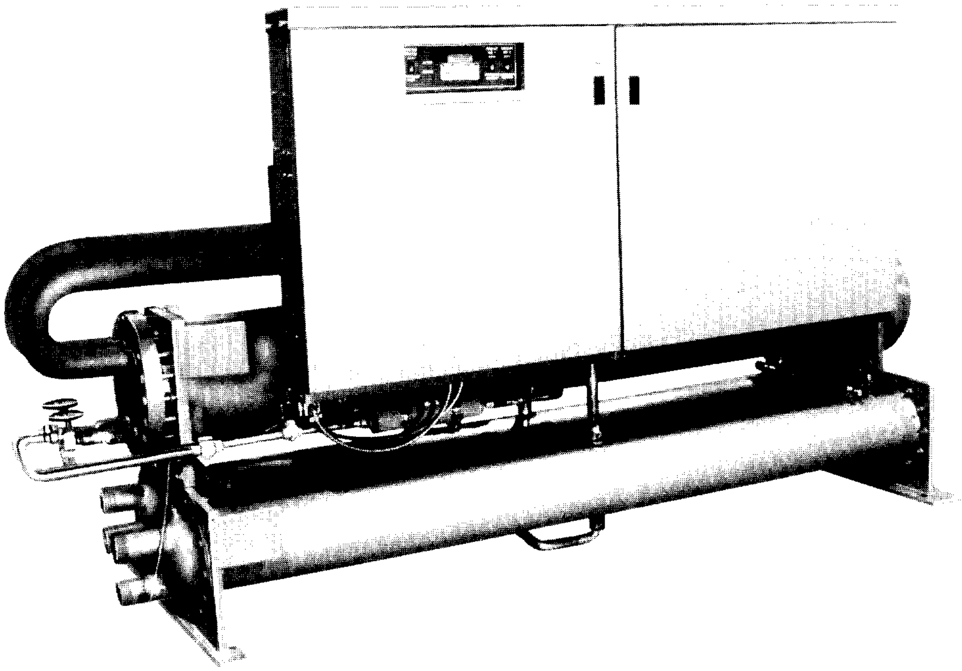
INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 508
JUNE, 1991
FORM NO. 572986Y

SEASONPAK PACKAGED WATER CHILLER WITH MICROTECH™ CONTROL



Type WHR 040 Thru 240 Tons "D" Vintage

TABLE OF CONTENTS

INTRODUCTION

This manual covers only the mechanical aspects of WHR chillers equipped with the MicroTech reciprocating chiller control. All of the operating, safety control and installation requirements of the MicroTech control are coveted in the separate Installation and Maintenance Bulletin 493, which must be consulted before startup and operation is attempted.

GENERAL DESCRIPTION

McQuay Type WHR SEASONPAK water chillers are designed for indoor installations and are compatible with either air or water as a condensing medium. 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 or partial refrigerant piping depending on the condensing medium.

Liquid line components that are included are manual liquid line shutoff valves, charging valves, filter-driers, liquid line solenoid valves, sightglass/moisture indicators, and balance port type thermal expansion valves. Other features include compressor 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

W HR - 040 D W — Basic Unit with Single Water Cooled Condenser per Refrigerant Circuit
A — Basic Unit Less Condensers
H — Basic Unit with Dual Water Cooled Condensers per Refrigerant Circuit

Water Cooled Condensing
Compressor Type (Accessible Hermetic)
Nominal Capacity (Tons)
Vintage

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.

NOTE: Unit shipping and operating weights are available in the physical data table (pages 21 through 23).

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 WHR SEASONPAK water chiller with water cooled condensers (Arrangements W and H) is supplied with a full refrigerant charge. A holding charge is supplied in condenserless models (Arrangement A). 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 exposing an open flame to refrigerant. 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 BASE.

MOVING THE UNIT

The McQuay SEASONPAK water chiller 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.

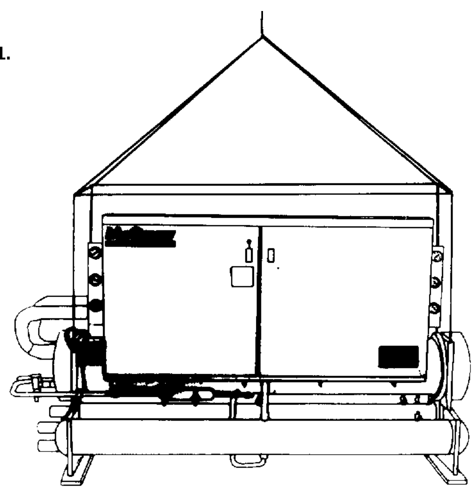
When moving the unit, dollies or simple rollers can be used under the skids.

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).

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 240D, 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.

LOCATION

Unit is designed for indoor application and must be located in an area where the surrounding ambient temperatures are 40°F or above. A good rule of thumb is to place units where ambients are at least 5 degrees above the leaving water temperature.

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 SEASONPAK water chiller. 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 21 through 23.

SPACE REQUIREMENTS FOR CONNECTIONS AND SERVICING

The chilled water piping for all units enters and leaves the cooler 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.

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.

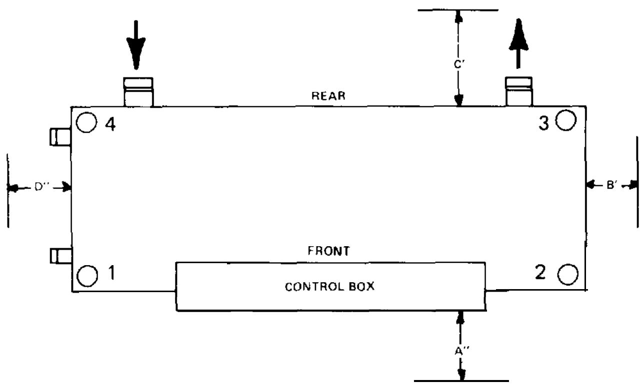
Clearance should be provided for cleaning condenser tubes or for removing cooler tubes on one end of the unit as specified in Table 1. It is also necessary to leave a work area on the end opposite that used for replacement of a cooler tube.

Table 1. Minimum recommended clearance requirements

WHR-040 THRU 110D				WHR-120 THRU 240D			
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).

Figure 2. Clearance requirements



PLACING THE UNIT

The small amount of vibration normally encountered with the SEASONPAK water chiller 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 WHR 120D thru 240D, 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 SEASONPAK water chiller are recommended to avoid straining the piping and transmitting vibration and noise.

Figure 3. Isolator Locations

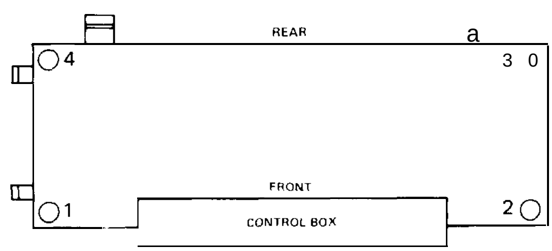


Table 2. Vibration isolators

WHR UNIT SIZE	OPER-ATING WEIGHT	CORNER WEIGHT				NEOPRENE-IN-SHEAR MOUNTINGS				SPRING-FLEX MOUNTINGS			
		1	2	3	4	1	2	3	4	1	2	3	4
ARRANGEMENT W — WHR WITH WATER COOLED CONDENSERS													
040	3580	833	747	945	1055	4-Black	4-Black	4-Black	4-Black	CP2-27	CP2-27	CP2-27	CP2-27
050	3630	845	755	958	1071	4-Black	4-Black	4-Black	4-Black	CP2-27	CP2-27	CP2-27	CP2-27
060	3920	912	816	1034	1158	4-Black	4-Black	4-Black	4-Black	CP2-28	CP2-28	CP2-28	CP2-28
070	4010	933	834	1058	1185	4-Black	4-Black	4-Black	4-Black	CP2-28	CP2-28	CP2-28	CP2-28
080	4165	946	856	1123	1240	4-Black	4-Black	4-Black	4-Black	CP2-28	CP2-28	CP2-28	CP2-28
090	4675	1067	992	1260	1356	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
100	5215	1190	1105	1406	1514	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
110	5365	1264	1228	1415	1458	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
120	6250	1492	1404	1626	1728	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
130	6405	1513	1453	1684	1755	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
140	6480	1524	1472	1712	1772	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
150	7020	1624	1594	1882	1920	4-Green	4-Green	4-Green	4-Green	CP4-27	CP4-27	CP4-27	CP4-27
160	7170	1657	1620	1925	1968	4-Green	4-Green	4-Green	4-Green	CP4-27	CP4-27	CP4-27	CP4-27
170	7280	1685	1635	1950	2010	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
175	7300	1690	1640	1955	2015	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
180	7850	1800	1805	2120	2125	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
190	7850	1800	1805	2120	2125	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
200	7850	1800	1805	2120	2125	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
210	9150	2160	2190	2350	2450	4-Gray	4-Gray	4-Gray	4-Gray	CP4-31	CP4-31	CP4-31	CP4-31
220	9200	2170	2205	2365	2460	4-Gray	4-Gray	4-Gray	4-Gray	CP4-31	CP4-31	CP4-31	CP4-31
230	9300	2195	2225	2390	2490	4-Gray	4-Gray	4-Gray	4-Gray	CP4-31	CP4-31	CP4-31	CP4-31
240	9300	2195	2225	2390	2490	4-Gray	4-Gray	4-Gray	4-Gray	CP4-31	CP4-31	CP4-31	CP4-31
ARRANGEMENT A — WHR WITHOUT WATER COOLED CONDENSERS													
040	2640	681	587	635	737	3-Gray	3-Gray	3-Gray	3-Gray	CP2-26	CP2-26	CP2-26	CP2-26
050	2660	686	588	640	746	3-Gray	3-Gray	3-Gray	3-Gray	CP2-26	CP2-26	CP2-26	CP2-26
060	2910	750	644	700	816	3-Gray	3-Gray	3-Gray	3-Gray	CP2-27	CP2-27	CP2-27	CP2-27
070	2930	756	648	705	821	3-Gray	3-Gray	3-Gray	3-Gray	CP2-27	CP2-27	CP2-27	CP2-27
080	3030	753	658	755	864	3-Gray	3-Gray	3-Gray	3-Gray	CP2-27	CP2-27	CP2-27	CP2-27
090	3270	789	710	839	932	3-Gray	3-Gray	3-Gray	3-Gray	CP2-27	CP2-27	CP2-27	CP2-27
100	3800	917	825	975	1083	4-Black	4-Black	4-Black	4-Black	CP2-28	CP2-28	CP2-28	CP2-28
110	3865	882	845	1046	1092	4-Black	4-Black	4-Black	4-Black	CP2-28	CP2-28	CP2-28	CP2-28
120	4560	1060	973	1209	1318	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
130	4630	1060	1000	1248	1322	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
140	4700	1070	1018	1274	1338	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
150	5105	1136	1106	1411	1452	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
160	5245	1167	1130	1450	1498	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
170	5345	1193	1142	1472	1538	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
180	5800	1290	1280	1605	1625	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
190	5800	1290	1280	1605	1625	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
200	5800	1290	1280	1605	1625	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
210	6750	1500	1530	1830	1890	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
220	5820	1515	1545	1850	1910	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
230	6900	1535	1565	1870	1930	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
240	6900	1535	1565	1870	1930	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
ARRANGEMENT H — WHR WITH HEAT RECOVERY CONDENSERS													
040	4495	1038	950	1199	1308	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
050	4565	1054	963	1217	1331	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
060	4885	1128	1031	1303	1423	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
070	5040	1163	1064	1343	1470	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
080	5235	1185	1095	1419	1536	4-Red	4-Red	4-Red	4-Red	CP2-31	CP2-31	CP2-31	CP2-31
090	6025	1408	1330	1597	1690	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
100	6555	1533	1447	1737	1838	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
110	6780	1618	1580	1770	1812	4-Red	4-Red	4-Red	4-Red	CP2-32	CP2-32	CP2-32	CP2-32
120	7875	1900	1810	2032	2133	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
130	8095	1936	1875	2107	2177	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
140	8170	1945	1895	2135	2195	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
150	8845	2081	2050	2339	2375	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
160	8990	2110	2075	2380	2425	4-Green	4-Green	4-Green	4-Green	CP4-28	CP4-28	CP4-28	CP4-28
170	9105	2145	2090	2405	2465	4-Green	4-Green	4-Green	4-Green	CP4-31	CP4-31	CP4-31	CP4-31
175	9200	2190	2140	2405	2465	4-Green	4-Green	4-Green	4-Green	CP4-31	CP4-31	CP4-31	CP4-31
180	9940	2345	2350	2620	2625	4-Gray	4-Gray	4-Gray	4-Gray	CP4-31	CP4-31	CP4-31	CP4-31
190	9940	2345	2350	2620	2625	4-Gray	4-Gray	4-Gray	4-Gray	CP4-31	CP4-31	CP4-31	CP4-31
200	9940	2345	2350	2620	2625	4-Gray	4-Gray	4-Gray	4-Gray	CP4-31	CP4-31	CP4-31	CP4-31
210	11500	2750	2775	2935	3040	4-Gray	4-Gray	4-Gray	4-Gray	CP-32	CP-32	CP-32	CP-32
220	11700	2800	2825	2985	3090	4-Gray	4-Gray	4-Gray	4-Gray	CP-32	CP-32	CP-32	CP-32
230	11900	2850	2875	3035	3140	4-Gray	4-Gray	4-Gray	4-Gray	CP-32	CP-32	CP-32	CP-32
240	11900	2850	2875	3035	3140	4-Gray	4-Gray	4-Gray	4-Gray	CP-32	CP-32	CP-32	CP-32

Table 3. Spring Flex Isolators

TYPE	COLOR	MAX. LOAD EACH LBS.	DEFL. (IN.)	DIMENSIONS (INCHES) A	B	C	D	E	McQUAY PART NO.
CP-1-25	RED	450	1.22	7½	6½	5	2¾	5⅞	886-477927A-25
CP-1-26	PURPLE	600	1.17	7½	6½	5	2¾	5⅞	886-477927A-26
CP-1-27	ORANGE	750	1.06	7½	6½	5	2¾	5⅞	886-477927A-27
CP-1-28	GREEN	900	1.02	7½	6½	5	2¾	5⅞	886-477927A-28
CP-1-31	WHITE	1100	0.83	7½	6½	5	2¾	5⅞	886-477927A-31
CP-1-32	GRAY	1300	0.70	7½	6½	5	2¾	5⅞	886-477927A-32
CP-2-25	RED	900	1.20	10¼	9¼	8	2¾	5⅞	886-477929A-25
CP-2-26	PURPLE	1200	1.17	10¼	9¼	8	2¾	5⅞	886-477929A-26
CP-2-27	ORANGE	1500	1.06	10¼	9¼	8	2¾	5⅞	886-477929A-27
CP-2-28	GREEN	1800	1.02	10¼	9½	8	2¾	5⅞	886-477929A-28
CP-2-31	GRAY	2200	0.83	10¼	9½	8	2¾	5⅞	886-477929A-31
CP-2-32	WHITE	2600	0.70	10¼	9½	8	2¾	5⅞	886-477929A-32
CP-4-26	PURPLE	2400	1.20	10¼	9½	7½	5	6⅛	886-580513A-26
CP-4-27	ORANGE	3000	1.10	10¼	9½	7½	5	6⅛	886-580513A-27
CP-4-28	GREEN	3600	1.00	10¼	9½	7½	5	6⅛	886-580513A-28
CP-4-31	GRAY	4400	0.80	10¼	9½	7½	5	6⅛	886-580513A-31
CP-4-32	WHITE	5200	0.70	10¼	9½	7½	5	6⅛	886-580513A-32

Figure 4. Spring Flex Mountings

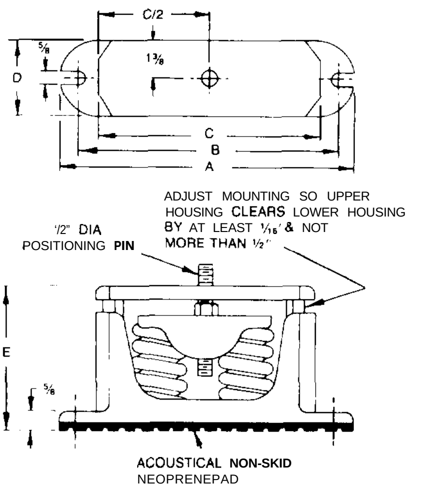
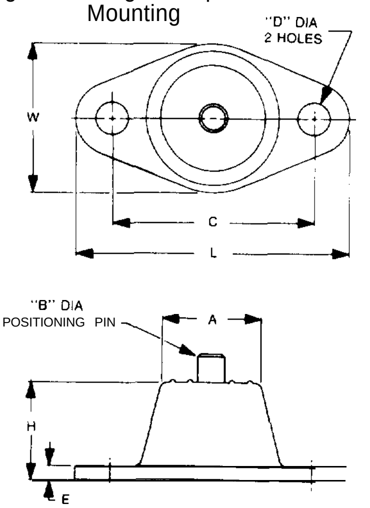


Table 4. Neoprene-in-Shear Isolators

TYPE		MAX. LOAD EACH LBS.	DEFL. (IN.)	DIMENSIONS (INCHES) A	B	C	D	E	H	L	W	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
	Gray	4000										216398A-05

Figure 5. Single Neoprene-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 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 TO ASSURE WATER FLOW BEFORE STARTING THE UNIT

CHILLED WATER PIPING

The water flow entering the cooler must always be on the end nearest the expansion valves and cooler refrigerant connections to assure proper expansion valve operation and unit capacity (see pages 16 thru 20).

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.

CHILLED WATER SENSOR

On units WHR-040D thru 240D. the chilled water sensor is factory installed in the leaving water connection on the evaporator. For detailed specifications regarding the chilled water sensor or any other sensors/transducers, refer to IM 493. 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.

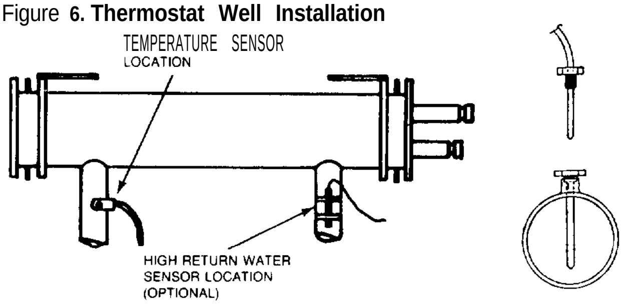
NOTE: See IM 493 for additional thermostat information.

CAUTION: The thermostat bulb should not be exposed to water temperatures above 125°F since this will damage the control.

Table 5.

VENDOR MODEL NO.	IM BULLETIN NUMBER	SENSOR LOCATION RETURN	SENSOR LOCATION LEAVING
Barber Coleman CP8161	348	X	
Honeywell W7100G	385		X
MicroTech, Control Manual	493		X
MicroTech, Unit Manual	508		X

Figure **6. Thermostat Well Installation**



FLOW SWITCH

A WATER FLOW SWITCH MUST SE MOUNTED in either the entering or leaving water line to insure that there will be adequate water flow and cooling load to the evaporator before the unit can start. This will safeguard against slugging 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 under ordering number 1750338-00. 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 6. Installation should be as shown in Figure 7. The flow switch should be wired per actual unit wiring diagram found on the inside of the unit control panel door or refer to IM 493.

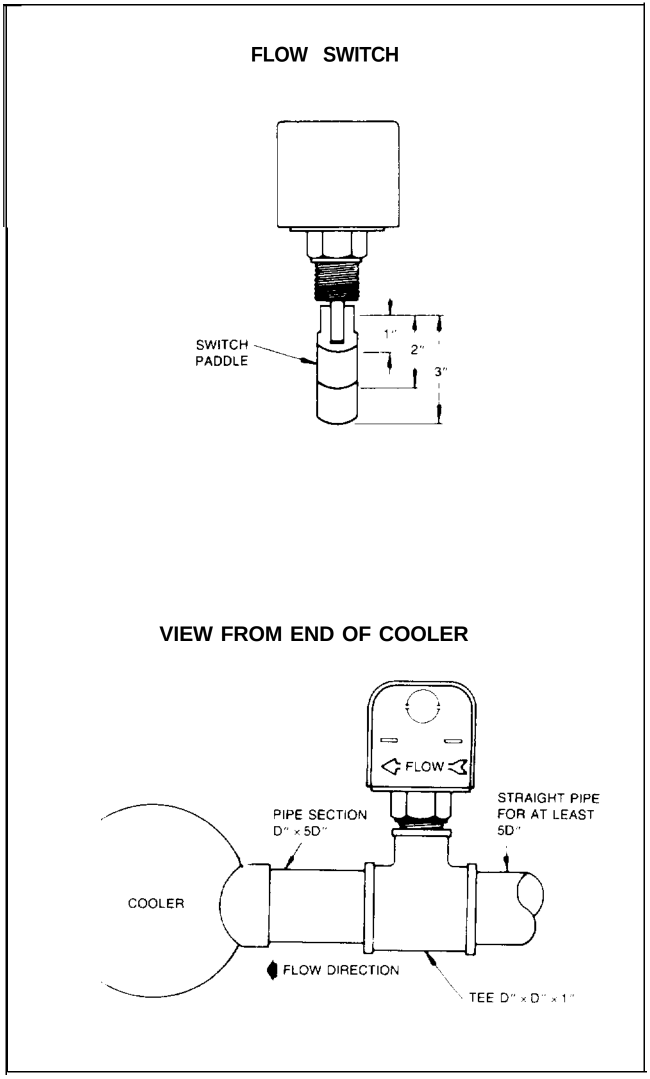
1. Apply pipe sealing compound to only the threads of the switch and screw unit into D”x D”x 1” reducing tee (see Figure 7). The flow arrow must be pointed in the correct direction.
2. Piping should provide a straight length before and after the flow switch of at least five times the pipe diameter.
3. 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 6. 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
2 %	24.30
3	30.00
4	39.70
5	58.70
	79.20

Fioure 7.



GLYCOL SOLUTIONS

The system glycol capacity, glycol solution flow rate in gpm, and pressure drop through the cooler may be calculated using the following formulas and table.

1. CAPACITY — Capacity is reduced from that with plain water. To find the reduced value multiply the chiller's water system tonnage by the capacity correction factor C to find the chiller's capacity in the glycol system.
2. GPM -To determine gpm (or $\triangle$ T) knowing $\triangle$ T (or gpm) and tons:

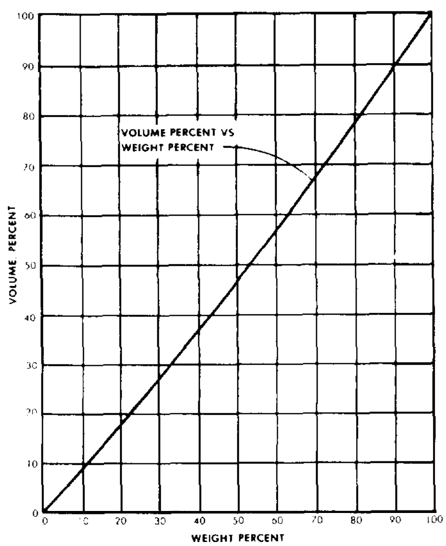
$$\text{Glycol } gpm = \frac{24 \times Tons\ (Glycol)}{\Delta T} \times G\ (\text{from table})$$

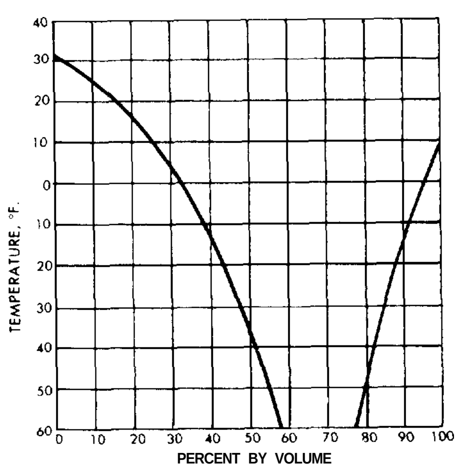
3. PRESSURE DROP -To determine glycol pressure drop through the cooler, enter the water pressure drop graph on page 9 at the glycol gpm. Multiply the water pressure drop found there by P to obtain corrected glycol pressure drop.

