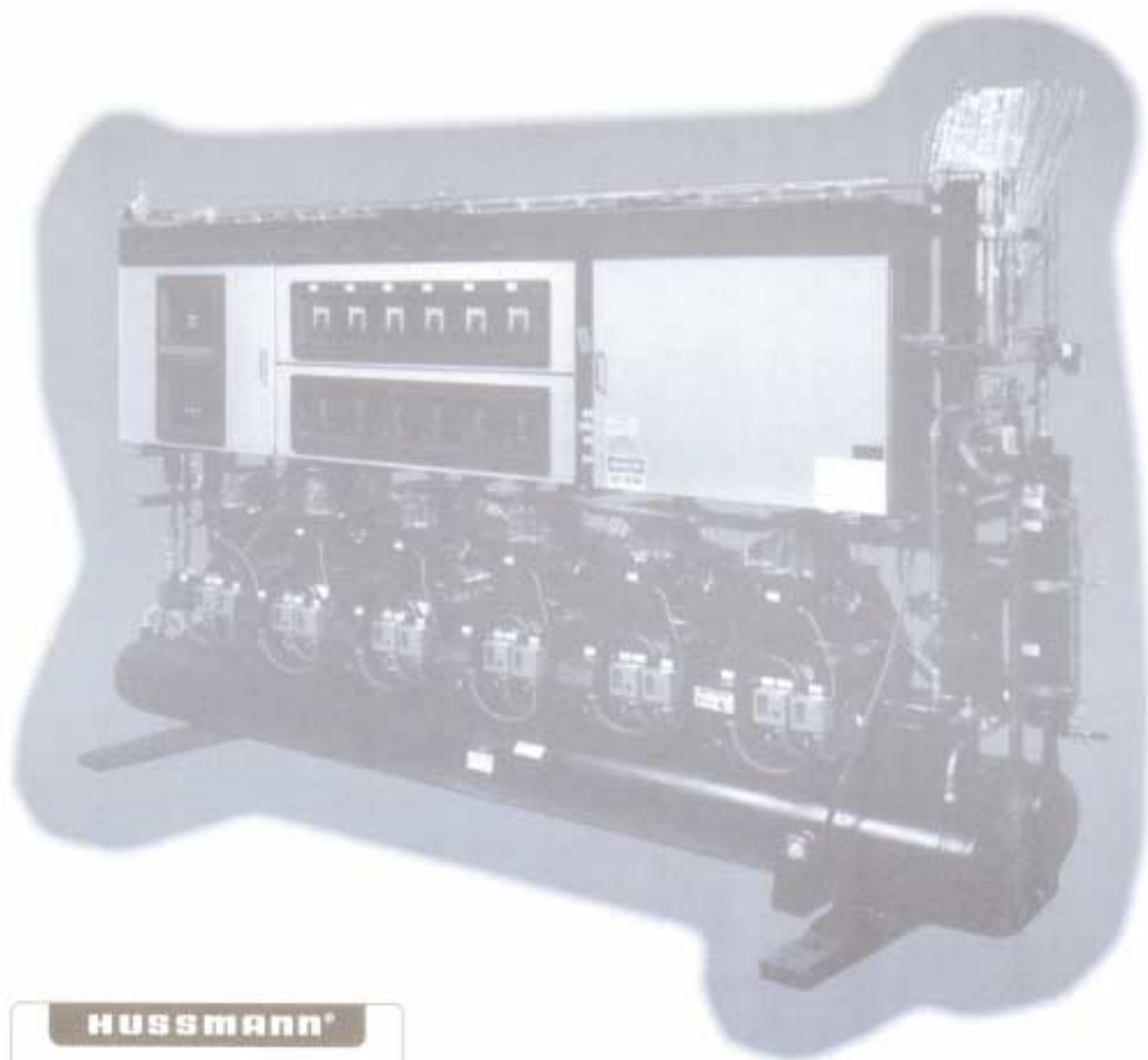


HUSSMANN®

Super Plus™

Fibertronic™



P/N 340272A

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.

WARNING

Some equipment has more than one power supply.

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, MO 63044-2483
(314) 291-2000

Congratulations!

With the purchase of Husmann's Super Plus™ 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

Super Plus[™] Fibertronic[™]

Installation and Service Manual

12999 St. Charles Rock Road • Bridgeton, MO 63044-2483 • (314) 291-2000

August, 1996

Printed in USA

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No. 7538

April 18, 1997

TO: Region Vice Presidents, Account Executives, District Managers,
Sales Managers, Sales Representatives, Branch Managers,
Hussmann Distributors, International

SUBJECT: *Update for SuperPlus Fibertronic Manual, P/N 340272, Rev. A*

The Super Plus Installation Manual has been updated as follows:

- **Addendum – Condenser Installation**
provides information on installing condensers with SuperPlus systems
(place behind index and in front of warranty page).
- **Section 3 – Piping**
changed Equalizing Line size to 7/8-inch (when required)
(discard page 3-3 and replace with page 3-3 dated April 15, 1997).
- **Section 8 – Settings**
updated Impact medium temperature settings and
added low temperature settings and new case settings
(discard pages 8-9 through 8-18 and replace with pages 8-9 through 8-20
dated March 1, 1997).

INSTALLATION INSTRUCTIONS

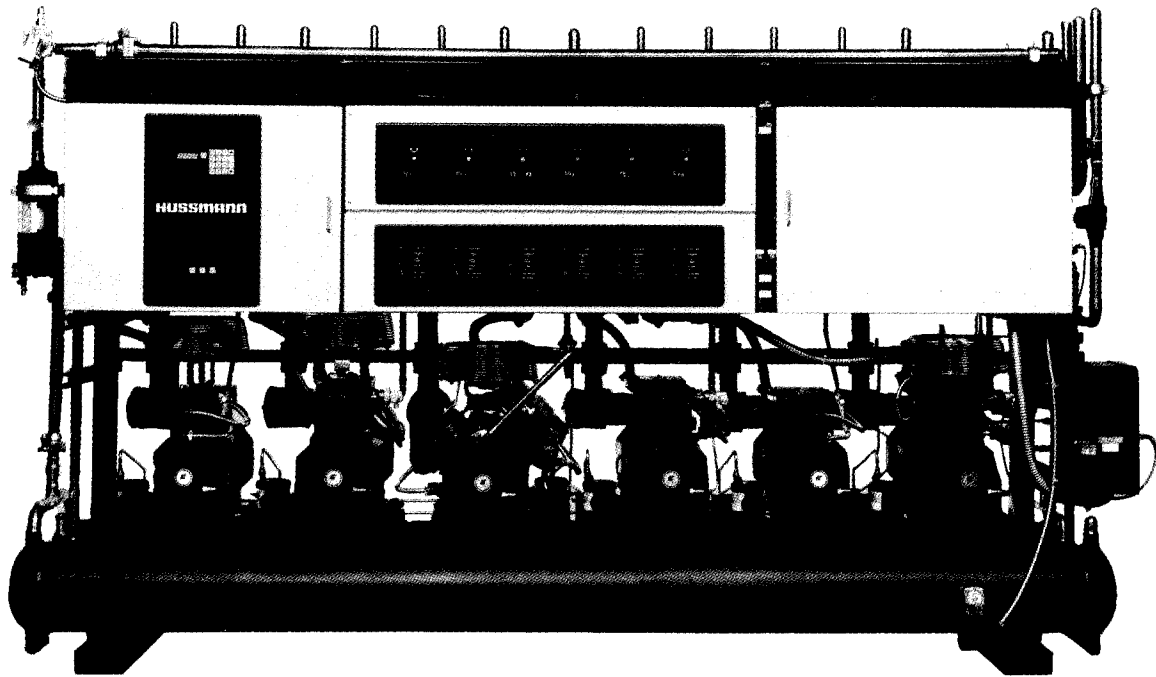


Figure 1-1 – Super Plus™ System

OVERVIEW

This section is limited to the information needed to set the Super Plus™ Compressor Rack. Power Supply requirements are found under “Electrical”; piping, under “Piping”; and charging, under “Startup and Maintenance”. Auxiliary units are found in the sections devoted to them or in the manuals accompanying them.

SUPER PLUS™ COMPONENTS

Each Super Plus contains the following:

1. Two to eight Copeland, or two to seven Carlyle semi-hermetic compressors with
 - a. High and Low Pressure Controls
 - b. Oil Pressure Safety Control
 - c. Primary Overload Protection
 - d. Compressor Cooling Fans on low temperature application, or $\frac{3}{4}$ to 3 HP rating on Copeland air cooled compressors
2. Factory piping with
 - a. Suction, Discharge and Liquid Headers
 - b. Turba-shed Oil Separator and return system
 - c. Dual Receiver Tanks
 - d. Suction Filters on each compressor
 - e. Liquid Filter Drier and Sight-glass
 - f. Liquid Level Indicator
3. Factory-wired control panel with
 - a. Pre-wired Distribution Power Block
 - b. Individual component Circuit Breakers and 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.

SUPER PLUS™ FRAME DIMENSIONS

Rack Assembly Nomenclature	Length (in.)	Height (in.)	Depth (in.)
01VK, 02VK, 04VY	77	78	35
03VK, 04VK, 05VY	90.5	78	35
05VK, 06VK, 06VY	113	78	35
07VK, 08VK, 07VY	135.5	78	35
08VY	158	78	35

Shell and Tube Mechanical Subcooler, or Vertical receiver, adds 32 inches to length.

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

Optional suction accumulators or water-cooled condensers will add 15 inches to depth.

Note: For 08VY and other Extended Racks, consult with Hussmann Engineering, Bridgeton, Mo.

SYSTEM WEIGHTS

Base Rack Weight

Rack Assembly Nomenclature	Base Weight (lbs)
01VK, 02VK, 04VY	1600
03VK, 04VK, 05VY	1700
05VK, 06VK, 06VY	1800
07VK, 08VK, 07VY	1900
08VY	2200

Shell and Tube Mechanical Subcooler adds 500 lbs to rack. Plate Subcooler adds 100 lbs.

Compressor Weights

Copeland Compressor Body	Weight per compressor (lbs)
M and N	300
2D and 3D	385
4D and 6D	575
3 AND 9	380
4 and 6	530

Carlyle Compressor Style	Weight per compressor (lbs)
06D	295
06E	500

Shipping Weight =
the Sum of Compressor Weights
+ the Rack Base Weight.

RECEIVER REFRIGERANT CAPACITIES

Receiver Capacities are based on 80% liquid fill at 110°F. All receiver tanks have a 10¾ inch diameter.

Rack Assembly Nomenclature	Receiver Length (in.)	R-404a / R507 (lbs)	R-22 (lbs)
01VK, 02VK, 04VY	77	328	394
03VK, 04VK, 05VY	90.5	387	465
05VK, 06VK, 06VY	113	487	584
07VK, 08VK, 07VY	135.5	585	702
08VY	158	684	821

MACHINE ROOM REQUIREMENTS

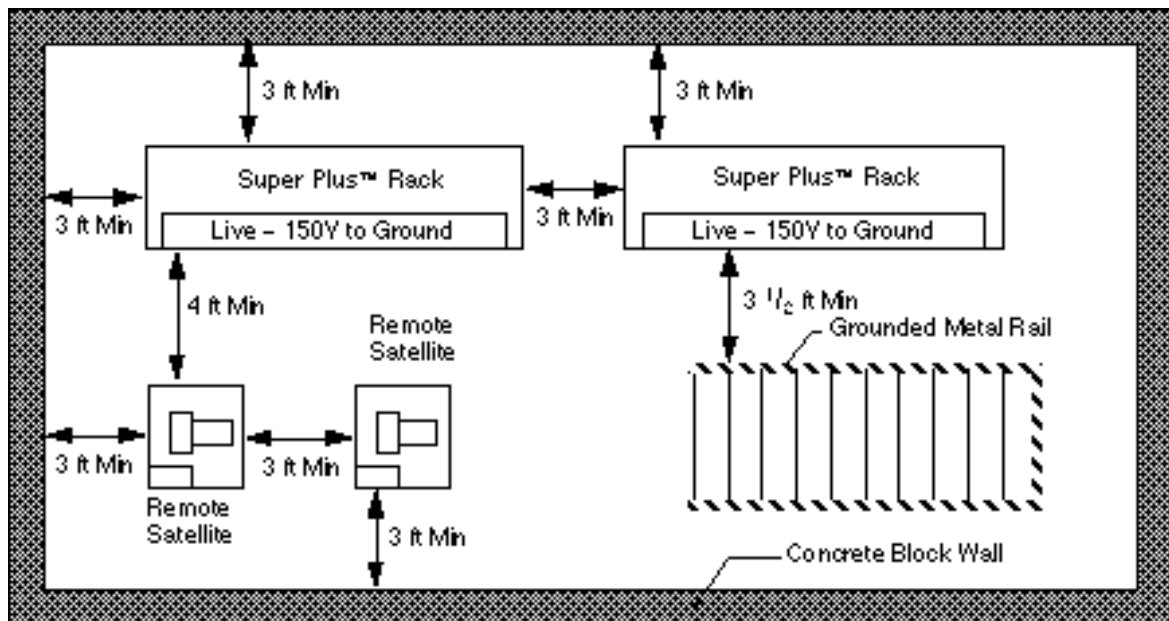
- The equipment room floor must solidly support the compressor unit as a live load. Ground level installation seldom presents problems, but a mezzanine installation must be carefully engineered.
- Ventilation should be 100 cfm per compressor unit horsepower. The air inlet should be sized for a maximum 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 header defrost 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.

Super Plus Load Points (Center to Center)

Rack Assembly Nomenclature	Load Point Dimensions Length (in.)	Width (in.)
01VK, 02VK, 04VY	51	30
03VK, 04VK, 05VY	64.5	30
05VK, 06VK, 06VY	87	30
07VK, 08VK, 07VY	109.5	30
08VY	66 & 66	30

Note: The 08VY and other Extended Rack have three cross feet and six load points, not the usual two and four. For nonstandard racks such as with mechanical subcooling consult Hussmann Engineering, Bridgeton, Mo.



UNIT PLACEMENT

When setting the Super Plus Rack 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.

Minimum Allowable Distances

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

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

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

Maximum Allowable Distances

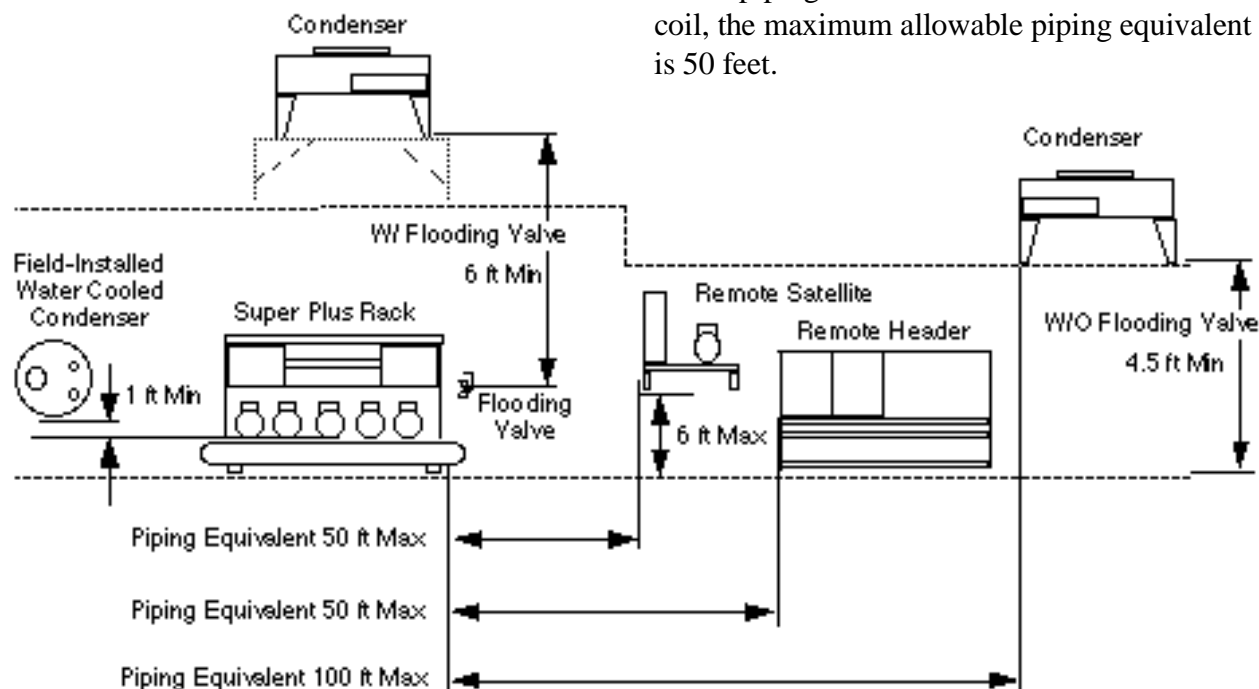
Remote Satellites should not be placed below the level of the Super Plus Rack. The Satellite may be positioned above the Rack. The maximum allowable elevation is 6 feet from the bottom of the Satellite to the bottom of the Rack.

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.



LIFTING AND LEVELING

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

NOTE: This unit is slightly front heavy, due to the Control Panel. Take necessary precautions when lifting.

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 3x3-inch galvanized steel shims between the vibration pads and the floor. (Shims must be field supplied.)

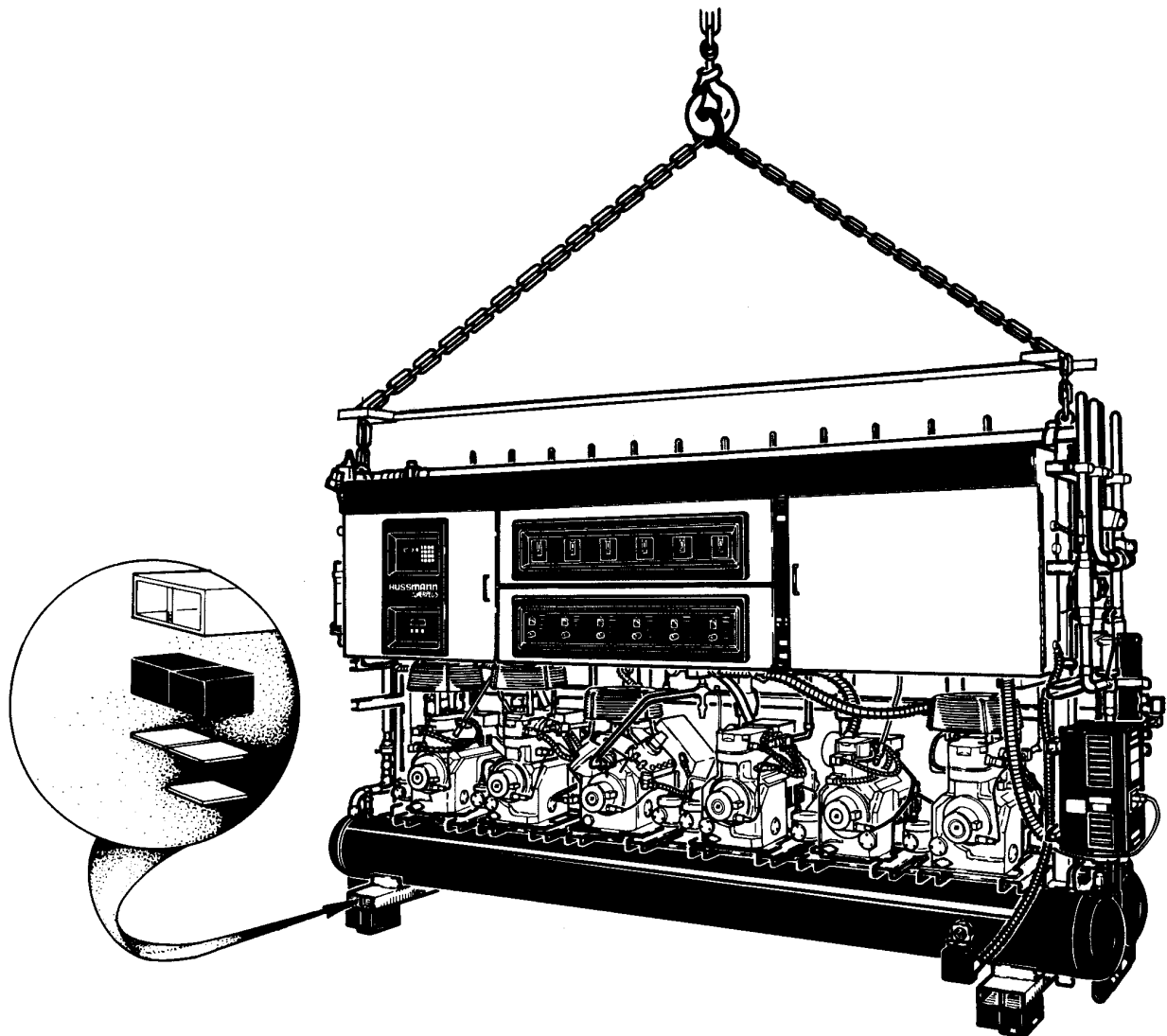


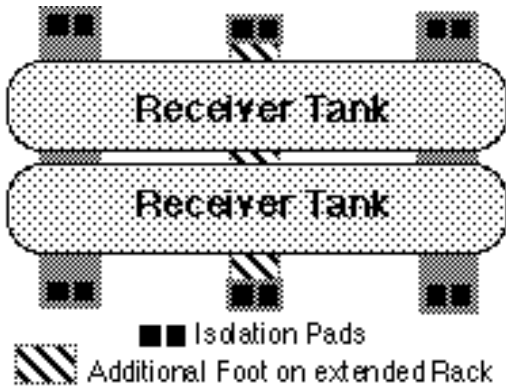
Figure 1-4 – Lifting and Leveling the Super Plus™

INSTALLATION INSTRUCTIONS

Revised August 1, 1996

1 - 6

Extended racks may have an additional cross foot. These racks are supplied with 12 isolation pads and require cross leveling for all six load points.



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 Panel when moving the Super Plus Rack.

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

NOTE: This unit is slightly front heavy, due to the Control Panel. Take necessary precautions when moving and lifting.

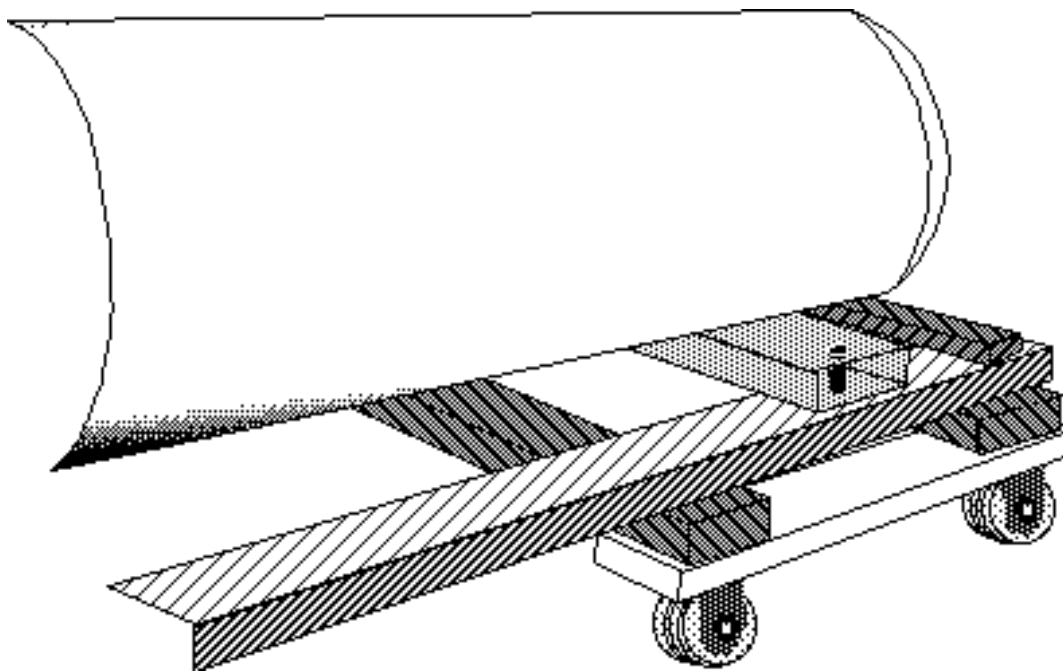


Figure 1-6
Dolly Placement

SUPER PLUS REFRIGERATION PROCESS

OVERVIEW

This section details the refrigeration process by tracking the refrigerant flow through the system components. Oil separation and return is explained.

In this instruction the following constants are maintained to assist the reader:

In the diagrams, refrigerant flow direction is generally clockwise.

Super Plus™ Refrigeration System.....2
 Basic Refrigeration.....4
 Heat Reclaim.....6
 Receiver Pressure and Vapor Temperature
 Regulation6
 Koolgas Defrost.....7
 Oil System.....8
 Subcooling
 Autosurge9
 Mechanical10
 Demand Cooling™.....11

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 removed.

Each specific refrigerant state and pressure maintains the same fill pattern throughout the instruction.

Pressures in oil lines will also retain a fixed pattern.

The Super Plus™ is designed with twin receivers for increased receiver volume. The compact design reduces height and width requirements, yet provides convenient access to components for easy maintenance and service. Because service is of prime interest, it should be noted that the low center of gravity inherent with the twin receiver design minimizes vibration, extending system life and reducing service needs.

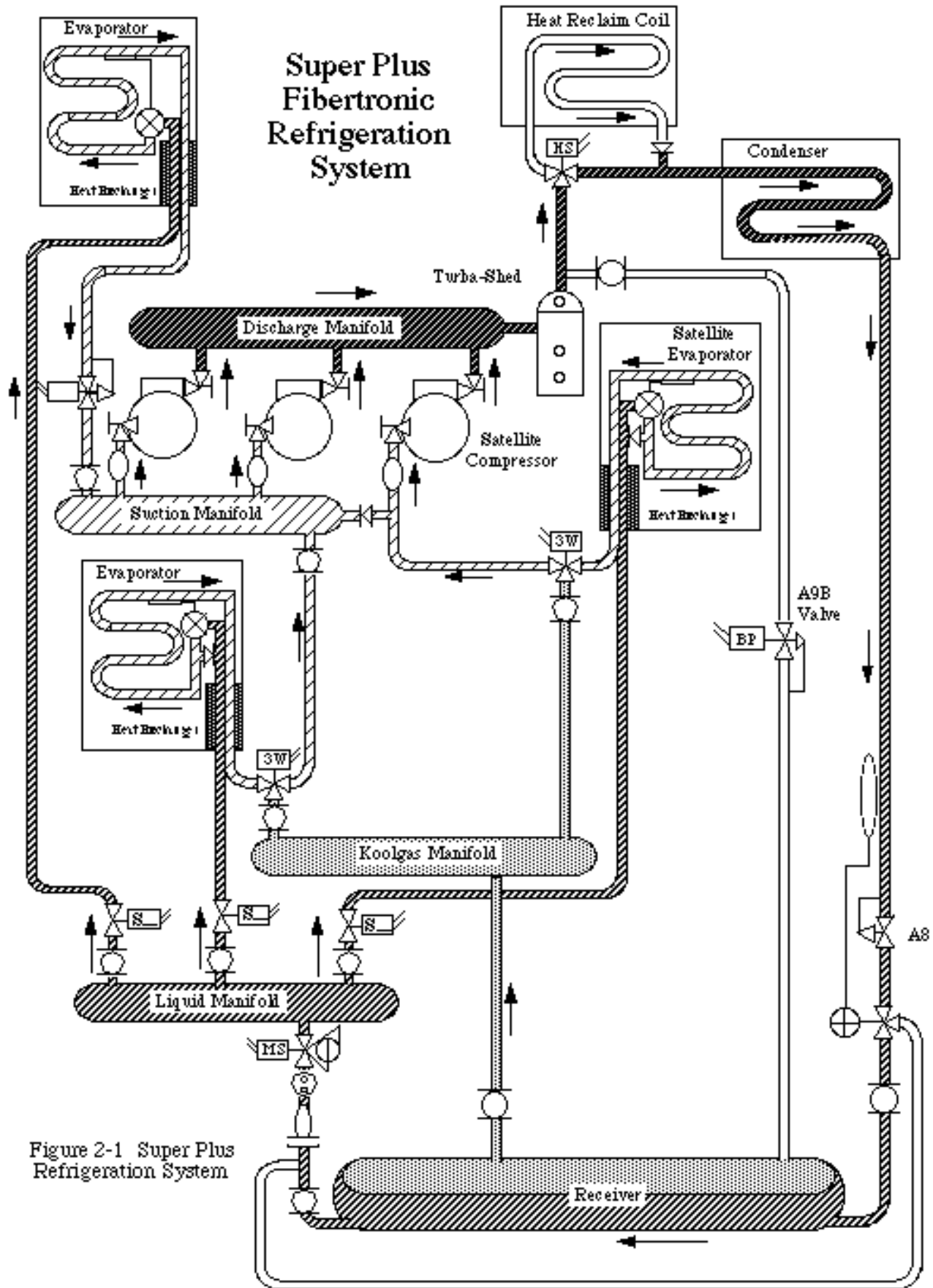





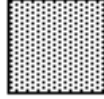











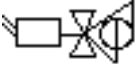


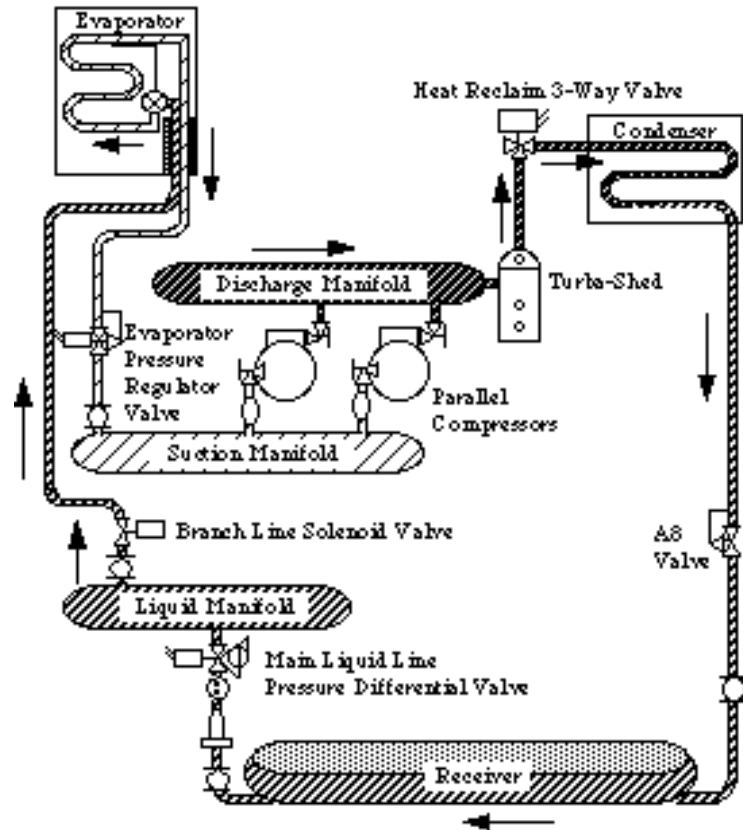
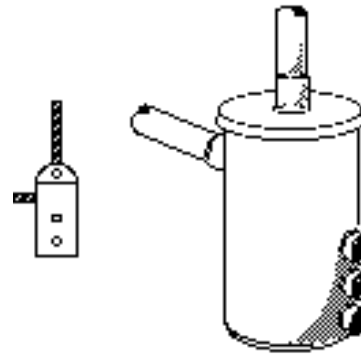


Figure 2-1 Super Plus Refrigeration System

	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)		



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.

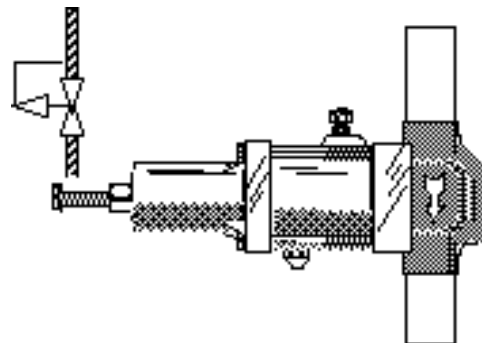
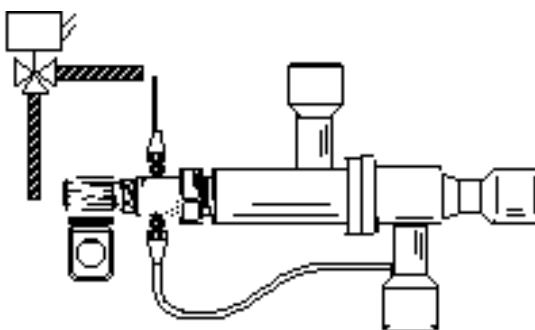


The **Condenser** discharges the unwanted heat from the system.

BASIC REFRIGERATION CYCLE

Beginning with the **Parallel Compressors**, vapor refrigerant is compressed into the **Discharge Manifold** and flows to the **Turba-shed**. The Turba-shed separates the vapor refrigerant from liquid oil by centrifugal force and screen baffles. The oil is stored in the bottom of the Turba-shed and returned to the compressors.

The **Flooding Valve** 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.



The **Twin Receivers** act as a vapor trap and supply the Main Liquid Solenoid with quality liquid refrigerant. Sufficient liquid, vapor, and pressure are critical to the operation of the system. The system maintains these balances in the Twin Receivers for use as needed.

The **Main Liquid Pressure Differential Valve (MS)** functions during Koolgas defrost to reduce pressure to the Liquid Manifold. This solenoid operated valve never closes completely but restricts the liquid line, reducing the pressure in the Liquid Manifold. The reduced pressure allows reverse flow of refrigerant necessary for Koolgas Defrost.

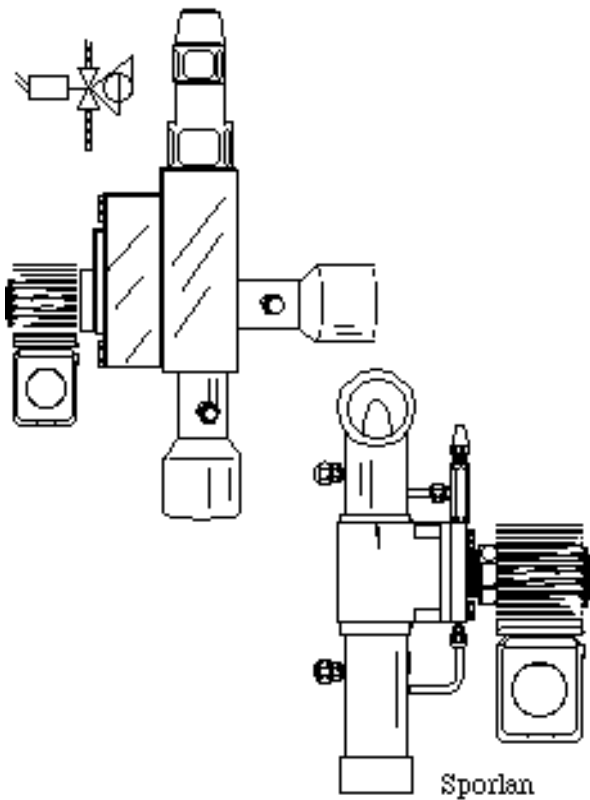


Figure 2-6 Main Liquid Line Pressure

The **Liquid Manifold** distributes liquid refrigerant to all Branch Liquid Lines.

The **Branch Liquid Line Solenoid Valve (S₁)** closes off refrigerant supply to the evaporator, yet allows back flow of refrigerant into the Liquid Manifold.

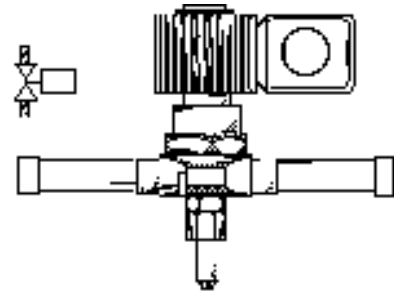
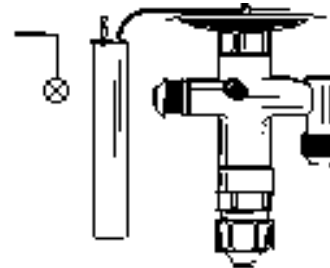
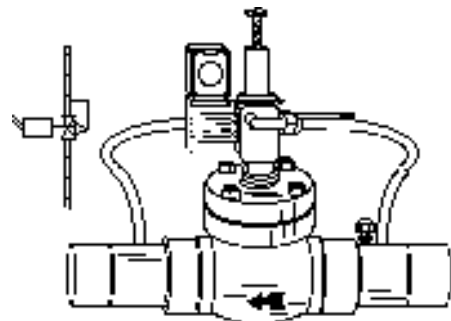


Figure 2-7 Liquid Branch

The **TEV**, located in the merchandiser, meters liquid refrigerant through its orifice to the low pressure side of the system where it evaporates absorbing heat from the coil.



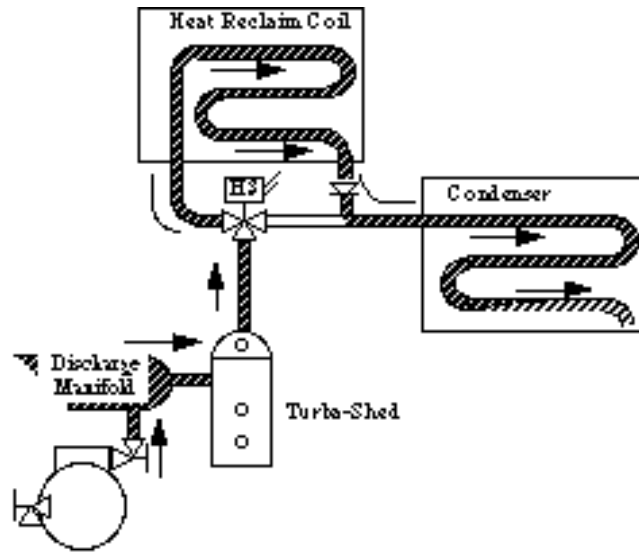
An evaporator pressure regulating valve may be used to control the evaporator temperature by preventing the evaporator pressure from dropping below a set point.



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

HEAT RECLAIM CYCLE

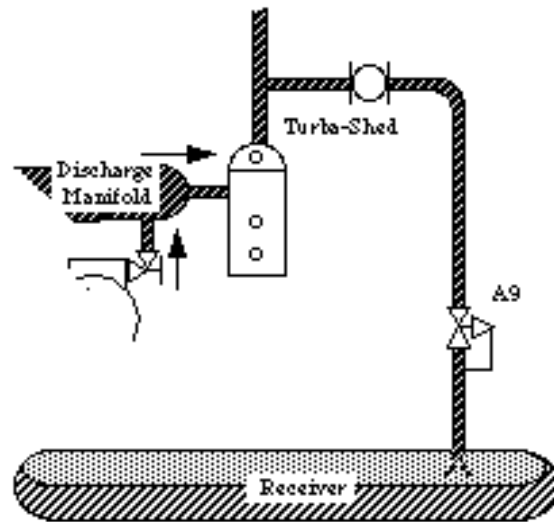
The **Heat Reclaim 3-Way Valve (HS)** routes the discharge heat laden vapor to an **remote mounted coil** or **water heating coil**. The heat energy removed from the merchandisers can be returned for a desired function. A **Check Valve** assures no back flow and flooding when Heat Reclaim Cycle is off. The Heat Reclaim Cycle removes superheat from the refrigerant vapor, then dumps the vapor into the **Condenser** to discharge latent heat and produce quality liquid for the refrigeration process.



