McQuay®
Air Conditioning

Installation and Maintenance Data

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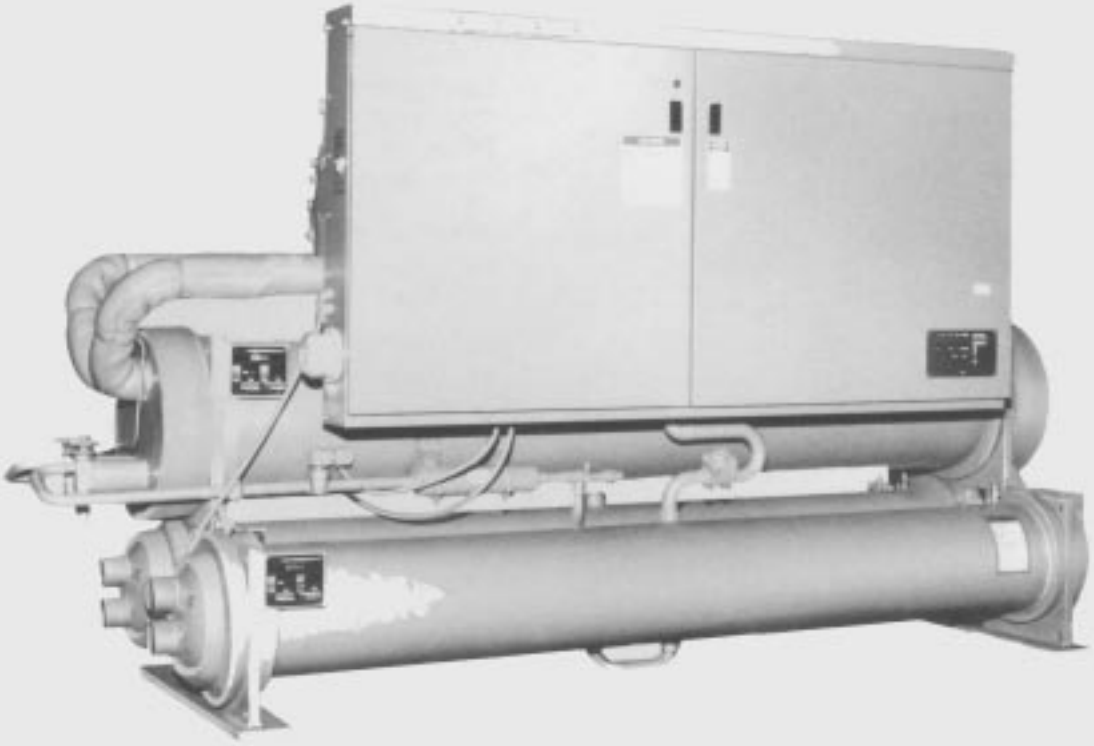
Templifier® Heat Pump



Type THR 040 thru 170 Tons
"D" Vintage

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INTRODUCTION

GENERAL DESCRIPTION

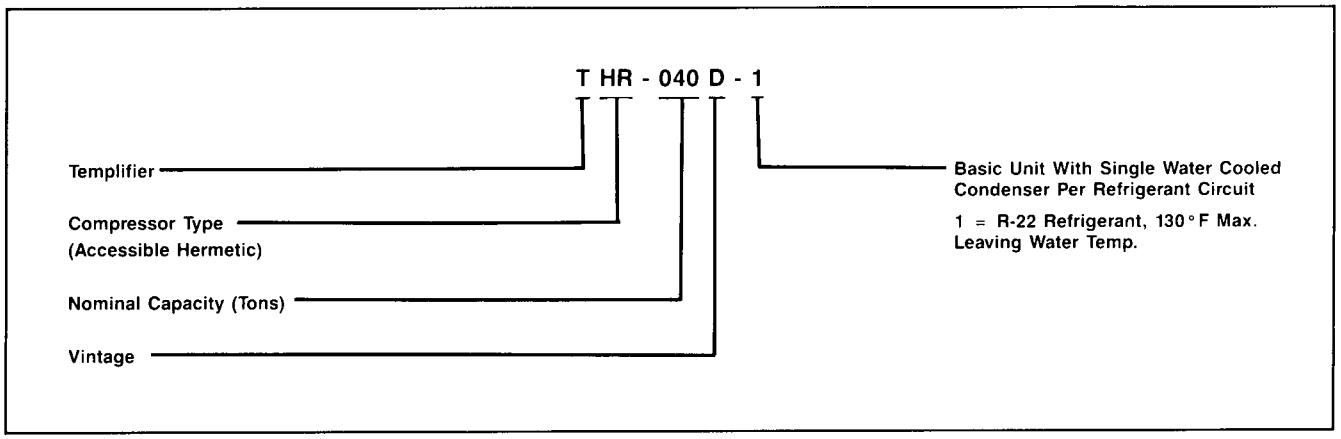
McQuay Type THR Templifier heat pump water heaters are designed for indoor installations. Each unit is completely assembled and factory wired before evacuation, charging and testing. Each unit consists of multiple accessible hermetic compressors, replaceable tube dual circuit shell-and-tube evaporator, water cooled condenser, and complete refrigerant piping.

Liquid line components that are included are manual liquid line shutoff valves, charging valves, filter-driers, liquid line solenoid valves, sightglass/moisture indicators, and diaphragm element thermal expansion valves. Other features include compressor discharge check valves, crankcase heaters, recycling pumpdown during "on" or "off" seasons, compressor lead-lag switch to alternate the compressor starting sequence, and sequenced starting of compressors.

The electrical control center includes all safety and operating controls necessary for dependable automatic operation.

Compressors are not fused, but may be protected by optional circuit breakers, or may rely on the field installed fused disconnect for protection.

NOMENCLATURE



INSPECTION

When the equipment is received, all items should be carefully checked against the bill of lading to insure a complete shipment. All units should be carefully inspected for damage upon arrival. All shipping damage should be reported to the carrier and a claim should be filed. The unit serial plate should be checked before unloading the unit to be sure that it agrees with the power supply available. Physical damage to unit after acceptance is not the responsibility of McQuay International.

Note: Unit shipping and operating weights are available in the physical data table (pages 17 and 18).

INSTALLATION

Note: Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. Caution: Sharp edges are a potential injury hazard. Avoid contact.

HANDLING

Every model THR Templifier heat pump is supplied with a full refrigerant charge. For shipment the charge is contained in the condenser and is isolated by the manual condenser liquid valve and the compressor discharge service valve.

Should the unit be damaged, allowing the refrigerant to escape, there may be danger of suffocation in the equipment, area since the refrigerant will displace the air. Avoid exposure area since the refrigerant will displace the air. Avoid exposing an open flame to refrigerant when moving the unit. Care should be taken to avoid rough handling or shock due to dropping the unit. **Never lift, push or pull unit from anything other than the unit base, unit skid, or rigging holes in the evaporator or condenser vessels.**

MOVING THE UNIT

The McQuay Templifier heat pump is mounted on heavy wooden skids to protect the unit from accidental damage and to permit easy handling and moving.

It is recommended that all moving and handling be performed with the skids under the unit when possible and that the skids not be removed until the unit is in the final location.

When moving the unit, dollies or simple rollers can be used under the skids.

Never put the weight of the unit against the control box.

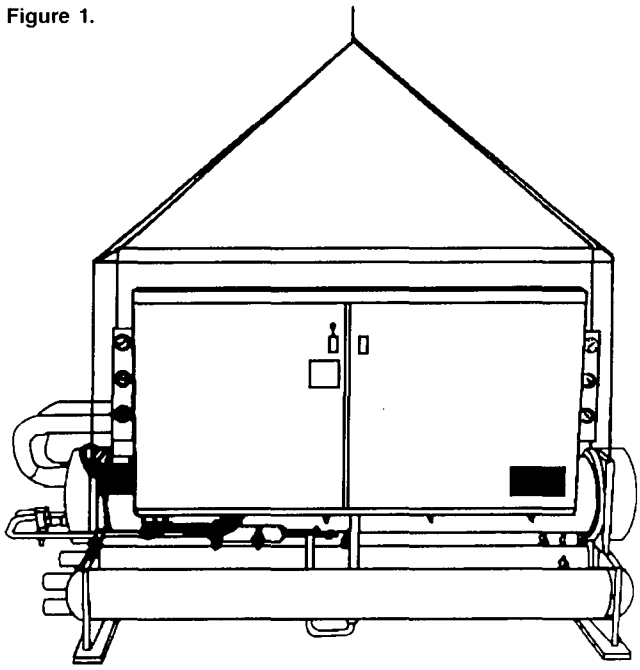
In moving, always apply pressure to the base on skids only and not to the piping or shells. A long bar helps move the unit easily. Avoid dropping the unit at the end of the roll.

If the unit must be hoisted, it is necessary to lift the unit by attaching cables or chains at the lifting holes in the evaporator tube sheets. Spreader bars must be used to protect the control cabinet and other areas of the chiller (see Figure 1).

Do not attach slings to piping or equipment. Move unit in the upright horizontal position at all times. Set unit down gently when lowering from the trucks or rollers.

Note: On unit sizes 120 through 170D, ordered with the optional acoustical enclosure, there will be extension brackets attached to the evaporator tube sheets. These brackets will be used for hoisting the unit and should be removed when unit is in place.

Figure 1.



LOCATION

Unit is designed for indoor application and must be located in an area where the surrounding ambient temperatures are 40°F or above.

Because of the electrical control devices, the units should not be exposed to the weather. A plastic cover over the control box is supplied as temporary protection during transfer.

A reasonably level and sufficiently strong floor is all that is required for the Templifier heat pump. If necessary, additional structural members should be provided to transfer the weight of the unit to the nearest beams.

Note: Unit shipping and operating weights are available in the physical data table, pages 17 and 18.

SPACE REQUIREMENTS FOR CONNECTIONS AND SERVICING

The chilled water piping for all units enters and leaves the evaporator from the rear, with the control box side being the front side of the unit. (A clearance of 3 to 4 feet should be provided for this piping and for replacing the filter-driers, for servicing the solenoid valves, or for changing the compressors, should it ever become necessary). Recommended service clearances are shown in Figure 2.

The condenser water piping enters and leaves the shell from the ends. Work space must be provided in case water regulating valves are being used and for general servicing.

Clearance should be provided for cleaning condenser tubes or for removing evaporator tubes on one end of the unit as specified in Table 1. It is also necessary to leave a work area on the end opposite that used for replacement of a cooler tube.

Figure 2. Clearance requirements

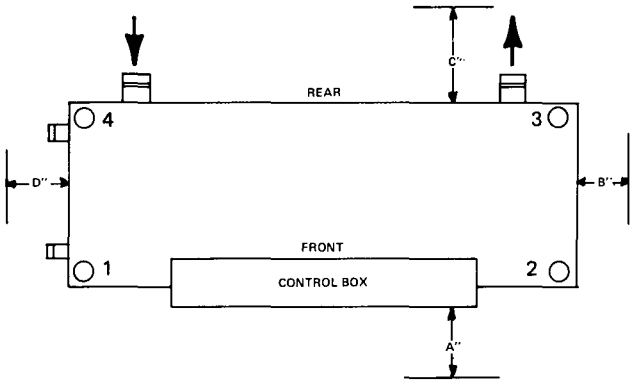


Table 1. Minimum recommended clearance requirements

THR-040 THRU 110D				THR-120 THRU 170D			
A	B	C	D	A	B	C	D
41"	96" ①	36"	96" ①	46"	120" ①	36"	120" ①

① Minimum clearance required for removal and replacement of cooler tubes (either end).

PLACING THE UNIT

The small amount of vibration normally encountered with the Templifier makes this unit particularly desirable for basement or ground floor installations where the unit can be bolted directly to the floor. The floor construction should be such that the unit will not affect the building structure, or transmit noise and vibration into the structure. See vibration isolator section for additional mounting information.

Note: On the THR 120D thru 170D, shipping bolts are used to secure the compressor rails to the evaporator brackets. Remove these and discard after unit is mounted and before unit is started.

VIBRATION ISOLATORS

Rubber-in-shear or spring isolators can be furnished and field placed under each corner of the package. It is recommended that a rubber-in-shear pad be used as the minimum isolation on all upper level installations or areas in which vibration transmission is a consideration.

Transfer the unit as indicated under "Moving the Unit." In all cases, set the unit in place and level with a spirit level. When spring type isolators are required, install springs running under the main unit supports. Adjust spring type mountings so that upper housing clears lower housing by at least ¼" and not more than ½". A rubber anti-skid pad should be used under isolators if hold-down bolts are not used.

Vibration eliminators in all water piping connected to the Templifier are recommended to avoid straining the piping and transmitting vibration and noise.

Figure 3. Isolator Locations

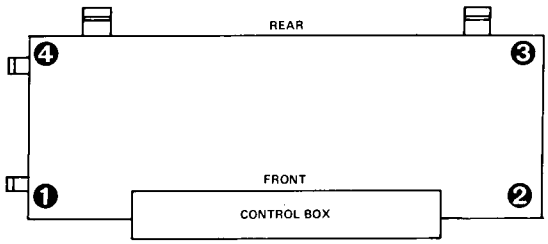


Table 2.

THR. UNIT SIZE	OPER. RATING WEIGHT	CORNER WEIGHT				RUBBER-IN-SHEAR MOUNTINGS				SPRING-FLEX MOUNTINGS			
		1	2	3	4	1	2	3	4	1	2	3	4
040	3580	833	747	945	1055	3-Gray	3-Gray	3-Gray	3-Gray	1-31	1-28	1-31	2-26
050	3630	845	755	958	1071	3-Gray	3-Gray	3-Gray	3-Gray	1-31	1-28	1-31	2-26
060	3920	912	816	1034	1158	3-Gray	3-Gray	4-Black	4-Black	1-31	1-31	2-26	2-27
070	4010	933	834	1058	1185	3-Gray	3-Gray	4-Black	4-Black	1-31	1-31	2-26	2-27
080	4165	946	856	1123	1240	3-Gray	3-Gray	4-Black	4-Black	1-31	1-31	2-27	2-27
090	4675	1067	992	1260	1356	3-Gray	3-Gray	4-Black	4-Black	2-26	1-31	2-27	2-28
100	5215	1190	1105	1406	1514	4-Black	4-Black	4-Red	4-Red	2-27	2-26	2-28	2-28
110	5365	1264	1228	1415	1458	4-Red	4-Red	4-Red	4-Red	2-28	2-28	2-31	2-31
120	6250	1492	1404	1626	1728	4-Red	4-Red	4-Red	4-Red	2-28	2-28	2-31	2-31
130	6405	1513	1453	1684	1755	4-Red	4-Red	4-Red	4-Red	2-28	2-28	2-31	2-31
140	6480	1524	1472	1712	1772	4-Red	4-Red	4-Red	4-Red	2-28	2-28	2-31	2-31
150	7020	1624	1594	1882	1920	4-Red	4-Red	4-Red	4-Red	2-31	2-31	2-31	2-31
160	7170	1657	1620	1925	1968	4-Red	4-Red	4-Red	4-Red	2-31	2-31	2-31	4-27
170	7280	1685	1635	1950	2010	4-Red	4-Red	4-Red	4-Red	2-31	2-31	2-31	4-27

Table 3. Spring Flex Isolators

TYPE	COLOR	MAX. LOAD EACH LBS.	DEFL. IN.	DIMENSIONS (INCHES) A	B	C	D	E	McQUAY PART NUMBER
CP-1-25	Gray w/ 1 Red Stripe	450	1.22	7½	6½	5	2¾	5⅞	886-477927A-25
CP-1-26	Gray w/ 2 White Stripes	600	1.17	7½	6½	5	2¾	5⅞	886-477927A-26
CP-1-27	Gray w/ 1 Orange Stripe	750	1.06	7½	6½	5	2¾	5⅞	886-477927A-27
CP-1-28	Gray w/ 1 Green Stripe	900	1.02	7½	6½	5	2¾	5⅞	886-477927A-28
CP-1-31	Gray w/ 2 Yellow Stripes	1100	0.83	7½	6½	5	2¾	5⅞	886-477927A-31
CP-2-26	Gray w/ 2 White Stripes	1200	1.17	10¼	9¼	8	2¾	5⅞	886-477929A-26
CP-2-27	Gray w/ 1 Orange Stripe	1500	1.06	10¼	9¼	8	2¾	5⅞	886-477929A-27
CP-2-28	Gray w/ 1 Green Stripe	1800	1.02	10¼	9½	8	2¾	5⅞	886-477929A-28
CP-2-31	Gray w/ 2 Yellow Stripes	2200	0.83	10¼	9½	8	2¾	5⅞	886-477929A-31
CP-4-27	Gray w/ 1 Orange Stripe	3000	1.06	10¼	9½	7½	5	6⅛	886-580513A-27

Figure 4. Spring Flex Mountings

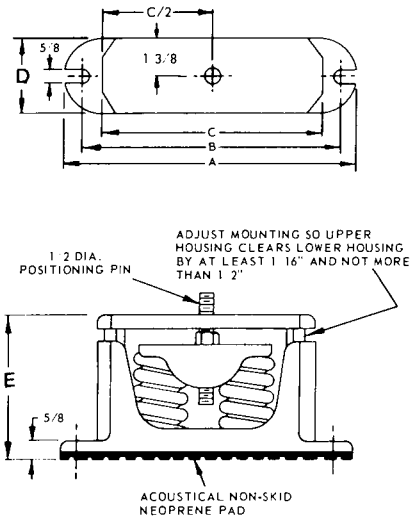
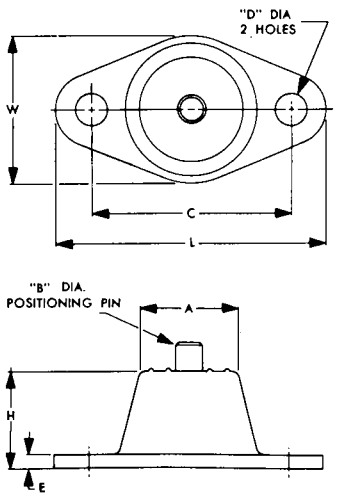


Table 4. Rubber-in-Shear Isolators

TYPE		MAX. LOAD EACH LBS.	DEFL. IN.	DIMENSIONS (INCHES) W	C	L	D	E	H	A	B	McQUAY PART NUMBER
RP-3	Black	250	0.25	2½	½	4⅛	9/16	¼	1¾	5½	3⅜	216397A-04
	Red	525										216397A-01
	Green	750										216397A-03
	Gray	1100										216397A-05
RP-4	Black	1500	0.25	3¾	⅝	5	9/16	¼	1¾	6½	4¼	216398A-04
	Red	2250										216398A-01
	Green	3300										216398A-03

Figure 5. Single Rubber-in-Shear Mounting



WATER PIPING

GENERAL

Since regional piping practices vary considerably, local ordinances and practices will govern the selection and installation of piping. In all cases local building and safety codes and ordinances should be studied and complied with.

All piping should be installed and supported to prevent the unit connections from bearing any strain or weight of the system piping.

Vibration eliminators in all water piping connected to the unit are recommended to avoid straining the piping and transmitting pump noise and vibration to the building structure.

It is recommended that temperature and pressure indicators be installed within 3 feet of the inlet and outlet of the shells to aid in the normal checking and servicing of the unit.

A strainer or some means of removing foreign matter from the water before it enters the unit or the pump is recommended. It should be placed far enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer will prolong pump and unit life and thus keep system performance up.

A preliminary leak check of the water piping should be made before filling the system.

Shutoff valves should be provided at the unit so that normal servicing can be accomplished without draining the system.

A water flow switch or pressure differential switch must be mounted in the water lines to the evaporator and the condenser to verify water flow before unit is permitted to start.

EVAPORATOR PIPING

The water flow entering the evaporator must always be on the end nearest the expansion valves and evaporator refrigerant piping connections to assure proper expansion valve operation and unit capacity (see pages 14 thru 16).

Design the piping so that it has a minimum number of changes in elevation. Include manual or automatic vent valves at the high points of the chilled water piping, so that air can be vented from the water circuit. System pressures can be maintained by using an expansion tank or a combination pressure relief and reducing valve.

All chilled water piping should be insulated to prevent condensation on the lines. If insulation is not of the self-contained vapor barrier type, it should be covered with a vapor seal. Piping should not be insulated until completely leak tested.

Vent and drain connections must extend beyond proposed insulation thickness for accessibility.

EVAPORATOR TEMPERATURE LIMITS

Table 5. Evaporator Source Water Temperature Limits with Unit Operating ①

UNIT SERIES	REFRIG. TYPE	SOURCE WATER TEMPERATURE MAXIMUM ENTERING (°F)	MAXIMUM LEAVING (°F)	MINIMUM LEAVING (°F)
1	R-22	110	70	42

Note ①: Water flow must be controlled to prevent exceeding these temperature limits.

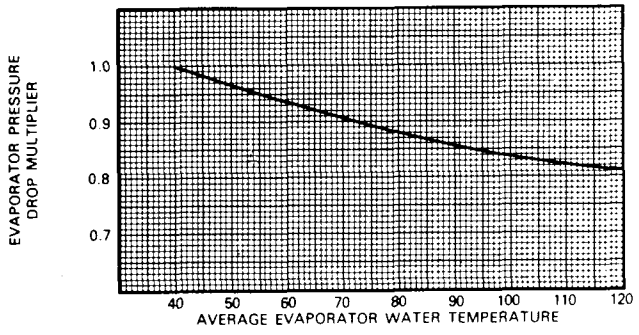
EVAPORATOR FLOW RATE LIMITS—GPM*

Table 6.

THR UNIT SIZE	CHILLER WATER FLOW*		EVAPORATOR MODEL NUMBER
	MAX.	MIN.	
040D	230	31	E-1008-2
050D	244	34	E-1008-1
060D	316	45	E-1208-3
070D	312	47	E-1208-2
080D	352	44	E-1208-1
090D	352	44	E-1208-1
100D	370	54	E-1408-2
110D	460	68	E-1408-1
120D	403	50	E-1410-2
130D	463	67	E-1410-1
140D	463	67	E-1410-1
150D	439	41	E-1610-3
160D	579	93	E-1610-1
170D	579	93	E-1610-1

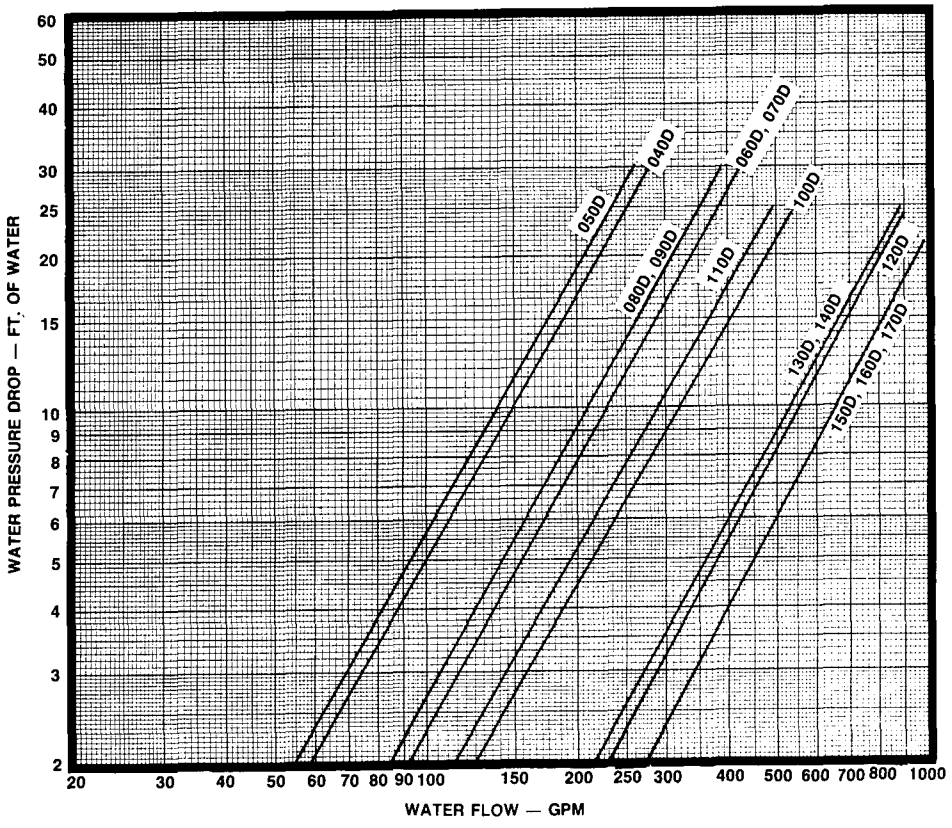
* Water flows are based on 10 FPS for max. flow and 3 FPS for min. flow.

EVAPORATOR PRESSURE DROP CORRECTION



EVAPORATOR PRESSURE DROP CURVE

NOTE: Maximum allowable evaporator water pressure is 175 psig



CONDENSER WATER PIPING

THR condensers have factory manifolds for single inlet and outlet connections. Water flow may be 2-pass parallel, 4-pass parallel or 8-pass series/parallel to suit the application. Refer to Figure 6 to determine condenser water circuiting arrangement. For proper performance, the condenser water must enter the bottom connection of the condenser on all circuiting arrangements.

Condenser water pressure drop for the unit should be measured at the common inlet and outlet pipe, through a port provided by the installing contractor. All pressure drop measurements should be made with the same gauge to insure an accurate reading. Before the pressure drop curves can be read, the pressure drop values on the curve must be corrected based on the average hot condenser water temperature. The correction factor can be obtained from page 9, and then multiplied by the values on the pressure drop curves to adjust them according to the average water temperature in the system.

CONDENSER TEMPERATURE LIMITS

Table 7. Condenser temperature limits, operating and maximum (°F)

UNIT SERIES	REFRIGERANT TYPE	OPERATING MAX. LEAVING WATER TEMP. (°F)	MAX. ALLOWABLE WATER TEMP. IN CONDENSER (°F)
1	R-22	130	145

Note: Water flowing through the condenser should never exceed the maximum allowable temperature in the table above even when the unit is not operating.

CONDENSER TEMPERATURE RISE

Table 8. Allowable condenser temperature rise applicable to refrigerant 22

WATER CIRCUITING ARRANGEMENT	NOMINAL TEMP. RISE °F	ALLOWABLE TEMP. RISE °F
2-pass parallel	10	5—15
4-pass parallel	20	15—30
8-pass series/parallel	40	30—50

Note: Temperature rise for various water circuit arrangements may for a given load be limited by the maximum or minimum flow listed in the unit condenser and evaporator flow limit tables. The flow limits for a given unit should be used to calculate the temperature rise limit before a water circuiting arrangement and temperature rise are established.

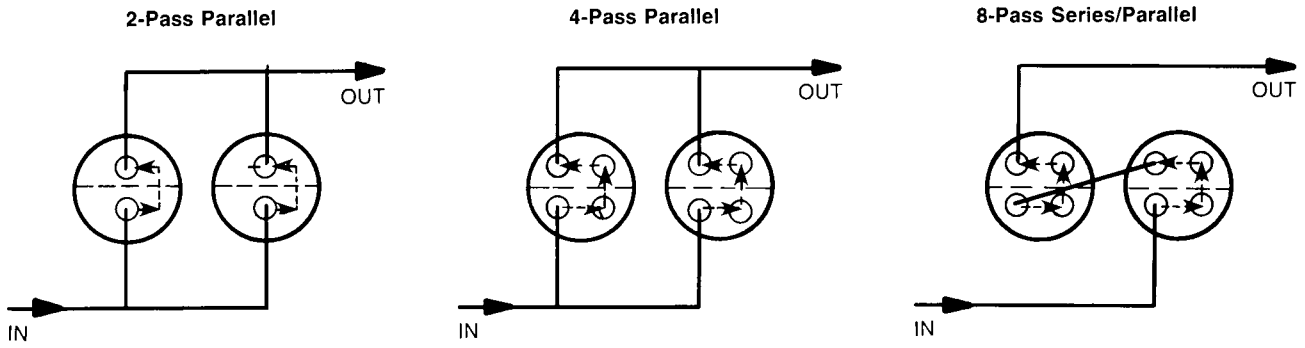
CONDENSER FLOW RATE LIMITS

Table 9. Unit Condenser Water Flow Limits (GPM)*

MODEL THR UNIT SIZE	CONDENSER WATER CIRCUITING ARRANGEMENT					
	2-PASS PARALLEL		4-PASS PARALLEL		8-PASS SERIES/PARALLEL	
	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM
040D	188	24	94	12	47	6
050D	224	28	112	14	56	7
060D	252	32	126	16	63	8
070D	316	40	158	20	79	10
080D	360	44	180	22	90	11
090D	444	56	222	28	111	14
100D	444	56	222	28	111	14
110D	508	62	254	31	130	16
120D	440	56	224	28	112	14
130D	506	64	260	32	130	16
140D	506	64	260	32	130	16
150D	610	80	305	40	150	20
160D	610	80	305	40	150	20
170D	610	80	305	40	150	20

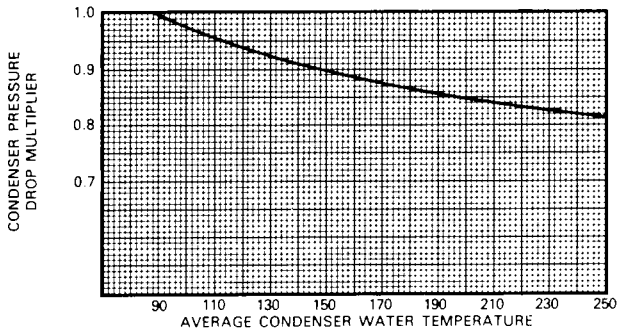
*Values shown are total unit flow. Adjust flow per condenser to meet flow requirement for flow arrangement being used.

Figure 6. Condenser Water Arrangements.



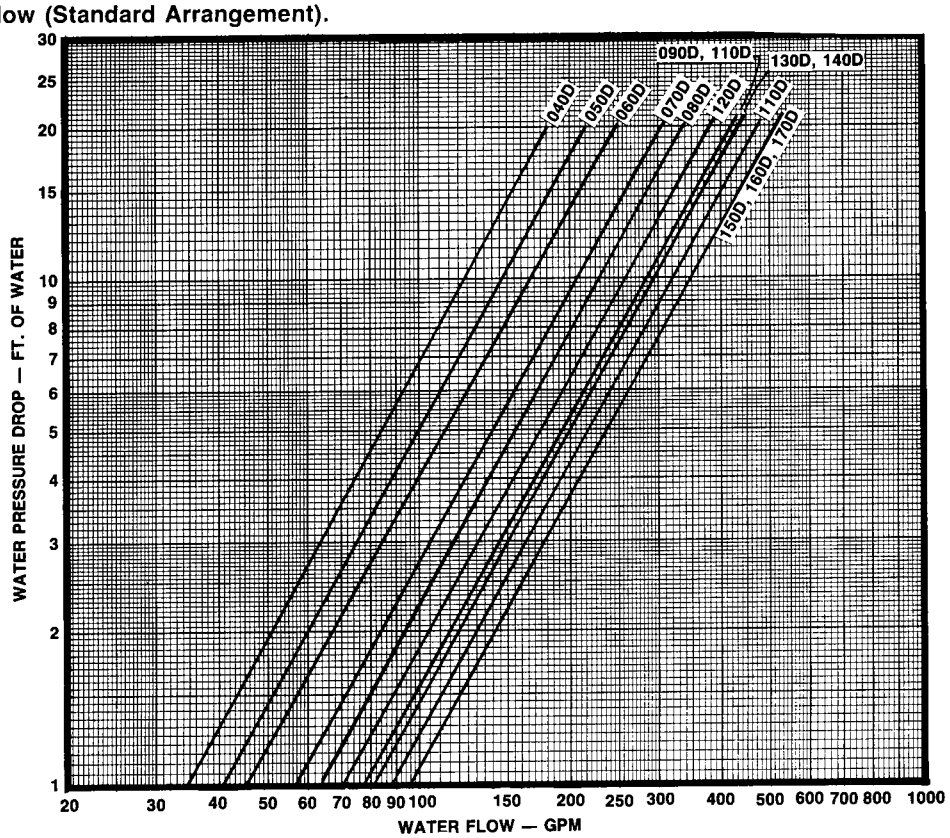
NOTE: When parallel circuiting is used, design leaving condenser water temperature may not be obtainable unless both condenser circuits are in operation.

