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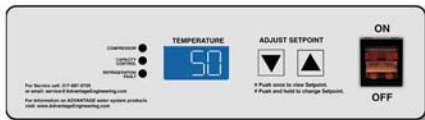
INSTRUCTION MANUAL • INSTALLATION • OPERATION • MAINTENANCE

# MAXIMUM

## PORTABLE CHILLER

TM

Covering models from 1/4 to 1.5 tons  
with the IC-5 Chiller Control



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# MAXIMUM

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## PORTABLE CHILLER

TM

### INSTRUCTION MANUAL

#### IC-5 CHILLER CONTROL

#### 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 1/4 to 1.5 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 (chlorodifluoromethane). 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.

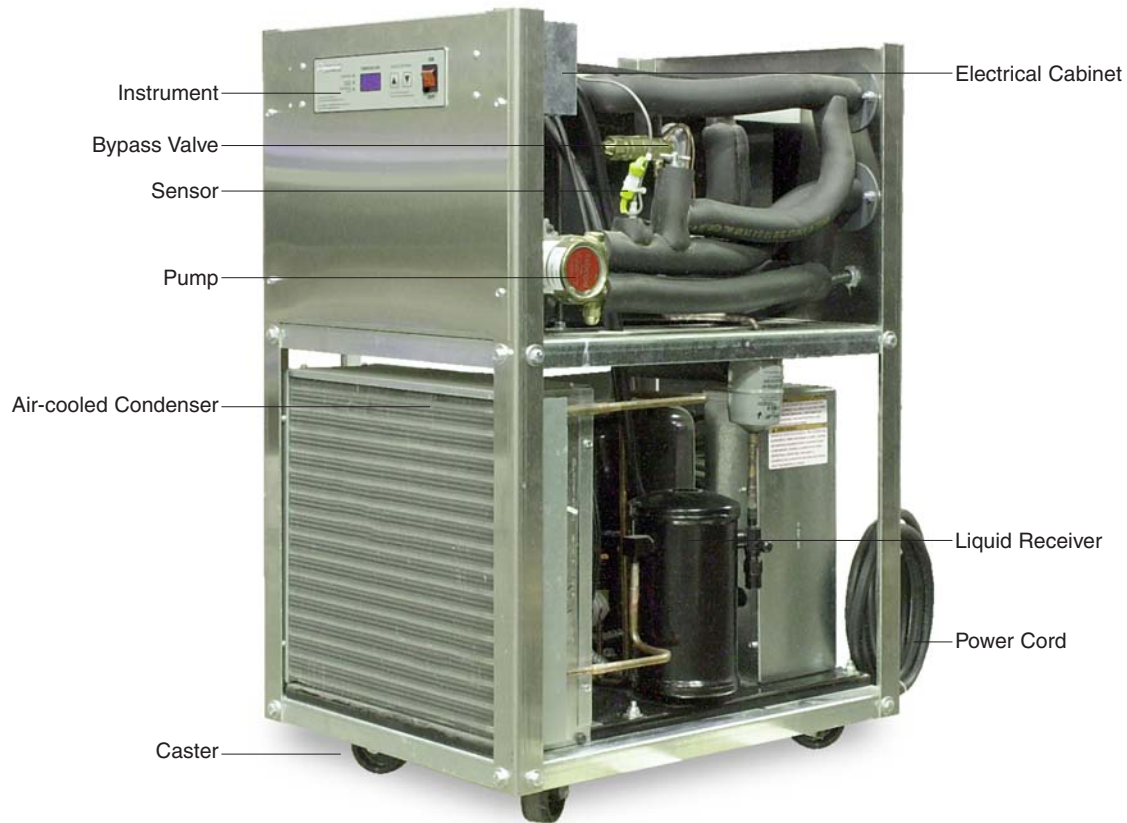
#### **1.7 WATER TREATMENT**

- 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



## **2.0 INSTALLATION**

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



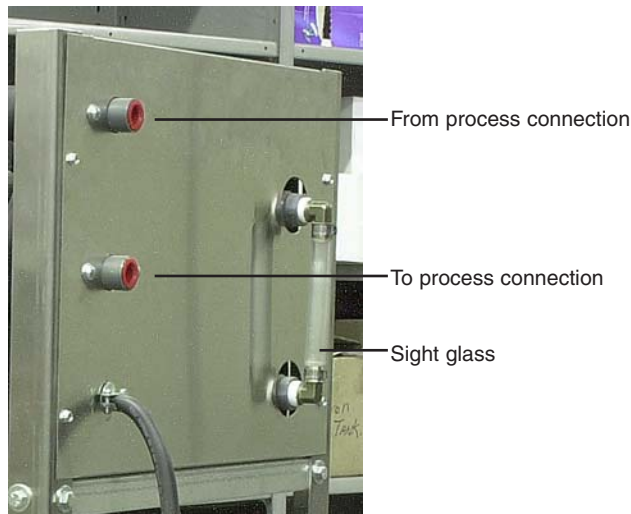
## 2.1 GENERAL

- 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

**Note:** for reverse flow models as designate by a “R” in the model number, please refer to section 8.7 for installation instructions.

- 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.



## 2.3 WATER SUPPLY CONNECTION (OPTIONAL)

- 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 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 ambient air temperatures above 95°F or below 60°F.
- B. Air flow is generated by the motor mounted fans. 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.
- 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.
- D. At full load, the chiller will discharge approximately 15,000 BTU's per hour per ton of cooling.
- E. 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.
- B. Required consumption from a city water source is 1.5 gpm at 65°F per ton of rated capacity.