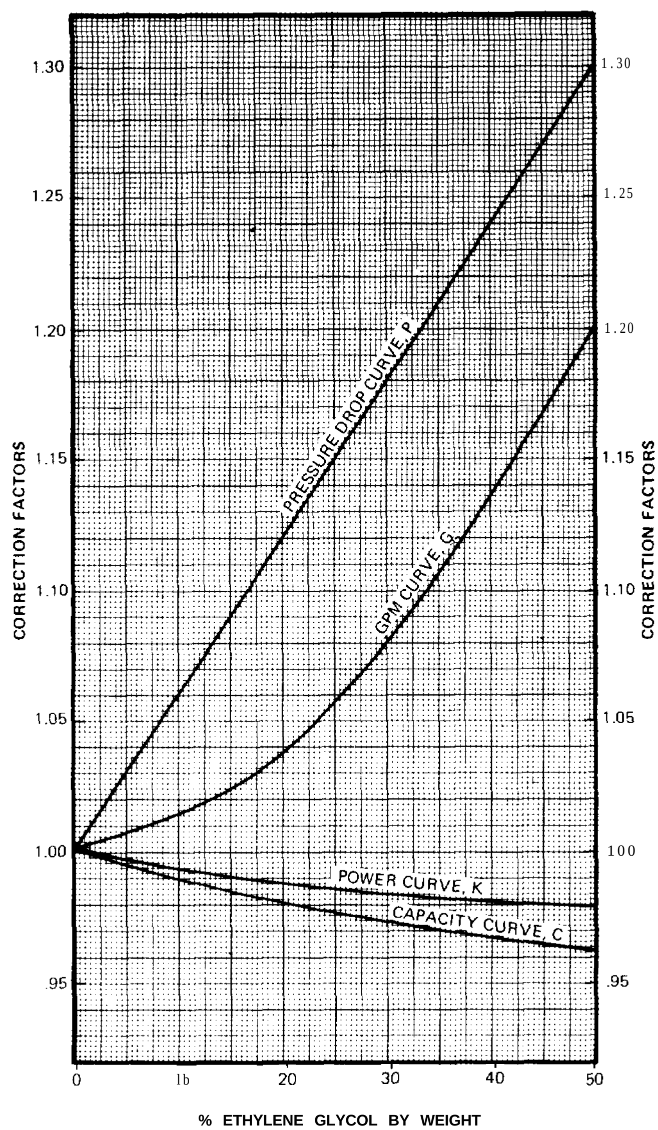
Test coolant with a clean accurate glycol solution hydrometer (similar to that found in service stations) to determine freezing point. Then obtain percent glycol from the freezing point table below.

PERCENT GLYCOL	FREEZING POINT	C	K	G	P
0	32°F	1.000	1.000	1.00	1.00
10	24°F	0.990	0.994	1.01	1.06
20	15°F	0.981	0.988	1.04	1.12
30	4°F	0.974	0.984	1.08	1.18
40	-12°F	0.968	0.981	1.13	1.24
50	-33°F	0.964	0.980	1.20	1.30

CONDENSER — The use of a glycol solution in the heat recovery condensers will not affect heat recovery capacity.

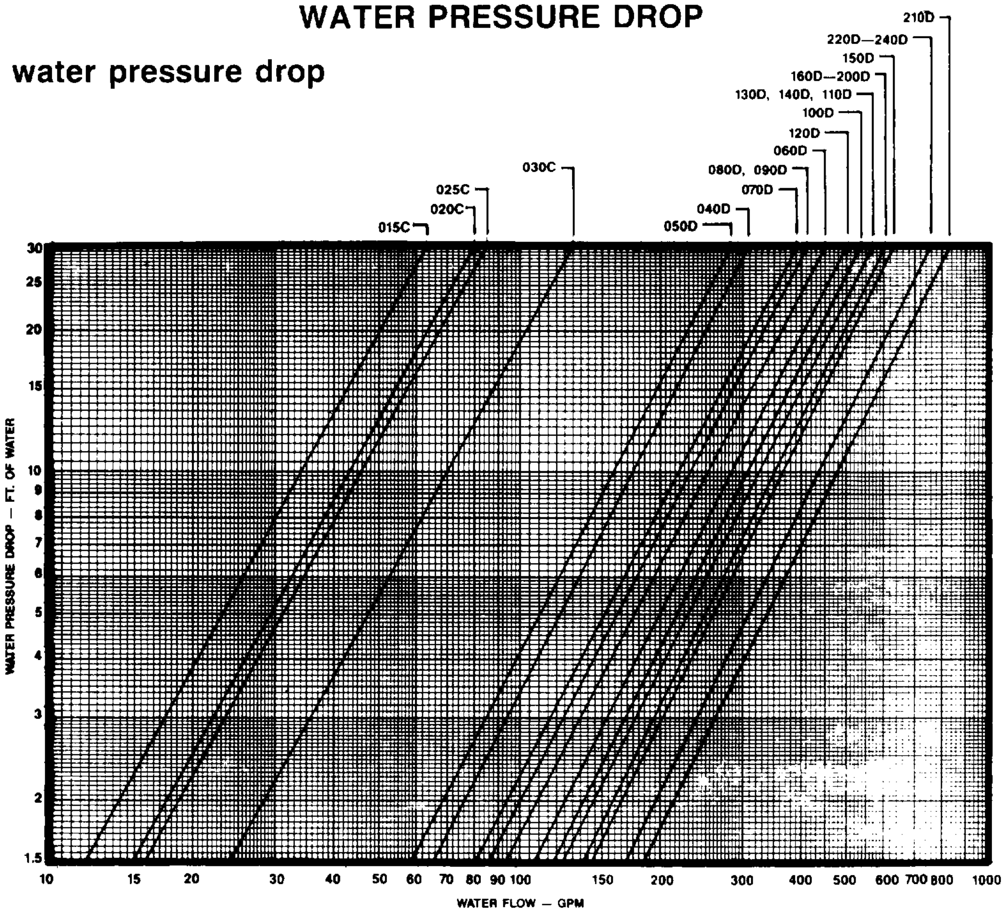




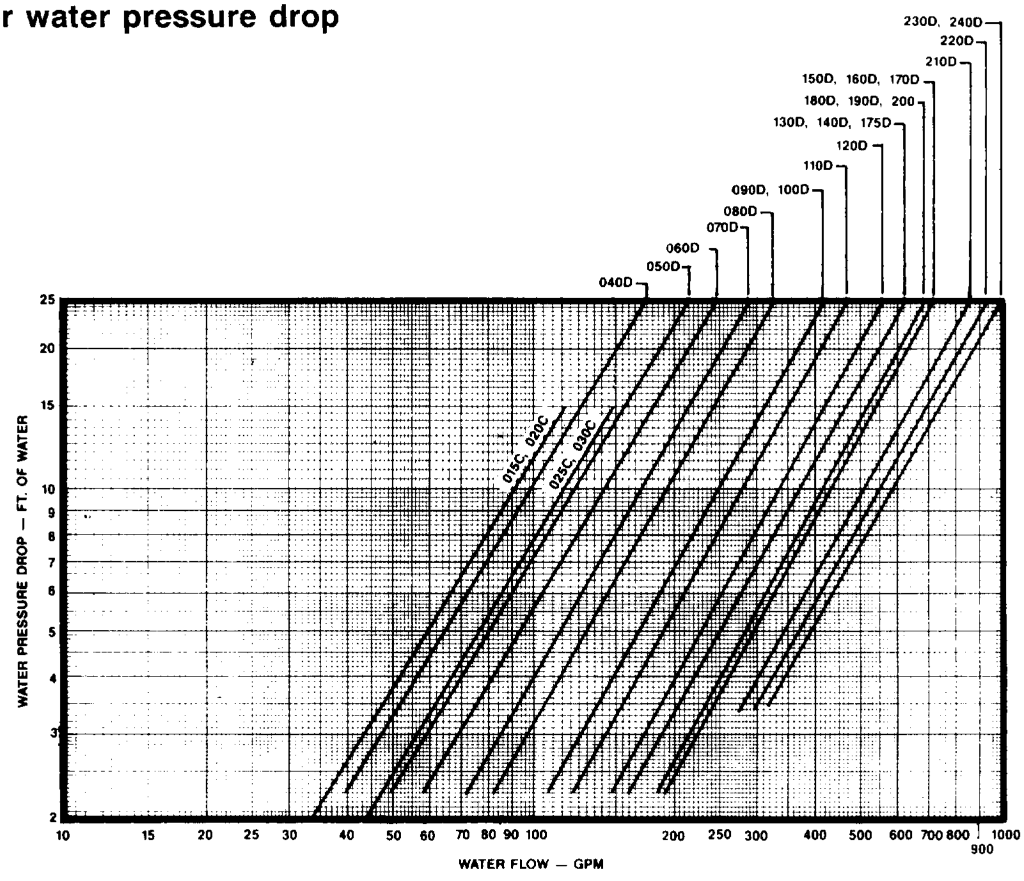


WATER PRESSURE DROP

Evaporator water pressure drop



Condenser water pressure drop



NOTE: Additional information on the evaporator and condenser vessels can be found in the physical data tables on pages 20 through 22.

CONDENSER WATER PIPING

GENERAL — For proper performance, the condenser water must enter the bottom connection of the condenser. Water cooled condensers may be piped for use with cooling towers, well water or heat recovery applications. Cooling tower applications should be made with consideration to freeze protection and scaling problems. For specific applications, contact cooling tower manufacturer for equipment characteristics and limitations.

HEAD PRESSURE CONTROL, TOWER SYSTEM — Some means of controlling operating head pressure must be provided. Minimum condensing temperature allowed is 80°F. Minimum entering tower condenser water temperature is 70°F. Typical systems are shown in Figures 8 and 9. In Figure 8, a three-way pressure actuator water regulating valve is used for cooling applications, In Figure 9 the capacity of the cooling tower is controlled through damper and/or fan modulation. These typical systems, depending on the specific application, must maintain a constant condensing pressure, regardless of temperature conditions and must assure enough head pressure for proper thermal expansion valve operation. Note also that both systems assure full water flow to the tower.

HEAD PRESSURE CONTROL, WELL WATER SYSTEM — Where well water is used for condensing refrigerant, a direct acting water regulating valve is recommended (see Figure 10). The valve is normally installed at the outlet of the condenser. On shutdown, the valve will close and, in this way, prevent water siphoning out of the condenser. Siphoning causes drying of the waterside of the condenser and rapid build-up of fouling. When no valve is used, a loop at the outlet end is recommended (See Figure 10).

COOLING TOWER SYSTEMS-HEAD PRESSURE CONTROL

Figure 8. **3-Way Water Valve**

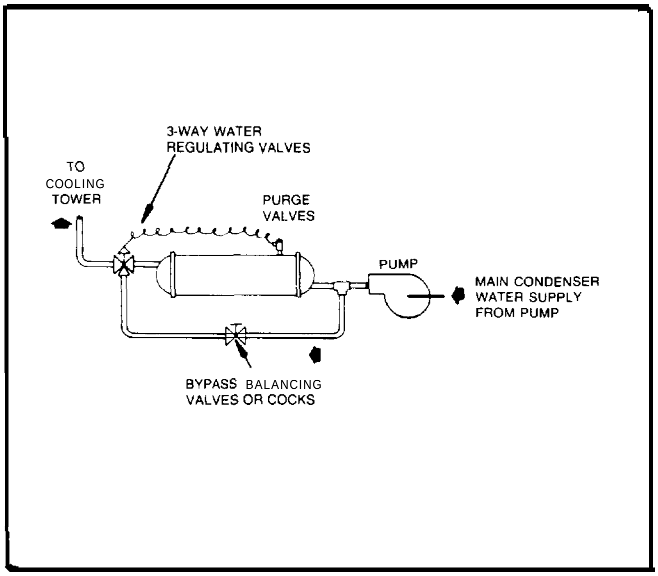


Figure 9. Fan Modulation

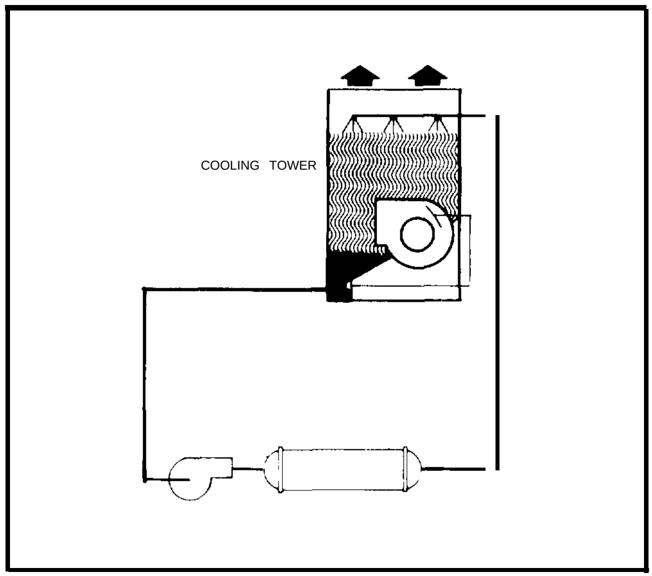
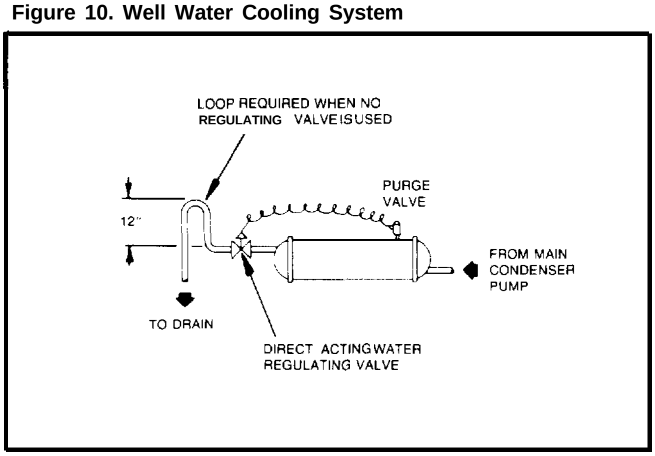


Figure 10. Well Water Cooling System



SINGLE CONDENSER HEAT RECOVERY — ARRANGEMENT W

Single circuit heat recovery employs a standard water cooled chiller equipped with heavier electrical components and a 380 psig high pressure limit switch. These modifications allow leaving condenser water temperatures up to 135°F for building or process heating applications.

A typical heat recovery arrangement will include a closed circuit cooling tower used to reject unwanted condenser heat to the outdoor ambient air. The cooling tower should be sized to reject all the condenser heat during summer design operation. This insures proper operation in the nonheat-recovery mode. Use of a closed circuit tower is normally required in order to prevent fouling of heating coils in the heat recovery loop. Condenser water remains free of contamination from minerals and impurities normally contained in make-up water in an open cooling tower.

If a closed circuit cooling tower is to be located in an ambient temperature below freezing, protection against coil and sump freeze-up must be provided. Coil freeze protection can be provided by using a glycol solution or by maintaining a heat load on the coil at all times and maintaining water flow through the coil. Sump water freeze protection can be provided by locating the spray water circulating pump and sump tank inside a heated space or by placing heating coils in the sump. Head pressure and water temperature are normally controlled by the tower capacity control. Adequate capacity control is usually obtained by fan cycling and regulating dampers located in the fan discharge. This will maintain a constant tower water temperature. Consult the closed circuit manufacturer for information on specific applications.

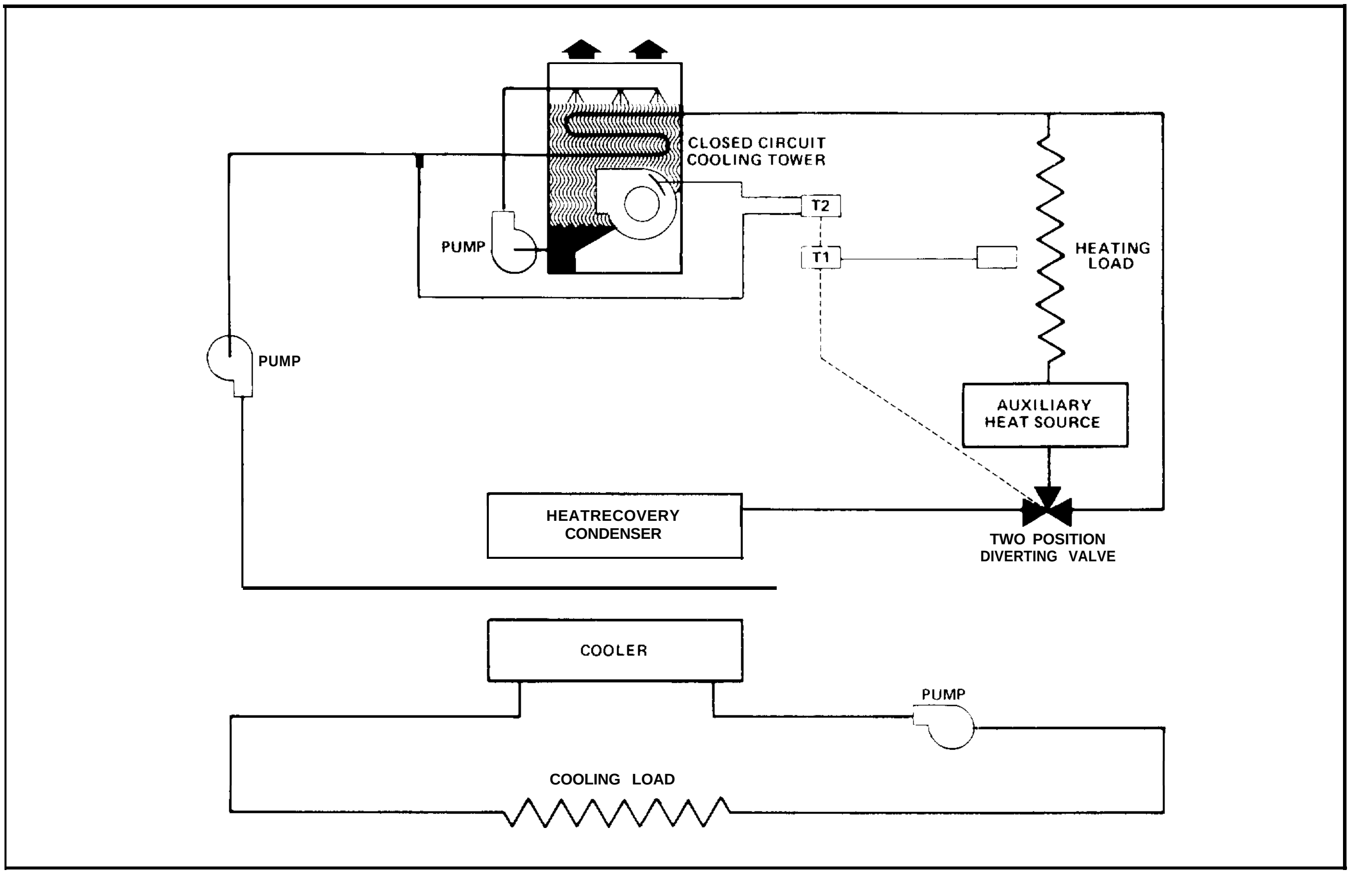
An auxiliary heat source is necessary if the available condenser heat is not sufficient to satisfy all of the heat load. The auxiliary heat source must be located between the condenser and the heat load and the control should be interlocked with the closed circuit tower to prevent auxiliary heating while rejecting heat to the ambient.

When the heating load is satisfied, a two-position, three-way valve is set to divert condenser water around the heat load and the auxiliary heat source. Whether operating in summer or winter, the chiller is always controlled by the cooling load and not the heating load.

TYPICAL OPERATION — On a call for cooling, the chiller starts and hot condenser water flows through the diverting valve to the closed circuit cooling tower rejecting heat to the outdoors. The tower dampers modulate to maintain a proper entering condenser water temperature which will give efficient operation by means of the proportional controller T2 located in the outlet fluid line of the tower.

When a heating load is sensed by mode switch T1, the three-way valve is switched to allow condenser water to flow through the heating circuit. The proportional controller T2 is also reset upwards to give the desired water temperature for heat recovery. The unused condenser heat will be rejected out through the closed circuit tower. If the condenser heat of rejection cannot satisfy the heating load after an appropriate delay, the auxiliary heat source will be activated.

Figure **11. Typical Single Condenser (Per Refrigerant Circuit) Heat Recovery**



NOTE: The schematic shows one refrigerant circuit. Models with two refrigerant circuits have two condensers

Dual condenser heat recovery chiller models have two water cooled condensers per refrigerant circuit. The upper condenser is the heat recovery condenser and is piped into the building's hot water system. The lower condenser is the tower condenser and is piped to an open cooling tower. Condensing is done in either the tower condenser or heat recovery condenser, or partial condensing is done in each. The tower and heat recovery water circuits are independent and do not intermix. This use of an open tower and the closed heat recovery loop prevents fouling of the building's heating system.

A subcooling circuit is provided in the tower condenser to provide optimum cooling efficiency. When the unit is operating on maximum heat recovery, the cooling tower will be modulated down to its minimum capacity, usually about 5% of full capacity. This provides subcooling for the system during heat recovery operation. Water can be heated up to 135°F in the heat recovery condensers to satisfy a heating load. If all of the condenser heat of rejection cannot be used, the remainder is rejected out through the cooling tower.

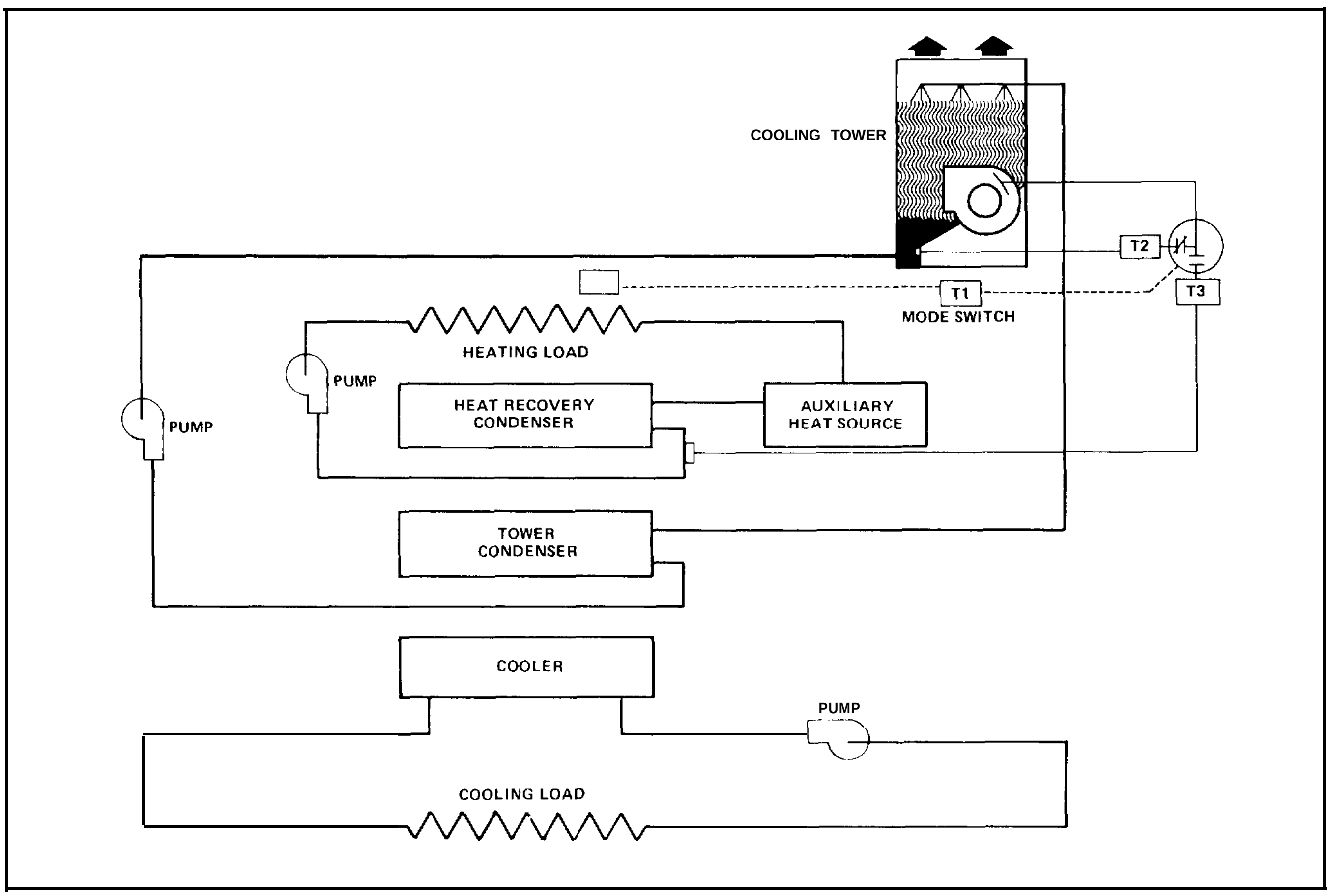
The cooling tower should be sized to reject all of the condenser heat during summer operation. Freeze protection for the cooling tower must be provided if it is to operate in below freezing temperatures, Adequate capacity control must be provided to maintain a constant water temperature leaving the cooling tower. Head pressure and water temperature are controlled by the tower capacity control. Fan cycling and modulating fan discharge dampers should be used. Consult the cooling tower manufacturer for information on specific applications.

If the available condenser heat cannot satisfy all of the heat load, an auxiliary heat source must be provided. The auxiliary heat source should be located between the heat recovery condenser and the heat load and interlocked with the cooling tower so that auxiliary heat is not being supplied unless the cooling tower is modulated down all the way. The chiller operation is always controlled by the building's cooling load and not the heating load.

TYPICAL OPERATION — On a call for cooling the chiller starts. If a heating load is sensed by mode switch T1, the heat recovery water pump P1 will start and the cooling tower dampers will modulate to control the heat recovery condenser by means of proportional temperature controller T3. If maximum heat recovery is required, the tower dampers close and the fans shut off. The tower will then provide only subcooling. If more heat is required than the heat recovery condensers can provide, the auxiliary heat source is activated.

When mode switch T1 senses that a heating load no longer exists, the heat recovery pump shuts off and the cooling tower modulates to control the entering tower condenser water temperature by means of proportional controller T2 and a sensor located in the tower sump. Proportional controller T2 is set at a temperature lower than T3 to provide optimum efficiency.

Figure **12. Typical Dual Condenser (Per Circuit) Heat Recovery**



NOTE: The schematic shows one refrigerant circuit. Heat recovery WHR models with two refrigerant circuits have two heat recovery condensers and two tower condensers.

