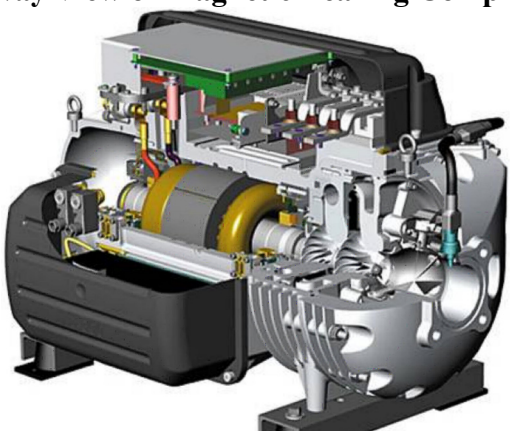
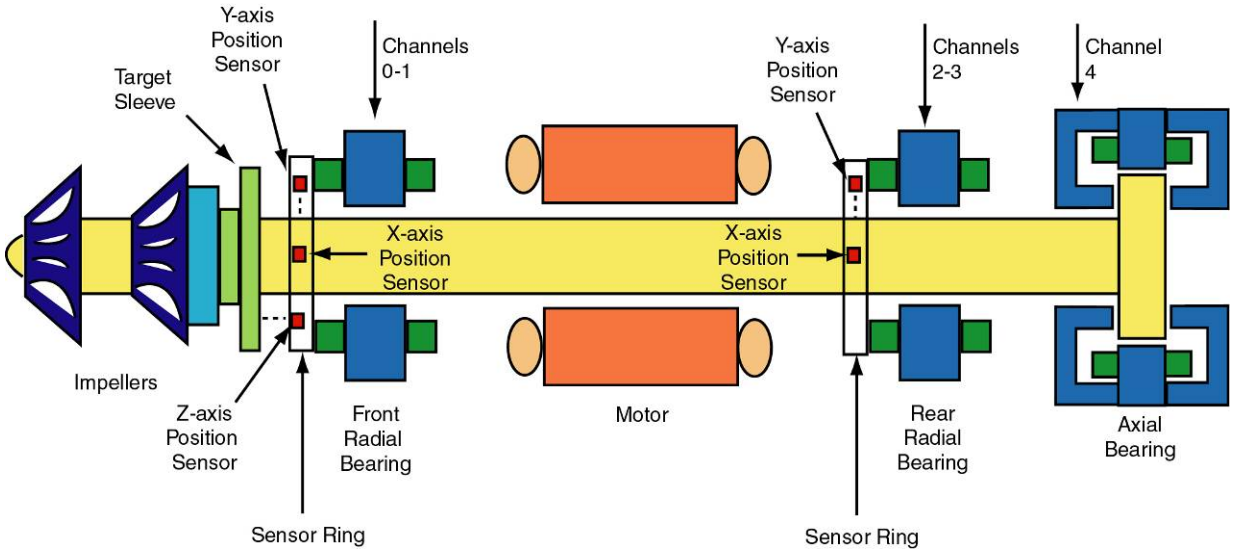
Magnitude™ Magnetic Bearing Centrifugal Chillers Catalog 602-2

Model WMC, B Vintage • 145 to 400 tons • 500 to 1400 kW • R-134a

Cutaway View of Magnetic Bearing Compressor



Compressor Major Running Gear Components



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BACnet International

Modbus™

LONMARK 3.3

Applies to 60 HZ only

AHRI CERTIFIED™ www.ahridirectory.org Water-Cooled Chillers AHRI Standard 550/590

Applies to 60 HZ only

*Unit Controllers are LONMARK certified with an optional LONWORKS communication module.

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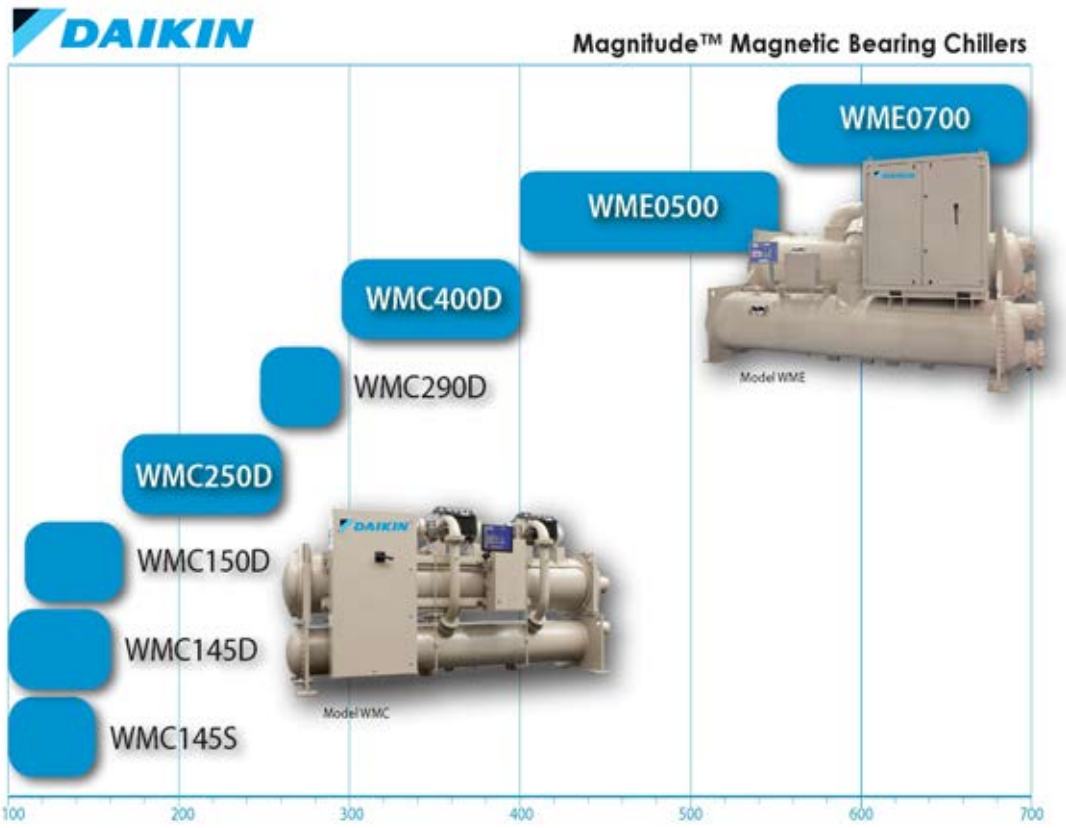
Manufactured in an ISO Certified Facility

The New Compressor Technology

For Magnitude™ Model WME information see Catalog 604



Next Generation Centrifugal - Here Today

The industry's next generation of centrifugal chillers is here today with Daikin Magnitude chillers. The new technology begins with centrifugal compressors utilizing frictionless magnetic bearings for oil-free operation, integral variable-frequency drives, and high-speed direct drive technology. The high efficiency compressor is matched with highly efficient heat exchanges to make an impressive chiller. The control system is based on Daikin's MicroTech II® family to provide the optimum chiller control system. We invite you to look at how the features and benefits compare to older compressor technologies.

Benefit Summary

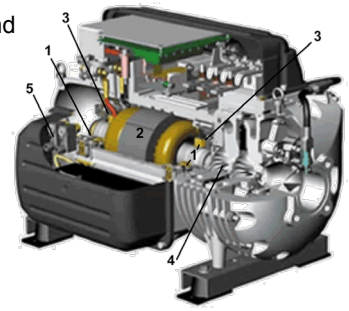
- **Highest Efficiency**- in its size range; as low as 0.328 kW/ton.
- **Increased Reliability** This frictionless magnetic bearing design needs no oil. With no oil to coat the heat transfer surfaces, a gain in heat exchanger efficiency can be realized.
- **Ultra Quiet** A compressor sound level as low as 76 dBA, with virtually no structure-borne vibration, eliminates the need for expensive sound attenuation accessories.
- **Sustainable Performance** All oil-lubricated chillers will deposit oil on heat transfer surfaces and eventually lose some efficiency. Since the Magnitude chiller uses a positive pressure refrigerant and has no oil, its industry-leading efficiency is maintained for the life of the chiller. Additionally, over time negative pressure chillers may draw air and moisture into the system, which can significantly increase energy consumption.
- **Smart refrigerant choice** The compressor is optimized for HFC 134a, the positive pressure refrigerant with no phase-out schedule and no ozone depletion.
- **Smart controls**. The compressor is self-correcting and incorporates a system of sophisticated self-diagnostics, monitoring and controls. **Safe power interruption** In the event of a power failure, the compressor motor acts as a generator, providing power for the bearing control system during coast down. It also has a system to gently de-levitate the shaft.

The Compressor Technology

The advanced, magnetic bearing, permanent magnet synchronous motor technology used in Magnitude chillers offers many owner benefits.

Figure 1, Compressor Cutaway

1. Magnetic Bearings and Bearing Sensors
2. Permanent Magnet Synchronous Motor
3. Touchdown Bearings
4. Shaft and Impellers
5. Compressor Cooling
6. VFD



VFD = Ultra-Low IPLV

The well-proven energy performance advantages of large central plant type variable-speed centrifugal chiller compressors now benefit mainstream, middle-market applications through the use of high-speed, centrifugal compression with integral variable-speed drive.

The compressor speed reduces as the condensing temperature and/or cooling load reduces, optimizing energy performance through the entire operating range. Movable inlet guide vanes redirect gas flow into the first stage impeller during low loads, after the compressor has reached minimum speed.

Ultra-Smart Controls

The chillers utilize digital control electronics to proactively manage unit operation and providing control of external chilled water and cooling tower pumps.

Greater Reliability

Oil Handling Equipment Removed

With magnetic bearings operating in a magnetic electrical field instead of oil lubricated ball or roller friction type bearings as the basis of design, the oil handling equipment is removed.

Oil-Free Design Benefits

Totally Oil-Free Operation = Greater Efficiency

With no oil to coat the heat transfer surfaces, a gain in heat exchanger efficiency can be realized.

No Oil Loss = Sustainable Performance

With no possibility of oil loss at light loads or due to worn seals, the original energy saving efficiency can be maintained for the life of the chiller.

No Oil Handling Equipment = Greater Reliability

With magnetic bearings operating in a magnetic electrical field instead of oil-lubricated bearings, the oil handling equipment is removed. No need for:

- oil pumps
- oil reservoirs
- oil coolers
- oil filters
- water regulating valves
- oil relief valves
- oil system controls, starter, piping, heaters, etc...

that are needed to maintain oil quality. These devices can be a fault source in traditional chillers, and removing them significantly increases unit and system reliability.

No Oil System = Reduced Maintenance Costs

With oil removed from the system, oil samples, oil changes, oil system maintenance, oil filter changes and leaks are eliminated.

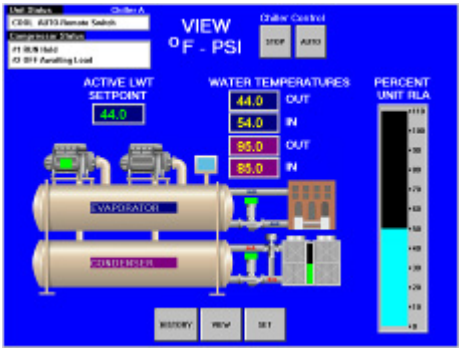
Exceptional Control

User-Friendly Touch Screen Panel

Every Magnitude chiller is provided with the user-friendly operator interface touch screen panel mounted on the moveable positioning arm for easy viewing and operation.

View chiller status, clear faults and change parameters by merely touching the screen.

For added convenience, the unit operating and maintenance manual is viewable on the screen and can be downloaded and printed via the USB port located in the control panel.



Flexible BAS Interface Modules

Every Magnitude chiller with MicroTech®II controls and the Open Choices™ feature can be provided with LONWORKS®, BACnet®, or Modbus® communications modules for an easy, low cost connection to the building automation system of your choice. Expensive and complex interface gateways are not required.

Modules can also be easily retrofitted after installation.

Variable Frequency Drives

Compressor unloading and subsequent chiller capacity reduction is accomplished by a compressor-mounted variable frequency drive. It operates in conjunction with the inlet guide vanes.

The VFDs are a key factor in providing the tremendous energy savings at part load operation.

Seismic Certification Option

WMC units are OSHPD Pre-Approved and so labeled. (California only).

WMC units are certified to IBC 2009

Low Operating Costs

Shrink Your Utility Costs with Ultra Efficient Part-Load Performance

The Magnitude chiller Integrated Part Load Value (IPLV) is as low as 0.328 kW/Ton. Compare this with most screw compressor chillers - approximately 0.575 kW/Ton. There is a potential for up to 40% energy savings at part load compared to other chillers.

Virtually Eliminate Maintenance Costs

Oil samples, oil change-outs, oil system maintenance, oil filter changes are eliminated. The bearing system, shafting and impellers are shown here.

Environmental Responsibility

Long Term Refrigerant Solution

The Magnitude chiller uses R-134a refrigerant, which does not have a phase-out date and does not attack the ozone layer.

Ultra Quiet Sound Levels

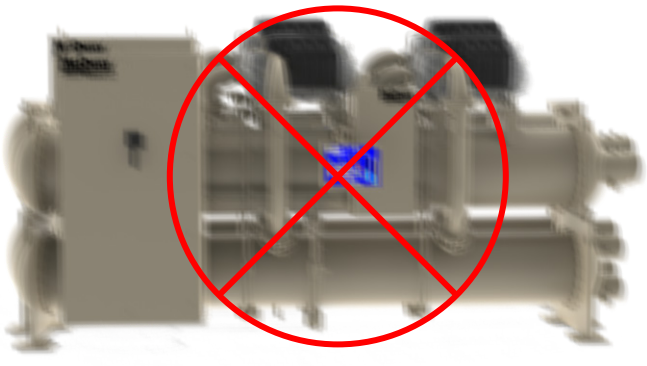
The Magnitude chiller is the quietest chiller in the industry for its size range. It is perfect for sound sensitive applications. See ratings on page 17.

The best way to appreciate how quiet these units are is to hear one operate. It is important to compare the sound data in this catalog to other offerings. Remember that a sound pressure difference of only two to three dBA is a very noticeable difference. A number of owners have asked for a large indicating light on the unit so they can tell when it's on!

Extremely Low Vibration Levels

As a result of the magnetic bearings and low inertia design, the compressor vibration levels are extremely low, minimizing vibration that could be transmitted to the structure.

The unit is shipped with rubber mounting pads and spring vibration isolators are not required.



Unit Control Features

Magnitude Chillers Feature MicroTech

It is only fitting that the world's most revolutionary chiller design be matched with the advanced Daikin MicroTech control technology to give you the ultimate in chiller performance and control. The control includes many energy-saving features and interface enhancements not found in any other unit controller system on the market today. MicroTech controller's innovative design will help keep your chiller running efficiently . . . day in, day out, for years to come.

Control Architecture

The Magnitude chiller takes advantage of Daikin International's 30 years of experience in designing and manufacturing the highly regarded WDC line of conventional, dual centrifugal compressor chillers.

The operator interface panel is a 15-inch Super VGA touch-screen, utilizing graphics to provide clear and concise information on the chiller status, (see page 9) alarms, trends, and setpoint adjustment. Should the touch-screen become inoperable, the unit controller will continue uninterrupted operation of the chiller.

The controller minds those functions that are common to the chiller as a whole (pumps, cooling tower, valves, etc.) and is the interface point for BAS connection and other control inputs to the chiller, as well as outputs such as operation of the electronic expansion valve.

The control panel contains a USB port for downloading the unit's fault history, major parameter trends, and the unit operating manual that is stored in the microprocessor.

MicroTech II® Control Features and Benefits

FEATURE	BENEFIT
Easy integration into Building Automation System (BAS) via the exclusive Open Choice™ communication module	Designer can select any BAS supplier using standard open protocols and know the MicroTech II control will interface with it.
Easy to read, adjustable, 15 inch, Super VGA color touch screen operator interface	Operators can observe chiller operation and easily select various data screens and change setpoints
Historic trend data-downloadable	Water temperatures, refrigerant pressures, and motor load plots can provide valuable information for energy conservation
Precise ± 0.2 °F chilled water control	Provides stability in chilled water system
Proactive pre-shutdown correction of “unusual conditions” allows chiller to stay online	Activates alarm and modifies chiller operation to provide maximum possible cooling
Automatic control of chilled water and condenser water pumps	Integrated lead/lag and automatic engagement of backup pump
Controls up to four stages of tower fans and modulation of tower fan and/or bypass valve	Optimum integrated, efficient, control of cooling tower water based on system conditions
Twenty-five previous alarm descriptions are stored in memory	Valuable asset for trouble shooting
Up to four WMC chillers* can be interconnected for coordinated operation	Simplifies multi-chiller installations

Designed with the Operator in Mind

Reliable, economic use of any chiller depends largely on an easy operator interface. That’s why operation simplicity was one of the main considerations in the development of the MicroTech controller. The operator’s interface with the chiller is through a 15-inch, Super VGA color monitor with touch-screen capability. The operator can clearly see the entire chiller graphically displayed with the key operating parameters viewable on the screen. Pressing a single on-screen button will access the set screens where setpoints can be reviewed and changed, if necessary. Other screens, such as alarm history, are easily accessed through touch screen buttons. See the following page for some typical screens.

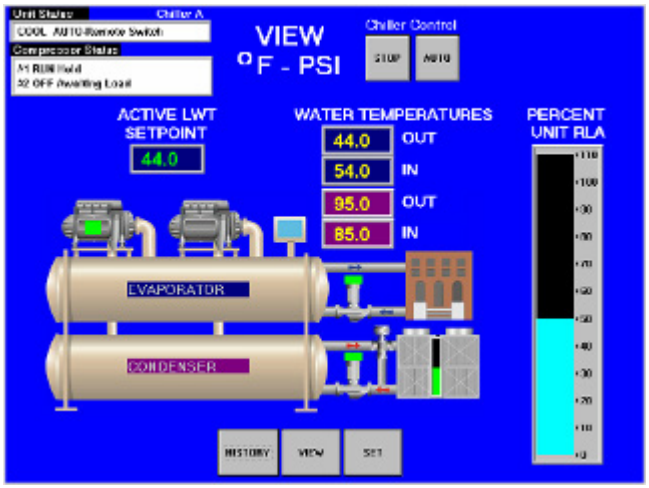
By constantly monitoring chiller status, the MicroTech controller will automatically take proactive measures to relieve abnormal conditions or shut the unit down if a fault occurs. For example, if a problem occurs in the cooling tower and discharge pressure starts to rise, the controller will automatically hold the load point and activate an alarm signal. A further rise in pressure will initiate compressor unloading in an effort to maintain the setpoint pressure and stay online. If the pressure continues to rise, the unit will shut off at the cutout pressure setting.

The MicroTech controller's memory retains a record of faults and the time/date stamp. The controller's memory (no batteries required) can retain and display the cause of the current fault and the last twenty-five fault conditions. This method for retaining the fault is extremely useful for trouble shooting and maintaining an accurate record of unit performance and history. The controller features a two-level password security system to provide protection against unauthorized use.

The Home Screen shown in Figure 2 is usually used as the primary viewing screen. It provides real time data on unit status, water temperatures, chilled water set point and motor amp draw. In other words, it very clearly answers the vital question: is the chiller doing what it is supposed to do?

*Note: WMC B-vintage chillers may not be interconnected with any other model, including WMC A-vintage models. See IM 1029-2 for more information.

Figure 2, MicroTech II Home Screen



If an alarm occurs, a red button appears on the screen (a remote signal is also available). Pressing this button immediately accesses the Active Fault Screen that gives complete fault information. The problem can be fixed and the fault can be quickly and easily cleared at this point.

Changing Setpoints

The mystery of changing set points is a thing of the past. Look at how easy the job becomes with the Daikin MicroTech. For example, to change the chilled water set point, press SET from any screen, then press the WATER button and this screen appears, press button #1, Leaving Water Temperature, and you are ready to input a new value. Selected setpoints can also be changed by the BAS.

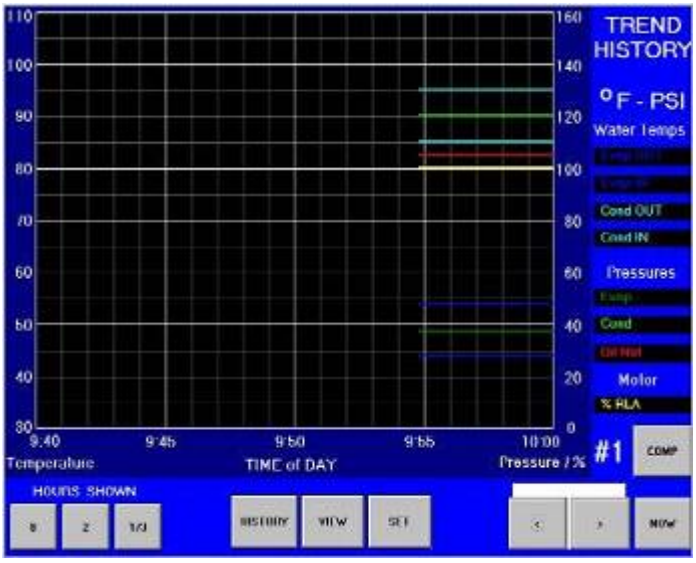
Figure 3, MicroTech II Setpoints Screen

Trend Logging

Ever wonder how your chiller performed last week? Were you holding the required chilled water temperature? What kind of cooling load did the chiller have?

The Daikin MicroTech controller can record and plot water temperatures, refrigerant pressures, and motor load in order to trend performance. These values can also be downloaded through a convenient USB port in the control panel, and exported into a spreadsheet for further evaluation and record purposes.

Figure 4, Trend Logging Screen



MicroTech Controller Increases Chiller Operating Economy

Many standard features have been incorporated into MicroTech control in order to maintain the operating economy of Daikin centrifugal chillers. In addition to replacing normal relay logic circuits, we've enhanced the controller's energy saving capabilities with the following features:

- Direct control of water pumps. Optically isolated, digital output relays provide automatic lead-lag of the evaporator and condenser pumps, permitting pump operation only when required.
- User-programmable compressor soft loading. Prevents excessive power draw during pull down from high unoccupied chilled water temperature conditions.
- Chilled-water reset. Accomplished directly on the unit by resetting the leaving water temperature based on the return water temperature. A remote 4-20 ma or 1-5 VDC BAS signal can also be used to reset the leaving water. Raising the chilled water setpoint during periods of light loads dramatically reduces electrical consumption.