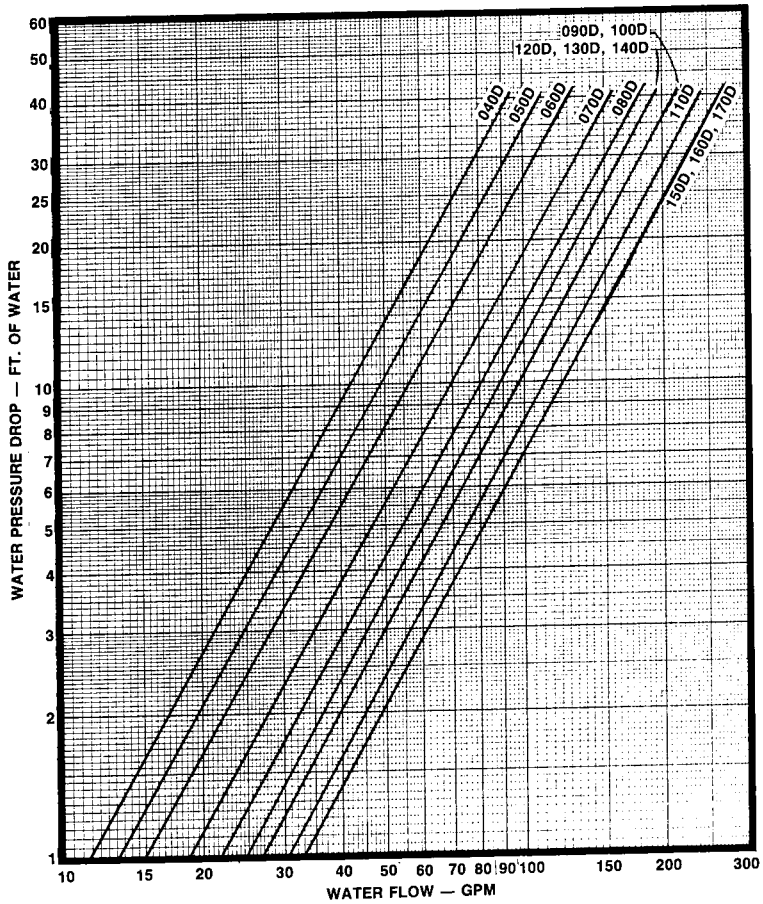
CONDENSER PRESSURE DROP CORRECTION



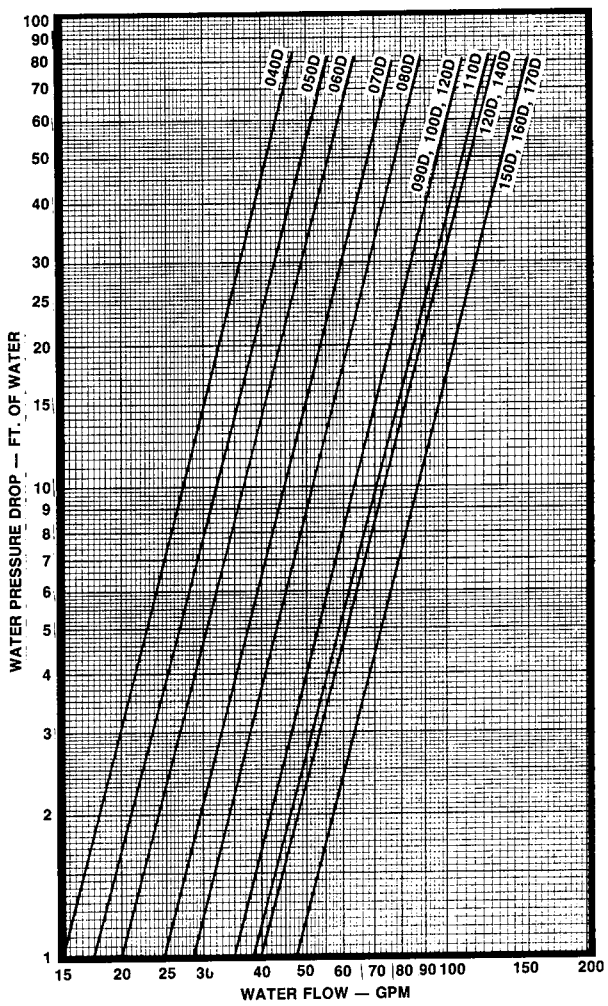
CONDENSER PRESSURE DROP CURVES
NOTE: Maximum allowable condenser water pressure is 250 psig.

2-Pass Parallel Flow (Standard Arrangement).





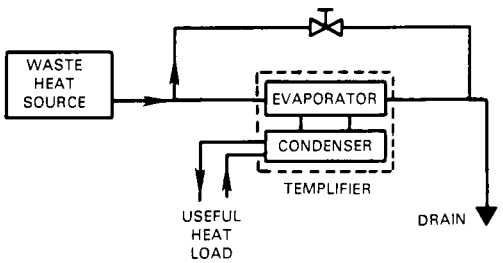
4-Pass Parallel Flow (Alternate Arrangement).



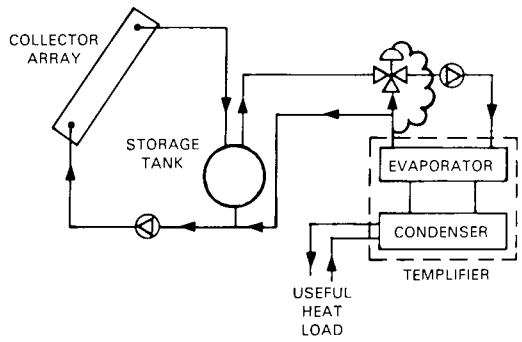
8-Pass Series/Parallel Flow (Alternate Arrangement).

TYPICAL PIPING DIAGRAMS

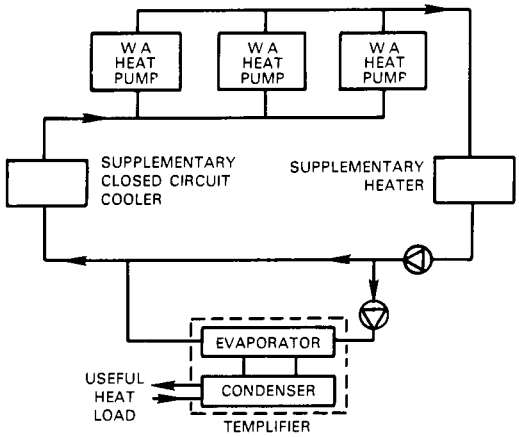
HEAT RECOVERY
FROM WASTE FLUID



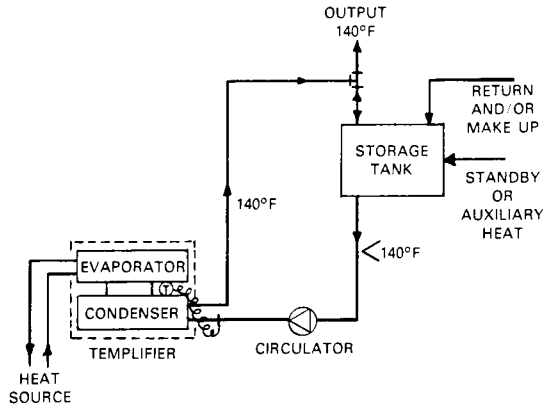
SOLAR HEAT SOURCE



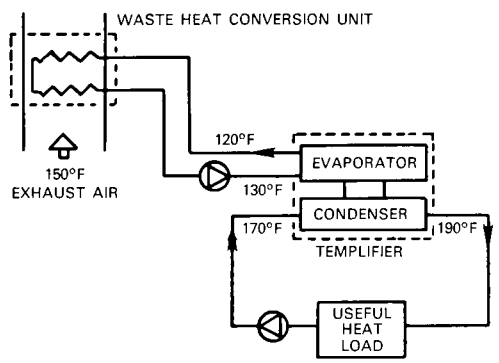
HEAT RECOVERY
FROM WATER TO AIR HEAT PUMP SOURCE



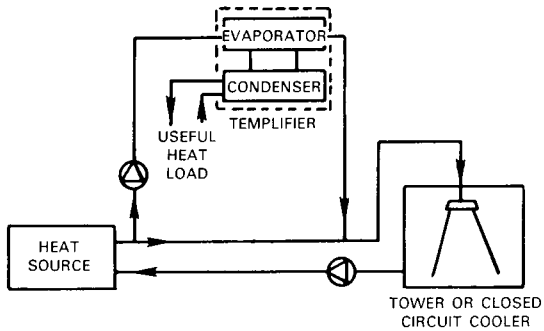
HEAT OUTPUT
WITH INTERMITTENT WATER FLOW
(SERVICE HOT WATER)



HEAT RECOVERY
FROM GAS OR AIR SOURCE



HEAT RECOVERY
FROM PARTIAL SOURCE FLUID FLOW



NOTES: Valves, drains, vents, expansion tanks and instrumentation must be added in accordance with good piping practice.
Temperatures, where shown, are for illustration only.
These are typical Templifier application possibilities shown in schematic way. Each specific application will vary in the use of storage, supplemental heat, etc., to suit the job characteristics.

WATER QUALITY

The water flowing through the condenser and evaporator must be of suitable quality for use with standard materials of construction:

Condenser:	Steel heads and tube sheets, rubber gaskets, copper tubes.
Evaporator:	Steel shell, copper tubes, polypropylene baffles

Any additives that may be harmful should not be used. Where water or other fluids of unsuitable quality, or where quality may deteriorate later, an intermediate heat exchanger is recommended. Plate type exchangers should be considered for minimum temperature approach at economical cost.

Note: If cooling tower or other source water containing dirt, sediment or other foreign matter is used, assure that take-offs to the Templifier are at the top of horizontal pipelines to minimize foreign matter getting into the evaporator. Depending on water conditions, dual strainers and/or a settling drum should be considered.

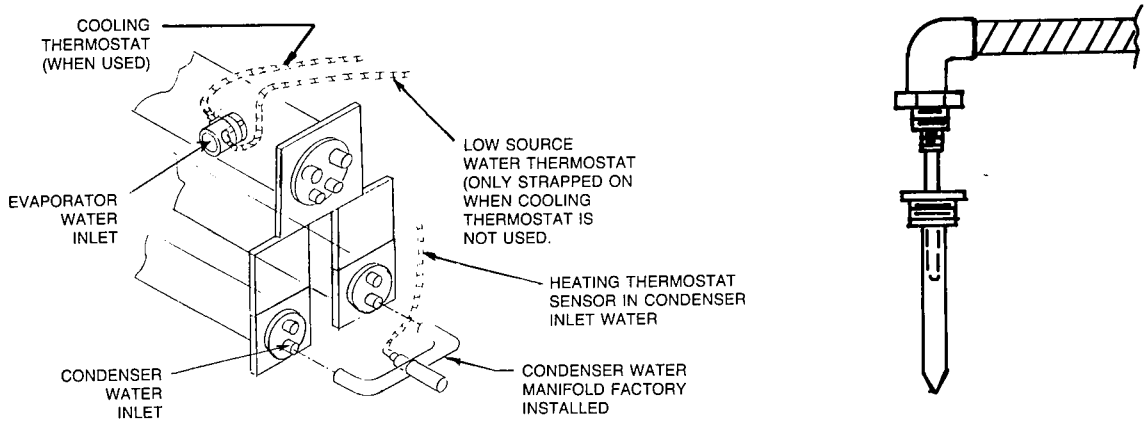
CONDENSER WATER THERMOSTAT

On units THR-040D thru 170D units, the condenser water thermostat (CP1) is mounted inside the control console. The control sensor is mounted in a well, located in the condenser water inlet manifold. Care should be taken not to damage the sensor cable or leadwires when working around the unit. It is also advisable to check the leadwire before running the unit to be sure that it is firmly anchored and not rubbing on the frame or any other component. Should the sensor ever be removed from the well for servicing, care should be taken as not to wipe off the heat conducting compound supplied in the well.

Note: See page 51 for additional thermostat information.

Caution: The thermostat bulb should not be exposed to water temperatures above those listed in the condenser water temperature limit Table 7.

Figure 7. Thermostat Well Installation



FLOW SWITCHES

The water flow switches must be mounted in either the entering or leaving water lines to insure that there will be adequate water flow and load to the evaporator and condenser before the unit can start. This will safeguard against liquid refrigerant entering the compressors on startup. It also serves to shut down the unit in the event that water flow is interrupted to guard against evaporator freeze-up.

A flow switch is available from McQuay under ordering number 175033B-00. It is a "paddle" type switch and adaptable to any pipe size from 1″ to 6″ nominal. Certain minimum flow rates are required to close the switch and are listed in Table 10. Installation should be as shown in Figure 8. Electrical connections in the unit control center should be made at terminals 5 and 6. The normally open contacts of the flow switch should be wired between these two terminals. There is also a set of normally closed contacts on the switch that could be used for an indicator light or an alarm to indicate when a "no flow" condition exists.

1. Apply pipe sealing compound to only the threads of the switch and screw unit into D″× D″×1″ reducing tee (see Figure 8). The flow arrow must be pointed in the correct direction.
2. Piping should provide a straight length before and after the flow switch of at least five times the pipe diameter.
3. Trim flow switch paddle if needed to fit the pipe diameter. Make sure paddle does not hang up in pipe.

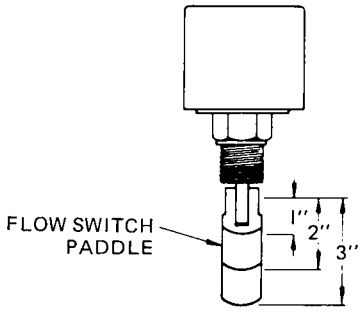
Caution: Make sure the arrow on the side of the switch is pointed in the proper direction of flow. The flow switch is designed to handle the control voltage and should be connected according to the wiring diagram (see wiring diagram inside control box door).

Table 10. Flow Switch Minimum Flow Rates

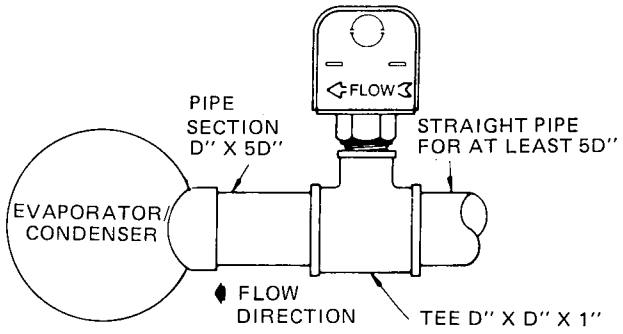
NOMINAL PIPE SIZE (INCHES)	MINIMUM REQUIRED FLOW TO ACTIVATE SWITCH (GPM)
1	6.00
1¼	9.80
1½	12.70
2	18.80
2½	24.30
3	30.00
4	39.70
5	58.70
6	79.20

Figure 8.

FLOW SWITCH



VIEW FROM END OF EVAPORATOR/CONDENSER



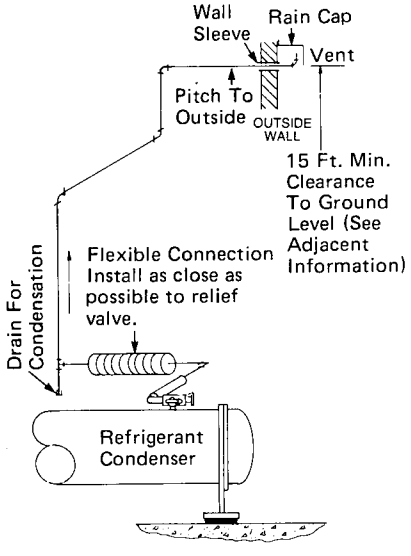
RELIEF VALVE PIPING

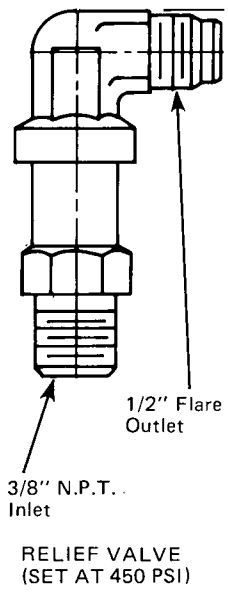
The ANSI/ASHRAE Standard 15-1978 specifies that pressure relief valves on vessels containing Group 1 refrigerants (R-22) "shall discharge to the atmosphere at a location not less than 15 feet above the adjoining ground level and not less than 20 feet from any window, ventilation opening or exit in any building." The piping must be provided with a rain cap at the outside terminating point and a drain at the low point on the vent piping to prevent water buildup on the atmospheric side of the relief valve. In addition, a flexible pipe section should be installed in the line to eliminate any piping stress on the relief valve(s).

The size of the discharge pipe from the pressure relief valve shall not be less than the size of the pressure relief outlet. When two or more vessels are piped together, the common header and piping to the atmosphere shall not be less than the sum of the area of the relief valve outlets connected to the header. Fittings should be provided to permit vent piping to be easily disconnected for inspection or replacement of the relief valve.

Note: Provide adequate fittings in piping to permit repair or replacement of relief valve.

Figure 9. Relief Valve Piping





DIMENSIONAL DATA

Figure 10. THR-040D thru 110D, 2-pass parallel.

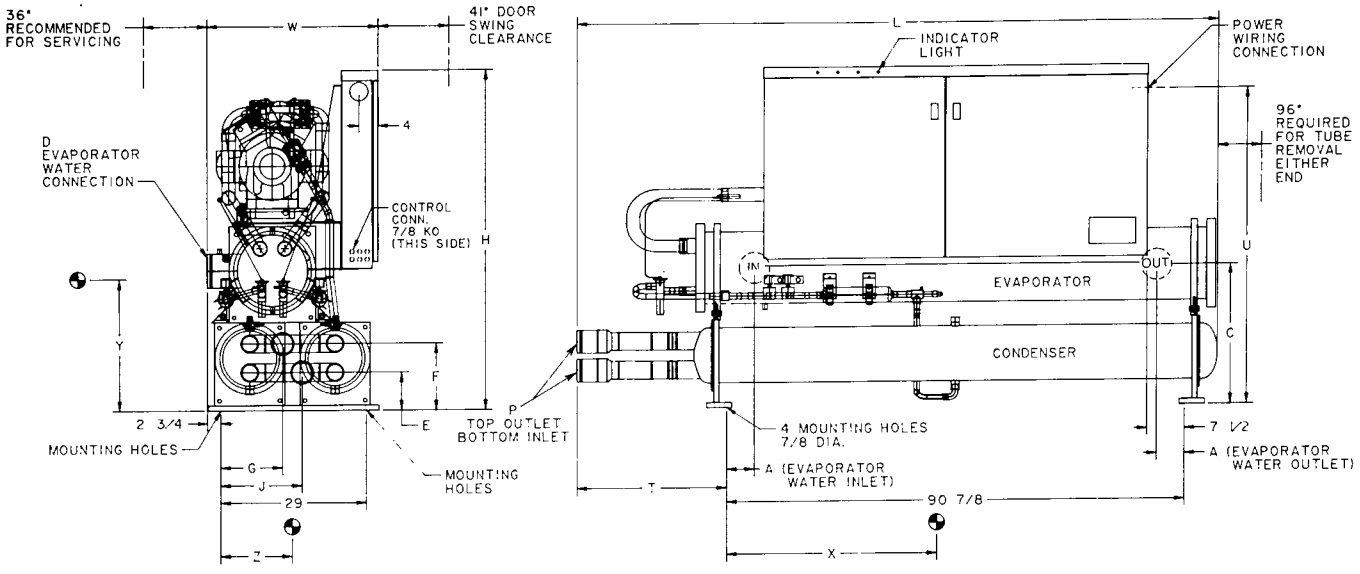


Table 11. THR-040D thru 110D, 2-pass parallel.

THR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (VICTAULIC)					T	U	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P			X	Y	Z
040D	125¾	34	62¼	2¾	23⅜	4	6⅝	11⅜	11½	17⅛	3	28⅜	58⅛	42⅝	23	13
050D	125¾	34	62¼	2¾	23⅜	4	6⅝	11⅜	11½	17⅛	3	28⅜	58⅛	42⅝	23	13
060D	125¾	34	63¾	3½	24⅞	5	6⅝	11⅜	11½	17⅛	3	28⅜	59⅝	43	25⅛	12¾
070D	125¾	34	63¾	3½	24⅞	5	6⅝	11⅜	11½	17⅛	3	28⅜	59⅝	43	25⅛	12¾
080D	125¾	34	63¾	3½	24⅞	5	6⅝	11⅜	11½	17⅛	3	28⅜	59⅝	43	25⅛	12¾
090D	127	34	65⅝	3½	26½	5	7½	13⅛	12⅜	16¼	4	29¾	61½	43½	27⅝	13
100D	127	34	66¼	5½	27⅛	6	7½	13⅛	12⅜	16¼	4	29¾	62⅛	43⅞	28	12⅝
110D	127	34	66¼	5½	27⅛	6	7½	13⅛	12⅜	16¼	4	29¾	62⅛	43¾	28	12⅝

Figure 11. THR-120D thru 170D, 2-pass parallel.

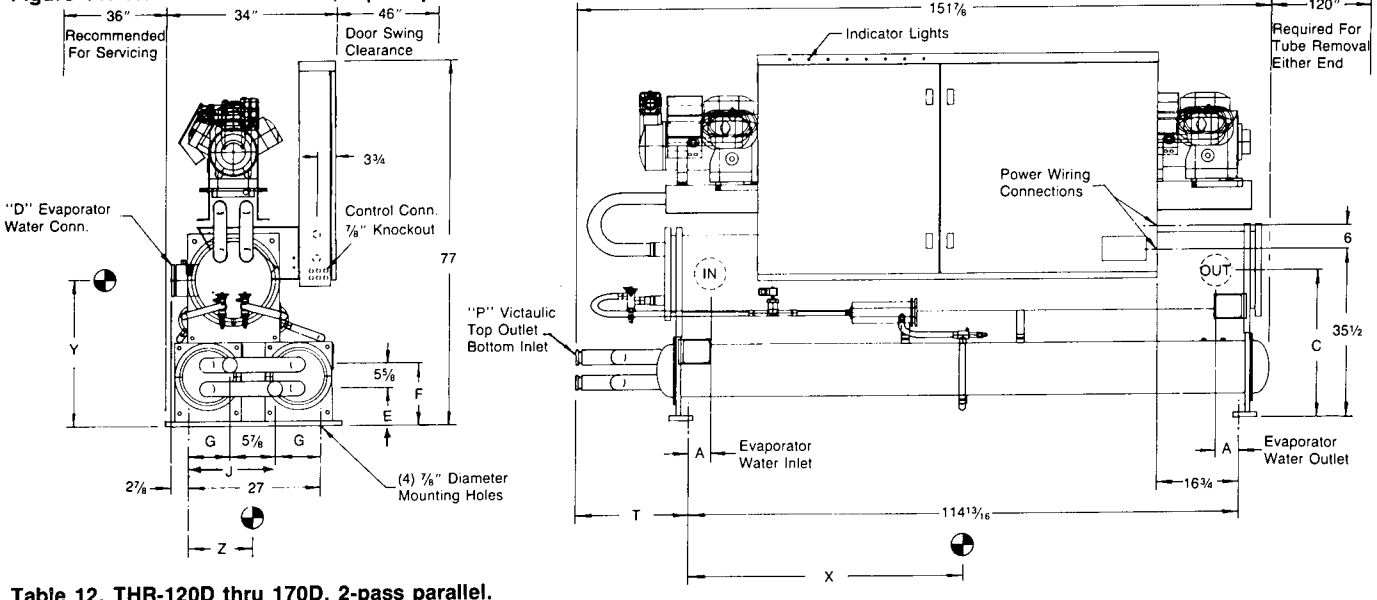


Table 12. THR-120D thru 170D, 2-pass parallel.

THR MODEL NO.	MAXIMUM OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (VICTAULIC)					T	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P		X	Y	Z
120D	151⅞	34	77	5½	30¼	6	7 7/16	13 1/16	10 9/16	16 7/16	4	29¾	55¼	32⅝	13⅝
130D	151⅞	34	77	5½	30¼	6	7 7/16	13 1/16	10 9/16	16 7/16	4	29¾	55⅞	32⅝	13½
140D	151⅞	34	77	5½	30¼	6	7 7/16	13 1/16	10 9/16	16 7/16	4	29¾	56⅛	32⅞	13½
150D	151⅞	34	77	5½	30¼	6	7 7/16	13 1/16	10 9/16	16 7/16	4	29¾	56⅝	32⅞	13½
160D	151⅞	34	77	5½	30¼	6	7 7/16	13 1/16	10 9/16	16 7/16	4	29¾	56½	33¼	13⅜
170D	151⅞	34	77	5½	30¼	6	7 7/16	13 1/16	10 9/16	16 7/16	4	29¾	56¼	33½	13⅜

Figure 12. THR-040D thru 110D, 4-pass parallel.

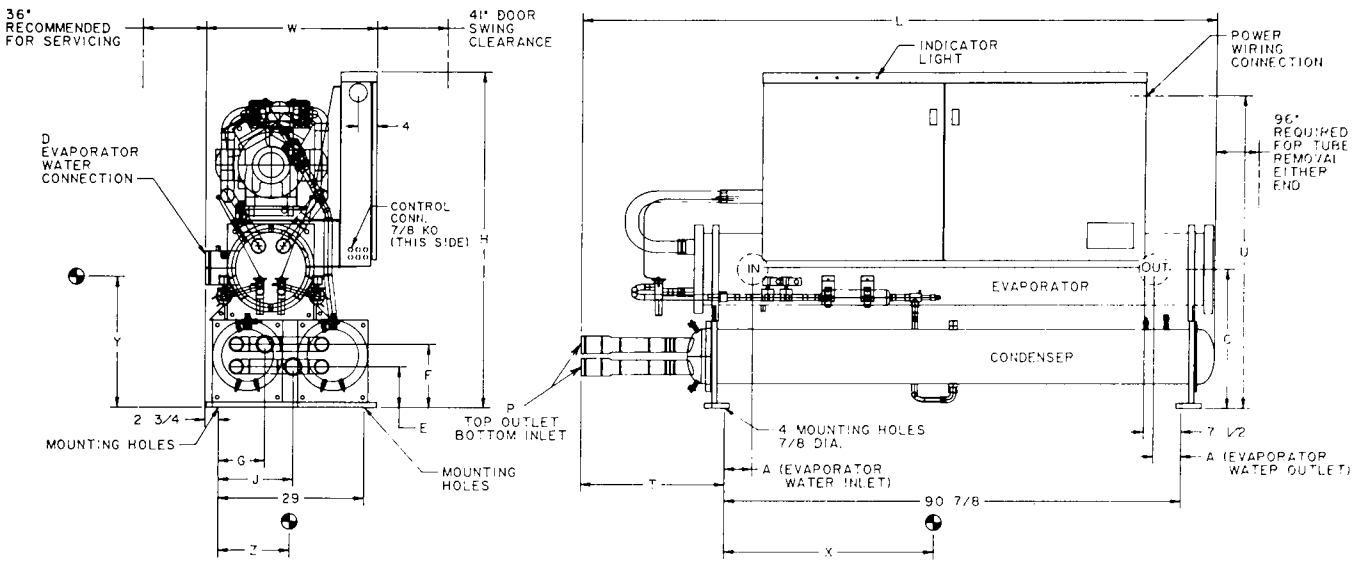


Table 13. THR-040D thru 110D, 4-pass parallel.

THR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (VICTAULIC)					T	U	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P			X	Y	Z
040D	124¾	34	62¼	2¾	23⅜	4	7⅜	11⅛	8¼	15⅞	2½	27½	58⅛	42⅝	23	13
050D	124¾	34	62¼	2¾	23⅜	4	7⅜	11⅛	8¼	15⅞	2½	27½	58⅛	42⅝	23	13
060D	124¾	34	63¾	3½	24⅞	4	7⅜	11⅛	8¼	15⅞	2½	27½	59⅝	43	25⅛	12¾
070D	124¾	34	63¾	3½	24⅞	5	7⅜	11⅛	8¼	15⅞	2½	27½	59⅝	43	25⅛	12¾
080D	124¾	34	63¾	3½	24⅞	5	7⅜	11⅛	8¼	15⅞	2½	27½	59⅝	43	25⅛	12¾
090D	125¾	34	65⅝	3½	26½	5	8	12½	9¼	14⅞	3	28½	61½	43½	27⅝	13
100D	125¾	34	66¼	5½	27⅛	6	8	12½	9¼	14⅞	3	28½	62⅛	43⅞	28	12⅝
110D	125¾	34	66¼	5½	27⅛	6	8	12½	9¼	14⅞	3	28½	62⅛	43¾	28	12⅝

Figure 13. THR-120D thru 170D, 4-pass parallel.

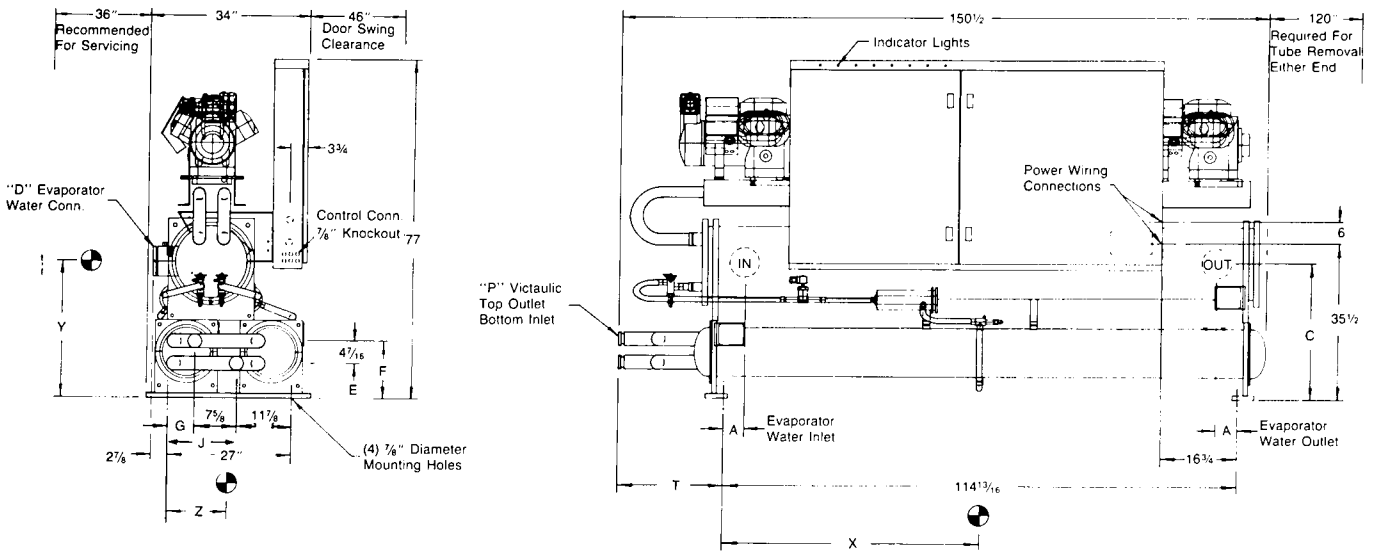


Table 14. THR-120D thru 170D, 4-pass parallel.