REFRIGERANT PIPING

UNIT WITH REMOTE CONDENSER-ARRANGEMENT A

General — For remote condenser application such as an air cooled condenser, the chillers are shipped containing a Refrigerant 22 holding charge. It is important that the unit be kept tightly closed until the remote condenser is installed, piped to the unit and the high side evacuated.

Refrigerant piping, to and from the remote unit, should be sized and installed according to the latest ASHRAE Handbook. It is important that the piping be properly suported with sound and vibration isolation between tubing and hanger and that the discharge lines be looped at the condenser and trapped at the compressor to prevent refrigerant and oil from draining into the compressor discharge manifold. Looping the discharge line also provides greater line flexibility.

The discharge gas valve(s), liquid line solenoid(s), filter-drier(s), moisture indicator(s), and thermostatic expansion valve(s) are all provided as standard equipment with the SEASONPAK water chiller.

A liquid line shutoff valve must be added in the field on condenserless units (Arrangement A) between the liquid line filter-drier and remote condenser.

After the equipment is properly installed, the unit may be charged with Refrigerant 22, then run at design load conditions, adding charge until the liquid line sightglass is clear, with no bubbles flowing to the expansion valve. Total operating charge will depend on the air cooled condenser used and the length of external piping, but generally will be similar to the water cooled charge shown in Tables 16, 17, and 18, pages 21 through 23.

NOTE: On the Arrangement A units (units with remote condensers), the installer is required to record the refrigerant charge by stamping the total charge and the charge per circuit on the serial plate in the appropriate blocks provided for this purpose.

SEASONPAK water chillers without condensers require field piping to a remote condenser of some type. The design of refrigerant piping when using air cooled condensers involves a number of considerations not commonly associated with other types of condensing equipment. The following discussion is intended for use as a general guide to sound, economical and trouble-free piping of air cooled condensers.

Discharge lines must be designed to handle oil properly and to protect the compressor from damage that may result from condensing liquid refrigerant in the line during shutdown. Total friction loss for discharge lines of 3 to 6 psi is considered good design. Careful consideration must be given for sizing each section of piping to insure that gas velocities are sufficient at all operating conditions to carry oil. If the velocity in a vertical discharge riser is too low, considerable oil may collect in the riser and the horizontal header, causing the compressor to lose its oil and result in damage due to lack of lubrication. When the compressor load is increased, the oil that had collected during reduced loads may be carried as a slug through the system and back to the compressor, where a sudden increase of oil concentration may cause liquid slugging and damage to the compressor.

Any horizontal run of discharge piping should be pitched away from the compressor approximately ¼″ per foot or more. This is necessary to move by gravity any oil lying in the header. Oil pockets must be avoided as oil needed in the compressor would collect at such points and the compressor crankcase may become starved.

It is recommended that any discharge lines coming into a horizontal discharge header rise above the center line of the discharge header. This is necessary to prevent any oil or condensed liquid from draining to the top heads when the compressor is not running.

In designing liquid lines it is important that the liquid reach the expansion valve with no presence of flash gas since this gas will reduce the capacity of the valve. Because "flashing" can be caused by a pressure drop in the liquid lines, the pressure losses due to friction and changes in static head should be kept to a minimum.

A check valve must be installed in the liquid line in all applications where the ambient temperature can get below the equipment room temperature. This prevents liquid migration to the condenser, helps maintain a supply of refrigerant in the liquid line for initial startup and keeps liquid line pressure high enough on "off" cycle to keep the expansion valve closed.

On systems as described above, a relief valve or relief type check valve must be used in the liquid line as shown in piping systems (Figure 14) to relieve dangerous hydraulic pressures that could be created as cool liquid refrigerant in the line between the check valve and expansion or shutoff valve warms up. A relief device is also recommended in the hot gas piping at the condenser coil as shown in Figures 14 through 16.

Typical Arrangements — Figure 14 illustrates a typical piping arrangement involving a remote air cooled condenser located at a higher elevation than the compressor and receiver. This arrangement is commonly encountered when the air cooled condenser is on a roof and the compressor and receiver are on grade level or in a basement equipment room.

In this case, the design of the discharge line is very critical. If properly sized for full load condition, the gas velocity might be too low at reduced loads to carry oil up through the discharge line and condenser coil. Reducing the discharge line size would increase the gas velocity sufficiently at reduced load conditions; however, when operating at full load, the line might be greatly undersized and thereby create an excessive refrigerant pressure drop. If this condition occurs, it can be overcome in one of the two following ways:

1. The discharge line may be properly sized for the desired pressure drop at full load condition and an oil separator installed at the bottom of the trap on the discharge line from the compressor.
2. A double riser discharge line may be used as shown in Figure 15, page 15. Line 'A" should be sized to carry the oil at a minimum load condition and line "B" should be sized so that at the full load condition, both lines would carry oil properly.

Notice in all illustrations that the hot gas line is looped at the bottom and top of the vertical run. This is done to prevent oil and condensed refrigerant from flowing back into the compressor and causing damage. The highest point in the discharge line should always be above the highest point in the condenser coil; it is advisable to include a purging vent at this point to release noncondensables from the system.

Figure 16 illustrates another very common application where the air cooled condenser is located on essentially the same level as the compressor and receiver. The discharge line piping in this case is not too critical. The principal problem encountered with this arrangement is that there is frequently insufficient vertical distance to allow free drainage of liquid refrigerant from the condenser coil to the receiver.

UNIT WITH FACTORY MOUNTED CONDENSER(S)

Units with factory mounted condensers are provided with complete refrigerant piping and full operating refrigerant charge at the factory.

There is a remote possibility on Arrangement W units utilizing low temperature pond or river water as a condensing medium, and if the water valves leak, that the condenser and liquid line refrigerant temperature could get below the equipment room temperature on the off cycle. This could open the expansion valve and cause recycling pumpdown. This problem only arises during periods when cold water continues to circulate through the condenser and the unit remains off due to satisfied cooling load.

If this condition occurs:

1. Cycle the condenser pump off with the unit.
2. Check the liquid line solenoid valve for proper operation. If these valves are closing liquid tight as designed, no recycling of pumpdown should occur.

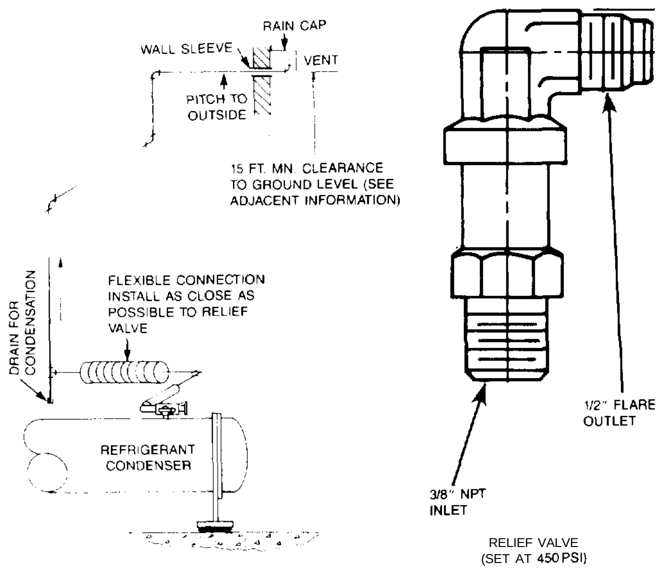
RELIEF VALVE PIPING

The ANSMASHRAE Standard 15-1978 specifies that pressure relief valves on vessels containing Group 1 refrigerants (R-12, R-22 and R-500) “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 **13. Relief Valve Piping**



REFRIGERANT PIPING

Figure 14. Condenser Above Compressor and Receiver

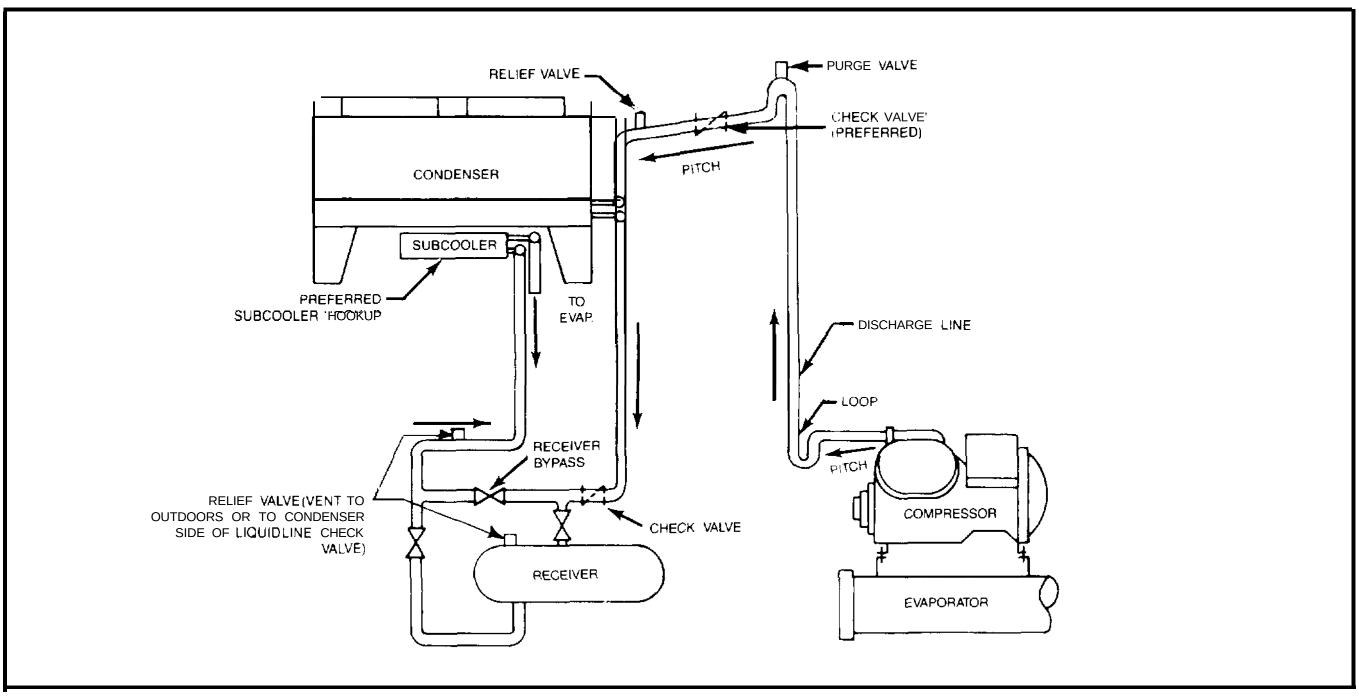


Figure 15. Condenser Above Compressor and Receiver. Receiver Isolated During Operation.

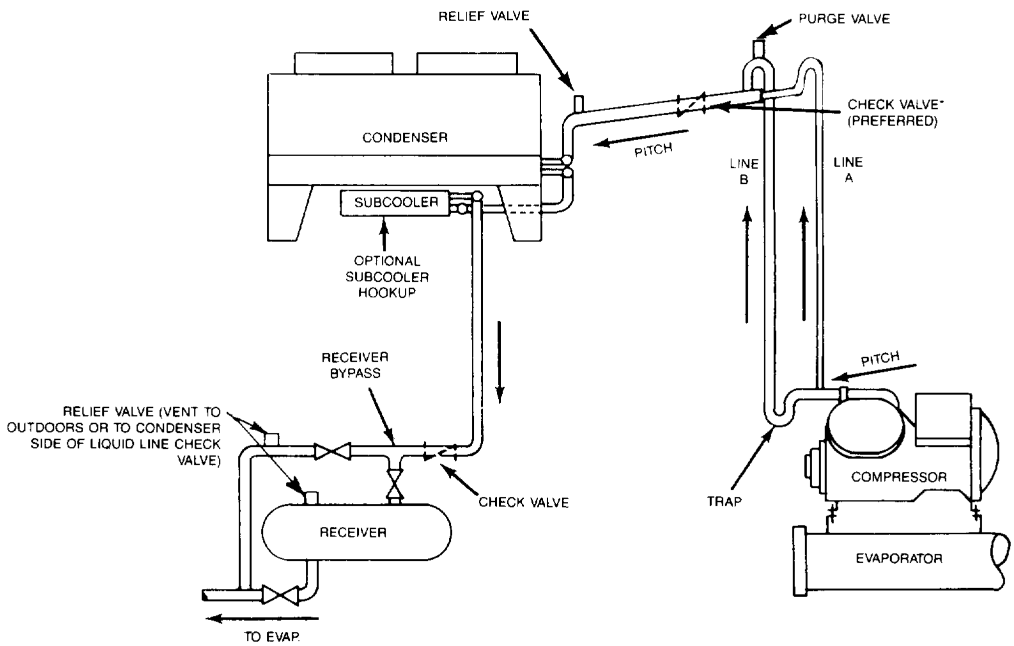
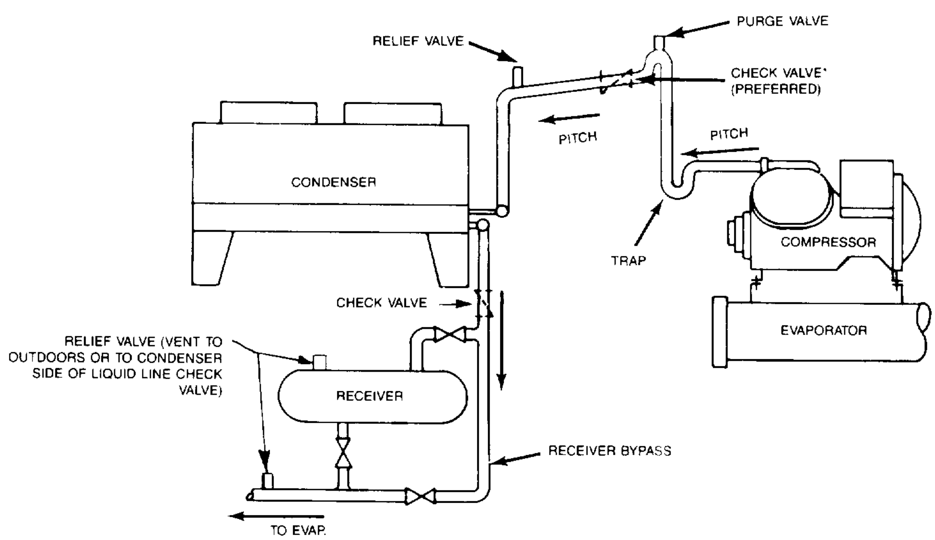


Figure 16. Condenser and Compressor On Same Level.



*Refer to ASHRAE Handbook.

DIMENSIONAL DATA

Figure 17. Arrangement W (With Water Cooled Condensers) — WHR-040DW thru 110DW

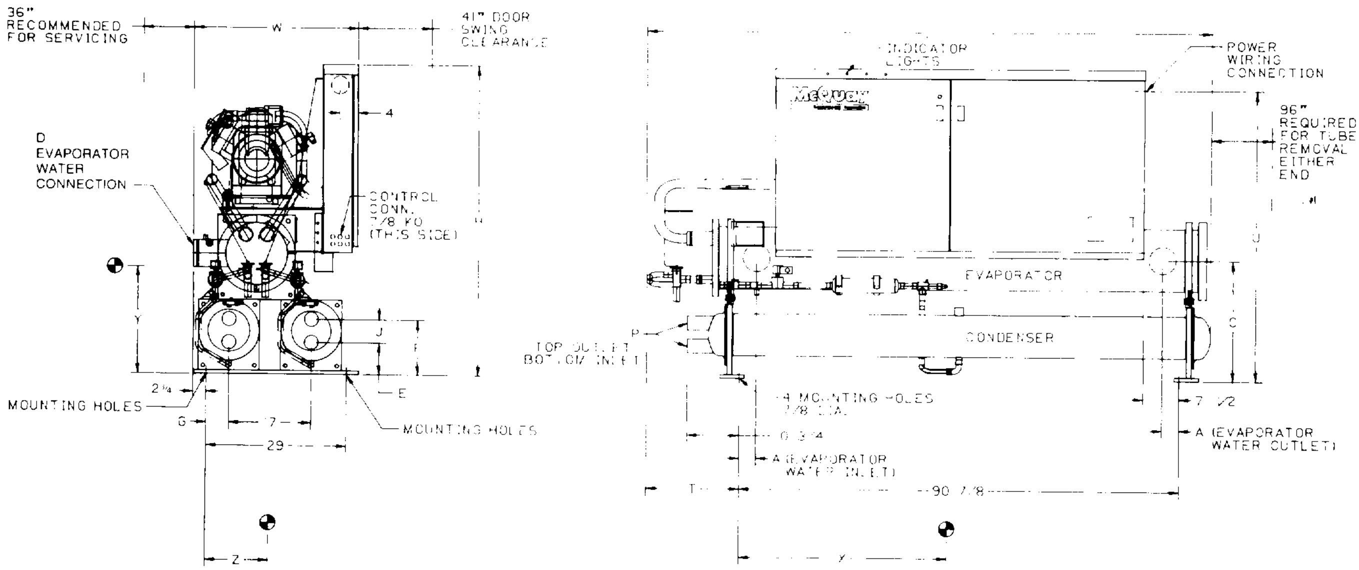


Table 7.

WHR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (NPT)					T	U	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P			X	Y	Z
040DW	116 7/8	34	62 1/4	2 3/4	23 3/8	4	6 5/8	11 3/8	4 3/4	4 3/4	2 1/2	19 5/8	58 1/8	42 5/8	23	13
050DW	116 7/8	34	62 1/4	2 3/4	23 3/8	4	6 5/8	11 3/8	4 3/4	4 3/4	2 1/2	19 5/8	58 1/8	42 5/8	23	13
060DW	116 7/8	34	63 3/4	3 1/2	24 7/8	5	6 5/8	11 3/8	4 3/4	4 3/4	2 1/2	19 5/8	59 5/8	43	25 1/8	12 3/4
070DW	116 7/8	34	63 3/4	3 1/2	24 7/8	5	6 5/8	11 3/8	4 3/4	4 3/4	2 1/2	19 5/8	59 5/8	43	25 1/8	12 3/4
080DW	116 7/8	34	63 3/4	3 1/2	24 7/8	5	6 5/8	11 3/8	4 3/4	4 3/4	2 1/2	19 5/8	59 5/8	43	25 1/8	12 3/4
090DW	115 3/4	34	65 5/8	3 1/2	26 1/2	5	7 1/2	13 1/8	5 3/4	5 5/8	3	18 1/2	61 1/2	43 1/2	27 5/8	13
100DW	115 3/4	34	66 1/4	5 1/2	27 1/8	6	7 1/2	13 1/8	5 3/4	5 5/8	3	18 1/2	62 1/8	43 7/8	28	12 5/8
110DW	115 3/4	34	66 1/4	5 1/2	27 1/8	6	7 1/2	13 1/8	5 3/4	5 5/8	3	18 1/2	62 1/8	43 3/4	28	12 5/8

Figure 18. Arrangement W (With Water Cooled Condensers) — WHR-120DW thru 200DW

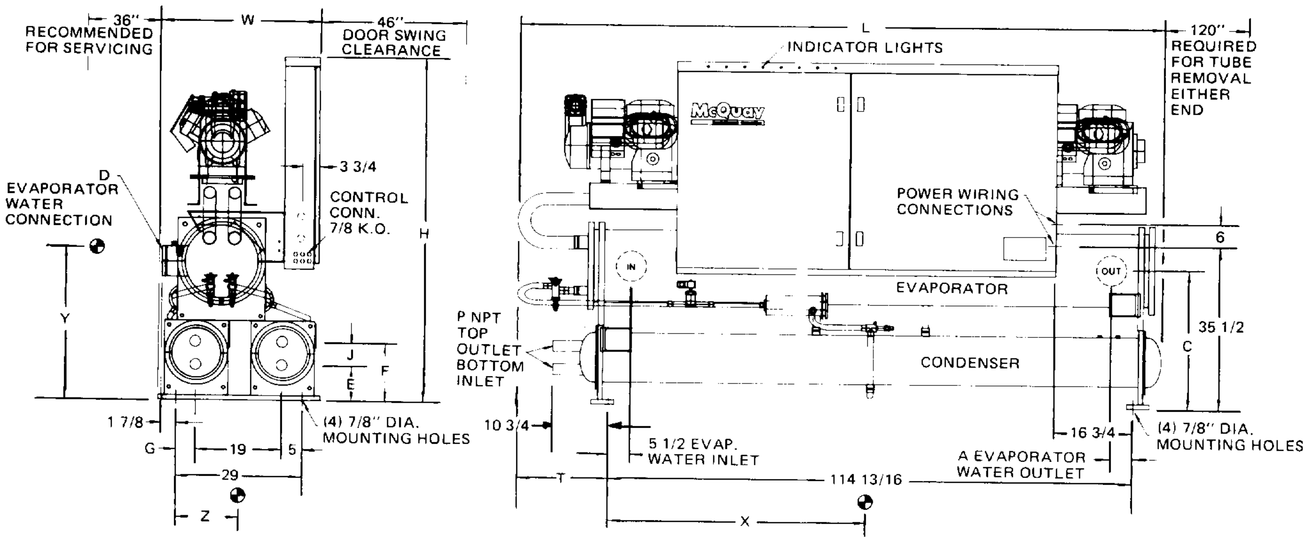


Table 8.

WHR MODEL NO.	MAXIMUM OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (NPT)					T	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P		X	Y	Z
120DW	142 3/4	34	77	5 1/2	30 1/4	6	7 7/8	13 1/16	5	5 5/8	3	20 5/8	55 1/4	32 5/8	13 5/8
130DW	142 3/4	34	77	5 1/2	30 1/4	6	7 7/8	13 1/16	5	5 5/8	3	20 5/8	55 7/8	32 5/8	13 1/2
140DW	142 3/4	34	77	5 1/2	30 1/4	6	7 7/8	13 1/16	5	5 5/8	3	20 5/8	56 1/8	32 7/8	13 1/2
150DW	142 3/4	34	77	5 1/2	30 1/4	6	7 7/8	13 1/16	5	5 5/8	3	20 5/8	56 5/8	32 7/8	13 1/2
160DW	142 3/4	34	77	5 1/2	30 1/4	6	7 7/8	13 1/16	5	5 5/8	3	20 5/8	56 1/2	33 1/4	13 3/8
170–200DW	142 3/4	34	77	5 1/2	30 1/4	6	7 7/8	13 1/16	5	5 5/8	3	20 5/8	56 1/4	33 1/2	13 3/8

Figure 19. Arrangement W (With Water Cooled Condensers) — WHR-210DW thru 240DW

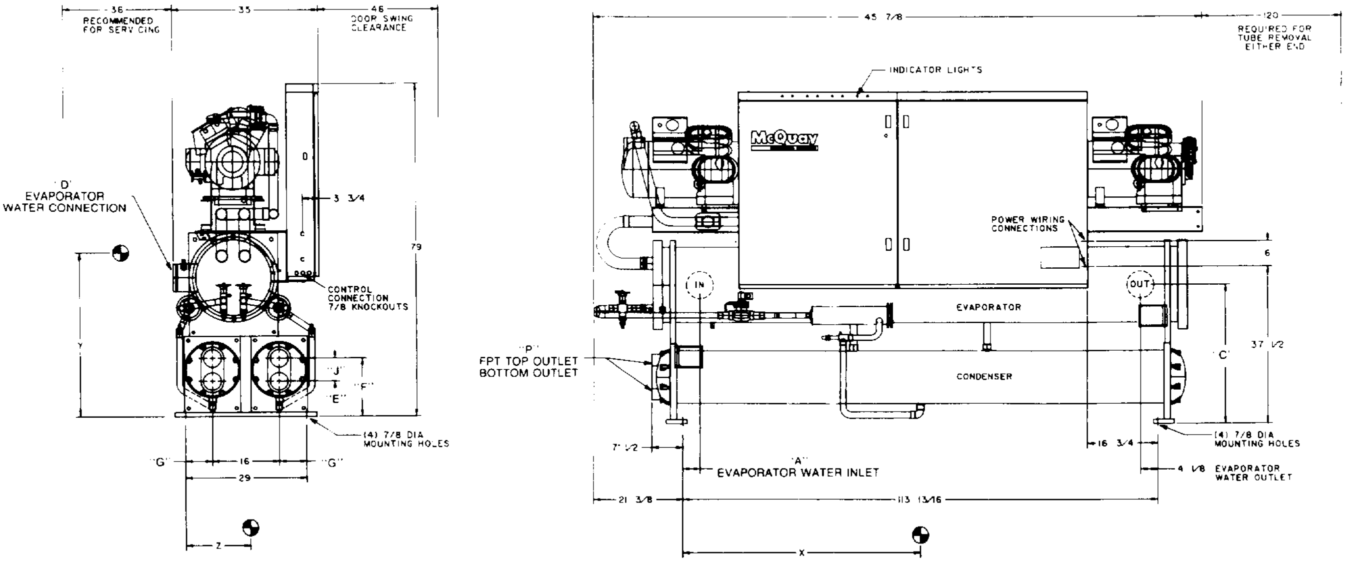


Table 9.