- Demand limit control. Maximum motor current draw can be set on the panel, or can be adjusted from a remote 4-20 ma or 1-5 VDC BAS signal. This feature controls maximum demand charges during high usage periods.
- Condenser water temperature control. Capable of four stages of tower fan control plus an optional analog control of either a three-way tower-bypass valve or variable speed tower-fan motor. Stages are controlled from condenser-water temperature. The three-way valve can be controlled to a different water temperature or track the current tower stage. This allows optimum chilled water plant performance based upon specific job requirements.
- Staging Options (Multiple Chiller Installations). Lead-lag and load-balance: the MicroTech II controller is capable of compressor lead-lag decisions and balancing compressor loads between two compressors on one unit or two separate Magnitude chillers, using defaults or operator defined staging. For example, in the 30 to 60 percent load segment, one compressor running on each of two chillers will provide better efficiency than two compressors running on one chiller.
- Plotting Historic Trends. Past operation of the chiller can be plotted as trend lines and even downloaded to spread sheets for evaluation - a valuable tool for optimizing efficiency.

Versatile Communications Capabilities Give You Even More Control

For complete flexibility there are four ways to interface with the MicroTech II controller:

1. Direct entry and readout locally at the operator interface panel on the unit.
2. Direct entry as above plus digital and analog input/output signals for certain functions such as: enable run input, alarm signal output, 4-20 ma or 0-5 VDC inputs for chilled water reset and load limiting, pump and tower fan control, analog output for variable speed fan and tower bypass.
3. Interface with BACnet, LONWORKS, or Modbus.
4. Direct communication between three Magnitude WMC chillers (not compatible with WME models).

Building Automation Systems

All MicroTech II controllers are capable of communications providing seamless integration and comprehensive monitoring, control, and two-way data exchange with industry standard protocols LonTalk® or BACnet™ or Modbus™.

Open Choice Benefits

- Easy to integrate into your building automation system supplier of choice
- Factory- or field-installed communications module
- Provides efficient equipment operation
- Integrated control logic for factory options
- Easy-to-use local user interface
- Owner/designer can select the BAS that best meets building requirements
- Comprehensive data exchange

Figure 5, Sample System Architecture

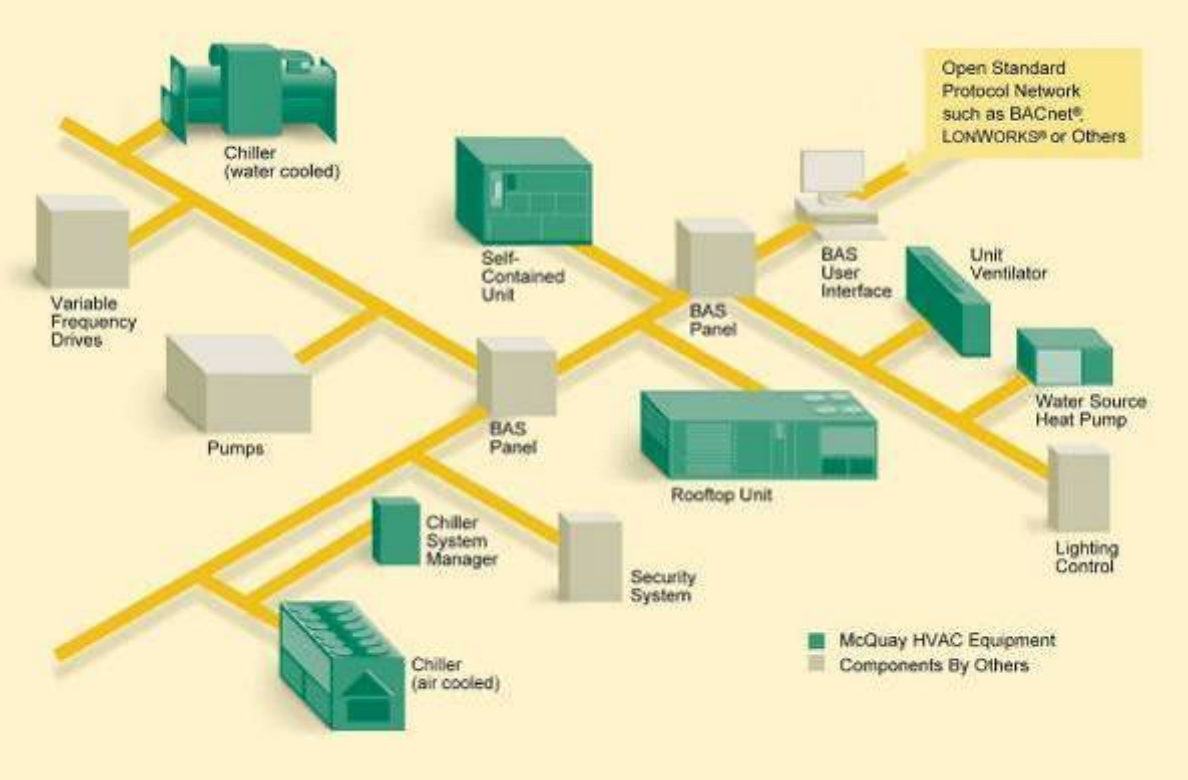


Table 1, Typical Data Point Availability

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

Notes: Data points available are dependent upon options selected

Network Protocol Options

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

Unit Design Features

Variable Frequency Drive

Efficiency: The standard variable frequency drive is a technology that has been used for decades to control motor speed on a wide variety of motor-drive applications. When applied to centrifugal compressor motors, significant gains in part load performance can be realized. The improvement in efficiency and reduction of annual energy cost is maximized when there are long periods of part load operation, combined with low compressor lift (lower condenser water temperatures).

The attributes of VFD and the compressor technology produces one of the industry's most efficient chiller based on the all-important IPLV value. See “IPLV/NPLV Defined” on page 14 for details on the AHRI IPLV efficiency rating.

Starting Inrush: The use of a VFD on centrifugal chillers also provides an excellent method of reducing motor starting inrush-even better than "solid state" starters. Starting current can be closely controlled since both the frequency and voltage are regulated. This can be an important benefit to a building's electrical distribution system. The low inrush feature, combined with two one-half size compressors having a staggered start, is particularly attractive where chillers will be asked to operate on emergency generators. Since inrush has much to do with sizing the generators, much smaller generators can be used.

Optional Harmonic Filter

An optional field-mounted harmonic filter is available. See page 40 for details.

HFC-134a

Daikin Positive Pressure Design:

- **No Purge**
- **No Vacuum Prevention System**
- **No Contaminants**

HFC-134a operates above atmospheric pressure in the entire refrigerant circuit and at normal temperatures. All Daikin centrifugal chillers use a positive pressure refrigerant, with the following benefits:

- No absorption of impurities into the refrigerant circuit
- No breakdown of motor insulation, refrigerant or lubricant
- No increase in operating cost due to displacement of heat transfer surface by non-condensables
- No crevice corrosion and tube failure due to moisture in the system
- No annual service expense to maintain and rebuild purge unit
- No abnormal annual service expense for oil, filter, and refrigerant replacement
- No periodic emissions of refrigerant into the atmosphere

Heat Exchangers

Daikin Magnitude chillers are equipped with high performance heat exchangers. The unique design greatly increases heat transfer and reduces unit footprint and refrigerant charge. Vessels are designed, constructed and tested in accordance with ASME Section VIII, ASHRAE Standard 15 requirements and TEMA recommendations.

The replaceable water tubes are internally rifled and externally enhanced copper, and are mechanically bonded to steel tube sheets. Standard tubes are 0.025-inch wall thickness. Consult factory for other options.

Vessels are available for 1, 2 or 3 pass water flow. A 3/4" or 1-1/2 thick layer of vinyl/nitrate polymer evaporator insulation is optional. All seams are glued to form an effective vapor barrier. Detailed information on the insulation can be found under “Physical Data” on page 27.

Pumpdown

Pumpout systems provide a means to collect and contain the refrigerant charge without loss when access to internal chiller components is required for service.

Daikin condensers and evaporators are sized to hold the entire unit refrigerant charge when not more than 90% full and at 90°F (32°C) ambient temperature. They are equipped with valves in the compressor discharge lines, suction lines, and in the liquid line. These valves, coupled with the vessel design, satisfy the stringent requirements of the U.S. Department of Transportation for refrigerant shipping containers, as well as ASME vessel codes. When service is required, the refrigerant charge can be pumped down into either the condenser or evaporator by compressor operation and use of a refrigerant transfer unit.

Elimination of the cost and space requirements of an external pumpout system on most jobs is a major Daikin advantage.

Electronic Expansion Valve

Controlled refrigerant flow over the entire capacity range saves energy and dollars. Cooling loads and condenser water temperatures can change constantly. On Magnitude chillers, a modern electronic expansion valve meters refrigerant flow in direct response to the unit controller input, which looks at unit kW and lift (discharge minus suction pressure) to set the valve position. The controller then balances suction superheat and liquid subcooling to reach the optimum efficiency, regardless of changing load or condensing temperatures. In doing so, full utilization of compressor, evaporator, and condenser efficiency over the entire operating range is achieved.

Flow Switch

All chiller units must be provided with flow switches for the evaporator and condenser. Daikin furnishes factory-installed and wired, thermal dispersion-type flow switches as standard equipment on Magnitude chillers. This eliminates the expense of field mounting and wiring conventional paddle or differential pressure switches.

The flow switches 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.

Optional Certified Test

A factory engineer oversees the testing, certifies the accuracy of the computerized results, and translates the test data onto an easy-to-read spreadsheet. The tests are run to AHRI tolerance of capacity and power. 50 Hertz units are tested using an on-site 50 Hertz generator.

Optional Witness Test

A factory engineer oversees the testing in the presence of the customer or their designate and translates the test data onto an easy-to-read spreadsheet. Tests are run to AHRI tolerances of capacity and power. 50 Hertz units are tested using an on-site 50 Hertz generator.

Daikin Factory Service Startup

All Daikin centrifugal chillers are commissioned by local Daikin Factory Service personnel or by authorized Daikin startup technicians. This procedure helps assure that proper starting and checkout procedures are employed and helps speed up the commissioning process.

Part Load Efficiency

According to ASHRAE, chillers usually spend 99% of their operating hours under part load conditions and most of this time at less than 60% of design capacity. One compressor of a dual chiller operates with the full heat transfer surface of the entire unit. For example, one 75-ton compressor on a 150-ton dual chiller utilizes 150 tons of evaporator and condenser surface. This results in very high unit efficiency and also increases the compressor's capacity.
The inclusion of VFDs, as standard, to the dual compressor chiller can produce astonishing AHRI Certified IPLVs, as low as 0.328 kW/ton. Specific selections can vary from this example.

Compliance with ASHRAE Std. 90.1

With the Magnitude chiller capacity range of 145 to 400 tons, they fall into three ASHRAE Std. 90.1 efficiency groups and revisions.

Table 2, ASHRAE 90.1 Requirements (kW/ton)

Std. 90.1 Capacity Range	Pre 2010		Starting in 2010			
			Path A		Path B	
	Full Load	IPLV	Full Load-	IPLV	Full Load-	IPLV
< 150 Tons	0.703	0.669	0.634	0.596	0.639	0.450
≥ 150 Tons < 300 Tons	0.634	0.596	0.634	0.596	0.639	0.450
≥ 300 Tons < 600 Tons	0.576	0.549	0.576	0.549	0.600	0.400

NOTE: Beginning in 2010, the 90.1 efficiency requirements have been divided into two groups, designated as Path A and Path B. Path B is a new category created for units with VFD compressor drives that by nature have superior part-load efficiencies. WMC Magnitude chillers, with their built-in VFDs, fall into Path B.

The Path B IPLV values for 2010 are about 30 percent less than the 2007 equivalent values. Also beginning in 2010, the minimum efficiency values are formula derived instead tabular so that they can take flows and temperatures other than AHRI standard into account.

AHRI Certification

Daikin has an on-going commitment to supply chillers that perform as specified. To this extent, Daikin centrifugal chillers are part of the AHRI Certification Program. On-going performance verification of chiller capacity and power input plus AHRI certified computerized selection output provide the owner with specified performance in accordance with the latest version of AHRI Standard 550/590.

All chillers that fall within the scope of the certification program have an AHRI certification label at no cost to the owner. Equipment covered by the AHRI certification program includes all water-cooled centrifugal and screw water chilling packages rated up to 2500 tons (8800 kW) at AHRI standard rating conditions, hermetic or open drive, with electric driven motor not exceeding 5000 volts, and cooling water (not glycol).

Published certified ratings verified through testing by AHRI include:

- Capacity, tons (kW)
- Power, kW/ton (COP)
- Pressure drops, ft. of water (kPa)
- Integrated Part Load Value (IPLV) or Non-Standard Part Load Value (NPLV)

The AHRI Standard 550/590 for Centrifugal or Screw Water-Chilling Packages and associated manuals define certification and testing procedures and performance tolerances of all units that fall within the application rating conditions.

Leaving chilled water temp.: 40°F to 48°F (44°F standard)

Entering condenser water temp.: 60°F to 95°F

Leaving chilled water temp.: 44°F

Evap. waterside field fouling allowance: 0.0001

Chilled water flow rate: 2.4 gpm/ton

Entering condenser water temp.: 85°F

Condenser waterside field fouling allowance: 0.00025

Condenser water flow rate: 3.0 gpm/ton

IPLV/NPLV Defined

Part load performance can be presented in terms of Integrated Part Load Value (IPLV), which is based on AHRI standard rating conditions (listed above), or Non-Standard Part Load Values (NPLV), which is based on specified or job site conditions. IPLV and NPLV are based on the following weighting equation from AHRI 550/590:

Using kW/ton:

$$IPLVorNPLV = \frac{1}{\frac{0.01}{A} + \frac{0.42}{B} + \frac{0.45}{C} + \frac{0.12}{D}}$$

Where:

A = kW/ton at 100%
B = kW/ton at 75%
C = kW/ton at 50%
D = kW/ton at 25%

Or, using COP values:

$$IPLVorNPLV = 0.01A + 0.42B + 0.45C + 0.12D$$

Where:

A = COP at 100%
B = COP at 75%
C = COP at 50%
D = COP at 25%

Weighting

The percent of annual hours of operation at the four load points are as follows:

100% Load at 1%

75% Load at 42%

50% Load at 45%

25% Load at 12%

Note that the vast majority of hours are at the operating range where dual compressor chillers excel.

Tolerances

The AHRI test tolerance, per AHRI Standard 550/590-98, for capacity (tons), power input per ton (kW/ton), and heat balance is:

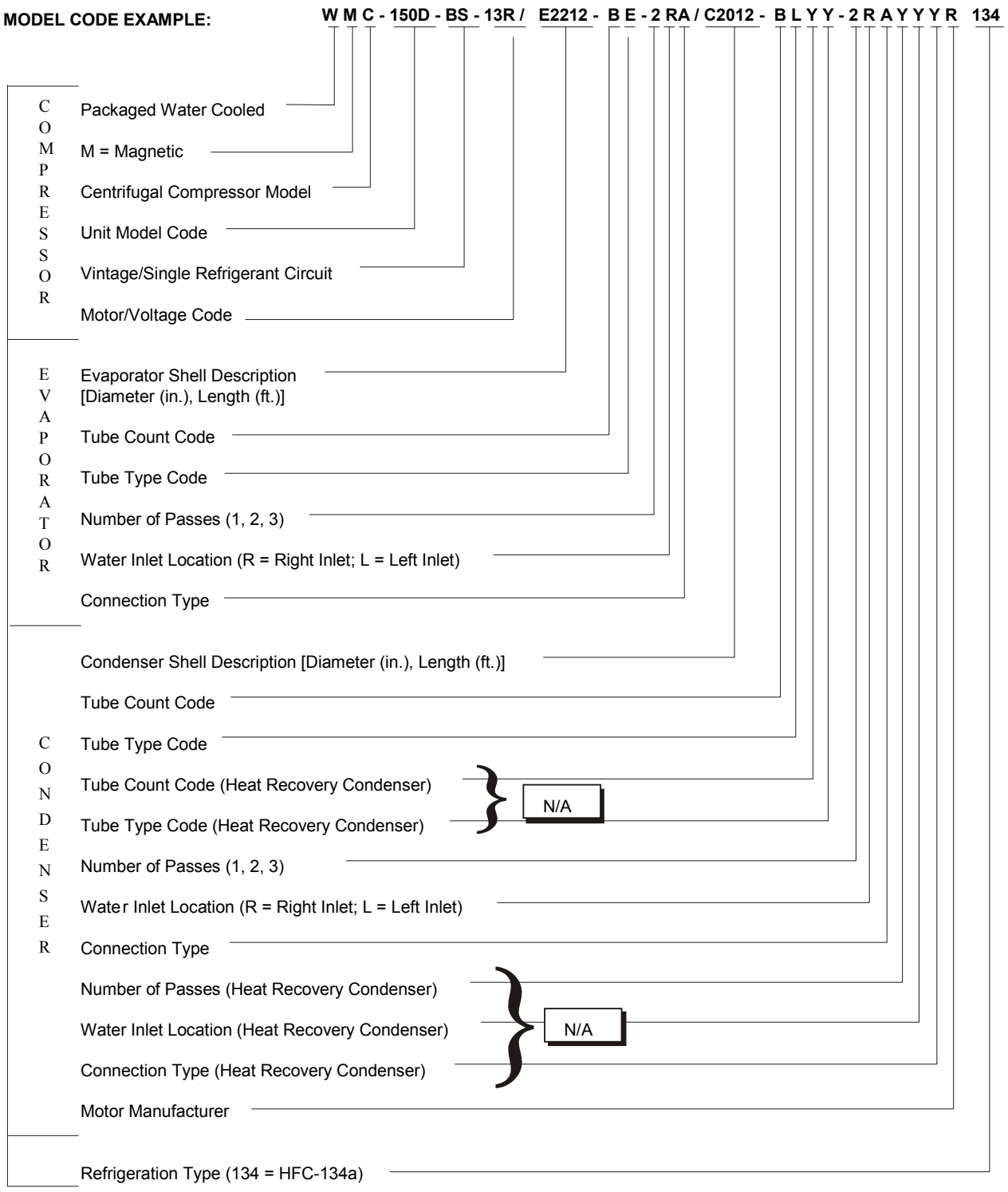
$$\%Tolerance = 10.5 - (0.07x\%FL) + \left(\frac{1500}{DTFLx\%FL}\right)$$

Where:
FL = Full Load
DTFL = Chilled Water Delta-T at Full Load
This formula results in a ±5% tolerance on tons and kW/ton at the 100% load point and AHRI conditions.

Chiller Identification

Magnitude centrifugal chillers are selected by computer and identified by their components on the selection printout as a Model #. The unit model code is as follows:

Figure 6, Chiller Identification



Sound Data

The following sound pressure ratings are for measurements one meter from the unit and in accordance with ANSI/AHRI Standard 575. The ratings are for the various part loads shown and at the center bands. Note that there is a considerable lowering of sound level as the units unload. Ratings are "A" weighted measured at one-meter from the unit. The 25 percent values are with one compressor running.

