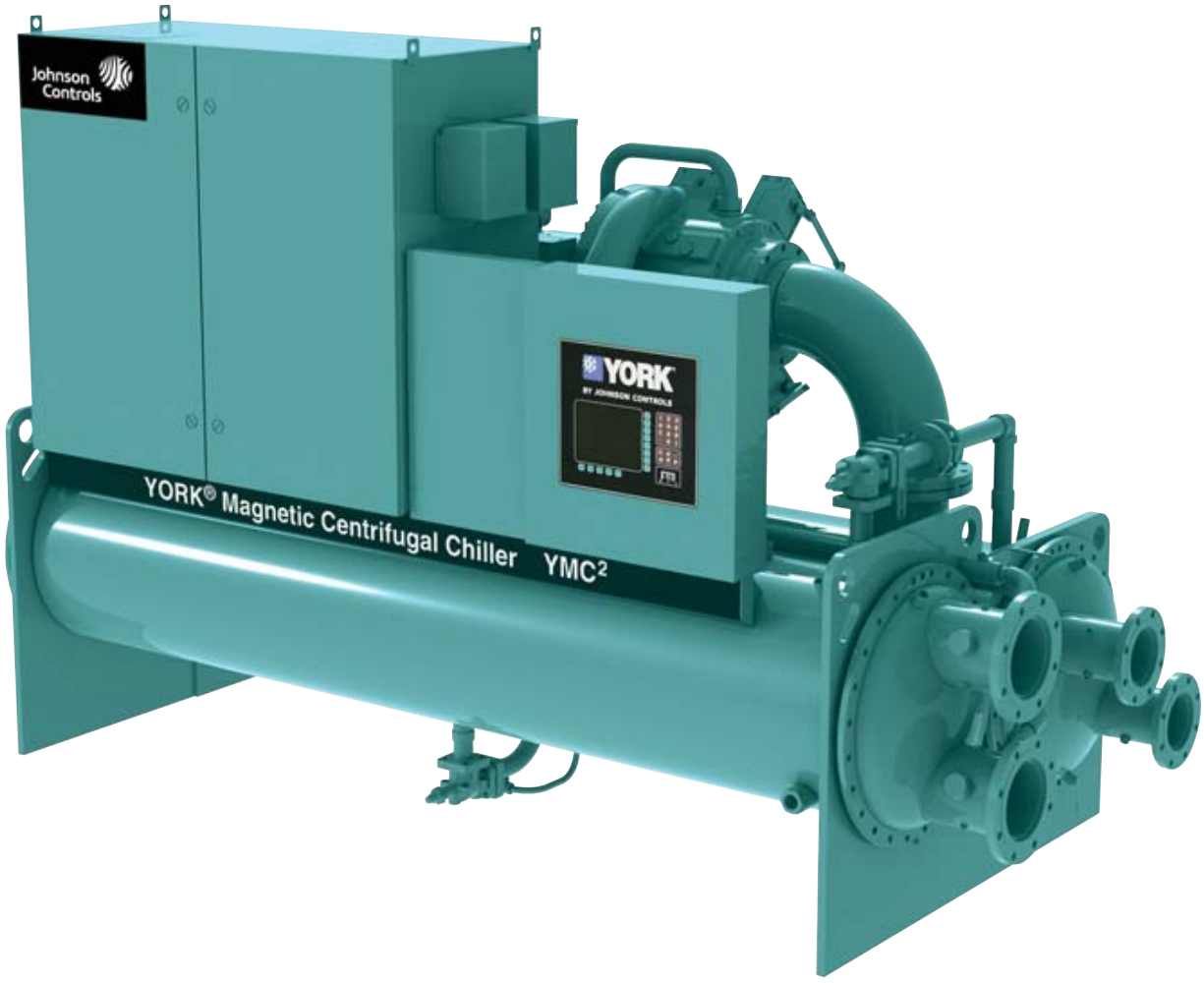
YMC² - ALL MODELS

ENGINEERING GUIDE	Revision 0	Form 160.78-EG1.EN.CE/PED (1010)

MAGNETIC BEARING CENTRIFUGAL LIQUID CHILLERS
STYLE A
(735 - 1350 KW)



R134a

YORK BY JOHNSON CONTROLS

Johnson Controls

CONTENTS

INTRODUCTION

The YORK® YMC²™ offers a full package of features for total owner satisfaction.

EFFICIENCY

- Lower energy costs achieved with up to 10% better efficiency than existing designs at both at full and part load conditions.
- Space saving design takes up less space in the machine room.
- Accurate performance by our best-in-class Johnson Controls intuitive chiller control and seamless BAS integration.

SUSTAINABILITY

- Lower direct and indirect environmental impact through:
  - Reduced total energy consumption.
  - A leak-free design using environmentally friendly HFC R-134a .
  - 30% lower refrigerant charge than traditional systems available in the market.
  - Elimination of oil from the system by use of the magnetic bearings system.

QUIET OPERATION

- The quietest performance available in the market made possible, in part, through the use of YORK OptiSound™ Control and the employment of magnetic bearing technology.
- Quiet throughout its wide operating range (capacity and lift) with magnetic bearing technology.

RELIABILITY

- High uptime operation with fewer parts.
- Using proven magnetic driveline technology that has been incorporated in YORK chiller designs for more than 10 years.
- Field Serviceability and fully trained service support.

EFFICIENCY

Matched Components Maximize Efficiency

Actual chiller efficiency cannot be determined by analysing the theoretical efficiency of any one chiller component. It requires a specific combination of heat exchanger, compressor, and motor performance to achieve the lowest system kW. YORK YMC² technology matches chiller system components to provide maximum chiller efficiency under actual – not just theoretical – operating conditions. YORK YMC² lower energy costs achieved with up to 10% better efficiency than existing designs at both at full and part load conditions.

Real-World Energy Performance

Johnson Controls pioneered the term "Real-World Energy" to illustrate the energy-saving potential of focusing on chiller performance during off-design conditions. Off-design conditions are not only seen at part load, but at full load operation as well, by taking advantage of reduced entering condenser water temperatures (ECWTs). This is where chillers operate 99% of the time, and where operating costs add up. YORK YMC² are the only chillers designed to operate on a continuous basis with cold ECWT and full condenser flow at all load points, taking full advantage of Real-World conditions. This type of operation benefits the cooling tower as well; reducing cycling of the fan motor and ensuring good coverage of the cooling fill. YORK YMC² chillers offer the most efficient Real-World operation of any chiller, meaning lower operating costs and an excellent return on chiller investment.

Efficiency Proven in the Most Demanding Applications

YORK single-stage compressors reduce energy costs. High strength aluminium-alloy compressor impellers feature backward-curved vanes for high efficiency.

Airfoil shaped pre-rotation vanes minimize flow disruption for the most efficient part load performance. Precisely positioned, they allow the compressor to unload smoothly from 100% to minimum load for excellent operation in air conditioning applications.

Space Saving Design Takes Up Less Space in the Machine Room

The YORK YMC² heat exchangers offer the latest technology such as falling film in addition to the latest technology in heat transfer surface design to give maximum efficiency, reduced refrigerant charge, and a compact design. The largest unit has only a 4.27m heat exchanger length.

Accurate Performance By an Intuitive OPTIVIEW™ Control Centre and Seamless BAS Integration

The YORK OptiView Control Centre, furnished as standard on each chiller, provides the ultimate in efficiency, monitoring, data recording, chiller protection and operating ease. The OptiView Control Centre is a factory-mounted, wired and tested state-of-the-art microprocessor based control system for HFC R-134a centrifugal chillers.

Setpoints can be changed from a remote location via 0-10VDC, 4-20mA, contact closures or through serial communications. The adjustable remote reset range (up to 11.1°C) provides flexible, efficient use of remote signal depending on reset needs. Serial data interface to the Building Automation System (BAS) is through the optional factory mounted E-Link installed inside the Control Centre.

SUSTAINABILITY

Lower Direct and Indirect Environmental Impact.

98% of the Global Warming Potential (GWP) of a centrifugal chiller is from the indirect effect – the greenhouse gases produced to produce the electricity to run the chiller. 2% of the GWP is from the direct effect or release of the refrigerant gases into the atmosphere.

The YORK YMC^2 chiller and its superior efficiency levels reduce the indirect effect

To address the direct effect, the YORK YMC^2, first reduces the chances for refrigerant leaks by dramatically reducing the number of connections, down 57% compared to traditional chiller designs. Falling film evaporator technology reduces the overall refrigerant charge by 30% and improves the efficiency of the evaporator. Finally, by eliminating the lubrication system, the YMC^2 avoids the environmental issues of handling and disposal of refrigerant saturated oil. This enables the YORK YMC^2 to yield a positive environment result.

Environmentally Friendly HFC R-134a

The YORK YMC^2 chiller employs one the most environmentally friendly refrigerants available, HFC R-134a, with no Ozone Depletion Potential and no phase out date per the Montreal Protocol.

Environmental Heat Exchangers Technology

The heat exchangers utilized on the YORK YMC^2 introduce a proprietary falling film evaporator design that helps not only operate more efficiently, but also allows reduction of refrigerant charges by up to 30% beyond conventional chiller designs.

Elimination of Lubrication System and Oil Management Hardware

To ensure maximum efficiency, the YORK YMC^2 utilizes a hermetically sealed permanent magnet motor. The compressor is directly driven by the motor, eliminating any losses from using gears for power transmission. Active magnetic bearings are used to support the motor shaft allowing this chiller series to be completely OIL FREE with no oil management system required.

QUIET OPERATION

OPTISOUND™ CONTROL

YORK YMC^2 chillers are equipped with YORK OptiSound Control as standard. OptiSound Control is a patented combination of centrifugal-chiller hardware and software that reduces operational sound levels, expands the chiller operating range, and improves chiller performance. The OptiSound™ Control feature continuously monitors the characteristics of the compressor-discharge gas and optimizes the diffuser spacing to minimize gas-flow disruptions from the impeller. It can also reduce part-load sound levels below the full-load level

Quiet Operating Range with Magnetic Bearing Technology

A permanent-magnet motor and active magnetic-bearing technology eliminate the friction losses associated with oil-lubricated bearings and also eliminate driveline sound.

RELIABILITY

Single-Stage Compressor Design for Highest Uptime Operation with Fewer Parts

YMC^2 YORK Magnetic Bearing centrifugal compressors are based on a successful line of efficient YORK single-stage compressors. With fewer moving parts and straightforward design, YORK single-stage compressors have proven durability in numerous applications especially applications where minimal downtime is a critical concern.

OPTISPEED™ Variable Speed Drive (VSD) Technology to delivery Low Harmonics and Flexible Power Input

The YORK YMC^2 chiller will always be driven by a Johnson Controls OptiSpeed Variable Speed Drive (VSD) to ensure optimal Real-World performance especially at part load conditions. Beyond chiller efficiency there are several distinct advantages with the OptiSpeed Variable Speed Drive (VSD). First, the OptiSpeed is equipped with a standard, factory packaged, IEEE-519 harmonic filter to ensure the % current Total Harmonic Distortion (THD) is kept below 5% and that a chiller power factor of at least 0.97 is maintained. Second, to ensure equipment safety and longevity the YMC^2 is equipped with the option of either a circuit breaker of a disconnect switch. Third, a number of voltage options are available to serve our global customers: 400V and 415V (50Hz).

Factory Packing Reduces Field Labour Costs and Increase Reliability

YORK YMC^2 chillers are designed to keep installation costs low. Where installation access is not a problem, the unit can be shipped completely packaged including the unit mounted OptiSpeed™ Variable Speed Drive (VSD), requiring minimal piping and wiring to complete the installation.

Using Proven Magnetic Driveline Technology That Has Been Incorporated in YORK Chiller Designs for More Than 10 years

The majority of chiller components on the YMC^2 have been time tested in the tens of thousands of YK chillers operating globally. YORK YMC^2 chillers employ the most advanced drive available - an active magnetic-bearing drive - to levitate the driveshaft in mid-air. The result is frictionless operation and fewer moving parts subject to breakdown. This magnetic drive system has been used in our military-grade chillers since 1999.