THR MODEL NO.	MAXIMUM OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (VICTAULIC)					T	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P		X	Y	Z
120D	150½	34	77	5½	30¼	6	8	12 7/16	7½	15⅛	3	20⅝	55¼	32⅝	13⅝
130D	150½	34	77	5½	30¼	6	8	12 7/16	7½	15⅛	3	20⅝	55⅞	32⅝	13½
140D	150½	34	77	5½	30¼	6	8	12 7/16	7½	15⅛	3	20⅝	56⅛	32⅞	13½
150D	150½	34	77	5½	30¼	6	8	12 7/16	7½	15⅛	3	20⅝	56⅝	32⅞	13½
160D	150½	34	77	5½	30¼	6	8	12 7/16	7½	15⅛	3	20⅝	56½	33¼	13⅜
170D	150½	34	77	5½	30¼	6	8	12 7/16	7½	15⅛	3	20⅝	56¼	33½	13⅜

Figure 14. THR-040D thru 110D, 8-pass series/parallel.

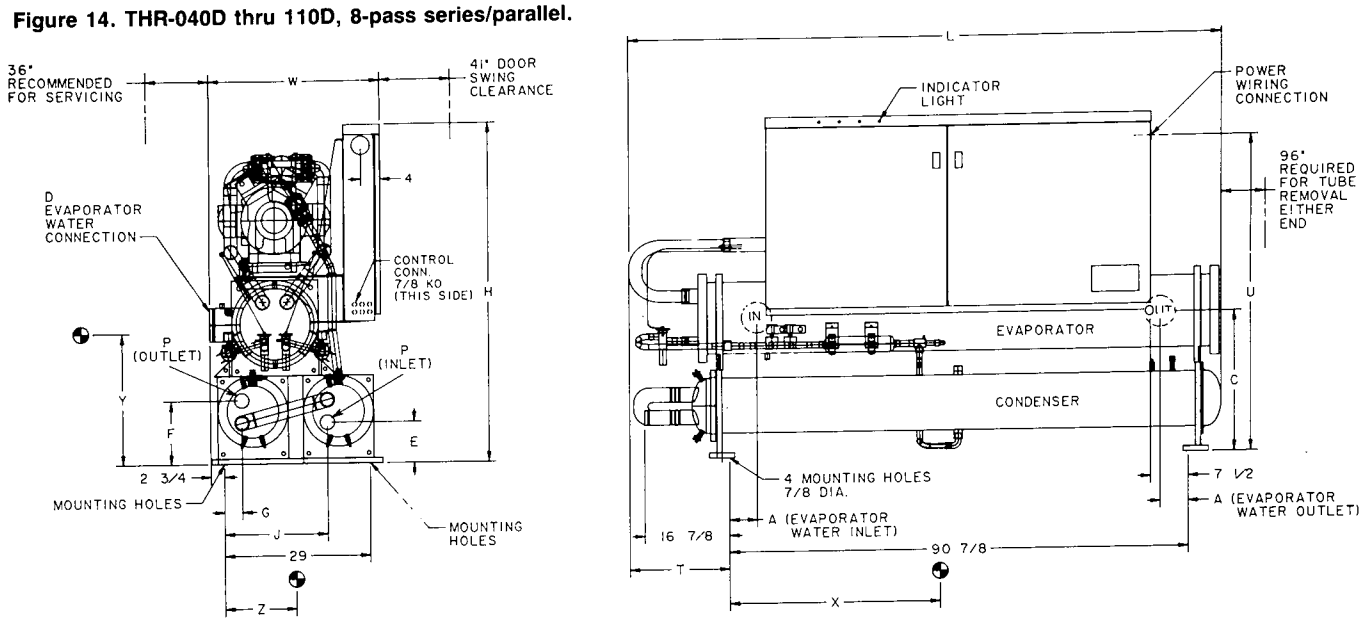


Table 15. THR-040D thru 110D, 8-pass series/parallel.

THR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (VICTAULIC)					T	U	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P			X	Y	Z
040D	116 7/8	34	62 1/4	2 3/4	2 3/8	4	7 3/8	11 1/8	2 3/4	19 3/4	2	19 5/8	58 1/8	42 5/8	23	13
050D	116 7/8	34	62 1/4	2 3/4	2 3/8	4	7 3/8	11 1/8	2 3/4	19 3/4	2	19 5/8	58 1/8	42 5/8	23	13
060D	116 7/8	34	63 3/4	3 1/2	2 4/7	4	7 3/8	11 1/8	2 3/4	19 3/4	2	19 5/8	59 5/8	43	25 1/8	12 3/4
070D	116 7/8	34	63 3/4	3 1/2	2 4/7	5	7 3/8	11 1/8	2 3/4	19 3/4	2	19 5/8	59 5/8	43	25 1/8	12 3/4
080D	116 7/8	34	63 3/4	3 1/2	2 4/7	5	7 3/8	11 1/8	2 3/4	19 3/4	2	19 5/8	59 5/8	43	25 1/8	12 3/4
090D	117 1/8	34	65 5/8	3 1/2	26 1/2	5	8	12 1/2	3 1/2	20 1/2	2 1/2	19 7/8	61 1/2	43 1/2	27 5/8	13
100D	117 1/8	34	66 1/4	5 1/2	27 1/8	6	8	12 1/2	3 1/2	20 1/2	2 1/2	19 7/8	62 1/8	43 7/8	28	12 5/8
110D	117 1/8	34	66 1/4	5 1/2	27 1/8	6	8	12 1/2	3 1/2	20 1/2	2 1/2	19 7/8	62 1/8	43 3/4	28	12 5/8

Figure 15. THR-120D thru 170D, 8-pass series/parallel.

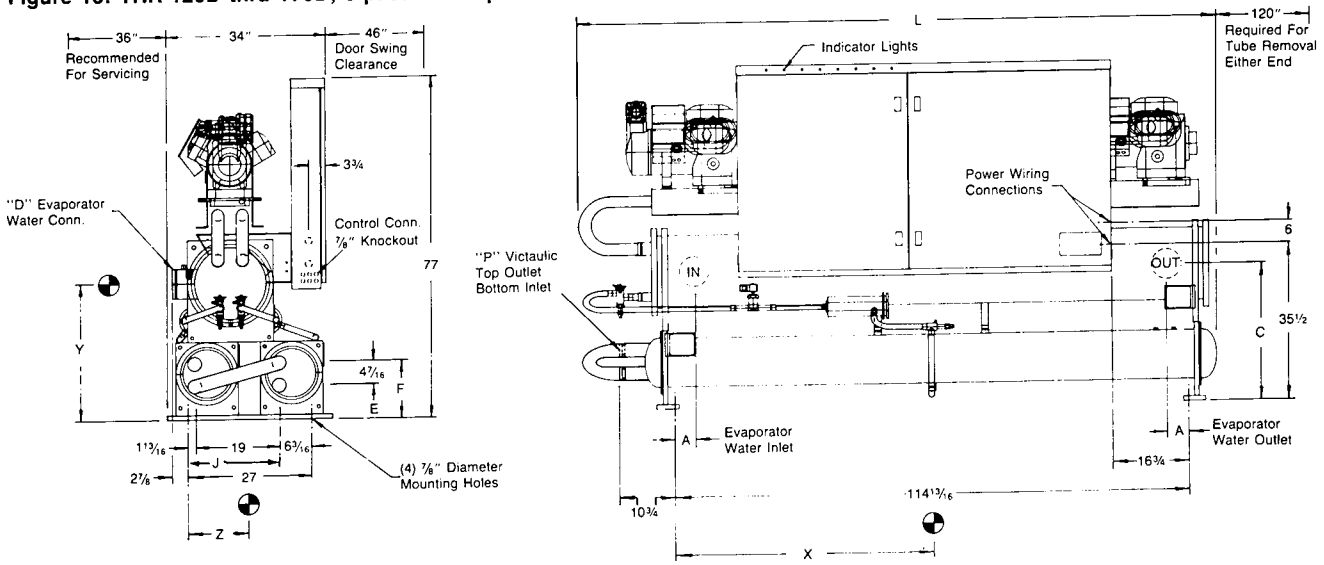


Table 16. THR-120D thru 170D, 8-pass series/parallel.

THR MODEL NO.	MAXIMUM OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (VICTAULIC)					T	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P		X	Y	Z
120D	142 3/4	34	77	5 1/2	30 1/4	6	8	12 7/16	1 13/16	20 13/16	2 1/2	10 3/4	55 1/4	32 5/8	13 5/8
130D	142 3/4	34	77	5 1/2	30 1/4	6	8	12 7/16	1 13/16	20 13/16	2 1/2	10 3/4	55 7/8	32 5/8	13 1/2
140D	142 3/4	34	77	5 1/2	30 1/4	6	8	12 7/16	1 13/16	20 13/16	2 1/2	10 3/4	56 1/8	32 7/8	13 1/2
150D	142 3/4	34	77	5 1/2	30 1/4	6	8	12 7/16	1 13/16	20 13/16	2 1/2	10 3/4	56 5/8	32 7/8	13 1/2
160D	142 3/4	34	77	5 1/2	30 1/4	6	8	12 7/16	1 13/16	20 13/16	2 1/2	10 3/4	56 1/2	33 1/4	13 3/8
170D	142 3/4	34	77	5 1/2	30 1/4	6	8	12 7/16	1 13/16	20 13/16	2 1/2	10 3/4	56 1/4	33 1/2	13 3/8

PHYSICAL DATA

Table 17. THR-040D thru 110D

UNIT SIZE	040D		050D		060D		070D		080D		090D		100D		110D	
COMPRESSORS																
Nominal Horsepower	20	25	25	25	30	35	35	35	40	40	50	50	50	60	60	60
Number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Speed RPM (60 Hz/50 Hz)	1750/1450		1750/1450		1750/1450		1750/1450		1750/1450		1750/1450		1750/1450		1750/1450	
No. of Cylinders	4	4	4	4	4	6	6	6	6	6	8	8	8	8	8	8
Oil Charge (Oz.)	136	136	136	136	152	160	160	160	242	242	260	260	260	260	260	260
Discharge Line Size (In.)	1⅛	1⅛	1⅛	1⅛	1⅜	1⅜	1⅜	1⅜	1⅜	1⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝
CONDENSERS																
Number	2		2		2		2		2		2		2		2	
Diameter (In.)	8⅝	8⅝	8⅝	8⅝	8⅝	8⅝	8⅝	8⅝	8⅝	8⅝	10¾	10¾	10¾	10¾	10¾	10¾
Tube Length (In.)	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96
Design W.P. (PSIG):																
Refrigerant Side	450		450		450		450		450		450		450		450	
Water Side	250		250		250		250		250		250		250		250	
Relief Flare	½		½		½		½		½		½		½		½	
Purge Valve Flare	¼ & ½		¼ & ½		¼ & ½		¼ & ½		¼ & ½		¼ & ½		¼ & ½		¼ & ½	
Liquid Subcooler	Integral		Integral		Integral		Integral		Integral		Integral		Integral		Integral	
2-PASS ARRANGEMENT																
No. Water Passes	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Pump-Out Capacity ①	130	130	130	130	125	125	116	116	109	109	199	199	188	188	188	188
Connections:																
Water Inlet & Outlet (Victaulic)	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	3	3	3	3	3	3
4-PASS ARRANGEMENT																
No. Water Passes	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Pump-Out Capacity ①	130	130	130	130	125	125	116	116	109	109	199	199	188	188	188	188
Connections:																
Water Inlet & Outlet (Victaulic)	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	3	3	3	3	3	3
8-PASS ARRANGEMENT																
No. Water Passes②	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Pump-Out Capacity ①	130	130	130	130	125	125	116	116	109	109	199	199	188	188	188	188
Connections:																
Water Inlet & Outlet (Victaulic)	2	2	2	2	2	2	2	2	2	2	2½	2½	2½	2½	2½	2½
EVAPORATOR																
No. Refrigerant Circuits	2		2		2		2		2		2		2		2	
Diameter (In.)	10¾		10¾		12¾		12¾		12¾		12¾		14		14	
Tube Length (In.)	96		96		96		96		96		96		96		96	
Water Volume (Gallons)	20.6		17.9		28.0		25.8		24.3		24.3		30.5		27.8	
Refrigerant Side D.W.P. (PSIG)	225		225		225		225		225		225		225		225	
Water Side D.W.P. (PSIG)	175		175		175		175		175		175		175		175	
Water Connections:																
Inlet & Outlet (NPT EXT.)	4		4		5		5		5		5		6		6	
Drain & Vent (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜		⅜		⅜	
DIMENSIONS — 2-PASS																
Length (In.)	125¾		125¾		125¾		125¾		125¾		127		127		127	
Width (In.)	34		34		34		34		34		34		34		34	
Height (In.)	62¼		62¼		63¾		63¾		63¾		65⅝		66¼		66¼	
DIMENSIONS — 4-PASS																
Length (In.)	124¾		124¾		124¾		124¾		124¾		125¾		125¾		125¾	
Width (In.)	34		34		34		34		34		34		34		34	
Height (In.)	62¼		62¼		63¾		63¾		63¾		65⅝		66¼		66¼	
DIMENSIONS — 8-PASS																
Length (In.)	116⅞		116⅞		116⅞		116⅞		116⅞		117⅛		117⅛		117⅛	
Width (In.)	34		34		34		34		34		34		34		34	
Height (In.)	62¼		62¼		63¾		63¾		63¾		65⅝		66¼		66¼	
WEIGHTS — 2- & 4-PASS																
Operating Weight (Lbs.)	3655		3705		3995		4085		4240		4675		5315		5465	
Shipping Weight (Lbs.)	3655		3735		3935		4025		4185		4690		5175		5325	
Operating Charge Lbs. R-22	40	50	50	50	50	60	60	60	65	65	70	70	80	80	80	80
WEIGHTS — 8-PASS																
Operating Weight (Lbs.)	3635		3665		3955		4045		4200		4715		5255		5405	
Shipping Weight (Lbs.)	3635		3695		3895		3985		4045		4630		5115		5265	
Operating Charge Lbs. R-22	40	50	50	50	50	60	60	60	65	65	70	70	80	80	80	80

NOTES:
① 80% Full refrigerant at 90°F.
② 8-Pass Series/Parallel Arrangement.

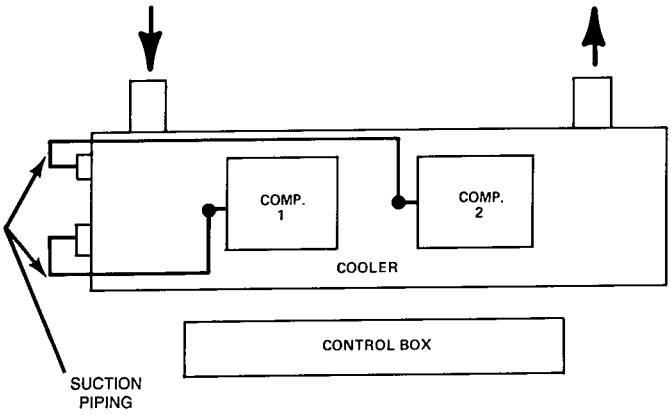
Table 18. WHR-120D thru 170D.

UNIT SIZE	120D		130D		140D		150D		160D		170D	
COMPRESSORS												
Nominal Horsepower	35/25	35/25	35/25	35/35	35/35	35/35	35/35	35/40	35/40	35/40	40/40	40/40
Number	2	2	2	2	2	2	2	2	2	2	2	2
Speed RPM (60 Hz/50 Hz)	1750/1450		1750/1450		1750/1450		1750/1450		1750/1450		1750/1450	
No. of Cylinders	6/4	6/4	6/4	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6
Oil Charge (Oz.)	160/136	160/136	160/136	160/160	160/160	160/160	160/160	160/242	160/242	160/242	242/242	242/242
Discharge Line Size (In.)	1⅜/1⅛	1⅜/1⅛	1⅜/1⅛	1⅜/1⅛	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜
CONDENSERS												
Number	2		2		2		2		2		2	
Diameter (In.)	10¾	10¾	10¾	10¾	10¾	10¾	10¾	10¾	10¾	10¾	10¾	10¾
Tube Length (In.)	120	120	120	120	120	120	120	120	120	120	120	120
Design W.P. (PSIG):												
Refrigerant Side	450		450		450		450		450		450	
Water Side	250		250		250		250		250		250	
Relief Flare	⅝		⅝		⅝		⅝		⅝		⅝	
Purge Valve Flare	¼ & ½		¼ & ½		¼ & ½		¼ & ½		¼ & ½		¼ & ½	
Liquid Subcooler	Integral		Integral		Integral		Integral		Integral		Integral	
2-PASS ARRANGEMENT												
No. Water Passes	2	2	2	2	2	2	2	2	2	2	2	2
Pump-Out Capacity ①	250.0	250.0	238.6	238.6	238.6	236.6	219.2	219.2	219.2	219.2	219.2	219.2
Connections:												
Water Inlet & Outlet (Victaulic)	4	4	4	4	4	4	4	4	4	4	4	4
4-PASS ARRANGEMENT												
No. Water Passes	4	4	4	4	4	4	4	4	4	4	4	4
Pump-Out Capacity ①	250.0	250.0	238.6	238.6	238.6	238.6	219.2	219.2	219.2	219.2	219.2	219.2
Connections:												
Water Inlet & Outlet (Victaulic)	3	3	3	3	3	3	3	3	3	3	3	3
8-PASS ARRANGEMENT												
No. Water Passes②	4	4	4	4	4	4	4	4	4	4	4	4
Pump-Out Capacity ①	250.0	250.0	238.6	238.6	238.6	238.6	219.2	219.2	219.2	219.2	219.2	219.2
Connections:												
Water Inlet & Outlet (Victaulic)	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½
EVAPORATOR												
No. Refrigerant Circuits	2		2		2		2		2		2	
Diameter (In.)	14		14		14		14		16		16	
Tube Length (In.)	120		120		120		120		120		120	
Water Volume (Gallons)	38.2		36.1		36.1		53.7		45.1		45.1	
Refrigerant Side D.W.P. (PSIG)	225		225		225		225		225		225	
Water Side D.W.P. (PSIG)	175		175		175		175		175		175	
Water Connections:												
Inlet & Outlet (NPT EXT.)	6		6		6		6		6		6	
Drain & Vent (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜	
DIMENSIONS — 2-PASS												
Length (In.)	151⅞		151⅞		151⅞		151⅞		151⅞		151⅞	
Width (In.)	34		34		34		34		34		34	
Height (In.)	77		77		77		77		77		77	
DIMENSIONS — 4-PASS												
Length (In.)	150½		150½		150½		150½		150½		150½	
Width (In.)	34		34		34		34		34		34	
Height (In.)	77		77		77		77		77		77	
DIMENSIONS — 8-PASS												
Length (In.)	142¾		142¾		142¾		142¾		142¾		142¾	
Width (In.)	34		34		34		34		34		34	
Height (In.)	77		77		77		77		77		77	
WEIGHTS — 2 & 4 PASS												
Operating Weight (Lbs.)	6370		6525		6600		6940		7290		7400	
Shipping Weight (Lbs.)	6180		6335		6410		6775		6990		7100	
Operating Charge Lbs. R-22	100	100	105	110	110	110	115	115	120	120	125	125
WEIGHTS — 8 PASS												
Operating Weight (Lbs.)	6330		6485		6560		6900		7250		7360	
Shipping Weight (Lbs.)	6140		6295		6380		6735		6950		7060	
Operating Charge Lbs. R-22	100	100	105	110	110	110	115	115	120	120	125	125

NOTES:
① 80% Full refrigerant at 90°F.
② 8 Pass Series/Parallel Arrangement.

Figure 16. Compressor Locations

UNITS 040D thru 110D



UNITS 120D thru 170D

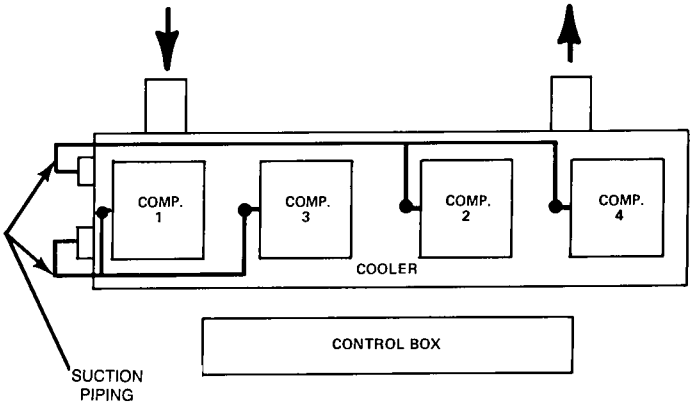


Table 19. Contactor Designation

MODEL	CONTACTOR DESIGNATION FOR COMPRESSOR			
	1	2	3	4
THR-040D	M1—M5	M2—M6	—	—
THR-050D	M1—M5	M2—M6	—	—
THR-060D	M1—M5	M2—M6	—	—
THR-070D	M1—M5	M2—M6	—	—
THR-080D	M1—M5	M2—M6	—	—
THR-090D	M1—M5	M2—M6	—	—
THR-100D	M1—M5	M2—M6	—	—
THR-110D	M1—M5	M2—M6	—	—
THR-120D	M1—M5	M2—M6	M3—M7	M4—M8
THR-130D	M1—M5	M2—M6	M3—M7	M4—M8
THR-140D	M1—M5	M2—M6	M3—M7	M4—M8
THR-150D	M1—M5	M2—M6	M3—M7	M4—M8
THR-160D	M1—M5	M2—M6	M3—M7	M4—M8
THR-170D	M1—M5	M2—M6	M3—M7	M4—M8

NOTE: Two contactors are used per compressor on all 208 volts units. Two contactors are also used on THR-090—110 all voltages, and on all 460 & 575 part winding start units.

WIRING

FIELD WIRING, POWER

The THR TEMPLIFIERS are built standard with compressor contactors and power terminal block, designed for single power supply to unit. Optional power connections include a non-fused disconnect switch mounted in the control box or multi-point power connection.

A factory installed control circuit transformer is available as an option with single power supply or disconnect switch; it is not available with multi-point option.

Optional circuit breakers are available for backup compressor short circuit protection on 040D thru 110D units and are standard on all four (4) compressor units 120D thru 170D.

Wiring and conduit selections must comply with the National Electrical Code and/or local requirements.

An open fuse indicates a short, ground, or overload. Before replacing a fuse or restarting a compressor or fan motor, the trouble must be found and corrected. Tables in the Electrical Data section give specific information on recommended wire sizes.

Unit power inlet wiring must enter the side of the control box (right side) through an inlet hole provided for field terminating conduit. (Refer to control panel layout drawings for general location of power inlet and components.)

WARNING: Use only copper conductors in main terminal block. If the power input conductors are aluminum, use a compression splice to change to copper before terminating in block.

FIELD WIRING, CONTROL

Control circuits on all units are designed for 115 volt operation. A separate source of 20 amp, 115 volt AC power may be brought to terminals 1 and 14 (terminal 14 on the ground side) to power the control circuit. On 208 volt power, leads from any line and neutral of the 208 volt system may be brought to terminals 1 and 14 to provide 120 volts to the control circuit.

An optional factory mounted transformer is available to provide the correct control circuit voltage. All models include the necessary factory wiring to power the transformer.

On models THR-040D thru 170D the transformer power leads are connected to the power block PB1 or disconnect switch DS1.

Six ½″ conduit knockout openings are provided for field wired options and are located on the left side of the control panel when facing the unit control panel doors.

NOTE: See page 51 for additional information on the control thermostat.

INTERLOCK WIRING — PUMP STARTERS

The control arrangement shown on the wiring diagram will permit continuous or cycling operation of the source water pump. Provision has been made to permit source water pump cycling by the addition of a field supplied relay "MA" and wiring it between terminals 11 and 16. If relay "MA" is not added the pump must be wired for continuous operation. When continuous source water circulation is used, the flow switch contacts should be tied into the control circuit as shown on the interlock schematic (see Figure 17).

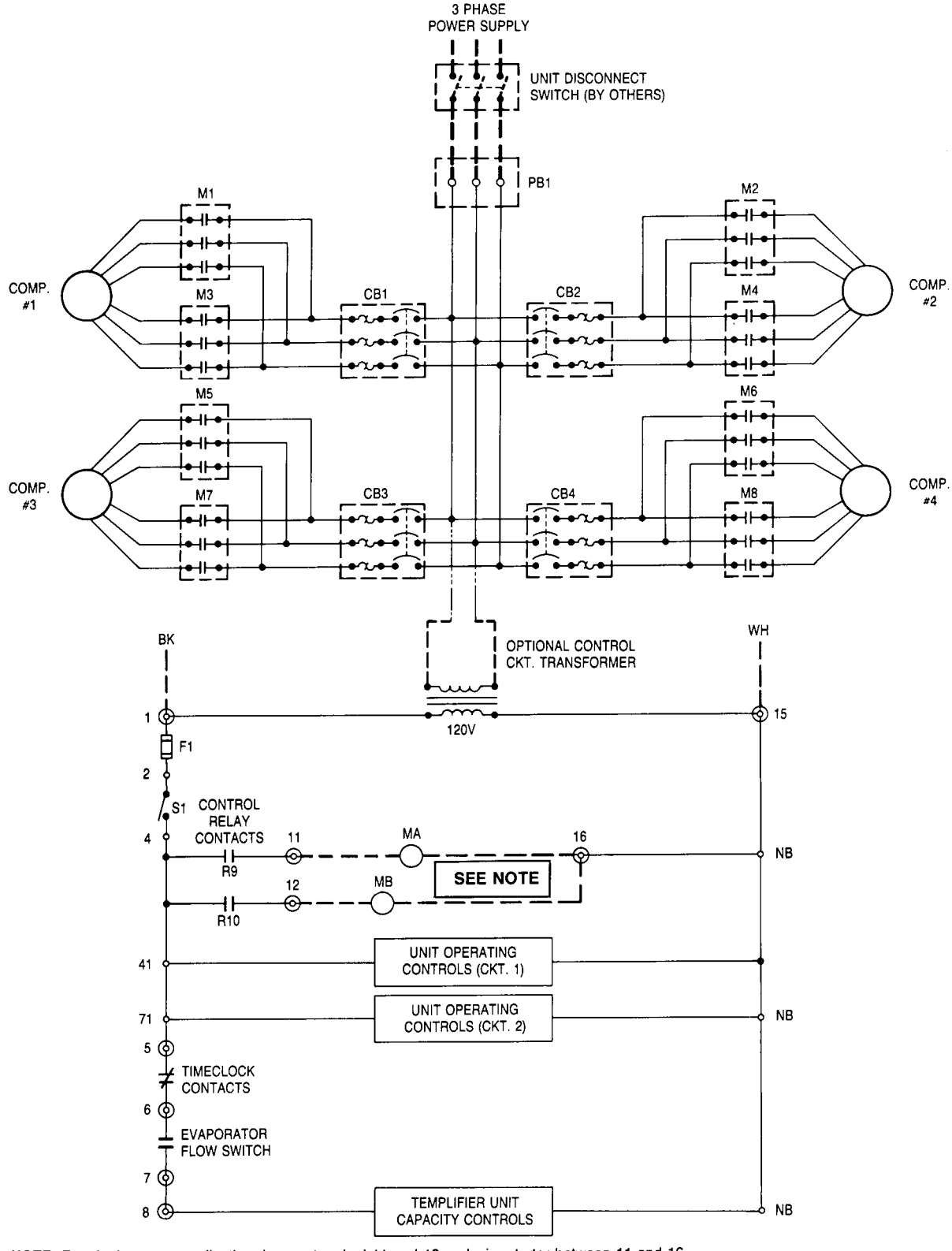
The condenser water pump must be arranged for continuous water circulation, otherwise leaving condenser water temperatures will not be properly controlled.

Condenser water flow switches must be wired into the control circuit as shown on the interlock schematic and depending on the application it may be necessary to install a time delay relay with timed open contacts connected into the control circuit in parallel with the flow switch to prevent nuisance tripping.

Whenever the application will permit, continuous water circulation in both the source water and condenser water circuits is preferred and the use of flow switches in both circuits is recommended.

Figure 17. Typical Interlock Schematic

NOTE: FOR SINGLE STARTER APPLICATION, JUMPER TERMINAL 11 AND 12 AND WIRE STARTER BETWEEN 11 AND 16.



NOTE: For single starter application, jumper terminal 11 and 12 and wire starter between 11 and 16.

LEGEND

◎	FIELD CONNECTION TERMINAL	M1—M8	COMPRESSOR CONTACTORS
———	FACTORY WIRING	CB1—CB4	COMPRESSOR CIRCUIT BREAKERS
— — —	FIELD WIRING	PB1	UNIT POWER TERMINAL BLOCK
— - - —	OPTIONAL FACTORY WIRING	MA, MB	CONDENSER PUMP STARTERS (MAX. 20VA EA.)

SEQUENCE OF OPERATION — THR-040D thru 110D

The following sequence of operation is typical for THR TEMPLIFIER HEAT PUMP, models THR-040D thru THR-110D. The sequence varies somewhat depending upon options.

HEAT ONLY OPERATION

Compressor Heaters — With the control circuit power on and the control stop switch S1 open, 115V power is applied through the control circuit fuse F1 to the compressor crankcase heaters HTR1 and HTR2.

Startup — With the control stop switch S1 closed, 115V power is applied to the compressor motor protectors MP1 and MP2 and the primary of the 24V control circuit transformer. The 24V transformer provides power to the central processor thermostat CP1 and to the optional alarm bell.

When the remote time clock or manual shutdown switch turns on the water pump, the flow switch closes and 115V power is applied to the relay contacts on the central processor CP1. The unit will automatically operate in response to the central processor CP1 provided the manual pumpdown switches PS1 and PS2 are closed (in the auto position), the compressor lockout time delays TD1 and TD2 have closed, energizing the safety relays R5 and R6, and the freezestats FS1 and FS2, high pressure controls HP1 and HP2, and compressor motor protectors MP1 and MP2 do not sense failure conditions.

On a call for heating, the central processor CP1 energizes the liquid line solenoid SV1 for refrigerant circuit #1, opening the valve and allowing refrigerant to flow through the expansion valve and into the evaporator. As the evaporator refrigerant pressure increases, the low pressure control LP1 closes. This energizes the compressor contactors M1 and M5, starting the compressor. Also, R9 relay is energized. R9 relay is wired to terminals providing a means for interlocking the pump starter, MA with the compressor operation. See page 21 for pump control.

As additional stages of heating capacity are required, the central processor CP1 energizes the liquid line solenoid valve SV2 of refrigerant circuit #2. After the compressor sequencing time delay TD11 has closed, the same starting sequence is initiated in refrigerant circuit #2.

If additional heating is still required, the central processor will de-energize the unloader solenoids of each compressor, respectively.

HEATING/COOLING OPERATION

Heat/cool units are designed to supply hot water for heating needs and to allow switching to cooling operation when it is needed.

The sequence of operation for combination heating/cooling units is similar to heating only, the difference is in the thermostat arrangement. On heat/cool models the heating thermostat "CP1" is still used, but in conjunction with a changeover switch and the addition of a separate cooling thermostat "CP2". Changeover from heating to cooling operation or cooling to heating is accomplished by setting the changeover switch for the desired mode to activate the desired heat or cool thermostat. The thermostat relay contacts then activate the control circuit whenever compressor operation and/or loading or unloading is required to satisfy the thermostat setting for the mode selected.

The heating thermostat controls the leaving hot water temperature leaving the condenser through a sensor located in the return water to the condenser.

