valve and plugged with plastic shipping caps.

3.7 Refrigerant Piping Pressure Test

After all lines are connected, the entire system must be leak tested - including the ORE and condensing unit. The complete system should be pressurized to not more than 150 psig 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.

3.8 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.

3.9 Refrigerant Charge

See Section 5.0 for further details.

3.10 Glycol Solution Piping

The evaporator shall be equipped with a PVC 150-pound slip-on type flange. An in-line strainer shall be shipped loose for field installation. Locate strainer as close to the evaporator as possible. The matting flanges and field piping shall be supplied by others.

3.11 Electrical

The MaximICE wire 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 refrigerating equipment including motor - compressor and controllers from the circuits feeder.” The breakers and/or disconnect switches should be selected and located within the NEC guidelines.

3.12 Electrical Specifications

50 Hertz: Drive Motor 3 Horsepower

200 volts

13.8 amps ($\pm .2$)

708 rpm

50 Hertz: Drive Motor 3 Horsepower

380 volts

6.9 amps ($\pm .2$)

78 rpm

60 Hertz: Drive Motor 3 Horsepower

230 volts

12.6 amps ($\pm .2$)

850 rpm

60 Hertz: Drive Motor 3 Horsepower

460 volts

6.3 amps ($\pm .2$)

850 rpm

3.13 Ice Storage Tank - Full Ice Sensor

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 26°F the PLC receives an input from the 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 or kinks. Do not down size the piping between the ORE and tank.

3.15 Ice Storage Tank - Suction Header/Spraying System

To ensure that the stored liquid ice is burned efficiently so that a low temperature supply solution can be maintained to the cooling loads, a suction header/spray system is recommended. The suction header normally consists of a flat plate with holes punched in varies. The plate is positioned at an angle and located at the bottom of the tank. Anchored bolt should be used to secure the plate to the tank floor and walls. The spray system consists of a high-velocity spray nozzle mounted to a PVC header, hanging from the top inside surface of the tank. The nozzles are 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 at least 80% coverage over the entire tank area. Please consult PMC for design detail or refer to the MaximICE application manual section under tank design guidelines.

3.16 Glycol Solution Specification

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

1. Glycol Manufacturer Supplied Information

The following information should be provided to the owner:

- Manufacturer's name, address, and telephone no.'s
- Material Safety Data Sheet
- Instruction as to system cleaning and flushing, and testing of system water prior to charging
- Off-season lay-up of equipment.

2. Solution Additives

It is imperative that these guidelines be followed. Since the concentration in the tank will be between 6.5% and 7% (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 is commonly used as a corrosion inhibitor at a concentration no less than 4,000 ppm. To inhibit bacterial growth, 100 ppm iodine for initial disinfecting and 200 ppm quaternary amine for residual disinfecting are commonly used. Anti-foaming agents may also be added as needed. 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.

3.16 Glycol Solution Specification (continued)

3. 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. The PMC recommends calling your county or city water department to find out the specifications 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 an HACH test kit. One word of caution about the common practice of using softeners as a temporary fix 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 wastewater. 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 50 ppm of magnesium
- Less than 100 ppm (or 6 grains) of total hardness
- Less than 25 ppm of chloride
- Less than 25 ppm of sulfate

After combining the proper amounts of water and inhibited propylene 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 supplier of the glycol should be consulted to determine the 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 glycol concentration will change as the production of liquid ice begins. An accurate measurement of the concentration of propylene 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 for first year and annually after that.

3.16 Glycol Solution Specification (continued)

4. Glycol Solution Concentration Adjustments

It is sometimes necessary to increase or decrease the concentration of the glycol solution in your system and to replace fluid lost through leakage or moisture absorbed from the atmosphere. Either adjustment can be carried out in batch or continuous operation.

5. 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 propylene 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:

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

Where,

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

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

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 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) the solution may freeze and cause piping damage.

3.18 Insulation

All glycol solution piping should be insulated - 2" polyfoam/armflex to prevent external heat gain. The ice storage tank(s) supplied by PMC (polyethylene type) must be placed on top of at least 3" of styrofoam with a loading strength of 25 psi. Heat gains and proper insulation 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. **Caution** - Do not operated drive system without circulating glycol solution.

Note: Refer to PMC drawings 82000135 & 137 in Section 11.0 - with the following drive installation steps:

1. Using a flash light inspect each tube for ice freeze-up or any foreign debris.
2. Apply a small coating of petrol-jelly on each countercrank prior to installing (lower center and top edges).
3. Starting at the alignment mark, working in a clockwise direction place each countercrank in a left-hand/right-hand arrangement. Determine countercrank type by positioning the drive pin at six o'clock, whichever direction the slot points determines the type. **NOTE:** Several countercranks that are misarranged, see Drawing 82000137 for specific alignment.
4. Install each whip rod and thrust washer (if not installed).
5. Position all drive pins towards the evaporator top tube-sheet alignment mark.
6. Install lower rubber gasket.
7. Install drive plate - match 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 before rotating the motor fan blades with small screwdriver.
12. Tighten top plate mounting bolt - use a star pattern while tightening bolts.
13. Adjust motor where approximately 1/32" clearance is between the eccentric crank and drive plate bearing.

3.20 Gravity Feed System

For systems where the evaporator is installed on top of the ice storage tank, a gravity feed ice discharge system is incorporated. The is equipped with a telescopic-type housing mounted to the evaporator (bottom), which extends into the ice opening. Once the unit is set in place and the housing is lowered into the opening, a water tight seal must be applied. The gap (approximately 1/2") can be filled with insulation rope and sealed with a layer of silicone. The bottom outlets must be installed prior to the arrival of the PMC start-up personnel.

3.21 Pumped Ice Discharge

For system where the evaporator is mounted remote from the ice storage tank, a pumping system is used to remove ice away from the evaporator. Mounted to the bottom of the evaporator is an ice collection assembly (bottom outlet). **Note:** the bottom outlet must be disassembled to remove the cellophane wrap, which is used to secure the whip rods during shipping.

3.22 Packing Material(s)

To reduce the possibility of shipping damage, the drive assembly is packed with special materials. Disassemble the top housing plate/drive motor and drive plate and remove the spacer plugs. Additionally, the whip rods are secured in place with cellophane wrap which must be removed prior to start-up. On units with ice discharge pump option, the low ice manifold ships loose and should be installed after removing the cellophane wrap.

SECTION 4

4.0 Prestart-Up/Installation Requirements

4.1 Evaporator Unit - Leveling

- a. The unit must be level within .125" over the entire length and width of the evaporator compartment (shim and grout as necessary).
- b. The unit must be uniformly supported along the base beams.
- c. The unit must not have restricted access. At least 4' of clearance is required on all sides of the unit. Service access must be provided for removal of whip rods - approximately 4' above evaporator compartment. Do not suspend or support any piping or conduit from this unit.
- d. Vibration and sound control may be required for this unit. This unit contains rotating equipment. Where vibration may be transmitted to a structure, all external piping to the unit should be vibration isolated.

4.2 Water Loop/Piping

- a. All piping must be complete and correctly installed.
- b. 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' per second for six hours. The water piping shall then be flushed with clean water to remove any residue.
- c. All exposed exterior water piping shall be heat traced and insulated. The Paul Mueller Company warranty specifically excludes any liability for freeze damage resulting from low-ambient temperatures.
- d. 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 7% 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.
- e. 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.

4.2 Water Loop/Piping (continued)

- f. Evaporative condensers shall be flushed and properly treated. A proper water-treatment system usually consists of a continuous blowdown 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 - operation.**
- g. Water-cooled units shall be provided with a condenser water-regulating valve, which is shipped loose for field installation at the outlet side of the condenser.
- h. 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.
- i. (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, 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

- a. 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.
- b. The following control interlocks must be installed prior to operating the unit:
 - 1. Condenser 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

- a. The installing contractor shall provide and install all interconnection piping and service valves. All piping shall be purged with an inert gas during welding or brazing.
- b. A pressure leak test of the complete refrigeration system is required once field piping is complete.
- c. The entire system must be evacuated to at least 500 microns with a five-minute hold period.
- d. 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

- a. 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; 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.
- b. 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 have a factory-authorized start-up allowance of two, three, or four days 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 PMC, Thermal Energy Storage Service Department, if you have any questions pertaining to the installation requirements of this equipment.

SECTION 5

5.0 Start-Up/Refrigerant Charging

Apply main power at least 12 hours prior to starting unit. This will allow the oil separator heater ample time to warm the oil within the separator.

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.

Approximate refrigerant charge(s) — Evaporator Only

ORE-200 = (1,400 lbs. R-22) (700 lbs. R-717)

ORE-300 = (2,100 lbs. R-22) (1,050 lbs. R-717)

ORE-400 = (2,800 lbs. R-22) (1,400 lbs. R-717)

On PMC-supplied refrigeration packages, a valve is mounted at the bottom of the low-pressure receiver (LPR) which can be used for charging. After completion of field piping and with the system in a vacuum, fill the LPR to approximately 40% or until pressure equalization. At this point, the refrigeration system must be started to reduce system pressure. As compressor operation begins the pressure will drop, which will continue the charging process. 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. Once the MaximICE units have reached ice-making mode, add refrigerant until the level in the LPR is approximately 30% of the LPR height. During initial start-up, the evaporator filter-drier cores will require replacement.

SECTION 6

6.0 Programmable Controller

The operation of the MaximICE system is controlled by a Programmable Logic Controller (PLC), a very reliable, continuous-duty, automatic control device. 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.

The on/off switch located on the control panel door controls 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 control (input/output) signals, as well as the system sequence of operation.

6.1 Input

Remote Start
Auto/Reset/Manual - Toggle Switch
Remote Start - Toggle Switch
Compressor (Fault)
Compressor Motor (Fault)
Evaporator Glycol Solution Inlet Flow Switch (Fault)
Evaporator Low Pressure Switch (Fault)
Drive Motor(s) (Fault)
High R-22 Level - Low Pressure Receiver/Economizer Vessel (Fault)
R-22 Pump Differential Switch (Fault)
Bottom Feed Vent Switch - Slush Pump Unit (Fault)
Top Feed Vent Switch - Slush Pump Unit (Fault)
Condenser Pump Flow Switch - Water Cooled Unit or VFD Fault
- Evaporatively Cooled (Fault)
High Solution Temperature - Drive Shut Down
Note: stops drive motor(s) operation with inlet evaporator temperatures above approximately 55°F. Unit shall operate as a chiller unit solution temperature drops below 53°F.

6.2 Outputs

ORE Drive Motor(s)
R-22 Pump Start
Condenser Pump/Fan/VFD Start
Compressor Start
Glycol Pump Start
Ice Slurry Pump Start - Pump Discharge Option
Oil Return Solenoid Valve
On/Off Status
Full Ice
Safety Failure
Message Display

6.3 Start-Up

Start-up input received (local or remote):

1. Output energizes to start glycol solution/ice slurry pump - verification of input signal to PLC. **Note:** Pumps shall operate for three minutes prior to starting drive motors to ensure that evaporators are clear of ice.
2. Output(s) energize to start drive motors - verification of input signal to PLC.
3. Outputs energize to start R-22 and condenser - verification of input signal to PLC.
4. 15-second delay - output to start compressor package.
5. The compressor micro panel shall start oil pump once oil differential pressure is verified compressor motor starter panel is energized.
6. Anytime during operation, if the glycol solution temperature is above 55°F, the drive motors will stop and system will operate as a chiller. Once the solution temperature drops to 53°F, drive motors shall restart.
7. Start-up sequence is complete - the system remains in operation until a normal shutdown or safety failure occurs. (See additional sections below.)

6.4 Normal Shut Down

If local/auto start input is lost:

1. All outputs de-energize.
2. Wash down cycle - glycol solution pump and drive motor(s) remain operational for 3 minutes to clear ice from evaporator(s).

6.5 Failure - Total System Shutdown with No Delay

Faulted Inputs - glycol solution flow switch, evaporator low pressure, drive motor(s), slush pump(s), and top vent switch:

Total system shutdown - all outputs de-energize - no delays - no wash down

Faulted Input - bottom vent switch:

Total system shutdown - all outputs de-energize - no delays.

The system will automatically restart to try to clear the vent alarm three times in one hour. After the third attempt, the system shall fail.

6.6 Failure - Partial System Shutdown with Delays

Faulted Inputs - Compressor, compressor motor starter, high R-22 level low receiver, pressure/economizer vessel, condenser pump/VFD, R-22 pump, and top vent switch:

1. All outputs de-energize except for the solution pump and drive motors.
2. Glycol solution pump and drive motor(s) operational for 3 minutes to clear ice from evaporator(s).

6.7 Full Ice Tank Shutdown/Monitoring Mode

During operation, if full ice inventory input is received:

1. All outputs de-energize except for the glycol solution pump.
2. Glycol solution pump and drive motor(s) operational for 3 minutes to clear ice from the evaporator(s).

Full Ice Monitoring Mode

Every one hour the glycol solution pump and drive motor(s) is automatically started by the MaximICE control panel - for approximately 10 minutes of pump operation, a check is made of the full ice inventory input. See the following full ice and no full ice descriptions.

Full Ice:

After approximately 10 minutes, if the the full ice inventory input is energized, indicating full ice condition remains, glycol pump will shut off and the one-hour counter begins timing.

No Full Ice

During the 10 minute check, if the input is de-energized, the system will cycle on normally.

SECTION 7

7.0 Maintenance

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

7.1 Daily Checks

- a. Inspect the ORE unit for solution and excessive vibrations.
- b. Inspect around ice storage tank for solution leaks (piping, fittings, and tank surface).
- c. Check for oil spots around refrigeration package.
- d. Listen to compressor for any noises different than normal - sound level(s) should be constant.
- e. Check oil level in compressor oil separator (minimum 1/2 level in bottom sight glass).
- f. Check refrigerant level in low-pressure receiver.

7.2 Preventative Maintenance

It is recommended to inspect the entire drive system after the first month of operation - excessive wear would be addressed immediately. The drive assembly part(s) - **whip rods, thrust washer inserts, countercranks, drive plate, and bearing** - are all parts that will encounter a certain amount of wear. The time interval between replacement shall be established by the site operators with regular physical inspections. Any piece with excessive wear and/or damage must be replaced immediately.

7.3 Recommended Drive Component(s) Replacement Schedule

ORE Unit - 1,000 hours: disassemble drive assembly - inspect wear surfaces - apply a thin coating of Petroleum-Gel to all surface wearing drive parts.

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.

ORE Unit - 8,000 hours: probable replacement - countercranks, thrust washers, drive plate, flange bearing - clean ORE inlet strainer and oil return.

7.3 Recommended Drive Component(s) Replacement Schedule (continued)

Compressor Package - 2,000 hours

Check compressor/motor alignment, axial float, and vibration.

Grease motor bearings per manufacturer's recommendations.

