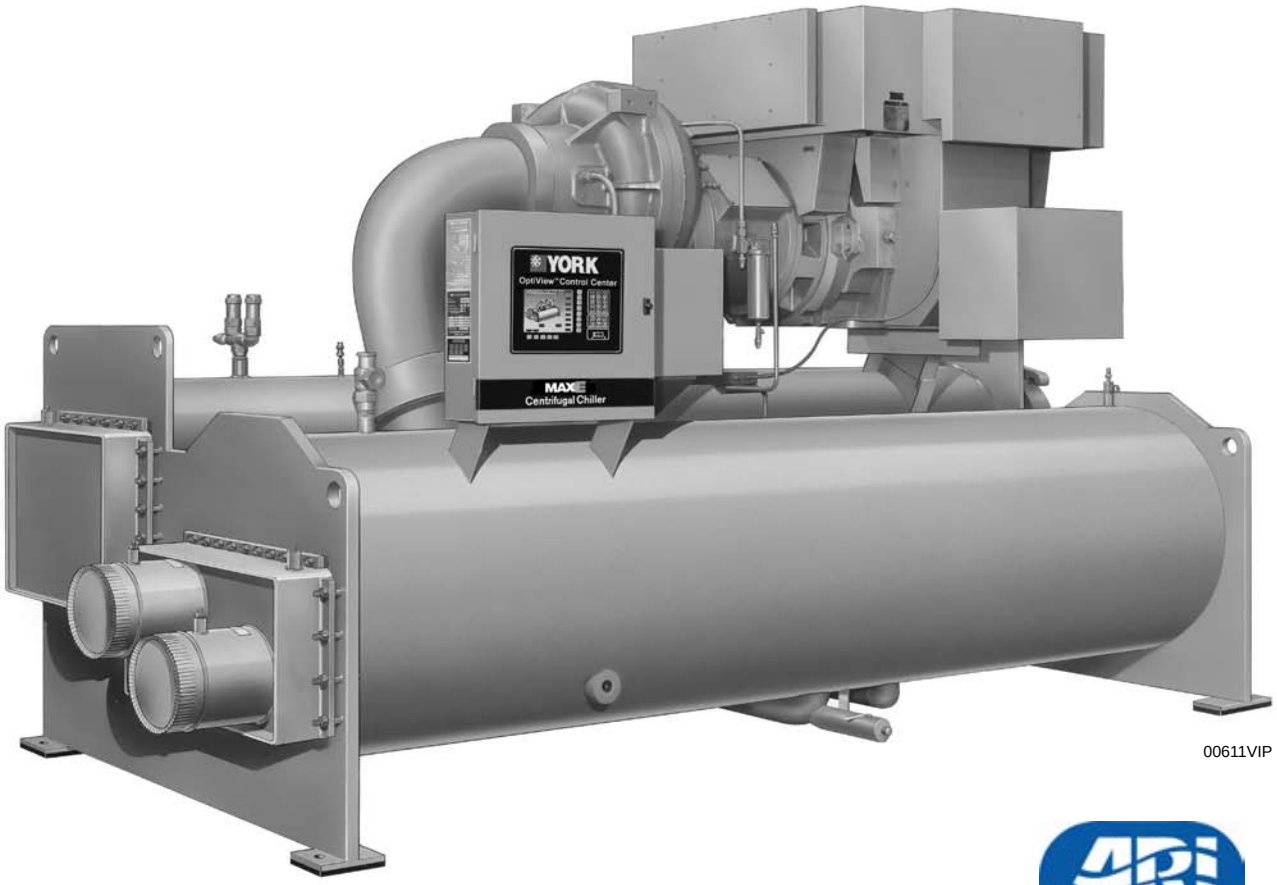
FORM 160.73-EG1 (606)

YORK®
A JOHNSON CONTROLS COMPANY

MAXE™

Centrifugal Liquid Chillers

Design Level F



00611VIP

250 THROUGH 3000 TONS
(879 through 8440 kW)
Utilizing HFC-134a

ARI PERFORMANCE CERTIFIED™
ARI Standard 550/590 WC

Rated in Accordance with the latest edition of ARI STANDARD 550/590

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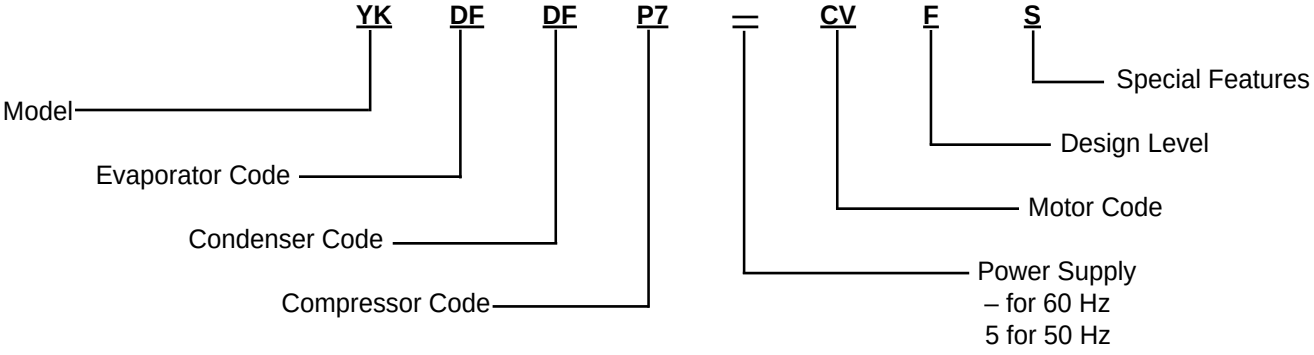
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NOMENCLATURE



Introduction

The YORK **MAXE™** YK Chillers offer a complete combination of features for total owner satisfaction.

MATCHED COMPONENTS MAXIMIZE EFFICIENCY

Actual chiller efficiency cannot be determined by analyzing the theoretical efficiency of any one chiller component. It requires a specific combination of heat exchanger, compressor, and motor performance to achieve the lowest system kW/ton. YORK MAXE chiller technology matches chiller system components to provide maximum chiller efficiency under actual – not just theoretical – operating conditions.

REAL-WORLD ENERGY PERFORMANCE

YORK pioneered the 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.

The YK MAXE chillers are the only chillers designed to operate on a continuous basis with cold ECWT and full condenser flow at all load points, taking full advantage of Real-World conditions. This type of operation benefits the cooling tower as well; reducing cycling of the fan motor and ensuring good coverage of the cooling fill.

YORK MAXE chillers offer the most efficient Real-World operation of any chiller, meaning lower operating costs and an excellent return on your chiller investment.

OPEN DRIVE DESIGN

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

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

HIGH-EFFICIENCY HEAT EXCHANGERS

MAXE chiller heat exchangers offer the latest technology in heat transfer surface design to give you maximum efficiency and compact design. 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 YK MAXE centrifugal chillers incorporate single-stage compressor design. With fewer moving parts and straightforward, efficient engineering, YORK single-stage compressors have proven durability records in hospitals, chemical plants, gas processing plants, the U.S. Navy, and in other applications where minimal downtime is a crucial concern.

In thousands of installations worldwide, YORK single-stage compressors are working to reduce energy costs. High strength aluminum-alloy compressor impellers feature backward-curved vanes for high efficiency. Airfoil shaped pre-rotation vanes minimize flow disruption for the most efficient part load performance. Precisely positioned and tightly fitted, they allow the compressor to unload smoothly from 100% to minimum load for excellent operation in air conditioning applications.

PRECISION CONTROL OF COMPRESSOR OIL PRESSURE

Utilizing our expertise in variable speed drive technology and applications, YORK has moved beyond the fixed head and bypass approach of oil pressure control. The old approach only assures oil pressure at the outlet of the pump rather than at the compressor, and allows no adjustment during chiller operation. The YK MAXE chillers feature a variable speed drive oil pump, monitoring and providing the right amount of oil flow to the compressor on a continuous basis. This design also provides sophisticated electronic monitoring and protection of the oil pump electrical supply, ensuring long life and reliable operation of the oil pump motor. Variable speed drive technology reduces oil pump power consumption, running only at the speed required, rather than at full head with a pressure regulating bypass valve.

FACTORY PACKAGING REDUCES FIELD LABOR COSTS

YORK MAXE centrifugal chillers are designed to keep installation costs low. Where installation access is not a problem, the unit can be shipped completely packaged, requiring minimal piping and wiring to complete the installation.

For those units utilizing Variable Speed Drive or a factory-installed Solid State Starter, the three power leads provide all power to the chiller and its auxiliaries.

TAKE ADVANTAGE OF COLDER COOLING TOWER WATER TEMPERATURES

YORK MAXE centrifugal chillers have been designed to take full advantage of colder cooling tower water temperatures, which are naturally available during most operating hours. Considerable energy savings are available by letting tower water temperature drop, rather than artificially holding it above 75°F (23.9°C), especially at low load, as some chillers require.

U.L. ACCEPTANCE – YOUR ASSURANCE OF RELIABILITY

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

Ratings



Rated in accordance with the latest issue of ARI Standard 550/590.

ARI CERTIFICATION PROGRAM

The performance of YORK MAXE chillers has been certified to the Air Conditioning and Refrigeration Institute (ARI) as complying with the certification sections of the latest issue of ARI Standard 550. Under this Certification Program, chillers are regularly tested in strict compliance with this Standard. This provides an independent, third-party verification of chiller performance.

COMPUTERIZED PERFORMANCE RATINGS

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

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

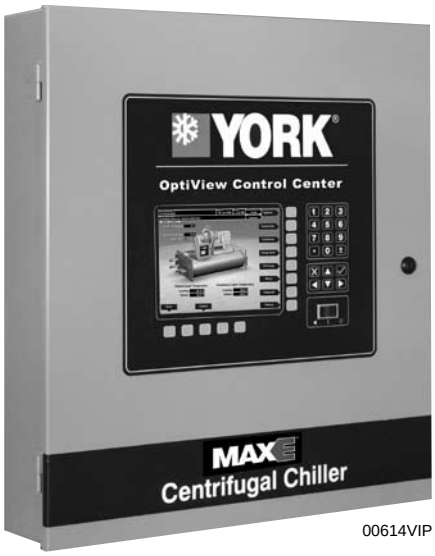
OFF-DESIGN PERFORMANCE

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 ARI Certification Program in the form of an Integrated Part Load Value (IPLV), and Non-Standard Part Load Value (NPLV).

The IPLV / NPLV formulas from ARI Standard 550/590 much more closely track actual chiller operations, and provide a more accurate indication of chiller performance than the previous IPLV/APLV formula. A more detailed analysis must take into account actual building load profiles, and local weather data. Part load performance data should be obtained for each job using its own design criteria.

OptiView Control Center



00614VIP

YK OPTIVIEW CONTROL CENTER

The YORK OptiView Control Center, furnished as standard on each chiller, provides the ultimate in efficiency, monitoring, data recording, chiller protection and operating ease. The Control Center is a factory-mounted, wired and tested state-of-the-art microprocessor based control system for R134a centrifugal chillers. The panel is configured with a 10.4-in. diagonal color Liquid Crystal Display (LCD) surrounded by “soft” keys, which are redefined with one keystroke based on the screen displayed at that time. This revolutionary development makes chiller operation quicker and easier than ever before. Instead of requiring keystroke after keystroke to hunt for information on a small monochrome LCD screen, a single button reveals a wide array of information on a large, full-color illustration of the appropriate component, which makes information easier to interpret. This is all mounted in the middle of a keypad interface and installed in a locked enclosure.

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

During prelube and coastdown, the system status will include a countdown timer indicating the time remaining. The control panel is compatible with the YORK Solid State Starter (optional); YORK Variable Speed Drive (VSD) (Optional); Electro-mechanical (E-M) starter or any customer supplied E-M starter that complies with the YORK R-1132 standard. The locations of various chiller parameters are clearly marked and instructions for specific operations are provided for on many of the screens. The panel verbiage is available in eight languages as standard and can be changed on the fly without having to turn off the chiller. 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 panel is fused through a 1-1/2 or 2 KVA transformer in the compressor motor starter to provide individual over-current protected power for all controls. Numbered terminal strips for wiring such as Remote Start/Stop, Flow Switches, Chilled Water Pump and Local or Remote Cycling devices are provided. The Panel also provides field interlocks that indicate the chiller status. These contacts include a Remote Mode Ready-to-Start, a Cycling Shutdown, a Safety Shutdown and a chiller Run contact. Pressure transducers sense system pressures and thermistors sense system temperatures. The output of each transducer is a DC voltage that is analogous to the pressure input. The output of each thermistor is a DC voltage that is analogous to the temperature it is sensing.

Setpoints can be changed from a remote location via 0-10VDC, 4-20mA, contact closures or through serial communications. The adjustable remote reset range [up

to 20°F (11.1°C)] provides flexible, efficient use of remote signal depending on reset needs. Serial data interface to the Building Automation System (BAS) is through the optional Microgateway, which can be mounted inside the Control Center.

This printed circuit board requests the required data from the Microboard and makes it available for the 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 11 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. 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)
- % Full Load Amps
- Operating Hours
- Input Power (kW) (VSD Only)

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

- Discharge Temperature
- 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
- Oil Pressure
- % Full Load Amps
- Current Limit

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 – Control 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
- High Pressure Switch (Open/Closed)
- 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 the compressor, this reveals the impeller and shows all the conditions associated with the compressor. When the compressor impeller is spinning this indicates that the chiller is presently in RUN condition. With the proper access level, the pre-rotation vanes may be manually controlled. This screen also serves as a gateway to sub-screens for calibrating the pre-rotation vanes, the proximity probe, configuring the Hot Gas Bypass, or providing advanced control of the compressor motor Variable Speed Drive. From this screen you can view the following:

Display Only

- Oil Pressure
- Oil Sump Temperature
- Discharge Temperature
- High Speed Thrust Bearing Oil Drain Temperature
- High Speed Thrust Bearing Proximity Differential
- High Speed Thrust Solenoid (LED)
- Vane Motor Switch (LED)
- Oil Return Solenoid (LED)
- Vent Line Solenoid (LED)
- Liquid Line Solenoid (LED)
- Oil Pump Drive Command Frequency (VS OIL Pump Only)

The **OIL SUMP** screen displays a close-up view of the chiller oil sump and provides all the necessary setpoints for maintaining the Variable Speed Oil Pump (VSOP). This screen also allows manual control of the Frequency Command sent to the VSOP. From this screen you can perform the following:

Display Only

- Oil Sump Temperature
- Sump Oil Pressure (LOP)
- Pump Oil Pressure (HOP)
- Oil Pressure
- Oil Pump Run Output (LED)
- Oil Return Solenoid (LED)
- Oil Heater (LED – VSOP Only)
- Target/Setpoint Oil Pressure (VSOP Only)
- Pulldown Time Remaining (VSOP Only)
- Variable Speed Oil Pump Control Mode (VSOP Only)
- Oil pump Drive Command Frequency (VSOP Only)
- Manual Oil Pump Operation Time Left

Programmable

- **Manual Pump**

  The **MOTOR** “soft” key on the Home screen when pressed shows a picture of either a YORK Electro-Mechanical Starter, Solid State Starter or a Variable Speed Drive Screen depending on chiller configuration. Programmable pulldown demand to automatically limit motor loading for minimizing building demand charges. Pulldown time period control over four hours, and verification of time remaining in pulldown cycle from

display readout. Separate digital setpoint for current limiting between 30 and 100%.

The **ELECTRO-MECHANICAL STARTER – (E-M)** screen displays a picture of the starter and the following values, the ones below are common among all three offerings and the values will be displayed on all types of starter screens. From this screen you can perform the following:

Display Only

- Motor Run (LED)
- Motor Current %Full Load Amps
- Current Limit Setpoints
- Pulldown Demand Time Left

Programmable

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

The **SOLID STATE STARTER – (SSS)** screen displays a picture of the starter and following values that are displayed in addition to the common ones listed above.

Display Only

- Scale/Model
- Voltage – Phase A, B, C
- Current – Phase A, B, C
- Input Power
- Kilowatt hours

The **VARIABLE SPEED DRIVE - (VSD)** screen displays a picture of the VSD and the following values that are in addition to the common ones listed above. From this screen you can view the following:

Display Only

- Output Voltage
- Output Frequency
- Current – Phase A, B, C
- Input Power
- kW Hours
- Pre-Rotation Vane Position
- Harmonic Filter Data (Filter option only)
  - Supply KVA
  - Total Power Factor
  - Voltage Total Harmonic Distortion – L1, L2, L3
  - Supply Current Total Demand Distortion – L1, L2, L3

There are two additional screens (Sub-screens) that have further VSD information. From these screens you can view the following:

1. **Variable Speed Drive Details**
   Display Only

- Water Pump Output (LED)
- Precharge Relay Output (LED)
- Trigger SCR Output (LED)
- DC Bus Voltage
- DC Inverter Link Current
- Internal Ambient Temperature
- Converter Heatsink Temperature
- Heatsink Temperature – Phase A, B, C
- Motor HP
- 100% Full Load Amps

2. **Harmonic Filter Details (Filter option only)**
   Display Only

- Operating Mode (Run/Stop)
- DC Bus Voltage
- Supply Contactor (LED)
- Precharge Contactor (LED)
- Phase Rotation
- Total Supply KVA
- Base Plate Heatsink Temperature
- Voltage Peak (N-L1, N-L2, N-L3)
- RMS Voltage (L1, L2, L3)
- Voltage Total Harmonic Distortion (L1, L2, L3)
- RMS Filter Current (L1, L2, L3)
- Supply Current Total Demand Distortion
- RMS Supply Current L1, L2, L3

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

Display Only

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

Programmable

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

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

Display Only

- Chilled Liquid Pump Operation: (Displays Standard or Enhanced)
- Motor Type: (Displays Fixed Speed or Variable Speed)
- Refrigerant Selection: (Displays R-22 or R134a)
- Anti-Recycle: (Displays Disabled or Enabled)
- Power Failure Restart: (Displays Manual or Automatic)
- Liquid Type: (Water or Brine)
- Coastdown: (Displays Standard or Enhanced)
- Pre-Run: (Displays Standard or Extended)
- Oil Pump Package: (Displays Fixed Speed or Variable Speed)
- Power Line Frequency (VSD only): (Displays 60 Hz or 50 Hz)

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 allows definition of the language for the chiller to display and defines the unit of measure.

Programmable

- System Language
- 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
- ACC Auto Map Print (Enable/Disabled)
- ACC Map Report
- 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

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

Programmable

- Chart Type (select Continuous or One Screen)
- Collection Interval

- Select
- Data Point Slot # (1-6)
- Data Point Min (1-6)
- Data Point Max (1-6)

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

Display Only

- Slot Numbers

Programmable

- Page Up
- Page Down

DISPLAY MESSAGES

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

Status Messages include:

- System Ready to Start
- Cycling Shutdown – Auto Restart
- Safety Shutdown – Manual Restart
- System Prelube (with countdown timers)
- System Run (with countdown timers)
- System Coastdown (with countdown timers)
- Start Inhibit
- Vanes Closing Before Shutdown

Run Messages include:

- Leaving Chilled Liquid Control
- Current Pulldown Limit

Start Inhibit Messages include:

- Anti-Recycle XX Min/Sec
- Vane Motor Switch Open
- Motor Current >15% FLA

Warning Messages include:

- Real Time Clock Failure
- Condenser or Evaporator Transducer Error
- Refrigerant level Out-of-Range
- Standby Lube – Low Oil Pressure
- Setpoint Override
- Condenser – High Pressure Limit
- Evaporator – Low Pressure Limit
- Motor – High Current Limit **(E-M and SSS options only)**
- Vane Uncalibrated – Fixed Speed **(VSD option only)**

(Filter option only)

- Harmonic Filter – Operation Inhibited
- Harmonic Filter – Data Loss
- Harmonic Filter – Input Frequency Range

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
- Motor Controller – Loss of Current
- Power Fault
- Control Panel – Schedule
- Starter – Low Supply Line Voltage **(SSS option only)**
- Starter – High Supply Line Voltage **(SSS option only)**
- Proximity Probe – Low Supply Voltage
- Oil – Variable Speed Pump – Drive Contacts Open

Compressor Motor Variable Speed Drive: Cycling

OptiView Control Center *(continued)*

Shutdown Messages include (VSD only):

- VSD Shutdown – Requesting Fault Data
- VSD – Stop Contacts Open
- VSD – Initialization Failed
- VSD – High Phase A, B, C Instantaneous Current
- VSD – Phase A, B, C Gate Driver
- VSD – Single-Phase Input Power
- VSD – High DC Bus Voltage
- VSD – Logic Board Power Supply
- VSD – Low DC Bus Voltage
- VSD – DC Bus Voltage Imbalance
- VSD – Precharge – DC Bus Voltage Imbalance
- VSD – High Internal Ambient Temperature
- VSD – Invalid Current Scale Selection
- VSD – Low Phase A, B, C Inverter Heatsink Temperature
- VSD – Low Converter Heatsink Temperature
- VSD – Precharge – Low DC Bus Voltage
- VSD – Logic Board Processor
- VSD – Run Signal
- VSD – Serial Communications

(Filter option only)

- Harmonic Filter – Logic Board or Communications
- Harmonic Filter – High DC Bus Voltage
- Harmonic Filter – High Phase A, B, C Current
- Harmonic Filter – Phase Locked Loop
- Harmonic Filter – Precharge – Low DC Bus Voltage
- Harmonic Filter – Low DC Bus Voltage
- Harmonic Filter – DC Bus Voltage Imbalance
- Harmonic Filter – 110% Input Current Overload
- Harmonic Filter – Logic Board Power Supply
- Harmonic Filter – Run Signal
- Harmonic Filter – DC Current Transformer 1
- Harmonic Filter – DC Current Transformer 2

Safety Shutdown Messages include:

- Evaporator – Low Pressure
- Evaporator – Transducer or Leaving Liquid Probe
- Evaporator – Transducer or Temperature Sensor
- Condenser – High Pressure Contacts Open
- Condenser – High Pressure
- Condenser – Pressure Transducer Out-of-Range
- Auxiliary Safety – Contacts Closed
- Discharge – High Temperature
- Discharge – Low Temperature
- Oil – High Temperature
- Oil – Low Differential Pressure
- Oil – High Differential Pressure
- Oil – Pump Pressure Transducer Out-of-Range
- Transducer Out-of-Range
- Oil – Differential Pressure Calibration
- Oil – Variable Speed Pump – Setpoint Not Achieved
- Control Panel – Power Failure
- Motor Or Starter – Current Imbalance **(SSS option only)**
- Thrust Bearing – Proximity Probe Clearance (J & H3 Compressor)
- Thrust Bearing – Proximity Probe Out Of Range (J & H3 Compressor)
- Thrust Bearing – Position Switch (P, Q & H5-H9 Compressors)
- Watchdog – Software Reboot

Compressor Motor VSD: Safety Shutdown Messages include: (VSD only)

- VSD Shutdown – Requesting Fault Data
- VSD – Stop contacts Open
- VSD – 105% Motor Current Overload
- VSD – High Phase A, B, C Inverter Heatsink Temperature
- VSD – High Converter Heatsink Temperature
- VSD – Precharge Lockout

(Filter option only)

- Harmonic Filter – High Heatsink Temperature
- Harmonic Filter – High Total Demand Distortion

Mechanical Specifications

GENERAL

The YORK **MAXE** Centrifugal Liquid Chillers are completely factory-packaged including the evaporator, condenser, compressor, motor, lubrication system, control center, and all interconnecting unit piping and wiring.

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

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

COMPRESSOR

The 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) 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.

LUBRICATION SYSTEM

Lubrication oil is force-fed to all bearings, gears and rotating surfaces by a variable speed drive pump which operates prior to startup, continuously during operation and during coastdown.

A gravity-fed oil reservoir is built into the top of the compressor to provide lubrication during coastdown in the event of a power failure.

An oil reservoir, separate from the compressor, contains the submersible oil pump, 2 HP pump motor and 3000 watt immersion-type oil heater. The oil heater is thermostatically controlled to remove refrigerant from the oil.

Oil is filtered by an externally mounted 1/2 micron replaceable cartridge oil filter equipped with service valves. Oil is cooled via a refrigerant-cooled oil cooler, eliminating the requirement for field water piping. The oil side of the oil cooler is provided with service valves. An automatic oil return system recovers any oil that may have migrated to the evaporator. Oil piping is completely factory-installed.

WATER-COOLED OIL COOLER

Optional condenser water-cooled oil cooler is offered for units with Q3 compressors AA-AD and BA-BD shells only. This oil cooler is a shell and tube heat exchanger. Water from condenser supply water box circulates through the tube side of the heat exchanger and discharges back into the return side of the water box. Hot oil circulates through the tubes within the oil cooler, and is cooled by the cold condenser water. The cooled oil is then sent back to the compressor through a temperature regulator valve and oil filters. Both the oil and water piping are competely factory-installed, eliminating the requirement for field piping.

MOTOR DRIVELINE

The compressor motor is an 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.

For units utilizing remote electro-mechanical starters, a large, steel terminal box with gasketed front access cover is provided 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. For units furnished with factory-packaged Solid State Starters or Variable Speed Drive, refer to the Accessories and Modifications Section.

Mechanical Specifications *(continued)*

HEAT EXCHANGERS

Shells

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

Tubes

Heat exchanger tubes are state-of-the-art, high-efficiency, externally and internally enhanced type to provide optimum performance. Tubes in both the evaporator and condenser are 3/4" O.D. standard (or 1" optional in some shells) 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. A suction baffle or aluminum mesh eliminators are located above the tube bundle to prevent liquid refrigerant carryover into the compressor. A 1-1/2" liquid level sight glass is conveniently located on the side of the shell to aid in determining proper refrigerant charge. The evaporator shell contains a dual refrigerant relief valve arrangement set at 180 PSIG (1241 kPa) on H and J Compressor models; 235 PSIG (1620 kPa) on P and Q Compressor Models; or single-relief valve arrangement, if the chiller is supplied with the optional refrigerant isolation valves. A 1" refrigerant charging valve is provided.

Condenser

The condenser is a shell and tube type, with a discharge gas baffle to prevent direct high velocity impingement on the tubes. The baffle is also used to distribute the refrigerant gas flow properly for most efficient heat transfer. An integral sub-cooler is located at the bottom of the condenser shell providing highly effective liquid refrigerant subcooling to provide the highest cycle efficiency. The condenser contains dual refrigerant relief valves set at 235 PSIG (1620 kPa).

Water Boxes

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

WATER FLOW SWITCHES

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

REFRIGERANT FLOW CONTROL

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

OPTIVIEW CONTROL CENTER

General

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

Control Panel

The control panel includes a 10.4-in. diagonal color liquid crystal display (LCD) surrounded by “soft” keys which are redefined based on the screen displayed at that time, mounted in the middle of a keypad interface and installed in a locked enclosure. The screen details all operations and parameters, using a graphical representation of the chiller and its major components. Panel verbiage is available in eight languages and can be changed on the fly without having to turn off the chiller. Data can be displayed in either English or Metric units. Smart Freeze Point Protection will run the chiller at 36°F (2.2°C) leaving chilled water temperature, and not have nuisance trips on

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

1. System operating information including:
   a. return and leaving chilled water temperature
   b. return and leaving condenser water temperature
   c. evaporator and condenser saturation pressure
   d. differential oil pressure
   e. percent motor current
   f. evaporator and condenser saturation temperature
   g. compressor discharge temperature
   h. oil reservoir temperature
   i. compressor thrust bearing positioning (J & H3 compressors only)
   j. operating hours
   k. number of compressor starts

2. Digital programming of setpoints through the universal keypad including:
   a. leaving chilled water temperature
   b. percent current limit
   c. pull-down demand limiting
   d. six-week schedule for starting and stopping the chiller, pumps and tower
   e. remote reset temperature range

3. Status messages indicating:
   a. system ready to start
   b. system running
   c. system coastdown
   d. system safety shutdown – manual restart
   e. system cycling shutdown – auto restart
   f. system prelube
   g. start inhibit

4. The text displayed within the system status and system details field is displayed as a color-coded message to indicate severity: red for safety fault, orange for cycling faults, yellow for warnings, and green for normal messages.

5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. Safety shutdowns with a fixed speed drive include:
   a. evaporator – low pressure
   b. evaporator – transducer or leaving liquid probe
   c. evaporator – transducer or temperature sensor
   d. condenser – high pressure contacts open
   e. condenser – high pressure
   f. condenser – pressure transducer out-of-range
   g. auxiliary safety – contacts closed
   h. discharge – high temperature
   i. discharge – low temperature
   j. oil – high temperature
   k. oil – low differential pressure
   l. oil – high differential pressure
   m. oil – sump pressure transducer out-of-range
   n. oil – differential pressure calibration
   o. oil – variable speed pump – pressure setpoint not achieved
   p. control panel – power failure
   q. motor or starter – current imbalance
   r. thrust bearing – proximity probe clearance (J & H3 compressors only)
   s. thrust bearing – proximity probe out-of-range (J & H3 compressors only)
   t. thrust bearing – position switch (P, Q & H5-H9 compressors)
   u. watchdog – software reboot

5.1 Safety shutdowns with a VSD include:
   a. VSD shutdown – requesting fault data
   b. VSD – stop contacts open
   c. VSD – 105% motor current overload
   d. VSD – high phase A, B, C inverter heatsink temp.
   e. VSD – high converter heatsink temperature

(Filter Option Only)
   f. harmonic filter – high heatsink temperature
   g. harmonic filter – high total demand distortion

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.

