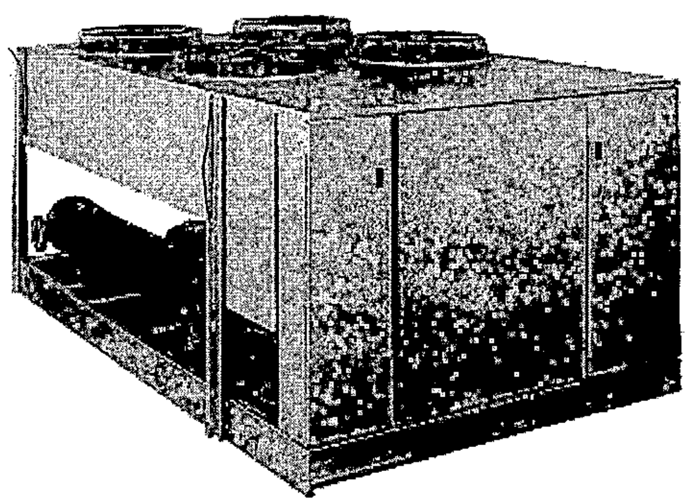
API KETEMA

Heat Transfer

Installation
Operation
Maintenance

H-IM-***	October 1998	P/N 250*****

MODEL: AIR COOLED RECIPROCATING PACKAGED CHILLERS



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INSPECTION

Unit inspection should be assigned to a dependable individual. Unit should be inspected carefully for concealed damage. All items on bill of lading should be accounted for prior to signing the shipping receipt. Note any shortages or damage on carrier's delivery receipt (Specify the extent and type of damage found). Notify Heatcraft sales representative and carrier of the damage immediately. Request an immediate joint inspection with the carrier (Do not repair unit until inspected by carrier's representative). Care should be exercised when uncrating units to prevent damage. The unit's shipping base should be left intact until unit has been moved to final location. After receiving, shipped loose items should be enclosed in either the control panel or attached to the unit skid to prevent loss or possible interchanging with other units.

STORAGE

If the unit is to be stored for an extended period of time prior to installation, the following precautions should be followed:

1. Unit should be stored in a secure location.
2. Unit should be left on its shipping base.
3. Every three months, the pressure of the refrigerant circuits should be checked to assure no refrigerant leakage has occurred. If a refrigerant leak is indicated, the refrigerant charge should be removed, the leak fixed, the circuit leak tested, evacuated and recharged by a qualified refrigeration service company.

SYSTEM WARRANTY

This equipment is designed to operate properly and produce rated capacity when installed in accordance with accepted industry standards. Failure to meet the following conditions may result in voiding of the system warranty:

1. System piping must be installed following industry standards for good piping practices.
2. Power supply to standard units must meet the tolerances listed in the electrical data tables in Appendix A.: All other voltages must not exceed $\pm$10% of nameplate ratings. Phase imbalance should not exceed 2%. Refer to unit data plate for Voltage, Minimum Circuit Ampacity (MCA) and Maximum Overcurrent Protection (MOPD).
3. All controls and safety switch circuits properly connected per wiring diagram.
4. Factory installed wiring must not be changed without factory approval.
5. A paddle type flow switch must be properly installed and wired into the unit's control circuit.

GENERAL

- Installation and maintenance to be performed only by qualified personnel who are familiar with this type of equipment.
- Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.
- Units are designed for outdoor installations.
- Vertical air discharge allows for either rooftop or ground installations.
- Avoid contact with sharp edges and coil surfaces. They are a potential injury hazard.
- Make sure all power sources are disconnected before any service work is done on units.

RIGGING

The chiller should be moved by lifting. Lifting holes are provided in the base frame on all units. Lifting bars should be inserted through the frame holes. Cables/chains should be connected to the lifting bars and then connected to an overhead spreader bar. Each Cable/Chain should be strong enough to support the weight of the unit. Cables/chains may need to be adjusted to keep the unit level while it is lifted. Please see the physical data tables in the Appendix for estimated operating weight of standard base units (no options).

> Caution: TO PREVENT DAMAGE TO UNIT HOUSING DURING RIGGING; CABLES OR CHAINS MUST BE USED AND HELD AWAY FROM THE UNIT HOUSING BY SPREADER BARS.

> Caution: THE REFRIGERANT PIPING SHOULD NOT BE USED AS A HAND HOLD OR A LADDER.

> **WARNING:** UNIT RIGGING SHOULD BE PERFORMED BY A QUALIFIED RIGGING COMPANY.

MOUNTING

- The mounting platform or base should be level and located so as to permit free access of supply air.
- Units must not be located in the vicinity of steam, hot air or fume exhausts.
- The unit should be mounted away from noise sensitive spaces such as offices.
- The unit must have adequate support to avoid vibration and noise transmission into the building. Sound and structural consultants should be retained for recommendations.

Ground Mounting

The unit must be set on a flat and level foundation. A single piece concrete slab with footings extending below the frost line and raised approximately six inches above ground level provides a suitable base. Raising the base above ground level provides some protection from ground water and wind blown matter. The concrete slab should be isolated from the building structure. Finally, before tightening mounting bolts, recheck the level of the unit.

Roof Mounting

Rooftop installations require adequate structural beams to support the weight of the unit and service personnel. The design of the beams/supports must minimize deflection and attendant vibration transmission.

Due to the weights involved, a structural analysis by a qualified engineer may be required before mounting. **Also, for sound sensitive applications, unit vibration isolators should be used.**

UNIT VIBRATION ISOLATION

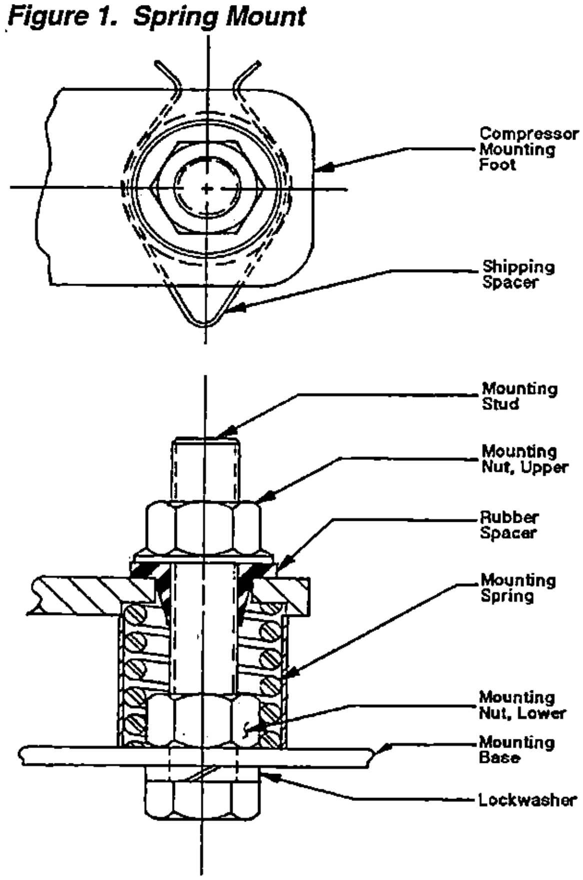
Under certain critical conditions, it is recommended that vibration isolators, of a suitable type, be installed under the base. The isolators must be designed for the operating weight of the unit. Rubber-in-shear or spring type isolators (by others) are available for this purpose. To further reduce the transmission of vibrations, it is recommended that flexible connections, suitable for the system water pressure, be installed on the water connections of the chiller barrel.

COMPRESSOR SPRING VIBRATION ISOLATORS

On units with this option, the compressors are secured rigidly to make sure there is no transit damage. Before operating the unit, it is necessary to follow these steps:

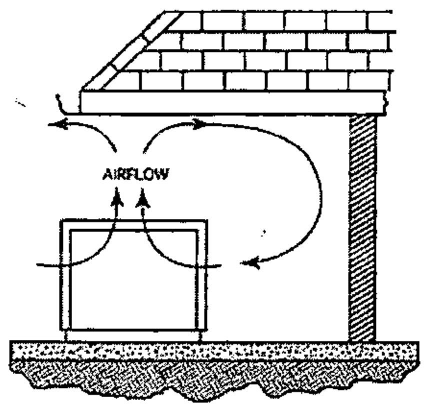
1. Remove the upper nuts and washers.
2. Discard the shipping spacers.
3. Install the neoprene spacers. (Spacers located in the electrical panel or tied to compressor.)
4. Replace the upper mounting nuts and washers.
5. Allow 1/16 inch space between the mounting nut/washer and the neoprene spacer.

Figure 1. Spring Mount



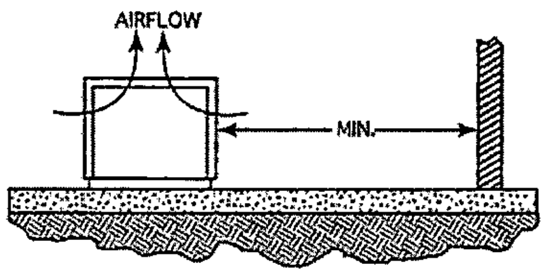
Unit Access

Always provide sufficient clearance for unit maintenance and service. Minimum clearances for most situations are described below (except 60 Inches of free space is required in front of the control panel). Please note that these are minimums and more clearance may be required by local codes.



Vertical Clearance

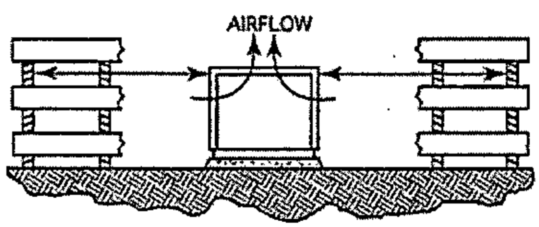
Overhead obstructions are not permitted. Vertical air discharge from the condenser must have no obstructions which can cause the discharge air to be recirculated back to the inlet side of the unit.