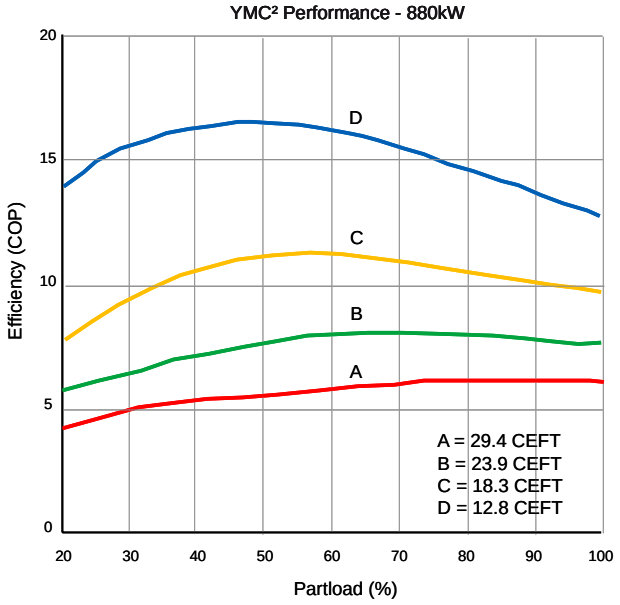
Field Serviceability and Fully Trained Service Support

YORK YMC^2 chillers incorporate service design principles that are consistent with Model YK Centrifugal Chillers. The chiller, and specifically the driveline, is field serviceable by a single source supplier.

RATINGS

COLDER COOLING TOWER WATER TEMPERATURES

The YORK YMC² chillers have been designed to take full advantage of colder cooling tower water temperatures, which are naturally available during most operating hours. Considerable energy savings are available by letting tower water temperature drop, rather than artificially holding it above 24°C, especially at low load, as some chillers require.



SPECIFICATION

YMC² chillers are designed within EN ISO 9001 and built within an EN ISO 9002 accredited manufacturing organisation.

Chillers conform with the following European Directives:

- Machinery directive (2006/42/EC)
- EMC Directive (2004/108/EC)
- Pressure Equipment Directive (97/23/EC)
- Safety Code for Mechanical Refrigeration (EN378-2 (2008))

Fluorinated Greenhouse Gases

- This equipment contains fluorinated greenhouse gases covered by the Kyoto Protocol.
- The global warming potential of the refrigerant (R134a) used in this unit is 1300.
- The refrigerant quantity is stated in the Weights table in this document.
- The fluorinated greenhouse gases in this equipment may not be vented to the atmosphere.
- This equipment should only be serviced by qualified technicians.

COMPUTERIZED PERFORMANCE RATINGS

Each chiller is custom-matched to meet the individual building load and energy requirements. A variety of standard heat exchangers and pass arrangements are available to provide the best possible match.

It is not practical to provide tabulated performance for each combination, as the energy requirements at both full and part load vary significantly with each heat exchanger and pass arrangement. Computerized ratings are available through each Johnson Controls sales office. These ratings can be tailored to specific job requirements.

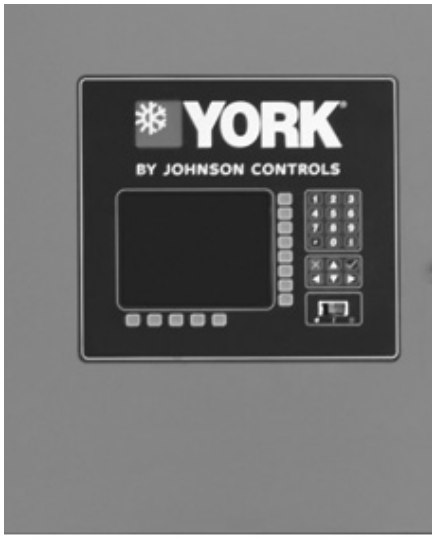
OFF-DESIGN PERFORMANCE

Since the vast majority of its operating hours are spent at off-design conditions, a chiller should be chosen not only to meet the full load design, but also for its ability to perform efficiently at lower loads and lower tower water temperatures. It is not uncommon for chillers with the same full load kW to have an operating cost difference of over 10% due to part-load operation.

Part load information can be easily and accurately generated by use of the computer. And because it is so important to an owner's operating budget, this information has now been standardized.

A more detailed analysis must take into account actual building load profiles, and local weather data. Part load performance data should be obtained for each job using its own design criteria.

OPTIVIEW CONTROL CENTRE



The YORK OptiView Control Centre, furnished as standard on each chiller, provides the ultimate in efficiency, monitoring, data recording, chiller protection and operating ease. The OptiView Control Centre is a factory-mounted, wired and tested state-of-the-art microprocessor based control system for HFC R-134a centrifugal chillers. The panel is configured with a 10.4-in. (264 mm) diagonal colour Liquid Crystal Display (LCD) surrounded by "soft" keys, which are redefined with one keystroke based on the screen displayed at that time. This revolutionary development makes chiller operation quicker and easier than ever before. Instead of requiring keystroke after keystroke to hunt for information on a small monochrome LCD screen, a single button reveals a wide array of information on a large, full-colour illustration of the appropriate component, which makes information easier to interpret. This is all mounted in the middle of a keypad interface and installed in a locked enclosure.

The LCD display allows graphic animated display of the chiller sub-systems and system parameters; this allows the presentation of several operating parameters at once. In addition, the operator may view a graphical representation of the historical operation of the chiller as well as the present operation. A Status Bar is displayed at all times on all screens. It contains the System - Status Line and Details Line, the Control Source, Access Level, Time and Date.

The locations of various chiller parameters are clearly marked and instructions for specific operations are provided for on many of the screens. The panel verbiage is available in eight languages and can be changed on the fly without having to turn off the chiller. Data can be displayed in either Imperical or Metric units plus keypad entry of setpoints to 0.1 increments.

Security access is provided to prevent unauthorized changes of setpoints. This is accomplished with three different levels of access and passwords for each level. There are certain screens, displayed values, programmable setpoints and manual controls not shown that are for servicing the chiller. They are only displayed when logged in at service access level. Included in this is the Advanced Diagnostics and troubleshooting information for the chiller and the panel.

The panel is fused through a 1-1/2 or 2 KVA transformer in the compressor motor starter to provide individual over-current protected power for all controls. Numbered terminal strips for wiring such as Remote Start/Stop, Flow Switches, Chilled Water Pump and Local or Remote Cycling devices are provided. The Panel also provides field interlocks that indicate the chiller status. These contacts include a Remote Mode Ready-to-Start, a Cycling Shutdown, a Safety Shutdown and a chiller Run contact. Pressure transducers sense system pressures and thermistors sense system temperatures. The output of each transducer is a DC voltage that is analogous to the pressure input. The output of each thermistor is a DC voltage that is analogous to the temperature it is sensing.

Setpoints can be changed from a remote location via 0-10VDC, 4-20mA, contact closures or through serial communications. The adjustable remote reset range [up to 11.1°C] provides flexible, efficient use of remote signal depending on reset needs. Serial data interface to the Building Automation System (BAS) is through the optional factory mounted E-Link installed inside the Control Centre

The operating program is stored in non-volatile memory (EPROM) to eliminate chiller failure due to AC power failure/battery discharge. Programmed setpoints are retained in lithium battery-backed RTC memory for 10 years minimum.

Smart Freeze Point Protection will run the chiller at 2.2°C leaving chilled water temperature, and not permit nuisance trips on Low Water Temperature. The sophisticated program and sensor will monitor the chiller water temperature to prevent freeze up. Every programmable point has a pop-up screen with the allowable ranges, so that the chiller can not be programmed to operate outside of its design limits.

When the power is applied to the chiller, the **HOME** screen is displayed. This screen displays a visual representation of the chiller and a collection of data detailing important operations and parameters. When the chiller is running the flow of chilled liquid is animated by the alternating shades of colour moving in and out of the pipe nozzles. The primary values that need to be monitored and controlled are shown on this screen.

With the "soft" keys the operator is only one touch away from the 8 main screens that allows access to the major information and components of the chiller. The 8 screens are the SYSTEM, EVAPORATOR, CONDENSER, COMPRESSOR, CAPACITY CONTROL, MOTOR, SETPOINTS and the HISTORY. Also on the Home screen is the ability to Run/Stop the unit, Log IN, Log Out and Print. Log In and Log Out is the means by which different security levels are accessed.

The **SYSTEM** screen gives a general overview of common chiller parameters for both shells. This is an end view of the chiller with a 3D cutaway of both the shells.

The **EVAPORATOR** screen displays a cutaway view of the chiller evaporator. All setpoints relating to the evaporator side of the chiller are maintained on this screen. Animation of the evaporation process indicates whether the chiller is presently in RUN condition (bubbling) and liquid flow in the pipes is indicated by alternating shades of colour moving in and out of the pipes. Adjustable limits on the low water temperature setpoints allow the chiller to cycle on and off

for greater efficiency and less chiller cycling. The chiller cycles off when the leaving chilled water temperature is below setpoint and is adjustable from 0.55°C below to a minimum of 2.2°C. Restart is adjustable from setpoint up to a max of 44.4°C. The panel will check for flow to avoid freeze up of the tubes. If flow is interrupted shutdown will occur after a minimum of two seconds.

The **CONDENSER** screen displays a cutaway view of the chiller condenser. The liquid flow is animated to indicate flow through the condenser. All setpoints relating to the condenser side of the chiller are maintained on this screen. With the proper access level, this screen also serves as a gateway to controlling the Refrigerant Level.

The **COMPRESSOR** screen displays a cutaway view of the compressor, this reveals the impeller and shows all the conditions associated with the compressor. When the compressor impeller is spinning this indicates that the chiller is presently in RUN condition. With the proper access level, the pre-rotation vanes may be manually controlled. This screen also serves as a gateway to sub-screens for calibrating the pre-rotation vanes, configuring the Hot Gas Bypass, or providing advanced control of the Magnetic Bearing Controller (MBC) and the OptiSpeed Variable Speed Drive (VSD).

The **MOTOR** screen displays a view of the OptiSpeed Variable Speed Drive (VSD) and includes a programmable pulldown demand to automatically limit motor loading for minimizing building demand charges. Pulldown time period control over four hours, and verification of time remaining in pulldown cycle from display readout. Separate digital setpoint for current limiting between 30 and 100%.

The **MOTOR DETAILS** screen displays additional motor winding temperature information.

The **CAPACITY CONTROL** screen displays all of the data and settings relating to top level capacity control. From this screen you can view and adjust readings and setpoints relating to temperature control, override limits, anti-surge control, Pre-Rotation Vanes, Hot Gas By-Pass, and the OptiSpeed Variable Speed Drive (VSD). With proper access these setpoints can be adjusted and the manual control screen can be accessed.

The **OPTISPEED VARIABLE SPEED DRIVE (VSD)** screen displays a picture of the OptiSpeed and displays VSD data.

The **SETPOINTS** screen provides a convenient location for programming the most common setpoints involved in the chiller control. The Setpoints are shown on other individual screens but to cut down on needless searching they are on this one screen. This screen also serves as a gateway to a subscreen for defining the setup of general system parameters. From this screen you can perform the following:

The **SETUP** is the top level of the general configuration parameters. It allows programming of the time and date, along with specifications as to how the time will be displayed. In addition, the chiller configuration as determined by the microboard program jumpers and program switches is displayed.

The following 6 sub-screens can be accessed from the setup screen:

The **SCHEDULE** screen contains more programmable values than a normal display screen. Each programmable value is not linked to a specific button; instead the select key is used to enable the cursor arrows and check key to program the Start/Stop times for any day of the week up to 6 weeks in advance. The user has the ability to define a standard set of Start/Stop times that are utilized every week or specify exceptions to create a special week.

The **USER** screen allows definition of the language for the chiller to display and defines the unit of measure.

The **COMMS** screen allows definition of the necessary communications parameters.

The **PRINTER** screen allows definition of the necessary communications Parameters for the printer.

The **SALES ORDER** screen allows definition of the order parameters.

Note: This information is loaded at the factory or by the installation/ service technician.