Mechanical Specifications *(continued)*

Cycling shutdowns with a fixed speed drive 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
i. motor controller – loss of current
j. power fault
k. control panel – schedule
l. starter – low supply line voltage (SSS option)
m. starter – high supply line voltage (SSS option)
n. proximity probe – low supply voltage (J & H3 Compressor)
o. oil – variable speed pump – drive contacts open

6.1 Cycling shutdowns with a VSD include:

a. VSD shutdown – requesting fault data
b. VSD – stop contacts open
c. VSD – initialization failed
d. VSD – high phase A, B, C instantaneous current
e. VSD – phase A, B, C gate driver
f. VSD – single phase input power
g. VSD – high DC bus voltage
h. VSD – precharge DC bus voltage imbalance
i. VSD – high internal ambient temperature
j. VSD – invalid current scale selection
k. VSD – low phase A, B, C inverter heatsink temp.
l. VSD – low converter heatsink temperature
m. VSD – precharge – low DC bus voltage
n. VSD – logic board processor
o. VSD – run signal
p. VSD – serial communications

(Filter Option Only)

q. harmonic filter – logic board or communications
r. harmonic filter – high DC bus voltage
s. harmonic filter – high phase A, B, C current
t. harmonic filter – phase locked loop
u. harmonic filter – precharge – low DC bus voltage
v. harmonic filter – DC bus voltage imbalance
w. harmonic filter – 110% input current overload
x. harmonic filter – logic board power supply
y. harmonic filter – run signal
z. harmonic filter – DC current transformer 1
aa. harmonic filter – DC current transformer 2

7. Security access to prevent unauthorized change of setpoints, to allow local or remote control of the chiller, and to allow manual operation of the pre-rotation vanes and oil pump. Access is through ID and password recognition, which is defined by three different levels of user competence: view, operator, and service.

8. Trending data with the ability to customize points of once every second to once every hour. The panel will trend up to 6 different parameters from a list of over 140, without the need of an external monitoring system.

9. The operating program stored in non-volatile memory (EPROM) to eliminate reprogramming the chiller due to AC power failure or battery discharge. Programmed setpoints are retained in lithium battery-backed RTC memory for a minimum of 11 years with power removed from the system.

10. A fused connection through a transformer in the compressor motor starter to provide individual over-current protected power for all controls.

11. A numbered terminal strip for all required field interlock wiring.

12. An RS-232 port to output all system operating data, shutdown/cycling message, and a record of the last 10 cycling or safety shutdowns to a field-supplied printer. Data logs to a printer at a set programmable interval. This data can be preprogrammed to print from 1 minute to 1 day.

13. The capability to interface with a building automation system via hard-wired connections to each feature to provide:

a. remote chiller start and stop
b. remote leaving chiller liquid temperature adjust
c. remote current limit setpoint adjust
d. remote ready to start contacts

e. safety shutdown contacts
f. cycling shutdown contacts
g. run contacts

CODES AND STANDARDS

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

ISOLATION MOUNTING

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

REFRIGERANT CONTAINMENT

The standard unit has been designed as a complete and compact factory-packaged chiller. As such, it has minimum joints from which refrigerant can leak. The entire assembly has been thoroughly leak tested at the factory prior to shipment. The YORK 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

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

Accessories and Modifications

OPTISPEED DRIVE

A 460V 3-ph 60 Hz or 380V 3-ph 50 Hz variable speed drive is factory-packaged and mounted on the MAXE chiller. It is designed to vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The adaptive capacity control logic automatically adjusts motor speed and compressor pre-rotation vane position independently for maximum part load efficiency by analyzing information fed to it by sensors located throughout the chiller.

The variable speed drive is mounted in a NEMA-1 enclosure with all power and control wiring between the drive and chiller factory-installed. Electrical lugs for incoming power wiring are provided, and the entire chiller package is U.L. listed.

The variable speed drive provides automatic power factor correction to 0.95 or better at all load conditions. Separate power factor correction capacitors are not required. The power factor is 0.98 or better when the optional harmonic filter is provided.

Standard features include: a door interlocked padlockable circuit breaker; U.L. listed ground fault protection; overvoltage and undervoltage protection; 3-phase sensing motor overcurrent protection; single-phase protection; insensitive to phase rotation; overtemperature protection; digital readout at the OptiView Control Center of:

- Output Frequency
- Output Voltage
- 3-phase output current
- Input Kilowatts (kW)
- Self diagnostic service parameters
- Kilowatt-hours (kWH)

An optional harmonic filter limits electrical power supply distortion from the variable speed drive to comply with the guidelines of IEEE Std. 519-1992. The filter is unit-mounted within the same NEMA-1 enclosure and is U.L. listed. The following digital readout is standard with the optional filter:

- Input KVA
- Total power factor
- 3-phase input voltage
- 3-phase input current
- 3-phase input voltage total harmonic distortion (THD)
- 3-phase input current total demand distortion (TDD)
- Self diagnostic service parameters

SOLID STATE STARTER

The Solid State Starter is a reduced voltage starter that controls and maintains a constant current flow to the motor during startup. It is compact and mounted on the unit. Power and control wiring between the starter and the chiller are factory-installed. Available for 200 - 600 volts, the starter enclosure is NEMA-1, with a hinged access door with lock and key. Electrical lugs for incoming power wiring are provided.

Standard Features include digital readout at the OptiView Control Center of the following:

Display Only

- 3-phase voltage A, B, C
- 3-phase current A, B, C
- Input Power (kW)
- kW Hours
- Starter Model
- Motor Run (LED)
- Motor Current % Full Load Amps
- Current Limit Setpoints
- Pulldown Demand Time Left

Programmable

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

Other features include: low line voltage; 115-volt control transformer; three-leg sensing overloads; phase rotation and single-phase failure protection; high temperature safety protection; motor current imbalance and undervoltage safeties; open and close SCR protection; momentary power interruption protection. The Solid State Starter is cooled by a closed loop, fresh water circuit consisting of a water-to-water heat exchanger and 1/25 HP circulating pump. All interconnecting water piping is factory-installed and rated for 150 PSIG working pressure. **Optional:** Unit-mounted circuit breaker includes ground fault protection and provides 65,000 amp. Short circuit withstand rating in accordance with U.L. Standard 508. A non-fused disconnect switch is also available. Both options are padlockable.

BAS REMOTE CONTROL

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

FACTORY INSULATION OF EVAPORATOR

Factory-applied thermal insulation of the flexible, closed-cell plastic type, 3/4" (19 mm) thick is attached with vapor-proof cement to the evaporator shell, flow chamber, tube sheets, suction connection, and (as necessary) to the auxiliary tubing. Not included is the insulation of compact water boxes and nozzles. This insulation will normally prevent condensation in environments with relative humidities up to 75% and dry bulb temperatures ranging from 50° to 90°F (10° to 32.2°C). 1-1/2" (38 mm) thick insulation is also available for relative humidities up to 90% and dry bulb temperatures ranging from 50° to 90°F (10° to 32.2°C).

WATER FLANGES

Four 150 lb. ANSI raised-face flanges for condenser and evaporator water connections, are factory-welded to water nozzles. Companion flanges, bolts, nuts and gaskets are not included.

SPRING ISOLATION MOUNTING

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

SEQUENCE CONTROL KIT

For two, three or four units with chilled water circuits connected in series or parallel, the kit consists of return water thermostat, lead-lag selector switch for sequence starting, and time delay relay, with NEMA-1 enclosures, designed for 115V-1-50/60 service.

STARTER – FIELD-INSTALLED

A field-installed, electro-mechanical compressor motor starter is available, selected for proper size and type for job requirements and in accordance with YORK Engineering Standard (R-1132) for Starters.

MARINE WATER BOXES

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

KNOCK-DOWN SHIPMENT

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

REFRIGERANT ISOLATION VALVES

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

REFRIGERANT STORAGE/RECYCLING SYSTEM

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

Application Data

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

LOCATION

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

The unit site must be a floor, mounting pad or foundation which is level within 1/4" (6.4 mm) and capable of supporting the operating weight of the unit.

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

The chiller should be installed in an indoor location where temperatures range from 40°F to 104°F (4.4°C to 40°C).

WATER CIRCUITS

Flow Rate – For normal water chilling duty, evaporator and condenser flow rates are permitted at water velocity levels in the heat exchangers tubes of between 3 ft/sec (3.3 for condensers) and 12 ft/sec (0.91 m/s and 3.66 m/s). Two pass units are also limited to 45 ft H_20 (134 kPA) water pressure drop. Three pass limit is 67.5 ft H_20 (201 kPA).

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

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

YORK YK chillers will operate successfully in VPF systems. With a minimum allowable evaporator tube velocity of 1-1/2 fps (feet per second) for standard tubes at part-load rating conditions, YK chillers will accommodate the wide variation in flow required by many chilled water VPF applications.

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

Temperature Ranges – For normal water chilling duty, leaving chilled water temperatures may be selected between 38°F (3.3°C) [36°F (2.2°C) with Smart Freeze enabled] and 70°F (21.1°C) for water temperature ranges between 3°F and 30°F (1.7°C and 16.7°C).

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

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

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

Connections – The standard chiller is designed for 150 PSIG (1034 kPA) design working pressure in both the chilled water and condenser water circuits. The connections (water nozzles) to these circuits are furnished with grooves to ANSI/AWWA C-606 Standard for grooved and

TABLE 1 – WATER FLOW RATE LIMITS (GPM) — BASED UPON STANDARD TUBES @ DESIGN FULL LOAD CONDITIONS

Model	Evaporator						Model	Condenser					
	1 Pass		2 Pass		3 Pass			1 Pass		2 Pass		3 Pass	
	Min	Max	Min	Max	Min	Max		Min	Max	Min	Max	Min	Max
AP	329	1316	164	586	110	380	AP	479	1727	240	855	160	576
AQ	403	1613	202	712	134	460	AQ	612	2205	306	1065	204	732
AR	493	1973	247	860	164	552	AR	681	2455	341	1169	227	811
AS	602	2408	301	1029	201	655	AS	770	2773	385	1295	–	–
AA	652	2606	326	1156	217	757	AA	779	2807	389	1398	260	921
AB	732	2929	366	1292	244	846	AB	896	3228	448	1590	299	1048
AC	869	3475	434	1515	290	994	AC	1120	4035	560	1942	373	1282
AD	1043	4170	521	1788	348	1174	AD	1397	5035	699	2343	–	–
BA	652	2606	326	992	217	650	BA	779	2807	389	1203	260	792
BB	732	2929	366	1110	244	728	BB	896	3228	448	1372	299	904
BC	869	3475	434	1306	290	856	BC	1120	4035	560	1686	373	1112
BD	1043	4170	521	1548	348	1016	BD	1397	5035	699	2049	–	–
CD	859	3438	430	1535	286	1009	CD	1120	4035	560	2017	373	1338
CE	1046	4183	523	1853	349	1220	CE	1344	4842	672	2394	448	1591
CF	1232	4927	616	2163	411	1428	CF	1583	5705	792	2778	–	–
CG	1452	5809	726	2518	484	1668	CG	1750	6308	875	3036	583	2032
CH	1676	6702	838	2864	559	1904	CH	1946	7012	973	3326	–	–
DE	1046	4183	523	1591	349	1046	DE	1344	4842	672	2064	–	–
DF	1232	4927	616	1862	411	1226	DF	1583	5705	792	2404	528	1599
DG	1452	5809	726	2174	484	1436	DG	1750	6308	875	2635	583	1757
DH	1676	6702	838	2482	559	1644	DH	1946	7012	973	2897	–	–
EB	1238	4952	619	2006	413	1323	EB	1517	5467	758	2475	–	–
–	–	–	–	–	–	–	EC	1665	6001	833	2693	555	1796
–	–	–	–	–	–	–	ED	1741	6274	870	2803	–	–
EK	1443	5771	721	2503	481	1658	EK	1583	5705	792	2778	528	1854
EL	1629	6516	814	2793	543	1855	EL	1750	6308	875	3036	–	–
EM	1843	7372	922	3114	614	2076	EM	1946	7012	973	3326	–	–
–	–	–	–	–	–	–	FA	1741	6274	870	2885	580	1871
FB	1421	5684	711	2283	474	1509	FB	2028	7308	1014	3328	676	2149
FC	1604	6417	802	2552	535	1691	FC	2113	7615	1057	3457	–	–
FD	1756	7025	878	2769	585	1839	FD	2242	8081	1121	3650	–	–
FK	1443	5771	721	2161	481	1427	FK	1583	5705	792	2404	528	1599
FL	1629	6516	814	2418	543	1601	FL	1750	6308	875	2635	583	1757
FM	1843	7372	922	2706	614	1796	FM	1946	7012	973	2897	–	–
GB	1831	7323	915	2962	610	1961	GB	2633	9490	1317	4300	878	2838
GC	2048	8191	1024	3290	683	2183	GC	2902	10456	1451	4697	967	3102
GD	2343	9371	1171	3722	781	2480	GD	3088	11126	1544	4965	–	–
GF	1536	6144	768	2452	512	1624	–	–	–	–	–	–	–
GH	1790	7161	895	2817	597	1872	–	–	–	–	–	–	–
GJ	1582	6330	791	2797	527	1849	GJ	1583	5705	792	2778	528	1899
GK	1933	7732	967	3374	644	2240	GK	1892	6819	946	3248	631	2253
GL	2352	9408	1176	4032	784	2695	GL	2479	8933	1239	4051	1612	4051
GM	2659	10637	1330	4491	886	3018	GM	2756	9933	1378	4390	–	–
HB	2578	10314	1289	4057	859	2713	HB	3589	12933	1795	5847	1196	3883
HC	2938	11754	1469	4549	979	3060	HC	3785	13638	1892	6135	1262	4079
HF	2094	8378	1047	3359	698	2231	HD	3892	14025	1946	6292	–	–
HH	2464	9855	1232	3895	821	2600	–	–	–	–	–	–	–

Application Data *(continued)*

TABLE 1 – WATER FLOW RATE LIMITS (GPM) — BASED UPON STANDARD TUBES @ DESIGN FULL LOAD CONDITIONS - cont.

Model	Evaporator						Model	Condenser					
	1 Pass		2 Pass		3 Pass			1 Pass		2 Pass		3 Pass	
	Min	Max	Min	Max	Min	Max		Min	Max	Min	Max	Min	Max
HK	1933	7732	967	2908	644	1924	HK	1892	6819	946	2826	631	1935
HL	2352	9408	1176	3491	784	2322	HL	2479	8933	1239	3564	826	2504
HM	2659	10637	1330	3903	886	2606	HM	2756	9933	1378	3885	–	–
KJ	1582	6330	791	2580	527	1703	KJ	1583	5705	792	2573	528	1749
KK	1933	7732	967	3118	644	2066	KK	1892	6819	946	3017	631	2078
KL	2352	9408	1176	3735	784	2489	KL	2479	8933	1239	3787	826	2683
KM	2659	10637	1330	4169	886	2792	KM	2756	9933	1378	4117	–	–
–	–	–	–	–	–	–	LJ	2681	9660	1340	4371	894	2885
LK	2482	9929	1241	3989	827	2664	LK	3075	11081	1537	4947	1025	3269
LL	2870	11480	1435	4558	957	3064	LL	3469	12502	1735	5500	1156	3639
LM	3258	13032	1629	5105	1086	3456	LM	3863	13922	1932	6028	–	–
JF	2895	11580	1447	4593	965	3089	JB	4456	16059	2228	7094	1485	4816
JG	3131	12523	1565	4928	1044	3328	JC	4810	17332	2405	7577	1603	5167
JH	3363	13454	1682	5250	1121	3561	JD	4951	17843	2476	7767	–	–
TF	2895	11580	1447	4293	965	2878	TB	4456	16059	2228	6645	1485	4494
TG	3131	12523	1565	4611	1044	3102	TC	4810	17332	2405	7107	1603	4826
TH	3363	13454	1682	4917	1121	3321	TD	4951	17843	2476	7288	–	–
VF	3708	14832	1854	5514	1236	3641	VB	5661	20400	2831	8449	1887	5604
VH	4055	16222	2028	5985	1352	3959	VC	5898	21253	2949	8760	1966	5815
–	–	–	–	–	–	–	VD	6330	22810	3165	9318	–	–
WF	4633	18530	2316	6902	1544	4542	–	–	–	–	–	–	–
WH	5405	21621	2703	7946	1802	5240	–	–	–	–	–	–	–
XF	4633	18530	2316	6493	1544	4271	XA	6200	22344	3100	8640	2067	5862
XH	5405	21621	2703	7487	1802	4933	XB	6724	24230	3362	9275	2241	6324
–	–	–	–	–	–	–	XC	7326	26401	3663	9981	2442	6846
–	–	–	–	–	–	–	XD	7484	26969	3742	10162	–	–
YB	3103	12411	1551	3973	1034	2605	YB	5242	18889	2621	6695	1747	4487
YC	3829	15316	1914	4871	1276	3197	YC	5765	20775	2883	7310	1922	4917
YD	4633	18530	2316	5842	1544	3840	YD	6289	22662	3144	7911	–	–
Y1	3173	12693	1587	5209	1058	3419	Y1	4123	14859	2062	6638	1374	4441
Y2	3800	15198	1900	6180	1267	4062	Y2	5134	18500	2567	8151	1711	5506
Y3	4296	17183	2148	6929	1432	4559	Y3	6014	21672	3007	9395	2005	6406
Y4	4816	19263	2408	7693	1605	5069	Y4	6659	23995	3329	10260	–	–
ZB	4769	19076	2385	6671	1590	4390	ZB	6115	22037	3058	8712	2038	5787
ZC	5272	21087	2636	7318	1757	4820	ZC	6841	24651	3420	9653	2280	6426
ZD	5740	22961	2870	7907	1913	5214	ZD	7774	28015	3887	10824	–	–
Z1	3959	15836	1980	7122	1320	4686	Z1	4012	14457	2006	7229	1337	4803
Z2	4769	19074	2384	8427	1590	5559	Z2	4842	17450	2421	8703	1614	5772
Z3	5637	22549	2819	9748	1879	6450	Z3	6361	22923	3181	11181	2120	7465
Z4	6281	25125	3141	10672	2094	7077	Z4	7973	28731	3986	13579	–	–

TABLE 1A – WATER FLOW RATE LIMITS (L/S) — BASED UPON STANDARD TUBES @ DESIGN FULL LOAD CONDITIONS

Model	Evaporator						Model	Condenser					
	1 Pass		2 Pass		3 Pass			1 Pass		2 Pass		3 Pass	
	Min	Max	Min	Max	Min	Max		Min	Max	Min	Max	Min	Max
AP	21	83	10	37	7	24	AP	30	109	15	54	10	36
AQ	25	102	13	45	8	29	AQ	39	139	19	67	13	46
AR	31	125	16	54	10	35	AR	43	155	21	74	14	51
AS	38	152	19	65	13	41	AS	49	175	24	82	–	–
AA	41	164	21	73	14	48	AA	49	177	25	88	16	58
AB	46	185	23	81	15	53	AB	57	204	28	100	19	66
AC	55	219	27	96	18	63	AC	71	255	35	123	24	81
AD	66	263	33	113	22	74	AD	88	318	44	148	–	–
BA	41	164	21	63	14	41	BA	49	177	25	76	16	50
BB	46	185	23	70	15	46	BB	57	204	28	87	19	57
BC	55	219	27	82	18	54	BC	71	255	35	106	24	70
BD	66	263	33	98	22	64	BD	88	318	44	129	–	–
CD	54	217	27	97	18	64	CD	71	255	35	127	24	84
CE	66	264	33	117	22	77	CE	85	305	42	151	28	100
CF	78	311	39	136	26	90	CF	100	360	50	175	–	–
CG	92	366	46	159	31	105	CG	110	398	55	192	37	128
CH	106	423	53	181	35	120	CH	123	442	61	210	–	–
DE	66	264	33	100	22	66	DE	85	305	42	130	–	–
DF	78	311	39	117	26	77	DF	100	360	50	152	33	101
DG	92	366	46	137	31	91	DG	110	398	55	166	37	111
DH	106	423	53	157	35	104	DH	123	442	61	183	–	–
EB	78	312	39	127	26	83	EB	96	345	48	156	–	–
–	–	–	–	–	–	–	EC	105	379	53	170	35	113
–	–	–	–	–	–	–	ED	110	396	55	177	–	–
EK	91	364	46	158	30	105	EK	100	360	50	175	33	117
EL	103	411	51	176	34	117	EL	110	398	55	192	–	–
EM	116	465	58	196	39	131	EM	123	442	61	210	–	–
–	–	–	–	–	–	–	FA	110	396	55	182	37	118
FB	90	359	45	144	30	95	FB	128	461	64	210	43	136
FC	101	405	51	161	34	107	FC	133	480	67	218	–	–
FD	111	443	55	175	37	116	FD	141	510	71	230	–	–
FK	91	364	46	136	30	90	FK	100	360	50	152	33	101
FL	103	411	51	153	34	101	FL	110	398	55	166	37	111
FM	116	465	58	171	39	113	FM	123	442	61	183	–	–
GB	115	462	58	187	38	124	GB	166	599	83	271	55	179
GC	129	517	65	208	43	138	GC	183	660	92	296	61	196
GD	148	591	74	235	49	156	GD	195	702	97	313	–	–
GF	97	388	48	155	32	102	–	–	–	–	–	–	–
GH	113	452	56	178	38	118	–	–	–	–	–	–	–
GJ	100	399	50	176	33	117	GJ	100	360	50	175	33	120
GK	122	488	61	213	41	141	GK	119	430	60	205	40	142
GL	148	594	74	254	49	170	GL	156	564	78	256	102	256
GM	168	671	84	283	56	190	GM	174	627	87	277	–	–
HB	163	651	81	256	54	171	HB	226	816	113	369	75	245
HC	185	742	93	287	62	193	HC	239	860	119	387	80	257
HF	132	529	66	212	44	141	HD	246	885	123	397	–	–

Application Data *(continued)*

TABLE 1A – WATER FLOW RATE LIMITS (L/S) — BASED UPON STANDARD TUBES @ DESIGN FULL LOAD CONDITIONS - cont.

HH	155	622	78	246	52	164							
HK	122	488	61	183	41	121	HK	119	430	60	178	40	122
HL	148	594	74	220	49	146	HL	156	564	78	225	52	158
HM	168	671	84	246	56	164	HM	174	627	87	245	–	–
KJ	100	399	50	163	33	107	KJ	100	360	50	162	33	110
KK	122	488	61	197	41	130	KK	119	430	60	190	40	131
KL	148	594	74	236	49	157	KL	156	564	78	239	52	169
KM	168	671	84	263	56	176	KM	174	627	87	260	–	–
–	–	–	–	–	–	–	LJ	169	609	85	276	56	182
LK	157	626	78	252	52	168	LK	194	699	97	312	65	206
LL	181	724	91	288	60	193	LL	219	789	109	347	73	230
LM	206	822	103	322	69	218	LM	244	878	122	380	–	–
JF	183	731	91	290	61	195	JB	281	1013	141	448	94	304
JG	198	790	99	311	66	210	JC	303	1093	152	478	101	326
JH	212	849	106	331	71	225	JD	312	1126	156	490	–	–
TF	183	731	91	271	61	182	TB	281	1013	141	419	94	284
TG	198	790	99	291	66	196	TC	303	1093	152	448	101	304
TH	212	849	106	310	71	210	TD	312	1126	156	460	–	–
VF	234	936	117	348	78	230	VB	357	1287	179	533	119	354
VH	256	1023	128	378	85	250	VC	372	1341	186	553	124	367
–	–	–	–	–	–	–	VD	399	1439	200	588	–	–
WF	292	1169	146	435	97	287	–	–	–	–	–	–	–
WH	341	1364	171	501	114	331	–	–	–	–	–	–	–
XF	292	1169	146	410	97	269	XA	391	1410	196	545	130	370
XH	341	1364	171	472	114	311	XB	424	1529	212	585	141	399
–	–	–	–	–	–	–	XC	462	1666	231	630	154	432
–	–	–	–	–	–	–	XD	472	1701	236	641	–	–
YB	196	783	98	251	65	164	YB	331	1192	165	422	110	283
YC	242	966	121	307	81	202	YC	364	1311	182	461	121	310
YD	292	1169	146	369	97	242	YD	397	1430	198	499	–	–
Y1	200	801	100	329	67	216	Y1	260	937	130	419	87	280
Y2	240	959	120	390	80	256	Y2	324	1167	162	514	108	347
Y3	271	1084	136	437	90	288	Y3	379	1367	190	593	126	404
Y4	304	1215	152	485	101	320	Y4	420	1514	210	647	–	–
ZB	301	1204	150	421	100	277	ZB	386	1390	193	550	129	365
ZC	333	1330	166	462	111	304	ZC	432	1555	216	609	144	405
ZD	362	1449	181	499	121	329	ZD	490	1767	245	683	–	–
Z1	250	999	125	449	83	296	Z1	253	912	127	456	84	303
Z2	301	1203	150	532	100	351	Z2	306	1101	153	549	102	364
Z3	356	1423	178	615	119	407	Z3	401	1446	201	705	134	471
Z4	396	1585	198	673	132	447	Z4	503	1813	251	857	–	–

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.

Chilled Water – A water strainer of maximum 1/8" (3.2 mm) perforated holes must be field-installed in the chilled water inlet line as close as possible to the chiller. If located close enough to the chiller, the chilled water pump may be protected by the same strainer. The strainer is important to protect the chiller from debris or objects which could block flow through individual heat exchanger tubs. A reduction in flow through tubes could seriously impair the chiller performance or even result in tube freeze-up. A thermal-type flow switch is factory installed in the evaporator nozzle and connected to the OptiView panel, which assures adequate chilled water flow during operation.

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

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

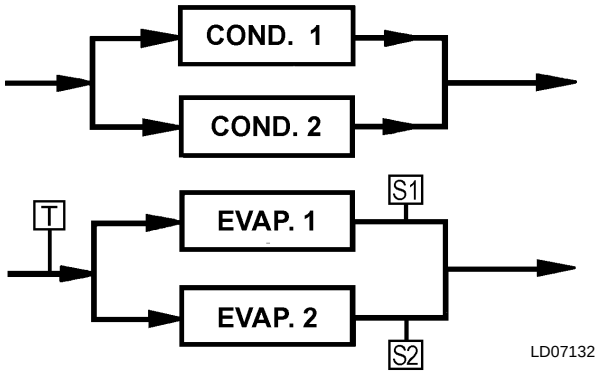
$$\text{Min. ECWT} = \text{LCHWT} - \text{C RANGE} + 5°\text{F} + 12\left(\frac{\%\text{Load}}{100}\right)$$

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

where:

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

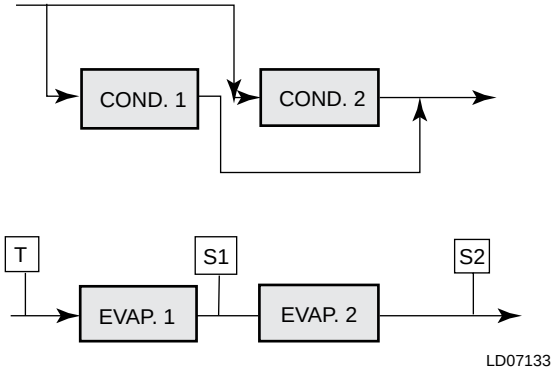
At initial startup, entering condensing water temperature may be as much as 25°F (13.9°C) colder than the standby chilled water temperature.



S – Temperature Sensor for Chiller Capacity Control

T – Thermostat for Chiller Capacity Control

FIG. 1 – PARALLEL EVAPORATORS PARALLEL CONDENSERS



S – Temperature Sensor for Chiller Capacity Control

T – Thermostat for Chiller Capacity Control

FIG. 2 – SERIES EVAPORATORS PARALLEL CONDENSERS

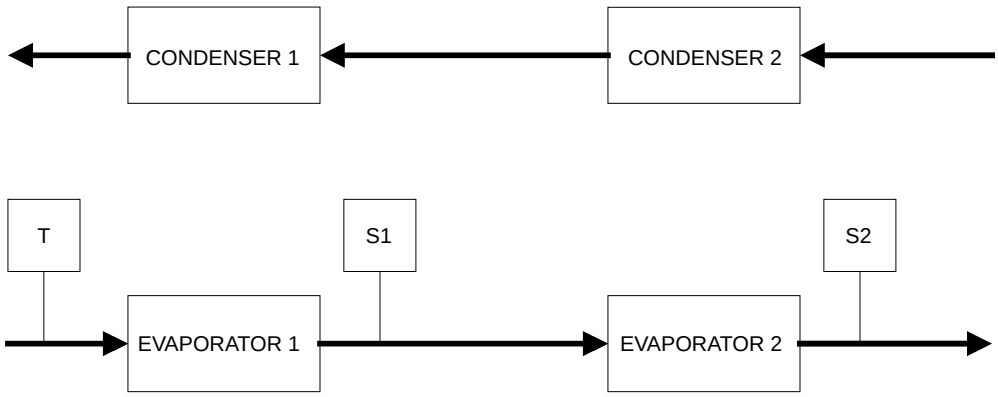


FIG. 3 – SERIES EVAPORATORS SERIES-COUNTER FLOW CONDENSERS

MULTIPLE UNITS

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

Parallel Arrangement (Refer to Fig. 1) **–** Chillers may be applied in multiples with chilled and condenser water circuits connected in parallel between the units. Fig. 1 represents a parallel arrangement with two chillers. Parallel chiller arrangements may consist of equally or unequally sized units. When multiple units are in operation, they will load and unload at equal percentages of design full load for the chiller.

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

Series Arrangement (Refer to Fig. 2) **–** Chillers may be applied in pairs with chilled water circuits connected in series and condenser water circuits connected in parallel. All of the chilled water flows through both evaporators with each unit handling approximately one-half of the total load. When the load decreases to a customer selected load value, one of the units will be shut down by a sequence control. Since all water is flowing through the operating unit, that unit will cool the water to the desired temperature.

Series Counter Flow Arrangement (Refer to Fig. 3) - Chillers may be applied in pairs with chilled water circuits connected in series and with the condenser water in series counter flow. All of the chilled water flows through both evaporators. All of the condenser water flows through both condensers. The water ranges are split, which allows a lower temperature difference or "head" on each chiller, than multiple units in parallel. For equal chillers, the machine at higher temperature level will typically provide slightly more than half the capacity. The compressor motors and gear codes on the two chillers are often matched, such that the high temperature machine can operate at the low temperature conditions when one unit is cycled off at part loads. (as compared to series-parallel chillers which are typically not identical).

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

REFRIGERANT RELIEF PIPING

Each chiller is equipped with dual pressure relief valves on the condenser and two dual relief valves on the evaporator, or two single relief valves on the evaporator if the optional refrigerant isolation valves are ordered. The dual relief valves on the condenser are redundant and allow changing of either valve while the unit is fully charged. The purpose of the relief valves is to quickly relieve excess pressure of the refrigerant charge to the atmosphere, as a safety precaution in the event of an emergency such as fire. They are set to relieve at an internal pressure as noted on the pressure vessel data plate, and are provided in accordance with ASHRAE 15 safety code and ASME or applicable pressure vessel code.

