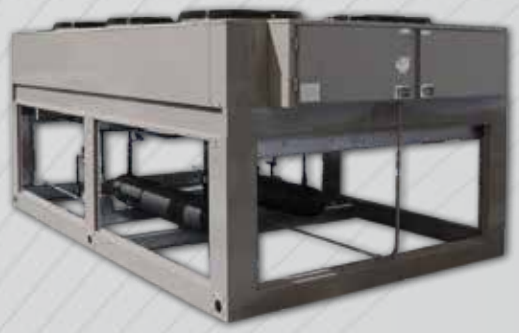
CENTURY
REFRIGERATION
DIVISION RAE CORPORATION

INSTALLATION OPERATION MANUAL



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INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS CENTURY REFRIGERATION AIR COOLED CONDENSERS, CONDENSING UNITS & PACKAGED CHILLERS

I. RECEIVING AND INSPECTION

A. Immediately upon receiving shipment, equipment should be inspected for evidence of any damage received in transit. (Suggestion: photograph unit for documentation.) If shipping damage has occurred, a claim should be made with the transportation company, and the local Century Refrigeration representative should be advised of the nature of the damage.

B. Equipment should be inspected for compliance with original order acknowledgment (equipment model numbers, voltages, etc.)

C. System should be checked for positive pressure.

II. RIGGING

A. Equipment is equipped with lifting eyes or sling points. These should be used to prevent structural damage.

B. Equipment should be lifted in a near level condition to prevent undue stress on structural members.

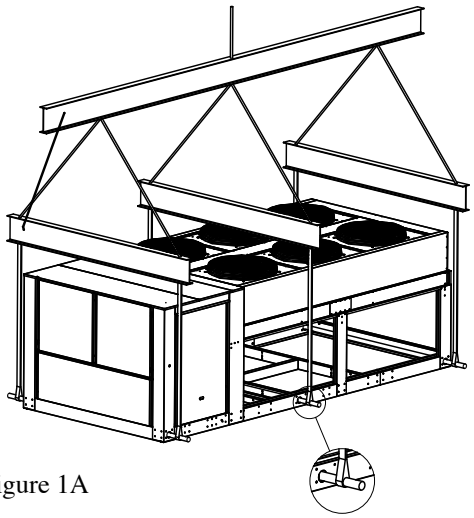


Figure 1A

III. MOUNTING

A. Equipment should be mounted on a smooth, hard, level surface.

B. Mounting surface should be rigid, and provision should be made to prevent noise transmission (structural) to surrounding areas.

C. Air cooled equipment should not be installed under low structural overhangs which can cause condenser air recirculation or restriction.

D. Adequate area (approx. 1 unit width) must be provided around equipment for unrestricted air flow and service. Two units side by side should have a minimum of 1 1/2 unit width between them. See Figures 2A through 2E and Figures 3A through 3D.

E. Care should be taken to prevent air from other sources from entering condenser if this air is at an elevated temperature.

F. Indoor design equipment must be installed in a protected enclosure.

SPRING MOUNTED COMPRESSOR

Compressors are secured rigidly to make sure there is no transit damage. Before operating the unit, it is necessary to follow these steps:

1. Loosen the upper nuts and washers until compressor floats on springs.
2. Discard the shipping spacers.
3. Allow 1/16 inch space between the mounting nut/washer and rubber spacer. Mounting spring must not be fully compressed when mounting nut is properly installed. See Figures 1B, 1C, and 1D.

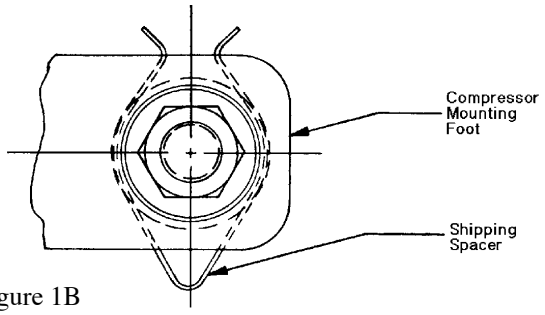


Figure 1B

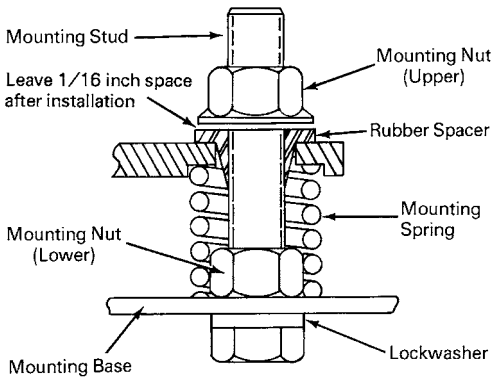


Figure 1C

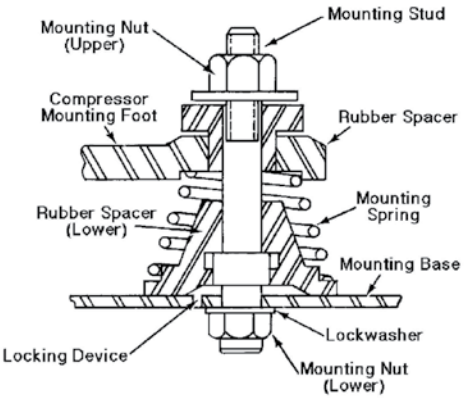


Figure 1D

UNIT CLEARANCE DRAWINGS

RECOMMENDED

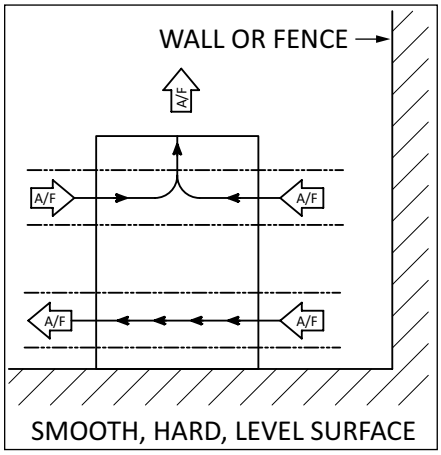


Figure 2A

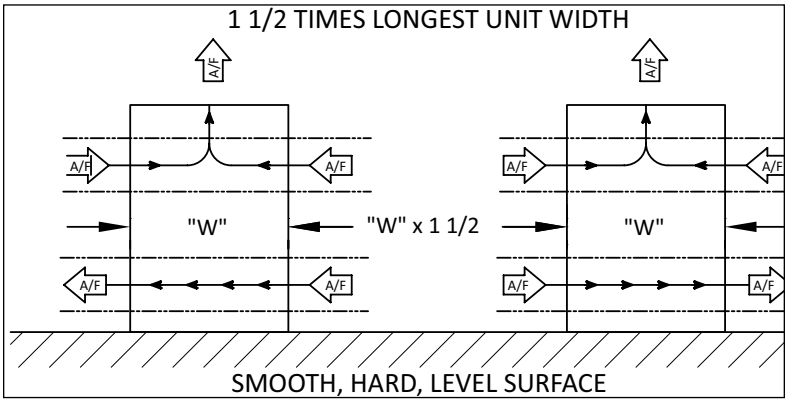


Figure 2B

NOT RECOMMENDED

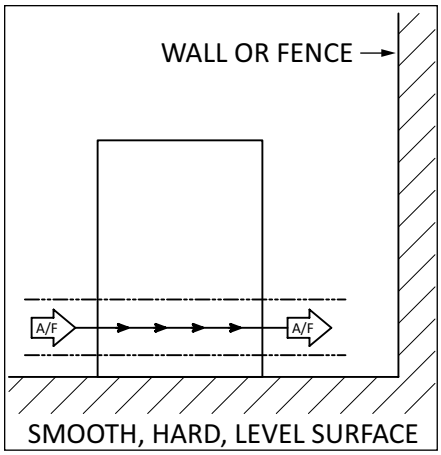


Figure 2C

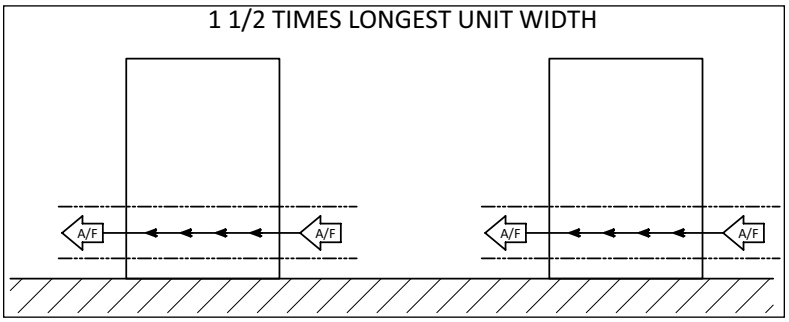


Figure 2D

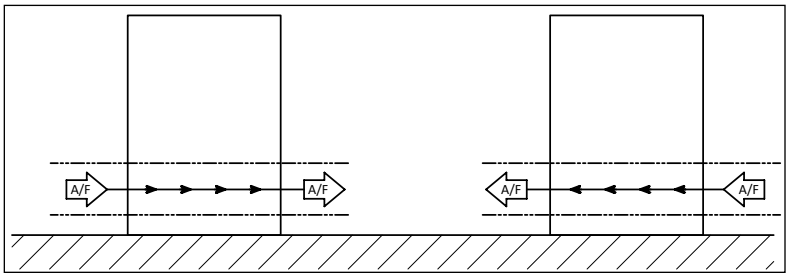


Figure 2E

UNIT COOLER CLEARANCE DRAWINGS

A & BOC SERIES RECOMMENDED

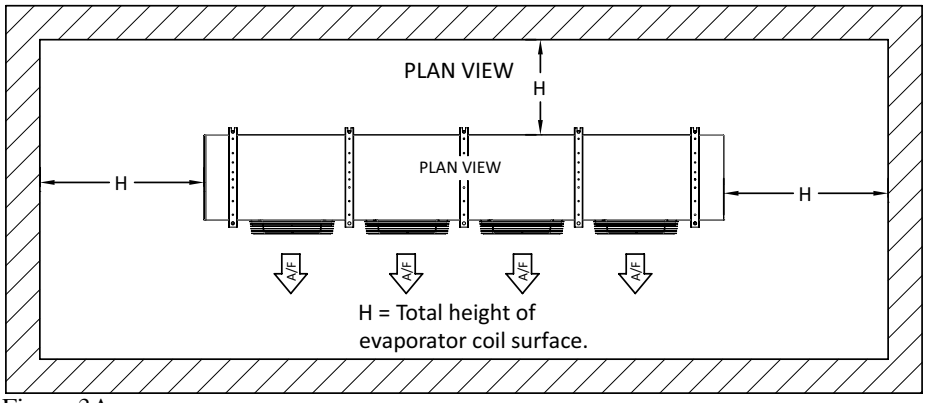


Figure 3A ONE EVAPORATOR

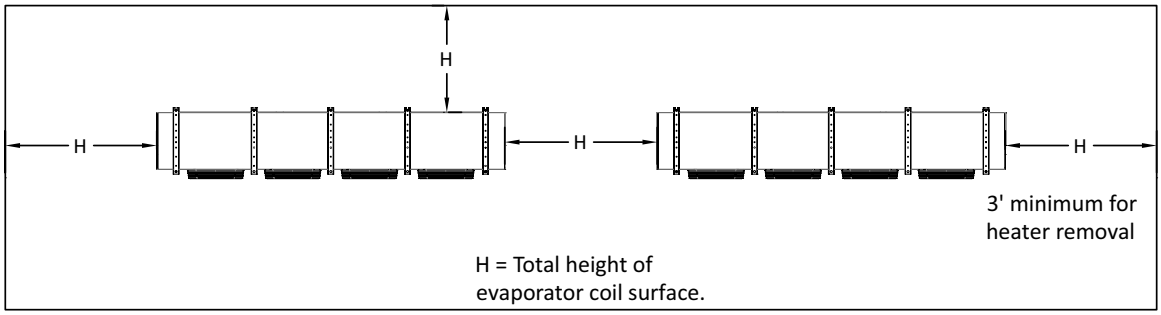


Figure 3B TWO EVAPORATORS

FH SERIES RECOMMENDED

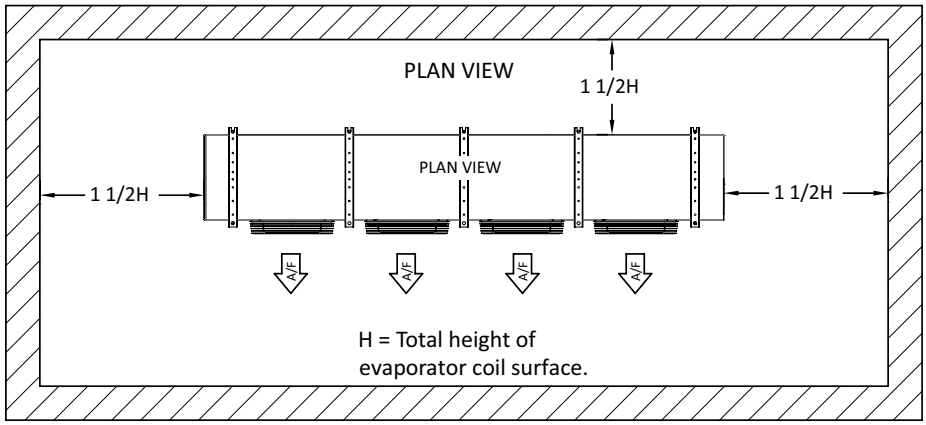


Figure 3C ONE EVAPORATOR

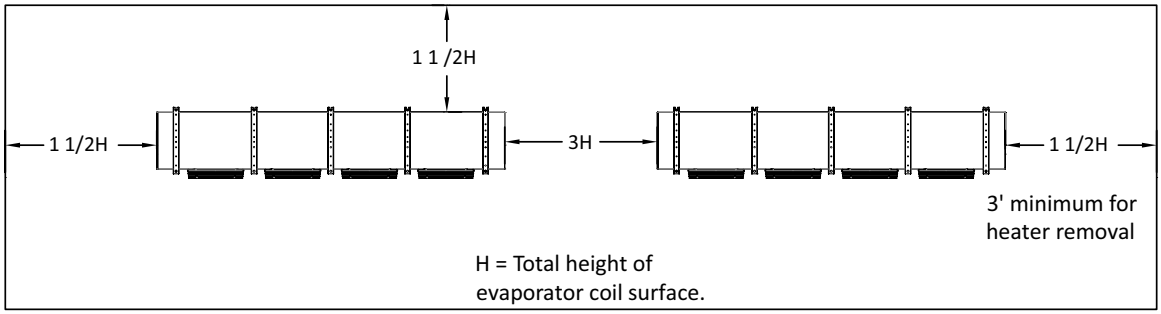


Figure 3D TWO EVAPORATORS

RIGID MOUNTED COMPRESSOR

Some products use rigid mounted compressors. Check the compressor mounting bolts to ensure they have not vibrated loose during shipment. See Figure 4A.

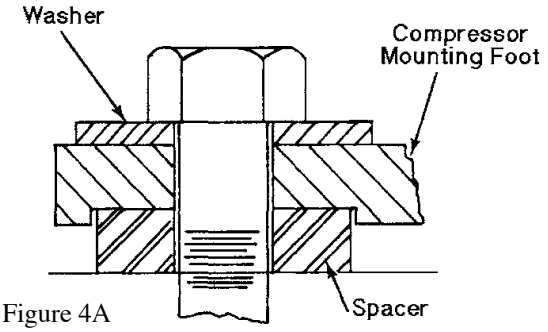


Figure 4A

IV. PIPING

A. All piping must be in accordance with applicable local and state codes.

B. Refrigerant piping (split systems) should be designed and installed in accordance with recommended practices as outlined in ARI or ASHRAE piping guides.

C. Water piping (chillers) should be designed and installed to meet application requirements. Provisions must be made to prevent freezing if design ambient temperatures dictate. All piping must be cleaned and flushed before opening the system to the chiller.

D. All mechanical connections (rotolock connections, flare fitting, packing glands, etc.) should be checked for tightness before pressure testing and evacuation of the system.

E. When piping is completed, a thorough leak test should be performed before evacuation start-up. Do not exceed 150 psig dry nitrogen/CO^2 test pressure on system for leak checking.

V. WIRING

A. All local and state codes must be strictly adhered to and good electrical practices should be followed to achieve the best installation possible.

B. Power wiring to equipment must be adequately sized for minimum ampacity as shown on unit nameplate. A disconnect should be located adjacent to unit for both safety and servicing purposes.

C. Equipment wiring diagram should be examined and thoroughly understood before field wiring connections are made.

D. Power supply should be checked to be certain that supply voltage agrees with equipment nameplate. Serious damage to compressors and motors can occur if improper voltage is applied.

E. All unit wiring terminals should be checked for tightness before power is applied to the equipment.

F. When wiring is completed, motors should be checked for proper rotation in accordance with function. All equipment has been factory wired to operate with the same rotation. If rotation is found to be incorrect, reverse two of the three leads on main incoming power.

G. Power quality must comply with industrial standards.

VI. SYSTEM EVACUATION

A. With refrigerant piping completed and leak tested, equipment is ready to evacuate. Do not use compressor to evacuate system. A quality vacuum pump capable of a 350 micron vacuum is necessary for adequate and dependable system vacuum. Moisture in a refrigeration system can cause corrosion, expansion valve freeze-up, and oil sludge.

B. Attach vacuum pump to both high and low side of system through compressor service valves and evacuate to 350 microns (all service valves*, hand valves, and solenoids must be open to ensure complete evacuation throughout the system). It is suggested that vacuum pump be run for a period of time after vacuum of 350 microns has been reached.

*Service valves are back seating valves and must be in mid-position to open to both sides of the system.

CAUTION: Ensure all sectors of refrigeration system are evacuated.

VII. SYSTEM CHARGING (Less Flooded Head Pressure Control)

With system wired, piped, and evacuated, unit is ready for refrigerant charging. All charging lines and manifolds must be evacuated prior to admitting refrigerant into system to prevent contaminating system with noncondensibles. (See Appendix "B" for proper oil usage.)

A. Connect charging line to receiver outlet valve and admit "liquid" refrigerant into high side of system until flow stops due to pressure equalization between high side and drum pressure. Backseat outlet valve and disconnect charging line.

B. Energize equipment and check sight glasses. If sight glass is not clear, continue to admit liquid into liquid side of system until liquid line sight glass clears, indicating a fully charged system (it may be necessary to defeat low pressure control on initial start to prevent nuisance trip until low side pressure is above cut out point of control.)

VIII. SYSTEM CHARGING (With Flooded Head Pressure Control)

A. Initial charging is the same as outlined in Section VII.

B. All adjustable flood control valves need to be adjusted according to proper refrigerant type and application.

C. Set hot gas regulating valves and unloaders (if supplied) to load compressors to 100% while charging. Add additional charge through liquid side (liquid) as outlined in Section VII, Item B.

IX. START-UP

This is a continuation of "system charging" and must be performed before equipment can be left operating and unattended. This will involve the checking and adjusting of all safety and operating controls (pressure and temperature controls need to be adjusted according to proper refrigerant type and application, and it is desirable to confirm that settings are correct and controls function properly.) Do not attempt to function safety controls without some means of stopping compressor in event of extreme high or low pressure conditions that could damage the equipment. If controls fail to function at set points, determine cause and correct.

WARNING: Jumpering any safety control other than for tesing purposes is dangerous to personnel and equipment, and nullifies equipment warranty.

CAUTION: Energize crankcase heaters and allow a minimum of 24 hours operation before a compressor start.

A. HIGH PRESSURE CONTROL – Connect a gauge to the compressor discharge service valve. Stop condenser air flow by stopping fans on air cooled equipment or restricting water flow on water cooled equipment. Control should open immediately when discharge pressure reaches control set point.

WARNING: Stop operation if "cut-out" exceeds set point.

B. LOW PRESSURE (PUMP-DOWN) CONTROL – Connect a gauge to the compressor suction service valve. Throttle receiver outlet valve to lower suction pressure at compressor. Compressor should pump-down and be de-energized when suction pressure reaches "cut-out" setting of control. Open receiver outlet valve and observe rise in pressure at compressor suction connection. Compressor should be energized when pressure reaches "cut-in" setting of control.

C. Approved Oil Types (see Appendix "B")

D. TEMPERATURE CONTROL (Water Chillers) – This control is the main unit operating thermostat. As standard, the control cycles both the compressor and the unloader(s) in response to return fluid temperature. The sensing bulb is located in a well on the return fluid nozzle. This control has been factory set to maintain desired leaving fluid temperature. The temperature control can be field adjusted. To calculate the proper set point, add the specified leaving fluid temperature and the design temperature difference of return to supply (TD.) Temperature control adjustment should be made as follows:

EXAMPLE FOR REFERENCE ONLY (This is for 100% H^2O fluid application):

Design conditions: 10°F TD, 55°F entering (return) fluid, 45°F leaving (supply) fluid and 5 psi fluid side pressure drop at rated flow.

1. Check proper flow through cooler. Pressure gauges at the entering and leaving nozzles should be used. Adjust flow by balancing valves or throttling valves on discharge side of the cooler to corresponding pressure drop.
2. The system fluid temperature should be at 60°F or above to simulate a pull down for proper start-up and check out.
3. Adjust temperature control dial to 55°F. This will produce 45°F leaving fluid temperature at designed flow rate.
4. Observe the pressures as the return fluid temperature continues to fall and the compressor(s) and/or unloader(s) are staged by the temperature control. The suction temperature at the compressor should not fall below approximately 32°F during all stages of compressor(s) operation. The compressor(s) will eventually be staged off by the temperature control. When this occurs, the return fluid temperature must rise to the "cut-in" set point of the temperature control (the dial setting) before the compressor(s) is staged on again.

