I.O.M. #023 10/96 *Revision 10/12*

INSTRUCTION MANUAL • INSTALLATION • OPERATION • MAINTENANCE

TITAN CENTRAL CHILLER®

Covering Models From 20 - 180 Tons • Air & Water Cooled

ADVANTAGE® MAKING WATER WORK™

ADVANTAGE ENGINEERING, INC.
525 East Stop 18 Road Greenwood, IN 46142
317-887-0729 fax: 317-881-1277
Service Department fax: 317-885-8683
www.AdvantageEngineering.com
e-mail: sales@AdvantageEngineering.com

TITAN

CENTRAL CHILLER®

INSTRUCTION MANUAL

AIR & WATER COOLED MODELS

With **MZC III CONTROLLER**

COVERING

INSTALLATION
OPERATION
MAINTENANCE

ADVANTAGE® MAKING WATER WORK™

ADVANTAGE ENGINEERING, INC. 525 East Stop 18 Road Greenwood, IN 46142
317-887-0729 fax: 317-881-1277 Service Department fax: 317-885-8683
www.AdvantageEngineering.com e-mail: sales@AdvantageEngineering.com

TABLE OF CONTENTS

Note: This page intentionally left blank

1.1 INTRODUCTION

A. This manual covers Titan central chillers from 20 to 180 tons with the MZC (Multi Zone Control) instrument.

B. 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 encodes critical unit information which is helpful in any attempt to troubleshoot 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 UNIT LOCATION

A. For Air-Cooled models:

1. Air cooled models are conjoined with an indoor unit and a remote condenser. The indoor unit contains the refrigeration circuits, pumping station and control

2. Locate the indoor unit in a clean, dry and well ventilated environment.

3. The remote air-cooled condenser for use with air-cooled chiller modules is designed to be located outdoors and may be mounted on a roof or concrete slab (ground level installation). See the remote condenser manual for location recommendations and conditions.

B. For Water-Cooled models:

1. Locate the chiller and pumping units indoors, in a clean, dry and well ventilated environment.

1.3 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.

1.4 CLEAN AIR ACT

A. Effective July 1, 1992, 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 class 2 substance used as a refrigerant in the manner which permits such substance to enter the atmosphere.

C. De minimis 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. All new Advantage chillers manufactured after january 1, 2010 use non ozone depleting refrigerants such a R410A, R407C, R134A, R404A and others depending on the application.

1.5 MISCELLANEOUS

A. The unit is designed to circulate temperature stabilized fluid through the process resulting in process temperature control.

B. The ability of the unit to maintain process temperature control is significantly affected by the method of installation as outline in section 2 of this manual.

C. If the operator has any questions concerning the location and operation of the unit, contact the The Manufacturer's Service Department.

1.6 WATER TREATMENT

A. The use of untreated or improperly treated water in a central chilling module may result in scaling, erosion, corrosion, algae or slime which will cause premature component failure, loss of use and extensive unit damage.

B. It is recommended that the services of a qualified water treatment specialist be engaged to determine what water treatment is required.

C. Advantage assumes no responsibility for equipment failures which result from untreated or improperly treated water.

D. Thoroughly flush all water piping before making the final piping connections to the unit. If connecting to existing piping be sure it is clear of loose debris or debris that might break loose during operation before connecting to the unit.

E. Water filters with 40 mesh or finer screens should be installed prior to the chiller to protect the evaporator and condenser (on water cooled models) from debris. Basket type strainers are recommended rather than wye type strainers because they are generally more rugged and hold more debris.

F. These filters must be kept clean and free of debris that will reduce flow to the chiller.

1.7 RECEIVING YOUR UNIT

A. Immediately upon receipt of your chiller inspect the unit carefully for shipment damage.

B. If damage is found, contact the freight carrier immediately.

1.8 PREPARING UNIT FOR OPERATION

A. Remove crate and skid from the machine. When removing the skid, be careful not to disturb or damage refrigeration lines.

B. Check the data plate on the electrical cabinet to verify the plant's power supply matches the electrical specifications required by the unit. Incorrect voltage could void warranty.

C. Locate the unit such that the control panel and all service access panels are easily reached for maintenance and inspection purposes.

1.9 MODEL DESIGNATION

Model Designator for Titan® Series Central Chillers

TI - 100A

Titan® Series

Condenser
A: Air-Cooled
W: Water-Cooled

Nominal Tons of Capacity

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

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

ADVANTAGE ENGINEERING, INC.
525 East Stop 18 Road Greenwood, Indiana 46142
317-887-0729 Fax: 317-881-1277 Service Fax: 317-885-8683
Web Site: www.AdvantageEngineering.com
Service Department Email: service@AdvantageEngineering.com

Titan TI-60W shown

A - Water cooled condensers
B - Pump suction valve handles
C - Alarm
D - Gauge panel
E - Compressors
F - Fluid reservoir
G - Evaporator pump
H - Operator control panel
I - Electrical cabinet
J - Standby pump
K - Pump discharge valves
L - Process pump

ADVANTAGE ENGINEERING, INC.
525 East Stop 18 Road Greenwood, Indiana 46142
317-887-0729 Fax: 317-881-1277 Service Fax: 317-885-8683
Web site: www.AdvantageEngineering.com
Service Department Email: service@AdvantageEngineering.com

Note: This page intentionally left blank

2.0 INSTALLATION

2.1 GENERAL

A. 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.

B. 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 CHILLED WATER PIPING INSTALLATION

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

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

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

D. It is very important to maintain the same piping "ID" to and from the chiller as the port sizes on the unit or recommended pipe size shown on plant layout drawing.

Typical reservoir lid and from process opening.

Typical To Process Port.

E. It is also advisable to install ball or butterfly valves in these lines to facilitate service and regulate water flow.

F. All connections should be tight and secure. Avoid excessive elbows, tees and other restrictive fittings.

G. Insulation of these lines is recommended to prevent condensation and capacity losses due to heat absorption.

2.3 WATER-COOLED CONDENSERS (TI-W MODELS)

A. The TI-W chiller is designed for indoor use and should be located in a clean, dry and well-ventilated environment.

B. TI-W chillers 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.

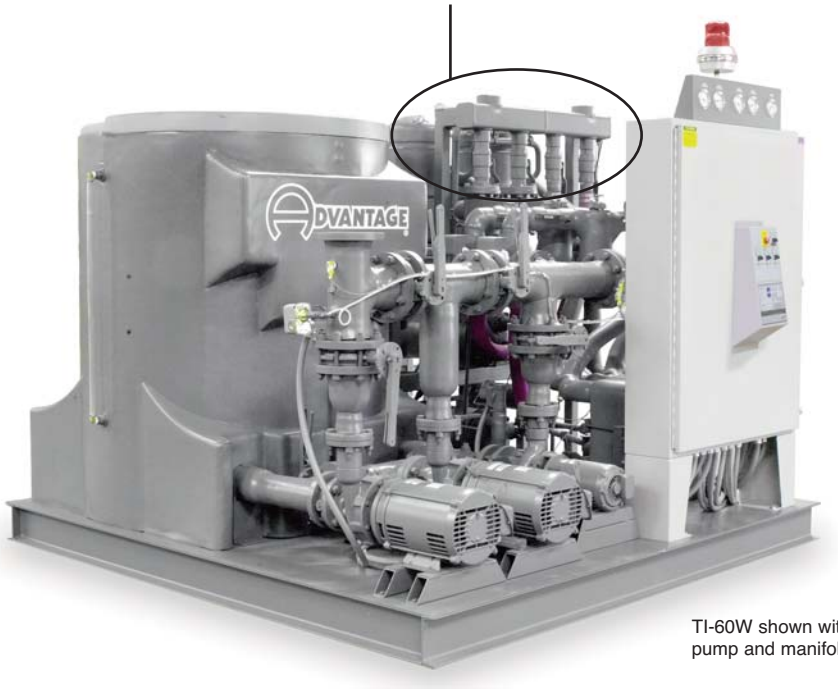
C. Nominal flow rate requirements:

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

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

Typical Water-Cooled Condenser Connections



TI-60W shown with optional standby pump and manifold.

ADVANTAGE ENGINEERING, INC.
525 East Stop 18 Road Greenwood, Indiana 46142
317-887-0729 Fax: 317-881-1277 Service Fax: 317-885-8683
Web site: www.AdvantageEngineering.com
Service Department Email: service@AdvantageEngineering.com

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.

2.4 AIR-COOLED CONDENSER (TI-A 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.

TI-60A shown with optional variable speed drive.

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.

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.

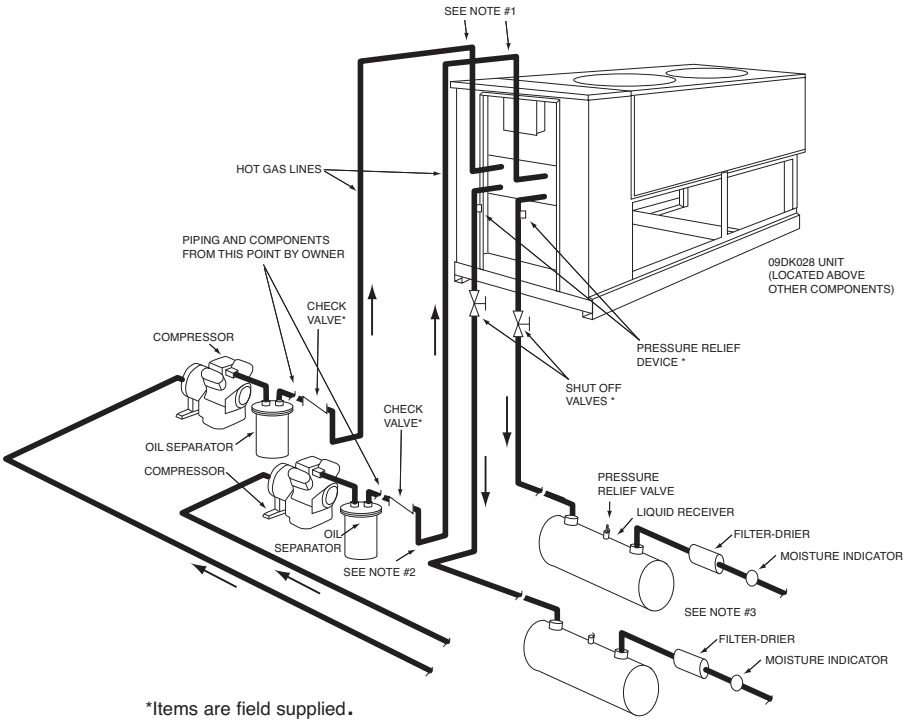
I. For units using a 09DK condenser with a dual spilt system:

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.



*Items are field supplied.

2.5 ELECTRICAL CONNECTION

A. Electrical power supply requirements are identified on the equipment data plate. Determine the plant's voltage supply is the same as the unit's voltage requirements.

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.

B. 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.

C. Connect the four conductor power cable to power entry terminal block on the unit's electrical panel. Then connect the power cable to the fused disconnect switch, selected by an electrician to meet all local and national codes.