Check operating controls/safeties, replace oil filters @ 15 psi pressure drop.

Clean strainers-compressor suction, oil pump suction, AMOT, "SOC"-liquid injection.

Perform analysis.

Replace oil separator coalescer filters @ 5 psi pressure drop.

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

Oil Filter

Main Voltage

AMPS

Compressor Motor

Evaporator Drive Motor

Evaporator Solution Pump Motor

Evaporator Slurry Pump Motor

SECTION 8

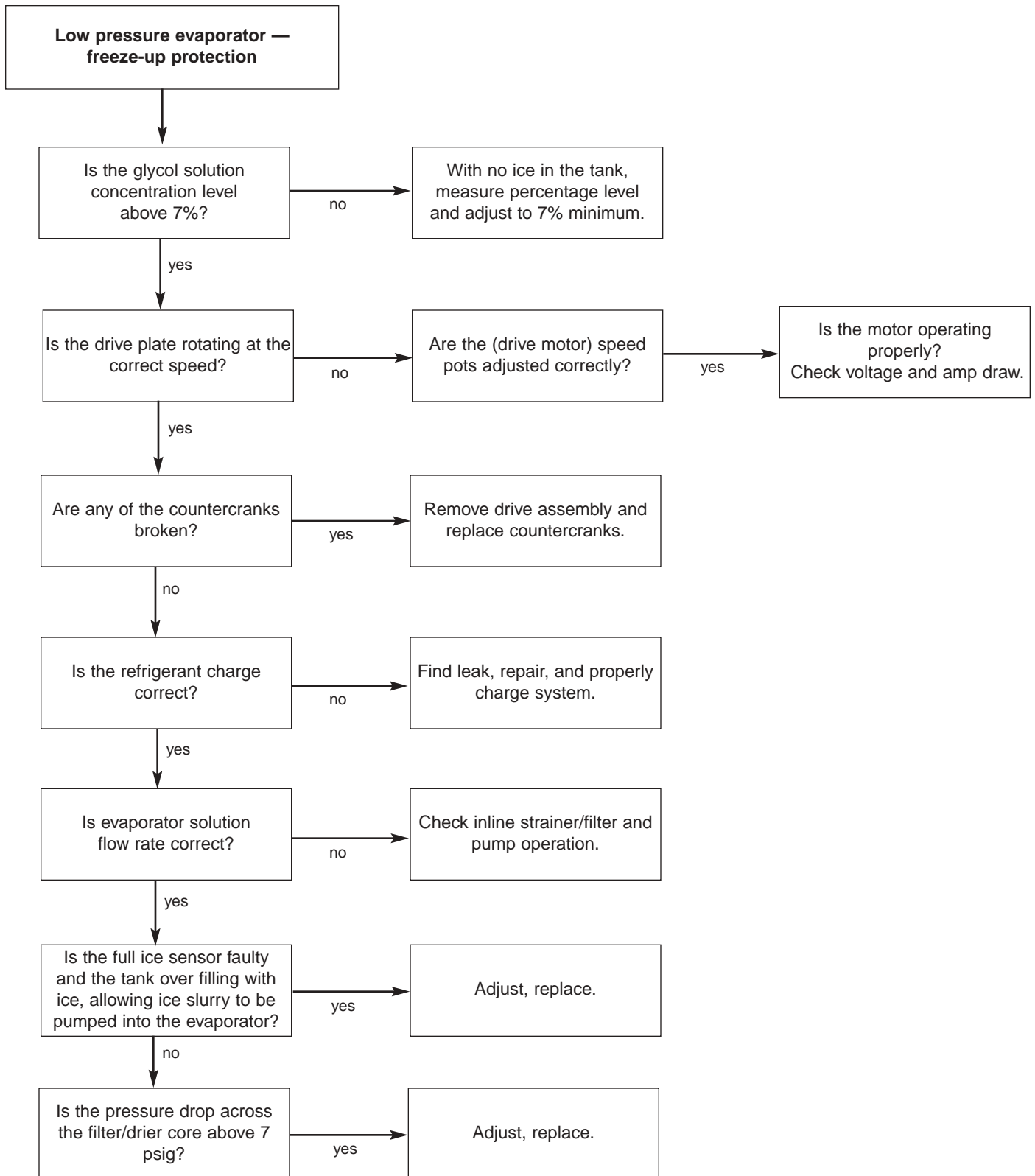
8.0 Recommended Spare Parts

The following list consists of specialty-type or hard-to-find parts, while most all other parts can be purchased locally. See PMC Drawing #8200137 in Section 12.0.

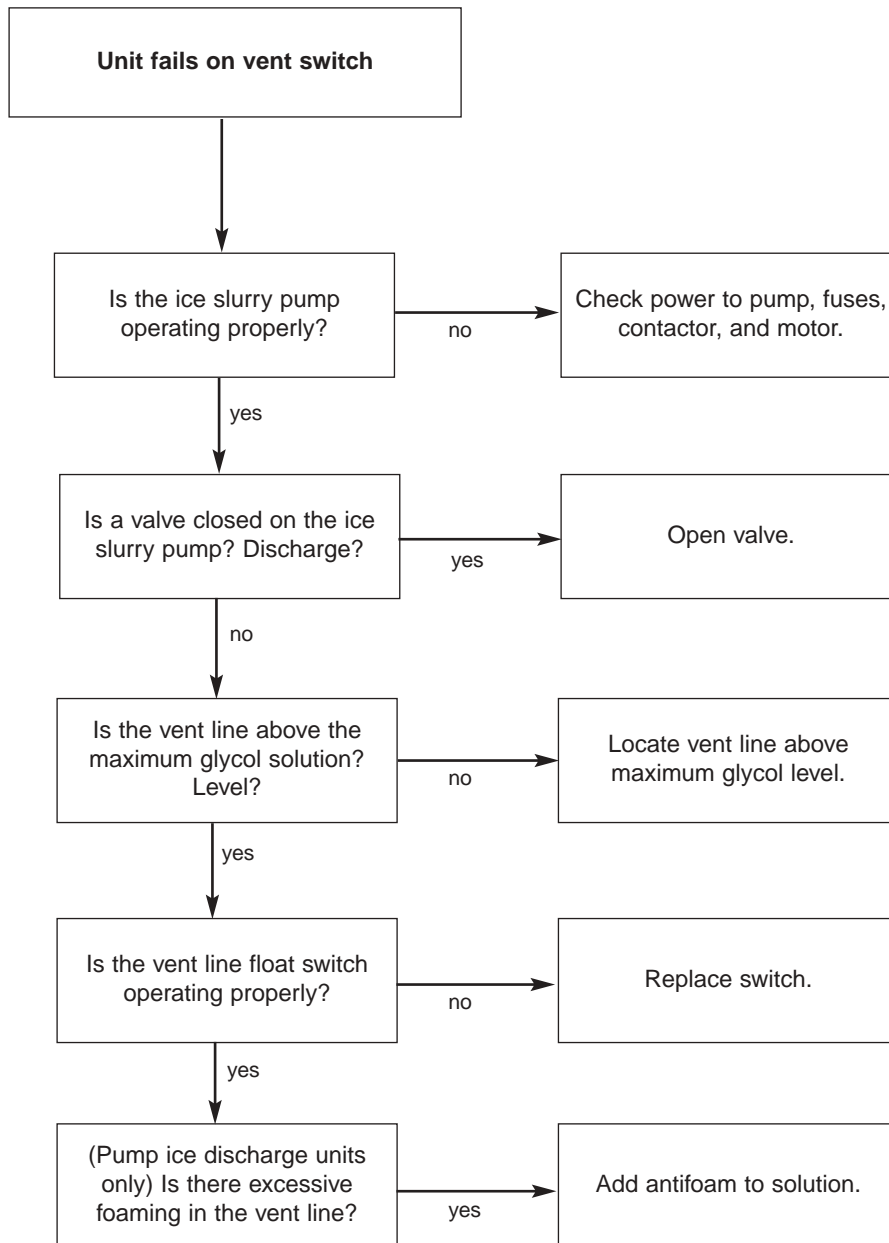
Description	Recommended Qty.	PMC Part #
ORE-Common Parts:		
Whip Rod	ORE-200 (80) ORE-300 (120) ORE-400 (160)	8850044
Counter Crank - Right Hand	ORE-200 (80) ORE-300 (120) ORE-400 (160)	9840481
Counter Crank - Left Hand	ORE-200 (80) ORE-300 (120) ORE-400 (160)	9840482
Thrust Washer	ORE-200 (80) ORE-300 (120) ORE-400 (160)	9840477
Full Ice Sensor (Temperature Controller)	1	9840492
Full Ice Sensor (RTD)	1	9840550
Drive Plate	ORE-200 (2) ORE-300 (3) ORE-400 (4)	9840727
Drive Motor Shaft Seal	ORE-200 (2) ORE-300 (3) ORE-400 (4)	9840666
Housing Bearing	ORE-200 (2) ORE-300 (3) ORE-400 (4)	9841251
Bearing Sleeve	ORE-200 (2) ORE-300 (3) ORE-400 (4)	9840320

SECTION 9

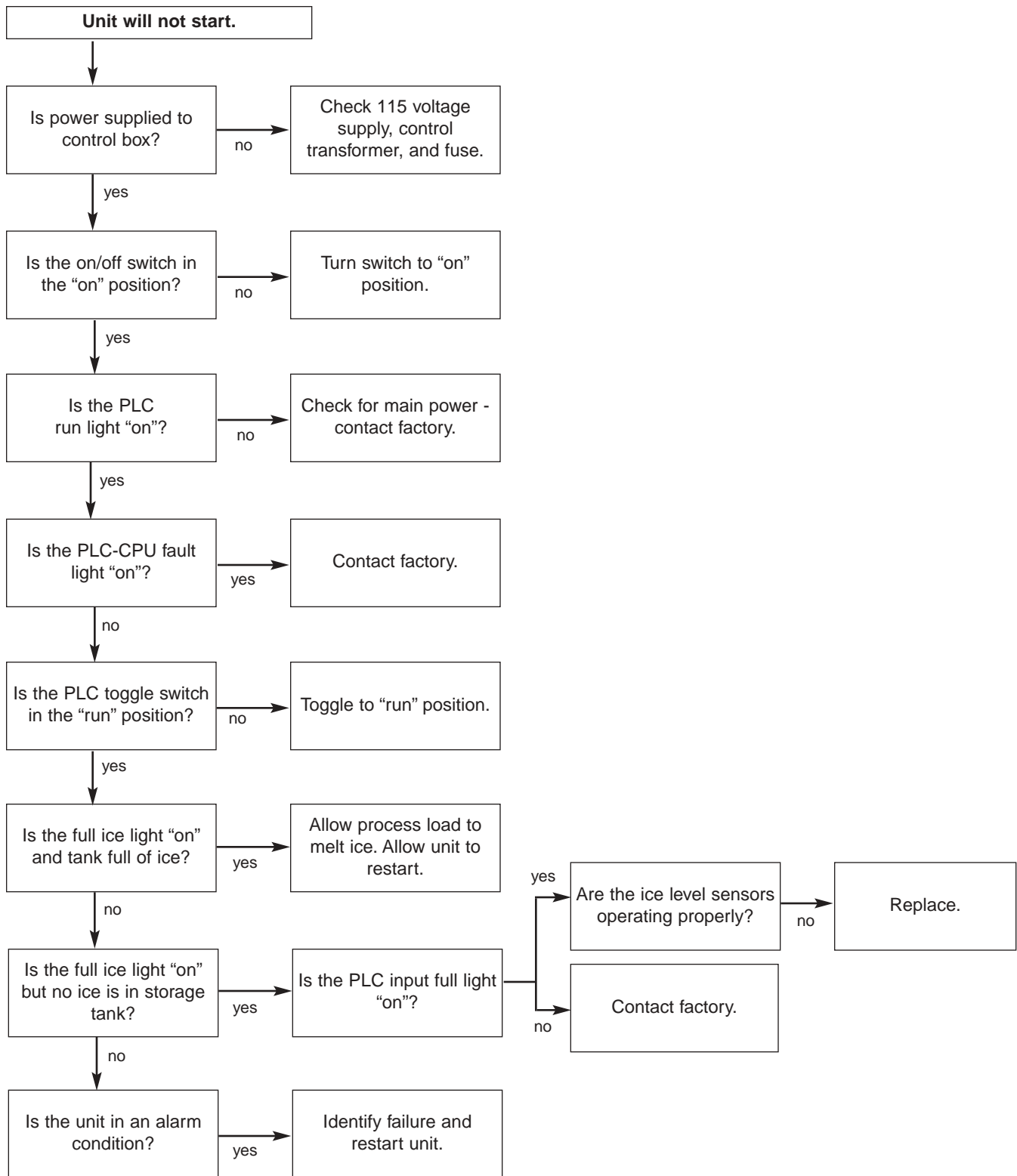
9.1 Troubleshooting Chart 1: Low Pressure Evaporator - Freeze-Up



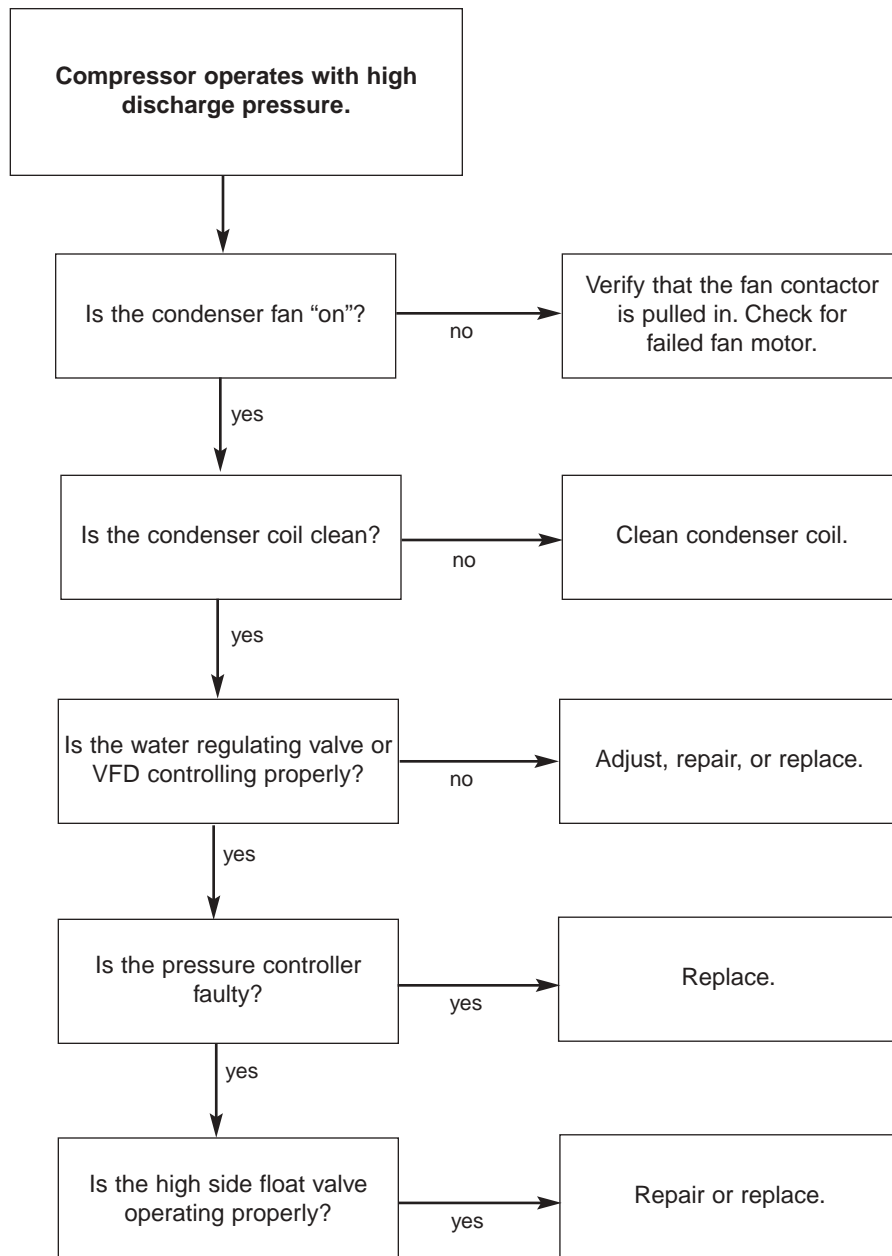
9.2 Troubleshooting Chart 2: Unit Fails on Vent Switch