WARNING: Always consult equipment submittals for the proper design conditions before adjusting the temperature control.

E. FREEZE PROTECTION CONTROL (Water Chillers) - Control is a pressure sensing, manual reset safety control. It responds to suction pressure and prevents circuit operation should suction pressure fall below control set point for a period in excess of 120 seconds. For straight water systems, the control is factory set at 32°F. The fixed time delay (120 seconds) allows circuit to stabilize on start-up and normal pump-down operation. For systems other than straight water systems, refer to electrical diagram for freeze control settings.

F. THERMOSTATIC EXPANSION VALVE – Adjust superheat setting to job requirements. To determine superheat correctly:

1. Measure the temperature of the suction line at the point the bulb is clamped.
2. Obtain the suction pressure that exists in the suction line at the bulb location by either of the following methods:
   a. If the valve is externally equalized, a gauge in the external equalizer line will indicate the desired pressure directly and accurately, **OR,**
   b. Read the gauge pressure at the suction valve of the compressor. To the pressure, add the estimated pressure drop through the suction line between bulb location and compressor suction valve.

The sum of the gauge reading and the estimated pressure drop will equal the approximate suction line pressure at the bulb.

3. Convert the pressure obtained in 2a or 2b to saturated evaporator temperature by using a temperature-pressure chart (see Appendix "A.")

4. Subtract the two temperatures obtained in F1 and F3, the difference is superheat.

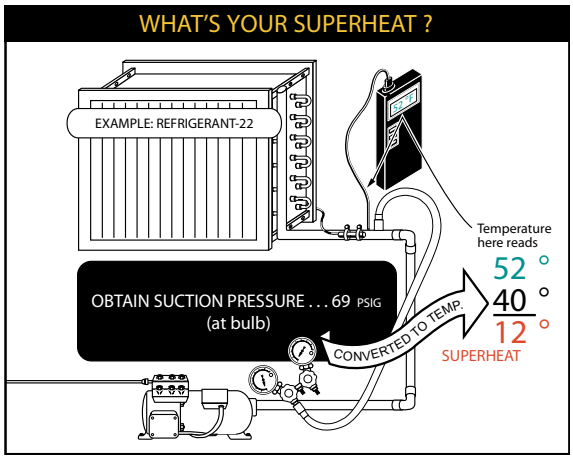


Figure 6A

Figure 6A illustrates a typical example of superheat measurement on a refrigeration system using R-22. The temperature of the suction line at the bulb location is read at 52°F. The suction pressure at the compressor is 69 psig and the estimated suction line pressure drop is 2 psig…

69 psig + 2 psig = 71 psig at the bulb, which is equivalent to a 40°F saturation temperature.

40°F subtracted from 52°F = 12°F superheat.

(See Appendix "C" for Electronic Expansion Valve, Appendix "D" for Superheat Controller, and Appendix "E" for Kelvin Control)

G. HOT GAS BYPASS (if supplied) – Connect gauge to compressor suction service valve. Throttle receiver outlet valve to lower suction pressure at compressor. Hot gas regulator should begin to open as suction pressure approaches design suction pressure. This should be done before unit has pulled down to design conditions.

X. SHUT DOWN

Equipment which will not be required to operate for a period of time should be secured by storing refrigerant charge in the receiver or condenser.

A. Front seat the receiver outlet valve. Set thermostat at a setting below system temperature to ensure that liquid line solenoid is energized. Defeat the low pressure control and allow unit to pump down to a suction pressure of approximately 5 psig. It may be necessary to repeat pump-down as some refrigerant will remain in oil and will slowly boil off. When suction pressure holds at 5 psig, front seat suction service valve. Lock disconnect in "off" position.

B. On units with water cooled condensers, special precautions must be taken to completely drain the vessels to prevent freezing if ambient should be below 32°F.

C. Inspect system for possible worn or faulty components and repair if required.

XI. SYSTEM RESTART AFTER SHUT DOWN

A. Thorough leak test should be performed.

B. Coil(s) should be checked for dirt accumulation or obstruction and cleaned if necessary.

CAUTION: Energize crankcase heaters and allow a minimum of 24 hours operation before a compressor start.

C. Install gauges, start system, and check for correct refrigerant charge and proper system operation and balance.

RAE CORPORATION EXPRESS LIMITED AND EXTENDED EXPRESS LIMITED WARRANTY

The Express Limited Warranty and Extended Express Limited Warranty are only available to customers if the Start-Up Warranty Checklist and Warranty Registration Card is completed and returned to RAE Corp. service department. The Start-Up Warranty Checklist must be; (1) completed at the time of start-up, (2) dated and signed by the technician, and (3) forwarded with the warranty registration card to the RAE Corp service department for warranty validation within 10 days after start-up. The Start-Up Warranty Checklist and Warranty registration Card are included with each product sold.

I. EXPRESS LIMITED WARRANTY

Subject to the terms, limitations, and disclaimer provisions set forth herein, RAE Corp. warrants to the original Purchaser that products manufactured by RAE Corp. shall be free from defects in material and workmanship under normal use and service. This warranty as to material and workmanship shall extend for a period of (1) year from original date of installation, (18) months from the date of shipment from RAE Corp. plant, whichever occurs first.

This warranty is issued only to the original Purchaser, is not transferable, applies only to a unit installed within the United States of America, its territories or possessions and Canada and is in lieu of all other warranties expressed or implied. RAE Corp. neither assumes, nor authorizes any other person to issue or assume for RAE Corp., any obligations or liabilities not herein stated.

It is agreed that in the event of breach of any of the express warranties described herein, the liability of RAE Corp. shall be limited to RAE Corp. repairing or replacing the non-conforming goods. RAE Corp. will repair or replace, free of cost to Purchase-User, F.O.B. RAE Corp. factory, any part or parts that in RAE Corp.'s judgment is defective. Upon RAE Corp. authorization, the said part or parts should be returned to RAE Corp., transportation prepaid by purchaser, for inspection and judgment. RAE Corp. assumes no responsibility for the expense of labor or materials necessary to remove a defective part or install repaired or new parts.

The Express Limited Warranty is subject to the terms and conditions described herein.

II. EXTENDED EXPRESS LIMITED WARRANTY

A four-year Extended Express Limited Warranty ("Extended Warranty") may be purchased at the time of purchase. The warranty runs until an additional 4 years after expiration of the Express Limited Warranty. The Extended Warranty must be purchased prior to the start-up date. RAE Corp., at its sole discretion, may authorize the purchase of an extended warranty after the unit is initially started, based on approval of the provided start-up documentation. The Extended Warranty is limited to the original purchaser and may not be transferred to subsequent purchasers.

The Extended Warranty is subject to the terms and conditions described herein

III. GENERAL DISCLAIMERS AND LIMITATIONS ON WARRANTY

RAE CORP. DISCLAIMS, AND MAKES NO WARRANTY OF MERCHANTABILITY AND NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, NOR DOES IT MAKE ANY WARRANTY, EXPRESS OR IMPLIED, OF ANY NATURE WHATSOEVER WITH RESPECT TO PRODUCTS SOLD BY RAE CORP. OR THE USE THEREOF EXCEPT AS IS SPECIFICALLY SET FORTH ON THE FACE HEREOF. THIS WARRANTY, WHICH IS GIVEN EXPRESSLY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED CONSTITUTES THE ONLY WARRANTY MADE BY THE SELLER.

RAE CORP. SHALL IN NO EVENT BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR PENAL DAMAGES. RAE CORP. MAKES NO WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, TO 'CONSUMERS' AS THAT TERM IS DEFINED IN SEC. 101 OF PUBLIC LAW 93-637, THE MAGNUSON-MOSS WARRANTY-FEDERAL TRADE COMMISSION IMPROVEMENT ACT.

RAE CORP. SHALL NOT BE LIABLE FOR ANY DAMAGE OR DELAYS OCCURRING IN TRANSIT, FOR ANY DEFAULT OR DELAYS IN PERFORMANCE CAUSED BY ANY CONTINGENCY BEYOND ITS CONTROL INCLUDING WAR, GOVERNMENT RESTRICTIONS OR RESTRAINTS, STRIKES, SHORT OR REDUCED SUPPLY OF RAW MATERIALS, FIRE, FLOOD OR OTHER ACTS OF GOD, NOR FOR DAMAGE OR LOSS OF ANY PRODUCTS, REFRIGERANT, PROPERTY, LOSS OF INCOME OR PROFIT DUE TO MALFUNCTIONING OF SAID UNIT.

ANY AND ALL CONTROVERSIES, ISSUES, CLAIMS OR DISPUTES RELATING TO THIS PURCHASE AND SALE TRANSACTION, INCLUDING BUT NOT LIMITED TO, ANY CONTROVERSIES, ISSUES, CLAIMS AND DISPUTES CONCERNING THE INTERPRETATION OR ENFORCEMENT OF ANY WARRANTY (OR ANY LIMITATION OR OTHER ASPECT THEREOF), SHALL BE GOVERNED BY OKLAHOMA LAW.

IV. SPECIFIC LIMITATIONS TO WARRANTY

PARTS ONLY -

This warranty is limited to repair or replacement of defective parts only and does not include labor. RAE Corp., at its sole discretion, may preauthorize the inclusion of labor expense. No claim for labor charges will be allowed without a written preauthorization from RAE Corp.'s service department. Prior written approval from RAE Corp. is required, in the event RAE Corp has authorized the customer to purchase replacement parts for any warranted parts; and, such replacement parts must be

obtained directly from a manufacturer's representative or RAE Corp. Claims for replacement parts obtained locally will be disallowed unless accompanied by a RAE Corp. purchase order for such replacement parts.

Orders for warranty replacement parts will be shipped ground transportation prepaid using the most appropriate transportation method. Any premium transportation service will be at the cost of the requestor.

EXPORT EQUIPMENT -

Equipment exported outside the United States will be covered under the same parts only warranty as non exported equipment; provided that, all warranty transactions must take place within the territorial United States. Parts covered under warranty must be paid for in advance of any parts shipment. The customer will be reimbursed upon return of the warranty part and after the part has been inspected and determined defective. All exporting paperwork and shipping costs, including crating, will be the responsibility of the party ordering the part.

INITIAL INSPECTION -

RAE Corp. will not be responsible for shipping damage, or for parts lost in transit, or for any claims of concealed damage. It is the responsibility of the receiving party to thoroughly inspect the equipment upon delivery for damage, refrigerant leaks or dry nitrogen pressure loss in transit, and to verify that any loose parts have been included in the shipment. The bill of lading will indicate if parts are shipped loose in the unit. If shipping damage has occurred, or loose parts are missing, the receiving party must resolve the issue through the claim process with the company responsible for transporting the equipment..

REFRIGERANT -

Refrigerant is excluded from the warranty. RAE Corp., at its sole discretion, may preauthorize the inclusion of refrigerant. No payment will be made for any leak that occurs at a threaded, mechanical joint (defined as flare joints, pipe thread joints or rotolock joints). It is the responsibility of the Contractor to check these joints upon arrival of the equipment or prior to charging the system. Any claim for refrigerant reimbursement must be pre-authorized by RAE Corp's service department and a purchase order issued. Any claims received without a RAE Corp. purchase order will be disallowed. Should an obligation be approved by RAE Corp., RAE Corp. specifically reserves the right to provide the refrigerant, or replace the refrigerant in a like quantity to the user.

V. DOA WARRANTY PROBLEMS

In the event of a DOA problem, the purchaser must notify and contact the RAE Corp. service department or the selling representative and provide the unit Model Number, Serial Number, complete problem description and estimate for repair. If repairs are authorized by RAE Corp., the RAE Corp. service department may:

A. Authorize the job site contractor to make the repairs.

B. Select a different contractor to make the repairs.

C. Dispatch a factory technician to make the repairs. If field repairs are authorized, a RAE Corp. purchase order will be issued in the amount of the approved repair cost (including parts, material and labor), and repairs can be performed. Upon completion of repairs, the contractor is to send the invoice referencing the purchase order number to the service department with supporting documentation, including a service report and parts/material invoices. No back charges or service billings will be accepted without prior authorization by the service department.

A DOA problem is a defect in material or workmanship that prevents a successful start-up of the unit. The problem will be discovered prior to or at the time of start-up. A DOA claim is not valid after the date of initial unit start-up. Shipping damage is not a DOA problem or a warranty issue.

VI. COMPRESSOR REPLACEMENTS

In the event a compressor fails, RAE Corp. service department must be notified by telephone or e-mail within 24 hours of discovering the compressor failure for the compressor to be covered by warranty. The customer must provide RAE Corp. service department with the Unit Model Number, Unit Serial Number, Compressor Model Number, and Compressor Serial Number before any replacement will be provided.

RAE Corp. reserves the right to determine the source of the replacement compressor. The failed compressor body core must be returned to the re-manufacturer or the wholesale house as determined by RAE Corp. service department before the compressor will be replaced pursuant to this warranty. If the core is not returned, the customer will be invoiced for the compressor and the warranty will not be extended. Although RAE Corp. will replace the compressor, RAE Corp. is not responsible for any labor, travel, crane or tax expense. Moreover, RAE Corp. assumes no responsibility for additional parts, refrigerant or other expenses incurred in making the unit operational.

VII. NOTICE TO RAE CORPORATION

To contact and/or notify RAE Corp. service department the following contact information must be used:

Address: P.O. Box 1206, Pryor, OK 74362
Office Phone: 918-825-7222
After Hours Emergency Cell Phone: 918-633-2838
Fax 918-825-6366
Email: customerservice@rae-corp.com

OIL CONTROL SYSTEM - PARALLEL SERIES UNITS

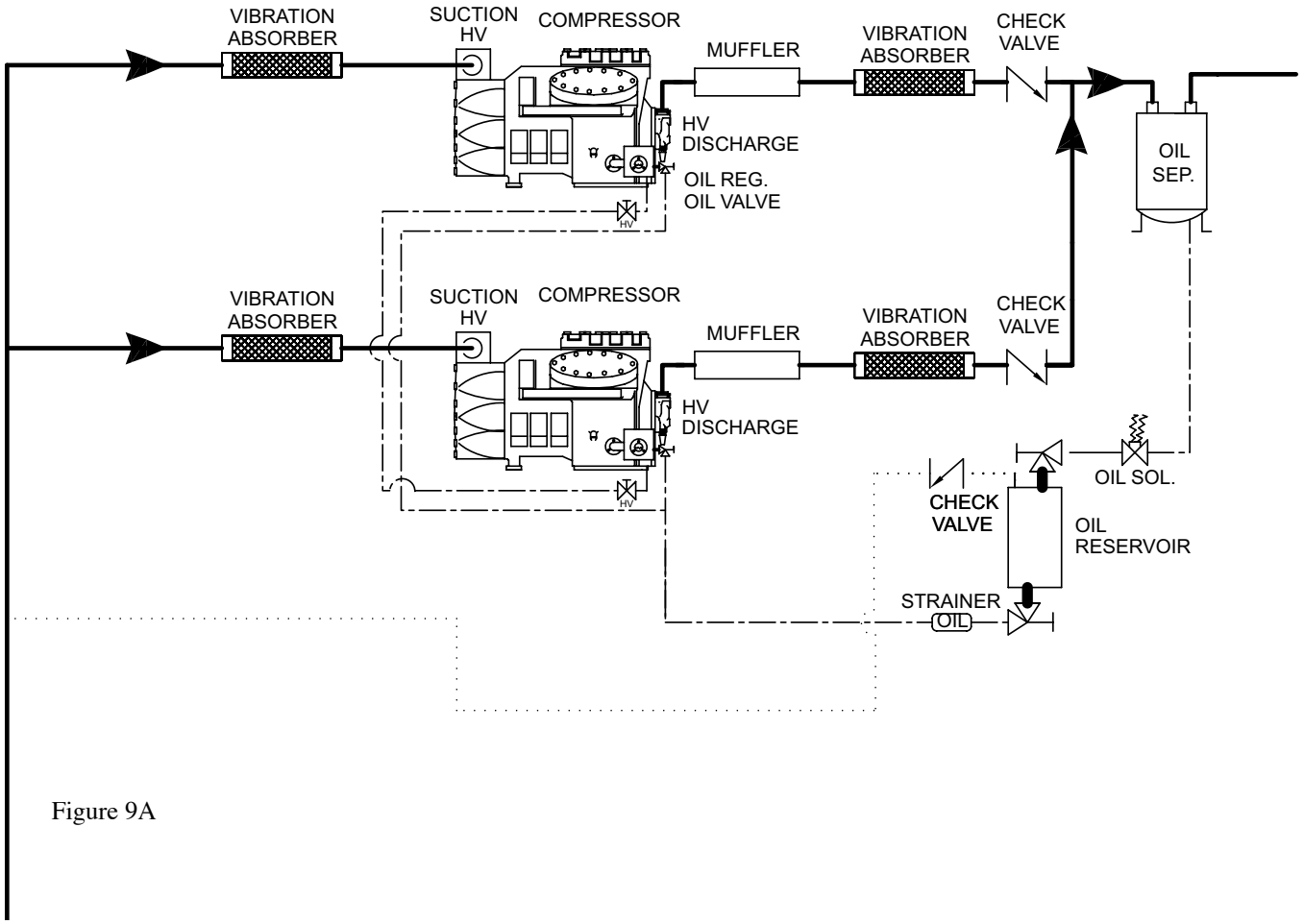


Figure 9A

The Parallel Series condensing units and chillers are designed having multiple compressors on a common circuit. When using this method, it is necessary that oil equalization between each compressor be maintained to prevent loss of oil from either compressor.

The method of crankcase equalization used by Century Refrigeration consists of an oil separator mounted in the common discharge line, an oil reservoir, and an oil regulating valve mounted on each compressor crankcase. In addition, a check valve having a 20 pound differential is installed in the vent line from the reservoir to the suction line.

With any or all compressors running, the oil separator will collect the oil leaving the compressor(s) and return this oil to the reservoir. The reservoir will be at a pressure approximately 20 pounds above the compressor crankcase pressure. Oil from the reservoir is piped to the oil regulators which are mounted on the compressor crankcase. As crankcase oil level drops, the regulator will admit oil to the crankcase to maintain a proper operating level.

HOW IT WORKS

A reserve of oil is necessary for the operation of the OIL CONTROL SYSTEM. The OIL RESERVOIR is the holding vessel for this stand-by oil. It has two sight glass ports on the shell to observe the oil level inside the vessel. Oil is fed into the OIL RESERVOIR by the OIL SEPARATOR.

High pressure from the high side returns with the oil from the OIL SEPARATOR to the RESERVOIR. In a period of time, enough pressure could build up to adversely affect the float and needle assembly in the OIL LEVEL REGULATOR. For protection, a vent line is installed from the top of the OIL RESERVOIR (a fitting is provided) back to the low pressure suction line. This line permits the pressure in the OIL RESERVOIR to be approximately the same as the pressure in the suction line and the crankcases of the compressors. Oil in the OIL RESERVOIR feeds down through 3/8 inch and 1/4 inch OD tubing and keeps the OIL LEVEL REGULATORS supplied with oil.

A REGULATING VALVE is mounted on the suction line vent connection on top of the OIL RESERVOIR and will maintain 20 pounds pressure differential over the crankcase. This positive pressure will keep the oil line to the OIL LEVEL REGULATORS filled and ready.

The valve on the top of the OIL RESERVOIR automatically receives oil from the OIL SEPARATOR (open position). To add oil to the OIL RESERVOIR, manually close the valve and fill the OIL RESERVOIR through the 1/4 inch flare connection on the side of the valve. Open valve after filling.

The valve on the bottom of the OIL RESERVOIR is the distribution valve to the OIL LEVEL REGULATORS (open position.) To remove oil from the OIL RESERVOIR, close the valve and use the 1/4 inch flare connection on the side of the valve to drain the oil out. Open valve after draining.

NEW SYSTEM START-UP

NOTE: On system start-up of a new parallel system, oil should be added to the OIL RESERVOIR to the upper sight glass portion, NOT ABOVE IT

It is commonly accepted that in a new refrigeration system, some oil will be absorbed by the refrigerant as the system becomes balanced out. After two hours of operation, the OIL RESERVOIR, if necessary, should again be filled to the upper sight glass. After two days, by which time the entire refrigeration system should be balanced out, check oil again. Then the OIL RESERVOIR must be observed on each service call. No oil should be added again until the oil level falls below the lower sight glass port.

EXISTING SYSTEM START-UP

When installing this OIL CONTROL SYSTEM on a parallel system that has been in operation for some time the amount of oil should be added cautiously. With the efficiency of the new OIL SEPARATOR, the oil return could likely be sufficient to fill the OIL RESERVOIR. Fill the OIL RESERVOIR to the lower sight glass port only. Observe for one day. After the second day, if the oil level has not risen to the upper sight glass, add oil. If the oil level has risen above the upper sight glass port, remove the excess oil from the OIL RESERVOIR.

NOTE: Only approved oil types and viscosities should be added to a system. See Appendix "B."

