I.O.M. #119 5/11

INSTRUCTION MANUAL • INSTALLATION • OPERATION • MAINTENANCE

Portable Chiller

INSTRUCTION MANUAL

For 5 - 40 Ton Models
Air-Cooled & Water-Cooled

Portable Chiller

INSTRUCTION MANUAL
AIR & WATER-COOLED MODELS

COVERING

INSTALLATION
OPERATION
MAINTENANCE

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1.0 GENERAL

1.1 INTRODUCTION
1.2 UNIT LOCATION
1.3 EFFICIENCY
1.4 SAFETY
1.5 CLEAN AIR ACT
1.6 MISCELLANEOUS
1.7 WATER TREATMENT
1.8 COMPONENTS

1.1 INTRODUCTION

A. This manual covers portable chillers from 5 to 40 tons.

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 and water-cooled models:

1. These units are designed for indoor use only.

2. For most efficient operation, locate the chiller in a clean, dry and well ventilated environment.

B. For air-cooled models:

1. The unit has an air-cooled refrigerant condenser. For air-cooled condensers, a motor driven fan (on models from 5 to 15 tons) or a centrifugal blower (on models from 15 to 30 tons) generates air flow through the condenser to remove heat from the refrigerant system. The air cooled condenser on the unit will discharge a maximum of 15,000 BTU's per hour per ton of cooling.

2. The unit must have a minimum entering air temperature of 60°F and a maximum entering air temperature of 95°F for efficient operation.

3. The unit must have a minimum of two feet clearance at the air intake and six feet at the vertical exhaust air discharge.

4. The unit must have all enclosure panels in place before operating compressor. Air will not be drawn through the condenser coil if they are not in place. This will cause the compressor to lockout on the high pressure safety fault.

1.3 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 where required to prevent solids from plugging critical parts (pumps, heaters, seals for example). The Manufacturer highly recommends the services of a competent water treatment specialist be obtained and his

recommendations followed. The Manufacturer accepts no responsibility for inefficient operation, or damage caused by foreign materials or failure to use adequate water treatment.

1.4 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.

1.5 CLEAN AIR ACT

A. The unit contains HCFC-22 (chlorodifloromethane). This is a class 2 substance.

B. 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.

1.6 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.

1.7 WATER TREATMENT

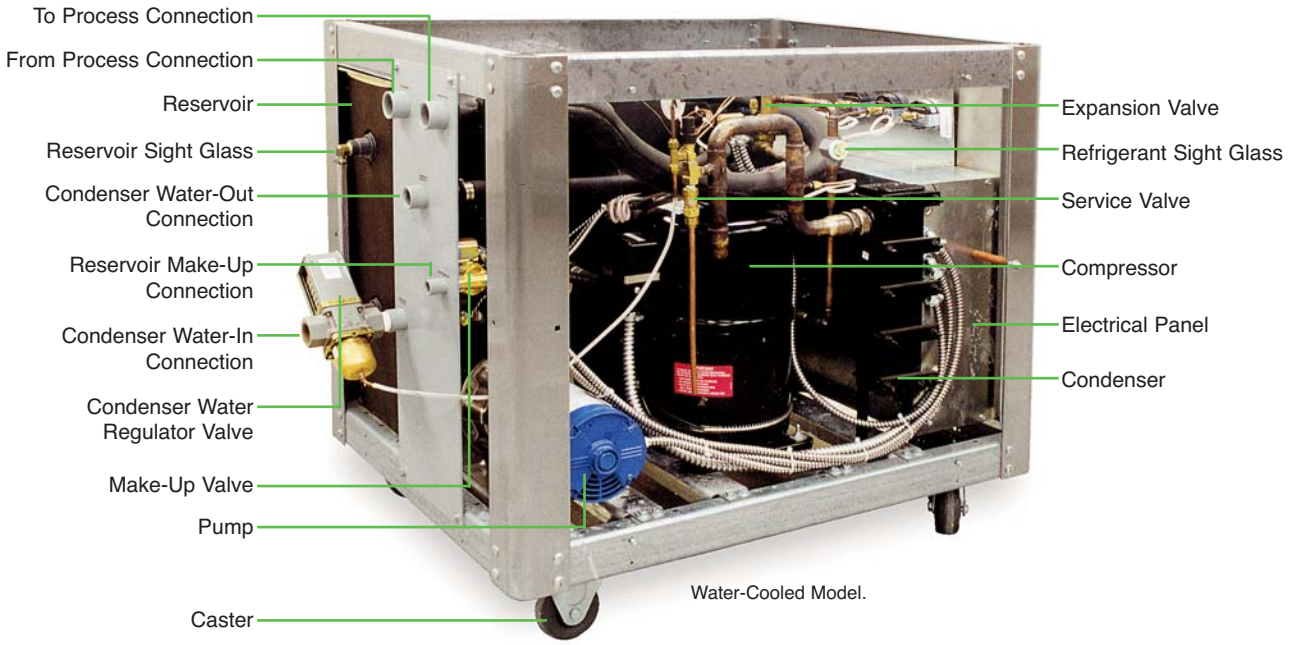
A. The use of untreated or improperly treated water in a portable chiller may result in scaling, erosion, corrosion, algae or slime.

B. It is recommended that the services of a qualified water treatment

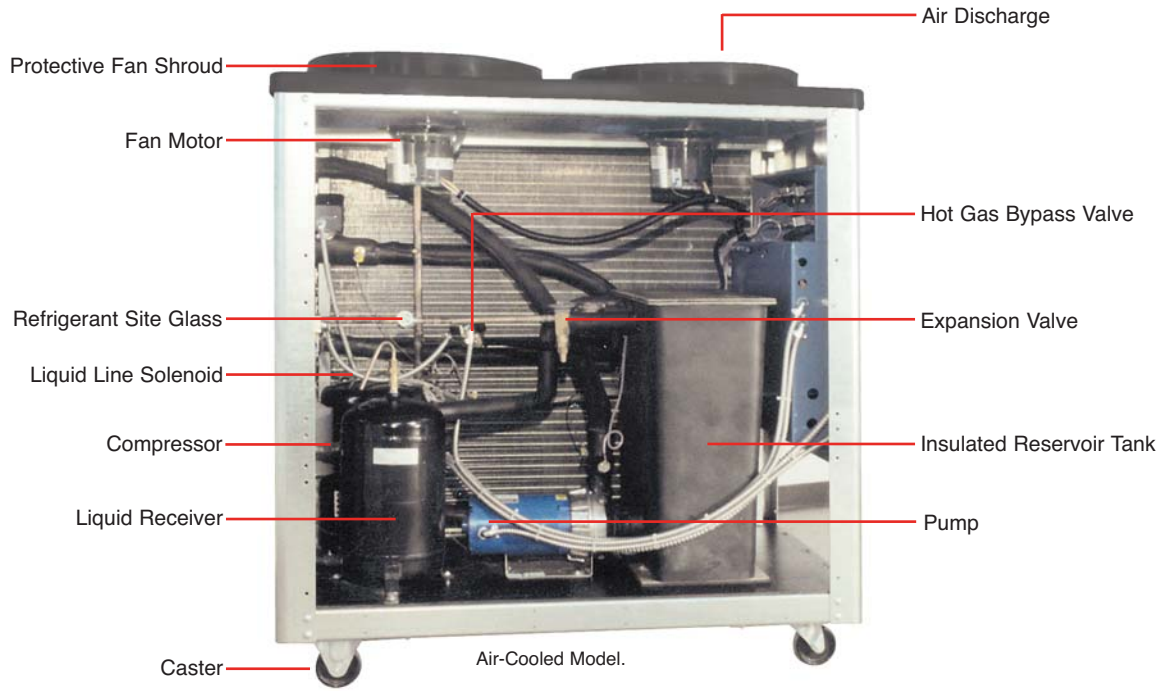
specialist be engaged to determine what water treatment is required.

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

1.8 COMPONENTS



Water-Cooled Model.



Air-Cooled Model.

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2.0 INSTALLATION

2.1 GENERAL
2.2 TO AND FROM PROCESS CONNECTIONS
2.3 WATER SUPPLY CONNECTION
2.4 AIR COOLED CONDENSER INSTALLATION
2.5 WATER-COOL CONDENSER INSTALLATION
2.6 ELECTRICAL CONNECTION

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.

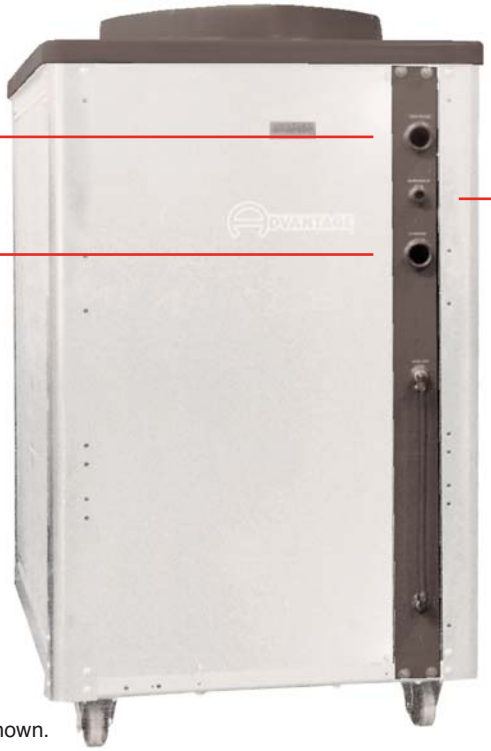
2.2 TO AND FROM PROCESS CONNECTIONS

A. Connect the **'TO PROCESS'** to the 'water in' manifold on the mold or process.

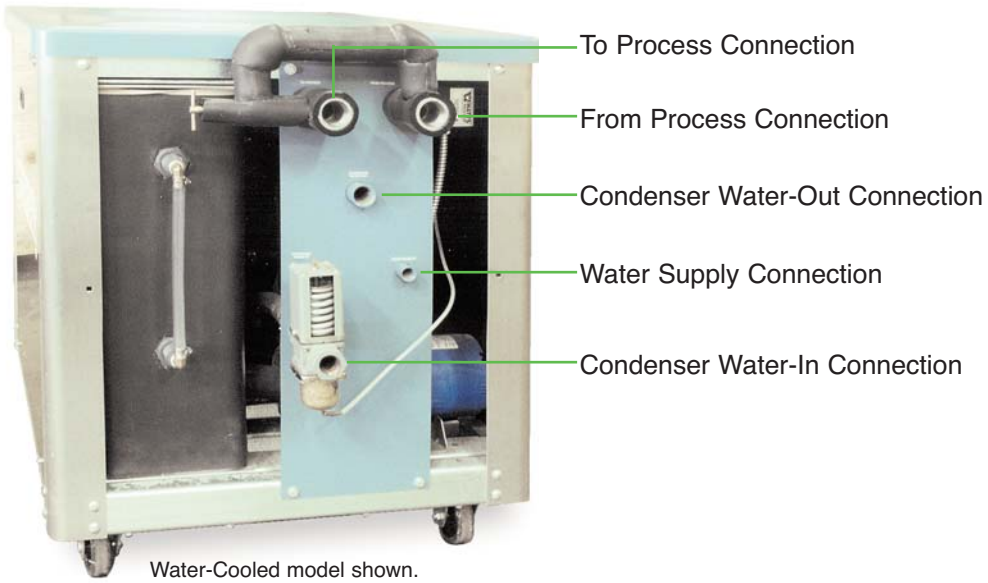
B. Connect the **'FROM PROCESS'** port to the 'water out' port on the process manifold.

C. Process water piping circuitry should be designed to avoid an excessive use of elbows and/or lengths of pipe or hose. If hose is the material of choice, avoid tight twists or curls and excessive lengths.

D. Valves and filters may be installed in the process water piping circuitry 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.



Air-cooled model shown.



Water-Cooled model shown.

2.3 WATER SUPPLY CONNECTION

A. The automatic water supply make-up system continually monitors the reservoir tank and fills it when needed. Connect as follows:

1. Connect the chiller's **'WATER SUPPLY'** port to the plant's city water source.

2. Minimum water supply pressure requirement is identified on the equipment data plate. This is normally 20 psi.

3. Be certain to use a water supply line equipped with a back flow prevention device to prevent contamination of potable water.

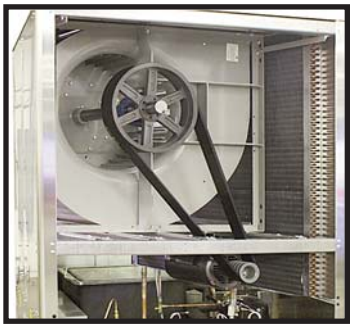
2.4 AIR COOLED CONDENSER

A. Air-cooled condensers require ambient air temperatures between 60°F and 95°F for efficient operation. Operating above above 95°F may result in elevated condensing pressures and eventual shut-down on the high pressure safety switch. In such cases, a water assist unit may be necessary for operations. Air temperatures below 60°F may result in below normal condensing pressures and poor condensing. In such cases, a low-ambient damper assembly is required. Check with the the Manufacturer's service department for more information on operating with ambients air temperatures above 95°F or below 60°F.

