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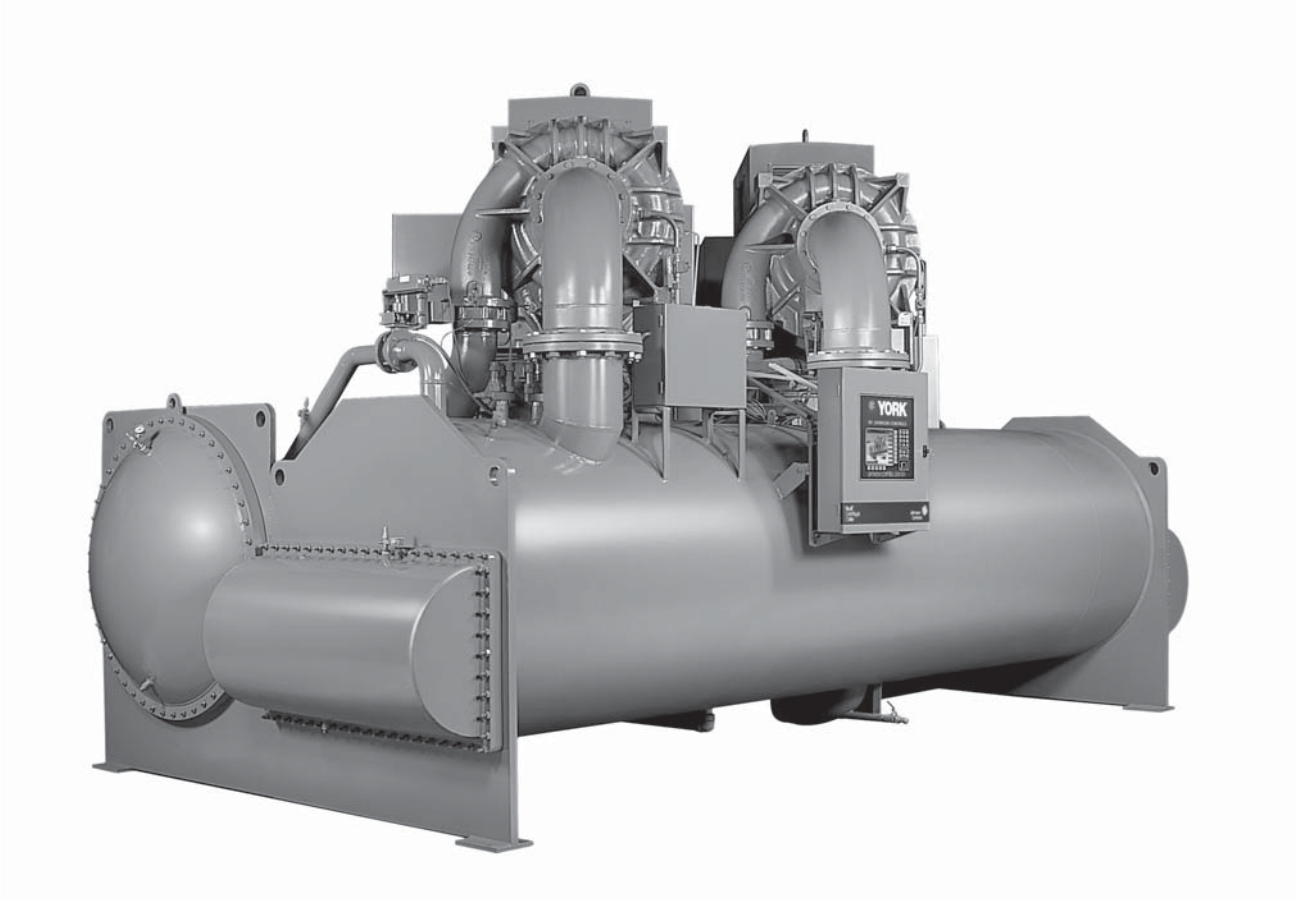
YORK®

BY JOHNSON CONTROLS



Model YD Dual Centrifugal Compressor Liquid Chillers
Design Level C

1500 THROUGH 6000 TONS
(5265 through 21096 kW)

Utilizing HFC-134a

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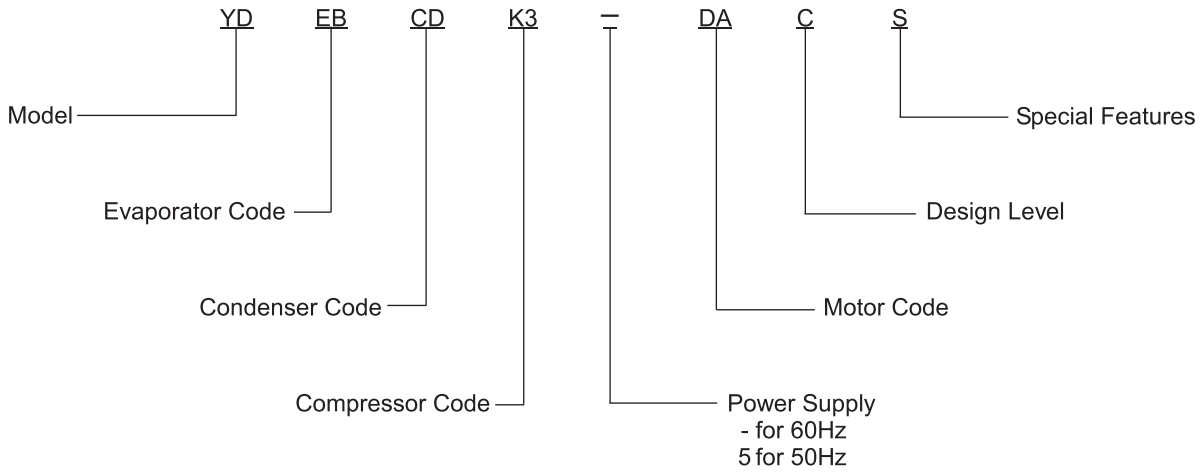
NOMENCLATURE



Introduction

The YORK® 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 YD chiller technology matches chiller system components to provide maximum chiller efficiency under actual – not just theoretical – operating conditions.

REAL WORLD ENERGY PERFORMANCE

Johnson Controls pioneered the term “Real World Energy” to illustrate the energy saving potential of focusing on chiller performance during off design conditions. Off design 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 YD 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 YD 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 YD 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 in-rush current of each smaller motor is less. This provides a lower burden on the building electrical system. Also, use of two smaller motors allows low 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

YD chiller heat exchangers offer the latest technology in heat transfer surface design to give you maximum efficiency and compact design. Waterside 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 YD centrifugal chillers incorporate single stage compressor design. With fewer moving parts and straightforward, efficient engineering, YORK single stage compressors have proven durability records in the U.S. Navy, hospitals, chemical plants, gas processing plants, 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, Johnson Controls 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 chillers feature two variable speed drive oil pumps, monitoring 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 YD centrifugal chillers are designed to keep installation costs low. Where installation access is not a problem, the K1 and K2 compressor size YD dual compressor chillers may be shipped completely packaged. In order to save on shipping and rigging costs, larger K3 to K7 compressor size units are disassembled into four major components: two drivelines, the evaporator, and the 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 YD 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 YD 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 Johnson Controls sales office. These ratings can be tailored to specific job requirements.

OFF DESIGN PERFORMANCE

Since the vast majority of its operating hours are spent at off-design conditions, a chiller should be chosen not only to meet the full load design, but also for its ability to perform efficiently at lower loads and lower tower water temperatures. It is not uncommon for chillers with the same full load kW/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 within the AHRI Certification Program in the form of an Integrated Part Load Value (IPLV), and Non Standard Part Load Value (NPLV).

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

Sustainability Focus

OZONE-DEPLETION POTENTIAL (ODP)

The YORK YD chiller employs one the most environmentally friendly refrigerants available today, HFC-134a, with no Ozone Depletion Potential (ODP) and no phase out date per the Montreal Protocol.

Ozone is a very small part of the atmosphere, but its presence is nevertheless vital to human well-being. Most ozone resides in the upper part of the atmosphere. This region, called the stratosphere, is more than 10 kilometers (6 miles) above the Earth's surface. There, about 90% of atmospheric ozone is contained in the "ozone layer," which shields us from harmful ultraviolet radiation from the sun. However, it was discovered in the mid-1970s that some human-produced chemicals could destroy ozone and deplete the ozone layer. The resulting increase in ultraviolet radiation at the Earth's surface may increase the incidences of skin cancer and eye cataracts. Following the discovery of this environmental issue, researchers focused on gaining a better understanding of this threat to the ozone layer.

Monitoring stations showed that ozone-depleting chemicals were steadily increasing in the atmosphere. These trends were linked to growing production and use of chemicals like chlorofluorocarbons (CFCs) for refrigeration and air conditioning, foam blowing, and industrial cleaning. Measurements in the laboratory and the atmosphere characterized the chemical reactions that were involved in ozone destruction. Computer models employing this information could predict how much ozone depletion was occurring and how much more could occur in the future.

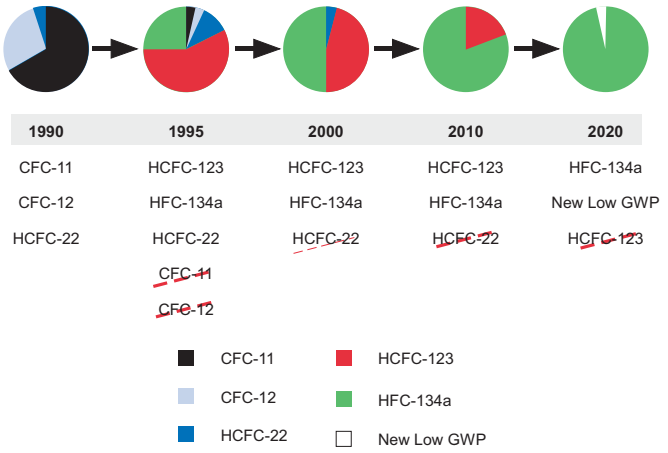
Observations of the ozone layer showed that depletion was indeed occurring. The most severe and most surprising ozone loss was discovered to be recurring in springtime over Antarctica. The loss in this region is commonly called the "ozone hole" because the ozone depletion is so large and localized. A thinning of the ozone layer also has been observed over other regions of the globe, such as the Arctic and northern middle latitudes. The work of many scientists throughout the world has provided a basis for building a broad and solid scientific understanding of the ozone depletion process. With this understanding, we know that ozone depletion is occurring and why. And, most important, we know that if ozone-depleting gases were to continue to accumulate in the atmosphere, the result would be more depletion of the ozone layer. In response to the prospect of increasing ozone depletion, the governments of the world crafted the 1987 United Nations Montreal Protocol as a global means to address this global issue. As a result of the broad compliance with the Protocol and its Amendments and Adjustments and, of great significance, industry's development of "ozone friendly" substitutes for the now-controlled chemicals, the total global accumulation of ozone-depleting gases has slowed and begun to decrease. This has reduced the risk of further ozone depletion.

THE MONTREAL PROTOCOL ADDRESSED CFC'S AND HCFC'S

The Montreal Protocol (MP) addressed CFC's and HCFC's with phase out schedule for all member parties of the MP based on the ODP characteristics. So this affects the first two categories of refrigerants listed in the table. Manufacturers in developed nations are in the final processes of converting from HCFC's to HFC's in accordance with the Montreal Protocol treaty. Markets in developing countries are already seeing a transition away from HCFC's ahead of legislative requirements.

HCFC's were used as a transitional refrigerant as they were a "Lesser Evil" and allowed the HVAC industry to quickly transition away from CFCs while maintaining

	REFRIGERANT	COMMON USE	ODP	GWP	STATUS	2007 GLOBAL USAGE (TONS)
CFC	CFC-11	CENTRIFUGALS	1.00	5000	PHASED OUT	TRACE
	CFC-12	CENTRIFUGALS	0.80	8500	PHASED OUT	TRACE
HCFC	HCFC-22	SCROLLS, SCREWS, UNITARY PRODUCTS	0.05	1700	PHASING OUT	700,000
	HCFC-123	CENTRIFUGALS	0.02	120	PHASING OUT	4,000
HFC	HFC-134A	CENTRIFUGALS, SCREWS	-	1300	NO PHASE OUT	250,000
	HFC-407C	SCREWS, SCROLLS	-	1600	NO PHASE OUT	100,000
	HFC-410A	SCROLLS, UNITARY PRODUCTS	-	1890	NO PHASE OUT	
	HFC-404A		-	3750	NO PHASE OUT	
	HFC-245FA	CENTRIFUGALS	-	1020	NO PHASE OUT	TRACE
	HFO-1234YF	CENTRIFUGALS	-	4	NO PHASE OUT	
HC (NATURAL REFR.)	HC-717 (NH_3)	SCREWS, CENTRIFUGALS	-	1	NO PHASE OUT	
	HC-718 (WATER)	ABSORPTION, VAPOR COMPRESSION	-	0	NO PHASE OUT	
	HC-290 (PROPANE)		-	3	NO PHASE OUT	
	HC-600A (BUTANE)		-	3	NO PHASE OUT	
	HC-744 (CO_2)		-	1	NO PHASE OUT	



energy efficiency. The fact remains that they destroy the ozone layer and are legislated to be completely phased out.

The Montreal Protocol does not extend to HFC's as they have no ODP nor does it extend to natural refrigerants for the same reason.

The typical usage of the refrigerant, the phase-out status by the Montreal Protocol and the global usage of refrigerant in tons is shown in the table on pg 5.

The chart above shows the growing use of HFC-134a in centrifugal chillers from 1995 up to 2010 and the forecast until the phase-out of HCFC's.

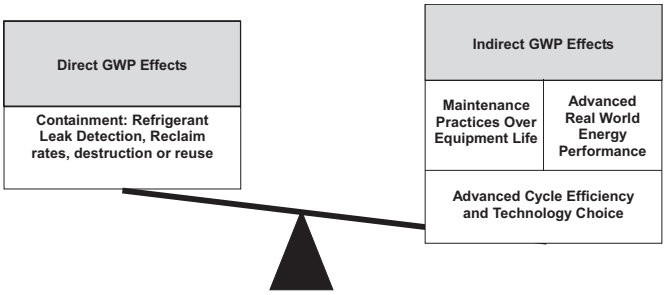
GLOBAL WARMING POTENTIAL (GWP)

Another main environmental topic is Global Warming potential (GWP), and when we talk about global warming we're primarily talking about smoke stacks and tail pipes. 85% of GWP is attributed to CO2 emissions, while only about 2% is related to HFC's.

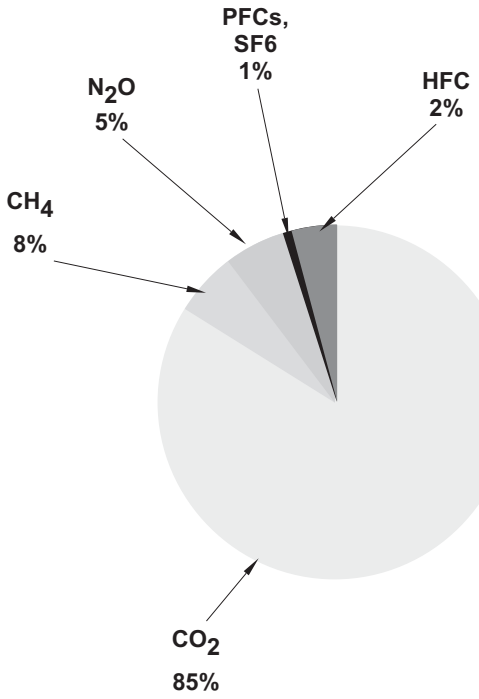
However, when we talk about the direct impact our YORK YD Centrifugal Chiller has on the environment we can make strides forward, like ensuring leak tight designs are created, and manufacturers are working to reduce refrigerant charges as much as possible.

DIRECT & INDIRECT GLOBAL WARMING POTENTIAL

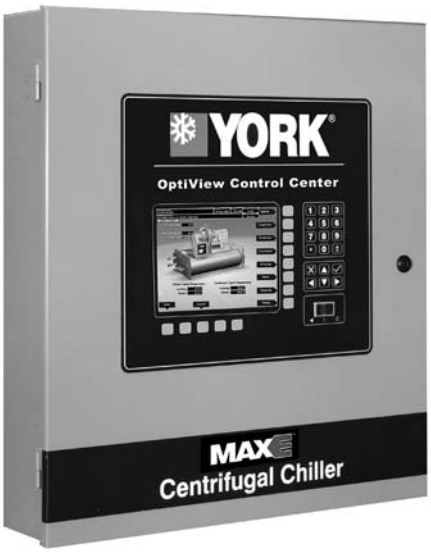
98% of the global warming potential of a centrifugal chiller is from the indirect effect or the greenhouse gases produced to generate the electricity to run the chiller. The YORK YD centrifugal chiller and its superior efficiency levels dramatically reduces the indirect GWP. 2% of the GWP is from the direct effect or release of the refrigerant gases into the atmosphere.



Minimizing the total climatic impact (direct and indirect GWP) requires a comprehensive approach to refrigerant choice.



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 microprocessor-based control system for R-134a centrifugal chillers. The panel is configured with a 10.4" diagonal color Liquid Crystal Display (LCD) surrounded by "soft" keys, which are redefined with one keystroke based on the screen displayed at that time. A single button push reveals a wide array of information on a large, full-color animated illustration of the appropriate component, which makes information easier to interpret. This revolutionary development makes chiller operation quicker and easier than ever before. The display is rated at 450 nits.

The use of on-screen animation enables operators to more readily identify component status. Additionally, the operator may view a graphical representation of the historical operation of the chiller as well as the present operation.

A Status Bar is displayed at all times on all screens. It contains the System - Status Line and Details Line, the Control Source, Access Level, Time and Date.