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

SOUND AND VIBRATION CONSIDERATIONS

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

MAXE chiller sound pressure level ratings will be furnished on request.

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

THERMAL INSULATION

No appreciable operating economy can be achieved by thermally insulating the chiller. However, the chiller's cold surfaces should be insulated with a vapor barrier insulation sufficient to prevent condensation. A chiller can be factory-insulated with 3/4" (19 mm) or 1-1/2" (38 mm) thick insulation, as an option. This insulation will normally prevent condensation in environments with dry bulb temperatures of 50°F to 90°F (10°C to 32°C) and relative humidities up to 75% [3/4" (19 mm) thickness] or 90% [1-1/2" (38 mm) thickness]. The insulation is painted and the surface is flexible and reasonably resistant to wear. It is intended for a chiller installed indoors and, therefore, no protective covering of the insulation is usually required. If insulation is applied to the water boxes at the job site,

it must be removable to permit access to the tubes for routine maintenance.

VENTILATION

The ASHRAE Standard 15 Safety Code for Mechanical Refrigeration requires that all machinery rooms be vented to the outdoors utilizing mechanical ventilation by one or more power-driven fans. This standard, plus National Fire Protection Association Standard 90A, state, local and any other related codes should be reviewed for specific requirements. Since the MAXE chiller motor is air-cooled, ventilation should allow for the removal of heat from the motor.

In addition, the ASHRAE Standard 15 requires a refrigerant vapor detector to be employed for all refrigerants. It is to be located in an area where refrigerant from a leak would be likely to concentrate. An alarm is to be activated and the mechanical ventilation started at a value no greater than the TLV (Threshold Limit Value) of the refrigerant.

ELECTRICAL CONSIDERATIONS

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

TABLE 2 – MOTOR VOLTAGE VARIATIONS

FREQ.	RATED VOLTAGE	NAMEPLATE VOLTAGE	OPERATING VOLTAGE	
			MIN.	MAX.
60 HZ	200	200/208	180	220
	230	220/240	208	254
	380	380	342	415
	416	416	375	457
	460	440/460/480	414	508
	575	575/600	520	635
	2300	2300	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

Starters – A separate starter is not required if the chiller is equipped with a Variable Speed Drive (VSD). The MAXE chillers are also available with a factory-mounted and wired YORK Solid State Starter for low voltage applications. Other types of remote mounted starters are available. These electro-mechanical starters must be furnished in accordance with YORK Standard Specifications (R-1132). This will ensure that starter components, controls, circuits, and terminal markings will be suitable for required overall system performance. Remote-mounted medium voltage York Solid State Starters are also available.

Controls – A 115 volt, single-phase, 60 or 50 Hertz 2 KVA power supply must be furnished to the chiller from a separate, fused disconnect or from a control transformer included as an option with electro-mechanical starters. No field control wiring is required when the YORK Variable Speed Drive or Solid State Starter is supplied.

Oil Pump Power Supply – A separate 3-phase power supply with a fused disconnect for the factory-mounted oil pump variable speed drive is required unless the VSD or SSS is supplied. Power can also be supplied through an electro-mechanical starter.

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 – When the chiller is equipped with a VSD, automatic power factor correction to a minimum of 0.95 is provided at all operating conditions, so additional capacitors are not required. For other starting methods, 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. For YORK Solid State Starters the capacitors must be located on the line-side of the starter. The capacitors must be sized and installed to meet the National Electrical Code and be verified by YORK.

Ampacity on Load Side of Starter – Electrical power wire size to the chiller is based on the minimum unit ampacity. For Solid State Starters or Variable Speed Drive, this wiring is done at the factory. For remote starters, the National Electrical Code defines the calculation of ampacity, as summarized below. More specific information on actual amperage ratings will be supplied with the submittal drawings.

- Six-lead type of starting (Star-Delta)

  Minimum circuit ampacity per conductor (1 of 6):

Ampacity = .721 x compressor motor amps.

- Three-lead type of starting

  (Across-the-Line, Autotransformer and Primary Reactor)

  Minimum circuit ampacity per conductor (1 of 3):

  Ampacity = 1.25 x compressor motor amps.

Ampacity on Line-Side of Starter – The only additional load on the circuit for the chiller would be the control transformer and oil pump motor unless they are supplied by a separate source.

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

Branch Circuit Overcurrent Protection – The branch circuit overcurrent protection device(s) should be a time-delay type, with a minimum rating equal to the next standard fuse/breaker rating above the calculated value. It is calculated taking into account the compressor motor amps and may also include control transformer and oil pump motor. Refer to submittal drawings for the specific calculations for each application.

MOTOR ELECTRICAL DATA

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

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

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 3 and 4 for specific Motor Code and voltage. This is because the LRA is dependent only on motor size and voltage and is independent of input power (kW).

Inrush amperes (IRA) depend on LRA and the type of starter applied. The inrush can be calculated using a percentage of LRA shown in Table 3.

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Application Data *(continued)*

TABLE 3 – 60 Hz ELECTRICAL DATA

MOTOR CODE		CF	CG	CH	CJ	CK	CL	CM	CN	CP	CR	CS	CT	CU	CV	CW
KW (MAX)		125	144	161	190	214	240	257	276	302	333	368	395	435	478	514
SHAFT HPFL.		154	177	201	237	270	302	327	351	385	424	468	503	554	608	655
EFF. - %		92	92	93	93	94	94	95	95	95	95	95	95	95	95	95
VOLTS		AMPERES (MAX.)														
200	FLA	405	465	527	618	707	787	921	1,014	1,085	1,208	—	—	—	—	—
	LRA	2,598	3,111	3,810	4,550	4,900	5,470	5,780	7,350	7,794	—	—	—	—	—	
208	FLA	389	447	507	594	680	757	799	886	975	1,043	1,162	—	—	—	—
	LRA	2,702	3,235	3,235	3,962	4,732	5,096	5,689	6,011	6,011	7,644	8,106	—	—	—	—
230	FLA	352	404	464	540	610	685	749	804	882	944	1,050	1,130	—	—	—
	LRA	2,598	2,598	2,865	3,460	3,788	4,260	4,755	5,162	5,780	5,780	6,900	7,400	—	—	—
240	FLA	337	387	445	518	585	656	718	771	845	905	1,006	1,083	—	—	—
	LRA	2,711	2,711	3,120	3,610	3,953	4,445	4,962	5,386	6,031	6,031	7,200	7,722	—	—	—
380	FLA	217	249	285	336	378	421	453	487	534	571	636	684	756	817	879
	LRA	1,385	1,385	1,730	2,153	2,500	2,577	2,955	3,254	3,637	3,810	4,179	4,480	4,671	5,326	5,780
41 6	FLA	199	228	260	307	346	385	412	445	488	522	581	625	691	747	810
	LRA	1,385	1,385	1,638	1,967	2,190	2,356	2,700	2,976	3,536	3,637	3,810	3,810	4,270	4,869	5,640
440	FLA	184	211	238	281	319	358	392	397	461	493	549	591	646	706	579
	LRA	1,177	1,301	1,320	1,655	1,865	2,037	2,485	2,485	2,976	2,976	3,300	3,644	3,644	4,209	4,783
460	FLA	176	202	228	269	305	342	375	380	441	472	525	565	618	675	726
	LRA	1,230	1,360	1,380	1,730	1,950	2,130	2,598	2,598	3,111	3,111	3,450	3,810	3,810	4,400	5,000
480	FLA	169	194	219	258	292	328	359	364	423	452	503	541	592	647	696
	LRA	1,283	1,419	1,440	1,805	2,053	2,223	2,711	2,711	3,246	3,246	3,600	3,976	3,976	4,591	5,217
575	FLA	141	162	185	216	250	247	300	318	353	377	420	452	500	540	581
	LRA	909	909	1,100	1,384	1,556	1,700	1,900	2,066	2,078	2,413	2,760	2,960	3,089	3,550	4,039
600	FLA	135	155	177	207	240	263	288	305	338	361	403	433	479	518	557
	LRA	949	949	1,148	1,444	1,624	1,774	1,983	2,156	2,168	2,518	2,880	3,089	3,223	3,704	4,215
2300	FLA	36	41	46	55	63	70	74	80	87	95	106	113	124	135	146
	LRA	240	267	298	340	397	435	480	520	530	590	669	719	791	867	935
3300	FLA	25	29	33	39	44	49	52	55	61	67	73	79	86	94	102
	LRA	160	175	210	240	280	310	310	343	382	415	466	501	551	576	652
4000	FLA	21	24	27	32	36	40	43	46	50	55	60	65	71	78	84
	LRA	135	154	166	195	230	240	270	283	315	340	384	413	455	499	538
4160	FLA	20	23	26	30	34	38	41	44	48	52	58	63	68	75	81
	LRA	140	160	173	203	239	250	270	294	328	328	399	430	473	519	560

TABLE 4 – 50 Hz ELECTRICAL DATA[1]

MOTOR CODE		5CC	5CD	5CE	5CF	5CG	5CH	5CI	5CJ	5CK	5CL	5CM	5CN	5CO	5CP	5CQ	5CR	5CS
KW (MAX)		121	136	160	180	201	215	231	254	280	309	332	366	402	432	455	481	518
SHAFT HPFL		148	168	198	225	252	272	292	321	353	390	419	462	507	546	575	608	658
EFF.-%FL PF		91.1	92.4	92.4	93.4	93.4	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.7
		0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.88
VOLTS		AMPERES (MAX.)																
346	FLA	224	258	302	340	380	417	437	481	528	584	630	692	578	816	860	909	982
	LRA	1,385	1,721	1,790	2,208	2,467	2,598	2,840	3,081	3,350	3,706	3,810	4,177	4,830	4,944	5,373	5,780	5,780
380	FLA	204	235	275	309	346	379	398	438	481	532	572	630	690	743	783	841	895
	LRA	1,385	1,385	1,640	1,890	2,144	2,464	2,590	2,806	3,050	3,375	3,700	3,810	4,400	4,500	4,892	5,600	5,491
400	FLA	194	223	261	294	329	360	378	416	457	505	543	599	656	706	744	799	850
	LRA	1,458	1,458	1,726	1,990	2,257	2,594	2,726	2,954	3,211	3,553	3,895	4,011	4,632	4,737	5,149	5,895	5,780
415	FLA	187	215	252	284	317	347	364	401	441	487	526	577	632	680	717	764	819
	LRA	1,283	1,385	1,490	1,700	2,031	2,175	2,366	2,569	2,794	3,088	3,402	3,478	3,810	4,117	4,480	5,130	5,108
3300	FLA	24	27	32	36	41	44	47	50	56	62	66	73	80	87	91	96	103
	LRA	159	162	209	236	241	274	294	318	317	388	423	455	499	516	572	614	644

NOTE: 1. Chiller performance for 50 Hertz applications is outside the scope of the ARI Certification Program.

CX	CY	CZ	CA	CB	DA	DB	DC	DD	DE	DF	DH	DJ	DK	DL	MOTOR CODE	
542	578	617	660	703	781	859	937	1,015	1,093	1,171	1,359	1,554	1748	1942	KW (MAX.)	
690	740	790	845	900	1,000	1,100	1,200	1,300	1,400	1,500	1,750	2,000	2250	2500	SHAFT HPFL	
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	EFF.-%**	
AMPERES (MAX.)															VOLTS	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	FLA	200
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LRA	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	FLA	208
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LRA	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	FLA	230
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LRA	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	FLA	240
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LRA	
942	997	1065	1,126	1,200	1,364	1,500	1,636	—	—	—	—	—	—	—	FLA	380
6,782	5,780	6,644	7,106	7,513	7,794	8,491	9,431	—	—	—	—	—	—	—	LRA	
860	911	973	1,029	1,096	1,246	1,370	1,495	—	—	—	—	—	—	—	FLA	416
5,780	5,694	6,069	6,489	6,863	7,120	7,755	8,608	—	—	—	—	—	—	—	LRA	
813	861	920	973	1,036	1,178	1,295	1,413	—	—	—	—	—	—	—	FLA	440
5,357	4,783	5,249	5,529	5,529	6,160	6,709	7,455	—	—	—	—	—	—	—	LRA	
778	824	880	931	991	1,127	1,239	1,352	—	—	—	—	—	—	—	FLA	460
5,600	5,000	5,488	5,780	5,780	6,440	7,014	7,794	—	—	—	—	—	—	—	LRA	
746	790	843	892	950	1,080	1,187	1,296	—	—	—	—	—	—	—	FLA	480
5,843	5,217	5,727	6,031	6,031	6,720	7,319	8,133	—	—	—	—	—	—	—	LRA	
622	659	704	744	793	901	991	1,081	—	—	—	—	—	—	—	FLA	575
4,440	4,300	4,200	4,694	4,963	5,148	5,610	6,232	—	—	—	—	—	—	—	LRA	
596	632	675	713	760	863	950	1,036	—	—	—	—	—	—	—	FLA	600
4,633	4,484	4,383	4,898	5,179	5,372	5,854	6,503	—	—	—	—	—	—	—	LRA	
154	165	176	186	198	225	248	267	290	312	334	389	438	493	548	FLA	2,300
960	1,008	1,100	1,172	1,230	1,234	1,592	1,592	1,592	2,031	2,031	2,390	2,879	2908	3012	LRA	
108	115	123	130	138	157	173	186	202	217	233	271	306	344	382	FLA	3,300
682	719	744	744	858	861	1,110	1,110	1,110	1,416	1,416	1,661	2,011	2027	2100	LRA	
89	95	101	107	114	130	143	154	166	179	192	224	252	283	315	FLA	4,000
540	554	631	674	713	715	923	923	923	1,177	1,177	1,386	1,669	1672	1732	LRA	
85	91	97	103	110	125	137	149	160	172	185	215	242	273	303	FLA	4,160
562	576	656	701	742	744	960	960	960	1,224	1,224	1,441	1,736	1608	1666	LRA	

5CT	5CU	5CV	5CW	5CX	5DA	5DB	5DC	5DD	5DE	5DF	5DG	5DH	*5DJ	5DK	5DL	MOTOR CODE	
554	591	630	669	709	785	863	942	1,015	1,093	1,171	1,288	1,360	1,554	1,748	1,942	KW(MAX.)	
704	750	800	850	900	1,000	1,100	1,200	1,300	1,400	1,500	1,650	1,750	2,000	2,250	2,500	SHAFT HP	
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	FL EFF.-%**	
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	FL PF**	
AMPERES (MAX.)																VOLTS	
1,051	1,107	1,181	1,255	1,329	1,488	1,656	—	—	—	—	—	—	—	—	—	FLA	346
6,615	6,931	7,356	7,794	8,319	8,559	9,346	—	—	—	—	—	—	—	—	—	LRA	
957	1,008	1,075	1,143	1,210	1,355	1,508	—	—	—	—	—	—	—	—	—	FLA	380
5,491	6,313	6,694	7,113	7,404	7,794	8,511	—	—	—	—	—	—	—	—	—	LRA	
909	958	1,021	1,086	1,150	1,287	1,433	—	—	—	—	—	—	—	—	—	FLA	400
5,780	6,645	7,046	7,487	7,794	8,204	8,959	—	—	—	—	—	—	—	—	—	LRA	
876	923	985	1,046	1,108	1,241	1,381	—	—	—	—	—	—	—	—	—	FLA	415
5,512	5,780	6,131	6,513	6,938	7,138	7,794	—	—	—	—	—	—	—	—	—	LRA	
110	116	124	132	139	156	174	187	202	217	233	256	267	306	344	382	FLA	3,300
693	725	744	819	875	871	1,135	1,135	1,135	1,415	1,415	1,415	1,667	1,591	2,231	2,481	LRA	

*Min. reduced voltage tap 80%.
** High voltage and special motor designs may not meet efficiency and P. F. shown for standard motors

Application Data *(continued)*

TABLE 5 – MOTOR STARTERS

TYPE STARTER	SOLID STATES TARTER	STAR DELTA	AUTO TRANSFORMER			ACROSS-THE-LINE	PRIMARY REACTOR	
VOLTAGE	LOW/MEDIUM	LOW	LOW	LOW/MEDIUM	LOW/MEDIUM	LOW/MEDIUM	MEDIUM	MEDIUM
60 HZ	200-4160	200-600	200-600	200-4160	200-4160	200-4160	2300-4160	2300-4160
50 HZ	380-3300	346-415	346-415	346-3300	346-3300	346-3300	2300-3300	2300-3300
TRANSITION	—	CLOSED	CLOSED	CLOSED	CLOSED	—	CLOSED	CLOSED
% TAP	—	—	57.7	65	80	—	65	80
INRUSHAS A % OF LRA	45	33	33	42.3	64	100	65	80

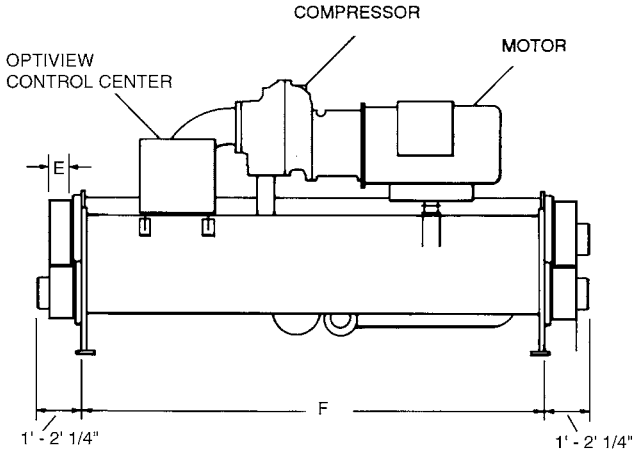
NOTE: Inrush less than 100% of full load amps (FLA).

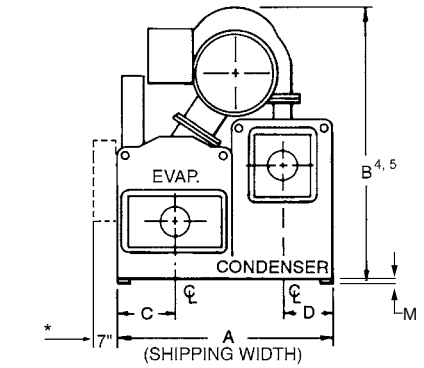
TABLE 6 – AVAILABLE COMPRESSOR/SHELL/MOTOR COMBINATIONS

COMPRESSOR CODE	EVAPORATOR CODE	CONDENSER CODE	MOTOR CODES	
			60 HZ	50 HZ
Q3	AP, AQ, AR, AS	AP, AQ, AR, AS	CF - CT	5CC - 5CO
	AA, AB, AC, AD	AA, AB, AC, AD		
	BA, BB, BC, BD	BA, BB, BC, BD		
Q4	AA, AB, AC, AD	AA, AB, AC, AD	CF - CT	5CC - 5CO
	BA, BB, BC, BD	BA, BB, BC, BD		
	CD, CE, CF, CG, CH	CD, CE, CF, CG, CH		
Q5	AA, AB, AC, AD	AA, AB, AC, AD	CH - CT	5CE - 5CO
Q5,Q6	CD, CE, DF, CG, CH	CD, CE, DF, CG, CH	CH - CT	5CE - 5CO
	DE, DF, DG, DH	DE, DF, DG, DH		
P1, P2, P3, P4	AA, AB, AC, AD	AA, AB, AC, AD	CF – CT	5CC – 5CO
	BA, BB, BC, BD	BA, BB, BC, BD		
P5	AA, AB, AC, AD	AA, AB, AC, AD	CH – CT	5CE – 5CO
	BA, BB, BC, BD	BA, BB, BC, BD		
	CD, CE, CF, CG, CH	CD, CE, CF, CG, CH		
P6	CD, CE, CF, CG, CH	CD, CE, CF, CG, CH	CH – CY	5CE – 5CU
	DE, DF, DG, DH	DE, DF, DG, DH		
Q7	CD, CE, CF, CG, CH	CD, CE, CF, CG, CH	CH – CT	5CE – 5CO
	DE, DF, DG, DH	DE, DF, DG, DH		
P7	CD, CE, CF, CG, CH	CD, CE, CF, CG, CH	CU – CY	5CP – 5CU
	DE, DF, DG, DH	DE, DF, DG, DH		
P8	EK, EL, EM	EK, EL, EM	CH – CZ	5CE – 5CU
P8, P9	FK, FL, FM	FK, FL, FM		
	GJ, GK, GL, GM	GJ, GK, GL, GM		
	HK, HL, HM	HK, HL, HM		
H5	EB	EB, EC, ED, FB, FC, FD	CN – CY	5CK – 5CU
	FB, FC, FD	EB, EC, ED, FB, FC, FD, GB, GC, GD		
	GC, GD	FB, FC, FD, GB, GC, GD		
H6	FB, FC	FA, FB, FC, FD, GB, GC, GD	CN – CZ	5CK – 5CU
	GB, GC, GD	FA, FB, FC, FD, GB, GC, GD		
	HB, HC	GB, GC, GD		
H7, H8		FA, FB, FC, FD, GB, GC, GD	CN – CZ	5CK – 5CU
	GB, GC, GD	FB, FC, FD, GB, GC, GD		
	HB, HC	GB, GC, GD		
H9	KJ, KK, KL, KM	KJ, KK, KL, KM	CN – CA	5CK – 5CW
	LK, LL, LM	LJ, LK, LL, LM		
H3	GB, GC, GD	FB, FC, FD, GB, GC, GD	CA – DB	5CV – 5DB
	HB, HC	GB, GC, GD		
J1, J2	GF, GH	GB, GC, GD, HB, HC, HD	CW – DC	5CS – 5DC
	HF, HH	GB, GC, GD, HB, HC, HD, JB, JC, JD		
	JF, JG, JH	HB, HC, HD, JB, JC, JD		
	TB, TC, TD ,TF, TG, TH	TB, TC, TD ,TF, TG, TH		
J3	HF, HH	HB, HC, HD, JB, JC, JD	DA – DJ	5DA – 5DH
	JF, JG, JH	HB, HC, HD, JB, JC, JD		
	TF, TG, TH	TB, TC, TD, VB, VC, VD		
	VF, VH	TB, TC, TD, VB, VC, VD		
	WF, WH	VB, VC, VD		
J4	JF, JG, JH	JB, JC, JD	DA – DJ	5DA – 5OJ
	TF, TG, TH	TB, TC, TD, VB, VC, VD		
	VF, VH	TB, TC, TD, VB, VC, VD		
	WF, WH	VB, VC, VD		
J5	XF, XH	XA, XB, XC, XD	DA – DJ	5DA – 5OJ
J7	YB-YD, Y1-Y4	YB-YD, Y1-Y4	DD - DL	5DD - 5DL
	ZB-ZD, Z1-Z4	ZB-ZD, Z1-Z4		

Dimensions (Ft. - In.) – Unit

P & Q COMPRESSOR UNITS





* Operating Location of Control Center on Evaporator Codes G & H

LD07134

P1, P2, P3, P4 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES		
	A–A	B–B
A	5'–6"	5'–6"
B	10'–5/8"	10'–5/8"
C	1'–5 1/2"	1'–5 1/2"
D	1'–3 1/2"	1'–3 1/2"
E	0'–6 5/16"	0'–6 5/16"
F	12'–0"	16'–0"

P5 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES			
	A–A	B–B	C–C
A	5'–6"	5'–6"	6'–2"
B	7'–4 1/2"	7'–4 1/2"	7'–6 1/2"
C	1'–5 1/2"	1'–5 1/2"	1'–7 1/2"
D	1'–3 1/2"	1'–3 1/2"	1'–5 1/2"
E	0'–6 5/16"	0'–6 5/16"	0'–6 7/8"
F	12'–0"	16'–0"	12'–0"

P8 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES				
	E–E	F–F	G–G	H–H
A	6'–11"	6'–11"	7'–6 1/2"	7'–6 1/2"
B	10'–3 1/2"	10'–3 1/2"	10'–9 1/2"	10'–9 1/2"
C	2'–0"	2'–0"	2'–1 1/4"	2'–1 1/4"
D	1'–5 1/2"	1'–5 1/2"	1'–8"	1'–8"
E	1'–2 7/8"	1'–2 7/8"	1'–3 5/8"	1'–3 5/8"
F	12'–0"	16'–0"	12'–0"	16'–0"

P6, P7, Q7 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES		
	C–C	D–D
A	6'–2"	6'–2"
B	7'–6 1/2"	7'–6 1/2"
C	1'–7 1/2"	1'–7 1/2"
D	1'–5 1/2"	1'–5 1/2"
E	0'–6 7/8"	0'–6 7/8"
F	12'–0"	16'–0"

P9 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES			
	F–F	G–G	H–H
A	6'–11"	7'–6 1/2"	7'–6 1/2"
B	9'–11 7/8"	10'–6"	10'–6"
C	2'–0"	2'–1 1/4"	2'–1 1/4"
D	1'–5 1/2"	1'–8"	1'–8"
E	1'–2 7/8"	1'–3 5/8"	1'–3 5/8"
F	16'–0"	12'–0"	16'–0"

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"

Q3 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES			
	A*-A*	A-A	B-B
A	5' - 1"	5 1/2'	5 1/2'
B	6' - 8 21/32"	6' - 10 21/32"	6' - 10 21/32"
C	1' - 3 1/2"	1' - 5 1/2"	1' - 5 1/2"
D	1' - 3"	1' - 3 1/2"	1' - 3 1/2"
E	0' - 5 13/16"	0' - 6 5/16"	0' - 6 5/16"
F	12' - 0"	12' - 0"	16' - 0"

Q5 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES			
	A-A	C-C	D-D
A	5 1/2'	6' 2"	6' 2"
B	7' - 6 15/32"	7' - 11 13/32"	7' - 11 13/32"
C	1' - 5 1/2"	1' - 7 1/2"	1' - 7 1/2"
D	1' - 3 1/2"	1' - 5 1/2"	1' - 5 1/2"
E	0' - 6 5/16"	0' - 6 7/8"	0' - 6 7/8"
F	12' - 0"	16' - 0"	12' - 0"

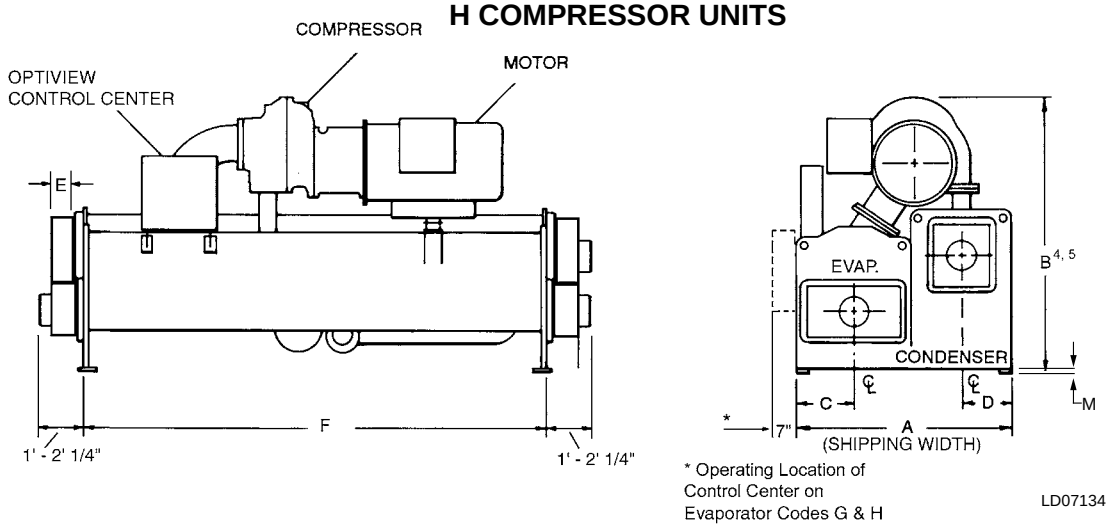
Q4 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES			
	A-A	B-B	C-C
A	5 1/2'	5 1/2'	6' 2"
B	6' - 8 15/16"	6' - 8 15/16"	7' - 8 3/8"
C	1' - 5 1/2"	1' - 5 1/2"	1' - 7 1/2"
D	1' - 3 1/2"	1' - 3 1/2"	1' - 5 1/2"
E	0' - 6 5/16"	0' - 6 5/16"	0' - 6 7/8"
F	12' - 0"	16' - 0"	12' - 0"

Q6 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES		
	C-C	D-D
A	6' 2"	6' 2"
B	7' - 9 13/16"	7' - 9 13/16"
C	1' - 7 1/2"	1' - 7 1/2"
D	1' - 5 1/2"	1' - 5 1/2"
E	0' - 6 7/8"	0' - 6 7/8"
F	12' - 0"	16' - 0"

A*-A* - AP through AS Evaporators and Condensers
A-A - AA through AD Evaporators and Condensers

Dimensions (Ft. - In.) – Unit

H COMPRESSOR UNITS



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"

H5 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES							
	E–E	E–F	F–E	F–F	F–G	G–F	G–G
A	6'–6"	6'–9"	6'–11"	7'–2"	7'–6"	7'–4 1/2"	7'–8 1/2"
B	8'–0 1/4"	8'–2 3/4"	8'–0 1/4"	8'–2 3/4"	8'–6 3/4"	8'–2 3/4"	8'–6 3/4"
C	1'–9 1/2"	1'–9 1/2"	2'–0"	2'–0"	2'–0"	2'–1 1/4"	2'–1 1/4"
D	1'–5 1/2"	1'–7"	1'–5 1/2"	1'–7"	1'–9"	1'–7"	1'–9"
E	0'–5 7/8"	0'–5 7/8"	0'–5 7/8"	0'–5 7/8"	0'–5 7/8"	0'–6 1/4"	0'–6 1/4"
F	14'–0"	14'–0"	14'–0"	14'–0"	14'–0"	14'–0"	14'–0"

H9 COMPRESSORS EVAP. – COND. SHELL CODES		
	K–K	L–L
A	7'–6 1/2"	9'–0"
B	9'–5"	10'–2"
C	2'–1 1/4"	2'–4 1/2"
D	1'–8"	2'–1 1/2"
E	1'–3 5/8"	0'–7 5/8"
F	14'–0"	14'–0"

H6 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES					
	F–F	F—G	G–F	G–G	H–G
A	7'–2"	7'–6"	7'–4 1/2"	7'–8 1/2"	8'–0"
B	8'–6"	8'–9 1/2"	8'–6"	8'–9 1/2"	8'–9 1/2"
C	2'–0"	2'–0"	2'–1 1/4"	2'–1 1/4"	2'–3"
D	1'–7"	1'–9"	1'–7"	1'–9"	1'–9"
E	0'–5 7/8"	0'–5 7/8"	0'–6 1/4"	0'–6 1/4"	0'–6 1/4"
F	14'–0"	14'–0"	14'–0"	14'–0"	14'–0"

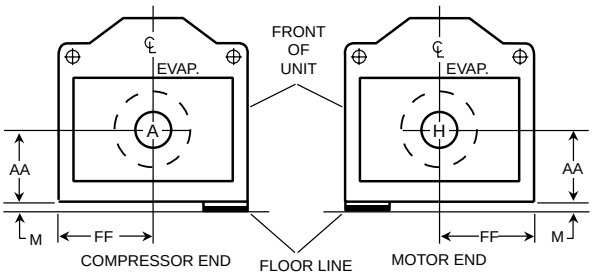
H7/H3/H8 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES			
	G–F	G–G	H–G
A	7'–4-1/2"	7'–8-1/2"	8'–0"
B	8'–6"	8'–9-1/2"	8'–9-1/2"
C	2'–1-1/4"	2'–1-1/4"	2'–3"
D	1'–7"	1'–9"	1'–9"
E	0'–6-1/4"	0'–6-1/4"	0'–6-1/4"
F	14'–0"	14'–0"	14'–0"

NOTES: 1. All dimensions on pages 33 and 34 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.
3. Water nozzles can be located on either end of unit. Add 1/2" to nozzle length for flanged connections.
4. To determine overall height, add dimension "M" for the appropriate isolator type.
5. Use of motors with motor hoods may increase overall unit dimensions.