Lateral Clearance

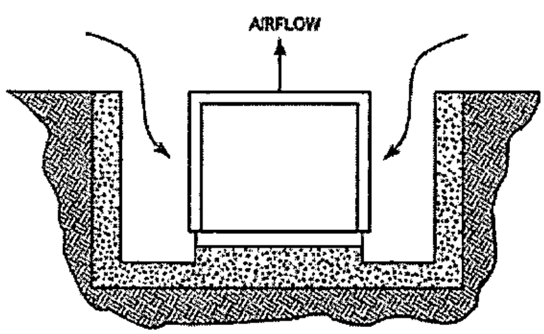
(Walls or Obstructions)

The unit should be located so that air may circulate freely and not be recirculated. For proper air flow and access, all sides of the unit (except control panel end) should be a minimum of four feet (1.2 m) away from any wall or obstruction. It is preferred that this distance be increased whenever possible. Care should be taken to see that ample room is left for maintenance work through access doors and panels. When the unit is in an area where it is enclosed by three walls the unit must be installed under the guidelines for unit installations in pits.



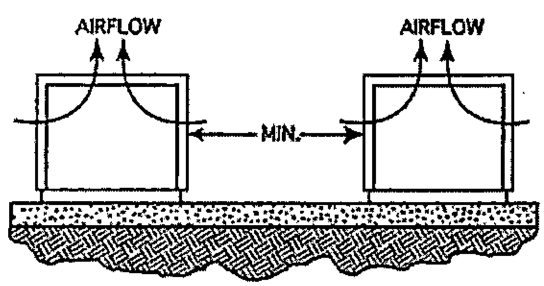
Decorative Fences

Fences may be installed closer than the four foot (1.2 m) lateral minimum (except on the control panel end) requirement whenever fences permit sufficient free area to allow adequate air flow to the unit. Once again, care should be taken to leave ample room for unit service. Recommended service clearances are listed above.



Units in Pits

The top of the unit should be level with the top of the pit. If the top of the unit is not level with the top of the pit, a wider pit or discharge stacks must be used to raise discharge air to the top of the pit. This is a minimum requirement. This situation should be reviewed by the factory prior to unit installation.



Multiple Units

(Unit-to-Unit Clearance)

For units placed side by side, the minimum distance between units is eight feet (2.4 M) to prevent air recirculation.

Electrical System

Field wiring to the unit should comply with all local codes as well as the National Electric Code. **The supply power source should be checked against the unit's nameplate to assure proper voltage, phase and frequency.** Wire sizes and overcurrent protection device size should be confirmed using the MCA and MOPD data located on the unit's nameplate. (Electrical data on standard units can be found in the Appendix). A copy of order specific wiring diagrams are attached to the inside of the unit's control panel doors. An additional copy is shipped loose in an envelope located in the. control panel.

Caution: Use copper conductors of the appropriate size only.

Chilled Water Distribution System

In order for the packaged chiller to function, a properly sized pump and water distribution system must be installed. Failure to pay close attention to the water system design can result in poor machine performance, equipment damage, and possible voiding of the system warranty. The following information is offered as a guide only, and does not remove the responsibility of installing an efficient, trouble free water distribution system from the installing contractor or design engineer.

Water Flow Switch

A properly located and wired paddle type flow switch in the outlet of the chiller barrel is mandatory for a valid unit warranty. The flow switch should be mounted as follows:

1. The switch should be mounted in a straight (at least 5 pipe diameters from nearest bend) horizontal line on the outlet of the chiller barrel. Locate switch with arrow pointing in the direction of liquid flow. Paddle should be at right angles to fluid flow. Do not locate adjacent to valves, elbows or orifices. The switch should be mounted so wiring connections are accessible.
2. Mount in a standard 1"x1"x1" tee for a 1"pipe or use a reducing tee for larger pipe. If a standard tee is used, a face or hex busing will need to be used in the top opening.
3. Adjust paddle to proper size for the pipe size.
4. Wire the switch to the appropriate terminals in the unit using copper conductors and according to local/national codes.

Caution: Paddle must not touch the pipe or any other restrictions in the pipe.

Water Condition

Proper care should be given to maintain a clean system. Foreign matter such as scale, dirt and corrosion material can severely affect the system performance. Such matter may also cause blockage which increases water pressure drop and reduces water flow. In addition, the use of improperly treated or untreated water in this system may cause evaporator fouling (scaling, alga or slime), erosion or corrosion which may void system warranty.

Due to the regional differences of water conditions, a local water treatment specialist should be retained to determine a proper water treatment program. **Do not use salt or brackish water in chilled water systems.** Both have a detrimental effect on the life of system components.

Water Flow Requirements

It is imperative for system performance and protection that the proper fluid flow rate be maintained. Operation at flow rates below the design may cause stratification, scaling, erratic operation or evaporator freeze up. Excessive water flow can cause erosion to the tubes in the heat exchanger. Protection devices (water flow switch) shall ensure that the chiller does not operate when water flow is stopped or below the minimum gpm.

Evaporator Freeze Protection

It is recommended that the cooler and piping of the chiller in pure water systems be drained during the winter months if not in use. Units are equipped with a chiller barrel heater cable which is designed to protect the cooler from freezing in ambients down to -20°F (-29°C). If the unit is to be operated during times that the ambient is below freezing, one of the following precautions must be utilized:

1. Add the appropriate percentage of ethylene or propylene glycol to the chilled water system. This amount should be calculated at a freeze point approximately 10°F (5.6°C) below the lowest anticipated ambient condition. (Do not use automotive antifreeze as the inhibitors in this type solution will foul the heat transfer surfaces.) Please note that use of glycol will affect system performance and should be accounted for when selecting the components.
2. Heat tape and insulation should be applied to the fluid lines that are exposed to low ambient temperatures. The heat tape must be rated for the lowest expected ambient temperature.

WARNING:WARNING - THE EVAPORATOR MAY FREEZE DURING A LOSS OF POWER OR HEATER CABLE FAILURE.

Water Piping Practices

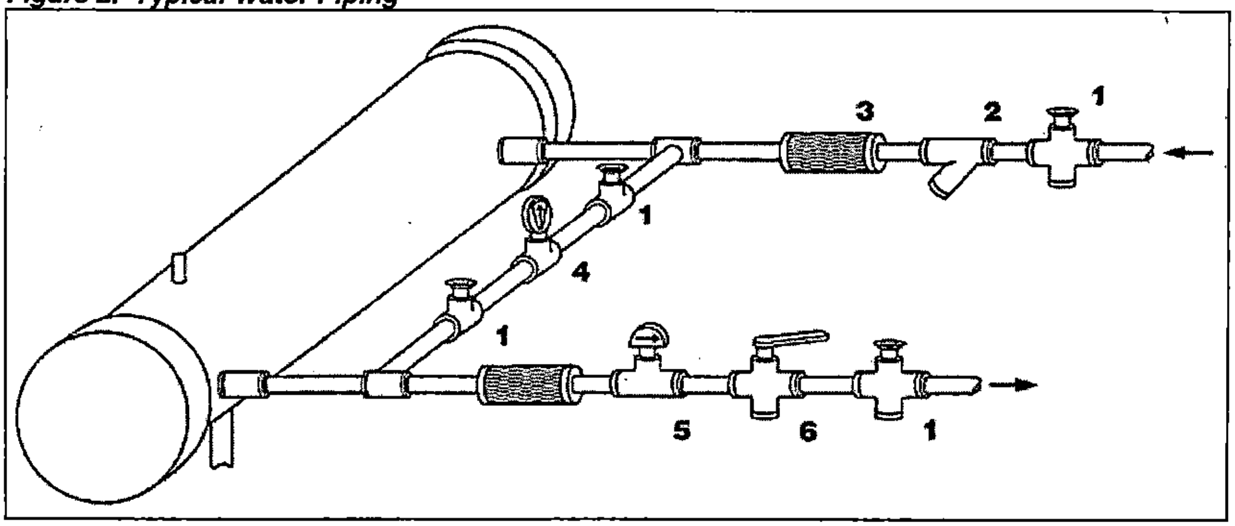
Please refer to Figures 2 and 3 for typical water piping configurations. For typical piping, the following should be observed:

1. Water piping should be selected and installed to provide minimal pressure drop.
2. The water piping design should make provisions for purging (at all high points), draining, and charging. All piping should be installed per local and national codes.
3. Water piping should be insulated with a low permeation rate insulation to prevent condensation and to reduce heat gain.
4. Before final connections are made to the chiller, the piping should be thoroughly flushed.
5. Water piping should include properly sized relief valves and be located as required by local and national codes.
6. The water piping should be adequately supported to prevent external forces from being applied to the chiller barrel connections.