RECEIVER PRESSURE AND VAPOR TEMPERATURE REGULATION

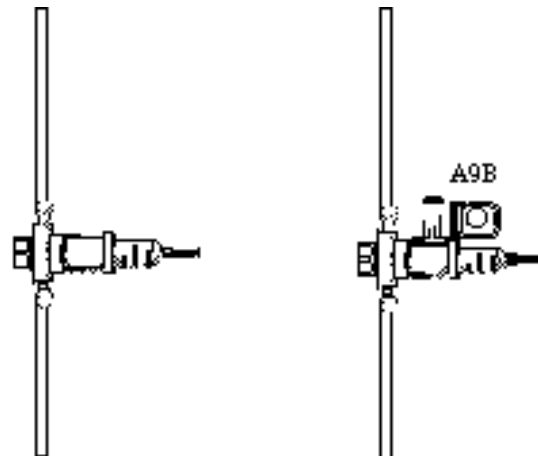
Receiver Pressure

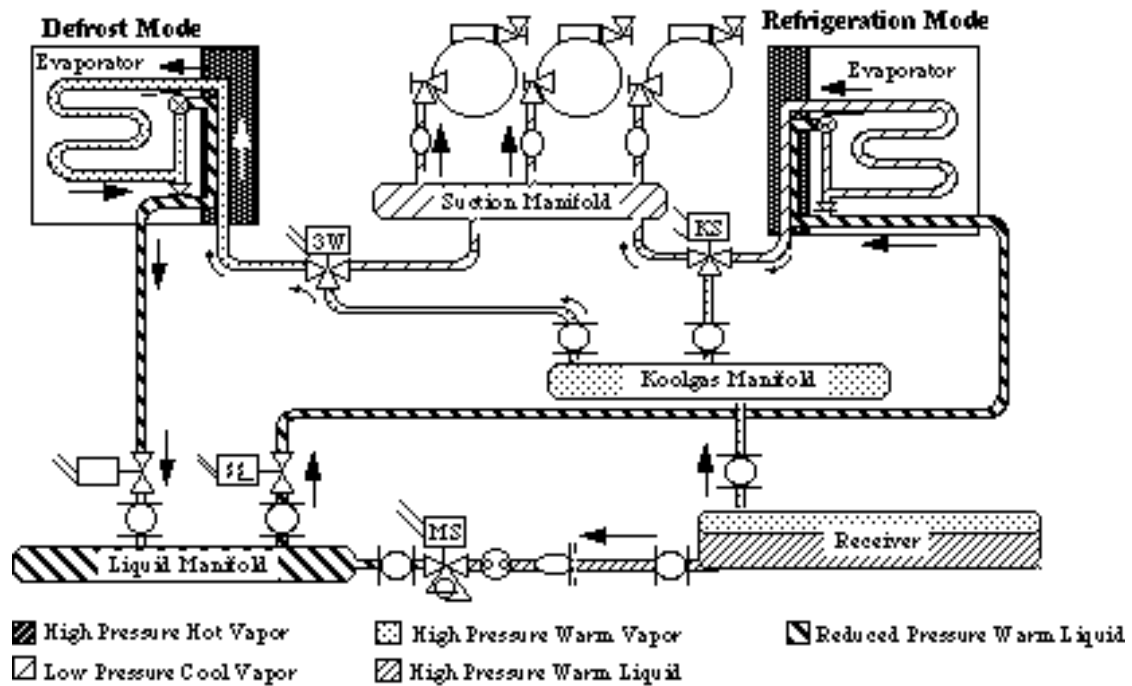
The **Pressure Regulator Valve (A9 or A9B Valve)** responds to Receiver pressure. If the Receiver pressure drops below its set point the A9 Valve opens, directing Hot High Pressure Vapor to the Receiver.



Receiver Temperature

During Koolgas Defrost, if the Koolgas Manifold temperature drops below 85°F the A9B Solenoid opens its valve, directing Hot High Pressure Vapor to the Receiver. Electrically, the circuit is supplied with power only during Koolgas Defrost. The circuit is closed by a thermostat responding to Koolgas Manifold temperature.





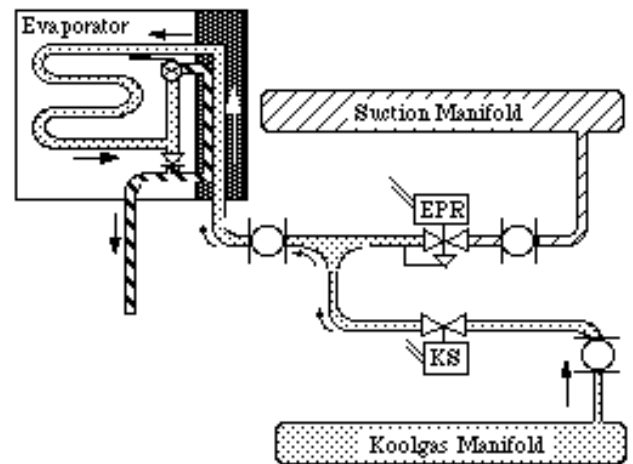
KOOLGAS DEFROST CYCLE

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**.



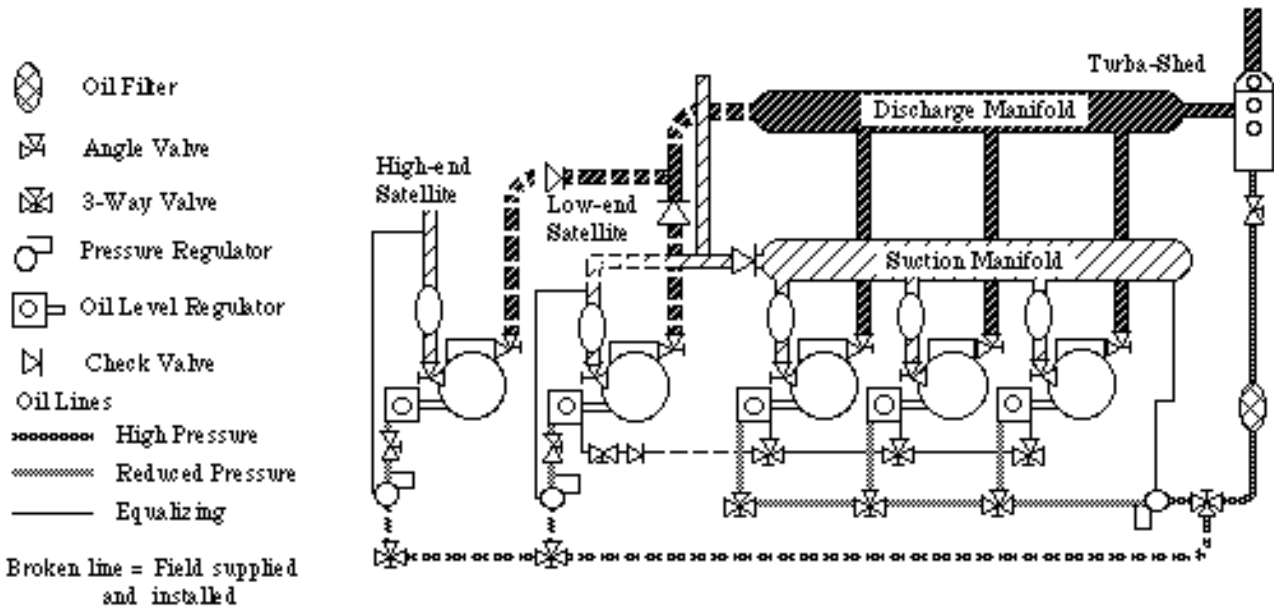
If a **Suction Stop EPR Valve** is used to control Evaporator temperature, the 3-Way Valve is not used. When defrost is called for, the suction line control valve closes and a two-way **Koolgas Valve** opens the line from the Koolgas Manifold to the Evaporator.

OIL CYCLE

Discharge refrigerant carries droplets of oil from the compressors' lubrication system. The **Turba-shed** returns the oil from its reservoir along the high pressure line to the **Oil Pressure Differential Regulator Valve**. This valve reduces the oil pressure to between 10 and 15 psig above the crankcase pressure, providing even flow of oil to the **Oil Level Regulators**.

To balance oil level among the compressors An **Equalizing Line** returns any excess oil in one Oil Level Regulator to the rest of the system. A **Check Valve** is placed in the Equalizing Line between the Low End Satellite and the rest of the system. The check valve is necessary to keep the Low End Satellite from filling up with oil. With a High End Satellite, note that the Satellite has no Equalizing Line.

Note: Certain Carlyle compressors do not require an oil equalizing line.



SUBCOOLING

Autosurge for Ambient Subcooling

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

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.

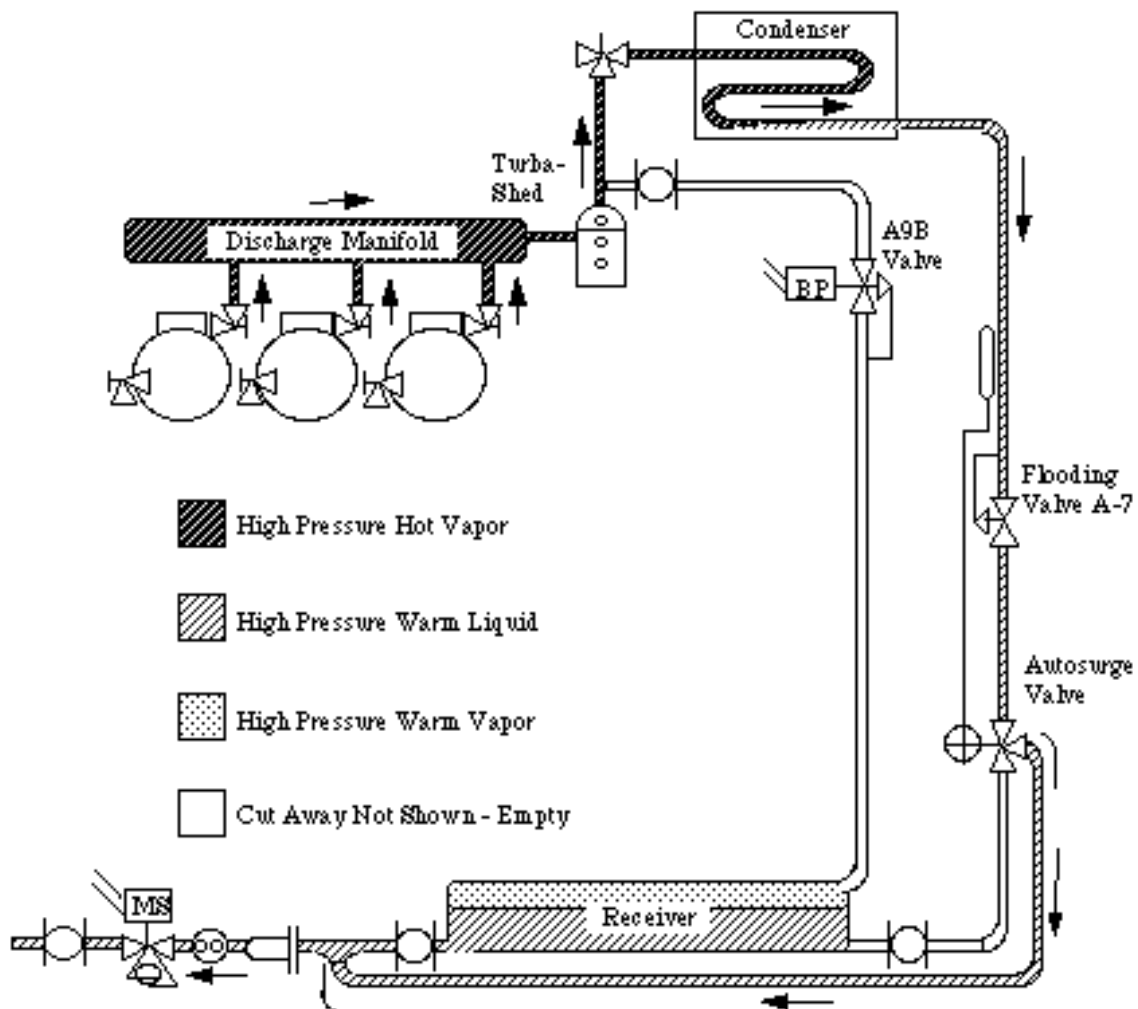


Figure 2-16 Autosurge

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. Since mechanical subcooling uses a direct expansion device, it is not limited by ambient temperature.

A **Liquid Line Solenoid Valve** and a **TEV** control refrigerant to the subcooler. An **EPR** prevents the subcooler temperature from dropping below desired liquid temperature.

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

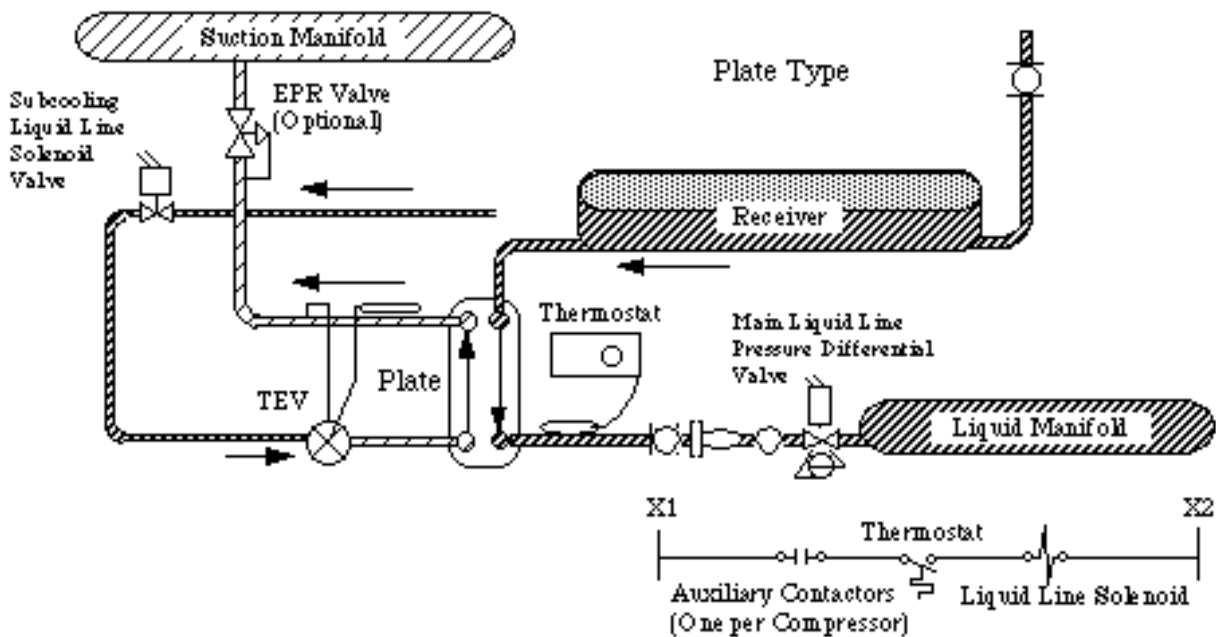
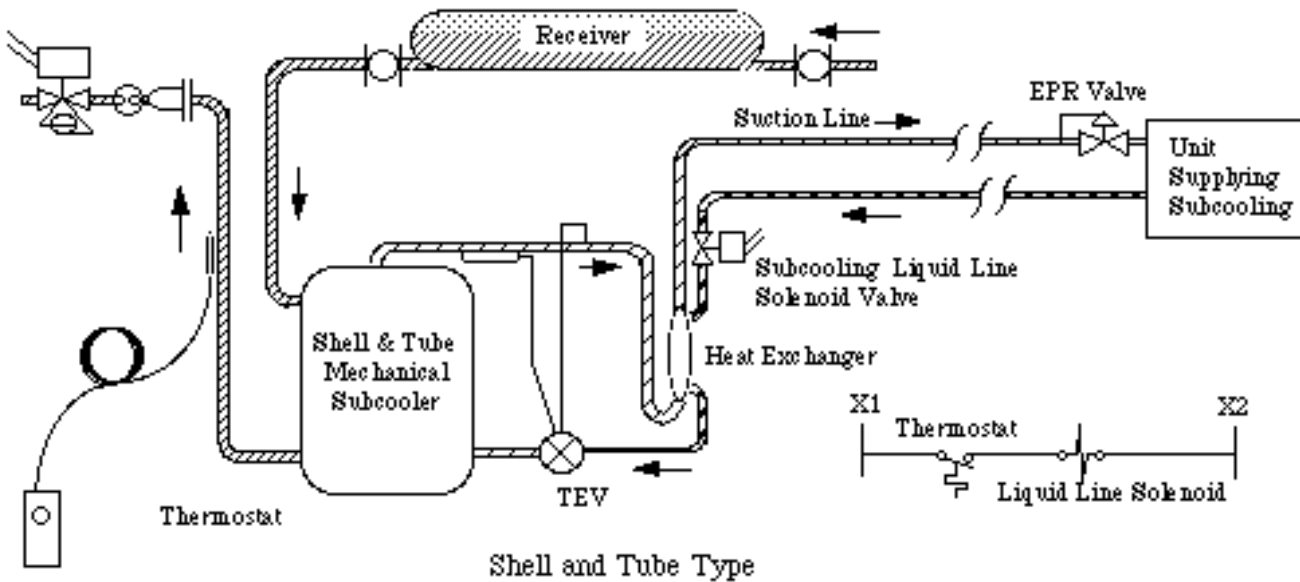


Figure 2-17 Mechanical Subcooling

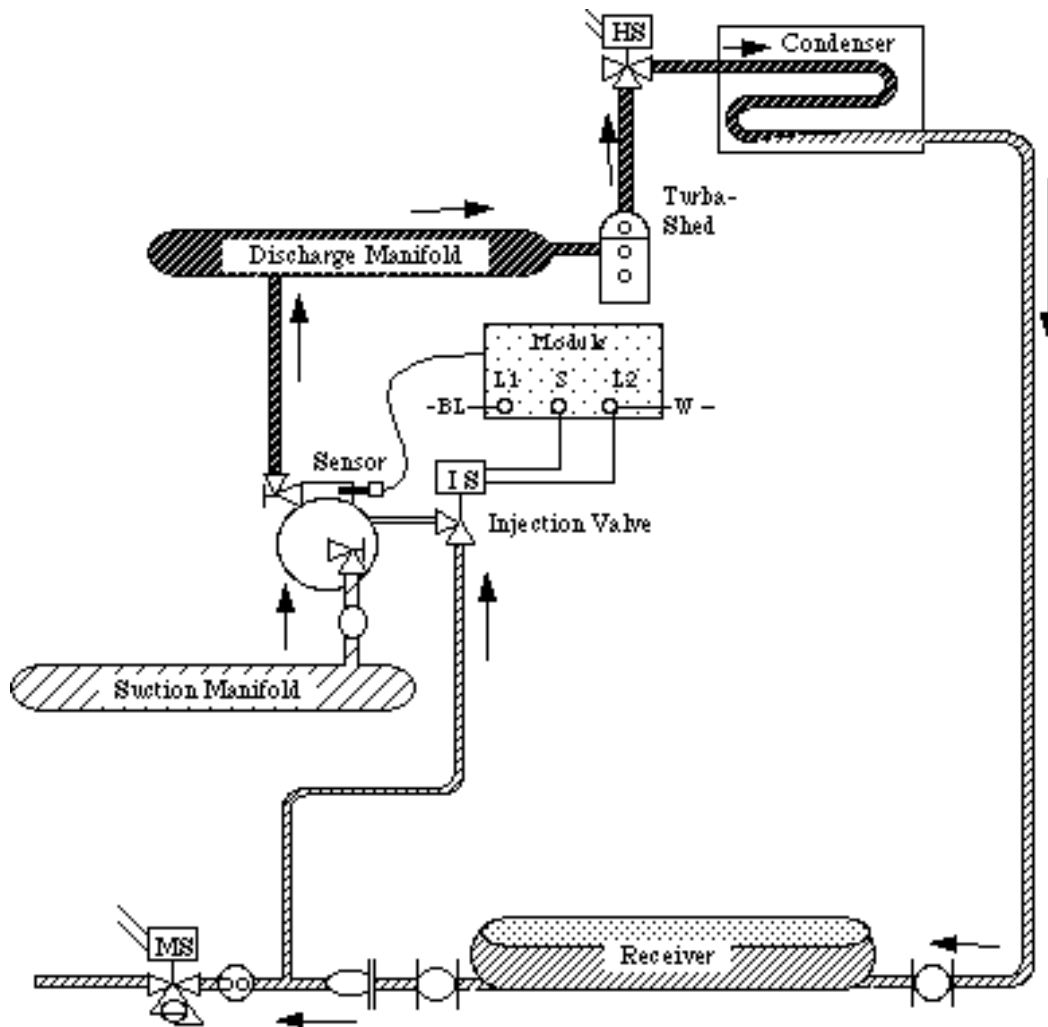
DEMAND COOLING™ (Copeland)

The Demand Cooling System is designed to inject saturated refrigerant into the suction cavity when the compressor internal head temperature exceeds 292°F. Injection continues until the temperature is reduced to 282°F. If the temperature remains above 310°F for one minute the control shuts down the compressor.

The Temperature Sensor employs a Negative Temperature Coefficient (NTC) Thermistor to provide signals to the Control Module. The NTC resistance drops on temperature rise.

The Control Module responds to the Temperature Sensor input by energizing the Injection Valve Solenoid when 292°F is exceeded. Too high or too low a resistance from the thermistor circuit will cause the Module to shutdown the compressor after one minute.

The Injection Valve meters saturated refrigerant into the suction cavity of the compressor.



COMPONENT PIPING

OVERVIEW

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

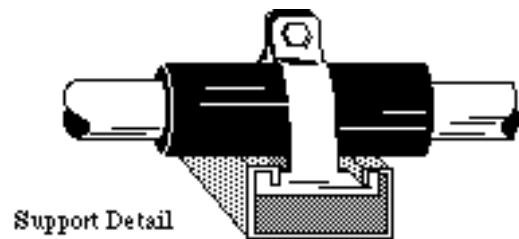
WARNING

Always use a Pressure Regulator on nitrogen tanks.

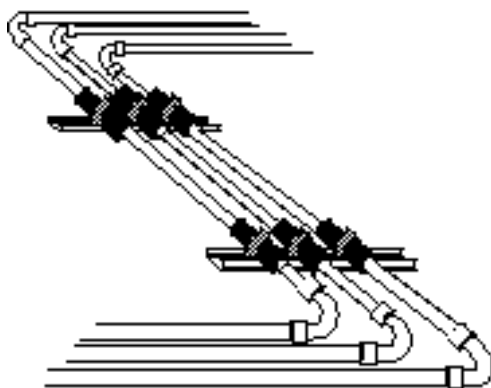
Use only clean, dehydrated, sealed refrigeration grade copper tubing. Use dry nitrogen in the tubing during brazing to prevent the formation of copper oxide. All joints should be made with silver alloy brazing material; use 35% silver solder for dissimilar metals.

REFRIGERATION LINE RUNS

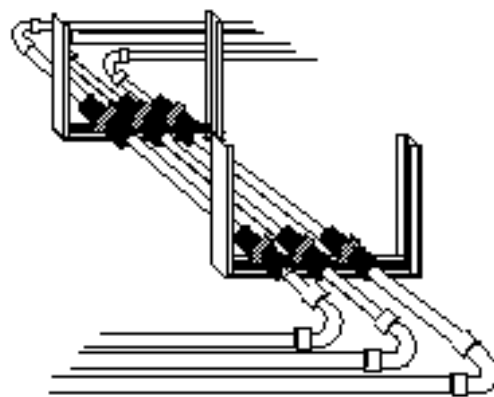
Liquid lines and suction lines must be free to expand and contract independently of each other. Do not clamp or solder them together. Run supports must allow tubing to expand and contract freely. Do not exceed 100 feet without a change of direction or an offset. Plan proper pitching, expansion allowance, 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



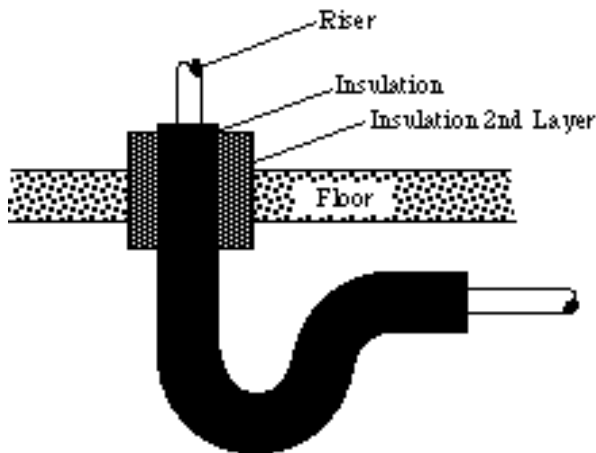
Floor Run



Ceiling Run

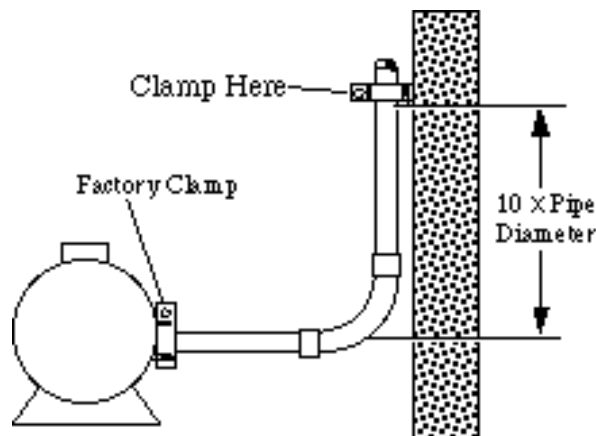
Through Walls or Floors

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.



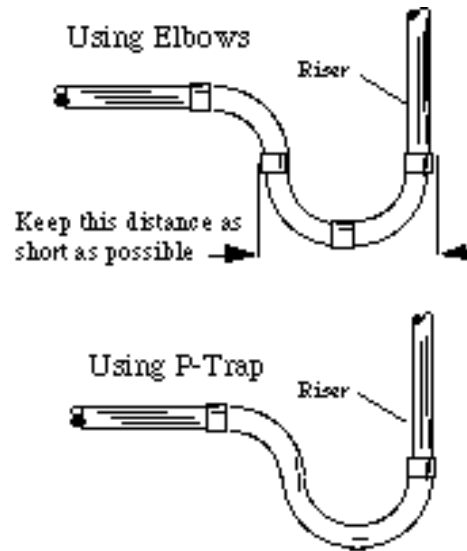
From Machinery to Solid Object

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



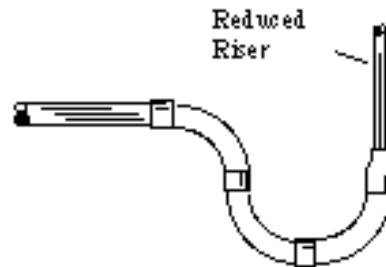
P-Trap Construction

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



Reduced Riser

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



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.

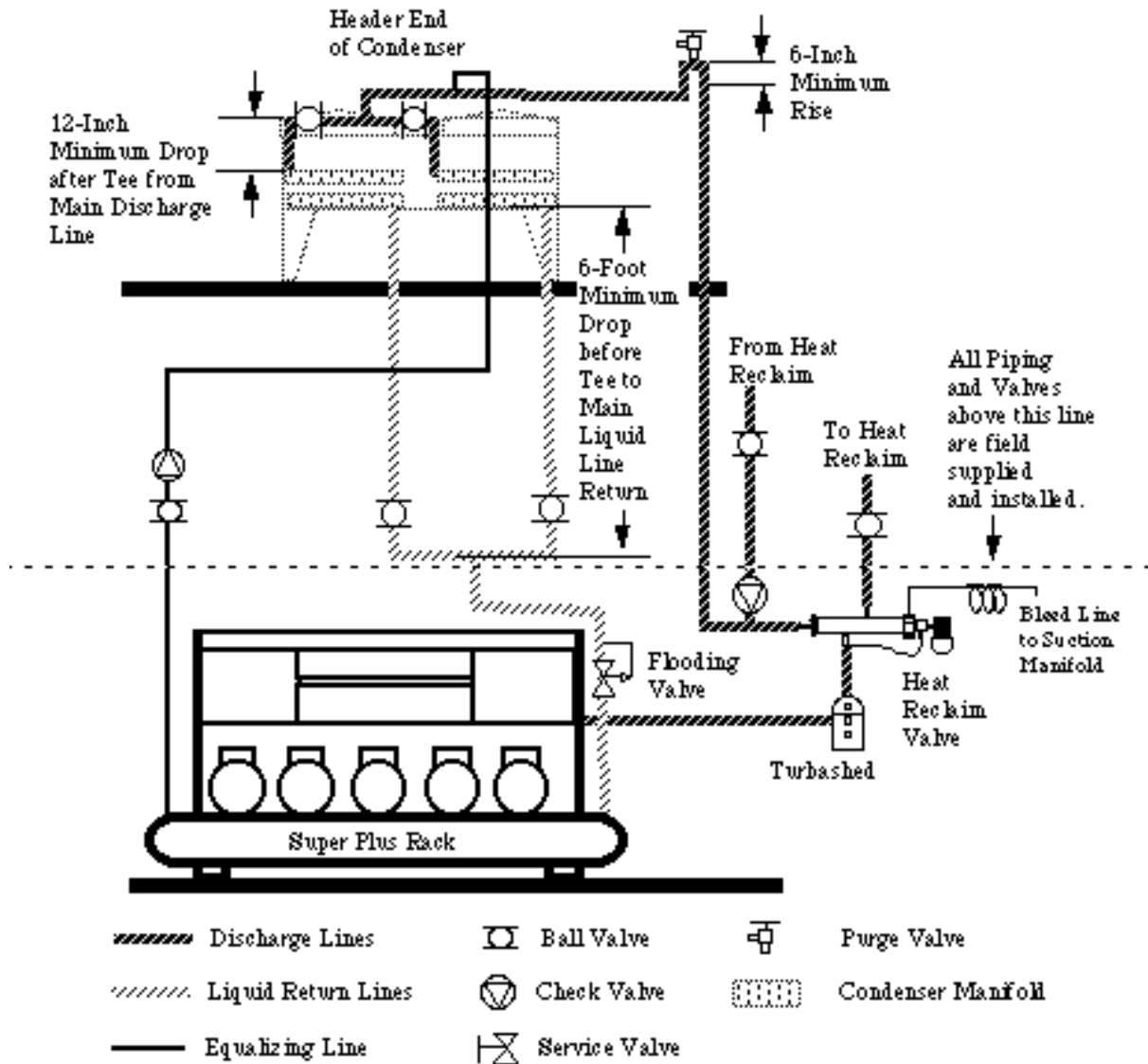
RACK TO CONDENSER PIPING

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 Super Plus.

WARNING

Vent the Receiver Safety Relief Valve properly.



Equalizing Line (WHEN REQUIRED)

A 1/8-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 tee'd 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 Super Plus.

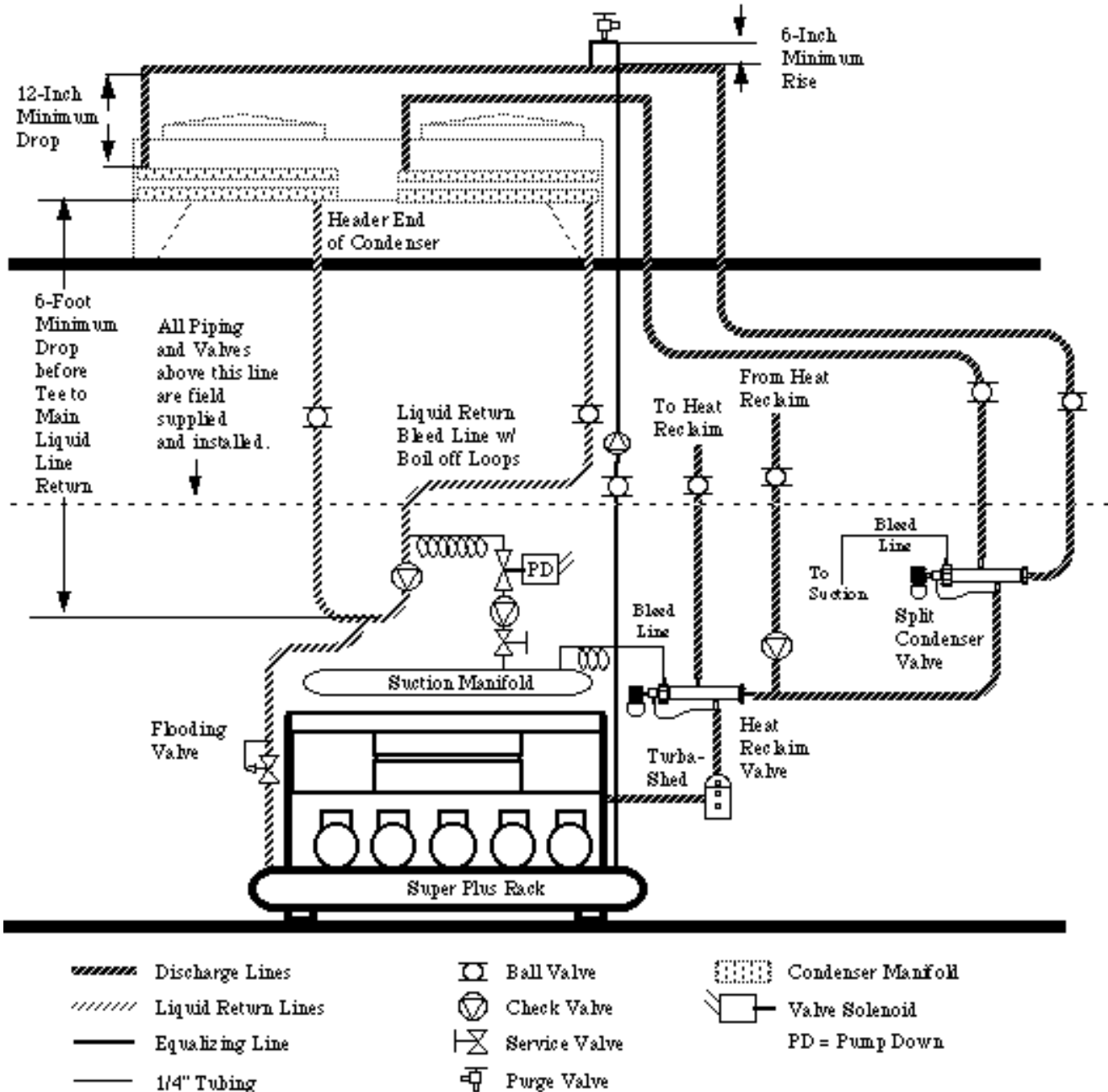


Figure 3-7 Rack to Condenser, 3-Way Valve

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

WARNING
Vent the Receiver
Safety Relief Valve
PROPERLY.

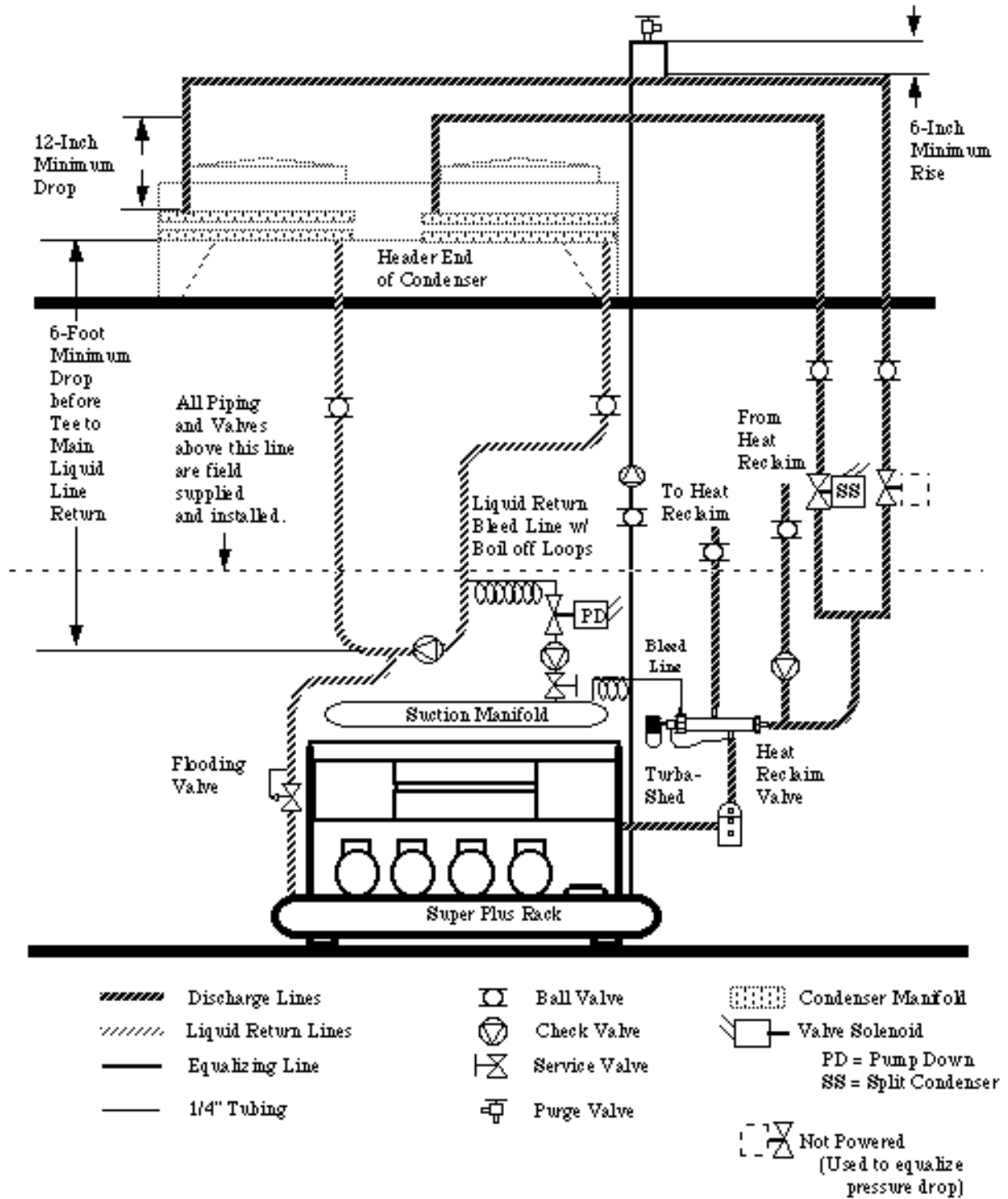


Figure 3-8 Rack to Condenser, 2-Way Valves

Note:

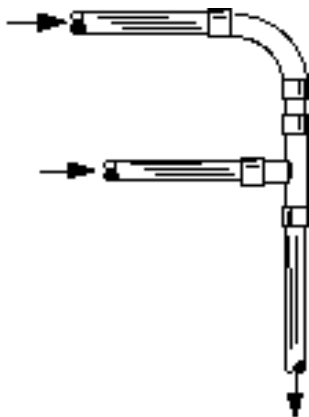
- Liquid Return Lines must be free draining with no Traps
- Install Solenoid Valves inside Equipment Room
- Pump Down Line should not enter the Suction Manifold over a Compressor Inlet
- Install Ball Valves to isolate Condenser
- All Inter-connecting Valving to be Field Supplied and Installed

WARNING

Vent the Receiver
Safety Relief Valve
PROPERLY.