Dimensions (Ft. - In.) – Nozzle Arrangements

EVAPORATORS – COMPACT WATER BOXES – P, Q & H COMPRESSOR UNITS

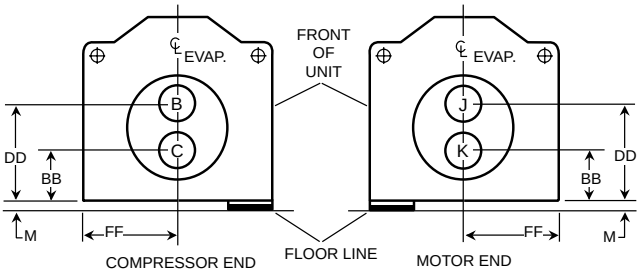
1-PASS



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

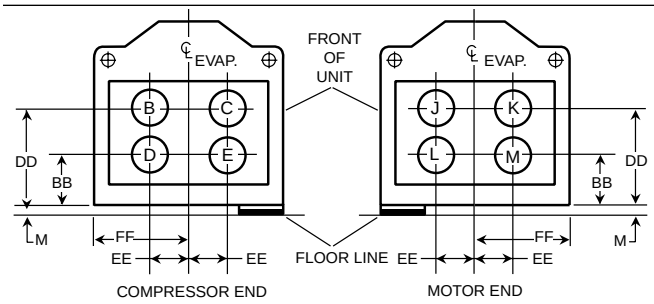
NOTE: Round water boxes are for P & Q Compressor codes. Rectangular water boxes are for H Compressor codes.

2-PASS



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

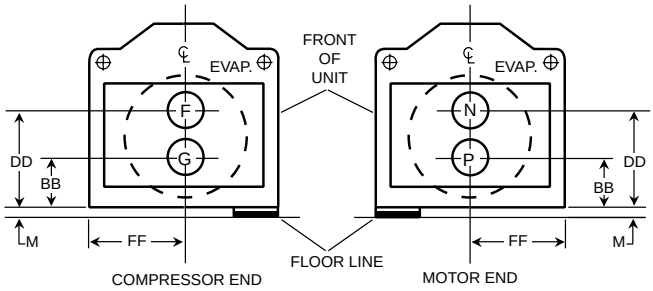
P & Q COMPRESSOR CODES AND H9 COMPRESSOR WITH K EVAPORATOR (150/300#) and L EVAPORATOR (300#)



H COMPRESSOR CODE

NOZZLE ARRANGEMENTS				
NO. OF PASSES	EVAPORATOR		"L" EVAPORATOR (150#)	
	IN	OUT	IN	OUT
2	D	C	B	C
	E	B	C	B
	L	K	J	K
	M	J	K	J

3-PASS



NOZZLE ARRANGEMENTS				
NO. OF	EVAPORATOR		"L" EVAPORATOR	
PASSES	IN	OUT	IN	OUT
3	G	N	F	N
	P	F	N	F

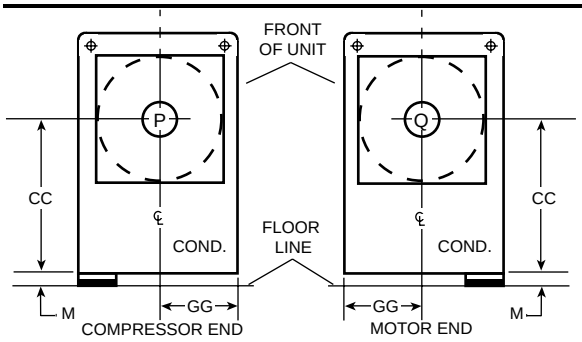
NOZZLE COMPR. CODE	EVAP. SHELL CODE	PIPE SIZES			EVAPORATOR NOZZLE DIMENSIONS								
		NO. OF PASSES			1-PASS		2-PASS				3-PASS		
		1	2	3	AA[5]	FF	BB[5]	DD[5]	EE	FF	BB[5]	DD[5]	FF
Q3	AP,AQ AR,AS	8"	6"	4"	1' – 10"	1' – 3 1/2"	1' – 2 1/4"	2' – 5 3/4"	0"	1' – 3 1/2"	1' – 2 1/4"	2' – 5 3/4"	1' – 3 1/2"
P, Q	AA-AD , B	10"	8"	6"	2'–0"	1'–5 1/2"	1'–4"	2'–8"	0"	1'–5 1/2"	1'–4"	2'–8"	1'–5 1/2"
	C, D	14"	10"	8"	2'–2"	1'–7"	1'–4"	3'–0"	0"	1'–7"	1'–4"	3'–0"	1'–7"
P	E, F	14"	10"	8"	2'–3 1/2"	2'–0"	1'–4"	3'–3"	0"	2'–0"	1'–4"	3'–3"	2'–0"
	G, H	16"	12"	10"	2'–6"	2'–1 1/4"	1'–4 1/2"	3'–7 1/2"	0"	2'–1 1/4"	1'–5"	3'–7"	2'–1 1/4"
H	E	14"	10"	8"	1'–6 1/2"	1'–9 1/2"	1'–1 1/2"	1'–11 1/2"	9"	1'–9 1/2"	0'–11 1/2"	2'–1 1/2"	1'–9 1/2"
	F	14"	10"	8"	1'–7 3/4"	2'–0"	1'–2 3/4"	2'–0 3/4"	9"	2'–0"	1'–0 3/4"	2'–2 3/4"	2'–0"
	G	16"	12"	10"	1'–8 7/8"	2'–1 1/4"	1'–2 7/8"	2'–2 7/8"	10 3/4"	2'–1 1/4"	0'–11 7/8"	2'–5 7/8"	2'–1 1/4"
	H	16"	12"	10"	1'–10"	2'–3"	1'–4"	2'–4"	10 3/4"	2'–3"	1'–1"	2'–7"	2'–3"
	4K	16"	12"	10"	2'–6"	2'–1 1/4"	1'–4 1/2"	3'–7 1/2"	0"	2'–1 1/4"	1'–5"	3'–7"	2'–1 1/4"
	L	18"	14"	12"	2'–2"	2'–4 1/2"	—	2'–2"	1'–1"	2'–4 1/2"	—	2'–2"	2'–4 1/2"

See Notes on pg. 36

Dimensions (Ft. - In.) – Nozzle Arrangements

CONDENSERS – COMPACT WATER BOXES – P, Q & H COMPRESSOR UNITS

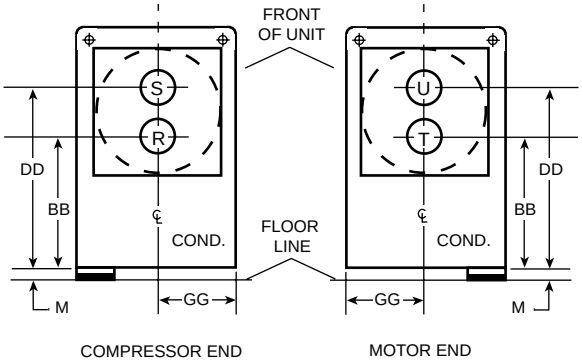
1-PASS



NOZZLE ARRANGEMENTS

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

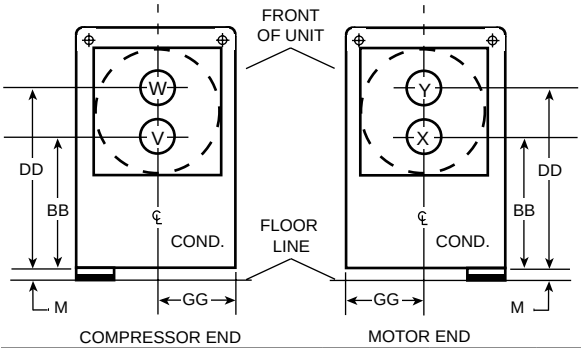
2-PASS



NOZZLE ARRANGEMENTS

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

3-PASS



NOZZLE ARRANGEMENTS

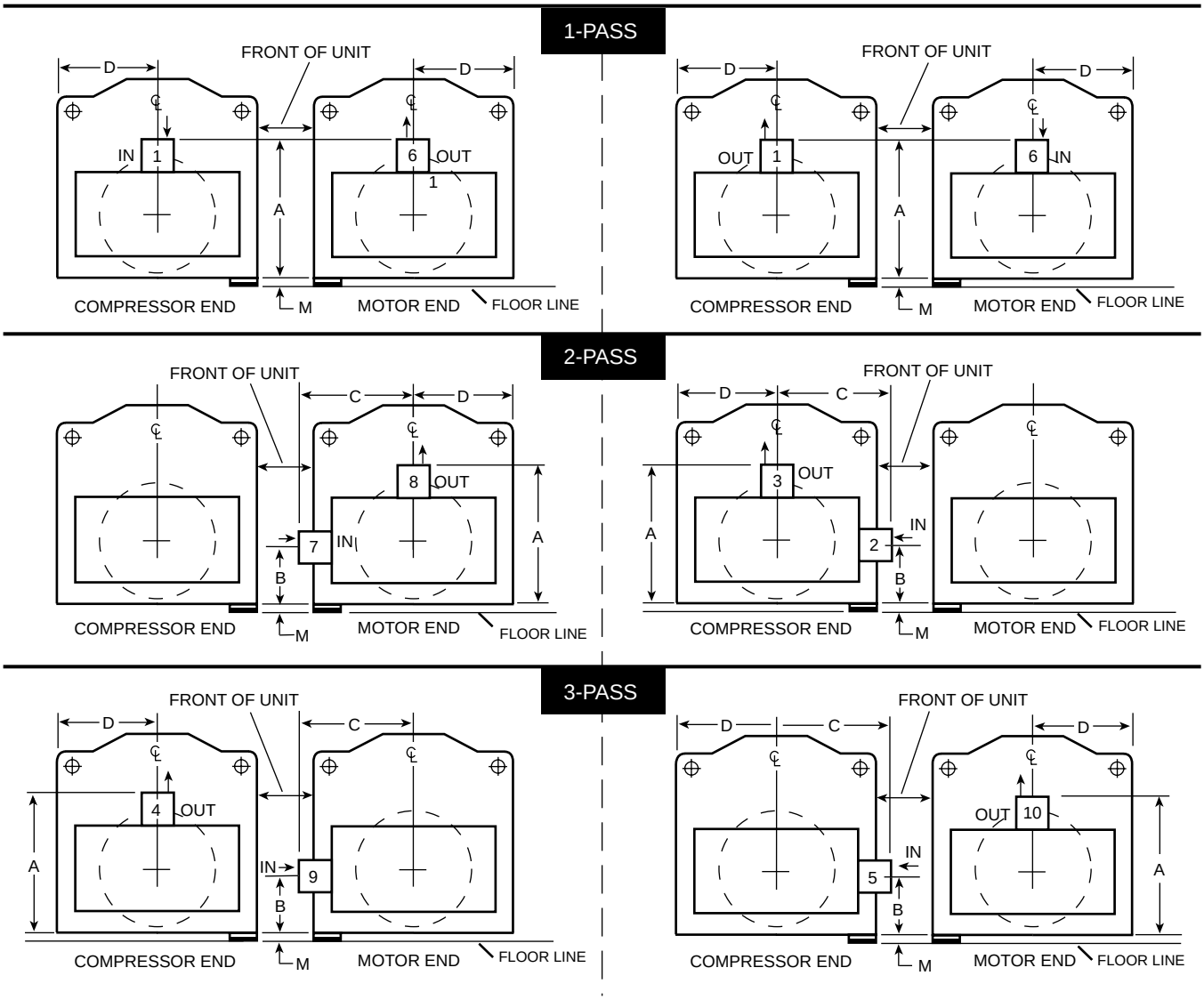
NO. OF PASSES	COND.	
	IN	OUT
3	V	Y
	X	W

COMPR. CODE	COND. SHELL CODE	NOZZLE PIPE SIZE (IN.)			CONDENSER NOZZLE DIMENSIONS (MM)							
		NO. OF PASSES			1 PASS		2 PASS			3 PASS		
		1	2	3	CC[5]	GG	BB[5]	DD[5]	GG	BB[5]	DD[5]	GG
Q3	AP,AQ AR,AS	10"	6"	6"	2' – 4"	1' – 3"	1' – 9"	2' – 11"	1' – 3"	1' – 9"	2' – 11"	1' – 3"
P, Q	AA-AD, B	12"	8"	6"	2'–6"	1'–3 1/2"	1'–10 1/4"	3'–1 3/4"	1'–3 1/2"	1'–10 1/4"	3'–1 1/4"	1'–3 1/2"
	C, D	14"	10"	8"	2'–8"	1'–5 1/2"	1'–11"	3'–5"	1'–5 1/2"	1'–11"	3'–5"	1'–5 1/2"
P	E, F	14"	10"	8"	2'–8"	1'–5 1/2"	1'–11 3/4"	3'–4 1/4"	1'–5 1/2"	1'–11"	3'–5"	1'–5 1/2"
	G, H	16"	10"	10"	3'	1'–8"	2'–2"	3'–10"	1'–8"	2'–1 1/4"	3'–10 1/4"	1'–8"
H	E	14"	10"	8"	3'–0 1/2"	1'–5 1/2"	2'–4 1/2"	3'–9"	1'–5 1/2"	2'–5 1/2"	3'–9 1/2"	1'–5 1/2"
	F	16"	12"	10"	3'–2"	1'–7"	2'–4 1/4"	3'–11 3/4"	1'–7"	2'–5 1/2"	4'–0 3/4"	1'–7"
	G	16"	14"	10"	3'–4"	1'–9"	2'–5 1/4"	4'–2 3/4"	1'–9"	2'–6 1/2"	4'–3"	1'–9"
	K	16"	10"	10"	3'–0"	1'–8"	2'–2"	3'–10"	1'–8"	2'–1 1/4"	3'–10 1/4"	1'–8"
	L	20"	14"	10"	3'–6"	2'–1 1/2"	2'–6 1/4"	4'–5 3/4"	2'–1 1/2"	2'–6 1/4"	4'–5 3/4"	2'–1 1/2"

NOTES:

1. Standard water nozzles are furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. One-, two- and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles.
3. Evaporator and condenser water must enter the water box through the bottom connection to achieve rated performance.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.
5. Add dimension "M" as shown on page 33 - 34 for the appropriate isolator type.
6. Round waterboxes are for H9, P & Q Compressors and rectangular waterboxes for H3-H8 Compressor.

EVAPORATORS – MARINE WATER BOXES – P, Q & H COMPRESSOR UNITS



LD07175a

COMPR. CODE	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
Q3	AP,AQ AR,AS	3' – 6 3/4"	1' – 3 1/2"	3' – 6 1/4"	1' – 1 5/16"	1' – 3 13/16"	1' – 3 1/2"	3' – 5 3/4"	1' – 3/4"	1' – 3 1/16"	1' – 3 1/2"
P, Q	AA-AD, B C, D	3'–11"	1'–5 1/2"	3'–11"	1'–0 1/4"	1'–7 1/4"	1'–5 1/2"	3'–11"	1'–0 5/8"	1'–4"	1'–5 1/2"
		4'–3"	1'–7 1/2"	4'–3"	1'–0"	1'–10 7/8"	1'–7 1/2"	4'–3"	0'–11"	1'–6 1/2"	1'–7 1/2"
P	E, F G, H	4'–5 1/2"	2'–0"	4'–5 1/2"	1'–0 1/2"	1'–9 7/8"	2'–0"	4'–5 1/2"	0'–11"	1'–9 7/8"	2'–0"
		4'–11"	2'–1 1/4"	4'–11"	1'–2"	2'–0 5/8"	2'–1 1/4"	4'–11"	0'–10"	1'–1 7/8"	2'–1 1/4"
H	E F	3'–3 3/4"	1'–9 1/2"	3'–3 3/4"	1'–1 1/2"	2'–3"	1'–9 1/2"	3'–3 3/4"	0'–11 1/2"	2'–3"	1'–9 1/2"
		3'–5"	2'–0"	3'–5"	1'–2 3/4"	2'–3"	2'–0"	3'–5"	1'–0 3/4"	2'–3"	2'–0"
	G H K L	3'–10 3/8"	2'–1 1/4"	3'–9 3/8"	1'–4"	2'–7"	2'–1 1/4"	3'–9 3/8"	0'–11 7/8"	2'–7"	2'–1 1/4"
		3'–11 1/2"	2'–3"	3'–10 1/2"	1'–5 1/8"	2'–7"	2'–3"	3'–10 1/2"	1'–1"	2'–7"	2'–3"
		4'–11"	2'–1 1/4"	4'–11"	1'–2"	2'–0 5/8"	2'–1 1/4"	4'–11"	0–10"	1'–1 7/8"	2'–1 1/4"
		4'–0 3/4"	2'–4 1/2"	4'–0 3/4"	1'–10"	2'–11"	2'–4 1/2"	4'–0 3/4"	1'–9"	2'–11"	2'–4 1/2"

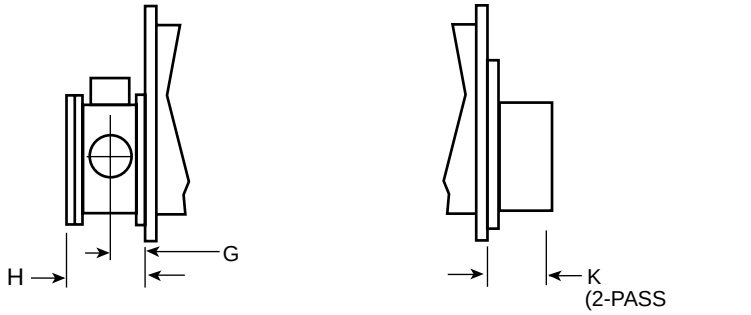
See Notes on page 38.

Dimensions (Ft. - In.) – Nozzle Arrangements

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



LD01342B

COMPR. CODE	EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (1 PASS)	
		G	H
Q3	AP-AS	1'–11/16"	2'–2 5/8"
P, Q	AA-AD, B	1'–1 1/4"	2'–3"
	C, D	1'–2 3/4"	2'–7"
P	E, F	1'–1 7/8"	2'–5 5/8"
	G, H	1'–3 1/2"	2'–9 5/16"
H	E, F	1'–0 1/4"	2'–1 7/8"
	G, H	1'–1 1/4"	2'–4 3/8"
	K	1'–3 1/2"	2'–9 5/16"
	L	1'–1 5/8"	2'–5 1/2"

COMPR. CODE	EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (2 PASS)		
		G	H	K
Q3	AP-AS	1'–11/16"	2'–2 5/8"	8 3/4"
P, Q	AA-AD, B	1'–1 3/4"	2'–3"	5 5/8"
	C, D	1'–2 3/4"	2'–7"	5 7/8"
P	E, F	1'–1 7/8"	2'–5 5/8"	7 11/16"
	G, H	1'–3 1/2"	2'–9 5/16"	9 7/16"
H	E, F	9 3/4"	1'–8 7/8"	5 7/8"
	G, H	11 1/4"	2'–0 3/8"	6 1/4"
	K	1'–3 1/2"	2'–9 5/16"	9 7/16"
	L	0'–11 5/8"	2'–1 1/2"	1'–2 3/4"

EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
AP-AS	8"	6"	4"
AA-AD, B	10"	8"	6"
C, D	14"	10"	8"
E, F	14"	10"	8"
G, H, K	16"	12"	10"
L	18"	14"	12"

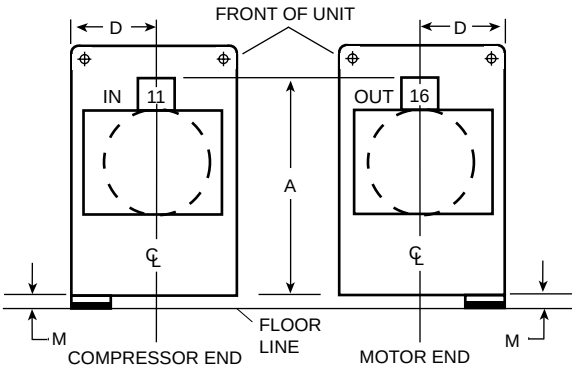
COMPR. CODE	EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (3 PASS)	
		G	H
Q3	AP-AS	1'–11/16"	2'–2 5/8"
P, Q	AA-AD, B	1'–1 1/4"	2'–3"
	C, D	1'–2 3/4"	2'–7"
P	E, F	1'–1 7/8"	2'–5 5/8"
	G, H	1'–3 1/2"	2'–9 5/16"
H	E, F	0'–9 3/4"	1'–8 7/8"
	G, H	0'–9 3/4"	1'–9 3/8"
	K	1'–3 1/2"	2'–9 5/16"
	L	0'–10 5/8"	1'–11 1/2"

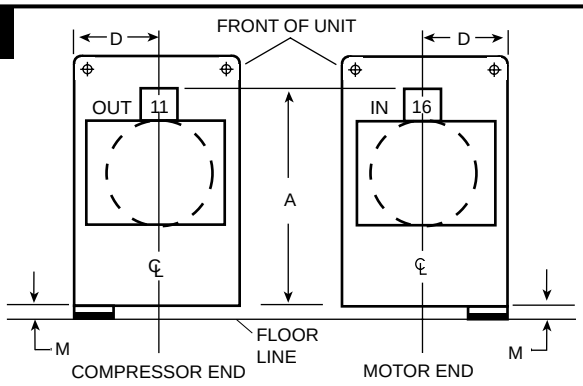
NOTES (see chart on page 37):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" on page 33 - 34 for the appropriate isolator type.
6. Waterboxes are round for P & Q Compressors and rectangular for H Compressor. H9 compressor "K" evaporators are round.

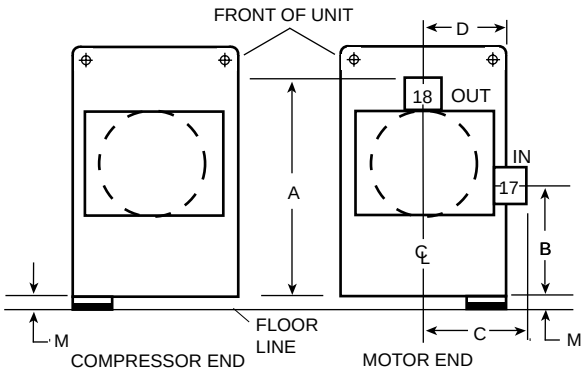
CONDENSERS – MARINE WATER BOXES – P, Q & H COMPRESSOR UNITS

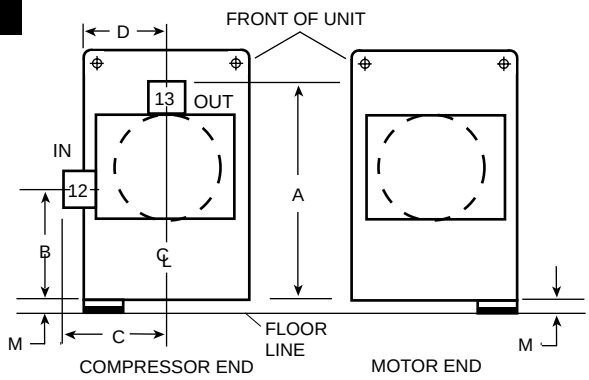
1-PASS



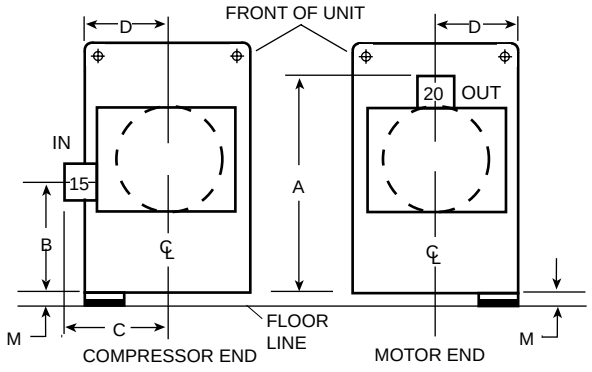


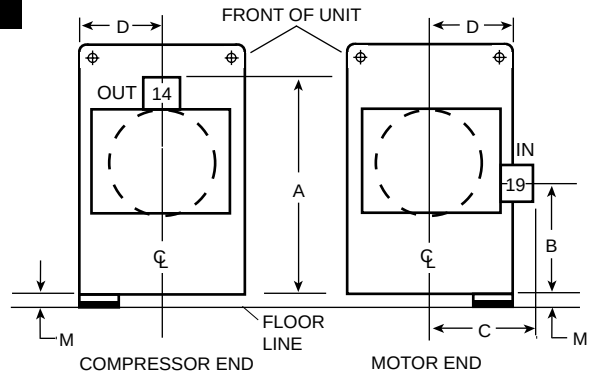
2-PASS





3-PASS



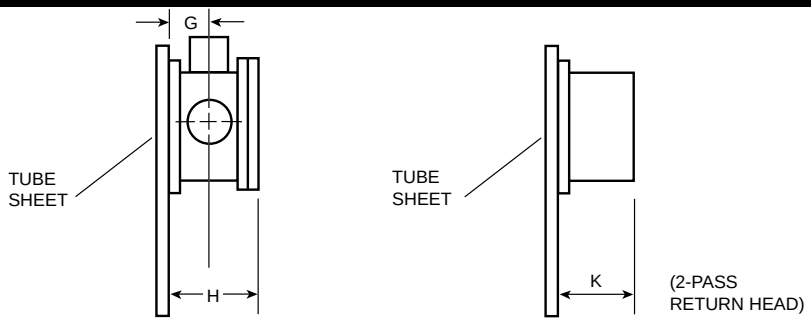


COMPR. CODE	COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS									
		1 PASS		2 PASS				3 PASS			
		A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
Q3	AP,AQ AR,AS	3' - 11 3/4"	1' - 3"	3' - 10 1/4"	1' - 8 3/4"	1' - 2 3/8"	1' - 3 1/2"	3' - 10 1/4"	1' - 8 3/4"	1' - 2 3/8"	1' - 3 1/2"
P, Q	AA-AD, B	4'–3"	1'–3 1/2"	4'–2"	1'–7 3/4"	1'–6"	1'–3 1/2"	4'–1 1/2"	1'–8 1/2"	1'–3 3/4"	1'–3 1/2"
	C, D	4'–7"	1'–5 1/2"	4'–7"	1'–7 3/8"	1'–9 1/2"	1'–5 1/2"	4'–7"	1'–8 1/4"	1'–7 1/4"	1'–5 1/2"
P	E, F	4'–7"	1'–5 1/2"	4'–7"	1'–7 3/8"	1'–9 1/2"	1'–5 1/2"	4'–7"	1'–8 1/4"	1'–7 3/8"	1'–5 1/2"
	G, H	5'–1"	1'–8"	5'–1"	1'–10"	1'–10 7/8"	1'–8"	5'–1"	1'–10"	1'–10 7/8"	1'–8"
H	E	5'–1 1/8"	1'–5 1/2"	5'–1 1/8"	2'–6"	2'–0 5/8"	1'–5 1/2"	5'–1 1/8"	2'–4 1/2"	2'–0 5/8"	1'–5 1/2"
	F	5'–5 1/4"	1'–7"	5'–4 1/4"	2'–7"	2'–2 1/4"	1'–7"	5'–4 1/4"	2'–6"	2'–2 1/4"	1'–7"
	G	5'–9 1/8"	1'–9"	5'–8 1/8"	2'–8"	2'–4 1/8"	1'–9"	5'–8 1/8"	2'–6 1/2"	2'–4 1/8"	1'–9"
	K	5'–1"	1'–8"	5'–1"	1'–10"	1'–10 7/8"	1'–8"	5'–1"	1'–10"	1'–10 7/8"	1'–8"
	L	5'–9"	2'–1 1/2"	5'–9"	2'–5"	1'–11 5/8"	2'–1 1/2"	5'–9"	2'–4"	1'–10 7/8"	2'–1 1/2"

See Notes on page 40.