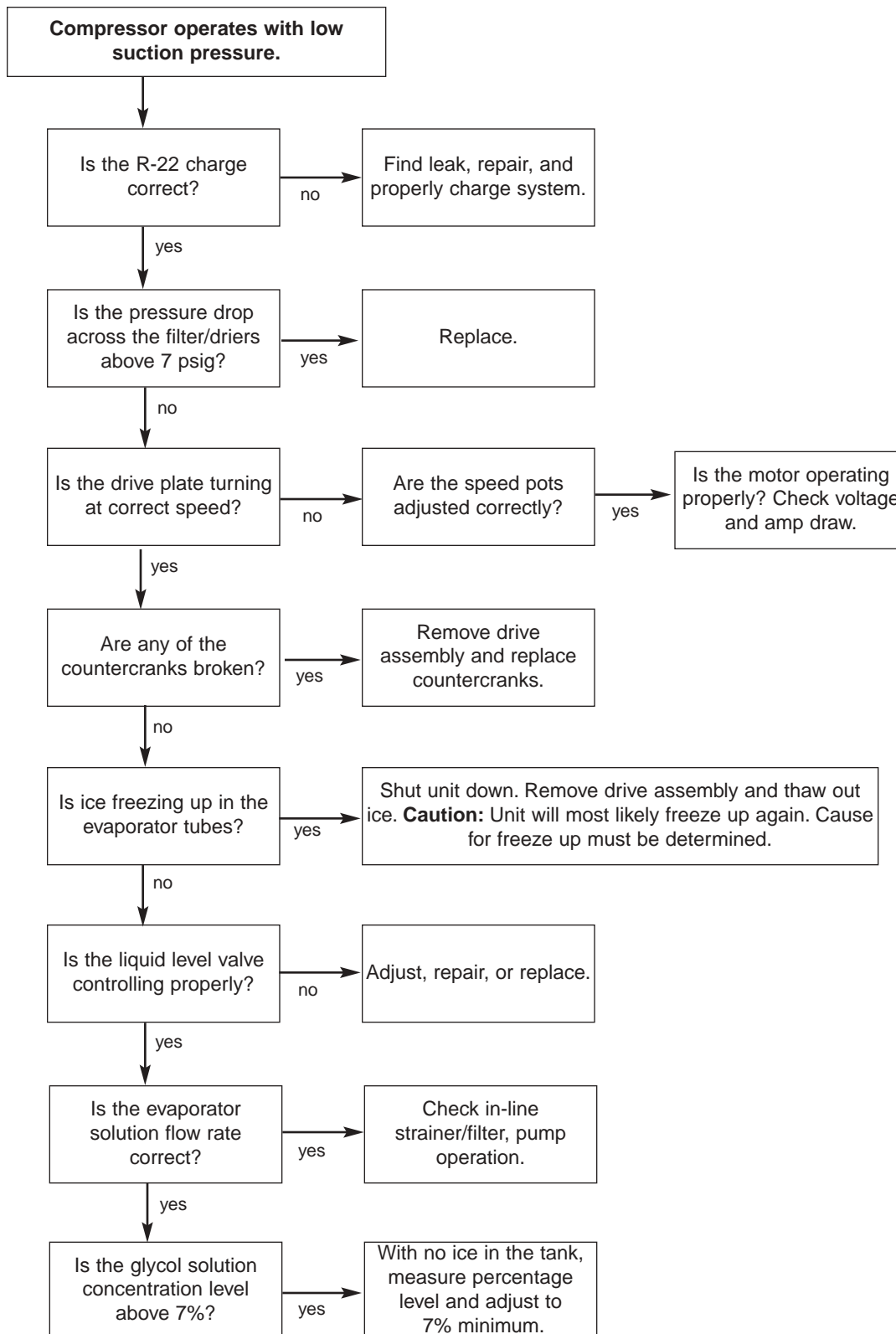
9.3 Troubleshooting Chart 3: Unit Will Not Start



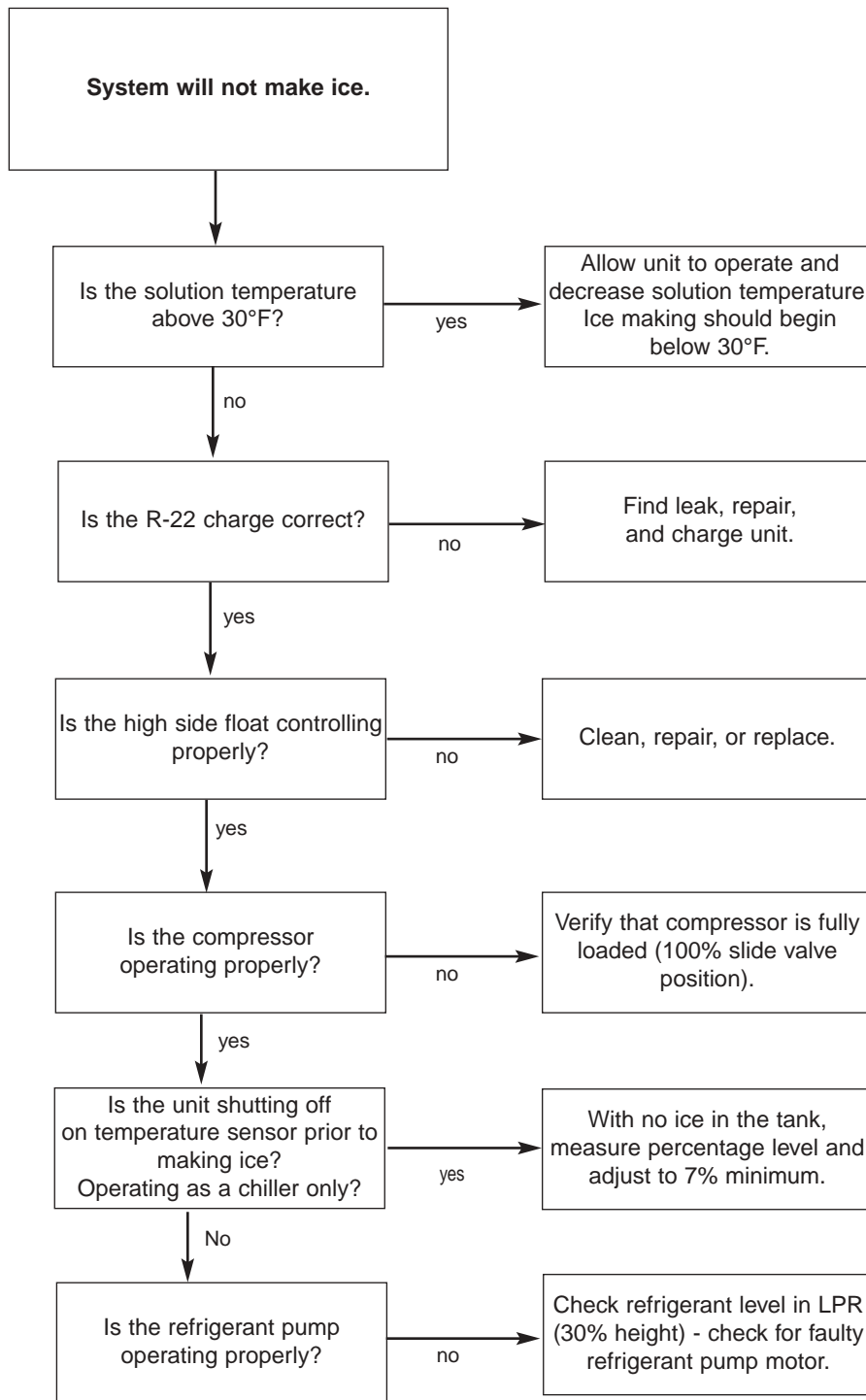
9.4 Troubleshooting Chart 4: Compressor Operates with High Discharge Pressure



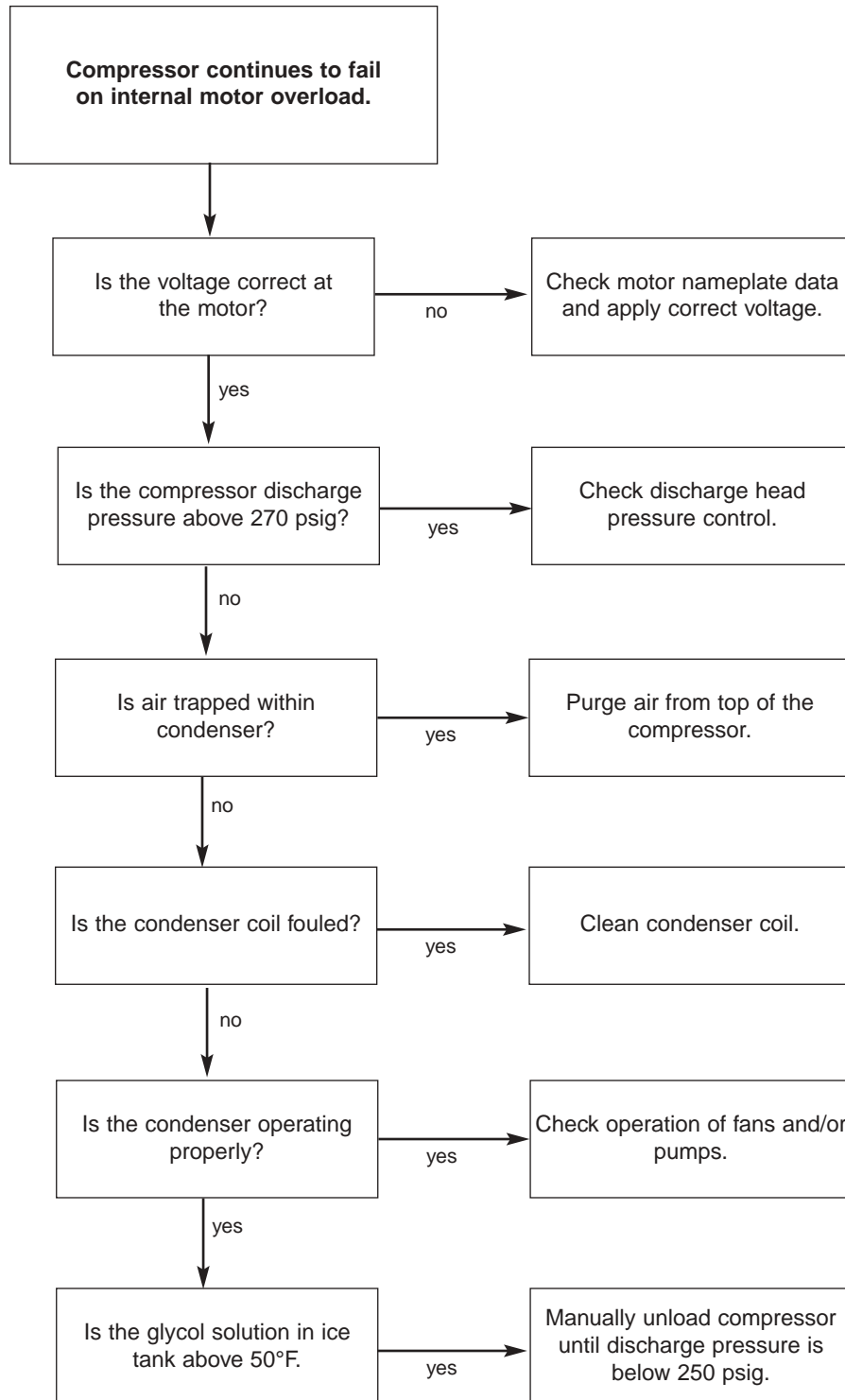
9.5 Troubleshooting Chart 5: Compressor Operates with Low Suction Pressure



