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# **HUSSMANN®**

## **Scroll Plus™**

## **Fibertronic™**



**HUSSMANN®**

**BRIDGETON  
REFRIGERATION**

S Y S T E M S  
• • • • •

P/N 401789

**Installation and  
Service Manual**

## **SAFETY TIPS**

### **Being Safe is Your Responsibility.**

**Wear proper eye protection whenever working.**

**Wear proper hearing protection whenever working in a machine room.**

**Stand to one side—never work directly in front of:**

- Any valve you are opening or closing
  - Manual refrigeration valves
  - Regulator valves on brazing tanks and nitrogen tanks
- Electrical Circuit Breakers
- Refrigeration lines you are cutting or opening

**Always use a pressure regulator with a nitrogen tank.**

- Do not exceed 2 pounds of pressure and vent lines when brazing.
- Do not exceed 350 pounds of pressure for leak testing high side.
- Do not exceed 150 pounds of pressure for leak testing low side.

**Use only a striker to light torch.**

**Know whether a circuit is open at the power supply or not. Remove all power before opening control panels.**

**Always supply proper ventilation.**

•Refrigerants and nitrogen can displace oxygen causing suffocation.

•Refrigerants exposed to flame can produce phosgene, a poisonous gas.

**Be sure refrigeration lines are free of pressure before cutting. Check:**

- Both sides of a two way valve
- All lines to a 3-way or 4-way valve

**Dangerous hydraulic explosions may result if you**

- Isolate liquid lines or compressor when they can absorb heat over an extended time period
- Overfill pumpdown refrigerant containers

**Never vent refrigerants into the atmosphere.**



**Husmann Corporation**  
12999 St. Charles Rock Road  
Bridgeton, Missouri 63044-2483  
(314) 291-2000

## **Congratulations!**

With the purchase of Husmann's Scroll Plus™ Fibertronic™ System, you are receiving equipment designed to provide the finest refrigeration and temperature control for modern supermarket display equipment and coolers.

Since the introduction of Husmann Central Refrigeration Systems, thousands of installations have confirmed our belief that, as with all fine equipment, good installation and proper adjustment are the keys to customer satisfaction.

The information presented in this manual includes many details resulting from our experience over many years. Its use will guide the contractor to a successful installation. Time taken to read and to understand this information will pay off in reducing lost time and duplication work.

Should there be questions concerning this information, do not hesitate to write me. Your inquiry will be welcomed.

George Ballinger  
Manager of Field Service

**HUSSmann®**

# Scroll Plus™

# Fibertronic™

## Installation and Service Manual

Hussmann Corporation  
12999 St. Charles Rock Road  
Bridgeton, MO 63044-2483

Printed in USA



P/N 401789  
September, 1997

## Installation and Service Manual

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## INSTALLATION INSTRUCTIONS



Figure 1-1 — Scroll Plus™ Fibertronic™ System

### OVERVIEW

This section is limited to the information needed to set the Scroll Plus™ Compressor System. Power supply requirements are found under “Electrical”; piping, under “Piping”; and charging, under “Start-up and Maintenance”. Auxiliary units are found in the sections devoted to them or in the manuals accompanying them.

### SCROLL PLUS™ COMPONENTS

Each Scroll Plus System contains the following:

1. The Scroll Plus System is capable of two tiers of compressors, with two to four Copeland scroll compressors in parallel per tier, equipped with:
  - a. High and Low Pressure Controls
  - b. Traxoil Oil Safety Control
  - c. Primary Overload Protection
2. Factory piping with
  - a. Suction, Discharge and Liquid Headers
  - b. Turbashed Oil Separator
  - c. Vertical Receiver per Tier of Compressors
  - d. Suction Filters on each Compressor
  - e. Liquid Drier and Sight-glass
  - f. Liquid Level Indicator
3. Factory-wired control panel(s) with
  - a. Pre-wired Distribution Power Block
  - b. Individual Compressor Integral Breaker / Contactors
  - c. Compressor Time Delays
  - d. Color-coded wiring system
  - e. Customized wiring diagram
4. Items supplied separately for field installation
  - a. Liquid Drier Core
  - b. Vibration Isolation Pads (8)
  - c. Loose shipped items for accessories.

## SHIPPING DAMAGE

All equipment should be thoroughly examined for shipping damage before and while unloading.

This equipment has been carefully inspected at our factory and the carrier has assumed responsibility for safe arrival. If damaged, either apparent or concealed, claim must be made to the carrier.

### Apparent Loss or Damage

If there is an obvious loss or damage, it must be noted on the freight bill or express receipt and signed by the carrier's agent; otherwise, carrier may refuse claim. The carrier will supply the necessary claim forms.

### Concealed Loss or Damage

When loss or damage is not apparent until after equipment is uncrated, a claim for concealed damage is made. Upon discovering damage, make request in writing to carrier for inspection within 15 days and retain all packing. The carrier will supply inspection report and required claim forms.

## SCROLL PLUS™ FRAME DIMENSIONS

Rack Assembly Nomenclature	Length (in.)	Height (in.)	Depth (in.)
22YU	123	50	35
01FY	99	76	35
03FY	123	76	35

Piping stubs, and shipping crate may extend 6 inches beyond the frame.

## SYSTEM WEIGHTS

### Base Rack Weight

Rack or Receiver Nomenclature	Weight (lbs)
22YU	500
01FY	600
03FY	700
05FY, 06FY	300
07FY, 08FY	500

Plate Subcoolers add 100 lbs.

### Compressor Weights

Compressor Horsepower	Weight per compressor (lbs)
3 — 6	100
7.5 — 10	300
13 — 15	350

Shipping Weight = Rack Base Weight  
+ Receiver(s) Weight  
+ Sum of Compressor Weights

## RECEIVER REFRIGERANT CAPACITIES

Receiver Capacities are based on 80% liquid fill at 110°F. Dimensions are in inches or pounds.

Receiver Assembly	Dia.	Length (in.)	R-404a / R507 (lbs)	R-22 (lbs)
05FY, 06FY	12	45	175	205
07FY, 08FY	14	68	355	425

## MACHINE ROOM REQUIREMENTS

The equipment room floor must solidly support the compressor unit as a live load. Ground level installation seldom presents problems, but a mezzanine installation must be carefully engineered.

Ventilation should be 100 cfm per compressor unit horsepower. The air inlet should be sized for a maximum of 600 fpm velocity. The ventilation fans should cycle by thermostatic control.

All machine room ventilation equipment must be field supplied. Check local codes for variances.

Proper ventilation provides airflow across the compressors. Duct work may be necessary.

Provide a floor drain for disposal of condensate that may form on the compressor unit or defrost header assembly.

Equipment must be located in the machine room to provide enough working space for service personnel, and to meet electrical codes.

Consult NEC National Fire Handbook, particularly “Installation of Switch Boards” and “Working Space Requirements”. The figure below demonstrates some suggested distances. Refer to local codes for each installation.

### SCROLL PLUS LOAD POINTS

Rack Assembly Nomenclature	Load Point Dimensions	
	Length	Width
	(in.)	(in.)
All	62.7	30

### UNIT PLACEMENT

When setting the Scroll Plus System plan in relation to the rest of the equipment to be installed, some minimum and maximum distances are listed. **Note:** Piping equivalent is not the same as linear distance.

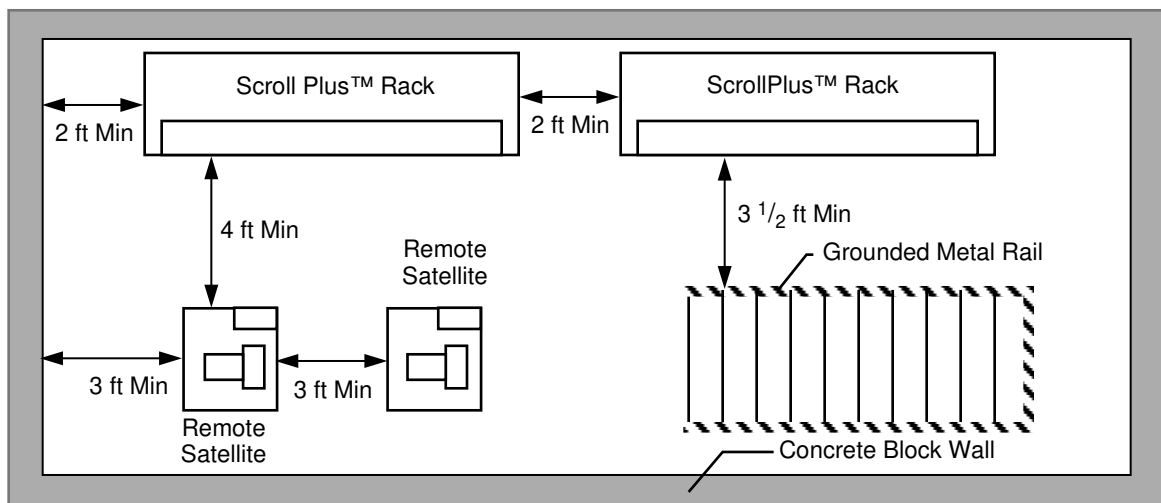


Figure 1-2 — Electrical Clearance Requirements

## Minimum Allowable Distances

From a Water Cooled Condenser Outlet to the Scroll Plus Receiver Inlet, the minimum allowable elevation is 1 foot.

With no Flooding Valve, the minimum allowable distance is 4.5 feet from the mounting surface of the air cooled Condenser to the mounting surface of the Scroll Plus Rack.

With a Flooding Valve, the minimum allowable distance is 6 feet from the mounting surface of the air cooled Condenser to the center of the flooding valve.

## Maximum Allowable Distances

Remote Satellites should not be placed below the level of the Scroll Plus Rack. The Satellite may be positioned above the Rack. The maximum allowable elevation is 6 feet from the bottom of the Satellite to the bottom of the Rack.

When piping from the Rack to a Remote Satellite, the maximum allowable piping equivalent is 50 feet.

When piping from the Rack to a Remote Header, the maximum allowable piping equivalent is 50 feet.

When piping from the Rack to a Condenser, the maximum allowable piping equivalent is 100 feet.

When piping from the Rack to a Heat Reclaim coil, the maximum allowable piping equivalent is 50 feet.

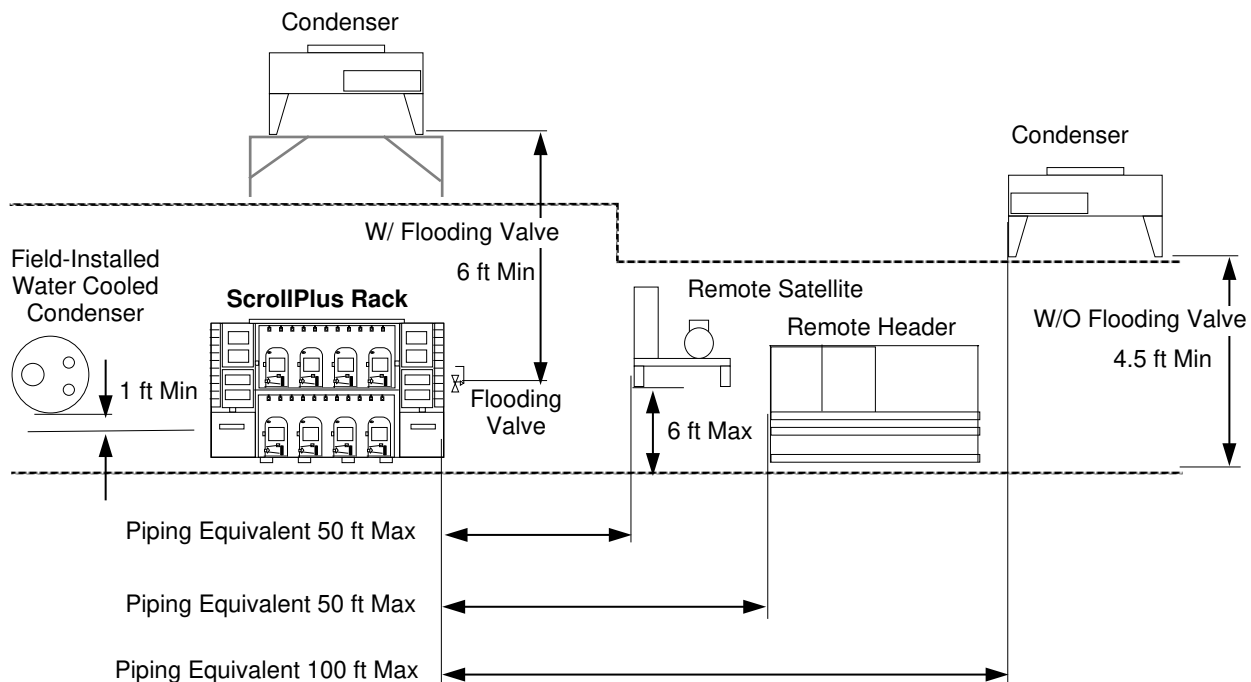


Figure 1-3 — Allowable Distances

## LIFTING AND LEVELING

Using rigging with a spreader bar, the Scroll Plus System may be lifted into position. The spreader bar is required to prevent damage to the unit.

Note: This unit is front heavy, due to the control Panel(s), and compressor locations. Take necessary precautions when lifting, and lift only from lower base support feet.

Vibration isolation pads are supplied with each rack. The entire weight of the rack must rest on these pads, with the rack cross leveled. To adjust for slightly uneven floors, place 16 gauge 3 x 3 galvanized steel shims between the pads and the floor. (Shims must be field supplied.)

## SETTING WITHOUT A CRANE

In many locations crane lifting may not be practical. Where possible use equipment dollies centered under each foot, or Johnny Bars. Do not push or pull on any of the pipes, valves, accessories, or control panels when moving the Scroll Plus System.

For mezzanine installations, a fork lift (operated within its height and weight limits) may be used to raise the Rack into position.

**Caution:** The unit is front heavy due to the control panel(s), and compressor locations. Take necessary precautions when lifting, and lift only from lower base support feet.

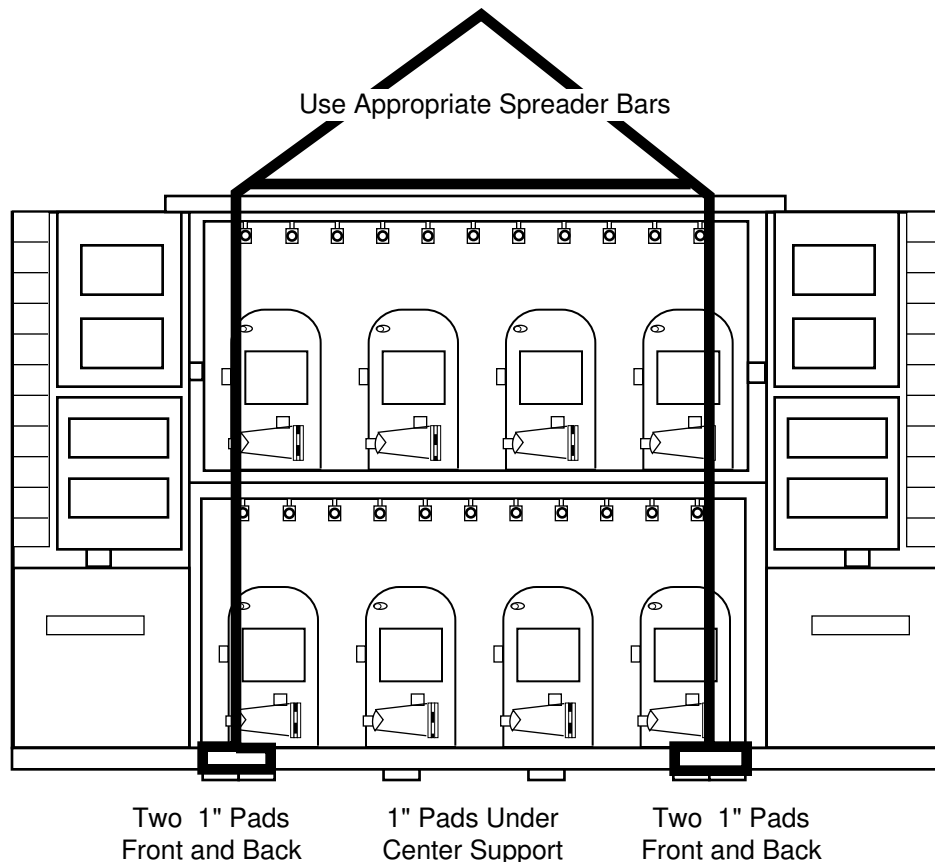


Figure 1-4 — Lifting and Leveling the Scroll Plus System



## REFRIGERATION PROCESS

### OVERVIEW

This section details the refrigeration process by tracking the refrigerant flow through the system components. The following topics are discussed in this section.

Scroll Plus™ Refrigeration System  
Basic Refrigeration  
Heat Reclaim  
Receiver Pressure and  
Vapor Temperature Regulation  
Koolgas Defrost  
Oil System  
Subcooling — Autosurge and Mechanical  
Liquid Injection

The Scroll Plus™ system is designed with vertical receivers to reduce the effective refrigerant charge. The compact design reduces height and width requirements, yet provides access to components for maintenance and service from the front or sides of the unit. Because of the use of Scroll Compressors, vibration characteristics are greatly reduced, extending system life and minimizing chances for fatigued line breakage.

In this instruction the following criteria is maintained to assist the reader.

Electrical solenoid valves carry the same initial abbreviations as in the electrical schematics.

Refrigeration lines not actually in the cycle being discussed are shown closed or are removed.

Each refrigerant state maintains the same fill pattern throughout the instruction.

Pressures in oil lines will also retain a fixed pattern.

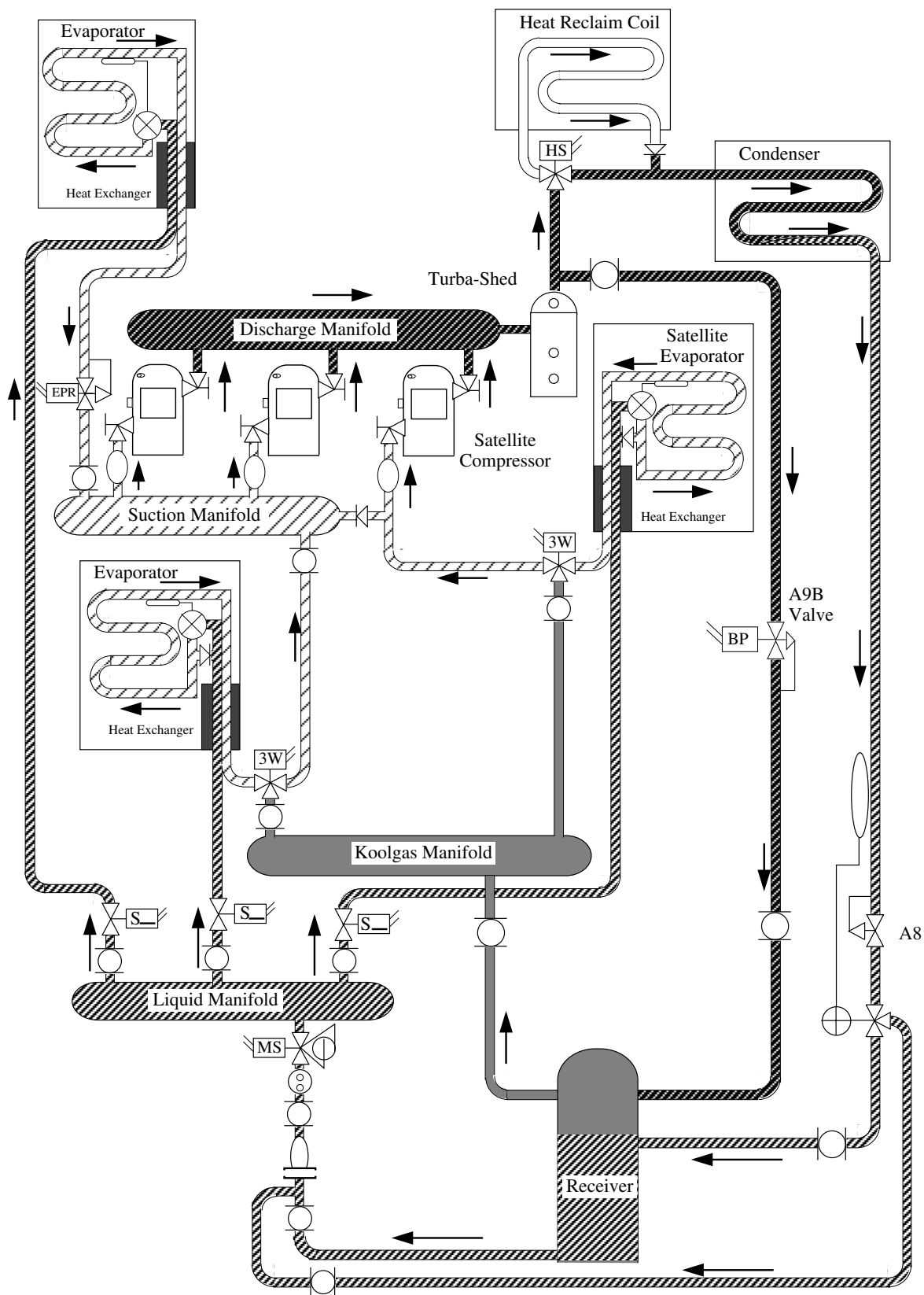







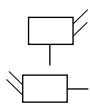
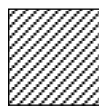








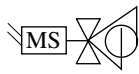
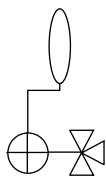



Figure 2-1 — Scroll Plus™ Fibertronic™ Refrigeration System

	Ball Valve		
	Check Valve		High Pressure Hot Vapor
	Compressor Service Valve		
	2-Way Valve		High Pressure Warm Vapor
	3-Way Valve		
	Valve Solenoids		High Pressure Warm Liquid
	Sight Glass		Reduced Pressure Warm Liquid
	Suction Filter		
	Liquid Line Drier		
	Thermal Expansion Valve (TEV)		Low Pressure Cool Vapor
	Pressure Regulating Valve A8 for Condenser A9 for Receiver EPR for Evaporator		Cut-away not shown (Empty)
	Main Liquid Line Pressure Differential Valve		
	Autosurge Valve (Optional)		
	Heat Exchanger (Optional)		

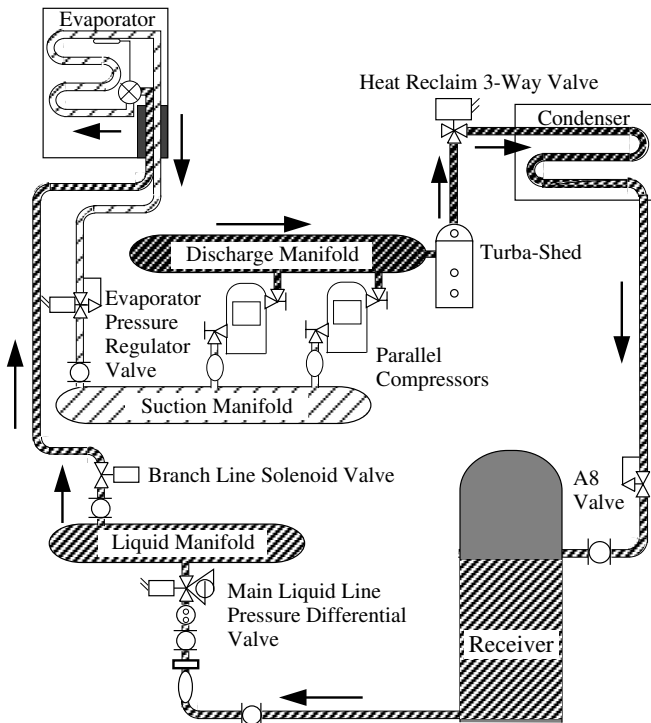


Figure 2-2 — Refrigeration Cycle

## BASIC REFRIGERATION CYCLE

Beginning with the **Parallel Compressors**, refrigerant vapor is compressed into the **Discharge Manifold** and is routed to the **Turbashed** oil separator. The Turbashed separates the liquid oil from the refrigerant vapor by centrifugal force, screen baffles and velocity reduction. The oil is stored in the bottom reservoir portion of the Turbashed and from there is distributed to the compressors.

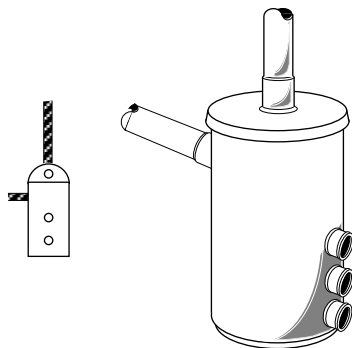


Figure 2-3 — Turba-Shed

A 3-way **Heat Reclaim Valve (HS)** directs the refrigerant to either the condenser or a heat reclaim coil. When the HS solenoid is de-energized the valve directs the refrigerant to the condenser.

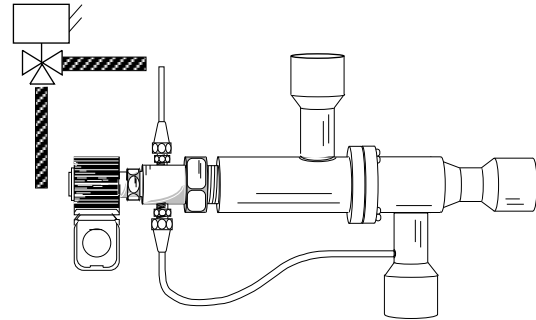


Figure 2-4 — Heat Reclaim Valve

The **Condenser** rejects the unwanted heat to atmosphere, out of the system.

The **Flooding Valve (A8)** maintains minimum discharge pressure during low ambient temperature conditions by reducing the effective condensing surface. Restricting liquid refrigerant flow from the Condenser, the Flooding Valve prevents liquid refrigerant from leaving the condenser as fast as it is forming, so the Condenser floods with its own condensate.

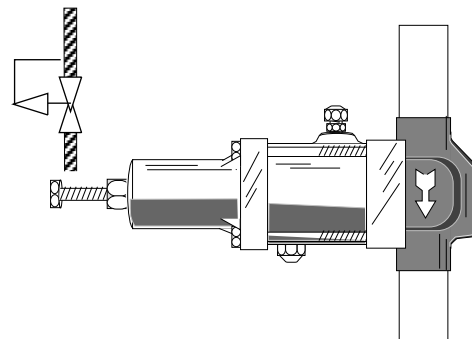


Figure 2-5 — Flooding Valve

The **Vertical Receiver** acts as a vapor trap and supply the Main Liquid Pressure Differential Solenoid Valve with quality liquid refrigerant. Sufficient liquid, vapor, and pressure are critical to the operation of the system. The system maintains these balances in the Vertical Receiver for use as needed.

The **Main Liquid Pressure Differential Solenoid Valve (MS)** functions during Koolgas defrost to reduce pressure to the Liquid Manifold. This valve never closes completely but restricts the liquid line, reducing the pressure in the liquid manifold, thus enabling the reverse flow of refrigerant necessary for Koolgas Defrost. The **Liquid Manifold** distributes liquid refrigerant to all the Branches Liquid Lines connected.

The **Branch Liquid Line Solenoid Valve (S<sub>1</sub>)** closes off refrigeration liquid supply to the expansion valve, yet allows back flow of refrigerant into the liquid manifold during defrost.

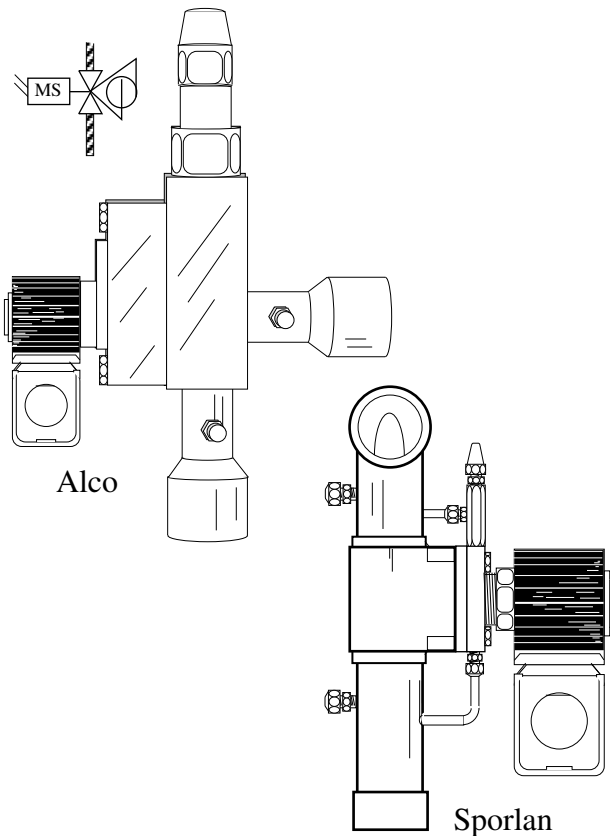


Figure 2-6 — Main Liquid Line Pressure Differential Valve

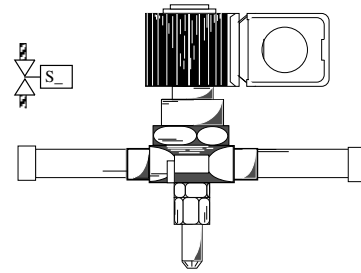


Figure 2-7 — Branch Liquid Line Solenoid Valve

The **Expansion Valve**, located in the merchandiser, meters liquid refrigerant through its orifice to the low pressure side of the system. As the refrigerant passes through the evaporator coil it

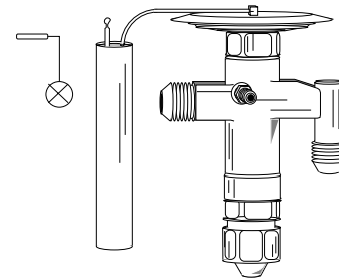


Figure 2-8 — TEV

absorbs heat from the coil and flashes into vapor. An **Evaporator Pressure Regulating Valve** may be used to control the evaporator temperature by preventing the evaporator pressure from dropping below a set point.

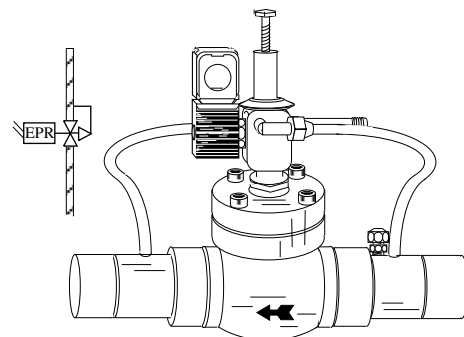


Figure 2-9 — EPR Valve

At critical locations along the refrigerant path, service valves or ball valves allow isolation of components.

## HEAT RECLAIM CYCLE

The **Heat Reclaim 3-way Valve (HS)**, when energized, routes the superheated discharge vapor to a remote mounted coil or to a water heating coil. A check valve in the return lines prevents reverse flow and refrigerant migration to the heat reclaim coil. The Heat Reclaim coil removes superheat from the refrigerant vapor before it is routed to the condenser.

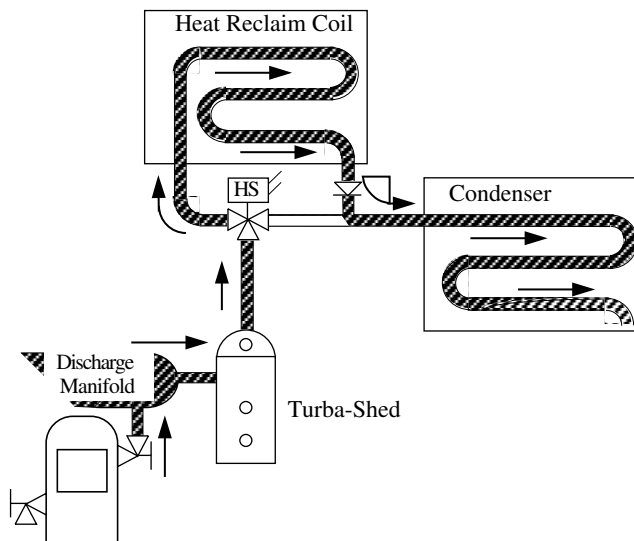


Figure 2-10 — Heat Reclaim Cycle

## RECEIVER PRESSURE AND VAPOR TEMPERATURE REGULATION

### Receiver Pressure

The **Receiver Pressure Regulator Valve (A9 or A9B)** responds to receiver pressure. If the receiver pressure decreases below its set point the A9 valve opens, directing hot high pressure vapor into the receiver. When the receiver pressure increases to the setpoint the valve will modulate closed.

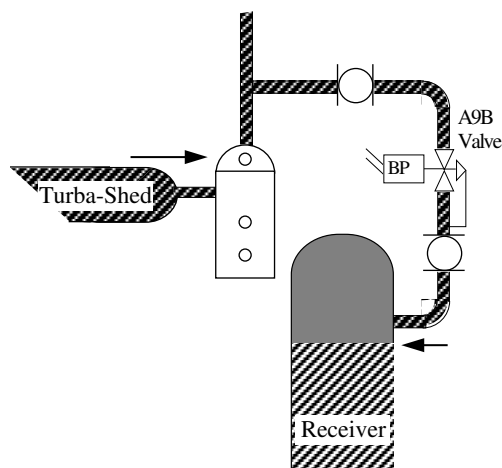


Figure 2-11 — Receiver Pressure Regulation

### Receiver Temperature

The receiver temperature is only controlled when the Autosurge system has been applied, with Koolgas defrost. During Koolgas defrost, if the Koolgas Manifold temperature drops below 85 deg F the A9B Solenoid coil is energized, forcing the valve to an open position. This allows hot gas to enter the receiver, thereby regulating the defrost gas temperature. The solenoid is controlled by a thermostat responding to the Koolgas Manifold temperature, and only allowed to operate during defrost.

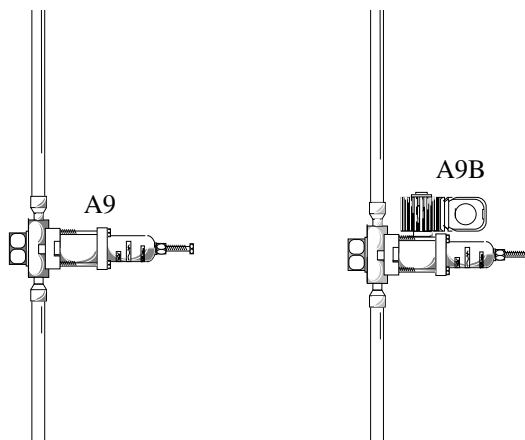


Figure 2-12 — A9 and A9B Valves

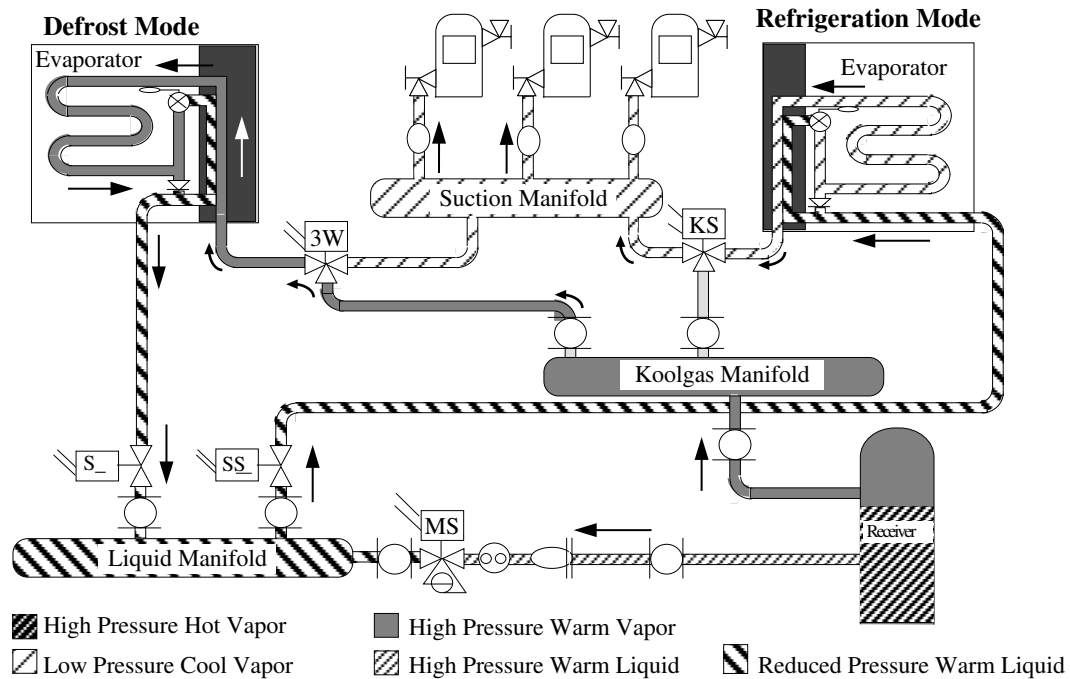


Figure 2-13 — Koolgas Defrost Cycle

## KOOLGAS DEFROST CYCLE

Beginning with the **Receiver** the Koolgas Cycle splits in two directions—Receiver Vapor and Receiver Liquid. The high pressure liquid flowing from the Receiver is throttled by the **Main Liquid Line Solenoid Valve** causing a pressure reduction in the **Liquid Manifold**.

The **Branch Liquid Line Solenoid Valve** is designed to allow backflow into the reduced pressure Liquid Manifold. When a branch of refrigeration cases enters the defrost cycle its **Branch Valve** allows refrigerant to flow into the Liquid Manifold. The valve solenoid is energized both for refrigeration and for defrost.

The Receiver Vapor flows directly into the **Koolgas Manifold**. This Koolgas Vapor maintains the same high pressure as the Receiver. A **3-Way Valve** closes the suction line to the **Suction Manifold** and opens the Koolgas line to the **Evaporator**. Koolgas Vapor flows backward through the Evaporator, giving up heat to the Evaporator for defrost.

The Koolgas Vapor condenses and flows into the reduced pressure liquid line through a **Bypass Check Valve** around the TEV. From there it is returned to the **Liquid Line Manifold**.

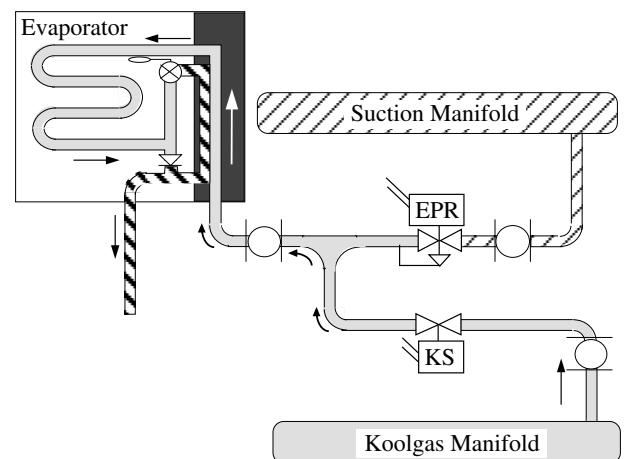


Figure 2-14 — Koolgas Defrost with Valve

If a **Suction Stop EPR Valve** is used to control Evaporator temperature, the 3-Way Valve is not used. When defrost is called for, the suction line control valve closes and a two-way **Koolgas Valve** opens the line from the Koolgas Manifold to the Evaporator.

## OIL CYCLE

Discharge refrigerant carries droplets of oil from the compressors' lubrication system. The **Turba-shed** separates the oil from the refrigerant and stores it in its internal reservoir until needed. The oil returns to the compressors along the high pressure line through an oil filter.

The Oil Filter removes impurities from the oil. The high pressure oil then enters an oil manifold where it is distributed to individual compressor oil feed lines. **Note: the oil manifold has a shutoff valve incorporated that shuts off oil flow in both the full clockwise and counter-clockwise positions. Proper adjust to this shutoff valve is the center position.**

The high pressure oil is then distributed to individual Traxoil regulators, which inject oil through a solenoid into the compressor.

The **Sporlan Traxoil** is an electronic oil level regulator. The unit is powered by a 24V power supply. When the oil level drops below 1/2 sightglass, the oil fill light comes on and the oil solenoid is energized. After 90 seconds, if the oil level doesn't rise above 1/2 sightglass, the Traxoil relay contacts open the compressor control circuit. It is possible after an Oil Level Failure that oil will refill the compressor crankcase causing the oil fill and oil failure lights to turn off, but the compressor alarm light remains on, and the compressor switch requires a manual reset.

