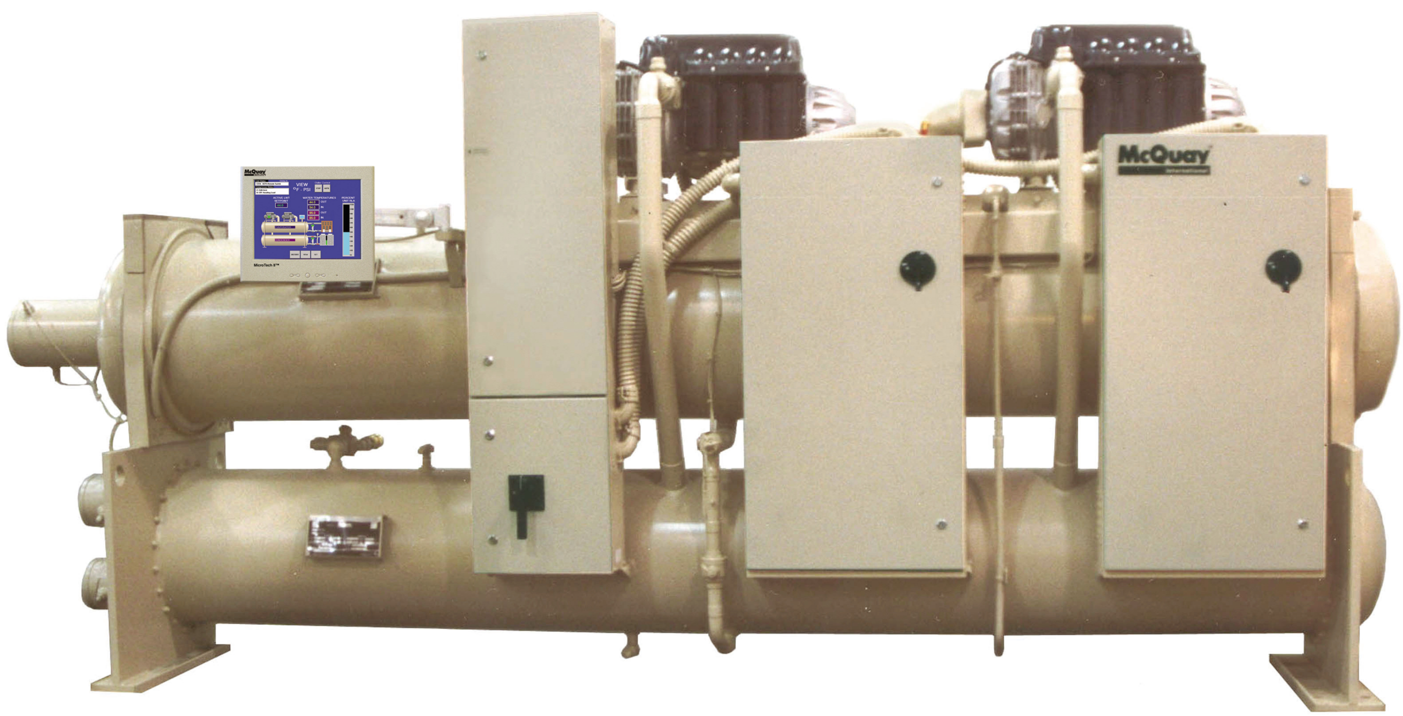
Installation and Maintenance Manual	IMM WMC-2
	Group: **Chiller**
	Part Number: **331374601**
	Effective: **March 2008**
	Supersedes: **December 2007**

Water-Cooled Centrifugal Chiller With Oil-Free Magnetic Bearing Compressors

Model WMC-145S to 290D (50/60 Hertz)

R-134a



McQuay®
Air Conditioning

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*Unit Controllers are LonMark certified with an optional LonWorks communication module.

Manufactured in an ISO Certified Facility

Document:	Catalog WMC-4
Issue Date:	August 2007
Replaces:	Catalog WMC-2

Introduction

General Description

The McQuay Model WMC Centrifugal Water Chillers are complete, self-contained, automatically controlled, fluid-chilling units featuring oil-free, magnetic bearing compressors. Each unit is completely assembled and factory tested before shipment.

The WMC chillers are equipped with two compressors operating in parallel with a single evaporator and single condenser. The model WMC 145S has a single compressor.

The chillers use refrigerant R-134a that operates at a positive pressure over the entire operation range, so no purge system is required.

The controls are pre-wired, adjusted and tested. Only normal field connections such as water piping, relief valve piping, electric power and control interlocks are required, thereby simplifying installation and increasing reliability. Necessary equipment protection and operating controls are included.

All McQuay centrifugal chillers are factory-tested prior to shipment and must be commissioned by a factory-trained McQuay service technician. Failure to follow this startup procedure can affect the equipment warranty.

The standard limited warranty on this equipment covers parts that prove defective in material or workmanship. Specific details of this warranty can be found in the warranty statement furnished with the equipment.

Cooling towers used with McQuay centrifugal chillers are normally selected for condenser water inlet water temperatures between 75°F and 90°F (24°C and 32°C). Lower entering water temperatures are desirable from the standpoint of energy reduction, but a minimum does exist. For recommendations on optimum entering water temperature and cooling tower fan control, consult the “Condenser Water” section on page 7.

Nomenclature

W M C 290 D

- **W**ater-cooled
- **M**agnetic Bearings
- **C**entrifugal Compressor
- Nominal Tons
- D=Dual Compressors
  S=Single Compressor

HAZARD IDENTIFICATION INFORMATION

⚠ DANGER

Dangers indicate a hazardous situation which will result in death or serious injury if not avoided.

⚠ WARNING

Warnings indicate potentially hazardous situations, which can result in property damage, severe personal injury, or death if not avoided.

⚠ CAUTION

Cautions indicate potentially hazardous situations, which can result in personal injury or equipment damage if not avoided.

Installation

Receiving and Handling

The unit should be inspected immediately after receipt for possible damage.

All McQuay centrifugal water chillers are shipped FOB factory and all claims for handling and shipping damage are the responsibility of the consignee.

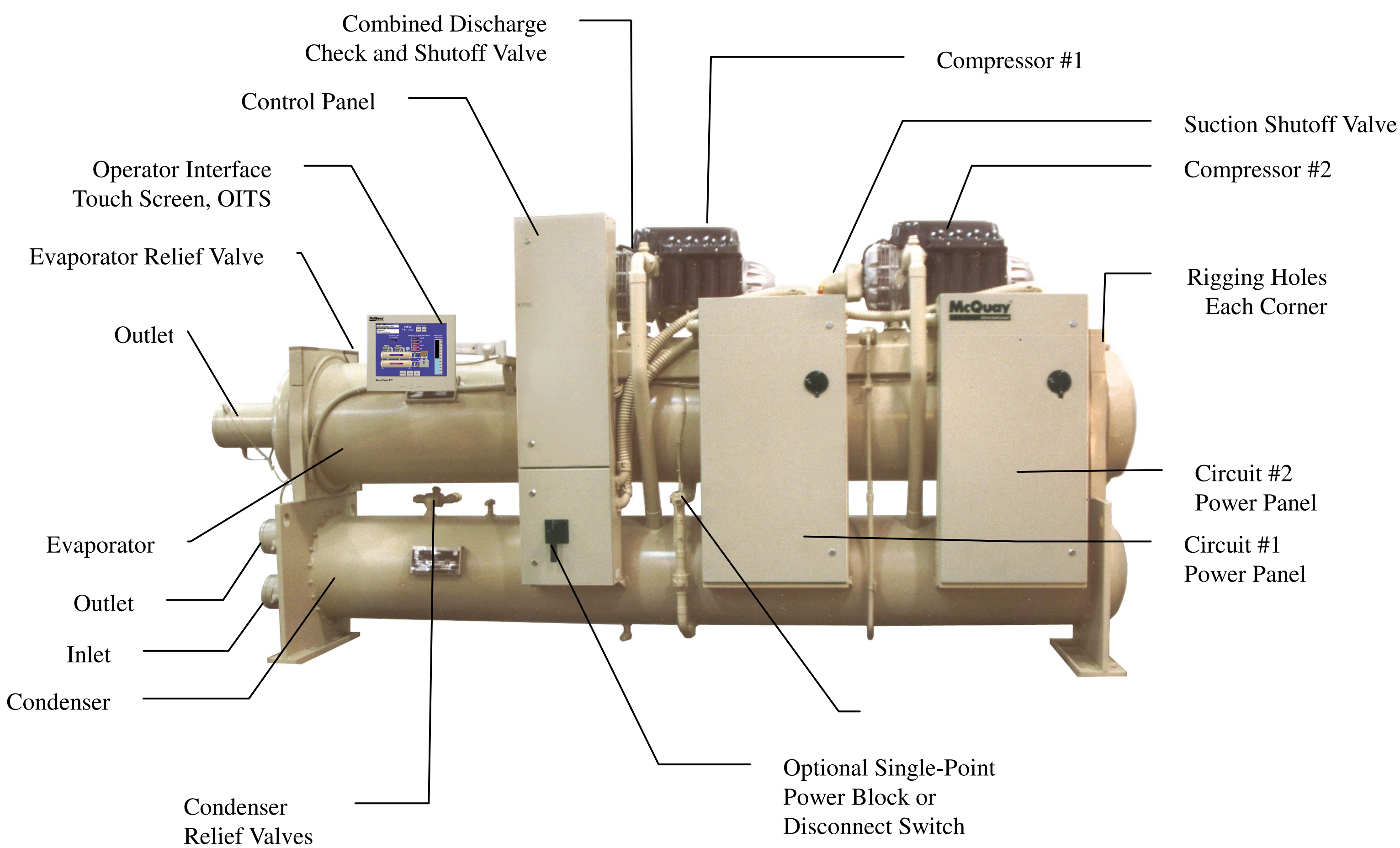
On units with factory-installed insulation, the insulation is removed from the vessel lifting hole (also used for transportation tie-downs) locations and are shipped loose. They should be glued in place after the unit is finally placed. Neoprene vibration pads are also shipped loose. Check that these items have been delivered with the unit. They are usually placed in a control panel.

If so equipped, leave the shipping skid in place until the unit is in its final position. This will aid in handling the equipment.

Extreme care must be used when rigging the unit to prevent damage to the control panels and refrigerant piping. See the certified dimension drawings included in the job submittal for the center of gravity of the unit. If the drawings are not available, consult the local McQuay sales office for assistance.

The unit can be lifted by fastening the rigging hooks to the four corners of the unit where the rigging eyes are located (see Figure 1). Spreader bars must be used between the rigging lines to prevent damage to the control panels, piping and electrical panels.

Figure 1, WMC-D, Major Component Locations



Location and Mounting

Clearance

The unit must be mounted on a level concrete or steel base and must be located to provide service clearance at one end of the unit for possible removal of evaporator and/or condenser tubes. Evaporator and condenser tubes are rolled into the tube sheets to permit replacement if necessary. The length of the vessel should be allowed at one end. Doors or removable wall sections can be utilized. Clearance at all sides, including the top, is 3 feet (1 meter). The U.S. National Electric Code (NEC) or local codes can require more clearance in and around electrical components (4-feet in front of electrical panels) and must be checked for compliance.

Vibration Pads

The shipped-loose neoprene vibration pads (shipped in the power panels) should be located under the corners of the unit (unless the job specifications state otherwise). They are installed to be flush with the sides and outside edge of the feet.

Insulation Corners

Insulation corners that cover the rigging holes on the upper corners of the vessel end plates are shipped loose (in the power panels) and should be installed with adhesive after the init is set in place.

Mounting

Make sure that the floor or structural support is adequate to support the full operating weight of the complete unit.

It is not necessary to bolt the unit to the mounting slab or framework; but should this be desirable, 1-1/8" (28.5 mm) mounting holes are provided in the unit support at the four corners.

Note: Units are shipped with refrigerant valves closed to isolate the refrigerant in the unit condenser. Valves must remain closed until start-up by the McQuay technician.

Nameplates

There are several identification nameplates on the chiller:

- The unit nameplate is located on the Unit Control Panel. It has a Model No. XXXX and Serial No. XXXX. Both are unique to the unit and will identify it. These numbers should be used to identify the unit for service, parts, or warranty questions. This plate also has the unit refrigerant charge.
- Vessel nameplates are located on the evaporator and condenser. Along with other information, they have a National Board Number (NB) and a serial number, either of which identify the vessel (but not the entire unit).

Water Piping

Vessel Drains at Start-up

The unit is tilted and drained of water in the factory and shipped with open drain valves in each head of the evaporator and condenser. Be sure to close the valves prior to filling the vessel with fluid.

Evaporator and Condenser Water Piping

All evaporators and condensers come standard with groove-type nozzles for Victaulic couplings (also suitable for welding), or optional flange connections. The installing contractor must provide matching mechanical connections of the size and type required.

⚠ CAUTION

Freeze Notice: Neither the evaporator nor the condenser is self-draining; both must be blown out to help avoid damage from freezing temperatures.

The piping should include thermometers at the inlet and outlet connections and air vents at the high points.

The water heads can be interchanged (end for end) so that the water connections can be made at either end of the unit. If this is done, use new head gaskets and relocate the control sensors.

In cases where the water pump noise can be objectionable, vibration isolation sections are recommended at both the inlet and outlet of the pump. In most cases, it will not be necessary to provide vibration eliminator sections in the condenser inlet and outlet water lines. But they can be required where noise and vibration are critical.

Important Notes on Welding

If welding is to be performed on the mechanical or flange connections:

1. Remove the solid-state temperature sensor, thermostat bulbs and optional nozzle mounted flow switches (if so equipped) from the wells to prevent damage to those components.
2. Properly ground the unit or severe damage to the MicroTech II® unit controller can occur.

Note: ASME certification will be revoked if welding is performed on a vessel shell or tube sheet.

Water pressure gauge connection taps and gauges must be provided in the field piping at the inlet and outlet connections of both vessels for measuring the water pressure drop. The pressure drops and flow rates for the various evaporators and condensers are job specific and the original job documentation can be consulted for this information. Refer to the nameplate on the vessel shell for identification.

Connections

Be sure that water inlet and outlet connections match certified drawings and stenciled nozzle markings. The condenser is connected with the coolest water entering at the bottom connection to maximize subcooling. The evaporator outlet is on the right side of the head, regardless of which end the connections are on.

⚠CAUTION

When common piping is used for both building heating and cooling modes, care must be taken to provide that water flowing through the evaporator cannot exceed 110°F. Water this hot can cause the relief valve to discharge refrigerant or damage controls.

Piping must be supported to eliminate weight and strain on the fittings and connections. Chilled water piping must be adequately insulated. A cleanable 20-mesh water strainer must be installed in both water inlet lines. Sufficient shutoff valves must be installed to permit draining the water from the evaporator or condenser without draining the complete system.

Flow Switch

Note: Chiller units must have flow switches for the evaporator and condenser. McQuay furnishes factory-installed and wired, thermal-type flow switches as standard equipment on WMC chillers. Field-installed and wired Delta-P switches can be used instead.

They prevent the unit from starting without sufficient water flow through the vessels. They also serve to shut down the unit in the event that water flow is interrupted to guard against evaporator freeze-up or excessive discharge pressure.

Additionally, for a higher margin of protection, normally open auxiliary contacts in the pump starters can be wired in series with the flow switches as shown in the Field Wiring Diagram on page 23.