Dimensions (Ft. - In.) – Nozzle Arrangements

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

COMPR. CODE	CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (1 PASS)	
		G	H
Q3	AP-AS	1'–5/16"	2'–1 3/4"
P, Q	AA-AD, B	1'–0 1/4"	2'–2 3/4"
	C, D	1'–1 1/4"	2'–3 3/4"
P	E, F	1'–2 1/8"	2'–6"
	G, H	1'–3 3/8"	2'–8 3/8"
H	E	1'–0 1/4"	2'–1 7/8"
	F	1'–1 1/4"	2'–4"
	G	1'–1 1/4"	2'–4 3/8"
	K	1'–3 3/8"	2'–8 3/8"
	L	1'–4"	2'–11"

COMPR. CODE	CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (2 PASS)		
		G	H	K
Q3	AP-AS	1'–5/16"	2'–1 3/4"	7 9/16"
P, Q	AA-AD, B	1'–0 3/4"	2'–2 1/2"	5 1/2"
	C, D	1'–1 1/4"	2'–3 3/4"	5 1/2"
P	E, F	1'–2 1/8"	2'–6"	7"
	G, H	1'–3 3/8"	2'–8 3/8"	7 1/2"
H	E	9 3/4"	1'–8 7/8"	5 3/4"
	F	11 1/4"	2'–0"	5 3/4"
	G	1'–0 1/4"	2'–2 3/8"	6"
	K	1'–3 3/8"	2'–8 3/8"	7 1/2"
	L	1'–4"	2'–11"	1 2"

COMPR. CODE	COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
		1	2	3
Q3	AP-AS	10"	6"	6"
P, Q	AA-AD, B	12"	8"	6"
	C, D	14"	10"	8"
P	E, F	14"	10"	8"
	G, H	16"	10"	10"
H	E	14"	10"	8"
	F	16"	12"	10"
	G	16"	14"	10"
	K	16"	10"	10"
	L	20"	14"	10"

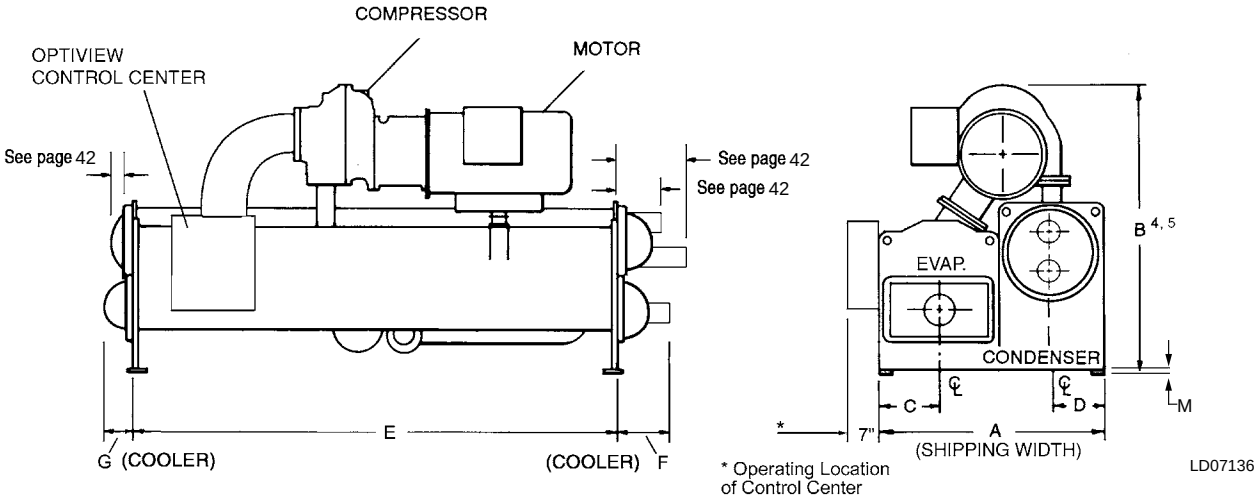
COMPR. CODE	CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (3 PASS)	
		G	H
Q3	AP-AS	1'–11/16"	2'–2 5/8"
P, Q	AA-AD, B	1'–0 3/4"	2'–2 1/2"
	C, D	1'–1 1/4"	2'–3 3/4"
P	E, F	1'–2 1/8"	2'–6"
	G, H	1'–3 3/8"	2'–8 3/8"
H	E	8 3/4"	1'–6 7/8"
	F	9 3/4"	1'–9"
	G	9 5/8"	1'–9 1/8"
	K	1'–3 3/8"	2'–8 3/8"
	L	1'–4"	2'–11"

NOTES (see chart on page 39):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
5. Add dimension "M" as shown on pages 33 - 34 for the appropriate isolator type.
6. Round waterboxes are for H9, P & Q Compressors and rectangular waterboxes for H3-H8 Compressor.

Dimensions (Ft. - In.) – Unit

J COMPRESSOR UNITS



J1/J2 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES								
	G G	G H	H G	H H	H J	J H	J J	T T
A	7'–6"	7'–10"	7'–10 1/2"	8'–2 1/2"	8'–6 1/2"	8'–11"	9'–1"	9'–1"
B	9'–3"	9'–9"	9'–3"	9'–9"	9'–9"	9'–9"	9'–9"	9'–9"
C	2'–0"	2'–0"	2'–2 1/4"	2'–2 1/4"	2'–2 1/4"	2'–5 1/2"	2'–5 1/2"	2'–5 1/2"
D	1'–9"	1'–11"	1'–9"	1'–11"	2'–1"	1'–11"	2'–1"	2'–1"
E	14'–0"	14'–0"	14'–0"	14'–0"	14'–0"	14'–0"	14'–0"	16'–0"
F	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"
G	1'–2 3/4"	1'–2 3/4"	1'–2 3/4"	1'–2 3/4"	1'–2 3/4"	1'–2 3/4"	1'–2 3/4"	1'–2 3/4"

ADDITIONAL OPERATNG HEIGHT CLEARANCE	
TYPE OF CHILLER MOUNTING	M
NEOPRENE PAD ISOLATORS	1-3/4"
SPRING ISOLATORS 1" DEFLECTION	1"
DIRECT MOUNT	3/4"

J3 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES			
	H H	H J	J H
A	8'–2 1/2"	8'–6 1/2"	8'–9"
B	9'–8"	10'–0"	9'–8"
C	2'–2 1/4"	2'–2 1/4"	2'–5 1/2"
D	1'–11"	2'–1"	1'–11"
E	14'–0"	14'–0"	14'–0"
F	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"
G	1'–2 3/4"	1'–2 3/4"	1'–2 3/4"

J3/J4 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES						
	J J	T T	T V	V T	V V	W V
A	9'–1"	9'–1"	9'–6"	9'–1"	9'–6"	9'–11"
B	10'–0"	10'–0"	10'–5"	10'–0"	10'–5"	10'–5"
C	2'–5 1/2"	2'–5 1/2"	2'–5 1/2"	2'–5 1/2"	2'–5 1/2"	2'–8"
D	2'–1"	2'–1"	2'–3 1/2"	2'–1"	2'–3 1/2"	2'–3 1/2"
E	14'–0"	16'–0"	16'–0"	16'–0"	16'–0"	16'–0"
F	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	1'–11 3/4"	2'–0 3/4"
G	1 '–2 3/4"	1 '–2 3/4"	1 '–2 3/4"	1 '–2 3/4"	1 '–2 3/4"	1'–4 1/2"

J5/J7 COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES			
	X-X	Y-Y	Z-Z
A	10'–3"	10'-3"	11'-3
B	11'–5"	12'-2"	12'-10"
C	2'–8"	2'-8"	2'-11 1/2"
D	2'–5-1/2"	2'-5 1/2"	2'-8"
E	18'-0"	22'-0"	18'-0"
F	2'–0-3/4"	2'-0 3/4"	1'-10"
G	1'–4-3/4"	1'-4 3/4"	1'-2"

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 46 - 49.
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.

Dimensions (Ft. - In.)



1 PASS CONDENSERS

DIM.	G	H	J	T	V	X/Y	Z
A	1'–2"	1'–9"	1'–9 3/4"	1'–9 3/4"	1'–11 1/8"	1'–7 5/8"	1–9 3/4"



2 PASS CONDENSERS

DIM.	G	H	J	T	V	X/Y	Z
B	6"	11–1/2"	1'–0 /4"	1'–0 1/4"	1'–1 7/8"	0'–11 3/4"	1'–1 7/8"
C	1'–2"	2'–0 1/4"	1'–7 5/8"	1'–7 5/8"	1'–10 1/8"	1'–7 5/8"	1'–9 1/4"
D	1'–2"	1'–6 1/4"	1'–7 5/8"	1'–7 5/8"	1'–10 1/8"	1'–7 5/8"	1'–9 1/4"



3 PASS CONDENSERS

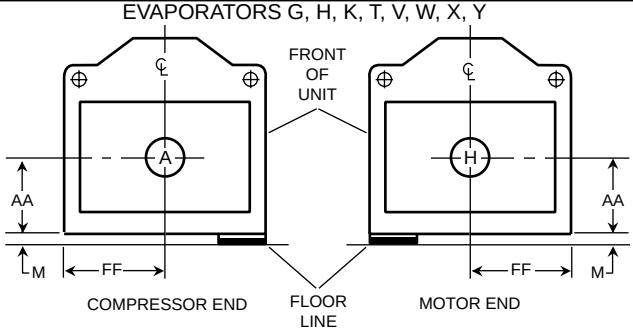
DIM.	G	H	J	T	V	X/Y	Z
E	1'–2"	1'–4 7/8"	1'–7"	1'–7"	1'–7 3/4"	1'–7 5/8"	1'–9 1/4"
F	1'–2"	1'–8 1/8"	1'–10 1/8"	1'–10 1/8"	1'–11 3/8"	1'–7 5/8"	1'–9 1/4"

Dimensions (Ft. - In.) – Nozzle Arrangements

EVAPORATORS – COMPACT WATER BOXES – J COMPRESSOR UNITS

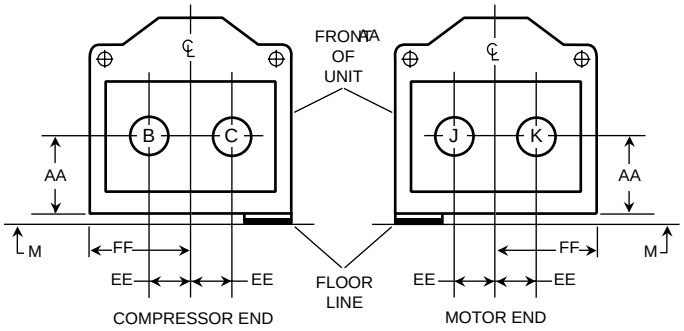
EVAPORATORS G, H, K, T, V, W, X, Y

1-PASS



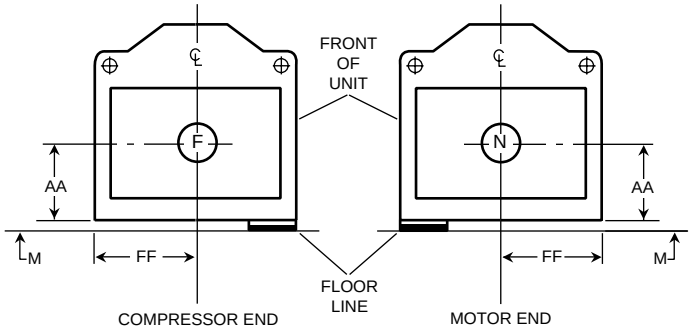
SHELL CODE	1 PASS	
	IN	OUT
G-Y	A	H
	H	A

2-PASS



SHELL CODES	2 PASS	
	IN	OUT
G-Y	B	C
	C	B
	J	K
	K	J

3-PASS



SHELL CODES	3 PASS	
	IN	OUT
G-Y	F	N
	N	F

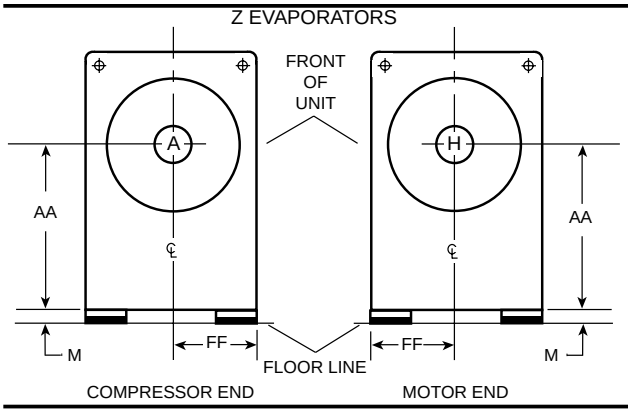
EVAP. SHELL CODE	NOZZLE PIPE SIZE			EVAPORATOR NOZZLE DIM ENSIONS				
	NO. OF PASSES				1–PASS	2–PASS		3–PASS
	1	2	3	FF	AA[2]	AA[2]	EE	AA[2]
G	14"	1 0"	8"	2'–0"	1'–10 3/8"	1'–10 3/8"	11"	1'–10 3/8"
H	16"	12"	10"	2'–2 1/4"	2'–0 3/4"	2'–0 3/4"	11"	2'–0 3/4"
J, T	18"	14"	12"	2'–5 1/2"	2'–1"	2'–1"	11"	2'–1"
V	20"	16"	12"	2'–5 1/2"	2'–4 1/2"	2'–4 1/2"	1'–1"	2'–4 1/2"
W, X	20"	18"	14"	2'–8"	2'–6 1/2"	2'–6 1/2"	1'–3"	2'–6 1/2"
Y	20"	18"	14"	2'–8"	2'–7"	2'–7"	1'–3"	2'–7"

NOTES:

1. Standard water nozzles are furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add dimension "M" as shown on page 41 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.
5. Standard 150 psi design pressure boxes shown.

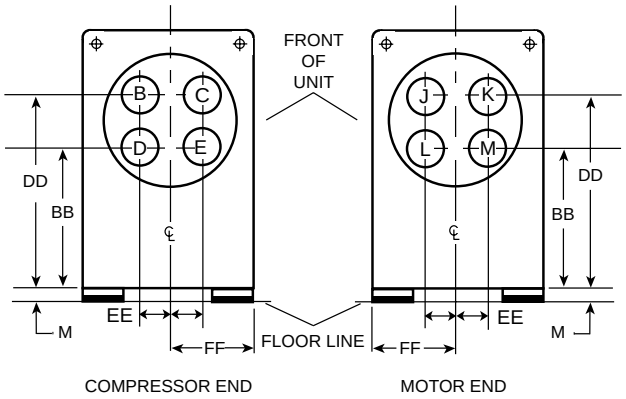
EVAPORATORS – COMPACT WATER BOXES – J COMPRESSOR UNITS

1-PASS



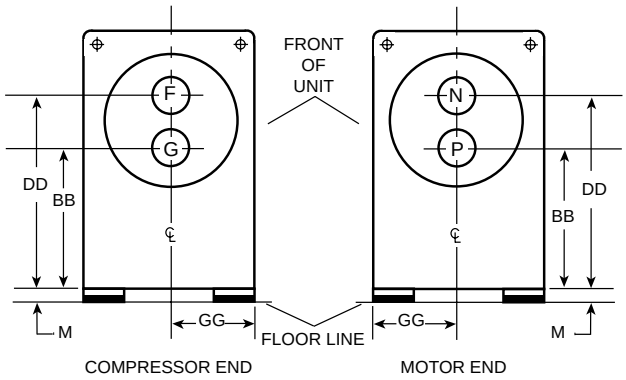
SHELL CODE	1 PASS	
	IN	OUT
Z	A	H
	H	A

2-PASS



SHELL CODES	2 PASS	
	IN	OUT
Z	D	C
	E	B
	L	K
	M	J

3-PASS



SHELL CODES	3 PASS	
	IN	OUT
Z	G	N
	P	F

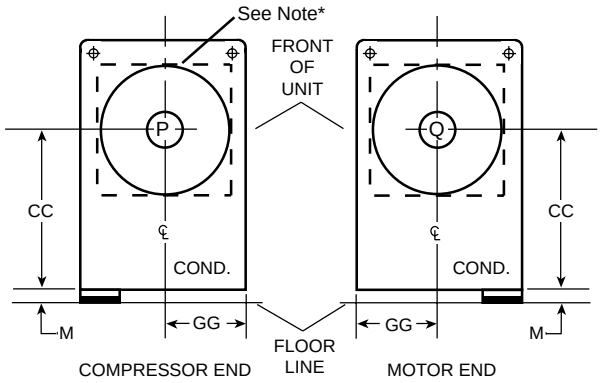
EVAP. SHELL CODE	NOZZLE PIPE SIZE			EVAPORATOR NOZZLE DIMENSIONS						
	NO. OF PASSES				1–PASS	2–PASS			3–PASS	
	1	2	3	FF	AA[2]	BB[2]	DD[2]	EE	BB[2]	DD[2]
Z	20"	18"	14"	2'–11 1/2"	3'–9 3/4"	2'–9 3/4"	4'–9 3/4"	1'–0"	2'–3 1/4"	5–3 3/4"

See Notes on pg 43

Dimensions (Ft. - In.) – Nozzle Arrangements

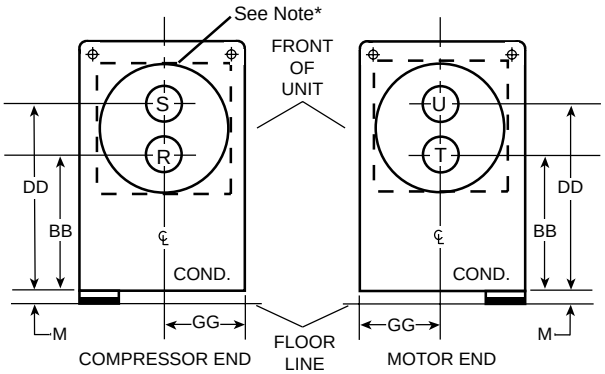
CONDENSERS – COMPACT WATER BOXES – J COMPRESSOR UNITS

1-PASS



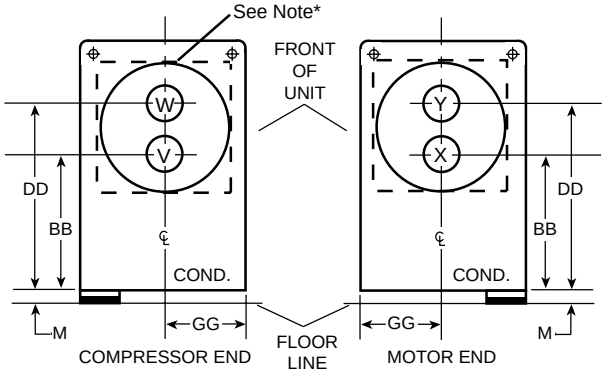
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS



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

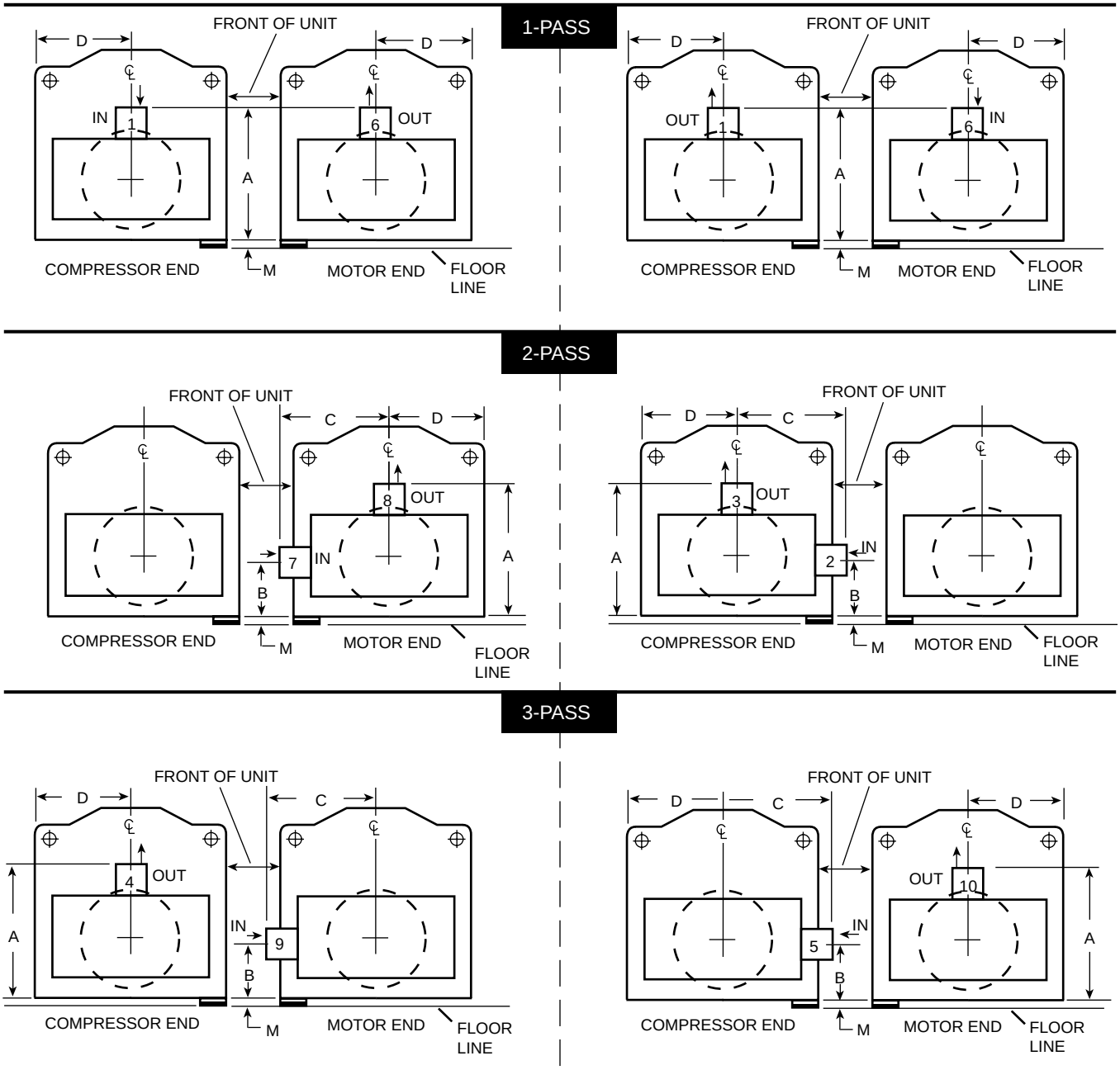
LD07174

CONDENSER SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES			CONDENSER NOZZLE DIMENSIONS							
				1-PASS		2-PASS			3-PASS		
	1	2	3	CC[2]	GG	BB[2]	DD[2]	GG	BB[2]	DD	GG
G*	16"	14"	10"	3'–4"	1'–9"	2'–5 1/4"	4'–2 3/4"	1'–9"	2'–6 1/2"	4'–3"	1'–9"
H	20"	16"	12"	3'–6"	1'–11"	2'–7"	4'–5"	1'–11"	2'–6 1/2"	4'–6 3/4"	1'–11"
J, T	20"	16"	14"	3'–8"	2'–1"	2'–7 1/2"	4'–8 1/2"	2'–1"	2'–8 1/2"	4'–10"	2'–1"
V	20"	18"	14"	3'–10 1/2"	2'–3 1/2"	2'–9"	5'–0"	2'–3 1/2"	2'–10 1/2"	5'–2 1/8"	2'–3 1/2"
X	24"	18"	16"	4'–0 1/2"	2'–5 1/2"	2' 11 1/2"	5'–1 1/2"	2'–5 1/2"	2'–11 1/2"	5'–1 1/2"	2'–5 1/2"
Y	24"	18"	16"	3'–11 1/2"	2'–5 1/2"	2'–10 1/2"	5'–0 1/2"	2'–5 1/2"	2'–10 1/2"	5'–0 1/2"	2'–5 1/2"
Z	24"	20"	16"	4'–1 1/4"	2'–8"	2'–9 1/2"	5'–5"	2'–8"	2'–9 1/2"	5'–5"	2'–8"

(See Notes on page 45.)

* **NOTE:** "G" Condenser Water Boxes are square; other codes are round as shown.
** Water must enter through bottom connection to achieve rated performance.

EVAPORATORS – MARINE WATER BOXES – J COMPRESSOR UNITS



LD07180

EVAPORATOR NOZZLE DIMENSIONS

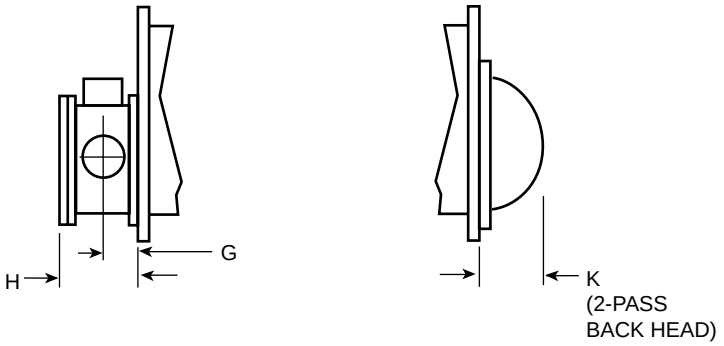
SHELL CODE	1-PASS		2-PASS				3-PASS			
	A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
G	3'–8-3/8"	2'–0"	3'–8-3/8"	1'–5-1/2"	2'–5"	2'–0"	3'–8-3/8"	1'–3-3/8"	2'–5"	2'–0"
H	3'–11-1/2"	2'–2-1/4"	3'–11-1/2"	1'–8-1/4"	2'–7 -1 /4"	2'–2-1/4"	3'–11-1/2"	1'–6-3/4"	2'–7-1/4"	2'–2 -1 /4"
J, T	3'–11"	2'–5-1/2"	3'–11"	1'–9"	2'–10-1/4"	2'–5-1/2"	3'–11"	1'–8"	2'–10-1/4"	2'–5-1/2"
V	4'–2-1/2"	2'–5-1/2"	4'–2-1/2"	2'–0-3/4"	2'–10-1/4"	2'–5-1/2"	4'–2-1/2"	1'–11-1/8"	2'–10-1/4"	2'–5-1/2"
W, X	4'–6-1/2"	2'–8"	4'–6-1/2"	2'–2-3/4"	3'–2"	2'–8"	4'–6-1/2"	2'–0-3/4"	3'–1-7/8"	2'–8"
Y	4'-7 1/16"	2'-8"	4'-7 1/16"	2'-3 5 1/16"	3'-2"	2'-8"	4'-7 1/16"	2'-1 5/16"	3'-1 7/8"	2'-8"
Z	6'-11 1/2"	2'-11 1/2"	6'-11 1/2"	2'-1 3/4"	3'-2 5/8"	2'-11 1/2"	6'-11 1/2"	1'-8 1/4"	3'-2 5/8"	2'-11 1/2"

Note: Z evaporators have round style waterboxes.

See Notes on page 47.

Dimensions (Ft. - In.) – Nozzle Arrangements

EVAPORATOR 1-PASS	
IN	OUT
1	6
6	1



EVAPORATOR 2-PASS	
IN	OUT
2	3
7	8

EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (1–PASS)	
	G	H
G	1'–0 3/8"	2'–2 1/2"
H	1'–1 3/8"	2'–4 3/4"
J, T	1'–2 3/8"	2'–6 3/4"
V	1'–4"	2'–10"
W, X, Y	1'–4"	2'–10"
Z	1'–4 1/4"	3'–1"

EVAPORATOR 3-PASS	
IN	OUT
5	10
9	4

EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
G	10 3/8"	1'–10 1/2"	1'–2 3/4"
H	11 3/8"	2'–0 3/4"	1'–2 3/4"
J, T	1'–0 3/8"	2'–2 3/4"	1'–2 3/4"
V	1'–2"	2'–6"	1'–2 3/4"
W, X, Y	1'–3"	2'–6"	1'–4–1/2"
Z	1'–1 5/8"	2'–8 1/2"	1'–2"

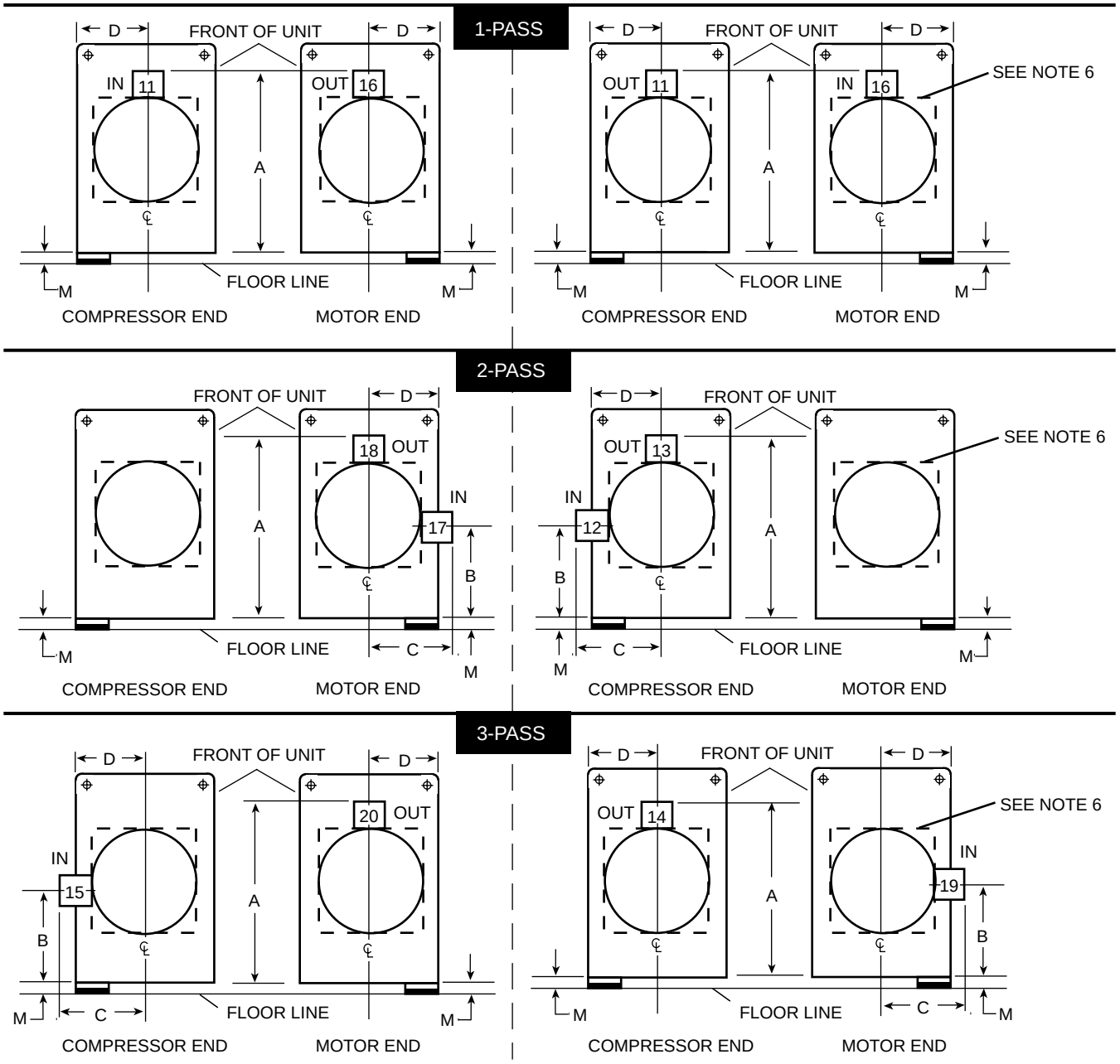
EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
G	14"	10"	8"
H	16"	12"	10"
J, T	18"	14"	12"
V	20"	16"	12"
W, X, Y, Z	20"	18"	14"

EVAPORATOR-SHELLCODE	EVAPORATOR NOZZLEDIMENSIONS (3-PASS)	
	G	H
G	9–3/8"	1'–8–1/2"
H	10–3/8"	1'–10 1/2"
J, T	11–3/8"	2'–0 3/4"
V	1'–0–3/8"	2'–2 3/4"
W, X, Y	1'–1"	2'–4"
Z	1'–1"	2'–6 1/2"

NOTES (see table on page 46):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" as shown on page 41 for the appropriate isolator type.

