HUSSMANN®

Plus™ SYSTEMS

INSTALLATION AND SERVICE MANUAL

HUSSMANN®
CORPORATION
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PLUS SYSTEM REFRIGERATION PROCESS

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PLUS SYSTEM REFRIGERATION PROCESS

INTRODUCTION

The Plus System compressor unit operates with either 4 or 5 compressors in parallel. With the 4 compressor unit, a Satellite can be mounted on the compressor rack. The Satellite can operate at either a lower suction pressure than the main compressor unit (low end Satellite) or at a high suction pressure (high end Satellite).

Figure I-1 at the end of this chapter is a piping and flow diagram intended to assist the installer and service personnel in understanding the various sequences of events during the operation of Plus System. It can also be used to determine valve and control locations to assist service personnel during start up or in isolating serviceable components.

Normally, all supermarket refrigeration is handled by two Plus System units and their Satellites: a medium temperature unit which operates refrigerators that maintain product temperature above freezing and a low temperature unit which operates refrigerators that maintain product temperature below freezing.

The following overview examines the operation and various components in Plus System by breaking the system down into six subsystems.

1. Refrigeration cycle
2. Temperature control
3. KOOLGAS® defrost
4. Heat Reclaim
5. Oil distribution
6. Winter condensing pressure control

REFRIGERATION CYCLE

The refrigeration cycle for Plus System is basically the same as with single compressor units operating a single refrigerator. The following explanation traces the refrigeration circuit, illustrated in Figure I-1, as the refrigerant changes from liquid, to suction gas, to hot discharge gas, and back into liquid again.

Liquid - During refrigeration, liquid refrigerant leaves the receiver, passes through the filter-drier and the main liquid line solenoid. It enters the liquid manifold where it is available to feed individual systems. From the liquid manifold, the liquid passes through the liquid line solenoid to the

Refrigeration Cycle-Liquid (cont'd.)

refrigerator group assigned to that branch. Most refrigerator groups will have several evaporators, but for simplicity, the schematic shows only one. The liquid passes through an optional heat exchanger and then through the thermostatic expansion valve into the evaporator where the liquid boils.

Suction - The evaporated refrigerant then leaves the evaporators and returns to the suction manifold, passing through the temperature control valves (see "Temperature Control"), suction filters, and into the compressors.

Discharge - In the compressors, the cool refrigerant vapor is compressed into a hot discharge gas and sent to the condenser (or heat reclaim coil) where heat is extracted and the refrigerant converted into liquid. It then returns to the receiver where it is ready to begin the cycle again.

TEMPERATURE CONTROL

Since there is only one compressor unit operating many refrigerator systems, each refrigerator system has its own means of controlling temperature. Briefly, they are as follows:

Refrigeration Thermostat - A close on rise thermostat controls refrigerator temperature by making or breaking the electrical circuit to the branch liquid line solenoid valve (or motor contactor on Satellites). Best control is obtained when the solenoid valve is located at the refrigerator because there is no long run of liquid piping to empty out after the valve closes, as would be the case if the solenoid valves at the liquid manifold were used.

Evaporator Pressure Regulator (EPR) - This valve maintains a steady evaporator temperature by holding the evaporation pressure at the valve setting. To perform satisfactorily, the setting must be at least 4 psi higher than the suction pressure downstream of the valve. This makes it unsuitable for temperature control of the coldest systems connected to the unit because the compressor unit will have to operate at lower pressure than would otherwise be necessary.

An EPR alone is generally inadequate for temperature control because it maintains a constant evaporator temperature regardless of load changes. Thus, an EPR set to maintain a refrigerator's temperature during the day, when the refrigerator is working hardest, may tend to overcool the refrigerator in the evening, when store temperature, humidity, and customer activity are lower. For this reason a refrigeration thermostat operating a liquid line solenoid must be used in conjunction with an EPR for every application except preparation areas. EPR valves should not be applied to systems operated by Satellites because the small benefit that may be achieved in controlling temperature is more than offset by the penalty in inefficiency and the possibility of compressor damage as a result of short cycling and higher compression ratios.

Oil Vent Line - Also called "overflow" line. The paralleled compressors are interconnected by an oil vent line. This line prevents an idle compressor from filling with oil during extended shutdown periods. Operation is as follows:

> Oil collecting in the suction drop leg of an idle compressor can slowly increase the crankcase oil level. If this level rises as high as the dip tube of the oil vent line (about 1/2 sightglass), the slightly higher pressure in the idle compressor will cause the additional oil to be aspirated into the operating compressors.

KOOLGAS® DEFROST

The basic difference between Hussmann's KOOLGAS defrost and other forms of gas defrost is that cooler, saturated vapor from the receiver is used to accomplish defrost instead of hot discharge gas. Since most defrosting occurs as a result of the latent heat given off as the refrigerant changes to the liquid state, defrost time is not appreciably longer for a KOOLGAS defrost than for a hot gas defrost, but stress on tubing is appreciably lessened. The following is an explanation of the roles played by various KOOLGAS controls and valves: the main liquid line solenoid, either the 3-way defrost reversing valve or suction stop control valves, various bypass check valves, and the main liquid differential check valve.

Main Liquid Line Solenoid - When KOOLGAS defrost initiates, the defrost timer de-energizes the main liquid line solenoid, stopping flow to the liquid manifold. Since evaporators other than the ones being defrosted are still using liquid, the pressure in the liquid manifold quickly lowers.

3-way Valve - (Loadmaster or no temperature control) When a 3-way valve is used, the defrost timer energizes and shifts the 3-way valve, stopping flow to the suction manifold and opening the circuit to the top of the receiver by way of the KOOLGAS manifold. As the pressure lowers in the liquid manifold, refrigerant vapor from the receiver travels through the evaporators against the normal direction of flow.

Suction Stop Temperature Control Valve - When a CDA or EPR valve is used, the defrost timer energizes the valve to stop flow to the suction manifold. The timer simultaneously opens the KOOLGAS solenoid to permit flow to the evaporator. As the pressure lowers in the liquid manifold, the refrigerant vapor from the receiver travels through the evaporator against the normal direction of flow. For more information about CDA valve operation refer to the chapter "CDA Valve."

Bypass Check Valve - The refrigerant vapor turns to liquid in the evaporator as it gives off its latent heat to melt the frost on the evaporator. The liquid then flows out of the evaporator to the liquid manifold, bypassing the expansion valve and branch liquid line solenoid valve by way of two bypass check valves.

Differential Check Valve - Once in the liquid manifold, the refrigerant continues to feed the other refrigerators. If the quantity generated during defrost is insufficient to feed the other systems, pressure in the liquid manifold drops below the rating of the differential check valve, causing it to open and permit liquid flow from the receiver.

HEAT RECLAIM

Heat reclaim is a simple system for returning to the store, heat that has been removed from the refrigerators. Following is a brief description of its operation.

Heat Reclaim On - When the sales area needs heat, the 3-way/4-way heat reclaim valve shifts to route discharge gas to the heat reclaim coil before it goes to the condenser.

Heat Reclaim Off - When the sales area is warm enough, the valve de-energizes, routing the discharge gas directly to the condenser. The fourth port is connected to the suction header: any refrigerant remaining in the heat reclaim coil is bled into the suction header.

Heat Reclaim Lockout (not depicted in Figure I-1) - This pressure control, mounted on the compressor rack, locks out heat reclaim when receiver pressure drops below a safe minimum. For the factory setting, see "Summary of Control Settings."

WINTER CONDENSING PRESSURE CONTROL

During cold weather, the condenser of a Plus System will work too well. Unchecked, its capacity can increase to the point where liquid line pressures are too low to operate the thermostatic expansion valves, and the refrigerators will warm up.

To prevent this, several forms of condensing pressure control can be used on Plus System to maintain a minimum condensing pressure:

1. Water regulating valve

2. Fan-cycling controls

3. Condensing pressure control valves

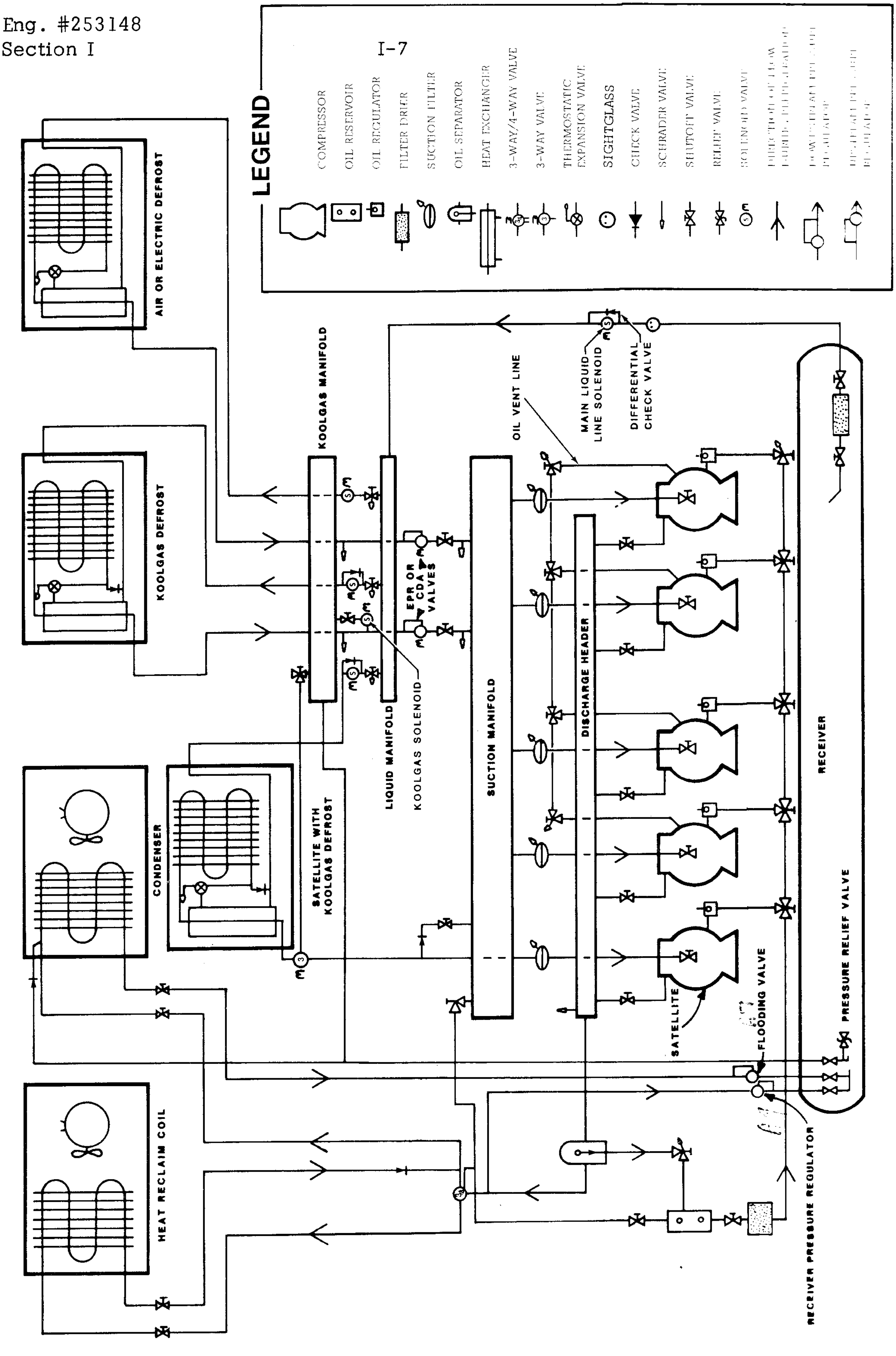
Water Regulating Valve - Used with water cooled condensers, the water regulating valve slows the flow of water through the condenser when condensing pressure goes below the valve setting. This slows the condensing process and keeps pressure at the valve setting.

<u>Fan Cycling Controls</u> - Used on remote air cooled condensers, fan cycling controls turn fans off in sequence to maintain a minimum condensing pressure. Three methods of control are used: (1) thermostatic, (2) thermostatic with pressure override, and (3) Control-B (pressure controls and gravity dampers). See the chapter "Condenser" for more details.

<u>Condensing Pressure Control Valves</u> - When either of the thermostatic fan cycling controls are used, condensing pressure control valves are required on Plus System. The system uses two valves to provide high enough pressure to feed the evaporators: a flooding valve (Flo-Con A7) and a receiver pressure regulating valve (Flo-Con A9).

1. The Flooding Valve A7 - The flooding valve is installed just upstream of the receiver in the liquid return line of the condenser. If upstream (condensing) pressure goes below the valve setting, the valve restricts the refrigerant flow, causing liquid refrigerant to accumulate in the condenser. This, in effect, shrinks the condensing area available for the discharge gas and pressure increases until the valve setting is attained.

2. Receiver Pressure Regulating Valve A9 - The flooding valve raises condensing pressure, which in turn increases discharge pressure. The receiver pressure regulating valve communicates this pressure to the receiver, which in turn raises the pressure at the inlet of the expansion valves so the refrigerators perform properly. The receiver pressure regulator should be set 10 to 12 pounds lower than the flooding valve to insure an adequate pressure differential to operate the flooding valve.



Piping & Flow Diagram
Figure I-1

GENERAL REFRIGERATION PIPING

GENERAL REFRIGERATION PIPING

INTRODUCTION

A complete discussion of refrigeration piping would of course be a book by itself. Therefore, it is not the intention of this section to cover the subject entirely, but rather to highlight or point out some areas where difficulties have occurred in the past.

BRAZING

Use only clean, dehydrated, sealed refrigeration grade copper tubing. All joints should be made with silver alloy brazing material, such as Sil-Fos or equivalent, commonly used for copper to copper; and 35% silver solder for dissimilar metals. Dry nitrogen should be allowed to flow through the tubing during brazing to prevent the formation of copper oxide.

CAUTION: PRESSURE REGULATOR MUST ALWAYS BE USED WITH NITROGEN.

SERVICE VALVES

Field installed service valves are recommended at several locations for ease of maintenance and reduction of service costs. These valves must be UL approved for 410 psig minimum working pressure. Service valves for discharge lines should have lead seats.

ELBOWS

Long radius elbows are recommended because of their low pressure drop and because they are less susceptible to breakage.

PIPING SUPPORT

All piping must be properly supported to eliminate excessive line vibration. Vibration is transmitted to refrigeration piping by movement of the compressor to which it is connected, and by pressure pulsations as the refrigerant passes through the tubing. Insufficient and improper supporting of refrigerant piping can cause excessive line vibration which can result in:

- Excessive noise
- Noise transmission to other parts of the building
- Vibration transmission to floors, walls, and ceilings
- Vibration transmission back to the compressor and attached components
- Line breakage
- Decreased life of all attached components

When brazing connections near factory-installed clamps, be sure to protect clamps with a wet rag to avoid overheating.

To eliminate the preceding conditions the following guidelines must be considered.

1. Normally, any straight run of tubing must be supported in at least two locations near each end of the run. Long runs require additional supports.

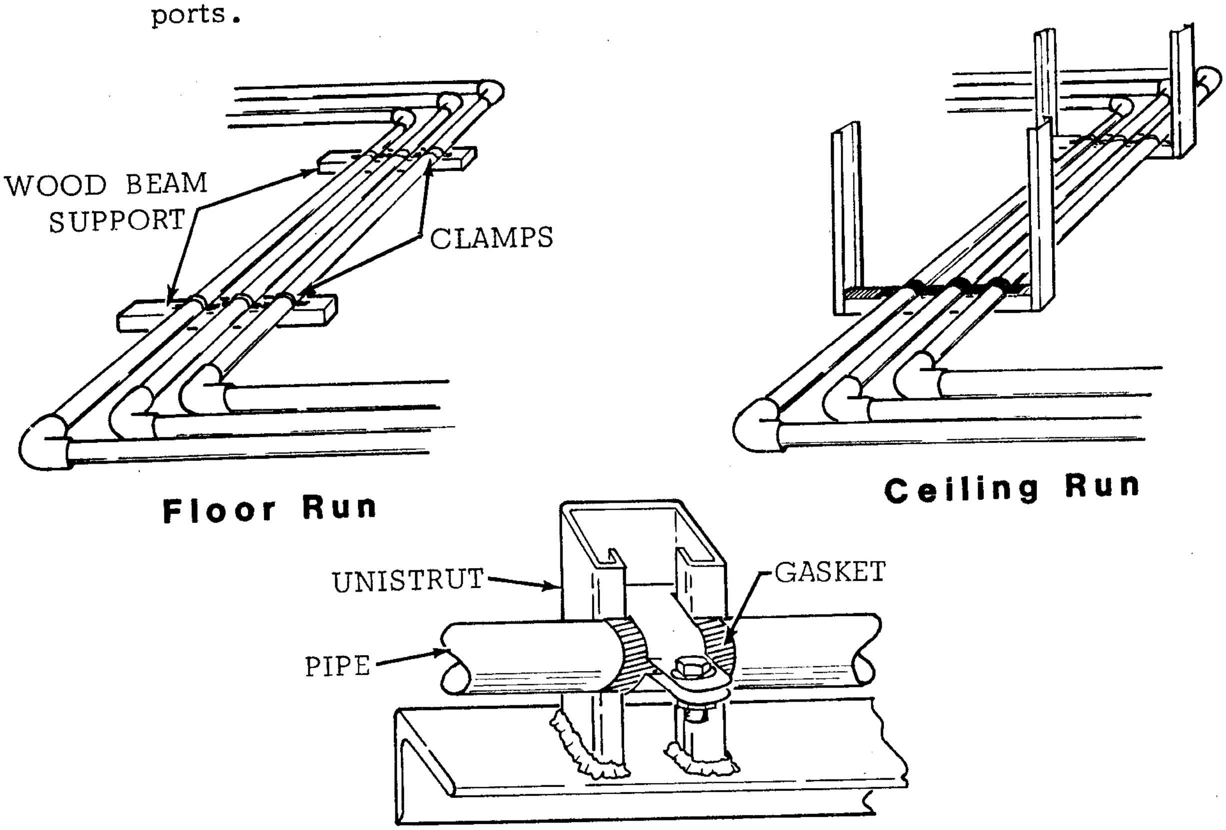


Figure II-1
Support Construction

2. When changing directions in a run of tubing no corner should be left unsupported.

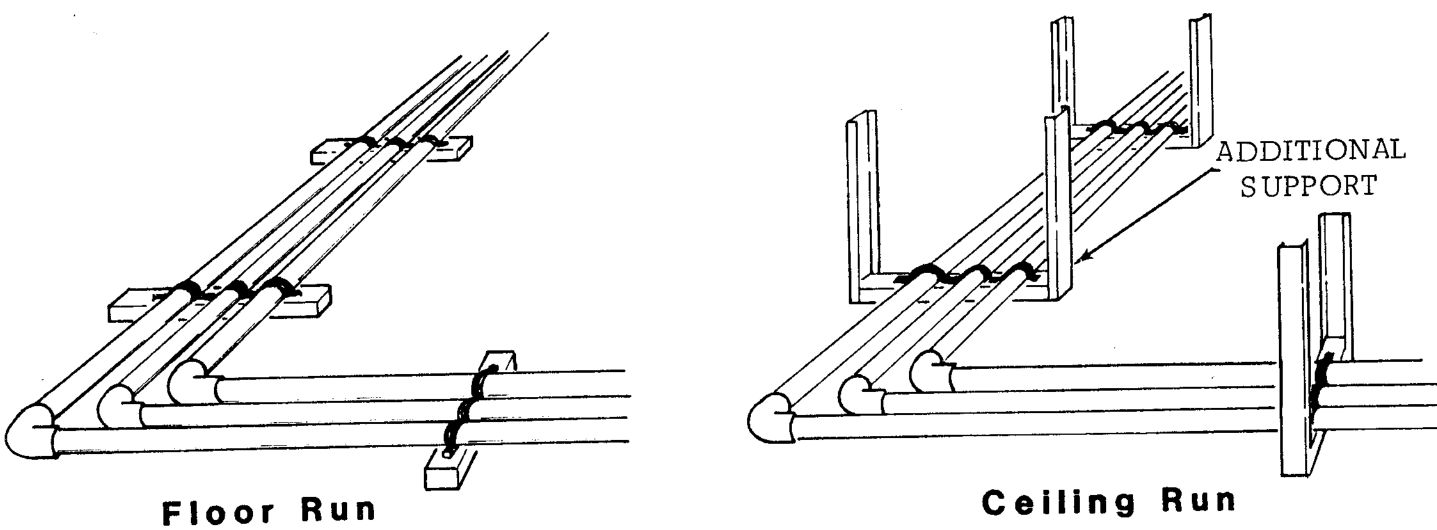


Figure II-2
Corner Support

3. Piping attached to a vibrating object (such as a compressor or compressor base) must be supported in such a manner that it will not restrict the movement of the vibrating object. Rigid mounting will fatigue the copper tubing.

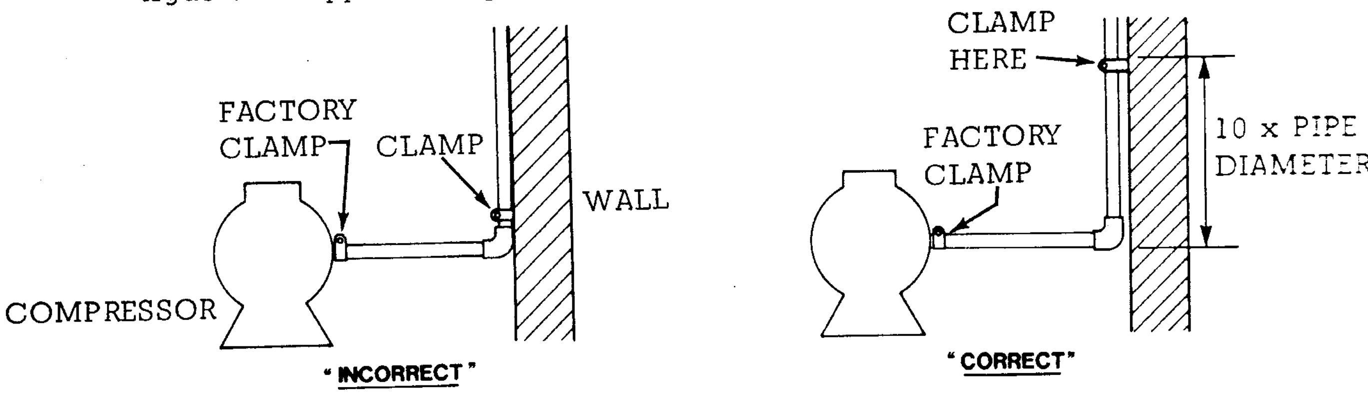


Figure II-3
Vibration Support

4. A P-trap must be constructed at the bottom of all suction risers to insure a proper return of oil to the compressor.

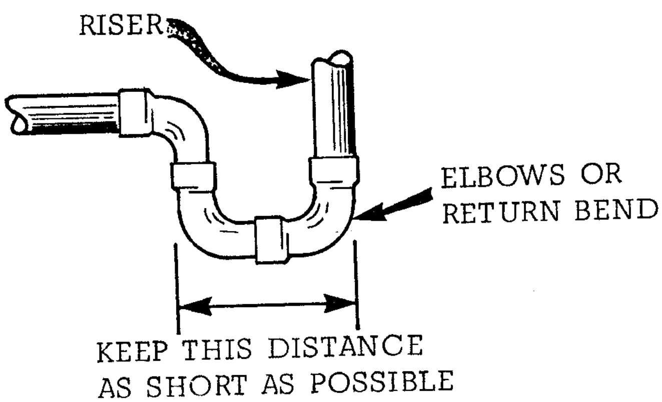


Figure II-4
Riser Construction

5. When a reduced riser is necessary, reduce the pipe on the high side of the riser only. A reduction on the low side backs up a large quantity of oil on the horizontal pipe run, not in the trap.

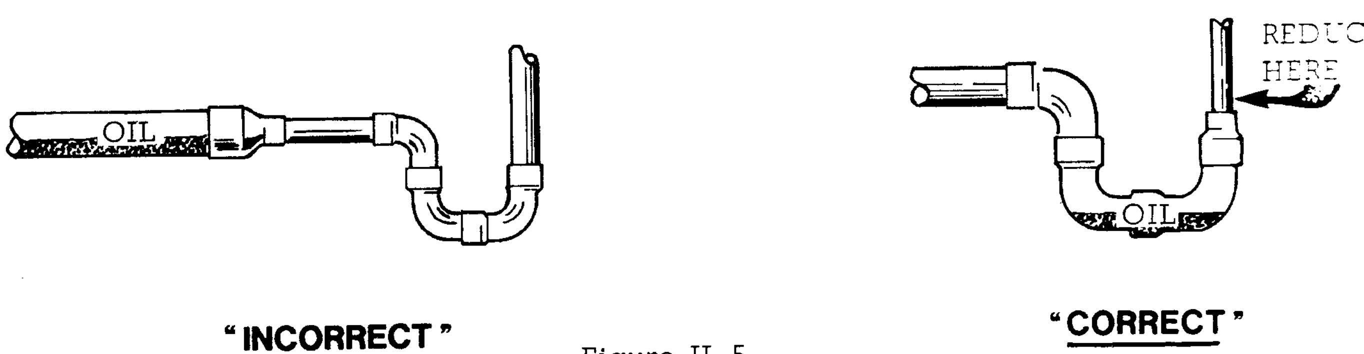


Figure II-5
Reduced Riser

6. Do not use short radius elbows. Short radius elbows can have points of excessive stress concentration and are subject to breakage at these points.

7. Thoroughly inspect all piping after the equipment is in operation and add supports wherever line vibration is significantly greater than most of the other piping. Extra supports are relatively inexpensive as compared to refrigerant loss.

LIQUID AND SUCTION LINE PIPING FOR KOOLGAS® DEFROST

All refrigerant lines undergo expansion and contraction during the normal refrigeration cycle. Liquid and suction lines for KOOLGAS systems undergo the greatest expansion and contraction and must be allowed to expand and contract freely during refrigeration and defrost cycles. To reduce maintenance the following guidelines must be considered.

1. The liquid and suction lines must not be clamped or soldered together in the tubing run for support. Since both lines will expand and contract independently, a break will occur at the joined areas.

2. Tubing hangers must be of the type that will allow copper lines to expand and contract freely.

3. Most refrigeration runs normally provide for enough linear expansion by the many directions taken to get piping from compressor to evaporator to condenser. If there is a long straight run, an offset must be constructed.

   To size an offset correctly, find the expected linear expansion from Table II-1. Offsets can be determined according to tube size from Table II-2.

Table II-1
Thermal Linear Expansion of Copper Tubing

Application	Expansion Inches/100' Copper
Low Temperature R-502 Medium Temperature R-22	1.69 Based on 150°F Temp. Change 1.12 Based on 100°F Temp. Change

Table II-2
Copper Expansion Loops and Offsets
Length (L) in Inches

Tube OD (in.)	Linear Expansion - Inches/100' Copper						
	1/2"	1"	1-1/2"	2"	2-1/2"	3"	4"
7/8	10	15	19	22	25	27	30
1-1/8	11	16	20	24	27	29	33
1-3/8	11	17	21	26	29	32	36
1-5/8	12	18	23	28	31	35	39
2-1/8	14	20	25	31	34	38	44
2-5/8	16	22	27	32	37	42	47
3-1/8	18	24	30	34	39	45	53
4-1/8	20	28	34	39	44	48	58

The drawing in Figure II-6 shows the construction of a simple offset. An offset using two 90° elbows should have a minimum offset of not less than three times the length (L) determined from Table II-2.

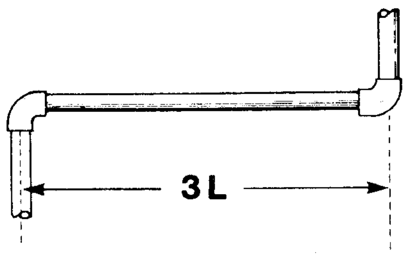


Figure II-6
Offset Construction

4. Expansion loops, like offsets, are constructed to absorb a definite amount of movement. The expansion loop should be located one half the estimated travel of the pipe run. In this manner, the bend is subject to only one half the stress when the line is at the highest temperature.

Figure II-7 shows the method of constructing an expansion loop. Length (L) is determined by applying the expected linear expansion from Table II-2.

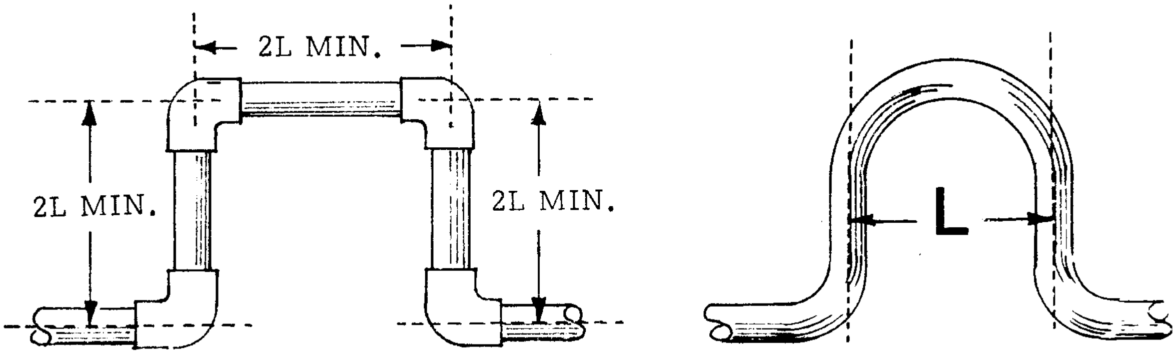


Figure II-7
Expansion Loop Construction

5. Where refrigerant lines are run beneath the floor or in a sand-filled trench the contractor must use heavy thickness insulation (Armaflex or equal) around the pipe where it comes through the concrete floor.

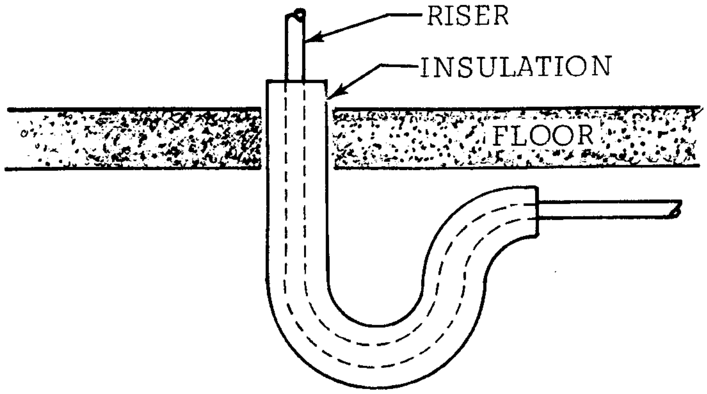


Figure II-8
Tube Through Floor

6. A line sizing guide for all lines and units is supplied in the Plus System Planning Data. Sizing of all refrigerant lines is the responsibility of the installing contractor.

STORE LEGEND

Section III

Page

STORE LEGEND

INTRODUCTION TO THE STORE LEGEND

The Plus System equipment is keyed to the Store Legend made specifically for each store. It shows what models have been applied to your store, and serves as a master plan for connecting the refrigerated fixtures to the Plus System, and for interconnecting the Plus System components.

Figure III-1 is a typical Plus System Store Legend showing how the various components are identified and interrelated to the total store package. (Note : Legends shown is for a low temperature system only. Some legends may show medium temperature only or both low and medium temperature.)

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An IC Industries Company

STORE DESIGN CONDITIONS
INSIDE DESIGN TEMP 75°F/55%R.H.
OUTSIDE DESIGN TEMP. — DRY BULB 100 °F WET BULB ____ °F
CONDENSER TYPE REMOTE AIR COOLED
VOLTS 208 HERTZ 60 PHASE 3

☐ __ SYSTEM
☐ __ SYSTEM
☒ __ PLUS SY
☐ ____

UNIT LTR	SYS NO.	REFRIGERATOR SIZE	REFRIGERATOR MODEL	REFRIGERATOR USE	DISCH AIR TEMP	REQUIRED CAPACITY BTU/HR 1981 EACH SYSTEM	REQUIRED CAPACITY BTU/HR TOTAL	EVAP TEMP	COMPRESSOR UNIT MODEL BTU @ 0°F SUB COOLING UNIT	CAPACITY Ⓐ Ⓑ	DEFROST SYSTEMS BRANCH KITS OFF-TIME ELECTRIC	BRANCH KITS KOOLGAS	ELECTRIC MOUNTING KITS	ELECTRIC CONTROLS	TEMPERATURE CONTROL CDA (6)	EPR	OTHER	EVAPORATOR QTY	EVAPORATOR MODEL	E…
S1	1	48'	GC	I.C.	-20°		19,200	-30°	SATELLITE	-35° 110° 24,500		10EC				NONE	NOTE 5			
	2	6' 20'	GWI-6 GWI	F.F.	-10°	13,800		-20°				16EB				//	//			
	3	6' 24'	GWI-6 GWI	//	-10°	Ⓐ 16,200						16EB				//	//			
	4	9DR	RHFA	//	-5°	13,050						16EB				//	//			
	5	9DR	RHFA	//	-5°	13,050						16EB				//	//			
	6	12'	G6FL	F.M.T.	-8°	17,700						16EB				//	//			
	7	1624	COOLER	F.F.	-5°	20,300		-20°				16EB				//	60EA	1	Ⓒ HS45160KGE	1 G
A							94,100		S41GJRLLK	-20° 110° 108,000										
									HRT 702VS											
S2	8	64'					34,560	9°	SATELLITE							NONE	NOTE 3 98DM NOTE 5			
	9	2028	COOLER	//	28°	28,700		18°								//	60EA	2 2	KGG GA1700KG	2 G
	10	8x8	//	DELI.	30°	6,100		20°								//	60EA	1 1	KGG GA750KG	1 G
	11	24'	DMD	//	32°	NOTE 8 46,140		18°	12' PEG + 12' STANDARD			16EB				//	NOTE 5			
	12	24'	DMD	//	32°	NOTE 8 43,200		18°				16EB				//	//			
	13	24'	DMZ	DAIRY	32°	NOTE 8 34,800		21°				16EB				//	//			
	14	24'	DMZ	//	32°	NOTE 8 34,800		21°				16EB				//	//			
	15	56'	PHMS	PROD.	33°	39,200		18°			42EB					//	//			
	Ⓓ															//	60EA		Ⓒ	
	16	1628	COOLER	DAIRY	36°	21,800		23°			60EB					Ⓐ Ⓑ 13	60EA	1	HS46180A	1 G
	17	1618	//	PROD.	40°	14,200		32°			58EB					Ⓐ 12	60EA	Ⓓ 2	HS2690A	2
	18		PREP	MT.	55°	40,560		30°			60EB					13	60DR		(FURNISHED BY	
	19	18x25	//	PROD.	70°	18,000		40°			58EB					Ⓐ 12	60DR		(FURNISHED BY	
B									S41JFVSSK Ⓒ	18° 115° 376,000										

SYSTEM CAPACITY: Btu/Hr used for line sizing

UNIT LETTERS: Assigned to each compressor unit.

REMOTE SATELLITE MODEL NUMBER

REFRIGERATION SYSTEM: System branches bear these numbers at each stub.

COMPRESSOR UNIT MODEL NUMBER

COMPRESSOR UNITS	UNIT LETTER S1	A	S2	B	
COMPRESSOR MODEL	9RS-0760	9RJ-0500	MRH-0760	9RS-1500	
NOMINAL HP (EACH)	7½	5	7½	15	
NUMBER OF COMPRESSORS	1	4	1	4	
SUCTION TEMPERATURE	-35°	-20°	9°	Ⓐ 17°	
BTU/HR @ ___ °F SUBCOOLING Ⓐ	24,500	108,000	40,000	376,000	
REJECTION (BTU/HR) Ⓐ	44,000	178,000	56,000	508,000	
DESIGN CONDENSING TEMPERATURE	110°	110°	115°	115°	
REFRIGERANT	502	502	Ⓑ	Ⓑ	
DESIGN KILOWATTS Ⓐ	5.30	22.76	6.26	49.04	
MINIMUM CIRCUIT AMPACITY					

REMOTE CONDENSERS

	MAKE AND MODEL	UNIT LETTER	FAN CONTROL	FAN FUSING	OTHER	TD	CIR CUITS	REJECTION BTU/HR	NO FANS	…
Ⓐ	HACD-49K	S/A		34DW	79DX	10°	ALL	222,000	4	14
	HACD-82K	S/B		35DW	80DX	15°	ALL	569,000 Ⓑ Ⓒ	6	26

REMARKS ____

☐ — SYSTEM IV LEGEND ☐ SINGLE TIER ☐ DOUBLE TIER
☐ — SYSTEM II LEGEND
☒ — PLUS SYSTEM LEGEND
☐ —

F.O. No. 76448 SHEET 1 of 1
CUSTOMER
STORE NAME
STORE ADDRESS
CITY & STATE

... WET BULB ____ °F
... COOLED
PHASE 3

SYSTEMS / ELECTRIC	CDA[5]	EPR	OTHER	EVAPORATOR QTY	EVAPORATOR MODEL	EXP VALVES QTY	EXP VALVES MODEL (B)	HEAT EXCHANGER	DOOR SWITCH	REMARKS
		NONE	NOTES				(C)			
		"	"							
		"	"							
		"	"							
		"	"							
		"	"							
		"	60EA	1	(C) HS45160KGE	1	GRE020ZP		M-116	
		NONE	NOTE 3 98DM NOTE 5							
...LLITE ...R		"	60EA	2 2	KGG GA1700KG	2	GVE015C			
		"	60EA	1 1	KGG GA750KG	1	GVE010C			
		"	NOTES							
		"	"							
		"	"							
		"	"							
		"	"							
		"	60EA		(C)					
		(A)(B) /3	60EA	1	HS46180A	1	GVE020C			
		(A) /2	60EA	(D) 2	HS2690A	2	GVE010C (D)			REVISION CODES
		/3	60DR	(FURNISHED	BY	OTHERS)				
		(A) /2	60DR	(FURNISHED	BY	OTHERS)				
...UNIT ...ER										

UNIT MODIFICATIONS AND ACCESSORIES	S_1	A	S_2	B	
REMOTE HEADER DEFROST ASSEMBLY					
BASIC DEFROST KIT		30EC		31EC	
KOOLGAS DEFROST BASIC KIT		09EB		10EB	
CDA BASIC KIT					
CDA THERMOSTAT MOUNTING BOARD					
DEFROST TIMER					
SLAVE TIMER				(E) 71EB	
UNIT MODIFICATION FOR HRT SATELLITE					
COMPRESSOR CONTROLLER					
WINTER CONTROL VALVES FAN CYCLE					
HEAT RECLAIM 120 VOLT		78EB		79EB	
HEAT RECLAIM VOLTAGE MODIFICATION					
BASIC ALARM KIT		12EB		12EB	
AUXILIARY CONTACTS					
REFRIGERANT LOSS ALARM		54EC		54EC	
CDA TRANSFORMER ALARM					
REMOTE ALARM				63EC	
REMOTE SATELLITE ALARM					
ALARM BELL		25EC		25EC	
NEMA CONTACTORS ALLEN BRADLEY	94EB	(4)02EC	94EB	(4)96EB	
CURRENT SENSING RELAY		(5)25DD	25DD		
SINGLE PHASE PROTECTION		01EB		01EB	
CIRCUIT BREAKERS:					
CONTACTORS:					
PRESSURE CONTROLS:					
OIL FAILURE CONTROLS:					
INSULATE SUCTION MANIFOLD		87EC		87EC	
ELECTRICAL RACEWAY		81EC		81EC	
CAL. PRES.		13.0#		3?# (C)	

REMOTE CONDENSERS ALTITUDE ____ FT

FAN FUSING	OTHER	TD	CIRCUITS	REJECTION BTU/HR	NO FANS	NAMEPLATE FULL LOAD AMPS	DRIVE BD/DD	LENGTH	WIDTH	HEIGHT	NET WEIGHT
34DW	79DX	10°	ALL	222,000	4	14	DD	130	78	52 3/8	1730
35DW	80DX	15°	ALL	569,000 (B) (C)	6	26.4	DD	193	78	55	2920

NOTES

(1) An electric defrost type coil must be used. The defrost timer is not included in the control panel, the proper timer should be purchased separately and installed on the job.

(2) Required capacity is an estimate only, in lieu of more accurate [illegible] from the local engineer

(3) This information supplied by the local engineer

(4) Cooler door switches are recommended

(5) A 1°TD thermostat is recommended for all thermostatica[illegible] cases

(6) A temperature sensor is required for all CDA controlled [illegible]

(7) Field installed

(8) BTU values are for cases with unlighted shelves

This legend has been prepared at no charge as an [illegible] the information is based on our best technical knowledge [illegible] should be used only as a general recommendation [illegible] many local variables which are unknown to and [illegible] Refrigeration Inc. the final application [illegible] responsibilities must rest with the local engineer [illegible]

REV	DATE	BY
A	[illegible] FEB 82	RJW
B	[illegible] FEB 82	RJW
C	3-24-82	ACF
D	3-30-82	ACF

[illegible] -25-82 -616-D
[illegible] RJW
[illegible] -25-82

COMPRESSOR UNIT INSTALATION

COMPRESSOR UNIT INSTALLATION

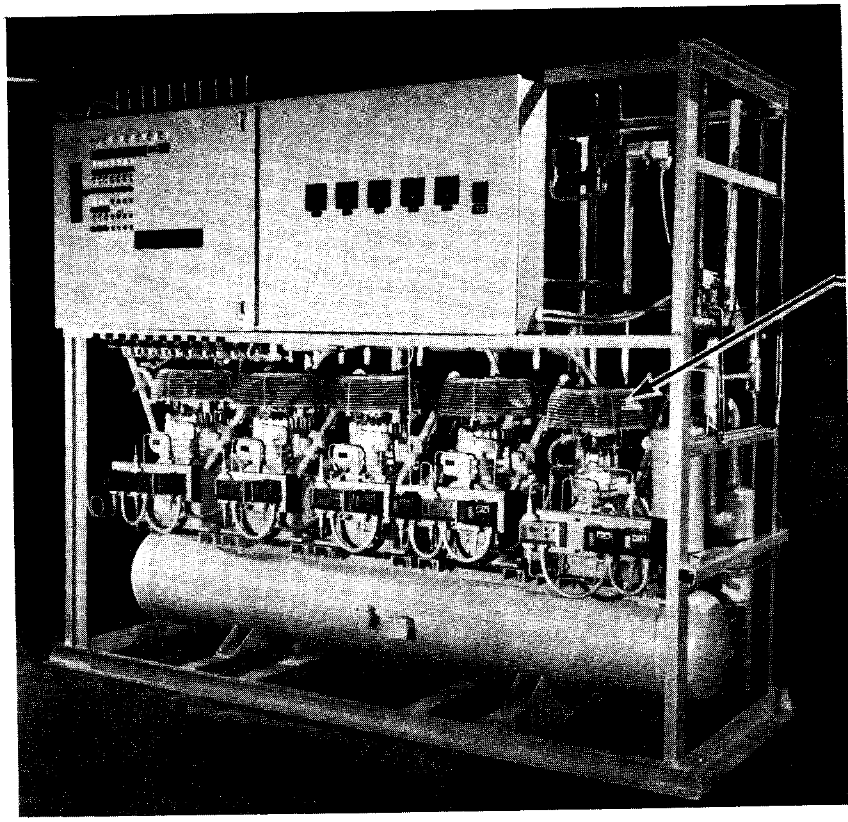


Figure IV-1
Plus System Compressor Unit

DESCRIPTION OF MODELS

The compressor unit is available with either 4 or 5 identical semi-hermetic compressors piped in parallel. Units with four parallel compressors are available with a Satellite compressor factory installed on the compressor rack.