Table 3, WMC 145S Sound Pressure (dB), 50/60 Hz

Percent Load	Octave Band								A-Weighted
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
100	37.0	50.0	61.0	67.0	74.5	71.5	73.0	75.5	**80.5**
75	39.5	49.0	60.5	66.0	72.5	69.0	71.0	72.0	**78.0**
50	37.0	47.5	60.0	64.5	66.5	68.0	69.5	68.0	**75.0**
25	38.0	50.0	58.0	66.5	68.5	70.0	69.5	70.0	**76.5**

Table 4, WMC 145D/150D, Sound Pressure (dB), 50/60 Hz

Percent Load	Octave Band								A-Weighted
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
100	37.5	49.5	56.0	65.0	72.0	70.0	66.5	64.0	**75.5**
75	39.5	48.5	55.0	61.0	69.5	64.5	64.0	60.0	**72.5**
50	35.5	48.0	54.5	58.0	66.0	61.0	58.5	53.5	**68.5**
25	36.0	48.5	54.5	57.5	65.5	60.5	57.5	52.0	**68.0**

Table 5, WMC 250D/290D, Sound Pressure (dB), 50/60 Hz

Percent Load	Octave Band								A-Weighted
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
100	37.5	51.5	59.5	72.0	75.0	72.5	76.5	75.0	**81.5**
75	37.0	50.5	62.5	66.5	70.0	69.5	74.0	70.5	**78.0**
50	37.5	50.0	60.0	65.0	65.5	66.0	71.5	66.0	**75.0**
25	37.5	49.0	59.0	63.0	65.0	66.0	69.5	64.0	**73.5**

Table 6, WMC 400D, Sound Pressure (dB), 50/60 Hz

Percent Load	Octave Band								A-Weighted
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
100	46.0	55.5	65.5	70.5	74.5	76.0	80.0	74.5	**83.5**
75	45.5	55.5	65.5	69.5	73.5	76.5	79.0	72.5	**82.5**
50	45.0	54.5	64.0	69.0	71.0	74.5	77.5	70.0	**81.0**
25	44.5	51.5	61.0	64.5	67.5	73.0	73.0	62.0	**77.0**

One-Third Octave Band

Table 7, WMC 145S, One-Third Octave Band Sound Ratings

Percent Load	Octave Band												
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
100	33.5	32.0	30.5	38.0	46.5	46.5	49.0	59.0	56.0	60.5	63.0	63.0	69.5
75	34.0	36.0	33.0	39.0	45.0	45.5	49.5	58.5	54.5	58.5	60.0	63.5	71.0
50	31.5	33.5	31.5	37.5	44.5	43.5	48.0	58.5	54.0	53.0	57.0	63.5	58.0
25	32.0	32.5	34.5	37.0	47.0	46.5	49.5	55.5	53.0	55.0	59.0	65.0	59.5

Table 7, continued

Percent Load	Octave Band											A- Weighted
	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	
100	64.0	72.5	66.0	67.5	66.5	66.5	68.0	69.5	72.0	71.0	69.5	67.5	**80.5**
75	64.0	65.5	64.5	65.5	63.0	64.0	66.0	68.0	69.5	66.5	64.5	62.0	**78.0**
50	60.5	64.0	63.5	64.5	61.0	61.5	65.5	65.5	65.5	62.5	60.0	58.5	**75.0**
25	62.5	66.5	65.0	66.5	64.0	63.5	65.0	66.0	67.0	64.5	62.5	60.0	**76.5**

Table 8, WMC 145D/150D, One-Third Octave Band Sound Ratings

Percent Load	Octave Band												
	50 Hz	**63 Hz**	**80 Hz**	**100 Hz**	**125 Hz**	**160 Hz**	**200 Hz**	**250 Hz**	**315 Hz**	**400 Hz**	**500 Hz**	**630 Hz**	**800 Hz**
100	32.5	32.0	34.0	38.0	48.0	42.0	46.0	53.5	51.0	53.0	62.5	60.5	61.0
75	32.0	32.0	37.5	37.0	47.0	41.0	45.5	52.5	50.0	53.5	58.0	55.5	62.5
50	26.5	30.5	33.0	36.5	47.0	39.0	43.5	52.5	48.5	52.0	53.5	54.5	62.0
25	31.5	30.5	32.0	36.5	47.5	40.5	43.5	52.5	49.5	50.5	52.5	54.5	57.5

Table 8, continued

Percent Load	Octave Band												A- Weighted
	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	
100	70.5	65.0	68.0	62.0	63.0	62.5	61.0	61.5	60.0	59.0	59.0	58.0	**75.5**
75	67.5	61.5	59.5	58.5	60.5	59.0	60.0	58.0	55.0	54.0	56.5	57.5	**72.5**
50	57.5	62.5	57.0	55.5	55.5	54.5	55.5	50.0	48.0	45.5	51.0	50.5	**68.5**
25	63.5	58.0	56.5	56.0	54.0	53.5	54.0	49.5	48.0	45.0	47.5	48.0	**68.0**

Table 9, WMC 250D/290D, One-Third Octave Band Sound Ratings

Percent Load	Octave Band												
	50 Hz	**63 Hz**	**80 Hz**	**100 Hz**	**125 Hz**	**160 Hz**	**200 Hz**	**250 Hz**	**315 Hz**	**400 Hz**	**500 Hz**	**630 Hz**	**800 Hz**
100	32.0	32.5	33.0	38.0	49.0	47.5	50.5	56.0	56.0	70.0	65.5	65.0	71.0
75	32.0	32.5	32.5	37.5	48.0	46.0	48.5	54.0	61.5	60.5	58.0	64.0	63.0
50	33.0	33.0	32.0	37.0	48.5	43.5	47.5	53.0	58.5	52.5	57.5	64.0	57.5
25	33.0	33.0	31.5	35.5	48.0	42.0	45.5	56.0	56.0	49.5	58.5	61.0	59.0

Table 9, continued

Percent Load	Octave Band												A-Weighted
	1 kHz	**1.25 kHz**	**1.6 kHz**	**2 kHz**	**2.5 kHz**	**3.15 kHz**	**4 kHz**	**5 kHz**	**6.3 kHz**	**8 kHz**	**10 kHz**	**12.5 kHz**	
100	67.0	71.0	68.0	67.0	68.5	69.5	71.5	73.0	71.0	72.0	67.0	64.5	**81.5**
75	66.0	65.5	64.5	64.5	64.5	67.5	69.5	70.5	66.5	67.0	63.5	60.5	**78.0**
50	60.0	63.0	60.5	61.0	62.0	65.0	68.5	66.5	62.0	62.0	59.0	57.5	**75.0**
25	58.5	62.0	60.5	61.0	62.0	63.5	66.0	64.5	59.5	61.0	55.5	54.4	**73.5**

Table 10, WMC 400D, One-Third Octave Band Sound Ratings

Percent Load	Octave Band												
	50 Hz	**63 Hz**	**80 Hz**	**100 Hz**	**125 Hz**	**160 Hz**	**200 Hz**	**250 Hz**	**315 Hz**	**400 Hz**	**500 Hz**	**630 Hz**	**800 Hz**
100	36.0	42.5	42.5	45.5	52.0	52.0	56.0	60.0	63.5	64.5	65.5	67.0	69.5
75	35.5	42.5	42.0	45.5	51.5	52.0	55.5	60.0	63.5	64.0	65.0	65.0	70.5
50	34.0	41.5	42.0	43.5	49.0	52.5	56.0	61.5	58.5	63.5	65.0	64.0	66.0
25	34.0	41.5	41.0	41.5	45.5	50.0	57.0	55.5	55.5	58.5	59.0	61.0	62.0

Table 11, continued

Percent Load	Octave Band												A-Weighted
	1 kHz	**1.25 kHz**	**1.6 kHz**	**2 kHz**	**2.5 kHz**	**3.15 kHz**	**4 kHz**	**5 kHz**	**6.3 kHz**	**8 kHz**	**10 kHz**	**12.5 kHz**	
100	71.0	68.5	70.0	72.0	72.0	72.0	75.0	77.5	71.5	69.5	66.0	63.0	**83.5**
75	68.0	67.5	69.5	71.0	73.5	72.0	74.5	75.5	69.5	68.0	65.0	61.5	**82.5**
50	65.5	66.5	68.0	69.0	71.5	70.0	73.0	74.5	67.0	65.0	63.5	57.5	**81.0**
25	62.0	63.5	65.5	71.5	64.5	66.0	71.0	64.0	59.5	57.0	53.5	49.0	**77.0**

Dimensions

Figure 7, WMC 145S (B-vintage), 2-Pass, Right-hand (See page 26 for notes.)

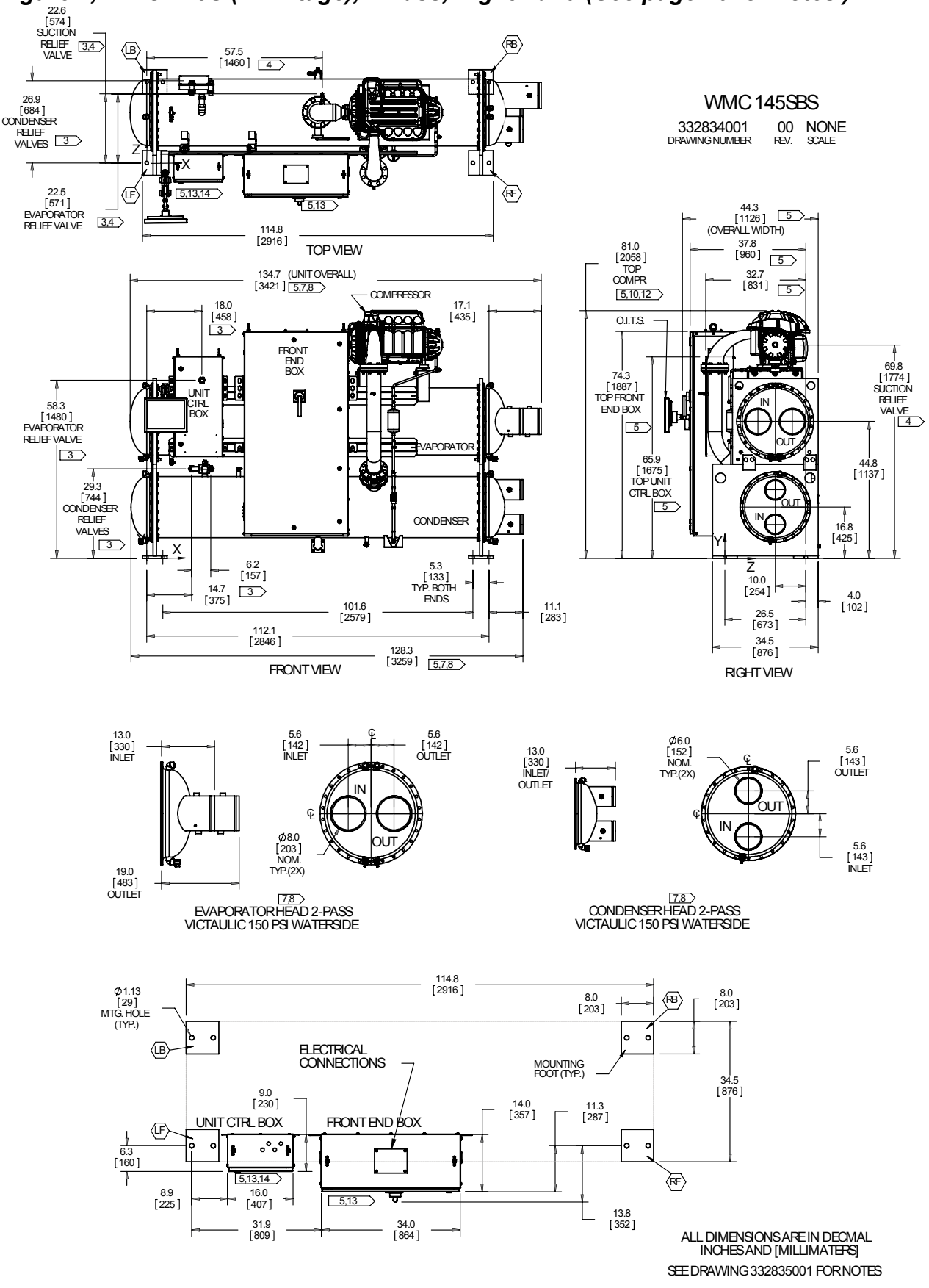


Figure 8, WMC 145D (B-vintage), 2-Pass, Right-hand (See page 26 for notes)

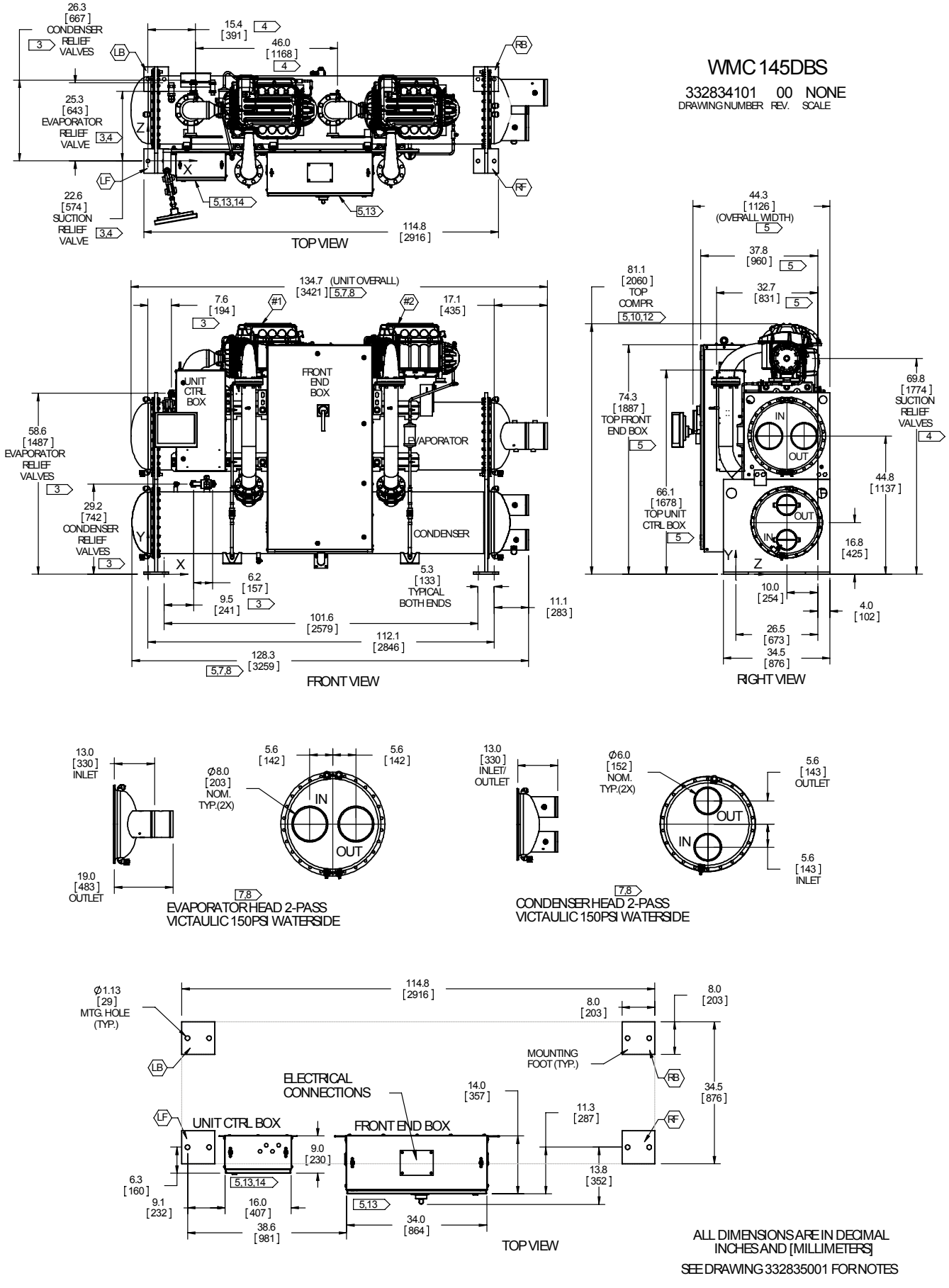
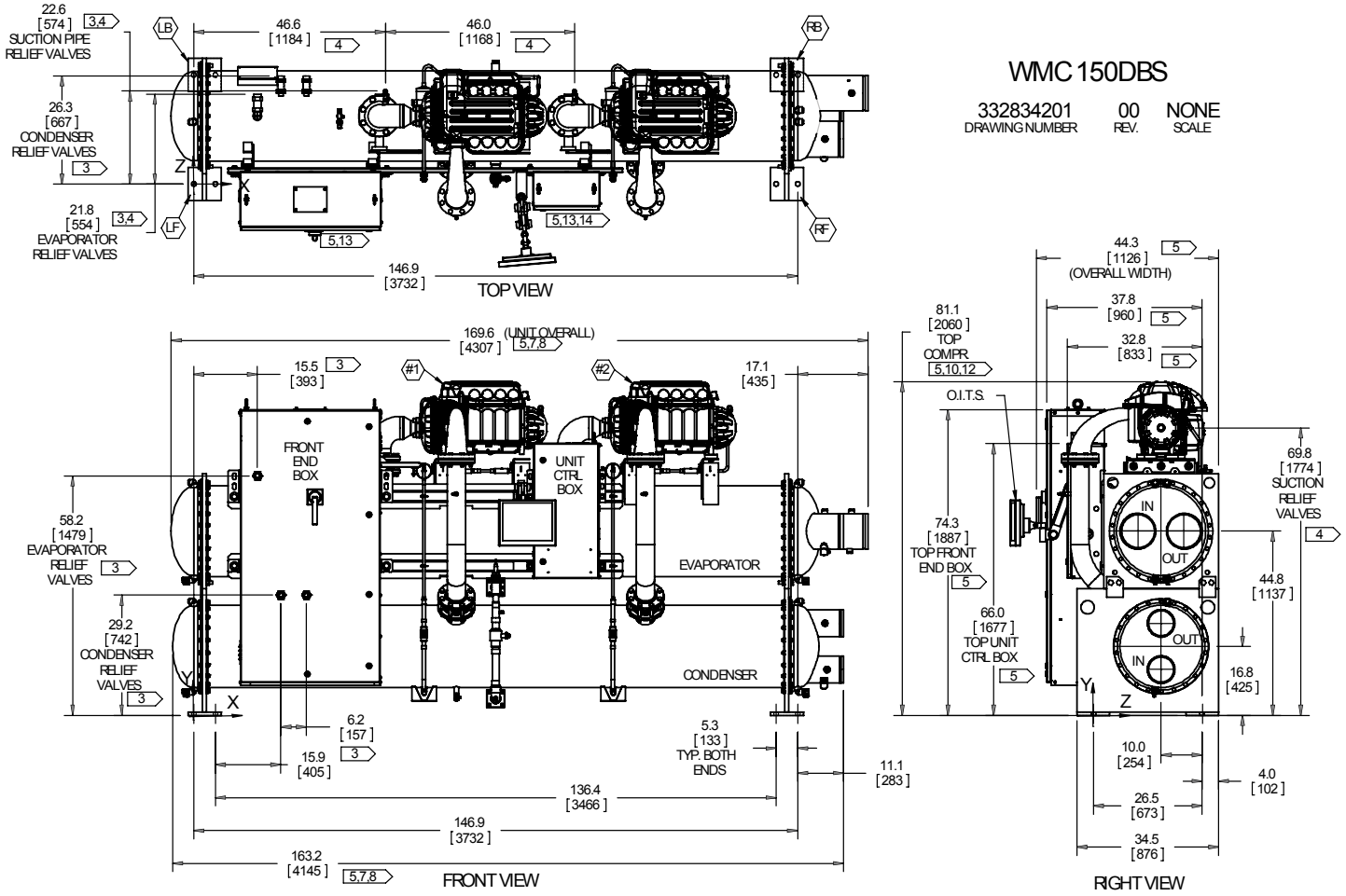
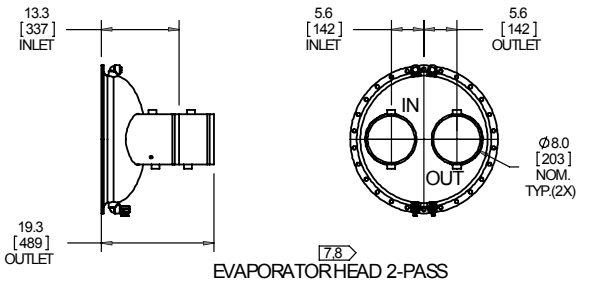
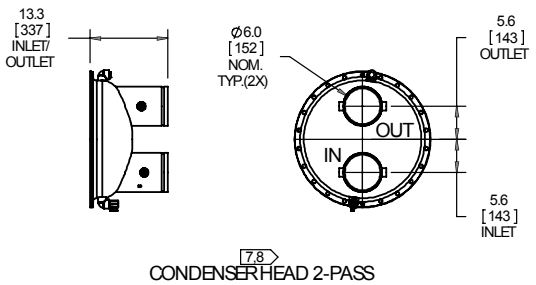


Figure 9, WMC 150D (B-vintage), 2-Pass, Right-hand (See page 26 for notes)







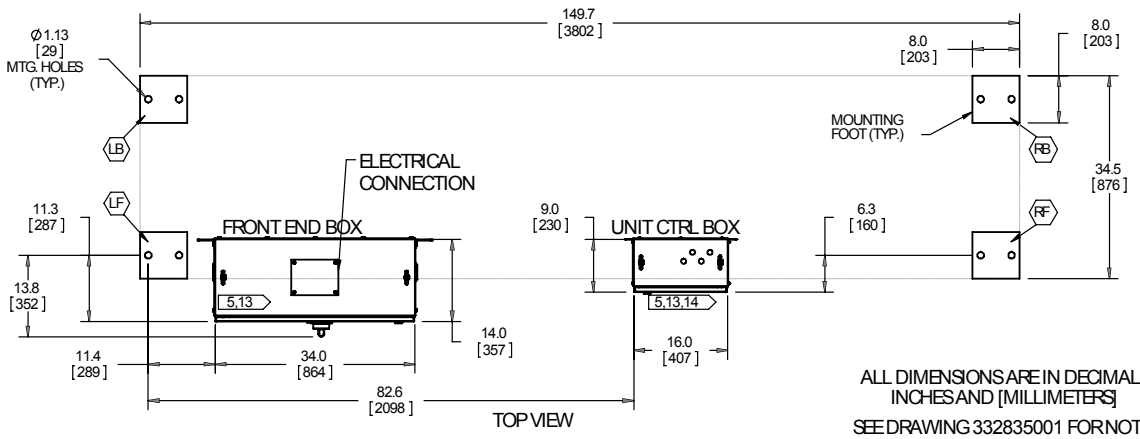
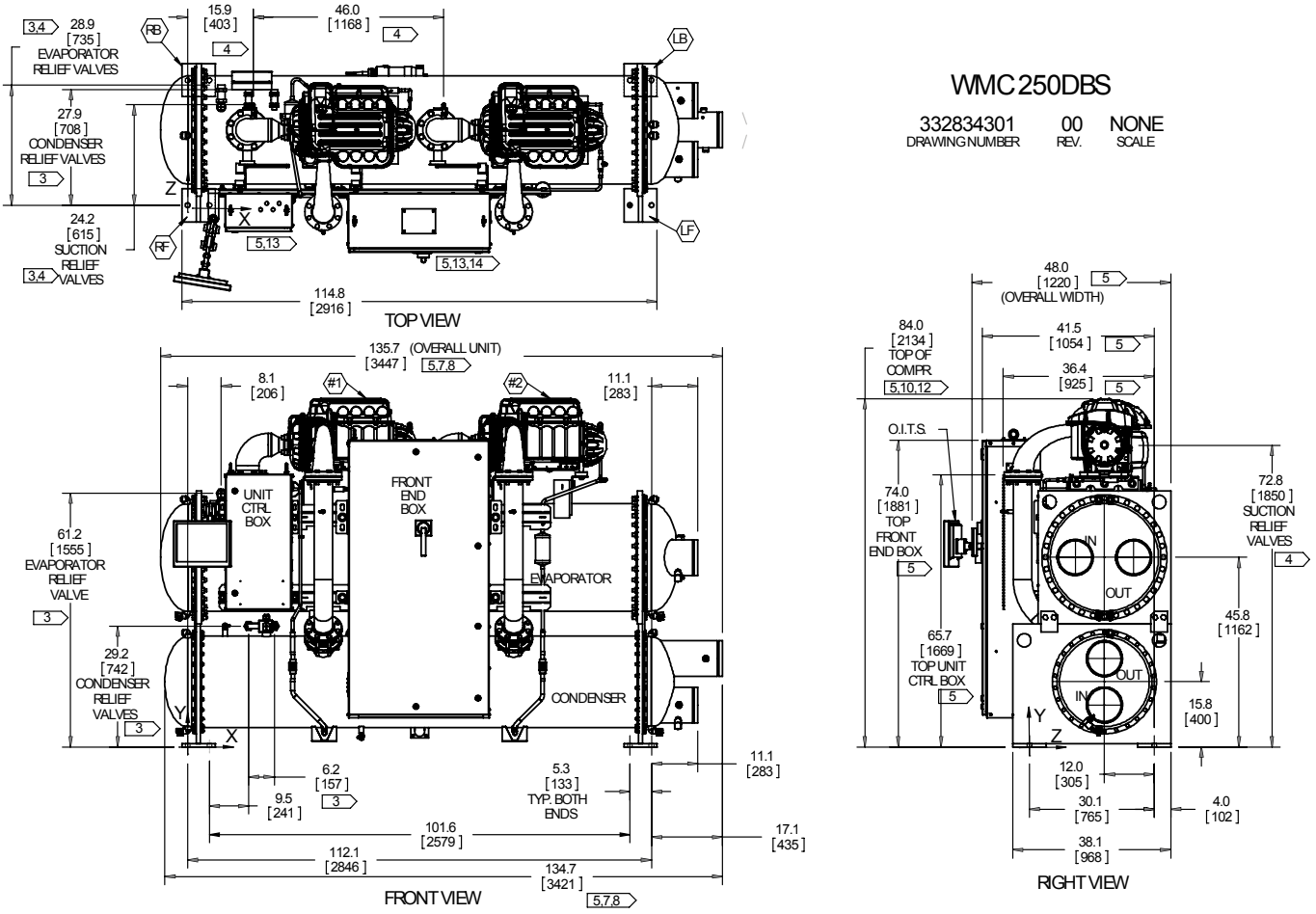
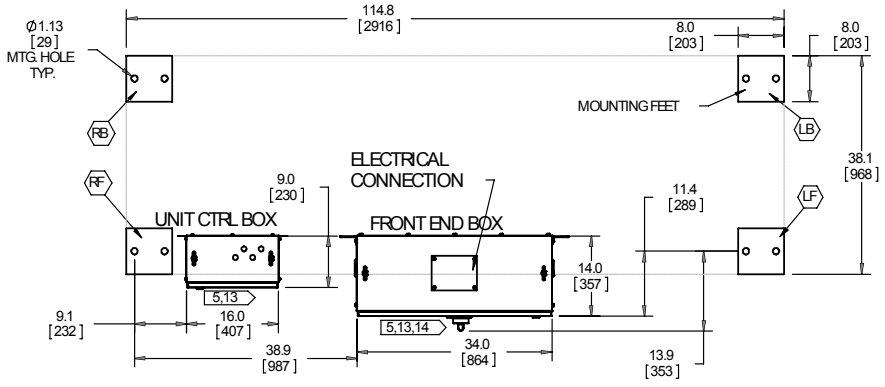