CONDENSERS – MARINE WATER BOXES – J COMPRESSOR UNITS



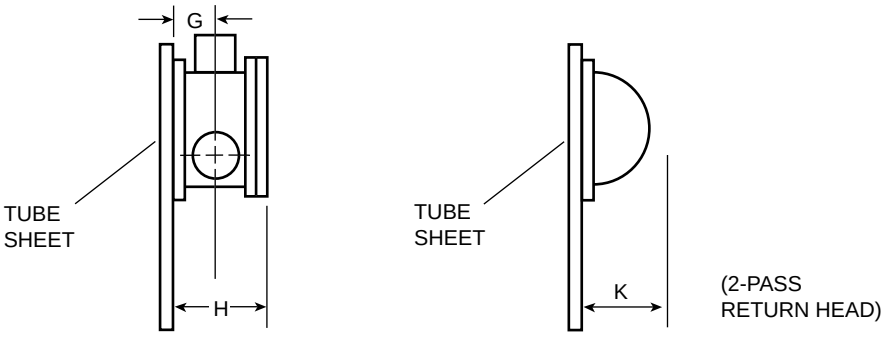
LD07182a

ND. 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
G	5'–9"	1'–9"	5'–9"	2'–8"	2'–5"	1'–9"	5'–9"	2'–6 1/2"	2'–5"	1'–9"
H	5'–10 1/4"	1'–11"	5'–9 1/2"	2'–0"	2'–1"	1'–11"	5'–9 1/8"	2'–0 3/8"	1'–11 3/4"	1'–11"
J, T	6'–2 5/8"	2'–1"	6'–1 5/8"	2'–0 3/4"	2'–1 1/8"	2'–1"	6'–1 1/8"	2'–1"	2'–1 7/8"	2'–1"
V	6'–8"	2'–3 1/2"	6'–7 3/8"	2'–1"	2'–5 3/8"	2'–3 1/2"	6'–6 1/4"	2'–1 3/4"	2'–3 3/4"	2'–3 1/2"
X	7'–0 1/2"	2'–5 1/2"	7'–0 1/2"	3'–1"	2'–10"	2'–5 1/2"	7'–0 1/2"	2'–10"	2'–10"	2'–5 1/2"
Y	6'–11 1/2"	2'–5 1/2"	6'–11 1/2"	3'–0"	2'–10"	2'–5 1/2"	6'–11 1/2"	2'–9"	2'–10	2'–5 1/2"
Z	7'–3"	2'–8"	7'–3"	2'–3 1/4"	2'–10 1/2"	2'–8"	7'–3"	2'–3 1/4"	2'–10 1/2"	2'–8"

See Notes on page 49.

Dimensions (Ft. - In.) – Nozzle Arrangements

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

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (1-PASS)	
	G	H
G	1'–1 1/4"	2'–4 3/8"
H	1'–3 1/2"	2'–8 3/4"
J, T	1'–3 1/2"	2'–8 7/8"
V	1'–3 1/2"	2'–9 3/8"
X, Y	1'–5 7/8"	3'–2 1/4"
Z	1'–6 1/2"	3'–5 1/2"

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
G	1'–0 1/4"	2'–2 3/8"	0'–5
H	1'–1 5/8"	2'–5"	0'–11
J, T	1'–1 5/8"	2'–5 1/8"	1'–0
V	1'–2 1/4"	2'–6 3/4"	1'–1
X, Y	1'–2 1/8"	2'–7 1/4"	0'–11
Z	1'–4 1/4"	3'–0 1/2"	1'–2"

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (3-PASS)	
	G	H
G	0'–9 5/8"	1'–9 1/8"
H	0'–11 1/4"	2'–0 1/4"
J, T	1'–0 1/4"	2'–2 3/8"
V	1'–0 1/4"	2'–2 3/4"
X, Y	1'–1 5/8"	2'–5 3/4"
Z	1'–2	2'–9 1/2"

COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
G	16"	14"	10"
H	20"	16"	12"
J, T	20"	16"	14"
V	20"	18"	14"
X, Y	24"	18"	16"
Z	24"	20"	16"

NOTES (see table on page 48):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
5. Add dimension "M" as shown on page 41 for the appropriate isolator type.
6. “G” Condenser Water Boxes are square; other codes are round as shown.

Weights

TABLE 7 – APPROXIMATE UNIT WEIGHT INCLUDING MOTOR*

SHELLS	COMPRESSOR	SHIPPING WEIGHT (LBS.)	OPERATING WEIGHT (LBS.)	EST. REFRIGERANT CHARGE (LBS.)
AP - AS	Q3	13,100	15,330	1,150
AA - AD	Q3	14,900	17,930	1,250
B - B	Q3	17,200	20,950	1,550
AA - AD	Q4	14,920	17,950	1,250
B - B	Q4	17,215	20,970	1,550
C - C	Q4	17,950	22,080	1,600
AA - AD	Q5	15,330	18,360	1,250
C - C	Q5	18,360	22,490	1,600
D - D	Q5	18,720	23,790	1,900
C - C	Q6	18,350	22,480	1,600
D - D	Q6	18,710	23,780	1,900
AA - AD	P1, P2, P3, P4	13,240	16,470	1,250
B-B	P1, P2, P3, P4	14,836	18,870	1,550
C-C	P5, P6, P7, Q7	18,232	22,775	1,600
D-D	P6, P7, Q7	21,704	24,000	1,750
E-E	P8	20,300	24,000	1,750
F-F	P8, P9	23,100	27,800	2,330
G-G	P8, P9	24,000	28,700	2,050
H-H	P8, P9	27,400	33,500	2,700
E-E	H5	22,861	27,875	1,690
E-F	H5	24,370	29,960	1,790
F-E	H5	23,897	29,300	1,900
F-F	H5, H6	25,396	31,395	2,020
F-G	H5, H6	27,788	34,635	2,150
G-F	H3, H5, H6, H7, H8	27,932	34,780	2,290
G-G	H3, H5, H6, H7, H8	30,315	37,995	2,415
G-G	J1, J2	29,410	36,850	2,415
G-H	J1, J2	30,675	38,690	2,560
H-G	H3, H5, H6, H7, H8	32,420	40,675	2,560
K-K	H9	28,530	35,500	2,300
L-L	H9	34,200	43,536	3,075
H-G	J1, J2	31,890	40,145	2,625
H-H	J1, J2	33,170	42,050	2,825
H-H	J3	34,380	43,265	2,825
H-J	J1, J2	35,570	45,470	3,010
H-J	J3	36,785	46,682	3,010
J-H	J1, J2	36,675	46,880	3,310
J-H	J3	37,885	48,095	3,310
J-J	J1, J2	39,075	50,295	3,495
J-J	J3, J4	40,290	51,510	3,495
T-T	J1, J2	42,560	55,136	3,995
T-T	J3, J4	43,775	56,340	3,995
T-V	J3, J4	47,450	61,620	4,290
V-T	J3, J4	44,885	57,915	3,820
V-V	J3, J4	48,565	63,215	4,150
W-V	J3, J4	53,230	69,610	4,460
X-X	J5	67,100	86,760	5,810
Y-Y	J7	82,600	99,100	6,200
Z-Z	J7	81,500	102,000	5,500

* Refer to product drawings for detailed weight information.

Weights

TABLE 8 – MARINE WATER BOX WEIGHTS (LBS.) – P, Q Compressor Units

WEIGHTS (To be added to Standard Unit weights shown on Table 7).

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
AP - AS	924	744	978	1,468	1,288	1,522	AP - AS	762	566	810	1,274	1,078	1,322
AA - AD, B	1,352	1,114	1,480	2,224	1,986	2,352	AA - AD, B	946	778	1,046	1,692	1,524	1,792
C, D	1,878	1,260	2,080	3,378	2,760	3,580	C, D	1,462	1,197	1,620	2,622	2,357	2,780
E, F	1,213	1,296	1,293	2,655	2,738	2,735	E, F	726	811	791	1,337	1,722	1,702
G, H	1,751	1,843	1,856	3,864	3,956	3,969	G, H	1,029	1,167	1,151	2,309	2,447	2,431

TABLE 9 – MARINE WATER BOX WEIGHTS (LBS.) – H Compressor Units

WEIGHTS (To be added to Standard Unit weights shown on Table 7).

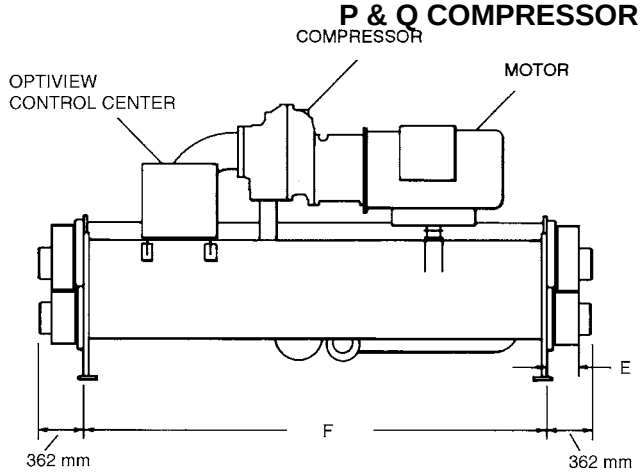
EVAP. CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING WEIGHT INCREASE – LBS.			COND. CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING WEIGHT INCREASE – LBS.		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
E	1,602	1,574	1,394	1,832	1,814	1,624	E	2,572	1,167	2,340	2,670	1,261	2,510
F	2,296	1,122	2,129	2,568	1,394	2,400	F	1,046	752	900	1,159	865	970
G	2,838	1,238	2,339	3,206	1,606	2,707	G	1,382	965	1,100	1,576	1,159	1,380
H	3,468	1,575	2,916	3,945	2,052	3,393	K	1,029	1,167	1,151	2,309	2,447	2,431
K	1,751	1,843	1,856	3,864	3,956	3,969	L	2,432	1,328	2,676	4,893	2,508	5,002
L	3,626	1,742	3,402	4,945	2,148	4,120							

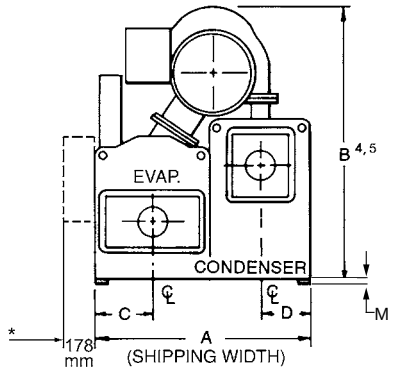
TABLE 10 – MARINE WATER BOX WEIGHTS (LBS.) – J Compressor Units

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
G	2,415	975	1,915	2,690	1,225	2,200	G	2,380	1,140	1,670	2,500	1,250	1,775
H	2,775	1,514	2,800	3,140	1,775	3,200	H	2,495	1,210	2,290	2,650	1,340	2,610
J, T	3,576	1,715	3,400	4,050	2,100	3,900	J, T	2,990	1,485	2,895	3,390	1,700	3,230
V	3,760	1,820	3,460	4,450	2,490	4,000	V	3,930	1,900	3,815	4,440	2,300	4,670
W, X, Y	4,650	2,455	4,330	5,460	3,270	5,120	X	5,094	2,276	4,522	9,809	4,021	7,778
Z	6,398	3,342	6,842	10,639	4,523	9,112	Z	5,840	2,953	5,380	9,900	4,649	8,100

Dimensions (mm) – Unit

P & Q COMPRESSOR UNITS





*Operating Location of Control Center on Evaporator Codes G & H

P1, P2, P3, P4, COMPRESSORS EVAPORATOR – CONDENSER SHELL CODES		
	A–A	B–B
A	1,676	1,676
B	2,099	2,099
C	445	445
D	394	394
E	160	160
F	3,658	4,877

P5 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES			
	A–A	B–B	C–C
A	1,676	1,676	1,880
B	2,248	2,248	2,299
C	445	445	495
D	394	394	445
E	160	160	175
F	3,658	4,877	3,658

P6, P7, Q7 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES		
	C–C	D–D
A	1,880	1,880
B	2,299	2,299
C	495	495
D	445	445
E	175	175
F	3,658	4,877

P8 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES				
	E–E	F–F	G–G	H–H
A	2,108	2,108	2,299	2,299
B	3,137	3,137	3,289	3,289
C	610	610	641	641
D	445	445	508	508
E	378	378	397	397
F	3,658	4,877	3,658	4,877

P9 COMPRESSOR EVAPORATOR – CONDENSER SHELL CODES			
	F–F	G–G	H–H
A	2,108	2,299	2,299
B	3,045	3,200	3,200
C	610	641	641
D	445	508	508
E	378	379	397
F	4,877	3,658	4,877

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

Q3 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES			
	A*-A*	A-A	B-B
A	1,549	1,676	1,676
B	2,049	2,099	2,099
C	394	445	445
D	381	394	394
E	148	160	160
F	3,658	3,658	4,877

Q4 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES			
	A-A	B-B	C-C
A	1,676	1,676	1,877
B	2,056	2,056	2,346
C	445	445	495
D	394	394	445
E	160	160	175
F	3,658	4,877	3,658

Q5 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES			
	A-A	C-C	D-D
A	1,676	1,877	1,877
B	2,298	2,423	2,423
C	445	495	495
D	394	445	445
E	160	175	175
F	3,658	3,658	4,877

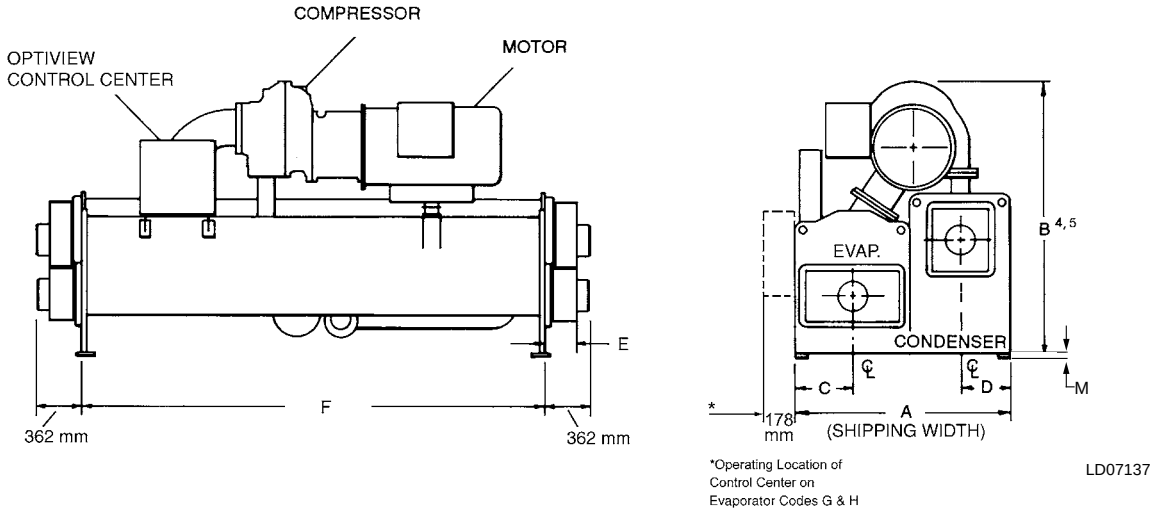
Q6 COMPRESSOR EVAPORATOR - CONDENSER SHELL CODES		
	C-C	D-D
A	1,877	1,877
B	2,383	2,383
C	495	495
D	445	445
E	175	175
F	3,658	4,877

A*-A* - AP through AS Evaporators and Condensers

A-A - AA through AD Evaporators and Condensers

Dimensions (mm) – Unit

H COMPRESSOR UNITS



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

H5 COMPRESSORS							
EVAPORATOR – CONDENSER SHELL CODES							
	E–E	E–F	F–E	F–F	F–G	G–F	G–G
A	1,981	2,057	2,108	2,184	2,286	2,248	2,350
B	2,445	2,508	2,443	2,508	2,305	2,508	2,305
C	546	546	610	610	610	641	641
D	445	483	445	483	533	483	533
E	149	149	149	149	149	159	159
F	4,268	4,268	4,268	4,268	4,268	4,268	4,268

H9 COMPRESSORS		
EVAP. – COND. SHELL CODES		
	K–K	L–L
A	2,300	2,743
B	2,872	3,100
C	641	724
D	508	648
E	397	194
F	4,268	4,268

H6 COMPRESSORS					
EVAPORATOR – CONDENSER SHELL CODES					
	F–F	F–G	G–F	G–G	H–G
A	2,184	2,286	2,248	2,350	2,438
B	2,508	2,305	2,508	2,305	2,672
C	610	610	641	641	686
D	483	533	483	533	533
E	149	149	159	159	159
F	4,268	4,268	4,268	4,268	4,268

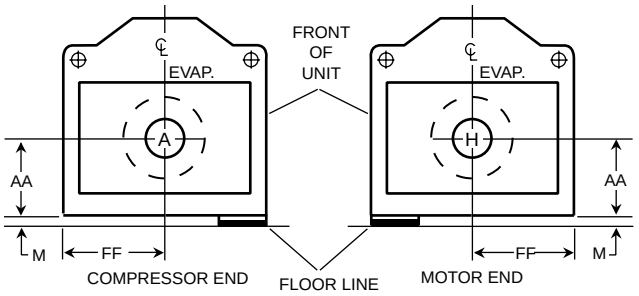
H7/H3/H8 COMPRESSORS			
EVAPORATOR – CONDENSER SHELL CODES			
	G–F	G–G	H–G
A	2,248	2,350	2,438
B	2,508	2,305	2,672
C	641	641	686
D	483	533	533
E	159	159	159
F	4,268	4,268	4,268

NOTES:
1. All dimensions on pgs 52 and 53 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.
3. Water nozzles can be located on either end of unit. Add 13 mm to nozzle length for flanged connections.
4. To determine overall height, add dimension "M" for the appropriate isolator type.
5. Use of motors with motor hoods may increase overall unit dimensions.

Dimensions (mm) – Nozzle Arrangements

EVAPORATORS – COMPACT WATER BOXES – P, Q & H COMPRESSOR UNITS

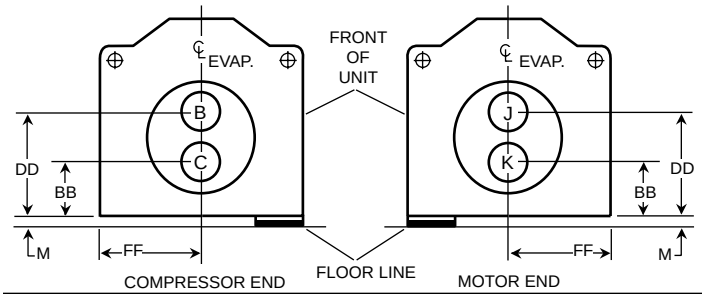
1-PASS



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

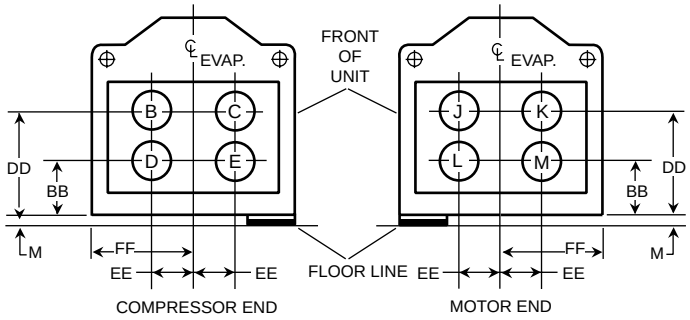
NOTE: Round water boxes are for P & Q Compressor codes. Rectangular water boxes are for H Compressor codes.

2-PASS



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

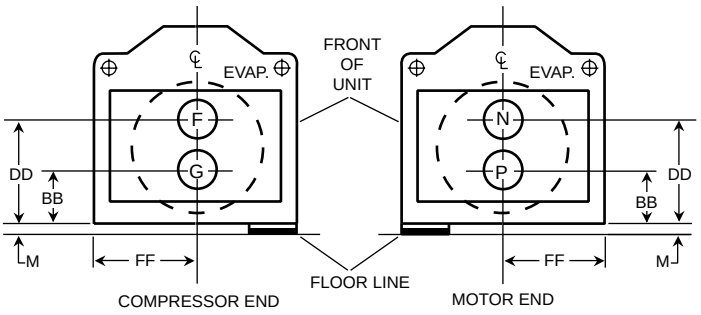
P & Q COMPRESSOR CODES AND H9 COMPRESSOR WITH K EVAPORATOR (150/300#) and L EVAPORTOR (300#)



H COMPRESSOR CODE

NOZZLE ARRANGEMENTS				
NO. OF PASSES	EVAPORATOR		"L" EVAPORATOR (150#)	
	IN	OUT	IN	OUT
2	D	C	B	C
	E	B	C	B
	L	K	J	K
	M	J	K	J

3-PASS



NOZZLE ARRANGEMENTS				
NO. OF	EVAPORATOR		"L" EVAPORATOR	
PASSES	IN	OUT	IN	OUT
3	G	N	F	N
	P	F	N	F

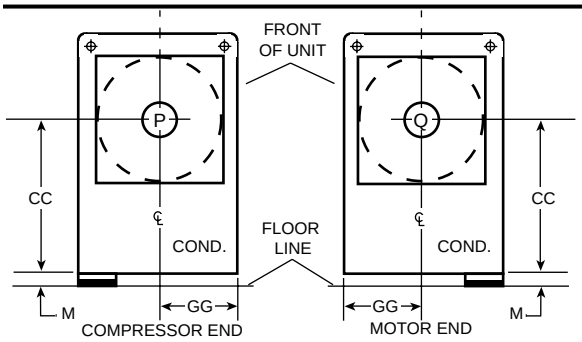
NOZZLE COMPR. CODE	EVAP. SHELL CODE	PIPE SIZE (IN.)			EVAPORATOR NOZZLE DIMENSIONS (MM)								
		NO. OF PASSES			1-PASS		2-PASS				3-PASS		
		1	2	3	AA[5]	FF	BB[5]	DD[5]	EE	FF	BB[5]	DD[5]	FF
Q3	AP,AQ AR,AS	8"	6"	4"	559	394	362	756	0"	394	362	756	394
P, Q	AA-AD, B	10"	8"	6"	610	445	406	813	0	445	406	813	445
P, Q	C, D	14"	10"	8"	661	483	407	915	0	483	407	915	483
P	E, F	14"	10"	8"	699	610	406	991	0	610	406	991	610
	G, H	16"	12"	10"	762	641	419	1105	0	641	432	1092	641
H	E	14"	10"	8"	470	546	343	597	229	546	292	648	546
	F	14"	10"	8"	502	610	375	629	229	610	324	680	610
	G	16"	12"	10"	530	641	378	683	273	641	302	759	641
	H	16"	12"	10"	559	686	406	711	273	686	330	787	686
	K	16"	12"	10"	762	641	419	1105	0	641	432	1092	641
	L	18"	14"	12"	660	724	—	660	330	724	—	660	724

See Notes on pg 55.

Dimensions (mm) – Nozzle Arrangements

CONDENSERS – COMPACT WATER BOXES – P, Q & H COMPRESSOR UNITS

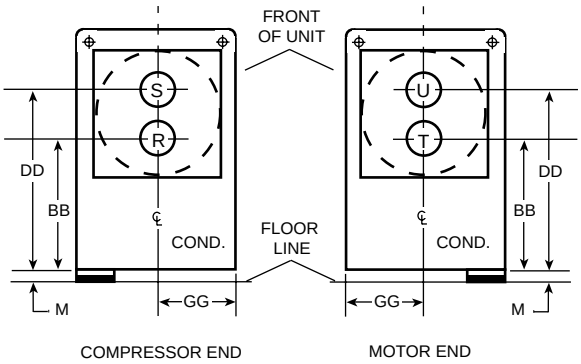
1-PASS



NOZZLE ARRANGEMENTS

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

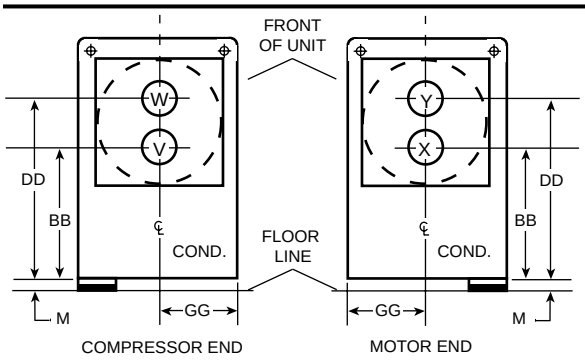
2-PASS



NOZZLE ARRANGEMENTS

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

3-PASS



NOZZLE ARRANGEMENTS

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

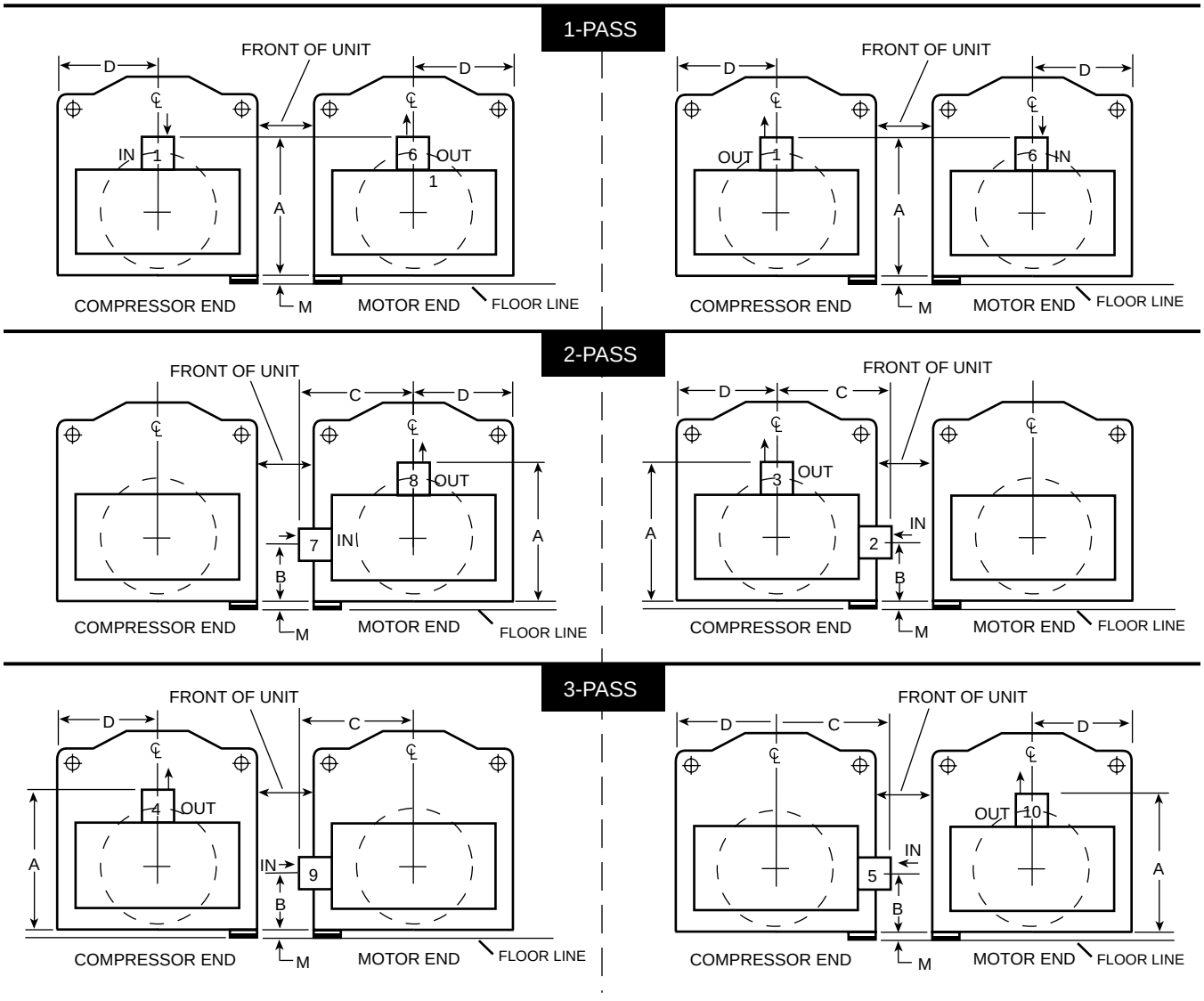
LD07131

NOZZLE COMPR. CODE	COND. SHELL CODE	PIPE SIZE (IN.) NO. OF PASSES 1	2	3	CONDENSER NOZZLE DIMENSIONS (MM) 1-PASS CC[5]	GG	BB[5]	2-PASS DD[5]	GG	BB[5]	3-PASS DD[5]	GG
Q3	AP,AQ AR,AS	10"	6"	6"	711	381	533	889	381	533	889	381
P, Q	AA-AD, B	12"	8"	6"	762	394	565	959	394	565	959	394
P, Q	C, D	14"	10"	8"	813	445	584	1042	445	584	1042	445
P	E, F	14"	10"	8"	813	445	603	1022	445	584	1042	445
	G, H	16"	10"	10"	914	508	660	1168	508	641	1187	508
H	E	14"	10"	8"	927	445	724	1,143	445	749	1,156	445
	F	16"	12"	10"	965	483	718	1,213	483	749	1,238	483
	G	16"	14"	10"	1,016	533	743	1,289	533	775	1,295	533
	K	16"	10"	10"	914	508	660	1168	508	641	1187	508
	L	20"	14"	10"	1067	648	768	1365	648	768	1365	648

NOTES:

1. Standard water nozzles are furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanges nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. One, two and three pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles.
3. Evaporator and condenser water must enter the water box through the bottom connection to achieve rated performance.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.
5. Add dimension "M" as shown on pages 52 - 53 for the appropriate isolator type.
6. Round waterboxes are for H9, P & Q Compressors and rectangular waterboxes for H3-H8 Compressor.