The compressor unit has its own piping, receiver, control circuit, temperature and defrost controls, and an optional alarm system to signal a malfunction. The temperature and defrost controls are also available installed on a remote header defrost assembly.

The following is a description of model numbers:

S 4 1 E D V S H K

- S — System (Hussmann designation for paralleled compressors) S=Copeland, C=Carlyle
- 4 — Number of compressors in parallel
- 1 — Number of Satellites (mounted on the unit)
- E — Compressor model code (parallel compressors)
- D — Compressor model code (Satellite)
- V — Refrigerant
  - F - R12
  - V - R22
  - R - R502
- S — Evaporator Temperature Range (parallel compressors)
  - L - Low temperature
  - S - Medium temperature
  - H - High or medium temperature
- H — Evaporator Temperature Range (Satellite)
  - L - Low temperature
  - S - Medium temperature
  - H - High or medium temperature
- K — Electrical type
  - K - 208/3/60
  - M - 460/3/60

Since Plus System has a somewhat more complex nomenclature than other Hussmann compressor units, the following will help clarify key code letters.

S 4 1 E D V S H K

- E, V, S — Letters needed for finding the <u>paralleled</u> compressors model.
- D, V, H — Letters needed for finding the <u>Satellite</u> compressor model.

COPELAND

Compressor Model Code	Refrigerant and Temperature Range	Compressor Model No.	Nominal hp
B	VH, RH	ERF-0310	3
C	VS, RS	3RA-0310	3
	FS, RL VH, RH	LAL-0310 NRA-0500	3 5
	VS, RS FS, RL	NRM-0500 MRA-0500	5 5
F	FS, RL VH, RH	MRB-0500 MRH-0760	5 7-1/2
G	FS, RL VS, RS	9RJ-0500 9RA-0760	5 7-1/2
H	VH, RH	9RC-1010	10
J	FS, RL VH, RH	9RS-0760 9RS-1500	7-1/2 15
K	FH, RL	4RA-1000	10
L	RL FH,	4RL-1500 4RH-1500	15
M	FH, RL VH, RH	6RA-2000 6RA-3000	20 30
N	RL VA, RH	6RL-2500 6RH-3500	25 35

CARLYLE

Compressor Model Code	Refrigerant and Temperature Range	Compressor Model No.	Nominal hp
U	(RL, FH (RH, VH	06DR-228	7-1/2
V	RL FH, RH, VH	06DR-337 06DM-337	10 10
W	RL FH, RH, VH	06ER-150 06EM-150	15 15
X	(RL, FH (RH, VH	06ER-166 06EM-266	20 25

Table IV-1
Compressor Code Description

The model applied to your store is given in the heading of the store legend. Dimensions and weights of the compressor racks are in the planning data supplied with the unit.

Strapped to the compressor rack is an accessory packing box including:

1. Liquid level gauge for the receiver or the optional 2-stage refrigerant loss alarm/indicator.
2. Liquid drier cores
3. Suction filter replacements (extra set)
4. Vibration isolation pads (8)
5. Loose shipped items for accessories

HANDLING

Each compressor rack has four, 2 inch holes in the frame for rigging and lifting. Figure IV-2 illustrates the recommended method of setting up the rigging. It is important to use the spreader bar to prevent the rigging from damaging the copper tubing. Before locating in the machine room remove the shipping skid.

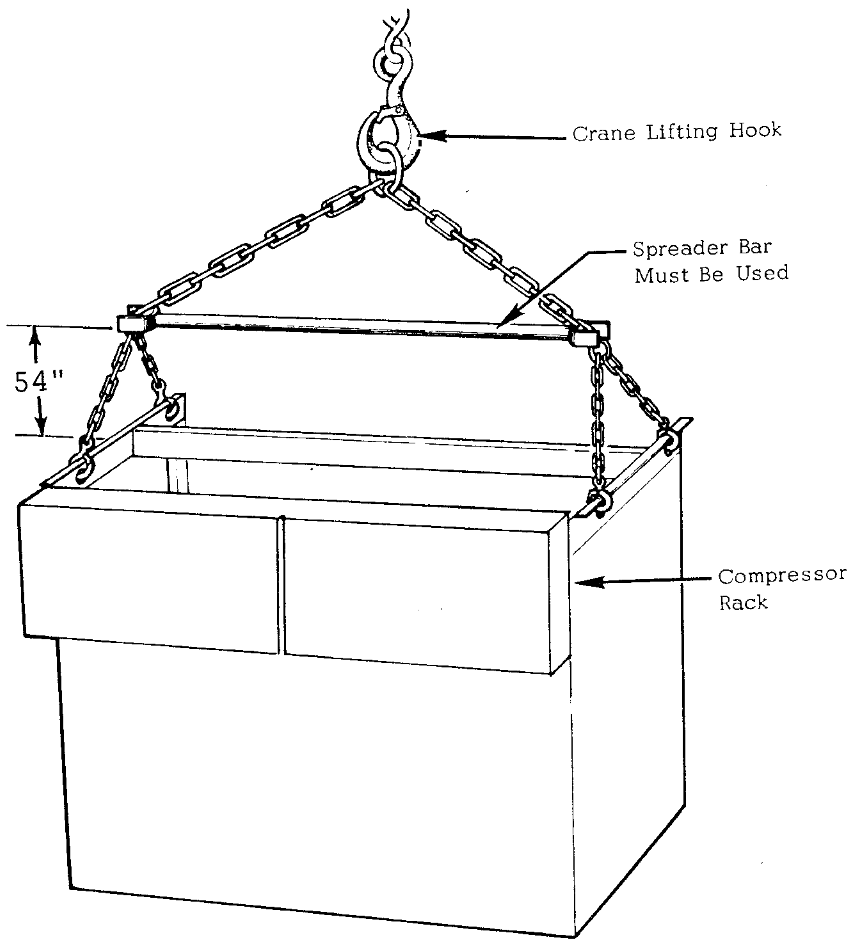


Figure IV-2
Lifting the Compressor

LOCATING & LEVELING

Each compressor unit must be located in the compressor room so that it is accessible from all sides. A minimum of 36 inches clearance is recommended to provide easy access to equipment.

Vibration isolation pads are supplied with each rack. The entire weight of the rack must rest on these pads. The pads should be located as shown in Figure IV-3. Cross-level the compressor unit so all compressors are level with each other.

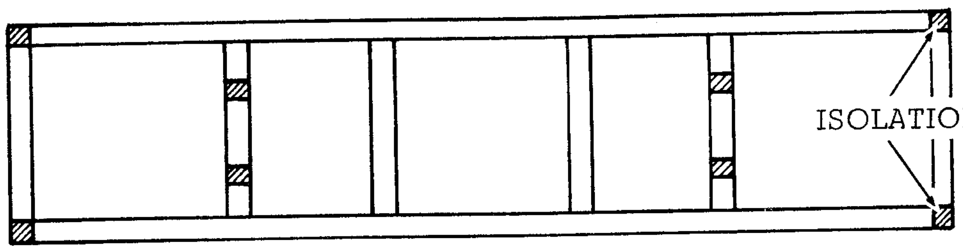


Figure IV-3
Isolation Pad Location

INSTALLATION OF THE LIQUID LEVEL INDICATOR

-Plus System gets an alarm/indicator, skip this section and turn to "Accessories" chapter. Follow these steps to install the standard indicator.

1. Remove the flange plate on the front of the receiver (facing the control panel). Discard the original gasket and check to see that the new gasket and joints are free from flaws.

2. Coat the new gasket with a light film of oil and install it over the flange on the back of the indicator. Holding the dial face straight up, insert the float into the receiver. See Figure IV-4. Swing the head down to complete the insertion, taking care not to bend the float arm.

3. Check for freedom of float movement by rotating the gauge from side to side. A slight jar should be felt when the float swings to the upper and lower stops.

4. Rotate the device right side up - the square lug securing the dial to its flange should be on the bottom. Install the screws finger tight and tighten in a diagonal pattern.

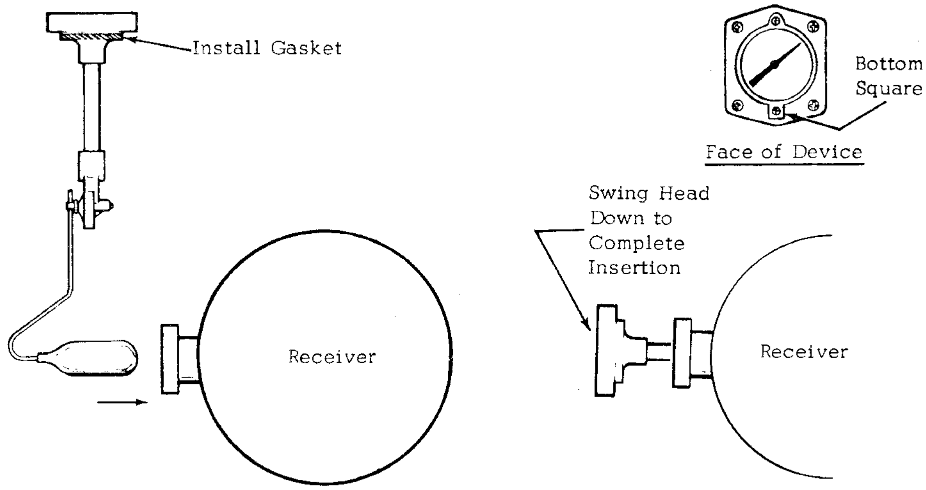


Figure IV-4
Installation of the Liquid Level Indicator

PIPING INSTALLATION

Refer to the Chapter "General Refrigeration Piping" before proceeding. For condenser, remote Satellite, or heat reclaim piping see the corresponding chapters.

Plus System is available with or without a remote header defrost assembly. If a header defrost assembly is provided, interconnect the header defrost assembly to the compressor unit according to the chapter "Remote Header Defrost Assembly." Refrigerator suction and liquid lines should be connected to the header defrost assembly in the same manner as they would if the branch stubs were located on the compressor unit.

When no header defrost assembly is provided, the branch stubs are located on the compressor unit. See Figure IV-1. Usually there will be one liquid branch and one suction branch numbered for each system specified on the store legend.

One liquid and one suction line must be run from each refrigerator system to the liquid and suction branch stubs bearing the same number. In some instances the store legend may show two separate refrigeration loads connected to one system number or branch. If this occurs, the liquid and suction lines from each circuit must be run individually back to the compressor rack and connected to the appropriate branch stub.

NOTE: TO FACILITATE FASTER SYSTEM REFRIGERANT CHARGING AT START-UP, IT'S RECOMMENDED A FIELD SUPPLIED, FIELD INSTALLED LIQUID CHARGING VALVE BE PROVIDED BY THE INSTALLING CONTRACTOR. BEING GUIDED BY STORE LEGEND, SELECT SYSTEM HAVING LARGE BTU/HR REQUIREMENT AND INSTALL CHARGING VALVE DOWN STREAM OF SYSTEM LIQUID LINE SOLENOID. PROVIDE MEANS TO SEAL AGAINST LEAKAGE WHEN NOT IN USE.

WARNING: VENT THE RECEIVER SAFETY RELIEF VALVE TO THE OUTSIDE. REFRIGERANT RELEASED DUE TO EXCESSIVE RECEIVER PRESSURE CAN OBSCURE VISION AND CAUSE ASPHYXIATION.

Suction Lines - The suction line is the most critical refrigeration line because oil must be returned to the compressor without excessive pressure drop.

The suction line size should already have been determined from the Plus System Planning Data. These sizing tables must also be used to determine whether vertical risers should be reduced in size. A P-trap of the same size as the horizontal suction line must be installed at the bottom of all suction risers.

On systems with multiple evaporators, maintain the size selected for the main suction line through at least one third of the cases. At this point, the suction line should be reduced to the next smaller size for the second one third of the case line up. The suction line may be further reduced one size for the remainder of the cases, but may not be reduced smaller than the case suction line. (See Figure IV-5)

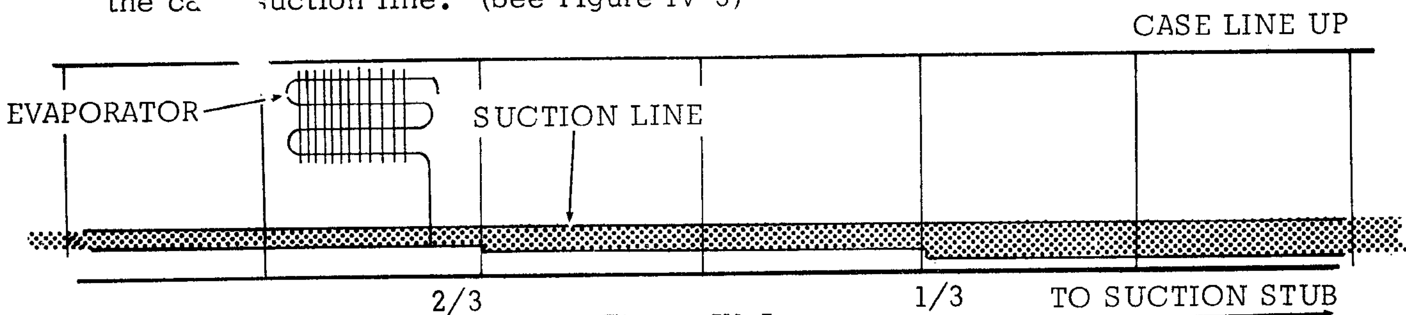


Figure IV-5
Suction Line Reduction

Liquid Lines - Liquid lines are sized in the Plus System Planning Data selection tables to prevent flashing. Flashing in the liquid lines would create additional pressure drop and poor expansion valve operation.

On multiple case systems, liquid line take-off's to the individual evaporator should be from the bottom half of the branch liquid line. This will further insure a full liquid column to the evaporator. (See Figure IV-6)

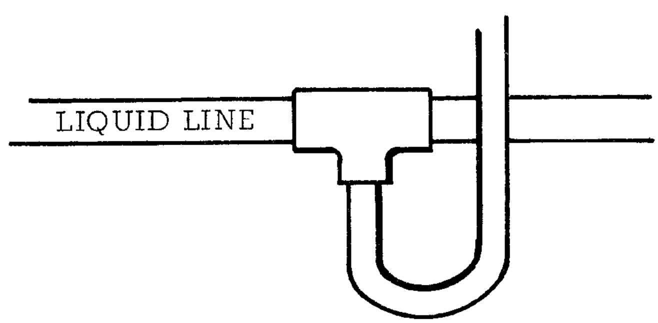


Figure IV-6
Liquid Line Take-off

Maintain the liquid line size selected for the main liquid run through at least one half of the evaporators. At this point, the line may be reduced to the next size smaller for the balance of the run, but should not be reduced smaller than a case liquid line. (See Figure IV-7)

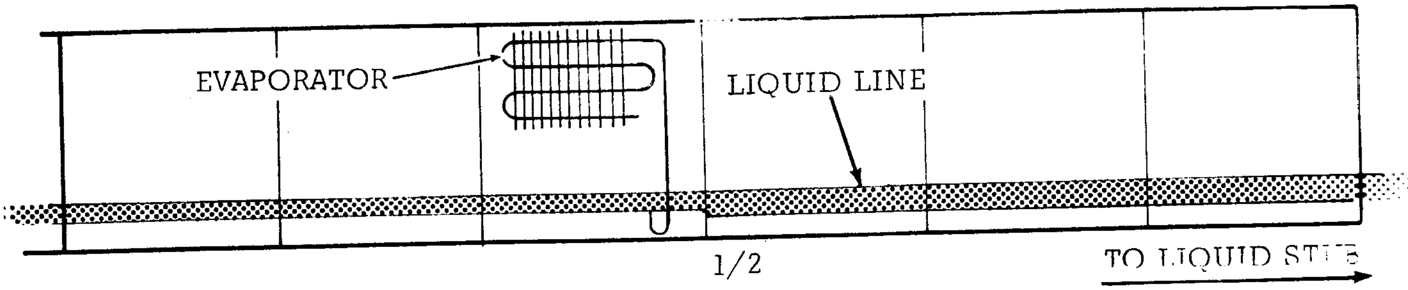


Figure IV-7
Liquid Line Reduction

KOOLGAS Systems - Liquid and suction lines for systems with KOOLGAS defrost should not run through other display cases. If there is no other practical alternative, these lines should be insulated separately for the portion of the run through other display cases. For general KOOLGAS piping procedures see the chapter "General Refrigeration Piping."

1. Liquid Lines - For evaporators using KOOLGAS defrost, the portion of the liquid line between take-offs to the evaporators must be sized 2 sizes larger than the portion of the liquid line between the refrigerator and the compressor unit. The take-offs to the evaporators need not be increased.

Provisions for expansion must be planned in making the individual fixture take-offs. A loop of tubing with a minimum diameter of 3 inches will usually be sufficient. (See Figure IV-8)

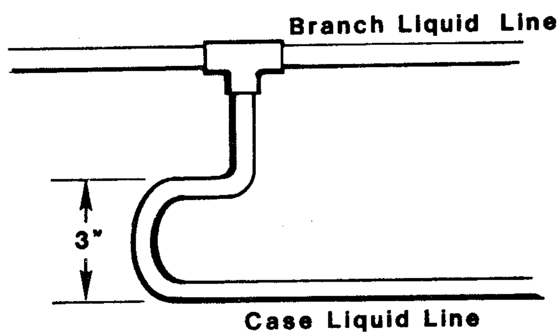


Figure IV-8
Liquid Line Expansion Loop

2. Suction Lines - Due to the size limitations of 3-way valves some of the larger KOOLGAS systems will require parallel connection to 2 suction branch stubs at the suction header. Figure IV-9 is a typical method for making this type of connection.

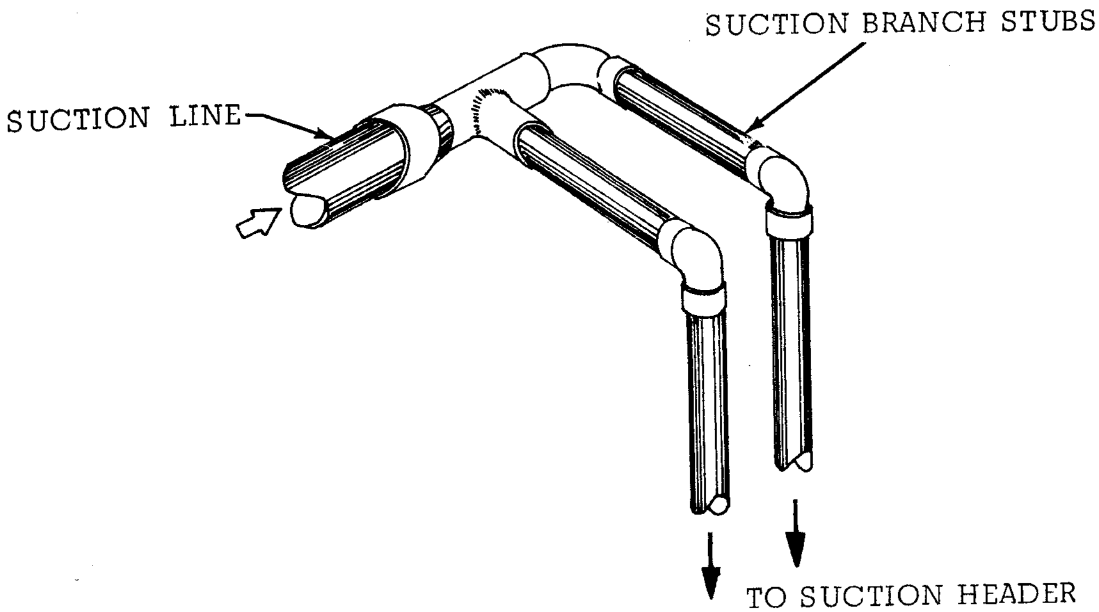


Figure IV-9
Connections for Parallel Suction Branch Stubs

Special Piping for Open Preparation Rooms - The following application may not be covered in specific refrigerator instructions.

An open preparation room is not completely enclosed. Air from the general store area is allowed to infiltrate into the preparation room. This type of area generally cannot be controlled accurately since the preparation room is, in effect, trying to air condition the whole store. This may jeopardize refrigeration performance since the preparation room evaporators are connected to the same central unit the refrigerators are connected to.

To protect the refrigerators, open preparation room evaporators must be provided with a crankcase pressure regulating valve (CPR) in the suction line to prevent these rooms from demanding excessive system capacity.

The CPR valve must be field installed in the main suction line(s) from the open preparation room. The side marked "OUT" connects to the suction stub on the compressor unit.

See "Start Up" section for valve adjustment.

ELECTRICAL

Plus System is available wired for 208-230/3/60 or 460/3/60 compressors. In either case the control circuit is 208-230/1/60. Refer to the serial plate located on the control panel to determine wire size and overcurrent protection. All wiring must be in compliance with governing electrical codes.

Field Wiring - The control panel is wired as completely as possible at the factory. For 208-230/3/60 volt units, connect only the main power. For 460/3/60 volt units, connect the main power and a 208-230/1/60 volt control circuit. Where the main power supply connects to the compressor units, a one foot minimum length of flexable conduit is highly recommended to absorb vibration. Satellites mounted on the compressor rack are prewired for control and power. Remote Satellites or a remote header defrost assembly will require additional connections. Refer to their individual chapters for electrical interconnection.

Compressor Controls - Each control panel is wired with independent compressor control circuits so any compressor can be electrically isolated without causing other compressors to be shutdown.

Each compressor has a time delay to prevent all compressors from coming on the line at one time following a power interruption. Time delays range from 24 to 40 seconds at 4 second intervals.

Figure IV-10 is a picture of a control panel.

The compressor rack wiring diagram is shown in Figure IV-11. This basic diagram will show the control and power circuit for all compressor types. Where variations occur, the area has been shaded and coded. These coded areas are described in the lower bottom half of the diagram.

Defrost Controls - There are 8 types of defrost circuits and they are shown in Figure IV-11. These circuits may be repeated in multiple and intermixed in any one store. If Plus System is used in conjunction with a remote header defrost assembly, the defrost controls will be located in the defrost control panel. For electrical requirements of a remote header defrost assembly see the corresponding chapter.

In the wiring diagram, terminal points in a circuit are often identified by a letter with a dash suffix (for example T_). The actual terminals in the control panel will have the system number in place of the dash.

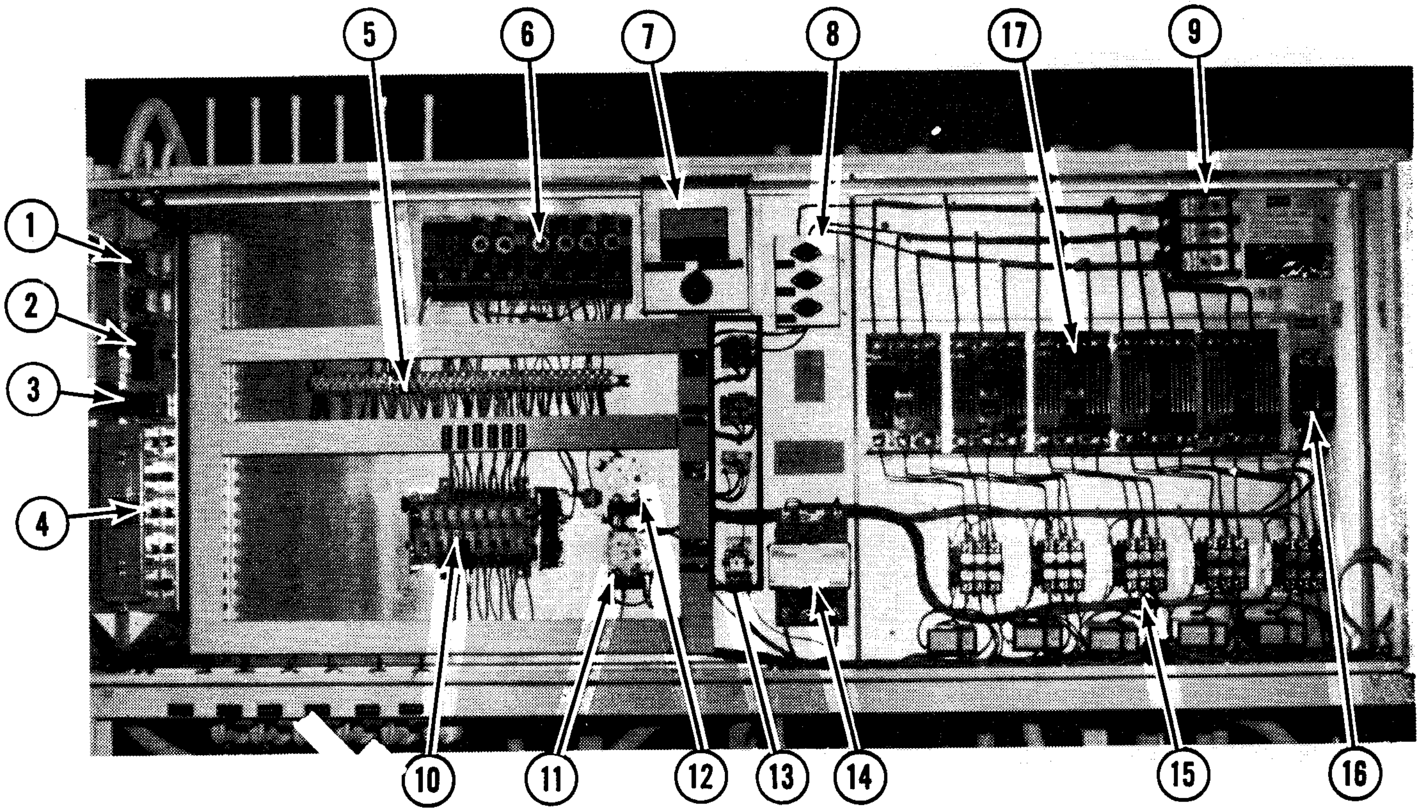


Figure IV-10
Compressor Unit Control Panel

The individual components of each Plus System control panel may be identified in the photo above by the number designations.

1. Single phase protection circuitry
2. Alarm time delay and fuse
3. Bell and alarm relays
4. Compressor time delay relays and control circuit sub-fusing
5. Terminal block
6. CDA panel boards (if applicable)
7. DC voltmeter (CDA only)
8. Single phase protection fuses
9. Power terminal block
10. Defrost program timer
11. 1/2 hour time delay for alarm on compressor #1
12. 1/2 hour time delay for high suction and refrigerant loss alarm
13. Bell, KOOLGAS, and refrigerant loss alarm relays
14. 24 volt transformer (CDA only)
15. Compressor motor contactors
16. Control circuit breaker
17. Compressor motor circuit breakers

Switches and fuses for individual system branches, alarm, and heat reclaim are mounted on the exterior door of the control panel.

THERMOSTAT WIRING

For CDA temperature control see "CDA Valve" chapter (Sensor Wiring). For Satellite temperature control see "Satellite" chapter.

Refrigeration Thermostat - (Preferred) When thermostats are used to control refrigerator temperature they should operate a liquid line solenoid field installed at the refrigerator rather than the branch liquid line solenoid on the compressor unit.

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

Refrigeration Thermostat - (Alternate) If it is desired to have the refrigeration thermostat operate the branch liquid line solenoid on the compressor unit, wire it to the control panel in the following manner.

Determine the system number from the store legend. The system will be the suffix of the appropriate "T" and "B" terminals.

Remove the jumper from the T_ and B_ terminals.
Connect one thermostat wire to the T_ terminal.
Connect the other thermostat wire to the B_ terminal.

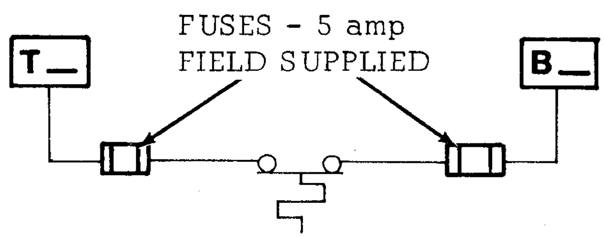


Figure IV-12
Wiring Refrigeration Thermostat

Defrost Termination Thermostat - For each system using defrost termination thermostats, run a two-wire control circuit from all termination thermostats (in series, one per case) to the R_ and F_ terminals in the control panel with a suffix corresponding to the system number.

All thermostat control wires should be sized for pilot duty operation with a maximum power requirement of 125 va to 208-230 volts. Two field supplied fuses are recommended as shown in Figure IV-13.

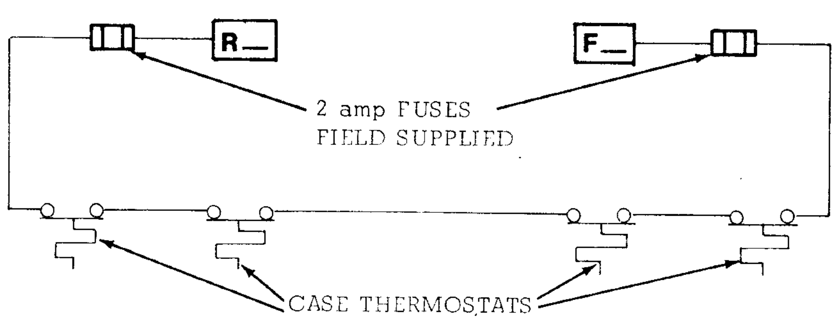


Figure IV-13
Wiring Defrost Termination Thermostats

SERVICE TIPS

REPLACING A COMPRESSOR

Maintain a close watch on the operating compressors if No. 1 compressor is the one being serviced.

Disconnect Electrical -

1. Turn off power and control circuit of the compressor to be removed.
2. Disconnect the compressor wires from the load side of its motor contactor.
3. Disconnect the pilot circuit wires for the compressor. A harness connector is provided for each compressor.
4. Disconnect the conduit from the bottom of the control panel and carefully pull the wires out of the control panel.

Isolating the Compressor -

5. Back-seat the suction and discharge service valves and install a gauge set across the discharge service valve and the suction filter.
6. Front-seat the suction and discharge service valves and close the oil line shutoff valves.
7. Bleed the discharge pressure into the suction filter.
8. Drain oil from the crankcase.
9. Disconnect the discharge and suction service valves, the oil regulator, and the oil vent line from the compressor block.
10. Remove the bolts and studs holding the pressure control's mounting bracket and support the controls off to one side where they will not be damaged during compressor removal.

Removing the Compressor -

11. Remove the four compressor mounting bolts and install an eye bolt in the top rear of the compressor. On some compressor models, the cooling fan will have to be removed to accommodate the eye bolt.
12. Install a come-a-long from the eye bolt up to the rear support channel on the compressor rack. Safety hooks should be used at each connection.
13. If the compressor is below the liquid header, tape a piece of wood to the liquid header to protect it from the cable.

Service Tips (cont'd.)

14. Use several 3 to 3 1/2 foot long 2x4's as a ramp in front of the compressor unit, and using the come-a-long, lower the compressor to the floor. Make sure all service valves and control lines are free. Do not use the fan guard as a lift.

15. On the floor, the fan assembly and junction box can be removed as a single unit and reinstalled on the new compressor. Do not reuse the solid state compressor protector. Transfer the oil float to the new compressor.

Installat...

16. To install the compressor use the come-a-long to slide the compressor up the ramp. After the compressor is slightly above the mounting plate, the boards can be used as a lever to lift and slide the compressor into position.

17. Replace the spacer nuts and bolt the compressor into place. Do not tighten compressor bolts at this time.

18. Install new valve gaskets and connect service valves, the oil regulator and the oil vent lines to the compressors.

19. Tighten compressor mounting bolts to 50 ft./lbs.

20. Reinstall pressure controls.

21. Reinstall wiring.

22. Evacuate and leak test the compressor before opening valves and starting the compressor.

SERVICING ULTIMA COMPRESSOR CONTROLLER

If the Ultima compressor controller is suspected of malfunctioning, check the operation of the sequencer by following the precedure in "Start Up." If the sequencer is satisfactory, the problem may be a clogged strainer or oil logged in the capillary tubing.

To clear the capillary tubing, disconnect it from the pressure reservoir and cap the fitting to the reservoir. Attach a refrigerant tank to the capillary tubing and feed refrigerant into the tubing for a few seconds until the obstruction is cleared. Reattach the capillary tubing to the pressure reservoir and restart the unit. Be sure no traps exist in the 3/8 inch tubing running to the suction header.

SPORLAN OL-1 OIL LEVEL REGULATOR

The Sporlan OL-1 oil level control is preset to maintain an oil level at the centerline of the sightglass. Each turn of the adjustment will change the level by .05 inches. Remove the brass cap from the top connection and adjust as follows:

1. To raise the oil level, turn the stem counterclockwise. When resistance is felt, you have reached the highest oil level possible.

2. lower the oil level, first establish the original setting by counting the umbers of counterclockwise turns it takes to reach the top stop. Then turn clockwise the desired number of turns to adjust below the setting.

WARNING: Do not adjust the Sporlan regulator 10 turns below the top stop or the control may be damaged.

NOTE: When pressure testing, do not exceed 175 psig to avoid damaging the floats.

3. Replace the brass sealing cap and turn on oil supply. Restart compressor.

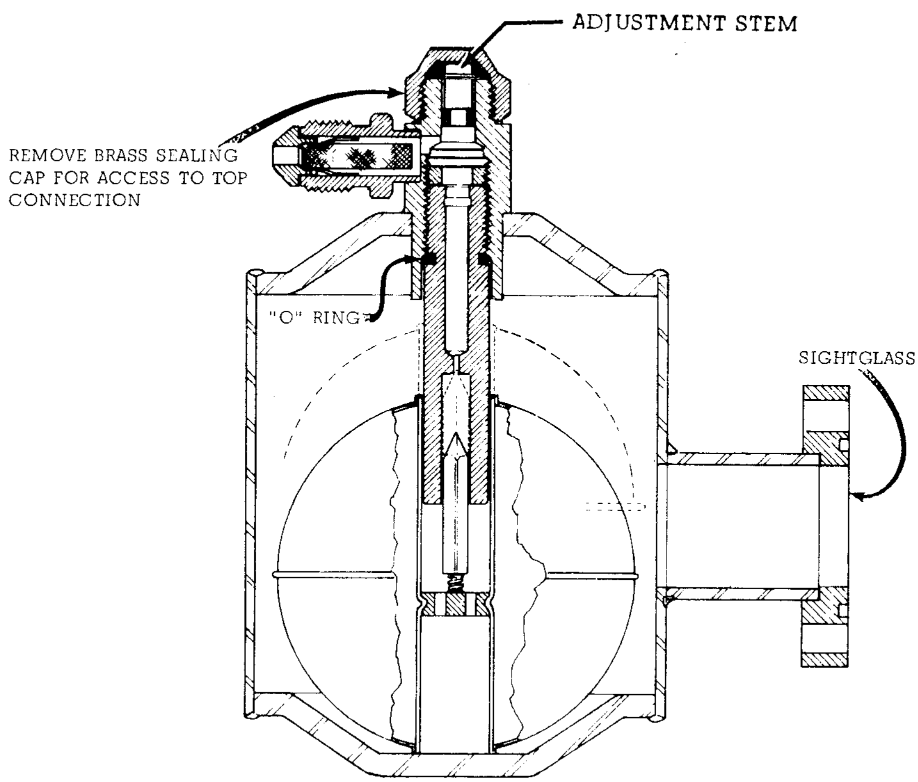
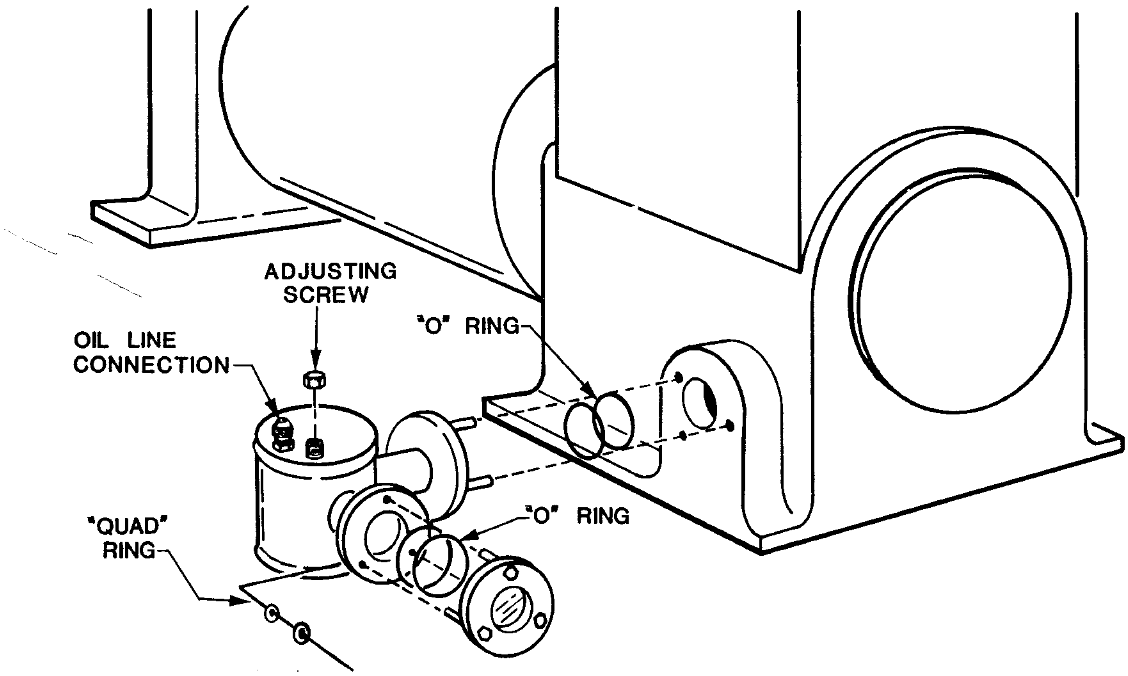


Figure IV-15
Oil Level Regulator



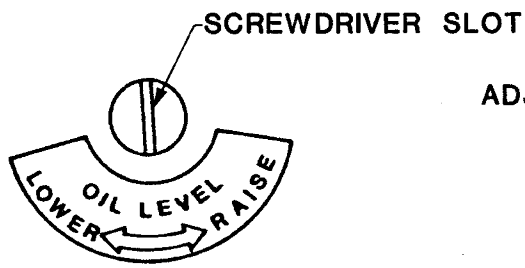


FIG. 1

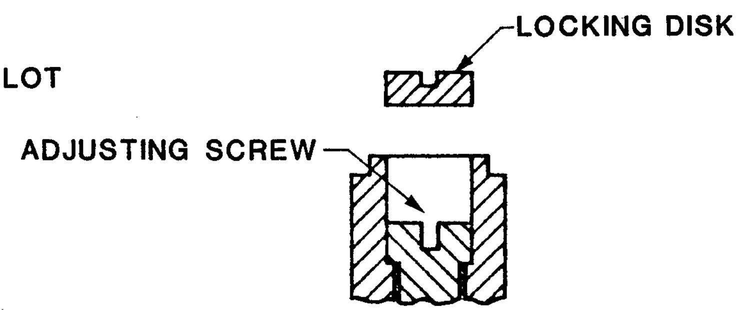


FIG. 2

OIL LEVEL ADJUSTMENT

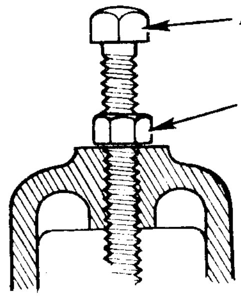
The oil level regulator as shipped is set to maintain an oil level 1/8 inch below the centerline of the sightglass. The level can be lowered by 2 turns and raised 8 turns. Each turn of the adjusting screw alters the level by .005 (.11 inches down and .44 inches up). The regulator may be adjusted while under system pressure.

IMPORTANT- Unit must be level to insure adjustment accuracy.

1. Remove locking disc to expose adjusting screw. (See Fig. 2).
2. To increase oil level rotate adjusting screw counterclockwise. (See Fig.-1).
3. To decrease oil level rotate adjusting screw clockwise. (See Fig. 1).
4. After adjustment replace locking disc and seal cap.

FLOODING AND RECEIVER PRESSURE REGULATOR VALVES

A Flo-Con A7 is used to control the condenser discharge pressure and an A9 is used to control receiver pressure. If replacing the diaphram spring, adjustment stem, or spring plate, Range D parts are required.



Adjustment - Before adjustments can be made the system must be charged and operate near the normal design conditions.

To lower condenser or receiver pressure, loosen the seat nut and turn the adjusting nut counter-clockwise. To raise condenser or receiver pressure, turn the adjusting nut clockwise. Retighten the seat nut. Settings are listed in the chapter, "Control Settings."

One complete turn of the adjusting stem will increase (or decrease) the condenser or receiver pressure approximately 20 psi on A7-0 valves, 75 psi on valves A7-1 and A7-2, and 25 psi on A9 valves.

