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INSTRUCTION MANUAL • INSTALLATION • OPERATION • MAINTENANCE

TT-OACS *Series*

CENTRAL CHILLER



***Air-Cooled Central Chillers for
Outdoor Installation
Models from 5 - 210 Tons***



TEMPTEK, INC.

525 East Stop 18 Road Greenwood, IN 46142

317-887-6352 fax: 317-881-1277

Service Department fax: 317-885-8683

www.TempTek.com

E-mail service@TempTek.com

Model: _____

Serial Number : _____

***TT-OACS* Series**

CENTRAL CHILLER

INSTRUCTION MANUAL AIR-COOLED MODELS

COVERING

INSTALLATION OPERATION MAINTENANCE



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TABLE OF CONTENTS

1.0	GENERAL	7
1.1	Introduction	8
1.2	Safety	8
1.3	Receiving instructions	10
1.4	Efficiency	10
1.5	Clean air act	10
1.6	Water Treatment	11
1.7	Model Designation	11
1.8	Components	12
2.0	INSTALLATION	13
2.1	General	14
2.2	Unit Location	14
2.3	Chilled Water Piping Installation	15
2.4	Air-Cooled Condenser	15
2.5	Make-Up Water Supply Connection	17
2.6	Electrical Connection	17
2.7	Piping Installation (Typical)	20
3.0	OPERATIONS	21
3.1	General	22
3.2	Start Up / Operation Procedure	23
3.3	CF Control Instrument	27
3.4	LE Control Instrument	31
3.5	MZC Control Instrument	36
3.6	MZC Zone Board	45
3.7	Configuration Switch Adjustment (MZC only)	48
3.8	Controls	50
3.9	Pressure Gauges & Alarm Beacon	51
3.10	Digital Pressurestat Setup	52
3.11	Zone Lead Lag (MZC Only)	54
3.10	Shut Down Procedure	55
4.0	TROUBLESHOOTING	57
4.1	Unit Will Not Start	58
4.2	Compressor Hums But Will Not Start	58
4.3	Shuts Off On High Pressure	58
4.4	Shuts Off On Low Pressure	59
4.5	Compressor Shuts Off On Internal Overload	60
4.6	Low or No Process Pressure or Water Flow	60
4.7	Cooling Capacity Inadequate	60
4.8	Sensor	60
4.9	Coolant Pumps	61
4.10	Oil Pressure	61
4.11	Crankcase Heater	61
4.12	Chiller Controller	61



5.0	MAINTENANCE	63
5.1	Warranty Service Procedure	64
5.2	Periodic Preventative Maintenance	64
5.3	Special Maintenance	65
5.4	Solenoid Valve Service	66
5.5	Pump Seal Service	68
5.6	Checking Refrigerant Charge	71
5.7	Proper Cleaning Procedure for Brazed Plate Evaporators	71
6.0	COMPONENTS	73
6.1	Refrigeration Components	74
6.2	Coolant System	76
7.0	RELATED DRAWINGS	77
7.1	Typical Circuit Schematic	78
7.2	Typical Physical Drawing	79
7.3	Typical Press Drip	80
7.4	Typical Vacuum Breaker / Anti-Siphon System	81
7.5	Typical Label Placement Drawing	82
7.6	Typical Panel / Control Station Drawing	83
8.0	APPENDIX	85
8.1	Operations Below 48°F Fluid or 38°F Ambient	86
8.2	Refrigerant Pressure-Temperature Chart	88
8.3	Inhibited Propylene Glycol	89
8.4	Chiller Capacity & Derate Chart	89



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1.0 GENERAL

- 1.1 Introduction
- 1.2 Safety
- 1.3 Receiving Instructions
- 1.4 Efficiency
- 1.5 Clean Air Act
- 1.6 Water Treatment
- 1.7 Model Designation
- 1.8 Components



1.1 INTRODUCTION


- A. This manual covers TTOACS central chillers from 5 to 210 tons (17.2 to 717.4 kW) of cooling capacity using the CF, LE or MZC (Multi Zone Control) microprocessor control instruments and fixed displacement scroll compressors and digital scroll compressors. The standard fluid operating temperature range for this chiller is 20°F to 80°F for units using R410A refrigerant. Units using other refrigerants have different standard operating ranges. Units operating below 48°F fluid require the use of a water/propylene glycol to prevent freezing. Customized units may have different operating ranges. Consult the factory if you have questions about the operating range of your chiller.
- B. The intent of this manual is to serve as a guide in the installation, operation and maintenance of your chiller. Improper installation can lead to equipment damage and poor performance. Failure to follow the installation, operation and maintenance instructions may result in damage to the unit that is not covered under the limited warranty. This manual is for standard products. The information contained in this manual is intended to be general in nature. The information is typical only and may not represent the actual unit purchased.
- C. Chemical refrigerants are used in this unit. The refrigerant is sealed and tested in a pressurized system however a system failure will release it. Refrigerant gas can cause toxic fumes if exposed to fire. Install this unit in a well-ventilated area away from open flames. Failure to follow these instructions may result in a hazardous condition. Recover refrigerant to relieve pressure before opening the system. See nameplate for refrigerant type. Do not use non-approved refrigerants or refrigerant substitutes.
- D. Customers should implement a refrigerant management program to document the type and quantity of refrigerant in each chiller. All refrigeration service technicians performing work on this chiller must be licensed and certified.
- E. When calling for assistance from the Manufacturer's Service Department, it is important to know the model and serial number of the particular unit. The model number includes critical unit information which is helpful when troubleshooting operating difficulties. The serial number allows the service team to locate manufacturing and testing records which can have additional information relating to a particular unit.


1.2 SAFETY


- A. It is important to become thoroughly familiar with this manual and the operating characteristics of the unit.
- B. It is the owner's responsibility to assure proper operator training, installation, operation, and maintenance of the unit.
- C. Observe all warning and safety placards applied to the chiller. Failure to observe all warnings can result in serious injury or death to the operator and severe mechanical damage to the unit.
- D. Observe all safety precautions during installation, startup and service of this equipment due to the presence of high voltage and refrigerant charge. Only qualified personnel should install, startup and service this equipment.



- E. When working on this equipment, observe precautions in literature and on tags, stickers and labels located on the equipment. Wear work gloves and safety glasses.

 **WARNING:** This equipment contains hazardous voltages that can cause severe injury or death. Disconnect and lock out incoming power before installing or servicing the equipment.

 **WARNING:** This equipment contains refrigerant under pressure. Accidental release of refrigerant under pressure can cause personal injury and or property damage. Exercise care while working on or around this equipment.

 **WARNING:** Vent all refrigerant relief valves in accordance to ANSI/ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. This equipment should be located within a well-ventilated area. Inhalation of refrigerant can be hazardous to your health and the accumulation of refrigerant within an enclosed space can displace oxygen and cause suffocation



Samples of Warning Labels applied to typical chillers.

1. Alerts users to the danger of high voltage.



2. Alerts user to the danger of the rotating condenser fans on air condensed units.



3. Alerts user to the danger of belt drive systems on unit with blowers.



4. This symbol is seen on all chillers to alert user to the danger of the refrigeration system under pressure. System should only be serviced by a licensed technician.

1.3 RECEIVING INSTRUCTIONS

- A. Check the overall condition of the equipment prior to accepting delivery.
- B. Check for visible damage and document any evident damage on the delivery receipt. Check the refrigerant gauges to be sure the system charge is intact. See the chart in section 8.4 for proper pressure readings based on the ambient temperature and refrigerant type used in the chiller. Shipping damage is the responsibility of the carrier.
- C. In order to expedite payment for damages, should they occur, follow proper procedures and keep detailed records. Take photographs of any suspected damage.

1.4 EFFICIENCY

- A. Long term efficiency of operation is largely determined by proper maintenance of the mechanical parts of the unit and the water quality. The Manufacturer recommends filtering the process water to prevent solids from plugging critical parts. The Manufacturer highly recommends that the services of a qualified water treatment specialist be obtained and their recommendations be followed. The Manufacturer accepts no responsibility for inefficient operation, or damage caused by foreign materials or failure to use adequate water treatment.

1.5 CLEAN AIR ACT



WARNING: Vent all refrigerant relief valves in accordance to ANSI/ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. This equipment should be located within a well-ventilated area. Inhalation of refrigerant can be hazardous to your health and the accumulation of refrigerant within an enclosed space can displace oxygen and cause suffocation.

- A. Units manufactured after January 1, 2010 may contain refrigerant HFC-410A, HFC-407C, HFC-404A or HFC-134A. Most units manufactured prior to January 1, 2010 contain refrigerant HCFC-22.
- B. It is unlawful for any person in the course of maintaining, servicing, repairing, or disposing of refrigeration equipment to knowingly vent or otherwise dispose of any substance used as a refrigerant in the manner which permits such substance to enter the atmosphere.
- C. Very small releases associated with good faith attempts to recapture, reclaim or recycle such substance shall not be subject to the prohibition set forth in the preceding paragraph.
- D. Customers should implement a refrigerant management program to document the type and quantity of refrigerant in each chiller. All refrigeration service technicians performing work on this chiller must be licensed and certified.
- E. Vent all refrigerant relief valves in accordance to ANSI/ASHRAE Standard 15.

1.6 WATER TREATMENT



WARNING: Improper water treatment will void unit warranty.

- A. The use of untreated or improperly treated water in a portable chiller may result in scaling, erosion, corrosion, algae or slime.
- B. It is recommended that the services of a qualified water treatment specialist be engaged to determine what water treatment is required.
- C. The Manufacturer assumes no responsibility for equipment failures which result from untreated or improperly treated water.
- D. Do not use deionized water in this unit. Some customized units may be compatible with deionized water. Consult the factory before using deionized water.

1.7 MODEL DESIGNATION

- A. The Serial Number identifies the exact configuration of your unit and should be available when contacting the Factory for service or information.
- B. There maybe additional numbers and letters at the end of the model number to indicate additional configuration options on the machine.



Typical placement of the Data tag. Note: Data tag may be placed elsewhere on certain models.

OACS - 10S - M1 - 1P

OACS Series
Chiller Model

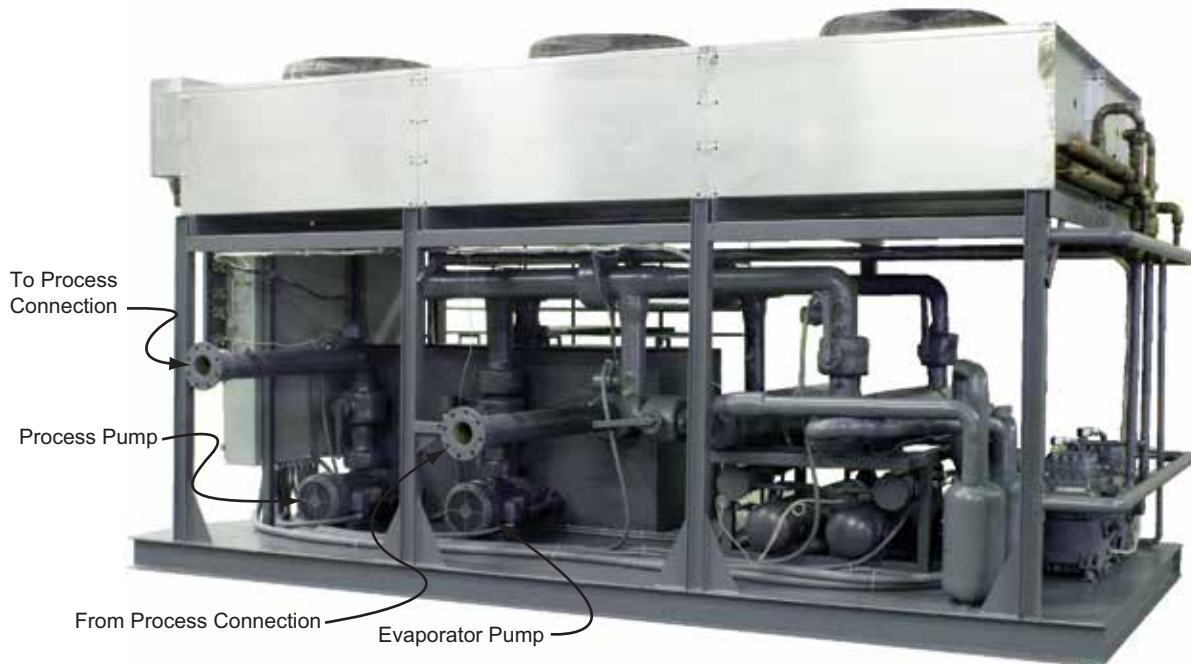
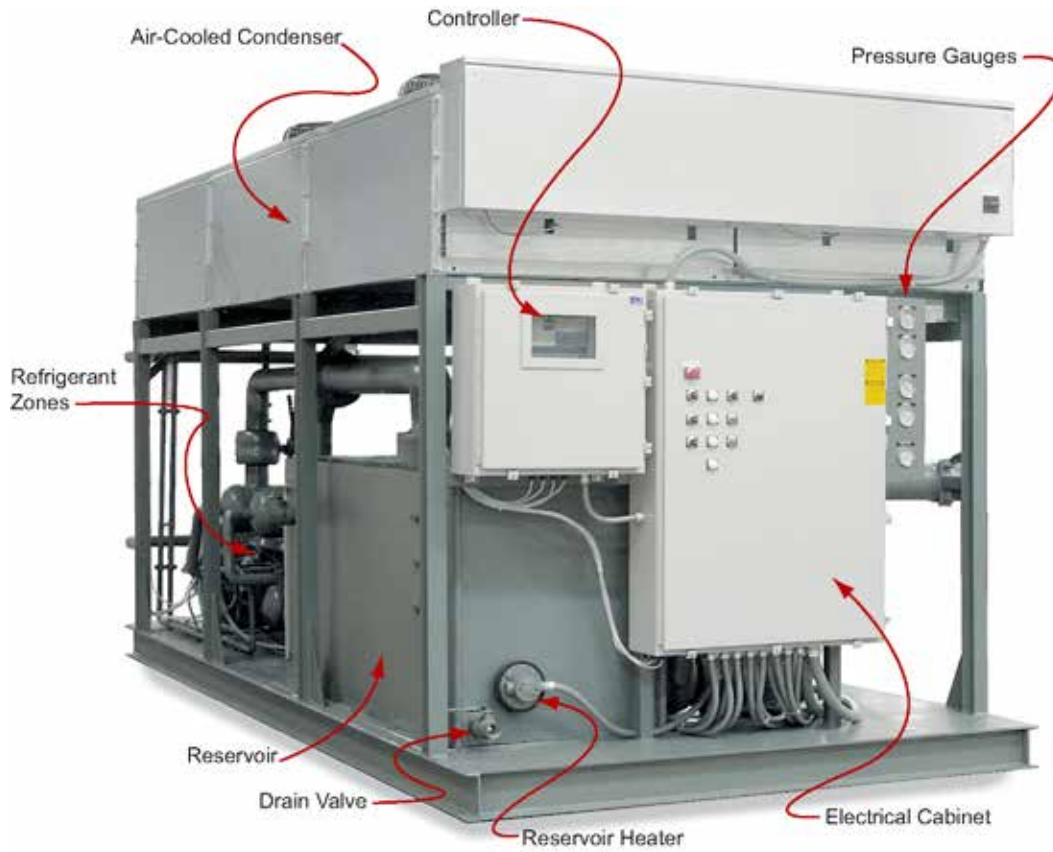
Nominal Capacity

Zones
S: Single Zone
D: Dual Zone

Chiller Control
M1: Single Zone
MZC: Dual Zone
PLC: Single or Dual Zone

of Pumps
1P: Single Process Pump
2P: Process & Evaporator Pumps
3P: Process, Evaporator & Standby Pumps

1.8 COMPONENTS



2.0 INSTALLATION

- 2.1 General
- 2.2 Unit Location
- 2.3 Chilled Water Piping Installation
- 2.4 Air-Cooled Condenser
- 2.5 Make-Up Water Supply Connection
- 2.6 Electrical Connection
- 2.7 Piping installation



2.1 GENERAL

- A. Check the overall condition of the equipment prior to accepting delivery. Check for visible damage and document any evident damage on the delivery receipt. Shipping damage is the responsibility of the carrier.
- B. All process piping materials (such as hose, rigid piping, valves or filters) used in process water piping circuitry must be rated for 100°F minimum temperature and 100 PSI minimum pressure.
- C. All such materials must have the equivalent or larger diameter of the particular process connection that length of process water piping is connected to.

2.2 UNIT LOCATION

- A. Before placing the unit into position a review of the most suitable location must be made. This unit is designed for outdoor installation.
- B. Factors to consider when selecting a suitable installation location:
 - 1. Provision for adequate ambient air supply to the condenser.
 - 2. Loading capacity of roof or pad.
 - 3. Distance to suitable electrical supply.
 - 4. Accessibility for maintenance.
 - 5. Applicable building codes.
 - 6. Adjacent buildings relative to noise levels.
- C. **Foundation or roof location.** The chiller must be installed on a rigid and level mounting surface with adequate strength to support the operating weight of the chiller including the weight of water and attached piping.
- D. Provision for adequate air supply for condenser:
 - 1. The unit should be located in an area free of foreign material which could clog the condenser air intake. It should be located on a hard level surface, a concrete pad is recommended.
 - 2. All sides of the unit must be a minimum of 4 feet away from any wall or obstruction. Overhead obstructions are not permitted. If enclosed by walls, the unit must be installed as indicated for a unit in a pit.
 - 3. For installation of multiple units, a minimum of 8 feet is required between units placed side by side. If placed end to end a minimum of 4 feet is required between units.
 - 4. Units in pits must have the top of the condenser level with or above the top of the pit and a minimum of 8 feet is required between the unit and the pit walls.



5. Louvers/fences must have a minimum of 80% free area 4 feet minimum clearance between the unit and the lovers/fence. Height of the louver/fence must not exceed the top of the unit.
6. If the chiller is installed in an environment where ambient temperatures could be under 35°F and/or if the unit operating set point will be 48°F or lower, a glycol and water solution must be used instead of water. See section 8.1 for glycol ratio recommendations and proper unit settings.

2.3 CHILLED WATER PIPING INSTALLATION

- A. There are two piping connections on the unit. One is labeled **TO PROCESS**, and the other is labeled **FROM PROCESS**. Refer to typical drawings for recommended piping practices or optional plant layout drawing if supplied.

- B. **FROM PROCESS** : a rigid pipe should be connected to the return process header and dropped through the circular opening in the reservoir lid on the 'hot' side of the reservoir. The return water pipe must extend below the surface of the tank water during operation (approx. 1.5' above the bottom of the tank to prevent unwanted aeration of the process water). Cut the end of the return pipe at a diagonal and face the open side of the pipe end away from the suction ports of the tank.

From Process

This label marks the From Process connection

- C. **TO PROCESS** : Connect the to process port to the process supply header.

To Process

This label marks the To Process connection

- D. Install a high volume basket strainer in the **FROM PROCESS** line with isolation valves. A basket strainer or bag filter with a 20 mesh (400 micron) or finer screen will protect the unit. Installing a filter that is too fine may be unnecessary and may result in frequent filter maintenance.



Typical wye strainer - Not recommended.

A “wye” type strainer is not recommended because it does not have adequate debris holding capacity.

- E. Process water piping should be designed to avoid excessive elbows and/or lengths of pipe or hose. Insulation of these lines is recommended to prevent condensation and capacity losses due to heat absorption.
- F. Valves and filters may be installed in the process water piping to facilitate service and maintenance provided that such devices maintain the full inside diameter of the process connection. If installed, all such devices must be open and clean during unit operation.

2.4 AIR-COOLED CONDENSER

- A. The unit should be located in an area free of foreign material which could clog the condenser air intake. It should be located on a hard level surface, a concrete pad is recommended.
- B. All sides of the unit must be a minimum of 4 feet away from any wall or obstruction. Overhead obstructions are not permitted. If enclosed by walls, the unit must be installed

as indicated for a unit in a pit.

- C. For installation of multiple units, a minimum of 8 feet is required between units placed side by side. If placed end to end a minimum of 4 feet is required between units.
- D. Units in pits must have the top of the condenser level with or above the top of the pit and a minimum of 8 feet is required between the unit and the pit walls.
- E. Louvers/fences must have a minimum of 80% free area and 4 feet minimum clearance between the unit and the louvers/fence. Height of the louver/fence must not exceed the top of the unit.
- F. If the chiller is installed in an environment where ambient temperatures could be under 35°F and/or if the unit operating set point will be 48°F or lower, a glycol and water solution must be used instead of water. See section 8.1 for glycol ratio recommendations and proper unit setting.



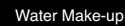
Typical Process Connections shown on a single zone unit.



Typical Process Connections shown on a dual zone unit.

2.5 Make-up WATER SUPPLY CONNECTION (Optional - in non-freeze Climate applications only)

- A.** The automatic water make-up system continually monitors the reservoir tank and fills it when needed. Connect as follows:
1. Using appropriately rated hose or fluid piping connect the “water make-up” connection to the plant’s water source.
 2. Minimum make-up water supply pressure is normally 20 psi.
 3. Install an owner supplied shut off valve in the make-up water supply line. Install this valve on the outside of the unit.
 4. Use a back flow prevention device as may be required by local codes to prevent possible contamination of potable water.
- B.** Do not use automatic water make-up system when operating with glycol below 48°F or when ambient temperature may be 35°F or lower.



This label marks the Water Make-up connection

2.6 ELECTRICAL CONNECTION



WARNING: Check local codes to determine proper use of back flow prevention device in water make-up supply line.



WARNING: Do not connect the unit to a voltage supply not equal to the unit’s voltage requirements as specified on the unit’s data plate. Use of incorrect voltage will void the unit’s warranty and cause a significant hazard that may result in serious personal injury and unit damage.



WARNING: Electric Shock Hazard. High Voltage is present in the electrical cabinet. Disconnect power before servicing. Follow all facility lock-out tag-out procedures.

