I.O.M. #062 2/03

INSTRUCTION MANUAL • INSTALLATION • OPERATION • MAINTENANCE

ICECUBE

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Water-Cooled models
from 2 to 4 tons

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INSTRUCTION MANUAL

FOR ICE CUBE 'IK' MODELS
IK-2AY / IK-2WY / IK-3WY / IK-4AY
AIR or WATER COOLED PORTABLE CHILLERS

COVERING

INSTALLATION
OPERATION
MAINTENANCE

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TABLE OF CONTENTS

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1.0 GENERAL

1.1 UNIT LOCATION

1.2 EFFICIENCY

1.3 SAFETY

1.4 CLEAN AIR ACT

1.5 MISCELLANEOUS

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2.1 GENERAL

A. The portable chiller is designed for indoor use only. For most efficient operation, locate the chiller in a clean, dry and well ventilated environment.

B. The air cooled portable chiller has an air cooled refrigerant condenser. A motor driven fan generates air flow through the condenser to remove heat from the refrigerant system. The air cooled condenser on the portable chiller will discharge a maximum of 15,000 BTU's per hour per ton of cooling.

C. The air cooled portable chiller must have a minimum entering air temperature of 60°F and a maximum entering air temperature of 95°F for efficient operation.

D. The air cooled portable chiller must have a minimum of two feet clearance at the air intake and six feet at the exhaust air discharge.

E. The water cooled portable chiller is designed for indoor use only. For most efficient operation, locate the chiller in a clean, dry and well ventilated environment.

F. If the operator has any questions concerning the location and operation of the air or water cooled portable chiller, contact the ADVANTAGE Engineering Service Department at 317-887-0729.

1.2 EFFICIENCY

A. Long term efficiency of operation is largely determined by proper maintenance of the mechanical parts of the unit and the water quality. ADVANTAGE recommends filtering where required to prevent solids from plugging critical parts (pumps, heaters, seals for example). ADVANTAGE highly recommends the services of a competent water treatment specialist be obtained and his recommendations followed. ADVANTAGE accepts no responsibility for inefficient operation, or damage caused by foreign materials or failure to use adequate water treatment.

1.3 SAFETY

A. It is important to become thoroughly familiar with this manual and the operating characteristics of the portable chiller.

B. It is the owner's responsibility to assure proper operator training, installation, operation, and maintenance of the portable chiller.

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.

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1.4 CLEAN AIR ACT

A. The portable chiller 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.

1.5 MISCELLANEOUS

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

B. The ability of the portable chiller to maintain process temperature control is significantly affected by the method of installation.

C. If the operator has any questions concerning the location and operation of the portable chiller, contact the ADVANTAGE service department at 317-887-0729.

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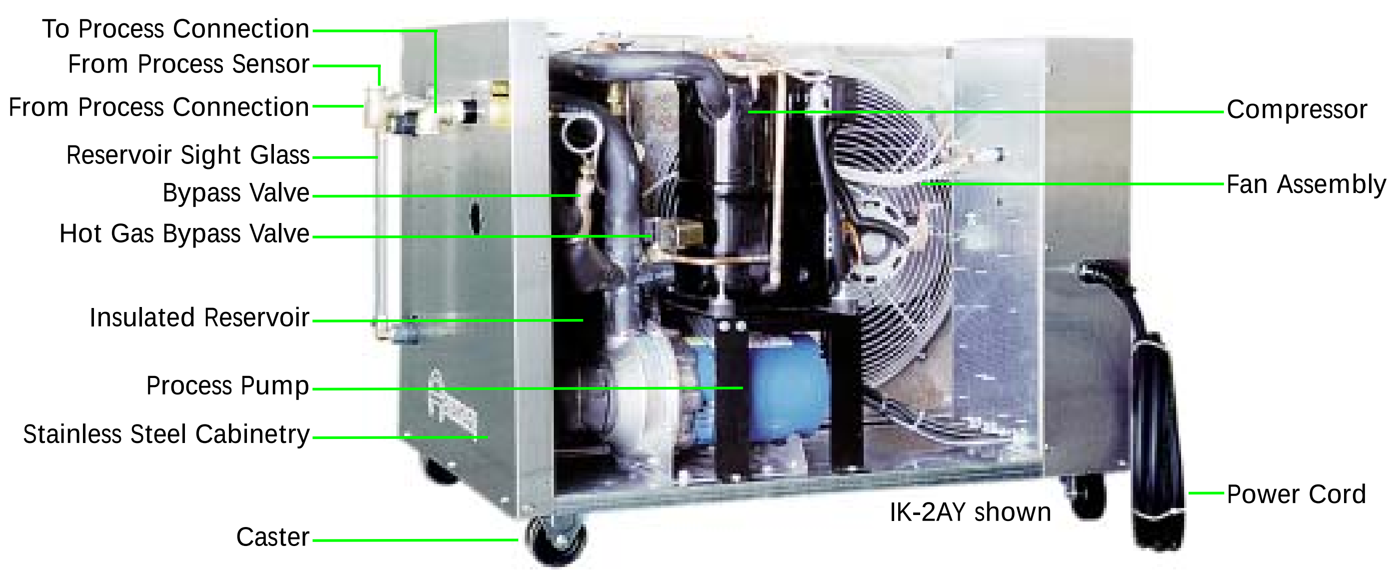
1.6 COMPONENTS



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2.0 INSTALLATION

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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.

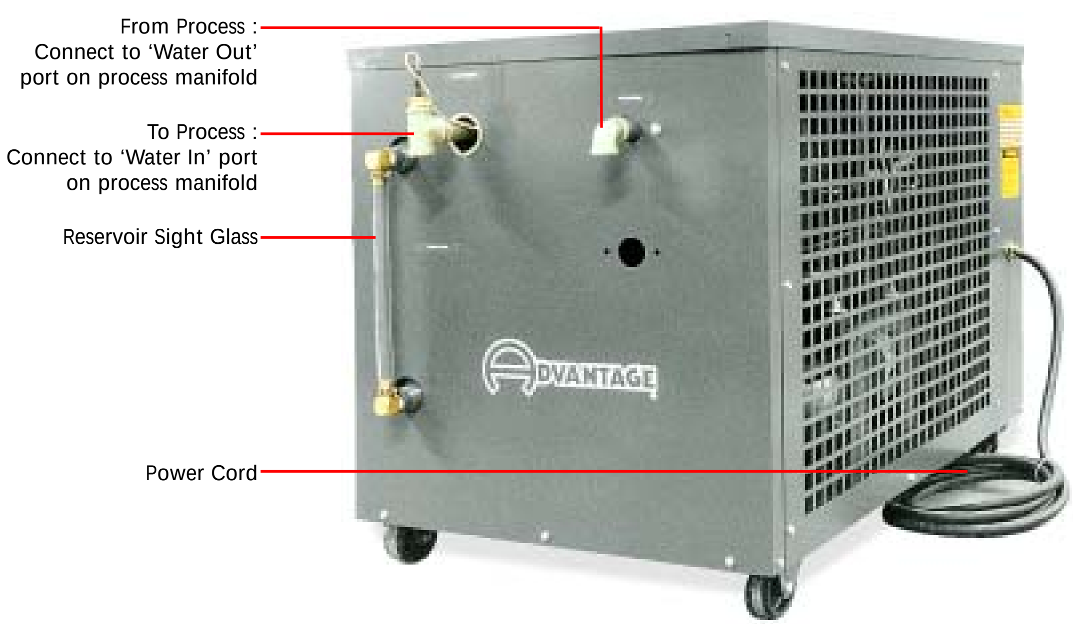
2.2 TO AND FROM PROCESS CONNECTIONS

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.