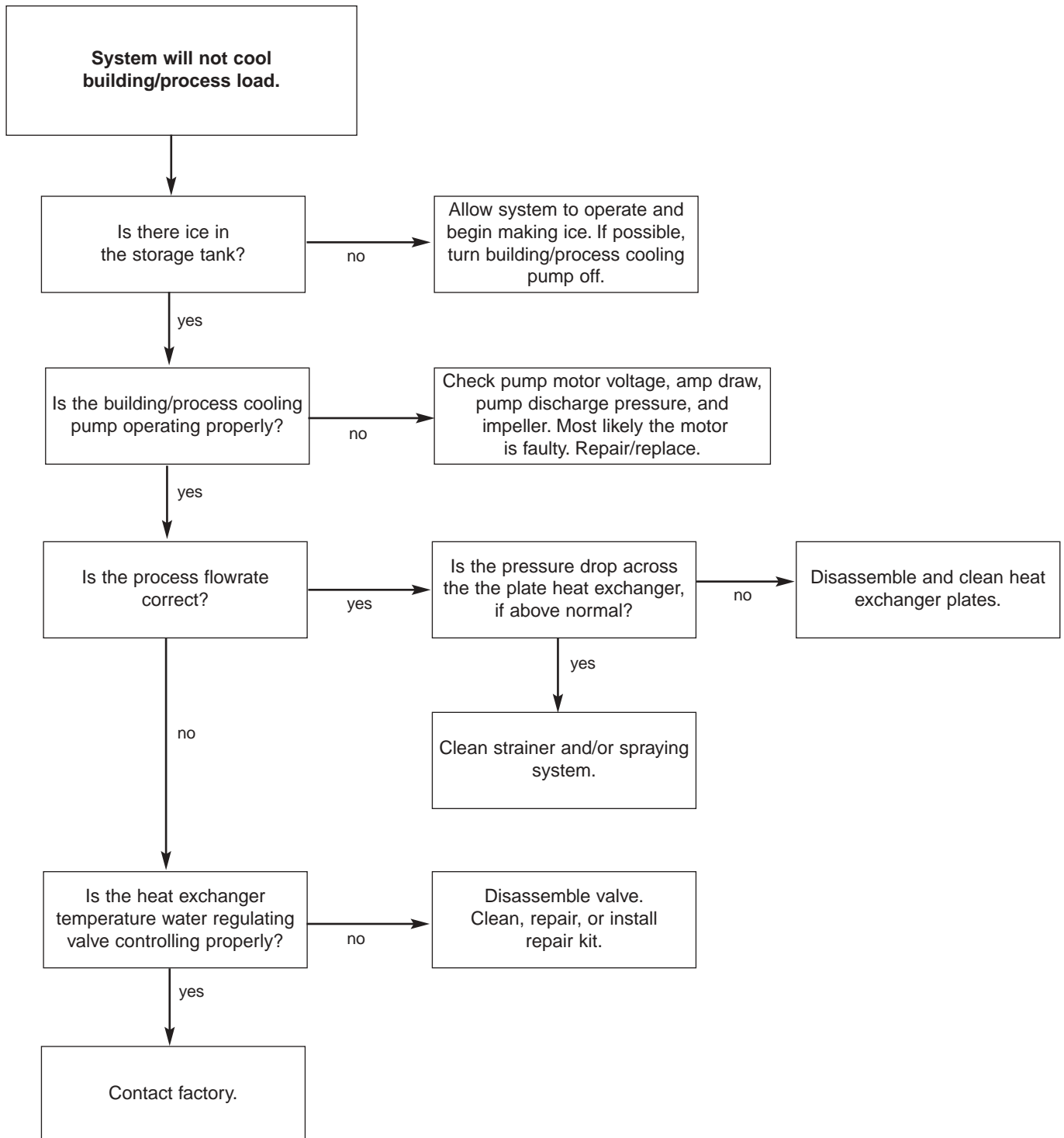
9.6 Troubleshooting Chart 6: System Will Not Make Ice



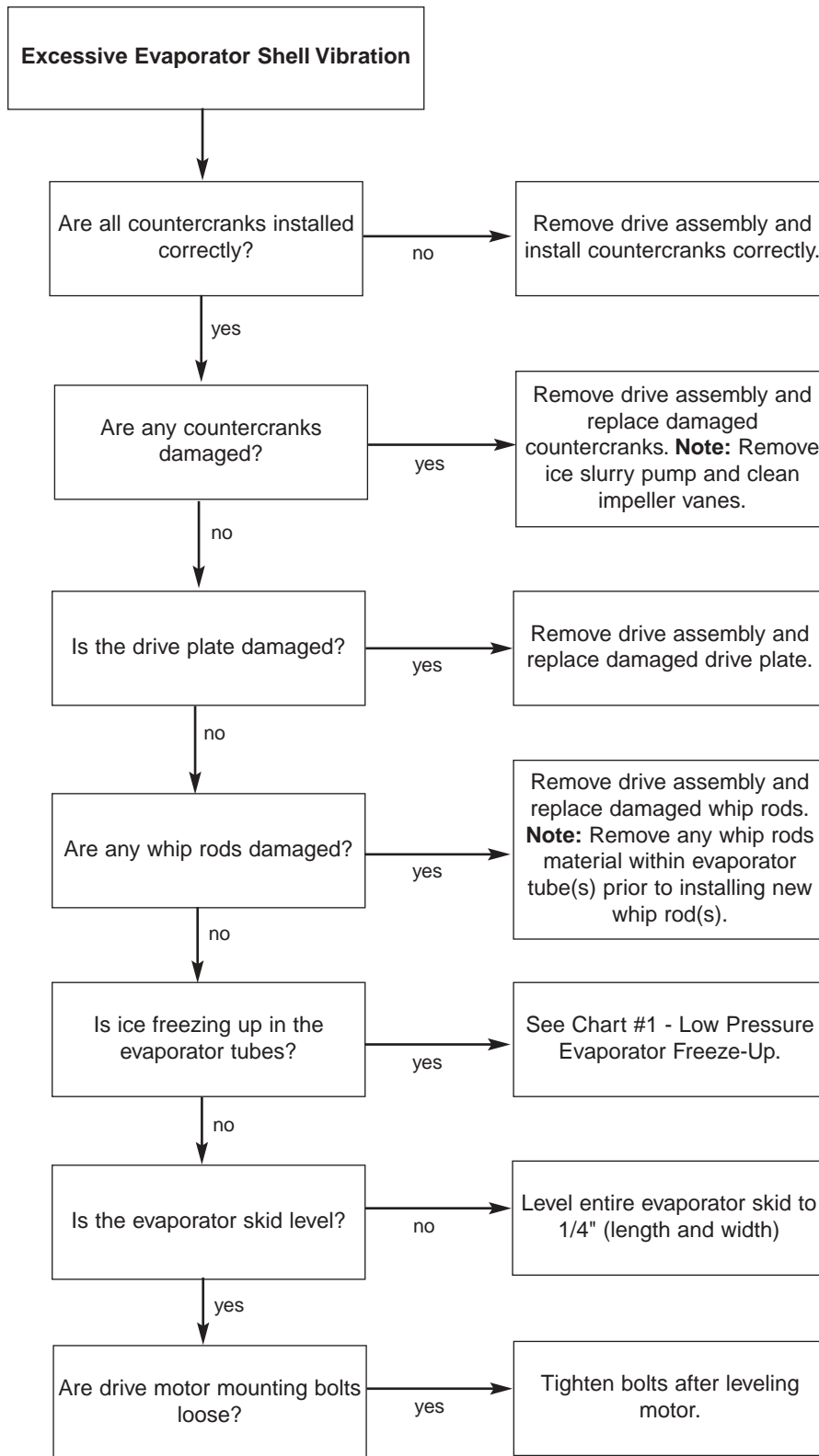
9.7 Troubleshooting Chart 7: Compressor Fails on Motor Overload



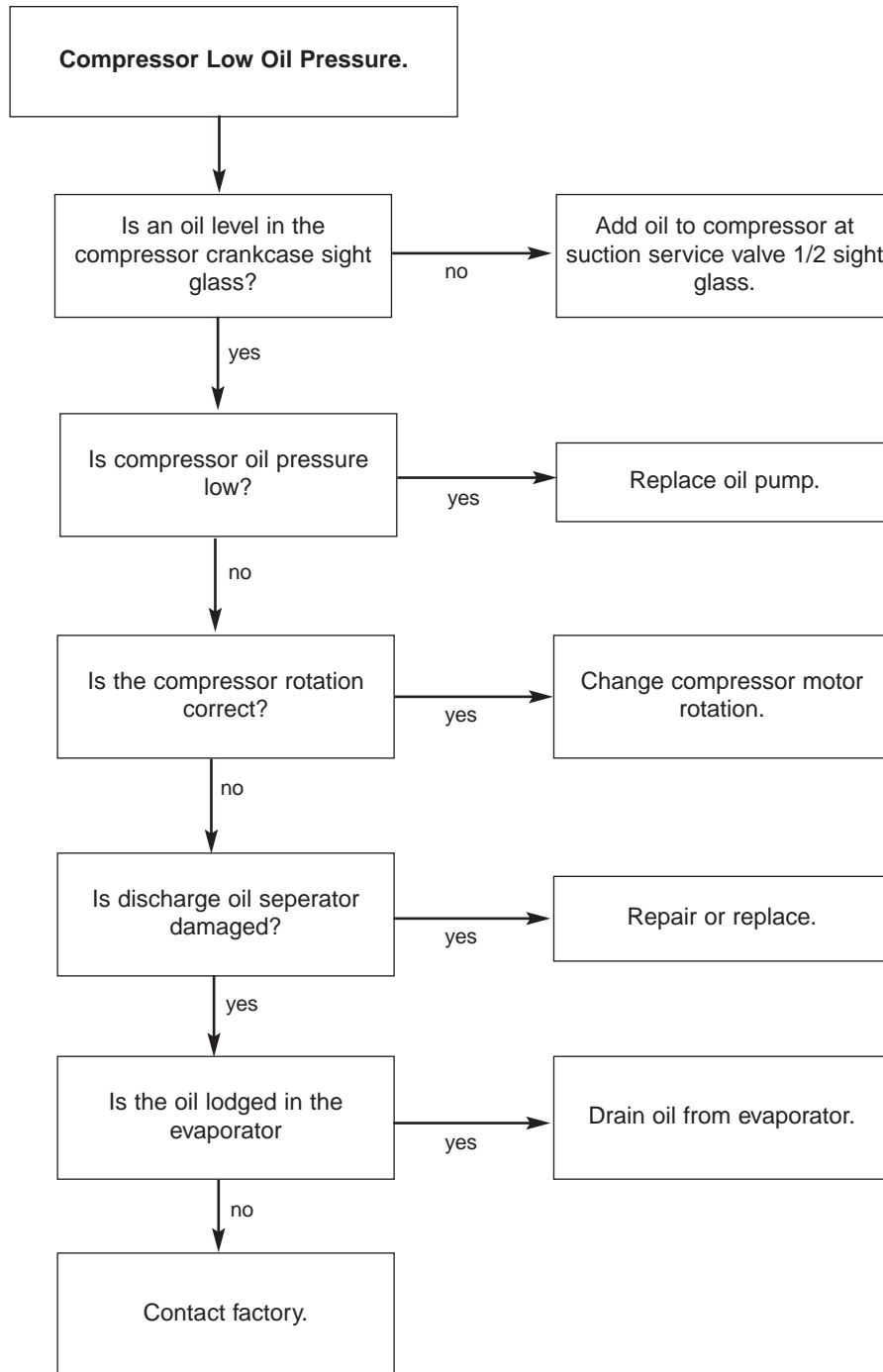
9.8 Troubleshooting Chart 8: System Will Not Cool Building/Process Load



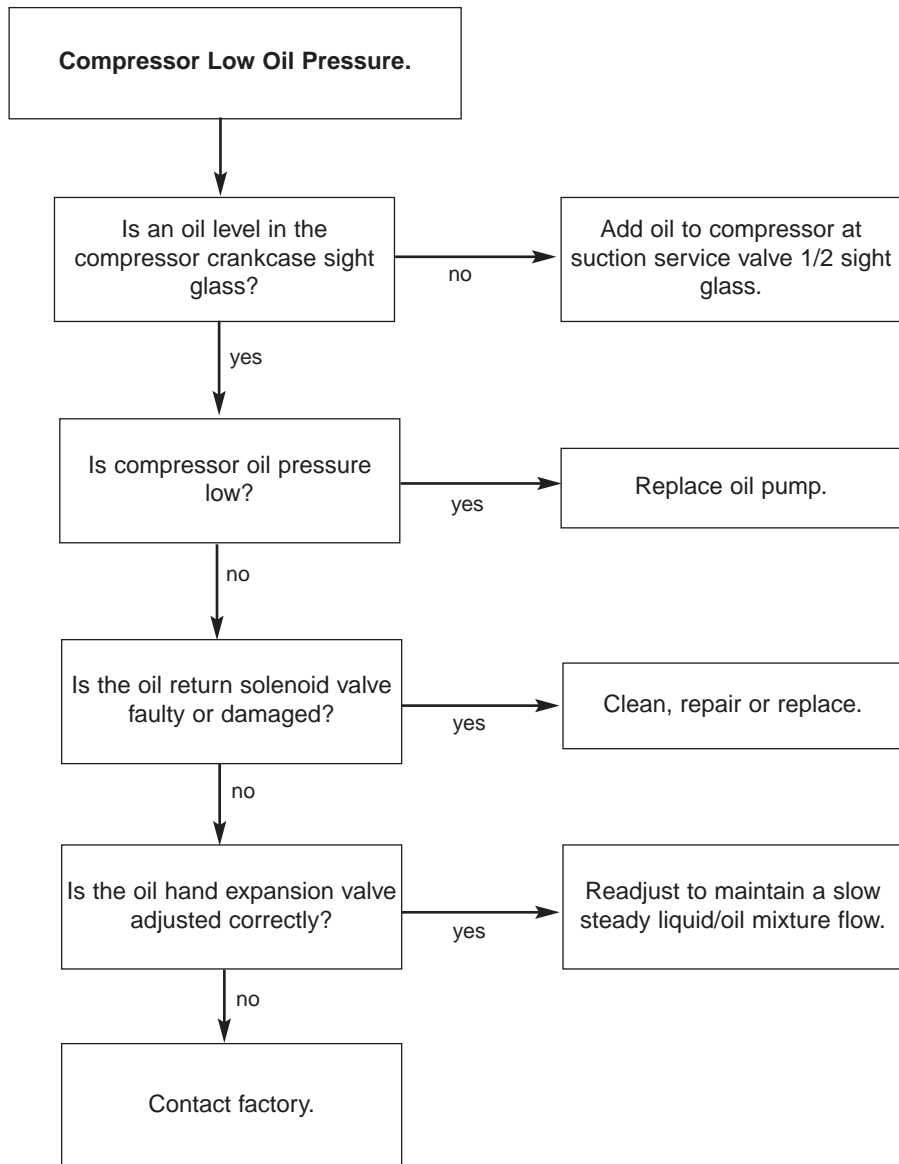
9.9 Troubleshooting Chart 9: Excessive Evaporator Shell Vibration