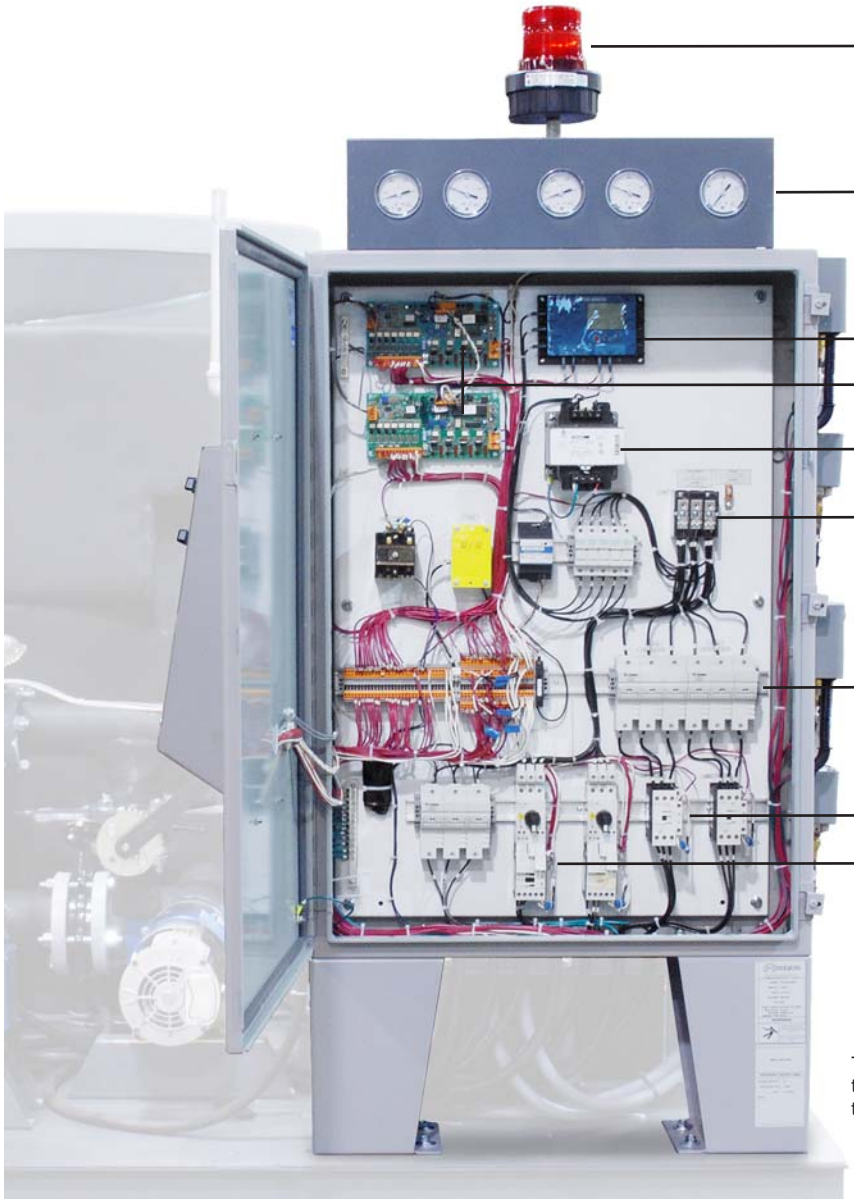
D. Appropriate conduit and fittings should be selected which will maintain the integrity of the cabinet.

E. CONTROL CIRCUIT WIRING. The unit's supplied control circuit is 110 volt, 1 phase, 60 cycle. The control circuit is supplied by the factory installed transformer. An inline control circuit fuse is provided.

F. GENERAL

1. Make certain all ground connections are properly affixed.

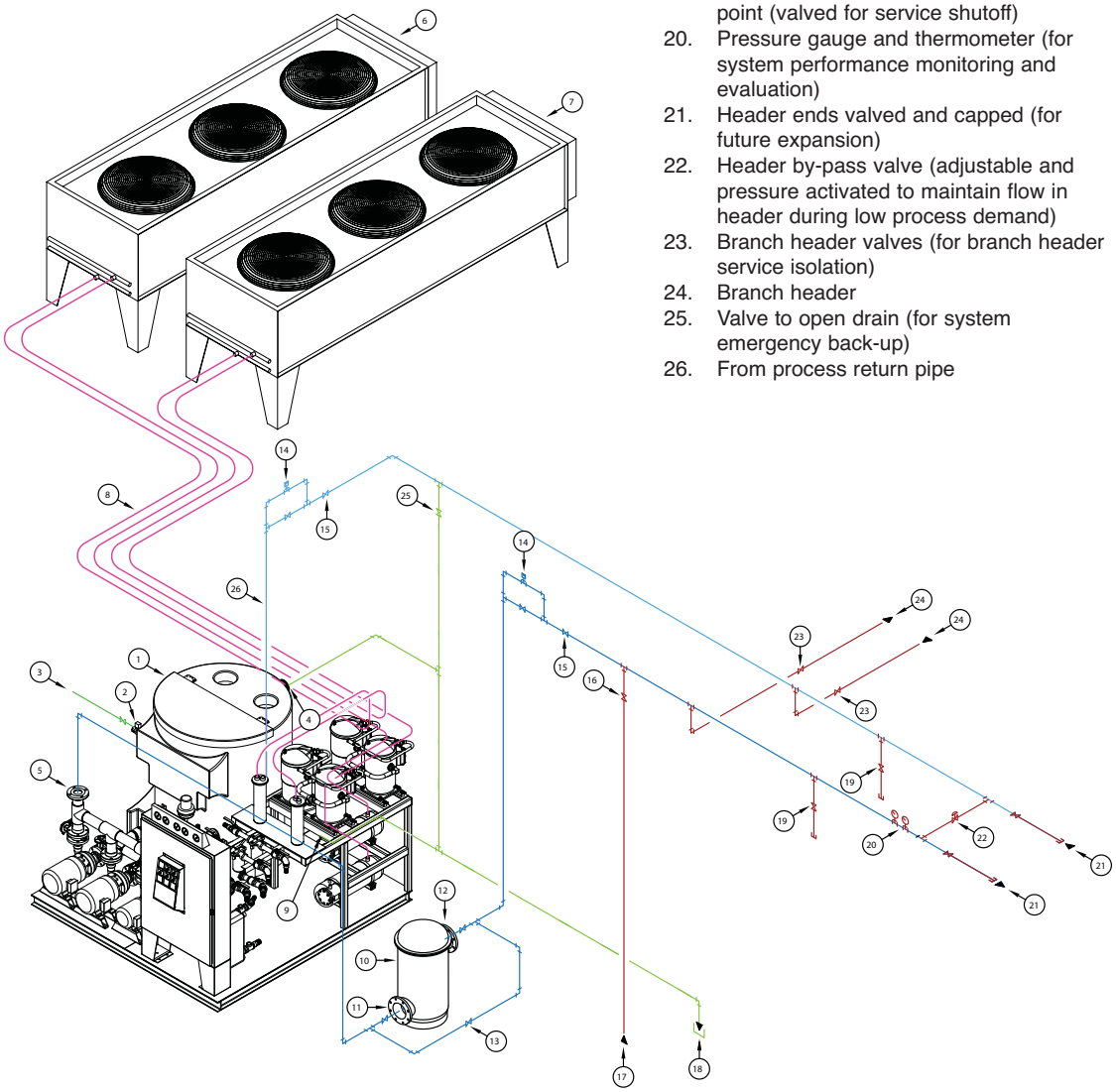
2. Make certain power conductor, disconnecting means, and fusing are properly sized according to the unit's power supply requirements.



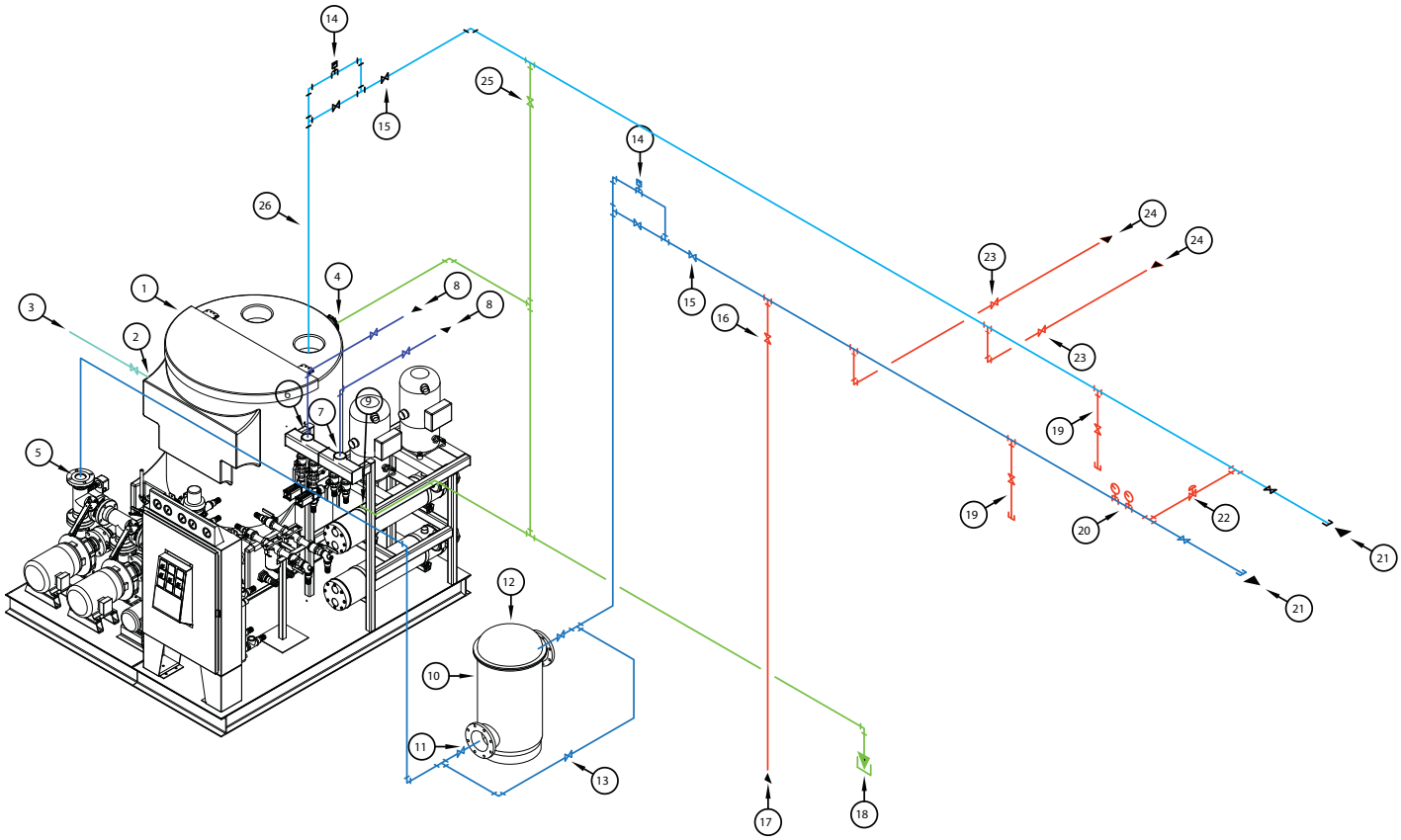
Typical electrical panel show. Refer to the electrical drawing provided for details to the particular unit.

