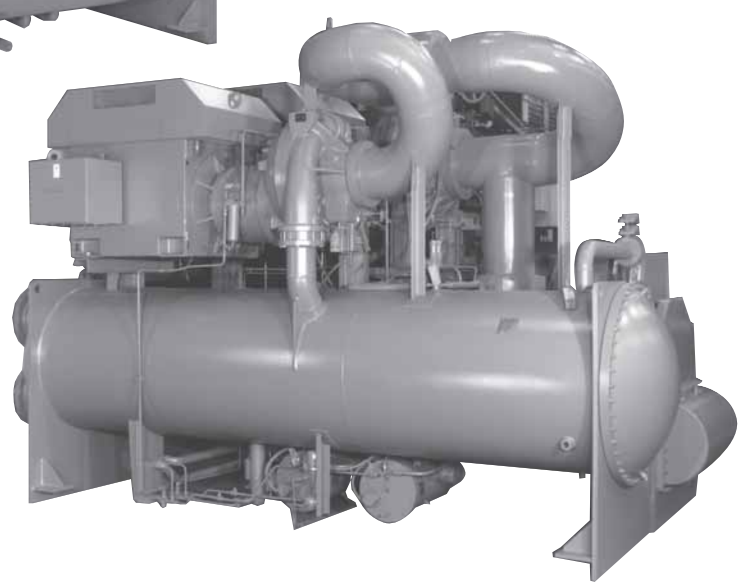
FORM 160.82-EG1 (803)

Model CYK Compound Centrifugal Liquid Chillers

Design Level F



700 Through 2200 TONS
(2500 Through 7730 kW)
Utilizing HFC-134a

Metric Conversions

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NOMENCLATURE

YK	WH	TB	J4	J1	—	DA	DA	F	S
Model	Cooler Code	Condenser Code	Low Stage Compressor Code	High Stage Compressor Code	Power Supply - for 60 Hz 5 for 50 Hz	Low Stage Motor Code	High Stage Motor Code	Design Level	Special Features

Introduction

YORK MAXE Compound YK Chiller is a design using two centrifugal compressors arranged in series to handle air-cooled, brine-chilling, and heat-pump applications at conditions outside the range of typical centrifugal chillers. These custom units use HFC-134a refrigerant and are available in a wide range of capacities:

- For air-cooled applications, (air-cooled radiators) 700 to 2,200 tons at 45°F LWT and up to 155°F LCWT (2,500 to 7,730 kWR at 7°C LWT and up to 68.3°C LCWT).
- For brine chilling, 700 to 1,500 tons at 20°F LBT and 95°F LCWT (2,500 to 5,271 kWR at -7°C LBT and 35°C LCWT). Brine temperatures as low as 0°F (-17.8°C) can be achieved.
- For heat pump applications, 11,000 to 32,000 MBH (3,200 to 9,400 kWR) heat rejection

STANDARD COMPONENTS

Each MAXE compound chiller employs common parts instead of a one-of-a-kind design. The compressors and heat exchangers use standard technology proven in the successful YORK packaged chiller line. Each compressor is driven by a standard, open-drive electric motor.

COMPACT FOOTPRINT

Compressors and motors are mounted above the shells to assure the smallest footprint for this type of chiller.

GREATER ADAPTABILITY

With the MAXE compound chiller, the impeller diameter, width and speed can be optimized for each stage of compression based on operating conditions.

SUPERIOR PART-LOAD PERFORMANCE

Using a compound arrangement allows the use of pre-rotation-vane (PRV) capacity control for the centrifugal impellers of both compressors. Pre-rotation vanes act like a throttle on the suction side of the compressor to control compressor load. With PRV control on both compressors, the result is better part-load performance than for typical multistage compressors.

HANDLES VARYING CONDENSING CONDITIONS

Since chillers most often operate at off-design conditions, off-design performance is a major factor in the energy saving equation. A compound chiller can operate with a wider range of condensing water temperatures than typical chillers. The MAXE compound unit allows one compressor to be shut off, so the chiller can run on just one compressor during low head conditions. This practice not only ensures system stability, it allows the chiller to run more efficiently and takes advantage of cooling water temperatures well below design.

LOWER INRUSH CURRENT

Instead of starting a single, large motor, the MAXE compound chiller stagger-starts the motors in sequence. Consequently, peak inrush current is reduced to about 58% compared to starting a motor for a single large compressor.

LOWER SOUND LEVELS

Acoustically, with compound compressors sharing the workload, compressor RPMs are lower than in standard centrifugal designs — and lower RPMs help lower sound levels.

GRAPHIC CONTROL

A powerful, graphic control panel makes chiller operation easy. Startup is handled by a push of the button; there is no need for manual intervention in the staggered-start sequence of the compressors. A color graphical operator interface means operating parameters, set-points and alarms are clearly visible, ensuring proper reading and response.

ECONOMIZER OPTION

An optional economizer is available to further improve cycle efficiency for lower energy consumption.

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.

Introduction *(continued)*

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

Designed to be the most reliable chillers we've ever made, YORK MAXE centrifugal chillers incorporate 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 Compound MAXE chillers feature two variable speed drive oil pumps, monitoring and providing the right amount of oil flow to each compressor on a continuous basis. This design also provides sophisticated electronic monitoring and protection of the oil pump electrical supply, ensuring long life and reliable operation of the oil pump motor. Variable speed drive technology reduces oil pump power consumption, running only at the speed required, rather than at full head with a pressure regulating bypass valve.

FACTORY PACKAGING REDUCES FIELD LABOR COSTS

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

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.

COMPUTERIZED PERFORMANCE RATINGS

Each chiller is custom-matched to meet the individual building load and energy requirements. Standard heat exchanger tube bundle sizes and pass arrangements, are available to provide the best possible match. It is not practical to provide tabulated performance for each combination, as the energy requirements at both full and part load vary significantly with each heat exchanger and pass arrangement. Computerized ratings are available through each YORK sales office. These ratings can be tailored to specific job requirements.

Mechanical Specifications

GENERAL

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

The initial charge of refrigerant and oil is supplied for each chiller. Under certain conditions the unit may ship fully charged with refrigerant and oil. Actual shipping procedures will depend on a number of project-specific details.

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

COMPRESSOR

Each compressor is a single-stage centrifugal type powered by an open-drive electric motor. The casing is fully accessible with vertical circular joints and fabricated of close-grain cast iron. The complete operating assembly is removable from the compressor and scroll housing.

The rotor assembly consists of a heat-treated alloy steel drive shaft and impeller shaft with a high strength, cast aluminum alloy, fully shrouded impeller. The impeller is designed for balanced thrust and is dynamically balanced and overspeed tested for smooth, vibration free operation.

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

CAPACITY CONTROL

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

Both compressors are normally operated to satisfy the evaporator load. Should the entering condensing water temperature drop below a preset temperature, a compressor will be taken off line. This allows the remaining compressor to continue operating more efficiently at low entering condensing water temperatures.

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, and continuously during operation and during coast-down. A gravity-fed oil reservoir is built into the top of each compressor to provide lubrication during coast-down in the event of a power failure.

Dual oil reservoirs, separate from the compressors, contain the 2 HP submersible oil pumps and 1500 watt immersion-type oil heaters for each compressor. The oil heaters are thermostatically controlled to remove refrigerant from the oil.

A water-cooled oil cooler, including flow control valves and strainer, is provided after each oil pump, with factory installed water piping terminating at the center on the condenser side of the unit. A thermostatically controlled bypass valve maintains the required oil temperature supply from each oil cooler to its compressor. Oil is filtered by externally mounted, 1/2 micron, replaceable cartridge oil filters, equipped with service valves. An automatic oil return system recovers any oil that may have migrated to the evaporator. Oil piping is completely factory installed.

MOTOR DRIVELINE

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

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

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

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

Mechanical Specifications *(continued)*

HEAT EXCHANGERS

Shells

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

Tubes

Heat exchanger tubes are state-of-the-art, high-efficiency, externally and internally enhanced type to provide optimum performance. Tubes in both the evaporator and condenser are 3/4" O.D. copper alloy and utilize the “skip-fin” design, providing a smooth internal and external surface at each intermediate tube support. This provides extra wall thickness (up to twice as thick) and non-work hardened copper at the support location, extending the life of the heat exchangers. Each tube is roller expanded into the tube sheets providing a leak-proof seal, and is individually replaceable.

Evaporator

The evaporator is a shell and tube, flooded type heat exchanger. A distributor trough provides uniform distribution of refrigerant over the entire shell length to yield optimum heat transfer. Mesh eliminators are located above the tube bundle to prevent liquid refrigerant carryover into the compressor. A 1.5" (38mm) liquid level sight glass is conveniently located on the side of the shell to aid in determining proper refrigerant charge. The evaporator shell contains a dual refrigerant relief valve arrangement set to pressures up to 235 PSIG (1620 kPa). A 1" refrigerant charging valve is provided.

Condenser

The condenser is a shell and tube type, with discharge gas baffles to prevent direct high velocity impingement on the tubes. The baffles are also used to distribute the refrigerant gas flow properly for most efficient heat transfer. An integral sub-cooler is located at the bottom of the condenser shell providing highly effective liquid refrigerant sub-cooling to provide the highest cycle efficiency. The condenser contains dual refrigerant relief valves that can be set to pressures up to 300 PSIG (2069 kPa). In certain refrigerant capacity ranges, this pressure can be increased to 350 PSIG (2413 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 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 sub-cooler, condenser and evaporator performance. A high quality, tight closing, “V” ball type variable orifice electronically adjusts to all Real-World operating conditions, providing the most efficient and reliable operation of refrigerant flow control.

COMPRESSOR DISCHARGE VALVES

A check valve is located in the discharge of the high stage compressor. This discharge valve ensures that there is no backspin of the compressors during shutdown as well as preventing rapid equalization of the high pressure side of the system.

ZERO LOAD HOT GAS BYPASS

Sized for operation to 0% load to prevent nuisance shutdowns due to low load conditions, and critical industrial and process applications.

LOW INLET CONDENSER WATER CAPABILITY

The MAXE CYK Compound chiller incorporates a control strategy that allows a compressor to shut down automatically when two-compressor operation is no longer required. This allows the chiller to take advantage of low-inlet condenser water temperatures to reduce energy consumption.

CONTROL CENTER

The chiller is controlled by a stand-alone PLC based control center. The chiller control center provides all the necessary controls and control logic to provide automatic start-up, automatic operation, capacity control and safety protection of the chiller.

Control Panel

The control panel includes a 10.4" color active matrix display with integral keypad for operator interface. The control panel is a factory wired, unit mounted, Nema 12, gasketed enclosure. The panel is fabricated of 10 gauge steel and includes full height front access doors. The panel enclosure is painted to match the chiller color on the outside, and gloss white on interior surfaces. All controls are arranged for easy access and internally wired to clearly marked terminal strips or pre-wired PLC interface modules for external wiring connections. Wiring is color-coded black (control), white (neutral), and green (ground), with each wire numerically identified at both ends with heat shrinkable wire markers. Wiring enclosed in shielded cables and pre-wired cables are color coded per the wiring diagram.

The screen details all operations and parameters, using a graphical representation of the chiller and its components. Graphic screens are provided for:

a. Chiller Overview
b. Evaporator
c. Condenser
d. Low stage compressor
e. High stage compressor
f. Motors
g. Capacity control diagram
h. Manual/Auto stations for all control outputs

The operator interface is programmed to provide display of all major operating parameters in both graphical and list type screen displays. PID control loop set points, and Manual/Auto functions are also accomplished by the operator interface. Alarm indicators on the graphic display screen provide annunciation, and an alarm history screen is provided which shows the most recent alarms, with the time and date of occurrence. Trip status screens are provided which show the values of all analog inputs at the time of the last five chiller safety shutdowns. The time and date of the shutdown are also shown. Separate pushbuttons are provided on the face of the control panel for Chiller Start, Stop, Reset and Emergency Stop.

Capacity Controls System

The Capacity Control philosophy of the York CYK chiller control system allows efficient, fully automated control, without need for operator intervention. This control system also monitors and displays all safety aspects of the chiller and provides alarms and a shutdown if safety limits are exceeded. If operator intervention is required, manual controls are provided on the electronic operator interface, for all electric actuators.

The capacity controls algorithm automatically seeks out the most efficient operation of the CYK chiller. The pre-rotation vanes are automated to obey the temperature controller to maintain chilled water production. In cases of low load, the pre-rotation vanes automatically throttle and are limited to a minimum anti-surge position, which is calculated from a head curve. To provide light duty operation, the hot gas recycle valve is seamlessly throttled open according to temperature demands. This keeps the centrifugal compressor out of surge and maintains chilled water production.

In cases of high load, which exceeds the motor kilowatt (or current) usage, the capacity controls algorithm automatically unloads the system to maintain a restriction on power consumption. In the same way, conditions of high discharge pressure or low suction pressure override the production of chilled water in the interests of keeping the chiller system online.

In cases of light load and low head, the booster compressor is dropped offline, and the unit will be run with the high stage compressor like a normal single compressor chiller.

Analog Input List:

1. Low Stage Motor Current (% FLA)
2. High Stage Motor Current (% FLA)
3. Sub-cooler Refrigerant Liquid Level
4. Low Stage Oil Reservoir Oil Level
5. High Stage Oil Reservoir Oil Level
6. Evaporator Refrigerant Pressure
7. Condenser Refrigerant Pressure
8. Low Stage Compressor Low Oil Pressure
9. High Stage Compressor Low Oil Pressure
10. Low Stage Compressor High Oil Pressure
11. High Stage Compressor High Oil Pressure
12. Chilled Water-Out Temperature.
13. Chilled Water-In Temperature.

Mechanical Specifications *(continued)*

14. Condenser Water In Temperature
15. Condenser Water Out Temperature
16. Evaporator Refrigerant Liquid Temp.
17. Low Stage Compressor Refrigerant Discharge Temperature
18. High Stage Compressor Refrigerant Discharge Temperature
19. Sub-cooled Refrigerant Liquid Temperature
20. Low Stage Compressor Oil Temperature
21. High Stage Compressor Oil Temperature
22. Low Stage PRV Position
23. High Stage PRV Position
24. Low Stage Compressor high stage thrust Bearing Probe Gap
25. High Stage Compressor thrust bearing Probe gap
26. Inter-cooler Pressure (inter-cooler models)

Digital Inputs:

1. Start-up Bypass Valve Open Limit Switch
2. Start-up Bypass Valve Closed Limit Switch
3. Chilled Water Low Flow Switch
4. Condenser Water Low Flow Switch
5. Low Stage Motor Starter Full Voltage (Run) Auxiliary Contact
6. High Stage Motor Starter Full Voltage (Run) Auxiliary Contact
7. Low Stage Motor Starter Safety Fault Lockout Relay
8. High Stage Motor Starter Safety Fault Lockout Relay
9. Condenser Refrigerant High Pressure Cutout
10. Low Stage Compressor Oil Heater Thermostat
11. HIGH STAGE Compressor Oil Heater Thermostat
12. LOW STAGE PRV Closed Limit Switch
13. HIGH STAGE PRV Closed Limit Switch
14. LOW STAGE Compressor V.S. Oil Pump Drive Faulted Contact
15. HIGH STAGE Compressor V.S. Oil Pump Drive Faulted Contact
16. Chiller Start
17. Chiller Stop
18. System Reset
19. Emergency Stop

Analog Output List

1. Hot Gas Bypass Valve
2. Low Stage Compressor, V.S. Oil Pump Drive Control
3. High Stage Compressor, V.S. Oil Pump Drive Control
4. Variable Orifice Valve
5. Inter-stage Valve (inter-cooler models)

Digital Output List

1. Low Stage Liquid Line Solenoid Valve
2. High Stage Liquid Line Solenoid Valve
3. High Stage Oil Return Solenoid
4. Low Stage Oil Return Solenoid Valve
5. Low Stage Compressor Oil Heater Contactor
6. High Stage Compressor Oil Heater Contactor
7. LOW STAGE Compressor Motor Start/Stop Control Relay
8. HIGH STAGE Compressor Motor Start/Stop Control Relay
9. LOW STAGE Compressor Oil Pump Start/Stop Relay
10. HIGH STAGE Compressor Oil Pump Start/Stop Relay
11. Oil Level Control Pump Start/Stop Relay
12. Start-up Bypass Valve Open/Close Relay
13. Open Low Stage PRV
14. Open High Stage PRV
15. Close Low Stage PRV
16. Close High Stage PRV

Security

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: operator, service and programming.

Memory Back-up

The operating program is stored in non-volatile memory (EPROM) to eliminate reprogramming the chiller due to AC power failure or battery discharge.

Over-Current Protection

A fused connection through a transformer on the Variable Speed Oil Pump Panel to provide individual overcurrent protected power for all controls.

Communication

The chiller network interface can be accomplished with the following native mediums with the listed protocol:

a. Ethernet/IP over CAT-5 cable
b. ControlNet over RG6 coaxial cable
c. DH-485 over RS-485
d. DF1 over RS-232c

The PLC tag database will be provided to show all analog and discrete data that can be accessed.

Remote setting of the leaving chilled water set-point can be accomplished by a remote 4-20mA signal or by the network. Remote start and stop can be accomplished across the network protocol, or thru a hard-wired contact.

CODES AND STANDARDS

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

ISOLATION MOUNTING

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

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, Control Center 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

BAS REMOTE CONTROL

Alternate network mediums and protocols may be accomplished with the addition of a protocol translator gateway. These include: Modbus RTU, Modbus TCP/IP, Profibus, DNP, Remote I/0 and ASCII. Contact the factory for more information.

