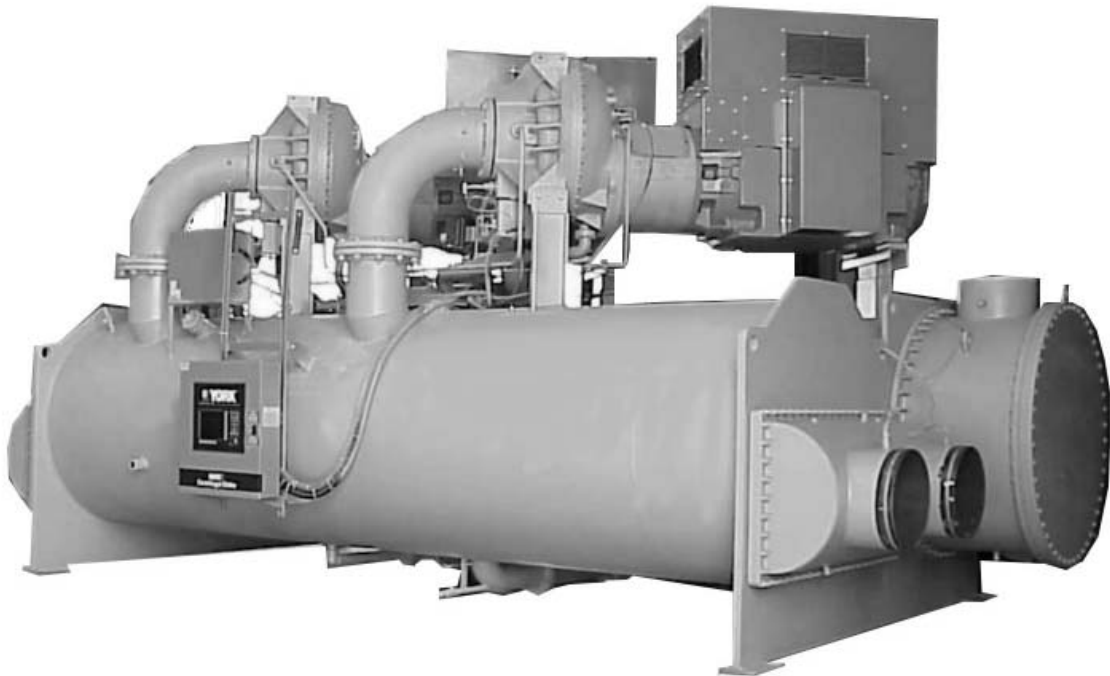




**YD Dual Centrifugal Compressor  
Liquid Chillers  
Design Level A**



**2001 THROUGH 4600 TONS  
(7035 through 16174 kW)  
Utilizing HFC-134a**

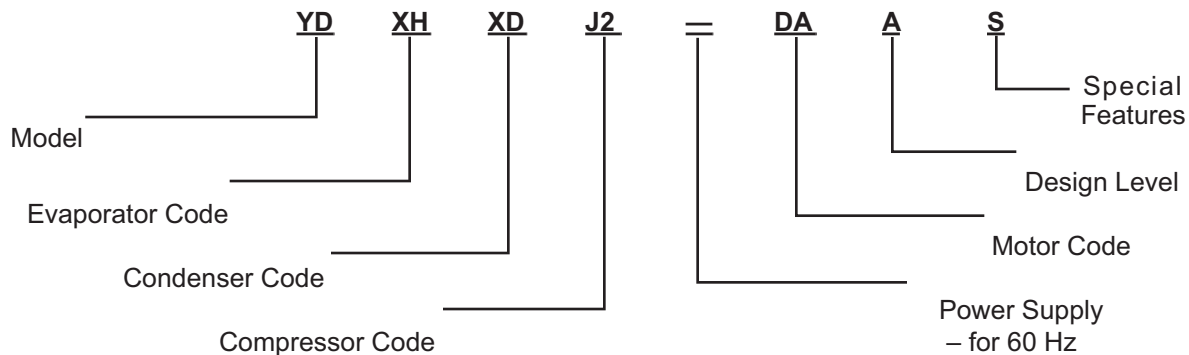


Metric Conversions

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## NOMENCLATURE



# Introduction

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The YORK **MaxE™** YD Chillers offer a complete combination of features for total owner satisfaction. The YD line of chillers utilize two York centrifugal compressors operating in parallel on a common set of heat exchanger shells to obtain large chiller capacities, and efficient part load operation.

## **MATCHED COMPONENTS MAXIMIZE EFFICIENCY**

Actual chiller efficiency cannot be determined by analyzing 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/ton. YORK **MaxE** chiller technology matches chiller system components to provide maximum chiller efficiency under actual – not just theoretical – operating conditions.

## **REAL-WORLD ENERGY PERFORMANCE**

YORK pioneered the concept of “Real-World Energy” to illustrate the energy-saving potential of focusing on chiller performance during off-design conditions. Off-design is not only part load, but full load operation as well, with reduced entering condenser water temperatures (ECWTs). This is where chillers operate 99% of the time, and where operating costs add up.

YORK **MaxE** chillers 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.

The YD dual compressor chiller provides further energy savings by running in single compressor mode at part loads of 50% and lower. The chiller operates more efficiently by running with a single, more fully loaded compressor. The two compressors share a common refrigerant circuit, thereby utilizing the full heat transfer surface available for part load single compressor operation.

YORK **MaxE** chillers offer the most efficient real-world operation of any chiller, meaning lower operating costs and an excellent return on your chiller investment.

## **OPEN DRIVE DESIGN**

Hermetic-motor burnout can cause catastrophic damage to a chiller. The entire chiller must be cleaned, and the refrigerant replaced. YORK **MaxE** centrifugal chillers eliminate this risk by utilizing air-cooled motors. Refrigerant never comes in contact with the motor, preventing contamination of the rest of the chiller.

Insurance companies that offer policies on large air conditioning equipment often consider air-cooled motors a significant advantage over hermetic refrigerant-cooled units.

The YD chiller uses two motors, each roughly half the size of a motor used on an equivalent size single compressor chiller. By staggering the start of these motors, the starting inrush current of each smaller motor is less. This provides a lower burden on the building electrical system. Also, the use of two smaller motors allows lower voltage compressor drive motors to be applied on larger chillers. This can be an advantage for applications where medium voltage power sources are not available.

## **HIGH-EFFICIENCY HEAT EXCHANGERS**

**MaxE** chiller heat exchangers offer the latest technology in heat transfer surface design to give you maximum efficiency and compact design. Water-side and refrigerant-side design enhancements minimize both energy consumption and tube fouling.

## **SINGLE-STAGE COMPRESSOR DESIGN AND EFFICIENCY PROVEN IN THE MOST DEMANDING APPLICATIONS**

Designed to be the most reliable chillers we've ever made, YORK **MaxE** centrifugal chillers incorporate a single-stage compressor design. With fewer moving parts and straightforward, efficient engineering, YORK single-stage compressors have proven durability records in hospitals, chemical plants, gas processing plants, the U.S. Navy, and in other applications where minimal downtime is a crucial concern.

In thousands of installations worldwide, YORK single-stage compressors are working to reduce energy costs. High strength aluminum-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 and tightly fitted, they allow the compressor to unload smoothly from 100% to minimum load for excellent operation in air conditioning applications.

## **PRECISION CONTROL OF COMPRESSOR OIL PRESSURE**

Utilizing our expertise in variable speed drive technology and applications, YORK has moved beyond the fixed head and bypass approach of oil pressure control. The old approach only assures oil pressure at the outlet of the pump rather than at the compressor, and allows no adjustment during chiller operation. The YD **MaxE** chillers feature two variable speed drive oil pumps, monitoring

# Introduction (continued)

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and providing the right amount of oil flow to each compressor on a continuous basis. This design also provides sophisticated electronic monitoring and protection of the oil pump electrical supply, ensuring long life and reliable operation of the oil pump motor. Variable speed drive technology reduces oil pump power consumption, running only at the speed required, rather than at full head with a pressure regulating bypass valve.

## **FACTORY PACKAGING REDUCES FIELD LABOR COSTS**

YORK MaxE centrifugal chillers are designed to keep installation costs low. The chillers are factory assembled, wired and given functional checks. Where installation access is not a problem, the J1 and J2 compressor size YD dual compressor chillers may be shipped completely packaged. In order to save on shipping and rigging costs, larger J3 to J5 compressor size units are disassembled to four major components: two drivelines, the evaporator and condenser. Piping break points are flanged, and wiring connections are simple plug connections to ensure a simple chiller commissioning process on site.

## **TAKE ADVANTAGE OF COLDER COOLING TOWER WATER TEMPERATURES**

YORK MaxE centrifugal 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 75°F (23.9°C), especially at low load, as some chillers require.

## **U.L. ACCEPTANCE – YOUR ASSURANCE OF RELIABILITY**

YORK MaxE centrifugal chillers are approved for listing by Underwriter's Laboratories for the United States and Canada. Recognition of safety and reliability is your assurance of trouble-free performance in day-to-day building operation.

## **COMPUTERIZED PERFORMANCE RATINGS**

Each chiller is custom-matched to meet the individual building load and energy requirements. Several standard heat exchanger tube bundle sizes 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 YORK sales office. These ratings can be tailored to specific job requirements.

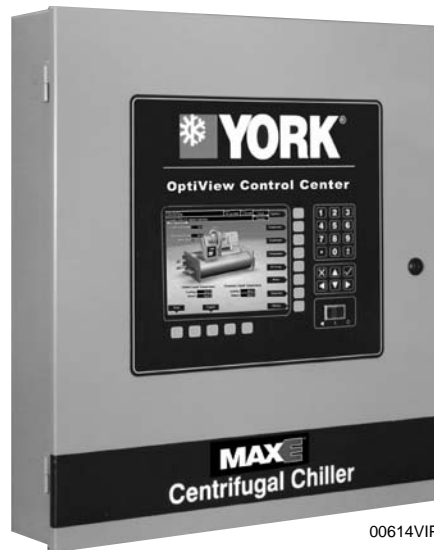
## **OFF-DESIGN PERFORMANCE**

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/ton 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 in the form of an Integrated Part Load Value (IPLV), and Non-Standard Part Load Value (NPLV).

The IPLV / NPLV formulas from ARI Standard 550/590 much more closely track actual chiller operations, and provide a more accurate indication of chiller performance than the previous IPLV/APLV formula. 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 Center



## YD OPTIVIEW CONTROL CENTER

The YORK OptiView Control Center, furnished as standard on each chiller, provides the ultimate in efficiency, monitoring, data recording, chiller protection and operating ease. The Control Center is a factory-mounted, wired and tested state-of-the-art microprocessor based control system for R134a centrifugal chillers. The panel is configured with a 10.4-in. (diagonal screen measure) color liquid crystal display (LCD) surrounded by “soft” keys. The functions of the soft keys are redefined depending upon what screen is displayed. 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-color illustration of the appropriate component, which makes information easier to interpret. This is all mounted in the middle of the keypad and installed in a locked enclosure.

The LCD display allows an animated graphic display of the chiller, 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.

During prelube and coastdown, the system status will include a countdown timer indicating the time remaining. The control panel is compatible with Electro-mechanical (E-M) starters or any customer supplied E-M starters that comply with the YORK R-1137 standard. The locations

of various chiller parameters are clearly marked and instructions for specific operations are provided for on many of the screens. Data can be displayed in either English or Metric units. Keypad entry of setpoints is 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 2 KVA transformer in the auxiliary variable speed oil pump panel to provide individual over-current protected power for all controls. Numbered terminal strips for wiring devices such as Remote Start/Stop, Flow Switches, Chilled Water Pump and Local or Remote Cycling 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 Compressor Run contacts. 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 20°F (11.1°C)] provides flexible, efficient use of remote

# OptiView Control Center (continued)

signal depending on reset needs. Serial data interface to the YORK ISN Building Automation System (BAS) is through the optional MicroGateway Card, which can be mounted inside the Control Center.

This printed circuit board requests the required data from the Microboard and makes it available for the YORK ISN network. This optional board is available through the YORK BAS group. 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 11 years minimum.

The Smart Freeze Point Protection will run the chiller at 36°F (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 color moving in and out of the pipe nozzles. The primary values that need to be monitored and controlled are shown on this screen. They are as follows:

## Display Only

- Chilled Liquid Temperature – Leaving
- Chilled Liquid Temperature – Return
- Condenser Liquid Temperature – Return
- Condenser Liquid Temperature – Leaving
- Motor Run (LED) for both motors
- % Full Load Amps for both motors
- Chiller Operating Hours

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, OIL SUMP, MOTOR, SETPOINTS** and the **HISTORY**. Also on the Home screen is the ability to **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. From this screen you can view the following.

## Display Only

- Both Discharge Temperatures
- Chilled Liquid Temperature – Leaving
- Chilled Liquid Temperature – Return
- Chilled Liquid Temperature – Setpoint
- Evaporator Pressure
- Evaporator Saturation Temperature
- Condenser Liquid Temperature – Leaving
- Condenser Liquid Temperature – Return
- Condenser Pressure
- Condenser Saturation Temperature
- Oil Sump Temperature
- Both Oil Pressures
- Both % Full Load Amps
- Current Limit Setpoint

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 color 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 1°F (.55°C) below to a minimum of 36°F (2.2°C). Restart is adjustable from setpoint up to a max of 80°F (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. From this screen you can perform the following.

## Display Only

- Chilled Liquid Flow Switch (Open/Closed)
- Chilled Liquid Pump (Run/Stop)
- Evaporator Pressure
- Evaporator Saturation Temperature
- Return Chilled Liquid Temperature
- Leaving Chilled Liquid Temperature
- Evaporator Refrigerant Temperature
- Small Temperature Difference
- Leaving Chilled Liquid Temperature Setpoints – Setpoint

- Leaving Chilled Liquid Temperature Setpoints – Shutdown
- Leaving Chilled Liquid Temperature Setpoints – Restart

### Programmable

- Local Leaving Chilled Liquid Temperature – Range
- Local Leaving Chilled Liquid Temperature – Setpoint
- Leaving Chilled Liquid Temperature Cycling Offset – Shutdown
- Leaving Chilled Liquid Temperature Cycling Offset – Restart

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. From this screen you can view the following:

### Display Only

- Leaving Condenser Liquid Temperature
- Return Condenser Liquid Temperature
- Condenser Pressure
- Condenser Saturation Temperature
- Small Temperature Difference
- Drop Leg Refrigerant Temperature
- Sub-Cooling Temperature
- Condenser Liquid Flow Switch
- Condenser Liquid Pump (Run/Stop)
- Refrigerant Level Position
- Refrigerant Level Setpoint
- Ramp Up Time Remaining

The **COMPRESSOR** screen displays a cutaway view of both compressors; this reveals the impellers and shows all the conditions associated with each compressor. When the compressor impeller is spinning, this indicates that the compressors are presently in RUN condition. This screen also serves as a gateway to sub-screens for viewing the details for each compressor individually (including precalibration and proximity probe calibration), configuring the surge detection or configuring the optional Hot Gas By-Pass. From this screen you can view the following:

### Display Only

- Both Oil Pressures
- Oil Sump Temperature
- Both Discharge Temperatures
- Both High Speed Thrust Bearing Proximity Differentials
- Both Vane Motor Switches (LED)
- Oil Return Solenoid (LED)

The **OIL SUMP** screen displays a close-up view of the chiller oil sump and provides access to each individual oil pump screen. From this screen you can view the following:

### Display Only

- Oil Sump Temperature
- Sump Oil Pressure (LOP)
- Both Pump Oil Pressures (HOP)
- Both Oil Pressures
- Both Oil Pump Run Outputs (LED)
- Oil Return Solenoid (LED)
- Oil Heater (LED)
- Both Target/Setpoint Oil Pressures
- Both Pulldown Times Remaining
- Both Oil pump Drive Command Frequencies

### Programmable

- **Manual Pump** The Oil Pump screens display a detailed view of each oil pump and provides the setpoints for VSOP control and manual oil pump

The **MOTOR** “soft” key on the Home screen when pressed shows a picture of a YORK Electro-Mechanical Starter. 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 **ELECTRO-MECHANICAL STARTER – (E-M)** screen displays a picture of the starter and the following values. From this screen you can perform the following:

### Display Only

- Both Motor Run (LED)
- Both Motor Current %Full Load Amps

# OptiView Control Center (continued)

- Current Limit Setpoints
- Pulldown Demand Time Left

## Programmable

- Local Motor Current Limit
- Pulldown Demand Limit
- Pulldown Demand Time

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 sub-screen for defining the setup of general system parameters. From this screen you can perform the following:

## Display Only

- Leaving Chilled Liquid Temperature – Setpoint
- Leaving Chilled Liquid Temperature Cycling – Shutdown
- Leaving Chilled Liquid Temperature Cycling – Restart

## Programmable

- Local Leaving Chilled Liquid Temperature – Range
- Local Leaving Chilled Liquid Temperature – Setpoint
- Leaving Chilled Liquid Temperature Cycling Offset – Shutdown
- Leaving Chilled Liquid Temperature Cycling Offset – Restart
- Motor Current Limit
- Pulldown Demand Limit
- Pulldown Demand Time
- Print

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. From this screen you can perform the following:

## Display Only

- Chilled Liquid Pump Operation: (Displays Standard or Enhanced)

- Refrigerant Selection: (Displays R-22 or R134a)
- Anti-Recycle: (Displays Disabled or Enabled)
- Power Failure Restart: (Displays Manual or Automatic)
- Liquid Type: (Water or Brine)
- Coastdown: (Displays Standard or Enhanced)
- Pre-Run: (Displays Standard or Extended)

## Programmable

- Set Date
- Set Time
- Clock (Enabled/Disabled)
- 12/24 Hr

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.

## Programmable

- Exception Start/Stop Times
- Schedule (Enable/ Disabled)
- Repeat Sunday Schedule
- Standard Week Start/Stop Times
- Reset All Exception Days
- Select
- Print

The **USER** screen defines the unit of measure.

## Programmable

- English/Metric Units

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

## Programmable

- Chiller ID
- Com 2 Baud Rate
- Com 2 Data Bit(s)



- Com 2 Parity Bit(s)
- Com 2 Stop Bit(s)
- Printer Baud Rate
- Printer Data Bit(s)
- Printer Parity Bit(s)
- Printer Stop Bit(s)

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

#### Display Only

- Time Remaining Until Next Print

#### Programmable

- Log Start Time
- Output Interval
- Automatic Printer Logging (Enabled/Disabled)
- Print Type
- Print Report
- Print All Histories

The **SALES ORDER** screen allows definition of the order parameters. Note: This information is loaded at the factory or by the installation/service technician.

#### Display Only

- Model Number
- Panel Serial Number
- Chiller Serial Number
- YORK Order Number
- System Information
- Condenser and Evaporator Design Load Information
- Nameplate Information

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 ISN Remote.

#### Programmable

- Control Source
- Enable Hot Gas By-Pass
- Enable Level Control
- Display Operating Hours
- Display Number of Starts
- Display Chiller Run Time

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 color coded for ease in determining the severity at a glance, recording the date, time and description. **(See Display Messages for Color Code meanings.)**

#### Display Only

- Last Normal Shutdown
- Last Fault While Running
- Last Ten Faults

#### Programmable

- Print History
- Print All Histories

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.

#### Display Only

- History Printout

#### Programmable

- Page Up
- Page Down
- Print History

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 labeling is color coordinated.