Diagnostic Chart

Valve	Problem	Cause
A7	Failure to open	1. Adjusting screw may be set at too high a setting. 2. Excessive dirt on power disc 3. Excessive dirt on valve seat 4. Diaphram dirty or misaligned
	Failure to close	1. Adjusting screw may be set at too low of a setting 2. Excessive dirt on pilot seat 3. Regulator may have been installed backwards
A9	Failure to open	1. Adjusting screw may be set at too high a setting 2. Piston plug may be jammed due to excessive dirt
	Failure to close	1. Adjusting screw may be set at too low a setting. 2. Piston plug may be jammed due to excessive dirt 3. Pilot plug may be dirty or corroded 4. Diaphram may be cracked or eroded

SINGLE PHASE PROTECTORS

The single phase protector consists of two relays wired across the three phase power wiring supplying the motor-compressors. When energized, the relays close the pilot circuits. Should the incoming power single phase or drop below 132 volts, one or both relays will open the control circuit. On resumption of three phase power, the single phase protector will again close the circuits.

When power voltages above 240 volts are used, resistors are added in two legs of the three phase supply to the two relays. These are wire wound, ceramic coated resistors. Any resistor of 5 watts or more, ±5%, is acceptable for replacement.

Resistor value for the United States is 27,000 ohms. Values for this and other locations are shown in Table IV-2.

The resistors are located on the back side of the relay sockets. Access is gained by shutting off power at the field supplied disconnect switch, and at the 208 volt pilot disconnect switch, then removing the bolts holding the relay board to the control panel. The relay board can then be rotated forward, exposing the rear of the sockets.

No resistors are required for 208/240/3/60 power supply.

NOTE: On the single phase protector, terminal 4 on the K9 relay, and 5 on the K10 relay have been disconnected from the circuit and are used for wiring terminals only.

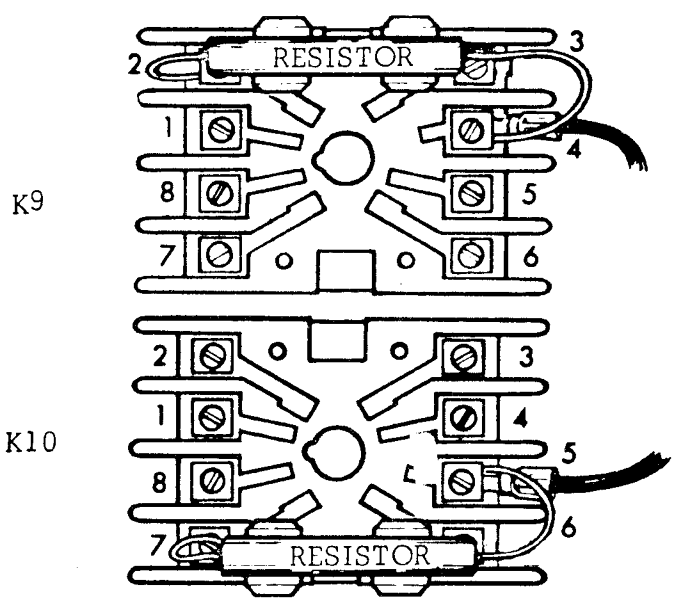


Figure IV-16
Location of Resistors

Location	Volts	Hertz	Ohms
U.S.A.	480	60	27,000
Europe-Africa	380	50	22,000
Australia	415	50	25,000
Canada	550-600	60	33,000

Table IV-2
Resistor Values in Various Locations

Relays - Two especially calibrated, 230 volt relays are used in each single phase protector. Because of the calibration, replacement relays should be ordered from Hussmann, and not procured locally.

One of two brands of relays may be used:

Relay Part #MK5642 (MKH2) Line Electric

Relay Part #22Q1620 Eagle Signal

REMOTE HEADER DEFROST ASSEMBLY

HEADER DEFROST ASSEMBLY

DESCRIPTION OF MODEL NUMBERS

Twelve models of header defrost assemblies are available and each model can serve either one or two compressor units. The store legend indicates which models have been applied to your store.

A typical header defrost model number signifies the following:

H-2-32 A

- H — Horizontal branches
- 2 — Number of Plus Systems served (1 or 2).
- 32 — Total available branches
- A — Revised design

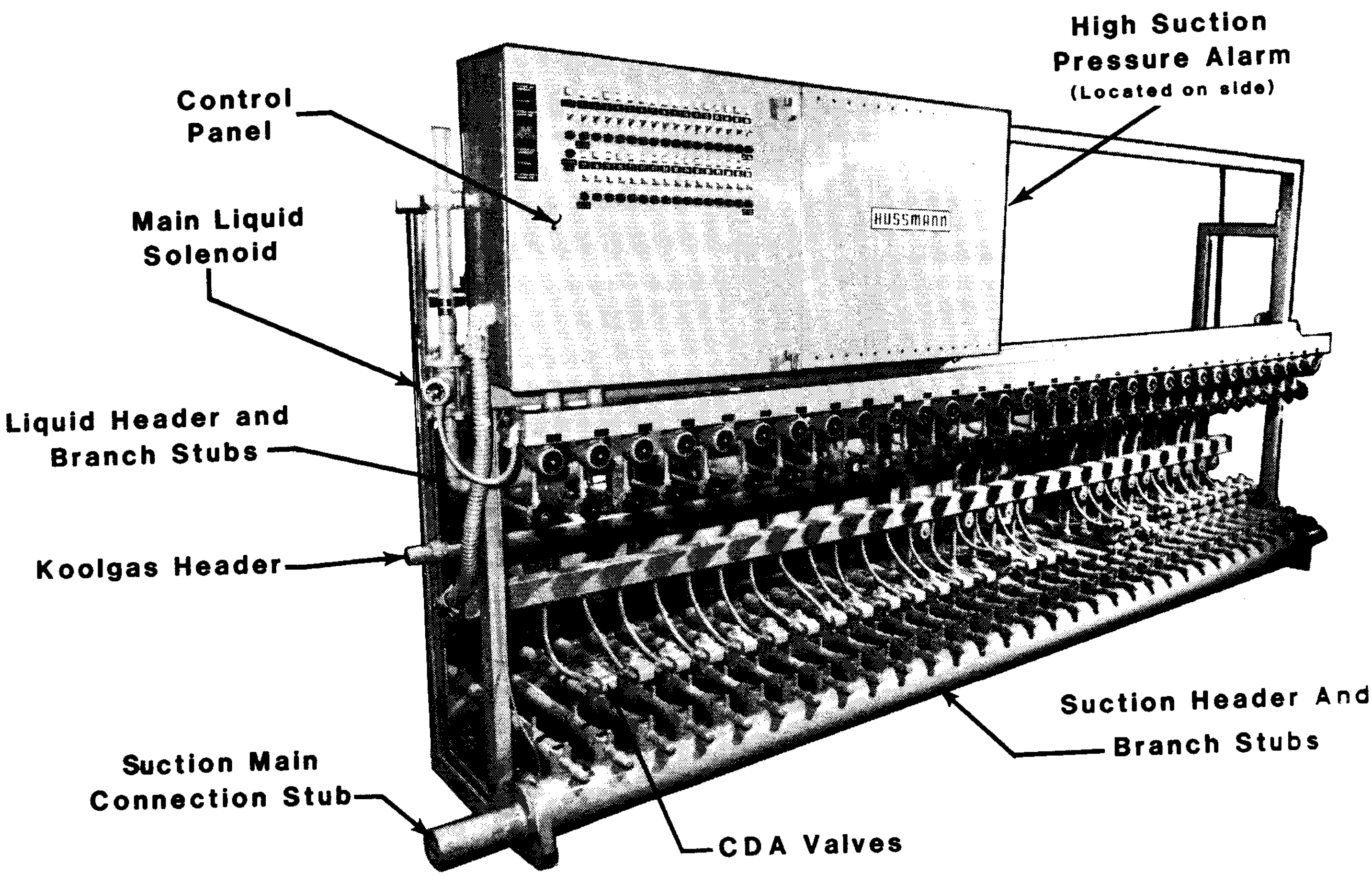


FIGURE V-1
REMOTE HEADER DEFROST ASSEMBLY

HANDLING

It is recommended that rigging and unloading of the header defrost assembly be done before removing the crating.

LOCATION

Locate the header defrost assembly as close as possible to the compressor rack to minimize pressure drop. The interconnecting piping should not exceed 50 equivalent feet. Provide a drain pan to collect condensation from the assembly. A field installed and supplied filter-drier is recommended in the Koolgas line between the header assembly and compressor rack.

LEVELING

The header defrost assembly must be leveled on the suction header to prevent oil trapping.

PIPING

When the header defrost assembly is used in conjunction with Plus System, piping from individual refrigerators will be connected to stubs located on the header defrost assembly instead of on the compressor rack. Construction requirements will, however, be the same, and are discussed in the compressor installation chapter.

Interconnection between the two units require connection of the liquid and suction manifolds on the header defrost assembly to the matching stubs on the compressor rack. A field supplied and installed filter-drier is recommended in the Koolgas line. For units equipped with KOOLGAS defrost, an additional line must be run from the header defrost assembly to the compressor rack equalizing line stub.

For proper line sizing see Plus System Planning Data.

ELECTRICAL

Figure V-2 indicates the necessary field wiring required to connect the header defrost assembly to the compressor rack electrically. Figure V-3 is a wiring diagram for the defrost control panel.

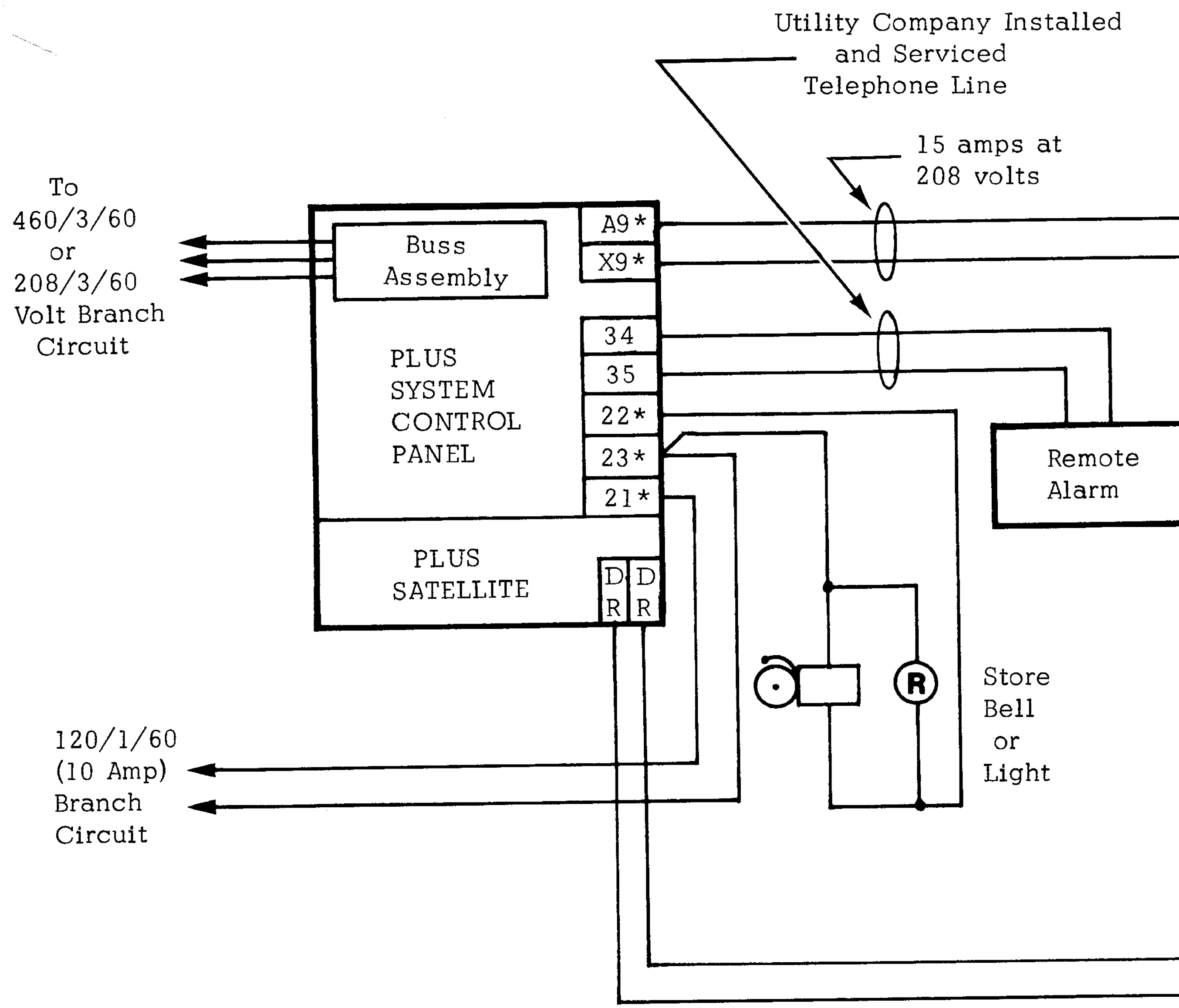
DEFROST CONTROL PANEL

There are eight types of defrost circuits and they are shown in Figure V-3. These circuits may be repeated in multiple and intermixed in any one store.

The terminal points in a circuit are identified by a letter with a dash suffix. The suffix will always be the system number corresponding to the store legend.

S<u>5</u> =
Store legend defrost System #5
D<u>5</u> =

Figure V-2
Field Wiring for Plus System, HRN Satellites, and Remote Header Defrost Assembly



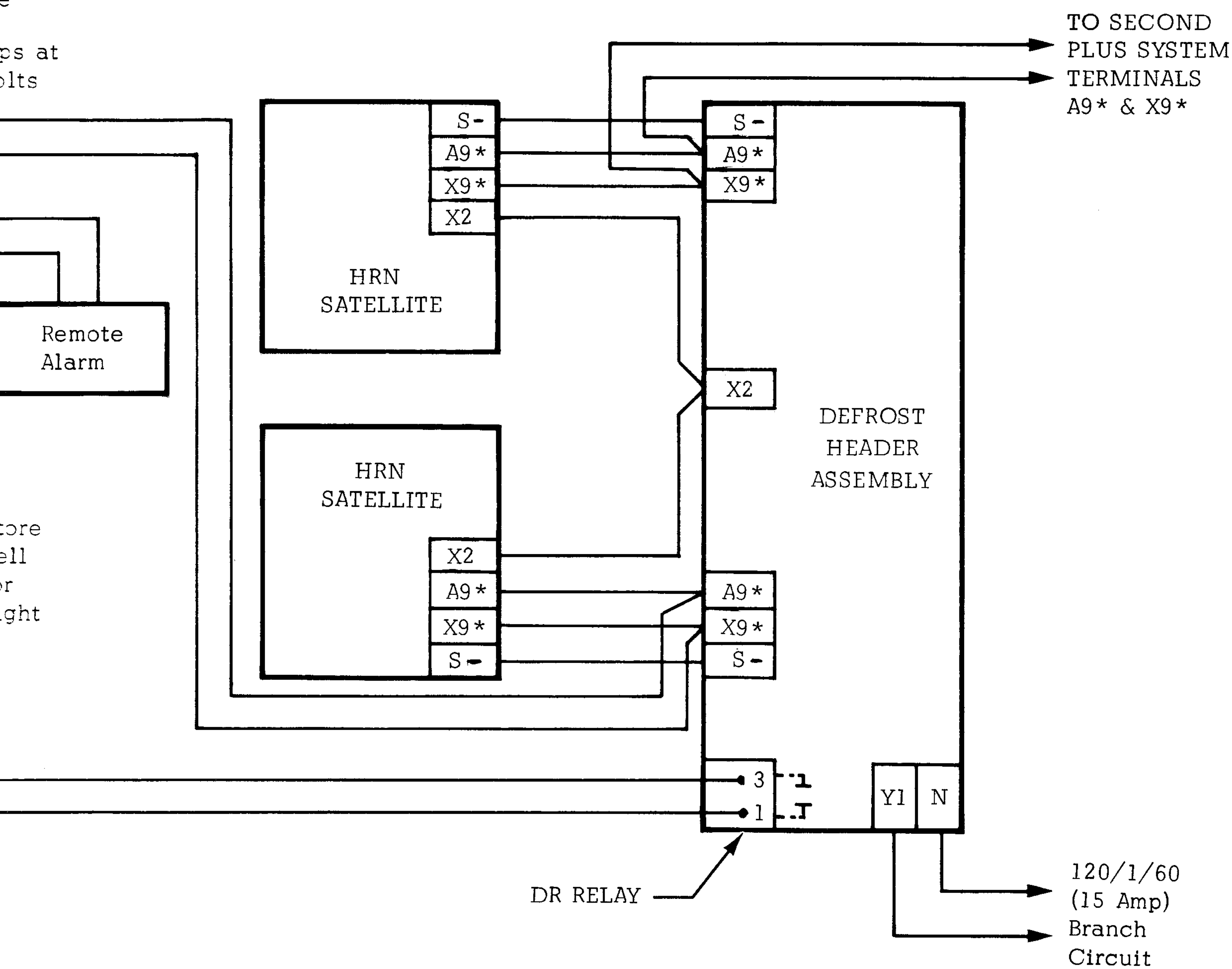
Notes: - Designations refer to Satellite Refrigeration System Number as called out on the Store Legend.

* Designations refer to Compressor Unit Letter as called out on Store Legend.

: Assembly

Installed
d
e

ps at
lts



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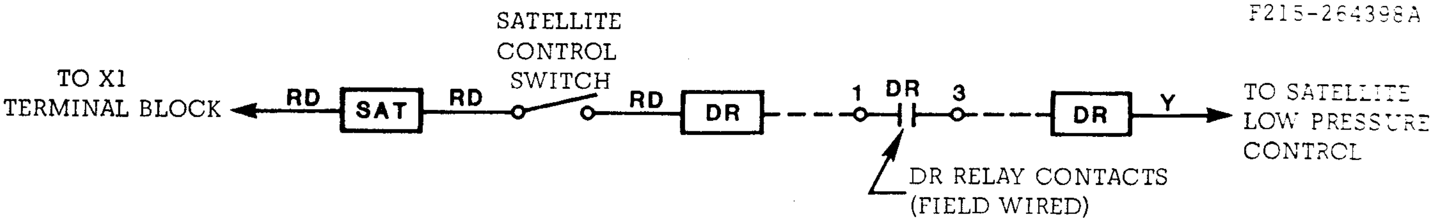
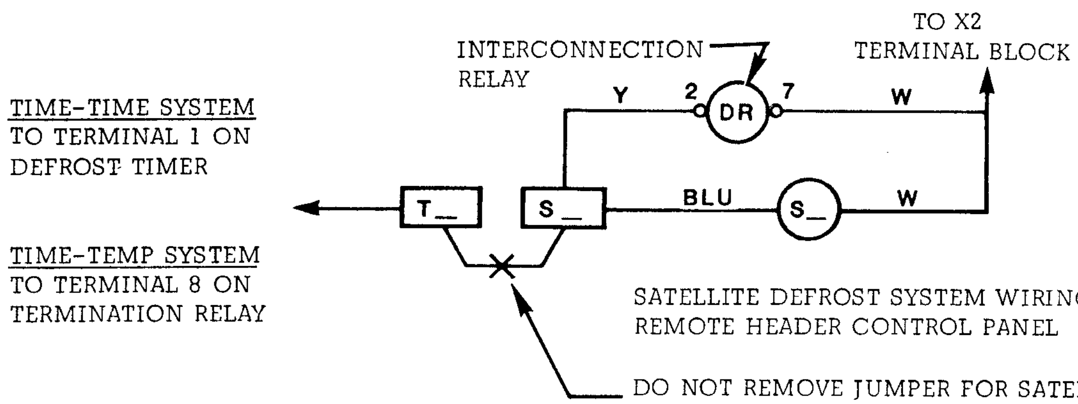
WIRING DIAGRAM - REMOTE DEFROST HEADER USED WITH S41 PLUS SYSTEM SATELLITE



SATELLITE CONTROL CIRCUIT WIRING
IN PLUS SYSTEM CONTROL PANEL

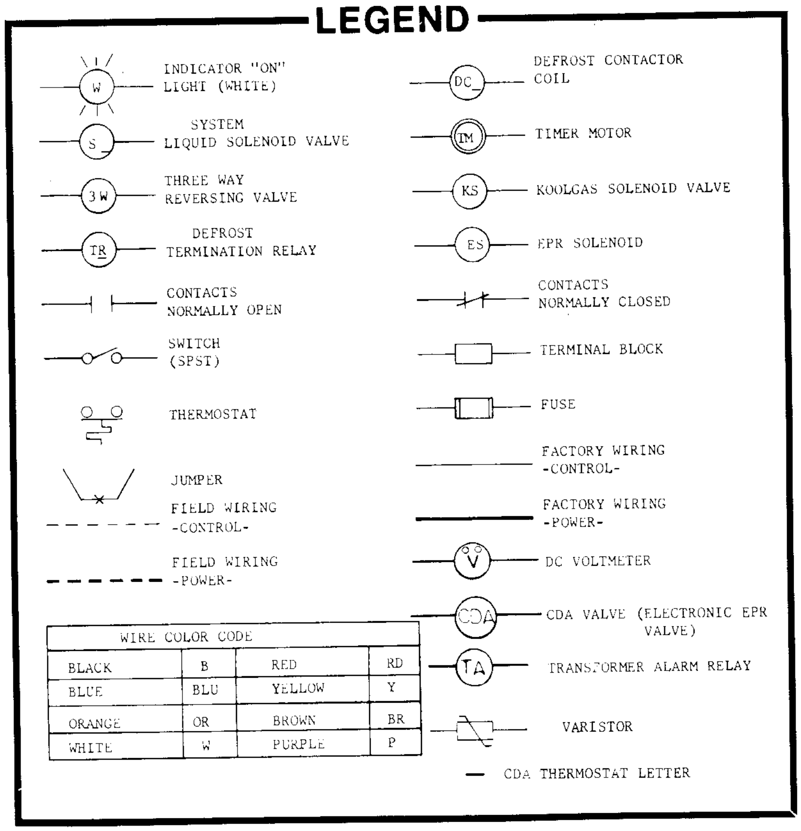


SATELLITE DEFROST SYSTEM WIRING IN
REMOTE HEADER CONTROL PANEL

DO NOT REMOVE JUMPER FOR SATELLITE SYSTEM - USE
THERMOSTAT TERMINALS PROVIDED IN SATELLITE PANEL.

Figure V-3

LEGEND



WIRE COLOR CODE			
BLACK	B	RED	RD
BLUE	BLU	YELLOW	Y
ORANGE	OR	BROWN	BR
WHITE	W	PURPLE	P

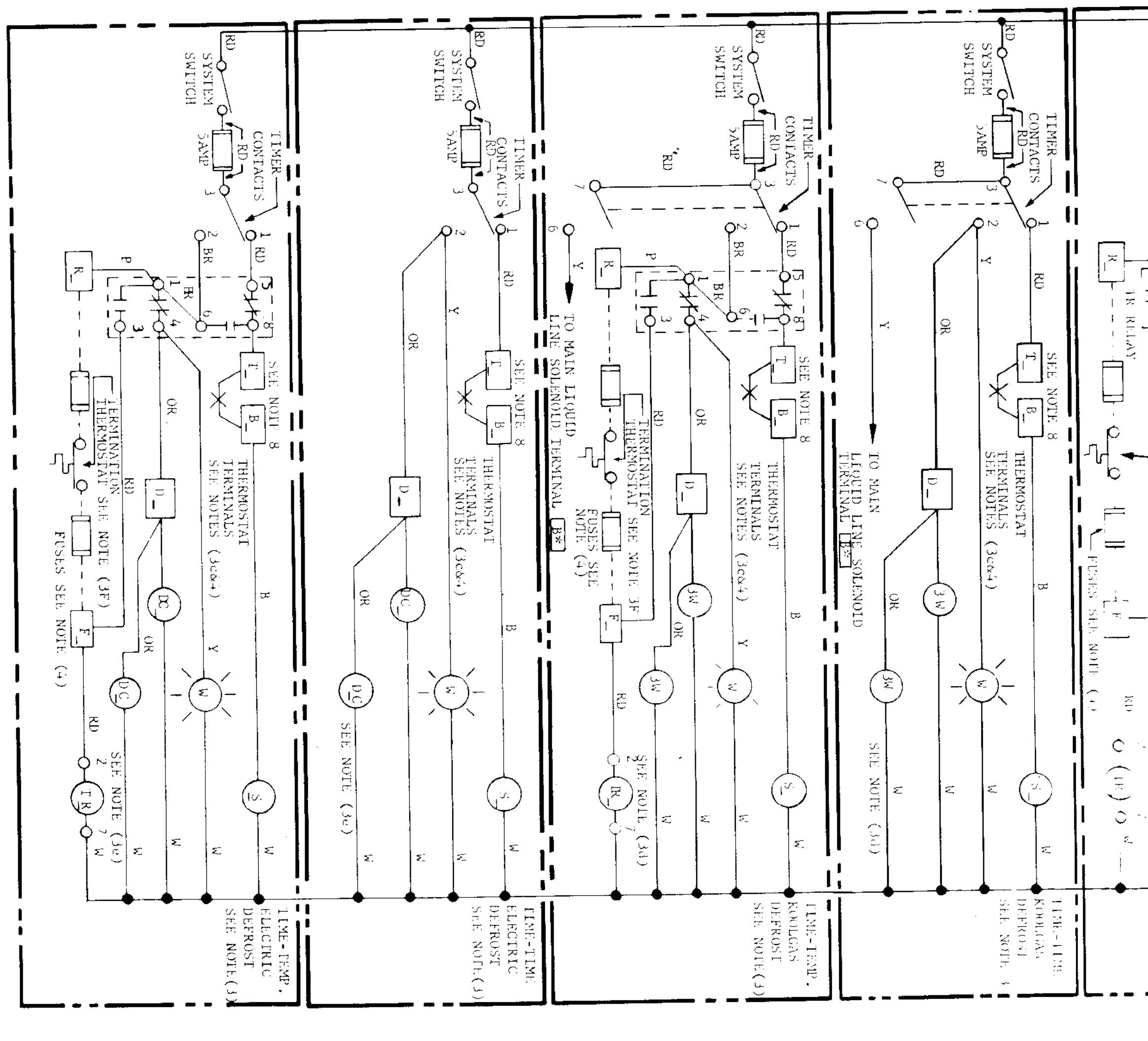
NOTES:

1. CONNECT TO CONTRO
UNIT LETTER.

2. DEFROST POWER WIRI
DEFROST CIRCUIT BRE
IF A SINGLE DEFROST
CIRCUIT BREAKER.

3. DEFROST CONTROL W
A. SHOWN ARE TYPIC
BE MULTIPLES OF C
OF 32 SYSTEMS.
B. THE DASH (-) DESI
TUAL DEFROST SYST
C. REFRIGERATION TH
RUN FIELD WIRIN
DEFROST SYSTEM.
ONLY.
D. TWO 3-WAY REVERS
ESSARY REFRIGERA
BE WIRED IN PARA
E. TWO DEFROST CO
ESSARY AMPERAGE
THE CONTACTOR C
F. DEFROST TERMINA
DUTY ONLY.
G. "*" DESIGNATION
FROM THE STORE
LETTER A.
H. "#" DESIGNATION
DETERMINED BY T
D5 INDICATE SY

4. THERMOSTAT FUSING
QUIRED BY N. E. C. C
PLACED IN UNIT CC
PERES.



ING DIAGRAM

IRING OF THE TIMERS IS SUCH THAT:
S IN THE TIMER TERMINAL IDENTIFICATION BLOCKS
AGRAM REFERENCES.
YCLE ---- CONTACTS 3 TO 1 ARE CLOSED DURING

--- DELTROL TIMER -- 3 TO 2 AND 3 TO 6 ARE CLOSED
.
--- PARAGON TIMER -- 3 TO 2 AND 7 TO 6 ARE CLOS-
OST.
O FROM LEFT TO RIGHT TO THE SYSTEM NUMBER SE-

--- 3 IS JUMPERED TO 7 FOR KOOLGAS® APPLICATIONS

EFROST WIRING SEE SEPARATE WIRING DIAGRAM.

MBER OF DEFROST COMPONENTS WILL VARY DEPEND-
OF DEFROST SYSTEMS INSTALLED. SYSTEM SWITCHES
HTS ARE PROVIDED.

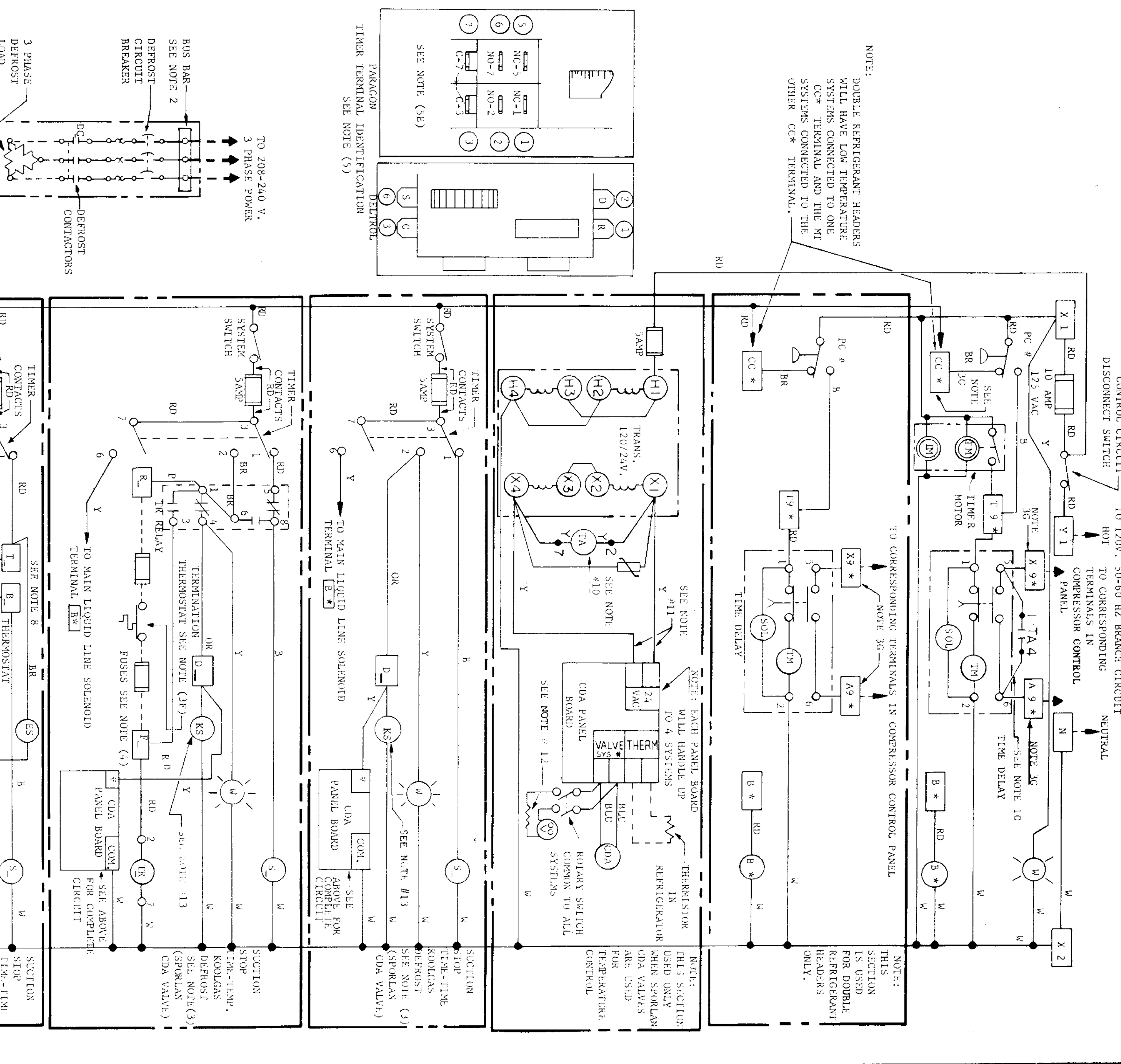
8. TERMINAL "B_" WILL BE CHANGED TO "S_" TO DESIGNATE THE CONNECTION FOR A SATELLITE UNIT. MAXIMUM LOAD 2.5 AMPS AT 208/230 VOLTS.

9. X2 TERMINAL BLOCKS - ALL X2 TERMINAL BLOCKS IN THE CONTROL PANEL MUST BE JUMPERED TOGETHER. X1 TERMINAL BLOCKS IN THE CONTROL PANEL MUST BE JUMPERED TOGETHER. (DO NOT JUMPER X2 TO X1)

10. TA CONTACTS USED ONLY WHEN CDA VALVES ARE FURNISHED.

11. MOUNTING BOARDS CAN BE JUMPERED TOGETHER UP TO 5. DUAL WIRES ARE REQUIRED FOR MORE THAN 5 MOUNTING BOARDS.

12. RESISTOR REQUIRED ON MODUTEC VOLTMETER ONLY.



CONDENSOR INSTALLATION

CONDENSER INSTALLATION

GENERAL DESCRIPTION

Plus System is available for use with three types of condensers; remote air cooled, water cooled, and evaporative water cooled. Refer to specific manufacturers' 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 there will generally be two individual condensers. In some applications only one condenser is applied with circuits for both the low and medium temperature systems.

Water Cooled Condensers - When water cooled condensers are used they will be shell and tube construction. The water cooled condensers are not factory installed.

Evaporative Water Coolers or 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 fans 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 Figure VI-1 for the proper rigging technique.

LOCATING

Locate the condenser with at least three feet of clear 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 88 inches higher than the machine room floor when the compressor unit is equipped with condensing pressure control valves. This height requirement is reduced to 54 inches for installations not using condensing pressure control valves, such as when Control B is applied to the condenser.

Connecting to One Manifold - When a compressor unit is served by one set of condenser circuits, an equalizing line is not required. 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. See Figure VI-2.

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 and an equalizing line must be provided. See Figure VI-3.

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 12 inches between the outlet stubs before teeing into the main liquid return line. After the tee, route the main liquid return line in a manner

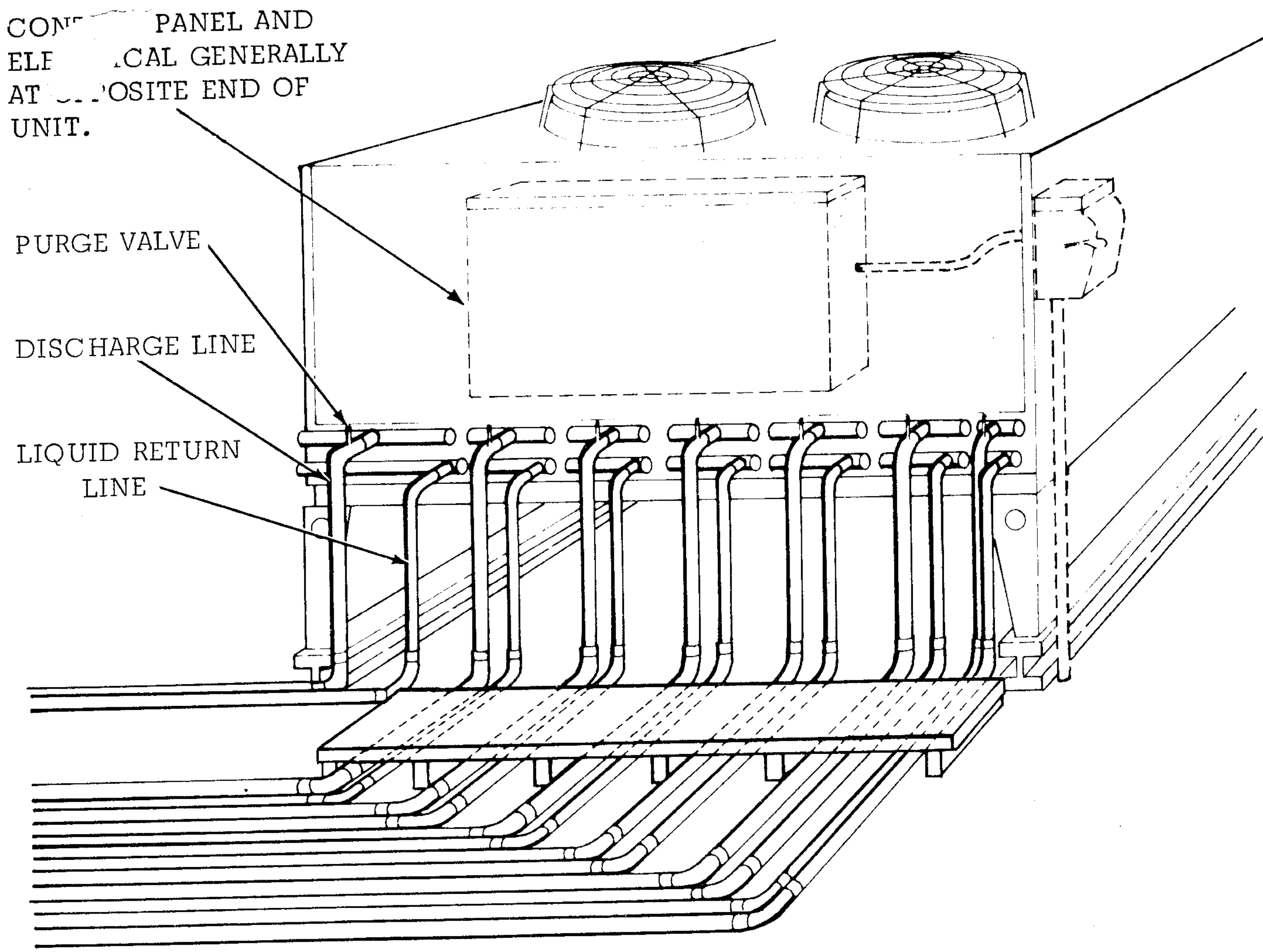


Figure VI-2
Connecting to One Manifold

providing free trapless drainage from the rooftop to the connection at the compressor unit.

3. Equalizing line: To insure positive drainage of both circuits, an equalizing line must be run from the compressor unit receiver to the point where the discharge line tees into the condenser. Install a check valve in this line as depicted in the illustration. Be sure the equalizing line is pitched to provide free trapless drainage away from the check valve in both directions. Install a purge valve and shutoff valve downstream of the check valve.

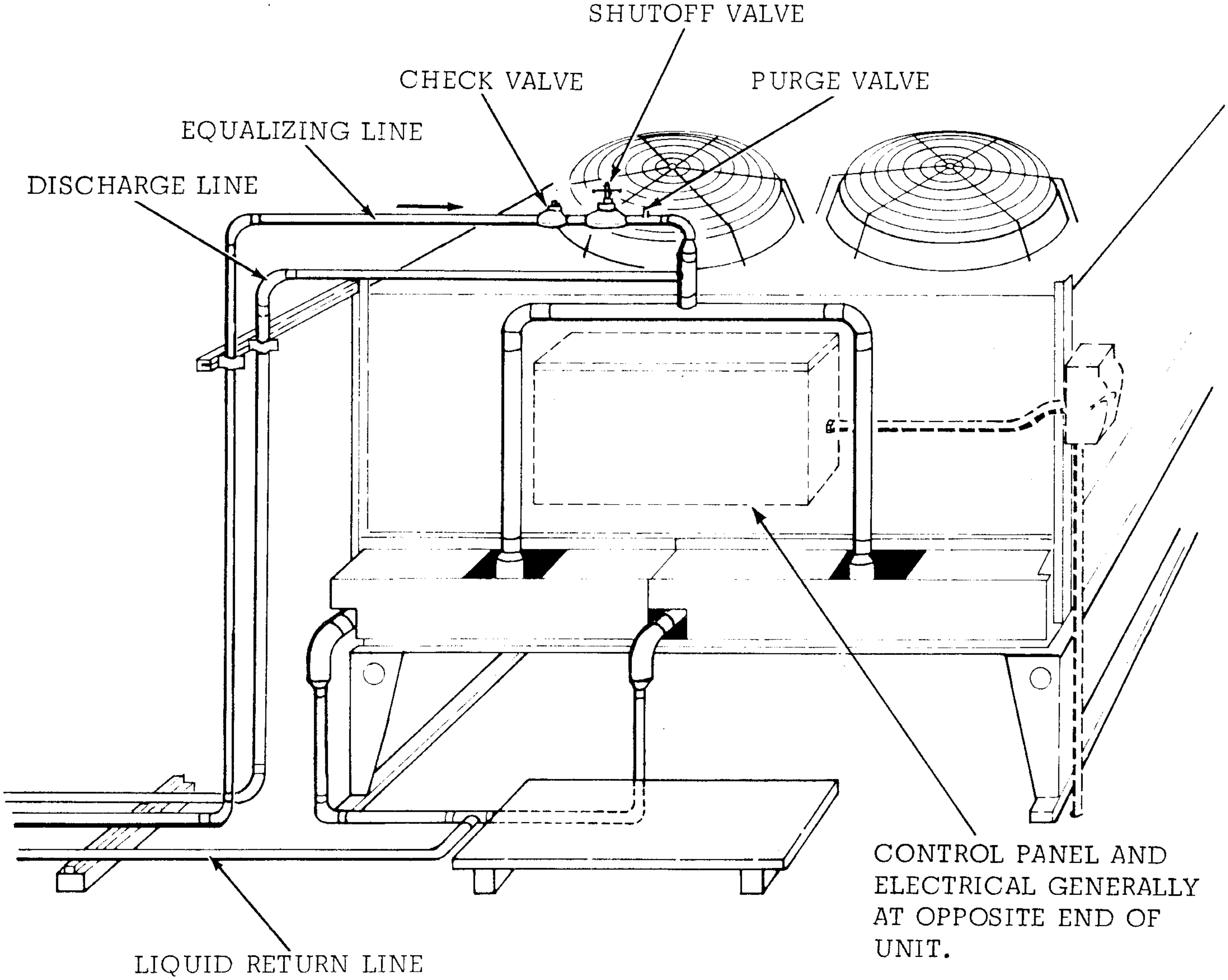


Figure VI-3
Connecting to Two Manifolds

ELECTRICAL AND PRELIMINARY CHECK-OUT

The following electrical diagrams (Figure VI-4 through 9) 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. By-pass the fan cycling controls so all fans are in the electrical circuits.