Conversely the cooling thermostat controls the water temperature leaving the evaporator through a sensor located in the return water, to the evaporator temperature selection dials inside the thermostats, are used to set the desired leaving water temperatures for either heating or cooling. See the thermostat bulletin packed with the unit for additional information.

Check the applicable 4 or 6 stage heat/cool wiring diagrams starting on page 39 for specific wiring details.

Pumpdown Cycle System Shutdown — As the central processor is satisfied, it will unload the compressors and then de-energize the liquid line solenoid valves SV1 and SV2, causing the valves to close, starting the pumpdown cycle. When the compressor has pumped most of the refrigerant out of the evaporator and into the condenser, the low pressure controls LP1 or LP2 will open, shutting down the compressors. During the off cycle, if a closed solenoid valve allows refrigerant to leak into the evaporator, the increase in pressure will cause the low pressure control LP1 or LP2 to close. This will energize the compressor contactors M1 and M2 and start the compressor, which will quickly pump the refrigerant out of the evaporator and into the condenser (recycling pumpdown).

A compressor which repeats recycling pumpdown every 5 minutes indicates a malfunction due to the temperature control or a system cause. A buildup of heat in the compressor without proper cooling of suction gas could cause a mechanical failure in the compressor. McQuay recommends corrective measures be taken if the compressor recycles repeatedly within 15-minute intervals.

Safety Relay Operation — The safety relays R5 and R6 must be energized to permit normal operation. If the freezestats FS1 and FS2, high pressure controls HP1 and HP2, oil pressure controls OP1 and OP2 or compressor motor protectors MP1 and MP2 sense a fault condition and open, the safety relay R5 or R6 will be de-energized. The relay contacts open and de-energize the compressor contactor and the liquid line solenoid valve.

Compressor Anti-Short Cycle Time Delay — The unit is equipped with 5-minute time delay relays TD1 and TD2 which provide anti-short cycling protection. When low pressure control LP1 closes and energizes M1 compressor contactor, LP1 also energizes R9 which provides power to auxiliary relay MA for control of a starter for a remote evaporator pump. A second contact on R9 shunts out TD1 opening up TD1. When LP1 opens, cutting power to R9, then compressor #1 cannot be started until TD1 times out and energizes safety relay R5.

Operation of LP2, TD2, M2, R10 and R6 is similar for operation of the second compressor.

Note: The motor protector in the compressor terminal box has a 2-minute time delay. When power is interrupted to terminals 3 and 4 of any motor protector, the MP contacts between MP terminals 1 and 2 open and will not close for two minutes.

Indicator Lights — The THR unit control box is equipped with indicator lights to show the status of electrical control operation.

1. ON-STOP Switch — Has an inherent light which glows when the control circuit is energized.
2. Lights SV1 and SV2 — Glow when the safety relays are energized indicating compressor circuit safety contacts are closed, and compressor will operate in response to CP1 thermostat.
3. Lights RL1 and RL2 — Glow when the compressor contactors are energized and cooling circuit is in operation.
4. Heating Stage Indicator Lights — Red lights next to the relays on the main central processor thermostat indicate which heating stages are energized.

SEQUENCE OF OPERATION — THR-120D thru 170D

The following sequence of operation is typical for THR TEMPLIFIER, models THR-120D thru THR-170D. The sequence varies somewhat depending upon options.

Compressor Heaters — With the control circuit power on and the control stop switch S1 open, 115V power is applied through the control circuit fuse F1 to the compressor crankcase heaters HTR1, HTR2, HTR3, and HTR4.

Startup — With the control stop switch S1 closed, 115V power is applied to the compressor motor protectors MP1, MP2, MP3, and MP4 and the primary of the 24V control circuit transformer. The 24V transformer provides power to the central processor thermostat CP1 and to the optional alarm bell.

When the remote time clock or manual shutdown switch turns on the water pump, the flow switch closes and 115V power is applied to the relay contacts on the central processor CP1. The unit will automatically operate in response to the central processor CP1 provided the manual pumpdown switches PS1 and PS2 are closed (in the auto position), the compressor lockout time delays TD1 and TD2 have closed, energizing the safety relays R5 and R6, and the freezestats FS1 and FS2, high pressure controls HP1 and HP2, and compressor motor protectors MP1, MP2, MP3, and MP4 do not sense failure conditions.

On a call for heating, the central processor CP1 energizes the liquid line solenoid SV1 for refrigerant circuit #1, opening the valve and allowing refrigerant to flow through the expansion valve and into the evaporator refrigerant pressure increases, the low pressure control LP1 closes. This energizes the compressor contactors M1 and M5, starting the compressor. Also, R9 relay is energized. R9 relay is wired to terminals providing a means for interlocking the pump starter MA with the compressor operation.

As additional stages of capacity are required, the central processor CP1 energizes the liquid line solenoid valve SV2 of refrigerant circuit #2. After the compressor sequencing time delay TD11 has closed, the same starting sequence is initiated in refrigerant circuit #2.

If additional heating is still required, the central processor will activate additional cylinders on the lead compressor of each system or activate compressors #3 and #4, depending on the load requirements and the capacity control stops available on the unit.

Pumpdown Cycle System Shutdown — As the central processor is satisfied, it will cut off compressor #4 and #3, then unload compressors #2 and #1, and finally de-energize the liquid line solenoid valves SV1 and SV2, causing the valves to close. When the compressor has pumped most of the refrigerant out of the evaporator and into the condenser, the low pressure controls LP1 or LP2 will open, shutting down the compressors. In the event a closed solenoid valve allows refrigerant to leak into the evaporator, the increase in pressure will cause the low pressure control LP1 or LP2 to close. This will energize the compressor contactors M1 and M2 and start the compressor, which will quickly pump the refrigerant out of the evaporator and into the condenser (recycling pumpdown).

A compressor which repeats recycling pumpdown every 5 minutes indicates a malfunction due to the temperature control or a system cause. A buildup of heat in the compressor without proper cooling of suction gas could cause a mechanical failure in the compressor. McQuay recommends corrective measures be taken if the compressor recycles repeatedly within 15-minute intervals.

Safety Relay Operation — The safety relays R5 and R6 must be energized to permit normal operation. If the freezestats FS1 and FS2, high pressure controls HP1 and HP2, oil pressure controls OP1 and OP2 or compressor motor protectors MP1 and MP2 sense a fault condition and open, the safety relay R5 or R6 will be de-energized. The relay contacts open and de-energize the compressor contactor and the liquid line solenoid valve. Safety relays R7 and R8 provide a similar function for compressors #3 and #4.

Compressor Anti-Short Cycle Time Delay — The unit is equipped with 5-minute time delay relays TD1, TD2, TD3 and TD4 which provide anti-short cycling protection. When low pressure control LP1 closes and energizes M1 compressor contactor, LP1 also energizes R9 which provides power to auxiliary relay MA for control of a starter for a remote pump. A second contact on R9 shunts out TD1 opening up TD1. When LP1 opens, cutting power to R9, then compressor #1 cannot be started until TD1 times out and energizes safety relay R5.

Operation of LP2, TD2, M2, R10, R6 and M1 is similar for operation of the second compressor.

Note: The motor protector in the compressor terminal box has a 2-minute time delay. When power is interrupted to terminals 3 and 4 of any motor protector, the MP contacts between MP terminals 1 and 2 open and will not close for two minutes.

Indicator Lights — The THR unit control box is equipped with indicator lights to show the status of electrical control operation.

1. ON-STOP Switch — Has an inherent light which glows when the control circuit is energized.
2. Lights SV1, SV2, SV3, and SV4 — Glow when the safety relays are energized indicating compressor circuit safety contacts are closed, and compressor will operate in response to CP1 thermostat.
3. Lights RL1, RL2, RL3, and RL4 — Glow when the compressor contactors are energized and cooling circuit is in operation.
4. Heating Stage Indicator Lights — Red lights next to the relays on the main central processor thermostat indicate which heating stages are energized. **Note:** Located inside control box.

Table 13. Compressor motor amp draw

Unit Size	3Ph, 60 Hz ① Input Power Voltage	Rated Load Amps ② Circuit 1	Rated Load Amps ② Circuit 2	Locked Rotor Amps ③ AL Start Circuit 1	Locked Rotor Amps ③ AL Start Circuit 2	Locked Rotor Amps ③ PW Start Circuit 1	Locked Rotor Amps ③ PW Start Circuit 2	Wire Sizing Amps ④ Single Pt. Power Supply ⑤	Wire Sizing Amps ④ Mult. Pt. Power Supply ⑥ Circuit 1	Wire Sizing Amps ④ Mult. Pt. Power Supply ⑥ Circuit 1
040D	208	63	77	308	428	188	250	159	79	96
	230	63	77	308	428	188	250	159	79	96
	460 ⑦	32	42	154	214	84	117	85	40	53
	575	26	31	135	172	81	103	65	33	39
050D	208	77	77	428	428	250	250	173	96	96
	230	77	77	428	428	250	250	173	96	96
	460 ⑦	42	42	214	214	117	117	95	53	53
	575	31	31	172	172	103	103	70	39	39
060D	208	106	113	470	565	292	340	247	133	141
	230	106	113	470	565	292	340	247	133	141
	460 ⑦	53	61	235	283	141	156	129	66	76
	575	39	45	200	230	130	138	95	49	56
070D	208	113	113	565	565	340	340	254	141	141
	230	113	113	565	565	340	340	254	141	141
	460 ⑦	61	61	283	283	156	156	137	76	76
	575	45	45	230	230	138	138	101	56	56
080D	208	153	153	660	660	400	400	344	191	191
	230	129	129	594	594	340	340	290	161	161
	460 ⑦	65	65	297	297	170	170	146	81	81
	575	52	52	235	235	135	135	117	65	65
090D	208	162	162	1070	1070	654	654	365	203	203
	230	162	162	1070	1070	654	654	365	203	203
	460 ⑦	82	82	535	535	330	330	185	103	103
	575	60	60	405	405	262	262	135	75	75
100D	208	162	202	1070	1070	654	654	415	203	253
	230	162	202	1070	1070	654	654	415	203	253
	460 ⑦	82	101	535	535	330	330	208	103	126
	575	60	72	405	405	262	262	150	75	90
110D	208	202	202	1070	1070	654	654	455	253	253
	230	202	202	1070	1070	654	654	455	253	253
	460 ⑦	101	101	535	535	330	330	227	126	126
	575	72	72	405	405	262	262	162	90	90
120D	208	113, 77	113, 77	565, 428	565, 428	340, 250	340, 250	408	218	218
	230	113, 77	113, 77	565, 428	565, 428	340, 250	340, 250	408	218	218
	460 ⑦	61, 42	61, 42	283, 214	283, 214	156, 117	156, 117	221	118	118
	575	45, 31	45, 31	230, 172	230, 172	138, 103	138, 103	163	87	87
130D	208	113, 77	113, 113	565, 428	565, 428	340, 250	340, 250	444	218	254
	230	113, 77	113, 113	565, 428	565, 428	340, 250	340, 250	444	218	254
	460 ⑦	61, 42	61, 61	283, 214	283, 214	156, 117	156, 117	250	118	137
	575	45, 31	45, 45	230, 172	230, 172	138, 103	138, 103	177	87	101
140D	208	113, 113	113, 113	565, 565	565, 565	340, 340	340, 340	480	254	254
	230	113, 113	113, 113	565, 565	565, 565	340, 340	340, 340	480	254	254
	460 ⑦	61, 61	61, 61	283, 283	283, 283	156, 156	156, 156	259	137	137
	575	45, 45	45, 45	230, 230	230, 230	138, 138	138, 138	191	101	101
150D	208	113, 113	113, 153	565, 565	565, 660	340, 340	340, 400	530	254	304
	230	113, 113	113, 153	565, 565	565, 660	340, 340	340, 400	500	254	274
	460 ⑦	61, 61	61, 65	283, 283	283, 297	156, 156	156, 170	264	137	142
	575	45, 45	45, 52	230, 230	230, 235	138, 138	138, 135	300	101	110
160D	208	113, 153	113, 153	565, 660	565, 660	340, 400	340, 400	570	304	304
	230	113, 129	113, 129	565, 594	565, 594	340, 340	340, 340	516	274	274
	460 ⑦	61, 65	61, 65	283, 297	283, 297	156, 170	156, 170	268	142	142
	575	45, 52	45, 52	230, 235	230, 235	138, 135	138, 135	207	110	110
170D	208	153, 153	153, 153	660, 660	660, 660	400, 400	400, 400	650	344	344
	230	129, 129	129, 129	594, 594	594, 594	340, 340	340, 340	548	290	290
	460 ⑦	65, 65	65, 65	297, 297	297, 297	170, 170	170, 170	276	146	146
	575	52, 52	52, 52	235, 235	235, 235	135, 135	135, 135	221	117	117

NOTES:

① ALLOWABLE VOLTAGE LIMITS:
Unit Nameplate 208V/60Hz/3Ph: 187V to 253V (except THR-080D: 180V to 220V).
Unit Nameplate 230V/60Hz/3Ph: 187V to 253V (except THR-080D: 207V to 253V).
Unit Nameplate 460V/60Hz/3Ph: 414V to 506V.
Unit Nameplate 575V/60Hz/3Ph: 517V to 633V.
Unit Nameplate 380V/50Hz/3Ph: 342V to 418V.

② Compressor RLA values are for wire sizing purposes only and do not reflect normal operating current draw.

③ Compressor LRA for part winding start are for the first winding.

④ Unit wire size amps are equal to 125% of the largest compressor-motor RLA plus 100% of RLA of all other loads in the circuit including control transformer. Wire size amps for separate 115V control circuit power is 10 amps.

⑤ *Single point power supply requires a single fused disconnect to supply electrical power to the unit.*

⑥ Multiple point power supply requires three independent power circuits with separate fused disconnects (two compressor circuits, one control circuit).

⑦ Data also applies to 380V/50Hz/3Ph units.

CONTROL CENTER

All electrical controls are enclosed in a control center with locking, hinged access door(s). A partition separates the adjustable safety controls from the starting and operating controls. A "deadfront" panel covers all starting and operating controls so that no electrical contacts or terminals are exposed. The deadfront panel is hinged for servicing. The adjustable controls are covered and can be adjusted without fear of contacting line voltage.

CONTROL CENTER LAYOUT, THR-040D thru 110D

Figure 18. Left Side, 115V Control Section

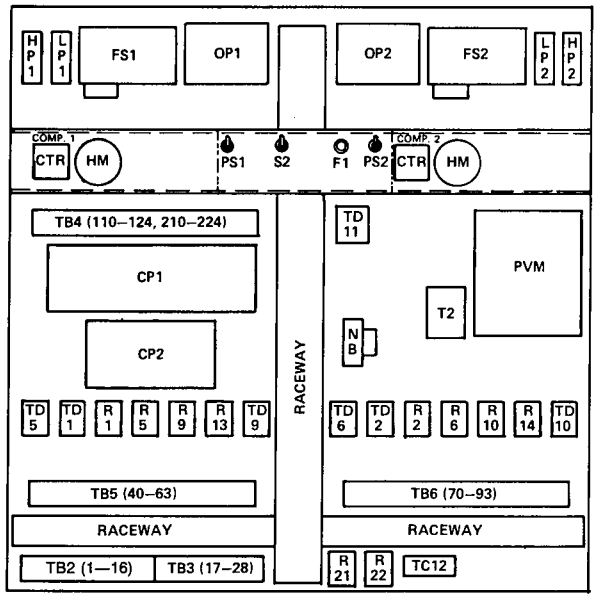
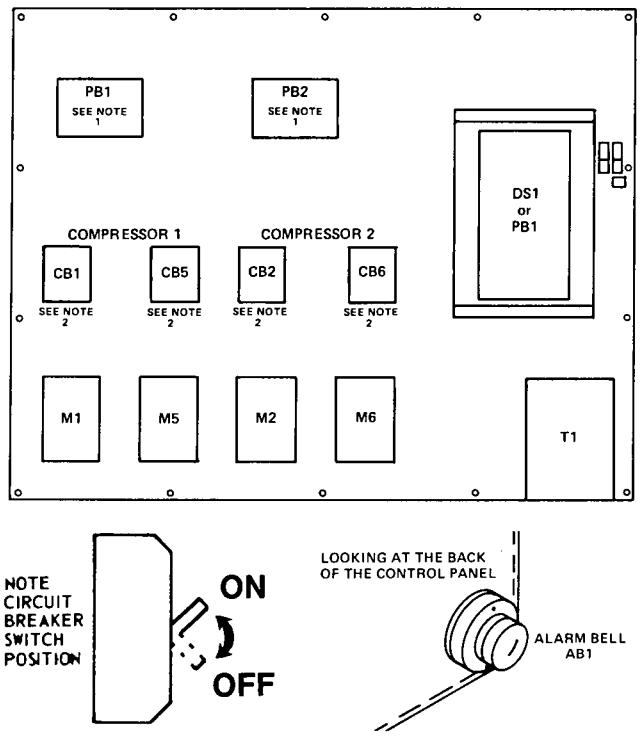


Figure 19. Right Side, High Voltage Control Section



CONTROL CENTER LAYOUT, THR-120D thru 170D

Figure 20. Left Side, 115V Control Section

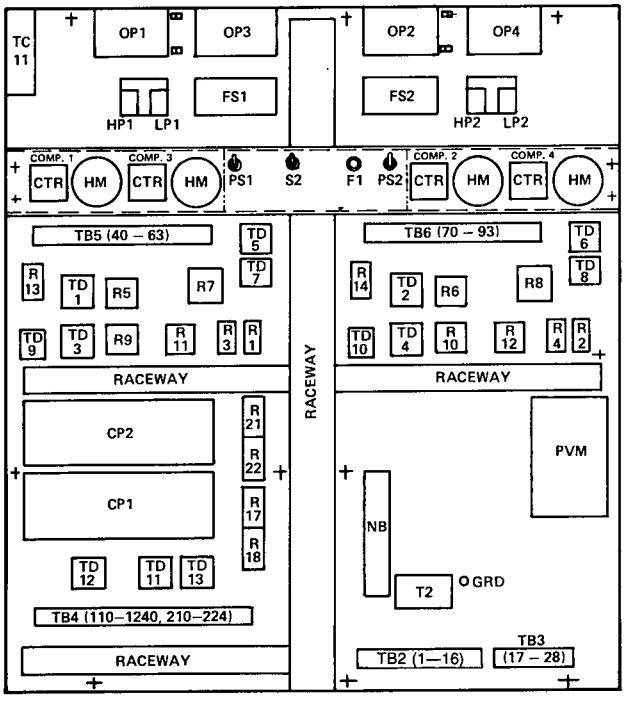
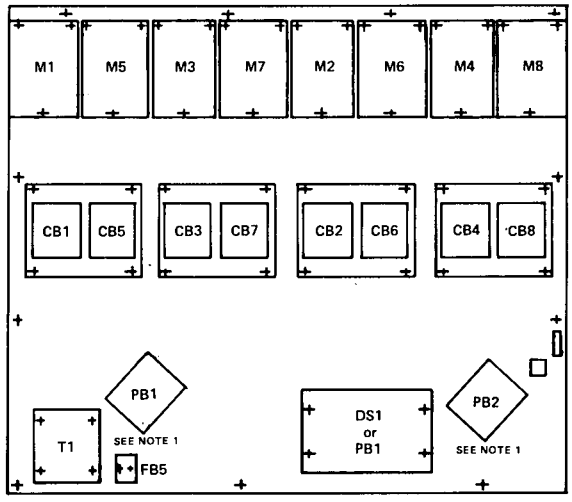


Figure 21. Right Side, High Voltage Power Section



NOTES:
1. PB1 and PB2 are used with multiple point power wiring.
2. Circuit breakers are provided as an option, on THR-040D—110 units.

ELECTRICAL LEGEND

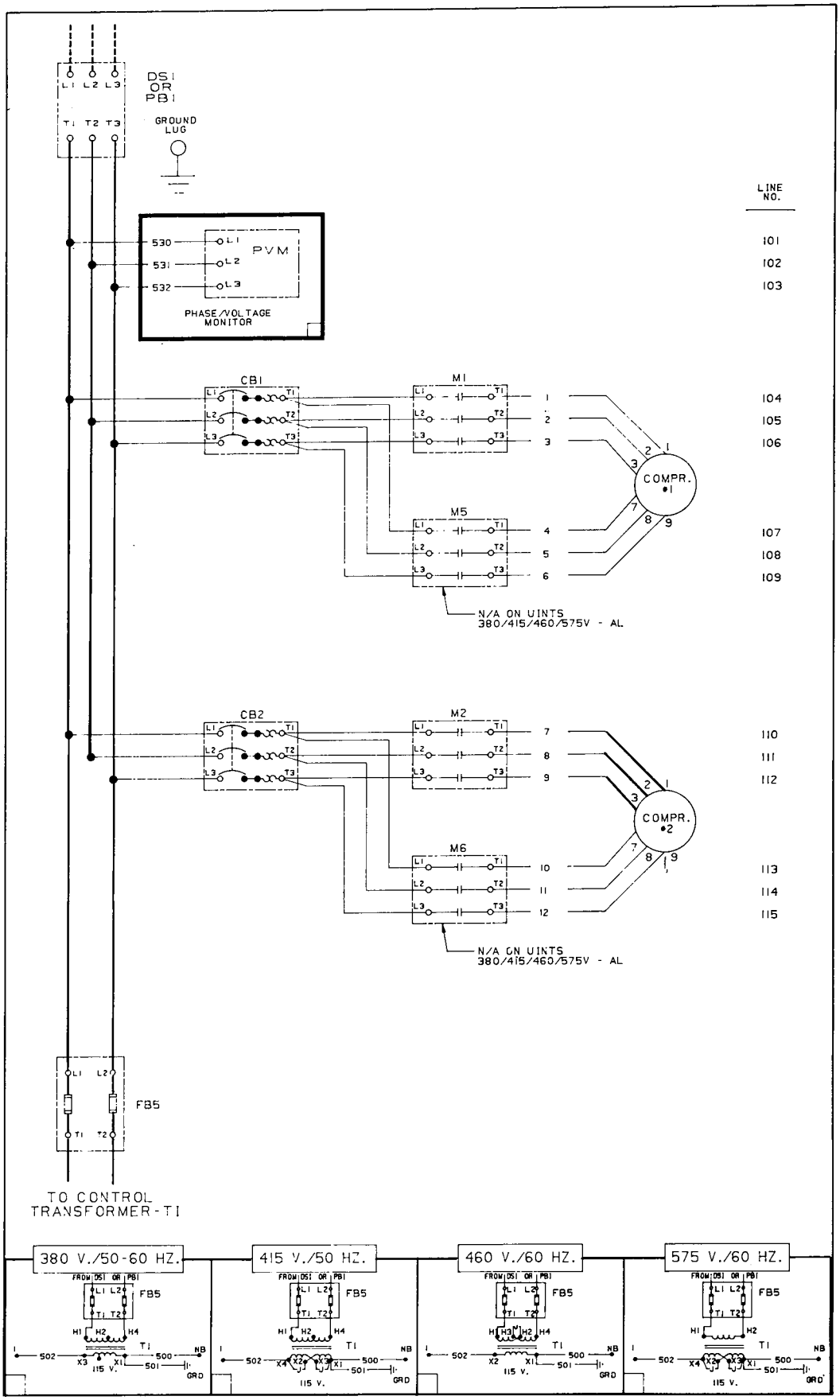
DESIGNATION	DESCRIPTION	STANDARD LOCATION
AB	Alarm Bell	Back or Side of Control Box
CB1—6	Circuit Breakers Compr. Motors	Control Box
COMPR. 1—4	Compressors 1—4	Top of Evaporator
CP1	Central Processor	Control Box
CP2	Central Processor Satellite, Cool/Heat	Control Box
CTR 1—4	Counter Compr. Total Hours	Control Box
DS1	Disconnect Switch Main	Control Box
F1	Fuse Control Circuit	Control Box
FB5	Fuseblock Control Power	Control Box
FS1, 2	Freezestats, Pressure Control	Control Box
GFI	Ground Fault Interruptor	Control Box
GRD	Ground	Control Box
HM1—4	Hour Meter Compressors	Control Box
HP1, 2	High Pressure Controls	Control Box
HTR1—4	Heaters, Compressor Crankcase	On Compressor
LP1, 2	Low Pressure Controls	Control Box
M1—8	Contactors, Compressor	Control Box
MA, MB	Pump Starter Coils	Field Installed
MJ	Mechanical Jumpers	Control Box
MP1—4	Motor Protectors, Compressor	Compressor Junction Box
NB	Neutral Block	Control Box
OL1—8	Overloads	Control Box
OP1—4	Oil Pressure Controls	Control Box
PB1, 2	Power Block, Main	Control Box
PS1, 2	Pumpdown Switches	Control Box
PVM	Phase Voltage Monitor	Control Box
R1, 2	Relays, Alarm	Control Box
R3, 4	Relays, Starting	Control Box
R5—8	Relays, Safety or Alarm	Control Box
R9—12	Relays, Starting	Control Box
R13, 14	Relays, Low Ambient Start	Control Box
R17, 18	Relays, Capacity Control	Control Box
R21, 22	Relays, High Return/Low Source Water	Control Box
R23, 24	Relays, Unloader Control	Control Box
R25—30	Relays, Special	Control Box
RL1—4	Run Indicator Lights	Front of Control Box
RRM	Remote Reset Module	Control Box
S1	Switch, Control Stop	Side of Control Box
S2	Switch, Lead-Lag	Control Box
SD1	Solenoid Door Lock	Control Box
SL1—4	Safety Indicator Lights	Front of Control Box
SV1, 2	Solenoid Valves, Liquid Lines	On Liquid Piping
SV5, 6	Solenoid Valves, Hot Gas Bypass	On Hot Gas Piping
T1	Transformer, Main Control	Control Box
T2	Transformer, 23V Control	Control Box
TB2	Terminal Block, 120V Field	Control Box
TB3	Terminal Block, 24V Field	Control Box
TB4—6	Terminal Blocks, Controls	Control Box
TC1	Thermostat, Special	Control Box
TC10	Thermostat, Special	Control Box or On Unit
TC11	Thermostat, Low Source Water	Control Box
TC12	Thermostat, Special	Control Box or On Unit
TD1—4	Time Delays, Compressor Lockout	Control Box
TD5—8	Time Delays, Compressor PW Start	Control Box
TD11—13	Time Delays, Compressor Sequencing	Control Box
TD20—24	Time Delays, Special	Control Box
U1, 2	Unloaders	On Compressors

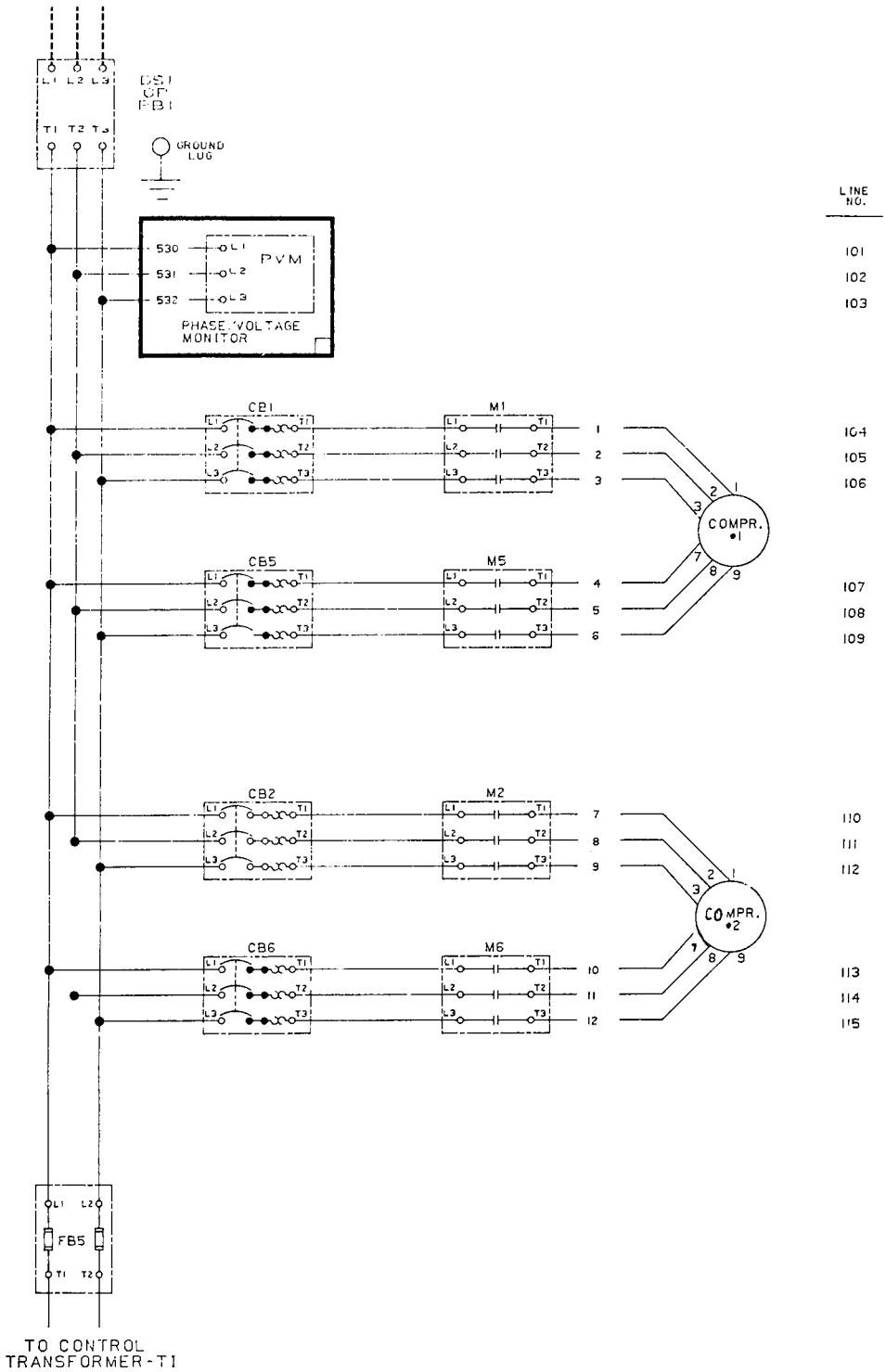
GENERAL NOTES

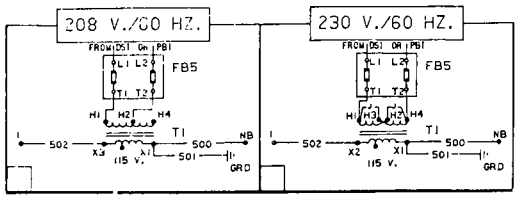
1. FIELD WIRING
2. WIRING IN REMOTE UNIT
3. WIRING CONNECTING UNITS
4. 200 WIRE NUMBER
5. OPTION BLOCK
6. FACTORY WIRED TERMINAL
7. FIELD WIRED TERMINAL
8. REMOTE PANEL TERMINAL
9. WIRE CONNECTOR
10. PLUG CONNECTOR
11. 289* OPTIONAL LINE ON TERMINAL BLOCK