The **OPERATIONS** screen allows definition of parameters related to the operation of the chiller. What is defined is whether the control of the chiller will be Local, Digital Remote, Analog Remote, Modem Remote or Metasys™ Remote.

The **HISTORY** screen allows the user to browse through the last ten faults; either safety or cycling shutdowns with the conditions while the chiller is running or stopped. The faults are colour coded for ease in determining the severity at a glance, recording the date, time and description.

By pressing the **VIEW DETAILS** key you will move to the **HISTORY DETAILS** screen. From these screens you are able to see an on-screen printout of all the system parameters at the time of the selected shutdown.

Also under the History screen is the **TRENDING** screen, accessible by the key marked the same. On this screen up to 6 operator-selected parameters selected from a list of over 140, can be plotted in an X/Y graph format. The graph can be customized to record points once every second up to once every hour. There are two types of charts that can be created: a single or continuous screen. The single screen collects data for one screen width (450 data points across the x-axis) then stops. The continuous screen keeps collecting the data but the oldest data drops off the graph from left to right at the next data collection interval. For ease of identification, each plotted parameter, title and associated Y- axis labelling is colour coordinated.

The **TREND SETUP** screen is used to configure the trending screen. The parameters to be trended are selected from the Trend Common Slots Screen accessed from the Slot #s button or the Master Slot Numbers List found in the operating manual. The interval at which all the parameters are sampled is selected under the Collection Interval button.

The data point min. and max. values may be adjusted closer within the range to increase viewing resolution.

The **TREND COMMON SLOTS** screen displays the Master Slot Numbers List of the monitored parameters.

DISPLAY MESSAGES

The OptiView Control Centre continually monitors the operating system displaying and recording the cause of any shutdowns (Safety, Cycling or Normal). The condition of the chiller is displayed at the System Status line that contains a message describing the operating state of the chiller; whether it is stopped, running, starting or shutting down. A System Details line displays Warning, Cycling, Safety, Start Inhibit and other messages that provide further details of Status Bar messages. Messages are color-coded: Green – Normal Operations, Yellow - Warnings, Orange – Cycling Shutdowns, and Red – Safety Shutdowns to aid in identifying problems quickly.

OPTISPEED VARIABLE SPEED DRIVE (VSD)

The new YORK OptiSpeed Variable Speed Drive (VSD) is a liquid cooled, insulated gate bipolar transistor (IGBT)-based, pulse width modulated (PWM) rectifier/inverter in a highly integrated package. This package is small enough to mount directly onto the chiller. The power section of the drive is composed of four major blocks: a three-phase AC-to-DC rectifier section with an integrated input filter and pre-charge circuit, a DC link filter section, a three phase DC to AC inverter section, and an output sine filter network.

An input disconnect device connects the AC line to an input filter and then to the AC-to-DC three-phase PWM rectifier. The disconnect device can be a three-phase rotary disconnect switch (standard offering), or an electronic circuit breaker (optional offering). The inductors in the input filter shall limit the amount of fault current into the VSD; however, for the additional protection of the PWM rectifier's IGBT transistors, semiconductor fuses are provided between the input disconnect device and input filter. The three-phase PWM rectifier uses IGBT transistors, mounted on a liquid-cooled heatsink and controlled at a high frequency, to convert AC line voltage into a tightly regulated DC voltage. Additionally, the PWM rectifier shapes the line current into an almost-sinusoidal waveform, allowing every YMC^2 VSD to comply with the harmonic distortion requirements of the IEEE Std 519 - 1992, "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems". The PWM rectifier also contains the proprietary precharge circuit, which keeps the inrush current into the VSD at a minimal value, well below the nominal.

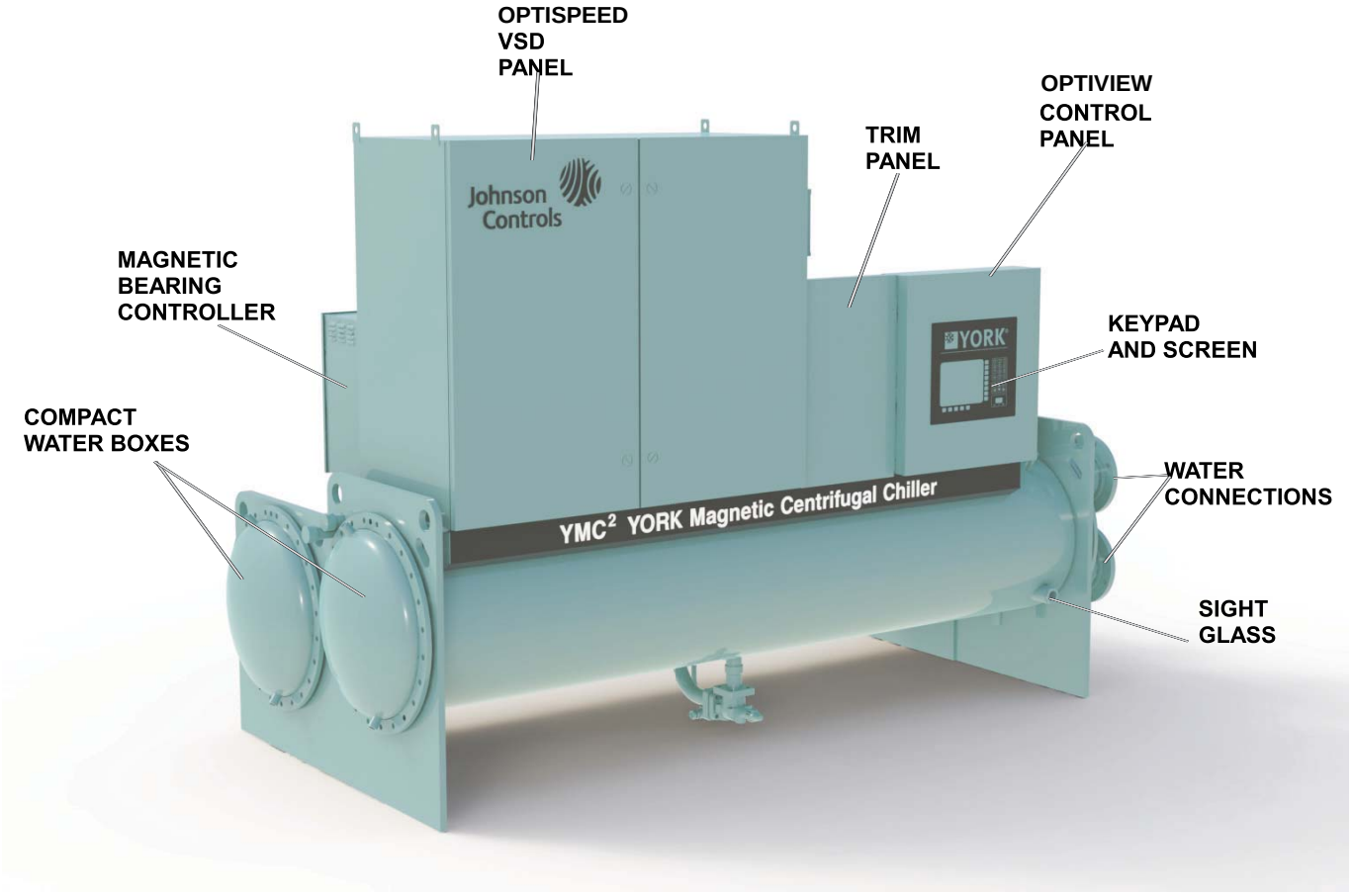
The DC Link filter section of the drive consists of one basic component, a bank of filter capacitors. The capacitors provide an energy reservoir for use by the DC to AC inverter section of the OptiSpeed. The capacitors are contained in the OptiSpeed Power Pole, as are the "bleeder" resistors, which provide a discharge path for the stored energy in the capacitors.

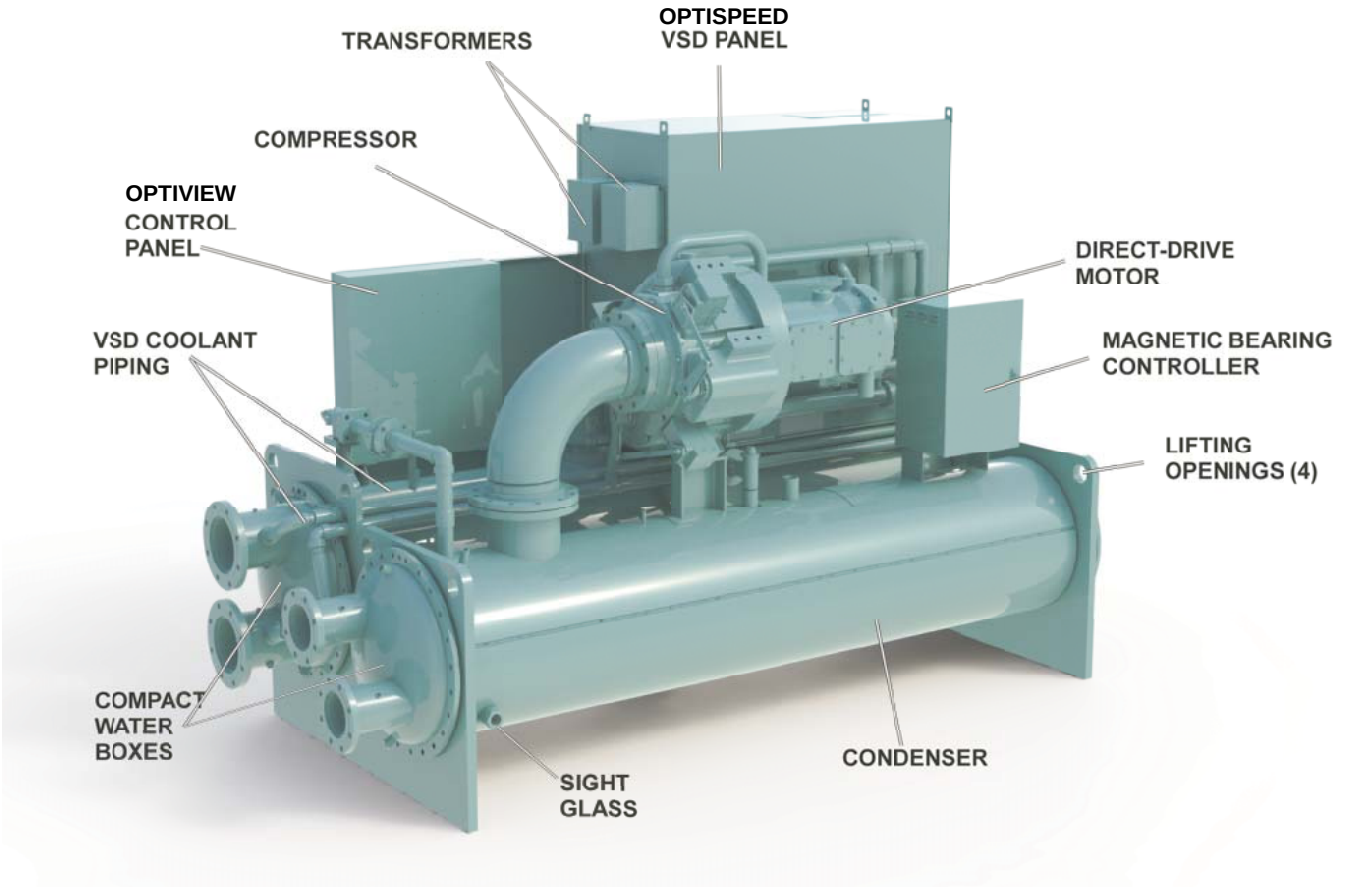
The DC to AC PWM inverter section of the OptiSpeed serves to convert the DC voltage to AC voltage at the proper magnitude and frequency as commanded by the OptiSpeed Logic board. The inverter section consists of fast switching IGBT transistors mounted on a liquid cooled heatsink. The inverter IGBT modules (with heatsink), the rectifier IGBT modules (with heatsink), the DC link filter capacitor, the "bleeder" resistors, the laminated interconnecting busbar, and the OptiSpeed Gate Driver board form the OptiSpeed Power Pole. The OptiSpeed Gate Driver board provides the turn-on, and turn-off commands to the rectifier's and inverter's transistors. The OptiSpeed Logic board determines when the turn-on, and turn-off commands should occur. Additionally, the OptiSpeed logic board monitors the status of the OptiSpeed VSD system, generates all OptiSpeed system faults (including the ground fault), and communicates with OptiView control panel.