B. Air flow is generated by the motor mounted fans (figure 2.4A) or centrifugal blowers (figure 2.4B). Air flow is from the outside of the chiller, through the condenser and exhausted through the top of the unit. On centrifugal blowers models, exhaust air can be ducted outside of the plant's interior environment. Special duct work is required and a HVAC contractor should be consulted for sizing and material specifications. Exhaust air can not be ducted on motor mounted fan models.

Typical fan assembly Figure 2.4A

C. A free air space of at least two (2) feet is required at the condenser intake and six (6) feet at the condenser discharge to allow for proper air flow.



Typical blower assembly Figure 2.4B

D. At full load, the chiller will discharge approximately 15,000 BTU's per hour per ton of cooling.

E. On blower units, air discharge duct work should be sized by a qualified HVAC engineer. Sizing shall be according to rated CFM at the static pressure of .90 inches of water. See figure 2.4C at right.

CFM RATINGS

MODEL	*CFM*
15 TONS	15,000
20 TONS	20,000
25 TONS	25,000
30 TONS	30,000

Figure 2.4C

F. On blower units, a damper control assembly is required in low ambient temperature areas or when outdoor air make-up is used. The assembly works in conjunction with refrigerant head pressure to regulate air flow to maintain proper refrigerant head pressure when condenser intake air temperature will be less than 60°F. See figure 2.4D to the right.

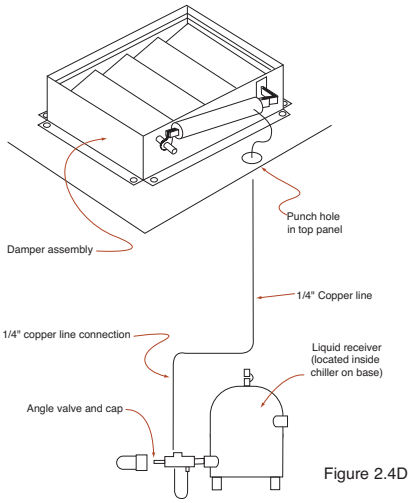


Figure 2.4D

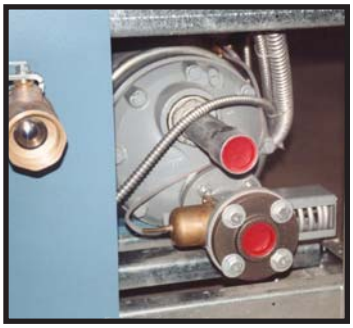
G. All air cooled units must have all enclosure panels in place before operating compressor. Air will not be drawn through the condenser coil if they are not in place. This will cause the compressor to lockout on the high pressure safety fault.

2.5 WATER-COOLED CONDENSER

A. Connect the '**CONDENSER WATER IN'** port to the plant's city water supply or tower system supply.

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.



Typical condenser connections - 30 ton unit Figure 2.5A

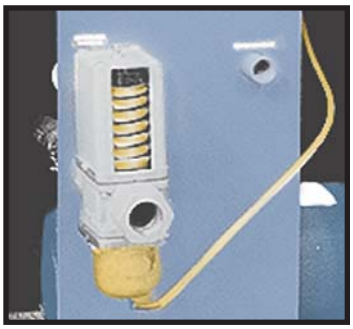
B. Connect the chiller's **'CONDENSER WATER OUT'** port to the plant's drain or tower system return.

1. **Note:** if dumping to the plant's open drain, drainage shall be done according to local codes.

C. The pressure differential requirement between the condenser "water in" and the condenser "water out" lines must be 30 psi for adequate efficiency.

D. The installation of a strainer in the condenser "water in" line is recommended. This removes solids from the water supply and serves to protect the water saver (regulator) valve.

E. The water saver (regulator) valve (figure 2.5B) is located in the condenser "water in" line. During winter months, or cold seasons, the valve will throttle the water flow through the condenser. The amount of flow is based on the refrigerant head pressure and the regulator will modulate the valve orifice to maintain 100° - 105°F condensing temperature for best efficiency*.



Typical Regulator Valve Figure 2.5B

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

2.5 ELECTRICAL CONNECTION

A. NEMA 1 MODELS

1. Electrical power supply requirements for Nema 1 units 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.

2. 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.

3. 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.

B. NEMA 12 MODELS

1. NEMA 12 units are constructed with a dust tight electrical enclosure and branch circuit fusing. Electrical power supply requirements are identified on the equipment data plate. Determine the plant's voltage supply is the same as the unit's voltage requirements.

WARNING: Do not connect the unit to a voltage supply source 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.

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

3. Supply a power conductor sized according to the unit's power supply requirements. Connect the power conductor to the unit's power supply entry terminal block or the fused disconnect switch. Some Nema 12 models may be supplied with an optional disconnect switch. The owner supplied fused disconnecting means shall be sized and installed according to the unit's power supply requirements and local electrical codes.

C. CONTROL CIRCUIT WIRING

1. 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.

D. 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.

E. INFORMATION REGARDING 'PHASING' OF SCROLL COMPRESSORS

1. All portable chillers that have pumps, the compressor(s) will be set in phase with the pump during the testing process at the factory.

2. After installation the phase status must be checked by observing the pump motor shaft on the end of the pump and comparing its rotation to the directional arrow on the motor. In either case, if the phase needs to be altered, it should be done at the main power entry.

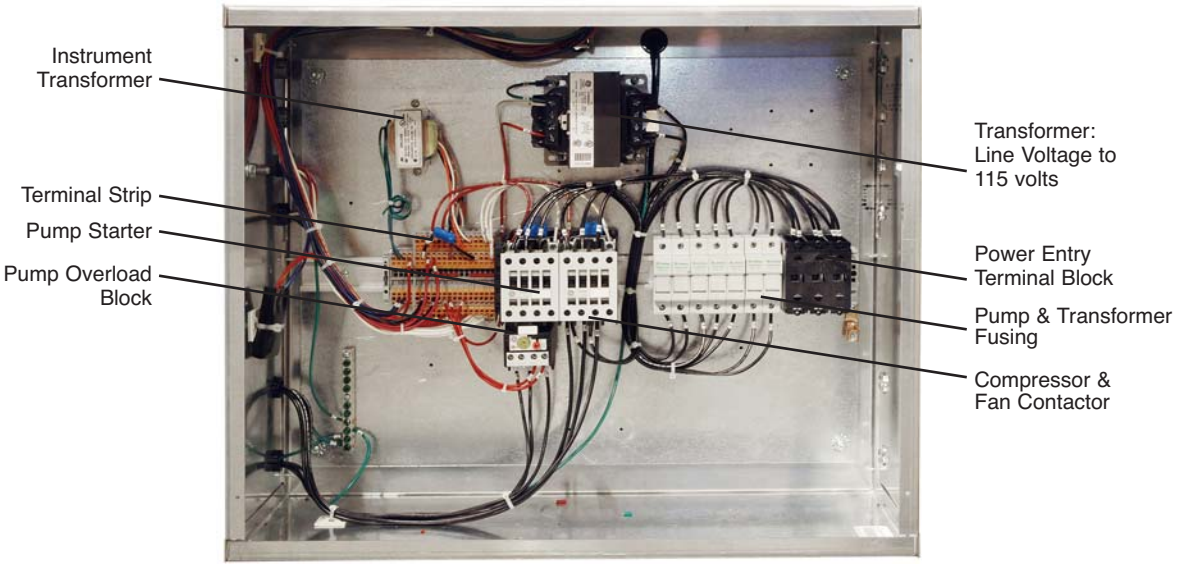


Figure 2.5A Typical electrical panel

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3.0 OPERATIONS

3.1 GENERAL
3.2 START UP/OPERATIONS PROCEDURE
3.3 INSTRUMENT
3.4 SHUT DOWN

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. **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.

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

3.2 **Start up/operations** - follow this segment to start the unit after the initial install to the process system or to restart the unit after reinstallation to the same or different process system. This section includes information on system fill, electric motor phasing (pump 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.

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

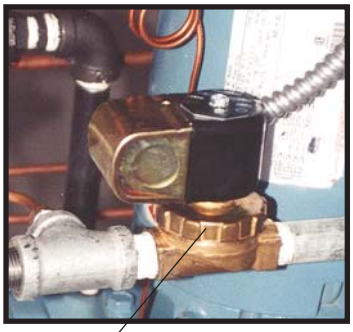
3.2 START UP / OPERATION PROCEDURE

A. SYSTEM FILL

1. The unit has an internal reservoir which must be filled and maintained for proper operation. The unit has a level switch mounted at the proper water level in the reservoir.

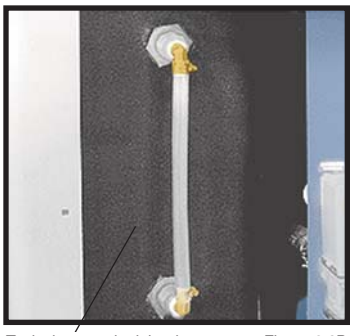
2. **WATER QUALITY CONTROL.** Lack of, as well as, improper water treatment can damage the chilling unit. The services of competent water treatment specialist should be obtained and their recommendations followed. It is the equipment owner's responsibility to prevent damage from foreign material or inadequate water treatment. See water treatment section in **section 8** of this manual for more information.

3. **FOR OPTIONAL AUTOMATIC FILL**: engage the water supply to unit. The level switch will activate the make-up solenoid (figure 3.2A), which will open and the water supply will fill the reservoir tank.



Make-up solenoid valve Figure 3.2A

4. **MANUAL FILL:** disconnect the electrical power supply and remove all necessary cover panels to access the reservoir. Add fluid directly to the reservoir. When the pump is first started, as process lines are filled and air is purged, additional fluid may be required to restore the reservoir to the correct level. Verify reservoir level via the coolant sight glass (figure 3.2B).



Typical reservoir sight glass Figure 3.2B

B. ELECTRIC MOTOR PHASING (PUMP ROTATION)

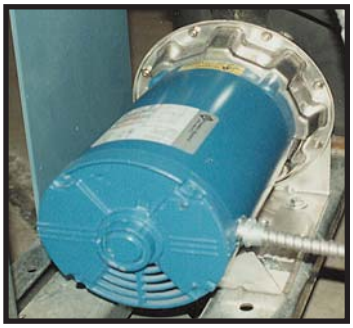
1. The operator must determine the unit is phased correctly by visually inspecting the rotation of the pump motor shaft. The procedure is outlined below. Incorrect phasing results in poor operation and eventual damage to the unit.

a. Supply electrical power to the unit. Once the correct voltage is supplied to the unit, the POWER switch on the unit's control panel will illuminate. Adjust the

setpoint to 70°F to prevent the compressor from activating during this procedure.

b. Remove all necessary cover panels to access the pump motor. **Note that the electrical power is engaged at this point and caution must be observed while the electrical supply is engaged and cabinet panels are removed and opened.**

c. Locate the electric motor (figure 3.2C). The electric motor can be identified when the electrical panel cover is open. The operator must identify the motor shaft inside the electric motor housing. The motor shaft can be seen through the vent slots in the motor housing or by removing the shaft cover.



Electric motor Figure 3.2C

d. Toggle the pump motor. This will quickly cycle the pump motor “on” and then “off”.

e. Observe the motor shaft. When the ON/OFF SWITCH is on, the motor shaft will rotate. When switched off, the shaft will slowly “coast” to a stop. As the shaft slows, the operator can identify the rotation of the motor shaft. Correct rotation (correct phase) is “clockwise”, when viewed from the rear of the motor. Incorrect rotation is “counter-clockwise” (incorrect phase) when viewed from the rear of the motor. If the shaft does not rotate when the ON/OFF SWITCH is on, the operator must identify the cause as outlined in the troubleshooting and repair section of this manual.

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

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

a. Disengage the electrical power supply to the unit at the unit’s disconnect switch. Follow proper lockout procedures before proceeding.

b. Once the electrical power supply is disengaged,

reverse any two power leads of the power cord at the disconnect terminals.

c. **Note:** reversing any two power leads of the power cord will correctly phase the power supply to the unit. **The operator must reverse the power leads at the disconnect switch only and *not* at the power entry terminals on the unit's electrical panel.** The unit's internal electrical system wiring is phased correctly at the factory and must not be altered in the field.

C. PROCESS FLOW ADJUSTMENTS

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

a. Water flow rate through the process is determined by the pressure losses in the process loop. Generally, higher flow rates result in turbulent flow achieving maximum temperature control and lower maintenance. Since the evaporator in most liquid chillers is flow sensitive, the efficiency of operation is directly related to the flow of liquid.

b. Maximum chiller efficiency is obtained at approximately 2.4 gpm per ton of rated capacity. Low liquid flow can reduce efficiency and in some cases allow ice to develop in the evaporator which can damage the evaporator. Excessive liquid flow will trip the motor overload protection circuit.