FACTORY INSULATION OF EVAPORATOR

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

WATER FLANGES

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

SPRING ISOLATION MOUNTING

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

STARTER – FIELD-INSTALLED

A field-installed, electro-mechanical compressor motor starter assembly is available, selected for proper size and type for job requirements and in accordance with YORK Engineering Standard (R-1137) for Starters. The starter assembly has contactors and accessories for controlling the two compressor motors per chiller.

MARINE WATER BOXES

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

KNOCK-DOWN SHIPMENT

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

REFRIGERANT ISOLATION VALVES

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. Typically not required if unit isolation valves are provided.

HIGH VOLTAGE MOTORS

High voltage induction motors (11 kV to 13.8 kV), special motor enclosures such as TEWAC or WPII, may be substituted.

TUBE AND/OR TUBE SHEET MATERIALS AND/OR WATER BOX COATING

For condenser and/or cooler for protection against aggressive water conditions. Alternate cupro-nickel or titanium tubes can be provided in lieu of standard copper. Tube sheets may be of the clad type. A coal tar epoxy coating (International Coatings Intertuf 132 HS) may be applied to water boxes or to tubesheet and water boxes.

SACRIFICIAL ZINC ANODES

With mounting hardware for condenser and/or cooler corrosion protection.

HIGHER WATER CIRCUIT DWP

Condenser and/or cooler water circuit(s) DWP higher than the standard 150 PSIG (1034 kPa) DWP.

OUTDOOR AND/OR HAZARDOUS DUTY APPLICATIONS

Necessary unit, control and control center modifications for Outdoor (NEMA-3 & 4) and/or Hazardous Duty (NEMA-7 or 9) application in lieu of standard NEMA-1 construction. Suitable alternate surface preparation and protective coating systems also available.

FIELD PERFORMANCE TEST

Services of a factory engineer or independent consultant to supervise a field performance test. Various levels of instrumentation can be offered by YORK.

Application Data

The following discussion is a user's guide in the application and installation of *Millennium* 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

Millennium 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 cooler 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, cooler and condenser flow rates are permitted at water velocity levels in the heat exchangers tubes of between 3 ft/sec and 12 ft/sec (0.91 m/s and 3.66 m/s). Variable flow applications are possible, and initial chiller selections should be made accordingly to allow proper range of flow while maintaining the minimum velocity noted above. Variable flow in the condenser is not recommended, as it generally raises the energy consumption of the system by keeping the condenser pressure high in the chiller. Additionally, the rate of fouling in the condenser will increase at lower water velocities associated with variable flow, raising system maintenance costs. Cooling towers typically have narrow ranges of operation with respect to flow rates, and will be more effective with full design flow. Ref. Table 1 for flow limits.

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

Water Quality – The practical and economical application of liquid chillers requires that the quality of the water supply for the condenser and cooler 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 cooler 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. Cooler and condenser water boxes are equipped with plugged vent and drain connections. If desired, vent and drain valves may be installed with or without piping to an open drain. Pressure gauges with stop cocks and stop valves may be installed in the inlets and outlets of the condenser and chilled water line as close as possible to the chiller. An overhead monorail or beam may be used to facilitate servicing.

Connections – The standard chiller is designed for 150 PSIG (1034 kPA) design working pressure in both the chilled water and condenser water circuits. The connections (water nozzles) to these circuits are furnished with grooves for Victaulic couplings. Piping should be arranged for ease of disassembly at the unit for tube cleaning. All water piping should be thoroughly cleaned of all dirt and debris before final connections are made to the chiller.

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:

TABLE 1 – WATER FLOW RATE LIMITS (GPM)

MODEL	COOLER						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
DB	–	–	–	–	–	–	1073	4292	536	2146	–	–
DC	–	–	–	–	–	–	–	–	–	–	400	1439
EB	–	–	–	–	–	–	1466	5864	733	2467	–	–
EC	–	–	–	–	–	–	–	–	–	–	596	1794
FB	1352	5410	676	2265	451	1503	1960	7839	980	3314	–	–
FC	1532	6127	766	2531	511	1682	–	–	–	–	756	2305
GB	1735	6938	867	2932	578	1947	2551	10205	1276	4277	–	–
GC	1940	7762	970	3256	647	2166	–	–	–	–	1048	3093
GD	2220	8879	1110	3682	740	2460	–	–	–	–	–	–
GF	1467	5868	734	2485	489	1647	–	–	–	–	–	–
GH	1714	6856	857	2875	571	1908	–	–	–	–	–	–
HB	2455	9820	1227	4015	818	2690	3469	13874	1734	5823	–	–
HC	2808	11231	1404	4503	936	3033	–	–	–	–	1223	4072
HF	2008	8032	1004	3336	669	2224	–	–	–	–	–	–
HH	2346	9384	1173	3863	782	2590	–	–	–	–	–	–
JB	–	–	–	–	–	–	4307	17227	2153	7059	–	–
JC	–	–	–	–	–	–	–	–	–	–	1549	5151
JF	2743	10972	1372	4552	914	3069	–	–	–	–	–	–
JG	2978	11913	1489	4885	993	3305	–	–	–	–	–	–
JH	3210	12842	1605	5198	1070	3529	–	–	–	–	–	–
TB	–	–	–	–	–	–	4307	17227	2153	6626	–	–
TC	–	–	–	–	–	–	–	–	–	–	1549	4826
TF	2743	10972	1372	4278	914	2880	–	–	–	–	–	–
TG	2978	11913	1489	4591	993	3101	–	–	–	–	–	–
TH	3210	12842	1605	4896	1070	3318	–	–	–	–	–	–
VB	–	–	–	–	–	–	5471	21885	2736	8417	–	–
VC	–	–	–	–	–	–	–	–	–	–	1900	5806
VF	3513	14053	1757	5480	1171	3634	–	–	–	–	–	–
VH	3843	15370	1921	5947	1281	3947	–	–	–	–	–	–
WF	4389	17558	2195	6851	1463	4524	–	–	–	–	–	–
WH	5139	20556	2570	7886	1713	5214	–	–	–	–	–	–
XA	–	–	–	–	–	–	5600	22378	2800	8620	1867	5865
XB	–	–	–	–	–	–	6072	24264	3036	9250	2024	6322
XC	–	–	–	–	–	–	–	–	–	–	2204	6725
XD	–	–	–	–	–	–	6758	27000	3379	10131	–	–
XF	4384	17516	2192	6424	1462	4244	–	–	–	–	–	–
XH	5115	20430	2558	7400	1706	4895	–	–	–	–	–	–

Min. ECWT = LCHWT – C RANGE + 17 ➞ °F

Min. ECWT = LCHWT – C RANGE + 9.4 ➞ °C

where:

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

At initial startup, entering condensing water temperature may be as much as 25°F (13.9°C) colder than the standby chilled water temperature as long as it is above the minimum ECWT allowed.

Application Data *(continued)*

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

MODEL	COOLER						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
DB	–	–	–	–	–	–	68	271	34	135	–	–
DC	–	–	–	–	–	–	–	–	–	–	25	91
EB	–	–	–	–	–	–	93	370	46	155	–	–
EC	–	–	–	–	–	–	–	–	–	–	38	113
FB	85	341	43	142	28	94	124	495	62	209	–	–
FC	97	387	48	193	32	129	–	–	–	–	48	145
GB	109	438	55	185	36	122	161	644	80	270	–	–
GC	122	490	61	205	41	136	–	–	–	–	66	195
GD	140	560	70	232	47	155	–	–	–	–	–	–
GF	93	370	46	156	31	104	–	–	–	–	–	–
GH	108	433	54	181	36	120	–	–	–	–	–	–
HB	155	620	77	253	52	169	219	875	109	367	–	–
HC	177	709	89	354	59	236	–	–	–	–	86	257
HF	127	507	63	210	42	140	–	–	–	–	–	–
HH	148	592	74	243	49	163	–	–	–	–	–	–
JB	–	–	–	–	–	–	272	1087	136	445	–	–
JC	–	–	–	–	–	–	–	–	–	–	109	325
JF	173	692	87	287	58	193	–	–	–	–	–	–
JG	188	752	94	308	63	208	–	–	–	–	–	–
JH	203	810	101	328	68	222	–	–	–	–	–	–
TB	–	–	–	–	–	–	272	1087	136	418	–	–
TC	–	–	–	–	–	–	–	–	–	–	109	304
TF	173	692	87	270	58	181	–	–	–	–	–	–
TG	188	752	94	289	63	195	–	–	–	–	–	–
TH	203	810	101	309	68	209	–	–	–	–	–	–
VB	–	–	–	–	–	–	345	1381	173	531	–	–
VC	–	–	–	–	–	–	–	–	–	–	133	366
VF	222	887	111	345	74	229	–	–	–	–	–	–
VH	242	970	121	375	81	249	–	–	–	–	–	–
WF	277	1108	138	432	92	285	–	–	–	–	–	–
WH	324	1297	162	497	108	329	–	–	–	–	–	–
XA	–	–	–	–	–	–	353	1412	177	544	118	370
XB	–	–	–	–	–	–	383	1531	192	584	128	399
XC	–	–	–	–	–	–	–	–	–	–	139	424
XD	–	–	–	–	–	–	426	1703	213	639	–	–
XF	277	1105	138	405	92	268	–	–	–	–	–	–
XH	323	1289	162	467	108	309	–	–	–	–	–	–

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 *Millennium* 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.

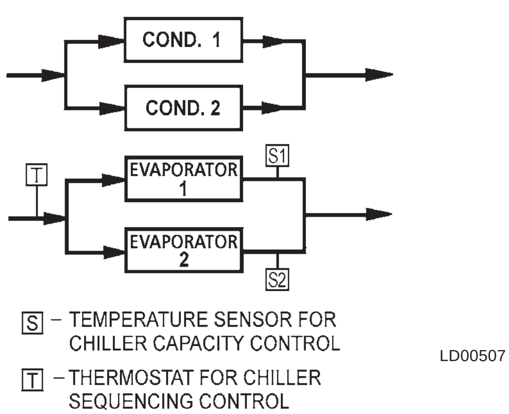
Depending on the number of units and operating characteristics of the units, loading and unloading schemes should be designed to optimize the overall efficiency of the chiller plant. It is recommended to use an evaporator by-pass piping arrangement to bypass fluid around evaporator of any unit which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

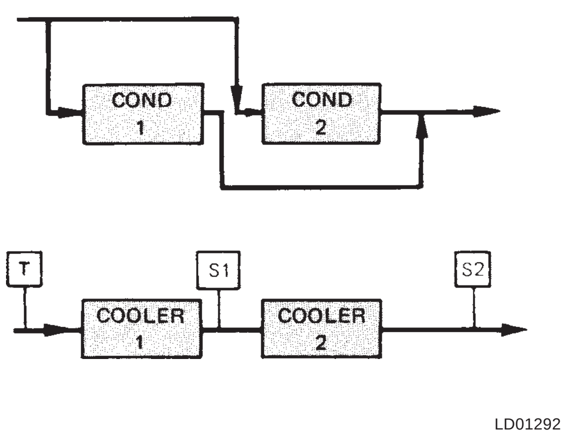
Series Arrangement (Refer to Fig. 2) **–** Chillers may be applied in pairs with chilled water circuits connected in series and condenser water circuits connected in parallel. All of the chilled water flows through both coolers with each unit handling approximately one-half of the total load. When the 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.

REFRIGERANT RELIEF PIPING

Each chiller is equipped with dual pressure relief valves on the condenser and two dual relief valves on the cooler, or two single relief valves on the cooler 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.





S – Temperature Sensor for Chiller Capacity Control

T – Thermostat for Chiller Capacity Control

FIG. 1 – PARALLEL COOLERS
PARALLEL CONDENSERS

FIG. 2 – SERIES COOLERS
PARALLEL CONDENSERS

Application Data *(continued)*

SOUND AND VIBRATION CONSIDERATIONS

A *Millennium* 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.

Millennium 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 jobsite, 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 *Millennium* 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 (NEC), 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.

Starters – A separate starter is not required if the chiller is equipped with a Variable Speed Drive (VSD). The *Millennium* chillers are also available with a factory-mounted and wired YORK Solid State Starter for voltages up to 600 volts and up to 900 HP (671 kW). Other types of remote mounted starters are available. These electro-mechanical starters must be furnished in accordance with YORK Standard Specifications (R-1051). This will ensure that starter components, controls, circuits, and terminal markings will be suitable for required overall system performance.

Controls – A 115 volt, single phase, 60 or 50 Hertz 2 KVA power supply must be furnished to the chiller from a

TABLE 2 – MOTOR VOLTAGE VARIATIONS

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

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. 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 – 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 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 5.

Application Data *(continued)*

TABLE 3 – 60 HZ ELECTRICAL DATA

MOTOR CODE		CH	CJ	CK	CL	CM	CN	CP	CR	CS	CT	CU	CV	CW
KW (MAX)		161	190	214	240	257	276	302	333	368	395	435	478	514
SHAFT HP		201	237	270	302	327	351	385	424	468	503	554	608	655
FL. EFF. - %		93	93	94	94	95	95	95	95	95	95	95	95	95
VOLTS		**AMPERES (MAX.)**												
200	FLA	527	618	707	787	921	1,014	1,085	1,208	—	—	—	—	—
	LRA	3,111	3,810	4,550	4,900	5,470	5,780	7,350	7,794	—	—	—	—	—
208	FLA	507	594	680	757	799	886	975	1,043	1,162	—	—	—	—
	LRA	3,235	3,962	4,732	5,096	5,689	6,011	6,011	7,644	8,106	—	—	—	—
230	FLA	464	540	610	685	749	804	882	944	1,050	1,130	—	—	—
	LRA	2,865	3,460	3,788	4,260	4,755	5,162	5,780	5,780	6,900	7,400	—	—	—
240	FLA	445	518	585	656	718	771	845	905	1,006	1,083	—	—	—
	LRA	3,120	3,610	3,953	4,445	4,962	5,386	6,031	6,031	7,200	7,722	—	—	—
380	FLA	285	336	378	421	453	487	534	571	636	684	756	817	879
	LRA	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
416	FLA	260	307	346	385	412	445	488	522	581	625	691	747	810
	LRA	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	238	281	319	358	392	397	461	493	549	591	646	706	579
	LRA	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	228	269	305	342	375	380	441	472	525	565	618	675	726
	LRA	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	219	258	292	328	359	364	423	452	503	541	592	647	696
	LRA	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	185	216	250	247	300	318	353	377	420	452	500	540	581
	LRA	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	177	207	240	263	288	305	338	361	403	433	479	518	557
	LRA	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	46	55	63	70	74	80	87	95	106	113	124	135	146
	LRA	298	340	397	435	480	520	530	590	669	719	791	867	935
3300	FLA	33	39	44	49	52	55	61	67	73	79	86	94	102
	LRA	210	240	280	310	310	343	382	415	466	501	551	576	652
4000	FLA	27	32	36	40	43	46	50	55	60	65	71	78	84
	LRA	166	195	230	240	270	283	315	340	384	413	455	499	538
4160	FLA	26	30	34	38	41	44	48	52	58	63	68	75	81
	LRA	173	203	239	250	270	294	328	328	399	430	473	519	560

TABLE 4 – 50 HZ ELECTRICAL DATA[1]

MOTOR CODE		5CE	5CF	5CG	5CH	5CI	5CJ	5CK	5CL	5CM	5CN	5CO	5CP	5CQ	5CR	5CS
KW (MAX)		160	180	201	215	231	254	280	309	332	366	402	432	455	481	518
SHAFT HP		198	225	252	272	292	321	353	390	419	462	507	546	575	608	658
FL EFF.-%		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
FL PF		.86	.86	.86	.86	.86	.86	.87	.87	.87	.87	.87	.87	.87	.87	.88
VOLTS		**AMPERES (MAX.)**														
346	FLA	302	340	380	417	437	481	528	584	630	692	578	816	860	909	982
	LRA	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	275	309	346	379	398	438	481	532	572	630	690	743	783	841	895
	LRA	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	261	294	329	360	378	416	457	505	543	599	656	706	744	799	850
	LRA	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	252	284	317	347	364	401	441	487	526	577	632	680	717	764	819
	LRA	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	32	36	41	44	47	50	56	62	66	73	80	87	91	96	103
	LRA	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	MOTOR CODE	
542	578	617	660	703	781	859	937	1,015	1,093	1,171	1,359	1,554	**KW(MAX.)**	
690	740	790	845	900	1,000	1,100	1,200	1,300	1,400	1,500	1,750	2,000	**SHAFT HP**	
95	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	96	96	**FL 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	**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	**LRA**	
108	115	123	130	138	157	173	186	202	217	233	271	306	**FLA**	**3,300**
682	719	744	744	858	861	1,110	1,110	1,110	1,416	1,416	1,661	2,011	**LRA**	
89	95	101	107	114	130	143	154	166	179	192	224	252	**FLA**	**4,000**
540	554	631	674	713	715	923	923	923	1,177	1,177	1,386	1,669	**LRA**	
85	91	97	103	110	125	137	149	160	172	185	215	242	**FLA**	**4,160**
562	576	656	701	742	744	960	960	960	1,224	1,224	1,441	1,736	**LRA**	

5CT	5CU	5CV	5CW	5CX	5DA	5DB	5DC	5DD	5DE	5DF	5DG	5DH	5OJ	MOTOR CODE	
554	591	630	669	709	785	863	942	1,015	1,093	1,171	1,288	1,360	1,554	**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	**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	**FL EFF.-%**	
.88	.89	.89	.89	.89	.88	.87	.88	.88	.88	.88	.88	.89	.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	**FLA**	**3,300**
693	725	744	819	875	871	1,135	1,135	1,135	1,415	1,415	1,415	1,667	2,011	**LRA**	