2.6 AIR-COOLED PIPING INSTALLATION (TYPICAL)

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



2.7 WATER-COOLED PIPING INSTALLATION (TYPICAL)



1. Chiller (2 pump system with standby pump)
2. Water make-up connection (chiller reservoir)
3. From city water supply (reservoir make up)
4. Overflow connection (chiller reservoir)
5. Pump discharge connection (Supply to process)
6. Condenser connection (supply from cooling tower or city water)
7. Condenser connection (return back to cooling tower or if using city water - return to open drain)
8. Condenser water pipes
9. Reservoir Drain Connection
10. Filter (MLS Series In-Line full flow design - see piping options)
11. Water inlet connection (filter)
12. Water outlet connection (filter)
13. Bypass pipe with Valves (redirection of process water flow during filter service)
14. Drain-back dam (keeps header pipes full during shut-down periods)
15. Main header valves (closed for header service or during use of alternate source of cooling water)
16. Alternate source of cooling water on/off valve (for system emergency back up)
17. Alternate water supply source (for system emergency back up)
18. System multi-use open drain (reservoir overflow, reservoir drain, system emergency back up)
19. Process water drops from header to use point (valved for service shutoff)
20. Pressure gauge and thermometer (for system performance monitoring and evaluation)
21. header ends valved and capped (for future expansion)
22. Header by-pass valve (adjustable and pressure activated to maintain flow in header during low process demand)
23. Branch header valves (for branch header service isolation)
24. Branch header
25. Valve to open drain (for system emergency back-up)
26. From process return pipe

Note: This page intentionally left blank

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.

B. The use of untreated or improperly treated water in a central chilling module may result in scaling, erosion, corrosion, algae or slime which will cause premature component failure, loss of use and extensive unit damage.

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

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

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

UNITS WITH SCROLL COMPRESSORS DO NOT HAVE A CRANKCASE HEATER AND THIS PROCEDURE IS NOT NECESSARY.

3.2 START UP / OPERATION PROCEDURE

A. SYSTEM FILL

1. General: This system utilizes a separate chilled water reservoir and plumping system that must be filled, activated and maintained for proper operation.

2. WATER TREATMENT

a. The use of untreated or improperly treated water in a central chilling module may result in scaling, erosion, corrosion, algae or slime which will cause premature component failure, loss of use and extensive unit damage.

b. It is recommended that the services of a qualified water treatment specialist be engaged to determine what water treatment is required.

c. Advantage assumes no responsibility for equipment failures which result from untreated or improperly treated water.

d. Thoroughly flush all water piping before making the final piping connections to the unit. If connecting to existing piping be sure it is clear of loose debris or debris that might break loose during operation before connecting to the unit.

e. Water filters with 40 mesh or finer screens should be installed prior to the chiller to protect the evaporator and condenser (on water cooled models) from debris. Basket type strainers are recommended rather than wye type strainers because they are generally more rugged and hold more debris.

f. These filters must be kept clean and free of debris that will reduce flow to the chiller.

B. ELECTRIC MOTOR PHASING

1. To obtain proper rotation, Scroll type compressors require phasing. All models, excluding remote outdoor condenser systems, have their motors factory phased in unison. Therefore, you should only need to check one motor to verify phasing. However, we recommend verifying all motor rotations.

2. 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.

C. SUGGESTED REMOTE PUMP FLOW ADJUSTMENTS

1. Pump flow must be adjusted based on motor rated amperage at your operating voltage.

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 in 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.

D. PRESSURE GAUGES

1. **Refrigerant Head Pressure.** Compressor discharge and refrigerant condensing pressure, normally at pressures corresponding to 95°F - 105°F for water-cooled models and 105°F - 115°F for air-cooled models. Will vary depending on refrigerant.

2. **Refrigerant Low Pressure.** Compressor pressure corresponding suction and refrigerant evaporating pressure, normally at 40 - 75 PSIG for 50°F to 55°F fluid temperatures. Will vary depending on refrigerant and unit operating temperature.

Note: Refer to chart in Section 8.5 with your specific refrigerant type for gauge readings.

3. **Water In Pressure.** 0 - 160 PSIG. Evaporator or process pump supply pressure to chiller.

E. ADJUSTMENT OF CENTRIFUGAL PUMP. When starting a piece of equipment with a centrifugal pump, it is important to properly set

the flow rate to prevent overloading of the electric motor. The following example is the start up procedure for a two pump central chiller.

1. Fully open the suction valves to the pumps allowing the pump case to fill with water. Never allow the pump to operate dry, this can cause shaft seal failure.

2. Close the discharge valves. A centrifugal pump can be operated with no flow without damage, although this should not be for an extended period of time. Internal friction will cause the water in the pump case to overheat.

3. Place an amp meter on one leg of the process pump leads at the motor starter block and start the motor. Slowly open the discharge valve allowing the process piping to fill with water. After flow is established, continue to open the discharge valve. The amp draw will increase as the flow increases until you reach the run load amp rating listed on the motor data tag.

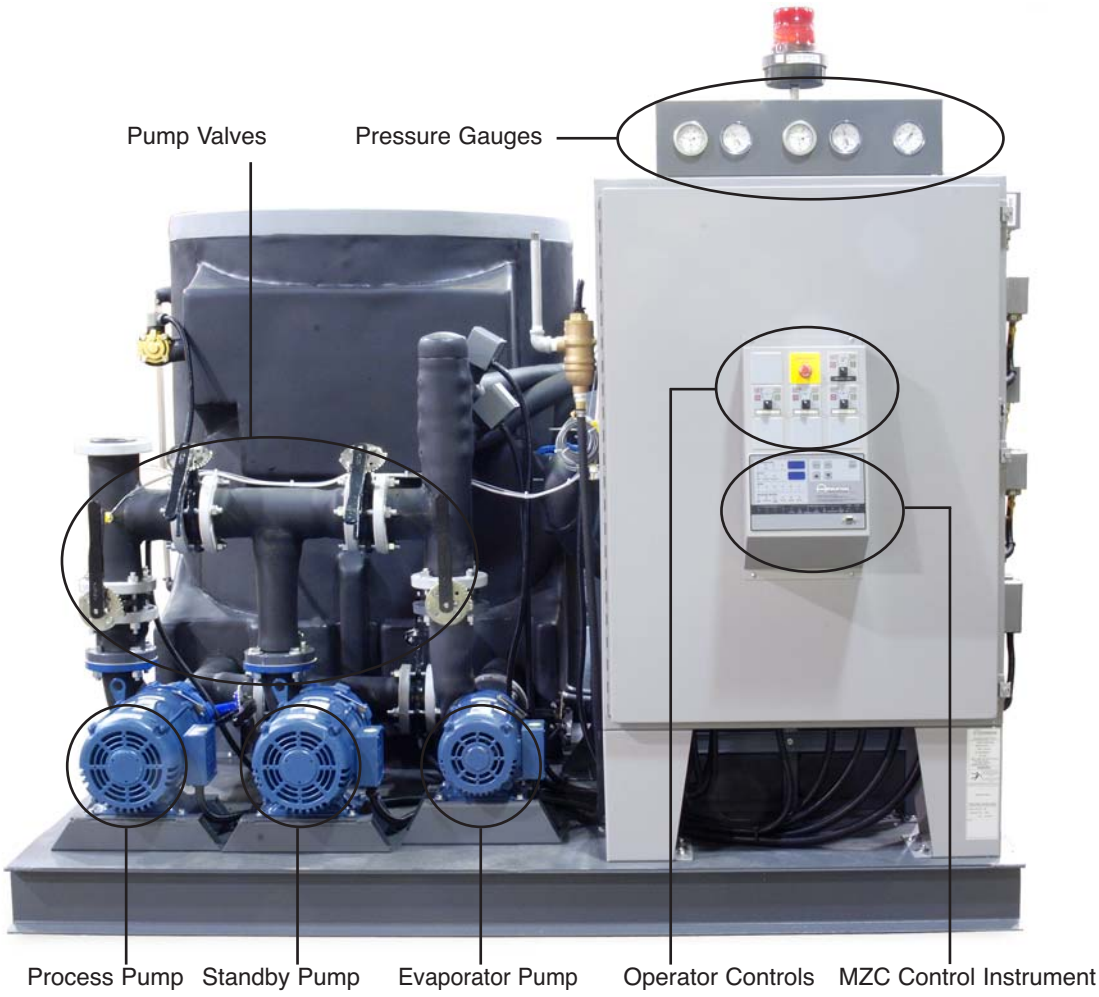
4. **Please note:** On initial start up the water use points may not be sufficient to fully load the motor, as you add use points you should recheck the amp draw on the motor and adjust the discharge valve as needed to prevent overloading of the motor.

5. Place an amp meter on one leg of the tower pump leads and start the motor. Slowly open the discharge valve allowing the piping to fill with water. After flow is established, continue to open the discharge valve. The amp draw will increase as the flow increases until you reach the run load amp rating listed on the motor data tag.

6. Never operate a pump without water in the case or never operate a pump without checking for proper amp draw.

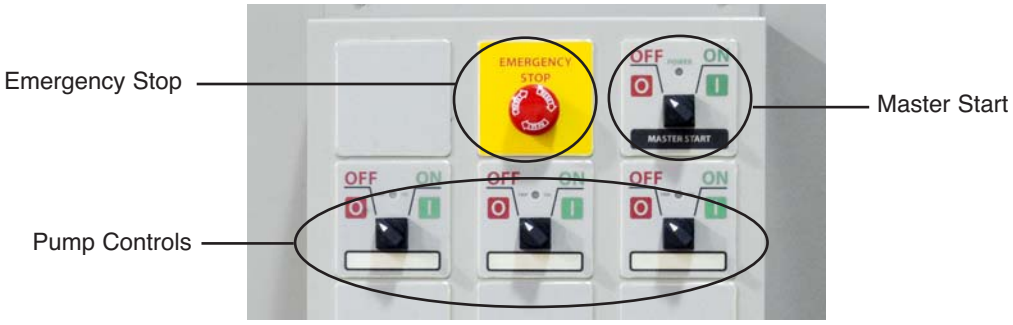
7. Always operate the pump with the suction valve fully open. Adjust the amp draw with the discharge valve starting from a closed position. Starting from a wide open position can give a false reading and result in motor failure.

8. If during operations the motor overload trips, the overloads will need to be manually reset to restart operations. Once the pump is restarted, check for excessive motor amps at the motor starter block and throttle back the pump's discharge valve as required.



3.3 OPERATOR CONTROLS

A. Depending on the unit's standard and option configuration, the number of switches and buttons maybe different than shown below. A typical configuration is shown here.



B. Operator Controls

1. **MASTER STOP / STOP.** This controls the overall operation of the unit. In the On position, the unit can operation. In the Off position, the unit will not operate even if power is applied to the unit. A power indication is provided.

Master Start / Stop

2. **EMERGENCY STOP.** This mushroom type button will instantly stop all unit operation.