WHR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (NPT)					T	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P		X	Y	Z
210DW	145⅞	35	79	4⅛	33¼	6	8½	14	6½	5½	4	21⅜	55	36	13½
220DW	145⅞	35	79	4⅛	33¼	6	8½	14	6½	5½	4	21⅜	55	36	13½
230DW	145⅞	35	79	4⅛	33¼	6	8½	14	6½	5½	4	21⅜	55	36	13½
240DW	145⅞	35	79	4⅛	33¼	6	8½	14	6½	5½	4	21⅜	55	36	13½

Figure 20. Arrangement A (Without Water Cooled Condensers) — WHR-040DA thru 110DA

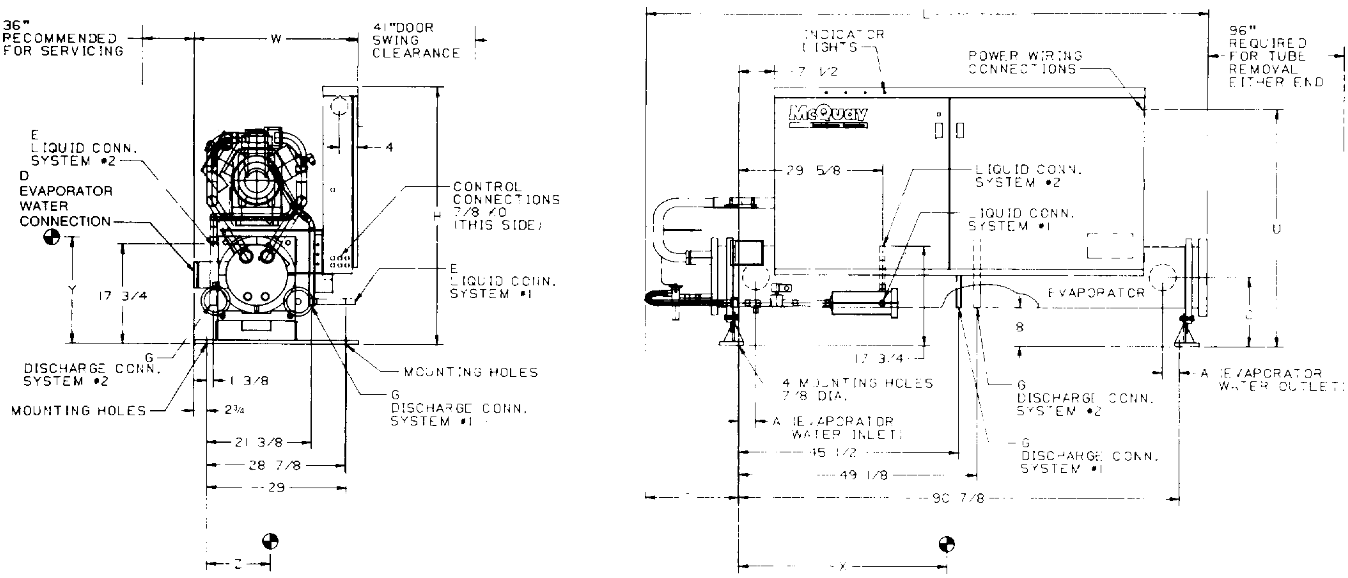


Table 10.

WHR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			REFRIG. CONN. LIQ.	REFRIG. CONN. DISCH.	T	U	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	G			X	Y	Z
040DA	115¾	34	52⅛	2¾	13¼	4	⅞ O.D.	1⅛ O.D.	10⅝	48	41¾	18⅞	14⅛
050DA	115¾	34	52⅛	2¾	13¼	4	⅞ O.D.	1⅛ O.D.	19⅝	48	41¾	18⅞	14⅛
060DA	115¾	34	53⅛	3½	14¼	5	⅞ O.D.	1⅜ O.D.	19⅝	49½	42	22⅛	13¾
070DA	115¾	34	53⅛	3½	14¼	5	⅞ O.D.	1⅜ O.D.	19⅝	49½	42	22⅛	13¾
080DA	115¾	34	53⅛	3½	14¼	5	1⅛ O.D.	1⅜ O.D.	19⅝	49½	42	22⅛	13¾
090DA	115¾	34	53⅜	3½	14¼	6	1⅛ O.D.	1⅝ O.D.	18½	49½	42¾	23⅜	13½
100DA	115¾	34	54	5½	14⅞	6	1⅛ O.D.	1⅝ O.D.	18½	50⅜	43⅜	22½	13¼
110DA	115¾	34	54	5½	14⅞	6	1⅛ O.D.	1⅝ O.D.	18½	50⅜	43⅛	22½	13¼

Figure 21. Arrangement A (Without Water Cooled Condensers) — WHR-120DA thru 200DA

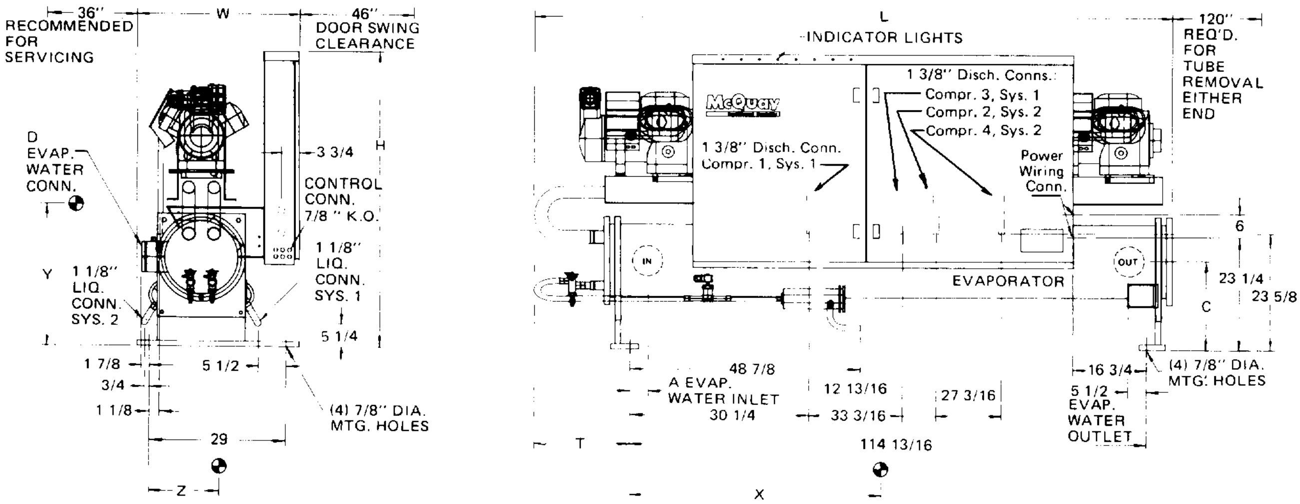


Table 11.

WHR MODEL NO.	MAXIMUM OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			T	CENTER OF GRAVITY		
	L	W	H	A	C	D		X	Y	Z
120DA	142¾	34	64¾	5½	18	6	20⅝	54½	28¾	13⅛
130DA	142¾	34	64¾	5½	18	6	20⅝	55⅜	29	13⅛
140DA	142¾	34	64¾	5½	18	6	20⅝	55⅜	29⅛	13
150DA	142¾	34	64¾	5½	18	6	20⅝	56¼	29¼	13
160DA	142¾	34	64¾	5½	18	6	20⅝	56⅛	29½	12⅞
170DA	142¾	34	64¾	5½	18	6	20⅝	55¾	29¾	12⅞
180DA — 200DA	142¾	34	64¾	5½	18	6	20⅝	55¾	30½	12⅞

Figure 22. Arrangement A (Without Water Cooled Condensers) — WHR-210DA thru 240DA

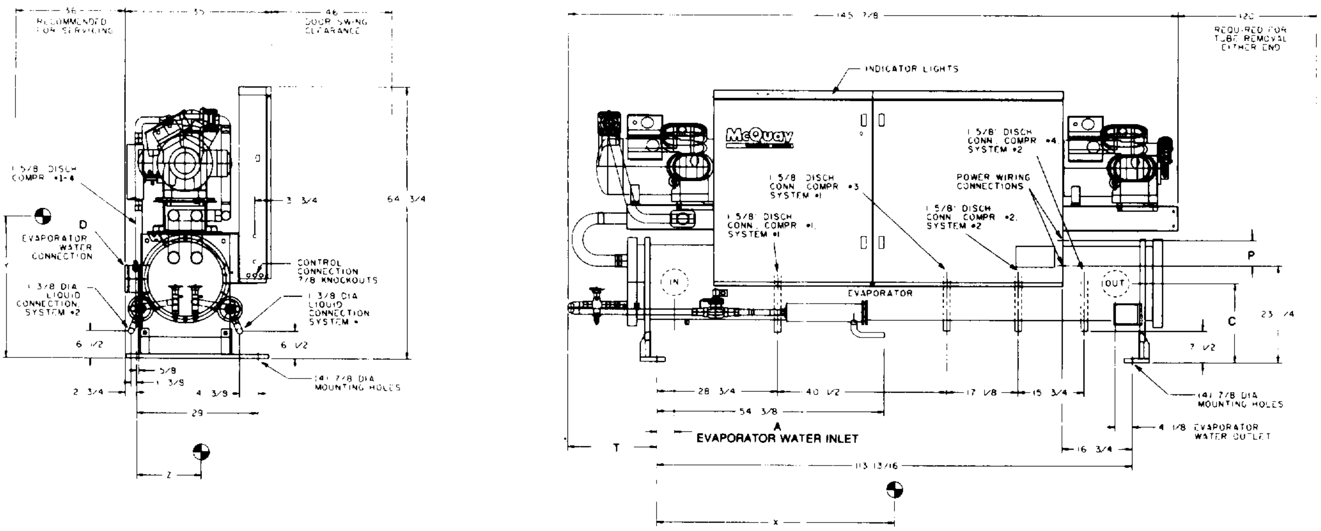


Table 12.

WHR MODEL NO.	MAXIMUM OVERAL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			P	T	CENTER OF GRAVITY		
	L	W	H	A	C	D			X	Y	Z
210DA — 220DA	145⅞	35	64¾	4⅛	19	6	6	21⅜	54	32½	16
230DA — 240DA	145⅞	35	64¾	4⅛	19	6	6	21⅜	54	32	16

Figure 23. Arrangement H (With Heat Recovery Condensers) — WHR-040DH thru 110DH

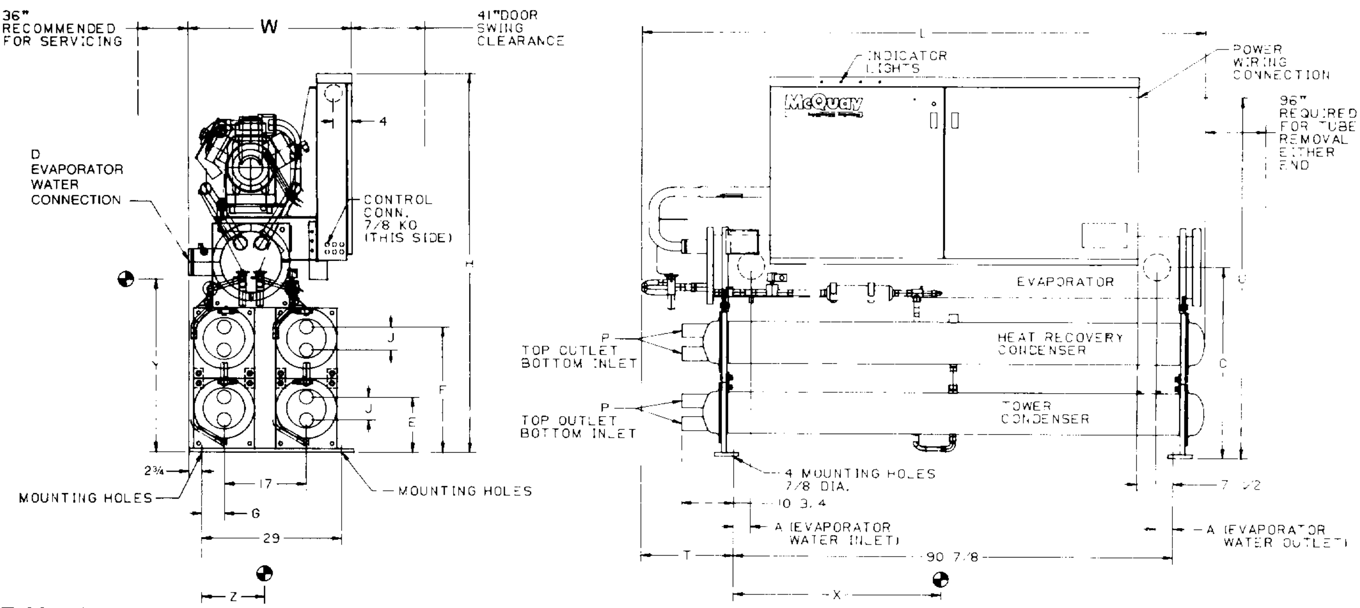


Table 13.

WHR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (NPT)					T	M	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P			X	Y	Z
040DH	116⅞	34	76	2¾	37⅛	4	11⅜	26	4¾	4¾	2½	19⅝	71⅞	43⅛	30½	13
050DH	116⅞	34	76	2¾	37⅛	4	11⅜	26	4¾	4¾	2½	19⅝	71⅞	43⅛	30½	13
060DH	116⅞	34	78¼	3½	39½	5	11⅜	26	4¾	4¾	2½	19⅝	74⅛	43⅜	33⅝	12⅞
070DH	116⅞	34	78¼	3½	39½	5	11⅜	26	4¾	4¾	2½	19⅝	74⅛	43⅜	33⅝	12⅞
080DH	116⅞	34	78¼	3½	39½	5	11⅜	26	4¾	4¾	2½	19⅝	74⅛	43⅜	33⅝	12⅞
090DH	115¾	34	81⅞	3½	42¾	5	13⅛	29⅜	6¼	5⅝	3	18½	77¾	43⅞	34¾	13¼
100DH	115¾	34	82½	5½	43⅜	6	13⅛	29⅜	6¼	5⅝	3	18½	78⅜	44⅛	35½	13
110DH	115¾	34	82½	5½	43⅜	6	13⅛	29⅜	6¼	5⅝	3	18½	78⅜	44	35½	13

Figure 24. Arrangement H (With Heat Recovery Condensers) — WHR-120DH thru 200DH

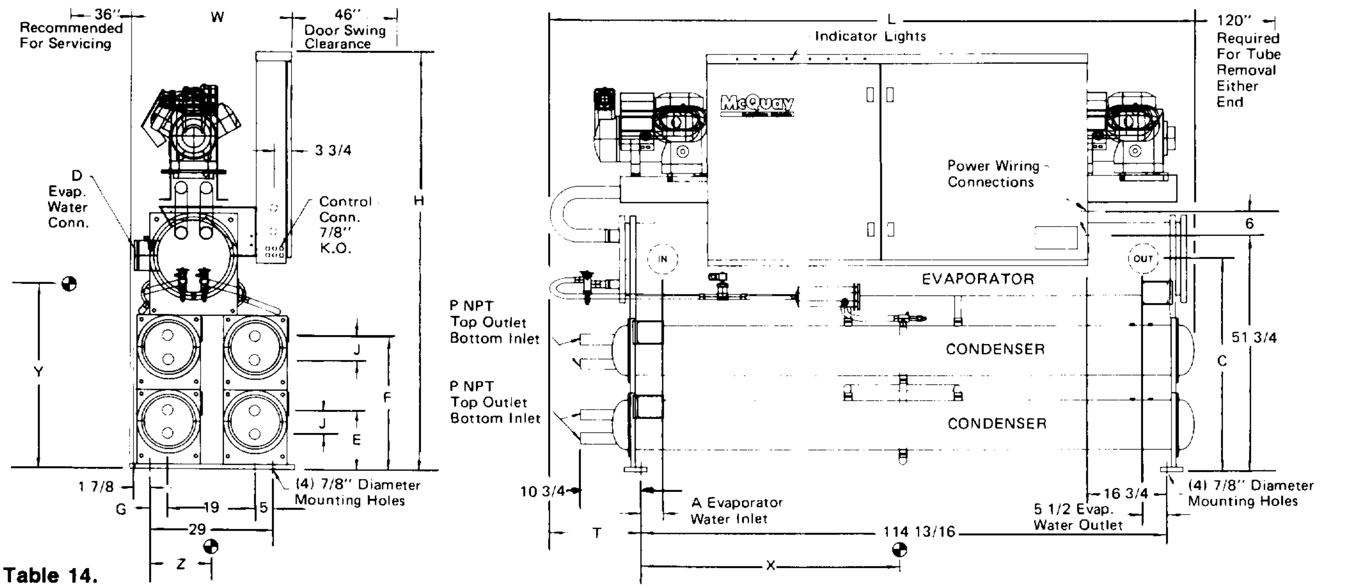


Table 14.

WHR MODEL NO.	MAX. OVERALL DIMENSIONS			COOLER & CONDENSER WATER CONNECTION LOCATION								T	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	G	J	F	P		X	Y	Z
120DH	142¾	34	93¼	5½	46½	6	13 1/16	5	5⅝	29 5/16	3	20⅝	55¾	40½	13¾
130DH	142¾	34	93¼	5½	46½	6	13 1/16	5	5⅝	29 5/16	3	20⅝	56¼	40½	13¾
140DH	142¾	34	93¼	5½	46½	6	13 1/16	5	5⅝	29 5/16	3	20⅝	56⅜	40¾	13¾
150DH	142¾	34	93¼	5½	46½	6	13 1/16	5	5⅝	29 5/16	3	20⅝	56¾	40¾	13⅝
160DH	142¾	34	93¼	5½	46½	6	13 1/16	5	5⅝	29 5/16	3	20⅝	56⅝	41¼	13⅝
170DH — 200DH	142¾	34	93¼	5½	46½	6	13 1/16	5	5⅝	29 5/16	3	20⅝	56½	41⅝	13⅝

Figure 25. Arrangement H (With Heat Recovery Condensers) — WHR-210DH thru 240DH

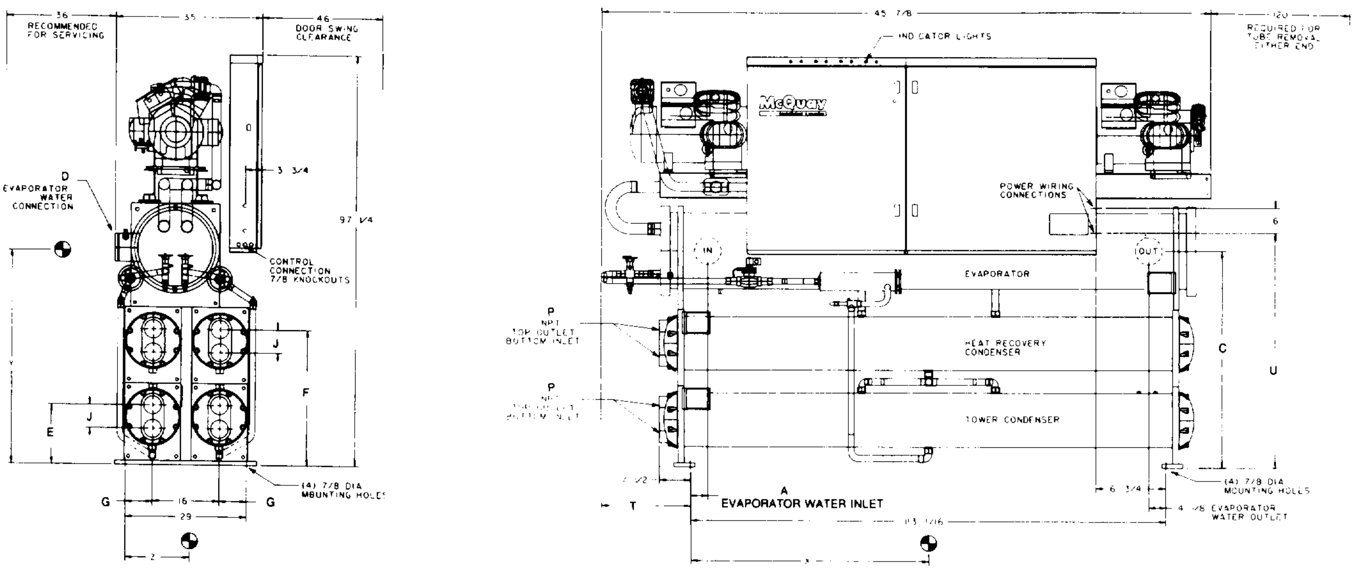


Table 15.

WHR MODEL NO.	MAX. OVERALL DIMENSIONS			EVAP. WATER CONN. (VICTAULIC)			CONDENSER WATER CONNECTIONS (NPT)					T	U	CENTER OF GRAVITY		
	L	W	H	A	C	D	E	F	G	J	P			X	Y	Z
210DH	145⅞	35	97¼	4⅛	51½	6	14	32¼	6½	5½	4	21⅜	55¾	55½	46	14
220DH	145⅞	35	97¼	4⅛	51½	6	14	32¼	6½	5½	4	21⅜	55¾	55½	46	14
230DH	145⅞	35	97¼	4⅛	51½	6	14	32¼	6½	5½	4	21⅜	55¾	55½	46	14
240DH	145⅞	35	97¼	4⅛	51½	6	14	32¼	6½	5½	4	21⅜	55¾	55½	46	14

PHYSICAL DATA

Table 16. WHR-040 thru 110D

WHR UNIT SIZE	040D		050D		060D		070D		080D		090D		100D		110D	
Nom. Cap. Tons (60 Hz) ①	42.7		49.8		61.4		71.4		83.2		94.6		102.5		110.8	
No. of Circuits	2		2		2		2		2		2		2		2	
Nom. Tons per Circuit (60 Hz)	19.1	23.6	24.9	24.9	28.3	33.1	35.7	35.7	41.6	41.6	47.3	47.3	48.6	53.9	55.4	55.4
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 Valve (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	
No. Water Passes	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Pump-Out Capacity ④	130	130	130	130	125	125	116	116	109	109	199	199	188	188	188	188
Connections:																
Water Inlet (NPT INT.)	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	3	3	3	3	3	3
Water Out (NPT INT.)	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	3	3	3	3	3	3
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	
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 (Vitaulic)	4		4		5		5		5		5		6		6	
Drain (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜		⅜		⅜	
Vent (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜		⅜		⅜	
DIMENSIONS — WITH CONDENSERS — OVERALL (W)																
Length (In.)	117		117		117		117		117		117		117		117	
Width (In.)	34		34		34		34		34		34		34		34	
Height (In.)	62¼		62¼		63¾		63¾		63¾		65⅝		66¼		66¼	
DIMENSIONS — LESS CONDENSERS (A)																
Length (In.)	115¾		115¾		115¾		115¾		115¾		115¾		115¾		115¾	
Width (In.)	34		34		34		34		34		34		34		34	
Height (In.)	52⅛		52⅛		53⅛		53⅛		53⅛		53⅜		54		54	
DIMENSIONS — HEAT RECOVERY (H)																
Length	116⅞		116⅞		116⅞		116⅞		116⅞		115¾		115¾		115¾	
Width	34		34		34		34		34		34		34		34	
Height	76		76		78¼		78¼		78¼		81⅞		82½		82½	
WEIGHTS — WITH CONDENSERS (W)																
Operating Weight	3580		3630		3920		3950		4165		4675		5215		5365	
Shipping Weight	3580		3660		3860		4010		4110		4590		5075		5225	
Operating Charge Lbs. R-22 ②⑤	40	40	45	45	50	50	55	55	60	60	65	65	70	70	75	75
WEIGHTS — LESS CONDENSERS (A)																
Operating Weight	2640		2660		2910		2930		3030		3270		3800		3865	
Shipping Weight	2715		2755		2920		2960		3075		3315		3790		3860	
Operating Charge Lbs. R-22 ③⑤	22	24	24	24	24	26	26	26	28	28	30	30	34	34	34	34
WEIGHTS — HEAT RECOVERY (H)																
Operating Weight	4495		4565		4885		5040		5235		6025		6555		6780	
Shipping Weight	4430		4225		4750		4885		5080		5810		6290		6500	
Operating Charge Lbs. R-22 ⑤	50	50	55	55	60	60	65	65	70	70	80	80	85	85	90	90

NOTES:

① According to ARI Standard 590 (44F leaving chilled water, 85F entering condenser water).
② Full operating charge.
③ Operating charge of unit. Remote condenser and field piping charge not shown.
④ 80% Full R-22 at 90F.
⑤ Per refrigerant circuit.