#### Display Only

- This screen allows the user to view the graphical trending of the selected parameters and is a gateway to the graph setup screens.

#### Programmable

- Start

# OptiView Control Center (continued)

- Stop
- Y-axis
- X-axis

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.

## Programmable

- Chart Type (select Continuous or One Screen)
- Collection Interval
- Select
- Data Point Slot # (1-6)
- Data Point Min (1-6)
- Data Point Max (1-6)

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

## Display Only

- Slot Numbers

## Programmable

- Page Up
- Page Down

## DISPLAY MESSAGES

The Control Center 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.

### Status Messages include:

- System Ready to Start
- Cycling Shutdown – Auto Restart

- Safety Shutdown – Manual Restart
- System Prelube (with countdown timers)
- System Run (with countdown timers)
- System Coastdown (with countdown timers)
- Start Inhibit
- Chiller Unloading Before Shutdown

### Run Messages include:

- Leaving Chilled Liquid Control
- Current Pulldown Limit
- Motor – High Current Limit for both motors

### Start Inhibit Messages include:

- Anti-Recycle XX Min/Sec for both motors
- Vane Motor Switch Open for both PRV's
- Motor Current >15% FLA for both motors

### Warning Messages include:

- Real Time Clock Failure
- Condenser or Evaporator Transducer Error
- Surge Protection - Excess Surge Limit
- Excess Surge Detected
- Seal Lubrication in Process
- Standby Lube – Low Oil Pressure for both Oil Pumps
- External I/O - Serial Communication
- Setpoint Override
- Condenser – High Pressure Limit
- Evaporator – Low Pressure Limit
- Vane Uncalibrated for both PRV's

### Routine Shutdown Messages include:

- Remote Stop
- Local Stop
- Place Compressor Switch in Run Position

### Cycling Shutdown Messages include:

- Multi Unit Cycling – Contacts Open
- System Cycling – Contacts Open
- Oil – Low Temperature Differential
- Oil – Low Temperature
- Control Panel – Power Failure
- Leaving Chilled Liquid – Low Temperature
- Leaving Chilled Liquid – Flow Switch Open
- Condenser – Flow Switch Open

- 
- Motor Controller – Contacts Open for each motor
  - Motor Controller – Loss of Current for each motor
  - Power Fault for each motor
  - Control Panel – Schedule
  - Proximity Probe – Low Supply Voltage
  - Oil – Variable Speed Pump – Drive Contacts Open, for both oil pumps

**Safety Shutdown Messages include:**

- Evaporator – Low Pressure
- Evaporator – Transducer or Leaving Liquid Probe
- Evaporator – Transducer or Temperature Sensor
- Discharge – High Pressure Contacts Open for both contacts
- Condenser – High Pressure
- Condenser – Pressure Transducer Out-of-Range
- Auxiliary Safety – Contacts Closed
- Discharge – High Temperature for both sensors
- Discharge – Low Temperature for both sensors
- Oil – High Temperature
- Oil – Low Differential Pressure for both oil pumps
- Oil – High Differential Pressure for both oil pumps
- Oil – Pump Pressure Transducer Out-of-Range for both sensors
- Oil – Sump Transducer Out-of-Range
- Oil – Differential Pressure Calibration for both pumps
- Oil – Variable Speed Pump – Setpoint Not Achieved – both pumps
- Control Panel – Power Failure
- Thrust Bearing – Proximity Probe Clearance for both probes
- Thrust Bearing – Proximity Probe Out Of Range for both probes
- Thrust Bearing – Proximity probe uncalibrated for both probes
- Surge Protection - Excess surge
- Watchdog – Software Reboot

# Mechanical Specifications

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## GENERAL

The YORK MAXE YD Centrifugal Liquid Chillers are completely factory-packaged including the evaporator, condenser, compressor, motor, lubrication system, control center, and all interconnecting unit piping and wiring. Larger (J3 to J5 compressor) YD chillers are disassembled for shipment.

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

The services of a YORK 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

Each compressor is a single-stage centrifugal type powered by an open-drive electric motor. The casing is fully accessible with vertical circular joints and fabricated of close-grain cast iron. The complete operating assembly is removable from the compressor and scroll housing. The rotor assembly consists of a heat-treated alloy steel drive shaft and impeller shaft with a high strength, cast aluminum alloy, fully shrouded impeller. The impeller is designed for balanced thrust and is dynamically balanced and overspeed tested for smooth, vibration free operation.

The insert-type journal and thrust bearings are fabricated of aluminum alloy and are precision bored and axially grooved. The specially engineered, single helical gears with crowned teeth are designed so that more than one tooth is in contact at all times to provide even distribution of compressor load and quiet operation. Gears are integrally assembled in the compressor rotor support and are film lubricated. Each gear is individually mounted in its own journal and thrust bearings to isolate it from impeller and motor forces.

## CAPACITY CONTROL

Pre-rotation vanes (PRV) in each compressor modulate chiller capacity from 100% to 15% of design for normal air conditioning applications. Operation is by an external, electric PRV actuator which automatically controls the vane position to maintain a constant leaving chilled liquid temperature. Rugged airfoil shaped cast manganese bronze vanes are precisely positioned by solid vane linkages connected to the electric actuator.

Both compressors are operated when needed to satisfy the building load. At loads below 50%, a single compressor is able to handle the load more efficiently.

## LUBRICATION SYSTEM

Lubrication oil is force-fed to all bearings, gears and rotating surfaces by a variable speed drive pump which operates prior to startup, continuously during operation and during coastdown. A gravity-fed oil reservoir is built into the top of each compressor to provide lubrication during coastdown in the event of a power failure.

A common oil reservoir is mounted below the dual compressors. The reservoir contains a 2 HP submersible oil pump for each compressor. Each pump is built into a removable cast iron cover, one at each end of the reservoir.

An external rubber impregnated blanket heater is applied to the lower half of the oil reservoir. The heater is thermostatically controlled from the sump oil temperature sensor. An additional over temperature protection thermostat is included on the heater. A removable fiberglass blanket provides insulation for the heater and reservoir.

A refrigerant cooled oil cooler is provided after each oil pump, eliminating the need for field water piping. A thermostatically controlled bypass valve maintains the required oil temperature supply from each oil cooler to its compressor. Oil is filtered by externally mounted 0.5 micron replaceable cartridge oil filters, equipped with service valves. An automatic oil return system recovers any oil that may have migrated to the evaporator. Oil piping is completely factory installed.

## MOTOR DRIVELINE

The compressor motors are open drip-proof, squirrel cage, induction type constructed to YORK design specifications. 60 hertz motors operate at 3570 rpm. 50 hertz motors operate at 2975 rpm.

The open motor is provided with a D-flange, and is factory-mounted to a cast iron adaptor mounted on the compressor. This unique design allows the motor to be rigidly coupled to the compressor to provide factory alignment of motor and compressor shafts.

The motor drive shaft is directly connected to the compressor shaft with a flexible disc coupling. Coupling has all metal construction with no wearing parts to assure long life, and no lubrication requirements to provide low maintenance.

A large, steel terminal box with gasketed front access cover is provided on each motor for field-connected conduit. There are six terminals (three for medium voltage) brought through the motor casing into the terminal box. Jumpers are furnished for three-lead types of starting. Motor terminal lugs are not furnished. Overload/over-current transformers are furnished with all units.

## HEAT EXCHANGERS

### Shells

Evaporator and condenser shells are fabricated from rolled carbon steel plates with fusion welded seams. 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 ASME Boiler and Pressure Vessel Code, Section VIII – Division I, or other pressure vessel code 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 3/4" 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, flooded type heat exchanger. A distributor trough provides uniform distribution of refrigerant over the entire shell length to yield optimum heat transfer. Mesh eliminators are located above the tube bundle to prevent liquid refrigerant carryover into the compressor. A 1.5" (38mm) 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 180 PSIG (1241 kPa) or single-relief valve arrangement, if the chiller is supplied with the optional refrigerant isolation valves. A 1" refrigerant charging valve is provided.

### Condenser

The condenser is a shell and tube type, with discharge gas baffles to prevent direct high velocity impingement on the tubes. The baffles are 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 235 PSIG (1620 kPa).

### Water Boxes

The removable water boxes are fabricated of steel. The design working pressure is 150 PSIG (1034 kPa) and the boxes are tested at 225 PSIG (1551 kPa). Integral steel water baffles are located and welded within the water box to provide the required pass arrangements. Stub-out water nozzle connections with Victaulic grooves are welded to the water boxes. These nozzle connections are suitable for Victaulic couplings, welding or flanges, and are capped for shipment. Plugged 3/4" drain and vent connections are provided in each water box.

## 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.

## COMPRESSOR DISCHARGE VALVES

Automated valves are provided in the discharge of each compressor. The discharge valve ensures that there is no backspin of the non-running compressor when the chiller is in single compressor operating mode. These valves are cycled by the control panel during the start and stop sequence of the lag (2<sup>nd</sup>) compressor.

# Mechanical Specifications (continued)

## OPTIVIEW CONTROL CENTER

### General

The chiller is controlled by a stand-alone microprocessor based control center. 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 10.4-in. diagonal color 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 other languages as an option, with English always available. Data can be displayed in either English or Metric units. Smart Freeze Point Protection will run the chiller at 36°F (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 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 can not 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 temperature
  - d. differential oil pressure for both oil pumps
  - e. percent motor current for both motors
  - f. evaporator and condenser saturation temperature
  - g. compressor discharge temperature for both
  - h. oil reservoir temperature
  - i. compressor thrust bearing positioning
  - j. Chiller operating hours and compressor operating hours
  - k. number of chiller and 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 coastdown
  - d. system safety shutdown – manual restart
  - e. system cycling shutdown – auto restart
  - f. system prelube
  - g. start inhibit
4. The text displayed within the system status and system details field is displayed as a color-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. Safety shutdowns include:
  - a. Evaporator – Low Pressure
  - b. Evaporator – Transducer or Leaving Liquid Probe
  - c. Evaporator – Transducer or Temperature Sensor
  - d. Discharge – High Pressure Contacts Open for both contacts x 2
  - e. Condenser – High Pressure
  - f. Condenser – Pressure Transducer Out-of-Range
  - g. Auxiliary Safety – Contacts Closed
  - h. Discharge – High Temperature for both sensors
  - i. Discharge – Low Temperature for both sensors
  - j. Oil – High Temperature
  - k. Oil – Low Differential Pressure for both oil pumps
  - l. Oil – High Differential Pressure for both oil pumps
  - m. Oil – Pump Pressure Transducer Out-of-Range for both oil pumps
  - n. Oil - sump pressure transducer out of range

- o. Oil – Differential Pressure Calibration
  - p. Oil – Variable Speed Pump – Setpoint Not Achieved
  - q. Control Panel – Power Failure
  - r. Thrust Bearing – Proximity Probe Clearance for both probes
  - s. Thrust Bearing – Proximity Probe Out Of Range for both probes
  - t. Thrust Bearing – Proximity probe uncalibrated for both probes
  - u. Surge Protection - Excess surge
  - v. Watchdog – Software Reboot
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.
- Cycling shutdowns include:
- a. multi unit cycling – contacts open
  - b. system cycling – contacts open
  - c. oil – low temperature differential
  - d. oil – low temperature
  - e. control panel – power failure
  - f. leaving chilled liquid – low temperature
  - g. leaving chilled liquid – flow switch open
  - h. motor controller – contacts open for each motor
  - i. motor controller – loss of current for each motor
  - j. power fault for each motor
  - k. control panel – schedule
  - l. oil – proximity probe – low supply voltage
  - m. oil – variable speed pump – drive contacts open for both pumps
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 11 years with power removed from the system.
10. A fused connection through a transformer on the Variable Speed Oil Pump Panel 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 preprogrammed to print from 1 minute to 1 day.
13. The capability to interface with a building automation system 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**

- ASME Boiler and Pressure Vessel Code – Section VIII Division 1.
- ARI Standard 550/590
- c/U.L. – Underwriters Laboratory
- ASHRAE 15 – Safety Code for Mechanical Refrigeration
- ASHRAE Guideline 3 – Reducing Emission of Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems
- N.E.C. – National Electrical Code
- OSHA – Occupational Safety and Health Act

### **ISOLATION MOUNTING**

The unit is provided with four vibration isolation mounts consisting of 1" (25.4 mm) thick neoprene isolation pads for field mounting under the steel mounting pads located on the tube sheets.

# ***Mechanical Specifications (continued)***

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## **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 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 Carib-

bean blue, durable alkyd-modified, vinyl enamel, machinery paint.

## **SHIPMENT**

J1 and J2 compressor size units may ship as a complete assembly. J3 to J5 compressor size units are disassembled for shipment. The two drivelines are removed and skidded. The evaporator and condenser shells are split. The control center, oil pump panel and wire remain mounted on the evaporator shell. The oil sump housing remains attached to the condenser. Connections are closed and the heat exchanger refrigerant sides are charged with nitrogen. Electrical boxes and the motor openings are covered with shrink wrap plastic.



# Accessories and Modifications

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## BAS REMOTE CONTROL

A communication interface permitting complete exchange of chiller data with any BAS System is available with optional ISN translator. ISN translator also allows BAS System to issue commands to the chiller to control its operation. ISN 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, 3/4" (19 mm) thick is attached with vapor-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 humidities up to 75% and dry bulb temperatures ranging from 50° to 90°F (10° to 32.2°C). 1-1/2" (38 mm) thick insulation is also available for relative humidities up to 90% and dry bulb temperatures ranging from 50° to 90°F (10° to 32.2°C).

## WATER FLANGES

Four 150 lb. ANSI 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 one-inch (25 mm) deflection.

## STARTER – FIELD-INSTALLED

A field-installed, electro-mechanical compressor motor starter assembly is available, selected for proper size

and type for job requirements and in accordance with YORK Engineering Standard (R-1137) for Starters. The starter assembly has contactors and accessories for controlling the two compressor motors per chiller.

## 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. Victaulic nozzle connections are standard; flanges are optional. Marine water boxes are available for condenser and/or evaporator.

## KNOCK-DOWN SHIPMENT

The chiller can be shipped knocked down into major subassemblies (evaporator, condenser, driveline, etc.) as required to rig into tight spaces. This is particularly convenient for existing buildings where equipment room access does not allow rigging a factory-packaged chiller.

## REFRIGERANT ISOLATION VALVES

The standard compressor discharge line valves are supplemented by a valve in the refrigerant liquid line. 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.

## REFRIGERANT STORAGE/RECYCLING SYSTEM

A refrigerant storage/recycling system is a self-contained package consisting of a refrigerant compressor with oil separator, storage receiver, water-cooled condenser, filter drier and necessary valves and hoses to remove, replace and distill refrigerant. All necessary controls and safety devices are a permanent part of the system. Typically not required if unit isolation valves are provided.

# Application Data

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

## LOCATION

MAXE 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 1/4" (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 40°F to 104°F (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 3 ft/sec and 12 ft/sec (0.91 m/s and 3.66 m/s). Variable flow applications are possible, and initial chiller selections should be made accordingly to allow proper range of flow while maintaining the minimum velocity noted above. 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.

**Temperature Ranges** – For normal water chilling duty, leaving chilled water temperatures may be selected between 38°F (3.3°C) [36°F (2.2°C) with Smart Freeze enabled] and 70°F (21.1°C) for water temperature ranges between 3°F and 30°F (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 analyzed 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 150 PSIG (1034 kPa) design working pressure in both the chilled water and condenser water circuits. The connections (water nozzles) to these circuits are furnished with grooves for Victaulic couplings. 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.

**Chilled Water** – A water strainer of maximum 1/8" (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.

**TABLE 1 – WATER FLOW RATE LIMITS (GPM) - BASED UPON STANDARD TUBES**

MODEL	EVAPORATOR						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
XA	—	—	—	—	—	—	5,600	22,378	2,800	8,620	1,867	5,865
XB	—	—	—	—	—	—	6,072	24,264	3,036	9,250	2,024	6,322
XC	—	—	—	—	—	—	—	—	—	—	2,204	6,725
XD	—	—	—	—	—	—	6,758	27,000	3,379	10,131	—	—
XF	4,384	17,516	2,192	6,424	1,462	4,244	—	—	—	—	—	—
XH	5,115	20,400	2,558	7,400	1,706	4,895	—	—	—	—	—	—
YA	—	—	—	—	—	—	6,820	27,000	3,410	10,500	2,273	7,180
YB	—	—	—	—	—	—	7,604	27,000	3,802	11,580	2535	7,950
YC	—	—	—	—	—	—	8,400	27,000	4,200	12,620	2,800	8,700
YD	—	—	—	—	—	—	8,750	27,000	4,375	12,900	—	—
YF	5,900	20,600	2,950	8,600	1,967	5,720	—	—	—	—	—	—
YG	6,648	20,600	3,324	9,630	2,216	6,400	—	—	—	—	—	—
YH	7,372	20,600	3,686	10,560	2,457	7,030	—	—	—	—	—	—
ZA	—	—	—	—	—	—	8,222	27,000	4,111	12,900	2,741	8,660
ZB	—	—	—	—	—	—	9,094	27,000	4,547	14,150	3,031	9,540
ZC	—	—	—	—	—	—	9,778	27,000	4,889	15,120	3,259	10,200
ZD	—	—	—	—	—	—	9,548	27,000	4,774	15,610	—	—
ZF	7,400	20,600	3,700	10,600	2,467	7,200	—	—	—	—	—	—
ZG	8,280	20,600	4,140	11,700	2,760	8,000	—	—	—	—	—	—
ZH	9,172	20,600	4,586	12,800	3,057	8,800	—	—	—	—	—	—
AA	—	—	—	—	—	—	9,700	27,000	4,850	15,050	3,233	10,120
AB	—	—	—	—	—	—	10,800	27,000	5,400	16,500	3,600	11,150
AC	—	—	—	—	—	—	11,400	27,000	5,700	17,300	3,800	11,740
AD	—	—	—	—	—	—	12,000	27,000	6,000	18,100	—	—
AF	8,480	20,600	4,240	11,960	2,827	8,190	—	—	—	—	—	—
AG	9,340	20,600	4,670	12,980	3,113	8,930	—	—	—	—	—	—
AH	10,420	20,600	5,210	14,200	3,473	9,860	—	—	—	—	—	—

# Application Data (continued)

TABLE 1A – WATER FLOW RATE LIMITS (L/S)

MODEL	EVAPORATOR						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
XA	—	—	—	—	—	—	353	1,412	177	544	118	370
XB	—	—	—	—	—	—	383	1,531	192	584	128	399
XC	—	—	—	—	—	—	—	—	—	—	139	424
XD	—	—	—	—	—	—	426	1,704	213	639	—	—
XF	277	1,105	138	405	92	268	—	—	—	—	—	—
XH	323	1,287	161	467	108	309	—	—	—	—	—	—
YA	—	—	—	—	—	—	430	1,704	215	663	143	453
YB	—	—	—	—	—	—	480	1,704	240	731	160	502
YC	—	—	—	—	—	—	530	1,704	265	796	177	549
YD	—	—	—	—	—	—	552	1,704	276	814	—	—
YF	372	1,300	186	543	124	361	—	—	—	—	—	—
YG	419	1,300	210	608	140	404	—	—	—	—	—	—
YH	465	1,300	233	666	155	444	—	—	—	—	—	—
ZA	—	—	—	—	—	—	519	1,704	259	814	173	546
ZB	—	—	—	—	—	—	574	1,704	287	893	191	602
ZC	—	—	—	—	—	—	617	1,704	308	954	206	644
ZD	—	—	—	—	—	—	602	1,704	301	985	—	—
ZF	467	1,300	233	669	156	454	—	—	—	—	—	—
ZG	522	1,300	261	738	174	505	—	—	—	—	—	—
ZH	579	1,300	289	808	193	555	—	—	—	—	—	—
AA	—	—	—	—	—	—	612	1,704	306	950	204	639
AB	—	—	—	—	—	—	681	1,704	341	1,041	227	704
AC	—	—	—	—	—	—	719	1,704	360	1,092	240	741
AD	—	—	—	—	—	—	757	1,704	—	—	—	—
AF	535	1,300	268	755	178	517	—	—	—	—	—	—
AG	589	1,300	295	819	196	563	—	—	—	—	—	—
AH	658	1,300	329	896	219	622	—	—	—	—	—	—

**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:

$$\text{Min. ECWT} = \text{LCHWT} - \text{C RANGE} + 17 \text{ } ^\circ\text{F}$$

$$\text{Min. ECWT} = \text{LCHWT} - \text{C RANGE} + 9.4 \text{ } ^\circ\text{C}$$

where:

- ECWT = entering condensing water temperature
- LCHWT = leaving chilled water temperature
- C RANGE = condensing water temperature range at the given load condition.