The locations of various chiller parameters are clearly marked and instructions for specific operations are provided for on many of the screens. Data can be displayed in either English or Metric units plus keypad entry of setpoints to 0.1 increments.

Security access is provided to prevent unauthorized changes of setpoints. This is accomplished with three different levels of access and passwords for each level.

There are certain screens, displayed values, programmable setpoints and manual controls not shown that are for servicing the chiller. They are only displayed when logged in at service access level. Included in this is the Advanced Diagnostics and troubleshooting information for the chiller and the panel.

The control panel is compatible with any electro-mechanical (E M) starter that complies with the YORK R-1137 standard.

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 Remote Start/Stop, Flow Switches, Chilled Water Pump and Local or Remote Cycling devices are provided. The panel also provides field interface contacts that indicate the chiller status. These 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 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 signal depending on reset needs. Serial data interface to the Johnson Controls Metasys™ Building Automation System (BAS) is through the optional MicroGateway Card, which can be mounted inside the Control Center.

OptiView Control Center - continued

This printed circuit board requests the required data from the Microboard and makes it available for the Johnson Controls Metasys network. This optional board is available through the Johnson Controls Building Efficiency 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 10 years minimum.

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.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.

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 Pull down 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 Electromechanical Starter. Programmable pull down demand to automatically limit motor loading for minimizing building demand charges. Pull down time period control over four hours, and verification of time remaining in pull down 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
- Current Limit Setpoints
- Pull down Demand Time Left

Programmable

- Local Motor Current Limit
- Pull down Demand Limit
- Pull down 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 pa-

rameters. 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
- Pull down Demand Limit
- Pull down 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 R-134a)
- 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 Metasys® 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
- 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 minimum and maximum 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)

OptiView Control Center - continued

- 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. During prelube and coast down, the system status will include a countdown timer indicating the time remaining. 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 Coast down (with countdown timers)
- Start Inhibit
- Chiller Unloading Before Shutdown

Run Messages include:
- Leaving Chilled Liquid Control
- Current Pull down 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

GENERAL

The YORK 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 (K3 to K7 compressor) YD chillers are disassembled for shipment.

The initial charge of refrigerant and oil is supplied for each chiller. Actual shipping procedures will depend on a number of project specific details.

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

COMPRESSOR

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 coast down. A gravity-fed oil reservoir is built into the top of each compressor to provide lubrication during coast down 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 cover, one at each end of the reservoir.

Two 2 kW immersion oil heaters are provided, one mounted in each pump cover. The heaters are thermostatically controlled from the sump oil temperature sensor.

A refrigerant cooled oil cooler is provided after each oil pump, eliminating the need for field water piping. A thermostatically controlled expansion valve maintains the required oil temperature supply from each oil cooler to its compressor. Oil is filtered by externally mounted ½ 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.

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" or 1" 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 single relief valve arrangement set at 180 PSIG (12.4 bar). A 1" refrigerant charging valve is provided.

Condenser

The condenser is a shell and tube type, with discharge gas diffuser to prevent direct high velocity impingement on the tubes. The diffusers provide dynamic pressure recovery and enhanced chiller efficiency. 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 (16.2 bar).

Water Boxes

The removable water boxes are fabricated of steel. The design working pressure is 150 PSIG (10.3 bar) and the boxes are tested at 225 PSIG (15.5 bar). Integral steel water baffles are located and welded within the water box to provide the required pass arrangements. Stub-out water nozzle connections with ANSI/AWWA C-606 couplings grooves are welded to the water boxes. These nozzle connections are suitable for ANSI/AWWA C-606 couplings, welding or flanges, and are capped for shipment. Plugged 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 (2nd) compressor.

CODES AND STANDARDS

- ASME Boiler and Pressure Vessel Code –Section VIII Division 1.
- AHRI 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

Mechanical Specifications - continued

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.

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. Optional condenser isolation valves allow storage of the charge in the condenser.

PAINT

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

SHIPMENT

K1 and K2 compressor size units may ship as a complete assembly. K3 to K7 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

BAS REMOTE CONTROL

A communication interface permitting a exchange of chiller data with a BACnet MS/TP, Modbus RTU, LONworks or N2 Metasys network is available by means of an optional E-Link®Gateway. The Johnson Controls E-Link® Gateway mounts conveniently inside the Optiview panel and allows remote BAS networks to monitor values and issue commands to the chiller to control operation.

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, tube sheets, suction connection, and (as necessary) to the auxiliary tubing. Not included is the insulation of waterboxes 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.

ELECTRO-MECHANICAL 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.

A. Characteristics

For comparison purposes, here is a description of some of the general characteristics of electromechanical starters. Until the development of the Solid State Starter, all centrifugal chillers required the use of starters using electro-mechanical contactors, which are limited to operating totally ON, or totally OFF. There was no alternative to this mechanical equipment with its inability to control applied voltage or power. This contrasts markedly with the YORK Medium Voltage Solid State Starter which automatically maintains a predetermined current during starting, regardless of variations in line voltage or motor load, to give optimum acceleration without surges. Even with the addition of transformers, reactors, resistors and additional contactors, timers and relays, the mechanical controllers offer limited adjustment, no positive control during starting and impose an objectionable transition spike. Some also require modified motors. A field-installed, electro-mechanical compressor motor starter is available, selected for proper size and type for job requirements and in accordance with Johnson Controls Engineering Standard (R-1137) for Starters. See Table 1, below.

The most common failure mode of mechanical contactors is OFF. This occurs due to the coil open-circuiting or failure of a pole to make an electrical contact when it closes. How-

TABLE 1 – ELECTRO-MECHANICAL STARTER

STARTER OPTIONS	LOW VOLTAGE / FREQUENCY															
LV ACROSS THE LINE (DOL) (FLOOR MOUNTED)	60HZ											50HZ				
	200V	208V	230V	240V	380V	416V	440V	460V	480V	575V	600V	346V	380V	400V	415V	440V
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LV STAR-DELTA CLOSED (FLOOR MOUNTED)	60HZ											50HZ				
	200V	208V	230V	240V	380V	416V	440V	460V	480V	575V	600V	346V	380V	400V	415V	440V
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
STARTER OPTIONS	MEDIUM VOLTAGE / FREQUENCY															
MV ACROSS THE LINE (DOL) (FLOOR MOUNTED)	60HZ							50HZ								
	2300	3300	4000	4160	6600	12470	13800	2300	3000	3300	6600	10000	11000			
	X	X	X	X	Y	Y	Y	X	X	X	Y	Y	Y			
MV AUTOTRANS-FORMER 65% (FLOOR MOUNTED)	60HZ							50HZ								
	2300	3300	4000	4160	6600	12470	13800	2300	3000	3300	6600	10000	11000			
	X	X	X	X	Y	Y	Y	X	X*	X*	Y	Y	Y			
MV AUTOTRANS-FORMER 80% (FLOOR MOUNTED)	60HZ							50HZ								
	2300	3300	4000	4160	6600	12470	13800	2300	3000	3300	6600	10000	11000			
	X	X	X	X	Y	Y	Y	X	X	X	Y	Y	Y			

* NOT AVAILABLE WITH 5DJ MOTOR / Y= AVAILABLE BY SPECIAL QUOTE (SQ)

** MEDIUM VOLTAGE SOLID STATE STARTERS (FLOOR MOUNTED) ARE AVAILABLE BY SPECIAL QUOTE (SQ)

ever, failure in the ON mode is not completely uncommon and can be a more dramatic type of failure, particularly if this failure mode exists at the same time that equipment safety controls are demanding a shutdown.

When contacts are "made," the current builds up to its maximum value from zero, but when contacts are separated the current tends to flow through the gap thus formed and causes an arc. This arcing depends upon the voltage between the separating contacts. For medium voltage the use of vacuum contactors mitigates this problem somewhat by providing an environment to extinguish the arc. In the alternating current circuit, the separation of contacts may take place when the current is zero or maximum or at any value in between. An alternating current passes through zero and reverses its polarity twice during each cycle. If two or more contacts, one in each leg of a polyphase system, are separated simultaneously, the current values in each will vary. In a three-phase system, if one contact has zero current when opened, the other two contacts will have 86.6% of their maximum values, as an example. Additionally, when inductive circuits are broken, the voltage is increased at the contacts due to the counter (induced) EMF of the circuit. The instant the contacts separate, the voltage between them momentarily rises from zero to the maximum of the circuit, or higher if inductance is present in the circuit. In practice, every time the contacts close, they bounce. When they bounce, they arc. The arcing occurs as the contacts make or break may result in rapid and excessive erosion of the contacts, causing prematurely short contact life.

B. Types

YORK chillers are designed for use with the following types of electro-mechanical starters, here briefly described.

Across-the-Line (ACL) – These are the simplest and lowest-cost starters available. They apply full voltage to the three motor leads at the instant of starting. Since inrush is 100% of LRA and starting torque is 100%, this is the roughest type of starting on the motor and driveline. In physical size, the ACL is the smallest of electro-mechanical starters and there is no transition surge. In most areas, utilities will not permit the use of this type of starter for chiller-size motors because of their large current draw on startup.

Auto-Transformer (AT) – These starters are reduced-voltage starters. Transformers are used to step down the voltage to the motor during startup. The result is reduced inrush current and starting torque at the level of 42% or 64% depending upon whether 65% or 80% voltage taps are used. They provide closed transition (with three-lead motors) with reduced line disturbance.

Star-Delta Starters – During starting, the motor is connected in a Star or Wye configuration. This reduces the voltage to the motor stator by a factor of three. This 1/3 voltage results in 1/3 current into the motor at start and 1/3 torque to the shaft. Centrifugal compressor starting torque requirements are low enough to allow the motor to start at 1/3 of full load torque.

SPECIAL MOTORS ENCLOSURES

There are job applications, primarily in manufacturing, comfort cooling plants, and process applications, where more motor protection is required. Listed below are several alternatives. NOTE: Chiller certification to UL by a third party could be affected. Contact JCI sales office for a specific selection.

Weather-Protected Type I Motors (WP-I) – A Weather-Protected Type I motor is an open machine with its ventilating passages constructed to prevent the passage of a cylindrical rod ¾" in diameter. This affords protection against intrusion of rodents and some types of debris. These are regularly used in the pulp industry and where grime is present.

Weather-Protected Type II Motors (WP-II) – A Weather-Protected Type II motor has, in addition to the enclosure defined for Weather-Protected Type I motor, ventilating passages at both intake and exhaust so arranged that high-velocity air and air-borne particles, blown into the motor, can be discharged without entering the internal ventilating passages leading directly to the electric parts of the machine itself. Space heaters are required with WP-II.

Totally Enclosed Fan-Cooled Motors (TEFC) – TEFC motors are used where the location is extremely dirty, dusty, or wet, both indoors and outdoors. A totally enclosed fan-cooled unit is enclosed to prevent the free exchange of air between the inside and outside of the case but not sufficiently enclosed as to be termed air-tight. It is air-cooled by means of a fully guarded fan blowing cooling air over the outside of the motor. The fan is externally mounted on the motor shaft.

Totally Enclosed Air-to-Air Cooled (TEAAC) – TEAAC motors are used when the environment is dirty or corrosive. A TEAAC motor is a totally enclosed motor, cooled by circulating the internal air through an air-to-air heat exchanger.

Totally Enclosed Water-to-Air Cooled (TEWAC) – TEWAC motors are used when the environment is dirty or corrosive, in hazardous areas, or where minimum noise levels are required. A TEWAC motor is a totally enclosed machine which is cooled by circulating internal air which, in turn, is cooled by circulating water. It is provided with an internal water-cooled heat exchanger for cooling the internal air and fans, integral with the rotor shaft for circulating the internal air.

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. ANSI/AWWA C-606 couplings 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

Standard isolation valves allow for 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.

OPTISOUND™ CONTROL

The YORK OptiSound™ Control is a patented combination of centrifugal chiller hardware and software that reduces operational sound levels, expands the chiller operating range, and improves chiller performance. The OptiSound Control feature continuously monitors the characteristics of the compressor discharge gas and optimizes the diffuser spacing to minimize gas flow disruptions from the impeller. This innovative technology improves operating sound levels of the chiller an average of 7 dBA, and up to 13 dBA on the largest models. It can also reduce part load sound levels below the full load level. See Figure 1.

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

Johnson Controls recommends the OptiSound Control for chiller applications with elevated entering condenser water temperatures (high head) or applications requiring low load operation with constant condenser temperature. At high head conditions, improved chiller operation is visible at all load points.

OptiSound Control Availability
Standard: Compressors K1 - K7

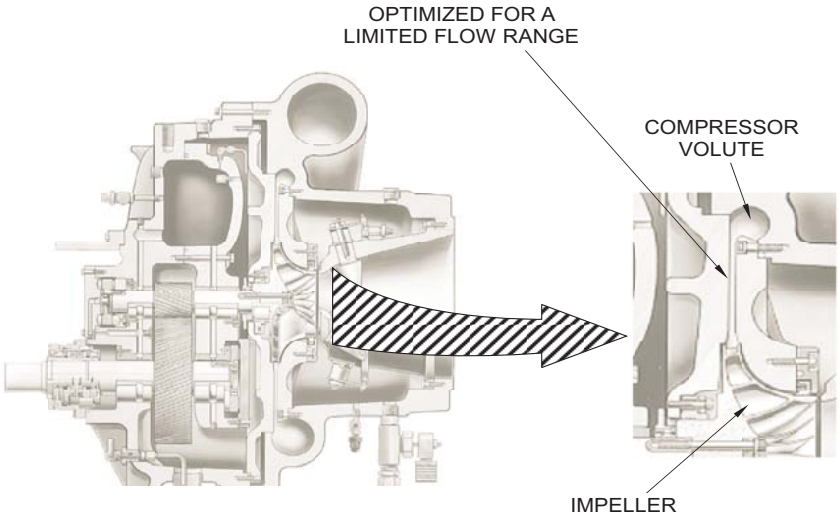


FIGURE 1 – TYPICAL CENTRIFUGAL COMPRESSOR

Application Data

The following discussion is a user's guide in the application and installation of YD 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 Johnson Controls sales representative can provide complete recommendations on other types of applications.

LOCATION

YD 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). The dew point temperature in the equipment room must be below the entering condenser water temperature to prevent condensing water vapor inside of the low voltage SSS cabinet (if applicable). Applications using cooling sources other than evaporative or closed loop air exchange methods need to request a factory-supplied temperature control valve to prevent condensation inside the SSS cabinet (if applicable). Other areas susceptible to water vapor condensate are outside of the condenser shell and condenser water boxes. Example applications include when the condenser water comes from chilled water, wells, river, or other low temperature fluids.

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 2 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 stopcocks 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 (10.3 bar) design working pressure in both the chilled water and condenser water circuits. The connections (water nozzles) to these circuits are furnished with grooves to ANSI/AWWA C 606 Standard for grooved and shouldered joints. Piping should be arranged for ease of disassembly at the unit for tube cleaning. All water piping should be thoroughly cleaned of all dirt and debris before final connections are made to the chiller.