Table 17. WHR-120D thru 170D

WHR UNIT SIZE	120D		130D		140D		150D		160D		170D	
Nom. Cap. Tons (60 Hz) ①	117.2		128.4		136.4		147.9		157.5		166.5	
No. of Circuits	2		2		2		2		2		2	
Nom. Tons per Circuit (60 Hz)	55.8	55.8	56.8	64.5	65.0	65.0	68.3	72.6	75.0	75.0	79.3	79.3
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	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 Valve (In.)	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜	1⅜/1⅜	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	
Tube Length (In.)	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	
No. Water Passes	2		2		2		2		2		2	
Pump-Out Capacity ④	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 (NPT INT.)	3	3	3	3	3	3	3	3	3	3	3	3
Water Out (NPT INT.)	3	3	3	3	3	3	3	3	3	3	3	3
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	
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 (Vitaulic)	6		6		6		6		6		6	
Drain (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜	
Vent (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜	
DIMENSIONS — WITH CONDENSERS — OVERALL (W)												
Length (In.)	142¾		142¾		142¾		142¾		142¾		142¾	
Width (In.)	34		34		34		34		34		34	
Height (In.)	77		77		77		77		77		77	
DIMENSIONS — LESS CONDENSERS (A)												
Length (In.)	142¾		142¾		142¾		142¾		142¾		142¾	
Width (In.)	34		34		34		34		34		34	
Height (In.)	64¾		64¾		64¾		64¾		64¾		64¾	
DIMENSIONS — HEAT RECOVERY (H)												
Length	142¾		142¾		142¾		142¾		142¾		142¾	
Width	34		34		34		34		34		34	
Height	93¼		93¼		93¼		93¼		93¼		93¼	
WEIGHTS — WITH CONDENSERS (W)												
Operating Weight	6250		6405		6480		6820		7170		7280	
Shipping Weight	6060		6215		6290		6655		6870		6980	
Operating Charge Lbs. R-22 ⑤	90	90	95	95	95	95	100	100	100	100	105	105
WEIGHTS — LESS CONDENSERS (A)												
Operating Weight	4560		4630		4700		5105		5245		5345	
Shipping Weight	4520		4610		4780		4940		5145		5245	
Operating Charge Lbs. R-22 ③⑤	35	35	38	38	42	42	44	44	46	46	48	48
WEIGHTS — HEAT RECOVERY (H)												
Operating Weight	7875		8095		8170		8845		8990		9105	
Shipping Weight	7530		7735		7810		8280		8490		8605	
Operating Charge Lbs. R-22 ⑤	110	110	115	115	115	115	125	125	125	125	130	130

NOTES:

① According to ARI Standard 590 (44F leaving chilled water, 85F entering condenser water).
② Unit sizes 120 thru 170D have two compressors per circuit in parallel.
③ Operating charge of unit. Remote condenser and field piping charge not shown.
④ 80% Full R-22 at 90F.
⑤ Per refrigerant charge.

Table 18. WHR-175D thru 240D

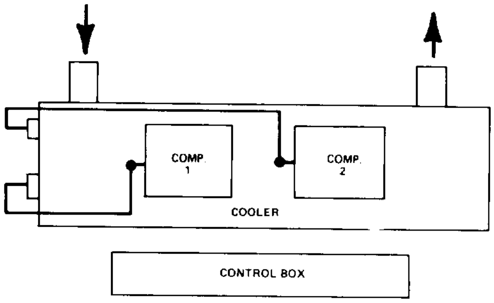
WHR UNIT SIZE	175D		180D		190D		200D		210D		220D		230D		240D	
Nom. Cap. Tons (60 Hz) ①	171.9		182.8		188.3		194.3		203.1		213.2		222.4		228.7	
No. of Circuits	2		2		2		2		2		2		2		2	
Nom. Tons per Circuit (60 Hz)	86.0	86.0	91.4	91.4	89.2	99.1	97.2	97.2	96.7	106.4	106.6	106.6	105.4	117.0	114.4	114.4
COMPRESSORS																
Nominal Horsepower	40/40	40/40	40/50	40/50	40/50	40/60	40/60	40/60	50/50	50/60	50/60	50/60	50/60	60/60	60/60	60/60
Number ②	2	2	2	2	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		1750/1450		1750/1450	
No. of Cylinders	6/6	6/6	6/8	6/8	6/8	6/8	6/8	6/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8
Oil Charge (Oz.)	242/242	242/242	242/260	242/260	242/260	242/260	242/260	242/260	260/260	260/260	260/260	260/260	260/260	260/260	260/260	260/260
Discharge Valve (In.)	1⅜	1⅜	1⅜	1⅝	1⅜	1⅝	1⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝
CONDENSERS																
Number	2		2		2		2		2		2		2		2	
Diameter (In.)	10¾		10¾		10¾		10¾		12¾		12¾		12¾		12¾	
Tube Length (In.)	120		120		120		120		120		120		120		120	
Design W.P. (PSIG):																
Refrigerant Side	450		450		450		450		450		450		450		450	
Water Side	250		250		250		250		250		250		250		250	
No. Water Passes	2		2		2		2		2		2		2		2	
Pump-Out Capacity ④ ⑤	205	205	190	190	190	190	190	190	287	287	270	270	253	253	253	253
Connections:																
Water Inlet (NPT INT.)	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4
Water Out (NPT INT.)	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4
Relief Flare	⅝		⅝		⅝		⅝		⅝		⅝		⅝		⅝	
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	
EVAPORATOR																
No. Refrigerant Circuits	2		2		2		2		2		2		2		2	
Diameter (In.)	16		16		16		16		18		18		18		18	
Tube Length (In.)	120		120		120		120		120		120		120		120	
Water Volume (Gallons)	45.1		45.1		45.1		45.1		67.5		63.2		57.3		57.3	
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 (Vitaulic)	6		6		6		6		6		6		6		6	
Drain (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜		⅜		⅜	
Vent (NPT INT.)	⅜		⅜		⅜		⅜		⅜		⅜		⅜		⅜	
DIMENSIONS — WITH CONDENSERS — OVERALL (W)																
Length (In.)	142		142		142		142		145⅞		145⅞		145⅞		145⅞	
Width (In.)	34¼		34¼		34¼		34¼		35		35		35		35	
Height (In.)	77		77		77		77		79		79		79		79	
DIMENSIONS — LESS CONDENSERS (A)																
Length (In.)	142		142		142		142		145⅞		145⅞		145⅞		145⅞	
Width (In.)	34		34		34		34		35		35		35		35	
Height (In.)	64¾		64¾		64¾		64¾		64¾		64¾		64¾		64¾	
DIMENSIONS — HEAT RECOVERY (H)																
Length	142		142		142		142		145⅞		145⅞		145⅞		145⅞	
Width	34		34		34		34		35		35		35		35	
Height	93¼		93¼		93¼		93¼		97¼		97¼		97¼		97¼	
WEIGHTS — WITH CONDENSERS (W)																
Operating Weight	7300		7800		7850		7850		9150		9200		9300		9300	
Shipping Weight	6980		7450		7450		7450		8730		8800		8900		8900	
Operating Charge Lbs. R-22 ⑤	105	105	110	110	110	110	110	110	130	130	140	140	150	150	150	150
WEIGHTS — LESS CONDENSERS (A)																
Operating Weight	5400		5800		5800		5800		6750		6820		6900		6900	
Shipping Weight	5300		5680		5680		5680		6640		6700		6760		6760	
Operating Charge Lbs. R-22 ③⑤	48	48	48	48	48	48	48	48	55	55	58	58	61	61	61	61
WEIGHTS — HEAT RECOVERY (H)																
Operating Weight	9200		9940		9940		9940		11500		11700		11900		11900	
Shipping Weight	8950		9500		9500		9500		10900		11000		11000		11000	
Operating Charge Lbs. R-22 ⑤	130	130	135	135	135	135	135	135	170	170	180	180	190	190	190	190

NOTES:

① According to ARI Standard 590 (44F leaving chilled water, 85F entering condenser water).
② Full operating charge.
③ Operating charge of unit. Remote condenser and field piping charge not shown.
④ 80% Full R-22 at 90F.
⑤ Per refrigerant circuit.

Figure 26. Compressor Locations

UNITS 040D thru 110D



UNITS 120D thru 240D

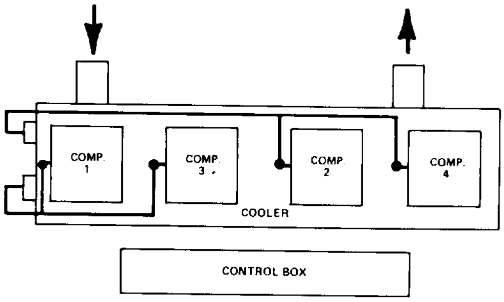


Table 19. Contactor Designation

MODEL	CONTACTOR DESIGNATION FOR COMPRESSOR			
	1	2	3	4
WHR-040D WHR-050D	M1—M5 M1—M5	M2—M6 M2—M6	— —	— —
WHR-060D WHR-070D	M1—M5 M1—M5	M2—M6 M2—M6	— —	— —
WHR-080D WHR-090D	M1—M5 M1—M5	M2—M6 M2—M6	— —	— —
WHR-100D WHR-110D	M1—M5 M1—M5	M2—M6 M2—M6	— —	— —
WHR-120D WHR-130D	M1—M5 M1—M5	M2—M6 M2—M6	M3—M7 M3—M7	M4—M8 M4—M8
WHR-140D WHR-150D	M1—M5 M1—M5	M2—M6 M2—M6	M3—M7 M3—M7	M4—M8 M4—M8
WHR-160D WHR-170D	M1—M5 M1—M5	M2—M6 M2—M6	M3—M7 M3—M7	M4—M8 M4—M8
WHR-175D WHR-180D	M1—M5 M1—M5	M2—M6 M2—M6	M3—M7 M3—M7	M4—M8 M4—M8
WHR-190D WHR-200D	M1—M5 M1—M5	M2—M6 M2—M6	M3—M7 M3—M7	M4—M8 M4—M8
WHR-210D WHR-220D	M1—M5 M1—M5	M2—M6 M2—M6	M3—M7 M3—M7	M4—M8 M4—M8
WHR-230D WHR-240D	M1—M5 M1—M5	M2—M6 M2—M6	M3—M7 M3—M7	M4—M8 M4—M8

Table 20. Major Components

UNIT SIZE	SYSTEM #1		SYSTEM #2		EVAPOR.	COND. (2X)	EXPANSION VALVE	
	COMP. NO. 1	COMP. NO. 3	COMP. NO. 2	COMP. NO. 4	VESSEL SIZE	VESSEL SIZE	SYSTEM NO. 1	SYSTEM NO. 2
WHR-040D WHR-050D	4D-20 hp 4D-25 hp	— —	4D-25 hp 4D-25 hp	— —	1008-2 1008-1	808-G 808-F	OVE-20 OVE-20	OVE-20 OVE-20
WHR-060D WHR-070D	4D-30 hp 6D-35 hp	— —	6D-35 hp 6D-35 hp	— —	1208-3 1208-2	808-E 808-D	OVE-30 OVE-30	OVE-30 OVE-30
WHR-080D WHR-090D	6D-40 hp 8D-50 hp	— —	6D-40 hp 8D-50 hp	— —	1208-1 1208-1	808-C 1008-E	OVE-40 OVE-55	OVE-40 OVE-55
WHR-100D WHR-110D	8D-50 hp 8D-60 hp	— —	8D-60 hp 8D-60 hp	— —	1408-2 1408-1	1008-E 1008-D	OVE-55 OVE-55	OVE-55 OVE-55
WHR-120D WHR-130D	6D-35 hp 6D-35 hp	4D-25 hp 4D-25 hp	6D-35 hp 6D-35 hp	4D-25 hp 6D-35 hp	1410-2 1410-1	1010-D 1010-C	OVE-55 OVE-55	OVE-55 OVE-70
WHR-140D WHR-150D	6D-35 hp 6D-35 hp	6D-35 hp 6D-35 hp	6D-35 hp 6D-35 hp	6D-35 hp 6D-40 hp	1410-1 1610-3	1010-C 1010-B	OVE-70 OVE-70	OVE-70 OVE-70
WHR-160D WHR-170D	6D-35 hp 6D-40 hp	6D-40 hp 6D-40 hp	6D-35 hp 6D-40 hp	6D-40 hp 6D-40 hp	1610-1 1610-1	1010-B 1010-B	OVE-70 Y-OVE-100	OVE-70 Y-OVE-100
WHR-175D WHR-180D	6D-40 hp 6D-40 hp	6D-40 hp 8D-50 hp	6D-40 hp 6D-40 hp	6D-40 hp 8D-50 hp	1610-1 1610-1	1010-A 1010-Z	Y-OVE-100 Y-OVE-100	Y-OVE-100 Y-OVE-100
WHR-190D WHR-200D	6D-40 hp 6D-40 hp	8D-50 hp 8D-60 hp	6D-40 hp 6D-40 hp	8D-60 hp 8D-60 hp	1610-1 1610-1	1010-Z 1010-Z	Y-OVE-100 KVE-100	Y-OVE-100 KVE-100
WHR-210D WHR-220D	8D-50 hp 8D-50 hp	8D-50 hp 8D-60 hp	8D-50 hp 8D-50 hp	8D-50 hp 8D-60 hp	1810-3 1810-2	1210-C 1210-B	KVE-100 KVE-100	KVE-100 KVE-100
WHR-230D WHR-240D	8D-50 hp 8D-60 hp	8D-60 hp 8D-60 hp	8D-60 hp 8D-60 hp	8D-60 hp 8D-60 hp	1810-1 1810-1	1210-A 1210-A	KVE-100 KVE-100	KVE-100 KVE-100

NOTES:

1. All units have two independent refrigerant systems.
2. Compressors 1 and 3 used on System 1 of 4-compressor WHR-120D thru 240D units. Compressors 2 and 4 used on System 2 of 4-compressor WHR-120D thru 240D units.
3. Compressors 3 and 4 of 4-compressor units do not use unloaders unless capacity control steps are optional 10 steps.
4. Two identical condensers are used. Data shown is for each condenser.
   Condenser Tubing: 1010 Vessels = Turbo-C low pressure drop type (WHR-175—200D)
   1210 Vessels = Turbo-C low pressure drop type (WHR-210—240D)
   808 Vessels = Turbo-C low pressure drop type (WHR-040—080D)
   1008 Vessels = Turbo-C low pressure drop type (WHR-090—110D)
   1010 Vessels = Turbo-C (plain I.D.) (WHR-120—170D)
5. Y-OVE-100 is special OVE valve with approximately 100 ton rating.

ELECTRICAL DATA

Table 21. Compressor motor amp draw

UNIT SIZE	3 PH, 60 HZ ① INPUT POWER VOLTAGE	RATED LOAD AMPS ②				LOCKED ROTOR AMPS ③			
		w/o Supplemen'l Overloads For WHR-DW, DA or DH		w/ Supplemen'l Overloads For WHR-DW ONLY		Across-The-Line Start		Part Winding Start	
		Circuit 1	Circuit 2	Circuit 1	Circuit 2	Circuit 1	Circuit 2	Circuit 1	Circuit 2
040D	208	63	77	52	70	308	428	188	250
	230	63	77	50	67	308	428	188	250
	460 ④	32	42	25	34	154	214	84	117
	575	26	31	21	28	135	172	81	103
050D	208	77	77	70	70	428	428	250	250
	230	77	77	67	67	428	428	250	250
	460 ④	42	42	34	34	214	214	117	117
	575	31	31	28	28	172	172	103	103
060D	208	106	113	89	108	470	565	292	340
	230	106	113	85	103	470	565	292	340
	460 ④	53	61	43	52	235	283	141	156
	575	39	45	34	42	200	230	130	138
070D	208	113	113	108	108	565	565	340	340
	230	113	113	103	103	565	565	340	340
	460 ④	61	61	52	52	283	283	156	156
	575	45	45	42	42	230	230	138	138
080D	208	153	153	136	136	660	660	400	400
	230	129	129	124	124	594	594	340	340
	460 ④	65	65	62	62	297	297	170	170
	575	52	52	50	50	235	235	135	135
090D	208	162	162	158	158	1070	1070	654	654
	230	162	162	150	150	1070	1070	654	654
	460 ④	82	82	76	76	535	535	330	330
	575	60	60	58	58	405	405	262	262
100D	208	162	202	158	199	1070	1070	654	654
	230	162	202	150	190	1070	1070	654	654
	460 ④	82	101	76	95	535	535	330	330
	575	60	72	58	70	405	405	262	262
110D	208	202	202	199	199	1070	1070	654	654
	230	202	202	190	190	1070	1070	654	654
	460 ④	101	101	95	95	535	535	330	330
	575	72	72	70	70	405	405	262	262
120D	208	113, 77	113, 77	108, 70	108, 70	565, 428	565, 428	340, 250	340, 250
	230	113, 77	113, 77	103, 67	103, 67	565, 428	565, 428	340, 250	340, 250
	460 ④	61, 42	61, 42	52, 34	52, 34	283, 214	283, 214	156, 117	156, 117
	575	45, 31	45, 31	42, 28	42, 28	230, 172	230, 172	138, 103	138, 103
130D	208	113, 77	113, 113	108, 70	108, 108	565, 428	565, 428	340, 250	340, 250
	230	113, 77	113, 113	103, 67	103, 103	565, 428	565, 428	340, 250	340, 250
	460 ④	61, 42	61, 61	52, 34	52, 52	283, 214	283, 214	156, 117	156, 117
	575	45, 31	45, 45	42, 28	42, 42	230, 172	230, 172	138, 103	138, 103
140D	208	113, 113	113, 113	108, 108	108, 108	565, 565	565, 565	340, 340	340, 340
	230	113, 113	113, 113	103, 103	103, 103	565, 565	565, 565	340, 340	340, 340
	460 ④	61, 61	61, 61	52, 52	52, 52	283, 283	283, 283	156, 156	156, 156
	575	45, 45	45, 45	42, 42	42, 42	230, 230	230, 230	138, 138	138, 138
150D	208	113, 113	113, 153	108, 108	108, 136	565, 565	565, 660	340, 340	340, 400
	230	113, 113	113, 153	103, 103	103, 124	565, 565	565, 660	340, 340	340, 400
	460 ④	61, 61	61, 65	52, 52	52, 62	283, 283	283, 297	156, 156	156, 170
	575	45, 45	45, 52	42, 42	42, 50	230, 230	230, 235	138, 138	138, 135
160D	208	113, 153	113, 153	108, 136	108, 136	565, 660	565, 660	340, 400	340, 400
	230	113, 129	113, 129	103, 124	103, 124	565, 594	565, 594	340, 340	340, 340
	460 ④	61, 65	61, 65	52, 62	52, 62	283, 297	283, 297	156, 170	156, 170
	575	45, 52	45, 52	45, 52	45, 52	230, 235	230, 235	138, 135	138, 135
170D	208	153, 153	153, 153	136, 136	136, 136	660, 660	660, 660	400, 400	400, 400
	230	129, 129	129, 129	124, 124	124, 124	594, 594	594, 594	340, 340	340, 340
	460 ④	65, 65	65, 65	62, 62	62, 62	297, 297	297, 297	170, 170	170, 170
	575	52, 52	52, 52	50, 50	50, 50	235, 235	235, 235	135, 135	135, 135

NOTES:

① ALLOWABLE VOLTAGE LIMITS:
Unit Nameplate 208V/60Hz/3Ph: 187V to 253V (except WHR-080D, WHR-150D — 200D: 180V to 220V).
Unit Nameplate 230V/60Hz/3Ph: 187V to 253V (except WHR-080D, WHR-150D — 200D: 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 Data also applies to 380V/50Hz/3Ph units.

Table 21. (Continued) Compressor motor amp draw

UNIT SIZE	3 PH, 60 HZ ① INPUT POWER VOLTAGE	RATED LOAD AMPS ②				LOCKED ROTOR AMPS ③			
		w/o Supplemen'l Overloads		w/ Supplemen'l Overloads		Across-The-Line Start		Part Winding Start	
		For WHR-DW, DA or DH		For WHR-DW ONLY					
		Circuit 1	Circuit 2	Circuit 1	Circuit 2	Circuit 1	Circuit 2	Circuit 1	Circuit 2
175D	208	153, 153	153, 153	136, 136	136, 136	660, 660	660, 660	400, 400	400, 400
	230	129, 129	129, 129	124, 124	124, 124	594, 594	594, 594	340, 340	340, 340
	460 ④	65, 65	65, 65	62, 62	62, 62	297, 297	297, 297	170, 170	170, 170
	575	52, 52	52, 52	50, 50	50, 50	235, 235	235, 235	135, 135	135, 135
180D	208	153, 162	153, 162	136, 158	136, 158	660, 1070	660, 1070	400, 654	400, 654
	230	129, 162	129, 162	124, 146	124, 146	594, 1070	594, 1070	340, 654	340, 654
	460 ④	65, 82	65, 82	62, 73	62, 73	297, 510	297, 510	170, 330	170, 330
	575	52, 68	52, 68	50, 58	50, 58	235, 405	235, 405	135, 262	135, 262
190D	208	153, 162	153, 202	136, 158	136, 194	660, 1070	660, 1070	400, 654	400, 654
	230	129, 162	129, 202	124, 146	124, 176	594, 1070	594, 1070	340, 654	340, 654
	460 ④	65, 82	65, 93	62, 73	62, 88	297, 510	297, 510	170, 330	170, 300
	575	52, 68	52, 72	50, 58	50, 70	235, 405	235, 405	135, 262	135, 262
200D	208	153, 202	153, 202	136, 194	136, 194	660, 1070	660, 1070	400, 654	400, 654
	230	129, 202	129, 202	124, 176	124, 176	594, 1070	594, 1070	340, 654	340, 654
	460 ④	65, 93	65, 93	62, 88	62, 88	297, 510	297, 510	170, 330	170, 330
	575	52, 72	52, 72	50, 70	50, 70	235, 405	235, 405	135, 262	135, 262
210D	208	162, 162	162, 202	158, 158	158, 194	1070, 1070	1070, 1070	654, 654	654, 654
	230	162, 162	162, 202	146, 146	146, 176	1070, 1070	1070, 1070	654, 654	654, 654
	460 ④	82, 82	82, 93	73, 73	73, 88	510, 510	510, 510	330, 330	330, 330
	575	68, 68	68, 72	58, 58	58, 70	405, 405	405, 405	262, 262	262, 262
220D	208	162, 202	162, 202	158, 194	158, 194	1070, 1070	1070, 1070	654, 654	654, 654
	230	162, 202	162, 202	146, 176	146, 176	1070, 1070	1070, 1070	654, 654	654, 654
	460 ④	82, 93	82, 93	73, 88	73, 88	510, 510	510, 510	330, 330	330, 330
	575	68, 72	68, 72	58, 70	58, 70	405, 405	405, 405	262, 262	262, 262
230D	208	162, 202	202, 202	158, 194	194, 194	1070, 1070	1070, 1070	654, 654	654, 654
	230	162, 202	202, 202	146, 176	176, 176	1070, 1070	1070, 1070	654, 654	654, 654
	460 ④	82, 93	93, 93	88, 88	88, 88	510, 510	510, 510	330, 330	330, 330
	575	68, 72	72, 72	58, 70	70, 70	405, 405	405, 405	262, 262	262, 262
240D	208	202, 202	202, 202	194, 194	194, 194	1070, 1070	1070, 1070	654, 654	654, 654
	230	202, 202	202, 202	194, 194	194, 194	1070, 1070	1070, 1070	654, 654	654, 654
	460 ④	93, 93	93, 93	88, 88	88, 88	510, 510	510, 510	330, 330	330, 330
	575	72, 72	72, 72	70, 70	70, 70	405, 405	405, 405	262, 262	262, 262

NOTES:

① ALLOWABLE VOLTAGE LIMITS:
Unit Nameplate 208V/60Hz/3Ph: 187V to 253V (except WHR-080D, WHR-150D—200D: 180V to 220V).
Unit Nameplate 230V/60Hz/3Ph: 187V to 253V (except WHR-080D, WHR-150D—200D: 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 Data also applies to 380V/50Hz/3Ph units.

Table 22. Wire sizing amps

Unit Size	3Ph, 60 Hz ① Input Power Voltage	Wire Sizing Amps w/o Supplemen'l Overloads ① ⑤ For Use With WHR-DW, DA or DH			Wire Sizing Amps w/ Supplemen'l Overloads ① ⑤ For Use With WHR-DW Only		
		Single Point Power Supply ②	Multiple Point Power Supply ③		Single Point Power Supply ②	Multiple Point Power Supply ③	
			Circuit 1	Circuit 2		Circuit 1	Circuit 2
040D	208	159	79	96	140	65	88
	230	159	79	96	134	63	84
	460 ④	85	40	53	68	31	43
	575	65	33	39	56	26	35
050D	208	173	96	96	158	88	88
	230	173	96	96	151	84	84
	460 ④	95	53	53	77	43	43
	575	70	39	39	63	35	35
060D	208	247	133	141	224	111	135
	230	247	133	141	214	106	129
	460 ④	129	66	76	108	54	65
	575	95	49	56	87	43	53
070D	208	254	141	141	243	135	135
	230	254	141	141	232	129	129
	460 ④	137	76	76	117	65	65
	575	101	56	56	95	53	53
080D	208	344	191	191	306	170	170
	230	290	161	161	279	155	155
	460 ④	146	81	81	140	78	78
	575	117	65	65	113	63	63
090D	208	365	203	203	356	198	198
	230	365	203	203	338	188	188
	460 ④	185	103	103	171	95	95
	575	135	75	75	131	73	73
100D	208	415	203	253	407	198	249
	230	415	203	253	388	188	238
	460 ④	208	103	126	195	95	119
	575	150	75	90	146	73	88
110D	208	455	253	253	448	249	249
	230	455	253	253	428	238	238
	460 ④	227	126	126	214	119	119
	575	162	90	90	158	88	88
120D	208	408	218	218	383	205	205
	230	408	218	218	366	196	196
	460 ④	221	118	118	185	99	99
	575	163	87	87	151	81	81
130D	208	444	218	254	421	205	243
	230	444	218	254	402	196	232
	460 ④	240	118	137	203	99	117
	575	177	87	101	165	81	95
140D	208	480	254	254	459	243	243
	230	480	254	254	438	232	232
	460 ④	259	137	137	221	117	117
	575	191	101	101	179	95	95
150D	208	530	254	304	494	243	278
	230	500	254	274	464	232	258
	460 ④	264	137	142	234	117	130
	575	300	101	110	189	95	105
160D	208	570	304	304	522	278	278
	230	516	274	274	485	258	258
	460 ④	268	142	142	244	130	130
	575	207	110	110	197	105	105

NOTES:

① 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 9 amps.
② Single point power supply requires a single fused disconnect to supply electrical power to the unit.
③ Multiple point power supply requires three independent power circuits with separate fused disconnects. (Two compressor circuits, one control circuit.)
④ Data also applies to 380V/50Hz/3Ph units.
⑤ Supplemental overloads can be used in conjunction with standard inherent overload protection on water cooled type "W" units only.