RACK TO REMOTE HEADER

- Super Plus Suction Stub is connected as directly as possible to the Header Suction Manifold.
- Super Plus Liquid Line Stub is connected as directly as possible to the Header Liquid Manifold.
- If equipped with Koolgas Defrost, the Super Plus Koolgas Stub is connected as directly as possible to the Header Koolgas Manifold.



RACK TO REMOTE SATELLITE

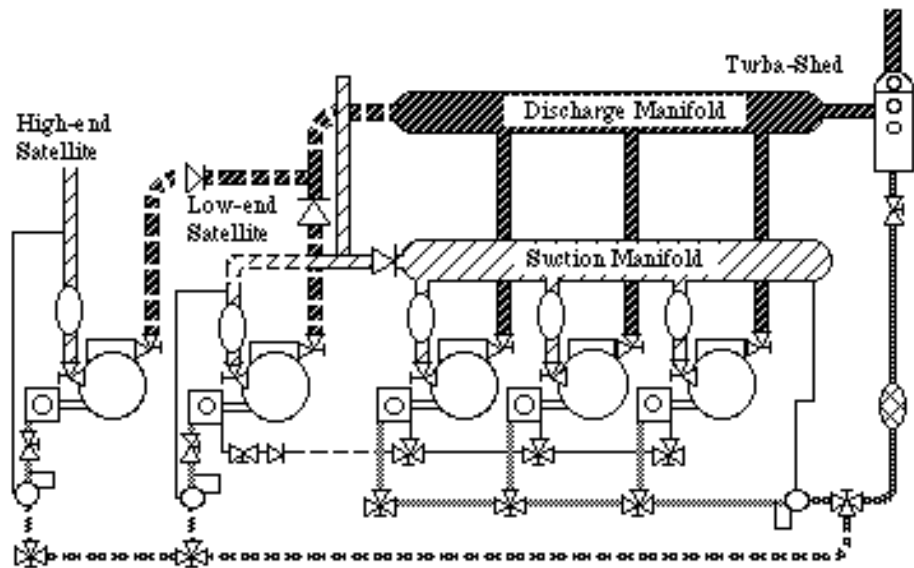
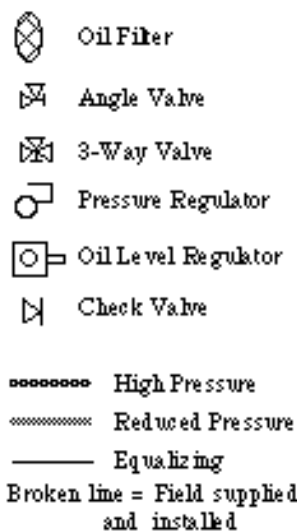
- The compressor Discharge Line will be piped through a vibration absorber to its stub on the Super Plus Discharge Manifold.
- The compressor Suction Line will be piped one of two ways depending on whether a Low-end or High-end Satellite is used. A Low-end Satellite Suction Line is piped to its check valve on the Suction Manifold, and from there to the evaporator. (If Koolgas Defrost is used, pipe through the proper Koolgas valve.) A High-end Satellite is piped directly to the evaporator.

Discharge Lines for Two Satellites

Installations having two Satellites are tee'd together upstream of the discharge manifold. Use an offset tee construction. Do not use a bullhead tee.

Oil Lines for Remote Satellites

All oil lines are run in 3/8-inch copper. Lines will be installed securely and run under tapered cover-plates when crossing walkways.



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 3/8 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 3/8 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 5/8
18	24	30	34	3 1/8
20	28	34	39	4 1/8

STEP 3

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

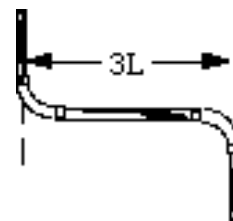
Example:

An "L" value of 21 would mean

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

$$3L = 63.$$

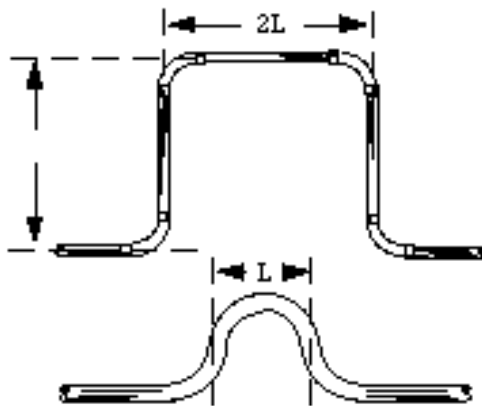
The offset distance required for low temperature application for an 84 foot run of 1 3/8 line is 63 inches.



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.



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.

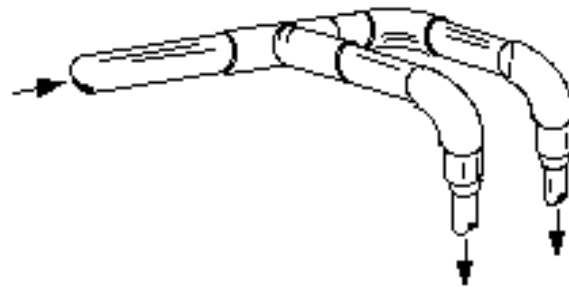


Figure 3-13

RUN LENGTHS AND EQUIVALENT FEET

When figuring run lengths angle valves and elbow 90° 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-90°*

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

*ASHRAE *Fundamentals Handbook*

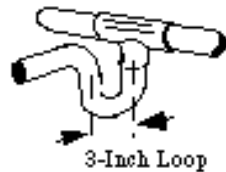
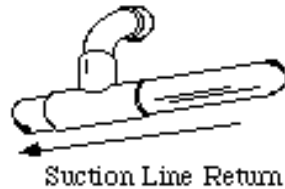
LINE SIZING

Sizing of all refrigerant lines is the responsibility of the installing contractor. Refer to *Hussmann Refrigerant Line Sizing*, and *SuperPlus Fibertronic™ System Planning Data* documents.

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

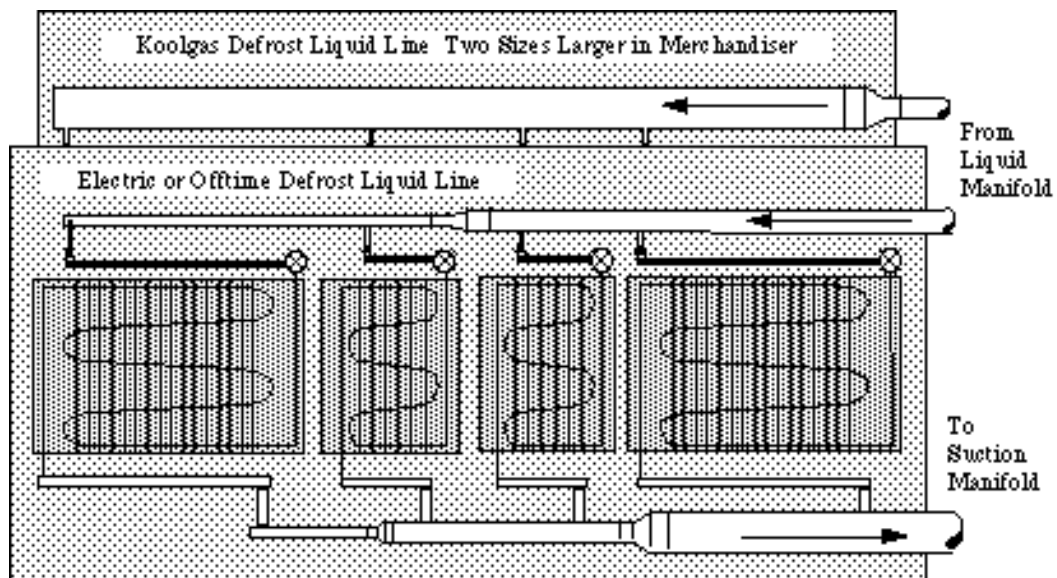
- May be reduced by one size after one half the case load run. Do not reduce below evaporator connection size.
- Take-offs to evaporators exit the bottom of the liquid line. Provide an expansion loop for each evaporator take-off. (Minimum 3 inch diameter.)

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
1/2	7/8
5/8	1 1/8
7/8	1 3/8
1 1/8	1 5/8
1 3/8	2 1/8

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



ELECTRICAL

OVERVIEW

The scope of this section is limited to main field wiring connections and to the control panel. Hussmann's Super 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 Super 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

Super 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 Super Plus System provide

- one 120V 15A 2-wire circuit.

For 208-230/3/60 Compressor Units:

To each Super 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 Super 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 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

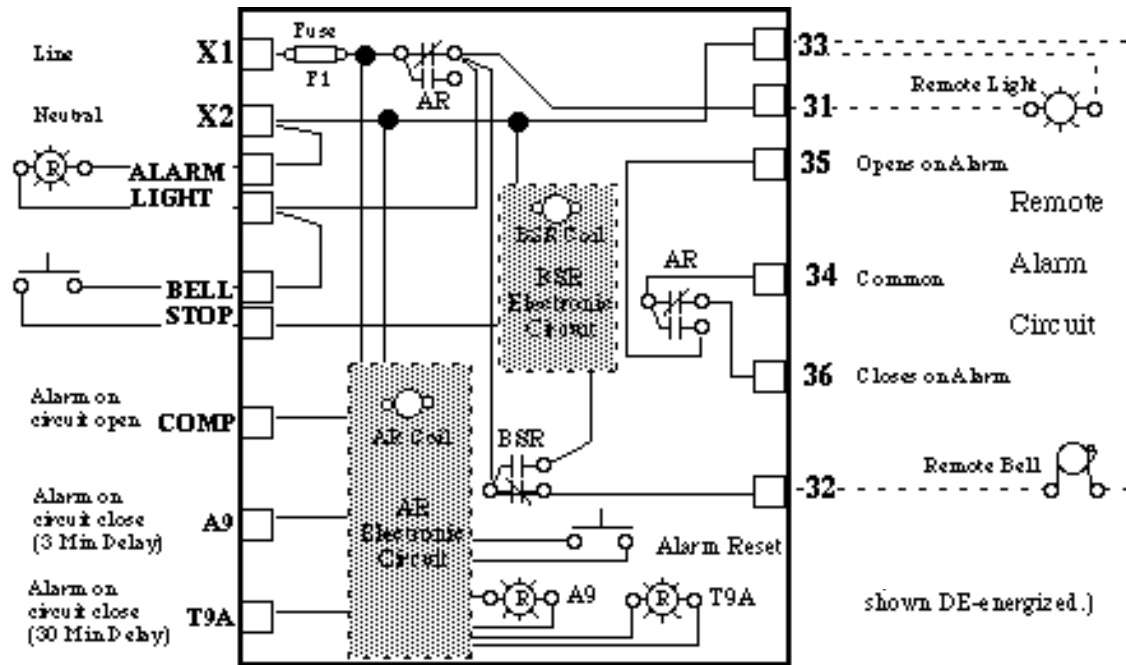


Figure 4-1 Alarm Board Circuits

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**.

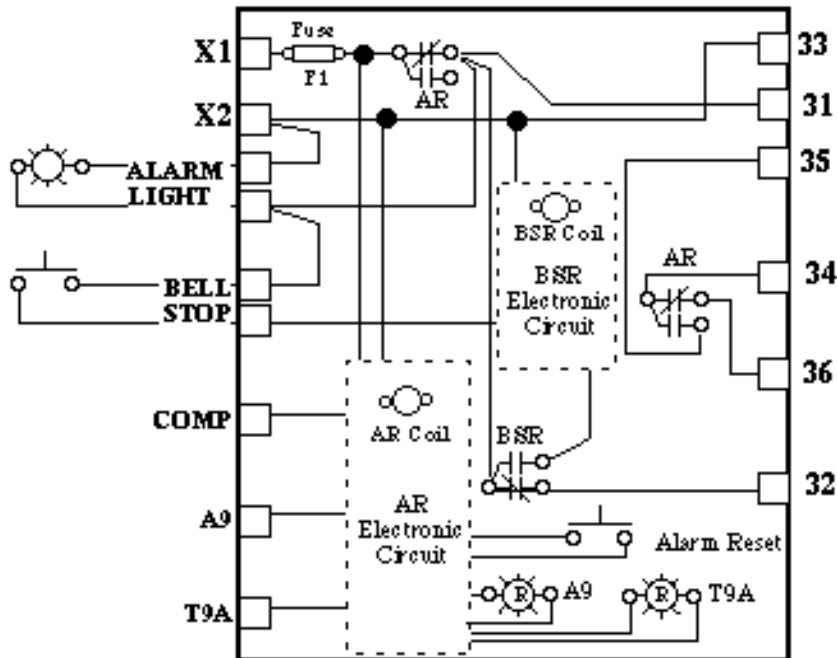
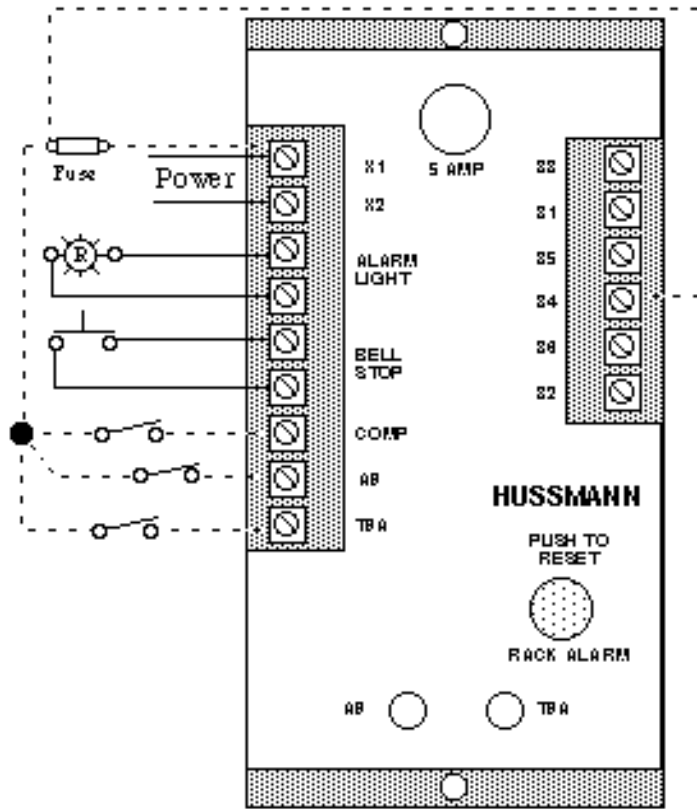
The A9 and T9A circuits remain open during normal operation. If either circuit closes a 120V input to the Alarm Board activates A9 or T9A LED and Alarm Condition.

- 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.)

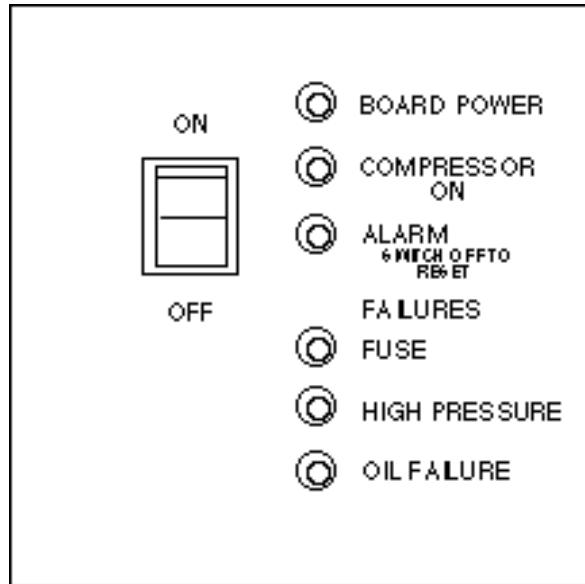
Alarm Board Troubleshooting

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.

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

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.

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.

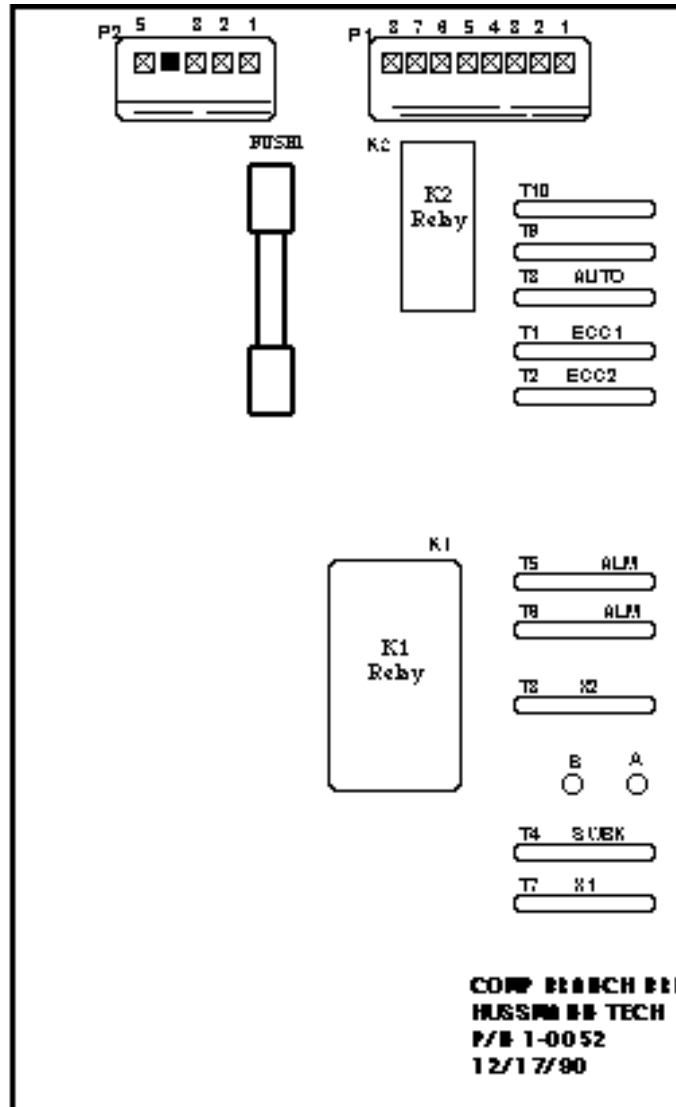
Oil Failure – Red LED – lights under oil failure condition.

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.

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.

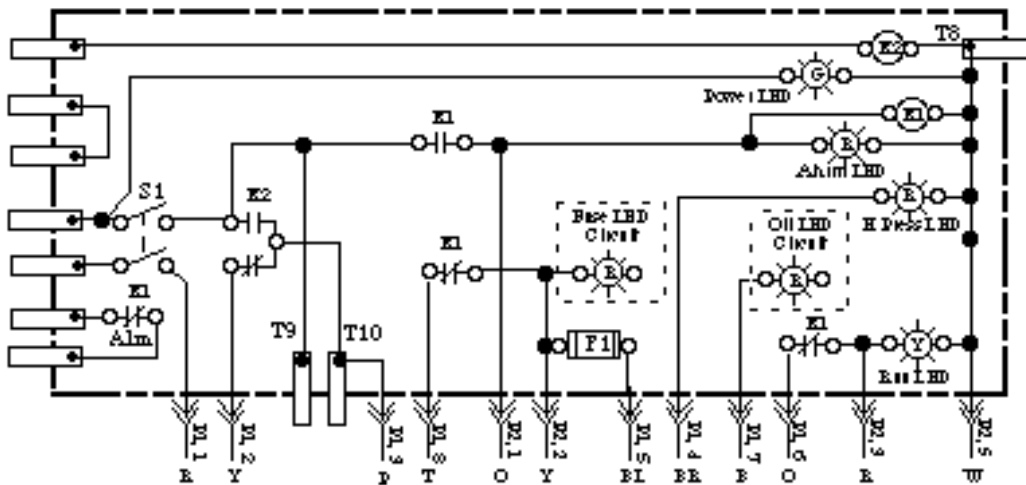
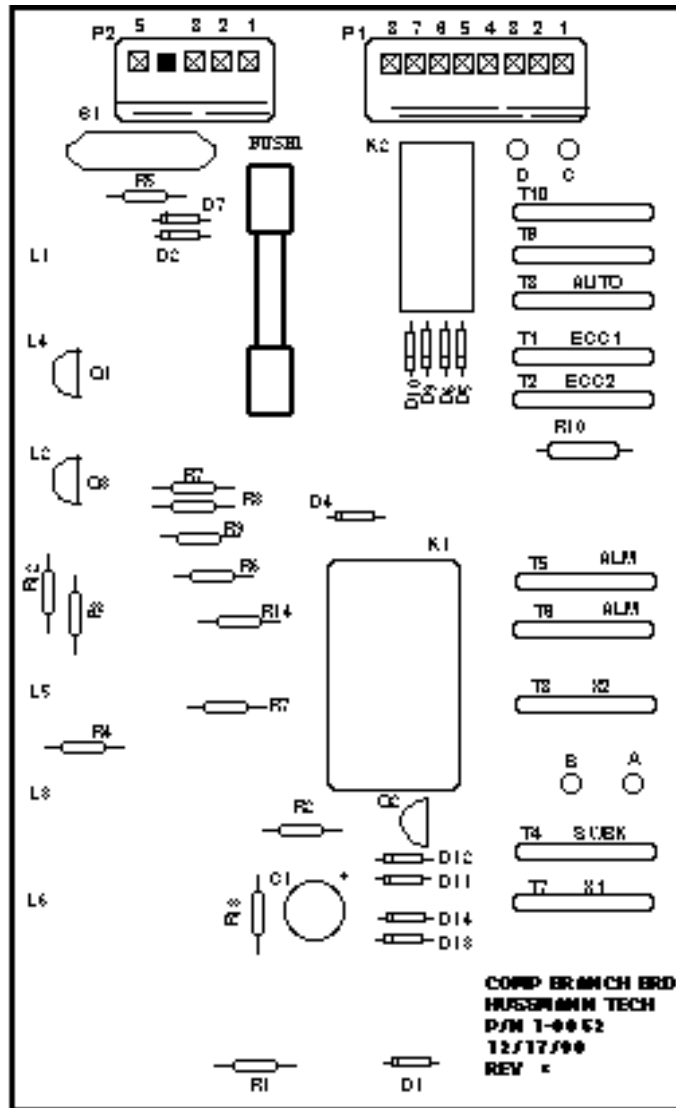
T5 and **T6** provide output to the Alarm Board Compressor Relay.

T8 provides common for all board circuits.

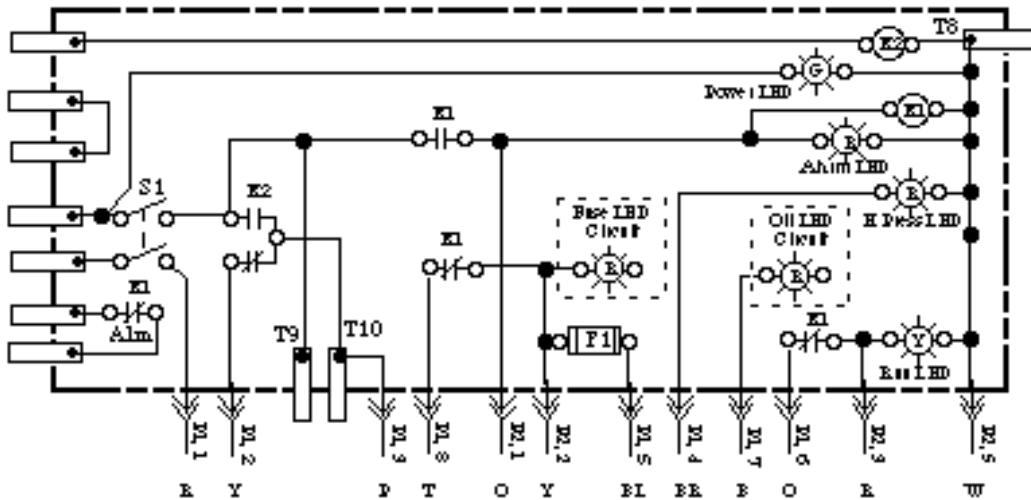
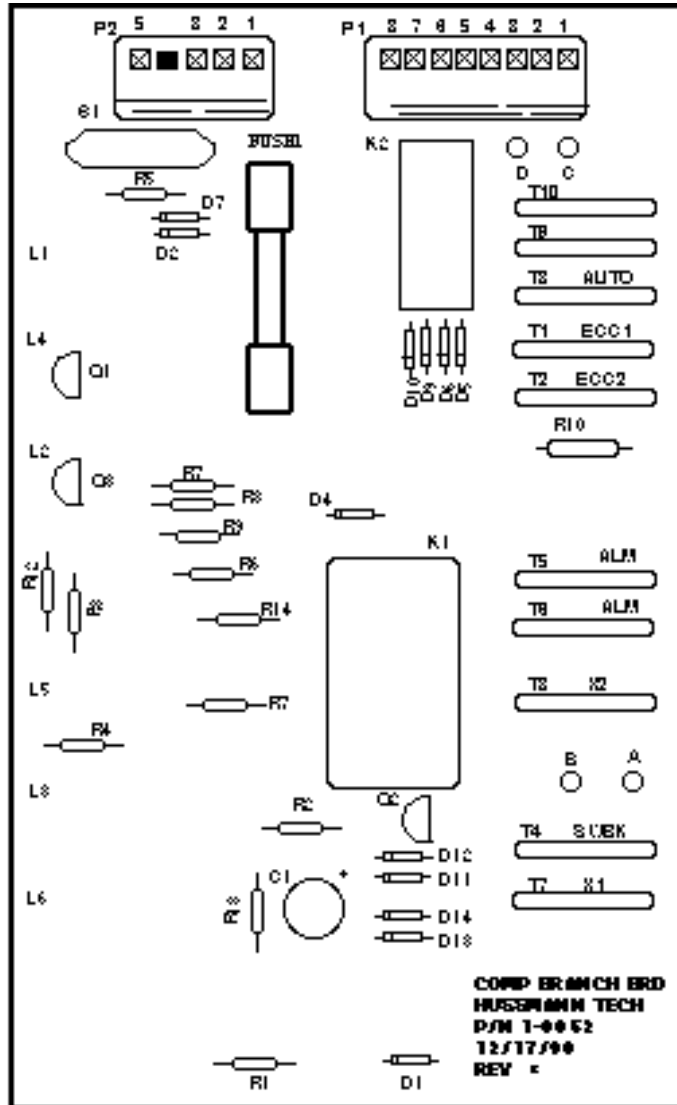
T4 is the power input from a switchback control contact.

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

Compressor Board using Mechanical Low Pressure Control or Series Switchback

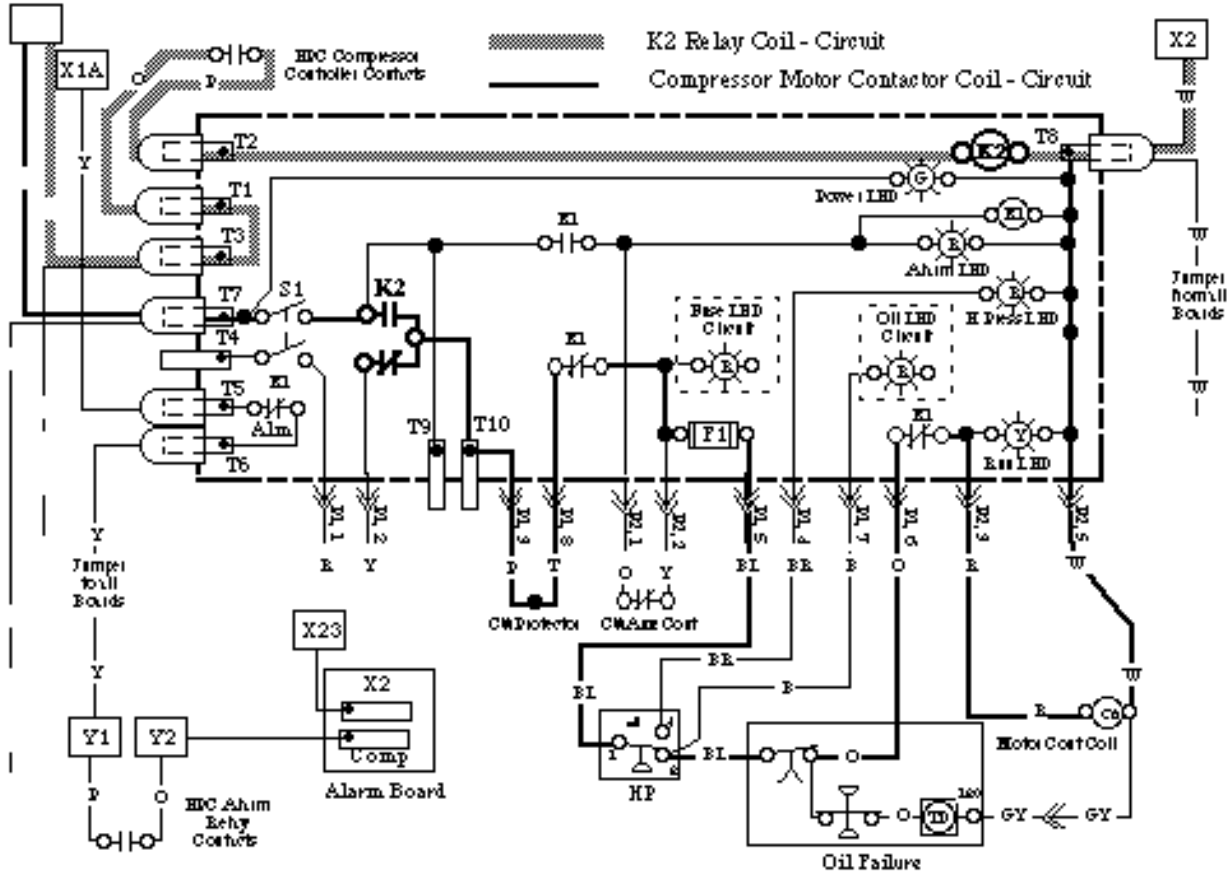


Troubleshooting—Compressor Board (Mechanical Low Pressure Control or Series Switchback)				
Be sure Board Switch is closed. Run, Refrigeration Mode				
	Voltmeter Lead Placement		Voltmeter Readings	Action
	Lead 1	Lead 2		
1	T7	T8	120	Go to 2
			0	Check Power Supply to Board
2	T5	T8	120	Go to 3
			0	Check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



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

**COMPRESSOR BOARD RELATED
CIRCUITS**

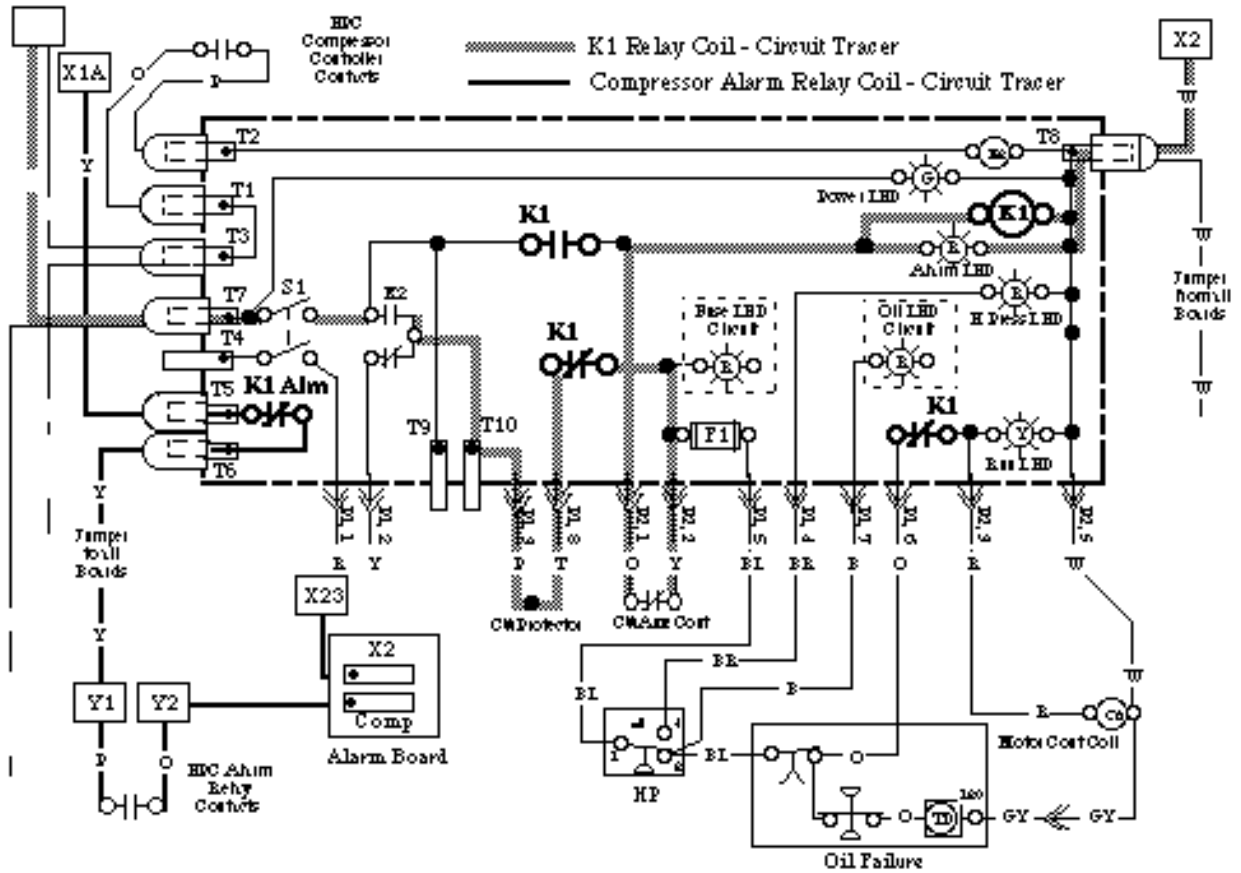


Compressor Run Circuits

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.

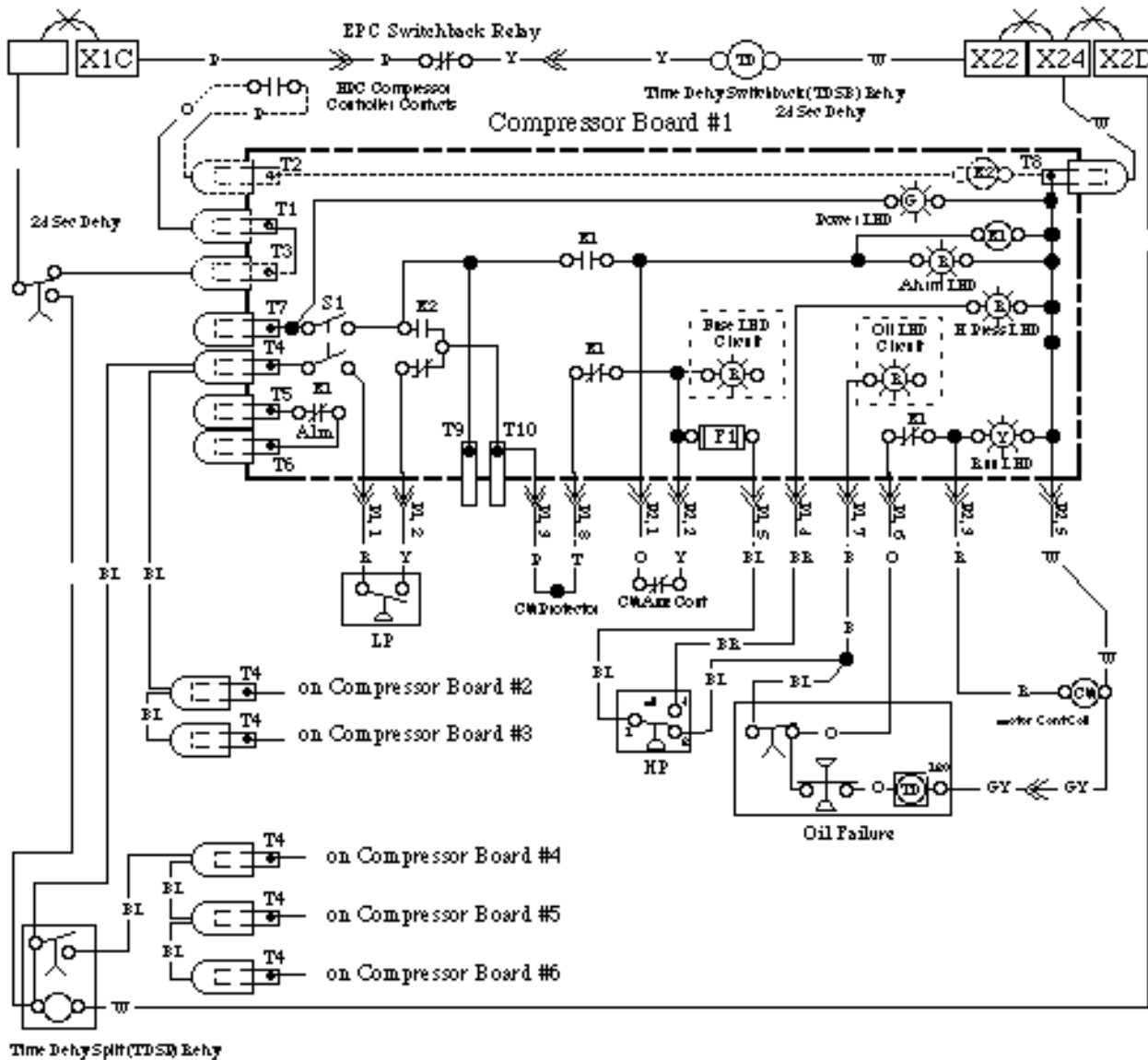
If an electronic control other than EPC is applied with Series Switchback, the K2 Circuit is not used. Normally Closed Contacts from the controller are wired in series with the low pressure control through terminal T4.



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.