- C. Required consumption for a tower water source is 3 gpm at 85°F per ton of rated capacity.
- D. The pressure differential requirement between the condenser 'water in' and the condenser 'water out' lines must be 30 psi for adequate efficiency.
- E. 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 (if installed).
- F. If necessary, an optional water saver (regulator) valve should be installed 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 a head pressure of 210 psig for best efficiency. Refer to the factory for more details.
- G. Connect the condenser '**WATER OUT**' port to the plant's drain or tower system return. Note: if dumping to the plant's open drain, drainage shall be done according to local codes.

## 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.



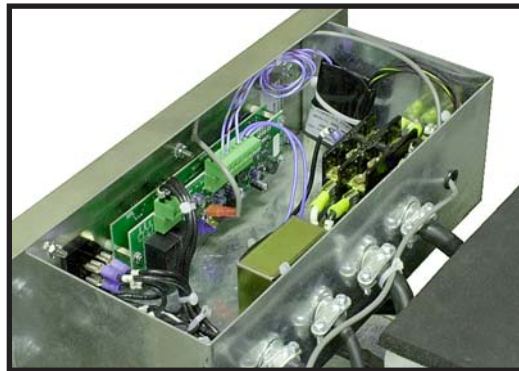
3. Connect the four conductor power cable to power entry terminal block on the unit's electrical panel. Then connect the power cable to the fused disconnect switch.

**B. CONTROL CIRCUIT WIRING**

1. The unit's supplied control circuit is 24 volt, 1 phase, 60 cycle. The control circuit is supplied by the factory installed transformer. An inline control circuit fuse is provided.

**C. GENERAL**

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



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

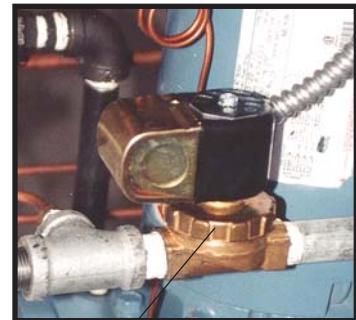
#### A. SYSTEM FILL

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. Note: reverse flow units utilize a remote 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.



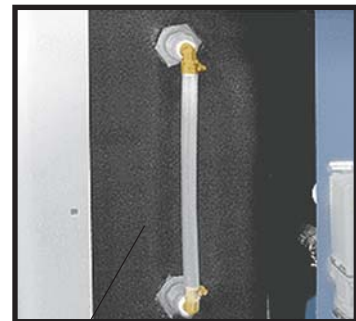
Reservoir tank - lid removed for picture

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.
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).