**Note: Scroll compressors do not have a positive displacement oil pump, and therefore no oil pressure control.**

## Standard Valves

- (a) Compressor Service Valves
- (b) Oil Supply Shutoff Valve
- (c) Oil Filter Isolation Valve
- (d) Trax-Oil Regulator

## Scroll Plus™ Oil Return System

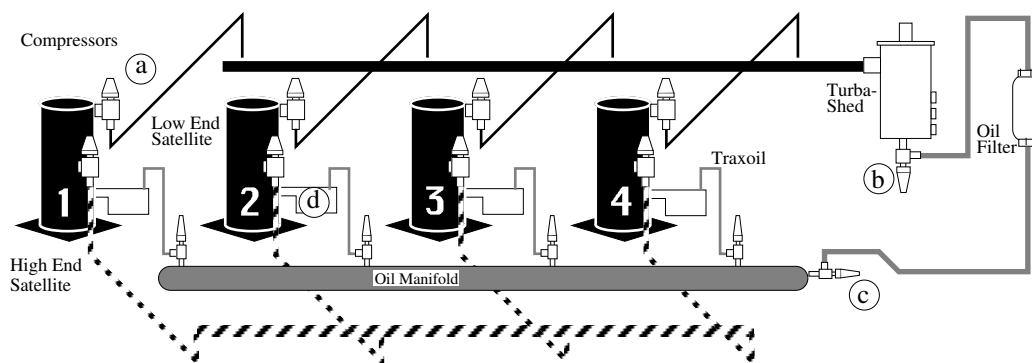


Figure 2-15 — Scroll Plus Oil Return System



## LIQUID INJECTION OVERVIEW

Scroll compressors require liquid injection when applied in low temperature applications. Liquid injection is only available with ZF models. The liquid injection controls introduce a steady volume of refrigerant midway through the compression process to reduce the temperature of the scrolls. Unlike traditional injection systems on reciprocating compressors, this does not reduce the refrigeration capacity of a scroll compressor. A precision sized capillary tube meters more liquid refrigerant as condensing pressure rises. Refrigeration flow to this capillary tube is controlled by a solenoid valve. A current sensing relay should be wired in series with the solenoid valve coil (3-6 hp only). This will halt liquid flow in the event of a compressor protector trip.

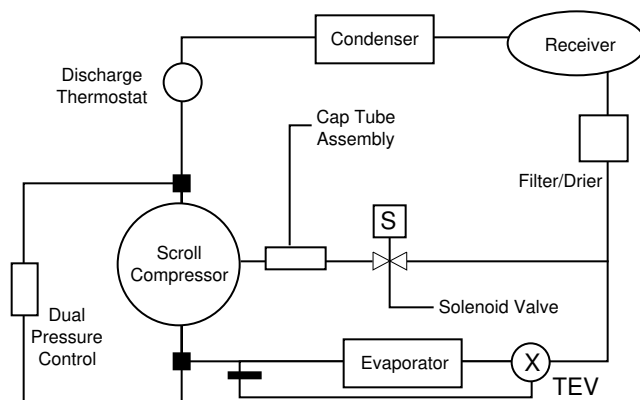


Figure 2-16 —Liquid Injection Schematic

## SUBCOOLING

### Autosurge for Ambient Subcooling

The **Autosurge Valve** directs the flow of refrigerant either **through the Receiver** (Flow Through), or **around the Receiver** (Surge) in response to ambient subcooling obtained in the condenser.

The Autosurge Valve reacts to the condensing pressure through its equalizer line, and to the temperature of the liquid refrigerant returning from the Condenser through a bulb mounted on the Liquid Return Line up stream of the Flooding Valve. When the refrigerant temperature returning from the condenser drops below its condensing temperature, the system has ambient subcooling. *The valve is factory set at 10°F of subcooling and is **not** field adjustable.*

## MECHANICAL SUBCOOLING

By lowering the temperature of the liquid supplied to the TEV, the efficiency of the evaporator is increased. The lower temperature liquid refrigerant has more heat absorption capability, and can therefore remove more heat with less refrigerant. Mechanical subcoolers are able to maintain consistent liquid temperatures year round, and are not limited by seasonal conditions.

A liquid line solenoid valve and a TEV control refrigerant to the subcooler. An EPR is often used to prevent the subcooler suction temperature from dropping below freezing.

Electrically, a thermostat responding to the main liquid line temperature cycles the solenoid valve on the liquid supply.

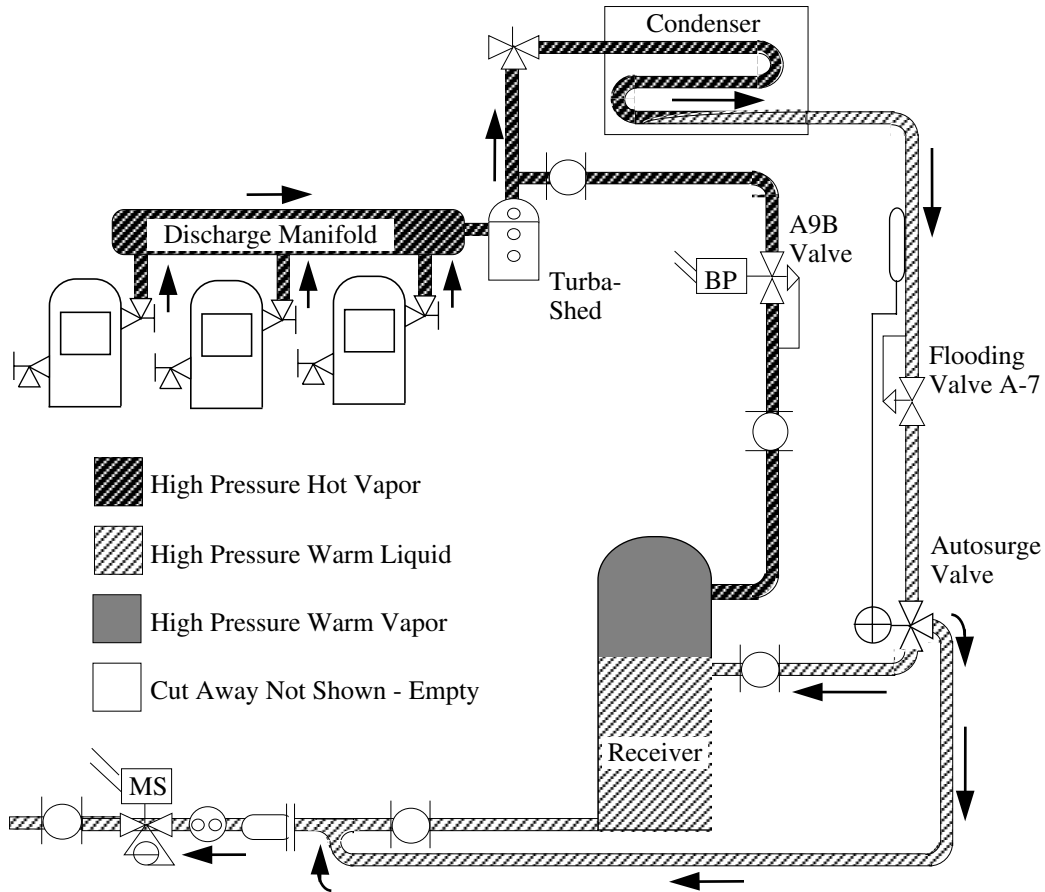


Figure 2-17 — Autosurge for Ambient Cooling

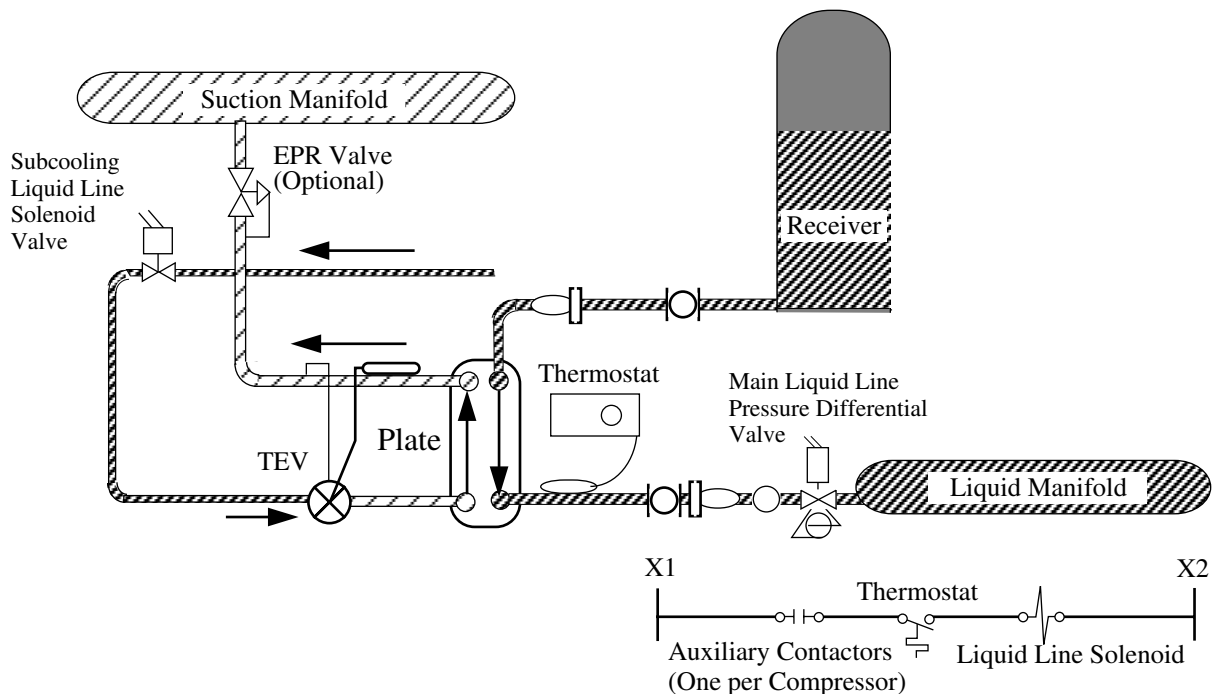


Figure 2-18 — Mechanical Subcooling

## COMPONENT PIPING

### OVERVIEW

This section deals with the information necessary for installing the refrigeration lines for a Scroll Plus™ refrigeration system. The Scroll Plus™ components are piped as completely as practical at the factory. Field piping requires only inter-connection of the major components and to the refrigerators.

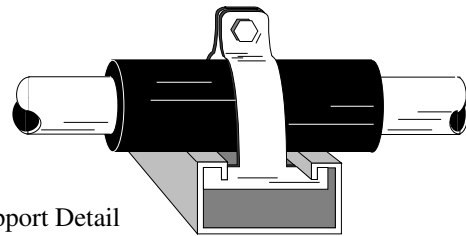
#### WARNING

Always use a Pressure Regulator on nitrogen tanks.

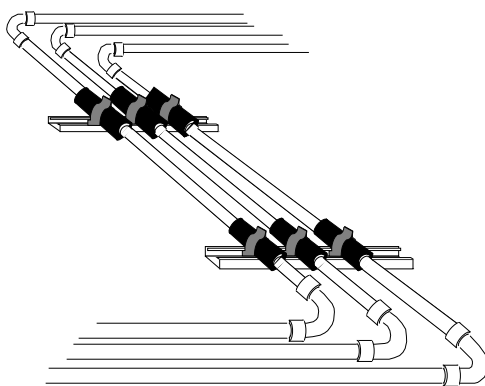
Use only clean, dehydrated, sealed refrigeration grade copper tubing. Use dry nitrogen in the tubing during brazing to prevent the formation of copper oxide. All joints should be made with silver alloy brazing material; use 35% silver solder for dissimilar metals.

### REFRIGERATION LINE RUNS

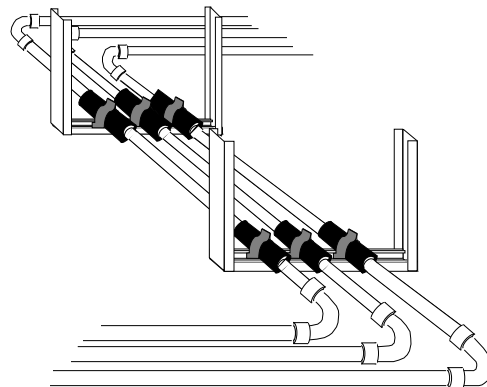
Liquid lines and suction lines must be free to expand and contract independently of each other. Do not clamp or solder them together. Run supports must allow tubing to expand and contract freely. Do not exceed 100 feet without a change of direction or an offset. Plan proper pitching, expansion allowance, and P-traps at the base of all suction risers. Use long radius elbows to reduce line resistance and breakage. Avoid completely the use of 45° elbows. Install service valves at several locations for ease of maintenance and reduced service costs. These valves must be UL approved for 450 psig minimum working pressure.



Support Detail



Floor Run



Ceiling Run

Figure 3-1 — Supporting Refrigeration Lines

## Through Walls or Floors

Refrigeration lines run through walls or floors must be properly insulated. Avoid running lines through the refrigeration cases. When this is done the lines must be adequately insulated—Armaflex or equivalent.

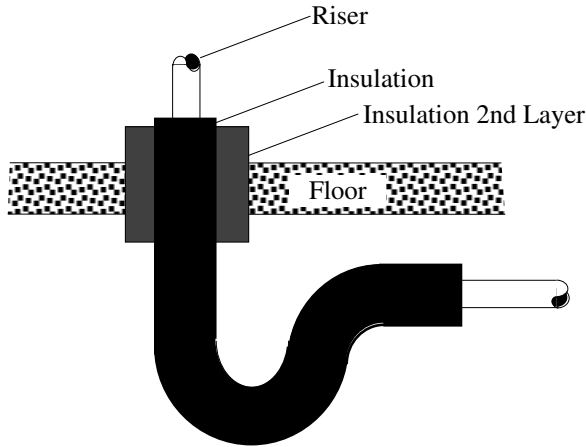


Figure 3-2 — Insulating a Riser

## From Machinery to Solid Object

When mounting lines from machinery to a solid object allow line freedom for vibration to prevent metal fatigue.

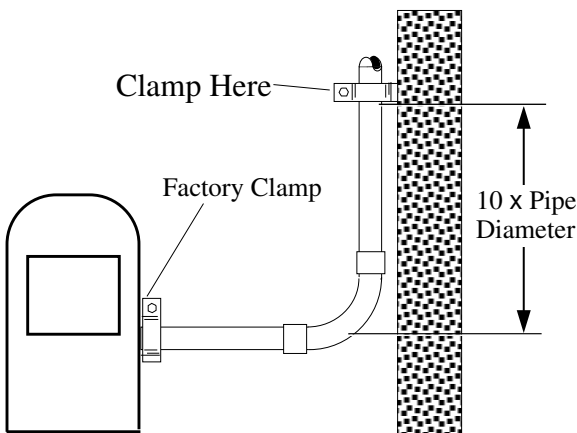


Figure 3-3 — Vibration Allowance

## P-Trap Construction

A P-Trap must be installed at the bottom of all suction risers to return oil to the compressors.

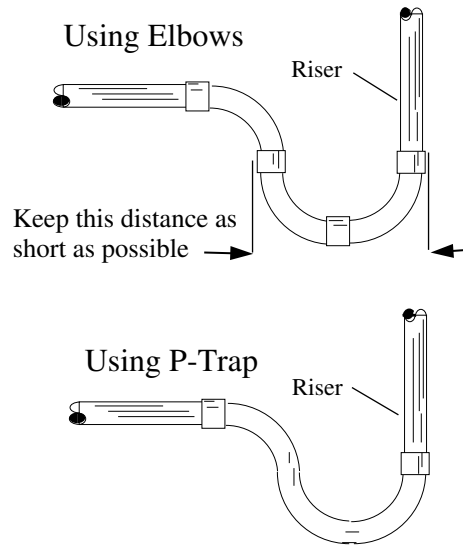


Figure 3-4 — Trap Construction

## Reduced Riser

When a reduced riser is necessary, place the reduction coupling downstream of the P-Trap.

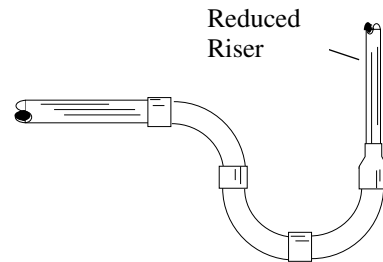


Figure 3-5 — Reduced Riser

## Factory Supplied Stubs

Stub sizes provided from the Manifolds do not automatically correspond to the line sizes necessary. It is the installer's responsibility to supply reduction couplings.

## Protecting Valves and Clamps

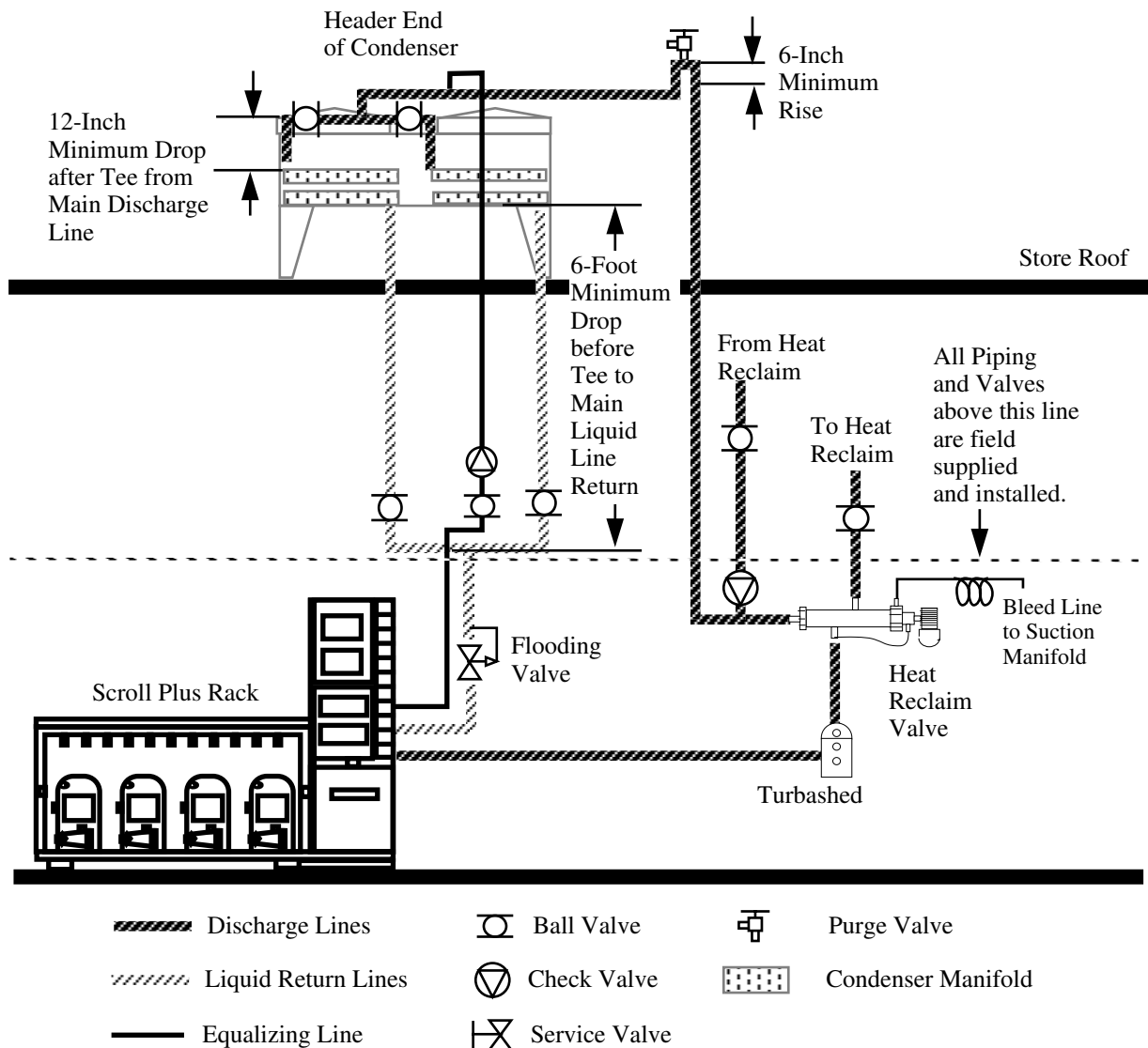
When brazing near factory installed clamps or valves, be sure to protect them with a wet rag to avoid overheating.

**RACK TO CONDENSER PIPING****Connecting to One Manifold**

- Discharge Line will be routed directly to the condenser inlet stub with a purge valve at the highest point.
- Liquid Return Line will be pitched downstream, and provide trapless drainage to the Scroll Plus.

**WARNING**

Vent the Receiver  
Safety Relief Valve  
properly.

**Figure 3-6 — Rack to Condenser Piping****Equalizing Line (WHEN REQUIRED)**

A  $\frac{7}{8}$ -inch equalizer line is piped between the Receiver and the Condenser. A Check Valve allowing flow only to the Condenser and a shut off valve upstream of the Check Valve will be field supplied and installed.

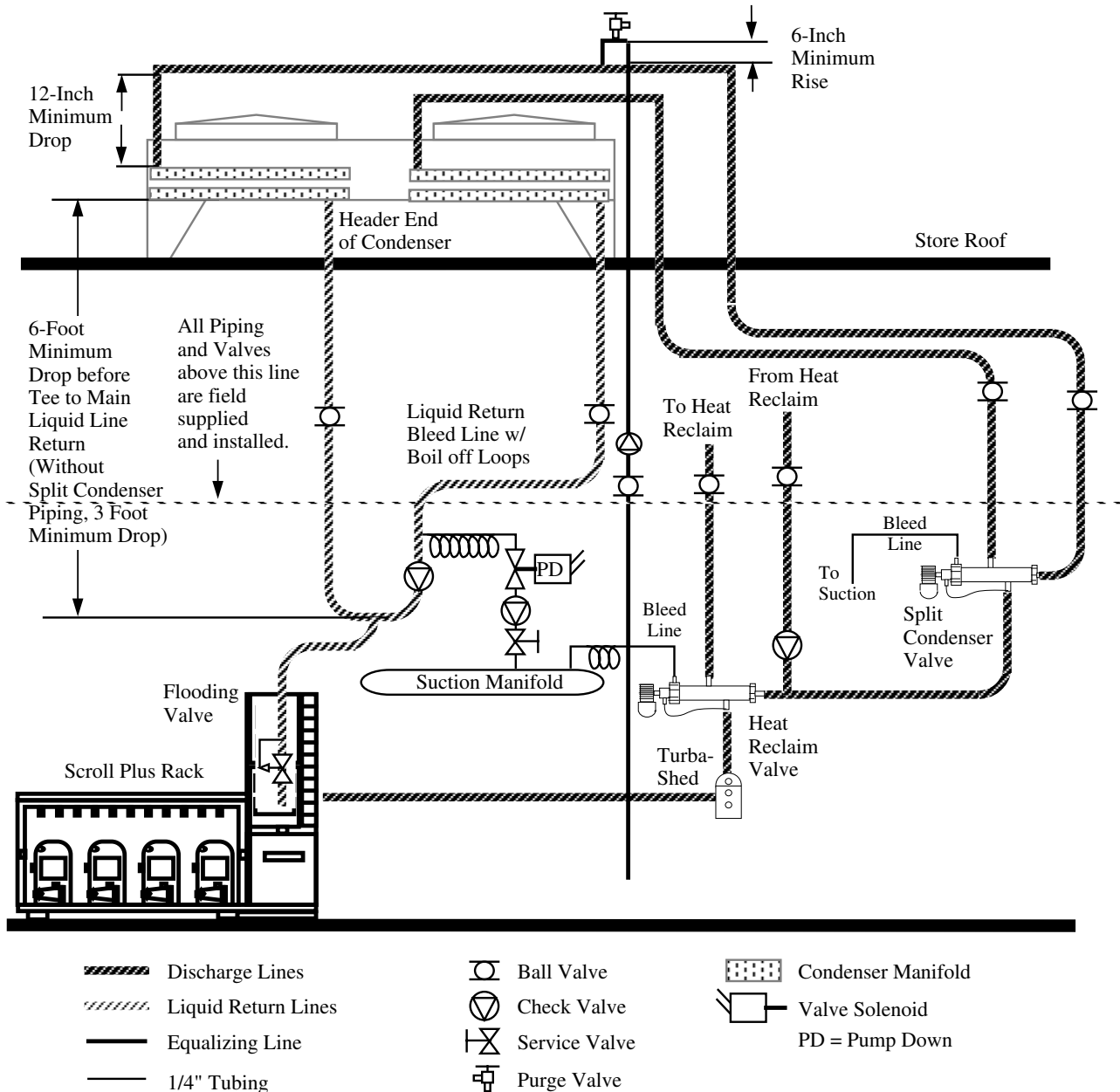
**Purge Valve Location**

The purge valve will be installed at the highest point of an inverted P-trap, with at least a 6-inch rise. Use with approved recovery vessel.

### Connecting to Two Manifolds

•Discharge Line will be tee'd upstream of the manifolds into expansion offsets with at least a 1 foot drop to the manifolds. Provide Purge valve at the highest point

•Liquid Return Lines will be teed into the Main Liquid Return Line after 6 feet of vertical drop from the outlet stubs. Liquid Return Line will be pitched downstream, and provide trapless drainage to the Scroll Plus.



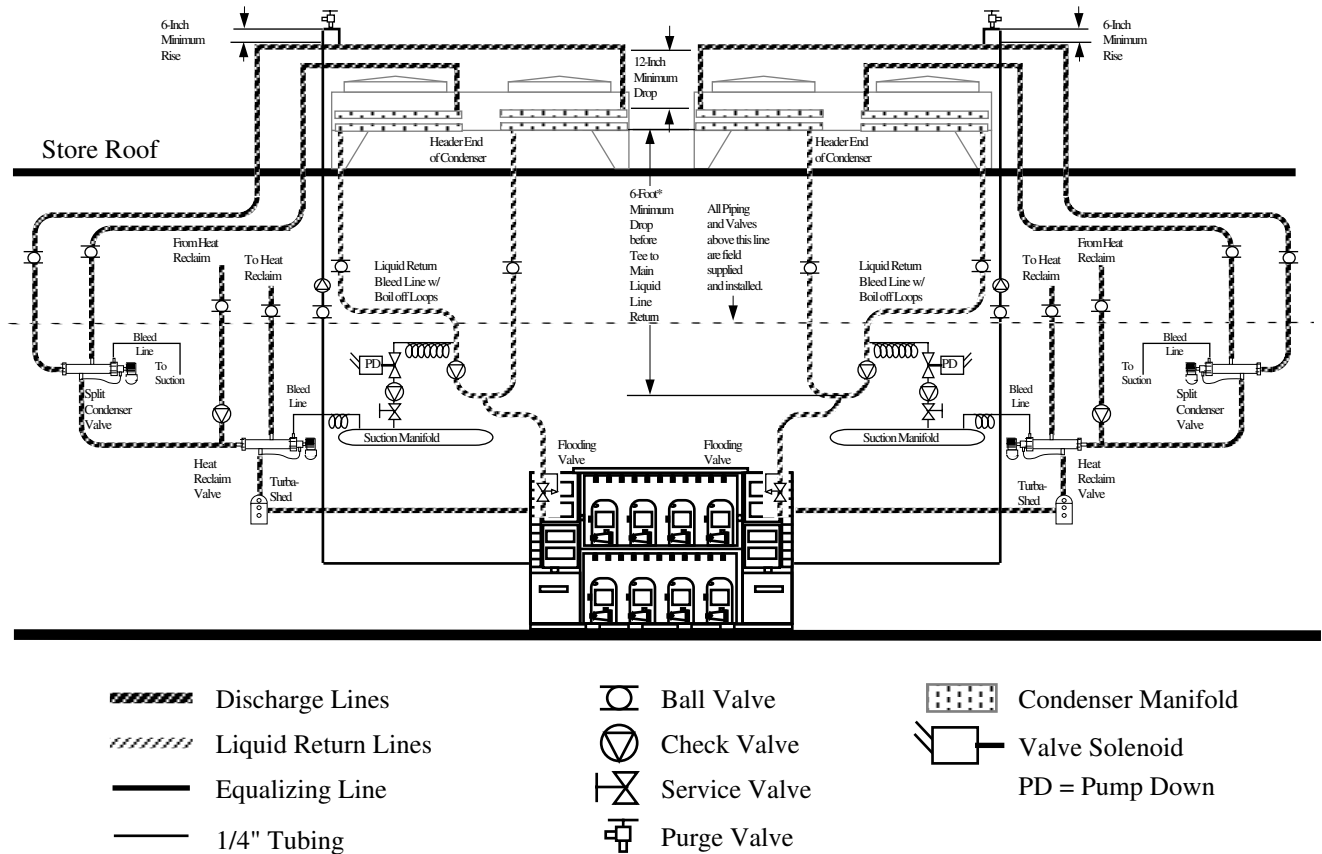
**Figure 3-7 — Rack to Condenser, 3-Way Valve**

**Note:**

- Liquid Return Lines must be free draining with no Traps
- Install Solenoid Valves inside Equipment Room
- Pump Down Line should not enter the Suction Manifold over a Compressor Inlet
- Install Ball Valves to isolate Condenser
- All Inter-connecting Valving to be Field Supplied and Installed

**WARNING**

Vent the Receiver  
Safety Relief Valve  
PROPERLY.



**Figure 3-8 — Rack to Condenser  
Two Tiers with Split Condenser Piping**

\*Without split condenser piping, 6 ft minimum drop is reduced to 3 ft .

Note:

- Liquid Return Lines must be free draining with no Traps and be sized for a maximum of 100 FPM.
- Install Solenoid Valves inside Equipment Room
- Pump Down Line should not enter the Suction Manifold over a Compressor Inlet
- Install Ball Valves to isolate Condenser
- All Inter-connecting Valving to be Field Supplied and Installed

**WARNING**

Vent the Receiver  
Safety Relief Valve  
PROPERLY.

**RACK TO HEAT RECLAIM**

Because of the variety of Heat Reclaim systems, refer to the instructions accompanying the system to be installed at the site.

**OFFSET AND EXPANSION LOOP CONSTRUCTION****Sizing***STEP 1*

For low temperature application multiply the length of the run in feet by 0.0169.

For medium temperature application multiply the length of the run in feet by 0.0112.

The product will be inches of linear expansion for the length of run.

**Example:**

A low temperature application with a run of 84 feet of 1 <sup>3</sup>/<sub>4</sub> inch OD.

$$84 \times 0.0169 = 1.4196 \text{ inches expansion.}$$

*STEP 2*

Select the smallest "Inches Expansion" figure equal to or greater than the product in step one from Table 3-1. Follow that column down until it intersects the OD line size of the run. The number listed at the intersection is the "L" value for figuring offset and expansion loop sizes.

**Example:**

The smallest "Inches Expansion" equal to or greater than 1.4196 is 1.5. The 1.5 column intersects with the 1 <sup>3</sup>/<sub>4</sub> line at 21. Use "L" value 21.

**Table 3-1 "L" Values for Figuring Offsets and Expansion Loops**

Inches Expansion				Line Size
0.5	1.0	1.5	2.0	OD
10	15	19	22	7/8
11	16	20	24	1 1/8
11	17	21	26	1 3/8
12	18	23	28	1 5/8
14	20	25	31	1 7/8
16	22	27	32	2 1/8
18	24	30	34	2 3/8
20	28	34	39	3 1/8

*STEP 3*

For an offset, multiply the "L" value by 3 to determine the length of the offset.

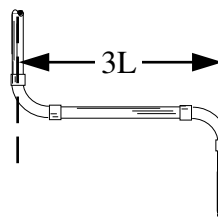
**Example:**

An "L" value of 21 would mean

$$3L = 3 \times 21 \text{ or}$$

$$3L = 63.$$

The offset distance required for low temperature application for an 84 foot run of 1 <sup>3</sup>/<sub>4</sub> line is 63 inches.



**Figure 3-9 — Offset Construction**



For an expansion loop, multiply the “L” value by 2 if hard copper and long radius elbows are used. If the the expansion loop is formed in soft copper, the loop diameter equals “L”.

Example:

For the same 84 foot run, a hard copper loop is 42 by 42 inches. A soft copper loop is 21 inches.

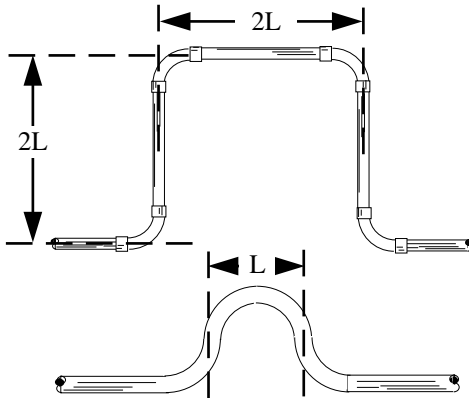


Figure 3-10 — Expansion Loop Connection

### Application

Do not exceed a 100 foot straight run without constructing an offset or expansion loop. Place the offset or loop in the middle of the run to minimize pipe shift and joint stress.

### SPECIAL PIPING FOR OPEN ROOMS

An open preparation room allows heat infiltration from the rest of the store at a rate which may jeopardize total refrigeration performance. Open preparation evaporators must be piped with a Crankcase Pressure Regulating Valve (CPR) to protect the rest of the refrigeration system.

The CPR is field installed in the suction line(s) from the evaporator(s). The installer is responsible for proper adjustment of the Valve (see “Control Valve” Section for adjustment procedures).

### CONNECTING PARALLEL 3-WAY VALVES

Due to the size limitations of 3-Way Valves, some of the larger Koolgas systems will require parallel connection to two suction stubs at the header, using an offset tee construction. Do **not** use a bull head tee.

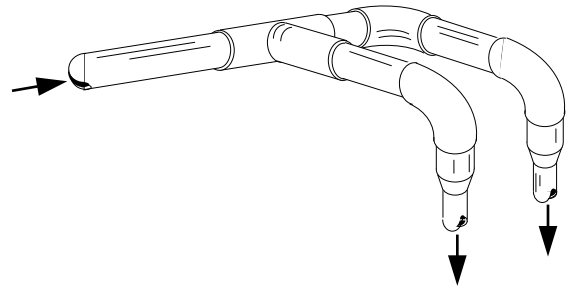


Figure 3-11 — Connection to Parallel Suction Stubs

### RUN LENGTHS AND EQUIVALENT FEET

When figuring run lengths angle valves and elbow 90P are figured as additional straight pipe. The chart below gives equivalent lengths for these components.

**Table 3-2 Equivalent Feet for Angle Valve and Elbow-90P\***

Tubing Size	Angle Valve	Long Radius Elbow-90P
$1\frac{1}{4}$	6	0.9
$1\frac{5}{8}$	7	1.0
$1\frac{7}{8}$	9	1.4
2 $1\frac{1}{4}$	12	1.7
2 $1\frac{3}{8}$	15	2.3
2 $1\frac{5}{8}$	18	2.6
2 $1\frac{7}{8}$	24	3.3
3 $1\frac{1}{4}$	29	4.1
3 $1\frac{3}{8}$	35	5.0
3 $1\frac{5}{8}$	41	5.9
4 $1\frac{1}{4}$	47	6.7

\*ASHRAE Fundamentals Handbook

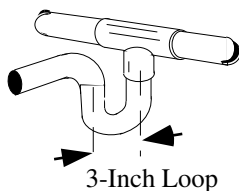
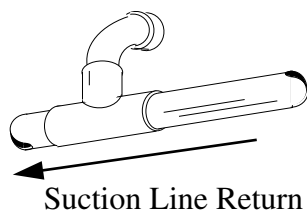
## LINE SIZING

Sizing of all refrigerant lines is the responsibility of the installing contractor. Refer to **Hussmann Refrigerant Line Sizing**.

## BRANCH LINE PIPING

## Suction Line

- Pitch in direction of flow.
- May be reduced by one size at one third of case run load and again after the second third. Do not reduce below evaporator connection size.
- Suction returns from evaporators enter at the top of the branch line.



## Liquid Line

## OFF-TIME AND ELECTRIC DEFROST

- May be reduced by one size after one half the case load run. Do not reduce below evaporator connection size.
- Take-offs to evaporators exit the bottom of the liquid line. Provide an expansion loop for each evaporator take-off. (Minimum 3 inch diameter.)

## KOOLGAS DEFROST

- Maximum of 6 evaporators per Branch System.
- Increase the liquid line size inside the case by two sizes over the branch size.

Branch Size	In Case Size
$1\frac{1}{42}$	$7\frac{1}{48}$
$5\frac{1}{48}$	$1\frac{1}{48}$
$7\frac{1}{48}$	$1\frac{31}{48}$
$1\frac{1}{48}$	$1\frac{51}{48}$
$1\frac{31}{48}$	$2\frac{1}{48}$

- Take-offs to evaporators exit the bottom of the liquid line. Provide an expansion loop for each evaporator take-off. (Minimum 3 inch diameter.)

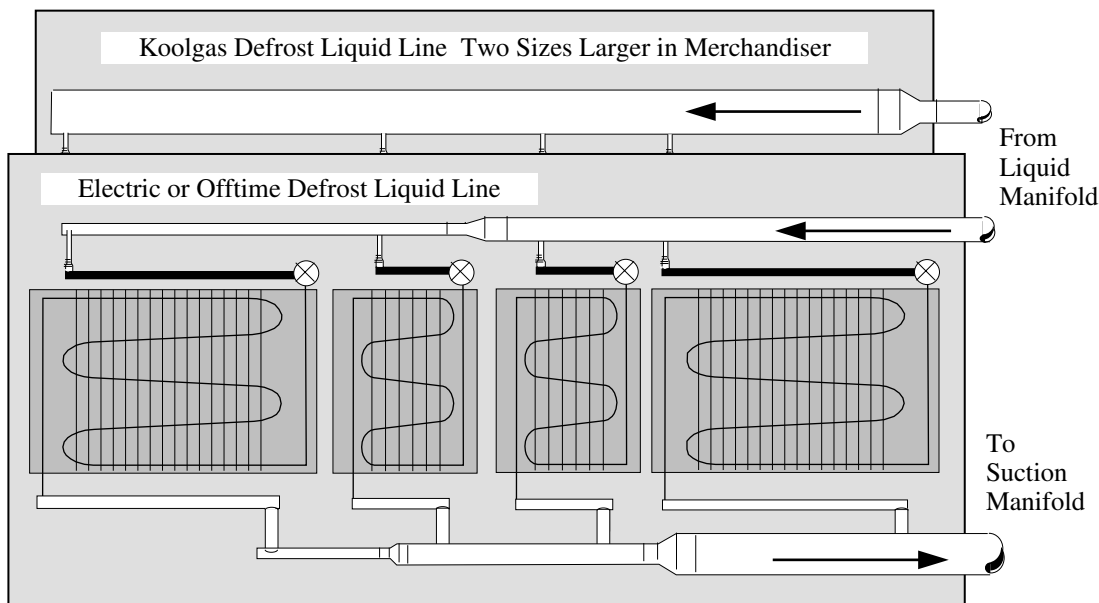


Figure 3-12 — Branch Piping

## ELECTRICAL

### OVERVIEW

The scope of this section is limited to main field wiring connections and to the control panel. Hussmann's Scroll Plus™ Control Panels feature custom wiring schematics. Most of the common user choices are detailed in this section. For a schematic of the control panel as shipped, see the diagrams on the panel. There are three:

- Compressor Control Circuit Diagram
- Defrost Diagram
- Power and Accessories Diagram.

The Fibertronic Circuit Boards are discussed at length. Both explanation of Board layout and a troubleshooting chart to determine Board continuity are here. The Scroll Plus System is available wired for 208-230/3/60 or 460/3/60 or other international voltages. In any case, the control circuit is 120V. Refer to the serial plate located on the control panel to determine wire size (MCA) and overcurrent protection (MOPD).

### FIELD WIRING

Scroll Plus components are wired as completely as possible at the factory with all work completed in accordance with the National Electrical Code (NEC). All deviations required by governing electric codes will be the responsibility of the installer.

The lugs on the circuit breaker package in the compressor control panel are sized for copper wire only, with 75°C THW insulation. All wiring must be in compliance with governing electrical codes.

#### **For Remote Header Defrost Assembly:**

To the remote defrost control panel provide

- one 120V 1PH 15A branch circuit.

Between the remote defrost control panel and the Scroll Plus System provide

- one 120V 15A 2-wire circuit.

#### **For 208-230/3/60 Compressor Units:**

To each Scroll Plus System rack provide

- one 208-230/3/60 branch circuit
- one 120V 1PH 30A circuit—omit when single point connection kit is used.

To each remote air-cooled condenser provide

- one 208-230/3/60 branch circuit.

#### **For 460/3/60 Compressor Units:**

To each Scroll Plus System rack provide

- one 460/3/60 branch circuit
- one 120V 1PH 30A circuit—omit when single point connection kit is used.

To each remote air-cooled condenser provide

- one 460/3/60 branch circuit.

#### **For Alarm Wiring**

Between the Compressor Control Panel and the in store alarm bell provide

- one 120/1/60 10A circuit.

## WIRING GUIDELINES BASED ON VARIOUS COMPONENTS

Check the store legend for components requiring electrical circuits to either the compressor unit or the defrost control panel. These include:

- Defrost termination thermostat
- Thermostat controlling a header mounted liquid line solenoid
- CDA temperature control
- ETR temperature control
- Satellite control

All thermostat and temperature sensor wires should be sized for pilot duty at 120VA 120VAC. Run a 2-wire circuit for each system using any of the five controls listed above.