Minimum System Water

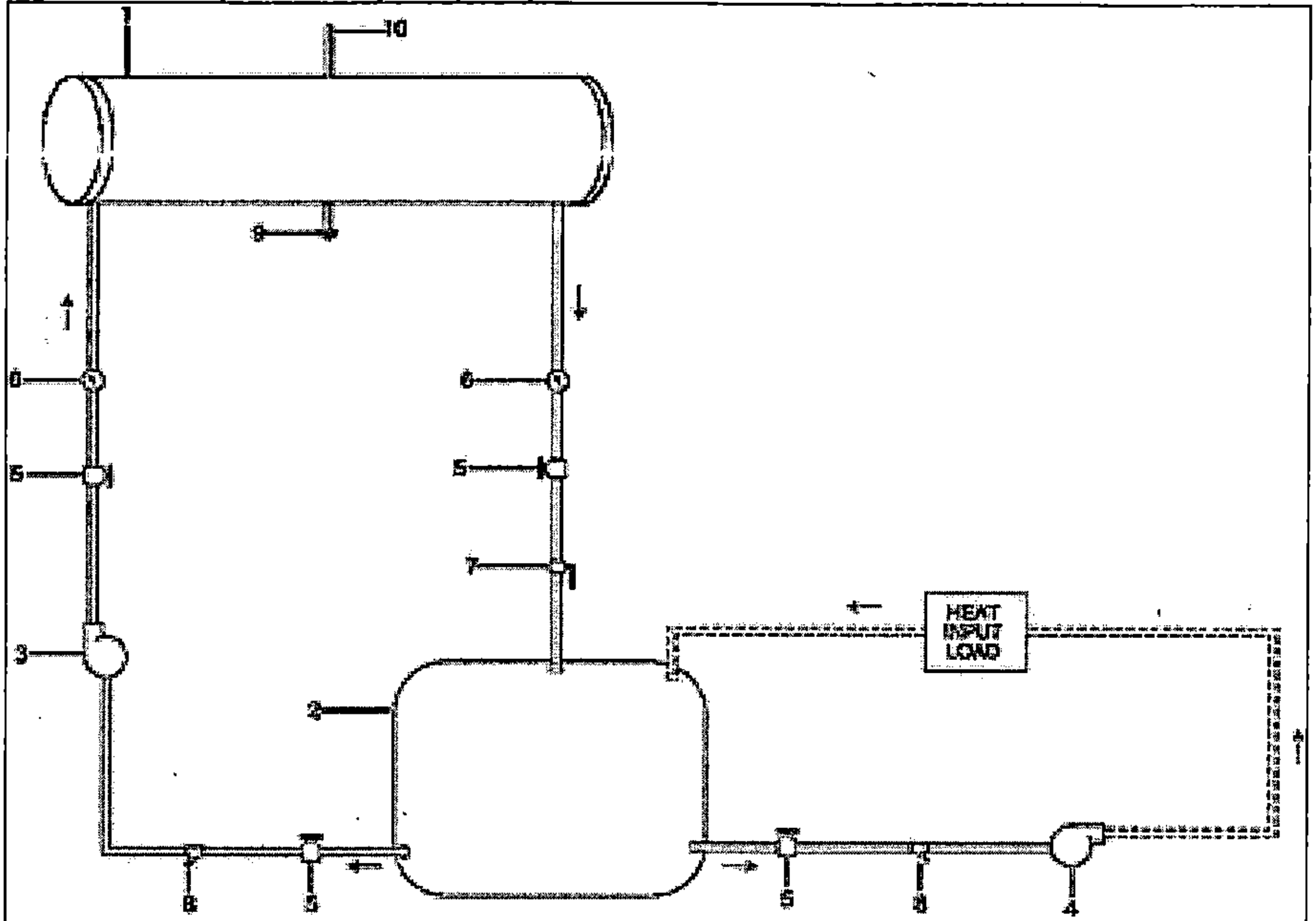
To eliminate excessive compressor cycling and loss of capacity control, a minimum of 7 gallons of water per nominal ton (7.7 liters/kW) should be contained within the chilled water loop. An insufficient volume of water will not provide an adequate buffer to temperature changes. An oversized header and/or a storage tank would eliminate this potential problem.

Figure 2. Typical Water Piping



1. Shut off valve
2. Strainer
3. Vibration dampener
4. Differential pressure gauge
5. Flow switch
6. Balancing valve

Figure 3. Primary / Secondary Pump Loop



1. Chiller
2. Tank
3. Recirculating Pump
4. System Pump
5. Flow Valve / Union
6. Pressure Gauge
7. Flow Switch
8. Strainer
9. Drain
10. Vent

——— Factory Piping (optional)
------- Field Piping

Pump Selection

In any powered chilled water system, the fluid pump is the "heart" of the system. Failure of the pump to perform as required will cause the entire system to malfunction. The following items should be considered when selecting a pump:

1. The pump must be sized to provide the specified flow rate at the maximum anticipated total feet of head. The total head must include all associated valves, fittings and coils, plus the expected pressure drop through the chiller. (Refer to the chiller specifications for chiller barrel pressure drop).
2. The pump, valves, controls and fittings must all be rated for operation at your design water temperature. If you are using chemical freeze protection, the components must also be rated compatible with the solution. Total head may increase due to the higher viscosity of some solutions. (NOTE: Chiller barrel pressure drop multipliers for ethylene glycol solutions can be found in the chiller brochure.)
3. **Units are designed for a constant volume of fluid through the chiller barrel.** Use of VFD pumps in the evaporator water piping system is prohibited.

OPERATING RESTRICTIONS

Ambient Temperature Limits

Standard units are equipped for operation in ambients from 20° F (-6.7° C) through 110° F (43° C). [Except model 90B] Optional low ambient controls allow for operation down to -20° F (-29° C).

WATER TEMPERATURE LIMITS

Leaving Water Temperature

Standard chillers are designed to operate at a Leaving Water Temperature (LWT) range of 42° F through 65° F (6° C) through 18° C.), and can operate safely at this range without the need of special controls or glycol additives. LWT below 42° F. (6° C.) will result in evaporator suction temperatures at or below the freezing point of water and therefore require a glycol solution additive. Glycol solutions will decrease system capacity and this should be accounted for at the design phase of the project.

Entering Water Temperature

The maximum entering water temperature (EWT) allowed on standard units is 75°F. In addition, standard units are designed for a 10°F (5.6°C) chilled water temperature difference. Temperature difference above or below this range will affect system capacity and should be determined in the design phase of the project. If minimum and maximum water temperature and proper flow rates are maintained, the chiller can operate at water temperature difference from 6°F through 18°F (3.3°C through 10°C). Such temperature differences are outside the standard operating conditions and should be verified by the factory.

SEQUENCE OF OPERATION

Electrical power is field supplied to the main distribution block (L1, L2 and L3) in the electrical control panel. Electrical power is then distributed to the compressor contactors, the condenser fan motor contactors and the optional pump starter and optional control power transformer. Electrical control power is field supplied to the appropriate terminals when the optional transformer is not included in the system package. The compressor crankcase heater (CCH) circuit is energized whenever control power is present and the compressor contactor is not energized. The chiller barrel heater (CBH) is energized when the ambient temperature drops below the temperature setting of the adjustable chiller barrel thermostat (CBT). During periods of freezing ambient, the CBH will protect the chiller barrel from freezing.

Caution: THE CRANKCASE HEATER SHOULD BE ENERGIZED 24 HRS. PRIOR TO START-UP.

WARNING: THE LOSS OF CONTROL POWER WILL DISABLE SYSTEM SAFETIES AND MAY VOID WARRANTY.

Whenever main electrical power is present, the compressor can operate and pump down as necessary using the low pressure switch (LPS) as the control. Before the chiller system can start and operate automatically, the chilled fluid pump must be operating and the fluid flow-switch must be closed. The pump starter should have a normally open auxiliary contact that closes when the pump starter is energized. This contact and the flow switch should be wired in series prior to the system thermostat controls. Review the unit wiring diagram for connection points. (Any other type switches, i.e. remote on/off, timers, etc. should be wired in series with the auxiliary contact and the flow switch)

WARNING: WARRANTY WILL BE VOID IF A FLOW SWITCH IS NOT INSTALLED.

With the pump starter auxiliary contact and the flow switch closed, control power is supplied to the leaving water temperature safety thermostat (T2) which will be closed unless the leaving water temperature is below the set point. This control is manual reset and will open on sensing low water temperature (below its set point). The cooling cycle is sensed from the automatic thermostat (T1) (close on rise) usually located in the entering fluid stream. On multiple circuit chillers, this control may be a sequential staging type. When the T1 thermostat closes, the temperature control relay (R1/R2) energizes.

When the temperature control relay energizes, a normally open contact closes and bypasses the low pressure switch (LPS) and starts to complete the liquid line solenoid valve (LLSV) circuit. If all of the following safeties are satisfied, the compressor and condenser fans can start. The safeties that must be satisfied are the compressor solid state protection module (SSM), the high pressure safety switch (HPS), the low pressure freezstat (LPF) and the oil pressure safety control (OP). When the control circuit is completed to the compressor contactor(s), another relay (R3 / R4) is energized. This relay controls a normally open contact that closes and completes the control circuit to the LLSV. This relay also acts as a safety and will cause the LLSV to close whenever one of the compressor safeties open shutting off the compressor. This prevents the continued flow of liquid refrigerant through the chiller barrel when the compressor is not operating.

When the relays R1 (and/or R2) and R3 (and/or R4) are energized, the liquid line solenoid valve will energize (open) and allow refrigerant to flow to the thermal expansion valve (TEV). If the refrigeration load requirement falls, the suction pressure will drop causing the unloader pressure control (UPC) to close and the unloader solenoid valve (USV) to energize. This action effectively causes the compressor to unload to try to match the load condition. If the cooling load requirement rises, the suction pressure will rise causing the unloader pressure switch to open. This action de-energizes the unloader solenoid valve returning the compressor to full load status. (In multiple circuit units, the compressor unloaders may also be operated by the temperature staging control.)

When the cooling load has been satisfied, the thermostat T1 opens and de-energizes the temperature control relay (R1 and/or R2). This action immediately opens the control circuit to the LLSV and opens the bypass to the LPS. The LLSV closes stopping the flow of refrigerant and now allows the compressor control circuit to operate via the LPS. The compressor will continue to run until the set point of the low pressure pumpdown switch (LPS) is reached. At that time, the compressor control circuit opens and the compressor and condenser fans stop. The compressor will periodically repeat the pumpdown cycle to maintain the suction pressure set point of the LPS.

OPTIONAL FEATURE OPERATION

Low Ambient Lockout (LAT)

This safety switch will prevent unit from operating in ambient conditions lower than the design parameters of the unit. The switch opens the control circuit when the ambient temperature drops below the LAT cut-out set point disabling the operating thermostat (T1). The unit can operate normally when the ambient temperature rises above the LAT cut-in set point.

Control Circuit Transformer

When field supplied control power is not available, this option will convert the high voltage power supply to the low voltage control power. When factory installed, the primary side of the transformer will be protected by fuses.

Fused/Non Fused Disconnect Switch (single compressor units only)

Mounted through the control panel door, this option is used to disconnect the unit from the main power source for servicing purposes. The fused version will have a fuse in all three phases (The fuses protect the wire conductors from the disconnect switch to the unit terminal block).

Caution: THE DISCONNECT SWITCH IS NOT TO BE USED TO TURN UNIT ON AND OFF.

WARNING: UNITS MAY HAVE MULTIPLE POWER SUPPLIES. MAKE SURE ALL POWER SOURCES ARE DISCONNECTED PRIOR TO SERVICING.

Part Winding Start

(not available on models 15 and 30)

This option is used to reduce the starting inrush current of the compressor. This is accomplished by the use of a time delay between the two compressor contactors. When control power is supplied, the first compressor contactor is energized allowing power to 1/2 the compressor motor windings and the time-delay timer is activated. Upon the completion of the timing cycle (approximately 1 sec.), the second compressor contactor is energized allowing power to the rest of the motor windings.