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:

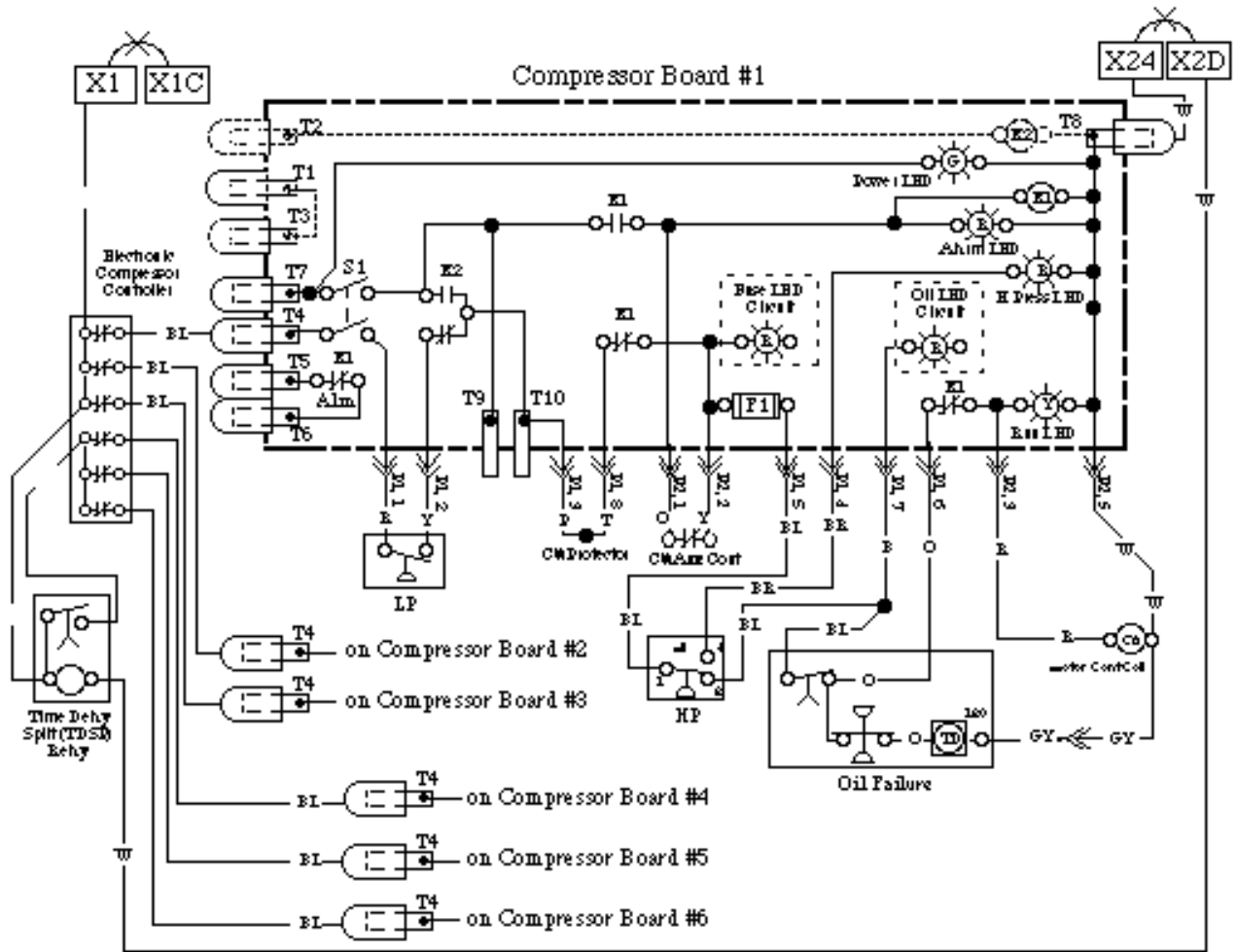
T3 on **all** the rack's compressor boards and closes the circuits to

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.

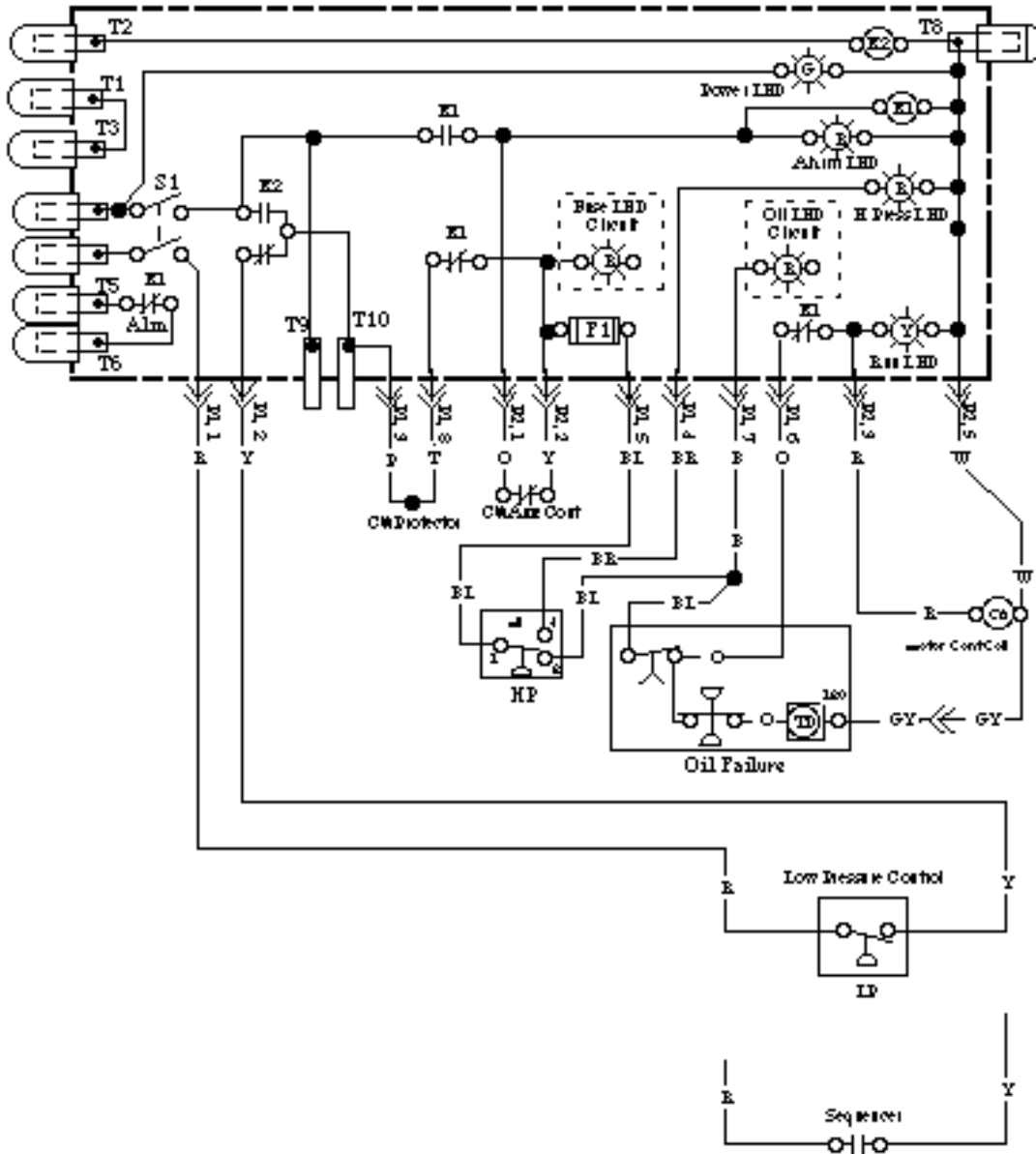
With a compound rack the medium temperature side is brought on first, and the low temperature side by the Split Relay.



Series Switchback

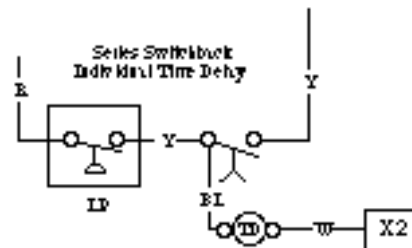
If the electronic compressor controller fails, its normally closed contacts remain closed and compressor cycling falls to the control wired between P1,1 and P1,2.

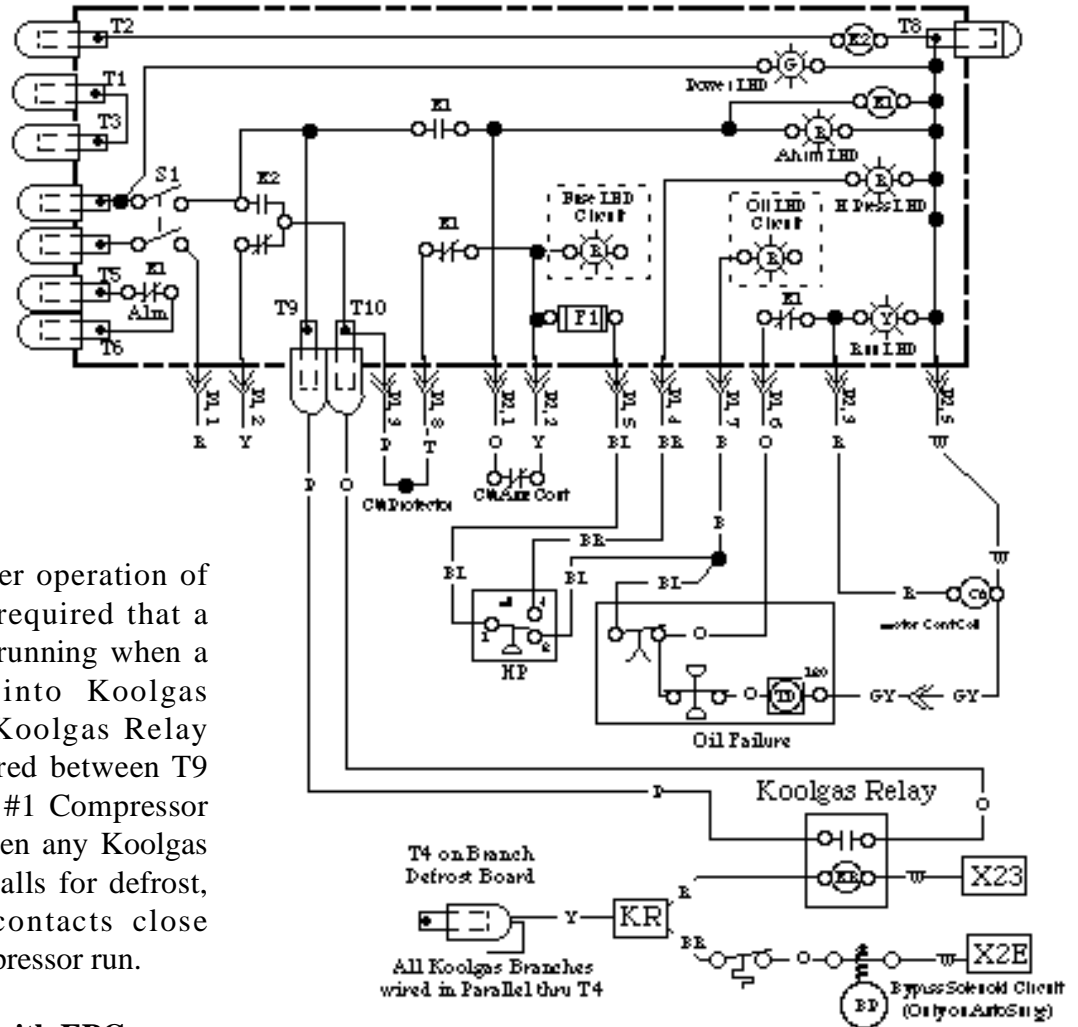
A Time Delay Split (TDS) prevents all the compressors from coming on at once on start-up after the control panel has been off.



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.





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.

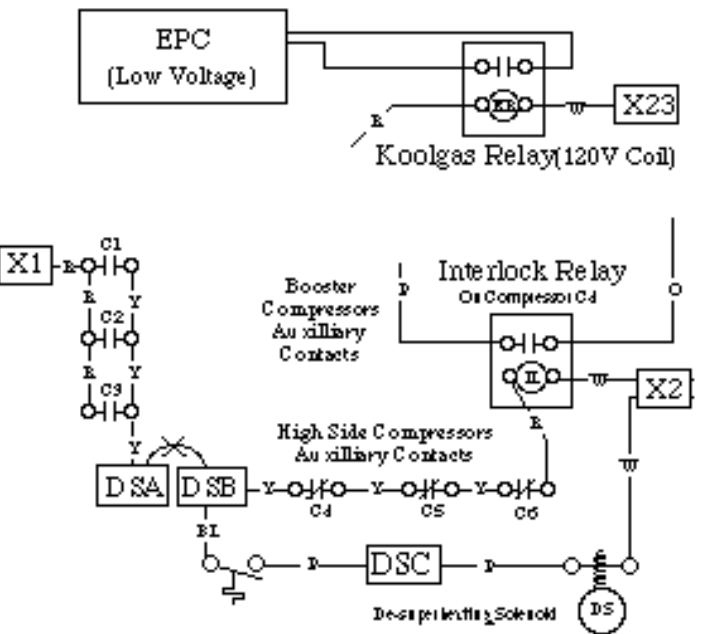
Koolgas Relay with EPC

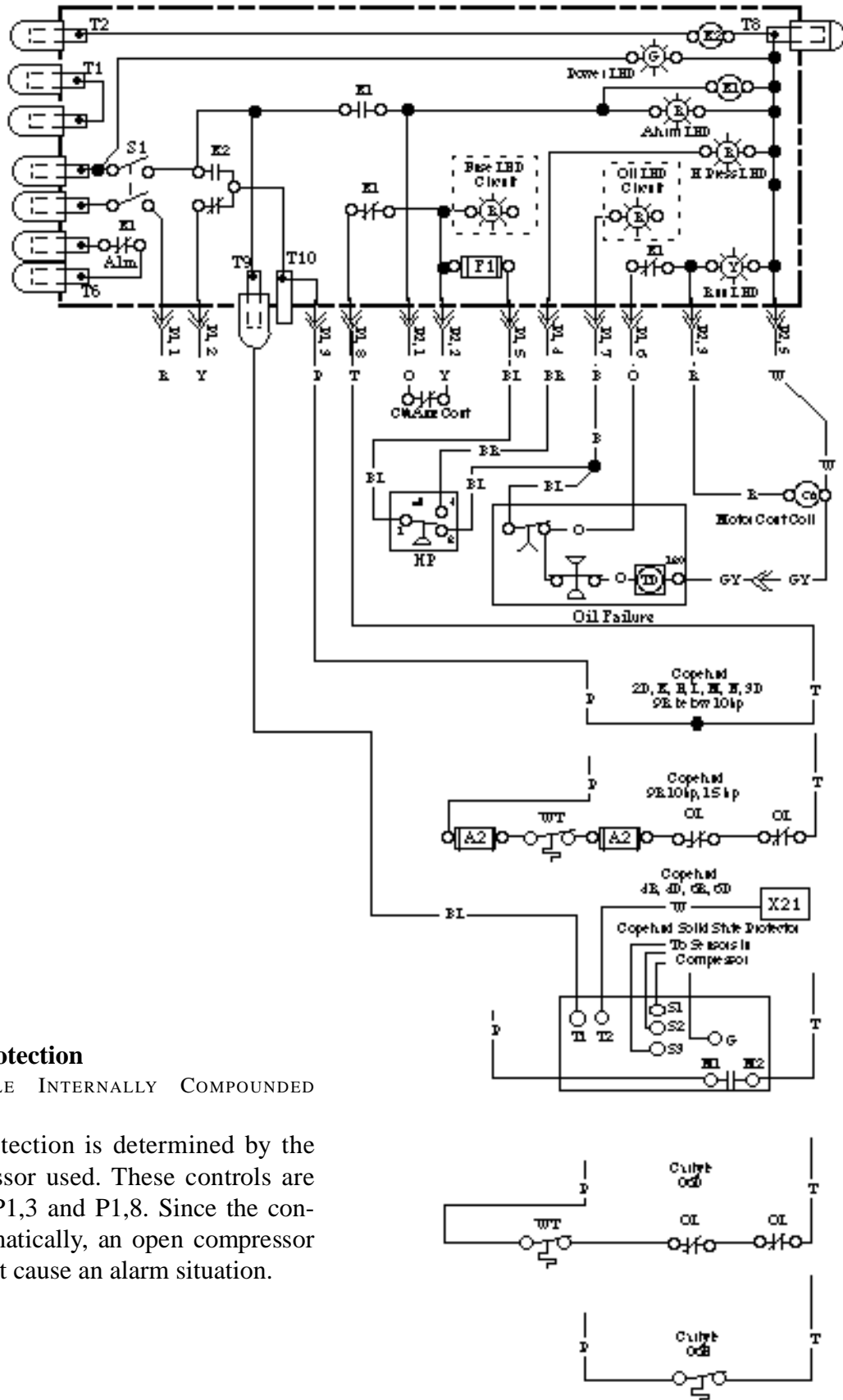
With an EPC Control, the Koolgas acts as an interface between the 120V Control Panel and the low Voltage EPC circuit boards.

DO NOT CROSS VOLTAGES.

Interlock Relay

On Compound Systems, at least one high side compressor must be running when a booster compressor comes on. The first high side compressor is designated for this function. If compounding is between racks this will be the #1 Compressor. On a compound rack the first high side compressor will be forced on if no others are running. The schematic shows a six compressor rack with the #4 Compressor being the first high side unit.





Compressor Protection

(EXCEPT CARLYLE INTERNALLY COMPOUNDED COMPRESSORS)

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.

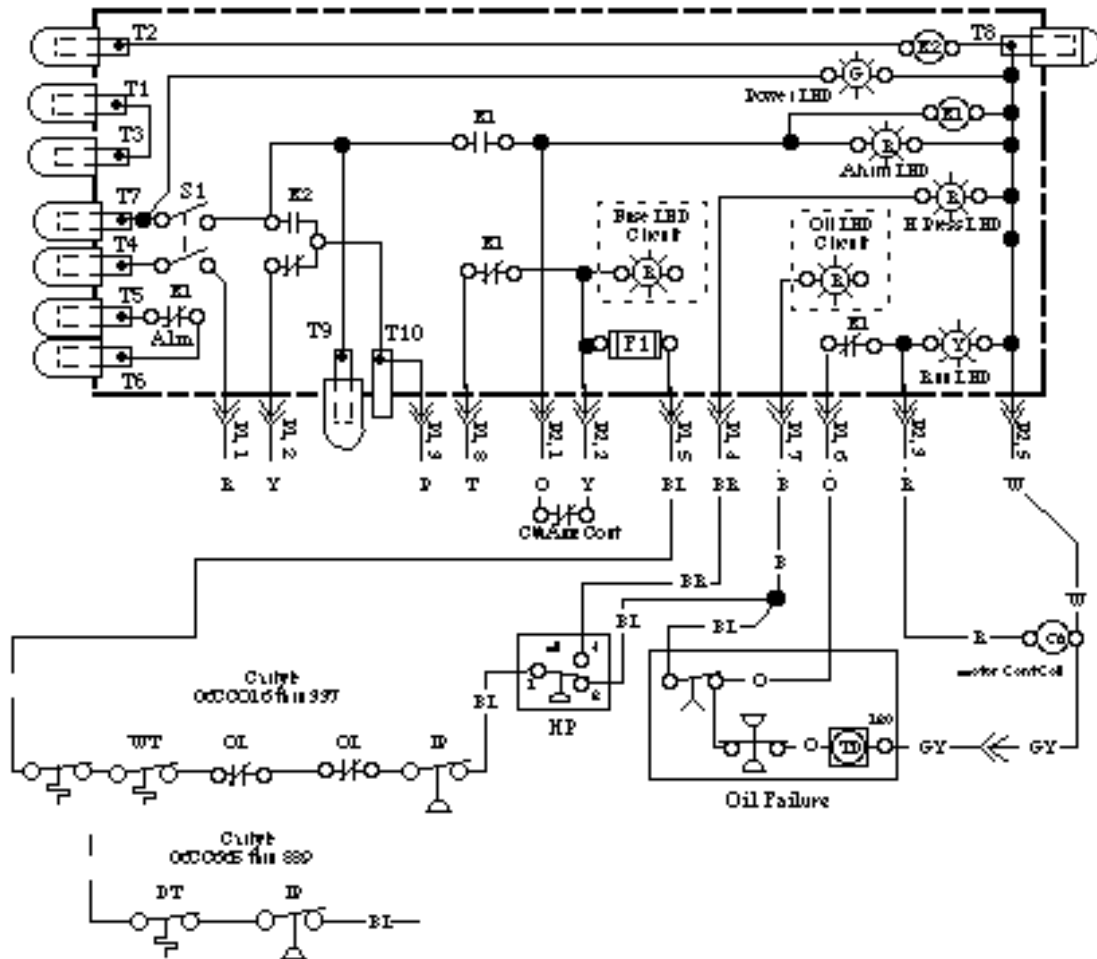


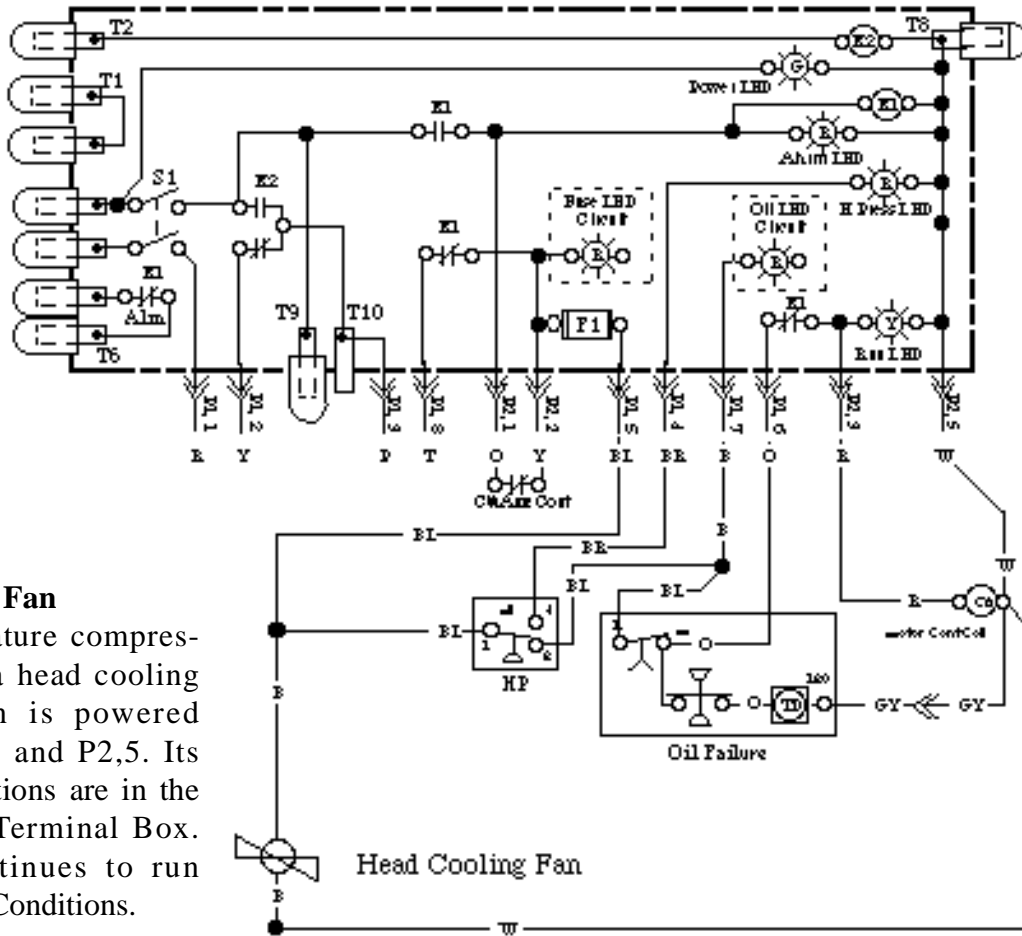
Figure 4-14 Carlyle Internally Compounded

Compressor Protection for Carlyle Internally Compounded Compressors

For these Carlyle Compressors the compressor protection is wired in series with the high pressure and oil failure controls. In this position an open circuit will cause an alarm condition.

The Oil LED lights for both Oil Failure and compressor protection. To determine which caused the failure take the following steps in order.

1. Turn off the compressor board switch to reset it, then turn it on. If the compressor starts the failure was from a compressor protector.
2. If the compressor does not start, press the reset for the oil safety. If the compressor starts the failure was from Oil Failure.

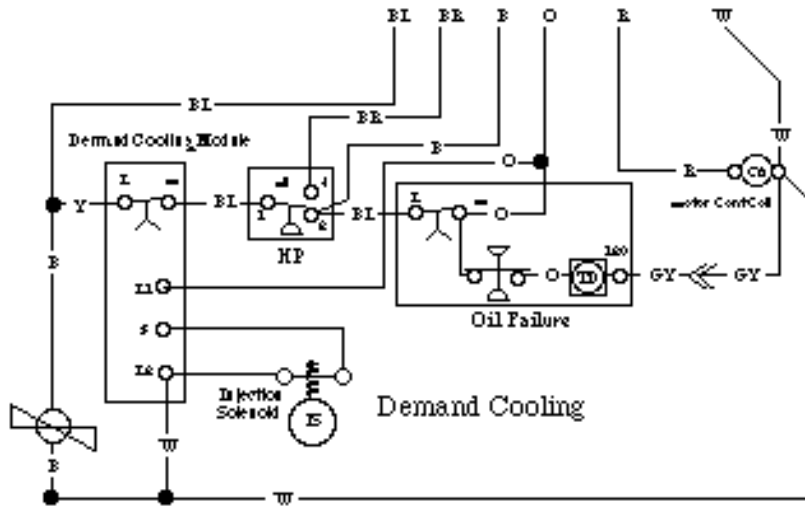


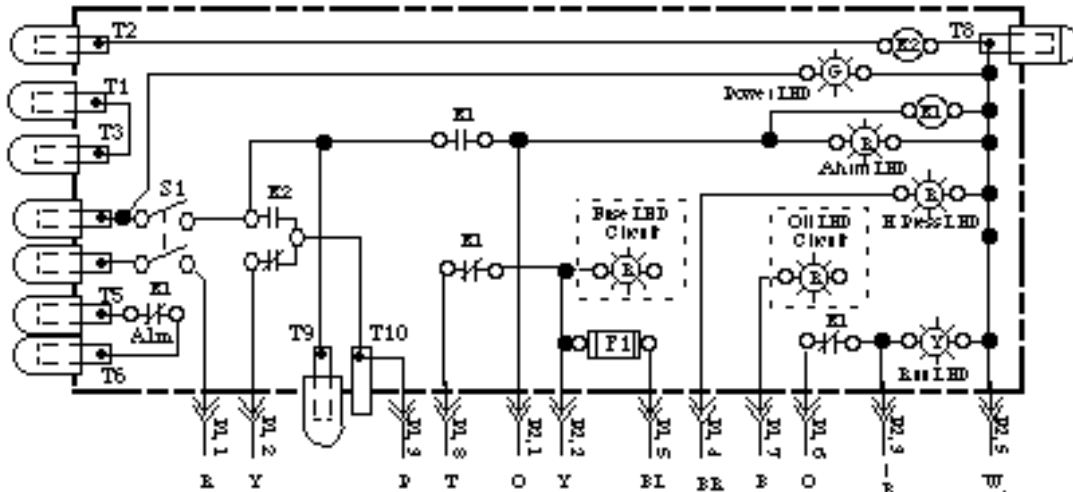
Head Cooling Fan

Low Temperature compressors require a head cooling fan. The fan is powered between P1,5 and P2,5. Its actual connections are in the Compressor Terminal Box. The fan continues to run during Alarm Conditions.

Demand Cooling

Demand Cooling is powered between P1,6 and P2,5. L1 and L2 are spliced into the P1,6 and P2,5 circuits in the Compressor Terminal Box. The module's time delayed safety is placed in front of the High Pressure control. If opened by sustained high temperature, it will cause a compressor alarm condition.





Internally Compounded Carlyle Compressors

Both the Injection Solenoid and the Oil Solenoid are wired parallel to the Compressor Motor Contactor Coil.

Elapsed Time Meter

This meter is wired to run when the Motor Contactor Coil is energized.

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.

Unloader

The Unloader circuit is powered only during compressor run. The Unloader is controlled by the normally open contacts of the EPC Unloader Board.

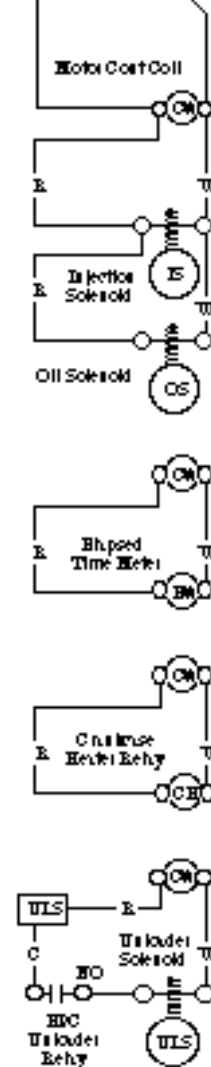
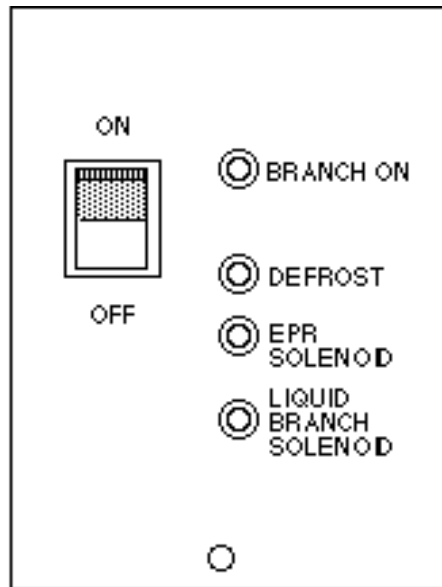


Figure 4-16
Circuits Parallel to the
Compressor Motor Contactor Coil

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.

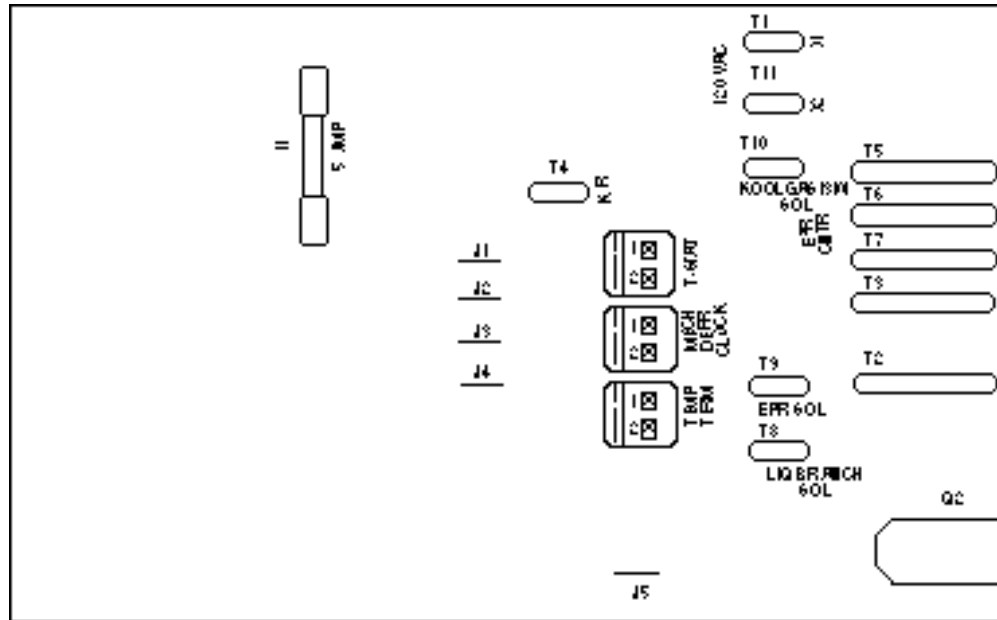


Figure 4-18 Defrost Board Inputs and Outputs

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.

MECH DEFR CLOCK is input from the normally open contacts on the mechanical defrost clock, when contacts close branch relay R1 will switch into defrost.

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

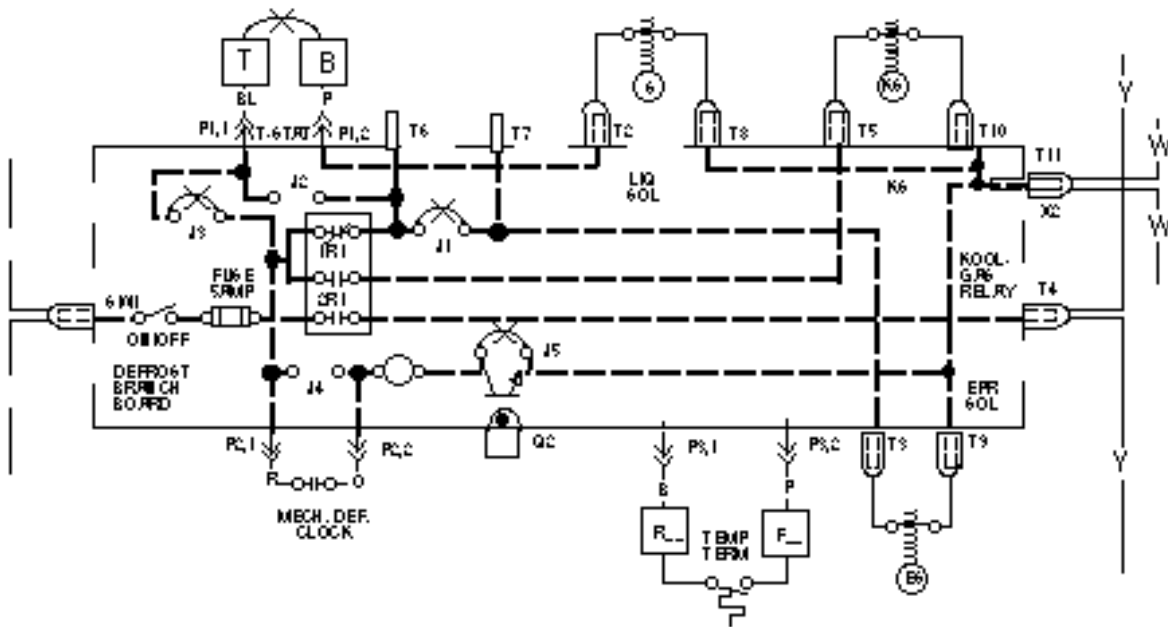
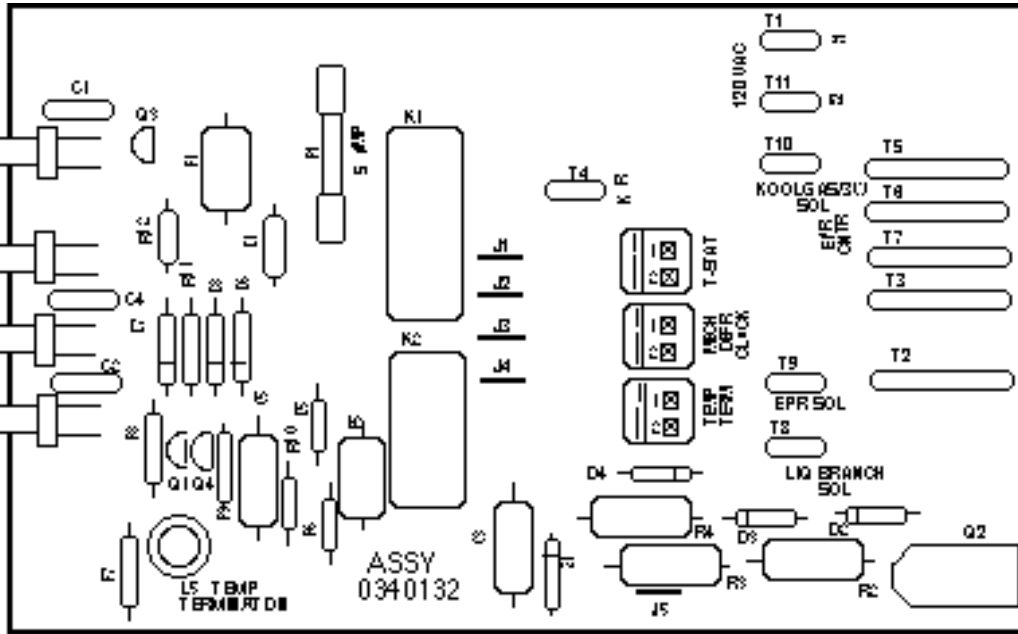
KG/3W SOL is output to the Koolgas or 3-Way Valve Solenoid, depending on which is applied.

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.



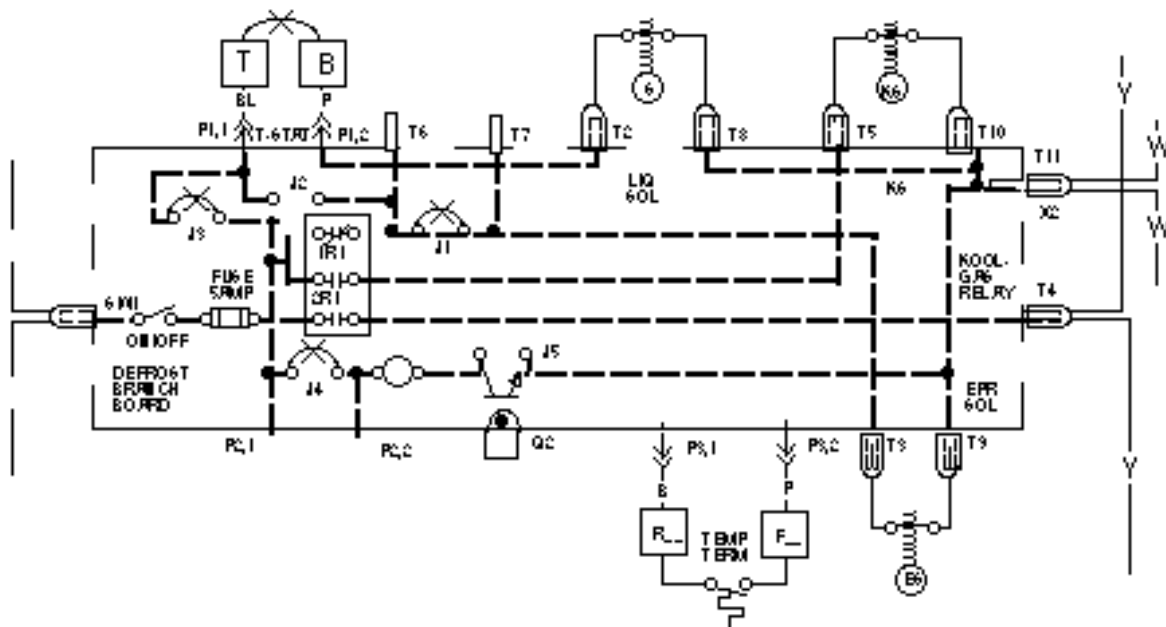
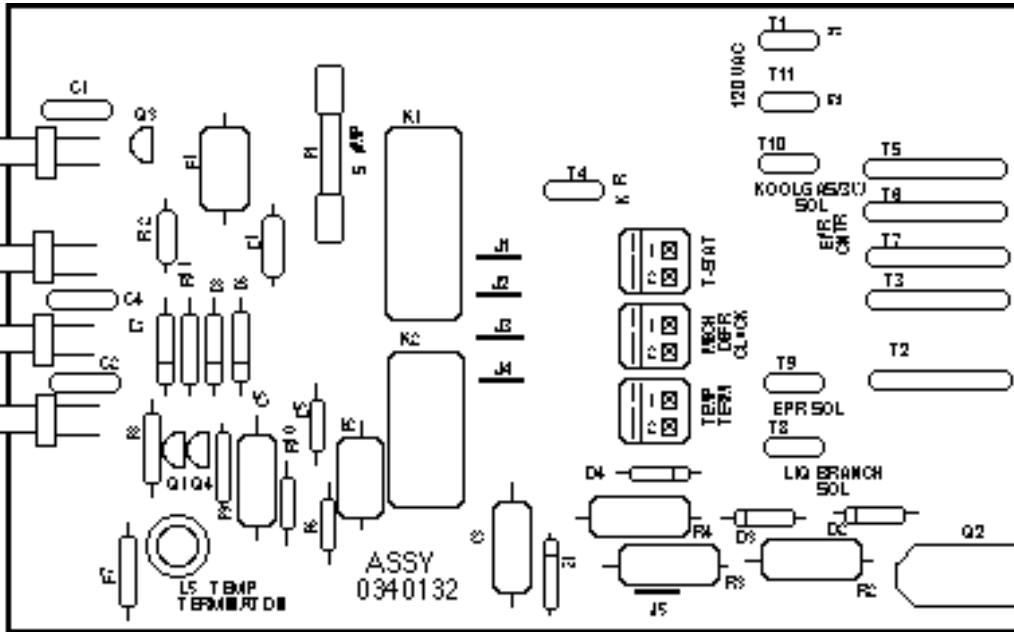
Troubleshooting—Defrost Board with Mechanical Time Clock

Be sure Board Switch is closed.