Emergency Stop

3. **PUMP CONTROL.** This controls the operation of the pump. Each pump will has it's own control. There is 3 operations in this single control:

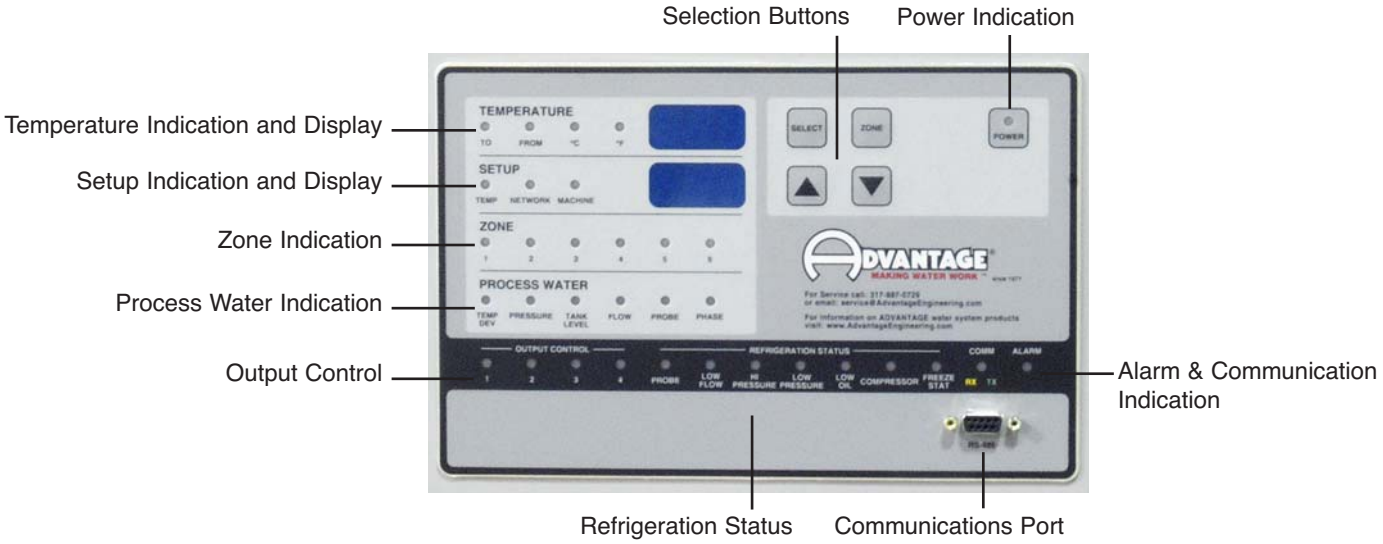
Pump Control

   a. **On / Off switch.** Turn On to activate the pump and Off to deactivate.

   b. **Running Light.** When the pump is operating this light will glow Amber.

   b. **Overload Trip Light.** If the pump has tripped on the overload relay, this light will glow red.

3.4 MZC CONTROL INSTRUMENT



A. OPERATION NOTES

1. The chiller control is programmed from the factory with a setpoint range of 48°F - 90°F. To operate below 48°F, inhibited glycol must be added to the system and the system limit switches must be adjusted. In addition to the operating range of the chiller control instrument must be modified by changing the DIP switch on the control panel to allow for a wider setpoint range. Refer to section 8 of this manual for more information.

2. Diligent monitoring of the water/glycol solution is required to prevent freezing of the evaporator. Freezing may cause the evaporator to rupture allowing water and refrigerant to mix causing severe damage to the refrigeration system which is not covered under warranty.

3. On R22, R134A and R407C models operating above 70°F and R404A models operating above 60°F requires the addition of a refrigerant crankcase pressure regulating (CPR) valve. The CPR valve is necessary to prevent overloading of the compressor which can cause premature failure. R410A models may be operated up to 80°F without a CPR valve.

B. TEMPERATURE INDICATION AND DISPLAY

1. Temperature information is displayed via the three digit display window.

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

3. **FROM:** Illuminates when the **FROM PROCESS** water temperature is selected. **NOTE:** The instrument will revert back to the **TO PROCESS** temperature display after 10 seconds if the **SELECT** key is used to move from the **TO PROCESS** display. **NOTE:** Both TO and FROM lights are on when zone EVA IN and EVA OUT temperatures are displayed. **NOTE:** Both to and from lights are on when zone EVA IN and EVA OUT temperatures are displayed

4. **° C:** Illuminates when the ° C (Celsius) temperature display parameter is selected.

5. **° F:** Illuminates when the ° F (Fahrenheit) temperature

display parameter is selected. °F is the default setting of the instrument.

C. SETUP DISPLAY

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

2. Temperature/Setup display sequence:

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

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

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

a. When the instrument is in the TO, FROM or SP temperature display, the operator may adjust the setpoint temperature with the UP/DOWN arrow keys.

b. **SP:** programs the process setpoint. It can be set to a range of 70° - 48° or 90°- 10° depending on the state of SW-1, referenced in the switch description section.

c. **HI:** programs the high alarm temperature deviation limit. This is the high temperature setting at which an alarm is activated if the 'to process' temperature reaches it. 1-30 units selectable.

d. **Lo:** programs the low alarm temperature deviation limit. This is the low temperature setting at which an alarm is activated if the 'to process' temperature decreases to it. 1-30 units selectable.

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

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

a. **Pro:** Sets the protocol selection. The protocol is the data format for communications between the unit and the host computer. SPI (standard Society of Plastics Industry) or CAC (standard used on older CMI machines) protocols selectable.

b. **Adr:** Sets the communication address. This is the number assigned to the unit in a network. 1-99 units selectable in SPI protocol and 0 - 9 in CAMAC protocol.

c. **rAt:** Programs the baud rate. The baud rate is the data transfer rate between the unit and the host computer. 1200, 2400, 4800, 9600 units selectable.

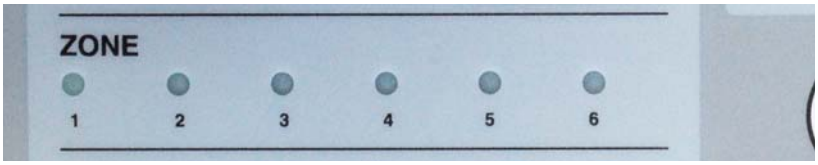
4. **MACHINE:** Illuminates when the following parameters are selected:

Unt	Temperature unit selection
Prb	From process probe calibration

a. **Unt:** Sets temperature display. Select 'F' for Fahrenheit temperature display or select 'C' for Celsius temperature display.

b. **Prb:** Contact factory for details.

D. ZONE DISPLAY

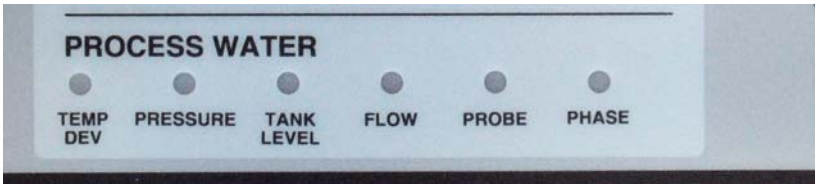


a. The LED's in this section indicate which ZONE is selected for viewing.

b. The status for the selected Zone is displayed in the 'OUTPUT CONTROL' and 'REFRIGERATION STATUS' sections.

c. The operator can select which zone is displayed by using the **ZONE** button. An ON or FLASHING LED indicates the selected zone.

E. PROCESS WATER DISPLAY



1. **TEMP DEV:** Illuminates according to the current state of temperature deviation:

a. **SOLID GREEN:** When the process temperature is within the programmed parameters.

b. **YELLOW:** If the SETPOINT or TO PROCESS temperature different is greater than the programmed HI/LO deviation settings.

c. **FLASHING RED:** after about 90 seconds in the YELLOW condition, the LED will display FLASHING RED and the alarm will be sounded. If the difference returns to within acceptable limits before the 90 seconds has elapsed, then the LED will return to GREEN.

2. **PRESSURE:** Illuminates according to the current state of process pressure:

a **SOLID GREEN:** The process pressure is within the programmed parameters.

b. **FLASHING RED:** The process pressure has deviated out of the programmed parameters.

c. **SOLID RED:** The process pressure had once deviated out of the programmed parameters but is now within the programmed parameters.

3. **TANK LEVEL:** Illuminates according to the current state of tank level:

a. **SOLID GREEN:** The reservoir tank is at proper operating level.

b. **FLASHING RED:** The reservoir level has dropped below the proper operating level and the make-up supply system is activated to restore the water level

c. **SOLID RED:** The proper operating level has been restored.

4. **FLOW:** Does not display flow status at this time.

5. **PROBE:** Illuminates according to the current state of the process and zone probes:

a. **SOLID GREEN:** The process probes are ok and working fine.

b. **FLASHING RED:** One of the process probes is not functioning correctly.

c. **SOLID RED:** One of the probes had a fault, but the fault is no longer present.

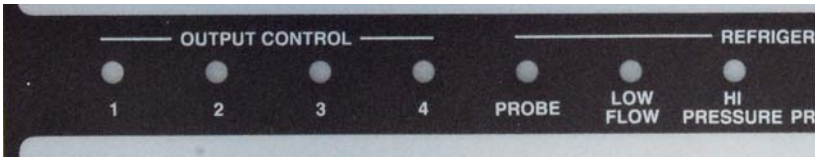
6. **PHASE:** Illuminates according to the current state of electrical phase:

a. **SOLID GREEN:** The electrical phase is within the acceptable parameters.

b. **FLASHING RED:** Indicates improper phasing of the incoming 3 phase supply.

c. **SOLID RED:** The phasing had once been 'in fault' but is now restored.

F. OUTPUT CONTROL SECTION



1. The following LED's are SOLID GREEN when the output is "ON".

2. **COMPRESSOR:** Illuminates when the compressor has cycled on.

3. **CAPACITY 1:** Illuminates when the controller has cycled on the first stage of capacity control, either a hot gas bypass system or a cylinder unloading system, depending on the configuration.

4. **CAPACITY 2:** Illuminates when the controller has cycled on the second stage of capacity control. May not be available, depending on capacity control configuration.

5. **CAPACITY 3:** Illuminates when the controller has cycled on the third stage of capacity control. May not be available, depending on capacity control configuration.

G. REFRIGERATION STATUS SECTION

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

2. For each component (listed below):

   a. **SOLID GREEN:** Indicates the component is currently at an acceptable run condition.

   b. **FLASHING RED:** Indicates the component is currently at an unacceptable run condition.

   c. **SOLID RED:** Indicates the component had once been at an unacceptable run condition, but is now at an acceptable run condition. A solid red light can be changed into a solid green light by pressing the 'select' key.

3. **PROBE:** Indicates the status of the zone evaporator temperature probes.

4. **LOW FLOW:** Indicates the status of the zone 'low flow' switch.

5. **HI PRESSURE:** Indicates the status of the refrigerant 'high pressure' safety switch.

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

7. **LOW OIL:** Indicates the status of the 'low oil' pressure safety switch. This light activates on models with a 15-30 ton semi-hermetic compressor.

8. **COMPRESSOR:** Indicates the status of the zone compressor motor overload relay.

9. **FREEZESTAT:** Indicates the status of the 'freezestat' safety switch.

H. COMMUNICATION STATUS

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

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

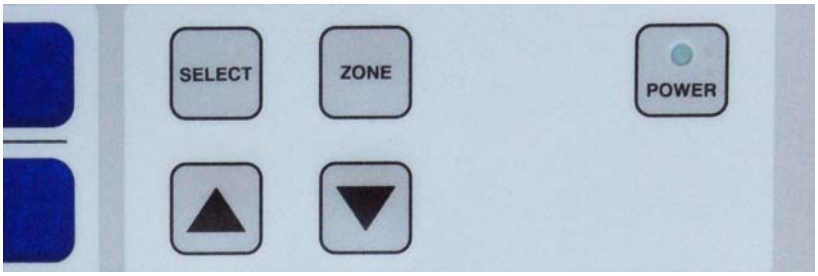
   b. **FLASHING YELLOW:** Indicates the host computer is sending information to the controller.