Application Data *(continued)*

TABLE 5 – MOTOR STARTERS

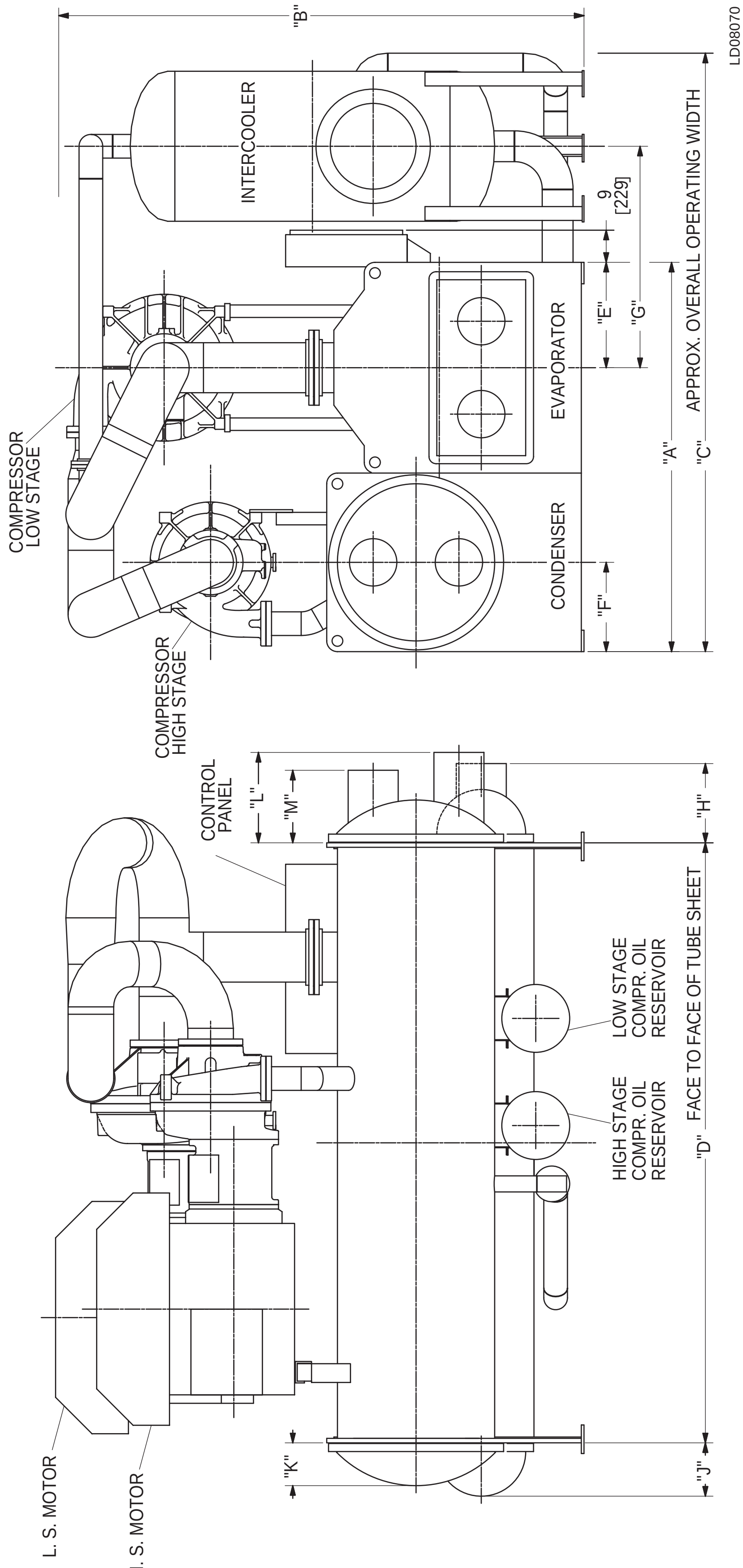
TYPE STARTER	SOLID STATE STARTER	STAR DELTA	AUTO TRANSFORMER			ACROSS THE LINE	PRIMARY REACTOR	
VOLTAGE	LOW	LOW	LOW	LOW/HIGH	LOW/HIGH	LOW/HIGH	HIGH	HIGH
60 HZ	460, 575	200-600	200-600	200-4160	200-4160	200-4160	2300-4160	2300-4160
50 HZ	380-415	346-415	346-415	346-3300	346-3300	346-3300	2300-3300	2300-3300
TRANSITION	—	CLOSED	CLOSED	CLOSED	CLOSED	—	CLOSED	CLOSED
% TAP	—	—	57.7	65	80	—	65	80
INRUSH AS 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 CODES	EVAPORATOR CODES	CONDENSER CODES	MOTOR	MOTOR CODES 60 HZ	MOTOR CODES 50 HZ
HG, H0 H7, H0	FB, FC, GB, GC GD, HB, HC	DB, DC, EF EC, FB, FC	30	(H0) CN–CB (H6, H7) CN–CZ	5CK –5CX 5CK–5CU
J1, H1 (H5) J2, H2 (H6) J2, H3 (H8)	GF, GH, HF, HH JF, JG, JH	FB, FC, GB GC, JB, JC	30	(H1-H3) CN–DD (H5, 6, 8) CN–CZ (J1-J2) CS–DD	5CK–5DD 5CK–5CU 5C0–5DD
J3, H3 (H7) J3, J1/U1	HF, HH, JF, JG, JH TF, TG, TH, VF, VH, WF, WH	FB, FC, GB, GC HB, HC TB, TC, VB, VC	36	(H3) EN–DD (H7) CN–CZ (J1, U1) CS–DD (J3) CW–DJ	5CK–5DD 5CK–5CU 5CO–5DD 5CR–50J
J4, J1/U1 J4, J2/U2	JF, JG,JH TF, TG, TH, VF, VH, WF, WH	JB, JC TB, TC, VB, VC	42	(J1, J2) CS–DD (U1, U2) (J4) CX–DJ	5CO–5DD 5CT–50J
J5, J2/U2 J5, J3	XF, XH	XA, XB, XC	42	(J2, U2) CS–DD (J5) CX–DJ	5C0–5DD 5CT–50J

Dimensions (Ft. - In.) – Unit



Dimensions (Ft. - In.) – Unit (continued)

COMPRESSOR OPTION - H6 OR H7 LOW STAGE / H0 HIGH STAGE									
30" O.D. INTERCOOLER									
COOLER - CONDENSER SHELL CODES									
	F–D	F–E	F–F	G–D	G–E	G–F	H–D	H–E	H–F
A	6' - 11"	6' - 11"	7' - 2"	7' - 1-1/2"	7' - 1-1/2"	7' - 4-1/2"	7' - 5"	7' - 5"	7' - 8"
B	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"
C	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"
D	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"
E	2' - 0"	2' - 0"	2' - 0"	2' - 1-1/4"	2' - 1-1/4"	2' - 1-1/4"	2' - 3"	2' - 3"	2' - 3"
F	1' - 5-1/2"	1' - 5-1/2"	1' - 7"	1' - 5-1/2"	1' - 5-1/2"	1' - 7"	1' - 5-1/2"	1' - 5-1/2"	1' - 7"
G	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"
H	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"
J	0' - 5-5/8"	0' - 5-5/8"	0' - 5-5/8"	0' - 6"	0' - 6"	0' - 6"	0' - 6"	0' - 6"	0' - 6"

COMPRESSOR OPTION 1 - J1 LOW STAGE / H1 (H5) HIGH STAGE									
COMPRESSOR OPTION 2 - J2 LOW STAGE / H2 (H6) OR H3 (H8) HIGH STAGE									
30" O.D. INTERCOOLER									
COOLER - CONDENSER SHELL CODES									
	G–F	G–G	G–J	H–F	H–G	H–J	J–F	J–G	J–J
A	7' - 2"	7' - 6"	8' - 2"	7' - 6-1/2"	7' - 10-1/2"	8' - 6-1/2"	8' - 1"	8' - 5"	9' - 1"
B	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"
C	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"	12' - 0"
D	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"
E	2' - 0"	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"
F	1' - 7"	1' - 9"	2' - 1"	1' - 7"	1' - 9"	2' - 1"	1' - 7"	1' - 9"	2' - 1"
G	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"	4' - 8"
H	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"	1' - 11-3/4"
J	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"	1' - 2-3/4"

COMPRESSOR OPTION - J3 LOW STAGE / H3 (H7) OR J1 (U1) HIGH STAGE						
36" O.D. INTERCOOLER						
COOLER - CONDENSER SHELL CODES						
	H–F	H–G	H–H	J–F	J–G	J–H
A	7' - 6-1/2"	7' - 10-1/2"	8' - 2-1/2"	8' - 1"	8' - 5"	8' - 9"
B	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"
C	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"	13' - 0"
D	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"	14' - 0"
E	2' - 2-1/4"	2' - 2-1/4"	2' - 2-1/4"	2' - 5-1/2"	2' - 5-1/2"	2' - 5-1/2"
F	1' - 7"	1' - 9"	1' - 11"	1' - 7"	1' - 9"	1' - 11"
G	5' - 0"	5' - 0"	5' - 0"	5' - 0"	5' - 0"	5' - 0"
H	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"
J	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"

COMPRESSOR OPTION - J3 LOW STAGE / H3 (H7) OR J1 (U1) HIGH STAGE						
36" O.D. INTERCOOLER						
COOLER - CONDENSER SHELL CODES						
	T–T	T–V	V–T	V–V	W–T	W–V
A	9' - 1"	9' - 6"	9' - 1"	9' - 6"	9' - 6"	9' - 11"
B	14' - 6"	14' - 6"	14' - 6"	14' - 6"	14' - 6"	14' - 6"
C	13' - 6"	13' - 6"	13' - 6"	13' - 6"	13' - 6"	13' - 6"
D	16' - 0"	16' - 0"	16' - 0"	16' - 0"	16' - 0"	16' - 0"
E	2' - 5-1/2"	2' - 5-1/2"	2' - 5-1/2"	2' - 5-1/2"	2' - 8"	2' - 8"
F	2' - 1"	2' - 3-1/2"	2' - 1"	2' - 3-1/2"	2' - 1"	2' - 3-1/2"
G	5' - 0"	5' - 0"	5' - 0"	5' - 0"	5' - 0"	5' - 0"
H	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	2' - 0-3/4"	2' - 0-3/4"
J	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 4-3/4"	1' - 4-3/4"

COMPRESSOR OPTION - J4 LOW STAGE / J1 (U1) OR J2 (U2) HIGH STAGE							
42" O.D. INTERCOOLER							
COOLER - CONDENSER SHELL CODES							
	J–J	T–T	T–V	V–T	V–V	W–T	W–V
A	9' - 1"	9' - 1"	9' - 6"	9' - 1"	9' - 6"	9' - 6"	9' - 11"
B	15' - 0"	15' - 0"	15' - 0"	15' - 0"	15' - 0"	15' - 0"	15' - 0"
C	13' - 6"	13' - 6"	13' - 6"	13' - 6"	13' - 6"	13' - 6"	13' - 6"
D	14' - 0"	16' - 0"	16' - 0"	16' - 0"	16' - 0"	16' - 0"	16' - 0"
E	2' - 5-1/2"	2' - 5-1/2"	2' - 5-1/2"	2' - 5-1/2"	2' - 5-1/2"	2' - 8"	2' - 8"
F	2' - 1"	2' - 1"	2' - 3-1/2"	2' - 1"	2' - 3-1/2"	2' - 1"	2' - 3-1/2"
G	5' - 2"	5' - 2"	5' - 2"	5' - 2"	5' - 2"	5' - 2"	5' - 2"
H	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	1' - 11-3/4"	2' - 0-3/4"	2' - 0-3/4"
J	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 2-3/4"	1' - 4-3/4"	1' - 4-3/4"

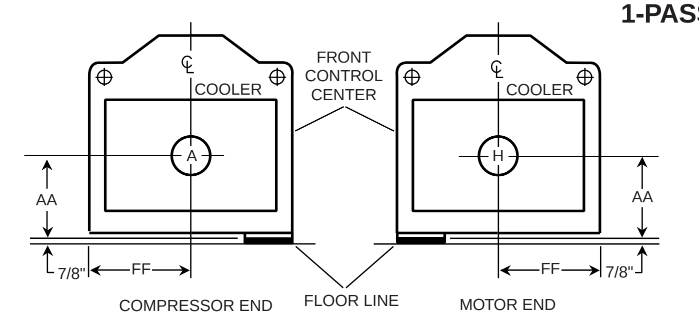
COMPRESSOR OPTION - J5 LOW STAGE / J2 (U2) OR J3 HIGH STAGE	
42" O.D. INTERCOOLER	
COOLER - CONDENSER SHELL CODES	
	XX
A	10' - 3"
B	15' - 6"
C	13' - 6"
D	18' - 0"
E	2' - 8"
F	2' - 5-1/2"
G	5' - 2"
H	2' - 0-3/4"
J	1' - 4-3/4"

CONDENSER SHELL CODES										
	NO. OF PASSES	D	E	F	G	H	J	T	V	X
K	1, 2 or 3	5-1/4"	5-1/2"	5-5/8"	5-7/8"	11-5/8"	1' - 0-1/2"	1' - 0-1/2"	1' - 1-5/8"	11-3/4"
L	1	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 8-7/8"	1' - 9-5/8"	1' - 9-5/8"	1' - 11"	1' - 7-3/8"
	2	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 6-1/8"	1' - 7-1/2"	1' - 7-1/2"	1' - 10"	1' - 7-3/8"
	3	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 4-5/8"	1' - 6-3/4"	1' - 6-3/4"	1' - 7-1/2"	1' - 7-3/8"
M	1	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 8-7/8"	1' - 9-5/8"	1' - 9-5/8"	1' - 11"	1' - 7-3/8"
	2	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 6-1/8"	1' - 7-1/2"	1' - 7-1/2"	1' - 10"	1' - 7-3/8"
	3	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 1-3/4"	1' - 8"	1' - 10"	1' - 10"	1' - 11-1/4"	1' - 7-3/8"

Dimensions (Ft. - In.) – Nozzle Arrangements

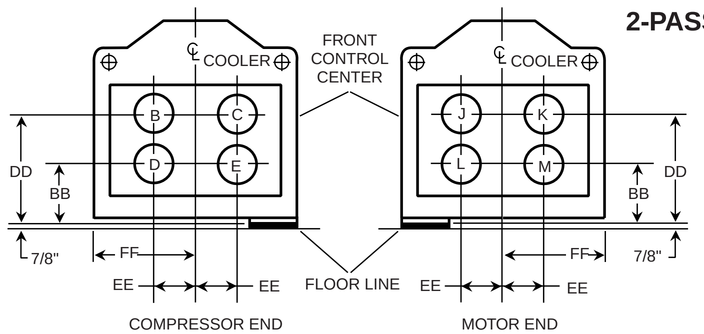
COOLERS – COMPACT WATER BOXES – H LOW STAGE COMPRESSOR UNITS

1-PASS



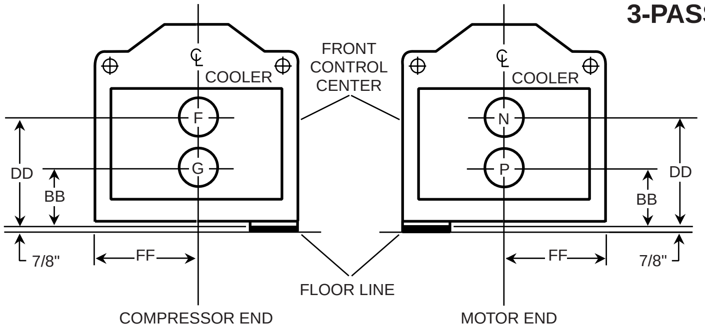
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER	
	IN	OUT
1	A	H
	H	A

2-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER	
	IN	OUT
2	D	C
	E	B
	L	K
	M	J

3-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER	
	IN	OUT
3	G	N
	P	F

LD02712

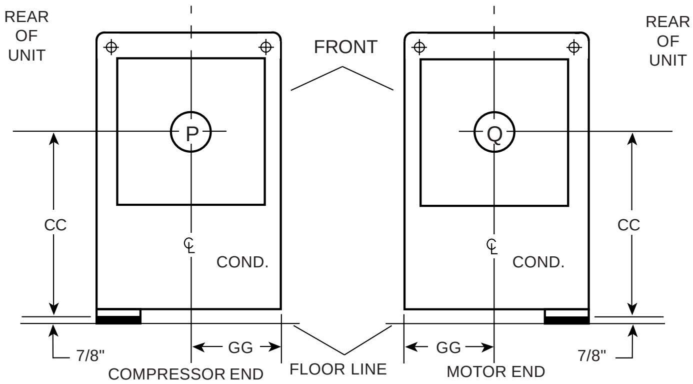
COOLER SHELL CODE	NOZZLE PIPE SIZE			COOLER NOZZLE DIMENSIONS								
	NO. OF PASSES			1-PASS		2-PASS				3-PASS		
	1	2	3	AA	FF	BB	DD	EE	FF	BB	DD	FF
F	14"	10"	8"	1'–8-1/2"	2'–0"	1'–3-1/2"	2'–1-1/2"	9"	2'–0"	1'–1-1/2"	2'–3-1/2"	2'–0"
G	16"	12"	10"	1'–9-5/8"	2'–1-1/4"	1'–3-5/8"	2'–3-5/8"	10-3/4"	2'–1-1/4"	1'–0-5/8"	2'–6-5/8"	2'–1-1/4"
H	16"	12"	10"	1'–10-3/4"	2'–3"	1'–4-3/4"	2'–4-3/4"	10-3/4"	2'–3"	1'–1-3/4"	2'–7-3/4"	2'–3"

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. Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add 7/8" for isolators as shown.
3. One-, two- and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler nozzles may be used in combination with any pair of condenser nozzles.
4. Cooler and condenser water must enter the water box through the bottom connection to achieve rated performance.
5. Connected piping should allow for removal of compact water boxes for tube access and cleaning.