TABLE 2 – WATER FLOW RATE LIMITS (GPM) BASED ON STANDARD TABLES

COMP	LENGTH (FT)	SHELL CODE	EVAPORATOR FLOW RATE (GPM)						SHELL CODE	CONDENSER FLOW RATE (GPM)					
			1 PASS		2 PASS		3 PASS			1 PASS		2 PASS		3 PASS	
			MIN	MAX	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX	MIN	MAX
K1	18	BB	3770	15080	1885	5345	1257	3510	LB	4983	17957	2492	7091	1661	4762
		BC	4605	18418	2302	6457	1535	4247	LC	5466	19696	2733	7717	1822	5203
		BD	5405	21621	2703	7487	1802	4933	LD	5828	21003	2914	8177	1943	5530
		B2	3870	15482	1935	6975	1290	4588	L2	4303	15508	2152	7645	1434	5143
		B3	4603	18413	2302	8166	1534	5384	L3	5072	18278	2536	8886	1691	6031
		B4	5241	20965	2621	9157	1747	6050	L4	5989	21584	2995	10278	1996	7057
K2	22	MB	3770	15080	1885	4798	1257	3150	MB	4992	17991	2496	6472	1664	4281
		MC	4605	18418	2302	5809	1535	3818	MC	5466	19696	2733	7056	1822	4672
		MD	5405	21621	2703	6751	1802	4444	MD	5828	21003	2914	7498		
		M2	3870	15482	1935	6288	1290	4133	M2	4303	15508	2152	7002	1434	4629
		M3	4603	18413	2302	7383	1534	4862	M3	5072	18278	2536	8205	1691	5438
		M4	5241	20965	2621	8302	1747	5477	M4	5989	21584	2995	9591		
	18	NB	4769	19076	2385	6756	1590	4448	BB	6213	22389	3107	8841	2071	5944
		NC	5272	21087	2636	7430	1757	4897	BC	6740	24287	3370	9524	2247	6426
		ND	5740	22961	2870	8049	1913	5312	BD	7115	25640	3557	10002	2372	6767
									BE	7449	26844	3725	10422		
		N2	4769	19074	2384	8600	1590	5678	B2	5772	20802	2886	10240	1924	6928
		N3	5637	22549	2819	10018	1879	6637	B3	6380	22991	3190	11206	2127	7627
		N4	6281	25125	3141	11028	2094	7327	B4	6981	25157	3491	12129	2327	8307
									B5	7713	27793	3856	13204		
K3	22	EB	6218	24872	3109	7808	2073	5151	CB	6241	22491	3121	7996	2080	5356
		EC	7006	28025	3503	8725	2335	5768	CC	6967	25105	3483	8855	2322	5956
		ED	7769	31078	3885	9591	2590	6353	CD	7900	28470	3950	9930	2633	6718
		E2	6287	25149	3144	9998	2096	6626	C2	4969	17905	2484	8003	1656	5352
		E3	6961	27843	3480	10944	2320	7272	C3	6487	23378	3244	10280	2162	6959
		E4	7670	30680	3835	11905	2557	7933	C4	8099	29185	4049	12516	2700	8601
	18	FB	7825	31301	3913	10675	2608	7217	DB	7569	27276	3785	10902	2523	7247
		FC	8756	35025	4378	11776	2919	8018	DC	8440	30413	4220	12073	2813	8045
		FD	9699	38798	4850	12843	3233	8813	DD	9326	33607	4663	13240	3109	8847
									DE	9714	35004	4857	13742		
		F2	7871	31483	3935	13358	2624	9199	D2	7206	25969	3603	12967	2402	8647
		F3	8745	34981	4373	14540	2915	10112	D3	7944	28627	3972	14196	2648	9496
		F4	9703	38811	4851	15751	3234	11079	D4	8756	31553	4378	15512	2919	10414
									D5	9909	35708	4954	17309		
K4	22	GB	7825	31301	3913	9653	2608	6488	EB	7708	27776	3854	9967	2569	6616
		GC	8756	35025	4378	10675	2919	7218	EC	8578	30913	4289	11030	2859	7337
		GD	9699	38798	4850	11673	3233	7945	ED	9465	34107	4732	12094	3155	8062
									EE	9853	35505	4926	12553		
		G2	7871	31483	3935	12170	2624	8308	E2	7345	26469	3673	11870	2448	7898
		G3	8745	34981	4373	13291	2915	9151	E3	8083	29127	4041	12997	2694	8671
		G4	9703	38811	4851	14453	3234	10048	E4	8895	32053	4447	14208	2965	9508
									E5	10048	36208	5024	15874		
	18	HB	8961	35844	4480	12012	2987	8192	FB	9121	32868	4560	12972	3040	8662
		HC	9855	39418	4927	13013	3285	8941	FC	10098	36391	5049	14235	3366	9535
		HD	11009	44035	5504	14241	3670	9884	FD	10865	39153	5432	15201	3622	10209
									FE	11281	40000	5641	15716		
		H2	8804	35218	4402	14617	2935	10173	F2	8721	31428	4361	15405	2907	10337
		H3	9785	39141	4893	15852	3262	11160	F3	9620	34666	4810	16817	3207	11333
		H4	10873	43490	5436	17118	3624	12210	F4	10605	38218	5303	18307	3535	12397
K7	22								F5	11703	40000	5851	19890		
		KB	8961	35844	4480	10895	2987	7377	KB	10767	38800	5384	13620	3589	9112
		KC	9855	39418	4927	11834	3285	8063	KC	11969	40000	5984	14985	3990	10061
		KD	11009	44035	5504	12995	3670	8930	KD	12647	40000	6323	15737	4216	10588
									KE	13303	40000	6651	16451		
		K2	8804	35218	4402	13365	2935	9207	K2	9944	35834	4972	15693	3315	10544
		K3	9785	39141	4893	14550	3262	10124	K3	10961	39497	5480	17114	3654	11549
		K4	10873	43490	5436	15779	3624	11105	K4	12082	40000	6041	18619	4027	12627
									K5	13682	40000	6841	20649		

Application Data - continued

TABLE 2A – WATER FLOW RATES LIMITS (lps)

COMP	LENGTH (FT)	SHELL CODE	EVAPORATOR FLOW RATE (LPS)						SHELL CODE	CONDENSER FLOW RATE (LPS)					
			1 PASS		2 PASS		3 PASS			1 PASS		2 PASS		3 PASS	
			MIN	MAX	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX	MIN	MAX
K1	18	BB	238	952	119	337	79	221	LB	314	1133	157	447	105	301
		BC	291	1162	145	407	97	268	LC	345	1243	172	487	115	328
		BD	341	1364	171	472	114	311	LD	368	1325	184	516	123	349
			N/A	N/A	N/A	N/A	N/A	N/A							
		B2	244	977	122	440	81	290	L2	272	979	136	482	91	325
		B3	290	1162	145	515	97	340	L3	320	1153	160	561	107	381
		B4	331	1323	165	578	110	382	L4	378	1362	189	649	126	445
K2	22	MB	238	952	119	303	79	199	MB	315	1135	158	408	105	270
		MC	291	1162	145	367	97	241	MC	345	1243	172	445	115	295
		MD	341	1364	171	426	114	280	MD	368	1325	184	473		
		M2	244	977	122	397	81	261	M2	272	979	136	442	91	292
		M3	290	1162	145	466	97	307	M3	320	1153	160	518	107	343
		M4	331	1323	165	524	110	346	M4	378	1362	189	605		
	18	NB	301	1204	150	426	100	281	BB	392	1413	196	558	131	375
		NC	333	1331	166	469	111	309	BC	425	1533	213	601	142	406
		ND	362	1449	181	508	121	335	BD	449	1618	224	631	150	427
									BE	470	1694	235	658		
		N2	301	1204	150	543	100	358	B2	364	1313	182	646	121	437
		N3	356	1423	178	632	119	419	B3	403	1451	201	707	134	481
		N4	396	1585	198	696	132	462	B4	441	1587	220	765	147	524
									B5	487	1754	243	833		
K3	22	EB	392	1569	196	493	131	325	CB	394	1419	197	505	131	338
		EC	442	1768	221	551	147	364	CC	440	1584	220	559	147	376
		ED	490	1961	245	605	163	401	CD	499	1796	249	627	166	424
		E2	397	1587	198	631	132	418	C2	314	1130	157	505	105	338
		E3	439	1757	220	691	146	459	C3	409	1475	205	649	136	439
		E4	484	1936	242	751	161	501	C4	511	1842	256	790	170	543
	18	FB	494	1975	247	674	165	455	DB	478	1721	239	688	159	457
		FC	553	2210	276	743	184	506	DC	533	1919	266	762	178	508
		FD	612	2448	306	810	204	556	DD	588	2121	294	835	196	558
									DE	613	2209	306	867		
		F2	497	1987	248	843	166	580	D2	455	1639	227	818	152	546
		F3	552	2207	276	917	184	638	D3	501	1806	251	896	167	599
		F4	612	2449	306	994	204	699	D4	552	1991	276	979	184	657
									D5	625	2253	313	1092		
K4	22	GB	494	1975	247	609	165	409	EB	486	1753	243	629	162	417
		GC	553	2210	276	674	184	455	EC	541	1951	271	696	180	463
		GD	612	2448	306	737	204	501	ED	597	2152	299	763	199	509
									EE	622	2240	311	792		
		G2	497	1987	248	768	166	524	E2	463	1670	232	749	154	498
		G3	552	2207	276	839	184	577	E3	510	1838	255	820	170	547
		G4	612	2449	306	912	204	634	E4	561	2023	281	897	187	600
									E5	634	2285	317	1002		
	18	HB	565	2262	283	758	188	517	FB	576	2074	288	819	192	547
		HC	622	2487	311	821	207	564	FC	637	2296	319	898	212	602
		HD	695	2779	347	899	232	624	FD	686	2471	343	959	229	644
									FE	712	2524	356	992		
		H2	556	2222	278	922	185	642	F2	550	1983	275	972	183	652
		H3	617	2470	309	1000	206	704	F3	607	2187	304	1061	202	715
		H4	686	2744	343	1080	229	770	F4	669	2412	335	1155	223	782
									F5	738	2524	369	1255		
K7	22	KB	565	2262	283	687	188	465	KB	679	2448	340	859	226	575
		KC	622	2487	311	747	207	509	KC	755	2524	378	946	252	635
		KD	695	2779	347	820	232	563	KD	798	2524	399	993	266	668
									KE	839	2524	420	1038		
		K2	556	2222	278	843	185	581	K2	627	2261	314	990	209	665
		K3	617	2470	309	918	206	639	K3	692	2492	346	1080	231	729
		K4	686	2744	343	996	229	701	K4	762	2524	381	1175	254	797
									K5	863	2524	432	1303		

Chilled Water – A water strainer with perforated holes no larger than 1/8" (3.2 mm) 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 to protect the chiller from debris or objects which could block flow through individual heat exchanger tubes. A reduction in flow through tubes could seriously impair the chiller performance or even result in tube freeze up. A thermal-type flow switch is factory installed in the evaporator nozzle and connected to the OptiView panel, which assures adequate chilled water flow during operation.

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

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

Min. ECWT = LCHWT – C RANGE+17 °F

Min. ECWT = LCHWT – C RANGE+9.4 °C

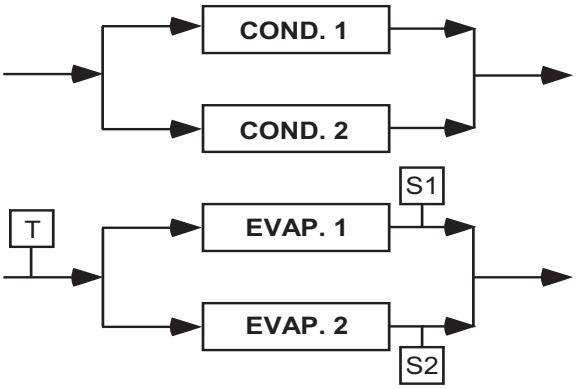
where:

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.

BRINE APPLICATIONS

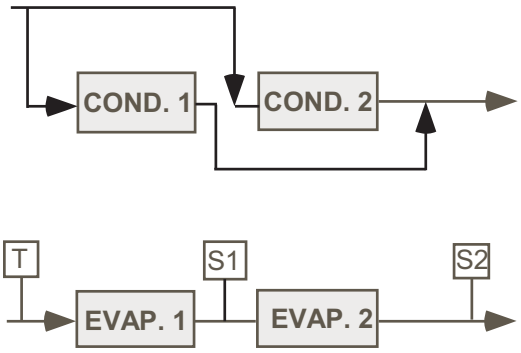
Various types of brine can be used in both the evaporator and condenser in lieu of water. The OptiView panel is programmed in the factory to allow extending the evaporator leaving brine temperature setpoint below 36°F (2.2°C). The low evaporator pressure cutout is factory programmed to the appropriate value depending on the percentage



S – Temperature Sensor for Chiller Capacity Control

T – Thermostat for Chiller Capacity Control

FIG. 2 – PARALLEL EVAPORATORS PARALLEL CONDENSERS



S – Temperature Sensor for Chiller Capacity Control

T – Thermostat for Chiller Capacity Control

FIG. 3 – SERIES EVAPORATORS PARALLEL CONDENSERS

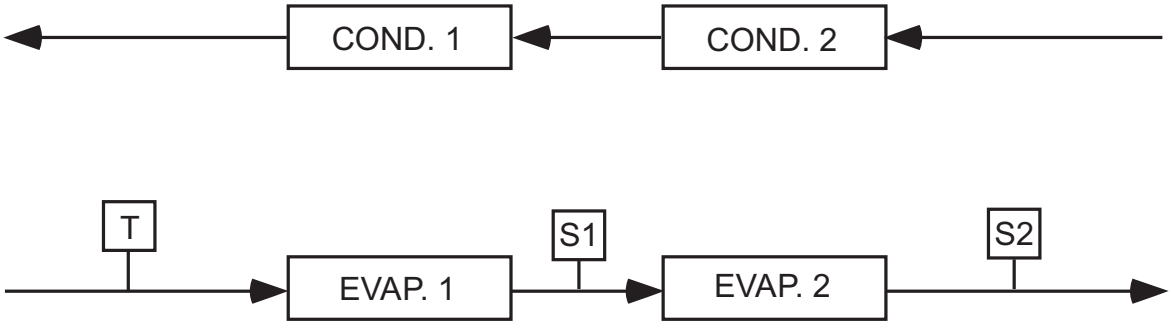


FIG. 4 – SERIES EVAPORATORS SERIES-COUNTER FLOW CONDENSERS

Application Data - continued

concentration and type of brine solution.

When the chiller is not running, brine should not be flowing through the evaporator. However, if there is brine flowing through the evaporator, there must be flow through the condenser to prevent tubes from freezing. In brine applications, the condenser pump control will close when the condenser saturation temperature reaches 35°F (1.7°C) and the pump will shut off when the temperature increases to 40°F (4.4°C). This is applicable if tied to the condenser pump control.

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 YD chiller has been designed to be readily adapted to the requirements of these various arrangements.

Parallel Arrangement (Refer to Fig. 2, pg. 23) **–** Chillers may be applied in multiples with chilled and condenser water circuits connected in parallel between the units. Fig. 2 represents a parallel arrangement with two chillers. Parallel chiller arrangements may consist of equally or unequally sized units. When multiple units are in operation, they will load and unload at equal percentages of design full load for the chiller.

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

Series Arrangement (Refer to Fig. 3, pg 23) **–** 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 Counterflow Arrangement (Refer to Fig. 4, pg 23) – Chillers may be applied in pairs with chilled water circuits connected in series and with the condenser water in series counterflow. 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 dual relief valves on the condenser and a single relief valve on the evaporator. 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 at least one flexible connection.

SOUND AND VIBRATION CONSIDERATIONS

A YD 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 Johnson Controls.

YD 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 insu-

lation, 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 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 (380 to 600 volts) are furnished with six leads. Medium voltage (2300 volts and above) 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 3 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 3 – MOTOR VOLTAGE VARIATIONS

FREQ.	RATED VOLTAGE	NAME PLATE VOLTAGE*	OPERATING VOLTAGE	
			MIN.	MAX.
60 HZ	380	380	342	415
	416	416	375	457
	460	440/460/480	414	508
	575	575/600	520	635
	2300	2300	2070	2530
	3300	3300	2970	3630
	4000	4000/4160	3600	4576
50 HZ	346	346	311	381
	380	380/400	342	423
	415	415	374	440
	3300	3300	2970	3630

*For motor voltage above 4160V/60Hz and 3300V/50HZ contact the JCI Sales Office for a specific selection.

Starters – The 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 auxilary 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 3 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 Johnson Controls.

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):

Application Data - continued

- Ampacity = 0.721 x compressor motor amps.
- Three-lead type of starting
- (Across-the-Line, Autotransformer and Primary Reactor)
- Minimum circuit ampacity per conductor (1 of 3):
- Ampacity = 1.25 x compressor motor amps.

Ampacity on Line-Side of Starter – The YD 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 4 and 5. 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

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

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 4 and 5 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).

In-rush amperes (IRA) depend on LRA and the type of starter applied. The in-rush can be calculated using a percentage of LRA shown in Table 4 or 5.

TABLE 4 – 60 Hz ELECTRICAL DATA

MOTOR CODE		CW	CX	CY	CZ	CA	CB	DA	DB	DC	DD	DE	DF	DH	DJ	DK	DL
KW (MAX.)		514	542	578	617	660	703	781	859	937	1015	1093	1171	1359	1554	1748	1942
SHAFT HP		655	690	740	790	845	900	1000	1100	1200	1300	1400	1500	1750	2000	2250	2500
FL EFF.-%		95	95	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	96	96	96	96
VOLTS		AMPERES (MAX.)															
380	FLA	879	942	997	1065	1126	1200	1364	1500	1636	—	—	—	—	—	—	—
	LRA	5780	6782	5780	6644	7106	7513	7794	8491	9431	—	—	—	—	—	—	—
416	FLA	810	860	911	973	1029	1096	1246	1370	1495	—	—	—	—	—	—	—
	LRA	5640	5780	5694	6069	6489	6863	7120	7755	8608	—	—	—	—	—	—	—
440	FLA	579	813	861	920	973	1036	1178	1295	1413	—	—	—	—	—	—	—
	LRA	4783	5357	4783	5249	5529	5529	6160	6709	7455	—	—	—	—	—	—	—
460	FLA	726	778	824	880	931	991	1127	1239	1352	—	—	—	—	—	—	—
	LRA	5000	5600	5000	5488	5780	5780	6440	7014	7794	—	—	—	—	—	—	—
480	FLA	696	746	790	843	892	950	1080	1187	1296	—	—	—	—	—	—	—
	LRA	5217	5843	5217	5727	6031	6031	6720	7319	8133	—	—	—	—	—	—	—
575	FLA	581	622	659	704	744	793	901	991	1081	—	—	—	—	—	—	—
	LRA	4039	4440	4300	4200	4694	4963	5148	5610	6232	—	—	—	—	—	—	—
600	FLA	557	596	632	675	713	760	863	950	1036	—	—	—	—	—	—	—
	LRA	4215	4633	4484	4383	4898	5179	5372	5854	6503	—	—	—	—	—	—	—
2300	FLA	146	154	165	176	186	198	225	248	267	290	312	334	389	438	493	548
	LRA	935	960	1008	1100	1172	1230	1234	1592	1592	1592	2031	2031	2390	2879	2908	3012
3300	FLA	102	108	115	123	130	138	157	173	186	202	217	233	271	306	344	382
	LRA	652	682	719	744	744	858	861	1110	1110	1110	1416	1416	1661	2011	283	2100
4000	FLA	84	89	95	101	107	114	130	143	154	166	179	192	224	252	2027	315
	LRA	538	540	554	631	674	713	715	923	923	923	1177	1177	1386	1669	1672	1732
4160	FLA	81	85	91	97	103	110	125	137	149	160	172	185	215	242	273	303
	LRA	560	562	576	656	701	742	744	960	960	960	1224	1224	1441	1736	1608	1666

TABLE 5 – 50 Hz ELECTRICAL DATA

MOTOR CODE		5CS	5CT	5CU	5CV	5CW	5CX	5DA	5DB	5DC	5DD	5DE	5DF	5DG	5DH	5DJ	5DK	5DL
KW (MAX)		518	554	591	630	669	709	785	863	942	1015	1093	1171	1288	1360	1554	1748	1942
SHAFT HP		658	704	750	800	850	900	1000	1100	1200	1300	1400	1500	1650	1750	2000	2250	2500
FL EFF. % FL		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	96	96
PF		0.88	0.88	0.89	0.89	0.89	0.89	0.88	0.87	0.88	0.88	0.88	0.88	0.88	0.89	0.89	0.89	0.89
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	306	344	382
	LRA	644	693	725	744	819	875	871	1,135	1,135	1,135	1,415	1,415	1,415	1,667	1,591	2233	2481

Application Data - continued

TABLE 6 – MOTOR STARTERS

TYPE STARTER	STAR DELTA	AUTO TRANSFORMER			ACROSS THE LINE	PRIMARY REACTOR	
VOLTAGE	LOW	LOW	LOW/HIGH	LOW/HIGH	LOW/HIGH	HIGH	HIGH
60 HZ 50 HZ	380–600 346–415	380–600 346–415	380–4160 346–3300	380–4160 346–3300	380–4160 346–3300	2300–4160 2300–4160	2300–4160 2300–4160
TRANSITION % TAP IN-RUSH AS A % OF LRA	CLOSED — 33	CLOSED 57.7 33	CLOSED 65 42.3	CLOSED 80 64	— — 100	CLOSED 65 65	CLOSED 80 80

NOTE: In-rush less than 100% of full load amps (FLA).
Minimum tap for 5DJ motor is 80%.