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2.3 WATER SUPPLY CONNECTION

A. The optional automatic water supply make-up system continually monitors the reservoir tank and fills it when needed. If the supplied unit has a factory installed system, 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 CONDENSER INSTALLATION - AIR COOLED MODELS

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 ADVANTAGE 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 driven fans (figure 2.4A). Air flow is from the outside of the chiller, through the condenser and exhausted through the top of the unit on IK-4AY models or through the side of the unit on IK-2AY 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.

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

2.5 CONDENSER INSTALLATION - WATER COOLED MODELS

A. Connect the condenser 'water in' port to the plant's city water supply or tower system supply (figure 2.5B).

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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.

F. The optional water saver (regulator) valve 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 a head pressure of 210 psig for best efficiency.

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.

2.6 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.

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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.

3. Make certain all electrical connections are tightly affixed. Any loose wiring connections must be tighten before engaging the power supply.

4. Make certain no moisture or standing water is present inside the electrical cabinet.

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.

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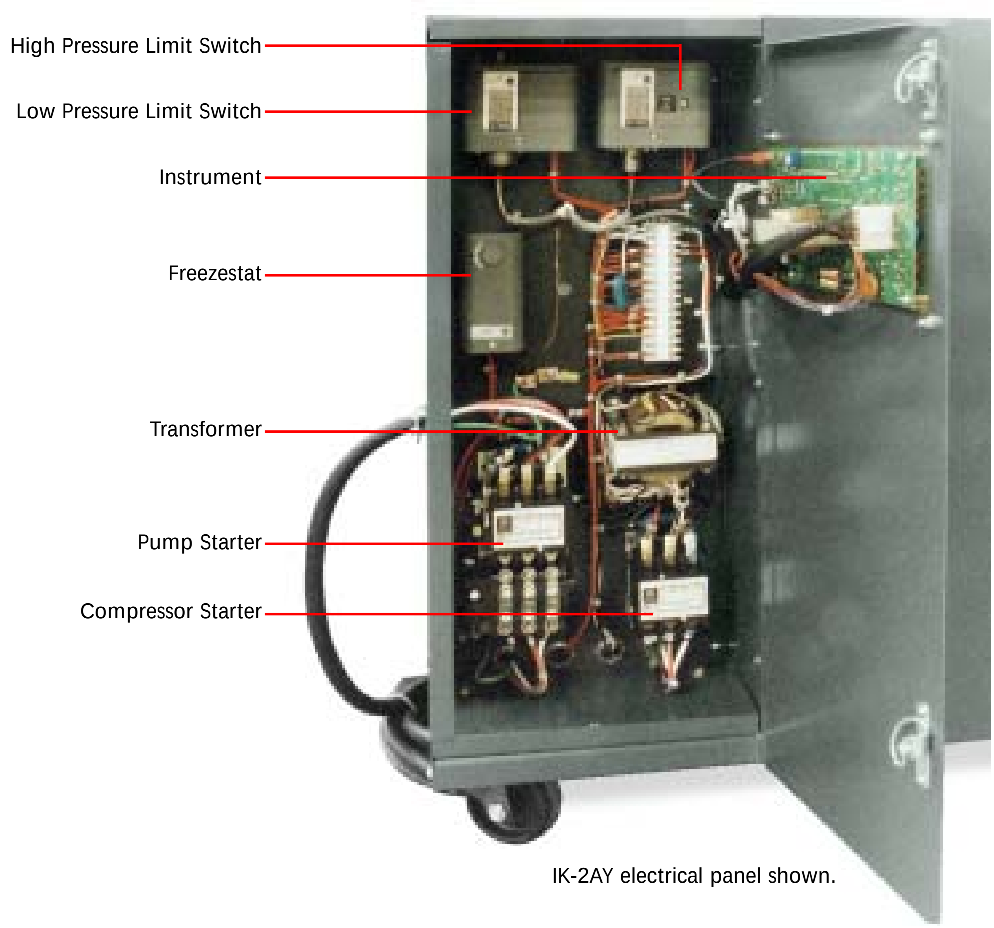
2. After installation, the phase status must be checked by observing the pump motor shaft on the end of the pump and comparing its rotation to the directional arrow on the motor. In either case, if the phase needs to be altered, it should be done at the main power entry.



IK-2AY electrical panel shown.

3.0 OPERATIONS

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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 Instrument - follow this segment to start up and operate the instrument. 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.

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3.2 START UP / OPERATION PROCEDURE

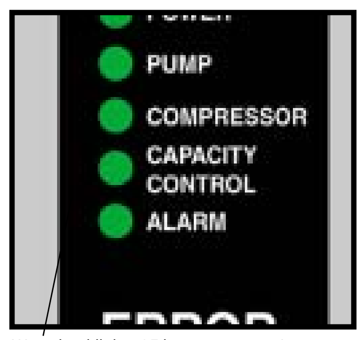
A. SYSTEM FILL

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. The RESERVOIR LEVEL light (figure 3.2B) will flash red while the make-up solenoid valve is open. When the reservoir tank is filled, the RESERVOIR LEVEL light will illuminate green. During operations, with the water supply source "on", the unit will automatically maintain the correct reservoir level.

Make-up solenoid valve Figure 3.2A



Water level light - LE instruments Figure 3.2B

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 as indicated by a flashing red RESERVOIR LEVEL light. During operations, when the

Typical reservoir sight glass Figure 3.2C

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RESERVOIR LEVEL light flashes red, the operator must add fluid to the reservoir. Verify reservoir level via the coolant sight glass (figure 3.2C).

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 light 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 3.2D). 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 3.2D

d. Toggle the PUMP ON switch (figure 3.2E). This will quickly cycle the pump motor "on" and then "off".

Pump On switch Figure 3.2E

e. Observe the motor shaft. When the PUMP ON switch is pressed, the motor shaft will rotate. When pressed off, the shaft will slowly "coast" to a stop. As the shaft slows, the operator can identify the rotation of the motor

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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 START key is pressed, the operator must identify the cause as outlined in the troubleshooting and repair section.

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.

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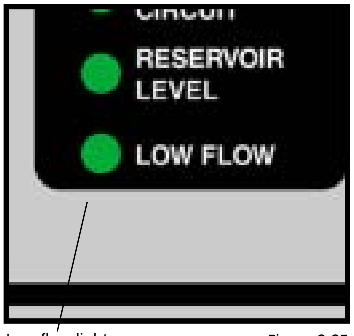
2. Press the PUMP ON switch to activate the process pump. Wait a few moments to allow air to be purge from system. Observe the COOLANT pressure gauge for steady readout. Two items the operator for look for are low flow or excessive flow conditions.

3. LOW FLOW: If the LOW FLOW light (figure 3.2F) is 'flashing red' be sure all process valves are open. If all process valves are open, then a low flow condition exists.



Low flow light Figure 3.2F

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 3.2G illustrates a typical bypass loop.

