I.O.M. #170 *updated 08/11/2021*

INSTRUCTION MANUAL • INSTALLATION • OPERATION • MAINTENANCE

MA-RC & MW

Central Chilling Modules

Covering Models From 5 - 180 Tons
Air & Water Cooled

Model:: _____

Serial Number :: _____

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

MA-RC & MW

Central Chilling Modules

INSTRUCTION MANUAL
AIR & WATER COOLED MODELS

COVERING

INSTALLATION
OPERATION
MAINTENANCE

TEMPTEK, INC. 525 East Stop 18 Road Greenwood, IN 46143
317-887-6352 fax: 317-881-1277 Service Department fax: 317-885-8683
Website: www.Temptek.com E-mail: service@Temptek.com

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY BLANK

1.0 GENERAL

1.1 INTRODUCTION

A. This manual covers MA & MW central chilling modules from 5 to 180 tons (17.5 to 633 kW) of cooling capacity using the MZC (Multi Zone Control) microprocessor control instrument, CF or LE 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.*

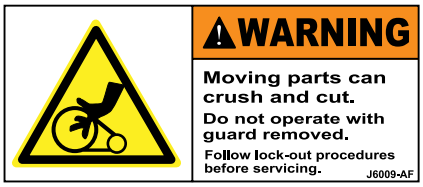
WARNING: *This equipment contains refrigerant under pressure. Accidental release of refrigerant under pressure can cause personal injury and or property damage. Exercise care while working on or around this equipment.*

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.

Alerts users to the danger of high voltage.

Alerts user to the danger of the rotating condenser fans on air condensed units (APT-RC models).



Alerts user to the danger of belt drive systems on unit with centrifugal blowers (APT-RC models).

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. Chillers are shipped skid mounted and wrapped in plastic prior to shipment. 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 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.

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.*

1.5 CLEAN AIR ACT

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.

WARNING: *Improper water treatment will void unit warranty.*

1.6 WATER TREATMENT

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.

Model Designator

MA-25A-CC-RC

Series

Tons of Capacity

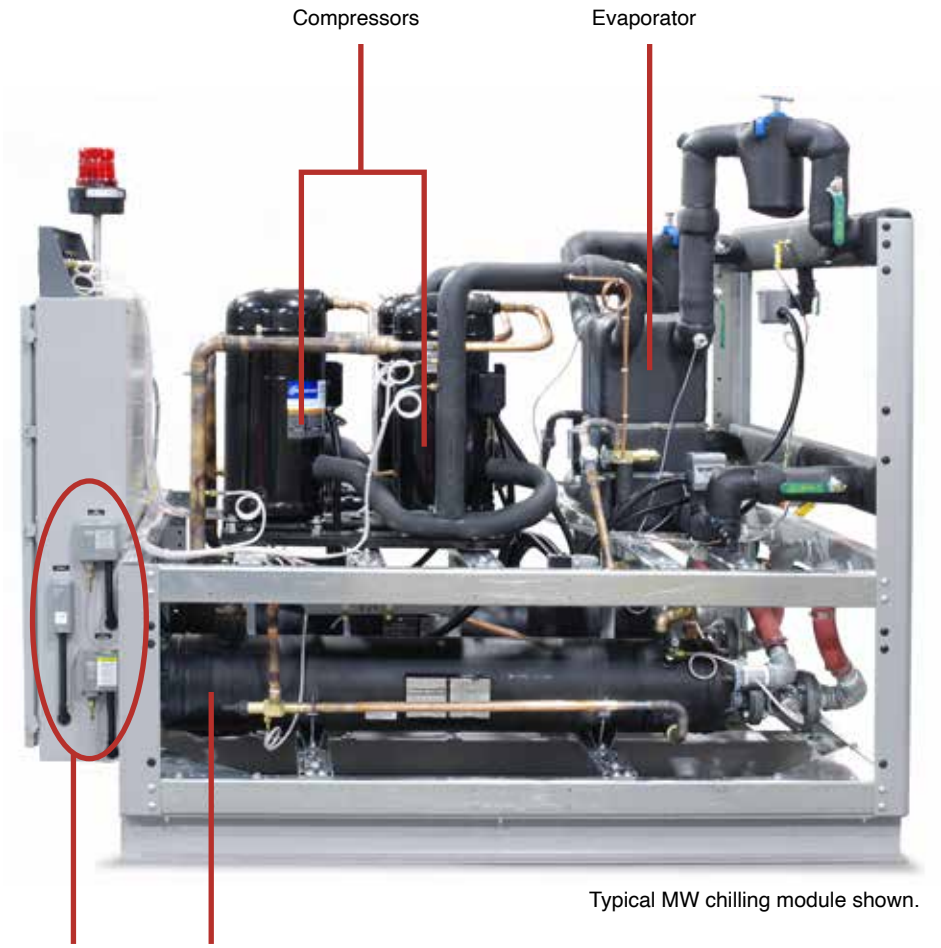
Type
A : *Air-Cooled*
W : *Water-Cooled*

Zones
C : *Single*
CC : *Dual*
CCC : *Triple*

Remote Air-Cooled
Applies to Air-Cooled Units

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

1.8 COMPONENTS



Typical MW chilling module shown.

2.0 INSTALLATION

2.1 GENERAL

A. Chillers are shipped skid mounted and wrapped in plastic prior to shipment. 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. **Foundation.** The chilling module must be installed on a rigid and level mounting surface with adequate strength to support the operating weight of the chiller and attached piping.

This unit will contain water or water/glycol when operating. Locate the chiller where an unforeseen fluid leak will not cause damage to the surroundings or install the unit in such a way that an unforeseen fluid leak will not damage its surroundings.

B. Air-cooled units are conjoined with an indoor unit (chiller) and a remote condenser. The indoor unit contains the refrigeration circuits, and microprocessor control and is located inside the facility. The remote air-cooled condenser is located outside the facility.

C. Water-cooled units include the refrigeration circuits, microprocessor control and water-cooled condenser on a single skid.

D. For most efficient operation, locate the water-cooled unit and the air-cooled chiller in a level, clean, dry and well ventilated environment. Please note the air-cooled condenser (air-cooled models only) is located outside of the facility.

2.3 CHILLED WATER PIPING INSTALLATION

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

B. **PROCESS WATER IN** : A rigid pipe should be connected to the remote pumping station. The pumping station will supply hot water from the process to the chilling module.

PROCESS WATER IN

This label marks the Process Water In connection

C. **PROCESS WATER OUT**: A rigid pipe should be connected to the chilled water side of the pumping station reservoir. The pumping station supplies the chilled water to process.

PROCESS WATER OUT

This label marks the Process Water Out connection

D. Install a high volume basket strainer in the **PROCESS WATER IN** line with isolation valves. A basket strainer or bag filter with a mesh screen of 20-

40 microns will protect the unit. **A "wye" type strainer is not recommended because it does not have adequate debris holding capacity.** Note that some units may be equipped with a basket type strainer from the factory.

Typical wye strainer - Not recommended.

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 WATER-COOLED CONDENSERS (WPT MODELS)

A. The WPT chilling module is designed for indoor use and should be located in a clean, dry and well-ventilated environment.

B. WPT chilling modules require an external water source at 85°F maximum temperature for the water-cooled condenser. Tower water is the most common selection. However, city or well water may be utilized. A water regulator valve is supplied to vary flow based on refrigerant discharge pressure.

Condenser Water In

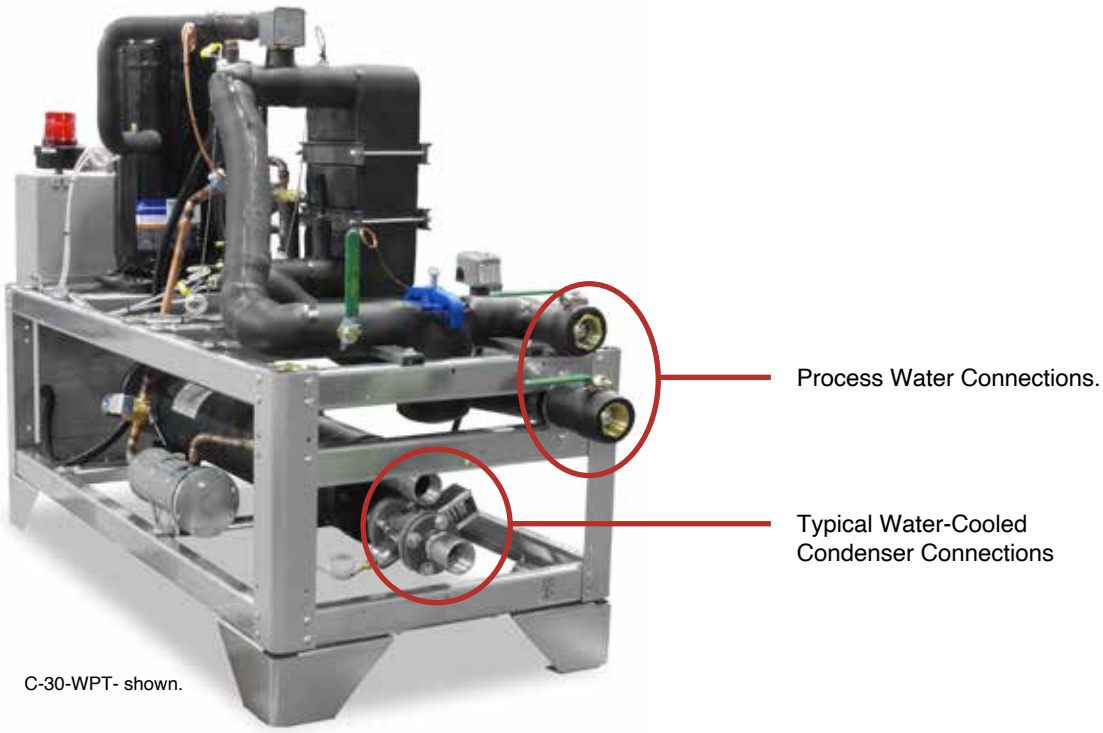
This label marks the Condenser Water In connection

Condenser Water Out

This label marks the Condenser Water Out connection

C. Nominal flow rate requirements:

1. Required consumption from a city water source is 1.5 gpm at 65°F per ton of rated capacity.



C-30-WPT- shown.

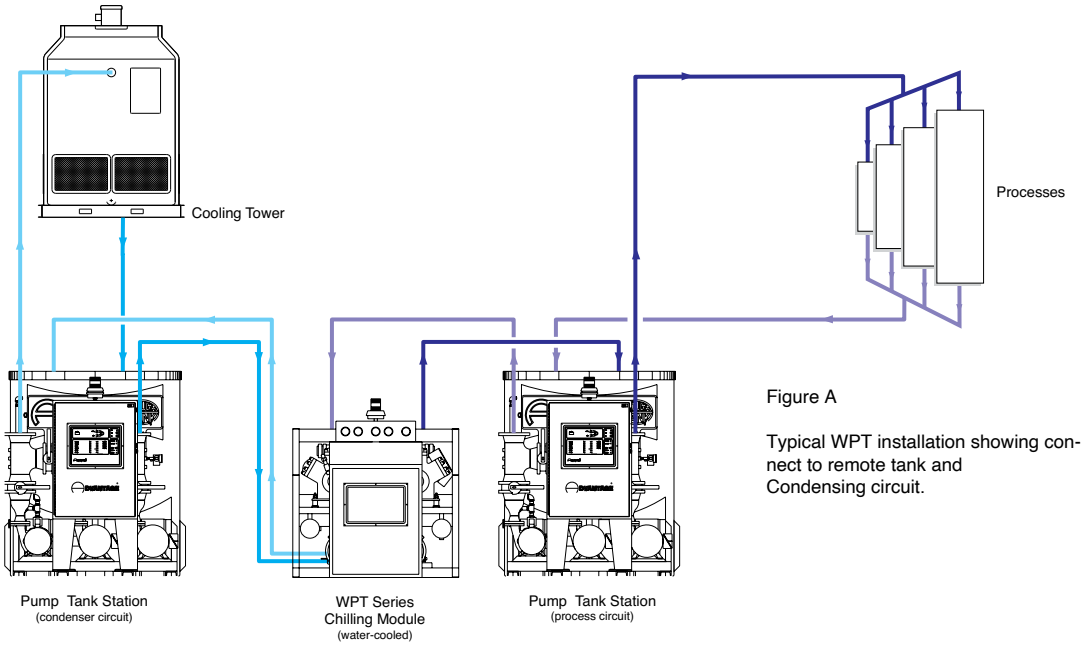


Figure A

Typical WPT installation showing connect to remote tank and Condensing circuit.