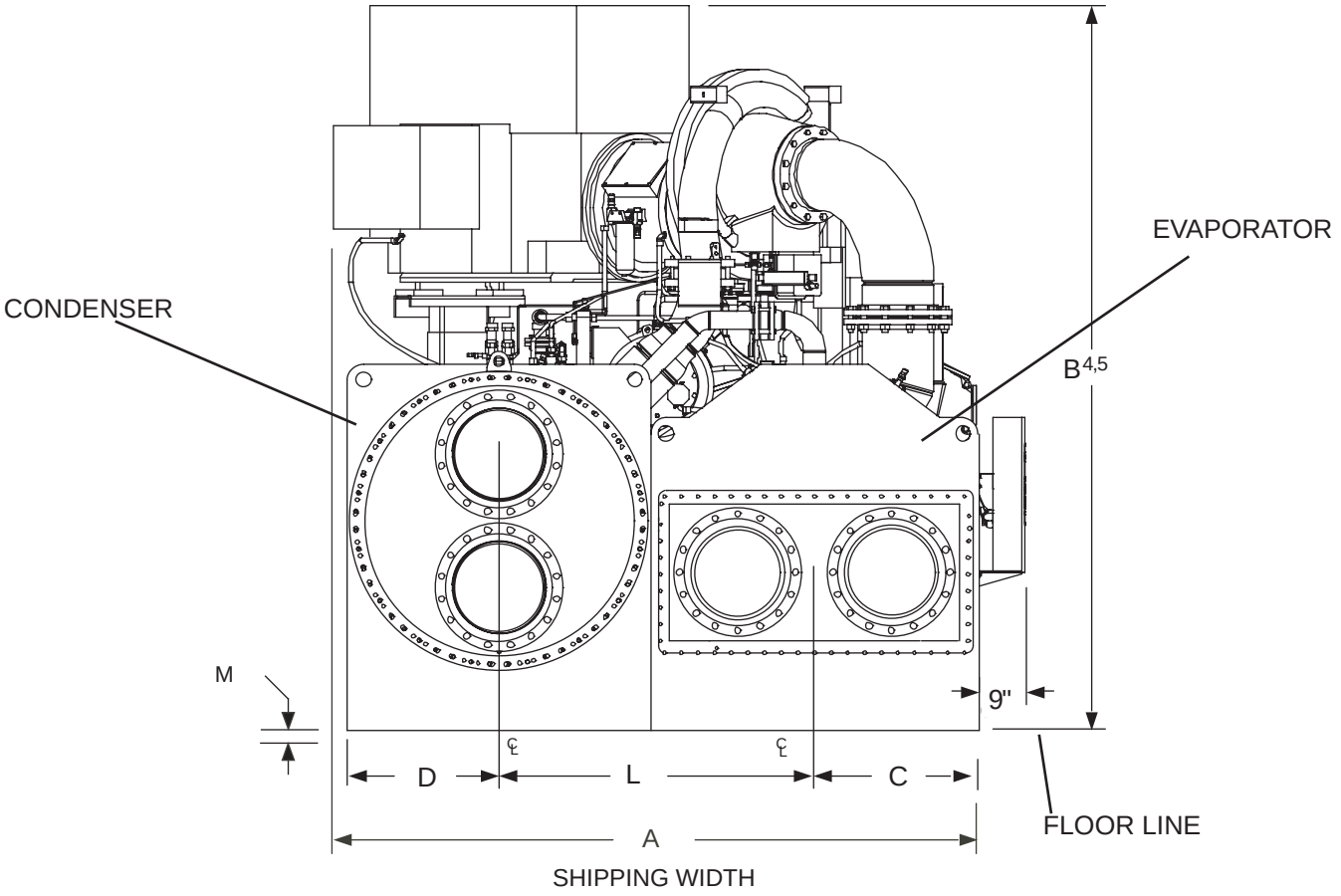
TABLE 7 – AVAILABLE COMPRESSOR / SHELL / MOTOR COMBINATIONS

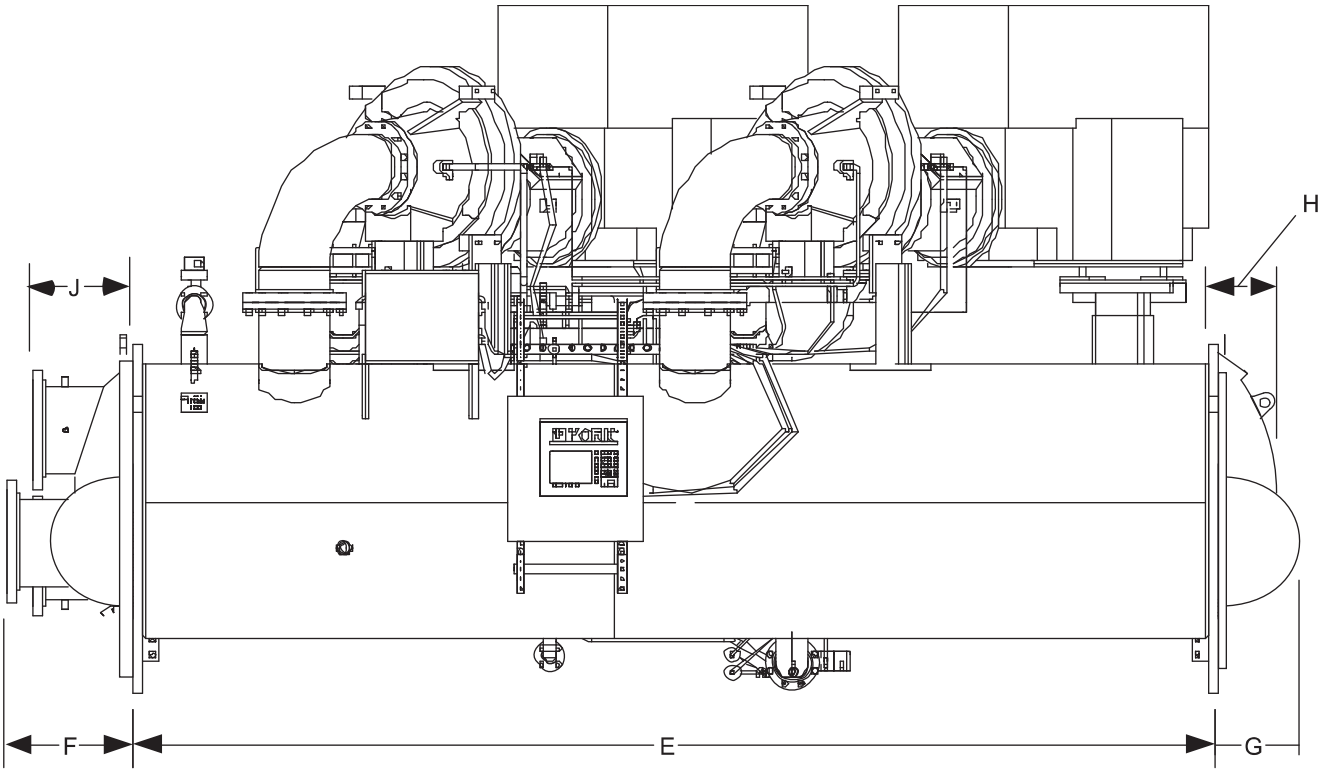
COMPRESSOR CODE	EVAPORATOR CODE	CONDENSER CODE	MOTOR CODES	
			60 HZ	50 HZ
K1	BB, BC, BD, B2, B3, B4	LB, LC, LD, L2, L3, L4	CW-DC	5CS-5DC
K2	MB, MC, MD, M2, M3, M4	MB, MC, MD, M2, M3, M4	CW-DC	5CS-5DC
	NB, NC, ND, N2, N3, N4	BB, BC, BD, BE, B2, B3, B4, B5		
K3	EB, EC, ED, E2, E3, E4	CB, CC, CD, C2, C3, C4	DA-DJ	5DA-5DJ
	FB, FC, FD, F2, F3, F4	DB, DC, DD, DE, D2, D3, D4, D5		
K4	GB, GC, GD, G2, G3, G4	EB, EC, ED, EE, E2, E3, E4, E5	DA-DJ	5DA-5DJ
	HB, HC, HD, H2, H3, H4	FB, FC, FD, FE, F2, F3, F4, F5		
K7	KB, KC, KD, K2, K3, K4	KB, KC, KD, KE, K2, K3, K4, K5	DD-DL	5DD-5DL

INTENTIONALLY LEFT BLANK

Unit Dimensions - English

K COMPRESSOR UNITS





EVAPORATOR - CONDENSER SHELL CODES								
DIM.	**B-L**	**M-M**	**N-B**	**E-C**	**F-D**	**G-E**	**H-F**	**K-K**
A	11’-6”	11’-6”	11’-11”	13’-4”	14’-6”	14’-6”	15’-0”	16’-0”
B	12’-8”	12’-8”	13’-0”	13’-10”	14’-4”	14’-4”	14’-10”	15’-3”
C	2’-8”	2’-8”	2’-11 1/2”	3’-5”	3’-9”	3’-9”	4’-0”	4’-0”
D	2’-5 1/2”	2’-5 1/2”	2’-5 1/2”	2’-8”	3’-1 1/2”	3’-1 1/2”	3’-1 1/2”	3’-4”
E	18’-0”	22’-0”	18’-0”	22’-0”	18’-0”	22’-0”	18’-0”	22’-0”
F	2’-3/4”	2’-3/4”	2’-1 11/16”	2’-13/16”	2’-3”	2’-3”	2’-3 9/16”	2’-3 9/16”
G	1’-4 1/2”	1’-4 1/2”	1’-5 11/16”	1’-4 3/16”	1’-6 1/4”	1’-6 1/4”	1’-6 7/8”	1’-6 7/8”
H	0’-11 11/16”	0’-11 11/16”	0’-11”	0’-11”	1’-2 9/16”	1’-2 9/16”	1’-3 9/16”	1’-4 3/16”
J	1’-7 3/8”	1’-7 3/8”	1’-7 1/2”	1’-7 3/8”	2’-1 1/2”	2’-1 1/2”	2’-2”	2’-13/16”
L	5’-1 1/2”	5’-1 1/2”	5’-5”	6’-1”	6’-10 1/2”	6’-10 1/2”	7’-1 1/2”	7’-4”

NOTE:
B-L, M-M & N-B: A AND B DIMENSIONS BASED ON RAM 5808 FRAME MOTOR
E-C, F-D, G-E & H-F: A AND B DIMENSIONS BASED ON RAM 5810 FRAME MOTOR
K-K: A AND B DIMENSIONS BASED ON RAM 500M FRAME MOTOR

ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR	
TYPE OF CHILLER MOUNTING	**M**
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.

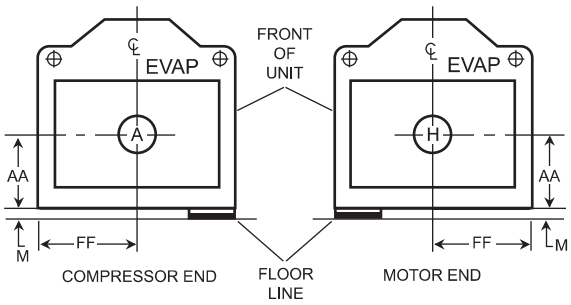
Nozzle Arrangements Dimensions - English

EVAPORATORS – COMPACT WATER BOXES

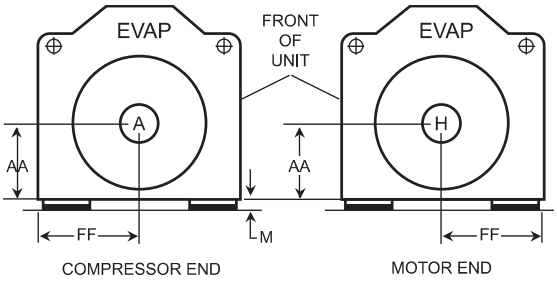
B, M, N SHELLS

E, F, G, H, K SHELLS

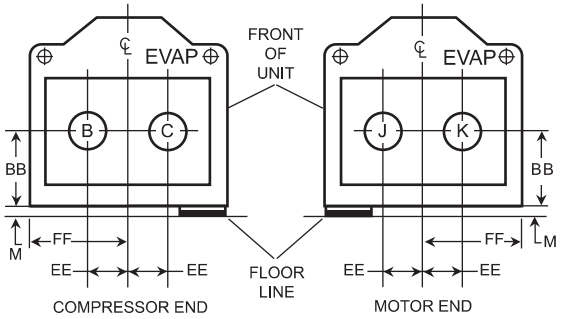
1-PASS



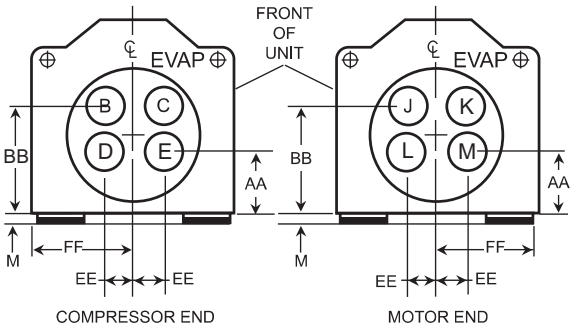
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
1	A	H
	H	A



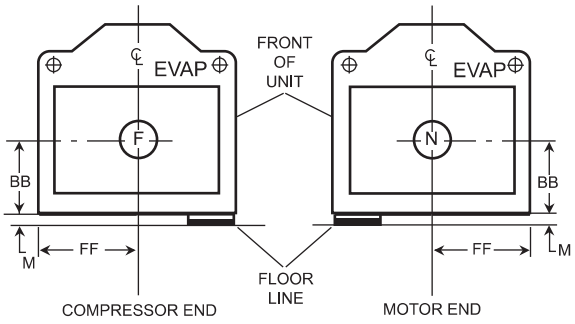
2-PASS



NOZZLE ARRANGEMENTS			
EVAP CODES			
B, M, N		E, F, G, H, K	
IN	OUT	IN	OUT
B	C	–	–
C	B	E	B
J	K	–	–
K	J	M	J

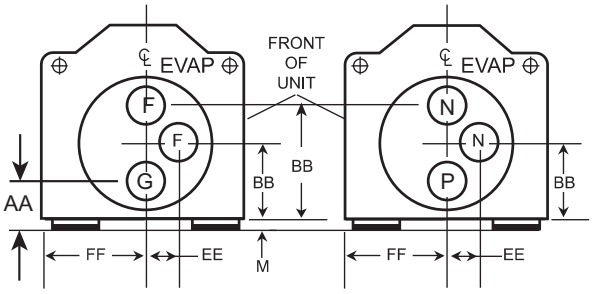


3-PASS



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

"C" Evaporator Connections on Vertical Centerline



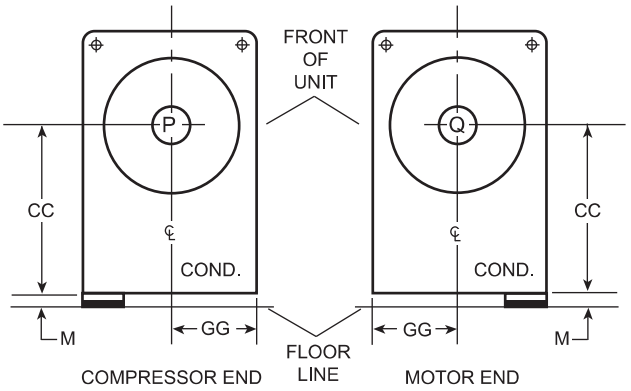
EVAP. SHELL CODE	EVAPORATOR											
	NOZZLE PIPE SIZE NO. OF PASSES			NOZZLE DIMENSIONS								
	1 PASS	2 PASS	3 PASS	1-PASS		2-PASS				3-PASS		
	1	2	3	AA[2]	FF	AA	BB[2]	EE	FF	BB[2]	EE	FF
B,M	20”	18”	14”	2’-8 1/4”	2’-8”	—	2’-8 1/4”	1’-3”	2’-8”	2’-8 1/4”	—	2’-8”
N	20”	18”	14”	2’-10 1/2”	2’-11”	—	2’-10 1/2”	1’-3”	2’-11”	2’-10 1/2”	—	2’-11”
E	24”	20”	16”	4’-1”	3’-5”	3’-0”	5’-2”	1’-1”	3’-5”	4’-1”	1’-4”	3’-5”
F,G	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”
H,K	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:

1. Standard water nozzles are furnished as welding stub outs with ANSI/AWWA C-606 couplings grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory installed, class 150 (ANSI B16.5, round slip on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add dimension "M" as shown on pg 29 for the appropriate isolator type.
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.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.