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

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



Troubleshooting—Defrost Board with Fibertronic Time Clock

Be sure Branch Board Switch is Closed.

Refrigeration Mode				
Test			Result	Action
1	From the Time Clock force the Branch into Defrost Mode. (Refer to Defrost Clock 1000 Manual)		Branch Board Defrost Yellow LED lights	System OK to Branch Board Go to 5
			Branch Board Defrost Yellow LED does NOT light	Consult Defrost Clock 1000 Manual to test up to Q2 Input on the Branch Board - if OK, Go to 2
			Branch Board Defrost Yellow LED lights for a different Branch Board	Verify Clock Terminal and Branch Board for match. Consult Defrost Clock 1000 Manual for correction procedures
Voltmeter Lead Placement			Voltmeter Reading	Action
2	T1 (X1)	T11 (X2)	120	Go to 3
			0	Check Power Supply to Board
3	P2,1	T11 (X2)	120	Go to 4
			0	Check Fuse F1 (5Amp) - If OK, Board Failure
4	P2,2	T11 (X2)	120	Go to 5
			0	If Jumper J4 open, closed; if closed Board Failure
5	T4	T11 (X2)	120	Go to 6
			0	Board Failure
6	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 TIMER MOTOR

Timer motors are wired directly between “X1B” and neutral “X2F”, so they are energized unless:

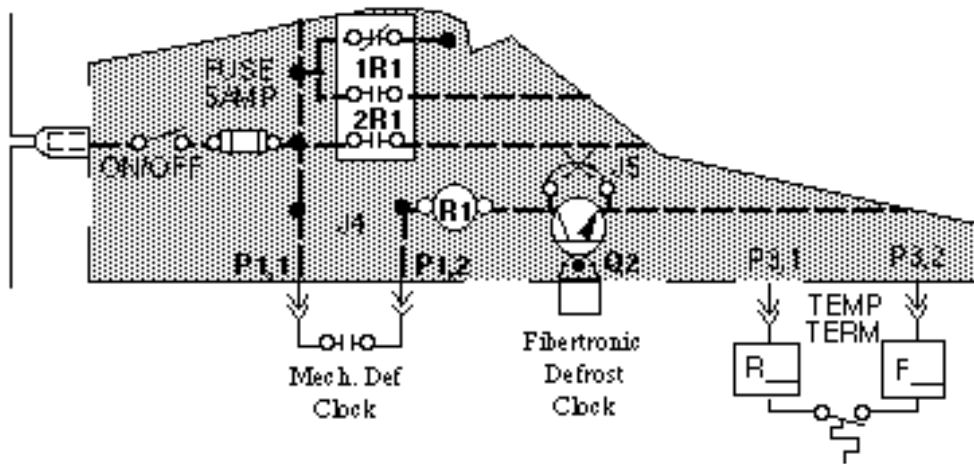
- Power fails
- Control Panel Circuit Breaker is open
- Single Phasing Protector opens.

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.



Suction Stop Koolgas Defrost

When the defrost clock energizes Defrost Relay Coil R1

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

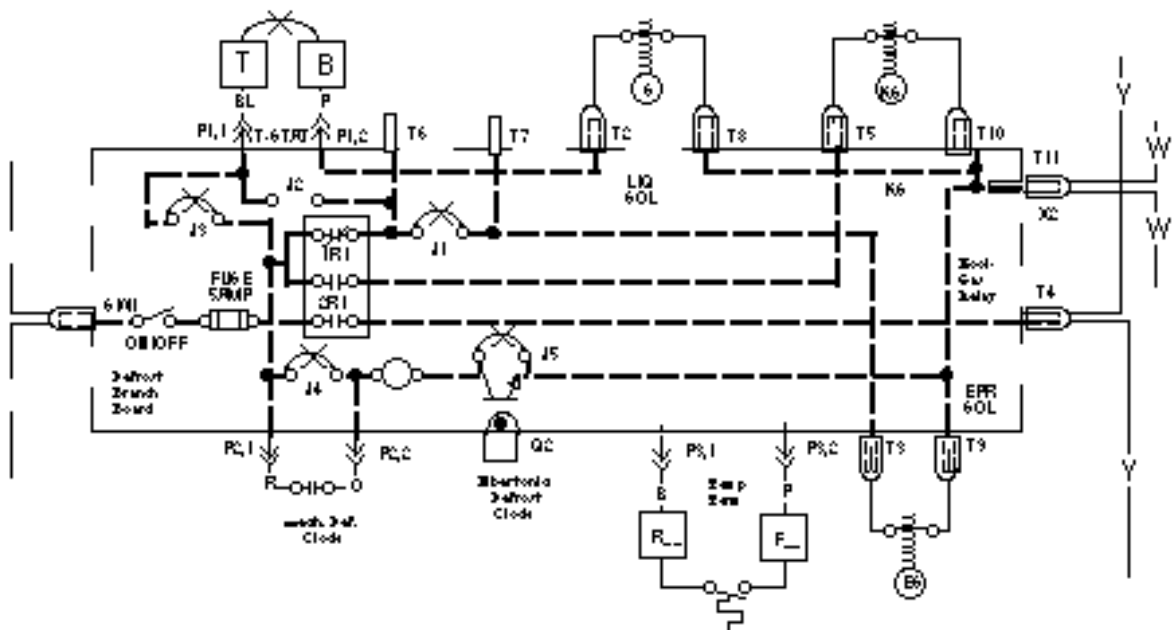
Contacts 2R1 will turn "ON" the Koolgas Solenoid (KS)
and Koolgas Relay (KR)

power to T4

thru Yellow wire to KR terminal

thru Red wire to Koolgas Relay (KR)

and thru Brown wire to Bypass Circuit.

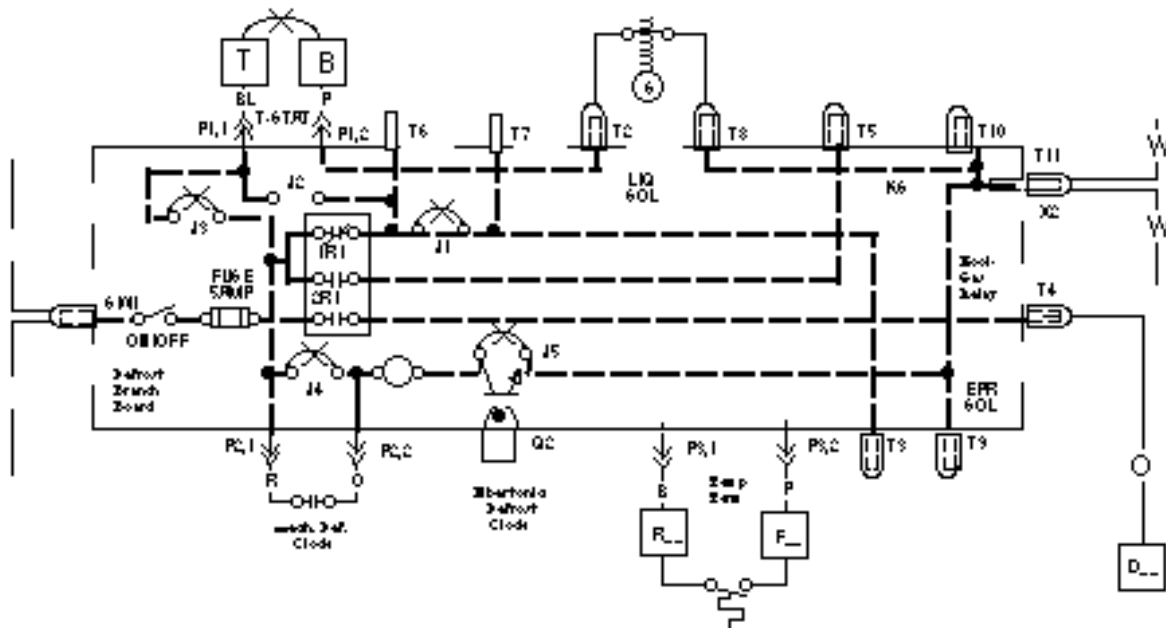


Electric Defrost

When the defrost clock energizes Defrost Relay Coil R1

Contact 1R1 will turn "OFF" the Liquid Line Solenoid

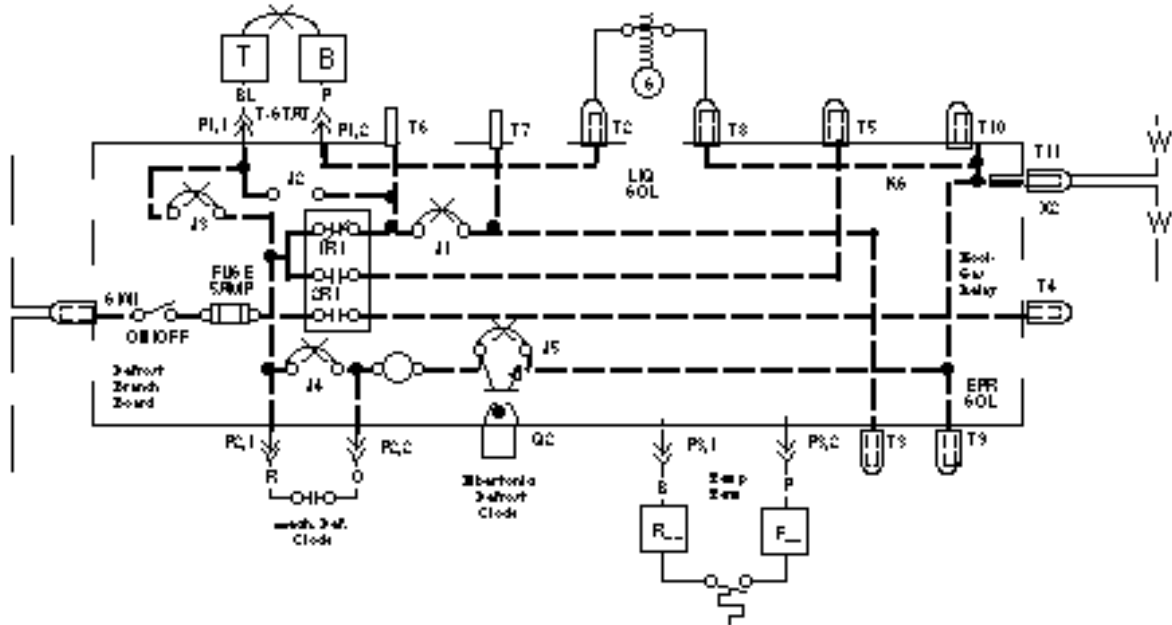
Contact 2R1 will turn "ON" Branch Defrost Contactor in the Electric Defrost Panel
power to T4
thru Orange wire to D__ terminal
thru field wiring to corresponding D__ terminal in Electric Defrost Panel.



Off Cycle Defrost

When defrost clock energizes Defrost Relay Coil R1

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



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 Super 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.

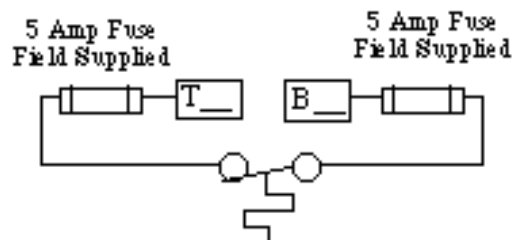


Figure 4-25 Refrigeration Thermostat

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.

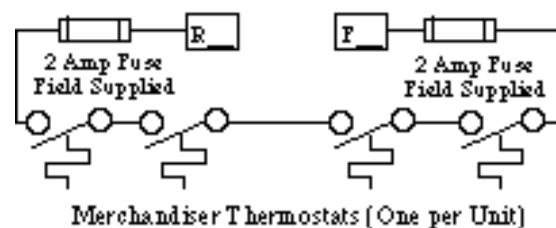
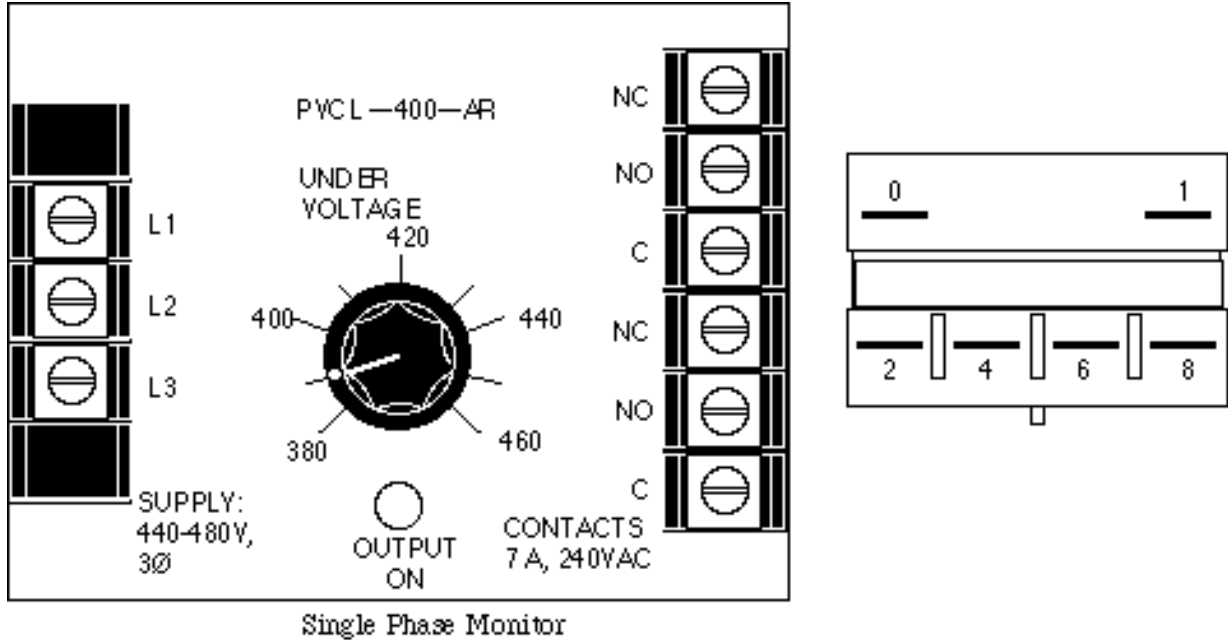


Figure 4-26 Wiring Defrost

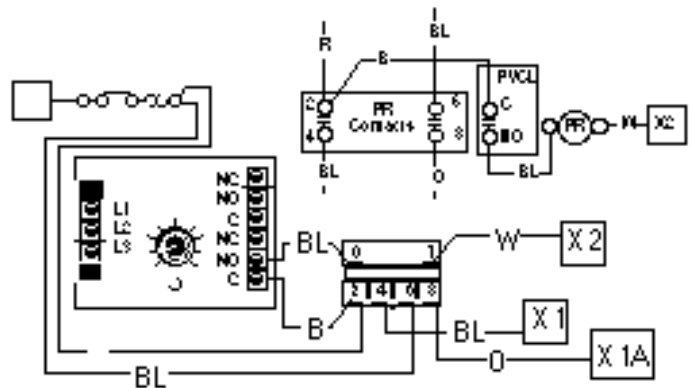


POWER MONITOR

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 3PH 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.



REMOTE CONDENSER, REMOTE SATELLITE

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 CONDENSERS

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.

Other Applications

If Water Cooled Condensers are used, they will be shell and tube construction and must be field installed. Evaporative Condensers are shipped directly to the job site by the selected supplier. Proper installation is the installer's responsibility.

Shutoff Valves

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

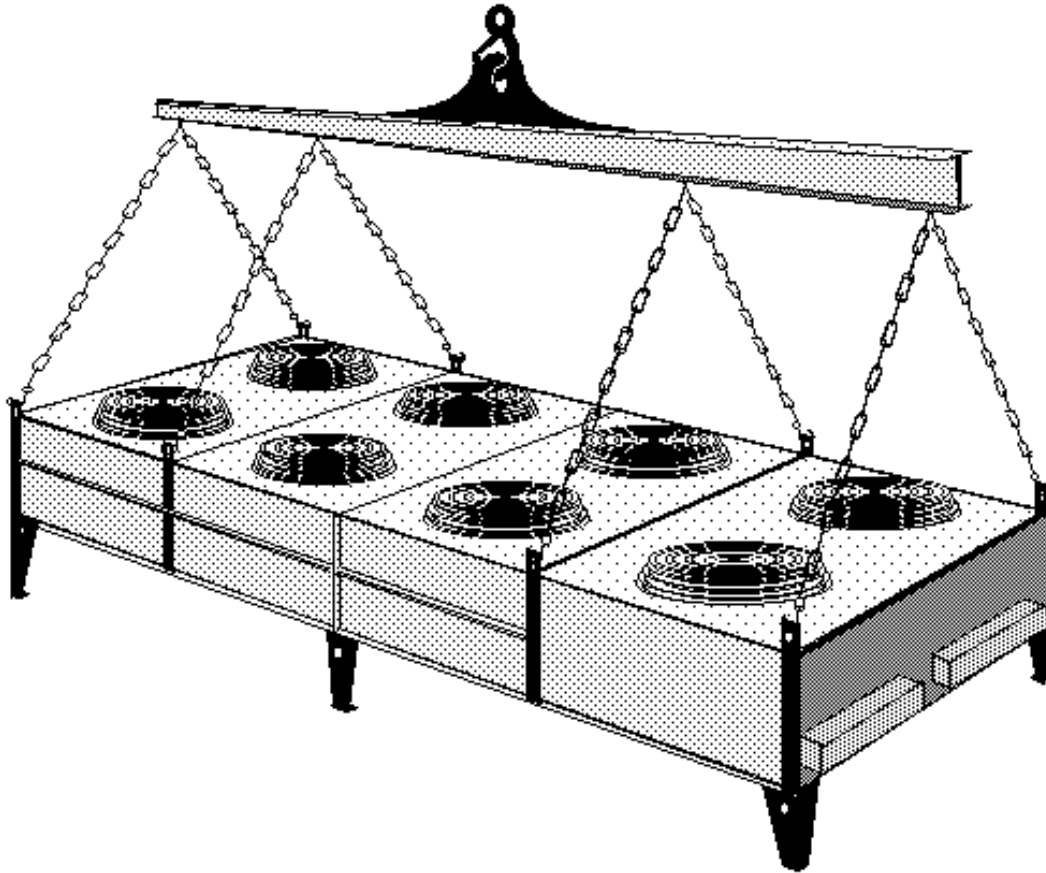


Figure 5-1. Lifting the Condenser

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 compressor,s be sure the condenser serving that unit has power and that all isolation valves are open.

Physical Data

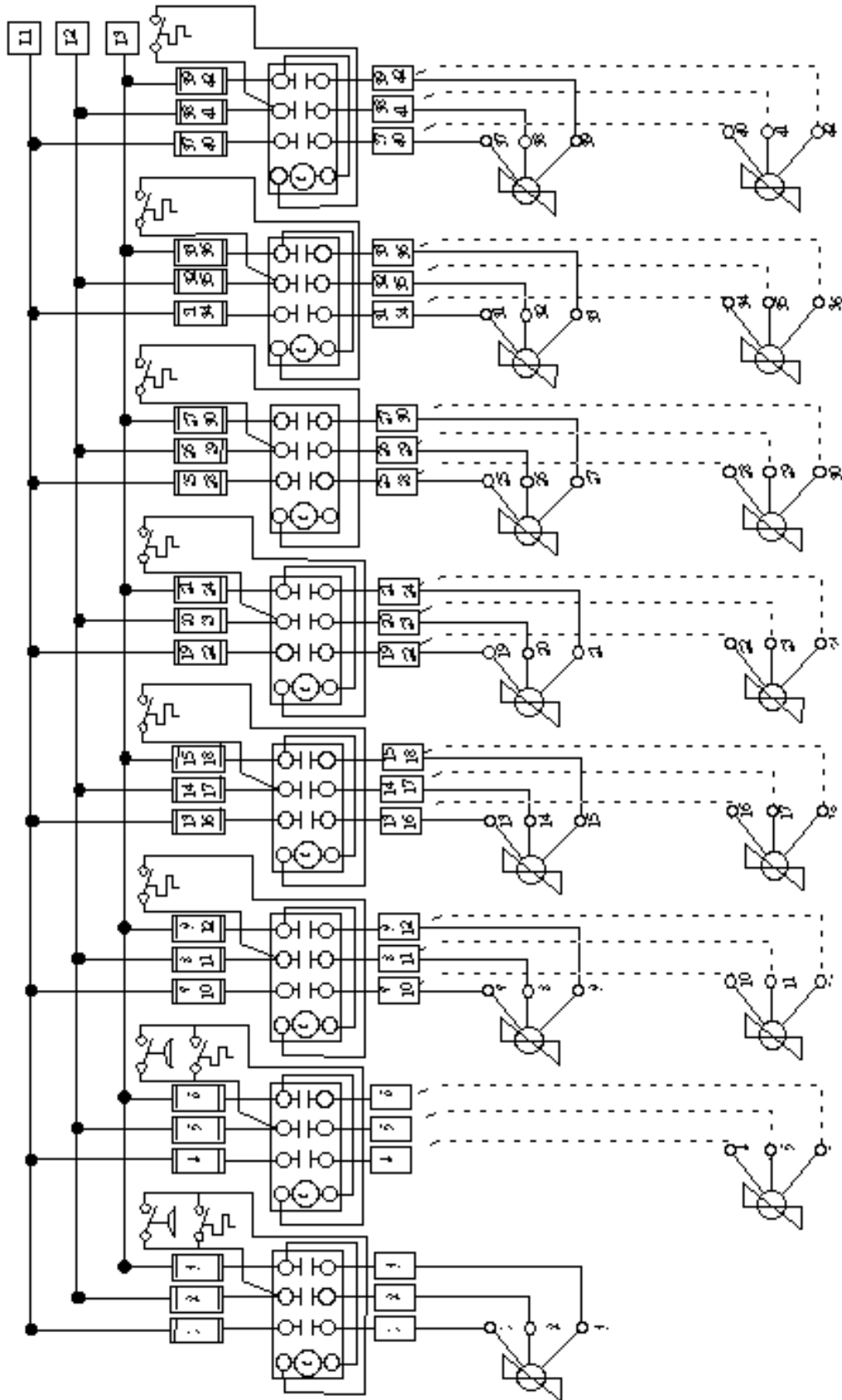
Model	No. Fans	FLA 3PH			Weight /w Max. Flood (lbs)		Max Flood Charge (lbs)		Inlet/Outlet Connections OD	
		208V	230V	460V	R22	R404A/ R507	R22	R404A/ R507		
O N E F A N	HLCVB	1x1	2.8	2.6	1.3	205	221	19	35	1 1/8
		1x2	5.6	5.2	2.6	410	445	40	75	1 3/8*
		1x3	8.4	7.8	3.9	615	666	59	110	1 3/8
		1x4	11.2	10.4	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
W I D E	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
E	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
T W O F A N S	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
W I D E	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
E	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										

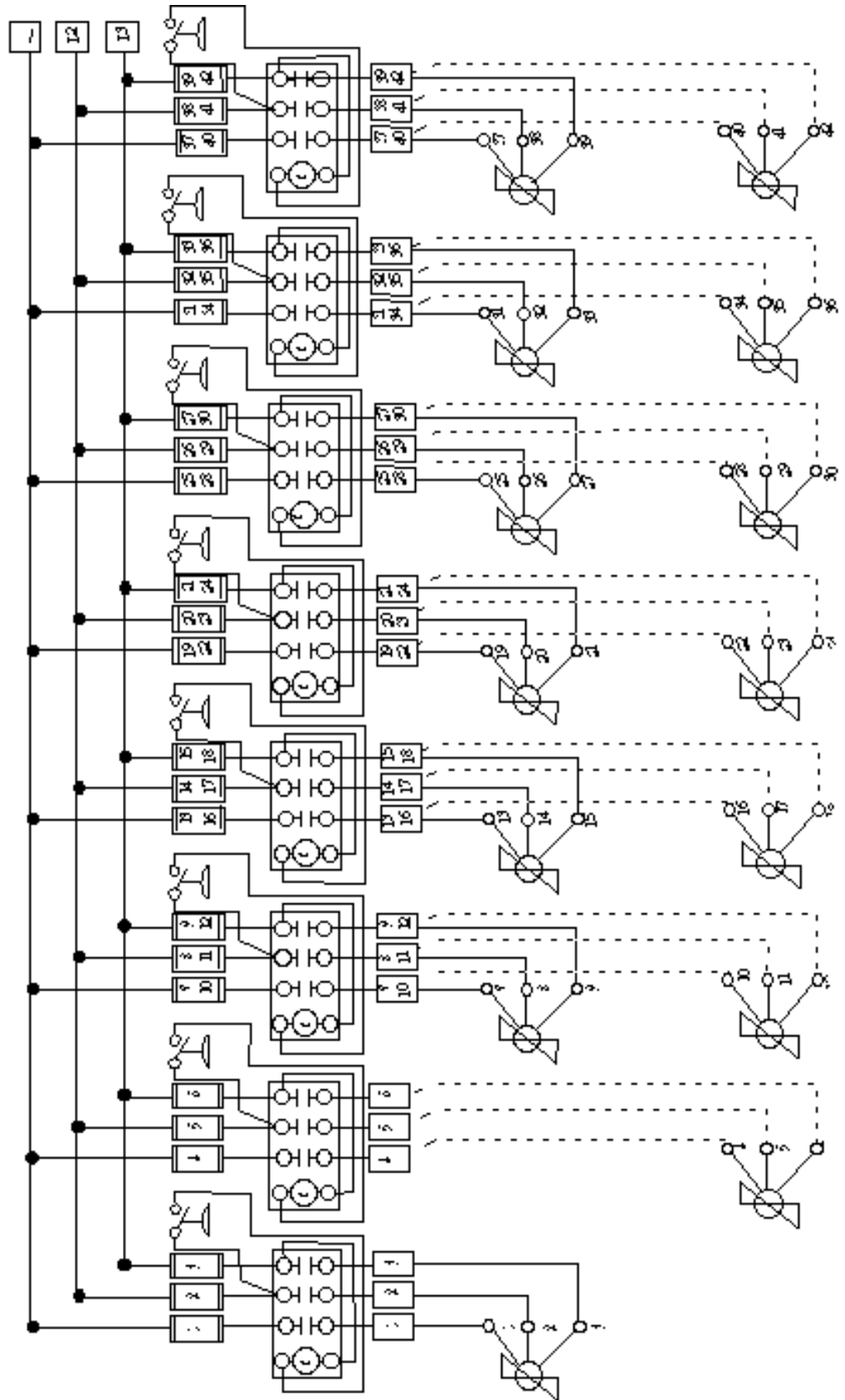
The Flooding Charges listed in the table above reflect additional refrigerant required for split condenser method of winter control above normal summer operating charge and heat reclaim coil requirements.

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.





Remote Satellite Components

Each Remote Satellite contains the following:

1. One Copeland, or Carlyle semi-hermetic compressor with:
 - a. High and Low Pressure Controls,
 - b. Oil Pressure Safety Control (when required),
 - c. Primary Overload Protection, and
 - d. Compressor Cooling Fans on low temperature application
2. Factory piping with:
 - a. Suction and Discharge Stubs, and
 - b. Oil Float
 - c. Suction Filter
3. Factory-wired control panel with:
 - a. Compressor Circuit Breaker and 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°.

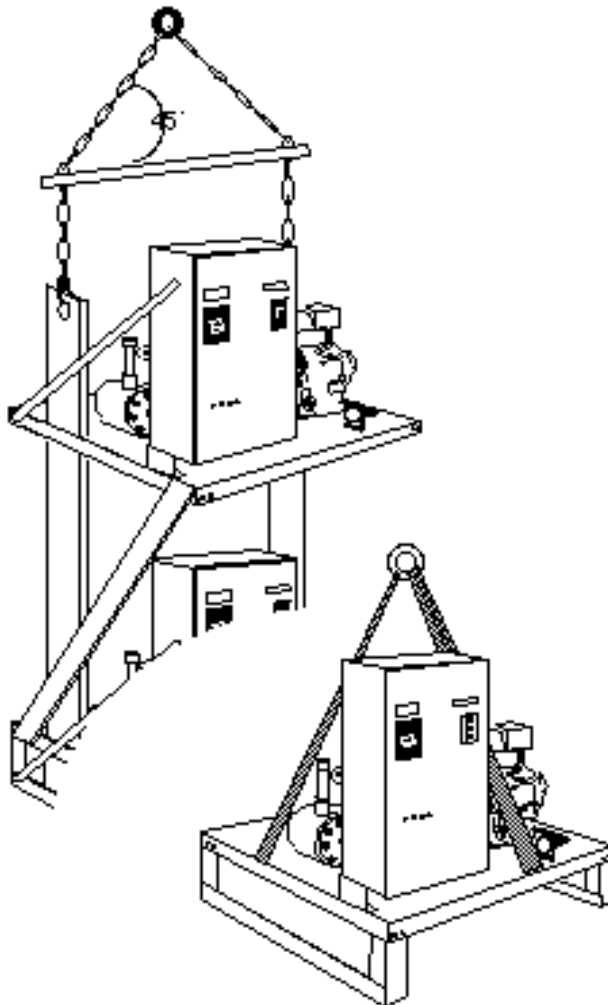


Figure 5-2. Satellite Rigging and Lifting

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.

MECHANICAL DEFROST TIMERS

OVERVIEW

This section deals with the Precision and Paragon Defrost Timers. When used, these Time Clocks handle defrost periods of 2 hours or less. Cycles requiring longer defrost periods must be controlled through supplemental time clocks. Hussmann's Electronic Defrost Time Clock carries its own manual. Specific guidelines for setting the Time Clocks are in "Control Settings." General instructions are handled here.

PRECISION DEFROST TIMER

Three main sets of components are involved in setting up a defrost program for the system. These are:

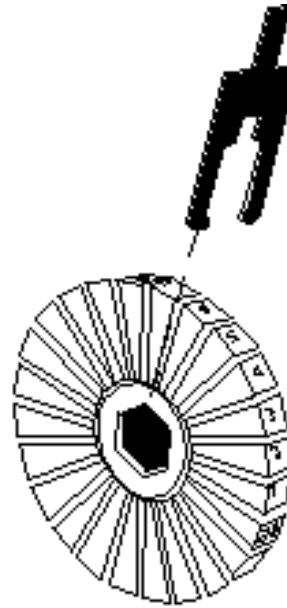
1. Program Timer Dials rotate once in 24 hours and are slotted at one hour increments. The field technician will insert a tripper each time a defrost cycle is to start in the 24 hour clock day.
2. Cycle Timer Dials rotate each defrost cycle and stop in refrigeration. The field technician will set the length of each defrost cycle from 2 to 120 minutes.
3. The Time Setting Dial rotates once every 24 hours and appears to be 7 hours ahead of the Program Timers. This time difference compensates for the location of the defrost switches and the pointer marked *TIME*. The field technician will set the Time Setting Dial at the approximate time of day.

Setting Precision Defrost Timer

Setting Defrost Start Times

Rotate the Program Timer Dials by turning the setting knob at the end of the Timer opposite the Motors. As the Dial slots for start of defrost become accessible, install a tripper for

each desired time start. The slot for each tripper time is located immediately *above* its number on the dial face.



To install a tripper, push straight in until it snaps over its holding detent. A properly installed tripper has its shoulders extended $\frac{1}{32}$ inch above the dial face, and is square to it. A misaligned tripper can jam the timer.

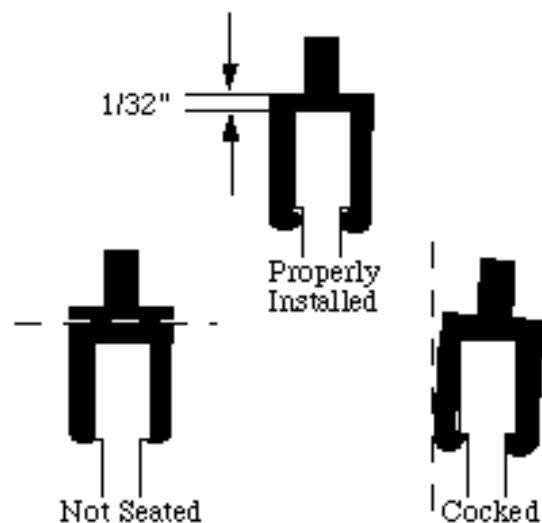


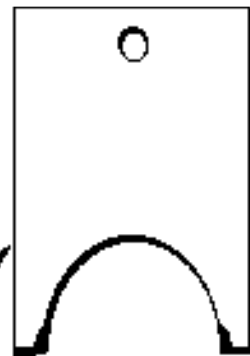
Figure 6-2 Proper Installation

Setting Length of Defrost

To set the length of each defrost cycle, turn the setting knob until the indicator mark is facing forward and the Cycle Timer Dial stops.

CAUTION: Failure to have the indicator mark visible before adjusting the Cycle Timer Dial may cause damage to the clock.

Insert the Time Setting Tool, pull the dials apart and reset teeth when required minutes of defrost is opposite the indicator mark.



Time Setting Tool

Rotate

Figure 6-3
Setting Precision Timer

Indicator Mark

Pull Dial Teeth Apart to Set Length of Defrost

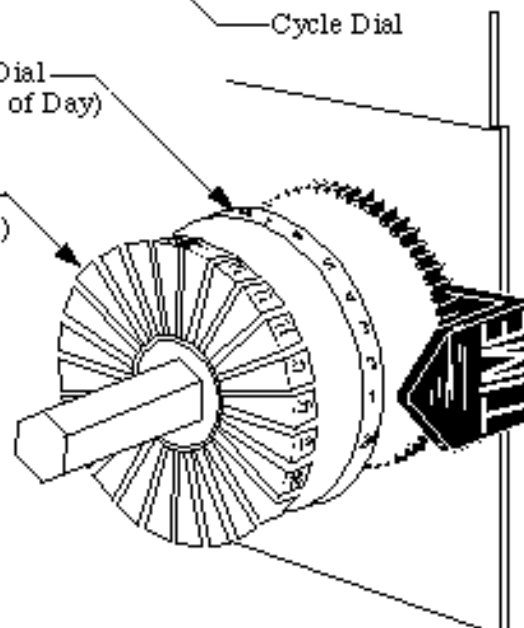
Cycle Dial

Time Setting Dial
(Time of Day)

Timer Dial
(Defrost Start Time)

Setting Time of Day

Turn the setting knob until the correct time of day on the Time Setting Dial is opposite the Arrow Time Marker. Note that the time indicated on the Time Setting Dial does not match the position of the numbers on the Program Timer Dials.



Precision Alarm Switch

The timer is provided with two motors and an alarm switch which is normally open. Both motors operate continuously. If one motor fails, the other motor will continue to drive the timer; the alarm switch will close, warning that the timer requires service.

To reset the alarm switch

1. Push gear "A" toward the motor, or lever "B" will be broken.
2. Using a non-metallic object, depress the plastic cam until it snaps into position holding the switch open.