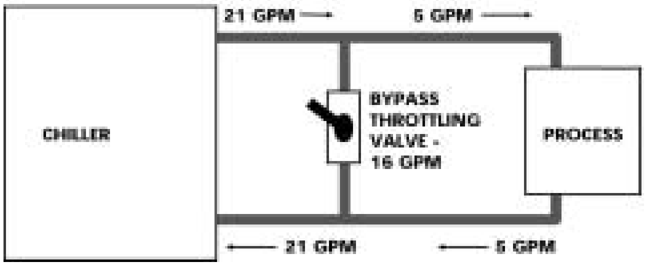
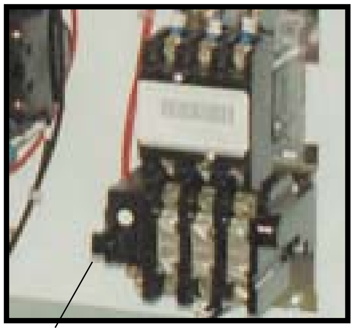


Figure 3.2G Typical low flow by-pass loop

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

4. EXCESSIVE FLOW: if the flow rate exceeds the motor HP capacity, the electric motor will draw excessive amps. This is a result of the process loop's ability to flow water at a greater rate than can be provided by the pump. This eventually results in tripping the thermal motor overload relay (overload relays open) and the unit will shut down and illuminate red the LOW FLOW light on the display.


Reset level on overload relay Figure 3.2H

a. If an excessive flow

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situation is encountered and the motor overload circuit has tripped, the operator must manually reset the overload relay (figure 3.2H) before operations can continue. This is done by opening the electrical panel cover, identifying the reset lever on the overload relay, and pushing the reset lever "in" until the overloads are reset (evidenced by a "clicking" sound as the overloads reset).

5. Set the process flow rate by measuring the pump motor amperage and adjusting the process flow rate via the motor amperage:

   a. Open electrical cabinet panel door. Note that the electrical power is engaged at this point and caution must be observed while the cabinet panel is open.

   b. Identify the motor starter block. This block consists of the motor starter contactor and the overload relay.

   c. Place an amp meter on a single power lead emanating from the overload relay.

   d. Identify the electric pump motor. Locate the name plate on the motor housing (figure 3.2I). The full load amp rating for the motor is listed on the name plate.

Motor Data Plate Figure 3.2I

   e. Engage the electrical power supply and start the pump motor by pressing the START key on the display.

   f. The amp meter will display the motor amps. Compare the actual motor amps as displayed on the amp meter to the full load amp rating as listed on the motor name plate.

   g. If the amp draw is excessive (higher than the listed name plate amp rating), a throttling valve must be installed in the "from process" circuit line. The preferred throttling valve is a manual activated ball valve. If necessary, follow proper shut down and disconnect procedures to install a throttling valve.

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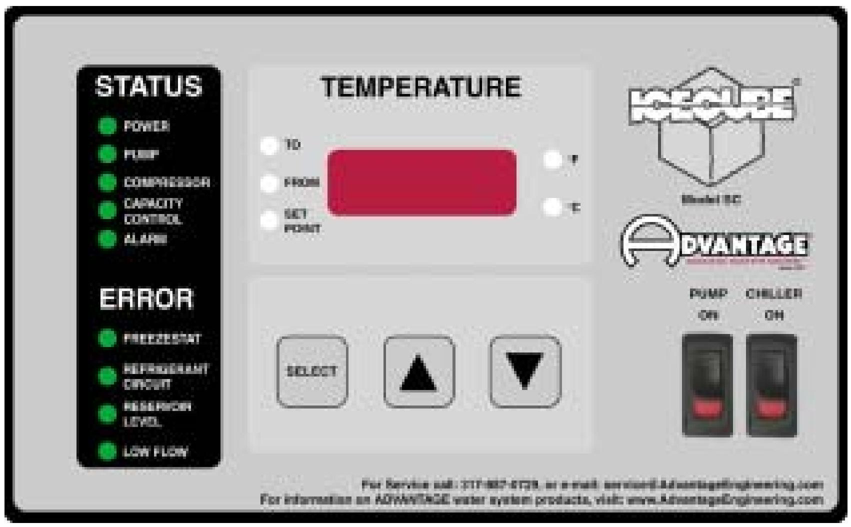
h. With the throttling valve installed, fully close the valve and then engage the pump. Slowly open the throttling valve and monitor the motor amps as displayed on the amp meter until the actual motor amps equals the listed full load amp rating of the motor. The process flow is now correctly adjusted.

3.3 INSTRUMENT/OPERATION



Instrument display

Figure 3.3A

A. INSTRUMENT START-UP

1. When the correct electrical power and adequate water supply pressure are supplied to the unit, it is possible to start the unit for temperature control duty.

2. When the electrical power supply is engaged to the unit, the instrument (figure 3.3A) will momentarily illuminate all indicating lights and digits on the display head. After a short delay, the instrument will display the controller software version number. At this time, the operator can verify that all lights and digits are functioning properly. If the operator determines an indicating light or digit does not illuminate, the instrument must be removed and sent to the factory for repair. When power is supplied to the unit, the POWER light illuminates.

3. Use the SELECT key to index through the temperature and set up functions until the SET POINT light is illuminated. The operator can push and hold the SELECT key to automatically index through each function.

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4. When the SET POINT light is illuminated, the setpoint temperature is displayed in the temperature display window. Use the UP and DOWN ARROW keys to change the setpoint temperature.

5. PRECAUTIONS: the instrument is programmed from the factory with a setpoint range of 48° to 70°F. To operate below 48°F, the addition of inhibited propylene glycol and modification of the safety control settings are required. Diligent monitoring of the water/glycol solution is mandatory to prevent freezing of the evaporator. Freezing may cause the evaporator to rupture allowing water and freon to mix which will cause major damage to the refrigeration system. Operating above 70°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. Contact your local refrigeration contractor or the factory for further information. The operating range of the instrument may be changed to 20°F - 90°F by adjustment of the CPU DIP switches. Refer to the technical section of this manual for more information.

6. After selecting the setpoint temperature, the operator may leave the display in the SET POINT state. The display will automatically return to the TO PROCESS temperature state after thirty seconds. If the operator leaves the display in any state other than the TO PROCESS state, the display will automatically revert after 30 seconds of inactivity.

7. With the chiller pump operating (start the pump by pressing the PUMP ONLY KEY), press the START key to activate the chiller. The operator can stop process operations (refrigerant and coolant circuits) by pressing the STOP key.

B. INSTRUMENT OPERATION

1. When the CHILLER ON switch is toggled on, the instrument will begin temperature control operations and the ‘to process’ temperature will begin to drop.

2. When the ‘to process’ temperature drops 1° below the setpoint, the instrument will activate the capacity control system to match the cooling capacity to the present load, as indicated by the CAPACITY CONTROL light.

3. If the load is less than the minimum capacity of the chiller, the ‘to process’ temperature will continue to drop. At 3° below setpoint the compressor will stop and enter a 3 minute time delay period before restarting at 1° above setpoint. The time delay is to prevent short cycling damage to the compressor.