I. ALARM STATUS

1. When this light illuminates RED, an unacceptable condition has developed, at which time a 115 volt alarm output is generated for an external (factory or customer installed) alarm beacon or buzzer.

2. Pressing the SELECT or ZONE key can silence the visual and/or audible alarm signal.

J. OPERATOR CONTROLS



1. **SELECT:** Depress this button to index through the 'system/zone' temperature and 'system/zone' parameters.

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

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

3. **UP ARROW:** Depress this push button to increase the parameter displayed in the SETUP window. If this push button is pressed momentarily, the value is incremented by one. If the push button is held down for more than one second, the value will increase slowly at first and then faster after about two seconds.

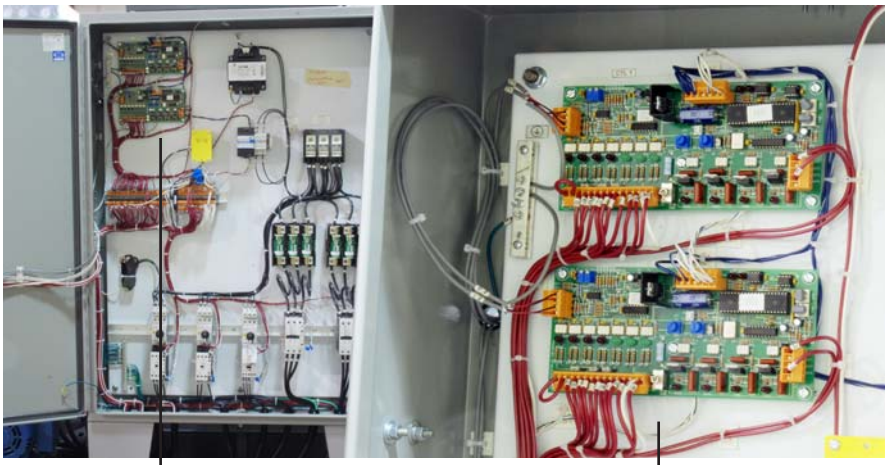
4. **UP ARROW:** Depress this push button to decrease the parameter displayed in the SETUP window. If this push button is pressed momentarily, the value is decremented by one. If the push button is held down for more than one second, the value will decrease slowly at first and then faster after about two seconds.

5. **Note:** When setting the Low Pressure Delay or Backup Setpoint on the zone boards, press the UP or DOWN buttons to keep the display from timing out and reverting back to the default to PROCESS mode.

6. **POWER:** This LED indicates when the power to the unit is turned on.

7. **POWER ON LED**: Indicates that power is applied to the controller board.

3.5 MZC ZONE BOARD



Zone Board location inside electrical cabinet.

Close up of Zone Boards.

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

2. ADDRESS SWITCH (Rotary Switch)

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

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

3. CONFIGURATION SWITCH (Rotary Switch)

Selects configuration number from 0 to F

4. LOW PRESSURE TIME DELAY POTENTIOMETER

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

5. Alternate Setpoint Potentiometer

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

C. STATUS DISPLAY SECTION

LED displays that indicate the status of the chiller.

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

2. SAFETY/PROTECTION LED's

OIL: Low oil pressure safety switch fault.
COMP: Compressor motor overload fault.
HP: Refrigerant high-pressure safety switch fault.
FREEZE: Freezestat safety switch fault.
LF: Low water flow switch fault.
LP: Refrigerant low -pressure safety switch fault
ZONE: Zone Board 110VAC power switch is 'ON'.

3. AC OUTPUT LED's

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

OUT 1: Indicates output status of OUT 1
OUT 2: Indicates output status of OUT 2
OUT 3: Indicates output status of OUT 3
OUT 4: Indicates output status of OUT 4

D. INTERFACE SECTION

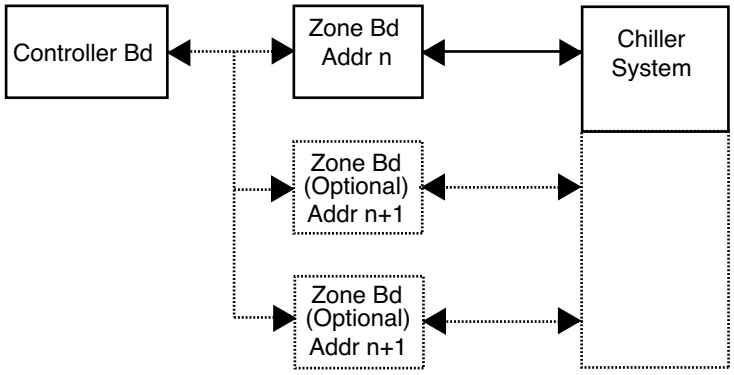
1. SAFETY/PROTECTION CONNECTOR

Electrical connections to safety switches.

OIL: Low oil pressure safety switch.
COMP: Compressor motor overload safety switch.
HP: Refrigerant high-pressure safety switch.
FREEZE: Freezestat safety switch.
LF: Low water flow switch fault.
LP: Refrigerant low -pressure safety switch.
ZONE: Zone Board 110 AC power input.

2. AC OUTPUT CONNECTOR

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



Note: n= 1 to 7

OUT 1: output 1AC 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

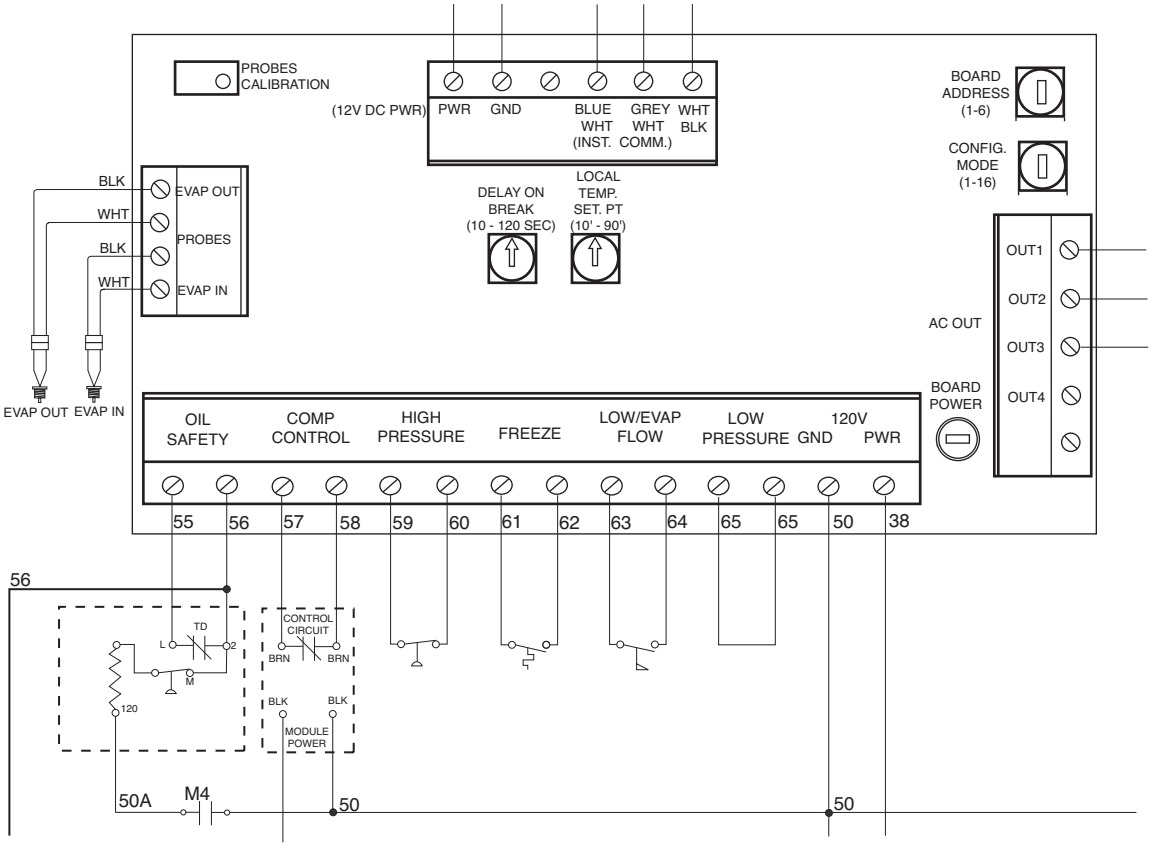
Conf. Setting	OUT1	OUT2	OUT3	OUT4
0	COMPRESSOR	RESERVED	RESERVED	HGBP
1	COMPRESSOR	UNLOADER	RESERVED	HGBP
2	COMPRESSOR	UNLOADER	UNLOADER	HGBP
3	COMPRESSOR	UNLOADER	RESERVED	RESERVED
4	COMPRESSOR	UNLOADER	UNLOADER	RESERVED
5	COMPRESSOR	COMPRESSOR	RESERVED	HGBP
6	SCREW COMPRESSOR	SOLENIOD 2	SOLENOID 3	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.

Configuration Matrix Chart : Zone B

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

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



3.6 CONTROLS

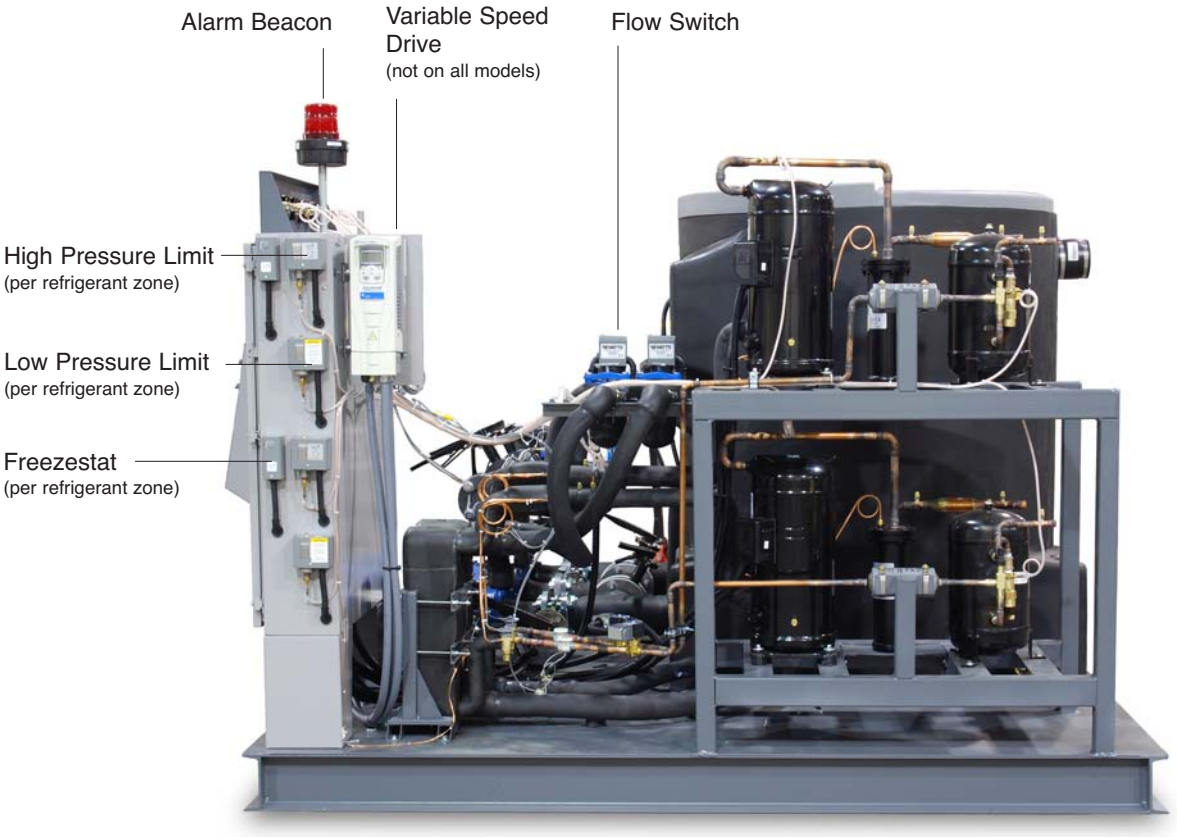
A. **Flow switch**: Installed on each evaporator water circuit. Its mission is to monitor the fluid flow and to shut down the compressor in case a harmful low flow condition should develop.