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 fan checks 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 control 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 not required).

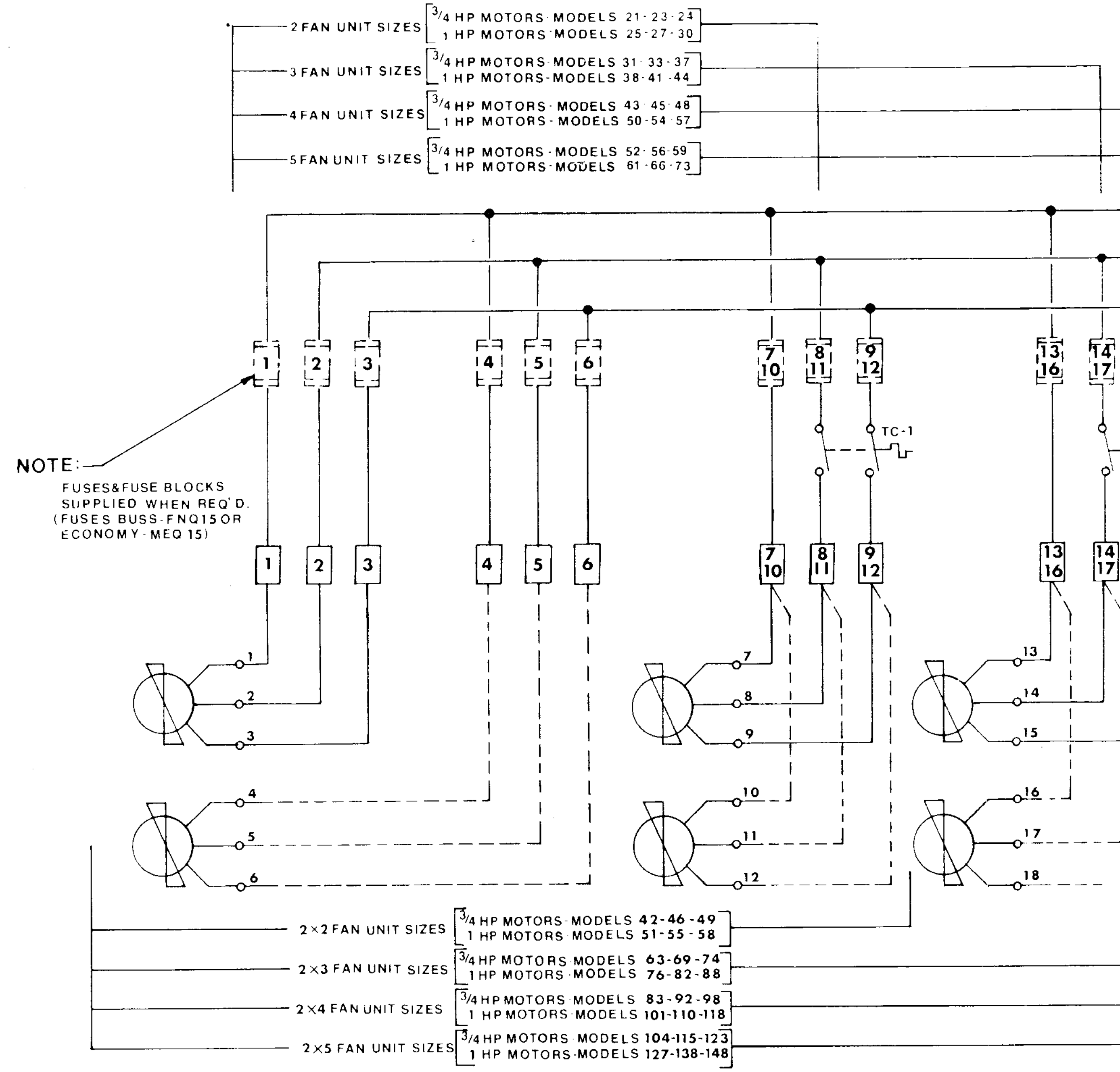
4. Adjust controls to the settings specified on the wiring diagram. These are approximate settings and may be changed to suit local conditions.

5. Leave condenser disconnect closed and turn off power at the store distribution panel.

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

AMBIENT TEMPERATURE CONTROL OF

THE ONE NEAREST THE HEADER FOR 2, 3,



REPLACEMENT PARTS

THERMOSTAT CONTROL
PENN #A72-AA3 OR
RANCO #020-7013

MOTOR (INHERENTLY PROTECTED)
200.230.460/60/3 .825 RPM
1HP K. CORP. P.N. 11503
3/4HP K. CORP. P.N. 11504
30 DIA. FAN BLADES
25° PITCH 3/4HP K CORP. P.N. 11248
29° PITCH 1HP K CORP. P.N. 11247

TERMINAL BLOCK
BUCHANAN HEAVY DUTY #212

TERMINAL BLOCK
BUCHANAN MEDIUM DUTY #514

FUSE HOLDER
BUCHANAN # 362

CONTROL SETTINGS				
NUMBER OF THERMOSTATS	CUT IN SETTINGS FOR THERMOSTATS °F			
	TC-1	TC-2	TC-3	TC-4
1	75°	—	—	—
2	68°	75°	—	—
3	60°	70°	75°	—
4	55°	65°	71°	75°

SET CUT OUT 5°F BELOW CUT IN

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

TOTAL FLA NO OF MOTORS x APPLICABLE MOTOR FLA

VOLTAGE THERMOSTATIC FAN CONTROL

...NT TEMPERATURE CONTROL OF ALL BANKS OF FANS EXCEPT

...EAREST THE HEADER FOR 2, 3, 4, or 5 FAN BANK HACD CONDENSER

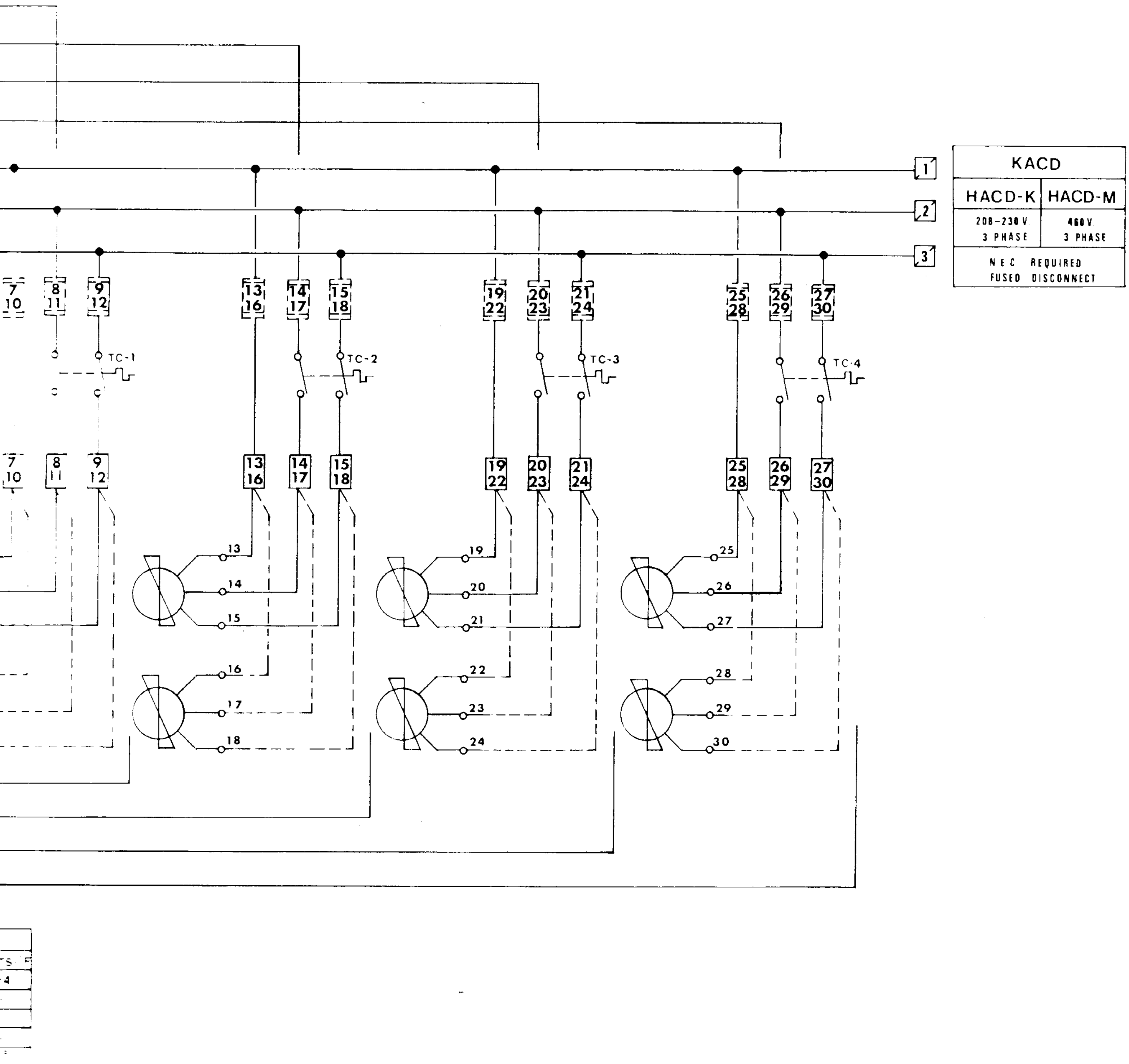


Figure VI-4

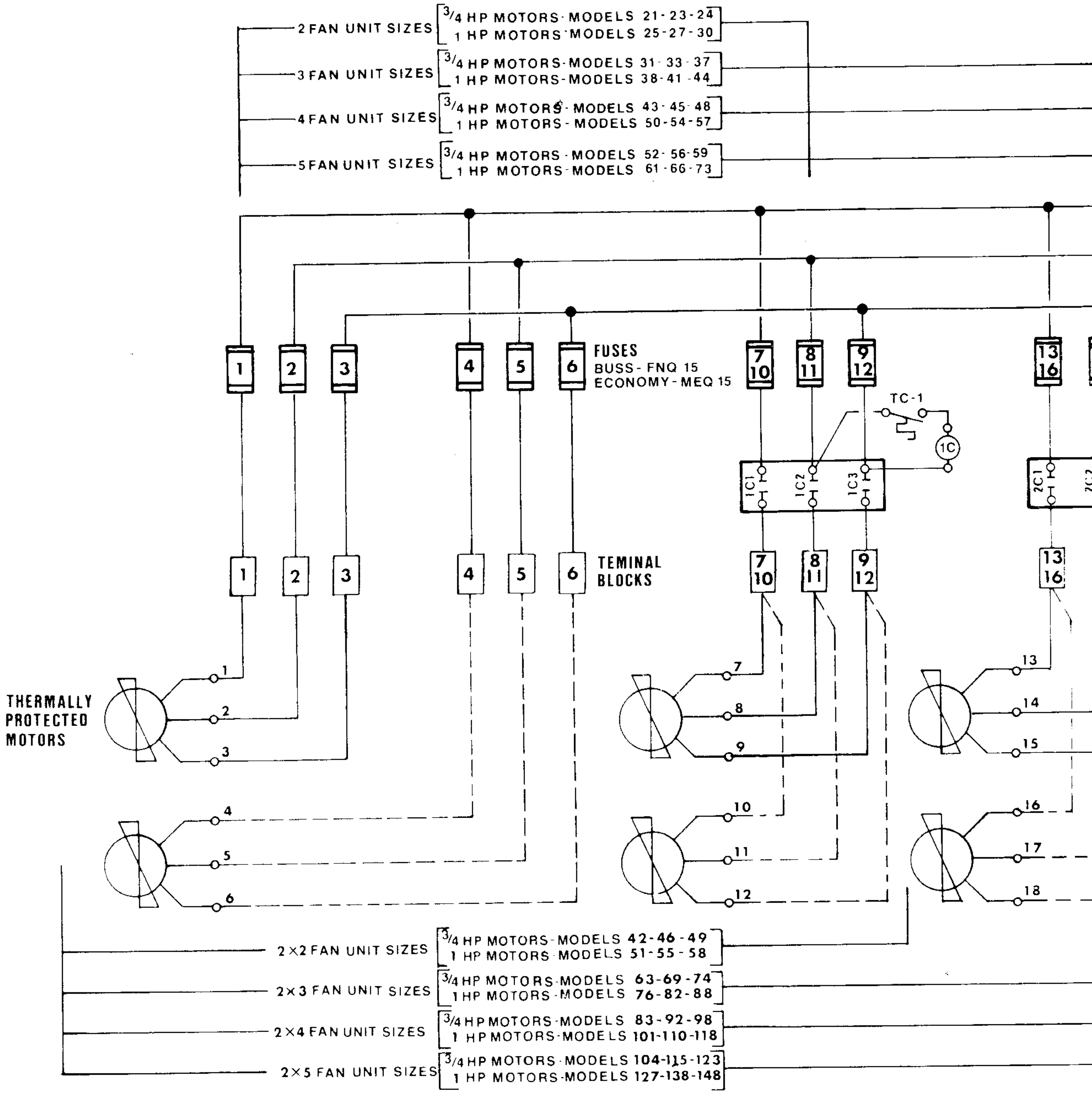
P315-145900-E

P315-145904-E

PILOT OPERATED THERMOSTA

AMBIENT TEMPERATURE CONTROL OF ALL BAN

OVERRIDE OF THE FIRST CYCLING FAN BANK FOR 2, 3



REPLACEMENT PARTS

THERMOSTAT CONTROL
PENN # A19-ABC-24

MOTOR (INHERENTLY PROTECTED)
200, 230, 460/60/3 825 RPM
1HP K. CORP. P.N. 11503
3/4HP K. CORP. P.N. 11504

30 DIA. FAN BLADES
25° PITCH 3/4HP K. CORP. P.N. 11248
29° PITCH 1 HP K. CORP. P.N. 11247

TERMINAL BLOCK
BUCHANAN HEAVY DUTY #212

TERMINAL BLOCK
BUCHANAN MEDIUM DUTY #514

FUSE HOLDER
BUCHANAN # 362

CONTROL SETTINGS

NUMBER OF THERMOSTATS	CUT IN SETTINGS FOR THERMOSTATS-°F			
	TC-1	TC-2	TC-3	TC-4
1	75°	—	—	—
2	68°	75°	—	—
3	60°	70°	75°	—
4	55°	65°	71°	75°

SET CUT OUT 5°F BELOW CUT IN

INDIVIDUAL MOTOR FLA

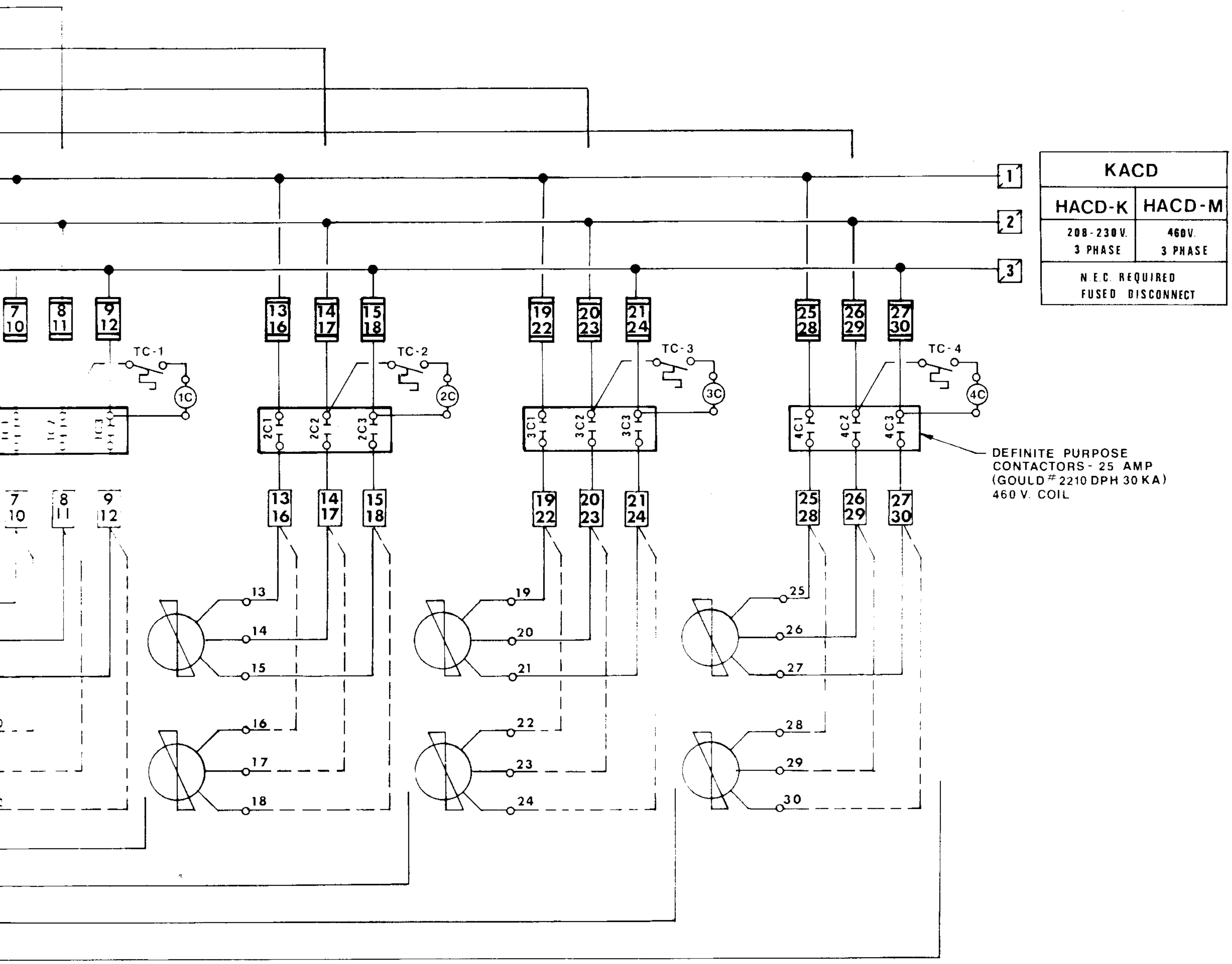
HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0

TOTAL FLA NO. OF MOTORS x APPLICABLE MOTOR FLA

ATED THERMOSTATIC FAN CONTROL

RE CONTROL OF ALL BANKS OF FANS WITH PRESSURE

G FAN BANK FOR 2, 3, 4, or 5 FAN BANK HACD CONDENSER



KACD	
HACD-K	HACD-M
208-230 V. 3 PHASE	460 V. 3 PHASE
N.E.C. REQUIRED FUSED DISCONNECT	

Figure VI-5

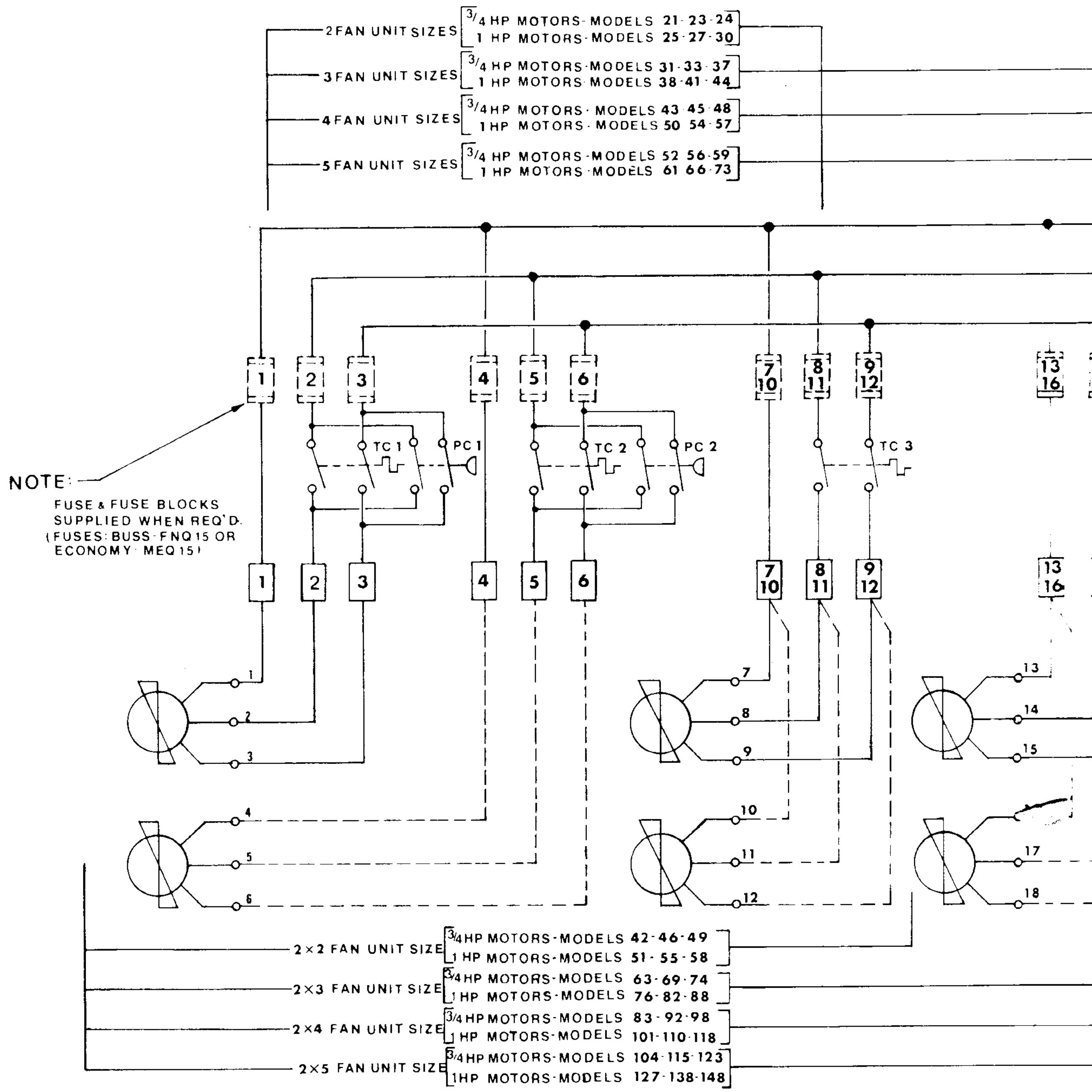
P315-260387-B

P315-260393-B

LINE VOLTAGE TH
WITH PRESSURE OVERR

AMBIENT TEMPERATURE CONTROL OF

THE ONE NEAREST THE HEADER FOR 2, 3, 4,



REPLACEMENT PARTS

- THERMOSTAT CONTROL PENN #A72-AA3 OR RANCO #020-7013
- PRESSURE CONTROL PENN #P72-AA-35 OR RANCO #020-7006
- MOTOR (INHERENTLY PROTECTED) 200,230,460/60/3 825 RPM
  1 HP. K CORP. P.N. 11503
  3/4 HP. K CORP. P.N. 11504
  30 DIA. FAN BLADES
  25° PITCH-3/4 HP. K CORP. P.N. 11248
  29° PITCH-1 H.P. K CORP. P.N. 11247
- FUSE HOLDER BUCHANAN #362
- TERMINAL BLOCK BUCHANAN HEAVY DUTY #212
- TERMINAL BLOCK BUCHANAN MEDIUM DUTY #514

CONTROL SETTINGS									
NUMBER OF THERMOSTATS	CUT IN SETTING FOR THERMOSTAT- °F						PC-1 & PC 2 SETTINGS-PSG		
	TC-1	TC-2	TC-3	TC-4	TC-5	TC-6	REFRIG	CUT IN	CUT OUT
3	80°	75°	55°	—	—	—	R-12	158	[illegible]
4	80°	75°	65°	50°	—	—	R-22	260	[illegible]96
5	80°	75°	70°	60°	50°	—	R-502	283	2[illegible]6
6	80°	75°	70°	65°	55°	50°			

SET CUT OUT 5°F BELOW CUT IN

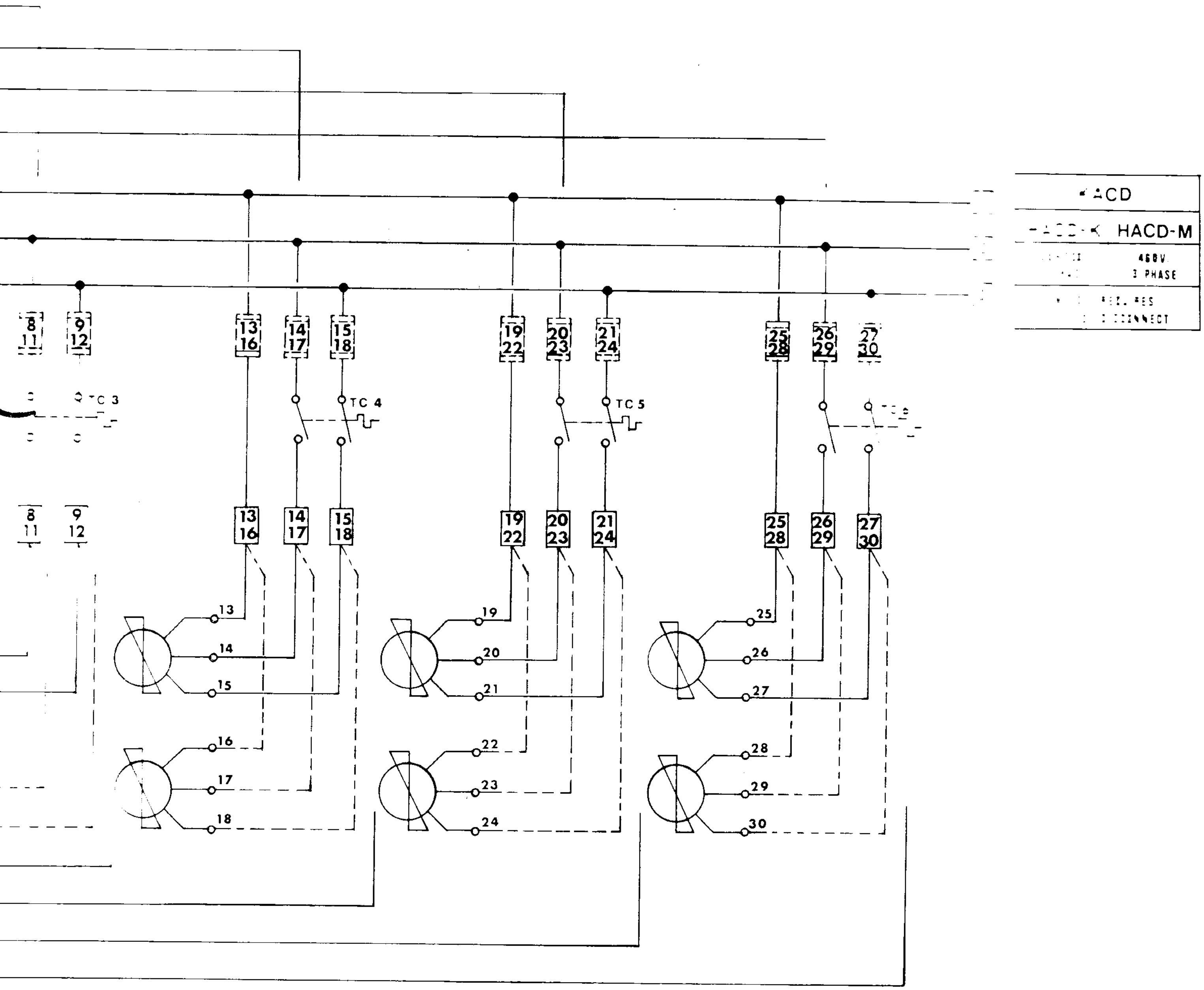
	INDIVIDUAL MOTOR FLA		
HP	208/3/60	230/3/60	460/3/60
3/4	3.5	3.2	1.6
1	4.4	4.0	2.0

TOTAL FLA = NO. OF MOTOR × APPLICABLE MOTOR FLA

INE VOLTAGE THERMOSTATIC
RESSURE OVERRIDE FAN CONTROL

E..PERATURE CONTROL OF ALL BANKS OF FANS EXCEPT

..E HEADER FOR 2, 3, 4, or 5, FAN BANK HACD CONDENSER



°F	PC 1 & PC 2 SETTINGS-PSIG		
TC-6	REFRIG	CUT IN	CUT OUT
--	R-12	158	117
—	R-22	260	196
—	R-502	283	216
50°			

Figure VI-6

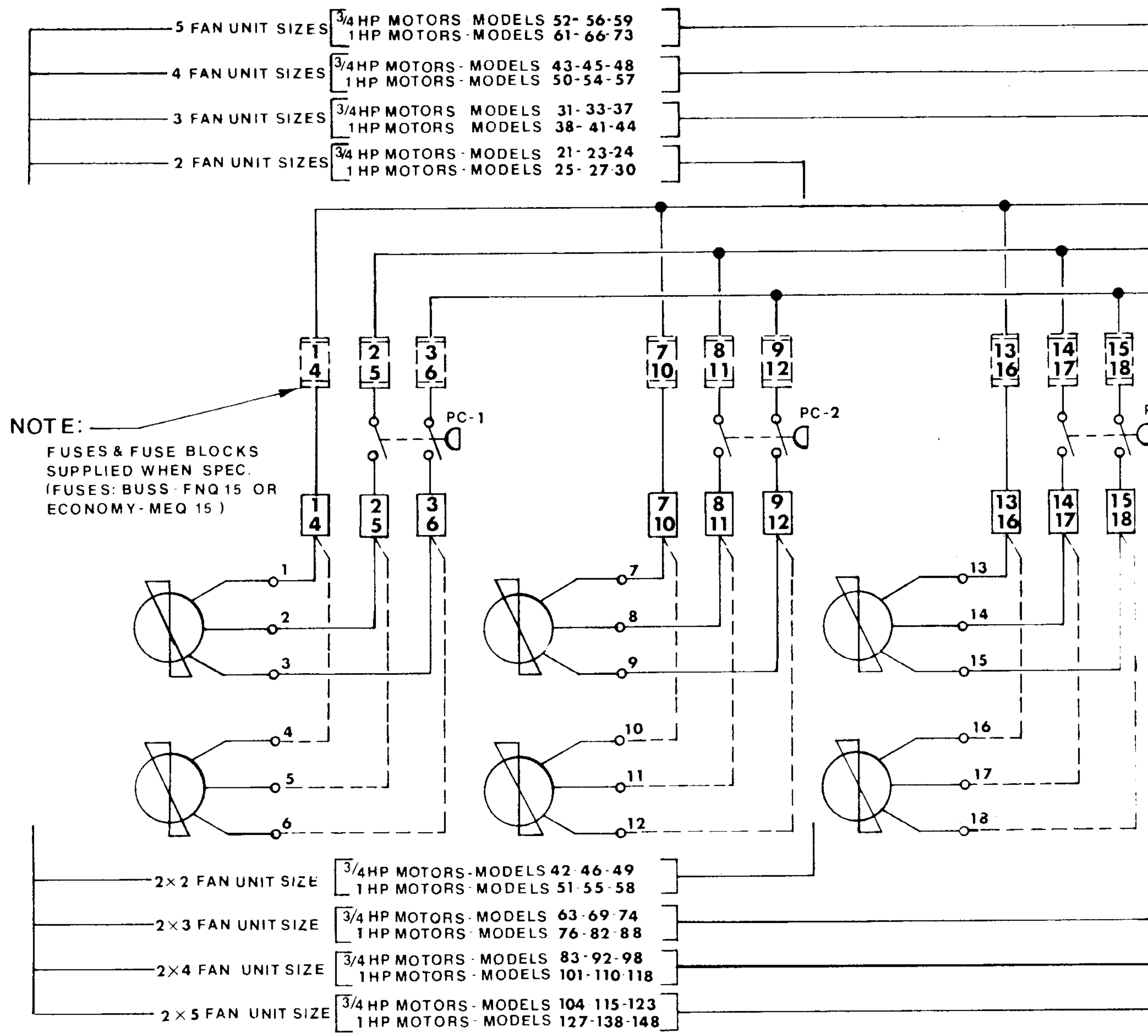
OF MOTOR
E MOTOR FLA

P315-145901-E

P315-145905-E

CONTROL

LINE VOLTAGE PRESSURE CONTROL AND GR



REPLACEMENT PARTS

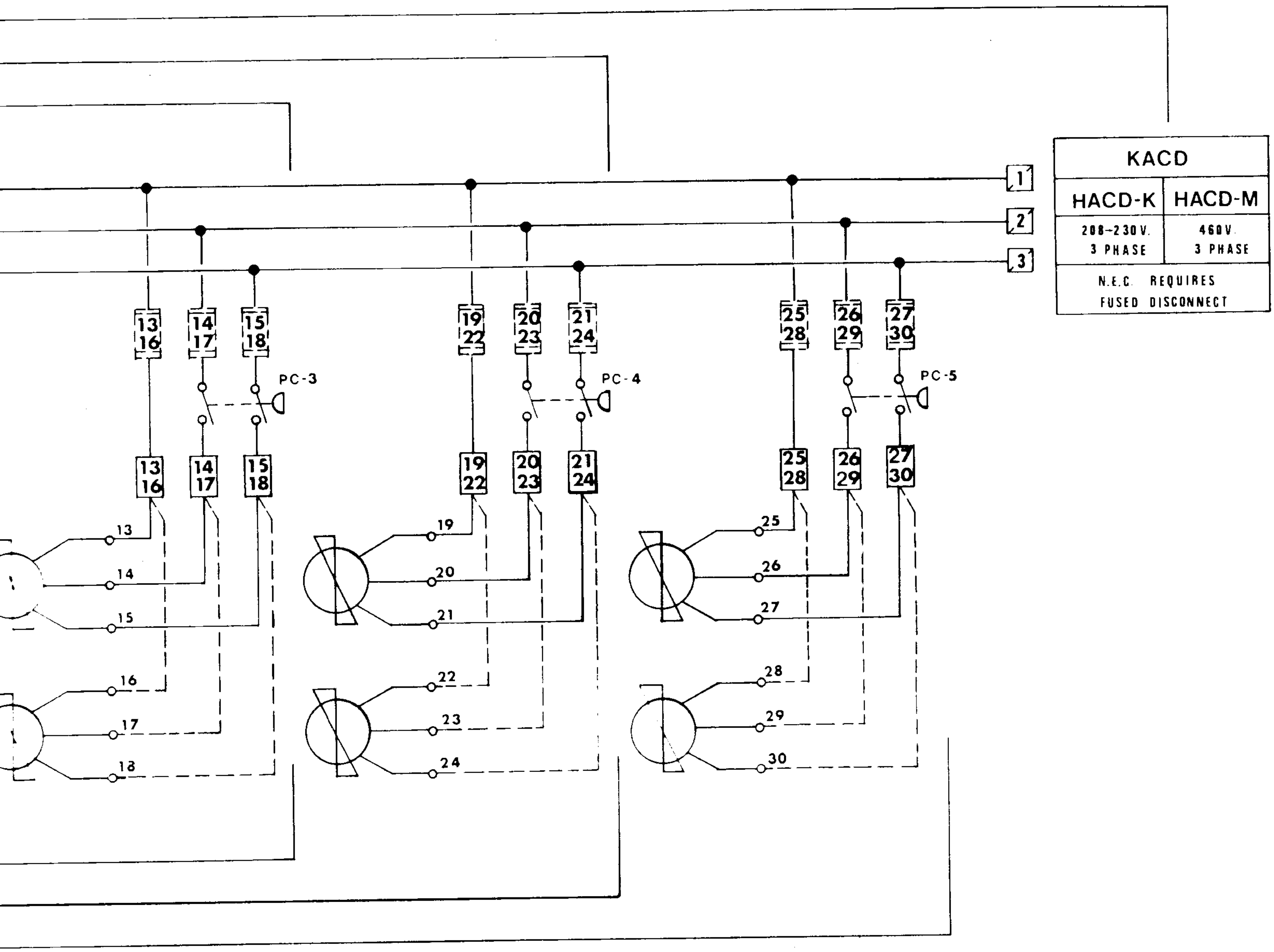
- PRESSURE CONTROL — PENN #P72-AA-35 OR RANCO #020-7006
- MOTOR (INHERENTLY PROTECTED) 200.230.460/60/3 825 RPM
  1 HP K.CORP. P.N. 11503
  3/4 HP K.CORP. P.N. 11504
- 30 DIA. FAN BLADES
  25° PITCH 3/4 HP K.CORP. P.N. 11248
  29° PITCH 1 HP K.CORP. P.N. 11247
- TERMINAL BLOCK — BUCHANAN HEAVY DUTY #212
- TERMINAL BLOCK — BUCHANAN MEDIUM DUTY #514
- FUSE HOLDER — BUCHANAN #362

NUMBER OF FANS		CONTROL SETTINGS					
			PRESSURE SWITCH CUT-IN SETTINGS psig				
SINGLE BANK	DOUBLE BANK	REFRIG.	PC-1	PC-2	PC-3	PC-4	PC-5
1	NA	R-12	143	—	—	—	—
		R-22	215	—	—	—	—
		R-502	236	—	—	—	—
2	2×2	R-12	143	152	—	—	—
		R-22	215	247	—	—	—
		R-502	236	270	—	—	—
3	2×3	R-12	143	147	152	—	—
		R-22	215	231	247	—	—
		R-502	236	253	270	—	—
4	2×4	R-12	143	146	149	152	—
		R-22	215	225	236	247	—
		R-502	236	247	259	270	—
5	2×5	R-12	143	145	148	150	152
		R-22	215	223	231	239	247
		R-502	236	244	253	261	270

SET CUT-OUT 35 psig BELOW CUT-IN

CONTROL "B"

URE CONTROL AND GRAVITY DAMPERS FOR ALL FANS



...NGS		
...N SETTINGS psig		
PC-3	PC-4	PC-5
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
152	—	—
247	—	—
270	—	—
149	152	—
236	247	—
259	270	—
148	150	152
231	239	247
253	261	270

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

TOTAL FLA-NO OF MOTORS x APPLICABLE MOTOR FLA

NOTE: SOLID LINES REPRESENT WIRING FOR 2,3,4&5 FAN UNITS. DASHED LINES REPRESENT ADDITIONAL WIRING FOR 4,6,8&10 FAN UNITS.

Figure VI-8

P415-149881-C

WATER COOLED CONDENSERS

LOCATION

The shell and tube condensers are normally located near the machine room. Each condenser must be elevated to insure proper drainage. The condenser condensate outlet must be elevated to a minimum of one foot above the liquid inlet valve to the receiver tank. The condenser comes with saddles to facilitate frame mounting.

LEVELING

The water cooled condensers require lengthwise leveling.

LAGGING

Mounting and lagging will be the responsibility of the installing contractor.

REFRIGERANT PIPING

Figure VI-10 shows a typical refrigeration piping for a water cooled condenser. Refer to manufacturer's installation instructions for proper line sizing and water piping requirements.

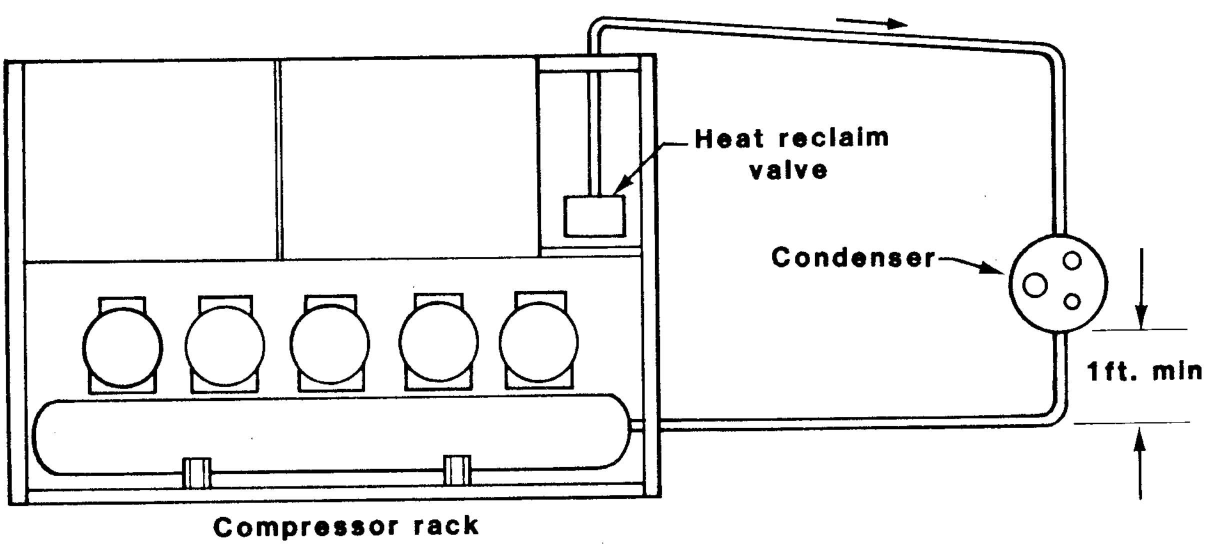


Figure VI-10
Elevation and Refrigerant Piping
for Water Cooled Condensers

Discharge and condensate lines must be free of any traps. Discharge lines must be pitched toward the condenser. Condensate lines must be pitched toward the receiver.

EVAPORATIVE WATER COOLERS AND CONDENSERS

The use of evaporative condensers is specified on the store legend when applied. They are shipped directly to the job site by the manufacturer.

Refer to specific manufacturer's instructions for the installation of these components. See legend for manufacturer and model number.

SERVICE TIPS

REPLACING HACD CONDENSER FAN BLADES

To insure proper air flow, be sure to position the fan blade as depicted in Figure VI-11. The clearance for the blades is based upon the pitch of the blade as indicated below.

CAUTION: Do not measure from the blade center or hub. The measurement must be from the top of the blade edge to the top of the opening (collar).