Phase Line Monitor (PLM)

The phase line monitor is a microprocessor-based voltage and phase sensing circuit that constantly monitors the three phase voltages to detect harmful power conditions. This control protects the unit from loss of any phase, voltage unbalance, phase reversal, under voltage and over voltage.

When a harmful condition is detected, the output relay is deactivated after a specified trip delay. The output relay re-activates after power line conditions return to an acceptable level for a specified amount of time (Restart Delay).

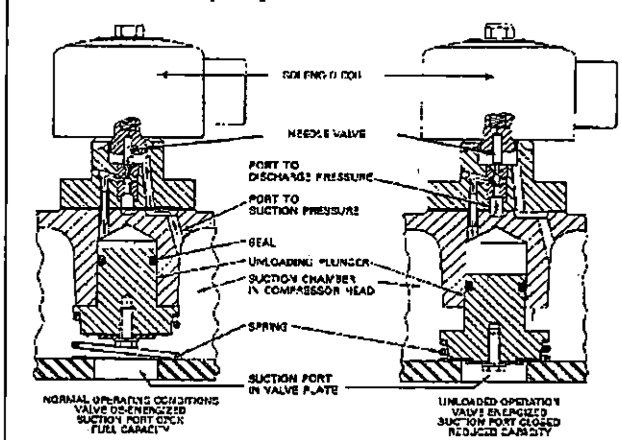
The relay output consist of a normally open and a normally closed contact. The control circuit is wired through the normally open contact. Should a fault occur, the output deactivates and the control circuit is interrupted.

Cylinder Unloading

One step of cylinder unloading per compressor is standard on all units. One additional step of cylinder unloading per compressor is available on models 30A, 35A, 60B, 70B, 80B, 90B and 100B. When supplied, the second unloader pressure switch (UPC2 and/or UPC4) on each circuit receives control power at the same time the first unloader pressure switch (UPC1 and/or UPC3). If the suction pressure continues to decrease after the first step of unloading, the second unloader pressure switch will close energizing the corresponding unloader solenoid valve (USV2 and/or USV4) which causes the compressor to unload an additional step. When the suction pressure rises above the switch's cut in set point, the switch will open de-energizing the unloader solenoid valve on that circuit and causing that compressor to load up.

Figure 4. Capacity Control

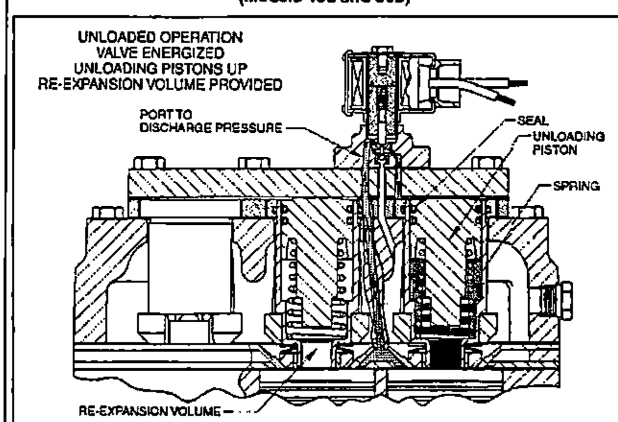
Capacity Control ARC Series



SCHEMATIC OPERATION OF INTERNAL UNLOADER VALVE

Figure 5. Capacity Control (15 & 30)

Capacity Control
(Models 15a and 30b)



SUCTION GAS ■ DISCHARGE GAS

Hot Gas Bypass

A method of capacity control, hot gas bypass allows hot discharge gas to flow directly to the chiller barrel refrigerant inlet connection(s) immediately after the thermal expansion valve(s). This influx of hot gas creates a false load preventing the unit from cycling off during low loads. Hot gas bypass, in conjunction with cylinder unloading, is designed to allow the unit to operate down to ten percent of the unit's overall capacity. Hot gas bypass for each circuit is wired in series with the last unloader pressure switch on that compressor circuit. When the unloader pressure switch closes, a time delay (90 seconds) is activated. Upon completion of the time delay, control power energizes the hot gas solenoid valve (HGSV) which opens and allows compressor discharge gas to flow to the hot gas bypass regulator which senses suction pressure on the circuit. On a decrease in pressure, the regulator will open feeding hot gas prior to the chiller barrel but after the thermal expansion valve. As load returns, the suction pressure will rise causing the regulator to close and the unloader pressure switch to open which de-energizes the hot gas solenoid valve.

Load Limit Control

Load limit control is utilized to prevent the unit's compressor(s) from overloading during pulldown/start up. The load limit thermostat senses the entering fluid temperature to the chiller barrel. If the fluid temperature is above the thermostat's set point, the switch will close allowing relays wired in series to be energized. When energized, the relays close a set of normally open contacts which are wired in parallel with the compressor(s) unloader pressure switches bypassing the unloader pressure switches (UPC) and energizing the unloading solenoid valves causing the compressor(s) to unload. When the entering fluid temperature reaches the thermostat's set point, the switch will open, de-energizing the relays and the unloader solenoid valves.

> Caution: LOAD LIMIT THERMOSTAT SENSING BULB MUST BE FIELD INSTALLED IN A BULBWELL IN THE ENTERING FLUID STREAM.

Anti Short Cycle Timer (ASCT)

Each refrigerant circuit will have a solid state timer that helps prevent the corresponding compressor from short cycling. The timers are wired after the operating thermostat and before the corresponding control relay(s) (R1 and/or R2). When the cooling load is satisfied and the operating thermostat opens for that circuit, the timer is activated and the refrigeration circuit is disabled for a set amount of time. The timers are adjustable but are factory set for five minutes.

Lead/Lag Switch

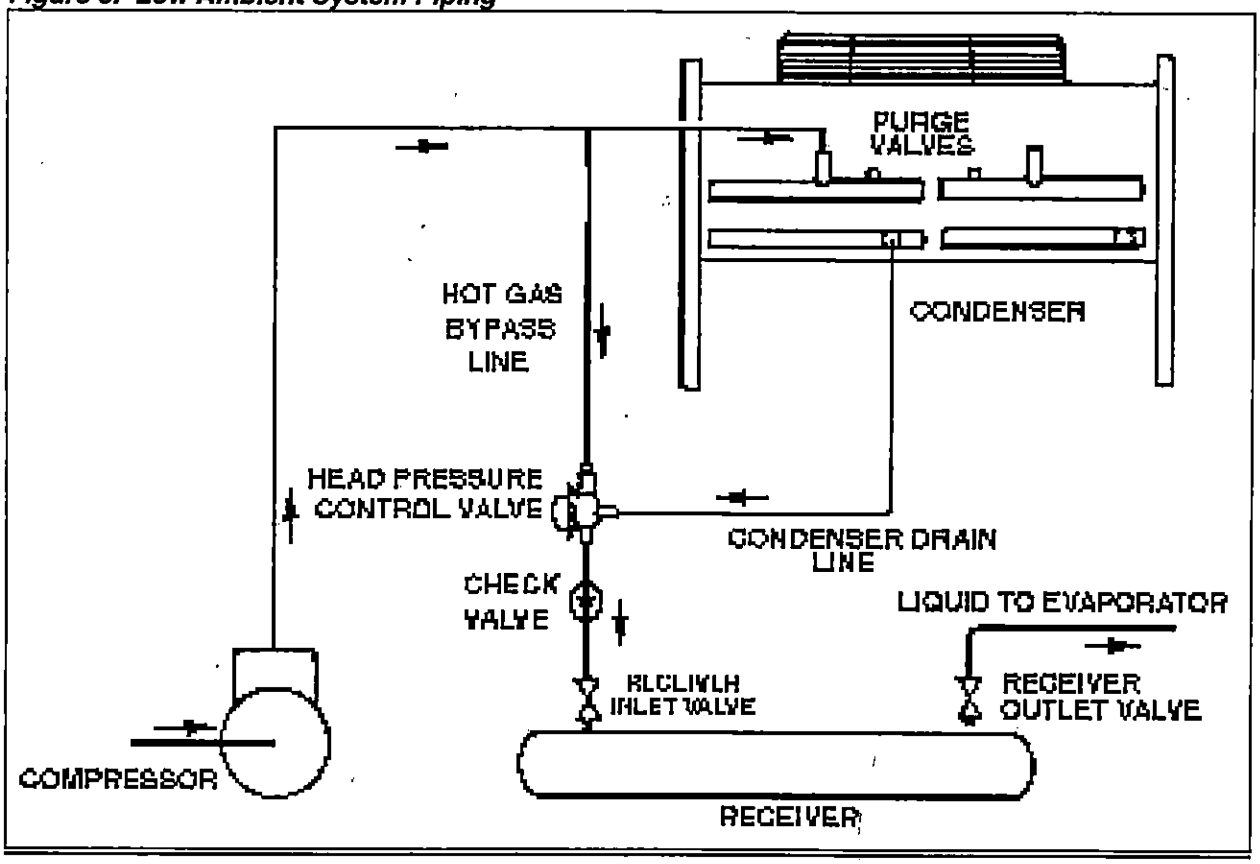
(Dual Compressor Models Only)

Allows the starting sequence of the compressors to be rotated so that running times on the compressors can be balanced. Units may be configured with either manual or automatic lead/lag. Manual lead/lag utilizes a four pole, single throw, double pull switch wired after the operating thermostat to change the compressor sequence. The switch will allow stage one of the operating thermostat to energize refrigerant circuit two. The automatic lead/lag option uses an alternating relay wired after the operating thermostat and before the control relays (R1 and R2) to rotate the starting sequence of the refrigerant circuits. The rotation will only occur when both stages of the operating thermostat open (i.e. unit shuts off due to no load).

Low Ambient Kit

The low ambient kit allows the unit to operate in conditions down to -20°F. A non-adjustable head pressure control valve is installed between the condenser outlet and the receiver inlet. When the condensing pressure falls below the valve setting, the valve modulates to permit discharge gas to enter the refrigerant flow from the condenser. Metering discharge gas into the refrigerant flow leaving the condenser produces a higher pressure at the condenser outlet, reduces the flow, and causes the level of liquid refrigerant to rise in the condenser. This flooding of the condenser with liquid refrigerant reduces the available condensing surface, holding the condensing pressure at the valve setting. The valve is fixed to maintain a 165 PSIG +/- 10 PSIG head pressure. The kit also includes a cold start timer per circuit which extends the start up time delay of the low pressure freezstat. This allows the unit to build sufficient head pressure on start up during cold ambient to prevent nuisance trips. The low ambient feature does require additional refrigerant charge per circuit to flood the condenser. Please note that some additional field charging maybe required for this option.