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.

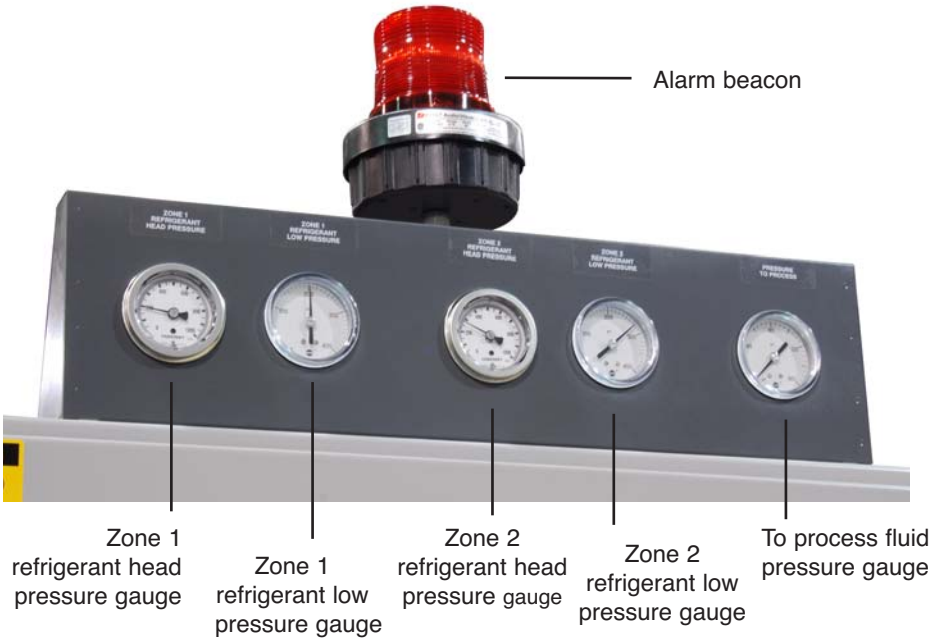
3.7 PRESSURE GAUGES

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.



THIS PAGE LEFT BLANK

4.0 TROUBLESHOOTING

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.** 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.** Tighten terminals with POWER OFF.

4.3 SHUTS OFF ON HIGH PRESSURE CONTROL

Note. Refrigerant high pressure will vary with ambient temperature. The high pressure switch manually reset when discharge pressure falls to a safe level. The switch is located inside the electrical panel.

A. **Air-cooled units:**

1. **Insufficient condenser air flow.** Check remote air-cooled condenser filter (if equipped with a 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 condnesr must be in place.

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 8.5 for refrigerant pressure.

1. **Water regulator valve.** Adjust condenser water regulator valve to maintain 105°F refrigerant condensing

temperature*. If valve is defective, have valve repaired or replaced by a refrigeration serviceman.

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

3. **Condenser water temperature too high.** Check cooling tower or proper operation city water temperature.

4. **Condenser water tubes scaled.** Clean with brushes and chemicals approved by the Advantage 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: The low pressure switch automatically resets when the pressure rises above the cut-in pressure. If this does not occur contact the Manufacturer's service department for instructions.

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

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

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

A. **Air-cooled units:**

Head pressure too low.

Units with remote outdoor condensers (TI-A models) - Fan pressure setting may require adjustment. Call factory service for proper settings.

B. **Water-cooled units:**

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

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

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 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 serviceman.

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

The sensor is a solid state temperature transducer which converts temperature input to proportional current output. 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.

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.

C. Check the amp draw and if overloaded, partially close the from process line valve until the amp draw drops to the proper level.

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 chiller controller is not field repairable. It can be easily removed and replaced if required. Contact the Advantage service department (317-887-0729) for additional information.

B. In Warranty Service Incident

1. Call Advantage Service at 317-887-0729 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.

C. Out-Of-Warranty Service Incident

1. Call Advantage Service at 317-887-0729 for diagnostic assistance.

2. If a control instrument is determined to be at fault, you will be referred to the instrument manufacturer, Advantage Electronics (an Advantage Engineering affiliated company 317-888-1946). You have 3 options:

a. Purchase a new instrument as a replacement.

b. Send your instrument back for repair, freight prepaid. For a nominal fee 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.

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.

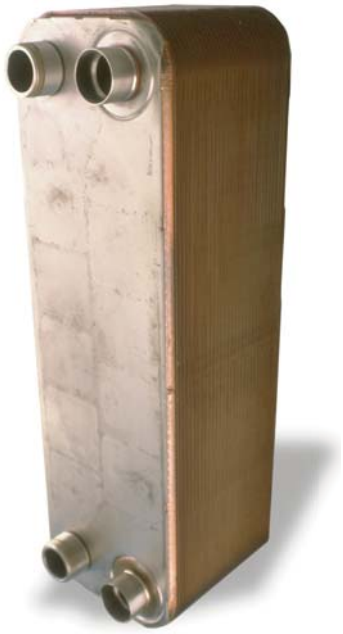
3. With the unit operating at 100% capacity (not in the “capacity control” mode) the sight glass should appear clear with no foam or bubbles evident. If foam or bubbles are evident, the chiller has suffered from a loss of refrigerant and should be checked by a qualified refrigeration technician.

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 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.

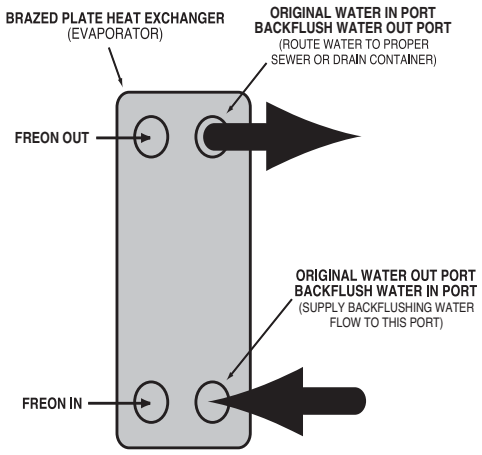
3. Connect a hose to the evaporator water supply port and to an appropriate containment vessel. If acid cleaning, connect the evaporator water inlet port to an acid solution reservoir

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.

Zone Board location inside 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.

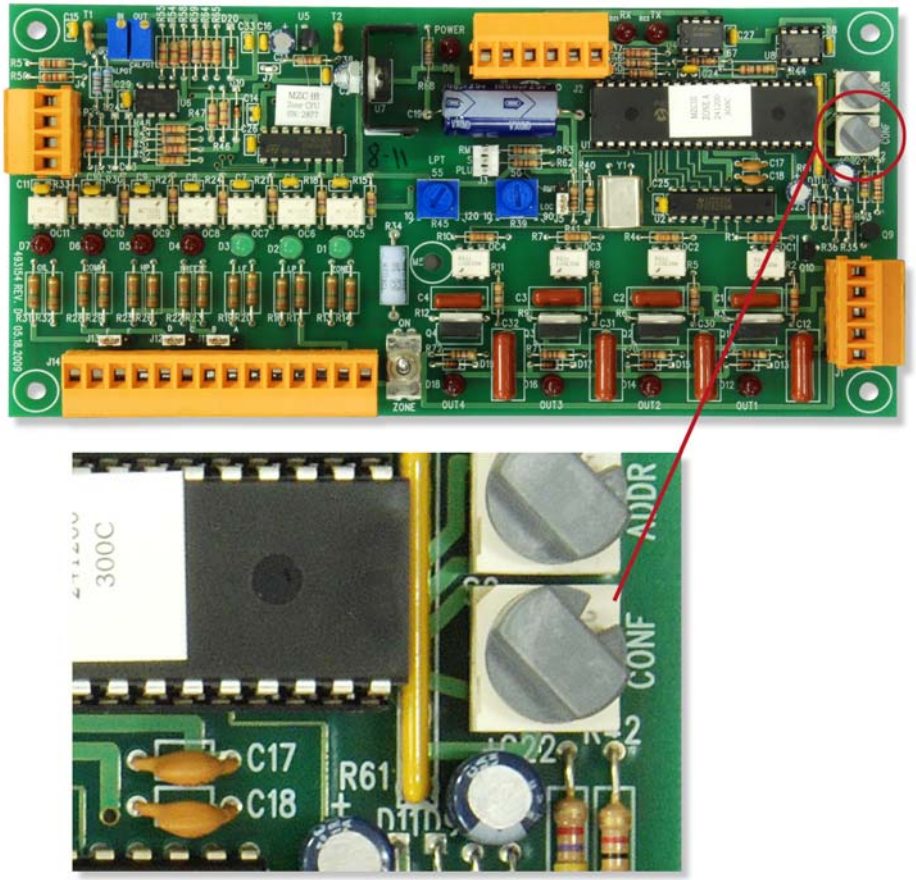
D. Rotate the switch until the

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.



6.0 COMPONENTS

6.1 REFRIGERATION SYSTEM

6.2 COOLANT SYSTEM

6.1 REFRIGERATION SYSTEM

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

Compressors. Configuration may be different on specific units.

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.