2. Switch on the illuminated ON/OFF SWITCH to activate the process pump. Wait a few moments to allow air to be purge from system. Observe the COOLANT pressure gauge for steady readout. Two items the operator for look for are *low flow* or *excessive flow* conditions.

3. ***LOW FLOW:*** If a low flow condition is present, be sure all process valves are open. If all process valves are open and a low flow conditions exists, consider the following:

a. To operate under a low flow condition, it is necessary to install a flow bypass system in the process circuitry. This will allow a portion of the flow to bypass the process and return directly to the chiller. This keeps the total flow above the cutoff point. Figure 3.2E illustrates a typical bypass loop.

b. Some models may have a factory installed bypass. Adjust the valve accordingly.

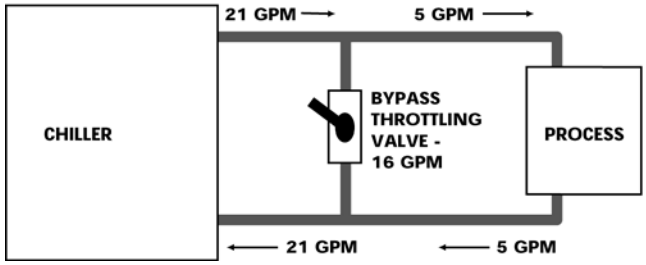
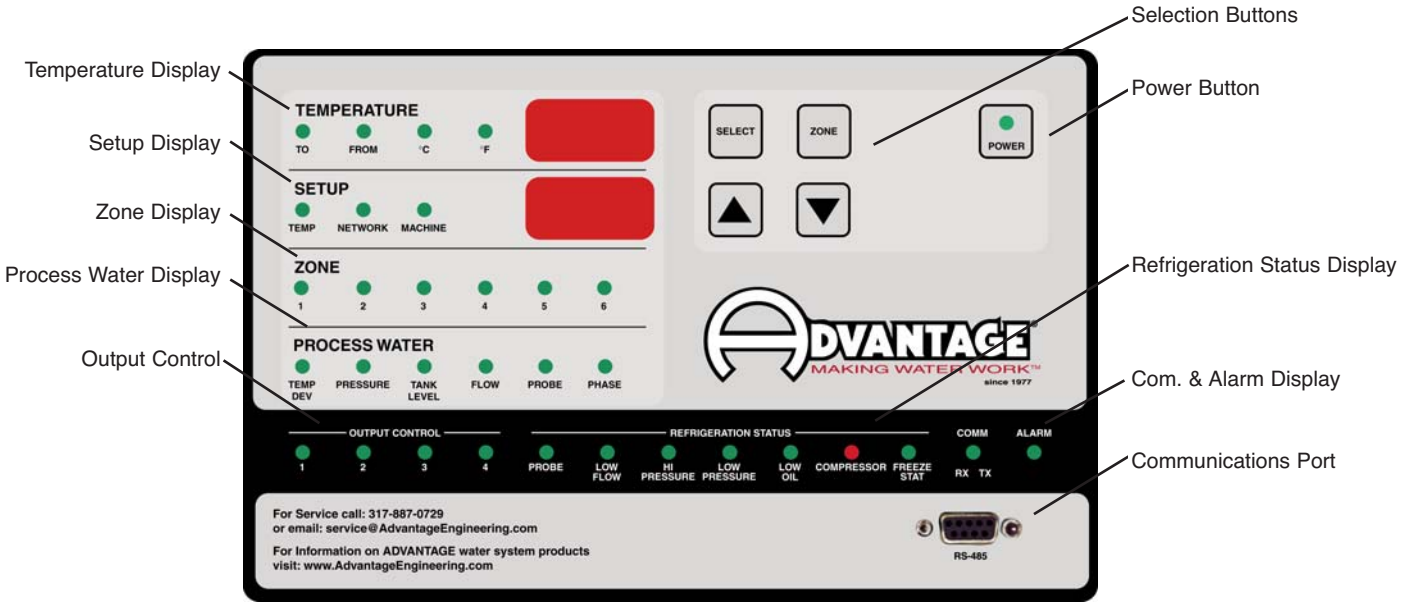


Figure 3.2E Typical low flow by-pass loop

3.3 INSTRUMENT OPERATION



Miltizone Control Instrument

Figure 3.3A

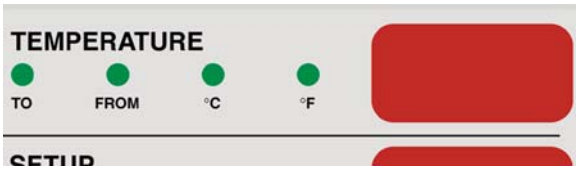
A. GENERAL

1. The operator interface is mounted (in most cases) on the electrical cabinet door.

2. The MZC (multi-zone controller) instrument is mounted inside the electrical cabinet. The MZC controller and its operation are detailed in section 3.13.

3. This section covers the operation of the operator control panel.

B. Temperature Display



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

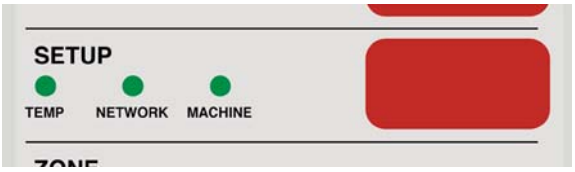
2. **TO:** illuminates when the **TO PROCESS** water temperature is displayed. **TO** is the default setting of the **TEMPERATURE DISPLAY** window.

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:

STANDARD DISPLAY MODE:

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-2, 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.

4. **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.

5. **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.

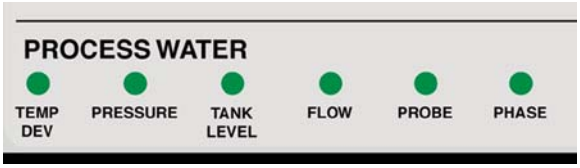
b. **Prb:** contact factory for details.

D. ZONE DISPLAY

1. The LED's in this section indicate which ZONE is selected for viewing. The status for the selected Zone is displayed in the 'OUTPUT CONTROL' and 'REFRIGERATION STATUS' sections.

2. 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.

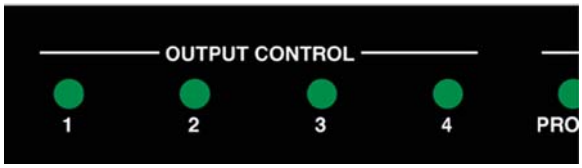
c. **SOLID RED:** one of the probes had a fault, but the fault is no longer present.

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".

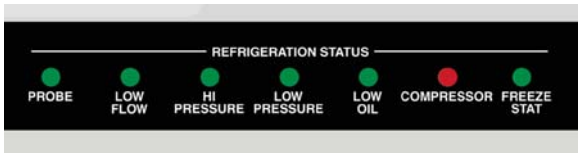
2. **COMPRESSOR:** illuminates when the compressor has cycled on.

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

component is located elsewhere in this manual. For each component:

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.

2. **PROBE:** indicates the status of the zone evaporator temperature probes.

3. **LOW FLOW:** indicates the status of the zone 'low flow' switch.

4. **HI PRESSURE:** indicates the status of the refrigerant 'high pressure' safety switch.

5. **LOW PRESSURE:** indicates the status of the refrigerant 'low pressure' safety switch.

6. **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.

7. **COMPRESSOR:** indicates the status of the zone compressor motor overload relay.

8. **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.

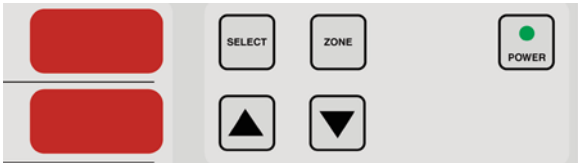
b. **FLASHING YELLOW:** indicates the host computer is sending information to the controller.

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.

Zone parameter sequence.

TEMPERATURE DISPLAY	SETPOINT DISPLAY
Eix	Evapin Temp
Eox	EvapOut Temp
CFx	Configuration (0 - F)
SPx	Backup Setpoint (10 - 90)
LPx	Low Pressure time Delay (10 - 120 sec)

Note: 'x' represents the displayed zone number. The display will revert back to the NORMAL display after approximately 10 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 Dela 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.

3.4 MZCIII 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. 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

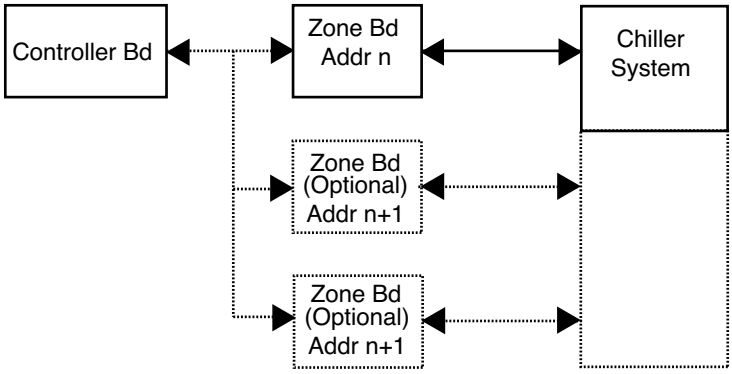
D. INTERFACE SECTION

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

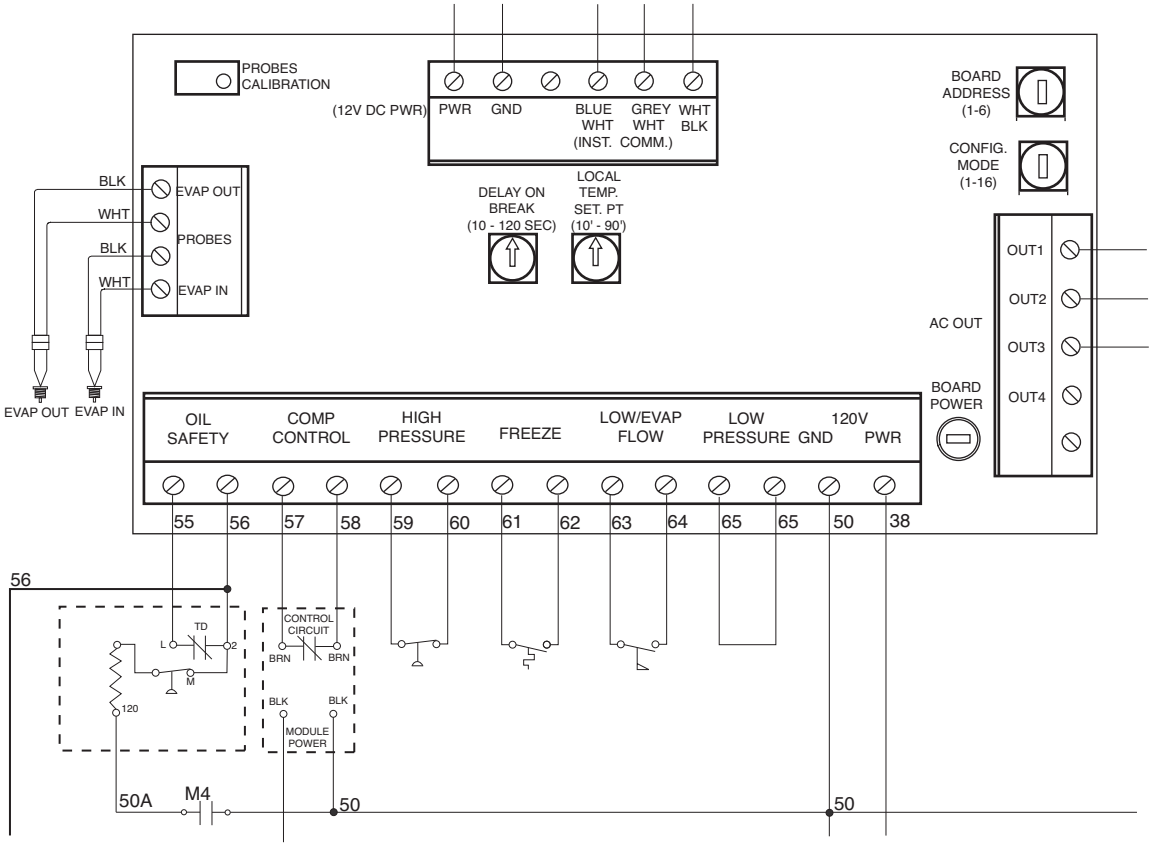
5. **EVAPORATOR TEMPERATURE PROBE INPUT CONNECTOR**

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.