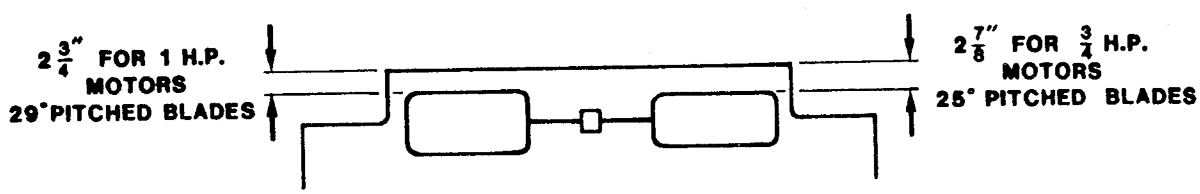


Figure IV-11
HACD Fan Blade Positions

SATELLITE INSTALLATION

SATELLITE INSTALLATION

GENERAL DESCRIPTION

The following refers to all Satellite compressor units.

A Satellite is a separate compressor that independantly operates the refrigerators connected to it, but uses the same source of refrigerant as the main compressor unit. Satellites are available for both medium and low temperature applications and can be installed either as remote units or prepiped and wired on the main compressor rack.

Within a given temperature range Satellites can be classified as either low end or high end Satellites.

Low End Satellite - By using a Satellite to handle the lowest temperature refrigerators, Plus IV operates at a higher, more efficient suction pressure. Should the Satellite fail, the main compressor unit operates the evaporators connected to the Satellite.

High End Satellite - A high end Satellite operates the warmest refrigerators connected to the compressor system. A Satellite applied in this manner provides more efficient operation of the warmest refrigerators and reduces the required capacity of the main compressor unit. Also, when a high end Satellite is used instead of a separate HR unit, the need for a separate condenser circuit is eliminated, permitting Condenser Control - B to be applied to the condenser.

TABLE VII -1
SATELLITE COMPRESSOR MODELS

Low Temperature		Medium Temperature				Low Temperature	Medium Temperature			
*HRT or HRN Model	Copeland Compressor	*HRT or HRN Model			Copeland Compressor	*HRT or HRN Model	*HRT or HRN Model			Carlyle Compressor
R502		R12 (1)	R22	R502		R502	R12	R22	R502	
535RL	MRA-0500		202VS	205RS	ERC-0200	315RL	310FH			06DR-[illegible]
		300FS			LAL-0310					
545RL	MRB-0500		302VS	305RS	ERF-0310	415RL	410FH			06DR-316
600RL	9RJ-0760		402VS	405RS	3RA-0310			312VH	315RH	06DM-313
		500FS			MRF-0500	515RL				06DR-718
		520FS			MRB-0500					
765RL	9RB-0760		502VS	505RS	NRA-0500			412VH	415RH	06DM-316
		550FS			9RL-0500					
770RL	9RS-0760		602VS	605RS	NRM-0500	815RL	810FH	812VH		06DR-[illegible]
1030RL	4RA-1000		702VS	705RS	MRH-0760	1115RL	1110FH			06DR-[illegible]
		750FS			9RB-0760					
		760FS			9RS-0760					
1402RL	4RL-1500		802VS	805RS	9RA-0760			1112VH		06DM-[illegible]
		1000FS			4RA-1000					
1502RL	6RA-2000		1002VS	1005RS	9RC-1010					
2102RL	6RL-2500		1502VS	1505RS	9RS-1500					
				2005RS	4RA-2000					
				2505RS	4RH-2500					

*HRT Satellites have 208-230 volt pilot circuits and should be interconnected with the compressor unit control panel. HRN Satellites have 120 volt circuits for interconnection with the header defrost assembly control panel. For factory installed Satellite nomenclature, refer to "Compressor Unit" chapter.

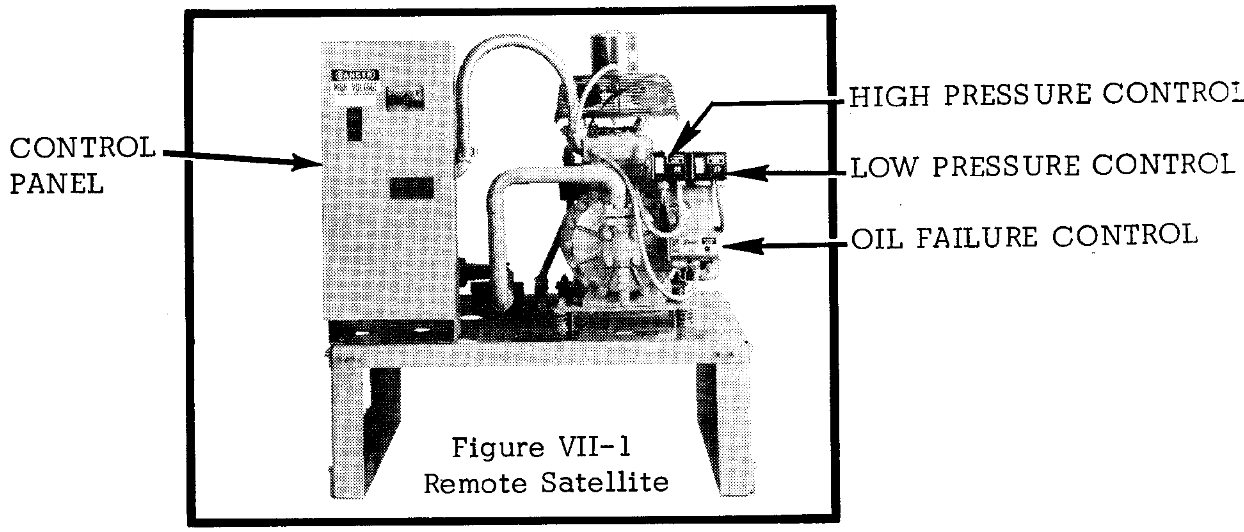


Figure VII-1
Remote Satellite

LOCATION OF REMOTE SATELLITES

Locate the Satellite as close as possible to the compressor unit (or header defrost assembly if so equipped). The suction line from the Satellite to its branch on the suction manifold must not exceed 50 equivalent feet.

To insure sufficient oil being fed to the Satellite, high end Satellites must be located on the same plane as the main compressor unit. Low end Satellites, however, may be located up to 10 feet above the compressor unit.

NOTE: Satellite units are shipped with the compressor pulled down on shipping blocks. Turn the mounting spring nuts one full turn counterclockwise. The blocks can then be removed and the spring adjustment is correct. Do this before piping the unit.

SATELLITE INTERCONNECTING PIPING

Suction Line - For low end units run piping from the suction filter on the Satellite unit to the stub marked "Satellite Suction" on the suction manifold. For high end units run piping from the suction filter on the Satellite unit directly to the evaporator.

Discharge Line - Run piping from the discharge stub on the Satellite unit to the stub marked "Satellite Discharge" on the discharge header of the main compressor unit. If there is more than one Satellite, construct a tee at this connection. Do not bullhead the tee in the discharge line. See Figure VII-2.

A discharge line check valve should be installed at the point of connection to the main compressor unit to prevent liquid accumulation in the discharge line during off cycles. A discharge line muffler installed horizontally at each Satellite is also recommended.

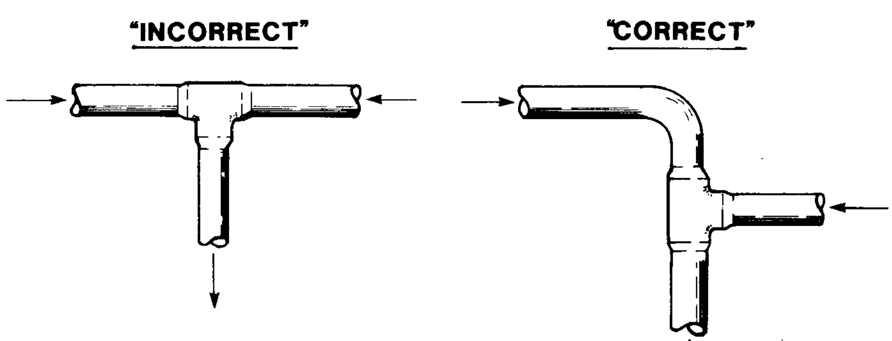


Figure VII-2
Double Satellite Connection

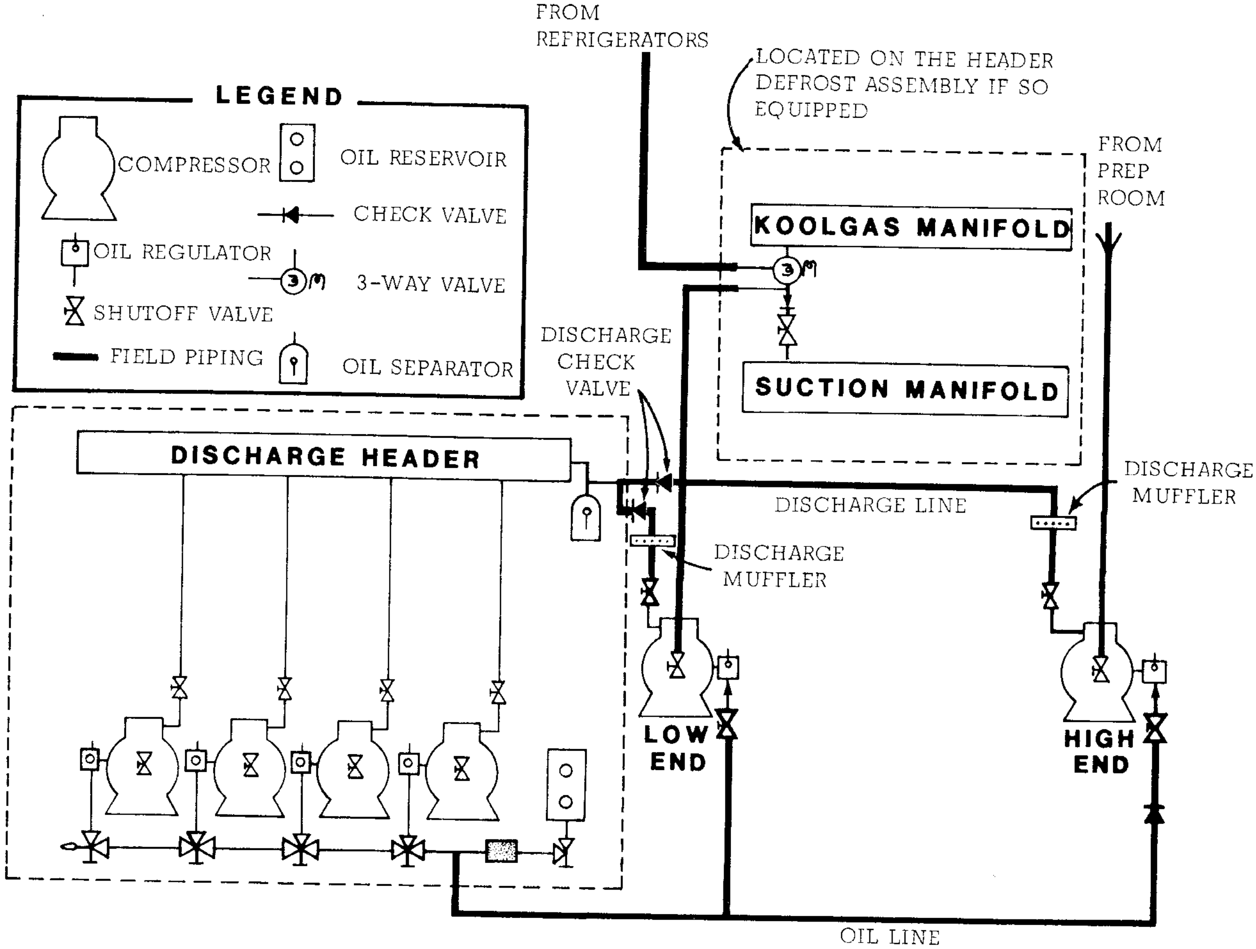


Figure VII-3
Remote Satellite Piping

Oil Supply Line - Run a 3/8" OD line from the oil level regulator on the Satellite unit to the oil supply line connection on the main compressor unit. Provide a vibration loop between the oil regulator inlet and the point where the oil line clamps to the base. Use two clamps to secure the line to the base. Install shutoff valves at the oil level regulators to facilitate servicing. On high end Satellites a check valve should be installed in the oil line to prevent back flow.

If the oil line is to be run across a walkway, it should be protected possibly with a cover plate securely fastened to the floor. Both sides of the cover plate should taper to the floor to prevent tripping. For low end Satellites, this line can be run up to 10 feet above its connection on the main compressor unit. The oil line for high end Satellites must not be raised above its connection stub.

REMOTE SATELLITE WIRING

For factory installed Satellite wiring, refer to the main compressor unit wiring diagram.

The 208-230/3/60 or 460/3/60 branch circuit powering the compressor cannot be run from the Plus IV control panel.

The control circuit, however, must be interconnected with the Plus IV (or defrost) control panel as noted in the pertinent wiring diagram.

Figure VII-4
HRT Satellite Wiring Diagram

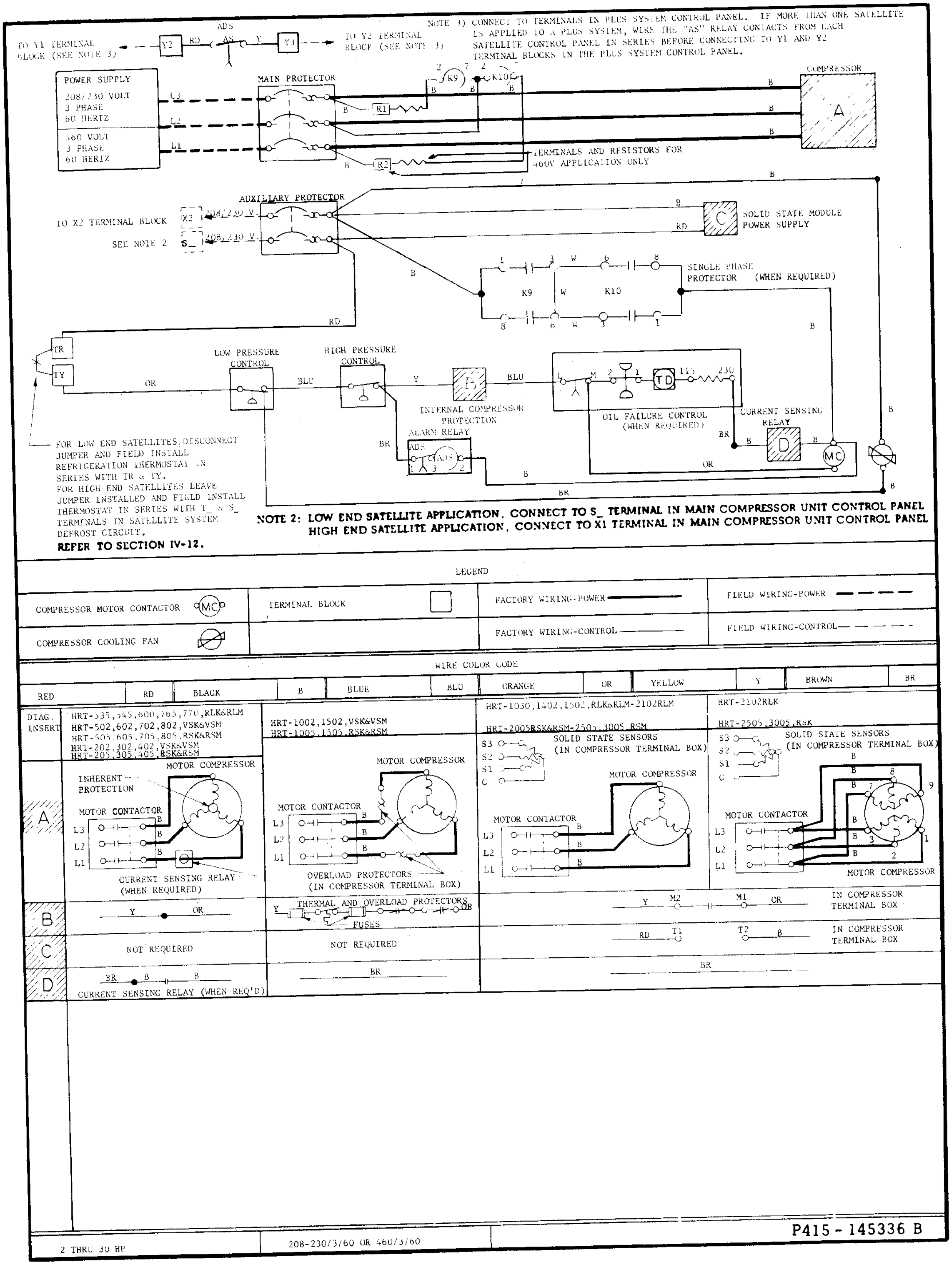


Figure VII-5
HRT With Alarm

2) REFRIGERATION THERMOSTAT (230V. 125VA MIN.)
3) CONNECT TO TERMINALS IN MAIN COMPRESSOR UNIT CONTROL PANEL. IF MORE THAN ONE SATELLITE IS APPLIED TO A MAIN COMPRESSOR UNIT CONTROL PANEL, WIRE THE "AS" RELAY CONTACTS FROM EACH SATELLITE CONTROL PANEL IN SERIES BEFORS CONNECTING TO Y1 AND Y2 TERMINAL BLOCKS IN THE MAIN COMPRESSOR UNIT CONTROL PANEL.

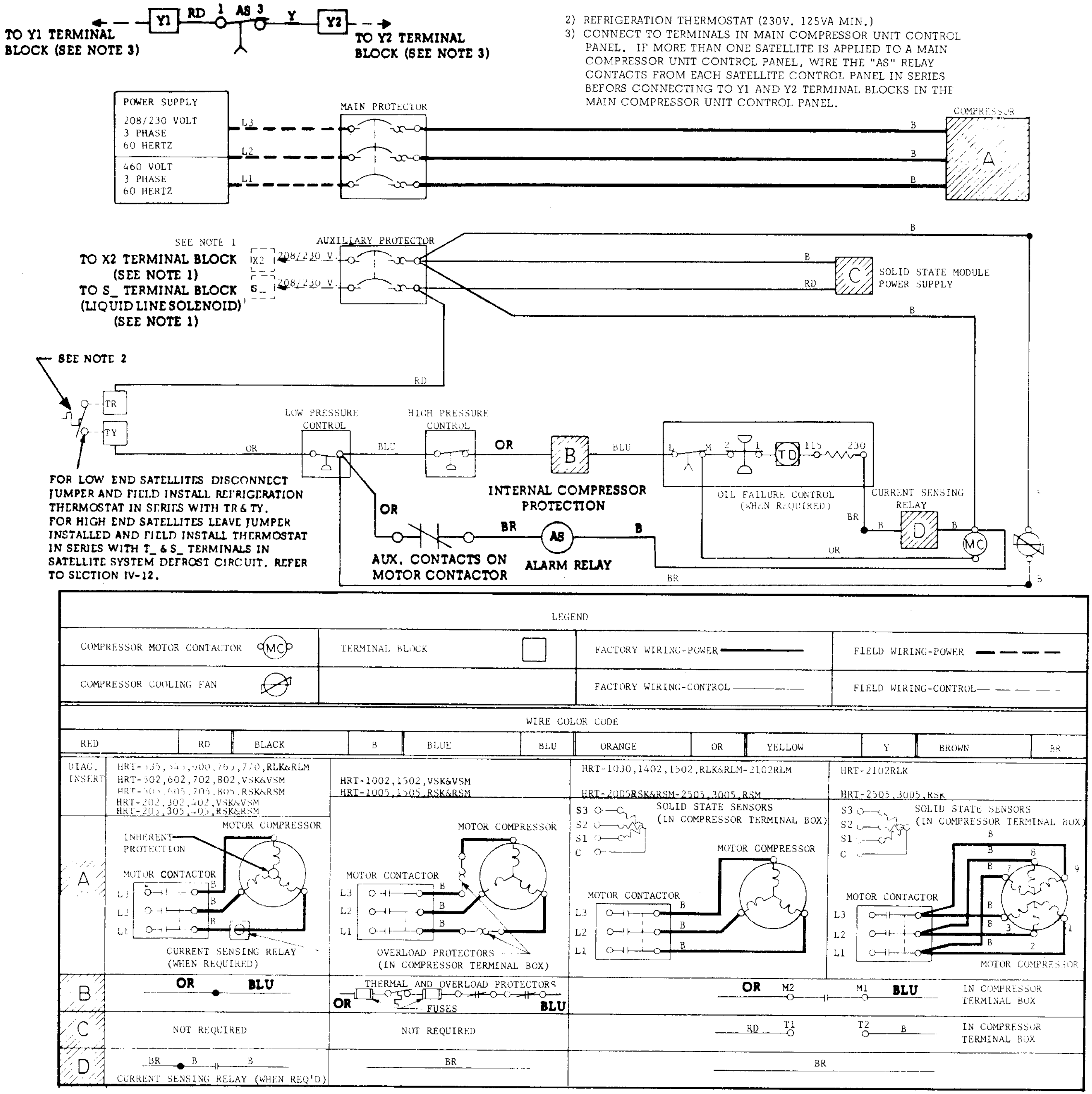


Figure VII-6
HRN Satellite Wiring Diagram (Copeland)

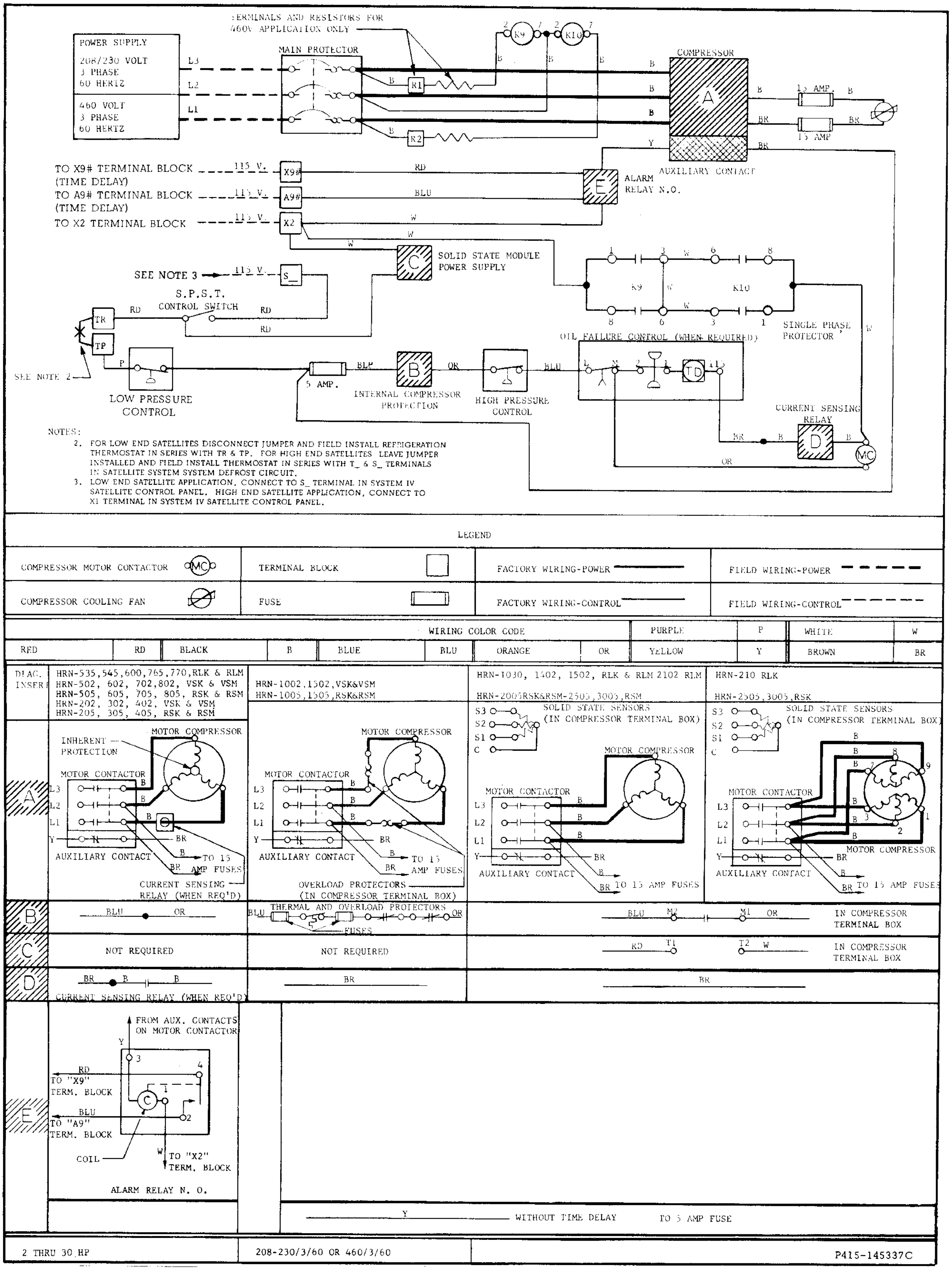


Figure VII-7
HRN Satellite Wiring Diagram (Carlyle)

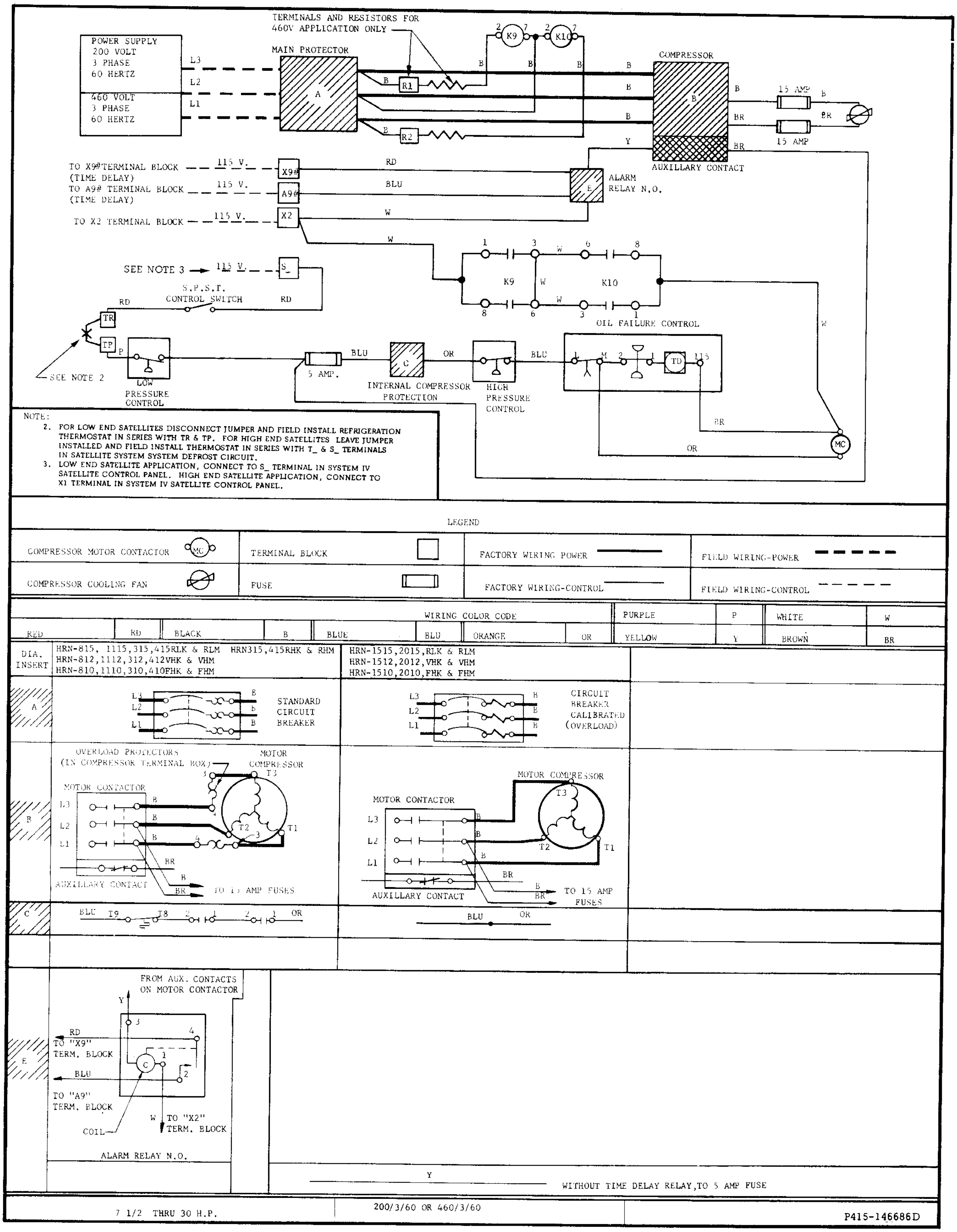
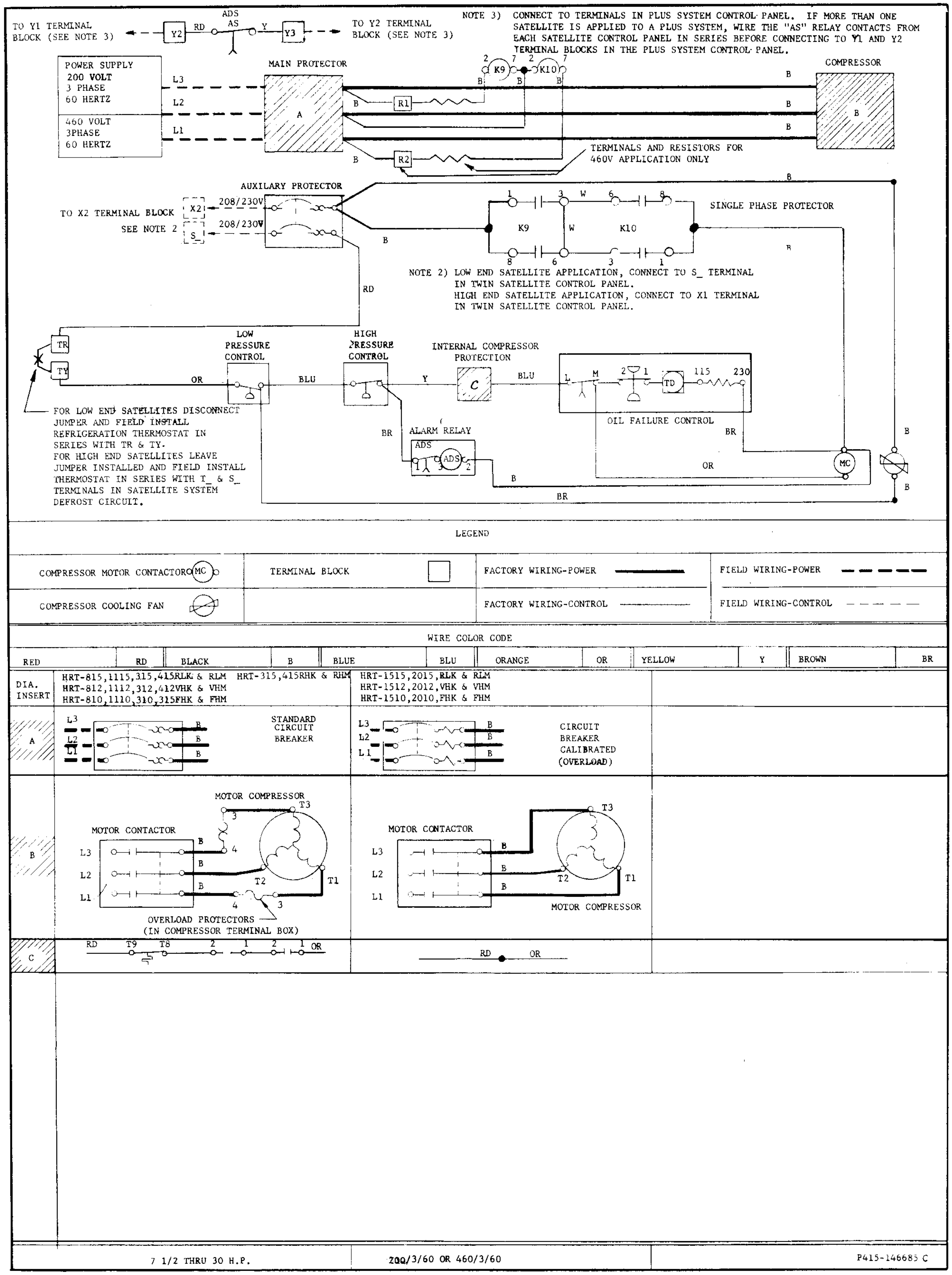


Figure VII-8
HRT Satellite Wiring Diagram (Carlyle)



SERVICE TIPS

Table VII-2
Suction Filter Replacement Chart for Satellites

COPELAND COMPRESSORS						CARLYLE COMPRESSORS				
HRT or HRN Model		Suction Filter Replacement	HRT or HRN Model		Suction Filter Replacement	HRT or HRN Model	HRT Model	HRT or HRN Model		Suction Filter Replacement
R12	R502		R22	R502		R502	R12	R22	R502	
300FS		Superior F 25								
500FS	535RL	Henry 824-CF	202VS	205RS	Superior F 25	315RL	310FH			Superior F 25
520FS	545RL		302VS	305RS		415RL	410FH			
550FS	600RL		402VS	405RS				312VH	315RH	
750FS	765RL		502VS	505RS				412VH	415RH	
760FS	770RL		602VS	605RS		815RL	810FH	812VH		Henry 824-CF
1000FS	1030RL		702VS	705RS	Henry 824-CF	1115RL	1110FH			
	1402RL	Henry 848-CF or Sporlan RFE-48-BD	802VS	805RS				1112VH		
	1502RL		1002VS	1005RS						
	2102RL		1502VS	1505RS						
				2005RS	Henry 848-CF or Sporlan RFE-48-BD					
				2505RS						

DEFROST CONTROL PROGRAM TIMER

Section VIII — Page

INSTRUCTIONS FOR SETTING THE DEFROST CONTROL PROGRAM TIMER

<u>To Set the Program Timer</u> - Install the trippers as follows:

1. Determine the time or times of day each system is to go into defrost.

2. Turn the setting knob, causing the program timer shaft to turn. As the desired slots in the program timer become accessible, install trippers in these slots. Continue until the desired program is set up.

   The slot for each tripper is located immediately <u>above</u> the number on the program timer.

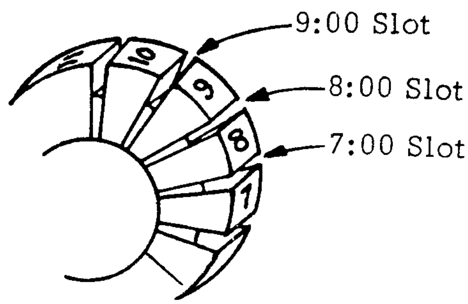


Figure VIII-2
Program Timer Dial

To install a tripper, push straight in until it is felt to snap over its holding detent. A properly installed tripper has its shoulders extending 1/32 inch outside the program timer dial. When the tripper is installed, make sure it is extending straight out from the dial. A badly cocked tripper could cause jamming of the mechanism.

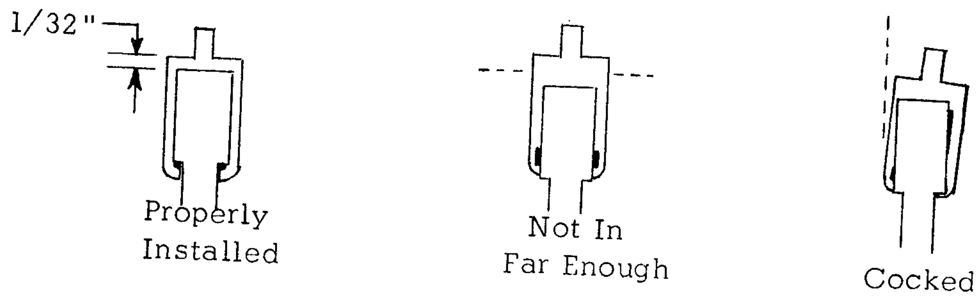


Figure VIII-3
Tripper Installation

Precision Brand (cont'd.)

To Set the Cycle Timers - Adjust as follows:

1. Turn the setting knob clockwise until the indicator mark is facing forward and the cycle dial stops turning.

   WARNING: FAILURE TO HAVE THE INDICATOR MARKS VISIBLE BEFORE ADJUSTMENT MAY CAUSE DAMAGE TO THE CLOCK.

2. Insert the tool in the cycle dial as shown in Figure VIII-4.

   Hold the cycle timer from rotating by grasping the cycle timer gear. Then using the tool, turn the cycle dial until the desired time is opposite the indicator mark.

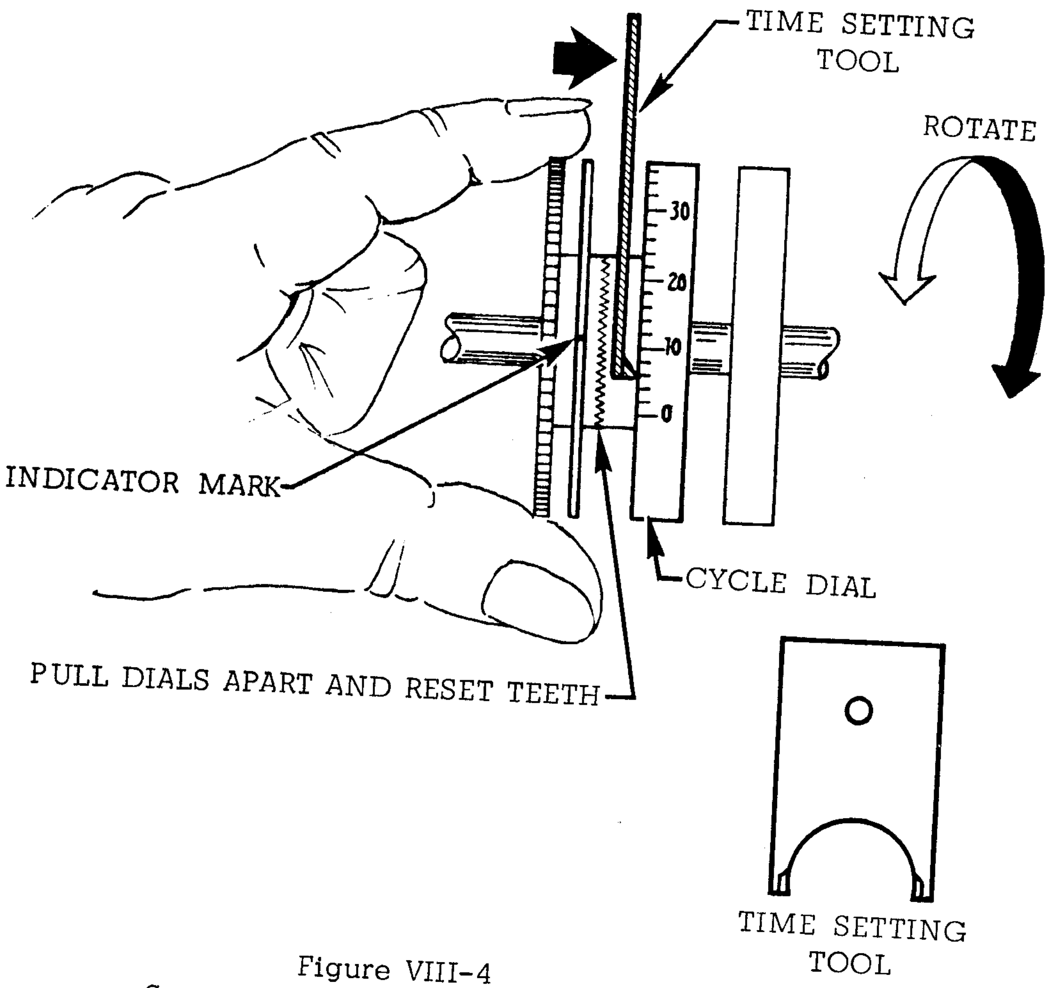


Figure VIII-4
Setting the Defrost Cycle Timer

To Set the Time Index Dial - Adjust as follows:

1. Turn the setting knob until the correct time of day is indicated by the arrow and the number on the time index dial. See Figure VIII-5.

Precision Brand (cont'd.)

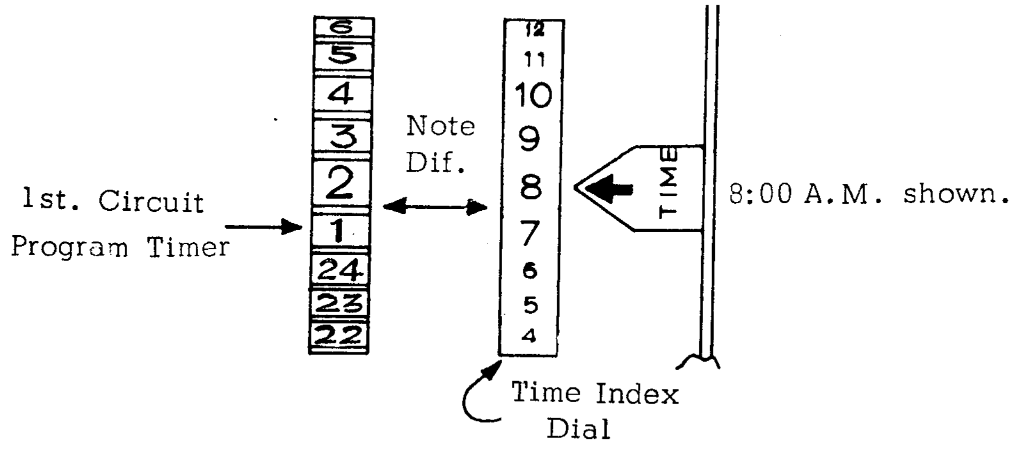


Figure VIII-5
Setting the Time Index Dial

DEFROST CONTROL PROGRAM TIMER ALARM SWITCH

The program 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, however, giving warning that the timer requires service.

To reset the alarm switch:

1. Push gear B toward the motor before attempting to reset the lever or part A will be broken.

2. Use a non-metallic object to depress the plastic cam arm until it snaps into position and separates the alarm switch contact points.