Figure 6. Low Ambient System Piping



Start Up Procedure

> Caution: To start unit, there must be heat load present.

Pre Start Up

1. Main Unit Disconnect Switch should be open.
2. Check all electrical, refrigerant, and water connections. Be sure they are all tight. Fittings connections can loosen during transit and installation.
3. Check that incoming power voltage characteristics match that listed on unit data serial tag. (Voltage tolerance is +/- 10% nameplate voltage.)
4. Check line fuse sizing against serial tag.
5. Check that condenser fans and drives are free from obstructions or loose material.
6. Check that mounting bolts on compressor(s) and chiller vessel did not loosen during transit and installation.
7. Check that all unit service valves are opened on water and refrigerant circuits.
8. Check oil level in compressor oil sight glass. The oil level should be at 1/2 to 3/4 of the full sight glass
9. Set Operating thermostat (T1) according to either standard settings or enclosed custom unit's set point chart.
10. High pressure switch(es) (HPS) is fixed and does not need to be set.
11. On standard units, the low pressure switch(es) (LPS) is fixed and does not need to be set. On custom units, the low pressure switch(es) may need to be adjusted and should be set according to enclosed custom unit's set point chart.
12. The oil pressure switch (OPS) is fixed and does not need to be set.
13. Set the low pressure freezstat(s) according to either standard settings or enclosed custom unit's set point chart.
14. Set the low water temperature freezstat (T2) according to either standard settings or enclosed custom unit's set point chart.
15. Set the fan cycling thermostat(s) (FCT) according to either standard settings or enclosed custom unit's set point chart.
16. Set the fan cycling pressure switch(s) (FCP) according to either standard settings or enclosed custom unit's set point chart.
17. Set the unloader pressure switch(es) (UPC) according to either standard settings or enclosed custom unit's set point chart.
18. Set the chiller barrel heater thermostat (CBT) at 35°F.
19. Check that all drain plugs are in prior to filling system.
20. Verify that inlet fluid pipe is attached to proper chiller barrel connection. (See label on chiller barrel connection.)
21. Check that water piping exerts no force on chiller barrel connections.
22. Flush water system.
23. Fill system with appropriate fluid. Fluid should be inhibited according to local water quality. Consult local water treatment specialist.
24. Check chilled water pump rotation.
25. Check water flow switch operation.
26. Close Main Disconnect Switch.
27. Check crankcase heater(s) for proper operation. **Allow crankcase heater to energize for 24 hours prior to continuing.**

Start Up

1. Start auxiliary equipment (pumps, fans, etc.)
2. Make sure pump-down switch is closed.
3. Close control toggle switch on single compressor units. Close the compressor control toggle switch on dual compressor units.
4. Compressor(s) start with a call for cooling.
5. Check that compressor(s) have adequate oil pressure.
6. Check that the condenser fans start when called for and have proper rotation.
7. Check the amperage of the compressor(s) and fans to verify they are within operating limits.
8. Check the operation of the liquid line solenoid valve(s).
9. Check the operation of the high pressure control(s).
10. Check the operation of the oil pressure control(s).
11. Check the operation of the low pressure control(s) and make adjustments as necessary.
12. Check the operation of the low pressure freezestat(s) (manual reset).
13. Check the operation of the low water temperature freezstat. (manual reset) (Suggest using a glass of ice water to check.)
14. Check the operation of the system thermostat.

15. Check the operation of the fan cycling thermostat(s) / pressure switch(s).
16. Adjust thermal expansion valve(s) superheat to 10 to 12°F.
17. Check the operation of the compressor unloader(s) operation and make adjustments as necessary.
18. When the system is at stable operation, check that the sight glass/moisture indicator is green and that there are no bubbles.
19. When the system is at stable operation, verify the oil level in compressor is at 1/4 to 1/2 the compressor oil sight glass.

Post Start Up

1. Final leak tests made.
2. Control panel/access covers secured.
3. Unit area cleaned up.
4. Operating personnel instructed on unit operation.

CONTROL SET POINTS

Table 1. Standard Chiller Control Settings

CONTROL	SETTING
Chiller Barrel T'stat (CBT)	Cut-in 35°F - Cut-out 40°F
Low Pressure Switch (LPS 1 & 2)	Cut-in 65 psig - Cut-out 45 psig
High Pressure Control (HPS)	Cut-out 400 psig (manual reset)
Low Pressure Freezstat (LPF 1 & 2)	Cut-out 57 psig (manual reset)
Fan Cycle Control (FCP 1 & 2)	Cut-out 150 psig - Cut-in 250 psig
Fan Cycle Control (1st stg.)	Cut-out 60°F - Cut-in 70°F
Fan Cycle Control (2nd stg.)	Cut-out 75°F - Cut-in 85°F
Unloader Pressure Control (UPC)	Cut-in 60 psig - Cut-out 66 psig
Low Water Temperature (T2)	Cut-out 38°F (manual reset)

Table 2. Optional Control Settings

CONTROL	SETTING
Cold Start timer (TD 2 / 3)	90 sec.
Anti-short cycle timer (TD 4 / 5)	5 min.
Part-Wind Start Timer (TD 6 / 7)	1 sec.
Load Limit T'stat (LLT)	Cut-out 55°F - Cut-in 70°F
Stage Start Timer	15 sec.

Table 3. Operating Thermostat Settings

SET POINT	LVG FLUID TEMP
60°F	50°F
58°F	48°F
56°F	46°F
54°F	44°F
52°F	42°F

Set Two stage thermostat so that the second stage is at one half the temperature range.

Physical Data - English

Table 4. Unit Compressors

		Single Compressor					Dual Compressors							
Model AAWC		15	20	25	30	35	30	40	50	60	70	80	90	100
Capacity Nominal - Tons(44°F LWT 2.4		14.2	20.1	22.8	30.9	33.4	28.7	39.9	45.9	61.7	68	79.5	90.4	93.6
Independent Circuits		1	1	1	1	1	2	2	2	2	2	2	2	2
Compressors (Nominal HP)	Circ. #1	15	25	30	35	40	15	25	30	35	40	50	60	60
Semi-hermetic Discus	Circ. #2	—	—	—	—	—	15	25	30	35	40	50	60	60
Total Nominal Compressor		15	25	30	35	40	30	50	60	70	80	100	120	120
Minimum (%) capacity		†	50	50	70	70	†	25	25	35	35	39	39	39
Refrigerant Oper. Charge	Circ. #1	22	30	34	44	44	21	31	34	43	49	56	68	77
HCFC-22 (Lbs. per circuit)	Circ. #2	—	—	—	—	—	21	31	34	43	49	56	68	77
Total Unit Oper. Refrig HCFC-22 (Lbs.)		22	30	34	44	44	42	62	68	86	98	112	136	154
Oil Charge (Oz.)	Circ. #1	115	130	140	140	255	115	130	140	140	255	255	255	255
	Circ. #2	—	—	—	—	—	115	130	140	140	255	255	255	255
Total Unit Oil Charge (Oz.)		115	130	140	140	255	230	260	280	280	510	510	510	510
Crankcase heaters 115v		(1) 70	(1) 100	(1) 100	(1) 100	(1) 200	(2) 70	(2) 100	(2) 100	(2) 100	(2) 200	(2) 200	(2) 200	(2) 200
Unit Dimensions:(In.)	Length	144	144	144	199	199	144	144	144	199	199	199	199	254
	Width	45	45	45	45	45	88	88	88	88	88	88	88	88
	Height	67	67	67	67	67	67	67	67	67	67	67	67	67
Approx. Unit Oper. Weight:(lbs.)		2380	2640	2720	3520	3530	4240	5050	5190	6520	6850	7310	8210	9040

Table 5. Condenser

Model AAWC		15	20	25	30	35	30	40	50	60	70	80	90	100
Condenser Face Area (Sq.		31.5	31.5	31.5	47.5	47.5	63.0	63.0	63.0	95.1	95.1	95.1	95.1	127.2
Number of Coils		1	1	1	1	1	1	2	2	2	2	2	2	2
Number of Rows		2	3	3	3	3	2	3	3	3	3	4	4	4
Condenser Series		RP	RP	RP	RP	RP	RP	RP	RP	RP	RP	RP	RP	RP
Coil Dimensions (In.)	Length	108	108	108	163	163	108	108	108	163	163	163	163	218
	Width	42	42	42	42	42	84	84	84	84	84	84	84	84
Condenser Fans (Qty.)		2	2	2	3	3	4	4	4	6	6	6	6	8
Diameter (In.)		30	30	30	30	30	30	30	30	30	30	30	30	30
Nominal RPM		1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140
Type Drive D = Direct		D	D	D	D	D	D	D	D	D	D	D	D	D
Airflow Total (Cfm)		20700	19820	19820	29730	29730	41400	38560	38560	59460	59460	57180	57180	76240
Fan Motor Nominal HP		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total kW		3.2	3.6	3.6	5.4	5.4	6.4	7.2	7.2	10.8	10.8	12	12	16

Table 6. Cooler - Direct Expansion

Model AAWC		15	20	25	30	35	30	40	50	60	70	80	90	100
Cooler Dimensions (In.)	Dia.	8 5/8	8 5/8	8 5/8	8 5/8	8 5/8	8 5/8	10 3/4	10 3/4	10 3/4	12 3/4	12 3/4	14	14
	Length	48	60	72	79	79	79	84	96	108	96	96	120	120
Refrigerant Circuits (Qty.)		1	1	1	1	1	2	2	2	2	2	2	2	2
Water Volume (Gal.)		7.7	9.7	11.7	13.7	13.7	13.7	21.5	24.6	27.8	34	34	51.2	51.2
Flow Rate (GPM)	Min.	24	34	39	52	57	49	68	78	105	116	135	154	159
	Max.	92	92	92	92	92	92	158	158	249	249	249	382	382
Max Design Working		Water Shell Side - 150												
Pressure (Psig)		Refrigerant Side -												
Water Conn. Inlet/Outlet (In.)		3" MPT	3" MPT	3" MPT	3" MPT	3" MPT	3" MPT	4"FL	4"FL	5"FL	5"FL	5"FL	6"FL	6"FL
Wattage - Heaters		78	96	114	132	132	132	162	186	210	216	216	300	300
Insulation Thickness (In.)		3/4"												