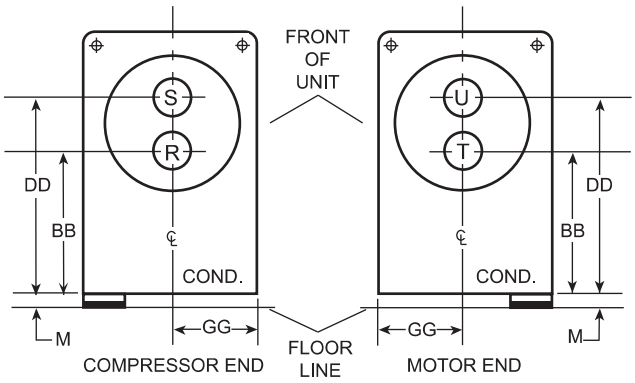
CONDENSERS – COMPACT WATER BOXES

1-PASS



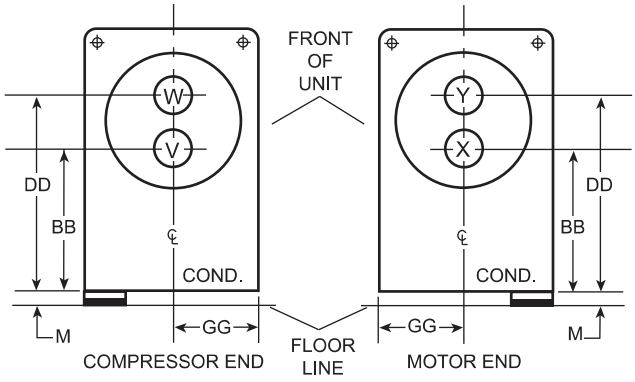
CONDENSER NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS



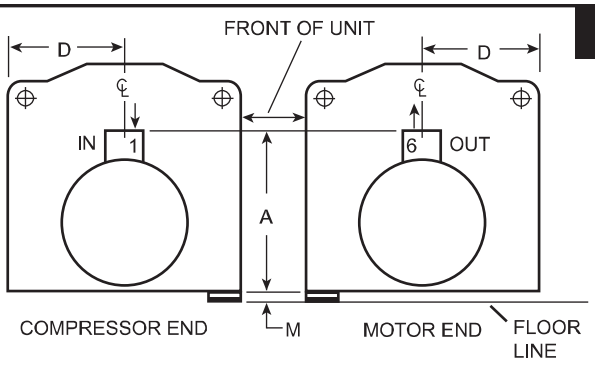
CONDENSER NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	V	Y
	X	W

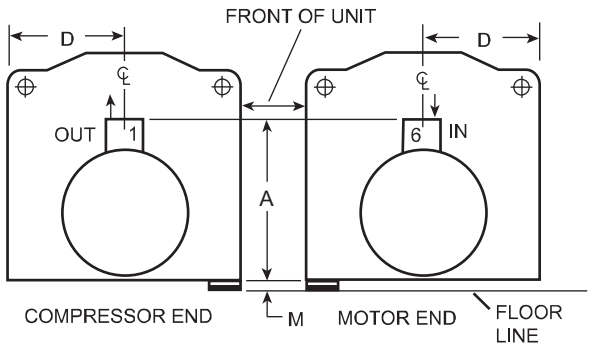
COND. SHELL CODE	CONDENSER										
	NOZZLE PIPE SIZE NO. OF PASSES			NOZZLE DIMENSIONS							
	1 PASS	2 PASS	3 PASS	1 PASS		2 PASS			3 PASS		
	1	2	3	CC[2]	GG	BB[2]	DD[2]	GG	BB[2]	DD	GG
L, M	20”	18”	14”	3’-6”	2’-5 1/2”	2’-5”	4’-7”	2’-5 1/2”	2’-5”	4’-7”	2’-5 1/2”
B	24”	18”	16”	3’-6 3/4”	2’-5 1/2”	2’-4 1/2”	4’-9 1/4”	2’-5 1/2”	2’-4 1/4”	4’-9 1/4”	2’-5 1/2”
C	24”	20”	16”	3’-11 1/2”	2’-8”	2’-7 1/2”	5’-3 1/2”	2’-8”	2’-7 1/2”	5’-3 1/2”	2’-8”
D, E	24”	20”	18”	4’-0”	3’-1 1/2”	2’-8 1/2”	5’-3 1/2”	3’-1 1/2”	2’-6”	5-6”	3’-1 1/2”
F	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”
K	24”	24”	20”	4’-6”	3’-4”	3’-0”	6’-0”	3-4”	2’-9 3/4”	6’-2 1/4”	3’-4”

Nozzle Arrangements Dimensions - English

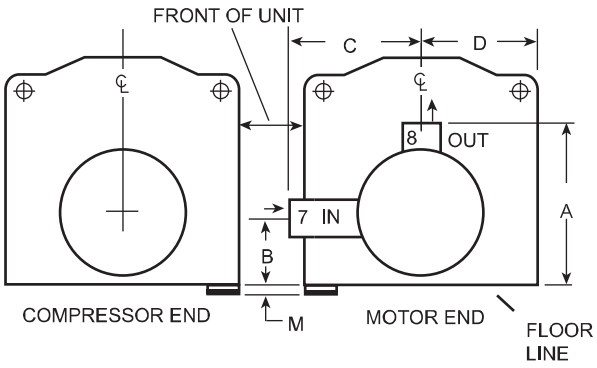
EVAPORATORS – MARINE WATER BOXES

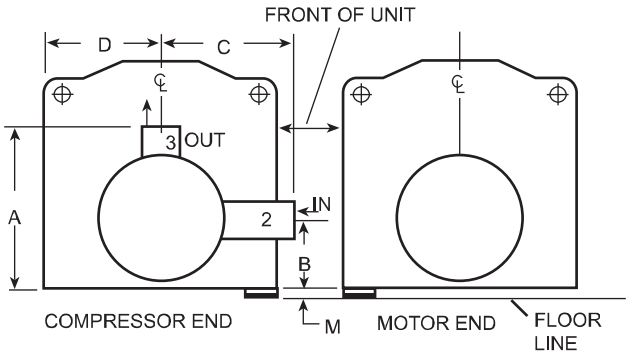
1-PASS





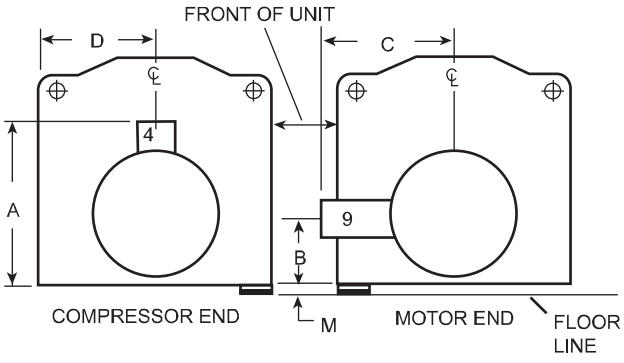
2-PASS



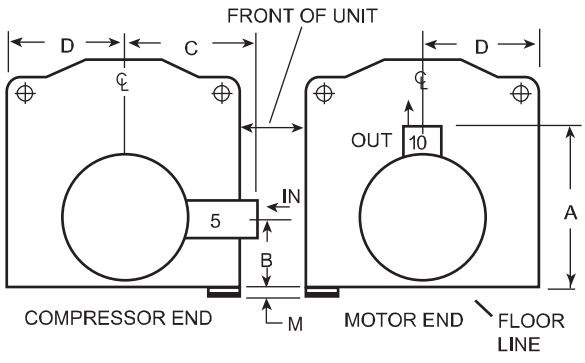


3-PASS

IN-4, OUT-9: D-K Evaporators Only
IN-9, OUT-4: All YD Evaporators



B, C Shells Only



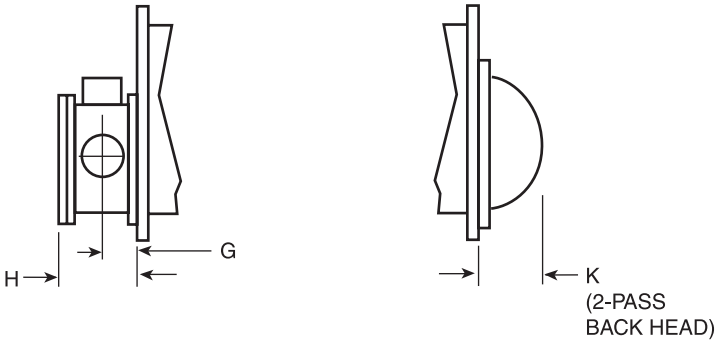
EVAP. SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS									
	1 PASS		2 PASS				3 PASS			
	A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
B, M	6’-5 3/4”	2’-8”	6’-5 3/4”	1’-3 3/4”	3’-0 1/4”	2’-8”	6’-5 3/4”	1’-3 3/4”	3’-0 1/4”	2’-8”
N	7’-1 1/4”	2’ 11 1/2”	7’-1 1/4”	1’-9 3/4”	3’-0 3/4”	2’ 11 1/2”	7’-1 1/4”	1’-9 3/4”	3’-0 3/4”	2’-11 1/2”
E	7’-8 1/2”	3’-5”	7’-8 1/2”	4’-1”	3’-7 1/2”	3’-5”	7’-8 1/2”	4’-1”	3’-7 1/2”	3’-5”
F, G	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’-9”
H, K	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 31.

EVAPORATOR 1 PASS	
IN	**OUT**
1	6
6	1

EVAPORATOR 2 PASS	
IN	**OUT**
2	3
7	8

EVAPORATOR 3 PASS	
IN	**OUT**
5	10
9	4



EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	**2**	**3**
B,M	20”	18”	14”
N	20”	18”	14”
E	24”	20”	16”
F.G	24”	20”	18”
H, K	24”	20”	18”

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	EVAPORATOR NOZZLE DIMENSIONS (2-PASS)		
		G	**H**	**K**
B,M	150	1’-1 1/2”	2’-6”	0’-11”
	300	1’-2 3/4”	2’-9 1/4”	1’-2 1/2”
N	150	1’-1 1/2”	2’-6”	0’-11”
	300	1’-2 1/2”	2’-8”	1’-3”
E	150	1’-4 1/4”	3’-0”	1’-4”
	300	1’-7”	3’-5 1/2”	1’-5 1/2”
F,G	150	1’-4 1/2”	3’-1 1/4”	1’-6 1/4”
	300	1’-7 1/4”	3’-6 1/2”	1’-7 1/2”
H,K	150	1’-4 1/4”	3’- 1/2”	1’-7”
	300	1’-6 3/4”	3’-5 1/2”	1’-8”

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	EVAPORATOR NOZZLE DIMENSIONS (1-PASS)	
		G	**H**
B,M	150	1’-2 1/2”	2’-8”
	300	1’-3 3/4”	2’-11 1/4”
N	150	1’-2 1/2”	2’-8”
	300	1’-3 1/4”	2’-9 1/2”
E	150	1’-6 1/2”	3’-4 1/2”
	300	1’-9 3/4”	3’-11”
F,G	150	1’-7”	3’-5 3/4”
	300	1’-10”	4’-0”
H,K	150	1’-6 1/2”	3’-5”
	300	1’-9 1/2”	3’-11”

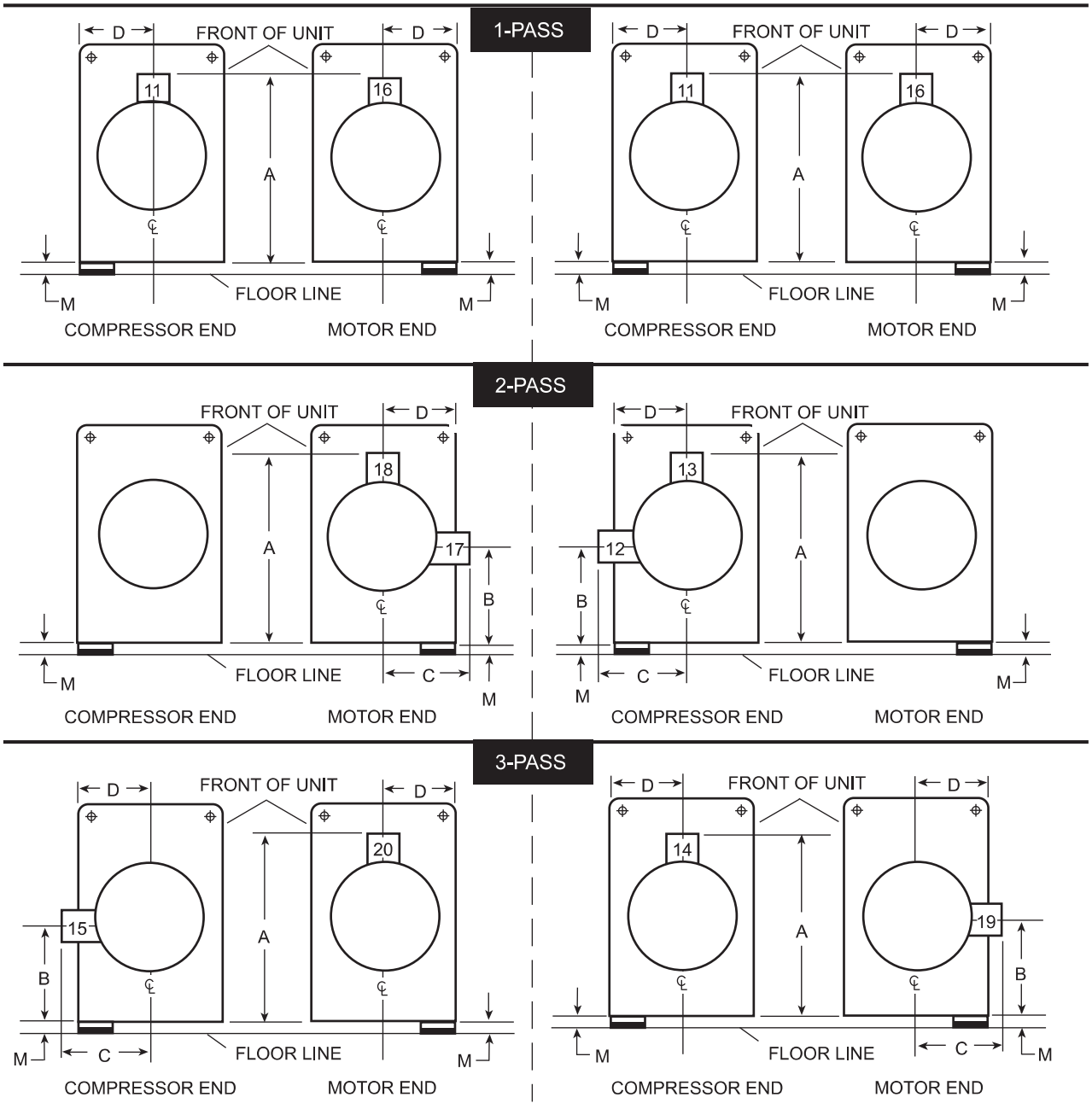
EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	EVAPORATOR NOZZLE DIMENSIONS (3-PASS)	
		G	**H**
B,M	150	1’-1 1/2”	2’-6”
	300	1’-2 3/4”	2’-9 1/4”
N	150	1’-1 1/2”	2’-6”
	300	1’-2 1/2”	2’-8”
E	150	1’-2 1/4”	2’-8”
	300	1’-4 1/2”	3’- 1/2”
F,G	150	1’-3 1/2”	3’- 10 3/4”
	300	1’-6”	3’-4”
H,K	150	1’-3”	2’-10”
	300	1’-5 1/2”	3’-3”

NOTES (see table on page 32):

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 ANSI/AWWA C-606 couplings grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory installed, class 150 (ANSI B16.5, round slip on, forged carbon steel with 1/16" 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. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" as shown on pg 29 for the appropriate isolator type.

Nozzle Arrangements Dimensions - English

CONDENSERS – MARINE WATER BOXES



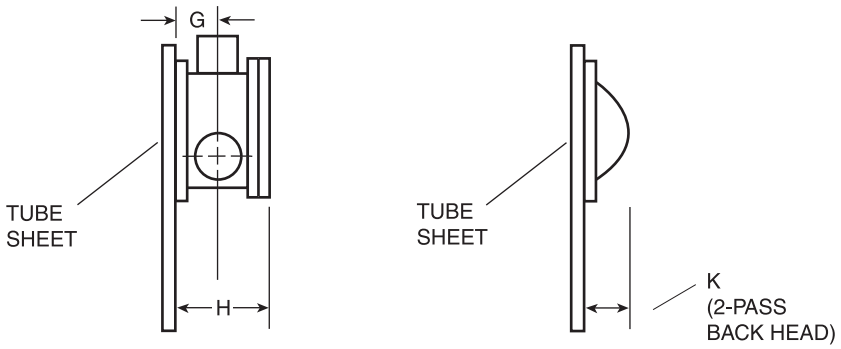
COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS									
	1 PASS		2 PASS				3 PASS			
	A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
L, M	6’-2 1/2”	2’-5 1/2”	6’-2 1/2”	2’-2”	2’-7 1/2”	2’-5 1/2”	6’-2 1/2”	2’-2”	2’-7 1/2”	2’-5 1/2”
B	6’ 5 1/2”	2’-5 1/2”	6’ 5 1/2”	2’ 1 1/4”	2’-10”	2’-5 1/2”	6’ 5 1/2”	2’ 1 1/4”	2’-10”	2’-5 1/2”
C	7’-0”	2’-8”	7’-0”	2’-6”	2’-11 1/2	2’-8”	7’-0”	2’-6”	2’-11 1/2	2’-8”
D, E	7’-4”	3-1 1/2”	7’-4”	2’-9”	3’-4”	3-1 1/2”	7’-4”	2’-5”	3’-4”	3-1 1/2”
F	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”
K	8’-1 1/2”	3’-4”	8’-1 1/2”	3’-2”	3’-7 1/2”	3’-4”	8’-1 1/2”	2’-10”	3’-7 1/2”	3’-4”

See Notes on page 33.