3.4 PRESSURE GAUGES

A. PROCESS PRESSURE GAUGE: indicates process pump pressure.

B. REFRIGERANT HEAD PRESSURE GAUGE: indicates refrigerant pressure on the discharge side of the compressor. The refrigerant head pressure is also the condensing pressure which is critical to equipment efficiency. Head pressure on water condensed units will vary with ambient temperatures between 190-290 psig.

C. LOW PRESSURE GAUGE: indicates refrigerant pressure on the suction side of the compressor. This pressure will fluctuate with the process temperature.

3.5 SHUT DOWN/DISCONNECT SEQUENCE

A. PRECAUTIONS/WARNINGS

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

B. UNIT SHUT DOWN

1. To shut down the unit without disconnecting from the process:

a. Move the ON / OFF switch to the off position.

b. Maintain electrical power to the unit at all times except for service purposes.

2. To shut down the unit and disconnect from the process:

a. Move the ON / OFF switch to the off position.

b. Disengage the electrical supply to the chiller at the disconnecting device.

c. Disconnect all process lines.

4.0 TROUBLESHOOTING

4.1 UNIT WILL NOT START
4.2 COMPRESSOR HUMS BUT WILL NOT START
4.3 SHUTS OFF ON HIGH PRESSURE
4.4 SHUTS OFF ON LOW PRESSURE
4.5 COMPRESSOR SHUTS OFF ON INTERNAL OVERLOAD
4.6 LOW OR NO PROCESS PRESSURE OR WATER FLOW
4.7 COOLING CAPACITY INADEQUATE
4.8 SENSOR
4.9 PUMPS
4.10 CRANKCASE HEATER
4.11 CHILLER CONTROLLER

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 from minimum of 190 psi to as high as 280 psi. The high pressure switch manually resets 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 condenser filter for dirt, fins may be plugged with dirt or foreign material. Also, check for proper fan rotation.

Note: all enclosure panels must be in place while the unit is operating.

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:**

1. **Water regulator valve.** Adjust condenser water regulator valve to maintain 100°F to 105°F refrigerant condensing

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

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 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 will automatically resets when the pressure rises above the cut-in pressure. If this does not occur contact the the 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°F - 39°F*. If a low pressure condition exists for more than five seconds the compressor will stop and a “L-P” fault will appear in the display window.

After the refrigerant pressure rises above the cut-in pressure, a three minute time delay will occur before the compressor restarts. This protects 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. Check that entering air temperature is above 60°F. If below 60°F, find out reason why and correct.

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 - 105°F refrigerant condensing temperature*. Have a 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

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 CRANKCASE HEATER

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.

4.11 CHILLER CONTROLLER

A. The display is used for all normal set ups, diagnostics, temperature readout and operational information. **Note:** the display is not field repairable. It can be easily removed and replaced if required.

B. The CPU contains the software and various electronic components which makeup the instrument. **Note:** the CPU is not a field repairable part. It can be easily removed and replaced if a problem arises.

5.0 MAINTENANCE

5.1 WARRANTY SERVICE PROCEDURE
5.2 PERIODIC PREVENTATIVE MAINTENANCE
5.3 SPECIAL MAINTENANCE
5.4 SOLENOID VALVE SERVICE
5.5 PUMP SEAL SERVICE
5.6 CHECKING THE REFRIGERANT CHARGE
5.7 PROPER CLEANING PROCEDURE FOR BRAZED PLATE EVAPORATOR

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.

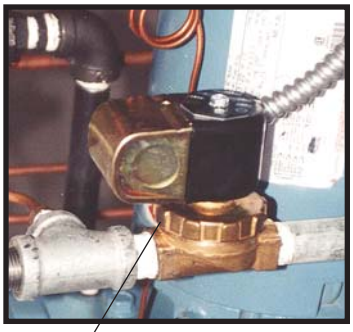
4. Adjustment of super heat.

5. Changing of filter-drier or drier core.

6. Repair of a refrigeration solenoid.

5.4 SOLENOID VALVE SERVICE

A. Units with the water make-up system use a solenoid valve (figure 5.4A) to regulate flow into the reservoir tank. The solenoid valve is controlled by the float switch.



Typical water make-up solenoid valve

Figure 5.4A

B. Generally, solenoid valves fail due to poor water quality, low water flow, or defective valve elements.

C. The operator should follow this procedure to service the make-up solenoid valve:

1. Disengage process operations according to the procedure outlined in **section 3.4**. The operator must be certain process fluid temperature is under 100°F and pressure is relieved (pressure gauge reads “0”) and water system flow is shut off and all pressure relieved.

2. Disengage main power supply. The operator must verify the proper lockout procedures are followed.

3. Remove or open any access cover panel and set aside to gain access to the cooling solenoid valve.

4. The operator must be certain all water system pressure is relieved.

5. Identify the retaining screw (figure 5.4B) on the solenoid valve coil. Remove the screw. Keeping all electrical connections intact, lift the coil off of the enclosure tube and set aside.

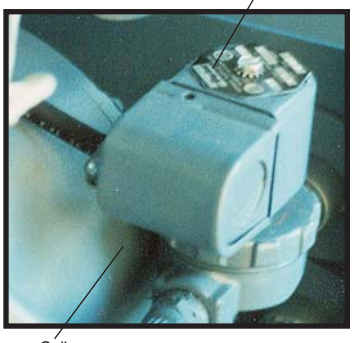


Figure 5.4B

6. Use a pair of channel lock pliers or a pipe wrench to separate the bonnet assembly from the valve body. The plunger is “loose” inside the enclosing tube. Be certain it is retained in the enclosure tube as the bonnet is removed (figure 5.4C).

7. Identify the diaphragm assembly. Gently remove the assembly from the valve body (figure 5.4D).

8. Identify the mesh screen. Gently removed the mesh screen and clean or replace as necessary.

9. Clean the valve body.

10. Reset the mesh screen into the valve body.

11. If a new diaphragm assembly was obtained, continue with step 12. If not, disassemble the diaphragm assembly and note component order (figure 5.4E). Clean the valve port, plate, collar and O-ring. Once cleaned, reassemble the diaphragm.

12. Set the reassembled diaphragm assembly or the new assembly back into the valve body. The stem should be facing out of the valve body.

13. Inset the plunger with spring first into the enclosing tube of the top bonnet (figure 5.4F). Holding the plunger in the enclosure tube, set the top bonnet onto the valve body and tighten.

14. Place the coil onto the top bonnet and replace the retaining screw.

15. Open the water supply and drain valves (if installed) to circulate water through the supply and drain manifolds. Check the solenoid valve for leakage. Restart the unit as outlined in **section 3.**

Figure 5.4C

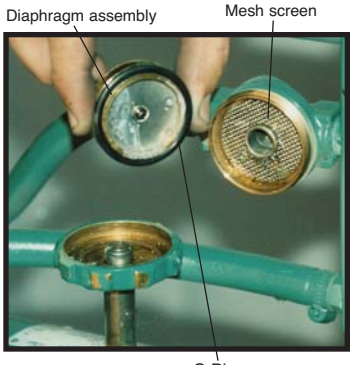


Figure 5.4D

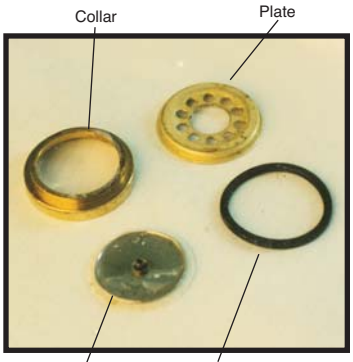


Figure 5.4E

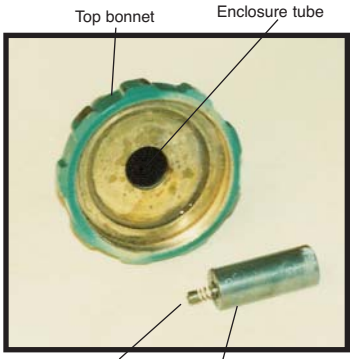


Figure 5.4F

5.5 PUMP SEAL SERVICE

A. The coolant pump seal is a carbon/niresist shaft seal assembly including a stationary member, rotating member and tension spring (figure 5.5A).

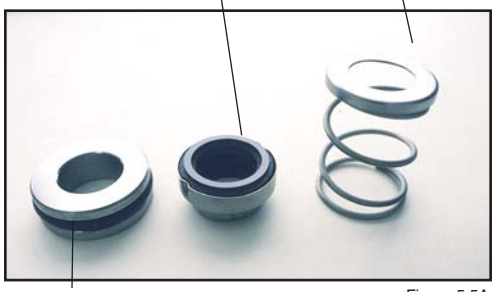


Figure 5.5A

B. The operator can determine the pump seal is leaking when fluid is identified leaking from the pump case adapter. Generally, a pump seal will leak due to inadequate unit pressure, excessive flow and poor fluid quality.

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

1. Disengage process operations according to the procedure outlined in **section 3.4**. The operator must be certain process fluid temperature is under 100°F and pressure is relieved (COOLANT pressure gauge reads “0”) and water make-up flow is shut off and all pressure relieved.

2. Disengage main power supply. The operator must verify the proper lockout procedures are followed.

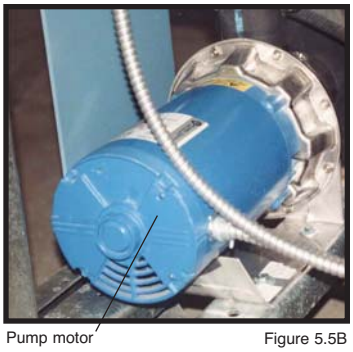


Figure 5.5B

3. Access the pump motor by opening or removing any cover panels as necessary (figure 5.5B).

4. Drain machine. The machine can be drained by using the drain valve located on the pump case. Drain fluid into a suitable container for reuse or disposal according to manufacturer’s instructions (if a glycol solution is used).

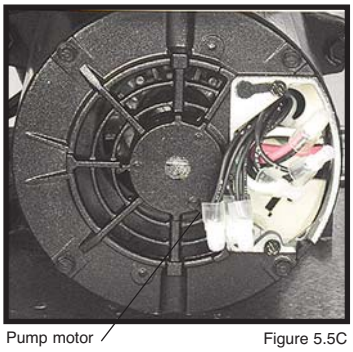


Figure 5.5C

5. Locate and remove the three motor wire leads from the motor wiring terminals. The operator should “map”

the wire terminal locations to ensure correct rewiring. The power cord should be removed from the motor housing (figure 5.5C).

6. Locate and remove the pump casing bolts. These bolts secure the motor and motor adapter to the pump casing (figure 5.5D).

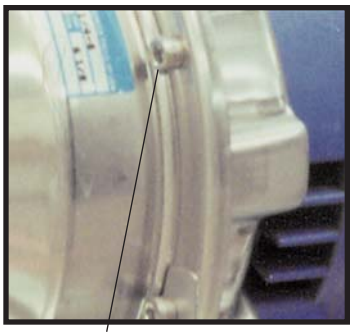


Figure 5.5D

7. Separate the motor and motor adapter from the pump casing to expose the pump impeller (figure 5.5E). Remove the motor and motor adapter from the unit and place on a workbench to continue the procedure.

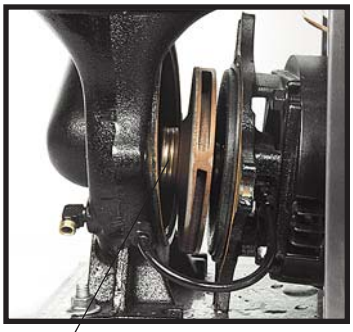


Figure 5.5E

8. Locate and remove the dust cap from motor end to expose slotted motor shaft. The motor shaft is free to rotate, but must be secured to remove the impeller. To secure the motor shaft, insert a flat bladed screw driver in slot to hold the shaft stationary (Figure 5.5F).

Figure 5.5F

9. Locate and remove impeller locking screw (Figure 5.5G). Using a socket and ratchet, the impeller retaining screw can be removed. Once the retaining screw is removed, the impeller can be “unthreaded” from the motor shaft to expose the pump seal assembly.

10. Remove all seal parts (Figure 5.5H). Note seal component arrangement to facilitate reassembly.

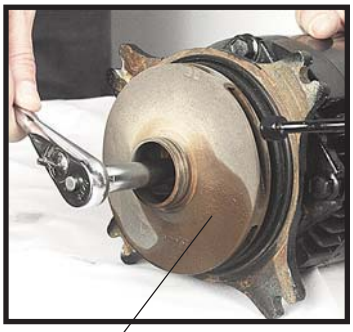


Figure 5.5G

11. Clean motor shaft and lubricate with a mild soap solution.

12. Install new stationary seal member in pump casing cavity (figure 5.5I). The operator must be certain the stationary seal member is fully squared and seated in cavity.

Figure 5.5H

13. Slide the rotating member onto lubricated pump shaft (figure 5.5J). The operator must be certain not to damage or tear rubber bellows assembly.