Make-up solenoid valve

Figure 3.2A

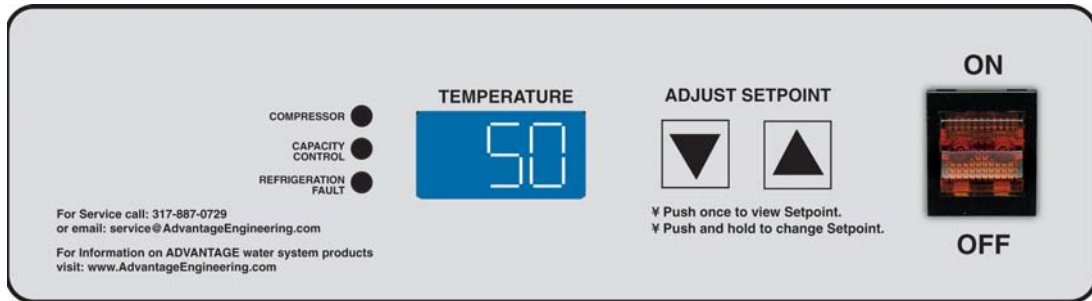


Typical reservoir sight glass

Figure 3.2B

## B. 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.



### 3.3 CHILLER CONTROL / OPERATION

#### A. CHILLER CONTROL START-UP

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

#### 3. PRECAUTIONS:

The chiller control is programmed from the factory with a setpoint range of 48° to 90°F. To operate below 48°F, the addition of inhibited propylene glycol and modification of the safety control settings are required. Diligent monitoring of the water/glycol solution is mandatory to prevent freezing of the evaporator. Freezing may cause the evaporator to rupture allowing water and freon to mix which will cause major damage to the refrigeration system.

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.

Contact your local refrigeration contractor or the factory for further information. The operating range of the chiller control may be changed to 10°F - 90°F by adjusting the Setpoint Lockout (SPL) jumper. Refer to the technical section of this manual for more information.

## B. INSTRUMENT OPERATION

1. **To start the unit, toggle on the illuminated ON/OFF SWITCH.** The chiller control will begin temperature control operations.
2. To select setpoint temperature, press and hold the UP ARROW or DOWN ARROW keys until the desired set point temperature is displayed in the TEMPERATURE WINDOW. The default range for the setpoint temperature is 48° - 90°F or 9° - 32°C.
3. The setpoint temperature can be displayed by pressing the UP ARROW or DOWN ARROW keys. The setpoint temperature will be displayed for 5 seconds.
4. When the compressor is turned off, the chiller control will wait 3 minutes before turning it back on regardless of the To Process temperature or setpoint. If a fault has occurred, the control will attempt to turn the compressor on after 3 minutes powered down. If the fault condition remains, the control will turn the compressor off and retry after 1 minute. This sequence will repeat until the compressor turns on or instrument power is cycled.
5. Under normal conditions (no fault conditions, compressor has been off for three minutes) the chiller control will turn on the compressor when the To Process temperature is above the setpoint. The chiller control will turn on the hot gas bypass when the To Process temperature is below the setpoint by no more than 3 degrees.

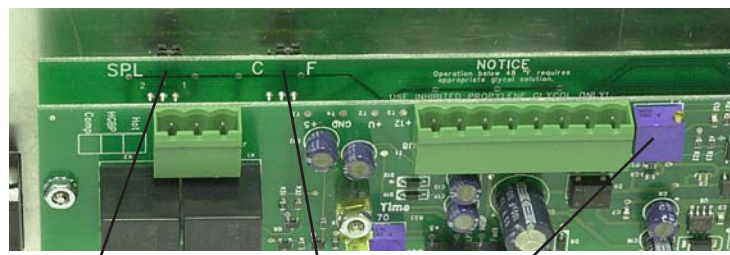
The chiller control will turn off the compressor and hot gas bypass when the To Process temperature is 4 degrees or more below the setpoint.