### Unit Cooler Fan Wiring

Provide a 120/1/60 fused power supply for each cooler. (Check the store legend to see if 208-230/1/60 is required at this location.)

### Evaporator Mounted Liquid Line Solenoid

Power for a liquid line solenoid in the case can be picked up from the fan circuit. (Check fan motor and solenoid voltages first.)

### Select Wire Size

Based on the serial plate ampacity of the system, select the largest connectable wire size from Table 1.

### Cooler Door Switch Wiring

Check the store legend for door switch kits (M115 or M116). The switch must be mounted to the cooler door frame, and must be wired to control the field installed liquid line solenoid and the fan circuit. For Koolgas applications, kit M116 includes a check valve to bypass the liquid line solenoid valve.

### Sizing Wire and Overcurrent Protectors

Check the serial plate for Minimum Circuit Ampacity (MCA) and Maximum Overcurrent Protective Devices (MOPD). Follow NEC guidelines.

### Defrost Controls

These circuits may be repeated and/or intermixed in one store.

### Other Controls

When other controls are used, refer to the manual included with that control.

**Table 4-1 — Required Field Wire Size**

TOTAL CONNECTED MCA* (Based on no more than 3 wires in the raceway and 30°C environment per NEC.)	LARGEST CONNECTABLE WIRE 75°C Wire Rating 50°C
140A (max)	00 per Phase
248A (max)	350 mcm per Phase
408A (max)	2 x (250 mcm) per Phase
608A (max)	2 x (500 mcm) per Phase

\*Include control circuit amps if single point connection transformer option is used

12A for 208V systems

6A for 460V systems

(Refer to NEC for temperature derating factors.)

## USING SCHEMATICS

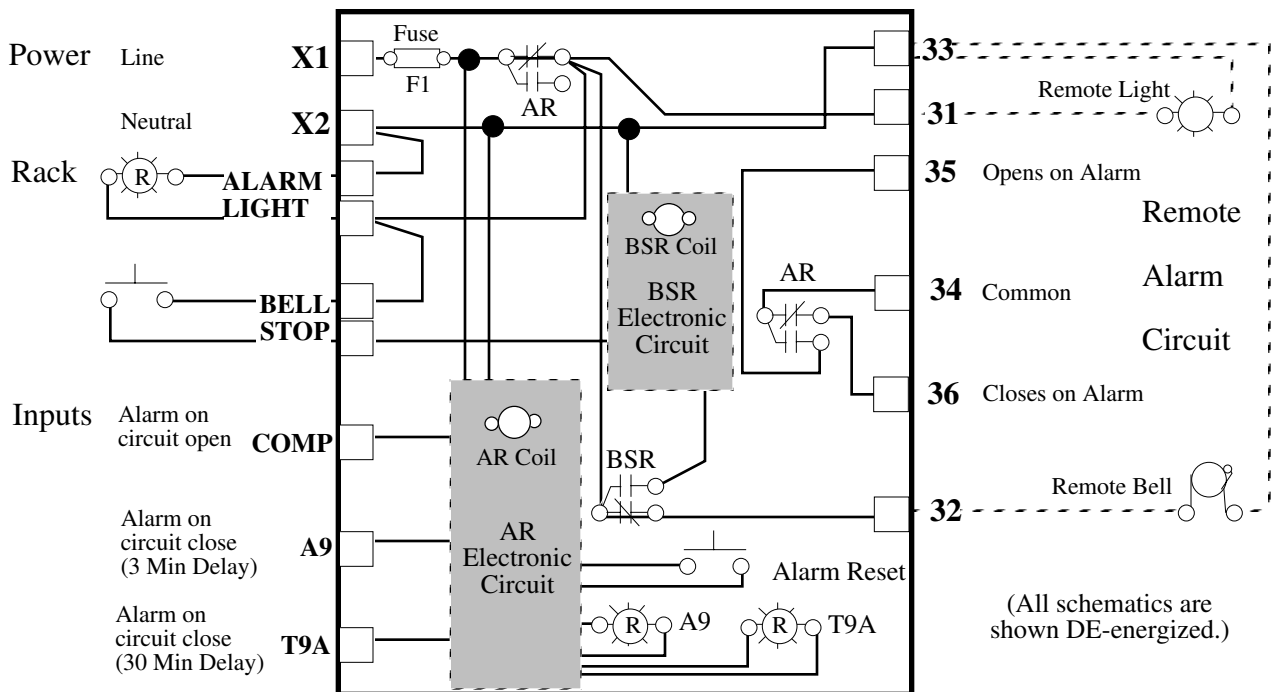


Figure 4-1 — Alarm Board Circuits

Schematics show Sequence of Operation.  
Electronic circuit logic is omitted, since printed circuits are not field repairable.

**Sequence of Operation**

Control Panel 120V circuit closes  
Power to **X1** energizes Alarm Relay (AR)  
AR Electronic Circuit energizes  
AR Coil

AR Contacts open  
between Terminals **34** and **36**  
after Fuse F1  
AR Contacts close  
between Terminals **34** and **35**.

The closed Compressor Alarm Circuit inputs 120V at Terminal **COMP**. If the circuit opens

AR Coil DE-energizes  
AR Contacts open  
between Terminals **34** and **35**.  
AR Contacts close  
between Terminals **34** and **36**  
after Fuse F1  
Energizing  
Alarm Light, Bell Stop Switch,  
Terminals **31** and **32**.

The A9 and T9A circuits remain open during normal operation. If either circuit closes a 120V input to the Alarm Board activates A9 or T9A LED and Alarm Condition.

AR Coil DE-energizes

AR Contacts open  
between Terminals **34** and **35**.  
AR Contacts close  
between Terminals **34** and **36**  
after Fuse F1

Energizing

Alarm Light, Bell Stop Switch,  
Terminals **31** and **32**.

With A9 or T9A the Board will remain in Alarm until the Reset is pressed or power turn off/turn on is used.

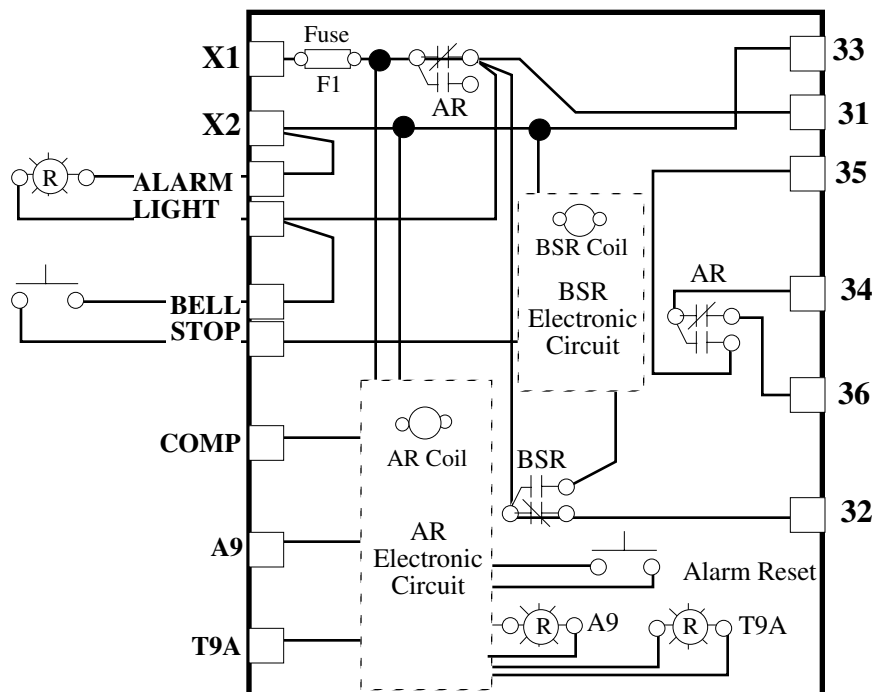
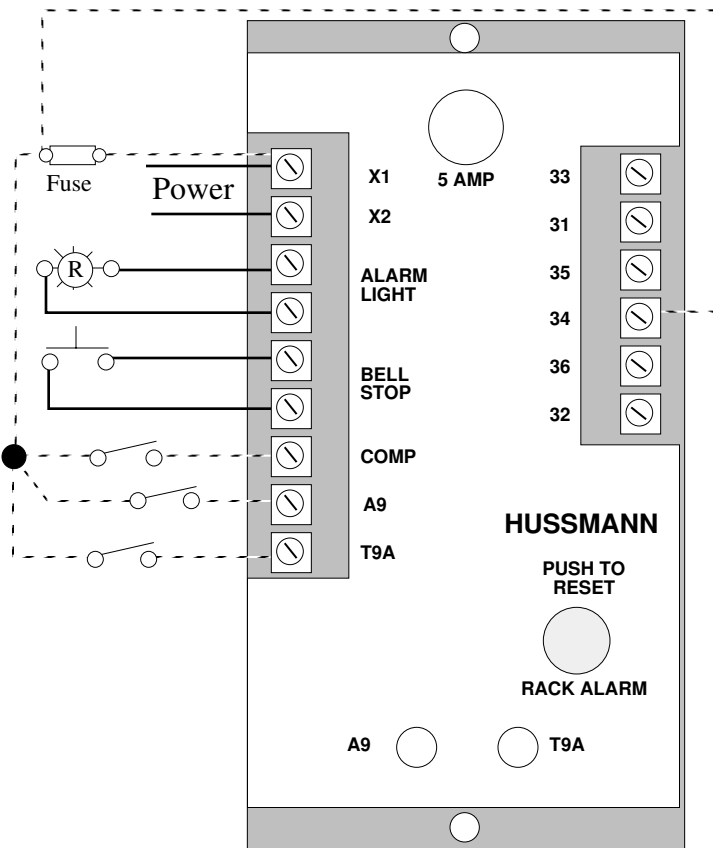
The Bell Stop Relay (BSR) circuit may operate only during Alarm Conditions. When the Bell Stop Switch is closed

BSR Electronic Circuit energizes  
BSR Coil

BSR Contacts open  
the circuit to Terminal **32**  
BSR Contacts close  
the circuit for its own power supply.

## COMPRESSOR CONTROLS

## Alarm Board



(All schematics are shown DE-energized.)

Figure 4-2 — Alarm Board

### Alarm Board Troubleshooting

Check power supply to the Alarm Board and its Fuse F1. Disconnect power. Label, disconnect and cap wires on terminals **COMP, A9, T9A, 33, 31, 35, 34, 36, 32**. Install a fused jumper from **X1** to **34** and with open switches to **COMP, A9, T9A**.

Turn Control panel ON. **Note:** Alarm Board will come up in Alarm Condition.

**Table 4-2 — Alarm Board Troubleshooting**

	<b>Inspect or Place Probes</b>		<b>Result</b>	<b>Action</b>
<b>1</b>	Alarm Light		Lit	Go to <b>3</b>
			Not Lit	Go to <b>2</b>
<b>2</b>	Probe across Alarm Light Terminals		120V	Repair Alarm Light Circuit, Go to <b>3</b>
			0V	Alarm Board Failure
<b>3</b>	31 X2		120V	Go to <b>4</b>
			0V	Alarm Board Failure
<b>4</b>	36 X2		120V	Go to <b>5</b>
			0V	Alarm Board Failure
<b>5</b>	32 X2		120V	Close Jumper Circuit from X1 to COMP. Go to <b>6</b>
			0V	Alarm Board Failure
<b>6</b>	Alarm Light		Not Lit	Close Jumper Circuit from X1 to A9. Go to <b>7</b>
			Lit	Alarm Board Failure
<b>7</b>	A9 Light		Lit	Go to <b>8</b>
			Not Lit	Alarm Board Failure
<b>8</b>	3 Min Delay Alarm Light		Lit	Open Jumper Circuit from X1 to A9. Go to <b>9</b>
			Not Lit	Alarm Board Failure
<b>9</b>	Alarm Light		Lit	Go to <b>10</b>
			Not Lit	Alarm Board Failure
<b>10</b>	32 X2		120V	Press Bell Stop Switch. Go to <b>11</b>
			0V	Alarm Board Failure
<b>11</b>	32 X2		0V	Press Reset. Go to <b>12</b>
			120V	Check Bell Stop circuit. If O. K. - Alarm Board Failure
<b>12</b>	35 X2		120V	Go to <b>13</b>
			0V	Alarm Board Failure
<b>13</b>	Alarm Light		Not Lit	Close Jumper Circuit from X1 to T9A. Go to <b>14</b>
			Lit	Alarm Board Failure
<b>14</b>	T9A Light		Lit	Go to <b>15</b>
			Not Lit	Alarm Board Failure
<b>15</b>	30 Min Delay Alarm Light		Lit	Open Jumper Circuit from X1 to T9A. Press Reset. Go to <b>16</b>
			Not Lit	Alarm Board Failure
<b>16</b>	Alarm Light		Not Lit	Test Completed, Power OFF, Re-instate Control.
			Lit	Alarm Board Failure

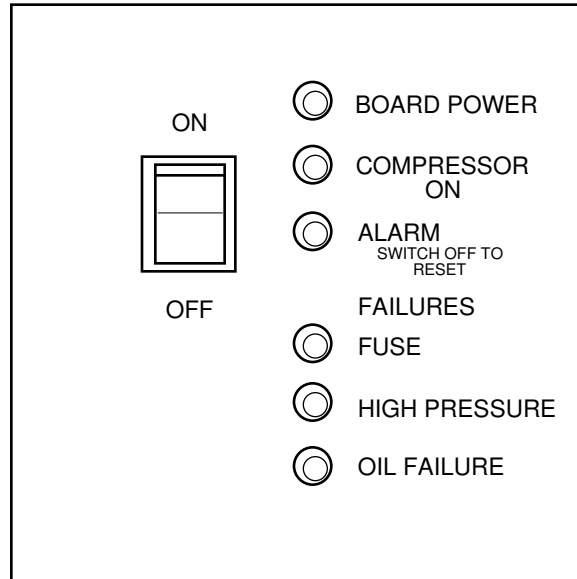


Figure 4-3 — Compressor Board Faceplate

## Compressor Circuit Board

### Compressor Control Circuit Switch

("ON/OFF") shuts off all power to the compressor contactor and all components in that compressor's control circuit, and resets the alarm circuit. After a failure condition is corrected and reset, the switch must be turned "OFF" until the alarm light turns off then the switch may be turned "ON" again.

#### WARNING

ON/OFF switch does not remove power from the circuit board.  
The Control Panel Circuit Breaker must be shut off.

**Board Power** – Green LED – indicates that 120VAC is applied to the board. It can only be turned off at the panel circuit breaker.

**Compressor On** – Yellow LED – indicates that there is 120VAC to the contactor coil.

**Alarm** – Red LED – indicates that this compressor has had an alarm failure, and the alarm relay is energized. This light will go off when the alarm condition is corrected and the control switch is reset.

**Fuse Failure** – Red LED – lights if the fuse has blown. (Fuse is on board.)

**High Pressure Failure** – Red LED – lights under high pressure failure condition.

**Oil Failure** – Red LED – lights under oil failure condition.



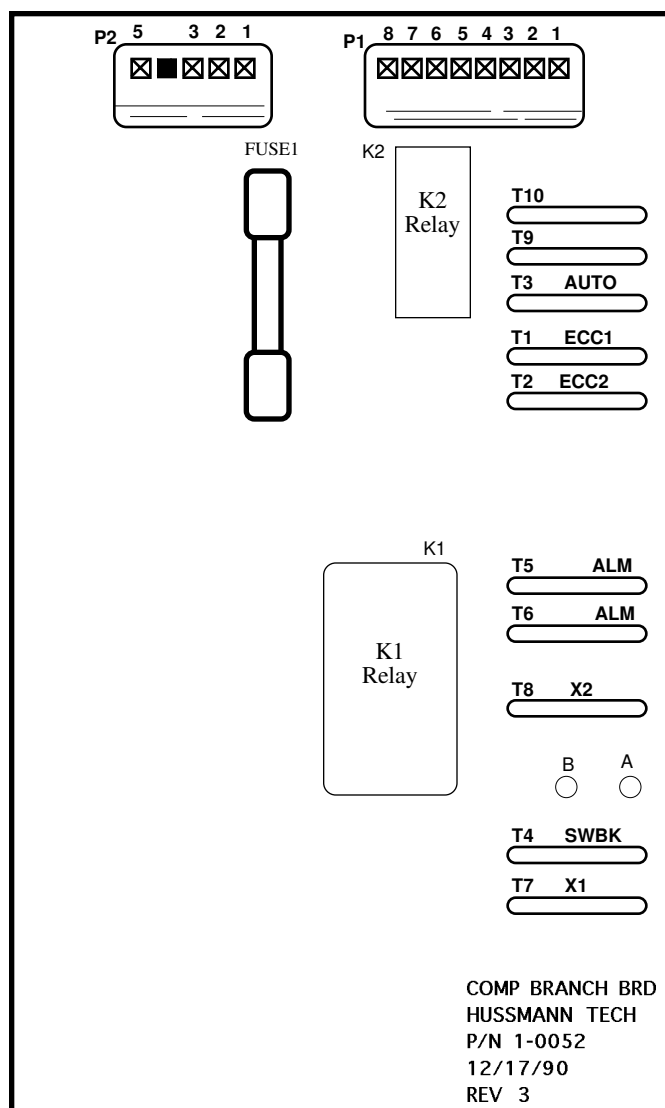


Figure 4-4 — Compressor Circuit Board Connections

**P2** connects to the contactor, supplying output to the contactor coil and receiving input from the compressor auxiliary contacts. Pin numbers run right (P2,1) to left (P2,5).

**P1** connects to the compressor harness, providing input to the board from the oil failure, high pressure, and low pressure controls. Pin numbers run right (P1,1) to left (P1,8).

**Fuse 1** provides overload protection.

**T10** and **T9** provide input to the board from Koolgas or Interlock contacts.

**T3** provides power to the K2 Relay Circuit.

**T1** and **T2** provide input to the board from EPC compressor contacts for the K2 Relay.

**T5** and **T6** provide output to the Alarm Board Compressor Relay.

**T8** provides common for all board circuits.

**T4** is the power input from a switchback control contact.

**T7** is the power input during normal operation when the EPC is in control.

# Compressor Board using Mechanical Low Pressure Control or Series Switchback

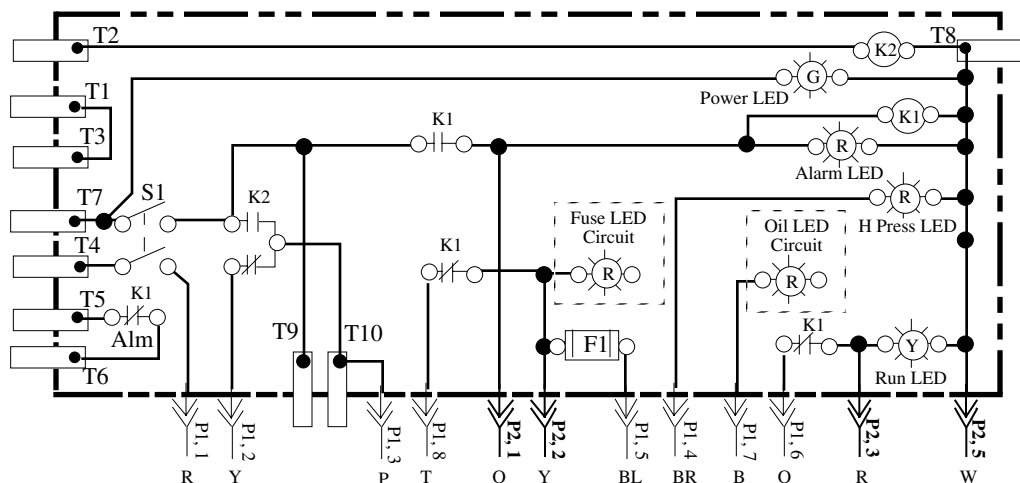
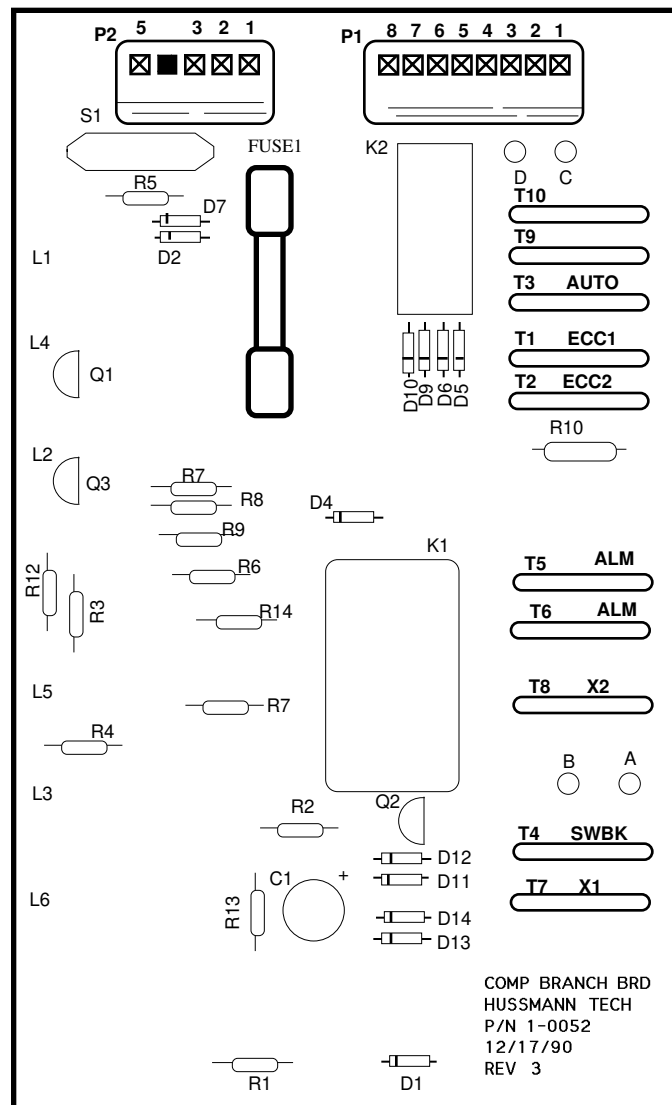


Figure 4-5 — Compressor Board — Mechanical Low Pressure Control

**Table 4-3 — Compressor Board Troubleshooting — Mechanical**

<b>Troubleshooting—Compressor Board (Mechanical Low Pressure Control or Series Switchback)</b>				
Be sure Board Switch is closed. Run, Refrigeration Mode				
Voltmeter Lead Placement Lead 1      Lead 2		Voltmeter Readings	Action	
<b>1</b>	T7	T8	120	Go to <b>2</b>
			0	Check Power Supply to Board
<b>2</b>	T5	T8	120	Go to <b>3</b>
			0	Check Power Supply to T5 from X1A
<b>3</b>	T6	T8	120	Go to <b>4</b>
			0	Alarm Circuit open – correct cause and reset
<b>4</b>	T4	T8	120	Go to <b>5</b>
			0	Failed connection between T7 and T4 – Repair
<b>5</b>	P1,1	T8	120	Go to <b>7</b>
			0	Test “ON/OFF” Switch and connections to Board – If OK, Board Failure
<b>6</b>	P1,2	T8	120	Low Pressure Control closed – Go to <b>7</b>
			0	Low Pressure Control opened – Should be closed to continue Board check
<b>7</b>	P1,3	T8	120	Go to <b>8</b>
			0	Board Failure
<b>8</b>	P1,8	T8	120	Go to <b>9</b>
			0	Compressor Protector open,
<b>9</b>	P2,2	T8	120	Go to <b>10</b>
			0	Board Failure
<b>10</b>	P1,5	T8	120	Go to <b>11</b>
			0	Check Fuse and connections – If OK, Board Failure
<b>11</b>	P1,6	T8	120	Go to <b>14</b>
			0	Alarm tripped - Go to <b>12</b>
<b>12</b>	P1,4	T8	0	Go to <b>13</b>
			120	High Pressure Alarm – Correct cause and reset
<b>13</b>	P1,7	T8	0	Go to <b>14</b>
			120	Oil Alarm – Correct cause and reset
<b>14</b>	P2,3	T8	120	Go to <b>15</b>
			0	If K1 Contacts are open, correct and reset If closed, Board Failure
<b>15</b>	P2,5	T8	0	Circuit Complete – End Test
			120	Board Failure

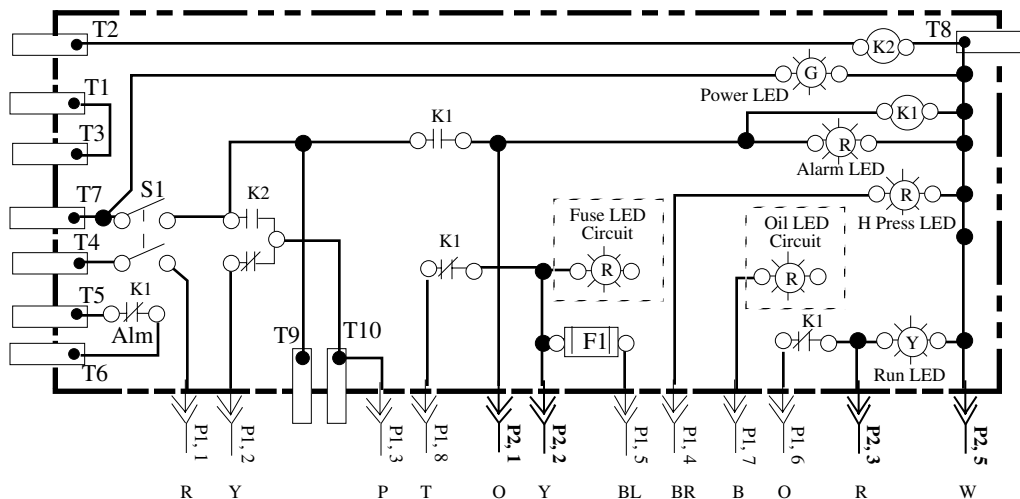
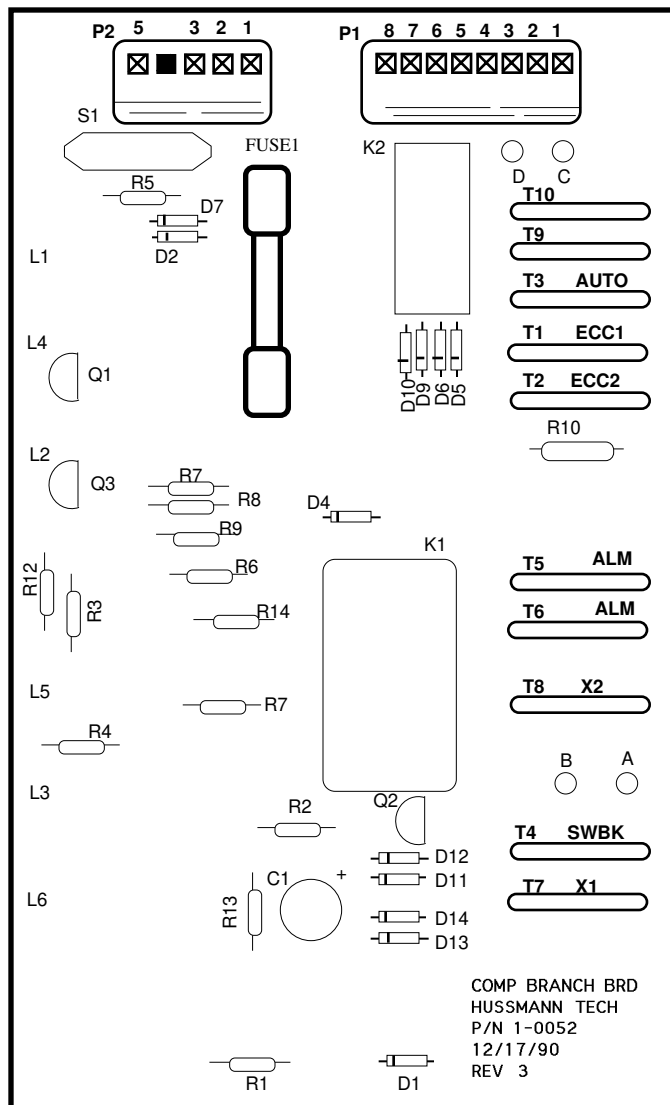


Figure 4-6 — Compressor Board — EPC Control

**Table 4-4 — Compressor Board Troubleshooting — Electronic**

<b>Troubleshooting—Compressor Board (EPC Control)</b>				
Be sure Board Switch is closed. Run, Refrigeration Mode				
Voltmeter Lead Placement Lead 1      Lead 2		Voltmeter Readings	Action	
<b>1</b>	T7	T8	120	Go to <b>2</b>
			0	Check Power Supply to Board
<b>2</b>	T5	T8	120	Go to <b>3</b>
			0	Check Power Supply to T5 from X1A
<b>3</b>	T6	T8	120	Go to <b>4</b>
			0	Alarm Circuit open – correct cause and reset
<b>4</b>	T4	T8	0	Go to <b>5</b>
			120	In Switchback - correct cause and reset
<b>5</b>	T3	T8	120	Go to <b>6</b>
			0	Check Power Supply to T3 from X1
<b>6</b>	T1	T8	120	Go to <b>7</b>
			0	Board Failure
<b>7</b>	T2	T8	120	Go to <b>8</b>
			0	EPC not calling for compressor run
<b>8</b>	P1,3	T8	120	Go to <b>9</b>
			0	Board Failure
<b>9</b>	P1,8	T8	120	Go to <b>10</b>
			0	Compressor Protector open
<b>10</b>	P1,5	T8	120	Go to <b>11</b>
			0	Check Fuse and connections – If OK, Board Failure
<b>11</b>	P1,6	T8	120	Go to <b>14</b>
			0	Alarm tripped - Go to <b>12</b>
<b>12</b>	P1,4	T8	0	Go to <b>13</b>
			120	High Pressure Alarm – Correct cause and reset
<b>13</b>	P1,7	T8	0	Go to <b>14</b>
			120	Oil Alarm – Correct cause and reset
<b>14</b>	P2,3	T8	120	Go to <b>15</b>
			0	If K1 Contacts are open, correct and reset If closed, Board Failure
<b>15</b>	P2,5	T8	0	Circuit Complete – End Test
			120	Board Failure

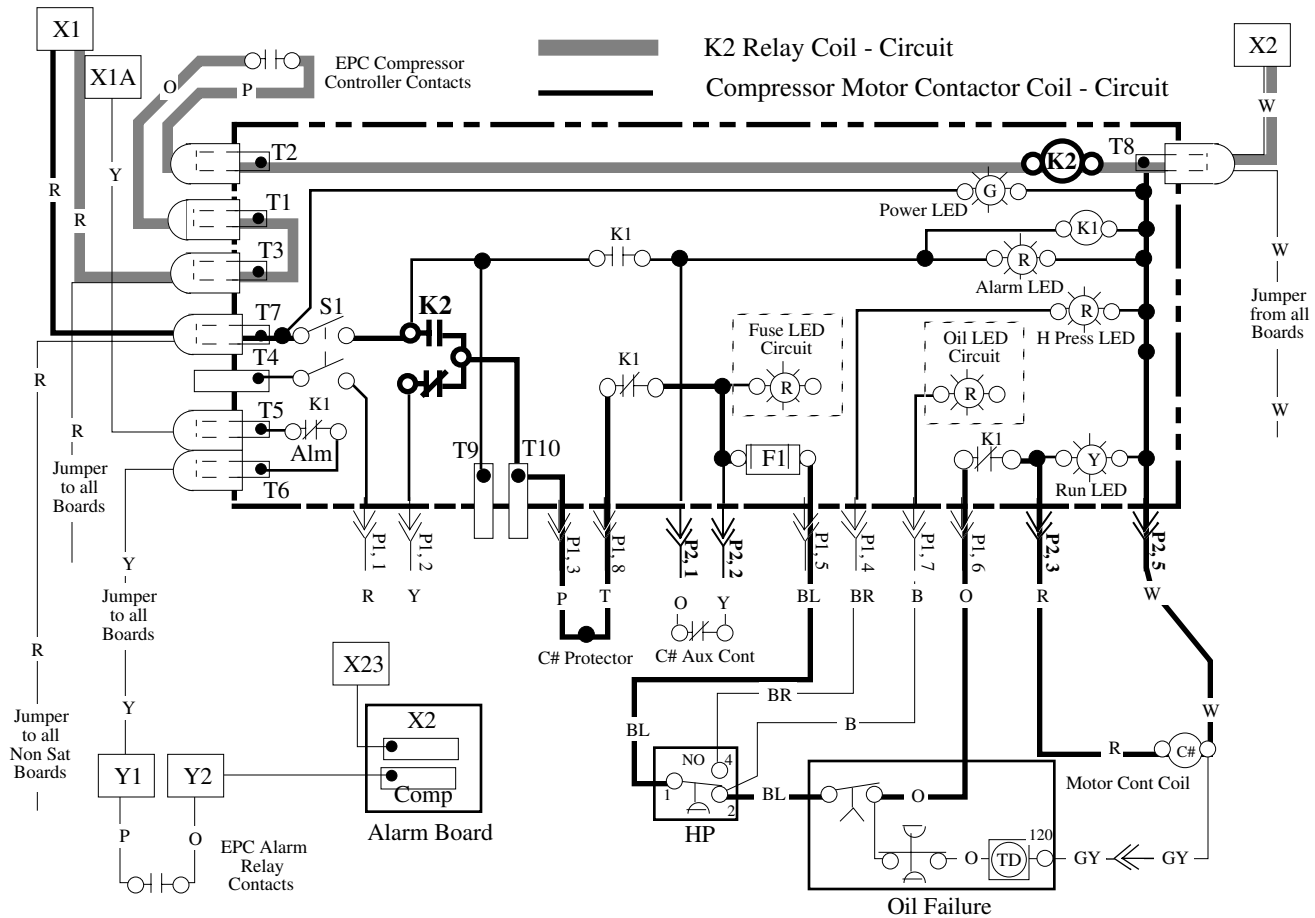


Figure 4-7 — K2 & Motor Contactor Circuits

## COMPRESSOR BOARD RELATED CIRCUITS

### Compressor Run Circuits

On call for compressor run the EPC Compressor Controller Contacts energizing the K2 Relay Coil.

When the Normally Open K2 Contacts close the Compressor Motor Contactor Coil is energized.

If an electronic control other than EPC is applied with Series Switchback, the K2 Circuit is not used. Normally Closed Contacts from the controller are wired in series with the low pressure control through terminal T4.

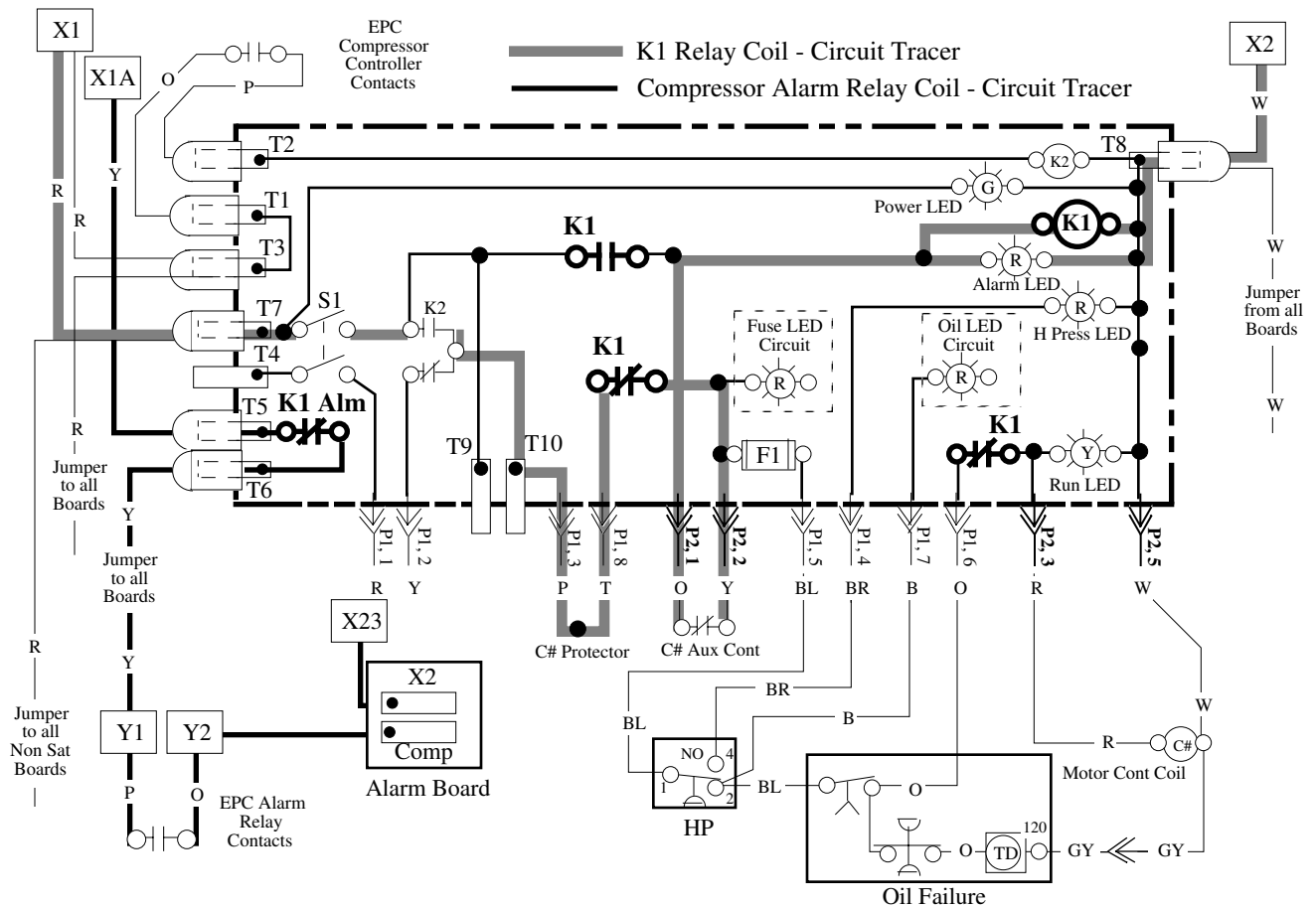


Figure 4-8 — K1 &amp; Compressor Alarm Circuits

### Compressor Alarm Circuits

If the Compressor Motor Contactor fails to complete the motor circuit, its Normally Closed Auxiliary contacts energize the K1 Alarm Relay. Once energized the K1 Relay maintains its own circuit through the Normally Open K1 Contacts. The Compressor Board Switch must be opened to de-energize the K1 Relay.

The three Normally Closed K1 Contacts are held open during alarm conditions. The K1 Contacts between T5 and T6 open the circuit to the Compressor Alarm on the rack's Alarm Board.

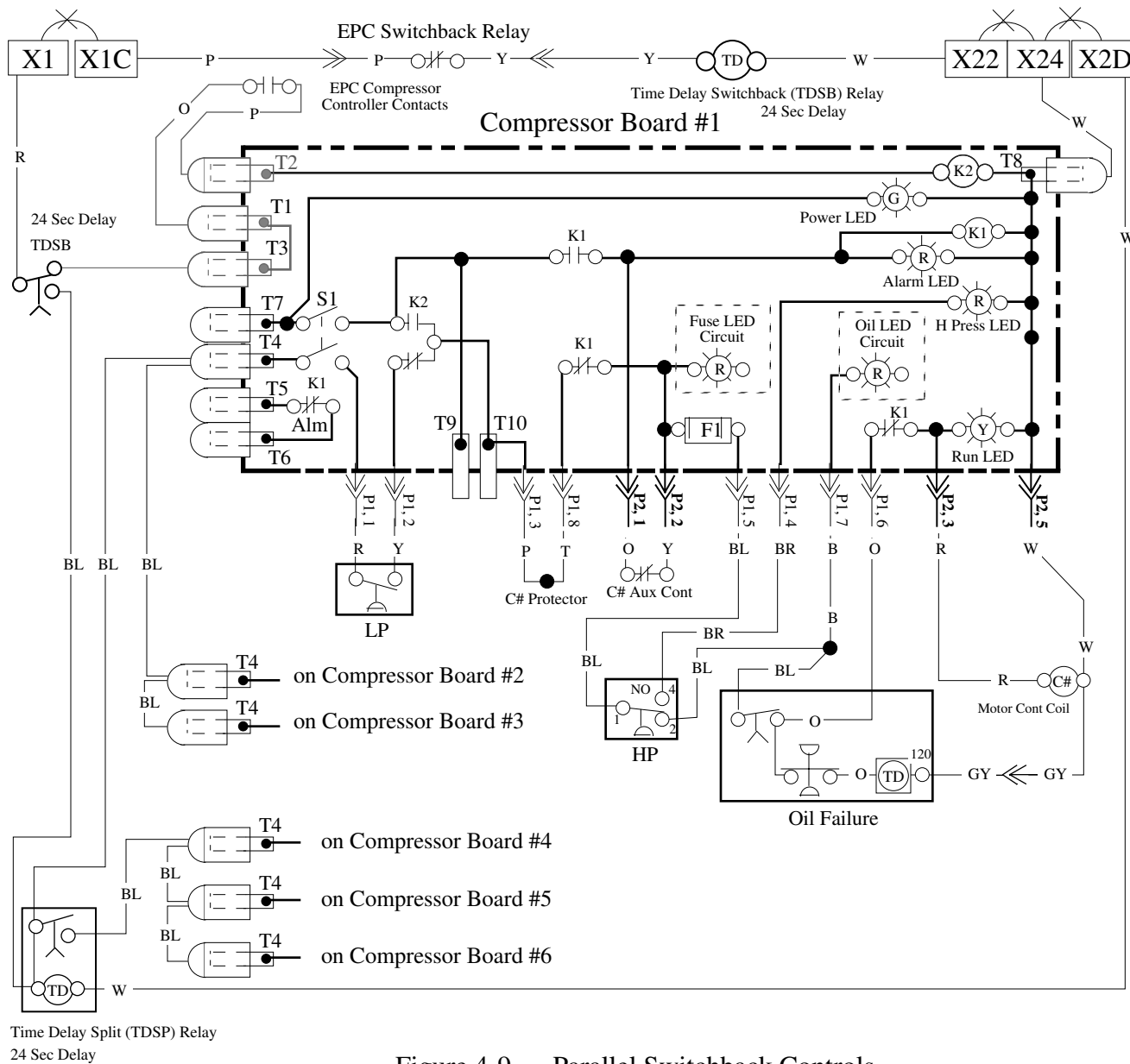


Figure 4-9 — Parallel Switchback Controls

### Parallel Switchback

If the EPC fails to maintain control of the rack, its Switchback Relay de-energizes allowing the normally closed contacts to complete the Time Delay Switchback Relay circuit. After a 24 second delay, the Switchback Relay opens the circuits to:

T3 on **all** the rack's compressor boards and closes the circuits to

T4 on **half** the boards, plus Time Delay Split Relay.

