ENGINEERING SUBMITTAL DATA

ED 19144

MARCH 2025

MAGNITUDE® WMC-E

MAGNETIC BEARING OIL-FREE CENTRIFUGAL CHILLERS

Model WMC-E
180 - 270 Tons
R-515B REFRIGERANT
50/60 Hz

LEARN MORE AT **DAIKINAPPLIED.COM**

Hazard Identification

⚠ DANGER

Danger indicates a hazardous situation, which will result in death or serious injury if not avoided.

⚠ WARNING

Warning indicates a potentially hazardous situations, which can result in property damage, personal injury, or death if not avoided.

⚠ CAUTION

Caution indicates a potentially hazardous situations, which can result in minor injury or equipment damage if not avoided.

NOTICE

Notice indicates practices not related to physical injury.

Introduction

General Description

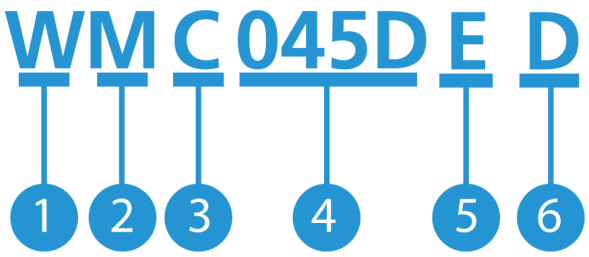
Daikin Applied Magnitude Chillers are complete, self-contained, automatically controlled, liquid-chilling units featuring oil-free, magnetic bearing centrifugal compressors. All Magnitude chillers are equipped with a single evaporator and a single condenser along with either one or two compressors depending on the model.

Magnitude chillers are designed for indoor, non-freezing installation only. The chillers use refrigerant R-515B that operates at a positive pressure over the entire operation range, so no purge system is required.

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

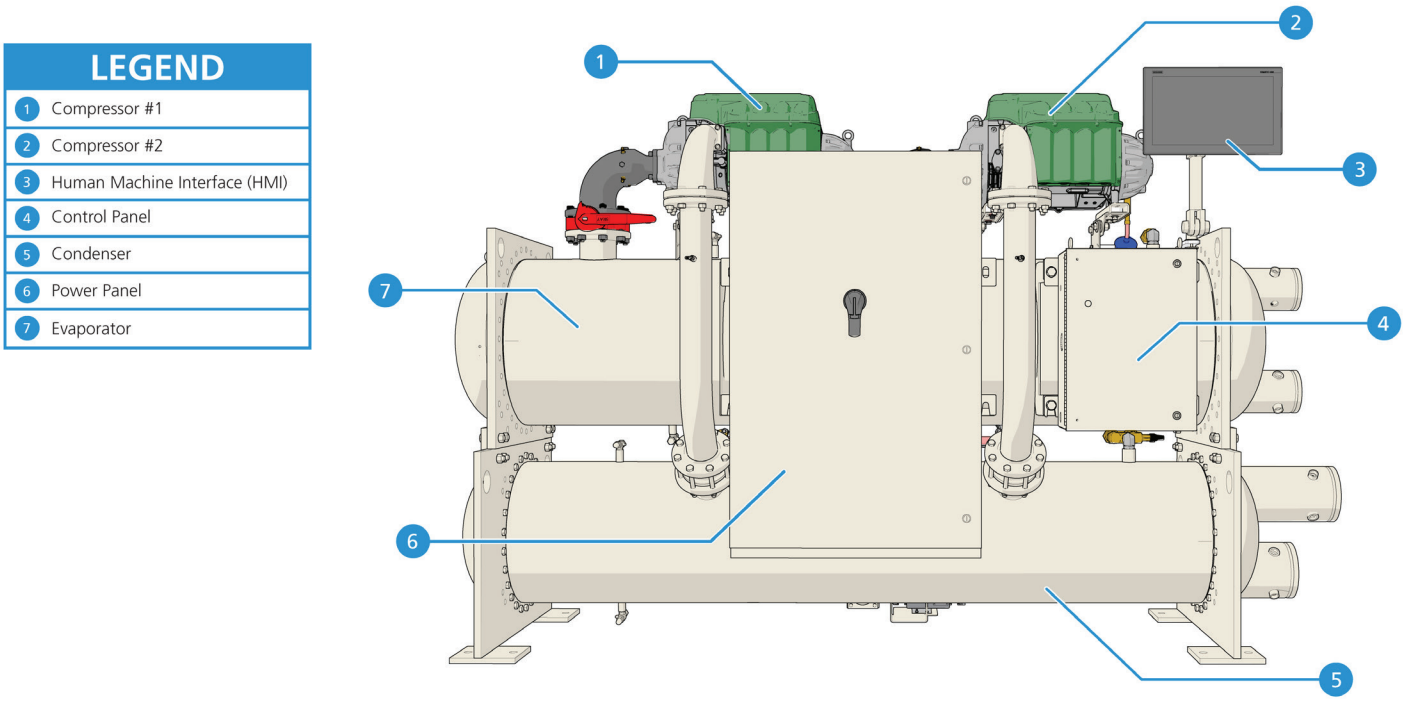
All Daikin Applied centrifugal chillers must be commissioned by a factory-trained Daikin Applied service technician. Failure to follow this startup procedure can affect the equipment warranty.

Nomenclature



No.	Description
1	W = Water-cooled
2	M = Magnetic Bearing
3	C = Centrifugal Compressor
4	Model Code
5	Design Vintage
6	D = Dual

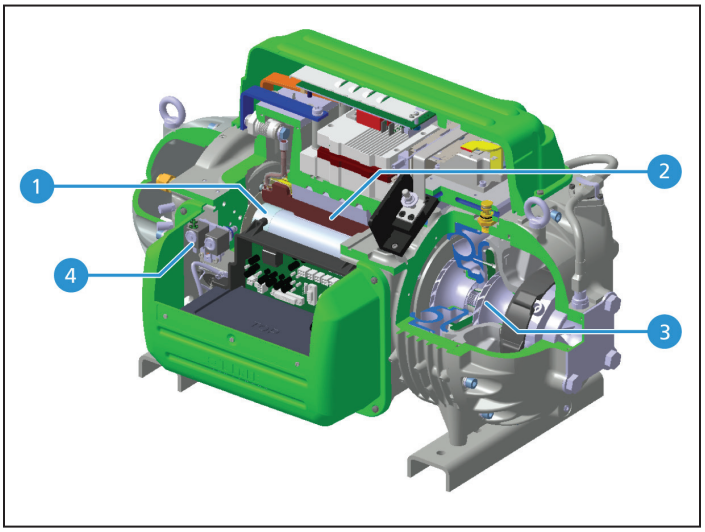
Figure 1: WMC-E Major Component Locations



The Compressor Technology

Model WMC's efficiency and reliability is due to its cutting-edge permanent magnet motor and magnetic bearing compressor technology. A digitally-controlled magnetic bearing system replaces conventional oil lubricated bearings and a direct drive motor eliminates the need for a lubricated gear box. The compressor shaft, shown in Figure 2, levitates on a magnetic cushion and is the compressor's only major moving component. Sensors at each magnetic bearing provide real-time feedback to the bearing control system. As a result of this sophisticated design, model WMC has many advantages over chillers with traditional centrifugal compressors.