## C. INSTRUMENT CONTROLS

1. **ILLUMINATED ON/OFF SWITCH:** this rocker switch starts or stops the unit. Electrical power is supplied to the unit when the switch is illuminated.
2. **UP ARROW and DOWN ARROW KEYS:** depress and hold this push button to increase (UP ARROW) or decrease (DOWN ARROW) the setpoint temperature. If the push button is pressed momentarily the setpoint value is incremented or decremented by one degree. If the push button is held down the setpoint will increase or decrease continuously.
3. **SETPOINT LOCK OUT JUMPER:** this jumper controls whether the user is allowed to reduce the setpoint below

48°F or 9°C. If the jumper is in position 1 (farthest from the SPL label) the user IS NOT ALLOWED to reduce the setpoint below 48°F or 9°C. If the jumper is in position 2 (closest to the SPL label) the user is allowed to reduce the setpoint to 10°F or -11°C.

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



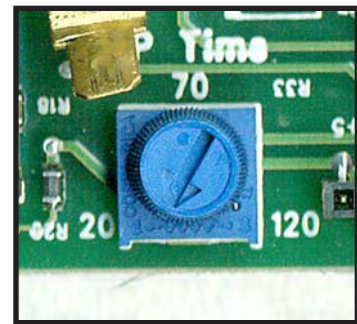
Setpoint Lock Out Jumper      Temperature Display Jumper      Probe Calibration      Figure 3.3B

#### D. STATUS LIGHTS

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

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

**Low Pressure Alarm.** After the compressor is turned on, the control has a 15 second buffer for the low pressure alarm. If a low pressure condition occurs within the first 15 seconds, the control waits the amount of time specified by the “LP TIME” potentiometer before indicating an alarm and



Low Pressure Potentiometer.      Figure 3.3C

turning off the compressor. If the condition is corrected before the time expires, no alarm occurs. If a low pressure condition occurs 15 seconds after the compressor turns on, the instrument waits 20 seconds before indicating an alarm and turning off the compressor.

**E. TEMPERATURE DISPLAY**

1. A three digit display window indicates the appropriate temperature. The window also displays the numeric value for the setpoint temperature.
2. The To Process temperature is always displayed unless a button has been pressed. If there is a probe error, the display will show three dashes “---”.

**F. PRESSURE GAUGES**

1. **PROCESS PRESSURE GAUGE:** indicates process pump pressure.
2. **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.
3. **LOW PRESSURE GAUGE:** indicates refrigerant pressure on the suction side of the compressor. This pressure will fluctuate with the process temperature.

**3.4 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.



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## **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.** 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 reset when discharge pressure falls to a safe level. The switch is located inside the electrical panel.

- 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 attached.**

- 2. **Fan motor not operating.** Have electrician check fuses and wiring, motor starter and overloads, and motor. Repair or replace motor 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 **ADVANTAGE** 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 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. **Head pressure too low.** Check that entering air temperature is above 60°F. If below 60°F, find out reason why.
- B. **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.
- C. **Improperly set low pressure switch.** Have a refrigeration serviceman reset control or replace if defective.
- D. **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 PUMP

- A.** The vane pump is designed to operate at a specific flow and pressure at the maximum run load amp draw of the motor. Too little 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, open bypass valve until the amp draw drops to the proper level.

#### 4.10 CRANKCASE HEATER (optional)

- 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 CONTROL

- 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 make the instrument work. **Note:** the CPU is not a field repairable part. It can be easily removed and replaced if a problem arises.

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## **5.0 MAINTENANCE**

- 5.1** WARRANTY SERVICE PROCEDURE
- 5.2** PERIODIC PREVENTATIVE MAINTENANCE
- 5.3** SPECIAL MAINTENANCE
- 5.4** CHECKING THE REFRIGERANT CHARGE



## 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 have a refrigerant sight glass with a moisture indicator. To check the refrigerant charge under normal operating conditions:
  - 1. Remove the plastic cap covering the sight glass and start the chiller and allow system pressures and temperatures to stabilize.
  - 2. 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” is the moisture indicator. It should appear green at all times. A white or yellow color indicates moisture is present in the refrigeration system, which is detrimental to the life of the compressor. The filter-drier should be replaced by a qualified refrigeration technician.

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## **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.