The OptiSpeed output sine filter network is composed of inductors and capacitors. The job of the output filter network is to eliminate voltage harmonics from the inverter's output, and provide a high-quality, almost-sinusoidal voltage to the motor. This completely eliminates all issues related to premature motor insulation failures due to high voltage peaks generated by the inverter, and it additionally allows the motor to run cooler, thus increasing system reliability.

Other sensors and boards are used to provide safe operation of the OptiSpeed Compressor Drive. The IGBT transistor modules have thermistors mounted on them that provide information to the OptiSpeed logic board. These sensors, as well as additional thermistors monitoring the internal ambient temperature, protect the OptiSpeed from over-temperature conditions. A voltage sensor is used to ensure that the DC link filter capacitors are properly charged. Three input and three output current transformers protect the drive and motor from over current conditions.

UNIT COMPONENTS





MECHANICAL SPECIFICATIONS

GENERAL

YORK YMC² Centrifugal Liquid Chillers are completely factory-packaged including the evaporator, condenser, compressor, motor, Variable Speed Drive (VSD), control centre, and all interconnecting unit piping and wiring.

The initial charge of refrigerant is supplied for each chiller. When the optional condenser isolation valves are ordered, most units may ship fully charged with refrigerant. Actual shipping procedures will depend on a number of project-specific details.

The services of a Johnson Controls factory-trained, field service representative are incurred to supervise or perform the final leak testing, charging, the initial start-up, and concurrent operator instructions.

COMPRESSOR

The compressor is a single-stage centrifugal type directly driven by a hermetically sealed high speed permanent magnet motor. A cast aluminium fully shrouded impeller is mounted directly to the motor shaft using a stretched tie-bolt. Impeller seals employ labyrinth geometry, sized to provide minimal thrust loading on the impeller throughout the operating range. The impeller is dynamically balanced and overspeed tested for smooth, vibration-free operation.

The cast iron compressor housings are designed for 16.2 barg working pressure and hydrostatically pressure tested at 24.4 barg.

CAPACITY CONTROL

Capacity control will be achieved by the combined use of variable speed control and pre-rotation vanes (PRV) to provide fully modulating control from maximum to minimum load. For normal air conditioning applications, the chiller can adjust capacity from 100% to 15% of design. For each condition the speed and the PRV position will be automatically optimized to maintain a constant leaving chilled liquid temperature.

PRV operation is by an external, electric actuator which automatically and precisely positions the rugged airfoil shaped, cast manganese-bronze vanes using solid vane linkages.

MOTOR

The compressor motor is a hermetically sealed, high-speed design with a permanent magnet rotor supported with active magnetic bearings. Each magnetic bearing cartridge includes both radial and thrust bearings. The bearing controls are based on successful products providing a completely oil-free operating system. The motor rotor and stator are cooled by a pressure driven refrigerant loop to maintain acceptable operating temperatures.

The active magnetic bearings are equipped with auto vibration reduction and balancing systems to ensure smooth and reliable operation. In the event of a power failure, the magnetic bearings will remain active throughout the compressor coast down using a reserve energy supply. Rolling element bearings are included as backup to the magnetic bearings and designed for emergency touch down situations.

The cast aluminium motor housing is designed for 16.2 barg working pressure and hydrostatically pressure tested at 24.4 barg.

OPTISOUND™ CONTROL

YORK YMC² chillers are equipped with YORK OptiSound™ Control as standard. The YORK OptiSound Control is a patented combination of centrifugal-chiller hardware and software that reduces operational sound levels, expands the chiller operating range, and improves chiller performance. The OptiSound Control feature continuously monitors the characteristics of the compressor-discharge gas and optimizes the diffuser spacing to minimize gas-flow disruptions from the impeller. This innovative technology improves operating sound levels of the chiller an average of 7 dBA, and up to 13 dBA on the largest models. It can also reduce part-load sound levels below the full-load level.

In addition, the OptiSound Control provides the benefit of an expanded operating range. It improves performance and reliability by minimizing diffuser-gas stall at off-design operation, particularly conditions of very low load combined with little or no condenser-water relief. The elimination of the gas-stall condition can also result in improved chiller efficiency at off design conditions.

OPTISPEED™ VARIABLE SPEED DRIVE (VSD)

A 415 V 3-phase 50 Hz or 400V 3-phase 50 Hz variable speed drive is factory-packaged and mounted on the YORK YMC² chiller. It is designed to vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The capacity control logic automatically adjusts motor speed and compressor pre-rotation vane position independently for maximum part load efficiency by analysing information fed to it by sensors located throughout the chiller.

The variable speed drive is mounted in an enclosure with all power and control wiring between the drive and chiller factory-installed. Electrical lugs for incoming power wiring are provided, and the entire chiller package is CE approved.

The variable speed drive provides automatic power-factor correction to 0.975 or better at all load conditions. Separate power-factor correction capacitors are not required.

Standard features include: a door interlocked padlockable disconnect switch or circuit breaker; Ground fault protection; over voltage and under-voltage protection; 3-phase sensing motor over-current protection; 3-phase sensing input over current protection; single-phase protection; insensitive to phase rotation; over-temperature protection; digital readout at the OptiView Control Centre of:

- Output Frequency
- Output Voltage
- 3-phase input current

- 3-phase output current
- Input kVA
- Input Power (kW)
- Kilowatt-Hours (kWH)
- Input Voltage Total harmonic Distortion (THD)
- Input Current Total Demand Distortion (TDD)
- Self diagnostic service parameters

HEAT EXCHANGERS

Shells

Evaporator and condenser shells are fabricated from rolled carbon steel plates with fusion welded seams or carbon steel pipe. Carbon steel tube sheets, drilled and reamed to accommodate the tubes, are welded to the end of each shell. Intermediate tube supports are fabricated from carbon steel plates, drilled and reamed to eliminate sharp edges, and spaced no more than four feet apart. The refrigerant side of each shell is designed, tested, and stamped in accordance with the Pressure Equipment Directive – or other local pressure vessel codes as appropriate.

Tubes

Heat exchanger tubes are state-of-the-art, high-efficiency, externally and internally enhanced type to provide optimum performance. Tubes in both the evaporator and condenser are 19 mm O.D. or 25.4 mm O.D. copper alloy and utilize the "skip-fin" design, providing a smooth internal and external surface at each intermediate tube support. This provides extra wall thickness (up to twice as thick) and non work-hardened copper at the support location, extending the life of the heat exchangers. Each tube is roller expanded into the tube sheets providing a leak-proof seal, and is individually replaceable.

Evaporator

The evaporator is a shell and tube, hybrid falling film type heat exchanger. It contains a balance of flooded and falling film technology to optimize efficiency, minimize refrigerant charge, and maintain reliable control. A specifically designed spray distributor provides uniform distribution of refrigerant over the entire shell length to yield optimum heat transfer. A suction baffle is located above the tube bundle to prevent liquid refrigerant carryover into the compressor. A 38 mm liquid level sight glass is conveniently located on the side of the shell to aid in determining proper refrigerant charge. The evaporator shell contains a dual refrigerant relief valve arrangement set at 16.2 barg or a single-relief valve arrangement, if the chiller is supplied with the optional refrigerant isolation valves. A 25.4 mm refrigerant charging valve is provided for service access.

Condenser

The condenser is a shell and tube type, with a discharge gas baffle to prevent direct high velocity impingement on the tubes. The baffle is also used to distribute the refrigerant gas flow properly for most efficient heat transfer. An integral sub-cooler is located at the bottom of the condenser shell providing highly effective liquid refrigerant subcooling to provide the highest cycle efficiency. The condenser contains dual refrigerant relief valves set at 16.2 barg.

Water Boxes

The removable water boxes are fabricated of steel. The design working pressure is 10.3 barg and the boxes are tested at 15.5 barg. Integral steel water baffles are located and welded within the water box to provide the required pass arrangements. Water nozzle connections with grooves are welded to the water boxes. These nozzle connections are suitable couplings, welding or flanges, and are capped for shipment. Plugged 19 mm drain and vent connections are provided in each water box.

REFRIGERANT ISOLATION VALVES

Factory-installed isolation valves in the compressor discharge line and refrigerant liquid line are provided as standard. This allows isolation and storage of the refrigerant charge in the chiller condenser during servicing, eliminating time-consuming transfers to remote storage vessels. Both valves are positive shut-off, assuring integrity of the storage system.

WATER FLOW SWITCHES

Thermal type water flow switches are factory mounted in the chilled and condenser water nozzles, and are factory wired to the OptiView control panel. These solid state flow sensors have a small internal heating-element. They use the cooling effect of the flowing fluid to sense when an adequate flow rate has been established. The sealed sensor probe is 316 stainless steel, which is suited to very high working pressures.

REFRIGERANT FLOW CONTROL

Refrigerant flow to the evaporator is controlled by the YORK variable orifice control system. Liquid refrigerant level is continuously monitored to provide optimum subcooler, condenser and evaporator performance. The variable orifice electronically adjusts to all Real-World operating conditions, providing the most efficient and reliable operation of refrigerant flow control.

OPTIVIEW CONTROL CENTRE

General

The chiller is controlled by a stand-alone microprocessor based control centre. The chiller control panel provides control of chiller operation and monitoring of chiller sensors, actuators, relays and switches.

Control Panel

The control panel includes a 264 mm diagonal colour liquid crystal display (LCD) surrounded by "soft" keys which are redefined based on the screen displayed at that time, mounted in the middle of a keypad interface and installed in a locked enclosure. The screen details all operations and parameters, using a graphical representation of the chiller and its major components. Panel verbiage is available in eight languages and can be changed on the fly without having to turn off the chiller. Data can be displayed in either Imperical or Metric units. Smart Freeze Point Protection will run the chiller at 2.2°C leaving chilled water temperature, and not have nuisance trips on low

water temperature. The sophisticated program and sensor monitors the chiller water temperature to prevent freeze-up. When needed, Hot Gas Bypass control is available as an option. The panel displays countdown timer messages so the operator knows when functions are starting and stopping. Every programmable point has a pop-up screen with the allowable ranges, so that the chiller cannot be programmed to operate outside of its design limits.

The chiller control panel also provides:

1. System operating information including:
    a. return and leaving chilled water temperature
    b. return and leaving condenser water temperature
    c. evaporator and condenser saturation pressure
    d. percent motor current
    e. evaporator and condenser saturation temperature
    f. compressor discharge temperature
    g. operating hours
    h. number of compressor starts
2. Digital programming of setpoints through the universal keypad including:
    a. leaving chilled water temperature
    b. percent current limit
    c. pull-down demand limiting
    d. six-week schedule for starting and stopping the chiller, pumps and tower
    e. remote reset temperature range
3. Status messages indicating:
    a. system ready to start
    b. system running
    c. system safety shutdown – manual restart
    d. system cycling shutdown – auto restart
    e. system soft shutdown – manual restart
    f. MBC Start-Up
    g. start inhibit
    h. system coastdown
4. The text displayed within the system status and system details field is displayed as a colour-coded message to indicate severity: red for safety fault, orange for cycling faults, yellow for warnings, and green for normal messages.
5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. See the Optiview control centre section for a list of safety shutdown messages.
6. Cycling shutdowns enunciated through the display and the status bar, and consists of system status, system details, day, time, cause of shutdown, and type of restart required. See the Optiview Control Centre section for a list of cycling shutdowns.
7. Security access to prevent unauthorized change of setpoints, to allow local or remote control of the chiller, and to allow manual operation of the pre-rotation vanes and oil pump. Access is through ID and password recognition, which is defined by three different levels of user competence: view, operator, and service.
8. Trending data with the ability to customize points of once every second to once every hour. The panel will trend up to 6 different parameters from a list of over 140, without the need of an external monitoring system.
9. The operating program stored in non-volatile memory (EPROM) to eliminate reprogramming the chiller due to AC power failure or battery discharge. Programmed setpoints are retained in lithium battery-backed RTC memory for a minimum of 10 years with power removed from the system.
10. A fused connection through a transformer in the compressor motor starter to provide individual over-current protected power for all controls.
11. A numbered terminal strip for all required field interlock wiring.
12. An RS-232 port to output all system operating data, shutdown/cycling message, and a record of the last 10 cycling or safety shutdowns to a field-supplied printer. Data logs to a printer at a set programmable interval. This data can be pre-programmed to print from 1 minute to 1 day.
13. The capability to interface with a building automation system via hard-wired connections to each feature to provide:
    a. remote chiller start and stop
    b. remote leaving chiller liquid temperature adjust
    c. remote current limit setpoint adjust
    d. remote ready to start contacts
    e. safety shutdown contacts
    f. cycling shutdown contacts
    g. run contacts

CODES AND STANDARDS

Chillers conform with the following European Directives:

- Machinery directive (2006/42/EC)
- EMC Directive (2004/108/EC)
- Pressure Equipment Directive (97/23/EC)
- Safety Code for Mechanical Refrigeration (EN378-2 (2008))

ISOLATION MOUNTING

The unit is provided with four vibration isolation mounts of nominal 1" operating height. The pads have a neoprene pad to contact the foundation, bonded to a steel plate. The vibration isolation pads assemblies mount under steel plates affixed to the chiller tube sheets.