14. Place the spring onto the rotating member.

Figure 5.5I

15. Align the impeller, spring and rotating member before reinstalling the impeller (figure 5.5K). The operator must be certain the spring and rotating member are aligned before the impeller is fully tighten and the impeller retaining screw is reinstalled.

16. Clean pump casing, cavities, impeller and O-ring before reassembly.

Figure 5.5J

17. Mate the motor and motor adapter to the pump casing. Reinstall the pump casing bolts.

18. Reconnect the motor power cord and leads.

19. Restore all cover panels as were removed.

Figure 5.5K

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

5.6 CHECKING THE REFRIGERANT CHARGE

A. All standard chillers are manufactured with thermostatic expansion valves as the metering device to the evaporator.

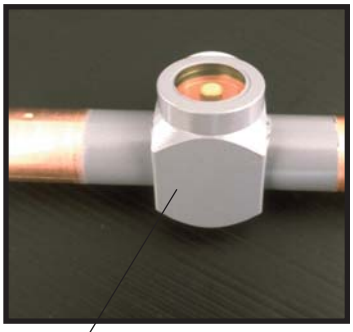


Figure 5.6A

B. All standard chillers have a refrigerant sight glass (figure 5.6A) with a moisture indicator. To check the refrigerant charge under normal operating conditions:

1. Remove the plastic cap covering the sight glass.

2. Start the chiller and allow system pressures and temperatures to stabilize.

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

4. The “dot” in the middle of the sight glass is the moisture indicator. It should appear green at all times. A white or yellow color indicates moisture has invaded the refrigeration system, which is detrimental to the life of the compressor. The filter-drier should be replaced by a qualified refrigeration technician.

5.7 PROPER CLEANING PROCEDURE FOR BRAZED PLATE EVAPORATORS

A. The brazed plate evaporator is made of stamped stainless steel plates, furnace brazed together with copper based joints. The complex geometry of the flow passages promotes turbulent flow which gives high efficiency and reduces fouling by mineral deposits. Large solids such as plastic pellets or chunks of mineral deposits will collect at the water inlet port at the evaporator and restrict flow through some of the passages. If this possibility exists, the Manufacturer recommends filters or strainers be added to the “from process” line. If the evaporator becomes fouled there are a couple of methods for

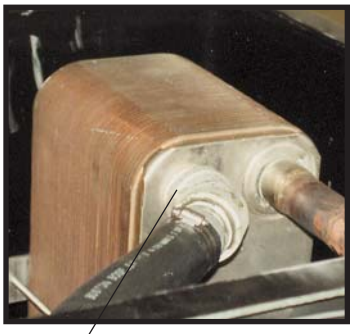


Figure 5.6A

cleaning.

B. To begin, remove the piping to the “water in” port at the evaporator. Remove any solids that have collected at this point. Then back flush the evaporator to remove any solids that may be trapped between the plates (see back flush procedure below). If there are mineral deposits adhered to the plates, the evaporator must be back flushed with a mild acid solution (5% phosphoric or 5% oxalic acid is recommended.) After cleaning rinse with clear water before returning to service. Continue with step C on the next page.

C. Back flushing procedure:

1. Turn off all power to the machine. For chillers with a reservoir tank, drain the tank to below the evaporator outlet. For chillers without a reservoir tank, drain total unit.

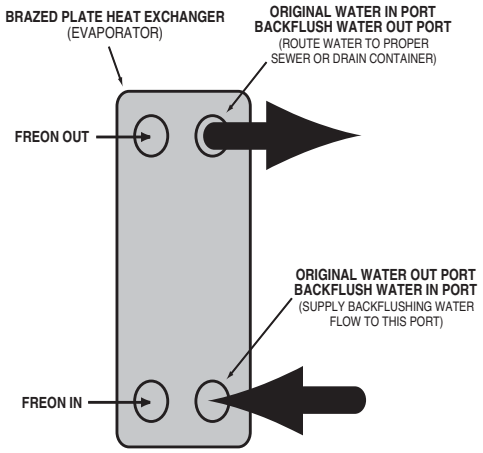
2. Connect a water supply hose to the evaporator water outlet. If acid cleaning, connect the discharge hose from the acid pump to the evaporator outlet port.

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



6.0 COMPONENTS

6.1 WATER SYSTEM

6.2 REFRIGERATION SYSTEM

6.1 WATER SYSTEM

A. MOTOR/PUMP ASSEMBLY: the motor/pump assembly circulates chilled fluid to the process loop. The pump assembly is built of total stainless steel to maintain water quality (figure 6.1A).

Figure 6.1A

6.2 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 (figure 6.2A).

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 or centrifugal blower (figure 6.2B).

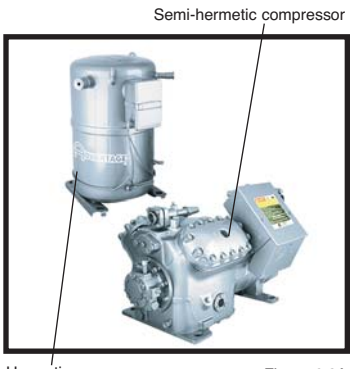


Figure 6.2A

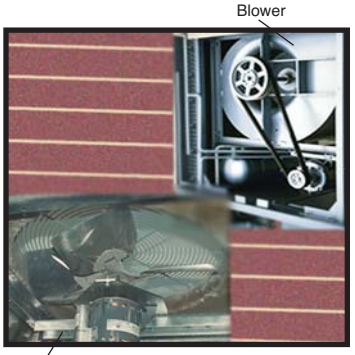


Figure 6.2B

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

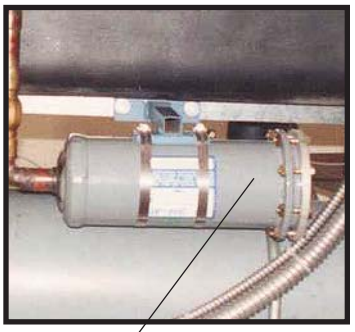
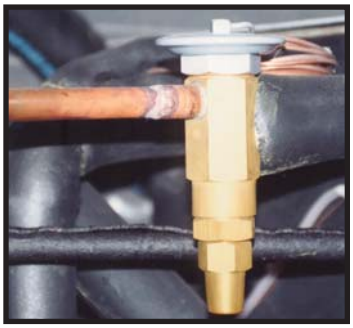


Figure 6.2C

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 (figure 6.2D).

Refrigerant sight glass Figure 6.2D

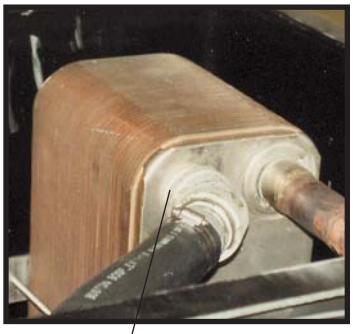
F. **EXPANSION VALVE:** the expansion valve throttles flow of refrigerant liquid into the evaporator and creates a pressure drop in the refrigerant system that allows the liquid refrigerant to “boil off” inside the evaporator (figure 6.2E).



Expansion Valve Figure 6.2E

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 (figure 6.2F).

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.



Typical hot gas bypass valve Figure 6.2H

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.) 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.

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

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 condenser, this component receives and stores liquid refrigerant leaving the condenser.

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

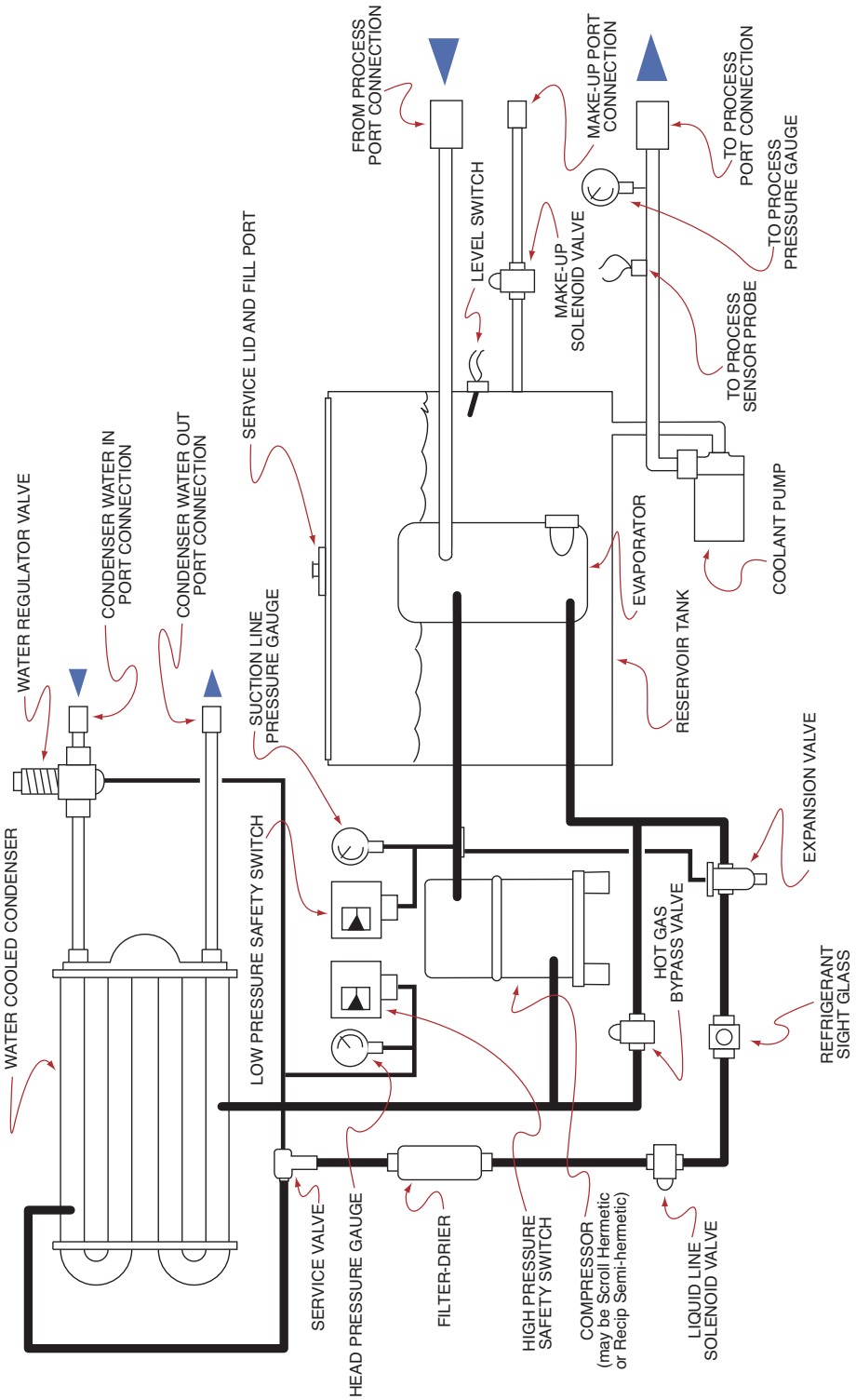
L. **Crankcase heater:** insures that freon and compressor crankcase oil do not mix during the compressor's "off" cycles. Power must be applied to the chiller previous to startup.