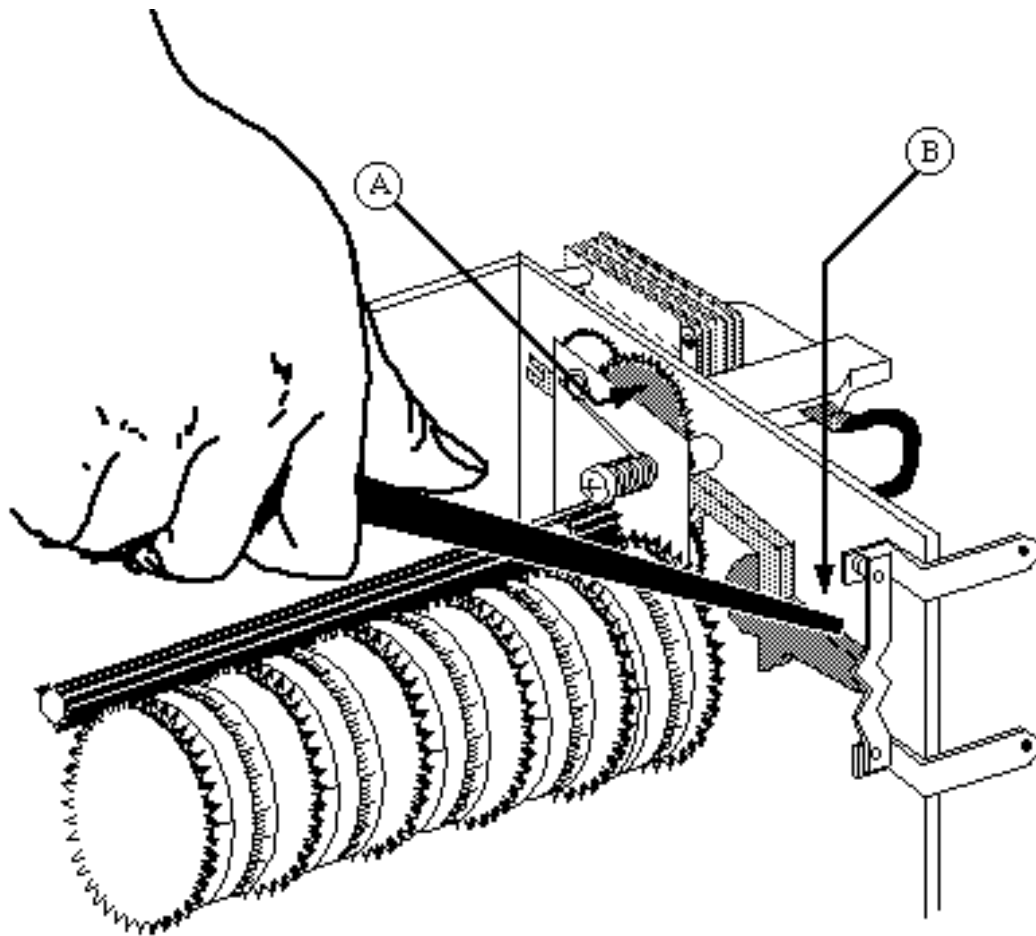


Figure 6-4

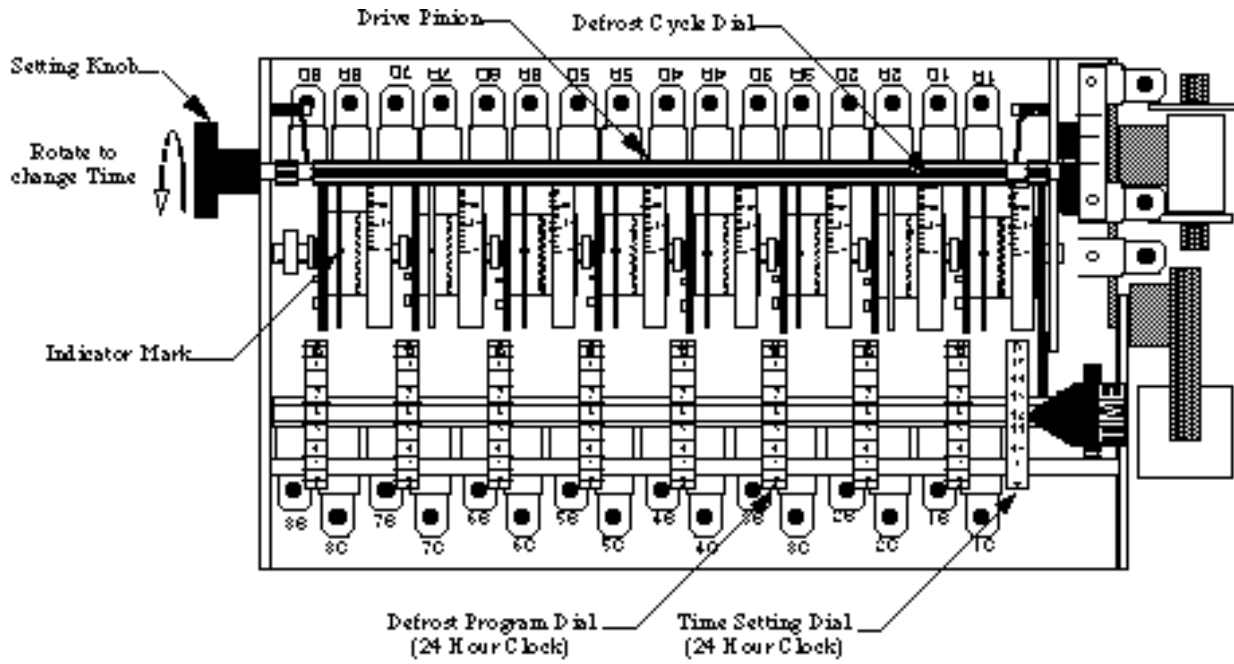


Figure 6-5

PARAGON DEFROST TIMER

The Paragon Defrost Timer Consists of three components. These are:

1. The **Frame** holds a Drive Motor Module, and as many Program Modules as needed for the defrost systems.
2. The **Drive Motor Module** mounts on the frame end and powers the Program Modules through the Main Drive Gear. Note that the Drive Motor and the Defrost Circuits do not have to be the same voltage.
3. **Program Modules** contain a Time of Day Dial, which rotates once every 24 hours, and a Minute Dial, which rotates once every defrost cycle. The Time of Day Dial is notched to accept defrost start trippers either on the "EVEN HOUR" or on the "ODD HOUR" of the 24 hour dial. These Modules **cannot** be substituted for each other, or converted to the other type.

Setting Paragon Defrost Timer

Setting Defrost Start Times

Insert a black tripper in white Program Module Dial notch for each defrost start time on a system. Remove any extra trippers. (P.M. hours are represented by numbers 13 through 24.)

Setting Length of Defrost

Rotate the copper termination lever of the Minute Dial to the required minutes of defrost. Be careful not to bend the lever any further than is necessary to disengage it from the dial teeth. **DO NOT MOVE THE RED TAB.**

Setting the Time of Day

Rotate the Main Drive Gear on the Motor Module with an upward push of the thumb until the correct hour on the black Time of Day Dial aligns with the pointed alignment mark on the modules.

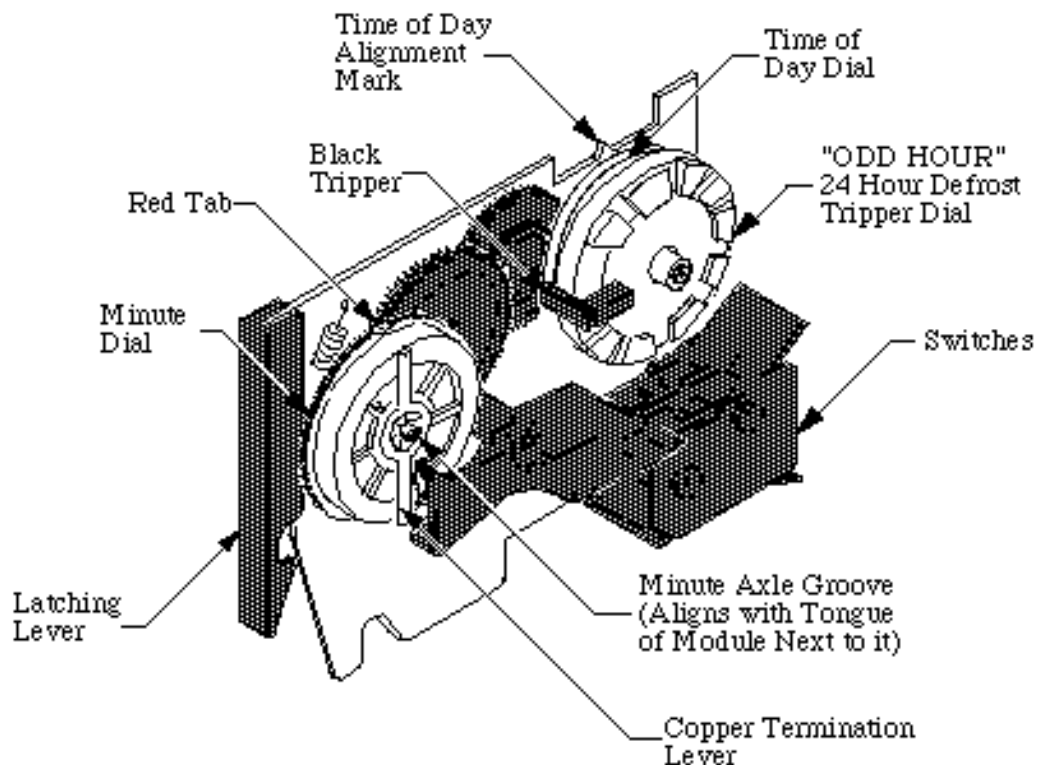


Figure 6-6

Paragon Program Module Replacement

Removal

Turn off power to control panel and meter check the Paragon to assure technician safety.

Disconnect and mark wires from the switch at the top rear of the Module. The switch terminals are C, NC, and NO.

Adjust the timer so all the red tabs on the Minute Dials are facing directly front of the timer. At the bottom rear of the Module, pull down on the plastic latching lever and out on the bottom of the Module.

Installation

Be sure power is off.

Set all the Modules including the one to be installed for the same hour on the 24 hour dials. Set all red tabs on the Minute Dials, including the one to be installed, in a front most position.

Slip the Module onto the slotted rod of the frame top and mate the Minute Dial axle into the axles on both sides of it.

Insure that all the red tabs are aligned, and replace wires on switch terminals. Reset time of day and turn on the control circuit.

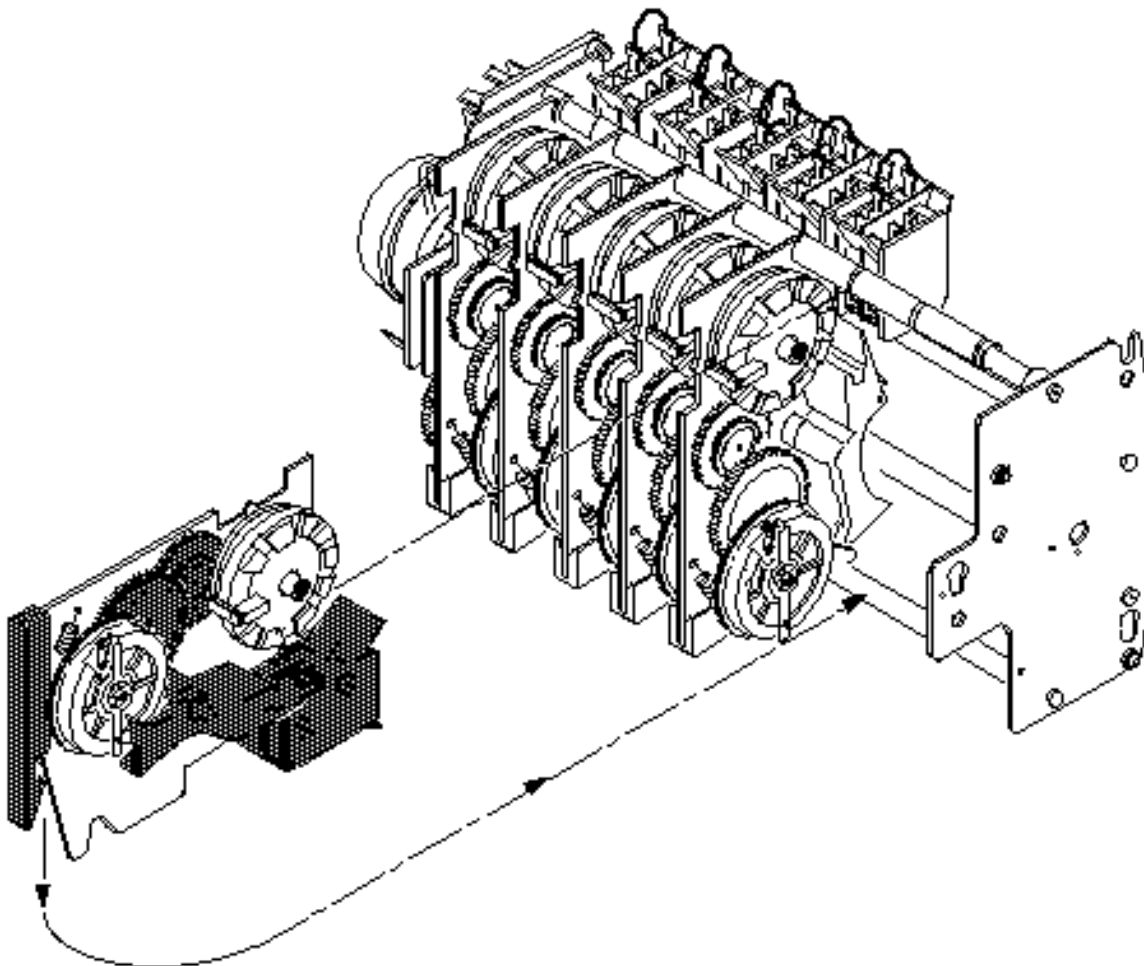


Figure 6-7

Paragon Program Motor Replacement

Removal

Turn off power to control panel and meter check the Paragon to assure technician safety Disconnect and mark wires to motor.

Rotate the main drive gear until the axle tongues and grooves are vertical (red tabs will be directly above the axle).

Loosen the hex head bolt next to the motor. And slide the module up until the three locator studs clear the key slots.

Installation

Be sure power is off. Check new motor voltage application.

Rotate the main drive gear until the axle tongues and grooves are vertical (red tabs will be directly above the axle).

Place locator studs in key slots and slide down. Tighten hex head bolt. Reconnect wires.

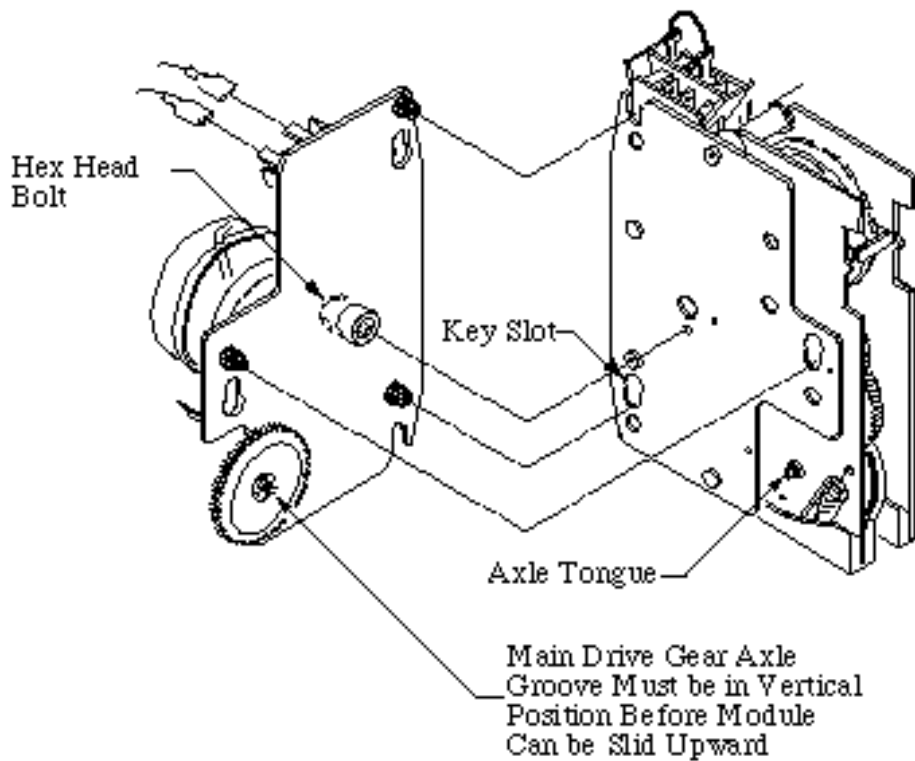


Figure 6-8

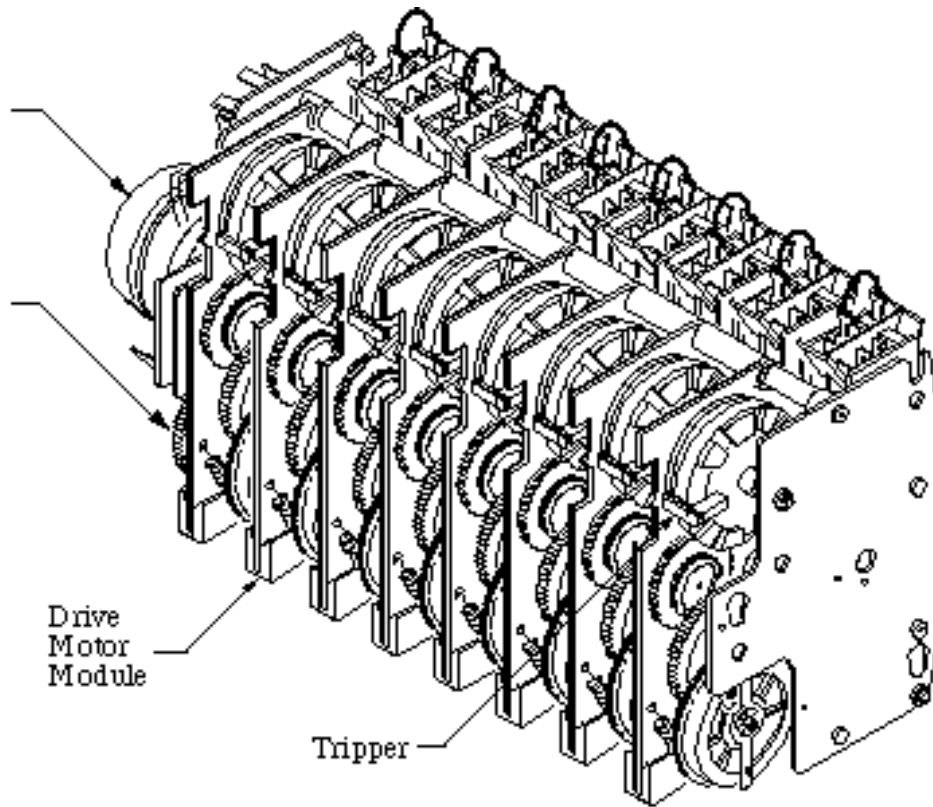


Figure 6-9

CONTROL VALVES

OVERVIEW

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

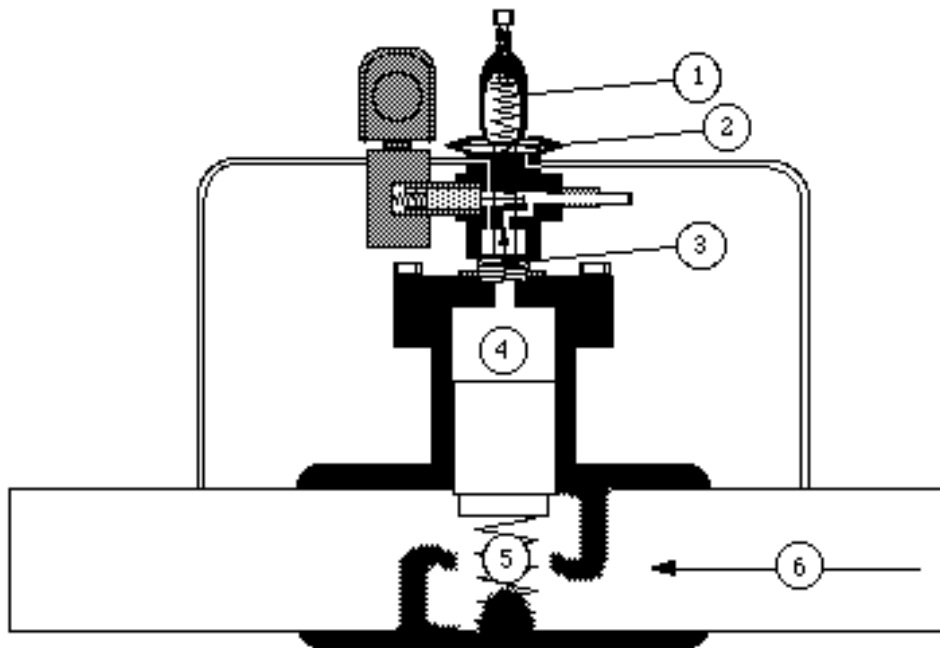
EPR VALVE

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 Super 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.

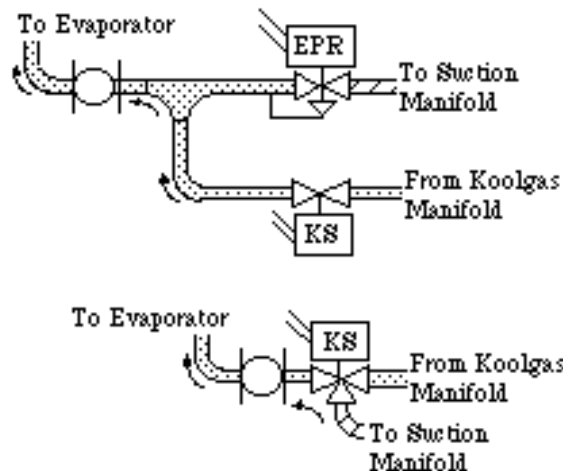


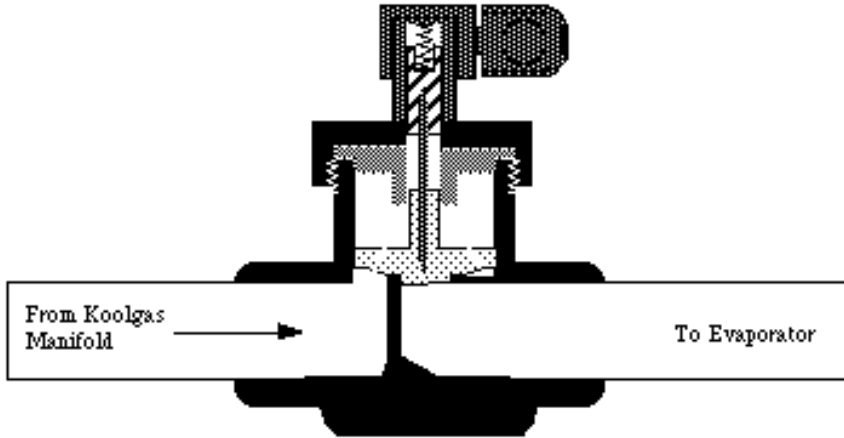
Troubleshooting EPR Valves

Malfunction	Cause	Action
Fails to Open	Dirt holding pilot port open	Disassemble and clean
	Solenoid not energized -bad solenoid -circuit open -stuck in defrost mode	Replace solenoid find and repair open 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, repipe 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	Repipe
	(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

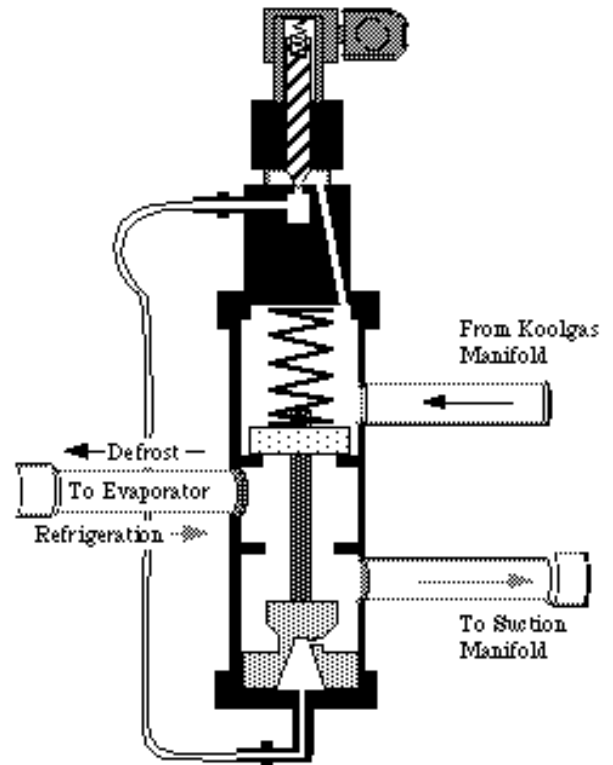
Koolgas valving is piped in one of two ways. With a stop suction EPR, a simple 2-way solenoid valve is used. Without, a 3-way solenoid valve is used. Unless there is damage to the valve body itself, both the 2-way and 3-way valve may be disassembled and repaired in the field.





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.



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

CONTROL VALVES

7 - 4

Revised August 1, 1996

MAIN LIQUID LINE SOLENOID VALVES

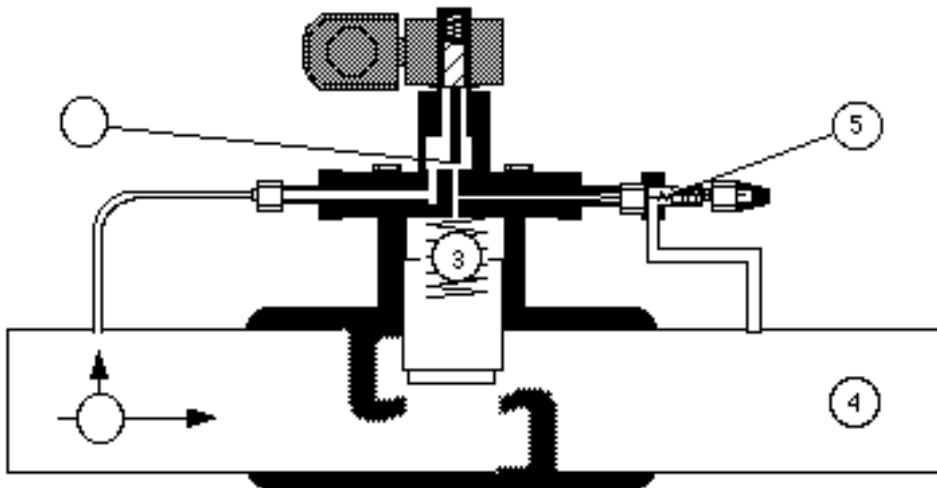
The Sporlan Main Liquid Line Solenoid Valve goes into differential mode when the coil is de-energized or fails. When the Pilot Port ① opens, Upstream pressure ② fills the Main Valve Chamber ③ and forces the Main Valve towards a closed position. The downstream pressure ④ falls to the point that the Pilot 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 down-stream 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.

Downstream pressure
+ pilot spring pressure
= upstream pressure.



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.

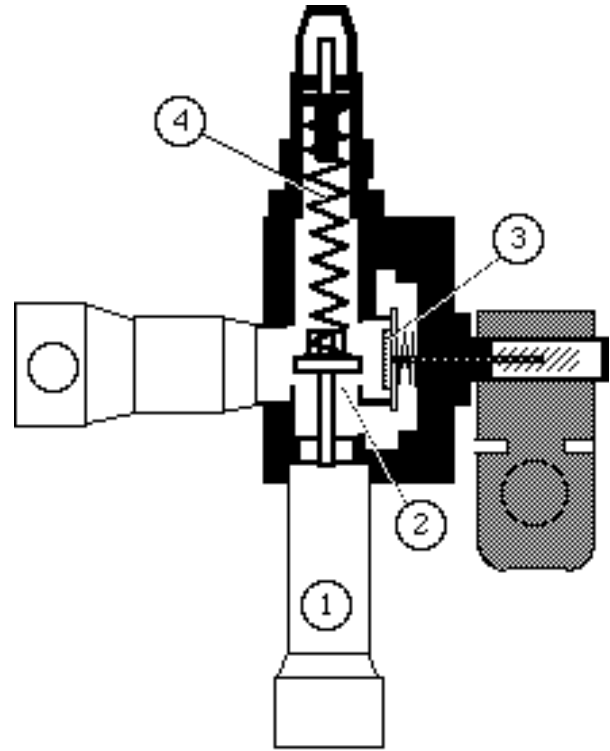
In refrigeration mode, the solenoid valve ③ is held open allowing flow around the modulating valve ②.

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

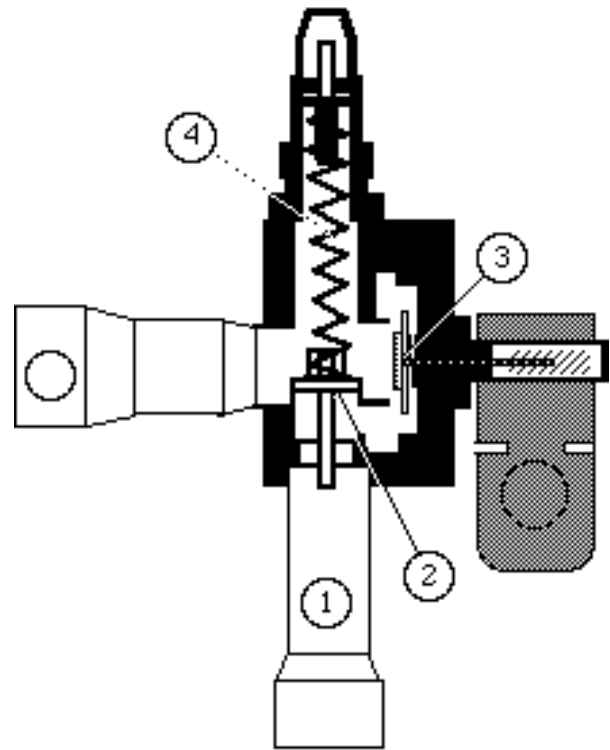
Differential Mode Quick Test

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

**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.

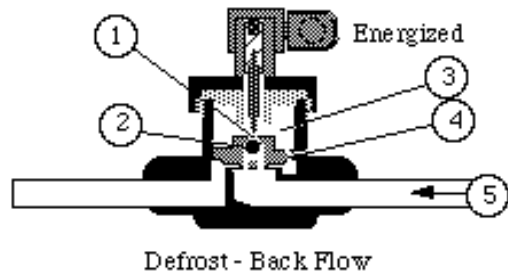
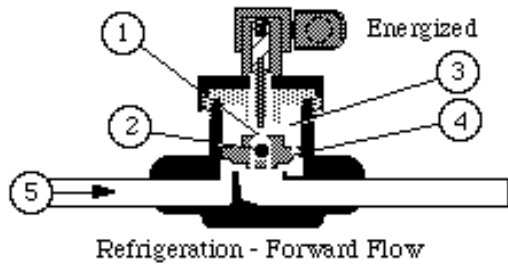
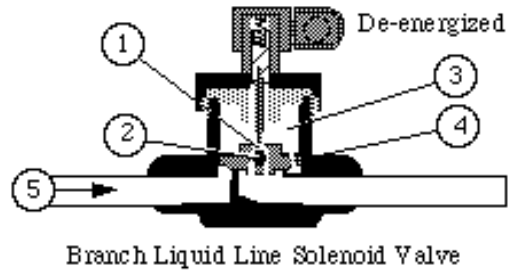
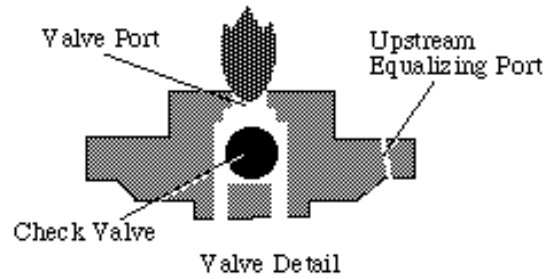


Figure 7-7
Branch Liquid Line with Back Flow

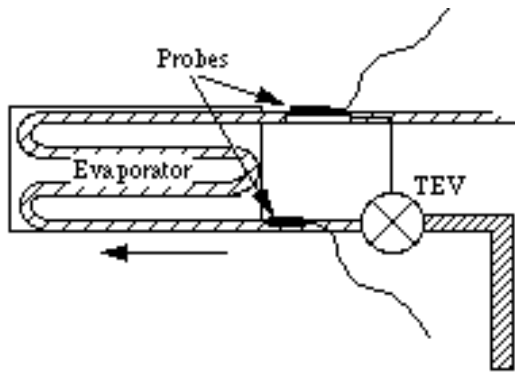
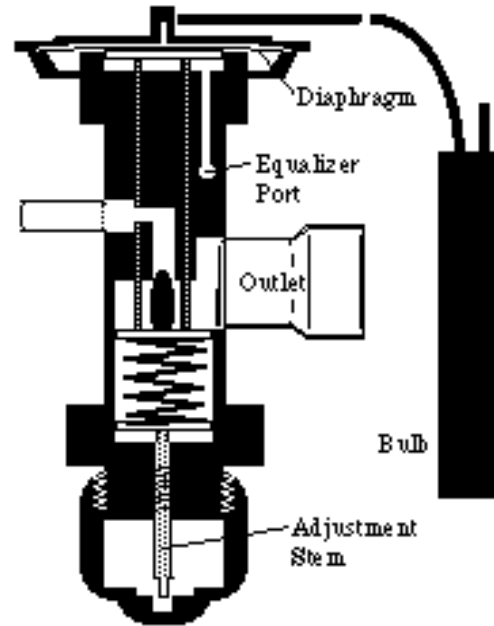
Troubleshooting Branch Liquid Line Solenoid Valves

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.



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	½ turn
BF	¼ turn

Troubleshooting the TEV

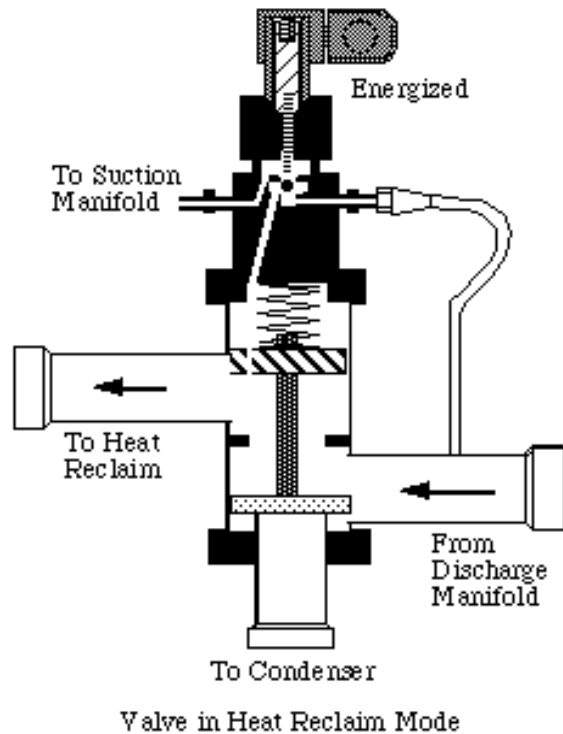
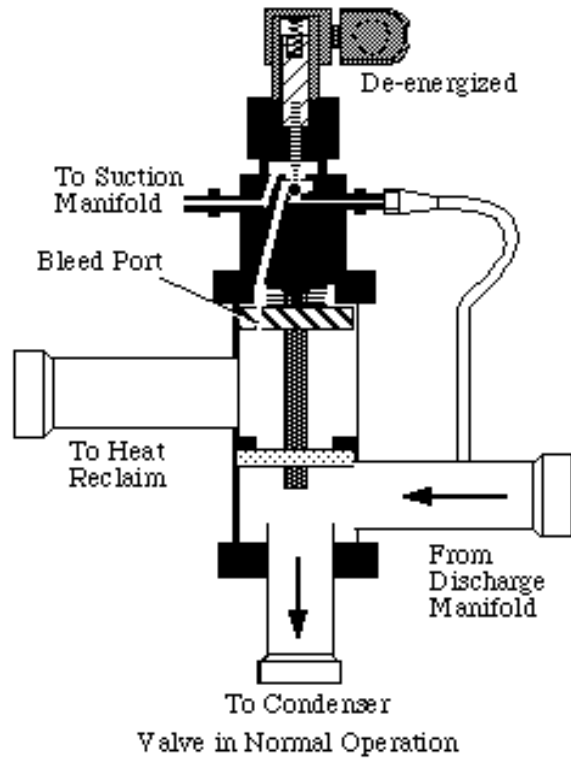
Malfunction	Cause	Action
Evaporator Starved	Superheat adjusted too high	Adjust to proper superheat
	Moisture	Dehydrate and install new liquid line filter dryer
	Dirt plugging strainer or valve mechanism	Remove and clean or replace
	Wax	Clean valve and install wax trapping dryer
	Equalizer Internal misapplied External plugged Capped Restricted Incorrect location	Install externally equalized TEV Clear Install properly Correct or repipe Repipe
	Flash gas upstream of TEV	Head pressure too low, raise head pressure Liquid supply line not exiting branch line from bottom, repipe Liquid supply line too small, repipe
	Insufficient pressure drop across valve	Raise head pressure Install valve with adequate capacity at reduced pressure
	“Dead” Bulb	Replace
	Undersized TEV	Install correct size
Evaporator Flooded	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
Poor Performance	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.



CONTROL VALVES

7 - 10

Revised August 1, 1996

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. (½ Turn = 35 psig change.)

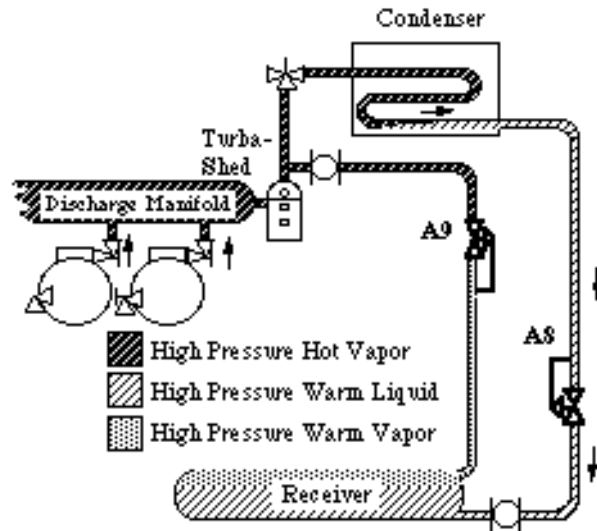
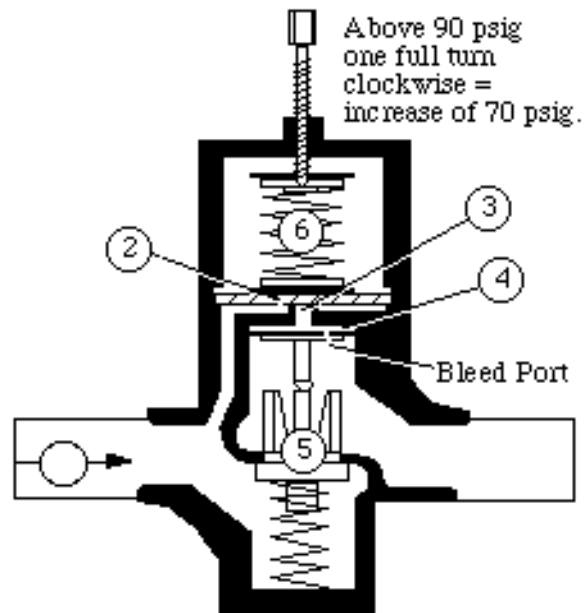


Figure 7-11

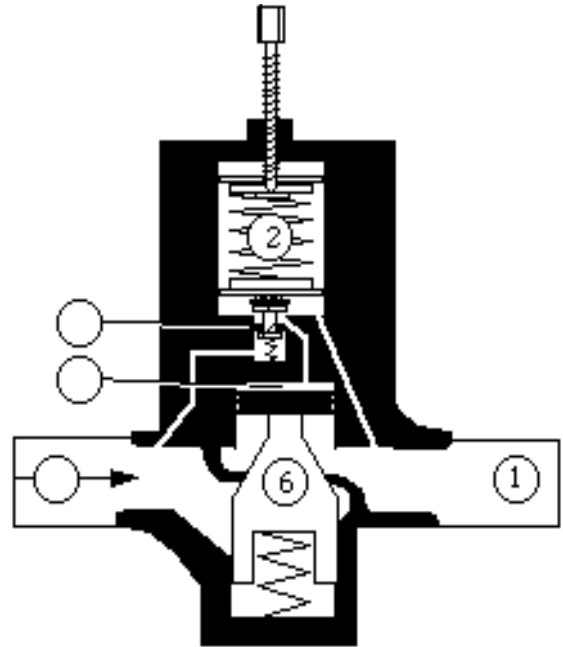


Troubleshooting

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).



A9B Valve

Racks equipped with a 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).