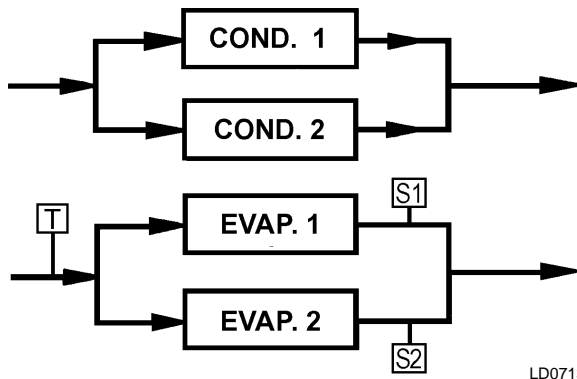
At initial startup, entering condensing water temperature may be as much as 25°F (13.9°C) colder than the

standby chilled water temperature as long as it is above the minimum ECWT allowed.

**MULTIPLE UNITS**

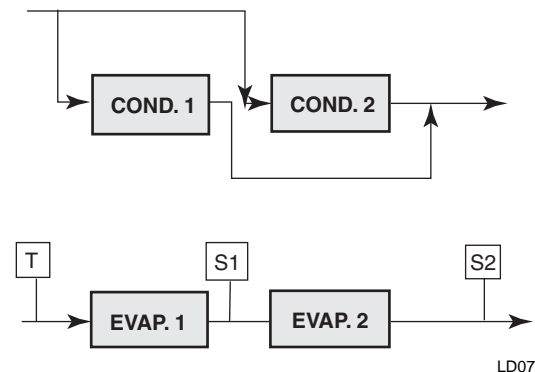
**Selection** – Many applications require multiple units to meet the total capacity requirements as well as to provide flexibility and some degree of protection against equipment shutdown. There are several common unit arrangements for this type of application. The MAXE chiller has been designed to be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

**Parallel Arrangement** (Refer to Fig. 1) – Chillers may be applied in multiples with chilled and condenser water circuits connected in parallel between the units. Fig. 1 represents a parallel arrangement with two chillers. Parallel chiller arrangements may consist of equally or



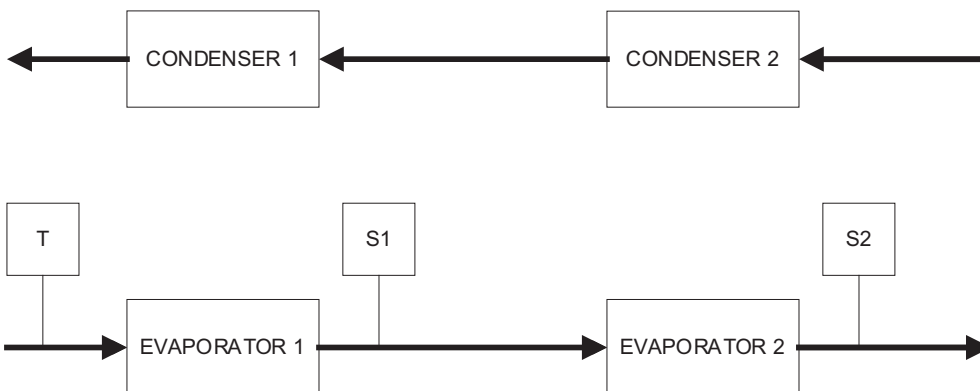
- S** – Temperature Sensor for Chiller Capacity Control
- T** – Thermostat for Chiller Capacity Control

**FIG. 1 – PARALLEL EVAPORATORS  
PARALLEL CONDENSERS**



- S** – Temperature Sensor for Chiller Capacity Control
- T** – Thermostat for Chiller Capacity Control

**FIG. 2 – SERIES EVAPORATORS  
PARALLEL CONDENSERS**



**FIG. 3 - SERIES EVAPORATORS  
SERIES-COUNTER FLOW CONDENSERS**

# Application Data (continued)

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** (Refer to Fig. 2) – 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** (Refer to Fig. 3) - 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 ARI.

## REFRIGERANT RELIEF PIPING

Each chiller is equipped with two 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 ASHRAE 15 safety code and ASME or 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 MAXE chiller is not a source of objectionable sound and vibration in normal air conditioning applications. Neoprene isolation mounts are furnished as standard with each unit. Optional level-adjusting spring isolator assemblies designed for 1" (25 mm) static deflection are available from YORK.

MAXE chiller 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 vapor barrier insulation sufficient to prevent condensation. A chiller can be factory-insulated with 3/4" (19 mm) or 1-1/2" (38 mm) thick insulation, as an option. This insulation will normally prevent condensation in environments with dry bulb temperatures of 50°F to 90°F (10°C to 32°C) and relative humidities up to 75% [3/4" (19 mm) thickness] or 90% [1-1/2" (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

The ASHRAE Standard 15 Safety Code for Mechanical

Refrigeration requires that all machinery rooms be vented to the outdoors utilizing mechanical ventilation by one or more power-driven fans. This standard, plus National Fire Protection Association Standard 90A, state, local and any other related codes should be reviewed for specific requirements. Since the MaxE YD chiller motors are air-cooled, ventilation should allow for the removal of heat from the motors.

In addition, the ASHRAE Standard 15 requires a refrigerant vapor detector 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

**Motor Voltage** – Low voltage motors (200 to 600 volts) are furnished with six leads. Medium voltage (2300 to 4160 volts) motors have three leads. Motor circuit conductor size must be in accordance with the National Electrical Code (N.E.C.), or other applicable codes, for the motor full load amperes (FLA). Flexible conduit should be used for the last several feet to the chiller in order to provide vibration isolation. Table 2 lists the allowable variation in voltage supplied to the chiller motor. The unit name plate is stamped with the specific motor voltage, and frequency for the appropriate motor.

**TABLE 2 – MOTOR VOLTAGE VARIATIONS**

FREQ.	RATED VOLTAGE	NAMEPLATE VOLTAGE	OPERATING VOLTAGE	
			MIN.	MAX.
60 HZ	200	200/208	180	220
	230	220/240	208	254
	380	380	342	415
	416	416	375	457
	460	440/460/480	414	508
	575	575/600	520	635
	2300	2300	2,070	2,530
	3300	3300	2,970	3,630
	4000	4000/4160	3,600	4,576
50 HZ	346	346	311	381
	380	380/400	342	423
	415	415	374	440
	3300	3300	2,970	3,630

**Starters** – The MaxE YD chiller requires two remote mounted electro-mechanical starters, one connected to each of the chiller motors. The two starters may be

individually connected to a power source, or the starters may be furnished as a package with the two incoming feeds bussed or cabled together. These electro-mechanical starters must be furnished in accordance with YORK Standard Specifications (R-1137). This will ensure that starter components, controls, circuits, and terminal markings will be suitable for required overall system performance.

**Controls** – A 115 volt, single-phase, 60 or 50 Hertz 2 KVA power supply is furnished at the chiller from a separate control transformer, included in the 3-phase variable speed oil pump auxiliary power panel.

**Oil Pump Power Supply** – The YD chiller is provided with an auxiliary variable speed oil pump drive panel. This panel operates the two oil pump motors, powers the 3 phase oil reservoir heater, and includes the control power transformer for the chiller control panel. A common incoming disconnect is provided at the panel. Component power feeds are individually fused. A separate 3-phase power supply (200 to 575 voltages as listed on Table 2 for Motors) is required. This power can be from a separate source available in the building, or optionally fed from an auxiliary source in one of the drive motor starters

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

**Power Factor Correction Capacitors** – Capacitors can be applied to a chiller for the purpose of power factor correction. For remote-mounted electro-mechanical starters, the capacitors should be located on the load-side of the starter. The capacitors must be sized and installed to meet the National Electrical Code and be verified by YORK.

**Ampacity on Load Side of Starter** – Electrical power wire size to each chiller motor is based on the minimum ampacity. For remote starters, the National Electrical Code defines the calculation of ampacity, as summarized below. More specific information on actual amperage ratings will be supplied with the submittal drawings.

- Six-lead type of starting (Star-Delta)  
Minimum circuit ampacity per conductor (1 of 6):  
Ampacity = .721 x compressor motor amps.
- Three-lead type of starting  
(Across-the-Line, Autotransformer and Primary

# Application Data (continued)

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Reactor)

Minimum circuit ampacity per conductor (1 of 3):

Ampacity = 1.25 x compressor motor amps.

**Ampacity on Line-Side of Starter** – The YD MaxE chiller utilizes two compressor motors and starters. If the starters are connected together to the line side, the individual ampacity requirements should be multiplied by two to obtain the total. The only additional load on the circuit for the chiller would be the control transformer and oil pump motors unless they are supplied by a separate source.

Minimum Circuit Ampacity = 125% of compressor motor amps + FLA of all other loads on the circuit.

**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. It is calculated taking into account the compressor motor amps and may also include control transformer and oil pump motor. Refer to submittal drawings for the specific calculations for each application.

## MOTOR ELECTRICAL DATA

The smallest motor available which equals or exceeds the Input power (kW) from the chiller rating program is selected from Tables 3 and 4. The full load amperes (FLA) listed in the tables are maximum values and correspond to the maximum motor kW listed. When the input power (kW) is less than maximum motor kW, the FLA should be reduced per the following equation

$$FLA = \frac{\text{Motor kW}}{\text{Max. Motor kW}} \times \text{Max. Motor FLA}$$

The benefit from the FLA correction is the possible use of smaller power wiring and/or starter size.

The locked rotor amperes (LRA) are read directly from Tables 3 and 4 for specific Motor Code and voltage. This is because the LRA is dependent only on motor size and voltage and is independent of input power (kW).

Inrush amperes (IRA) depend on LRA and the type of starter applied. The inrush can be calculated using a percentage of LRA shown in Table 5.



**TABLE 3 - 60 Hz ELECTRICAL DATA**

MOTOR CODE	CW	CX	CY	CZ	CA	CB	DA	DB	DC	DD	DE	DF	DH	DJ
<b>kW (MAX.)</b>	514	542	578	617	660	703	781	859	937	1,015	1,093	1,171	1,359	1,554
<b>SHAFT HP</b>	655	690	740	790	845	900	1,000	1,100	1,200	1,300	1,400	1,500	1,750	2,000
<b>FL EFF.-%</b>	95	95	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	96	96

VOLTS		AMPERES (MAX.)													
380	FLA	879	942	997	1065	1,126	1,200	1,364	1,500	1,636	—	—	—	—	—
	LRA	5,780	6,782	5,780	6,644	7,106	7,513	7,794	8,491	9,431	—	—	—	—	—
416	FLA	810	860	911	973	1,029	1,096	1,246	1,370	1,495	—	—	—	—	—
	LRA	5,640	5,780	5,694	6,069	6,489	6,863	7,120	7,755	8,608	—	—	—	—	—
440	FLA	579	813	861	920	973	1,036	1,178	1,295	1,413	—	—	—	—	—
	LRA	4,783	5,357	4,783	5,249	5,529	5,529	6,160	6,709	7,455	—	—	—	—	—
460	FLA	726	778	824	880	931	991	1,127	1,239	1,352	—	—	—	—	—
	LRA	5,000	5,600	5,000	5,488	5,780	5,780	6,440	7,014	7,794	—	—	—	—	—
480	FLA	696	746	790	843	892	950	1,080	1,187	1,296	—	—	—	—	—
	LRA	5,217	5,843	5,217	5,727	6,031	6,031	6,720	7,319	8,133	—	—	—	—	—
575	FLA	581	622	659	704	744	793	901	991	1,081	—	—	—	—	—
	LRA	4,039	4,440	4,300	4,200	4,694	4,963	5,148	5,610	6,232	—	—	—	—	—
600	FLA	557	596	632	675	713	760	863	950	1,036	—	—	—	—	—
	LRA	4,215	4,633	4,484	4,383	4,898	5,179	5,372	5,854	6,503	—	—	—	—	—
2300	FLA	146	154	165	176	186	198	225	248	267	290	312	334	389	438
	LRA	935	960	1,008	1,100	1,172	1,230	1,234	1,592	1,592	1,592	2,031	2,031	2,390	2,879
3300	FLA	102	108	115	123	130	138	157	173	186	202	217	233	271	306
	LRA	652	682	719	744	744	858	861	1,110	1,110	1,110	1,416	1,416	1,661	2,011
4000	FLA	84	89	95	101	107	114	130	143	154	166	179	192	224	252
	LRA	538	540	554	631	674	713	715	923	923	923	1,177	1,177	1,386	1,669
4160	FLA	81	85	91	97	103	110	125	137	149	160	172	185	215	242
	LRA	560	562	576	656	701	742	744	960	960	960	1,224	1,224	1,441	1,736

**TABLE 4 - 50 Hz ELECTRICAL DATA**

MOTOR CODE	5CS	5CT	5CU	5CV	5CW	5CX	5DA	5DB	5DC	5DD	5DE	5DF	5DG	5DH	5DJ
<b>kW (MAX)</b>	518	554	591	630	669	709	785	863	942	1,015	1,093	1,171	1,288	1,360	1,554
<b>SHAFT HP</b>	658	704	750	800	850	900	1,000	1,100	1,200	1,300	1,400	1,500	1,650	1,750	2,000
<b>FL EFF.-%</b>	94.7	94.7	94.7	94.7	94.7	94.7	95	95	95	95.5	95.5	95.5	95.5	96	96
<b>FL PF</b>	.88	.88	.89	.89	.89	.89	.88	.87	.88	.88	.88	.88	.88	.89	.89

VOLTS		AMPERES (MAX.)													
346	FLA	982	1,051	1,107	1,181	1,255	1,329	1,488	1,656	—	—	—	—	—	—
	LRA	5,780	6,615	6,931	7,356	7,794	8,319	8,559	9,346	—	—	—	—	—	—
380	FLA	895	957	1,008	1,075	1,143	1,210	1,355	1,508	—	—	—	—	—	—
	LRA	5,491	5,491	6,313	6,694	7,113	7,404	7,794	8,511	—	—	—	—	—	—
400	FLA	850	909	958	1,021	1,086	1,150	1,287	1,433	—	—	—	—	—	—
	LRA	5,780	5,780	6,645	7,046	7,487	7,794	8,204	8,959	—	—	—	—	—	—
415	FLA	819	876	923	985	1,046	1,108	1,241	1,381	—	—	—	—	—	—
	LRA	5,108	5,512	5,780	6,131	6,513	6,938	7,138	7,794	—	—	—	—	—	—
3300	FLA	103	110	116	124	132	139	156	174	187	202	217	233	256	267
	LRA	644	693	725	744	819	875	871	1,135	1,135	1,135	1,415	1,415	1,415	1,667

# Application Data (continued)

**TABLE 5 – MOTOR STARTERS**

TYPE STARTER	STAR DELTA	AUTO TRANSFORMER			ACROSS-THE-LINE	PRIMARY REACTOR	
		LOW	LOW/HIGH	LOW/HIGH		LOW/HIGH	HIGH
VOLTAGE	LOW	LOW	LOW/HIGH	LOW/HIGH	LOW/HIGH	HIGH	HIGH
60 HZ	200-600	200-600	200-4160	200-4160	200-4160	2300-4160	2300-4160
50 HZ	346-415	346-415	346-3300	346-3300	346-3300	2300-3300	2300-3300
TRANSITION	CLOSED	CLOSED	CLOSED	CLOSED	—	CLOSED	CLOSED
% TAP	—	57.7	65	80	—	65	80
INRUSH	33	33	42.3	64	100	65	80
AS A % OF LRA							

**NOTE:** Inrush less than 100% of full load amps (FLA).

Minimum tap for 5DJ motor is 80%.