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
L, M	20”	18”	14”
B	24”	18”	16”
C	24”	20”	16”
D, E	24”	20”	18”
F, K	24”	24”	20”

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	CONDENSER NOZZLE DIMENSIONS (1-PASS)	
		G	H
L,M	150	1’-2 1/2”	2’-7 1/4”
	300	1’-3 1/2”	2’-10 1/4”
B	150	1’-4 1/2”	2’-11 1/2”
	300	1’-5 1/4”	3’-2”
C	150	1’-4 1/2”	3’-0”
	300	1’-5 1/2”	3’-3 3/4”
D,E	150	1’-6 3/4”	3’-4 3/4”
	300	1’-9 3/4’	3’-10 3/4”
F	150	1’-7”	3’-5 1/4”
	300	1’-11”	4’-1 1/4”
K	150	1’-6 1/2”	3’-4 1/2”
	300	1’-9 3/4”	3’11”

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	CONDENSER NOZZLE DIMENSIONS (2-PASS)		
		G	H	K
L,M	150	1’-1 1/2”	2’-5 1/4”	0’-11 3/4”
	300	1’-2 1/2”	2’-8 1/4”	1’-0”
B	150	1’-1 1/2”	2’-5 1/2”	0’-11”
	300	1’-2 1/4”	2’-8”	1’-1 1/2”
C	150	1’-2 1/2”	2’-8’	0’-11”
	300	1’-3 3/4”	1’-11 1/4”	1’-2 1/2”
D,E	150	1’-4 1/2”	3’- 1/4”	1’-2 1/2”
	300	1’-5 1/2”	3’-2 1/4”	1’-3 1/2”
F	150	1-7”	3’-5 1/2”	1’-3 1/2”
	300	1’-11”	4’-1 1/4”	1’-4 1/2”
K	150	1’-6 1/2”	3’-4 1/2”	1’-4 1/4”
	300	1’-9 3/4”	3’-11”	1’-5 1/2”

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	CONDENSER NOZZLE DIMENSIONS (3-PASS)	
		G	H
L,M	150	1'-1 1/2"	2'-5 1/4"
	300	1'-2 1/2"	2'-8 1/4"
B	150	1'- 1/2"	2'-5 1/2'
	300	1'-2 1/4"	2'-8"
C	150	1'-2 1/2"	2'-8"
	300	1'-3 3/4"	2'-11 1/4"
D,E	150	1'-3 1/4'	2'-9 3/4"
	300	1'-5 1/2"	3'-2 1/4'
F	150	1'-4 3/4"	3'-3 3/4"
	300	1'-7 3/4"	3'-6 3/4"
K	150	1'-4 1/4"	3'-0"
	300	1'-7"	3'-5 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 ANSI/AWWA C-606 couplings grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory installed, class 150 (ANSI B16.5, round slip on, forged carbon steel with 1/16" 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 - English

TABLE 8 – APPROXIMATE UNIT WEIGHT INCLUDING MOTOR & 150 # COMPACT WATER BOXES*

SHELLS	COMPRESSOR	SHIPPING WEIGHT (LBS) **	OPERATION WEIGHT (LBS)	EST. REFRIGERANT CHARGE (LBS) ***
B-L	K1	74,800	92,500	6,000
M-M	K2	83,200	104,100	7,300
N-B	K2	84,200	105,100	7,200
E-C	K3	116,600	147,100	10,600
F-D	K3	125,500	157,500	9,800
G-E	K4	141,100	179,100	12,200
H-F	K4	139,000	176,300	11,500
K-K	K7	174,100	222,200	15,800

* REFER TO PRODUCT DRAWINGS FOR DETAILED WEIGHT INFORMATION.
** DOES NOT INCLUDE REFRIGERANT CHARGE.
*** ADD 5% FOR 1” TUBE OPTION.

TABLE 9 – MARINE WATER BOX WEIGHTS (LBS.) (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
B	7124	3851	7086	8966	5520	8755	**L**	3808	1947	3960	5901	3195	5256
M	7124	3851	7086	8966	5520	8755	**M**	3808	1947	3960	5901	3195	5256
N	7088	3604	7244	9319	5758	9320	**B**	5092	2498	5060	7103	3945	6631
E	10692	6554	13316	14334	9502	15708	**C**	5768	2882	5826	8127	4864	7872
F	15696	8370	16778	19517	12191	20599	**D**	7394	3889	7592	10256	6333	9722
G	15696	8370	16778	19517	12191	20599	**E**	7394	3889	7592	10256	6333	9722
H	17374	8478	16744	22366	12630	20267	**F**	8422	4643	8910	11745	7965	11637
K	17374	8478	16744	22366	12630	20267	**K**	10332	5520	10798	14048	9236	13809

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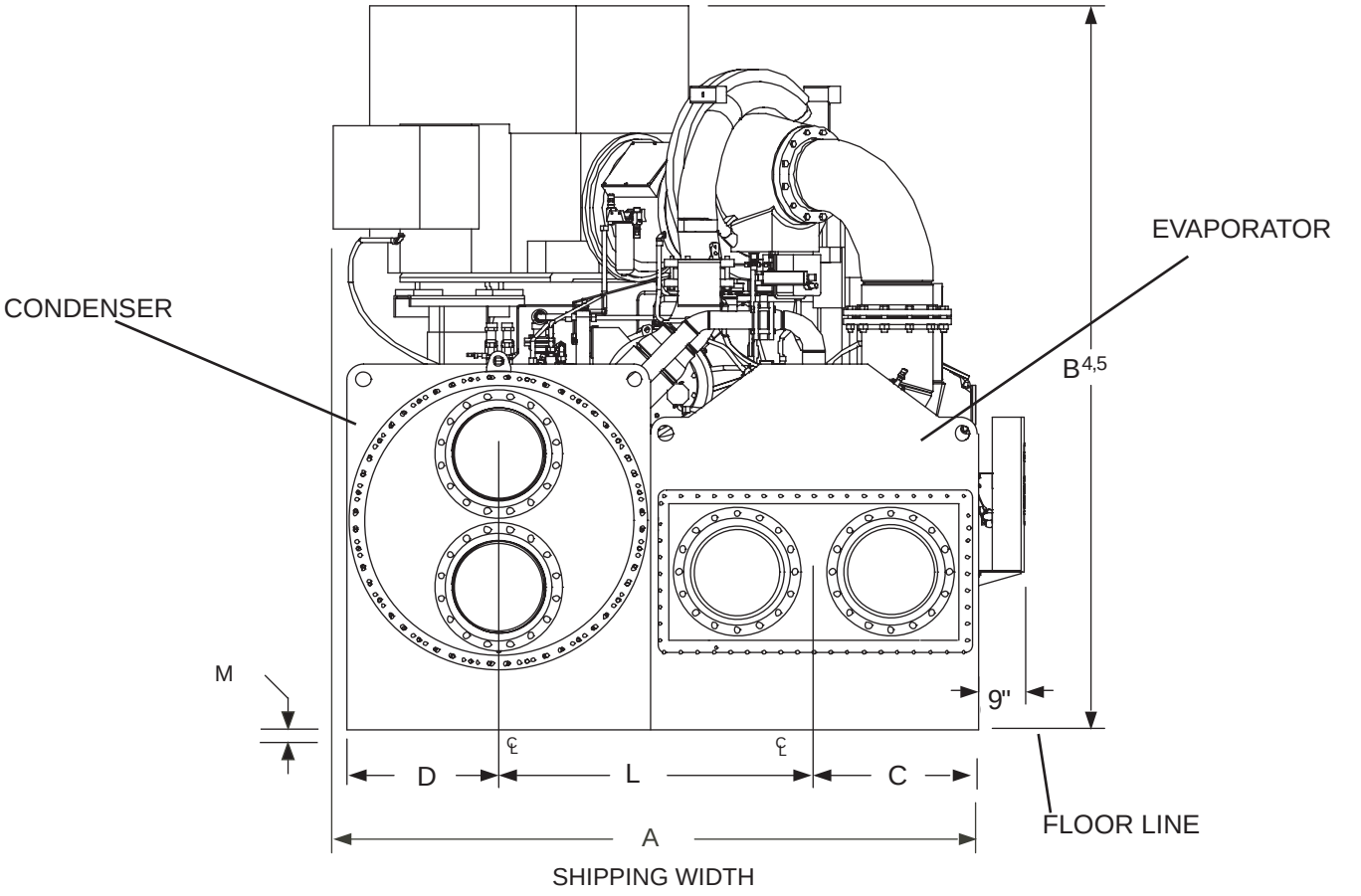
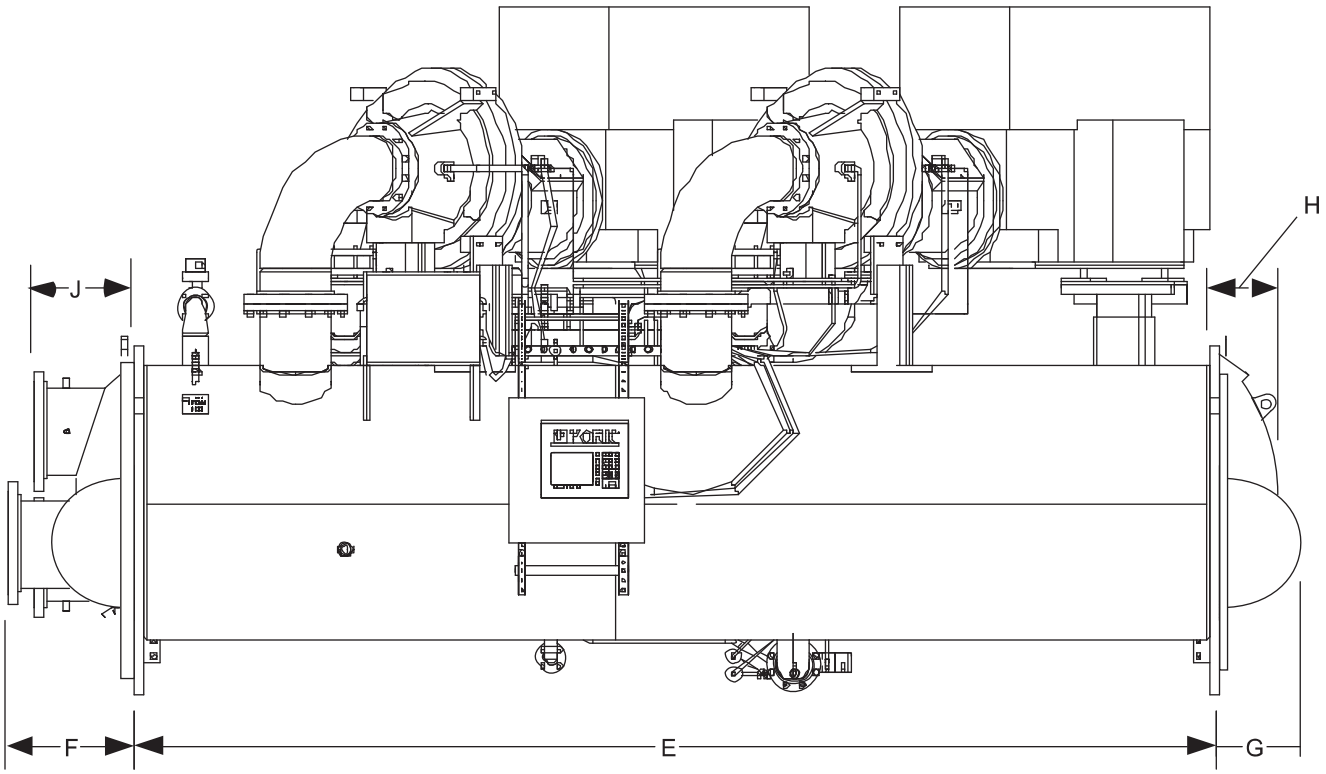
Unit Dimensions - SI





EVAPORATOR - CONDENSER SHELL CODES								
DIM.	**B-L**	**M-M**	**N-B**	**E-C**	**F-D**	**G-E**	**H-F**	**K-K**
A	3505	3505	3632	4064	4420	4420	4572	4877
B	3861	3861	3962	4216	4369	4369	4521	4648
C	813	813	902	1041	1143	1143	1219	1219
D	749	749	749	813	953	953	953	1016
E	5486	6706	5486	6706	5486	6706	5486	6706
F	629	629	660	635	686	686	699	699
G	419	419	445	413	464	464	483	483
H	305	305	279	279	368	368	394	413
J	492	492	495	492	648	648	660	635
L	1562	1562	1651	1854	2096	2096	2172	2235

NOTE:
B-L, M-M & N-B: A AND B DIMENSIONS BASED ON RAM 5808 FRAME MOTOR
E-C, F-D, G-E & H-F: A AND B DIMENSIONS BASED ON RAM 5810 FRAME MOTOR
K-K: A AND B DIMENSIONS BASED ON RAM 500M FRAME MOTOR

ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR	
TYPE OF CHILLER MOUNTING	**M**
NEOPRENE PAD ISOLATORS	44
SPRING ISOLATORS 1” DEFLECTION	25
DIRECT MOUNT	19

NOTES:

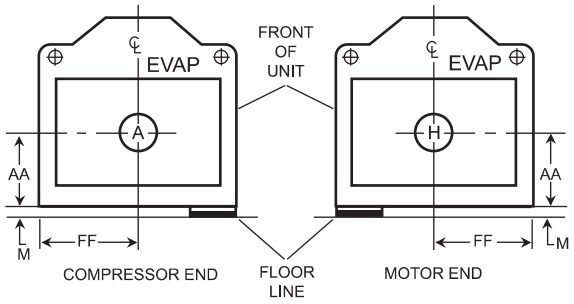
1. All dimensions are approximate. Certified dimensions are available on request.
2. For compact water boxes (shown above), determine overall unit length by adding water box depth to tube sheet length. For Marine Water Boxes, see pages 41-44.
3. Water nozzles can be located on either end of unit. Add 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.

Nozzle Arrangements Dimensions - SI

EVAPORATORS – COMPACT WATER BOXES

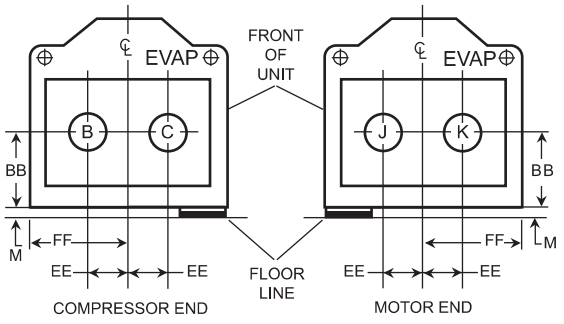
B, M, N SHELLS

1-PASS



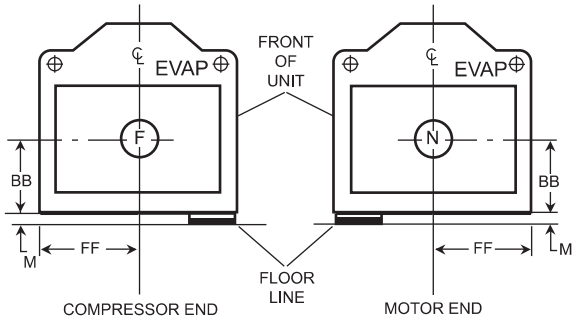
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
1	A	H
	H	A

2-PASS



NOZZLE ARANGEMENTS			
EVAP CODES			
B, M, N		E, F, G, H, K	
IN	OUT	IN	OUT
B	C	–	–
C	B	E	B
J	K	–	–
K	J	M	J

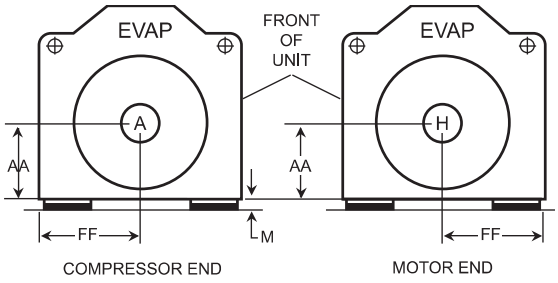
3-PASS



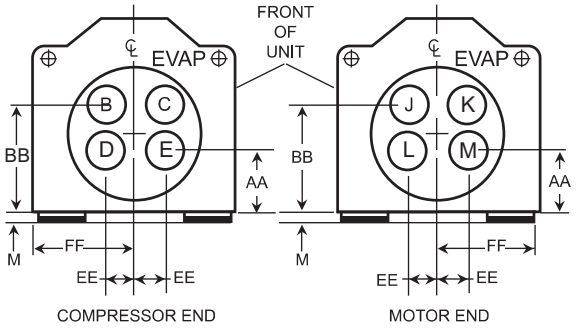
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAPORATOR	
	IN	OUT
3	F	N
	N	F

E, F, G, H, K SHELLS

1-PASS

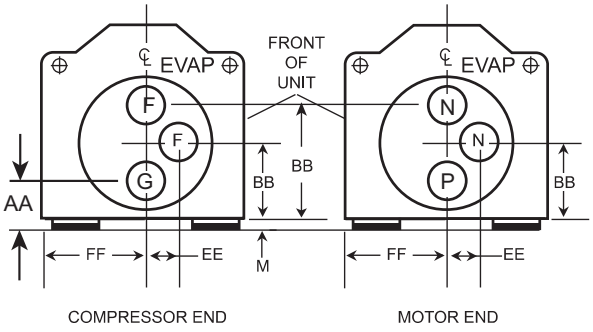


2-PASS



3-PASS

"C" Evaporator Connections on Vertical Centerline



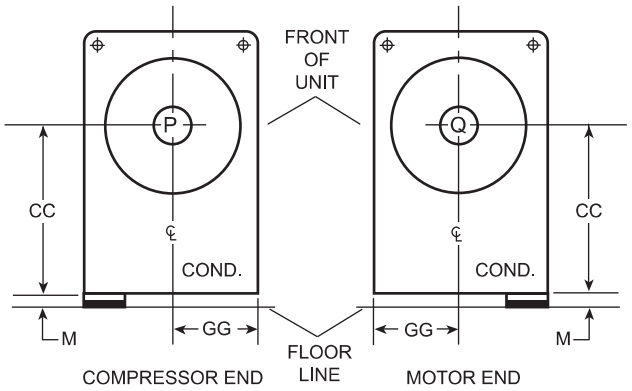
EVAP. SHELL CODE	EVAPORATOR											
	NOZZLE PIPE SIZE NO. OF PASSES			NOZZLE DIMENSIONS								
	1 PASS	2 PASS	3 PASS	1-PASS		2-PASS				3-PASS		
	1	2	3	AA[2]	FF	AA	BB[2]	EE	FF	BB[2]	EE	FF
B,M	20”	18”	14”	819	813	—	819	381	813	813	—	813
N	20”	18”	14”	876	889	—	889	381	889	889	—	889
E	24”	20”	16”	1245	1041	914	1575	330	1041	1245	406	1041
F,G	24”	20”	18”	1461	1143	1130	1791	330	1143	1461	406	1143
H,K	24”	20”	18”	1537	1219	1207	1867	330	1219	1537	406	1219

NOTES:

1. Standard water nozzles are furnished as welding stub outs with ANSI/AWWA C-606 couplings grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory installed, class 150 (ANSI B16.5, round slip on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add dimension "M" as shown on pg 39 for the appropriate isolator type.
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.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.