M. **Oil pressure safety switch:** protects the compressor from lubrication failure.

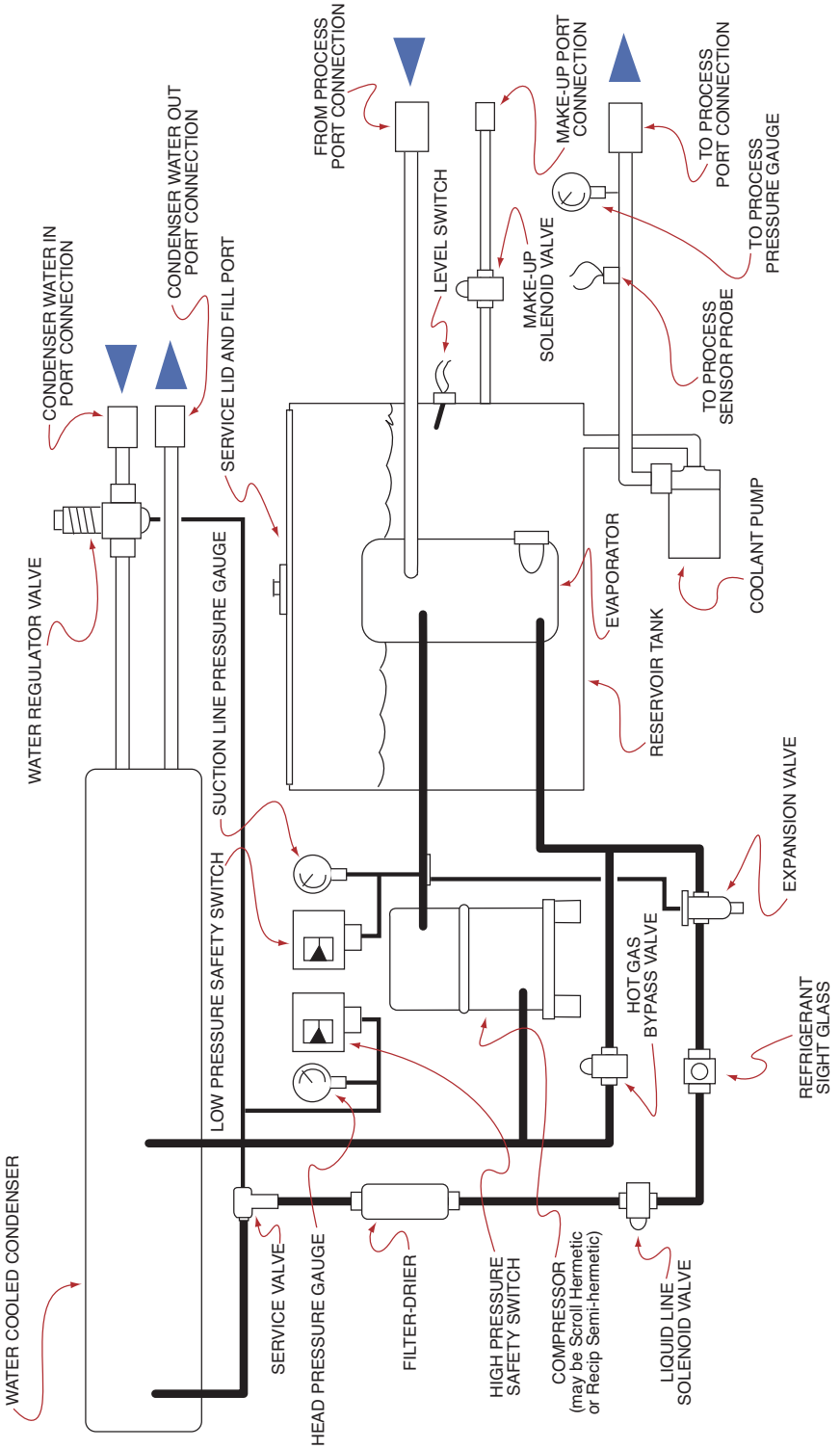
7.0 RELATED DRAWINGS

7.1 MECHANICAL SCHEMATIC : WATER-COOLED : 5 - 10 TONS
7.2 MECHANICAL SCHEMATIC : WATER-COOLED : 15 - 40 TONS
7.3 MECHANICAL SCHEMATIC : AIR-COOLED : 5 - 10 TONS
7.4 MECHANICAL SCHEMATIC : AIR-COOLED : 15 - 30 TONS
7.5 TYPICAL ELECTRICAL : AIR-COOLED
7.6 TYPICAL ELECTRICAL : WATER-COOLED
7.7 PHYSICAL SCHEMATIC : AIR-COOLED : 7.5 - 10 TONS
7.8 PHYSICAL SCHEMATIC : AIR-COOLED : 5 TONS
7.9 PHYSICAL SCHEMATIC : WATER - COOLED :
7.10 DUCT SCHEMATIC FOR AIR-COOLED CHILLERS

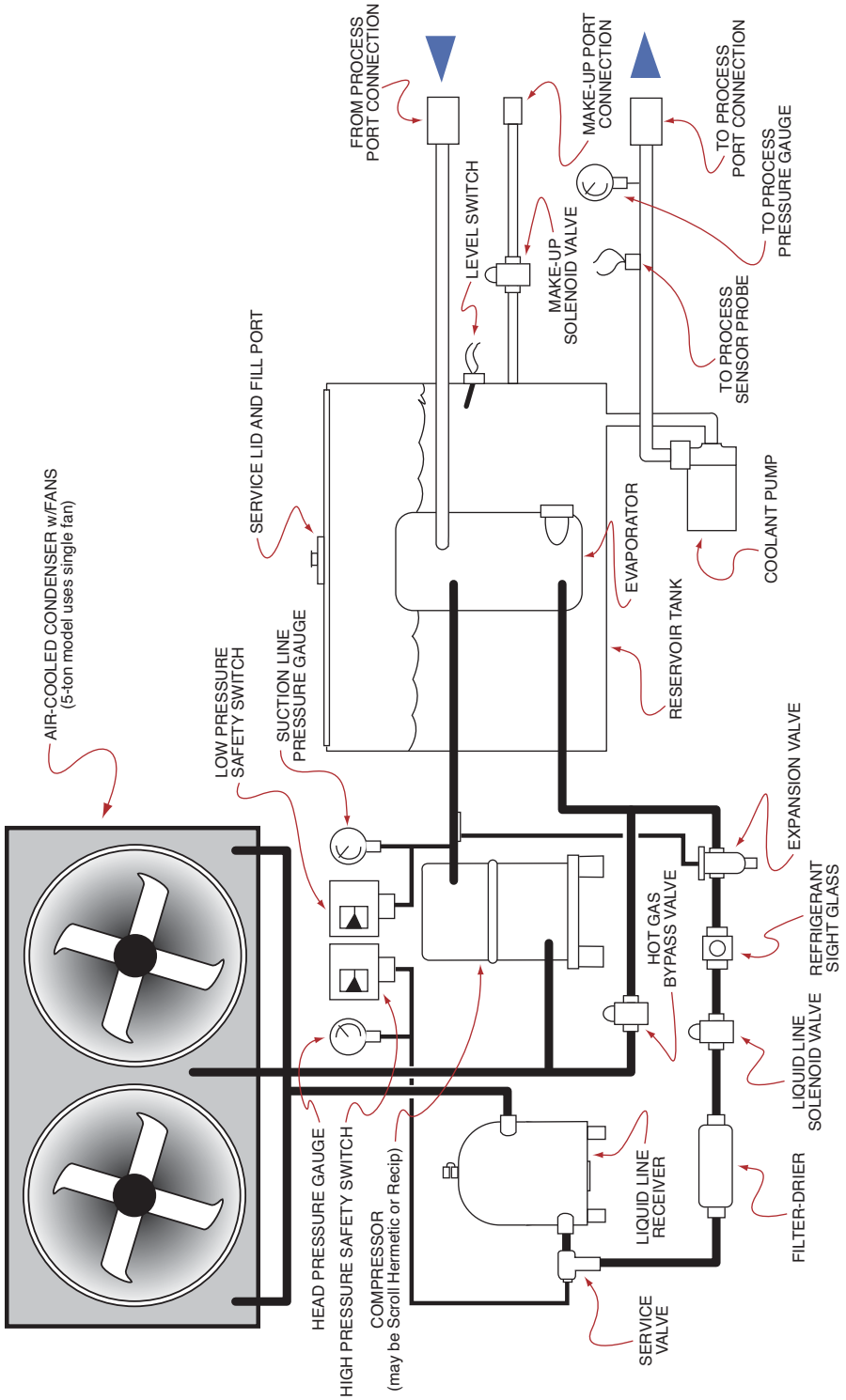
7.1 MECHANICAL SCHEMATIC : WATER-COOLED : 5 - 10 TON MODELS



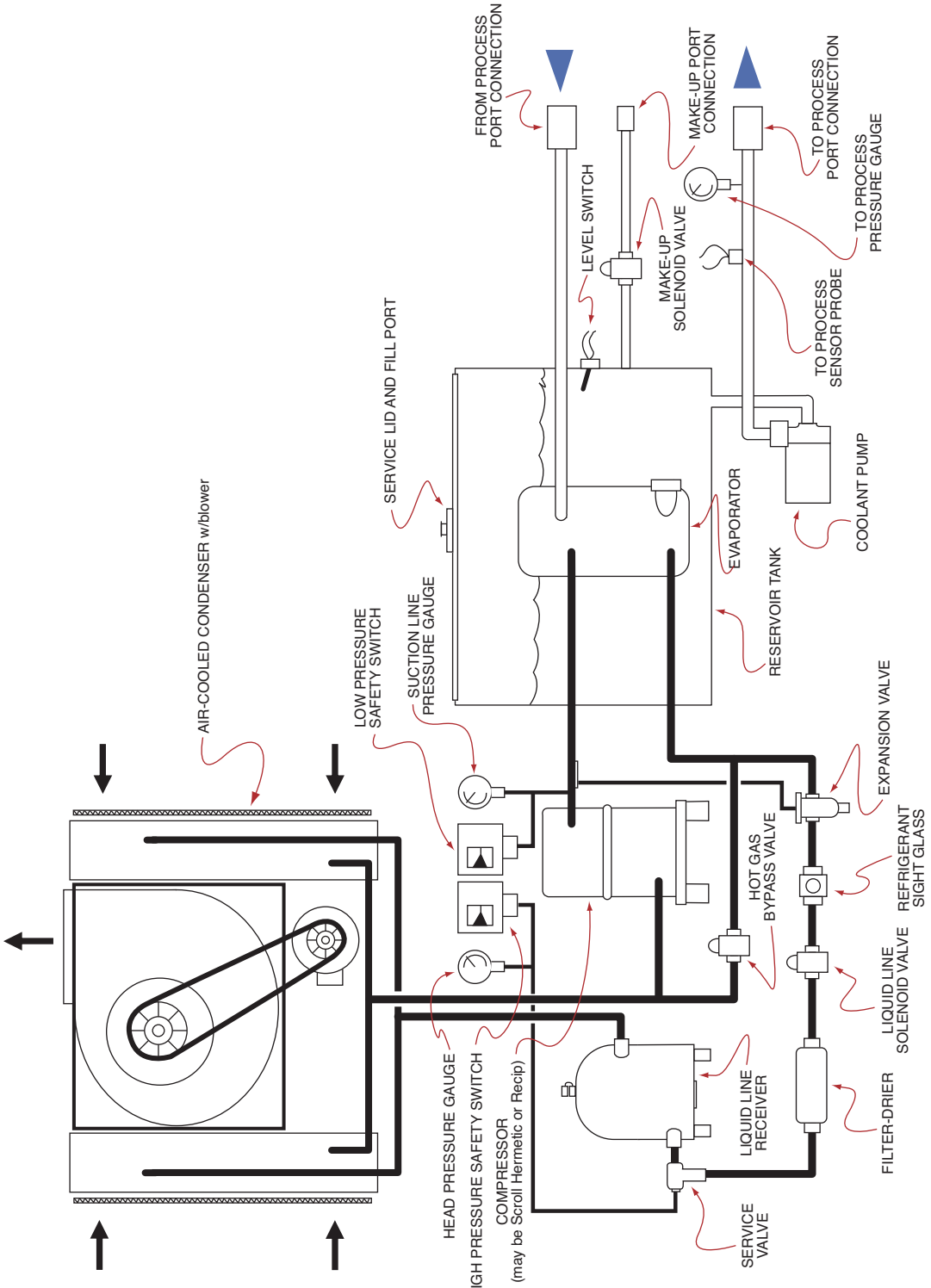
7.2 MECHANICAL SCHEMATIC : WATER-COOLED : 15 - 40 TON MODELS