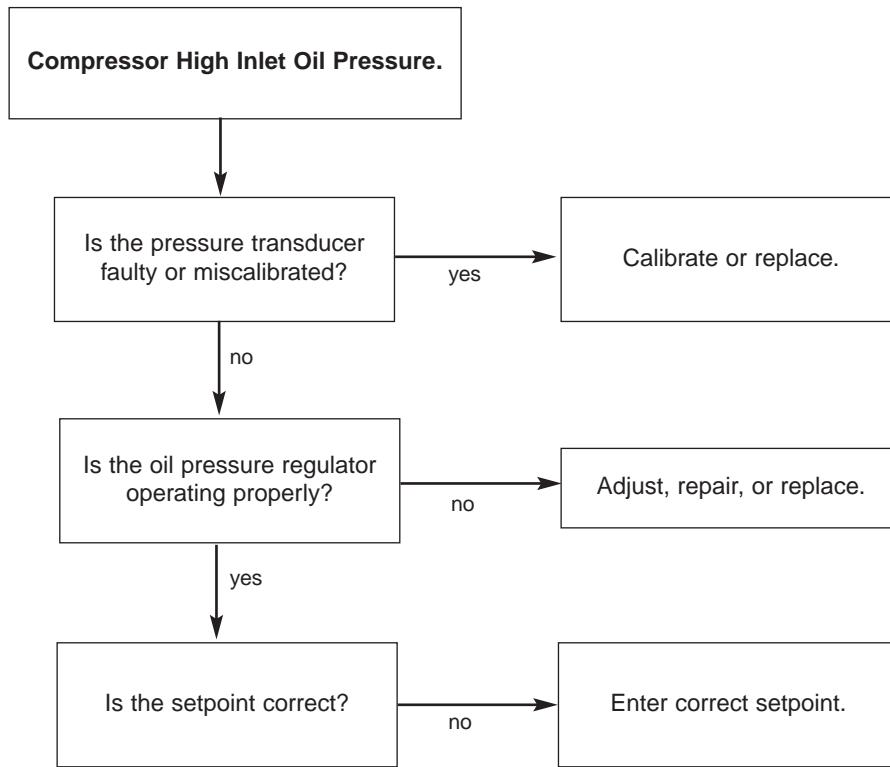
9.10 Troubleshooting Chart 10: Compressor Fails on Low Oil Pressure



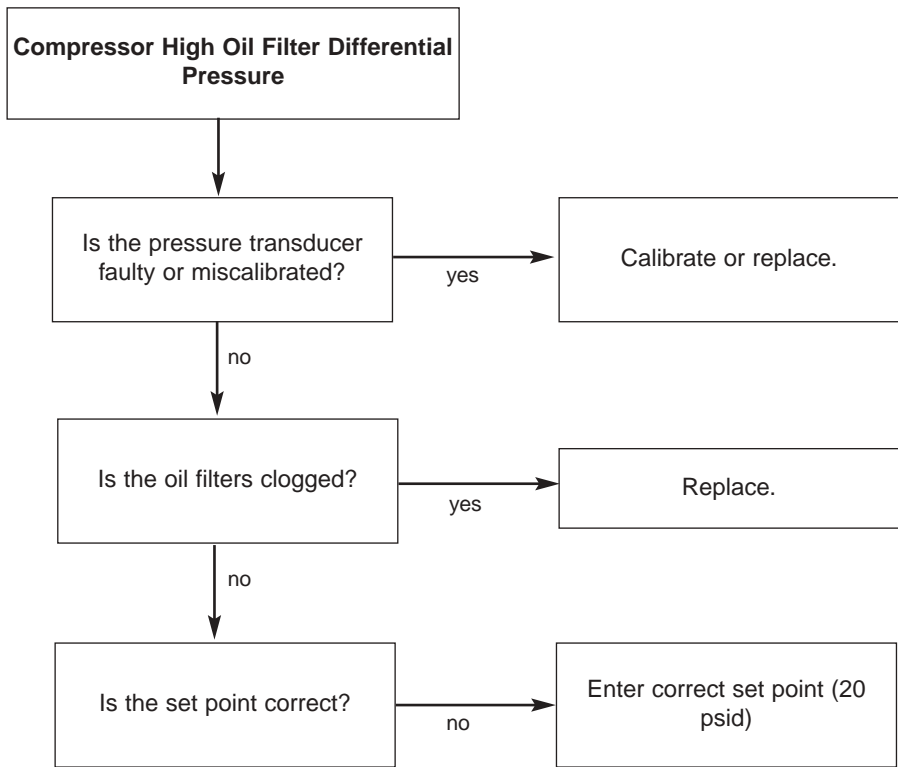
9.11 Troubleshooting Chart 11: Compressor Will Not Start



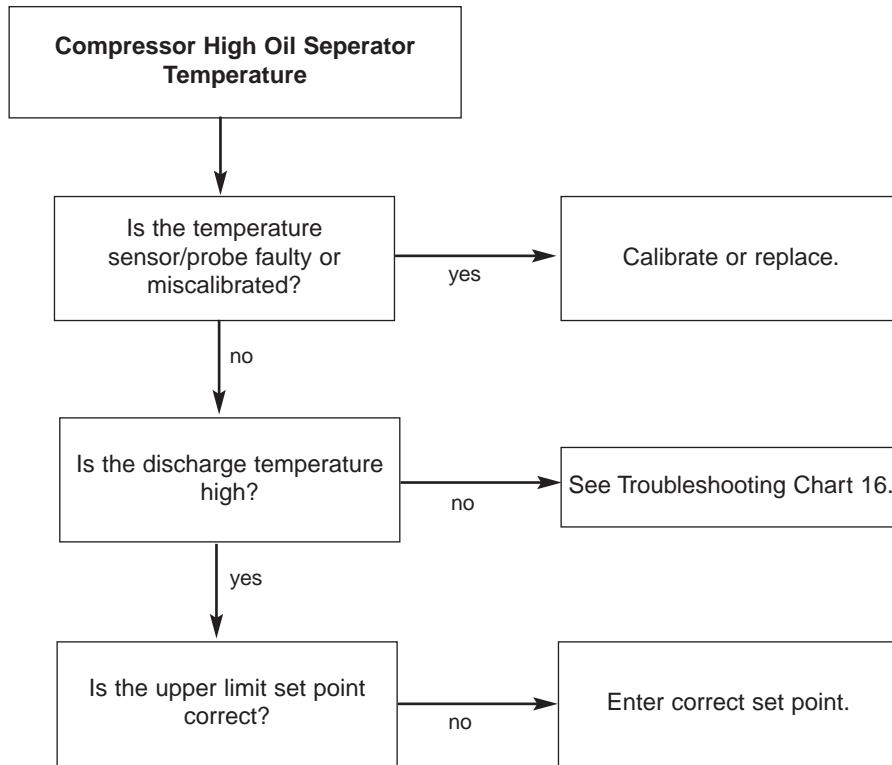
9.12 Troubleshooting Chart 12: Compressor High Inlet Oil Pressure



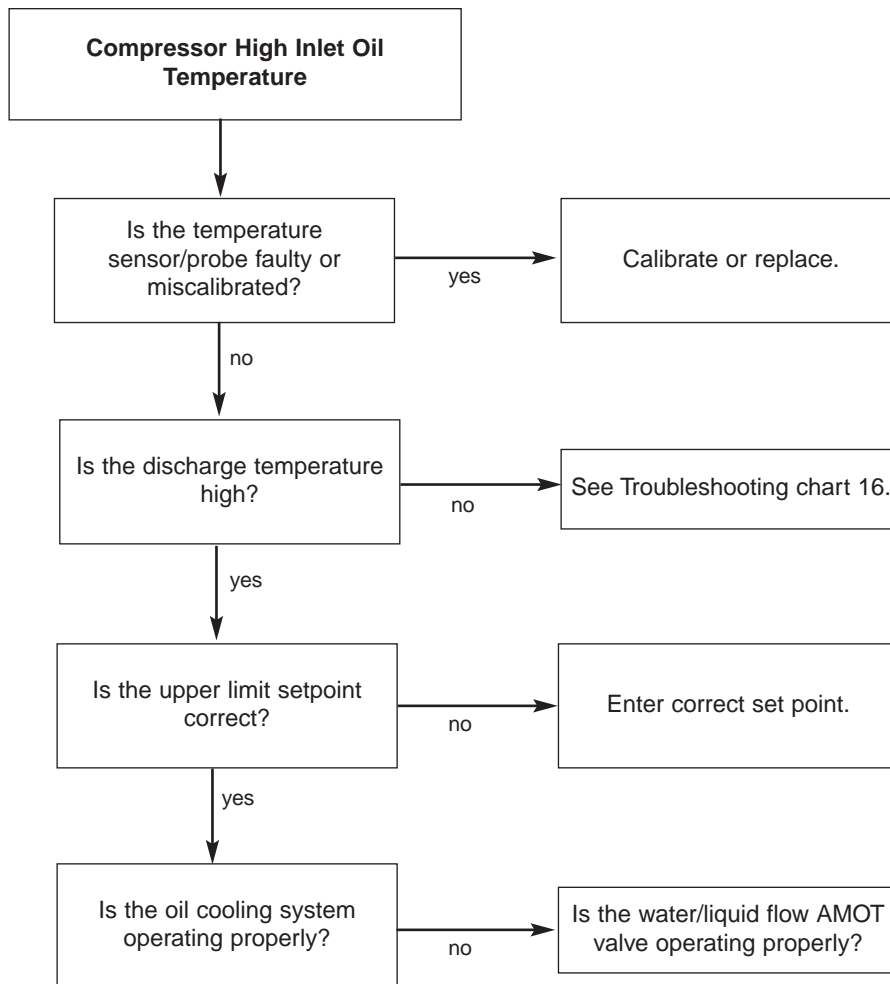
9.13 Troubleshooting Chart 13: Compressor High Oil Filter Differential Pressure



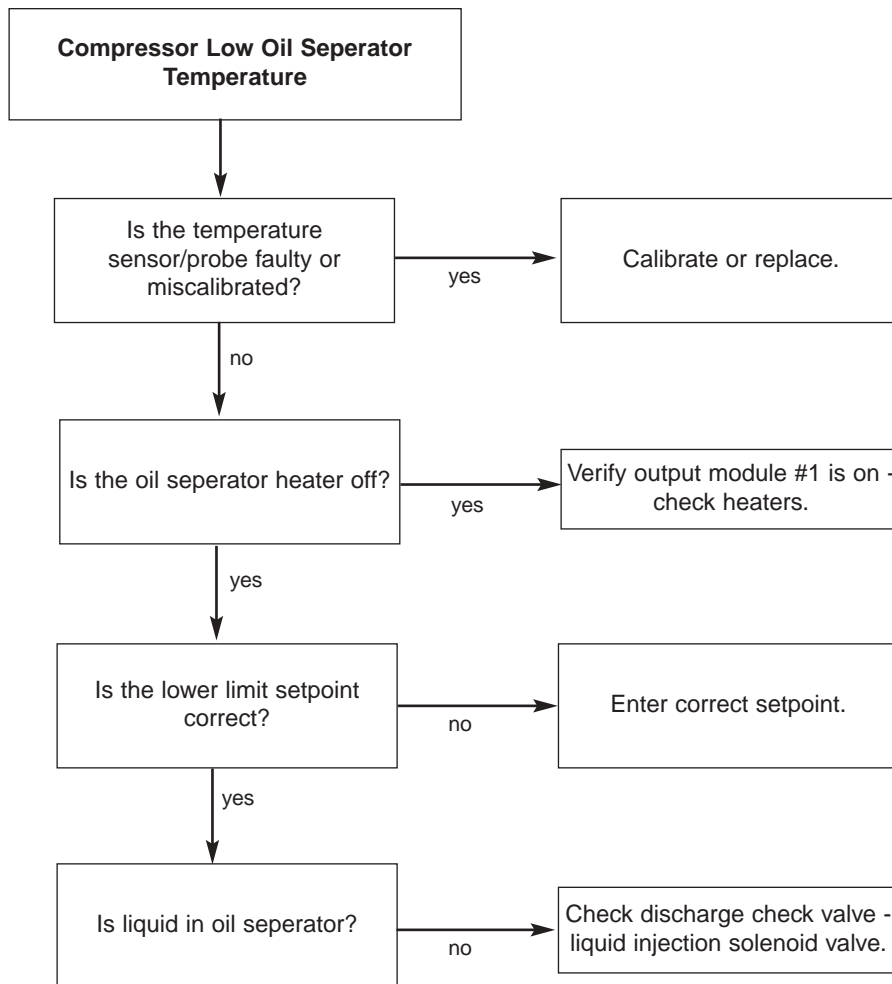
9.14 Troubleshooting Chart 14: Compressor High Oil Separator Temperature



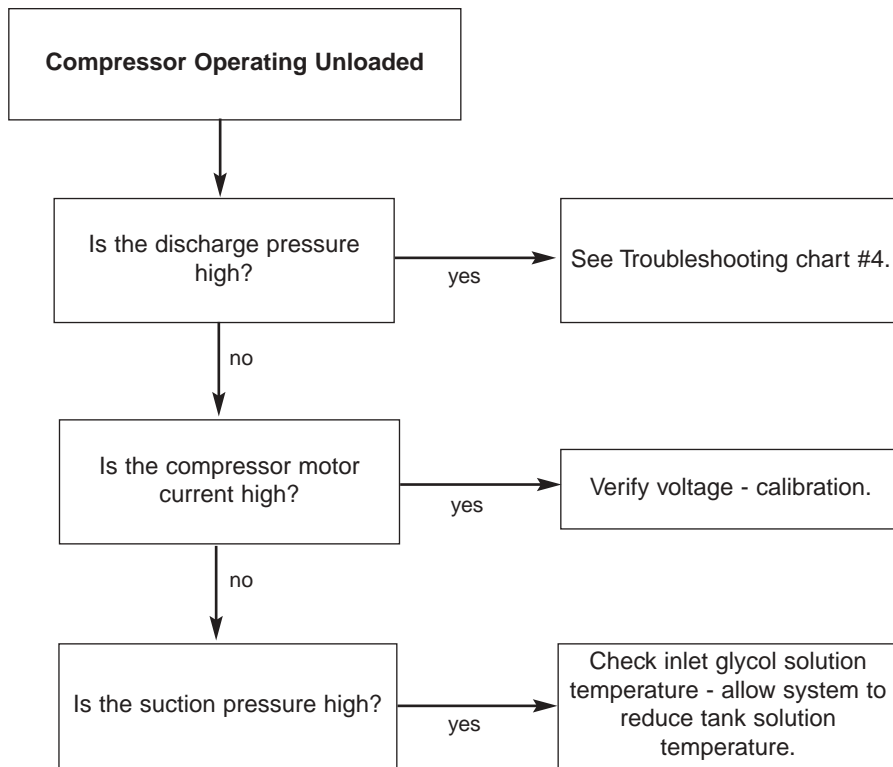
9.15 Troubleshooting Chart 15: Compressor High Inlet Oil Temperature