Figure 2, Unit-Mounted Flow Switch

Cooling Towers

The condenser water flow rate must be checked to be sure that it conforms to the system design. A tower bypass valve, controlled by the unit controller, is required to control the minimum condenser entering temperature. Unless the system and chiller unit are specifically designed for them, *condenser bypass* or variable condenser flow is not recommended, since low condenser flow rates can cause unstable operation and excessive tube fouling.

Condenser Water Temperature

When the ambient wet bulb temperature is lower than design, the entering condenser water temperature can be allowed to fall, improving chiller performance.

McQuay chillers will *start* with entering condenser water temperature as low as 55°F (12.8°C) providing the chilled water temperature is below the condenser water temperature.

Depending on local climatic conditions, using the lowest possible entering condenser water temperature can be more costly in total system power consumed than the expected savings in chiller power would suggest due to the excessive fan power required.

To obtain lower than 55°F (12.8°C) entering condenser water temperature with a tower selected to produce 85°F (29.4°C) water temperature at design ambient air temperatures, cooling tower fans must continue to operate at 100% capacity at low wet bulb temperatures. As chillers are selected for lower kW per ton, the cooling tower fan motor power becomes a higher percentage of the peak load chiller power. The offsets of compressor power and fan power must be examined. On the other hand, the low condenser water temperatures can be easy and economical to achieve in mild climates with low wet bulb temperatures.

Even with tower fan control, some form of water flow control such as tower bypass must be used and controlled by the chiller MicroTech II controller.

Figure 3 and Figure 4 illustrate two temperature-actuated tower bypass arrangements. The "Cold Weather" scheme, Figure 4, provides better startup under cold ambient air temperature conditions. The check valve may be required to prevent air at the pump inlet.

Figure 3, Tower Bypass, Mild Weather Operation

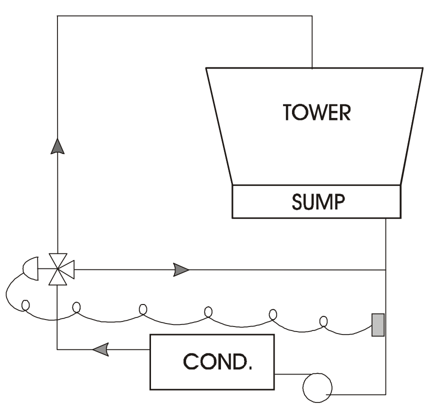
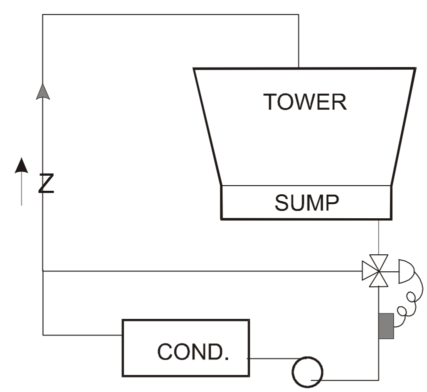


Figure 4, Tower Bypass, Cold Weather Operation



⚠ CAUTION

Tower water treatment is essential for continued efficient and reliable unit operation. If not available in-house, competent water treatment specialists should be contracted.

Field Insulation

If the optional factory-installation of thermal insulation is not ordered, insulation should be field installed to reduce heat loss and prevent condensation from forming. Insulation should cover the evaporator barrel, tube sheet, and water heads, plus the suction line to the compressor flange and the compressor end bell opposite the suction connection.

The optional factory-installed insulation of cold surfaces includes the evaporator and non-connection water head, suction piping, compressor inlet, and motor housing.

Insulation is UL recognized (File # E55475). It is 3/4" thick ABS/PVC flexible foam with a skin. The K factor is 0.28 at 75°F. Sheet insulation is fitted and cemented in place forming a vapor barrier, then painted with a resilient epoxy finish that resists cracking.

The insulation complies to or has been tested in accordance with the following:

ASTM-C-177 ASTM-C-534 Type 2 UL 94-5V
ASTM-D-1056-91-2C1 ASTM E 84 MEA 186-86-M Vol. N
CAN/ULC S102-M88

Physical Data and Weights

Evaporator

Refrigerant-side design pressure is 200 psi (1380 kPa). Water-side is 150 psi (1034 kPa).

Approximate total square footage of insulation surface required for individual packaged chillers is tabulated by evaporator code and can be found below. The suction elbow and compressor also require insulation.

Table 1, Evaporator Physical Data

WMC Model	Evaporator Code	Tube Length	Unit Refrigerant Charge lb. (kg)	Evaporator Water Volume, gal (L)	Insulation Area sq. ft. (m^2)	Number of Relief Valves
145S,	**E2209**	9 ft.	500 (227)	38 (145)	66 (6.1)	1
145D	**E2209**	9 ft.	600 (272)	38 (145)	66 (6.1)	1
150D	**E2212**	12 ft.	800 (363)	45 (170)	90 (8.3)	1
250D	**E2609**	9 ft.	600 (272)	61 (231)	76 (7.1)	1
290D	**E2612**	12 ft.	1100 (500)	72 (273)	102 (9.4)	1

Notes:
1. Refrigerant charge is for the entire unit and is approximate since the actual charge will depend on other variables. Actual charge will be shown on the unit nameplate.
2. Water capacity is based on standard tube configuration and standard dished heads.

Condenser

With positive pressure systems, the pressure variance with temperature is always predictable, and the vessel design and pressure relief protection are based upon pure refrigerant characteristics. R-134a requires ASME vessel design, inspection and testing and uses spring-loaded pressure relief valves. When an over-pressure condition occurs, spring-loaded relief valves purge only that quantity of refrigerant required to reduce the pressure to the valve's set pressure and then close.

Refrigerant-side design pressure is 200 psi (1380 kPa). Water-side design is 150 psi (1034 kPa).

Table 2, Condenser Physical Data

WMC Model	Condenser Code	Tube Length	Maximum Pumpdown Capacity lb. (kg)	Water Volume gal. (L)	Number of Relief Valves
145S, 145D	**C2009**	9 ft.	724 (328)	47 (147)	2
150D	**C2012**	12 ft.	971 (440)	62 (236)	2
250D	**C2209**	9 ft.	883 (401)	61 (231)	2
290D	**C2212**	12 ft.	1174 (533)	72 (273)	2

Notes:
1. Condenser pumpdown capacity based on 90% full at 90°F.
2. Water capacity based on standard configuration and standard heads and can be less with lower tube counts.
3. See Relief Valves section for additional information.
4. See page 8 for unit operating, shipping and corner weights.

Dimensions

Figure 5, WMC 145S *(NOTE: See page 14 for notes.)*

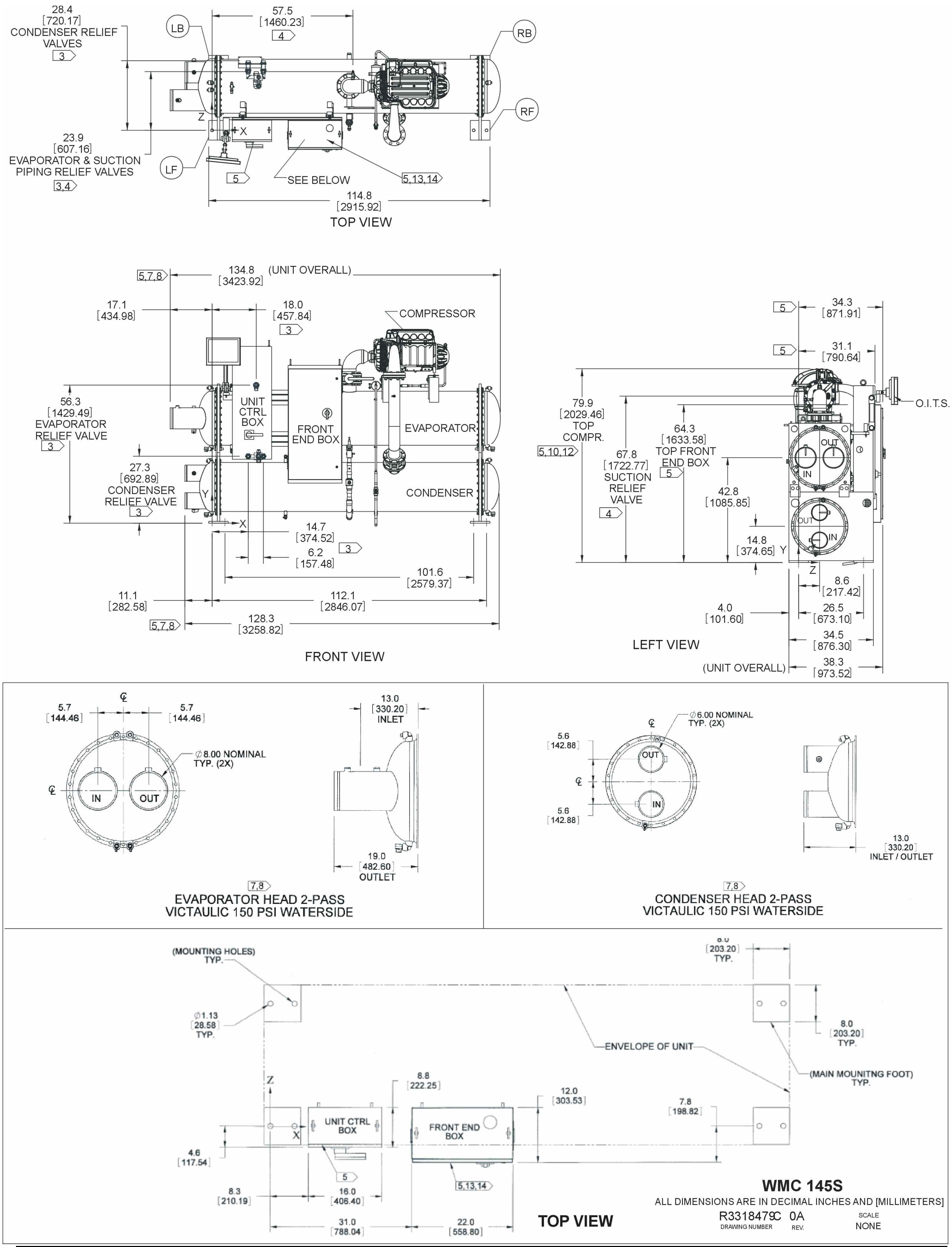


Figure 6, **WMC 145D** *(See page 14 for notes.)*

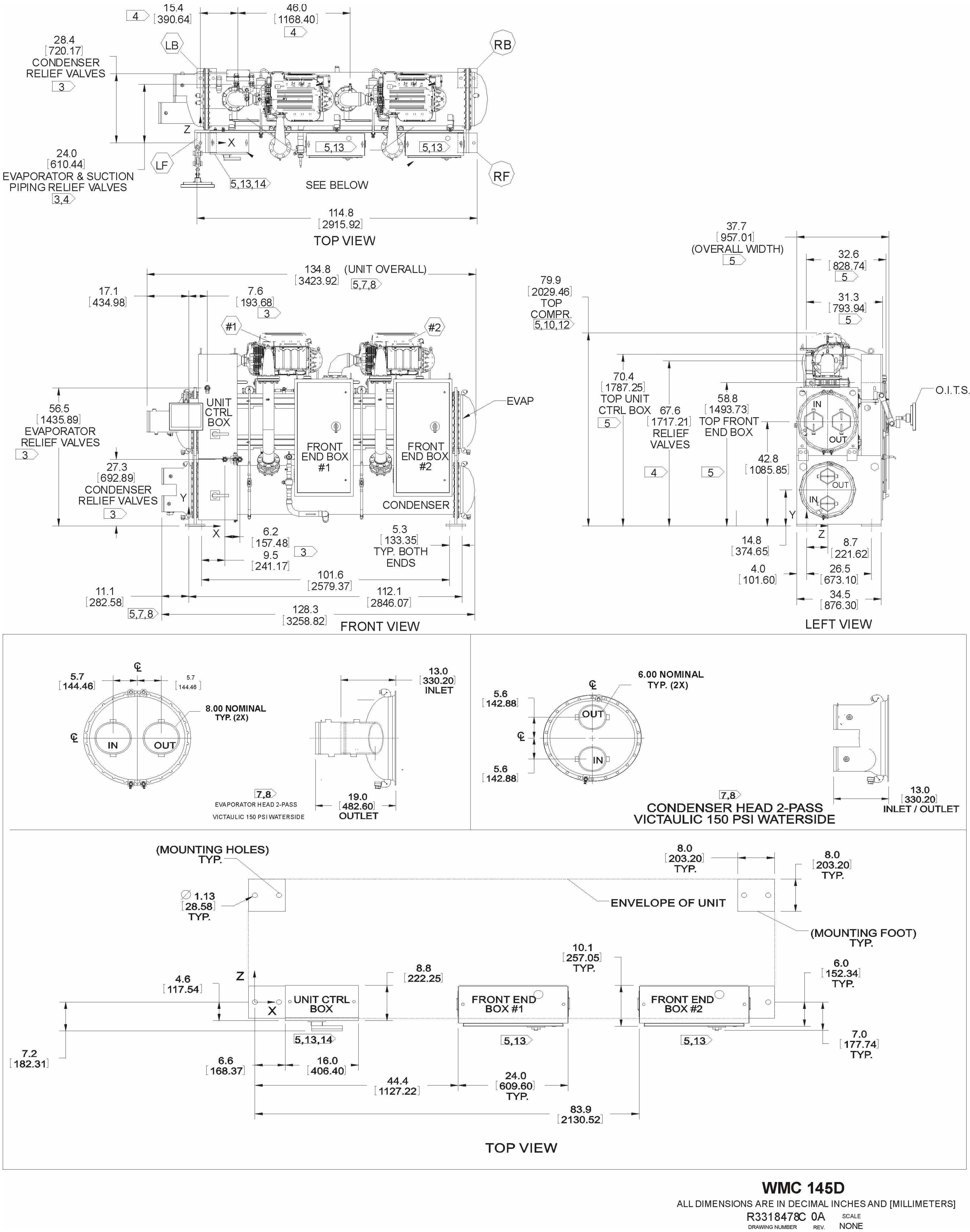


Figure 7,* WMC 150D*, 2-Pass Evaporator, 2-Pass Condenser (* See page 14 for notes*.)