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C. INSTRUMENT CONTROLS (figures 3.3B)

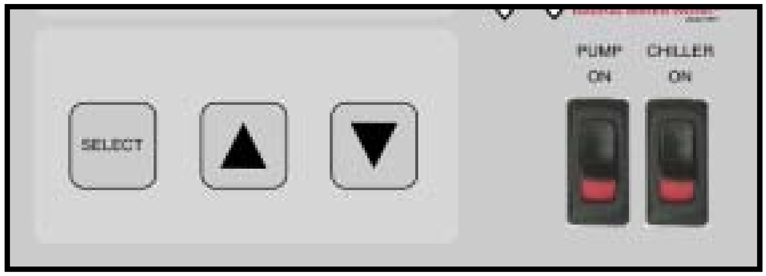

Figure 3.3B

1. PUMP ON SWITCH: this rocker switch engages/disengages electrical supply to the pump.

2. CHILLER ON SWITCH: this rocker switch engages/disengages electrical supply to the compressor.

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

4. UP ARROW: depress and hold this push button to increase the setpoint temperature. If this push button is pressed momentarily the setpoint value is incremented by one degree. If the push button is held down for more than one second, the setpoint will increase slowly at first and then faster after about two seconds.

5. DOWN ARROW: depress and hold this push button to decrease the setpoint temperature. If this push button is pressed momentarily the setpoint value is incremented by one degree. If the push button is held down for more than one second, the setpoint will increase slowly at first and then faster after about two seconds.

D. STATUS DISPLAY (figures 3.3C)

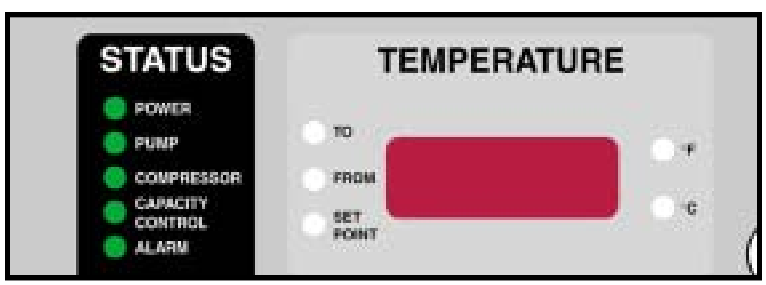

Figure 3.3C

1. POWER: illuminates when the proper supply of electrical power is applied to the unit.

2. PUMP: illuminates when the PUMP ON rocker switch is turned on and the pump is operating. Even with the PUMP

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ON rocker switch on, the PUMP light will not illuminate if a safety fault condition exists.

3. COMPRESSOR: illuminates when the instrument engages the compressor contactor. Engaging the compressor contactor supplies electrical current to the compressor. This action will decrease process water temperature.

4. CAPACITY CONTROL: illuminates when the instrument has engaged the capacity control system.

5. ALARM: illuminates when the “to process” temperature has deviated +/- 10° from setpoint. Note: the temperature deviation alarm circuit is only activated after the chiller has cooled the circulating fluid to the setpoint one time.

E. ERROR INDICATING LIGHTS (figures 3.3D)

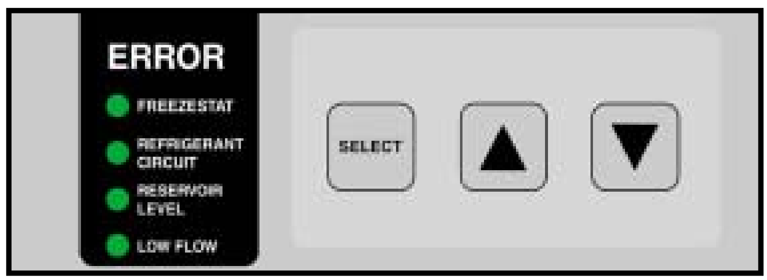

Figure 3.3D

1. FREEZESTAT: illuminates when the evaporator out temperature has reached the minimum safe operating temperature (normally 40°F).

2. REFRIGERANT CIRCUIT: illuminates when a refrigerant safety switch (high pressure safety or low pressure safety) has opened preventing the compressor from operating until the condition is resolved.

3. RESERVOIR LEVEL: illuminates when the process fluid level has dropped below the safe operating level and fluid needs to be added to the system.

4. LOW FLOW: illuminates when the process fluid flow is below the minimum safe operating rate.

F. TEMPERATURE DISPLAY (figures 3.3E)

1. A three digit display window indicates the appropriate temperature either in Fahrenheit or Celsius (as selected). The window also displays the numeric value for the setpoint temperature. A red light will illuminate beside the parameter currently being displayed.

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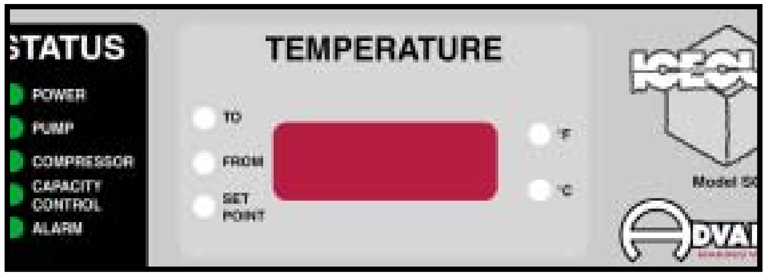

Figure 3.3E

2. The instrument is programmed at the factory to indicate temperature in Fahrenheit. The instrument can be programmed to display temperature in Celsius by changing the orientation of the DIP switch. Refer to the technical section of this manual for more information.

   a. To process: indicates liquid temperature being delivered from the chiller.

   b. From process: indicates liquid temperature returning to the chiller.

   c. Setpoint: indicates selected temperature control point.

   d. °F: indicates temperature is displayed in Fahrenheit temperature scale.

   e. °C: indicates temperature is displayed in Celsius temperature scale.

G PRESSURE GAUGES (figure 3.3J)

Figure 3.3E

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.

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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

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. SHUT DOWN PROCEDURE

1. To shut down the unit without disconnecting from the process: press the STOP. 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. Press the STOP key.

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

    c. Disconnect all process lines.

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4.0 TROUBLESHOOTING

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4.1 SENSORS

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

B. To quickly test for a defective probe, switch connections between the defective probe and a probe known to be working properly.

4.2 PROCESS/EVAPORATOR 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.

4.3 COMPRESSOR

A. Semi-hermetic compressors are protected by an external overload device (Klixon switch, solid state module, etc.). If the safety switch opens, this indicates an overload condition exists.

B. Check for electrical shorts, loose wires, bad fuses, or bad motor starter contacts. If these check ok, check for a defective protection device.

C. Hermetic compressors have internal protection.

4.4 LOW FLOW

A. Two pump chillers have a pump dedicated to the evaporator. The flow safety switch is located in the evaporator circuit and does not sense process flow.

B. One pump chillers require 100% of the process flow to circulate through the evaporator.

C. In some process conditions the minimum flow required cannot be maintained making it necessary to install a bypass line between the to and from process lines.

4.5 BLOWER/FAN

A. Check for an electrical short, loose wires, bad fuses, or bad motor starter contacts.

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B. Check the blower for defective bearings or other forms of drag on the blower wheel.

4.6 HIGH PRESSURE

A. If the refrigerant high pressure safety switch has opened, this switch must be manually reset after the problem has been resolved.