After another 24 second delay, the Split Relay closes the circuits to:

T4 on the remaining **half** of the boards.

With a compound rack the medium temperature side is brought on first, and the low temperature side by the Split Relay.



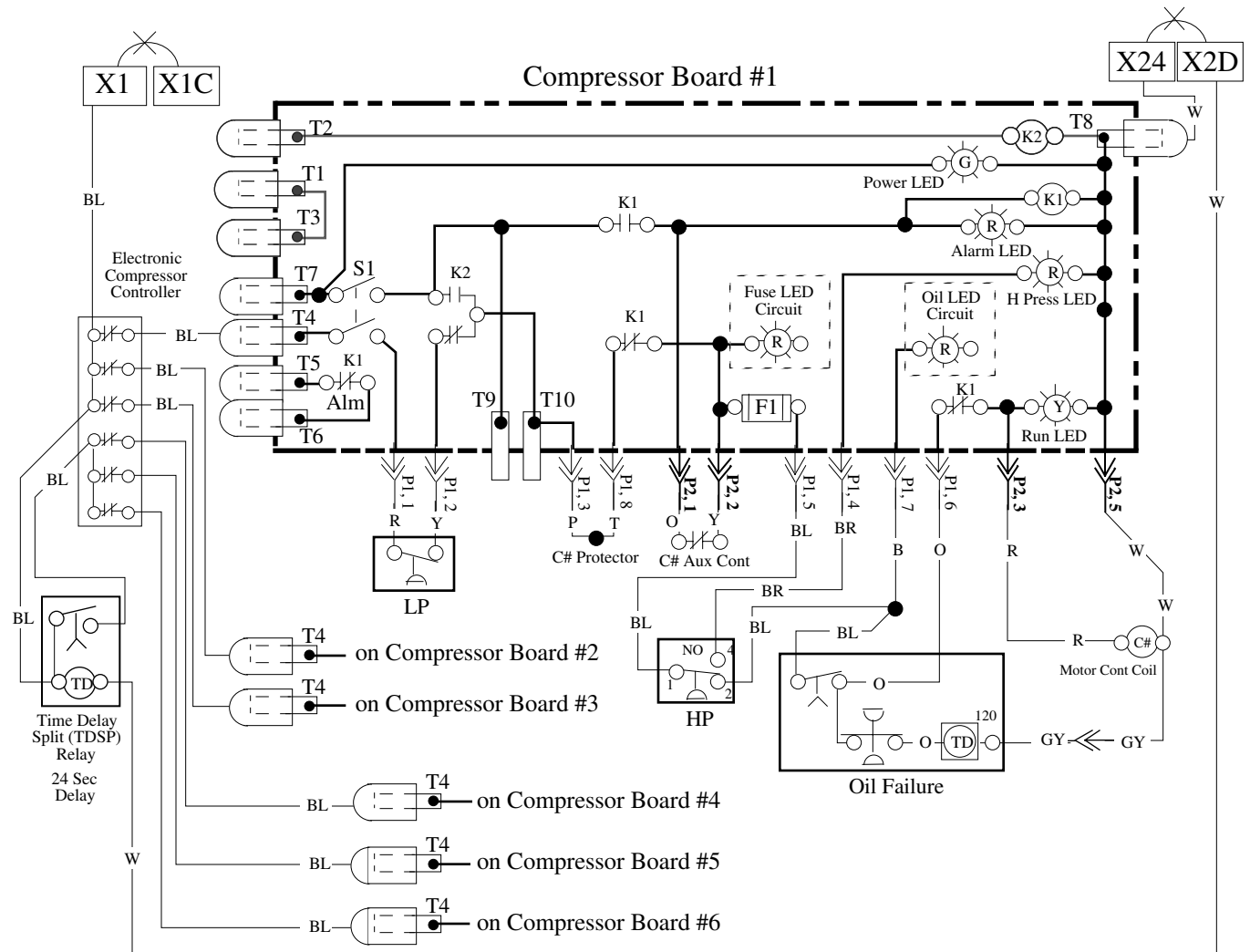
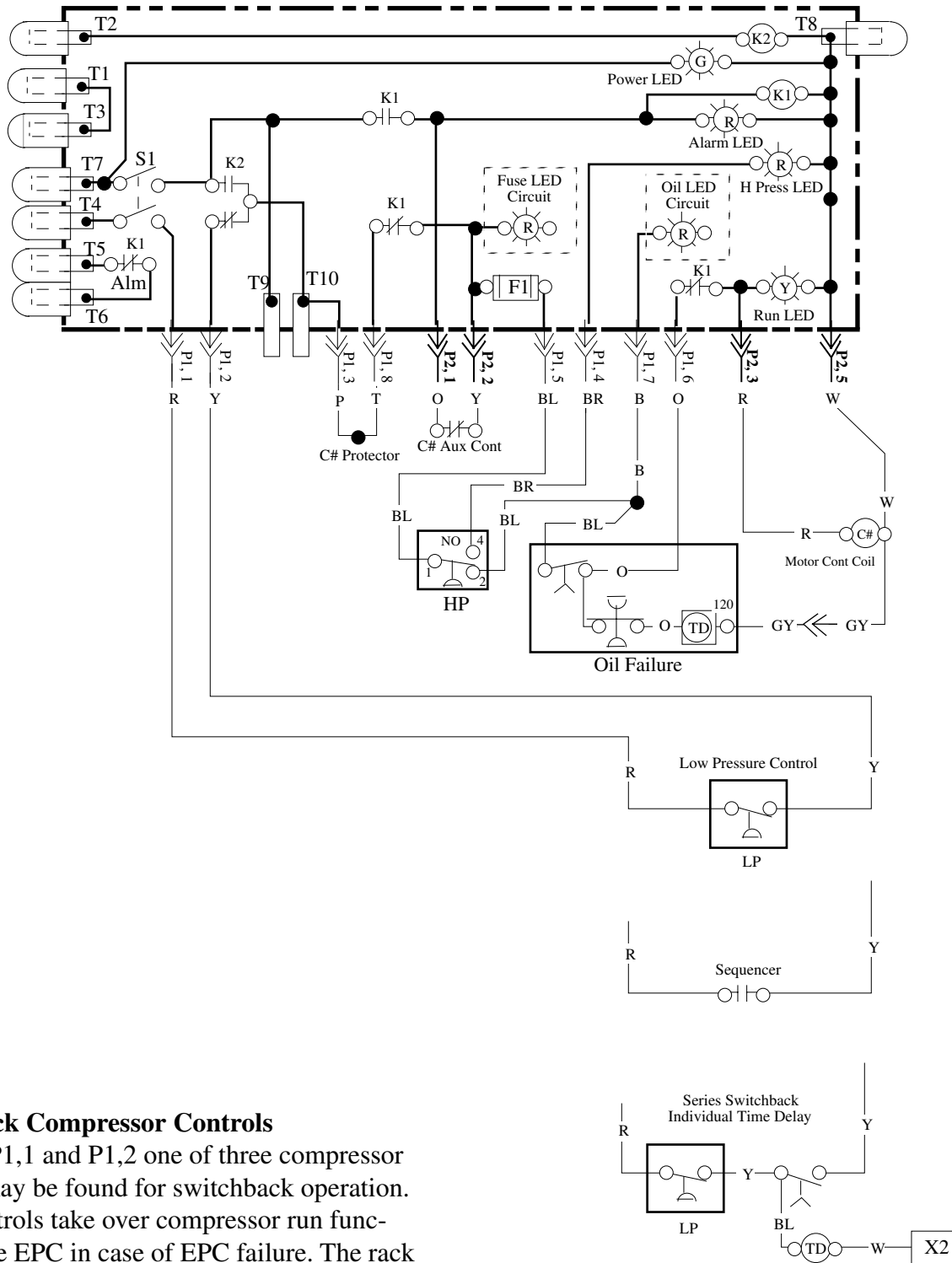


Figure 4-10 — Series Switchback Controls

### Series Switchback

If the electronic compressor controller fails, its normally closed contacts remain closed and compressor cycling falls to the control wired between P1,1 and P1,2.

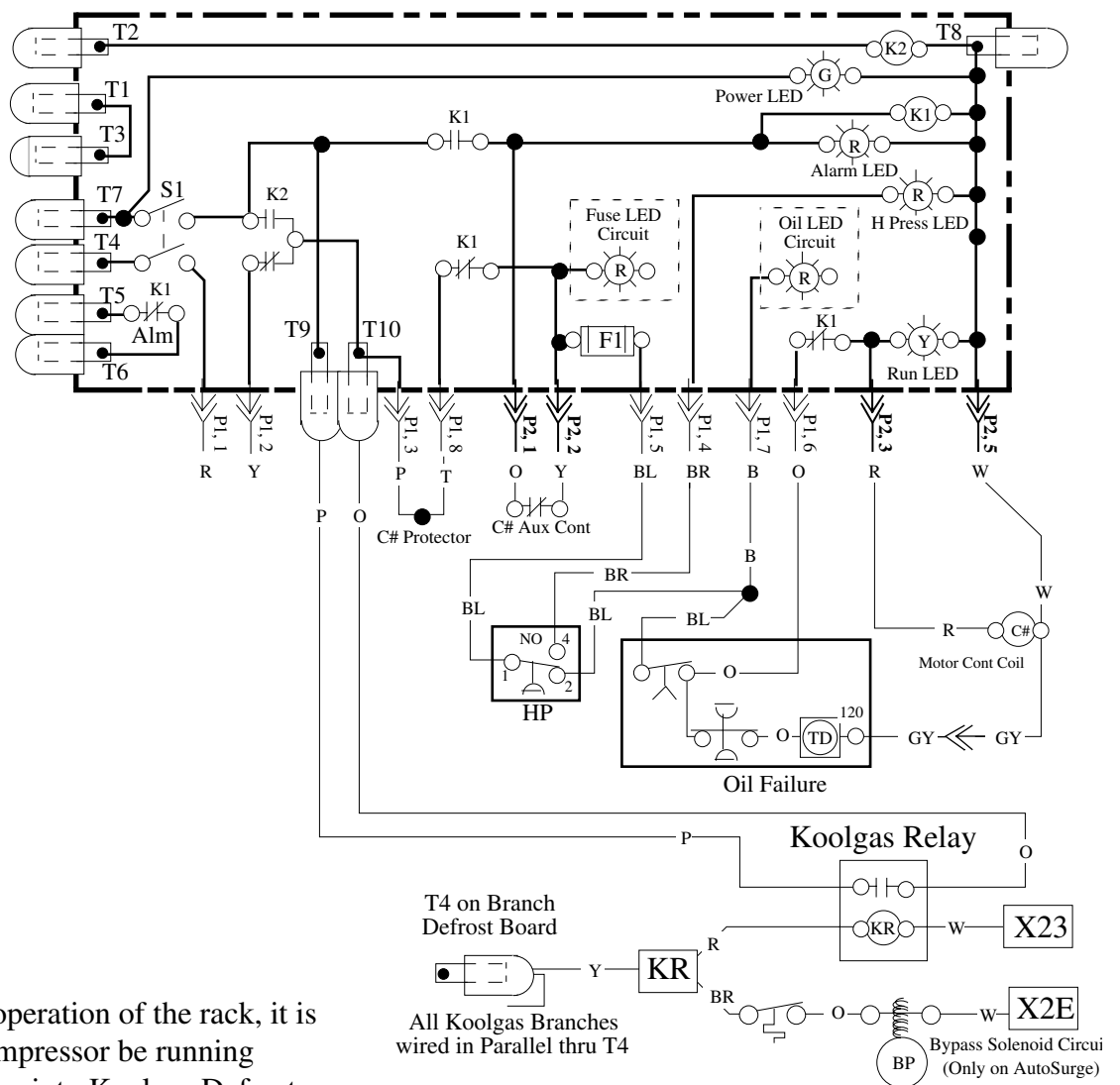
A Time Delay Split (TDSP) prevents all the compressors from coming on at once on start-up after the control panel has been off.



### Switchback Compressor Controls

Between P1,1 and P1,2 one of three compressor controls may be found for switchback operation. These controls take over compressor run functions of the EPC in case of EPC failure. The rack will continue to operate less efficiently, until the EPC is brought back on line.

Figure 4-11 — Switchback Controls



### Koolgas Relay

To assure proper operation of the rack, it is required that a compressor be running when a branch goes into Koolgas Defrost. The Koolgas Relay contacts are wired between T9 and T10 of the #1 Compressor Board only. When any Koolgas Branch Board calls for defrost, the Koolgas contacts close, forcing #1 Compressor run.

Figure 4-12 — Koolgas Relay

### Compressor Protection

Compressor protection is determined by the type of compressor used. These controls are wired between P1,3 and P1,8. Since the controls reset automatically, an open compressor protector will not cause an alarm situation.

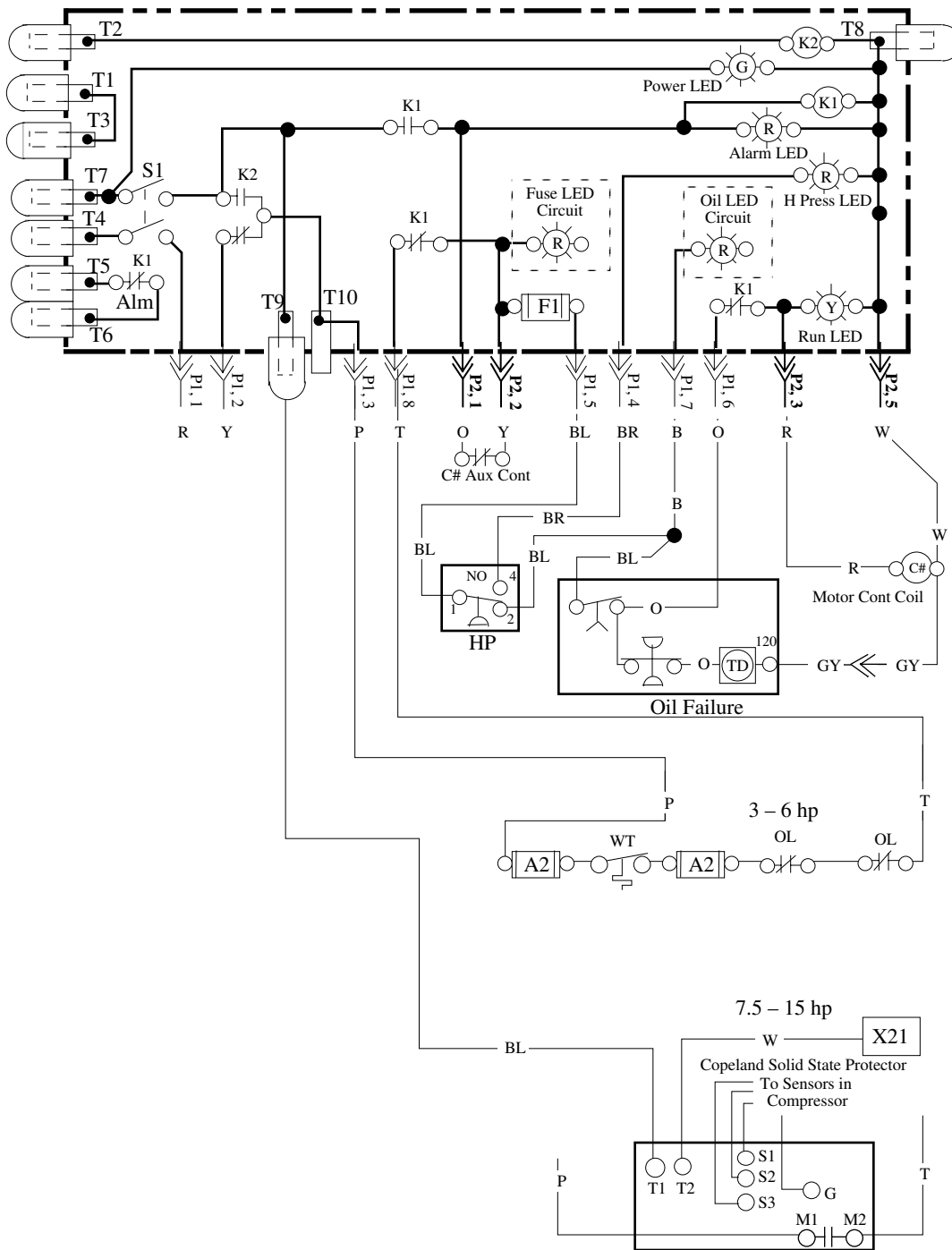


Figure 4-13 — Compressor Protection

### Crankcase Heater

The normally closed contacts of the Crankcase Heater Relay open when the Compressor Motor Contactor Coil is energized, so the heater is off while the compressor is running.

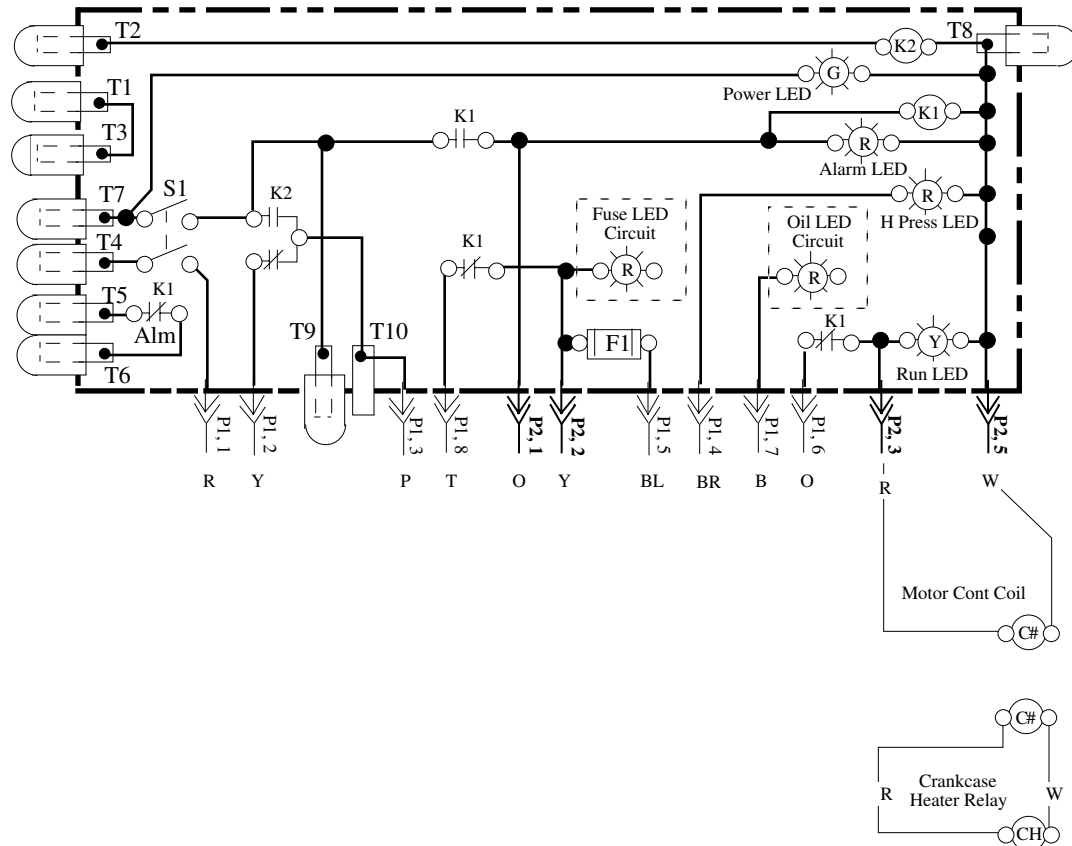


Figure 4-14 — Circuits Parallel to the Compressor Motor Contactor Coil

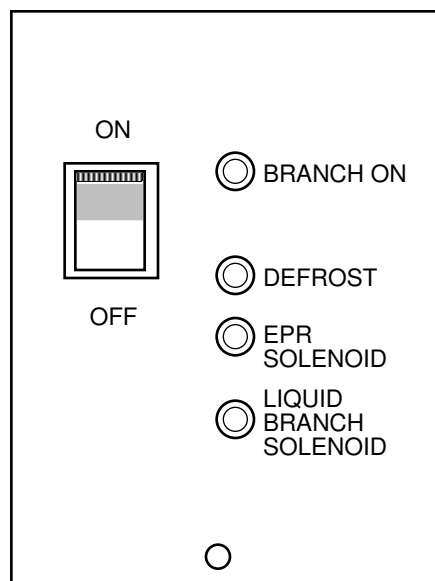


Figure 4-15 — Branch Board Faceplate

## DEFROST CIRCUIT BOARDS

**Defrost Control Circuit Switch** (“ON/OFF”) shuts off all power to the defrost branch circuit.

**Branch On** – Green LED – indicates that there is 120VAC to the system branch circuit. If the switch is off, the light will turn off.

**Defrost** – Yellow LED – indicates the system is in defrost. This light will turn off if the defrost has been terminated due to time or temperature, and if the branch is in drip cycle.

**EPR Solenoid** – Green LED – indicates the suction stop solenoid is energized, which means the valve is open.

**Liquid Branch Solenoid** – Green LED – indicates the liquid branch solenoid is energized. It will turn off when the thermostat no longer calls for refrigeration.

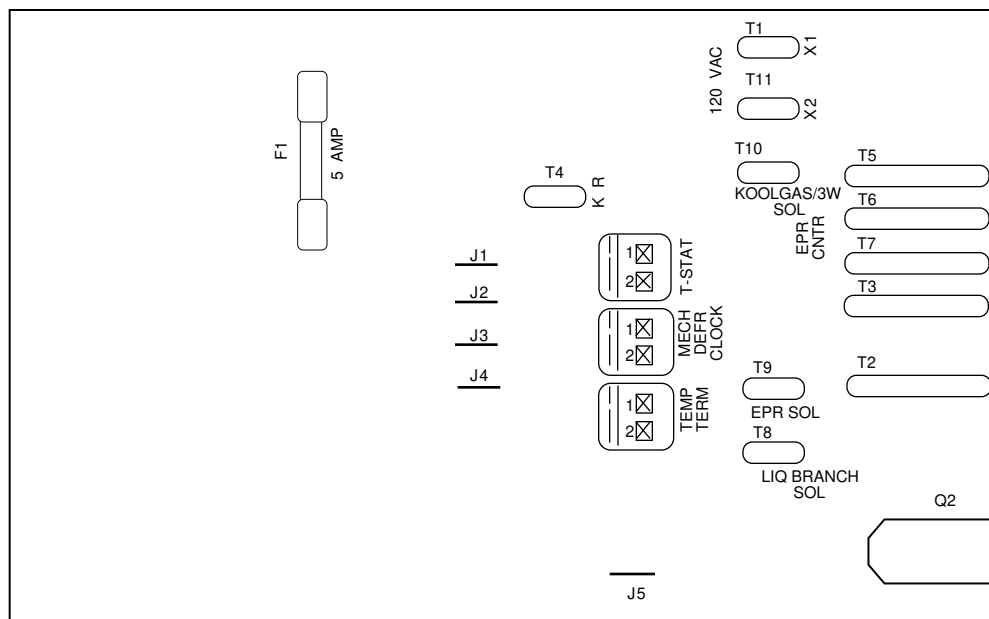


Figure 4-16 — Defrost Board Inputs and Outputs  
(View—removed from panel, faceplate held in left hand.)

**FUSE, 5A on circuit board** can only be replaced by removing board from panel. Remove the screw on the front and on the top of the faceplate.

**J1 through J5 Jumpers** should be clipped for the following conditions:

**J1** if thermostat controls EPR solenoid

**J2** for Koolgas defrost

**J3** and **J1** for Off-time/Electric defrost (Do not clip **J1** if suction stop EPR is used.)

**J4** if mechanical defrost time clock is used

**J5** if Fibertronic Defrost Clock 1000 is used

**T-STAT** is input for temperature control thermostat.

**TEMP TERM** is input from defrost termination thermostat – closes to end defrost.

**X1** and **X2** are 120VAC input to the board and defrost branch. X1 is Line and X2 is Neutral

**KR** is output to Koolgas Relay

**KG/3W SOL** is output to the Koolgas or 3-Way Valve Solenoid, depending on which is applied.

**EPR CNTR** is input from case thermostat when controlling the suction stop solenoid for temperature. J1 must be cut.

**EPR SOL** is output to the suction stop solenoid valve.

**LIQ BRANCH SOL** is output to the liquid branch solenoid valve.

**Q2** is fiber optic input from Fibertronic Defrost Clock 1000.

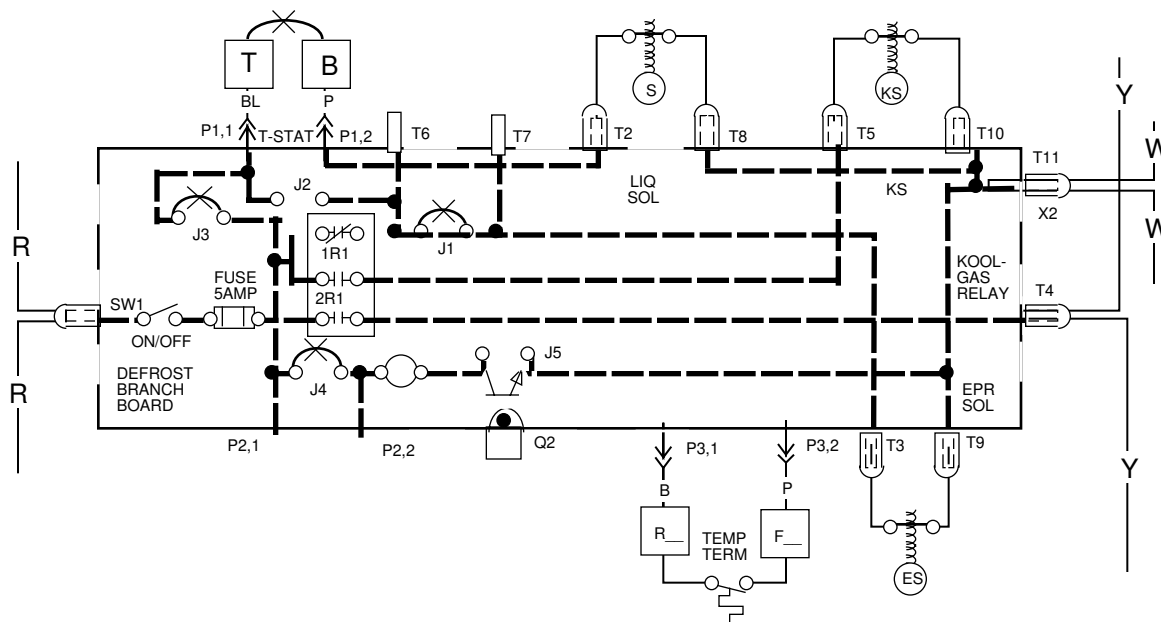
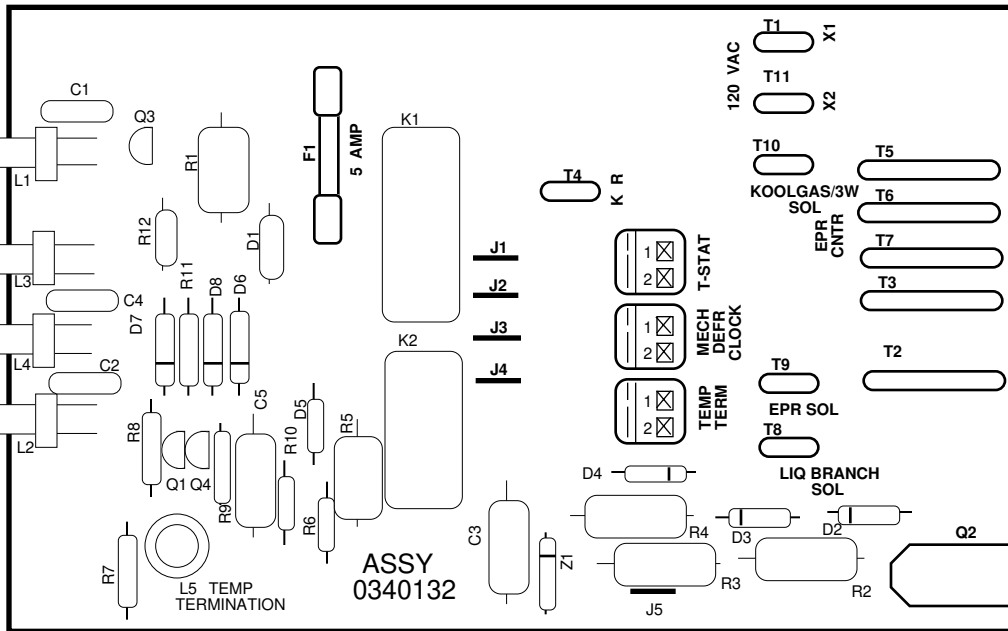


Figure 4-17 — Defrost Board – Electronic Timer



**Table 4-4 — Troubleshooting—Defrost Board with Mechanical Time Clock**

Be sure Board Switch is closed.

Refrigeration Mode				
Voltmeter Lead Placement Lead 1      Lead 2			Voltmeter Reading	Action
<b>1</b>	T1 (X1)	T11 (X2)	120	Go to <b>2</b>
			0	Check Power Supply to Board
<b>2</b>	P2,1	T11 (X2)	120	Go to <b>3</b>
			0	Check Fuse F1 (5 Amp) – If OK, Board Failure
<b>3</b>	P2,2	T11 (X2)	0	End Test
			120	Defrost timer contacts closed – Correct and reset system

Defrost Mode				
Voltmeter Lead Placement Lead 1      Lead 2			Voltmeter Reading	Action
<b>1</b>	T1 (X1)	T11 (X2)	120	Go to <b>2</b>
			0	Check Power Supply to Board
<b>2</b>	P2,1	T11 (X2)	120	Go to <b>3</b>
			0	Check Fuse F1 (5 Amp) – If OK, Board Failure
<b>3</b>	P2,2	T11 (X2)	120	Go to <b>4</b>
			0	Defrost timer circuit open – Check and correct
<b>4</b>	T4	T11 (X2)	120	Go to <b>5</b>
			0	Board Failure
<b>5</b>	T5	T11 (X2)	120	End Test
			0	Board Failure

For each remote component, determine its board terminals from the wiring diagram, then use standard test procedures.

## DEFROST CONTROL CIRCUITS

The different defrost systems shown on the wiring diagrams all work from the same basic circuit. The variations come from tailoring the systems to the customers' needs by selection of components used to accomplish defrost.

The basic circuit is controlled by a defrost clock which closes the circuit, energizing relay coil R1. R1 controls **one** contact 1R1 (normally closed) and **two** contacts 2R1 (normally open). NC 1R1 controls refrigeration components. NO 2R1's control defrost components. As the system requirements vary so will the components controlled by the contacts.

Once begun, defrost continues until the defrost termination thermostat or defrost clock opens the defrost circuit de-energizing relay coil R1.

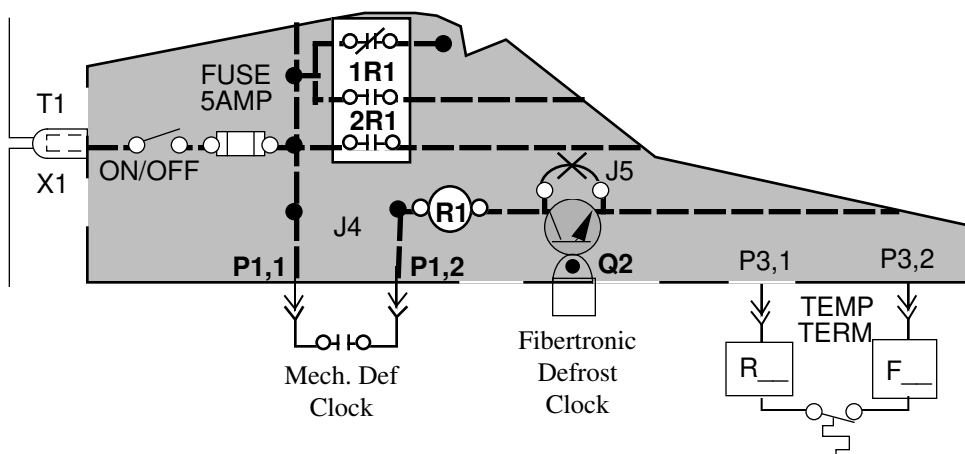


Figure 4-18 — Defrost Control Circuit

## Suction Stop Koolgas Defrost

When the defrost clock energizes Defrost Relay Coil R1

Contact 1R1 will turn “OFF” the EPR Solenoid (ES)

Contacts 2R1 will turn “ON” the Koolgas Solenoid (KS)  
and Koolgas Relay (KR)

power to T4

thru Yellow wire to KR terminal

thru Red wire to Koolgas Relay (KR)

and thru Brown wire to Bypass Circuit.

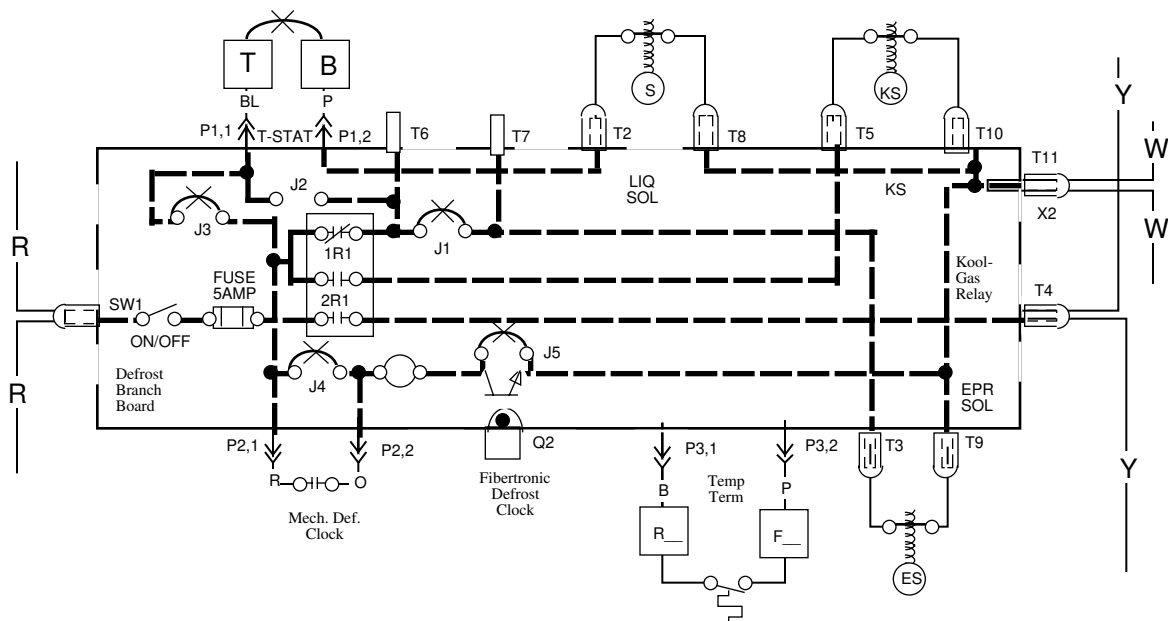


Figure 4-19 — Suction Stop Koolgas Defrost

## Electric Defrost

When the defrost clock energizes Defrost Relay Coil R1

Contact 1R1 will turn “OFF” the Liquid Line Solenoid

Contact 2R1 will turn “ON” Branch Defrost Contactor in the Electric Defrost Panel  
power to T4  
thru Orange wire to D\_\_ terminal  
thru field wiring to corresponding D\_\_ terminal in Electric Defrost Panel.

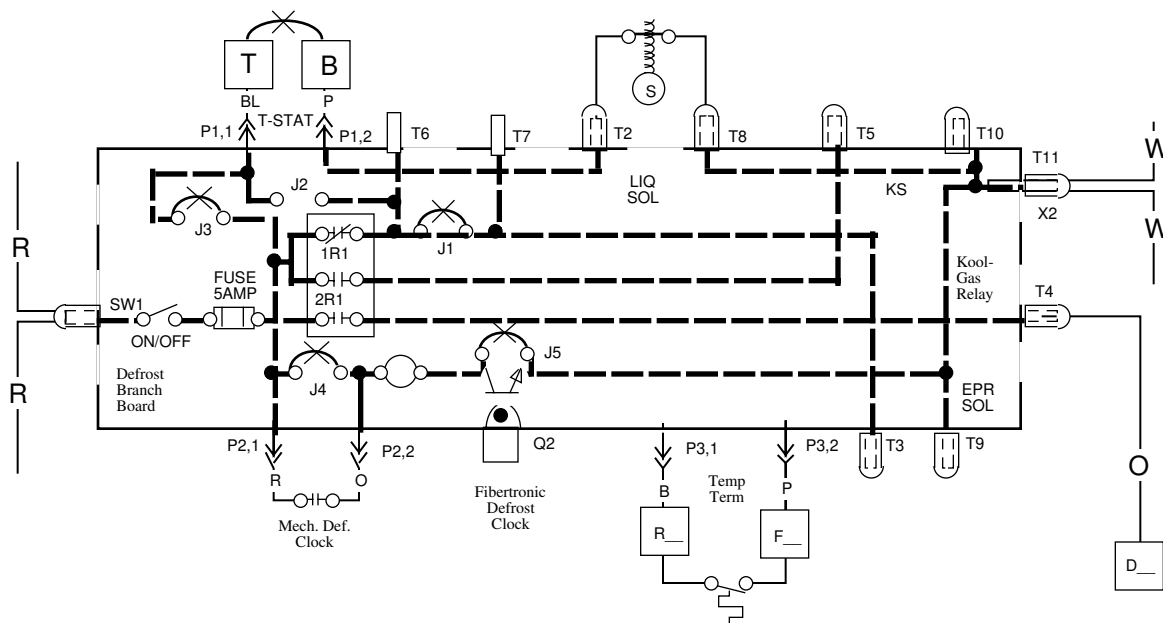


Figure 4-20 — Electric Defrost

## Off Cycle Defrost

When defrost clock energizes Defrost Relay Coil R1

Contact 1R1 will turn “OFF” Liquid Line Solenoid Valve (S).