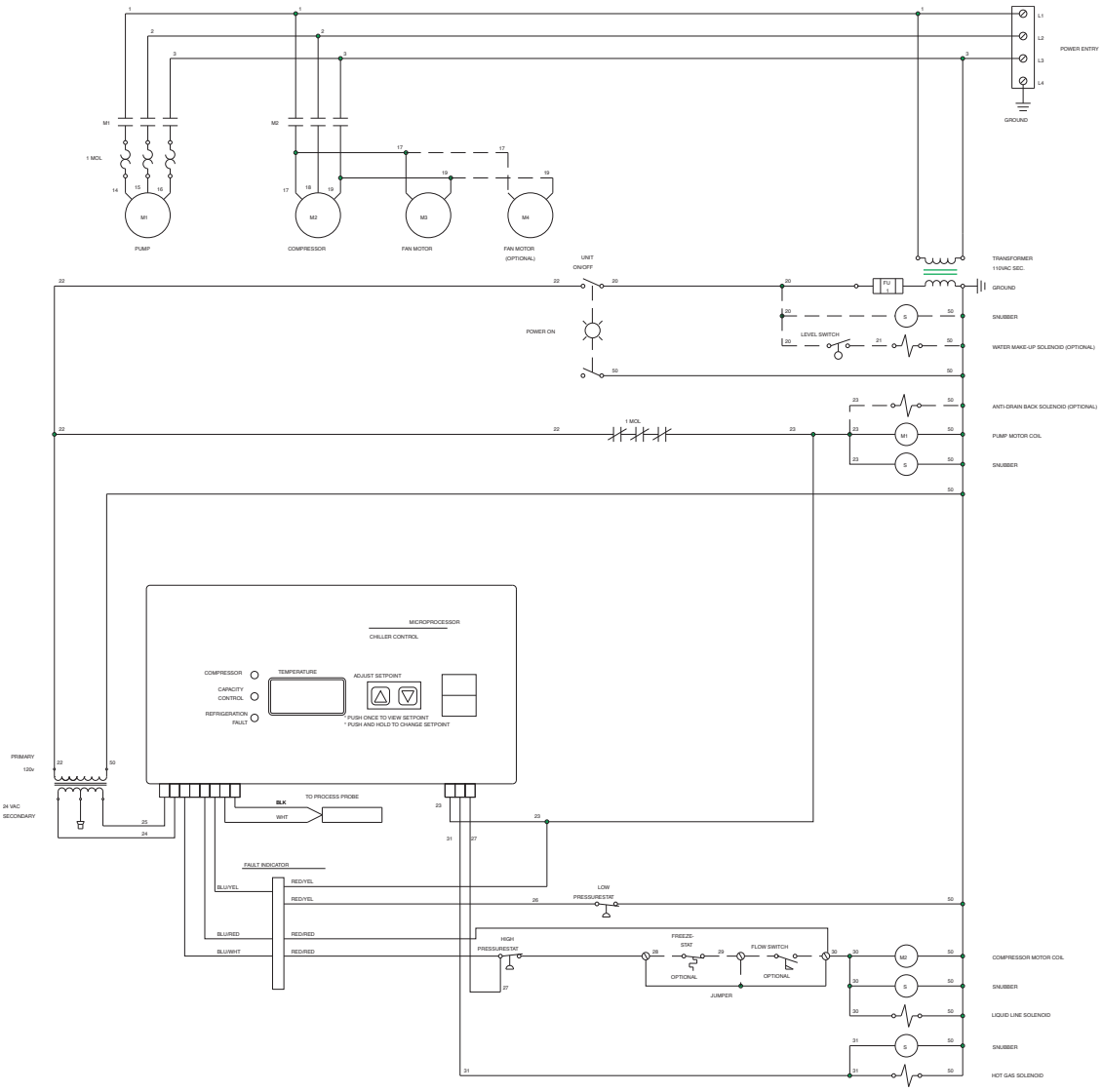
7.3 MECHANICAL SCHEMATIC : AIR-COOLED : 5 - 10 TON MODELS



7.4 MECHANICAL SCHEMATIC : AIR-COOLED : 15 - 30 TON MODELS

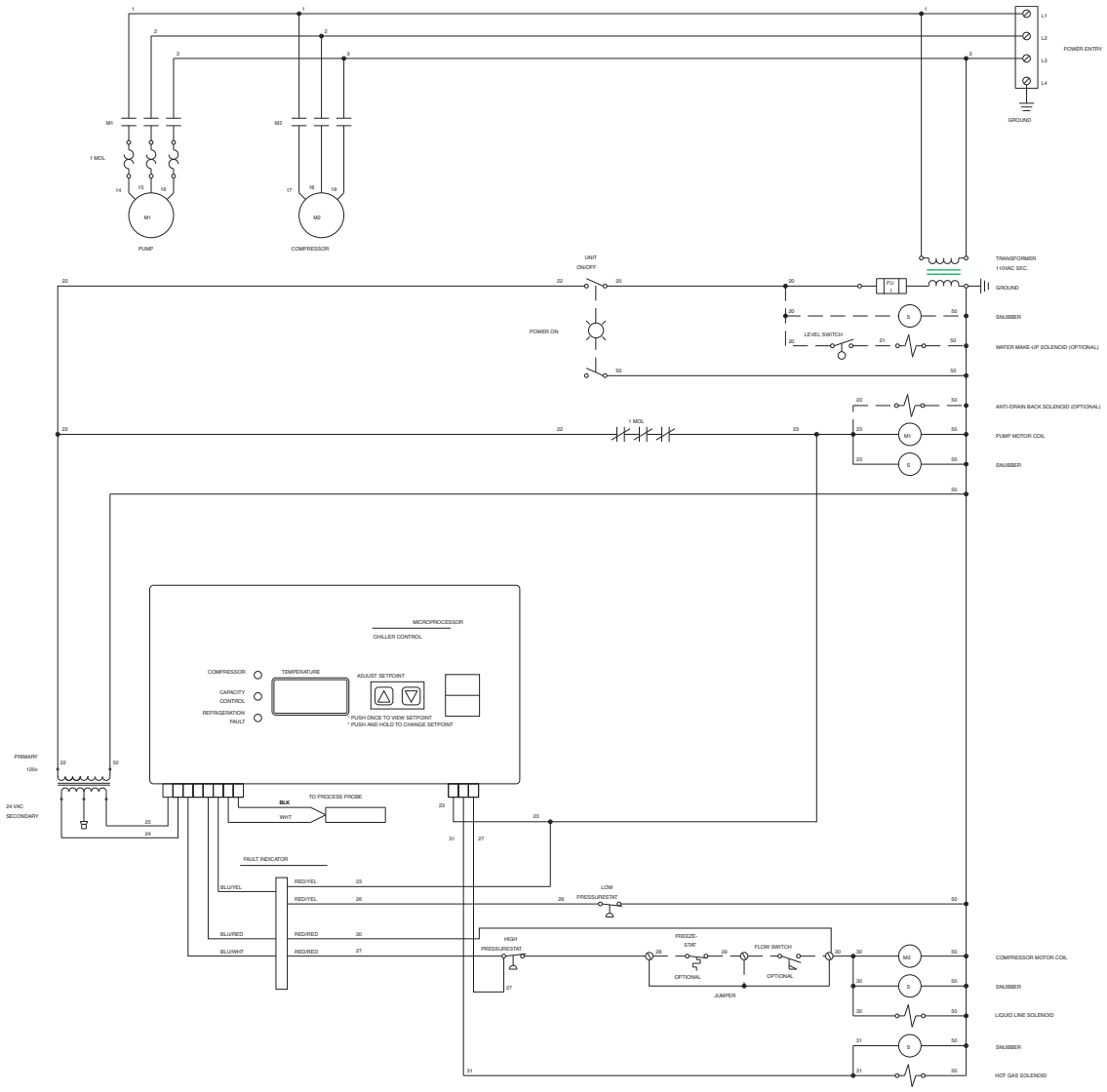


7.5 TYPICAL ELECTRICAL SCHEMATIC : AIR-COOLED MODELS



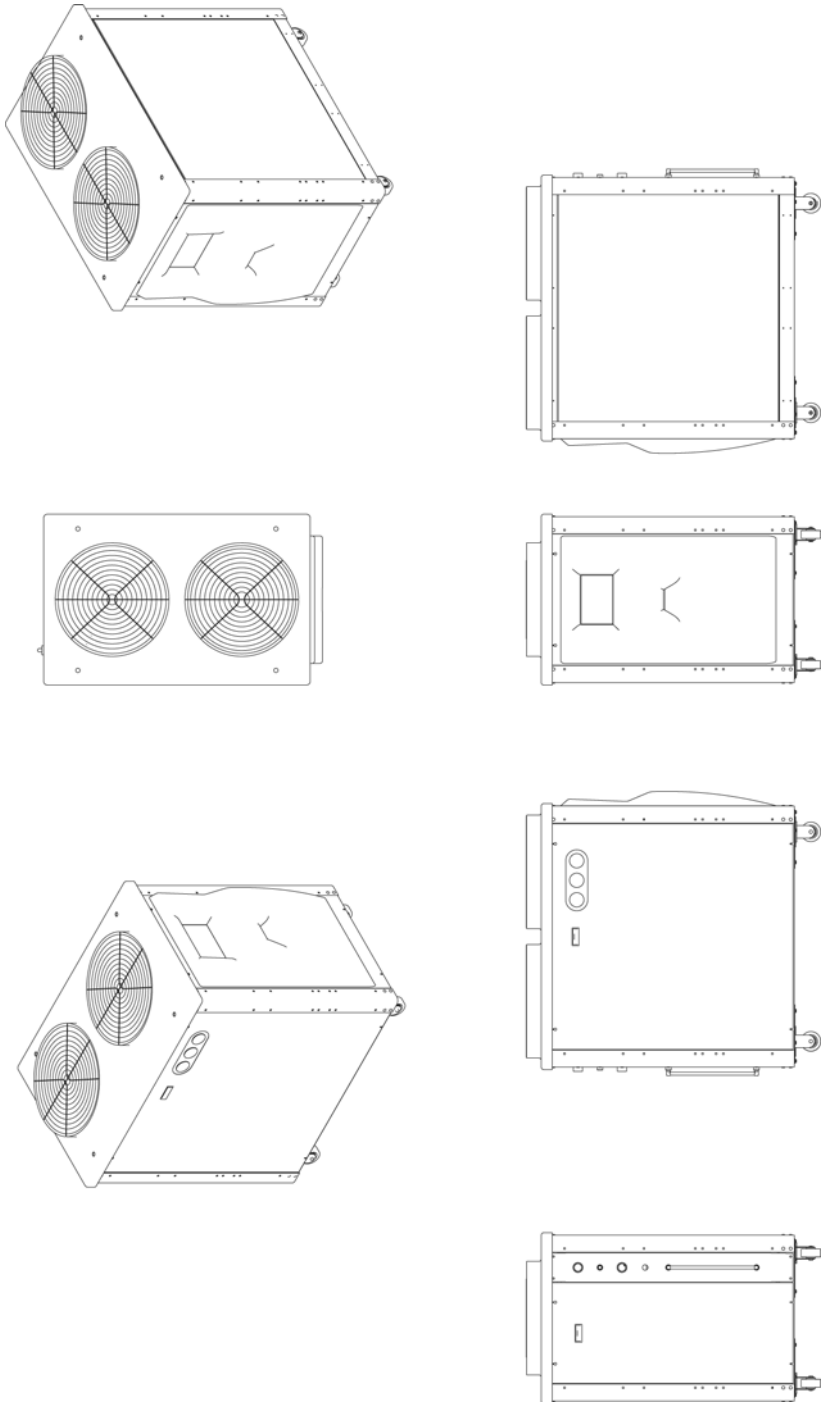
Electrical schematic is presented for illustration purposes only.
For exact details, consult the electrical drawing supplied with your machine.

7.6 TYPICAL ELECTRICAL SCHEMATIC : WATER-COOLED MODELS

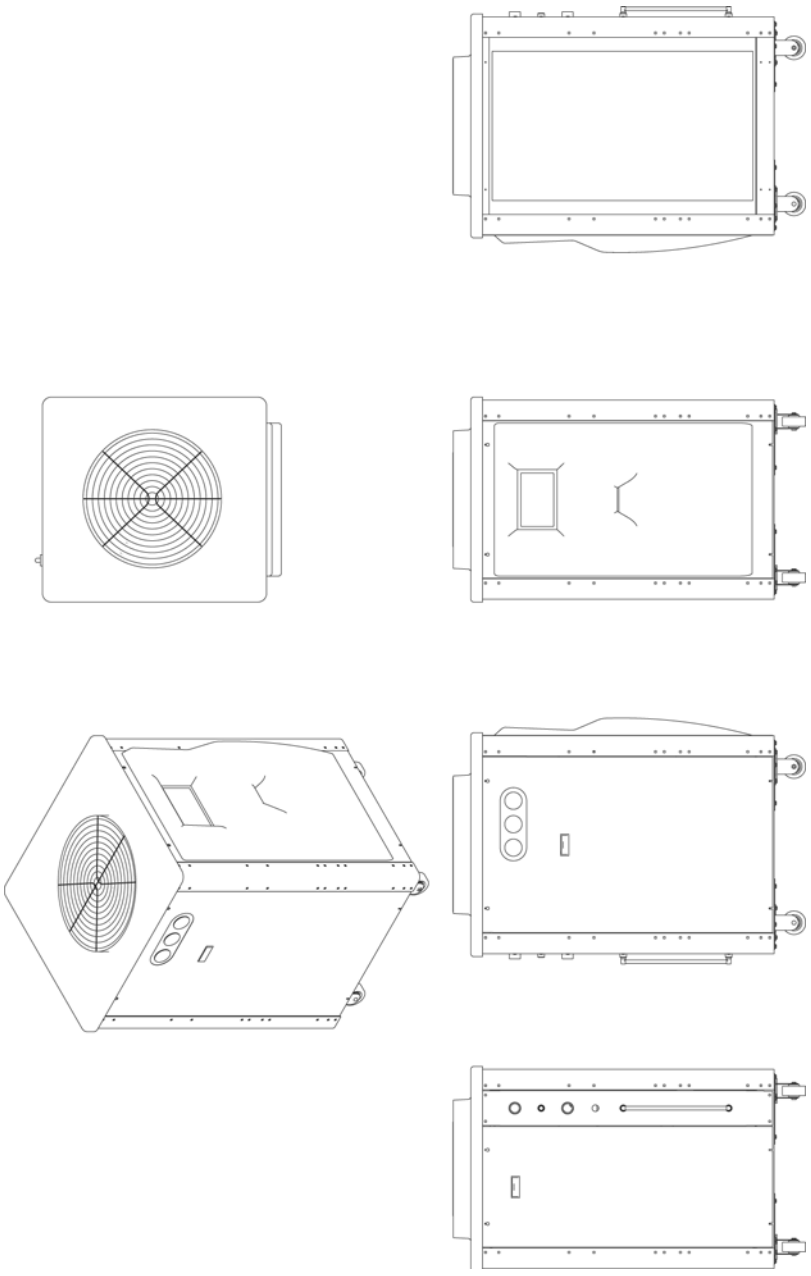


Electrical schematic is presented for illustration purposes only.
For exact details, consult the electrical drawing supplied with your machine.