Figure 2: Magnetic Bearing Compressor



No.	Description
1	Oil-free Magnetic Bearings
2	Permanent Magnetic Synchronous Motor
3	Two-stage Compression
4	Compressor Cooling

Oil-Free Compressor Design Benefits

No Oil Management System = Greater Reliability

With magnetic bearings operating in a magnetic 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 storage and disposal
- 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.

Totally Oil-Free Operation = Greater Efficiency

The use of oil-free magnetic bearing technology significantly increases chiller efficiency by reducing frictional losses within the bearing system.

In addition, efficiency improvements can be realized since there is no oil to coat the heat transfer surfaces.

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 System = Low Vibration & Sound Levels

With the use of magnetic bearings, the compressor vibration levels are extremely low, minimizing vibration that could be transmitted to the structure.

With low vibration levels, sound levels are lower compared to traditional centrifugal chillers.

Additional Compressor Design Benefits

Model WMC's magnetic bearing compressor design offers many benefits not only because of its oil free design but also because of its use of a positive pressure refrigerant and a variable frequency drive.

Low Operating Costs

Model WMC offers world class part load efficiency due to its advanced permanent magnet motor and magnetic bearing VFD compressor design. This allows for significant energy savings at off-design conditions compared to fixed speed chillers.

Integrated Variable Frequency Drive

A Variable Frequency Drive (VFD) modulates compressor speed in response to load and evaporator/condenser pressure. When minimum speed is reached, movable inlet guide vanes redirect the gas flow into the impeller. VFD's have the following benefits:

- Reduced annual energy costs when there are long periods of part load operation and/or low compressor lift (lower condenser water temperature)
- Reduced motor starting inrush current
- Reduced size of backup generators used to provide emergency power to chillers used on mission critical applications
- Increased power factor to reduce utility surcharges

WMC Reduced Harmonic Option

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.

The standard VFD includes 5% line reactors, which dramatically reduce the harmonic distortion. An optional unit- mounted harmonic filter is available for all models to meet lower harmonic level requirements.

The Control Technology

It is only fitting that this revolutionary chiller design be matched with the advanced control technology to provide the ultimate chiller performance. Our control design includes many unique energy-saving features and interface enhancements.

MicroTech Controller

The model WMC chiller utilizes MicroTech digital control electronics to proactively manage unit operation and provide control of external chilled water and cooling tower pumps. The compressor runs at the minimum speed necessary to maintain cooling capacity and lift (which decreases with lower condenser water temperatures), thus minimizing energy usage over the entire range of operating conditions. By constantly monitoring chiller status and real time data, the MicroTech unit controller will automatically take proactive measures to relieve abnormal conditions or shut the unit down if a fault occurs.

Additional smart features that optimize operating efficiency have been incorporated into our MicroTech controls:

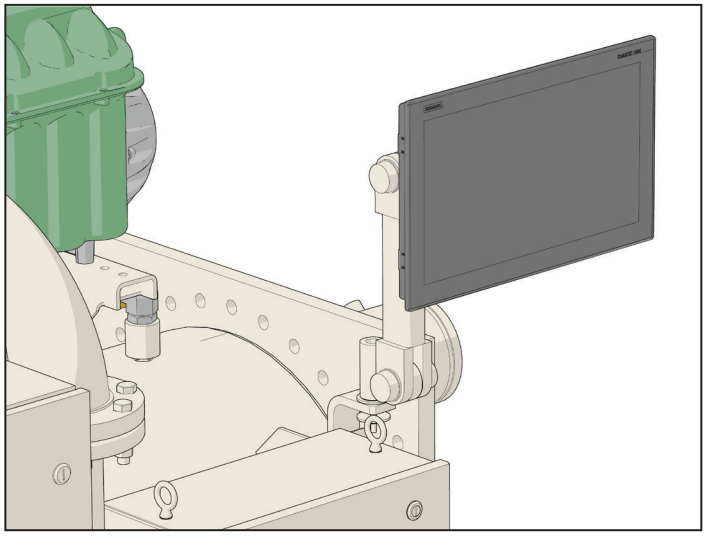
- Cooling tower control including on/off, staging, and VFD
- Direct control of water pumps
- Chilled water rest
- Demand limit control
- Ability to stage up to four WMC chillers

Operator Interface

Operation simplicity was one of the main considerations in the development of the MicroTech control system. The operator interface is a 15-inch, color touch-screen monitor that is mounted on an adjustable arm. Key operating parameters and setpoints are easily accessible. For added convenience, the unit Operating and Maintenance Manual is also viewable on the touch-screen panel.

In order to track chiller performance, the MicroTech unit controller can record and plot water temperatures, refrigerant pressures, and motor load. These values can be downloaded through a convenient USB port in the interface and exported into a spreadsheet for further evaluation and record purposes. The trend history screen is shown in Figure 3.

Figure 3: Human Machine Interface (HMI)



The controller memory (no batteries required) also retains the fault history for troubleshooting and monitoring unit performance. A time/date stamp is associated with each fault. The fault history can be downloaded through the USB port.

RapidRestore

Quickly restores cooling capacity when power is restored after a power failure. Mission critical facilities such as data centers and hospitals are demanding stringent capabilities for chillers to restart and reach full load operation quickly in the event of a power loss. With the capability of RapidRestore, Magnitude model WMC chillers are engineered to meet those needs. See Table 1 for specifications.

Table 1: WMC RapidRestore® Times- After Power Restoration

Compressor Start	Fast Loading to 80% Load
43 sec	120 sec*

NOTE: *Estimated load time. Times may vary depending on operating conditions.

Electrical

Field Wiring

The standard power wiring connection to Magnitude chillers is single point to a common disconnect switch, which is then factory-wired to individual disconnect switches for each compressor. Refer to the unit nameplate and the Daikin Tools selection report for the correct electrical ratings.

⚠ DANGER

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

The field power wiring required varies depending on unit model. See "Figure 4: WMC-E Control Box Schematic" on page 8, "Figure 6: WMC-E Power Box Schematic" on page 10 for wiring information. These wiring diagrams are also provided with the chiller. Factory-mounted and wired line reactors are standard, but not included when the optional combo harmonic filters are included.

NOTICE

Wiring, fuse and wire size must be in accordance with the National Electric Code (NEC). The supply voltage to these units must be within minimum and maximum range per the following table. Also, the voltage unbalance between phases must not exceed 2%.

WMC Nameplate Voltage	Minimum Voltage to Unit	Maximum Voltage to Unit
380	360 (5%)	440 (15%)
400	360 (10%)	440 (10%)
415	360 (13%)	440 (6%)
440	414 (6%)	506 (15%)
460	414 (10%)	506 (10%)
480	414 (13%)	506 (5%)
575	518 (10%)	632 (10%)

⚠ CAUTION

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.

Chiller Control Power

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

Use with On-Site Generators

Magnitude Model WMC chillers have their total tonnage divided between the number of compressors on the chiller. The compressor(s) are operated with variable frequency drives and if the unit has two compressors, the compressors start sequentially. These features make Magnitude chillers especially appropriate for use in applications where they may be required to run with on-site electrical generators. This is particularly true when the generators are used for temporary power when the utility power is lost.

Generator Sizing

Natural gas and diesel generators are sensitive to the compressor's locked-rotor characteristics when the chillers start up. Use the electrical data supplied with the performance output sheet, obtained from the Daikin Applied sales office, for generator sizing purposes. The chiller data sheet will show the RLA, which is for each compressor. Refer to Electrical Data to determine the LRA, which is based on the RLA. It is important to size the generator to handle the LRA at startup.

⚠ WARNING

Generator must be sized by an electrical engineer familiar with generator applications.