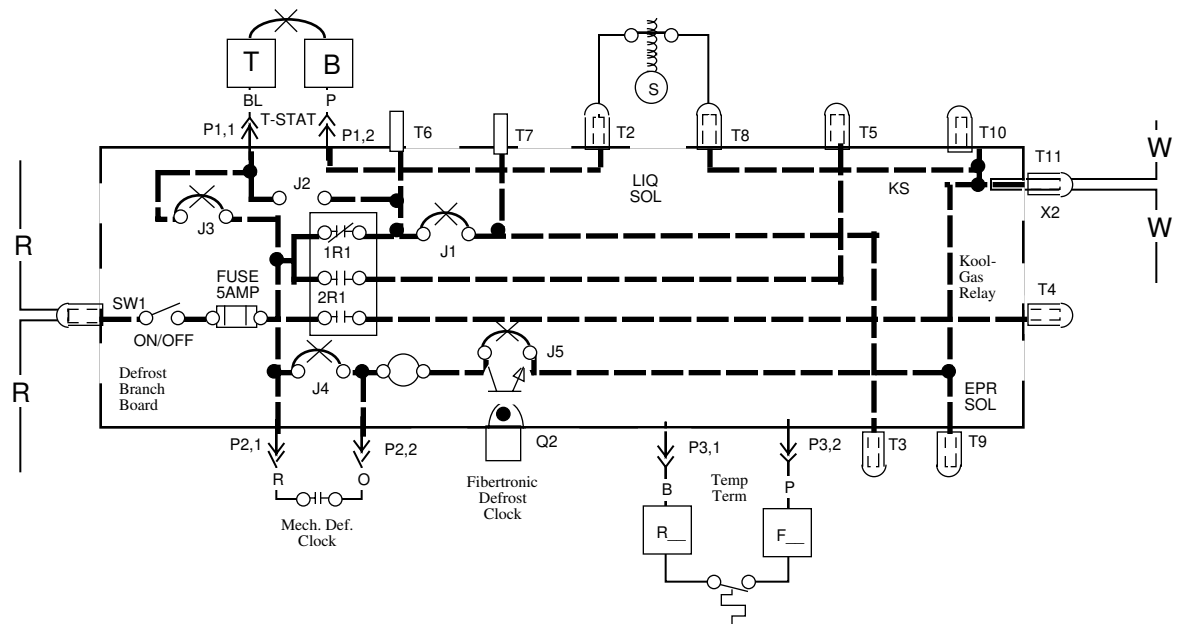


Figure 4-21 — Off Cycle Defrost

## OTHER CONTROLS

Each control panel is wired with independent compressor control circuits so any compressor can be electrically isolated without causing the other compressors to be shut down.

### Time Delays

Automatic time delays on the Scroll Plus™ System help avoid electrical overload or component damage. Awareness of time delays will reduce confusion in starting and troubleshooting the system.

Hussmann's EPC-2000 provides both anti-short cycle and stagger-start delays. During switchback operation when the EPC-2000 is not controlling the system, sensible delays, safeties and controls can maintain less efficient operation. These backup systems are tailored to individual customers. Check the store legend for component listing

### Alarm Delays

Alarm delays are used where trip points are passed in normal operation, yet system damage would result if cause continued beyond the timed delay.

Compressor oil pressure failure

Copeland—120 seconds  $\pm$  15 seconds

Carlyle—60 seconds  $\pm$  15 seconds

Low liquid level—30 minutes

High suction level pressure—30 minutes

(for EPC-2000 not needed or recommended)

Faulty defrost timer motor—30 minutes

(not available with Paragon timer)

### Copeland Solid-state Delay

Copeland compressors equipped with an internal solid-state protector cycle 120 seconds after power break.

### Thermostats

EVAPORATOR MOUNTED LIQUID LINE SOLENOID

Wire the thermostat in series with the liquid line solenoid. Any 120V uninterrupted power supply may be used.

### HEADER MOUNTED LIQUID LINE SOLENOID

Wire the thermostat in the following manner. Determine the system number from the store legend. In the control panel the system number matches the suffix of the appropriate "T" and "B" terminals.

Remove the jumper between T\_ and B\_ terminals.

Connect one thermostat wire to the T\_ terminal.

Connect the other wire to the B\_ terminal.

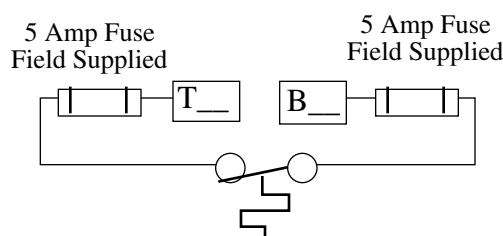
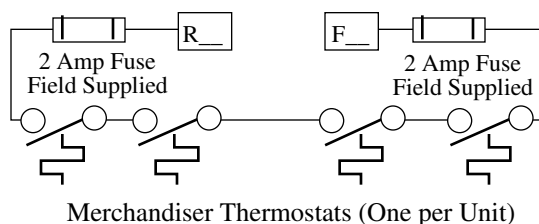


Figure 4-22 — Refrigeration Thermostat w/ Header Mounted Solenoid

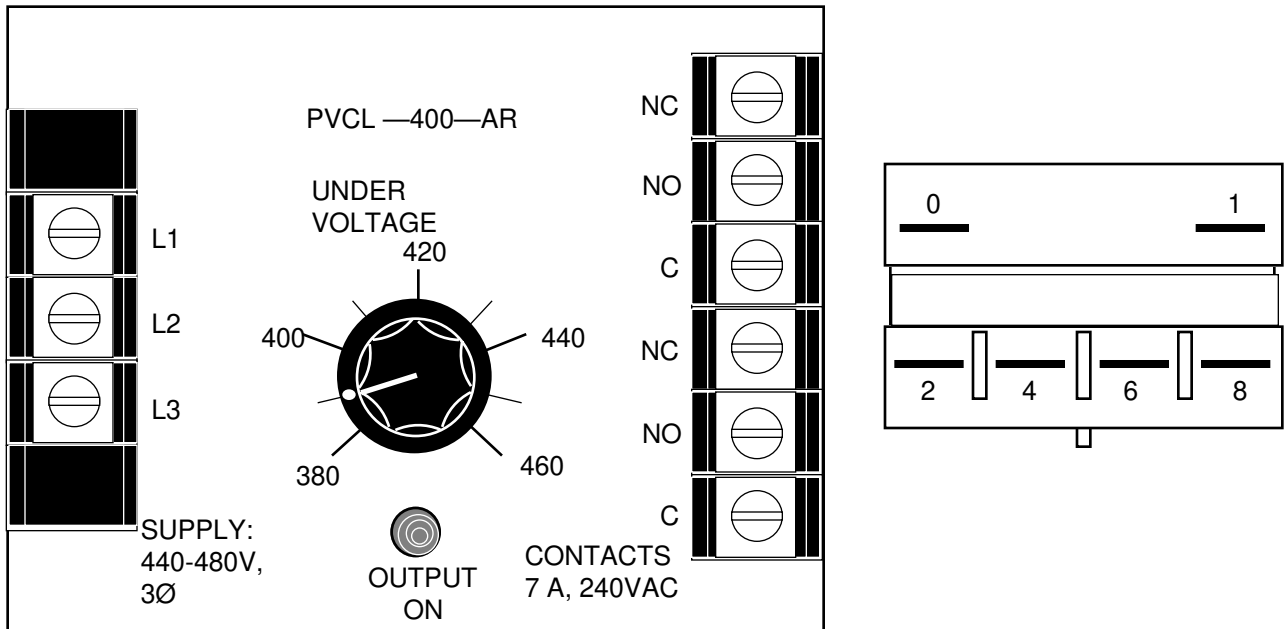
### Defrost Termination Thermostats

For each system using defrost termination thermostats, run one 2-wire control circuit placing all termination thermostats in series and connected between the R\_ and F\_ terminals in the control panel with the suffix corresponding to the system number. Check the store legend for system number.



Merchandise Thermostats (One per Unit)

Figure 4-23 — Wiring Defrost Termination Thermostats



Single Phase Monitor

Figure 4-24 — Power Monitor and Slave Contactor

## POWER MONITOR

The single phase monitor detects phase loss, phase reversal, low voltage, and phase imbalance. It opens the control circuit when any of these conditions occurs. When the fault is corrected, it will automatically reset. The normally open contacts will close when 3 Phase voltage is applied to the three input terminals. The monitor has an indicator that lights as long as it is **not** tripped.

The low voltage cutout is adjustable from 180 to 230 volts for 208/230 volt units, and from 380 to 460 volts for 440 volt units. This should be adjusted to 15% below the nominal line voltage at power source. A voltmeter should be used to establish actual supply voltage.

The monitor controls a two pole bypass relay (BP) making and breaking power to the control panel.

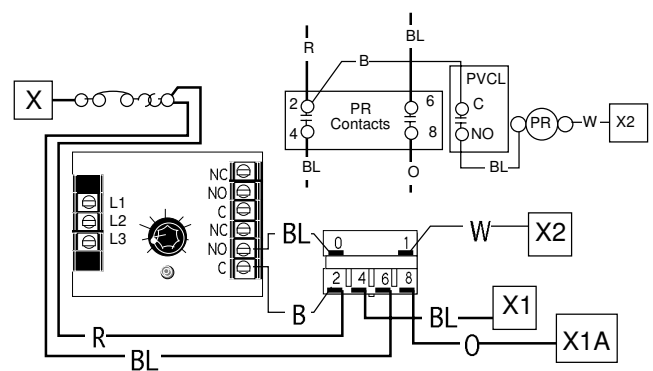


Figure 4-25 — Electrical Hook-Up

## REMOTE SATELLITES AND CONDENSERS

### OVERVIEW

This section deals with standard guidelines for installation of Remote Satellites and Remote Air Cooled Condensers. Piping is covered in "Piping." Refer to specific manufacturer's instructions for installation. Proper installation is the installer's responsibility.

### REMOTE SATELLITES

#### Remote Satellite Components

Each Remote Satellite contains the following:

1. One Copeland scroll compressor with:
  - a. High and Low Pressure Controls,
  - b. Traxoil, and
  - c. Primary Overload Protection.
2. Factory piping with:
  - a. Suction and Discharge Stubs, and
  - b. Suction Filter
3. Factory-wired control panel with:
  - a. Compressor Integral Circuit Breaker Contactors, and
  - b. Compressor Time Delay.

#### Shipping Damage

All equipment should be thoroughly examined for shipping damage before and while unloading. This equipment has been carefully inspected at our factory and the carrier has assumed responsibility for safe arrival. If damaged, either apparent or concealed, claim must be made to the carrier.

#### *Apparent Loss or Damage*

If there is an obvious loss or damage, it must be noted on the freight bill or express receipt and signed by the carrier's agent, otherwise, carrier may refuse claim. The carrier will supply the necessary claim forms.

#### *Concealed Loss or Damage*

When loss or damage is not apparent until after equipment is uncrated, a claim for concealed damage is made. Upon discovering damage, make request in writing to carrier for inspection within 15 days and retain all packing. The carrier will supply inspection report and required claim forms.

**NOTE:** The compressor is pulled down on shipping blocks. Before piping, loosen mounting spring by turning spring nuts one full turn counterclockwise. Shipping blocks can then be removed, and spring tension is correct.



### Lifting and Leveling

Single-tier Satellites require three straps, front and two sides supported. Two-tier Satellites are provided with lifting eyes. Use a spreader bar and observe minimum rigging angle of 45°.

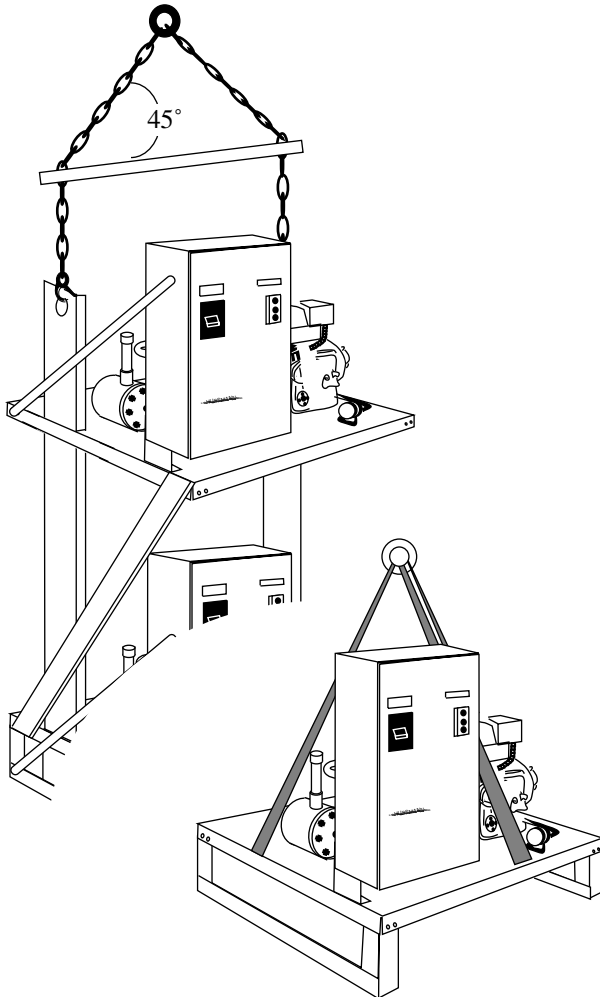


Figure 5-1 — Satellite Rigging and Lifting

### Remote Satellite Dimensions

Satellite	Length (in.)	Height (in.)	Depth (in.)
Single-tier	38	40	29.5
Two-tier	38	85	29.5

### Remote Satellite Weights

Shipping Weight =  
the Sum of Compressor Weights  
+ 115 pounds.

## REMOTE CONDENSERS

### General Description

The Scroll Plus Fibertronic system is available for use with three types of condensers: remote air cooled, water cooled, and evaporative water cooled. Refer to specific manufacturer's instructions for the installation of these components. See the store legend for manufacturer and model number.

#### *Remote Air Cooled Condensers*

When air cooled condensers are used, generally there will be individual condensers for each rack. Split condenser valving is an option to reduce the refrigerant charge. During certain conditions, the valving will automatically valve off one-half of the condenser to minimize the refrigerant charge. The valving may be field or factory installed.

#### *Water Cooled Condensers*

When water cooled condensers are used, they generally will be shell and tube construction. The water cooled condensers may be factory or field installed.

#### *Evaporative Water Coolers for Condensers*

Evaporative water cooled condensers are shipped directly to the job site by the manufacturer.

### Air Cooled Application

Split condenser valving is recommended if any of the following conditions exist:

1. The difference between summer and winter dry bulb temperatures is greater than 90°F.
2. The local climate conditions are anticipated to be more severe than those stated in the ASHRAE charts.
3. The heat reclaim coil is sized for more than 50% of the heat of rejection for the unit.
4. The condenser liquid return line is longer than 100 feet.
5. The system is equipped for low head pressure operation that seeks to obtain a maximum of subcooling.

### Shutoff Valves

These valves are field supplied and should be installed in such a manner as to isolate the entire condenser.

### Maximum Allowable Distances

Remote Satellites should not be placed below the level of the Scroll Plus Rack. The Satellite may be positioned above the Rack. The maximum allowable elevation is 6 feet from the bottom of the Satellite to the bottom of the Rack.

When piping from the Rack to a Remote Satellite, the maximum allowable piping equivalent is 50 feet.

When piping from the Rack to a Remote Header, the maximum allowable piping equivalent is 50 feet.

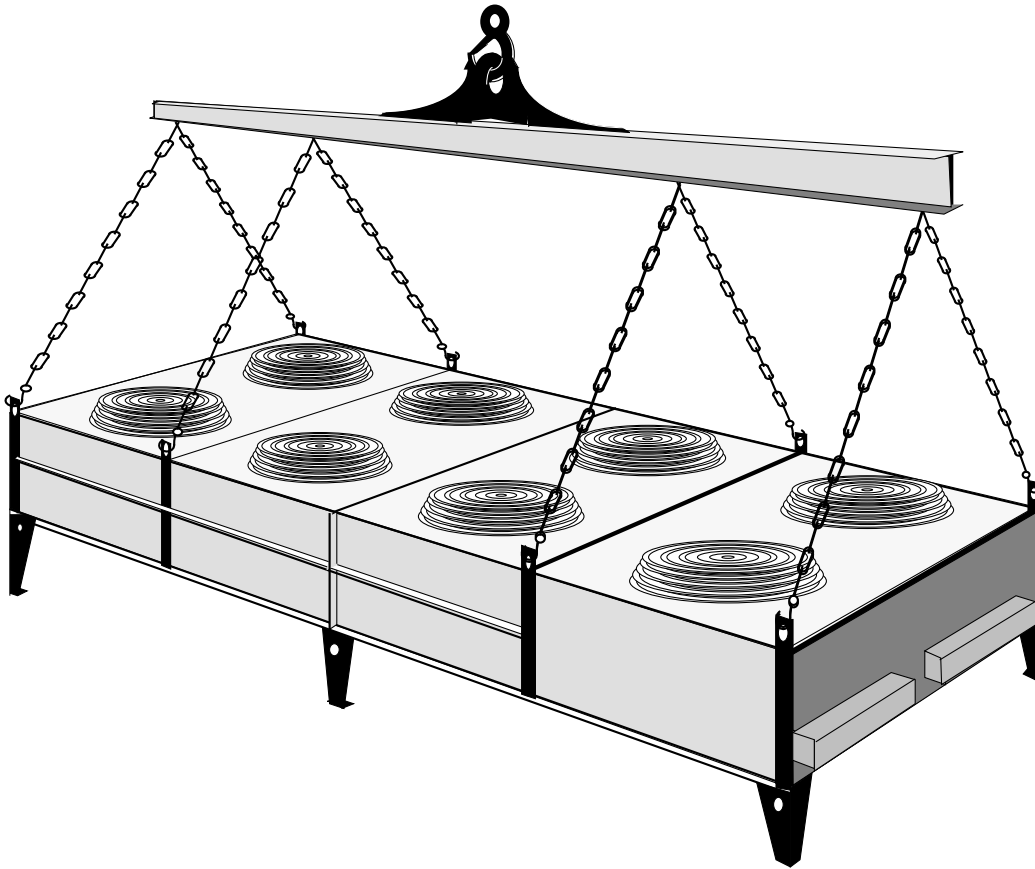


Figure 5-2 — Lifting the Condenser

### Lifting and Leg Assembly

Under no circumstances should the condenser manifolds, piping return bends or control panel be used for lifting or moving the unit. Lifting channels are provided at each corner of the condenser. Condensers with three or more fans will have additional intermediate lifting channels. Use these locations only for attaching cables during leg assembly.

Unmounted legs and lifting channels are furnished with necessary bolts, washers and nuts. Mount legs and channels with the hardware provided.

### Location

Locate the condenser with at least six feet of clearance on all sides to provide adequate air circulation. If roof mounted, place on column supported beams or load-bearing walls.

The mounting surface for the condenser should be at least six feet higher than the flooding valve.

### Leveling and Mounting

Cross level the coil section carefully, then bolt the condenser legs to the support beams.

For multi-circuit condensers, consult the store legend and refer to the identification tags on the manifold end of the condenser to determine compressor unit and manifold connections.

Route and support all piping in a manner that relieves stress caused by vibration, thermal expansion, and gradual base or building movement. Where piping is routed through a roof, construct a pitch box.

#### *Connecting to One Manifold*

Route the discharge line directly to its respective condenser inlet stub and install a purge valve at the highest point in the line. Route the liquid return line in a manner providing free trapless drainage from the condenser to the connection at the compressor unit. Horizontal piping runs must be pitched in direction of flow.

#### *Connecting to Two Manifolds*

When a compressor unit is served by two sets of condenser circuits, an expansion loop must be constructed between the manifolds.

Note: a connection is provided on the rack for  $\frac{7}{16}$  inch equalizer line. The use of an equalizing line is left to the discretion of the store engineer. It is recommended that the condenser manufacturer's installation instructions be consulted. When used, the equalizing line should have a field supplied check valve installed to prevent flow from the condenser to the receiver. A shutoff valve should be installed on the condenser side of the check valve. Normally, equalizer lines are not required unless the condensate lines are trapped and/or undersized.

1. Discharge line: Connect the two inlet stubs to the discharge line by forming an expansion loop extending at least 12 inches away from the manifolds. Do not route the discharge line directly in front of the control panel.

2. Liquid return line: Route each liquid return line downward at least 6 feet between outlet stubs before teeing into the main liquid return line. (Note: If split condenser valving is not used, drop may be reduced to 2 feet.) After the tee, route the main liquid return line in a manner providing free trapless drainage from the condenser to the connection at the compressor unit.

#### **Preliminary Electrical Check**

Before working on any electric equipment, disconnect all power supplies to it and verify that power is off.

After the condenser is connected to its power supply, check to see that the supply coming to the condenser disconnect is acceptable according to the serial plate. Be sure the disconnect is open and jumper the fan controls. Close disconnect and check the following:

- Volt drop and ampere draw
- Leg balance for volts and amperes
- Fan discharge from the top of the condenser (To reverse, change L1 and L3 at the motor.)
- (If equipped) Gravity dampers moving freely.

#### **Preliminary Control Setting**

Set controls according to the charts in "Control Settings" for start-up. These settings will need to be checked and adjusted once the system is running. The settings listed are general guidelines and may require some variation because of local conditions or store design.

**NOTE:** Before starting any compressors be sure the condenser serving that unit has power and that all isolation valves are open.

## Physical Data

Table 5-1 — Physical Data

Model		No. Fans	FLA 3PH			Weight /w Max. Flood (lbs)		Max Flood Charge (lbs)		Inlet/Outlet Connections OD
			208V	230V	460V	R22	R404A/ R507	R22	R404A/ R507	
ONE FAN  WIDE	HLCVB	1x1	2.8	2.6	1.3	205	221	19	35	1 1/8
		1x2	5.6	5.2	2.6	410	445	40	75	1 3/8*
		1x3	8.4	7.8	3.9	615	666	59	110	1 3/8
		1x4	11.2	10.4	5.2	925	1002	88	165	1 5/8
		1x5	14.0	13.0	6.5	1039	1125	99	185	2 1/8
		1x6	16.8	15.6	7.8	1239	1343	119	223	2 1/8
		1x7	19.6	18.2	9.1	1551	1679	147	275	2 5/8
	HLCVF	1x2	8.8	8.0	4.0	1081	1137	64	120	1 5/8
		1x3	13.2	12.0	6.0	1574	1658	96	180	2 1/8
		1x4	17.6	16.0	8.0	2240	2352	128	240	1 5/8
HLCVG	1x5	22.0	20.0	10.0	3020	3231	242	453	2 5/8	
	1x6	26.4	24.0	12.0	3555	3809	291	545	2 5/8	
TWO FANS  WIDE	HLCVI	2x2	11.2	10.4	5.2	820	897	88	165	1 3/8*
		2x3	16.8	15.6	7.8	1230	1334	119	223	1 3/8
		2x4	22.4	20.8	10.4	1850	2003	176	329	1 5/8
		2x5	28.0	26.0	13.0	2078	2263	212	397	2 1/8
		2x6	33.6	31.2	15.6	2420	2627	237	444	2 1/8
		2x7	39.2	36.4	18.2	3075	3332	295	552	2 5/8
	HLCVV	2x2	17.6	16.0	8.0	2001	2113	128	240	1 5/8
		2x3	26.4	24.0	12.0	2889	3055	191	357	2 1/8
		2x4	35.2	32.0	16.0	3733	3955	255	477	2 1/8
	HLCVW	2x5	44.0	40.0	20.0	5020	5433	474	887	2 5/8
2x6		52.8	48.0	24.0	6030	6527	570	1067	2 5/8	
*Inlet = 1 3/8, Outlet = 1 1/8										

\*Inlet = 1 3/8, Outlet = 1 1/8

The Flooding Charges listed in the table above reflect additional refrigerant required for split condenser method of winter control above normal summer operating charge and heat reclaim coil requirements.

**Note:** Condenser ambient should be noted when determining the flooding charge.

- If above 65°F, add the specified amounts of refrigerant when the system stabilizes after start-up.
- If below 65°F but above the coldest expected, some condenser flooding will already be occurring and required additional charge will be lower.
- If the coldest expected temperature is above 20°F, the flooding charge required will be less than 50% of each condenser circuit.

Figure 5-3 — Ambient Control of All Banks With Pressure Override of the First Fan Bank  
208/3/60    230/3/60    460/3/60

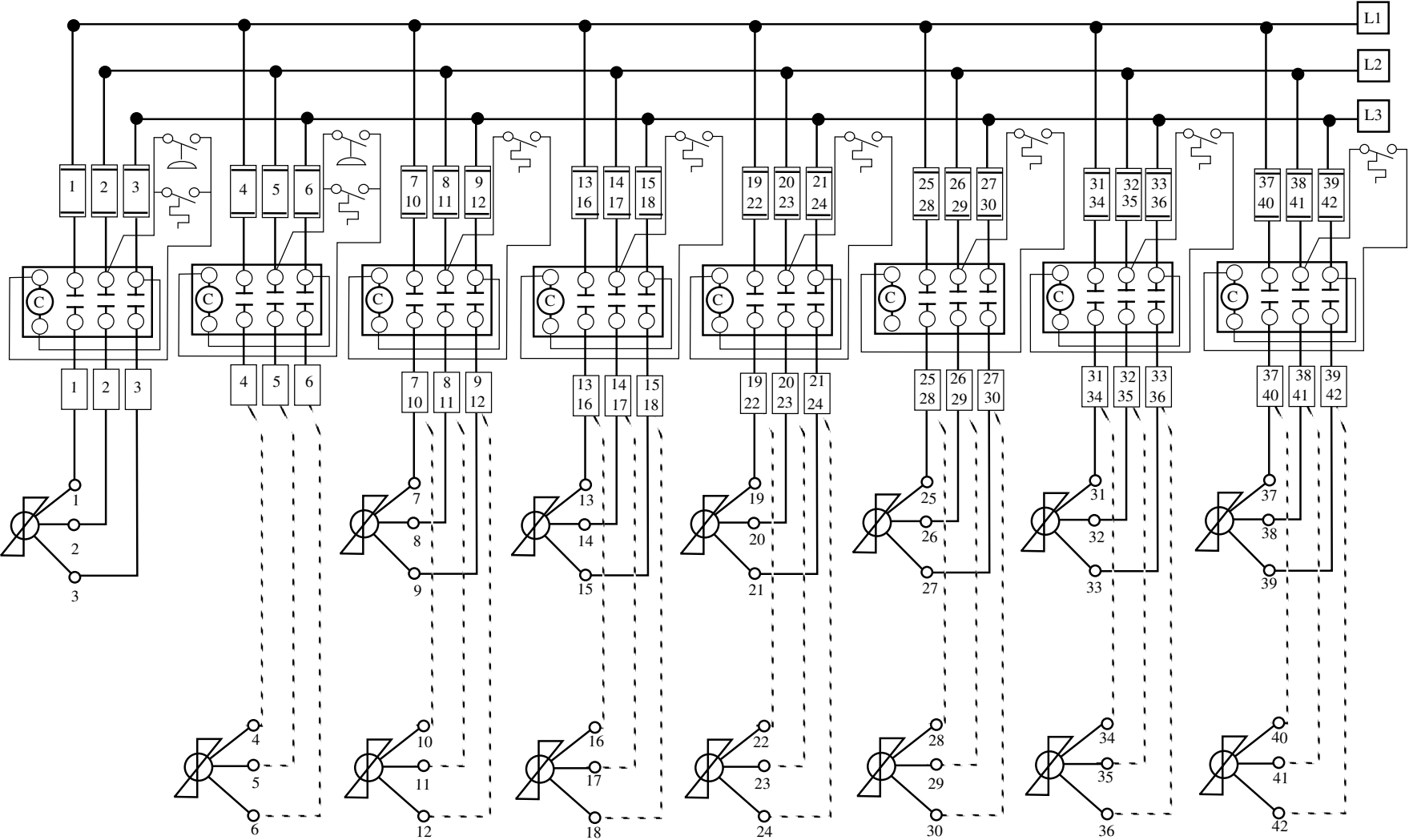
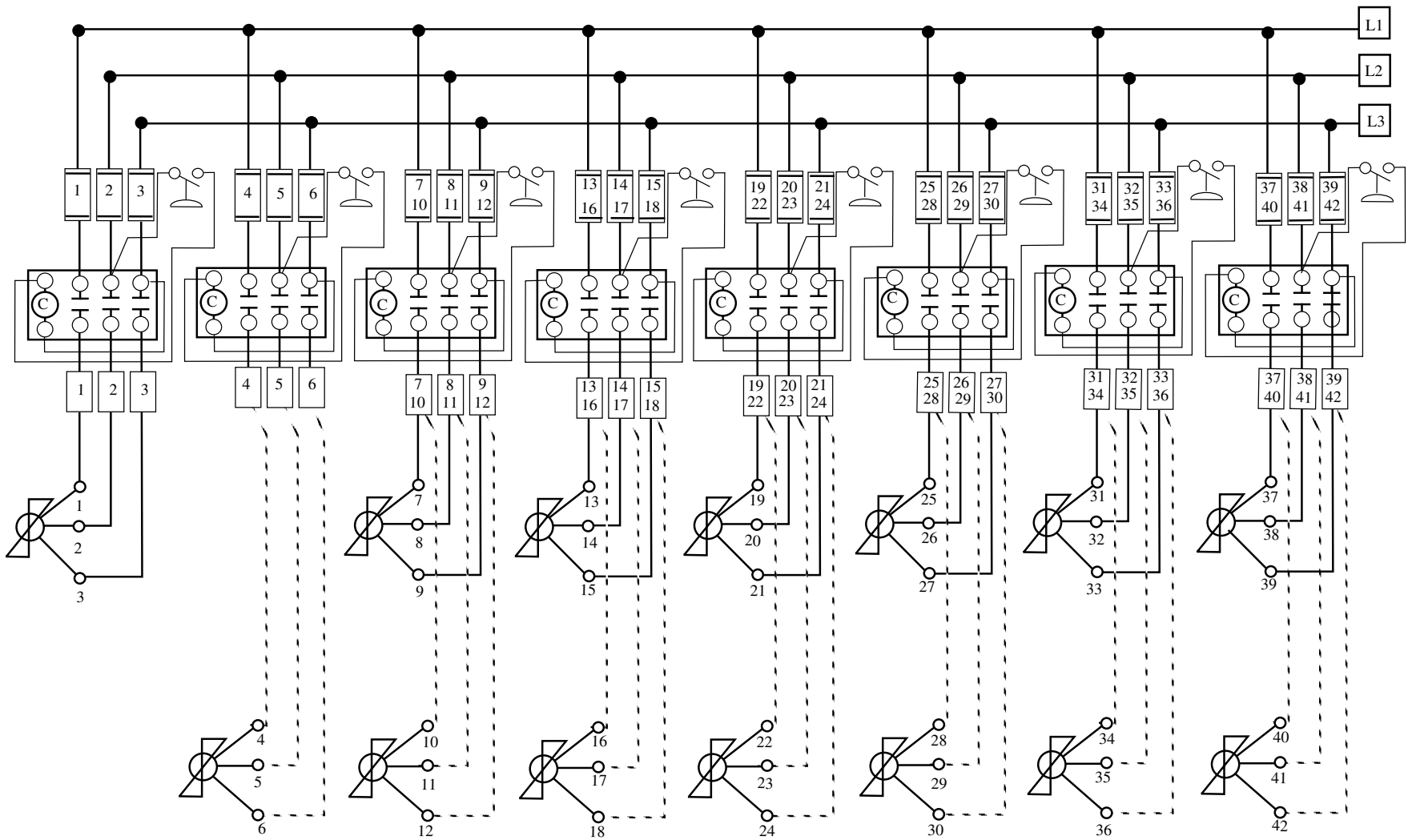


Figure 5-4 — Pressure Control and Gravity Dampers for all Fan Banks  
208/3/60 230/3/60 460/3/60



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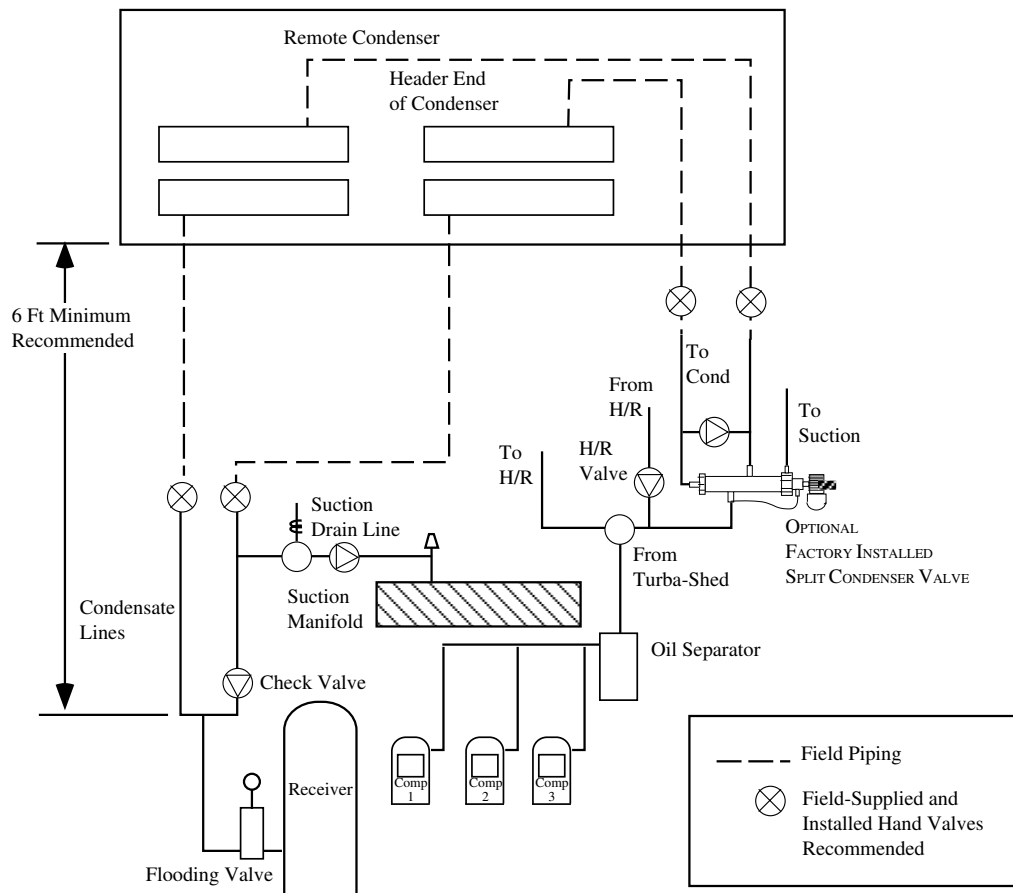
**SPLIT CONDENSERS**

Figure 5-5 — Split Condenser Piping Method

High Pressure Control Settings		
Refrigerant	Cut-Out	Cut In
R-404a	250	195
R22	210	160
R507	260	200

Note: Units with Heat Reclaim should have the lockout control set to prevent the heat reclaim from being activated below the following discharge pressure values:

R-22 — 135 psig  
 R-507 — 170 psig  
 R404a — 165 psig

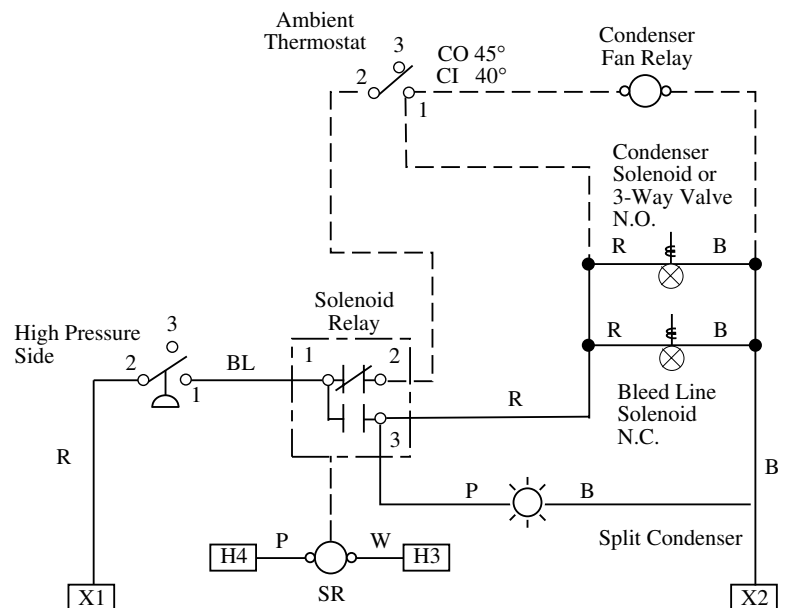


Figure 5-6 — Split Condenser Wiring Diagram – Factory and Field Installed Kits



## ELECTRICAL AND PRELIMINARY CHECK-OUT

The following electrical diagrams show the internal wiring. Consult motor serial plate for wire sizes.

After wiring is complete check condenser operation in the following manner prior to compressor start-up.

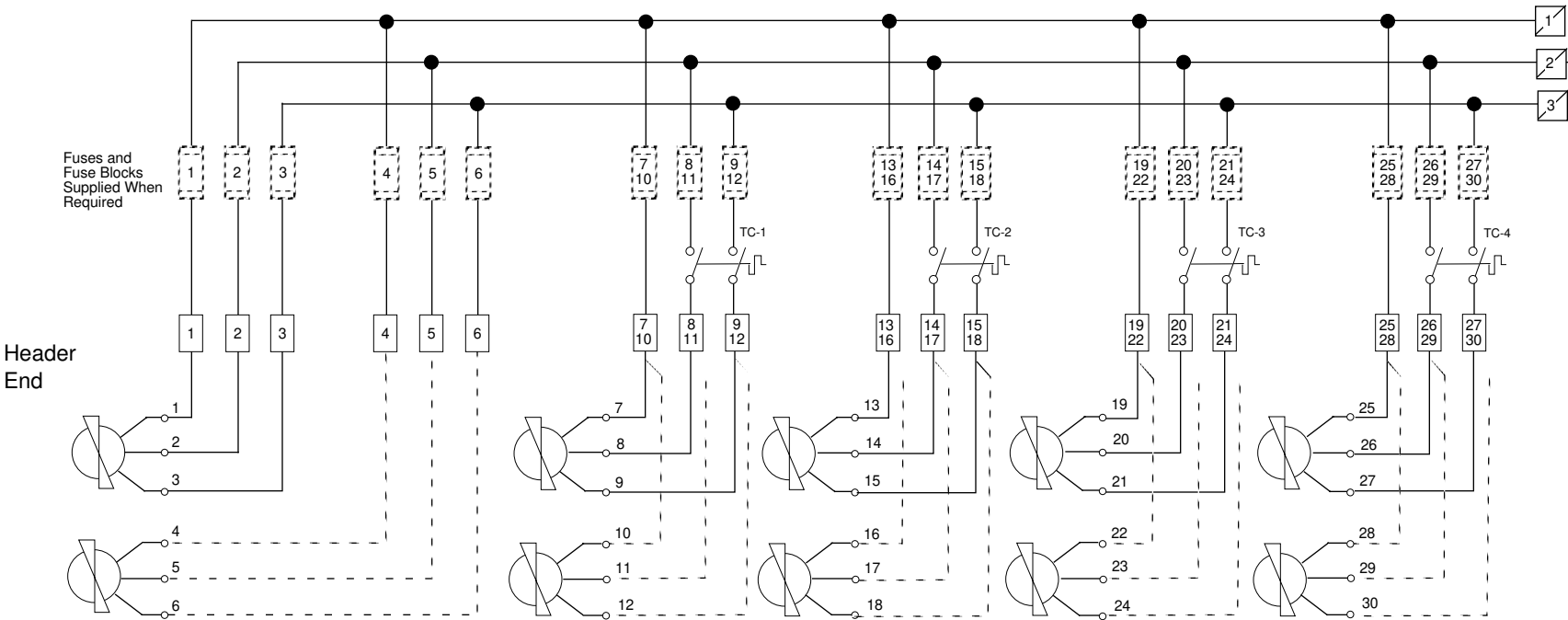
1. Be sure the disconnect at the condenser is open, then turn on power to the condenser at the store distribution panel. Bypass the fan cycling controls so all fans will operate.
2. Close the condenser disconnect and check the fans for proper operation. The fans should discharge air from the top of the condenser. Reverse the rotation of any fans blowing in the wrong direction. If the condenser is equipped with gravity dampers, check that they open and close freely. After fans check out, place the fan-cycling controls back into operation.

**Caution:** *Before entering any fan section, make sure power to the fan motors is disconnected.*

3. Check that the proper winter condensing pressure control has been applied as follows:
  - a. When more than one compressor unit is connected to the same condenser, all fan banks except the one nearest the discharge and liquid manifolds must be cycled by thermostats. each compressor unit must also be equipped with condenser flooding valves.
  - b. When only one compressor unit is connected to a condenser, either of two types of controls can be used: (1) thermostatic fan-cycling of all fan banks with a pressure-control override of the first cycling fan bank (requires flooding controls), or (2) Control B pressure controlled fan-cycling of all fan banks and gravity dampers for each fan (flooding controls may be required in severe winter climate).
4. Adjust controls to the settings specified on the wiring diagram. These are approximate settings and may be changed to suit local conditions.
5. Leave condenser disconnect closed and turn off power at the store distribution panel.

Evacuate, leak test, charge and start each system according to the start-up section.