2. Required consumption for a tower water source is 3 gpm at 85°F per ton of rated capacity.

D. The pressure differential requirement between the condenser water in and water out connections must be a minimum of 30 PSIG to obtain adequate flow.

E. A water filter with 40 mesh or finer screen should be installed prior to the chiller to protect the condenser from debris. Basket type strainers are recommended rather than wye type strainers because they are generally more rugged and hold more debris.

2.5 AIR-COOLED CONDENSER (APT-RC MODELS)

A. Air-cooled units have an indoor module contains the chiller's compressor, evaporator, control system and pumping station and a remote outdoor condenser that discharges the process heat outdoors.

1. The indoor portion of the system containing the compressor, evaporator, control system and pumping stations should be installed in a clean, dry and well ventilated environment.

2. The remote air-cooled condenser is designed for outdoor installation normally selected for ambient air temperatures from -20°F minimum to 95°F maximum. Ambient conditions outside of the rated temperatures may require an alternate selections for proper operations.

B. Refrigerant piping for remote outdoor condenser models:

1. Only refrigerant grade copper and solder shall be used.

2. The refrigerant line sizes shall be based on equivalent line lengths and acceptable refrigerant pressure drops.

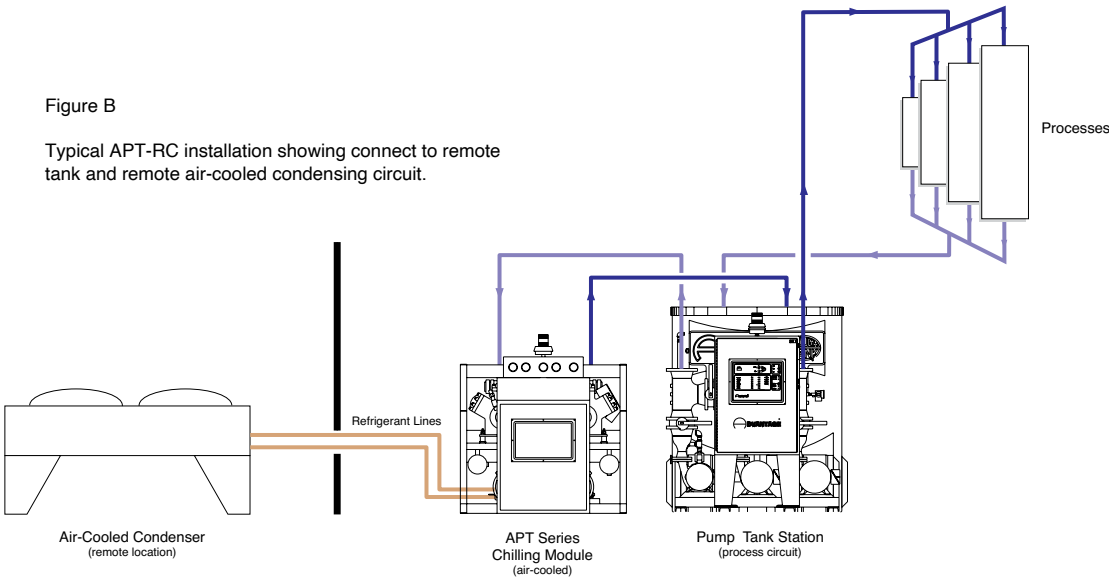
3. A certified refrigerant technician shall evacuate and charge the refrigerant system under loaded conditions.

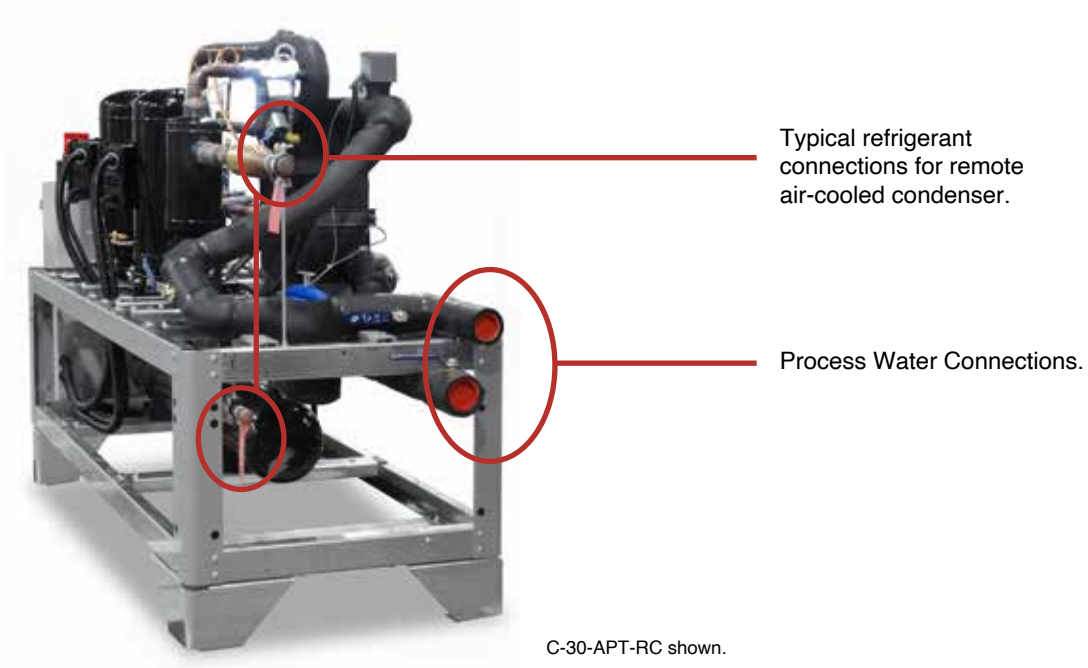
C. Installation instructions are provided by the manufacturer of the condensing unit and are shipped in the electrical cabinet. The following is a short overview of the instructions.

D. The condenser is designed to be rigged from overhead. Lifting holes are provided and marked.

Figure B

Typical APT-RC installation showing connect to remote tank and remote air-cooled condensing circuit.





C-30-APT-RC shown.

E. 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.

F. Interconnecting refrigerant piping is field supplied and installed. Only refrigerant approved copper should be used. Water piping and soft solder joints are not acceptable. High temperature phos-copper should be used on all joints.

F. The condensing unit can be split into various coil capacities. Generally it will be used as a 50% - 50% split.

G. The following should be field provided and installed in the interconnecting piping :

1. Discharge line check valves installed after the oil separator.

2. Shut off valves in the hot gas and liquid lines.

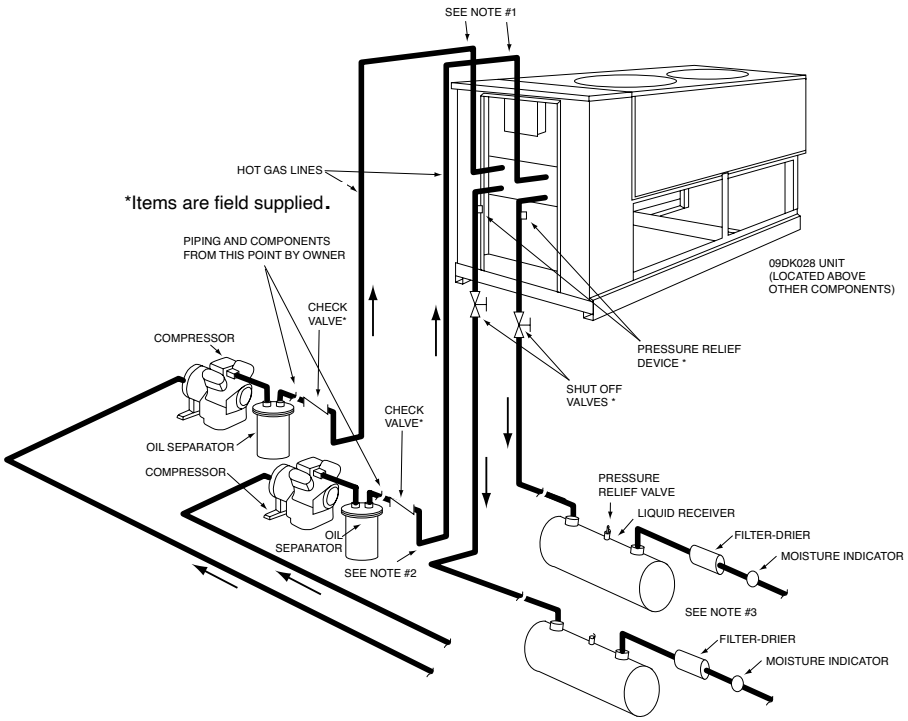
3. Pressure relief valves located at the condensing unit.

4. Refrigerant recovery ports located at the condensing unit,

5. Inverted traps in the refrigerant piping (refer to typical piping schematic).

H. The electrical installation must conform to all national and local electrical codes. Refer to the electrical schematics for actual circuit design.

I. For units using a 09DK condenser with a dual split system:



1. Hot gas lines should rise above refrigerant level in condenser circuit.

2. Trap should be installed on hot gas lines to prevent condenser oil and refrigerant vapor migration from accumulating on compressor heads during off cycle.

3. Refer to Carrier System Design Manual, part 3, for proper piping sizes and design.

4. For piping lengths greater than 50 ft provide support to liquid and gas lines near the connections to the coil.

2.6 ELECTRICAL CONNECTION

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. All electrical wiring must comply with local codes and the National Electric Code.

2. 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.

3. 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.)

4. 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.

5. A unit specific electrical drawing is shipped with the unit.

6. 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.

7. A proper ground is required for the unit.

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.

Typical data tag.

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.

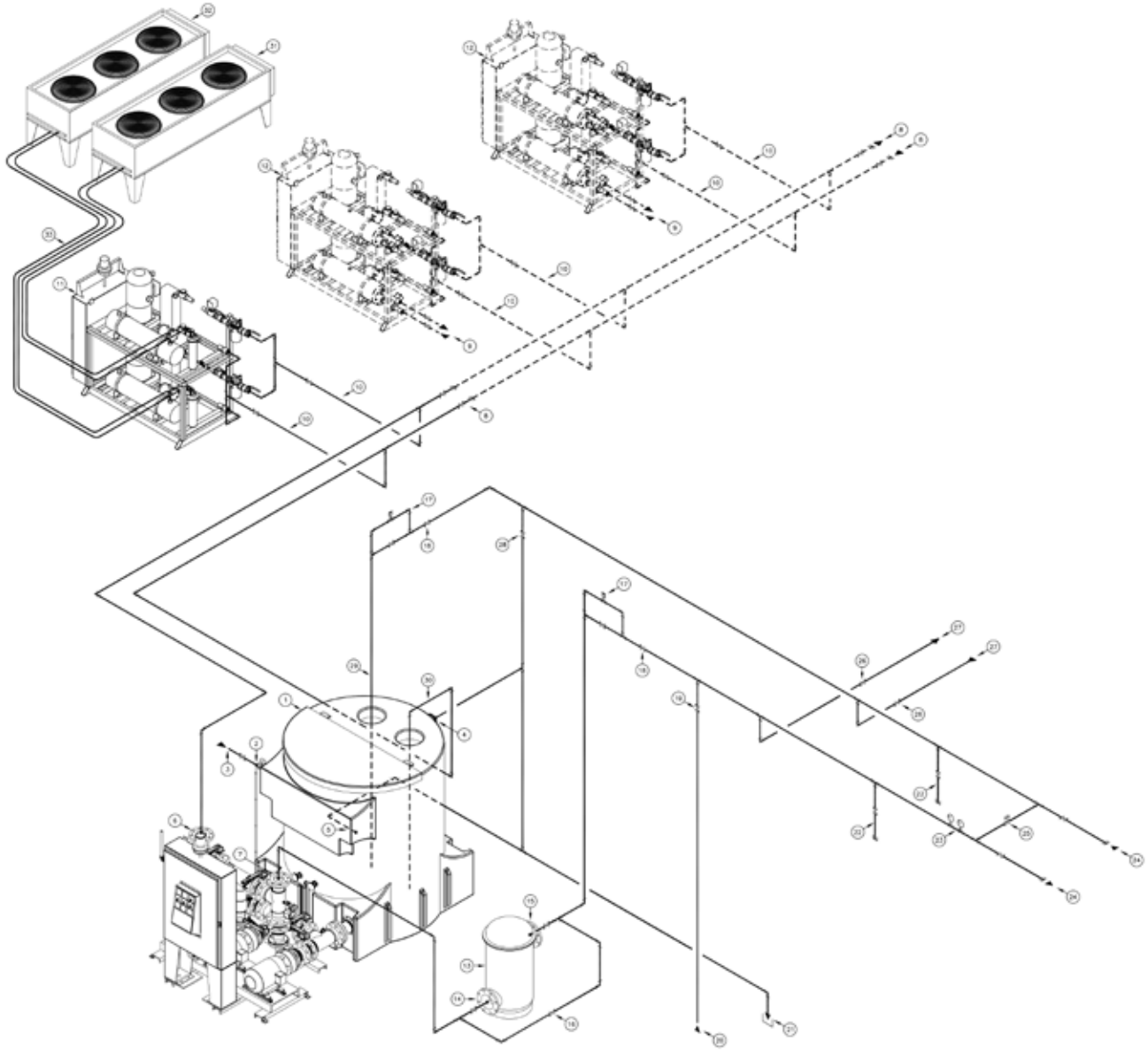
3. Follow all local and national codes.