A. STANDARD MODELS

1. Units are constructed with a weather resistant electrical enclosure and branch circuit fusing. Electrical power supply requirements are identified on the equipment data plate. Determine the plant’s voltage supply is the same as the unit’s voltage requirements.
2. All electrical wiring must comply with local codes and the National Electric Code.
3. Electrical power supply requirements for standard units are identified on the equipment data tag. Determine that the plant’s voltage supply is the same as the unit’s voltage requirements, taking into account the SSCR Rating.

4. A customer supplied, four conductor cable is required for connection to a customer supplied fused disconnecting means. The fused disconnecting means shall be sized and installed according to the unit's power supply requirements and local electrical codes. (Some custom units may include a fused or non-fused disconnect switch.)
5. Connect the four conductor power cable to the power entry terminal block on the unit's electrical panel. Then connect the power cable to the fused disconnect switch. There is no power entry hole into the electrical cabinet. This allows the matching of the entry hole size and location to the customer supplied fittings.
6. A unit specific electrical drawing is shipped with the unit.
7. Voltage supplies must be within +/- 10% of the name plate voltage and must be within 2% from leg to leg. Extreme voltage imbalance or using the wrong voltage can damage your chiller and cause premature unit failure as well as a safety risk.
8. A proper ground is required for the unit.



Typical data tag.

B. CONTROL CIRCUIT WIRING

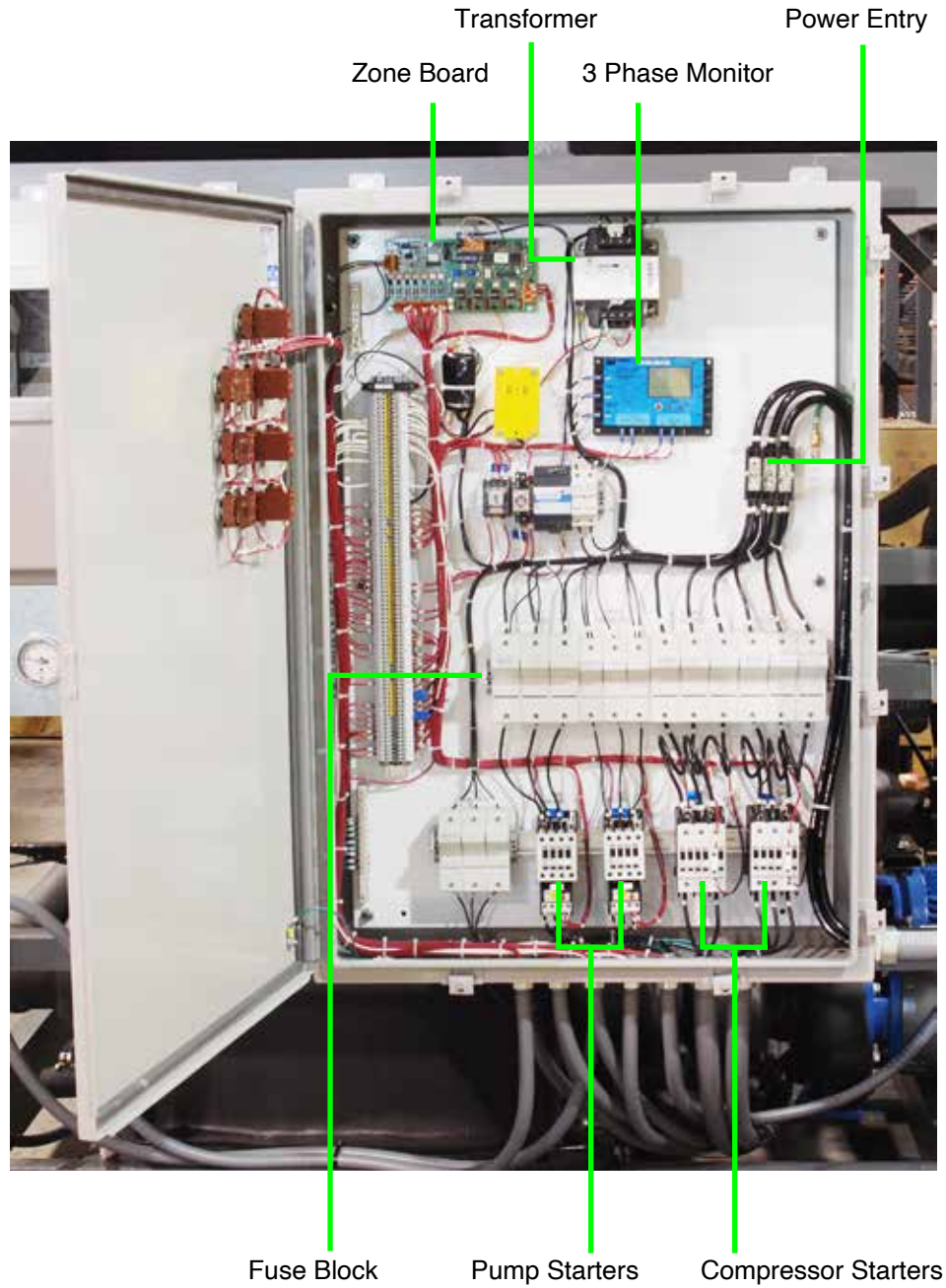
1. The unit's supplied control circuit is 110 volt, 1 phase, 60 cycle.
2. The control circuit is supplied by the factory installed transformer. A control circuit fuse is provided.

C. GENERAL

1. Make certain all ground connections to the unit are properly affixed.
2. Make certain power conductor, disconnecting means, and fusing are properly sized according to the unit's power supply requirements.
3. Follow all local and national codes.
4. Make certain that all owner and factory wire connections are tight before applying power to the unit.

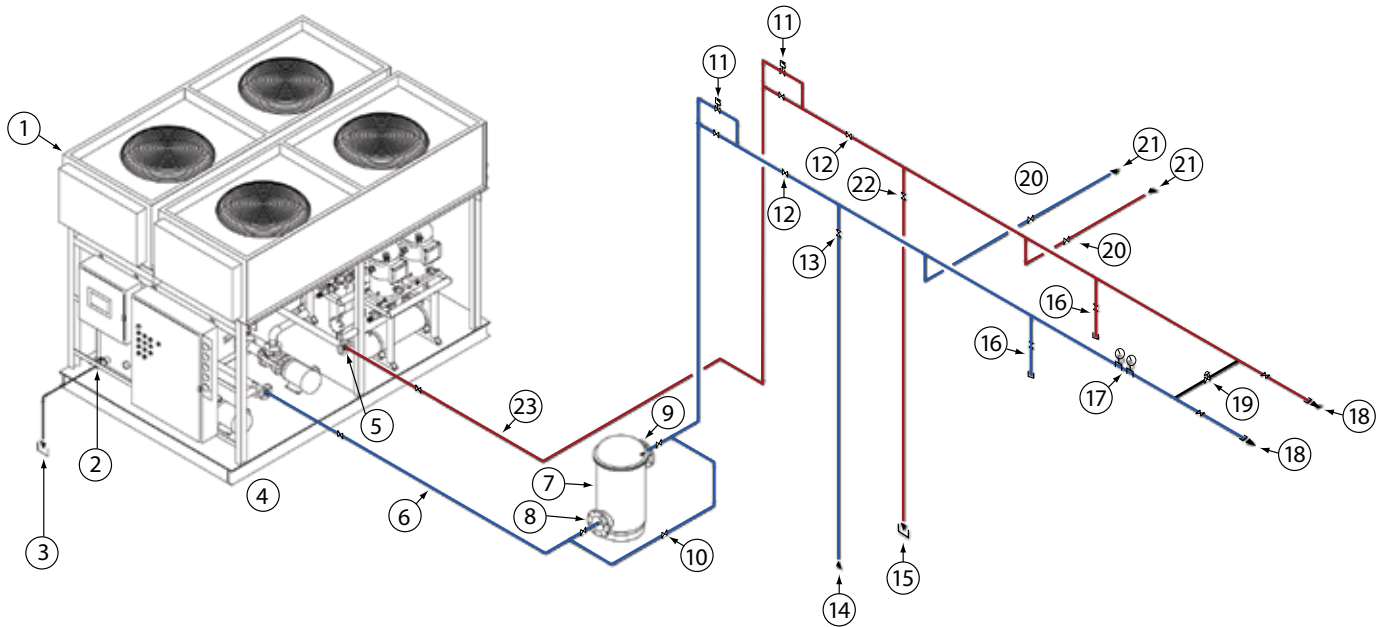


WARNING: Check that all electrical connections are tight before starting. Disconnect power before servicing. Follow all facility lock-out tag-out procedures.



Typical electrical panel show. Refer to the electrical drawing provided for details to the particular unit.

2.7 PIPING INSTALLATION (TYPICAL)



This drawing is supplied to demonstrate a possible piping configuration for the equipment and is general in nature showing pipe sizes and basic routing. It is not intended to be inclusive of every detail required for specific location and installation. Consult with a professional engineer to determine specific needs before installation.

1. Chiller (2 pump outdoor system).
2. Reservoir Drain Connection.
3. Open Drain (can use separate drain or tie into system multi-use drain Item #15).
4. Pump discharge connection (supply To Process).
5. Reservoir Return Connection (From Process).
6. Chilled Water Pipe (To Process, this pipe runs from the outdoor chiller location into the building / process area).
7. Filter (MLS Series In-Line full flow design).
8. Water Inlet Connection (filter).
9. Water Outlet Connection (filter).
10. Bypass Pipe With Valves (redirection of process water flow during filter service).
11. Drain-Back Dam (keeps header pipes full during pump shut down periods).
12. Main Header Valves (closed for header service or during use of alternate source of cooling water).
13. Alternate Source of Cooling Water On/Off Valve (for system emergency back-up).
14. Alternate Water Supply Source (for system emergency back-up).
15. System Multi-Use Open Drain (reservoir overflow, reservoir drain, system emergency back-up).
16. Process Water Drops From Header To Use Point (valved for service shut-off).
17. Pressure Gauge and Thermometer (for system performance monitoring and evaluation).
18. Header Ends Valved and Capped (for future expansion).
19. Header By-Pass Valve (adjustable and pressure activated to maintain flow in header during low process demand).
20. Branch Header Valves (for header service isolation).
21. Branch Header.
22. Valve to Open Drain (for system emergency back-up).
23. Chilled Water Pipe (from process, this pipe runs from the building / process area to the outdoor chiller location).

3.0 OPERATIONS

- 3.1** General
- 3.2** Start Up / Operations Procedure
- 3.3** M1 Control Instrument
- 3.4** LE Control Instrument
- 3.5** MZC Control Instrument
- 3.6** MZC Zone Board
- 3.7** Configuration Switch Adjustment (MZC only)
- 3.8** Controls
- 3.9** Pressure Gauges and Alarm Beacon
- 3.10** Digital Pressurestat Setup
- 3.11** Zone Lead Lag (MZC only)
- 3.12** Shut Down Procedure



3.1 GENERAL



WARNING: Follow all Factory operations procedures. Failure to do so may create a hazardous operating condition which may result in serious operator injury and/or unit damage.

A. Failure to follow the factory required operations procedure may adversely affect the unit's ability to adequately control process temperature and may create a hazardous operating condition which may result in serious operator injury and/or unit damage.

B. IMPORTANT. If this unit contains a hermetic or semi-hermetic reciprocating compressor it is equipped with a crankcase heater on the compressor. While the compressor is idle, the crankcase heater prevents freon vapor from migrating to and condensing in the compressor crankcase. If freon is allowed to condense in the crankcase, it can be drawn into the cylinders upon start up. This can cause catastrophic damage to the connecting rods, pistons, and valve plates.

To avoid this, **BEFORE THE UNIT IS STARTED, THE POWER SUPPLY SHOULD BE APPLIED TO THE UNIT FOR AT LEAST 12 HOURS, OR UNTIL THE BOTTOM OF THE COMPRESSOR IS WARM TO THE TOUCH.**

If the power has been disconnected more than two hours, the power should be applied for six hours before restarting. Power should be applied to the unit continuously, except for service purposes. The crankcase heater should be checked for proper operation on a regular basis.

C. The OPERATIONS segment of this manual is divided into the following sections:

3.2 Start up/operations - follow this segment to start the unit after the initial installation to the process system or to restart the unit after re-installation to the same or different process system. This section includes information on system fill, electric motor phasing (motor rotation) and process flow adjustments.

3.3 Chiller Control - follow this segment to start up and operate the chiller control. This section includes information on setpoint selection and adjustment, and feature explanations. There are three types of control that can be installed on the OACS unit:

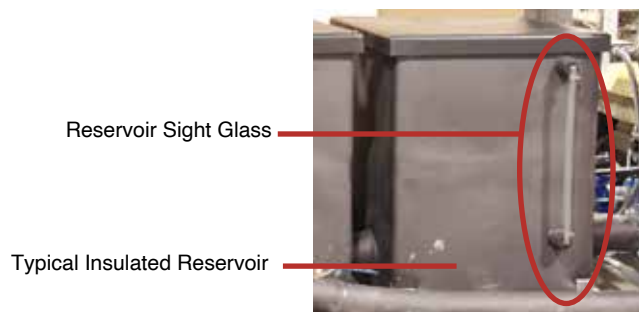
- a. CF Controller
- b. LE Controller
- c. MZC III Controller

3.4 Shut down procedure - follow this segment to shut down the unit. This segment includes information on system shut down, electrical power supply precautions, and disconnection from system.

3.2 START UP / OPERATION PROCEDURE

A. System Fill

1. For operating temperatures from 48°F to 80°F use water to fill the unit. For operating temperatures below 48°F a water and propylene glycol mixtures must be used. An inhibited propylene glycol can be used for operating temperatures above 48°F if desired to prevent corrosion and scaling. Use the minimum ratio that is recommended by the glycol manufacturer. See section 8 of this manual for more information.
2. The unit has an internal reservoir which must be filled and maintained for proper operation. The unit has a level switch mounted at the proper water level in the reservoir.
3. **WATER QUALITY CONTROL.** Lack of, as well as, improper water treatment can damage the chilling unit. The services of competent water treatment specialist should be obtained and their recommendations followed. It is the equipment owner's responsibility to prevent damage from foreign material or inadequate water treatment. See water treatment section in **section 1.6** of this manual for more information.
4. **FOR AUTOMATIC FILL:** Always install a manual shut off valve on the make-up water supply on the outside of the unit. When electrical power is applied to the unit but the On/Off Selector is in the 'off' position open the owner supplied shut off valve. The level switch will activate the make-up solenoid which will open and the water supply will fill the reservoir tank. **Do not use automatic fill when operating at temperature below 48°F or when ambient temperature may be 35°F or lower.**
5. **MANUAL FILL:** Add fluid directly to the reservoir. When the pump is first started, as process lines are filled and air is purged, additional fluid may be required to restore the reservoir to the correct level. Verify reservoir level via the coolant sight glass.



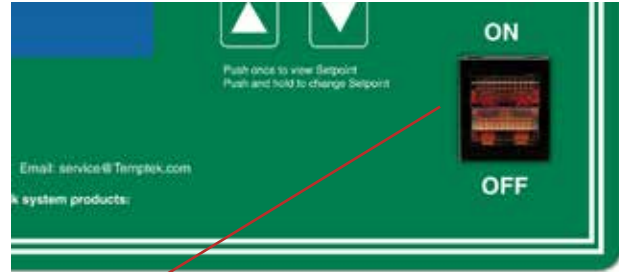
6. Do not use deionized water in this unit unless your unit was specifically designed for use with deionized water. Consult factory if not certain.

B. PROPER ROTATION (PHASING) OF SCROLL COMPRESSORS & PUMPS & FANS

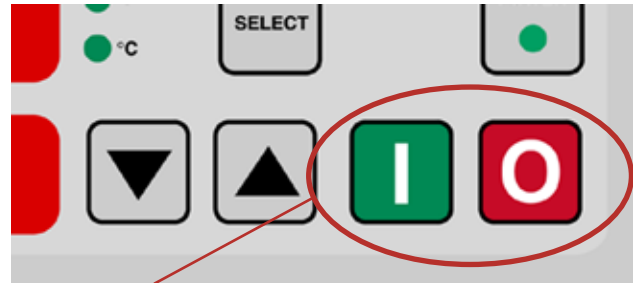
1. Correct compressor and pump rotation is critical for unit performance and to avoid severe damage to the compressor.
2. All models, excluding remote outdoor condenser systems, have their compressor and pump motors factory phased in unison. Therefore, you should only need to check one motor to verify phasing. However, we recommend verifying all motor rotations.
3. After electrical installation the rotation must be checked by observing the pump motor shaft on the end of the pump and comparing its rotation to the directional arrow on the motor.
4. If the rotation needs to be changed it should be done at the main power entry by switching any two power conductors at the terminal block or customer supplied main power disconnect. Recheck rotation before operating the units.
5. Caution must be taken when checking rotation to avoid electrical shock.
6. A scroll compressor may make a loud rattling noise when rotating in the wrong direction.
7. Operating the scroll compressor in the wrong direction will cause the unit to trip on it's internal temperature limit and may cause unit damage. When the temperature limit trips, the compressor must be allowed to cool before it will restart. This may take substantial time.
8. Procedure to set proper rotation:
 - a. Supply electrical power to the unit. Once the correct voltage is supplied to the unit, the POWER switch on the unit's control panel will illuminate. Adjust the setpoint to 70°F or higher to prevent the compressor from activating during this procedure.
 - b. Remove all necessary cover panels to access the pump motor.
 - c. Locate the pump's electric motor. The operator must identify the motor shaft inside the electric motor housing. The motor shaft can be seen through the vent slots in the motor housing or by removing the shaft cover.
 - d. Toggle the Pump ON/OFF switch. This will quickly cycle the pump motor "on" and then "off".

CF Controller. Toggle the illuminated On/Off switch.
LE Controller. Toggle the Start and Stop buttons.
MZC Controller. Toggle the Process Pump Operator.
 - e. Observe the motor shaft. When the ON/OFF SWITCH is on, the motor shaft will rotate. When switched off, the shaft will slowly "coast" to a stop. As the shaft slows, the operator can identify the rotation of the motor





Illuminated On/Off switch on CF Controller



On/Off push buttons on LE Series Controller



Typical Process Pump Switch on units with MZC control.

shaft. Correct rotation (correct phase) is “clockwise”, when viewed from the rear of the motor. Incorrect rotation is “counter-clockwise” (incorrect phase) when viewed from the rear of the motor. If the shaft does not rotate when the ON/OFF SWITCH is on, the operator must identify the cause as outlined in the troubleshooting and repair section of this manual.



Correct shaft rotation is clockwise.

- f. If the motor shaft is phased correctly (shaft turns in a clockwise direction), continue with **step C**. If the motor shaft is **NOT** phased correctly (shaft turns in a counter-clockwise direction), correct as outlined in **step 2**.

- 2. If the unit is phased **incorrectly**, the operator must:

- a. Disengage the electrical power supply to the unit at the unit’s disconnect

switch. Follow all facility proper lock-out tag-out procedures before proceeding.

- b. Once the electrical power supply is disengaged the operator can change rotation by switching any two power conductors at the terminal block or customer supplied main power disconnect.

C. PROCESS FLOW ADJUSTMENTS

1. The operator must determine and set proper water flow rate for the most efficient and trouble free operation.
 - a. Water flow rate through the process is determined by the pressure losses in the process loop. Generally, higher flow rates result in turbulent flow achieving maximum temperature control and lower maintenance. Since the evaporator in most liquid chillers is flow sensitive, the efficiency of operation is directly related to the flow of liquid.
 - b. Maximum chiller efficiency is obtained at approximately 2.4 gpm per ton of rated capacity. Low liquid flow can reduce efficiency and in some cases allow ice to develop in the evaporator which can damage the evaporator. Excessive liquid flow will trip the motor overload protection circuit.
2. **Excessive flow will cause the motor to operate at high amperage and eventually open the thermal overload safety shutting off the motor.** Motor amperage rating may be acquired on the motor nameplate.
3. **Low flow may result in poor temperature control and high temperature rises.** To correct this problem, a bypass system must be installed between the to and from process lines. With the bypass valve fully closed, slowly open the valve until the correct motor amperage is achieved. Motor amperage rating may be acquired on the motor nameplate.

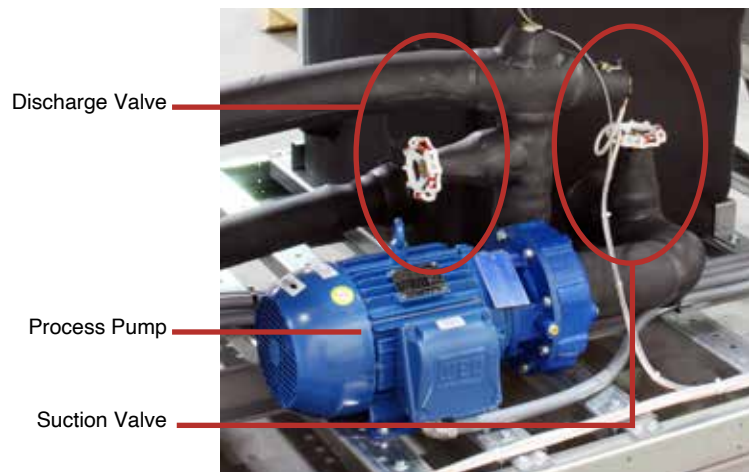
D. ADJUSTMENT OF CENTRIFUGAL PUMP.

When starting a piece of equipment with a centrifugal pump, it is important to properly set the flow rate to prevent overloading of the electric motor. The following example is the start up procedure for a two pump central chiller.