HEAD PRESSURE CONTROL

Since air-cooled systems are normally subjected to varying load requirements, and fluctuating ambient temperatures, it is difficult to design units to operate satisfactorily and with optimum efficiencies without some means of control of discharge pressures

In order to achieve proper system operation, it is necessary that adequate discharge pressures be maintained to ensure that the expansion valve will feed correctly to prevent low suction conditions. The expansion valve is sized to meet capacity requirements at a pressure differential between discharge pressure and design suction pressure. If discharge pressure is allowed to drop below a point which will not maintain this design differential, the suction will also drop due to "starving" of the evaporator. When this happens, nuisance tripping of low pressure control, or low evaporator temperature will occur.

Normal system design will allow satisfactory operation with discharge pressure down to approximately 95°F. On air cooled equipment, a number of methods can be used to maintain this minimum discharge pressure. The most common (and suitable for applications where ambient temperatures are not extreme) is fan cycling. When closer control or extreme ambient differentials are encountered, condenser flooding and fan cycling are preferred methods.

On water cooled equipment, discharge pressures are much easier to control, and the most common would be by the use of condenser water regulating valves directly sensing discharge pressure. (See Piping Illustration, Figures 10A and 10B.).

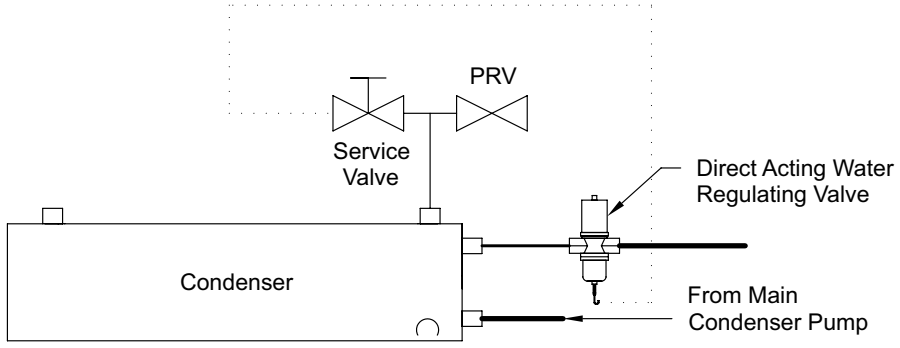


Figure 10A

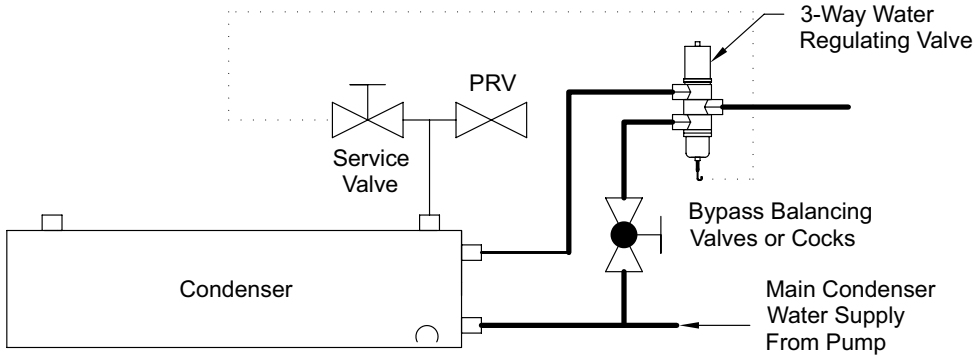


Figure 10B

AIR COOLED CONDENSING UNITS - LOW AMBIENT OPERATION

Refrigeration systems utilizing air cooled condensing units operating at ambient temperatures below design will require some means to stabilize high side pressure. In order to maintain sufficient high side pressure, the condenser capacity must be reduced in response to decreasing high side pressure. This may be accomplished by either reducing the air flow across the condenser, or reducing effective condenser surface by "flooding" the condenser with liquid refrigerant. Century Refrigeration offers both means of control, factory installed and preset.

FAN CYCLE

Controls head pressure by cycling condenser fan(s) in response to a decrease in high side pressure. This system is normally satisfactory during mild conditions. Each step of control is accomplished by a pilot duty pressure control(s), fused fan motor contactor(s), completely installed, wired, and factory calibrated. See Figure 11A for typical fan cycle wiring.

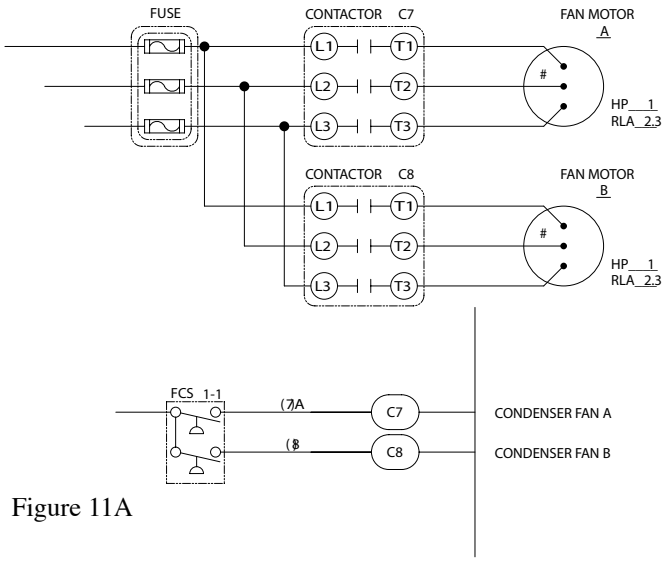


Figure 11A

FAN CYCLE WITH POSITIVE START

Includes, in addition to fan cycling controls, a "positive start" control circuit to ensure that the compressor will start at low ambient. All Century Refrigeration condensing units operate on a pumpdown cycle. During low ambient, sufficient low side pressure may not develop to start the compressor upon a call for cooling. The "positive start" time relay momentarily bypasses the low pressure operating control to ensure compressor operation for 90 seconds. At the end of this timed period, the system pressure will be up to normal operating levels. The timer contacts open returning compressor control to the low pressure operating control. See Figures 11B and 11C for typical wiring of the positive start circuit.

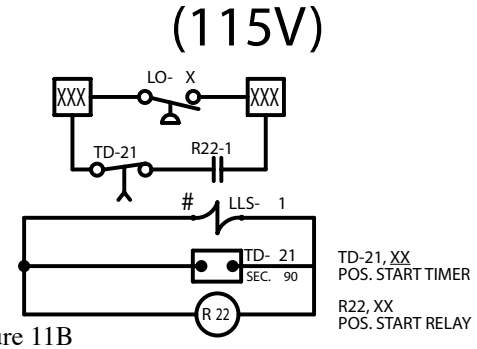


Figure 11B

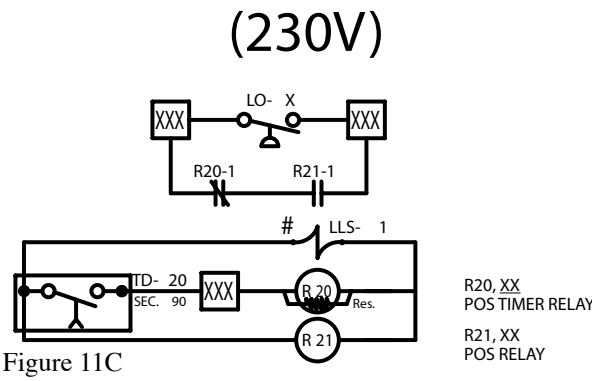


Figure 11C

COMPRESSOR COMPARTMENTS

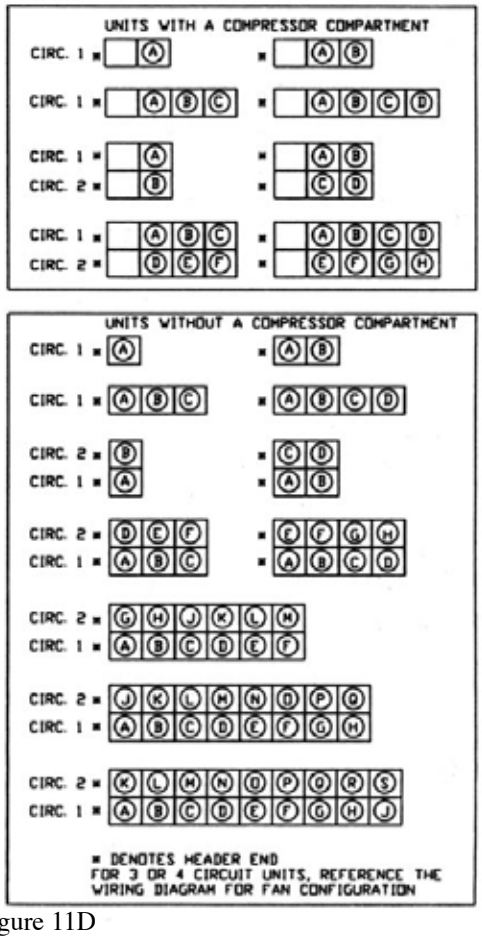


Figure 11D

PRESSURE SWITCH SETTINGS

CONROL		R-22, 407C		R134a*		R-404a, 507		R-410a*	
		In	Out	In	Out	In	Out	In	Out
High Pressure		Manual	400	Manual	280	Manual	400	Manual	585
Low Pressure (High/Low Temp.)		50/20	20/0	40	20	50	20	70	40
Fan Cycle (4 Steps)	Step 1	220	200	140	120	270	200*	340	320
	Step 2	230	210	170	140	280	210*	360	340
	Step 3	240	230	160	140	290	220*	380	360
	Step 4	250	240	170	150	300	230*	400	380
Fan Cycle (3 Steps)	Step 1	220	200	140	120	270	200*	340	320
	Step 2	230	210	150	130	280	210*	360	340
	Step 3	250	230	170	150	290	220*	400	360
Fan Cycle (2 Steps)	Step 1	220	200	140	120	270	200*	360	320
	Step 2	250	230	170	120	290	220*	400	360
Fan Cycle	Step 1	250	200	170	120	270	200*	400	320
Penn Adjustable Fan Cycle		250	200	170	120	270	200	400	320
Freeze Control		Manual	54	Manual	26	Manual	70 (407c=48)	Manual	97

* Use adjustable switches

NOTE:

1. Set for job site requirements per shop wiring diagram. All low pressure controls may require further adjustments per equipment specifications.
2. Water and evaporative-cooled high pressure switch R-22, R407c -315 psig.
3. Load limit pressure switch R-22 makes at 380psig/opens at 350psig.
4. Freeze controls to be adjusted per conditions below freezing.
5. Un-loaders to be adjusted per the application requirements.
6. High pressure cut-out setting shall not be set above 90% of the pressure relief valve setting.

Applicable to: TSI, CRI, RSI

A20 FLOOD CONTROL

Utilizes a valve(s) mounted, piped, and adjusted to regulate condensing pressure by flooding the condenser with liquid refrigerant. This option does require additional refrigerant in the system. As shown in Figure 12A, during the normal cycle the valve will prevent flow from the discharge line into the receiver and allow free flow of liquid from the condenser. As the receiver pressure drops, the valve will modulate allowing discharge gas to enter the receiver and restrict liquid flow from the condenser. The valve continues to modulate in this manner, maintaining a constant receiver pressure.

B20 FLOOD CONTROL

Includes, in addition to flooding valve(s), a "positive start" control circuit to insure that the compressor will start at low ambient. All standard Century Refrigeration condensing units operate on a pumpdown cycle. During low ambient, sufficient low side pressure may not develop to start the compressor upon a call for cooling. The "positive start" time relay momentarily bypasses the low pressure operating control to ensure compressor operation for 90 seconds. At the end of this timed period, the system will be up to normal operating levels. The timer contacts open returning compressor control to the low pressure operating control. See Figures 11B and 11C for typical wiring.

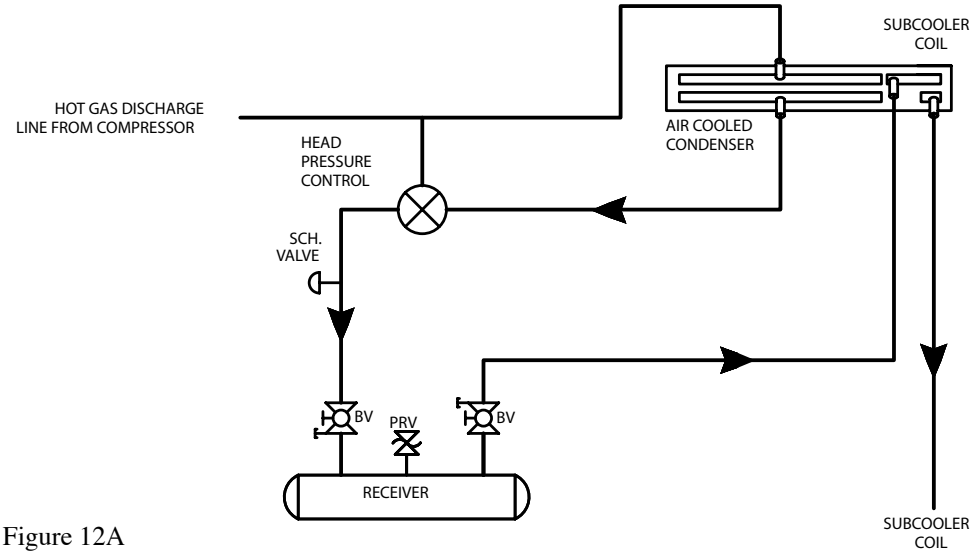


Figure 12A

REFRIGERANT PIPING

INTRODUCTION

Good equipment performance depends to a large extent on correct refrigerant line sizing. Friction losses, oil return, and piping cost must all be considered in determining the best sizes for discharge, liquid, and suction.

It must be understood that this brief treatise is a guide only for approximating typical line sizing. Detailed data in ASHRAE or ARI Data Books should be consulted for actual conditions found in specific applications.

Century Refrigeration does not warrant the adequacy of this data for any particular job, as field and installation conditions are not within our control.

GENERAL

It is necessary to determine 1) circuit capacity, 2) equivalent length of lines, and 3) line configuration. Lines must be sized to ensure oil return to the compressor and to keep frictional line losses to a minimum.

A. Circuit Capacity – This will be the actual compressor capacity at operating conditions. It will be necessary to provide a double suction riser for any circuit having a vertical lift from the evaporator and variable refrigerant flow (compressor unloading or hot gas bypass back to the suction side of the compressor.)

B. Equivalent Length of Lines – This will be the actual length plus allowance for valves, fittings, etc. (On normal air conditioning installations, it can be assumed that the equivalent length will be approximately two times the actual length.)

C. Line Configuration – This requires the actual piping layout to determine valves, elbows, risers, etc. This is also the time to determine if oil traps and dual risers are necessary.

On unloading type compressors, it is necessary that dual suction risers be used whenever the suction line rises vertically. It is also necessary to provide suction line traps if this vertical rise exceeds 10 to 12 feet. A suction line trap is nothing more than an "S" bend which will trap oil and form a seal when the compressor is running in the unloaded condition.

All horizontal lines are to slope approximately 1 inch downward per 10 feet in the direction of flow.

DISCHARGE (HOT GAS) LINE

Excessive discharge line pressure drops cause higher compressor discharge pressure, reducing volumetric efficiency and increasing power consumption. Discharge lines are usually sized for a pressure drop approximately equivalent to 1°F, which normally will result in adequate hot gas velocity for oil return. Discharge lines are sized for a higher velocity than are suction lines and therefore are less critical.

LIQUID LINE

The liquid line from the receiver to the expansion valve is usually sized for a pressure drop approximately equivalent to 1°F. (The liquid line from the condenser to the receiver is usually sized for a liquid velocity of 100 FPM to allow vapor generated in the receiver to return to the condenser.) Excessive liquid line pressure drops may cause some of the liquid to flash into vapor before entering the expansion valve, reducing system capacity. Liquid lines are not as critical as suction lines as oil will remain in solution with liquid refrigerant.

SUCTION LINE

Reduced suction pressure due to excessive suction line pressure drop will reduce the density of the suction gas in a reciprocating (fixed displacement) compressor. This means less weight of refrigerant pumped, resulting in reduced compressor capacity.

It is a generally accepted practice to size suction lines for a pressure drop approximately equivalent to 2°F to obtain the optimum compromise between piping cost, oil return, and friction loss.

HOT GAS BYPASS CONTROL

On many air conditioning and refrigeration systems, it is desirable to limit the minimum evaporator pressure during low load conditions. This may be necessary for a number of reasons, some of which are:

A. Capacity modulation beyond maximum steps of control offered by compressor design

B. Prevent compressor short cycling

C. Freeze protection

D. Humidity control

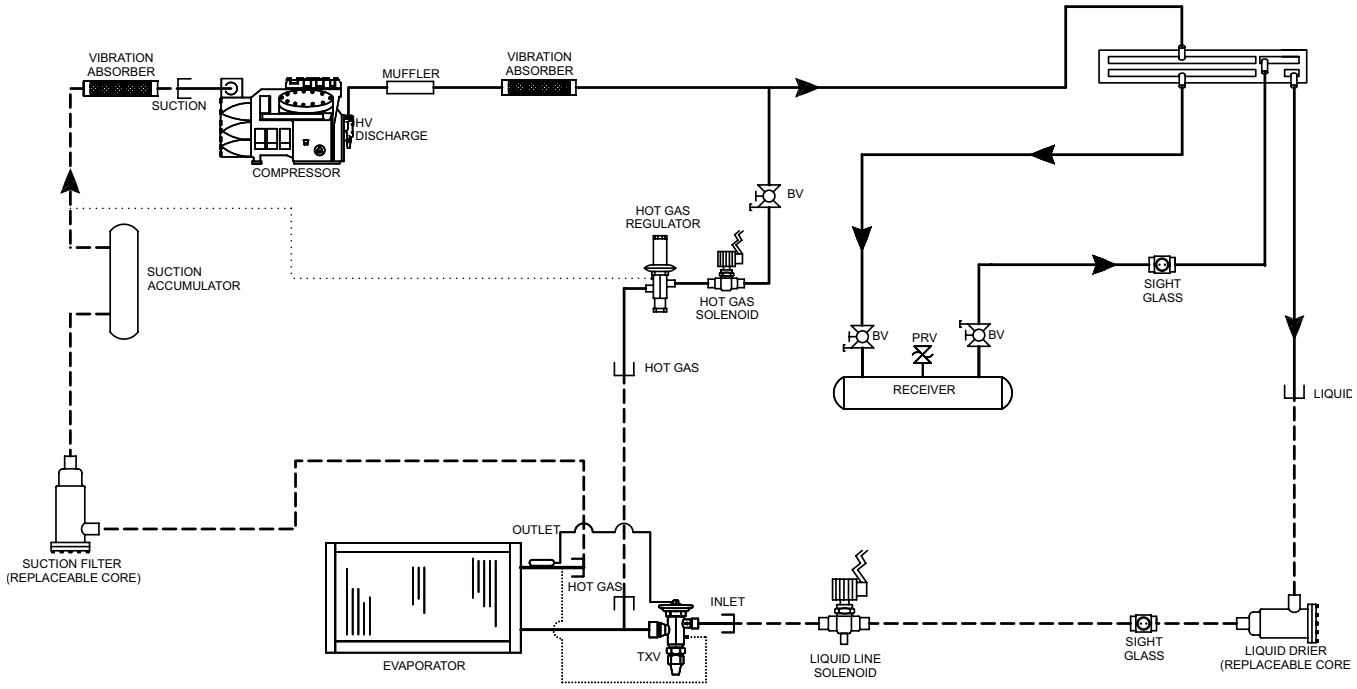
E. Oil Return at low load

One method of controlling minimum evaporator pressure is by metering a portion of the discharge gas into the low side of the system, thereby increasing the suction pressure.

STANDARD HOT GAS BYPASS

Hot gas bypass into the inlet side of evaporator.

This arrangement requires piping the hot gas bypass line into a point between the expansion valve and evaporator inlet. The hot gas regulator valve is equalized to the suction line and will meter hot gas into the evaporator maintaining the suction pressure preset on the regulator. The expansion valve installed in the conventional manner will sense suction pressure and degree of "superheat." As hot gas is introduced into the evaporator, the superheat will increase. However, this increase will be sensed by the expansion valve, and additional liquid will be fed into the evaporator. This will "false load" the evaporator to reduce the effective surface area, and still maintain required evaporator pressure and superheat.



Hot Gas Bypass Control, Figure 14A

EFFECTS OF UNBALANCED VOLTAGE ON MOTOR PERFORMANCE

Alternating current polyphase motors will operate successfully under running conditions at rated load when the voltage unbalance at the motor terminals does not exceed 1 percent. Performance will not necessarily be the same as when the motor is operating with an unbalanced voltage at the motor terminals.

A relatively small unbalance in voltage will cause a considerable increase in temperature rise. In the phase with the highest current, the percentage increase in temperature rise will be approximately two times the square of the percentage voltage unbalance. The increase in losses, and consequently, the increase in average heating of the whole winding will be slightly lower than the winding with the highest current.

If nuisance trip outs or repeated trip outs of a motor are experienced and diagnosis of the motor shows no faults, phase unbalance is a likely cause.

To illustrate the severity of this condition, an approximate 3.5 percent voltage unbalance will cause an approximate 25 percent increase in temperature rise.

The percent of voltage unbalance is equal to 100 times the maximum voltage deviation from the average voltage divided by the average voltage.