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. Pump tank (2-pump system with standby pump)
2. Water make-up connection (pump tank reservoir)
3. From city water supply (reservoir make up)
4. Overflow connection (chiller reservoir)
5. Drain connection (pump tank reservoir)
6. Pump discharge connection (supply to chillers)
7. Pump discharge connection (supply to process)
8. Valve and cap chiller supply and return pipes (for future capacity expansion)
9. Condenser water pipes (chiller supply & return, from tower water or city water source)
10. Chilled water pipes (chiller supply & return, from pump tank)
11. Chiller module (air condensed with remote condensers)
12. Chiller modules (future water condensed)
13. Filter (MLS Series in-line full flow design, see piping options detail drawing #MS-1045)
14. Water inlet connections (filter)
15. Water outlet connection (filter)
16. Bypass pipe with valves (redirection of process water flow during filter service)
17. Drain-back dam (keeps header pipes full during pump shut-down periods, see detail drawing #PL-617)
18. Main header valves (closed for header service or during use of alternate source of cooling water)
19. Alternate source of cooling water on/off valve (for system emergency back-up)
20. Alternate water supply source (for system emergency back-up)
21. System multi-use open drain (reservoir overflow, reservoir drain, system emergency back-up)
22. Process water drops from header to use point (valved for service shutoff, see installation detail drawing #MS-1046)
23. Pressure gauge and thermometer (for system performance monitoring and evaluation)
24. Header ends valved and capped (for future expansion)
25. Header by-pass valve (adjustable and pressure activated to maintain flow in header during lower process demand)
26. Branch header valves (for branch header service isolation)
27. Branch header
28. Valve to open drain (for system emergency back-up)
29. From process return pipe
30. From chillers return pipe
31. Condenser (zone #1 remote outdoor unit, mounted at ground level on concrete pad or on roof)
32. Condenser (zone #2 remote outdoor unit, mounted at ground level on concrete pad or on roof)
33. Condenser refrigerant piping (sized by refrigeration contractor based on your specific installation)

Notes

A. Avoid unnecessary use of elbows, fittings and other flow restricting components.
B. All valves should be a non-restirictive gate or butterfly type.
C. Extra pipe fittings (other than shown here) can be added to meet your specific plant requirements.
D. Brace all piping to prevent movement.
E. Insulate chilled water piping to prevent condensation and to reduce process water temperature head gain.
F. Check local codes for back flow prevention into the municipal water line.
G. Run all drain pipes to an adequately sized and unrestricted open style drain.
H. Return water pipes that drop into the pump tank 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 ends of the return pipes at a diagonal and face the open size of the pie end away from the suction ports of the tank.
I. Refer to the equipment operation manuals for detailed installation information.

3.0 OPERATIONS

3.1 GENERAL

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.

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.*

B. 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 and 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. This segment covers several instruments that could be included on the chilling module.

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. **IMPORTANT -** Prior to starting the chiller verify that the low and high refrigerant pressure limit settings are set per the pressure settings chart and instructions in section 3.9 of this manual for the fluid operating temperature. Failure to have these settings correct may cause damage to the chiller which is not covered by the chiller warranty.

B. **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. MA-RC and MW chilling modules require an external reservoir and pumping system. The external reservoir must be filled and maintained for proper operation.

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. Do not use deionized water in this unit. Some customized units may be compatible with deionized water. Consult the factory before using deionized water.

C. PROPER ROTATION (PHASING) OF SCROLL COMPRESSORS AND FANS (ON APT-RC UNITS)

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 factory phased in unison. Therefore, you should only need to check one motor to verify phasing. However, we recommend verifying all motor rotations.

3. Scroll type compressors may be verified by viewing the refrigerant high pressure and low pressure gauges. Normal operating pressures are 190 to 230 PSIG and 68 to 75 PSIG respectively. If pressure gauges are near equal when the compressor is operating, then the rotation is backwards. If phasing is incorrect, disengage power at the power source. Check for 0 voltage on load side of your disconnection means. With the absence of voltage, change any two legs of the power source. Change the phase at your power source. Do not change the internal equipment wiring. Check rotation before operating the units.

4. Caution must be taken when checking rotation to avoid electrical shock.

5. A scroll compressor may make a loud rattling noise when rotating in the wrong direction.

6. 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 many take substantial time.

D. PROCESS FLOW ADJUSTMENTS

1. The operator must determine and set proper water flow rate for the most efficient and trouble free operation.

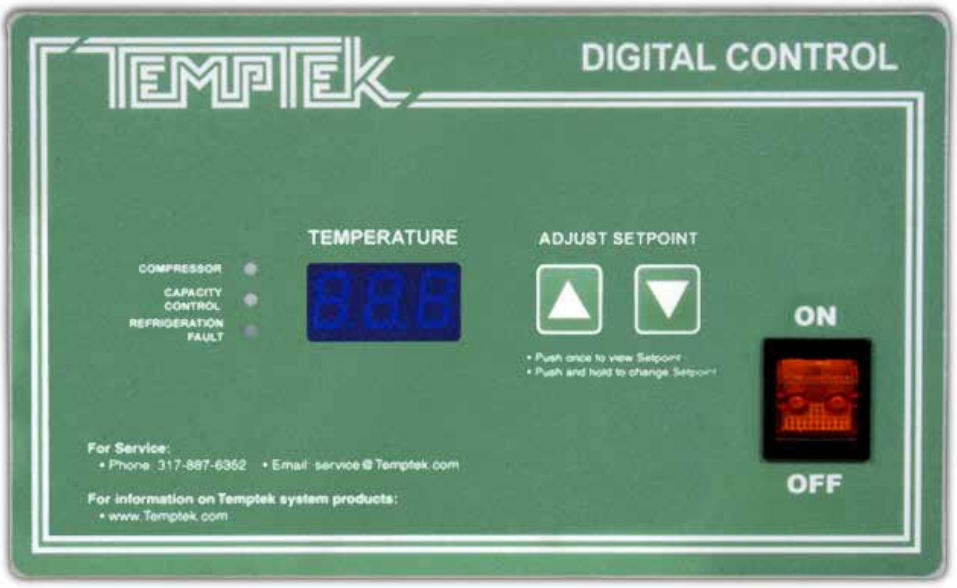
a. Water flow rate through the process is determined by the pressure losses in the process loop. Generally, higher flow rates result in turbulent flow achieving maximum temperature control and lower maintenance. Since the evaporator in most liquid chillers is flow sensitive, the efficiency of operation 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.** To correct this problem, a throttling valve must be installed i n the from process line. With the throttling valve fully closed, slowly open the valve until the correct motor amperage is achieved. 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.

3.3 CF CONTROL INSTRUMENT OPERATION



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:**

The chiller control is programmed from the factory with a setpoint range of 48° - 90°F. To operate below 48°F, the inhibited propylene glycol must be added to the system and the system limit switches must be adjusted. In addition, the operating range of the chiller control instrument must be changed by moving the

Setpoint Lockout (SPL) jumper. Refer to section 3.3 C3 in this manual for more information.
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.

Operating above 70°F setpoint with unit using R407C and R134A refrigerant requires the addition of a refrigerant crankcase pressure regulating (CPR) valve. Units using R410A refrigerant may operate up to 80°F with no CPR valve.

B. INSTRUMENT OPERATION

1. **To start the unit, toggle on the illuminated ON/OFF SWITCH.** The chiller control will begin temperature control operations.

2. The chilled water setpoint is selected by pressing or pressing and holding the up or down arrow keys. For the standard configuration where the control sensor is located in the fluid entering the chiller, select a temperature that is 8°-10°F above your desired fluid temperature which will result in a temperature 8°-10°F cooler leaving the chiller. If the control sensor is located on the to process connection of a system with a large fluid reservoir then set the temperature to your desired fluid temperature. Consult the factory if you have questions about your configuration. The default range for the setpoint temperature is 48°-90°F or 9°-32°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 on after 3 minutes powered down. If the fault condition remains, the control will turn the compressor off and retry after 1 minute. This sequence will repeat until the compressor turns on or instrument power is cycled.

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 turn on the hot gas bypass when the To Process temperature is below the setpoint by no more than 3 degrees.

   The instrument will turn off the compressor and hot gas bypass when the To Process temperature is 4 degrees or more below the setpoint.

C. INSTRUMENT CONTROLS

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.

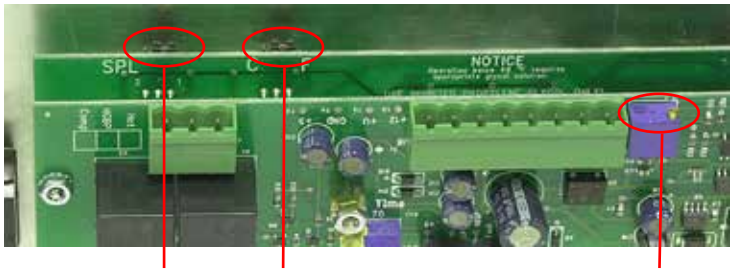
2. **UP ARROW and DOWN ARROW KEYS**: Depress and hold this push button to increase (UP ARROW) or decrease (DOWN ARROW) the setpoint temperature.

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.

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.



Setpoint Lock Out Jumper Temperature Display Jumper Probe Calibration

D. STATUS LIGHTS

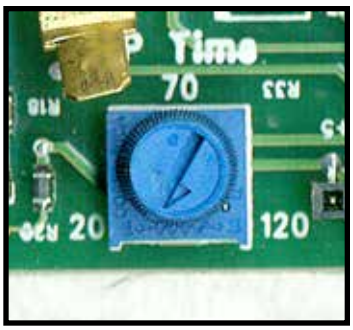
1. **COMPRESSOR**: Illuminates when compressor is turned on.

2. **CAPACITY CONTROL**: Illuminates when capacity control system is turned on.

3. **REFRIGERANT FAULT**: Illuminates when there is a high pressure or low pressure alarm. Check troubleshooting section of this manual for more details.

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

Low Pressure Alarm. After the compressor is turned on, the control has a 15 second buffer for the low pressure alarm. 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 alarm and turning off the compressor. If the condition is corrected before the time expires, no alarm occurs. If a low pressure condition occurs 15 seconds after the compressor turns on, the instrument waits 20 seconds before indicating an alarm and turning off the compressor.



Low Pressure Potentiometer

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 “---”.

3.4 LE CONTROL INSTRUMENT OPERATION

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 (figure 3.4A) 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. 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.

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:** A 'flashing red' CIRCUIT REFRIGERANT light indicates the oil pressure safety switch is open. The oil pressure safety switch is found on 15 to 30 ton semi-hermetic compressors. Normally, the switch will open if there is insufficient oil in the compressor crankcase or due to lack of sufficient compressor warn 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. For the standard configuration where the control sensor is located in the fluid entering the chiller, select a temperature that is 8°-10°F above your desired fluid temperature which will result in a temperature 8°-10°F cooler leaving the chiller. If the control sensor is located on the to process connection of a system with a large fluid reservoir then set the temperature to your desired fluid temperature. Consult the factory if you have questions about your configuration. The default range for the setpoint temperature is 48°-90°F or 9°-32°C.

8. PRECAUTIONS:

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 5.6 of the manual for more information.