Electrical Data

Table 7. Part Winding Start

			Circuit #1		Circuit #2		COMPRESSORS			FANS	
Model AAWC	Volts 60 Hz	Type of Start	MCA	MOPD	MCA	MOPD	Qty.	RLA Ea.	LRA Ea.	Qty.	FLA Ea.
Single	**3 PH.**										
20	208/230	PW	106.2	175			1	82.2	250	2	7
	460	PW	52.6	80			1	40.6	132	2	3.5
25	208/230	PW	119.5	200			1	94	292	2	7
	460	PW	57.5	90			1	45	141	2	3.5
30	208/230	PW	161.3	250			1	125	340	3	7
	460	PW	84.6	125			1	66	195	3	3.5
35	208/230	PW	180.3	300			1	142	340	3	7
	460	PW	89.0	150			1	70	195	3	3.5
Dual											
40	208/230	PW	194	250			2	82.2	250	4	7
	460	PW	96.0	125			2	40.6	132	4	3.5
50	208/230	PW	217.9	300			2	94	292	4	7
	460	PW	104.9	125			2	45	141	4	3.5
60	208/230	PW	294.5	400			2	125	340	6	7
	460	PW	154.3	200			2	66	195	6	3.5
70	208/230	PW	328.8	450			2	142	340	6	7
	460	PW	162.4	225			2	70	195	6	3.5
80	208/230	PW	223.0	350	223.0	350	2	180	654	6	7
	460	PW	204.8	250			2	91	330	6	3.5
90	208/230	PW	272.3	450	272.3	450	2	224	654	6	7
	460	PW	215.9	300			2	96.5	330	6	3.5
100	208/230	PW	279.3	450	279.3	450	2	224	654	8	7
	460	PW	229.9	300			2	96.5	330	8	3.5

1. PW: Part Winding Start
2. Minimum circuit ampacity complies with compressor's maximum continuos current rating per N.E.C.
3. 208 - 230 voltage requires two field-wiring supplies on models 80, 90, 100
4. Models 30A, 35A, 60B and 70B are 230 volt standard. Consult factory for 200 volt applications.
5. Compressor RLA is per Copeland nameplate.
6. MCA and MOPD calculations are per (RLA = MCC / 1.56)

Table 8. Voltage Tolerances:

Voltage	Minimum	Maximum
208 - 230 V	187 V	253 V
230 V	207 V	253 V
460 V	414 V	506 V

Legend:

RLA - Rated Load AMPS
LRA - Locked Rotor AMPS
FLA - Full Load AMPS
MCA - Minimum Circuit AMPS
MCC - Maximum Continuous Current
MOPD - Maximum Overcurrent Protective Device

Table 9. Across the Line Start

			Circuit #1		Circuit #2		COMPRESSORS			FANS	
Model AAWC	Volts 50 Hz	Type of Start	MCA	MOPD	MCA	MOPD	Qty.	RLA Ea.	LRA Ea.	Qty.	FLA Ea.
Single	3 Ph.										
15	200/220	AL	80.9	125			1	59.6	275	2	7
	380/420	AL	39.5	60			1	29	138	2	3.5
20	200	AL	106.2	175			1	82.2	428	2	7
	380/400	AL	53.1	90			1	41.1	214	2	3.5
25	200	AL	119.5	200			1	94	470	2	7
	380/400	AL	59.7	100			1	47	235	2	3.5
30	200	AL	161.3	250			1	125	594	3	7
	400	AL	80.6	125			1	62.5	297	3	3.5
35	200	AL	180.3	300			1	142	594	3	7
	400	AL	90.2	150			1	71	297	3	3.5
Dual											
30	200/220	AL	148.4	200			2	59.6	275	4	7
	380/420	AL	72.6	90			2	29	138	4	3.5
40	200	AL	194.0	250			2	82.2	428	4	7
	380/400	AL	97.0	125			2	41.1	214	4	3.5
50	200	AL	217.9	300			2	94	470	4	7
	380/400	AL	108.9	150			2	47	235	4	3.5
60	200	AL	294.5	400			2	125	594	6	7
	400	AL	147.3	200			2	62.5	297	6	3.5
70	200	AL	328.8	450			2	142	594	6	7
	400	AL	164.4	225			2	71	297	6	3.5
80	200	AL	223.0	350	223.0	350	2	180	1070	6	7
	400	AL	202.8	250			2	90	535	6	3.5
90	200	AL	272.3	450	272.3	450	2	224	1070	6	7
	400	AL	247.2	300			2	112	535	6	3.5
100	200	AL	279.3	450	279.3	450	2	224	1070	8	7
	400	AL	254.2	350			2	112	535	8	3.5

1. AL: Across the Line Start
2. Minimum circuit ampacity complies with compressor's maximum continuos current rating per N.E.C.
3. 208 - 230 voltage requires two field wiring supplies on models 80, 90, 100
4. Models 30A, 35A, 60B and 70B are 230 volt standard. Consult factory for 200 volt applications.
5. Compressor RLA is per Copeland nameplate.
6. MCA and MOPD calculations are per (RLA = MCC / 1.56)

Table 10. Voltage Tolerances:

Voltage	Minimum	Maximum
208 - 230 V	187 V	253 V
230 V	207 V	253 V
460 V	414 V	506 V

Legend:

RLA - Rated Load AMPS
LRA - Locked Rotor AMPS
FLA - Full Load AMPS
MCA - Minimum Circuit AMPS
MCC - Maximum Continuous Current
MOPD - Maximum Overcurrent Protective Device

Energy Saving Performance

Table 11. Capacity Control

Model AAWC	% Capacity Single		
	System On	1st Step	System Off
15A	100		0
20A	100	50	0
30A	100	70	0
35A	100	70	0

Capacity Control - AAWC Series chillers provide the benefits of compressor unloading.

Table 12. Capacity Control

Model AAWC	% Capacity Dual Compressor Models				
	System On	1st Step	2nd Step	3rd Step	System Off
40B	100	75	50	25	0
50B	100	75	50	25	0
60B	100	85	50	25	0
70B	100	85	50	25	0
80B	100	89	50	25	0
90B	100	89	50	25	0
100B	100	89	50	25	0

AAWC Series chillers are all equipped with a capacity control valve per compressor as standard. These capacity control valves (Figure 4 & 5, pg. 12) are fully automatic and controlled by the system.

The benefit of the ***AAWC Series*** capacity control is to allow the chiller to quickly sense changing evaporator load requirements and to match compressor output closer to actual load requirements. This allows the system to operate on a lower power consumption curve which conserves energy at ever changing load conditions.

Refrigerant System Charging, Evacuation And Recovery

Refrigerant charging, evacuation and recovery should only be performed by a certified service technician and should be performed in accordance with local, state and national codes.

The units refrigerant charge information can be found on the unit's data plate.

Information on standard units refrigerant charge can be found in the physical Data Table of this manual.

Sight Glass & Moisture Indicator

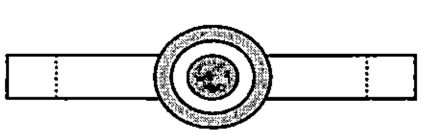
The sight glass/moisture indicator helps determine that a unit has sufficient refrigerant charge and/or when the liquid line filter drier cores need to be replaced.

Bubbles in the glass may indicate a shortage of refrigerant or a restriction in the liquid line (i.e. plugged liquid line filter drier). Moisture typically results from a leak in the refrigerant system or service operations which open the refrigerant system to the atmosphere.

Moisture is detrimental because it leads to the formation of acids which attack components in the system. A change of color in the indicating dial from green to either chartreuse or yellow indicates unacceptable moisture in the system in which case the liquid line filter drier cores need to be changed.

Upon changing the cores, the indicating dial should return to green within 12 hours of returning system to operation.

Figure 9. Sight Glass



Liquid Line Sight Glass
GREEN = DRY - CHARTREUSE = CAUTION
YELLOW = WET - WHITE = DAMAGED

The sight glass should not need to be replaced unless a large amount of water entered the system (ruptured chiller or water cooled condenser tube) in which case the sight glass will be damaged and the indicating dial will be white or a light yellow.

Liquid Filter-Driers & Suction Filters

A replaceable core liquid filter/drier is supplied as standard on all units. A schrader type access valve is installed in the flange plate of some models.

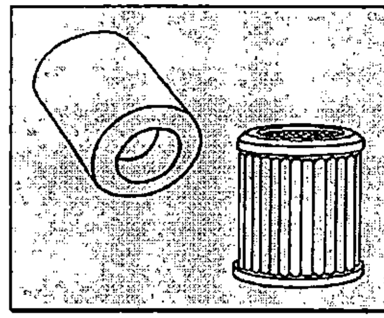


Table 13. Sporlan Valve Co.

SPORLAN MODEL	NO. OF CORES	DESICCANT VOLUME (CU IN)	# CORE PART NO.
C-489-(G)	1	48	RC-4864 RC-4864-HH RCW-48
C-969-(G)	2	96	
C14411-(G)	3	144	
C-19211-(G)	4	192	
C-4021-(G)	4	192	
C-4025-(G)	4	192	

"G" indicates flange plate supplied with ¼" FPT
"RC__" Standard Core, "RC__HH" Burn-out Core
"RCW_" High Water Capacity

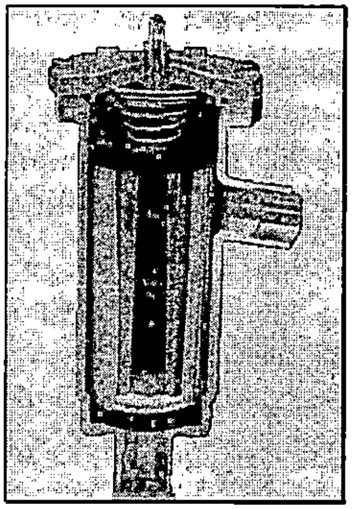
Table 14. Alco Controls

ALCO MODEL	NO. OF CORES	DESICCANT VOLUME (CU IN)	# CORE PART NO.
STAS-489-T*	1	48	D-48 H-48 UK-48 W-48
STAS-969-T	2	96	
STAS-14411-T	3	144	
STAS-19211-T	4	192	
STAS-19213-T	4	192	
STAS-19217-T	4	192	

* "T" indicates Liquid Line Service
# "D" Standard Capacity, "H" High Capacity
"UK" High Capacity, "W" Burn-out Block

Suction Filter

Replaceable core suction filters are supplied as an ***option*** on all units. The flanged shell holds replaceable pleated filter elements suitable for installation in the suction line of refrigeration systems. In this way any contaminants left in the system at start-up can be removed before they circulate back to the compressor.