1. Fully open the suction valves to the pumps allowing the pump case to fill with water. Never allow the pump to operate dry, this can cause shaft seal failure.
2. Close the discharge valves. A centrifugal pump can be operated with no flow without damage, although this should not be for an extended period of time. Internal friction will cause the water in the pump case to overheat.
3. Place an amp meter on one leg of the process pump leads at the motor starter block and start the motor. Slowly open the discharge valve allowing the process piping to fill with water. After flow is established, continue to open the discharge valve. The amp draw will increase as the flow increases until you reach the run load amp rating listed on the motor data tag.



4. **Please note:** On initial start up the water use points may not be sufficient to fully load the motor, as you add use points you should recheck the amp draw on the motor and adjust the discharge valve as needed to prevent overloading of the motor.
5. Place an amp meter on one leg of the tower pump leads and start the motor. Slowly open the discharge valve allowing the piping to fill with water. After flow is established, continue to open the discharge valve. The amp draw will increase as the flow increases until you reach the run load amp rating listed on the motor data tag.
6. Never operate a pump without water in the case or never operate a pump without checking for proper amp draw.
7. Always operate the pump with the suction valve fully open. Adjust the amp draw with the discharge valve starting from a closed position. Starting from a wide open position can give a false reading and result in motor failure.
8. If during operations the motor overload trips, the overloads will need to be manually reset to restart operations. Once the pump is restarted, check for excessive motor amps at the motor starter block and throttle back the pump's discharge valve as required.



Typical Process Pump with suction and discharge valves.

3.3 CF CONTROL INSTRUMENT

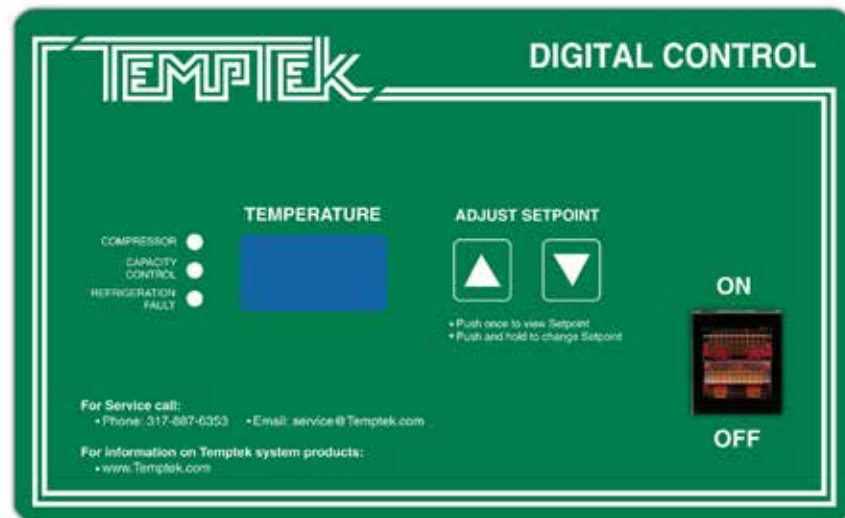
A. INSTRUMENT START-UP

1. When the correct electrical power and adequate water supply pressure are supplied to the unit, it is possible to start the unit.
2. Upon power up, the instrument displays "ChF" indicating that the unit is in Fahrenheit temperature mode or "ChC" indicating that it is in Celsius mode. The control then shows the current setpoint for approximately 2 seconds before reverting to the To Process temperature. When power is supplied to the unit, the ON/OFF switch will illuminate.

3. PRECAUTIONS:

- a. The chiller control is programmed from the factory with a setpoint range of 48° to 70°F. To operate below 48°F, the addition of inhibited propylene glycol and modification of the limit control settings are required. Diligent monitoring of the water/glycol solution is mandatory to prevent freezing of the evaporator. Freezing may cause the evaporator to rupture allowing water and freon to mix which will cause major damage to the refrigeration system.
- b. R134A and R407C models operating above 70°F and R404A models operating above 60°F require the addition of a refrigerant crankcase pressure regulating (CPR) valve. The CPR valve is necessary to prevent overloading of the compressor which can cause premature failure. R410A models may be operated up to 80°F without a CPR valve. Contact your local refrigeration contractor or the factory for further information. The operating range of the chiller control may be changed to 10°F - 90°F by adjusting the Setpoint Lockout (SPL) jumper. Refer to Section 3.3.c.3 of this manual for more information.

B. INSTRUMENT OPERATION



CF Series Control.

1. **To start the unit, toggle on the illuminated ON/OFF SWITCH.** The pump will start and the chiller control will begin temperature control operations.
2. To select setpoint temperature, press and hold the UP ARROW or DOWN ARROW keys until the desired set point temperature is displayed in the TEMPERATURE WINDOW. The default range for the setpoint temperature is 48° - 70°F or 9° - 21°C.
3. The setpoint temperature can be displayed by pressing the UP ARROW or DOWN ARROW keys. The setpoint temperature will be displayed for 5 seconds.

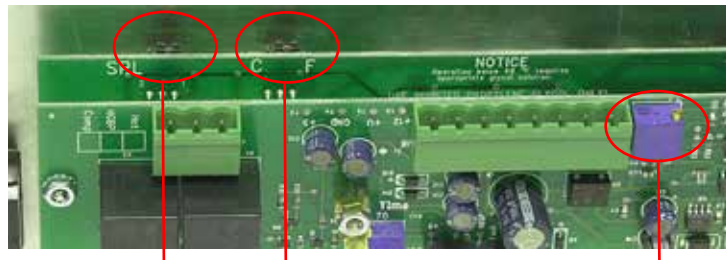
4. When the compressor is turned off, the instrument will wait 3 minutes before turning it back on regardless of the To Process temperature or setpoint. If a fault has occurred, the control will attempt to turn the compressor back on after 3 minutes. If the fault condition remains, the compressor will not restart and the control will retry after 1 minute. This sequence will repeat 3 times then the system will lock-out and the unit must be powered off/on to restart the unit.
5. Under normal conditions (no fault conditions, compressor has been off for three minutes) the instrument will turn on the compressor when the To Process temperature is above the setpoint. The instrument will engage the capacity control system (digital unloading or hot gas bypass) when the To Process temperature is below the setpoint by no more than 3 degrees.

Units equipped with a digital scroll compressor will operate in the unloaded state for a maximum of 50 seconds out of every 60 seconds.

The instrument will turn off the compressor and capacity control system when the To Process temperature is 4 degrees or more below the setpoint.

C. CONTROL INSTRUMENT COMPONENTS

1. **ILLUMINATED ON/OFF SWITCH:** This rocker switch starts or stops the unit. Electrical power is supplied to the unit when the switch is illuminated.
2. **UP ARROW and DOWN ARROW KEYS:** Depress and hold this push button to increase (UP ARROW) or decrease (DOWN ARROW) the setpoint temperature. If the push button is pressed momentarily the setpoint value is incremented or decremented by one degree. If the push button is held down the setpoint will increase or decrease continuously.
3. **SETPOINT LOCK OUT JUMPER:** This jumper controls whether the user is allowed to reduce the setpoint below 48°F or 9°C. If the jumper is in position 1 (farthest from the SPL label) the user IS NOT ALLOWED to reduce the setpoint below 48°F or 9°C. If the jumper is in position 2 (closest to the SPL label) the user is allowed to reduce the setpoint to 10°F or -11°C.



Setpoint Lock Out Jumper

Temperature Display Jumper

Probe Calibration

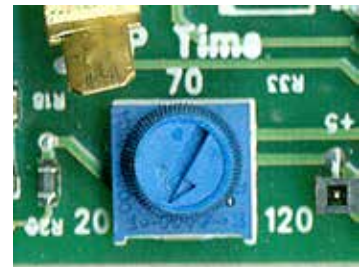
4. **TEMPERATURE DISPLAY JUMPER:** If this jumper is in the “F” position, the To Process and Setpoint temperatures are displayed in Fahrenheit. If the jumper is in the “C” position, the To Process and Setpoint temperatures are displayed in Celsius.
5. **Probe Calibration:** This pot (CALPOT 1) is used to calibrate the probe circuit.

D. STATUS LIGHTS

1. **COMPRESSOR:** Illuminates when compressor is turned on.
2. **CAPACITY CONTROL:** Illuminates when capacity control system is turned on.
3. **REFRIGERANT FAULT:** Illuminates when there is a high pressure or low pressure fault. Check troubleshooting section of this manual for more details.

High Pressure Fault. If the chiller control detects a high pressure condition it will immediately turn off the compressor and hot gas bypass.

Low Pressure Fault. After the compressor is turned on, the control has a 15 second buffer for the low pressure fault. If a low pressure condition occurs within the first 15 seconds, the control waits the amount of time specified by the “LP TIME” potentiometer before indicating an fault and turning off the compressor. If the condition is corrected before the time expires, no fault occurs. If a low pressure condition occurs 15 seconds after the compressor turns on, the instrument waits 20 seconds before indicating a fault and turning off the compressor.



Low Pressure Potentiometer.

Please Note : If the unit low pressure limit is activated three (3) consecutive times during start-up the unit will lock out and will not be allowed to start. When the chiller control locks out due to low pressure after three (3) attempts, there is a problem that must be resolved before the unit should be restarted. To re-start, the unit must be powered down and back on. This should only be attempted after the cause of the low pressure condition has been found and the issue has been resolved. Repeatedly re-starting the unit will cause damage to the unit often including freezing and rupture of the chiller evaporator. For other troubleshooting help, please refer to Section 4.4.

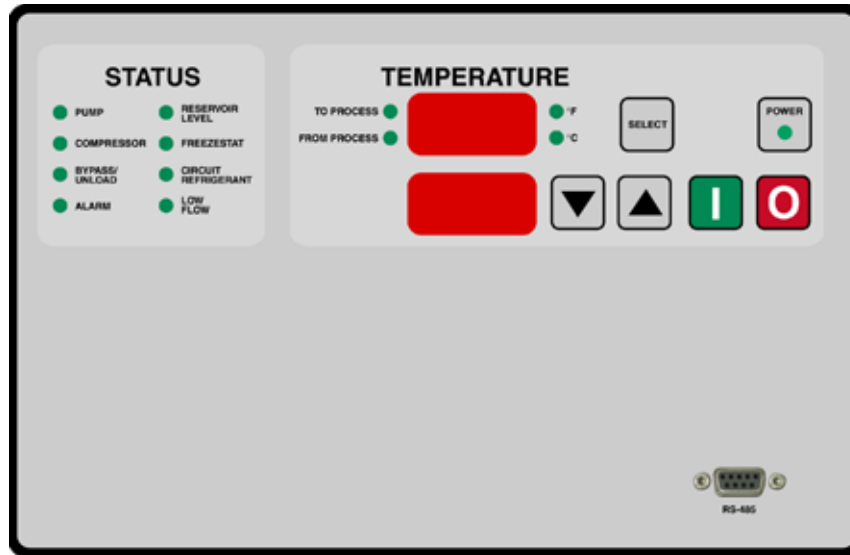
E. TEMPERATURE DISPLAY

1. A three digit display window indicates the appropriate temperature.

The window also displays the numeric value for the setpoint temperature.

2. The To Process temperature is always displayed unless a button has been pressed. If there is a probe error, the display will show three dashes "---".
3. When the water temperature in the chiller is above approximately 100°F the display will show three dashes "---".

3.4 LE CONTROL INSTRUMENT



LE instrument display

A. INSTRUMENT START-UP

1. When the correct electrical power and adequate water supply pressure are supplied to the unit, it is possible to start the unit for temperature control duty.
2. When the electrical power supply is supplied to the unit, the instrument will momentarily illuminate all indicating lights and digits on the display head. After a short delay, the instrument will display the software version number. At this time, the operator can verify that all lights and digits are functioning properly. If the operator determines an indicating light or digit does not illuminate, the instrument must be removed and sent to the factory for repair.
3. With electrical power supplied to the unit, the POWER light will illuminate. The display will remain dark with exception of the RESERVOIR LEVEL light which will be 'solid green' if this condition is 'ok'. The FLOW light will 'flash red' to indicate that the pump is not on (not generating flow). This is the normal "stop" state of the instrument. If the operator determines the RESERVOIR LEVEL light is 'flashing red', the operator must determine the reason and correct:
 - a. **Water level:** When the reservoir water level is below the level switch mount, the reservoir level light will flash. Restore the reservoir to the proper operating level.

4. After a 'flashing red' indication is diagnosed and repaired, the 'flashing red' indication will automatically turn 'solid red'.
5. When the START key is pressed, the instrument will immediately check the status of the motor overload switch (PUMP light); the freezestat safety switch (FREEZESTAT light); high pressure safety switch, low pressure safety switch and the oil pressure safety switch (CIRCUIT REFRIGERANT light) for acceptable operating conditions. If these systems are found to be 'ok', the lights will be 'solid green' and the unit will begin process operations. If a system is not found to be 'ok', the light will 'flash red' and the instrument will prevent operation (check the troubleshooting section of this manual for more information):
 - a. **Motor overload switch open:** A dark PUMP light possibly indicates the electric pump motor overload relay is open. The pump motor is protected from overload conditions (excessive flow) by a set of thermal overload relays which open (trip) with excessive amperage and prevent electric power from reaching the electric motor. If the overload relay is open, the overload relay must be reset before operations can continue. An excessive flow condition must be corrected immediately.
 - b. **Freezestat safety switch open:** A 'flashing red' FREEZESTAT light indicates the freezestat safety switch is open. This normally occurs when the 'to process' temperature is below the freezestat setting. The typical freezestat setting is 38°F for setpoint temperatures from 48° to 70°F. If the 'to process' temperature is higher than the freezestat setting, check for proper operation of the freezestat safety switch.
 - c. **High pressure switch open:** A 'flashing red' CIRCUIT REFRIGERANT light possibly indicates the refrigerant high pressure switch is open. This normally occurs when condensing pressures exceed normal parameters, as indicated by the HIGH PRESSURE refrigerant gauge. To continue operations, the operator must reset the safety switch by pressing in the reset lever. A high pressure condition must be corrected immediately.
 - d. **Low pressure switch open:** An "L-P" in the temperature display window indicates the low pressure safety switch is open. Chiller operations stop when the refrigerant suction pressure drops below 58 PSI. While the compressor is inactive, the pressure normally builds back up to the cut-in pressure of 63 PSI, at which point the low pressure safety switch automatically resets, and a 3 minute time delay cycle begins (to prevent compressor short-cycling). If the low pressure safety switch does not reset, operations are prevented. Contact the service department for further instructions.
 - e. **Low oil pressure switch open: (not applicable to all units)** A 'flashing red' CIRCUIT REFRIGERANT light indicates the oil pressure safety switch is open. The oil pressure safety switch is only found on some compressors. Normally, the switch will open if there is insufficient oil in the compressor crankcase or due to lack of sufficient compressor warm up before operations start. This switch must be manually reset before operations can continue.



6. Press the START push button to activate the coolant circuit. If the existing coolant temperature is above the currently selected setpoint temperature, the refrigerant circuit will activate. The operator can stop process operations (refrigerant and coolant circuits) by pressing the STOP push button.
7. To select the operating setpoint, use the SELECT key to index through the temperature functions until the 'SP' is displayed in the top window. The current setpoint temperature is displayed in the bottom window. Use the UP and DOWN ARROW keys to change the setpoint temperature.
8. **PRECAUTIONS:** The instrument is programmed from the factory with a setpoint range of 48° to 70°F. To operate below 48°F, the addition of inhibited propylene glycol and modification of the safety control settings are required. Diligent monitoring of the water/glycol solution is mandatory to prevent freezing of the evaporator. Freezing may cause the evaporator to rupture allowing water and freon to mix which will cause major damage to the refrigeration system. Consult Factory for operating above 70°F.
9. After selecting the setpoint temperature, the operator may leave the display in the SET POINT state. The display will automatically return to the TO PROCESS temperature state after thirty seconds. If the operator leaves the display in any state other than the TO PROCESS state, the display will automatically revert after 30 seconds of inactivity.
10. The setpoint temperature is continuously displayed in the lower window for quick comparison to actual process temperature.
11. The operator can stop operations by pressing the STOP push button. This will disengage the refrigerant and coolant circuits.

B. INSTRUMENT OPERATION

1. When the START push button switch is pressed on, the instrument will begin temperature control operations and the 'to process' temperature will begin to drop.
2. When the 'to process' temperature drops 1° below the setpoint, the instrument will activate the capacity control system to match the cooling capacity to the present load, as indicated by the BYPASS/UNLOAD light.
3. If the load is less than the minimum capacity of the chiller, the 'to process' temperature will continue to drop. At 3° below setpoint the compressor will stop and enter a 3 minute time delay period before restarting at 1° above setpoint. The time delay is to prevent short cycling damage to the compressor.

C. INSTRUMENT CONTROLS

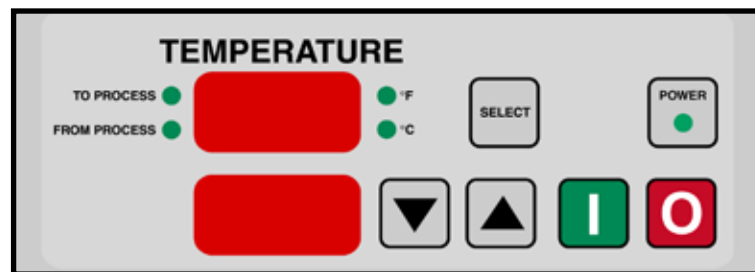
1. **START:** (green color button) this push button engages/disengages electrical supply to the coolant pump and refrigerant compressor. Please note that the refrigerant compressor will not start unless the coolant pump is operating.
2. **STOP:** (red color button) this push button disengages electrical supply to the



coolant pump and refrigerant compressor.

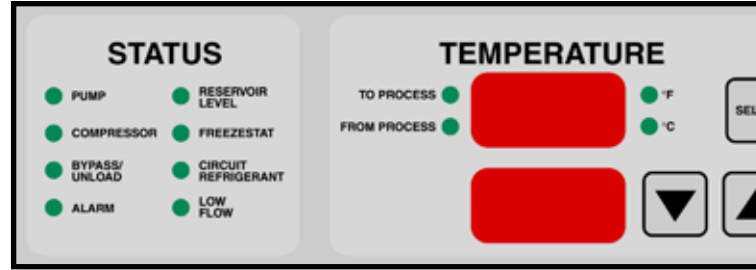
3. **SELECT:** Depress to index through the “to”, “from” and “set point” temperatures.
4. **UP ARROW:** Depress and hold this push button to increase the setpoint temperature. If this push button is pressed momentarily the setpoint value is incremented by one degree. If the push button is held down for more than one second, the setpoint will increase slowly at first and then faster after about two seconds.
5. **DOWN ARROW:** Depress and hold this push button to decrease the setpoint temperature. If this push button is pressed momentarily the setpoint value is incremented by one degree. If the push button is held down for more than one second, the setpoint will increase slowly at first and then faster after about two seconds.
6. **POWER LIGHT:** Illuminates when the proper supply of electrical power is applied to the unit.

D. TEMPERATURE DISPLAY



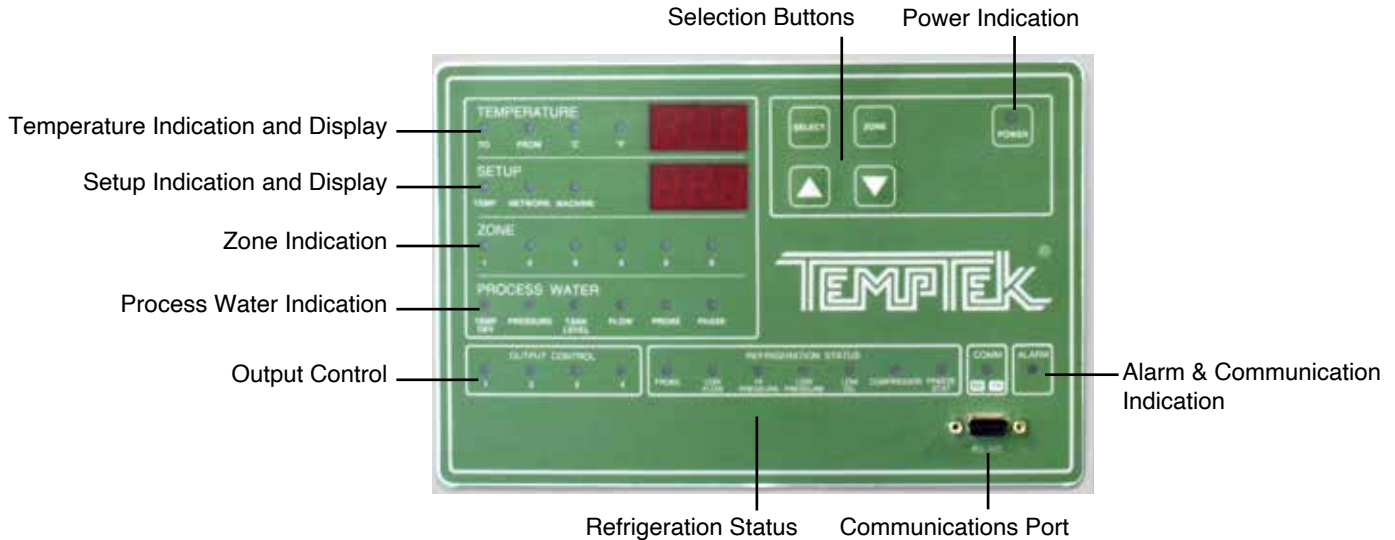
1. The upper three digit display window indicates the appropriate temperature either in **Fahrenheit** or **Celsius** (as selected). The lower window also displays the numeric value for the setpoint temperature. A ‘solid red’ TO or FROM light will illuminate beside the parameter currently being displayed.
2. The instrument is programmed at the factory to indicate temperature in Fahrenheit. The instrument can be programmed to display temperature in Celsius by changing the orientation of the DIP switch. Refer to the technical section of this manual for more information.
3. **TO PROCESS:** Indicates liquid temperature being delivered from the chiller.
4. **FROM PROCESS:** Indicates liquid temperature returning to the chiller.
5. **°F:** indicates temperature is displayed in Fahrenheit temperature scale.
6. **°C:** indicates temperature is displayed in Celsius temperature scale.