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.

Operating above 70°F setpoint with unit using R407C and R134A refrigerants requires the addition of a refringent crankcase pressure regulating (CPR) valve. Units using R410A refrigerant may operate up to 80°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

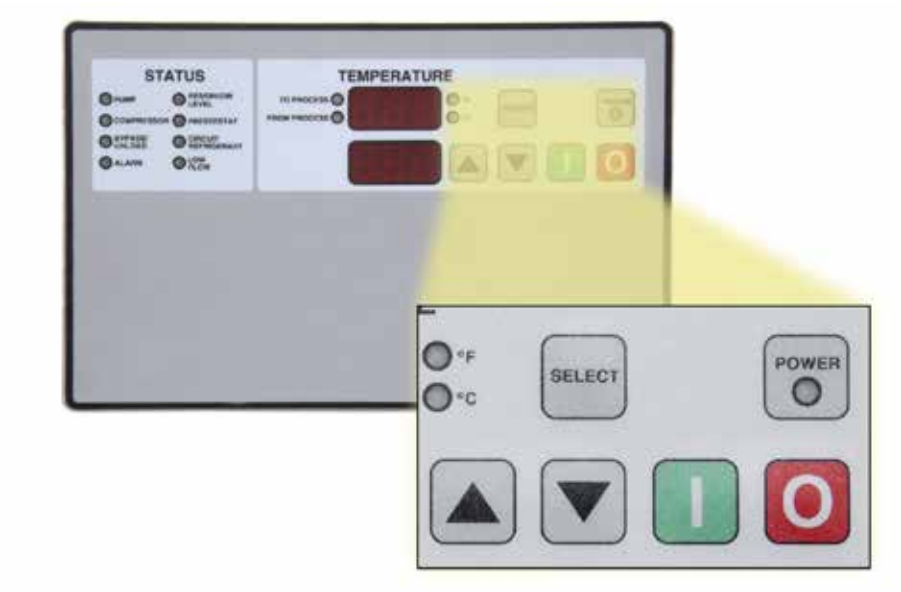
1. When the START push button switch is pressed on, the instrument will begin temperature control operations and the 'to process' temperature will begin to drop.

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 in operating.

2. **STOP**: (red color button) this push button disengages electrical supply to the coolant pump and refrigerant compressor.

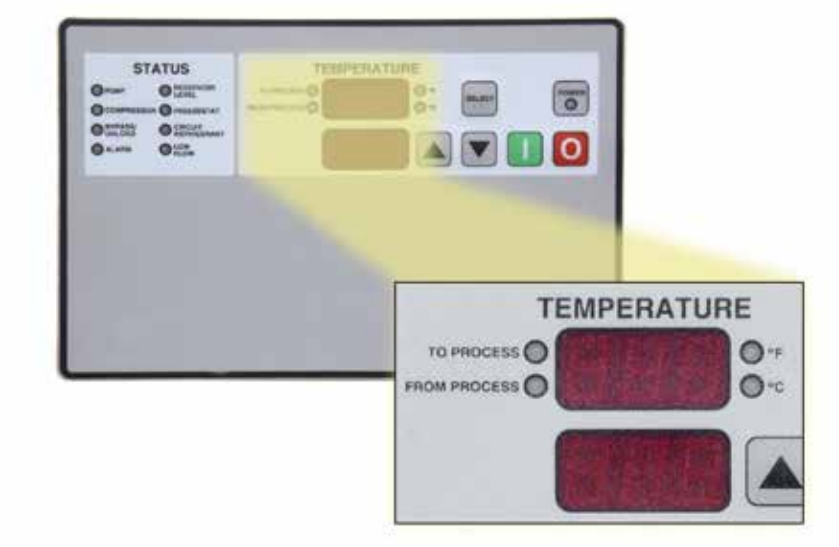
3. **SELECT:** Depress to index through the "to", "from" and "set point" temperatures.

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.

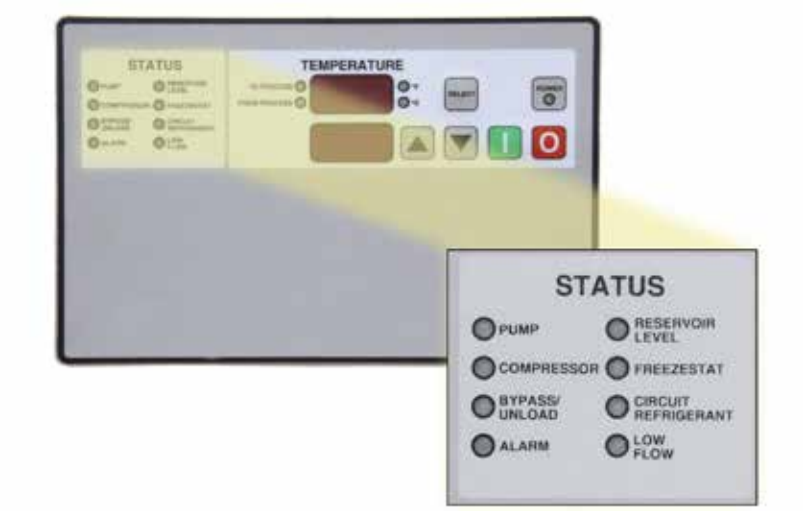
6. **°C:** indicates temperature is displayed in Celsius temperature scale.

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 compressor contactor is engaged which 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. **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.

6. **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.

7. **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.

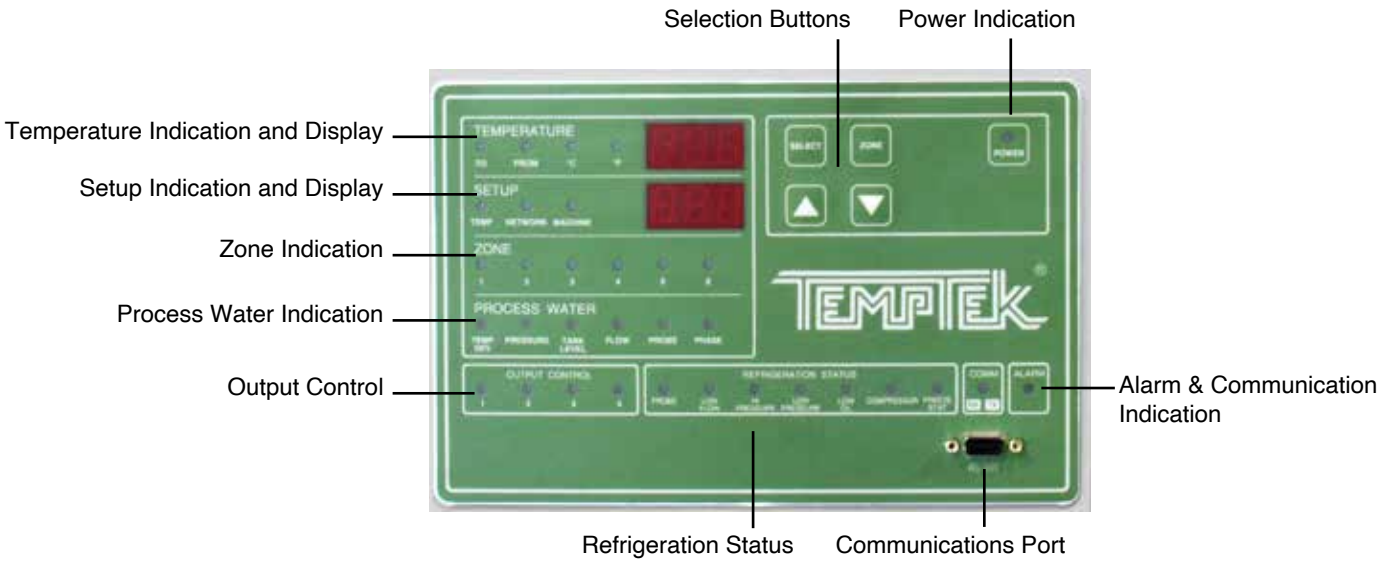
8. **L-P LOW REFRIGERANT PRESSURE:** When the refrigerant low pressure drops below 58PSI the compressor will stop and an "L-P" will be displayed in the temperature window. See troubleshooting section for more information.

3.5 MZC CONTROL INSTRUMENT OPERATION

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.

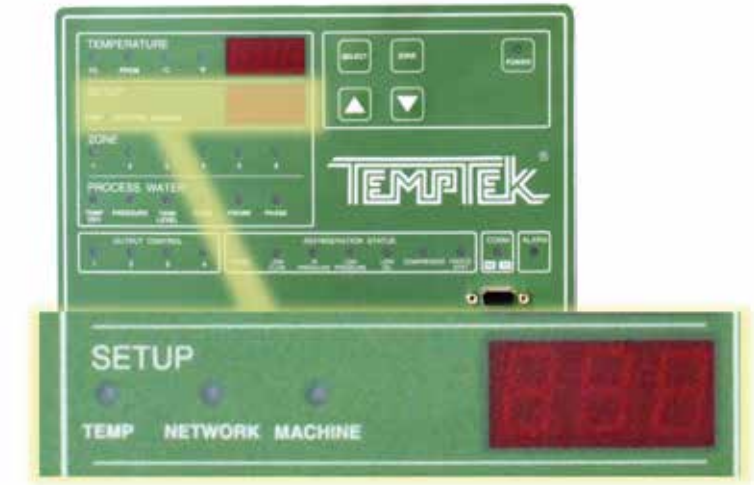
2. **TO:** Illuminates when the **TO PROCESS** water temperature is displayed. **TO** is the default setting of the **TEMPERATURE DISPLAY** window.

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. For the standard configuration where the control sensor is located in the fluid entering the chiller, select a temperature that is 8°-10°F above your desired fluid temperature which will result in a temperature 8°-10°F cooler leaving the chiller. If the control sensor is located on the to process connection of a system with a large fluid reservoir then set the temperature to your desired fluid temperature. Consult the factory if you have questions about your configuration.

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.

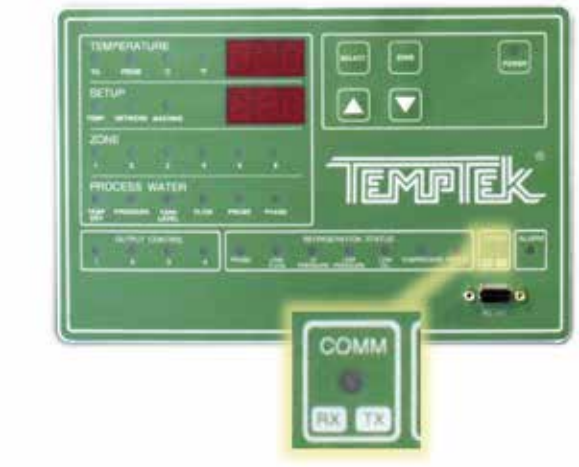
6. **LOW PRESSURE:** Indicates the status of the refrigerant 'low pressure' safety switch.

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.

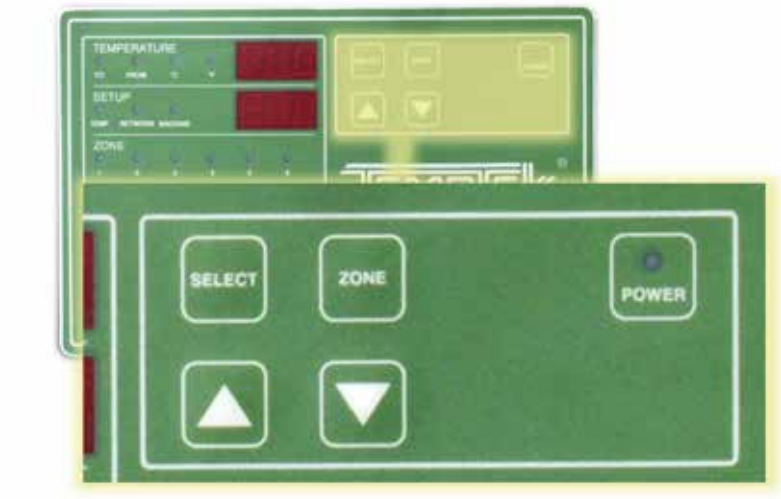
b. **FLASHING YELLOW:** Indicates the host computer is sending information to the controller.

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. 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.

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

Zone Board location inside electrical cabinet.

Close up of Zone Boards.

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.