Compressor
Motor Burnout Clean-up Procedure

Another benefit of the suction filter is its use in clean-up of a system after a burnout. Standard liquid cores can be installed in the shell to aid in the cleanup of acids and other contaminants from a motor burnout.
The following procedure can be used in case of a motor burn-out.

1. Determine the extent of the burnout. For mild burnout's where contamination has not spread through the system, it may be economical to save the refrigerant. Normally it is economical to save the refrigeration charge if the system has service valves. A severe burnout exists if the oil is discolored, an acid odor is present and contamination products are found in the high and low side. With this condition, extreme caution should be exercised to avoid breathing the acid vapors and to prevent contaminated liquid from making contact with the skin.
2. Thoroughly clean and replace all system controls, such as expansion valves, solenoids, check valves, reversing valves, oil separators, suction accumulators, etc. Remove all strainers and filter-driers.
3. Install a replacement compressor and make a complete electrical check.
4. Make sure the suction line adjacent to the compressor is clean. Install a liquid line filter-drier or a replaceable cartridge designed for "clean-up" into the suction line shell.
5. Install a burnout core in the liquid line shell.
6. Start the compressor and put the system in operation. Record the pressure drop across the suction line filter and keep for reference.
7. Replace the suction line filter-drier blocks if the pressure drop becomes excessive.
8. Observe the system during the first 4 hours. Repeat step 8 as often as required, until no further change in pressure drop is observed.
9. After the system has been in operation for 48 hours, check the condition of the oil for Acids. If the oil test indicates an acid condition, replace the liquid and suction line filter-driers.
10. Check the system again after approximately 2 weeks of operation. If the oil is still discolored, or checks acid, replace the liquid and suction line filter-driers.
11. Clean-up is complete when the oil is clean, odor free, and is determined to be acceptable by testing for acids or other contaminants.
12. Replace the suction line filter-drier with suction line filter cores to minimize suction line pressure drop and to provide maximum compressor protection.

For more detailed information on burn-out clean-up procedures and recommendations, consult the *RSES Service Manual, section 91.*

Sporlan Valve Company

Replaceable Suction Filter
The correct replacement suction filter element in Sporlan Valve replaceable shells is Sporlan part number RFE-48-BD. However any suitable filter that is sized to fit a 48 cu. inch vessel will substitute.

Superior Valve Company

Replaceable Suction Filter
On many parallel systems, the Superior Valve Co. suction filter is installed. The benefits of using this filter include:

- All brass one-piece shell
- No paint to peel
- No rust or corrosion
- Single cartridge design
- Corrosion resistant stainless steel bolts

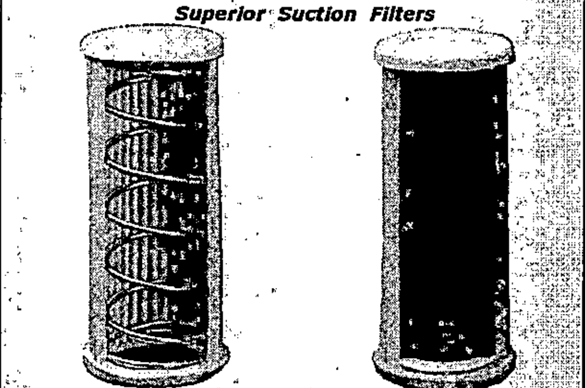
Table 15. Type F Filter
Replaceable Cartridges

Shell No.	Catalog No.	IBCA No.	Cartridge OD (in)	Filter Area (In^2)
2CFA	F25A	51071	1 - 23/32	66
3CFA	F35A	51072	2 - 5/8	115
4CFA	F45A	51073	3 - 17/32	189
5CFA	F55A	51074	4 - 1/16	270

Table 16. Type DF (for clean-up)
Replaceable Cartridges

Shell No.	Catalog No.	IBCA No.	Cartridge OD (in)	Filter Area (In^2)
2CFA	DF25A	51053	1 - 23/32	66
3CFA	DF35A	51059	2 - 5/8	115
4CFA	DF45A	51060	3 - 17/32	189
5CFA	DF55A	51061	4 - 1/16	270

Superior Suction Filters



Type F Filter Cartridge   Type DF Filter-Drier Cartridge

Alco Controls

Alco Suction Filter
Comparable to the Superior suction filters and interchangeable cores.

Table 17. Type AF Filter
Replaceable Cartridges -

Shell No.	Filter Core	Cartridge OD (In)	Filter Area (In^2)
BTAS-2	A2F	1 - 29/32	66
BTAS-3	A3F	2 - 3/4	115
BTAS-4	A4F	3 - 3/4	189
BTAS-5	A5F	4 - 5/16	270

Table 18. Type AFD (for clean-up)
Replaceable Cartridges

Shell No.	Filter Core	Cartridge OD (In)	Filter Area (In^2)
BTAS-2	A2F-D	1 - 29/32	66
BTAS-3	A2F-D	2 - 3/4	115
BTAS-4	A2F-D	3 - 3/4	189
BTAS-5	A2F-D	4 - 5/16	270

THERMAL EXPANSION VALVE SUPERHEAT ADJUSTMENT

Due to varying operating conditions of units, some minor adjustment of the thermal expansion valve may be needed to match field operating conditions. The following is a recommended guideline:

Measure evaporator superheat at the outlet of the chiller barrel using a reliable pressure gauge and a digital thermometer. The pressure gauge can be connected to the schrader fitting in the tee to the low pressure freezstat at the evaporator. The thermometer probe should be strapped to the copper suction piping and insulated from the ambient.

Proper evaporator superheat should be between 15°F and 18°F.

To make and adjustment to the TEV, remove the seal cap from the adjusting stem. To increase the superheat, turn the adjusting stem clockwise. To decrease the superheat, turn the adjusting stem counterclockwise.

Only make one turn of the stem at a time and observe the change in the superheat. It may take as much as 30 minutes for the new balance to take place after an adjustment is made.

Replace and retighten seal cap.

HOT GAS BYPASS REGULATOR ADJUSTMENT

Discharge Bypass Valves (DVB) respond to changes in downstream or suction pressure. When the evaporating pressure is above the valve setting, the valve remains closed. As the suction pressure drops below the valve setting, the valve responds and begins to open. As with all modulating type valves, the amount of opening is proportional to the change in the variable being controlled - in this case the suction pressure. As the suction pressure continues to drop, the valve continues to open farther until the limit of the valve stoke is reached.

On refrigeration systems discharge bypass valves are used to prevent the suction pressure from going below the minimum value determined by the job requirements.

Sporlan Valve Company

Valve Setting and Adjustment

A complete discussion on valve settings is given in Sporlan Application Bulletin 90-40. The fully adjustable models ADRS(E)-2, ADRP(E)-3, and ADRH(E)-6 are available with two adjustment ranges - 0/30 and 0/80 psig. The standard factory settings for these are 20 and 60 psig, respectively. The ADRI(E)-1-1/4 is available with a 0/55 psig range and the standard factory setting is 28 psig.

To adjust these valves, remove the cap and turn the adjustment nut with a 5/16" hex wrench for fully adjustable models ADRS(E)-2, ADRP(E)-3, and ADRH(E)-6. The ADRI(E)-1-1/4 model has a 3/8" adjustment screw on top of the adjustment housing. A clockwise rotation increases the setting and a counterclockwise rotation decreases the setting.

Adjusting these valves can be complicated because the load must be varied during the setting procedure and it is difficult to determine exactly when the bypass valve opens unless a pressure gauge can be located at the valve outlet.

Therefore, sufficient load must be available in some form to raise the suction pressure above the desired valve setting. Once this is accomplished, the load can be slowly decreased until the DBV opens (a hissing sound and/or an accompanying pressure rise at the outlet connection will indicate that the bypass valve has opened).

Alco Controls

Valve Setting and Adjustment

CPHE and DGRE regulators are commonly used to prevent the suction pressure from falling below a predetermined set point. Complete information about these valves can be found in *ALCO CONTROLS* Catalog 24-D.

The first step after installation is to determine the set point for the minimum suction pressure allowable for the application. The following procedure should be followed.

1. Start the system and determine if it is operating properly: Install a gauge on the compressor suction line and measure the suction pressure after the system has stabilized. To make certain that hot gas is not being bypassed, listen to the main regulator flow or feel the outlet piping. If the piping is warm, this would indicate hot gas is flowing.
2. Stop the flow of hot gas by de-energizing the hot gas solenoid valve or by turning the power assembly adjusting stem full COUNTERCLOCKWISE.
3. Reduce the evaporator load until the suction pressure lowers to the point at which bypass is desired.
4. If the hot gas solenoid was de-energized to stop hot gas flow, make sure it is now energized.
5. Turn the power assembly adjusting stem in a CLOCKWISE direction until bypass occurs and suction pressure does not fall below the predetermined set point. A CLOCKWISE turn of the adjusting stem will increase the pressure setting; a COUNTERCLOCKWISE turn will decrease it. Standard pressure pilot is adjustable from 0 to 80 psig, with one complete turn equal to approximately 4 psi change. Adjustments should be made in small increments, allowing for the system to stabilize after each turn.
6. Vary the evaporator load to test at various conditions that the suction pressure does not fall below the predetermined set point.
7. Replace the seal cap on the adjusting stem.