E. STATUS DISPLAY



1. **PUMP:** Illuminates 'solid red' when the coolant pump is operating. The PUMP light will remain dark if the pump is not operating.
2. **COMPRESSOR:** Illuminates 'solid red' when the instrument engages the compressor contactor. Engaging the compressor contactor supplies electrical current to the compressor. If the compressor is unable to operate, the light will remain dark.
3. **BYPASS/UNLOAD:** Illuminates 'solid red' when the instrument has engaged the capacity control system.
4. **ALARM:** Illuminates 'solid red' when the "to process" temperature has deviated +/- 10° from setpoint. Note: The temperature deviation alarm circuit is only activated after the chiller has cooled the circulating fluid to the setpoint one time.
5. **RESERVOIR LEVEL:** Illuminates 'flashing red' when the process water level has dropped below the safe operating level. When the reservoir level is 'ok', the light will remain dark.
6. **FREEZESTAT:** Illuminates 'flashing red' when the evaporator out temperature has reached the minimum safe operating temperature (normally 40°F) at which time the compressor will shut down to avoid water freezing. When the water temperature is above the freezestat setting, the light will remain dark.
7. **CIRCUIT REFRIGERANT:** Illuminates when a refrigerant safety switch (high pressure safety, low pressure safety or oil pressure safety) has opened preventing the compressor from operating until the condition is resolved. When the refrigerant circuit safety switch are 'ok', the light will remain dark.
8. **LOW FLOW:** Illuminates 'flashing red' when the process fluid flow is below the minimum safe operating rate. When the flow is above the safe operating rate, the light will be dark. When the flow rate is 'ok', the light will remain dark.
9. **L-P LOW REFRIGERANT PRESSURE:** When the refrigerant low pressure drops below 58PSI the compressor will stop and an "L-P" will be displayed in the temperature window. See troubleshooting section for more information.

3.5 MZC CONTROL INSTRUMENT



A. OPERATION NOTES

1. The chiller control is programmed from the factory with a setpoint range of 48°F - 90°F. To operate below 48°F, inhibited glycol must be added to the system and the system limit switches must be adjusted. In addition to the operating range of the chiller control instrument must be modified by changing the DIP switch on the control panel to allow for a wider setpoint range. Refer to section 8 of this manual for more information.
2. Diligent monitoring of the water/glycol solution is required to prevent freezing of the evaporator. Freezing may cause the evaporator to rupture allowing water and refrigerant to mix causing severe damage to the refrigeration system which is not covered under warranty.
3. On R22, R134A and R407C models operating above 70°F and R404A models operating above 60°F requires the addition of a refrigerant crankcase pressure regulating (CPR) valve. The CPR valve is necessary to prevent overloading of the compressor which can cause premature failure. R410A models may be operated up to 80°F without a CPR valve.

B. TEMPERATURE INDICATION AND DISPLAY

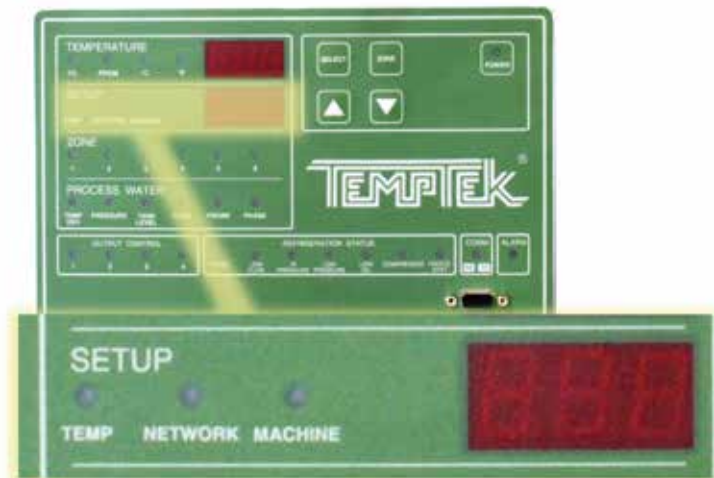
1. Temperature information is displayed via the three digit display window.
2. **TO:** Illuminates when the **TO PROCESS** water temperature is displayed. **TO** is the default setting of the **TEMPERATURE DISPLAY** window.
3. **FROM:** Illuminates when the **FROM PROCESS** water temperature is selected. **NOTE:** The instrument will revert back to the **TO PROCESS** temperature display after 10 seconds if the **SELECT** key is used to move from the **TO PROCESS** display. **NOTE:** Both **TO** and **FROM** lights are on when zone EVA IN and EVA



OUT temperatures are displayed. **NOTE:** Both to and from lights are on when zone EVA IN and EVA OUT temperatures are displayed

4. ° C: Illuminates when the ° C (Celsius) temperature display parameter is selected.
5. ° F: Illuminates when the ° F (Fahrenheit) temperature display parameter is selected. °F is the default setting of the instrument.

C. SETUP DISPLAY



1. When the **SELECT** key is pressed, and the unit is NOT in zone display the display will cycle forward through all available temperature and setup parameters. The currently selected setup parameter is indicated in the **TEMPERATURE** display window (i.e. "Hi" for High Deviation, "Lo" for Low Deviation) and the value is displayed in the **SETUP** display window. Values are changed with the **Up** and **Down** arrows. The available parameters are listed below:

2. Temperature/Setup display sequence:

Temperature Display	Setpoint Display
To	Setpoint
From	Setpoint
'SP'	Setpoint
'LE'	Lead Compressor
'HI'	High Temperature Deviation Limit
'LO'	Low Temperature Deviation Limit
'Pro'	Protocol Selection (SPI/CAC)
'Adr'	Protocol address selection (1-99 / 0-9)
'rAt'	Protocol baud rate selection (1200-9600)
'Unt'	Temperature units selection (° F/° C)

3. **TEMP:** Illuminates when the following parameters are selected:

To	To Process Temperature
From	From Process Temperature
SP	Setpoint Temperature
HI	High Temperature Deviation Limit
Lo	Low Temperature Deviation Limit

- a. When the instrument is in the TO, FROM or SP temperature display, the operator may adjust the setpoint temperature with the UP/DOWN arrow keys.
- b. **SP:** Programs the process setpoint. It can be set to a range of 70° - 48° or 90°- 10° depending on the state of SW-1, referenced in the switch description section.
- c. **HI:** Programs the high alarm temperature deviation limit. This is the high temperature setting at which an alarm is activated if the 'to process' temperature reaches it. 1-30 units selectable.
- d. **Lo:** Programs the low alarm temperature deviation limit. This is the low temperature setting at which an alarm is activated if the 'to process' temperature decreases to it. 1-30 units selectable.

3. **NETWORK:** Illuminates when the following parameters are selected:

Pro	Protocol selection
Adr	Protocol address selection
rAt	Protocol baud rate selection

- a. **Pro:** Sets the protocol selection. The protocol is the data format for communications between the unit and the host computer. SPI (standard Society of Plastics Industry) or CAC (standard used on older CMI machines) protocols selectable.
- b. **Adr:** Sets the communication address. This is the number assigned to the unit in a network. 1-99 units selectable in SPI protocol and 0 - 9 in CAMAC protocol.
- c. **rAt:** Programs the baud rate. The baud rate is the data transfer rate between the



unit and the host computer. 1200, 2400, 4800, 9600 units selectable.

4. **MACHINE:** Illuminates when the following parameters are selected:

Unt Temperature unit selection
Prb From process probe calibration

- a. **Unt:** Sets temperature display. Select 'F' for Fahrenheit temperature display or select 'C' for Celsius temperature display.
- b. **Prb:** Contact factory for details.

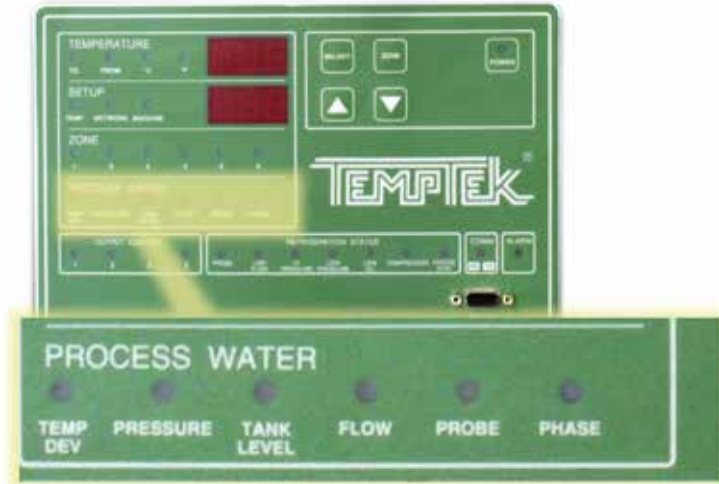
D. **ZONE DISPLAY**



- a. The LED's in this section indicate which ZONE is selected for viewing.
- b. The status for the selected Zone is displayed in the 'OUTPUT CONTROL' and 'REFRIGERATION STATUS' sections.
- c. The operator can select which zone is displayed by using the **ZONE** button. An ON or FLASHING LED indicates the selected zone.

E. **PROCESS WATER DISPLAY**

1. **TEMP DEV:** Illuminates according to the current state of temperature deviation:
 - a. **SOLID GREEN:** When the process temperature is within the programmed parameters.
 - b. **YELLOW:** If the SETPOINT or TO PROCESS temperature different is greater than the programmed HI/LO deviation settings.
 - c. **FLASHING RED:** after about 90 seconds in the YELLOW condition, the LED will display FLASHING RED and the alarm will be sounded. If the difference returns to within acceptable limits before the 90 seconds has elapsed, then the LED will return to GREEN.



2. **PRESSURE:** Illuminates according to the current state of process pressure:
 - a. **SOLID GREEN:** The process pressure is within the programmed parameters.
 - b. **FLASHING RED:** The process pressure has deviated out of the programmed parameters.
 - c. **SOLID RED:** The process pressure had once deviated out of the programmed parameters but is now within the programmed parameters.
3. **TANK LEVEL:** Illuminates according to the current state of tank level:
 - a. **SOLID GREEN:** The reservoir tank is at proper operating level.
 - b. **FLASHING RED:** The reservoir level has dropped below the proper operating level and the make-up supply system is activated to restore the water level
 - c. **SOLID RED:** The proper operating level has been restored.
4. **FLOW:** Does not display flow status at this time.
5. **PROBE:** Illuminates according to the current state of the process and zone probes:
 - a. **SOLID GREEN:** The process probes are ok and working fine.
 - b. **FLASHING RED:** One of the process probes is not functioning correctly.
 - c. **SOLID RED:** One of the probes had a fault, but the fault is no longer present.

6. **PHASE:** Illuminates according to the current state of electrical phase:
 - a. **SOLID GREEN:** The electrical phase is within the acceptable parameters.
 - b. **FLASHING RED:** Indicates improper phasing of the incoming 3 phase supply.
 - c. **SOLID RED:** The phasing had once been 'in fault' but is now restored.

F. OUTPUT CONTROL SECTION



1. The following LED's are SOLID GREEN when the output is "ON".
2. **COMPRESSOR:** Illuminates when the compressor has cycled on.
3. **CAPACITY 1:** Illuminates when the controller has cycled on the first stage of capacity control, either a hot gas bypass system or a cylinder unloading system, depending on the configuration.
4. **CAPACITY 2:** Illuminates when the controller has cycled on the second stage of capacity control. May not be available, depending on capacity control configuration.
5. **CAPACITY 3:** Illuminates when the controller has cycled on the third stage of capacity control. May not be available, depending on capacity control configuration.

G. REFRIGERATION STATUS SECTION

1. Machine status lights indicate the operating status of several machine components, PER ZONE. Further operational and troubleshooting information for each refrigerant component is located elsewhere in this manual.



2. For each component (listed below):
 - a. **SOLID GREEN:** Indicates the component is currently at an acceptable run condition.
 - b. **FLASHING RED:** Indicates the component is currently at an unacceptable run condition.
 - c. **SOLID RED:** Indicates the component had once been at an unacceptable run condition, but is now at an acceptable run condition. A solid red light can be changed into a solid green light by pressing the 'select' key.
3. **PROBE:** Indicates the status of the zone evaporator temperature probes.
4. **LOW FLOW:** Indicates the status of the zone 'low flow' switch.
5. **HI PRESSURE:** Indicates the status of the refrigerant 'high pressure' safety switch.
6. **LOW PRESSURE:** Indicates the status of the refrigerant 'low pressure' safety switch.
7. **LOW OIL:** Indicates the status of the 'low oil' pressure safety switch. This light activates on models with a 15-30 ton semi-hermetic compressor.
8. **COMPRESSOR:** Indicates the status of the zone compressor motor overload relay.
9. **FREEZESTAT:** Indicates the status of the 'freezestat' safety switch.

H. COMMUNICATION STATUS

1. The communication display indicates the type of (SPI/CAC) exchange between the host computer and the controller.



- a. **FLASHING GREEN:** Indicates the controller is sending information to the host computer.
- b. **FLASHING YELLOW:** Indicates the host computer is sending information to the controller.

I. ALARM STATUS



- 1. When this light illuminates RED, an unacceptable condition has developed, at which time a 115 volt alarm output is generated for an external (factory or customer installed) alarm beacon or buzzer.
- 2. Pressing the SELECT or ZONE key can silence the visual and/or audible alarm signal.

J. OPERATOR CONTROLS



1. **SELECT:** Depress this button to index through the 'system/zone' temperature and 'system/zone' parameters.
2. **ZONE:** Depress the button to index through the available refrigerant zone displays. When in the 'zone mode' the zone display LED's will flash. If the SELECT button is pressed while in a zone LED is flashing, the zone parameters will be displayed.

Temperature Display Setpoint Display

Ei(x)	Evaporator In Temperature
Eo(x)	Evaporator Out Temperature
CF(x)	Configuration (0 - F)
SP(x)	Backup Setpoint (10 - 90)
LP(x)	Low Pressure Time Display (10-120 sec)

3. **UP ARROW:** Depress this push button to increase the parameter displayed in the SETUP window. If this push button is pressed momentarily, the value is incremented by one. If the push button is held down for more than one second, the value will increase slowly at first and then faster after about two seconds.
4. **UP ARROW:** Depress this push button to decrease the parameter displayed in the SETUP window. If this push button is pressed momentarily, the value is decremented by one. If the push button is held down for more than one second, the value will decrease slowly at first and then faster after about two seconds.
5. **Note:** When setting the Low Pressure Delay or Backup Setpoint on the zone boards, press the UP or DOWN buttons to keep the display from timing out and reverting back to the default to PROCESS mode.
6. **POWER:** This LED indicates when the power to the unit is turned on.
7. **POWER ON LED:** Indicates that power is applied to the controller board.

3.6 MZC ZONE BOARD

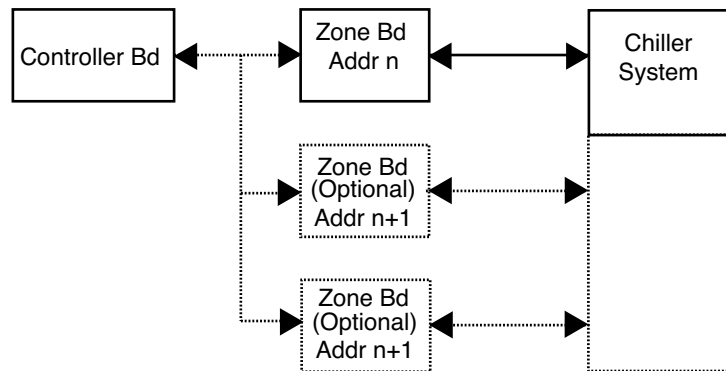


A.

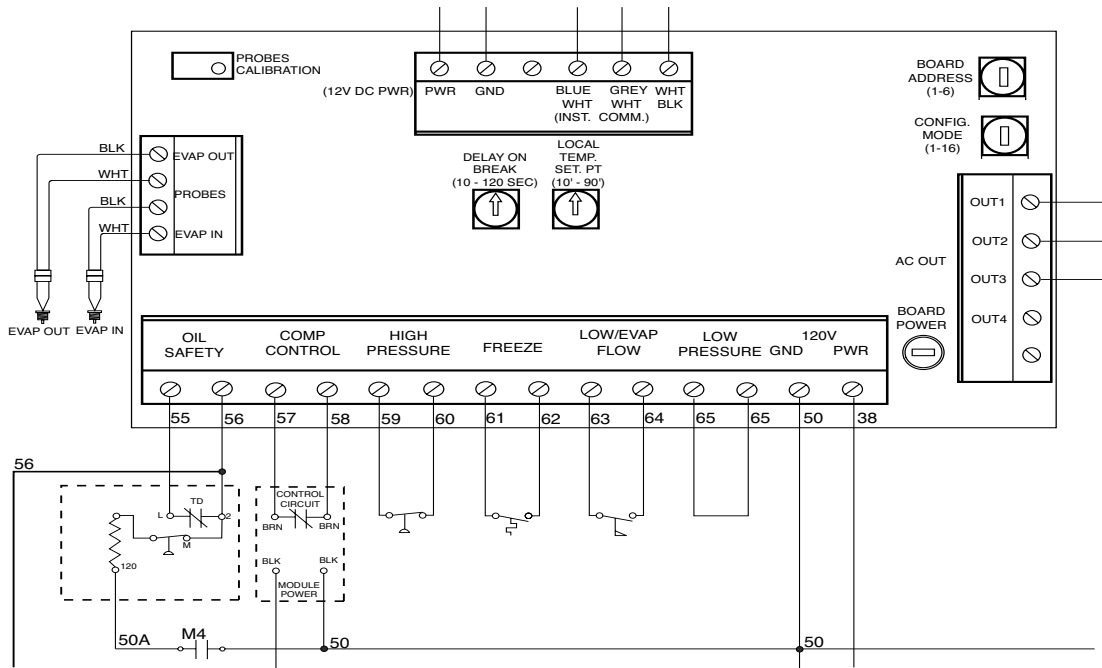
Typical Zone Board location inside electrical cabinet.

INTRODUCTION

1. The Zone Board is used to interface from the Controller Board to the chiller system compressors, bypass valves and safety switches. Communications with the MZC Controller Board is via an RS-485 network.
2. If communications with the Controller Board fails the Zone Board will switch to a stand-alone mode and maintain control of the system independent of the MZC Controller board based on the value of the Alternate Setpoint Potentiometer.



Note: n= 1 to 7



B. USER CONTROLS

1. ZONE AC POWER SWITCH (Toggle Switch)

'ON': Applies 110VAC power to Safety Switches and AC OUTPUT's
 'OFF': Disconnects 110VAC power from Safety Switches and ACOUTPUT's

2. ADDRESS SWITCH (Rotary Switch)

Selects address of ZONE Board from 1 to 7, 0 is not used for normal operation

NOTE: Each ZONE BOARD in the system must be set to a different address.

3. CONFIGURATION SWITCH (Rotary Switch)

Selects configuration number from 0 to F

4. LOW PRESSURE TIME DELAY POTENTIOMETER

Adjust value of low-pressure time delay from 10 to 120 seconds.

5. Alternate Setpoint Potentiometer

Adjust value of alternate setpoint from 10 to 90. This setpoint is **ONLY** used when the RS-485 communications with the Controller Board is not working properly.

C. STATUS DISPLAY SECTION

LED displays that indicate the status of the chiller.

1. **POWER LED:** Indicates that 12VDC power is applied to the Zone Board.

2. **SAFETY/PROTECTION LED's**

OIL: Low oil pressure safety switch fault.

COMP: Compressor motor overload fault.

HP: Refrigerant high-pressure safety switch fault.

FREEZE: Freezestat safety switch fault.

LF: Low water flow switch fault.

LP: Refrigerant low -pressure safety switch fault

ZONE: Zone Board 110VAC power switch is 'ON'.

3. **AC OUTPUT LED's**

See Configuration Matrix Chart for description of **OUTPUT LED's**. The state of these **LEDs** should correspond with the **OUTPUT CONTROL LEDs** on the **MZC** Controller Board.

OUT 1: Indicates output status of OUT 1

OUT 2: Indicates output status of OUT 2

OUT 3: Indicates output status of OUT 3

OUT 4: Indicates output status of OUT 4

D. INTERFACE SECTION

1. **SAFETY/PROTECTION CONNECTOR**

Electrical connections to safety switches.

OIL: Low oil pressure safety switch.

COMP: Compressor motor overload safety switch.

HP: Refrigerant high-pressure safety switch.

FREEZE: Freezestat safety switch.

LF: Low water flow switch fault.

LP: Refrigerant low -pressure safety switch.

ZONE: Zone Board 110 AC power input.

2. **AC OUTPUT CONNECTOR**

Electrical connections to AC outputs. See Configuration Matrix Chart for description of OUTPUT's.

OUT 1: output 1 AC Connection

OUT 2: output 2 AC Connection

OUT 3: output 3 AC Connection

OUT 4: output 4 AC Connection

3. **DC POWER SUPPLY/COMMUNICATIONS CONNECTOR**

PWR: 12VDC+

GND: 12VDC GND

GND: 12VDC GND



+: RS-485 + TXS/RXD to Controller Board
-: RS-485 - TXS/RXD to Controller Board
GND: RS-485 GND

4. INTERFACE SECTION (continued)

OUT BLK: 12VDC+
OUT WHT: 12VDC GND
IN BLK: 12VDC GND
+: RS-485 + TXS/RXD to Controller Board
-: RS-485 - TXS/RXD to Controller Board
GND: RS-485 GND

5. EVAPORATOR TEMPERATURE PROBE INPUT CONNECTOR

OUT BLK: Evaporator out temperature probe.
OUT WHT: Evaporator out temperature probe.
IN BLK: Evaporator in temperature probe.
OUT WHT: Evaporator in temperature probe.