B. Refrigerant high pressure will vary with ambient temperature from a minimum of 190 psi to as high as 280 psi. Check for restricted condensing water supply and return lines, defective regulator valve on water cooled models or restricted air flow on air cooled models.

4.7 LOW PRESSURE

A. If the refrigerant low pressure safety switch has opened, the cause of the problem must isolated and resolved.

B. The switch will automatically reset when the pressure rises above the cut-in pressure. If this does not occur contact the ADVANTAGE service department for instructions.

C. The low pressure switch is set to cut-out at 58 psi and cut-in at 63 psi. 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.

D. 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.

E. If a low pressure fault occurs, check for blockage in the evaporator water inlet. If a blockage is found, back flush the evaporator and flush complete process water system.

F. Check for low freon. The refrigerant sight glass should appear clear when the unit is operating at 100% cooling capacity. Constant foam or bubbles indicate a loss of freon.

G. Check to see if the condensing media is too cold. On air condensed units, the ambient air at the condenser intake must be at least 60°F. If this is not possible, a damper control assembly package may be required.

4.8 WATER LEVEL

A. The automatic make up solenoid valve will open and fill the reservoir. If the solenoid is activated but the reservoir is not filling check the solenoid for proper operation.

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B. If the automatic makeup is not being used, manually fill the unit. Use the indicator light to determine when the reservoir is properly filled.

4.9 FREEZESTAT

A. The freezestat sensor bulb is located at the evaporator water outlet port. If the water out temperature of the evaporator reaches the freezestat setting the switch will open and stop the refrigeration compressor.

B. Check for restricted water flow and add a bypass line if necessary.

C. The setpoint is adjusted too low for the safety switch settings.

D. The freezestat is adjusted incorrectly or is defective.

4.10 OIL PRESSURE

A. This switch must be manually reset after the problem is resolved.

B. Check for low oil level in the compressor crankcase or insufficient compressor warm up before start-up.

C. Defective crankcase heater, internal compressor damage causing the compressor to pump too much oil through the system, defective oil pump, or plugged pick up screen in compressor oil sump. Note: only semi-hermetic compressors 15-30 tons have an oil pressure safety switch.

4.11 CRANKCASE HEATER

A. If the crankcase heater is not drawing current during the compressor off cycle, check for a defective crankcase heater, defective fuses or defective interlock on the compressor starter.

B. Scroll compressors do not have crankcase heaters.

4.12 ELECTRONICS

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 is mounted inside the electrical enclosure, this 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. Do not attempt to open the enclosure box as this will void the warranty. The three phase module interprets the incoming power supply and sends the information to the CPU. Note: the 3 phase module is not field repairable. It can be easily removed and replaced if required.

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5.0 MAINTENANCE

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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 ADVANTAGE 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, ADVANTAGE 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, ADVANTAGE will advise on the repair and recommend available service contractors.

C. ADVANTAGE manufactures a complete line of heat transfer equipment. It is of the utmost importance that ADVANTAGE have the correct model number and serial number of the machine in question. This will allow ADVANTAGE to obtain the correct manufacturing records which will help the service department to properly troubleshoot the problem and obtain the proper replacement parts when they are required. This information is stamped on the metal data tag that is attached to the electrical enclosure of each machine.

D. The ADVANTAGE 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.

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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. Vacuum check compressor.
2. Addition of compressor oil.
3. Addition of refrigerant.
4. Repair of a refrigerant leak.
5. Adjustment of super heat.
6. Changing of filter-drier or drier core.
7. Repair of a refrigeration solenoid.
8. Valve plate replacement on compressor.

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5.4 SOLENOID VALVE SERVICE

A. Maximum 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 POWER light on the Maximum display is “off”.

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. Use the pressure relief valve mounted in the drain manifold to relieve all pressure.

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.

Retaining screw

Coil   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).

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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.

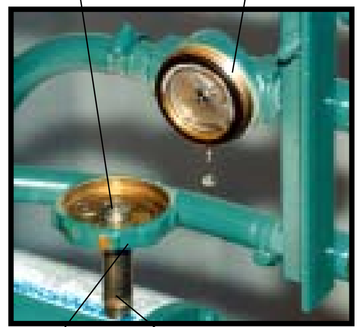

Figure 5.4C

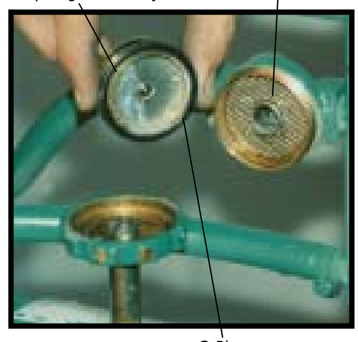

Figure 5.4D

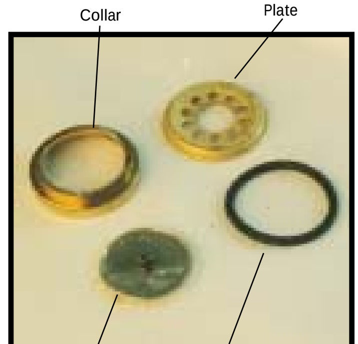

Figure 5.4E

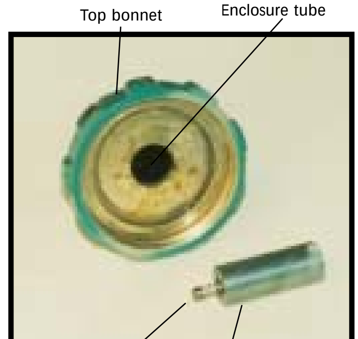

Figure 5.4F

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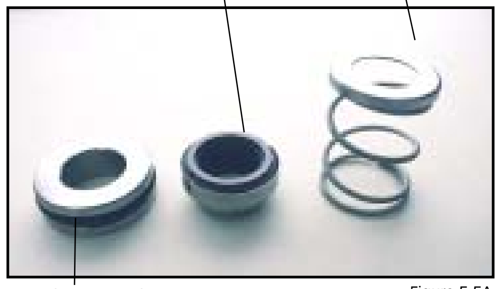
5.5 PUMP SEAL SERVICE

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

Rotating Member

Tension Spring



Stationary member

Figure 5.5A

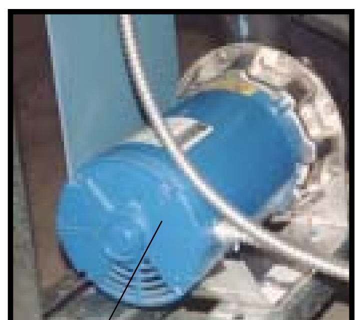
B. The operator can determine the pump seal is leaking when fluid is identified leaking from the pump case adapter. Generally, a pump seal will leak due to inadequate unit pressure, excessive flow and poor fluid quality.

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 POWER light on the display is “off”.

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



Pump motor

Figure 5.5B

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

5. Locate and remove the three motor wire leads from the motor wiring

Pump motor

Figure 5.5C

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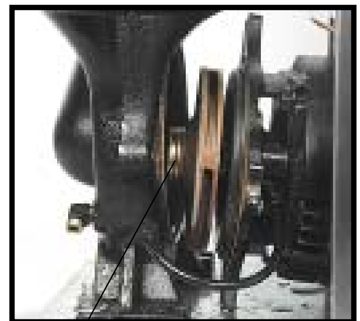
terminals. The operator should “map” the wire terminal locations to ensure correct rewiring. The power cord should be removed from the motor housing (figure 5.5C).