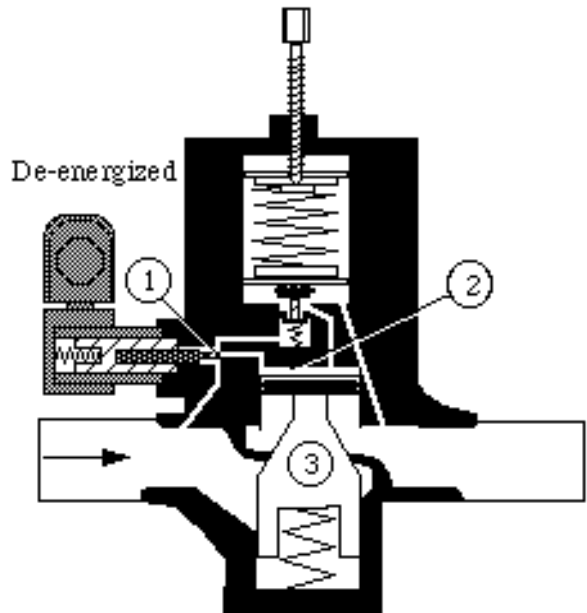


Figure 7-14
A9B Receiver Pressure Regulator with

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

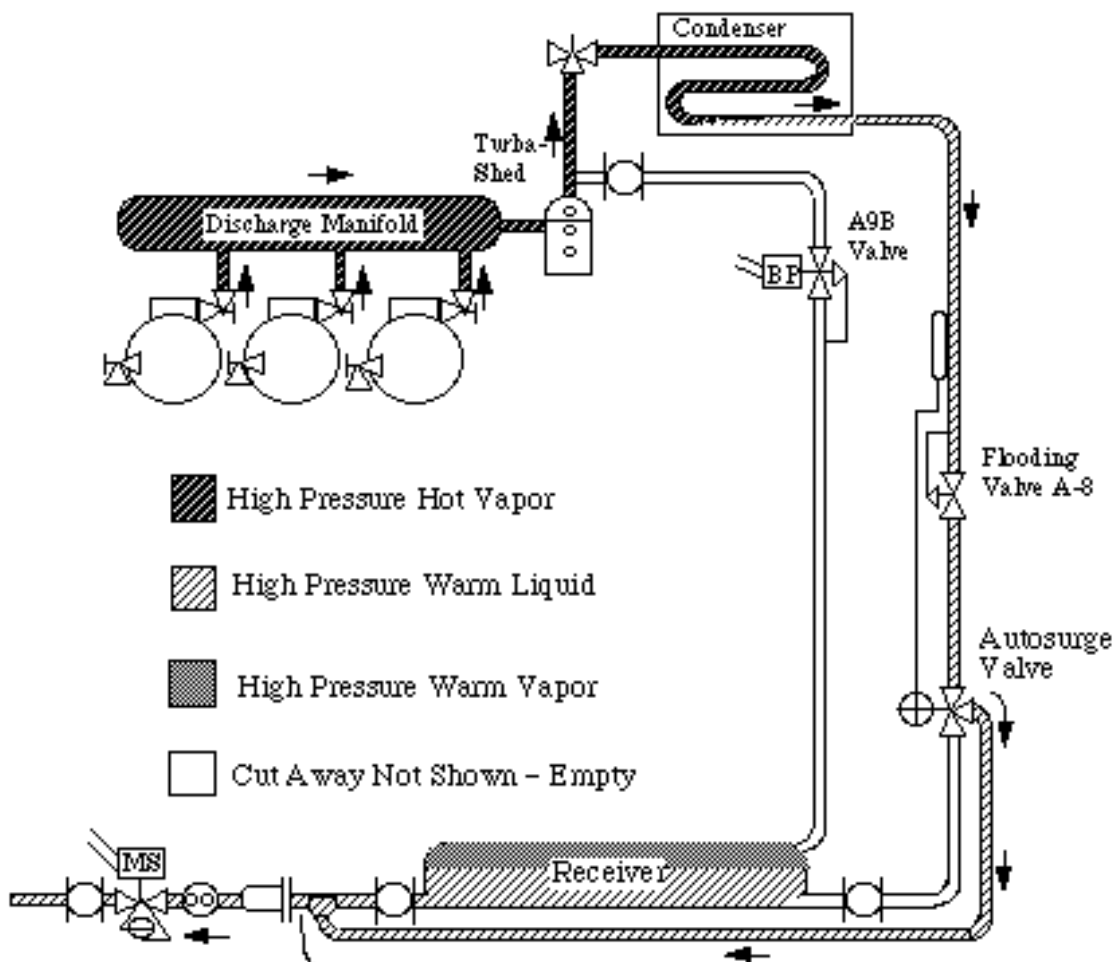
AUTOSURGE AND BY-PASS VALVES

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.



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.

- 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 ¼-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 ¼-inch flare cap.
6. Open suction pressure pilot line valve at Suction Manifold.

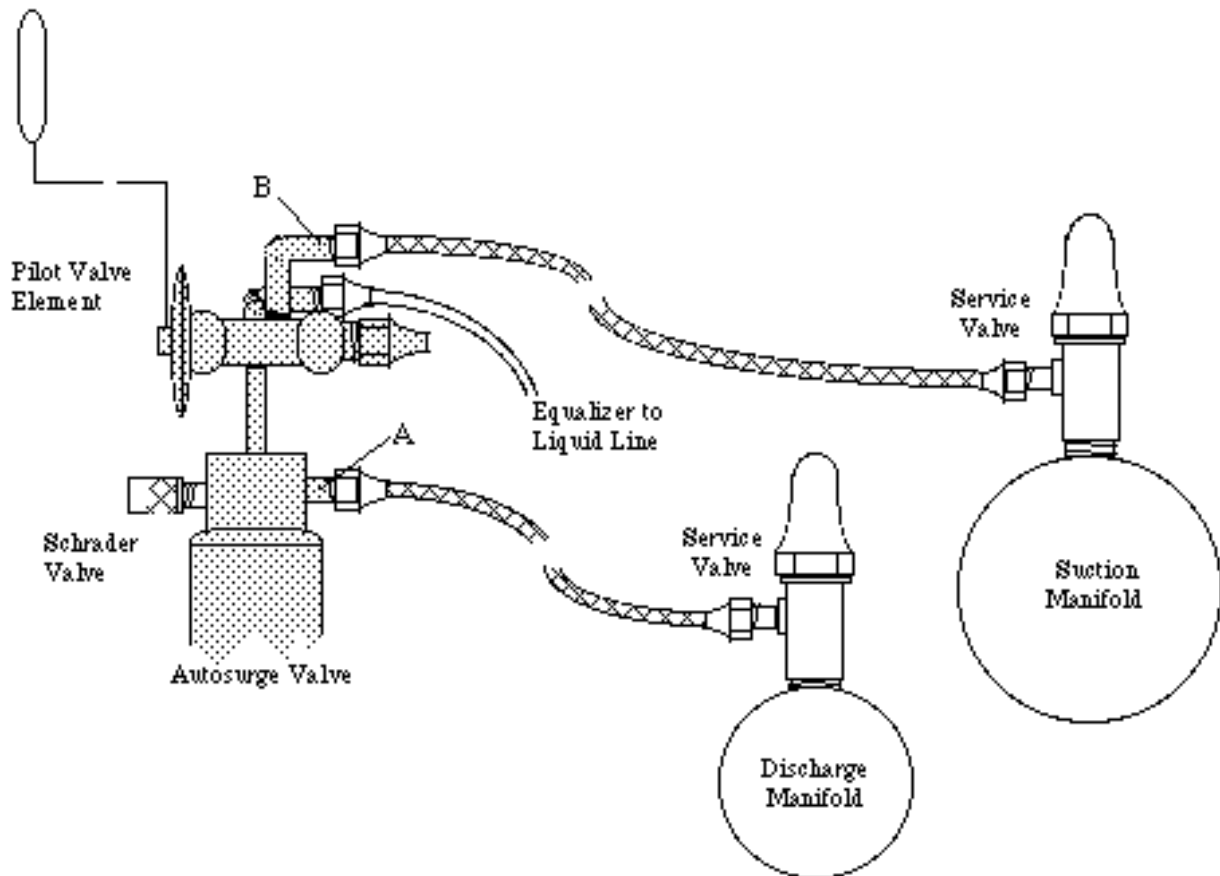


Figure 7-16

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 ± 5°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 ±5°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.

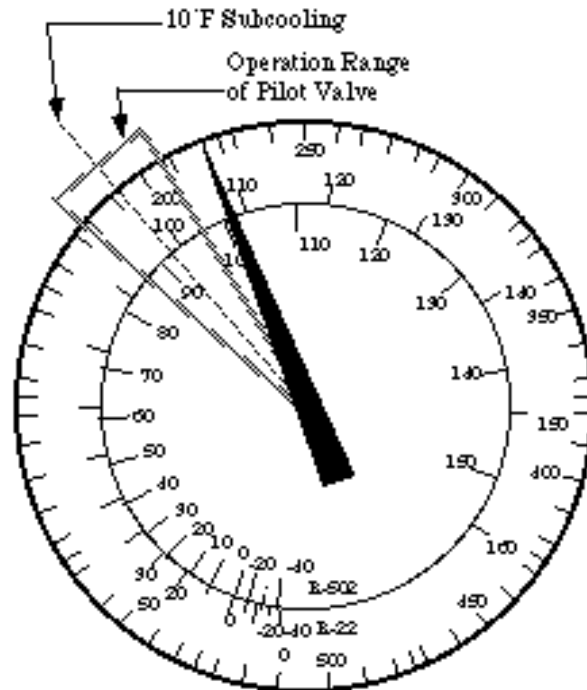
Determining Flow Direction

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 7-17

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.

Shell and Tube Subcooler

Electrically, a thermostat responding to main liquid line temperature of the rack receiving subcooling controls a solenoid valve on the liquid supply line from the unit supplying subcooling.

A standard liquid line solenoid valve and a TEV control refrigerant on the rack. An EPR on the unit supplying the subcooling prevents the subcooler temperature from dropping below desired liquid temperature.

Shell and Tube 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.

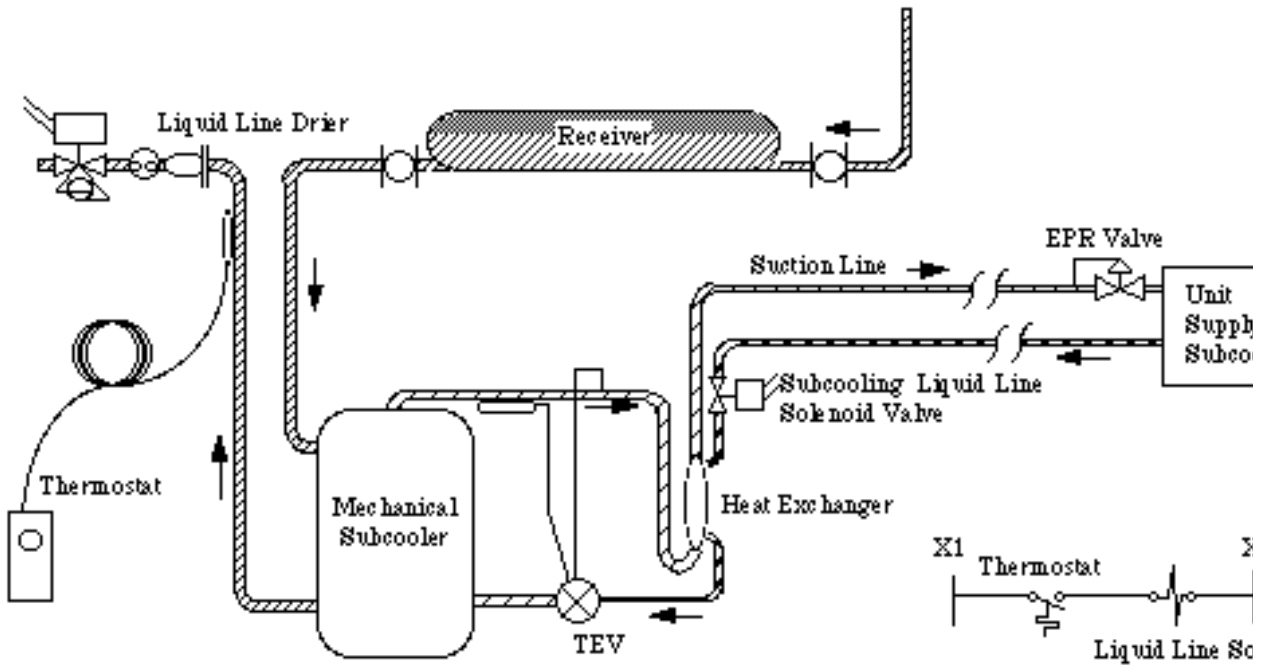


Figure 7-18

Plate Subcooler

Electrically, a thermostat responding to main liquid line temperature immediately downstream 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 subcooler 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.

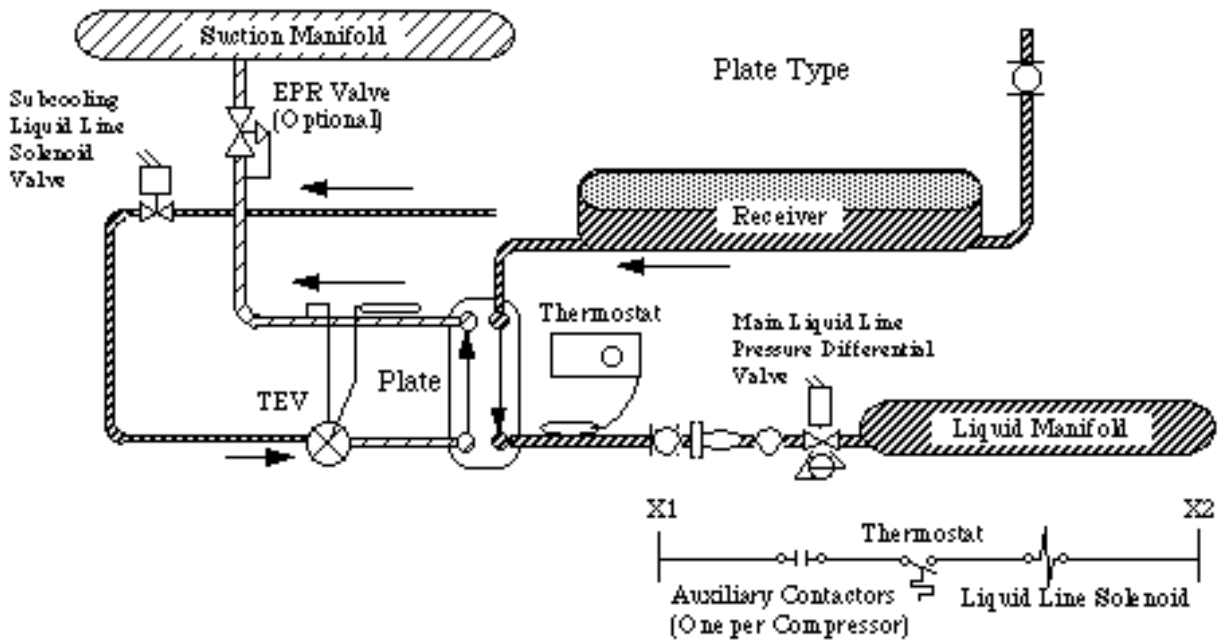


Figure 7-19

DEMAND COOLING® (COPELAND)

The Demand Cooling System is designed to inject saturated refrigerant into the suction cavity when the compressor internal head temperature exceeds 292°F. Injection continues until the temperature is reduced to 282°F. If the temperature remains above 310°F for one minute the control shuts down the compressor. After correcting the cause of shutdown, manual reset is required.

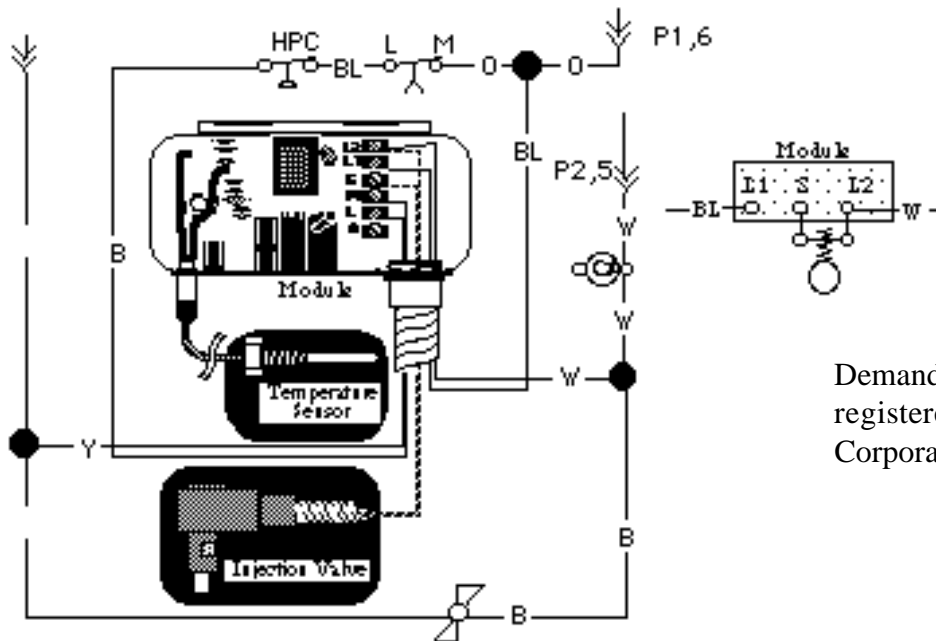
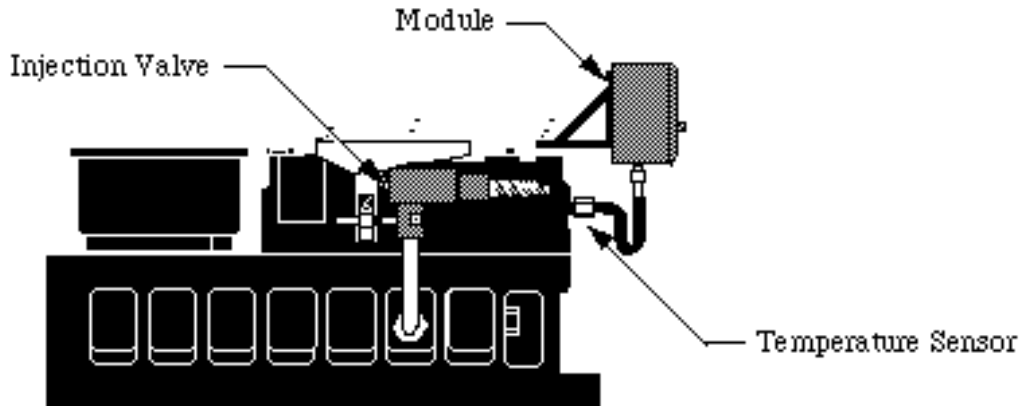
The Temperature Sensor employs a Negative Temperature Coefficient (NTC) Thermistor to provide signals to the Control Module. The NTC resistance drops on temperature rise.

The System Parts

- Temperature Sensor
- Control Module
- Injection Valve

Temperature °F	Approximate Ω Reading
77	90,000
282	2,420
292	2,110
310	1,660

Probe test readings between 100,000Ω and 1,600Ω usually indicate an operating probe.



Demand Cooling® is registered to Copeland Corporation.

The Control Module responds to the Temperature Sensor input by energizing the Injection Valve Solenoid when 292°F is exceeded. Too high or too low a resistance from the thermistor circuit will cause the Module to shutdown the compressor after one minute.

The Injection Valve meters saturated refrigerant into the suction cavity of the compressor. The valve orifice is carefully sized to meet the requirements of a specific compressor. Valve sizes correspond to the four compressor bodies—2D, 3D, 4D, 6D.

Component Testing

Remove power to the system. Unplug the Temperature Sensor from the Module. The Sensor should ohm out between 1,600Ω and 100,000Ω.

Leave the Sensor unplugged and restart the system. There should be **no** voltage between terminals “S” and “L2” on the Module. The inlet and outlet sides of the Injection Valve should feel the same temperature. After one minute the alarm relay should trip. Remove power to the system. Press the manual reset on the Module.

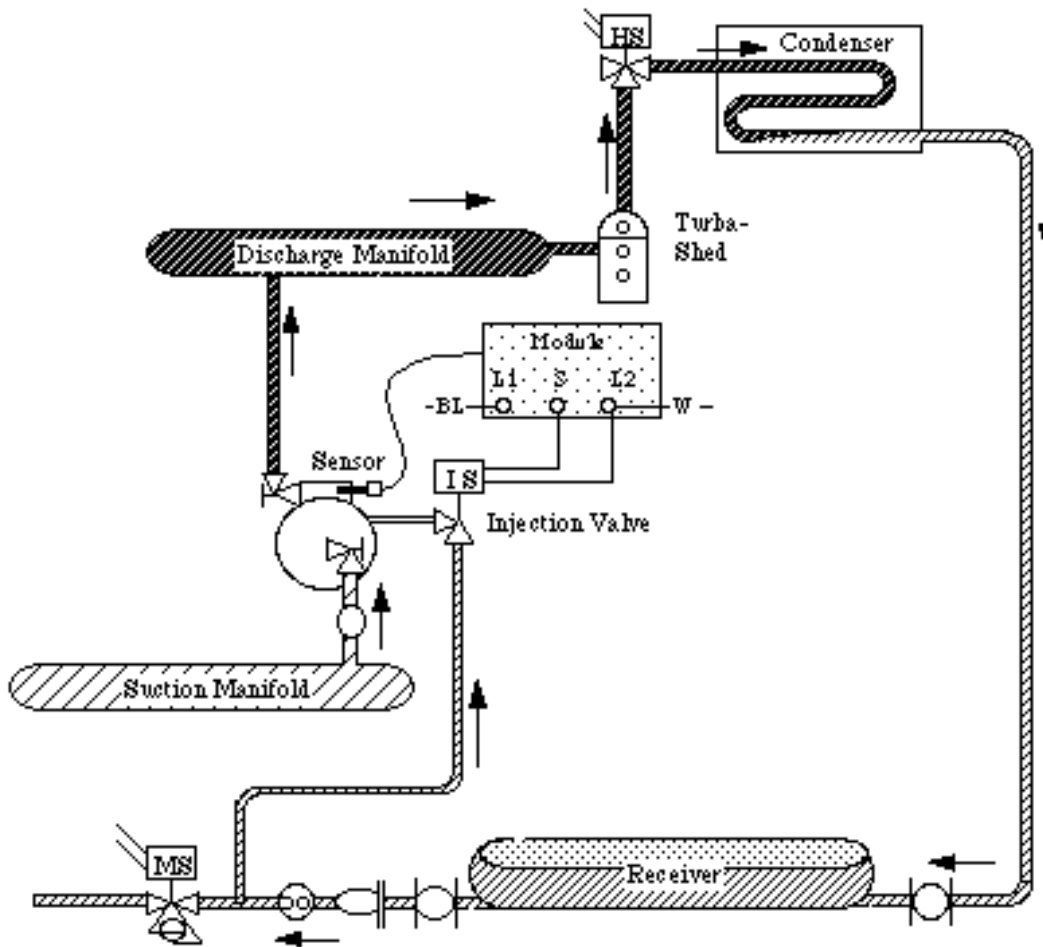


Figure 7-21

Using a small piece of wire jump the Sensor circuit at the female plug in the Module. Restart the system. There should be **voltage** between terminals “S” and “L2” on the Module. The outlet side of the Injection Valve should feel colder than the inlet side. After one minute the alarm relay should trip. Remove power to the system. Press the manual reset on the Module.

Remove the jumper wire and plug in the Temperature Sensor.

Restart the System.

Alarm Circuit

The Alarm Circuit has three terminals in the Control Module.

- “L” —Common
- “M” —Normally Closed
- “A” —Normally Open

“L” and “M” are wired into the compressor control circuit so an alarm condition removes the compressor from the line and power to the Module. A manual reset is required to call attention the alarm condition.

Alarm Relay

The Alarm Relay is activated after a one minute delay under the following three conditions:

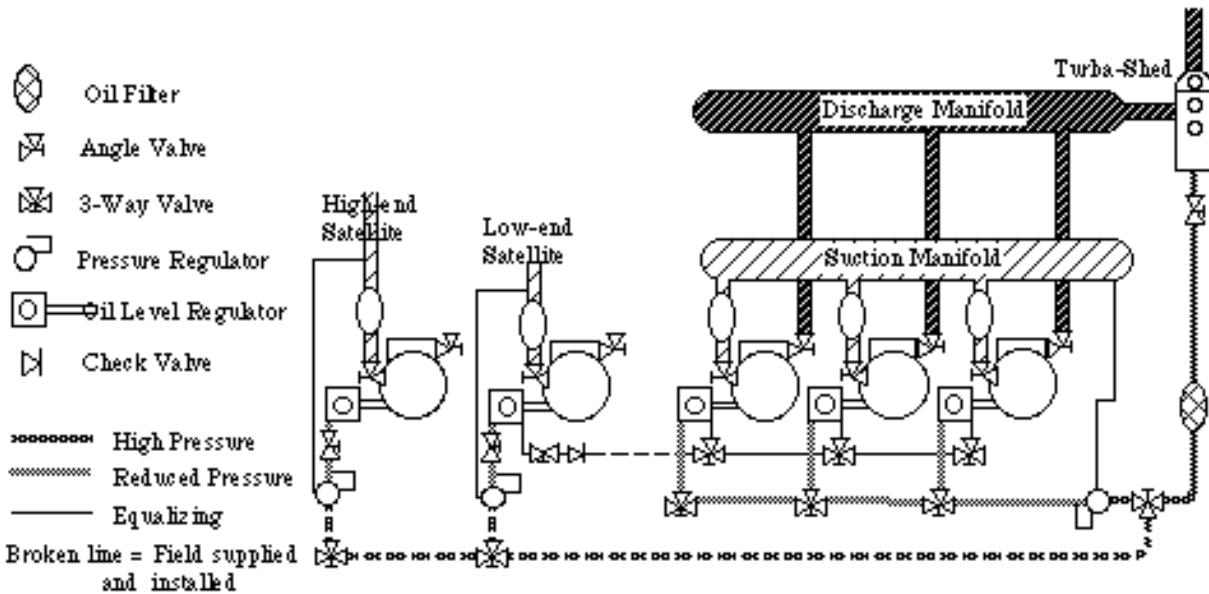
1. Compressor discharge temperature exceeds 310°F.
2. A shorted circuit or very low Thermistor Resistance.
3. An open circuit or very high Thermistor Resistance.

Operational Notes

Demand Cooling does **NOT** replace head cooling fans which are still required on low temperature applications.

Temperature Sensor cable must not touch any hot surfaces or the cable will be damaged.

OIL SYSTEM



Differential Pressure Regulating Valve

The oil pressure differential valve reduces oil pressure from high side pressure to a range of 3 to 20 psig above the suction pressure. Typically, the valve would be set between 10 and 15 psig above the suction pressure to prevent over feeding of the oil level regulator. A separate Oil Pressure Differential Regulating Valve must be applied for each different suction pressure on one oil system.

Turning the adjustment stem clockwise ¼ turn will increase the pressure to the oil level regulators about 1 psig.

¼ turn clockwise = 1 psig increase.

Oil Level Regulators

For any brand of oil level regulator to work accurately the unit and each compressor must be level. Both Sporlan and AC & R regulators may be damaged by over adjusting. Do not exceed 175 psig when testing to prevent damage to the floats. A sight glass filled with oil may indicate a damaged regulator.

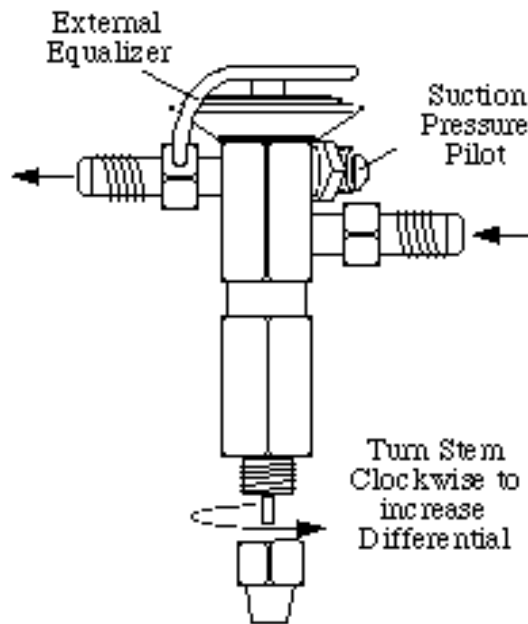


Figure 7-23

Floats may be adjustable or non-adjustable. For adjustable floats, before beginning adjustment, isolate the compressor by turning off its control circuit.

Sporlan Oil Level Control OL-1 Series

The Sporlan Oil Level Regulator comes preset to maintain oil level at the center line of the sight glass. If there is any question as to the actual set point of the regulator, turn the adjustment stem counterclockwise until the top stop is reached. Then adjust the oil level down to the desired height by turning the stem clockwise. Each full turn will represent about 0.05 inches change in oil level.

Do not exceed 9 turns from the top stop going down, or the control may be damaged.

AC & R Oil Level Regulator

The AC & R Oil Level Regulator comes preset to maintain oil level $\frac{1}{8}$ inch below the center line of the sight glass. Turn the adjustment stem counterclockwise to increase the oil level. Each full turn will represent about 0.055 inches change in oil level.

Do not exceed:

- 5 turns clockwise (downward)
- 4 turns counterclockwise (upward) from original factory setting.

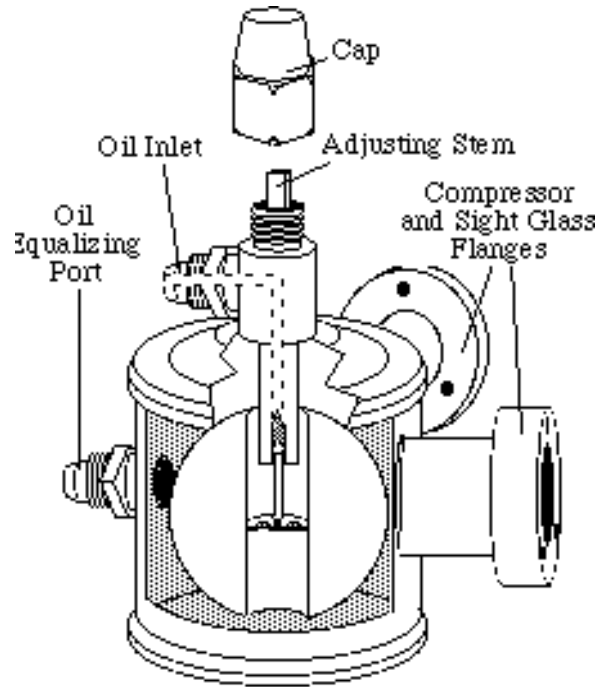


Figure 7-24
Sporlan Oil Level Regulator

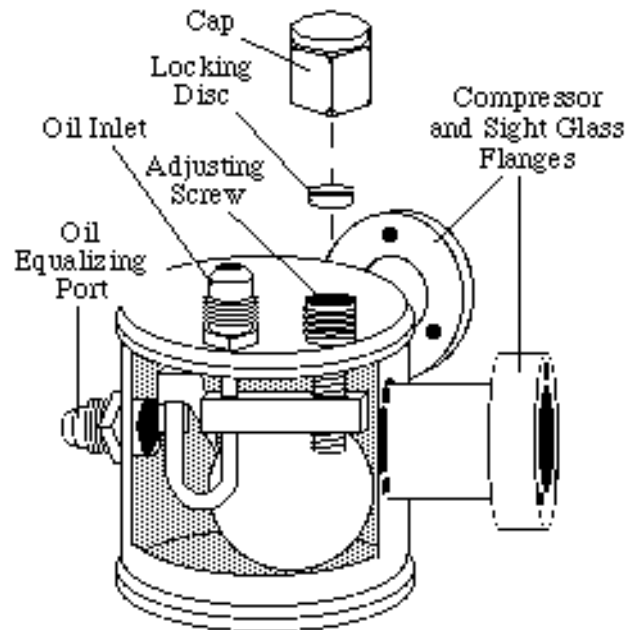


Figure 7-25
AC & R Oil Level Regulator

CONTROL SETTINGS

OVERVIEW

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

Compressor Oil Failure	1
Pressure Settings.....	1
Plate Subcooling Controls	1
Shell and Tube Subcooling Controls	1
Compound Rack, Additional Settings	1
EPR Settings	2
Winter Condensing Pressure Controls.....	2
Mechanical Low Pressure Controls.....	2
Alco	2
Others.....	4
Condenser Settings	8
Merchandise Settings	9

PRESSURE SETTINGS

Compressor Oil Failure Safety requires manual reset.

Compressor	Cut-in (psig)	Cut-out (psig)	Time Delay (seconds)
Copeland	12-14	7-9	105-135
Carlyle	8-11	4-8	45-75

High Pressure Safety for both R22 and R404A/507 is 395 psig. Differential is fixed.

High Suction Pressure is set at 50% above Design Pressure or to customer specification.

Satellite Low Pressure Controls

Low-end Satellites

Low Temperature	Cut-out	1 psig
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High-end Satellite

Refrigerant	Cut-out (psig)	Cut-in (psig)
R502	36	59
R22	29	49

PLATE SUBCOOLING 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.

SHELL AND TUBE SUBCOOLING 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.

COMPOUND RACK, ADDITIONAL SETTINGS

High Pressure Safeties

1st Stage	230 psig
2nd Stage	395 psig.

EPC Interlock (Factory Set)
Below 90 psig.

Liquid Injection

TEV Superheat (Factory Set)
25°F.

1st Stage Discharge Thermostat
50° to 65°F.
(Not adjustable.)

EPR SETTINGS

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

Evap Temp (°F)	EPR Pressure Refrigerant R404A/R507	Setting (psig) Application R22
-25	11	5
-22	13	7
-20	14	8
-15	18	12
6	37	27
9	41	30
12	44	33
15	47	36
18	51	39
21	55	42
25	60	47
30	68	53

NOTE: The final test for proper EPR setting must be discharge air temperature or product temperature.

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. If the condenser is mounted more than the 6 foot minimum distance above the Flooding Valve, add 1 psig to the Flooding Valve Setting for every additional 2 feet of elevation.

Refrigerant	Flooding Valve (Liquid) (psig)	Receiver Pressure (Vapor) (psig)
R22	175	165
R404A/R507	205	195

MECHANICAL LOW PRESSURE CONTROLS

Alco

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. A small right-angle Phillips screwdriver is required to access the adjustment screw—located next to the pressure connection. Turn the screw clockwise (when facing screw head) to increase cut-in pressure.

Note: 3 ½ rotations of the screw represent the entire 70 pound adjustment range. Very roughly, ½ turn equals 10 psig.

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.

R404A/R507						
Design Suction Temp	Compressor Capacity					
	Largest	2	3	4	5	Smallest
°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

R22						
Design Suction Temp	Compressor Capacity					
	Largest	2	3	4	5	Smallest
°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

Note: These Fanal/Westinghouse Low Pressure Controls have a fixed 10 psig differential.

Other Mechanical Low Pressure Control Settings

R404A/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.

R404A/R507 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	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 psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO 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 psig	CO psig	CI psig	CO psig	CI psig	CO psig	CI psig	CO 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

Caution: Never run the compressors in a vacuum.

CONTROL SETTINGS

Revised August 1, 1996

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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	CO	CI	CO	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig	psig	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	CO	CI	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	psig	psig	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	CO	CI	CO	CI	CO	CI	CO
	psig	psig	psig	psig	psig	psig	psig	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, HLVCV, HLCVCF, HLCVCG, HLCVI, HLCVCV, HLCVW

Refrigerants 404A/507 & 22

Condenser Fan Alignment	Pressure Settings							Ambient Control							Split Cond			Heat Reclaim Pressure Override psig	Lockout psig		
	PC1	PC2	PC3	PC4	PC5	PC6	PC7	Pressure psig	Temperature °F			Thermostat Setting °F	Thermostat Setting °F	Thermostat Setting °F							
	PC1	PC2	TC1	TC2	TC3	TC4	TC5	TC6	TC7	PC1	PC2	TC1	TC2	TC3	TC4	TC5	TC6	TC7	Thermostat Setting °F	Thermostat Setting °F	Thermostat Setting °F
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		40	50	60	65	70	75	80			50	190	165
	CO	155	160	165	170	175	180	185		35	45	55	60	65	70	75			55	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		215	40	50	60	65	70	75	80		50	190	165
	CO	155	160	165	170	175	180	185		175	35	45	55	60	65	70	75		55	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.

MERCHANDISER SETTINGS

Application	MEAT								
Models	M1	M1E	M1G	M1GE	M2E M2GE M4E M5E	M3 M4G M5	M3E M5GE	M3G	M3GE
Refrigeration									
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	—	—	—	—	—	—	—	—	—
Defrost									
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 Duration Min	43°F 35 Min	43°F 35 Min	43°F 35 Min	43°F 40 Min	48°F 30 Min	48°F 30 Min	48°F 35 Min	48°F 30 Min	48°F 35 Min

Application	MEAT				PRODUCE			
Models	M4	M4GE	M5G	MWG MWGE	P1	P1E	P2	P2E
Refrigeration								
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	—	—	—	—	—	—	—	—
Defrost								
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 Duration Min	48°F 25 Min	48°F 35 Min	48°F 35 Min	60°F 43 Min	43°F 35 Min	43°F 35 Min	48°F 30 Min	48°F 30 Min

MERCHANDISER SETTINGS (Cont'd)

Application	PRODUCE								
Models	P4	P4E	PW	PWE	PW (End)	PWE (End)			
Refrigeration									
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	—	—	—	—	—	—			
Defrost									
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 Duration Min	48°F 30 Min	48°F 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
Refrigeration								
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	—	—			—	—	—	—
Defrost								
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	48°F	48°F			48°F	48°F	48°F	48°F
Duration Min	30 Min	30 Min			30 Min	35 Min	35 Min	40 Min

MERCHANDISER SETTINGS (Cont'd)

Preliminary Data — Preliminary Data — Preliminary Data — Preliminary Data

Application	DAIRY	DELICATESSEN	FROZEN FOOD	ICE CREAM
Models	RM	RM	RL	RL
Refrigeration				
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	—	—	—	—
Defrost				
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	
Refrigeration								
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	—	—	—		—	—	—	
Defrost								
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 Product Temperature.	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			
						NF1	NF6H		
						NF1N	NF6L		
						NFN			
						NFW			
						NFCW			
						NFCW			
						NFFS			
						NFWE			
					NFCWE				
	NC1								
	NC1N								
	NCN								
	NCW								
	NFCW								
	NCFS								
	NCWE								
	NFCWE								
Refrigeration									
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	—	—	—	—	—	—	—	—	—
Defrost									
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 FHMH FHMGH 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 Product Temperature .	NEBDH NEBSH	NM3 NM3G NM4 NM4G NDD3 NDD3G NDD4 NDD4G	NM1 NM1G		NEGDF NEGSF NEGDT NEGDH	NF1 NF1N NFN NFW NFCW NFCWE NFFS		NVGB NVGC NVGA	NEBDH NEBSH
Refrigeration									
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	—	—	—	—	—
Defrost									
Frequency	24 Hrs	6 Hrs	12 Hrs	12 Hrs	24 Hrs	24 Hrs	8 Hrs	24 Hrs	24 Hrs
Electric									
Temp Term °F	54°F	—	48°F	48°F	—	52°F	—	—	—
Failsafe Min	40 Min	—	46 Min	46 Min	—	60 Min	—	—	—
Reverse Air									
Temp Term °F	—	48°F	48°F	48°F	48°F	48°F	48°F	48°F	—
Failsafe Min	—	46 Min	70 Min	70 Min	90 Min	60 Min	60 Min	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 RMA	VBL 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 Product Temperature.		NDD5 NDD5H NDD5A	NM3 NM3G NM4 NM4G NDD3 NDD3G NDD4 NDD4G	NM1 NM1G		NRD NRFL NRDV NRFLV	NVBA NVBB NVBC	NVGB NVGC NVGA	NEGDF NEGSF NEGDT
Refrigeration									
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	—	—	—	—	—
Defrost									
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 For all Merchandisers with Gravity Coils, the Temperature listed in the "Discharge Air" row is Product Temperature.	DMZ	JVMR	RDM	RMA	RMFA	Bulk	Pack	PVWI	CGBR
	DMZA	JVMRS		RMFA		PRO	PRO	PWI	
	DMZH					PHSM	PHSM	PWIRO	
	DMX					PH	PH	EPWI	
	DMXA					PHRO	PHRO	PVWI6	
	DMXH					P	P	PWI6	
								PWIRO6	
								EPWI6	
	ND5LZ			NRD	NRFL	NP1	NP1		NEBBDT
	ND5Z			NRDV	NRFLV	NP2	NP2		
	ND5HZ			NRFL					
	ND5LX			NRFLV					
	ND5X								
	ND5HX								
Refrigeration									
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	—	—	—	—	—	—	—	—	—
Defrost									
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	48°F	—	—	—	—	—	—	—	—
Failsafe Min	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 Product Temperature .	NESDH NESSH		NVSA NVSB NVSC			
Refrigeration						
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	—	—	—	—	—	—
Defrost						
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 Product Temperature .						
Refrigeration 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	—	—	—	—	—	—
Defrost 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 startup.