3.7 CONFIGURATION switch adjustment (MZC INSTRUMENTS ONLY)

- A. The Configuration Switch for Multizone instruments is located on the Zone board. The Zone board is placed inside the electrical cabinet.
- B. This applies to adjustment of the low ambient controls.
- C. With the power supply to the unit shut off, locate the Configuration switch.
- D. Rotate the switch until the correct number is shown. Select the number according to your machine set up as listed below.



Configuration Matrix Chart

Conf. Setting	OUT1	OUT2	OUT3	OUT4
0	COMPRESSOR	RESERVED	RESERVED	HGBP
1	COMPRESSOR	UNLOADER	RESERVED	HGBP
2	COMPRESSOR	UNLOADER	UNLOADER	HGBP
3	COMPRESSOR	UNLOADER	RESERVED	RESERVED
4	COMPRESSOR	UNLOADER	UNLOADER	RESERVED
5	COMPRESSOR	COMPRESSOR	RESERVED	HGBP
6	SCREW COMPRESSOR	SOLENIOD 2	SOLENIOD 3	SOLENIOD 4
7	SCREW COMPRESSOR	SOLENIOD 1	SOLENIOD 2	RESERVED
8*	COMPRESSOR	RESERVED	RESERVED	HGBP
9*	COMPRESSOR	UNLOADER	UNLOADER	HGBP
A*	COMPRESSOR	UNLOADER	RESERVED	HGBP
B*	COMPRESSOR	UNLOADER	UNLOADER	RESERVED
C*	COMPRESSOR	UNLOADER	RESERVED	RESERVED
D*	COMPRESSOR	COMPRESSOR	RESERVED	HGBP
E	SCREW COMPRESSOR	SOLENIOD 2	SOLENIOD 3	SOLENIOD 4
F	SCREW COMPRESSOR	SOLENIOD 1	SOLENIOD2	RESERVED

* Allow units with a remote condenser to start in low ambient/low pressure condition.

Configuration Matrix Chart : Zone B

Conf. Setting	OUT1	OUT2	OUT3	OUT4
0	COMPRESSOR	UNLOADER	UNLOADER	UNLOADER
1	DIG SCRL COMP	RESERVED	RESERVED	DIG SCRL UNL
2	DIG SCRL COMP	STD COMP	RESERVED	DIG SCRL UNL
3	RESERVED	RESERVED	RESERVED	RESERVED
4	RESERVED	RESERVED	RESERVED	RESERVED
5	RESERVED	RESERVED	RESERVED	RESERVED
6	RESERVED	RESERVED	RESERVED	RESERVED
7	RESERVED	RESERVED	RESERVED	RESERVED
8*	COMPRESSOR	UNLOADER	UNLOADER	UNLOADER
9*	DIG SCRL COMP	RESERVED	RESERVED	DIG SCRL UNL
A*	DIG SCRL COMP	STD COMP	RESERVED	DIG SCRL UNL
B	RESERVED	RESERVED	RESERVED	RESERVED
C	RESERVED	RESERVED	RESERVED	RESERVED
D	RESERVED	RESERVED	RESERVED	RESERVED
E	RESERVED	RESERVED	RESERVED	RESERVED
F	RESERVED	RESERVED	RESERVED	RESERVED

* Allow units with a remote condenser to start in low pressure condition.



3.8 CONTROLS

- A. **Flow switch:** Installed on each evaporator water circuit. Its mission is to monitor the fluid flow and to shut down the compressor in case a harmful low flow condition should develop.
- B. **Freezestat:** Factory adjusted to turn off the compressor in the event an unsafe temperature should exist from the evaporator. This switch should be periodically checked for proper operation.
- C. **High Pressure:** Factory set or fixed cut out, manual or automatic reset required. Opens due to high pressures associated with improper refrigerant condensing or high fluid temperature overloading the compressor.
- D. **Low Pressure:** Factory or fixed cut out and cut-in points based on refrigeration type, automatic reset. Opens due to low pressures associated with improper refrigerant evaporating temperatures.

NEVER LOWER THE CUT OUT SETTING WITHOUT ADDING GLYCOL TO THE CIRCULATING SYSTEM. EVAPORATOR DAMAGE WILL RESULT AND WILL NOT BE COVERED BY THE WARRANTY.

- E. **Oil pressure safety switch** de-energizes the compressor if oil pressure in the compressor is not adequate. Refer to the troubleshooting guide for common reasons for this failure. (Provided on certain models.)



High Pressure Limit
(Per refrigerant zone)

Low Pressure Limit
(Per refrigerant zone)

- F. The **alarm pressure switch** functions to energize the alarm if coolant pressure is denied the process.

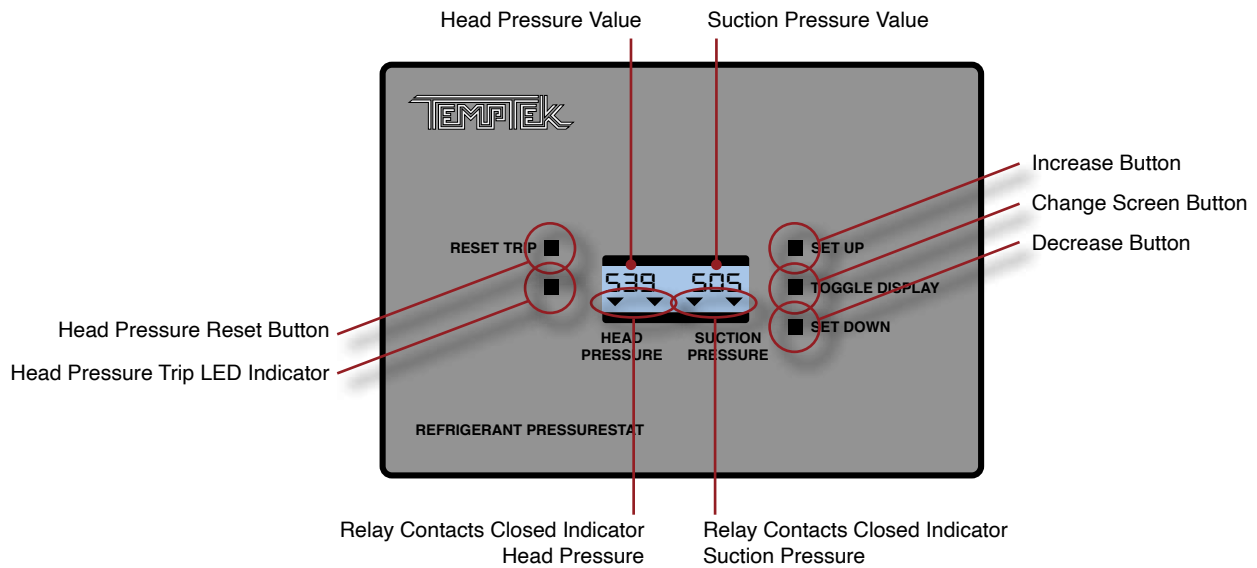
3.9 PRESSURE GAUGES & OPTIONAL ALARM BEACON

- A. The **to process pressure** gauge indicates fluid pressure being delivered by the process pump to the load.
- B. The **refrigerant head pressure** gauge indicates the pressure of the refrigerant as it is being condensed in the condenser.
- C. The **refrigerant low pressure** gauge indicates the compressor suction pressure, and is directly related to the temperature setting on the temperature control.
- D. The optional **alarm beacon** is visual and audible. The alarm will activate when the water temperature leaving the chiller is too high and when fluid pressure is lost from the process pump. An alarm silence switch is provided to deactivate the alarm while corrective measures are being taken.

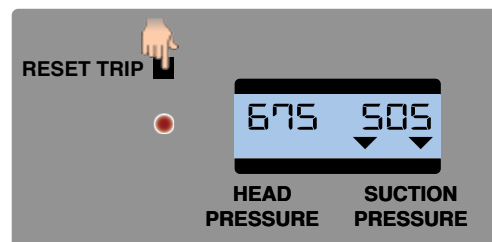
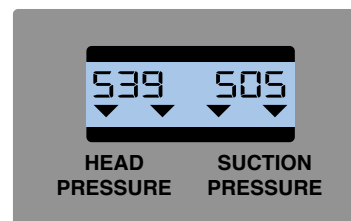
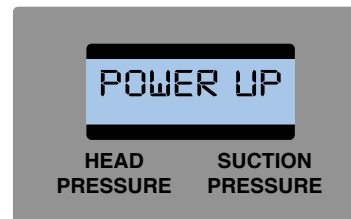


3.10 DIGITAL PRESSURESTAT SET UP

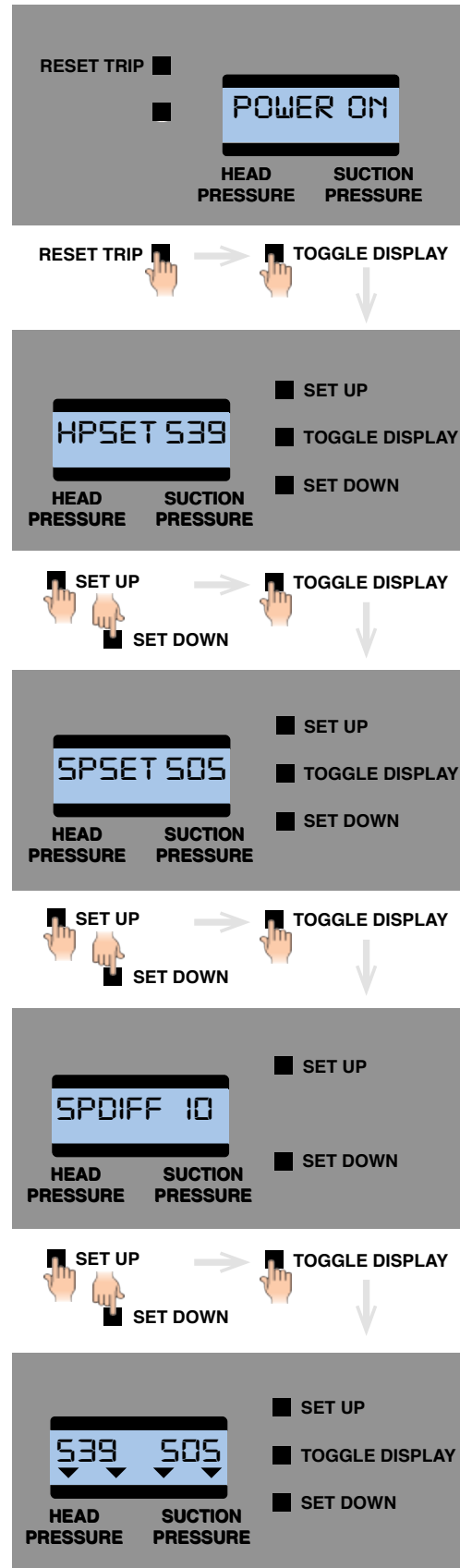
- A. Some models of this central chiller provide optional digital pressurestats for refrigerant high and low pressure monitoring and display in lieu of traditional analog gauges.
- B. The digital refrigerant pressurestat is a dual pressure safety switch as well as a current value refrigerant pressure display that uses transducers with a 0-10v output an in input source.



- C. In normal running mode the head pressure and the suction pressure for a single refrigerant zone is continuously displayed. The small arrows along the bottom of the display window indicate that the relay contacts are closed and the system is functional.
- D. When either the head pressure or suction pressure is measured out of the set point range the corresponding arrows will disappear. If the head pressure is out of range the red LED will come on and the reset button will have to be manually pushed after the condition has been corrected.
- E. If the suction pressure is out of range the system will reactivate automatically after the pressure rises above the differential value.



- G.** To change set point values :
1. On Initial Start-up press the Reset button to clear any errors.
 2. Press and release the Toggle Display button once. You will see **hpSET XXX**. The current set point for head pressure cut out will be in the place of the XXX. Use the Set Up and Set Down buttons to change the value. This value must not be set higher than 50 PSI below the relief device setting.
 3. Press and release the Toggle Display button again to save the new setpoint and move to the next value. You will see **spset XXX**, the suction pressure cut out value. Use the Up and Down buttons to adjust the value. This value must not be set lower than the pressure that corresponds to the freeze point of the fluid being chilled otherwise severe damage to the evaporator could occur.
 4. Press and release the Toggle Display button again to save the value and move to the next value.
 5. You will see **spDif XXX**, the suction pressure differential. This value indicates the number of PSI the suction pressure must rise above the cut out value before the system will restart. 10 PSI is usually a good number for this value and is the default value.
 6. Press the Toggle Display button once more to save the value and return to the display screen.



3.11 ZONE LEAD LAG (MZC ONLY)

- A. The Lead zone (refrigeration zone that turns on first) can be selected on models that have two or more zones and that include the MZCIII control instrument.
- B. This feature can be used to equalize run time on zones in the system if desired.
- C. The lead zone is selected as described below.
 - 1. On the MZCIII control press the Select Button until LEA appears in the top LED window.
 - 2. Press the zone button until the Zone LED light for the desired Lead zone is illuminated.
 - 3. The setting must be confirmed in one of these methods.
 - a. The chiller refrigeration zones need to turn off on satisfaction, meaning that no cooling is required so no zones are running. When the zones restart the Lead zone setting that was selected in steps 1 & 2 above will be enabled. This can be accomplished by raising the set point temperature about 10°F which will cause the chiller to quickly reduce cooling capacity and achieve satisfaction. Once all compressors have turned off, the set point can be reduced to the normal value. Do not use this method if a temporary increase in the chilled water temperature will affect your process.
 - b. Or, power the main disconnect off for at least 10 seconds, restart the system and the lead zone selected in steps 1 & 2 above will be enabled.





WARNING: Follow all shut down procedures outlined in this manual.



WARNING: Relieve static pressure before disconnection process lines.

3.12 UNIT SHUT DOWN/DISCONNECT SEQUENCE

A. PRECAUTIONS/WARNINGS

1. The operator must precisely follow all shut down procedures outlined in this manual. If the operator fails to follow precisely all procedures outlined in this manual, an unsafe condition can develop resulting in damage to the unit or personal injury.

B. UNIT SHUT DOWN

1. To shut down the unit without disconnecting from the process:
 - a. Turn off the unit..
 - b. Maintain electrical power to the unit at all times except for service purposes.
2. To shut down the unit and disconnect from the process:
 - a. Turn off the unit.
 - b. Disengage the electrical supply to the chiller at the disconnecting device.
 - c. Disconnect all process lines.



4.0 TROUBLESHOOTING

- 4.1** Unit Will Not Start
- 4.2** Compressor Hums But Will Not Start
- 4.3** Shuts Off On High Pressure
- 4.4** Shuts Off On Low Pressure
- 4.5** Compressor Shuts Off On Internal Overload
- 4.6** Low or No Process Pressure or Water Flow
- 4.7** Cooling Capacity Inadequate
- 4.8** Sensor
- 4.9** Coolant Pumps
- 4.10** Oil Pressure
- 4.11** Crankcase Heater
- 4.12** Chiller Controller





WARNING: Before troubleshooting or servicing this unit, follow all company lock-out tag-out procedures.

4.1 UNIT WILL NOT START

- A. **Power off.** Check main disconnect.
- B. **Main line open.** Check fuses.
- C. **Loose terminals.** Tighten terminals with POWER OFF.
- D. **Control circuit open.** Check control voltage fuses and transformer.

4.2 COMPRESSOR HUMS BUT WILL NOT START

- A. **Contactor problem.** Check contacts and contactor operation.
- B. **Low voltage.** Check voltage at main and at the unit. If voltage is OK at the main but low at the unit, increase wire size. If low at main, consult your local power company. Voltage must be +/- 10% nameplate rating.
- C. **No power on one phase of a three phase unit.** Check fuses in control panel and main disconnect. Also check unit wiring, main plant fuse and wiring. If the problem is with the main power supply coming into the plant, call the local power company.
- D. **Loose terminals.** Power off and follow all company lock-out tag-out procedure before tightening terminals.

4.3 SHUTS OFF ON HIGH PRESSURE LIMIT

Note: Units may be equipped with either an adjustable or non-adjustable “fixed” high pressure switch. If the refrigerant pressure exceeds the setting of the adjustable switch it must be manually reset when the discharge pressure falls to a safe level. The non-adjustable “fixed” high pressure switch will automatically reset when the discharge pressure falls to a safe level.

- A. **Insufficient condenser air flow.** Check condenser filter for dirt, fins may be plugged with dirt or foreign material. Also, check for proper fan rotation.

Note: All enclosure panels on the air-cooled condenser must be attached.

- B. **Fan motor not operating.** Have electrician check fuses and wiring, motor starter and overloads, and motor. Repair or replace motor if defective.
- C. **Improperly set high pressure control.** Have refrigeration serviceman reset or replace the control if defective.



Adjustable High Pressure Switch



Fixed High Pressure Switch

4.4 SHUTS OFF ON LOW PRESSURE CONTROL

Note: Units may be equipped with either an adjustable or non-adjustable “fixed” low pressure switch. The adjustable or fixed low pressure switch will automatically resets when the pressure rises above the cut-in pressure. If this does not occur contact the Manufacturer’s service department for instructions.

Note: If your chiller is equipped with the CF control instrument see section 3.3.D.3 for additional specific information on how the CF control instrument handles a low refrigerant pressure fault.

If the unit low pressure limit activated three (3) consecutive times during start-up the unit will lock out and will not be allowed to start. To restart, the unit must be powered down and back on.

*See Temperature-Pressure chart in Section 8.2 for refrigerant pressure.

The low pressure switch is set to cut-out at 32°F and cut-in at 36°F - 39°F*. If a low pressure condition exists for more than five seconds the compressor will stop and a “L-P” fault will appear in the display window.

After the refrigerant pressure rises above the cut-in pressure, a three minute time delay will occur before the compressor restarts. This will protect the evaporator and compressor from damage should a problem occur in the refrigeration system or if the chiller is operated under circumstances which could cause damage to the refrigeration system.



Adjustable Low Pressure Switch



Fixed Low Pressure Switch

- A. **Low or no water flow through the evaporator.** Adjust the flow per sections 3.2.C and 3.2.D.
- B. **Head pressure too low.** Check that entering air temperature is above 60°F. If below 60°F, find out reason why.
- C. **Low refrigerant charge.** Check for adequate refrigerant charge (bubbles or misty sight glass indicates low charge). If charge is low, have system checked for leaks and recharged by a refrigeration serviceman.
- D. **Improperly set low pressure switch.** Have a refrigeration serviceman reset control or replace if defective.
- E. **Restriction in the liquid line.**
 1. **Clogged filter drier.** Check for pressure or temperature drop and have drier core replaced by a refrigeration serviceman.
 2. **Liquid line valve or suction valve on compressor is partially closed.** Open fully.
 3. **Liquid line solenoid not opening fully or leaking during off cycle.** Have the solenoid repaired or replaced if defective by a refrigeration serviceman.
 4. **Expansion valve plugged or inoperative.** Check thermal bulb and capillary

tube for damage. Have repaired or replaced if defective by a refrigeration service man.

4.5 COMPRESSOR SHUTS OFF ON INTERNAL OVERLOAD

- A. **Control does not reset.** Have compressor windings and internal solid state safety control checked by a refrigeration serviceman. Have it repaired or replace if defective.

4.6 LOW OR NO PROCESS PRESSURE OR WATER FLOW

- A. **Valves.** Check if water valves are open.
- B. **Pump.** Check pump for correct rotation. Check pump suction for restriction. Replace motor if defective.
- C. **Filters.** Check filter in the chilled water circuit and clean if necessary.
- D. **Pressure switch (or flow switch).** Readjust or replace if defective.
- E. **Fuses and wiring.** Have electrician check the fuses and wiring.

4.7 COOLING CAPACITY INADEQUATE

- A. **Low refrigerant charge.** Check for adequate refrigerant charge (bubbles or misty sight glass indicates low charge). If charge is low, have system checked for leaks and recharged by a refrigeration serviceman.
- B. **Hot-gas bypass valve stuck open.** Have repaired or replace if defective by a refrigeration serviceman.
- C. **Expansion valve plugged or inoperative.** Check thermal bulb and capillary tube for damage. Have repaired or replaced if defective by a refrigeration serviceman.
- D. **Plugged filter.** Check filter in chilled water circuit and clean.
- E. **Air in system.** Purge air.

4.8 SENSOR

- A. The sensor is a solid state temperature transducer which converts temperature input to proportional current output.
- B. To quickly test for a defective probe, switch connections between the defective probe and a probe known to be working properly. A defective sensor will display a "---" in the display window on the instrument control. Please note that "---" will also display when process temperatures are above 100°F.



Typical chilled water sensor probe with 2 pole connector.

4.9 COOLANT PUMP (process, evaporator and standby)

- A. The centrifugal pump is designed to operate at a specific flow and pressure at the maximum run load amp draw of the motor. Too much flow can overload the motor and cause the overload circuit to open and stop the pump.
- B. If the overload trips, check for electrical shorts, loose wires, or blown fuses. If these check OK, reset the overload circuit and restart the chiller.

4.10 OIL PRESSURE (not on all models)

- A. This switch must be manually reset after the problem is resolved.
- B. Check for low oil level in the compressor crankcase or insufficient compressor warm up before start-up.
- C. Defective crankcase heater, internal compressor damage causing the compressor to pump too much oil through the system, defective oil pump, or plugged pick up screen in compressor oil sump. **Note:** Only semi-hermetic compressors 15-30 tons have an oil pressure safety switch.

4.11 CRANKCASE HEATER (not on all models)

- A. If the crankcase heater is not drawing current during the compressor off cycle, check for a defective crankcase heater, defective fuses or defective interlock on the compressor starter.
- B. Scroll compressors do not have crankcase heaters.