EXAMPLE:

$$\frac{217 + 221 + 228}{3} = 222V$$

220 Volt Circuit
Phase 1,2 = 217V
2,3 = 221V
3,1 = 228V

$$228\text{-}222 = 6V$$

$$\frac{100 \times 6}{222} = 2.7\% \text{ Voltage Unbalance}$$

Percent Voltage Unbalanced	Percent Current Rise	Percent Temperature Rise
3.5	29.4	25.0
3.0	25.2	18.0
2.5	21.0	12.5
2.0	16.75	8.0
1.5	12.5	4.5
1.0	8.0	2.0
0.5	3.8	0.5
0	0	0

NOTE: WE RECOMMEND A SETTING OF NO MORE THAN 3% UNBALANCE

TROUBLE SHOOTING CHART

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor will not run	a. Main switch open b. Fuse blown c. Thermal overloads tripped or fuses blown d. Defective contactor or coil e. System shut down f. No cooling required g. Liquid line solenoid will not open h. Motor electric trouble i. Loose wiring	a. Close switch b. Check electrical circuits and motor winding for shorts or grounds; investigate for possible over-loading; replace fuse or reset breakers after fault is corrected c. Overloads are auto reset; check unit closely when unit comes back on line d. Repair or replace contactor or coil e. Determine type and cause of shutdown and correct it before resetting safety switch f. None. Wait until unit calls for cooling g. Repair or replace coil h. Check motor for opens, short circuit or burnout i. Check all wire junctions, tighten all terminal screws
Compressor noisy or vibrating	a. Flooding of refrigerant into crankcase b. Improper piping support on discharge or liquid line c. Worn compressor	a. Check setting of expansion valve b. Relocate, add, or remove hangers c. Replace compressor
High discharge pressure	a. Condenser water insufficient or temperature too high b. Fouled condenser tubes (water-cooled condenser); clogged spray nozzles (evaporative condenser); dirty tube and fin surface (air cooled condenser) c. Non-condensibles in system d. System overcharged with refrigerant e. Discharge shut off valve partially closed f. Condenser undersized g. High ambient conditions	a. Readjust water regulating valve; investigate ways to increase water supply b. Clean c. Purge the non-condensibles d. Remove excess refrigerant e. Open valve f. Check condenser rating tables against the operation g. Check condenser rating tables against the operation
Low discharge pressure	a. Faulty condenser temperature regulation b. Suction shut off valve partially closed c. Insufficient refrigerant in system d. Low suction pressure e. Compressor operating unloaded f. Condenser too large g. Low ambient conditions	a. Check condenser control operation b. Open valve c. Check for leaks; repair and add charge d. See corrective steps for “low suction pressure” section e. See corrective steps for “compressor will not load or unload” section f. Check condenser rating tables against the operation g. Check condenser rating tables against the operation
High suction pressure	a. Excessive load b. Expansion valve overfeeding c. Compressor unloaders open	a. Reduce load or add additional equipment b. Check remote bulb; regulate superheat c. See corrective steps for “compressor will not load or unload” section
Low suction pressure	a. Lack of refrigerant b. Evaporator dirty c. Clogged liquid line filter drier d. Clogged suction line or compressor suction gas strainers e. Expansion valve malfunctioning f. Condensing temperature too low g. Compressor will not unload h. Insufficient water flow	a. Check for leaks; repair and add charge b. Clean chemically c. Replace cartridge(s) d. Clean strainers e. Check and reset for proper superheat; replace if necessary f. Check means for regulating condensing temperature g. See corrective steps for “compressor will not load or unload” section h. Adjust GPM

TROUBLE SHOOTING CHART

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor will not load or unload	a. Defective capacity control b. Unloader mechanism defective c. Faulty thermostat stage or broken capillary tube d. Stages not set for application	a. Replace capacity control b. Replace unloader mechanism c. Replace thermostat stage or capillary tube d. Reset thermostat setting to fit application
Compressor loading/unloading intervals too short	a. Erratic water thermostat b. Insufficient water flow	a. Replace water thermostat b. Adjust GPM
Little or no oil pressure	a. Clogged suction oil strainer b. Excessive liquid in crankcase c. Oil pressure gauge defective d. Low oil pressure safety switch defective e. Worn out pump f. Oil pump reversing gear stuck in wrong position g. Worn bearings h. Low oil level i. Loose fitting on oil lines j. Pump housing gasket leaks k. Flooding of refrigerant into crankcase	a. Clean suction oil strainer b. Check crankcase heater; reset expansion valve for higher superheat; check liquid line solenoid valve operation c. Repair or replace; keep valve closed except when taking reading d. Replace safety switch e. Replace pump f. Reverse direction of compressor rotation g. Replace compressor h. Add oil i. Check and tighten system j. Replace gasket k. Adjust thermal expansion valve
Compressor loses oil	a. Lack of refrigerant b. Velocity in risers too low c. Oil trapped in line d. Excessive compression ring blow by	a. Check for leaks and repair; add refrigerant b. Check riser sizes c. Check pitch of lines and refrigerant velocities d. Replace compressor
Motor overload relays or circuit breakers open	a. Low voltage during high load conditions b. Defective or grounded wiring in motor or power circuits c. Loose power wiring d. High condensing temperature e. Power line fault causing unbalanced voltage f. High ambient temperature around the overload relay g. Failure of second starter to pull in on part winding start system	a. Check supply voltage for excessive line drop b. Replace compressor motor c. Check all connections and tighten d. See corrective steps for “high discharge pressure” section e. Check supply voltage; notify power company; do not start until fault is corrected f. Provide ventilation to reduce heat g. Repair or replace starter or time delay mechanism
Compressor thermal protector switch open	a. Operating beyond design conditions b. Discharge valve partially shut c. Blown valve plate gasket	a. Add facilities so that conditions are within allowable limits b. Open valve c. Replace gasket
Freeze protection opens	a. Thermostat set too low b. Low water flow c. Low suction pressure	a. Reset to 40°F or above b. Adjust GPM c. See “low suction pressure” section

INSTALLATION, OPERATION & MAINTENANCE FOR UNIT COOLERS

SERIES "A," "BOC," "BALV," & "PFE"

MOUNTING

The "A," "BOC," "BALV," & "PFE" Series are shipped in the upright position. Check equipment for shipping damage. If shipping damage has occurred, a claim should be made with the transportation company. The local Century representative should be advised of the nature of the damage.

Remove top and sides of crate. Leave unit on skid in shipping position to do necessary electrical work and assemble expansion valve to coil. The shipping skid may be used to support unit while installing.

The Series A, BOC, BALV & PFE evaporators are designed to be mounted directly to ceiling or suspended by rods. The top of the evaporator must be closed and sealed to the ceiling or suspended to provide sufficient clearance so it is readily accessible for cleaning. Do not mount unit with less than 30 inches between coil face and wall. Ample space should be allowed at each end to adjust expansion valve or service electrical controls if required. Fan side of unit must be kept clear for proper air distribution. After unit is securely fastened in position, shipping legs may be removed from Series A units.

NOTE: Unit must be mounted level for proper condensate draining.

PIPING

All "A," "BOC," "BALV," "PFE," "FH," & "FV" Series evaporators are designed for use with remote condensing units. All connecting piping must be installed by qualified personnel in accordance with applicable local and national codes. All piping, traps, risers and line sizes should be in accordance with good piping practices for proper operation.

The drain line piping located inside the refrigerated space should be kept as short as possible and pitched a minimum of 1/2 inch per foot. If room is held below freezing, drain line must be wrapped with heat tape and insulated. Do not overlap heat tape unless otherwise instructed by manufacturer. Do not trap drains immediately after exit from low temperature area.

WIRING

The nameplate on the unit is marked with the current characteristics to be used for wiring the unit. If control circuit voltage is different from nameplate voltage, a separate decal is located by the electrical box marked "Control Circuit Voltage." All internal wiring is completed at the factory. A wiring diagram is furnished with each unit showing field connections and internal wiring. Access to internal connections may be made by removing end panel opposite expansion valve end of unit. All power must be turned off before removing any access panels. All wiring should be done in strict accordance with local and national electrical codes.

WARNING: The unit cabinet must be grounded.

SERIES "FH"

MOUNTING

The "FH" Series evaporators are shipped in the inverted position. Check equipment for shipping damage. If shipping damage has occurred, a claim should be made with the transportation company. The local Century representative should be advised of the nature of the damage.

Remove top and sides of crate or box. Leave unit on skid in shipping position to do necessary electrical work and assemble expansion valve to coil. Turn unit to mounting position and remove skid. Take necessary precautions not to damage the drain pan.

The "FH" Series evaporator is designed to be mounted directly to ceiling or suspended by rods. The top of the evaporator must be closed and sealed to the ceiling or suspended to provide sufficient clearance so it is readily accessible for cleaning. Do not mount unit with less than 15 inches between coil face and wall. Ample space should be allowed at each end to adjust expansion valve or service electrical controls if required. Fan side of unit must be kept clear for proper air distribution.

NOTE: Unit must be mounted level for proper condensate draining.

SERIES "FV"

MOUNTING

The "FV" Series evaporators are shipped in the inverted position. Check equipment for shipping damage. If shipping damage has occurred, a claim should be made with the transportation company. The local Century representative should be advised of the nature of the damage.

Remove top and sides of crate. Leave unit on shipping skid to do necessary electrical work and assemble expansion valve to coil. Remove bolts from skid, turn unit to mounting position and place back on skid, taking necessary precautions not to damage unit.

The "FV" Series evaporator is designed to be mounted directly to the ceiling or suspended from rods. The top of the evaporator must be closed and sealed to the ceiling or suspended to provide sufficient clearance so it is readily accessible for cleaning. Unit is pitched with the hangers for proper condensate drainage; therefore, unit must be mounted level with the top of the hangers. Unit is a blow-through type with air entering at the bottom and discharging out both sides. Ample space at each end to adjust expansion valve or service electrical controls is required. For proper air distribution, both sides and bottom of unit must be kept clear.

SEQUENCE OF OPERATION

NORMAL REFRIGERATION CYCLE:

1. Power is supplied to unit terminals designated on wiring diagram.
2. The defrost heaters are off (electric defrost units.)
3. Compressor operates in accordance with the demands of the refrigeration system temperature.
4. The unit cooler fan(s) operates continually.

DEFROST CYCLE

(ELECTRIC DEFROST MODELS)

1. Defrosting of the evaporator is started automatically by the timer at predetermined times. Typical settings of the timer would be four defrost periods per 24 hours.
2. Timer breaks circuit to evaporator fan motors and compressor, thereby shutting them off. At the same time, current is supplied to the heater circuit.
3. The properly positioned heaters warm up the evaporator coil above 32°F causing the frost to melt.
4. Frost on the evaporator is melted and defrost water drips into the heated drain pan and flows down the drain.
5. When the frost is melted, the evaporator coil continues to warm up to ensure a frost free coil.

COIL RECOOLING CYCLE

(ELECTRIC DEFROST MODELS)

1. When the coil warms up to approximately 55°F the defrost termination thermostat closes. This allows current to flow to the solenoid in the timer, which is then energized and trips the timer switch back to the normal refrigeration cycle. The fan delay portion of this thermostat is now open.
2. The compressor starts its normal refrigeration cycle.
3. The evaporator fan motor(s) remains off because fan delay thermostat is open. This will prevent warm air and moisture from being blown into the refrigerated space.
4. When evaporator coil temperature reaches approximately +30°F, the fan delay thermostat closes; this allows current to flow to the fan motor(s) and the unit returns to its normal refrigeration cycle.

FAN DELAY CONTROL

(STANDARD ON "FH" & "FV" SERIES UNITS)

This control is a single pole, double throw switch. The red lead wire is the common wire. The black wire is wired in series with the fan motors. The brown wire is wired in series with the defrost termination solenoid in the timer. The brown and red contacts are closed when the temperature is above 55°F while the black and red contacts are open. The black and red contacts are closed below 30°F and the brown and red contacts are open.

When the refrigeration system is first started up, the room ambient and the coil temperature are normally above 55°F, the fan delay thermostat is open, and the fan remains off. The fan motors will come on when the temperature is pulled below 30°F. The number of times the fan will cycle is dependent on the initial ambient temperature, size of cabinet, and the refrigeration equipment. This type of fan delay control cannot be adjusted.

FAN DELAY CONTROL – PENN TYPE A19ZBC

(STANDARD ON "A" & "BOC" SERIES UNITS, OPTIONAL ON "FH" & "FV" SERIES UNITS)

This control is a single pole, double throw switch (refer to the sequence of operation.) This control has an adjustable defrost period. It is obtained by turning the black knob clockwise to increase the temperature setting required to terminate defrost. The defrost duration increases only as long as necessary to remove frost and ice from the refrigeration unit cooler coil.

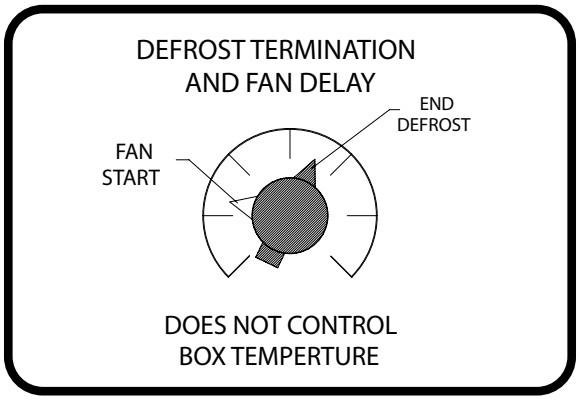


Figure 18A

SETTING DEFROST TERMINATION AND FAN DELAY

A. With a normal frost accumulation on the coil:
   1. Turn the knob clockwise to the end of the calibrated dial.
   2. Move the fan-start differential adjustment pin.
   3. Trip the timer to defrost cycle.
   4. Observe when the coil has completely defrosted and the condensate has completely drained. Then turn the knob counterclockwise until the refrigeration cycle resumes (the fans will remain idle with fan delay hookup.) This is the final setting of the indicator knob.

B. Fan start differential adjustment pin on thermostat:
   1. For fan delay adjustment, observe when the coil begins to frost.
   2. Holding the indicator knob firmly in place, move the differential adjustment pin clockwise until the fan motors start. This is the final setting of the differential adjustment pin.

MAINTENANCE

FAN MOTORS

The fan motors are lifetime lubricated for trouble-free operation. If fan motors should require servicing, the fan guard must be removed. If a motor does not operate or it cycles on thermal overload, the problem could be that the coil is blocked with ice.

DEFROST HEATERS (ELECTRIC DEFROST MODELS)

Heaters are maintenance free. If evaporator fails to defrost properly, check for defective heater. Series "A" & "BOC" defrost heaters can be replaced by removing side panel for access. Series "FH" & "FV" defrost heaters can be replaced by removing the drain pan for access.

MAINTENANCE ENTIRE UNIT

It is recommended that the unit be inspected occasionally for dirt accumulation on coil inlet. Grease and soil should be removed from the fan and guard.

MAINTENANCE (CONDENSING UNITS AND EVAPORATORS)

Under normal usage and conditions, it is recommended that the following list of preventive maintenance steps should be examined ***quarterly***:

1. Inspect electrical wiring, components, and connections. Verify that all connections are tight and complete as required.
2. Water Treatment (Water Chillers and Water Cooled Units) – The water should be tested by a local testing agency and their recommendations adhered to.
3. Check contactors and relays for proper operation; replace if points are worn.
4. Check fan motors; tighten motor mount bolts/nuts and fan set screws.
5. Visually inspect the equipment for oil stains (leaks) on interconnecting piping, solder joints, condenser and evaporator coil finned area.
6. Check and tighten all flare connections.
7. Check hand valve packing for leaks and tighten if needed.
8. Check condenser coil surface and clean if needed.
9. Visually check liquid line sight glass for flash gas. Glass must be clear with no bubbles. If glass is not clear, check system for leaks.
10. Check the liquid line sight glass moisture indicator and replace the liquid line drier if there is any indication of moisture.
11. Compressor Oil Level – The compressor oil level should be checked periodically. If oil is needed, allow equipment to pump down to approximately 5 psig crankcase pressure. Place disconnect in "off" position and close suction and discharge service valves. Add clean, dry oil then open discharge and suction service valves. Restart compressor and check oil level after two hours of operation. (Loss of oil would suggest that a leak may be in system. Carefully inspect entire system for evidence of oil and repair as necessary.)
12. Check for unusual noise and look for compressor pulsation or line vibration.
13. Check all safety and operating controls for proper settings and operation. Settings are listed on wiring diagram.
14. Check evaporator coil surface and clean if needed.
15. Check that all defrost controls and defrost heaters are functioning properly; check amperage.
16. Clean the drain pan with warm soapy water or mild acid and check for proper drainage.
17. Check drain line heater (if equipped) for proper operation. The heater power should be on continuously. The drain line should be insulated to prevent heat loss.
18. Check the evaporator for proper defrosting. The frost amount and pattern can vary greatly depending on the temperature of the room, the type of product being stored, how often new product is brought in, and the percentage of time the door to the room is open. It may be necessary to periodically change the number of defrost cycles or adjust the duration of defrost and fan delay.
19. Check the refrigeration cycle; take suction, discharge, and new oil pressure readings.
20. Check pressure drop across filters and driers (replace as required).
21. Verify that superheat conforms to specifications.

In addition to quarterly maintenance checks the following should be examined ***annually***:

1. Take an oil sample and check for high concentrations of acid or moisture. Change oil and driers, if test results are not normal. A test kit may be purchased at most wholesalers.
2. Take amperage readings on compressors, motors, and defrost circuits. Amperage is listed on the wiring diagram.

MAINTENANCE SCHEDULE

MONTHLY

- Visually inspect for physical damage of the unit.
- Check for adequate free area for service and operation.
- Inspect the condenser fans and motors for damage and proper operation:
  - Ensure that the condenser fans turn freely and have proper rotation.
  - Look for excessive or unusual vibration of fan blades or sheet metal panels when in operation, take corrective action as required.
  - Check all fan blades for signs of stress or wear.
  - Check all fan set screws and tighten if needed.
  - Inspect all motors, check volts, amps, and if required, rotation.
- Inspect the condenser coil for cleanliness:
  - Check the air passages through the finned surface.
  - Look for signs of corrosion on fins, cabinet, copper tubing, and solder joints.
- Check drain pan to ensure that drain is clear of debris, obstructions, or ice buildup and is free draining.
- Inspect electrical wiring and components:
  - Look for wear, kinks, bare areas, and discoloration of wiring.
  - Replace any wiring found to be damaged.
  - Verify that all electrical and ground connections are secure and tighten if necessary.
- Check operation and calibration of all timers, relays, pressure controls, and safety controls.
- Check and record (use Appendix F) suction and discharge pressures.
- Check and record (use Appendix F) compressor superheat and condenser sub cooling.
- Look for abnormal accumulation of ice patterns and adjust defrost cycles accordingly.
- Compare actual defrost heater amp draw against unit data plate.
- Check condensate drain line heat tape for proper operation.
- Verify operation of crankcase heater by measuring amp draw.
- Verify proper compressor oil levels.
- Inspect the liquid line sight glass for a dry and good quality refrigerant.
- Inspect refrigerant piping for signs of leaks, like oil stains.

QUARTERLY

- Check condenser performance (Ambient Temperature vs. Condensing Temperature)
- Check evaporator performance (Saturated Suction Temperature vs. Leaving Fluid Temperature)
- Check liquid temp entering metering device and evaporator superheat.

YEARLY

- Leak check refrigerant circuits.