Transfer Back to Grid Power

Proper transfer from stand-by generator power back to grid power is essential to avoid compressor damage.

⚠ WARNING

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

The necessary procedure for reconnecting power from the generator back to the utility grid is as follows:

1. Set the generator to always run five minutes longer than the unit start-to-start timer, which can be set from two to sixty minutes. The actual setting for the start-to-start timer can be viewed on the HMI on the TIMERS Setpoint Screen.
2. Configure the transfer switch provided with the generator to automatically shut down the chiller before transfer is made. The automatic shut-off function can be accomplished through a BAS interface or with the “remote on/off” wiring connection shown in “Figure 6: WMC-E Power Box Schematic” on page 10.

It is not necessary to shutdown the chiller if pumps are not directly controlled by the chiller. Doing so, however, provides a more coordinated restart. Please note an unsynchronized transfer switch may result in an alarm shutdown of the chiller.

A start signal can be given anytime after the stop signal since the start-to-start timer will be in effect.

Building Automation Systems

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

The following protocol options are available:

- BACnet MS/TP
- BACnet IP
- BACnet Ethernet
- Modbus RTU

The BAS communication module can be factory-mounted with the chiller or can be field-mounted at any time after the unit is installed. Connection to the chiller for all BAS protocols will be at the unit controller. An interface card, depending on the protocol being used, will have been factory installed in the unit controller if so ordered, or it can be field installed.

If an interface module was ordered, the appropriate BAS interface installation manual was shipped with the unit. If necessary, contact your local Daikin Applied sales office for a replacement manual or obtain one from www.DaikinApplied.com.

Figure 4: WMC-E Control Box Schematic

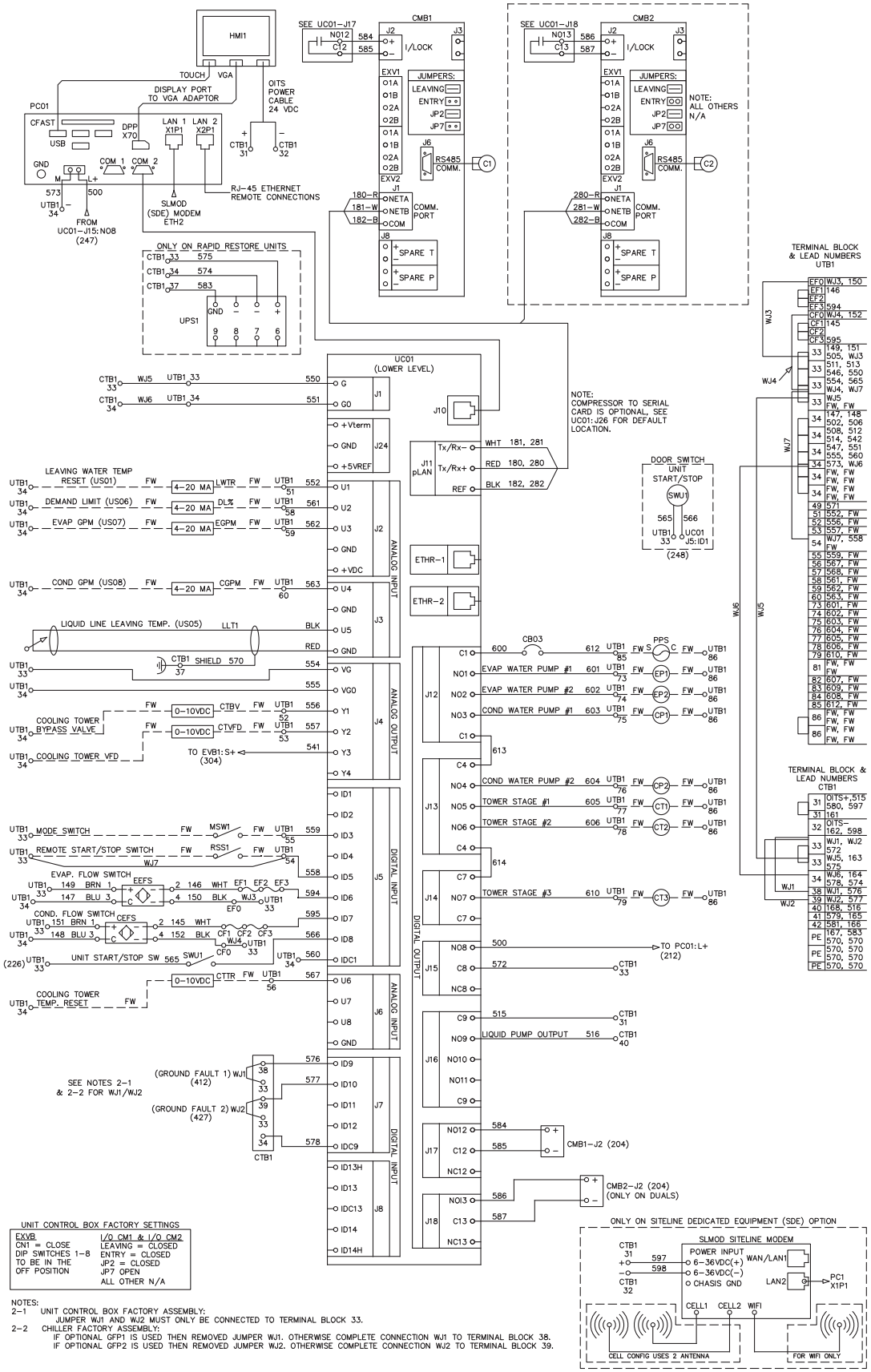
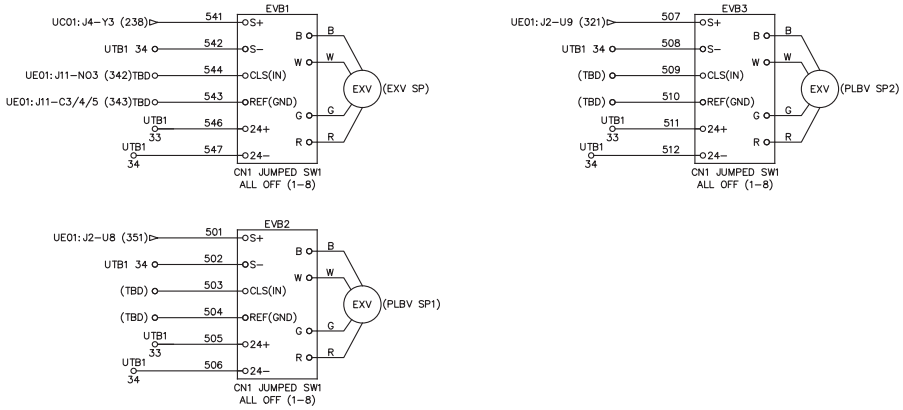
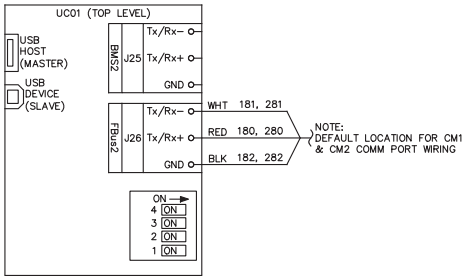


Figure 5: WMC-E Control Box Schematic (Continued)