Table 22. (Continued) Wire sizing amps

Unit Size	3Ph, 60 Hz ① Input Power Voltage	Wire Sizing Amps w/o Supplemen'l Overloads ① ⑤ For Use With WHR-DW, DA or DH			Wire Sizing Amps w/ Supplemen'l Overloads ① ⑤ For Use With WHR-DW Only		
		Single Point Power Supply ②	Multiple Point Power Supply ③		Single Point Power Supply ②	Multiple Point Power Supply ③	
			Circuit 1	Circuit 2		Circuit 1	Circuit 2
170D	208	650	344	344	578	306	306
	230	548	290	290	527	279	279
	460 ④	276	146	146	264	140	140
	575	221	117	117	213	113	113
175D	208	655	344	344	583	306	306
	230	553	290	290	531	279	279
	460 ④	278	146	146	266	140	140
	575	223	117	117	214	113	113
180D	208	676	356	356	633	334	334
	230	628	332	332	582	307	307
	460 ④	318	168	168	291	153	153
	575	259	137	137	232	123	123
190D	208	726	356	406	678	334	379
	230	718	382	382	649	344	344
	460 ④	343	181	181	325	172	172
	575	268	142	142	250	138	138
200D	208	766	406	406	714	379	379
	230	718	382	382	649	344	344
	460 ④	343	181	181	325	172	172
	575	268	142	142	250	138	138
210D	208	744	365	415	722	356	401
	230	744	365	415	663	329	366
	460 ④	365	185	198	332	164	183
	575	296	153	158	264	131	146
220D	208	784	415	415	758	401	401
	230	784	415	415	693	366	366
	460 ④	376	198	198	347	183	183
	575	300	158	158	276	146	146
230D	208	824	415	455	794	401	437
	230	824	415	455	723	366	396
	460 ④	387	198	209	362	183	198
	575	304	158	162	288	146	158
240D	208	864	455	455	830	437	437
	230	864	455	455	753	396	396
	460 ④	398	209	209	377	198	198
	575	308	162	162	300	158	158

NOTES:

① 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 11 amps.
② Single point power supply requires a single fused disconnect to supply electrical power to the unit.
③ Multiple point power supply requires three independent power circuits with separate fused disconnects. (Two compressor circuits, one control circuit.)
④ Data also applies to 380V/50Hz/3Ph units.
⑤ Supplemental overloads can be used in conjunction with standard inherent overload protection on water cooled type "W" units only.

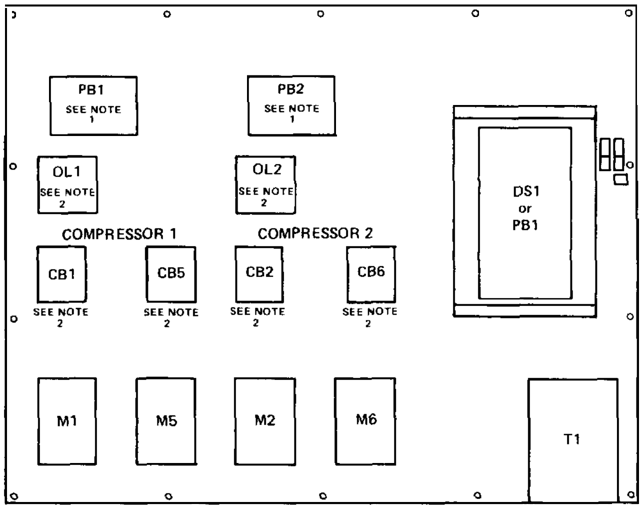
CONTROL CENTER

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.

Please refer to IM 493 for control section layout, all low voltage field wiring and normal sequence of operation for units equipped with MicroTech control.

POWER PANEL LAYOUT

Figure 27. WHR-040D **thru 110D**
Right Side, High Voltage Control Section



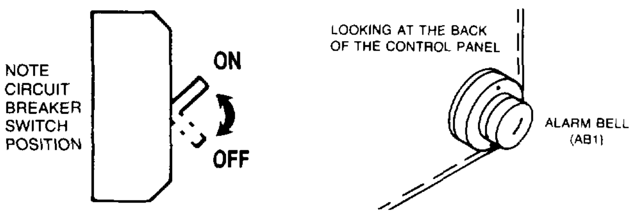
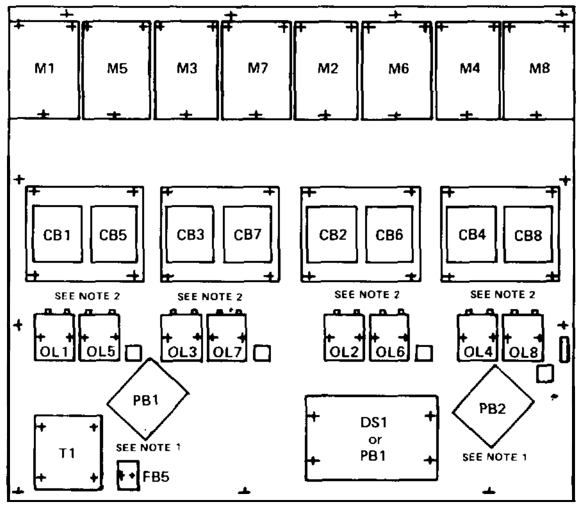


Figure 28. WHR-120D thru 240D
Right Side, High Voltage Power Section



NOTES:
1. PB1 and PB2 are used with multiple point power wiring.
2. Circuit breakers and overloads are provided as an option. The power panel could contain one, both, or neither of these options.

WIRING

FIELD WIRING, POWER

The WHR "D" vintage chillers are built standard with compressor contactors and power terminal block, designed for single power supply to unit. Optional power connections include a nonfused 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.

On water cooled units only, optional compressor overloads are available, allowing reduced unit ampacity ratings and smaller field wiring.

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 240D.

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 top of the control box (right side) through a patch plate 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.

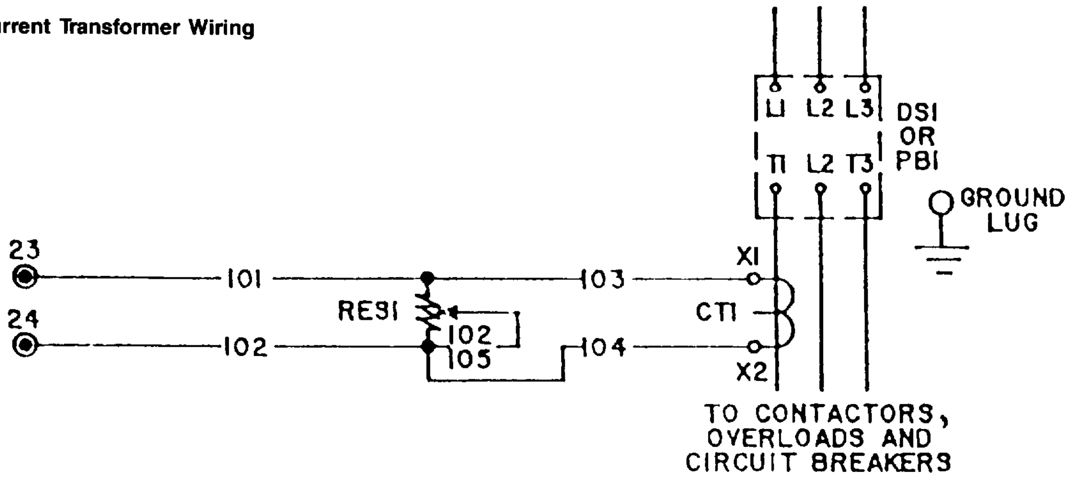
TYPICAL CONTROL AND SAFETY WIRING DIAGRAMS

Refer to IM 493 for typical control and safety wiring or actual unit wiring diagrams.

CURRENT TRANSFORMER

The typical power wiring diagrams shown on pages 19 thru 35 include the current transformer (CT1) wiring shown in Figure 29. CT1 provides a **O-4** vdc signal to the MicroTech panel which is then converted to XXX% RLA.

Figure 29. Current Transformer Wiring



ELECTRICAL LEGEND

DESIGNATION	DESCRIPTON	STD. LOCATION
AB	ALARM BELL	BACK OR SIDE OF CTRL BOX
ADI	ANALOG/DIGITAL INPUT BOARD	CTRL BOX, CTRL PANEL
C11, C21	CAPACITORS FOR SPEEDTROL MOTORS	BACK OF CONTROL BOX OR ON BULKHEAD
CB	CIRCUIT BREAKER (MICROTECH)	CTRL BOX, CTRL PANEL
CB1—8	CIRCUIT BREAKER (POWER)	CTRL BOX, POWER PANEL
CHWI	CHILLED WATER INTERLOCK	FIELD INSTALLED
COMPR.1-4	COMPRESSORS 1 THRU 4	BASE OF UNIT
CT1	CURRENT TRANSFORMER	CTRL BOX, POWER PANEL
CTR1—CTR4	COUNTER COMPRESSOR, TOTAL HOURS	CTRL BOX, SWITCH PANEL
DS1	DISCONNECT SWITCH, MAIN	CTRL BOX, POWER PANEL
F1	FUSE, CONTROL CIRCUIT	CTRL BOX, CTRL PANEL
F2	FUSE, EVAPORATOR HEATER	CTRL BOX, SWITCH PANEL
FB5	FUSEBLOCK, CONTROL POWER	CTRL BOX, POWER PANEL
GFP	GROUND FAULT PROTECTOR	CTRL BOX, POWER PANEL
GRD, GND	GROUND	CONTROL BOX
HM1—HM4	HOUR-METER, COMPRESSOR	CTRL BOX, SWITCH PANEL
HTR1—HTR4	COMPRESSOR HEATER, CRANKCASE	ON COMPRESSORS
HTR5	HEATER, EVAPORATOR	WRAPPED AROUND EVAP.
J1—J13, JJ1, JJ2	JUMPERS (LEAD)	CTRL BOX, CTRL PANEL
JB5	JUNCTION BOX FOR EVAP. HEATER	NEAR EVAP. ON BASE RAIL
JB6	JUNCTION BOX FOR HEAT RECOVERY	UNDERSIDE OF COIL ON IN-TERMEDIATE TUBE SHEET
KEYPAD	KEYPAD SWITCH & DISPLAY	CTRL BOX, KEYPAD PANEL
M1—M8	CONTACTORS, COMPRESSOR	CTRL BOX, POWER PANEL
M11—M27	CONTACTORS, FAN MOTORS	CTRL BOX, POWER PANEL
M250	MODEL 250P COMM. BOARD	CTRL BOX, CTRL PANEL
MHP1—MHP4	MECHANICAL HIGH PRESSURE SWITCH	ON COMPRESSOR
MHPR1—MHPR4	MECH. HIGH PRESSURE SWITCH RELAY	CTRL BOX, CTRL PANEL
MJ	MECHANICAL JUMPERS	CTRL BOX, CTRL PANEL
MODEM	MODEM, MICROTECH	CTRL BOX, CTRL PANEL
MPR1—MPR4	MOTOR PROTECT RELAY	CTRL BOX, CTRL PANEL
MTR11—MTR27	MOTORS, CONDENSER FANS	CONDENSER SECTION

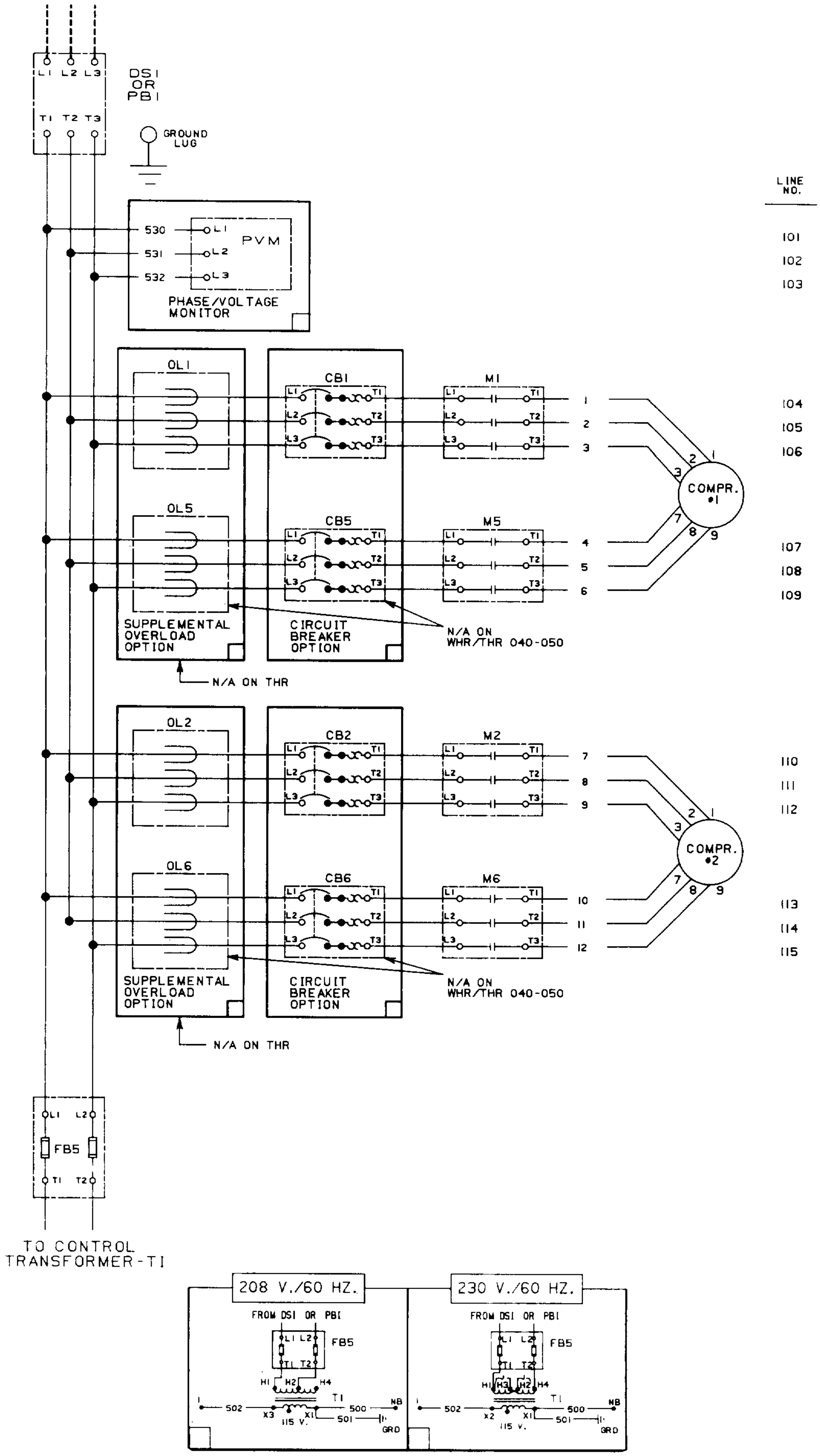
DESIGNATION	DESCRIPTION	STD. LOCATION
MP1—MP4	MOTOR PROTECTORS, COMPRESSOR	ON COMPRESSOR
NB	NEUTRAL BLOCK	CTRL BOX, CTRL PANEL
OB	OUTPUT BOARD, MICROTECH	CTRL BOX, CTRL PANEL
NSB	NIGHT SETBACK	CONTROL BOX
OL1—OL8	OVERLOAD	CTRL BOX, POWER PANEL
OP1—OP4	OIL PRESSURE SWITCH	CTRL BOX, CTRL PANEL
PB1—PB3	POWER BLOCK, MAIN	CTRL BOX, POWER PANEL
PS1, PS2	PUMPDOWN SWITCH, CKT. 1, CKT 2	CTRL BOX, KEYPAD PANEL
PVM	PHASE VOLTAGE MONITOR	CTRL BOX, CTRL PANEL
RES1	RESISTOR, CURRENT TRANSFORMER	CTRL BOX, POWER PANEL
R9—R12	RELAYS, STARTING	CTRL BOX, CTRL PANEL
R19	HEAT RECOVERY RELAY	CTRL BOX, CTRL PANEL
S1	SWITCH, SYSTEM	CTRL BOX, KEYPAD PANEL
S5	SWITCH, HEAT RECOVERY	CTRL BOX, SWITCH PANEL
SC11, SC12	SPEED CONTROLS	BACK OF CTRL BOX OR ON BULKHEAD
SIG. CONV	SIGNAL CONVERTER	CTRL BOX, CTRL PANEL
SV1, SV2	SOLENOID VALVE, LIQUID LINE	ON LIQUID LINES
SV5, SV6	SOLENOID VALVE, HOT GAS BYPASS	ON LINE TO HOT GAS VALVE
SV10, SV20	SOLENOID VALVE, WATER COND. (N.O.)	CONDENSER SECTION
SV11, SV21	SOLENOID VALVE, AIR COND. (N.C.)	CONDENSER SECTION
T1	TRANSFORMER, MAIN CONTROL	CTRL BOX, POWER PANEL
T2	TRANSFORMER, 120/24V CONTROL	CTRL BOX, CTRL PANEL
T3	TRANSFORMER, FAN SPEEDTROL	ON BULKHEAD
T4	TRANSFORMER, 24/18V CONTROL	CTRL BOX, CTRL PANEL
TB2	TERMINAL BLOCK, 120V FIELD	CTRL BOX, CTRL PANEL
TB3	TERMINAL BLOCK, 24V FIELD	CTRL BOX, CTRL PANEL
TB4—TB8	TERMINAL BLOCK, CONTROL	CTRL BOX, CTRL PANEL
TB7	TERMINAL BLOCK, LESS THAN 24V	CTRL BOX, CTRL PANEL
TC2	THERMOSTAT, EVAPORATOR	ON EVAPORATOR
TD5—TD8	TIME DELAY, COMPRESSOR PART WINDING	CTRL BOX, CTRL PANEL
TD17—TD19	TIME DELAY, HEAT RECOVERY	CTRL BOX, CTRL PANEL
U1, U2	UNLOADER	ON COMPRESSORS

GENERAL NOTES

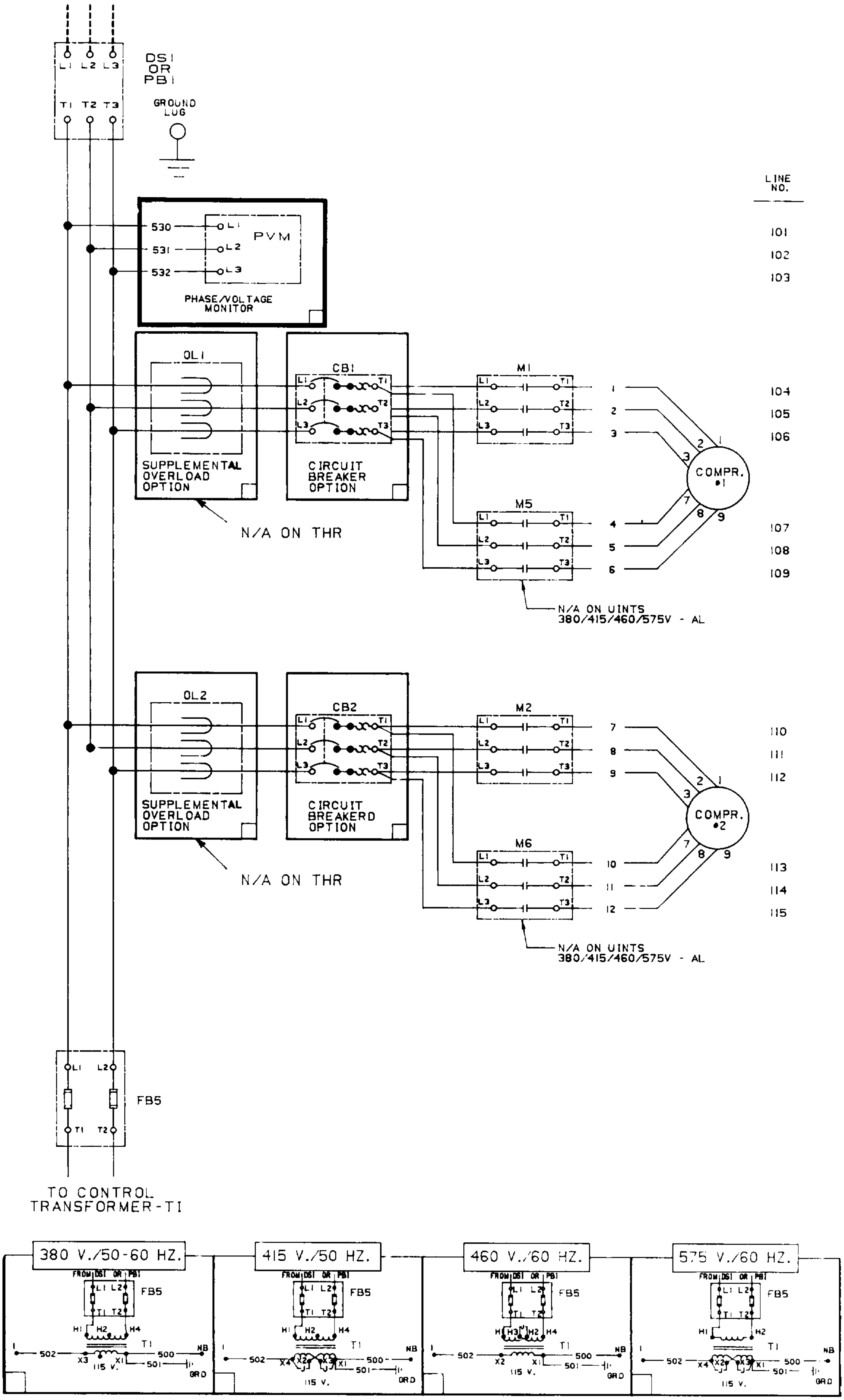
1. — — — — FIELD WIRING
2. ——— - - ——— WIRING IN REMOTE UNIT
3. ——— - ——— - - WIRING CONNECTING UNITS
4. — 200 — WIRE NUMBER
5. OPTION BLOCK
6. ——○—— FACTORY WIRED TERMINAL
7. ——◎—— FIELD WIRED TERMINAL
8. ——◉—— REMOTE PANEL TERMINAL
9. WIRE CONNECTOR
10. ——<<—— PLUG CONNECTOR
11. 289* OPTIONAL LINE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