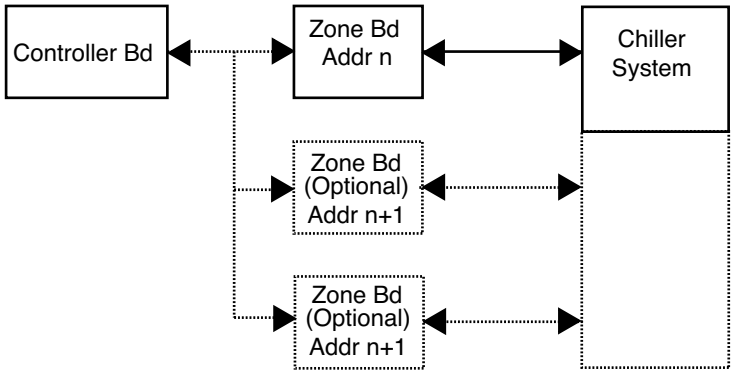
2. SAFETY/PROTECTION LED's

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.

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.



Note: n= 1 to 7

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

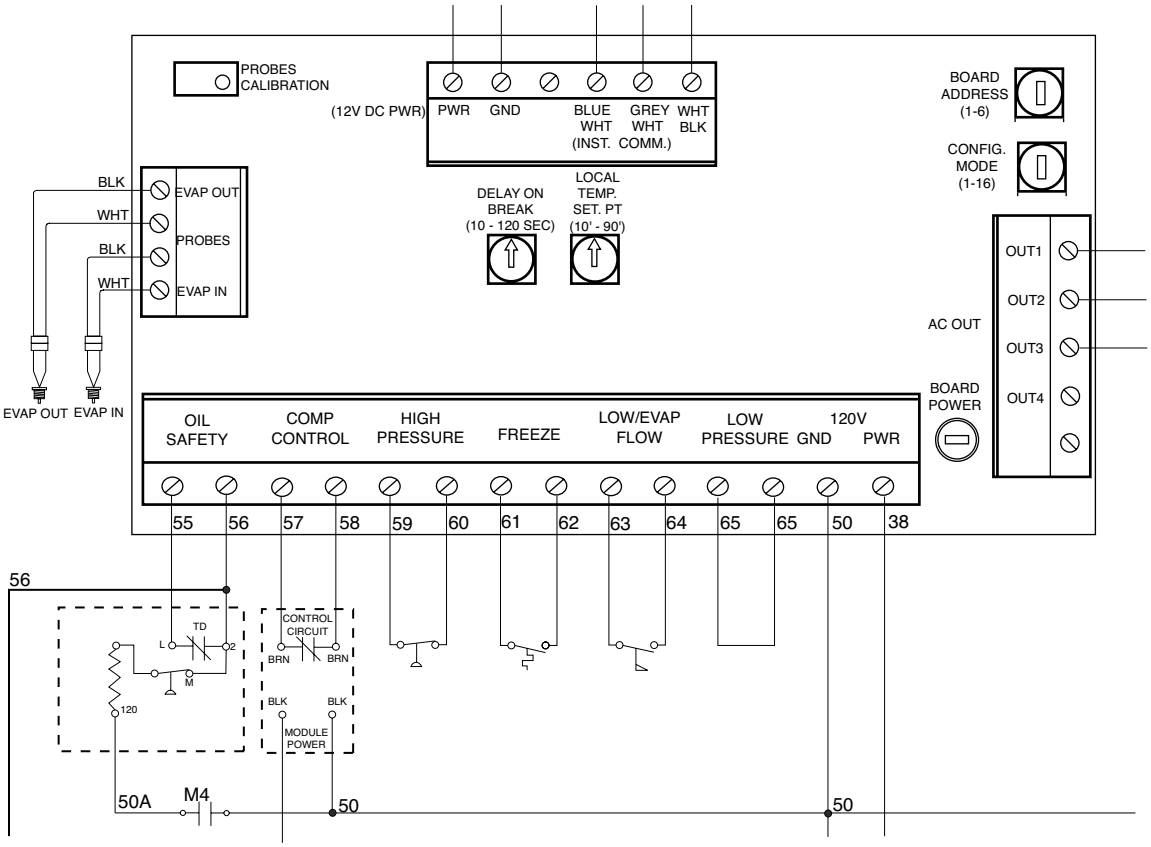
5. EVAPORATOR TEMPERATURE PROBE INPUT CONNECTOR

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

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	SOLENOID 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.



3.7 CONFIGURATION SWITCH ADJUSTMENT - MZC INSTRUMENT 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 : 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.

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	SOLENOID 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.

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.)

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

3.9 PRESSURE GAUGES & 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 **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. Most models of this central chiller include 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 limit switch as well as a current value refrigerant pressure display that uses transducers with a 0-10v output an in input source.

C. The digital pressurestat generally comes factory set for systems using water above 48F. Before starting the unit for the first time confirm that the settings are correct. See the chart below for the proper values based on fluid, refrigerant used in the system and operating temperature. Failure to set the low pressure limit properly can lead to unit freeze up and damage which is not covered by the warranty.

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

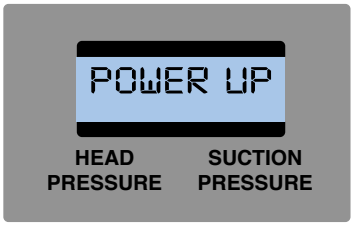
Ambient Temperature	*Operating Temperature*	*Glycol*	*Freeze Point*	*Cut Out Temp*	*Cut In Temp*	*R22*		*R134A*		*R410A*	
						Cut-Out	*Cut-In*	*Cut-Out*	*Cut-In*	*Cut-Out*	*Cut-In*
39°F +	48° - 70°F	0%	32°F	32°F	36°F - 39°F	58#	63#	28#	33#	102#	111#
15° to 38°F	25° - 47°F	30%	10°F	10°F	15°F - 18°F	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%									

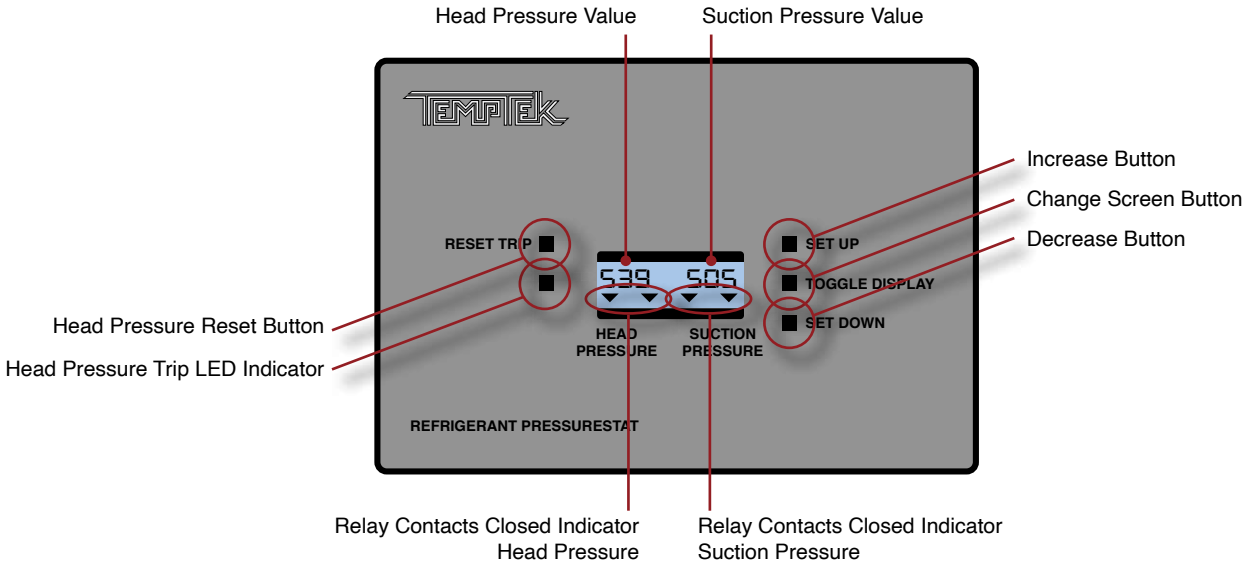
Ambient Temperature	*Operating Temperature*	*Glycol*	*Freeze Point*	*Cut Out Temp*	*Cut In Temp*	*R404A*		*R407C*	
						Cut-Out	*Cut-In*	*Cut-Out*	*Cut-In*
39°F +	48° - 70°F	0%	32°F	32°F	36°F - 3°9F	72#	79#	52#	58#
15° to 38°F	25° - 47°F	30%	10°F	10°F	15°F - 1°8F	44#	49#	28#	34#
0° to 14°F	10° - 24°F	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)*

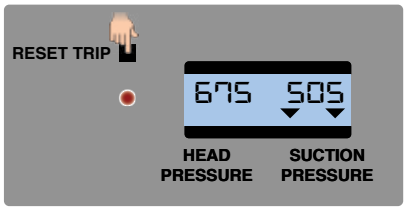
Refrigerant	*Air-Cooled*
R22	360#
R134A	260#
R407C	360#
R410A	550#
R404A	360#

D. 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.





E. 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.



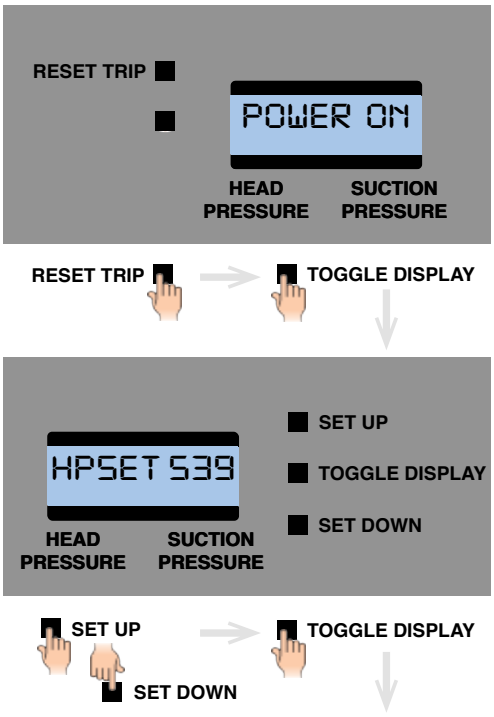
F. If the suction pressure is out of range the system will reactivate automatically after the pressure rises above the differential value.

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

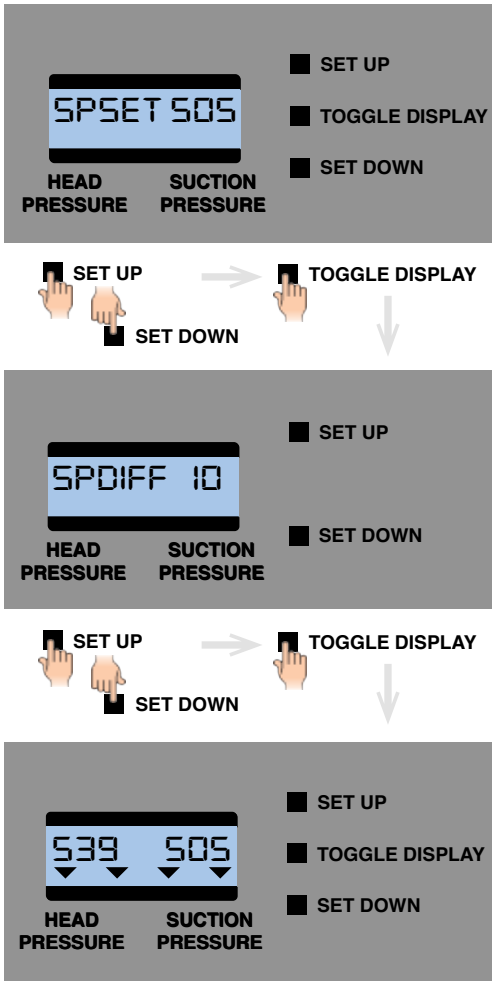


corresponds to the freeze point of the fluid being chilled otherwise severe damage to the evaporator could occur.

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

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 MZC III 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 re-start 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.

4.0 TROUBLESHOOTING

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

Adjustable High Pressure Switch

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.

Fixed High Pressure Switch

A. **Air-cooled units:**

1. **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.

2. **Fan motor not operating.** Have electrician check fuses and wiring, motor starter and overloads, and motor. Repair or replace motor if defective.