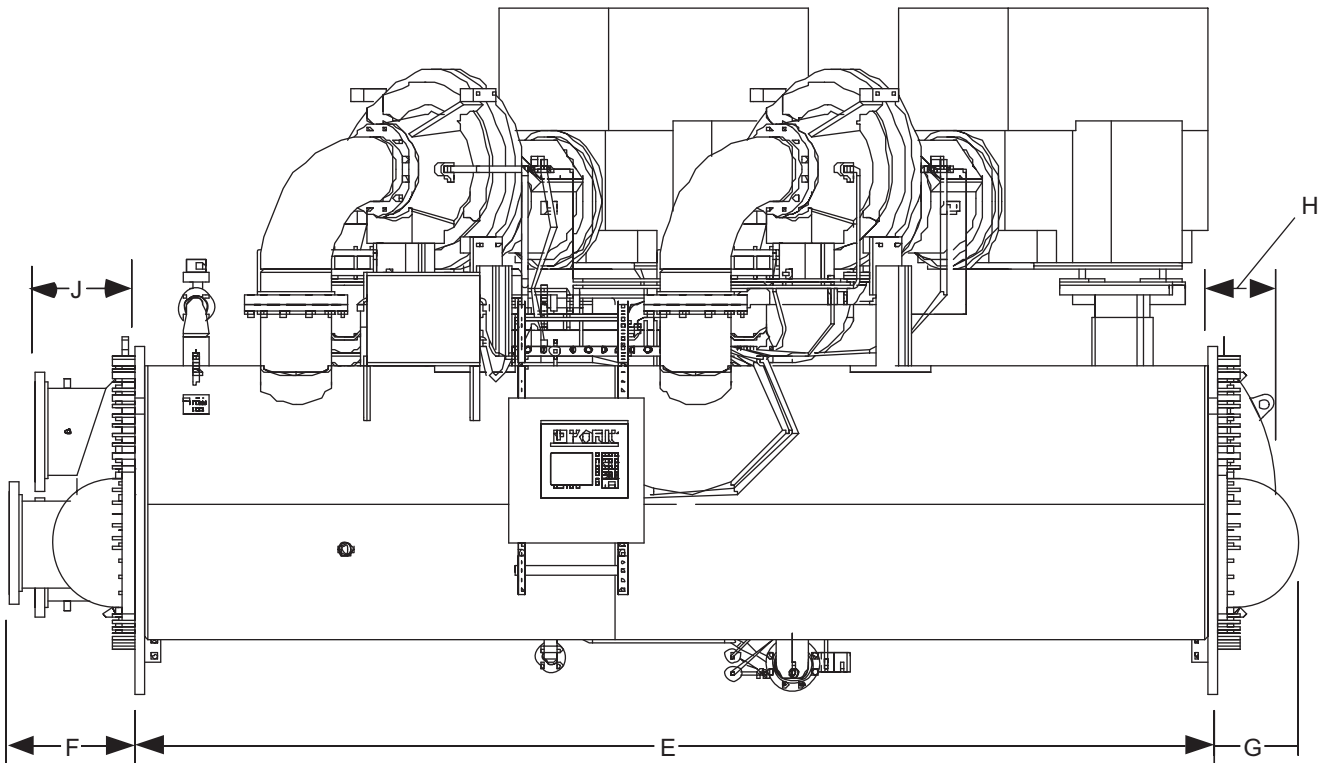
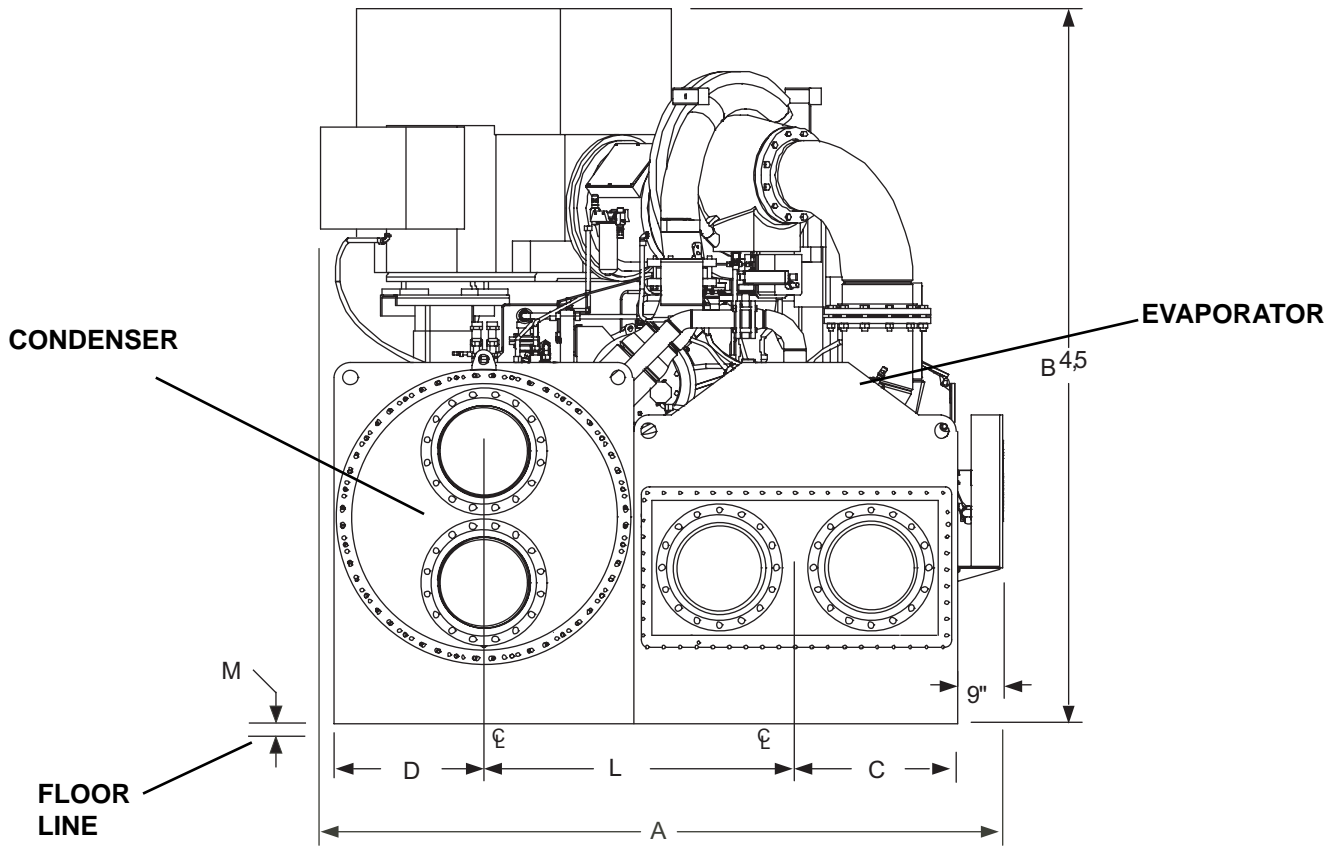
**TABLE 6 – AVAILABLE COMPRESSOR/SHELL/MOTOR COMBINATIONS**

COMPRESSOR CODE	EVAPORATOR CODE	CONDENSER CODE	MOTOR CODES	
			60 HZ	50 HZ
J1, J2	XF, XH	XA, XB, XC, XD	CW-DC	5CS-5DC
J3	YF, YG, YH	YA, YB, YC, YD	DA-DJ	5DA-5DJ
J4	ZF, ZG, ZH	ZA, ZB, ZC, ZD	DA-DJ	5DA-5DJ
J5	AF, AG, AH	AA, AB, AC, AD	DA-DJ	5DA-5DJ

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# Dimensions (Ft. - In.) – Unit

## J COMPRESSOR UNITS



<b>EVAPORATOR – CONDENSER SHELL CODES</b>				
	<b>X-X</b>	<b>Y-Y</b>	<b>Z-Z</b>	<b>A-A</b>
<b>A</b>	11'-5"	13'-6"	14'-6-1/4"	15'-5-1/4"
<b>B</b>	12'-0"	13'-0"	13'-8"	14'-2"
<b>C</b>	2'-8"	3'-5"	3'-9"	4'-0"
<b>D</b>	2'-5 1/2"	2'-11-1/2"	3'-1-1/2"	3'-4"
<b>E</b>	18'-0"	18'-0"	18'-0"	18'-0"
<b>F</b>	2'-0-3/4"	2'-1"	2'-3"	2'-3-9/16"
<b>G</b>	1'-4-3/4"	1'-4-1/4"	1'-6-1/4"	1'-6-7/8"
<b>H</b>	0'-11-11/16"	1'-2-5/8"	1'-3-5/8"	1'-4-1/4"
<b>J</b>	1'-7-5/8"	2'-1-1/2"	2'-2"	2'-1"
<b>L</b>	5'-1-1/2"	6'-4 1/2"	6'-10-1/2"	7'-4"

<b>ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR</b>	
<b>TYPE OF CHILLER MOUNTING</b>	<b>M</b>
NEOPRENE PAD ISOLATORS	1-3/4"
SPRING ISOLATORS 1" DEFLECTION	1"
DIRECT MOUNT	3/4"

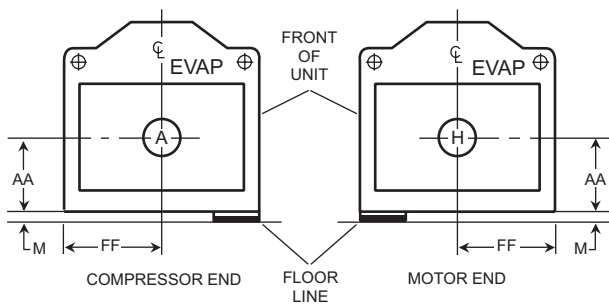
**NOTES:**

1. All dimensions are approximate. Certified dimensions are available on request.
2. For compact water boxes (shown above), determine overall unit length by adding water box depth to tube sheet length. For Marine Water Boxes, see pages 32 - 35.
3. Water nozzles can be located on either end of unit. Add 1/2" to nozzle length for flanges 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. Add 6" for 5DJ size motor.

# Dimensions (Ft. - In.) – Nozzle Arrangements

## EVAPORATORS – COMPACT WATER BOXES

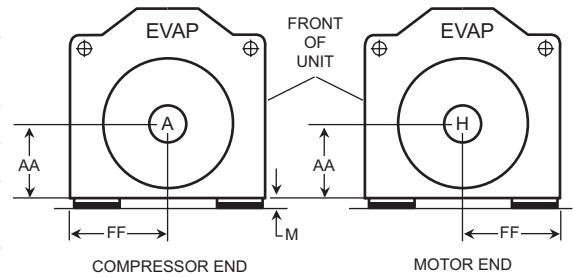
### X SIZE



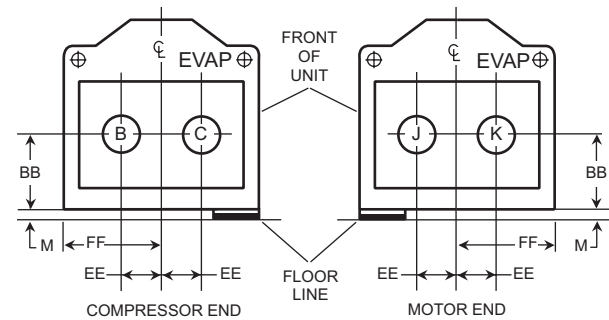
### 1-PASS

NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
1	A	H
	H	A

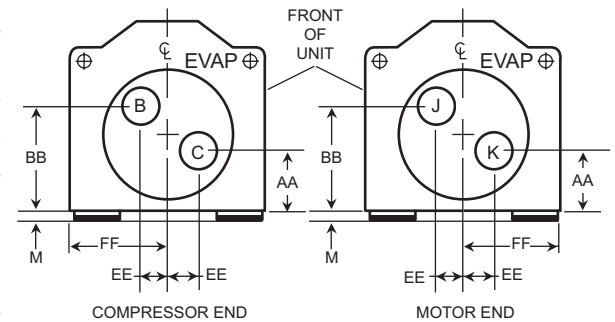
### Y, Z, A SIZES



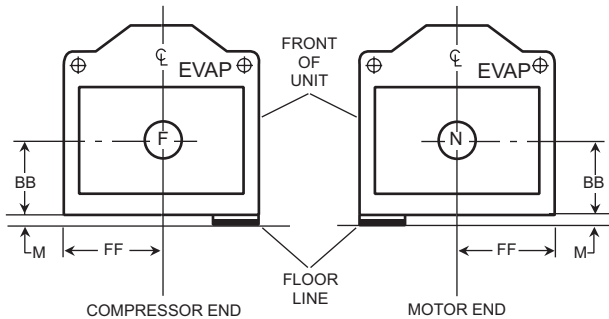
### 2-PASS



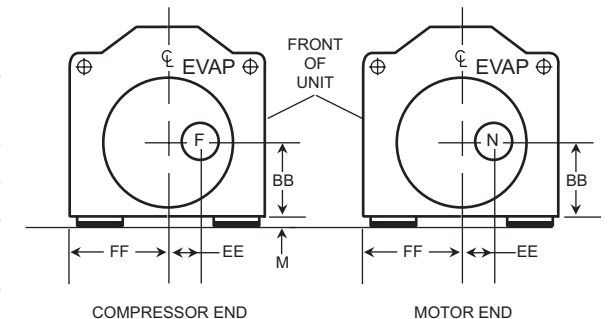
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
2	B	C
	C	B
	J	K
	K	J



### 3-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
3	F	N
	N	F



LD08641

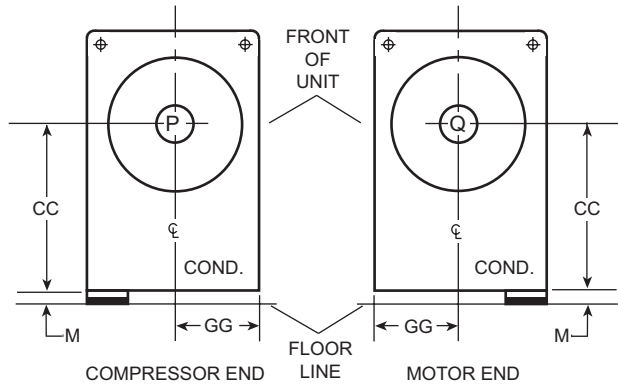
EVAP. SHELL CODE	EVAPORATOR											
	NOZZLE PIPE SIZE			NOZZLE DIMENSIONS								
	NO. OF PASSES			1-PASS		2-PASS				3-PASS		
	1	2	3	AA <sup>2</sup>	FF	AA	BB <sup>2</sup>	EE	FF	BB <sup>2</sup>	EE	FF
X	20"	18"	14"	2'-6-1/2"	2'-8"	—	2'-6-1/2"	1'-3"	2'-8"	2'-6-1/2"	—	2'-8"
Y	24"	20"	16"	4'-1"	3'-5"	3'-0"	5'-2"	1'-1"	3'-5"	4'-1"	1'-4"	3'-5"
Z	24"	20"	18"	4'-9-1/2"	3'-9"	3'-8-1/2"	5'-10-1/2"	1'-1"	3'-9"	4'-9-1/2"	1'-4"	3'-9"
A	24"	20"	18"	5'-0-1/2"	4'-0"	3'-11-1/2"	6'-1-1/2"	1'-1"	4'-0"	5'-0-1/2"	1'-4"	4'-0"

### NOTES:

- Standard water nozzles are furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
- Add dimension "M" as shown on pg 29 for the appropriate isolator type.
- 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.
- Connected piping should allow for removal of compact water boxes for tube access and cleaning.

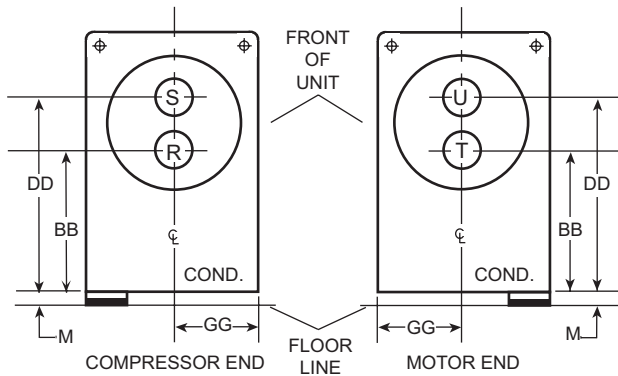
### CONDENSERS – COMPACT WATER BOXES

1-PASS



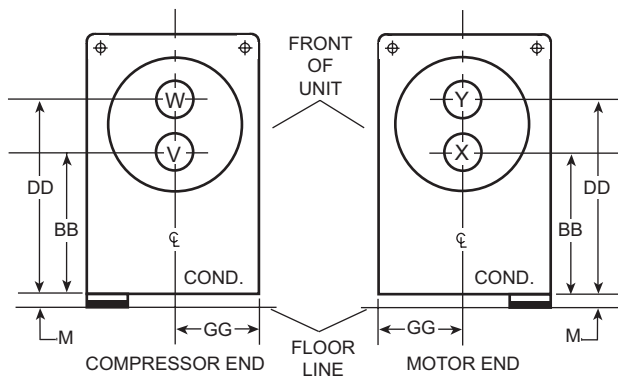
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	P Q	Q P

2-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
2	R T	S U

3-PASS



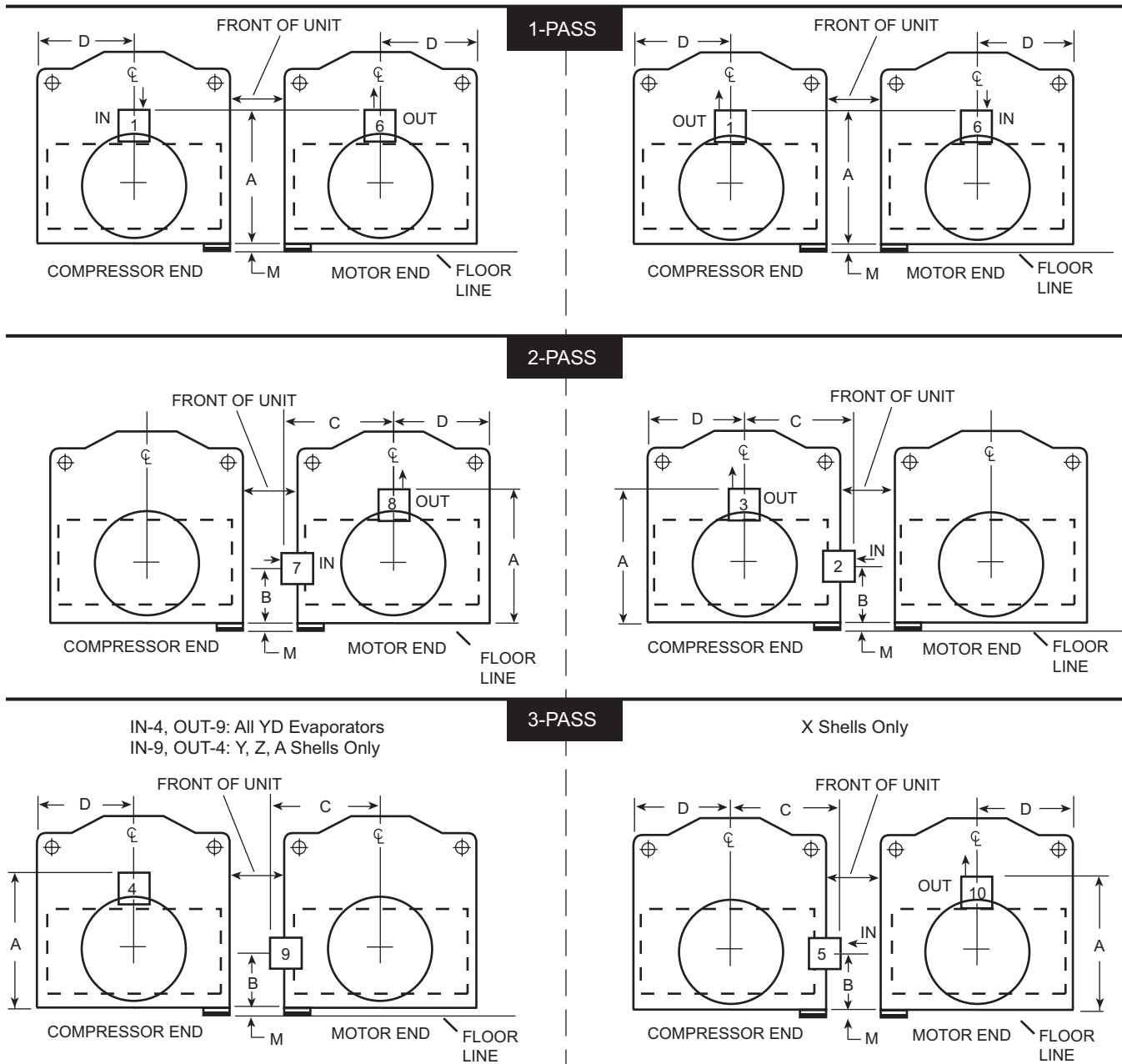
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
3	V X	Y W

LD08643

CONDENSER SHELL CODE	CONDENSER											
	NOZZLE PIPE SIZE			NOZZLE DIMENSIONS								
	NO. OF PASSES			1-PASS		2-PASS			3-PASS			
	1	2	3	CC <sup>2</sup>	GG	BB <sup>2</sup>	DD <sup>2</sup>	GG	BB <sup>2</sup>	DD	GG	
X	24"	18"	16"	3'-5-3/4"	2'-5-1/2"	2'-4"	4'-6"	2'-5-1/2"	2'-4"	4'-6"	2'-5-1/2"	
Y	24"	20"	18"	3'-10"	2'-11-1/2"	2'-6-1/2"	5'-1-1/2"	2'-11-1/2"	2'-4"	5'-4"	2'-11-1/2"	
Z	24"	24"	20"	4'-4"	3'-1-1/2"	2'-9-1/2"	5'-10-1/2"	3'-1-1/2"	2'-8"	6'-0"	3'-1-1/2"	
A	24"	24"	20"	4'-6"	3'-4"	2'-11-1/2"	6'-0-1/2"	3'-4"	2'-9-1/4"	6'-2-1/4"	3'-4"	

# Dimensions (Ft. - In.) – Nozzle Arrangements

## EVAPORATORS – MARINE WATER BOXES



NOTE: X Evaporator waterboxes are rectangular, Y, Z & A are round

LD08644

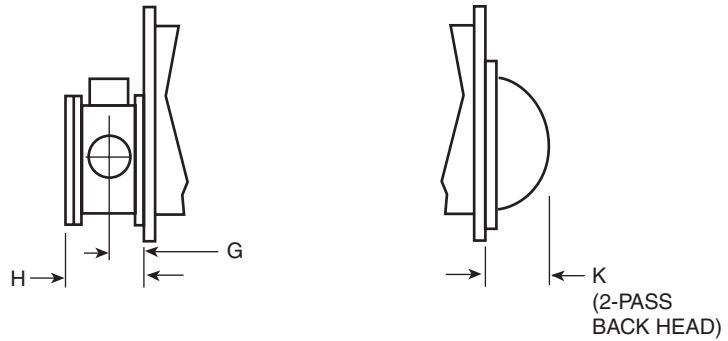
EVAP. SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A <sup>5</sup>	D	A <sup>5</sup>	B <sup>5</sup>	C	D	A <sup>5</sup>	B <sup>5</sup>	C	D
X	4'-5-3/4"	2'-8"	4'-5-3/4"	2'-2-3/4"	3'-2"	2'-8"	4'-5-3/4"	2'-0-3/4"	3'-1-7/8"	2'-8"
Y	7'-8-5/8"	3'-5"	7'-8-5/8"	4'-1"	3'-7-5/8"	3'-5"	7'-8-5/8"	4'-1"	3'-7-5/8"	3'-5"
Z	8'-9-3/4"	3'-9"	8'-9-3/4"	4'-9-1/2"	4'-0-1/4"	3'-9"	8'-9-3/4"	4'-9-1/2"	4'-0-1/4"	3'-8"
A	9'-4"	4'-0"	9'-4"	5'-0-1/2"	4'-3-1/2"	4'-0"	9'-4"	5'-0-1/2"	4'-3-1/2"	4'-0"

See Notes on page 33.