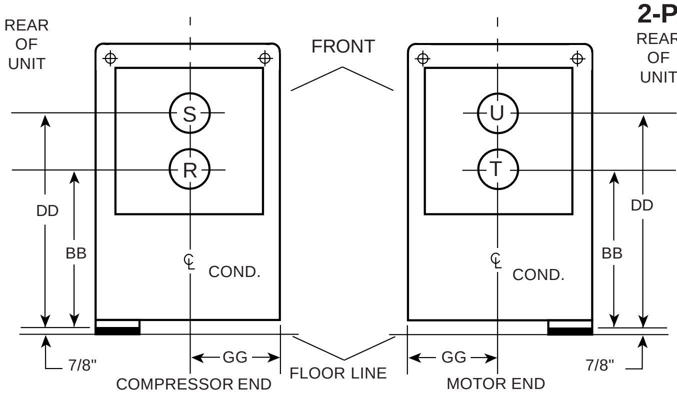
CONDENSERS – COMPACT WATER BOXES – H LOW STAGE COMPRESSOR UNITS

1-PASS



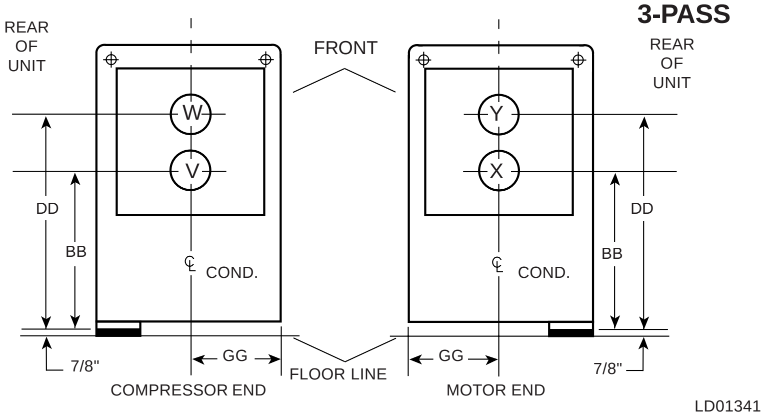
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS

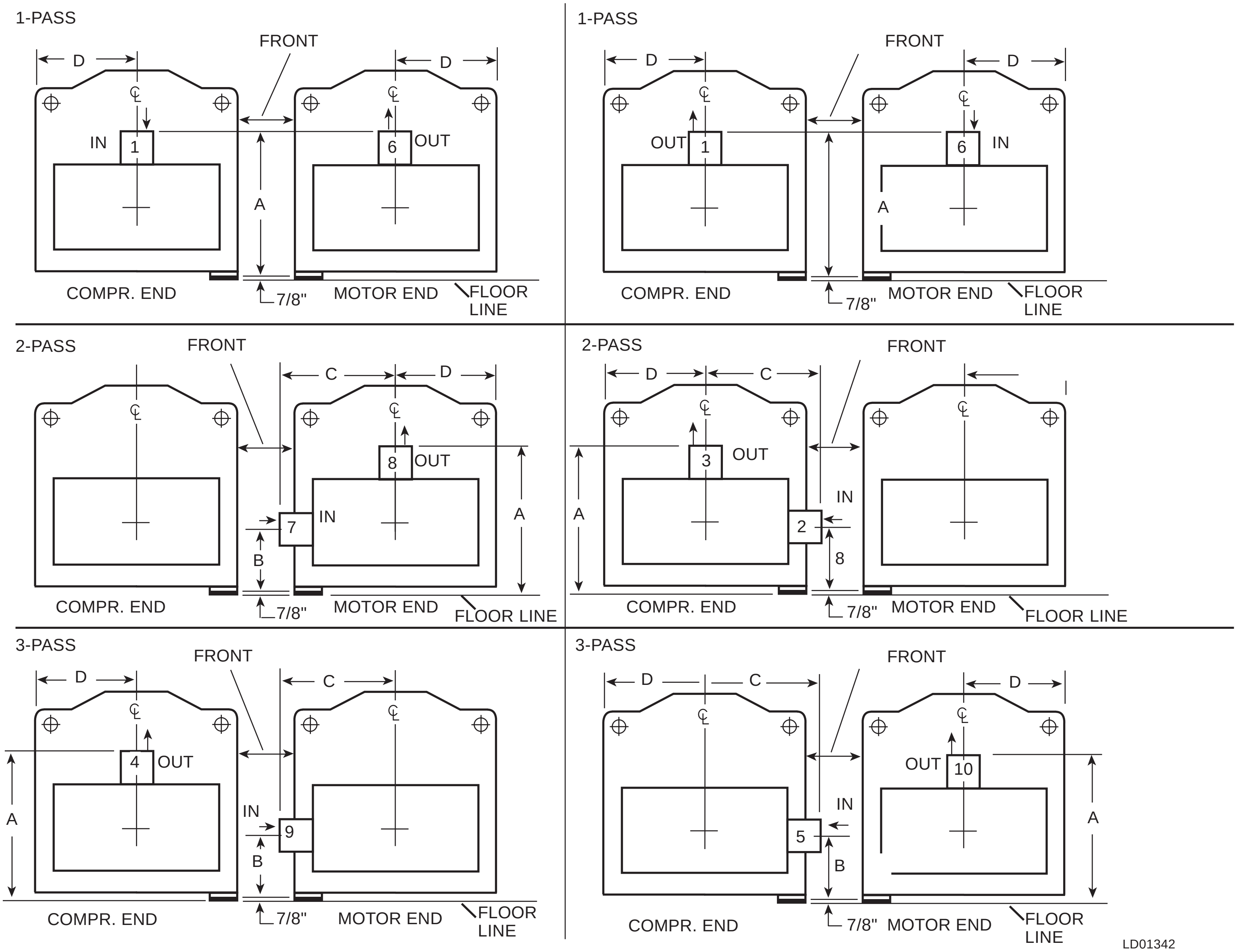


NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
3	V	Y
	X	W

CONDENSER SHELL CODE	NOZZLE PIPE SIZE			CONDENSER NOZZLE DIMENSIONS							
	NO. OF PASSES			1-PASS		2-PASS			3-PASS		
	1	2	3	CC	GG	BB	DD	GG	BB	DD	GG
D	12"	8"	6"	2'–11-3/4"	1'–5-1/2"	2'–4-3/4"	3'–6-3/4"	1–5-1/2"	2'–5-3/4"	3'–7-3/4"	1'–5-1/2"
E	14"	10"	8"	3'–1-1/4"	1'–5-1/2"	2'–6-1/4"	3'–8-3/4"	1–5-1/2"	2'–6-1/4"	3'–10-1/4"	1'–5-1/2"
F	16"	12"	10"	3'–2-3/4"	1'–7"	2'–7-3/4"	4'–0"	1'–7"	2'–6-1/4"	4'–1-1/2"	1'–7"

Dimensions (Ft. - In.) – Nozzle Arrangements

COOLERS – MARINE WATER BOXES – H LOW STAGE COMPRESSOR UNITS

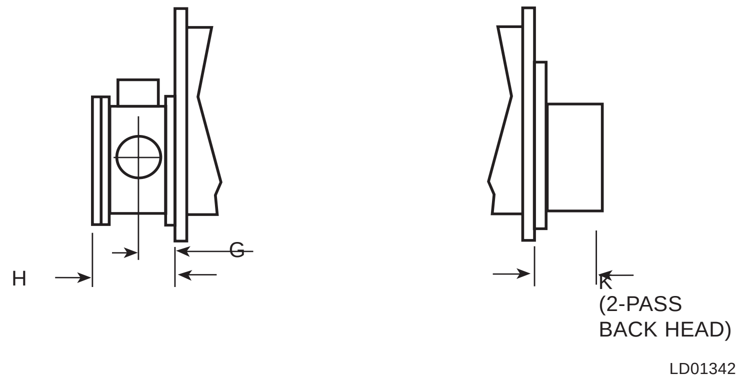


LD01342

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
F	3'–5-3/4"	2'–0"	3'–5-3/4"	1'–3-1/2"	2'–3"	2'–0"	3'–5-3/4"	1'–1-1/2"	2'–3"	2'–0"
G	3'–11-1/8"	2'–1-1/4"	3'–10-1/8"	1'–4-3/4"	2'–7"	2'–1-1/4"	3'–10-1/8"	1'–0-5/8"	2'–7"	2'–1-1/4"
H	4'–0-1/4"	2'–3"	3'–10-1/8"	1'–4-3/4"	2'–7"	2'–3"	3'–10-1/8"	1'–0-5/8"	2'–7"	2'–3"

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with 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. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 1/2" to Dim. A & C for flanged connections.
3. Add 7/8" for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Water must enter the water box through the bottom connection to achieve rated performance.



COOLER	
1-PASS	
IN	OUT
1	6
6	1

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (1-PASS)	
	G	H
F	1'–0-1/4"	2'–1-7/8"
G	1'–1-1/4"	2'–4-3/8"
H	1'–1-1/4"	2'–4-3/8"

COOLER	
2-PASS	
IN	OUT
2	3
7	8

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
F	9-3/4"	1'–8-7/8"	5-7/8"
G	11-1/4"	2'–0-3/8"	6-1/4"
H	11-1/4"	2'–0-3/8"	6-1/4"

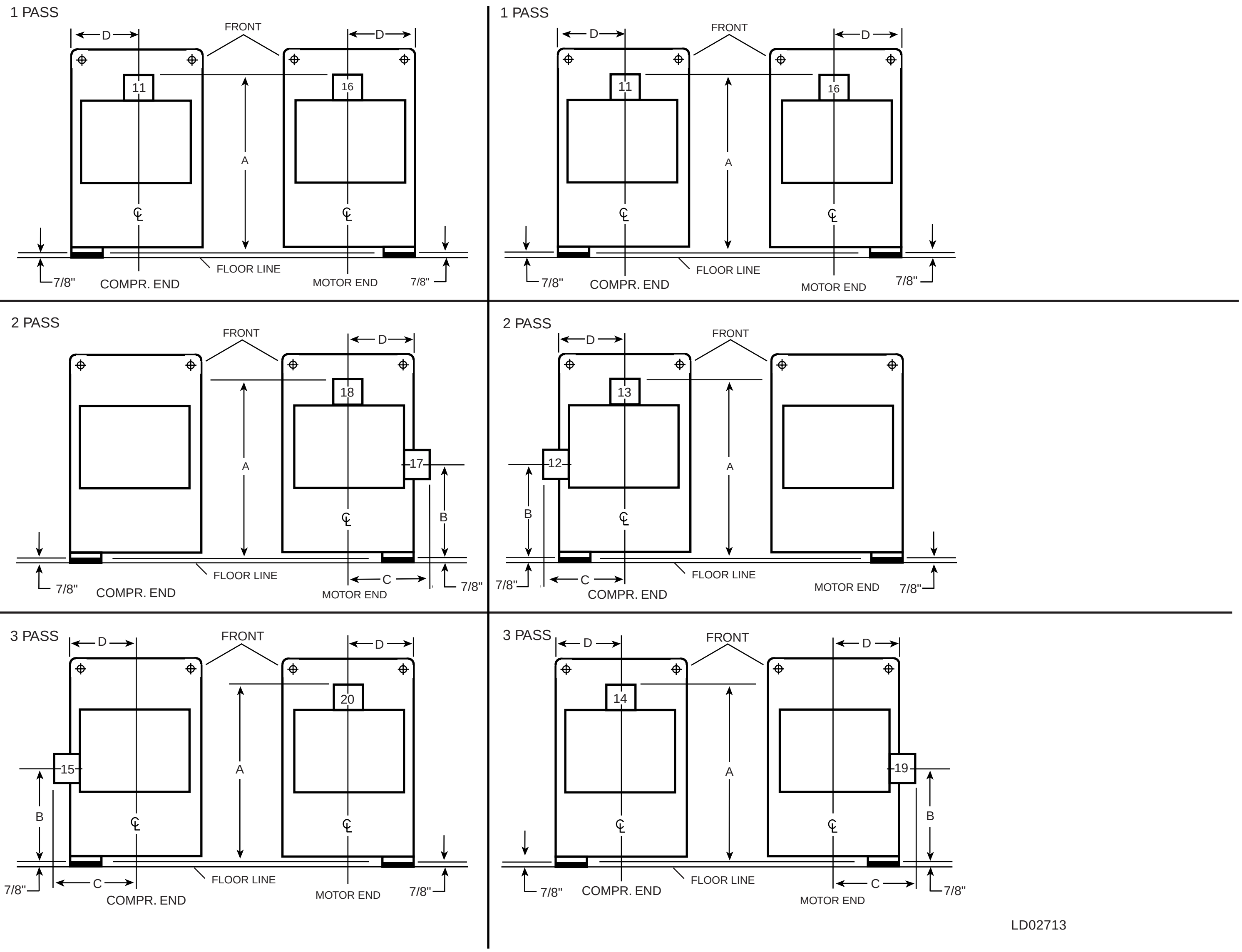
COOLER	
3-PASS	
IN	OUT
5	10
9	4

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (3-PASS)	
	G	H
F	9-3/4"	1'–8-7/8"
G	9-3/4"	1'–9-3/8"
H	9-3/4"	1'–9-3/8"

COOLER SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
F	14"	10"	8"
G	16"	12"	10"
H	16"	12"	10"

Dimensions (Ft. - In.) – Nozzle Arrangements

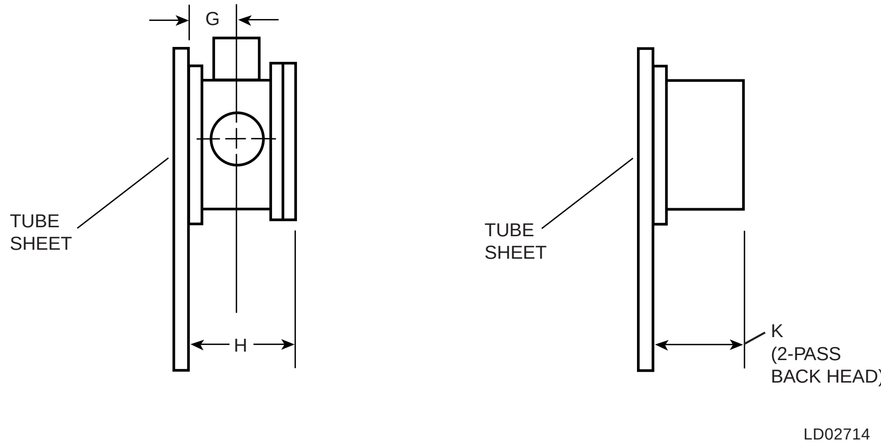
CONDENSERS – MARINE WATER BOXES – H LOW STAGE COMPRESSOR UNITS



COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
D	4'–10-1/2"	1'–5-1/2"	4'–10-1/2"	2'–7"	1'–10-3/4"	1'–5-1/2"	4'–10-1/2"	2'–6-1/2"	1'–10-3/4"	1'–5-1/2"
E	5'–1-7/8"	1'–5-1/2"	5'–1-7/8"	2'–6-3/4"	2'–0-5/8"	1'–5-1/2"	5'–1-7/8"	2'–5-1/4"	2'–0-5/8"	1'–5-1/2"
F	5'–6"	1'–7"	5'–6"	2'–7-3/4"	2'–2-1/4"	1'–7"	5'–5"	2'–6-3/4"	2'–2-1/4"	1'–7"

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with 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. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 1/2" to Dim. A & C for flanged connections.
3. Add 7/8" for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.