Figure 10, WMC 250D (B-vintage), 2-Pass, Right-hand (See page 26 for notes)



EVAPORATOR HEAD 2-PASS
VICTAULIC 150PSI WATERSIDE

CONDENSER HEAD 2-PASS
VICTAULIC 150PSI WATERSIDE



SEE DRAWING 332835001 FOR NOTES
ALL DIMENSIONS ARE IN DECIMAL INCHES AND [MILLIMETERS]

Figure 11, WMC 290D (B-vintage), 2-Pass, Right-hand (See page 26 for notes.)

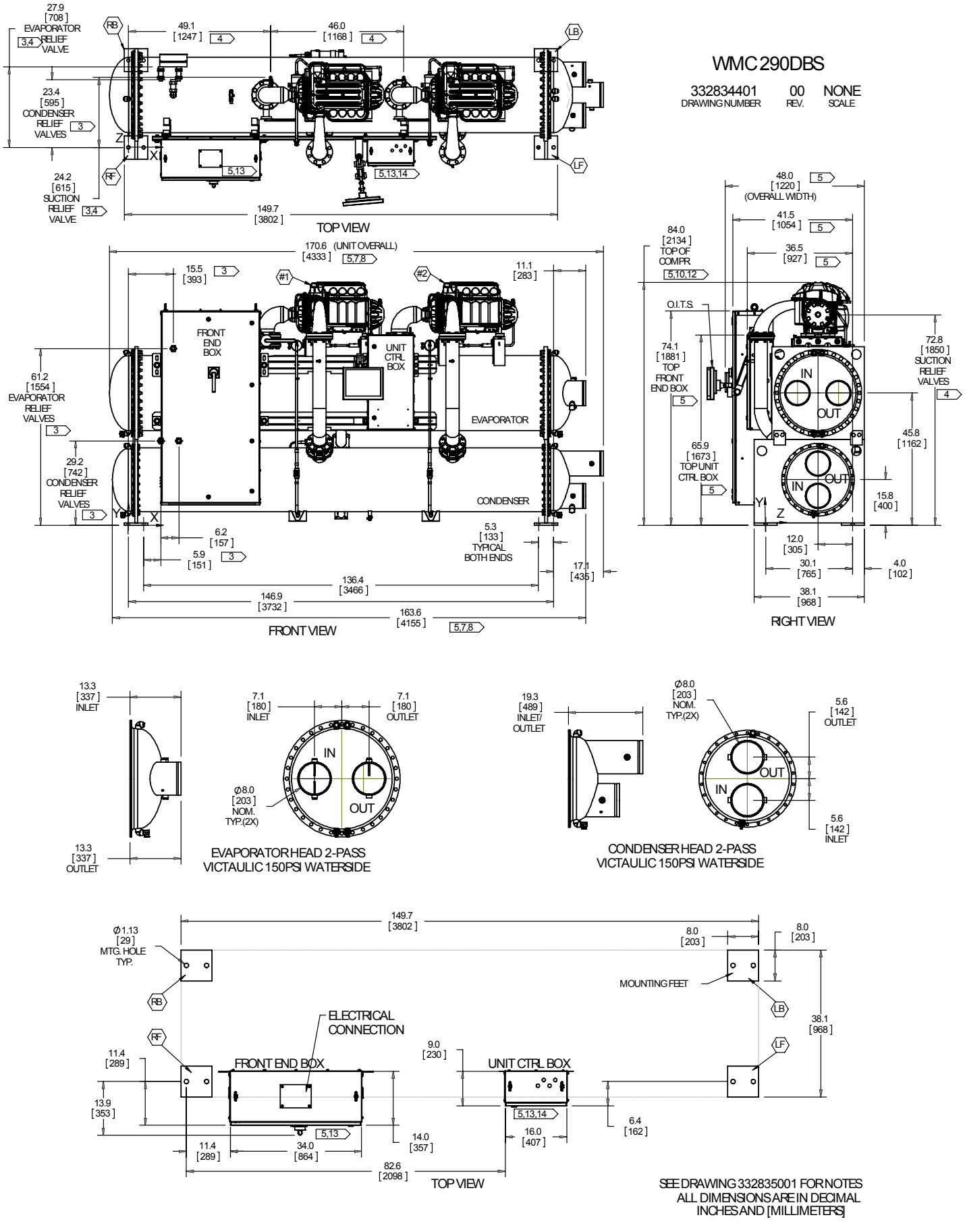
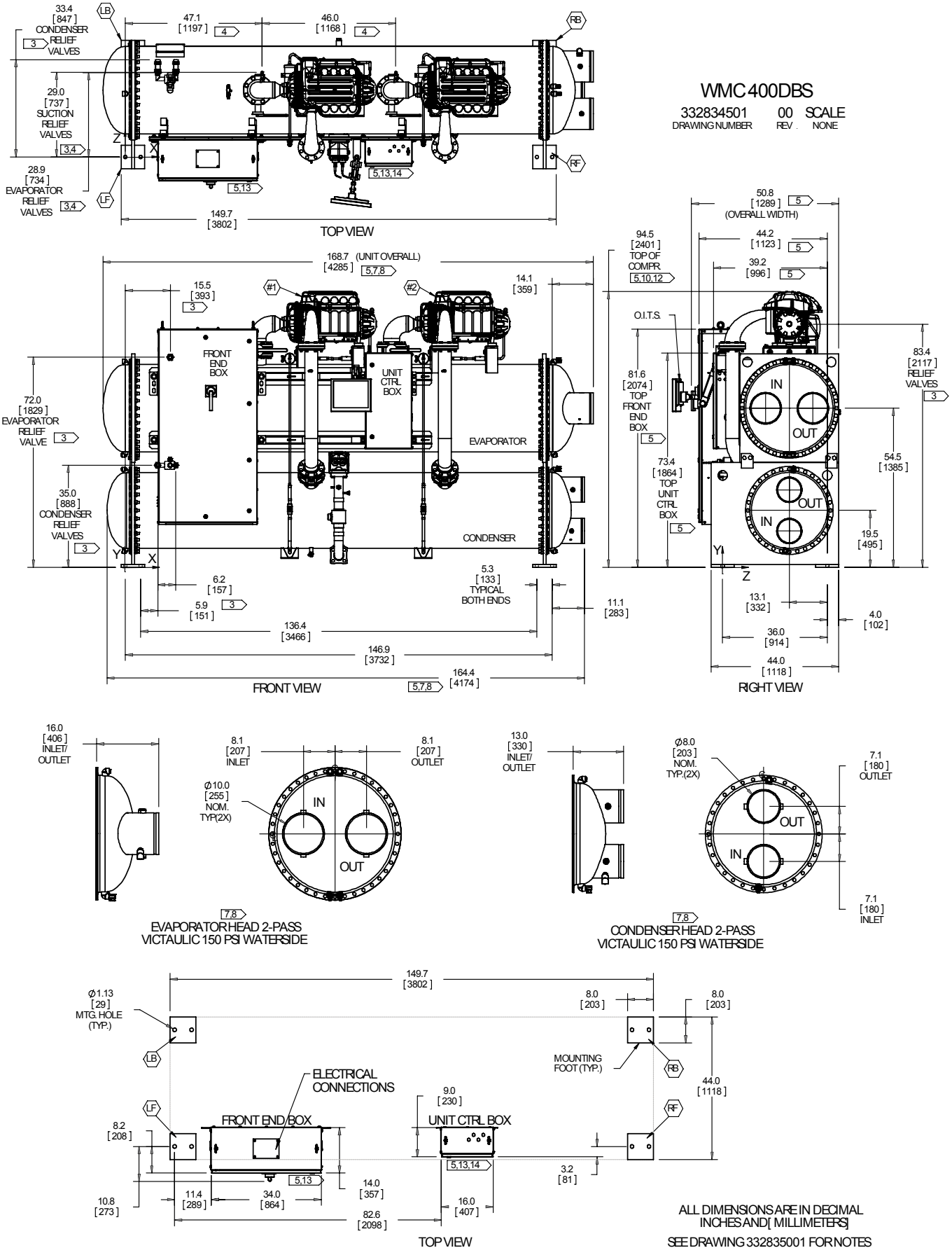


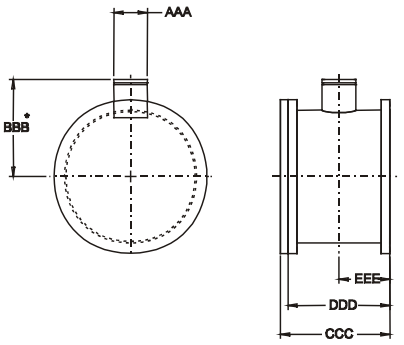
Figure 12, WMC 400D (B-vintage), 2-Pass, Right-hand (See page 26 for notes.)



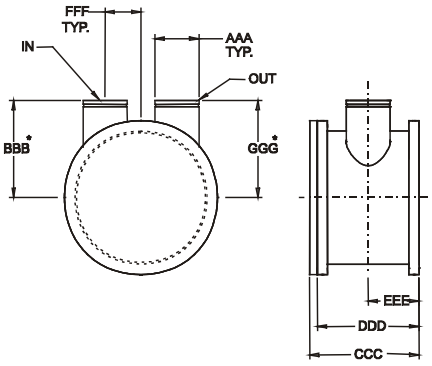
Marine Water Box Dimensions with Victaulic or Flanged Connections

Marine water boxes are an available option on all evaporator and condenser sizes. Caution: There is some nomenclature confusion in the industry. We refer to our standard dished heads as “dished heads”. Some manufacturers refer to them, or similar devices as “water boxes”. They are not “*marine* water boxes” with removable end covers as illustrated below.

EVAP 1 PASS

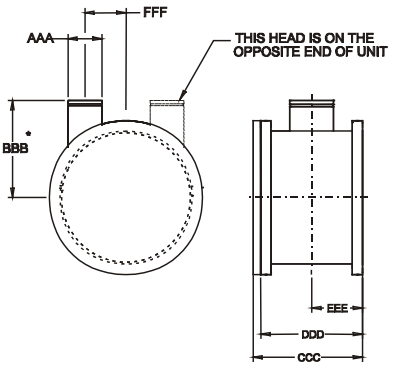


EVAP 2 PASS



REPRESENTATIVE OF RIGHT HAND
WITH VICTAULIC CONNECTIONS:
LEFT HAND CONNECTION IS MIRROR IMAGE OF ABOVE

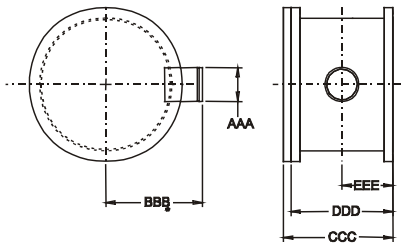
EVAP 3 PASS



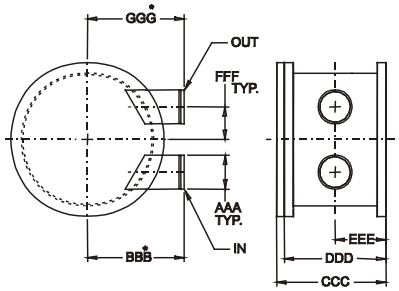
VIEW SHOWN REFLECTS A R.H. INLET OR
A L.H. OUTLET. MIRROR IMAGE OF ABOVE
REFLECTS A L.H. INLET OR R.H. OUTLET.

NOTE: * ADD .500 INCH FOR FLANGED CONNECTION.

REAR FACING ONLY
COND 1 PASS

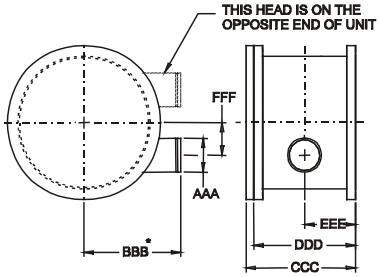


REAR FACING ONLY
COND 2 PASS



REPRESENTATIVE OF RIGHT HAND
WITH VICTAULIC CONNECTIONS:
LEFT HAND CONNECTION IS MIRROR IMAGE OF ABOVE

REAR FACING ONLY
COND 3 PASS



VIEW SHOWN REFLECTS A R.H. INLET. FOR
A L.H. INLET, MIRROR ABOUT VERTICAL C.L.
OUTLETS ARE MIRRORED ABOUT HORIZONTAL C.L.

150 PSI Non-ASME - Victaulic Connection

Evap. Dia.	1 PASS					2 PASS							3 PASS					
	'AAA'	'BBB'	'CCC	'DDD'	'EEE'	'AAA'	'BBB'	'CCC'	'DDD'	'EEE'	'FFF'	'GGG'	'AAA'	'BBB'	'CCC'	'DDD'	'EEE'	'FFF'
E22	10.75	17.00	21.25	20.00	10.00	8.625	17.00	21.00	20.00	10.00	5.59	23.00	5.563	17.00	21.25	20.00	10.00	7.12
E26	10.75	19.00	21.25	20.00	10.00	8.625	19.00	21.25	20.00	10.00	7.07	19.00	6.625	19.00	21.25	20.00	10.00	8.07
E30	14.00	21.00	28.50	26.50	13.25	10.75	21.00	28.50	26.50	13.25	8.13	21.00	6.625	21.00	28.50	26.50	13.25	10.19

Cond. Dia.	1 PASS					2 PASS							3 PASS					
	'AAA'	'BBB'	'CCC	'DDD'	'EEE'	'AAA'	'BBB	'CCC'	'DDD'	'EEE'	'FFF'	'GGG'	'AAA'	'BBB'	'CCC'	'DDD'	'EEE'	'FFF'
C20	8.62	16.00	19.00	18.00	9.00	6.625	16.00	19.00	18.00	9.00	5.63	16.00	Consult Daikin Sales Office					
C22	10.75	17.00	21.25	20.00	10.00	8.625	17.00	21.00	20.00	10.00	5.59	23.00						
C26	10.75	19.00	21.25	20.00	10.00	8.625	19.00	21.25	20.00	10.00	7.07	19.00						

Notes:
1. Dimensions in inches.
2. Flanges are ANSI raised face. Mating flanges by others.
3. Some condensers with flanges can have staggered connections due to flange interference. Consult factory.
4. Flanges add 0.5 inches to the distance from the vertical centerline to the flange face compared to Victaulic.

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 145S/D and WMC 250D at one end
   144 inches (3658 mm) on WMC 150D, WMC 290, and WMC 400D at one end
   plus 36 inches (910 mm) is required at the opposite end. If tube pull and cleaning clearance is at the connection end, do not block tube access with piping, pumps, etc.

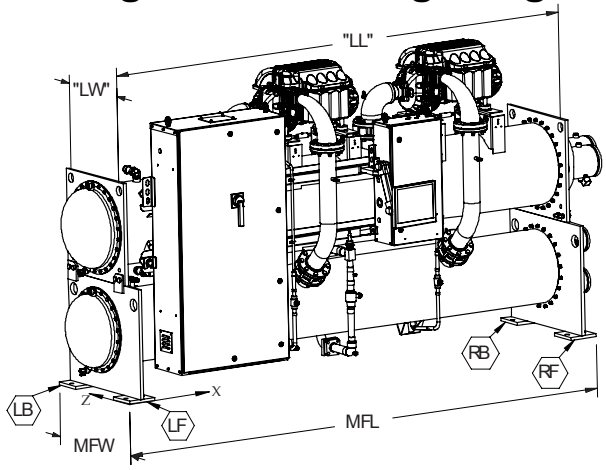
   Sides — 36 inches (914 mm) is recommended on all other sides and top for service clearance except unit front electric panels. See below..

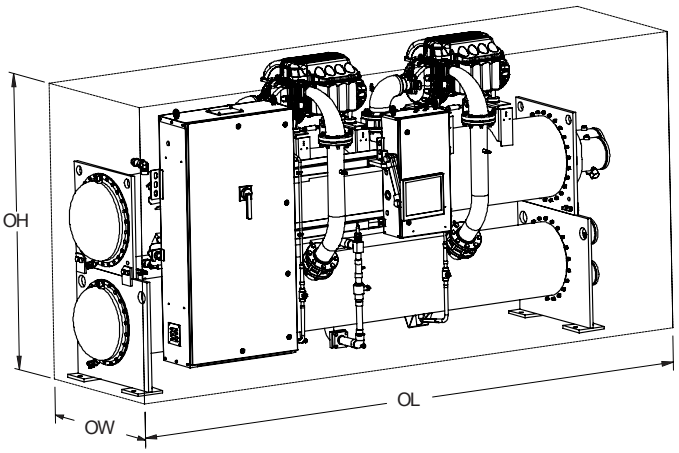
   Electric Panels — Most codes require 48 inches (1219 mm) clearance in front of the control boxes and electrical panels.

6. 3.25-inch [83mm] diameter lifting holes are provided at the upper corners of each vessel. See installation manual for lifting instructions.
7. All water connections are given in standard U.S. pipe sizes. Standard Victaulic® connections are also suitable for welding.
8. The water connection shown is for the default configuration; your unit may be configured differently. Orientation (left/right) is determined while facing the control panel. Consult the Item Summary sheet for exact configuration. Unit shown has standard right-hand water connections. Left-hand connections are available for either vessel. For left 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 are 0.250 inches [6 mm] thick.
11. These values are for units with standard wall thickness copper tubing only.
12. The shipping skid adds 6.0 inches [152 mm] to the overall unit height.
13. All-power wiring is brought into the top of the compressor power panel (Front End Box). Field control wiring is brought into the Unit Control Box.
14. The unit is shipped with an operating charge of refrigerant.
15. Optional marine water box connections are available upon request.