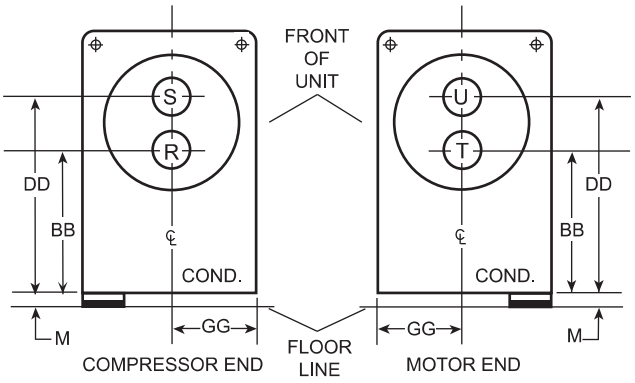
CONDENSERS – COMPACT WATER BOXES

1-PASS



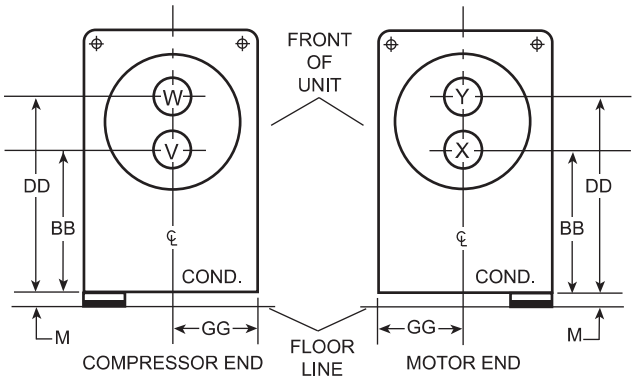
CONDENSER NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS

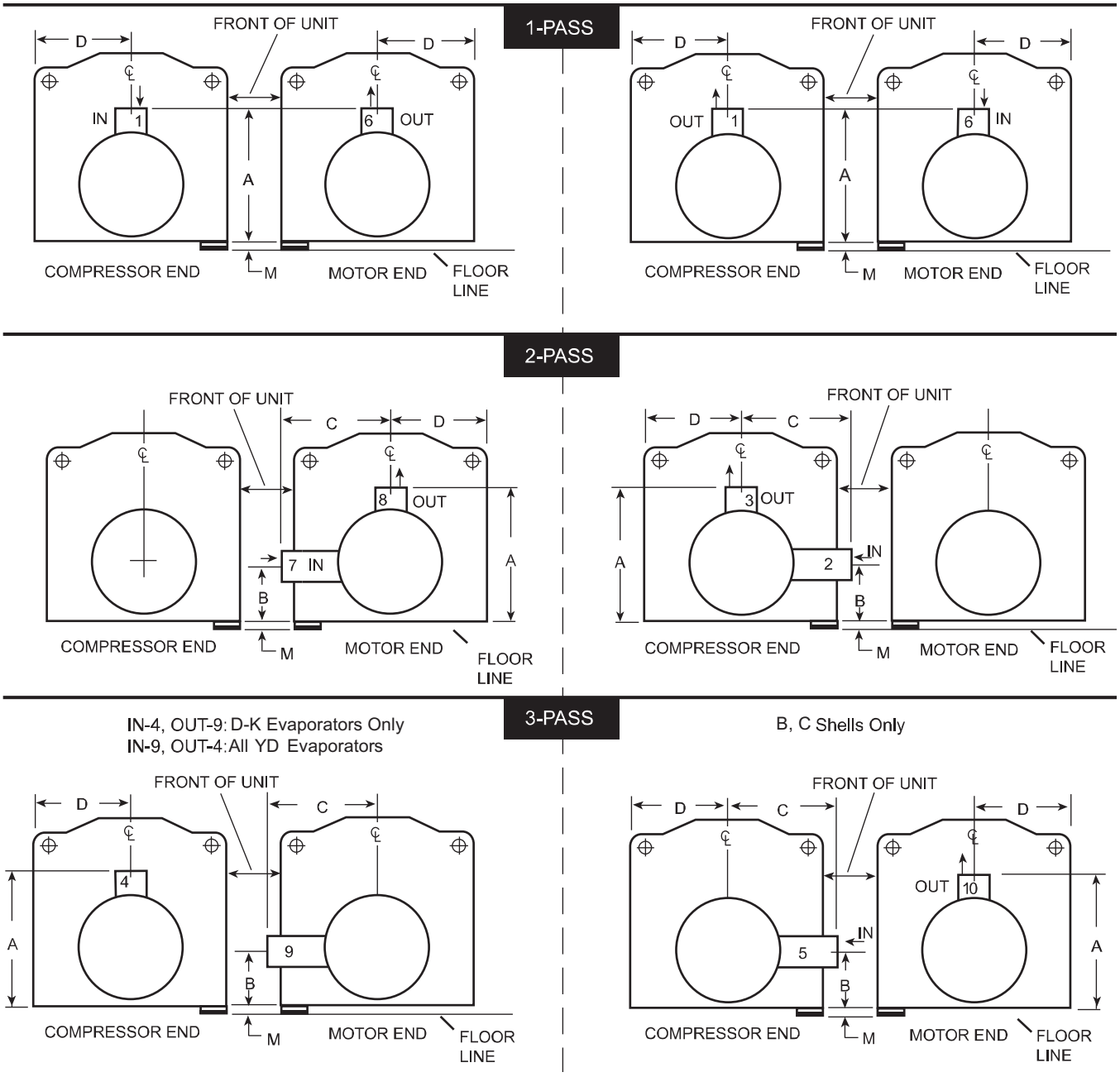


CONDENSER NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	V	Y
	X	W

COND. SHELL CODE	CONDENSER											
	NOZZLE PIPE SIZE NO. OF PASSES			NOZZLE DIMENSIONS								
	1 PASS	2 PASS	3 PASS	1 PASS		2 PASS			3 PASS			
	1	2	3	CC[2]	GG	BB[2]	DD[2]	GG	BB[2]	DD	GG	
L, M	20”	18”	14”	1067	749	737	1397	749	737	1397	749	
B	24”	18”	16”	1086	749	724	1461	749	718	1461	749	
C	24”	20”	16”	1207	813	800	1613	813	800	1613	813	
D, E	24”	20”	18”	1219	953	826	1613	953	762	1676	953	
F	24”	24”	20”	1321	953	851	1791	953	813	1829	953	
K	24”	24”	20”	1372	1016	914	1829	1016	857	1886	1016	

Nozzle Arrangements Dimensions - SI

EVAPORATORS – MARINE WATER BOXES



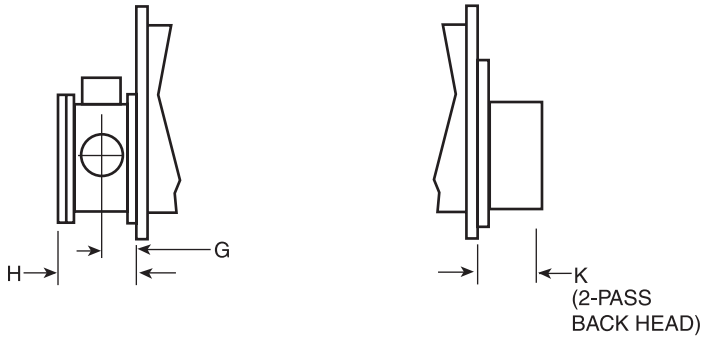
EVAP. SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS									
	1 PASS		2 PASS				3 PASS			
	A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
B, M	1975	813	1975	400	921	813	1975	400	921	813
N	2165	902	2165	540	933	902	2165	540	933	902
E	2350	1041	2350	1245	1105	1041	2350	1245	1105	1041
F, G	2686	1143	2686	1461	1226	1143	2686	1461	1226	1143
H, K	2845	1219	2845	1537	1308	1219	2845	1537	1308	1219

See Notes on page 41

EVAPORATOR 1 PASS	
IN	**OUT**
1	6
6	1

EVAPORATOR 2 PASS	
IN	**OUT**
2	3
7	8

EVAPORATOR 3 PASS	
IN	**OUT**
5	10
9	4



EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	**2**	**3**
B,M	20”	18”	14”
N	20”	18”	14”
E	24”	20”	16”
F.G	24”	20”	18”
H, K	24”	20”	18”

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (KPA)	EVAPORATOR NOZZLE DIMENSIONS (2-PASS)		
		G	**H**	**K**
B,M	1034	343	762	279
	2068	375	845	368
N	1034	343	762	279
	2068	368	813	381
E	1034	413	914	406
	2068	483	1054	445
F,G	1034	419	946	464
	2068	489	1080	495
H,K	1034	413	927	483
	2068	476	1054	508

EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (KPA)	EVAPORATOR NOZZLE DIMENSIONS (1-PASS)	
		G	**H**
B,M	1034	368	813
	2068	400	895
N	1034	368	813
	2068	387	851
E	1034	470	1029
	2068	552	1194
F,G	1034	483	1060
	2068	559	1219
H,K	1034	470	1041
	2068	546	1194

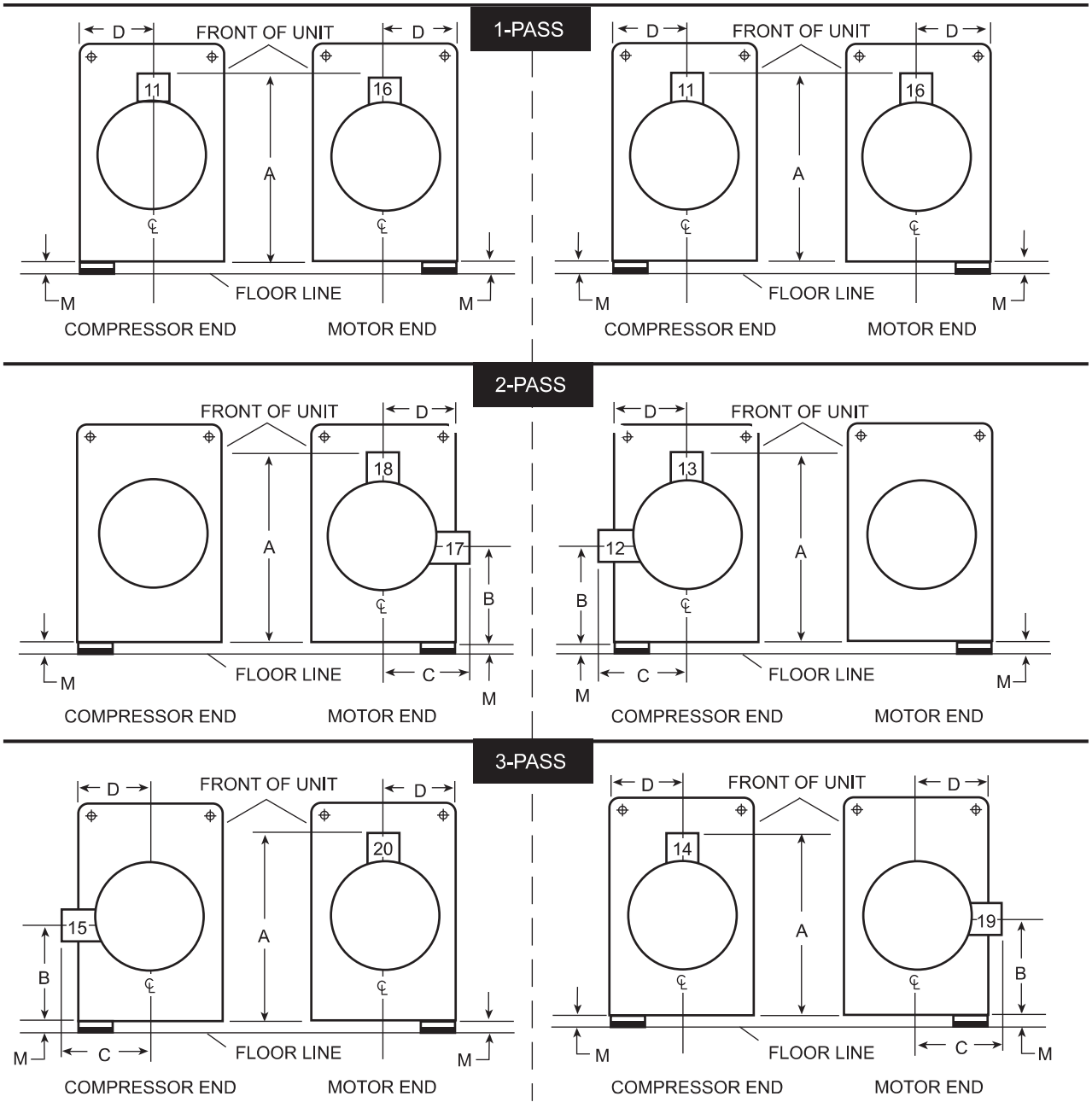
EVAPORATOR SHELL CODE	DESIGN WORKING PRESSURE (KPA)	EVAPORATOR NOZZLE DIMENSIONS (3-PASS)	
		G	**H**
B,M	1034	343	762
	2068	375	845
N	1034	343	762
	2068	368	813
E	1034	362	813
	2068	419	927
F,G	1034	394	1187
	2068	457	1016
H,K	1034	381	864
	2068	445	991

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 ANSI/AWWA C-606 couplings grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory installed, class 150 (ANSI B16.5, round slip on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One , two , and three pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" as shown on pg 39 for the appropriate isolator type.

Nozzle Arrangements Dimensions - SI

CONDENSERS – MARINE WATER BOXES



COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (mm)									
	1 PASS		2 PASS				3 PASS			
	A[5]	D	A[5]	B[5]	C	D	A[5]	B5	C	D
L, M	1892	749	1892	660	800	749	1892	660	800	749
B	1969	749	1969	641	864	749	1969	641	864	749
C	2134	813	2134	762	902	813	2134	762	902	813
D,E	2235	953	2235	838	1016	953	2235	737	1016	953
F	2388	953	2388	940	1067	953	2388	813	1067	953
K	2477	1016	2477	965	1105	1016	2477	864	1105	1016

See Notes on page 43.

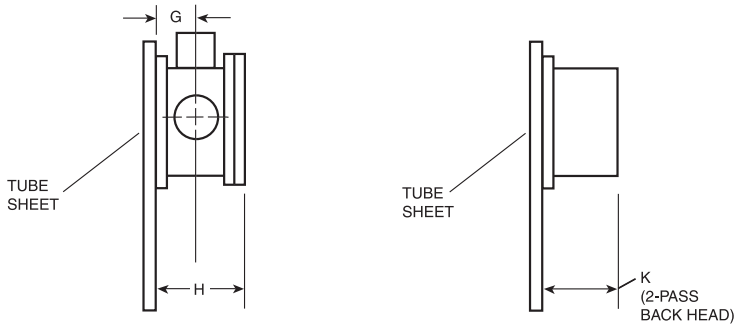
CONDENSER 1 PASS	
IN	OUT
11	16
16	11

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
L, M	20”	18”	14”
B	24”	18”	16”
C	24”	20”	16”
D, E	24”	20”	18”
F, K	24”	24”	20”

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (KPA)	CONDENSER NOZZLE DIMENSIONS (1-PASS)	
		G	H
L,M	1034	368	794
	2068	394	870
B	1034	419	902
	2068	438	965
C	1034	419	914
	2068	445	1010
D,E	1034	476	1035
	2068	552	1187
F	1034	483	1048
	2068	584	1251
K	1034	470	1029
	2068	552	1194



CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (KPA)	CONDENSER NOZZLE DIMENSIONS (2-PASS)		
		G	H	K
L,M	1034	343	743	298
	2068	368	819	305
B	1034	343	749	279
	2068	362	813	343
C	1034	368	813	279
	2068	400	591	368
D,E	1034	419	921	368
	2068	445	972	394
F	1034	483	1048	394
	2068	584	1251	419
K	1034	470	1029	413
	2068	552	1194	445

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (KPA)	CONDENSER NOZZLE DIMENSIONS (3-PASS)	
		G	H
L,M	1034	343	743
	2068	368	819
B	1034	343	749
	2068	362	813
C	1034	368	813
	2068	400	591
D,E	1034	387	857
	2068	495	972
F	1034	425	1010
	2068	502	1086
K	1034	413	914
	2068	483	1054

NOTES (see Table on page 44):

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 ANSI/AWWA C-606 couplings grooves, allowing the option of welding, flanges, or use of ANSI/AWWA C-606 couplings. Factory installed, class 150 (ANSI B16.5, round slip on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One , two , and three pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Condenser water must enter the water box through the bottom connection for proper operation of the sub cooler to achieve rated performance.
5. Add dimension "M" as shown on pg 39 for the appropriate isolator type.