B. Water-cooled units:

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

1. **Water regulator valve.** Adjust condenser water regulator valve to maintain 100°F to 105°F refrigerant condensing temperature*. If valve is defective, have valve repaired or replaced by a refrigeration serviceman.

2. The water regulator valve is normally factory set for proper operation. When field adjustments are required, turn the adjusting nut on the top of the valve counter clockwise to raise the refrigerant pressure and clockwise to lower the pressure. Adjustments should be made only when the chiller is running at full load.

3. **Insufficient condenser water flow.** Check condenser water pumping system.

4. **Condenser water temperature too high.** Check cooling tower for proper operation if used and the city water temperature if city water is used.

5. **Condenser water tubes scaled.** Clean with brushes and chemicals approved by the Service Department.

C. Improperly set high pressure control. Have refrigeration serviceman reset or replace the control if defective.

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.

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.

Adjustable Low Pressure Switch

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.

Fixed Low Pressure Switch

A. Air-cooled units:

1. **Head pressure too low.** Check that entering air temperature is above 60°F. If below 60°F, find out reason why.

B. Water-cooled units:

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

Head pressure too low. Adjust condenser water regulating valve to maintain 100°F - 105°F refrigerant condensing temperature*. Have a refrigeration serviceman repair the valve or replace if defective.

The water regulator valve is normally factory set for proper operation. When field adjustments are required, turn the adjusting nut on the top of the valve counter clockwise to raise the refrigerant pressure and clockwise to lower the pressure. Adjustments should be made only when the chiller is running at full load.

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 these water chillers are covered by the machine's warranty. Proprietary "tailor made" instrument are manufactured specifically for these chillers.

If you experience problems with the 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 the 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 Factory Service for diagnostic assistance.

2. If a control instrument is determined to be at fault, you will be referred to the instrument manufacturer. There are 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 ***include this form in the box***. 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).

THIS PAGE INTENTIONALLY BLANK

5.0 MAINTENANCE

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.

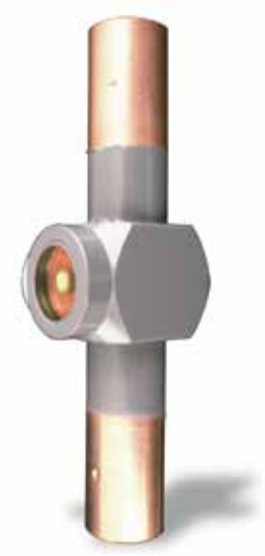
5. Changing of filter-drier or drier core.

6. Repair of a refrigeration solenoid.

5.4 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:



Refrigerant Sight Glass

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.

5.5 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.

Brazed Plate Evaporator

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

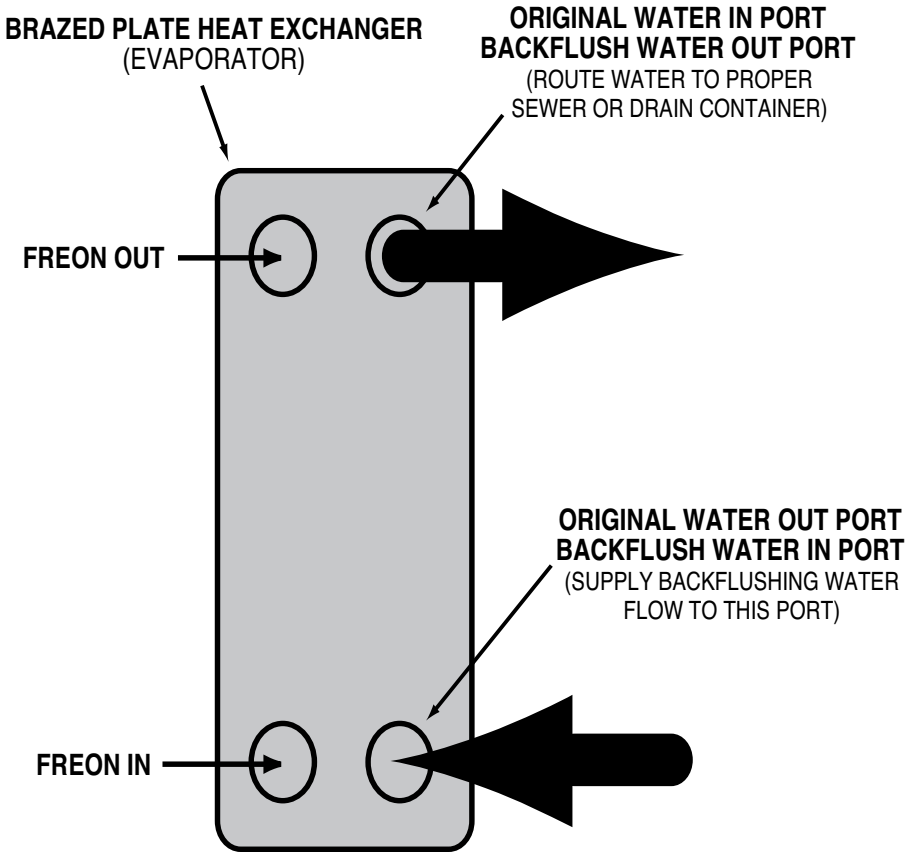
2. Connect a water supply hose to the evaporator water outlet. If acid cleaning, connect the discharge hose from the acid pump to the evaporator outlet port.

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.



5.6 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	SOLENOID 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.

5.7 DIP SWITCH ADJUSTMENT (LE INSTRUMENTS ONLY)

A. The 5 position DIP switch is located on the lower right side of the CPU board (figure 5.9A).

B. The switches are used to set options for machine operation.

C. The switches should only be changed when the instrument is turned OFF.

D. Use a small non-metallic device and gently toggle the switch to the appropriate position. Use the diagram below as reference.

E. Once the adjustments are made, reconnect the power and operate the chiller as normal.

F. Definition of the DIP switches are as follows:

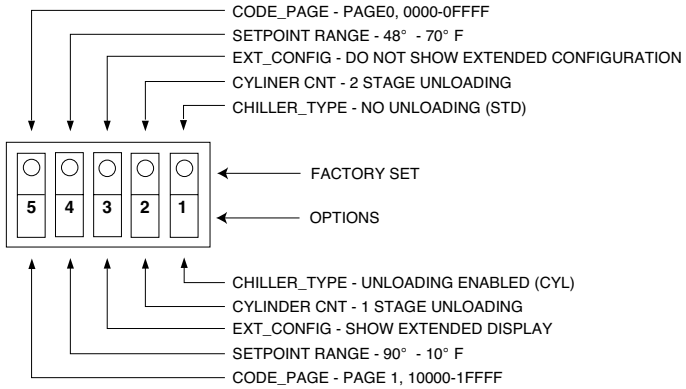
SW1 - Chiller Type:
ON - (default) standard, no cylinder unloading.
OFF - cylinder unloading enabled, see SW2.

SW2 - Cylinder count select, valid only when SW1 is OFF:
ON - (default) 2 stages of unloading
OFF - 1 stage of unloading

SW3 - Extended configuration:
ON - (default) extended configuration is disabled, the display will not show additional information.
OFF - extended configuration is enabled, the display will show the following after “Unt”, “F “:
LRt - low pressure alarm delay.

SW4 - Setpoint range:
ON - (default) setpoint range is 70° to 48° F.
OFF - setpoint range is 90° to 10° F.

SW5 - code page for EPROM:
ON - (default) code page 0 is active.
OFF - code page 1 is active.



THIS PAGE INTENTIONALLY BLANK

6.0 COMPONENTS

6.1 Refrigeration System

6.2 Coolant System

6.1 REFRIGERATION SYSTEM

Compressors. Configuration may be different on specific units.

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.

Air-cooled condenser. Typical unit shown.

C. **WATER-COOLED CONDENSER:** The water 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. Water flow across the condenser is provided by an external source, typically the plant's tower water. In some cases, city water is used also. Models using water-cooled condensers are designated with a TI-W in the model number.

Water-cooled condenser. Configuration may be different on specific units.

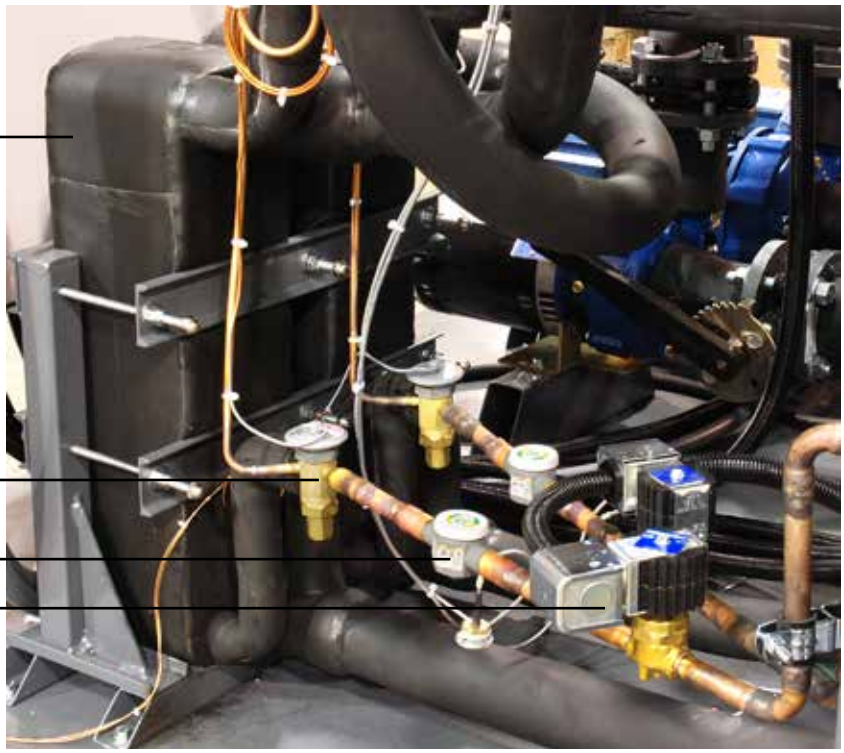
C. **FILTER-DRIER:** The filter-drier removes contaminants and moisture from the liquid refrigerant (figure 6.2C).

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.

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 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 high pressure switch

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.

Adjustable low pressure switch

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. **Flow switch:** Protects the evaporator from possible freezing caused by too little flow.

B **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.

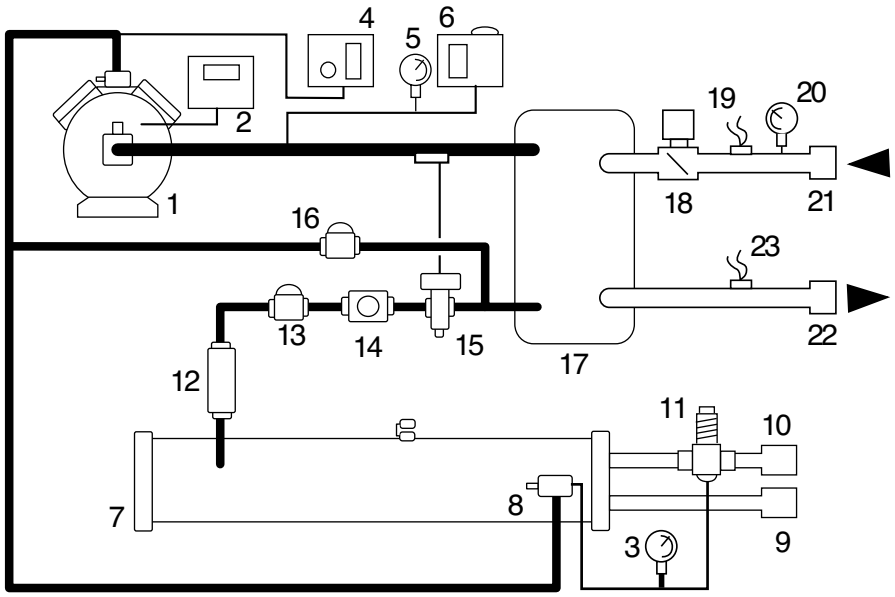
C. **Level control switch:** Controls water level by activating a solenoid valve (make-up solenoid) which allows water to enter the system from the water supply line.

D. **Water saver (regulator) valve:** modulates water into the condenser based on refrigerant head pressure. Used on water cooled models only.