EVAPORATORS – MARINE WATER BOXES – P, Q & H COMPRESSOR UNITS



LD07221

COMPR. CODE	EVAP. SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (MM)									
		1-PASS		2-PASS				3-PASS			
		A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
Q3	AP,AQ AR,AS	1,086	394	1,073	338	402	394	1,060	324	383	394
P, Q	AA-AD, B	1,194	445	1,194	311	489	445	1,194	321	406	445
P, Q	C, D	1,296	483	1,296	305	581	483	1,296	280	470	483
P	E, F	1,359	610	1,359	318	556	610	1,359	279	556	610
	G, H	1,499	641	1,499	356	625	641	1,499	254	352	641
H	E	1,010	546	1,010	343	686	546	1,010	292	686	546
	F	1,041	610	1,041	375	686	610	1,041	324	686	610
	G	1,178	641	1,153	406	787	641	1,153	302	787	641
	H	1,207	686	1,181	435	787	686	1,181	330	787	686
	K	1,499	641	1,499	356	625	641	1,499	254	352	641
	L	1,238	724	1,238	559	889	724	1,238	533	889	724

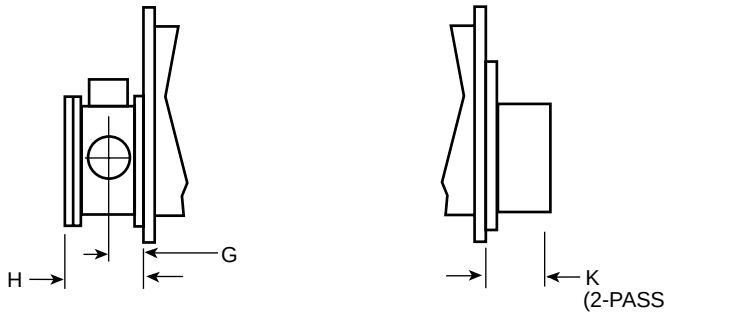
See Notes on page 57.

Dimensions (mm) – Nozzle Arrangements

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



LD01342BM

COMPR. CODE	EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS-MM (1-PASS)	
		G	H
Q3	AP-AS	322	676
P, Q	AA-AD, B	337	686
	C, D	375	787
P	E, F	352	752
	G, H	394	846
H	E, F	311	657
	G, H	337	721
	K	394	846
	L	346	749

COMPR. CODE	EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS-MM (2-PASS)		
		G	H	K
Q3	AP-AS	322	676	222
P, Q	AA-AD, B	337	686	143
	C, D	375	787	149
P	E, F	352	752	195
	G, H	394	846	240
H	E, F	258	530	149
	G, H	286	619	159
	K	394	846	240
	L	295	648	375

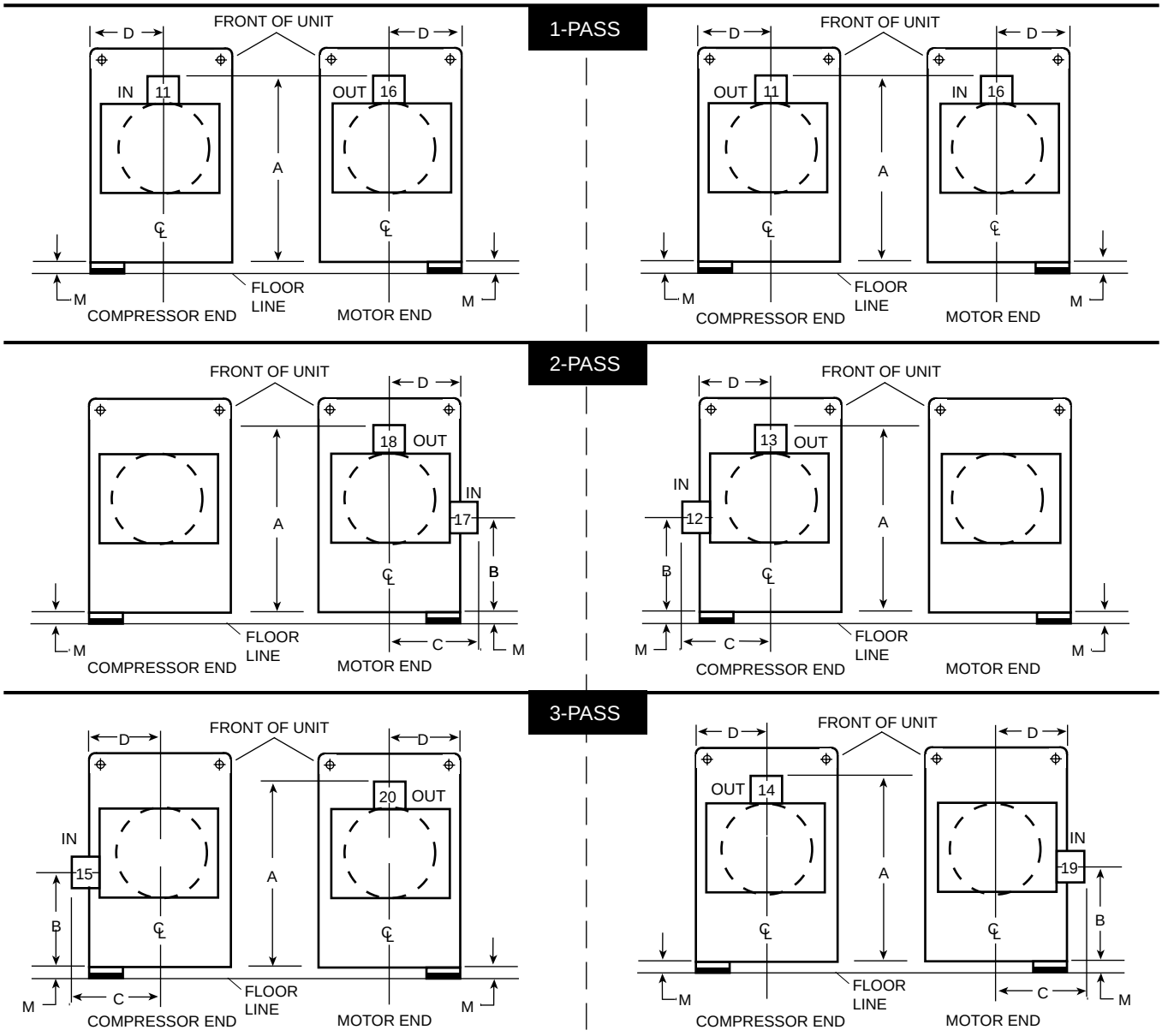
EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE		
	NO. OF PASSES		
	1	2	3
AP-AS	8"	6"	4"
AA-AD, B	10"	8"	6"
C, D	14"	10"	8"
E, F	14"	10"	8"
G, H, K	16"	12"	10"
L	18"	14"	12"

COMPR. CODE	EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS-MM(3-PASS)	
		G	H
Q3	AP-AS	322	676
P, Q	AA-AD, B	337	686
	C, D	375	787
P	E, F	352	752
	G, H	394	846
H	E, F	248	530
	G, H	248	543
	K	394	846
	L	270	597

NOTES (see Table on page 56):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" as shown on pages 52 - 53 for the appropriate isolator type.
6. Round waterboxes are for P & Q Compressors and rectangular waterboxes for H Compressor. H9 Compressor "K" Evaporator boxes are round.

CONDENSERS – MARINE WATER BOXES – P, Q & H COMPRESSOR UNITS



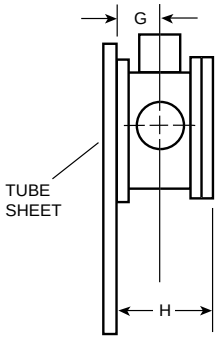
LD07178

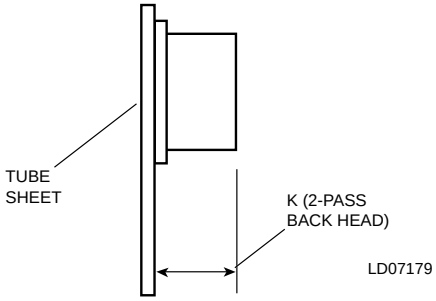
COMP. CODE	COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (MM)									
		1-PASS		2-PASS				3-PASS			
		A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
Q3	AP,AQ AR,AS	1,213	381	1,175	527	365	394	1,175	527	365	394
P, Q	AA-AD, B	1,295	394	1,270	502	457	394	1,257	521	400	394
	C, D	1,397	445	1,397	492	546	445	1,397	514	489	445
P	E, F	1,397	445	1,397	492	546	445	1,397	514	489	445
	G, H	1,549	508	1,549	559	581	508	1,549	559	581	508
H	E	1,553	444	1,553	762	625	445	1,553	724	625	445
	F	1,657	483	1,657	787	667	483	1,632	762	667	483
	G	1,755	533	1,632	813	713	533	1,730	775	714	533
	K	1,549	508	1,549	559	581	508	1,549	559	581	508
	L	1,753	648	1,753	737	600	648	1,753	711	581	648

See Notes on page 59.

Dimensions (mm) – Nozzle Arrangements

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

COMPR. CODE	CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS-MM (1-PASS)	
		G	H
Q3	AP-AS	322	676
P, Q	AA-AD, B	311	679
	C, D	337	705
P	E, F	359	762
	G, H	390	822
H	E	311	657
	F	337	711
	G	337	721
	K	390	822
	L	406	889

COMPR. CODE	CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS-MM (2-PASS)		
		G	H	K
Q3	AP-AS	313	654	192
P, Q	AA-AD, B	311	673	140
	C, D	337	705	140
P	E, F	359	762	178
	G, H	390	822	191
H	E	248	530	146
	F	286	610	146
	G	311	670	152
	K	390	822	191
	L	406	889	356

COMPR. CODE	COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
		1	2	3
Q3	AP-AS	10"	6"	6"
P, Q	AA-AD, B	12"	8"	6"
	C, D	14"	10"	8"
P	E, F	14"	10"	8"
	G, H	16"	10"	10"
H	E	14"	10"	8"
	F	16"	12"	10"
	G	16"	14"	10"
	K	16"	10"	10"
	L	20"	14"	10"

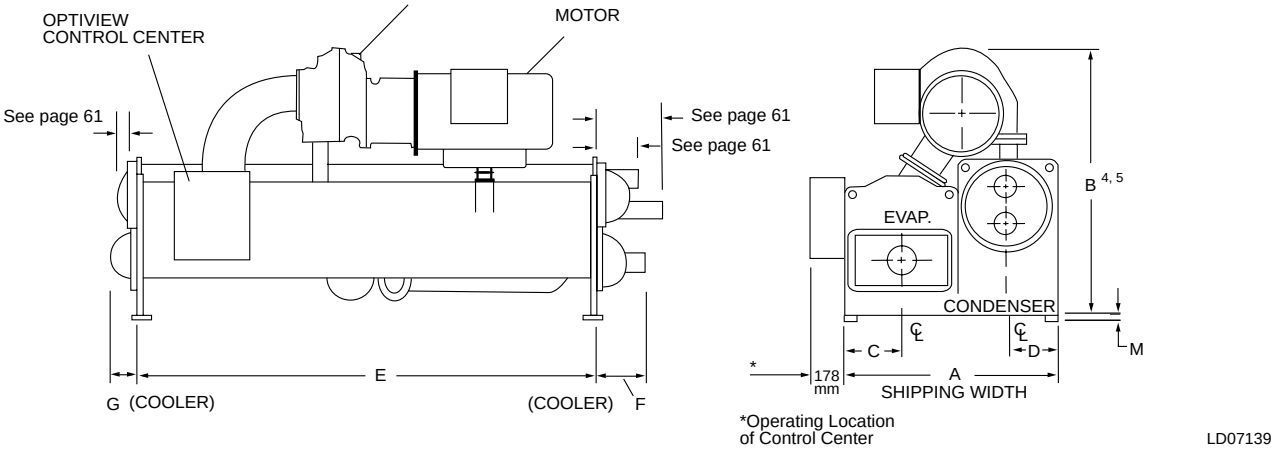
COMPR. CODE	CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS-MM (3-PASS)	
		G	H
Q3	AP-AS	322	676
P, Q	AA-AD, B	324	673
	C, D	337	705
P	E, F	359	762
	G, H	390	822
H	E	222	479
	F	248	533
	G	244	635
	K	390	822
	L	406	889

NOTES (see Table on page 58):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. 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 pages 52 - 53 for the appropriate isolator type.
6. Round waterboxes are for P & Q Compressors and rectangular waterboxes for H Compressor.

Dimensions (mm) – Unit

J COMPRESSOR UNITS



J1/J2 COMPRESSORS								
EVAPORATOR – CONDENSER SHELL CODES								
	G-G	G-H	H-G	H-H	H-J	J-H	J-J	T-T
A	2,286	2,388	2,400	2,502	2,604	2,718	2,769	2,769
B	2,819	2,972	2,819	2,972	2,972	2,972	2,972	2,966
C	610	610	667	667	667	749	749	749
D	533	584	533	584	635	584	635	635
E	4,267	4,267	4,267	4,267	4,267	4,267	4,267	4,877
F	603	603	603	603	603	603	603	603
G	375	375	375	375	375	375	375	375

J3 COMPRESSORS			
EVAPORATOR – CONDENSER SHELL CODES			
	H-H	H-J	J-H
A	2,502	2,604	2,667
B	2,946	3,048	2,946
C	667	667	749
D	584	635	584
E	4,267	4,267	4,267
F	603	603	603
G	375	375	375

ADDITIONAL OPERATNG HEIGHT CLEARANCE	
TYPE OF CHILLER MOUNTING	M
NEOPRENE PAD ISOLATORS	44
SPRING ISOLATORS 25MM DEFLECTION	25
DIRECT MOUNT	19

J3/J4 COMPRESSORS						
EVAPORATOR – CONDENSER SHELL CODES						
	J-J	T-T	T-V	V-T	V-V	W-V
A	2,769	2,769	2,896	2,769	2,896	3,023
B	3,048	3,048	3,175	3,048	3,175	3,175
C	749	749	749	749	749	813
D	635	635	699	635	699	699
E	4,267	4,877	4,877	4,877	4,877	4,877
F	603	603	603	603	603	629
G	375	375	375	375	375	419

J5/J7 COMPRESSORS			
EVAPORATOR–CONDENSER SHELL CODES			
	X-X	Y-Y	Z-Z
A	3,125	3,125	3,429
B	3,480	3,708	3,912
C	813	813	902
D	749	749	813
E	5,486	6,706	5,486
F	629	629	559
G	426	426	356

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 65 - 68.
3. Water nozzles can be located on either end of unit. Add 13mm to nozzle length for flanges connections.
4. To determine overall height, add dimension "M" for the apppropriate isolator type.
5. Use of motors with motor hoods may increase overall unit dimensions.

Dimensions (mm)



1 PASS CONDENSERS							
DIM	G	H	J	T	V	X, Y	Z
A	356	533	552	552	587	499	540



2 PASS CONDENSERS							
DIM.	G	H	J	T	V	X, Y	Z
B	152	292	311	311	352	299	352
C	356	616	498	498	562	499	540
D	356	464	498	498	562	499	540



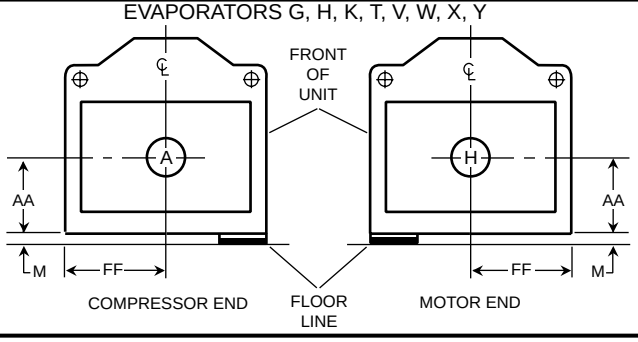
1 PASS CONDENSERS							
DIM.	G	H	J	T	V	X, Y	Z
E	356	429	483	483	502	499	540
F	356	511	562	562	594	499	540

Dimensions (mm) – Nozzle Arrangements

EVAPORATORS – COMPACT WATER BOXES – J COMPRESSOR UNITS

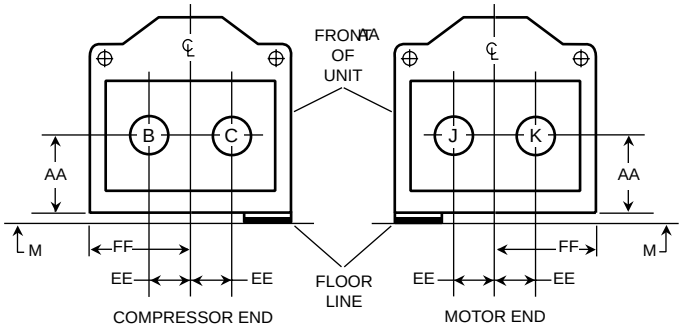
EVAPORATORS G, H, K, T, V, W, X, Y

1-PASS



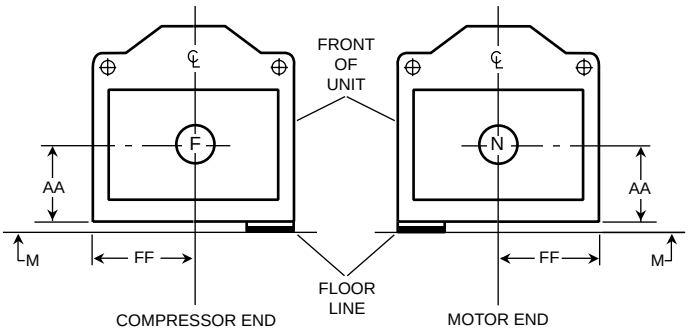
SHELL CODE	1 PASS	
	IN	OUT
G-Y	A	H
	H	A

2-PASS



SHELL CODES	2 PA SS	
	IN	OUT
G-Y	B	C
	C	B
	J	K
	K	J

3-PASS



SHELL CODES	3 PA SS	
	IN	OUT
G-Y	F	N
	N	F

EVAP. SHELL CODE	NOZZLE PIPE SIZE			EVAPORATOR NOZZLE DIMENSIONS (MM)				
	NO. OF PASSES				1-PASS	2-PASS		3-PASS
	1	2	3	FF	AA[2]	AA[2]	EE	AA[2]
G	14"	10"	8"	610	568	568	279	568
H	16"	12"	10"	667	629	629	279	629
J, T	18"	14"	12"	749	635	635	279	635
V	20"	16"	12"	749	724	724	330	724
W, X	20"	18"	14"	813	775	775	381	775
Y	20"	18"	14"	813	787	787	381	787

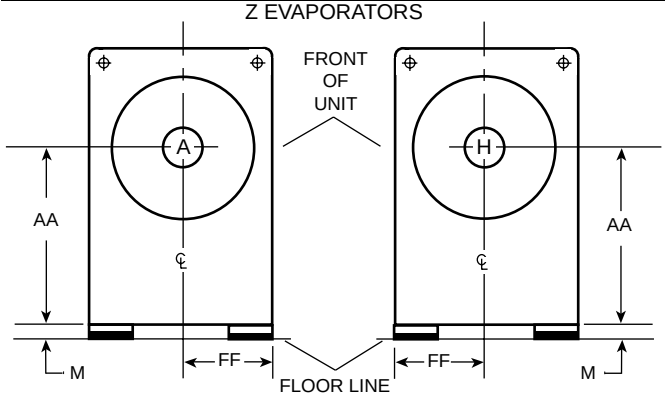
NOTES:

1. Standard water nozzles are furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add dimension "M" as shown on page 60 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.
5. Standard 1034 kPa design working pressure waterboxes are shown.

EVAPORATORS – COMPACT WATER BOXES – J COMPRESSOR UNITS

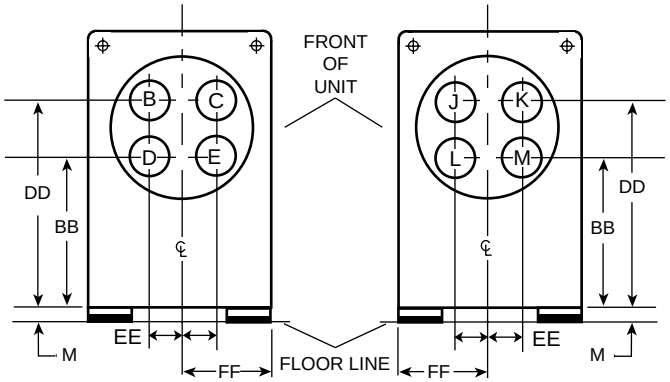
1-PASS

Z EVAPORATORS



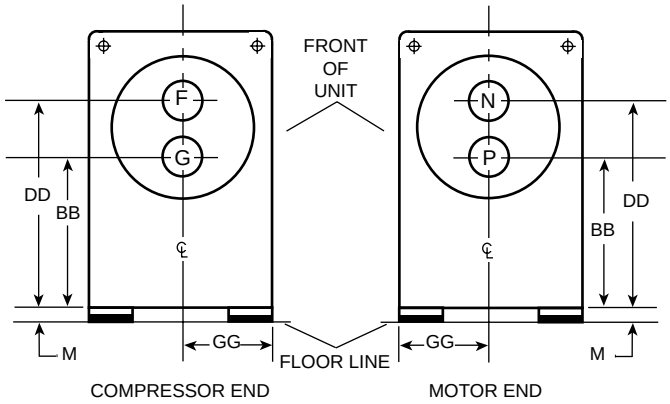
SHELL CODE	1 PASS	
	IN	OUT
Z	A	H
	H	A

2-PASS



SHELL CODES	2 PA SS	
	IN	OUT
Z	D	C
	E	B
	L	K
	M	J

3-PASS



SHELL CODES	3 PA SS	
	IN	OUT
Z	G	N
	P	F

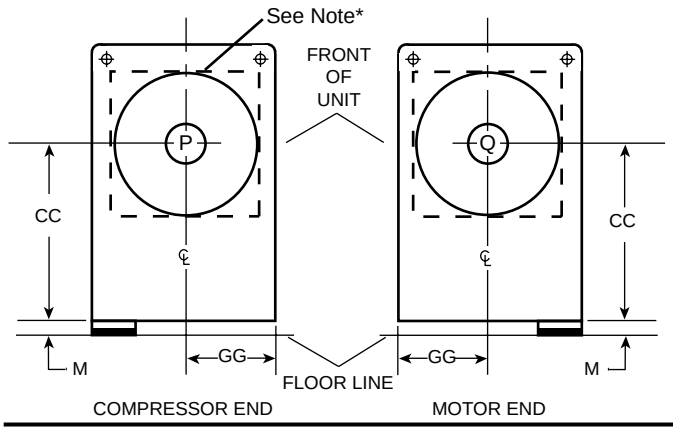
EVAP. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES			EVAPORATOR NOZZLE DIMENSIONS (MM)				
				1–PASS		2–PASS		3–PASS
	1	2	3	FF	AA^2	AA^2	EE	AA^2
Z	20"	18"	14"	902	1162	–	305	–

See Notes on pg. 62

Dimensions (mm) – Nozzle Arrangements

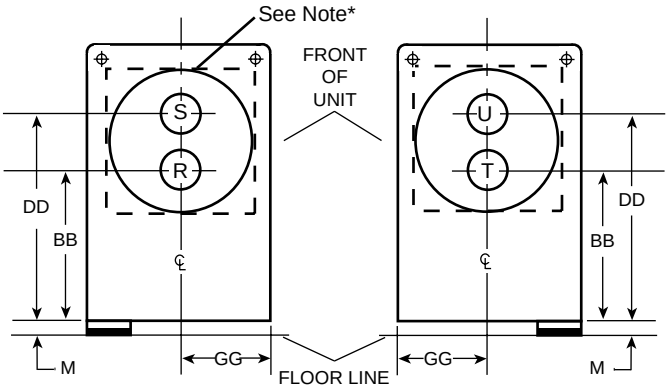
CONDENSERS – COMPACT WATER BOXES – J COMPRESSOR UNITS

1-PASS



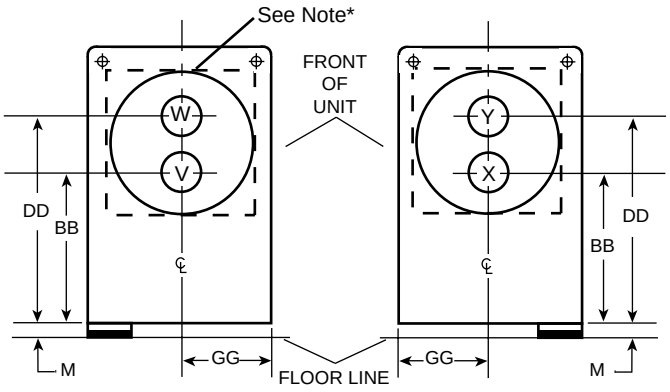
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND.	
	IN	OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS



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

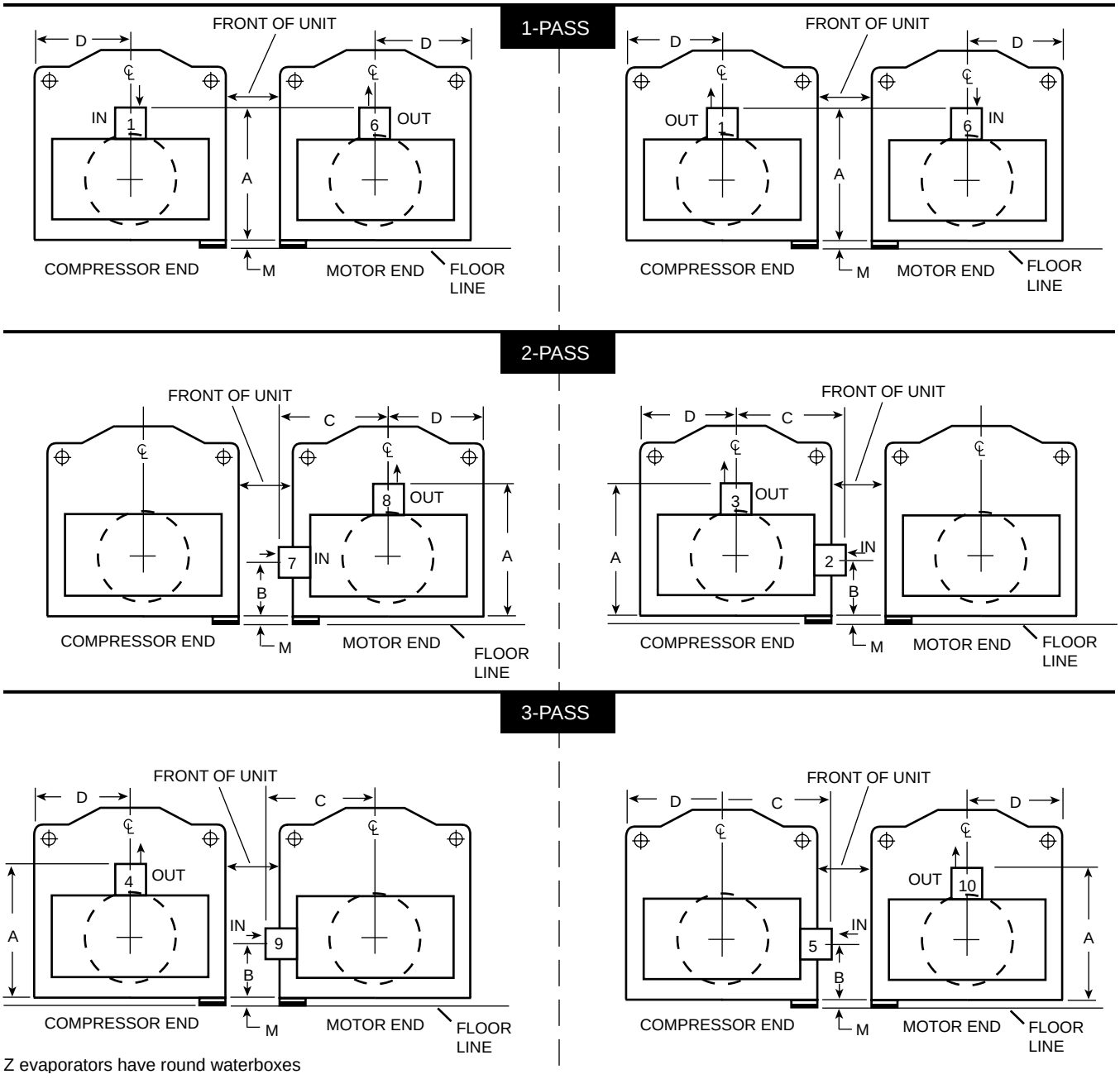
LD07191

CONDENSER SHELL CODE	NOZZLE PIPE SIZE			CONDENSER NOZZLE DIMENSIONS (MM)							
	NO. OF PASSES			1-PASS		2-PASS			3-PASS		
	1	2	3	CC2	GG	BB2	DD2	GG	BB2	DD2	GG
G*	16"	14"	10"	1,016	533	743	1,289	533	775	1,295	533
H	20"	16"	12"	1,067	584	787	1,346	584	775	1,391	584
J, T	20"	16"	14"	1,118	635	800	1,435	635	826	1,473	635
V	20"	18"	14"	1,181	699	838	1,524	699	876	1,578	699
X	24"	18"	16"	1,232	749	902	1,562	749	902	1,562	749
Y	24"	18"	16"	1207	749	876	1537	749	876	1537	749
Z	24"	20"	16"	1251	813	851	1651	813	851	1651	813

* **NOTE:** "G" Condenser Water Boxes are square; other codes are round as shown.
** Water must enter through bottom connector to achieve rated performance.