CONDENSER	
1-PASS	
IN	OUT
11	16
16	11

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (1-PASS)	
	G	H
D	11-1/8"	1'–11-5/8"
E	1'–0-1/4"	2'–1-7/8"
F	1'–1-1/4"	2'–4"

CONDENSER	
2-PASS	
IN	OUT
12	13
17	18

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
D	8-5/8"	1'–6-5/8"	5-1/2"
E	9-3/4"	1'–8-7/8"	5-3/4"
F	11-1/4"	2'–0"	5-3/4"

CONDENSER	
3-PASS	
IN	OUT
15	20
19	14

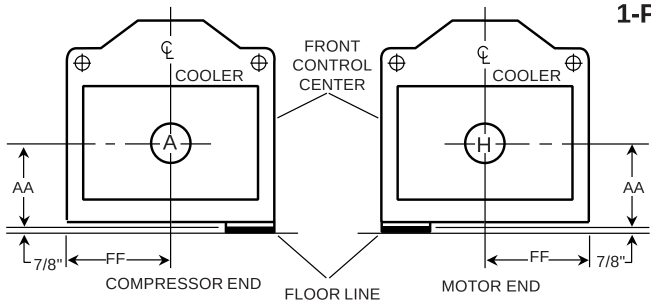
CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (3-PASS)	
	G	H
D	7-5/8"	1'–4-5/8"
E	8-3/4"	1'–6-7/8"
F	9-3/4"	1'–9"

COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
D	12"	8"	6"
E	14"	10"	8"
F	16"	12"	10"

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

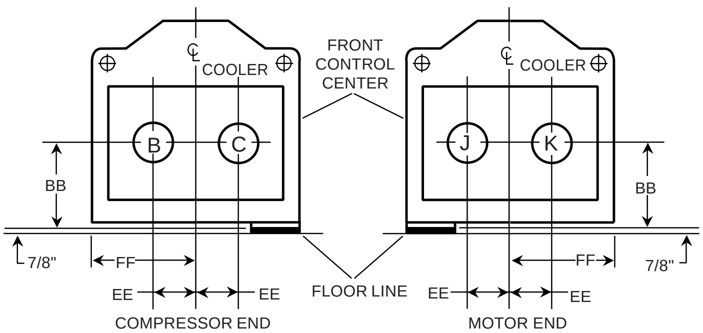
COOLERS – COMPACT WATER BOXES – J LOW STAGE COMPRESSOR UNITS

1-PASS



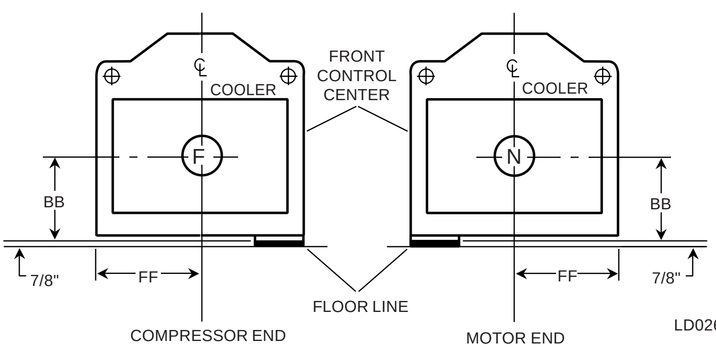
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER IN	COOLER OUT
1	A	H
	H	A

2-PASS



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

3-PASS



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

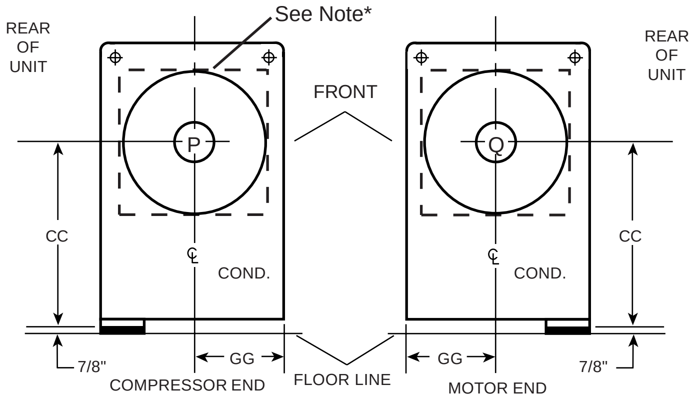
COOLER SHELL CODE	NOZZLE PIPE SIZE			COOLER NOZZLE DIMENSIONS						
	NO. OF PASSES			1-PASS		2-PASS			3-PASS	
	1	2	3	AA	FF	BB	EE	FF	BB	FF
G	14"	10"	8"	1'–11-1/8"	2'–0"	1'–11-1/8"	11"	2'–0"	1'–11-1/8"	2'–0"
H F	16"	12"	10"	2'–0-3/4"	2'–2-1/4"	2'–0-3/4"	11"	2'–2-1/4"	2'–0-3/4"	2'–2-1/4"
H H	16"	12"	10"	2'–1-1/2"	2'–2-1/4"	2'–1-1/2"	11"	2'–2-1/4"	2'–1-1/2"	2'–2-1/4"
J	18"	14"	12"	2'–1-3/4"	2'–5-1/2"	2'–1-3/4"	11"	2'–5-1/2"	2'–1-3/4"	2'–5-1/2"
T	18"	14"	12"	2'–1-3/4"	2'–5-1/2"	2'–1-3/4"	11"	2'–5-1/2"	2'–1-3/4"	2'–5-1/2"
V	20"	16"	12"	2'–5-1/4"	2'–5-1/2"	2'–5-1/4"	1'–1"	2'–5-1/2"	2'–5-1/4"	2'–5-1/2"
W	20"	18"	14"	2'–7-1/4"	2'–8"	2'–7-1/4"	1'–3"	2'–8"	2'–7-1/4"	2'–8"

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. Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add 7/8" for isolators as shown.
3. One-, two- and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler nozzles may be used in combination with any pair of condenser nozzles.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.

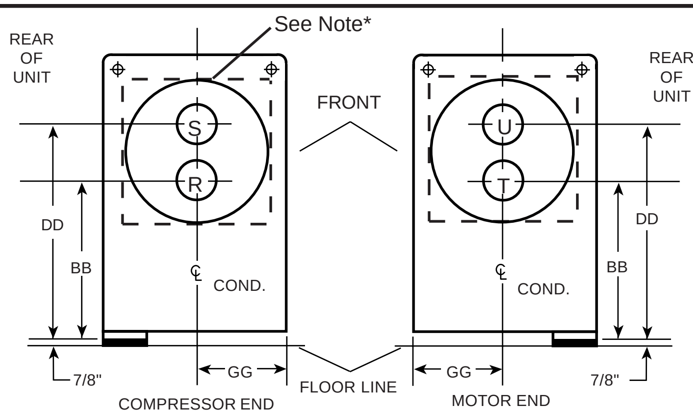
CONDENSERS – COMPACT WATER BOXES – J LOW STAGE COMPRESSOR UNITS

1-PASS



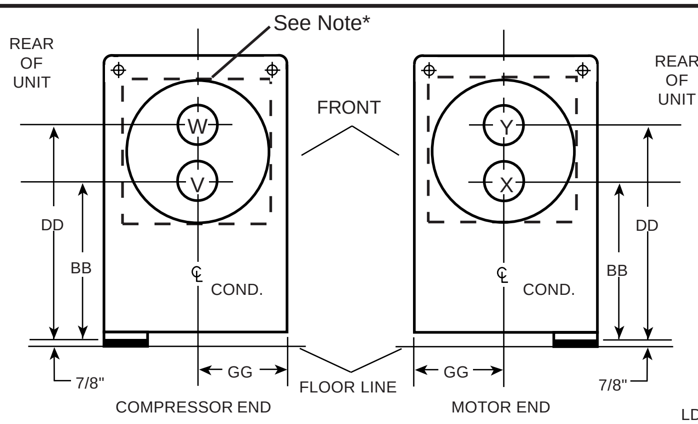
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS



LD02677

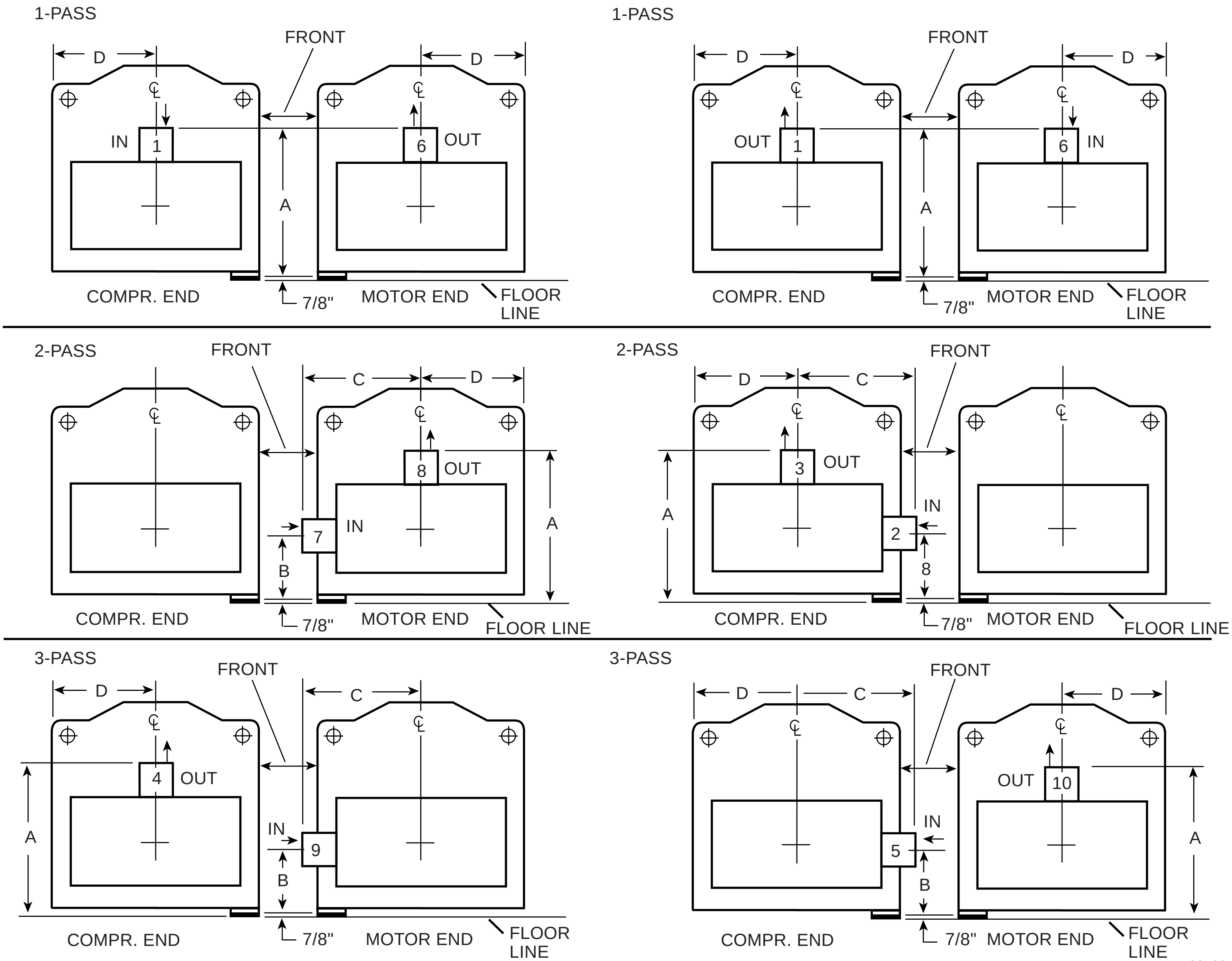
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
3	V	Y
	X	W

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

NOTE: "G" Condenser Water Boxes are square; other codes are round as shown.

Dimensions (Ft. - In.) – Nozzle Arrangements

COOLERS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS



LD02708

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
G	3'–9-1/8"	2'–0"	3'–9-1/8"	1'–6-1/4"	2'–5"	2'–0"	3'–9-1/8"	1'–4-1/8"	2'–5"	2'–0"
H F	4'–5-1/4"	2'–2-1/4"	4'–5-1/4"	2'–2-3/4"	2'–7-1/4"	2'–2-1/4"	4'–5-1/4"	2'–1-3/4"	2'–7-1/4"	2'–2-1/4"
H H	4'–6"	2'–2-1/4"	4'–6"	2'–3-1/2"	2'–7-1/4"	2'–2-1/4"	4'–6"	2'–2-1/2"	2'–7-1/4"	2'–2-1/4"
J	3'–11-3/4"	2'–5-1/2"	3'–11-3/4"	1'–9-3/4"	2'–10-1/4"	2'–5-1/2"	3'–11-3/4"	1'–8-3/4"	2'–10-1/4"	2'–5-1/2"
T	3'–11-3/4"	2'–5-1/2"	3'–11-3/4"	1'–9-3/4"	2'–10-1/4"	2'–5-1/2"	3'–11-3/4"	1'–8-3/4"	2'–10-1/4"	2'–5-1/2"
V	4'–3-1/4"	2'–5-1/2"	4'–3-1/4"	2'–1-1/2"	2'–10-1/4"	2'–5-1/2"	4'–3-1/4"	1'–11-7/8"	2'–10-1/4"	2'–5-1/2"
W	4'–6-1/2"	2'–6"	4'–6-1/2"	2'–3-1/2"	3'–2"	2'–6"	4'–6-1/2"	2'–1-1/2"	3'–1-7/8"	2'–6"

NOTES:

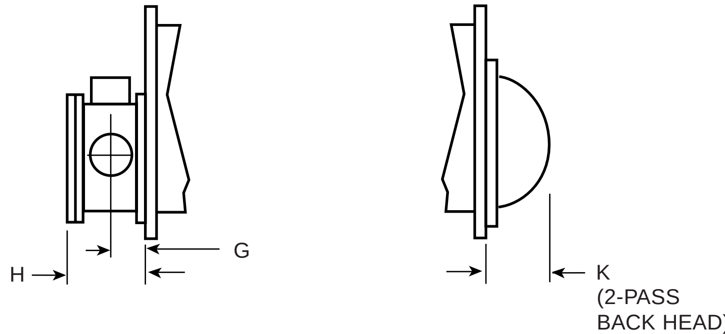
1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 1/2" to Dim. A & C for flanged connections.
3. Add 7/8" for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Water must enter the water box through the bottom connection to achieve rated performance.

COOLER	
1-PASS	
IN	OUT
1	6
6	1

COOLER	
2-PASS	
IN	OUT
2	3
7	8

COOLER	
3-PASS	
IN	OUT
5	10
9	4

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



LD02708

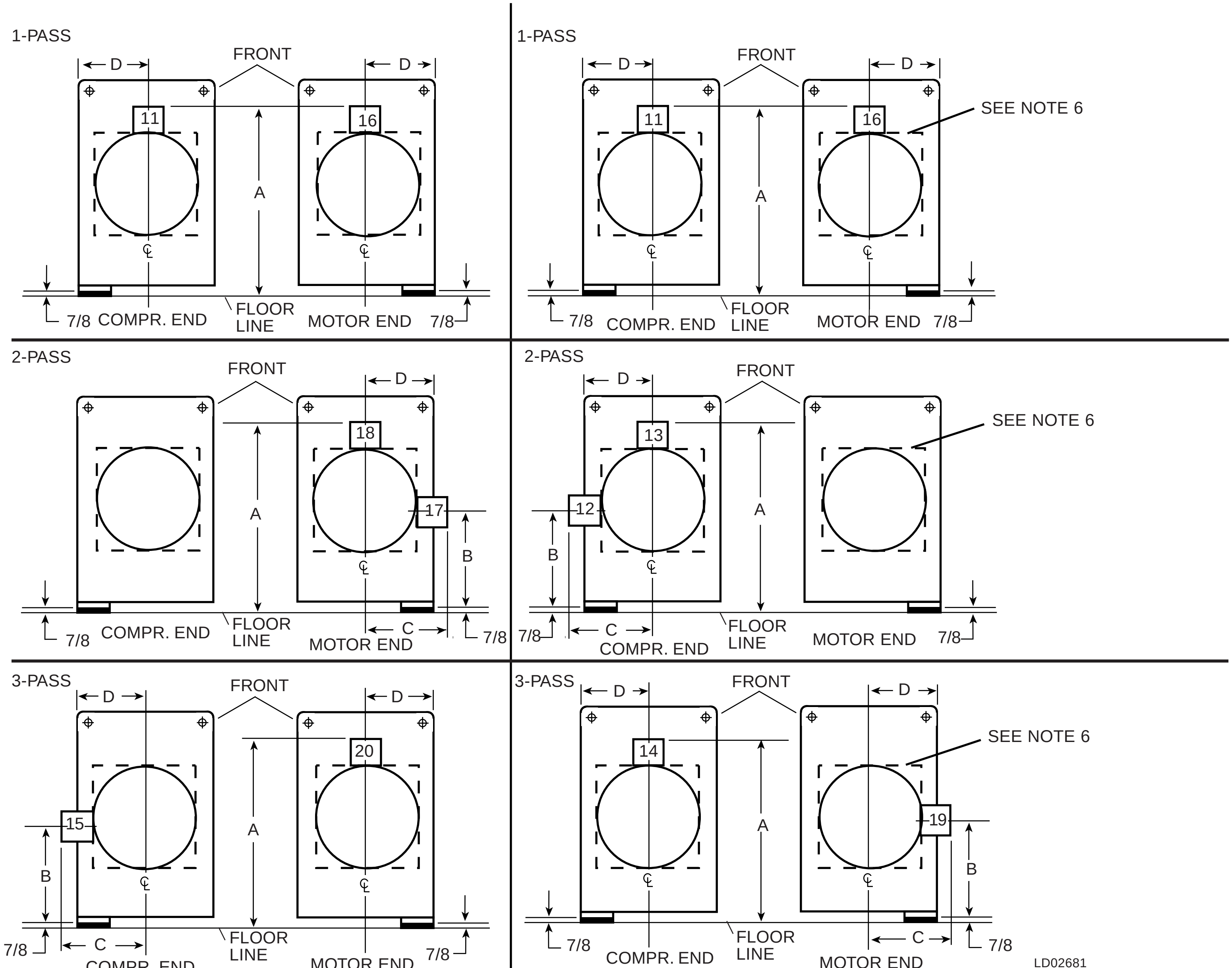
COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (1-PASS)	
	G	H
G	1'–0-3/8"	2'–2-1/2"
H	1'–1-3/8"	2'–4-3/4"
J	1'–2-3/8"	2'–6-3/4"
T	1'–2-3/8"	2'–6-3/4"
V	1'–4"	2'–10"
W	1'–4"	2'–10"

COOLER SHELL CODE	COOLER 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	1'–0-3/8"	2'–2-3/4"	1'–2-3/4"
T	1'–0-3/8"	2'–2-3/4"	1'–2-3/4"
V	1'–2"	2'–6"	1'–2-3/4"
W	1'–3"	2'–6"	1'–4-1/2"