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

Typical pump casing bolt — Figure 5.5D

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



Impeller — 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).

Motor shaft — 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.

Typical impeller — Figure 5.5G

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

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

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

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

14. Place the spring onto the rotating member.

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

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

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

18. Reconnect the motor power cord and leads.

19. Restore all cover panels as were removed.

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

Seal components Figure 5.5H

Stationary member Figure 5.5I

Stationary member Figure 5.5J

Seal members Figure 5.5K

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5.6 CHECKING THE REFRIGERANT CHARGE

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

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

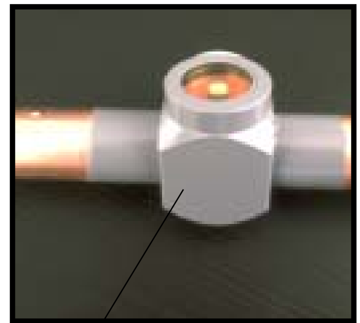

Figure 5.6A

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, ADVANTAGE recommends filters or strainers be added to the “from process” line. If the evaporator becomes fouled there are a couple of methods for cleaning.

Figure 5.6A

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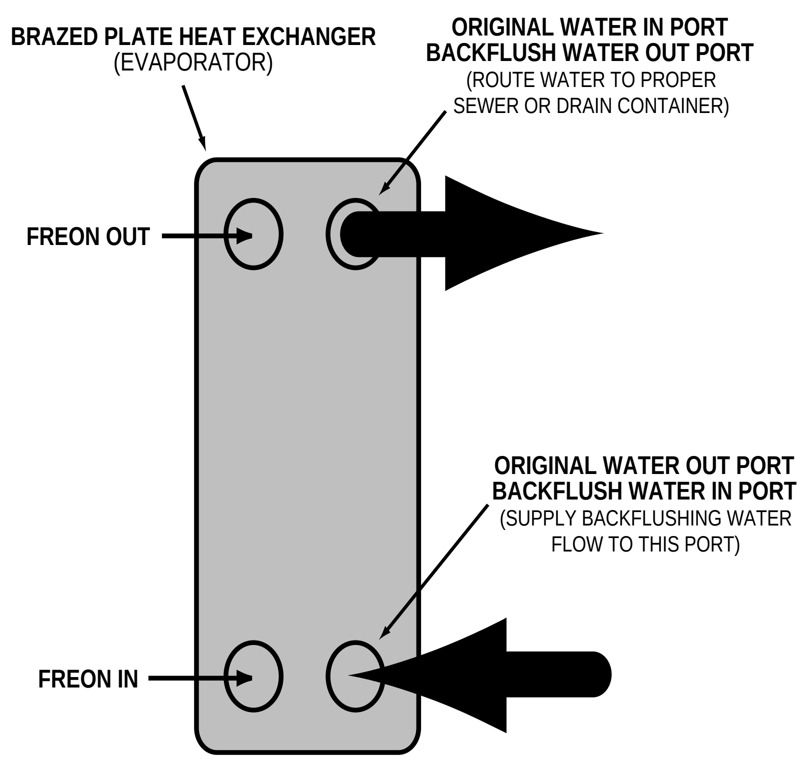
B. To begin, remove the piping to the "water in" port at the evaporator. Remove any solids that have collected at this point. Then back flush the evaporator to remove any solids that may be trapped between the plates (see back flush procedure below). If there are mineral deposits adhered to the plates, 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.



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4. The cleaning fluid source should have at least 20 psi available. If acid cleaning, follow the instructions supplied with the acid solution carefully.

5. When the procedure is complete, reinstall all water lines to original factory orientation. Restart the unit and check for proper operation.

6. Note: this procedure is not normal maintenance. Maintaining proper water quality and filtration will minimize the need to back flush the evaporator.

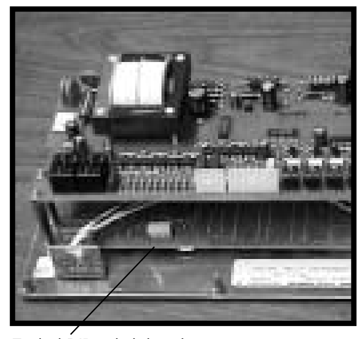
5.8 DIP SWITCH ADJUSTMENT

A. This switch is located on the CPU board (figure 5.8A).

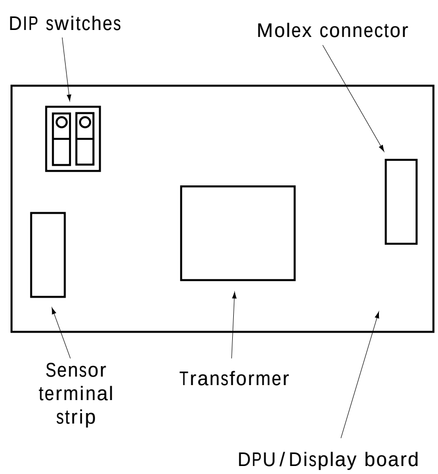
B. Disconnect the incoming power supply to the chiller.

C. Identify the DIP switch on the CPU board.

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


Typical DIP switch location Figure 5.8A

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



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6.0 COMPONENTS

6.1 WATER SYSTEM

6.2 REFRIGERATION SYSTEM

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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).

B. FREEZESTAT: the freezestat aids in protecting the evaporator from potential freezing. The freezestat is factory adjusted to 40°F. The freezestat must be field adjusted for operating with setpoints below 48°F (figure 6.1B).


Typical pump Figure 6.1A


Mechanical freezestat Figure 6.1C

6.2 REFRIGERATION SYSTEM

A. COMPRESSOR: 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).

C. WATER COOLED CONDENSER: the water cooled condenser removes BTU's (heat) from the compressed refrigerant gas. As the heat is removed, the gas "condenses" into a liquid state, still under high pressure. Tube-in-shell condensers are used on 15-30 ton models. Tube-in-tube condensers are used on 5-10 ton models. Water regulator valves are used on all models to control the refrigerant head pressure by modulating the condenser water flow (figure 6.2C).


Typical compressor Figure 6.2A


Typical air-cooled condenser Figure 6.2B

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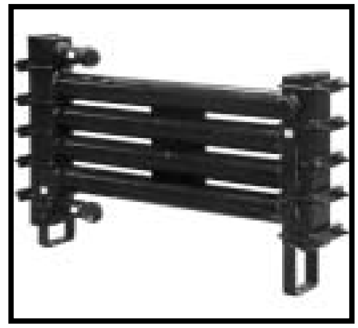


Typical water cooled condenser Figure 6.2C

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

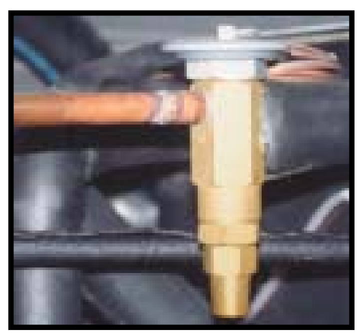
E. LIQUID LINE SOLENOID VALVE: controlled by the instrument, this valve closes when the compressor cycles off to prevent refrigerant liquid from migrating to the evaporator. The valve opens when the compressor cycles on.