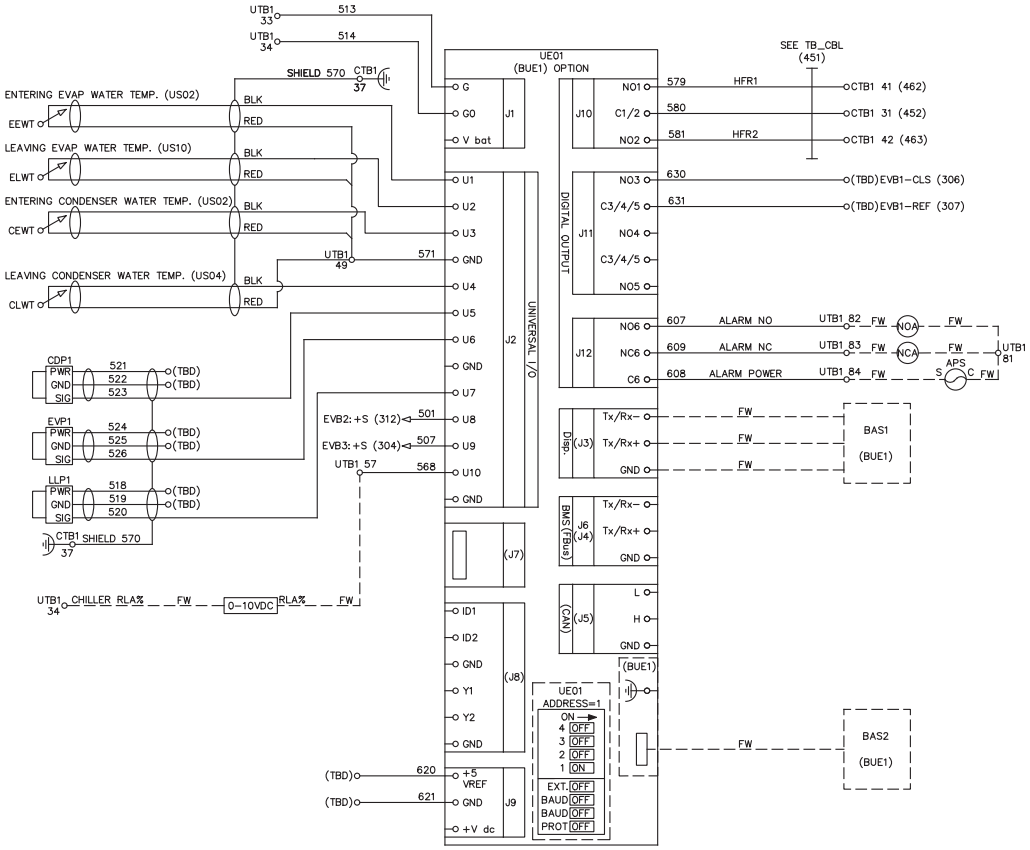
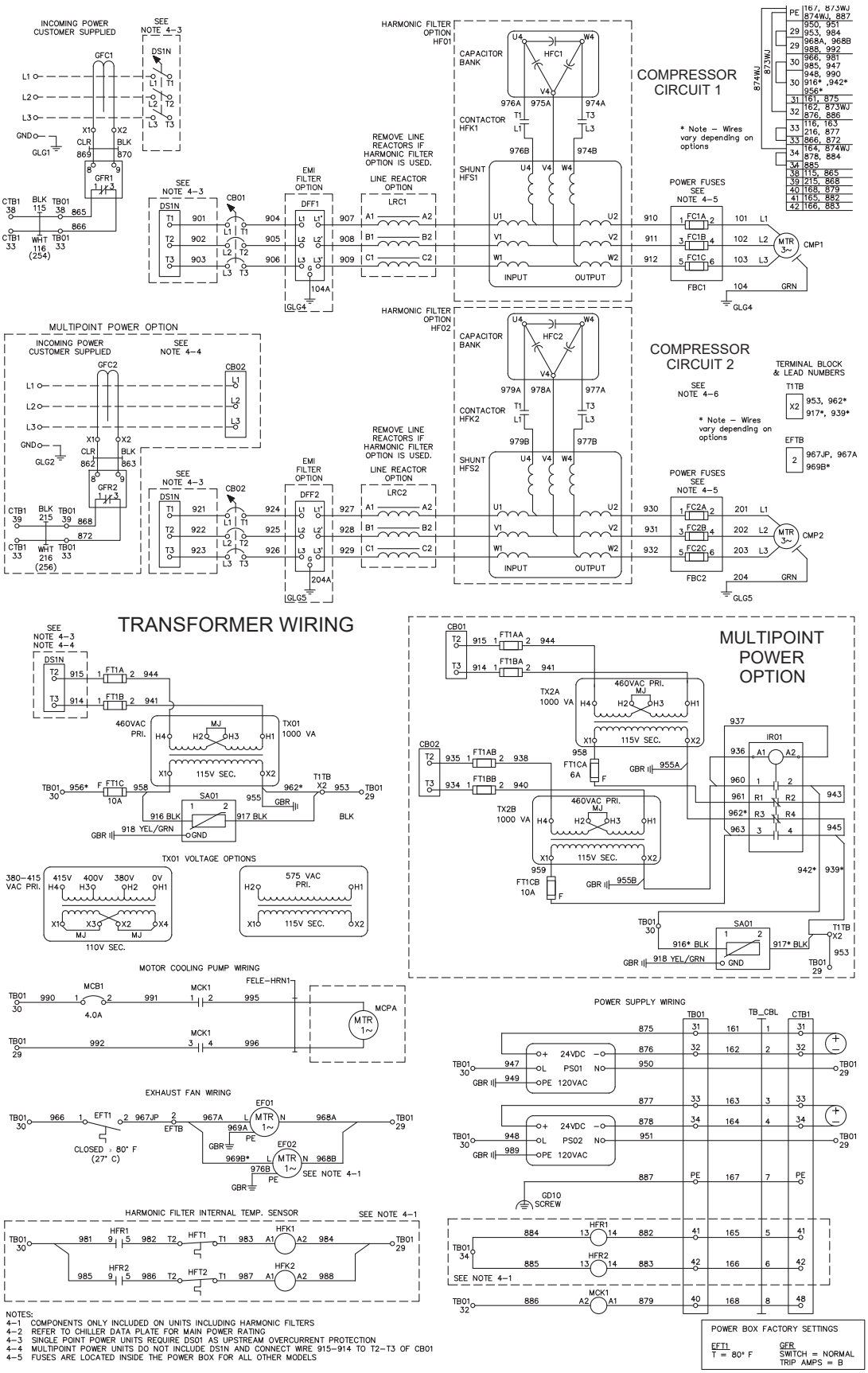