EVAPORATOR 1-PASS	
IN	OUT
1	6
6	1

EVAPORATOR 2-PASS	
IN	OUT
2	3
7	8



LD07181

EVAPORATOR 3-PASS		
SHELLS	IN	OUT
X	5	10
X, Y, Z, A	9	4
Y, Z, A	4	9

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	EVAPORATOR NOZZLE DIMENSIONS (2-PASS)		
		G	H	
X	150	1'-2-1/2"	2'-8"	1'-4-1/2"
	300	1'-7"	3'-6"	1'-1"
Y	150	1'-4-1/2"	3'-0-1/2"	1'-4-1/4"
	300	1'-7-1/8"	4'-0-1/2"	1'-5-5/8"
Z	150	1'-4-7/8"	3'-1"	1'-6-1/4"
	300	1'-7-3/8"	4'-2-1/4"	1'-7-1/2"
A	150	1'-4-3/8"	3'-0"	1'-7"
	300	1'-6-13/16"	4'-2"	1'-8-1/4"

EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
X	20"	18"	14"
Y	24"	20"	16"
Z	24"	20"	18"
A	24"	20"	18"

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	EVAPORATOR NOZZLE DIMENSIONS (1-PASS)	
		G	H
X	150	1'-3-1/2"	2'-10"
	300	1'-9"	3'-10"
Y	150	1'-6-3/4"	3'-5"
	300	1'-10"	4'-6"
Z	150	1'-7"	3'-5-1/2"
	300	1'-10-1/8"	4'-7-7/8"
A	150	1'-6-5/8"	3'-4-5/8"
	300	1'-9-5/8"	4'-7-1/2"

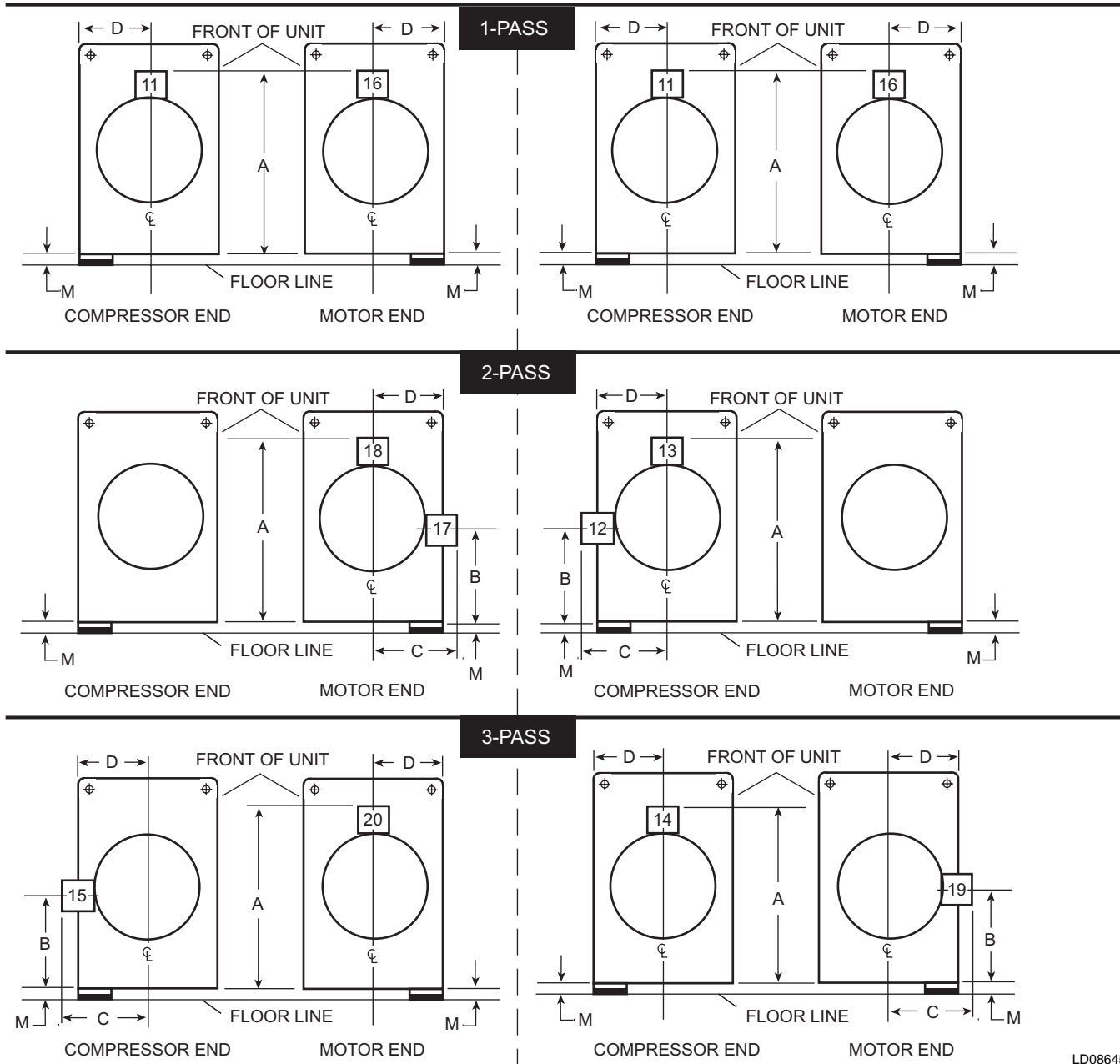
EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	EVAPORATOR NOZZLE DIMENSIONS (3-PASS)	
		G	H
X	150	1'-0-1/2"	2'-4"
	300	1'-3-1/2"	2'-11"
Y	150	1'-2-1/2"	2'-8-1/2"
	300	1'-4-5/8"	3'-7-1/2"
Z	150	1'-3-5/8"	2'-10-1/2"
	300	1'-6-1/8"	3'-11-7/8"
A	150	1'-3-1/8"	2'-9-5/8"
	300	1'-5-5/8"	3'-11-1/2"

**NOTES (see table on page 32):**

- All dimensions are approximate. Certified dimensions are available upon request.
- Standard water nozzles are Standard wall (0.375") pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
- 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.
- Water must enter the water box through the bottom connection to achieve rated performance.
- Add dimension "M" as shown on pg 29 for the appropriate isolator type.

# Dimensions (Ft. - In.) – Nozzle Arrangements

## CONDENSERS – MARINE WATER BOXES



LD08645

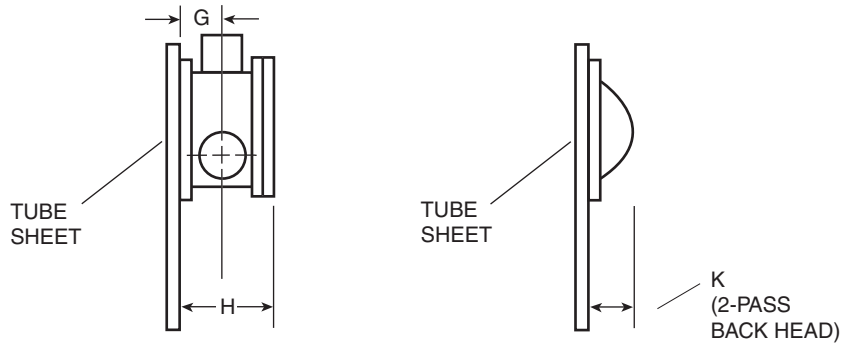
COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A <sup>5</sup>	D	A <sup>5</sup>	B <sup>5</sup>	C	D	A <sup>5</sup>	B <sup>5</sup>	C	D
X	6'-5"	2'-5-1/2"	6'-5"	2'-5-1/2"	2'-10"	2'-5-1/2"	6'-5"	2'-2-9/16"	2'-10"	2'-5-1/2"
Y	7'-2"	2'-11-1/2"	7'-2"	2'-7"	3'-4"	2'-11-1/2"	7'-2"	2'-3"	3'-4"	2'-11-1/2"
Z	7'-10"	3'-1-1/2"	7'-10"	3'-1"	3'-6"	3'-1-1/2"	7'-10"	2'-8"	3'-6"	3'-1-1/2"
A	8'-1-5/8"	3'-4"	8'-1-5/8"	3'-2"	3'-7-5/8"	3'-4"	8'-1-5/8"	2'-10"	3'-7-5/8"	3'-4"

CONDENSER 1-PASS	
IN	OUT
11	16
16	11

CONDENSER 2-PASS	
IN	OUT
12	13
17	18

CONDENSER 3-PASS	
IN	OUT
15	20
19	14

COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
X	24"	18"	16"
Y	24"	20"	18"
Z	24"	24"	20"
A	24"	24"	20"



LD07183

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	COND. NOZZLE DIMENSIONS (2-PASS)		
		G	H	K
X	150	1'-2-1/8"	2'-7-1/4"	0'-11-11/16"
	300	1'-5-3/16"	3'-1-7/8"	1'-1-1/8"
Y	150	1'-4-5/8"	3'-0-1/8"	1'-2-3/4"
	300	1'-6-7/8"	3'-10-3/8"	1'-3-3/4"
Z	150	1'-7-1/4"	3'-5-1/2"	1'-3-3/4"
	300	1'-11-1/4"	4'-7-3/4"	1'-4-7/8"
A	150	1'-6-3/4"	3'-4-7/8"	1'-4-1/4"
	300	1'-10"	4'-6"	1'-5-3/4"

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	COND. NOZZLE DIMENSIONS (1-PASS)	
		G	H
X	150	1'-5-7/8"	3'-2-1/4"
	300	1'-10-7/16"	4'-0-3/8"
Y	150	1'-6-7/8"	3'-5-1/8"
	300	1'-10"	4'-4-5/8"
Z	150	1'-7-1/4"	3'-5-1/2"
	300	1'-11-1/4"	4'-7-3/4"
A	150	1'-6-3/4"	3'-4-7/8"
	300	1'-10"	4'-6"

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	COND. NOZZLE DIMENSIONS (3-PASS)	
		G	H
X	150	1'-1-5/8"	2'-5-3/4"
	300	1'-3-15/16"	2'-11-3/8"
Y	150	1'-3-3/8"	2'-9-5/8"
	300	1'-5-5/8"	3'-7-7/8"
Z	150	1'-5"	3'-1"
	300	1'-7-7/8"	4'-1"
A	150	1'-4-1/2"	3'-0-3/8"
	300	1'-7-1/4"	4'-0-1/2"

**NOTES (see table on page 34):**

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are standard wall (0.375) pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" 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 pg 29 for the appropriate isolator type.

# Weights

**TABLE 7 – APPROXIMATE UNIT WEIGHT INCLUDING MOTOR & 150 # COMPACT WATER BOXES\***

SHELLS	COMPRESSOR	SHIPPING WEIGHT (LBS.)	OPERATING WEIGHT (LBS.)	EST. REFRIGERANT CHARGE (LBS.)
X-X	J1, J2	75,700	94,400	6,000
Y-Y	J3	116,000	146,000	7,925
Z-Z	J4	136,000	172,000	9,725
A-A	J5	155,000	197,000	10,875

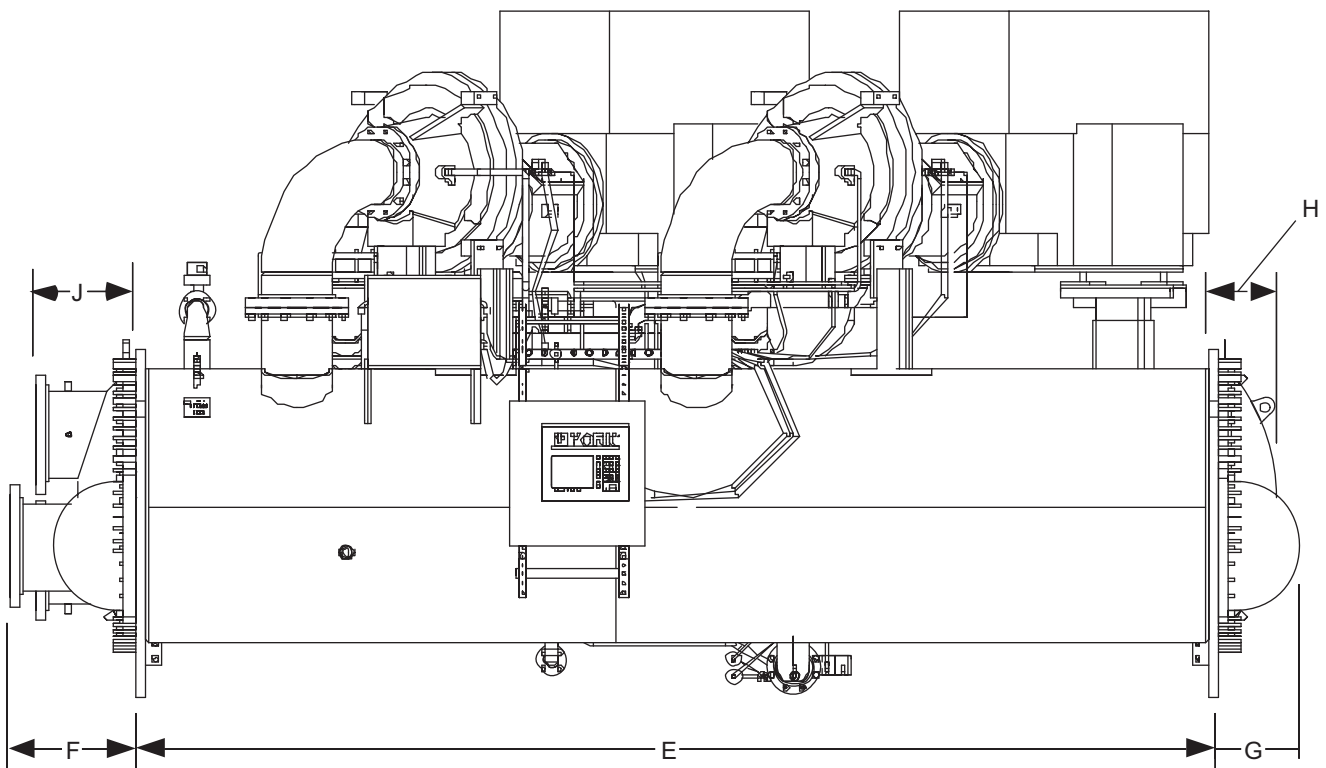
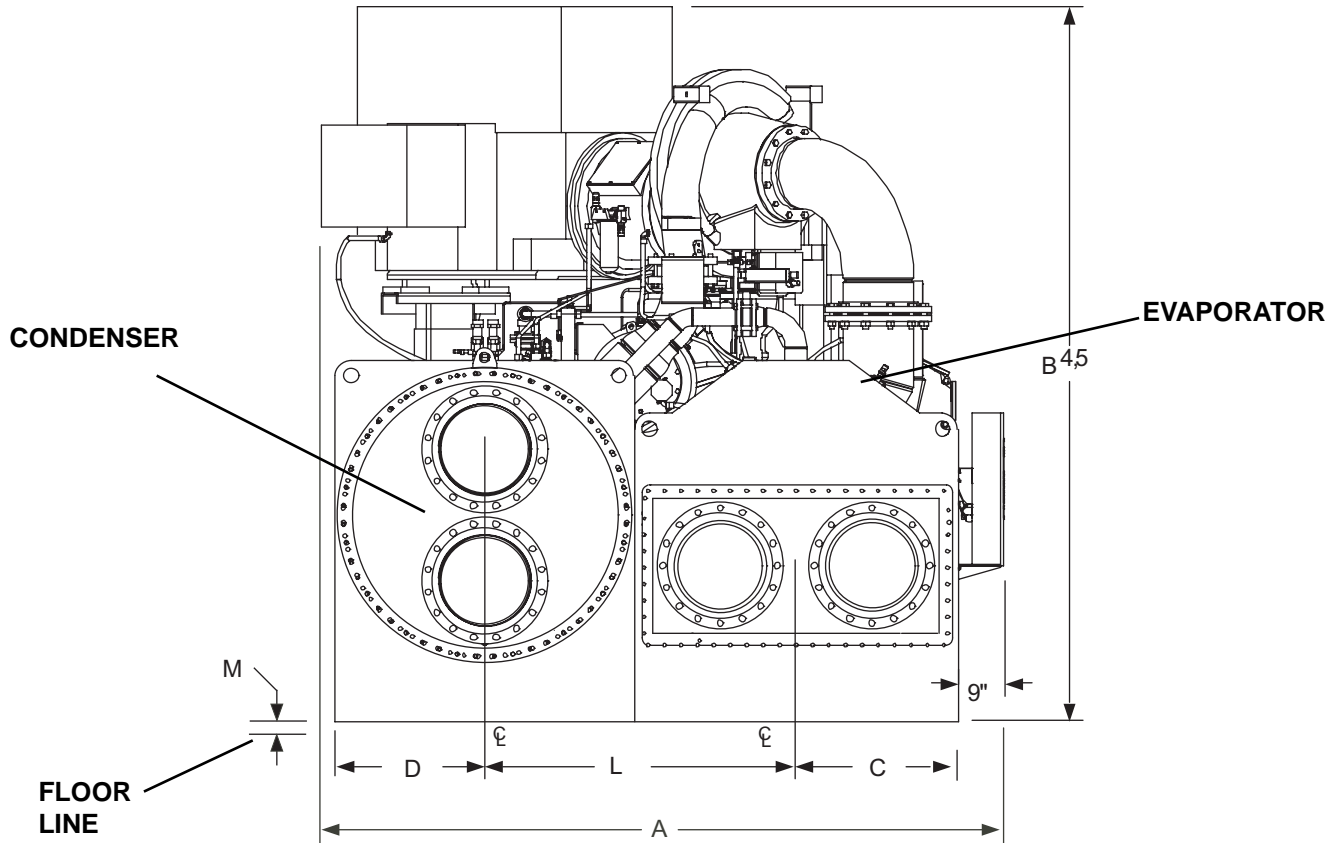
\* Refer to product drawings for detailed weight information.