Typical filter-drier Figure 6.2D

F. 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 (figure 6.2E).

Refrigerant sight glass Figure 6.2E

G. 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 6.2F).



Expansion Valve Figure 6.2F

H. 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 6.2G).

I. 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.

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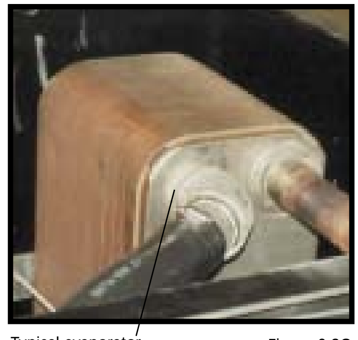

Typical evaporator Figure 6.2G

J. HIGH/LOW PRESSURESTATS: the high/low pressurestats protect the refrigeration system from unsafe operating levels. The high pressure switch is factory set to open at 325 psi 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. The low pressure switch is factory set to open at 58 psi and to close at 63 psi. 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.

K. Liquid receiver: located after the condenser, this component receives and stores liquid refrigerant leaving the condenser.

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

M. 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.

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7.0 RELATED DRAWINGS

7.1 AIR-COOLED MECHANICAL SCHEMATIC

7.2 WATER-COOLED MECHANICAL SCHEMATIC

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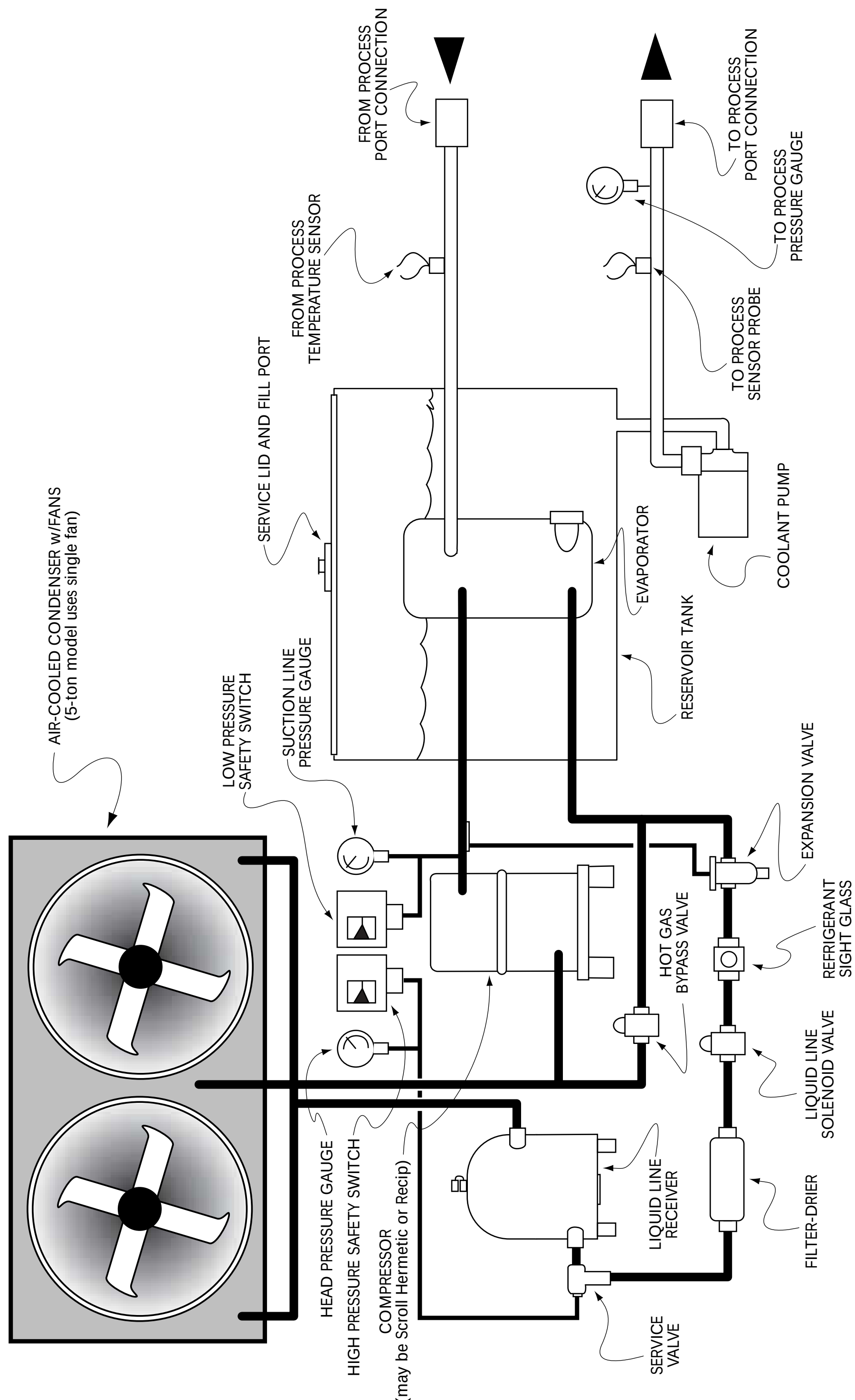
7.1 AIR-COOLED MECHANICAL SCHEMATIC