REFRIGERANT CONTAINMENT

The standard unit has been designed as a complete and compact factory-packaged chiller. As such, it has minimum joints from which refrigerant can leak. The entire assembly has been thoroughly leak tested at the factory prior to shipment. The YORK YMC^2 chiller includes service valves conveniently located to facilitate transfer of refrigerant to a remote refrigerant storage/recycling system. Condenser isolation valves allow storage of the charge in the condenser.

PAINT

Exterior surfaces are protected with one coat of Caribbean blue, durable alkyd-modified, vinyl enamel, machinery paint.

SHIPMENT

Protective covering is furnished on the motor starter, Control Centre VSD and unit-mounted controls. Water nozzles are capped with fitted plastic enclosures. Entire unit is protected with industrial-grade, reinforced shrinkwrapped covering.

ACCESSORIES AND MODIFICATIONS

BAS REMOTE CONTROL

A communication interface permitting complete exchange of chiller data with any BAS System is available with an optional Metasys™ translator. The Metasys translator also allows BAS System to issue commands to the chiller to control its operation. Metasys translators come in two models, controlling up to 4 chillers and 8 chillers respectively.

FACTORY INSULATION OF EVAPORATOR

Factory-applied thermal insulation of the flexible, closed cell plastic type, 19 mm thick is attached with vapour-proof cement to the evaporator shell, flow chamber, tube sheets, suction connection, and (as necessary) to the auxiliary tubing. Not included is the insulation of compact water boxes and nozzles. This insulation will normally prevent condensation in environments with relative humidifies up to 75% and dry bulb temperatures ranging from 10° to 32.2°C. 38 mm thick insulation is also available for relative humidifies up to 90% and dry bulb temperatures ranging from 10° to 32.2°C.

WATER FLANGES

Raised-face flanges for condenser and evaporator water connections are factory-welded to water nozzles. Companion flanges, bolts, nuts and gaskets are not included.

SPRING ISOLATION MOUNTING

Spring isolation mounting is available instead of standard isolation mounting pads when desired. Four level-adjusting, spring-type vibration isolator assemblies with non skid pads are provided for field-installation. Isolators are designed for 25 mm deflection.

MARINE WATER BOXES

Marine water boxes allow service access for cleaning of the heat exchanger tubes without the need to break the water piping. Bolted-on covers are arranged for convenient access. Nozzle connections are standard; flanges are optional. Marine water boxes are available for condenser and/or evaporator.

APPLICATION DATA

The following discussion is a user's guide in the application and installation of YORK YMC^2 chillers to ensure the reliable, trouble-free life for which this equipment was designed. While this guide is directed towards normal, water-chilling applications, a Johnson Controls sales engineer can provide complete recommendations on other types of applications.

LOCATION

YORK YMC^2 chillers are virtually vibration free and may generally be located at any level in a building where the construction will support the total system operating weight.

The unit site must be a floor, mounting pad or foundation which is level within 6.4 mm and capable of supporting the operating weight of the unit.

Sufficient clearance to permit normal service and maintenance work should be provided all around and above the unit. Additional space should be provided at one end of the unit to permit cleaning of evaporator and condenser tubes as required. A doorway or other properly located opening may be used.

The chiller should be installed in an indoor location where temperatures range from 4.4°C to 40°C.

WATER CIRCUITS

Flow Rate – For normal water chilling duty, evaporator and condenser flow rates are permitted at water velocity levels in the heat exchangers tubes of between 0.91 m/s (1.0 m/s for condensers) and 3.66 m/s. Two pass units are also limited to 134 kPA water pressure drop. Three pass limit is 201 kPA.

Variable flow in the condenser is not recommended, as it generally raises the energy consumption of the system by keeping the condenser pressure high in the chiller. Additionally, the rate of fouling in the condenser will increase at lower water velocities associated with variable flow, raising system maintenance costs. Cooling towers typically have narrow ranges of operation with respect to flow rates, and will be more effective with full design flow. Ref. Table 1 for flow limits at design conditions.

There is increasing interest to use variable primary flow (VPF) systems in large chilled water plants. VPF systems can offer lower installation and operating costs in many cases, but do require more sophisticated control and flow monitoring.

YORK YMC^2 chillers will operate successfully in VPF systems. With a minimum allowable evaporator tube velocity of 0.5 m/s for standard tubes at part-load rating conditions, YMC^2 chillers will accommodate the wide variation in flow required by many chilled water VPF applications.

The chillers can tolerate a 50% flow rate change in one minute that is typically associated with the staging on or off of an additional chiller, however a lower flow rate change is normally used for better system stability and set point control. Proper sequencing via the building automation system will make this a very smooth transition.

Temperature Ranges – For normal water chilling duty, leaving chilled water temperatures may be selected between 3.3°C [2.2°C with Smart Freeze enabled] and 21.1°C for water temperature ranges between 1.7°C and 16.7°C.

Water Quality – The practical and economical application of liquid chillers requires that the quality of the water supply for the condenser and evaporator be analysed by a water treatment specialist. Water quality may affect the performance of any chiller through corrosion, deposition of heat-resistant scale, sedimentation or organic growth. These will degrade chiller performance and increase operating and maintenance costs. Normally, performance may be maintained by corrective water treatment and periodic cleaning of tubes. If water conditions exist which cannot be corrected by proper water treatment, it may be necessary to provide a larger allowance for fouling, and/or to specify special materials of construction.

General Piping – All chilled water and condenser water piping should be designed and installed in accordance with accepted piping practice. Chilled water and condenser water pumps should be located to discharge through the chiller to assure positive pressure and flow through the unit. Piping should include offsets to provide flexibility and should be arranged to prevent drainage of water from the evaporator and condenser when the pumps are shut off. Piping should be adequately supported and braced independently of the chiller to avoid the imposition of strain on chiller components. Hangers must allow for alignment of the pipe. Isolators in the piping and in the hangers are highly desirable in achieving sound and vibration control.

Convenience Considerations – To facilitate the performance of routine maintenance work, some or all of the following steps may be taken by the purchaser. Evaporator and condenser water boxes are equipped with plugged vent and drain connections. If desired, vent and drain valves may be installed with or without piping to an open drain. Pressure gauges with stop-cocks and stop-valves may be installed in the inlets and outlets of the condenser and chilled water line as close as possible to the chiller. An overhead monorail or beam may be used to facilitate servicing.

Connections – The standard chiller is designed for 10.3 barg design working pressure in both the chilled water and condenser water circuits. The connections (water nozzles) to these circuits are furnished with grooves for grooved and shouldered joints. Piping should be arranged for ease of disassembly at the unit for tube cleaning. All water piping should be thoroughly cleaned of all dirt and debris before final connections are made to the chiller.

WATER FLOW RATE LIMITS (l/s) — BASED UPON STANDARD TUBES @ DESIGN FULL LOAD CONDITIONS

MODEL	EVAPORATOR						MODEL	CONDENSER					
	1 PASS		2 PASS		3 PASS			1 PASS		2 PASS		3 PASS	
	MIN	MAX	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX	MIN	MAX
							CA2110-BS	30	109	15	54	10	36
							CA2110-CS	39	139	19	70	13	46
							CA2110-DS	43	155	21	77	14	52
							CA2110-ES	49	175	24	87		
							CA2110-2S	38	137	19	68	13	46
							CA2110-3S	53	190	26	95		
EA2510-BS	40	159	20	74	13	47	CA2510-BS	49	177	25	89	16	59
EA2510-CS	47	187	23	85	16	53	CA2510-CS	57	204	28	102	19	68
EA2510-2S	30	120	15	60	10	40	CA2510-DS	71	255	35	127	24	85
EA2510-3S	42	167	21	83	14	56	CA2510-ES	88	318	44	159		
							CA2510-2S	58	207	29	104	19	69
							CA2510-3S	83	300	42	150	28	100
EA2514-BS	40	159	20	63	13	40	CA2514-BS	49	177	25	81		
EA2514-CS	47	187	23	73	16	46	CA2514-CS	57	204	28	93	19	61
EA2514-2S	30	120	15	60	10	40	CA2514-DS	71	255	35	114	24	75
EA2514-3S	42	167	21	83	14	52	CA2514-ES	88	318	44	138		
							CA2514-2S	58	207	29	104	19	69
							CA2514-3S	83	300	42	150		

Chilled Water – A water strainer of maximum 3.2 mm perforated holes must be field-installed in the chilled water inlet line as close as possible to the chiller. If located close enough to the chiller, the chilled water pump may be protected by the same strainer. The strainer is important to protect the chiller from debris or objects which could block flow through individual heat exchanger tubes. A reduction in flow through tubes could seriously impair the chiller performance or even result in tube freeze-up. A thermal-type flow switch is factory installed in the evaporator nozzle and connected to the OptiView panel, which assures adequate chilled water flow during operation.

Condenser Water – The chiller is engineered for maximum efficiency at both design and part load operation by taking advantage of the colder cooling tower water temperatures which naturally occur during the winter months. Appreciable power savings are realized from these reduced heads.

The minimum entering condenser water temperature for other full and part load conditions is provided by the following equation:

$$\text{Min. ECWT} = \text{LCHWT} - \text{C RANGE} + 2.8°\text{C} + 6.6\left(\frac{\%\ \text{load}}{100}\right)$$

where:

ECWT = entering condensing water temperature LCHWT = leaving chilled water temperature

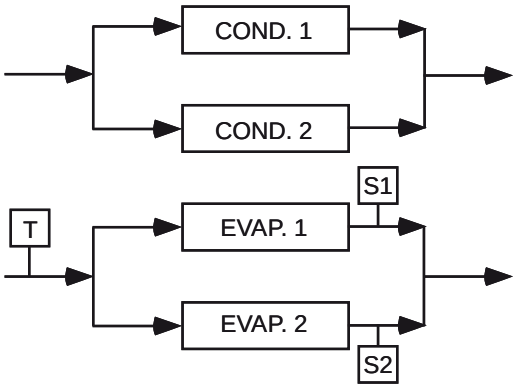
C RANGE = condensing water temperature range at the given load condition.

At initial startup, entering condensing water temperature may be as much as 13.9°C colder than the standby chilled water temperature.

MULTIPLE UNITS

Selection – Many applications require multiple units to meet the total capacity requirements as well as to provide flexibility and some degree of protection against equipment shutdown. There are several common unit arrangements for this type of application. The YORK YMC² chiller has been designed to be readily adapted to the requirements of these various arrangements.