4.12 CHILLER CONTROLLER

- A. The control instrument is used for all normal set ups, diagnostics, temperature readout and operational information. It contains the software and electronic components which operate the control instrument.
- B. The control instrument is not field repairable. It can be easily removed and replaced or repaired if a problem occurs.
- C. All control instruments used in water chillers are covered by the machine's warranty.

If you experience problems with your control instrument, it's as easy as 1-2-3 to execute our repair or replacement system in order to get your equipment running.

D. IN WARRANTY SERVICE INCIDENT

1. Call Manufacturer's Service Department for diagnostic assistance.
2. If a control instrument is determined to be at fault, a new or reconditioned instrument will be sent as a replacement.
3. Return the defective instrument freight pre-paid for a full credit. If the faulty



instrument is not returned you will need to pay for it.

E. OUT-OF-WARRANTY SERVICE INCIDENT

1. Call Manufacturer's Service Department for diagnostic assistance.
2. If a control instrument is determined to be at fault, you have 3 options:
 - a. Purchase a new instrument as a replacement.
 - b. Send your instrument back for repair, freight prepaid. For a nominal fee (contact factory for current fees) your instrument will be repaired and returned.
 - c. Purchase a new instrument and repair the old one as a back up.
3. If you are sending your instrument back for repair do not disassemble the instrument.

F. OTHER INFORMATION

1. Repair Warranty: 1 year.
2. **Ship to Manufacturer.**
3. Include in box: part, purchase order, contact name, phone number, symptom (if available).



5.0 MAINTENANCE

- 5.1** Warranty Service Procedure
- 5.2** Periodic Preventative Maintenance
- 5.3** Special Maintenance
- 5.4** Solenoid Valve Service
- 5.5** Pump Seal Service
- 5.6** Checking The Refrigerant Charge
- 5.7** Proper Cleaning Procedure for Brazed Plate Evaporators
- 5.8** Configuration Switch Adjustment (MZC Instruments Only)



5.1 WARRANTY SERVICE PROCEDURE

- A. In the event of a problem with a chiller that can not be resolved by normal troubleshooting procedures, the customer is invited to consult the Service Department for assistance. The correct model number and serial number of the chiller must be available. The service department will attempt to isolate the problem and advise repair procedures. Often times, with the customer's input and with the machine diagnostics, problems can be determined with "over-the-phone" consultation.
- B. If the problem is beyond the scope of "over-the-phone" consultation, and if the warranty status of the machine is valid, the Manufacturer will contact the nearest authorized service contractor and provide authorization to conduct an "on-site" inspection of the unit in order to determine the course of repair. If the chiller is not covered by the warranty, the Manufacturer will advise on the repair and recommend available service contractors.
- C. It is of the utmost importance that you provide the correct model number and serial number of the machine in question. This will allow the Service Department to obtain the correct manufacturing records which will help to properly troubleshoot the problem and obtain the proper replacement parts when they are required. This information is stamped on the data tag that is attached to the electrical enclosure of each machine.
- D. The Service Department must be notified prior to any repair or service of a warranty nature. Warranty claims will not be honored without prior authorization.

5.2 PERIODIC PREVENTATIVE MAINTENANCE

- A. Lubricate all motors. Note that some motors are supplied with sealed bearings.
- B. Tighten all wire terminals.
- C. Clean and check motor starter and contactor contacts.
- D. Check safety switch settings.
- E. Clean condenser fins of dust and dirt (air cooled models only).
- F. Back flush evaporator.
- G. Check glycol/water solution ratio for operating temperature.
- H. Check system for leaks.
- I. Refrigerant sight glass: Check for bubbles when compressor is operating at 100%. Check the moisture indicator for a color other than green.
- J. Clean unit.



5.3 SPECIAL MAINTENANCE

- A. Any service of the refrigeration system must be accomplished by a certified refrigeration technician.
1. Addition of compressor oil.
 2. Addition of refrigerant.
 3. Repair of a refrigerant leak.
 4. Adjustment of super heat.
 5. Changing of filter-drier or drier core.
 6. Repair of a refrigeration solenoid.



5.4 Optional AUTOMATIC WATER MAKE-UP SYSTEM service (Only units in No freeze climates)

- A.** The automatic water make-up system consists of a level switch and a solenoid valve (figure 5.4B). When the tank level is low the level switch signals the solenoid valve to open allowing make-up water to re-fill the tank.
- B.** Level switch maintenance and service.
1. The level switch contacts engage and disengage the water make-up solenoid valve.



Typical water make-up level switch

2. Poor water quality can allow debris or a film build-up on the level switch contacts which can impair operation. Clean the contacts on a regular basis. If cleaning the contacts does not remedy the problem the level switch must be replaced.

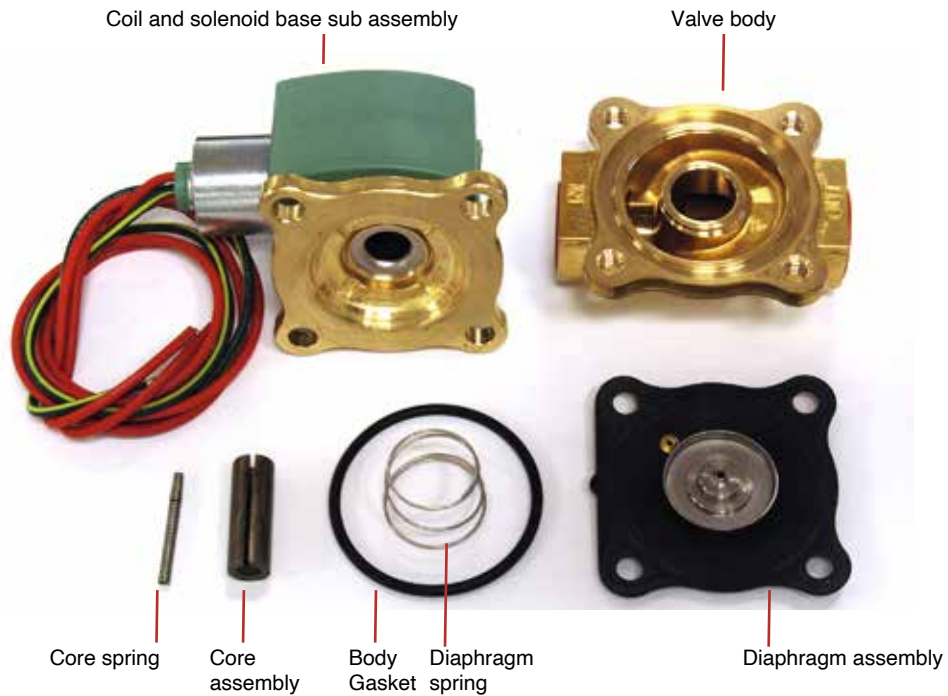
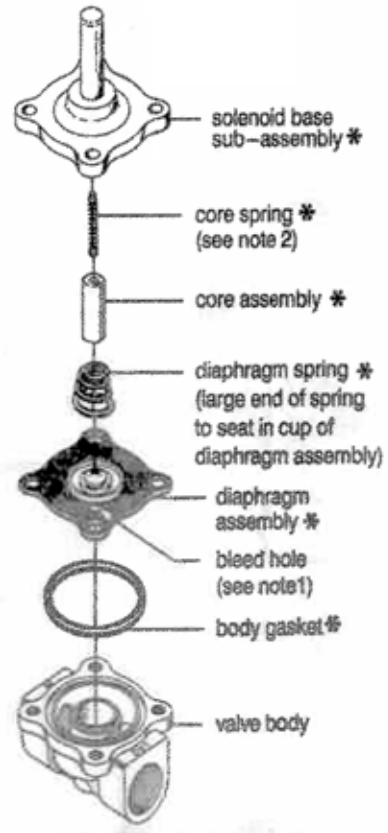
C. Make-up solenoid valve service.

1. The make-up solenoid valve may require service for a failed coil or more often it will not fully close because debris from poor make-up water quality is in the valve mechanism.
2. To replace the coil, disengage power from the unit following all lock-out tag-out procedures. Remove the wires from the failed coil and remove the coil from the valve stem. Install the new coil on the stem and reconnect the wires.



Typical water make-up solenoid valve

3. To service the solenoid valve follow the procedure below.
 - a. Disengage process operations according to the procedure outlined in this manual. Be certain process fluid pressure is relieved (coolant pressure gauge reads "0") and water system flow is shut off.
 - b. Disengage main power supply. The operator must follow all lockout/tagout procedures.
 - c. Remove or open any access cover panel and set aside to gain access to the make-up solenoid valve.
 - d. The solenoid valve can be disassemble by removing the 4 retaining screws.
 - e. Keeping all electrical connections intact, lift the coil and top solenoid base assembly and set aside.
 - f. **Note the arrangement of the core spring and core assembly, diaphragm spring and diaphragm assembly. (See diagram.)**
 - g. Clean all components as required.



5.5 PUMP SEAL SERVICE

- A.** The coolant pump seal is a carbon/niresist shaft seal assembly including a stationary member, rotating member and tension spring (figure 5.5A).
- B.** The operator can determine the pump seal is leaking when fluid is identified leaking from the pump case adapter. Generally, a pump seal will leak due to inadequate unit pressure, excessive flow and poor fluid quality.

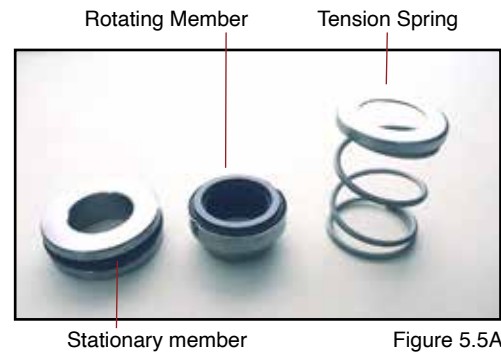


Figure 5.5A

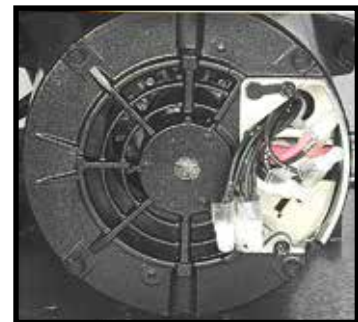
- C.** The operator should follow this procedure to replace the pump seal:

1. Disengage process operations according to the procedure outlined in **section 3.4**. The operator must be certain process fluid temperature is under 100°F and pressure is relieved (COOLANT pressure gauge reads "0") and water make-up flow is shut off and all pressure relieved.
2. Disengage main power supply. The operator must verify the proper lockout procedures are followed.
3. Access the pump motor by opening or removing any cover panels as necessary (figure 5.5B).
4. Drain machine. The machine can be drained by using the drain valve located on the pump case. Drain fluid into a suitable container for reuse or disposal according to manufacturer's instructions (if a glycol solution is used).
5. Locate and remove the three motor wire leads from the motor wiring terminals. The operator should "map" the wire terminal locations to ensure correct rewiring. The power cord should be removed from the motor housing (figure 5.5C).
6. Locate and remove the pump casing bolts. These bolts secure the motor and motor adapter to the pump casing (figure 5.5D).



Pump motor

Figure 5.5B



Pump motor

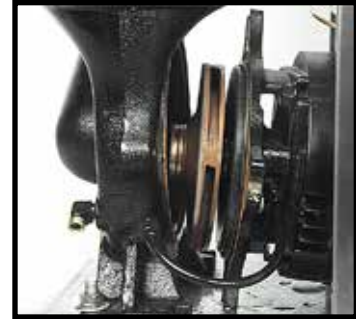
Figure 5.5C



Typical pump casing bolt

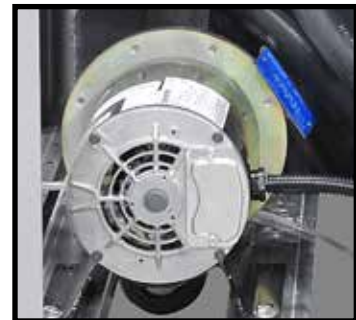
Figure 5.5D

7. Separate the motor and motor adapter from the pump casing to expose the pump impeller (figure 5.5E). Remove the motor and motor adapter from the unit and place on a workbench to continue the procedure.
8. Locate and remove the dust cap from motor end to expose slotted motor shaft. The motor shaft is free to rotate, but must be secured to remove the impeller. To secure the motor shaft, insert a flat bladed screw driver in slot to hold the shaft stationary (Figure 5.5F).
9. Locate and remove impeller locking screw (Figure 5.5G). Using a socket and ratchet, the impeller retaining screw can be removed. Once the retaining screw is removed, the impeller can be “unthreaded” from the motor shaft to expose the pump seal assembly.
10. Remove all seal parts (Figure 5.5H). Note seal component arrangement to facilitate reassembly.
11. Clean motor shaft and lubricate with a mild soap solution.
12. Install new stationary seal member in pump casing cavity (figure 5.5I). The operator must be certain the stationary seal member is fully squared and seated in cavity.
13. Slide the rotating member onto lubricated pump shaft (figure 5.5J). The operator must be certain not to damage or tear rubber bellows assembly.
14. Place the spring onto the rotating member.
15. Align the impeller, spring and rotating member before reinstalling the impeller (figure 5.5K). The operator must be certain the spring and rotating member are aligned before the impeller is fully tighten and the impeller retaining screw is reinstalled.



Impeller

Figure 5.5E



Motor shaft

Figure 5.5F



Typical impeller

Figure 5.5G



Seal components

Figure 5.5H

16. Clean pump casing, cavities, impeller and O-ring before reassembly.
17. Mate the motor and motor adapter to the pump casing. Reinstall the pump casing bolts.
18. Reconnect the motor power cord and leads.
19. Restore all cover panels as were removed.

E. When the pump seal replacement procedure is complete, the operator may restart the unit according to **section 3**.



Stationary member Figure 5.5I



Stationary member Figure 5.5J



Seal members Figure 5.5K

5.6 checking the refrigerant charge

- A.** All standard chillers are manufactured with thermostatic expansion valves as the metering device to the evaporator.
- B.** All standard chillers have a refrigerant sight glass with a moisture indicator. To check the refrigerant charge under normal operating conditions:
1. Remove the plastic cap covering the sight glass.
 2. Start the chiller and allow system pressures and temperatures to stabilize.
 3. With the unit operating at 100% capacity (not in the “capacity control” mode) the sight glass should appear clear with no foam or bubbles evident. If foam or bubbles are evident, the chiller has suffered from a loss of refrigerant and should be checked by a qualified refrigeration technician.
 4. The “dot” in the middle of the sight glass is the moisture indicator. It should appear green at all times. A white or yellow color indicates moisture has invaded the refrigeration system, which is detrimental to the life of the compressor. The filter-drier should be replaced by a qualified refrigeration technician.



Refrigerant Sight Glass

5.7 PROPER CLEANING PROCEDURE FOR BRAZED PLATE EVAPORATORS

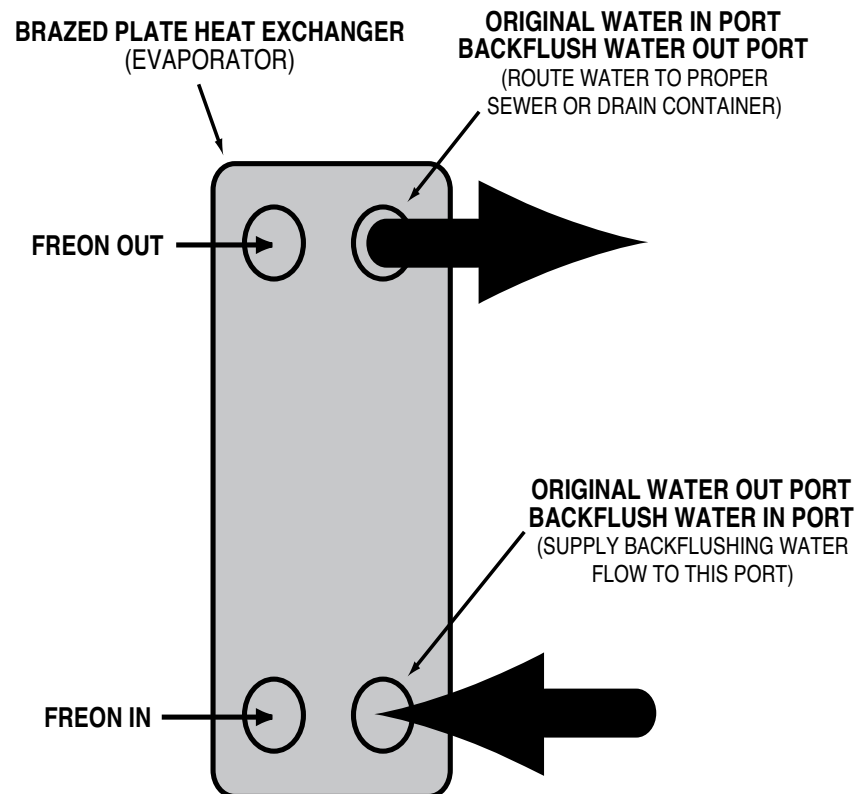
- A.** The brazed plate evaporator is made of stamped stainless steel plates, furnace brazed together with copper based joints. The complex geometry of the flow passages promotes turbulent flow which gives high efficiency and reduces fouling by mineral deposits. Large solids such as plastic pellets or chunks of mineral deposits will collect at the water inlet port at the evaporator and restrict flow through some of the passages. If this possibility exists, the Manufacturer recommends filters or strainers be added to the “from process” line. If the evaporator becomes fouled there are a couple of methods for cleaning.
- B.** To begin, remove the piping to the “water in” port at the evaporator. Remove any solids that have collected at this point. Then back flush the evaporator to remove any solids that may be trapped between the plates (see back flush procedure below). If there are mineral deposits adhered to the plates, the evaporator must be back flushed with a mild acid solution (5% phosphoric or 5% oxalic acid is recommended.) After cleaning rinse with clear water before returning to service. Continue with step C on the next page.
- C. Back flushing procedure:**
1. Turn off all power to the machine. For chillers with a reservoir tank, drain the tank



Brazed Plate Evaporator

to below the evaporator outlet. For chillers without a reservoir tank, drain total unit.

2. Connect a water supply hose to the evaporator water outlet. If acid cleaning, connect the discharge hose from the acid pump to the evaporator outlet port.
3. Connect a hose to the evaporator water supply port and to an appropriate containment vessel. If acid cleaning, connect the evaporator water inlet port to an acid solution reservoir tank. Dispose of all back flush fluid according to local codes.
4. The cleaning fluid source should have at least 20 psi available. If acid cleaning, follow the instructions supplied with the acid solution carefully.
5. When the procedure is complete, reinstall all water lines to original factory orientation. Restart the unit and check for proper operation.
6. **Note:** This procedure is not normal maintenance. Maintaining proper water quality and filtration will minimize the need to back flush the evaporator.



6.0 COMPONENTS

6.1 Refrigerant System

6.2 Coolant system



6.1 REFRIGERATION SYSTEM

A. COMPRESSOR: Hermetic or semi-hermetic compressors take low pressure/low temperature refrigerant gas and compress the gas into high pressure/high temperature gas.

B. AIR-COOLED CONDENSER: The air cooled condenser removes BTU's from the compressed refrigerant gas. The action causes the gas to "condense" into a liquid state still under high pressure. Air flow across the condenser is achieved via a motor driven fan assembly. The air-cooled condenser is located outdoors on most Titan central chillers. Models using air-cooled condensers are designated with a TI-A in the model number.



Compressors. Configuration may be different on specific units.

C. FILTER-DRIER: The filter-drier removes contaminants and moisture from the liquid refrigerant.

D. LIQUID LINE SOLENOID VALVE: Controlled by the instrument, this valve closes when the compressor cycles off to prevent refrigerant liquid from migrating to the evaporator. The valve opens when the compressor cycles on.



Air-cooled condenser. Typical unit shown.

E. REFRIGERANT SIGHT GLASS: The refrigerant sight glass indicates refrigerant charge and moisture content. Refrigerant charge is determined by a clear liquid flow. Bubbles indicate low refrigerant. Moisture content is indicated by the color of the element. Element color is normally green. If the color of the element is chartreuse or yellow, the system has been contaminated with moisture. In such case, the filter-drier must be replaced. The replacement of the filter-drier must be completed by a qualified refrigerant service technician.

F. EXPANSION VALVE: The expansion valve throttles flow of refrigerant liquid into the evaporator and creates a pressure drop in the refrigerant system that allows the liquid refrigerant to "boil off" inside the evaporator.

G. EVAPORATOR: The evaporator is a brazed plate heat exchanger where the refrigerant liquid is allowed to evaporate (boil off) to absorb heat (BTU) from the process fluid. As the heat is absorbed, the process fluid is chilled.

H. HOT GAS BY-PASS SOLENOID: The hot gas by-pass solenoid prevents short cycling of the compressor by reducing the capacity by 50% when the process fluid temperature nears the setpoint.

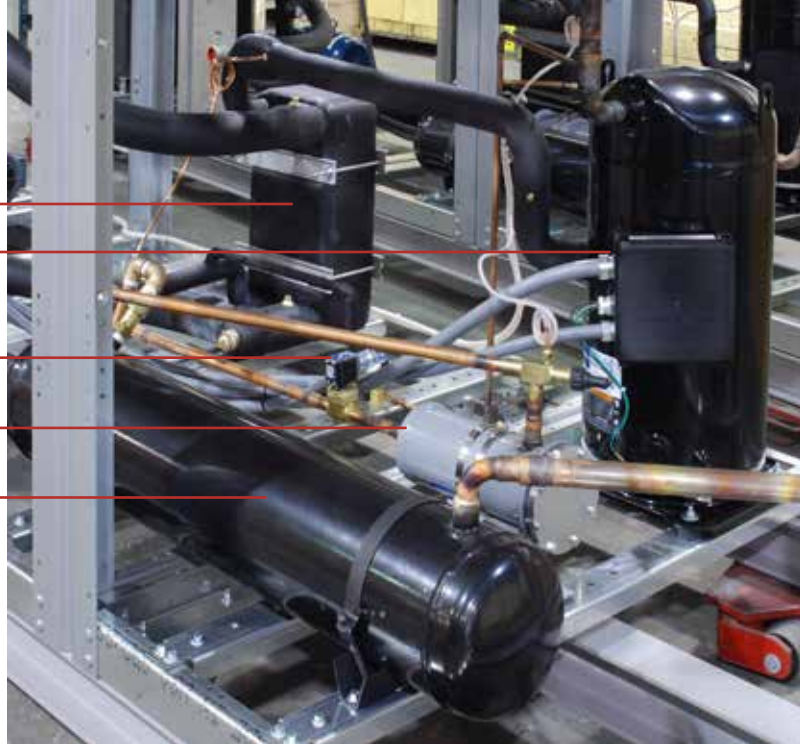
I. HIGH/LOW PRESSURESTATS: the high/low pressurestats protect the refrigeration system from unsafe operating levels.