**TABLE 8 – MARINE WATER BOX WEIGHTS (LBS.)  
WEIGHTS (To be added to Standard Unit weights shown above).**

EVAP. CODE	SHIPPING WEIGHT INCREASE - LBS.			OPERATING WEIGHT INCREASE - LBS.			COND. CODE	SHIPPING WEIGHT INCREASE - LBS.			OPERATING WEIGHT INCREASE - LBS.		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
X	4,650	2,455	4,330	5,460	3,270	5,120	X	5,094	2,276	4,522	9,809	4,021	7,778
Y	10,646	6,533	13,410	18,680	9,915	19,047	Y	7,168	3,770	7,493	12,559	5,994	11,418
Z	15,014	8,406	16,478	25,293	12,722	24,198	Z	8,464	5,079	9,152	13,988	7,840	13,605
A	17,214	8,932	17,084	28,408	13,585	25,340	A	10,076	5,907	10,754	18,111	9,924	17,520

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# Dimensions (mm) – Unit



EVAPORATOR – CONDENSER SHELL CODES				
	X-X	Y-Y	Z-Z	A-A
A	3,240	4,115	4,426	4,705
B	3,658	3,962	4,166	4,318
C	813	1,041	1,143	1,219
D	749	902	953	1,016
E	5,486	5,486	5,486	5,486
F	629	635	686	700
G	419	413	464	479
H	297	371	397	413
J	498	648	660	635
L	1,562	1,943	2,096	2,235

ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR	
TYPE OF CHILLER MOUNTING	M
NEOPRENE PAD ISOLATORS	44
SPRING ISOLATORS 25mm DEFLECTION	25
DIRECT MOUNT	19

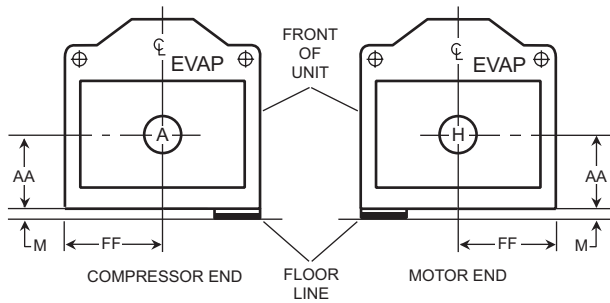
**NOTES:**

1. All dimensions are approximate. Certified dimensions are available on request.
2. For compact water boxes (shown above), determine overall unit length by adding water box depth to tube sheet length. For Marine Water Boxes, see pages 41 - 44.
3. Water nozzles can be located on either end of unit. Add 13mm to nozzle length for flanges connections.
4. Add dimension "M" as shown on pg 39 for the appropriate isolator type.
5. Use of motors with motor hoods may increase overall unit dimensions. Add 150mm for 5DJ motor.

# Dimensions (mm) – Nozzle Arrangements

## EVAPORATORS – COMPACT WATER BOXES

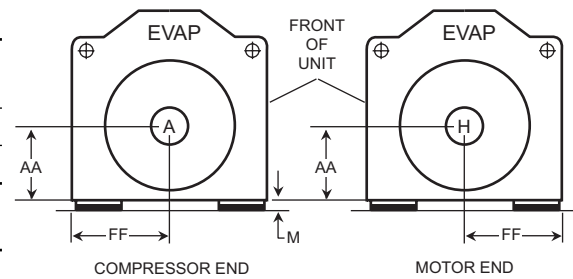
### X SIZE



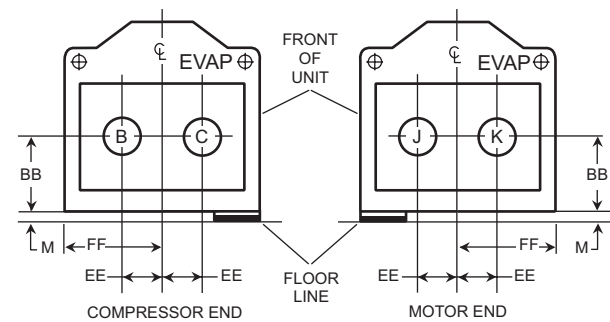
### 1-PASS

NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
1	A	H
	H	A

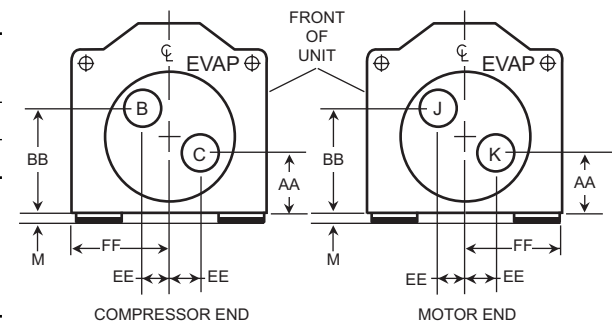
### Y, Z, A SIZES



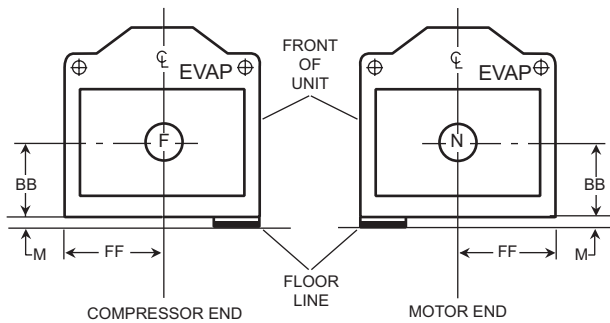
### 2-PASS



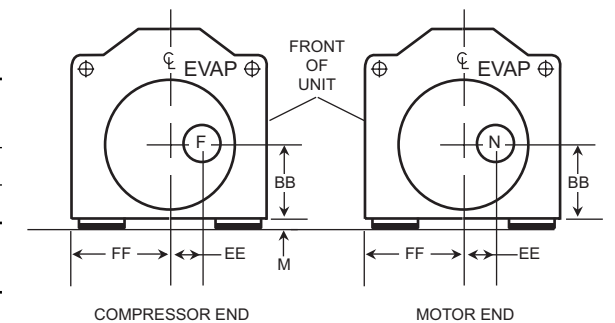
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
2	B	C
	C	B
	J	K
	K	J



### 3-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
3	F	N
	N	F



LD08641

EVAP. SHELL CODE	EVAPORATOR											
	NOZZLE PIPE SIZE			NOZZLE DIMENSIONS								
	NO. OF PASSES			1-PASS		2-PASS				3-PASS		
	1	2	3	AA <sup>2</sup>	FF	AA	BB <sup>2</sup>	EE	FF	BB <sup>2</sup>	EE	FF
X	20"	18"	14"	775	813	—	775	381	813	775	—	813
Y	24"	20"	16"	1,245	1,041	914	1,575	330	1,041	1,245	406	1,041
Z	24"	20"	18"	1,461	1,143	1,130	1,791	330	1,143	1,461	406	1,143
A	24"	20"	18"	1,537	1,219	1,207	1,867	330	1,219	1,537	406	1,219

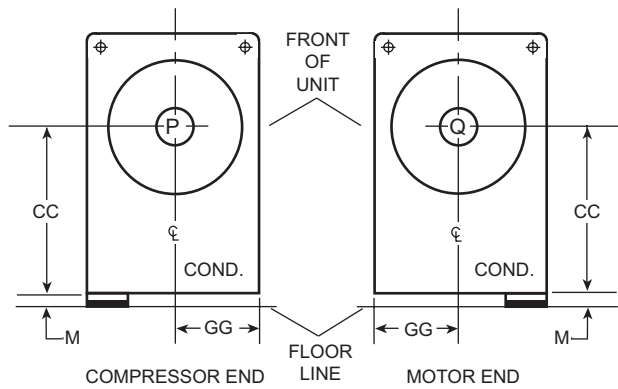
**NOTES:**

- Standard water nozzles are furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic 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.
- Add dimension "M" as shown on pg 39 for the appropriate isolator type.
- 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.
- Connected piping should allow for removal of compact water boxes for tube access and cleaning.



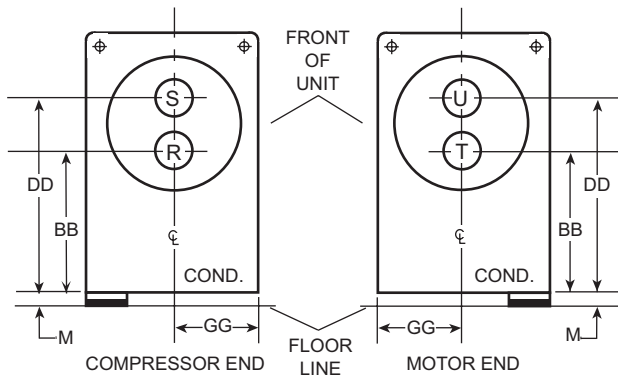
## CONDENSERS – COMPACT WATER BOXES

1-PASS



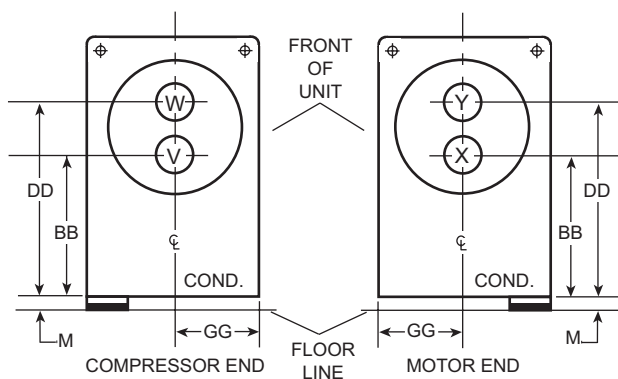
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	P Q	Q P

2-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
2	R T	S U

3-PASS



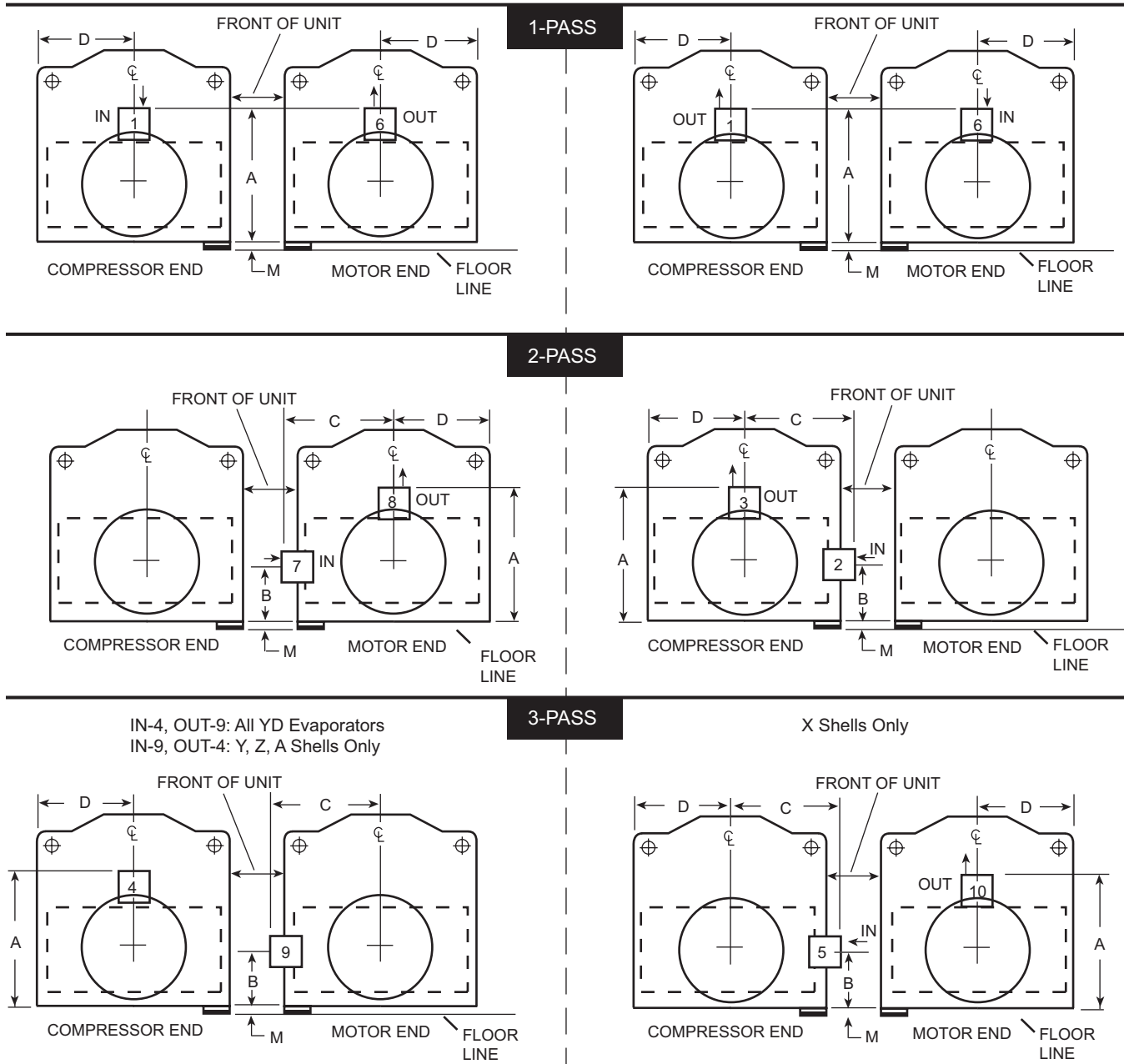
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
3	V X	Y W

LD08643

CONDENSER SHELL CODE	CONDENSER										
	NOZZLE PIPE SIZE			NOZZLE DIMENSIONS (mm)							
	NO. OF PASSES			1-PASS		2-PASS			3-PASS		
	1	2	3	CC <sup>2</sup>	GG	BB <sup>2</sup>	DD <sup>2</sup>	GG	BB <sup>2</sup>	DD <sup>2</sup>	GG
<b>X</b>	24"	18"	16"	1,041	749	711	1,372	749	711	1,372	749
<b>Y</b>	24"	20"	18"	1,168	902	775	1,562	902	711	1,626	902
<b>Z</b>	24"	20"	20"	1,321	953	851	1,791	953	813	1,829	953
<b>A</b>	24"	24"	20"	1,372	1,016	902	1,842	1,016	845	1,886	1,016

# Dimensions (mm) – Nozzle Arrangements

## EVAPORATORS – MARINE WATER BOXES



Note: X shells are rectangular. Y, Z & A shells have round waterboxes.

LD08644

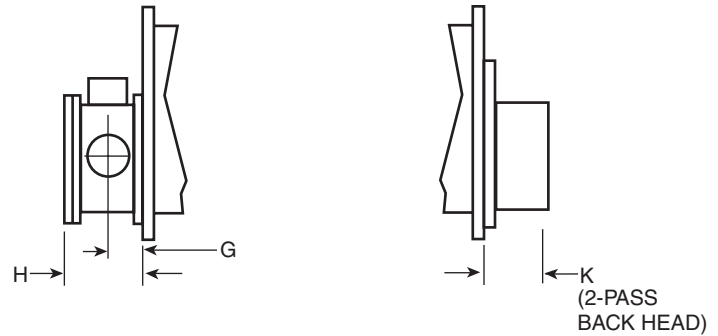
EVAP. SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (mm)									
	1-PASS		2-PASS				3-PASS			
	A <sup>5</sup>	D	A <sup>5</sup>	B <sup>5</sup>	C	D	A <sup>5</sup>	B <sup>5</sup>	C	D
X	1,365	813	1,365	679	965	813	1,365	629	962	813
Y	2,353	1,041	2,353	1,245	1,108	1,041	2,353	1,245	1,108	1,041
Z	2,686	1,143	2,686	1,461	1,226	1,143	2,686	1,461	1,226	1,143
A	2,845	1,219	2,845	1,537	1,308	1,219	2,845	1,537	1,308	1,219

CONDENSER	
1-PASS	
IN	OUT
1	6
6	1

CONDENSER	
2-PASS	
IN	OUT
2	3
7	8

EVAPORATOR		
3-PASS		
SHELLS	IN	OUT
X	5	10
X, Y, Z, A	9	4
Y, Z, A	4	9

EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
X	20"	18"	14"
Y	24"	20"	16"
Z	24"	20"	18"
A	24"	20"	18"



LD07195

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (kPa)	EVAPORATOR NOZZLE DIMENSIONS (2-PASS)		
		G	H	K
X	1034	368	813	419
	2068	483	1,067	330
Y	1034	419	927	413
	2068	486	1,232	448
Z	1034	429	940	464
	2068	492	1,276	495
A	1034	416	914	483
	2068	478	1,270	514

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (kPa)	EVAPORATOR NOZZLE DIMENSIONS (1-PASS)	
		G	H
X	1034	394	864
	2068	533	1,168
Y	1034	476	1,041
	2068	559	1,372
Z	1034	483	1,054
	2068	562	1,419
A	1034	473	1,032
	2068	549	1,410

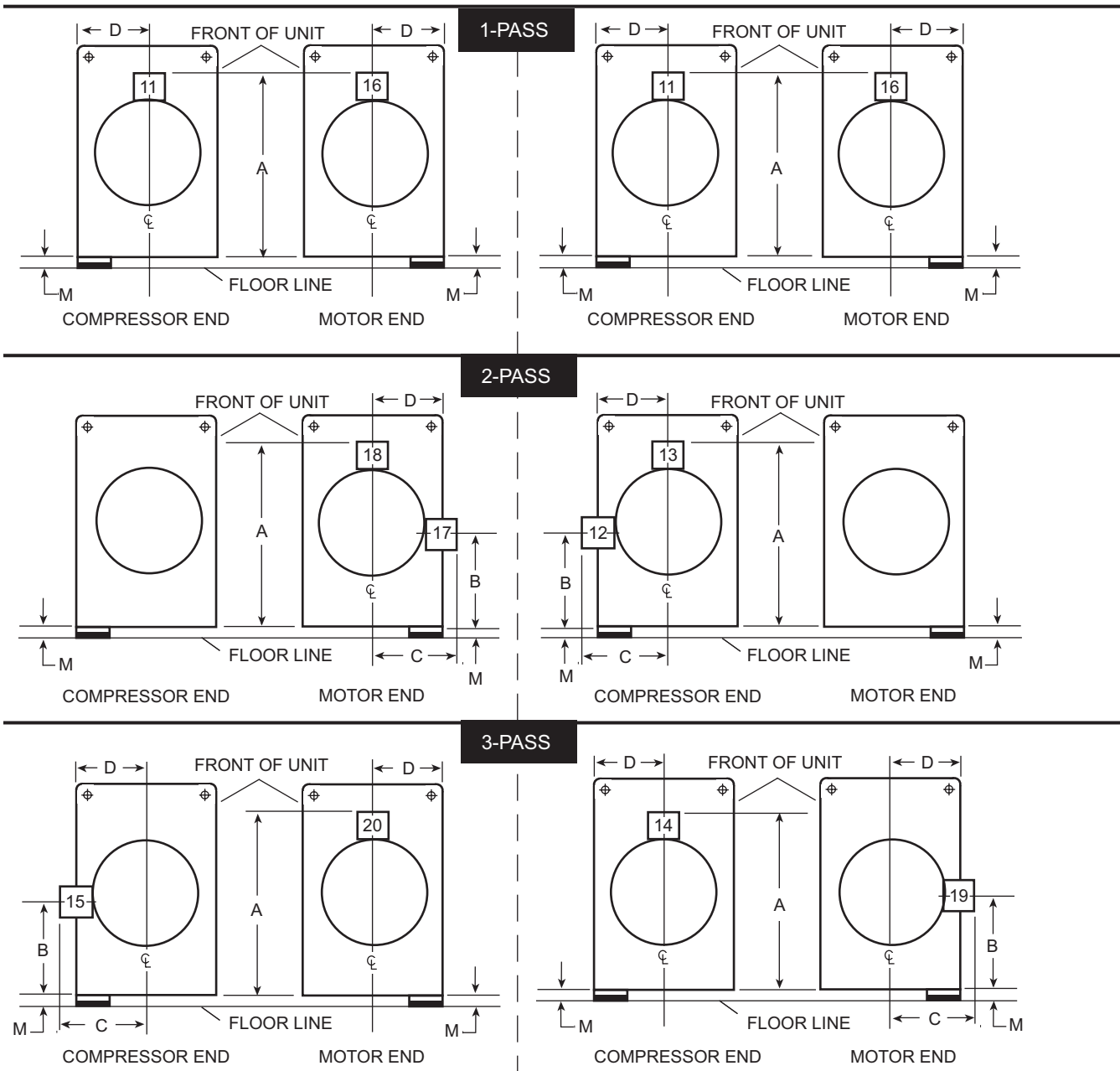
EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (kPa)	EVAPORATOR NOZZLE DIMENSIONS (3-PASS)	
		G	H
X	1034	318	711
	2068	394	889
Y	1034	368	826
	2068	422	1,105
Z	1034	397	876
	2068	460	1,216
A	1034	384	854
	2068	448	1,207

**NOTES (see Table on page 42):**

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Standard wall (9.5mm) pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic 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 pg 39 for the appropriate isolator type.