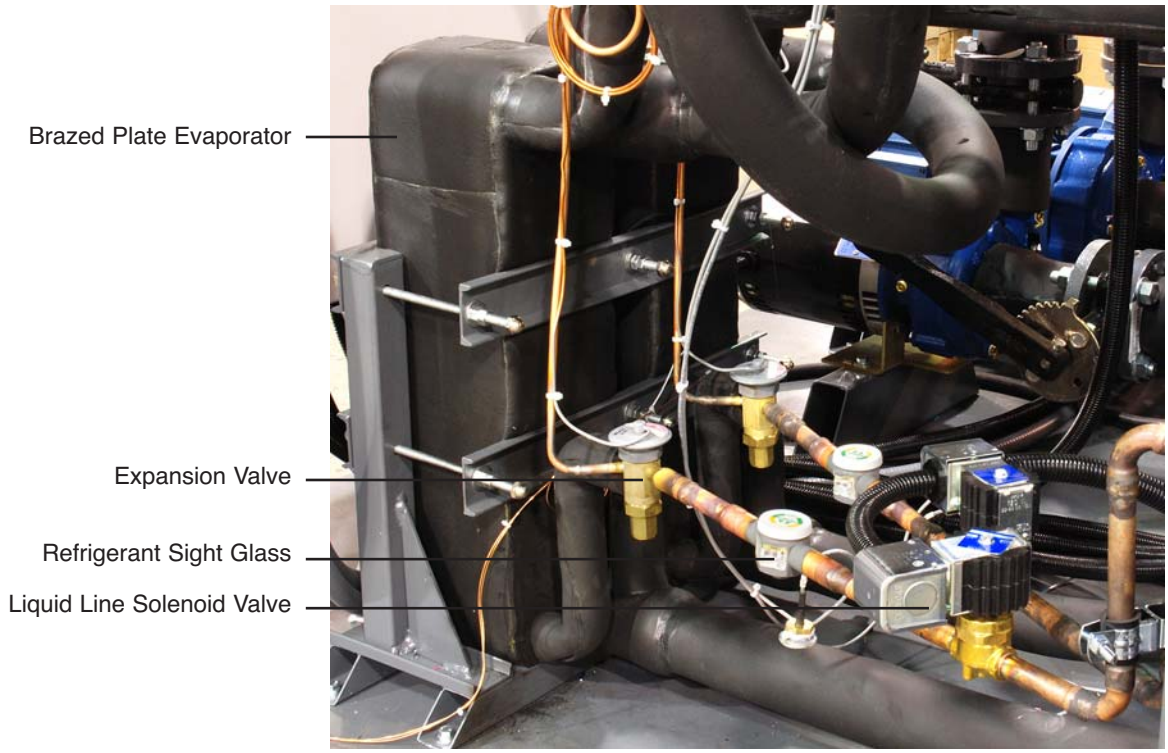
C. **WATER-COOLED CONDENSER:** The water cooled condenser removes BTU's from the compressed refrigerant gas. The action causes the gas to "condense" into a liquid state still under high pressure. Water flow across the condenser is provided by an external source, typically the plant's tower water. In 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

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

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

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

J. **Liquid receiver:** Located after the air-cooled condenser, this component receives and stores liquid refrigerant leaving the condenser. (Air-cooled models only).

K. **Service valves:** Have been provided throughout the system. Only a qualified refrigeration service technician shall operate these valves.

L. **Crankcase heater:** Insures that freon and compressor crankcase oil do not mix during the compressor's "off" cycles. Power must be applied to the chiller previous to startup. (Not on all models.)

M. **Oil pressure safety switch:** protects the compressor from lubrication failure. (Not on all models.)

N. **Pressure Gauges:**

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

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

6.2 COOLANT SYSTEM

A. **Reservoir:** Provides coolant storage during non operating periods. An internal baffel separates 'from process' and 'to process' fluid flows during operating periods.

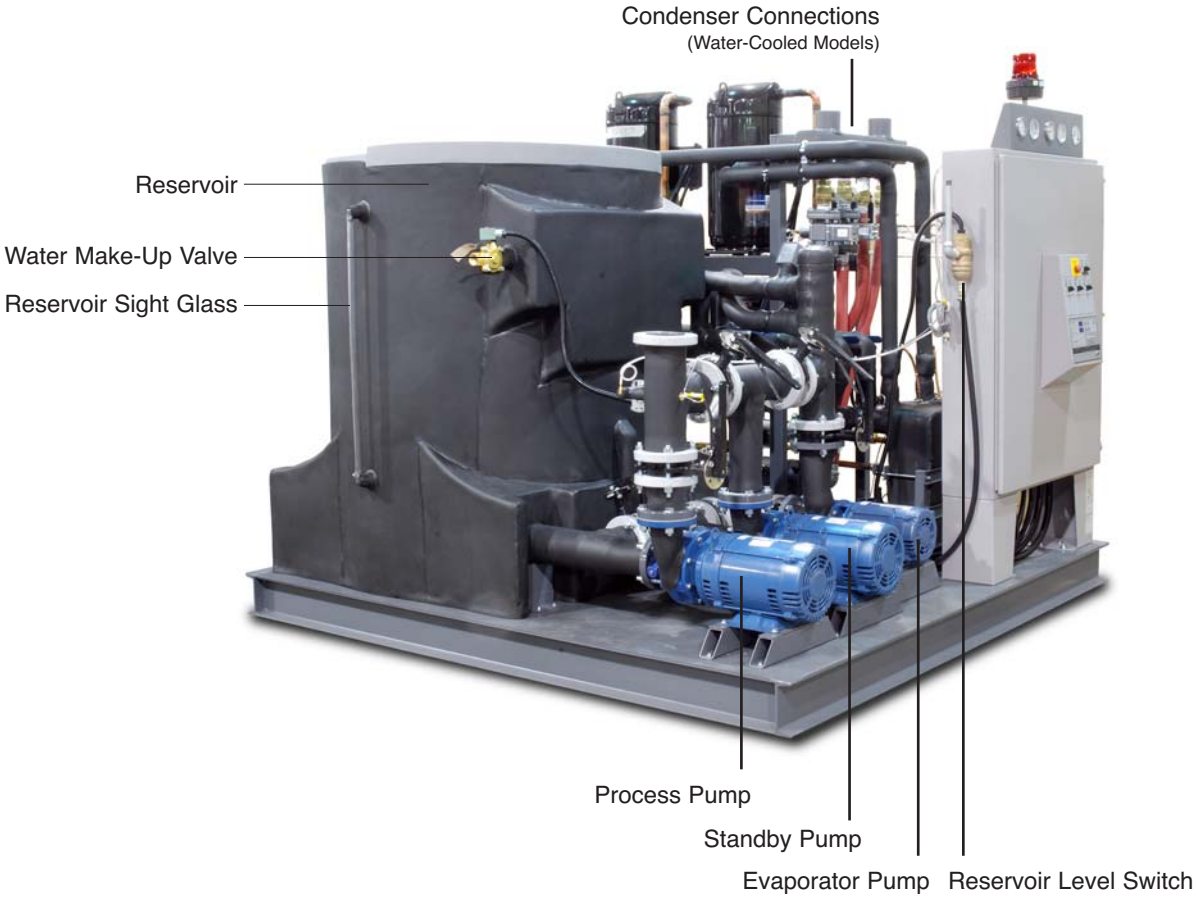
B. **Process Pump:** Provides fluid to the central system.

C. **Standby Pump:** Optional pump to provide backup for the process or evaporator pump.

D. **Evaporator pump:** Provides consistent flow through the brazed plate evaporators to maintain full capacity.

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

F. **Freezestat:** Protects the system from potential freezing. Factory



adjusted to 40°F. For operating temperatures below 48°F, see section 6.7 on page 39.

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

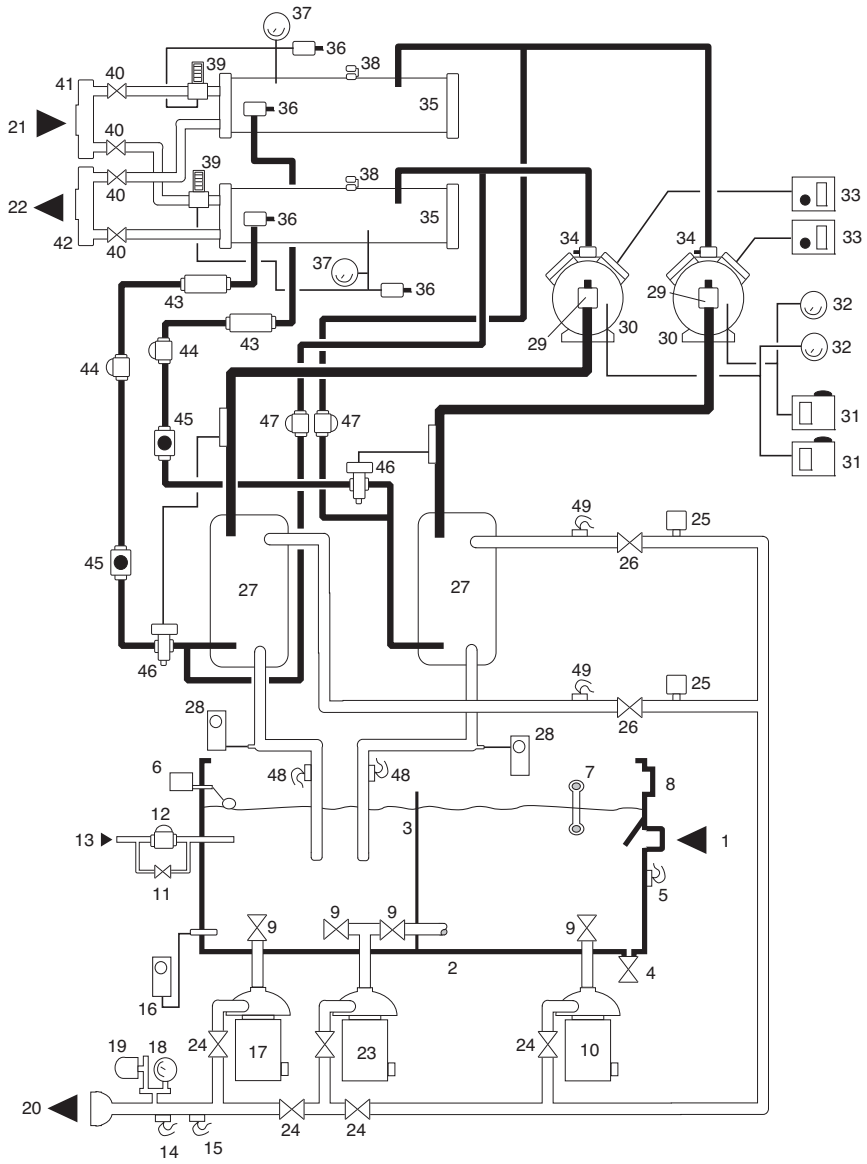
H. **Water saver (regulator) valve:** modulates water into the condenser based on refrigerant head pressure. Used on water cooled models only.