## 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.
- 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.
- C. **FILTER-DRIER:** the filter-drier removes contaminants and moisture from the liquid refrigerant.
- D. **LIQUID LINE SOLENOID VALVE:** controlled by the instrument, this valve closes when the compressor cycles off to prevent refrigerant liquid from migrating to the evaporator. The valve opens when the compressor cycles on.
- 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**

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

**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.

**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.

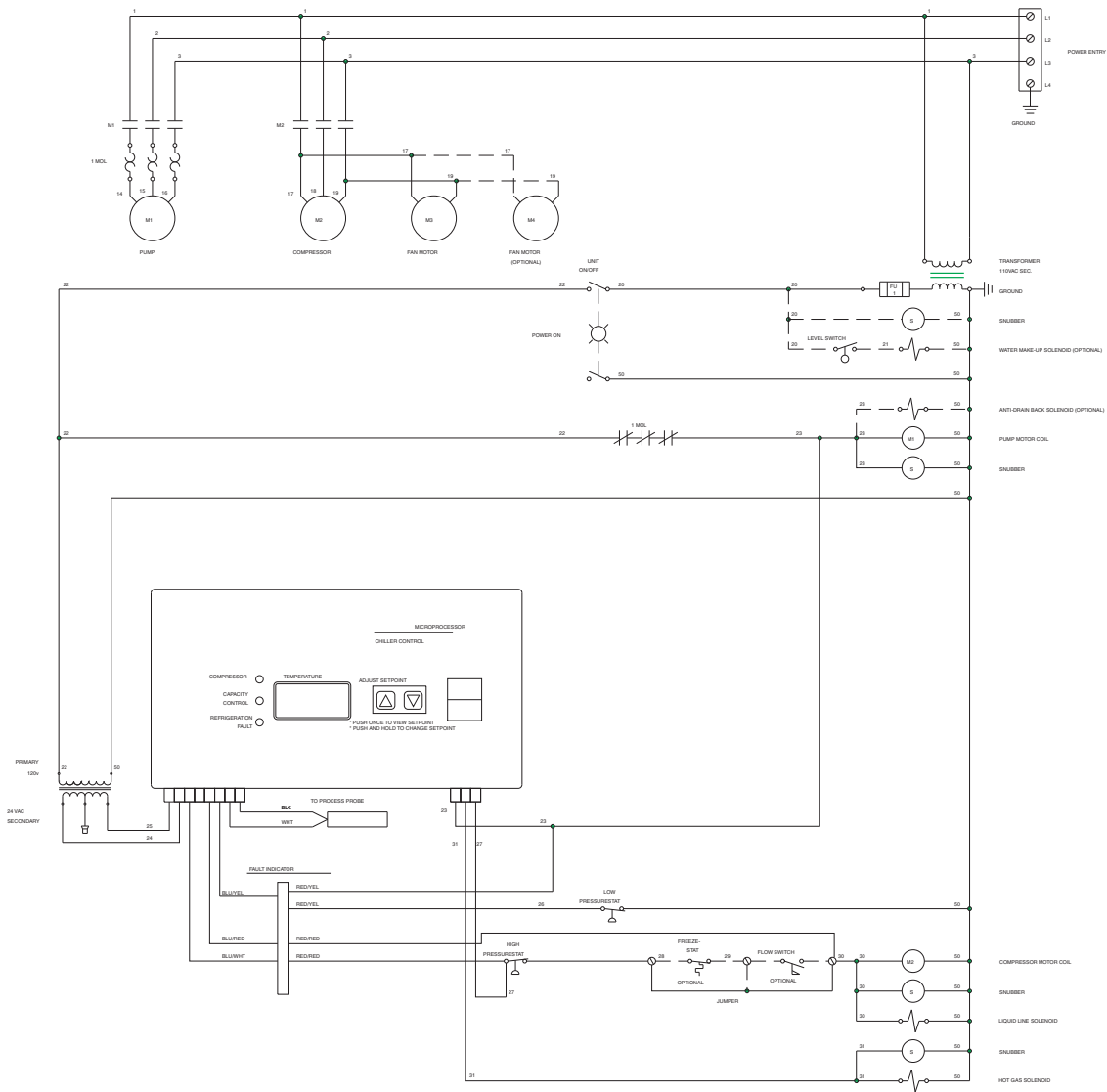
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## 7.0 RELATED DRAWINGS