APPENDIX A - TEMPERATURE PRESSURE CHARTS

Vacuum-Inches of Mercury
Italic Figures

SPORLAN

TEMPERATURE PRESSURE CHART - at sea level

Pressure-Pounds Per Square Inch Gauge
Bold Figures

TEMPERATURE		REFRIGERANT (SPORLAN CODE)			
°F	°C	R-22(V)	R-410A(Z)	R-407C(N)	R-134a(J)
-60	-51.1	*11.9*	*0.9*	*16.0*	*21.6*
-55	-48.3	*9.2*	*1.8*	*13.7*	*20.2*
-50	-45.6	*6.1*	*4.3*	*11.1*	*18.6*
-45	-42.8	*2.7*	**7.0**	*8.1*	*16.7*
-40	-40.0	**0.6**	**10.1**	*4.8*	*14.7*
-35	-37.2	**2.6**	**13.5**	*1.1*	*12.3*
-30	-34.4	**4.9**	**17.2**	**1.5**	*9.7*
-25	-31.7	**7.5**	**21.4**	**3.7**	*6.8*
-20	-28.9	**10.2**	**25.9**	**6.2**	*3.6*
-18	-27.8	**11.4**	**27.8**	**7.2**	*2.2*
-16	-26.7	**12.6**	**29.7**	**8.4**	*0.7*
-14	-25.6	**13.9**	**31.8**	**9.5**	**0.4**
-12	-24.4	**15.2**	**33.9**	**10.7**	**1.2**
-10	-23.3	**16.5**	**36.1**	**11.9**	**2.0**
-8	-22.2	**17.9**	**38.4**	**13.2**	**2.8**
-6	-21.1	**19.4**	**40.7**	**14.6**	**3.7**
-4	-20.0	**20.9**	**43.1**	**15.9**	**4.6**
-2	-18.9	**22.4**	**45.6**	**17.4**	**5.5**
0	-17.8	**24.0**	**48.2**	**18.9**	**6.5**
1	-17.2	**24.8**	**49.5**	**19.6**	**7.0**
2	-16.7	**25.7**	**50.9**	**20.4**	**7.5**
3	-16.1	**26.5**	**52.2**	**21.2**	**8.0**
4	-15.6	**27.4**	**53.6**	**22.0**	**8.6**
5	-15.0	**28.3**	**55.0**	**22.8**	**9.1**
6	-14.4	**29.1**	**56.4**	**23.7**	**9.7**
7	-13.9	**30.0**	**57.9**	**24.5**	**10.2**
8	-13.3	**31.0**	**59.3**	**25.4**	**10.8**
9	-12.8	**31.9**	**60.8**	**26.2**	**11.4**
10	-12.2	**32.8**	**62.3**	**27.1**	**12.0**
11	-11.7	**33.8**	**63.9**	**28.0**	**12.6**
12	-11.1	**34.8**	**65.4**	**29.0**	**13.2**
13	-10.6	**35.8**	**67.0**	**29.9**	**13.8**
14	-10.0	**36.8**	**68.6**	**30.9**	**14.4**
15	-9.4	**37.8**	**70.2**	**31.8**	**15.1**
16	-8.9	**38.8**	**71.9**	**32.8**	**15.7**
17	-8.3	**39.9**	**73.5**	**33.8**	**16.4**
18	-7.8	**40.9**	**75.2**	**34.8**	**17.1**
19	-7.2	**42.0**	**77.0**	**35.9**	**17.7**
20	-6.7	**43.1**	**78.7**	**36.9**	**18.4**
21	-6.1	**44.2**	**80.5**	**38.0**	**19.2**
22	-5.6	**45.3**	**82.3**	**39.1**	**19.9**
23	-5.0	**46.5**	**84.1**	**40.2**	**20.6**
24	-4.4	**47.6**	**85.9**	**41.3**	**21.4**
25	-3.9	**48.8**	**87.8**	**42.4**	**22.1**
26	-3.3	**50.0**	**89.7**	**43.6**	**22.9**
27	-2.8	**51.2**	**91.6**	**44.7**	**23.7**
28	-2.2	**52.4**	**93.5**	**45.9**	**24.5**
29	-1.7	**53.7**	**95.5**	**47.1**	**25.3**
30	-1.1	**54.9**	**97.5**	**48.4**	**26.1**
31	-0.6	**56.2**	**99.5**	**49.6**	**26.9**
32	0	**57.5**	**101.6**	**50.9**	**27.8**
33	0.6	**58.8**	**103.6**	**52.1**	**28.6**
34	1.1	**60.2**	**105.7**	**53.4**	**29.5**
35	1.7	**61.5**	**107.9**	**54.8**	**30.4**
36	2.2	**62.9**	**110.0**	**56.1**	**31.3**
37	2.8	**64.3**	**112.2**	**57.5**	**32.2**
38	3.3	**65.7**	**114.4**	**58.9**	**33.1**
39	3.9	**67.1**	**116.7**	**60.3**	**34.1**
40	4.4	**68.6**	**118.9**	**61.7**	**35.0**
41	5.0	**70.0**	**121.2**	**63.1**	**36.0**
42	5.6	**71.5**	**123.6**	**64.6**	**37.0**
43	6.1	**73.0**	**125.9**	**66.1**	**38.0**
44	6.7	**74.5**	**128.3**	**67.6**	**39.0**
45	7.2	**76.1**	**130.7**	**69.1**	**40.0**
46	7.8	**77.6**	**133.2**	**70.6**	**14.1**
47	8.3	**79.2**	**135.6**	**72.2**	**42.2**
48	8.9	**80.8**	**138.2**	**73.8**	**43.2**
49	9.4	**82.4**	**140.7**	**75.4**	**44.3**
50	10.0	**84.1**	**143.3**	**77.1**	**45.4**
55	12.8	**92.6**	**156.6**	**106.0**	**51.2**
60	15.6	**101.6**	**170.7**	**116.2**	**57.4**
65	18.3	**111.3**	**185.7**	**127.0**	**64.0**
70	21.1	**121.5**	**201.5**	**138.5**	**71.1**
75	23.9	**132.2**	**218.2**	**150.6**	**78.6**
80	26.7	**143.7**	**235.9**	**163.5**	**86.7**
85	29.4	**155.7**	**254.6**	**177.0**	**95.2**
90	32.2	**168.4**	**274.3**	**191.3**	**104.3**
95	35.0	**181.9**	**295.0**	**206.4**	**113.9**
100	37.8	**196.0**	**316.9**	**222.3**	**124.1**
105	40.6	**210.8**	**339.9**	**239.0**	**134.9**
110	43.3	**226.4**	**364.1**	**256.5**	**146.3**
115	46.1	**242.8**	**389.6**	**274.9**	**158.4**
120	48.9	**260.0**	**416.4**	**294.2**	**171.1**
125	51.7	**278.1**	**444.5**	**314.5**	**184.5**
130	54.4	**297.0**	**474.0**	**335.7**	**198.7**
135	57.2	**316.7**	**505.0**	**357.8**	**213.5**
140	60.0	**337.4**	**537.6**	**380.9**	**229.2**
145	62.8	**359.1**	**571.7**	**405.1**	**245.6**
150	65.6	**381.7**	**607.6**	**430.3**	**262.8**
155	68.3	**405.4**	**645.2**	**456.6**	**281.0**

To determine ***subcooling*** for refrigerant R-407C use BUBBLE POINT values (Temperatures above 50°F — Gray Background); to determine ***superheat*** R-407C, use DEW POINT values (Temperatures 50°F and below).

Figure 21A

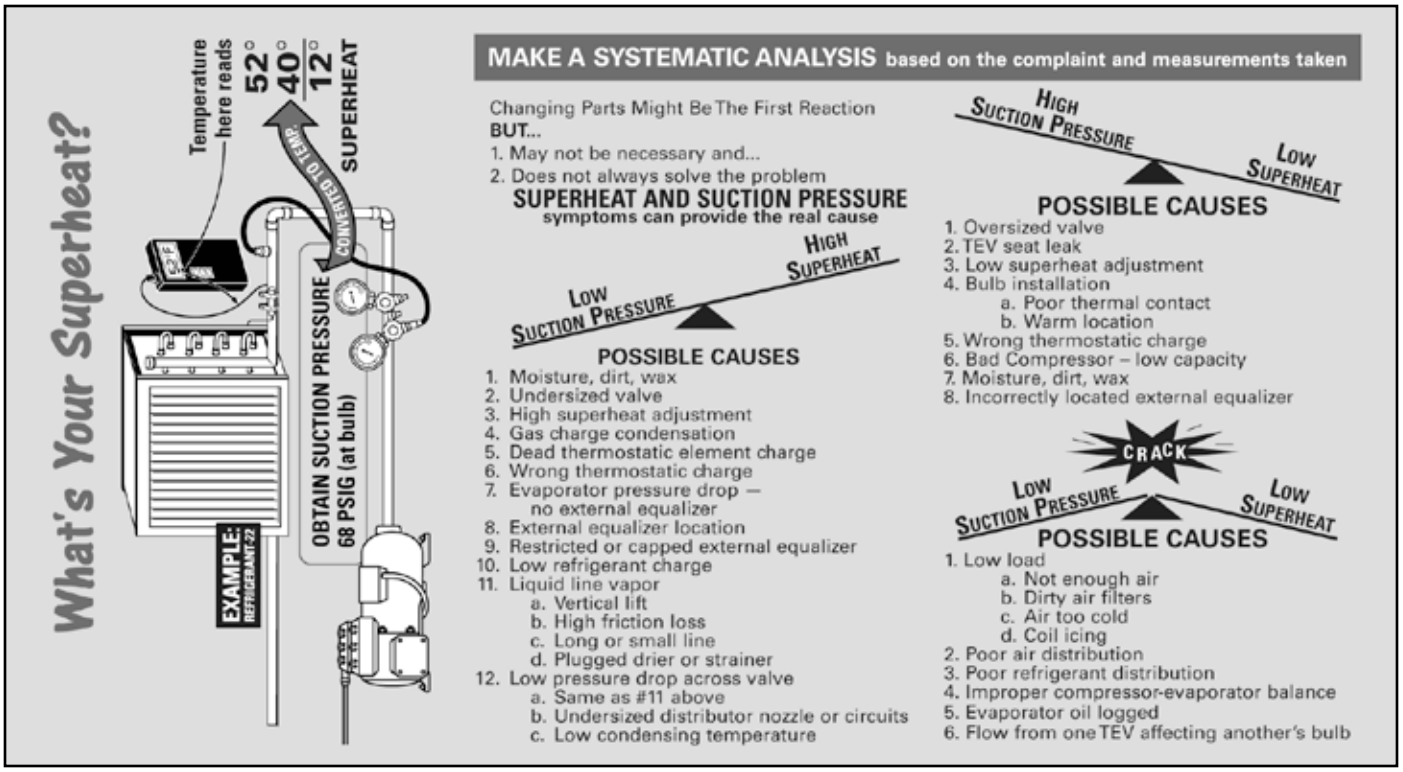


Figure 21B

PRESSURE-TEMPERATURE CHART
at SEA LEVEL

PSIG	TEMPERATURE °F					
	PINK	SAND	ORANGE	LIGHT BROWN	REDDISH PURPLE	BROWN
	REFRIGERANT - (SPORLAN CODE)					
	MP39 or 401A (X)	HP80 or 402A (L)	HP62 or 404A (S)	407C (N)	FX-10 or 408A (R)	FX-56 or 409A (F)
5*	-23	-59	-57	-48	-54	-22
4*	-22	-58	-56	-45	-52	-20
3*	-20	-56	-54	-42	-51	-19
2*	-19	-55	-53	-39	-49	-17
1*	-17	-54	-52	-36	-48	-16
0	-16	-53	-50	-34	-47	-15
1	-13	-50	-48	-31	-44	-12
2	-11	-48	-46	-29	-42	-9
3	-9	-45	-43	-27	-39	-7
4	-6	-43	-41	-24	-37	-5
5	-4	-41	-39	-22	-35	-2
6	-2	-39	-37	-20	-33	0
7	0	-37	-35	-18	-31	2
8	2	-36	-33	-17	-29	4
9	4	-34	-32	-15	-27	6
10	6	-32	-30	-13	-26	8
11	8	-30	-28	-12	-24	9
12	9	-29	-27	-10	-22	11
13	11	-27	-25	-8	-21	13
14	13	-26	-23	-7	-19	14
15	14	-24	-22	-5	-18	16
16	16	-23	-20	-4	-16	17
17	17	-21	-19	-3	-15	19
18	19	-20	-18	-1	-13	20
19	20	-19	-16	0	-12	22
20	21	-17	-15	1	-11	23
21	23	-16	-14	3	-9	25
22	24	-15	-12	4	-8	26
23	25	-14	-11	5	-7	27
24	27	-12	-10	6	-5	29
25	28	-11	-9	8	-4	30
26	29	-10	-8	9	-3	31
27	30	-9	-7	10	-2	32
28	32	-8	-5	11	-1	34
29	33	-7	-4	12	0	35
30	34	-6	-3	13	1	36
31	35	-5	-2	14	3	37
32	36	-4	-1	15	4	38
33	37	-2	0	16	5	39
34	38	-1	1	17	6	40
35	39	0	2	18	7	41
36	40	0	3	19	8	43
37	42	1	4	20	9	44
38	43	2	5	21	10	45
39	44	3	6	22	11	46
40	45	4	7	23	12	47
42	46	6	9	25	13	48
44	48	8	10	26	15	50
46	50	10	12	28	17	38
48	42	11	14	30	19	39
50	44	13	15	31	20	41
52	45	14	17	33	22	43
54	47	16	19	34	24	45
56	49	18	20	36	25	46
58	50	19	22	37	27	48
60	52	20	23	39	28	50
62	53	22	25	40	30	51
64	55	23	26	42	31	53
66	56	25	27	43	32	54
68	58	26	29	44	34	56
70	59	27	30	46	35	57
72	61	29	31	47	37	58
74	62	30	33	48	38	60
76	64	31	34	49	39	61
78	65	32	35	51	40	63
80	66	34	36	41	42	64
85	69	37	39	44	45	67
90	73	40	42	46	48	70
95	76	42	45	49	50	73
100	78	45	48	52	52	76
105	81	48	50	54	55	79
110	84	50	52	57	57	82
115	87	50	55	59	60	84
120	89	53	57	62	62	87
125	92	55	59	64	65	89
130	94	57	61	66	67	92
135	96	60	64	69	69	94
140	99	62	66	71	71	96
145	101	64	68	73	73	99
150	103	66	70	75	76	101
155	105	68	72	77	78	103
160	108	70	74	79	80	105
165	110	72	76	81	81	107
170	112	74	78	82	83	109
175	114	75	80	84	85	111

BUBBLE POINT

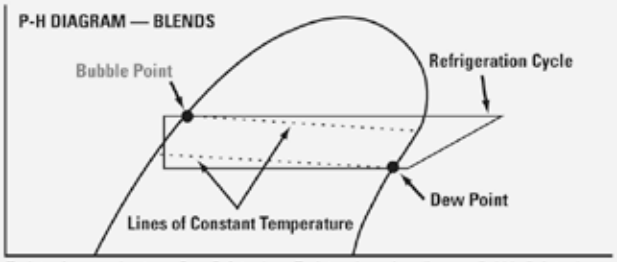
DEW POINT

Figure 22A

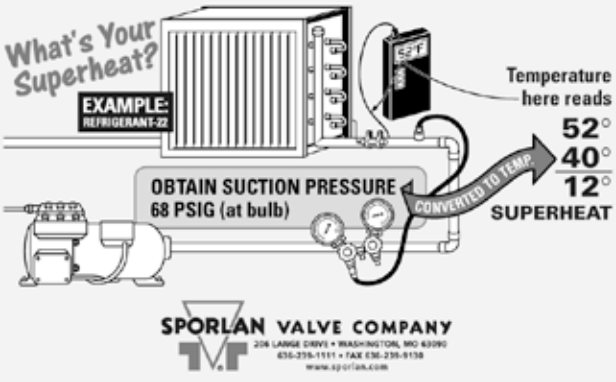
PRESSURE-TEMPERATURE CHART
(continued) *at SEA LEVEL*

PSIG	TEMPERATURE °F					
	PINK	SAND	ORANGE	LIGHT BROWN	REDDISH PURPLE	BROWN
	REFRIGERANT - (SPORLAN CODE)					
	MP39 or 401A (X)	HP80 or 402A (L)	HP62 or 404A (S)	407C (N)	FX-10 or 408A (R)	FX-56 or 409A (F)
180	116	77	81	86	87	113
185	117	79	83	88	89	115
190	119	81	85	90	91	117
195	121	82	87	91	92	119
200	123	84	88	93	94	121
205	125	86	90	95	96	123
210	127	87	92	96	97	124
220	130	91	95	99	100	128
230	133	94	98	102	104	131
240	136	97	101	105	107	134
250	140	99	104	108	109	137
260	143	102	107	111	112	141
275	147	106	111	115	116	145
290	151	110	114	119	120	149
305	155	114	118	123	124	153
320	159	118	122	126	128	157
335	163	121	125	130	131	161
350	167	125	129	133	135	165
365	170	128	132	137	138	169
380	174	131	135	140	141	172
400	178	135	139	144	145	177

* Inches mercury below one atmosphere



To determine superheat, use **Dew Point** values. To determine subcooling, use Bubble Point values.



SPORLAN VALVE COMPANY
206 LARGE DRIVE • WASHINGTON, MO 63090
636-239-1111 • FAX 636-239-9130
www.sporlan.com

Figure 22B

PRESSURE-TEMPERATURE CHART
at SEA LEVEL

PSIG	TEMPERATURE °F						
	YELLOW	GREEN	GREEN	BLUE	PURPLE	TEAL	WHITE
	REFRIGERANT - (SPORLAN CODE)						
	12 (F)	22 (V)	124 (M)	134a (J)	502 (R)	AZ50 or 507 (P)	717 (A)
5*	-29	-48	3	-22	-57	-60	-34
4*	-28	-47	4	-21	-55	-58	-33
3*	-26	-45	6	-19	-54	-57	-32
2*	-25	-44	7	-18	-52	-55	-30
1*	-23	-43	9	-16	-51	-54	-29
0	-22	-41	10	-15	-50	-53	-28
1	-19	-39	13	-12	-47	-50	-26
2	-16	-37	16	-10	-45	-48	-23
3	-14	-34	18	-8	-42	-46	-21
4	-11	-32	21	-5	-40	-44	-19
5	-9	-30	23	-3	-38	-41	-17
6	-7	-28	26	-1	-36	-39	-15
7	-4	-26	28	1	-34	-38	-13
8	-2	-24	30	3	-32	-36	-12
9	0	-22	32	5	-30	-34	-10
10	2	-20	34	7	-29	-32	-8
11	4	-19	36	8	-27	-31	-7
12	5	-17	38	10	-25	-29	-5
13	7	-15	40	12	-24	-27	-4
14	9	-14	41	13	-22	-26	-2
15	11	-12	43	15	-20	-24	-1
16	12	-11	45	16	-19	-23	1
17	14	-9	46	18	-18	-21	2
18	15	-8	48	19	-16	-20	3
19	17	-7	49	21	-15	-19	4
20	18	-5	51	22	-13	-17	6
21	20	-4	52	24	-12	-16	7
22	21	-3	54	25	-11	-15	8
23	23	-1	55	26	-9	-14	9
24	24	0	57	27	-8	-12	11
25	25	1	58	29	-7	-11	12
26	27	2	59	30	-6	-10	13
27	28	4	61	31	-5	-9	14
28	29	5	62	32	-3	-8	15
29	31	6	63	33	-2	-7	16
30	32	7	65	35	-1	-6	17
31	33	8	66	36	0	-4	18
32	34	9	67	37	1	-3	19
33	35	10	68	38	2	-2	19
34	37	11	69	39	3	-1	20
35	38	12	71	40	4	0	21
36	39	13	72	41	5	1	22
37	40	14	73	42	6	2	23
38	41	15	74	43	7	3	24
39	42	16	75	44	8	4	25
40	43	17	76	45	9	4	26
42	45	19	78	47	11	6	28
44	47	21	80	49	13	8	29
46	49	23	82	51	15	10	31
48	51	24	84	52	16	11	32
50	53	26	86	54	18	13	34
52	55	28	88	56	20	15	35
54	57	29	90	57	21	16	37
56	58	31	91	59	23	18	38
58	60	32	93	60	24	19	40
60	62	34	95	62	26	21	41
62	64	35	97	64	27	22	42
64	65	37	98	65	29	24	44
66	67	38	100	66	30	25	45
68	68	40	101	68	32	26	46
70	70	41	103	69	33	28	47
72	71	42	104	71	34	29	49
74	73	44	106	72	36	30	50
76	74	45	107	73	37	32	51
78	76	46	109	75	38	33	52
80	77	48	110	76	40	34	53
85	81	51	114	79	43	37	56

Figure 23A

PRESSURE-TEMPERATURE CHART
at SEA LEVEL

PSIG	TEMPERATURE °F						
	YELLOW	GREEN	GREEN	BLUE	PURPLE	TEAL	WHITE
	REFRIGERANT - (SPORLAN CODE)						
	12 (F)	22 (V)	124 (M)	134a (J)	502 (R)	AZ50 or 507 (P)	717 (A)
90	84	54	117	82	46	40	58
95	87	56	120	85	49	43	61
100	90	59	123	88	51	45	63
105	93	62	126	90	54	48	66
110	96	64	129	93	57	51	68
115	99	67	132	96	59	53	70
120	102	69	135	98	62	55	73
125	104	72	138	100	64	58	75
130	107	74	140	103	67	60	77
135	109	76	143	105	69	62	79
140	112	78	145	107	71	64	81
145	114	81	148	109	73	66	82
150	117	83	150	112	75	68	84
155	119	85	152	114	77	70	86
160	121	87	154	116	80	72	88
165	123	89	157	118	82	74	90
170	126	91	159	120	83	76	91
175	128	92	161	122	85	78	93
180	130	94	163	123	87	80	95
185	132	96	165	125	89	82	96
190	134	98	167	127	91	83	98
195	136	100	169	129	93	85	99
200	138	101	171	131	95	87	101
205	140	103	173	132	96	88	102
210	142	105	175	134	98	90	104
220	145	108	178	137	101	93	107
230	149	111	182	140	105	96	109
240	152	114	185	143	108	99	112
250	156	117	188	146	111	102	115
260	159	120	192	149	114	105	117
275	163	124	196	153	118	109	121
290	168	128	201	157	122	113	124
305	172	132	205	161	126	117	128
320	177	136	209	165	130	120	131
335	181	139	213	169	133	124	134
350	185	143	217	172	137	127	137
365	188	146	221	176	141	129	140
380	192	150	224	179	144	132	143
400	197	154	229	183	148	136	147

* Inches mercury below one atmosphere

APPROXIMATE PRESSURE CONTROL SETTINGS

Pressure - Pounds Per Square Inch Gauge

APPLICATION	TEMPERATURE RANGE (°F)	EVAPORATOR TD (°F)	REFRIGERANT							
			22		134a		404A		507	
			Out	In	Out	In	Out	In	Out	In
Beverage Cooler Floral Cooler Produce Cooler	35 to 38	15	41	66	17	33	53	82	56	86
Smoked Meat Cooler Meat Reach Thru Service Deli Seafood	32 to 35	15	38	62	15	30	49	77	52	81
Multi-Deck Fresh Meat	26 to 29	15	32	54	11	25	42	68	45	72
Frozen Glass Door Frozen Walk-In	-10 to 0	10	9	24	-	-	15	33	16	35
Frozen Ice Cream Frozen Food - Open Type	-30 to -20	10	0	10	-	-	4	16	4	18

Pressure control settings assume a suction line pressure loss equivalent to 2°F.