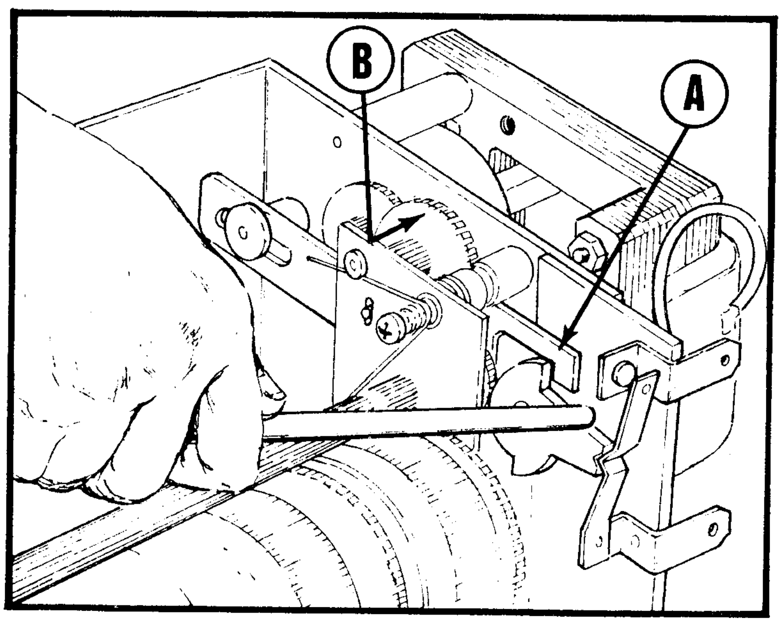


Figure VIII-6
Resetting Alarm Switch

GENERAL DESCRIPTION OF PARAGON BRAND

The Paragon timer is composed of three basic components; a frame, a drive motor module, and as many program modules as there are defrost systems.

There are two basic types of program modules: those which initiate defrosts on the even hours of the day and those which initiate defrosts on the odd hours. These modules are staggered in the frame so every other one is identical. Motor and program modules are removable.

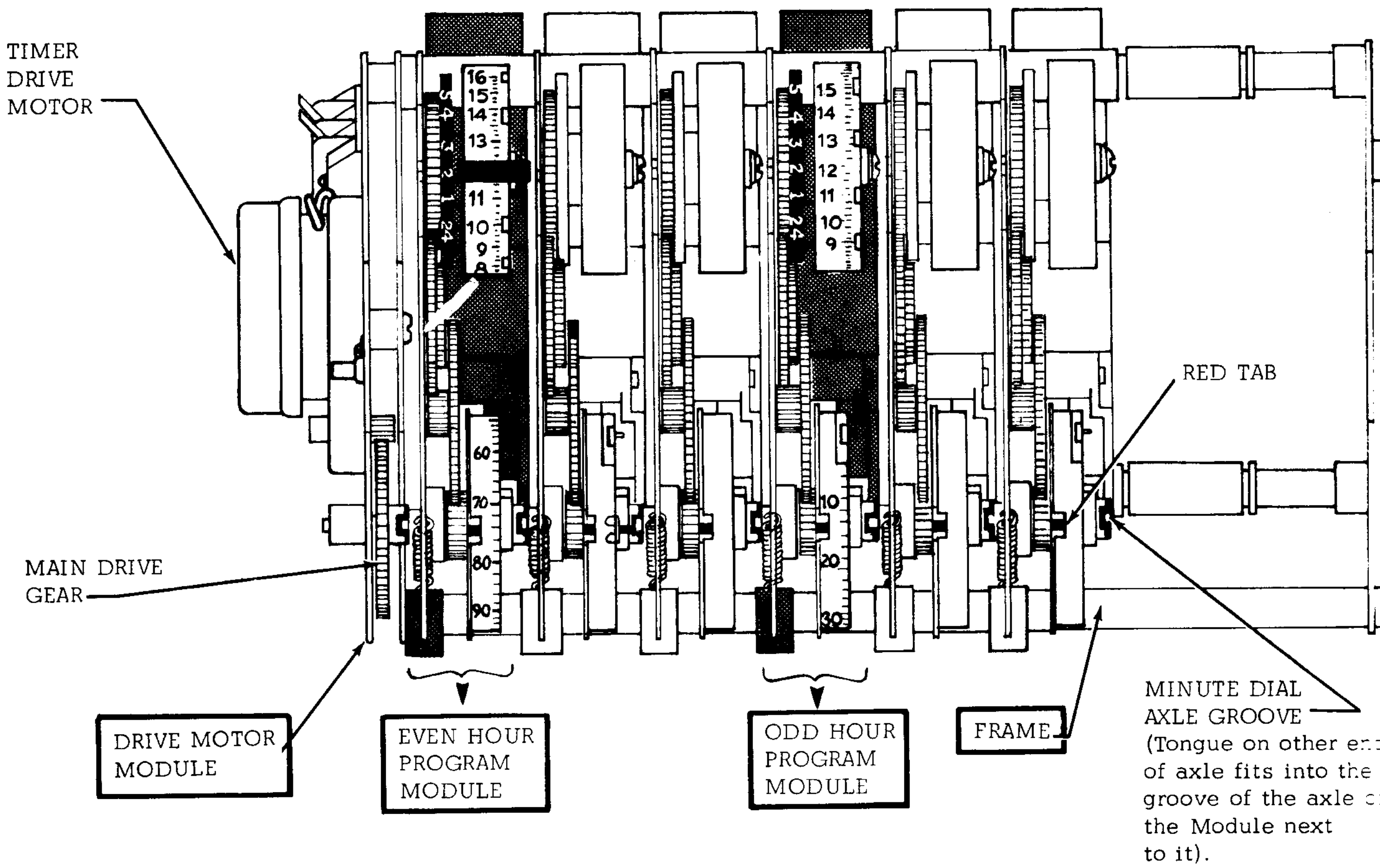


Figure VIII-7
Paragon Program Timer

Paragon Brand (cont'd.)

SETTING THE TIMER

To Set the Time for Defrost - Insert the black tripper into the slot in the 24 hour dial at the time of day defrost is desired. (Hours p.m. are represented by numbers 13 through 24.)

To Set Length of Defrost (or Fail-Safe Setting with Temperature Termination) - Rotate the copper termination lever of the minute dial to the desired number of minutes. Be careful not to bend this lever any further than is necessary to disengage it from the dial teeth. Do not move the red tab.

To Set the Time of Day - Rotate the main drive gear with an upward push of the thumb until the correct hour on the time of day dials aligns with the pointed alignment mark on the modules.

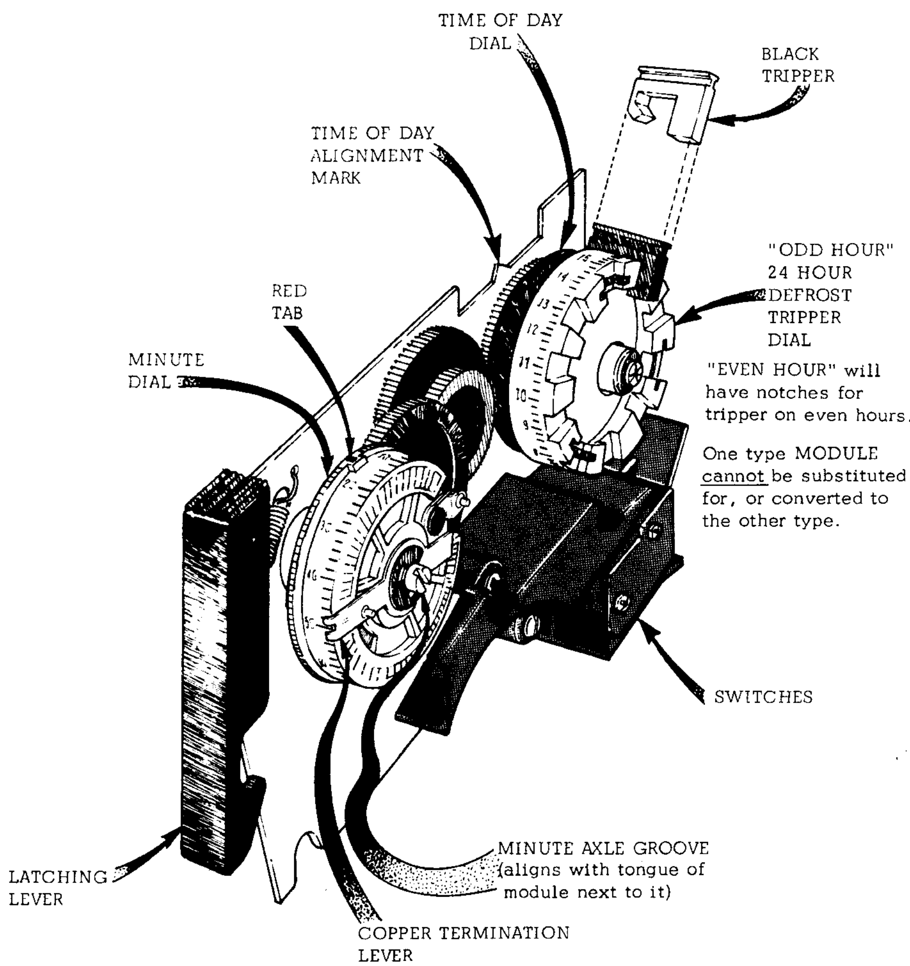


Figure VIII-8
Paragon Timer Program Module

Paragon Brand (cont'd.)

REPLACING PROGRAM MODULES

Removing a Program Module - Turn the control circuit off. Mark wires for identification and disconnect the wires from the switches at the top rear portion of the module. Adjust the timer until the red tabs on the minute dials are in their front most position, then pull the rear portion of the plastic latching lever down to release the module.

Installing a Program Module - Align the 24 hour dials to the same hour and place all red tabs in their front most positions (including the one on the module to be installed. Slip the module into the slotted rod and fit the tongue or groove of the minute dial axle into the mating parts of the adjacent modules. Double check to be sure all red tabs and 24 hour dial numbers line up, and replace the wires to the switches. Reset the time of day and turn on the control circuit.

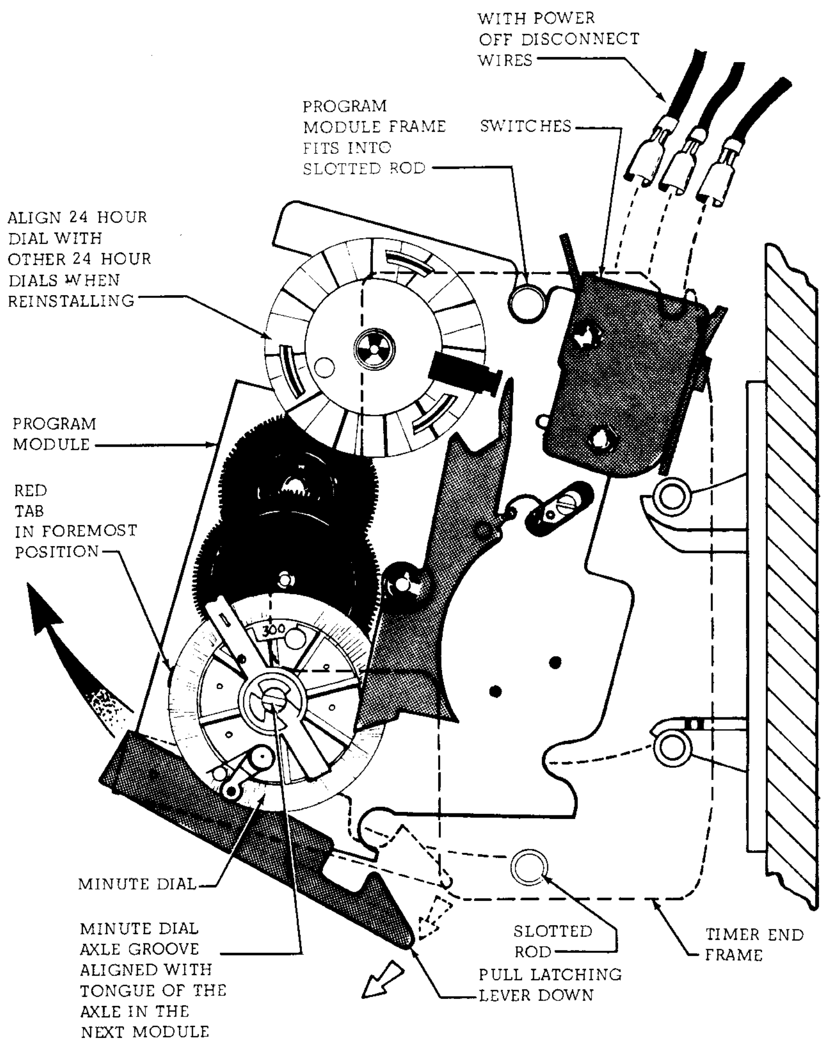


Figure VIII-9
Program Module Removal/Installation

Paragon Brand (cont'd.)

REPLACING THE MOTOR MODULE

1. Turn the control circuit off and disconnect wiring to motor.

2. Rotate the main drive gear until the axle tongues and grooves are vertical.

3. Loosen the hex head bolt on the side of the motor module.

4. Slide the module upward until the three locator studs clear the key slots.

5. Reverse the above for installation of the new motor module.

NOTE: Be sure to check motor voltage requirement before installing.

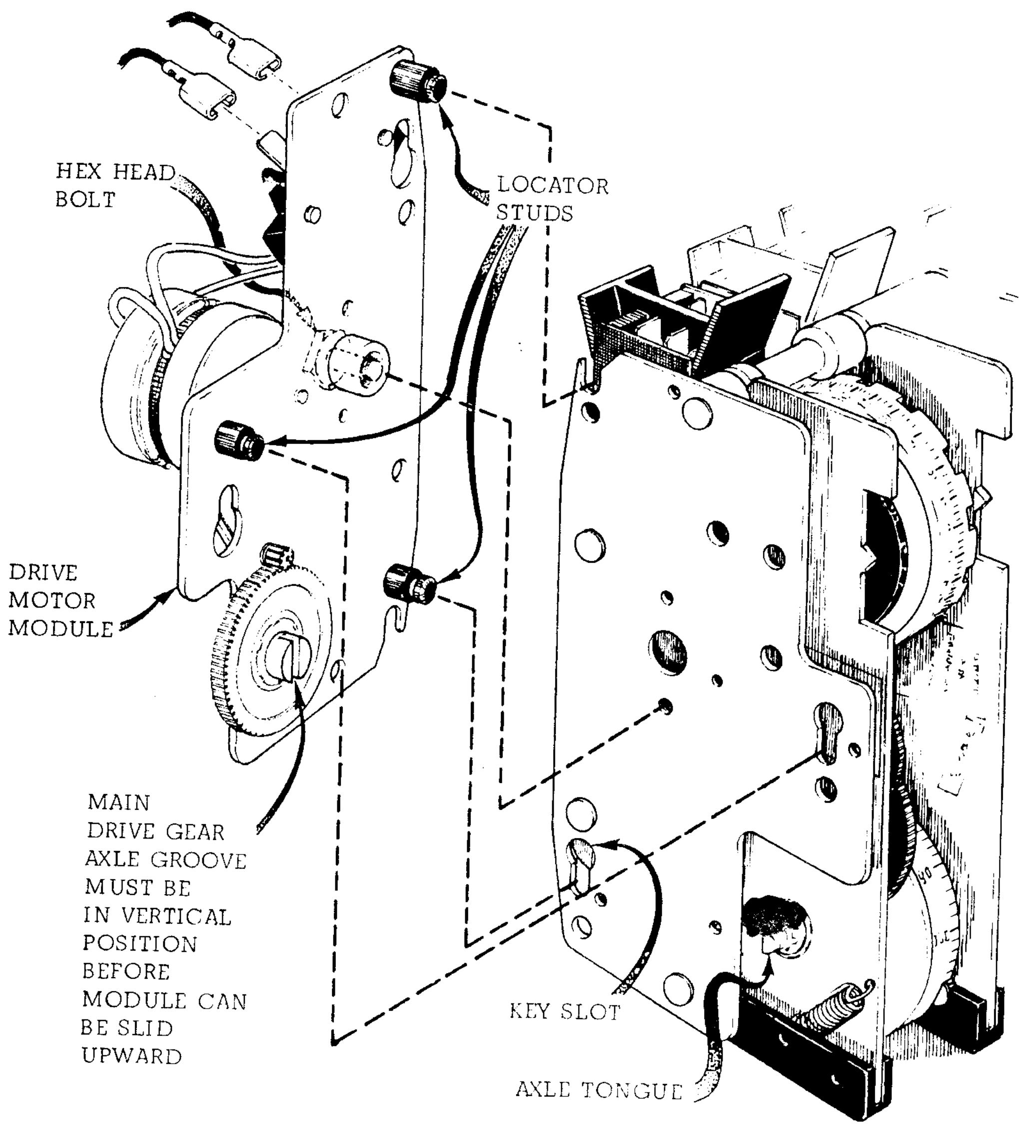


Figure VIII-10
Drive Motor Module Removal

ACCESSORIES

Section IX

ACCESSORIES

INSTALLATION OF THE IN-STORE ALARM

To install the in-store alarm the following field installed wiring must be run. See Figure IX-1.

1. One alarm bell for alarm system must be field wired at the location desired by the customer. Each bell is 120 volts and connects to terminals "*22" and "*23" in its respective compressor control circuit.

2. An optional in-store light for each alarm system may be installed. The light cannot exceed 300 watts. The light is connected in parallel to the same terminals as the bell, "*22" and "*23."

Should the installer not wish more than one bell or light when interconnecting several Plus System units, field wire the units according to Figure IX-2. In the event of an alarm, the alarm light mounted on the individual unit control panel will direct the serviceman to the unit on alarm. Since the alarm bell and light are on the same circuit, both will be shutoff by the alarm silencing switch. For the complete wiring diagram see Figure IV-13.

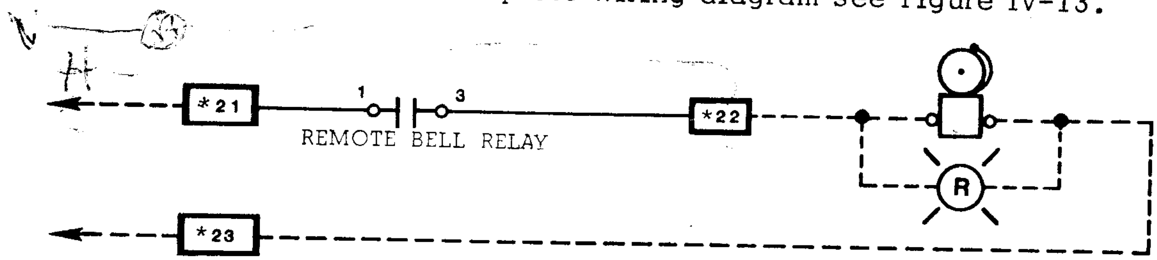
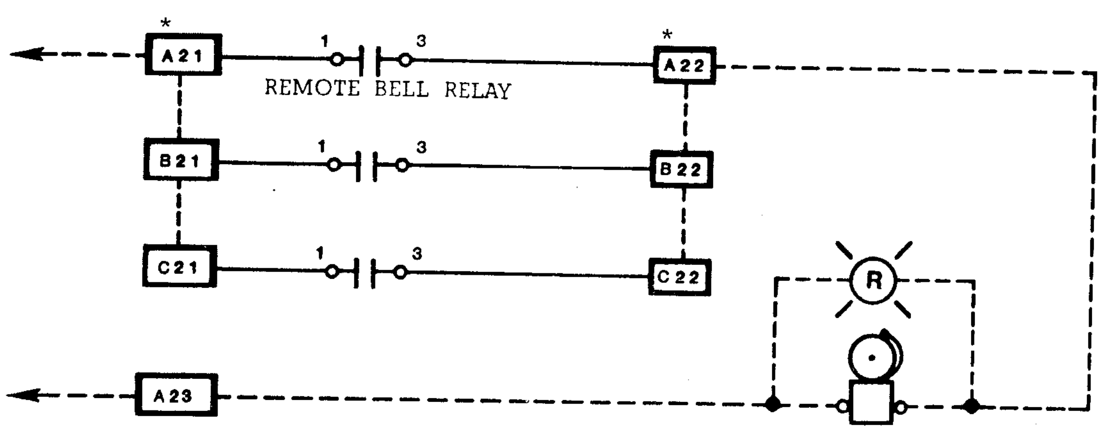


Figure IX-1
Field Wiring Remote Bell or Light



---------- Indicates Field Wiring
* Indicates the Plus System unit letter on the store legend

Figure IX-2
Alarm Isolation Circuit for Multiple Plus System Units

INSTALLATION OF HUSSMANN'S REMOTE ALARM

The remote alarm device is offered to signal the loss of 230 volt power and also signal operational problems during periods when the store is closed.

Typical field wiring for Hussmann's Remote Alarm is shown in Figure IX-4.

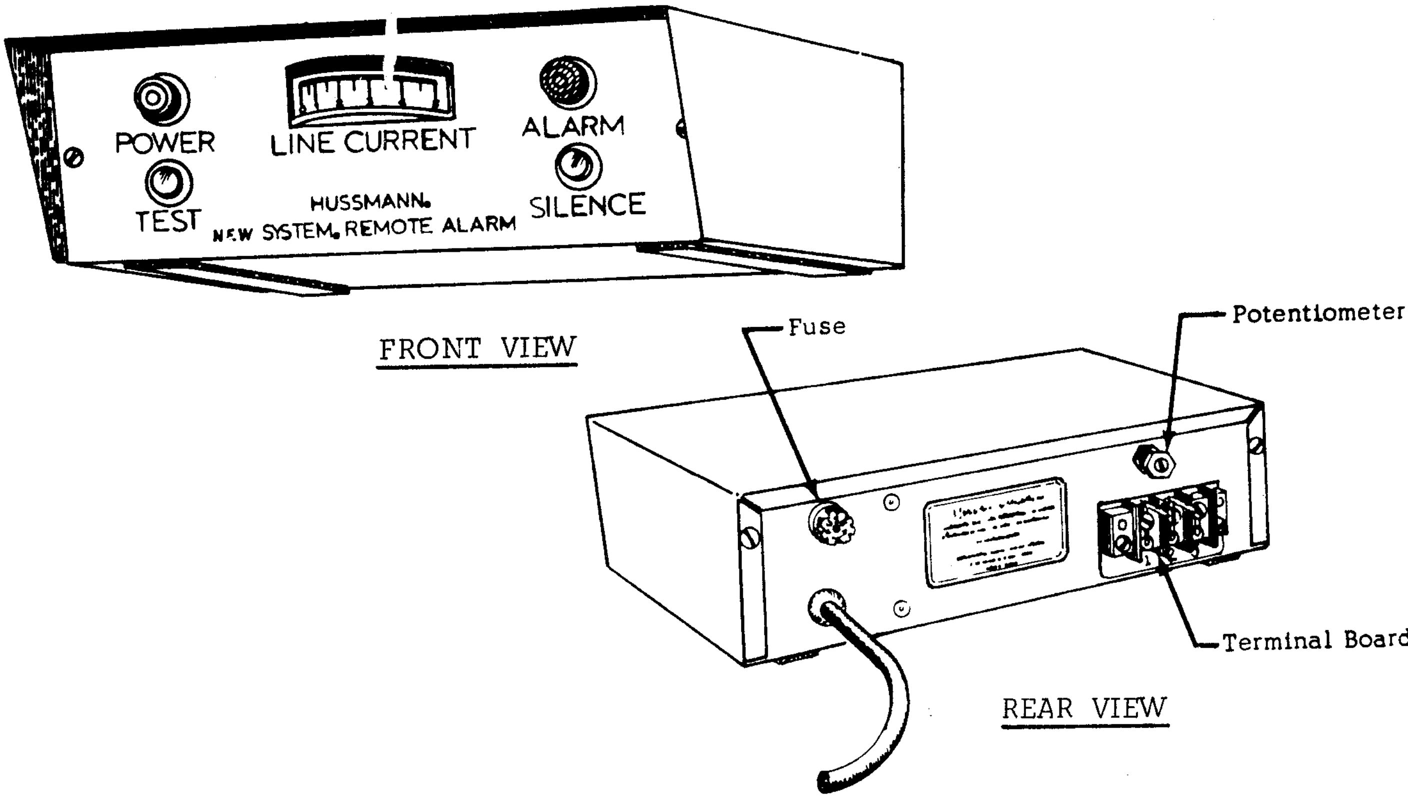


Figure IX-3
Hussmann's Remote Alarm

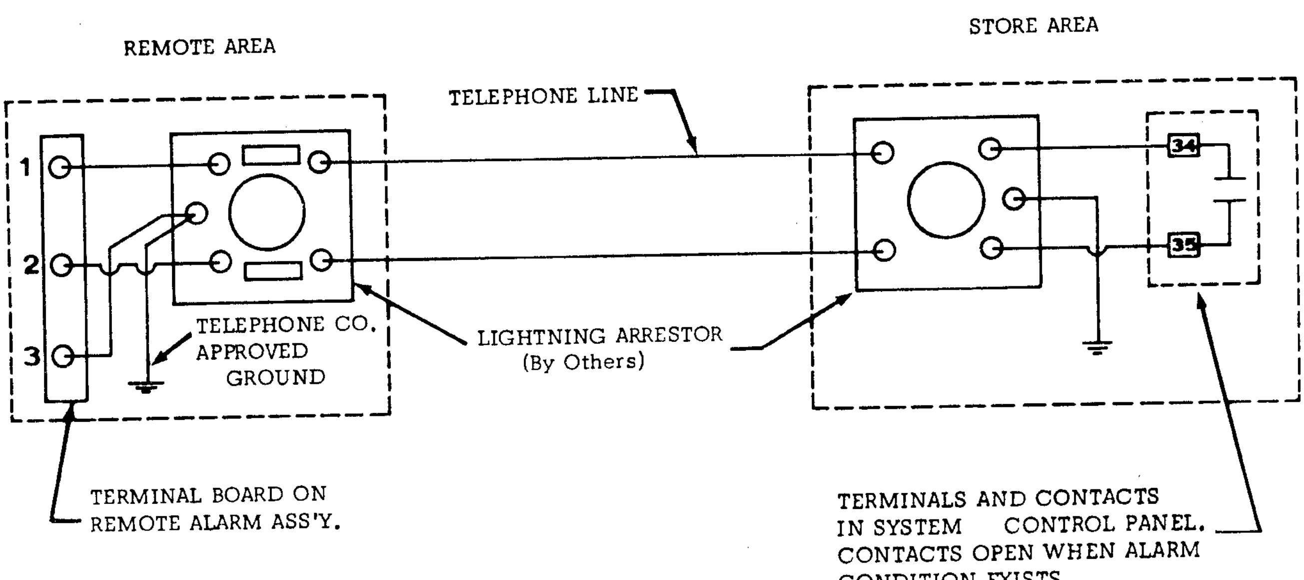


Figure IX-4
Field Wiring for Hussmann's Remote Alarm

OTHER TYPES OF ALARM DEVICES

The in-store alarm is wired to activate other types of alarm equipment. The alarm contains circuitry to activate two types of alarm receivers.

1. Terminals "34' and "36" will close a pair of contacts when an alarm condition is sensed.

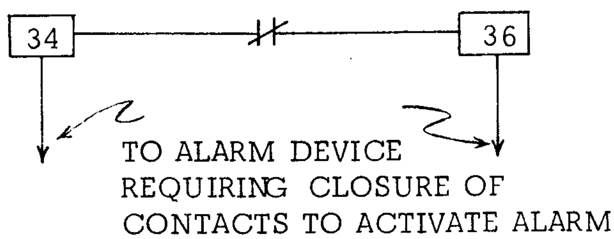
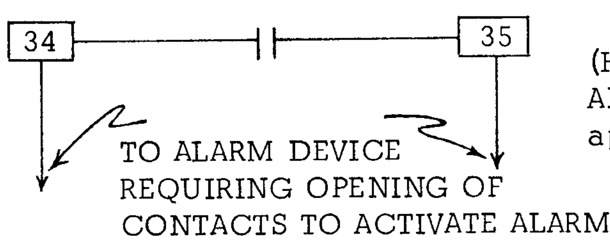


Figure IX-5

2. Terminals "34" and "35" will open a pair of contacts when an alarm condition is sensed.



(Hussmann Remote Alarm uses this application)

Figure IX-6

The local telephone company or private service company can be consulted as to types of equipment that will be compatible to Hussmann's in-store alarm.

NOTE: When using other types of alarm receivers, the Hussmann remote alarm cannot be used.

INSTALLATION OF THE 2-STAGE REFRIGERANT LOSS ALARM/INDICATOR (OPTIONAL)

1. Remove the flange plate on the front of the receiver (viewed from the control panel side of the compressor unit). Discard the original gasket and check to see that the new gasket and joints are free of flaws.

2. Remove the dial housing assembly by removing the 2 slot-head screws located on the dial cover. Coat the new gasket with a light film of oil and install over the flange on the back of the housing. Insert the float into the receiver making sure the gauge face is right side up. The word "Top" is stamped into the housing.

3. Check for freedom of float movement by rotating the gauge from side to side. A slight jar should be felt when the float swings to the upper and lower stops.

4. Install the 4 interior hex bolts finger tight and tighten in a diagonal pattern to 5-8 ft./lb. CAUTION: Overtightening may warp or crack the back of the indicator housing.

5. Install the dial housing right side up. Leak check carefully.

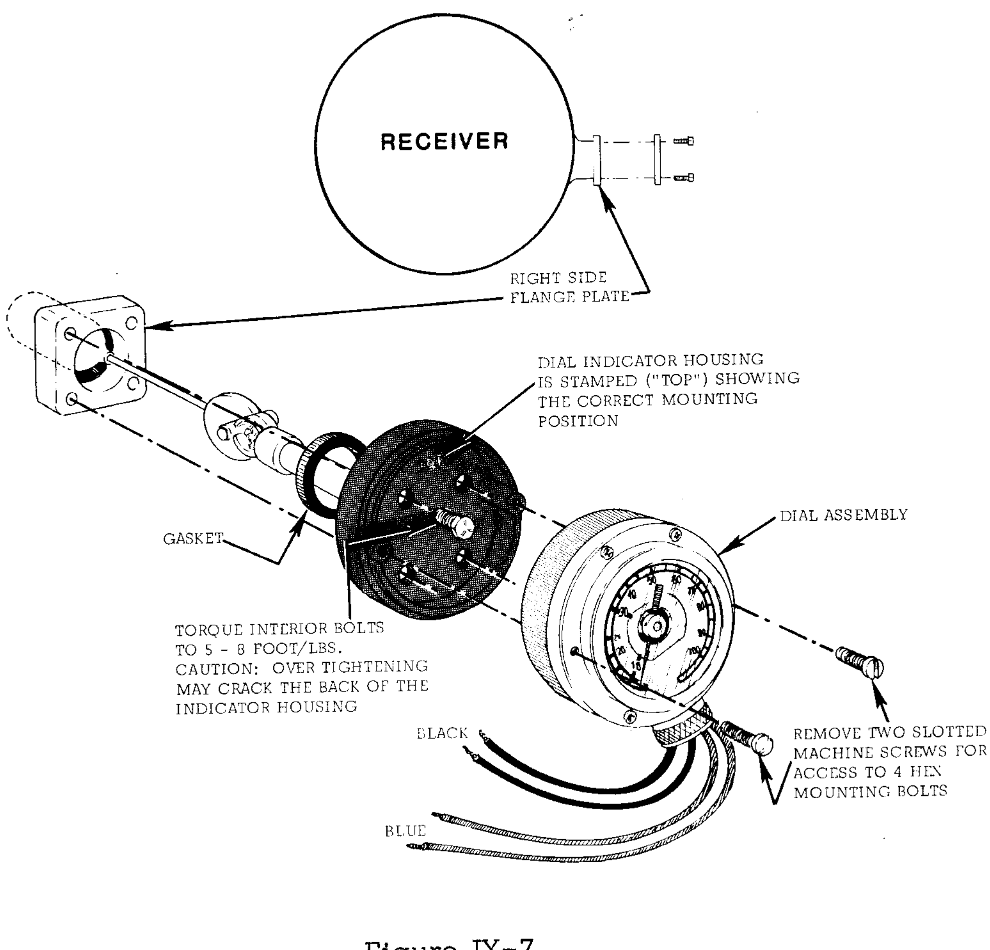


Figure IX-7
Installation of the 2-Stage Refrigerant Loss Alarm/Indicator

Single Stage Operation - On a Plus System without heat reclaim (or if condenser flooding valves are used) only one stage of the alarm should be utilized. If the liquid level remains below 10% of receiver capacity for half an hour, the alarm trips.

Two-Stage Operation - On a Plus System with heat reclaim (and without condenser flooding) both stages can be utilized. With heat reclaim on, the alarm trips if receiver level remains below 10% for half an hour. With heat reclaim off, the alarm trips if receiver level remains below 30% for half an hour.

Electrical - If the compressor unit has heat reclaim, connect the color coded wires from the wiring harness as per Figure IX-8. If the unit has no heat reclaim, only the black (B) wires are connected, as per wiring diagram Figure IX-9 (without heat reclaim). Tape the blue (BLU) wires that are not used.

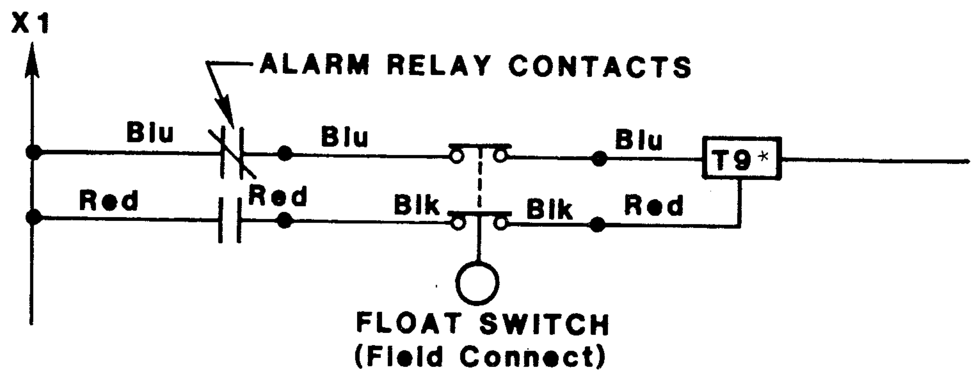


Figure IX-8
Wiring Diagram for Two - Stage Operation

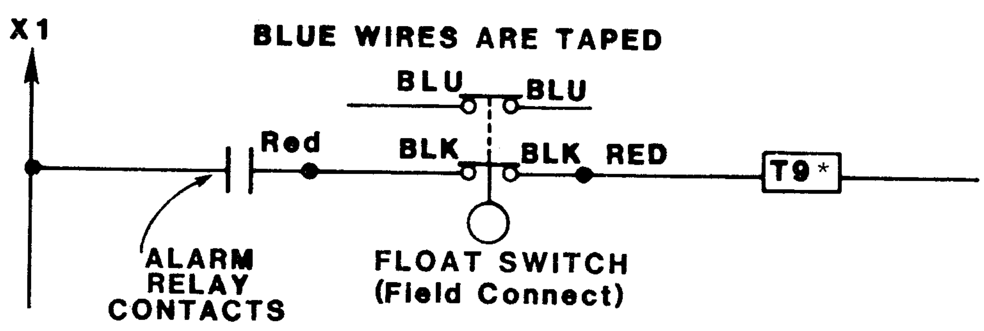


Figure IX-9
Wiring Diagram for Single Stage Operation

* Denotes Unit Letter
For A Complete Diagram See The Wiring Diagram in the "Compressor Unit" chapter.

INSTALLATION OF HEAT RECLAIM

If your heat reclaim is part of an HCD package do not use this section. Refer to the HCD Installation Instruction.

Location of the Heat Reclaim Coil - Install the heat reclaim coil in the duct system downstream of any air conditioning and upstream of any booster heat. See Figure IX-10. Allow sufficient space between the coil and booster heat so radiant heat will not affect performance. The heat reclaim coil should be placed 3 to 20 feet higher than the compressor unit's liquid receiver. Neither the supply nor the return line should exceed 150 equivalent feet. Provide gradual transitions in the duct work to insure full air coverage across the face of the heat reclaim coil.

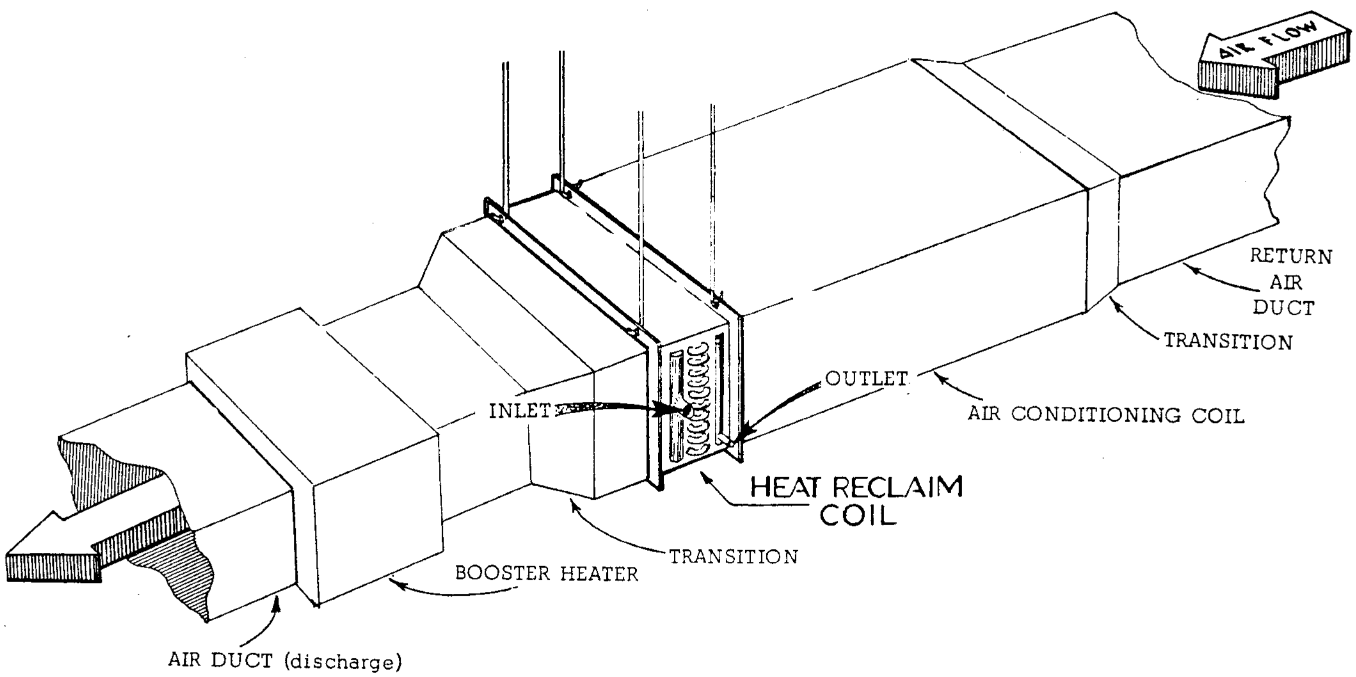


Figure IX-10
Coil Location

Heat Reclaim Piping - Pipe heat reclaim as follows:

1. Supply Line - Connect a supply line from the stub marked "Inlet Heat Coil" on the Plus System compressor unit to the inlet header on the heat reclaim coil. The inlet stub leads from a reversing valve located at the oil separator end of the compressor unit. See Figure IX-11. A hand valve located in the supply line is recommended.

2. Return Line - Connect a return line from the stub marked "Heat Coil Return" on Plus System to the liquid header (bottom connection) on the heat reclaim coil. See Figure IX-11. A hand valve located in the return line is recommended.

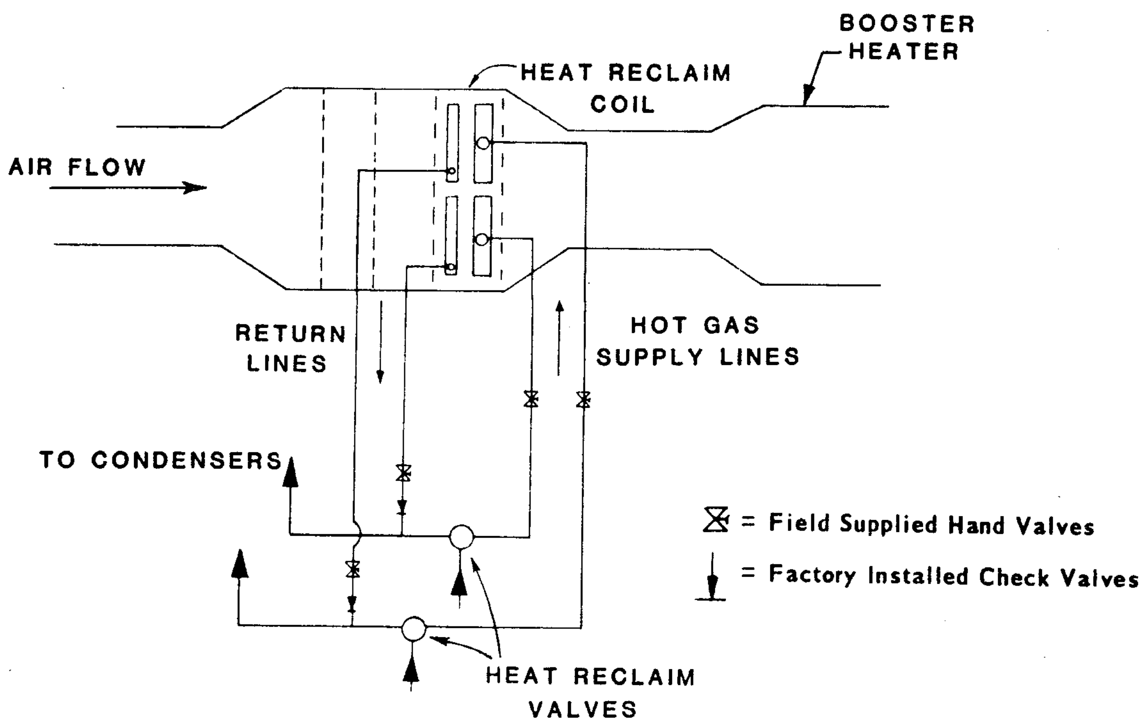


Figure IX-11
Heat Reclaim Piping Diagram

Refrigerant line sizing guide is located in the Plus IV Planning Data.

Heat Reclaim Wiring - The heat reclaim control is equipped with a manual control switch and operation pilot light for each stage. The operation pilot light is ON when the system is operating on heat reclaim. The manual switch and pilot light are located at the compressor control panel.