# Dimensions (mm) – Nozzle Arrangements

## CONDENSERS – MARINE WATER BOXES



COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (mm)									
	1-PASS		2-PASS				3-PASS			
	A <sup>5</sup>	D	A <sup>5</sup>	B <sup>5</sup>	C	D	A <sup>5</sup>	B <sup>5</sup>	C	D
X	1,956	749	1,956	749	864	749	1,956	675	864	749
Y	2,184	902	2,184	787	1,016	902	2,184	686	1,016	902
Z	2,388	953	2,388	940	1,067	953	2,388	813	1,067	953
A	2,480	1,016	2,480	965	1,108	1,016	2,480	864	1,108	1,016

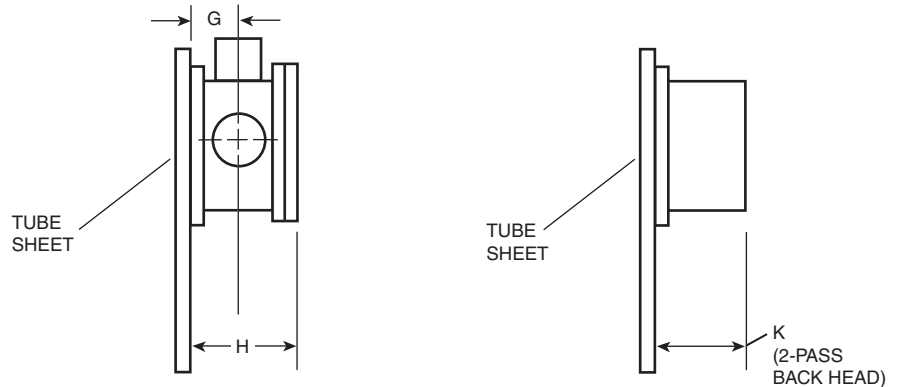
See Notes on page 45.

CONDENSER	
1-PASS	
IN	OUT
11	16
16	11

CONDENSER	
2-PASS	
IN	OUT
12	13
17	18

CONDENSER	
3-PASS	
IN	OUT
15	20
19	14

COND. SHELL CODE	NOZZLE PIPE SIZE		
	NO. OF PASSES		
	1	2	3
X	24"	18"	16"
Y	24"	20"	18"
Z	24"	24"	20"
A	24"	24"	20"



LD07195

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (kPa)	COND. NOZZLE DIMENSIONS (2-PASS)		
		G	H	K
X	1034	359	794	297
	2068	437	962	333
Y	1034	422	918	375
	2068	479	1,178	400
Z	1034	489	1,054	400
	2068	591	1,416	429
A	1034	476	1,038	413
	2068	559	1,372	451

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (kPa)	COND. NOZZLE DIMENSIONS (1-PASS)	
		G	H
X	1034	454	972
	2068	570	1,229
Y	1034	479	1,045
	2068	559	1,337
Z	1034	489	1,054
	2068	591	1,416
A	1034	476	1,038
	2068	559	1,372

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (kPa)	COND. NOZZLE DIMENSIONS (3-PASS)	
		G	H
X	1034	346	756
	2068	405	899
Y	1034	391	854
	2068	448	1,114
Z	1034	432	940
	2068	505	1,245
A	1034	419	924
	2068	489	1,232

**NOTES (see Table on page 44):**

- All dimensions are approximate. Certified dimensions are available upon request.
- Standard water nozzles are Standard wall (9.5mm) pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic 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.
- 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.
- Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
- Add dimension "M" as shown on pg 39 for the appropriate isolator type.

# Weights

**TABLE 10 – APPROXIMATE UNIT WEIGHT INCLUDING MOTOR & 150# COMPACT WATER BOXES\***

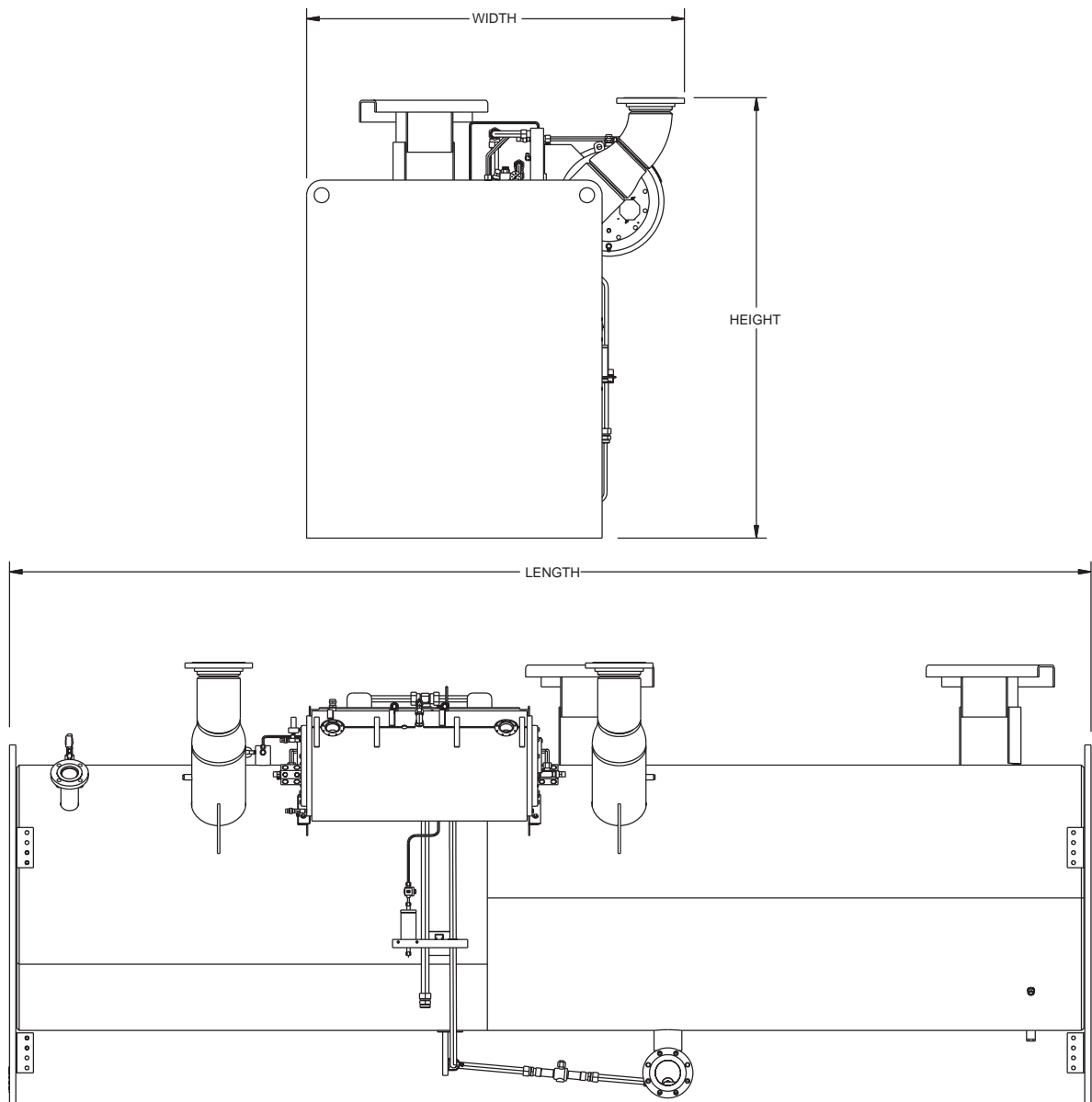
SHELLS	COMPRESSOR	SHIPPING WEIGHT (KG)	OPERATING WEIGHT (KG)	EST. REFRIGERANT CHARGE (KG)
X-X	J1,J2	34,300	42,800	2,722
Y-Y	J3	52,600	66,200	3,595
Z-Z	J4	61,700	78,000	4,411
A-A	J5	70,300	89,400	4,933

\* Refer to product drawings for detailed weight information.

**TABLE 11 – MARINE WATER BOX WEIGHTS (KG)  
WEIGHTS (To be added to Standard Unit weights shown above).**

EVAP. CODE	SHIPPING WEIGHT			OPERATING WEIGHT			COND. CODE	SHIPPING WEIGHT			OPERATING WEIGHT		
	INCREASE – KG			INCREASE – KG				INCREASE – KG			INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
X	2,109	1,114	1,964	2,477	1,483	2,322	X	2,311	1,032	2,051	4,449	1,824	3,528
Y	4,829	2,963	6,083	8,473	4,497	8,640	Y	3,251	1,710	3,399	5,697	2,719	5,179
Z	6,810	3,813	7,474	11,473	5,770	10,976	Z	3,839	2,304	4,151	6,345	3,556	6,171
A	7,808	4,051	7,749	12,886	6,162	11,494	A	4,570	2,679	4,878	8,215	4,501	7,947

# Component Dimensions



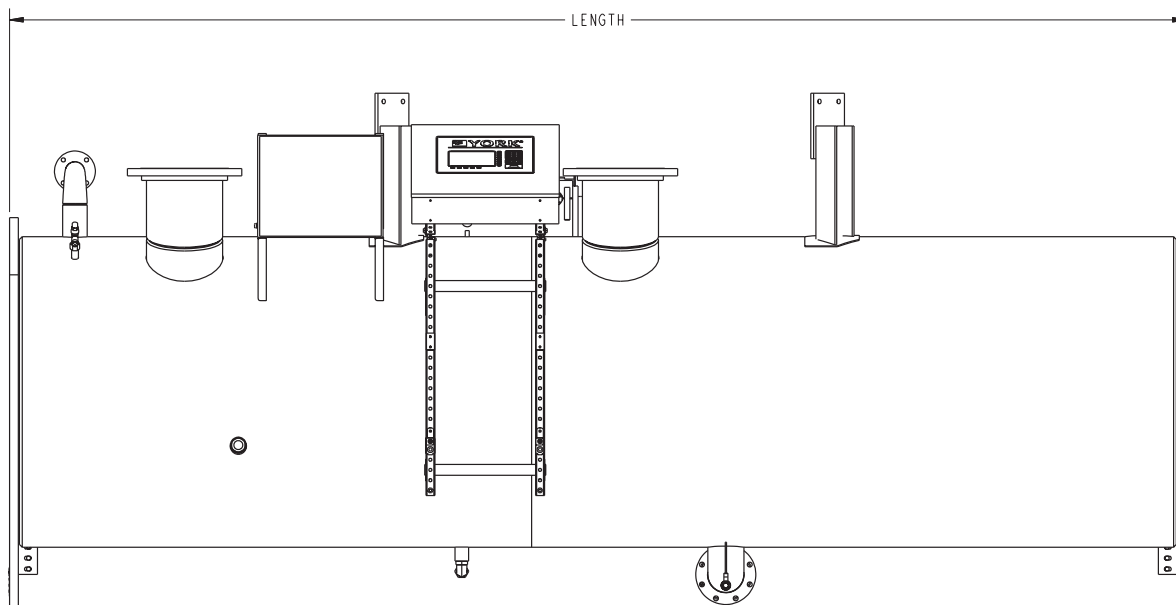
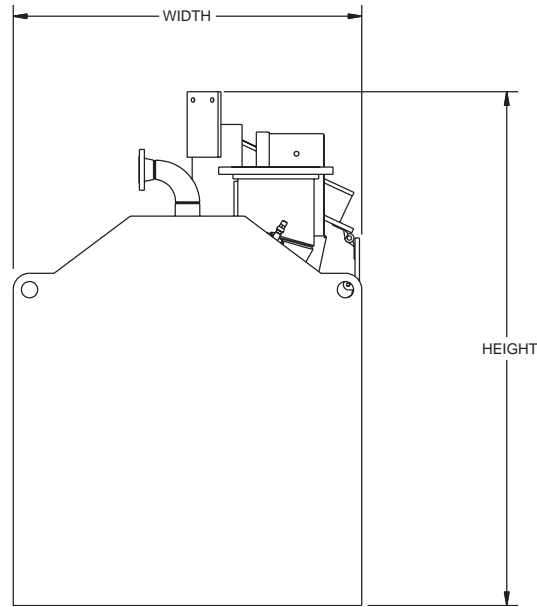
## CONDENSER SECTION

UNIT MODEL COMPR./ SHELLS	DIMENSIONS (FT./IN.)			DIMENSIONS (MM)		
	LENGTH	*HEIGHT	WIDTH	LENGTH	*HEIGHT	WIDTH
J1-J2/X Shells	18'-0"	7'-11"	5'-4"	5486	2413	1625
J3/Y Shells	18'-0"	8'-8"	7'-7-1/4"	5486	2642	2318
J4/Z Shells	18'-0"	9'-3"	7'-6-1/2"	5486	2819	2299
J5/A Shells	18'-0"	9'-9"	7'-10-3/4"	5486	2972	2407

For overall length dimension add the waterbox dimensions from YD Engineering Guide to Length dimension in chart.

\* Add an additional 6" to Height for optional skids.

# Component Dimensions (continued)



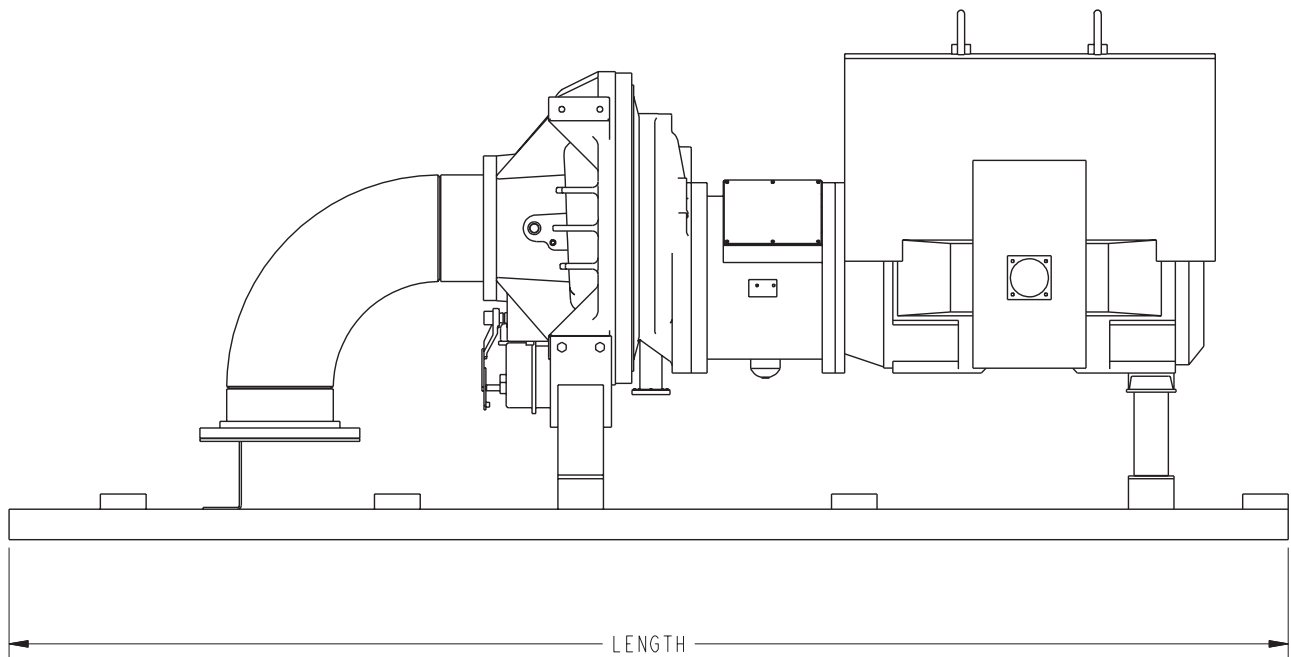
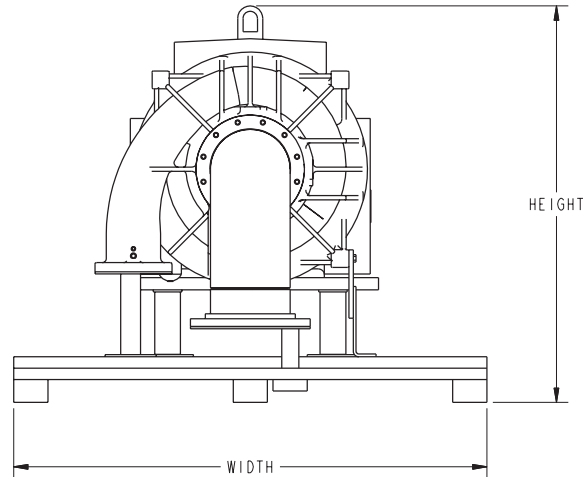
## EVAPORATOR SECTION

UNIT MODEL COMPR./ SHELLS	DIMENSIONS (FT./IN.)			DIMENSIONS (MM)		
	LENGTH	*HEIGHT	WIDTH	LENGTH	*HEIGHT	WIDTH
J1-J2/X Shells	18'-0"	7'-5"	6'-3'-1/2"	5486	2261	1918
J3/Y Shells	18'-0"	9'-1"	6'-10"	5486	2769	2083
J4/Z Shells	18'-0"	9'-8"	7'-6"	5486	2947	2286
J5/A Shells	18'-0"	10'-2"	8'-0"	5486	3099	2437

For overall length dimension add the waterbox dimensions from YD Engineering Guide to Length dimension in chart.