Parallel Arrangement



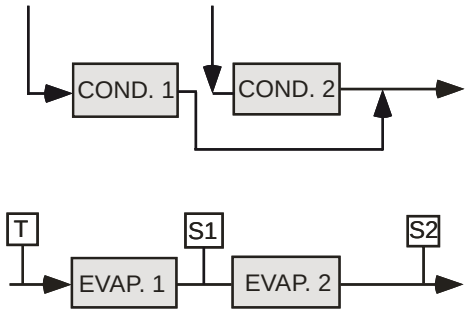
S – Temperature Sensor for Chiller Capacity Control

T – Thermostat for Chiller Capacity Control

Chillers may be applied in multiples with chilled and condenser water circuits connected in parallel between the units. Parallel chiller arrangements may consist of equally or unequally sized units. When multiple units are in operation, they will load and unload at equal percentages of design full load for the chiller.

Depending on the number of units and operating characteristics of the units, loading and unloading schemes should be designed to optimize the overall efficiency of the chiller plant. It is recommended to use an evaporator bypass piping arrangement to bypass fluid around evaporator of any unit which has cycled off at reduced load conditions. It is also recommended to alternate the chiller cycling order to equalize chiller starts and run hours.

Series Arrangement

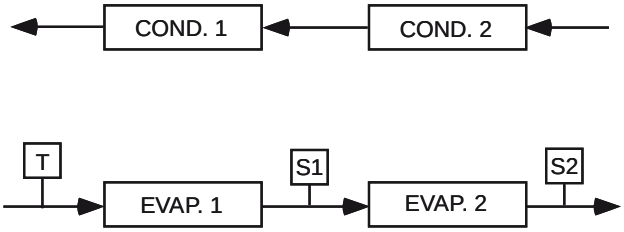


S – Temperature Sensor for Chiller Capacity Control

T – Thermostat for Chiller Capacity Control

Chillers may be applied in pairs with chilled water circuits connected in series and condenser water circuits connected in parallel. All of the chilled water flows through both evaporators with each unit handling approximately one-half of the total load. When the load decreases to a customer selected load value, one of the units will be shut down by a sequence control. Since all water is flowing through the operating unit, that unit will cool the water to the desired temperature.

Series Counter Flow Arrangement



Chillers may be applied in pairs with chilled water circuits connected in series and with the condenser water in series counter flow. All of the chilled water flows through both evaporators. All of the condenser water flows through both condensers. The water ranges are split, which allows a lower temperature difference or "head" on each chiller, than multiple units in parallel. For equal chillers, the machine at higher temperature level will typically provide slightly more than half the capacity. The compressor motors and gear codes on the two chillers are often matched, such that the high temperature machine can operate at the low temperature conditions when one unit is cycled off at part loads (as compared to series-parallel chillers which are typically not identical).

Series counter flow application can provide a significant building energy savings for large capacity plants which have chilled and condenser water temperature ranges greater than typical AHRI.

REFRIGERANT RELIEF PIPING

Each chiller is equipped with dual pressure relief valves on the condenser and two dual relief valves on the evaporator, or two single relief valves on the evaporator if the optional refrigerant isolation valves are ordered. The dual relief valves on the condenser are redundant and allow changing of either valve while the unit is fully charged. The purpose of the relief valves is to quickly relieve excess pressure of the refrigerant charge to the atmosphere, as a safety precaution in the event of an emergency such as fire. They are set to relieve at an internal pressure as noted on the pressure vessel data plate, and are provided in accordance with local applicable pressure vessel code.

Sized to the requirements of applicable codes, a vent line must run from the relief device to the outside of the building. This refrigerant relief piping must include a cleanable, vertical leg dirt trap to catch vent-stack condensation. Vent piping must be arranged to avoid imposing a strain on the relief connection and should include one flexible connection.

SOUND AND VIBRATION CONSIDERATIONS

A YORK YMC² chiller is not a source of objectionable sound and vibration in normal air conditioning applications. Optional neoprene isolation mounts are available with each unit to reduce vibration transmission. Optional level-adjusting spring isolator assemblies designed for 25 mm static deflection are also available for more isolation.

YORK YMC² sound pressure level ratings will be furnished

on request. Control of sound and vibration transmission must be taken into account in the equipment room construction as well as in the selection and installation of the equipment.

THERMAL INSULATION

No appreciable operating economy can be achieved by thermally insulating the chiller. However, the chiller's cold surfaces should be insulated with a vapour barrier insulation sufficient to prevent condensation. A chiller can be factory-insulated with 19 mm or 38 mm thick insulation, as an option. This insulation will normally prevent condensation in environments with dry bulb temperatures of 10°C to 32°C and relative humidities up to 75% (19 mm thickness) or 90% (38 mm thickness). The insulation is painted and the surface is flexible and reasonably resistant to wear. It is intended for a chiller installed indoors and, therefore, no protective covering of the insulation is usually required. If insulation is applied to the water boxes at the job site, it must be removable to permit access to the tubes for routine maintenance.

VENTILATION

Ventilation, in accordance with local codes, should be provided for machinery rooms containing refrigeration equipment. Since the YORK YMC^2 motor is hermetically sealed, no additional ventilation is needed due to motor heat.

A refrigerant vapour detector, in accordance with local codes, is to be employed for all refrigerants. It is to be located in an area where refrigerant from a leak would be likely to concentrate. An alarm is to be activated and the mechanical ventilation started at a value no greater than the TLV (Threshold Limit Value) of the refrigerant.

ELECTRICAL CONSIDERATIONS

Unit input conductor size must be in accordance with the local or other applicable codes, for the unit full load amperes (FLA). Refer to the submittal drawings for the FLA and Minimum Current.

Ampacity (MCA) specific to each application. Flexible conduit should be used for the last several feet to the chiller in order to provide vibration isolation. The table below lists the allowable variation in voltage supplied to the chiller. The unit nameplate is stamped with the unit voltage, and frequency.

FREQ.	RATED VOLTAGE	NAME-PLATE VOLTAGE	OPERATING VOLTAGE	
			MIN.	MAX.
50 HZ	400	380/400/415	342	423
	415	415	374	456

Starters – A separate starter is not required since the YORK YMC^2 chiller is equipped with a factory installed unit mounted Variable Speed Drive (VSD).

Controls – No field control wiring is required since the Optispeed Variable Speed Drive is factory installed as standard. The chiller including VSD is completely controlled by the control panel.

Copper Conductors – Only copper conductors should be connected to compressor motors and starters. Aluminium conductors have proven to be unsatisfactory when connected to copper lugs. Aluminium oxide and the difference in thermal conductivity between copper and aluminium cannot guarantee the required tight connection over a long period of time.

Power-factor Correction Capacitors – The YORK YMC^2 is equipped with a factory mounted Optispeed VSD providing automatic power-factor correction to a minimum of 0.97 at all operating conditions, so additional capacitors are not required.

Branch Circuit Overcurrent Protection – The branch circuit overcurrent protection device(s) should be a time-delay type, with a minimum rating equal to the next standard fuse/breaker rating above the calculated value. Refer to submittal drawings for the specific calculations for each application.

NOMENCLATURE

Unit Nomenclature

Position: 1,2,3,4 - 5 6,7,8,9 10 11	
YMC2	Chiller Model
S	Single Stage Compressor
# # # ##	Capacity in KW
A	Refrigerant HFC R-134a
A	Mod Level

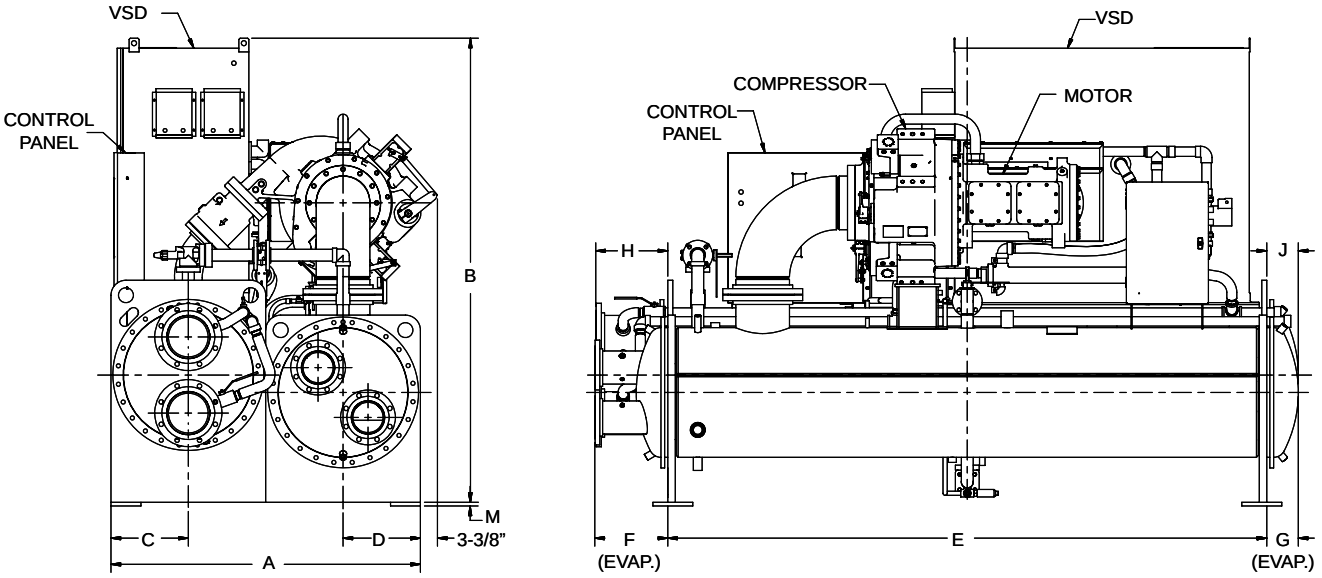
Compressor Nomenclature

Position: 1,2 3 - 4 5 6 7 8 9	
M1	Motor
A	Motor Revision Level
# # #	Impeller
F	Forward Rotation
A	Impeller Design Revision Level
A	Gas Path Revision Level

Heat Exchanger Nomenclature

Position: 1 2 3,4 5,6 - 7 8 9 - 10 11 12 - 13 14 15 16	
E	Evaporator
C	Condenser
A	Heat Exchanger Mod level
XX	Nominal Inside Diameter in inches
YY	Nominal Length in feet
# # #	Tube Number
B	3/4" Tube count code 1
C	3/4" Tube count code 2
D	3/4" Tube count code 3
E	3/4" Tube count code 4
2	1" Tube count code 1
3	1" Tube count code 2
4	1" Tube count code 3
5	1" Tube count code 4
S	Vessel Refrigerant Side Pressure Code, 235
1	Water Side Pressure Code, 150psi
3	Water Side Pressure Code, 300psi
#	Number of Passes
G	Water Connection Type, Grooved, Standard
F	Water Connection Type, Flanged
C	Water Box Type, Compact
M	Water Box Type, Marine
R	Inlet on Right (viewed from control panel)
L	Inlet on Left (viewed from control panel)

DIMENSIONS - UNIT



ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR	
TYPE OF CHILLER MOUNTING	M
NEOPRENE PAD ISOLATORS	45
SPRING ISOLATORS 1" DEFLECTION	25
DIRECT MOUNT	19

EVAPORATOR CODE	CONDENSER CODE	DIMENSIONS (MM)				
		A	B	C	D	E
EA2510	CA2110	1651	2235	394	394	3048
EA2510	CA2510	1651	2362	394	394	3048
EA2514	CA2514	1651	2362	394	394	4267

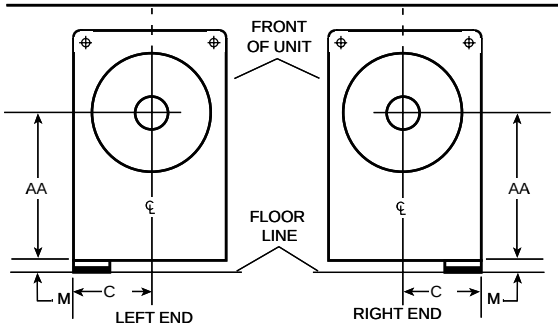
NOTES:

1. All dimensions are approximate. Certified dimensions are available on request.
2. For all water boxes (compact shown above), determine overall unit length by adding water box depth to tube sheet length.
3. Water nozzles can be located on either end of unit. Add 13 mm to nozzle length for flanged connections.
4. To determine overall height, add dimension "M" for the appropriate isolator type.
5. Use of motors with motor hoods may increase overall unit dimensions.