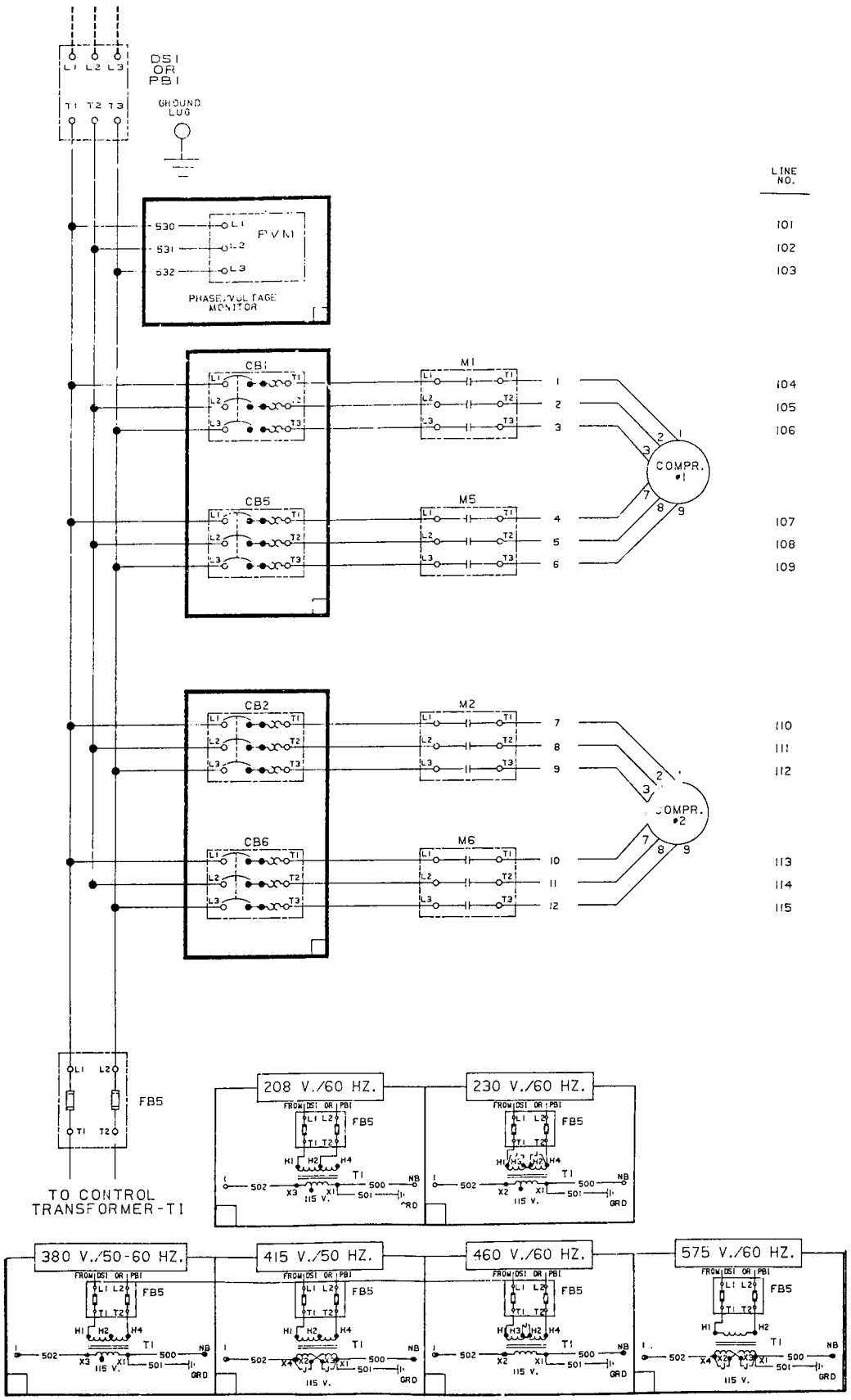
TYPICAL POWER WIRING DIAGRAMS

THR 040D THRU 080D—SINGLE POINT 380/415/575V — AL, PW

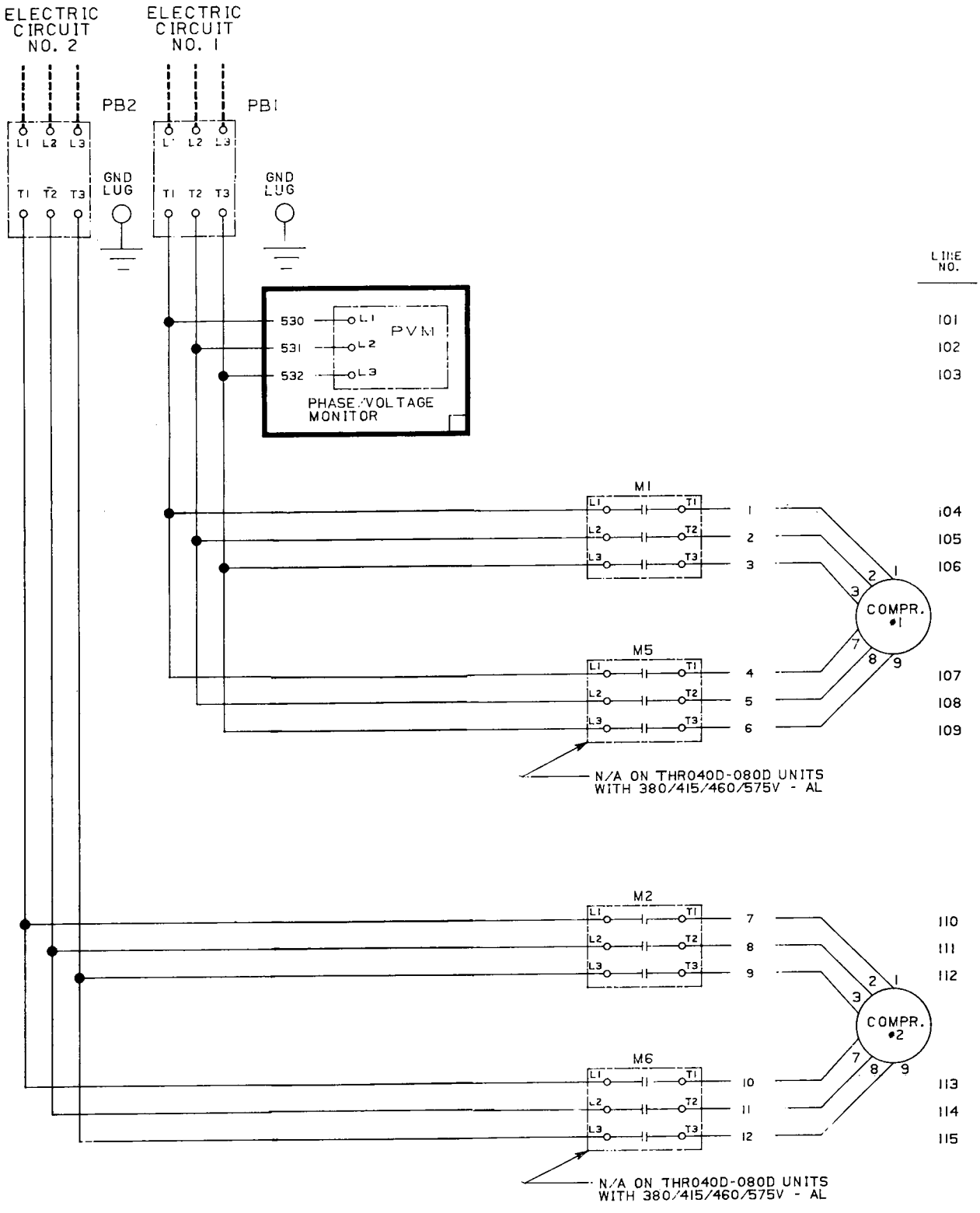



DISC OR PBT
GROUND LUG
PVM
PHASE VOLTAGE MONITOR
CB1
CB5
CB2
CB6
M1
M5
M2
M6
COMPR. #1
COMPR. #2
FB5
TO CONTROL TRANSFORMER-T1
LINE NO.
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115


208 V./60 HZ.
230 V./60 HZ.
FB5
T1
115 V.
GRD

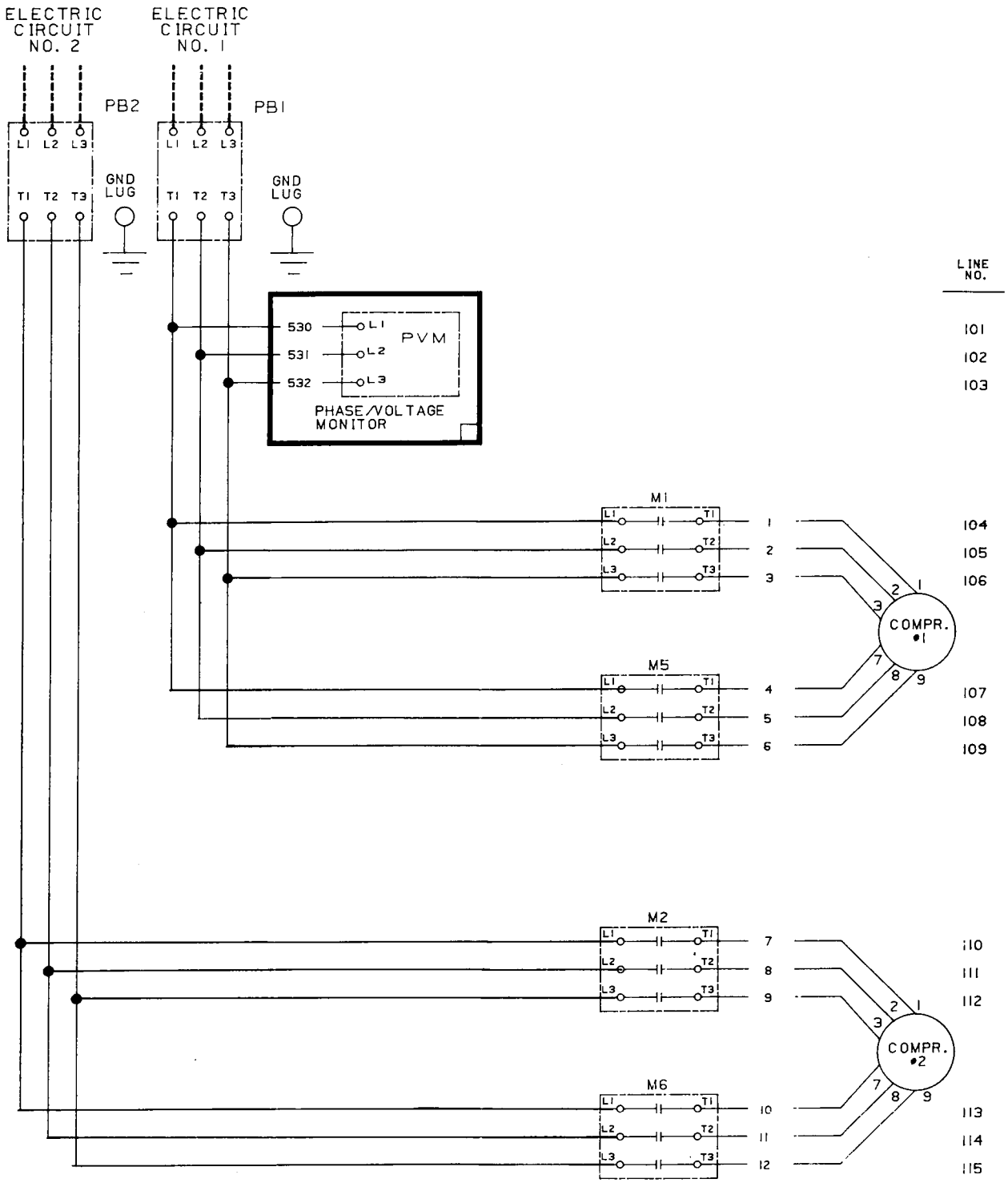

DSI OR PBI
GROUND LUG
LINE NO.
530
531
532
PVM
PHASE/VOLTAGE MONITOR
CB1
CB5
CB2
CB6
M1
M5
M2
M6
COMPR. #1
COMPR. #2
FB5
TO CONTROL TRANSFORMER-TI
208 V./60 HZ.
230 V./60 HZ.
380 V./50-60 HZ.
415 V./50 HZ.
460 V./60 HZ.
575 V./60 HZ.
FROM DSI OR PBI
T1
115 V.
GRD
NB

THR-040D THRU 110D—MULTIPLE POINT 380/415/460/575V — AL, PW

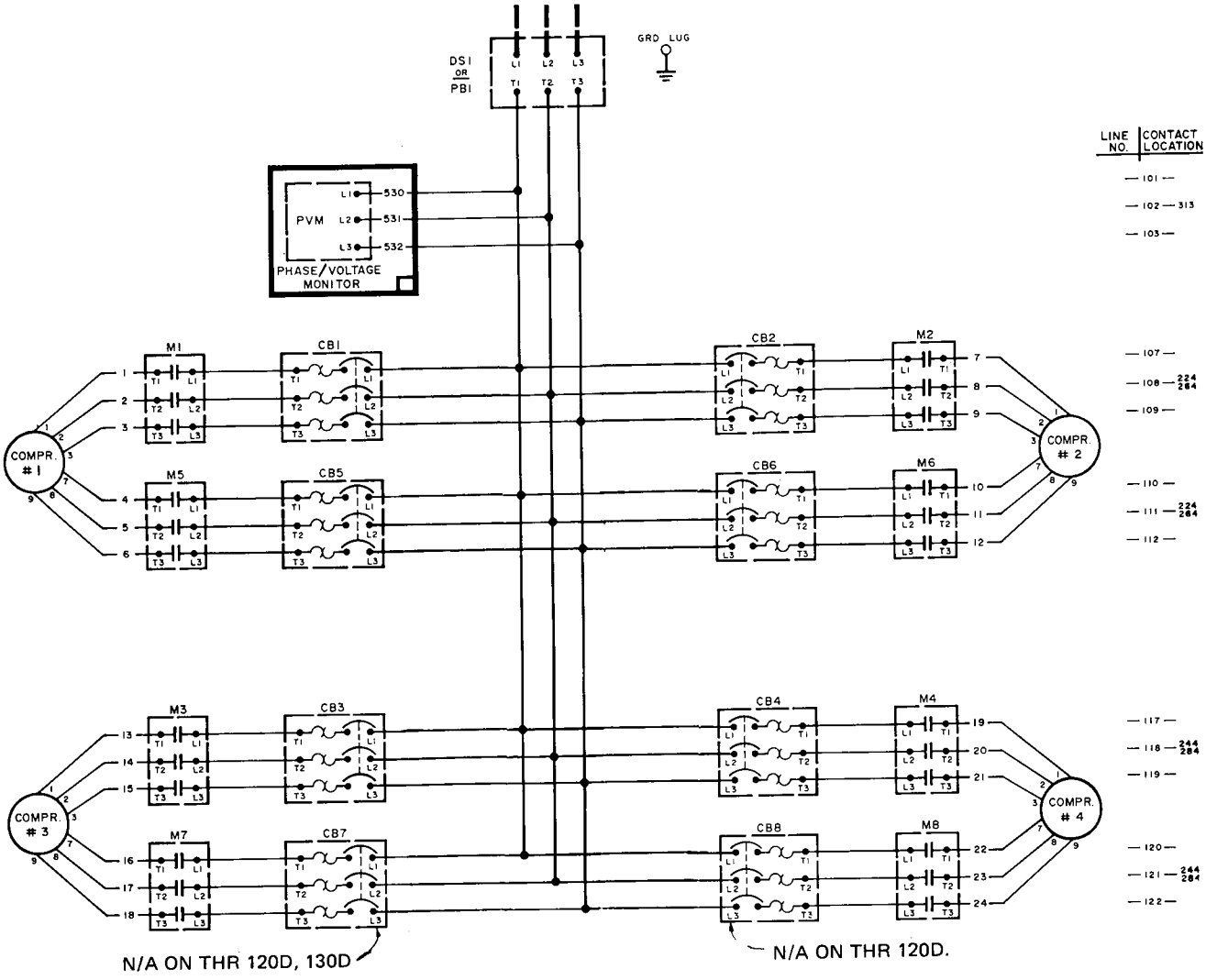


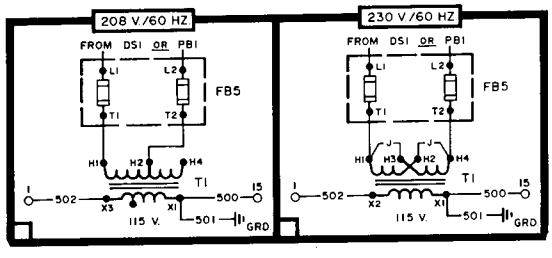
NOTES:
PB1 & PB2 ARE OMITTED ON 380/415/460/575V - AL (ACROSS LINE START) UNITS, FOR UNIT SIZES WHR040-080D WHEN OVERLOAD OPTION IS NOT USED.

FIELD CONNECT CIRCUIT NO.1 DIRECTLY TO M1 CONTACTOR AND CIRCUIT 2 TO M2 CONTACTOR.

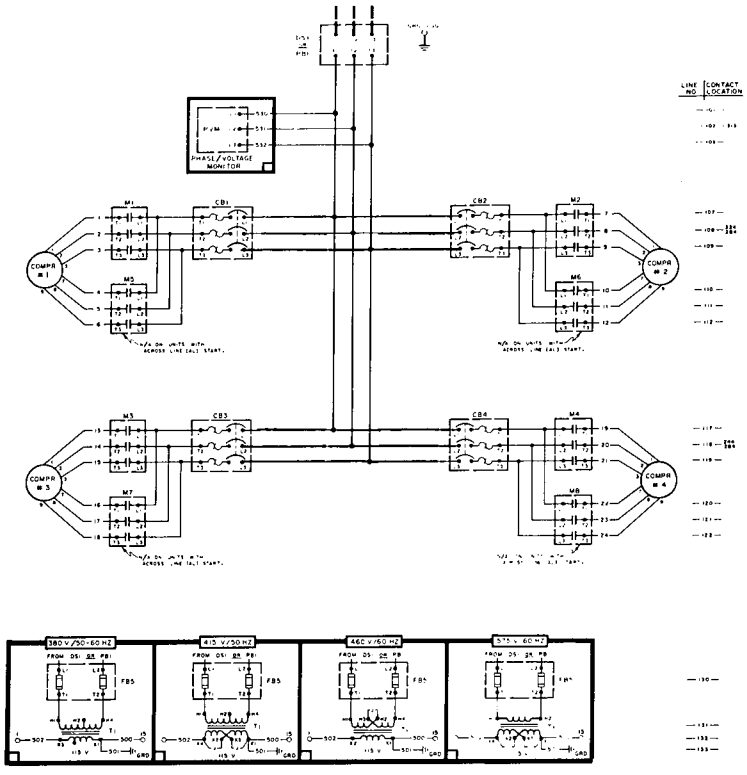

ELECTRIC CIRCUIT NO. 2
ELECTRIC CIRCUIT NO. 1
PB2
PB1
L1 L2 L3
T1 T2 T3
GND LUG
GND LUG
LINE NO.
530
531
532
L1
L2
L3
PVM
PHASE/VOLTAGE MONITOR
101
102
103
M1
M5
M2
M6
1
2
3
4
5
6
7
8
9
10
11
12
104
105
106
107
108
109
110
111
112
113
114
115
COMPR. #1
COMPR. #2

THR-120D THRU 170D—SINGLE POINT 380/415/460/575V — AL, PW

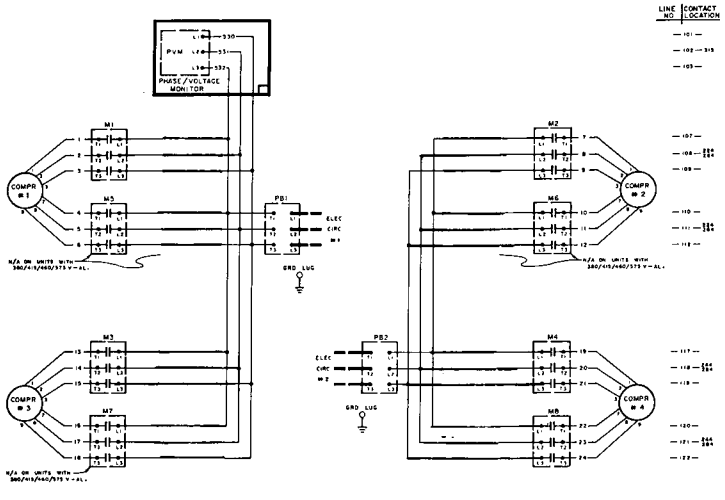




THR-120D THRU 170D—SINGLE POINT 208/230V — AL, PW

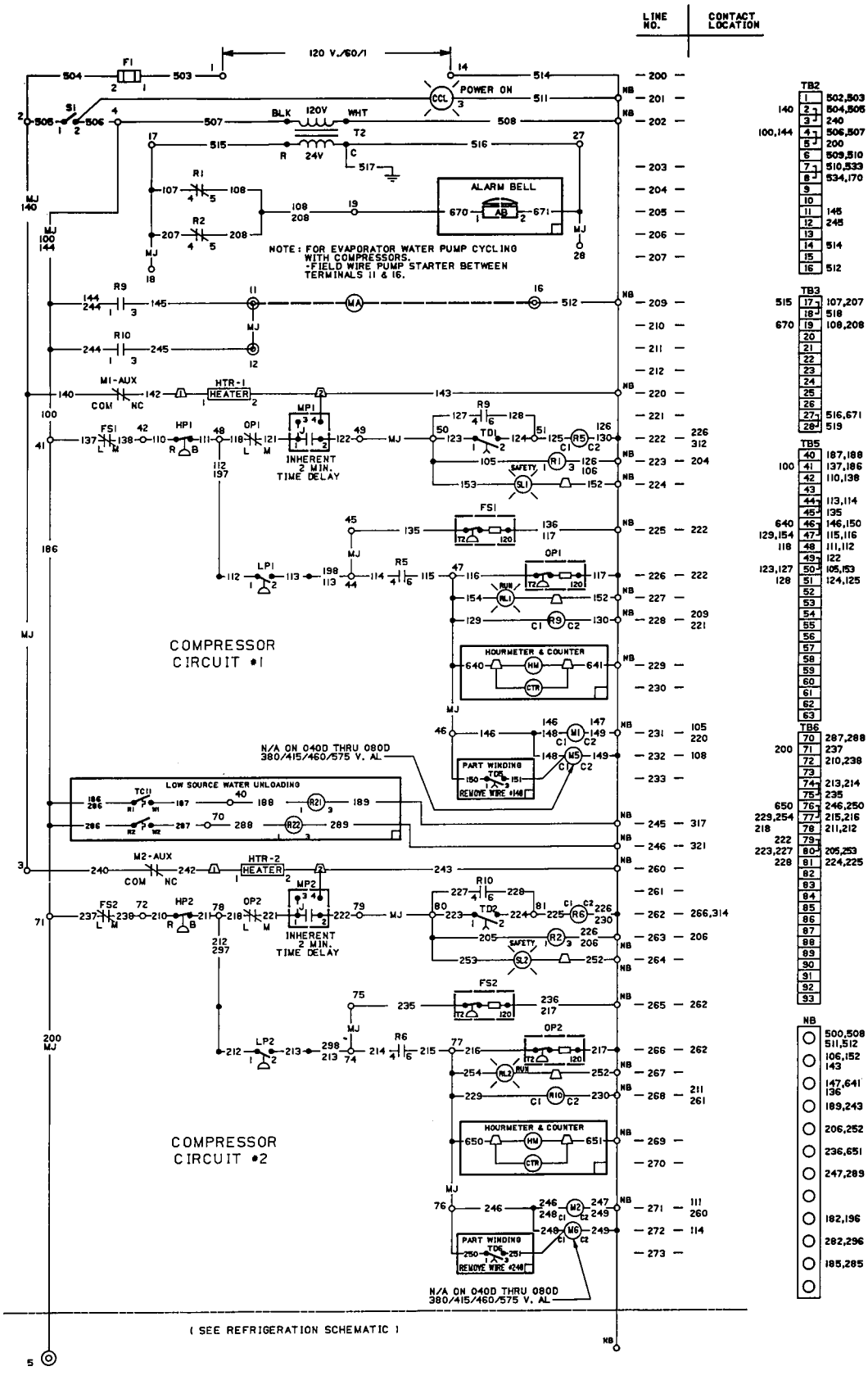


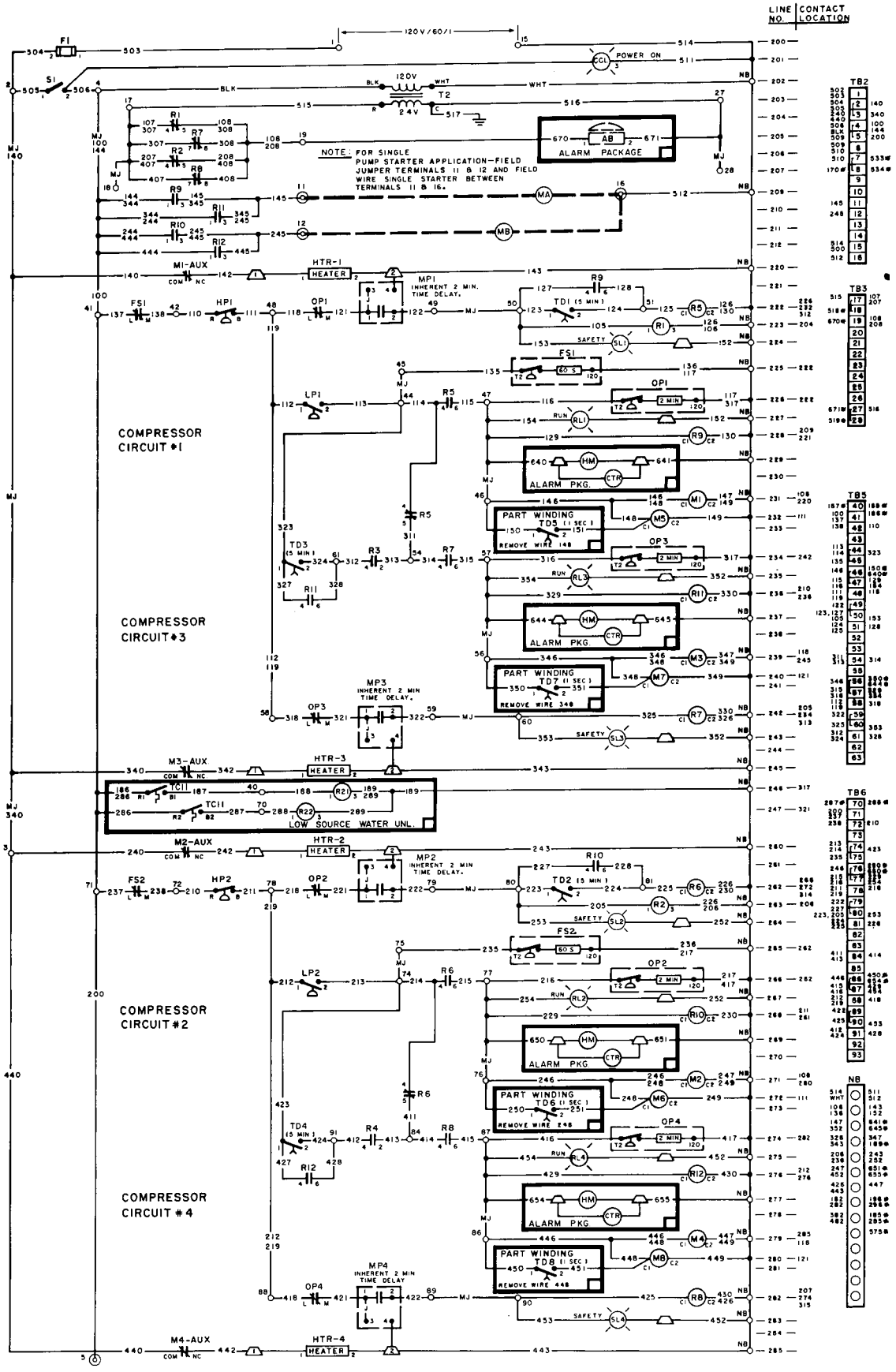
THR-120 THRU 170D—MULTIPLE POINT 208/230V & 380/415/460/575V — AL, PW



TYPICAL CONTROL & SAFETY WIRING DIAGRAMS

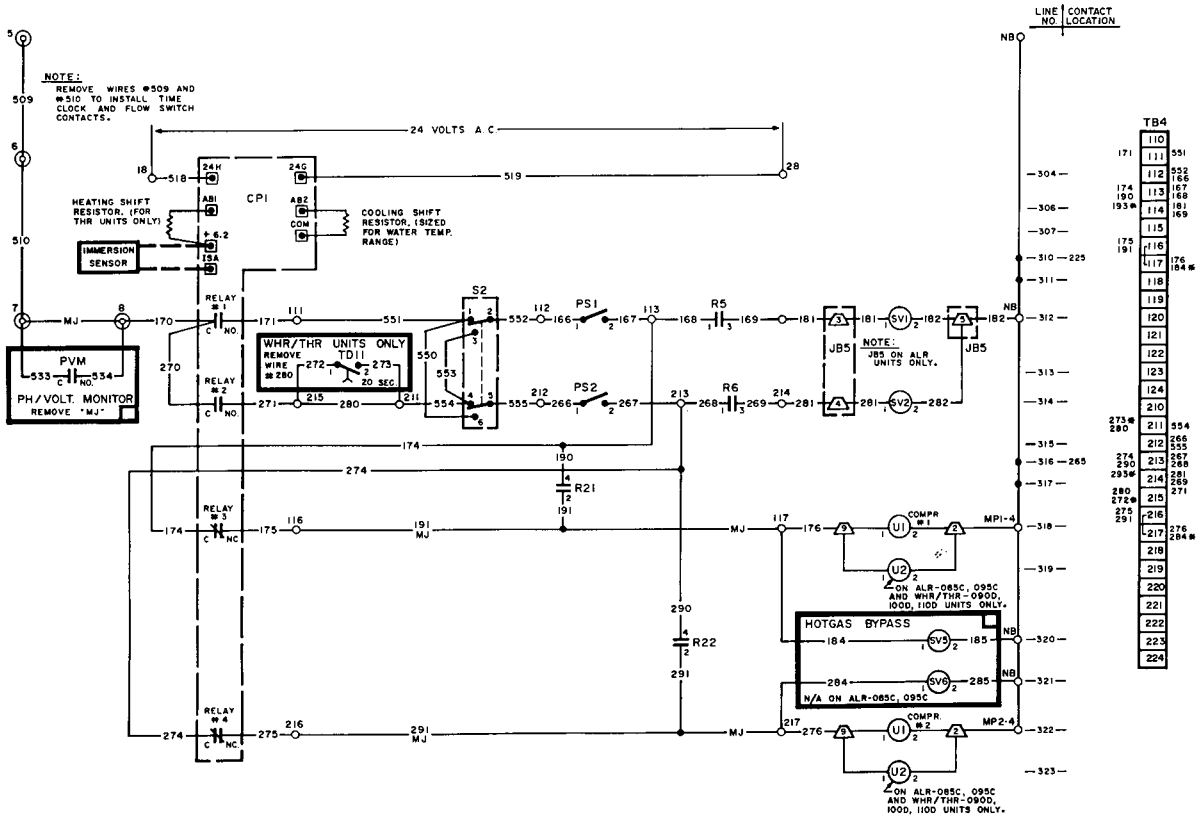
THR-040D THRU 110D



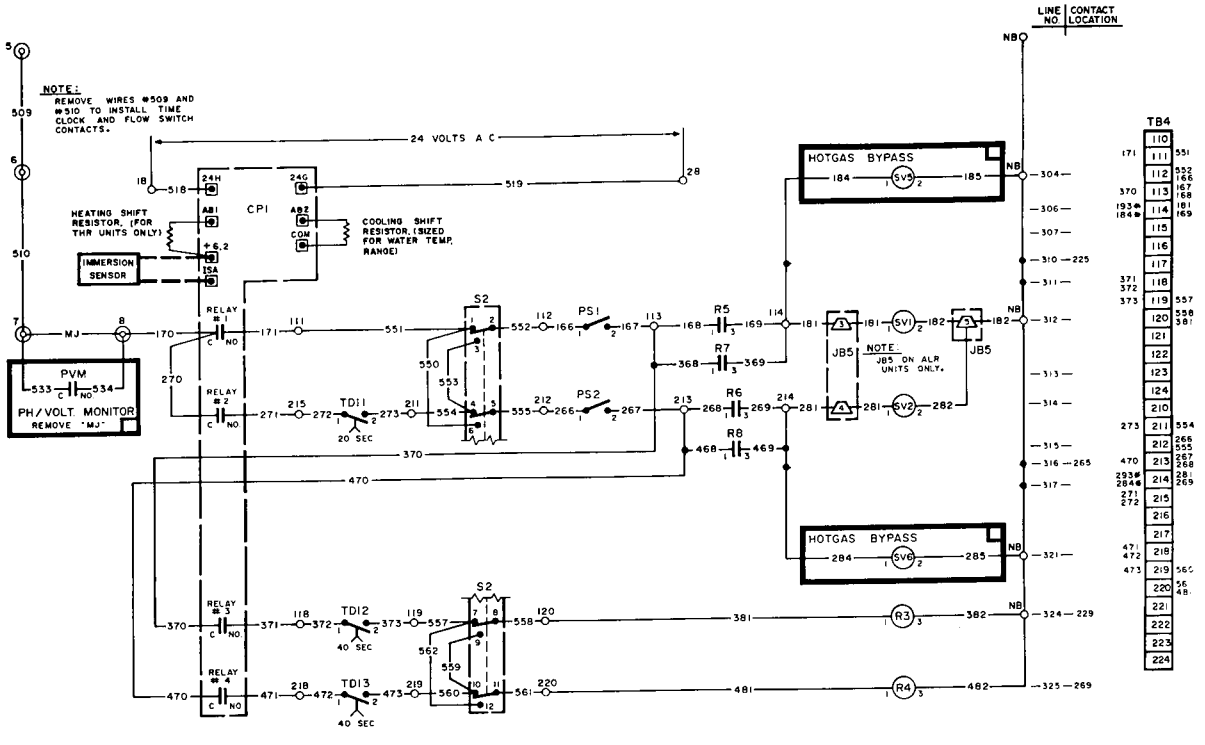

LINE NO.
CONTACT LOCATION
120V/60/1
POWER ON
ALARM PACKAGE
NOTE: FOR SINGLE PUMP STARTER APPLICATION-FIELD JUMPER TERMINALS 11 & 12 AND FIELD WIRE SINGLE STARTER BETWEEN TERMINALS 11 & 16.
COMPRESSOR CIRCUIT #1
COMPRESSOR CIRCUIT #3
COMPRESSOR CIRCUIT #2
COMPRESSOR CIRCUIT #4
PART WINDING
ALARM PKG.
LOW SOURCE WATER UNL.
HEATER
SAFETY
TB2
TB3
TB5
TB6
NB