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (3-PASS)	
	G	H
G	9-3/8"	1'–8-1/2"
H	10-3/8"	1'–10-1/2"
J	11-3/8"	2'–0-3/4"
T	11-3/8"	2'–0-3/4"
V	1'–0-3/8"	2'–2-3/4"
W	1'–1"	2'–4"

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

CONDENSERS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS

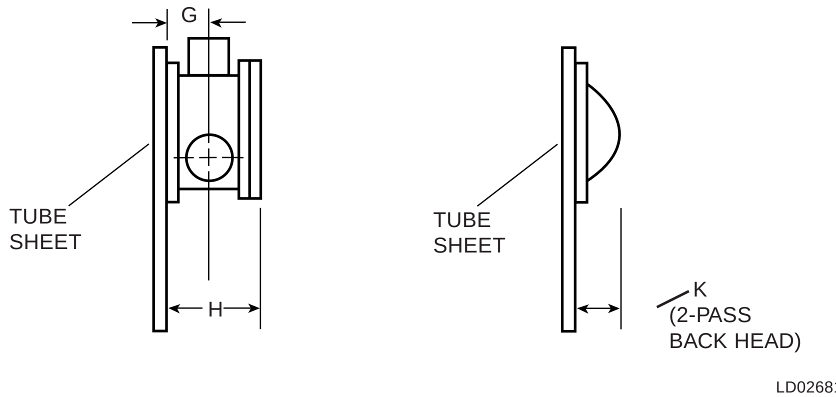


COND. SHELL CODE	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
G	5'–9-3/4"	1'–9"	5'–9-3/4"	2'–8-3/4"	2'–5"	1'–9"	5'–9-3/4"	2'–7-1/4"	2'–5"	1'–9"
H	5'–11"	1'–11"	5'–10-1/4"	2'–0-3/4"	2'–1"	1'–11"	5'–9-7/8"	2'–1-1/8"	1'–11-3/4"	1'–11"
J	6'–3-3/8"	2'–1"	6'–2-3/8"	2'–1-1/2"	2'–1-1/8"	2'–1"	6'–1-7/8"	2'–1-3/4"	2'–1-7/8"	2'–1"
T	6'–3-3/8"	2'–1"	6'–2-3/8"	2'–1-1/2"	2'–1-1/8"	2'–1"	6'–1-7/8"	2'-1-3/4"	2'–1-7/8"	2'–1"
V	6'–8-3/4"	2'–3-1/2"	6'–8-1/8"	2'–1-3/4"	2'–5-3/8"	2'–3-1/2"	6'–7"	2'–2-1/2"	2'–3-3/4"	2'–3-1/2"

CONDENSER NOZZLE DIMENSIONS

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with 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. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 1/2" to Dim. A & C for flanged connection.
3. Add 7/8" for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
6. "G" Condenser Water Boxes are square; other codes are round as shown.



CONDENSER	
1-PASS	
IN	OUT
11	16
16	11

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	1'–3-1/2"	2'–8-7/8"
T	1'–3-1/2"	2'–8-7/8"
V	1'–3-1/2"	2'–9-3/8"

CONDENSER	
2-PASS	
IN	OUT
12	13
17	18

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

CONDENSER	
3-PASS	
IN	OUT
15	20
19	14

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	1'–0-1/4"	2'–2-3/8"
T	1'–0-1/4"	2'–2-3/8"
V	1'–0-1/4"	2'–2-3/4"

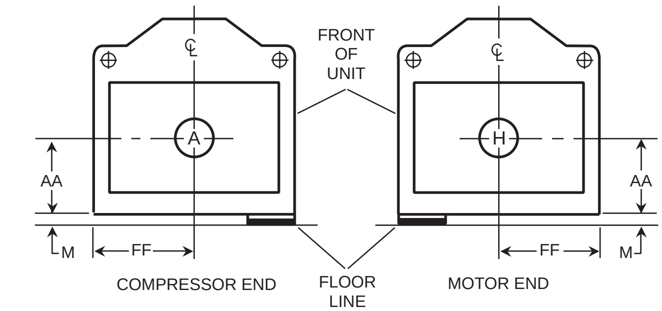
COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
G	16"	14"	10"
H	20"	16"	12"
J	20"	16"	14"
T	20"	16"	14"
V	20"	18"	14"

ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR	
TYPE OF CHILLER MOUNTING	**M**
NEOPRENE PAD ISOLATORS	1-3/4"
SPRING ISOLATORS 1" (25mm) DEFLECTION	1"
DIRECT MOUNT	3/4"

Dimensions (Ft. - In.) – Nozzle Arrangements

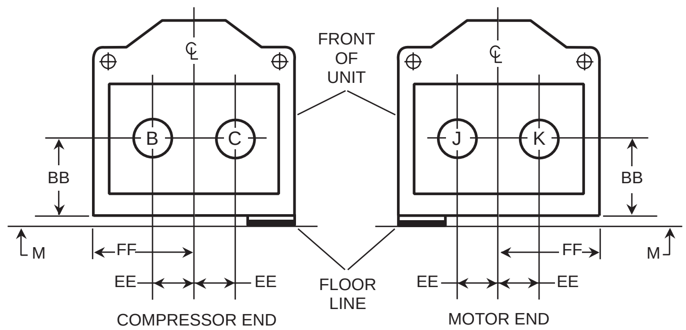
EVAPORATORS – COMPACT WATER BOXES – J LOW STAGE COMPRESSOR UNITS

1-PASS



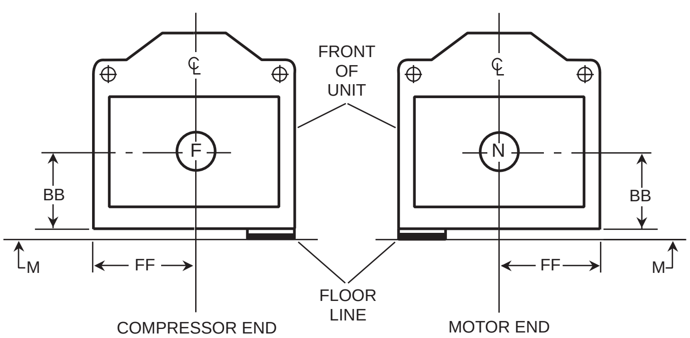
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER IN	COOLER OUT
1	A	H
	H	A

2-PASS



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

3-PASS



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

LD07173

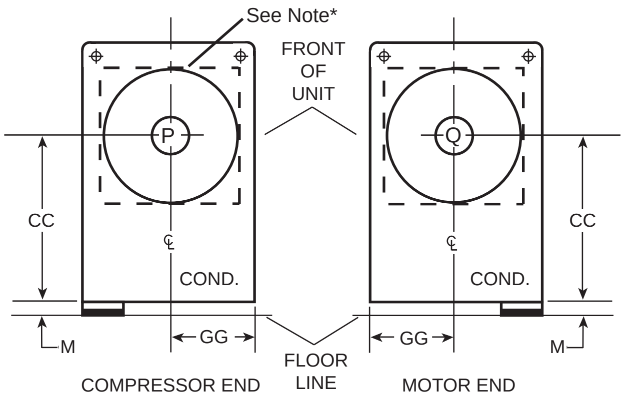
EVAP. SHELL CODE	EVAPORATOR									
	NOZZLE PIPE SIZE			NOZZLE DIMENSIONS						
	NO. OF PASSES			1-PASS		2-PASS			3-PASS	
	1	2	3	AA[2]	FF	BB[2]	EE	FP	BB[2]	FF
X	20"	18"	14"	2'–6-1/2"	2'–8"	2'–6-1/2"	1'–3"	2'–8"	2'–6-1/2"	2'–8"

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 pg. 35 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 cooler nozzles may be used in combination with any pair of condenser nozzles.
4. Connected piping should allow for removal of compact water boxes for tube access and cleaning.

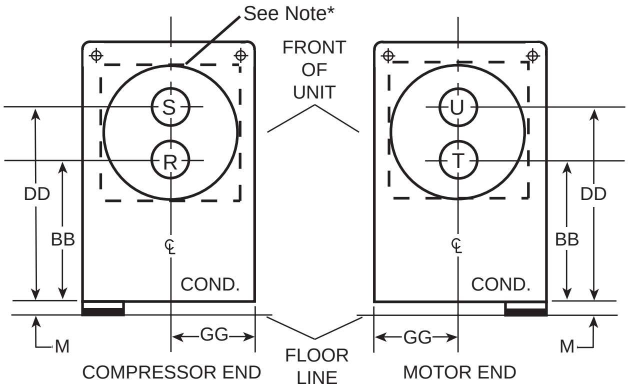
CONDENSERS – COMPACT WATER BOXES – J LOW STAGE COMPRESSOR UNITS

1-PASS



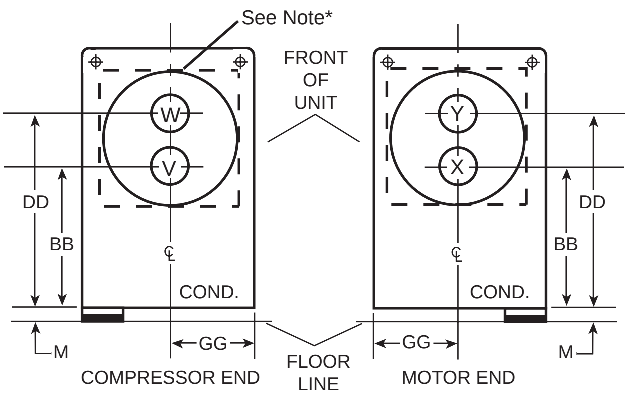
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
1	P	Q
	Q	P

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

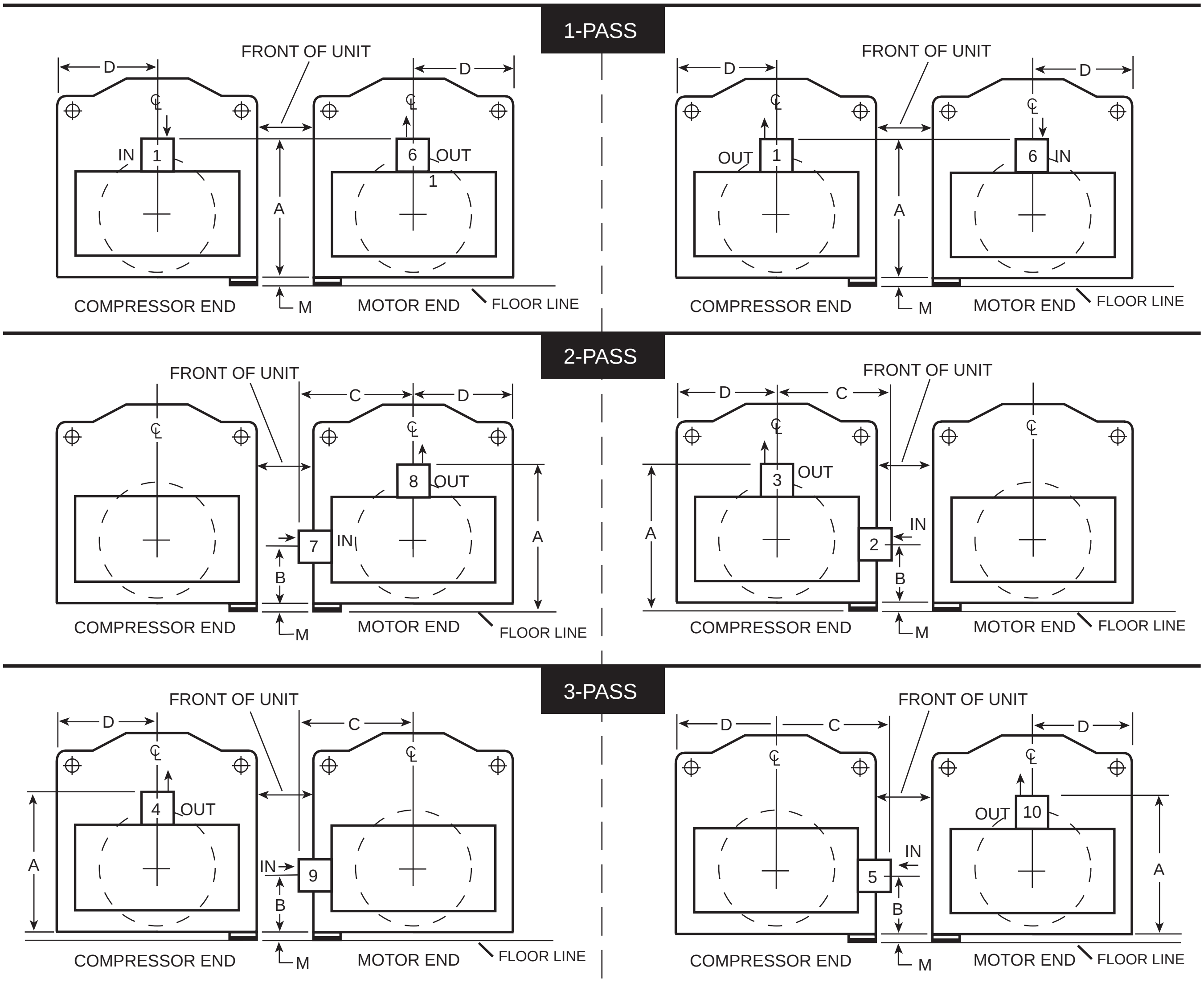
LD07174

EVAP. SHELL CODE	NOZZLE PIPE SIZE			EVAPORATOR NOZZLE DIMENSIONS							
	NO. OF PASSES			1-PASS		2-PASS			3-PASS		
	1	2	3	CC[2]	GG	BB[2]	DD[2]	GG	BB[2]	FF	GG
X	24"	18"	16"	3'–5-3/4"	2'–5-1/2"	2'–4"	4'–6"	2'–5-1/2"	2'–4"	4'–6"	2'–5-1/2"

NOTES: See page 36.

Dimensions (Ft. - In.) – Nozzle Arrangements

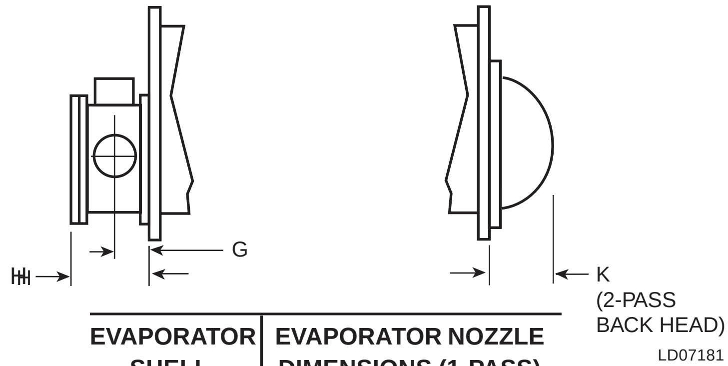
EVAPORATORS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS



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
X	4'–5-3/4"	2'–8"	4'–5-3/4"	2'–2-3/4"	3'–2"	2'–8"	4'–5-3/4"	2'–0-3/4"	3'–1-7/8"	2'–8"

See notes on page 39.

EVAPORATOR	
1-PASS	
IN	OUT
1	6
6	1



EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (1-PASS)	
	G	H
X	1'–3-1/2"	2'–10"

EVAPORATOR	
2-PASS	
IN	OUT
2	3
7	8

EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
X	1'–2-1/2"	2'–8"	1'–4-1/2"

EVAPORATOR	
3-PASS	
IN	OUT
5	10
9	4

EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS (3-PASS)	
	G	H
X	1'–0-1/2"	2'–4"

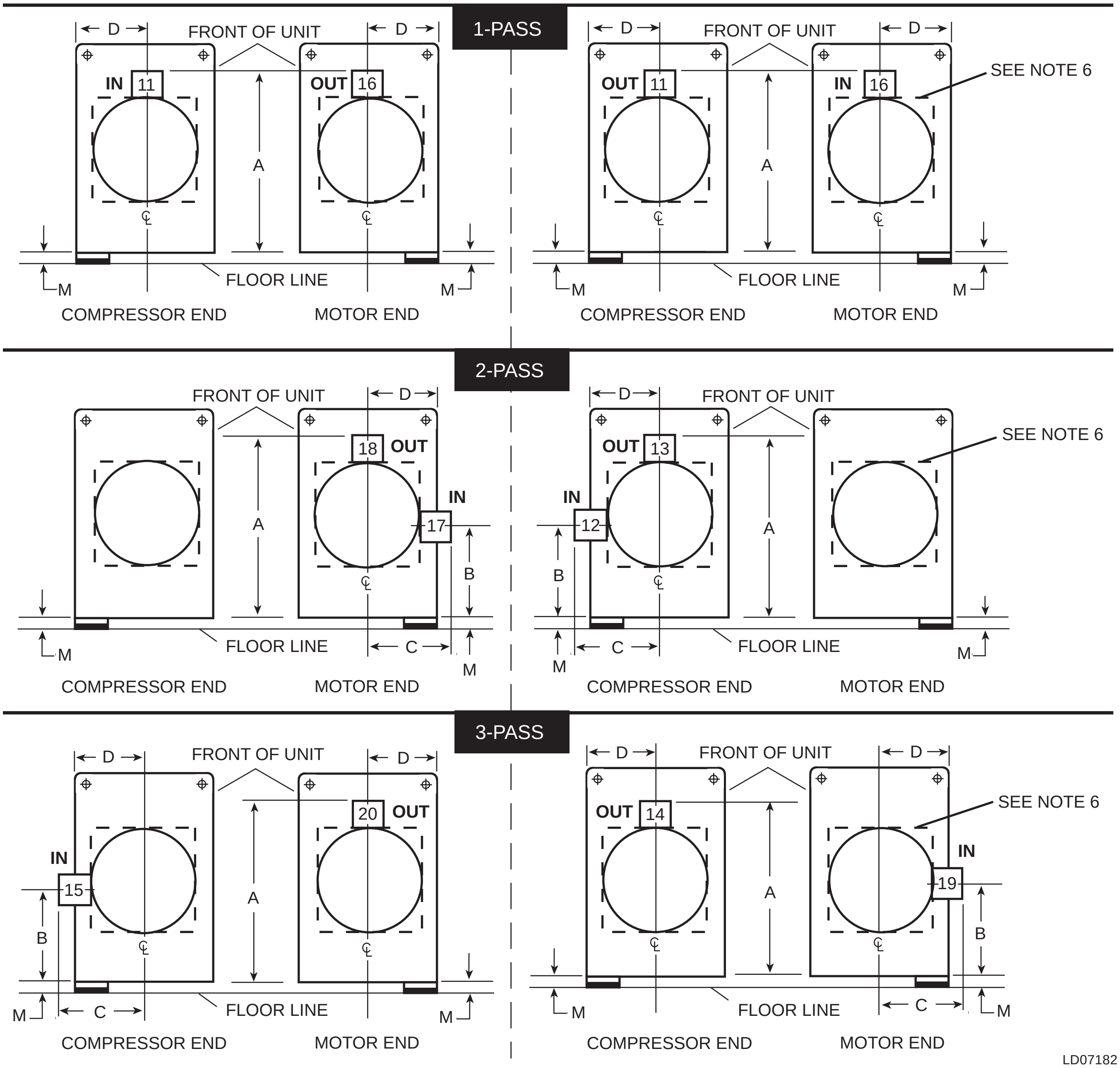
EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
X	20"	18"	14"

ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR	
TYPE OF CHILLER MOUNTING	M
NEOPRENE PAD ISOLATORS	1-3/4"
SPRING ISOLATORS 1" (25mm) DEFLECTION	1"
DIRECT MOUNT	3/4"

NOTES (see table on page 38):
1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Standard wall (0.375") pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension “M” as shown in the above table for the appropriate isolator type.