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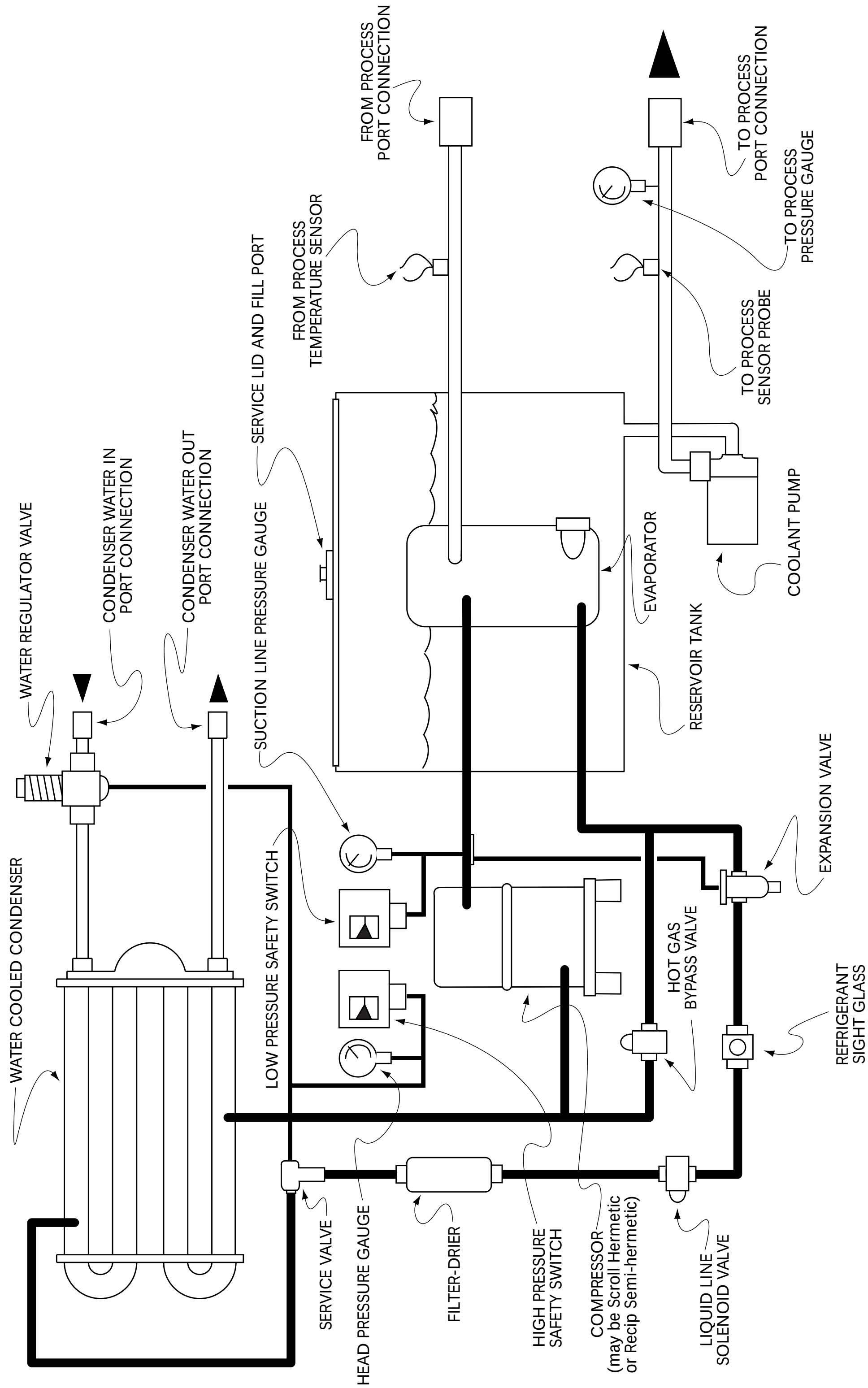
7.2 WATER-COOLED MECHANICAL SCHEMATIC



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8.0 APPENDIX

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8.1 SPECIFICATIONS

SPECIFICATIONS	***IK-***	***.25A***	***.33A***	***.5A***	***.75A***	***1A***	***1.5A***	***2A***	***2W***	***3W***	***3A***	***4A***
COMPRESSOR	Capacity[2]	.25	.32	.41	.70	.98	1.35	2	2	3	3	4
	HP each	.25	.33	.50	.75	1	1.5	2	2	3	3	4
	Type[3]	H	H	H	H	H	H	H	H	H	H	H
PROCESS PUMP	HP	1/4	1/4	1/4	1/4	1/2	1/2	3/4	3/4	3/4	3/4	3/4
	GPM	.6	.8	.9	1.7	2.4	3.6	4.8	4.8	7.2	7.2	9.6
	PSI	60	60	60	60	60	60	40	40	39	39	38
CONNECTION	Process	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	1 1/4	1 1/4
SIZES **(inches)**	Condenser	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1/2	1/2	n/a	n/a
FULL LOAD[1]	115/1ø/60[4]	14	15	19	28	30	n/a	n/a	n/a	n/a	n/a	n/a
AMPERAGE	220/1ø/60[4]	n/a	n/a	8	14	15	21	n/a	n/a	n/a	n/a	n/a
	208/3ø/60[4]	n/a	n/a	n/a	n/a	n/a	n/a	15	13	20	29	28
	230/3ø/60[4]	n/a	n/a	n/a	n/a	n/a	n/a	13	12	18	26	25
	460/3ø/60[4]	n/a	n/a	n/a	n/a	n/a	n/a	7	6	9	13	12
REFRIGERANT	Type HCFC	22	22	22	22	22	22	22	22	22	22	22
TANK CAPACITY	Gallons	4	4	4	4	4	4	7 1/2	7 1/2	7 1/2	25	25
DIMENSIONS	Height	33	33	33	33	33	37	30	30	30	43	60
(inches)	Width	18	18	18	18	18	19	37	37	37	34	34
	Depth	24	24	24	24	24	25	24	24	24	40	40
WEIGHTS	Net	150	150	170	205	210	220	290	320	340	640	650
(pounds)	Shipping[5]	185	185	205	240	245	255	415	445	470	845	855

Notes: 1. Full load amps must be used for sizing disconnects and supply wiring. **2.** Tons of capacity at 12,000 BTU/ton @ 50°F LWT @ 105°F condensing temperature for water-cooled units and 115°F for air-cooled units. Capacities may be +/- 5% as reserved by the compressor manufacturer. Capacity multipliers are 50°F - 1.00; 40°F -.80; 30°F - .60; 20°F - .40. The minimum recommended operating temperature when no glycol is used is 48°F. **3.** H - hermetic compressor used on this model. **4.** Consult factory for 50hz operation. **5.** Approximate unit weight crated for shipment.

8.2 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 8.2A. 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 8.2B.

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.

OPERATING TEMPERATURE	ANTI-FREEZE MIXTURE GLYCOL	WATER
40°F	20%	80%
35°F	25%	75%
30°F	30%	70%

Figure 8.2A

OPERATING TEMPERATURE	LOW CUT IN	LOW CUT OUT	FREEZESTAT SETTING
48°F	63#	58#	38°F
40°F	50#	35#	30°F
35°F	45#	30#	25°F
30°F	40#	25#	20°F

Figure 8.2B

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8.3 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.

8.4 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.

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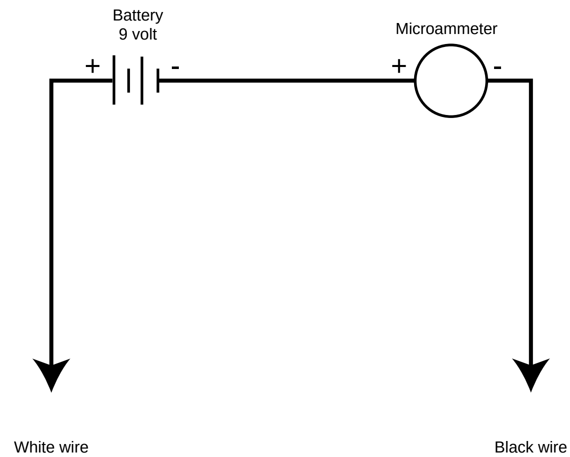
8.5 SENSOR CURRENT VS TEMPERATURE

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



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8.6 PRESSURE-TEMPERATURE CHART FOR R-22 REFRIGERANT

SATURATED TEMPERATURE	FREON PRESSURE
40°F	68
45°F	76
50°F	84
55°F	93
60°F	100
65°F	112
70°F	122
75°F	132
80°F	144
85°F	156
90°F	168
95°F	182
100°F	196

THESE PRESSURE/TEMPERATURE RELATIONSHIPS ARE IN AN AT-REST, SATURATED CONDITION. FOR EXAMPLE, IF THE UNIT HAS BEEN IN A WAREHOUSE AT 40° AND IS BROUGHT INTO A ROOM WHERE IT IS 80°, IT MAY TAKE A COUPLE OF HOURS FOR THE UNIT TO WARM UP AND THE PRESSURE TO RISE TO THE SURROUNDING AMBIENT CONDITIONS.

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8.7 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.

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