TYPICAL HEATING ONLY THERMOSTAT WIRING DIAGRAMS

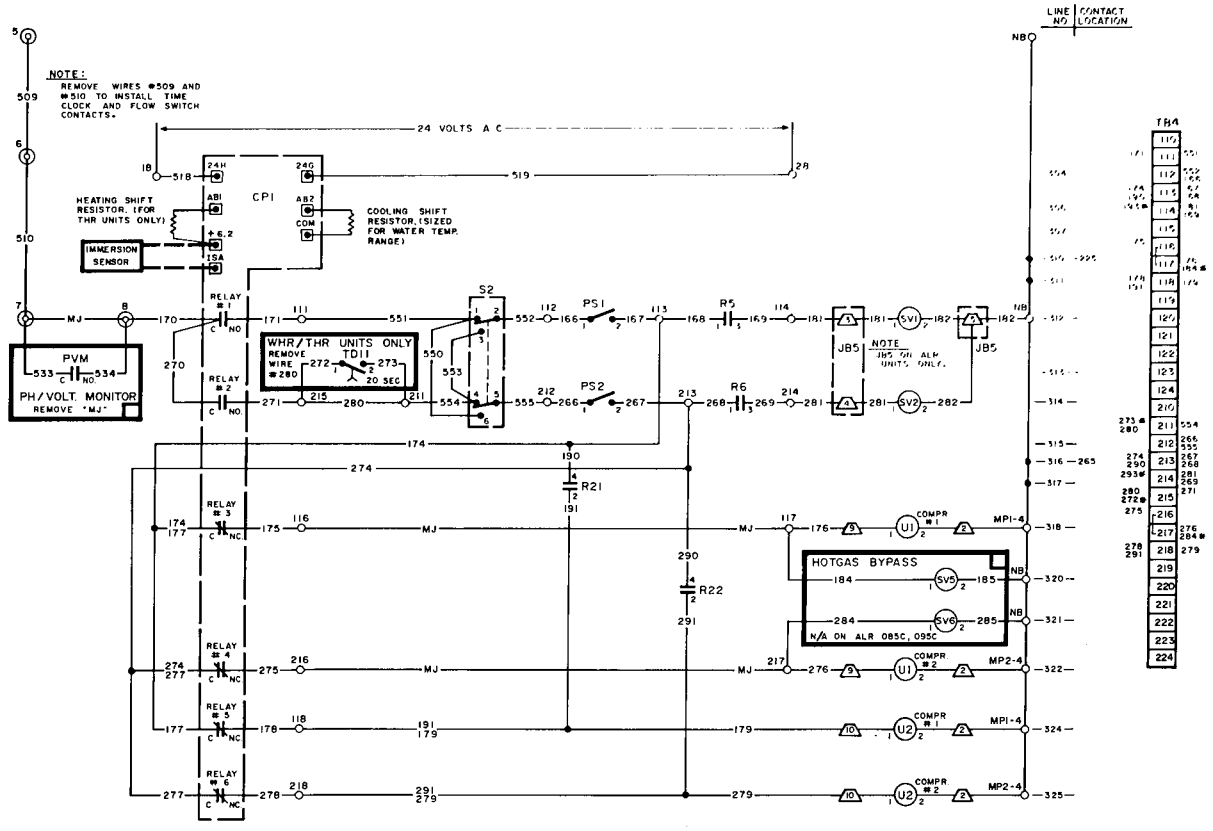
4-STAGE HEATING ONLY THERMOSTAT—THR 040, 050, 060, 070, 080, 090, 100, 110D
Hot Gas Bypass and Phase/Volt Monitor Options



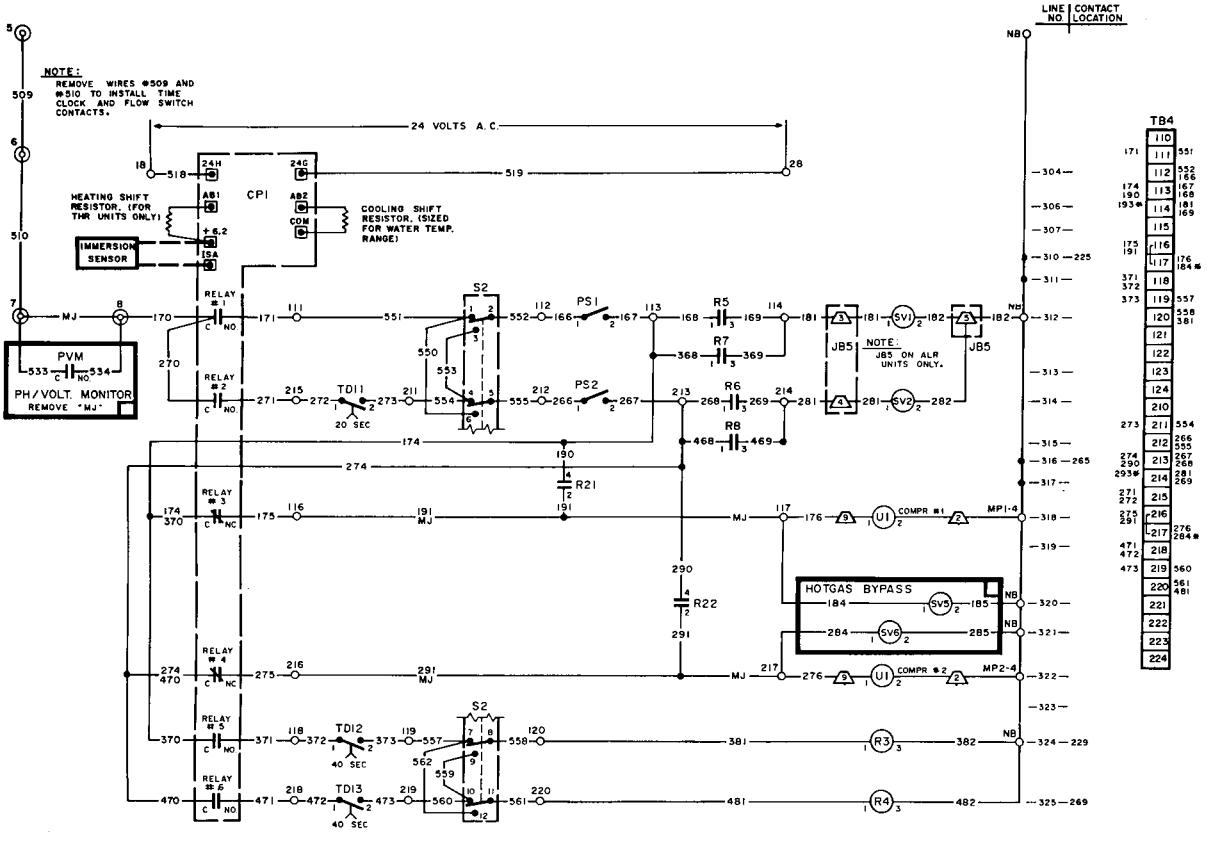
4-STAGE HEATING ONLY THERMOSTAT—THR 120, 130, 140, 150D
Hot Gas Bypass and Phase/Volt Monitor Options



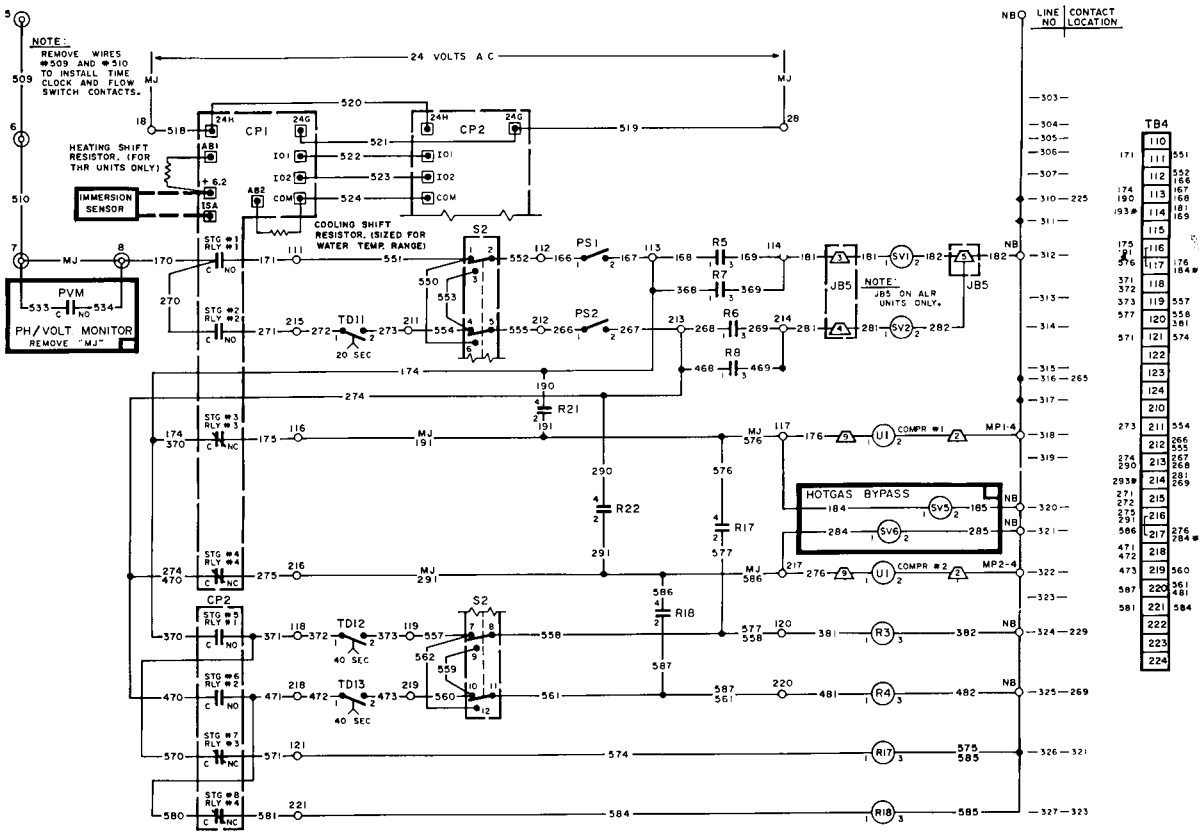
6-STAGE HEATING ONLY THERMOSTAT—THR 070, 080, 090, 100, 110D
Hot Gas Bypass and Phase/Volt Monitor Options



6-STAGE HEATING ONLY THERMOSTAT—THR 120, 130, 140, 150, 160, 170D
Hot Gas Bypass and Phase/Volt Monitor Options

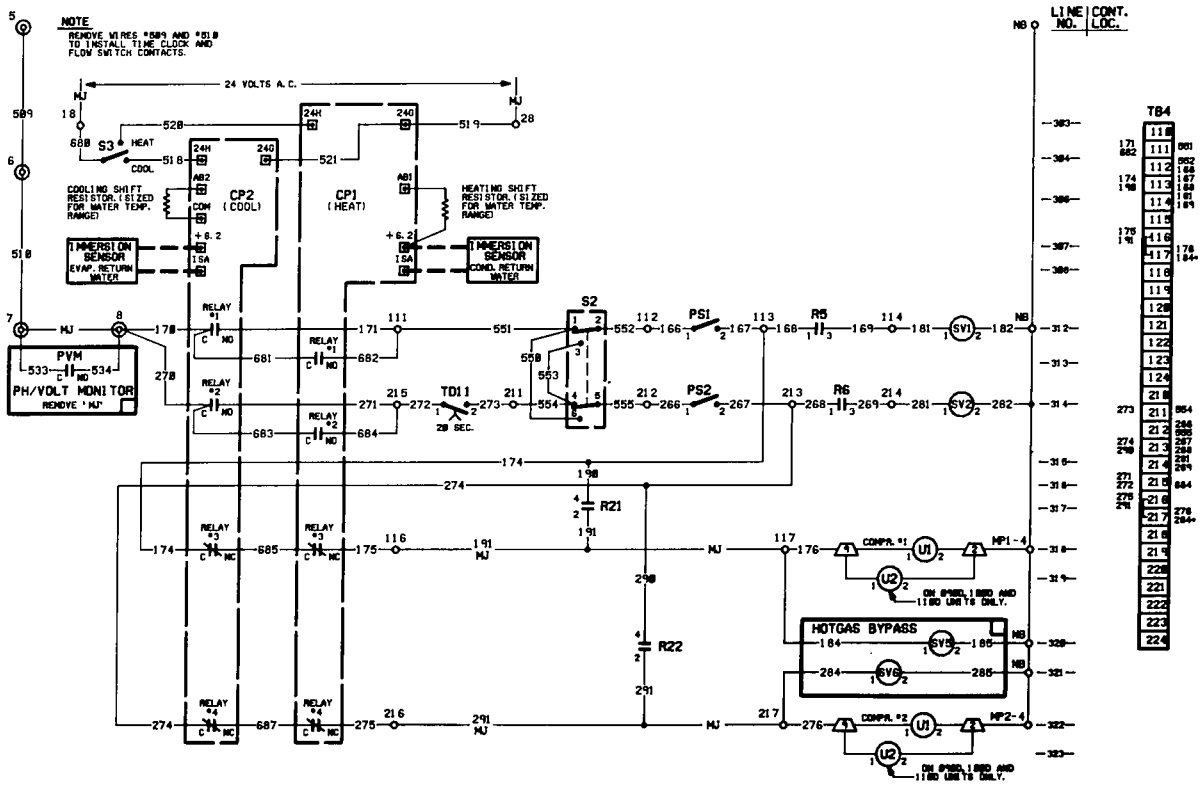


6-STAGE HEATING ONLY THERMOSTAT—THR 120, 130, 140, 150, 160, 170D
Hot Gas Bypass and Phase/Volt Monitor Options

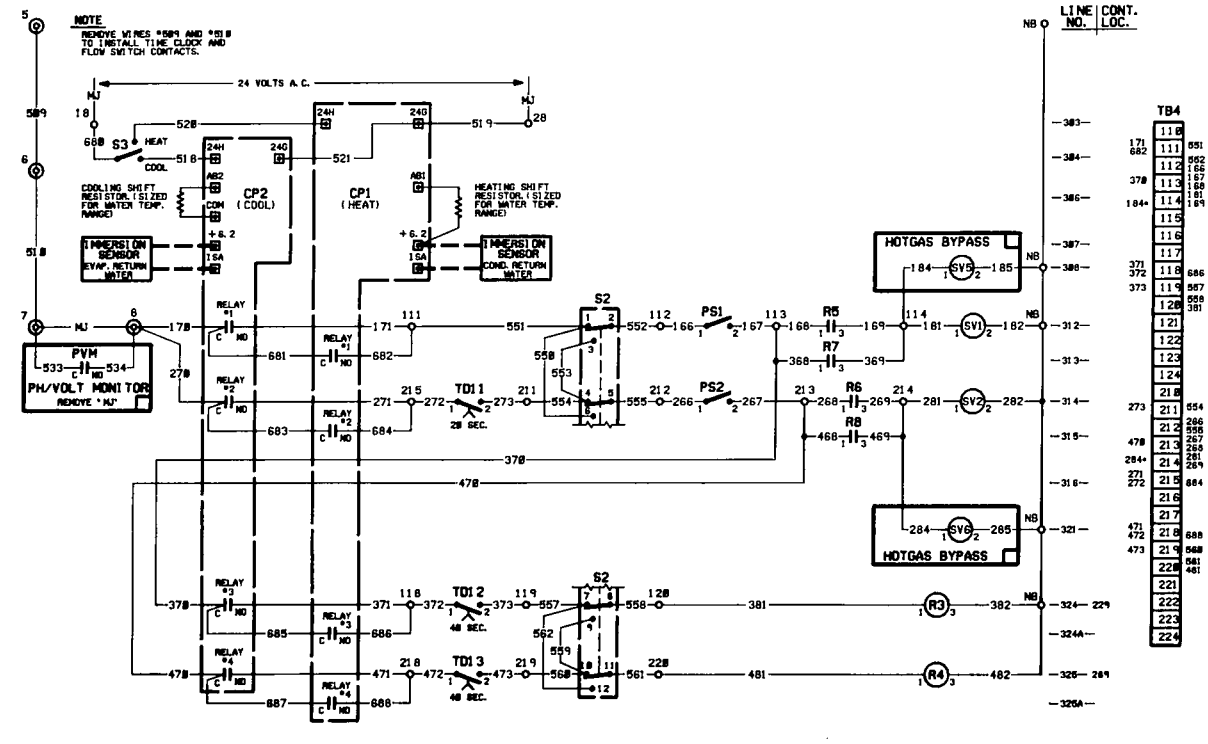


TYPICAL HEAT/COOL THERMOSTAT WIRING DIAGRAMS

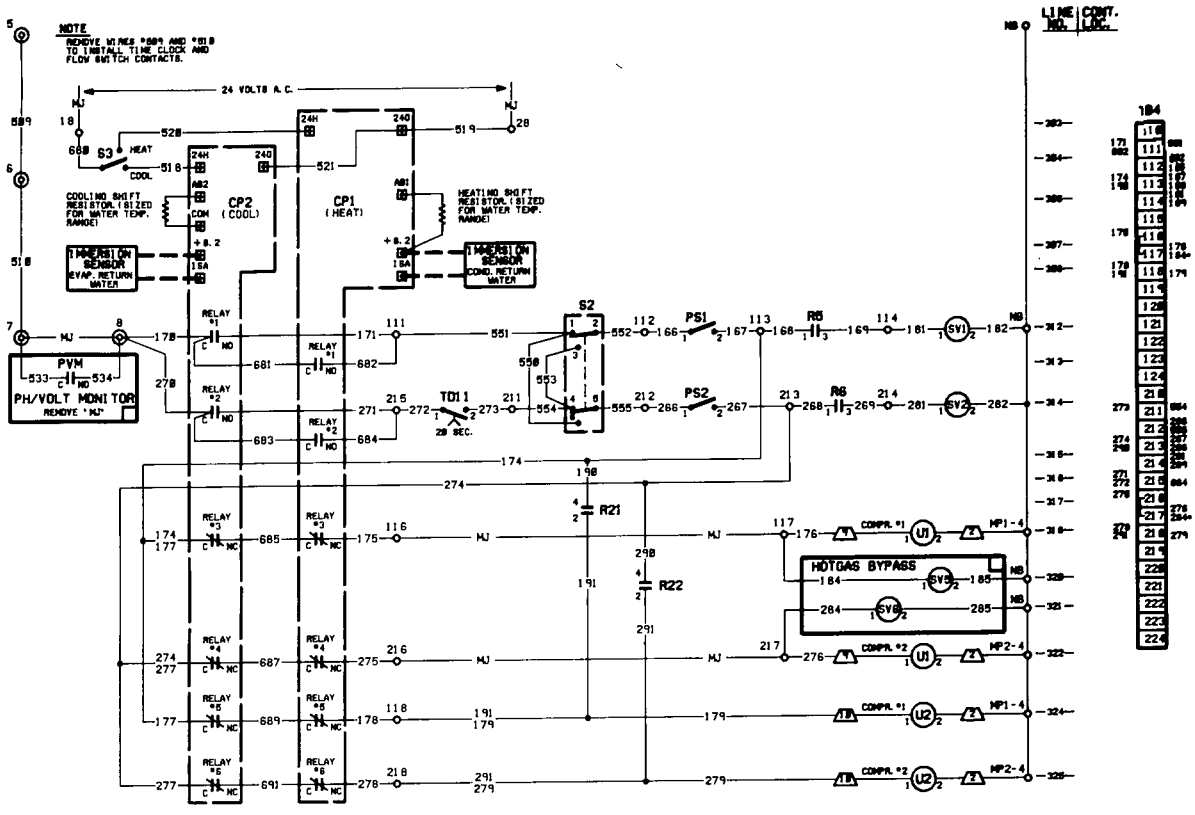
4-STAGE HEAT/COOL THERMOSTAT—THR 040, 050, 060, 070, 080, 090, 100, 110D
Hot Gas Bypass and Phase/Volt Monitor Options



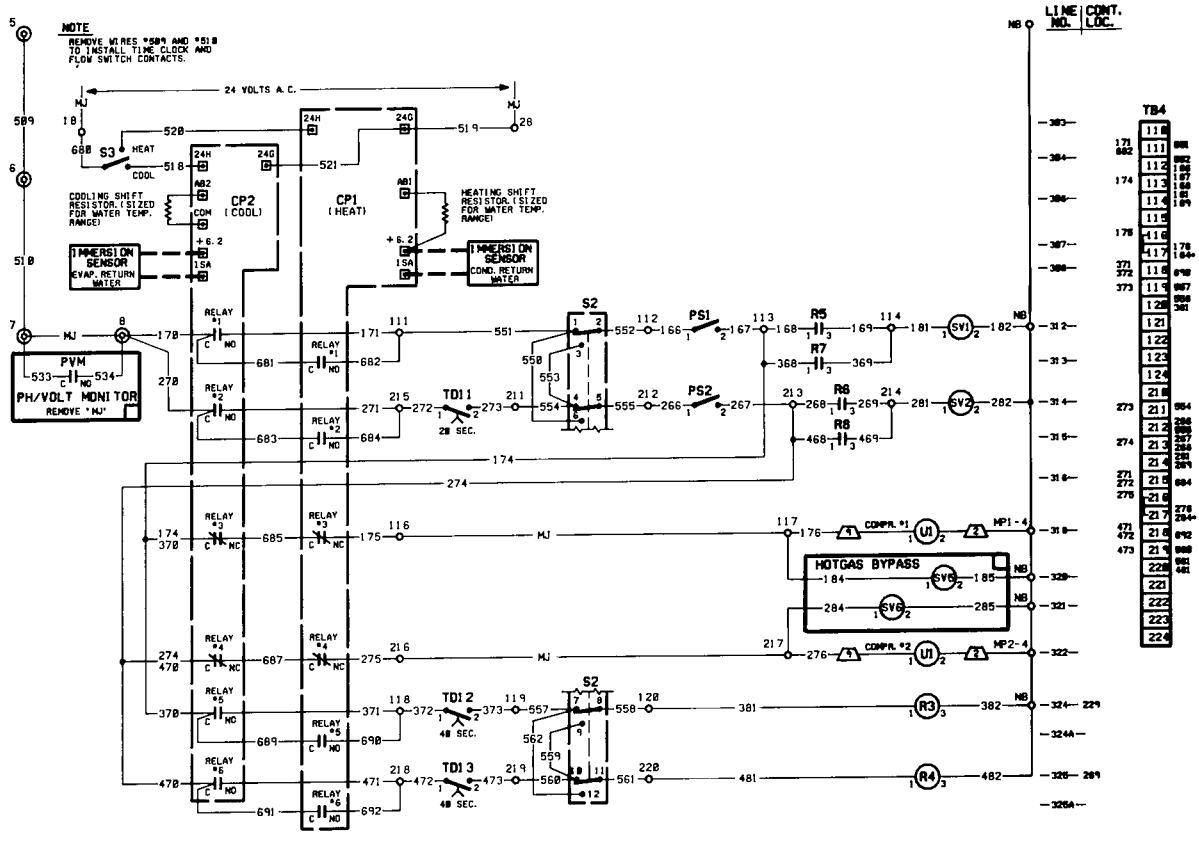
4-STAGE HEAT/COOL THERMOSTAT—THR 120, 130, 140, 150D
Hot Gas Bypass and Phase/Volt Monitor Options



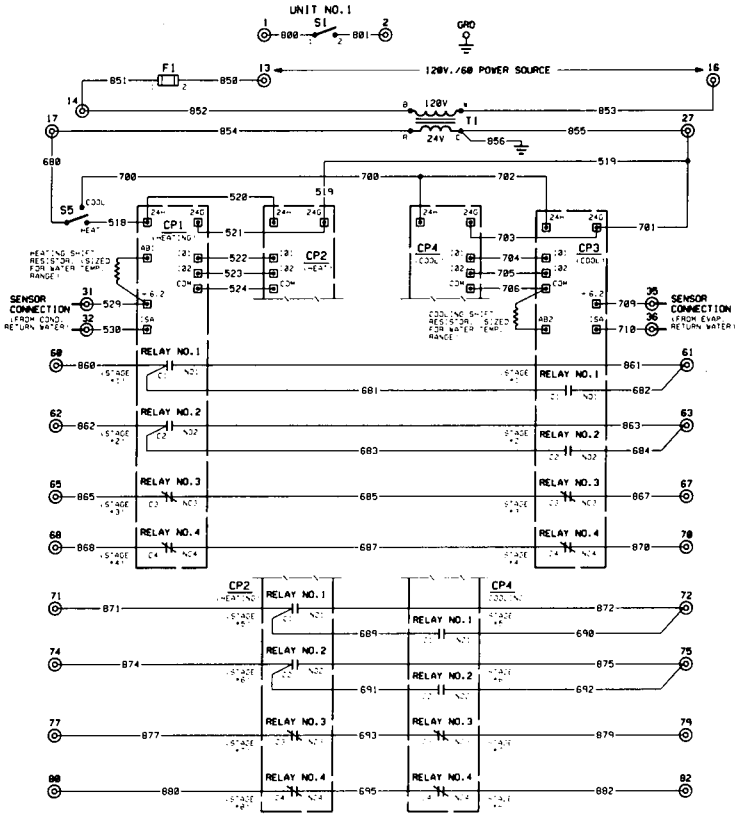
6-STAGE HEAT/COOL THERMOSTAT—THR 070, 080,090, 100, 110D
Hot Gas Bypass and Phase/Volt Monitor Options



6-STAGE HEAT/COOL THERMOSTAT—THR 120, 130, 140, 150, 160, 170D
Hot Gas Bypass and Phase/Volt Monitor Options



8-STAGE HEAT/COOL THERMOSTAT—THR 120, 130, 140, 150, 160, 170D
Hot Gas Bypass and Phase/Volt Monitor Options



TYPICAL LOW SOURCE WATER OR OUTDOOR AIR RESET DIAGRAM

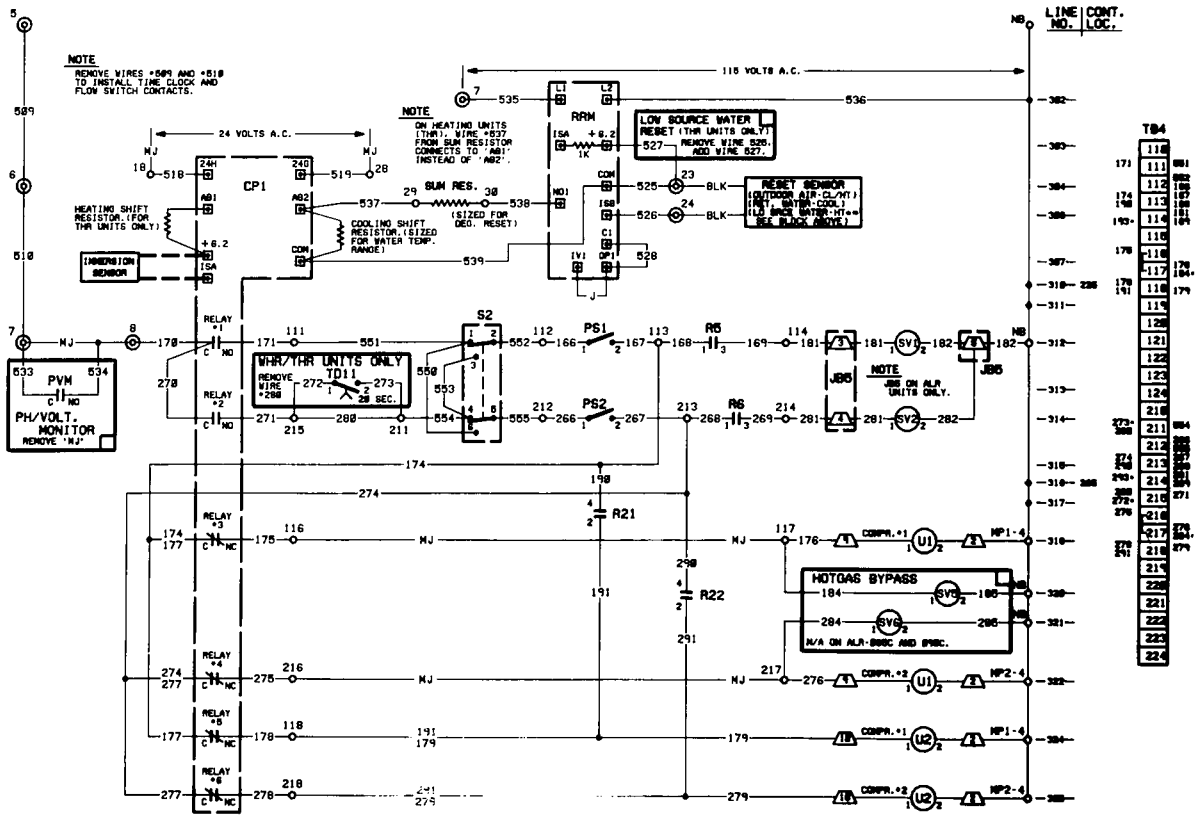


Table 23. Drawing Reference Decision Table for Compressor Power Schematics.