Physical Data and Weights

Lifting and Mounting Weights





WMC*BS CORNER WEIGHT

ACRONYMS:			
CG	CENTER OF GRAVITY	LHD	LIFTING HOLE DIAMETER
LB	LEFT BACK	LL	LIFTING LENGTH
LF	LEFT FRONT	LW	LIFTING WIDTH
RB	RIGHT BACK	MHD	MOUNTING HOLE DIAMETER
RF	RIGHT FRONT	MFL	MOUNTING FOOTPRINT LENGTH
OL	OVERALL LENGTH	MFW	MOUNTING FOOTPRINT WIDTH
OW	OVERALL WIDTH		
OH	OVERALL HEIGHT		

NOTES:	
1	DATA DISPLAYED BELOW APPLIES TO STANDARD UNITS WITH 2-PASS HEAT EXCHANGERS WITH RIGHT HAND, DISHED HEADS, VICTAULIC CONNECTIONS AND 150 PSI WATER SIDE RATING
2	DATA FOR OPTIONAL CONFIGURATIONS AVAILABLE THROUGH SELECTION SOFTWARE
3	DATA FOR SPECIAL DESIGN PRESSURE RATINGS AVAILABLE PER FPA REQUEST
4	SHIPPING SKIDS WHEN USED ADD 4" TO OH, 45" TO ML AND 210 LBS TO LIFTING WEIGHT

	WMC145SBS E2209*C2009		WMC145DBS E2209*C2009		WMC150DBS E2212*C2012		WMC250DBS E2609*C2209		WMC290DBS E2612*C2212		WMC400DBS E3012*C2612	
SHIPPING / LIFTING												
WEIGHT	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]
TOTAL	5,801	2,631	6,230	2,826	7,976	3,618	7,982	3,620	9,601	4,355	11,838	5,370
LB	1,562	709	1,654	750	2,247	1,019	2,117	960	2,625	1,190	3,439	1,560
LF	1,209	548	1,259	571	1,715	778	1,751	794	2,092	949	2,389	1,084
RB	1,708	775	1,884	854	2,277	1,033	2,251	1,021	2,717	1,233	3,546	1,609
RF	1,322	600	1,434	650	1,738	788	1,863	845	2,166	983	2,463	1,117
DIMENSIONS	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]
CG-X	59	1,486	60	1,515	74	1,878	58	1,467	75	1,898	75	1,894
CG-Y	32	820	34	864	35	878	36	922	35	878	39	1,001
CG-Z	15	379	15	382	15	382	16	418	17	425	21	540
LL	107	2,713	107	2,713	141	3,593	107	2,706	141	3,593	141	3,593
LW	24	597	24	597	24	597	27	673	27	673	29	733
LHD	2.50	63.5	2.50	63.5	2.50	63.5	3.25	82.6	3.25	82.6	3.25	82.6
OPERATING												
WEIGHT	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]	[Lb]	[Kg]
TOTAL	6,686	3,033	7,115	3,227	9,067	4,113	9,261	4,201	11,159	5,062	14,122	6,406
LB	1,826	828	1,917	870	2,576	1,168	2,486	1,127	3,078	1,396	4,140	1,878
LF	1,369	621	1,419	644	1,913	868	1,995	905	2,392	1,085	2,787	1,264
RB	1,995	905	2,171	985	2,626	1,191	2,652	1,203	3,201	1,452	4,300	1,951
RF	1,496	679	1,607	729	1,951	885	2,129	966	2,488	1,128	2,895	1,313
DIMENSIONS	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]
X	59	1,486	60	1,511	74	1,884	58	1,469	75	1,902	75	1,901
Y	32	820	34	861	34	874	36	915	35	882	40	1,006
Z	15	385	15	387	15	386	17	424	17	430	22	546
ML	115	2,916	115	2,916	150	3,802	115	2,916	150	3,802	150	3,802
MW	35	876	35	876	35	876	38	968	38	968	44	1,118
MHD	1.25	31.8	1.25	31.8	1.25	31.8	1.25	31.8	1.25	31.8	1.25	31.8
OL	135	3,421	135	3,421	170	4,307	136	3,447	171	4,333	169	4,285
OW	44	1,126	44	1,126	44	1,126	48	1,220	48	1,220	51	1,289
OH	81	2,060	81	2,060	81	2,060	84	2,134	84	2,134	95	2,401
WATER VOL	[Gal]	[Lt]	[Gal]	[Lt]	[Gal]	[Lt]	[Gal]	[Lt]	[Gal]	[Lt]	[Gal]	[Lt]
TOTAL	106	402	106	402	131	494	153	580	187	707	274	1,036
EVAPORATOR	44	168	44	168	53	202	77	292	91	346	130	493
CONDENSER	62	233	62	233	77	293	76	289	95	361	143	543

332834901 DRAWING NUMBER | 00 REV. | NONE SCALE

Physical Data

Evaporator

Refrigerant-side design pressure is 200 psi (1379 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 12, Evaporator Physical Data

WMC Model	Evaporator Model	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.	550 (250)	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
400D	E3012	12 ft.	1240 (562)	88 (336)	114 (11)	1

Notes:
1. Refrigerant charge is approximate since the actual charge will depend on other variables. Actual charge will be shown on the unit nameplate and is tabulated above.
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 system 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 13, Condenser Physical Data

WMC Model	Condenser Model	Tube Length	Maximum Pumpdown Capacity lb. (kg)	Water Volume gal. (L)	Number of Relief Valves
145S, 145D	C2009	9 ft.	728 (330)	47 (147)	2
150D	C2012	12 ft.	971 (440)	62 (236)	2
250D	C2209	9 ft.	883 (401)	50 (223)	2
290D	C2212	12 ft.	1174 (533)	72 (273)	2
400D	C2612	12 ft.	1676 (760)	111 (419)	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.

Relief Valves

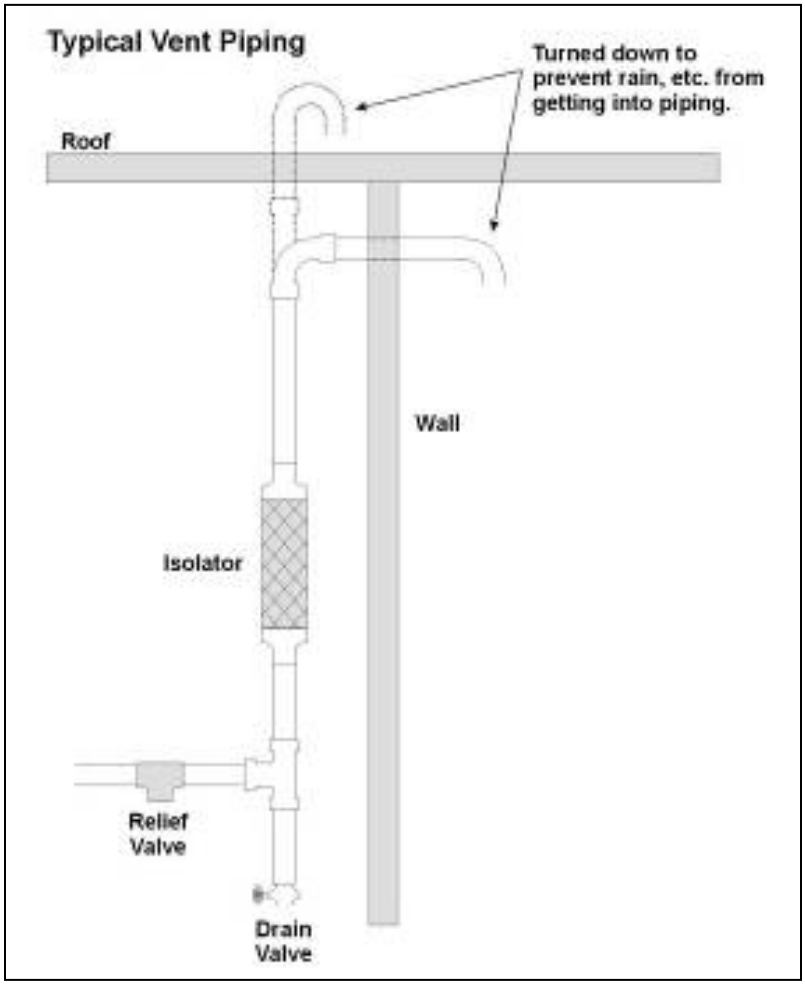
As a safety precaution and to meet code requirements, each chiller is equipped with pressure relief valves located on the condenser and evaporator for the purpose of relieving excessive refrigerant pressure (caused by equipment malfunction, fire, etc.) to the atmosphere. Most codes require that relief 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.
- Evaporators have a single valve. Each valve has a 1.0-inch female NPT connection.
- Each suction line on dual compressor units has a single 200 psig relief valve rated at 6.9 lb/min air with a 3/8-inch flare connection.

Vessel valve capacity is 75.5 lb/min air.

Figure 13, Typical Vent Piping



Electrical Data

General Note: The RLA for use in the following tables is obtained by the selection of a specific unit by Daikin. When shipped, a unit will bear the specific RLA, stamped on the nameplate, for the selected operating conditions.

⚠ CAUTION

The RLA stamped on the unit may be lower than the minimum shown in the following tables, in which case the minimum table value must be used for wire sizing.

Table 14, Electrical Acronyms and Notes

ACRONYMS:	
DS	Disconnect switch
LRA	Locked rotor amps
N/A	Not available
MCA	Minimum circuit ampacity
MOP	Maximum overcurrent protection
PB	Power block
RLA	Rated load amps
NOTES:	
1	Disconnect switch will also be a circuit breaker for short circuit protection.
2	RLA and LRA data is for each compressor
3	Wire size per NEC 2008, table 310.16, 75° C, copper
4	MOP size per NEC 2008, section 440.22(a) for air conditioning and refrigeration equip.
5	On single-point connection a circuit breaker for short circuit protection is installed downstream of the power block or disconnect switch .

WMC 145S, Single Compressor

Table 15, WMC 145S-B, 3/60/460

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR			**CHILLER**					
RLA [Amp]	**LRA [Amp]**	**QTY**	**MCA [Amp]**	**MOP [Amp]**	**Disc.Swt [Amp]**	**POWER BLOCK [Amp]**	**WIRE QTY**	**WIRE GAUGE**
79 - 80	110	1	99 - 100	175	150	N/A	3	3 GA
81 - 88	110	1	101 - 110	175	150		3	2 GA
89 - 92	110	1	111 - 115	200	150		3	2 GA
93 - 99	110	1	116 - 123	200	150		3	1 GA
100	110	1	125	225	150		3	1 GA
101 - 104	132	1	126 - 130	225	200		3	1 GA
105 - 111	132	1	131 - 138	225	200		3	1/0
112 - 120	132	1	140 - 150	250	200		3	1/0
121 - 133	154	1	151 - 166	250	225		3	2/0
134 - 140	154	1	167 - 175	300	225		3	2/0
141 - 150	165	1	176 - 187	300	225		3	3/0

Table 16, WMC 145S-B, 3/50/400

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	Disc.Swt [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
95 – 99	132	1	119 – 124	225	200	N/A	3	1 GA
100 – 104	132	1	125 – 130	225	200		3	1 GA
105 – 111	132	1	132 – 139	225	200		3	1/0
112 – 120	132	1	140 – 150	250	200		3	1/0
121 - 133	165	1	152 – 167	250	225		3	2/0
134 – 140	165	1	168 – 175	300	225		3	2/0
141 – 150	165	1	177 – 188	300	225		3	3/0
151 – 155	176	1	189 – 194	300	250		3	3/0
156 – 160	176	1	195 – 200	350	250		3	3/0
161 – 170	187	1	201 - 213	350	250		3	3/0

Table 17, WMC 145S-B, 3/50/380

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
108 - 111	149	1	135 - 139	225	200	N/A	3	1/0
112 - 120	149	1	140 - 150	250	200		3	1/0
121 - 133	149	1	152 - 167	250	225		3	2/0
134 - 135	149	1	168 - 169	300	225		3	2/0
136 - 140	187	1	170 – 175	300	225		3	2/0
141 - 155	187	1	177 - 194	300	250		3	3/0
156 - 170	187	1	195 - 213	350	250		3	3/0

WMC 145D & 150D, Dual Compressor

Table 18, WMC 145D-B & WMC 150D-B, 3/60/460

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR (EACH)			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
52 - 53	72	2	117 - 120	150	250	760	3	1 GA
54 - 57	72	2	122 - 129	175	250	760	3	1 GA
58 - 61	72	2	131 - 138	175	250	760	3	1/0
62 - 65	72	2	140 - 147	200	250	760	3	1/0
68 - 69	94	2	153 - 156	200	250	760	3	2/0
70 - 76	94	2	158 - 171	225	250	760	3	2/0
77	94	2	174	250	250	760	3	2/0
78 - 85	94	2	176 - 192	250	250	760	3	3/0
89 - 92	124	2	201 - 207	250	250	760	3	4/0
93 - 102	124	2	210 - 230	300	400	760	3	4/0
103 - 107	124	2	232 - 241	300	400	760	3	250 MCM
108 - 113	124	2	243 - 255	350	400	760	3	250 MCM

MULTI-POINT CONNECTION, OPTIONAL								
COMPRESSOR (EACH)			CHILLER (PER CIRCUIT)					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
52	72	2	65	110	100	N/A	3	6 GA
53 - 55	72	2	67 - 69	110	100	N/A	3	4 GA
56 - 65	72	2	70 - 82	125	100	N/A	3	4 GA
68	94	2	85	150	125	N/A	3	4 GA
69 - 77	94	2	87 - 97	150	125	N/A	3	3 GA
78 - 80	94	2	98 - 100	175	125	N/A	3	3 GA
81 - 85	94	2	102 - 107	175	150	N/A	3	2 GA
90 - 92	124	2	113 - 115	200	150	N/A	3	2 GA
93 - 99	124	2	117 - 124	200	150	N/A	3	1 GA
100 - 104	124	2	125 - 130	225	150	N/A	3	1 GA
105 - 111	124	2	132 - 139	225	150	N/A	3	1/0
112 - 113	124	2	140 - 142	250	150	N/A	3	1/0

Table 19, WMC 145D-B & WMC 150D-B, 3/60/575

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR (EACH)			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
51	71	2	115	150	250	760	3	2 GA
52 - 53	71	2	117 - 120	150	250	760	3	1 GA
54 - 57	71	2	122 - 129	175	250	760	3	1 GA
58 - 61	71	2	131 - 138	175	250	760	3	1/0
62 - 64	71	2	140 - 144	200	250	760	3	1/0
65 - 69	88	2	147 - 156	200	250	760	3	2/0
70 - 76	88	2	158 - 171	225	250	760	3	2/0
77	88	2	174	250	250	760	3	2/0
78 - 80	88	2	176 - 180	250	250	760	3	3/0
81 - 88	110	2	183 - 198	250	250	760	3	3/0
89 - 92	110	2	201 - 207	250	250	760	3	4/0
93 - 100	110	2	210 - 225	300	250	760	3	4/0

MULTI-POINT CONNECTION, OPTIONAL								
COMPRESSOR (EACH)			CHILLER (PER CIRCUIT)					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
51 - 52	71	2	64 - 65	110	100	N/A	3	6 GA
53 - 55	71	2	67 - 69	110	100	N/A	3	4 GA
56 - 64	71	2	70 - 80	125	100	N/A	3	4 GA
67 - 68	88	2	84 - 85	150	125	N/A	3	4 GA
69 - 77	88	2	87 - 97	150	125	N/A	3	3 GA
78 - 80	88	2	98 - 100	175	125	N/A	3	3 GA
81 - 88	110	2	102 - 110	175	150	N/A	3	2 GA
89 - 92	110	2	112 - 115	200	150	N/A	3	2 GA
93 - 99	110	2	117 - 124	200	150	N/A	3	1 GA
100	110	2	125	225	150	N/A	3	1 GA

Table 20, WMC 145D-B & WMC 150D-B, 3/50/400

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR (EACH)			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
68 – 69	94	2	153 – 159	250	200	760	3	2/0
70 – 78	94	2	158 0 171	225	400	760	3	2/0
77	94	2	174	250	400	760	3	2/0
78 – 85	94	2	176 – 192	250	400	760	3	3/0
89 – 92	124	2	201 – 207	250	400	760	3	4/0
93 – 102	124	2	210 – 230	300	400	760	3	4/0
103 – 107	124	2	232 – 241	300	400	760	3	250 MCM
108 – 113	124	2	243 – 255	350	400	760	3	250 MCM
114 - 122	134	2	257 - 275	350	400	760	3	300 MCM

MULTI-POINT CONNECTION, OPTIONAL								
COMPRESSOR (EACH)			CHILLER (PER CIRCUIT)					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
68	94	2	85	150	250	-	3	4 GA
69 - 77	94	2	87 - 97	150	250	-	3	3 GA
78 - 80	94	2	98 - 100	175	250	-	3	3 GA
81 - 85	94	2	102 - 107	175	250	-	3	2 GA
89 - 92	124	2	112 - 115	200	250	-	3	2 GA
93 - 99	124	2	117 - 124	200	250	-	3	1 GA
100 - 104	124	2	125 - 130	225	400	-	3	1 GA
105 - 111	124	2	132 - 139	225	400	-	3	1/0
112 - 113	124	2	140 - 142	250	400	-	3	1/0
114 - 120	134	2	143 - 150	250	400	-	3	2/0
121 - 122	134	2	152 - 153	250	400	-	3	2/0

WMC 250D & 290D, Dual Compressor

Table 21, WMC 250D-B & WMC 290D-B, 3/60/460

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR (Each)			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
79 to 88	110	2	178 to 198	250	250	760	3	3/0
89 to 92	110	2	201 to 208	250	250	760	3	4/0
93 to 100	110	2	210 to 226	300	250	760	3	4/0
101 to 107	132	2	228 to 241	300	400	760	3	250 MCM
108 to 113	132	2	244 to 255	350	400	760	3	250 MCM
114 to 120	132	2	257 to 271	350	400	760	3	300 MCM
121 to 123	154	2	273 to 277	350	400	760	3	300 MCM
124 to 126	154	2	280 to 284	400	400	760	3	300 MCM
127 to 137	154	2	286 to 309	400	400	760	3	350 MCM
138	154	2	311	400	400	760	3	400 MCM
139 to 140	154	2	313 to 316	450	400	760	3	400 MCM
141 to 149	165	2	318 to 335	450	400	760	3	400 MCM
150	165	2	338 Amps	450	400	760	3	500 MCM
MULTI POINT CONNECTION, OPTIONAL								
COMPRESSOR (EACH)			CHILLER (PER CIRCUIT)					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
79 to 80	110	2	99 to 100	175	150	N/A	3	3 GA
81 to 88	110	2	101 to 110	175	150	N/A	3	2 GA
89 to 92	110	2	111 to 115	200	150	N/A	3	2 GA
93 to 99	110	2	116 to 123	200	150	N/A	3	1 GA
100	110	2	125	225	150	N/A	3	1 GA
101 to 104	132	2	126 to 130	225	200	N/A	3	1 GA
105 to 111	132	2	131 to 138	225	200	N/A	3	1/0
112 to 120	132	2	140 to 150	250	200	N/A	3	1/0
121 to 133	154	2	151 to 166	250	225	N/A	3	2/0
134 to 140	154	2	167 to 175	300	225	N/A	3	2/0
141 to 150	165	2	176 to 187	300	225	N/A	3	3/0

Table 22, WMC 250D-B & WMC 290D-B, 3/50/400

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR (EACH)			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
95 - 99	132	2	214 - 223	300	200	760	3	1 GA
100 - 102	132	2	225 - 230	300	400	760	3	250 MCM
103 - 107	132	2	232- 241	300	400	760	3	250 MCM
108 - 113	132	2	243 - 255	350	400	760	3	250 MCM
114 - 120	132	2	257 - 270	350	400	760	3	300 MCM
121 - 123	165	2	273 - 277	350	400	760	3	300 MCM
124 - 126	165	2	279 - 284	400	400	760	3	300 MCM
127 - 137	165	2	286 - 309	400	400	760	3	350 MCM
138	165	2	311	400	400	760	3	400 MCM
139 - 148	165	2	313 - 333	450	400	760	3	400 MCM
149 - 150	165	2	336 - 338	450	400	760	3	500 MCM
151 - 153	176	2	340 - 345	450	400	760	3	500 MCM
154 - 160	176	2	347 - 360	500	400	760	3	500 MCM
161 - 169	187	2	363 - 381	500	400	760	3	500 MCM
170	187	2	383	550	400	760	3	500 MCM
MULTI POINT CONNECTION, OPTIONAL								
COMPRESSOR (EACH)			CHILLER (PER CIRCUIT)					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
95 - 99	132	2	119 - 124	225	200	N/A	3	1 GA
100 - 104	132	2	125 - 130	225	200	N/A	3	1 GA
105 - 111	132	2	132 - 139	225	200	N/A	3	1/0
112 - 120	132	2	140 - 150	250	200	N/A	3	1/0
121 - 133	165	2	152 - 167	250	225	N/A	3	2/0
134 - 140	165	2	168 - 175	300	225	N/A	3	2/0
141 - 150	165	2	177 - 188	300	225	N/A	3	3/0
151 - 155	176	2	189 - 194	300	250	N/A	3	3/0
156 - 160	176	2	195 - 200	350	250	N/A	3	3/0
161 - 170	187	2	202 - 212	350	250	N/A	3	3/0

Table 23, WMC 250D-B & WMC 290D-B, 3/50/380

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR (EACH)			CHILLER					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
108 - 113	149	2	243 - 255	350	400	760	3	250 MCM
114 - 123	149	2	257 - 277	350	400	760	3	300 MCM
124 – 126	149	2	279- 284	400	400	760	3	300 MCM
127 – 135	149	2	286 - 304	400	400	760	3	350 MCM
136 - 137	187	2	306 - 309	400	400	760	3	400 MCM
138	187	2	311	400	400	760	3	400 MCM
139 - 148	187	2	313 - 333	450	400	760	3	400 MCM
149 - 150	187	2	336 - 338	450	400	760	3	500 MCM
151 - 153	187	2	340 - 345	450	400	760	3	500 MCM
154 - 169	187	2	347 - 381	500	400	760	3	500 MCM
170	187	2	383	550	400	760	3	500 MCM
MULTI POINT CONNECTION, OPTIONAL								
COMPRESSOR (EACH)			CHILLER (PER CIRCUIT)					
RLA [Amp]	LRA [Amp]	QTY	MCA [Amp]	MOP [Amp]	DISC. SWT. [Amp]	POWER BLOCK [Amp]	WIRE QTY	WIRE GAUGE
108 - 111	149	2	135 - 139	225	200	N/A	3	1/0
112 - 120	149	2	140 - 150	250	200	N/A	3	1/0
121 - 133	149	2	152 - 167	250	225	N/A	3	2/0
134 – 135	149	2	168 - 169	300	225	N/A	3	2/0
136 - 140	187	2	170 - 175	300	225	N/A	3	2/0
141 - 155	187	2	177 - 194	300	250	N/A	3	3/0
156 - 170	187	2	195 - 213	350	250	N/A	3	3/0

WMC 400D 3/60/460 ONLY

Table 24, WMC 400D-B, 3/60/460

SINGLE POINT CONNECTION, STANDARD								
COMPRESSOR (EACH)			**CHILLER**					
RLA [Amp]	**LRA [Amp]**	**QTY**	**MCA [Amp]**	**MOP [Amp]**	**DISC. SWT. [Amp]**	**POWER BLOCK [Amp]**	**WIRE QTY**	**WIRE GAUGE**
118 – 123	165		266 – 277	350	400	760		300 MCM
124 - 125	165		279 - 284	400	400	760		300 MCM
126	176	2	284	400	400	760	3	300 MCM
127 to 137	176	2	286 to 309	400	400	760	3	350 MCM
138	176	2	311	400	400	760	3	400 MCM
139 to 148	176	2	313 to 334	450	400	760	3	400 MCM
149 to 153	176	2	336 to 345	450	400	760	3	500 MCM
154 to 160	176	2	347 to 361	500	400	760	3	500 MCM
161 – 166	187	2	363 – 376	500	400	760	3	500 MCM
169	187	2	381	500	400	760	3	(2) 3/0
170	187	2	383	500	400	760	3	(2) 3/0
MULTI-POINT CONNECTION, OPTIONAL								
COMPRESSOR (EACH)			**CHILLER (PER CIRCUIT)**					
RLA [Amp]	**LRA [Amp]**	**QTY**	**MCA [Amp]**	**MOP [Amp]**	**DISC. SWT. [Amp]**	**POWER BLOCK [Amp]**	**WIRE QTY**	**WIRE GAUGE**
126 to 133	176	2	157 to 166	250	250	N/A	3	2/0
134 to 140	176	2	167 to 175	300	250	N/A	3	2/0
141 to 155	176	2	176 to 193	300	250	N/A	3	3/0
156 to 160	176	2	195 to 200	350	250	N/A	3	3/0

Notes for following field wiring diagram

1. COMPRESSOR FRONT END BOX IS FACTORY MOUNTED AND WIRED. ALL LINE SIDE WIRING MUST BE WIRED IN ACCORDANCE WITH THE NEC AND BE MADE WITH COPPER WIRE AND COPPER LUGS ONLY. USE ONLY COPPER SUPPLY WIRES WITH AMPACITY BASED ON 75°C CONDUCTOR RATING. MAIN POWER WIRING BETWEEN THE FRONT END 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 Daikin 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 ANC COPPER LUGS ONLY.