The **high pressure switch** is factory set and protects the refrigeration components and personnel from potential damage of



Adjustable high pressure switch

Brazed Plate Evaporator
 Compressor
 Liquid Line Solenoid Valve
 Filter Drier
 Liquid Receiver



injury from excessive high pressure. The high pressure safety must not be altered in the field for any reason. (See section 8.1 for factory settings.)



Adjustable low pressure switch

* See Temperature-Pressure chart in Section 8.5 for refrigerant pressure.

The **low pressure switch** is factory set to open at 32°F and to close at 36° - 39°F.* The low pressure switch protects the chillers from possible damage due to low operating pressure. The low pressure switch is field adjustable for setpoints below 48°F.

NEVER LOWER THE CUT OUT SETTING WITHOUT ADDING GLYCOL TO THE CIRCULATING SYSTEM. EVAPORATOR DAMAGE WILL RESULT AND WILL NOT BE COVERED BY THE WARRANTY.

- J. Liquid receiver:** Located after the air-cooled condenser, this component receives and stores liquid refrigerant leaving the condenser. (Air-cooled models only).
- K. Service valves:** Have been provided throughout the system. Only a qualified refrigeration service technician shall operate these valves.
- L. Crankcase heater:** Insures that freon and compressor crankcase oil do not mix during the compressor's "off" cycles. Power must be applied to the chiller previous to startup. (Not on all models.)
- M. Oil pressure safety switch:** protects the compressor from lubrication failure. (Not on all models.)

N. Pressure Gauges:

Compressor Discharge (Head) Pressure: Compressor discharge and refrigerant condensing pressure. Pressure operating range will vary depending on refrigerant type.

Compressor Suction (Low) Pressure: Compressor suction and refrigerant evaporating pressure. Pressure operating range will vary depending on refrigerant type.

6.2 COOLANT SYSTEM

- A. Reservoir:** Provides coolant storage during non operating periods. An internal baffle separates 'from process' and 'to process' fluid flows during operating periods.
- B. Process Pump:** Provides fluid to the central system.
- C. Standby Pump:** Optional pump to provide backup for the process or evaporator pump.
- D. Evaporator pump:** Provides consistent flow through the brazed plate evaporators to maintain full capacity.
- E. Flow switch:** Protects the evaporator from possible freezing caused by too little flow.
- F. Freezestat:** Protects the system from potential freezing. Factory adjusted to 40°F. For operating temperatures below 48°F, see section 6.7 on page 39.
- G. Level control switch:** Indicates water level in reservoir.

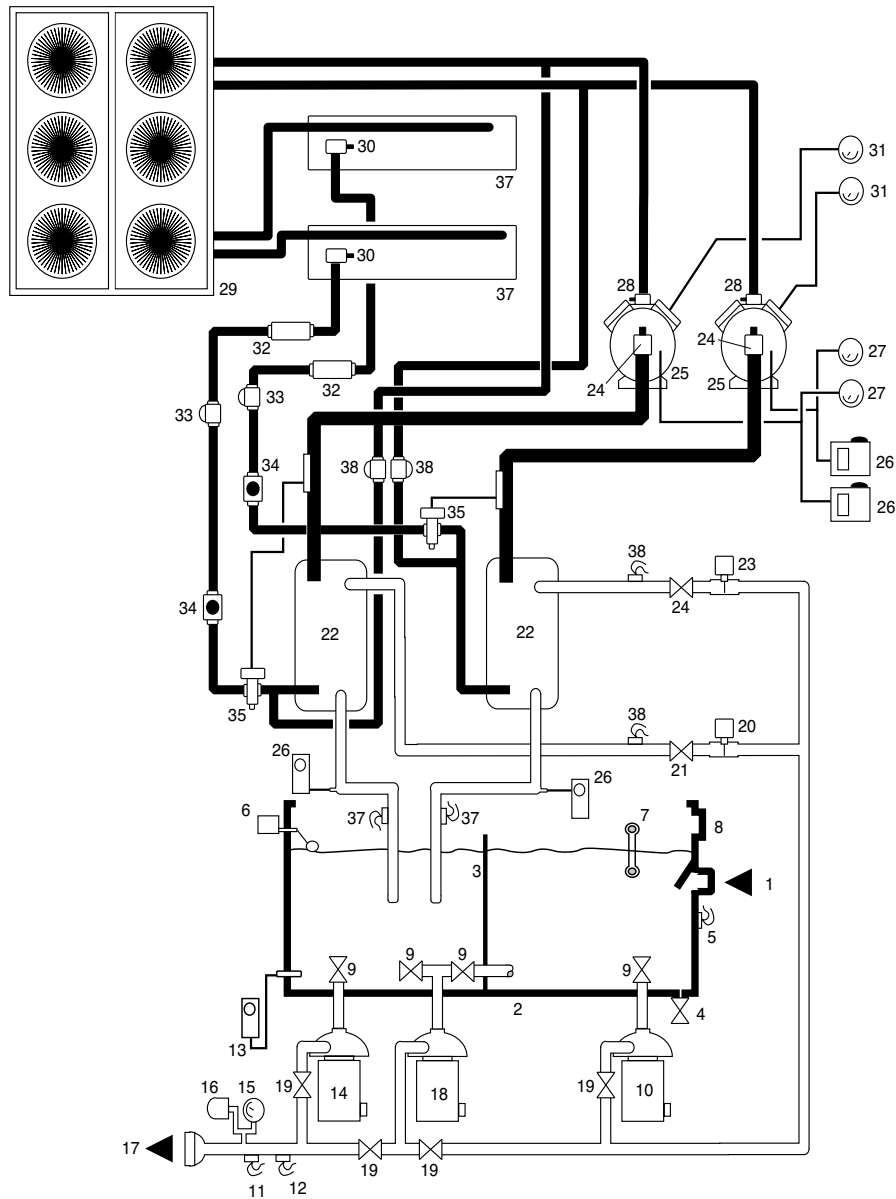


7.0 RELATED DRAWINGS

- 7.1 Typical Circuit Schematic
- 7.2 Typical Physical Drawing
- 7.3 Typical Press Drop
- 7.4 Typical Vacuum Breaker / Anti-Siphon System
- 7.5 Typical Label Placement Drawing
- 7.6 Typical Panel / Control Station Drawing

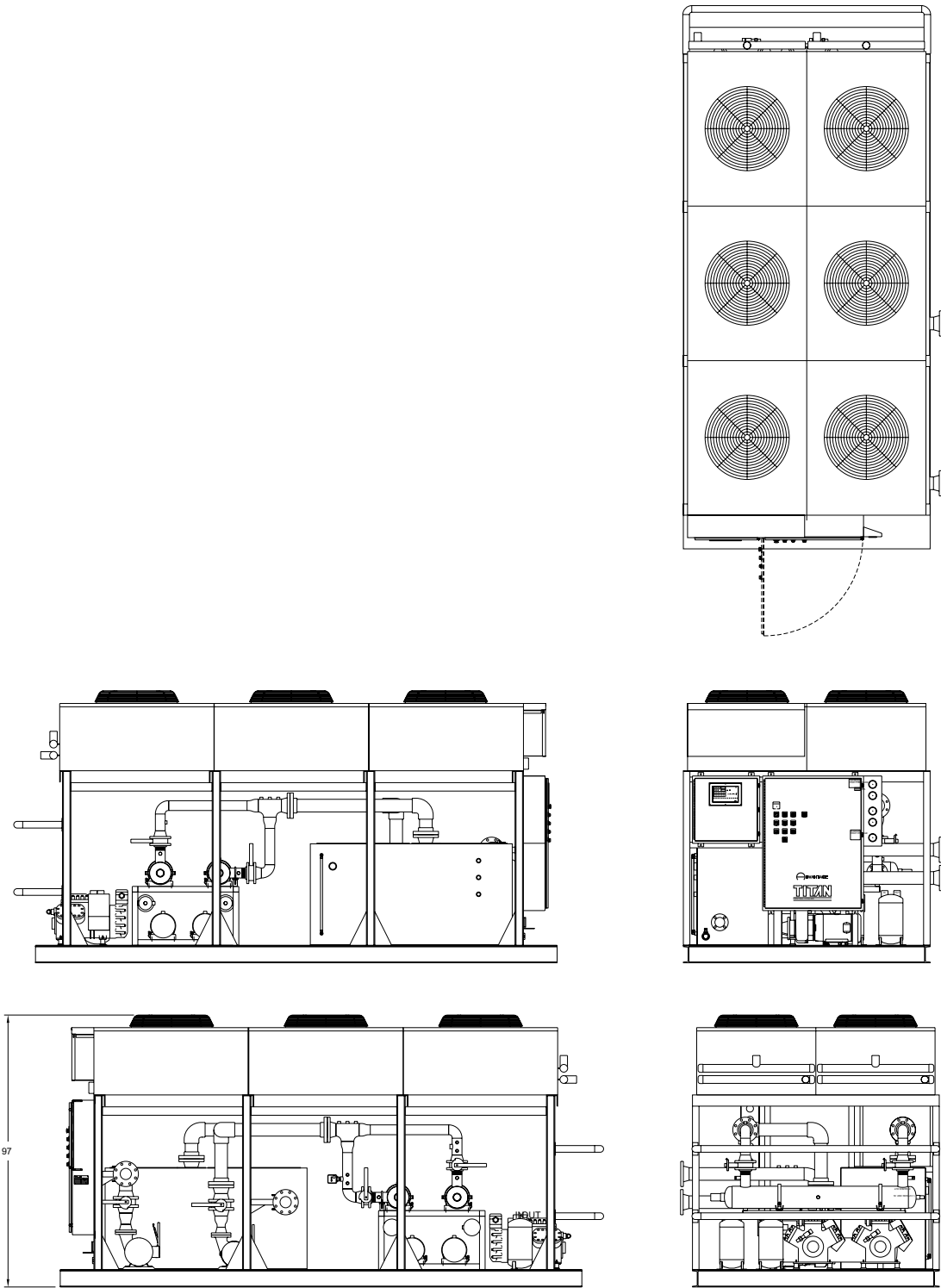


7.1 TYPICAL CIRCUIT SCHEMATIC

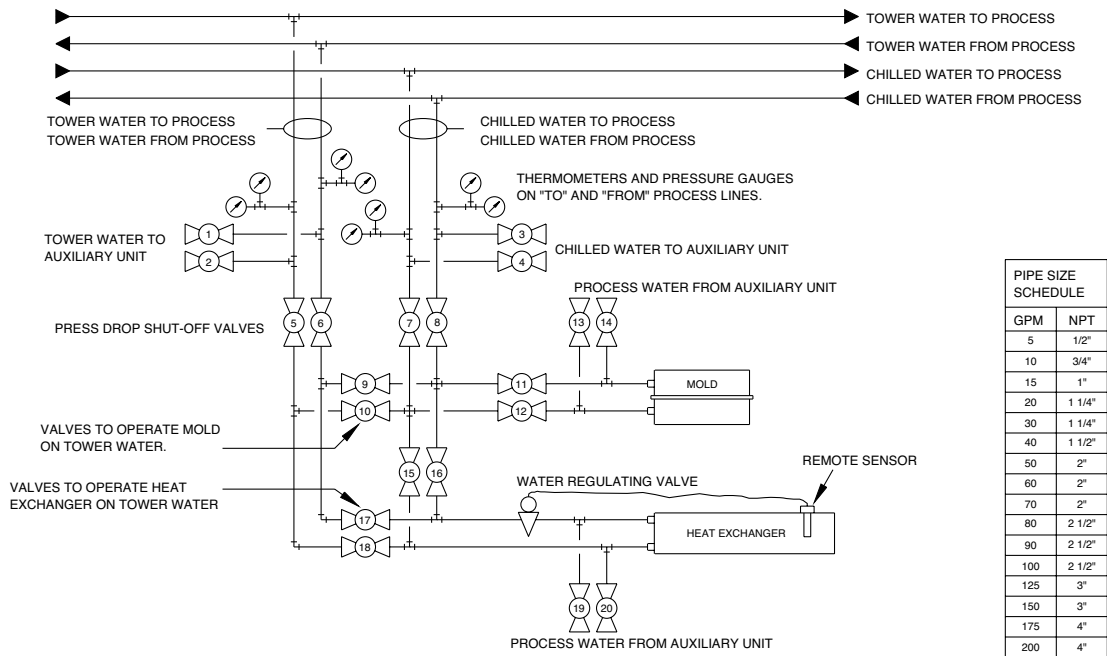


#	Item	#	Item	#	Item
1	From process connection	14	Process pump	28	Compressor discharge valve
2	Tank assembly	15	Supply pressure gauge	29	Condenser
3	Baffle plate	16	Alarm pressure switch	30	Service valve
4	Tank drain valve	17	To process connection	31	Head pressure gauge
5	Return probe	18	Standby pump	32	Filter-drier
6	Tank level control	19	Pump discharge valve	33	Liquid line solenoid valve
7	Level sight glass	20	Flow safety switch	34	Refrigerant sight glass
8	Overflow to drain	21	Factory adjusted flow control valve	35	Expansion valve
9	Pump suction valve	22	Evaporator	36	Hot gas by-pass valve
10	Evaporator pump	23	Freezestat	37	Evaporator out temperature sensor
11	Supply probe	24	Compressor suction valve	38	Evaporator in temperature sensor
12	Control sensor	25	Compressor		
13	Alarm thermostat	26	Low pressure safety switch		
		27	Low pressure gauge		

7.2 TYPICAL PHYSICAL DRAWING



7.3 TYPICAL PRESS DROP FOR INJECTION OR BLOW MOLDING



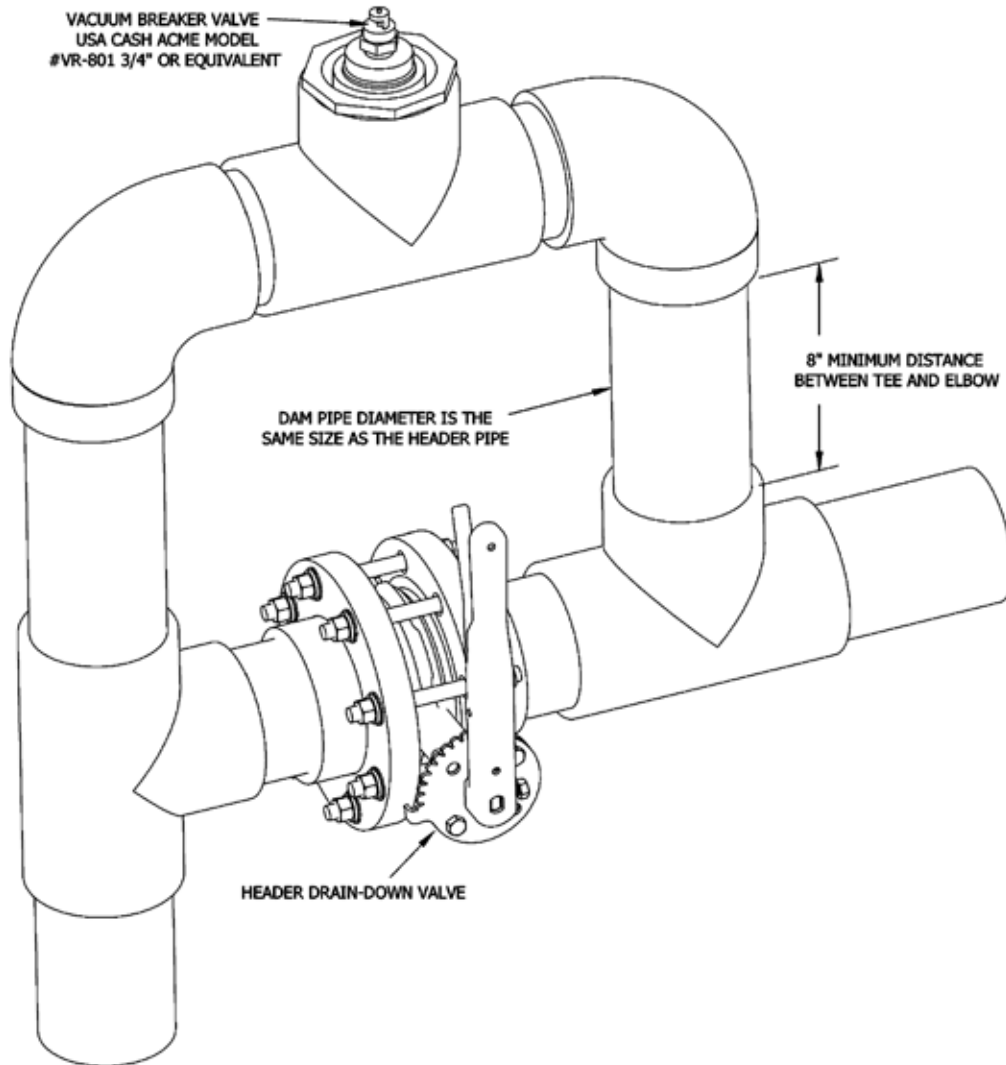
CONDITION	VALVES OPEN
WATER SUPPLY TO AUXILIARY EQUIPMENT	1,2,3,4
TO RUN TOWER WATER ON MOLD	5,6,9,10,11,12
TO RUN CHILLED WATER ON MOLD	7,8,11,12
TO RUN AUXILIARY EQUIPMENT ON MOLD	13,14
TO RUN TOWER WATER ON HEAT EXCHANGER	5,6,17,18
TO RUN CHILLED WATER ON HEAT EXCHANGER	7,8,15,16
TO RUN AUXILIARY EQUIPMENT ON HEAT EXCHANGER	19,20

- NOTES:
- 1) GPM @ 40 psig, 10°FΔT
 - 2) INSTALL SERVICE UNIONS AND GAUGES AS REQUIRED.
 - 3) INSULATE ALL CHILLED WATER PIPING.
 - 4) PIPE SIZES ARE BASED ON FLOW RATES AND PRESSURE REQUIREMENTS. (SEE SCHEDULE)
 - 5) SEE VALVE POSITION SCHEDULE FOR OPEN REQUIREMENTS (ALL OTHER VALVES ARE CLOSED). MORE THAN ONE CONDITION MAY EXIST AT ONE TIME, WITH THE EXCEPTION OF MIXING TOWER AND CHILLED WATER SYSTEMS.

This drawing is supplied to demonstrate a possible piping configuration for the equipment and is general in nature showing pipe sizes and basic routing. It is not intended to be inclusive of every detail required for specific location and installation. Consult with a professional engineer to determine specific needs before installation.



7.4 TYPICAL VACUUM BREAKER / ANTI-SIPHON SYSTEM



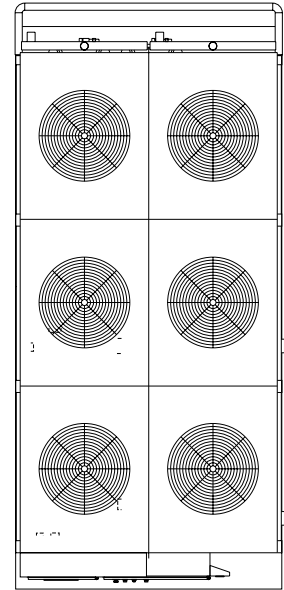
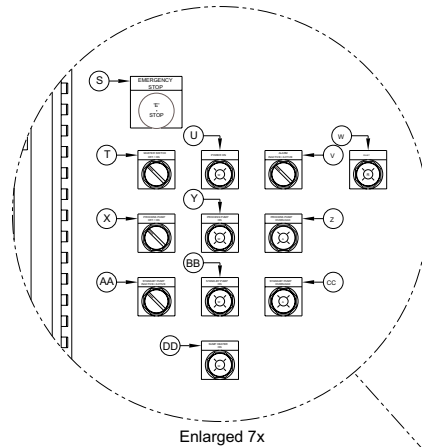
INSTALLATION NOTES:

1. The purpose of the vacuum breaker/anti-siphon (also called a drain-back dam), is to retain water in the header system during shut-down, and to eliminate air purge and shock to plumbing during start-up.
2. It is necessary to duplicate this arrangement on both the supply and return lines.
3. The drain-down valve allows header drainage for system maintenance and is closed during normal operation.
4. The vacuum breaker must be located at the highest point in the system, nearest to the tank to be most effective. A nipple length of 8 inches minimum is required to create sufficient vacuum to open the Cash Acme model VR-801.