Weights - SI

TABLE 10 - APPROXIMATE UNIT WEIGHT INCLUDING MOTOR & 150 LB COMPACT WATERBOXES *

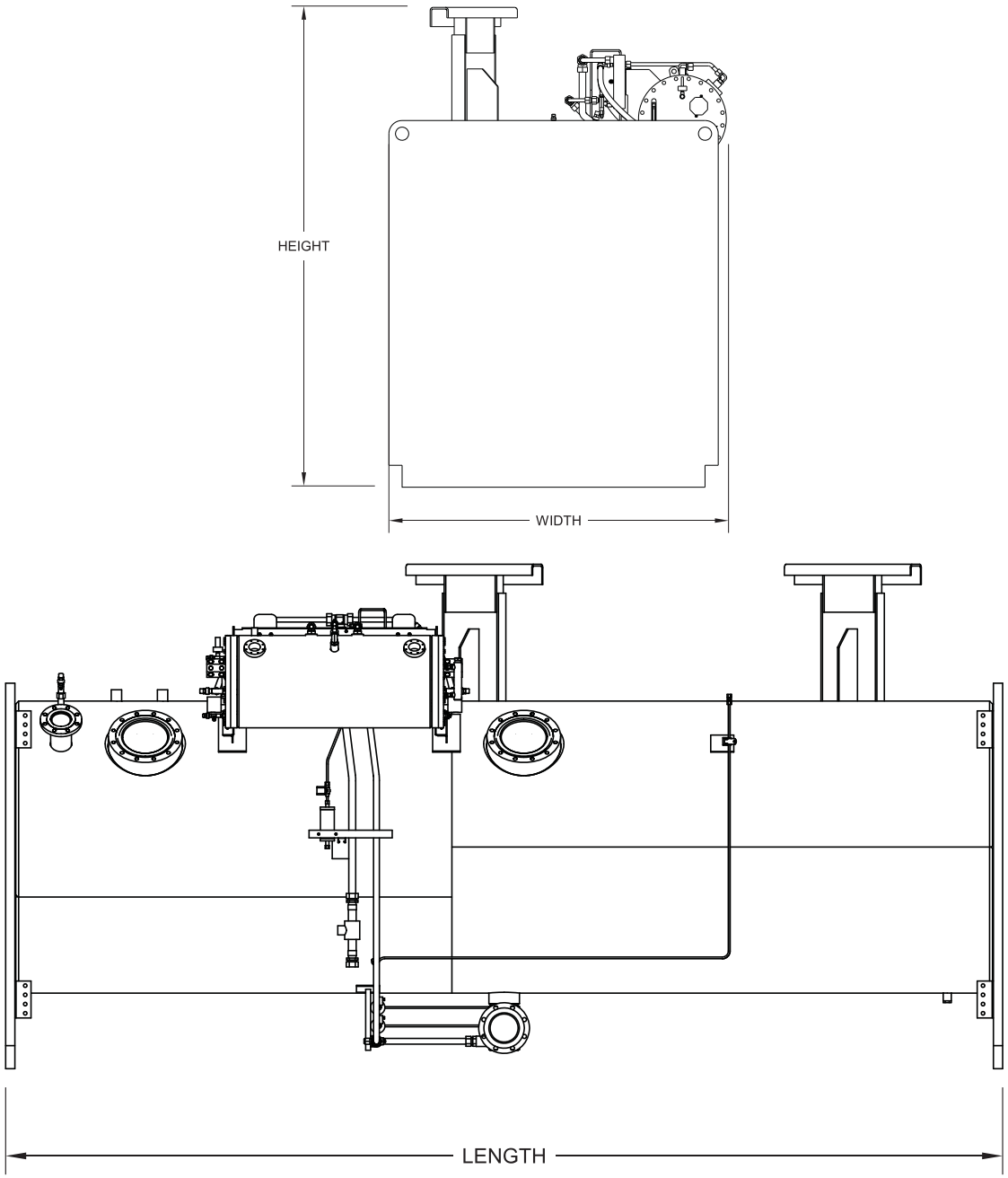
SHELLS	COMPRESSOR	SHIPPING WEIGHT (KGS) **	OPERATION WEIGHT (KGS)	EST. REFRIGERANT CHARGE (KGS) ***
B-L	K1	33926	41953	2721
M-M	K2	37735	47215	3311
N-B	K2	38189	47668	3266
E-C	K3	52884	66717	4808
F-D	K3	56921	71434	4445
G-E	K4	63996	81231	5533
H-F	K4	63043	79961	5216
K-K	K7	78963	100779	7166

* REFER TO PRODUCT DRAWINGS FOR DETAILED WEIGHT INFORMATION.
** DOES NOT INCLUDE REFRIGERANT CHARGE.
*** ADD 5% FOR 1" TUBE OPTION.

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

EVAP CODE	SHIPPING WEIGHT INCREASE (KGS)			OPERATING WEIGHT INCREASE (KGS)			COND. CODE	SHIPPING WEIGHT INCREASE (KGS)			OPERATING WEIGHT INCREASE (KGS)		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
B	3231	1747	3214	4067	2504	3971	**L**	1727	883	1796	2676	1449	2384
M	3231	1747	3214	4067	2504	3971	**M**	1727	883	1796	2676	1449	2384
N	3215	1635	3286	4227	2612	4227	**B**	2309	1133	2295	3222	1789	3007
E	4849	2973	6039	6501	4310	7124	**C**	2616	1307	2642	3686	2206	3570
F	7119	3796	7610	8852	5529	9343	**D**	3354	1764	3443	4652	2872	4409
G	7119	3796	7610	8852	5529	9343	**E**	3354	1764	3443	4652	2872	4409
H	7880	3845	7594	10144	5728	9192	**F**	3820	2106	4041	5327	3613	5278
K	7880	3845	7594	10144	5728	9192	**K**	4686	2504	4897	6371	4189	6263

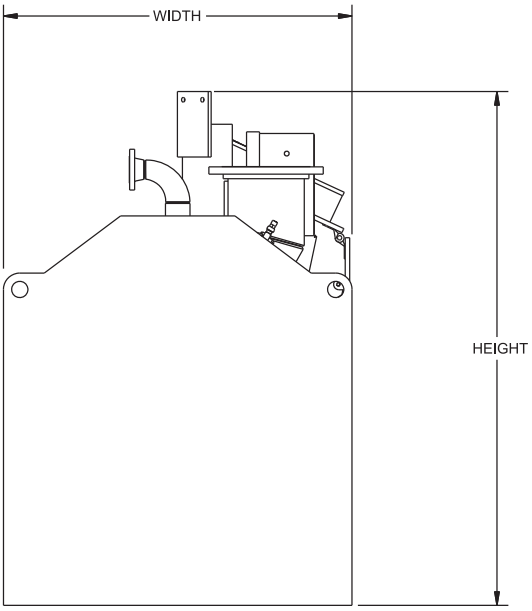
Component Dimensions

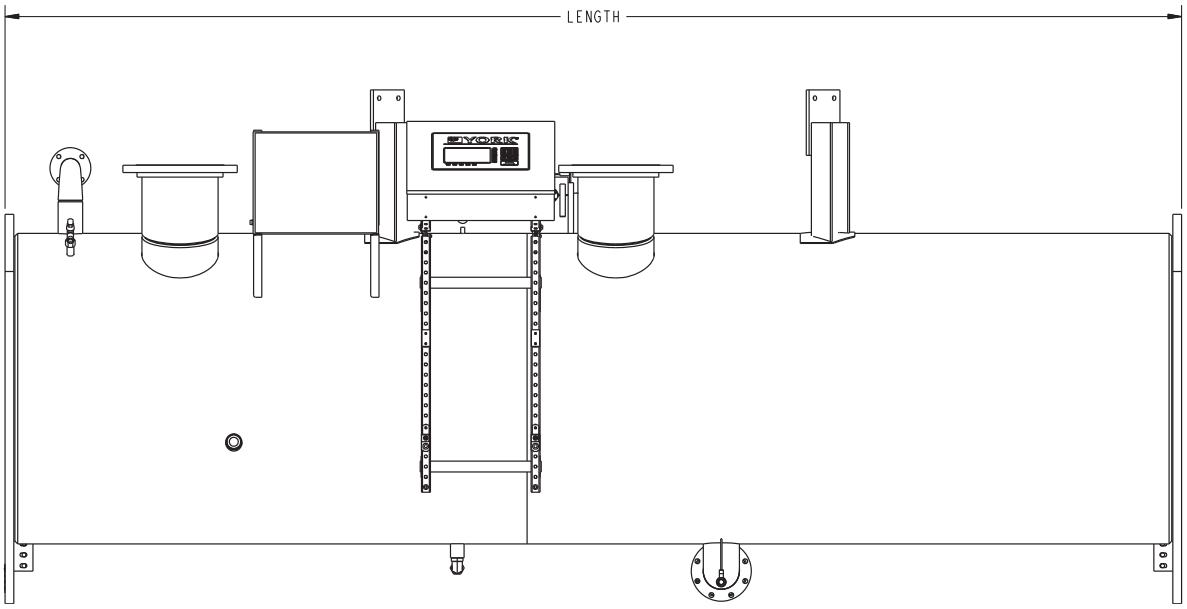


CONDENSER SECTION DIMENSIONS						
UNIT MODEL COMPR/SHELLS	DIMENSIONS (FT. IN.)			DIMENSIONS (MM)		
	LENGTH	HEIGHT	WIDTH	LENGTH	HEIGHT	WIDTH
K1/L SHELLS	18-0”	7’-8 3/4”	5’-8”	5486	2356	1727
K2/M SHELLS	22’-0”	7’-8 3/4”	5’-8”	6708	2356	1727
K2/B SHELLS	18’-0”	8’-0 3/4”	5’-9”	5486	2,457	1753
K3/C SHELLS	22’-0”	8’-7 1/4”	6’-2”	6708	2,623	1880
K3/D SHELLS	18’-0”	9’-1 1/4”	6’-6”	5486	2,775	1,981
K4/E SHELLS	22’-0”	9’-1 1/4”	6’-6”	6708	2775	1981
K4/F SHELLS	18’-0”	9’-7 1/4”	6’-8”	5486	2927	2032
K7/K SHELLS	22’-0”	9’-8”	7’-3”	6708	2946	2210

NOTE: Dimensions are approximate. Certified dimensions are available upon request.

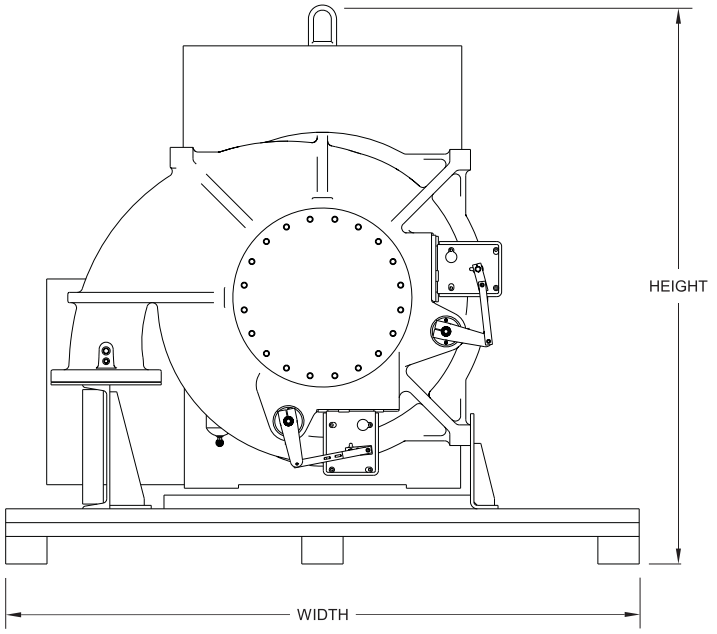
Component Dimensions - continued

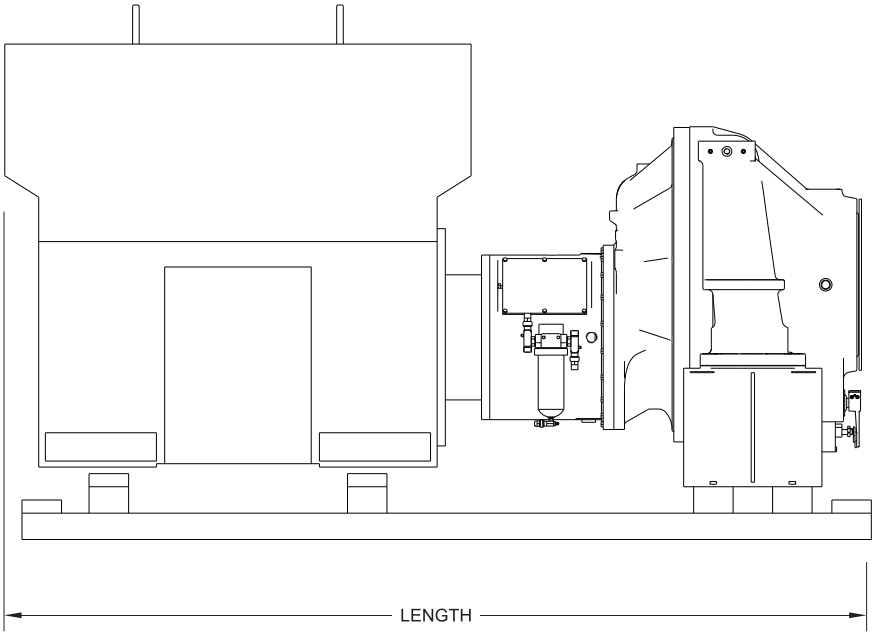




EVAPORATOR SECTION DIMENSIONS						
UNIT MODEL COMPR/SHELLS	DIMENSIONS (FT. IN.)			DIMENSIONS (MM)		
	LENGTH	HEIGHT	WIDTH	LENGTH	HEIGHT	WIDTH
K1/B SHELLS	18-0”	8’-2”	5’-4”	5486	2489	1626
K2/M SHELLS	22’-0”	8’-0”	5’-4”	6706	2438	1626
K2/N SHELLS	18’-0”	8’-4”	5’-11”	5486	2540	1803
K3/E SHELLS	22’-0”	9’-0”	6’-10”	6706	2743	2083
K3/F SHELLS	18’-0”	9’-6”	7’-6”	5486	2896	2286
K4/G SHELLS	22’-0”	9’-6”	7’-6”	6706	2896	2286
K4/H SHELLS	18’-0”	10’-0”	8’-0”	5486	3048	2438
K7/K SHELLS	22’-0”	10’-1”	8’-0”	6706	3073	2438

NOTE: Dimensions are approximate. Certified dimensions are available upon request.





DRIVELINE SECTION (TWO)						
UNIT MODEL COMPR./ SHELLS	DIMENSIONS (FT./IN.)			DIMENSIONS (MM)		
	LENGTH	*HEIGHT	WIDTH	LENGTH	*HEIGHT	WIDTH
K1	10’-9”	6’-6”	7’-8”	3277	1981	2337
K2	10’-9”	6’-6”	7’-8”	3277	1981	2337
K3	11’-3”	6’-10”	7’-8”	3429	2083	2337
K4	11’-3”	6’-10”	7’-8”	3429	2083	2337
K7	13’-0”	7’-0”	7’-0”	3962	2134	2134

NOTE: Dimensions are approximate. Certified dimensions are available upon request.

GENERAL

Furnish and install where indicated on the drawings____ YORK YD model 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 (NPLV) 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. Waterside 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 YD model 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 (NPLV) of ____. The evaporator shall be selected for ____m^2°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 AHRI 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 (K3 to K7 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 in the chiller.

COMPRESSORS

Two centrifugal compressors shall be provided, operating 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 coast down 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 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 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.

Two 2kW immersion oil heaters shall be provided, one in each pump cover. The heaters shall be thermostatically controlled to remove refrigerant from the oil.

Oil cooling shall be done via a refrigerant cooled oil cooler at the discharge of each oil pump. A thermostatically controlled expansion 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 (12.4 barg) 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” (0.9 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 ANSI/AWWA C-606 couplings grooves shall be provided. Water boxes shall be designed for 150 PSIG (1034 kPa) design working pressure and be tested at 225 PSIG (15.5 barg). 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” (0.9 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 shutoff 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 ANSI/AWWA C-606 couplings grooves shall be provided. Water boxes shall be designed for 150 PSIG (10.3 barg) design working pressure and be tested at 225 PSIG (15.5 barg). 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
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 coast down
   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 compres sor)
i. Discharge – low temperature (each compres sor)
j. Oil – high temperature
k. Oil – low differential pressure (each compres sor)
l. Oil – high differential pressure (each compres sor)
m. Oil – sump pressure transducer out of range
n. Oil – differential pressure calibration (each com pressor)
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)
   i. Motor controller – loss of current (each motor)
   j. Power fault for each motor
   k. Control panel – schedule
   l. Proximity probe – low supply voltage
   m. 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.

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
   c. Remote current limit setpoint adjust
   d. Remote ready to start contacts
   e. Safety shutdown contacts
   f. Cycling shutdown contacts
   g. Run contacts

Guide Specifications - continued

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 Conversions

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 (KPA)

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^2 °F hr/Btu)	EQUIVALENT SI METRIC (m^2 k/kW)
0.0001	.018
0.00025	.044
0.0005	.088
0.00075	.132

Printed on recycled paper

Form 160.69-EG3 (1111) Supersedes:160.69-EG3 (611)
 P.O. Box 423, Milwaukee, WI 53201 Printed in USA
www.johnsoncontrols.com

Johnson Controls