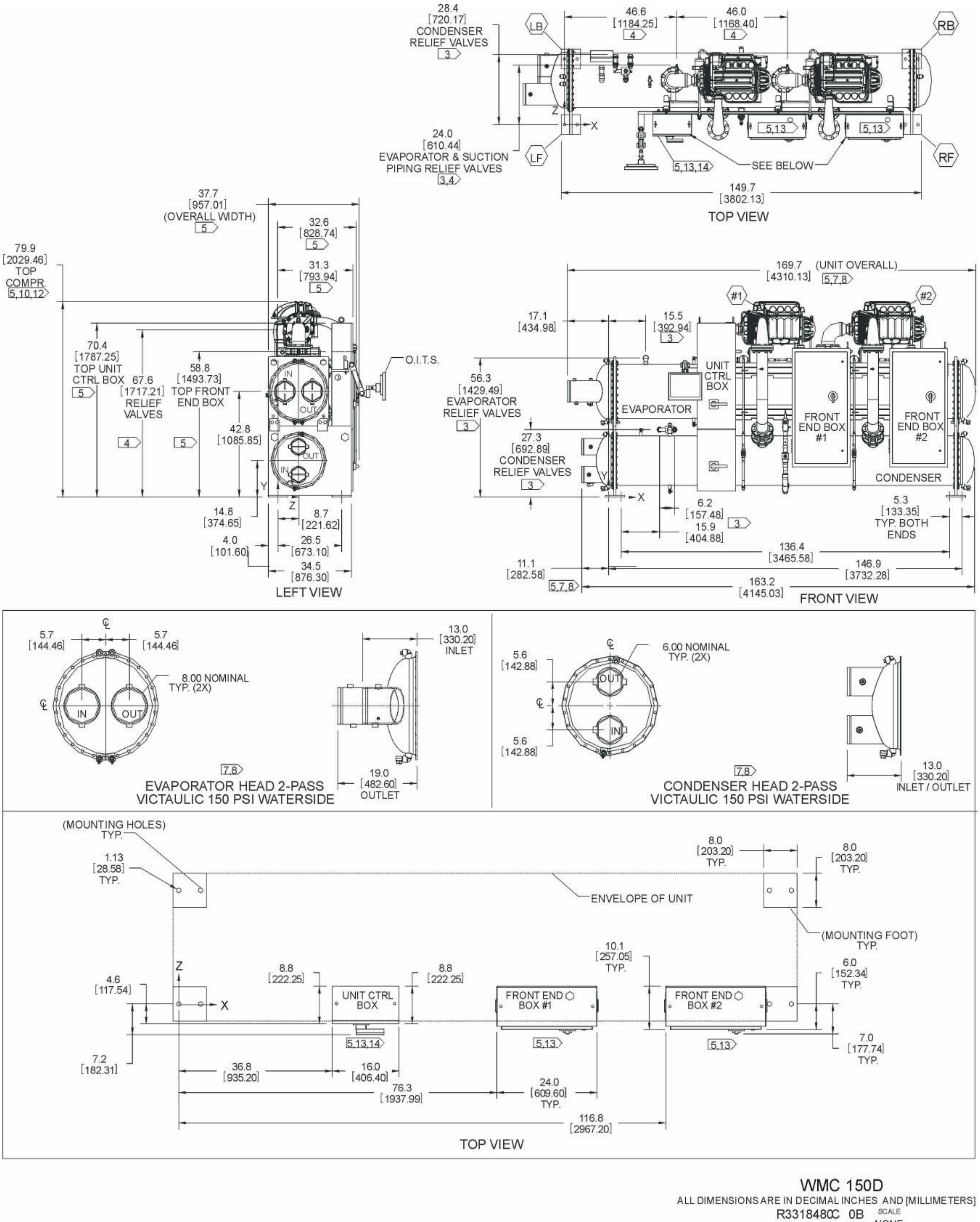


Figure 8, **WM C 250D***, 2-Pass Evaporator, 2-Pass Condenser*

(NOTE: See page 14 for notes.)

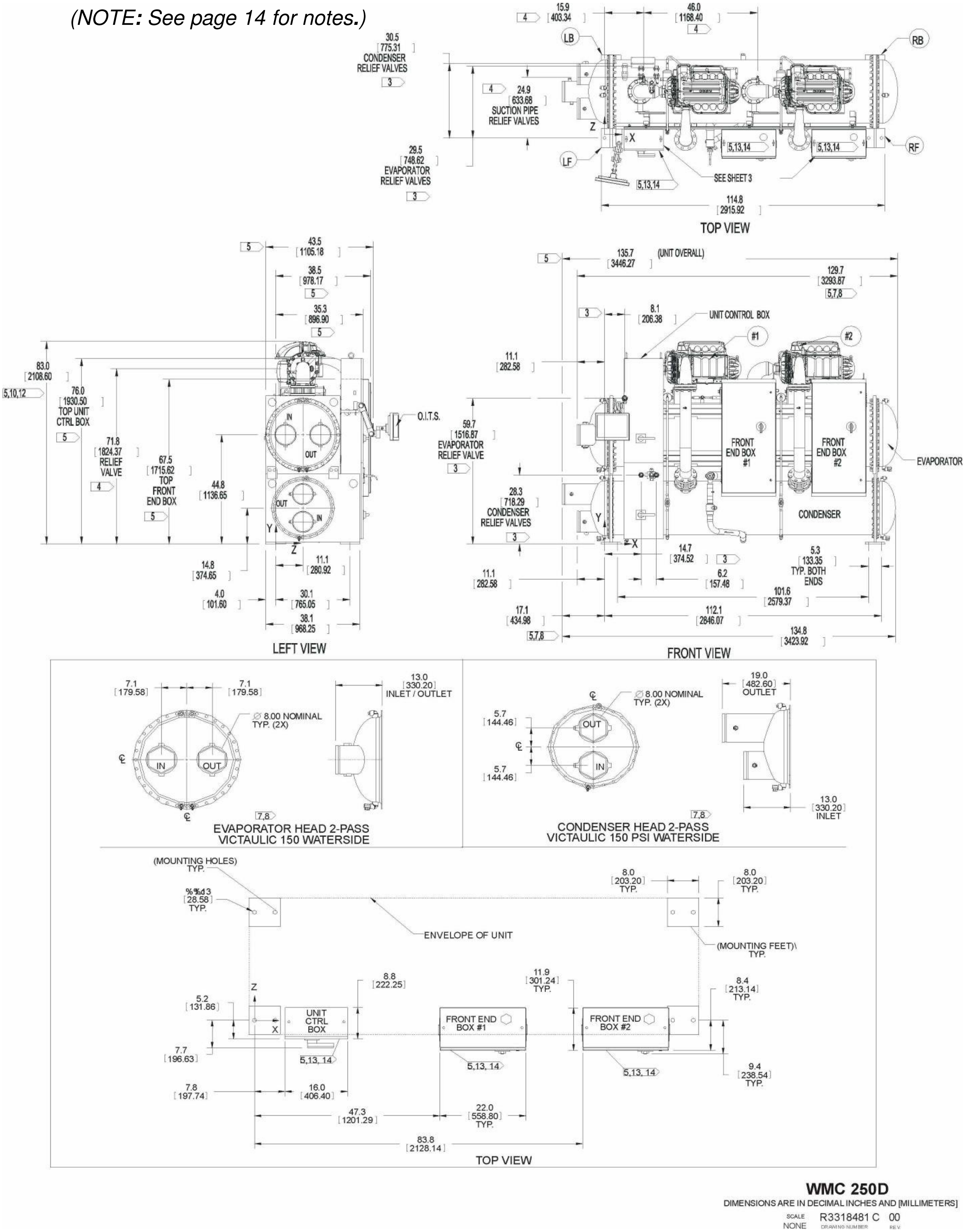
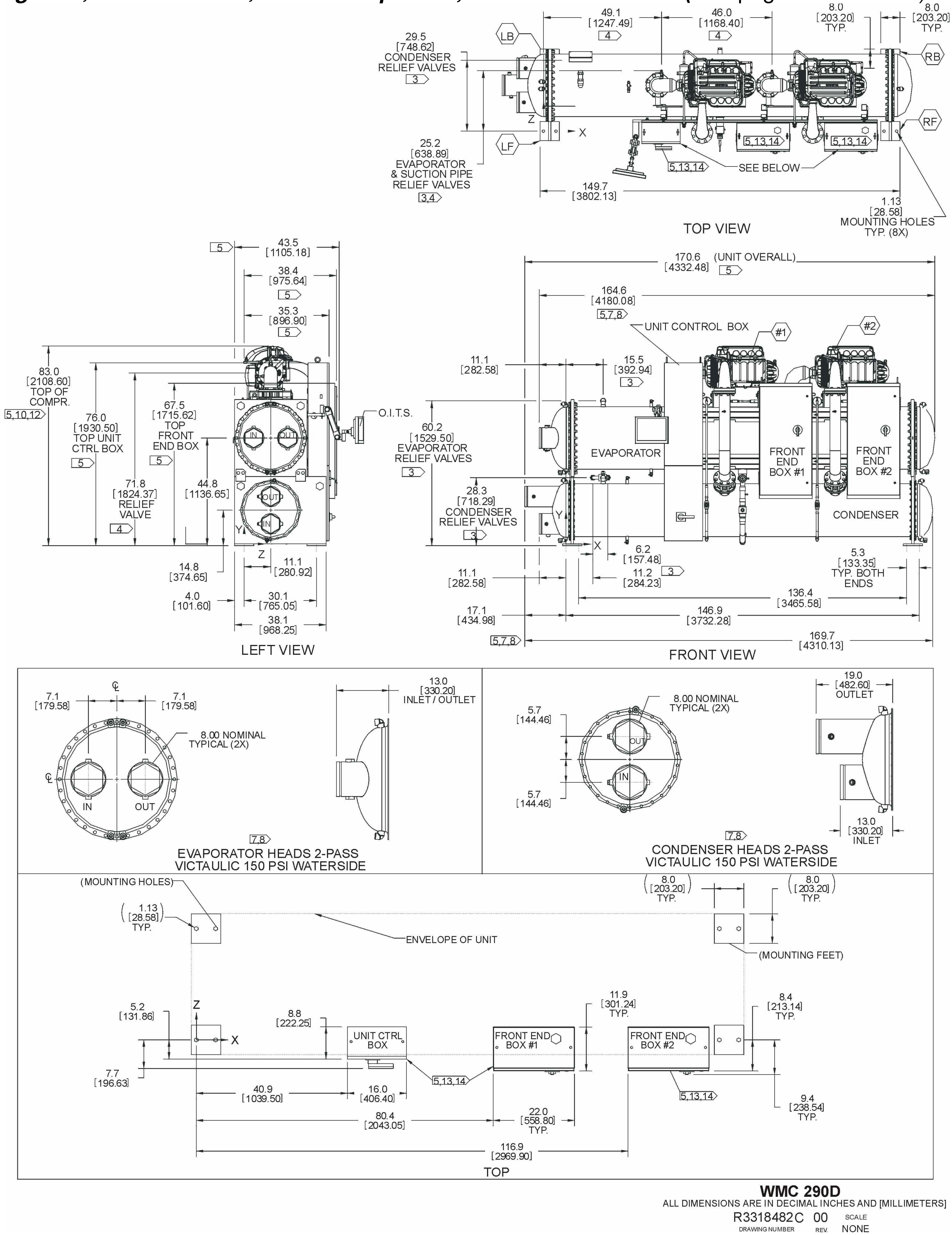


Figure 9, **WMC 290D***, 2-Pass Evaporator, 2- Pass Condenser* (*See* page 14 *for notes.*)



Drawing Notes

NOTES:

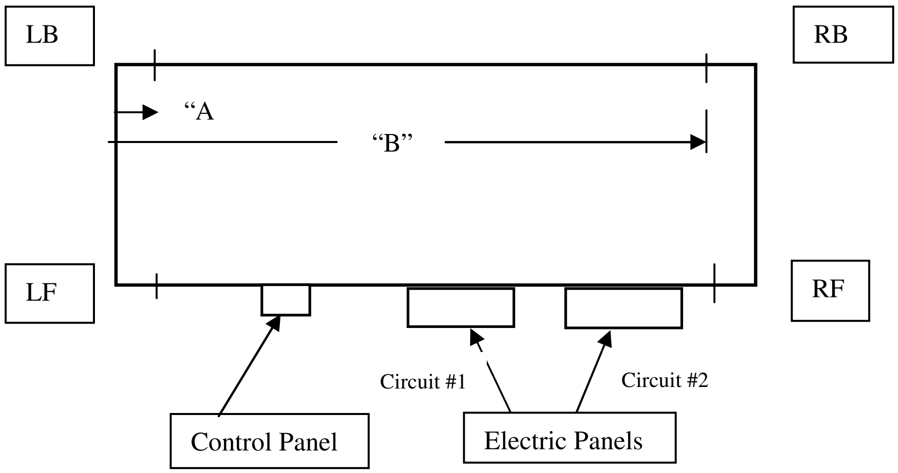
1. All dimensions are in Inches and [Millimeters] unless noted otherwise.
2. Final connections must allow for .500 inch +/- [12.7mm] manufacturing tolerances.
3. 1.00-inch FPT [25.4 mm] evaporator and condenser relief valves must be piped per ANSI / ASHRAE 15. Number of relief valves is 1 per evaporator and 2 per condenser.
4. .375 inch [9 mm] suction nozzle relief valve must be piped per ANSI / ASHRAE 15.
5. Clearances:
   Ends, 108 inches (2743 mm) on WMC 145, WMC 150 with 9 foot tubes, and WMC 250
   144 inches (3658 mm) on WMC 150 with 12 foot tubes and WMC 290
   plus 36 inches (910) is required at either end of the tube sheet for tube maintenance. If clearance is at the connection end, do not bloct tube access with piping, pumps, etc.
   Sides 36 inches (914 mm) is recommended on all other sides and top for service clearance.
   Electric Panels Most codes require 48 inches (1219 mm) clearance in front of the control boxes and electrical panels.
6. 3.25-inch [83mm] diameter lifting holes are provided. See installation manual for lifting instructions.
7. All water connections are given in standard U.S. pipe sizes. Standard connections are suitable for welding or victaulic couplings.
8. Unit shown has standard left-hand water connections. Right-hand connections are available for either vessel. For right hand evaporator the inlet and outlet nozzles are reversed. ANSI-flanged connections are available upon request. When using ANSI-flanged connections add .500 inch [13 mm] to each flanged end.
9. Dimensions shown are for units (evaporator / condenser) with standard design pressures. The refrigerant side design pressure is 200 PSI {1380 kPa} and the waterside design pressure is 150 PSI {1034 kPa}. Consult the factory for unit dimensions with higher design pressures.
10. The unit vibration isolator pads are provided for field installation. When fully loaded - .250 inches [6 mm] thick.
11. These values are for units with standard wall thickness copper tubing only.
12. The shipping skid, when used, adds 4.00 inches [105 mm] to the overall unit height.
13. If main power wiring is brought up through the floor, this wiring must be outside the envelope of the unit.
14. Typical wiring connections to the compressor control box are multi-power wiring into the top of each box. The unit control box has a lower section that contains a disconnect switch when the optional single-point connection is selected and is the landing point for the power connection. Otherwise it is empty.
15. The unit is shipped with an operating charge of refrigerant.
16. Optional marine water box connections are available upon request.

Table 3, Overall Dimensions, 2-Pass Vessels

In. (mm)	WMC 145S, WMC 145D		WMC 150		WMC 250		WMC 290	
	Same End	Opp. End	Same End	Opp. End	Same End	Opp. End	Same End	Opp. End
Length	135 (3429)	141 (3581)	171 (4343)	177 (4496)	135 (3429)	141 (3581)	171 (4343)	177 (4496)
Width	39 (991)	39 (991)	35 (889)	35 (889)	44 (1117)	44 (1117)	44 (1117)	44 (1117)
Height	80 (2032)	80 (2032)	80 (2032)	80 (2032)	83 (2108)	83 (2108)	83 (2108)	83 (2108)

Mounting/Lifting Weights

Figure 10



WMC Model	Vessel Models (Size)	Shipping Weight, lbs (kg)					Lifting Location inch (mm)	
		LF	RF	LB	RB	Total	"A"	"B"
145S	E2209/C2009	1238 (561)	1146 (520)	1565 (710)	1450 (6580	5399 (2449)	4.0 (102)	112.0 (2845)
145D	E2209/C2209	1438 (652)	1440 (653)	1685 (765)	1688 (766)	6252 (2836)	4.0 (102)	112.0 (2845)
150D	E2212/C2012	1619 (735)	1750 (794)	1927 (874)	2083 (945)	7380 (3347)	4.0 (102)	147.0 (3734)
250D	E2609/C2209	1850 (839)	1829 (830)	1933 (877)	1911 (867)	7525 (3414)	4.0 (102)	112.0 (2845)
290D	E2612/C2212	2793 (1242)	2105 (955)	3399 (1542)	2611 (1184)	10,953 (4923)	4.0 (102)	147.0 (3734)

WMC Model	Vessel Models (Size)	Mounting (Operating) Weight, lbs (kg)				
		LF	RF	LB	RB	Total
145S	E2209/C2009	1346 (611)	1260 (572)	1811 (821)	1695 (769)	6113 (2773)
145D	E2209/C2209	1518 (689)	1421 (645)	2042 (926)	1912 (867)	6894 (3127)
150D	E2212/C2012	1756 (797)	1883 (854)	2222 (1008)	2382 (1080)	8242 (3739)
250D	E2609/C2209	2015 (9140	1995 (905)	2236 (1544)	2213 (1004)	8459 (3837)
290D	E2612/C2212	3022 (1371)	2401 (1090)	3901 (1770)	3099 (1406)	12422 (5635)

NOTES:

1. The block shown above is the mounting footprint, not the entire unit footprint.
2. Lifting holes in the top of the tube sheets are 3.25-inch diameter. Mounting holes in the feet are 1.125-inch diameter.