Ambient Temperature Control of All Banks of Fans Except  
The One Nearest the Header for 2, 3, 4, or 5 Fan Bank Condenser



Replacement Parts

- Thermostat Control
- Motor (Inherently Protected)
- Terminal Block - Heavy Duty
- Terminal Block - Medium Duty
- Fuse Holder

Control Settings					
Number of Thermostats	Cut-In Settings for Thermostats – Deg F				
	TC-1	TC-2	TC-3	TC-4	TC-5
1	75	–	–	–	–
2	63	75	–	–	–
3	50	70	75	–	–
4	40	60	71	75	–
5	40	57	65	71	75

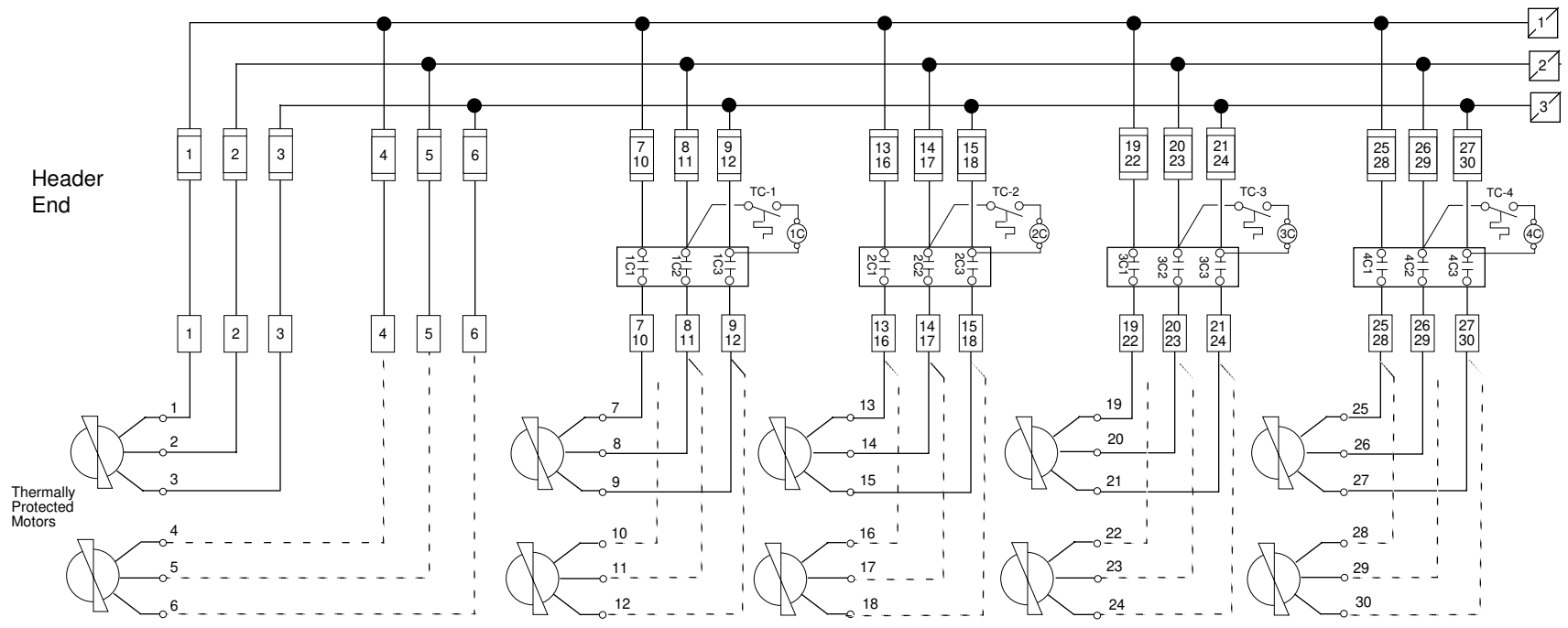
Set Cut-Out 5 Deg Below Cut-In

Individual Motor FLA			
HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0

Total FLA Number of Motors = Applicable Motor FLA

Figure 5-7 — Line Voltage Thermostatic Fan Control

Ambient Temperature Control of All Banks of Fans Except  
The One Nearest the Header for 2, 3, 4, or 5 Fan Bank Condenser



Replacement Parts

- Thermostat Control
- Motor (Inherently Protected)
- Terminal Block - Heavy Duty
- Terminal Block - Medium Duty
- Fuse Holder

Control Settings					
Number of Thermostats	Cut-In Settings for Thermostats - Deg F				
	TC-1	TC-2	TC-3	TC-4	TC-5
1	75	-	-	-	-
2	63	75	-	-	-
3	50	70	75	-	-
4	40	60	71	75	-
5	40	57	65	71	75

Set Cut-Out 5 Deg Below Cut-In

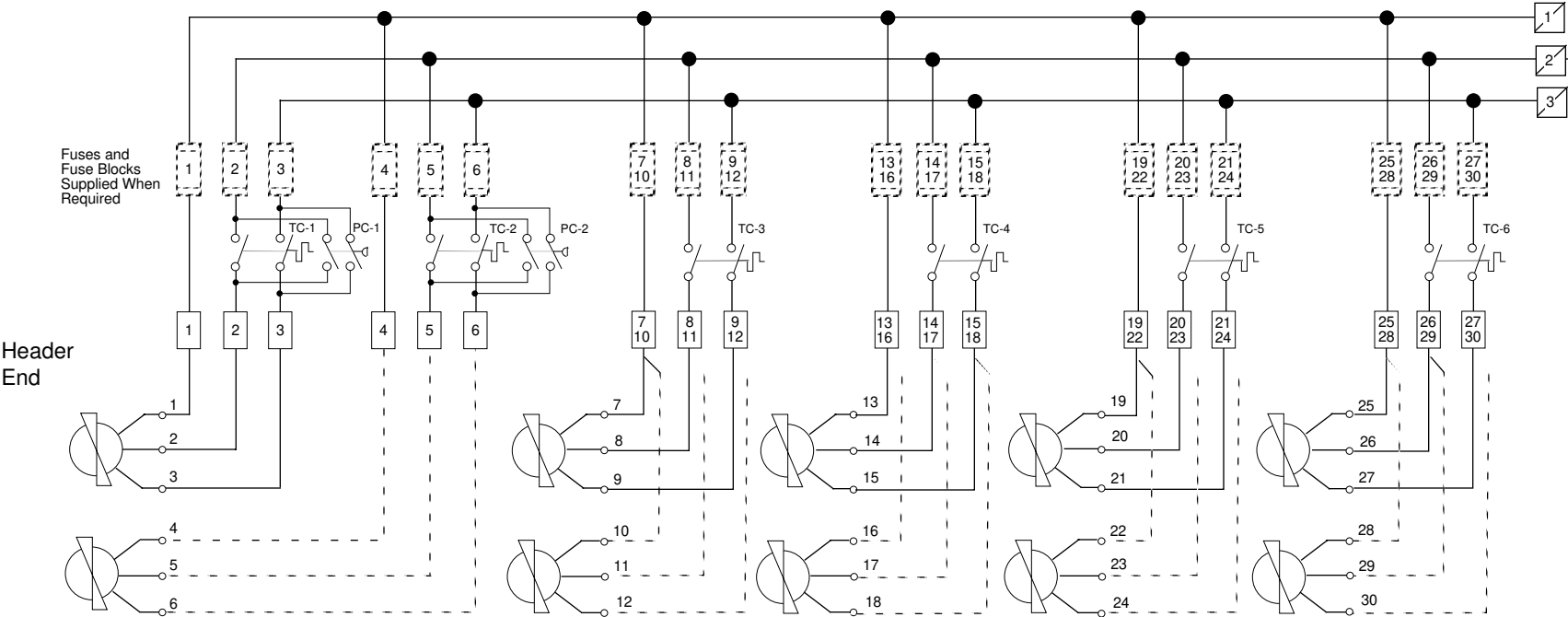
Individual Motor FLA			
HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0

Total FLA Number of Motors = Applicable Motor FLA

Figure 5-8 — Pilot Operated  
Thermostatic Fan Control

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Ambient Temperature Control of All Banks of Fans With  
Pressure Override of the First Cycling Fan Bank for 2, 3, 4, or 5 Fan Bank Condenser



Replacement Parts

- Thermostat Control
- Pressure Control
- Motor (Inherently Protected)
- Terminal Block - Heavy Duty
- Terminal Block - Medium Duty
- Fuse Holder

Control Settings								
Number of Thermostats	Cut-In Settings for Thermostats – Deg F					PC-1 Settings – psig		
	TC-1	TC-2	TC-3	TC-4	TC-5	Refrig	Cut-In	Cut-Out
2	80	75	–	–	–	R-404A	229	203
3	80	75	55	–	–	R-22	193	168
4	80	75	65	50	–	R-507	236	210
5	80	75	70	55	40			

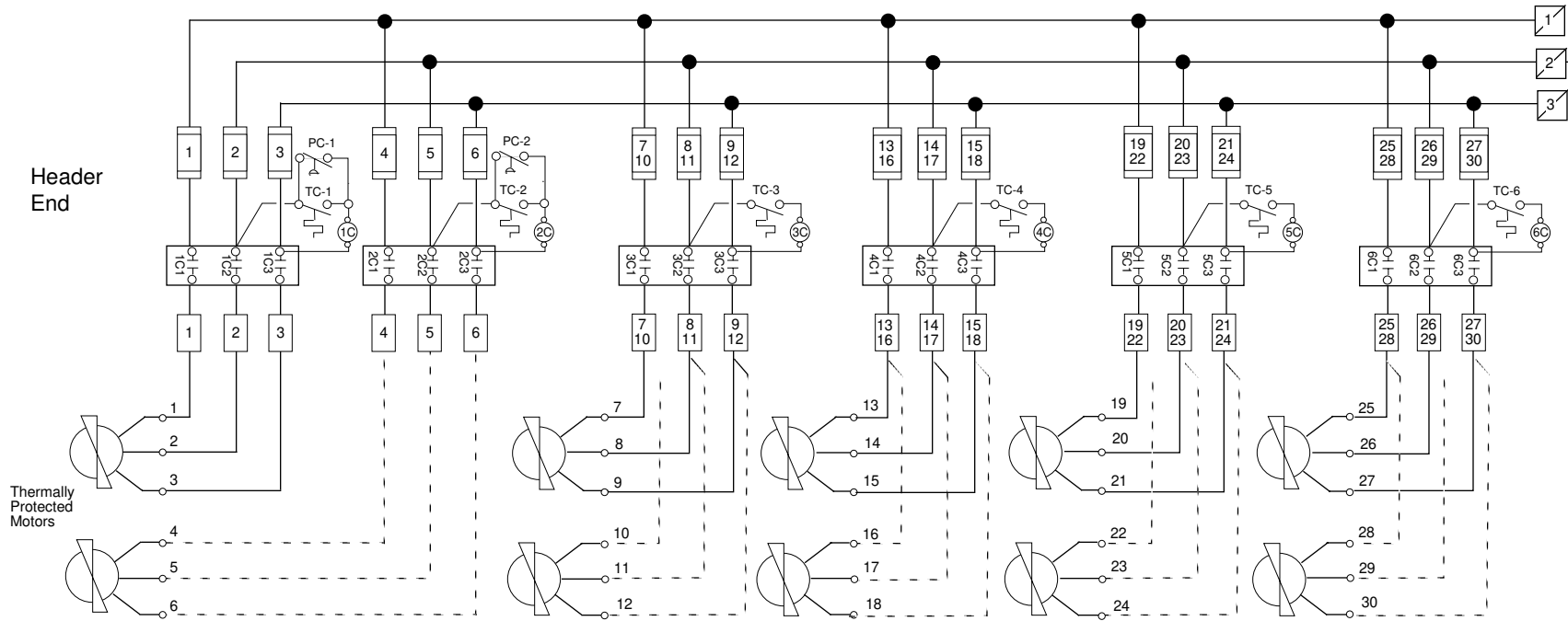
Set Cut-Out 5 Deg Below Cut-In

Individual Motor FLA			
HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0







Total FLA Number of Motors = Applicable Motor FLA

Figure 5-9 — Line Voltage Thermostatic  
with Pressure Override Fan Control

Ambient Temperature Control of All Banks of Fans With  
Pressure Override of the First Cycling Fan Bank for 2, 3, 4, or 5 Fan Bank Condenser



Replacement Parts

-  Thermostat Control
-  Pressure Control
-  Motor (Inherently Protected)
-  Terminal Block - Heavy Duty
-  Terminal Block - Medium Duty
-  Fuse Holder

Control Settings								
Number of Thermostats	Cut-In Settings for Thermostats – Deg F					PC-1 Settings – psig		
	TC-1	TC-2	TC-3	TC-4	TC-5	Refrig	Cut-In	Cut-Out
2	80	75	–	–	–	R-404A	229	203
3	80	75	55	–	–	R-22	193	168
4	80	75	65	50	–	R-507	236	210
5	80	75	70	55	40			

Set Cut-Out 5 Deg Below Cut-In

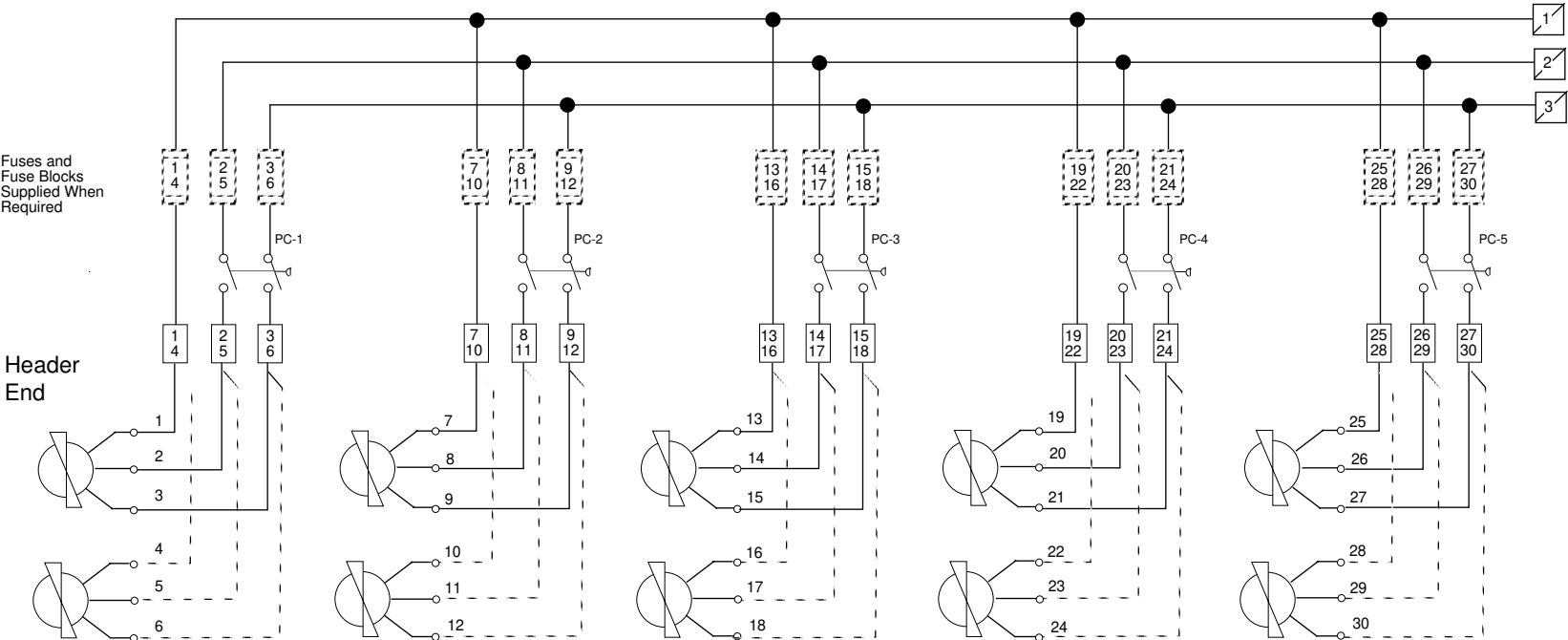
Individual Motor FLA			
HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0

Total FLA Number of Motors = Applicable Motor FLA

Figure 5-10 — Pilot Operated Thermostatic  
with Pressure Override Fan Control

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Line Voltage Pressure Control and Gravity Dampers for All Fans



Replacement Parts

- Pressure Control
- Motor (Inherently Protected)
- Terminal Block - Heavy Duty
- Terminal Block - Medium Duty
- Fuse Holder

**Note:** Solid lines represent wiring for 2, 3, 4 and 5 Fan Units  
Dashed lines represent additional wiring for 4, 6, 8 and 10 Fan Units

Control Settings							
Number of Fans			Pressure Switch Cut-In Settings – psig				
Single	Double	Refrigerant	PC-1	PC-2	PC-3	PC-4	PC-5
1	N/A	R-404A	222	—	—	—	—
		R-22	185	—	—	—	—
		R-507	230	—	—	—	—
2	2x4	R-404A	222	264	—	—	—
		R-22	185	217	—	—	—
		R-507	230	273	—	—	—
3	2x3	R-404A	222	242	64	—	—
		R-22	185	201	217	—	—
		R-507	230	250	240	—	—
4	2x4	R-404A	222	260	249	236	—
		R-22	185	193	205	217	—
		R-507	230	268	258	244	—
5	2x5	R-404A	222	235	242	225	260
		R-22	185	191	199	207	217
		R-507	230	244	250	233	270

Set Cut-Out 25 psig Below Cut-In

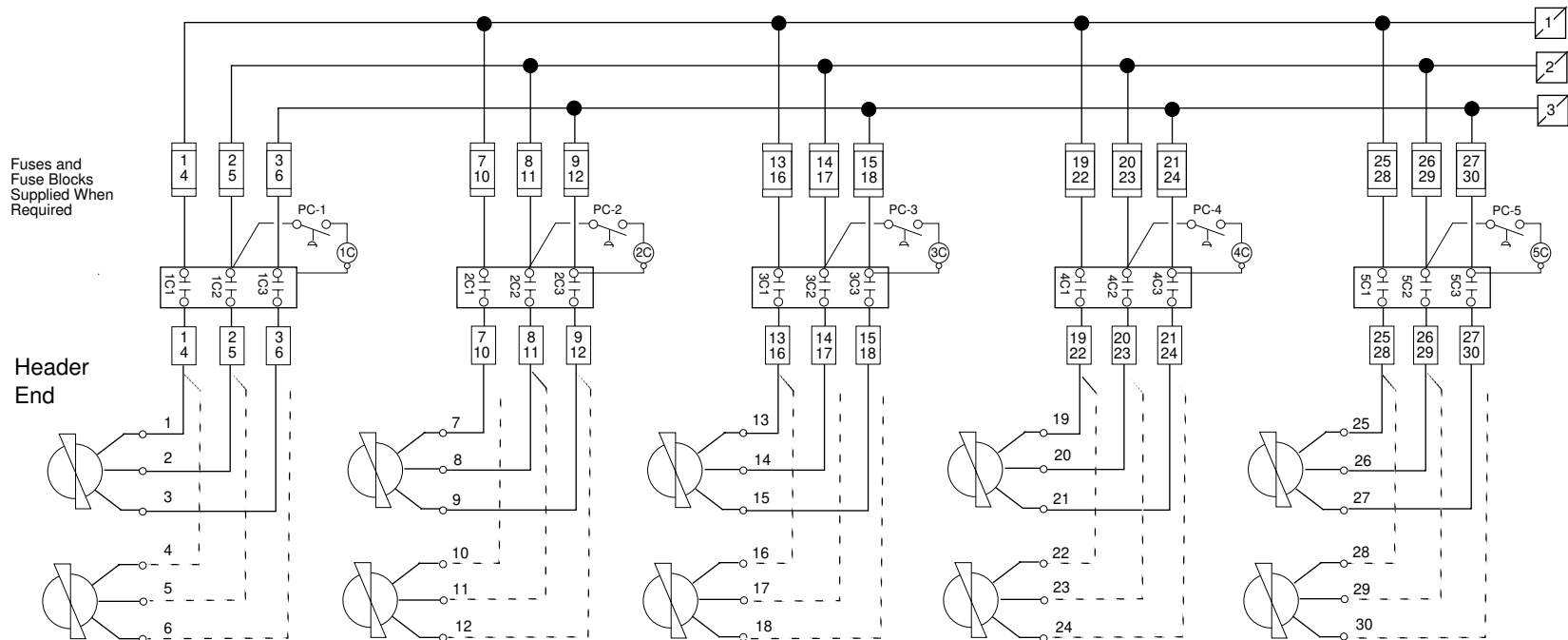
Individual Motor FLA			
HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0

Total FLA Number of Motors = Applicable Motor FLA

Figure 5-11 —Control B  
Line Voltage Pressure Control and  
Gravity Dampers for All Fans

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




Pilot Operated Pressure Control and Gravity Dampers for All Fans



Fuses and  
Fuse Blocks  
Supplied When  
Required

Header  
End

Replacement Parts

-  Pressure Control
-  Motor (Inherently Protected)
-  Terminal Block - Heavy Duty
-  Terminal Block - Medium Duty
-  Fuse Holder

**Note:** Solid lines represent wiring  
for 2, 3, 4 and 5 Fan Units  
Dashed lines represent additional  
wiring for 4, 6, 8 and 10 Fan Units

Control Settings

Number of Fans		Refrigerant	Pressure Switch Cut-In Settings – psig				
			PC-1	PC-2	PC-3	PC-4	PC-5
1	N/A	R-404A	222	—	—	—	—
		R-22	185	—	—	—	—
		R-507	230	—	—	—	—
2	2x4	R-404A	222	264	—	—	—
		R-22	185	217	—	—	—
		R-507	230	273	—	—	—
3	2x3	R-404A	222	242	64	—	—
		R-22	185	201	217	—	—
		R-507	230	250	240	—	—
4	2x4	R-404A	222	260	249	236	—
		R-22	185	193	205	217	—
		R-507	230	268	258	244	—
5	2x5	R-404A	222	235	242	225	260
		R-22	185	191	199	207	217
		R-507	230	244	250	233	270

Set Cut-Out 25 psig Below Cut-In

Individual Motor FLA

HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0

Total FLA Number of Motors = Applicable Motor FLA

Figure 5-12 —Control B  
Pilot Operated Pressure Control  
and Gravity Dampers for All Fans

## CONTROL VALVES

### OVERVIEW

This section deals with the operation and maintenance of the major valves which may be found with the Scroll Plus™ System.

### EPR VALVE

Evaporator Pressure Regulator Valves respond to upstream pressure and are used to maintain a minimum evaporator temperature. Remember two keys when dealing with rack mounted EPRs. The first is the pressure drop from the merchandiser to the machine room. The final test for setting an EPR should always be evaporator discharge air temperature or product temperature. The second is that low pressure drop EPR Valves used on the Scroll Plus™ require an external high pressure supply to power the main piston chamber. This high pressure supply must maintain a

positive differential of at least 50 psig above the down stream side of the valve. Lower pressure differentials may cause valve malfunction.

Basically all evaporator pressure regulator valves open on upstream suction pressure rise. Achieve the desired suction pressure by balancing Adjustment Spring ① against Upstream Suction Pressure ② and Fixed Pressure Counter Spring ③. As upstream pressure rises it closes the high pressure inlet to the Main Valve Chamber ④. The downstream bleed off reduces the Main Chamber pressure to the point that piston spring ⑤ and Upstream Pressure ⑥ open the main valve.

EPR Valves equipped with a Suction Stop Solenoid are used with Koolgas Defrost. When de-energized, this solenoid causes the Main Valve to close completely.

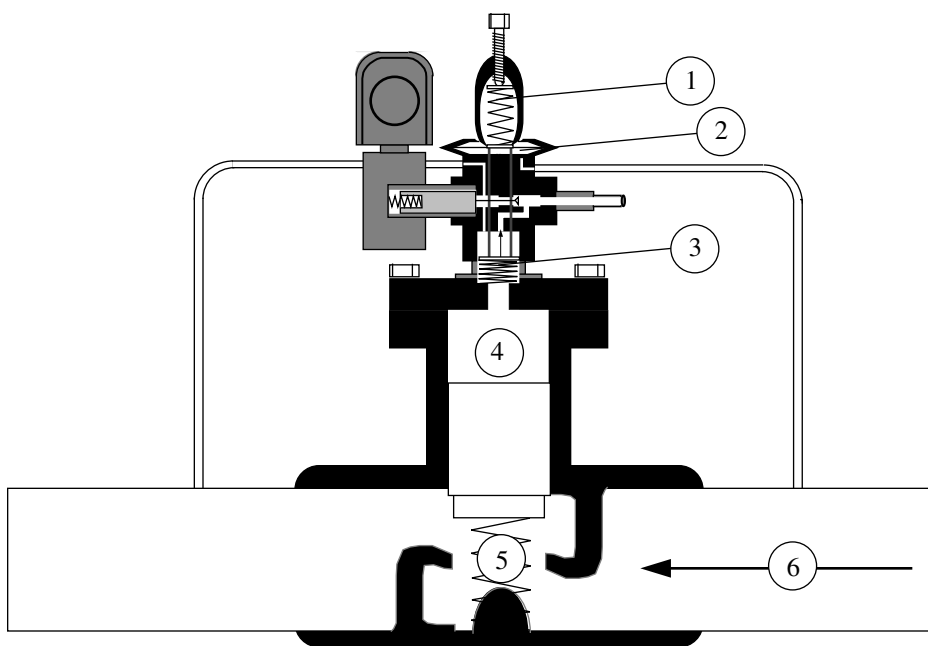


Figure 6-1 — Typical EPR Valve with Suction Stop Solenoid

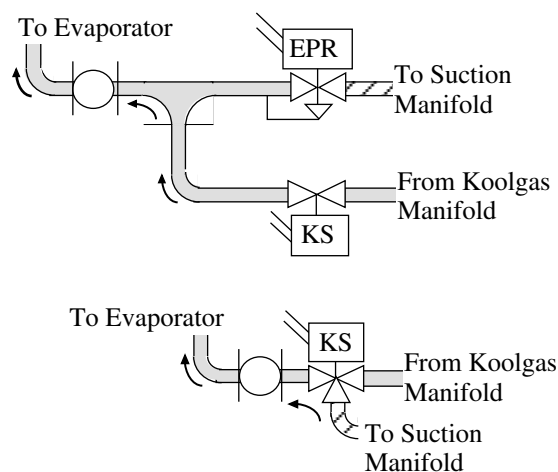


**Table 6-1 — Troubleshooting EPR Valves**

Malfunction	Cause	Action
Fails to Open	Dirt holding pilot port open	Disassemble and clean
	Solenoid not energized	
	-bad solenoid	Replace solenoid
	-circuit open	find and repair open
	-stuck in defrost mode	correct defrost clock problem
Fails to close	High pressure inlet strainer plugged	Clean or replace
	High pressure line pinched, shut off or plugged	Clean or replace. If oil filled, re-pipe so high pressure line is not an oil trap
	Sleeve or piston scored, allowing high pressure leak from piston chamber	Replace
	Dirt in piston chamber, causing drag	Clean or replace
	High pressure supply lower than defrost vapor pressure	Re-pipe
	(Sporlan) Faulty T-seal or Gasket	Replace
Does not Regulate Temperature	Low high pressure supply, 50 psig or more required in differential between high pressure and down stream suction	Increase pressure supply
	Condensation in long high pressure line	Insulate and/or relocate to higher pressure source

## KOOLGAS VALVES

Koolgas valving is piped in one of two ways. With a stop suction EPR, a simple 2-way solenoid valve is used. Without, a 3-way solenoid valve is used. Unless there is damage to the valve body itself, both the 2-way and 3-way valve may be disassembled and repaired in the field.



**Figure 6-2 — Koolgas Valve Piping**

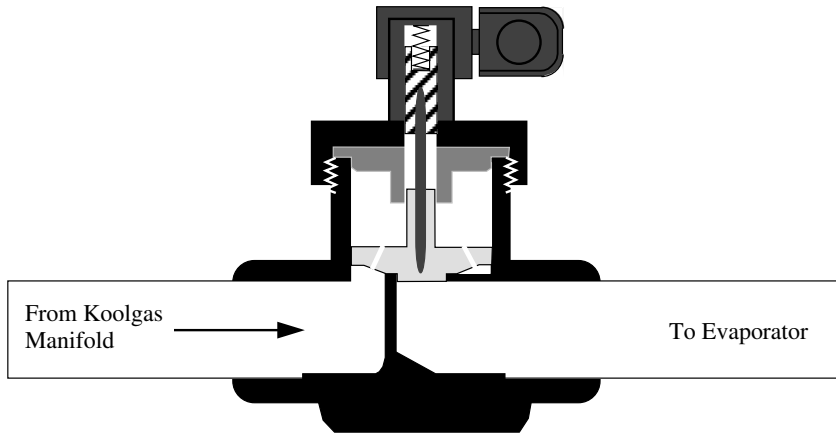


Figure 6-3 — 2-Way Solenoid Valve

Both the EPR and the 2-way solenoid valves are normally closed, so the EPR must be powered only during refrigeration and the 2-way valve only during defrost.

The 3-way valve is normally in refrigeration mode. Energizing the solenoid opens the pilot valve port which directs high pressure Koolgas vapor to the piston chamber. Pushed to its opposite position, the piston assembly stops the suction line and opens the Koolgas line. A bleed port in the piston provides for de-compression of the piston chamber when the pilot port closes.

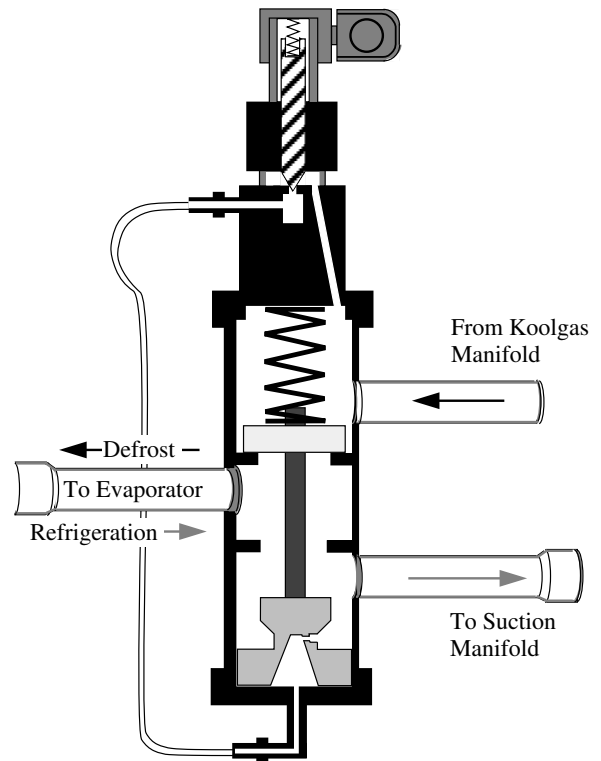


Figure 6-4 — 3-Way Solenoid Valve

Table 6-2 — Troubleshooting Koolgas Valves

Malfunction	Cause	Action
Fails to Open	Dirt plugging pilot port	Disassemble and clean
	Solenoid not energized -bad solenoid -circuit open -NOT in defrost mode	Replace solenoid Find and repair open Correct defrost clock problem
Fails to close	Piston port plugged	Clean or replace
	Barrel or piston scored	Replace
	Dirt in piston chamber, causing drag	Clean or replace
	Stuck in defrost mode	Correct defrost clock problem

## MAIN LIQUID LINE SOLENOID VALVES

The Sporlan Main Liquid Line Solenoid Valve goes into differential mode when the coil is de-energized or fails. When the Pilot Port ① opens, Upstream pressure ② fills the Main Valve Chamber ③ and forces the Main Valve towards a closed position. The downstream pressure ④ falls to the point that the Pilot Valve Spring ⑤ can not keep the downstream outlet closed. The Main Valve Chamber starts to empty and upstream pressure forces the main valve towards open.

### Differential Mode Quick Test

1. Connect pressure gauges up- and downstream of the valve.
2. All branches on the rack must be in refrigeration mode.
3. Disconnect power to Solenoid.
4. Check gauges for differential.

**NOTE:** Low refrigerant demand may prevent the differential from building up to the valve's real setting.

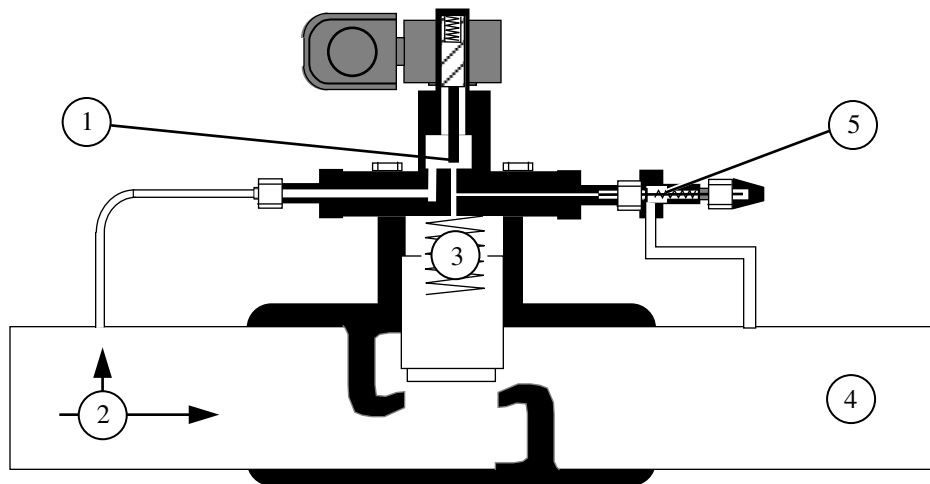


Figure 6-5 — Main Liquid Line Solenoid

The Alco Main Liquid Line Solenoid Valve goes into differential mode when the coil is de-energized or fails. Upstream liquid ① is forced through the modulating valve ② when the upstream pressure exceeds downstream pressure ⑤ plus the spring pressure ④.

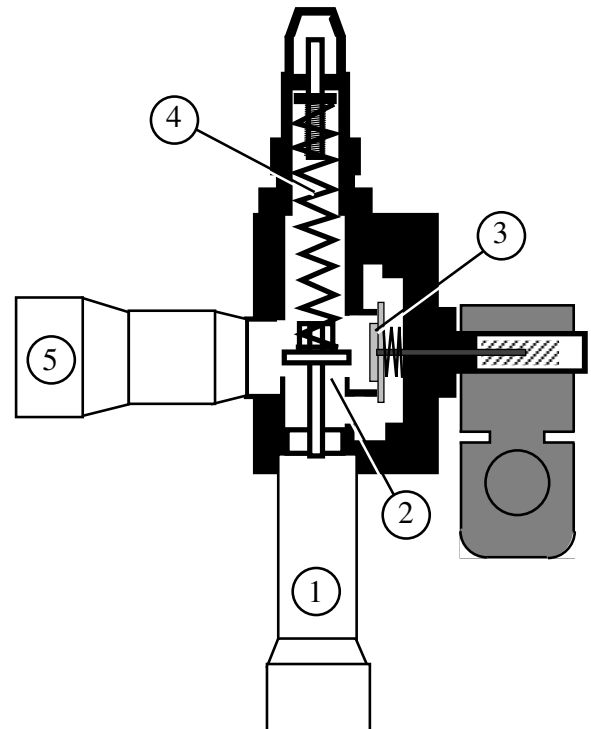
In refrigeration mode, the solenoid valve ③ is held open allowing flow around the modulating valve ②.

$$\begin{aligned} &\text{Downstream pressure} \\ &+ \text{spring pressure} \\ &= \text{upstream pressure.} \end{aligned}$$

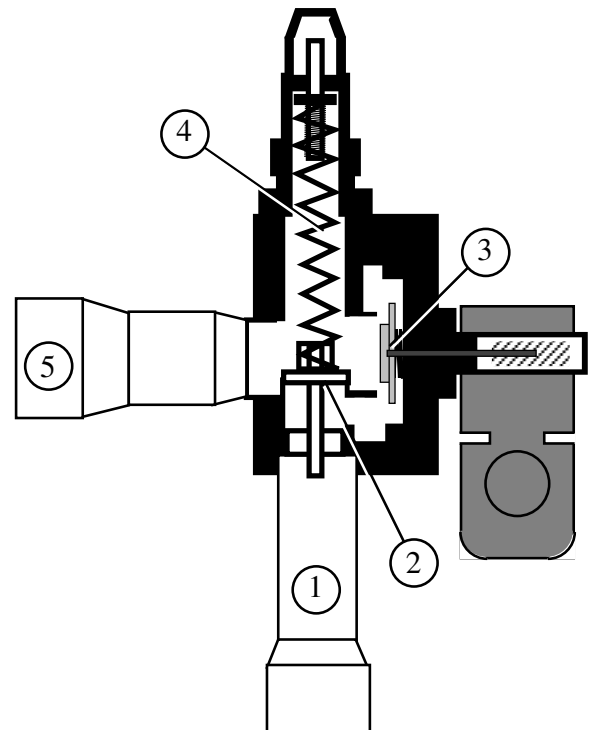
### Differential Mode Quick Test

1. Connect pressure gauges up- and downstream of the valve.
2. All branches on the rack must be in refrigeration mode.
3. Disconnect power to Solenoid.
4. Check gauges for differential.

**NOTE:** Low refrigerant demand may prevent the differential from building up to the valve's real setting.



Differential Mode - Coil De-energized



Refrigeration Mode - Coil Energized

Figure 6-6 — Alco Main Liquid Line Solenoid

## BRANCH LIQUID LINE SOLENOID VALVES

The Branch Liquid Line Solenoid Valve closes off refrigerant supply to the evaporator, yet allows back flow of refrigerant into the Liquid Manifold for Koolgas Defrost.

When the Solenoid is de-energized the Valve Port ① is held closed. Higher Pressure ⑤ upstream fills the Valve Chamber ③ through the Equalizing Port ④, keeping the Valve closed.

In refrigeration the Valve Port ① opens, emptying Valve Chamber ③ through the Check Valve ② faster than the Equalizing Port ④ can fill it. Higher Pressure ⑤ upstream forces the Valve open.

During Defrost, Valve Port ① opens, removing kick spring force from the valve. Higher Pressure ⑤ downstream back flows, closing the Check Valve ② and forcing the Valve up. Equalizing Port ④ allows Valve Chamber ③ pressure to escape upstream.

**Note:** The Solenoid of the branch valve is energized during refrigeration and for back flow during defrost.

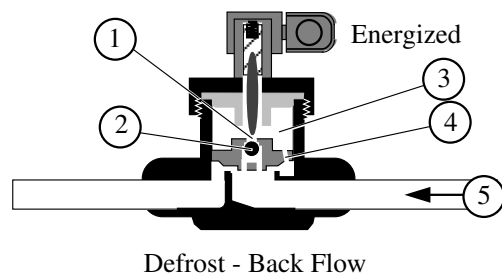
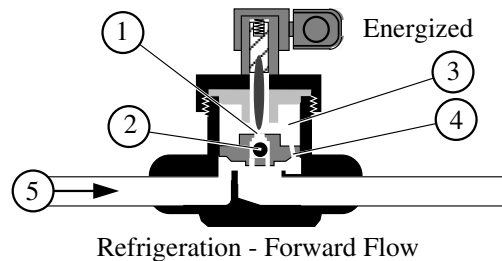
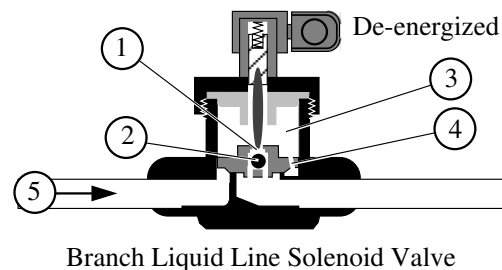
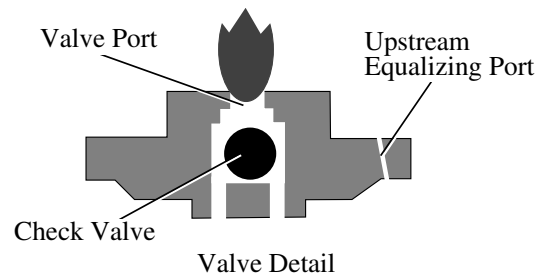


Figure 6-7 — Branch Liquid Line  
with Back Flow

**Table 6-3 — Troubleshooting  
Branch Liquid Line Solenoid Valves**

Malfunction	Cause	Action
Fails to Open	Dirt plugging valve port or equalizing port	Disassemble and clean
	Solenoid not energized -bad solenoid -circuit open	Replace solenoid Find and repair open
Fails to close	Dirt in valve port or equalizing port	Clean or replace
	Barrel or piston scored	Replace
	Dirt in piston chamber, causing drag	Clean or replace

**TEV**

The Thermal Expansion Valve regulates refrigerant flow into the evaporator by responding to the temperature of superheated vapor at the outlet of the evaporator.

Before attempting to set a TEV be sure the merchandiser is within 10°F of its normal operating range. Attach temperature probes at both the TEV bulb location (under the clamps), and between the TEV and the evaporator Inlet.

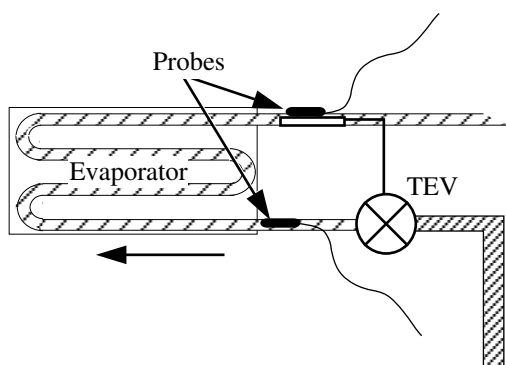


Figure 6-8 — Probe Locations for Setting TEV

While the valve is hunting, the temperature difference between the two probes should not exceed 3-5°F. The differential may fall to zero. To reduce differential, turn the adjusting stem counter clockwise and wait at least 15 minutes before checking results.