Figure 6: WMC-E Power Box Schematic

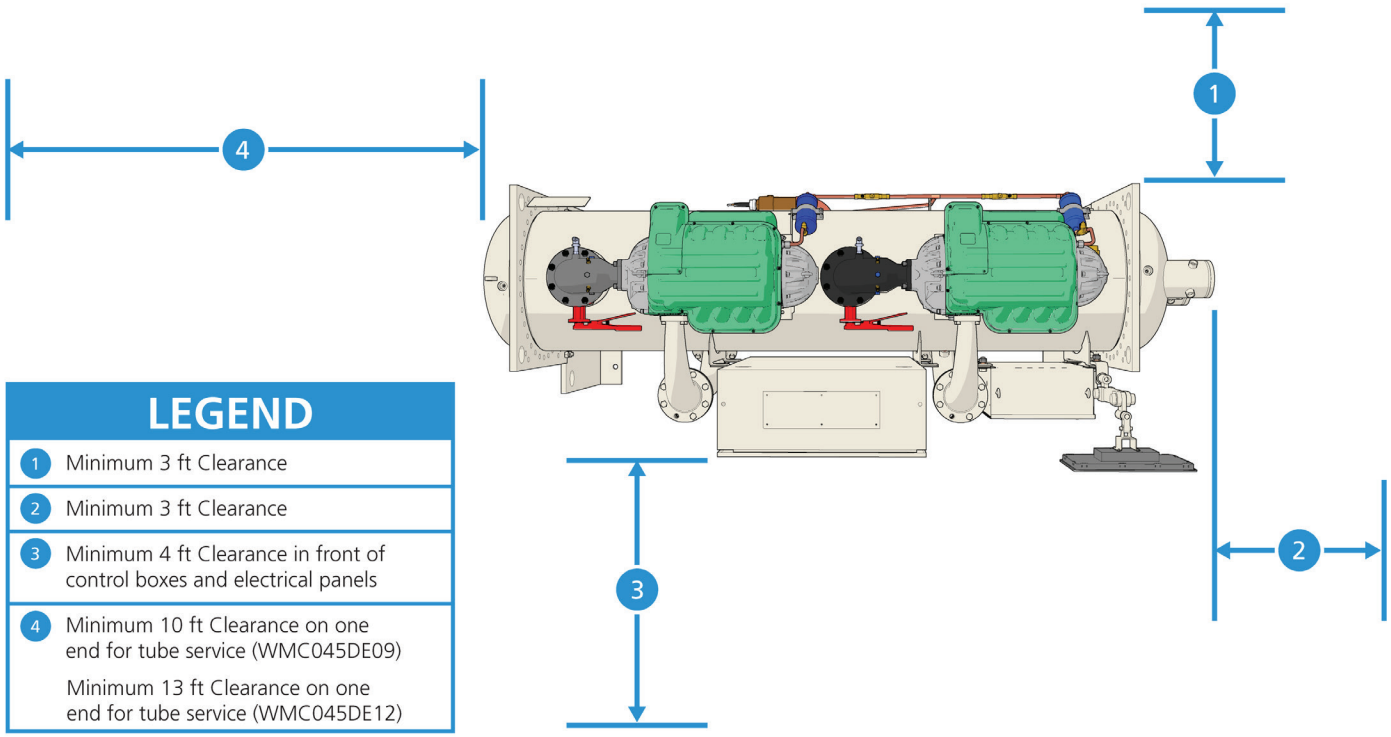


NOTES:
4–1 COMPONENTS ONLY INCLUDED ON UNITS INCLUDING HARMONIC FILTERS
4–2 REFER TO CHILLER DATA PLATE FOR MAIN POWER RATING
4–3 SINGLE POINT POWER UNITS REQUIRE DS01 AS UPSTREAM OVERCURRENT PROTECTION
4–4 MULTIPOINT POWER UNITS DO NOT INCLUDE DS1N AND CONNECT WIRE 915–914 TO T2–T3 OF CB01
4–5 FUSES ARE LOCATED INSIDE THE POWER BOX FOR ALL OTHER MODELS

Dimensional Drawings

Service Clearance

Figure 7: Minimum Service Clearance



The unit must be placed in an area that allows for adequate clearance around the unit. See Figure 7 for clearance requirements around the sides of the chiller. Doors and removable wall sections can be utilized to meet these clearance requirements. There must be a minimum 3-foot clearance above the top of the chiller. The U.S. National Electrical Code® (NEC) or local codes can require more clearance in and around electrical components and must be checked for compliance.

Drawing Notes

1. Final connections must allow for +/- 1/2 inch (0.5 inch, 12.7 mm) manufacturing tolerances.
2. 2.00-inch ANSI class 150 flange evaporator and condenser rupture disks must be piped per ANSI/ASHRAE 15.
3. Minimum Clearances (See Figure 7):

- Check local codes for any additional clearance requirements.
- Installation layout should be designed by qualified personnel familiar with local codes.
- Hinged type waterboxes may require more clearance. Consult a Daikin Applied representative for details.

4. Unit shown has standard right-hand water connections. Left-hand connections are available for either vessel. ANSI-flanged nozzle connections are available upon request. When using ANSI-flanged connections, add 0.5 inch (13 mm) to each flanged end.
5. Dimensions shown are for units (evaporator/condenser) with standard design pressures. The waterside design pressure is 150 psi (1034 kPa). Consult the factory for unit dimensions with higher design pressures.
6. Unit vibration isolator pads are provided for field installation and when fully loaded are 0.25 inches (6 mm) thick.
7. 3.50-inch (89 mm) diameter lifting holes are provided.
8. The shipping skid adds 4.00 inches (105 mm) to the overall unit height.
9. If main power wiring is brought up through the floor, this wiring must be outside the envelope of the unit.
10. The unit is shipped with a full operating charge of refrigerant except with the “Partial Disassembly” knockdown option.
11. Power landing panel is on the side of the cabinet.