Pressure Drop Curves

Figure 11, WMC 150, Evaporator Pressure Drops

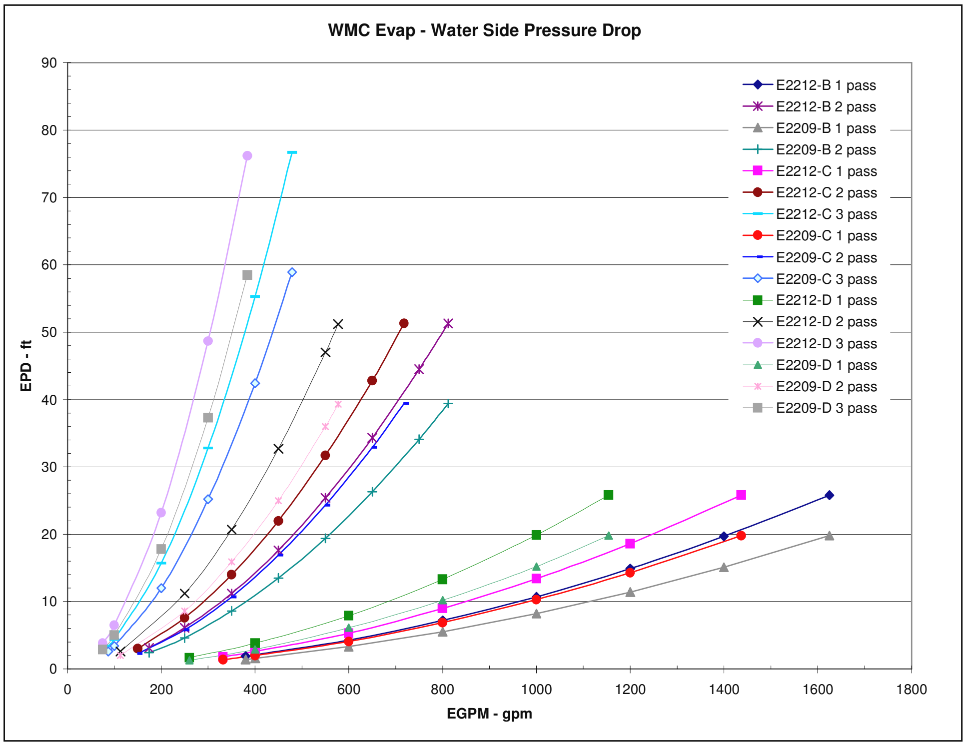
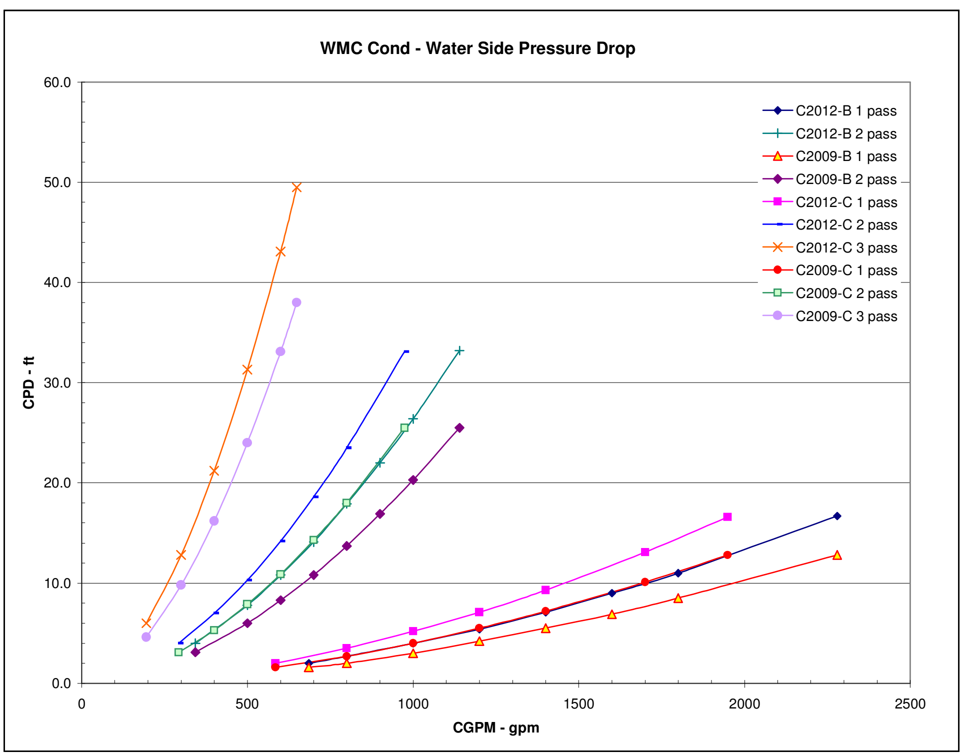
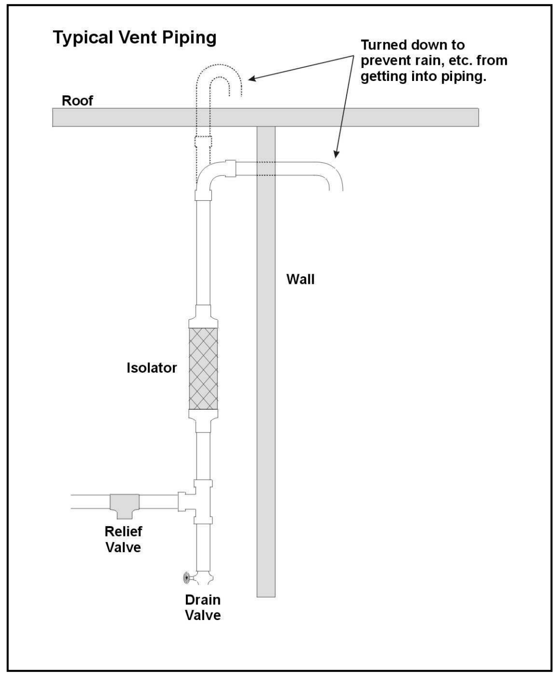


Figure 12, WMC 150, Condenser Pressure Drops



Relief Valves

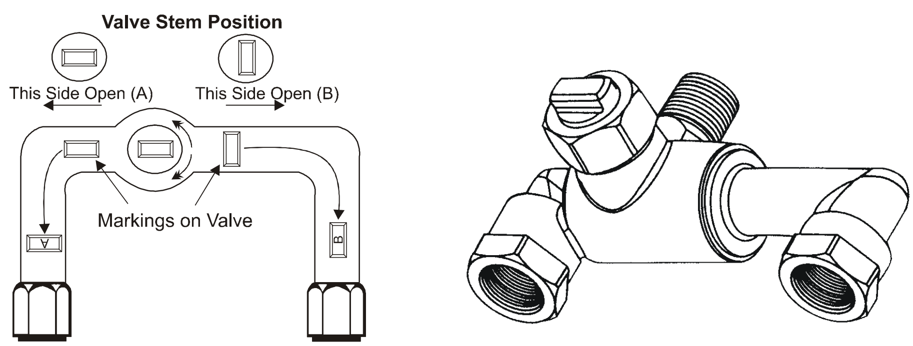
As a safety precaution and to meet code requirements, each chiller is equipped with pressure relief valves located on the condenser and evaporator for the purpose of relieving excessive refrigerant pressure (caused by equipment malfunction, fire, etc.) to the atmosphere. Most codes require that relief valves be vented to the outside of a building and this is a desirable practice for all installations. Relief piping connections to the relief valves must have flexible connectors.



Note: Remove plastic shipping plugs (if installed) from the inside of the valves prior to making pipe connections. Whenever vent piping is installed, the lines must be run in accordance with local code requirements; where local codes do not apply, the latest issue of ANSI/ASHRAE Standard 15 code recommendations must be followed.

Condensers have two relief valves as a set with a three-way valve separating the two valves. One valve remains active at all times and the second valve acts as a standby.

Figure 13, Condenser 3-Way Relief Valve



Refrigerant Vent Piping

Relief valve connection sizes are one-inch FPT and are in the quantity shown in Table 1 and Table 2 on page 8. Twin relief valves mounted on a transfer valve are used on the condenser so that one relief valve can be shut off and removed, leaving the other in operation. Only one of the two is in operation at any time.

Vent piping is sized for only one valve of the set (but connected to both) since only one can be in operation at a time. In no case would a combination of evaporator and condenser sizes require more refrigerant than the pumpdown capacity of the condenser. Condenser pumpdown capacities are based on the current ANSI/ASHRAE Standard 15 that recommend 90% full at 90°F (32°C). To convert values to the older ARI standard, multiply pumpdown capacity by 0.888.

Sizing Vent Piping (ASHRAE Method)

Relief valve pipe sizing is based on the discharge capacity for the given evaporator or condenser and the length of piping to be run. Discharge capacity for R-134a vessels is calculated using a complicated equation that accounts for equivalent length of pipe, valve capacity, Moody friction factor, pipe ID, outlet pressure and back pressure. The formula and tables are contained in ASHRAE Standard 15-2001.

The McQuay WMC centrifugal units have a relief valve setting of 200 psi.

Using the ASHRAE formula and basing calculations on the 225 psi design yields a conservative pipe size, which is summarized in Table 4. The table gives the pipe size required *per relief valve*. When valves are piped together, the common piping must follow the rules set out in the following paragraph on common piping.

Table 4. Relief Valve Piping Sizes

Equivalent length (ft)	2.2	18.5	105.8	296.7	973.6	4117.4
Pipe Size inch (NPT)	1 1/4	1 1/2	2	2 1/2	3	4
Moody Factor	0.0209	0.0202	0.0190	0.0182	0.0173	0.0163

NOTE: A 1-inch pipe is too small to handle these valves. A pipe increaser must always be installed at the valve outlet.

Common Piping

According to ASHRAE Standard 15, the pipe size cannot be less than the relief valve outlet size. The discharge from more than one relief valve can be run into a common header, the area of which cannot be less than the sum of the areas of the connected pipes. For further details, refer to ASHRAE Standard 15. The common header can be calculated by the formula:

$$D_{Common} = \left(D_1^2 + D_2^2 .... D_n^2 \right)^{0.5}$$

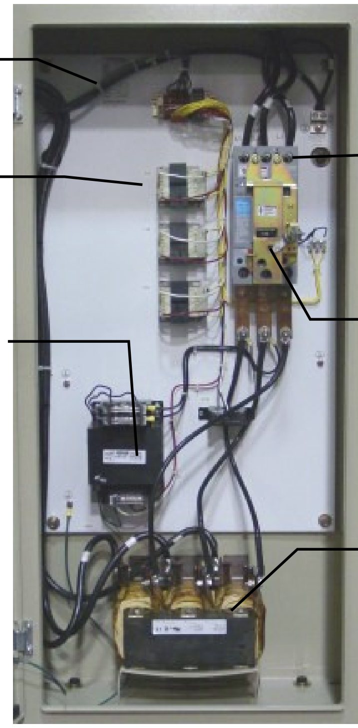
The above information is a guide only. Consult local codes and/or latest version of ASHRAE Standard 15 for sizing data.

Electrical Data

Wiring, fuse and wire size must be in accordance with the National Electric Code (NEC).

Important: The voltage to these units must be within ±10% of nameplate voltage, and the voltage unbalance between phases must not exceed 2%. Since a 2% voltage unbalance will cause a current unbalance of 6 to 10 times the voltage unbalance per NEMA MG-1, 1998 Standard, it is most important that the unbalance between phases be kept at a minimum.

Figure 14, Electrical Panel, Multi-Point Connection



Power Wiring

The standard power wiring connection to WMC chillers is multi-point, i.e. a separate power supply to each circuit's terminal box. Single-point connection to a terminal box, located under the low voltage control panel, is available as an option, in which case the individual circuit breakers for each circuit are retained. The single point connection is to a standard power block or optional single unit disconnect switch.

The electrical panel (as shown to the right) contains the circuit breaker/ disconnect (standard on both multi-point connection and single-point connection), a line reactor, and a radio frequency (RF) filter. The circuit breakers provide compressor overload protection.

Proper phase sequence to the unit is not required as far as the unit operation is concerned. Correct motor rotation is established by the chiller control system regardless of the connected phase sequence.

⚠ DANGER

Qualified and licensed electricians must perform wiring. An electrical shock hazard exists that can cause severe injury or death.

Table 5, WMC Electrical Connections

Power Connection		Standard Amp Rating		High Short Circuit Current Rating, HSCC	
		Power Block	**Disconnect**	**Power Block**	**Disconnect**
Single-point	Single-point Terminal Box	Standard Rated Power Block	Standard Rated Molded Case Disc. Switch	Not Available	HSCC Rated Circuit Breaker
	Each Compressor Electric Box	Standard Rated Circuit Breaker	Standard Rated Circuit Breaker		HSCC Rated Circuit Breaker
Multi-point		Not Available	(2) Standard Rated Circuit Breakers	Not Available	(2) HSCC Rated Circuit Breakers

NOTES

1. Bold type combination is standard offering, all other combinations are options.
2. Circuit breakers have through-the-door disconnect switch handle.
3. When HSCC rating is included, the entire two compressor electric boxes, and single-point box if ordered, are HSCC rated. HSCCR at 460volts is 65 kA.

General Note: The RLA for use in the following tables is obtained by the selection of a specific unit by McQuay. When shipped, a unit will bear the specific RLA, stamped on the nameplate, for the selected operating conditions. The tables below are for 60 Hz, 460 volts and 50 Hz, 400 volts.

WMC 145S, Single Compressor

Table 6, Standard Single Point Connection,

1 Compressor Only

RLA (Per Compressor)	LRA	Minimum Circuit Ampacity (MCA)	Field Wire		Max Fuse Size
			Quantity	Wire GA	
79 to 80 Amps	110	97 to 100	3	3 GA	175 Amps
81 to 88 Amps	110	101 to 110	3	2 GA	175 Amps
89 to 92 Amps	110	111 to 115	3	2 GA	200 Amps
93 to 99 Amps	110	116 to 123	3	1 GA	200 Amps
100 Amps	110	125	3	1 GA	225 Amps
101 to 104 Amps	132	126 to 130	3	1 GA	225 Amps
105 to 111 Amps	132	131 to 138	3	1/0	225 Amps
112 to 120 Amps	132	140 to 150	3	1/0	250 Amps
121 to 133 Amps	154	151 to 166	3	2/0	250 Amps
134 to 140 Amps	154	167 to 175	3	2/0	300 Amps
*141 to 150 Amps	165	176 to 187	3	3/0	300 Amps

*50 Hz TT-400 Compressor only

Table 7, Disconnect Switch Size

RLA	Single Point Connection
	Disconnect Switch only
79 to 100 Amps	175 Amps
101 to 150 Amps	225 Amps

NOTE: Disconnect Switch will also be a Circuit Breaker.