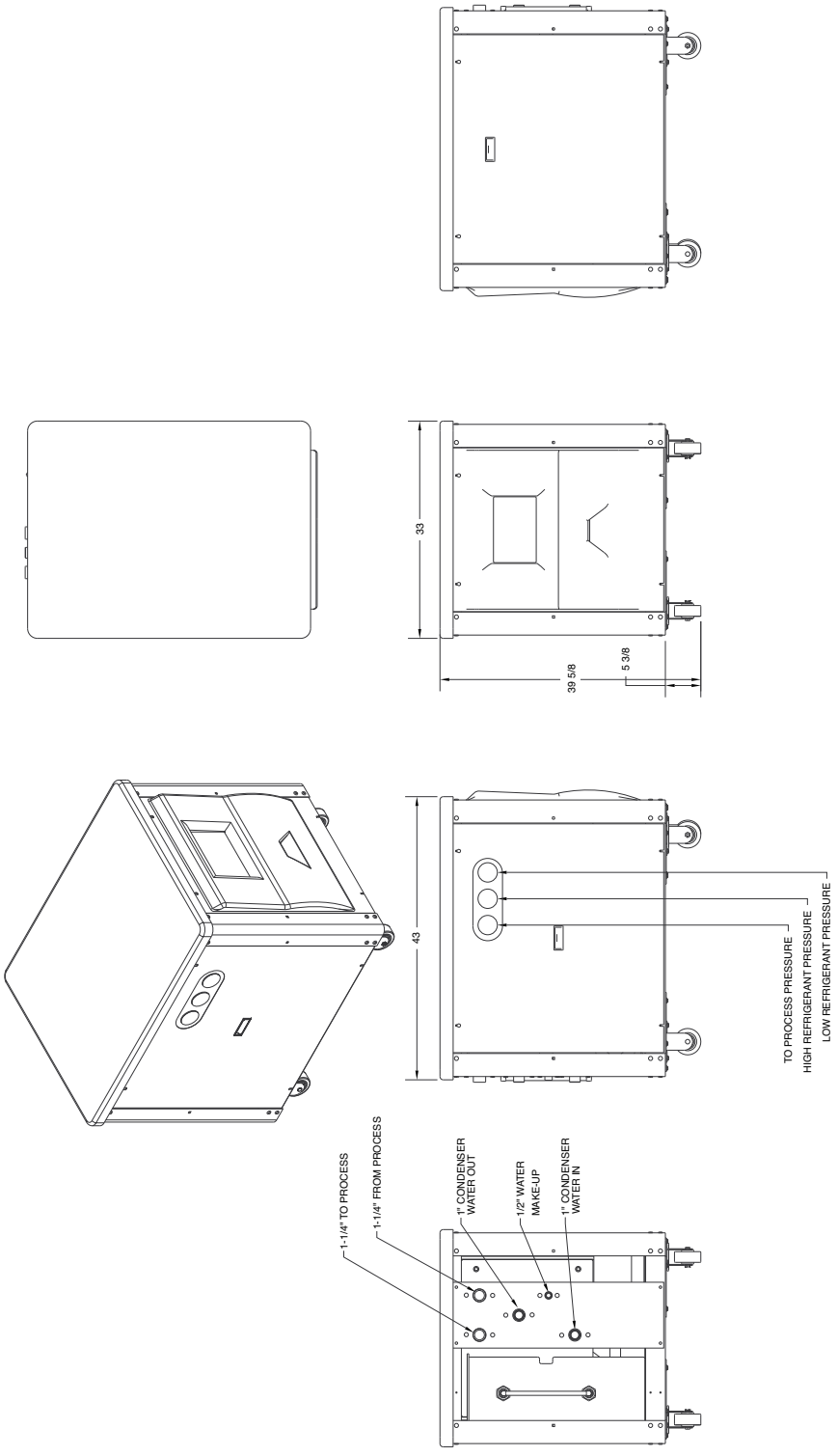
7.7 TYPICAL PHYSICAL : AIR-COOLED MODELS : 7.5 - 10 TONS



7.8 TYPICAL PHYSICAL : AIR-COOLED MODELS : 5 TONS



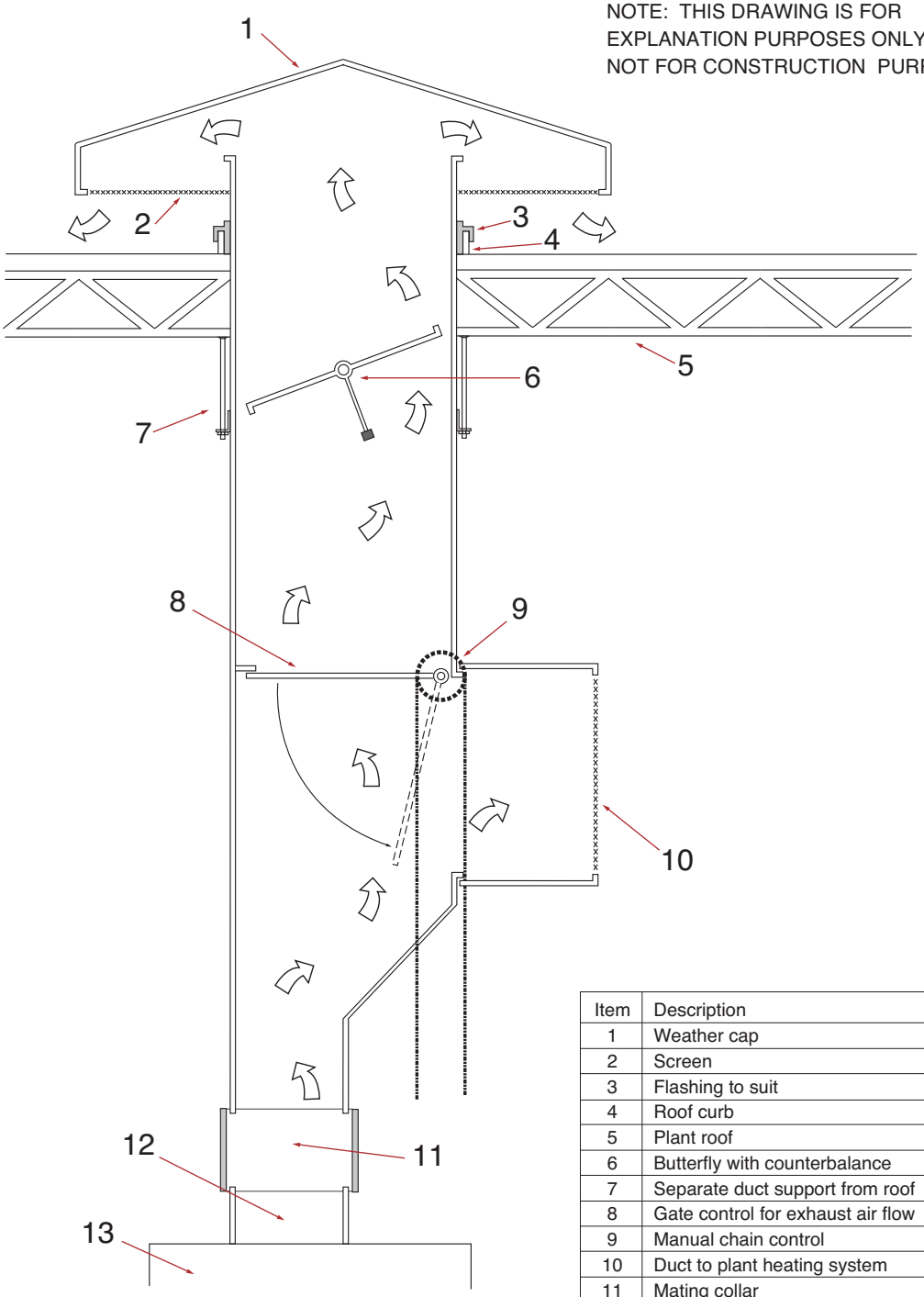
7.9 TYPICAL PHYSICAL : WATER-COOLED MODELS : % TONS



7.10 DUCT SCHEMATIC FOR AIR-COOLED CHILLERS

A. For models equiped with centrifugal blower. Models with equipped with fans can not be ducted.

NOTE: THIS DRAWING IS FOR EXPLANATION PURPOSES ONLY, NOT FOR CONSTRUCTION PURPOSES



Item	Description
1	Weather cap
2	Screen
3	Flashing to suit
4	Roof curb
5	Plant roof
6	Butterfly with counterbalance
7	Separate duct support from roof
8	Gate control for exhaust air flow
9	Manual chain control
10	Duct to plant heating system
11	Mating collar
12	Chiller air exhaust port
13	Air cooled chiller with blower

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8.0 APPENDIX

8.1 OPERATIONS BELOW 48°F
8.2 WATER QUALITY CONTROL
8.3 INHIBITED PROPYLENE GLYCOL
8.4 SENSOR CURRENT VS TEMPERATURE CHART
8.5 REFRIGERANT PRESSURE-TEMPERATURE CHART
8.6 CHILLER CAPACITY AND DERATE CHART

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

A. The chiller is never to be operated below 48°F leaving water temperature without several precautionary measures. All controls are factory adjusted for 48°F and above operations.

B. Before readjusting the protective devices, a satisfactory antifreeze solution must be substituted for the recirculating chilled water. This mixture will consist of inhibited propylene glycol and water. Do not substitute an inhibited propylene glycol and water solution with common automotive type antifreeze. 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 cn cause capacity and control problems.

D. DO NOT USE AUTOMOTIVE TYPE ANTI-FREEZE.

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

F. Adjust the low pressure safety switch according to the specifications in the chart below.

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

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*
48° - 70°F	0%	32°F	32°F	36°F - 39°F	58#	63#	28#	33#	102#	111#
25° - 47°F	30%	10°F	10°F	15°F - 18°F	33#	38#	12#	17#	63#	72#
10° - 24°F	40%	-5°F	-5°F	0°F - 7°F	20#	25#	4#	9#	43#	52#

Operating Temperature	*Glycol*	*Freeze Point*	*Cut Out Temp*	*Cut In Temp*	*R404A*		*R407C*	
					Cut-Out	*Cut-In*	*Cut-Out*	*Cut-In*
48° - 70°F	0%	32°F	32°F	36°F - 3°9F	72#	79#	52#	58#
25° - 47°F	30%	10°F	10°F	15°F - 1°8F	44#	49#	28#	34#
10° - 24°F	40%	-5°F	-5°F	0°F - 7°F	29#	34#	16#	22#

High Pressure Cut Out *(maximum)*

Refrigerant	*Air-Cooled*	*Water-Cooled*
R22	380#	360#
R134A	260#	260#
R407C	405#	360#
R410A	610#	550#
R404A	405#	360#

Figure 8.3A & Figure 8.3B

G. Once all safety provisions are made, the temperature control thermostat may now be lowered to the desired operating temperature.

H. **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.

8.2 WATER QUALITY CONTROL

A. Lack of proper water treatment can damage the chilling unit. The services of a 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.

B. The two main things to consider for water treatment in chillers are corrosion and organism growth. Proper chemical treatment can control PH levels and algae growth. An alternative to chemical treatment is the addition of 30% inhibited propylene glycol to the water. This will help prevent organism growth and coat the heat transfer surfaces with corrosion inhibitor.

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)

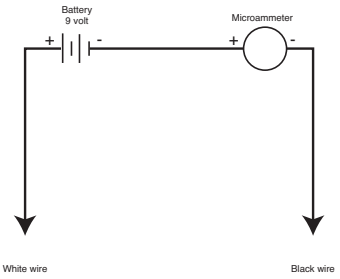
B. Automotive anti-freeze must never be used in industrial heat transfer applications. Automotive anti-freeze contains silicate type corrosion inhibitors designed to be compatible with automotive components. In an industrial application, the silicates will form a gel on the heat transfer surface which will result in substantial reduction in cooling capacity and is virtually impossible to remove.

8.4 SENSOR CURRENT VS TEMPERATURE

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

Formula:

- 1 u A = (556.8627 x 10 x °F) = (255 x 10)
- °F = (1 u A - 255 x 10) + (556.8627 x 10)



8.5 REFRIGERANT PRESSURE-TEMPERATURE

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
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	14.1	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)

8.6 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%	
15	30%	*
10	22%	*
5	15%	*
0	9%	*
-5	5%	*

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.

***** These ranges require special options.

END

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