Connect the store heating thermostat to the compressor control panel with a two wire, 125va pilot duty circuit.

The heating thermostat is a two pole device for connection of two stages of heat reclaim. If additional booster heat is desired, an additional (field supplied) thermostat is recommended.

For complete wiring diagram see Figure IV-13.

Thermostat Specifications -

1. Penn brand T25A, two sets of SPST contacts, line voltage (or equivalent)
2. Pilot duty rating of 125 va, 24 to 277 vac
3. Temperature range of $40^{\circ}F$ to $90^{\circ}F$
4. Differential $0.7^{\circ}F$ each stage, $3^{\circ}F$ between stages

Heat Reclaim Lockout Pressure Control - Factory set and installed, this control will shutoff heat reclaim when heat reclaim would otherwise cause condensing pressure to drop below a safe minimum. See "Control Settings" for the factory set adjustment.

SERVICING HEAT RECLAIM VALVE

Main Valve Body Check - Service the main valve body as follows:

1. Close the shutoff valve for the pilot pumpout line. The valve is on the end of the suction manifold.

2. Disconnect the lines from the main valve body running to the pilot assembly. Use flare plugs to prevent gas from escaping.

3. Connect a gauge set to the 1/4 inch SAE connections on the main valve body. See Figure IX-12. Hand valves "A" and "B" should be closed.

4. Connect the center hose of the gauge set to any suction connection, such as a suction filter.

5. Open the hand valve "A" on the gauge set. The heat reclaim valve will shift to that end. The gauge at "A" will read suction pressure. Gauge "B" will read discharge pressure.

6. Close hand valve "A" and open "B." The gauge at "B" will now read suction pressure while "A" will read discharge pressure.

7. Repeat 6 or 7 times. The heat reclaim valve should shift correctly each time. If no shift occurs, the main body should be disassembled, carefully cleaned, and reassembled. Refer to Disassembly instructions following this section.

8. After cleaning the main valve, reassemble and test again. If no shift occurs the entire valve should be replaced. If the valve shift is correct, remove the gauge connections and cap the 1/4 inch SAE connections on the valve body. Disconnect the gauge from the suction connection and proceed to test the pilot.

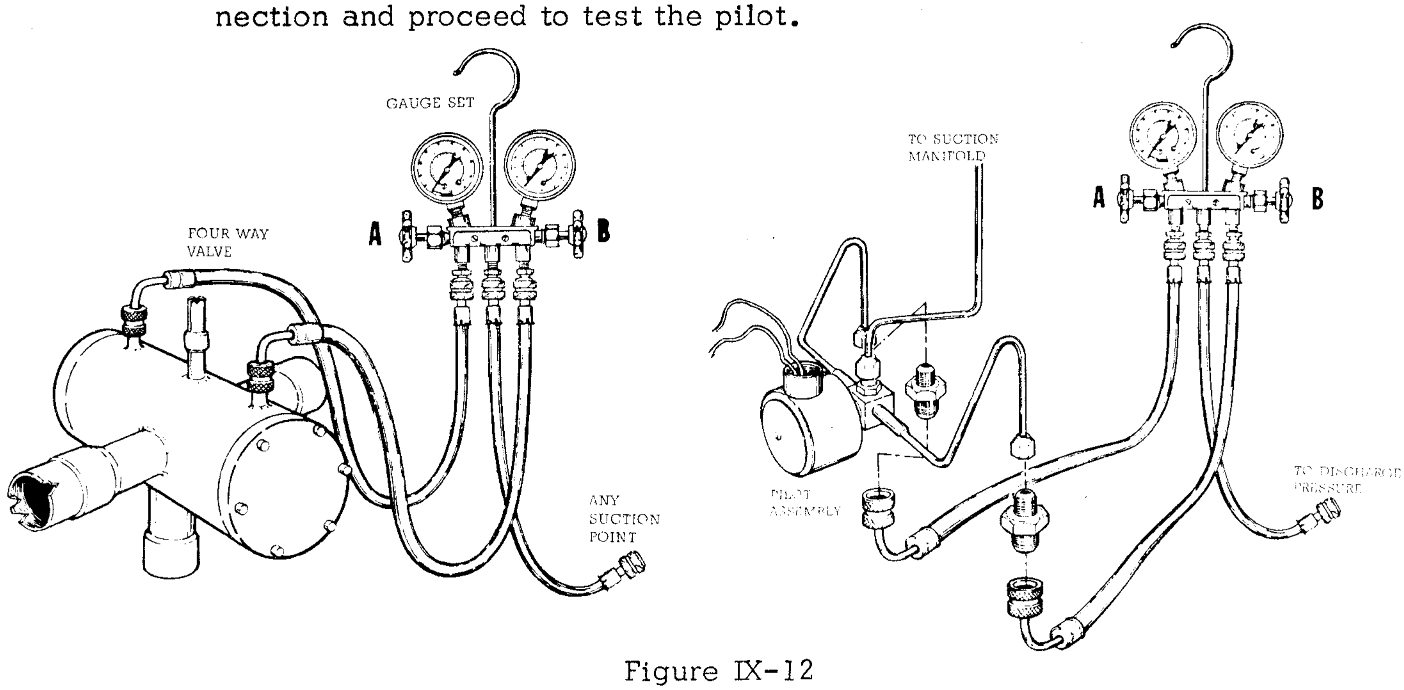


Figure IX-12
Main and Pilot Valve Check

<u>Pilot Assembly Check</u> - Service the pilot assembly as follows:

1. Place the store thermostat in a heat demand position and turn heat reclaim toggle switch "off" (at control panel).
2. Referring to the pilot assembly in Figure IX-12, connect the gauges to the 1/4 inch flare nuts of the pilot assembly tubing.
3. Open the shutoff valve on the suction manifold connecting the pilot pumpout line to the pilot assembly.
4. Connect the center hose of the gauge set to a discharge pressure connection. Gauge valves "A" and "B" to be closed.
5. The first check is made with the pilot solenoid de-energized.
6. Crack gauge valves "A" and "B" to allow a pressure reading on both gauges. One gauge should read discharge pressure, one gauge should read lower than discharge pressure (since the pressure is flowing through the pilot assembly into the suction manifold).
7. Energize the pilot solenoid by turning the heat reclaim toggle switch to "on." The two gauge pressure readings should reverse, indicating the pilot solenoid functions correctly.
8. If both gauges read low or high at the same time, the pilot assembly is either dirty or bad. (Two highs usually means the pilot assembly must be replaced.)
9. To clean the pilot, do the following:
   a. With gauges connected to the pilot assembly as in Figure IX-12, shutoff the pressure source to the center gauge hose and open the hose to the atmosphere.
   b. Open both gauges hand valves ("A" and "B").
   c. Energize and de-energize the pilot solenoid several times. This will blow any dirt backwards out of the pilot valve with suction pressure.
   d. Recheck for proper operation.

<u>To Disassemble Main Valve</u> - CAUTION: THE UNIT MUST BE SHUT DOWN FOR DISASSEMBLY. Loosen all screws in both end caps. Tap the end caps lightly to unseat them. This will release any vapor left in the valve. Then remove all the screws, both end caps, and carefully slide out interchange spool.

NOTE: The interchange spool must be handled with extreme care. It has been fitted to a very close tolerance and even small nicks or scratches will impair its smooth operation. This spool will enter the valve body only when it is correctly aligned. Do not use force when attempting to fit the spool into the valve body.

It may help to cool the spool and apply a light coat of refrigeration oil before assembling.

The valve body end cap has offset screw holes and an alignment pin to prevent misassembly.

To Assemble the Main Valve - Replace the spool carefully. There is a large index pin on the cap and an alignment hole in the piston; and a small pin on the same cap and matching hole on the valve body. This prevents misassembly of the valve.

Oil the O-ring grooves in the ends of the valve. Insert new O-rings. Replace the end cap with the large index pin first, making sure the pin is entered into the spool locating hole. This aligns the spool within the body in the correct radial location. Replace the other end cap and tighten all screws.

The O-rings for the 3-way/4-way heat reclaim valve on Plus IV are No. 234 Buna N Rings measuring 3" I.D., 3 1/4" O.D., and have a 1/8 inch cross section.

NOTE: The interchange spool is honed to the valve in which it is assembled. Do not install the spool from one valve body into a different body. Even though the spool fits, unsatisfactory operation will result.

Replacement of Valve - Should a 3-way/4-way heat reclaim valve require replacement, the following will provide a guidance.

The all metal construction of this valve makes disassembly unnecessary while brazing, although over-heating of the connections will make brazing more difficult. Point the flame toward the copper tubing more than on the steel valve connections. DO NOT WRAP WET RAGS AROUND THE VALVE BODY WHEN BRAZING.

It is important that the tubing be formed accurately so that excessive strain is not exerted on the connections and valve body.

As used on Plus IV, no additional mountings other than the tubing to the connections are required.

Connection identification is stamped on the valve body adjacent to each connection. Plus IV connections are:

D = Discharge Inlet
C = Outlet to Condenser
HC = Outlet to Heat Coil
S = Pump Out Line

Table IX-1
Plus IV Alarm Signal Diagnostic Chart

Alarm Device	Compressor Number	Alarm Indication	Cause of Alarm
AD1 AD2 AD3 AD4 AD5	1 2 3 4 5 or Satellite	1. High pressure control 2. Oil differential switch open 3. Compressor inherent overload or solid state module tripped	1. Check for following items: a. Condenser fan belt loose or off b. Condenser fan motor inoperative c. Condenser fan cycling controls d. Condenser surface obstructed e. Faulty condensing pressure control valve f. Excessive non-condensables in system g. Defective high pressure control 2. See Note 1. 3. Excessive motor current
AD1	1	1. All compressors off	1. Check for following: a. Loss of refrigerant charge b. Suction filter plugged c. Liquid drier plugged d. Excessive number of systems on defrost
AD9		1. Timer motor 2. Hi suction pressure alarm control 3. Low liquid level alarm	1. Program timer motor failure 2. If timer motor OK then check following: a. Compressor time delay failure b. Low pressure control failure c. Excessive load conditions causing high suction pressure 3. Receiver level has been low for over 1/2 hour a. Check system for leaks b. Check for undercharge

NOTE 1. Oil differential switch can be tripped directly by low oil pump pressure or indirectly by a variety of electrical failures.

a. Check oil levels
b. Reset oil control, if compressor starts then check following items:
   (1) Oil pump pressure for defective pump. Pressure should be approximately 30-50 psi above suction pressure (Copeland).
   (2) Possible liquid refrigerant flood back causing oil pump to cavitate.
c. The following items can cause the oil switch to trip:
   (1) Compressor contactor coil failure.
   (2) Compressor circuit breaker tripped.
   (3) Compressor electric motor failure.
   (4) Compressor mechanically defective (broken crankshaft, etc.).

d. On models with oil equalizing lines, an obstruction in the suction line (for example a clogged suction filter) to one or more compressors can cause oil to be forced from compressor with higher crankcase pressure resulting in oil failure.

NOTE 2. The remote alarm can sense and give warning of the following additional failures:

a. Complete power failure.
b. Failure of 120 volt control circuit.
c. Tripping of single phase protector.

CDA VALVE

Section X

DESCRIPTION OF CDA COMPONENTS

The Sporlan CDA valves are designed for precise and energy efficient control of the temperature in refrigerators. Proper temperature is maintained by regulating refrigerant flow.

The use of the CDA temperature control replaces evaporator pressure regulators, Loadmaster valves, and conventional thermostats.

The CDA valve system of temperature control is composed of the CDA valve and the electronic components that operate it. The purpose of this section is to acquaint you with the components and their operation.

THE VALVE

CDA valves are factory installed in the suction branches on the compressor unit or on the header defrost assembly. The valves modulate by the change in the magnetic pull of the dc-operated solenoid. There are three sizes: the CDA-12 and the CDA-15 and 20, nominal 1 ton and 3 ton ratings respectively.

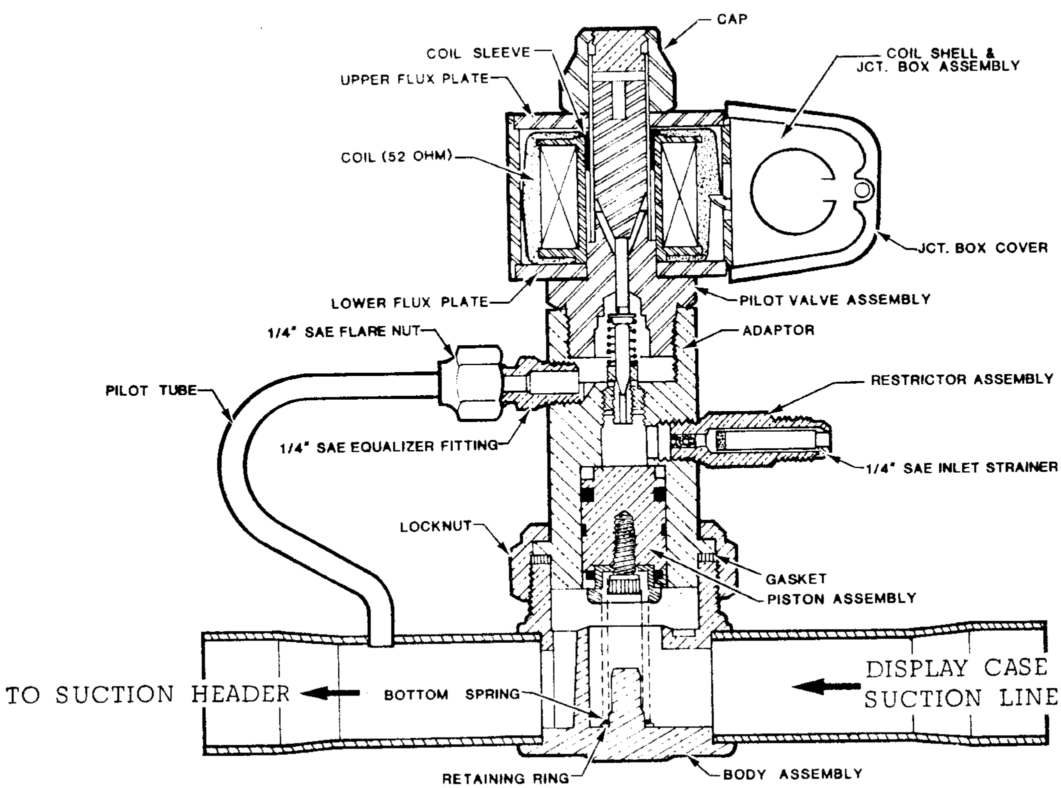


Figure X-1
CDA-12

Valve Construction - The CDA 12 valve differs slightly in construction from the CDA's 15 and 20, but operation is identical for all sizes. Figures and show cross sections of the valves.

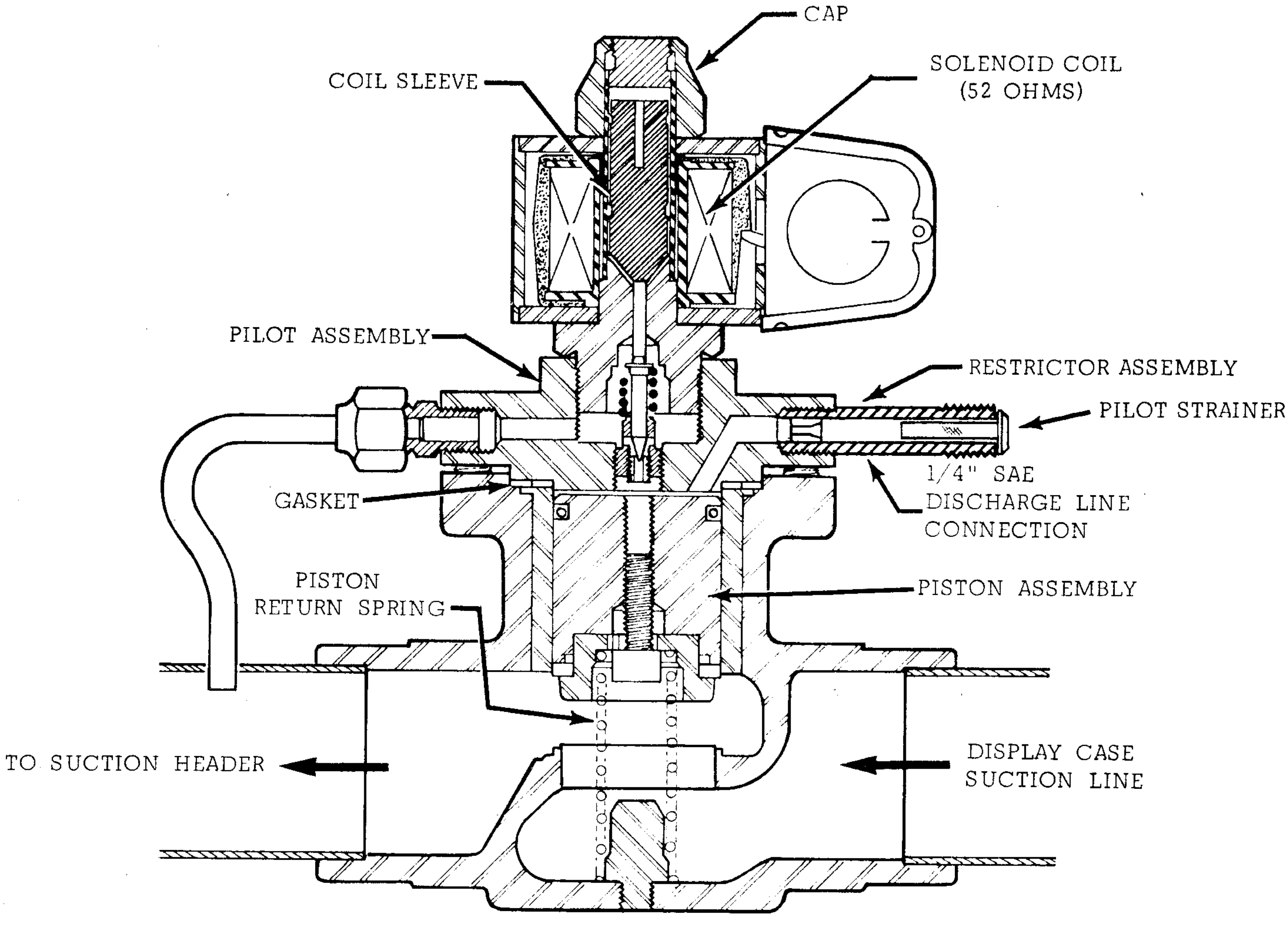


FIGURE X-2
CDA-15 AND CDA-20

Valve Operation - The CDA is pilot operated, requiring discharge pressure to close the valve. The valve is serviceable without removal from the suction line, and consists of a solenoid, pilot assembly, piston, piston return spring, and valve body. An exploded view of the CDA 15 and 20 is depicted on page 11 .

The main port of the CDA-20 is modulated by bleeding a controlled amount of discharge pressure to the chamber above the valve piston. The discharge pressure enters the piston chamber through an orifice and then drains through the modulating pilot valve to the suction line downstream of the valve; thus, as the pilot valve opens, the pressure decreases in the piston chamber and the piston return spring pushes the piston upward, opening the valve.

CDA CONTROL COMPONENTS

The components which control the CDA valve consist of a plug-in thermostat, a panelboard, a refrigerator air temperature sensor, and a 24 volt ac output transformer.

Plug-in thermostat. The plug-in thermostat is the brain of the CDA system. It has a temperature adjustment dial, operational amplifier, full-wave rectifier, and wheatstone bridge circuit for modulating the electrical output to the CDA valve solenoid. Plug-in thermostats can be easily checked for proper operation (see Service Tips). Thermostat ranges are shown on the temperature adjustment dial (see Figure X-3).

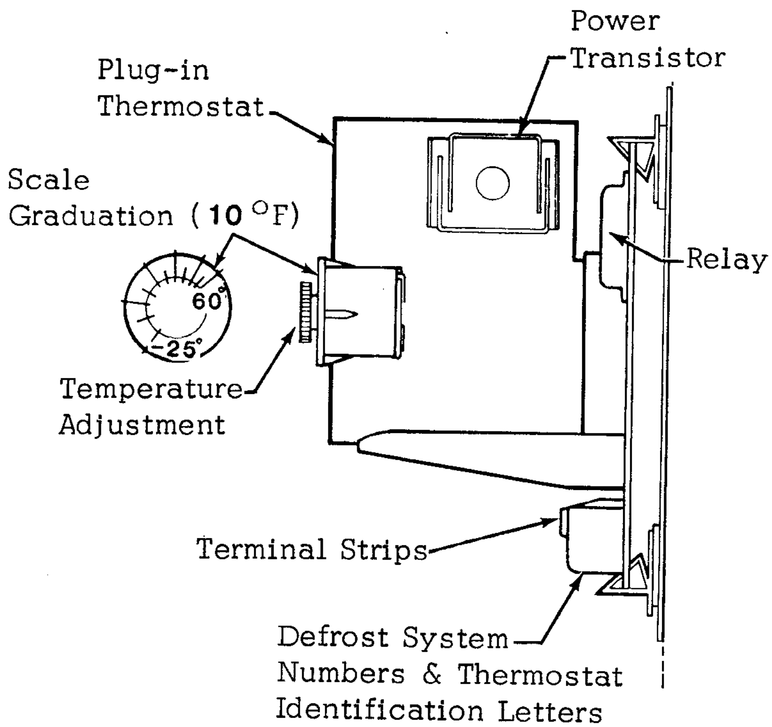


Figure X-3
Plug-in Thermostat

Operation of the plug-in thermostat is as follows (see Figure X-4):

1. The 24 volt ac power supply from the transformer is rectified to a variable dc voltage (0-34 volt dc).

2. When the temperature sensor's resistance is increased by a drop in temperature, a voltage difference occurs across the bridge circuit.

3. Voltage difference across the bridge is measured and amplified 50 times by the operational amplifier.

4. The operational amplifier transmits the amplified signal to the base of the transistor.

5. The current flow through the power transistor increases to a value equal to 100 times the base current. This current flows through the CDA solenoid coil to reposition the CDA valve and thereby regulate air temperature.

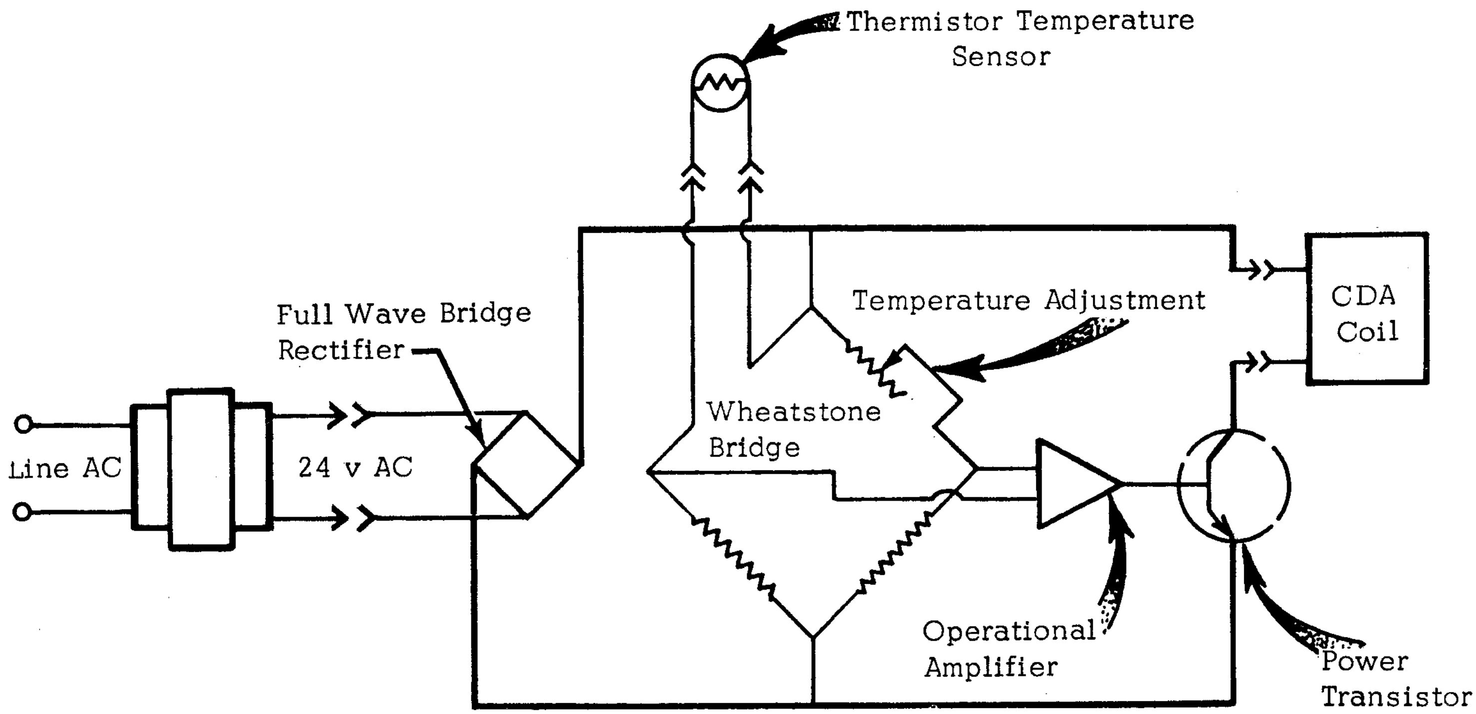


Figure X-4
CDA Plug-in Thermostat Diagram

Check.

Panelboard. The thermostat plugs into the panelboard; each section of the panelboard has slots to accept four thermostats. The panelboard has four wiring connections for each thermostat: two wires to the CDA valve solenoid, and two wires to the temperature sensor in the refrigerator. There are also terminals for wiring the defrost clock and for the 24 volt power supply from the transformer. The panelboard is equipped with a solid state reply that will cause the CDA valve to close when the defrost clock applies 208-240 volts to the CDA panelboard connections. Figure X-5 shows the panelboard wiring.

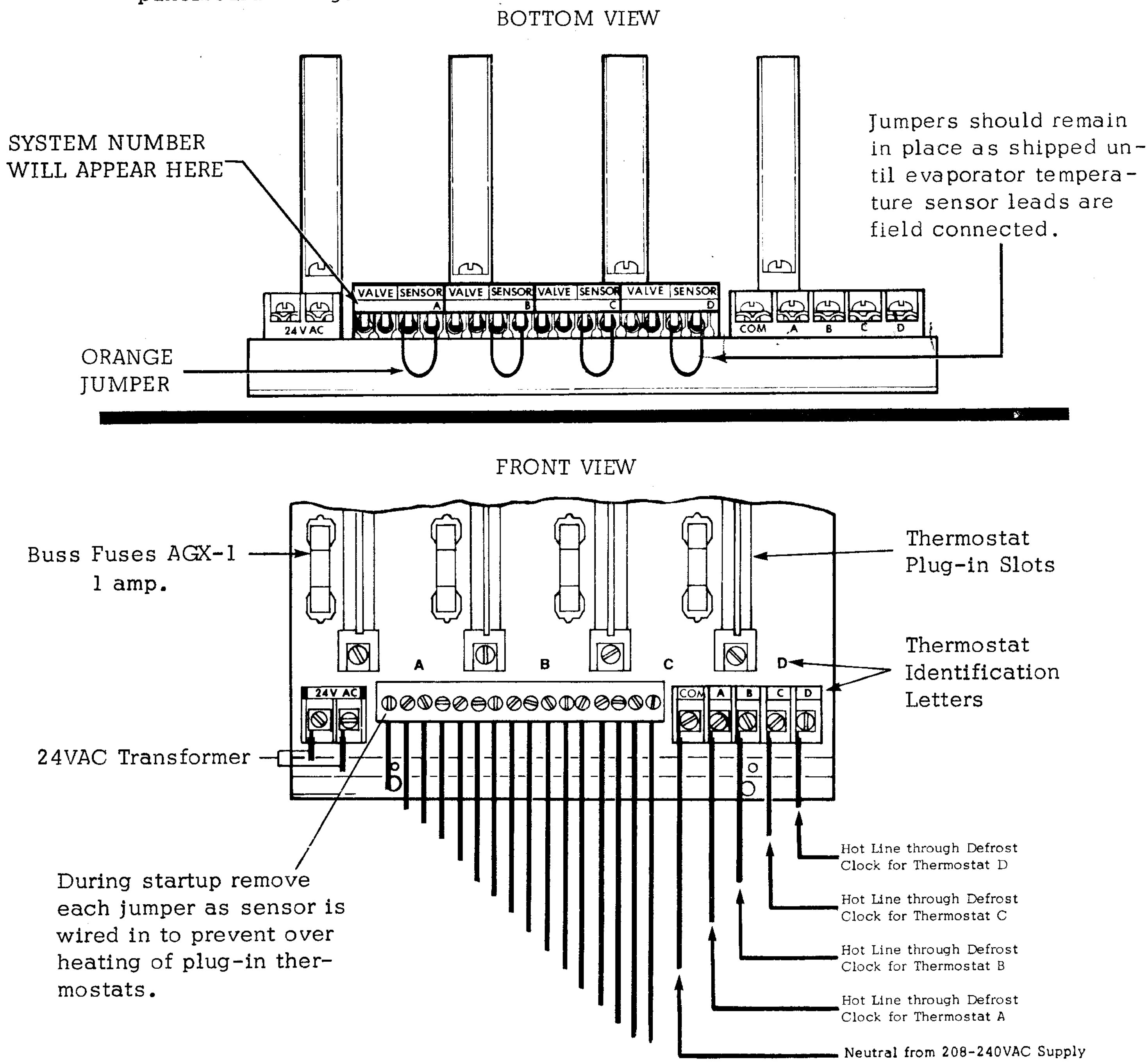


Figure X-5
Wiring Terminals on the CDA Panelboard

INSTALLATION AND SETTING PROCEDURE

INSTALLATION OF SENSOR WIRING

The only field wiring required for the CDA system is connecting the temperature sensor to the panelboard. Temperature sensors are already mounted in display refrigerators but wires must be run from the sensor to the panelboard. Use 14 gauge wire with 600 volt insulation. Route the sensor wiring in conduit to prevent damage. Each system (case or case line-up) has been assigned a number on the store legend. Corresponding system numbers are located on the panelboard terminal strip (see Figure X-5).

Temperature sensors for unit coolers and preparation areas are shipped in the compressor unit control panel and must be field installed. Locate the temperature sensor in the discharge air according to Figure X-9.

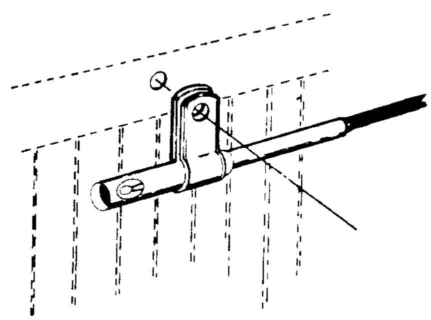


Figure X-9
Locate Temperature Sensor
In Discharge Air of Unit Cooler

CDA VALVE SETTING PROCEDURE

1. Insert the diagnostic board to make sure all systems are operational and no systems are on defrost. Then remove diagnostic board and install thermostat.

2. Set the CDA thermostat to the required temperature. See Table XII-8 for recommended control temperatures in Hussmann refrigerators.

3. Start the compressor unit and allow the fixtures to pull down.

   Note: This procedure assumes the refrigerators are too warm at the time of start up.

4. Place a thermometer in the air stream of the control fixture. For unit coolers, place the thermometer in the return air.

   Note: Further reference of control fixture and slave fixture will be as follows:

   Control Fixture - That refrigerated fixture which contains the CDA temperature sensor.

   Slave Fixture - The other refrigerated fixtures that are on the same suction line controlled by the CDA valve but do not contain the temperature sensor.

Setting Procedure (Cont'd.)

5. Allow a minimum of one hour operation at this setting. If the air temperature is more than $3^{o}F$ off of the desired setting, then adjust the CDA thermostat to bring it within this tolerance. Check those systems with the highest operating temperature first.

6. With the control fixtures adjusted to the correct temperature tolerance, the thermostatic expansion valve must be adjusted. To properly adjust the expansion valve, the CDA valve must not be allowed to control at this time. Mark the adjusted position of the CDA thermostat. See Figure X-3. Turn the thermostat adjustment to the coldest temperature (counter-clockwise). This will make the CDA valve open up and stay open until TEV adjustments are completed. Adjust all expansion valves that are controlled by the CDA valve at this time with the following procedure:

   a. Expansion valve must be adjusted to fully feed the evaporator. Before attempting to adjust valve, make sure the evaporators are either clear or only lightly covered with frost, and that the fixtures are within 10^{o} of their expected operating temperature. Adjust the valve as follows.

   b. Attach two sensing probes (either thermocouple or thermistor) to the evaporator: one under the clamp holding the expansion valve bulb, and the other securely taped to one of the return bends two-thirds through the evaporator circuit.

   c. Some "hunting" of the expansion valve is normal. The valve should be adjusted so that during the hunting the greatest difference between the two probes is 3^{o} to $5^{o}F$. With this adjustment, during a portion of the hunting, the temperature difference between the probes will be less than 3^{o} (at times as low as 0^{o}). Make adjustment of no more than one-half turn of the valve stem at a time and wait for at least fifteen minutes before rechecking the probe temperature and making further adjustments.

   Upon completion of setting the TEV's, reset the CDA thermostat to the reference setting. This should return the fixtures to the correct temperature tolerance.

7. Check the air temperature in the control fixture and make necessary adjustment on the CDA thermostat to bring it to the desired temperature. When making final adjustments, a minimum of thirty minutes must be allowed for system to balance to the new setting before checking results. This step should be repeated as many times as necessary to get correct control temperature.

8. Check the air temperature in all the fixtures and compare to the control fixture. A tolerance of $3^{o}F$ is an acceptable deviation from the control fixture. If one or more slave fixtures are out of this tolerance, then the cause must be found and corrected.

SERVICE TIPS

PLUG-IN THERMOSTAT

A dc voltmeter and 24 position switch is provided to test the plug-in thermostat. Turn the switch to the system number to be tested. Systems are numbered according to the store legend. Operation can be confirmed by placing a jumper across the sensor terminals to open the valve. The dc voltmeter should show almost no voltage when the sensor terminals are shorted and more than 20 volts when one sensor lead is disconnected.

If either test indicates a wrong voltage, replace the plug-in thermostat with another of the proper temperature range. If the problem is still apparent, check the wiring to the sensor and CDA solenoid according to the following procedure.

SOLENOID COIL

To check the coil, measure its resistance. The reading should be approximately 52 ohms at 70°F.

TEMPERATURE SENSOR

To check the temperature sensor, measure its resistance. The reading should be approximately 1000 ohms at 77°F. See Figure X-7 for resistance at other temperatures. See Figure X-11 for temperature sensor location in refrigerator fixtures.

VALVE REPLACEMENT

The following steps should be followed when installing the CDA valve:

1. Wrap the valve in wet cloth.

2. Solder or braze the body into the suction line. Heat should be applied away from the valve body. Low melting point, high strength solders such as 'Staybright' 95% tin and 5% silver is recommended to keep the valve body at as low in temperature as possible.

3. Reconnect the solenoid coil wires to the panelboard.

4. Test the system by plugging in the diagnostic board.

5. Adjust the CDA valve (see Settings Procedure).

DISSASSEMBLY OF CDA VALVES

The solenoid on the CDA valve can be serviced by removing the knurled nut holding the coil assembly in place.

To service these controls will require:

1. Close service valve located on receiver that feeds Koolgas main header. Connect gauge manifold to Schrader valve located on Koolgas main header and to low side of compressor rack.

2. Reduce Koolgas header pressure to 1 psig. Remove and plug 1/4" flair connection on valve requiring isolation.

3. To reinitiate operation of other controllers, close gauge manifold and open receiver Koolgas service valve.

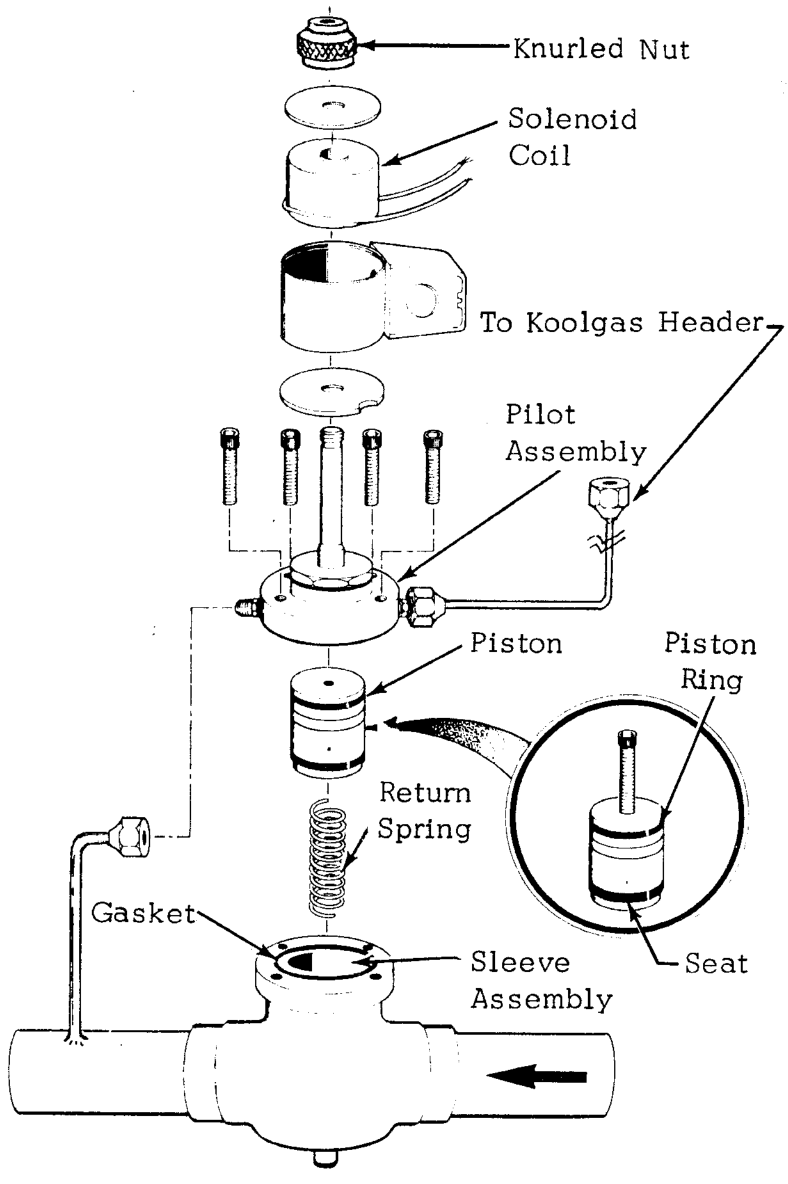
To disassemble the CDA valve.

4. Disconnect the suction pilot from the four bolts holding the pilot assembly with a 1/4 inch Allen wrench. Lift off the pilot assembly.

5. Remove the piston assembly by screwing one of the cap screws (previously removed in 3) into the threaded hole in the center of the piston out. Take precautions not to damage the piston ring.

6. Inspect the flange gasket and replace if worn or delaminated. Inspect the Nylatron seat for damage. Replace if necessary.

7. Reassemble by reversing the procedure. The pilot assembly has a locating pin to prevent misassembly.



CDA-15&20 Exploded View

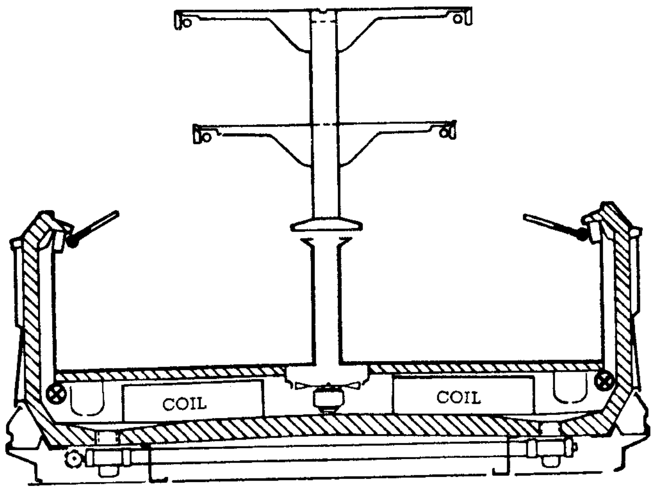
INTRODUCTION TO DIAGNOSTIC CHART

Poor refrigeration performance can be the result of causes other than the CDA valve. To eliminate guesswork, carefully observe the problem and screen out other possible causes before concluding the CDA valve is malfunctioning. For example:

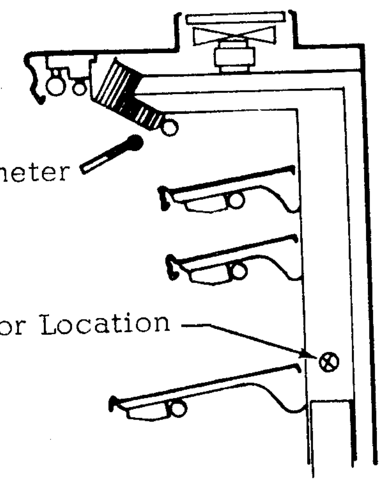
> Be sure all refrigerators controlled by the valve are performing poorly. If only some are, the CDA valve is probably not at fault; the fault is probably within the refrigerators.
>
> If all refrigerators are performing poorly, install pressure gauges at the nearest taps on each side of the CDA valve.
>
> Note the present setting of the thermostat and turn the dial to the coldest possible setting. The pressure difference across the valve should be 2 psi or less which indicates the valve is wide open.
>
> Next, turn the thermostat to the highest setting. The pressure difference should be significantly higher.
>
> If both gauge readings are correct, the problem is not with the CDA valve or its control.