See Notes on page 62.

EVAPORATORS – MARINE WATER BOXES – J COMPRESSOR UNITS



Z evaporators have round waterboxes

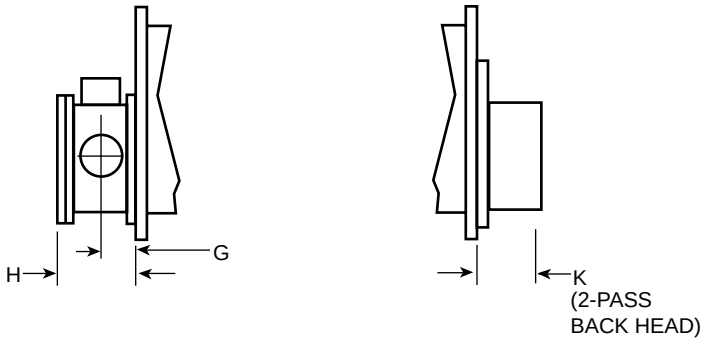
LD07192

EVAP.SHELL-CODE	EVAPORATOR NOZZLE DIMENSIONS (MM)									
	1-PASS		2-PASS				3-PASS			
	A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
G	1,127	610	1,127	451	737	610	1,127	391	737	610
H	1,207	667	1,207	514	794	667	1,207	476	794	667
J, T	1,194	749	1,194	533	870	749	1,194	508	870	749
V	1,283	749	1,283	629	870	749	1,283	587	870	749
W, X	1,384	813	1,384	679	965	813	1,384	629	962	813
Y	1400	813	1400	694	965	813	1,400	643	962	813
Z	2121	902	2121	654	981	902	2121	514	981	902

See Notes on page 66.

Dimensions (mm) – Nozzle Arrangements

EVAPORATOR 1-PASS	
IN	OUT
1	6
6	1



LD07195

EVAPORATOR 2-PASS	
IN	OUT
2	3
7	8

EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS – MM (1-PASS)	
	G	H
G	314	673
H	340	730
J, T	365	781
V	406	864
W, X, Y	406	864
Z	413	940

EVAPORATOR 3-PASS	
IN	OUT
5	10
9	4

EVAPORATOR SHELL CODE	EVAPORATOR DIMENSIONS NOZZLE – MM (2-PASS)		
	G	H	K
G	263	571	375
H	289	629	375
J, T	314	679	375
V	356	762	375
W, X, Y	381	762	419
Z	346	826	356

EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
G	14"	10"	8"
H	16"	12"	10"
J, T	18"	14"	12"
V	20"	16"	12"
W, X, Y, Z	20"	18"	14"

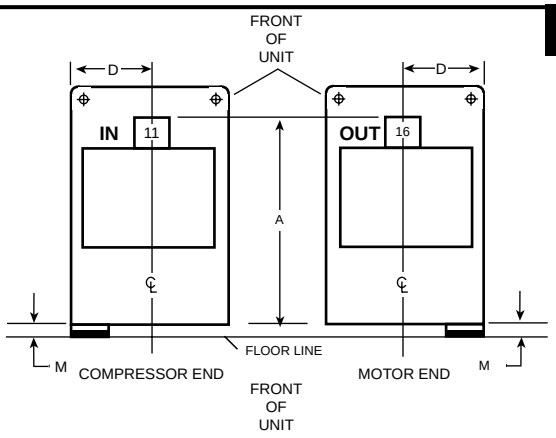
EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS – MM (3-PASS)	
	G	H
G	238	521
H	273	572
J, T	289	629
V	314	629
W, X, Y	330	711
Z	330	775

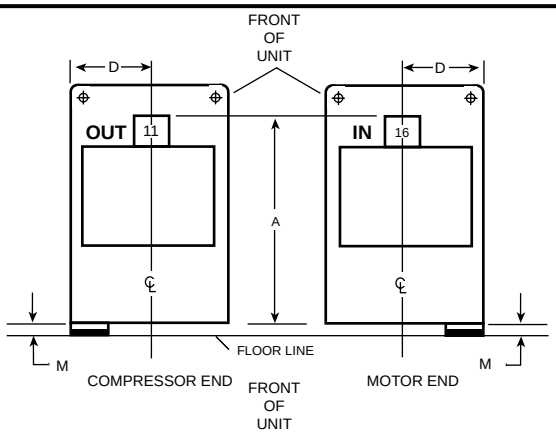
NOTES (see Table on page 65):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" as shown on page 60 for the appropriate isolator type.

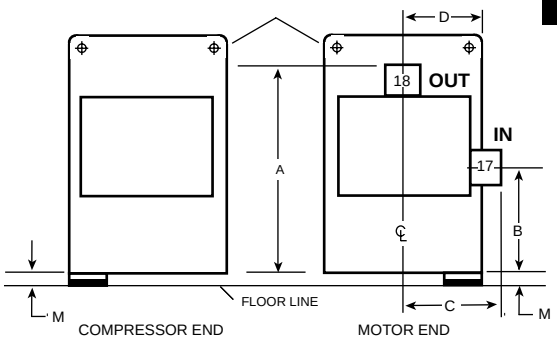
CONDENSERS – MARINE WATER BOXES – J COMPRESSOR UNITS

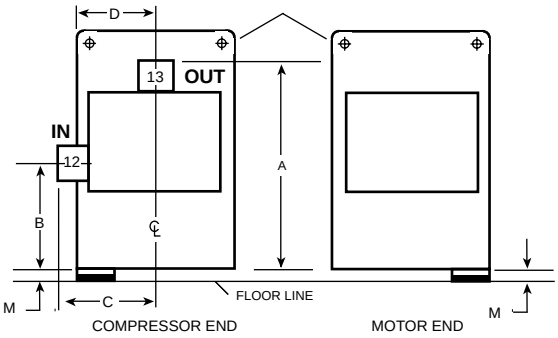
1-PASS



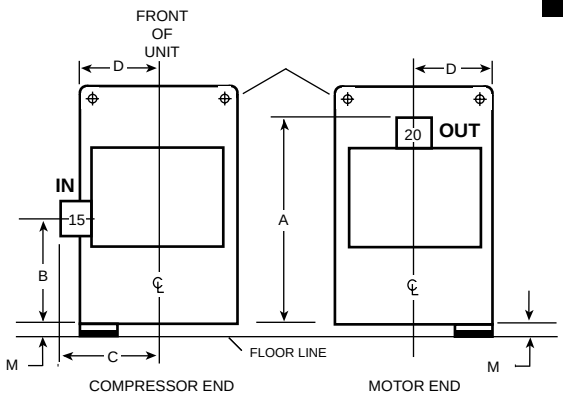


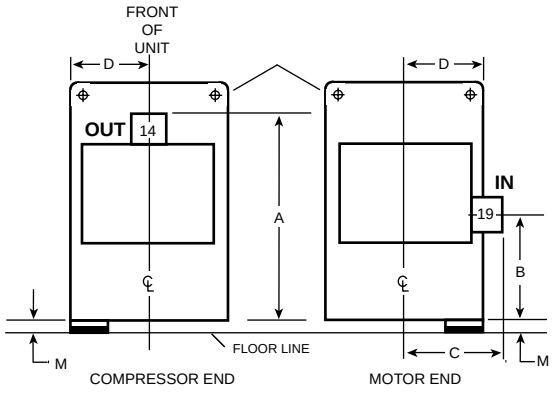
2-PASS





3-PASS



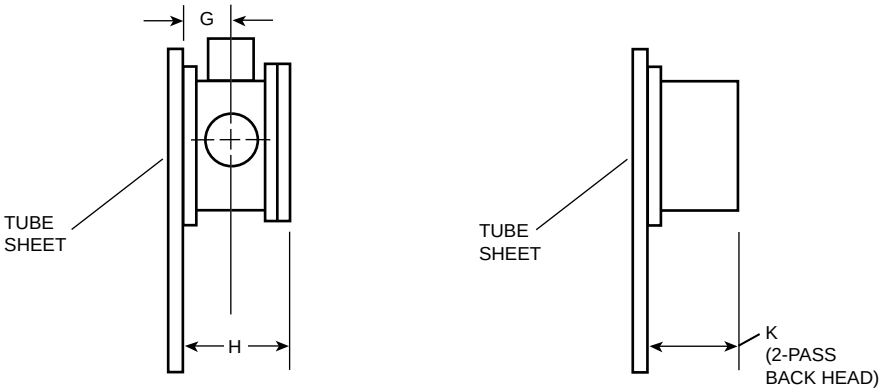


EVAP. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (MM)									
	1-PASS		2-PASS				3-PASS			
	A[5]	D	A[5]	B[5]	C	D	A[5]	B[5]	C	D
G	1,753	533	1,753	813	737	533	1,753	775	737	533
H	1,784	584	1,765	610	635	584	1,756	619	603	584
J, T	1,896	635	1,870	629	638	635	1,857	635	657	635
V	2,032	699	2,016	635	746	699	1,988	654	705	699
X	2,146	749	2,146	940	864	749	2,146	864	864	749
Y	2121	749	2121	914	864	749	2,121	838	864	749
Z	2210	813	2210	692	876	813	2210	692	876	813

See Notes on page 68.

Dimensions (mm) – Nozzle Arrangements

CONDENSER 1-PASS	
IN	OUT
11	16
16	11



LD07195

CONDENSER 2-PASS	
IN	OUT
12	13
17	18

COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS – MM (1-PASS)	
	G	H
G	337	721
H	394	832
J, T	394	835
V	394	848
X, Y	454	921
Z	470	1,054

CONDENSER 3-PASS	
IN	OUT
15	20
19	14

COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS – MM (2-PASS)		
	G	H	K
G	311	670	149
H	346	737	295
J, T	346	740	318
V	362	781	346
X, Y	359	794	297
Z	413	927	356

COND.SHELL CODE	NOZZLEPIPE SIZE NO. OF PASSES		
	1	2	3
G	16"	14"	10"
H	20"	16"	12"
J, T	20"	16"	14"
V	20"	18"	14"
X, Y	24"	18"	16"
Z	24"	20"	16"

COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS – MM (3-PASS)	
	G	H
G	244	537
H	286	616
J, T	311	670
V	311	679
X, Y	346	756
Z	356	851

NOTES (see Table on page 67):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. 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 page 60 for the appropriate isolator type.

Weights

TABLE 11 – APPROXIMATE UNIT WEIGHT INCLUDING MOTOR*

S HELL S	CO MPRE SSO R	SHIPPINGWEIGHT (KG)	OPERATINGWEIGHT (KG)	EST. REFRIGERANT CHARGE (KG)
AP - AS	Q3	5947	6960	522
AA - AD	Q3	6765	8140	568
B - B	Q3	7809	9511	704
AA - AD	Q4	6774	8149	568
B - B	Q4	7816	9520	704
C - C	Q4	8149	10024	726
AA - AD	Q5	6960	8335	568
C - C	Q5	8335	10210	726
D - D	Q5	8499	10801	863
C - C	Q6	8331	10206	726
D - D	Q6	8494	10796	863
A-A	P1, P2, P3, P4	6,005	7,470	568
B-B	P1, P2, P3, P4	6,730	8,560	704
C-C	P5, P6, P7, Q7	8,270	10,330	727
D-D	P6, P7, Q7	9,845	12,425	863
E-E	P8	9,208	10,886	794
F-F	P8, P9	10,478	12,610	1,057
G-G	P8, P9	10,886	13,018	930
H-H	P8, P9	12,428	15,195	1,225
E-E	H5	10,370	12,645	768
E-F	H5	11,055	13,590	813
F-E	H5	10,840	13,290	863
F-F	H5, H6	11,520	14,240	918
F-G	H5, H6	12,605	15,710	977
G-F	H3, H5, H6, H7, H8	12,670	15,775	1,040
G-G	H3, H5, H6, H7, H8	13,750	17,235	1,097
G-G	J1, J2	13,340	16,715	1,097
G-H	J1, J2	13,915	17,550	1,163
H-G	H3, H5, H6, H7, H8	14,705	18,450	1,163
K-K	H9	12,941	16,103	1,043
L-L	H9	15,512	19,748	1,395
H-G	J1, J2	14,465	18,210	1,193
H-H	J1, J2	15,045	19,075	1,284
H-H	J3	15,595	19,625	1,284
H-J	J1, J2	16,135	20,625	1,368
H-J	J3	16,685	21,175	1,368
J-H	J1, J2	16,635	21,265	1,504
J-H	J3	17,185	21,815	1,504
J-J	J1, J2	17,725	22,815	1,588
J-J	J3, J4	18,275	23,365	1,588
T-T	J1, J2	19,305	25,010	1,815
T-T	J3, J4	19,855	25,560	1,815
T-V	J3, J4	21,525	27,950	1,950
V-T	J3, J4	20,360	26,270	1,736
V-V	J3, J4	22,030	28,675	1,886
W-V	J3, J4	24,145	31,575	2,027
X-X	J5	30,430	39,350	2,635
Y-Y	J7	37,467	44,951	2,812
Z-Z	J7	36,968	46,266	2,495

* Refer to product drawings for detailed weight information.

Weights

TABLE 12 – MARINE WATER BOX WEIGHTS (KG) – P & Q Compressor Units

WEIGHTS (To be added to Standard Unit weights shown on Table 11).

EVAP. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG			COND. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
AP - AS	419	338	444	666	585	691	AP - AS	346	257	368	578	489	600
AA - AD, B	614	506	672	1,010	902	1,068	AA - AD, B	429	353	475	768	692	814
C, D	853	572	944	1,534	1,253	1,625	C, D	664	543	735	1,190	1,070	1,262
E, F	550	588	586	1,204	1,242	1,241	E, F	329	368	359	606	781	772
G, H	794	836	842	1,753	1,794	1,800	G, H	467	529	522	1,047	1,110	1,103

TABLE 13 – MARINE WATER BOX WEIGHTS (KG) – H Compressor Units

WEIGHTS (To be added to Standard Unit weights shown on Table 11).

EVAP. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG			COND. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
E	727	714	632	831	823	737	E	1,167	529	1,061	1,211	572	1,139
F	1,041	509	966	1,165	632	1,089	F	474	341	408	526	392	440
G	1,287	562	1,061	1,454	728	1,228	G	627	438	499	715	526	626
H	1,573	714	1,323	1,789	931	1,539	K	467	529	522	1,047	1,110	1,103
K	794	836	842	1,753	1,794	1,800	L	1,103	602	1,214	2,219	1,138	2,269
L	1,645	790	1,543	2,107	974	1,869							

TABLE 14 – MARINE WATER BOX WEIGHTS (KG) – J Compressor Units

WEIGHTS (To be added to Standard Unit weights shown on Table 11).

EVAP. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG			COND. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
G	1,095	442	869	1,220	556	998	G	1,080	517	758	1,134	567	805
H	1,249	687	1,270	1,424	805	1,452	H	1,132	549	1,039	1,202	608	1,184
J, T	1,622	778	1,542	1,837	953	1,769	J, T	1,356	674	1,313	1,538	771	1,465
V	1,706	826	1,569	2,019	1,129	1,814	V	1,783	862	1,730	2,014	1,043	2,118
W, X, Y	2,109	1,114	1,964	2,477	1,483	2,322	X, Y	2,311	1,032	2,051	4,450	1,824	3,528
Z	2902	1,516	3,103	4,825	2052	4133	Z	2649	1339	2440	4491	2108	3674

Guide Specifications

GENERAL

Furnish and install where indicated on the drawings____ YORK MAXE Centrifugal 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. Power input shall not exceed ____ kW with an IPLV (APLV) of ____ . The evaporator shall be selected for____ fouling factor and a maximum liquid pressure drop of ____ ft. Water side shall be designed for 150 PSIG working pressure. The condenser shall be selected for ____ fouling factor and maximum liquid pressure drop of ____ ft. Waterside shall be designed for 150 PSIG working pressure. Power shall be supplied to the compressor motor at ____ volts – 3-phase – (60)(50) Hertz.

(or)

Furnish and install where indicated on the drawings ___ YORK MAXE Centrifugal 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. Power input shall not exceed ____ kW with an IPLV (APLV) 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 bar g 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 motor at ____ volts – 3-phase – 50 Hertz and controls at 115 volts – 1-phase – 50 Hertz.

Performance shall be certified or rated in accordance with the latest edition of ARI Standard 550/590 as applicable. Only chillers that are listed in the ARI Certification Program for Water Chilling Packages Using the Vapor Compression Cycle are acceptable.

Each unit shall be completely factory-packaged including evaporator, condenser, sub-cooler, compressor, open motor, lubrication system, OptiView Control Center, Variable Speed Drive or Solid State Starter, and all interconnecting unit piping and wiring. The chiller shall be painted prior to shipment.

The initial charge of oil and refrigerant shall be supplied, shipped in containers and cylinders for field installation or factory charged in the chiller.

COMPRESSOR

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

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

(Fixed Speed Drive) Capacity control shall be achieved by use of pre-rotation vanes to provide fully modulating control from full load to minimum load. (Variable Speed Drive) Capacity control shall be accomplished by the Adaptive Capacity Control (ACC), providing optimal relationship between compressor speed and inlet pre-rotation vane position for maximum energy efficiency. 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.

LUBRICATION SYSTEM

Lubrication oil shall be force-fed to all compressor bearings, gears, and rotating surfaces by an external variable speed oil pump. The oil pump shall vary oil flow to the 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 coastdown. Compressor shall have an auxiliary reservoir to provide lubrication during coastdown in the event of a power failure.

An oil reservoir, separate from the compressor, shall contain the submersible 2 HP oil pump and a 3000 watt oil heater, thermostatically controlled to remove refrigerant from the oil. The oil reservoir shall be UL listed and shall be factory air strength tested at 1.1 times design working pressure.

Oil shall be filtered by an externally mounted 1/2 micron replaceable cartridge oil filter equipped with service valves. Oil cooling shall be done via a refrigerant cooled oil cooler, with all piping factory-installed. Oil side of the oil cooler shall be provided 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.

WATER-COOLED OIL COOLER

Optional condenser water-cooled oil cooler is offered for units with Q3 compressors only except with AP - AS shells. The four tube pass and one shell pass oil cooler is by API Basco, Model 05036 (shell diameter 5" OD, tube length 36"). The shell is steel pipe or tubing and tubesheets are steel to ASME specification. Bafflers are precision hot-rolled , punched, carbon steel to assure effective circulation by providing minimum clearances between the tubes and tube holes. The cooler is a straight-tube type and has 180 plain copper tubes of 1/4" OD with 24 BWG. The heat exchanger has either cast iron bonnets to be used for 150 psig condenser water boxes or carbon steel bon-nets to be used for 300 psig condenser water boxes. The water and shell side of the heat exchanger is UL burst pressure tested and certified. Condenser water is the cooling medium and water circulation is obtained by the water pressure drop across the condenser shell. The minimum requirement of 7 to 8 gpm water for this oil cooler is provided at a pressure drop as low as 3ft with the Q3 piping arrangement.

MOTOR DRIVELINE

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

The 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.

Motor drive shaft shall be directly connected to the compressor shaft with a flexible disc coupling. 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/overcurrent transformers
shall be furnished with all units. (For units furnished with factory-packaged Solid State Starters or Variable Speed Drive, refer to the “Options” section.)

EVAPORATOR

Evaporator shall be of the shell-and-tube, flooded type designed for a minimum of 180 PSIG (1241 kPa) on H & J Compressor models, 235 PSIG (1620 kPa) on P & Q Compressor models; working pressure on the refrigerant side. Shell shall be fabricated from rolled carbon steel plates with fusion welded seams, carbon steel tube sheets, drilled and reamed to accommodate the tubes, and intermediate tube supports spaced no more than four feet apart. The refrigerant side of each shell is designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII – Division I, or other pressure vessel code as appropriate.

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

Water boxes shall be removable to permit tube cleaning and replacement. Stub-out water connections having Victaulic grooves to ANSI/AWWA C-606 Standard for Grooved End Shoulder Joints shall be provided. Water boxes shall be designed for 150 PSIG (1034 kPa) design working pressure and be tested at 225 PSIG (1551 kPa). Vent and drain connections with plugs shall be provided on each water box. Low flow protection shall be provided by a thermal-type water flow sensor, factory mounted in the water nozzle connection and wired to the chiller control panel.

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 ac-

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

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

(Option) The condenser shall be provided with positive shutoff valves in the compressor discharge line to the condenser and in the liquid line leaving the condenser. This will allow pumpdown 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. Stubout water connections having Victaulic grooves shall be provided. Water boxes shall be designed for 150 PSIG (1034 kPa) design working pressure and be tested at 225 PSIG (1551 kPa). Vent and drain connections with plugs shall be provided on each water box.

REFRIGERANT FLOW CONTROL

Refrigerant flow to the evaporator shall be controlled by a variable orifice. 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 stand-alone microprocessor based control center. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches.

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. The panel verbiage is available in eight languages as standard and can be changed on the fly without having to turn off the chiller. 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
   e. percent motor current
   f. compressor discharge temperature
   g. oil reservoir temperature
   h. compressor thrust bearing positioning and oil temperature
   i. operating hours
   j. number of unit starts

2. Digital programming of setpoints through the universal keypad including:
   a. leaving chilled water temperature
   b. percent current limit
   c. pull-down demand limiting
   d. six-week schedule for starting and stopping the chiller, pumps and tower
   e. remote reset temperature range

3. Status messages indicating:
   a. system ready to start

b. system running
c. system coastdown
d. system safety shutdown – manual restart
e. system cycling shutdown – auto restart
f. system prelube
g. start inhibit

4. The text displayed within the system status and system details field shall be displayed as a color-coded message to indicate severity: red for safety fault, orange for cycling faults, yellow for warnings, and green for normal messages.

5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. Safety shutdowns with a fixed speed drive shall include:
   a. evaporator – low pressure
   b. evaporator – transducer or leaving liquid probe
   c. evaporator – transducer or temperature sensor
   d. condenser – high pressure contacts open
   e. condenser – high pressure
   f. condenser – pressure transducer out-of-range
   g. auxiliary safety – contacts closed
   h. discharge – high temperature
   i. discharge – low temperature
   j. oil – high temperature
   k. oil – low differential pressure
   l. oil – high differential pressure
   m. oil – sump pressure transducer out-of-range
   n. oil – differential pressure calibration
   o. oil – variable speed pump – pressure setpoint not achieved
   p. control panel – power failure
   q. motor or starter – current imbalance
   r. thrust bearing – proximity probe clearance (J & H3 compressors only)
   s. thrust bearing – proximity probe out-of-range (J & H3 compressors only)
   t. thrust bearing – position switch (P, Q & H5-H9 compressors)
   u. watchdog – software reboot

5.1 Safety shutdowns with a VSD shall include:
   a. VSD shutdown – requesting fault data
   b. VSD – stop contacts open
   c. VSD – 105% motor current overload
   d. VSD – high phase A, B, C inverter heatsink temp.
   e. VSD – high converter heatsink temperature

(Filter Option Only)
   f. harmonic filter – high heatsink temperature
   g. harmonic filter – high total demand distribution

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 with a fixed speed drive 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
   i. motor controller – loss of current
   j. power fault
   k. control panel – schedule
   l. starter – low supply line voltage (SSS option)
   m. starter – high supply line voltage (SSS option)
   n. proximity probe – low supply voltage (J & H3 compressors)
   o. oil – variable speed pump – drive contacts open

6.1 Cycling shutdowns with a VSD shall include:
   a. VSD shutdown – requesting fault data
   b. VSD – stop contacts open
   c. VSD – initialization failed
   d. VSD – high phase A, B, C instantaneous current
   e. VSD – phase A, B, C gate driver
   f. VSD – single phase input power
   g. VSD – high DC bus voltage
   h. VSD – pre charge DC bus voltage imbalance
   i. VSD – high internal ambient temperature
   j. VSD – invalid current scale selection
   k. VSD – low phase A, B, C inverter heatsink temp.

l. VSD – low converter heatsink temperature
m. VSD – pre-charge – low DC bus voltage
n. VSD – logic board processor
o. VSD – run signal
p. VSD – serial communications

(Filter Option Only)

q. harmonic filter – logic board or communications
r. harmonic filter – high DC bus voltage
s. harmonic filter – high phase A, B, C current
t. harmonic filter – phase locked loop
u. harmonic filter – precharge – low DC bus voltage
v. harmonic filter – DC bus voltage imbalance
w. harmonic filter – 110% input current overload
x. harmonic filter – logic board power supply
y. harmonic filter – run signal
z. harmonic filter – DC current transformer 1
aa. harmonic filter – DC current transformer 2

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 in the compressor motor starter to provide individual over-current protected power for all controls.

11. A numbered terminal strip for all required field interlock wiring.

12. An RS-232 port to output all system operating data, shutdown/cycling message, and a record of the last 10 cycling or safety shutdowns to a field-supplied printer. Data logs to a printer at a set programmable interval. This data can be preprogrammed to print from 1 minute to 1 day.

13. The capability to interface with a building automation system via hard-wired connections to each feature to provide:

    a. remote chiller start and stop
    b. remote leaving chiller liquid temperature adjust
    c. remote current limit setpoint adjust
    d. remote ready to start contacts
    e. safety shutdown contacts
    f. cycling shutdown contacts
    g. run contacts

VARIABLE SPEED DRIVE

A variable speed drive shall be factory-installed on the chiller. It shall vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part load efficiency by analyzing information fed to it by sensors located throughout the chiller.

Drive shall be PWM type utilizing IGBTs with a power factor of 0.95 or better at all loads and speeds.

The variable speed drive shall be unit-mounted in a NEMA-1 enclosure with all power and control wiring between the drive and chiller factory-installed, including power to the chiller oil pump. Field power wiring shall be a single-point connection and electrical lugs for incoming power wiring shall be provided. The entire chiller package shall be U.L. listed.

The variable speed drive is cooled by a closed loop, fresh water circuit consisting of a water-to water heat exchanger and circulating pump. All interconnecting water piping is factory installed and rated for 150 PSIG working pressure.

The following features shall be provided: a door interlocked circuit breaker, capable of being padlocked; U.L. listed ground fault protection; overvoltage and undervoltage protection; 3-phase sensing motor overcurrent protection; single phase protection; insensitive to phase

rotation; overtemperature protection; digital readout at the chiller unit control panel of:

- Output Frequency
- Output Voltage
- 3-phase output current
- Input Kilowatts (kW) and Kilowatt-hours (kWH)
- Self diagnostic service parameters

Separate meters for this information shall not be acceptable.

(Optional) A harmonic filter that limits electrical power supply distortion for the variable speed drive to comply with the guidelines of IEEE Std. 519-1992 shall be provided. The filter shall be unit mounted within the same NEMA-1 enclosure and shall be U.L. listed. The following digital readouts shall be provided at the chiller unit control panel as part of the filter package:

- Input KVA
- Total power factor
- 3-phase input voltage
- 3-phase input current
- 3-phase input voltage total harmonic distortion (THD)
- 3-phase input current total demand distortion (TDD)
- Self diagnostic service parameters

Separate meters for this information shall not be acceptable.

FACTORY-INSTALLED COMPRESSOR MOTOR STARTER [OPTION THROUGH 900 HP (671.1 kW) 200-600 VOLTS]

The chiller manufacturer shall furnish a reduced-voltage Solid State Starter for the compressor motor. Starter shall be factory-mounted and wired on the chiller. The starter shall provide, through the use of silicon controlled rectifiers, a smooth acceleration of the motor without current transitions or transients. The starter enclosure shall be NEMA 1, with a hinged access door with lock and key. Electrical lugs for incoming power wiring shall be provided.

Standard Features include: digital readout at the OptiView Control Center of the following:

Display Only

- 3-phase voltage A, B, C
- 3-phase current A, B, C
- Input Power (kW)
- kW Hours
- Starter Model
- Motor Run (LED)
- Motor Current % Full Load Amps
- Current Limit Setpoints
- Pulldown Demand Time Left

Programmable

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

Other features include: low line voltage; 115-volt control transformer; three-leg sensing overloads; phase rotation and single-phase failure protection; high temperature safety protection; motor current imbalance and undervoltage safeties; open and close SCR protection; momentary power interruption protection. The Solid State Starter is cooled by a closed loop, fresh water circuit consisting of a water-to-water heat exchanger and circulating pump. All interconnecting water piping is factory-installed and rated for 150 PSIG working pressure.

Optional: Unit-mounted circuit breaker includes ground fault protection and provides 65,000 amp. Short circuit withstand rating in accordance with U.L. Standard 508. A non-fused disconnect switch is also available. Both options are padlockable.

REMOTE ELECTRO-MECHANICAL COMPRESSOR MOTOR STARTER (OPTION)

A remote electro-mechanical starter of the R-1132 type shall be furnished for each compressor motor. The starter shall be furnished in accordance with the chiller manufacturer's starter specifications and as specified elsewhere in these specifications.

PORTABLE REFRIGERANT STORAGE / RECYCLING SYSTEM

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

SI Metric Conversion

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

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

TEMPERATURE

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

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

EFFICIENCY

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

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

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

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

kW / ton and COP are related as follows:

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

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

FOULING FACTOR

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

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