DIMENSIONS - EVAPORATOR NOZZLE ARRANGEMENTS (COMPACT WATER BOXES)

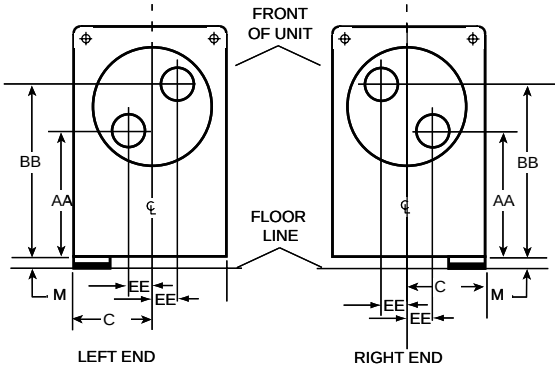
EVAPORATORS – COMPACT WATER BOXES

1-PASS



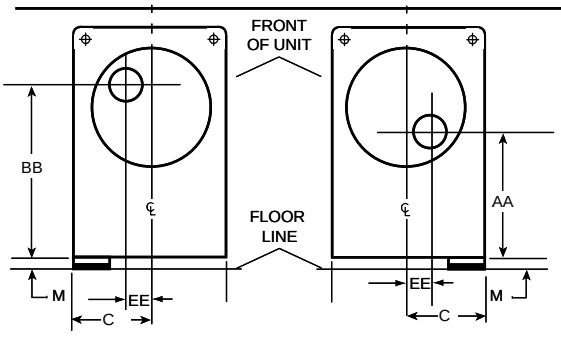
1-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
1	LEFT END	RIGHT END
	RIGHT END	LEFT END

2-PASS

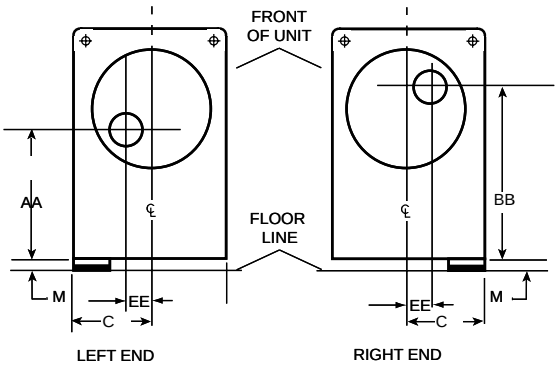


2-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
2	LOWER RIGHT END	UPPER RIGHT END
	LOWER LEFT END	UPPER LEFT END

3-PASS



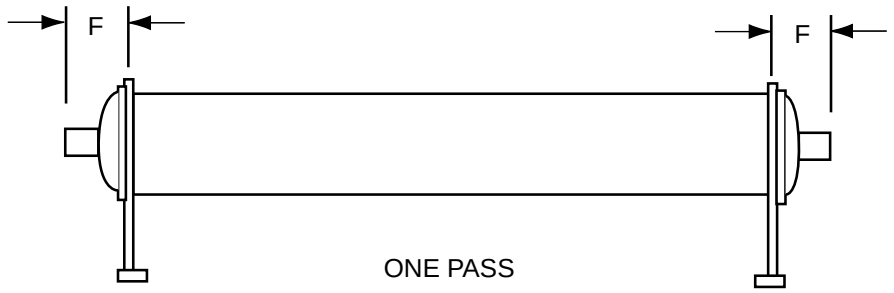
3-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
3	RIGHT END	LEFT END



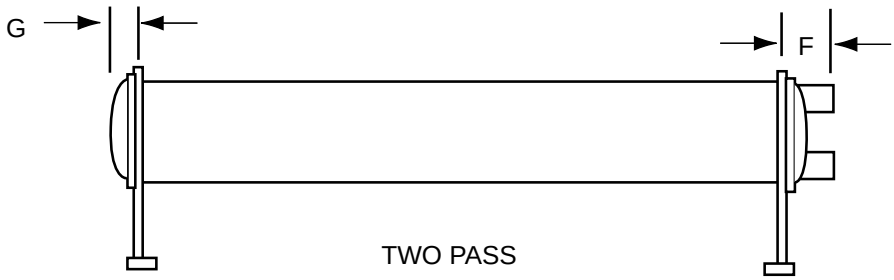
3-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
3	LEFT END	RIGHT END

COMPACT WATER BOXES-150 PSI											
EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE (IN)			EVAPORATOR NOZZLE DIMENSIONS (MM)							
	NO. OF PASSES			C	1-PASS	2-PASS			3-PASS		
	1	2	3		AA[5]	AA[5]	BB[5]	EE	AA[5]	BB[5]	EE
EA25	8	6	4	394	559	432	686	127	432	686	127

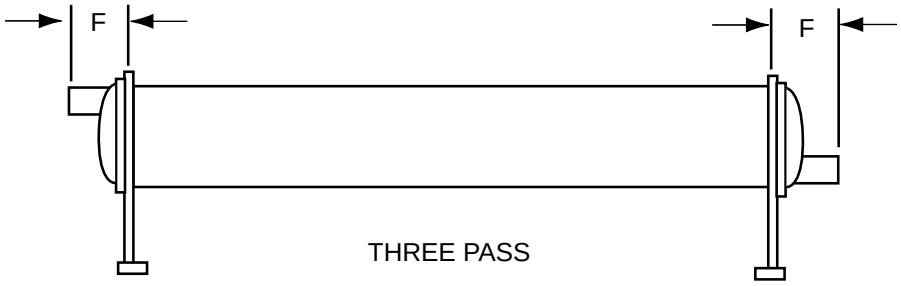
EVAPORATORS – COMPACT WATER BOXES



ONE PASS



TWO PASS



THREE PASS

EVAPORATOR SHELL CODE	DIMENSION (MM)	
	F	G
EA25	359	160

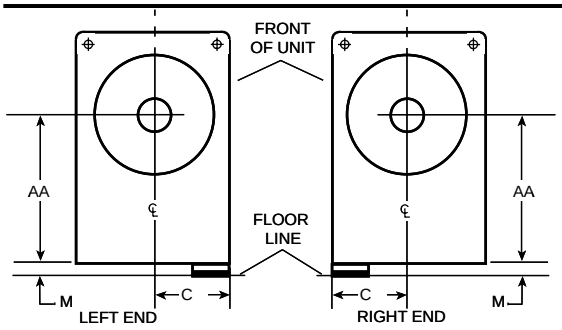
NOTES:

1. Standard water nozzles are furnished as welding stub-outs with ANSI/AWWA C-606 grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6mm raised face), water flanged nozzles are optional (add 13mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. One-, two- and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles.
3. Evaporator and condenser water must enter the water box through the bottom connection to achieve rated performance.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.
5. Add dimension "M" as shown on the unit dimensions page for the appropriate isolator type.
6. Standard 150 PSI (10.3 barg) design pressure boxes shown.

DIMENSIONS - CONDENSER NOZZLE ARRANGEMENTS (COMPACT WATER BOXES)

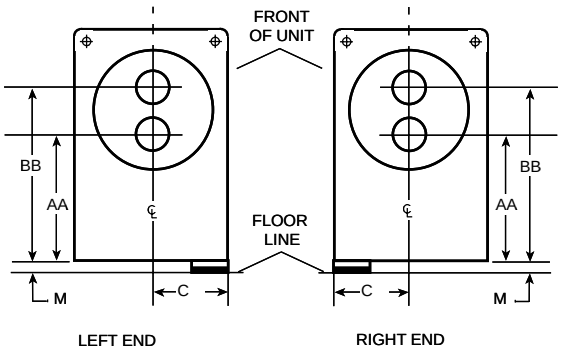
CONDENSERS – COMPACT WATER BOXES

1-PASS



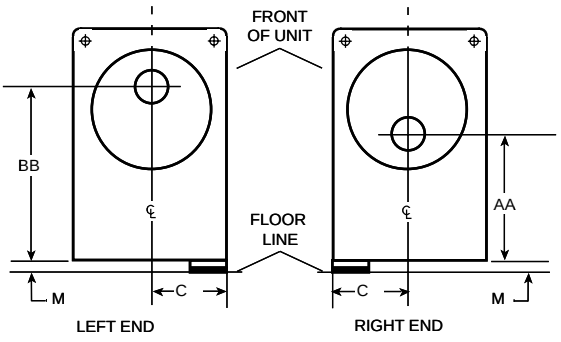
1-PASS NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
1	LEFT END	RIGHT END
	RIGHT END	LEFT END

2-PASS

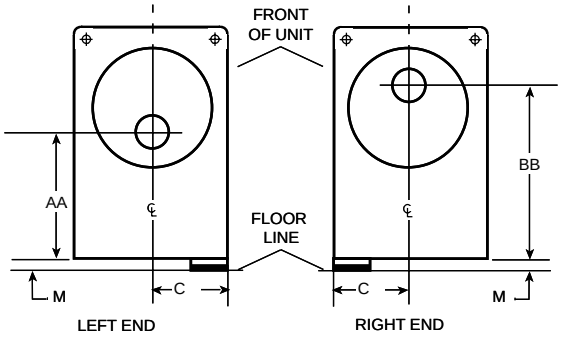


2-PASS NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
2	LOWER RIGHT END	UPPER RIGHT END
	LOWER LEFT END	UPPER LEFT END

3-PASS



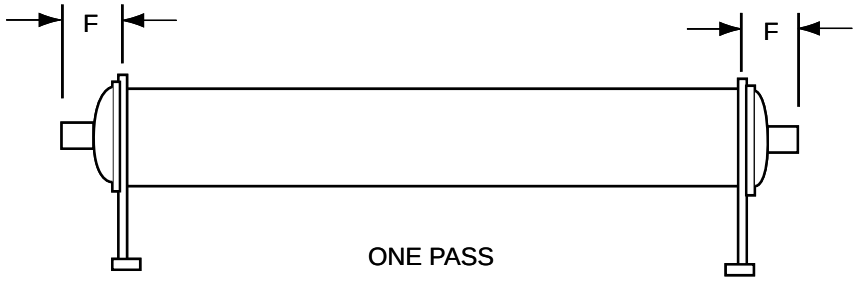
3-PASS NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
3	RIGHT END	LEFT END



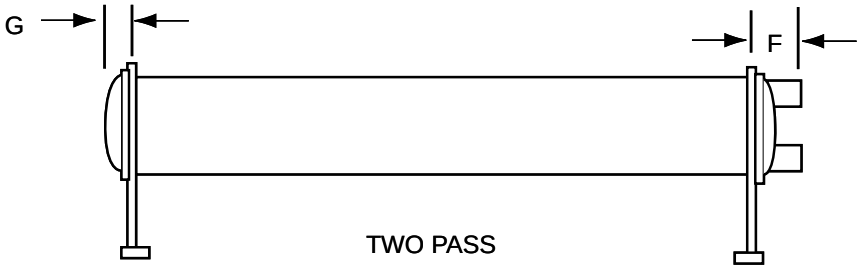
3-PASS NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
3	LEFT END	RIGHT END

COMPACT WATER BOXES-150 PSI									
CONDENSER SHELL CODE	NOZZLE PIPE SIZE (IN)			CONDENSER NOZZLE DIMENSIONS (MM)					
	NO. OF PASSES			C	1-PASS	2-PASS		3-PASS	
	1	2	3		AA[5]	AA[5]	BB[5]	AA[5]	BB[5]
CA21	10	6	6	394	597	432	762	432	762
CA25	12	8	6	394	648	454	841	454	841

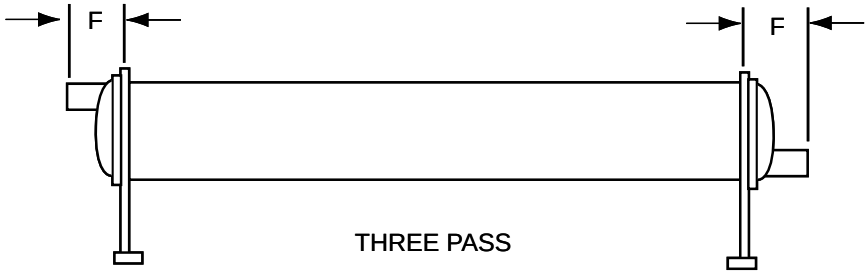
CONDENSERS – COMPACT WATER BOXES



ONE PASS



TWO PASS



THREE PASS

CONDENSER SHELL CODE	DIMENSION (MM)	
	H	J
CA21	349	148
CA25	349	160

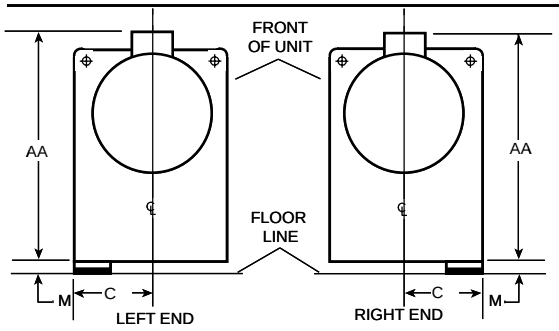
NOTES:

1. Standard water nozzles are furnished as welding stub-outs with ANSI/AWWA C-606 grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6mm raised face), water flanged nozzles are optional (add 13mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. One-, two- and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles.
3. Evaporator and condenser water must enter the water box through the bottom connection to achieve rated performance.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.
5. Add dimension "M" as shown on the unit dimensions page for the appropriate isolator type.
6. Standard 150 PSI design pressure boxes shown.