Unit Dimensions

Figure 8: WMC Dual Compressor Unit

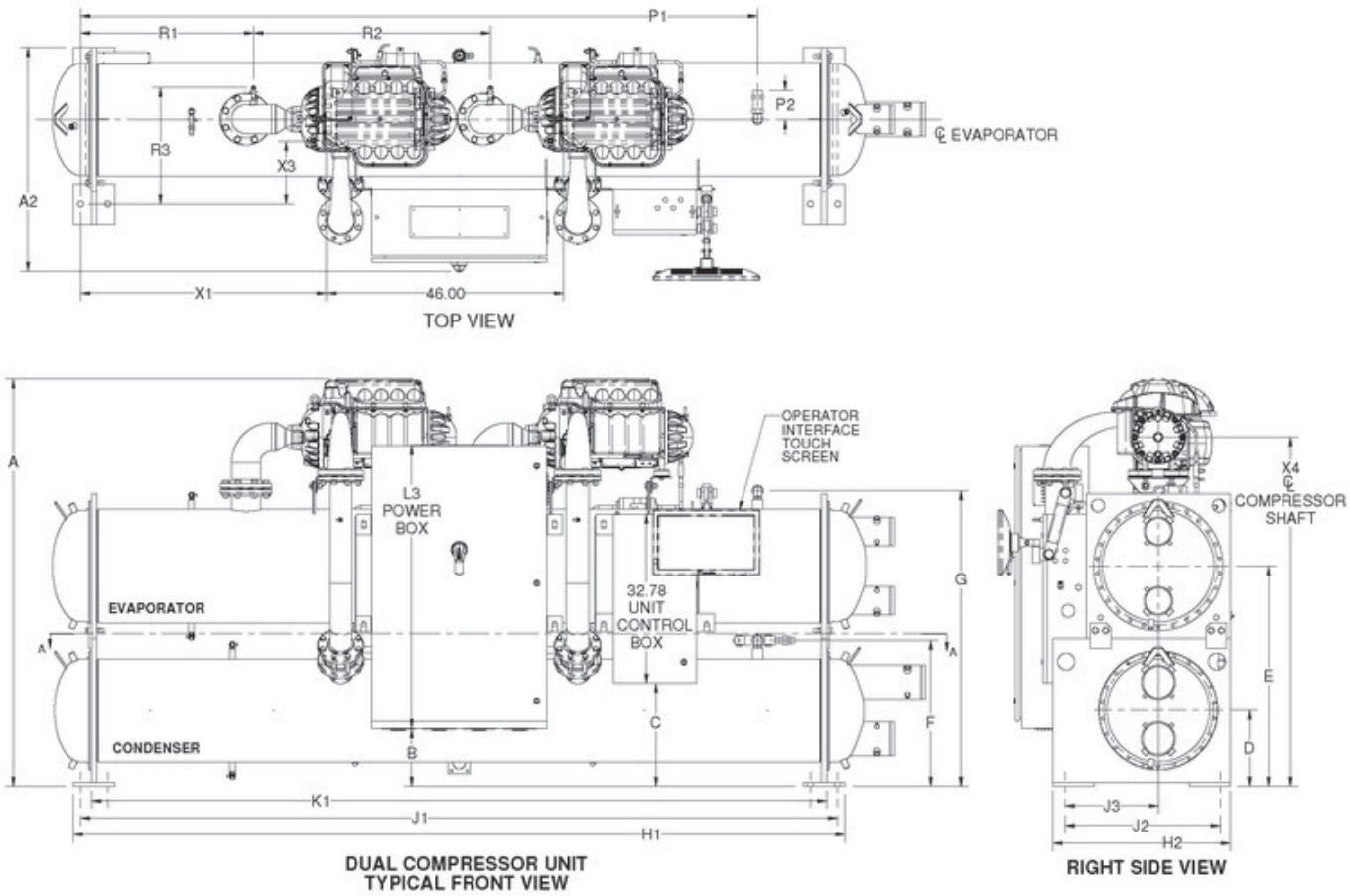


Table 2: WMC Dual Compressor Dimensions

Model	Heat Exchanger	Length in (mm)	Width * in (mm)	Height in (mm)
WMC045D09	**E2609/C2209**	114.8 (2916)	47.2 (1199)	84.02 (2134)
WMC045D12	**E2612/C2212**	149.7 (3802)	47.2 (1199)	84.02 (2134)

Installation Considerations

Operating Limits

Table 3: Operating/Standby Limits

Acceptable Temperatures[1]			Min Temp °F (°C)	Max Temp °F (°C)
Condition	**Component**	**Description**		
Standby	Evaporator	Water	40 (4.4)	140 (60)
		Water w/ Anti-freeze[2]	40 (4.4)	140 (60)
	Equipment Room	Air w/ Water in Vessels[4]	40 (4.4)	104 (40)
		Air w/ no Water in Vessels[4]	0 (-17.8)	104 (40)
Startup	Evaporator	Water	40 (4.4)	90 (32)
		Water w/ Anti-freeze[2]	40 (4.4)	90 (32)
	Condenser	Water	40 (4.4)	135 (57)
	Equipment Room	Air[4]	40 (4.4)	104 (40)
Operating	Evaporator	Entering Water	40 (4.4)	75 (24)
		Leaving Water[3]	38 (3.3)	55 (12.8)
		Entering Water w/ Antifreeze[2]	40 (4.4)	75 (24)
		Leaving Water w/ Antifreeze[2,3]	38 (3.3)	55 (12.8)
	Condenser	Entering Water	55 (13)	135 (57)
		Leaving Water[3]	57 (14)	142 (61)
	Equipment Room	Air[4]	40 (4.4)	104 (40)
NOTES:				
1	Contact a Daikin Applied representative for performance at specific operating conditions, as some limits depend on unit configuration			
2	Antifreeze temperature limits must have appropriate glycol concentration			
3	Allowable leaving fluid temperatures depend on Saturation Temperature			
4	5%-95% relative humidity, non-condensing			

Location Requirements

Daikin WMC units are designed only for indoor, weather-protected, non-freezing areas consistent with the NEMA 1 rating on the chiller, controls, and electrical panels. Equipment room temperature for operating and standby conditions is “40° - 104°F” (4.4°C to 40°C).

Vibration Mounting

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

Water Piping System Design

⚠ WARNING

Polyolester Oil, commonly known as POE oil is a synthetic oil used in many refrigeration systems, and may be present in this Daikin Applied product. POE oil, if ever in contact with PVC/CPVC, will coat the inside wall of PVC/CPVC pipe causing environmental stress fractures. Although there is no PVC/CPVC piping in this product, please keep this in mind when selecting piping materials for your application, as system failure and property damage could result. Refer to the pipe manufacturer’s recommendations to determine suitable applications of the pipe.

Field installed water piping to the chiller must include:

- air vents at the high points.
- a cleanable water strainer upstream of the evaporator and condenser inlet connections.
- a flow proving device for both the evaporator and condenser to prevent freeze up. Flow switches, thermal dispersion switches, or Delta-P switches can be used. Note that flow switches are factory installed. Additional flow switches can be used only if they are connected in series with the ones already provided.
- sufficient shutoff valves to allow vessel isolation. The chiller must be capable of draining the water from the evaporator or condenser without draining the complete system.

It is recommended that field installed water piping to the chiller include:

- temperature sensors at the inlet and outlet connections of both vessels.
- water pressure gauge connection taps and gauges at the inlet and outlet connections of both vessels for measuring water pressure drop.

Piping must be supported to eliminate weight and strain on the fittings and connections. All evaporators and condensers have OGS-type grooved water connections (adhering to Standard AWWA C606) or optional flange connections. The installing contractor must provide matching mechanical connections. Chilled water piping must be adequately insulated.

NOTICE

This product, in its standard configuration, is equipped with a shell and tube evaporator with carbon steel shell and copper tubes. The water or other fluid used in contact with the wetted surfaces of the heat exchangers must be clean and non-corrosive to the standard materials of construction. Daikin Applied makes no warranty as to the compatibility of fluids and materials. Non-compatible fluids may void the equipment warranty. If the compatibility of the fluid with the standard materials of construction is in question, a professional corrosion consultant should administer the proper testing and evaluate compatibility

Variable Fluid Flow Rates and Tube Velocities

Many chiller system control and energy optimization strategies require significant changes in evaporator water flow rates. The Magnitude chiller line is well suited to take full advantage of these energy saving opportunities using different combinations of shell sizes, number of tubes, and pass arrangements.

Both excessively high and excessively low fluid flow rates should be avoided. Excessively high fluid flow rates and correspondingly high tube velocities will result in high fluid pressure drops, high pumping power, and potential tube erosion or corrosion damage. Excessively low fluid flow rates and correspondingly low velocities should also be avoided as they will result in poor heat transfer, high compressor power, sedimentation, and tube fouling.

Water Volume

All chilled water systems need adequate time to recognize a load change to avoid short cycling of the compressors or loss of control. 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 that the chiller plant has reasonable turndown, a rule of thumb of “gallons of water volume equal to two to three times the chilled water gpm flow rate” is often used. A properly designed storage tank should be added if the system components do not provide sufficient water volume.

Optimizing Efficiency

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 optimum plant design must take into account all of the interactions between chiller, pumps, and tower. The Daikin Energy Analyzer™ II 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 your local Daikin Applied sales office for assistance on your particular application.

Evaporator

Reducing Evaporator Fluid Flow

Several popular chiller plant control practices — including Variable Primary Flow systems — advocate reducing the evaporator fluid flow rate as the chiller capacity is reduced. This practice can significantly reduce the evaporator pumping power while having little effect on chiller energy consumption. The Magnitude WMC chillers, with their wide range of shell, tube, and pass combinations, are ideal for application in variable evaporator flow systems as long as the minimum and maximum tube velocities are taken into consideration when selecting the chiller.