3. FOR OPTIONAL SENSOR WIRING SEE UNIT CONTROL DIAGRAM. IT IS RECOMMENDED THAT DC WIRES BE RUN SEPARATELY FROM 115 VAC WIRING.

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. THERMAL DISPERSION FLOW SWITCHES FOR THE EVAPORATOR AND CONDENSER ARE FACTORY MOUNTED AS STANDARD AND PROVIDE ADEQUET FLOW LOSS PROTECTION. IF DESIRED, ADDITIONAL FLOW OR PRESSURE DIFFERENTIAL SWITCHES CAN BE CUSTOMER SUPPLIED, MOUNTED AND WIRED AS SHOWN. A FACTORY WIRED EVAP FLOW SWITCH IS CONNECTED BETWEEN EF1 & EF2, AND A COND FLOW SWITCH BETWEEN CF1 & CF2. ANY ADDITIONAL DEVICES MUST BE WIRED IN SERIES WITH THEM. IF FIELD SUPPLIED PRESSURE DIFFERENTIAL SWITCHES ARE USED THEN THESE 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 EVAP AND COND WATER PUMP CONTROL POWER AND TOWER FANS IS SUPPLIED TO UNIT CONTROL TERMINALS (UTB1) 85 POWER / 86 NEUTRAL, PE EQUIPMENT GROUND.

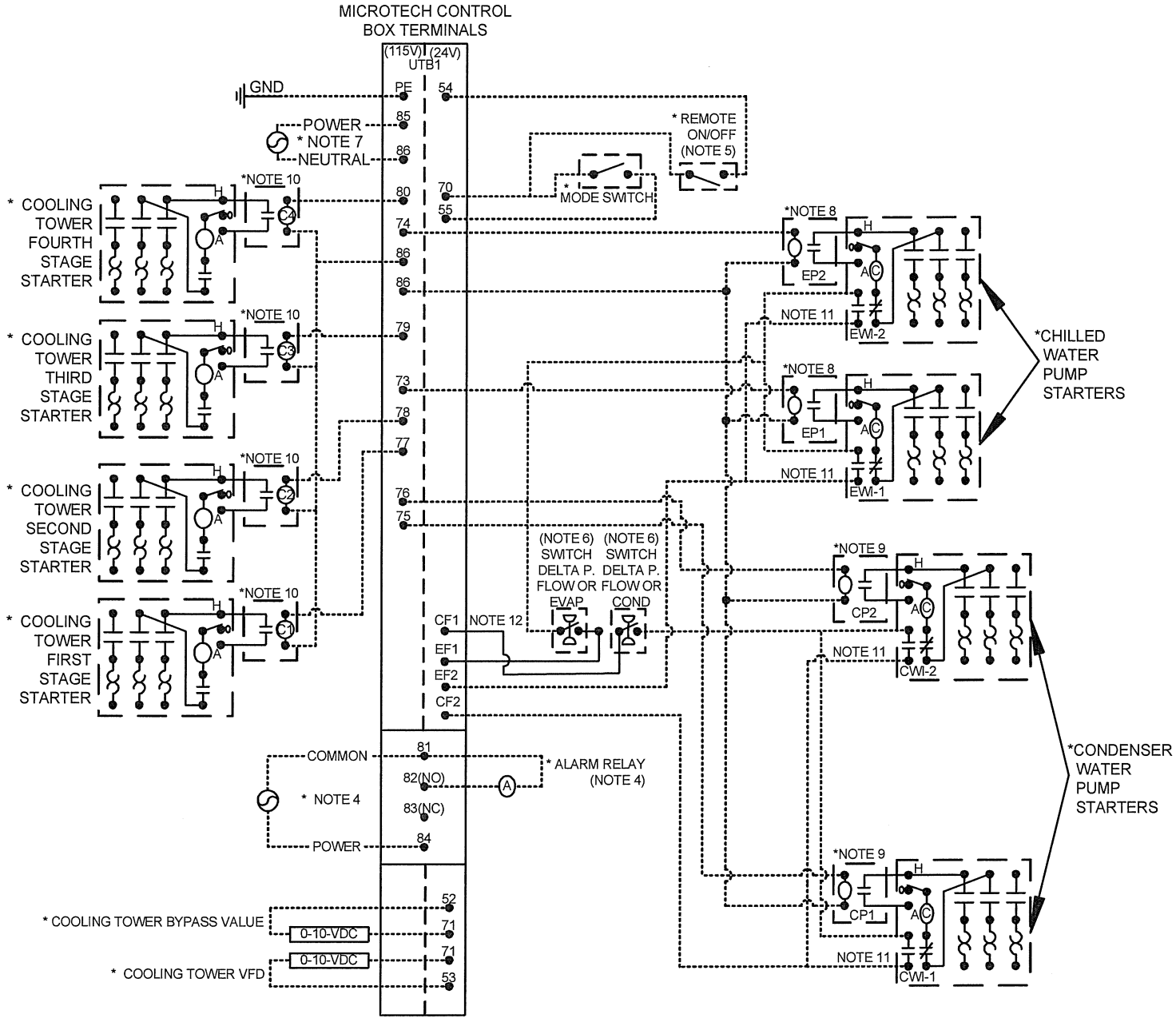
8. OPTIONAL CUSTOMER SUPPLIED 115 VAC 25 VA MAXIMUM COIL RATED CHILLED WATER PUMP RELAY (EP1 AND EP2) MAY BE WIRED AS SHOWN. THIS OPTIONAL WILL CYCLE THE CHILLED WATER PUMP IN RESPONSE TO CHILLER DEMAND.

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° 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 SHOULD BE WIRED AS SHOWN.

Figure 14, Field Wiring Diagram



See notes on page 38.

Power Factor Correction

Do not use power factor correction capacitors with WMC chillers. Doing so can cause harmful electrical resonance in the system. Correction capacitors are not necessary since VFDs inherently maintain high power factors.
The full load power factor exceeds 0.90 for all units.

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 5^{th}, 7^{th}, 11^{th}, and 13^{th}. 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 Magnitude 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 Magnitude chillers and located in each compressors power panel. They are employed to improve the power factor by reducing the effects of harmonics.

Optional Harmonic Filter

The Institute of Electrical and Electronics Engineers (IEEE) has developed a standard (IEEE519) that defines acceptable limits of site specific system current and voltage distortion. The designer may wish to consult this standard to ensure acceptable levels of harmonic distortion are maintained.

Harmonic filters are available as a field mounted and wired accessory, wired from the chiller power panel circuit breakers out to the filter and back to the chiller's power fuses and contactors. They limit current distortion and improve unit power factor. The filters are mounted in a UL Type 1 enclosure and are UL and cUL listed. The smallest filter Model HG60 is wall mounted, the balance are floor mounted.

The harmonic filter package includes power blocks, a 5% impedance line reactor, tuning reactor, a contactor and a capacitor bank. When the harmonic filter is selected, the normal line reactor in the unit's main electrical panel is removed at the factory.

A power monitoring package is included as standard. It consists of indication lights for filter operation and fuse failure on the HG60 size. Filters from size HG75 and up consist of a display board showing operating information such as current and voltage total harmonic distortion, true power factor and a series of fault and protection codes. It can be programmed to shut off under fault conditions or when the drive goes into a fault condition.

The filter size selection is based on the WMC Rated Load Amps (RLA) as determined by a computerized chiller selection program. The local Daikin sales office can provide selection and pricing information.

Filter dimensions, weights and terminal size range can be found in the WMC Installation manual IM 1029-2.

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. 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
- Radar disruption
- Sonar disruption
- Computer system failures loss of data

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.

VFD Harmonic Considerations

The Institute of Electrical and Electronics Engineers (IEEE) has developed a standard (IEEE519) that defines acceptable limits of site specific system current and voltage distortion. The designer may wish to consult this standard to ensure acceptable levels of harmonic distortion are maintained.

Application Considerations

Location

WMC chillers are intended only for installation in an indoor or weather protected area consistent with the NEMA 1 rating on the chiller, controls, and electrical panels.

Equipment room temperature for operating and standby conditions is 40°F to 104°F (4.4°C to 40°C).

Optimum Water Temperatures and Flow

A key to improving energy efficiency for any chiller is minimizing the compressor pressure lift. Reducing the lift reduces the compressor work and its energy consumption per unit of output. The chiller typically has the largest motor of any component in a chilled water system.

Higher leaving chilled water temperatures

Warmer leaving chilled water temperatures will raise the compressor's suction pressure and decrease the lift, improving efficiency. Using 45°F (7.0°C) leaving water instead of 42°F (5.5°C) will make a significant improvement.

Evaporator temperature drop

The industry standard has been a 10-degree F (5.5 degree C) temperature drop in the evaporator. Increasing the drop to 12 or 14 degrees F (6.6 or 7.7 degrees C) will improve the evaporator heat transfer, raise the suction pressure, and improve chiller efficiency. Chilled water pump energy will also be reduced.

Condenser entering water temperature

As a general rule, a one-degree drop in condenser entering water temperature will reduce chiller energy consumption by two percent. Cooler water lowers the condensing pressure and reduces compressor work. One or two degrees can make a noticeable difference. The incremental cost of a larger tower can be small and provide a good return on investment.

Condenser water temperature rise

The industry standard of 3 gpm/ton or about a 9.5-degree delta-T seems to work well for most applications. Reducing condenser water flow to lower pumping energy will increase the water temperature rise, resulting in an increase in the compressor's condensing pressure and energy consumption. This is usually not a productive strategy.

Chilled Water Temperature

The maximum temperature of water entering the chiller on standby must not exceed 110° F (43° C). Maximum temperature entering on start-up must not exceed 90°F (32.2°C). Minimum chilled water leaving temperature without antifreeze is approximately 36°F (2.2°C).

Piping

Piping must be adequately supported to remove weight and strain on the chiller's fittings and connections. Be sure piping is adequately insulated. Install a cleanable 20-mesh water strainer at the inlet of the evaporator and condenser. Install enough shutoff valves to permit draining water from the evaporator or condenser without draining the complete system.

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. 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. To obtain the lowest possible energy cost, the interaction between compressor power, fan power, and pumping power should all be studied.

Even with tower fan control, some form of water flow control such as tower bypass or variable speed condenser water flow may be required to maintain minimum acceptable entering condenser water temperatures. must be used. The MicroTech II control is capable of controlling tower fans and bypass valve directly or indirectly through an output signal to the building automation system ensure stable and efficient chiller operation.

Figure 15 and Figure 16 illustrate two temperature actuated tower bypass arrangements. The "Cold Weather" scheme, Figure 16, provides better startup under cold ambient air temperature conditions. The bypass valve and piping are indoors and thus warmer, allowing for warmer water to be immediately available to the condenser. The check valve may be required to prevent air at the pump inlet.

⚠ CAUTION

<u>Freeze Notice</u>: The evaporator and condenser are <u>not</u> self-draining. Both must be blown out to completely remove water to help prevent freeze up.

Figure 15, Tower Bypass, Mild Weather Operation

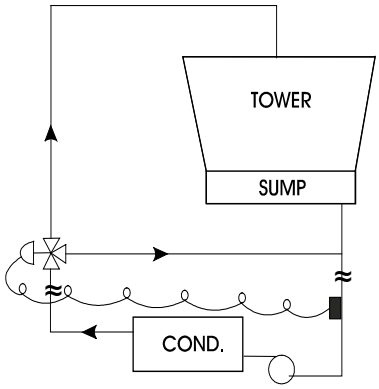
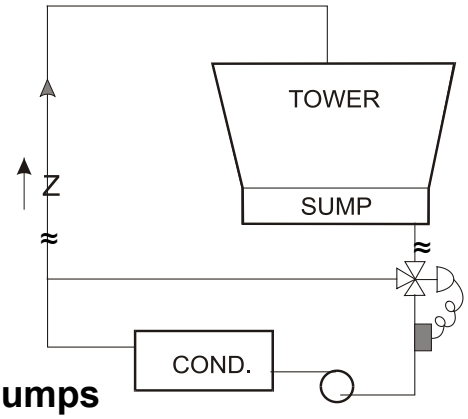


Figure 16, Tower Bypass, Cold Weather Operation (Bypass Indoors)



Pumps

To avoid the possibility of objectionable harmonics in the system piping, 4-pole, 1800/1500 rpm system pumps should be used. The condenser water pump(s) must be cycled off when the last chiller of the system cycles off. This will keep cold condenser water from migrating refrigerant to the condenser. Cold liquid refrigerant in the condenser can make start up difficult. In addition, turning off the condenser water pump(s) when the chillers are not operating will conserve energy.

Include thermometers and pressure gauges at the chiller inlet and outlet connections and install air vents at the high points of piping. Where noise and vibration are critical and the unit is mounted on spring isolators, flexible piping and conduit connections are necessary. Install a flow switch or pressure differential switch in the leaving chilled water line, if one is not factory installed.

Variable Speed Chilled Water Pumping

Variable speed pumping involves changing system water flow relative to cooling load changes. Daikin centrifugal chillers are designed for this duty with two limitations.

First, the rate of change in the water flow needs to be slow, not greater than 10% of the change per minute. The chiller needs time to sense a load change and respond.

Second, the water velocity in the vessels must be 3 to 10 fps (0.91 and 3.0 m/sec). Below 3 fps (0.91 m/sec), laminar flow occurs which reduces heat transfer and causes erratic operation. Above 10 fps (3.0 m/sec), excessively high pressure drops and tube erosion occur. These flow limits can be

determined from the Daikin selection program.

We recommend variable flow only in the evaporator because there is virtually no change in chiller efficiency compared to constant flow. In other words, there is no chiller energy penalty and considerable pumping energy can be saved. Although variable speed pumping can be done in the condenser loop, it is usually unwise. The intent of variable flow is to reduce pump horsepower. However, reducing condenser water flow increases the chiller's condensing pressure, increasing the lift that the compressor must overcome which, in turn, increases the compressor's energy use. Consequently, pump energy savings can be lost because the chiller operating power is significantly increased.

Low condenser flow and tube velocities can cause premature tube fouling and subsequent increased compressor power consumption. Increased cleaning and/or chemical use can also result.

Vibration Mounting

The Magnitude chillers are almost vibration-free. Consequently, floor mounted spring isolators are not usually required. Rubber mounting pads are shipped with each unit. It is wise to continue to use piping flexible connectors to reduce sound transmitted into the pipe and to allow for expansion and contraction.

System Water Volume

All chilled water systems need adequate time to recognize a load change, respond to that load change and stabilize, without undesirable short cycling of the compressors or loss of control. In air conditioning systems, the potential for short cycling usually exists when the building load falls below the minimum chiller plant capacity or on close-coupled systems with very small water volumes.

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 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.

A properly designed storage tank should be added if the system components do not provide sufficient water volume.

Pump Control

Operation of the chilled water pump can be to:
1) cycle the pump with the unit
2) operate continuously
3) cycle automatically by a remote source

The cooling tower pump must cycle with the compressor. 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 39 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 alarm used must not draw more than 10-volt amperes.

System analysis

Although Daikin is a proponent of analyzing the entire system, it is generally effective to place the chiller in the most efficient mode because it is a large energy consumer.

The Daikin Energy Analyzer™ program is an excellent tool to investigate the entire system efficiency, quickly and accurately. It is especially good at comparing different system types and operating parameters. Contact you local Daikin sales office for assistance on your particular application.

Retrofit Knockdown

It is estimated that fifty percent of retrofit applications require partial or complete disassembly of the chiller. Daikin offers two solutions to the disassembly and reassembly effort on Magnitude chillers.

Magnitude chillers are relatively easy to disassembly due to the small compressor size, simplified refrigerant piping and the absence of a lubrication system with its attendant components and piping. Two knockdown arrangements are available as options.

Contact local Daikin Factory Service for pricing and scheduling of required installation supervision.

TYPE IV: The compressor(s), control panel, and compressor power panel(s) are removed at the factory and put on skids. The stripped vessel stack is shipped as a single piece. Discharge piping, liquid line and the compressor cooling line(s) are removed and crated. All associated wiring and piping possible will remain on the vessel stack. The unit is shipped without refrigerant, which must be furnished and charged by the contractor.

Type IV reduces the height and weight of the unit. The width is determined by the evaporator tube sheet and is not decreased with this arrangement, nor is the overall unit length. If further weight or size reduction is required, the vessels can be separated by unbolting them.

TYPE V: The unit ships fully assembled and charged with refrigerant and is ready for field knockdown. This option allows components to be removed as required at the site. The unit dimension drawing gives sufficient dimensions to determine what components should be removed.

Type V gives the installing contractor the option to remove only those components necessary to complete the installation. The refrigerant is pumped down into the condenser and depending on the degree of knockdown, can remain there, decreasing the leak testing, evacuation and charging required in the field.

Table 25, Component Weight

WMC Model	Compressor Each	Evaporator		Condenser	
		Model	Weight	Model	Weight
145S	282	E2209	2490	C2009	2142
145D	262	E2209	2490	C2009	2142
150D	262	E2212	2857	C2012	2615
250D	282	E2609	3259	C2209	2392
290D	282	E2612	3812	C2212	2942
400D	282	E3012	5075	C2612	3900

NOTES:

1. All weights in pounds.
2. “S” models have one compressor; “D” models have two compressors.

Table 26, Component Dimensions, (Length x Width x Height)

WMC Model	Compressor	Power Panel (2)	Control Panel (2)	Evaporator		Condenser		Stack
				Model		Model		
145S	32 x 22 x 18	14 x 34 x 67	9 x 16 x 33	E2209	135 x 28 x 29	C2009	128 x 36 x 33	135 x 36 x 62
145D	32 x 18 x 18	14 x 34 x 67	9 x 16 x 33	E2209	135 x 28 x 29	C2009	128 x 36 x 33	135 x 36 x 62
150D	32 x 18 x 18	14 x 34 x 67	9 x 16 x 33	E2212	170 x 28 x 29	C2012	164 x 36 x 33	170 x 36 x 62
250D	32 x 22 x 18	14 x 34 x 67	9 x 16 x 33	E2609	130 x 32 x 33	C2209	135 x 39 x 33	135 x 39 x 66
290D	32 x 22 x 18	14 x 34 x 67	9 x 16 x 33	E2612	165 x 32 x 33	C2212	170 x 39 x 33	170 x 39 x 66
400D	32 x 22 x 18	14 x 34 x 67	9 x 16 x 33	E3012	169 x 36 x 36	C2612	165 x 44 x 36.	169 x 44 x 72

NOTES:

1. All dimensions in inches.
2. Panel dimensions are Depth x Width x Height

Pressure Drop Curves

NOTE: The Evaporator and Condenser Model Codes are shown on page 27. The -B and -C designations shown on the curves refer to vessel tube count, which is determined by the computer selection program. See page 27 for vessel/unit combination.