7.0 RELATED DRAWINGS

7.1 Circuit Drawing : Water Cooled Models
7.2 Circuit Drawing : Air Cooled Models
7.3 Typical Piping for Remote Air Cooled Condenser Dual Refrigerant Circuits
7.4 Typical Refrigerant Piping for Outdoor Condenser Single Refrigerant Circuit
7.5 Typical Vacuum Breaker / Anti-Siphon System

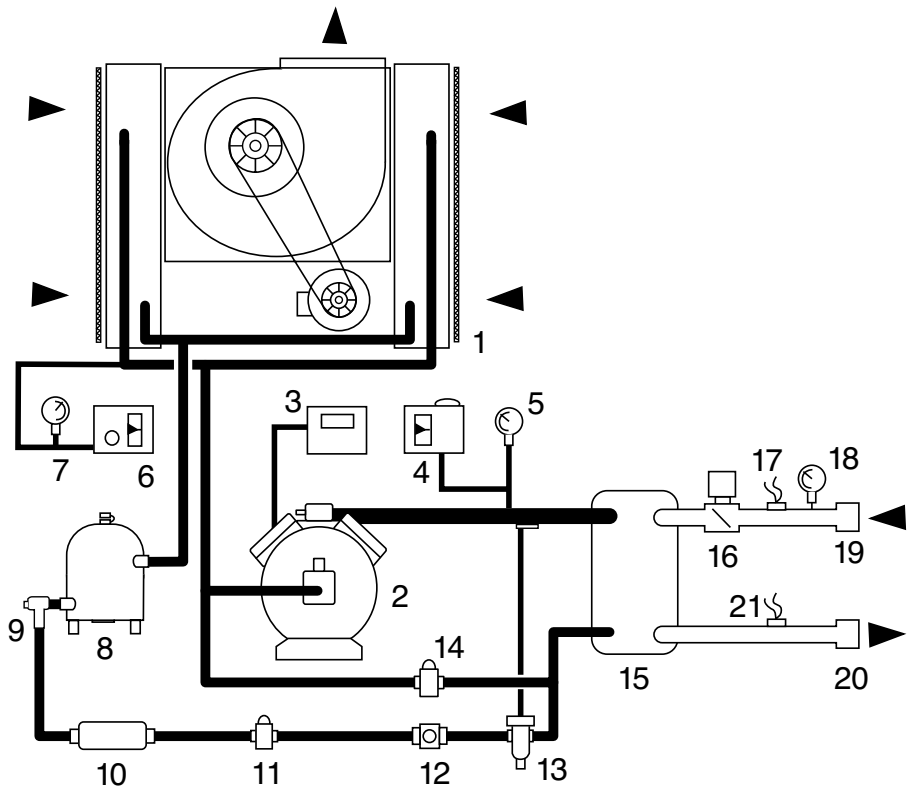
7.1 CIRCUIT DRAWING (WATER COOLED MODELS)



1 Semi-hermetic compressor (above 10 tons)
2 Oil pressure safety switch
3 Refrigerant high pressure gauge
4 Refrigerant high pressure safety
5 Refrigerant low pressure gauge
6 Refrigerant low pressure safety
7 Water cooled condenser
8 Service valve
9 Condenser water out connection
10 Condenser water in connection
11 Water regulator valve
12 Filter-drier
13 Liquid line solenoid valve
14 Refrigerant sight glass
15 Expansion valve
16 Hot gas by-pass valve
17 Brazed plate evaporator
18 Low flow safety switch
19 From process temperature sensor
20 From process pressure gauge
21 From process connection
22 To process connection
23 To process temperature sensor

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.

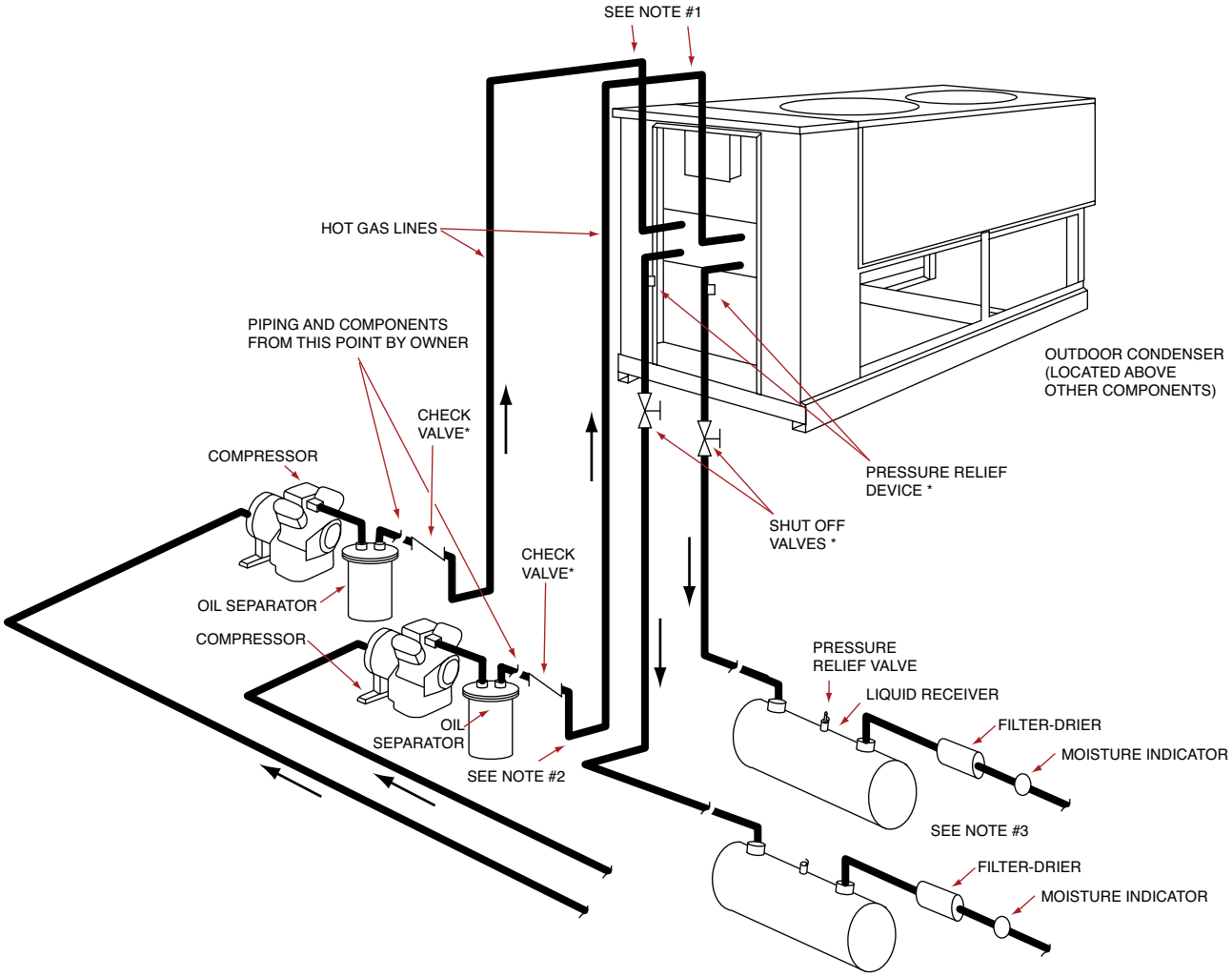
7.2 CIRCUIT DRAWING (AIR COOLED MODELS)



1 Centrifugal blower
2 Semi-hermetic compressor (above 10 tons)
3 Oil pressure safety
4 Refrigerant low pressure safety
5 Refrigerant low pressure gauge
6 Refrigerant high pressure safety
7 Refrigerant high pressure gauge
8 Liquid receiver
9 Service valve
10 Filter-drier
11 Liquid line solenoid valve
12 Refrigerant sight glass
13 Expansion valve
14 Hot-gas by-pass valve
15 Brazed plate evaporator
16 Low flow safety switch
17 From process temperature sensor
18 From process coolant pressure gauge
19 From process connection
20 To process connection
21 To process sensor

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.

7.3 TYPICAL PIPING FOR REMOTE AIR-COOLED CONDENSER DUAL REFRIGERANT CIRCUITS

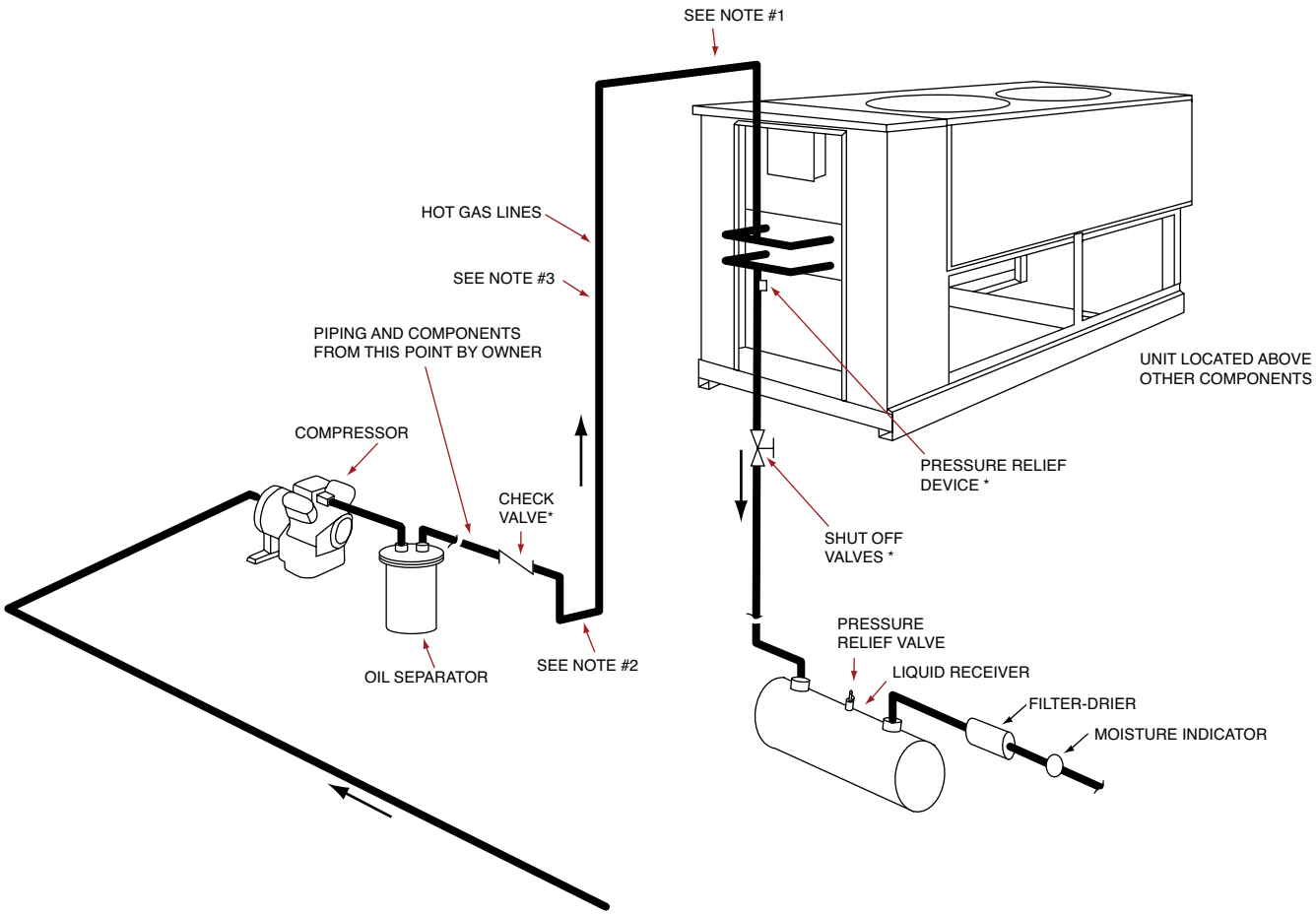


*Items are field supplied

Notes:

1. Hot gas lines should rise above refrigerant level in condenser circuit.
2. Trap should be installed on hot gas lines to prevent condenser oil and refrigerant vapor migration from accumulating on compressor heads during off cycle.
3. For piping lengths greater than 50 ft. Provide support to liquid and gas lines near the connections to the coil.