If it is decided to vary the evaporator water flow rate, the rate of change should not exceed 10% per minute and should not exceed the minimum or maximum velocity limits.

Evaporator Entering Water Temperature

The maximum temperature of water entering the chiller for R-515B on standby must not exceed “75°F” (24°C). Maximum temperature entering for R-515B on startup must not exceed “90°F” (32°C).

Evaporator Leaving Water Temperature

Warmer leaving chilled water temperatures will raise the compressor’s suction pressure and decrease the lift, improving efficiency. Using 45°F (7°C) leaving water instead of the typical 42°F (5.5°C) will significantly reduce chiller energy consumption.

Evaporator Water Temperature Difference

The industry standard has been a 10°F (5.5°C) temperature drop in the evaporator. Increasing the drop to 12°F or 14°F (6.6°C or 7.7°C) can improve chiller efficiency and reduce pump energy consumption.

Condenser

Reducing Condenser Fluid Flow

Several popular chiller plant control practices also advocate reducing the condenser fluid flow rate as the chiller load is reduced. This practice can significantly reduce the condenser pumping power, but it may also have the unintended consequence of significantly increasing compressor power since the leaving condenser water temperature is directly related to compressor lift and power. The higher compressor power will typically be larger than the condenser pumping power reduction and will result in a net increase in chiller plant energy consumption. Therefore, before this strategy is applied for energy saving purposes it should be extensively modeled or used in an adaptive chiller plant control system which will take into account all of the interdependent variables affecting chiller plant energy. If it is decided to use variable condenser fluid flow, the model WMC chiller can operate effectively as long as the minimum and maximum tube velocities are taken into consideration when selecting the chiller.

Reducing Condenser Entering Water Temperature

As a general rule, a 1°F (0.5°C) 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.

When the ambient wet bulb temperature is lower than design, the entering condenser water temperature of Magnitude® WMC chillers can be lowered to improve chiller performance.

Chillers can start with entering condenser water temperatures as low as “40°F” (4.4°C). For short periods of time during startup, the entering condenser water temperature can even be lower than the leaving chilled water temperature.

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

In this scenario, cooling tower fans would continue to operate at 100% capacity at low wet bulb temperatures. The trade-off between better chiller efficiency and fan power should be analyzed for best overall system efficiency. The Energy Analyzer™ II program (available from your Daikin Applied sales representative) can optimize the chiller/tower operation for specific buildings in specific locales.

Condenser Water Temperature Difference

The industry standard of 3 gpm/ton or about a 9.5°F (5.3°C) delta-T works well for most applications.

Condenser Water Temperature Control

Condenser water control is an important consideration in chiller plant design since condenser water temperature will directly impact chiller operation and efficiency. When the ambient wet bulb temperature is lower than peak design, the entering condenser water temperature from the cooling tower can be allowed to fall, improving chiller performance. However, operational issues may occur when the condenser water temperatures are either too high or too low. The WMC chiller provides several options to assist the chiller plant designer in providing the optimum control of condenser water temperature.

Cooling Tower Control

Control of the cooling tower is required to maintain stability and avoid operational issues. This can be achieved through a BAS or by using the MicroTech unit controller. For systems utilizing a common condenser water loop for multiple purposes, the BAS contractor must provide the control but use of the MicroTech® II output signal is still recommended.

The preferred cooling tower control utilizes a variable speed fan. MicroTech will provide a control signal to determine the proper fan speed. It can also control up to four stages of fan cycling. Note that fan cycling can cause cooling tower water temperature to fluctuate as fans stage on/off, potentially adding instability to the system.

Special consideration must be given to starting the chiller when cold condenser water is present, such as with inverted starts or changeover from free (tower) cooling to mechanical cooling. It is required that some method be used to control the condenser water to maintain proper head pressure as indicated by the MicroTech unit controller.

Acceptable methods include the following (Each of these options can be controlled by the MicroTech or through a BAS utilizing the MicroTech output signals.):

1. Three-Way Bypass Valve Operation

   A traditional method for building condenser pressure at startup with colder condenser water is with the use of a three-way bypass valve. The device blends warmer water leaving the condenser with cooler water from the cooling tower at the condenser inlet. The bypass valve position will change until full flow from the tower to the condenser is obtained. The MicroTech® II provides only the valve position control signal. Main power to drive the valve’s actuator must be provided by the installer. The three-way valve should be located close to the chiller within the equipment room to minimize the volume of water.

2. Two-Way Valve Operation

   Another condenser control method is to use a modulating two-way control valve located on the outlet connection of the condenser. The valve will be nearly closed at startup to restrict water flow, which keeps generated heat in the condenser until an acceptable minimum condenser pressure is reached. As heat builds, the valve will open slowly until a full flow condition from the cooling tower is established. A separate power source is required to provide power to the valve actuator.

3. VFD Operating with a Condenser Water Pump

   A third method of condenser control for startup is utilizing a variable frequency drive with the condenser water pump. The speed will change as directed by the MicroTech® II output signal until design flow is reached. Speed adjustments may be required during the initial chiller startup as determined by the service technician.

NOTICE
Not using the MicroTech logic to control valves and variable frequency drives may result in system instability, capacity reduction, and issues starting the chiller with cold condenser water temperature.

Condenser Pump Sequencing

It is recommended to utilize the logic built into the MicroTech unit controller to start the condenser pump and maintain condenser head pressure control. MicroTech has the capability to operate a primary pump and a secondary standby pump. The condenser water flow should be stopped when the chiller shuts off. This will conserve energy and prevent refrigerant from migrating to the condenser.

Lenient Flow Operation

For chiller startup, the condenser control systems can reduce the flow to low rates, which can make operation of a flow sensing device unreliable. The MicroTech unit controller has a “lenient flow” feature that acts as an override of the flow sensor while protecting the chiller by monitoring a condenser pressure setting that is below the high pressure cutout.

Water Side Economizer Cycle Operation

Water side economizers are commonly used for ASHRAE 90.1 compliance and energy savings. This system utilizes a heat exchanger external to the chiller when cold cooling tower water is available to provide cooling. The most common system has a heat exchanger used in conjunction with the chiller’s evaporator.

The BAS contractor will need to provide controls for the heat exchanger including isolation valves and temperature control. The BAS contractor will also need to control the isolation valves for the chiller. Changeover from economizer cooling to mechanical cooling requires one of the methods previously mentioned to maintain suitable condenser head pressure.

Contact your local Daikin Applied representative for more information on this application.

Engineering Specifications

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 9001 and ISO 14001 Certified.

C. The chiller shall be factory tested as standard at the manufacturer's plant prior to shipment.

1.5 DELIVERY AND HANDLING

A. Chillers shall be delivered to the job site completely assembled and charged with R-515B refrigerant and be shipped on skids with a weather resistant cover.

– OR –

A. [For Type A Knockdowns] The unit shall be delivered to the job site completely assembled and charged with refrigerant and ready for field knockdown. Contractor shall leak test, recover refrigerant, evacuate, and charge with refrigerant after reassembly.

– OR –

A. [For Type B Knockdowns] The compressor, suction and discharge piping, VFD power panel and touch screen shall be removed and shipped separately. All wiring and piping shall remain attached where possible. The remaining loose parts shall be packaged in a separate crate. The unit is to be factory tested and shipped with an inert gas holding charge, evaporator insulated and a kit for compressor insulation. Contractor shall leak test, evacuate and charge with refrigerant after reassembly.