NOTE: Each unit will have three electrical schematics: Power, Safety & Control, and Thermostat.

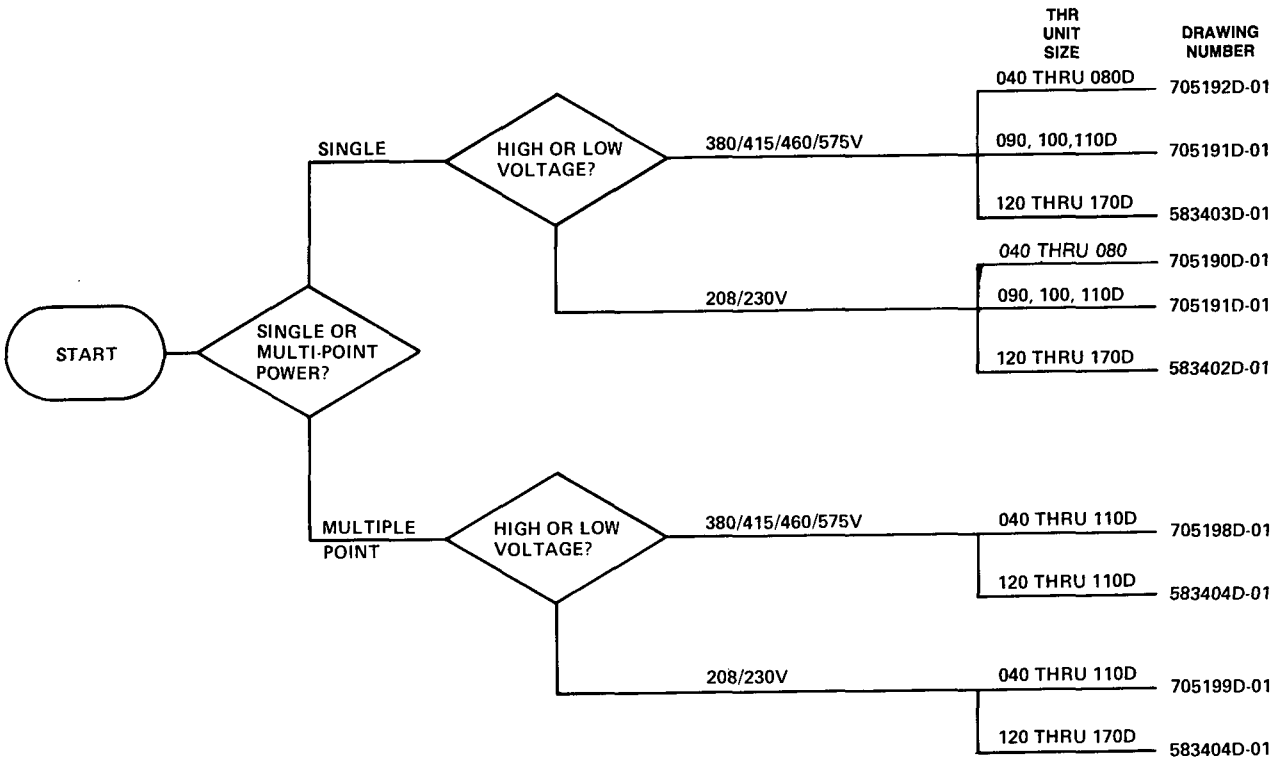


Table 24. Drawing Reference Decision Table for Control and Safety Schematics.

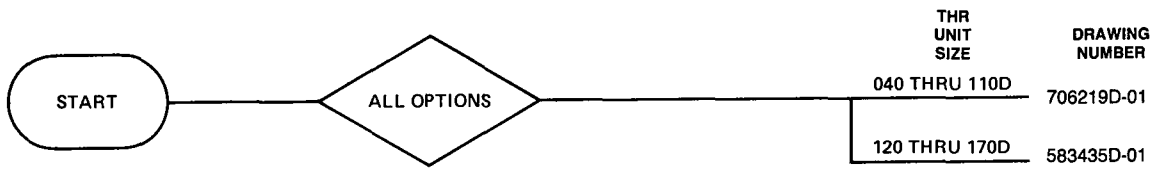
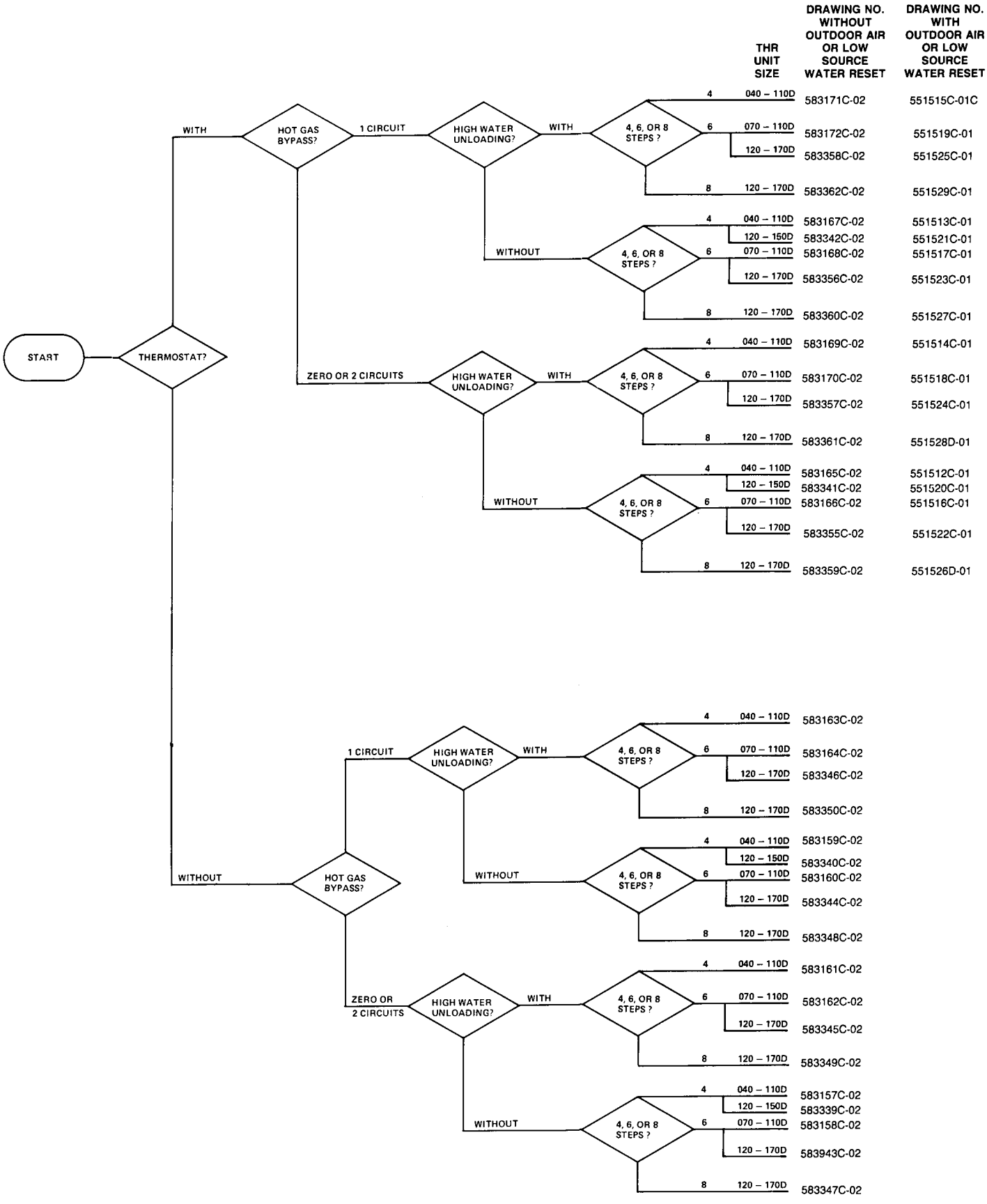
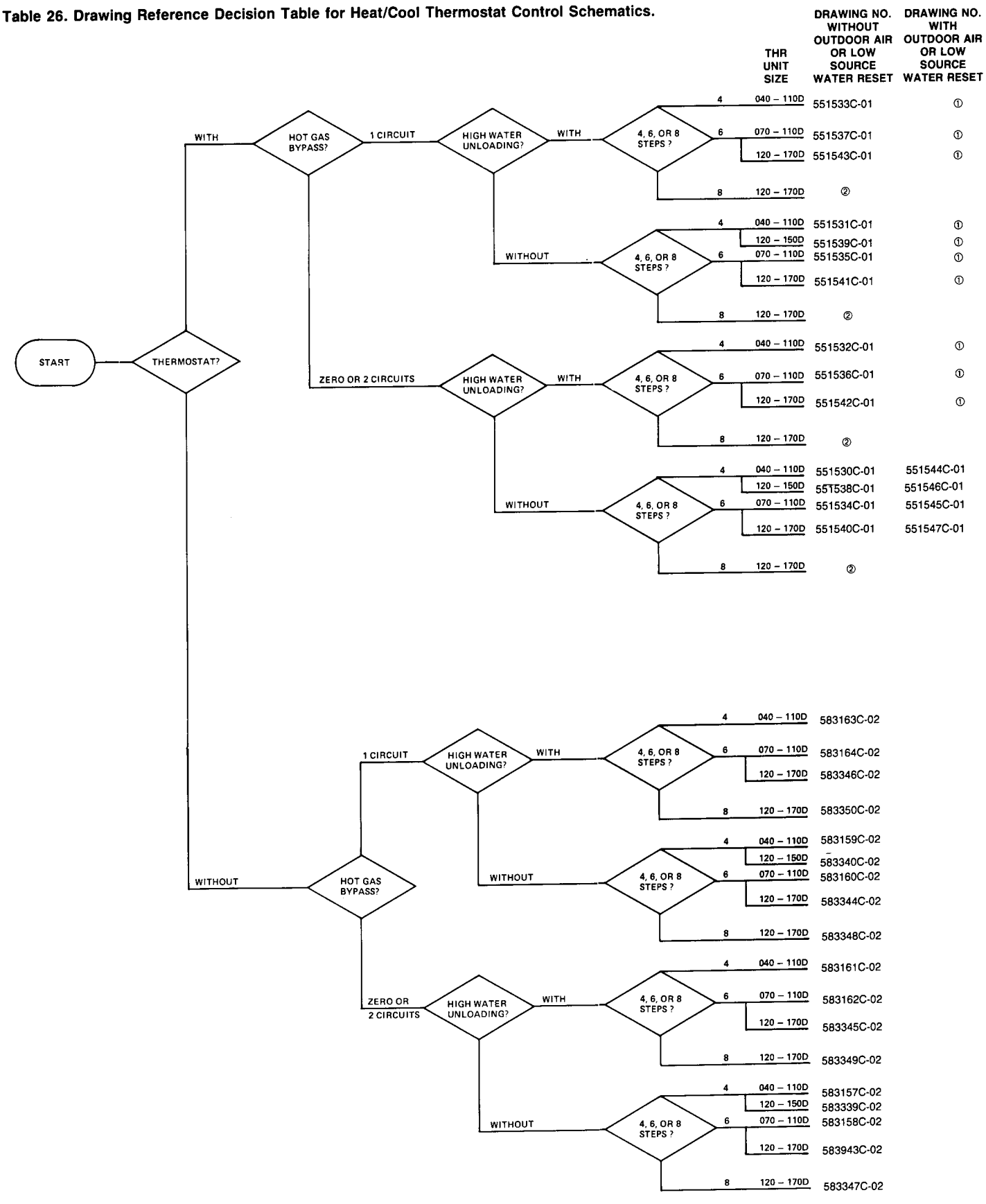


Table 25. Drawing Reference Decision Table for Heating Only Thermostat Control Schematics.



THR UNIT SIZE		DRAWING NO. WITHOUT OUTDOOR AIR OR LOW SOURCE WATER RESET	DRAWING NO. WITH OUTDOOR AIR OR LOW SOURCE WATER RESET
4	040 – 110D	583171C-02	551515C-01C
6	070 – 110D	583172C-02	551519C-01
	120 – 170D	583358C-02	551525C-01
8	120 – 170D	583362C-02	551529C-01
4	040 – 110D	583167C-02	551513C-01
	120 – 150D	583342C-02	551521C-01
6	070 – 110D	583168C-02	551517C-01
	120 – 170D	583356C-02	551523C-01
8	120 – 170D	583360C-02	551527C-01
4	040 – 110D	583169C-02	551514C-01
6	070 – 110D	583170C-02	551518C-01
	120 – 170D	583357C-02	551524C-01
8	120 – 170D	583361C-02	551528D-01
4	040 – 110D	583165C-02	551512C-01
	120 – 150D	583341C-02	551520C-01
6	070 – 110D	583166C-02	551516C-01
	120 – 170D	583355C-02	551522C-01
8	120 – 170D	583359C-02	551526D-01
4	040 – 110D	583163C-02	
6	070 – 110D	583164C-02	
	120 – 170D	583346C-02	
8	120 – 170D	583350C-02	
4	040 – 110D	583159C-02	
	120 – 150D	583340C-02	
6	070 – 110D	583160C-02	
	120 – 170D	583344C-02	
8	120 – 170D	583348C-02	
4	040 – 110D	583161C-02	
6	070 – 110D	583162C-02	
	120 – 170D	583345C-02	
8	120 – 170D	583349C-02	
4	040 – 110D	583157C-02	
	120 – 150D	583339C-02	
6	070 – 110D	583158C-02	
	120 – 170D	583943C-02	
8	120 – 170D	583347C-02	

Table 26. Drawing Reference Decision Table for Heat/Cool Thermostat Control Schematics.



THR UNIT SIZE	DRAWING NO. WITHOUT OUTDOOR AIR OR LOW SOURCE WATER RESET	DRAWING NO. WITH OUTDOOR AIR OR LOW SOURCE WATER RESET
4 040 – 110D	551533C-01	①
6 070 – 110D	551537C-01	①
120 – 170D	551543C-01	①
8 120 – 170D	②	
4 040 – 110D	551531C-01	①
120 – 150D	551539C-01	①
6 070 – 110D	551535C-01	①
120 – 170D	551541C-01	①
8 120 – 170D	②	
4 040 – 110D	551532C-01	①
6 070 – 110D	551536C-01	①
120 – 170D	551542C-01	①
8 120 – 170D	②	
4 040 – 110D	551530C-01	551544C-01
120 – 150D	551538C-01	551546C-01
6 070 – 110D	551534C-01	551545C-01
120 – 170D	551540C-01	551547C-01
8 120 – 170D	②	
4 040 – 110D	583163C-02	
6 070 – 110D	583164C-02	
120 – 170D	583346C-02	
8 120 – 170D	583350C-02	
4 040 – 110D	583159C-02	
120 – 150D	583340C-02	
6 070 – 110D	583160C-02	
120 – 170D	583344C-02	
8 120 – 170D	583348C-02	
4 040 – 110D	583161C-02	
6 070 – 110D	583162C-02	
120 – 170D	583345C-02	
8 120 – 170D	583349C-02	
4 040 – 110D	583157C-02	
120 – 150D	583339C-02	
6 070 – 110D	583158C-02	
120 – 170D	583943C-02	
8 120 – 170D	583347C-02	

NOTES:

1. For units with reset diagrams not listed contact McQuay Service.
2. Diagrams for 8-stage heat/cool units are as follows:
   - Unit application: 583455D-01
   - Remote control panel with outdoor air/low source water reset: 551576D-01
   - Remote control panel without reset: 551570D-01.

STARTUP AND SHUTDOWN

PRE STARTUP

1. With the main disconnect switch open, check all electrical connections in control panel and starter to be sure they are tight and provide good electrical contact. Although connections are tightened at the factory, they may have loosened enough in shipment to cause a malfunction.
2. Check and inspect all water piping. Make sure flow direction is correct and piping is made to correct connection on evaporator and condenser.
3. Open all water flow valves to the condenser and evaporator.
4. Flush the cooling tower (when used) and system piping. Start evaporator pump and manually start condenser pump and cooling tower. Check all piping for leaks. Vent the air from the evaporator and condenser water circuit as well as from the entire water system. The evaporator circuits should contain clean, non-corrosive water.
5. If water regulating valves are provided, connect the control capillary to the manual valves provided on the condensers and open the manual valves.
6. Check to see that the water temperature thermostat sensor is installed in the entering water line to the condenser.
7. Making sure control stop switch S1 is open (off) and pumpdown switches PS1 and PS2 are on "manual pumpdown," throw the main power and control disconnect switches to "on." This will energize crankcase heaters. Wait a minimum of 12 hours before starting up unit.
8. Check compressor oil level. Prior to startup, the oil level should cover at least one-third of the oil sightglass.
9. Check water pressure drop across evaporator and condenser, and see that water flow is correct per the pressure drop data on pages 7 and 10.
10. Check the actual line voltage to the unit to make sure it is the same as called for on the compressor nameplate within $\pm$ 10% and that phase voltage unbalance does not exceed 2%. Verify that adequate power supply and conductor size is available to handle load.
11. Make sure all wiring and fuses are of the proper size. Also make sure all interlock wiring connections are completed per McQuay diagrams.
12. Verify that all mechanical and electrical inspections by code authorities have been completed.
13. Make sure all auxiliary load and control equipment is operative and that an adequate cooling load is available for initial startup.

STARTUP

1. Open the compressor suction and discharge shutoff valves until backseated. Always replace valve seal caps.
2. Open the manual liquid line shutoff valve.
3. Check to see that the unit circuit breakers are in the "off" position.
4. Check to see that the pumpdown switches PS1 and PS2 are in the "manual pumpdown" position and the control system switch S1 is in the "off" position.
5. Throw the main power and control circuit disconnects to the "on" position.
6. Verify crankcase heaters have operated for at least 12 hours prior to startup. Crankcase should be warm.
7. Adjust the dial on the temperature controller to the desired hot and/or chilled water temperature.
8. Start the auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch and chilled water pump.
9. Check resets of all safety controls.
10. Switch the unit circuit breakers to on.
11. Throw pumpdown switches PS1 and PS2 to "auto" for restart and normal operation.
12. Start the system by pushing the system switch S1 to on.
13. After running the unit for a short time, check the oil level in each compressor crankcase, and check for flashing in the refrigerant sightglass.

After system performance has stabilized, it is necessary that the "Compressorized Equipment Warranty Form" (Form No. 206036A) be completed to obtain full warranty benefits. This form is shipped with the unit and after completion should be returned to McQuayService through your sales representative.

WEEKEND OR TEMPORARY SHUTDOWN

Move pumpdown switches PS1 and PS2 to the "manual pumpdown" position. After the compressors have pumped down, turn off the evaporator water pump. **NOTE:** With the unit in this condition, it is capable of recycling pumpdown. To defeat this mode of operation, simply move control system switch S1 to the "off" position.

It is important that the compressors pump down before the water flow to the unit is interrupted to avoid freeze-up in the evaporator.

STARTUP AFTER TEMPORARY SHUTDOWN

1. Start the evaporator water pump.
2. With the control system switch S1 in the "on" position, move the pumpdown switches PS1 and PS2 to the "auto pumpdown" position.
3. Observe the unit operation for a short time, noting unusual sounds or possible cycling of compressors.
4. Check compressor crankcase heaters.

EXTENDED SHUTDOWN

1. Close the manual liquid line shutoff valves.
2. After the compressors have pumped down, turn off the chilled water pump.
3. Turn off all power to the unit.
4. Move the control service switch S1 to the "off" position.
5. Close the suction and discharge shutoff valves on the compressor(s) and the liquid outlet valve(s) at the condenser(s)
6. Tag all opened disconnect switches to warn against start-up before opening the compressor suction and discharge valves.
7. Drain all water from the unit evaporator and chilled water piping if the unit is to be shut down during the winter and exposed to below freezing temperatures.

STARTUP AFTER EXTENDED SHUTDOWN

1. Inspect all equipment to see that it is in satisfactory operating condition.
2. If cooling tower is used, make sure it is clean and filled with water.
3. Open the compressor suction and discharge valves until backseated. Always replace valve seal caps.
4. Open the manual liquid line shutoff valves.
5. Check circuit breakers. They must be in the "off" position.
6. Check to see that the pumpdown switches PS1 and PS2 are in the "manual shutdown" position and the control system switch S1 is in the "off" position.
7. Throw the main power and control circuit disconnects to the "on" position.
8. Allow the crankcase heaters to operate for at least 12 hours prior to startup.
9. Start the chilled water pump and purge the water piping as well as the evaporator in the unit.
10. Start the auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch.
11. Adjust the dial on the temperature controller to the desired hot and/or chilled water temperature.
12. Check resets of all safety controls.
13. Switch the unit circuit breakers to "on."
14. Start the system by pushing the system switch S1 to "on." **CAUTION:** Most relays and terminals in the control center are hot with S1 and the control circuit disconnect on.
15. Throw pumpdown switches PS1 and PS2 to the "auto pumpdown" position for restart and normal operation.
16. After running the unit for a short time, check the oil level in each compressor crankcase and for flashing in the refrigerant sightglass (see Maintenance section).

SYSTEM MAINTENANCE

GENERAL

To assure smooth operation at peak capacity and to avoid damage to package components, a program of periodic inspections should be set up and followed. The following items are intended as a guide to be used during inspection and must be combined with sound refrigeration and electrical practices to assure trouble-free performance.

The liquid line sightglass/moisture indicator on all circuits must be checked to be sure the glass is full and clear and the moisture indicator indicates a dry condition. If the indicator shows that a wet condition exists or if bubbles show in the glass, even with a full refrigerant charge, the filter-drier element must be changed.

Water supplies in some areas may tend to foul the water cooled condenser to the point where cleaning is necessary. The fouled condenser will be indicated by an abnormally high condensing pressure and may result in nuisance tripouts. To clean the condenser, a chemical descaling solution should be used according to the manufacturer's directions.

A lead-lag switch is provided on all multiple compressor models to permit even distribution of wear on the compressors. This switch should be turned on on an annual basis.

The compressor oil level must be checked periodically to be sure the level is at the center of the oil sightglass. Low oil level may cause inadequate lubrication and oil failure switch tripout. If the oil level is low and oil must be added, use oils referred to in "Compressor Oil Level" section below.

A pressure tap has been provided on the liquid line downstream of the filter-drier and solenoid valve but before the expansion valve. An accurate subcooled liquid pressure and temperature can be taken here. The pressure read here could also provide an indication of excessive pressure drop through the filter-drier and solenoid valve due to a clogging filter-drier.

NOTE: A normal pressure drop through the solenoid valve is approximately 3 psig at full load conditions.

CONTROL CENTER ELECTRICAL SERVICE

The electrical control center is relatively easy to service since indicator lights are provided to show unit status. Determine that the problem is actually in the control panel before proceeding.

By referring to the schematic wiring diagrams, the trouble can be isolated to a particular section of the panel.

WARNING: Warranty is voided if field wiring is not in accordance with specifications. A blown fuse or tripped protector indicates a short ground or overload. Before replacing a fuse or restarting a compressor, the trouble must be found and corrected. It is important to have a qualified control panel electrician service this panel. Unqualified tampering with the controls can cause serious damage to equipment and void the warranty.

The following steps should be taken prior to attempting any service on the control center:

1. Study the wiring diagram so that you understand the operation of the TEMPLIFIER.
2. Before investigating trouble in the control center, check for burned out pilot lights by testing across the appropriate terminals.

   CAUTION: The panel is always energized to ground even though the system switch is off. If it is necessary to de-energize the complete panel including crankcase heaters, pull main disconnect.

If motor or compressor damage is suspected, do not restart until a qualified serviceman has checked the unit.

ELECTRICAL TERMINALS

CAUTION: *Electric shock hazard. Turn off all power before continuing with following service.*

All power electrical terminals should be retightened every six months, as they tend to loosen in service due to normal heating and cooling of the wire.

COMPRESSOR OIL LEVEL

The oil level should be watched carefully upon initial startup and for sometime thereafter.

At the present time, Suniso No. 3GS, Calumet R015, and Texaco WF32 oils are approved by Copeland for use in these compressors. The oil level should be maintained at about one-third of the sightglass on the compressor body.

Oil may be added to the Copeland compressor through the oil fill hole in the crankcase. To add oil, isolate the crankcase and pour or pump in the necessary oil. If the system contains no refrigerant, no special precautions are necessary other than keeping the oil clean and dry.

If the system contains a refrigerant charge, close the suction valve and reduce crankcase pressure to 1 to 2 psig. Stop the compressor and close the discharge valve.

Add the required amount of oil. During the period the compressor is exposed to the atmosphere, the refrigerant will generate a vapor pressure, retarding the entrance of contaminants. Before resealing the compressor, purge the crankcase by opening the suction valve slightly for 1 or 2 seconds. Close the oil port, open the compressor valves and restore the system to operation.

REFRIGERANT SIGHTGLASS AND MOISTURE INDICATOR

The refrigerant sightglasses should be observed periodically. (A monthly observation should be adequate.) A clear glass of liquid indicates that there is adequate refrigerant charge in the system to insure proper feed through the expansion valve. Bubbling refrigerant in the sightglass indicates that the system is short of refrigerant charge. Refrigerant gas flashing in the sightglass could also indicate an excessive pressure drop in the line, possibly due to a clogged filter-drier or a restriction elsewhere in the system. An element inside the sightglass indicates what moisture condition corresponds to a given element color. If the sightglass does not indicate a dry condition after about 12 hours of operation, the unit should be pumped down and the filter-driers changed.

LEAD-LAG

A standard feature on all McQuay TEMPLIFIERS is a system for reversing the sequence in which the compressors start. For example, on a unit with the lead-lag switches in the "circuit 1 leads" position, the normal starting sequence is compressor #1, then compressor #2. With the lead-lag switches in the "circuit 2 leads" position, the reversed starting sequence is compressor #2, then compressor #1. It is achieved electrically by multi-pole switching arrangement (see "Control Schematics" on pages 38 through 40). It is suggested that the lead-lag switches in the unit control center be switched annually to provide even compressor life.

CRANKCASE HEATERS

The compressors are equipped with crankcase heaters. The 20 hp and larger model compressors have heaters inserted into the crankcase. The function of the heater is to keep the temperature in the crankcase high enough to prevent refrigerant from migrating to the crankcase and condensing in the oil during off-cycle.

When a system is to be started up initially in cold ambient, the power to the heaters should be turned on for some time (at least 12 hours) before the compressor is started. The crankcase should be up to about 80°F before the system is started up, to minimize lubrication problems or liquid slugging of compressor on startup.

SYSTEM SERVICE

NOTE: *Service on this equipment is to be performed by qualified refrigeration personnel. Causes for repeated tripping of safety controls must be investigated and corrected.* **CAUTION:** *Disconnect all power before doing any service inside the unit.*

FILTER-DRIERS

To change the filter-drier, pump the unit down by moving pumpdown switches PS1 and PS2 to the "manual pumpdown" position.

UNIT SIZE	CIRCUIT NO.	JUMPER ACROSS TERMINALS
040D THRU 170D	1	44 to 48
	2	74 to 78

NOTE: Jumpers should be long enough to hang out of the panel and prevent the door from closing. This will insure jumper removal after unit is pumped-down.

Move the control switch S1 to the "off" position. Turn off all power to the unit and install jumpers across the terminals shown in the table. This will jump out the low pressure control. Close the manual liquid line shutoff valve(s). Turn power to the unit back on and restart the unit by moving the control switch S1 to the "on" position. The unit will start pumping down past the low pressure setting. When the evaporator pressure reaches 0 to 5 psig, move control switch S1 to the "off" position. BE SURE TO REMOVE THE JUMPER.

Frontseat the suction line King valve(s). Remove and replace the filter-drier(s). Evacuate the lines through the liquid line manual shutoff valve(s) to remove non-condensables that may have entered during filter replacement. A leak check is recommended before returning the unit to operation.

THR UNIT SIZE	TYPE FILTER-DRIER
040 thru 110D	Sealed Core
120 thru 170D	2 — Core Replaceable

NOTE: On Arrangement A units, the filter-drier cores are shipped in the unit control box and are to be installed prior to evacuating and charging the unit.

LIQUID LINE SOLENOID VALVE

The liquid line solenoid valves, which are responsible for automatic pumpdown during normal unit operation, do not normally require any maintenance. However, in the event of failure they may require replacement of the solenoid coil or of the entire valve assembly.

The solenoid coil may be removed from the valve body without opening the refrigerant piping by moving pumpdown switches PS1 and PS2 to the "manual pumpdown" position.

The coil can then be removed from the valve body by simply removing a nut or snap-ring located at the top of the coil. The coil can then be slipped off its mounting stud for replacement. Be sure to replace the coil on its mounting stud before returning pumpdown switches PS1 and PS2 to the "auto pumpdown" position.

To replace the entire solenoid valve, follow the steps involved when changing a filter-drier.

THERMOSTATIC EXPANSION VALVE

The expansion valve is responsible for allowing the proper amount of refrigerant to enter the evaporator regardless of cooling load. It does this by maintaining a constant superheat. (Superheat is the difference between refrigerant temperature as it leaves the evaporator and the saturation temperature corresponding to the evaporator pressure.) All TEMPLIFIERS are factory set for between 8°F and 12°F superheat, at leaving source water temperatures near the maximum allowed, superheats can be expected to rise above this setting. If it is necessary to increase the superheat setting of the valve, remove the cap at the bottom of the valve to expose the adjustment screw. Turn the screw clockwise (when viewed from the adjustment screw end) to increase the superheat and counterclockwise to reduce superheat. Allow time for system rebalance after each superheat adjustment.

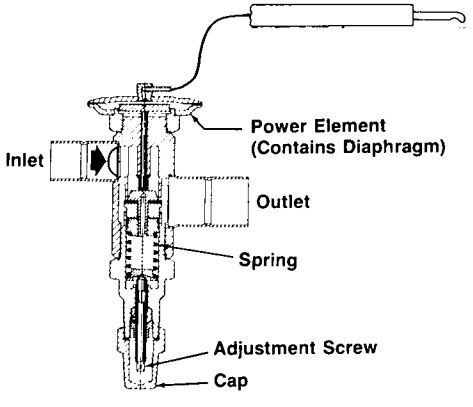
Unit operation near the maximum leaving source water temperature on a TEMPLIFIER unit can trigger the "Maximum Operating Pressure" (MOP) characteristic built into the units expansion valves. At higher leaving source water temperatures and loads, the "MOP" will occur when the expansion valve and control bulb pressure reaches a predetermined maximum value. Further increases in bulb temperature above the "MOP" point causes virtually no increase in bulb pressure. As a result adequate increases in refrigerant flow to the evaporator are no longer possible, and the ability of the unit to handle increases in load is limited. Once the "MOP" for the expansion valve is reached, increases in suction superheat can be expected near the maximum leaving source water temperature.

The expansion valve, like the solenoid valve, should not normally require replacement, but if it does, the unit must be pumped down by following the steps involved when changing a filter-drier.

If the problem can be traced to the power element only, it can be unscrewed from the valve body without removing the valve, but only after pumping the unit down.

WARNING: Adjustment of expansion valve should only be performed by a qualified service technician.

Figure 22.



EVAPORATOR

The evaporator is of the direct expansion, shell-and-tube type with refrigerant flowing through the tubes and water flowing through the shell over the tubes. The tubes are internally finned to provide extended surface as well as turbulent flow of refrigerant through the tubes. Normally no service work is required on the evaporator. There may be instances where a tube will leak refrigerant into the water side of the system. In the cases where only one or two tubes leak, the problem can best be solved by plugging the tube at both ends. When the tube must be replaced, the old tube can be removed and replaced.