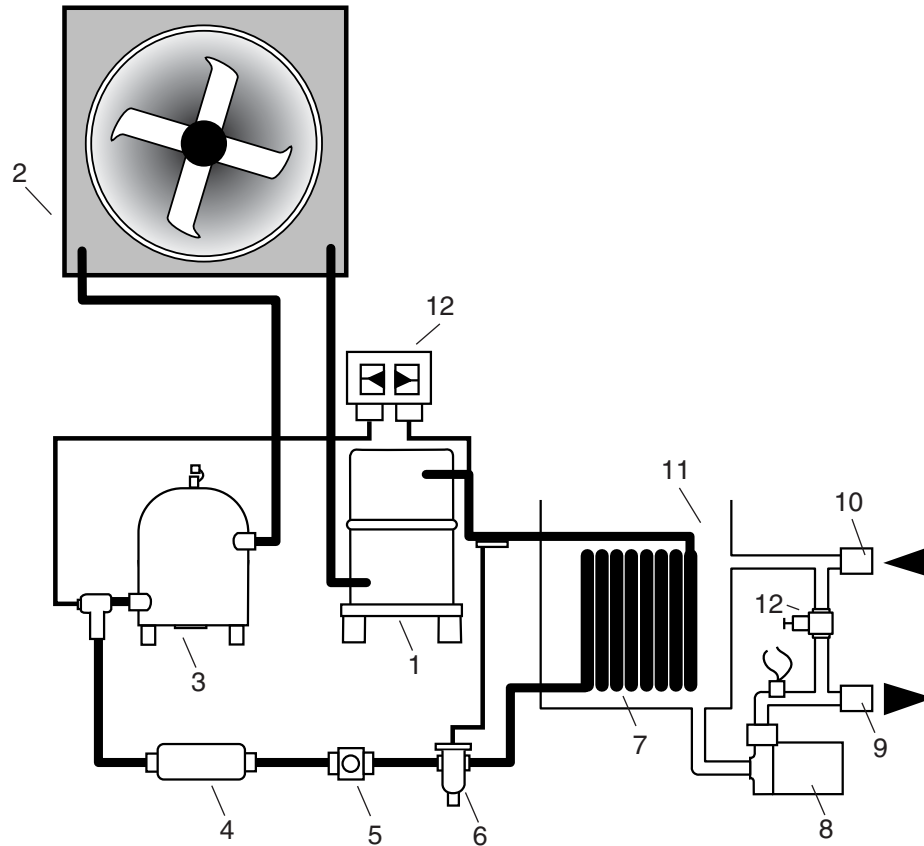
- 7.1 TYPICAL ELECTRICAL DRAWING
- 7.2 TYPICAL MECHANICAL DRAWING



## 7.1 TYPICAL ELECTRICAL DRAWING



## 7.2 MECHANICAL SCHEMATIC



ITEM	DESCRIPTION
1	Compressor
2	Air cooled condenser
3	Liquid receiver
4	Filter-drier
5	Refrigerant sight glass
6	Expansion valve
7	Evaporator
8	Pump
9	To process connection
10	From process connection
11	Reservoir tank
12	Refrigerant safety switch

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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** PRESSURE-TEMPERATURE CHART
- 8.6** CHILLER CAPACITY AND DERATE CHART
- 8.7** REVERSE FLOW MODEL INSTALLATION SUPPLEMENTAL



**8.1 OPERATIONS BELOW 48°F**

- A.** Chillers supplied with the automatic water supply system, the water supply connection must be plugged when operating below 48°F or anytime the system utilizes a water/inhibited propylene glycol solution. The system must be manually filled and the mix shall be checked for the proper ratio on a regular basis.
- B.** Addition of an inhibited propylene glycol solution is required. The ration shall be according to **figure 8.3A**. Too much glycol can cause capacity and control problems. Under no circumstances shall an automotive type antifreeze be used in the chilling unit.
- C.** The freezestat and low pressurestat settings must be field adjusted according to figure 8.3B.