Figure 17, Single Pass Evaporators

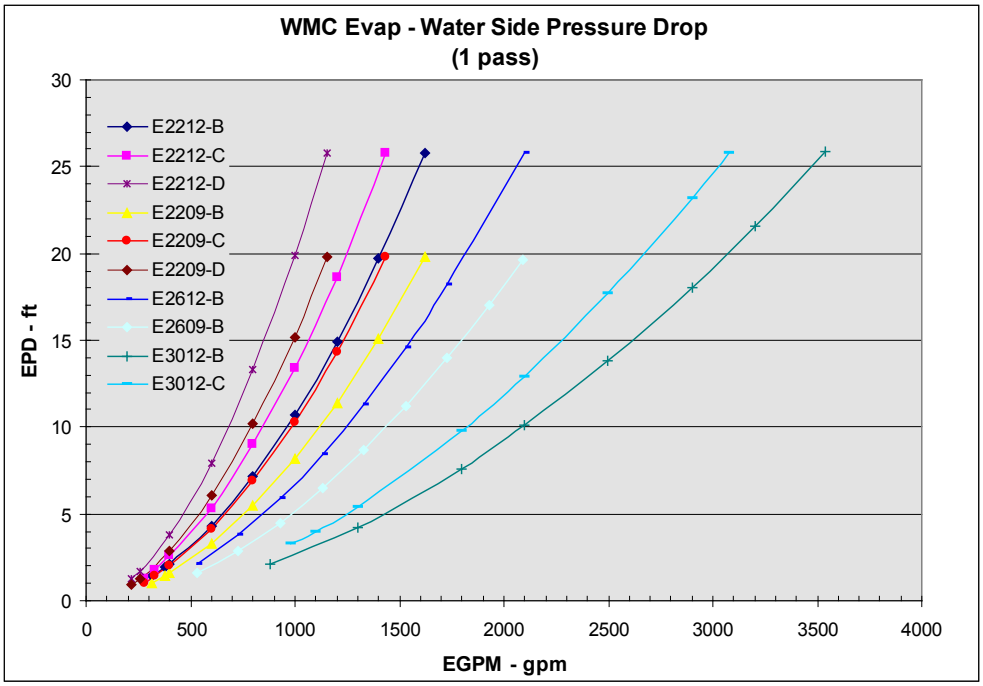


Figure 18, Single Pass Condensers

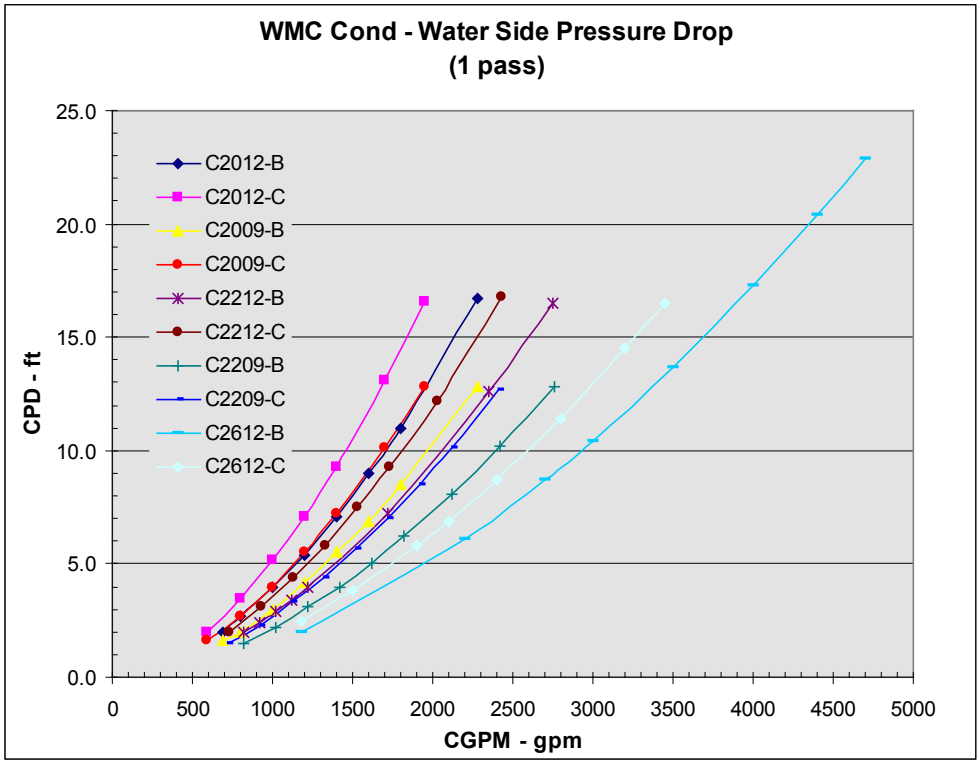


Figure 19, 2-Pass Evaporators

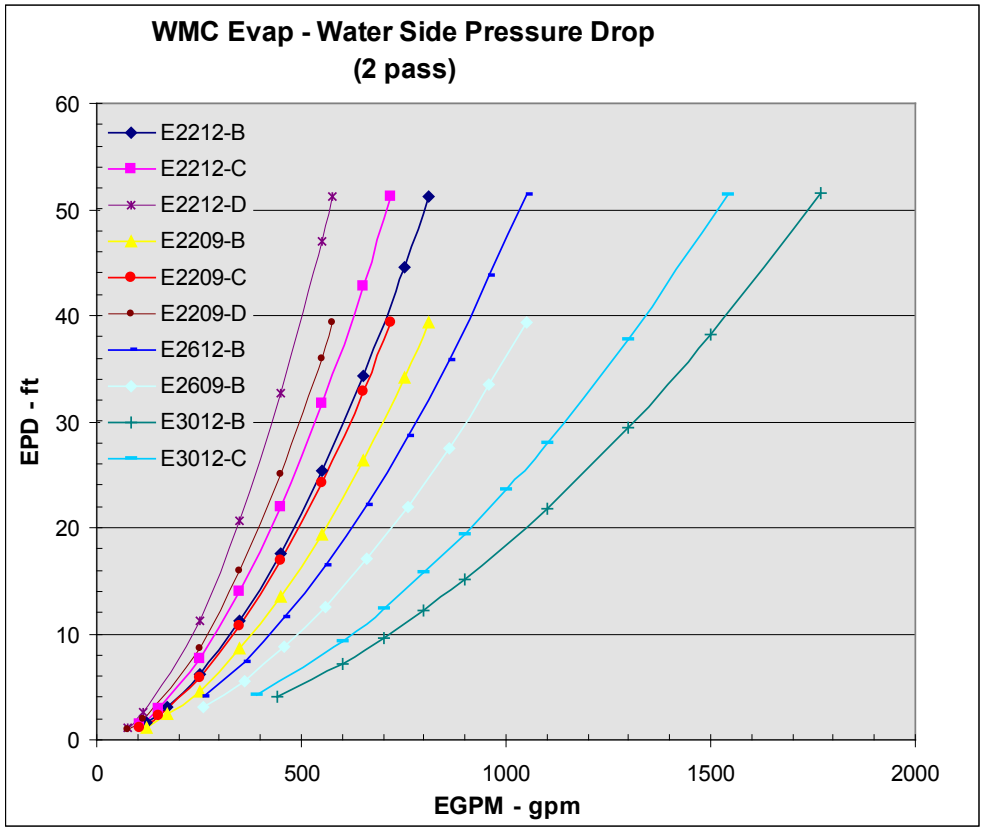


Figure 20, 2-Pass Condensers

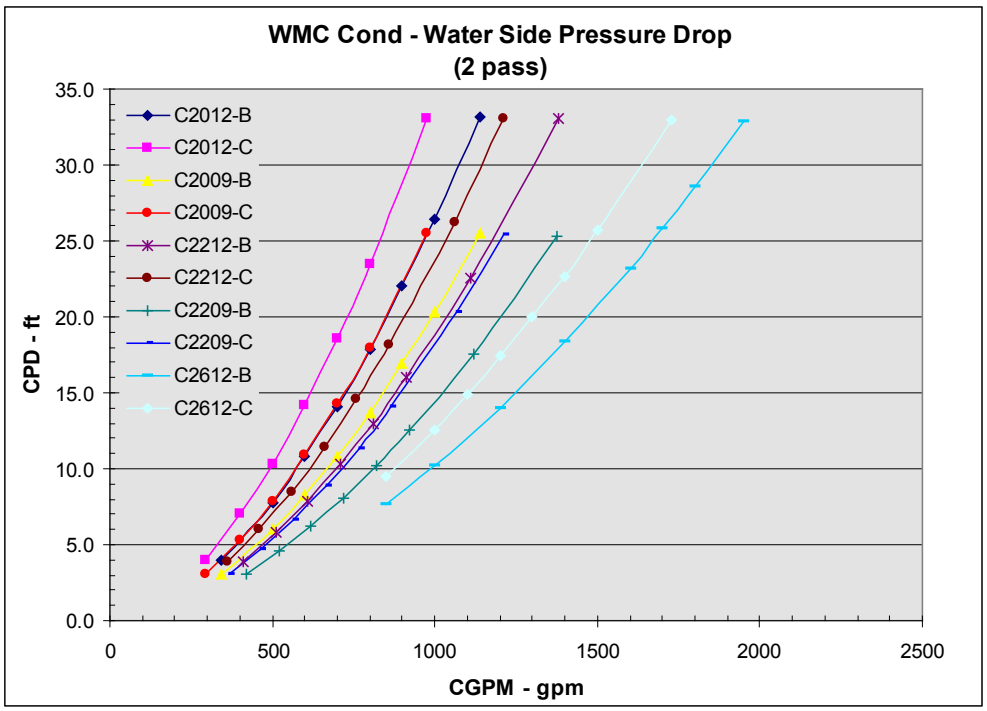


Figure 21, 3-Pass Evaporators

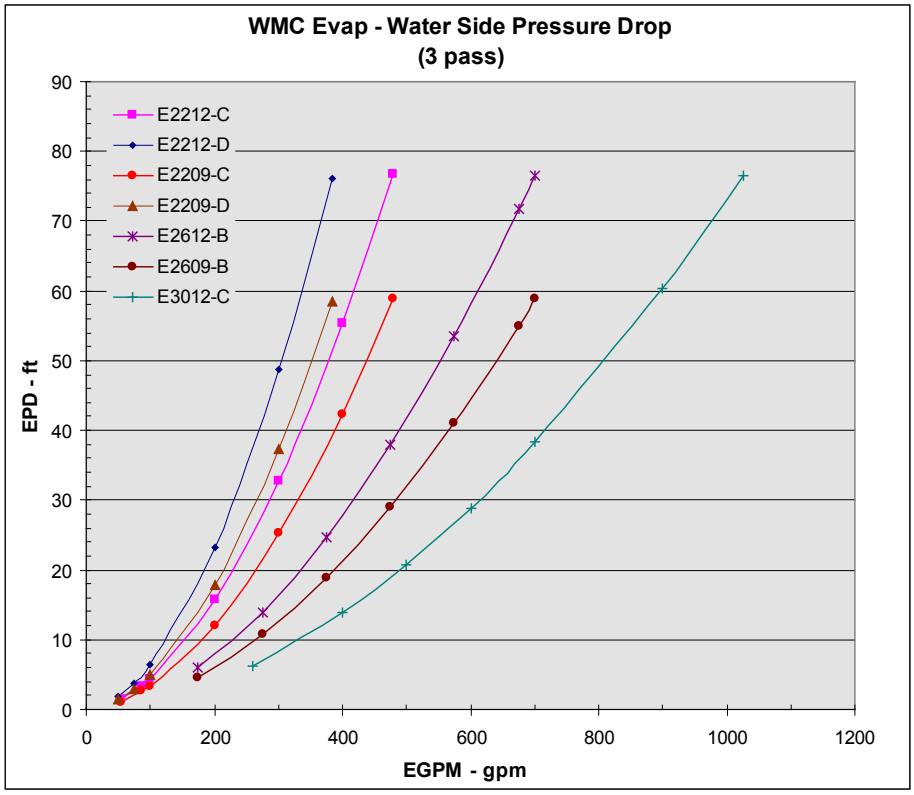
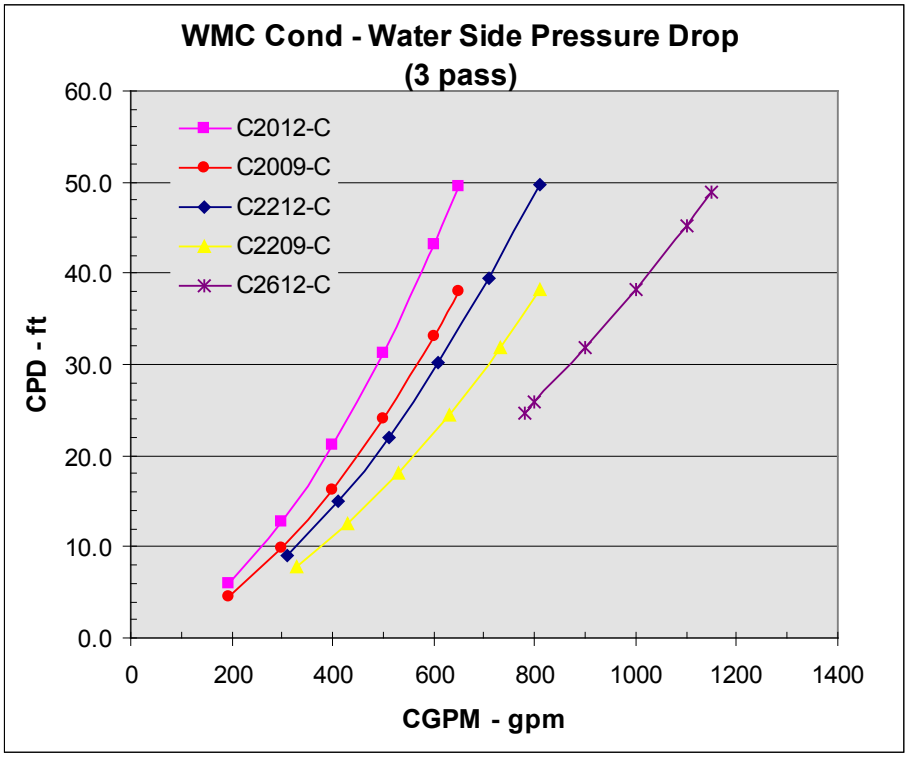


Figure 22, 3-Pass Condensers



Options and Accessories

Vessels

Marine water boxes
Provides tube access for inspection, cleaning, and removal without dismantling water piping.

Flanges (Victaulic® connections are standard)
ANSI raised face flanges on either the evaporator and/or condenser. Mating flanges are by others.

Water side vessel construction of 300 psi (150 psi is standard)
For high pressure water systems, typically high-rise building construction.

Single insulation, 3/4 inch, on evaporator (including heads) and suction piping
Insulation, either optional factory-installed or field-installed is generally required on all installations.

Double insulation, 1-½ inch, on evaporator (including heads) and suction piping
For high humidity locations and ice making applications.

Special vessel codes
Including Chinese and Canadian Registration (CRN).

Controls

BAS interface module.
Factory-installed on the unit controller for the applicable protocol being used. (Can also be retrofit)

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

Unit

Export packaging
Can be either slat or full crate for additional protection during shipment. Units normally shipped in containers.

Pumpout Unit, with or without storage vessel
Available in a variety of sizes. Details are in Catalog WSCWDC.

Refrigerant monitor
For remote mounting including accessories such as 4-20ma signal, strobe light, audible horn, air pick-up filter.

Extended warranties
Extended 1, 2, 3, or 4 year warranties for parts only or for parts and labor are available for the entire unit, entire unit plus refrigerant, or compressor/motor only.

Witness performance test
A full load run test is performed in the presence of the customer under the supervision of a factory engineer, includes compilation of the test data. Travel and local expenses are not included.

Certified performance test
A run test is performed under the supervision of a factory engineer; data is compiled and certified.

Approvals/listings
AHRI Approval and ETL/CETL listing is standard. MEA is optional.

Seismic Certification
Unit is OSHPD Pre-Approved and so labeled. (California only).

Unit is certified to IBC 2009 and so labeled.

Electrical

Multi-point power connection

Provides separate power connection to each compressor disconnect switch on two compressor units in lieu of standard single-point power.

High short circuit current rating

65 kA (at 460 V) panel rating. (Standard is 35 kA).

Harmonic filter

Field-installed option. See page 40 for details.

EMI filter

Factory-installed option. Radio interference filter. See page 40 for details.

Ground Fault Protection

Protects equipment from arcing ground fault damage from line-to-ground fault currents less than those required for conductor protection.

Special Order Options

The following special order options are available; requiring factory pricing, additional engineering and possible dimension changes and/or extended delivery:

- Non-standard location of nozzle connections on heads (compact water boxes) or marine water boxes
- Special corrosion inhibiting coatings on any “wetted surface” including tubesheets, heads (compact water boxes), marine water boxes, or nozzles
- Clad tube sheets
- Sacrificial anodes in heads (compact water boxes) or marine water boxes
- Special NEMA enclosures
- Davits or hinges for marine water box covers or heads (compact water boxes)
- Spacer rings on heads to accommodate automatic tube brush cleaning systems (installed by others)

Refrigerant Recovery Units

Although Daikin chillers can pump the entire refrigerant charge into the condenser and valve it off, there are occasions when pumpout units are required, due purely to specification requirements or unusual job considerations.

Daikin offers two sizes of refrigerant recovery units (Model RRU) and one recovery unit that is factory mounted on a storage vessel (Model PRU). Recovery units are ETL listed. Capacities for R-22 are AHRI certified. The storage tank is designed, constructed and stamped in accordance with ASME standards.

Model RRU Refrigerant Recovery Units

Model	(1) R-22 Liquid Transfer Rate lb/m (kg/m)	(1) R 22 Vapor Transfer Rate lb/m (kg/m)	Comp. HP	(2) Chiller Tons (kW)	Weight lbs (kg)	Dimensions L x W x H Inch (cm)	Electrical
RRU134-5	55 (25)	1.56 (0.71)	1.5	300 (1050)	115 (52)	21 x 14 x 19 (53 x 36 x 68)	1/50-60/110-115
RRU134-3	55 (25)	1.56 (0.71)	1.5	300 (1050)	115 (52)	21 x 14 x 19 (53 x 36 x 68)	1/50-60/220-230
RRU570-3	325 (148)	6.0 (2.7)	3	1000 (3500)	190 (86)	26 x 25 45 (66 x 63 x 114)	1/50-60/220-230
RRU570-V	325 (148)	6.0 (2.7)	3	1000 (3500)	190 (86)	26 x 25 45 (66 x 63 x 114)	3/50-60/220-230
RRU570-R	325 (148)	6.0 (2.7)	3	1000 (3500)	190 (86)	26 x 25 45 (66 x 63 x 114)	3/50-60/360-460
RRU570-D	325 (148)	6.0 (2.7)	3	1000 (3500)	190 (86)	26 x 25 45 (66 x 63 x 114)	3/60/575

Size and Specifications

NOTES:
1. Transfer rate for R-22 is AHRI certified. R-134a capacity is given below in each unit's description.
2. Suggested maximum chiller capacity.

Refrigerant Compatibility

Units are suitable for use with the following refrigerants normally found on Daikin chillers; R-12, R-22, R-134a, R-410A, and R-500.

Standard Equipment

Equipment	Model	
	RRU134	RRU570
Power Cord	X	X
Filter-Driers	(2) 30 cu. in.	(1) 48 cu. in
Electromechanical Control	X	X
Hoses	(4) 10 ft.	(1) 10 ft + (2) 20 ft
Reducing Fittings		X
12 ft. Tank Float Switch Cable		X
Connection Sizes	½ in. Flare	¾ in. Flare

Model RRU134

Large 1-½ HP open drive compressor, ½-inch lines, two-point vapor extraction and oversized air-cooled condenser speed recovery on smaller size chillers. Purging and switching from liquid to vapor recovery only involves turning 3-way valves-no switching of hoses is necessary. Capacity with R-134a is 55 lb/min liquid, 1.34 lb/min vapor.

MODEL RRU570

Recovers at R-134a at 300 lb/min liquid and 5.7 lb/min vapor, ideal for the medium size chiller job. Rugged 3 hp open-drive compressor provides years of reliable service, even on refrigerants heavily contaminated with oil, air, moisture, or acids. Purging and switching from liquid to vapor recovery only involves turning 3-way valves-no switching of hoses is necessary. Suitable for most high-pressure refrigerants and blends. Equipped with air-cooled condenser.

Model PRU Packaged Recovery Units

The Model RRU134 transfer unit can be factory-mounted on a storage vessel providing a packaged unit with a R-134a transfer capacity of 55 lb/min liquid and 1.34 lb/min of vapor combined with a storage vessel with a capacity of 2105 pounds of R-134a. Includes (2) 20-ft. hoses.

Model	R-22 Liquid Transfer Rate lb/m (kg/m)	R-22 Vapor Transfer Rate lb/m (kg/m)	Unit				Electrical
			Weight lb (kg)	Length in (cm)	Width in (cm)	Height in (cm)	
PRU134-5	55 (25)	1.56 (0.71)	770 (349)	94 (239)	30 (76)	55 (139)	1/50-60/110-115
PRU134-3	55 (25)	1.56 (0.71)	770 (349)	94 (239)	30 (76)	55 (139)	1/50-60/220-230

Accessories

RHK-120 1.25 in. x 10 ft. hose with ball valves

RHK-240 1.25 in. x 20 ft. hose with ball valves

Refrigerant Monitors

- Detects all halogen based refrigerants
- Optional analog output for remote monitoring
- Visual alarm indication
- Fresh air inlet for automatic re-zeroing
- ETL listed
- Continuous digital display of system status
- System malfunction detection and indication
- Can sample up to 250 feet (76 meters) away
- Multi-unit capability in a single monitor
- UL STD 3101-1 and CAN/CSA 1010.1

MODELS

Model RM-1 1 Zone Monitor

Model RM-4 4 Zone Monitor

Model RM-8 8 Zone Monitor

Model RM-16 16 Zone Model

SPECIFICATIONS

Sensitivity: As low as 1 PPM **Range**: 0 to 1000 PPM **Weight**: 25 lbs. (11 kg)

Power: 120/240 Volt, 50/60 Hz **Operating Environment**: 32°F-125°F **Size**: W=16.5in. D=6.75in. H=15in.