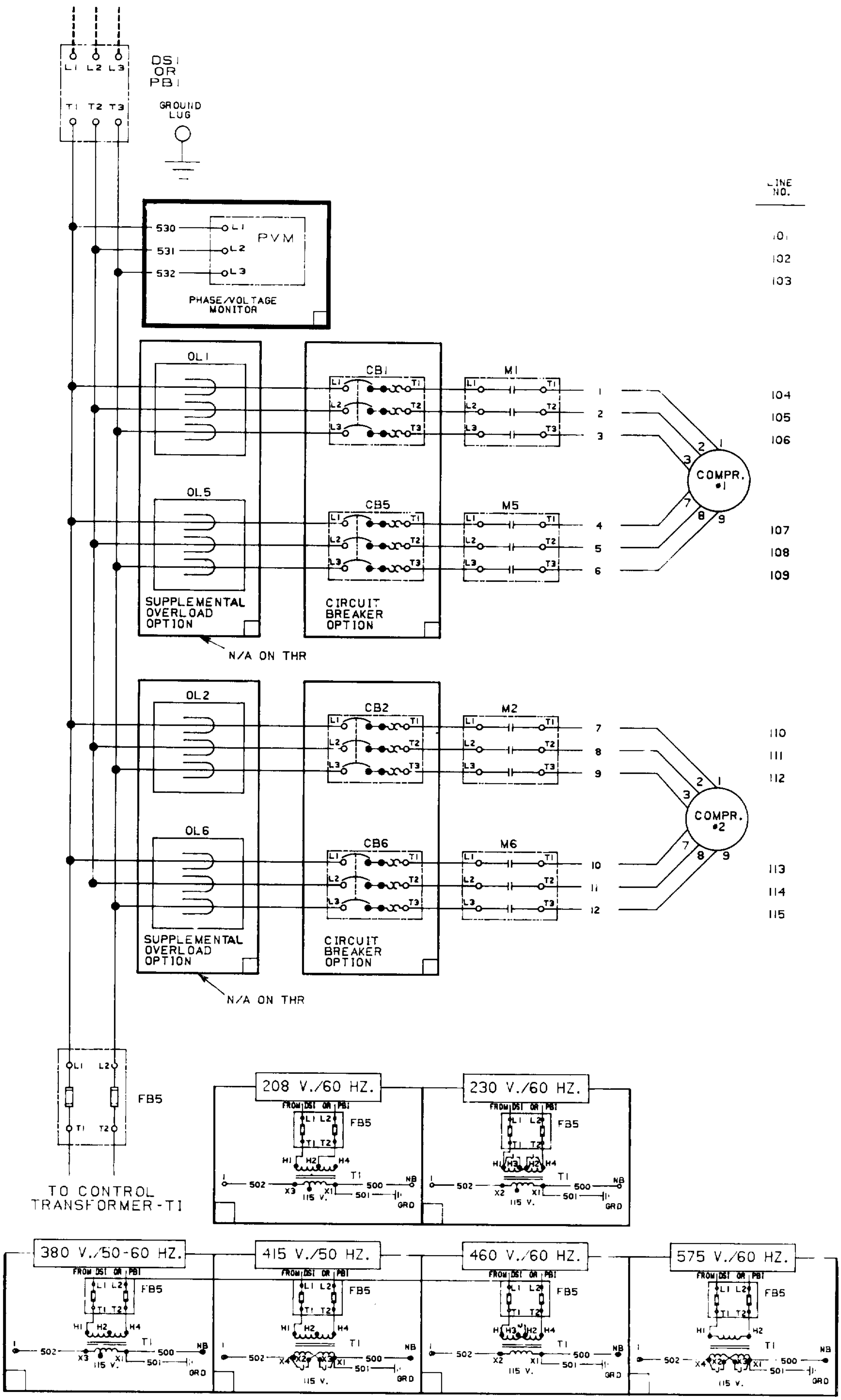
TYPICAL POWER WIRING DIAGRAMS

WHR 040D THRU 080D — SINGLE POINT 208/230V — AL, PW

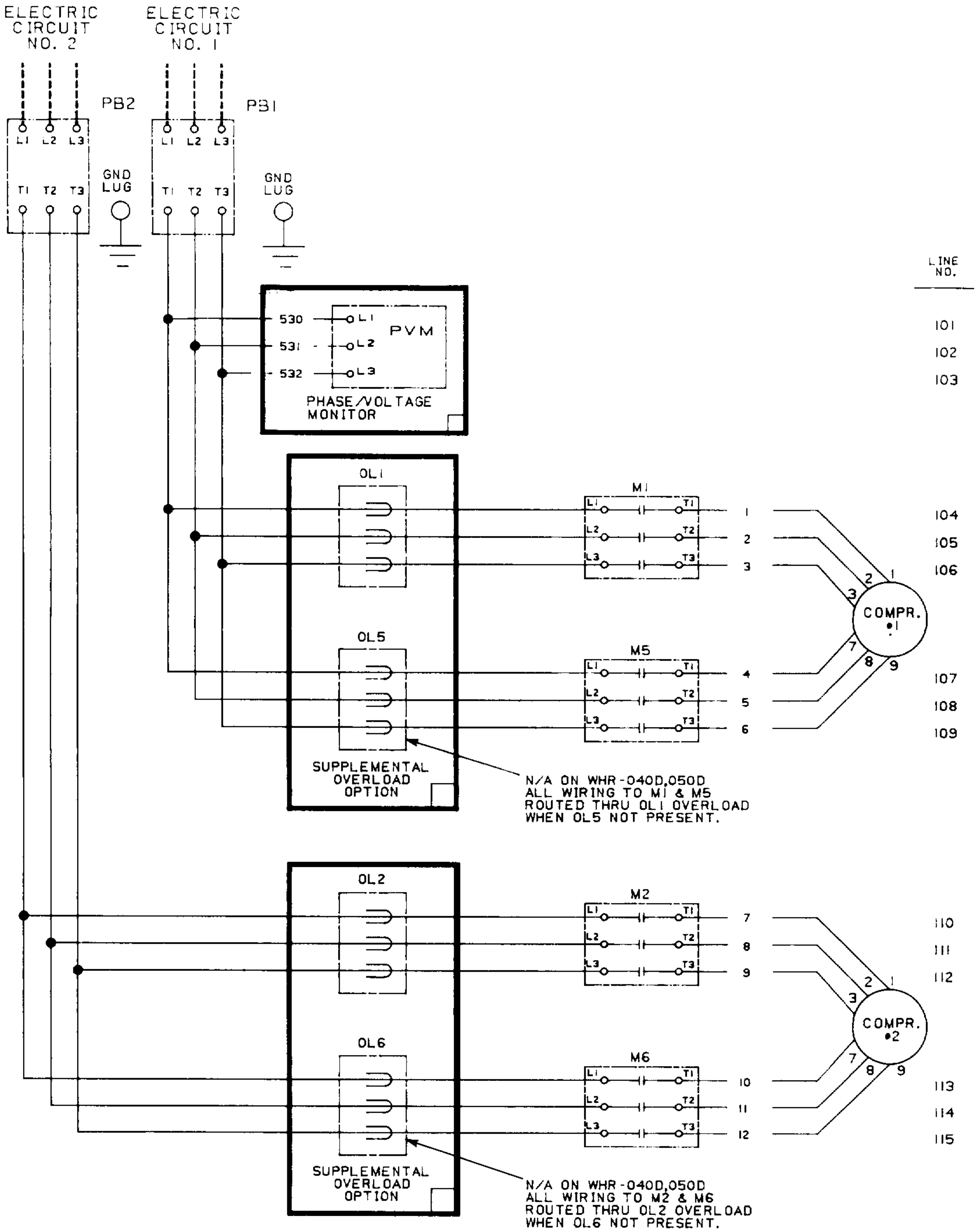


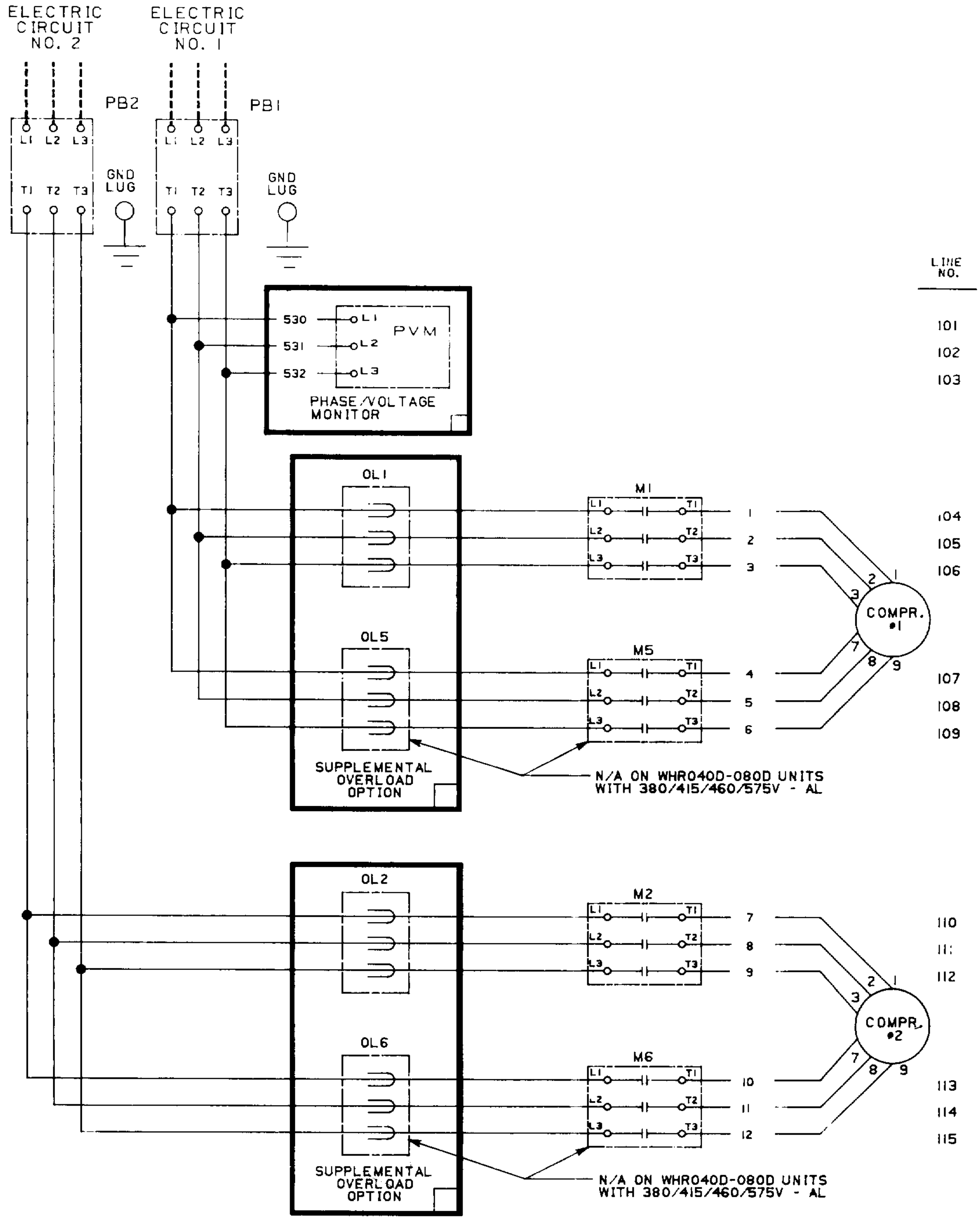
WHR 040D THRU 080D — SINGLE POINT 380/415/460/475V — AL, PW




DS1
OR
PB1
GROUND LUG
LINE NO.
PVM
PHASE/VOLTAGE MONITOR
OL1
OL5
SUPPLEMENTAL OVERLOAD OPTION
N/A ON THR
CB1
CB5
CIRCUIT BREAKER OPTION
M1
M5
COMPR. #1
OL2
OL6
CB2
CB6
M2
M6
COMPR. #2
FB5
TO CONTROL TRANSFORMER-T1
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 DS1 OR PB1
115 V.
GRD

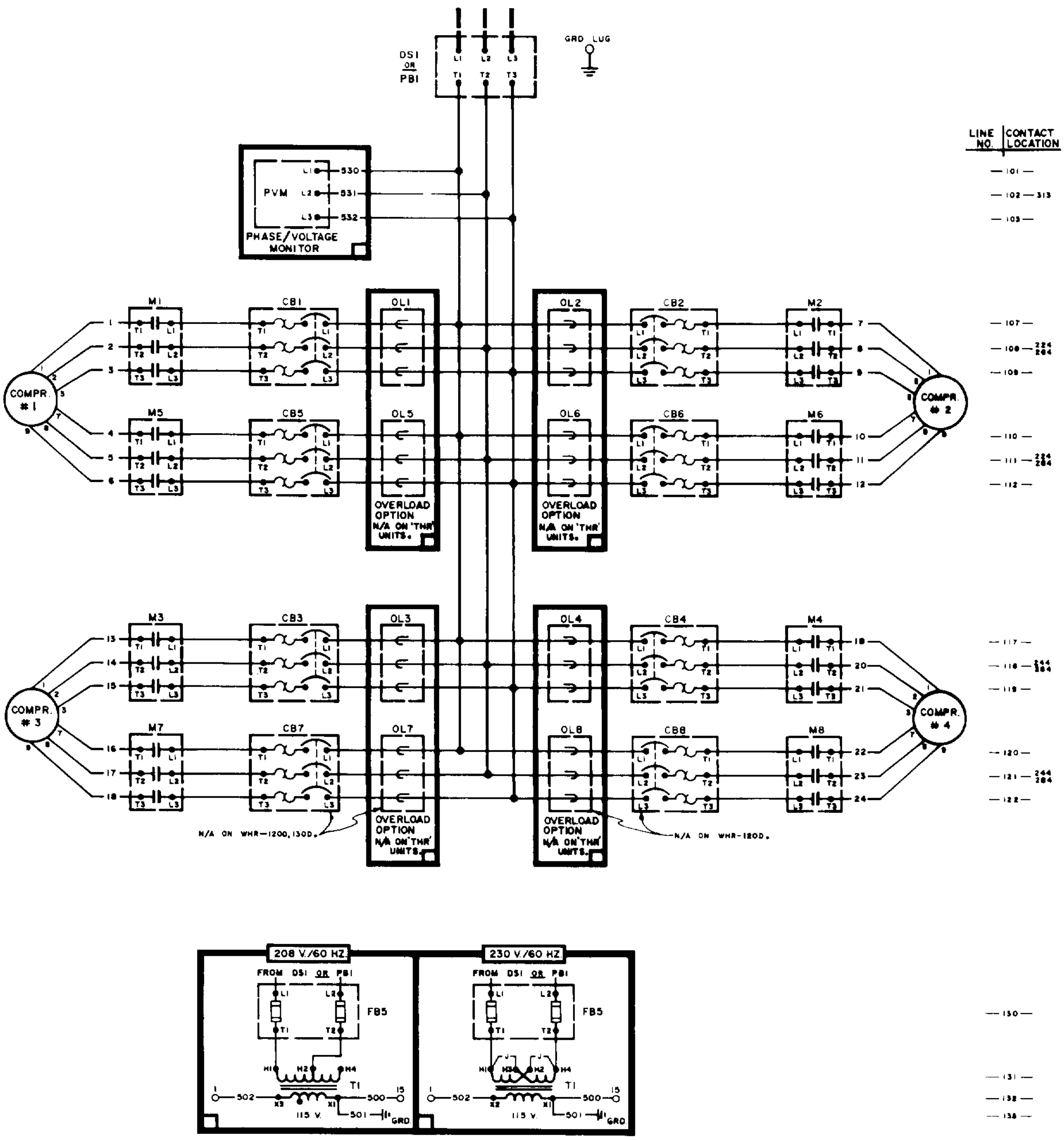
WHR 040D THRU 110D — MULTIPLE POINT 208/230V — AL, PW



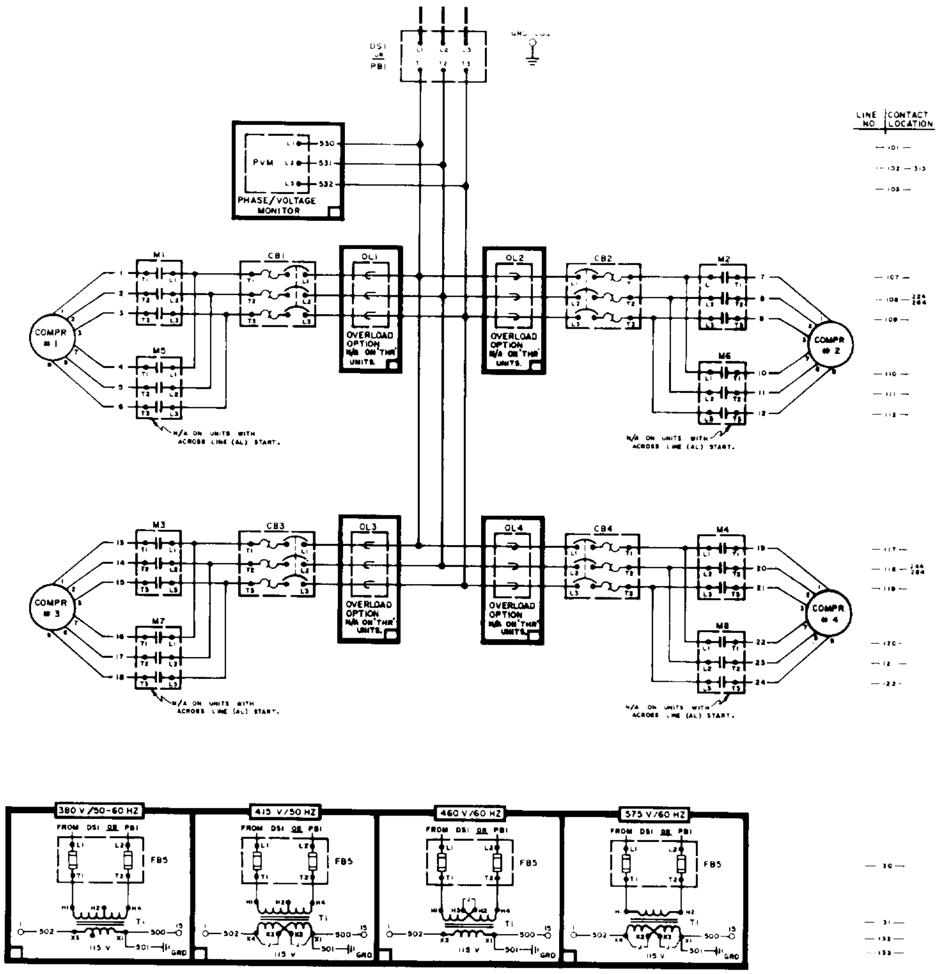


NOTES:
PB1 & PB2 ARE OMITTED ON 380/415/460/575V - AL (ACROSS LINE START) UNITS. FOR UNIT SIZES WHR040-080D WHEN OVERLOAD OPTION IS NOT USED.
FIELD CONNECT CIRCUIT NO.1 DIRECTLY TO M1 CONTACTOR AND CIRCUIT 2 TO M2 CONTACTOR.

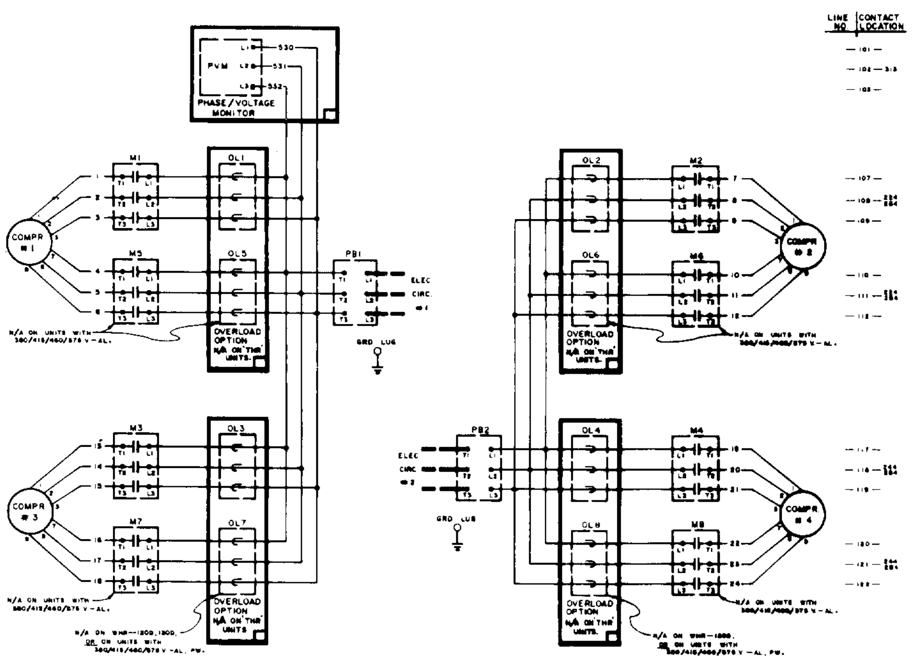
WHR 120D THRU 175D — SINGLE POINT 208/230V — AL, PW



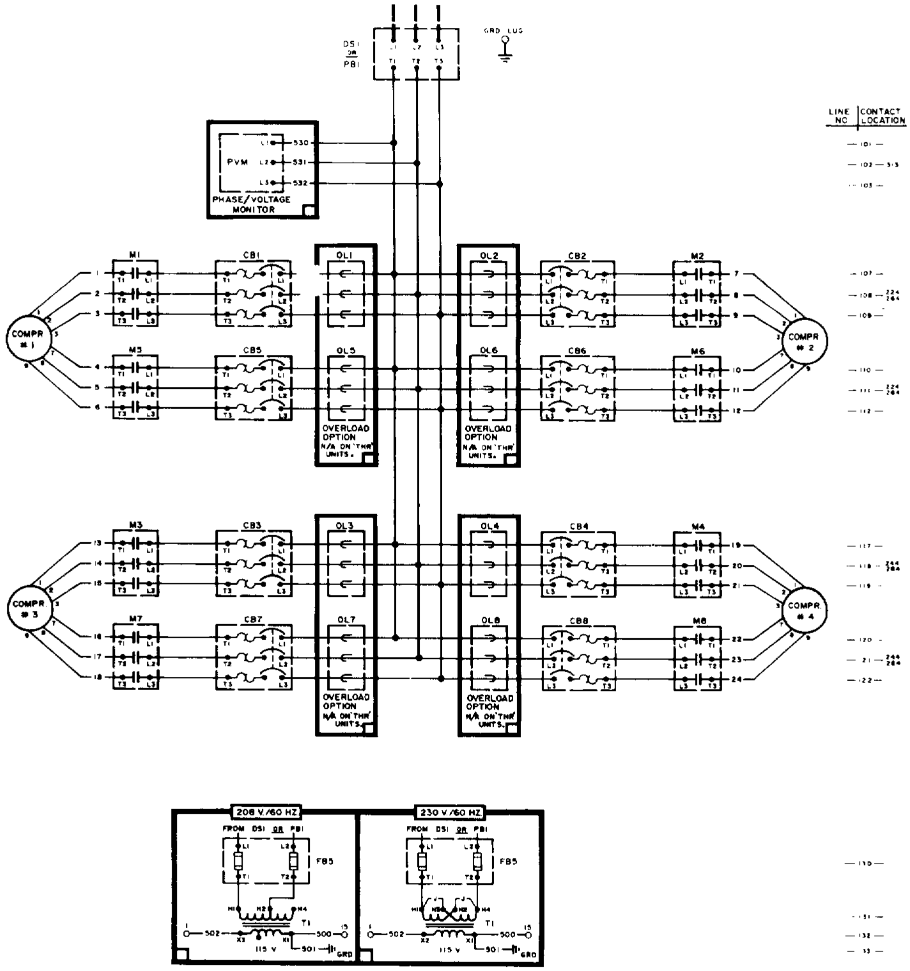
WHR 120D THRU 175D — SINGLE POINT 380/415/460/575V — AL, PW



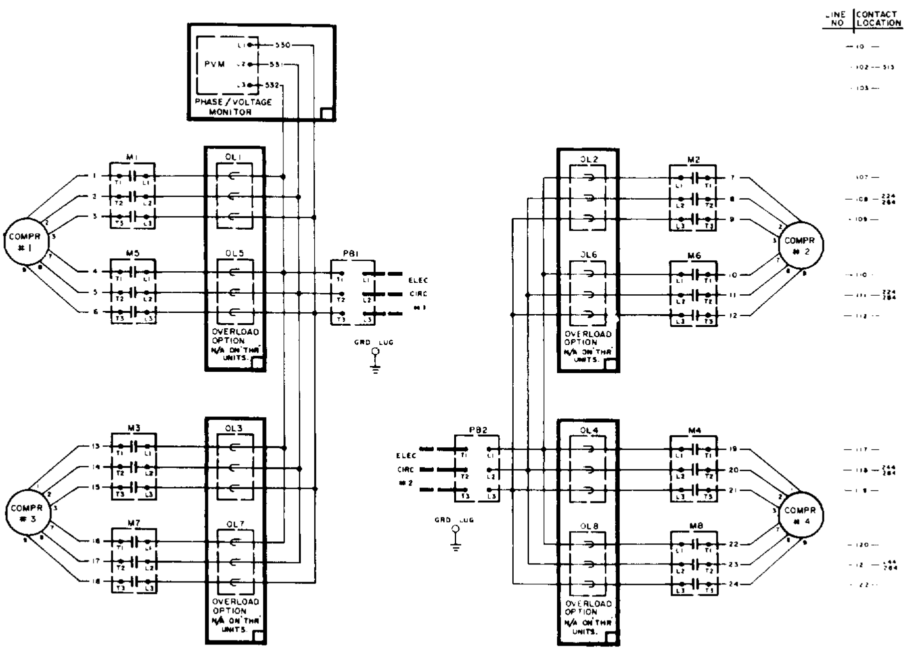
WHR 120D THRU 175D — MULTIPLE POINT 208/230/280/415/460/575V — AL, PW



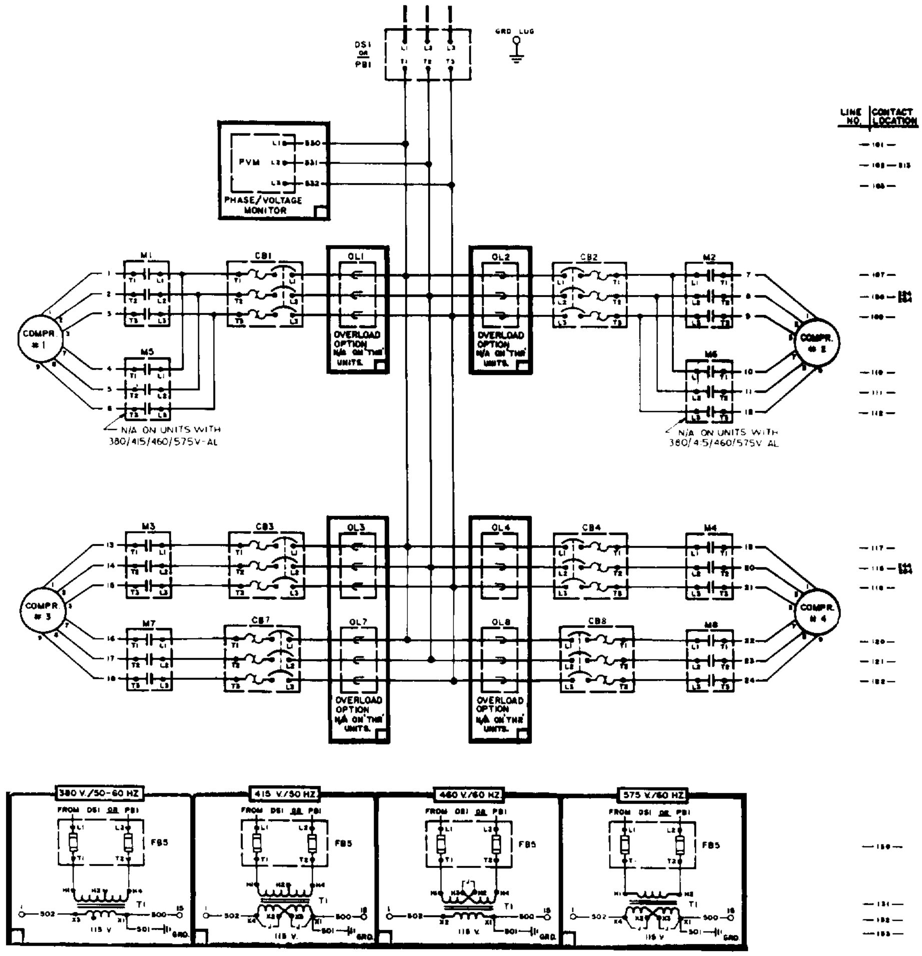
WHR 180D THRU 200D — SINGLE POINT 208/230V — AL, PW