Valve Body	Recommended Adjustment
G	$\frac{1}{42}$ turn
BF	$\frac{1}{44}$ turn

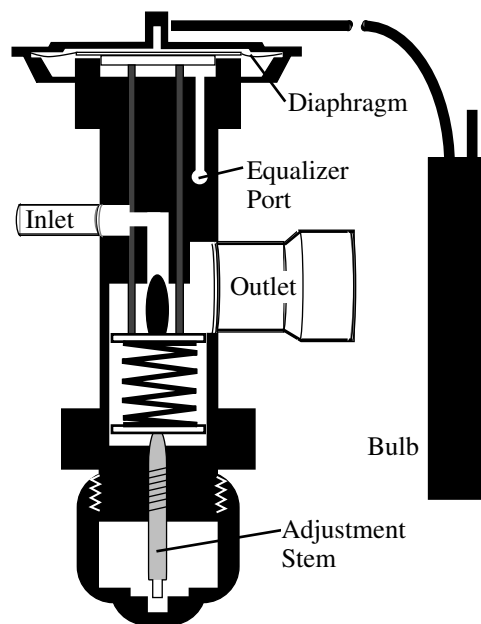


Figure 6-9 — TEV

**Table 6-4 — Troubleshooting the TEV**

Malfunction	Cause	Action
<b>Evaporator Starved</b>	Superheat adjusted too high	Adjust to proper superheat
	Moisture	Dehydrate and install new liquid line filter dryer
	Dirt plugging strainer or valve mechanism	Remove and clean or replace
	Wax	Clean valve and install wax trapping dryer
	Equalizer Internal misapplied External plugged Capped Restricted Incorrect location	Install externally equalized TEV Clear Install properly Correct or re-pipe Re-pipe
	Flash gas upstream of TEV	Head pressure too low, raise head pressure Liquid supply line not exiting branch line from bottom, re-pipe Liquid supply line too small, re-pipe
	Insufficient pressure drop across valve	Raise head pressure Install valve with adequate capacity at reduced pressure
	“Dead” Bulb	Replace
	Undersized TEV	Install correct size
<b>Evaporator Flooded</b>	Superheat adjusted too low	Adjust to proper superheat
	Bulb not getting good thermal pickup	Check bulb and correct for good contact, location, and ambient influence
	Moisture or dirt holding valve open	Clean and dehydrate and install new liquid line filter dryer
	Oversized TEV	Install correct size
	Valve damage or valve seat leak	Repair or replace
<b>Poor Performance</b>	Uneven circuit load on multiple evaporators	Balance load (lightly loaded evaporator is controlling TEV, starving loaded evaporator.)
	Moisture or Dirt	Clean and dehydrate and install new liquid line filter dryer
	TEV mis-sized	Install correct size

## HEAT RECLAIM

A 3-Way Heat Reclaim Valve directs the refrigerant to either the Condenser or a Heat Reclaim Coil. When the solenoid is de-energized, the valve directs the refrigerant to the condenser.

The pilot valve, a check valve, is directional. When the solenoid is de-energized the high pressure inlet is stopped and the passage between suction and valve chamber is open. When the solenoid is energized the suction outlet is stopped and the passage between high pressure and the valve chamber is open.

“B” version of the valve has a bleed port through the drive piston to the suction manifold. The bleed port provides a vent for fluids trapped in the Heat Reclaim circuits during normal operation.

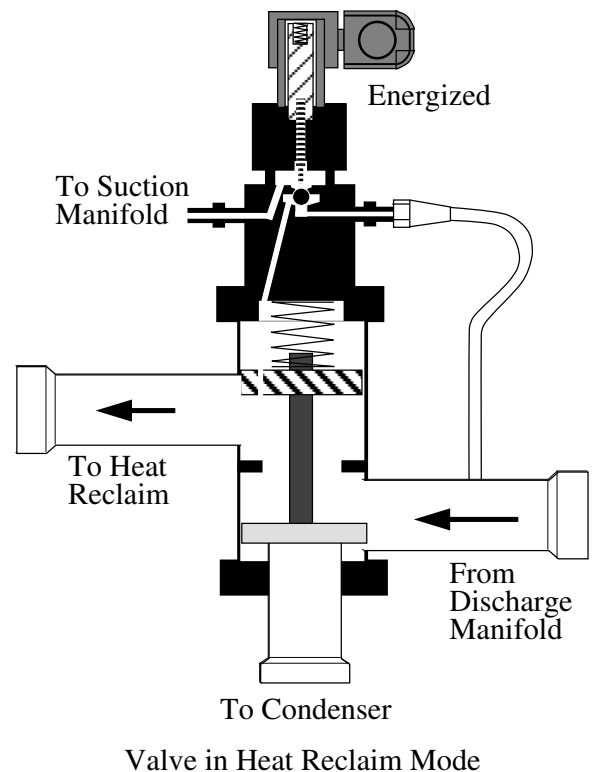
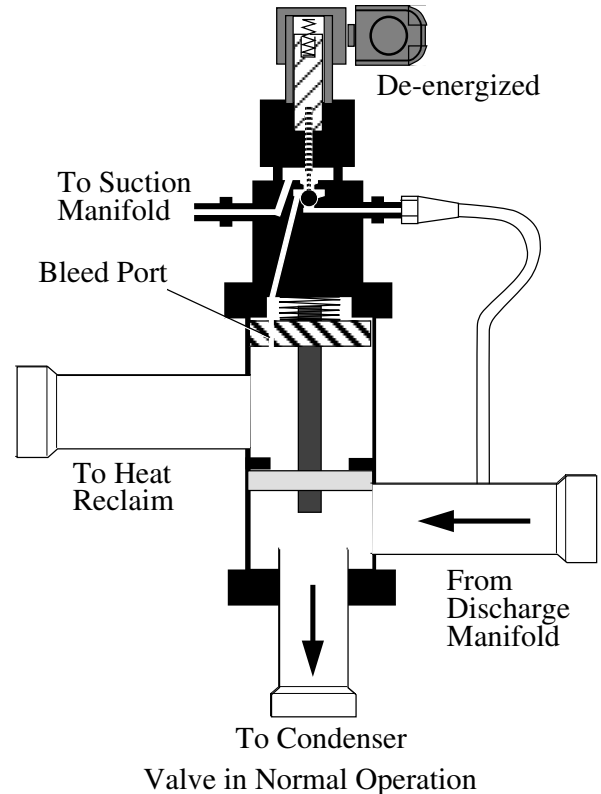


Figure 6-10 — 3-Way Heat Reclaim Valve



## FLOODING VALVE AND RECEIVER PRESSURE REGULATING VALVE

The Flooding Valve and the Receiver Pressure Regulating Valve work together—the operation of one affects the operation of the other. The Flooding Valve responds to upstream pressure from the Condenser. The Receiver Pressure Regulating Valve responds to downstream pressure in the Receiver.

The Pressure Regulator Valve (A9 Valve) responds to Receiver pressure. If the Receiver pressure drops below its set point the A9 Valve opens, directing Hot High Pressure Vapor to the Receiver.

The Flooding Valve (A8) maintains head pressure in low ambient conditions by reducing the available condensing area. Restricting liquid refrigerant flow from the Condenser, the Flooding Valve prevents the liquid refrigerant from leaving the Condenser as fast as it is forming, so the Condenser floods with its own condensate.

### A8 Valve Operation

Upstream Pressure ① from the condenser must be sufficient to hold Diaphragm ② off Valve Port ③ so main Valve Chamber ④ stays filled and holds Main Valve ⑤ open. When upstream pressure falls below Adjustment Spring ⑥ set point, the valve port closes, the main Valve Chamber ④ empties through the bleed port—closing the main valve. ( $1\frac{1}{2}$  Turn = 35 psig change.)

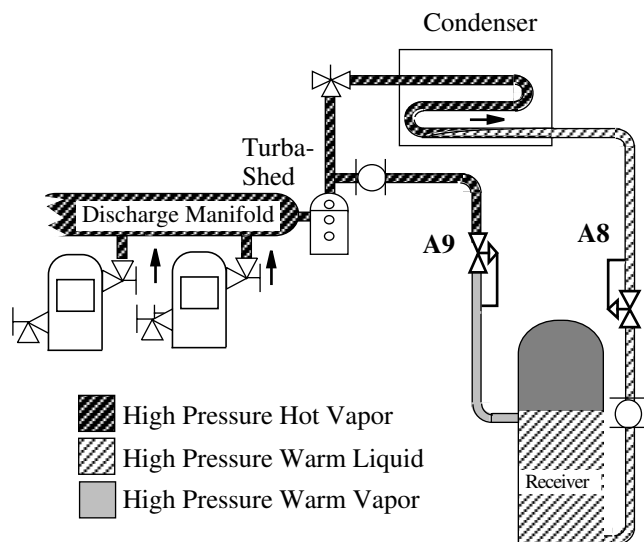


Figure 6-11 — Condenser and Receiver  
Pressure Regulation

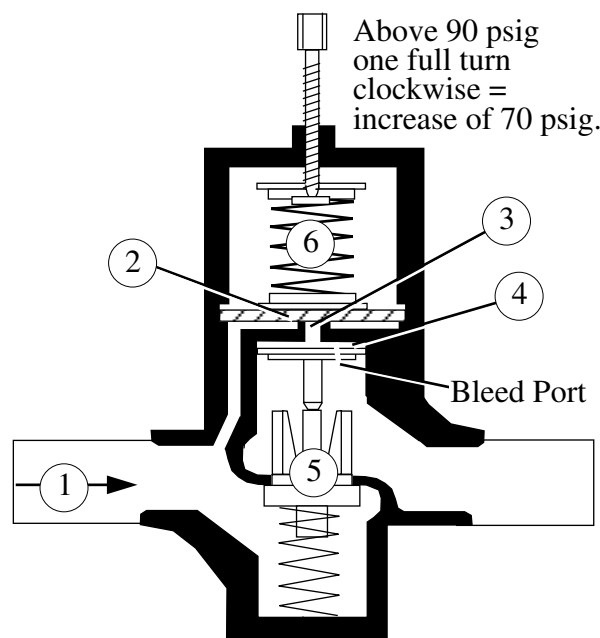


Figure 6-12 — A8 Flooding Valve

Table 6-5 — Troubleshooting Flooding Valve

Malfunction	Cause	Action
Fails to Open	Set too high	Reduce spring tension
	Dirt blocking Valve Port	Clean or replace
	Diaphragm dirty or misaligned	Clean, replace or align
Fails to close	Set too low	Increase spring tension
	Dirt in bleed port	Clean or replace
	Installed backwards	Re-install with direction of flow

**A9 Valve Operation**

Downstream Pressure ① must be sufficient to keep Adjustment Spring ② from opening Valve Port ③. If receiver pressure falls below the spring set point, the valve port opens, allowing Upstream Pressure ④ to fill the Valve Chamber ⑤, opening the Main Valve ⑥ (one full turn = 25 psig change).

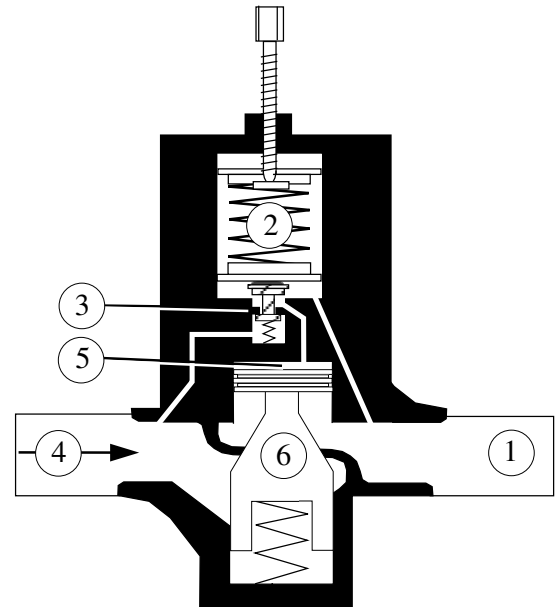


Figure 6-13 — A9 Receiver Pressure Regulator

**A9B Valve**

Racks equipped with an A9B Valve have no Bypass Solenoid for Koolgas Defrost operation. The single A9B valve covers both functions.

**A9B Valve Operation**

When the Solenoid is de-energized the valve operates like the standard A9. When the solenoid is energized the Solenoid Port ① opens, filling the Valve Chamber ②, and opening the Main Valve ③ (one full turn = 25 psig change).

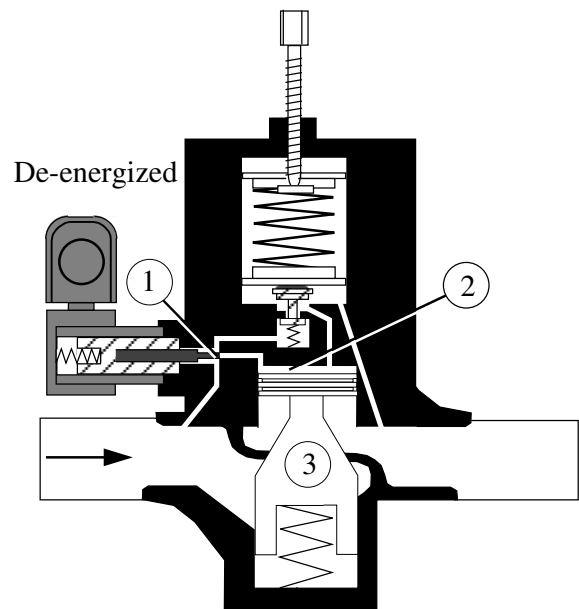


Figure 6-14 — A9B Receiver Pressure Regulator with Solenoid and Pilot Port

**Table 6-6 — Troubleshooting Receiver Pressure Regulator**

Malfunction	Cause	Action
Fails to Open	Set too high	Reduce spring tension
	Dirt blocking Valve Port	Clean or replace
	Diaphragm dirty or misaligned	Clean, replace or align
Fails to close	Set too low	Increase spring tension
	Dirt in bleed port	Clean or replace
	Installed backwards	Re-install with direction of flow

## AUTOSURGE AND BY-PASS VALVES

The A9B Valve needs to be working properly for the Autosurge Valve to function during Koolgas Defrost.

The Autosurge directs the flow of refrigerant either through the Receiver (Flow Through), or around the Receiver (Surge) in response to ambient subcooling obtained in the condenser.

Note: Both the Valve's sensing bulb and its equalizer line are located upstream of the Flooding Valve.

The Autosurge Valve reacts to the condensing pressure through its equalizer line, and to the temperature of the liquid refrigerant returning from the Condenser through a bulb mounted on the Liquid Return Line up stream of the Flooding Valve. When the refrigerant temperature returning from the condenser drops below its condensing temperature, the system has ambient subcooling. The valve is factory set at 10°F of subcooling and is **not** field adjustable.

(Note: A thermostat and solenoid valve are used to deactivate surge operation when the outside temperature falls to 40-45 deg F.)

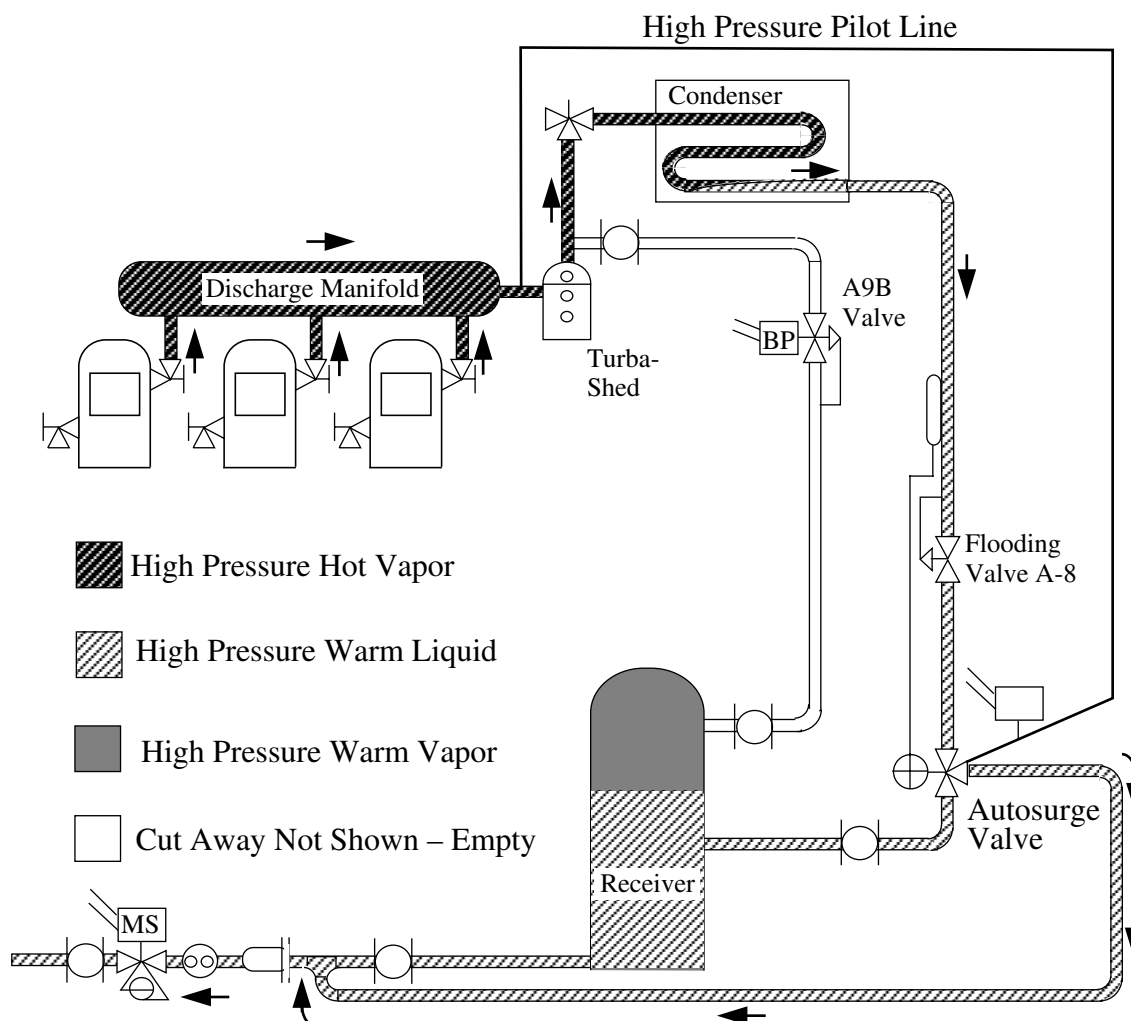


Figure 6-15 — Autosurge Cycle

### System Start-up

The pilot valve is pre-set at the factory for 10°F subcooling.

- Valve off pilot while leak testing the system; excessive pressure can damage the Pilot Valve Element.
- Do **not** attempt to field adjust.

On initial start up, valve off the high pressure pilot line from the Discharge Manifold. Once the system has stabilized, open the valve.

- Be sure all pilot lines are **open**.
- Be sure pilot valve bulb has good contact to the Liquid Return Line, and is well insulated.
- In case of bulb charge loss or pilot failure, do **not** attempt to substitute a TEV element.

### Emergency Bypass

If the pilot valve fails for any reason, the system will be forced into **Surge flow around the Receiver**. To achieve Flow through the Receiver follow the steps below:

1. Valve off the high pressure pilot line at Discharge Manifold
2. Disconnect flex hose at Surge Valve (A) and plug hose with a 1/4-inch flare plug (finger tighten).
3. Valve off the suction pressure pilot line at Suction Manifold.
4. Disconnect flex hose at Pilot Valve (B) and reconnect to Surge Valve Inlet (A).
5. Cap Pilot Valve Suction Outlet with a 1/4-inch flare cap.
6. Open suction pressure pilot line valve at Suction Manifold.

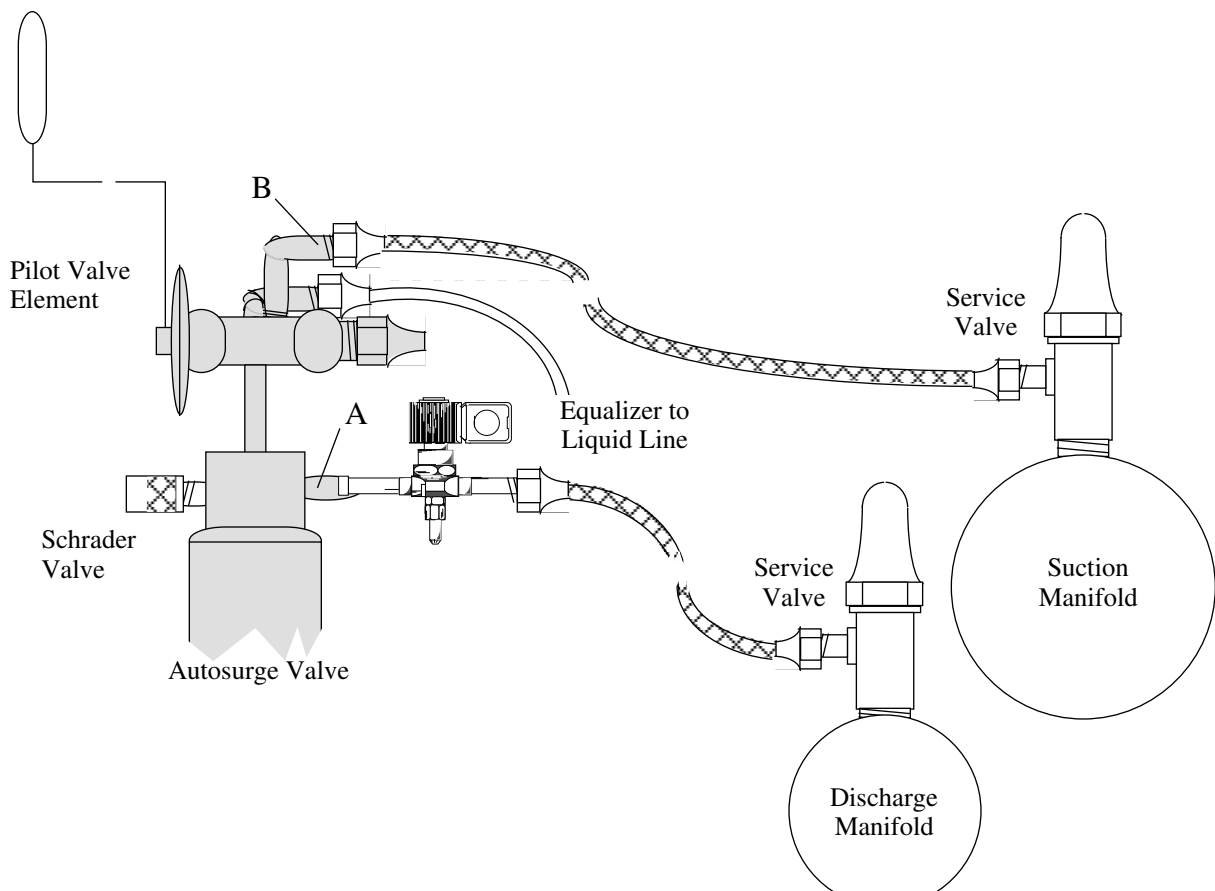


Figure 6-16 — Autosurge Valve Connections

## Testing Valve Operation

### General

When taking readings, account for liquid line drop, gauge error, and thermometer accuracy. Three measurements are required to determine if the Valve is working properly.

- Reading 1. Liquid Return Line Temperature, at the pilot valve bulb.
- Reading 2. High Side Pressure, up stream of the Flooding Valve.
- Reading 3. Autosurge Valve Chamber Pressure, through its Schrader Valve.

### Pilot Valve

When the Liquid Temperature (Reading 1) is 10°F or more below its saturation temperature for the High Side Pressure (Reading 2), the system should be in Surge around the Receiver. The pilot valve operates  $\pm 5^\circ\text{F}$  accuracy.

For example, a thermometer is attached to the liquid return line at the pilot valve bulb, and a pressure gauge is hooked up to the Liquid Return Line up stream of the Flooding Valve. The gauge face at the right shows a pressure of 220 psig (Reading 2). According to the gauge face, R-22 would have a saturated liquid temperature of 108°F. If the Liquid Return Line Temperature (Reading 1) is 98°F, the refrigerant has 10°F of subcooling. Because of the  $\pm 5^\circ\text{F}$  accuracy of the pilot valve the system may be in Surge as soon as 103°F is reached or not until 93°F is reached.

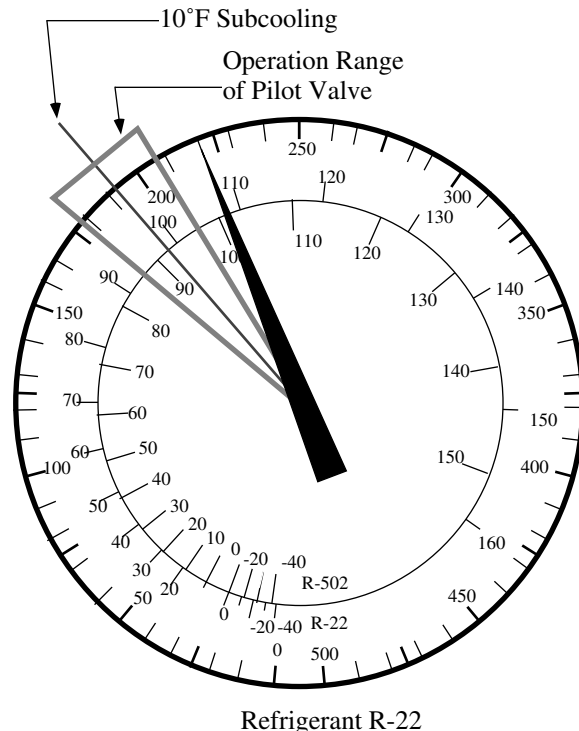
### Determining Flow Direction

When the Autosurge Valve Chamber Pressure (Reading 3) is five pounds or more below the High Side Pressure (Reading 2), the valve is in Flow through the Receiver.

For example, a pressure reading at the Liquid Return Line of 220 psig (Reading 2), and an Mechanical Surge Valve Chamber Pressure of 215 psig should place the system in Flow through the Receiver.

### Main Valve

To test the Main Valve, isolate the Pilot Valve and connect the Autosurge Schrader Valve to the center hose of a manifold. Connect the high and low side hoses to respective pressure sources. Operate the main valve through the gauge set.



Refrigerant R-22  
Pressure Reading = 220 psig  
Saturated Liquid Temperature = 108°F  
10 °F Subcooling = 98°F

Operation Range of Pilot Valve =  
between 93° and 103°F.

Figure 6-17 —Establishing Valve Operation Range

### WARNING

When entering a system's high side through a Schrader Valve, use a High Side Schrader Valve Adapter between the Schrader Valve and the gauge speed coupling. This will prevent excessive refrigerant loss into the environment and decrease the hazard of refrigerant burn.

## MECHANICAL SUBCOOLING

By lowering the temperature of the liquid supplied to the TEV, the efficiency of the evaporator is increased. The lower temperature liquid refrigerant produces less flash gas exiting the TEV.

### Plate Subcooler

Electrically, a thermostat responding to main liquid line temperature immediately down stream of the Plate Subcooler controls a solenoid valve on the liquid supply line from the Liquid manifold. This circuit is supplied with power through parallel auxiliary contactors on the compressor motor contactors

A liquid line solenoid valve and a TEV control refrigerant flow to the Plate Heat Exchanger. An EPR on the return suction line prevents the sub-cooler temperature from dropping below desired liquid temperature.

### Plate Subcooler Controls

Thermostat setting is 50°F with minimum differential, or customer specifications.

The TEV should be set with the highest possible superheat that will still maintain the desired liquid temperature.

EPR setting is listed on the store legend.

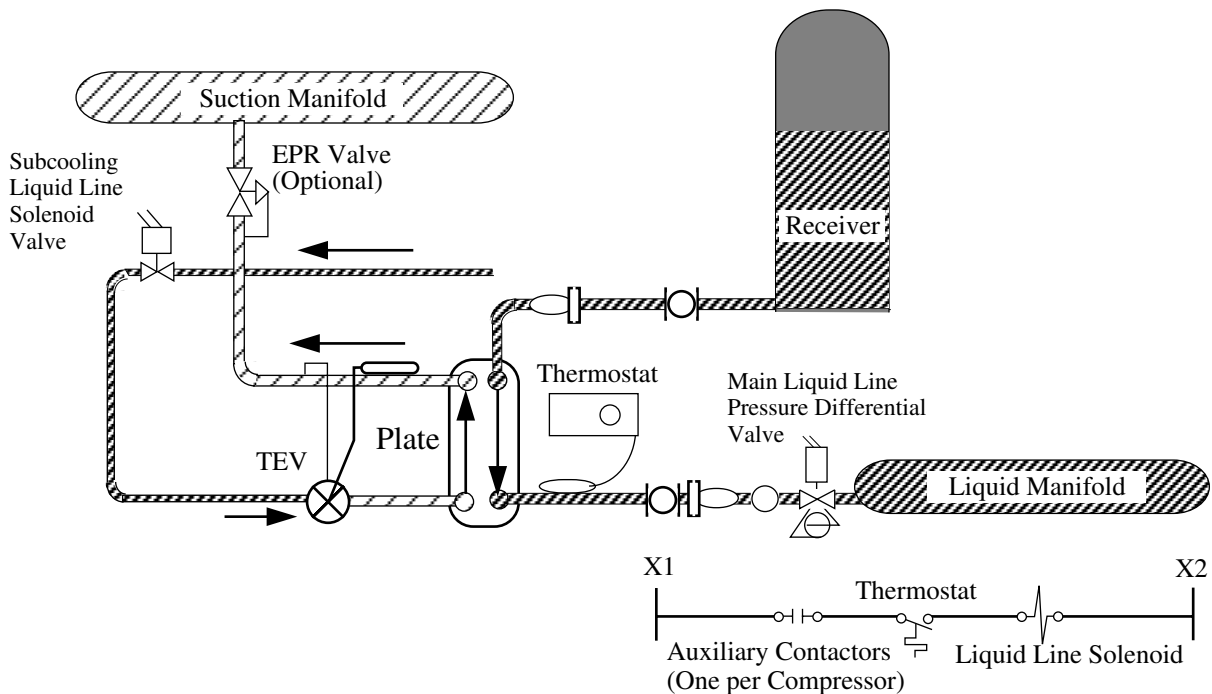


Figure 6-18 — Plate Type Mechanical Subcooler

## OIL CYCLE

Discharge refrigerant carries droplets of oil from the compressors' lubrication system. The Turbashed separates the oil from the refrigerant and stores it in its internal reservoir until needed. The oil returns to the compressors along the high pressure line through an oil filter.

The oil filter removes impurities from the oil. The high pressure oil then enters an oil manifold where it is distributed to individual compressor oil feed lines. **Note: the oil manifold has a shutoff valve incorporated that shuts off oil flow in both the full clockwise and counterclockwise positions. Proper adjustment to this shutoff valve is the center position.**

The high pressure oil is then distributed to individual Traxoil regulators which inject oil through a solenoid into the compressor.

The Sporlan Traxoil is an electronic oil level regulator. The unit is powered by a 24V power supply. When the oil level drops below 1/2 sight-glass, the oil fill light comes on and the oil solenoid is energized. If the oil level doesn't rise above 1/2 sightglass after 120 seconds, the Traxoil relay contacts open the compressor control circuit. It is possible that oil will refill the compressor crankcase after an Oil Level Failure, causing the oil fill and oil failure lights to turn off, but the compressor alarm light remains on and the compressor switch requires a manual reset.

**Note: Scroll compressors do not have a positive displacement oil pump, and therefore no oil pressure control.**

## Standard Valves

- (a) Compressor Service Valves
- (b) Oil Supply Shutoff Valve
- (c) Oil Filter Isolation Valve
- (d) Trax-Oil Regulator

# Scroll Plus™ Oil Return System

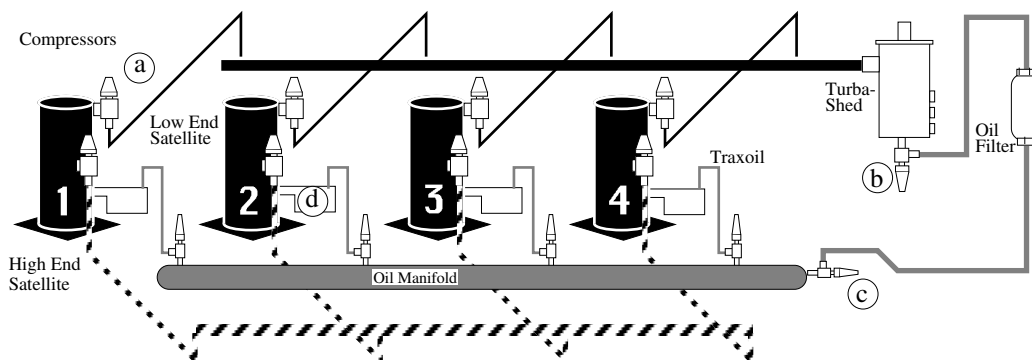


Figure 6-19 — Scroll Plus Oil Return System

## CONTROL SETTINGS

### OVERVIEW

This section is limited to the control settings required prior to and during start-up. These include

- Traxoil Oil Safety
- Pressure Settings
- Plate Subcooler Controls
- EPR Settings
- Winter Condensing Pressure Controls
- Mechanical Low Pressure Controls
- Condenser Settings
- Merchandiser Settings

### COMPRESSOR OIL FAILURE

The Traxoil oil safety is an automatic reset device but, because of the wiring method, it does require a manual reset of the compressor switch. The Traxoil will signal an alarm when the oil level falls below 1/2 sight-glass for more than 90 seconds.

### PRESSURE SETTINGS

*High Pressure Safety* for R-22, R-404a and R-507 is 395 psig. Differential is fixed.

*High Suction Pressure* is set at 50% above the suction design setpoint (minimum of 10 psi), or to customer specification

#### *Satellite Low Pressure Controls*

Low-end Temperature Satellites

Cut-out = 1 psig

High-end Medium Temperature Satellites

REFRIGERANT	CUT-OUT	CUT-IN
R-404a/507	36	59
R22	29	49

### PLATE SUBCOOLING CONTROLS

Thermostat setting is 50 deg F, with minimum differential, or customer specification.

The TEV should be set with the highest possible superheat that will still maintain the desired liquid temperature.

EPR setting, if used, is on the store legend.

### EPR SETTINGS

The pressure settings are based on a nominal 2 psig pressure drop in the suction line when the EPR control is mounted in the machine room.

EVAPORATOR TEMPERATURE	R-404a/507	R-22
-25	11	5
<b>-22</b>	<b>13</b>	<b>7</b>
-20	14	8
<b>-15</b>	<b>18</b>	<b>12</b>
6	37	27
<b>9</b>	<b>41</b>	<b>30</b>
12	44	33
<b>15</b>	<b>47</b>	<b>36</b>
18	51	39
<b>21</b>	<b>55</b>	<b>42</b>
25	60	47
<b>30</b>	<b>68</b>	<b>53</b>



**WINTER CONDENSING PRESSURE  
CONTROLS**

The customer may specify lower pressure settings than those recommended; however, refrigeration performance may be affected. Minimum receiver pressure is 140 psig.

Refrigerant	A8 (Flooding Valve)	A9 (Receiver Pressure)
R22	175	165
R-404a/507	205	195

**MECHANICAL LOW PRESSURE  
CONTROLS**

The Alco low pressure control comes with a factory set cut-in pressure of 15 psig. Since the differential is fixed at 10 psig, the cut-out is 5 psig, which is the lowest possible cut-out for this control. The adjustment screw is located next to the pressure connection. Turn the screw clockwise to increase cut-in pressure.

**Note:** 3  $\frac{1}{4}$  rotations of the screw represents the entire 70 psi adjustment range, or 1 turn = 20 psi.

**Alco Cartridge-style Low Pressure Control****Cut Out Pressures**

Apply data from compressors 1 and 2 for a 2-compressor rack; data from compressors 1 through 3 for a 3-compressor rack; and so on.