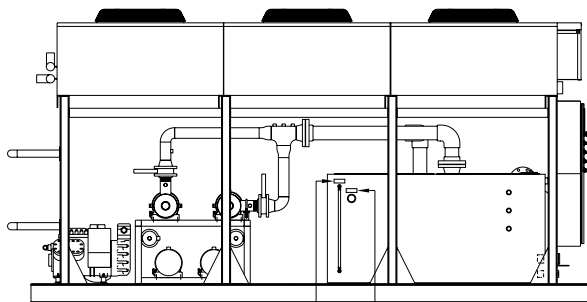
7.5 TYPICAL LABEL PLACEMENT DRAWING

LP-1452	ITEM QTY	LABELS	DESCRIPTION	OACS-80AD 2842SF
A	1	LIQUID LEVEL		
B	1	FILL PORT		
C	1	DRAIN		
D	1	HIGH VOLTAGE WARNING		
E	1	MADE IN AMERICA		
F	1	HIGH PRESSURE WARNING		
G	1	HEAD PRESSURE, ZONE #1		
H	1	LOW PRESSURE, ZONE #1		
I	1	HEAD PRESSURE, ZONE #2		
J	1	LOW PRESSURE, ZONE #2		
K	1	PRESSURE TO PROCESS		
L	1	ADVANTAGE LOGO		
M	1	TITAN LOGO		
N	1	TO PROCESS		
O	1	DATA TAG		
P	1	PROCESS PUMP		
Q	1	EVAPORATOR PUMP		
R	1	FROM PROCESS		
S	1	EMERGENCY STOP		
T	1	MASTER SWITCH OFF/ON		
U	1	POWER ON		
V	1	ALARM INACTIVE/ACTIVE		
W	1	FAULT		
X	1	PROCESS PUMP OFF/ON		
Y	1	PROCESS PUMP ON		
Z	1	PROCESS PUMP OVERLOAD		
AA	1	EVAP. PUMP OFF/ON		
BB	1	EVAP. PUMP ON		
CC	1	EVAP. PUMP OVERLOAD		
DD	1	SUMP HEATER ON		

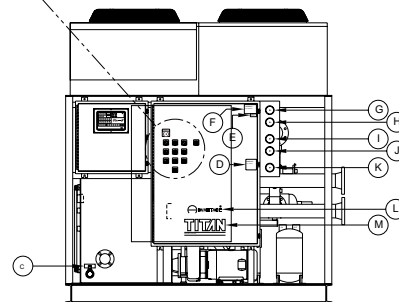
LP-1452	ITEM QTY	LABELS	DESCRIPTION	OACS-80AD 2842SF
R	1	FROM PROCESS		
S	1	EMERGENCY STOP		
T	1	MASTER SWITCH OFF/ON		
U	1	POWER ON		
V	1	ALARM INACTIVE/ACTIVE		
W	1	FAULT		
X	1	PROCESS PUMP OFF/ON		
Y	1	PROCESS PUMP ON		
Z	1	PROCESS PUMP OVERLOAD		
AA	1	EVAP. PUMP OFF/ON		
BB	1	EVAP. PUMP ON		
CC	1	EVAP. PUMP OVERLOAD		
DD	1	SUMP HEATER ON		



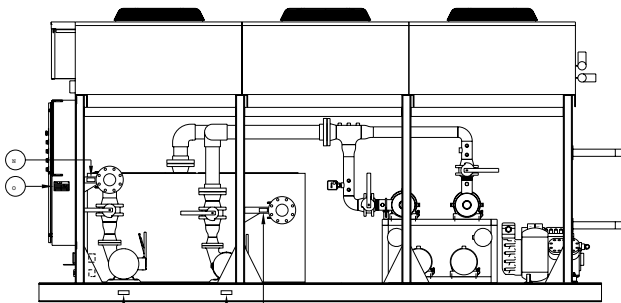
TOP VIEW



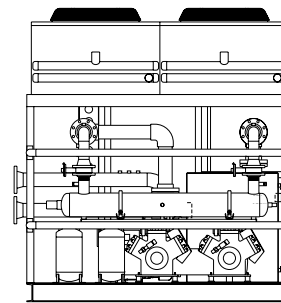
SIDE VIEW



FRONT VIEW

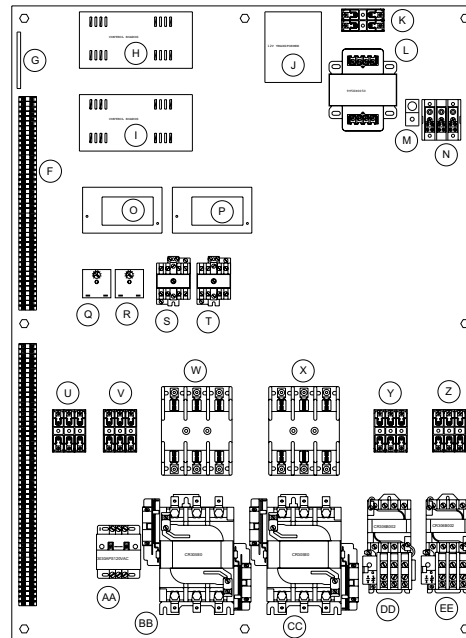
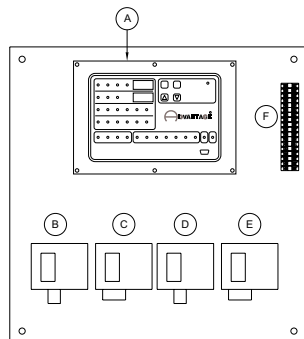
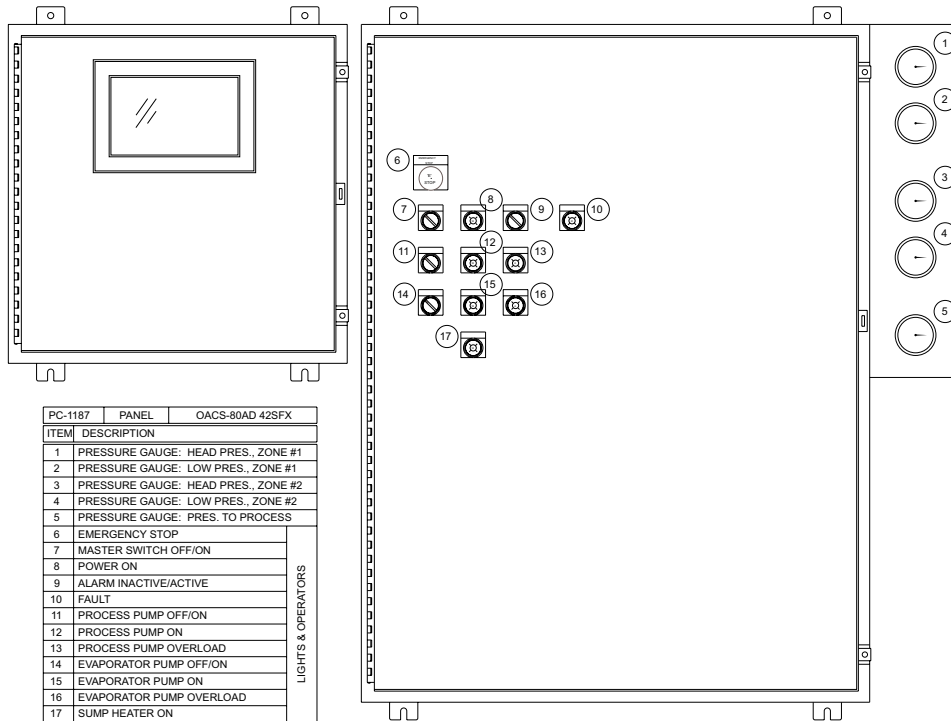


SIDE VIEW



SIDE VIEW

7.7 TYPICAL PANEL CONTROL STATION DRAWING



PC-1187	PANEL	OACS-80AD 42SFX
ITEM	DESCRIPTION	
A	INSTRUMENT: MZC-3	
B	REFRIGERANT HIGH PRES. SWITCH, ZONE #1	
C	REFRIGERANT LOW PRES. SWITCH, ZONE #1	
D	REFRIGERANT HIGH PRES. SWITCH, ZONE #2	
E	REFRIGERANT LOW PRES. SWITCH, ZONE #2	
F	TERMINAL STRIP	
G	BUS BAR	
H	INSTRUMENT: MZC-3 ZONE BOARD, ZONE #1	
I	INSTRUMENT: MZC-3 ZONE BOARD, ZONE #2	
J	INSTRUMENT TRANSFORMER	
K	FUSE BLOCK: FU-19,20	
L	CONTROL TRANSFORMER	
M	GROUND LUG	
N	POWER DISTRIBUTION BLOCK	
O	OIL PRESSURE SAFETY SWITCH, ZONE #1	
P	OIL PRESSURE SAFETY SWITCH, ZONE #2	
Q	SOLID STATE TIME DELAY RELAY: TANK LEVEL	
R	SOLID STATE TIME DELAY RELAY: HEATER	
S	RELAY: LOW LEVEL (R1)	
T	RELAY: ALARM/FAULT (R2)	
U	FUSE BLOCK: FU-16,17,18	
V	FUSE BLOCK: FU-13,14,15	
W	FUSE BLOCK: FU-10,11,12	

PC-1187	PANEL	OACS-80AD 42SFX
ITEM	DESCRIPTION	
X	FUSE BLOCK: FU-7,8,9	
Y	FUSE BLOCK: FU-4,5,6	
Z	FUSE BLOCK: FU-1,2,3	

PC-1187	PANEL	OACS-80AD 42SFX
ITEM	DESCRIPTION	
AA	HEATER CONTACTOR: H1	
BB	COMPRESSOR CONTACTOR: M4	
CC	COMPRESSOR CONTACTOR: M3	
DD	MOTOR STARTER: M2	
EE	MOTOR STARTER: M1	

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8.0 APPENDIX

- 8.1** Operations Below 48°F
- 8.2** Refrigerant Pressure - Temperature Chart CHART
- 8.3** Inhibited Propylene Glycol
- 8.4** Chiller Capacity and Derate Chart



8.1 OPERATIONS BELOW 48°F FLUID OR 38°F AMBIENT

- A. The chiller is never to be operated below 48°F leaving water temperature without several precautionary measures. All controls are factory adjusted for 48°F and above operations.
- B. Before readjusting the protective devices, a satisfactory antifreeze solution must be substituted for the recirculating chilled water. This mixture will consist of inhibited propylene glycol and water. Do not substitute an inhibited propylene glycol and water solution with common automotive type antifreeze. The chart on the next page outlines the glycol percentages at various water temperatures.
- C. Fluid must be tested with a hydrometer to verify proper glycol percentages for freeze protection. The ratio shall be according to the chart below. Too much glycol can cause capacity and control problems.
- D. **DO NOT USE AUTOMOTIVE TYPE ANTI-FREEZE.**
- E. **Once a satisfactory antifreeze solution is in place the protective devices may be adjusted and the control instrument can be unlocked to allow operation below 48°F.**
- F. If your unit is equipped with an adjustable low pressure switch, adjust the low pressure switch according to the specifications in the chart on the next page.

Never lower the cut out setting on the adjustable low pressure switch without adding glycol to the circulating system. Evaporator damage will result and this damage is not covered by the factory warranty.



Adjustable low pressure switch

- G. If your unit is equipped with a non-adjustable “fixed” pressure switch with a factory low limit of 48°F this switch must be replaced with a switch with a lower limit. The lower range low pressure switch can be obtained from the factory by calling 317-887-0729 and asking for the service department. The model and serial number of your unit is required. A qualified refrigeration technician is required to change the switch though no gas recovery is required. The switch attaches to a threaded fitting on the refrigeration line.
- H. Once all limit switches are adjusted, the temperature control instrument may be lowered to the desired operating temperature. Your control instrument may require moving a jumper or DIP switch to allow the temperature set points below 48°F. See the control instrument section of this manual or call the Service department for specific instructions.
- I. **LE Instruments.** The LE instrument requires an adjustment of the DIP switch to accommodate the expanded temperature range. Please see section 5.6 in this manual for more information.
- J. **Multizone Instruments.** The Multizone instrument requires an adjustment of the DIP switch to accommodate the expanded temperature range. Please see section 5.7 in this manual for more information.



Fixed low pressure switch

- K. Once all safety provisions are made, the temperature control set point may now be lowered to the desired operating temperature.
- L. **WARNING:** do not use any type or brand of automotive antifreeze. Automotive antifreeze contains corrosion inhibitors - silicates - designed for compatibility with the materials in automotive engines. Unfortunately, silicates can gel and cause deposits to foul and insulate heat exchanger surfaces. In your chilling system that can mean higher energy costs, high pumping costs, and possibly even shut downs for system cleaning. We recommend the use of DowFrost or Monsanto DFS-1.

Refrigerant Low Pressure Switch Cut-Out & Cut-In Settings

Ambient Temperature	Operating Temperature	Glycol	Freeze Point	Cut Out Temp	Cut In Temp	R22		R134A		R410A	
						Cut-Out	Cut-In	Cut-Out	Cut-In	Cut-Out	Cut-In
39°F +	48° - 70°F	0%	32°F	32°F	36°F - 39°F	58#	63#	28#	33#	102#	111#
15° to 38°F	25° - 47°F	30%	10°F	10°F	15°F - 18°F	33#	38#	12#	17#	63#	72#
0° to 14°F	10° - 24°F	40%	-5°F	-5°F	0°F - 7°F	20#	25#	4#	9#	43#	52#
-10° to 0°F	n/a	45%									
-20° to -10°F	n/a	50%									

Ambient Temperature	Operating Temperature	Glycol	Freeze Point	Cut Out Temp	Cut In Temp	R404A		R407C	
						Cut-Out	Cut-In	Cut-Out	Cut-In
39°F +	48° - 70°F	0%	32°F	32°F	36°F - 3°9F	72#	79#	52#	58#
15° to 38°F	25° - 47°F	30%	10°F	10°F	15°F - 1°8F	44#	49#	28#	34#
0° to 14°F	10° - 24°F	40%	-5°F	-5°F	0°F - 7°F	29#	34#	16#	22#
-10° to 0°F	n/a	45%							
-20° to -10°F	n/a	50%							

High Pressure Cut Out (maximum) (with liquid receiver)

Refrigerant	Air-Cooled
R22	360#
R134A	260#
R407C	360#
R410A	550#
R404A	360#



8.2 REFRIGERANT PRESSURE-TEMPERATURE CHART

Refrigerant Pressure Temperature Chart

Temperature		Refrigerant						Temperature		Refrigerant				
°F	°C	R-22	R-410a	R-407c	R-134a	R-404a		°F	°C	R-22	R-410a	R-407c	R-134a	R-404a
-60	-51.1	<i>11.9</i>	<i>0.9</i>	<i>16.0</i>	<i>21.6</i>	-	27	-2.8	51.2	91.6	44.7	23.7	66.2	
-55	-48.3	<i>9.2</i>	1.8	<i>13.7</i>	<i>20.2</i>	-	28	-2.2	52.4	93.5	45.9	24.5	67.7	
-50	-45.6	<i>6.1</i>	4.3	<i>11.1</i>	<i>18.6</i>	-	29	-1.7	53.7	95.5	47.1	25.3	69.2	
-45	-42.8	<i>2.7</i>	7.0	<i>8.1</i>	<i>16.7</i>	-	30	-1.1	54.9	97.5	48.4	26.1	70.7	
-40	-40.0	0.6	10.1	<i>4.8</i>	<i>14.7</i>	4.9	31	-0.6	56.2	99.5	49.6	26.9	72.1	
-35	-37.2	2.6	13.5	<i>1.1</i>	<i>12.3</i>	7.5	32	0.0	57.5	101.6	50.9	27.8	73.8	
-30	-34.4	4.9	17.2	1.5	<i>9.7</i>	10.3	33	0.6	58.8	103.6	52.1	28.6	75.3	
-25	-31.7	7.5	21.4	3.7	<i>6.8</i>	13.5	34	1.1	60.2	105.7	53.4	29.5	76.9	
-20	-28.9	10.2	25.9	6.2	<i>3.6</i>	16.8	35	1.7	61.5	107.9	54.8	30.4	78.5	
-18	-27.8	11.4	27.8	7.2	<i>2.2</i>	18.3	36	2.2	62.9	110.0	56.1	31.3	80.2	
-16	-26.7	12.6	29.7	8.4	<i>0.7</i>	19.8	37	2.8	64.3	112.2	57.5	32.2	81.7	
-14	-25.6	13.9	31.8	9.5	0.4	21.3	38	3.3	65.7	114.4	58.9	33.1	83.5	
-12	-24.4	15.2	33.9	10.7	1.2	22.9	39	3.9	67.1	116.7	60.3	34.1	85.2	
-10	-23.3	16.5	36.1	11.9	2.0	24.6	40	4.4	68.6	118.9	61.7	35.0	86.9	
-8	-22.2	17.9	38.4	13.2	2.8	26.3	41	5.0	70.0	121.2	63.1	36.0	88.6	
-6	-21.1	19.4	40.7	14.6	3.7	28.0	42	5.6	71.5	123.6	64.6	37.0	90.4	
-4	-20.0	20.9	43.1	15.9	4.6	29.8	43	6.1	73.0	125.9	66.1	38.0	92.2	
-2	-18.9	22.4	45.6	17.4	5.5	31.7	44	6.7	74.5	128.3	67.6	39.0	94.0	
0	-17.8	24.0	48.2	18.9	6.5	33.7	45	7.2	76.1	130.7	69.1	40.0	95.8	
1	-17.2	24.8	49.5	19.6	7.0	34.7	46	7.8	77.6	133.2	70.6	41.1	97.6	
2	-16.7	25.7	50.9	20.4	7.5	35.7	47	8.3	79.2	135.6	72.2	42.2	99.5	
3	-16.1	26.5	52.2	21.2	8.0	36.7	48	8.9	80.8	138.2	73.8	43.2	101.4	
4	-15.6	27.4	53.6	22.0	8.6	37.7	49	9.4	82.4	140.7	75.4	44.3	103.3	
5	-15.0	28.3	55.0	22.8	9.1	38.8	50	10.0	84.1	143.3	77.1	45.4	105.3	
6	-14.4	29.1	56.4	23.7	9.7	39.8	55	12.8	92.6	156.6	106.0	51.2	115.3	
7	-13.9	30.0	57.9	24.5	10.2	40.9	60	15.6	101.6	170.7	116.2	57.4	126.0	
8	-13.3	31.0	59.3	25.4	10.8	42.0	65	18.3	111.3	185.7	127.0	64.0	137.4	
9	-12.8	31.9	60.8	26.2	11.4	43.1	70	21.1	121.5	201.5	138.5	71.1	149.3	
10	-12.2	32.8	62.3	27.1	12.0	44.3	75	23.9	132.2	218.2	150.6	78.6	161.9	
11	-11.7	33.8	63.9	28.0	12.6	45.4	80	26.7	143.7	235.9	163.5	86.7	175.4	
12	-11.1	34.8	65.4	29.0	13.2	46.6	85	29.4	155.7	254.6	177.0	95.2	189.6	
13	-10.6	35.8	67.0	29.9	13.8	47.8	90	32.2	168.4	274.3	191.3	104.3	204.5	
14	-10.0	36.8	68.6	30.9	14.4	49.0	95	35.0	181.9	295.0	206.4	113.9	220.2	
15	-9.4	37.8	70.2	31.8	15.1	50.2	100	37.8	196.0	316.9	222.3	124.1	236.8	
16	-8.9	38.8	71.9	32.8	15.7	51.5	105	40.6	210.8	339.9	239.0	134.9	254.2	
17	-8.3	39.9	73.5	33.8	16.4	52.7	110	43.3	226.4	364.1	256.5	146.3	272.5	
18	-7.8	40.9	75.2	34.8	17.1	54.0	115	46.1	242.8	389.6	274.9	158.4	291.9	
19	-7.2	42.0	77.0	35.9	17.7	55.3	120	48.9	260.0	416.4	294.2	171.1	312.1	
20	-6.7	43.1	78.7	36.9	18.4	56.6	125	51.7	278.1	444.5	314.5	184.5	333.4	
21	-6.1	44.2	80.5	38.0	19.2	57.9	130	54.4	297.0	474.0	335.7	198.7	355.6	
22	-5.6	45.3	82.3	39.1	19.9	59.3	135	57.2	316.7	505.0	357.8	213.5	379.1	
23	-5.0	46.5	84.1	40.2	20.6	60.6	140	60.0	337.4	537.6	380.9	229.2	403.7	
24	-4.4	47.6	85.9	41.3	21.4	62.0	145	62.8	359.1	571.7	405.1	245.6	429.6	
25	-3.9	48.8	87.8	42.4	22.1	63.4	150	65.6	381.7	607.6	430.3	262.8	456.8	
26	-3.3	50.0	89.7	43.6	22.9	64.8	155	68.3	405.4	645.2	456.6	281.0	484.8	

Italics indicates vacuum (inches of mercury)

Standard font indicates pressure (pounds per inch gauge)



8.3 INHIBITED PROPYLENE GLYCOL

- A.** To operate liquid chillers below 48°F, it is necessary to add **inhibited propylene glycol** to the circulating system to lower the freeze point and prevent damage to the cooling system. Inhibited propylene glycol contains corrosion inhibitors which are compatible with most industrial heat transfer surfaces. Inhibited propylene glycol is manufactured by:
- Dow Chemical - "DowFrost" (1-800-258-2436)
 - Monsanto "Therminol FS" (1-800-459-2665)
- B.** Automotive anti-freeze must never be used in industrial heat transfer applications. Automotive anti-freeze contains silicate type corrosion inhibitors designed to be compatible with automotive components. In an industrial application, the silicates will form a gel on the heat transfer surface which will result in substantial reduction in cooling capacity and is virtually impossible to remove.

8.4 CHILLER CAPACITY AND DERATE CHART

- A.** Standard chiller rating is at 50°F. For all other temperature settings, output tonnage is altered as follows:
- B.** If operation of the chiller at less than 48°F is required, an inhibited propylene glycol solution is required.

OUTPUT TEMPERATURE °F	FULL AVAILABLE % CAPACITY
60	105%
50	100%
45	90%
40	80%
35	70%
30	60%
25	50%
20	40%

- C.** Consult factory for chiller operation below 20°F.
- D.** Ambient conditions affect air cooled chiller operation and capacity. Standard rating is at 95°F entering air temperature. For ambient air conditions greater than 95°F, chiller derating will occur. For ambients over 95°F consult factory.



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