WMC 145D, 150D Dual Compressors

Multi-point Connection, Standard

Table 8, WMC 145D, 150D Electrical Data

RLA (Per Compressor)	LRA	Minimum Circuit Ampacity (MCA)	Field Wire		Max Fuse Size
			Quantity	Wire GA	
52 to 55 Amps	72	65 to 69	3	4 GA	110 Amps
56 to 65 Amps	72	70 to 82	3	4 GA	125 Amps
68 to 77 Amps	94	85 to 97	3	3 GA	150 Amps
78 to 85 Amps	94	98 to 107	3	2 GA	175 Amps
89 to 91 Amps	124	112 to 114	3	2 GA	200 Amps
92 to 103 Amps	124	115 to 129	3	1 GA	200 Amps
104 to 110 Amps	124	130 to 138	3	1/0	225 Amps
111 to 113 Amps	124	139 to 142	3	1/0	250 Amps

NOTES

1. Data is for each of two circuits – 1 compressor per circuit
2. See Notes on page 19.

Single-point Connection, Optional

Table 9, WMC 145D, 150D Electrical Data

RLA (Per Compressor)	LRA	Minimum Circuit Ampacity (MCA)	Field Wire		Max Fuse Size
			Quantity	Wire GA	
52 to 53 Amps	72	117 to 120	3	1 GA	150 Amps
54 to 57 Amps	72	122 to 129	3	1 GA	175 Amps
58 to 61 Amps	72	131 to 138	3	1/0	175 Amps
62 to 65 Amps	72	140 to 147	3	1/0	200 Amps
68 to 69 Amps	94	153 to 156	3	2/0	200 Amps
70 to 76 Amps	94	158 to 171	3	2/0	225 Amps
77 to 85 Amps	94	174 to 192	3	3/0	250 Amps
89 to 92 Amps	124	201 to 207	3	4/0	250 Amps
93 to 102 Amps	124	210 to 230	3	4/0	300 Amps
103 to 107 Amps	124	232 to 241	3	250	300 Amps
108 to 113 Amps	124	243 to 255	3	250	350 Amps

NOTE: Total Unit – 2 Compressors per Unit (RLA per Compressor)

Single Point and Multi-point Connection

Table 10, WMC 145D, 150D Single and Multi-Point Connections

RLA (Per Compressor)	Multi-Point Connection Disconnect Switch only	Single Point Connection	
		Power Block	Disconnect Switch
52 to 65 Amps	100 Amps	335 Amps	400 Amps
68 to 85 Amps	150 Amps		
89 to 113 Amps	175 Amps		

NOTES:

1. Disconnect switch will also be a circuit breaker.
2. A circuit breaker is supplied in each circuit after the power block or molded case disconnect switch.

WMC250D and 290D Dual Compressor

Multi-Point Connection, Standard

RLA (Per Compressor)	LRA	Minimum Circuit Ampacity (MCA)	Field Wire		Max Fuse Size
			Quantity	Wire GA	
79 to 80 Amps	110	97 to 100	3	3 GA	175 Amps
81 to 88 Amps	110	101 to 110	3	2 GA	175 Amps
89 to 92 Amps	110	111 to 115	3	2 GA	200 Amps
93 to 99 Amps	110	116 to 123	3	1 GA	200 Amps
100 Amps	110	125	3	1 GA	225 Amps
101 to 104 Amps	132	126 to 130	3	1 GA	225 Amps
105 to 111 Amps	132	131 to 138	3	1/0	225 Amps
112 to 120 Amps	132	140 to 150	3	1/0	250 Amps
121 to 133 Amps	154	151 to 166	3	2/0	250 Amps
134 to 140 Amps	154	167 to 175	3	2/0	300 Amps
141 to 150 Amps)Note 1)	165	176 to 187	3	3/0	300 Amps

NOTES:

1. 50 Hz TT-400 Compressor only
2. Each Circuit – 1 Compressor per Circuit

Single Point Connection, Optional

RLA (Per Compressor)	LRA	Minimum Circuit Ampacity (MCA)	Field Wire		Max Fuse Size
			Quantity	Wire GA	
79 to 88 Amps	110	176 to 199	3	4/0	250 Amps
89 to 92 Amps	110	201 to 208	3	250 MCM	250 Amps
93 to 100 Amps	110	210 to 226	3	250 MCM	300 Amps
101 to 107 Amps	132	228 to 241	3	250 MCM	300 Amps
108 to 113 Amps	132	244 to 255	3	250 MCM	350 Amps
114 to 120 Amps	132	257 to 271	3	300 MCM	350 Amps
121 to 123 Amps	154	273 to 277	3	300 MCM	350 Amps
124 to 126 Amps	154	280 to 284	3	300 MCM	400 Amps
127 to 137 Amps	154	286 to 309	3	350 MCM	400 Amps
138 Amps	154	311	3	400 MCM	400 Amps
139 to 140 Amps	154	313 to 316	3	400 MCM	450 Amps
141 to 148 Amps (Note 1)	165	318 to 334	3	400 MCM	450 Amps
149 to 150 Amps (Note 1)	165	336 to 338	3	500 MCM	450 Amps

NOTES:

1. 50 Hz TT-400 Compressor only
2. Total Unit – 2 Compressors per Unit (RLA Per Compressor)

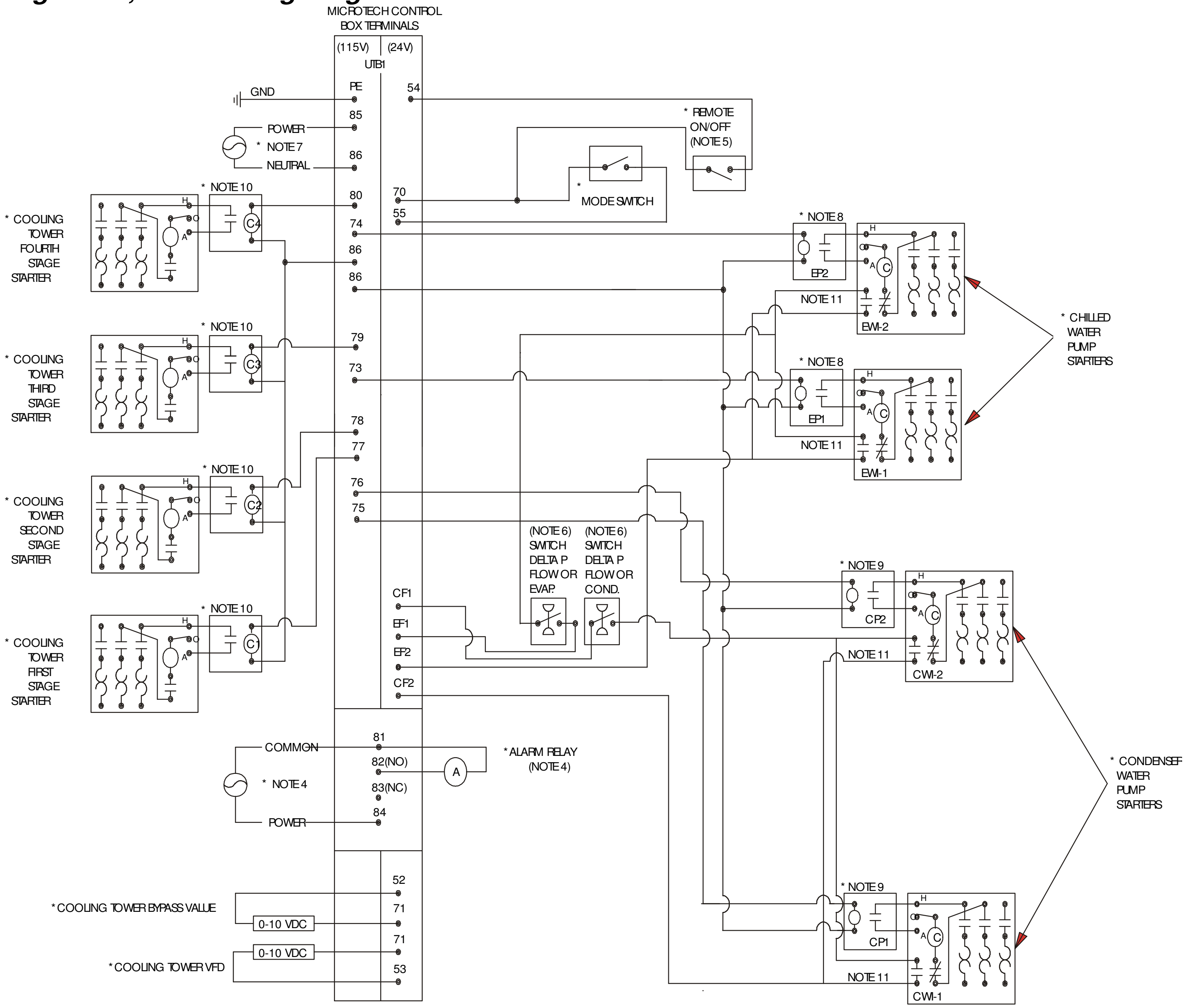
Table 11, Single Point and Multi-point Connection

RLA (Per Compressor)	Multi-Point Connection	Single Point Connection	
	Disconnect Switch only	Power Block	Disconnect Switch
79 to 100 Amps	175 Amps	335 Amps	250 Amps
101 to 150 Amps	225 Amps	380 Amps	400 Amps

NOTES:

1. Disconnect Switch will also be a Circuit Breaker.
2. Circuit Breaker in each circuit after Power Block or Molded Disconnect Switch.

Figure 15, Field Wiring Diagram



Field Wiring Diagram Notes

1. Compressor terminal boxes are factory-mounted and wired. All line-side wiring must be in accordance with the NEC and be made with copper wire and copper lugs only. Power wiring between the terminal box and compressor terminals is factory installed.
2. Minimum wire size for 115 VAC is 12 ga. for a maximum length of 50 feet. If greater than 50 feet refer to McQuay for recommended wire size minimum. Wire size for 24 VAC is 18 ga. All wiring to be installed as NEC Class 1 wiring system. All 24 VAC wiring must be run in separate conduit from 115 VAC wiring. Wiring must be wired in accordance with NEC and connection to be made with copper wire and copper lugs only.
3. Voltage unbalance not to exceed 2% with a resultant current unbalance of 6 to 10 times the voltage unbalance per NEMA MG-1, 1998 Standard.
4. A customer furnished 24 or 120 vac power for alarm relay coil may be connected between UTB1 terminals 84 power and 81 neutral of the control panel. For normally open contacts wire between 82 & 81. For normally closed wire between 83 & 81. The alarm is operator programmable. Maximum rating of the alarm relay coil is 25VA.
5. Remote on/off control of unit can be accomplished by installing a set of dry contacts between terminals 70 and 54.
6. If field supplied pressure differential switches are used, they must be installed across the vessel and not the pump. They must be suitable for 24 vac and low current application.
7. Customer supplied 115 VAC 20 amp power for optional evaporator and condenser water pump control power and tower fans is supplied to unit control terminals (UTB1) 85 power / 86 neutral, PE equipment ground.

8. Optional customer supplied 115 VAC, 25-VA maximum coil rated, chilled water pump relay (ep1 & 2) may be wired as shown. This option will cycle the chilled water pump in response to chiller demand.
9. The condenser water pump must cycle with the unit. A customer supplied 115 VAC 25 VA maximum coil rated, condenser water pump relay (CP1 & 2) is to be wired as shown. Units with free-cooling must have condenser water above 60°F before starting.
10. Optional customer supplied 115 VAC 25 VA maximum coil rated cooling tower fan relays (C1 - C2 standard, C3-C4 optional) may be wired as shown. This option will cycle the cooling tower fans in order to maintain unit head pressure.
11. Auxiliary 24 VAC rated contacts in both the chilled water and condenser water pump starters must be wired as shown.
12. 4-20mA external signal for chilled water reset are wired to terminals 71 and 51 on the unit controller; load limit is wired to terminals 71 and 58 on the unit controller.
13. Optional Control Inputs. The following 4-20 ma optional inputs are connected as shown:
    - Demand Limit; Terminals 58 and 71 common
    - Chilled Water Reset; Terminals 51 and 71 common
    - Evaporator Water Flow; Terminals 59 and 71 common
    - Condenser Water Flow; Terminals 60 and 71 common
14. Optional Control Power Source. 115 volt control power can be supplied from a separate circuit and fused at 20 amps inductive load. Connection is to terminals 85 and 86 common.
15. 4-20 mA external signal for chilled water reset are wired to terminals 71 and 51 on the unit controller; load limit is wired to terminals 71 and 58 on the unit controller.

Care must be taken when attaching leads to compressor terminals to assure proper sequencing and connection torque.

Control Wiring

The control circuit on the McQuay centrifugal packaged chiller is designed for 115-volts. Control power is supplied from a factory-wired transformer located in the electrical box.

Use with On-Site Generators

WMC chillers have their total tonnage divided between two compressors that start sequentially and they are operated with variable frequency drives. These features make WMC chillers especially appropriate for use in applications where they may be required to run with on-site electrical generators. This is particularly true when the generators are used for temporary power when the utility power is lost.

Generator Sizing: Gas and diesel generators are sensitive to the compressor's locked-rotor characteristics when the chillers start up. Use the electrical data supplied with the performance output sheet, obtained from the McQuay sales office, for generator sizing purposes. The chiller data sheet will show the RLA, which is for both compressors. Refer to the electrical data on page 19 to determine the LRA, based on the RLA. It is important to size the generator to handle the LRA at start up.

Starting/Stopping Procedure: The stopping of the chiller in the event of a power failure should be uneventful. The chiller will sense a loss of voltage and the compressors will stop, coasting down using power generated from their dynamic braking to maintain the bearing magnetic field. The stop signal will initiate a three-minute stop-to-start timer, effectively preventing compressor restart for three minutes. The timer is adjustable from three to fifteen minutes, but the recommended default value is three minutes. This interval allows the generator sufficient time to get up to speed and stabilize. The chiller will restart automatically when the start-to-start timer expires.

Transfer Back to Grid Power: Proper transfer from stand-by generator power back to grid power is essential to avoid compressor damage.

⚠ WARNING!

Stop the chiller before transferring supply power from the generator back to the utility power grid. Transferring power while the chiller is running can cause severe compressor damage..

The necessary procedure for reconnecting power from the generator back to the utility grid is show below. These procedures are not peculiar to McQuay units only, but should be observed for any chiller manufacturer.

1. Set the generator to always run five minutes longer than the unit start-to-start timer, which could be set from 15 to 60 minutes. The actual setting can be viewed on the operator interface panel on the Setpoint/Timer screen.
2. Configure the transfer switch, provided with the generator, to automatically shut down the chiller before transfer is made. This function can be accomplished through a BAS interface or with the "remote on/off" wiring connection shown in Figure 15. A start signal can be given anytime after the stop signal since the three-minute start-to-start timer will be in effect.