THIS PAGE LEFT BLANK

7.0 RELATED DRAWINGS

7.1 TITAN CIRCUIT DRAWING
7.2 TYPICAL PRESS DROP
7.3 TYPICAL VACUUM BREAKER / ANTI-SIPHON SYSTEM

7.1 TITAN CIRCUIT DRAWING (WATER-COOLED MODELS)

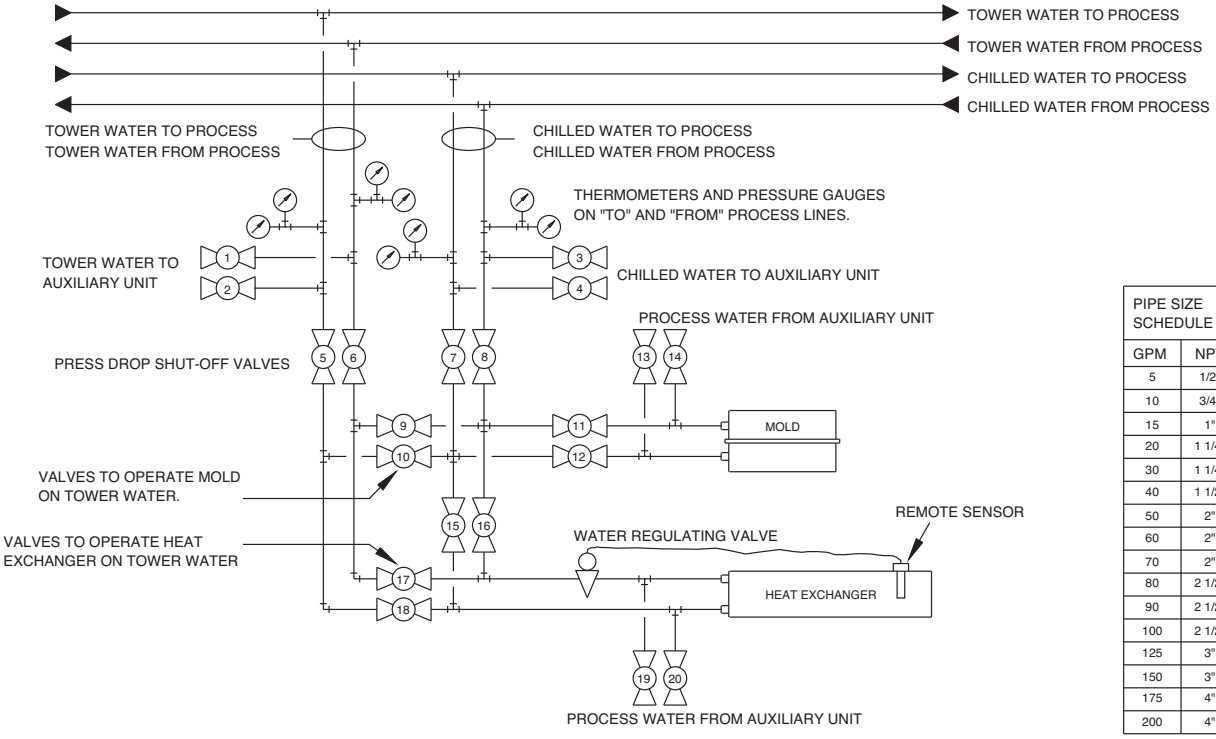


#	Item
1	From process connection
2	Tank assembly
3	Baffle plate
4	Tank drain valve
5	Return probe
6	Tank level control
7	Level sight glass
8	Overflow to drain
9	Pump suction valve
10	Evaporator pump
11	Manual fill valve
12	Water makeup solenoid valve
13	Water supply connection
14	Supply probe
15	Control sensor
16	Alarm thermostat

#	Item
17	Process pump
18	Supply pressure gauge
19	Alarm pressure switch
20	To process connection
21	Condenser water supply connection
22	Condenser water drain connection
23	Standby pump
24	Pump discharge valve
25	Flow safety switch
26	Factory adjusted flow control valve
27	Evaporator
28	Freezestat
29	Compressor suction valve
30	Compressor
31	Low pressure safety switch
32	Low pressure gauge

#	Item
33	High pressure safety switch
34	Compressor discharge valve
35	Condenser
36	Service valve
37	Head pressure gauge
38	Condenser safety relief valve
39	Water regulator valve
40	Condenser flow control valve
41	Condenser supply manifold
42	Condenser return manifold
43	Filter-drier
44	Liquid line solenoid valve
45	Refrigerant sight glass
46	Expansion valve
47	Hot gas by-pass valve
48	Evaporator out temperature sensor
49	Evaporator in temperature sensor

7.2 TYPICAL PRESS DROP

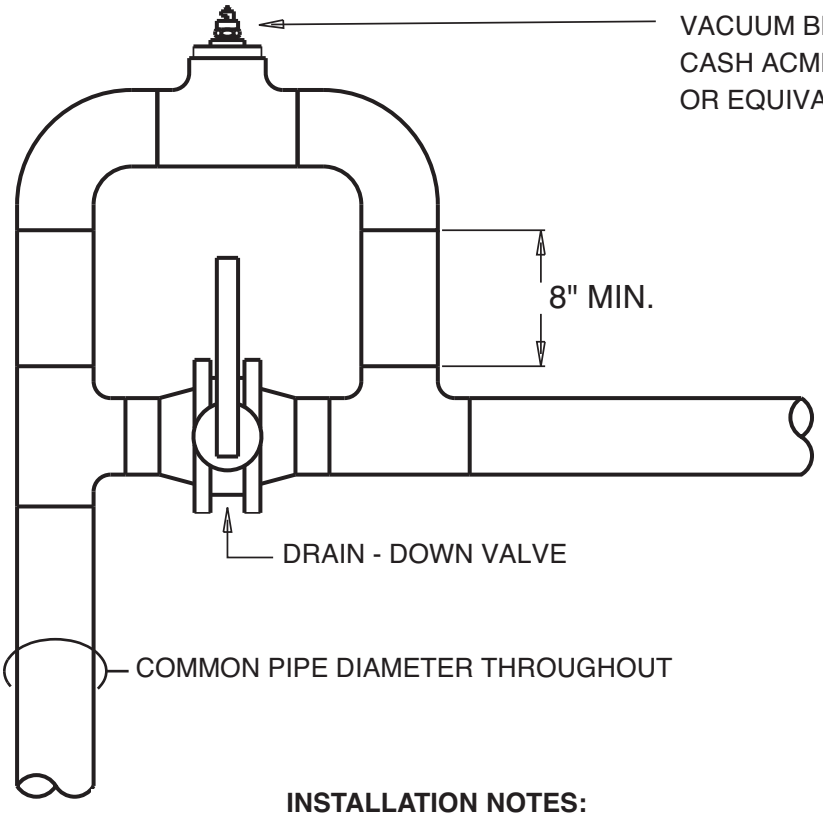


PIPE SIZE SCHEDULE	
GPM	NPT
5	1/2"
10	3/4"
15	1"
20	1 1/4"
30	1 1/4"
40	1 1/2"
50	2"
60	2"
70	2"
80	2 1/2"
90	2 1/2"
100	2 1/2"
125	3"
150	3"
175	4"
200	4"

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

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

7.3 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 without several precautionary measures. All controls are factory adjusted for 48°F and above operations.

B. Before readjusting the protective devices, a satisfactory antifreeze solution must be substituted for the recirculating chilled water. This mixture will consist of inhibited propylene glycol and water. Do not substitute an inhibited propylene glycol and water solution with common automotive type antifreeze. This chart outlines the glycol percentages at various water temperatures.

C. Fluid must be tested with a hydrometer to verify proper glycol percentages for freeze protection. The ratio shall be according to the chart below. Too much glycol can cause capacity and control problems.

D. DO NOT USE AUTOMOTIVE TYPE ANTI-FREEZE.

E. Once the antifreeze provision is satisfied, the freezestat limit switch may be readjusted. Adjust the freezestat according to this chart.

F. Adjust the low pressure limit switch according to the specifications in the chart below. Some units are equipped with non adjustable high and low pressure switches. See section 8.1.I.

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#

G. 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 swith 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.

H. **LE Instruments.** The LE instrument requires an adjustment of the DIP switch to accomodate the expanded temperature range. Please see section 5.6 in this manual for more information.

I. **Multizone Instruments.** The Multizone instrument requires an adjustment of the DIP switch to accomodate the expanded temperature range. Please see section 5.7 in this manual for more information.

J. **WARNING:** do not use any type or brand of automotive antifreeze. Automotive antifreeze contains corrosion inhibitors - silicates - designed for compatibility with the materials in automotive engines. Unfortunately, silicates can gel and cause deposits to foul and insulate heat exchanger surfaces. In your chilling system that can mean higher energy costs, high pumping costs, and possibly even shut downs for system cleaning. We recommend the use of DowFrost or Monsanto DFS-1.

K. **IMPORTANT.** Some chillers are equipped with non-adjustable high and low pressure switches. These are generally factory set for a minimum fluid temperature operating point of 48°F. For colder set points the low pressure switch must be replaced with a switch suitable for the new conditions. Contact Advantage's service department for more information at 318-887-0729.

Freezestat
- Adjustable

High pressurestat
- Adjustable

Low pressurestat
- Adjustable

High pressurestat, Low pressurestat
- Non Adjustable

8.2 WATER QUALITY CONTROL

A. The use of untreated or improperly treated water in a central chilling module may result in scaling, erosion, corrosion, algae or slime which will cause premature component failure, loss of use and extensive unit damage.

B. It is recommended that the services of a qualified water treatment specialist be engaged to determine what water treatment is required.

C. Advantage assumes no responsibility for equipment failures which result from untreated or improperly treated water.

D. Thoroughly flush all water piping before making the final piping connections to the unit. If connecting to existing piping be sure it is clear of loose debris or debris that might break loose during operation before connecting to the unit.

E. Water filters with 40 mesh or finer screens should be installed prior to the chiller to protect the evaporator and condenser (on water cooled models) from debris. Basket type strainers are recommended rather than wye type strainers because they are generally more rugged and hold more debris.

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)
- Advantage Engineering “Thermofluid” (1-317-887-0729)

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.

C. A refractometer should be used on a regular basis to determine the mixture strength according to freeze point. The freeze point temperature is outlined in this manual. Water will evaporate from the mixture and if you continue to add a premixed solution, eventually you will have too much glycol. It is necessary to add water or glycol to maintain proper freeze point temperature.

8.4 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

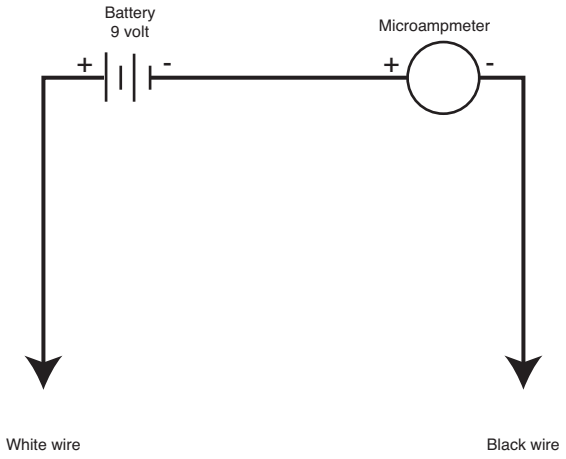
Temperature		Refrigerant				
°F	°C	R-22	R-410a	R-407c	R-134a	R-404a
27	-2.8	51.2	91.6	44.7	23.7	66.2
28	-2.2	52.4	93.5	45.9	24.5	67.7
29	-1.7	53.7	95.5	47.1	25.3	69.2
30	-1.1	54.9	97.5	48.4	26.1	70.7
31	-0.6	56.2	99.5	49.6	26.9	72.1
32	0.0	57.5	101.6	50.9	27.8	73.8
33	0.6	58.8	103.6	52.1	28.6	75.3
34	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)

8.5 SENSOR CURRENT VS TEMPERATURE

To determine whether your probe is performing properly, hook the probe up as shown in the schematic shown and read micro amps that correspond to the temperature that the probe is sensing. We recommend using an ice bath as a known temperature when doing this test.

-20°F = 243.86	µA	120°F = 321.82	µA
-10°F = 249.43	µA	130°F = 327.39	µA
0°F = 255.00	µA	140°F = 332.96	µA
10°F = 260.57	µA	150°F = 338.53	µA
20°F = 266.14	µA	160°F = 344.10	µA
30°F = 271.71	µA	170°F = 349.67	µA
40°F = 277.27	µA	180°F = 355.24	µA
50°F = 282.84	µA	190°F = 360.80	µA
60°F = 288.41	µA	200°F = 366.37	µA
70°F = 293.98	µA	210°F = 371.64	µA
80°F = 299.55	µA	220°F = 377.51	µA
90°F = 305.12	µA	230°F = 383.08	µA
100°F = 310.69	µA	240°F = 388.65	µA
110°F = 316.26	µA	250°F = 394.22	µA



8.6 CHILLER CAPACITY AND DERATE CHART

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

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 of 95-105°F, select the next larger capacity chiller. For ambients over 105°F, consult factory.

END

RE 11 10/12