CARRYING CAPACITY OF REFRIGERATION LINES

Tons of Refrigeration - 200 Feet Equivalent Pipe Length

TYPE L COPPER TUBE O.D. Inches	REFRIGERANT						IRON PIPE SIZE Inches	SCHEDULE	REFRIGERANT	
	22		134a		404A / 507				717 (Ammonia)	
	Liquid Line	Suction Line	Liquid Line	Suction Line	Liquid Line	Suction Line			Liquid Line	Suction Line
	20°F Evap.		20°F Evap.		-20°F Evap.				20°F Evap.	
3/8	0.99	0.09	0.73	0.06	0.71	0.04	3/8	80	10.2	0.41
1/2	2.37	0.23	1.77	0.13	1.71	0.10	1/2	80	20.1	0.81
5/8	4.48	0.43	3.36	0.25	3.23	0.18	3/4	80	45.5	1.85
7/8	11.9	1.13	8.97	0.67	8.58	0.49	1	80	89.4	3.64
1-1/8	24.3	2.30	18.3	1.36	17.5	0.99	1-1/4	80	192	7.84
1-3/8	42.6	4.02	32.2	2.38	30.6	1.74	1-1/2	80	293	12.0
1-5/8	67.6	6.37	51.1	3.78	48.4	2.76	2	40	683	28.0
2-1/8	141	13.2	107	7.88	101	5.74	2-1/2	40	1090	44.7
2-5/8	250	23.4	190	14.0	179	10.2	3	40	1930	79.1
3-1/8	400	37.5	304	22.4	286	16.3	3-1/2	40	2820	116
3-5/8	595	55.7	453	33.3	425	24.2	4	40	3930	162
4-1/8	841	78.7	641	47.0	600	34.2	5	40	7100	292

Refrigerants 22, 134a, 404A, and 507 values are based on 100°F liquid temperature and the stated evaporator temperature. Refrigerant 717 (ammonia) values are based on 86°F liquid temperature and 20°F evaporator temperature. Both suction and liquid line values are based on a pressure drop equivalent to 1°F change in saturation temperature. For additional information on refrigerant line sizing, consult ASHRAE's Refrigeration Handbook or equipment manufacturer.

Figure 23B

APPENDIX B - APPROVED OIL TYPES

BITZER RECIPROCATING

Model	Compressor Type	Refrigerant	Temperature	Oil Type
2C	Semi-hermetic	R134a/R407c/R404a/ R507a	L	BSE32
4C			(L)	BSE55
4B		R22 (R12/R502)	All	B5.2
6B		R124a	All	S68
8C		R410a	All	BSE55
2x.2	Open Semi-hermetic	R134a/R407c/R404a/ R507a	L	BSE32
4x.2			(L)	BSE55
6x.2		R22 (R12/R502)	All	B5.2
x=T, N, P, H, G, F		NH3 (R717)	All	Clavus G68
S4	2 Stage	R404a/R507a	L	BSE32
S6		R22	L	B5.2
I to VII	Open Slow Speed	R22		
		R134a/R407c/R404a/ R507a	All	BSE32
			(L)	BSE55

BITZER OIL PART NUMBERS (1 gallon = 3.78 liters)

Bitzer Oils	Lubricant Type	5 Gallon	1 Gallon	1 Quart
B5.2	AB & MIN	793-3150-34	793-1150-24	793-1150-04
BSE32	POE		793-1031-34	793-1031-04
BSE55	POE		793-1068-34	793-1068-04
Clavus G68	MIN	915119-01		
S68	AB	793-3300-34	793-3300-24	

Temperature Ranges	
H	te > 30°F
M	te > 20°F
L	te < 20°F
(L)	te < 20°F

te = saturated suction temperature

Bitzer Oil	Alternative Oil	Manufacturer
B5.2	Zerice S46	Exxon Mobil
	Zerice S68	Exxon Mobil
	Zerol 150	Petrosynthese
	Clavus SD2212	Shell
	Reniso SP46	Fuchs
	Reniso SP32	Fuchs
BSE32	Clavus R32	Shell
	RL32H	Uniquema
	SEZ32	Fuchs
	Castrol Icematic SW32	Deutsche BP
	EAL Arctic 22 CC	Exxon Mobil
	EAL Arctic 32	Exxon Mobil
	Solest 31-HE	CPI
BSE55	Solest 68	CPI
	SE55	Fuchs
	Castrol Icematic SW68	Deutsche BP
	RL68S	Uniquema
	Clavus R68	Shell
	EAL Arctic	Exxon Mobil
S68	Alkyl 300	BVA

REFRIGERANTS/LUBRICANTS APPROVED FOR USE IN COPELAND COMPRESSORS

Refrigerants		Similar To	Application		Lubricant Choices			Comments
			Retrofit	New	Preferred	Alt #1	Alt #2	
Ozone Depleting	CFC R-12		L, M		MIN	AB & MIN		Phased out in 1996
	CFC R-502		L, M		MIN	AB & MIN	POE-32	Phased out in 1996
	HCFC R-22		L, M, H		MIN	AB & MIN	POE-32	No new equipment 2010
Interims	HCFC R401a	R-12	M, H		AB & MIN	POE 32 & MIN	POE-32	Service only Suva MP39
	HCFC R401b	R-12	L, M		AB & MIN	POE 32 & MIN	POE-32	Service only Suva MP66
	HCFC R402a	R-502	L, M		AB & MIN	POE 32 & MIN	POE-32	Service only Suva HP80
	HCFC R402b	R-502	L, M		AB & MIN	POE 32 & MIN	POE-32	Service only Suva HP81
	HCFC R408a	R-502	L, M		AB & MIN	POE 32 & MIN	POE-32	Service only FX10
	HCFC R409a	R-12	L, M		AB & MIN	POE 32 & MIN	POE-32	Service only FX56
Non-Ozone Depleting	HFC R134a	R-12	M, H	M, H	POE-32			
	HFC R404a	R-502	L, M	L, M	POE-32			Suva HP62, Forane FX70
	HFC R507	R-502	L, M	L, M	POE-32			Genetron AZ50
	HFC R407a	R-22	L, M	L, M	POE-32			
	HFC R407c	R-22	L, M, H	L, M, H	POE-32			Suva 9000/ KLEA 66
	HFC R410a			M, H	POE-32			ZP & ZB KCP Copeland Scroll models only
	HFC R422a/d	R-22	L, M		MIN	POE-32	AB	Discus supermarket racks only
	HFC R438a	R-22	L, M		MIN	POE-32	AB	Discus supermarket racks only; ISCEON MO99
	R704 Helium			Cryogenic	PAG			ZC Copeland Scroll models only
	R744 CO2			Sub-critical	POE**			ZO Copeland Scroll models only

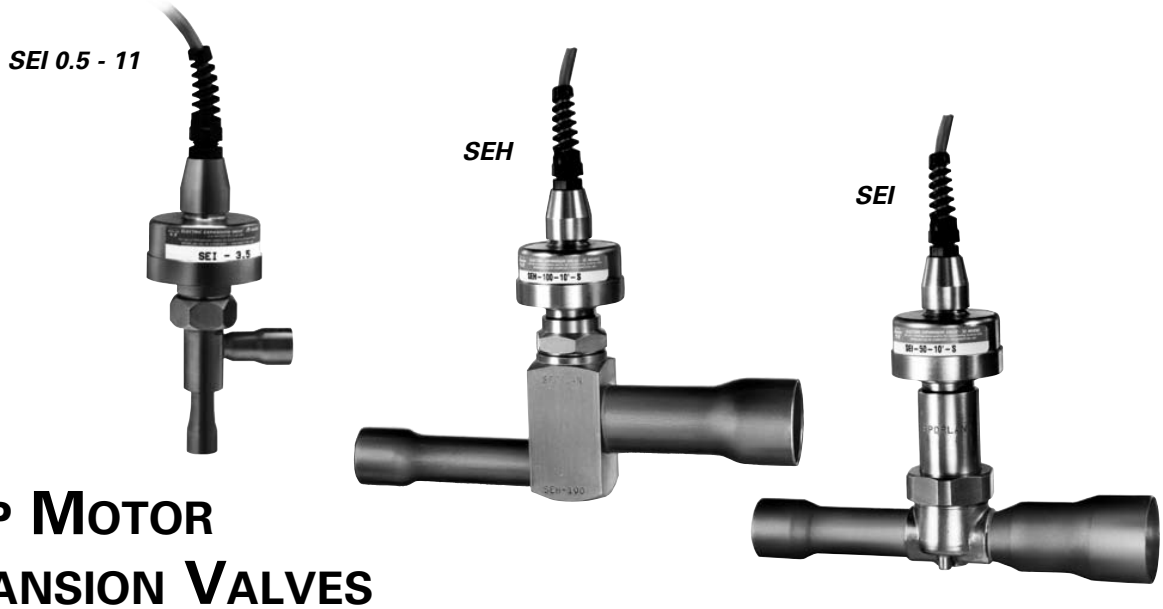
LEGEND:

MIN* -	Mineral Oil, *Mineral oils are interchangeable for "top off" purposes
AB -	Alkyl Benzene Oil
POE 32 -	Polyolester Oil
POE** -	Contact Application Engineer for oil details
PAG -	Polyalkylene Glycol Oil
POE-32 & MIN -	Minimum 50% POE
AB & MIN -	Minimum 50% Alkyl Benzene
(L) -	Freezer applications
L -	Low temperature application
M -	Medium temperature application
H -	High temperature application

SPORLAN MECHATRONICS

SEI & SEH

INSTALLATION INSTRUCTIONS



STEP MOTOR EXPANSION VALVES

OPERATION

The **SEI** and **SEH** series valves are step motor operated electric expansion valves. Step motors are designed to provide discrete segments of angular motion, or rotation, in response to an electronically generated signal. The advantages of step motors in valve applications are high resolution, repeatability and reliability with low hysteresis. Feedback loops are not required, simplifying controller design and circuitry.

The step motor used in the **SEI** and **SEH** valves is a 12-volt DC, two-phase, bi-polar, permanent magnet rotor type. Motor rotation is converted to linear motion by the use of a lead screw and threaded drive coupling. Forward motion of the motor extends the drive coupling and pin, which moves the valve to the closed position. Backward rotation of the motor retracts the drive coupling and pin modulating the valve in the opening direction. Full forward or backward travel, while the valve is assembled, is limited by the valve seat in the closed position or an upper stop in the open direction. A slight clicking sound may be heard at either of these two positions and does no harm to the valve or drive mechanism.

The valve will operate only when connected to a properly designed controller. The controller must supply the necessary square wave step signal at 12 volts DC and 200 PPS for the valve to control properly. Various Sporlan and third party controllers are available for use with the valve. Questions of suitability of a specific controller should be directed to Sporlan, Division of Parker, Attn.: Product Manager — Mechatronics Products. Control algorithms for the valve include a initialization sequence that will first over-drive the valve in the closing direction. This is to assure that the valve is completely shut and to establish the "zero" open position. The controller then keeps track of the valve's position for normal operation. During this initialization phase, a light clicking sound may be heard, which will serve as proof of the valve's operation and closure.

All valves are tight seating and uniquely characterized by pin and port combinations for exceptional control of refrigerant flow. The seats require no service and are not replaceable. The motor may be easily replaced without removing the valve body from the system.

INSTALLATION

The SE series valves are electronically controlled Step Motor Expansion Valves, and are installed before the distributor and evaporator just as one would install a Thermostatic Expansion Valve. The valves are directional, and the inlet is clearly marked. Location should be planned to provide serviceability and to allow controller installation within the maximum cable length of forty feet. The valve may be installed in the refrigerated space and may be mounted in any position except with the motor housing below the liquid line. Cable routing should avoid any sharp edges or other sources of potential physical damage such as defrost heaters and fan blades. For neatness and protection, the cable may be fastened to the suction or liquid lines with nylon wire ties.

The flare version is supplied with brass fittings and should be installed using properly made flare connections. A drop of refrigerant oil should be used to prevent galling of the threads when tightening. Inlet strainers that are removable for cleaning are supplied as part of the flare connection.

The sweat version has copper connections and any solder or brazing alloy may be used to install the valve. There is no need to disassemble the valve for installation, however, the torch flame should be directed away from the motor housing and cable. Care must be taken to assure that the cable is not damaged either directly from the flame, or indirectly from contact with hot piping. The valve is shipped in the open position to prevent heat being conducted into the motor, but it is strongly suggested that the valve body be wrapped with a wet cloth during the soldering operation. Inlet strainers are supplied optionally with ODF style valves, and if used, should be oriented in the proper direction as shown on the strainer package. The valve should be completely installed and reassembled before connecting to the controller and applying power. The wiring is color-coded and the controller manufacturer should be consulted for the proper attachment to the controller.

FIELD SERVICING INSTRUCTIONS
SEI & SEH Only

The following steps are necessary for the proper disassembly, inspection, cleaning and reassembly of all valves except SER 1.5, 6, 11 and 20 (whether in or out of the refrigerant piping).

1. Before disassembling the valve, be sure the refrigerant pressure in the system has been reduced to a safe level (0 psig).

2. Disconnect the line voltage to the valve controller.

3. Refer to the exploded view of the **SEI/SEH** for the remaining instructions. Using the appropriate wrenches or a vice to properly support the valve body, remove the motor assembly from the valve body by loosening the lock nut. **To prevent permanent damage to the motor, DO NOT attempt to disassemble the motor housing.**

   CAUTION: Regardless of whether the valve is in the system or in a vise, care must be taken to prevent distorting the valve parts when tightening.

4. The motor assembly may be removed for inspection and cleaning.

5. If the motor fails to operate properly, check the resistance of each motor phase. Resistance between the black and white leads or between the red and green leads should be as shown in Table 1. Differences of more than 10% between phases indicate a defective motor. Resistance between black and red, or any lead and housing should be infinite, any resistance reading will indicate a shorted winding and the motor will need to be replaced.

6. If you have access to a SMA test instrument, operation of the valve may be proven. Connect the motor leads to the proper color-coded connector on the SMA. Set the rate to 200 PPS and toggle in the "OPEN" direction. The white driver/piston should retract into the driver guide/adaptor. After approximately 30 seconds, the driver should be fully retracted and a light clicking or "ratcheting" sound may be heard, this is normal to the valves and proves operation of the motor. If the SMA is toggled in the "CLOSE" position, after approximately 30 seconds the white polyester driver/piston should disengage the lead screw, and can be removed. Inspect the driver/piston for damage. To replace the driver, toggle the SMA to the "OPEN" position and carefully engage the driver to the lead screw.

   CAUTION: Whenever the motor is powered while not in place on the valve, the driver must be fully retracted into the guide before the valve is reassembled. Failure to do this will permanently damage the valve.

7. If the motor responds to step 6 above, the valve body itself should be checked for obstruction. Check for contaminants in the port or strainer, if used.

8. If the valve body and strainer are clear and the motor operates as in step 6 above, the valve is considered operational and the problem lies in the controller or power supply. The manufacturer of these components should be contacted for further assistance.

MOTOR ADAPTOR ASSEMBLY REPLACEMENT
SER-30, -50 & SEH Only

If the motor is found to be defective in the above, the entire motor assembly must be replaced.

1. Remove all power from the valve and controller.

2. Cut the existing valve cable at a convenient point at the driest or most protected location.

3. Splice the new cable to the old cable using the waterproof butt splices. COLOR CODING ON THE INDIVIDUAL WIRES MUST BE MATCHED; FAILURE TO DO SO WILL RENDER THE VALVE INOPERATIVE AND MAY DAMAGE EITHER THE VALVE OR CONTROLLER.

4. Waterproof the splice with shrink tube or electrical tape suitable for use in cold and damp environments. Care should be taken to prevent the splice from lying in the case pan or other wet location.

VALVE REPLACEMENT

The entire valve may be replaced if desired. The old valve may be unbrazed or cut out of the piping. If cut out, use a tubing or pipe cutter and not a saw. When installing the new valve any convenient brazing alloy and method may be used. The valve need not be disassembled, but the body and motor assembly should be wrapped with a wet cloth to prevent damage.

Extra care should be taken to prevent damage to the motor cable, either directly from the torch, or indirectly from contact with a hot surface.

Waterproof butt splices are not supplied with complete valves but must be used to prevent corrosion on the motor leads.

Refer to the instruction for MOTOR REPLACEMENT above.

If the valve is disassembled for installation, refer to REASSEMBLY instructions, below.

REASSEMBLY

1. Use the SMA in the "OPEN" mode or valve controller to retract the white driver/piston fully into the driver guide. Remove power from the valve or controller.

2. Lightly oil the gasket or knife-edge on the new motor adaptor. Carefully seat the adaptor on the valve body or engage and tighten the lock nut if used. Lock nuts should be torqued to approximately 45 ft.-lbs. One eighth turn more than hand tight is sufficient to achieve a leak proof seal on knife edge joints. Locktite 242 should be applied to the threads on the SEI-0.5 through SEI-30. The motor kit should be attached to the valve, then tightened using a strap wrench ensuring the o-ring is fully compressed.

3. Pressurize the system and check for leaks.

4. Reapply power to the controller. Each controller manufacturer has a slightly different initialization scheme and the proper procedure must be followed. Since, during service, valve position as calculated by the controller will be lost, the controller should be initialized at least twice. In some instances, cycling power to the controller will accomplish this. However, the controller literature or the manufacturer should be consulted.

SMA-12 VDC BIPOLAR STEP MOTOR ACTUATOR

1. Connect any Sporlan step motor valve to the SMA-12 by matching wire color to terminal color. Any 12 VDC bipolar step motor may be tested with the SMA-12. Phase one leads should be connected to the black and white terminals, Phase two leads should be connected to the red and green terminals.

2. Select a step rate with the selector knob.

3. Push the open/close toggle switch in the "CLOSE" direction to extend the driver or close the valve.

4. Push the open/close toggle in either direction at the 1 step rate will alternate the phases energized.

5. Observe the terminal indicator lights. At rates other than 1, indicator lights will flash quickly. Pushing the open/close toggle in either direction at the 1 step rate will alternate the phases energized.

The following sequence of indicator lights will light.

OPENING	CLOSING
Black & Red	Red & White
Red & White	Red & Black
White & Green	Black & Green
Green & Black	Green & White

6. Check that the power indicator light is lit; if not, replace the batteries.

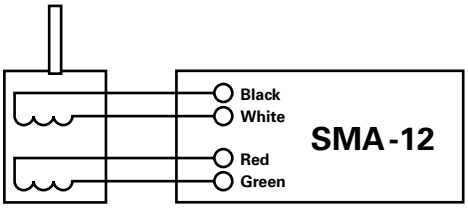
7. If the terminal indicator lights do not light, one or both motor phases are open and the motor must be replaced.

8. If the motor can be powered smoothly in both directions, the motor assembly is functional and the controller must be tested or replaced.

SPECIFICATIONS

Power input – Two 9 volt Alkaline batteries
Power output – 10 Watts intermittent
Step rate – Selectable - 1, 50, 100, 200 steps per second
Drive type – Bipolar
Connector – Binding post with banana plug socket

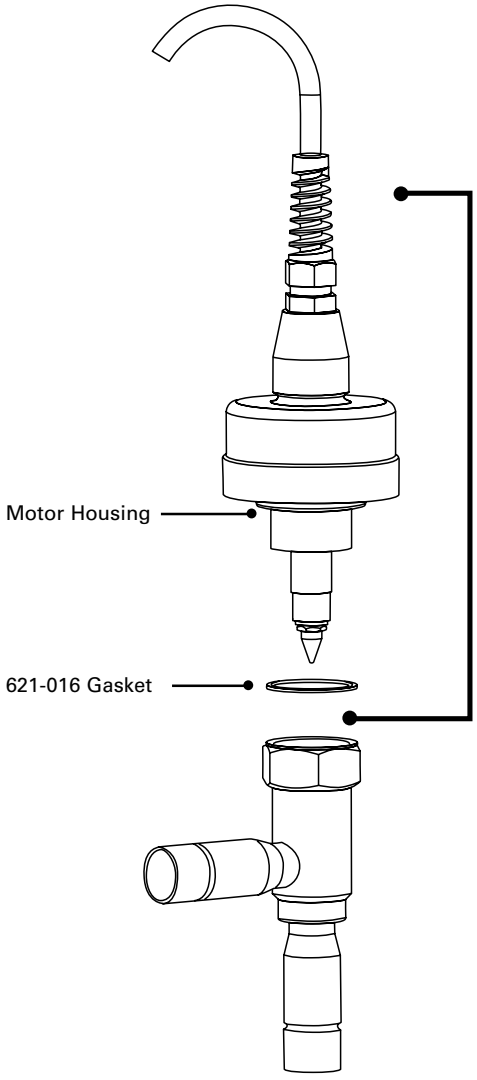
12 Volt DC Bipolar Step Motor



An accessory pigtail item number 958112 is available at extra charge to allow the SMA-12 to be directly connected to all Sporlan Packard Weather-Pack™ equipped valves.