To remove a tube, the unit should be temporarily pumped down. Follow the steps involved when changing a filter-drier. These steps will insure a minimum amount of refrigerant loss when the evaporator is opened up. The tubes are mechanically expanded into the tube sheets (see Figure 23) at each end of the cooler. In order to remove the tubes, it is necessary to break this bond by collapsing the tube. After doing this at both ends of the shell, the tube can be removed for replacement. The new tube can then be inserted and re-expanded into the tube sheet.

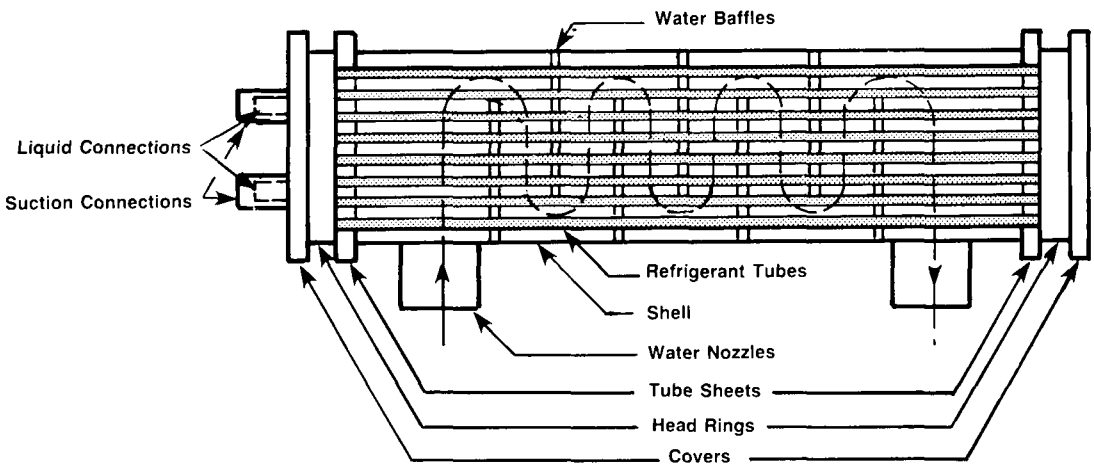
NOTE: *The bond produced by expansion must be refrigerant tight. This bond must be produced by applying Locktite (red) to the tube and rolling it into the tube sheet.*

After re-assembling the evaporator, a small amount of refrigerant should be introduced by momentarily opening the manual liquid line valve. A leak check should then be performed on the evaporator.

Tube removal can only take place after the leaking tube is located. One method that would work would be to subject each tube to air pressure by plugging each end and, with a pressure gauge attached to one of the end plugs, observing if there is a loss of air pressure over a period of a minute or two.

Another method is to place a cork plug in each tube on both ends of the cooler and applying pressure to the shell of the cooler. After a period of time, the pressure will leak from the shell into the leaking tube or tubes and pop out the cork plug.

Figure 23. Top View of Typical Dual Circuit Shell-and-Tube Evaporator



WATER COOLED CONDENSER

The condenser is of the shell-and-tube type with water flowing through the tubes and refrigerant in the shell. External finned copper tubes are rolled into steel tube sheets. Integral subcoolers are incorporated on 40 ton and larger units. All condensers are equipped with 450 psig relief valves.

IN-WARRANTY RETURN MATERIAL PROCEDURE

COMPRESSOR

Copeland Refrigeration Corporation has stocking wholesalers who maintain a stock of replacement compressors and service parts to serve refrigeration contractors and service personnel.

When a compressor fails in warranty, contact your local sales representative, or the McQuay International Warranty Claims Department at the address on the back cover of this bulletin. You will be authorized to exchange the defective compressor at a Copeland wholesaler, or an advance replacement can be obtained. A credit is issued you by the wholesaler for the returned compressor after Copeland factory inspection of the inoperative compressor. If that compressor is out of Copeland's warranty, a salvage credit only is allowed. Provide McQuay with full details; i.e., McQuay unit model and unit serial numbers. Include the invoice and the salvage value credit memo copies and we will reimburse the difference. In this transaction, be certain that the compressor is definitely defective. If a compressor is received from the field that tests satisfactorily, a service charge plus a transportation charge will be charged against its original credit value.

On all out-of-warranty compressor failures, Copeland offers the same field facilities for service and/or replacement as described above. The credit issued by Copeland on the returned compressor will be determined by the repair charge established for that particular unit.

Material may not be returned except by permission of authorized factory service personnel of McQuay International. A "return goods" tag will be sent to be included with the returned material. Enter the information as called for on the tag in order to expedite handling at our factories and prompt issuance of credits.

The return of the part does not constitute an order for replacement. Therefore, a purchase order must be entered through your nearest McQuay representative. The order should include part name, part number, model number and serial number of the unit involved.

Following our personal inspection of the returned part, and if it is determined that the failure is due to faulty material or workmanship, and in warranty, credit will be issued on customer's purchase order.

All parts shall be returned to the pre-designated McQuay factory, transportation charges prepaid.

APPENDIX — STANDARD CONTROLS

NOTE: *PERFORM AN OPERATIONAL CHECK ON ALL UNIT SAFETY CONTROLS ONCE PER YEAR.*

THERMOSTAT—THR HEATING UNITS

The thermostats supplied on all Templifiers are factory calibrated for use in the return water line to the condensers inlet. The thermostat bulb is installed in a well in the return water line in order to be more stable under temperature changes due to load conditions. The return water does not change temperature as rapidly as the outlet because of the "flywheel effect" of the total water system. This results in stable control of the outlet water temperature. Normally the thermostat requires no adjustment in the field other than the dial setting for the required control point. The control will maintain an average leaving water temperature corresponding to dial setpoint (SPA) throughout the loading and unloading sequence of the unit. It should be realized, however, that there will be fluctuation in the leaving water temperature as the unit cycles, unloads and loads.

The throttling range is adjustable from 1°F to 3°F per output relay via the TRA dial and is factory set at 3°F. The control setpoint is adjustable from 120°F to 150°F via the SPA dial and is field set to meet application. The ambient operating temperature limits of the control is from 0°F to 140°F.

Although the central processor CP1 is calibrated at the factory, it may be necessary to re-calibrate the control should any changes in unit operation be made in the field. Refer to Installation and Maintenance Bulletin No. 348 for a more complete description of the control's application, settings and adjustments, and checkout procedure. **Note:** See page 12 for thermostat bulb installation.

OIL PRESSURE SAFETY CONTROL

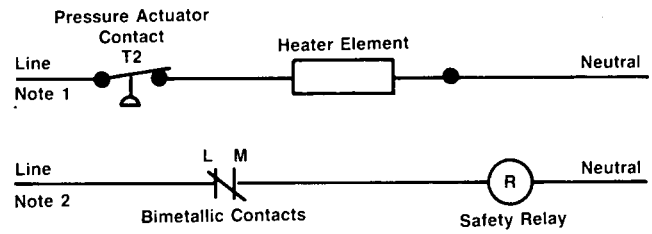
The oil pressure safety control is a manually resettable device which senses the differential between oil pressure at the discharge of the compressor oil pump and suction pressure inside the compressor crankcase. When the oil pressure reaches approximately 15 psi above the crankcase suction pressure, the pressure actuated contact of the control opens from its normally closed position. If this pressure differential cannot be developed, the contact will remain closed and energize a heater element within the control. The heater element warms a normally closed bimetallic contact and causes the contact to open, de-energizing a safety relay and breaking power to the compressor.

It takes about 120 seconds to warm the heater element enough to open the bimetallic contact, thus allowing time for the pressure differential to develop.

If during operation, the differential drops below 10 psi, the heater element will be energized and the compressor will stop. The control can be reset by pushing the reset button on the control. If the compressor does not restart, allow a few minutes for the heater elements and bimetallic contacts to cool and reset the control again.

To check the control, pump down and shut off all power to the unit. Open the circuit breakers or the fused disconnect for that compressor and install a voltmeter between terminals L and M of the oil pressure control. Turn on power to the unit control circuit (separate disconnect or main unit disconnect depending on the type of installation). Check to see that the control stop switch S1 is in the "on" position. The control circuit should not be energized, but with the absence of compressor power, no oil pressure differential can develop and thus the pressure actuated contacts of the control will energize the heater element and open the bimetallic contacts of the control within 120 seconds. When this happens, the safety relay is de-energized, the voltmeter reading will rise to 115V, and the compressor contactor should open. Repeated operations of the control will cause a slight heat buildup in the bimetallic contacts resulting in a slightly longer time for reset with each successive operation.

Figure 24.



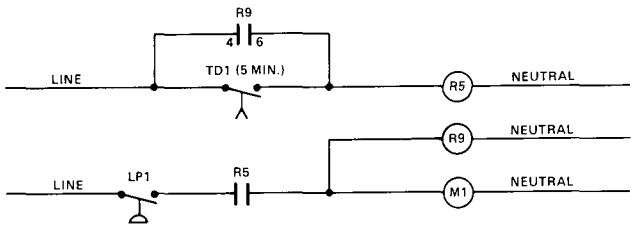
NOTES: 1. Hot only when the unit thermostat calls for compressor to run.
2. Hot only when other safety control contacts are closed.

COMPRESSOR LOCKOUT

This feature locks out the compressor and prevents restarting for 5 minutes after previous shutdown. The R9 relay is de-energized with M1 and the normally open contacts 4 and 6 open in parallel with TD1. After 5 minutes, TD1 contacts 1 and 2 time close, permitting the R5 safety relay to energize and M1 to close on a demand for cooling. As soon as the compressor starts, R9 is energized and normally open contacts 4 and 6 close, bypassing TD1 contact, permitting normal operation. The timer operation for the other compressor circuit is similar.

To check the control, the compressor must be running initially, Move the pumpdown switch PS1 or PS2 to the "manual pumpdown" position. Immediately after the compressor has stopped running, move the pumpdown switch back to the "auto pumpdown" position. The compressor should not restart for 5 minutes. Each refrigerant circuit can be checked the same way.

Figure 25. Compressor Lockout



Notes:
1. Line is only hot when freeze control and high pressure control permit safe operation.
2. Line is only hot when oil pressure and compressor protection modules are closed.

HIGH PRESSURE CONTROL

The high pressure switch will shut down the compressor and close the liquid line solenoid valve when the compressor discharge pressure reaches 380 psig. To check the control, slowly throttle the condenser inlet water or shut down the condenser fan. Observe the cutout point. During testing, stand by the system switch to shut down the unit should the safety device malfunction. Be sure the gauges used are accurate.

The water cooled condensers are supplied with a 450 psig relief valve. After testing the high pressure control, check the pressure relief device for leaks.

Caution: *Although there is a pressure relief device in the system set at 450 psig, it is highly recommended that the "control stop" switch S1 be close at hand in case the high pressure control should malfunction.*

LOW PRESSURE CONTROL

The low pressure control is a single pole pressure switch that closes on a pressure rise. The control senses evaporator pressure and must be set to suit unit application, refer to the nominal low pressure setting table for approximate control setting. To check the control (unit must be running), move the pumpdown switch(es) PS1 and PS2 to the "manual pumpdown" position. As the compressor pumps down, the evaporator pressure will drop. The lowest evaporator pressure reached before cutout is the cutout setting of the control. Wait for the compressor lockout time delays TD1 and TD2 to time out. By moving the pumpdown switch(es) PS1 and PS2 to the "auto pumpdown" position, evaporator pressure will rise. The highest evaporator pressure reached before compressor restart is the cut-in setting of the control.

Table 26. Nominal Low Pressure Cut-Out Settings

			R-22 REFRIG.
Auto Reset	LP1, LP2	Cut-Out Press.	35 psig
		Reset Press.	60 psig

Note: Settings may vary from the nominal values shown to suit the particular unit application.

FREEZESTAT

The freezestat is a pressure type control connected to the low side of the system and is set to shut down the system when the pressure drops low enough to be dangerous as far as cooler freeze-up is concerned. The control must be set to suit unit application, refer to nominal freezestat setting table for approximate control setting. When dropping to this point, the normally open pressure actuated contacts of this control will close, energizing a 115 volt heater. This causes the normally closed bimetallic relay switch of this control to open after a delay of approximately 60 seconds or less, stopping the compressor and closing the liquid line solenoid valve. The time delay prevents nuisance trip-out on momentary low suction pressure and permits the operation of the system on a 'pumpdown "cycle."

The control must be checked while the system is operating. To check the control, install a voltmeter or neon test light across terminal T1 and T2 of the low pressure freeze control. There should be a voltage indication or the test light will glow, indicating the contacts are opened. Throw the pumpdown switch to the manual position and check the pressure at which the test light goes out or the voltmeter goes to zero. In actual operation, the compressor will shut down and the safety light will go out. The control can be manually reset in about 2 minutes.

Table 27. Nominal Freezestat Pressure Settings

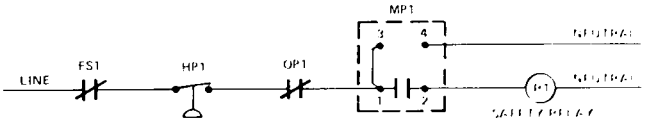
			R-22 REFRIG.
Manual Reset	FS1, FS2	Cut-Out Press.	52 psig
		Reset Press.	57 psig

Note: Settings may vary from the nominal values shown to suit the particular unit application.

COMPRESSOR MOTOR PROTECTOR

The solid-state compressor motor protector module incorporates a 2-minute "time off" relay utilizing the bleed down capacitor principle. Any time the protection system opens or power to the module is interrupted, the 2-minute "time off" delay is triggered, and the module will not reset for 2 minutes. Once the 2-minute period is passed, the motor protector contacts 1 and 2 reset, provided the protection system is satisfied and power is applied to the module.

Figure 26.



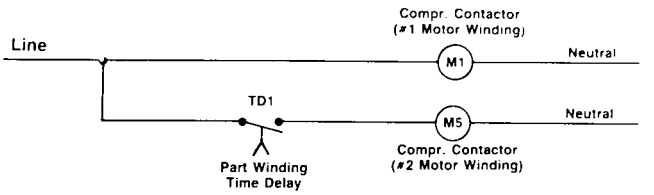
APPENDIX — OPTIONAL CONTROLS

PART WINDING START (OPTIONAL)

Part winding start is available on all units and consists of a solid-state time delay wired in series with the contactor that energizes the second winding of each compressor motor. Its purpose is to limit current inrush to the compressors upon startup. As each compressor starts, the contactor of the first motor winding is delayed for 1 second.

Control checkout is best accomplished by observation as each contactor is pulled in to see that the 1 second delay occurs before the second contactor pulls in.

Figure 27. Part Winding Start Option



Note: Line is only hot when the unit calls for compressor to run.

PHASE/VOLTAGE MONITOR (OPTIONAL)

The phase/voltage monitor is a device which provides protection against three-phase electrical motor loss due to power failure conditions, phase loss, and phase reversal. Whenever any of these conditions occur, an output relay is deactivated, disconnecting power to the thermostatic control circuit. The compressor will automatically pump down.

The output relay remains deactivated until power line conditions return to an acceptable level. Trip and reset delays have been provided to prevent nuisance tripping due to rapid power fluctuations.

When three-phase power has been applied, the output relay should close and the "run light" should come on. If the output relay does not close, perform the following tests.

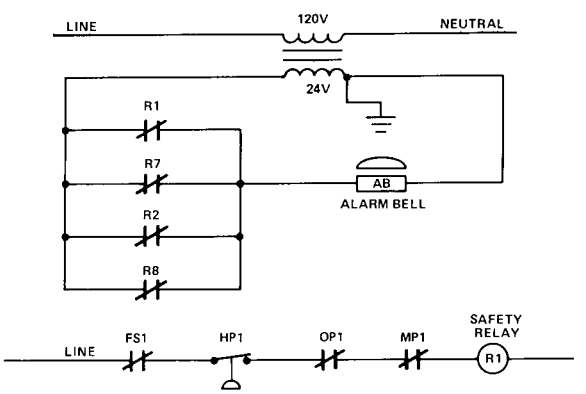
1. Check the voltages between L1—L2, L1—L3 and L2—L3. These voltages should be approximately equal and within + 10% of the rated three-phase line-to-line voltage.
2. If these voltages are extremely low or widely unbalanced, check the power system to determine the cause of the problem.
3. If the voltages are good, turn off the power and interchange any two of the supply power leads at the disconnect.

   This may be necessary as the phase/voltage monitor is sensitive to phase reversal. Turn on the power. The output relay should now close after the appropriate delay.

ALARM BELL (OPTIONAL)

This option is available and is factory installed with a 24 volt alarm bell which can be remotely mounted. The bell is wired into the control circuit so that it will sound whenever there is a failure due to an abnormal low pressure condition in the evaporator, excessive head pressure, motor overheating or low oil pressure. Page 25 shows location of bell in back of the control box.

Figure 36. Alarm Bell Option



LOW SOURCE WATER UNOLADING CONTROL (OPTIONAL)

The low source water unloading senses the temperature of evaorator return water and partially unloads one or both compressor circuits. The control has an adjustable 0°F to 100°F temperature range with 3°F switch differential.

The purpose of the control is to prevent overcooling the source water, which will result in low suction pressure at the compressor. Low suction pressure with the compressor at full load could result in damage to the compressor. A setpoint is recommended for the low source water thermostat of approximately 10°F to 15°F below the design return water temperature. The unit is shipped from the factory with the control sensor clamped to the side of the return water line neat the cooler connection. (See Figure 7 page 12). To check the control, the system should be operating at full load conditions. By slowly turning the dial setting up, the control should partially unload one compressor circuit. By continuing to dial the setting up, the second compressor circuit should unload depending on what the interstage differential is set at.

HOT GAS BYPASS (OPTIONAL)

This option allows passage of discharge gas to the evaporator permitting operation at lower loads than available with compressor unloading. It also keeps the velocity of refrigerant gas high enough for proper oil return at light load conditions. A solenoid valve in the hot gas bypass line is wired in parallel with the compressor unloader U1. Thus, the hot gas solenoid cannot open unless the compressor is operating in an unloaded mode. If only one hot gas valve is specified for the unit, the hot gas bypass is wired in the first refrigerant circuit and the lead-lag switches are therefore eliminated. The hot gas bypass option is also available for the second refrigerant circuit whereby the lead-lag switches remain.

The pressure regulating valve is factory set to begin opening at 58 psig (32°F for R-22). This setting can be changed by changing the pressure of the air charge in the adjustable bulb. To raise the pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. Do not force the adjustment beyond the range it is designed for, as this will damage the adjustment assembly.

The regulating valve opening point can be determined by slowly reducing the system load while observing the suction pressure. When the bypass valve starts to open, the refrigerant line on the evaporator side of the valve will begin to feel warm to the touch.

Caution: *The hot gas line may become hot enough to cause injury in a very short time; care should be taken during valve checkout.*

Figure 29. Hot Gas Bypass Piping Diagram

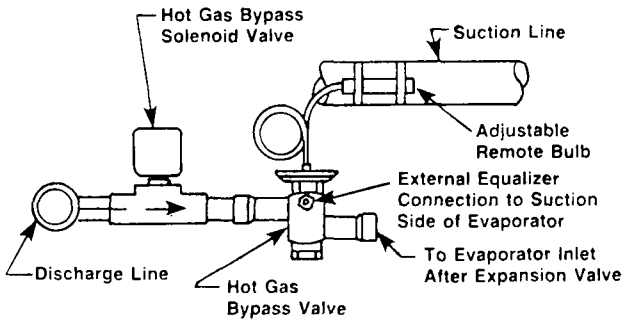


Figure 30. Hot Gas Bypass Adjustment Range

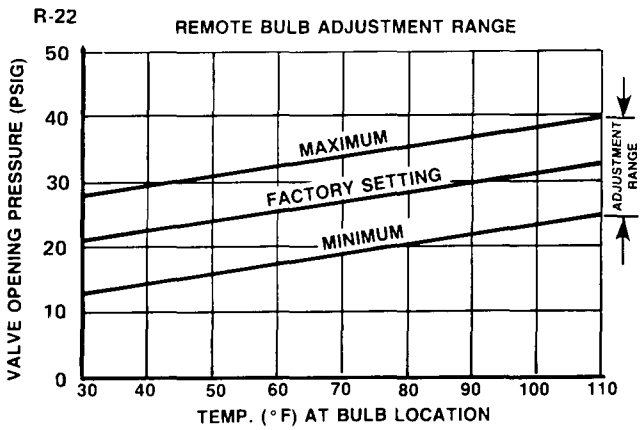


Table 28. Hot Gas Bypass Valve Selection

REFRIGERANT	VALVE CONN. ODF (INCHES)	EXT. EQUALIZER CONN. SAE FLARE	VENDOR PART NO. (SPORLAN)	ADJUSTABLE RANGE (PSIG) NO.	McQUAY PART NO.
R-22	1⅛	.25	DRHE-6-55/70AR	55—70	229735D-00

THR CONTROLS, SETTINGS AND FUNCTIONS

DESCRIPTION	FUNCTION	SYMBOL	SETTING	RESET	LOCATION	DIFFERENTIAL
Alarm Bell	Alarm will sound whenever there is a failure condition through a safety control.	AB	N/A	Manual through a safety or when conditions return to an acceptable level.	Back or side of control box	N/A
Compressor Counter	Displays the number of times each compressor starts and stops.	CTR1—4	N/A	N/A	Control box	N/A
Freeze Control	Protects the evaporator from water freezeup. Time delay prevents nuisance trips.	FS1, 2	Setting varies with refrigerant used & unit operating conditions Refer to pg. 52 for approximate control setting	Manual thru FS1, 2	Pressure sensor on suction line. Control in control box.	3 psig. fixed
Compressor Hour Meter	Displays total hours each compressor has been operating.	HM1—4	N/A	N/A	Control box	N/A
High Pressure Control	Stops compressor when discharge pressure is too high.	HP1, 2	Opens at 380 psig. Closes at 315 psig.	Manual thru HP1, 2	Control Box	65 psig fixed.
Low Pressure Control	(Used for pumpdown.) Stops compressor when suction pressure is too low.	LP1, 2	Setting varies with refrigerant used & unit operating conditions Refer to pg. 52 for approximate control setting.	Auto	Control Box	25 psig fixed.
Compressor Motor Protector (Texas Instruments)	Protects motor from high temperature by sensing winding temperature.	MP1—4	500 ohms cold to 20,000 ohms hot.	Auto from 2700—4500 ohms	Compressor junction box	15,000 ohms
Oil Pressure Control	Stops compressor if oil pressure drops below setpoint for 120 seconds.	OP1—4	Pressure sensor opens at 14 psig oil pressure. If pressure drops below 10 psig the sensor closes, energizing a 120 second delay before stopping the compressor.	Manual	Control box	5 psig
Pumpdown Switch	Used to manually pump down compressor circuit.	PS1, 2	Auto/manual	N/A	Control box	N/A
Phase/Voltage Monitor	Protects motor from power failure, phase loss, phase reversal and undervoltage.	PVM	N/A	When conditions return to an acceptable level.	Control box	N/A
Control Stop Switch	Shuts down entire control circuit.	S1	On/off	N/A	Control box	N/A
Lead-Lag Switch	Reverses sequence that compressors start in.	S2	Circuit 1 leads Circuit 2 or Circuit 2 leads Circuit 1	N/A	Control box	N/A
Solenoid Valves, Liquid Line	Close off liquid line for pumpdown.	SV1, 2	N/A	N/A	Condenser section on liquid line after filter-drier and before TEV.	N/A
Solenoid Valves, Hot Gas Bypass	Close off hot gas line for pumpdown.	SV5, 6	120° to 150°F	120° to 150°F	Condenser section	N/A
Unit Thermostat (Master)	Measures return condenser water temperature to control compressor staging.	CP1	Should be set to desired condenser leaving water temp.	N/A	Control box. Sensor in return water line from building to condenser.	Adjustable from 1°F to 3°F per stage.
Unit Thermostat (Satellite)	Adds additional stages of heating to unit thermostat CP1.	CP2	N/A	N/A	Control box	Adjustable thru CP1.
Low Source Water Thermostat	Unloads compressor circuits if return water temperature is too low.	TC11, R21, R22	Adjustable 0 to 100°F. Recommended setpoint 10—15°F below design source water temp.	Auto	Control box	3°F fixed
Compressor Lockout Time Delay	Prevents short cycling of compressors.	TD1—4	5 minutes.	Auto	Control box	N/A
Part Winding Start Time Delay	Reduces inrush amp draw on startup.	TD5—8	1 second	N/A	Control box	N/A
Compressor Sequencing Time Delay	Staggers compressor starting to reduce inrush amp draw.	TD11—13	TD11: 20 seconds TD12, 13: 40 seconds	N/A	Control box	N/A
Compressor Unloaders	Solenoid valves on compressor heads to load or unload compressors (energize to unload; de-energize to load).	U1, 2	N/A	N/A	On compressor	N/A

The McQuay THR TEMPLIFIER heat pump provides not only lower operating costs, but lower installation costs, low maintenance costs and greater design flexibility, in both comfort and process cooling applications.

In order for McQuay to better serve our customers, feedback of recurring service problems or complaints dealt with in the field would be appreciated. Problems or complaints can be reported to McQuay International by filling out a Product Quality Report (Form No. 2S-636-784). These forms are available from McQuay and sales representative organizations and should be routed back through these organizations to McQuay's Engineering and Marketing departments.

TROUBLESHOOTING CHART

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor Will Not Run	1. Main switch, circuit breakers open. 2. Fuse blown. 3. Defective contactor or coil. 4. System shut down by safety devices. 5. No cooling required. 6. Liquid line solenoid will not open. 7. Motor electrical trouble. 8. Loose wiring.	1. Close switch. 2. Check electrical circuits and motor winding for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected. 3. Repair or replace. 4. Determine type and cause of shutdown and correct it before resetting safety switch. 5. None. Wait until unit calls for heating or cooling. 6. Repair or replace coil. 7. Check motor for opens, short circuit, or burnout. 8. Check all wire junctions. Tighten all terminal screws.
Compressor Noisy or Vibrating	1. Flooding of refrigerant into crankcase. 2. Improper piping support on suction or liquid line. 3. Worn compressor.	1. Check superheat setting of expansion valve. 2. Relocate, add or remove hangers. 3. Replace.
High Discharge Pressure	1. Condenser water insufficient or temperature too high. 2. Fouled condenser tubes. 3. Noncondensables in system. 4. System overcharged with refrigerant. 5. Discharge shutoff valve partially closed. 6. Discharge check valve not opening fully.	1. Readjust temperature control or water regulating valve. Investigate ways to increase water supply. 2. Clean. 3. Purge the noncondensables. 4. Remove excess refrigerant. 5. Open valve. 6. Repair or replace discharge check valve.
Low Discharge Pressure	1. Fault condenser temperature regulation. 2. Suction shutoff valve partially closed. 3. Insufficient refrigerant in system. 4. Low suction pressure. 5. Compressor operating unloaded.	1. Check condenser control operation. 2. Open valve. 3. Check for leaks. Repair and add charge. 4. See corrective steps for low suction pressure below. 5. See corrective steps for failure of compressor to load.
High Suction Pressure	1. Excessive load—high return source water temp. 2. Expansion valve overfeeding. 3. Compressor unloaders open.	1. Reduce load or add additional equipment. 2. Check remote bulb. Regulate superheat. 3. See corrective steps for failure of compressor to load.
Low Suction Pressure	1. Lack of refrigerant. 2. Evaporator dirty. 3. Clogged liquid line filter-drier. 4. Clogged suction line or compressor suction gas strainers. 5. Expansion valve malfunctioning. 6. Gasket failure in evaporator head ring. 7. Condensing temperature too low. 8. Compressor will not unload. 9. Insufficient water flow.	1. Check for leaks. Repair and add charge. 2. Clean chemically. 3. Replace cartridge(s). 4. Clean strainers. 5. Check and reset for proper superheat. Replace if necessary. 6. Check $\triangle P$ across evaporator. 7. Check means for regulating condensing temperature. 8. See corrrective steps for failure of compressor to unload. 9. Adjust gpm.
Compressor Will Not Unload or Load Up	1. Defective capacity control. 2. Unloader mechanism defective. 3. Faulty thermostat stage or broken capillary tube. 4. Stages not set for application.	1. Replace. 2. Replace. 3. Replace. 4. Reset thermostat setting to fit application.
Compressor Loading/Unloading Intervals Too Short	1. Erratic water thermostat. 2. Insufficient water flow. 3. Throttling range set wrong thermostat.	1. Replace. 2. Adjust gpm. 3. Adjust thermostat settings.
Little or No Oil Pressure	1. Clogged suction oil strainer. 2. Excessive liquid in crankcase. 3. Oil pressure gauge defective. 4. Low oil pressure safety switch defective. 5. Worn oil pump. 6. Oil pump reversing gear stuck in wrong position. 7. Low oil level. 8. Loose fitting on oil lines. 9. Pump housing gasket leaks. 10. Flooding of refrigerant into crankcase.	1. Clean. 2. Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. 3. Repair or replace. Keep valve closed except when taking reading. 4. Replace. 5. Replace. 6. Reverse direction of compressor rotation by switching compressor leads. 7. Add oil. 8. Check and tighten system. 9. Replace gasket. 10. Adjust thermal expansion valve.
Compressor Loses Oil	1. Lack of refrigerant. 2. Excessive compression ring blow-by.	1. Check for leaks and repair. Add refrigerant. 2. Replace compressor.
Motor Circuit Circuit Breakers Open	1. Low voltage during high load conditions. 2. Defective or grounded wiring in motor or power circuits. 3. Loose power wiring. 4. High condensing temperature. 5. Power line fault causing unbalanced voltage. 6. High ambient temperature around the overload relay. 7. Failure of second starter to pull in on part winding start system.	1. Check supply voltage for excessive line drop. 2. Replace compressor-motor. 3. Check all connections and tighten. 4. See corrective steps for high discharge pressure. 5. Check supply voltage. Notify power company. Do not start until fault is corrected. 6. Provide ventilation to reduce heat. 7. Repair or replace starter or time delay mechanism.
Compressor Thermal Protector Switch Open	1. Operating beyond design conditions. 2. Discharge valve partially shut. 3. Blown valve plate gasket.	1. Add facilities so that conditions are within allowable limits. 2. Open valve. 3. Replace gasket.
Freeze Protection Opens	1. Evaporator water temp. too low. 2. Low water flow. 3. Low suction pressure.	1. Raise evaporator water temp. 2. Adjust gpm. 3. See "Low Suction Pressure."

PRESSURE TEMPERATURE TABLE

Table 29. R-22

°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG
30	54.9	64	109.3	98	190.8	132	304.6
32	57.2	66	112.2	100	195.9	134	312.5
34	60.1	68	117.3	102	201.8	136	320.6
36	62.8	70	121.4	104	207.7	138	328.4
38	65.9	72	125.7	106	213.8	140	337.3
40	68.5	74	130.0	108	220.0	142	345.8
42	71.5	76	134.5	110	226.4	144	354.5
44	74.5	78	139.0	112	232.8	146	363.3
46	77.6	80	143.6	114	239.4	148	372.3
48	82.7	82	148.4	116	246.1	150	381.5
50	84.0	84	153.2	118	252.9	152	390.8
52	87.4	86	158.2	120	259.9	154	400.3
54	90.8	88	163.3	122	267.1	156	409.9
56	94.3	90	168.4	124	274.3	158	419.8
58	97.9	92	173.7	126	281.6	160	429.8
60	101.6	94	179.1	128	289.1	162	440.1
62	105.4	96	184.6	130	296.8	164	450.4