Dimensions (Ft. - In.) – Nozzle Arrangements

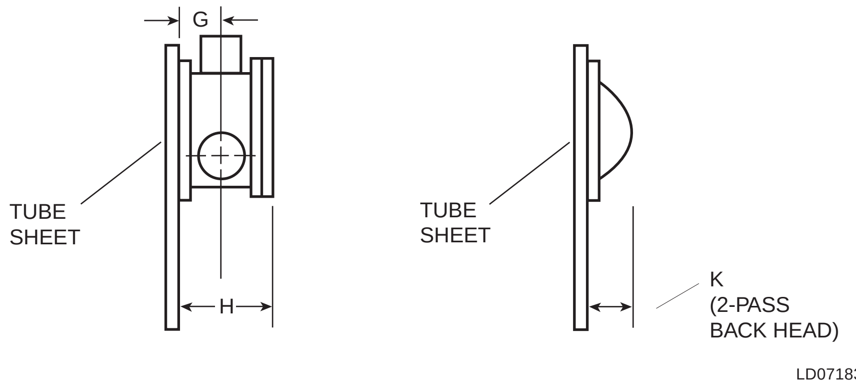
CONDENSERS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS



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
X	6'–5"	2'–5-1/2"	6'–5"	2'–5-1/2"	2'–10"	2'–5-1/2"	6'–5"	2'–2-9/16"	2'–10'	2'–5-1/2"

See Notes on page 41.

CONDENSER	
1-PASS	
IN	OUT
11	16
16	11



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

CONDENSER	
2-PASS	
IN	OUT
12	13
17	18

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

CONDENSER	
3-PASS	
IN	OUT
15	20
19	14

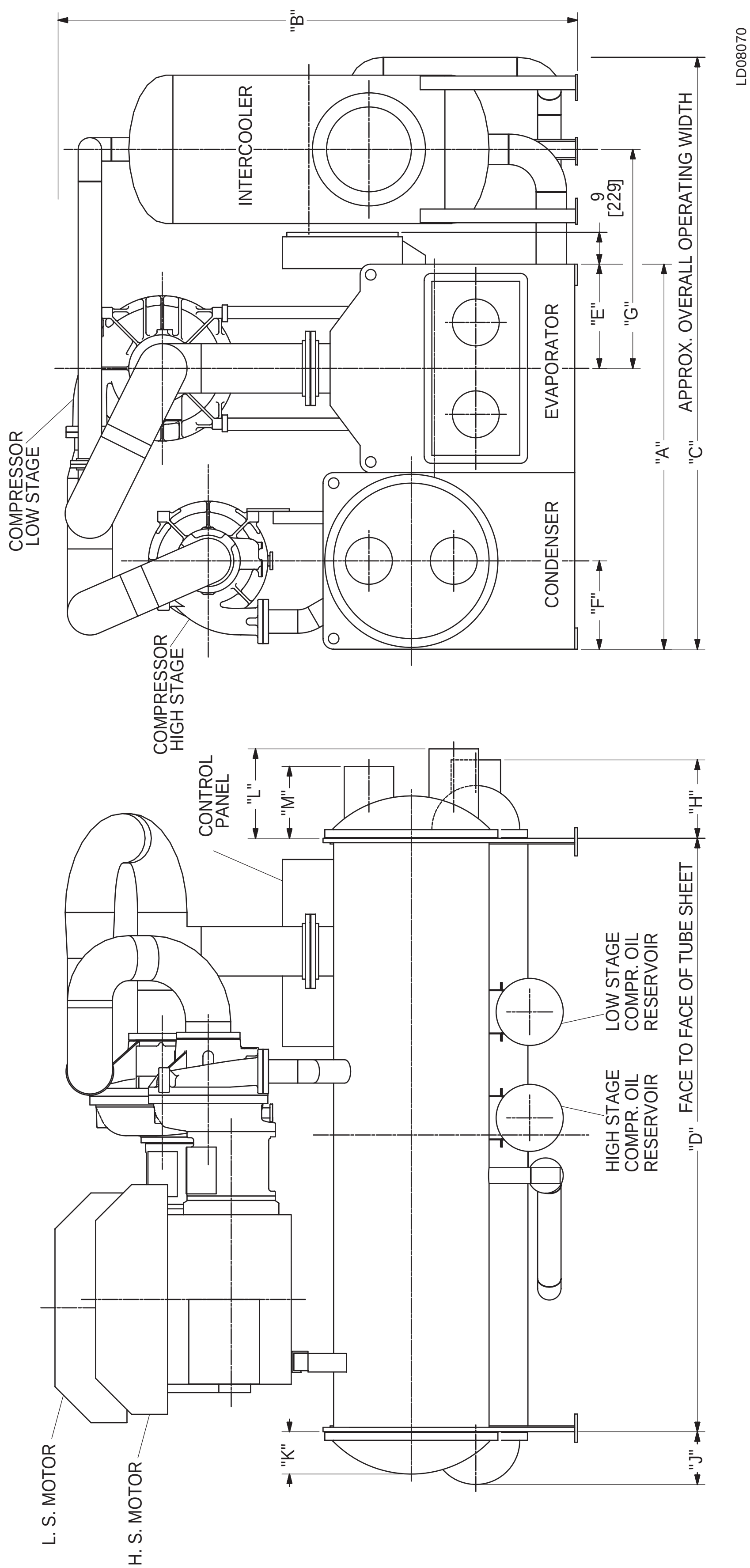
CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	COND. NOZZLE DIMENSIONS (3-PASS)	
		G	H
X	150	1'–1-5/8"	2'–5-3/4"
	300	1'–3-15/16"	2'–11-3/8"

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

NOTES (see table on page 40):

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are standard wall (0.375) pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1/16" raised face), water flanged nozzles are optional (add 1/2" to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
5. Add dimension “M” as shown on pg 39 for the appropriate isolator type.

Dimensions (mm) – Unit



COMPRESSOR OPTION - H6 OR H7 LOW STAGE / H0 HIGH STAGE									
30" O.D. INTERCOOLER									
COOLER - CONDENSER SHELL CODES									
	F–D	F–E	F–F	G–D	G–E	G–F	H–D	H–E	H–F
A	2,108	2,108	2,184	2,172	2,172	2,248	2,261	2,261	2,337
B	3,962	3,962	3,962	3,962	3,962	3,962	3,962	3,962	3,962
C	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658
D	4,267	4,267	4,267	4,267	4,267	4,267	4,267	4,267	4,267
E	610	610	610	641	641	641	686	686	686
F	445	445	483	445	445	483	445	445	483
G	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422
H	350	350	350	350	350	350	350	350	350
J	143	143	143	153	153	153	153	153	153

COMPRESSOR OPTION 1 - J1 LOW STAGE / H1 (H5) HIGH STAGE									
COMPRESSOR OPTION 2 - J2 LOW STAGE / H2 (H6) OR H3 (H8) HIGH STAGE									
30" O.D. INTERCOOLER									
COOLER - CONDENSER SHELL CODES									
	G–F	G–G	G–J	H–F	H–G	H–J	J–F	J–G	J–J
A	2,184	2,286	2,489	2,299	2,400	2,604	2,464	2,565	2,769
B	3,962	3,962	3,962	3,962	3,962	3,962	3,962	3,962	3,962
C	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658
D	4,267	4,267	4,267	4,267	4,267	4,267	4,267	4,267	4,267
E	610	610	610	667	667	667	749	749	749
F	483	533	635	483	533	635	483	533	635
G	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422
H	603	603	603	603	603	603	603	603	603
J	375	375	375	375	375	375	375	375	375

COMPRESSOR OPTION - J3 LOW STAGE / H3 (H7) OR J1 (U1) HIGH STAGE						
36" O.D. INTERCOOLER						
COOLER - CONDENSER SHELL CODES						
	H–F	H–G	H–H	J–F	J–G	J–H
A	2,299	2,400	2,502	2,464	2,565	2,667
B	4,267	4,267	4,267	4,267	4,267	4,267
C	3,962	3,962	3,962	3,962	3,962	3,962
D	4,267	4,267	4,267	4,267	4,267	4,267
E	667	667	667	749	749	749
F	483	533	584	483	533	584
G	1,524	1,524	1,524	1,524	1,524	1,524
H	603	603	603	603	603	603
J	375	375	375	375	375	375

Dimensions (mm) – Unit (continued)

COMPRESSOR OPTION - J3 LOW STAGE / H3 (H7) OR J1 (U1) HIGH STAGE						
36" O.D. INTERCOOLER						
COOLER - CONDENSER SHELL CODES						
	T–T	T–V	V–T	V–V	W–T	W–V
A	2,769	2,896	2,769	2,896	2,896	3,023
B	4,420	4,420	4,420	4,420	4,420	4,420
C	4,115	4,115	4,115	4,115	4,115	4,115
D	4,877	4,877	4,877	4,877	4,877	4,877
E	749	749	749	749	813	813
F	635	699	635	699	635	699
G	1,524	1,524	1,524	1,524	1,524	1,524
H	603	603	603	603	629	629
J	375	375	375	375	426	426

COMPRESSOR OPTION - J4 LOW STAGE / J1 (U1) OR J2 (U2) HIGH STAGE							
42" O.D. INTERCOOLER							
COOLER - CONDENSER SHELL CODES							
	J–J	T–T	T–V	V–T	V–V	W–T	W–V
A	2,769	2,769	2,896	2,769	2,896	2,896	3,023
B	4,572	4,572	4,572	4,572	4,572	4,572	4,572
C	4,115	4,115	4,115	4,115	4,115	4,115	4,115
D	4,267	4,877	4,877	4,877	4,877	4,877	4,877
E	749	749	749	749	749	813	813
F	635	635	699	635	699	635	699
G	1,575	1,575	1,575	1,575	1,575	1,575	1,575
H	603	603	603	603	603	629	629
J	375	375	375	375	375	426	426

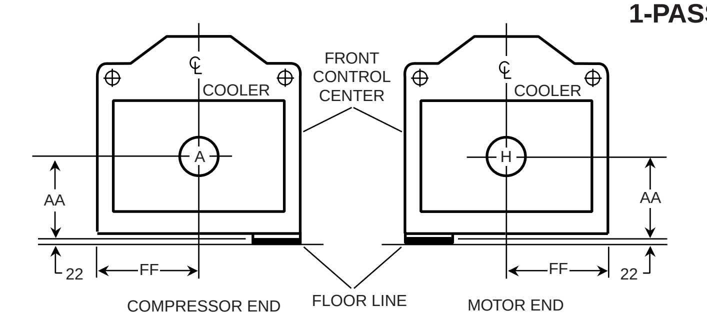
COMPRESSOR OPTION - J5 LOW STAGE / J2 (U2) OR J3 HIGH STAGE	
42" O.D. INTERCOOLER	
COOLER - CONDENSER SHELL CODES	
	XX
A	3,124
B	4,724
C	4,115
D	5,486
E	813
F	749
G	1,575
H	629
J	426

CONDENSER SHELL CODES										
	NO. OF PASSES	D	E	F	G	H	J	T	V	X
K	1, 2 or 3	133	140	143	149	295	318	318	346	299
L	1	349	349	349	349	530	549	549	4,267	492
	2	349	349	349	349	460	495	495	3,962	492
	3	349	349	349	349	422	476	476	4,267	492
M	1	349	349	349	349	530	549	549	749	492
	2	349	349	349	349	460	495	495	584	492
	3	349	349	349	349	508	559	559	1,524	492

Dimensions (mm) – Nozzle Arrangements

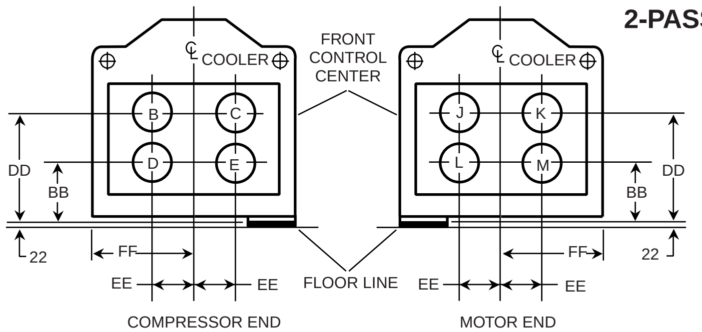
COOLERS – COMPACT WATER BOXES – H LOW STAGE COMPRESSOR UNITS

1-PASS



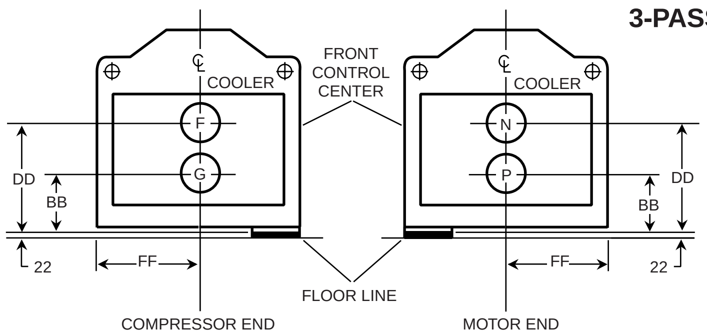
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER	
	IN	OUT
1	A	H
	H	A

2-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER	
	IN	OUT
2	D	C
	E	B
	L	K
	M	J

3-PASS



NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER	
	IN	OUT
3	G	N
	P	F

LD02712

COOLER SHELL CODE	NOZZLE PIPE SIZE			COOLER NOZZLE DIMENSIONS								
	NO. OF PASSES			1-PASS		2-PASS				3-PASS		
	1	2	3	AA	FF	BB	DD	EE	FF	BB	DD	FF
F	14"	10"	8"	521	610	394	648	229	610	343	699	610
G	16"	12"	10"	549	641	397	702	273	641	321	778	641
H	16"	12"	10"	578	686	425	730	273	686	349	806	686

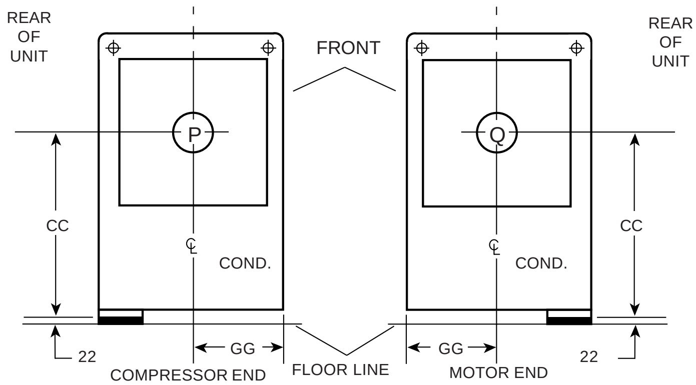
NOTES:

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. Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add 22 mm for isolators as shown.
3. One-, two- and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler nozzles may be used in combination with any pair of condenser nozzles.
4. Cooler and condenser water must enter the water box through the bottom connection to achieve rated performance.
5. Connected piping should allow for removal of compact water boxes for tube access and cleaning.