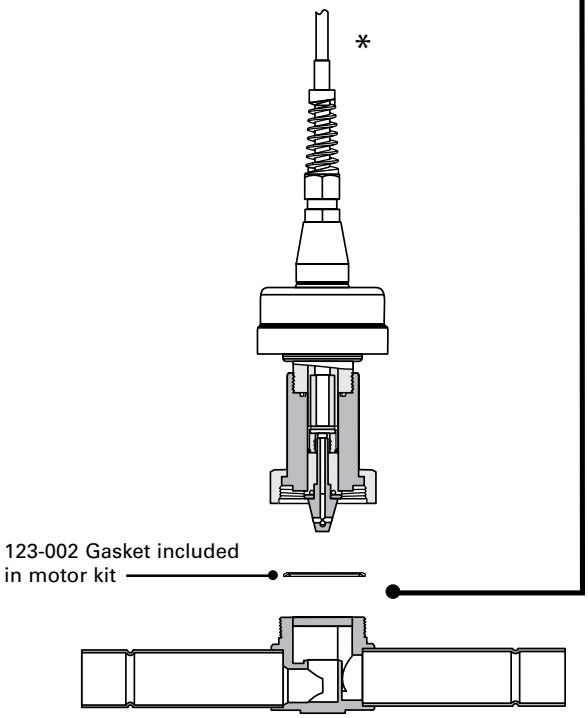
Table 1

Valve Model	Motor Kit	Gasket	Motor Phase Resistance Ohms	Number of Steps
SEI .5 to 11	Not available	0621-016	75 ± 10%	1596
SEI-30	KS-SEI-30	0621-016	75 ± 10%	3193
SEI-50	KS-SEI-50	0123-002	75 ± 10%	6386
SEH(I) 100 and 175	KS-SEH100/175	None required	75 ± 10%	6386

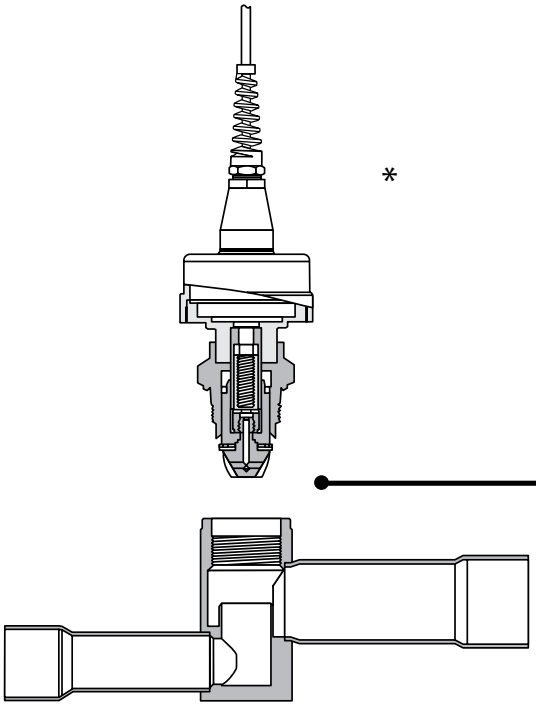


SEI-0.5 to SEI-30 Motor Assembly

SEI-50 Motor and Adapter Assembly



SEH Motor and Adapter Assembly



* Motor kits supplied with 24" lead wire with butt splice connectors.

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SUPERHEAT CONTROLLER

Installation and Servicing Instructions

SD-257
March 2005

The Superheat Controller will control one Sporlan Electric Expansion Valve by means of pressure-temperature control. Pressure-temperature superheat control for one of four common refrigerants may be selected. Controllers can be ordered configured for R-22, R-134a, R-404A, R-407C and R-507. The refrigerant type can be changed in the field by use of the optional "Panel Display". Onboard readouts show actual superheat, superheat set point, and valve position. Two push buttons are provided on the board, to change the superheat set point, as well as open, close, or position the valve. Proportional and Integral set points are also included to change responsiveness of the valve.

As illustrated in Figure 1, the controller is provided with hardware and input/output connections for a number of user specified purposes. See below:

- One valve control
- One pressure input (transducer supplied by Sporlan)
- One digital input (from external switches or relays)
- Two temperature inputs (Sporlan supplied surface or air sensors)
- Optional battery backup for onboard time clock and fail-safe valve closure
- Two digit LED readout
- One green LED indicator
- One red LED indicator
- Two push buttons for set point, alarm cancellation, etc.
- RS 485 port
- Panel Display jack

Please note that although RS485 port appears on the Superheat Board, standard software does not support communication. Custom (proprietary) software must be written for anything other than superheat control. Please contact Sporlan for more information.

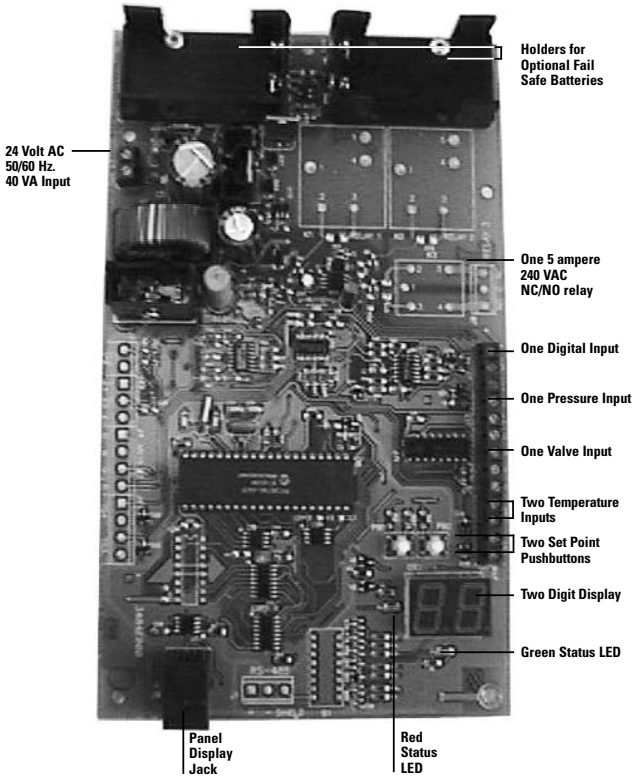


Figure 1

INSTALLATION

When handling the boards, electrostatic protection procedures should be followed. The installer should be grounded through a ground strap. If ground straps or other ESD protection is not available, ONLY handle the board by its edges or by the battery holders. DO NOT TOUCH ANY COMPONENTS ON THE BOARD EXCEPT THE BATTERY HOLDER AND RELAYS.

1. The board should be mounted in a dry, protected environment using the predrilled mounting holes in each corner. Make sure none of the printed circuit paths or components are touching the metal panel or anything conductive. See Figure 3.
2. Connections are to be made to terminal block shown.
3. Controllers are configured for pressure temperature superheat control.
4. Connect temperature sensor to **TS2**. The sensor is not polarized. For suction lines 7/8" or less, the sensor should be mounted to the copper suction line after the evaporator, using the furnished clamps. For larger lines or steel piping, a well sensor (P/N 952795), available from Sporlan, should be installed.
5. The pressure transducer should be mounted on the top of the suction line near the temperature sensor location. Transducer connections to the board are as follows:
   - The power wire is red and is connected to the **1+** terminal.
   - The signal wire is green and is connected to the **1S** terminal.
   - The ground wire is black and is connected the **1-** terminal.
6. The valve leads are connected to the terminals labeled **Valve 1**.
   - The black lead is connected to terminal labeled **B** of **Valve 1**.
   - The white lead is connected to terminal labeled **W** of **Valve 1**.
   - The green lead is connected to terminal labeled **G** of **Valve 1**.
   - The red lead is connected to terminal labeled **R** of **Valve 1**.
7. **DI1** is a digital input used as a pumpdown terminal. A short or closed contact from an external relay will close the valve for pumpdown. When the relay opens or the short is removed, the valve will return to normal operation.
8. Power is connected to the terminal marked **24VAC**. Power requirements are 24 volts AC at 40 VA. For protection from electrical transients, connect one MOV varistor between one leg of the input voltage of the 24 VAC transformer and earth ground. Connect a second MOV varistor between the other leg of the input voltage of the 24 VAC transformer to earth ground. Two MOV varistors are included with the controller.

NOTE: Sensor and valve wires may be extended for remote applications. Waterproof butt connectors should be used, and the cable should be at least 16 gauge. Care must be taken to ensure a good splice and that the individual wires are correctly identified. For remote installation where the sensors are located more than 25 ft. from the controller, contact Sporlan for guidance.

OPERATION

1. When first powered up the numeric display will show actual super heat.
2. The small Green LED will be lit.

3. PB2 will toggle the readings as follows and the small Green LED will be steady or flash:
   • Actual Superheat, LED constant.
   • Valve percentage open, LED slow flash.
4. To change superheat set point:
   • Make sure the display shows the superheat.
   • Press and hold PB1 and PB2 for 8 seconds, LED will flash rapidly.
   • Use PB1 to increment set point.
   • Use PB2 to decrement set point.
   • Press and hold PB1 and PB2 simultaneously for 5 seconds to lock in set point and return to actual superheat.
5. To manually change valve position:
   • Scroll to valve position reading with PB2.
   • Press and hold PB1 and PB2 simultaneously for 8 seconds, Green LED will flash rapidly.
   • Increment "valve open" percentage by pressing PB1 for 1 second.
   • Decrement "valve open" percentage by pressing PB2 for 1 second. Valve will maintain manual open position for 1 hour or until PB1 and PB2 are pressed simultaneously and held for 5 seconds.

REMOTE PANEL DISPLAY

A remote panel display is available that will allow access to all the parameters of the controller. The Remote Panel Display can be used as a set point tool in production, a diagnostic tool in the field or as a permanent readout device for the controller. A five-foot cable is included.

Plug the remote display into the telephone jack (J9) on the controller. The following is a list of readings available:

SUPH Superheat read by controller for AC circuit 1
POSN Number of steps valve is open (0-6386) for AC circuit 1
PRES Pressure read by the transducer (0-153 psi gauge) for AC circuit 1
TEMP Temperature read by the temperature sensor (-50 to 103°F) for AC circuit 1
TSAT Saturated temperature for AC circuit 1
ACON, PMDN
ACON when in normal operation,
PMDN when in pumpdown
R22, 134A, 407C, 404A, 507
R22 for refrigerant R-22, 134A for refrigerant R-134a, 407C for refrigerant R-407C, and 404A for refrigerant R-404A and R507 for refrigerant R-507. **Note: not all controllers have both R-507 and R-407C.**
LRGE, SMAL, MEDM
LRGE if the EEV used is an SEI-50 or larger.
SMAL if the EEV used is smaller than an SEI-25 and all SER.
MEDM if the EEV used is a SEI-25.
SHSP Superheat set point (0 to 16°F). Default is 10°F.
MOPD Maximum operating suction pressure set point (0 to 153 PSI). Default is 153 PSI.
CTSP Cut out suction pressure set point (0 to 153 PSI)
CALP Calibrate pressure transducer for AC circuit 1
CALT Calibrate temperature sensor for AC circuit 1
PROP Proportional gain set point. Number of steps per degree that superheat is above or below the superheat set point (5 to 255 steps per degree). Default is 45 for LRGE setting, 22 for MEDM setting, and 11 for SMAL setting.
INTG Integral set point. Number of seconds the controller waits to update the reference valve position. (1 to 120 seconds). Default is 10 seconds.
DLCN Time to open and keep valve open 'DLST' steps when the pumpdown signal is removed (0 to 120 seconds). Default is 0.
DLST Number of steps to open valve when the pumpdown signal is removed (0 to 6386). Default is 0.

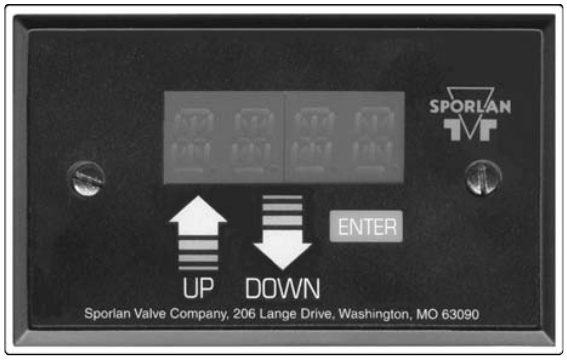


Figure 2

CONTROLLER MENUS

ENTER Will toggle display between one of the displays described above and the numeric value read for that particular display.
UP Will scroll through the menu from SHSP to POSN, etc.
DOWN Will scroll through the menu the opposite way.

POSN MODE

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to put the controller in manual valve position. The number of steps open will be displayed and the 1000's digit will blink.

Pressing the **UP** button will open the valve 1000 steps.
Pressing the **DOWN** button will close the valve 1000 steps.
Pressing the **ENTER** button will change the flashing digit from 1000's digit to the 100's digit.

Pressing the **UP** button will open the valve 100 steps.
Pressing the **DOWN** button will close the valve 100 steps.
Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will open the valve 10 steps.
Pressing the **DOWN** button will close the valve 10 steps.
Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will open the valve 1 step.
Pressing the **DOWN** button will close the valve 1 step.
Pressing the **ENTER** button will change the flashing digit from 1's digit to the 1000's digit.

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to put the controller in normal control. The digits will stop blinking.

SHSP MODE

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to enable the superheat set point to be changed. The set point is displayed and the 100's digit will blink.

Pressing the **UP** button will increase the set point by 100 degrees. Pressing the **DOWN** button will decrease the set point by 100 degrees. Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will increase the set point by 10 degrees.
Pressing the **DOWN** button will decrease the set point by 10 degrees.
Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will increase the set point by 1 degree.
Pressing the **DOWN** button will decrease the set point by 1 degree.
Pressing the **ENTER** button will change the flashing digit from 1's digit to the 100's digit.

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to save the set point. The digits will stop blinking.

MOPD MODE

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to enable the Maximum Operating suction Pressure set point to be changed. The set point is displayed and the 100's digit will blink.

Pressing the **UP** button will increase the set point by 100 PSI.
Pressing the **DOWN** button will decrease the set point by 100 PSI.
Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will increase the set point by 10 PSI.
Pressing the **DOWN** button will decrease the set point by 10 PSI.
Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will increase the set point by 1 PSI.
Pressing the **DOWN** button will decrease the set point by 1 PSI.
Pressing the **ENTER** button will change the flashing digit from 1's digit to the 100's digit.

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to save the set point. The digits will stop blinking.

CTSP MODE

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to enable the cut out suction pressure set point to be changed. The set point is displayed and the 100's digit will blink.

Pressing the **UP** button will increase the set point by 100 PSI.
Pressing the **DOWN** button will decrease the set point by 100 PSI.
Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will increase the set point by 10 PSI.
Pressing the **DOWN** button will decrease the set point by 10 PSI.
Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will increase the set point by 1 PSI.
Pressing the **DOWN** button will decrease the set point by 1 PSI.
Pressing the **ENTER** button will change the flashing digit from 1's digit to the 100's digit.

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to save the set point. The digits will stop blinking.

NOTE: CTSP set point is used to help stop nuisance, low suction pressure trips of the compressor. If the suction pressure goes below CTSP, and the superheat is above the superheat set point, the valve will keep opening until the suction pressure is above CTSP or the superheat is below its set point. The controller will start controlling superheat from this new valve position. If the superheat is below its set point and the suction pressure is below this set point, the controller will change CTSP to 12 PSI below current suction pressure. If power is lost, the original saved set point is used again.

When in **CALP or CALT**, the numeric display shows the PSI or degrees to be either added or subtracted from that particular sensor, depending if the reading is negative or positive. Press and hold the **UP** button and **ENTER** button for 5 seconds to enable the sensor to be calibrated.

The **CAL** number is displayed and the 10's digit will blink.
Pressing the **UP** button will increase the CAL number by 10 PSI or degrees.
Pressing the **DOWN** button will decrease the CAL number by 10 PSI or degrees.
Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will increase the CAL number by 1 PSI or degree.
Pressing the **DOWN** button will decrease the CAL number by 1 PSI or degree.
Pressing the **ENTER** button will change the flashing digit from 1's digit to the 0.1's digit.

Pressing the **UP** button will increase the CAL number by 0.2 PSI or degree.
Pressing the **DOWN** button will decrease the CAL number by 0.2 PSI or degree.
Pressing the **ENTER** button will change the flashing digit from 0.1's digit to the 10's digit.

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to save the CAL number. The digits will stop blinking.

PROP MODE

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to enable the proportional gain set point to be changed. The set point is displayed and the 100's digit will blink.

Pressing the **UP** button will increase the set point by 100 steps per degree.
Pressing the **DOWN** button will decrease the set point by 100 steps per degree.
Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will increase the set point by 10 steps per degree.
Pressing the **DOWN** button will decrease the set point by 10 steps per degree.
Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will increase the set point by 1 step per degree.
Pressing the **DOWN** button will decrease the set point by 1 step per degree.
Pressing the **ENTER** button will change the flashing digit from 1's digit to the 100's digit.

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to save the set point. The digits will stop blinking.

INTG MODE

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to enable the integral set point to be changed. The set point is displayed and the 100's digit will blink.

Pressing the **UP** button will increase the set point by 100 seconds.
Pressing the **DOWN** button will decrease the set point by 100 seconds.
Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will increase the set point by 10 seconds.
Pressing the **DOWN** button will decrease the set point by 10 seconds.
Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will increase the set point by 1 second.
Pressing the **DOWN** button will decrease the set point by 1 second.
Pressing the **ENTER** button will change the flashing digit from 1's digit to the 100's digit.

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to save the set point. The digits will stop blinking.

CHANGING REFRIGERANTS

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to enable the controller to change to another type of refrigerant. All 4 digits will start to blink.

Pressing the **UP** button or the **DOWN** button will change the display to other refrigerants.

When the display shows the desired refrigerant, press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds. The controller will save and use the selected refrigerant's table for saturated temperature. The digits will stop blinking.

CHANGING VALVE TYPES – LRGE, SMAL, or MEDM

Press and hold the **UP** button and **ENTER** button simultaneously for 5 seconds to enable the controller to change to the other type of valves. All 4 digits will start to blink.

Pressing either the **UP** button or the **DOWN** button will change the display between the different valve types. Press and hold the **UP** button and **ENTER** button together for 5 seconds to save the selection. The digits will stop blinking.

Pressing the **UP** button and the **DOWN** button simultaneously will toggle the display between AC circuit 1 and AC circuit 2.

DLCN MODE

Press and hold th **UP** button and **ENTER** button simultaneously for 5 seconds to enable the DLCN set point to be changed. The set point is displayed and the 100's digit will blink.

Pressing the **UP** button will increase the set point by 100 seconds. Pressing the **DOWN** button will decrease the set point by 100 seconds. Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will increase the set point by 10 seconds.
Pressing the **DOWN** button will decrease the set point by 10 seconds. Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

Pressing the **UP** button will increase the set point by 1 second.
Pressing the **DOWN** button will decrease the set point by 1 second. Pressing the **ENTER** button will change the flashing digit from 1's digit to the 100's digit.

Press and hold **UP** button and **ENTER** button simultaneously for 5 seconds to save the set point. The digits will stop blinking.

DLST MODE

Press and hold **UP** button and **ENTER** button simultaneously for 5 seconds to enable this set point to be changed. The number of steps to open will be displayed and the 1000's digit will blink.

Pressing the **UP** button will increase the set point by 1000 steps. Pressing the **DOWN** button will decrease the set point by 1000 steps. Pressing the **ENTER** button will change the flashing digit from 1000's digit to the 100's digit.

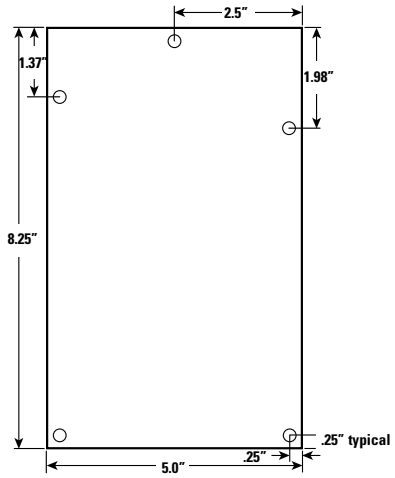
Pressing the **UP** button will increase the set point by 100 steps.
Pressing the **DOWN** button will decrease the set point by 100 steps. Pressing the **ENTER** button will change the flashing digit from 100's digit to the 10's digit.

Pressing the **UP** button will increase the set point by 10 steps.
Pressing the **DOWN** button will decrease the set point by 10 steps. Pressing the **ENTER** button will change the flashing digit from 10's digit to the 1's digit.

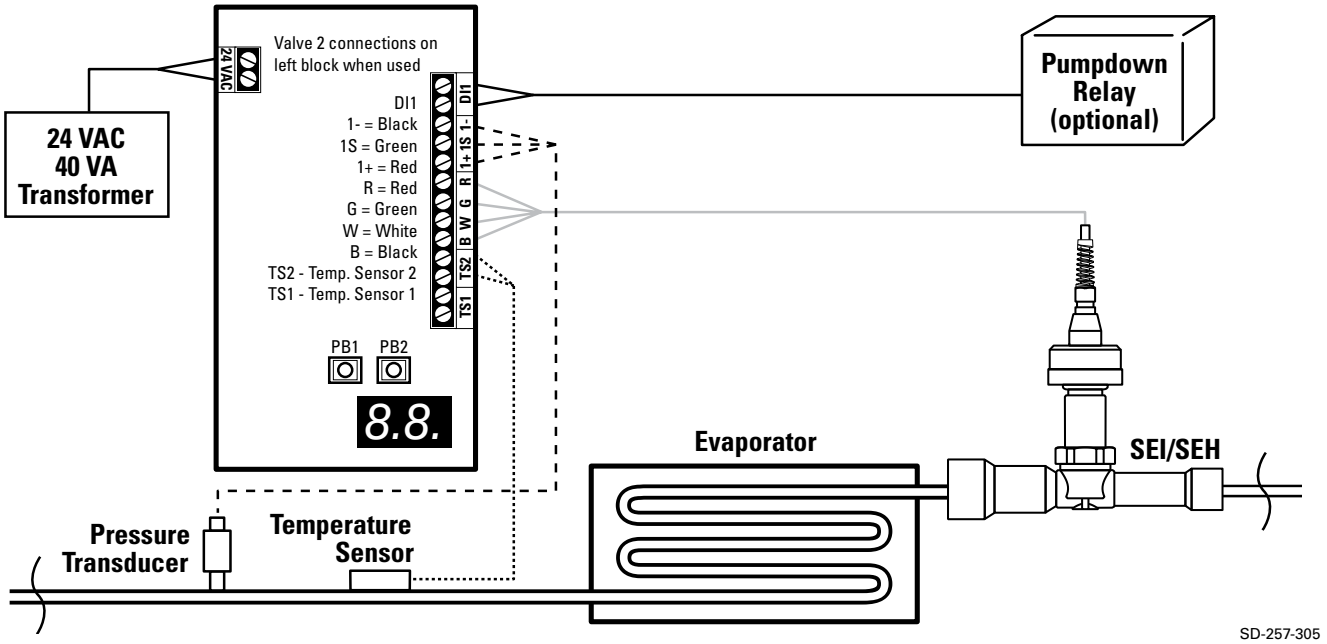
Pressing the **UP** button will increase the set point by 1 step.
Pressing the **DOWN** button will decrease the set point by 1 step. Pressing the **ENTER** button will change the flashing digit from 1's digit to the 1000's digit.