Chiller Control Power: For proper operation on standby power, the chiller control power must remain as factory-wired from a unit-mounted transformer. Do not supply chiller control power from an external power source because the chiller may not sense a loss of power and do a normal shutdown sequence.

System Pumps

Operation of the chilled water pump can be to 1) cycle the pump with the compressor, 2) operate continuously, or 3) start automatically by a remote source.

The cooling tower pump must cycle with the machine. The holding coil of the cooling tower pump motor starter must be rated at 115 volts, 60 Hz, with a maximum volt-amperage rating of 100. A control relay is required if the voltage-amperage rating is exceeded. See the Field Wiring Diagram on page 23 or in the cover of control panel for proper connections.

All interlock contacts must be rated for no less than 10 inductive amps. The alarm circuit provided in the control center utilizes 115-volts AC. The alarms must not draw more than 10-volt amperes.

VFD Line Harmonics

Despite their many benefits, care must be taken when applying VFDs due to the effect of line harmonics on the building electric system. VFDs cause distortion of the AC line because they are nonlinear loads, that is, they don't draw sinusoidal current from the line. They draw their current from only the peaks of the AC line, thereby flattening the top of the voltage waveform. Some other nonlinear loads are electronic ballasts and uninterruptible power supplies.

Line harmonics and their associated distortion can be critical to ac-drives for three reasons:

1. Current harmonics can cause additional heating to transformers, conductors, and switchgear.
2. Voltage harmonics upset the smooth voltage sinusoidal waveform.
3. High-frequency components of voltage distortion can interfere with signals transmitted on the AC line for some control systems.

The harmonics of concern are the 5th, 7th, 11th, and 13th. Even harmonics, harmonics divisible by three, and high magnitude harmonics are usually not a problem.

Current Harmonics

An increase in reactive impedance in front of the VFD helps reduce the harmonic currents. Reactive impedance can be added in the following ways:

1. Mount the drive far from the source transformer.
2. Add line reactors. They are standard equipment on WMC chillers.
3. Use an isolation transformer.
4. Use a harmonic filter.

Voltage Harmonics

Voltage distortion is caused by the flow of harmonic currents through a source impedance. A reduction in source impedance to the point of common coupling (PCC) will result in a reduction in voltage harmonics. This can be done in the following ways:

1. Keep the PCC as far from the drives (close to the power source) as possible.
2. Increase the size (decrease the impedance) of the source transformer.
3. Increase the capacity (decrease the impedance) of the busway or cables from the source to the PCC.
4. Make sure that added reactance is "downstream" (closer to the VFD than the source) from the PCC.

Line Reactors

Five-percent line reactors are standard equipment on WMC chillers and located in each compressors power panel. They are employed to improve the power factor by reducing the effects of harmonics.

Harmonic Filter

The harmonic filter is an option for field mounting and wiring outside of the power panel. It works in conjunction with the line reactor to further minimize harmonic distortion. It is wired between the line reactor and compressor. IEEE 519-1991 Standard defines acceptable limits.

See the WMC certified drawings for harmonic filter dimensions and wiring information.

EMI (Electro Magnetic Interference) and RFI (Radio Frequency Interference) Filter

This filter is a factory-installed option. The terms EMI and RFI are often used interchangeably. EMI is actually any frequency of electrical noise, whereas RFI is a specific subset of electrical noise on the EMI spectrum. There are two types of EMI. Conducted EMI is unwanted high frequencies that ride on the AC wave form.

EMI

Radiated EMI is similar to an unwanted radio broadcast being emitted from the power lines. There are many pieces of equipment that can generate EMI, variable frequency drives included. In the case of variable frequency drives, the electrical noise produced is primarily contained in the switching edges of the pulse width modulation (PWM) controller.

As the technology of drives evolves, switching frequencies increase. These increases also increase the effective edge frequencies produced, thereby increasing the amount of electrical noise.

The power line noise emissions associated with variable frequency and variable speed drives can cause disturbances in nearby equipment. Typical disturbances include:

- Dimmer and ballast instability
- Lighting disturbances such as flashing
- Poor radio reception
- Poor television reception
- Instability of control systems
- Flow meter totalizing
- Flow metering fluctuation
- Computer system failures including the loss of data
- Thermostat control problems
- Radar disruption
- Sonar disruption

RFI

Three-phase filters are supplied as an option for factory mounting in the compressor power panels. They use a combination of high frequency inductors and capacitors to reduce noise in the critical 150 kHz to 30 MHz frequency range. The inductors act as open circuits and the capacitors act as short circuits at high frequencies while allowing the lower power line frequencies to pass untouched. The filters assist with cost effective compliance to Electro Magnetic Compatibility (EMC) directives, in a compact, efficient, light-weight design. The high common mode and differential mode reduction in the critical 150kHz to 30MHz frequencies assures that potential interference from AC drives is reduced or eliminated.

The filters are current-rated devices. In order to properly size a filter, it is necessary to know the operating voltage and the input current rating of the drive. No derating or re-rating is necessary when applying the filter at voltages that are less than or equal to the maximum voltage listed on the filter.

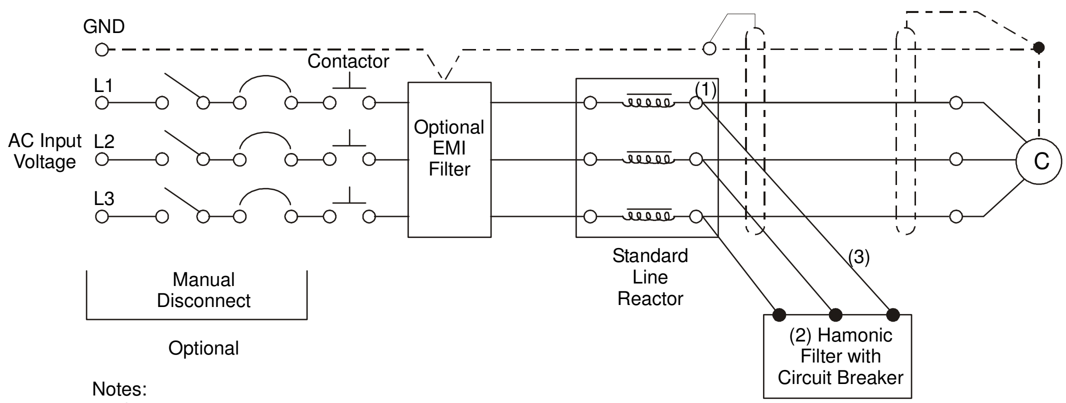
The IEEE 519-1991 Standard

The Institute of Electrical and Electronics Engineers (IEEE) has developed a standard that defines acceptable limits of system current and voltage distortion. A simple form is available from McQuay that allows McQuay to determine compliance with IEEE 519-1991.

Line reactors, isolation transformers, or phase-shifting transformers can be required on some installations.

Figure 16, Typical WMC Power Wiring

WMC Wiring



Notes:
(1) Single hole, crimp type compression terminal required.
(2) Connect to filter circuit breaker lugs.
(3) Conductors to be sized for 125 minimum circuit ampacity.
Size 1 AWG, 75°C wire recommended.

Multiple Chiller Setup

WMC dual compressor units have their main control components factory wired to an internal network so that the components can communicate with each other, within the chiller itself.

On multi-chiller WMC applications, two WMC chillers can be interconnected by simple field RS485 interconnecting wiring, the addition of an accessory communication isolation board(s) 485OPDR (McQuay P/N 330276202), and some MicroTech II control settings. The 485OPDR isolation board can be purchased with the unit or separately, during or after chiller installation. Only one board is required required. WMC chillers cannot be interconnected with WSC, WDC, or WCC chillers.

Communication Setup

Interconnecting MicroTech II pLAN RS485 wiring should be installed by the installing contractor prior to start-up. The McQuay start-up technician will check the connections and make the necessary set point settings.

1. With no pLAN connections between chillers, disconnect chiller control power and set the DIP switches as shown in Table 12.
2. With all manual switches off, turn on control power to each chiller and set each OITS address (see Note 2 on page 28).
3. Verify correct nodes on each OITS Service Screen.
4. Connect chillers together (RS485 wiring) as shown in Figure 16. The first chiller in the connection can be designated as Chiller A. The isolation board is attached to the DIN rail adjacent to the Chiller A unit controller. The isolation board has a pigtail that is plugged into J10 on the controller. Most chillers will already have a universal communication module (UCM) that connects the controller to the touchscreen already plugged onto J10. If this is the case, plug the isolation module pigtail into the empty RJ11 pLAN port on the UCM. This is equivalent to plugging into the unit controller directly.

   Next, interconnecting wiring is needed between Chiller A and Chiller B.

   Interconnection: Belden M9841 (RS 485 Spec Cable) is wired from the 485OPDR isolation board (terminals A, B, and C) on Chiller A to the J11 port on the unit controller of Chiller B. At J11, the shield connects to GND, the blue/white wire to the (+) connection, and the white/blue to the (-) connection.

   Note that Chiller B does not have, or need, an isolation board.
5. Verify correct nodes on each OITS Service Screen.

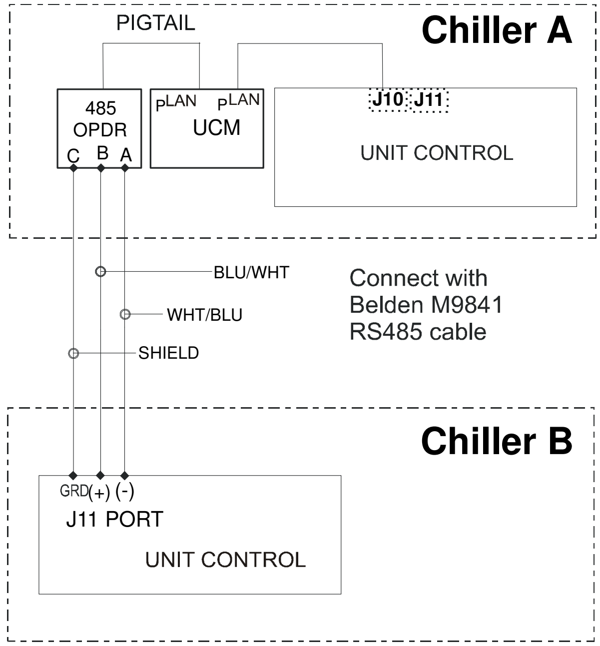
Table 12, Address DIP Switch Settings for Controllers Using pLAN.

Chiller (1)	Comp 1 Controller	Comp 2 Controller	Unit Controller	Reserved	Operator Interface (2)	Reserved
A	1	2	5	6	7	8
	100000	010000	101000	011000	111000	000100
B	9	10	13	14	15	16
	100100	010100	101100	011100	111100	000010

NOTES:

1. Up to four single or dual compressors can be interconnected.
2. The Operator Interface Touch Screen (OITS) setting is not a DIP switch setting. The OITS address is selected by selecting the 'service' set screen. Then, with the Technician level password active, select the 'pLAN Comm' button. Buttons A(7), B(15), C(23), D(31) will appear in the middle of the screen, then select the letter for the OITS address for the chiller that it is on. Then close the screen. Note that A is the default setting from the factory.
3. Six Binary Switches: Up is 'On', indicated by '1'. Down is 'Off', indicated by '0'**.**

Figure 17, Communication Wiring



MicroTech II Operator Interface Touch Screen (OITS) Settings

Settings for any type of linked multiple compressor operation must be made to the MicroTech II controller. Settings on a dual compressor unit are made in the factory prior to shipment, but must be verified in the field before startup. Settings for multiple chiller installations are set in the field on the Operator Interface Touch Screen as follows:

Maximum Compressors ON – SETPOINTS - MODES screen, Selection #10 '= 2 for a dual, 4 for 2 duals, 3 for three separate, single compressor chillers, etc. If all compressors in the system are to be available as normal running compressors, then the value entered in #10 should equal the total number of compressors. If any compressors are for standby and not operated in normal rotation, they should not be included in the compressor count in Selection #10. The Max Comp ON setting can be made in only one touchscreen, the system will observe the highest number set on all chillers-it is a global setting.

Sequence and Staging – SETPOINTS - MODES screen, Selection #12 & #14; #11 & #13. Sequence sets the sequence in which compressors will start. Setting one or more compressors to "1" evokes the automatic lead/lag feature and is the normal setting. The compressor with least starts will start first and the compressor with maximum hours will stop first, and so on. Units with higher numbers will stage on in sequence.

The Modes setpoints will do several different types of operation (Normal, Efficiency, Standby, etc.) as described in the operating manual.

The same Modes setting must be replicated on each chiller in the system.

Nominal Capacity – SETPOINTS - MOTOR screen, Selection #14. The setting is the compressor design tons. Compressors on dual units are always of equal capacity.

Operating Sequence

For multiple-chiller, parallel operation, the MicroTech II controllers are tied together by a communications network and stage and control compressor loading among the chillers. Each compressor, single or dual compressor chiller, will stage on or off depending on the sequence number programmed into it. For example, if all are set to “1”, the automatic lead/lag will be in effect.

When chiller #1 is fully loaded, the leaving chilled water temperature will rise slightly. When the Delta-T above setpoint reaches the Staging Delta-T, the next chiller scheduled to start will receive a start signal and start its pumps if they are set up to be controlled by the MicroTech II® controller. This procedure is repeated until all chillers are running. The compressors will load-balance themselves.

If any of the chillers in the group are dual compressor, they will stage and load according to the staging instructions.

See *OM WMC (current edition)* for a complete description of the various staging sequences available.

Prestart System Checklist

	Yes	No	N/A
Chilled Water			
Piping complete	☐	☐	☐
Water system filled, vented	☐	☐	☐
Pumps installed, (rotation checked), strainers cleaned............................	☐	☐	☐
Controls (3-way, face and bypass dampers, bypass valves, etc.) operable	☐	☐	☐
Water system operated and flow balanced to meet unit design requirements	☐	☐	☐
Condenser Water			
Cooling tower flushed, filled and vented	☐	☐	☐
Pumps installed, (rotation checked), strainers cleaned	☐	☐	☐
Controls (3-way, bypass valves, etc.) operable	☐	☐	☐
Water system operated and flow-balanced to meet unit requirements	☐	☐	☐
Electrical			
Power leads connected to the unit power panel(s)	☐	☐	☐
All interlock wiring complete between control panel and complies with specifications	☐	☐	☐
Pump starters and interlock wired	☐	☐	☐
Cooling tower fans and controls wired	☐	☐	☐
Wiring complies with National Electrical Code and local codes	☐	☐	☐
Condenser pump starting relay (CWR) installed and wired	☐	☐	☐
Miscellaneous			
Relief valve piping complete	☐	☐	☐
Thermometer wells, thermometers, gauges, control wells, controls, etc., installed	☐	☐	☐
Minimum system load of 80% of machine capacity available for testing and adjusting controls	☐	☐	☐
Control wiring between multiple units, if applicable...	☐	☐	☐

Note: This checklist must be completed and sent to the local McQuay Factory Service location two weeks prior to start-up.

Operation

Operator Responsibilities

It is important that the operator become familiar with the equipment and the system before attempting to operate the chiller.

During the initial startup of the chiller, the McQuay technician will be available to answer any questions and instruct in the proper operating procedures.

It is recommended that the operator maintain an operating log for each individual chiller unit. In addition, a separate maintenance log should be kept of the periodic maintenance and servicing activities.