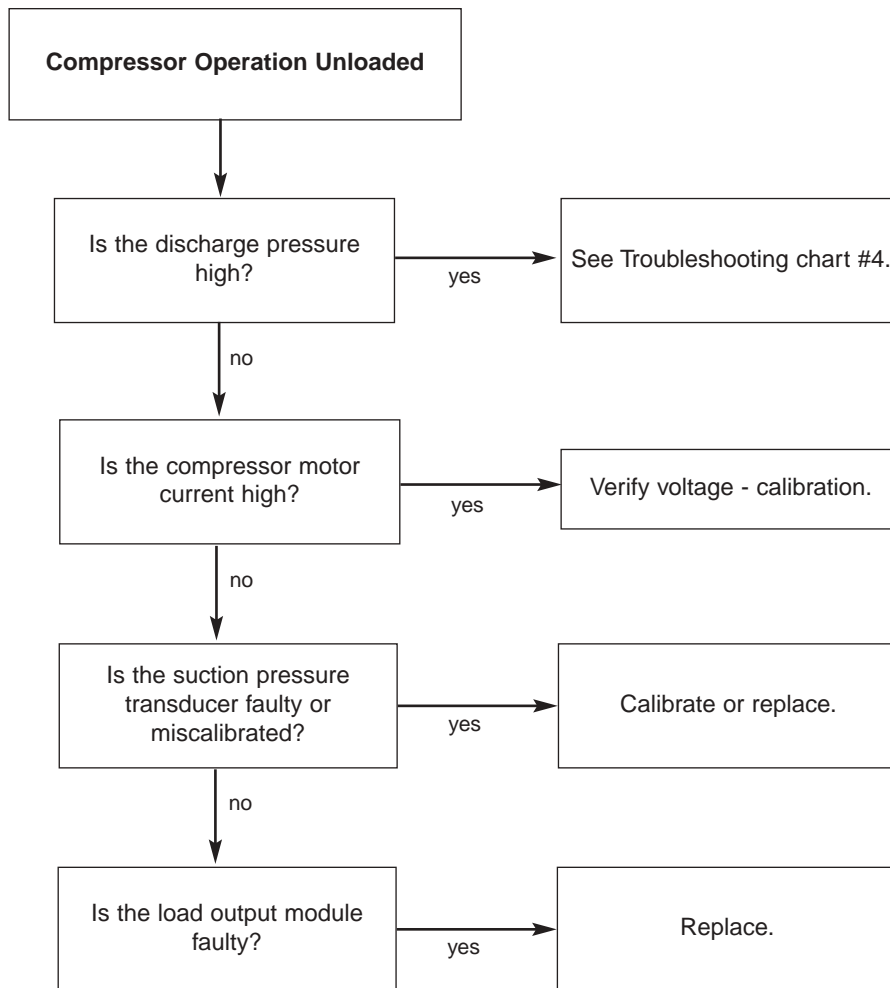
9.16 Troubleshooting Chart 16: Compressor Low Oil Separator Temperature



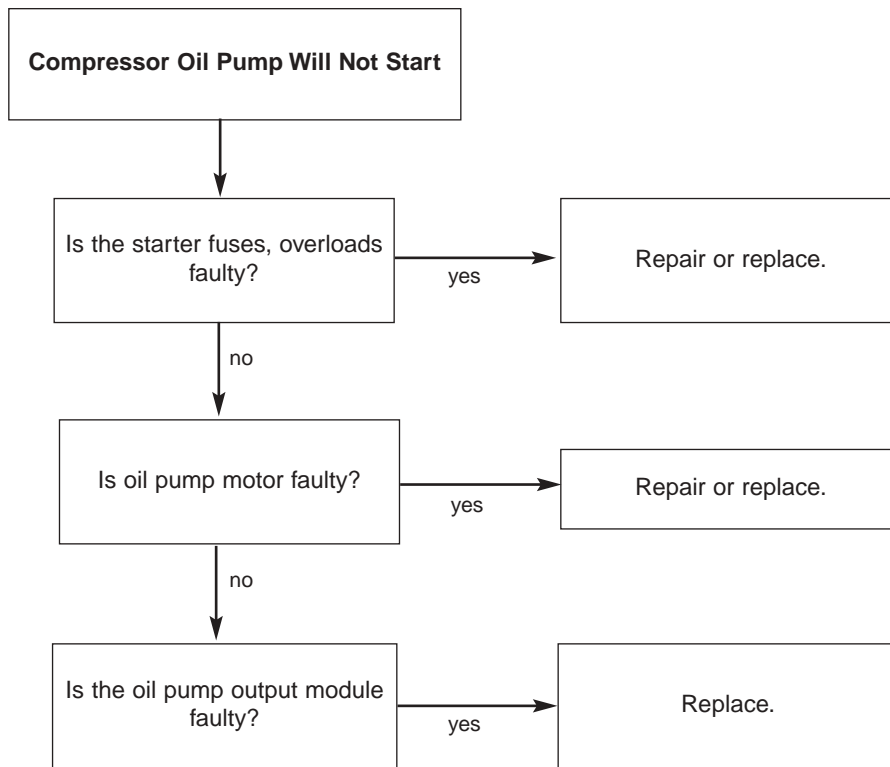
9.17 Troubleshooting Chart 17: Compressor Operating Unloaded



9.18 Troubleshooting Chart 18: Compressor Will Not Load



9.19 Troubleshooting Chart 19: Compressor Oil Pump Will Not Start



SECTION 10

10.0 Start-Up Requirements

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: _____

10.0 Start-Up Requirements (continued)

1. MaximICE Evaporator Unit

- a. 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.
- b. Check the packing slip or bill of lading to ensure that all accessory parts called for in the sales order are included.
- c. The unit must be level to within 1/8" over the length and width.
- d. All remote piping must be cleaned.
- e. All pumps must be secured (vertical shaft pumps should be properly protected and aligned).

2. Refrigerant Piping For Remote Condenser Systems

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

10.0 Start-Up Requirements (continued)

3. Water Piping

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

4. Electrical

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

5. Installing Contractor Shall Furnish The Following

- a. All materials and labor necessary to assist in the installation/start-up.
- b. 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.

6. Compressor Package

- a. Check compressor/motor alignment and align as necessary to within $\pm.004$ " angular/parallel.
- b. Check oil pump/motor alignment and align as necessary to within $\pm.004$ " angular/parallel.

10.0 Start-Up Requirements (continued)

7. Start-Up Request

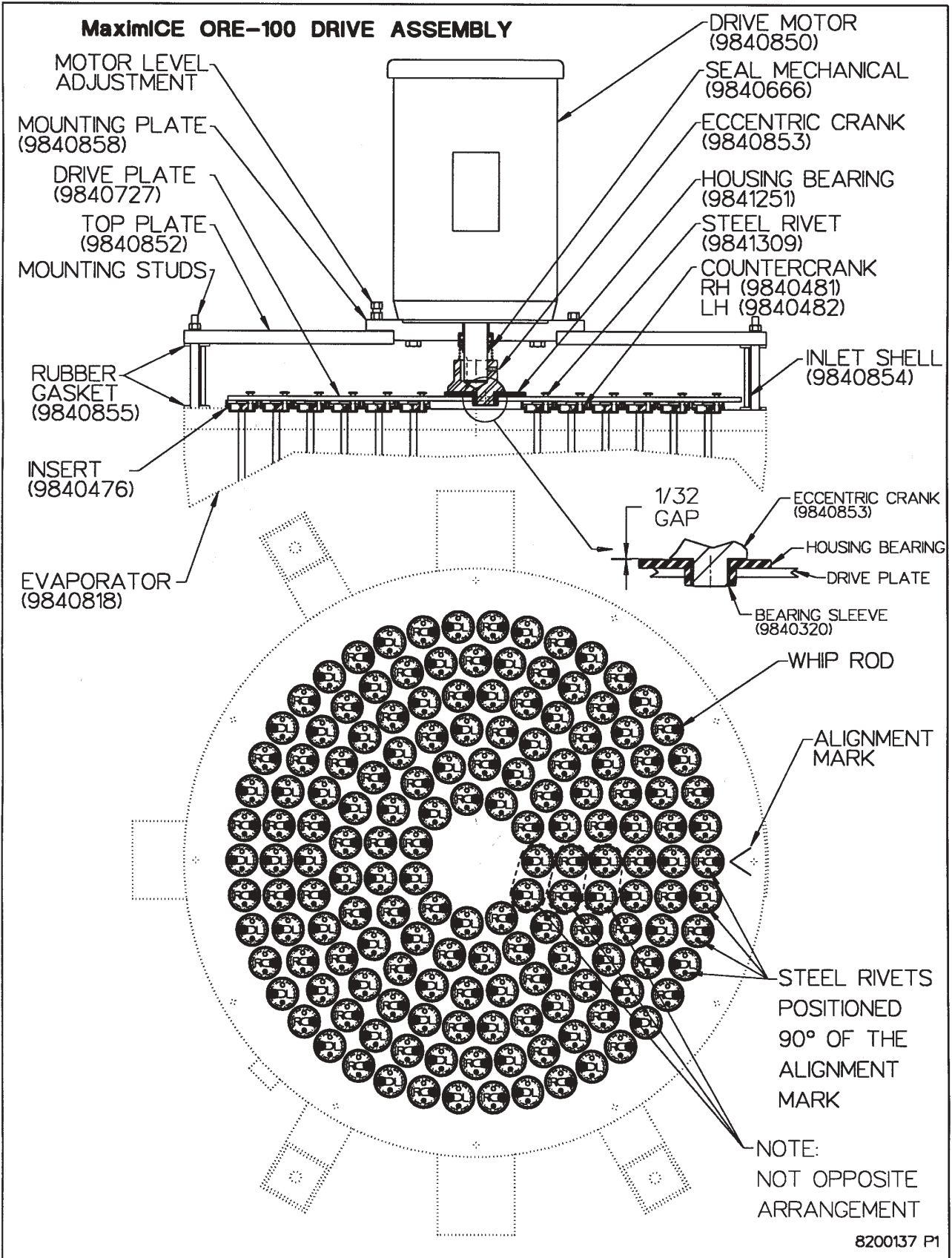
I request that a factory-authorized service representative be scheduled to perform start-up on or about the week of _____. Please note that this is a requested date and must be confirmed by the service department. Start-Up is usually performed within five days (travel included). Upon arrival on site, the start-up technician will verify that the system is capable of being started and that the items identified in the prestart-up check list have been satisfied.

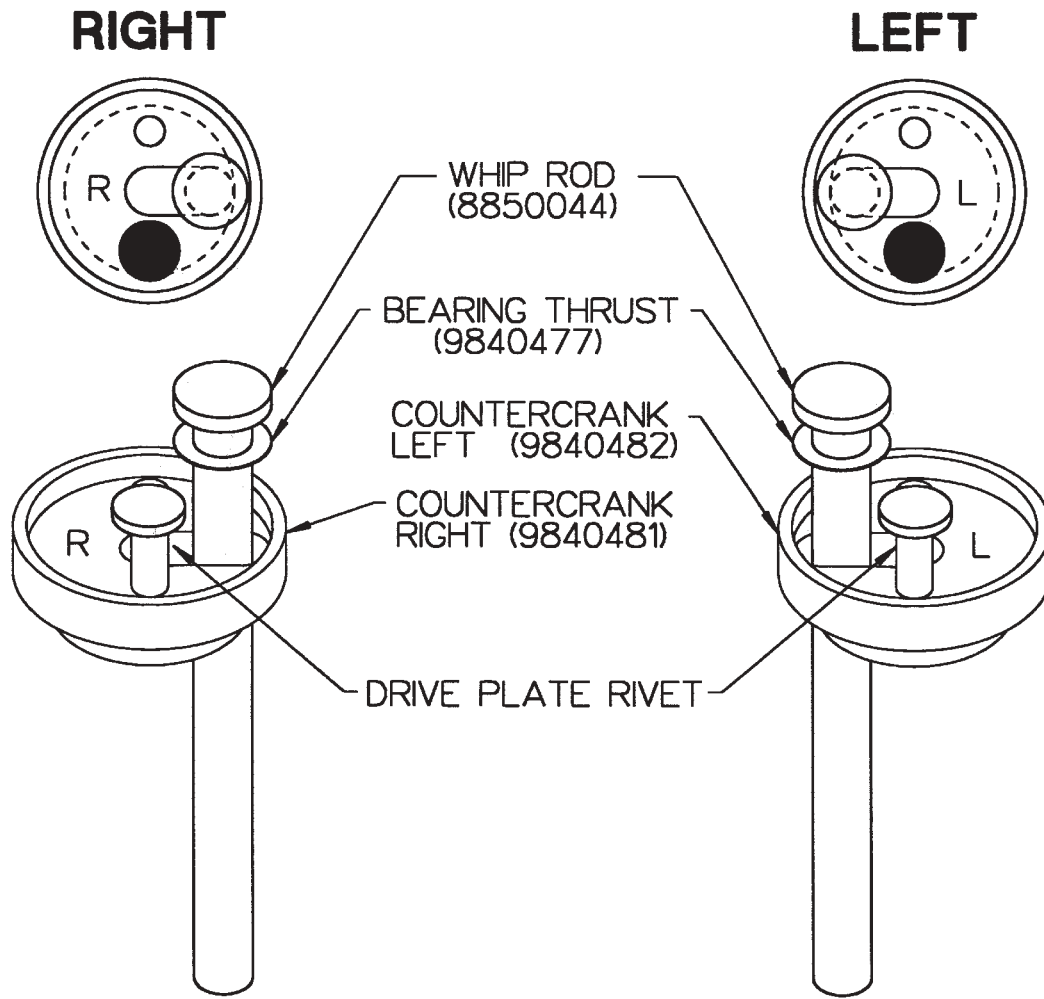
If site construction/installation cannot be completed within 24 hours, the service technician will depart from the job site. In this situation, all costs associated with this trip will be charged to the purchaser on a time-and-material basis. The technician will return to the installation site to perform start-up upon the following conditions:

- a. Verification of the purchaser that all construction items/issues are in compliance with and satisfy the concerns of the start-up technician.
- b. Full payment has been received for the initial start-up trip.

Please fax to 1-417-862-9008, attention Refrigeration Products Service Department. You will be contacted within two weeks to confirm the start-up of your unit(s). Contact our service department if you have any questions regarding this form or the installation of your equipment. We will be happy to assist you.