Press and hold **UP** button and **ENTER** button simultaneously for 5 seconds to save the set point. The digits will stop blinking.

Figure 3



SUPERHEAT CONTROLLER WIRING SCHEMATIC



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Sporlan Kelvin II Refrigeration Controller User's Manual

Description

The Kelvin II is a standalone superheat controller. The Kelvin II may be connected with a MODBUS master or a Network Master to give remote access to pressure and temperature readings in addition to viewing and editing the controller's setpoints. The user can also take advantage of the easy to use local display or a Remote Display to accomplish the same tasks.

1. Kelvin II Configuration

Specifications

- Input Voltage: 24 VAC (± 10%), 40 VA minimum to board with external transformer
- Operating ambient temperature: -40°F to 120°F
- LED: One Power LED
- Communications: 1 RS485 Port, 1 USB port (Not operational)
- 4 Digit 7 segment display
- Inputs:
  – Optical Encoder (Knob)
  – One Pressure Input
  – Three Temperature inputs
- Valve Control of all Sporlan Electric Expansion Valves "EEV"
- 3 amp Solid State Relay for Liquid Line Solenoid Kelvin II w/o Local Display
- 1 amp Solid State Relay for Liquid Line Solenoid Kelvin II w/Local Display

2. Kelvin II Connections

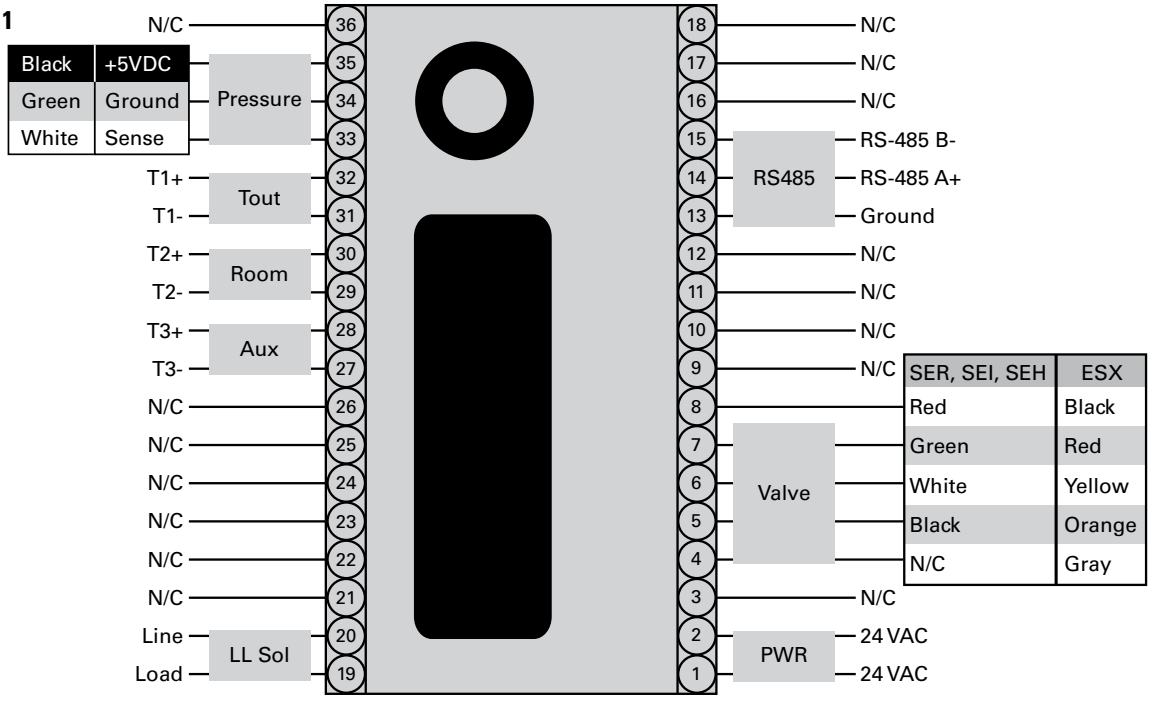
The Kelvin II has screw terminals on the each side of the controller. The controller should be wired as follows and as shown in Figure 1.

Item	Wire (line)		Kelvin II connect point
Power	24VAC		1
	24 VAC		2
Valve	SEI, SER, SEH	ESX	—
	N/C	Gray	4
	Black	Orange	5
	White	Yellow	6
	Green	Red	7
	Red	Black	8
RS-485	Ground		13
	A+		14
	B-		15
Liquid Line Solenoid	Line		19
	Load		20
Auxiliary Temperature Sensor (Displayed menu item: S-3)	T3		27
			28
Room Temperature Sensor (Displayed menu item: CtP)	T2		29
			30
Coil Out Temperature Sensor (Display option: tout)	T1		31
			32
Pressure Transducer (Displayed menu item: SucP)	Sense (WHITE)		33
	Ground (GREEN)		34
	+5 VDC (BLACK)		35

3. Kelvin II Display

Upon the first power-up from Sporlan, the Kelvin II will enter the setup menu. This menu allows the user to set some critical setpoint values, seen in Table 1, before the controller will operate. These critical values can be set via the local or remote displays, MODBUS, or Network Master. (Note: Only the Valve Type and Refrigerant have to be set via MODBUS or Network Master for the controller to operate) Once these values are entered the Kelvin II will then begin its control. If the setup menu is displayed on the local or remote displays

Figure 1



and the user sets these values via MODBUS then the Kelvin II will automatically leave the setup menu.

Table 1 Setup Menu

Displayed Menu Item	Description	Selections
StEP	Valve Type	1596, 3192, 2500, 6384, 400
rEFr	Refrigerant	r22, 134A, 402A, 404A, 407A, 407C, 410A, 417A, r507, 422d, r744, 245F
PtYP	Pressure Sensor Type	gAUg, AbSL
un_T	Temperature Units	FAHR, CELS
un_P	Pressure Units	PSI, BAR

After setup, the Kelvin II defaults to showing the Superheat value. The user can then turn the knob to view the other process values of their system. The screen will alternate between the process values identity and value alternating every 3 seconds. For ease of use, the value that is displayed for a process value may come in the form of text to eliminate the need of 'looking up the meaning'. The menu text and meanings for process values are described in Table 2.

The user may also view/edit the setpoints by pressing the knob and holding it down for 5 seconds. The user is then prompted for a password to verify his credentials. The knob should be rotated up to '111' for the password. If the password is correct the user may change the setpoints to the value he desires in order to obtain optimum system performance. The menu text and meanings for setpoint values are described in Table 3. Setpoints are saved to the controller when the user leaves the Setpoint menu by pressing the knob when "ESC" is shown. The setpoint menu has a timeout of 60 seconds for inactivity. When this timeout is reached the controller goes back to showing the process values and does not save any setpoints that might have been changed. If the user is in the Manual Valve Position setpoint then this timeout length is 60 minutes. As long as the controller does not time out the 60 minutes, Setpoints are saved to the controller when the user leaves the Setpoint menu by pressing the knob when "ESC" is shown.

All process values and setpoints are accessible① through the local and remote displays.

Table 2 Process Value Menus

Displayed Menu Item	Description	Range
SuPH	Superheat	0 to 165°F, 0 to 91.6°C
SucP	Suction Pressure④	0 to 150 PSI, 0 to 10.34 Bar
tSAt	Saturation Temperature	-60 to 150°F, -51.1 to 65.6°C
tout	Suction Temperature	-60 to 150°F, -51.1 to 65.6°C
CtP	System Temperature	-60 to 150°F, -51.1 to 65.6°C
PoSn	Valve Position	0 to 100% Open
S-3	Auxiliary Temperature②	-60 to 150°F, -51.1 to 65.6°C
rELA	Solenoid Status	dEng, Eng
StAt	System Cycle Status	Current cycle and manual valve position state
ALS	Alarm Status③	noAL or all active alarms

Table 3 Setpoint Menu

Displayed Menu Item	Description	Range	Default Setting	User Setpoints
ESC	Escape and save settings	—	—	
SHSP	Superheat Setpoint	0 to 45°F, 0 to 25°C	8	
rEFr	Refrigerant	r22, 134A, 402A, 404A, 407A, 407C, 410A, 417A, r507, 422d, r744, 245F	404A	
d_On	Delay On	0 to 60 seconds	0	
dOFF	Delay Off	0 to 60 seconds	0	
d_St	Delay Percent Open of Valve	0 to 100 percent	0	
CtSP	Cut-out Suction Pressure	0 to 150④ PSI, 0 to 10.3④ Bar	0	
H_oP	Maximum Operating Pressure	0 to 150④ PSI, 0 to 10.3④ Bar	150	
C_in	Cut-in Temperature	-60 to 125°F, -51.1 to 51.6°C	-59	
Cout	Cut-out Temperature	-60 to 124°F, -51.1 to 51.1°C	-60	
HiCP	Max Valve Capacity	20 to 100%	100	
SUPS	Supermarket Setting	OFF, ON	OFF	
-P-	Proportional Coefficient	0 to 100	40	
-I-	Integral Coefficient	0 to 100	25	
-d-	Derivative Coefficient	0 to 100	5	
StEP	Valve Type	1596, 3192, 2500, 6384, 400	1596	
SPoS	Manual Valve Position	0 to 100% Open	Present Position	
nEt	Network Type (MODBUS or Network Master)	nbUS (MODBUS) or ProP (Network Master)	nbUS	
Addr	MODBUS/Network Master Address	1 to 255	1	
un_P	Pressure Units	PSI, BAR	PSI	
un_T	Temperature Units	FAHR, CELS	FAHR	
PtYP	Pressure Sensor Type	AbSL, gAUg	gAUg	
CaLP	Pressure Sensor calibration value	-5 to 5 PSI, -0.34 to 0.34 Bar	0	
CLt1	Tout calibration value	-5 to 5°F, -2.7 to 2.7°C	0	
CLt2	Ctp calibration value	-5 to 5°F, -2.7 to 2.7°C	0	
CLt3	S-3 calibration value	-5 to 5°F, -2.7 to 2.7°C	0	
CAdr	Controller Display Address	0 to 99	0 or 1 for local display	

4. Kelvin II MODBUS

The Kelvin II can communicate with a MODBUS master. The Kelvin II will transfer process values and setpoints via MODBUS.

① Setpoints can only be viewed and edited when the proper password is entered.
② The Auxiliary Temperature sensor input has a special Pumpdown feature. If a "short" or switch closure is placed across these terminals, the valve will shut for pumpdown. The full details of this feature are described in Section 5.
③ The Alarm Status process value is described in Section 6.
④ The maximum value varies based on which refrigerant is selected. (R-410A is 300 PSI, R-744 is 500 PSI and all others are 150 PSI).

The Kelvin II only supports the RTU transmission mode. The serial settings are as follows:

- 9600 baud
- 8 data bits
- 1 stop bit
- Even parity

The Kelvin II supports the 'Read Input Registers', 'Read Holding Register', 'Write Single Register', 'Read Multiple Coils' and 'Write Single Coil' function codes. Any other request will result in an exception response. The Kelvin II will allow a full and partial block read of the Input and Holding registers and Coils.

4.1. Scaling

In order to preserve precision, scaling was implemented when using Bar or Celsius for units. PSI and Fahrenheit units are both in whole numbers and have no scaling. The tables of the MODBUS memory map below reflect this implementation.

The Celsius values that are transferred via MODBUS are 10X. For example, if Celsius is chosen for the temperature units then 45°C is transferred for the Superheat. The actual Superheat is 4.5°C. If the user desired to change a setpoint they should keep this in mind when they enter a value.

The Bar values that are transferred via MODBUS are 100X. For example, if Bar is chosen for the pressure units then 1034 Bar is transferred for the Maximum Operating Pressure. The actual Maximum Operating Pressure is 10.34 Bar. If the user desired to change a setpoint they should keep this in mind when they enter a value.

4.2. MODBUS Memory Map

Table 4 Memory Map

MODBUS Function Code	Mapped Data	Data Map	Range
Read Coils (0x01)	Manual Valve Control	Bit 0 = Manual Valve Enabled Flag Bit 1 = Manual Valve Duration Enabled Flag	0 = Disabled, 1 = Enabled.
Read Holding Register (0x03)	Setpoints	0. Superheat Setpoint	0 to 45°F, 0 to 250°C (0.0 to 25.0°C)
		1. Refrigerant Type	0 = r22 1 = 134A 2 = 402A 3 = 404A 4 = 407A 5 = 407C 6 = 410A 7 = 417A 8 = 422A 9 = 422d 10 = r507 11 = r744 12= 245F
		2. Delay On Relay	0 to 60 seconds
		3. Delay Off Relay	0 to 60 seconds
		4. Delay Steps	0 to 100 % Open
		5. Cut-out Suction Pressure	0 to 150[5] PSI, 0 to 1034 Bar (0 to 10.34 Bar)
Read Holding Register (0x03)	Setpoints	6. Max Operation Pressure	0 to 150 [6] PSI, 0 to 1034 Bar (0 to 10.34 Bar)
		7. Temperature Cut-in	-60 to 125°F, -511 to 516 °C (-51.1 to 51.6 °C)
		8. Temperature Cut-out	-60 to 124°F, -511 to 511 °C (-51.1 to 51.1 °C)
		9. Valve Maximum	20 to 100 %
		10. Supermarket Mode	0 = OFF 1 = ON
		11. P	0 to 100
		12. I	0 to 100
		13. D	0 to 100
		14. Valve Type	0 = 1596 1 = 3192 2 = 2500 3 = 6384 4 = 400
		15. Manual Valve Position	0 to 100 % Open
		16. Network Type	0 = MODBUS 1 = Network Master
		17. Unit Address	1 to 255
		18. Pressure Units	0 = PSI, 1 = BAR
		19. Temperature Units	0 = FAHR, 1 = CELS
		20. Pressure Sensor Type	0 = GauG, 1 = ABSL
		21. Pressure Calibration Offset	-5 to 5°F, -34 to 34 Bar (-0.34 to 0.34 Bar)
		22. Suction Temperature Calibration Offset	-5 to 5°F, -27 to 27°C (-2.7 to 2.7°C)
		23. Room Temperature Calibration Offset	-5 to 5°F, -27 to 27°C (-2.7 to 2.7°C)
		24. Auxiliary Temperature Calibration Offset	-5 to 5°F, -27 to 27°C (-2.7 to 2.7°C)
Read Input Registers (0x04)	Process Variables	0. Superheat	0 to 165°F, 0 to 916°C (0 to 91.6°C)
		1. Suction Pressure[6]	0 to 150 PSI, 0 to 1034 Bar (0 to 10.34 Bar)
		2. Saturation Temperature	-60 to 150°F, -511 to 656°C (-51.1 to 65.6°C)
		3. Suction Temperature	-60 to 125°F, -511 to 656°C (-51.1 to 65.6°C)
		4. Room Temperature	-60 to 125°F, -511 to 656°C (-51.1 to 65.6°C)
		5. Valve Capacity	0.0 to 100.0% Open (0.0 to 100.0)
		6. Auxiliary Temperature	-60 to 125°F, -511 to 656°C (-51.1 to 65.6°C)
		7. Relay Status	0 = Deenergized, 1 = Energized

⑤ The maximum value varies based on which refrigerant is selected. (410A is 300 PSI, r744 is 500 PSI and all others are 150 PSI).
⑥ The maximum value varies based on which refrigerant is selected. (410A is 300 PSI, r744 is 500 PSI and all others are 150 PSI).

MODBUS Function Code	Mapped Data	Data Map	Range
Read Input Registers (0x04)	Process Variables	8. Alarm Status	If Bit set then alarm is active: Bit 0 = Suction Transducer Failure Bit 1 = Tout Sensor Failure Bit 2 = High Superheat Bit 3 = Low Superheat
		9. System Cycle Status	If Bit set then mode is active: Bit 1 = Setup Mode Bit 2 = Off Cycle Bit 3 = Cooling Cycle Bit 4 = Pump-down Cycle Bit 5 = Manual Valve Override Mode
Write Single Coil (0x05)	Manual Valve Control	Bit 0 = Manual Valve Enabled Flag	0 = Disabled, 1 = Enabled. The Manual Valve duration Bit is read-only.
Write Single Register (0x06)	Setpoints	Same as above.	The max number of registers written at a time is 1. The limits can be seen above in the 'Read Holding Register' definition.

5. Kelvin II Features

5.1. Pumpdown Feature

The Kelvin II will initiate a pumpdown when Auxiliary Temperature sensor terminals are shorted. If desired, this temperature connection could be set up as a dry contact. When a pumpdown is desired the contact should be closed. The pumpdown will be ended when the short is removed provided that there are no sensor alarms.

5.2. Manual Valve Position Feature

The Kelvin II has the ability to manually control the valve. To enable this manual control via the local or remote displays simply open the setpoint menu and edit the 'SPoS' setpoint. When the value is displayed for this setpoint the user is manually controlling the valve. The valve position can be changed by rotating the knob clockwise or counterclockwise. There is an inactivity timer of 60 minutes while in manual control. The timer is reset each time the user moves the valve. The manual control of the valve is ended when the user presses the knob to go back to displaying 'SPoS' or a timeout has been reached.

6. Kelvin II Alarms

The Kelvin II has 4 alarms. The following table lists the possible alarms and the text that is seen on the controller. The controller's alarm status can be viewed via MODBUS, Network Master, and local and remote displays.

Table 5 Alarms

Alarm Text	Meaning
NoAL	No Alarms active
PSAL	Pressure Sensor alarm
TSAL	Tout Sensor alarm
HSAL	High Superheat alarm
LSAL	Low Superheat alarm

Normally, on the process value screens, the process value text alternates with its value. When an alarm is activated the alarm status "-AL-"screen is added to the rotation to make the user aware that an alarm has been activated. The Alarm Status menu display item ALS, will show the active alarms shown in Table 5.

7. Kelvin II Display Networking

The Kelvin II displays can be set up to access other Kelvin II controllers on the network. The controller's current 'CAdr' value can be determined by pressing down the button on the display while viewing a process value. To enable the display network the 'CAdr' setting MUST be set to a unique nonzero value with the RJ-45 connector on the side of the controller DISCONNECTED.

After 'CAdr' has been set, an 'End' screen is added just before the 'SuPH' process value. Pressing the button on the display while viewing the 'End' screen brings up a menu allowing the selection of other Kelvin II controllers connected to the display network. Turning the knob allows the selection of other Kelvin II controllers based on their appropriate 'CAdr' address. The local controller is listed as 'LocL' by a local display. Note: the remote display always includes the 'End' screen since it must be able to view any controller on the display network.

8. Kelvin II Factory Reset

A factory reset can be performed by holding the button down on the local or remote displays for 5 seconds when power is first applied. If using a local display the display will show 'FrSt' while the factory reset is being performed and then automatically connect to the local controller.

If using a remote display the display will show 'FrSt' and switch to a menu that allows the selection of the controller to reset. To perform a factory reset, select the controller with the appropriate 'CAdr' value. The display should show '----' while the reset is being performed. When finished performing factory resets turn the knob counterclockwise until 'ESC' is shown on the display. Pressing the button while 'ESC' is shown on the display exits the factory reset menu and should automatically connect to a controller on the display network.

Table 6 Replacement Parts

Part Number	Description
952560	Kelvin II without display
952561	Kelvin II with local display
952562	Kelvin II Remote panel display
952662	Temperature Sensor Assembly
952795	Well Sensor Kit
953091	Pressure Transducer 150 psig with cable
952995	Pressure Transducer 150 psia with cable
952740	Pressure Transducer 300 psig with cable for R-410A applications only
952504	Pressure Transducer 500 psig with cable for R-477 applications only

APPENDIX F - MAINTENANCE CHART

DATE	COMPRESSOR SUPERHEAT	DISCHARGE		SUCTION		EVAP SUPERHEAT	NOTES
		TEMP	PRESSURE	TEMP	PRESSURE		

DATE	COMPRESSOR SUPERHEAT	DISCHARGE		SUCTION		EVAP SUPERHEAT	NOTES
		TEMP	PRESSURE	TEMP	PRESSURE		

DATE	COMPRESSOR SUPERHEAT	DISCHARGE		SUCTION		EVAP SUPERHEAT	NOTES
		TEMP	PRESSURE	TEMP	PRESSURE		

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