<b>R-404A/R507</b>						
Design Suction Temp	Compressor Capacity					
	Largest		to		Smallest	
	1	2	3	4	5	6
°F	psig					
-33	5	6	7	8	9	10
-30	6	7	8	9	10	11
-28	8	9	10	11	12	13
-25	10	11	12	13	14	15
-23	11	12	13	14	15	16
-21	12	13	14	15	16	17
-20	13	14	15	16	17	18
-16	15	16	17	18	19	20
-15	16	17	18	19	20	21
-10	20	21	22	23	24	25
7	35	36	37	38	39	40
10	38	39	40	41	42	43
12	40	41	42	43	44	45
14	43	44	45	46	47	48
15	44	45	46	47	48	49
16	45	46	47	48	49	50
20	50	51	52	53	54	55
23	53	54	55	56	57	58
25	56	57	58	59	60	61

**Note:** These Alco Low Pressure Controls have a fixed 10 psig differential.

<b>R22</b>						
Design Suction Temp	Compressor Capacity					
	Largest		to		Smallest	
	1	2	3	4	5	6
°F	psig					
-33	5	6	7	8	9	10
-30	5	6	7	8	9	10
-28	5	6	7	8	9	10
-25	5	6	7	8	9	10
-23	5	6	7	8	9	10
-21	6	7	8	9	10	11
-20	7	8	9	10	11	12
-16	9	10	11	12	13	14
-15	10	11	12	13	14	15
-10	12	13	14	15	16	17
7	25	26	27	28	29	30
10	28	29	30	31	32	33
12	30	31	32	33	34	35
14	32	33	34	35	36	37
15	33	34	35	36	37	38
16	34	35	36	37	38	39
20	38	39	40	41	42	43
23	40	41	42	43	44	45
25	42	43	44	45	46	47
30	50	51	52	53	54	55
35	56	57	58	59	60	61
40	64	65	66	67	68	69
45	71	72	73	74	75	76

### Other Mechanical Low Pressure Control Settings

R-404A/R507 Low Temperature												
Design Suction Temp °F	Compressor Number 6		Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig
-33	14	10	13	9	12	8	11	7	10	6	9	5
-30	16	12	15	11	14	10	13	9	12	8	11	7
-28	17	13	16	12	15	11	14	10	13	9	12	8
-25	19	15	18	14	17	13	16	12	15	11	14	10
-23	20	16	19	15	18	14	17	13	16	12	15	11
-21	22	18	21	17	20	16	19	15	18	14	17	13
-20	23	19	22	18	21	17	20	16	19	15	18	14
-16	26	22	25	21	24	20	23	19	22	18	21	17
-15	27	23	28	22	25	21	24	20	23	19	22	18
-10	31	27	30	26	29	25	28	24	27	23	26	22

Design Suction Temp °F	Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig
-33	14	10	13	9	12	8	10	6	9	5
-30	16	12	15	11	14	10	12	8	11	7
-28	17	13	16	12	15	11	13	9	12	8
-25	19	15	18	14	17	13	15	11	14	10
-23	20	16	19	15	18	14	16	12	15	11
-21	22	18	21	17	20	16	18	14	17	13
-20	23	19	22	18	21	17	19	15	18	14
-16	26	22	25	21	24	20	22	18	21	17
-15	27	23	26	22	25	21	23	19	22	18
-10	31	27	30	26	29	25	27	23	26	22

Design Suction Temp °F	Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig
-33	14	10	12	8	10	6	9	5
-30	16	12	14	10	12	8	11	7
-28	17	13	15	11	13	9	12	8
-25	19	15	17	13	15	11	14	10
-23	20	16	18	14	16	12	15	11
-21	22	18	20	16	18	14	17	13
-20	23	19	21	17	19	15	18	14
-16	26	22	24	20	21	17	21	17
-15	27	23	25	21	22	18	22	18
-10	31	27	29	25	27	23	26	22

**Caution:** Never run the compressors in a vacuum.

R-404A Medium Temperature												
Design Suction Temp °F	Compressor Number 6		Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI	CO	CI	CO	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig
7	44	40	43	39	42	38	41	37	40	36	39	35
10	47	43	46	42	44	41	44	40	43	39	42	38
12	49	45	48	44	47	43	46	42	45	41	44	40
14	52	48	51	47	50	46	49	45	48	44	47	43
15	53	49	52	48	51	47	50	46	49	45	48	44
16	54	50	53	49	52	48	51	47	50	46	49	45
20	60	56	59	55	58	54	57	53	56	52	55	51
23	64	60	63	59	62	58	61	57	60	56	59	55
25	66	63	65	61	64	60	63	59	62	58	61	57

Design Suction Temp °F	Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI	CO	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig
7	44	38	42	36	40	34	38	32	36	30
10	47	41	45	39	43	37	41	35	39	33
12	49	43	47	41	45	39	43	37	41	35
14	51	45	49	43	47	41	45	39	43	37
15	52	46	50	44	48	42	46	40	44	38
16	54	48	52	46	50	44	48	42	46	40
20	59	53	57	51	55	49	53	47	51	45
23	64	58	62	56	60	54	58	52	56	50
25	68	62	66	60	64	58	62	56	60	54

Design Suction Temp °F	Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig
9	44	38	42	36	40	34	38	32
12	47	41	45	39	43	37	41	35
14	49	43	47	41	45	39	43	37
16	51	45	49	43	47	41	45	39
17	52	46	50	44	48	42	46	40
18	54	48	52	46	50	44	48	42
23	59	53	57	51	55	49	53	47
27	64	58	62	56	60	54	58	52
30	68	62	66	60	64	58	62	56

**Note:** Increase settings by 3 psi for R-507 applications in the medium temperature range.

**Caution:** Never run the compressors in a vacuum.

R22 Medium Temperature												
Design Suction Temp °F	Compressor Number 6		Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig
7	34	30	33	29	32	28	31	27	30	26	29	25
10	37	33	36	32	35	31	34	30	33	29	32	28
12	39	35	38	34	37	33	36	32	35	31	34	30
14	41	37	40	36	39	35	38	34	37	33	36	32
15	42	38	41	37	40	36	39	35	38	34	37	33
16	43	39	42	38	41	37	40	36	39	35	38	34
20	47	43	46	42	45	41	44	40	43	39	42	38
23	49	45	48	44	47	43	46	42	45	41	44	40
25	51	47	50	46	49	45	48	44	47	43	46	42
30	59	55	58	54	57	53	56	52	55	51	54	50
35	65	61	64	60	63	59	62	58	61	57	60	56
40	73	69	72	68	71	67	70	66	69	65	68	64
45	80	76	79	75	78	74	77	73	76	72	75	71

Design Suction Temp °F	Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig
7	34	28	32	26	30	24	28	22	26	20
10	37	31	35	29	33	27	31	25	29	23
12	39	33	37	31	35	29	33	27	31	25
14	41	35	39	33	37	31	35	29	33	27
15	42	36	40	34	38	32	36	30	34	28
16	43	37	41	35	39	33	37	31	35	29
20	47	41	45	39	43	37	41	35	39	33
23	50	44	48	42	46	40	44	38	42	36
25	53	47	51	45	49	43	47	41	45	39
30	59	53	57	51	55	49	53	47	51	45
35	65	59	63	57	61	55	59	53	57	51
40	72	66	70	64	68	62	66	60	64	58
45	80	74	78	72	76	70	74	68	72	66

Design Suction Temp °F	Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig
7	34	28	32	26	30	24	28	22
10	37	31	35	29	33	27	31	25
12	39	33	37	31	35	29	33	27
14	41	35	39	33	37	31	35	29
15	42	36	40	34	38	32	36	30
16	43	37	41	35	39	33	37	31
20	47	41	45	39	43	37	41	35
23	50	44	48	42	46	40	44	38
25	53	47	51	45	49	43	47	41
30	59	53	57	51	55	49	53	47
35	65	59	63	57	61	55	59	53
40	72	66	70	64	68	62	66	60
45	80	74	78	72	76	70	74	68

**Caution:** Never run the compressors in a vacuum.

R22 Low Temperature												
Design Suction Temp °F	Compressor Number 6		Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI	CO	CI	CO	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig
-33	9	5	8	4	7	3	6	2	5	1	4	0
-30	10	6	9	5	8	4	7	3	6	2	5	1
-28	11	7	10	6	9	5	8	4	7	3	6	2
-25	12	8	11	7	10	6	9	5	8	4	7	3
-23	13	9	12	8	11	7	10	6	9	5	8	4
-21	14	10	13	9	12	8	11	7	10	6	9	5
-20	15	11	14	10	13	9	12	8	11	7	10	6
-16	17	13	16	12	15	11	14	10	13	9	12	7
-15	18	14	17	13	16	12	15	11	14	10	13	9
-10	22	18	21	17	20	16	19	15	18	14	17	13

Design Suction Temp °F	Compressor Number 5		Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI	CO	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig
-33	9	5	8	4	7	3	5	1	4	0
-30	10	6	9	5	8	4	6	2	5	1
-28	11	7	10	6	9	5	7	3	6	2
-25	12	8	11	7	10	6	8	4	7	3
-23	13	9	12	8	11	7	9	5	8	4
-21	14	10	13	9	12	8	10	6	9	5
-20	15	11	14	10	13	9	11	7	10	6
-16	17	13	16	12	15	11	13	9	12	7
-15	18	14	17	13	16	12	14	10	13	9
-10	22	18	21	17	20	16	18	14	17	13

Design Suction Temp °F	Compressor Number 4		Compressor Number 3		Compressor Number 2		Compressor Number 1	
	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig
-33	9	5	7	3	5	1	4	0
-30	10	6	8	4	6	2	5	1
-28	11	7	9	5	7	3	6	2
-25	12	8	10	6	8	4	7	3
-23	13	9	11	7	9	5	8	4
-21	14	10	12	8	10	6	9	5
-20	15	11	13	9	11	7	10	6
-16	17	13	15	11	13	9	12	7
-15	18	14	16	12	14	10	13	9
-10	22	18	20	16	18	14	17	13

**Caution:** Never run the compressors in a vacuum.

# CONDENSER PRESSURE AND TEMPERATURE SETTINGS HLCVB, HLVCF, HLCVG, HLCVI, HLVCV, HLCVW

## Refrigerants 404A/507 &amp; 22

Condenser Fan Alignment		Pressure Settings psig							Ambient Control								Split Cond	Heat Reclaim	Heat Reclaim
		PC1	PC2	PC3	PC4	PC5	PC6	PC7	Pressure psig		Temperature °F						Thermostat	Pressure	Lockout
		CI	CI	CI	CI	CI	CI	CI	PC1	PC2	TC1	TC2	TC3	TC4	TC5	TC6	Setting	Override	psig
1 X 2	CI	195	205						215		40	75					50	190	165
	CO	155	165						190		35	70					55	265	140
1 X 3	CI	195	200	210					215		40	50	75				50	190	165
	CO	155	160	170					190		35	45	70				55	265	140
1 X 4	CI	195	200	205	215				215		40	50	70	75			50	190	165
	CO	155	160	165	175				190		35	45	65	70			55	265	140
1 X 5	CI	195	200	205	210	215			215		40	50	70	75	80		50	190	165
	CO	155	160	165	170	175			190		35	45	65	70	75		55	265	140
1 X 6	CI	195	200	205	210	215	220		215		40	50	60	65	70	75	50	190	165
	CO	155	160	165	170	175	180		190		35	45	55	60	65	70	55	265	140
1 X 7	CI	195	200	205	210	215	220	225	215		40	50	60	65	70	75	80	190	165
	CO	155	160	165	170	175	180	185	190		35	45	55	60	65	70	75	265	140
2 X 2	CI	195	205						200	215	40	75					50	190	165
	CO	155	165						175	190	35	70					55	265	140
2 X 3	CI	195	200	210					200	215	40	50	75				50	190	165
	CO	155	160	170					175	190	35	45	70				55	265	140
2 X 4	CI	195	200	205	215				200	215	40	50	70	75			50	190	165
	CO	155	160	165	175				175	190	35	45	65	70			55	265	140
2 X 5	CI	195	200	205	210	215			200	215	40	50	70	75	80		50	190	165
	CO	155	160	165	170	175			175	190	35	45	65	70	75		55	265	140
2 X 6	CI	195	200	205	210	215	220		200	215	40	50	60	65	70	75	50	190	165
	CO	155	160	165	170	175	180		175	190	35	45	55	60	65	70	55	265	140
2 X 7	CI	195	200	205	210	215	220	225	200	215	40	50	60	65	70	75	80	190	165
	CO	155	160	165	170	175	180	185	175	190	35	45	55	60	65	70	75	265	140

## Flooding Valve

Set Point A-9  
150 psig 140 psig

**Note:** For every 10 lb increase in flooding valve setting, increase  
•all thermostatic fan settings by 3°F  
•all pressure settings for fans by 10 lbs.

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**MERCHANDISER SETTINGS**

Application	MEAT								
Models	M1	M1E	M1G	M1GE	M2E M2GE M4E M5E	M3 M4G M5	M3E M5GE	M3G	M3GE
<b>Refrigeration</b>									
Discharge Air Temperature °F	27°F	28°F	26°F	26°F	29°F	28°F	28°F	27°F	28°F
Evaporator Temperature °F	18°F	21°F	18°F	21°F	21°F	18°F	21°F	18°F	21°F
Fan Cycling CI/CO °F	—	—	—	—	—	—	—	—	—
<b>Defrost</b>									
Frequency, Hrs	6 Hrs	6 Hrs	6 Hrs	6 Hrs	6 Hrs	6 Hrs	6 Hrs	6 Hrs	8 Hrs
Electric Temp Term °F									
Failsafe Min	—	—	—	—	—	—	—	—	—
Reverse Air Temp Term °F									
Failsafe Min	—	—	—	—	—	—	—	—	—
Koolgas Duration Min	—	—	—	—	—	—	—	—	—
Offtime Temp Term °F	43°F	43°F	43°F	43°F	48°F	48°F	48°F	48°F	48°F
Duration Min	35 Min	35 Min	35 Min	40 Min	30 Min	30 Min	35 Min	30 Min	35 Min

Application	MEAT				PRODUCE			
Models	M4	M4GE	M5G	MWG MWGE	P1	P1E	P2	P2E
<b>Refrigeration</b>								
Discharge Air Temperature °F	28°F	29°F	27°F	26°F	31°F	31°F	37°F	33°F
Evaporator Temperature °F	18°F	21°F	18°F	18°F	21°F	24°F	21°F	24°F
Fan Cycling CI/CO °F	—	—	—	—	—	—	—	—
<b>Defrost</b>								
Frequency, Hrs	6 Hrs	6 Hrs	6 Hrs	8 Hrs	8 Hrs	8 Hrs	6 Hrs	8 Hrs
Electric Temp Term °F								
Failsafe Min	—	—	—	—	—	—	—	—
Reverse Air Temp Term °F								
Failsafe Min	—	—	—	—	—	—	—	—
Koolgas Duration Min	—	—	—	—	—	—	—	—
Offtime Temp Term °F	48°F	48°F	48°F	60°F	43°F	43°F	48°F	48°F
Duration Min	25 Min	35 Min	35 Min	43 Min	35 Min	35 Min	30 Min	30 Min



## MERCHANDISER SETTINGS (Cont'd)

Application	PRODUCE								
Models	P4	P4E	PW	PWE	PW (End)	PWE (End)			
<b>Refrigeration</b>									
Discharge Air Temperature °F	29°F	31°F	34°F	34°F	32°F	32°F			
Evaporator Temperature °F	21°F	24°F	21°F	24°F	21°F	24°F			
Fan Cycling CI/CO °F	—	—	—	—	—	—			
<b>Defrost</b>									
Frequency, Hrs	6 Hrs	6 Hrs	8 Hrs	8 Hrs	8 Hrs	8 Hrs			
Electric Temp Term °F Failsafe Min	—	—	—	—	—	—			
Reverse Air Temp Term °F Failsafe Min	—	—	—	—	—	—			
Koolgas Duration Min	—	—	—	—	—	—			
Offtime									
Temp Term °F	48°F	48°F	—	—	—	—			
Duration Min	30 Min	30 Min	45 Min	45 Min	45 Min	45 Min			

**MERCHANDISER SETTINGS (Cont'd)**

Application	MEAT, DELI, DAIRY, PRE-CUT & PKG					DAIRY / DELICATESSEN			
Models		C2LE C2E C2LGE	C2XLE C2XE C2XLGE			D5L D5 D6L D6 D5LR D5R D5HR	D5LE D5E D5HE D6LE D6E D5LRE D5RE D5HRE D5NLE D5NE	D5G D5H	D5GE D5NHE D5NGE
<b>Refrigeration</b>									
Discharge Air Temperature °F		27°F	29°F			31°F	32°F	31°F	32°F
Evaporator Temperature°F		21°F	21°F			21°F	24°F	21°F	24°F
Fan Cycling CI/CO °F		—	—			—	—	—	—
<b>Defrost</b>									
Frequency, Hrs		6 Hrs	6 Hrs			6 Hrs	6 Hrs	6 Hrs	6 Hrs
Electric Temp Term°F Failsafe Min		—	—			—	—	—	—
Reverse Air Temp Term°F Failsafe Min		—	—			—	—	—	—
Koolgas Duration Min		—	—			—	—	—	—
Offtime									
Temp Term°F Duration Min		48°F 30 Min	48°F 30 Min			48°F 30 Min	48°F 35 Min	48°F 35 Min	48°F 40 Min

## MERCHANDISER SETTINGS (Cont'd)

Application	DAIRY	DELICATESSEN	FROZEN FOOD	ICE CREAM
Models	RM	RM	RL	RL
<b>Refrigeration</b>				
Discharge Air Temperature °F	34°F	30°F	-5°F	-12°F
Evaporator Temperature °F	27°F	23°F	-11°F	-19°F
Fan Cycling CI/CO °F	—	—	—	—
<b>Defrost</b>				
Frequency, Hrs	24 Hrs	24 Hrs	24 Hrs	24 Hrs
Electric Temp Term °F Failsafe Min	—	—	48°F 40 Min	48°F 40 Min
Reverse Air Temp Term °F Failsafe Min	—	—	—	—
Koolgas Duration Min	TBD	TBD	20 Min	20 Min
Offtime Temp Term °F Duration Min	TBD TBD	TBD TBD	—	—

**Preliminary Data — Preliminary Data — Preliminary Data — Preliminary Data**

**MERCHANDISER SETTINGS (Cont'd)**

Application	FROZEN FOOD					ICE CREAM			
Models	L LG LN LNG LI LIG LW LWG LWU LWUG LWE LWEG	LNG	LIG			L LG LN LI LW LWG LWU LWUG LWE LWEG	LNG	LIG	
<b>Refrigeration</b>									
Discharge Air Temperature °F	-12°F	-10°F	-12°F			-22°F	-20°F	-20°F	
Evaporator Temperature °F	-20°F	-20°F	-20°F			-30°F	-30°F	-30°F	
Fan Cycling CI/CO °F	—	—	—			—	—	—	
<b>Defrost</b>									
Frequency, Hrs	24 Hrs	24 Hrs	24 Hrs			24 Hrs	24 Hrs	24 Hrs	
Electric									
Temp Term °F	48°F	48°F	48°F			48°F	48°F	48°F	
Failsafe Min	60 Min	60 Min	60 Min			60 Min	60 Min	60 Min	
Reverse Air									
Temp Term °F	—	—	—			—	—	—	
Failsafe Min	—	—	—			—	—	—	
Koolgas									
Duration Min	15 Min	15 Min	18 Min			18 Min	18 Min	21 Min	
Offtime									
Temp Term °F	—	—	—			—	—	—	
Duration Min	—	—	—			—	—	—	

## MERCHANDISER SETTINGS (Cont'd)

Application	ICE CREAM			FROZEN FOOD				MEAT	
Models	GC	G5C	RCA	FML	GF	G5F	RFA	NM5	NEBSHM
For all Merchandisers with Gravity Coils, the Temperature listed in the "Discharge Air" row is <b>Product Temperature</b> .	GCI	G5CH	RCH	FMLG	GFI	G5FL	RFH		
	GGC	G6C			GG	G5FH			
	GTC	G6CH	NRC		GTF	G6F	NRF		
	GWIC		NRCV		GW	G6FL	NRFV		
	GWIT	NC6			GWIT	G6FH			
	GW16	NC6H			GW16				
						NF6			
	NC1				NF1	NF6H			
	NC1N				NF1N	NF6L			
	NCN				NFN				
	NCW				NFW				
	NFCW				NFCW				
	NCFS				NFFS				
	NCWE				NFWE				
	NFCWE				NFCWE				
<b>Refrigeration</b>									
Discharge Air Temperature °F	-20°F	-20°F	-12°F	-10°F	-10°F	-8°F	-5°F	24°F	24°F
Evaporator Temperature °F	-30°F	-30°F	-19°F	-25°F	-20°F	-18°F	-11°F	18°F	20°F
Fan Cycling CI/CO °F	—	—	—	—	—	—	—	—	—
<b>Defrost</b>									
Frequency	24 Hrs	6 Hrs	24 Hrs	12 Hrs	24 Hrs	12 Hrs	24 Hrs	6 Hrs	24 Hrs
Electric									
Temp Term °F	52°F	54°F	54°F	50°F	52°F	54°F	54°F	48°F	—
Failsafe Min	60 Min	36 Min	40 Min	46 Min	60 Min	36 Min	40 Min	40 Min	—
Reverse Air									
Temp Term °F	48°F	48°F	—	—	48°F	48°F	—	—	—
Failsafe Min	90 Min	60 Min	—	—	90 Min	60 Min	—	—	—
Koolgas									
Duration Min	24 Min	22 Min	20 Min	14 Min	20 Min	22 Min	20 Min	—	—
Offtime									
Temp Term °F	—	—	—	—	—	—	—	48°F	—
Duration Min	—	—	—	—	—	—	—	40 Min	90 Min

**MERCHANDISER SETTINGS (Cont'd)**

Application	MEAT								DELI
Models	CGDM CSDM	FHM FHMG FHHM FHHMGH FHMS FHMSG MHF MHFG MHFGH	FM FMG FMV FMGV FMGC VFMGC FMGCD	FMR FMRV FMRG FMRGV FMRGC	CGDMG CGDMGT CSDMG	GF GFI GG GWIT GWI GTF GWI6 GFFS	MWI MWI6	VGL VGK VGS VGLR VGSR	CGDM CSDM
For all Merchandisers with Gravity Coils, the Temperature listed in the "Discharge Air" row is <b>Product Temperature</b> .	NEBDH NEBSH	NM3 NM3G NM4 NM4G NDD3 NDD3G NDD4 NDD4G	NM1 NM1G		NEGDF NEGSF NEGDT NEGDM	NF1 NF1N NFN NFW NFCW NFCWE NFCWE NFFS		NVGB NVGC NVGA	NEBDH NEBSH
<b>Refrigeration</b> Discharge Air Temperature °F	24°F	22°F	22°F	22°F	24°F	24°F	22°F	24°F	26°F
Evaporator Temperature °F	20°F	11°F	17°F	9°F	21°F	18°F	10°F	22°F	22°F
Fan Cycling CI/CO °F	—	28/38°F	28/38°F	28/38°F	—	—	—	—	—
<b>Defrost</b> Frequency	24 Hrs	6 Hrs	12 Hrs	12 Hrs	24 Hrs	24 Hrs	8 Hrs	24 Hrs	24 Hrs
Electric Temp Term °F Failsafe Min	54°F 40 Min	— —	48°F 46 Min	48°F 46 Min	— —	52°F 60 Min	— —	— —	— —
Reverse Air Temp Term °F Failsafe Min	— —	48°F 46 Min	48°F 70 Min	48°F 70 Min	48°F 90 Min	48°F 60 Min	48°F 60 Min	48°F 110 Min	— —
Koolgas Duration Min	24 Min	14 Min	14 Min	14 Min	14 Min	20 Min	14 Min	—	—
Offtime Temp Term °F Duration Min	— 90 Min	— 46 Min	— 70 Min	— 70 Min	— 90 Min	— —	— 60 Min	— 110 Min	— 100 Min

## MERCHANDISER SETTINGS (Cont'd)

Application	DELI and CHEESE								
Models	CWI CWI6 MWI MWI6	DMD DMDH DMDA	FHM FHMG FHMH FHMGH FHMS FHMSG MHF MHFG MHFGH	FM FMG FMV FMGV FMGC VFMGC FMGCD	RDM RDMH	RMA RMFA	VLB VBS VBK VBT	VGL VGK VGS VGLR VGSR	CGDMG CGDMGT CSDMG
For all Merchandisers with Gravity Coils, the Temperature listed in the "Discharge Air" row is <b>Product Temperature</b> .									
<b>Refrigeration</b>									
Discharge Air Temperature °F	30°F	32°F	32°F	30°F	30°F	30°F	34°F	38°F	25°F
Evaporator Temperature °F	20°F	18°F	20°F	25°F	20°F	23°F	20°F	20°F	21°F
Fan Cycling CI/CO °F	—	—	28/38°F	28/38°F	—	—	—	—	—
<b>Defrost</b>									
Frequency	6 Hrs	6 Hrs	6 Hrs	12 Hrs	24 Hrs	24 Hrs	24 Hrs	24 Hrs	24 Hrs
Electric									
Temp Term °F	—	—	—	48°F	—	—	—	—	—
Failsafe Min	—	—	—	70 Min	—	—	—	—	—
Reverse Air									
Temp Term °F	—	48°F	48°F	—	—	—	—	—	—
Failsafe Min	—	40 Min	40 Min	—	—	—	—	—	—
Koolgas									
Duration Min	14 Min	14 Min	14 Min	14 Min	12 Min	12 Min	—	—	—
Offtime									
Temp Term °F	—	—	—	—	—	—	—	—	—
Duration Min	56 Min	40 Min	40 Min	70 Min	60 Min	60 Min	60 Min	110 Min	90 Min

**MERCHANDISER SETTINGS (Cont'd)**

Application	DAIRY				FLORAL	PRODUCE			BAKERY
Models	DMZ DMZA DMZH DMX DMXA DMXH	JVMR JVMRS	RDM	RMA RMFA	RMFA	Bulk PRO PHSM PH PHRO P	Pack PRO PHSM PH PHRO P	PVWI PWI PWIRO EPWI PVWI6 PWI6 PWIRO6 EPWI6	CGBR
For all Merchandisers with Gravity Coils, the Temperature listed in the "Discharge Air" row is <b>Product Temperature</b> .	ND5LZ ND5Z ND5HZ ND5LX ND5X ND5HX			NRD NRDV NRFL NRFLV	NRFL NRFLV	NP1 NP2	NP1 NP2		NEBBDT
<b>Refrigeration</b> Discharge Air Temperature °F	32°F	29°F	32°F	34°F	30°F	37°F	33°F	33°F	30°F
Evaporator Temperature °F	21°F	15°F	25°F	27°F	23°F	21°F	18°F	20°F	18°F
Fan Cycling CI/CO °F	—	—	—	—	—	—	—	—	—
<b>Defrost</b> Frequency	8 Hrs	6 Hrs	24 Hrs	24 Hrs	24 Hrs	6 Hrs	6 Hrs	8 Hrs	12 Hrs
Electric Temp Term °F Failsafe Min	— —	— —	— —	— —	— —	— —	— —	— —	— —
Reverse Air Temp Term °F Failsafe Min	48°F 40 Min	— —	— —	— —	— —	— —	— —	— —	— —
Koolgas Duration Min	14 Min	—	12 Min	12 Min	12 Min	12 Min	12 Min	—	—
Offtime Temp Term °F Duration Min	— 40 Min	— 60 Min	— 60 Min	— 60 Min	— 60 Min	— 40 Min	— 40 Min	— 46 Min	— 40 Min



## MERCHANDISER SETTINGS (Cont'd)

Application	Fresh Fish/Seafood			Additional Merchandisers		
Models	CGFM CSFM	CGFMG CSFMG	VFL VFS VFK VFT	Meat DSRP	Cheese DSRP	Produce DSRP DSRP-Y
For all Merchandisers with Gravity Coils, the Temperature listed in the "Discharge Air" row is <b>Product Temperature</b> .	NESDH NESSH		NVSA NVSB NVSC			
<b>Refrigeration</b> Discharge Air Temperature °F	24°F	36°F	34°F	26°F	30°F	36°F
Evaporator Temperature °F	20°F	20°F	27°F	12°F	18°F	18°F
Fan Cycling CI/CO °F	—	—	—	—	—	—
<b>Defrost</b> Frequency	24 Hrs	24 Hrs	24 Hrs	8 Hrs	8 Hrs	8 Hrs
Electric Temp Term °F	—	—	—	—	—	—
Failsafe Min	—	—	—	—	—	—
Reverse Air Temp Term °F	—	—	—	48°F	—	—
Failsafe Min	—	—	—	50 Min	—	—
Koolgas Duration Min	—	—	—	14-16 Min	12 Min	12 Min
Offtime Temp Term °F	—	—	—	—	—	—
Duration Min	100 Min	90 Min	110 Min	—	50 Min	50 Min

**MERCHANDISER SETTINGS (Concluded)**

Application	Walk-in and Prep Room Data					
Models	Low Temp Coolers		Medium Temp Coolers			
	Ice Cream	Frozen Food	Meat Deli	Dairy Beverage	Produce	Prep Areas
For all Merchandisers with Gravity Coils, the Temperature listed in the "Discharge Air" row is <b>Product Temperature</b> .						
<b>Refrigeration</b> Discharge Air Temperature °F	Return -15°F	Return -5°F	28°F	Return 36°F	Return 41°F	Return 55°F
Evaporator Temperature °F	—	—	—	—	—	—
Fan Cycling CI/CO °F	—	—	—	—	—	—
<b>Defrost</b> Frequency	12 Hrs	12 Hrs	12 Hrs	12 Hrs	12 Hrs	24 Hrs
Electric Temp Term °F Failsafe Min	54°F 24 Min	54°F 24 Min	54°F 24 Min	— —	— —	— —
Reverse Air Temp Term °F Failsafe Min	— —	— —	— —	— —	— —	— —
Koolgas Duration Min	16 Min	16 Min	16-24 Min	16 Min	16 Min	16 Min
Offtime Temp Term °F Duration Min	— —	— —	— 90 Min	— 60 Min	— 60 Min	— 120 Min

## START-UP AND MAINTENANCE

### Warning

**Know whether a circuit is open at the power supply or not. Remove all power before opening control panels.** Note: Some equipment has more than one power supply.

**Always use a pressure regulator with a nitrogen tank.** Do not exceed 2 pounds of pressure and vent lines when brazing. Do not exceed 350 pounds of pressure for leak testing high side. Do not exceed 150 pounds of pressure for leak testing low side.

Always follow current EPA regulations and guidelines.

### START-UP

**Note:** Regardless of which refrigerant will be used for the operating charge, R22 may be used for leak checking and pressure testing at start-up.

#### Leak Testing

Visually inspect all lines and joints for proper piping practices.

#### Isolate

- Compressors—Front-seat Service Valves on Suction and Discharge. Close oil supply line immediately downstream of the Turba-shed.
- Pressure Transducers—Close Angle Valves.
- Autosurge Pilot Valve—Close Angle Valves on suction and discharge manifolds.

#### Open

- Ball valves—to branches, condenser, heat reclaim, receiver.
- Main Liquid Line Solenoid Valve—Solenoid should be energized.
- Branch Liquid Line Solenoid Valve—solenoid should be energized or manual open used.
- Split Condenser—Both sides open. Energize valve solenoid.

#### Disconnect

- Defrost Time Clock—Disconnect power to the clock. Be sure all branches are in refrigeration mode and ensure that the defrost clock cannot initiate a defrost during start-up procedure.

#### Verify

- Refrigerant requirements for System, Compressors, and TEV's in merchandisers and coolers.
- Electrical supply and component requirements.

### Warning

**Always recapture test charge using approved recovery methods.**

#### Test Charge

Use properly regulated dry nitrogen and R22 to pressurize the system with vapor only. Charge about 25 pounds of R22 through a dehydrator. Through another line add dry nitrogen to bring the system pressure up to 150 psig. Use an electronic leak detector to inspect all connections. If a leak is found, isolate, repair, and retest. Be sure system is at 150 psig, and all valves closed to isolate the leak are opened. After the last leak is repaired and tested, the system must stand unaltered for 12 hours with no pressure drop from 150 psig.

### Oil Levels

Check oil levels for each compressor and the Turba-shed:

Compressor sight glass  $\frac{1}{8}$  to  $\frac{1}{2}$  full  
Turba-shed between two lower sight glasses.

If oil level is low, add recommended oil only:

	<b>Copeland</b>
<b>R22</b>	Suniso 3GS
<b>R404A/ R507</b>	Mobil EAL ARCTIC 22 CC

### Evacuation

Nitrogen and moisture will remain in the system unless proper evacuation procedures are followed. Nitrogen left in the system may cause head pressure problems. Moisture causes TEV ice blockage, wax build up, acid oil, and sludge formation.

**Do not** simply purge the system—this procedure is expensive, harmful to the environment, and may leave moisture and nitrogen behind.

**Do not** run the compressors to evacuate—this procedure introduces moisture into the compressor's crankcase oil and does not produce adequate vacuum to remove moisture from the rest of the system at normal temperatures.

### Setup

Using all copper lines and packless valves, connect an eight CFM or larger vacuum pump to a  $\frac{1}{8}$ -inch header and from the header to at least three access ports on the rack. Connect one micron vacuum gauge at the pump and one at the furthest point in the system from the rack. Plan procedures so breaking the vacuum with refrigerant will not introduce contaminants into the system. The vacuum pump must be in good condition filled with fresh oil to achieve desired results.

### Procedure

Pull a vacuum to 1500 microns. If the vacuum fails to hold, determine the cause and correct. Begin again with the first of the three required evacuations.

Break the vacuum with R22 vapor to a pressure of about 2 psig. Do not exceed the micron gauge transducer's maximum pressure limit. Liquid refrigerant may cause damage to components through thermal shock or a pressure surge to the transducer of the micron gauge.

Repeat first two steps.

Install the suction and liquid drier cores.

Pull a vacuum to 500 microns. Close vacuum header valves and allow system to stand for a minimum of 12 hours. If the 500 micron vacuum holds, charging may begin. If the 500 micron vacuum does not hold, the cause must be determined and corrected. Repeat the entire evacuation procedure from the first step.

*Pre-charge Check List*

Preparation for charging can begin while the system is being evacuated. During any of the pull downs, check:

*Merchandisers*

- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting.

*Walk-in coolers and freezers*

- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting.

*Condensers*

- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat or pressure settings
- Damper operation, if equipped.

*Heat Reclaim and other systems*

- Electrical requirements and power supply
- Electrical connections tight and clean
- Component operation.

**Note: Remember to reinstate control to unit components jumpered to make tests.**

Set all mechanical pressure controls. Compressors should still be isolated from the rest of the system. Set all electronic compressor controls into switch-back so the mechanical controls are in command of all system functions.

During the last evacuation look up and make a list of the required control settings for the system. A copy of the equipment legend will be needed to determine the system's design operating points. High and low pressure, heat reclaim lockout, winter control settings, and other controls on the system should be noted.

**Warning**

**Never trap liquid refrigerant  
between closed valves.  
Hydraulic explosion  
may result.**

**Charging***Open*

Compressors—Backseat Service Valves on Suction and Discharge. Open oil supply line immediately downstream of the Turba-shed.

Pressure Transducers—Open Angle Valves.

*Leave Isolated*

Autosurge Pilot Valve—Leave Angle Valves closed on suction and discharge manifolds until system stabilizes.

*Connect*

Defrost Time Clock—Connect power to the clock and set to proper time.

*Leave Open*

Ball valves—to branches, condenser, heat reclaim, receiver.

Main Liquid Line Solenoid Valve—Now under control of defrost clock.

Branch Liquid Line Solenoid Valve—Back out manual open screws.

Suction Stop EPR or CDA Valves—Suction Stop EPR under control of defrost clock. CDA Valves replace fuse in panel board to place under control of defrost clock.

Split Condenser—Operating under pressure controls.

*Check*

Oil levels for all compressors and Turba-shed.

Close the Ball Valve immediately downstream of the Receiver and connect the proper refrigerant to its Access Port. Slowly open the liquid valve on the refrigerant tank and charge the Receivers to 60% on the liquid gauge. Disconnect refrigerant tank and open the ball valve. Liquid level should decrease as refrigerant is drawn out into system field piping.

**CAUTION: The remaining charge must be added only as vapor through the suction header.**

**Note:** With non-azeotropic refrigerants, it is best to charge the entire contents of the cylinder to prevent fractionalization of the refrigerant when charging vapor.

Charge the system to approximately 30% of the receiver on the liquid gauge. Turn on compressor number one to speed up charging. Its suction pressure should remain below 20 psig for low temperature and below 45 psig for medium temperature units. If necessary, turn on more compressors. Monitor the oil levels carefully. At the first sign of trouble or unusual compressor operation shut off the system.

After 30% charge is achieved, check oil levels. Bring on each compressor one at a time.

Check:

- Suction and discharge pressure
- Oil Pressure
- Voltage differential and balance
- Ampere draw and balance.

Allow the full rack to operate until it stabilizes. If the Receiver charge drops below 15% add more vapor until a 15% level is obtained. Watch oil levels, receiver liquid level and possible flood back from evaporator.

Shut off all compressors and recheck oil levels in each compressor and the Turba-shed. Leak testing, evacuation and initial charging are now completed.

### Compressor Motor Rotation

To check compressor rotation, use the following procedure:

1. Install gauges on suction and discharge headers. Be aware of Satellite and Split-Suction Scroll Plus units when making hook-up. A momentary compressor run should cause a drop in suction header and a rise in discharge header pressure.
2. With main disconnect **OFF**, switch **OFF** all breakers in the control panel except the control circuit breaker.
3. Turn **ON** main disconnect.
4. Look for the red light on the single phase protector. If it is not lit, turn **OFF** the main disconnect. All Scroll Plus 3-Phase wiring is connected: L<sub>1</sub> to T<sub>1</sub>, L<sub>2</sub> to T<sub>2</sub>, and L<sub>3</sub> to T<sub>3</sub>. Have the field connections corrected so the phase protector indicates phase alignment. (The red light is lit.)
5. Turn **ON** main disconnect.
6. Using the compressor controller, force all compressors **ON**.
7. Momentarily turn **ON** compressor breaker #1 and verify correct pumping direction. Check all compressors before switching any wires. If all compressors are rotating backwards, change two Legs at the field side of the main disconnect. For individual compressors, change the Legs on the load side of the compressor contactor.
8. Using the compressor controller, remove all forced conditions.

## Final Checks

Once the system is up and running, **it is the responsibility of the installer** to see that all the fine adjustments are made so the Scroll Plus™ Fibertronic™ delivers maximum temperature performance and efficiency for the customer. These include:

- Defrost scheduling and timing
- Condenser controls
- Winter controls
- Subcooling
- EPR, ORI and CDA settings
- TEV superheat adjustment
- CPR settings
- High and low pressure controls
- Main liquid line solenoid differential
- Thermostat settings
- Adjustments to electronic controls.

Thoroughly inspect all field piping while the equipment is running and add supports where line vibration occurs. Be sure additional supports do not conflict with pipe expansion and contraction.

**When merchandisers are completely stocked,** check the operation of the system again.

**At 48 hours** of operation replace the liquid drier and suction filter cores.

**At 90 days** recheck the entire system, including all field wiring. Change the oil filter using a Sporlan SF-283-F. Future maintenance costs may be reduced if an oil acidity test is run at this time. Replace acid oil.

## MAINTENANCE

### Compressor Replacement

Since each machine room tends to be unique, plan carefully as to how you will move the compressors without harming personnel, equipment or the building. Before beginning removal of old compressor, make replacement unit ready to install:

*Verify*

Replacement compressor

- Electrical requirements

- Refrigerant application

- Capacity

- Piping hookup location and design

- Suction and discharge gaskets

- Mounting requirements.

Have compressor in an easily accessible position, uncrated and unbolted from shipping pallet.

*Disconnect Electrical Supply*

Turn off motor and control panel power supplies to the Rack.

Turn off control circuit and open all compressor circuit breakers.

Tag and remove electrical wires and conduit from the compressor.

*Isolate Compressor from Rack*

Front-seat Suction and Discharge Service Valves. Close oil supply and equalizing lines.

Bleed compressor pressure through both discharge and suction access ports into an **approved recovery vessel**.

Remove oil supply and equalizing lines.

Remove externally mounted components which will be re-used on the replacement compressor.

Plug holes to compressor manufacturer's specifications.

Remove suction and discharge rotolocks.

Remove mounting bolts.

When moving the compressor, use a come-along, hoist or hydraulic lift to carry the weight.

**Do not** use the rack piping or panel to support a hoist or come-along.

**Do not** use ceiling trusses to support a hoist or come-along.

If a compressor removal table is used, slide the compressor fully on to the table, then roll table to overhead hoist or hydraulic lift area.

Install the new compressor in reverse order of removal. Do not open the new compressor to the system until after it has been leak tested and triple evacuated.

Check rotation of new compressor (see Page 8-4).

**Note:** Oil level regulator sight glasses are designed to provide a hermetic seal when internally pressurized. Some leaking may occur when a deep vacuum is pulled.

### **Cleaning the Turba-shed™**

Should the Turba-shed require cleaning, first shut down the system. Isolate the Turba-shed and bleed off pressure into an **approved recovery vessel**. Remove the top and bottom sight glasses and the oil supply line. With a clean, dry, regulated pressure source like nitrogen, blow out any sludge or dirt. Install the sight glasses using new O-rings.

Parker Number 2-23,  
Compound557  
Precision Rubber, Number 023,  
Compound 2337

Leak test, evacuate, and charge with fresh oil (only Suniso 3G or Texaco Capella WF32). Open valves closed to isolate the oil system and bring the rack back on line.

### **Replacing Drier and Filter Cores**

Shut down the system. Isolate the core to be replaced and bleed off pressure into an **approved recovery vessel**. Open housing, replace core and close up. Pressurize, leak test and bring back into line.



# HUSSMANN®

## Limited Warranty

**This warranty is made to the original user at the original installation site and is not transferable.**

Hussmann merchandisers are warranted to be free from defect in material and workmanship under normal use and service for a period of one (1) year from the date of original installation (not to exceed fifteen (15) months from the date of shipment from the factory). **Hussmann Impact Modular Coils are warranted for a total of five (5) years based upon the above criteria.** Hussmann's obligation under this warranty shall be limited to repairing or exchanging any part or parts, without charge F.O.B. factory or nearest authorized parts depot within said period and which is proven to the satisfaction of the original manufacturing plant warranty group to be thus defective.

Hussmann covers the entire case or refrigeration product and all its components (except for lamps, driers, fuses, and other maintenance type replacement parts) for the one (1) year warranty period.

Additionally, Hussmann warrants for a total period of three (3) years all sealed, multi-glass assemblies except those used in sliding doors on closed meat display cases. If within three (3) years from the date of installation (not to exceed thirty-nine (39) months from the date of shipment from factory), it shall be proven to the satisfaction of the originating factory warranty group that there is impaired visibility through the multi-glass assemblies thereof caused by moisture between the glasses, the multi-glass assembly will be replaced free of charge, F.O.B. factory. This additional warranty excludes accident, misuse, or glass breakage.

On Hussmann-Gloversville manufactured self-contained display cases, Hussmann agrees to repair or exchange, at its option, the original motor/compressor unit only with a motor/compressor of like or of similar design and capacity if it is shown to the satisfaction of Hussmann that the motor/compressor is inoperative due to defects in factory workmanship or material under normal use and service as outlined in Hussmann's "Installation Instructions" which are shipped inside new Hussmann equipment. Hussmann's sole obligation under this warranty shall be limited to a period not to exceed five years from date of factory shipment.

On Hussmann refrigeration systems (Atlanta, Bridgeton, Brantford, Chino) and self-contained display cases (Bridgeton, Brantford, Chino, Denver), an additional (4) year extended warranty for the motor/compressor assembly is available, but must be purchased prior to shipment to be in effect. Hussmann reserves the right to inspect the job site, installation and reason for failure.

The motor/compressor warranties listed above do not include replacement or repair of controls, relays, capacitors, overload protectors, valve plates, oil pumps, gaskets or any external part on the motor/compressor replaceable in the field, or any other part of the refrigeration system or self-contained display case.

**THE WARRANTIES TO REPAIR OR REPLACE ABOVE RECITED ARE THE ONLY WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, MADE BY HUSSMANN WITH RESPECT TO THE ABOVE MENTIONED EQUIPMENT, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS, AND HUSSMANN NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT, ANY OTHER OBLIGATION OR LIABILITY IN CONNECTION WITH THE SALE OF SAID EQUIPMENT OR ANY PART THEREOF.**

***THIS WARRANTY SHALL NOT APPLY TO LOSS OF FOOD OR CONTENTS OF THE EQUIPMENT DUE TO FAILURE FOR ANY REASON. HUSSMANN SHALL NOT BE LIABLE:***

- For payment of labor for any removal or installation of warranted parts;
- For any repair or replacements made without the written consent of Hussmann, or when the equipment is installed or operated in a manner contrary to the printed instructions covering installation and service which accompanied such equipment;
- For any damages, delays, or losses, direct or consequential which may arise in connection with such equipment or part thereof;
- For damages caused by fire, flood, strikes, acts of God or circumstances beyond its control;
- When the equipment is subject to negligence, abuse, misuse or when the serial number of the equipment has been removed, defaced, or altered;
- When the equipment is operated on low or improper voltages
- When the equipment is put to a use other than normally recommended by Hussmann (i.e. deli case used for fresh meat);
- When operation of this equipment is impaired due to improper drain installation;
- For payment of refrigerant loss for any reason;
- For costs related to shipping or handling of replacement parts.

Hussmann Corporation, Corporate Headquarters: Bridgeton, Missouri, U.S.A. 63044-2483

August 15, 1998