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 1/8 to 1/2 full
- Turba-shed between two lower sight glasses.

If oil level is low, add recommended oil only:

	Copeland	Carlyle
R22	Suniso 3GS	Suniso 3GS
R404A/ R507	Mobile EAL ARCTIC 22 CC	ICI Emkarate RL68H

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 3/8-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 switchback 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.

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

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.

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 Super Plus™ Fibertronic™ delivers maximum temperature performance and efficiency for the customer. These include:

- Defrost scheduling and timing
- Condenser controls
- Winter controls
- Subcooling
- Compound System operation
- 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 bolts from suction and discharge service valves.

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.

The rear support channel on the rack or a properly constructed ceiling rail may be used to support a hoist or come-along.

To make hookup and lifting easier, an eye bolt may be installed in the rear top of the compressor head.

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.

When the old compressor has been removed, clean the suction and discharge service valve gasket surfaces to shiny metal. Clean the gasket surfaces on the new compressor to shiny metal. Be careful not to groove or round the surfaces. Gasket surfaces must be clean to prevent leaking.

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.

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

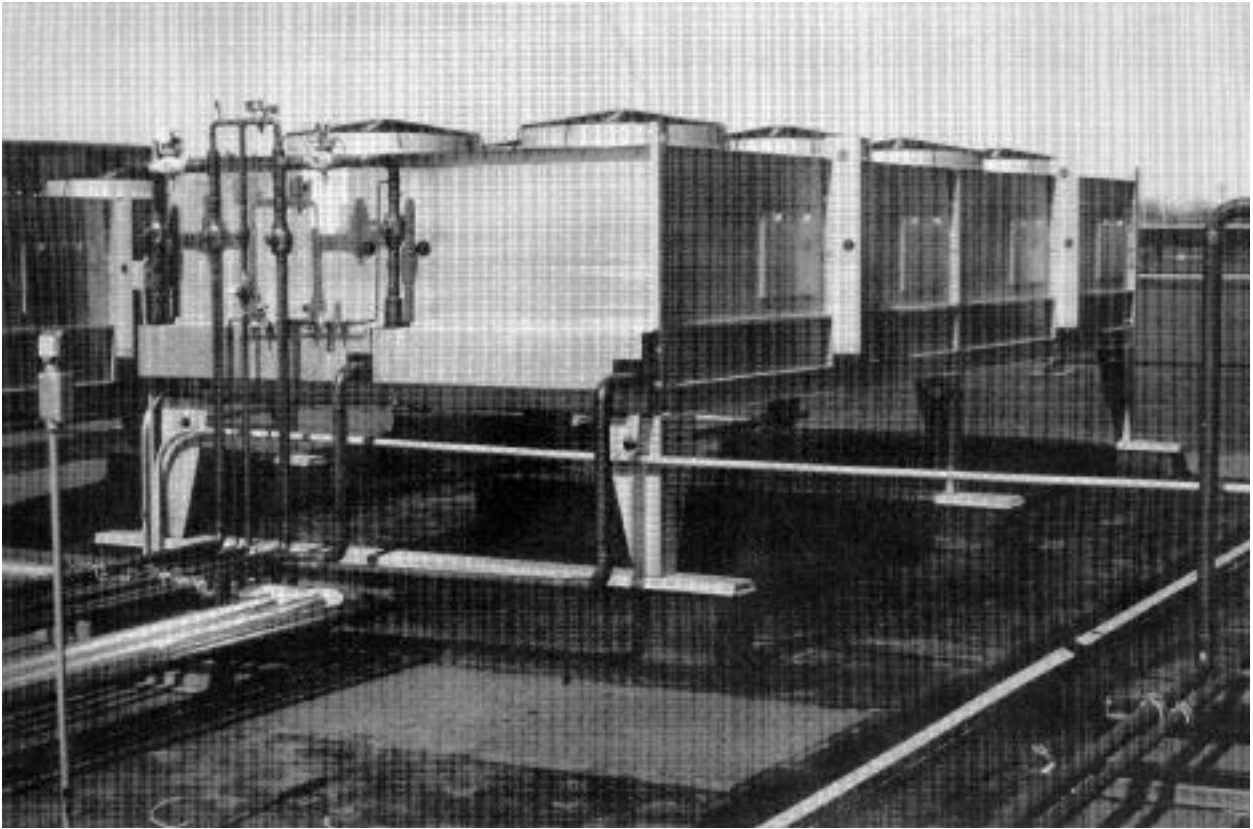
Shut down the system. Isolate the core to be replaced and bleed off pressure into an **approved recovery vessel**. Open housing, replace core and close up. Pressurize, leak test and bring back into line.

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ADDENDUM — CONDENSER INSTALLATION

**Figure A-1. Roof Mounted Condenser
(with field installed split condenser valving)**

CONDENSER INSTALLATION**General Description**

The SuperPlus 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. If any of the following conditions exist, split condenser valving is recommended.

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.

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.

REMOTE AIR COOLED CONDENSERS

Handling

Lifting channels are provided at each corner of the condenser. Condensers with three or more fan banks will have additional intermediate lifting channels. Use only these locations for attaching cables during leg assembly and lifting the condensers.

Rig cables to the lifting channels and position the condenser so the legs can be bolted to the frame. If the condenser was shipped on its side, the intermediate erection plates for that side should also be installed at this time. See illustration for proper rigging technique.

Unmounted legs and lifting channels are furnished with necessary bolts, nuts, and washers for mounting to the unit. Mount each leg and plate with the bolts provided.

Under no circumstances should the condenser coil manifolds, control panel, or return bends be used for lifting or moving the unit.

Locating

Locate the condenser with at least three feet of clearance space on all sides to provide adequate air circulation and room for servicing. Mount the condenser on beams supported by building columns or load-bearing walls.

The mounting surface for the condenser should be at least 6 feet higher than the flooding valve when the compressor unit is equipped with condensing pressure control valves. This height requirement is reduced to 4½ feet for installations not using condensing pressure control valves. Refer to Section 1, *Installation Requirements*, for details.

Leveling

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 metal identification tag on the manifold end of the condenser to determine which compressor unit to connect to each set of condenser circuits.

Route and support all piping in a manner that relieves stress caused by vibration, thermal expansion, and gradual base or building movement. Construct a pitch box to weather-proof the opening where piping is routed through the roof.

Shutoff Valves

Shutoff valves are highly recommended, but are not mandatory. These valves should be field supplied and installed in such a manner as to isolate the entire condenser.

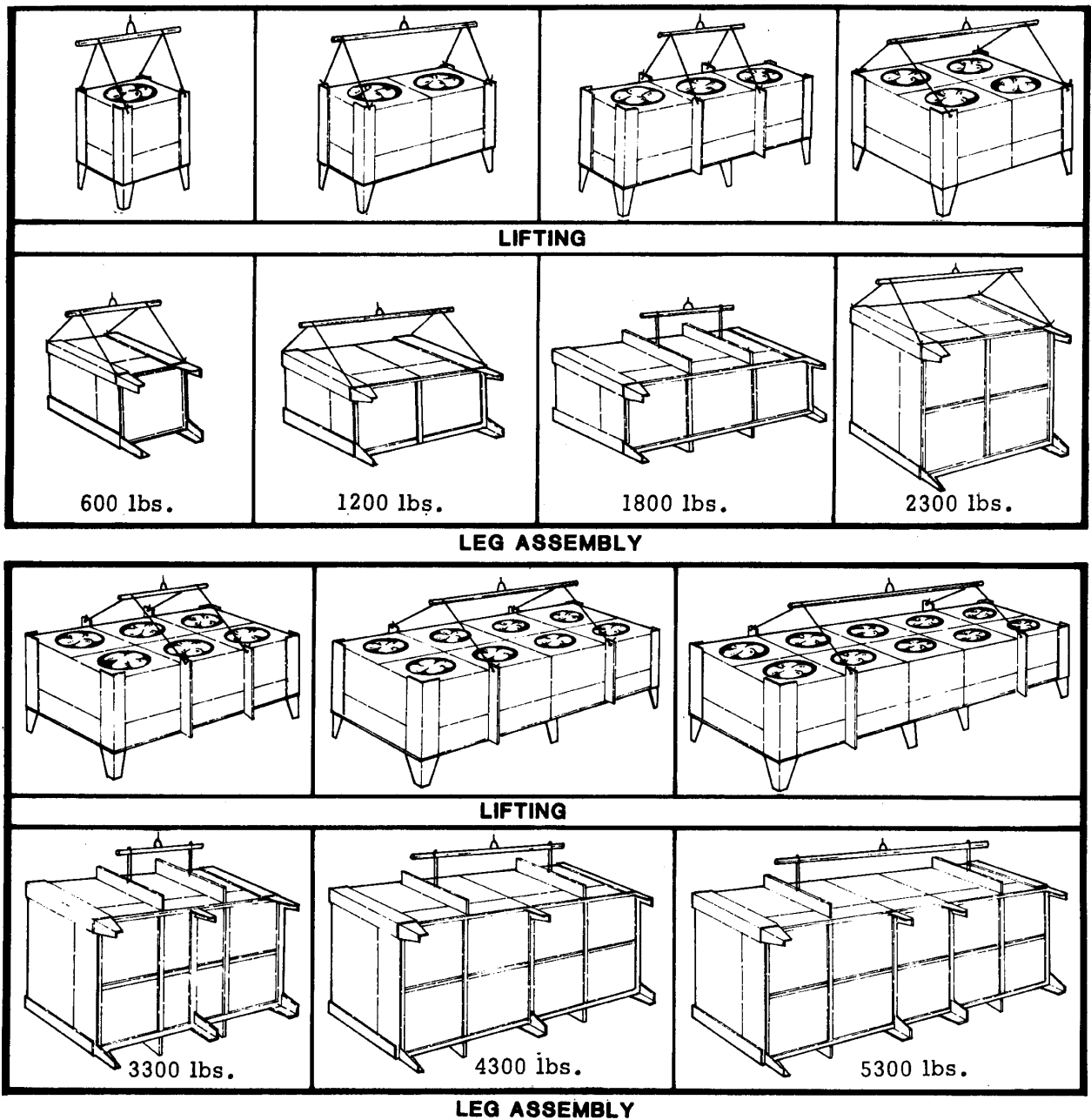


Figure A-2. Rigging for Leg Assembly and Lifting

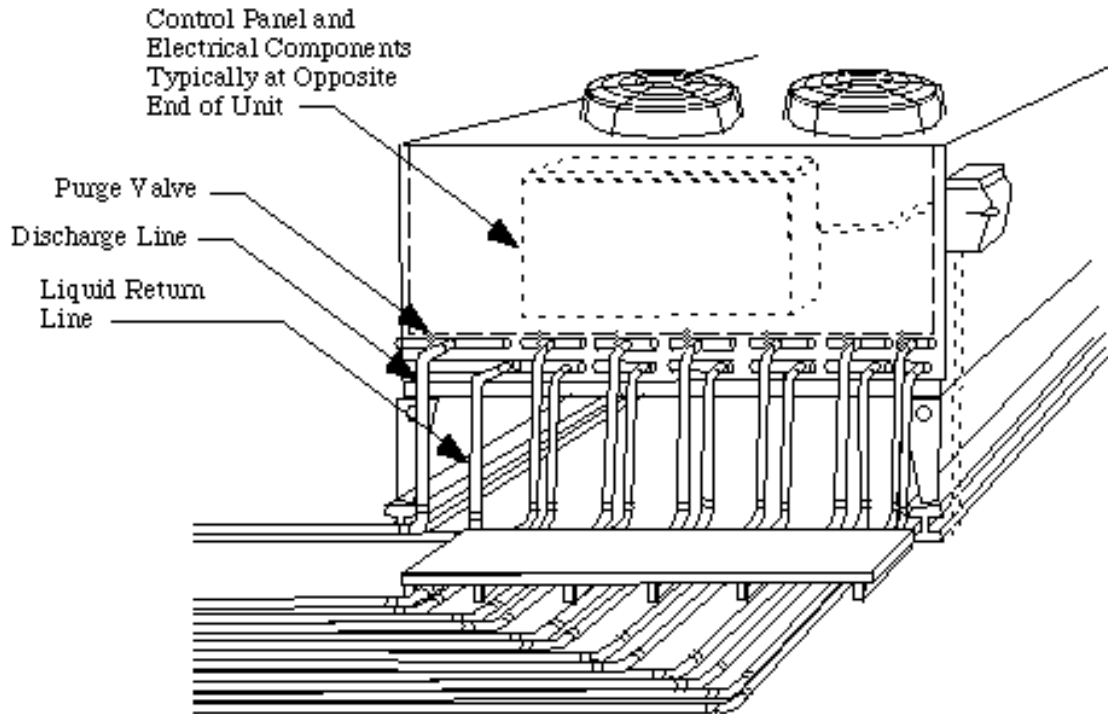


Figure A-3. Connecting to One Manifold

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 $\frac{7}{8}$ 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.

SPLIT CONDENSERS

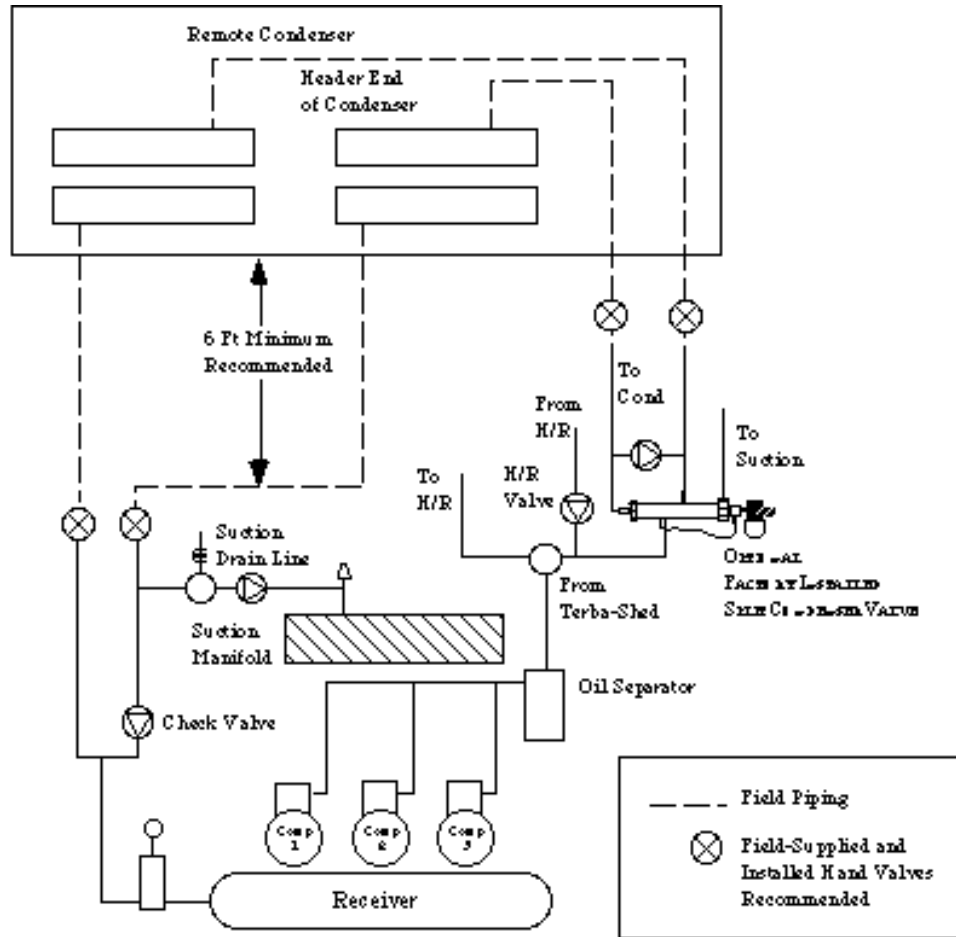


Figure A-4. Split Condenser Piping Method

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

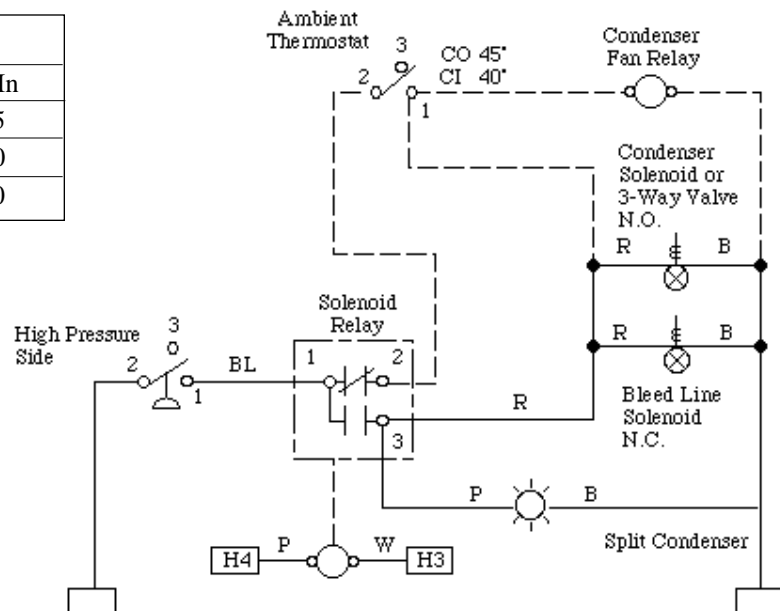


Figure A-5. Split Condenser Wiring Diagram – Factory and Field Installed Kits

ELECTRICAL AND PRELIMINARY CHECK-OUT

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

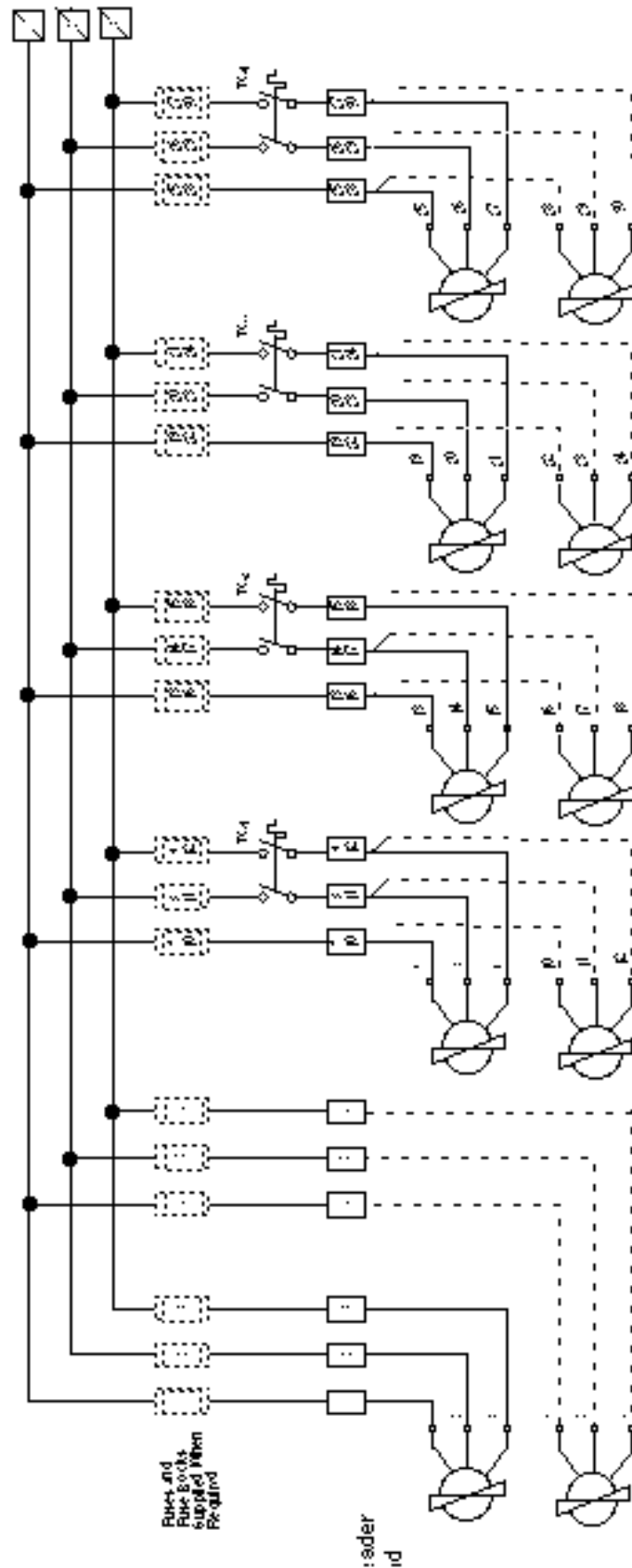
After wiring is complete check condenser operation in the following manner prior to compressor start-up.

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.



Replacement Parts

- Thermostat Control
- Motor (Integral, Protected)
- Terminal Block - Heavy Duty
- Terminal Block - Medium Duty
- Fuse holder

Control Settings					
Number of Thermostats	Gas In Settings for Thermostats - Deg F				
	TL1	TL2	TL3	TL4	TL5
1	5	5	5	5	5
2	5	5	5	5	5
3	5	5	5	5	5
4	5	5	5	5	5
5	5	5	5	5	5

6-41 Cur-Out 5 Deg Below Gas In

Individual Motor FLA	
HP	20/28/30
3/4"	3.5
1"	4.0
1 1/2"	4.0

Figure A-6
Line Voltage Thermostatic Fan Control

CONDENSER INSTALLATION

A - 8

Addendum – April 15, 1996

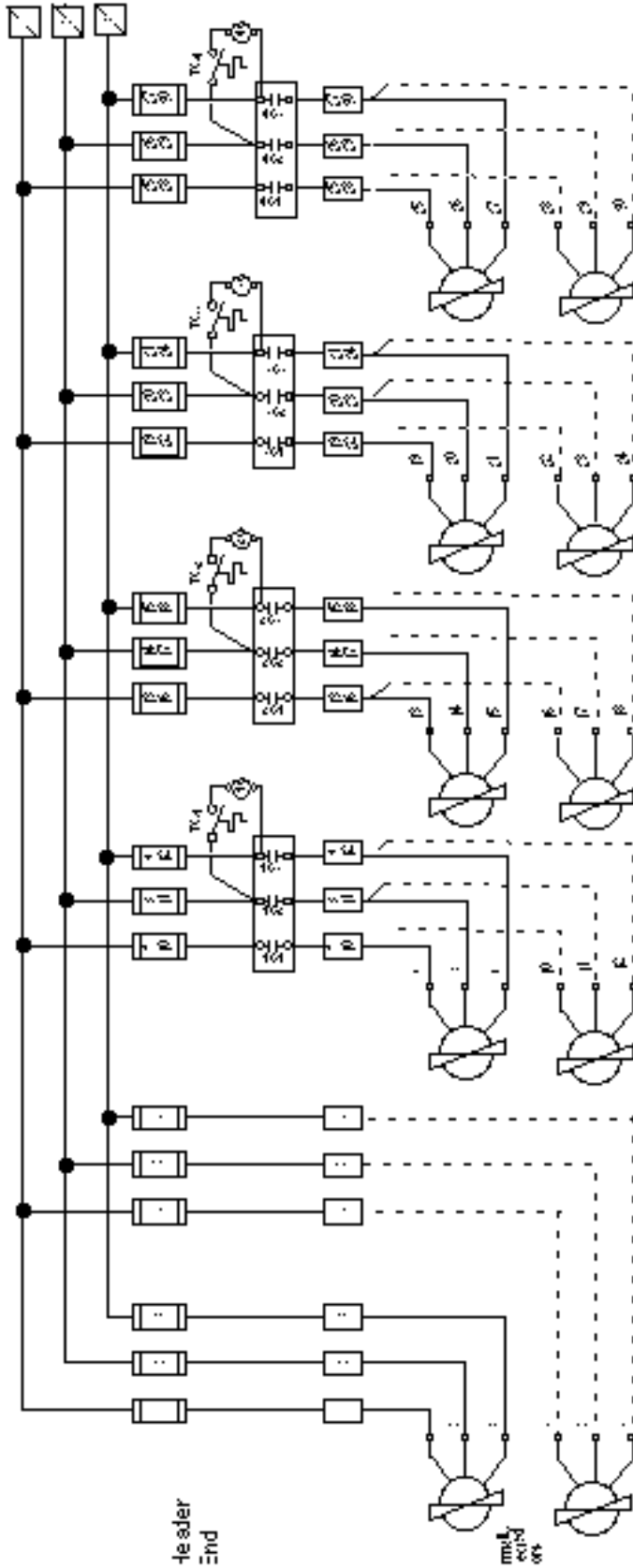


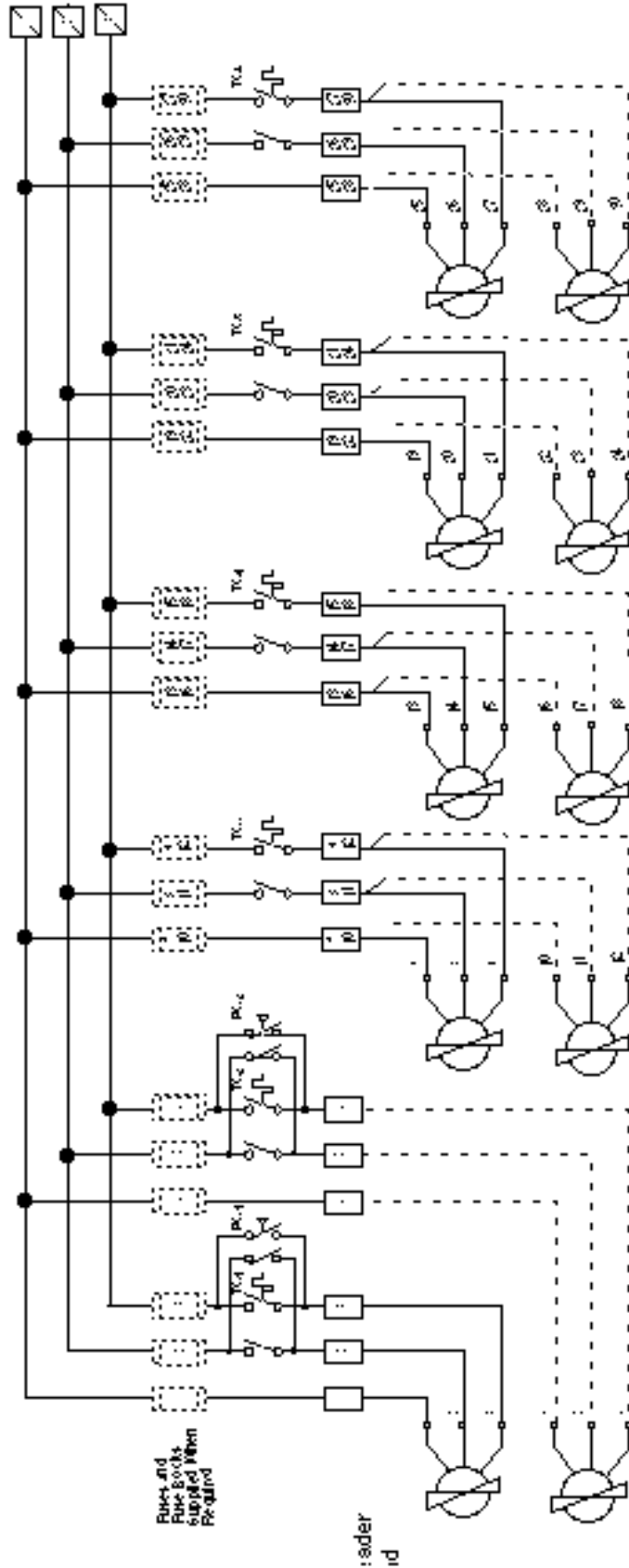
Figure A-7
Pilot Operated Thermostatic Fan Control

Control Settings					
Number of Thermo-Hub	Cup In 5 deg Below Thermo-Hub - Deg F				
	T-L1	T-L2	T-L3	T-L4	T-L5
1	5	5	5	5	5
2	5	5	5	5	5
3	5	5	5	5	5
4	5	5	5	5	5

6 deg Cup-Out 5 Deg Below Cup In

Individual Motor FLA		
HP	20.00000	45.00000
3/4	35	15
1	45	20

- Replicent Path
- Thermostat Control
- Mixer (Internal, Protected)
- Terminal Block - He-90, Du...
- Terminal Block - Medium Du...
- Fuse Holder



Replace ment Parts

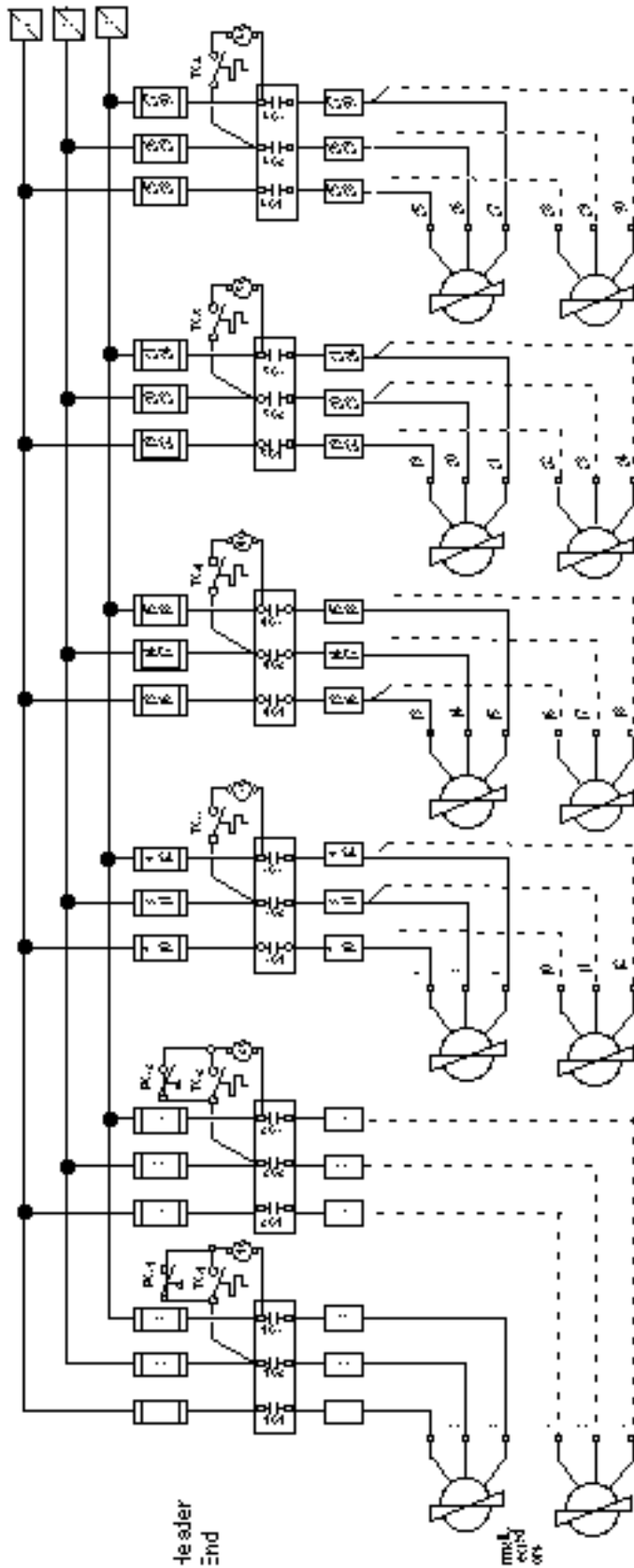
- Thermostat Control
- Pressure Control
- Motor (Inherent, Protected)
- Terminal Block - Heavy Duty
- Terminal Block - Medium Duty
- Fuse folder

Number of Thermostats	Cus In setting for Thermostat - Deg F					RC-1 setting - psig		
	TC-1	TC-2	TC-3	TC-4	TC-5	PR-1	Cu In	Cu Out
1	30	30	30	30	30	20	20	20
2	30	30	30	30	30	20	20	20
3	30	30	30	30	30	20	20	20

Set Cu-Out 5 Deg Below Cu-In

Individual Motor FLA		
HP	20-25	46.0
3/4	35	18
1	44	20

Figure A-8
Line Voltage Thermostatic with



Control Settings

Number of Thermo-stats	Cut-In Settings for Thermostats - Deg F				RC-1 Location - Pkg	
	T-1	T-2	T-3	T-4	Rating	Cut-In
1	30	30	30	30	1/2" Dia	108
2	30	30	30	30	1/2" Dia	108
3	30	30	30	30	1/2" Dia	108
4	30	30	30	30	1/2" Dia	108
5	30	30	30	30	1/2" Dia	108
6	30	30	30	30	1/2" Dia	108

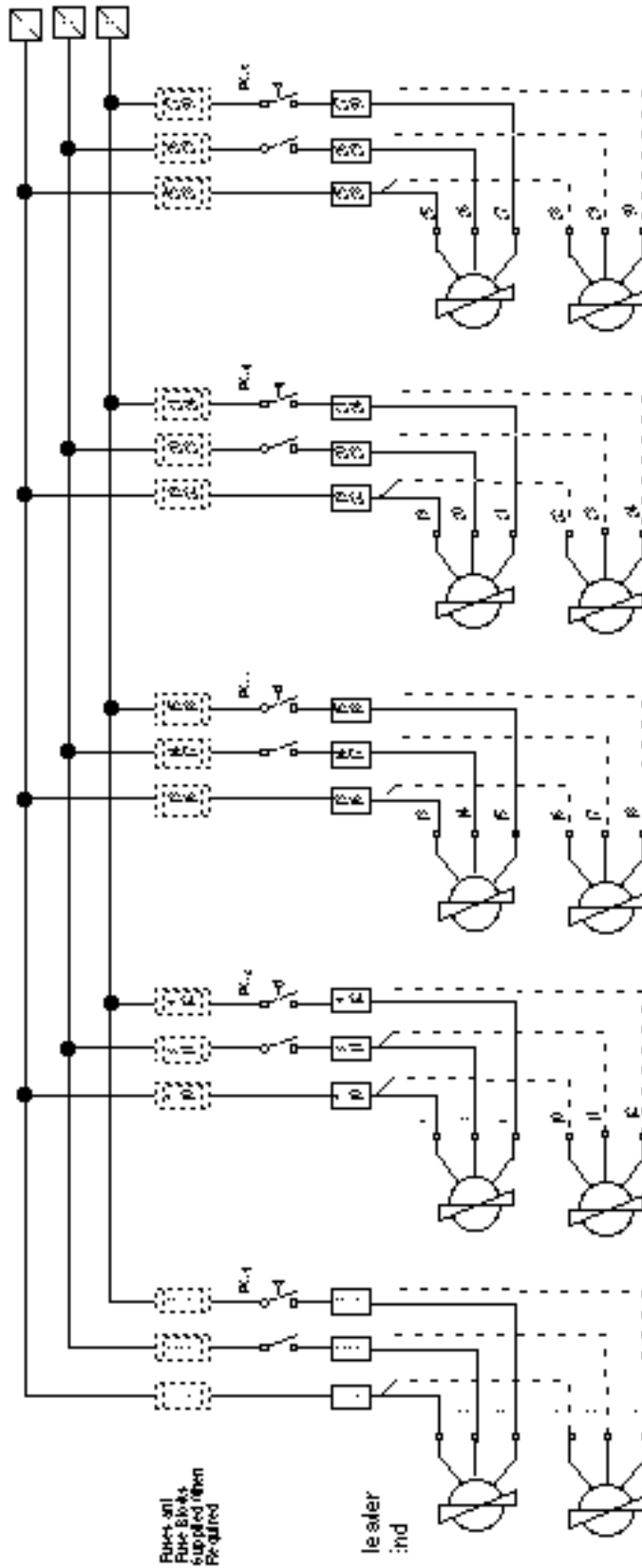
6-in Cut-Out 5 Deg Below Cut-In

Individual Motor FLA

HP	1/2	3/4	1	1 1/2	2
FLA	2.5	3.5	4.5	6.5	10.0

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

Figure A-9
Pilot Operated Thermostatic with



Control Settings

Number of Pans	Pressure Switch	Pressure Switch Cut-In Settings - p-Hg				
		PC-1	PC-2	PC-3	PC-4	PC-5
1	PC-1	2.0	2.0	2.0	2.0	2.0
2	PC-2	2.0	2.0	2.0	2.0	2.0
3	PC-3	2.0	2.0	2.0	2.0	2.0
4	PC-4	2.0	2.0	2.0	2.0	2.0
5	PC-5	2.0	2.0	2.0	2.0	2.0

Individual Motor FLA

HP	FLA
1	4.4
2	5.5
3	6.6
4	7.7
5	8.8

Total FLA Number of Motors = Applicable Motor FLA

- Replacement Parts**
- Pressure Control
 - Motor (Integral, Protected)
 - Terminal Block - Heavy Duty
 - Terminal Block - Medium Duty
 - Fuse holder

2 #6 solid lines represent wiring for S-4 and S-5 Air Units. 5 #10 solid lines represent additional

Figure A-10
Control B Line Voltage Pressure Control