Now that you have made an investment in modern, efficient McQuay equipment, its care and operation should be a high priority. For training information on all McQuay HVAC products, please visit us at www.mcquay.com and click on Training, or phone 540-248-0711 and ask for the Training Department. These sessions are structured to provide basic classroom instruction and include hands-on operating and troubleshooting exercises.

Compressor Operation

The WMC compressors are two-stage. Suction gas enters the compressor through inlet guide vanes that can be opened and closed to control refrigerant flow as the cooling load changes. The suction gas enters the first stage impeller, is compressed, and travels through the vaned radial diffuser to the second stage impeller where compression is completed. The gas travels to the condenser via the discharge volute, which converts any remaining velocity pressure to static pressure.

Motor cooling is accomplished by utilizing the refrigerant effect of high-pressure liquid refrigerant from the condenser expanded to a gas within the compressor. The refrigerant cools VFD heat sinks and the motor.

A five-axis magnetic bearing system supports the motor/compressor shaft, resisting radial and thrust forces. The bearing control system uses shaft position feedback to continually adjust the bearing to keep the shaft in the correct position. In the event of a power failure, the compressor motor acts as a generator and powers the bearing support system during coastdown. There is also a system to gently de-levitate the shaft.

Many controls are mounted directly on the compressor where they monitor and control compressor operation. These compressor controls are interfaced with the conventional MicroTech II controls to provide a complete chiller control system.

Operating Limits:

Maximum standby ambient temperature, 130°F (55°C)

Minimum operating ambient temperature (standard), 35°F (2°C)

Leaving chilled water range, 38°F to 60°F (3°C to 15°C)

Maximum operating evaporator inlet fluid temperature, 66°F (19°C)

Maximum startup evaporator inlet fluid temperature, 90°F (32°C)

Maximum non-operating inlet fluid temperature, 100°F (38°C)

Minimum condenser water entering temperature (with condenser bypass), 55°F (12.8°C)

Maximum entering condenser water temperature, 105°F (40.6°C)

Maximum leaving condenser water temperature, 115°F (46.1°C)

System Water Volume

It is important to have adequate water volume in the system to provide an opportunity for the chiller to sense a load change, adjust to the change, and stabilize. As the expected load change becomes more rapid, a greater water volume is needed. The system water volume is the total amount of water in the evaporator, air handling products and associated piping. If the water volume is too low, operational problems can occur including rapid compressor cycling, rapid loading and unloading of compressors, erratic refrigerant flow in the chiller, improper motor cooling, shortened equipment life and other undesirable consequences.

Some of the things the designer should consider when looking at water volume are the minimum cooling load, the minimum chiller plant capacity during the low load period and the desired cycle time for the compressors.

Assuming that there are no sudden load changes and that the chiller plant has reasonable turndown, a rule of thumb of "gallons of water volume equal to two to three times the chilled water gpm flow rate" is often used.

For process applications where the cooling load can change rapidly, additional system water volume is needed. A process example would be a quenching tank. The load would be very stable until the hot material is immersed in the water tank. Then, the load would increase drastically. For this type of application, system volume may need to be increased.

Since there are many other factors that can influence performance, systems may successfully operate below these suggestions. However, as the water volume decreases below these suggestions, the possibility of problems increases.

Variable Speed Pumping

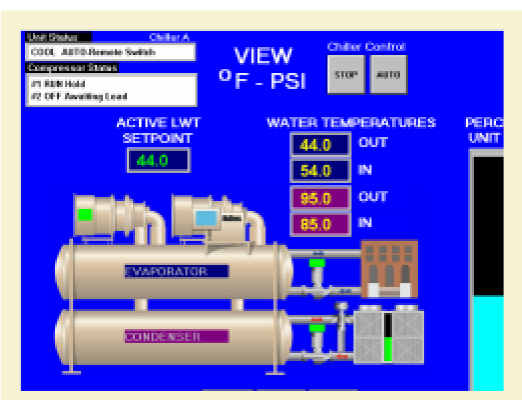
Variable water flow involves inversely changing the water flow through the evaporator as the load changes. McQuay chillers are designed for this duty provided that the rate of change in water flow is slow and the minimum and maximum flow rates for the vessel, as shown in Figure 11 on page 16 are not exceeded.

The recommended maximum change in water flow is 10 percent of the allowable flow change per minute. Flow is usually not reduced below 50 percent of design flow (provided vessel minimum flow rates are not exceeded).

For example, a 150-ton chiller might have chilled water flow of 360 gpm, reduced to 50 percent, would be 180 gpm. However, the minimum flow rate is 216 gpm, so the flow change would be 360 gpm minus 216 gpm, or 144 gpm. This means that the allowable flow rate change would be 10 percent of 144 or 14.4 gpm per minute.

MicroTech II Control

Figure 18, MicroTech II Control Panel



WMC chillers are equipped with the McQuay MicroTech II control system consisting of:

Operator interface touchscreen panel (shown at the left). It contains a 15-inch Super VGA color screen.

Control Panel containing the MicroTech II unit controller, two MicroTech II compressor controllers with connections to the compressor-mounted controls, and various switches and field connection terminals.

Operating instructions for the MicroTech II controller are contained in Operating Manual OM WMC-3.

Building Automation Systems

All MicroTech II controllers with Open Choices™ are capable of BAS communications, providing easy integration and comprehensive monitoring, control, and two-way data exchange with open standard protocols such as LonTalk®, Modbus® or BACnet®.

Open Choices™ Benefits

- Easy to integrate into your building automation system of choice
- Factory-installed and tested communication module
- Comprehensive point list for system integration, equipment monitoring and alarm notification
- Provides efficient equipment operation
- Owner/designer can select the BAS that best meets building requirements
- Comprehensive data exchange

Integration Made Easy

McQuay unit controllers strictly conform to the interoperability guidelines of the LONMARK ® Interoperability Association and BACnet International. They have received LONMARK certification with optional LONWORKS communication module.

Protocol Options

- BACnet MS/TP
- BACnet IP
- BACnet Ethernet
- LONWORKS® (FTT-10A)
- Modbus RTU

The BAS communication module can be ordered with a chiller and factory-mounted or can be field-mounted at any time after the chiller unit is installed.

Table 13, Typical Data Point Availability

Typical Data Points[1] (W = Write, R = Read)					
Active Setpoint	R	Cond EWT	R	Evap Water Pump Status	R
Actual Capacity	R	Cond Flow Switch Status	R	Liquid Line Refrigerant Pressure	R
Capacity Limit Output	R	Cond LWT	R	Liquid Line Refrigerant Temp	R
Capacity Limit Setpoint	W	Cond Pump Run Hours	R	Maximum Send Time	W
Chiller Enable	W	Cond Refrigerant Pressure	R	Minimum Send Time	W
Chiller Limited	R	Cond Sat. Refrigerant Temp	R	Network Clear Alarm	W
Chiller Local/Remote	R	Cond Water Pump Status	R	Pump Select	W
Chiller Mode Output	R	Cool Setpoint	W	Run Enabled	R
Chiller Mode Setpoint	W	Current Alarm	R		
Chiller On/Off	R	Default Values	W		
Chiller Status	R	Evap EWT	R		
Compressor Discharge Temp	R	Evap Flow Switch Status	R		
Compressor Percent RLA	R	Evap LWT for Unit	R		
Compressor Run Hours	R	Evap LWT for Compressor	R		
Compressor Select	W	Evap Pump Run Hours	R		
Compressor Starts	R	Evap Refrigerant Pressure	R		
Compressor Suction Line Temp	R	Evap Sat. Refrigerant Temp	R		

Note: Data points available are dependent upon options selected.

Connection to Chiller

Connection to the chiller for all BAS protocols will be at the unit controller. An interface card, depending on the protocol being used, will have been factory installed in the unit controller if so ordered, or it can be field installed.

Protocols Supported

Table 14, Standard Protocol Data

Protocol	Physical Layer	Data Rate	Controller	Other
BACnet®/IP	Ethernet 10 Base-T	10 Megabits/sec	Color graphics SBC	Reference ED 15057: BACnet PICS
BACnet MSTP	RS485	(TBD)	pCO^2 Unit Controller	Reference ED 15057: BACnet PICS
LonTalk®	FTT-10A	78kbits/sec	pCO^2 Unit Controller	LONMARK® Chiller Functional Profile
Modbus RTU	RS-485	(TBD)	pCO^2 Unit Controller	

NOTE: For additional information on the protocol data available through the BACnet or LonTalk communications modules, reference McQuay ED 15062, *MicroTech II Chiller Unit Controller Protocol Information.*

Modbus - When selected, the ident number and baud can also be changed to suit the application.

LONWORKS – When selected, the ident number and baud rate setpoints are not available. Baud rate is locked at 4800.

BACnet – When selected, the ident number and baud rate setpoints are not available. Baud rate is locked at 19200.

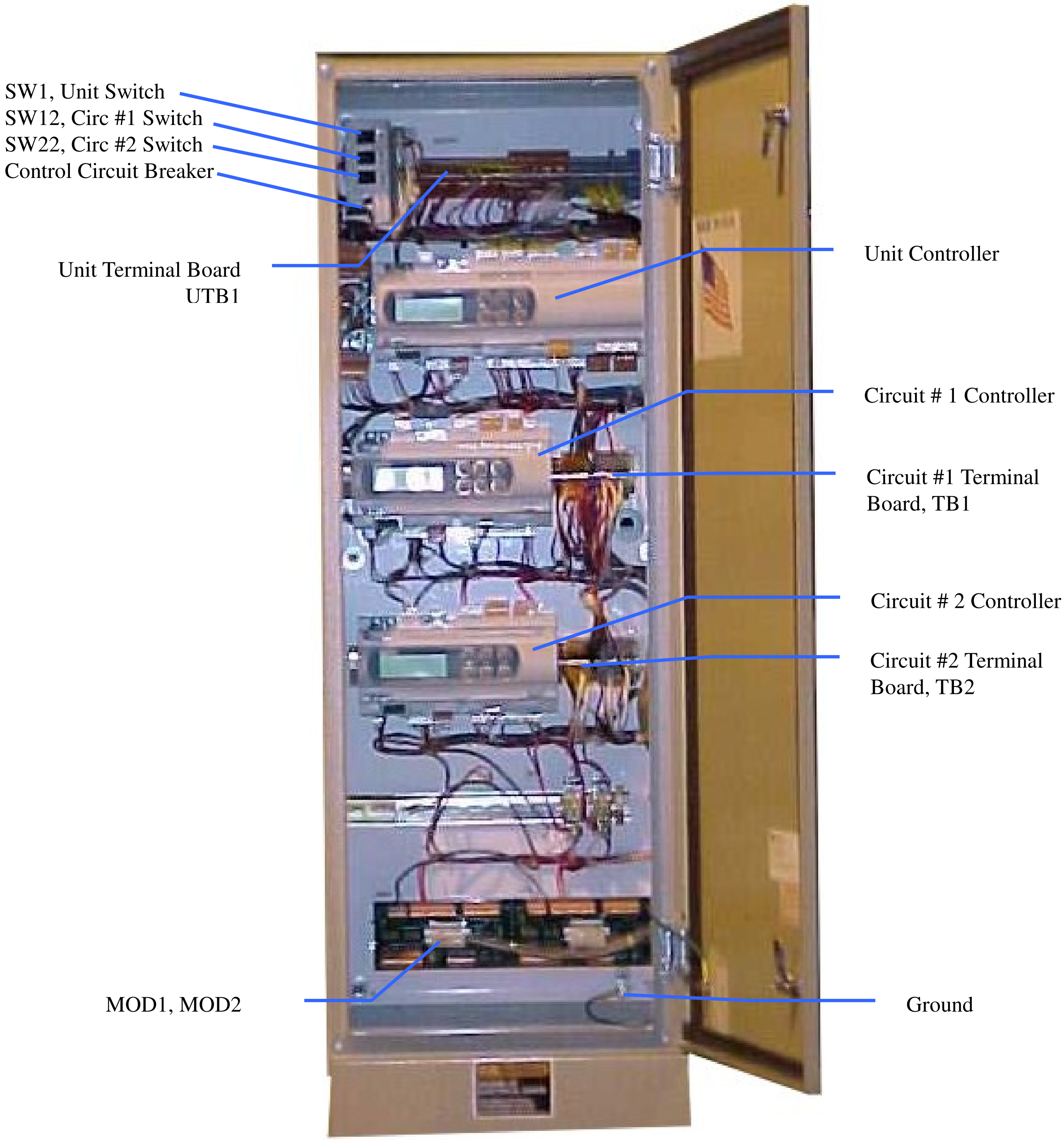
The factory installed communication module kits on the MicroTech II™ controller are as follows:

- BACnet Kit P/N 350147404: BACnet/IP, BACnet MS/TP, or BACnet Ethernet
- LONWORKS Kit P/N 350147401: LonTalk (FTT-10A)
- Modbus RTU

If an interface module was ordered, one of the following BAS interface installation manuals was shipped with the unit. If necessary, contact your local McQuay sales office for a replacement or obtain from www.mcquay.com.

- IM 735, LONWORKS® Communication Module Installation
- IM 736, BACnet® Communication Module Installation
- IM 743, Modbus® Communication Module Installation

Figure 19, Unit Control Panel



Capacity Control System

The capacity of the chiller is controlled by:

1) Staging the compressors on and off;
2) By adjusting the capacity of each compressor by opening or closing the inlet vanes to control the quantity of refrigerant entering the impeller; and,
3) Varying compressor speed to change capacity.

The speed control and vane control work in conjunction. As load decreases, compressor speed is reduced as low as possible but above the point where stall might begin. If further capacity reduction is required, the guide vanes will close to whatever position is required to match the compressor capacity to the load.

Surge and Stall

Stall and surge are a characteristic of all centrifugal compressors. These conditions can occur at low load conditions when the operating point moves to the left of the compressor surge line on the performance curve.

In surge, the discharge gas alternately flows backward and forward through the impeller reversing about every two seconds. Increased noise, vibration and heat occur and motor current varies widely. Surge can damage a compressor. The compressors are equipped with safety features that help prevent surge from occurring.

Another instability is stall or incipient surge, which occurs a little to the left, or before, the surge condition. Discharge gas in the diffuser forms rotating stall pockets or cells. The compressor sound level will change and the impeller starts to heat up. Motor current remains steady.

Normal Unit Startup/Shutdown

Startup and shutdown, other than seasonal shutdowns, are considered to be normal operation and the following procedures apply (assuming that the equipment room temperature are above freezing). The procedures would be used for a weekend shutdown, for example.

Note that the chiller is part of an entire building heating and cooling system that are usually unique to a particular site. For example, the chilled water loop and chilled water pump can also be used for heating and therefore must be operational year-around. The cooling tower can be used for other equipment besides the chiller and may have to remain functional even though the chiller is not. The following procedures, therefore, must take the peculiarities of the entire system into account.

Shutdown

If the unit is to be secured for several days, and is already off due to lack of load, the UNIT switch in the Unit Control Panel (and the remote Start/Stop switch, if used) should be placed in the OFF position. If the chilled water pump and cooling tower are not required for other purposes, they too can be turned off. If the pumps are controlled by the WMC unit controller, they will shut down after the compressors.

If the chiller is running, the chilled water and condenser water pumps must remain on until the compressors are stopped. This is true regardless of how the unit is turned off, whether by the local switches or through a remote signal. The compressors go through a short shutdown sequence, shutting guide vanes and performing other functions, before it finally stops. The pumps must remain on during this shutdown period.

Once the compressors and pumps have stopped, no further action is required other than opening disconnects, if so desired.