**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.**

*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



## 8.2 WATER QUALITY CONTROL

- A.** Lack of, as well as, improper 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 20% 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

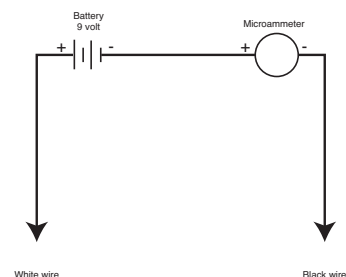
- A.** To operate liquid chillers below 48°F, it is necessary to add **inhibited propylene glycol** to the circulating system to lower the freeze point and prevent damage to the cooling system. Inhibited propylene glycol contains corrosion inhibitors which are compatible with most industrial heat transfer 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 = 371.94	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:

- $1 \mu A = (556.8627 \times 10 \times ^\circ F) = (255 \times 10)$
- $^\circ F = (1 \mu A - 255 \times 10) + (556.8627 \times 10)$



## 8.5 PRESSURE-TEMPERATURE CHART

Refrigerant Pressure Temperature Chart

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

*Italics indicates vacuum (inches of mercury)*

Standard font indicates pressure (pounds per inch gauge)



## 8.6 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.

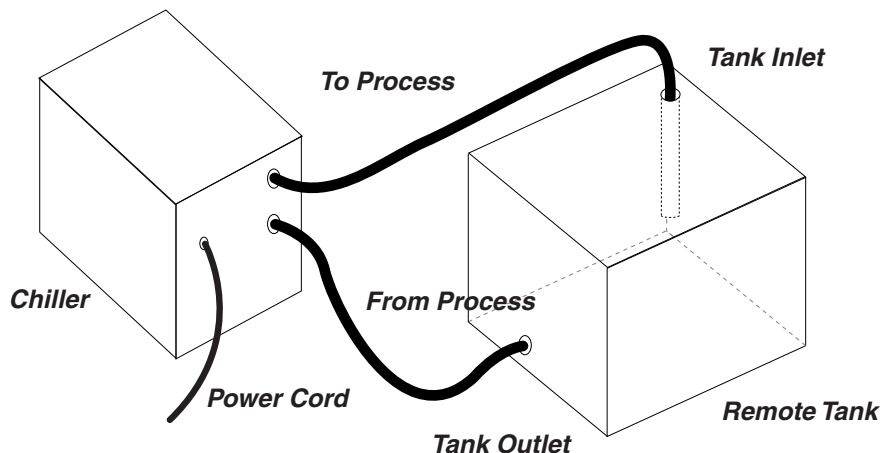
Ambient conditions affect air cooled chiller operation and capacity. Standard rating is at 95°F entering air temperature. For ambient air conditions greater than 95°F, chiller derating will occur. For ambient of 95-105°F, select the next larger capacity chiller. For ambient over 105°F, consult factory.

\* These ranges require special options.



## 8.7 REVERSE FLOW MODEL INSTALLATION SUPPLEMENTAL

- A. Reverse flow models are designed for use with a remote tank and are designated by an “R” in the model number. For example, model M1-AR. Therefore, these models do not have a tank or fluid level sight glass.
- B. These models use a vane pump and should self-prime with fluid. A wire reinforced clear hose is recommended. Minimum hose lengths should be used. Removed all hose kink locations. Models supplied with an alternate centrifugal pump may use a priming port for initial fill.
- C. Connect the chiller’s “From Process” port to the clean side tank outlet normally located at the bottom of the tank. Fluid must be free and clean of all debris.
- D. Connect the chiller’s “To Process” port to the tank inlet. The best location is at the end opposite the tank outlet. This will provide tank circulation and prevent fluid short cycling.
- E. Verify the chillers’ power supply requirements on the equipment data tag. Connect the power cord to the appropriate power supply and disconnecting means. Engage the power supply at the source and the power light (rocker switch) will illuminate. Switch the Off / On rocker switch to the On Position. The microprocessor will illuminate and the pump will start.
- F. Check the hose lines for collapse and connections for leaks. Check the tank inlet for water flow. Allow the pump to run until all air has purged. If the pump does not prime, a priming port may be added to the unit’s “From Process” connection.
- G. Adjust the chiller setpoint by depressing and holding the UP or DOWN arrow keys.



# END

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