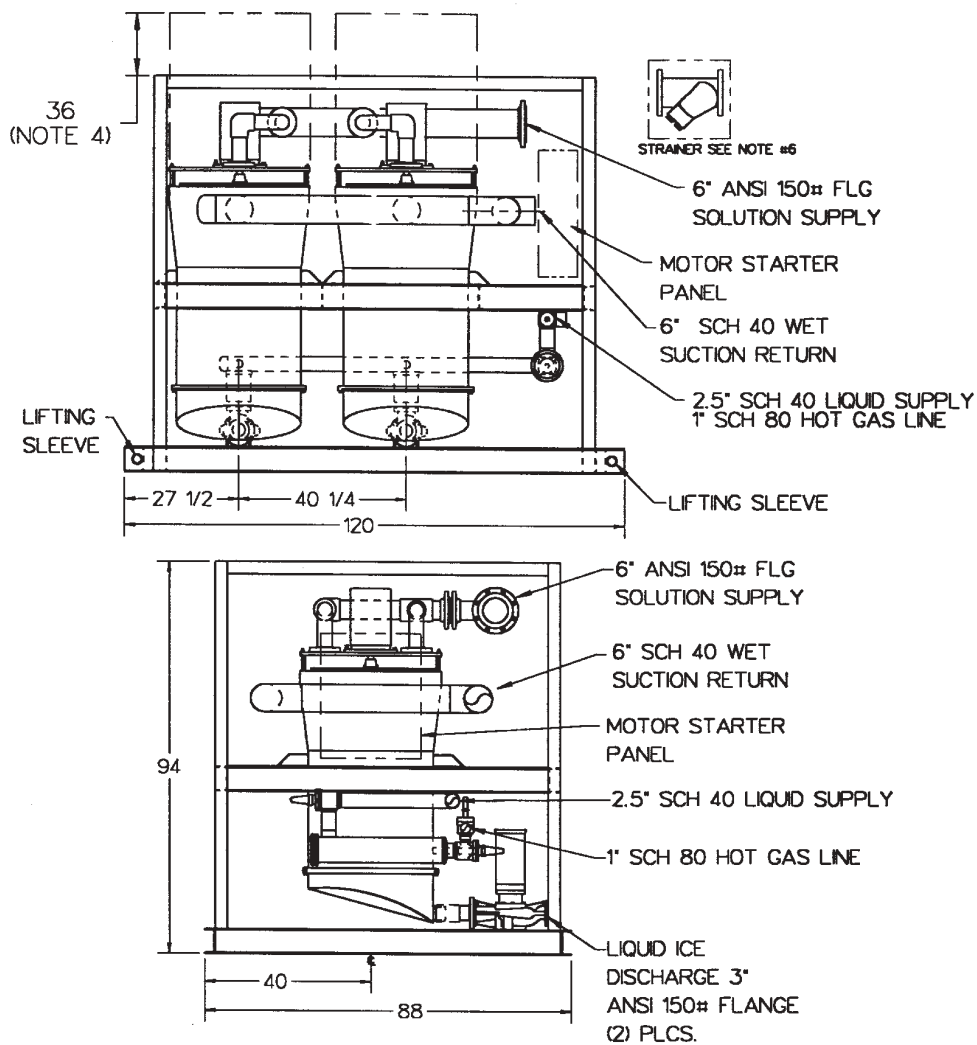
SECTION 11.0 - DRAWINGS





ORE COUNTERCRANK ASSEMBLY

Mueller MaximICE Liquid Ice Evaporator Assembly



SHIP WEIGHT (lbs)	DESIGN WEIGHT (lbs)	REFRIGERANT	REFRIGERANT CHARGE (lbs)	SOLUTION FEED (IN)		SLUSH PUMP (OUT)		
				FLOW RATE	INLET PRESS. REQD	HP	DISCHARGE HEAD	
							50 HZ	60HZ
8,400	10,550	R-22	1400	490 (gpm)	5-30 (psig)	3	21 FT	30 FT
	9,850	R-717	700			5	24 FT	38 FT
						7.5	44 FT	79 FT
						10	59 FT	97 FT

NOTES:

- All dimensions are in inches unless specified otherwise.
- PMC reserves the right to make product design changes which may alter the weights and or dimensions without prior notification.
- Three foot (3') minimum service clearance is required on all sides of assembly.
- Three foot (3') minimum clearance above ORE is required for removal of whip rods.
- Single point electrical connection through side of control panel.
- Strainer to be shipped loose and feild installed.
- Insulated paneling adds 5" to length, 5" to width, 2 1/2" to height.

MUELLER

MaximICE

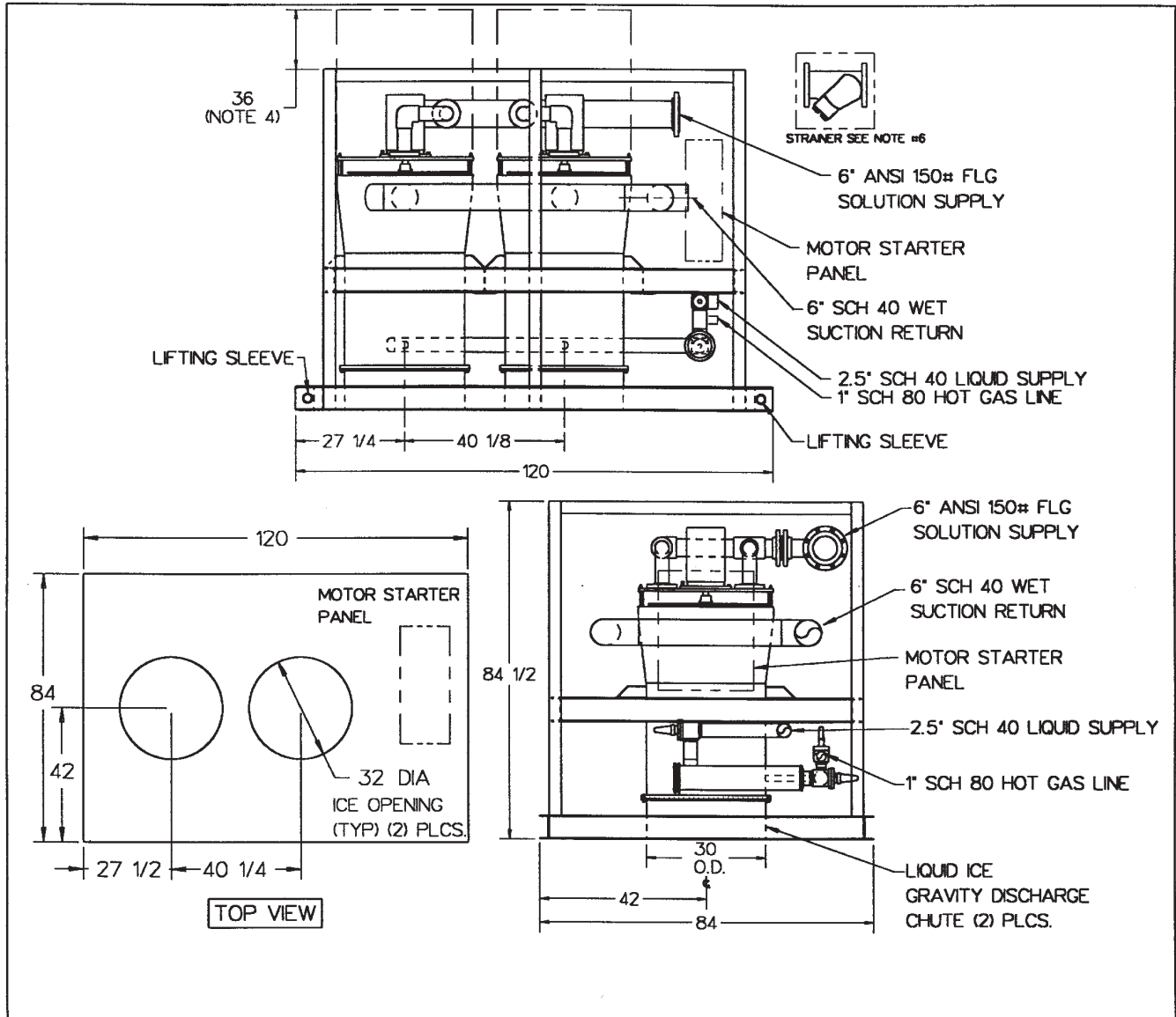
Liquid Ice System

MODEL ORE-200

Pumped Refrigerant Overfeed
Pumped Slush Discharge

8200224 3/12/97

Mueller MaximICE Liquid Ice Evaporator Assembly



NOTES:

1. All dimensions are in inches unless specified otherwise.
2. PMC reserves the right to make product design changes which may alter the weights and or dimensions without prior notification.
3. Three foot (3') minimum service clearance is required on all sides of assembly.
4. Three foot (3') minimum clearance above ORE is required for removal of whip rods.
5. Single point electrical connection through side of control panel.
6. Strainer to be shipped loose and field installed.
7. Insulated paneling adds 5" to length, 5" to width, 2 1/2" to height.

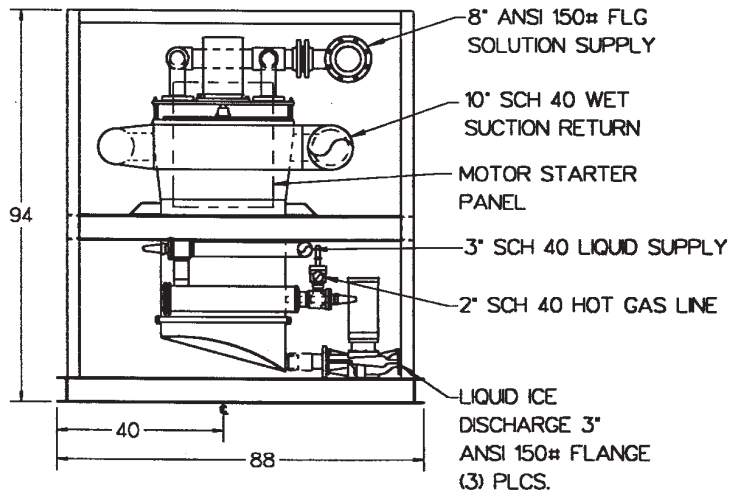
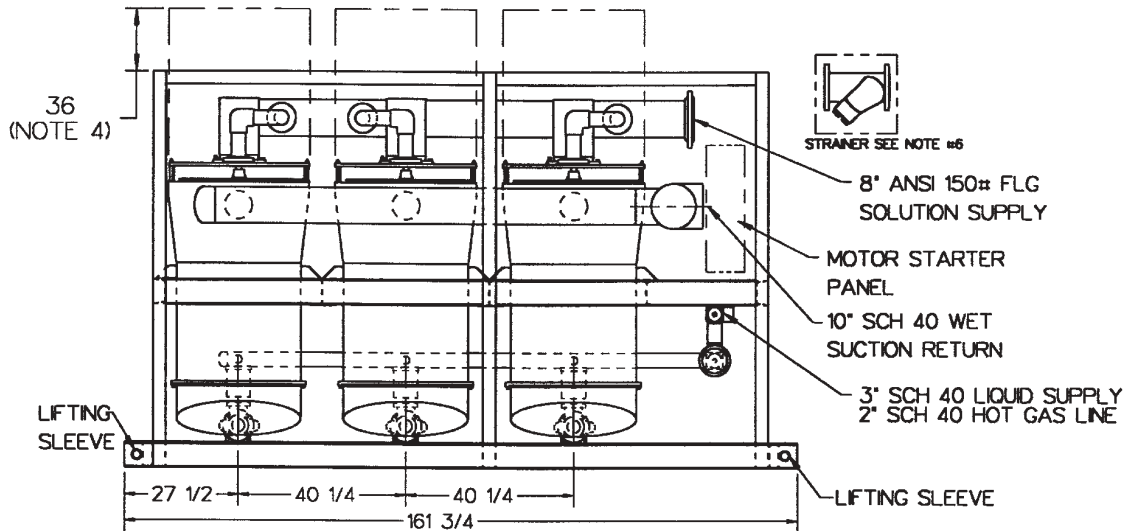


SHIP WEIGHT (lbs)	DESIGN WEIGHT (lbs)	REFRIGERANT	REFRIGERANT CHARGE (lbs)	CONNECTIONS		SOLUTION FEED (IN)	
				SUCTION	LIQUID	FLOW RATE	NET PRESS. REOD
8,200	10,350	R-22	1,400	6" SCH 40	2.5" SCH 40	490 (gpm)	5-30 (psig)
		R-717					

MODEL ORE-200
Pumped Refrigerant Overfeed Gravity Slush Discharge

8200220 3/13/97

Mueller MaximICE Liquid Ice Evaporator Assembly



SHIP WEIGHT (lbs)	DESIGN WEIGHT (lbs)	REFRIGERANT	REFRIGERANT CHARGE (lbs)	SOLUTION FEED (IN)		SLUSH PUMP (OUT)		
				FLOW RATE	INLET PRESS. REQ'D	HP	DISCHARGE HEAD	
12,600	15,800	R-22	2,100	735 (gpm)	5-30 (psig)	3	21 FT	30 FT
						5	24 FT	38 FT
	7.5	44 FT	79 FT					
	10	59 FT	97 FT					
	14,750	R-717	1,050					

NOTES:

1. All dimensions are in inches unless specified otherwise.
2. PMC reserves the right to make product design changes which may alter the weights and or dimensions without prior notification.
3. Three foot (3') minimum service clearance is required on all sides of assembly.
4. Three foot (3') minimum clearance above ORE is required for removal of whip fods.
5. Single point electrical connection through side of control panel.
6. Strainer to be shipped loose and field installed.
7. Insulated paneling adds 5" to length, 5" to width, 2 1/2" to height.

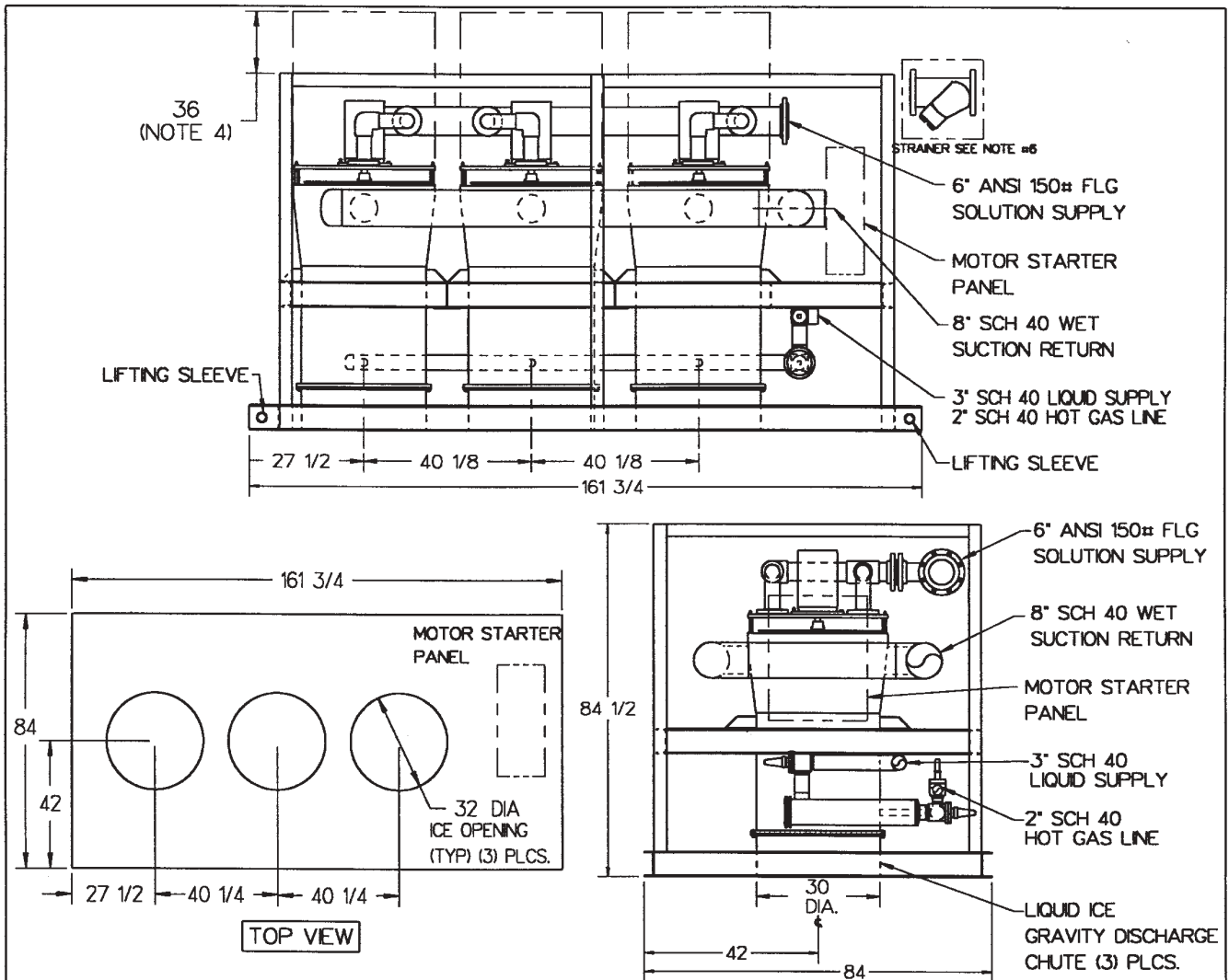
MUELLER

MODEL ORE-300

Pumped Refrigerant Overfeed
Pumped Slush Discharge

8200225 3/13/97

Mueller MaximICE Liquid Ice Evaporator Assembly



NOTES:

1. All dimensions are in inches unless specified otherwise.
2. PMC reserves the right to make product design changes which may alter the weights and or dimensions without prior notification.
3. Three foot (3') minimum service clearance is required on all sides of assembly.
4. Three foot (3') minimum clearance above ORE is required for removal of whip rods.
5. Single point electrical connection through side of control panel.
6. Strainer to be shipped loose and field installed.
7. Insulated paneling adds 5" to length, 5" to width, 2 1/2" to height.