Alarm Trip Points (Percent of Full Scale): Low Alarm=0 to 100, Main Alarm=0 to 100, High Alarm=100

Alarm Outputs: Indicator Light, Alarm Relays, RS232 Computer Interface

OPTIONS and ACCESSORIES

Analog Output, 4-20 ma (RMA-AO)

Remote Strobe Light, 120 V (RMA-L)

Remote Horn, 120V (RMA-H)

Remote Light and Horn Set (RMA-LH)

Plastic Pick-up Tubing, ¼ inch OD, 250 ft. Reel (RMA-T)

Diaphragm Pump (RMA-P) *

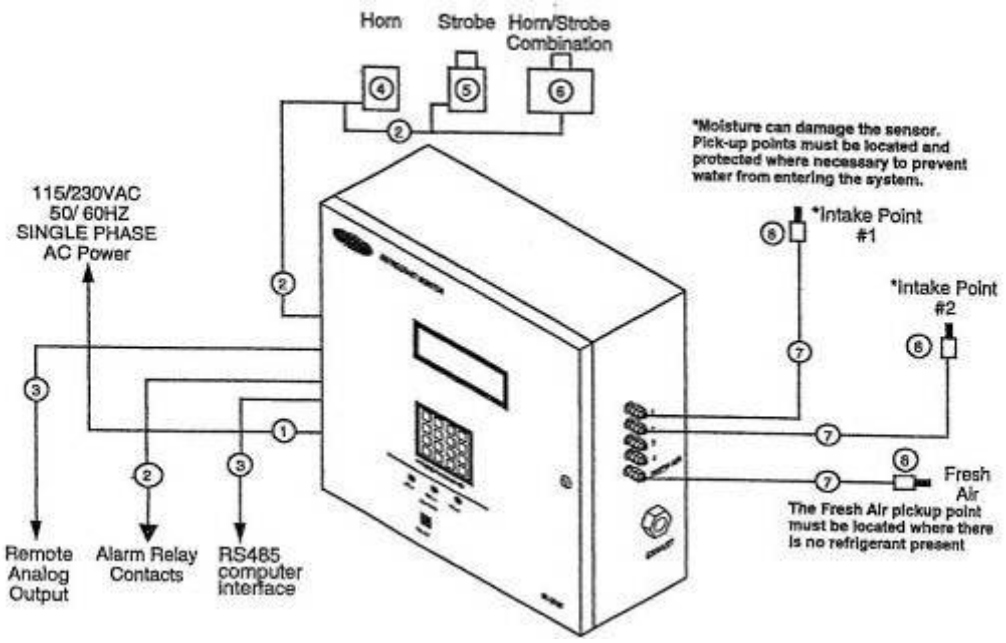
Course Replacement Filter (RMA-CF) *

5 Micron Replacement Filter (RMA-F) *

(*) Replacement parts. Original pump and filters are shipped with unit.

SYSTEM DESCRIPTION							
Item	**Description**	**Required**	**Supplied with Unit**	**Supplied by Customer**	**Optional**	**Available from Daikin Daikin**	**Comments**
1	16 gauge 3 conductor wire	Yes	No	Yes		No	
2	18 or 22 gauge 2 conductor cable	No			Yes	No	Required for horn, strobe, or combination
3	2 conductor twisted pair shielded cable	No			Yes	No	Required for remote analog output
4	Remote horn	No			Yes	Yes	
5	Remote strobe light	No			Yes	Yes	
6	Remote horn and strobe light set	No			Yes	Yes	
7	1/4 in. x 1/8 in. ID plastic pick-up tubing	Yes	No			Yes	Available in 250 foot reels
8	Course filter	Yes	Yes				For mounting at the end of the tubing

Figure 23, Refrigerant Monitor Diagram



Specifications

SECTION 15XXX
MAGNETIC BEARING CENTRIFUGAL CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for water-cooled centrifugal chillers.

1.2 REFERENCES

A. Comply with the following codes and standards:

- AHRI 550/590
- AHRI 575
- NEC
- ANSI/ASHRAE 15
- OSHA as adopted by the State
- ETL
- ASME Section VIII

1.3 SUBMITTALS

A. Submittals shall include the following:

1. Dimensioned plan and elevation view, including required clearances, and location of all field piping and electrical connections.
2. Summaries of all auxiliary utility requirements such as: electricity, water, air, etc. Summary shall indicate quality and quantity of each required utility.
3. Diagram of control system indicating points for field interface and field connection. Diagram shall fully depict field and factory wiring.
4. Manufacturer's certified performance data at full load plus IPLV or NPLV.
5. Installation and Operating Manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the codes and standards in Section 1.2.
B. Chiller manufacturer plant shall be ISO Certified.

1.5 DELIVERY AND HANDLING

A. Chillers shall be delivered to the job site completely assembled and charged with refrigerant R134a and be shipped on skids with a weather resistant cover.

-- OR --

A. (For Type IV Knockdown) The compressor(s) and control and power panel(s) shall be removed at the factory and shipped on skids. The stripped vessel stack shall be shipped as a single piece. Discharge piping, liquid line and the compressor cooling lines shall be removed and crated. All associated wiring and piping possible will remain on the vessel stack. The unit shall be shipped without refrigerant, which must be furnished and charged by the installing contractor.

-- OR --

A. (For Type V Knockdown) The unit shall be delivered to the job site completely assembled and charged with refrigerant (pumped down into condenser) and ready for field knockdown, as determined by the installing contractor.

B. Comply with the manufacturer's instructions for rigging and transporting units. Leave protective covers in place until installation.

1.6 WARRANTY

A. The chiller manufacturer's warranty shall cover parts and labor costs for the repair or replacement of defects in material or workmanship [OPTION] including refrigerant for the entire unit, for a period of one year from equipment startup or 18 months from shipment, whichever occurs first, [OPTION] and also include an additional extended warranty for (one OR two OR three OR four) years on (the entire unit) OR (on entire unit including refrigerant coverage) OR (compressor and drive train only). Warranty support shall be provided by company direct or factory authorized service permanently located near the job site.

1.7 MAINTENANCE

A. Maintenance of the chillers in accordance with manufacturer's recommendations as published in the installation and maintenance manuals shall be the responsibility of the owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis of Design - Daikin Magnitude Model WMC/WME, including the standard product features and all special features required per the plans and specifications.

B. Equal Products - Equipment manufactured by [ENTER MANUFACTURER NAME HERE] may be acceptable as an equal. Naming these products as equal does not imply that their standard construction or configuration is acceptable or meets the specifications. Equipment proposed "as equal", must meet the specifications including all architectural, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications.

2.2 UNIT DESCRIPTION

A. Provide and install as shown on the plans a factory assembled and charged water-cooled packaged centrifugal chiller. Chillers shall have no more than two oil-free, magnetic bearing, semi-hermetic centrifugal compressors (no exceptions). Each compressor shall have an integrated variable-frequency drive operating in concert with inlet guide vanes for optimized full and part load efficiency. On two-compressor units, the evaporator and condenser refrigerant sides and the expansion valve shall be common and the chiller shall be capable of running on one compressor with the other compressor or any of its auxiliaries inoperable or removed.

B. [Option] Each chiller shall undergo a [one] OR [two] OR [three] OR [four] or [five] or [ten] point certified factory performance tested on an AHRI qualified test stand with water at job conditions (excluding glycol applications). A manufacture's engineer shall oversee the testing, certify the accuracy of the computerized results, and then translates the test data onto an easy-to-read spreadsheet provided to the owner. The tests are to be run as specified in advance and are run to within AHRI tolerance of capacity and power. 50 Hz units are run tested at 60 Hz to their maximum motor power. Operating controls shall be adjusted and checked. The refrigerant charge shall be adjusted for optimum operation and recorded on the unit nameplate. Units operating with 50-Hz power shall be tested with a 50-Hz power supply. Any deviation in performance or operation shall be remedied prior to shipment and the unit retested if necessary to confirm repairs or adjustments.

--OR--

B. **[**Option**]** Each chiller shall undergo a [one] OR [two] OR [three] OR [four] or [five] or [ten] point certified witness performance test on an AHRI qualified test stand with water at job conditions (excluding glycol applications). A manufacture's engineer shall oversee the testing in the presence of the owner or owner's representative, certify the accuracy of the computerized results, and then translates the test data onto an easy-to-read spreadsheet provided to the owner. The tests are to be run as specified in advance and are run to within AHRI tolerance of capacity and power. 50 Hz units are run tested at 60 Hz to their maximum motor power. Operating controls shall be adjusted and checked. The refrigerant charge shall be adjusted for optimum operation and recorded on the unit nameplate. Units operating with 50-Hz power shall be tested with a 50-Hz power supply. Any deviation in performance or operation shall be remedied prior to shipment and the unit retested if necessary to confirm repairs or adjustments.

2.3 DESIGN REQUIREMENTS

General: Provide a complete water-cooled, semi-hermetic oil-free centrifugal compressor water chiller as specified herein. The unit shall be provided according to standards indicated in Section 1.2. In general, unit shall consist of one or two magnetic bearing, completely oil-free centrifugal compressors, refrigerant, condenser and evaporator, and control systems including integrated variable frequency drive, operating controls and equipment protection controls. Chillers shall be designed to operate within an ambient temperature range of 40ºF to 104ºF with a maximum humidity of 95% (non-condensing) and shall be charged with refrigerant HFC-134a. If manufacturer offers a chiller using any HCFC refrigerant that is subject to phase out by the Montreal Protocol or the U.S. Clean Air Act, manufacturer shall provide, in writing, documentation signed by an officer of the company assuring refrigerant availability and price schedule for a 20-year period.

A. The entire chiller system, including all pressure vessels, shall remain above atmospheric pressure during all operating conditions and during shut down to ensure that non-condensables and moisture do not contaminate the refrigerant and chiller system. If any portion of the chiller system is below atmospheric pressure during either operation or shut down, the manufacturer shall include, at no charge:

1. Purge System
    i. A complete purge system capable of removing non-condensables and moisture during operation and shut-down. The system shall consist of an air cooled condensing unit, purge condensing tank, pumpout compressor, and control system.
    ii. A dedicated condensing unit shall be provided with the purge system to provide a cooling source whether or not the chiller is running. The condensing unit shall provide a low purge coil temperature to result in a maximum loss of 0.1 pounds of refrigerant per pound of purged air.
    iii. The purge system shall be connected to a 100% reclaim device.
    iv. A 20-year purge maintenance agreement that provides parts, labor, and all preventative maintenance required by the manufacturer's operating and maintenance instructions.
2. Annual Oil/Refrigerant Analysis
    i. The manufacturer shall also include at no charge for a period of 20 years an annual oil and refrigerant analysis report to identify chiller contamination due to vacuum leaks. If the analysis identifies water, acid, or other contaminant levels higher than specified by the manufacturer, the oil and/or refrigerant must be replaced or returned to the manufacturer's original specification at no cost to the owner.
3. Shell Pressurization System
    i. The manufacturer shall include a factory-installed and wired system that will enable service personnel to readily elevate the vessel pressure during shutdown to facilitate leak testing.

ii. A factory mounted, wired, and installed shell pressurization system shall be provided to keep air out of the chiller when the unit is not in service. Electric blanket or hot water circulation system are both acceptable.

B. Performance: Refer to chiller performance rating.

C. Acoustics: Sound pressure for the unit shall not exceed the following specified levels. Provide the necessary acoustic treatment to chiller as required. Sound data shall be measured in dB according to AHRI Standard 575 and shall include overall dBA. Data shall be the highest levels recorded at all load points.

Octave Band								Overall (dBA)
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
							75% Load	
							50% Load	
							25% Load	

2.4 CHILLER COMPONENTS

A. Compressors:

1. The unit shall utilize magnetic bearing, oil-free, semi-hermetic centrifugal compressors. The levitated shaft position shall be digitally controlled and shall be monitored by X-axis position sensor, Y-axis position sensor, and Z-axis position sensor. The compressor drive train shall be capable of coming to a controlled, safe stop in the event of a power failure by diverting stored power to the magnetic bearing controls system.
2. The motor shall be of the semi-hermetic type, of sufficient size to efficiently fulfill compressor horsepower requirements. It shall be liquid refrigerant cooled with internal thermal sensing devices in the stator windings. The motor shall be compatible with variable frequency drive operation.
    1. If unit contains an atmospheric shaft seal, the manufacturer shall provide the following at no additional charge:
        a. 20 year warranty and all preventive maintenance required to maintain the shaft seal including appropriate disposal of all oil lost through the shaft seal. Such disposal shall be done in a manner consistent with all Federal, state, and local laws pertaining to disposal and documentation of appropriate disposal shall be provided
        b. Replacement and re-charging on a semi-annual basis, or more often if required, of all oil lost through the shaft seal
        c. 20 year refrigerant replacement warranty for any loss of refrigerant that can be directly attributable to the failure of the atmospheric shaft seal
    2. If the compressor drive motor is an open design the chiller manufacturer shall provide at no additional charge a self contained air conditioning system in the mechanical space sized to handle the maximum heat output the open drive motor. The energy required to operate this air conditioning system shall be added to the chiller power at all rating points for energy evaluation purposes.
    3. If the compressor drive motor uses any form of antifriction bearings (roller, ball, etc) the chiller manufacturer shall provide the following at no additional charge:
        a. A 20 year motor bearing warranty and all preventative maintenance, including lubrication, required to maintain the bearings as specified in the manufacturer's operating and maintenance instructions

b. At start up a three axis vibration analysis and written report which establishes a baseline of motor bearing condition.

c. An annual three axis vibration analysis and written report to indicate the trend of bearing wear.

3. The chiller shall be equipped with an integrated Variable Frequency Drive (VFD) to automatically regulate compressor speed in response to cooling load and the compressor pressure lift requirement. Movable inlet guide vanes and variable compressor speed acting together, shall provide unloading. The chiller controls shall coordinate compressor speed and guide vane position to optimize chiller efficiency.
4. [OPTIONAL) Each compressor shall be equipped with a field-mounted harmonic filter.
5. Each compressor circuit shall be equipped with a line reactor to help protect against incoming power surges and help reduce harmonic distortion.

B. Evaporator and Condenser:

The evaporator and condenser shall be separate vessels of the shell-and-tube type, designed, constructed, tested and stamped according to the requirements of the ASME Code, Section VIII. Regardless of the operating pressure, the refrigerant side of each vessel will bear the ASME stamp indicating compliance with the code and indicating a test pressure of 1.1 times the working pressure, but not less than 100 psig. The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.

1. The evaporator shall be flooded type with [0.025 in.] OR [0.028 in.] OR [0.035 in.] wall copper internally and externally enhanced tubes rolled into carbon steel tubesheets. The water side shall be designed for a minimum of [150 psig] OR [300 psig]. The refrigerant side shall be designed for a minimum of 200 psi. Provide intermediate tube supports at a maximum of 24 inch spacing. The heads shall be [carbon steel] OR [epoxy-coated steel]. Water connections shall be [grooved suitable for Victaulic couplings] OR [flanged connections]. The evaporator shall have [dished heads with valved drain and vent connections] OR [shall be equipped with marine water boxes with removable covers and vent and drain connections]. The evaporator shall have [right-hand] OR [left-hand] connections when looking at the unit control panel.
2. The condenser shall have [(0.025 in) OR (0.028 in.) OR (0.035 in.) wall copper] OR [(0.028 in.) or (0.035 in.) wall 90-10 cupro-nickel] internally and externally enhanced tubes rolled into carbon steel. Water connections shall be [grooved suitable for Victaulic couplings] OR [flanged]. The water side shall be designed for a minimum of [150 psig] OR [300 psig]. The refrigerant side shall be designed for a minimum of 200 psi. Provide intermediate tube supports at a maximum of 24 inch spacing. The condenser shall have [dished heads with valved drain and vent connections] OR [shall be equipped with marine water boxes with removable covers and vent and drain connections]. The heads shall be [carbon steel] OR [epoxy-coated steel]. The condenser shall have [right-hand] OR [left-hand] connections when looking at the unit control panel.
3. Provide sufficient isolation valves and condenser volume to hold the full unit refrigerant charge the condenser at 90ºF in accordance with ANSIASHRAE 15.A during servicing or provide a separate pumpout system and storage tank sufficient to hold the charge of the largest unit being furnished.
4. An electronic expansion valve shall control refrigerant flow to the evaporator. Fixed orifice devices or float controls with hot gas bypass are not acceptable because of inefficient control at low load conditions. The liquid line shall have moisture indicating sight glass.
5. Re-seating type spring loaded pressure relief valves according to ASHRAE-15 safety code shall be furnished. The evaporator shall be provided with single or multiple valves. The condenser shall be provided with dual relief valves equipped with a transfer valve so one relief valve can be removed for testing or replacement without loss of refrigerant or removal of refrigerant from the condenser.

Rupture disks are not acceptable. If rupture disks are required on negative pressure units to prevent air and moisture ingress, then factory mounted spring loaded pressure relief valves shall be provided in series with the rupture disks to contain the remaining refrigerant in the event of vessel over-pressurization. The space between the rupture disk and the relief valve shall include a suitable telltale indicator integrated into the chiller control system to alert the operator that a potential safety issue exists in the pressure relief system.

6. [OPTIONAL] The evaporator, including water heads, suction line, and any other component or part of a component subject to condensing moisture shall be insulated with UL recognized [3/4 inch] OR [1 ½ inch] closed cell insulation. All joints and seams shall be carefully sealed to form a vapor barrier.
7. Provide factory-mounted and wired, thermal-dispersion water flow switches on each vessel to prevent unit operation with no or low water flow. Paddle and pressure differential type switches are not acceptable due to high rates of failure and false indications from these types of flow indicators.

C. Long Term Reliability

1. All compressor/motor designs that require oil to lubricate their respective roller/ball bearing system must denote exactly how many gallons of oil are required for safe operation. The manufacturer must then provide the engineer and owner with a real world energy analysis showing the energy degradation over time due oil contamination of heat transfer surfaces.
2. Chillers containing oil shall include at no additional charge a 10 year parts and labor warranty on all oil system components including:

- Pumps
- Starter
- Piping
- Tank
- Heater
- Cooler
- Controls
- Valves

3. Manufacturer shall be responsible for covering all costs associated with annual oil and oil filter changes plus oil analysis as required

D. Vibration Isolation

1. Provide neoprene waffle-type vibration isolators for each corner of the unit.

E. Power Connections

1. Power connection shall be [single point to a factory-mounted disconnect switch] OR [multipoint to each compressor power panel on two-compressor units].

F. Chiller Control

1. The unit shall have a microprocessor-based control system consisting of a 15-inch VGA touch-screen operator interface and a unit controller.
2. The touch-screen shall display the unit operating parameters, accept setpoint changes (multi-level password protected) and be capable of resetting faults and alarms. The following parameters shall be displayed on the home screen and also as trend curves on the trend screen:

- Entering and leaving chilled water temperatures
- Entering and leaving condenser water temperatures
- Evaporator saturated refrigerant pressure
- Condenser saturated refrigerant pressure
- Percent of 100% speed (per compressor)

- % of rated load amps for entire unit

3. In addition to the trended items above, all other important real-time operating parameters shall also be shown on the touch-screen. These items shall be displayed on a chiller graphic showing each component. At a minimum, the following critical areas must be monitored:
   - Compressor actual speed, maximum speed, percent speed
   - Liquid line temperature
   - Chilled water setpoint
   - Compressor and unit state and input and output digital and analog values
4. A fault history shall be displayed using an easy to decipher, color coded set of messages that are date and time stamped. Time interval scale shall be user selectable as 20 mins, 2 hours, or 8 hours. The alarm history shall be downloadable from the unit's USB port. An operating and maintenance manual specific for the unit shall be viewable on the screen.
5. All setpoints shall be viewable and changeable (multi-level password protected) on the touch screen and include setpoint description and range of set values.
6. Automatic corrective action to reduce unnecessary cycling shall be accomplished through preemptive control of low evaporator or high discharge pressure conditions to keep the unit operating through abnormal transient conditions.
7. The chiller shall be capable of cycling and loading up to three other similar chillers through a local network and also automatic control of evaporator and condenser pumps (primary and standby), up to 3 stages of cooling tower fan cycling control and a tower modulating bypass valve or cooling tower fan variable frequency drives.
8. [OPTIONAL] The factory mounted controller(s) shall support operation on a BACnet®, Modbus® or LONWORKS® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.
   - Modbus
   - BACnet MS/TP master (Clause 9)
   - BACnet IP, (Annex J)
   - BACnet ISO 8802-3, (Ethernet)
   - LonTalk® FTT-10A. The unit controller shall be LONMARK ® certified.
9. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
10. For chillers communicating over a LONMARK network, the corresponding LONMARK eXternal Interface File (XIF) shall be provided with the chiller submittal data.
11. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.
12. The factory supplied VFD and controls should include the following:
    - High short circuit panel rating of [35 kA (standard)] OR [65kA at 460V (optional)] with a field-supplied matching disconnect switch
    - Phase loss protection
    - Under/over voltage protection

- [OPTIONAL] Ground Fault Protection to reduce the arcing ground fault damage from line-to-ground fault currents less than those required for conductor protection
- [OPTIONAL] EMI filters to reduce radio frequency interference

13. Energy saving software logic shall at a minimum offer the following
    - User programmable compressor soft loading
    - Chilled water reset
    - Demand limit control
    - Staging options lead lag between multiple compressors on a single chiller or up to two other similar chillers.
    - Plotting of historic trends for optimizing efficiency

2.5. OPTIONAL ITEMS

The following optional items shall be furnished:

1. [Open] OR [Closed] export crate
2. Pumpout unit, with or without storage vessel
3. Refrigerant monitor
4. OSHPD Certification: The chiller shall be OSHPD Pre-Approved per OSP–0116-10 and be so labeled. The chiller shall meet a minimum seismic design spectral response acceleration of 1.60 S_{DS}. The chiller must be mounted to a rigid base and may use neoprene waffle vibration pads.
5. IBC Certification: The chiller shall be certified to the following codes and standards; 2009 IBC, 2010 CBC, ICC-ES AC-156, ASCE 7-05. The chiller must be mounted to a rigid base and may use neoprene waffle vibration pads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installing contractor to:

1. Install per manufacturer's requirements, shop drawings, and contract documents.
2. Adjust chiller alignment on foundations, or subbases as called for on drawings.
3. Arrange piping to allow for dismantling to permit head removal and tube cleaning.
4. Coordinate electrical installation with electrical contractor.
5. Coordinate controls with control contractor.
6. Provide all material required for a fully operational and functional chiller.
7 Install unit in a dry indoor location consistent with NEMA 1 design.

3.2 START-UP

A. Factory Start-Up Services: Provide for as long a time as is necessary to ensure proper operation of the unit, but in no case for less than two full working days. During the period of start-up, the start-up technician shall instruct the owner's representative in proper care and operation of the unit.

Daikin Training and Development

Now that you have made an investment in modern, efficient Daikin equipment, its care should be a high priority. For training information on all Daikin HVAC products, please visit us at www.DaikinApplied.com and click on training, or call 540-248-9646 and ask for the Training Department.

Warranty

All Daikin equipment is sold pursuant to Daikin standard terms and conditions of sale, including Limited Product Warranty. Consult your local Daikin Representative for warranty details. To find your local Daikin Representative, go to www.DaikinApplied.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.DaikinApplied.com .