\* Add an additional 6" to Height for optional skids.





**DRIVELINE SECTION (TWO)**

UNIT MODEL COMPR./ SHELLS	DIMENSIONS (FT./IN.)			DIMENSIONS (MM)		
	LENGTH	*HEIGHT	WIDTH	LENGTH	*HEIGHT	WIDTH
J1-J2/X Shells	14'-0"	5'-9-5/8"	6'-11"	4267	1768	2108
J3/Y Shells	14'-0"	7'-3-3/8"	6'-11"	4267	2219	2108
J4/Z Shells	14'-0"	7'-3-3/8"	6'-11"	4267	2219	2108
J5/A Shells	14'-0"	7'-3-3/8"	6'-11"	4267	2219	2108

\*Height dimensions are for largest standard motor available for that compressor. Special motor enclosure hoods or motors above 4160 voltage may increase the shipping size.

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# Guide Specifications

## GENERAL

Furnish and install where indicated on the drawings \_\_\_\_\_ YORK MAXE model YD Dual Centrifugal Compressor Liquid Chilling Unit(s). Each unit shall produce a capacity of \_\_\_\_\_ tons, cooling \_\_\_\_\_ GPM of \_\_\_\_\_ from \_\_\_\_\_ °F to \_\_\_\_\_ °F when supplied with \_\_\_\_\_ GPM of condenser water at \_\_\_\_\_ °F. Total power input (two motors) shall not exceed \_\_\_\_\_ kW with an IPLV (APLV) of \_\_\_\_\_. The evaporator shall be selected for \_\_\_\_\_ fouling factor and a maximum liquid pressure drop of \_\_\_\_\_ ft. Water side shall be designed for 150 PSIG working pressure. The condenser shall be selected for \_\_\_\_\_ fouling factor and maximum liquid pressure drop of \_\_\_\_\_ ft. Water-side shall be designed for 150 PSIG working pressure. Power shall be supplied to the compressor drive motors at \_\_\_\_\_ volts – 3-phase – (60)(50) Hertz. Auxiliary power to the oil pump motors and controls shall be supplied at \_\_\_\_\_ volts – 3-phase – (60)(50) Hertz

(or)

Furnish and install where indicated on the drawings \_\_\_\_\_ YORK MAXE model YD Dual Centrifugal Compressor Liquid Chilling Unit(s). Each unit shall produce a capacity of \_\_\_\_\_ kW, cooling \_\_\_\_\_ L/S of \_\_\_\_\_ from \_\_\_\_\_ °C to \_\_\_\_\_ °C when supplied with \_\_\_\_\_ L/S of condenser water at \_\_\_\_\_ °C. Total power input (two motors) shall not exceed \_\_\_\_\_ kW with an IPLV (APLV) of \_\_\_\_\_. The evaporator shall be selected for \_\_\_\_\_ m<sup>2</sup>C/W fouling factor and maximum liquid pressure drop of \_\_\_\_\_ kPa. Waterside shall be designed for 10.3 barg working pressure. The condenser shall be selected for \_\_\_\_\_ fouling factor and maximum liquid pressure drop of \_\_\_\_\_ kPa. Waterside shall be designed for 10.3 bar g working pressure. Power shall be supplied to the compressor drive motors at \_\_\_\_\_ volts – 3-phase – 50 Hertz. Auxiliary power to the oil pump motors and controls shall be supplied at \_\_\_\_\_ volts - 3-phase – 50 Hertz.

Performance shall be rated in accordance with the latest edition of ARI Standard 550/590 as applicable.

Each unit shall be completely factory-packaged including evaporator, condenser, sub-cooler, compressors, open motors, lubrication system, OptiView Control Center, and all interconnecting unit piping and wiring. The chiller shall be painted prior to shipment. Larger (J3 to J5 compressor) size chillers shall be shipped disassembled, with the drivelines removed and skidded and the evaporator and condenser split. The initial charge of oil and refrigerant shall be supplied, shipped in containers and cylinders for field installation or factory charged in the chiller.

## COMPRESSORS

Two centrifugal compressors shall be provided, operat-

ing in parallel and utilizing a common Refrigerant circuit on the chiller. An electrically operated tight closing butterfly valve shall be furnished in the discharge of each compressor, to allow either compressor to be turned off at low chiller loads.

Each compressor shall be a single-stage centrifugal type, powered by an open-drive electric motor. The housing shall be fully accessible with vertical circular joints, with the complete operating assembly removable from the compressor and scroll housing. Compressor castings shall be designed for a minimum 235 PSIG working pressure and hydrostatically pressure tested at a minimum of 352 PSIG. The rotor assembly shall consist of a heat-treated alloy steel drive shaft and impeller shaft with a cast aluminum, fully shrouded impeller. The impeller shall be designed for balanced thrust, dynamically balanced and overspeed tested for smooth, vibration-free operation. Insert-type journal and thrust bearings shall be fabricated of aluminum alloy, precision bored and axially grooved.

Internal single helical gears with crowned teeth shall be designed so that more than one tooth is in contact at all times to provide even load distribution and quiet operation. Each gear shall be individually mounted in its own journal and thrust bearings to isolate it from impeller and motor forces. Shaft seal shall be provided in double bellows, double-seal, cartridge type. A gravity-fed oil reservoir shall be built into the top of the compressor to provide lubrication during coastdown in the event of a power failure.

Capacity control shall be achieved by use of pre-rotation vanes to provide fully modulating control from full load to minimum load. Control shall automatically compensate for adverse operating conditions, such as fouled tubes, and adjust to prior operation after correction of these conditions.

The unit shall be capable of continuous, reliable operation with low ECWT at all load conditions as outlined on the equipment schedule. An external electric actuator shall automatically control pre-rotation vane position for each compressor.

## LUBRICATION SYSTEM

Lubrication oil shall be force-fed to all compressor bearings, gears, and rotating surfaces by variable speed oil pumps mounted in a common pump housing or oil reservoir. Each oil pump shall vary oil flow to its compressor based on operating and stand-by conditions, ensuring adequate lubrication at all times. The oil pump shall operate prior to start-up, during compressor operation

# Guide Specifications (continued)

and during coast-down. Each compressor shall have an internal auxiliary reservoir to provide lubrication during coast-down in the event of a power failure.

A common oil reservoir mounted below the dual centrifugal compressors shall contain a 2 HP submersible oil pump for each compressor. Each oil pump shall be built into a removable cast iron cover, one at each end of the reservoir. The oil reservoir shall be UL listed and shall be factory air strength tested at 1.1 times design working pressure. A 4800 watt external rubber impregnated blanket heater shall be applied to the lower half of the oil reservoir. The heater shall be thermostatically controlled to remove refrigerant from the oil. A removable reinforced cloth covered fiberglass filled blanket shall provide thermal insulation and protection for the heater and reservoir.

Oil cooling shall be done via a refrigerant cooled oil cooler at the discharge of each oil pump. A thermostatically controlled bypass valve shall maintain the required oil temperature supply from each oil cooler to its compressor. Oil shall be filtered by externally mounted ½ micron replaceable cartridge oil filters, equipped with service valves. An automatic oil return system to recover any oil that may have migrated to the evaporator shall be provided. Oil piping shall be completely factory installed and tested.

## MOTOR DRIVELINE

Each compressor motor shall be an open drip-proof, squirrel cage, induction type operating at 3570 rpm (2975 rpm for 50 Hz operation).

Each open motor shall be provided with a D-flange, bolted to a cast iron adaptor mounted on the compressor to allow the motor to be rigidly coupled to the compressor to provide factory alignment of motor and compressor shafts.

Each Motor drive shaft shall be directly connected to its compressor shaft with a flexible disc coupling. The coupling shall have all metal construction with no wearing parts to assure long life, and no lubrication requirements to provide low maintenance. For units utilizing remote electromechanical starters, a large steel terminal box with gasketed front access cover shall be provided for field-connected conduit. Overload / over-current transformers shall be furnished with all units.

## EVAPORATOR

Evaporator shall be of the shell-and-tube, flooded type

designed for a minimum of 180 PSIG (1241 kPa) working pressure on the refrigerant side. Shell shall be fabricated from rolled carbon steel plates with fusion welded seams, carbon steel tube sheets, drilled and reamed to accommodate the tubes, and intermediate tube supports spaced no more than four feet apart. The refrigerant side of each shell is designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII – Division I, or other pressure vessel code as appropriate.

Heat exchanger tubes shall be high-efficiency, externally and internally enhanced type. Tubes shall utilize the "skip-fin" design, providing a smooth internal and external surface at each intermediate tube support. This provides extra wall thickness and non-work hardened copper at the support location, extending the life of the heat exchangers. If skip-fin tubes are not used, minimum tube wall thickness shall be 0.035" (0.889 mm). Each tube shall be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes shall not exceed 12 ft./sec. (3.65 m/sec). A liquid level sight glass shall be provided on the side of the shell to aid in determining proper refrigerant charge and to check condition of the refrigerant charge. Aluminum mesh eliminators shall be located above the tube bundle to prevent liquid refrigerant carryover to the compressor. The evaporator shall have a refrigerant relief device sized to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration.

Water boxes shall be removable to permit tube cleaning and replacement. Stub-out water connections having Victaulic grooves shall be provided. Water boxes shall be designed for 150 PSIG (1034 kPa) design working pressure and be tested at 225 PSIG (1551 kPa). Vent and drain connections with plugs shall be provided on each water box. Low flow protection shall be provided by a thermal-type flow sensor, factory mounted in the water nozzle connection and wired to the chiller panel.

## CONDENSER

Condenser shall be of the shell-and-tube type, designed for a minimum of 235 PSIG (1620 kPa) working pressure on the refrigerant side. Shell shall be fabricated from rolled carbon steel plates with fusion welded seams. Carbon steel tube sheets, drilled and reamed to accommodate the tubes, are welded to the end of each shell. Intermediate tube supports are drilled and reamed to eliminate sharp edges, fabricated from carbon steel plates. The refrigerant side of each shell is designed, tested and stamped in accordance with ASME Boiler

and Pressure Vessel Code, Section VIII – Division I, or other pressure vessel code as appropriate.

Heat exchanger tubes shall be high efficiency, externally and internally enhanced type. Tubes shall utilize the “skip-fin” design, providing a smooth internal and external surface at each intermediate tube support. This provides extra wall thickness and non-work hardened copper at the support location, extending the life of the heat exchangers. If skip-fin tubes are not used, minimum tube wall thickness shall be 0.035” (0.889 mm). Each tube shall be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes shall not exceed 12 ft./sec. (3.65 m/sec.). A liquid level sight glass shall be provided on the side of the shell to aid in determining proper refrigerant charge and to check condition of the refrigerant charge. The condenser shall have dual refrigerant relief devices; each sized to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration. Arrangement shall allow either valve to be isolated and replaced without removing the unit refrigerant charge.

The condenser shall be provided with positive shut-off valves in each compressor discharge line to the condenser. Additional tight closing valves shall be included in the liquid line leaving the condenser and the refrigerant liquid line to the oil coolers. This will allow pump-down and storage of the refrigerant charge in the condenser. Due to the possibility of not seating properly, check valves are not acceptable for isolation purposes. If a check valve is used, a positive shutoff valve must be provided in series with the check valve.

Water boxes shall be removable to permit tube cleaning and replacement. Stub-out water connections having Victaulic grooves shall be provided. Water boxes shall be designed for 150 PSIG (1034 kPa) design working pressure and be tested at 225 PSIG (1551 kPa). Vent and drain connections with plugs shall be provided on each water box. Low flow protection shall be provided by a thermal-type water flow sensor, factory mounted in the water nozzle connection and wired to the chiller control panel.

### REFRIGERANT FLOW CONTROL

Refrigerant flow to the evaporator shall be controlled by a variable orifice control valve. The variable orifice control shall automatically adjust to maintain proper refrigerant level in the condenser and evaporator. This shall be controlled by monitoring refrigerant liquid level in the condenser, assuring optimal subcooler performance.

### OPTIVIEW CONTROL CENTER

**General** – The chiller shall be controlled by a single microprocessor based control center. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches. The chiller panel shall provide capacity control operation of the two parallel compressors, and shall provide cycling of compressors in response to load requirements.

**Control Panel** – The control panel shall include a 10.4-in. diagonal color liquid crystal display (LCD) surrounded by “soft “ keys which are redefined based on the screen displayed at that time. This shall be mounted in the middle of a keypad interface and installed in a locked enclosure. The screen shall detail all operations and parameters, using a graphical representation of the chiller and its major components. Panel verbiage shall be available in other languages as an option, with English always available. Data shall be displayed in either English or Metric units. Smart Freeze Point Protection shall run the chiller at 36°F (2.2°C) leaving chilled water temperature, and not have nuisance trips on low water temperature. The sophisticated program and sensor shall monitor the chiller water temperature to prevent freeze-up. When needed, Hot Gas Bypass is available as an option. The panel shall display countdown timer messages so the operator knows when functions are starting and stopping. Every programmable point shall have a pop-up screen with the allowable ranges, so that the chiller can not be programmed to operate outside of its design limits.

The chiller control panel shall also provide:

1. System operating information including:
  - a. return and leaving chilled water temperature
  - b. return and leaving condenser water temperature
  - c. evaporator and condenser saturation temperature
  - d. differential oil pressure (both compressors)
  - e. percent motor current (both motors)
  - f. compressor discharge temperature (both compressors)
  - g. oil reservoir temperature
  - h. compressor thrust bearing positioning (both compressors)
  - i. chiller operating hours, and operating hours of each compressor
  - j. number of unit starts, and number of starts each compressor

# Guide Specifications (continued)

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 coastdown
  - d. system safety shutdown – manual restart
  - e. system cycling shutdown – auto restart
  - f. system prelube
  - g. start inhibit
4. The text displayed within the system status and system details field shall be displayed as color-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. Safety shutdowns shall include:
  - a. evaporator – low pressure
  - b. evaporator – transducer or leaving liquid probe
  - c. evaporator – transducer or temperature sensor
  - d. discharge – high pressure contacts open (each compressor)
  - e. condenser – high pressure
  - f. condenser – pressure transducer out-of-range
  - g. auxiliary safety – contacts closed
  - h. discharge – high temperature (each compressor)
  - i. discharge – low temperature (each compressor)
  - j. oil – high temperature
  - k. oil – low differential pressure (each compressor)
  - l. oil – high differential pressure (each compressor)
- m. oil – sump pressure transducer out-of-range
- n. oil – differential pressure calibration (each compressor)
- o. oil – variable speed pump – pressure setpoint not achieved (two)
- p. control panel – power failure
- q. thrust bearing – proximity probe clearance (each compressor)
- r. thrust bearing – proximity probe out-of-range (each compressor)
- s. thrust bearing – proximity probe uncalibrated (each compressor)
- t. watchdog – software reboot
- u. surge detection – excess surge
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. Cycling shutdowns shall include:
  - a. multi-unit cycling – contacts open
  - b. system cycling – contacts open
  - c. oil – low temperature differential
  - d. oil – low temperature
  - e. control panel – power failure
  - f. leaving chilled liquid – low temperature
  - g. leaving chilled liquid – flow switch open
  - h. motor controller – contacts open (each motor)
  - h. motor controller – loss of current (each motor)
  - i. power fault for each motor
  - j. control panel – schedule
  - k. proximity probe – low supply voltage
  - l. oil – variable speed pump – drive contacts open (each pump)
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 shall be 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 shall 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 shall be retained in lithium battery-backed RTC memory for a minimum of 11 years with power removed from the system.
    - c. remote current limit setpoint adjust
    - d. remote ready to start contacts
    - e. safety shutdown contacts
    - f. cycling shutdown contacts
    - g. run contacts
  10. A fused connection through a transformer mounted on the variable speed oil pump panel shall 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 preprogrammed to print from 1 minute to 1 day.
  13. The capability to interface with a building automation system to provide:
    - a. remote chiller start and stop
    - b. remote leaving chiller liquid temperature adjust

#### **REMOTE ELECTRO-MECHANICAL COMPRESSOR MOTOR STARTER (OPTION)**

A remote mounted electro-mechanical starter shall be furnished for each compressor motor. The starter shall be furnished in accordance with the chiller manufacturer's starter specifications R-1137, and as specified elsewhere in these specifications.

#### **PORTABLE REFRIGERANT STORAGE / RECYCLING SYSTEM**

(OPTION) A portable, self-contained refrigerant storage/recycling system shall be provided consisting of a refrigerant compressor with oil separator, storage receiver, water-cooled condenser, filter drier and necessary valves and hoses to remove, replace and distill refrigerant. All necessary controls and safety devices shall be a permanent part of the system.

# SI Metric Conversion

Values provided in this manual are in the English inch-pound (I-P) system.  
The following factors can be used to convert from English to the most common SI Metric values.

MEASUREMENT	MULTIPLY THIS ENGLISH VALUE	BY	TO OBTAIN THIS METRIC VALUE
CAPACITY	TONS REFRIGERANT EFFECT (ton)	3.516	KILOWATTS (kW)
POWER	KILOWATTS (kW)	NO CHANGE	KILOWATTS (kW)
	HORSEPOWER (hp)	0.7457	KILOWATTS (kW)
FLOW RATE	GALLONS / MINUTE (gpm)	0.0631	LITERS / SECOND (L/s)
LENGTH	FEET (ft)	304.8	MILLIMETERS (mm)
	INCHES (in)	25.4	MILLIMETERS (mm)
WEIGHT	POUNDS (lb)	0.4536	KILOGRAMS (kg)
VELOCITY	FEET / SECOND (fps)	0.3048	METERS / SECOND (m/s)
PRESSURE DROP	FEET OF WATER (ft)	2.989	KILOPASCALS (kPa)
	POUNDS / SQ. INCH (psi)	6.895	KILOPASCALS (k Pa)

## TEMPERATURE

To convert degrees Fahrenheit (°F) to degrees Celsius (°C), subtract 32° and multiply by 5/9 or 0.5556.

To convert a temperature range (i.e., 10°F or 12°F chilled water range) from Fahrenheit to Celsius, multiply by 5/9 or 0.5556.

## EFFICIENCY

In the English I-P system, chiller efficiency is measured in kW / ton:

$$\text{kW / ton} = \frac{\text{kW input}}{\text{tons refrigerant effect}}$$

In the SI Metric system, chiller efficiency is measured in Coefficient of Performance (COP).

$$\text{COP} = \frac{\text{kW refrigeration effect}}{\text{kW input}}$$

kW / ton and COP are related as follows:

$$\text{kW/ton} = \frac{3.516}{\text{COP}}$$

$$\text{COP} = \frac{3.516}{\text{kW/ton}}$$

## FOULING FACTOR

ENGLISH I-P (ft <sup>2</sup> °F hr/Btu)	EQUIVALENT SI METRIC (m <sup>2</sup> k/kW)
0.0001	.018
0.00025	.044
0.0005	.088
0.00075	.132