DIMENSIONS - EVAPORATOR NOZZLE ARRANGEMENTS (MARINE WATER BOXES)

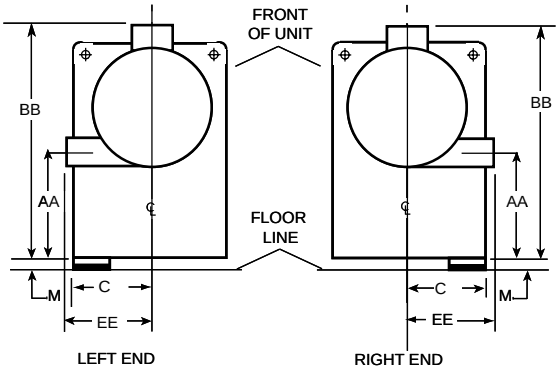
EVAPORATORS – MARINE WATER BOXES

1-PASS



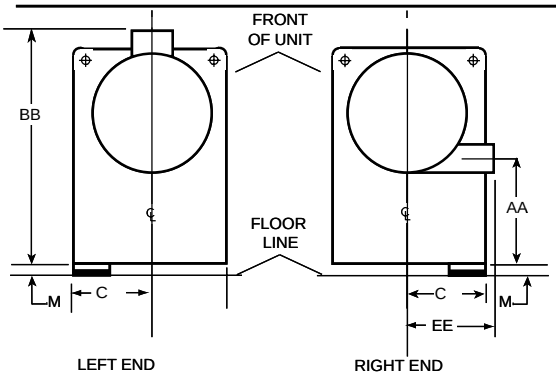
1-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
1	LEFT END	RIGHT END
	RIGHT END	LEFT END

2-PASS

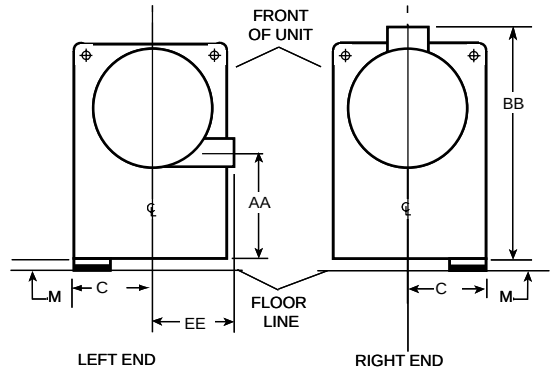


2-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
2	LOWER RIGHT END	UPPER RIGHT END
	LOWER LEFT END	UPPER LEFT END

3-PASS



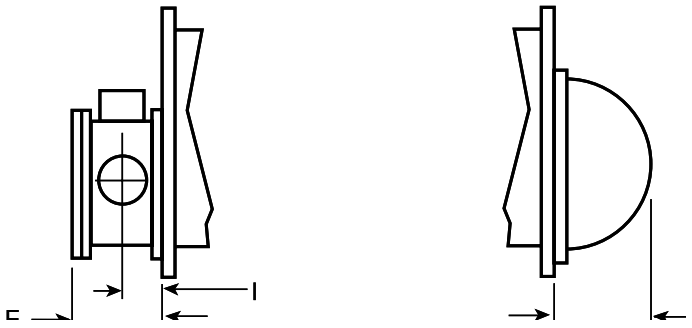
3-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
3	RIGHT END	LEFT END



3-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
3	LEFT END	RIGHT END

MARINE WATER BOXES-150 PSI												
EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE (IN)			EVAPORATOR NOZZLE DIMENSIONS (MM)								
	NO. OF PASSES			C	1-PASS	2-PASS			3-PASS			
	1	2	3		AA[5]	AA[5]	BB[5]	EE	AA[5]	BB[5]	EE	
EA25	8	6	4	394	1092	356	1092	445	356	1092	445	

EVAPORATORS – MARINE WATER BOXES



EVAPORATOR SHELL CODE	1-PASS		2-PASS			3-PASS	
	F	I	F	I	G	F	I
EA25	473	221	419	194	160	419	194

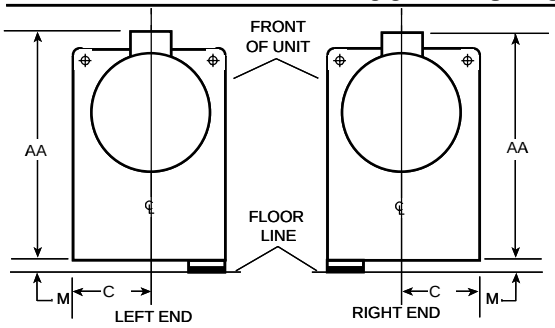
NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with ANSI/AWWA C-606 grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" as shown on the unit dimensions page for the appropriate isolator type.

DIMENSIONS - CONDENSER NOZZLE ARRANGEMENTS (MARINE WATER BOXES)

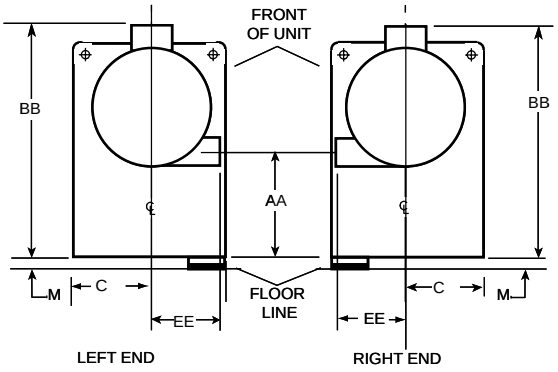
CONDENSERS – MARINE WATER BOXES

1-PASS



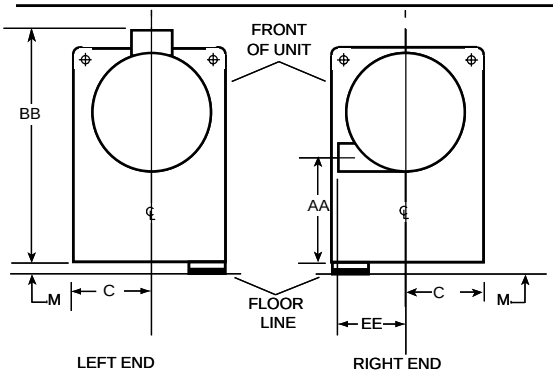
1-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
1	LEFT END	RIGHT END
	RIGHT END	LEFT END

2-PASS

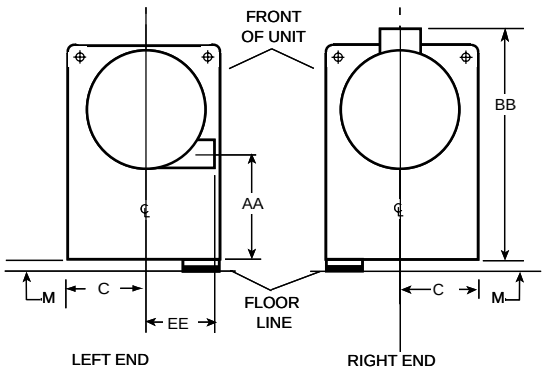


2-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
2	LOWER RIGHT END	UPPER RIGHT END
	LOWER LEFT END	UPPER LEFT END

3-PASS



3-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
3	RIGHT END	LEFT END

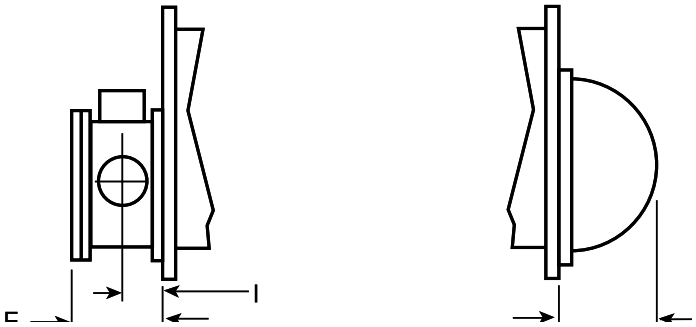


3-PASS		
NOZZLE ARRANGEMENTS		
NO. OF PASSES	CONDENSER	
	IN	OUT
3	LEFT END	RIGHT END

MARINE WATER BOXES-150 PSI

CONDENSER SHELL CODE	NOZZLE PIPE SIZE (IN)			CONDENSER NOZZLE DIMENSIONS (MM)							
	NO. OF PASSES			C	1-PASS	2-PASS			3-PASS		
	1	2	3		AA[5]	AA[5]	BB[5]	AA[5]	AA[5]	BB[5]	EE
CA21	10	6	6	394	1181	445	1181	419	445	1181	419
CA25	12	8	6	394	1232	445	1232	470	445	1232	470

CONDENSERS – MARINE WATER BOXES



CONDENSER SHELL CODE	1-PASS		2-PASS			3-PASS	
	F	I	F	I	G	F	I
CA21	522	248	418	195	148	418	195
CA25	591	279	486	227	160	418	227

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with ANSI/AWWA C-606 grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
5. Add dimension "M" as shown on the unit dimension page for the appropriate isolator type.

WEIGHTS

APPROXIMATE UNIT WEIGHT*(MAX TUBE COUNT USING COMPACT WATERBOXES)

COMPRESSOR	EVAPORATOR	CONDENSSER	SHIPPING WEIGHT (KG)	OPERATING WEIGHT (KG)	EST. REFRIGERANT CHARGE (KG) [1]
M1-197FAA	EA2510	CA2110	6315	6970	260
	EA2510	CA2510	6755	7605	285
	EA2514	CA2514	7855	8990	390
M2-205FAA	EA2510	CA2110	6435	7130	255
	EA2510	CA2510	6875	7735	280
	EA2514	CA2514	7865	9000	390

1. REFRIGERANT CHARGE QUANTITY AND WEIGHTS WILL VARY BASED ON TUBE COUNT.
* REFER TO PRODUCT DRAWINGS FOR DETAILED WEIGHT INFORMATION

EVAPORATOR MARINE WATER BOX WEIGHTS (ADD TO STANDARD UNIT WEIGHTS)

EVAPORATOR	SHIPPING WEIGHT INCREASE (KG)			OPERATING WEIGHT INCREASE (KG)		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
EA2510	320	170	335	545	255	515
EA2514	320	170	335	545	255	515

CONDENSER MARINE WATER BOX WEIGHTS (ADD TO STANDARD UNIT WEIGHTS)

CONDENSER	SHIPPING WEIGHT INCREASE (KG)			OPERATING WEIGHT INCREASE (KG)		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
CA2110	255	125	235	455	190	385
CA2510	365	185	370	660	325	635
CA2514	365	185	370	660	325	635

NOTES

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