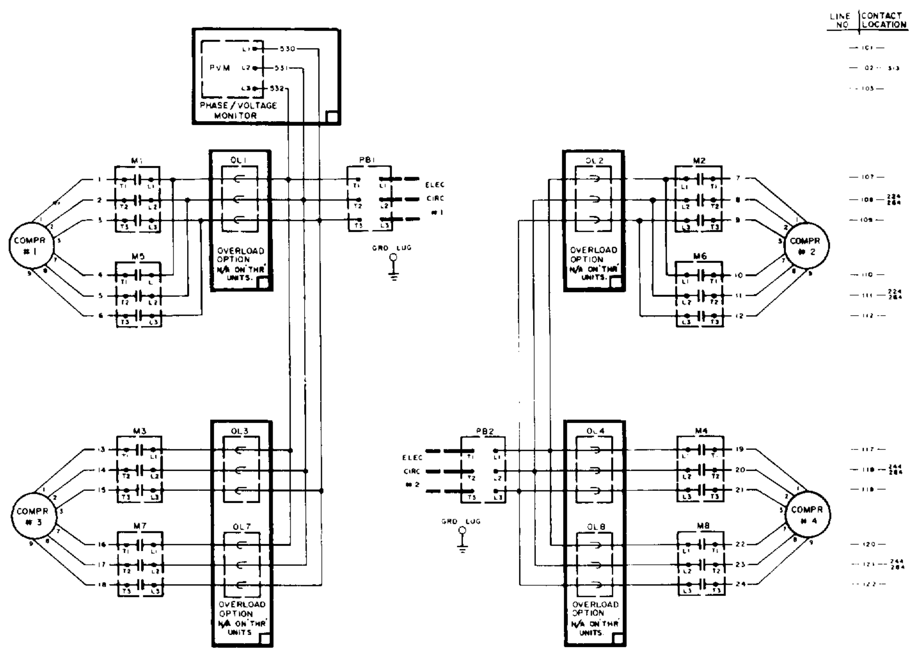
WHR 180D THRU 200D — MULTIPLE POINT 208/230V — AL, PW



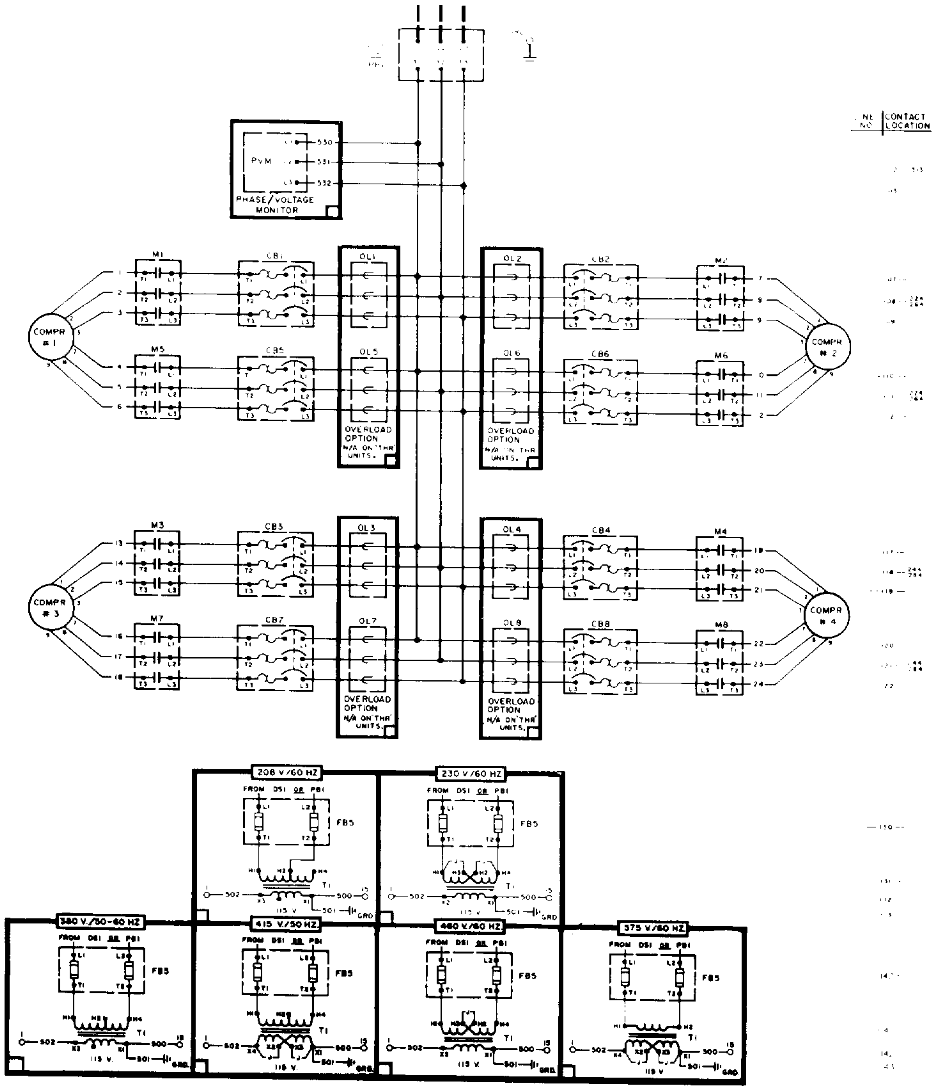
WHR 180D THRU 200D — SINGLE POINT 380/415/460/575V — AL, PW



WHR 180D THRU 200D — MULTIPLE POINT 380/415/460/575V — AL, PW



WHR 210D THRU 240D — SINGLE POINT 208/230/380/415/460/575V — AL, PW



WHR 210D THRU 240D — MULTIPLE POINT 208/230/380/415/460/575V — AL, PW

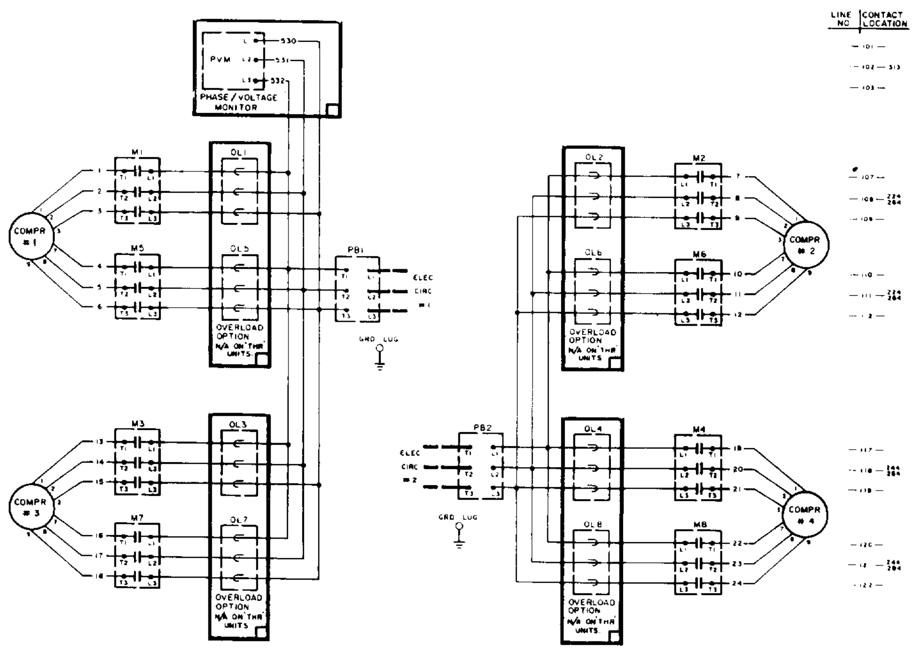


Table 23. Drawing Reference Decision Table for Compressor Power Schematics

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

START: Single or Multi-Point Power?	High or Low Voltage?	UNIT SIZE	DRAWING NO.
SINGLE	380/415/460/575V	040D THRU 080D	705192D-01
		090D, 100D, 100D	705191D-01
		120D THRU 175D	583403D-02
		180D THRU 200D	716335D-01
		210D THRU 240D	716460D-01
	208/230V	040D THRU 080D	705190D-01
		090D, 100D, 110D	705191D-01
		120D THRU 175D	583402D-02
		180D THRU 200D	716448D-01
		210D THRU 240D	716460D-01
MULTIPLE POINT	380/415/460/575V	040D THRU 110D	705198D-01
		120D THRU 175D	583404D-02
		180D THRU 200D	716450D-01
		210D THRU 240D	716459D-01
	208/230V	040D THRU 080D	705199D-01
		090D THRU 110D	716198D-01
		120D THRU 175D	583404D-02
		180D THRU 200D	716449D-01
		210D THRU 240D	716459D-01

STARTUP AND SHUTDOWN

This manual covers only the mechanical aspects of WHR chillers equipped with the MicroTech reciprocating chiller control. All of the operating, safety control and installation requirements of the MicroTech control are covered in the separate Installation and Maintenance Bulletin 493, which must be consulted before startup and operation is attempted.

PRE STARTUP

1. With main disconnect 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 and system piping to be sure the system is clean. 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 cooler circuits should contain clean, noncorrosive water.
5. If water regulating valves are provided, connect their 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 chiller.
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 pressure drop across evaporator and condenser, and see that water flow is correct per the design flow rates and data on page 9.
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 capacity is available to handle load.
11. Make sure all wiring and fuses are of the proper size. Also make sure all interlock wiring is 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. Verify crankcase heaters have operated for at least 12 hours prior to startup. Crankcase should be warm.
4. After running the unit for a short time, check the oil level n each compressor crankcase, rotation of condenser fans (if any), and check for flashing in the refrigerant sightglass.

At this point it will be necessary to complete MicroTech pre-start checkout found in IM 493 before system operation is attempted. After MicroTech pre-start checkout and startup is complete be sure to complete the following mechanical startup requirements.

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

TEMPORARY SHUTDOWN

1. Move the Circuit 1 and Circuit 2 switches to the "Pumpdown and Stop" position, causing each circuit to pump down and stop. In this condition, the compressors will remain off and no additional pumpdown will occur even if evaporator pressure rises above the low pressure control cut-in setpoint.
2. After both circuits have pumped down, open the remote stop switch and the controller will stop the chilled water pump.

STARTUP AFTER TEMPORARY SHUTDOWN

Close the remote stop switch to enable the chiller. Move the Circuit 1 and Circuit 2 switches to the Auto position. If the controller is calling for cooling, the compressors will start and the unit will stage as required. If the controller is not calling for cooling the compressors may pump down and stop until there is a call for cooling.

EXTENDED SHUTDOWN

1. Move the Circuit 1 and Circuit 2 switches to the "Pumpdown and Stop" position. After the compressors have shut off, open the remote stop switch and the controller will stop the chilled water pump.
2. Move the system switch to the "Emergency Stop" position and turn off main power to the chiller and the chilled water pumps.
3. Close the manual liquid line shutoff valves.
4. Close the compressor suction and discharge service valves and oil equalization valves on four compressor units.
5. Tag all opened electrical disconnect switches to warn against startup before opening the compressor sucton, discharge and liquid line service valves.

STARTUP AFTER EXTENDED SHUTDOWN

1. Inspect all equipment to see that it is in satisfactory operating condition.
2. Remove all debris that has collected on the surface of the condenser coils (remote condenser models).
3. Open the compressor suction and discharge valves until backseated. Always replace valve seal caps.
4. Open the manual liquid line shutoff valves.
5. Allow the crankcase heaters to operate for at least 12 hours prior to startup.

At this point is will be necessary to complete MicroTech pre-start checkout found in IM 493 before system operaiion is attempted. After MicroTech pre-start checkout and startup is complete be sure to complete the following mechanical startup requirements.

8 After running the unit for a short time, check the oil level in each copressor 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.

Systems with remote air cooled condensers require periodic cleaning of the finned surface of the condenser coil. Cleaning may be accomplished by using a cold water spray, brushing, vacuuming, or high pressure air. No tools should be used that could damage the coil tubes or fins.

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 relativelv easv 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 wiring is not in accordance with specifications. A blown fuse or tripped protector indicates a short ground or overload. Before replacing fuse or restarting 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 SEASONPAK water chiller.
2. Before investigating trouble in the control center, check for burned out light bulbs 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.

OPERATING LIMITS

- Maximum allowable condenser water pressure is 250 psig.
- Maximum allowable cooler water pressure is 225 psig.
- Maximum leaving condenser water temperature is 135°F. This corresponds to 340 to 350 psig head pressure.
- Maximum allowable water temperature to cooler in a non-operating cycle is 105°F. Maximum entering water temperature for operating cycle is 90°F (during system changeover from heating to cooling cycle).
- Minimum leaving water temperature from the cooler without freeze protection is 42°F.
- Minimum entering tower condenser water temperature is 70°F.

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 but is acceptable at any height on the sightglass.

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.

OIL EQUALIZATION

Some larger models with four compressors (WHR-180 thru 240D) come equipped with oil equalization lines connecting the crankcase of both compressors in each refrigerant circuit. This allows the oil to move from one compressor crankcase to the other during normal operation, and balance between the two when the compressors are off. This method of equalization prohibits the oil level from dropping below the bottom level of the sightglass. Some difference in crankcase oil levels will still exist during unit operation due to compressor internal pressures.

The oil equalization line contains a manual shutoff valve for isolating a compressor during service work. The ball valves are shipped in the closed position with a tag attached stating "Notice, Valve Shipped In Closed Position. Can Be Open For Normal Operation." When valves are closed for compressor service, make sure they are opened again for unit operation. For water cooled units, operation with oil equalization lines closed should be satisfactory for most jobs.

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.

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 on liquid slugging of compressor on startup.

If the crankcase is cool (below 80°F) and the oil level in the sightglass is FULL to top, allow more time for oil to warm before starting the compressor.

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 each refrigerant circuit down by closing the manual liquid line shutoff valve while a compressor is running. After both refrigerant circuits are pumped down, move the system switch to the "Emergency Stop" position. This will remove all liquid refrigerant from the evaporator and section of liquid line up to the shutoff valve. Only a small amount of vapor will remain in the liquid line/filter-drier section. Front seat the compressor suction valve(s), Remove and replace the filter-drier(s). Evacuate the lines through the liquid line manual shutoff valves to remove non-condensables that may have entered during filter replacement. A leak check is recommended before returning the unit to operation.

UNIT ARRANGEMENT	UNIT SIZE	TYPE FILTER-DRIER
H & W	040 thru 110D	Sealed Core
H & W	120 thru 200D	2 — Core Replaceable
A	040 thru 070D	1 — Core Replaceable
A	080 thru 200D	2 — Core Replaceable
H & W & A	210 thru 240D	3 — 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 Circuit 1 and Circuit 2 switches to the "Pumpdown and Stop" 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 the unit to operation.

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

THERMOSTATIC EXPANSION VALVE

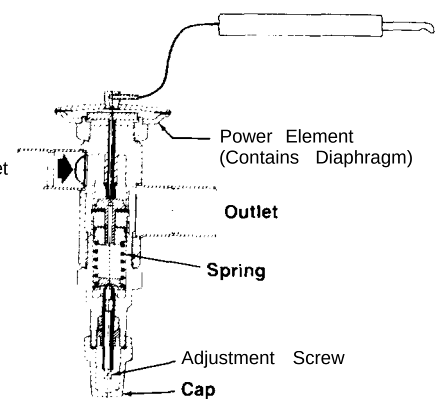
The expansion valve is responsible for allowing the proper amount of refrigerant to enter the evaporator regardless of cooling load. It does this by maintaining a constant superheat. (Superheat is the difference between refrigerant temperature as it leaves the evaporator and the saturation temperature corresponding to the evaporator pressure.) All WHR chillers are factory set for between 8°F and 12°F superheat at full load. 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.

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 30.



NOTE: Superheat will vary with compressor unloading, but should be approximately as follows- between 6°F and 12°F at full load; between 6°F and 10°F at part load.

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 31) 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.

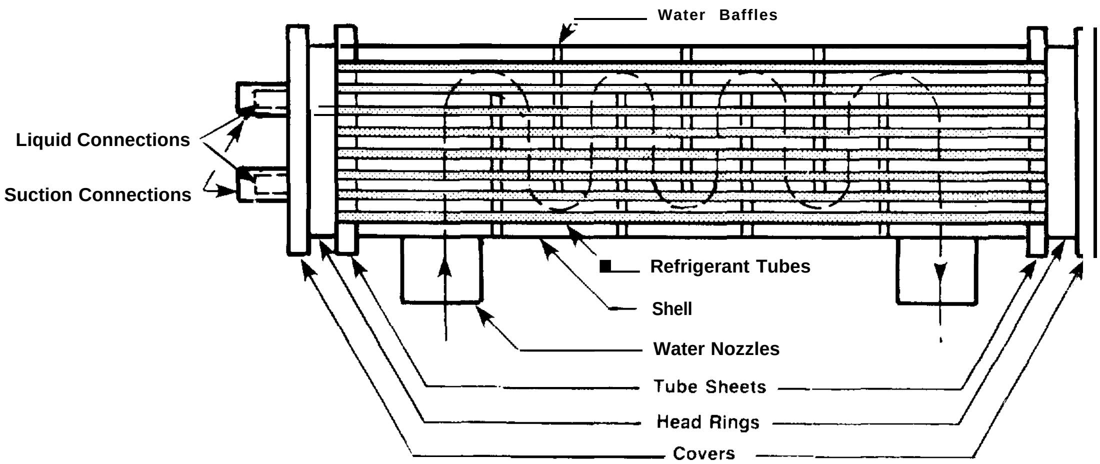
NOTE: The bond produced by expansion must *be* refrigerant tight. *This bond must be produced by applying Locktite (red) to the tube and rolling it into the tube sheet.*

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 31. 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 Arrangement W units. Heat recovery units have integral subcoolers in the tower condensers. All condensers are equipped with 450 psig relief valves. Heat recovery condensers are free-draining to the lower (tower) condensers and do not subcool.

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 32. **Hot Gas Bypass Piping Diagram**

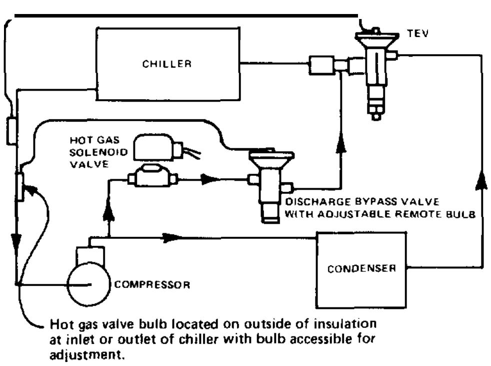
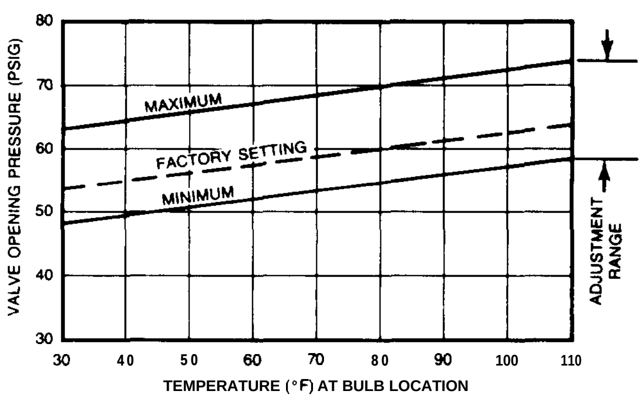


Figure 33. **Hot Gas Bypass Adjustment Range**



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 servicemen.

When a compressor fails in warranty, contact your local sales representative, or Warranty Claims Department at the address on the 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 full details; i.e., 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.

COMPONENTS OTHER THAN COMPRESSORS

Material may not be returned except by permission of authorized factory service personnel at Minneapolis, Minnesota. 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 factory, transportation charges prepaid.

TROUBLESHOOTING CHART

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor Will Not Run	1. Main switch, circuit breakers open. 2. Fuse blown. 3. Thermal overloads tripped or fuses blown 4. Defective contactor or coil. 5. System shut down by safety devices. 6. No cooling required. 7. Liquid line solenoid will not open. 6. Motor electrical trouble. 9. 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. Overloads are auto reset. Check unit closely when unit comes back on line. 4. Repair or replace. 5. Determine type and cause of shutdown and correct it before resetting safety switch. 6. None. Wait until unit calls for cooling. 7. Repair or replace coil. 6. Check motor for opens, short circuit, or burnout. 9. 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 (water cooled condenser). Clogged spray nozzles (evaporative condenser). Dirty tube and fin surface (air cooled condenser). 3. Noncondensables in system. '4. System overcharged with refrigerant. 5. Discharge shutoff valve partially closed. '6. Condenser undersized. '7. High ambient conditions.	1. Readjust temperature control or water regulating valve. Investigate ways to increase water supply 2. Clean. 3. Purge the noncondensabies. 4. Remove excess refrigerant. 5. Open valve. 6. Check condenser rating tables against the operation. 7. Check condenser rating tables against the operation.
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. '6. Condenser too large. '7. Low ambient conditions.	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. 6. Check condenser rating table against the operation. 7. Check condenser rating tables against the operation.
High Suction Pressure	1. Excessive load. 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 ΔP across evaporator. 7. Check means for regulating condensing temperature. 6. See corrrective steps for failure of compressor to unload. 9. Adjust gpm.
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. 6. Check and tighten system. 9. Replace gasket. 10. Adjust thermal expansion valve.
Compressor Loses Oil	1. Lack of refrigerant. '2. Velocity in risers too low. '3. Oil trapped in line. 4. Excessive compression ring blow-by.	1. Check for leaks and repair Add refrigerant. 2. Check riser sizes. 3. Check pitch of lines and refrigerant velocities. 4. Replace compressor.
Motor Overload Relays or 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. Thermostat set too low. 2. Low water flow. 3. Low suction oressure.	1 Reset to 42°F or above. 2. Adjust gpm. 3. See "Low Suction Pressure "

* Remote Condenser Models.

NOTE: FOR TROUBLESHOOTING PROCEDURES ON MICROTECH CONTROL REFER TO IM 493.

PRODUCT WARRANTY

SnyderGeneral Corporation, hereinafter referred to as the "Company," warrants that it will provide, at the Company's option, either free replacement parts or free repair of component parts in the event any product manufactured by the Company and used **in the United States proves defective** in material or workmanship within twelve (12) months from initial startup or eighteen (18) months from the date shipped by the Company, whichever comes first. For additional consideration, the Company warrants that for four (4) years following the initial warranty period it will provide, at the Company's option, free replacement parts for the motor-compressor, or, free replacement for any integral component of the motor-compressor which proves defective in material or workmanship. For an additional consideration, the Company warrants that for nine (9) years following the initial warranty period it will provide free replacement of the heat exchanger in gas-fired or oil-fired furnaces which proves defective in material and workmanship. (Extended warranties for motor-compressors and heat exchangers are not applicable unless separately purchased.)

To obtain assistance under this parts warranty, extended motor-compressor warranty, or extended heat exchanger warranty, simply contact the selling agency. To obtain information or to gain factory help: For brandnames Arcoaire and/or Comfortmaker contact SnyderGeneral Corporation, Warranty Department, 302 Nichols Drive, Hutchins, TX 75141, telephone (214) 225-7351. For McQuay, Climate Control, Barry Blower and JennFan brandnames, contact SnyderGeneral Corporation, Warranty Claims Department, P. 0. Box 1551, Minneapolis, MN 55440, telephone (612) 553-5330.

THIS WARRANTY CONSTITUTES THE BUYER'S SOLE REMEDY. IT IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT AND UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER THE THEORY BE BREACH OF THIS OR ANY OTHER WARRANTY, NEGLIGENCE OR STRICT TORT.

This parts warranty and the optional extended warranties extend only to the original user. Of course, abuse, misuse, or alteration of the product in any manner voids the Company's warranty obligation. Neither the parts or extended warranty obligates the Company to pay any labor or service costs for removing or replacing parts, or any shipping charges. Refrigerants, fluids, oils, and expendable items such as filters are not covered by this warranty.

The extended warranties apply only to integral components of the motor-compressor or heat exchanger, not to refrigerant controls, electrical controls, or mechanical controls, or to failures caused by failure of those controls.

Attached to this warranty is a requirement for equipment containing motor-compressors and/or furnaces to report start-up information. The registration form accompanying the product must be completed and returned to the Company within ten (10) days of original equipment start-up. If that is not done. the date of shipment shall be presumed to be the date of start-up and the warranty shall expire twelve (12) months from that date.

No person (including any agent, salesman, dealer or distributor) has authority to expand the Company's obligation beyond the terms of this express warranty, or to state that the performance of the product is other than that published by the Company.