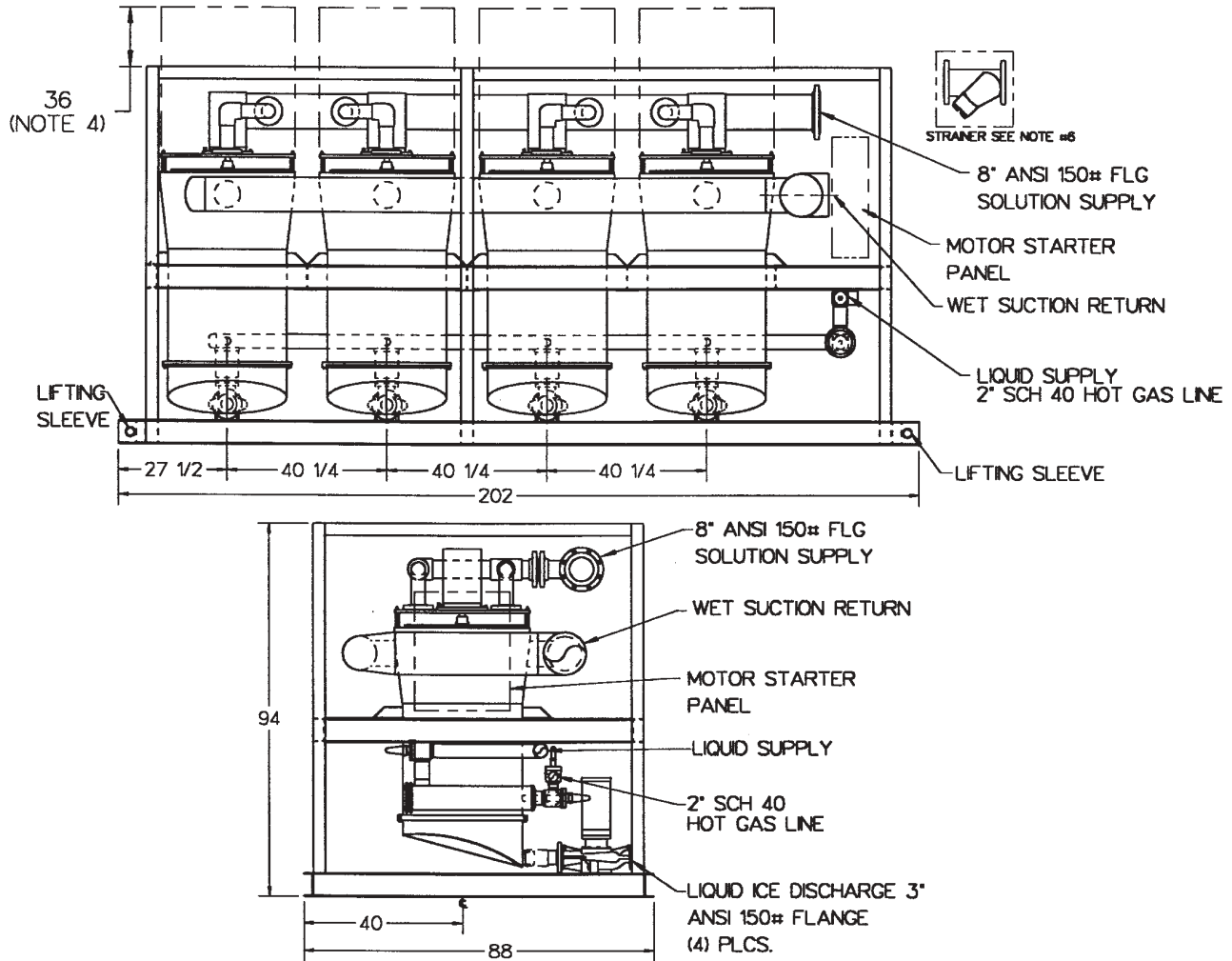


SHIP WEIGHT (lbs)	DESIGN WEIGHT (lbs)	REFRIGERANT	REFRIGERANT CHARGE (lbs)	CONNECTIONS		SOLUTION FEED (IN)	
				SUCTION	LIQUID	FLOW RATE	NET PRESS. REQ'D
12,300	15,500	R-22	2,100	8" SCH 40	3" SCH 40	735 (gpm)	5-30 (psig)
		R-717					

MODEL ORE-300
Pumped Refrigerant Overfeed Gravity Slush Discharge

8200217 3/13/97

Mueller MaximICE Liquid Ice Evaporator Assembly



SHIP WEIGHT (lbs)	DESIGN WEIGHT (lbs)	REFRIGERANT	REFRIGERANT CHARGE (lbs)	CONNECTIONS		SOLUTION FEED (IN)		SLUSH PUMP (OUT)		
				SUCTION	LIQUID	FLOW RATE	NET PRESS. REQD	HP	DISCHARGE HEAD	
16,400	21,800	R-22	2,800	10" SCH 40	3" SCH 40	980 (gpm)	5-30 (psig)	3	21 FT	30 FT
	20,400	R-717	1,400	8" SCH 40	2" SCH 40			5	24 FT	38 FT
								7.5	44 FT	79 FT
								10	59 FT	97 FT

NOTES:

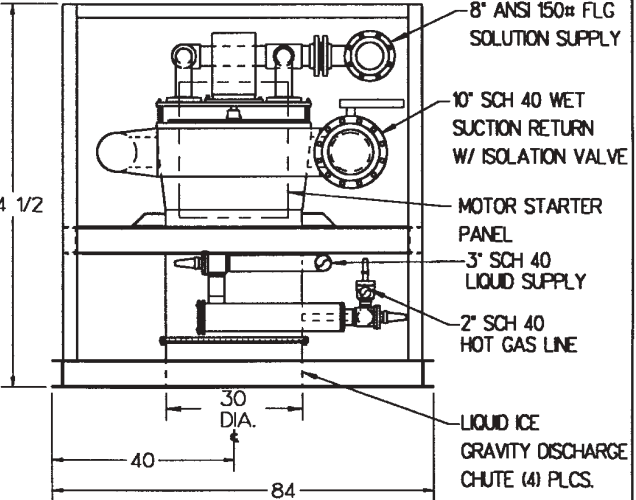
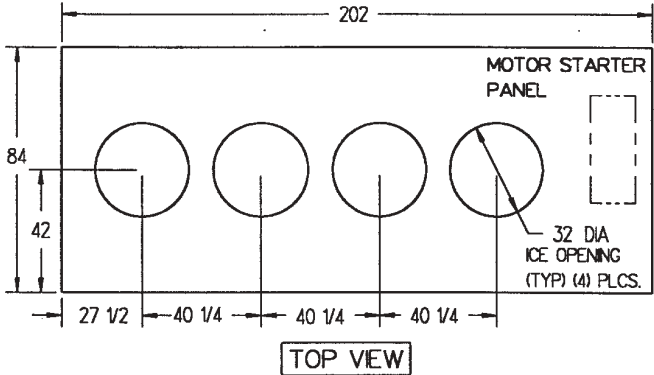
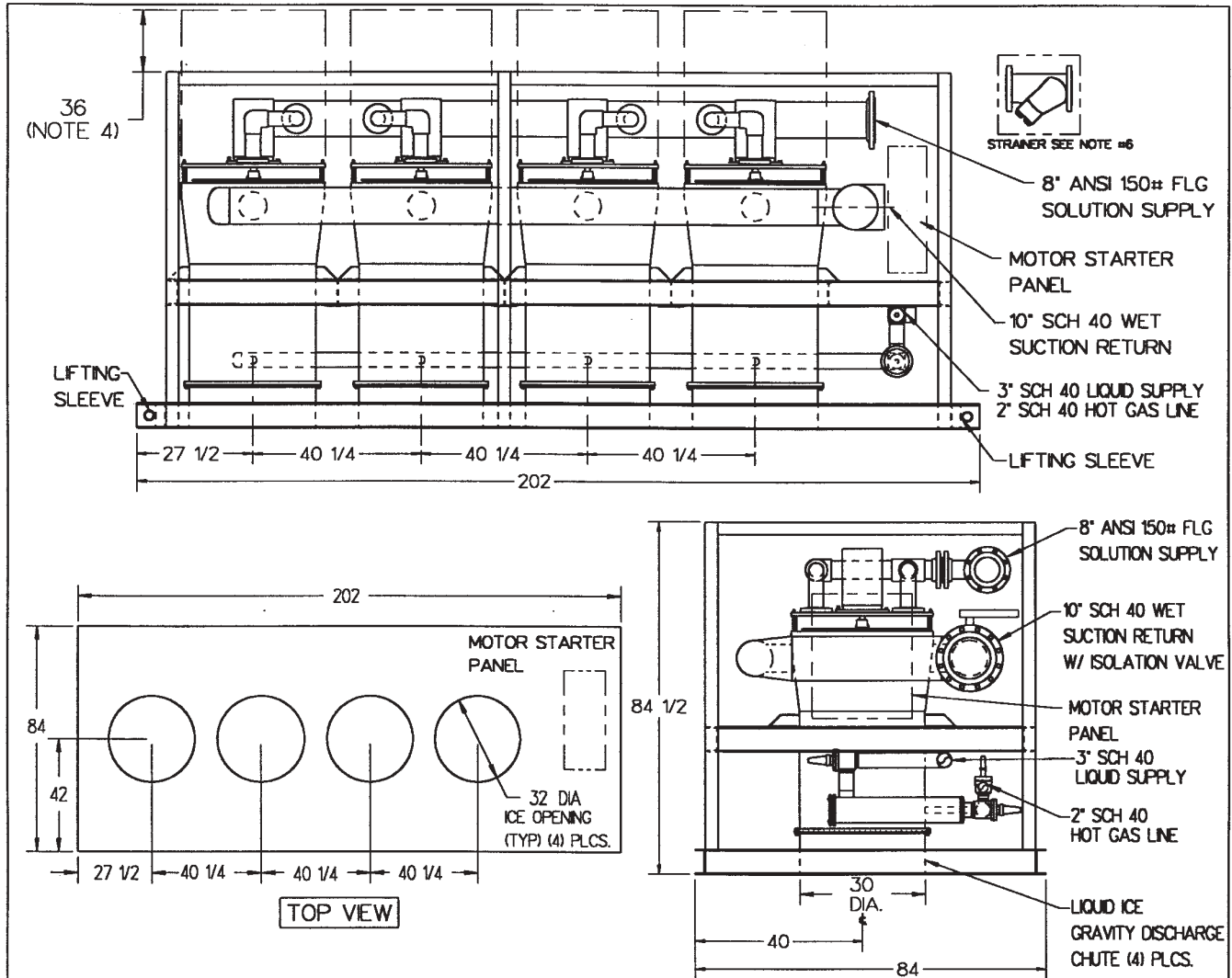
- All dimensions are in inches unless specified otherwise.
- PMC reserves the right to make product design changes which may alter the weights and or dimensions without prior notification.
- Three foot (3') minimum service clearance is required on all sides of assembly.
- Three foot (3') minimum clearance above ORE is required for removal of whip rods.
- Single point electrical connection through side of control panel.
- Strainer to be shipped loose and field installed.
- Insulated paneling adds 5" to length, 5" to width, 2 1/2" to height.



MODEL ORE-400
Pumped Refrigerant Overfeed
Pumped Slush Discharge

8200226 9/04/97

Mueller MaximICE Liquid Ice Evaporator Assembly



NOTES:

1. All dimensions are in inches unless specified otherwise.
2. PMC reserves the right to make product design changes which may alter the weights and or dimensions without prior notification.
3. Three foot (3') minimum service clearance is required on all sides of assembly.
4. Three foot (3') minimum clearance above ORE is required for removal of whip rods.
5. Single point electrical connection through side of control panel.
6. Strainer to be shipped loose and feild installed.
7. Insulated paneling adds 5" to length, 5" to width, 2 1/2" to height.



SHIP WEIGHT (lbs)	DESIGN WEIGHT (lbs)	REFRIGERANT	REFRIGERANT CHARGE (lbs)	CONNECTIONS		SOLUTION FEED (IN)	
				SUCTION	LIQUID	FLOW RATE	INLET PRESS. REQ'D
16,400	21,800	R-22	2,800	10" SCH 40	3" SCH 40	980 (gpm)	5-30 (psig)
		R-717	1,400	8" SCH 40	2" SCH 40		

MODEL ORE-400
Pumped Refrigerant Overfeed Gravity Slush Discharge
8200221 8/25/97

MUELLER®

P.O. Box 828 • Springfield, MO 65801-0828
Phone: (417) 831-3000 • 1-800-MUELLER • Fax: (417) 862-9008
www.muel.com

International Inquiries • Fax: (417) 831-6906

Part No. 9841385