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

1.6 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, 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, charged, and tested water-cooled packaged centrifugal chiller. Chillers shall have no more than two oil-free, magnetic bearing, semi-hermetic centrifugal compressors (no exceptions). [For TMC models] Provide and install as shown on the plans factory assembled, factory charged, magnetic bearing compressor water heater in the quantity specified. Chillers shall have no more than two oil-free, magnetic bearing, semi-hermetic centrifugal compressors with heat recovery capability.

B. 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.

2.3 DESIGN REQUIREMENTS

A. General: Provide a complete water-cooled, semi-hermetic oil-free centrifugal compressor water chiller or heater 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 [with water heaters for TMC models], refrigerant, condenser and evaporator, and control systems including integrated variable frequency drive, operating controls and equipment protection controls. Chillers shall be charged with R-134a or R-513A refrigerant. If manufacturer offers a chiller using any HCFC refrigerant, manufacturer shall provide, in writing, documentation signed by an officer of the company assuring refrigerant availability and price schedule for a 20-year period.

B. 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. A complete purge system capable of removing non-condensables and moisture during operation and shut-down.
2. A 20-year purge maintenance agreement that provides parts, labor, and all preventative maintenance required by the manufacturer's operating and maintenance instructions.
3. The manufacturer shall also include at no charge for a period of 20 years an annual 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 refrigerant must be replaced or returned to the manufacturer's original specification at no cost to the owner.
4. 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.

C. Performance: Refer to chiller performance rating.

A. 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
63	125	250	500	1000	2000	4000	8000	

2.4 CHILLER COMPONENTS

A. Compressors:

1. The unit shall utilize magnetic bearing, oil-free, semi-hermetic centrifugal compressors [with water heater for TMC models]. The compressor drive train shall be capable of coming to a controlled, safe stop in the event of a power failure.
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 designed for variable frequency drive operation.
   a. If the compressor design requires a shaft seal to contain the refrigerant, the manufacturer shall supply a 20 year parts and labor warranty on the shaft seal and a lifetime refrigerant replacement warranty if a seal failure leads to refrigerant loss, or the chiller manufacturer shall assume all costs to supply and install a self contained air conditioning system in the mechanical space sized to handle the maximum heat output of 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.
   b. If the compressor/motor uses any form of anti-friction bearing (roller, ball, etc), the chiller manufacturer shall provide the following at no additional charge:
      - A 20-year bearing warranty and all preventative maintenance as specified by the manufacturer's published maintenance instructions.
      - At start up, a three-axis vibration analysis and written report to establish bearing condition baseline.
      - An annual three-axis vibration analysis and written report indicating bearing condition.
3. The chiller shall be equipped with an air-cooled or integrated refrigerant-cooled Variable Frequency Drive to automatically regulate compressor speed in response to cooling load and the compressor pressure lift requirement. If a condenser water-cooled VFD is supplied, the manufacturer shall supply factory installed dual water filters with a bypass valve and pressure differential switch factory wired to the chiller control panel to indicate that a filter has clogged and requires service. The pressure differential switch shall also provide a separate dry contact which can be connected to the BAS system as a means of notifying operating personnel of the need to service the filters. If the condenser cooling circuit includes an intermediate heat exchanger, it must be of the brush cleanable shell and tube style. Brazed plate heat exchangers which cannot be field cleaned are not acceptable. Movable inlet guide vanes and variable compressor speed, shall provide unloading. The chiller controls shall coordinate compressor speed and guide vane position to optimize

chiller efficiency.

4. [OPTIONAL] The chiller shall be equipped with a factory-mounted and wired passive harmonic filter guaranteed to meet the IEEE Standard 519 at an Isc/IL ratio greater than 20.

B. Evaporator and Condenser:

1. 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. The tubes shall be individually replaceable and secured to the intermediate supports without rolling.
2. The evaporator shall be flooded type with [0.025 in.] –OR– [0.028 in.] –OR– [0.035 in.] wall [copper] –OR– [90/10 CuNi] tubes rolled into [carbon steel] –OR– [ceramic-coated steel] tubesheets. The water side shall be designed for a minimum of [150 psig] –OR– [300 psig]. The heads shall be [carbon steel] –OR– [epoxy-coated steel] –OR– [Monel-clad] –OR– [Stainless Steel]. Water connections shall be grooved suitable for [grooved couplings] –OR– [flanged connections]. The evaporator shall have [dished heads with valved drain and vent connections] –OR– [shall be equipped with marine waterboxes 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.
3. The condenser shall have [0.025 in.] –OR– [0.028 in.] –OR– [0.035 in.] wall [copper] –OR– [90/10 CuNi] –OR– [70/30 CuNi] –OR– [stainless steel] –OR– [titanium] tubes rolled into [carbon steel] –OR– [Monel-clad] –OR– [stainless steel clad] –OR– [titanium-clad] – OR– [ceramic-coated] tube sheets. Water connections shall be [grooved suitable for grooved couplings]— OR– [flanged]. The water side shall be designed for a minimum of [150 psig] –OR– [300 psig]. The condenser shall have [dished heads with valved drain and vent connections] –OR– [shall be equipped with marine waterboxes with removable covers and vent and drain connections]. The condenser shall have [right-hand]

–OR– [left-hand] connections when looking at the unit control panel.

4. Provide sufficient isolation valves and condenser volume to hold the full unit refrigerant charge in the condenser during servicing or provide a separate pumpout system and storage tank sufficient to hold the charge of the largest unit being furnished.
5. 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.
6. 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.
7. [OPTIONAL] The evaporator shall be insulated with [3/4 in.] OR [1.5 in.] thick CFC and HCFC-free closed-cell flexible elastomeric foam insulation material with 100% adhesive coverage. The insulation shall have an additional outer protective layer of 3mm thick PE embossed film to provide superior damage resistance. Insulation without the protective outer film shall not be acceptable. UV resistance level shall meet or exceed a rating of 'Good' in accordance with the UNI ISO 4892 - 2/94 testing method.
8. [OPTIONAL] The evaporator waterbox 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.
9. Provide factory-mounted and wired, thermal-dispersion water flow switches on each vessel to prevent unit operation with no or low water flow.

C. Vibration Isolation

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

D. Power Connections

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

E. Chiller Control

1. The unit shall have a microprocessor-based control system consisting of a 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 and condenser water temperatures
   - Evaporator and condenser saturated refrigerant pressures
   - 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
   - Evaporator water in and out temperatures,

refrigerant pressure and temperature
- Condenser water in and out temperatures, refrigerant pressure and temperature
- 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. 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 and downloadable.
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 sequencing up to four other similar chillers for WMC models. The contractor shall furnish and wire network isolators for n-1 units.
8. The chiller shall be capable of 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 drive.
9. [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)
10. 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.
11. For chillers communicating over a LonMark® network, the corresponding LonMark® eXternal Interface File (XIF) shall be provided with the chiller submittal data.
12. 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.
13. [OPTIONAL] The chiller shall be equipped with the capability to restart and reach full load quickly in the event of a power interruption. The compressor shall be capable of restarting within 43 seconds after power is restored and shall reach 80% load within 120 seconds. Chillers not able to restart or load within this time frame shall include a properly sized thermal storage tank to maintain temperature stability in the system.

2.5. OPTIONAL ITEMS

A. 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. Non-witness performance test (water only) in accordance with procedures and to the tolerances contained in AHRI Standard 550/590.

– OR –

Witness performance test (water only) in accordance with procedures and to the tolerances contained in AHRI Standard 550/590.

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.

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.

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