7.3 TYPICAL PIPING FOR REMOTE AIR-COOLED CONDENSER SINGLE REFRIGERANT CIRCUITS

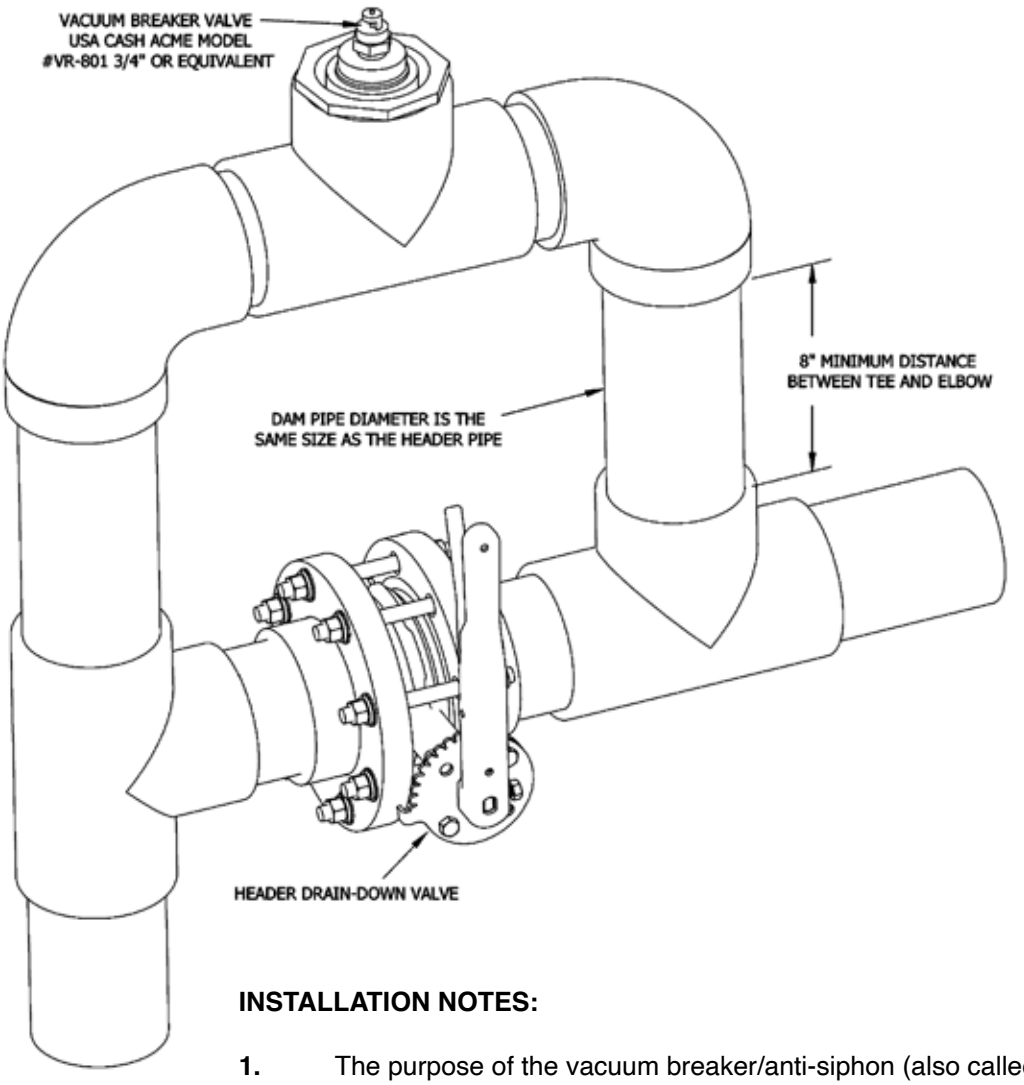


*Items are field supplied

Notes:

1. Hot gas lines should rise above refrigerant level in condenser circuit.
2. Trap should be installed on hot gas lines to prevent condenser oil and refrigerant vapor migration from accumulating on compressor heads during off cycle.
3. For piping lengths greater than 50 ft. Provide support to liquid and gas lines near the connections to the coil.

7.5 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.

8.0 Appendix

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 or installed in an area where the ambient temperature can get below 38°F without several precautionary measures.

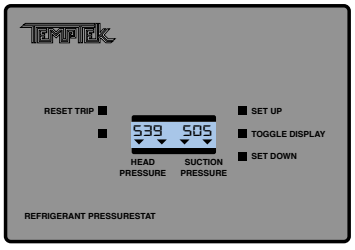
B. Always confirm that the low pressure limit is set properly for the fluid type, temperature and refrigerant type used. Operating with an improperly set low pressure limit can damage the system which is not covered by the warranty.

C. 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.

D. Fluid must be tested with a refractometer 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.

E. **DO NOT USE AUTOMOTIVE TYPE ANTI-FREEZE. 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. 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.

F. 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. Protective devices include the low refrigerant pressure switches and freezestats, although not all units are equipped with dedicated freezestats.



Digital Pressurestat Control

G. **The Unit may be equipped with :**

1. Digital Low Pressure Switch
2. Mechanical Low Pressure Switch
3. Fixed Low Pressure Switch

H. **Digital Low Pressure Switch**

1. If the unit is equipped with the optional Digital Pressurestats, refer to Section 3.9 in this manual for information to adjust the Low Pressure Switch.

2. Adjust the low pressure switch according to the specifications in the chart on the next page.


Adjustable low pressure switch

I. **Mechanical Low Pressure Switch**

1. 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.

2. Adjust the low pressure switch according to the specifications in the chart on the next page.

J. **WARNING: 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.**

K. **Fixed Low Pressure Switch**

1. 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. Note: Fixed Low Pressure Switches are not used on production models beyond the manufacturing date of January 2018.

2. 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.

3. 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.

L. 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 Advantage service department for specific instructions.

1. **Multizone Instruments.** Adjust the DIP switch to accommodate the expanded temperature range. Contact the factory for more information.

M. Once all safety provisions are made, the temperature control set point may now be lowered to the desired operating temperature.

Fixed low pressure switch

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				
°F	°C	R-22	R-410a	R-407c	R-134a	R-404a
-60	-51.1	*11.9*	*0.9*	*16.0*	*21.6*	-
-55	-48.3	*9.2*	1.8	*13.7*	*20.2*	-
-50	-45.6	*6.1*	4.3	*11.1*	*18.6*	-
-45	-42.8	*2.7*	7.0	*8.1*	*16.7*	-
-40	-40.0	0.6	10.1	*4.8*	*14.7*	4.9
-35	-37.2	2.6	13.5	*1.1*	*12.3*	7.5
-30	-34.4	4.9	17.2	1.5	*9.7*	10.3
-25	-31.7	7.5	21.4	3.7	*6.8*	13.5
-20	-28.9	10.2	25.9	6.2	*3.6*	16.8
-18	-27.8	11.4	27.8	7.2	*2.2*	18.3
-16	-26.7	12.6	29.7	8.4	*0.7*	19.8
-14	-25.6	13.9	31.8	9.5	0.4	21.3
-12	-24.4	15.2	33.9	10.7	1.2	22.9
-10	-23.3	16.5	36.1	11.9	2.0	24.6
-8	-22.2	17.9	38.4	13.2	2.8	26.3
-6	-21.1	19.4	40.7	14.6	3.7	28.0
-4	-20.0	20.9	43.1	15.9	4.6	29.8
-2	-18.9	22.4	45.6	17.4	5.5	31.7
0	-17.8	24.0	48.2	18.9	6.5	33.7
1	-17.2	24.8	49.5	19.6	7.0	34.7
2	-16.7	25.7	50.9	20.4	7.5	35.7
3	-16.1	26.5	52.2	21.2	8.0	36.7
4	-15.6	27.4	53.6	22.0	8.6	37.7
5	-15.0	28.3	55.0	22.8	9.1	38.8
6	-14.4	29.1	56.4	23.7	9.7	39.8
7	-13.9	30.0	57.9	24.5	10.2	40.9
8	-13.3	31.0	59.3	25.4	10.8	42.0
9	-12.8	31.9	60.8	26.2	11.4	43.1
10	-12.2	32.8	62.3	27.1	12.0	44.3
11	-11.7	33.8	63.9	28.0	12.6	45.4
12	-11.1	34.8	65.4	29.0	13.2	46.6
13	-10.6	35.8	67.0	29.9	13.8	47.8
14	-10.0	36.8	68.6	30.9	14.4	49.0
15	-9.4	37.8	70.2	31.8	15.1	50.2
16	-8.9	38.8	71.9	32.8	15.7	51.5
17	-8.3	39.9	73.5	33.8	16.4	52.7
18	-7.8	40.9	75.2	34.8	17.1	54.0
19	-7.2	42.0	77.0	35.9	17.7	55.3
20	-6.7	43.1	78.7	36.9	18.4	56.6
21	-6.1	44.2	80.5	38.0	19.2	57.9
22	-5.6	45.3	82.3	39.1	19.9	59.3
23	-5.0	46.5	84.1	40.2	20.6	60.6
24	-4.4	47.6	85.9	41.3	21.4	62.0
25	-3.9	48.8	87.8	42.4	22.1	63.4
26	-3.3	50.0	89.7	43.6	22.9	64.8

Temperature		Refrigerant				
°F	°C	R-22	R-410a	R-407c	R-134a	R-404a
27	-2.8	51.2	91.6	44.7	23.7	66.2
28	-2.2	52.4	93.5	45.9	24.5	67.7
29	-1.7	53.7	95.5	47.1	25.3	69.2
30	-1.1	54.9	97.5	48.4	26.1	70.7
31	-0.6	56.2	99.5	49.6	26.9	72.1
32	0.0	57.5	101.6	50.9	27.8	73.8
33	0.6	58.8	103.6	52.1	28.6	75.3
34	1.1	60.2	105.7	53.4	29.5	76.9
35	1.7	61.5	107.9	54.8	30.4	78.5
36	2.2	62.9	110.0	56.1	31.3	80.2
37	2.8	64.3	112.2	57.5	32.2	81.7
38	3.3	65.7	114.4	58.9	33.1	83.5
39	3.9	67.1	116.7	60.3	34.1	85.2
40	4.4	68.6	118.9	61.7	35.0	86.9
41	5.0	70.0	121.2	63.1	36.0	88.6
42	5.6	71.5	123.6	64.6	37.0	90.4
43	6.1	73.0	125.9	66.1	38.0	92.2
44	6.7	74.5	128.3	67.6	39.0	94.0
45	7.2	76.1	130.7	69.1	40.0	95.8
46	7.8	77.6	133.2	70.6	41.1	97.6
47	8.3	79.2	135.6	72.2	42.2	99.5
48	8.9	80.8	138.2	73.8	43.2	101.4
49	9.4	82.4	140.7	75.4	44.3	103.3
50	10.0	84.1	143.3	77.1	45.4	105.3
55	12.8	92.6	156.6	106.0	51.2	115.3
60	15.6	101.6	170.7	116.2	57.4	126.0
65	18.3	111.3	185.7	127.0	64.0	137.4
70	21.1	121.5	201.5	138.5	71.1	149.3
75	23.9	132.2	218.2	150.6	78.6	161.9
80	26.7	143.7	235.9	163.5	86.7	175.4
85	29.4	155.7	254.6	177.0	95.2	189.6
90	32.2	168.4	274.3	191.3	104.3	204.5
95	35.0	181.9	295.0	206.4	113.9	220.2
100	37.8	196.0	316.9	222.3	124.1	236.8
105	40.6	210.8	339.9	239.0	134.9	254.2
110	43.3	226.4	364.1	256.5	146.3	272.5
115	46.1	242.8	389.6	274.9	158.4	291.9
120	48.9	260.0	416.4	294.2	171.1	312.1
125	51.7	278.1	444.5	314.5	184.5	333.4
130	54.4	297.0	474.0	335.7	198.7	355.6
135	57.2	316.7	505.0	357.8	213.5	379.1
140	60.0	337.4	537.6	380.9	229.2	403.7
145	62.8	359.1	571.7	405.1	245.6	429.6
150	65.6	381.7	607.6	430.3	262.8	456.8
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)

TEMPTEK, INC.
525 East Stop 18 Road Greenwood, Indiana 46143
317-887-6352 Fax: 317-881-1277
Service Department Fax: 317-885-8683
Email: service@Temptek.com

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

Standard chiller rating is at 50°F. For all other temperature settings, output tonnage is altered as follows:

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

THIS PAGE INTENTIONALLY BLANK

NOTES:

If operation of the chiller at less than 48°F is required, an inhibited propylene glycol solution is required.

Consult factory for chiller operation below 20°F.

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.

END

RE 20210811