TROUBLE SHOOTING CHART:

Symptom	Cause	Remedy
Compressor does not run	1. Motor Line open.	1. Close starter or disconnect switch
	2. Fuse blown	2. Replace fuse
	3. Tripped overload	3. See electrical section
	4. Control contacts dirty or jammed in open position	4. Repair or replace
	5. Piston seized	5. Remove motor-compressor head, look for broken valve and jammed parts.
	6. Frozen compressor or motor bearings	6. Repair or replace.
	7. Control Circuit Open	7. Check FLOW Switch, Temperature Control, Control circuit protector
Unit short cycles	1. Control differential set too close	1. Widen differential
	2. Discharge valve leaking	2. Replace valve plate
	3. Motor compressor ???	3. Check for high head pressure, tight bearings, seized pistons, clogged air-cooled condenser.
	4. Refrigerant shortage	4. Repair leak and recharge.
	5. Refrigerant over charge	5. Remove some refrigerant.
	6. Cycling on high pres. cut-out	6. Check condenser / or non condensable in system
Compressor will not start - Hums intermittently	1. Improperly wired	1. Check wiring against diagram
	2. Low voltage	2. Check main line voltage - determine location of voltage drop
	3. Relay contacts not closing	3. Check my operating manually. Replace relay if defective
	4. Open circuit in start-winding	4. Check stator leads. If leads are all right, replace stator.
	5. Stator winding grounded	5. check stator. If leads are all right, replace stator.
	6. High discharge pressure	6. Eliminate cause of excessive pressure
	7. Tight compressor	7. Check oil level. Correct binding.
Unit operates long or continuously	1. Control contacts sticking in closed position.	1. Clean points or replace control.
	2. Insufficient refrigerant in system	2. Check for leaks. Repair and add charge
	3. Dirty condenser.	3. Clean condenser
	4. Air or non-condensables in system	4. Purge high point in system
	5. Compressor inefficient	5. Check valves and pistons
	6. Improper wiring	6. Check wiring and correct if necessary
High discharge pressure	1. Refrigerant overcharge	1. Remove the excess
	2. Non-condensables in system	2. Remove the non-condensables
	3. Dirty condenser coil	3. Clean
	4. High side restriction	4. Check all valves or remove restriction
	5. Head pressure control setting	5. Adjust controls
	6. Fan not running	6. Check electrical circuit

Symptom	Cause	Remedy
Low discharge pressure	1. Insufficient refrigerant in system 2. Faulty condenser temp. regulation 3. Compressor suction or discharge valve inefficiencies 4. Low suction pressure 5. Head pressure control valve set wrong or no head pres. control valve	2. Check for leaks. Repair and add charge 2. Check condenser control operation 3. Clean or replace leaky valve plates 4. See corrective steps for low suction pressure 5. Adjust valve or install a head pressure control valve
High suction pressure	1. Excessive load 2. Expansion valve overfeeding	1. Reduce load or add additional equipment 2. Check remote bulb. Regulate superheat.
Low suction pressure	1. Lack of refrigerant 2. Evaporator dirty or iced. 3. Clogged liquid line filter drier 4. Clogged suction line or compressor suction strainer 5. Expansion valve malfunctioning 6. Condensing temperature too low 7. Improper TXV	1. Check for leaks. Repair and add charge 2. Defrost or clean coil 3. Replace cartridge(s) 4. Clean strainer or replace filters 5. Check and reset for proper superheat 6. Check means for regulating condensing temperature 7. Check for proper sizing
Little or No oil pressure	1. Clogged suction oil strainer 2. Excessive liquid in crankcase 3. Low oil pressure safety switch defective 4. Worn oil pump 5. Oil pump reversing gear stuck in wrong position 6. Low oil level 7. Worn bearings 8. Loose fitting on oil lines 9. Pump house gasket leaks.	1. Clean 2. Check crankcase heater. Reset TXV for higher superheat. Check liquid line solenoid valve for proper operation. 3. Replace 4. Replace 5. Reverse direction of compressor rotation 6. Determine where the oil is or add oil. 7. Replace compressor 8. Check and tighten fittings 9. Replace gasket
Compressor loses oil	1. Lack of refrigerant 2. Excessive compression ring blow-by 3. Refrigerant floods back 4. Improper piping or traps	1. Check for leaks. Repair and add charge 2. Replace compressor 3. Maintain proper superheat at compressor 4. correct piping
Compressor thermal protector switch open	1. Operating beyond design limits 2. Discharge valve partially shut 3. Blown valve plate gasket 4. Dirty condenser coil 5. Overcharged system	1. Add facilities so that conditions are within allowable limits. 2. Open valve 3. Replace gasket 4. Clean coil 5. Reduce charge
Cause & Prevention of Freeze-up	1. Improper Refrigerant Charging 2. Improperly set safety time delay 3. Operating with safety time delay low pressure control bypassed. 4. Improper chilled water circulation 5. Improperly drained fluid system for Winter shut-down. 6. Chiller Barrel heater not operating.	1. Charge per Manufacturer's recommendations 2. Check the safety time delay low pressure control for proper setting 3. Check for bypassed electrical circuits and correct. 4. Check for proper fluid circulation. 5. Remove all traces of water for Winter shut-down. Add small amount of Glycol solution if necessary. 6. Check operation of heater.

General Maintenance Schedule

(Service/Maintenance should be performed only by a qualified/certified refrigeration/air conditioning service technician.)

Weekly

- Check refrigerant charge using the liquid line sight glass.
- Check compressor oil level.
- Check compressor crankcase heater operation.
- Check main power and control voltage
- Check appearance of area around the unit.
- Check system pressures

Monthly

- Check the refrigerant system for leaks.
- Check suction filters and liquid line filter driers.
- Check all flanged connection bolts, fittings and line clamps for tightness.
- Inspect condenser fan blades and motor mounts for cracks, loose set screws or mounting bolts.
- Tighten all electrical connections.
- Check operation and condition of contacts on compressor / fan motor contactors.
- Check appearance of control panel interior.
- Check appearance of exterior conduit / junction boxes.
- Check appearance of insulation.
- Check operation of auxiliary equipment.

Quarterly

With unit in stable operation, record all operating conditions:

- Suction / discharge / liquid refrigerant pressure(s) and temperatures(s)
- System superheat, liquid subcooling, ambient temperature
- Compressor amperage
- Chilled fluid temperatures and pressures.
- Test all operating and safety controls.

Annually

- Obtain oil sample for analysis. Change oil if required.
- Clean condenser coil.
- Straighten condenser fins as required.
- Chemically clean chiller barrel fluid side.
- Change liquid line filter drier and suction filter cores.

Note: The above information is provided only as a general guideline to aid servicing personnel and equipment owners in maintaining this particular equipment. Due to variables in the actual equipment application, operating conditions, and environment recommended service intervals may vary.

CONTROL SET POINTS (CUSTOM UNITS)

This information is provided as a guideline for units that are designed to operate outside standard operating conditions. Actual control set point values may need to be adjusted for field operating conditions.

Unit Info:

Model: _______________
Capacity:_______________
Refrigerant:_____________
Ambient _______________°F
Fluid: _______________________
Entering Fluid Temp: _______________
Leaving Fluid Temp: _______________

Control Set Points:

Operating Thermostat Setting: _______
Lvg Fluid Freezstat Setting: _________
High Pressure Switch Setting: _____/______
Low Pressure Switch Setting: _____/______
Oil Pressure Switch Setting: ______/_____
Low Pressure Freezstat Setting: _____/_____
Chiller Barrel Heater Thermostat Setting: _____
Unloader Pressure Switch Settings: ______/_______/______/______
Fan Cycling Pressure Switch Settings: ______/________
Fan Cycling Thermostat Settings: ____/_____/_____/_____/_____/___
Hot Gas Bypass Regulator Settings: ______/______

API KETEMA

START-UP CHECK LIST

Job Name: ____________________ Location: ________________

Unit Model No.:______________ Unit Serial No.:_____________

Comp. Serial No's.: 1_______________ 2___________________

Start Up Procedure Check Points	YES	NO
Equipment Inspection		
a. Unit damaged on arrival?	___	___
b. Material received agrees with shipping papers?	___	___
c. Is unit level?	___	___
d. Vibration isolators used?	___	___
e. Spring isolators adjusted for equal height?	___	___
c. Compressor/chiller mounting bolts are tight	___	___
d. Refrigerant/water fittings are tight	___	___
Wiring		
a. Power wiring complete	___	___
b. Control wiring complete	___	___
c. Electrical service adequate for load	___	___
d. Voltage source correct for motor(s) used	___	___
e. External disconnect has fuses in place of proper size	___	___
f. System wired per diagram	___	___
g. All connections tight	___	___
h. Wiring complies with local codes	___	___
Piping		
a. Piping complies with applicable codes	___	___
b. External piping independently supported	___	___
c. Chilled water line insulated	___	___
d. System leak tested	___	___
e. System flushed	___	___
f. System filled with appropriate fluid	___	___

Before Start-up	Yes	No
a. Compressor(s) have proper oil level	___	___
b. Condenser fans free from obstructions/loose debris	___	___
c. Controls set	___	___
d. Crankcase heater(s) operating properly	___	___
e. Compressor(s) suction and discharge service valves open	___	___
f. Receiver(s) liquid valves (if receiver(s) furnished) open	___	___
g. Pressure gauge valves open (if supplied)	___	___
h. Chiller water flow switch interlocked	___	___
i. Chiller water pump operating correctly	___	___

Start-Up

a. Start auxiliary equipment (pumps, fans, etc.) ____ ____
b. Check compressor(s) start ____ ____
c. Check oil pressure ____ ____
d. Check sight glass ____ ____
e. Check condenser fan operation ____ ____
f. Check RLA of compressor(s)/fans ____ ____
g. Recheck oil level in crankcase(s) ____ ____
h. Check high pressure control ____ ____
i. Check oil pressure safety switch ____ ____
j. Check low pressure freeze control (if furnished) ____ ____
k. Check operating the thermostat ____ ____
l. Check low pressure and/or pumpdown control ____ ____
m. Check low water temperature freezstat ____ ____
n. Check fan cycling operation ____ ____
o. Check compressor unloader operation ____ ____
p. Check hot gas bypass operation ____ ____
q. Check superheat and adjust if necessary ____ ____

Clean Up

a. Final leak tests made ____ ____
b. Shut-off valves backseated; packing nuts tight; caps replaced ____ ____
c. Control panel doors and/or covers secured ____ ____
d. Clean around unit ____ ____

Operating Personnel

a. Proper instructions given to customer's personnel in the operation of unit. ____ ____