Startup

Any disconnects that were opened must be closed. The chilled water pump and cooling tower should be turned on and flow verified. The chiller can then be started by placing the UNIT switch (and the remote Start/Stop switch, if used) in the ON position. There is no lube warm-up period required. The compressors go through a starting sequence and may not start immediately. Once started, it is prudent to observe unit operation on the operator interface screen for several minutes to check for normal functioning.

Start/Stop Switching

There are four ways to start/stop the chiller. Three are selected in SETPOINT\ MODE\SP3, the fourth way is through panel-mounted switches:

1. **Operator Interface Panel,** (LOCAL) Home Screen 1 has AUTO and STOP buttons that are only active when the unit is in "LOCAL CONTROL". This prevents the unit from being accidentally started or stopped

when it is under control from a remote switch or BAS. When these buttons are pressed, the unit will cycle through its normal starting or stopping sequence, both compressors will be stopped and normal dual compressor starting procedure will be in effect.

2. **Remote SWITCH**, Selecting SWITCH in SP3 will put the unit under the control of a remote switch that must be wired into the control. See Field Wiring Diagram, page 23.
3. **BAS**, BAS input is field-wired into a communication module that is factory-installed on the unit controller.
4. **Control Panel Switches**

   Three On/Off switches are located in the upper left corner of the main Control Panel, which is adjacent to the operator interface panel, and have the following function:

   - UNIT shuts down the chiller through the normal shutdown cycle of unloading the compressors.
   - COMPRESSOR one switch for each compressor on the unit, executes an immediate shutdown without the normal shutdown cycle.
   - CIRCUIT BREAKER disconnects optional external power to system pumps and tower fans.

   A fourth switch located on the left outside of the Unit Control Panel and labeled EMERGENCY STOP SWITCH stops the compressor immediately. It is wired in series with the COMPRESSOR On/Off switches.

Annual Unit Startup/Shutdown

Annual Shutdown

Where the chiller can be subject to freezing temperatures, the condenser and chiller must be drained of all water. Dry air blown through the condenser will aid in forcing all water out. Removal of condenser heads is also recommended. The condenser and evaporator are not self-draining and tubes must be blown out. Water permitted to remain in the piping and vessels can rupture these parts if subjected to freezing temperature.

Forced circulation of antifreeze through the water circuits is one method of avoiding freeze up.

1. Take measures to prevent the shutoff valve in the water supply line from being accidentally turned on.
2. If a cooling tower is used and if the water pump will be exposed to freezing temperatures, be sure to remove the pump drain plug and leave it out so any water that can accumulate will drain away.
3. Open the compressor disconnect switch**.** Set the manual COMPRESSOR and UNIT ON/OFF switches in the Unit Control Panel to the OFF position.
4. Check for corrosion and clean and paint rusted surfaces.
5. Clean and flush water tower for all units operating on a water tower.
6. Remove condenser heads at least once a year to inspect the condenser tubes and clean if required.

Annual Startup

1. Check and tighten all electrical connections.
2. Replace the drain plug in the cooling tower pump if it was removed at shutdown time the previous season.
3. Install fuses in main disconnect switch (if removed).
4. Reconnect water lines and turn on supply water. Flush condenser and check for leaks.

⚠ DANGER

Wait 10 minutes after compressor shutdown before opening any compressor access panel.
The DC link capacitors store enough energy to cause electrocution.

Pressure/Temperature Chart

R-134a Temperature Pressure Chart							
°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG
6	9.7	46	41.1	86	97.0	126	187.3
8	10.8	48	43.2	88	100.6	128	192.9
10	12.0	50	45.4	90	104.3	130	198.7
12	13.2	52	47.7	92	108.1	132	204.5
14	14.4	54	50.0	94	112.0	134	210.5
16	15.7	56	52.4	96	115.9	136	216.6
18	17.1	58	54.9	98	120.0	138	222.8
20	18.4	60	57.4	100	124.1	140	229.2
22	19.9	62	60.0	102	128.4	142	235.6
24	21.3	64	62.7	104	132.7	144	242.2
26	22.9	66	65.4	106	137.2	146	249.0
28	24.5	68	68.2	108	141.7	148	255.8
30	26.1	70	71.1	110	146.3	150	262.8
32	27.8	72	74.0	112	151.1	152	270.0
34	29.5	74	77.1	114	155.9	154	277.3
36	31.3	76	80.2	116	160.9	156	284.7
38	33.1	78	83.4	118	166.0	158	292.2
40	35.0	80	86.7	120	171.1	160	299.9
42	37.0	82	90.0	122	176.4	162	307.8
44	39.0	84	93.5	124	181.8	164	315.8

Routine Maintenance

Refrigerant Cycle

Maintenance of the refrigerant cycle includes maintaining a log of the operating conditions and checking that the unit has the proper refrigerant charge.

At every inspection, the suction, and discharge pressures should be noted and recorded, as well as condenser and chiller water temperatures.

The suction line temperature at the compressor should be taken at least once a month. Subtracting the saturated temperature equivalent of the suction pressure from this will give the suction superheat. Extreme changes in subcooling and/or superheat over a period of time will indicate losses of refrigerant or possible deterioration or malfunction of the expansion valve. The evaporator operates at 0º to 1º F (0.5º C) of superheat through most of the load range. The refrigerant used for compressor cooling dumps at the compressor suction, where the suction temperature sensor is located. This results in a warming of the suction gas and superheat readings of 4º to 5º F (2º to 3º C).

The discharge superheat should be between 16º and 18º F (9º to 10º C) and remains fairly constant through most of the load range.

Liquid subcooling is in the range of 8º to 9º F (4.5º to 5.0º C).

The MicroTech II operator interface touch-screen panel can display all superheat and subcooling temperatures.

Electrical System

Maintenance of the electrical system involves the general requirement of keeping contacts clean and connections tight and checking on specific items as follows:

1. The compressor current draw should be checked and compared to nameplate RLA value. Normally, the actual current will be lower, since the nameplate rating represents full load operation. Also check all pump and fan motor amperages, and compare with nameplate ratings.
2. At least once a quarter, all equipment protection controls, except compressor overloads, should be made to operate and their operating points checked. A control can shift its operating point as it ages, and this must be detected so the controls can be adjusted or replaced. Pump interlocks and flow switches should be checked to be sure they interrupt the control circuit when tripped.

Cleaning and Preserving

A common cause of service calls and equipment malfunction is dirt. This can be prevented with normal maintenance. The system components most subject to dirt are:

1. Permanent or cleanable filters in the air handling equipment must be cleaned in accordance with the manufacturer's instructions; throwaway filters should be replaced. The frequency of this service will vary with each installation.
2. Remove and clean strainers in the chilled water system and condenser water system at every inspection.

Water Treatment

Make sure tower blowdown or bleed-off is operating. Set up and use a good maintenance program to prevent "liming up" of both tower and condenser. It should be recognized that atmospheric air contains many contaminants that increase the need for proper water treatment. The use of untreated water can result in corrosion, erosion, sliming, scaling or algae formation. It is recommended that the service of a reliable water treatment company be used. McQuay International assumes no responsibility for the results of untreated or improperly treated water.

Repair of System

Pressure Relief Valve Replacement

Current condenser designs use two relief valves separated by a three-way shutoff valve (one set). This three-way valve allows either relief valve to be shut off, but at no time can both be shut off. In the event one of the relief valves are leaking in the two valve set, these procedures must be followed:

- If the valve closest to the valve stem is leaking, back seat the three-way valve all the way, closing the port to the leaking pressure relief valve. Remove and replace the faulty relief valve. The three-way shutoff valve must remain either fully back seated or fully forward to normal operation. If the relief valve farthest from the valve stem is leaking, front seat the three-way valve and replace the relief valve as stated above.
- The refrigerant must be pumped down into the condenser before the evaporator relief valve can be removed.

Pumping Down

If it becomes necessary to pump the system down, extreme care must be used to avoid damage to the evaporator from freezing. Always make sure that full water flow is maintained through the chiller and condenser while pumping down. To pump the system down, close all liquid line valves. With all liquid line valves closed and water flowing, start the compressor. Set the MicroTech II control to the manual load. The vanes must be open while pumping down to avoid a surge or other damaging condition. Pump the unit down until the MicroTech II controller cuts out at approximately 20 psig. It is possible that the unit might experience a mild surge condition prior to cutout. If this should occur, immediately shut off the compressor. Use a portable condensing unit to complete the pump down, condense the refrigerant, and pump it into the condenser or pumpout vessel using approved procedures.

Pressure Testing

No pressure testing is necessary unless some damage was incurred during shipment. Damage can be determined by a visual inspection of the exterior piping, checking that no breakage occurred or fittings loosened. Service gauges should show a positive pressure. If no pressure is evident on the gauges, a leak may have occurred, discharging the entire refrigerant charge. In this case, the unit must be leak tested to determine the location of the leak.

Leak Testing

In the case of loss of the entire refrigerant charge, the unit must be checked for leaks prior to charging the complete system. This can be done by charging enough refrigerant into the system to build the pressure up to approximately 10 psig (69 kPa) and adding sufficient dry nitrogen to bring the pressure up to a maximum of 125 psig (860 kPa). Leak test with an electronic leak detector. Halide leak detectors do not function with R-134a. Water flow through the vessels must be maintained anytime refrigerant is added or removed from the system.

⚠ WARNING

Do not use oxygen or a mixture of a refrigerant and air to build up pressure as an explosion can occur causing serious personal injury.

If any leaks are found in welded or brazed joints, or it is necessary to replace a gasket, relieve the test pressure in the system before proceeding. Brazing is required for copper joints.

After making any necessary repair, the system must be evacuated as described in the following section.

Evacuation

After it has been determined that there are no refrigerant leaks, the system must be evacuated using a vacuum pump with a capacity that will reduce the vacuum to **at least 1000 microns of mercury**.

A mercury manometer or an electronic or other type of micron gauge must be connected at the farthest point from the vacuum pump. For readings below 1000 microns, an electronic or other micron gauge must be used.

The triple evacuation method is recommended and is particularly helpful if the vacuum pump is unable to obtain the desired 1 millimeter of vacuum. The system is first evacuated to approximately 29 inches of mercury. Dry nitrogen is then added to the system to bring the pressure up to zero pounds.

Then the system is once again evacuated to approximately 29 inches of mercury. This is repeated three times. The first pulldown will remove about 90% of the noncondensables, the second about 90% of that remaining from the first pulldown and, after the third, only 1/10-1% noncondensables will remain.

Charging the System

McQuay water chillers are leak tested at the factory and shipped with the correct charge of refrigerant as indicated on the unit nameplate. In the event the refrigerant charge was lost due to shipping damage, the system should be charged as follows after first repairing the leaks and evacuating the system.

1. Connect the refrigerant drum to the gauge port on the liquid line shutoff valve and purge the charging line between the refrigerant cylinder and the valve. Then open the valve to the mid-position.
2. Turn on both the cooling tower water pump and chilled water pump and allow water to circulate through the condenser and the chiller. (It may be necessary to manually close the condenser pump starter.)
3. If the system is under a vacuum, stand the refrigerant drum with the connection up, and open the drum and break the vacuum with refrigerant gas to a saturated pressure above freezing.
4. With a system gas pressure higher than the equivalent of a freezing temperature, invert the charging cylinder and elevate the drum above the condenser. With the drum in this position, valves open, water

pumps operating, liquid refrigerant will flow into the condenser. Approximately 75% of the total requirement estimated for the unit can be charged in this manner.

5. After 75% of the required charge has entered the condenser, reconnect the refrigerant drum and charging line to the service valve on the bottom of the evaporator. Again purge the connecting line, stand the drum with the connection up, and place the service valve in the open position.

⚠ CAUTION

IMPORTANT: At this point, the charging procedure should be interrupted and prestart checks made before attempting to complete refrigerant charge. The compressor must not be started at this time.

(Preliminary check must first be completed.)

NOTE: It is of utmost importance that all local, national, and international regulations concerning the handling and emission of refrigerants are observed.

Maintenance Schedule

	Monthly	Quarterly	Semi-Annually	Annually	As Required By Performance
I. Compressor					
A. Performance Evaluation (Log & Analysis) *	O				
B. Motor					
• Ampere Balance (within 10%)		X			
• Terminal Check (tight connections, porcelain clean)				X	
• Motor Cooling (check temperature)		X			
C. Vane Operation					
• Compressor Loads:					
Operate Manual Switch		X			
Record Motor Amps		X			
• Compressor Unloads:					
Operate manual Switch		X			
Record Motor Amps		X			
• Vanes Will Hold (place manual switch in "hold")					
Observe Water Temp and Record Amps		X			
D. Internal Compressor Check					X
II. Controls					
A. Operating Controls					
• Check Settings and Operation			X		
• Check Vane Control Setting and Operation			X		
• Verify Motor Load Limit Control			X		
• Verify Load Balance Operation			X		
B. Protective Controls					
• Test Operation of:					
Alarm Relay		X			
Pump Interlocks		X			
III. Condenser					
A. Performance Evaluation	O				
B. Test Water Quality		X			
C. Clean Condenser Tubes				X	
D. Eddy current Test - Tube Wall Thickness					X
E. Seasonal Protection					X
IV. Evaporator					
A. Performance Evaluation (Log Conditions And Analysis)	O				
B. Test Water Quality		X			
C. Clean Evaporator Tubes (as required)					X
D. Eddy current Test - Tube Wall thickness (as required)					X
E. Seasonal Protection					X
V. Expansion Valve					
A. Performance Evaluation (Superheat Control)		X			
VI. Compressor - Chiller Unit					
A. Performance Evaluation	O				
B. Leak Test:					
• Compressor Fittings and Terminal		X			
• Piping Fittings		X			
• Vessel Relief Valves		X			
C. Vibration Isolation Test		X			
D. General Appearance:					
• Paint				X	
• Insulation				X	
VII. Electrical					
A. Capacitors, Replace every 5 years from startup, include bus bar. Consult McQuay for parts and instructions.					

Key: O = Performed by in-house personnel X = Performed by McQuay Service personnel

Service Programs

It is important that an air conditioning system receive adequate maintenance if the full equipment life and full system benefits are to be realized.

Maintenance should be an ongoing program from the time the system is initially started. A full inspection should be made after 3 to 4 weeks of normal operation on a new installation and on a regular basis thereafter.

McQuay offers a variety of maintenance services through the local McQuay Factory Service office, its worldwide service organization, and can tailor these services to suit the needs of the building owner. Most popular among these services is the McQuay Comprehensive Maintenance Contract.

For further information concerning the many services available, contact your local McQuay Factory Service office.

Operator Schools

Training courses for WMC Centrifugal Maintenance and Operation are held through the year at the McQuay Training Center in Staunton, Virginia. The school duration is three and one-half days and includes instruction on basic refrigeration, MicroTech II controllers, enhancing chiller efficiency and reliability, MicroTech II troubleshooting, system components, and other related subjects. Further information can be found by visiting www.mcquay.com and clicking on the Training link, or by calling McQuay at 540-248-0711 and ask for the Training Department.

Warranty Statement

Limited Warranty

Consult your local McQuay Representative for warranty details. Refer to Form 933-43285Y. To find your local McQuay Representative, go to www.mcquay.com.

This document contains the most current product information as of this printing. For the most up-to-date product information, please go to **www.mcquay.com.**

All McQuay equipment is sold pursuant to McQuay's Standard Terms and Conditions of Sale and Limited Product Warranty.