Table X-2
Diagnostic Chart

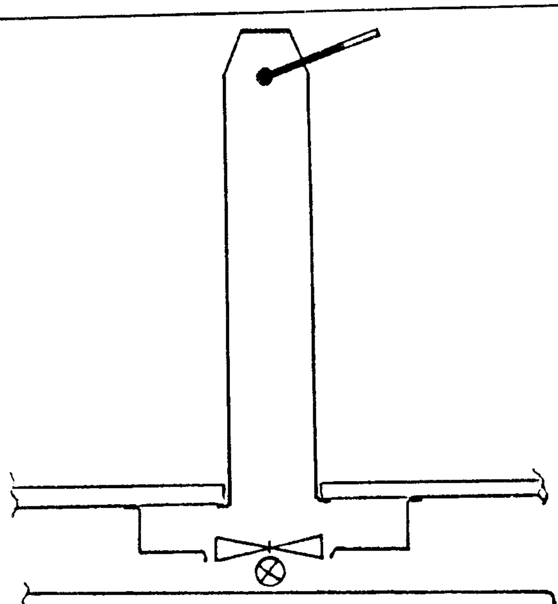
Malfunction	Diagnostic Board Indicator Lights	Possible Cause	Action
Valve Stays Closed	1. Defrost (lit)	1. Defrost in "on" mode	1. Readjust or repair defrost timer
	2. Sensor (unlit)	2a. Open circuit in temperature sensor wiring	2a. Locate and correct
		b. Temperature sensor damaged	b. Replace sensor
	3. Beyond scope of diagnostic board	3. Plug-in thermostat circuit defective or wrong range	3. Replace circuit
Valve Stays Open	1. 24V (unlit)	1. No 24vac to panel board	1. Verify 24vac supply
	2. Sensor (unlit)	2a. Short circuit in temperature sensor wire	2a. Locate and correct
		b. Temperature sensor damaged	b. Replace sensor
		c. Low temp case - frost on temperature sensor in flue	c. Relocate sensor away from evaporator
	3. Coil (unlit)	3a. Open circuit in coil wiring	3a. Locate and correct
		b. Coil has open winding	b. Replace coil
	4. Defrost (unlit)	4. No voltage or low voltage defrost signal	4. Readjust or repair defrost timer
	5. Beyond scope of diagnostic board	5a. Discharge to suction pressure difference below 45 psi	5a. Raise discharge pressure
		b. Plug-in thermostat circuit defective or wrong range	b. Replace circuit
		c. Blocked orifice or restricted strainer	c. Repair or replace Restrictor Assembly
		d. Valve held open by solder or dirt	d. Repair or replace valve
		e. Panel board damaged	e. Replace panel board
		f. Panel board relay defective	f. Replace panel board
Valve Does Not Control Temp.	1. Sensor (unlit)	1a. Temperature sensor damaged	1a. Replace sensor
		b. Open or short circuit in temperature sensor	b. Locate and correct
	2. Beyond scope of diagnostic board	2a. Plug-in thermostat circuit defective	2a. Replace circuit
		b. Valve damaged	b. Repair or replace valve



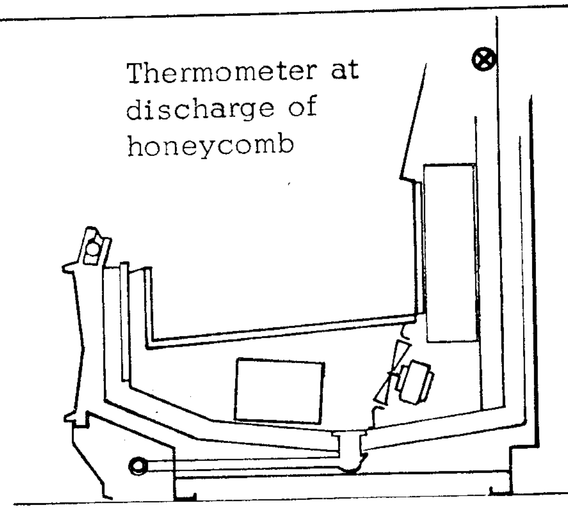
GWI - GWIT



FHM - FHMG - FHMS

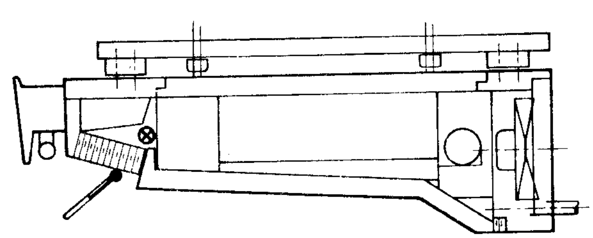


BTF



R6 - G6 - G5
(FROZEN FOOD ONLY)

NOTE: Locate the thermometer in the return air and the sensor in the discharge air of unit coolers.



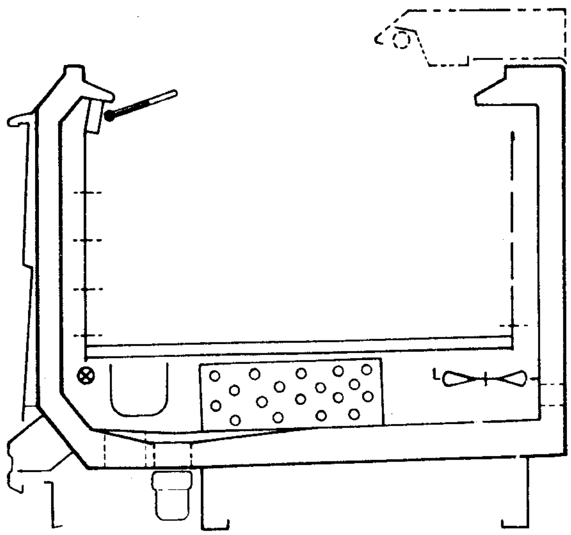
JVMR - JVMRS

Figure X - 11

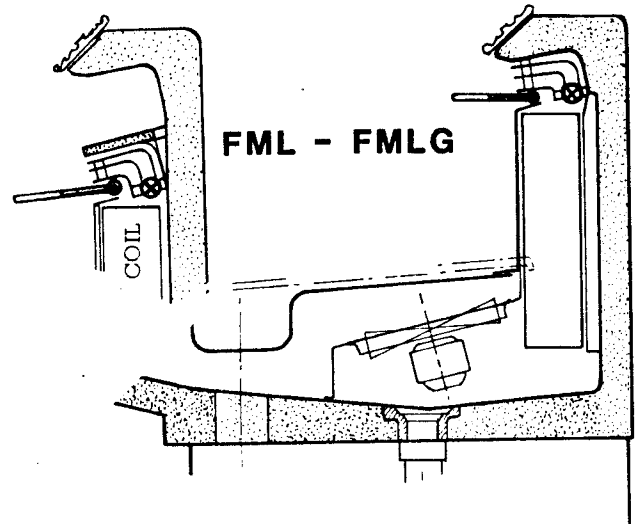
Thermometer and
Temperature Sensor Location

Thermometer

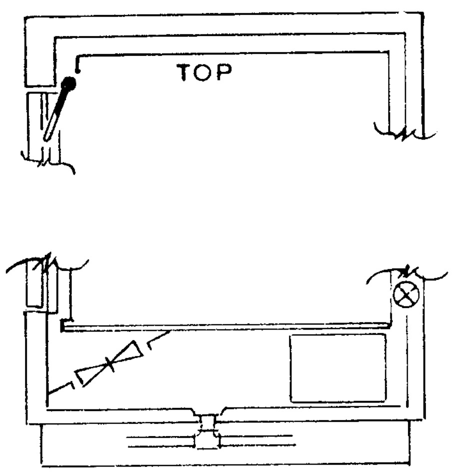
⊗ Sensor



GC(I)-GF(I)- GG(C)

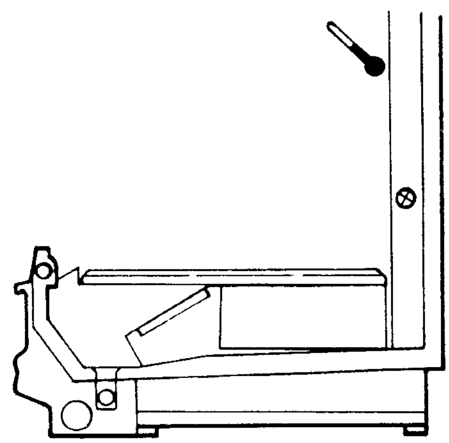


FM - FMG - FMRG

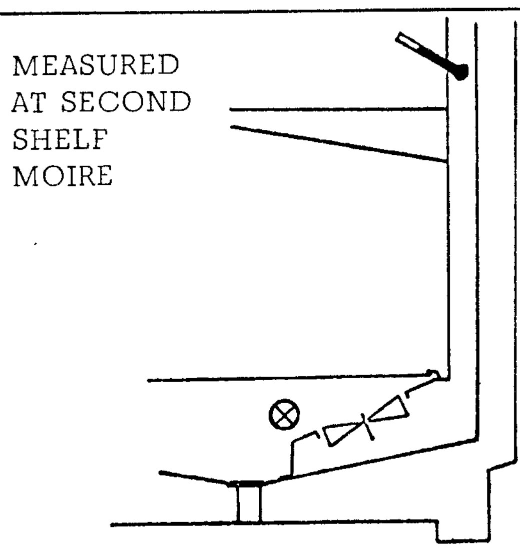


REACH - IN

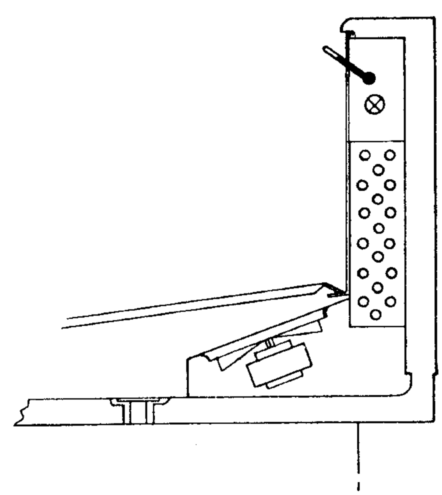
RHF - RHC - RHM



DM-DMD
RVM-JVM-JVMH



BHDB



P

CDA COMPONENTS PARTS LIST

Components	Sporlan Parts Number	Hussmann Parts Number
CDA-12 valve	CDA-12	P009 0251900
CDA-15 valve	CDA-15	P009 0260254
CDA-20 valve	CDA-20	P009 0251901
Coil	MKC-CDA-52 OHM	P011 0251901
CDA-12, 15, & 20 Valves includes the following Internal Parts Kits:		
Kit Number	Kit Contents Description	
KS-CDA-12 (Pilot Valve Included)	Pilot Body Piston Assembly Bottom Spring* Pilot - Body "T" Seal*	
KS-CDA-15 (Pilot Valve Not Included)	Piston Assembly Sleeve Assembly Bottom Spring* Pilot-Body "T" Seal*	
KS-CDA-15P	Pilot Valve Assembly Pilot-Body "T" Seal*	
KS-CDA-20 (Pilot Valve Not Included)	Piston Assembly Sleeve Assembly Bottom Spring* Pilot-Body Gasket*	*Individual Gasket/Springs
KS-CDA-20P	Pilot Valve Assembly Pilot-Body Gasket*	
Temperature Sensor (10 ft. lead)	2232-1	P211 0252213
Panelboard (for four plug-in thermostats)	2238-2	P011 0252691
Diagnostic Board	2241	P011 0252852
Relay (24 volt)	--------	P011 0147560
Voltmeter Assembly	--------	FA010 0143951
Transformer	9T58B2881 (GE brand)	P011 0149614
Varistor	V33ZA5 (GE brand)	P011 0149616
Thermostat		
	TP	P011 310856

SYSTEM START UP AND CHECK-OUT

Section XI — Page

SYSTEM START UP AND CHECK-OUT

PREPARATION

To simplify the following procedures and future servicing, turn to the chapter "Control Settings" and write down all recommended control settings where they will be visible during setting and servicing.

Prior to each of the following procedures (leak testing, evacuation, charging, and start up) be sure the refrigeration system has been prepared according to the following steps. These steps prepare the system for unrestricted refrigerant flow by opening all shutoff, solenoid, and regulating valves.

1. Turn off main and control circuit power at the store distribution panel.
2. Turn off compressor control circuits at the compressor control panel and the Remote Satellite (if so equipped).
3. Open all EPR, TEPR, CDA, and shutoff valves. See Figure I-1 in the chapter "Refrigeration Process" for valve locations.
4. Disconnect and tape the end of the red wire from the time clock motor in the control panel so the clock will not rotate when control circuit power is applied.
   NOTE: The defrost control panel will be located on the header defrost assembly if so equipped. Terminal numbers and jumpering procedures will remain the same.
5. Install a jumper from terminal X1 to CC#. Install a jumper from Z1 to X1.
6. Turn on control circuit power at the store distribution panel.
7. Turn on the control circuit.
8. Turn on system shutdown switches at the control panel.
9. Adjust the timer so all systems are in the refrigeration mode. All the defrost indicator lights should be out.

LEAK TESTING

The success of the following procedures (evacuation, charging, and start up) as well as the successful operation of the system, depends on a totally leak free system. Take your time and do a thorough job when leak testing.

Pressurize the system with a refrigerant-nitrogen mixture and check with an electronic leak detector. The refrigerant will be removed in the evacuation process so it makes no difference which type is used. You may check the system in parts or as a whole; the size of the system will dictate the best approach. This procedure will test the whole system, one compressor group at a time.

Caution: Do not start any compressors during this procedure, as serious compressor damage could result.

1. Construct a charging apparatus to introduce refrigerant and dry nitrogen.

   WARNING: WHEN USING HIGH PRESSURE NITROGEN, ALWAYS USE A PRESSURE REGULATOR AND PRESSURE RELIEF VALVE. FOLLOW ALL SAFETY RULES. BE CAREFUL!

2. Connect the pressurizing line to the receiver liquid line valve gauge port.

3. Slowly charge approximately 25 pounds of refrigerant into the system; then using the dry nitrogen tank, pressurize the system to 150 psig.

   Note: If higher than 150 psig is to be used for pressure testing, close the shutoff valve on the Ultima compressor controller prior to pressurization to avoid damage to the bellows.

   Oil level regulators must also be isolated to prevent damage to the floats. Turn off the oil supply line from the reservoir and the oil vent line shutoff valves to the individual compressors.

   If units are equipped with Satellites (mounted or Remote), turn off the suction, discharge, and oil supply service valves.

4. Using an electronic leak detector, carefully check the entire system for leaks. Take special care to inspect all connections. If leaks are found, isolate that system with hand valves, release the pressure, and repair them immediately. Do not attempt to repair leaks while the system is under pressure. Allow the system to stand for 12 hours with the pressure on; if no pressure change is observed, the system is tight.

5. When each system is proven leak free, release the pressure and remove the charging apparatus. Turn the control circuit off and open all valves.

PRELIMINARY OIL CHARGING

The compressor crankcase oil level should be between 1/8 and 1/2 of each oil level regulator sightglass. In the oil reservoir, maintain a level between the two sightglasses. The unit is factory charged with Suniso 3G oil. Add only Suniso 3G or Texaco Capella WF32 oil

EVACUATION

Complete evacuation is extremely important in guaranteeing good performance. An improper evacuation will cause service problems, lost time, and poor system performance. Hussmann recommends a triple evacuation process; we feel this is the most practical method for field evacuation.

Use a large displacement vacuum pump (8 CFM) capable of at least 500 microns absolute. Connection lines should be copper tubing at least 3/8 O.D. Do not start any compressors during these evacuation procedures, as serious damage could result.

1. The system should be prepared for unrestricted evacuation according to the steps at the beginning of this chapter. The defrost control circuit should be on.

2. Install a compound gauge on the low pressure side of the system to be evacuated.

3. Connect the vacuum pump so evacuation will occur from the Plus System high pressure side and both Plus System and Satellite low pressure sides. This can be done by installing a tee on the discharge valve of compressor No. 5 (or 4 if an S40 model) and connecting one copper line from the tee to the vacuum pump and the other line from the tee to the suction service valve of the same compressor. Install an electronic vacuum gauge on the system outside the machine room as far as possible from the vacuum pump.

4. Back-seat the main liquid line shutoff valve on the receiver. Connect a refrigerant tank, with gauge and dehydrator to the valve. (A 16 cubic inch drier should be used on a 145 pound cylinder.) Because the refriggerant charge will be removed, it makes no difference which refrigerant is used.

5. Evacuate the system to 1500 microns, purge the refrigerant charging line, and break the vacuum with a refrigerant charge to 2 psig.

6. Again evacuate the system to 1500 microns and break the vacuum with a refrigerant charge to 2 psig.

7. Install the liquid drier cores in the drier shell.

8. Now evacuate the system to 500 microns and allow the system to stand for a minimum of 12 hours for a final leak-test. If no pressure change is observed at the end of this time, the system is ready for charging.

9. After the system has been proven leak tight, break the vacuum with the proper refrigerant for that system and remove the vacuum gauge and pump.

10. Turn off the control circuit.

CONDENSER CHECKOUT

If the preliminary checkout of the condensers was not done after the condensers were installed, turn to the chapter "Condenser Installation" and do so at this time.

PRELIMINARY CHECK OF CONTROL SETTINGS

1. Close the Ultima compressor controller shutoff valve and remove the wooden shipping block which is taped to the sequencer.

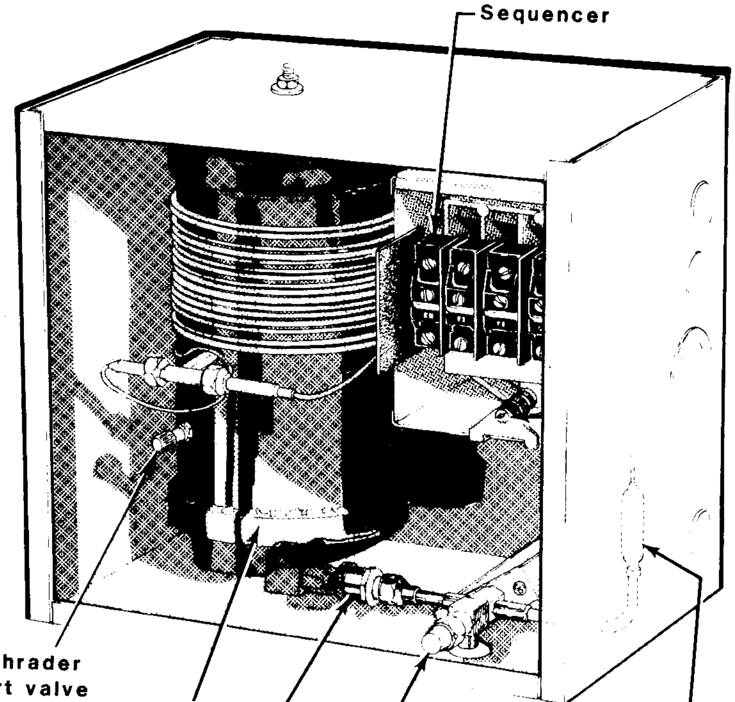


Figure XI-1
Ultima Compressor Controller

2. Connect a voltmeter or neon test light to the red and yellow terminals of the sequencer. (Sequencer switch No. 3 controls compressor number 3, 4 controls compressor number 4, etc.)

3. Open the compressor circuit breakers and turn on the compressor control circuit.

4. Charge the proper refrigerant into the pressure reservoir through the Schrader port and observe the opening and closing of the switches.

The appropriate cut-out pressure for compressor No. 5 (or 4 on a S4 model) is given in the chapter "Control Settings." The cut-out pressures for the remaining compressors are fixed at 2 psig lower for each succeeding compressor. The cut-out pressure for each compressor is fixed at 5 psig above the cut-out pressure for the same compressor. Open the shutoff valve after checking the settings.

5. Set the high suction alarm controls located in front of the compressors according to the table in "Summary of Control Settings."

6. Press the reset button on the high pressure safety control and the oil failure control on each compressor.

CHARGING AND INITIAL START UP

At this stage, all power at the store distribution panel should be off, and the condenser disconnect on the roof should be closed. Charge and start the system as follows:

1. Check that the compressor and defrost control circuit switches are off. Turn on all main power and 230 volt power at the store distribution panel.

2. Connect the proper refrigerant tank with a charging line equipped with a shutoff valve to the main liquid line valve at the receiver. Purge the charging line before tightening the connections.

CAUTION: LIQUID CHARGING MUST BE DONE ON THE HIGH PRESSURE SIDE ONLY. LIQUID CHARGING ON THE LOW PRESSURE SIDE CAN CAUSE SERIOUS COMPRESSOR DAMAGE. NEVER TRAP LIQUID BETWEEN CLOSED VALVES.

3. Front-seat the liquid line valve. Slowly open the valve on the refrigerant tank and charge liquid into the system. Continue charging until you hear the refrigerant flow slow down.

4. To accelerate charging, close the compressor circuit breakers, turn on the control circuit and compressor No. 1 and No. 2 switches. The compressors will start one at a time in about 30 seconds. During the charging operation, the suction pressure should remain below 20 psig for low temperature units and 45 psig for medium temperature units. If necessary, start compressors No. 3 and 4 to maintain suction pressure below these limits.

CAUTION: Because this is the initial start up of the compressors, be particularly watchful for peculiar pressure readings or compressor operation. Turn off the compressors at the first sign of trouble. Keep a close watch on compressor oil levels throughout the charging operation.

5. Charge the system to approximately 30% of the receiver level as indicated on the liquid level indicator.

6. When the 30% refrigerant level is obtained, close the valve at the refrigerant tank and back-seat the liquid line valve at the receiver. This allows refrigerant to flow through the entire system and should cause the refrigerant level to drop to approximately the 15% level.

7. If the refrigerant level drops below the 15% level, repeat the charging procedure until a 15% level is reached with the liquid line valve back-seated. Leave the refrigerant tank connected after the charging is complete because during the first hours of running, additional refrigerant is often required. Approximately 20 - 100 pounds of refrigerant should be added to compensate for heat reclaim coil requirements. See Section XII - 4 and 5 on Winter Charging.

OIL CHARGING REQUIREMENTS

After the equipment has been started and initial refrigerant charging is completed, all compressors should be turned off and oil levels must be checked. All compressors should have been running prior to shutdown. With all compressors off, all oil level sightglasses should be about 1/2 or less. The oil level in the oil reservoir should be maintained between the two sightglasses. If adjustment of the oil regulators is necessary, see Service Tips in the chapter "Compressor Installation."

BALANCING STORE REFRIGERATORS

Balancing of the refrigerators to Plus System is mandatory to obtain proper compressor operation and to insure the maximum temperature performance and efficiency of Hussmann refrigerators.

If Plus System is equipped with either CDA valves or Loadmasters, a thorough understanding of their operation is required. For CDA setting procedures, see the chapter "CDA Valve." For an understanding of Loadmaster valves, see Loadmaster Installation Instruction #146180.

The following guidelines apply to total store balancing for refrigerators using Loadmaster valves:

1. Thermometers must be placed in the control fixture of each system no later than 2 hours after the compressors have been started. The locations for these thermometers are shown in the Loadmaster installation instructions or in the CDA valve chapter. The use of thermometer kits installed in cases cannot be used because they are not located in the proper location required for adjustment of the refrigerators.

2. Adjustment of Loadmasters to a rough temperature should be started no later than 2 hours after start up. The highest temperature refrigerator first. This preliminary adjustment can be off as much as $5^{o}F$ if desired.

3. After all the preliminary temperature adjustments have been made on the Loadmasters, the refrigeration system should be allowed to operate in this mode from 12 to 24 hours before further adjustments are made. This allows sufficient time for compressors to balance to near operating suction pressure and allows the heat load of the hot cases and coolers to be removed.

4. Final adjustments must be made with one system at a time until all systems are completed. Before adjusting a system, thermometers are required in all refrigerators of that particular system. For each system, open the Loadmaster by turning the adjustment screw full clockwise, adjust TEV's, then re-adjust the Loadmasters to the exact temperature required.

5. After all branches have been adjusted the refrigerators should operate at peak efficiency and maintain proper temperature control. Balancing should be rechecked after 2 weeks.

SETTING OPEN PREPARATION ROOM CONTROLS

1. Install a low pressure gauge (0-60 psi) on each pressure tap.

2. Manually turn the temperature control valve to the maximum cold setting and observe gauge "A" and "B" reading.

3. Turn off one or more compressors to raise suction pressure.

4. When suction pressure (gauge "A") reaches 30 psi, the CPR valve should start throttling. This will make gauge "B" increase rapidly. Adjust the valve as required to obtain this operating condition.

5. Set the temperature control valve to maintain approximately 45°F coil discharge temperature. This may require deviation to satisfy local requirements.

It is possible to create frost on the coils and it is recommended that at least one defrost per day be initiated on this branch. This would also apply to closed preparation rooms. The recommended defrost length is a minimum of 60 minutes.

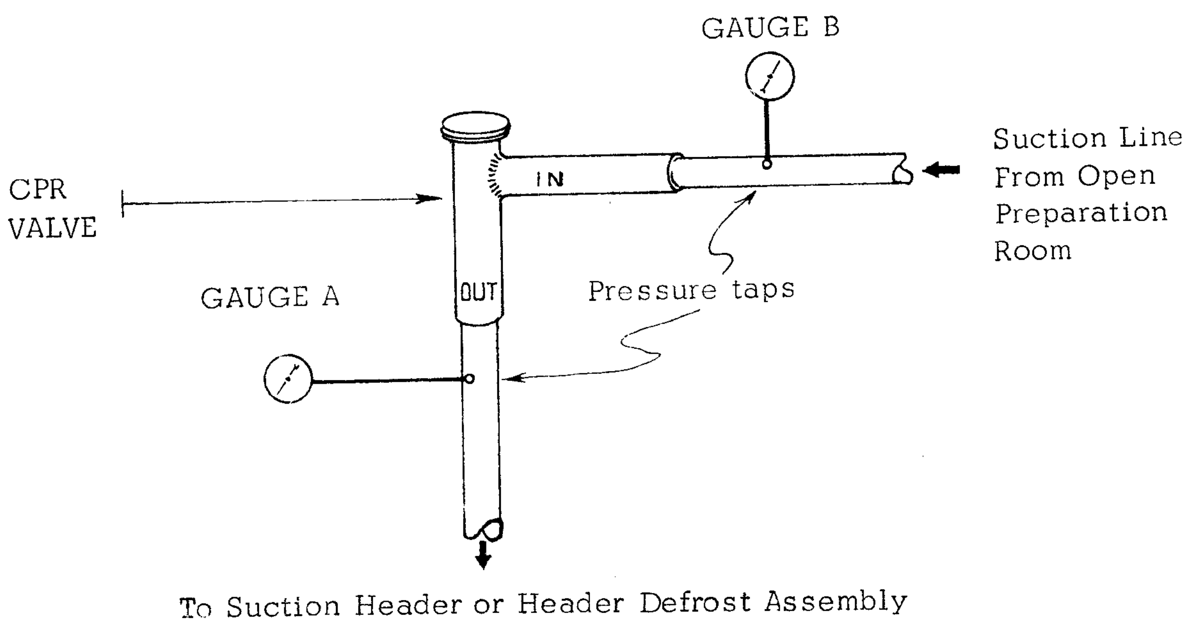


Figure XI-2
CPR Valve Adjustment

FINAL CHECKS

1. Check oil level.

2. Check refrigerant level.

3. Remove the jumper wires from the control panel.

4. Set the time clock to match the proper time. Reconnect the red wire to the time clock.

5. Remove all gauges from the system. Install all service caps. Check that caps are tight.

6. When refrigerators are completely stocked, check the operation of the system again.

7. After approximately 2 weeks of operation, the liquid drier cores and suction filters should be replaced.

8. Recheck the entire system after 90 days. Check for leaks at valves, liquid alarm and flare connections.

9. Recheck all field wiring.

10. Check compressor mounting bolts, tighten to 50 ft. lbs.

CONTROL SETTINGS

Page

Section XII

CONTROL SETTINGS

Table XII-1
Condenser Fan Cycling Control Settings

THERMOSTATIC FAN CONTROL

CONTROL SETTINGS				
NUMBER OF THERMOSTATS	CUT-IN SETTINGS FOR THERMOSTATS - °F			
	TC-1	TC-2	TC-3	TC-4
1	75°	—	—	—
2	68°	75°	—	—
3	60°	70°	75°	—
4	55°	65°	71°	75°

SET CUT-OUT 5°F BELOW CUT-IN

THERMOSTATIC FAN CONTROL WITH PRESSURE OVERRIDE

CONTROL SETTINGS								
NUMBER OF THERMOSTATS	CUT-IN SETTINGS FOR THERMOSTATS - °F					PC-1 SETTINGS psig.		
	TC-1	TC-2	TC-3	TC-4	TC-5	REFRIG.	CUT-IN	CUT-OUT
2	80°	75°	—	—	—	R-12	158	117
3	80°	75°	55°	—	—	R 22	260	196
4	80°	75°	65°	50°	—	R-502	283	216
5	80°	75°	70°	60°	50°			

SET CUT-OUT 5°F BELOW CUT-IN

PRESSURE CONTROL B WITH GRAVITY DAMPERS

NUMBER OF FANS		CONTROL SETTINGS					
			PRESSURE SWITCH CUT-IN SETTINGS psig				
SINGLE BANK	DOUBLE BANK	REFRIG.	PC-1	PC-2	PC-3	PC-4	PC-5
1	NA	R-12	143	—	—	—	—
		R-22	215	—	—	—	—
		R-502	236	—	—	—	—
2	2×2	R-12	143	152	—	—	—
		R-22	215	247	—	—	—
		R-502	236	270	—	—	—
3	2×3	R-12	143	147	152	—	—
		R-22	215	231	247	—	—
		R-502	236	253	270	—	—
4	2×4	R-12	143	146	149	152	—
		R-22	215	225	236	247	—
		R-502	236	247	259	270	—
5	2×5	R-12	143	145	148	150	152
		R-22	215	233	231	239	247
		R-502	236	244	253	261	270

SET CUT-OUT 35 psig BELOW CUT-IN

COMPRESSOR CYCLING PRESSURE CONTROL SETTINGS

Ultima compressor controller has been set to provide the lowest evaporator temperature connected to the Plus IV unit. In addition, a factory set and sealed low limit stop is provided to prevent destructively high compression ratios.

DO NOT TAMPER WITH THE SETTING OF THIS STOP WITHOUT WRITTEN AUTHORIZATION FROM HUSSMANN'S SERVICE OR ENGINEERING DEPARTMENT, BRIDGETON, MISSOURI.

The following table contains the proper evaporator temperatures and corresponding pressure settings.

In 48 54 57
Out 51

Table XII-2
Ultima Pressure Control Settings

Evaporator Temperature (°F)	Compressor No. 4 Cut-out (psig) R502	Evaporator Temperature (°F)	Compressor No. 4 Cut-out (psig) R502	R22	R12	Evaporator Temperature (°F)	Compressor No. 4 Cut-out (psig) R502	R22	R12
-35	5.0	-21	12.3			6	34	27	8.9
-34	5.3	-20	13.0			7	35	28	9.6
-33	5.7	-19	13.75			8	36	29	10.2
-32	6.1	-18	14.4			9	37	30	10.8
-31	6.6	-17	15.2			10	38	31	11.5
-30	7.0	-16	16.0			11	39	32	12.2
-29	7.5	-15	17.0			12	40	33	12.8
-28	8.0	0	28	21	5	13	41	34	13.5
-27	8.5	1	29	22	5.6	14	42	35	14.2
-26	9.1	2	30	23	6.3	15	43	36	14.8
-25	9.65	3	31	24	6.9	18	47	39	16.7
-24	10.3	4	32	25	7.6	21	50	42	18.5
-23	10.95	5	33	26	8.2	25	55	47	21.3
-22	11.6								

NOTE: Cut-out will be Compressor No. 5 on S50 models, No. 4 on models S40 and S41.

SATELLITE LOW PRESSURE CONTROL

The temperature of refrigerators connected to the Satellite must be controlled by a thermostat controlling the motor contactor. Adjust the Satellite compressor low pressure control according to Table XII-3.

Table XII-3
Satellite Low Pressure Control

	Refrigerant	Cut-out	Cut-in
Medium Temperature	R12	5	15
	R22	20	30
	R502	25	35
Low Temperature	R502	1	10

These settings apply to low end and high end Satellites.

Table XII-4
High Suction Alarm Controls

Saturated Suction Temperature (°F)		Alarm Set Point (psig) (1)
Low Temperature R-502	- 35	25
	- 30	30
	- 25 to - 23	35
	- 22 to - 20	40
Medium Temperature R-502	+ 6 to + 12	55
	+ 15 to + 21	60
Me m Temperature R-22	+ 6 to + 12	47
	+ 15 to + 21	57
edium Temperature R-12	+ 6 to + 12	25
	+ 15 to + 21	31

(1) Set the alarm differential 10 psi below the alarm set point.

HEAT Reclaim
LOCKOUT
175/155

Table XII-5
High Pressure Safety Controls

Refrigerant	Control Settings
R12	230
R502, R22	355

Table XII-6
Compressor Oil Failure Control

Compressor	Oil Pressure Differential Switch		Time Delay (Seconds)
	Cut-in (psig)	Cut-out (psig)	
Copeland	7 - 11	12 - 18	90 - 150
Carlyle	4 - 6	9 - 12	45 - 75

Oil failure control is a manual reset safety device.

Table XII-7
Receiver Capacity

Model	Receiver Size (inches)	R502* (lbs.)	R22* (lbs.)	R12* (lbs.)
S540	14 x 72	307	306	339
S541, S550	14 x 90	387	386	428

*Based on 80% receiver capacity at 110°F liquid refrigerant.

Table XII-8
Heat Reclaim Lockout Pressure Settings

Ref gerant	SETTINGS (psig)	
	Cut-In	Cut-Out
502	165	145
₹22	150	130
R12	100	80

ADDITIONAL REFRIGERANT CHARGE REQUIRED FOR COMPRESSOR UNITS WITH WINTER CONDENSING PRESSURE CONTROL VALVES

The following table lists the pounds of refrigerant required to flood each condenser circuit 50%. This is the refrigerant charge required in addition to the normal summer operating charge and heat reclaim coil requirements. Multiply it by the number of circuits used by each compressor unit to determine the charge.

If the temperature is above 60°F, add the specified amounts of refrigerant when the system stablilizes after start up. If it is below 60°F but above the coldest expected temperature, some condenser flooding will already be occurring and the additional charge required will be correspondingly lower. Also, if the coldest expected temperature is above 20°F, the flooding charge required will be less than 50%. Use your judgment in estimating the required charge based on the value indicated in the table.

Table XII-9

APPROXIMATE FLOODING CHARGES FOR HACD CONDENSERS

HACD Model	Total Available Circuits	Pounds of Refrigerant (90°F)			
		R12		R22 and R502	
		Per Circuit	Total	Per Circuit	Total
10, 11, 13	18	1.1	20	1.0	19
12, 15	24	1.1	27	1.0	25
14	24	1.7	41	1.6	39
21, 23, 25	18	2.3	41	2.2	39
24, 30	24	2.3	55	2.2	51
27	24	3.4	82	3.2	78
31, 33, 38	18	3.4	62	3.2	58
37, 44	24	3.4	82	3.2	78
41	24	5.6	124	4.7	116
42, 46, 51	36	2.3	85	2.2	80
49	48	2.3	113	2.2	107
55	48	3.5	170	3.3	160
58	48	1.8	85	1.7	80
63, 69, 76	36	3.5	126	3.2	119
74, 88	48	3.5	168	3.2	159
82	48	5.3	253	5.0	238
83, 92, 101	42	4.0	168	3.7	158
98, 118	56	4.0	224	3.7	211
110	56	6.0	336	5.6	317
104	42	5.0	209	4.6	197
123, 148	56	5.0	279	4.6	263
138	56	7.5	419	7.0	395

WINTER CONDENSING PRESSURE CONTROL

With two or more compressors running adjust the controls as follows:

Table XII-10
Winter Condensing Pressure Control Settings

Application	Flooding Value (Liquid) ① ② 57	Receiver Pressure Control (Gas) ② 147
R502	190 psig	180 psig
R22	175 psig	165 psig
R12	120 psig	110 psig

① Increase this pressure by 1 psig for every two feet in height that the condenser is above the 6 foot minimum.

② It may be desirable at times to go below these recommended pressure settings in the interest of power savings, but discretion should be used so as not to affect refrigeration performance. Absolute minimum receiver pressure is 140 psig for R502, 125 psig for R22, and 80 psig for R12. Even these settings may result in marginal performance.

Table XII-11
EPR Pressure Settings

Evaporator Temperature (°F) ①	EPR Pressure Settings ②	Evaporator Temperature (°F) ①	EPR Pressure Settings ②
-25°	10 (R502)	+15°	44 (R502)
-22°	12 (R502)		36 (R22)
-20°	13 (R502)		16 (R12)
-15°	17 (R502)	+18°	48 (R502)
+6°	35 (R502)		39 (R22)
	27 (R22)		18 (R12)
	10 (R12)	+21°	52 (R502)
+9°	38 (R502)		42 (R22)
	30 (R22)		20 (R12)
	12 (12)	+25°	57 (R502)
+12°	41 (R502)		47 (R22)
	33 (R22)		23 (R12)
	14 (R12)	+30°	64 (R502)
			53 (R22)
			26 (R12)

① Pressure settings are based on a nominal 2 psi pressure drop assumed to be in the suction line when the control is mounted in the machine room.

② When EPR's are applied, temperature must also be controlled by a thermostat (sensing fan discharge air) which operates a branch liquid line solenoid valve installed at the case. Consult individual case installation instructions for the thermostat setting. For KOOLGAS® systems, a bypass check valve must be installed around the solenoid valve.

RECOMMENDED APPROXIMATE DEFROST TIMER SETTINGS

Defrost is accomplished by means of the time clocks supplied in the control panel. These time clocks provide time-initiated, time or temperature terminated defrost action. Each system defrost can be tailored to suit the application. Space defrost periods on any load to allow for recovery time. Arrange defrost periods so only one KOOLGAS defrost system is energized at any one time for either the low or medium temperature compressors. Off time defrost loads should be arranged to allow no more than 33% of unit capacity on defrost at one time.

The settings in Table XII-12 are approximate and may change due to revisions in refrigerator instructions. The specific refrigerator instructions should be referred to for current data. The most recent date of publication will take precedence.

Table XII-12 gives approximate defrost timer settings for most installations. Adjust timing and frequency in accordance with voltage conditions and store conditions. Where liquid lines are long, increase off-time defrost to compensate for "pump down" time, as some refrigeration effect continues until the liquid line clears of liquid.

Table XII-12
Defrost Timer Settings

APPLICATION	REFRIGERATED FIXTURE	DEFROST LENGTH-MINUTES NON-ELEC.	ELEC.	KOOLGAS	NO. OF DEFROST PER 24 HRS.
MEAT	MMS	46	46	16-20	2
	VGL	120		10	1
	FM(G), FMR(G)	70	46	14	2
	FMTS, DTSMV	96		10	1
	FHM(S,G)	46	46	12-16	4
	FHD(G)	60	46	12-16	3
	DTS(V) DRS(V)	60		10	1
DELI	FMTSD	96		10	1
	FHDG	60	46	14	3
	FHMSG	46	46	14	4
	VBL, VGL	120		10	1
	DRSV, DTSV, DFTV	60		10	1
	FMGC, FMRGC	70	46	14	2
	JVM (ALL) DMD (ALL)	46	46	14	3
	BHDB	110	46	12-16	2
	RVM, RVMH, RVMA	60	46	12	1
DAIRY	AFF-AFR	60		16-18	4
	JVM (ALL) DM (ALL)	46		14	3
	BHDB	110	46	12-16	2
	RVM, RVMH, RVMA	60		12	1
PRODUCE	P, PH PWI	46		10-14	4
MISC.	RAM, RHM (Reach-In)	60		12	1
ICE CREAM	BJC, BJI-C, BTF-C, JJA-C		46	24	1
	GCI, GGC		60	24	1
	GWIC, GWIT		60	24	1
	G6C-G5C		36	20-24	4
	R6C		60	22	1
	RAC, RHC (Reach-In)		72	14	1
FROZEN FOOD	G6F-G5F		32	20-24	2
	GWI, GWIT		60	24	1
	GFI, GG		60	24	1
	BFI, BJI, BTF, JJA		46	20	1
	FMLG, FML		46	14	2
	R6F		60	22	1
	RAF, RHF (Reach-In)		72	14	1
LOW TEMP. COOLERS	Frozen Food - 5°F		24	16	2
	Ice Cream -15°F		24	16	2
MED. TEMP. COOLERS	Meat	90	24	16	2
	Deli	90	24	24	2
	Dairy & Bev.	60		16	2
	Produce Cooler	60			2
	Gravity Coils	240		16	1
	Prep. Areas	120			1

(1) For defrost applications that utilize temperature termination use the defrost lengths indicated as fail-safe setting. Refer to fixture instructions for temperature termination settings.

Table XII-13
Recommended Control Temperature
Settings for Refrigerators

Refrigerator Model	Recommended Air Temperatures **
FMG, FMRG, FM, FMR FHM, FHMG, FHMS	24°F Discharge Air - Meat 27°F Discharge Air - Deli
FHD, FHDG	26°F Discharge Air - Meat 29°F Discharge Air - Deli
JVM, JVMH, RVM DM, DMD	32°F Discharge Air - Dairy 30°F Discharge Air - Deli
BHDB, AFF, AFR, RHM	28°F Discharge Air
P, PH , PWI	37°F Discharge Air - Bulk Produce 33°F Discharge Air - Package Produce
FML, FMLG, JJA, GTF, GTC GWI(T), G/F, GC ,GG	-10°F Discharge Air - Frozen Food -20°F Discharge Air - Ice Cream
G6, G5	- 3°F Discharge Air - Non Code - 8°F Discharge Air - Zero Code *
FML, FMLG	-10°F Discharge Air
RHFA, RHCA, R6F, R6C	- 5°F Discharge Air - Frozen Food -12°F Discharge Air - Ice Cream
Meat Coolers	28°F Discharge Air
Dairy Coolers	36°F Return Air
Produce Coolers	41°F Return Air
Frozen Food Coolers	- 5°F Return Air
Ice Cream Coolers	-15°F Return Air
Preparation Areas	55°F Return Air

* Where codes require 0°F return air temperature.

** The settings shown above are approximate and may change due to revisions in refrigerator instructions. The specific refrigerator installation instruction should be referred to for current data.

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