Dimensions (mm) – Nozzle Arrangements

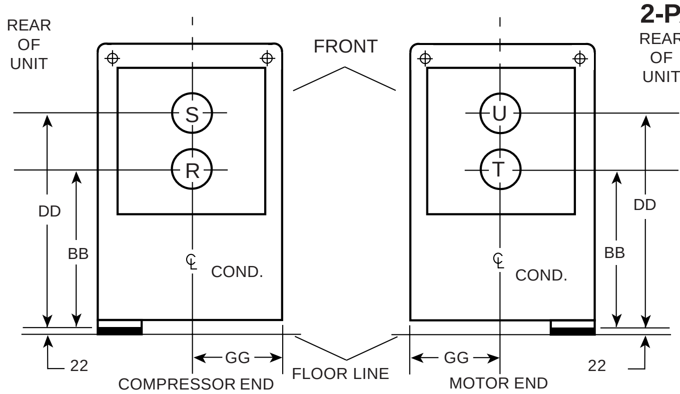
CONDENSERS – COMPACT WATER BOXES – H LOW STAGE COMPRESSOR UNITS

1-PASS



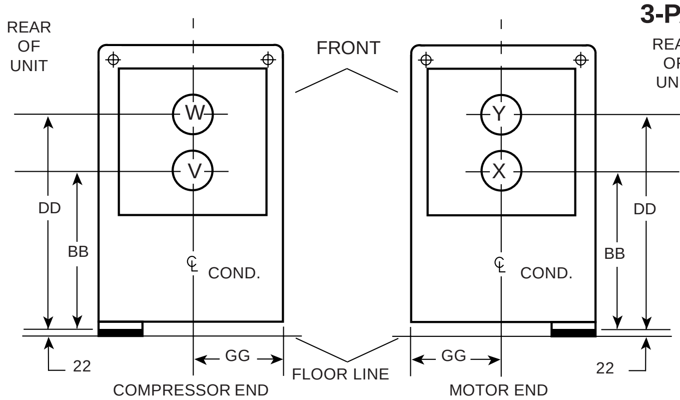
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS

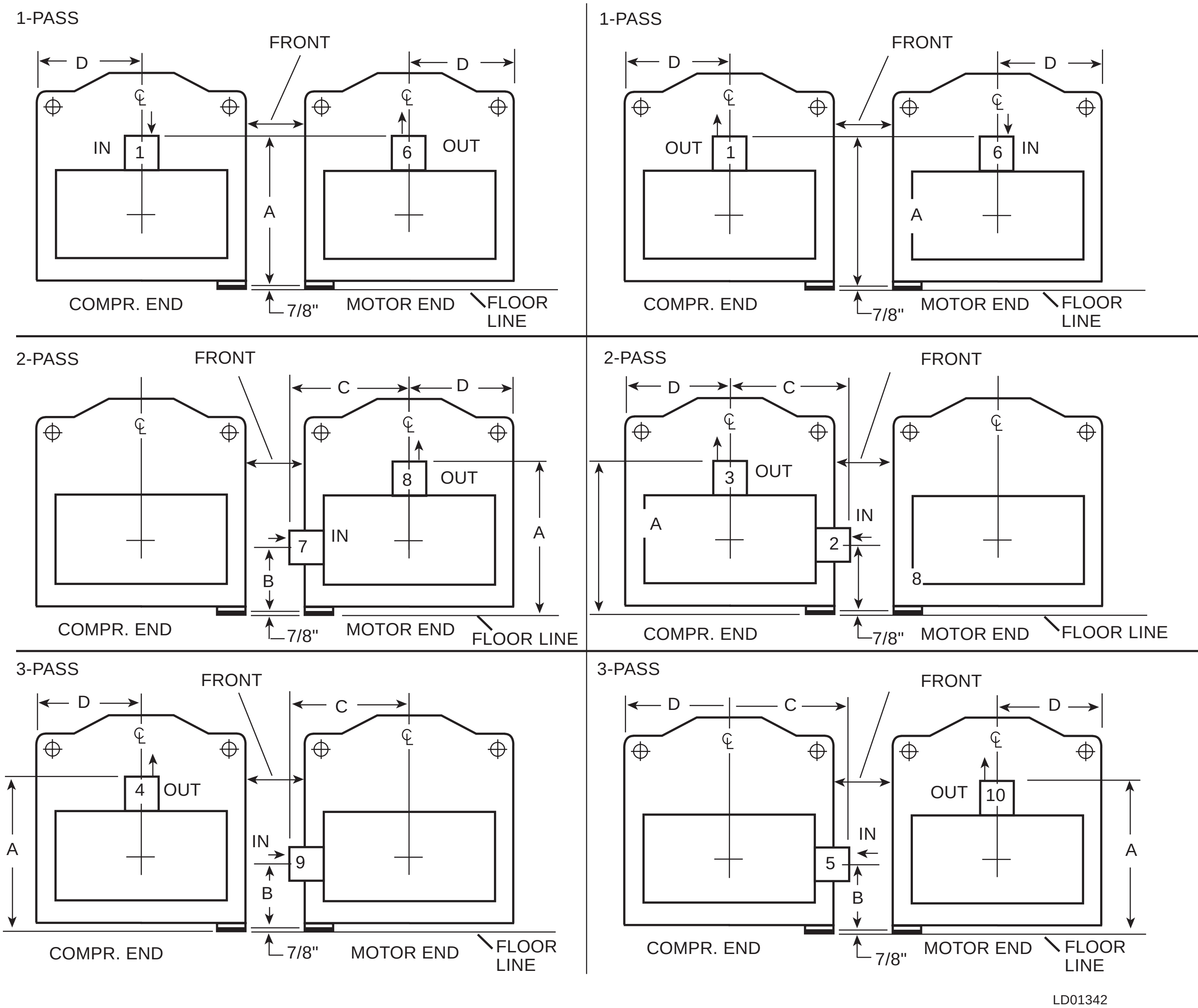


NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
3	V	Y
	X	W

LD01341

CONDENSER SHELL CODE	NOZZLE PIPE SIZE – NO. OF PASSES 1	2	3	CONDENSER NOZZLE DIMENSIONS 1-PASS CC	1-PASS GG	2-PASS BB	2-PASS DD	2-PASS GG	3-PASS BB	3-PASS DD	3-PASS GG
D	12"	8"	6"	908	445	756	1,086	445	756	1,111	445
E	14"	10"	8"	946	445	743	1,162	445	768	1,175	445
F	16"	12"	10"	984	483	737	1,232	483	768	1,257	483

COOLERS – MARINE WATER BOXES – H LOW STAGE COMPRESSOR UNITS

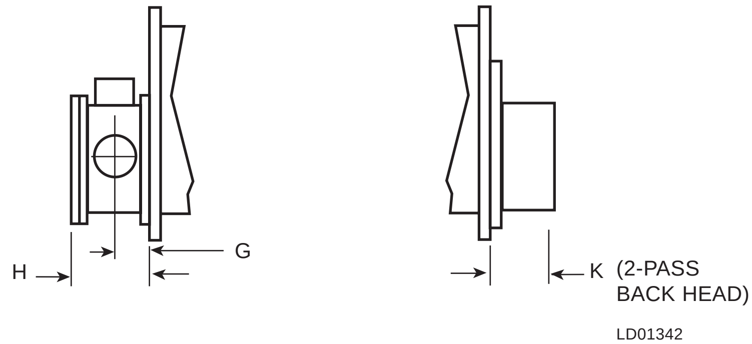


COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
F	1,060	610	1,060	394	686	610	1,060	343	686	610
G	1,197	641	1,172	425	787	641	1,172	321	787	641
H	1,226	686	1,200	454	787	686	1,200	349	787	686

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with 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. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 13 mm to Dim. A & C for flanged connections.
3. Add 22 mm for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Water must enter the water box through the bottom connection to achieve rated performance.

Dimensions (mm) – Nozzle Arrangements



COOLER	
1-PASS	
IN	OUT
1	6
6	1

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (1-PASS)	
	G	H
F	311	657
G	337	721
H	337	721

COOLER	
2-PASS	
IN	OUT
2	3
7	8

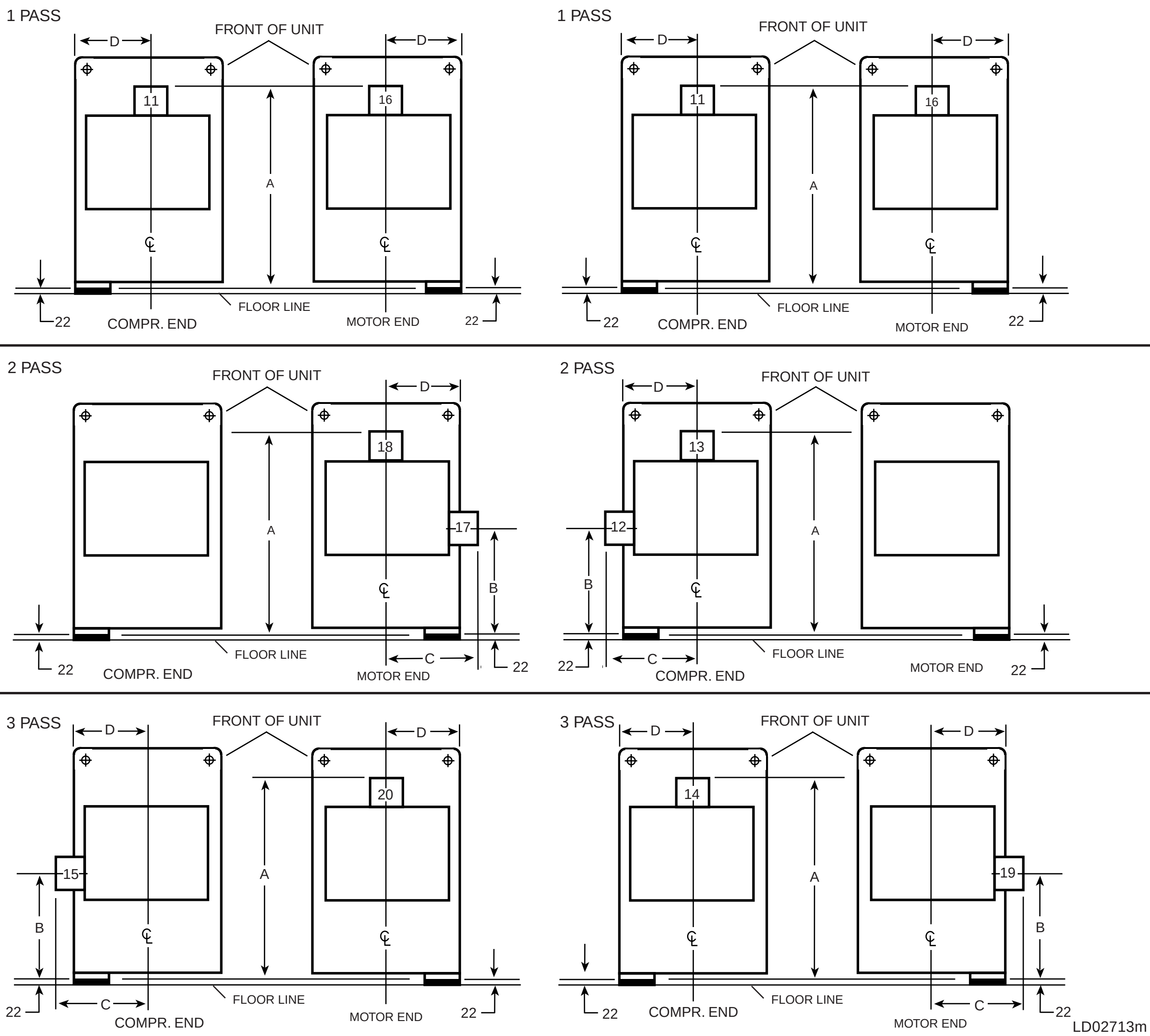
COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
F	258	530	149
G	286	619	159
H	286	619	159

COOLER	
3-PASS	
IN	OUT
5	10
9	4

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (3-PASS)	
	G	H
F	248	530
G	248	543
H	248	543

COOLER SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
F	14"	10"	8"
G	16"	12"	10"
H	16"	12"	10"

CONDENSERS – MARINE WATER BOXES – H LOW STAGE COMPRESSOR UNITS

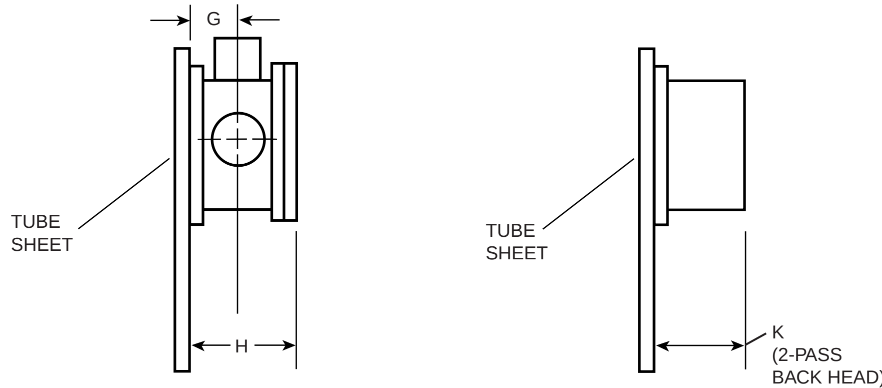


COOLER SHELL CODE	CONDENSER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
D	1486	444	1486	787	578	445	1486	775	578	445
E	1572	444	1572	781	625	445	1572	743	625	445
F	1676	483	1676	806	667	483	1651	781	667	483

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with 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. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 13mm to Dim. A & C. for flanged connections.
3. Add 22 mm for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.

Dimensions (mm) – Nozzle Arrangements



LD02714

CONDENSER 1-PASS	
IN	OUT
11	16
16	11

COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (1-PASS)	
	G	H
D	283	600
E	311	657
F	337	711

CONDENSER 2-PASS	
IN	OUT
12	13
17	18

COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
D	219	473	140
E	248	530	146
F	286	610	146

CONDENSER 3-PASS	
IN	OUT
15	20
19	14

COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (3-PASS)	
	G	H
D	194	422
E	222	479
F	248	533

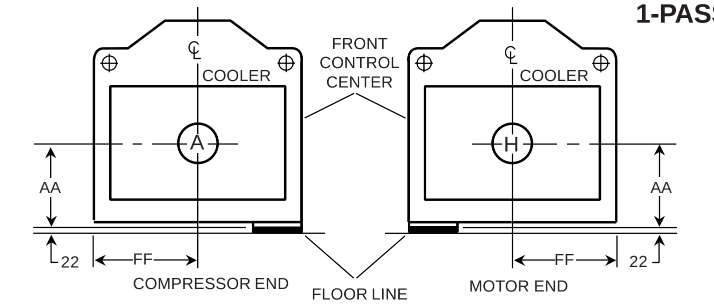
COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
D	12"	8"	6"
E	14"	10"	8"
F	16"	12"	10"

ADDITIONAL OPERATING HEIGHT CLEARANCE TO FLOOR	
TYPE OF CHILLER MOUNTING	M
NEOPRENE PAD ISOLATORS	44
SPRING ISOLATORS 1" (25mm) DEFLECTION	25
DIRECT MOUNT	19

Dimensions (mm) – Nozzle Arrangements

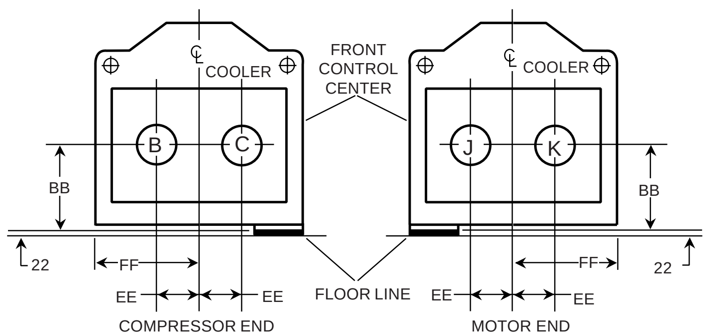
COOLERS – COMPACT WATER BOXES – J LOW STAGE COMPRESSOR UNITS

1-PASS



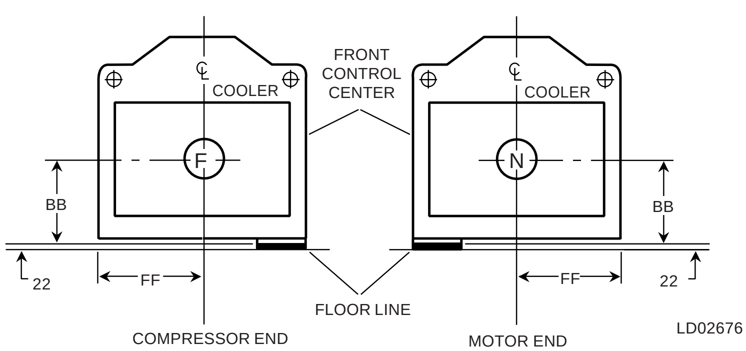
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COOLER	
	IN	OUT
1	A	H
	H	A

2-PASS



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

3-PASS



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

COOLER SHELL CODE	NOZZLE PIPE SIZE			COOLER NOZZLE DIMENSIONS						
	NO. OF PASSES			1-PASS		2-PASS			3-PASS	
	1	2	3	AA	FF	BB	EE	FF	BB	FF
G	14"	10"	8"	587	610	587	279	610	587	610
H F	16"	12"	10"	629	667	629	279	667	629	667
H H	16"	12"	10"	648	667	648	279	667	648	667
J	18"	14"	12"	654	749	654	279	749	654	749
T	18"	14"	12"	654	749	654	279	749	654	749
V	20"	16"	12"	743	749	743	330	749	743	749
W	20"	18"	14"	794	813	794	381	813	794	813

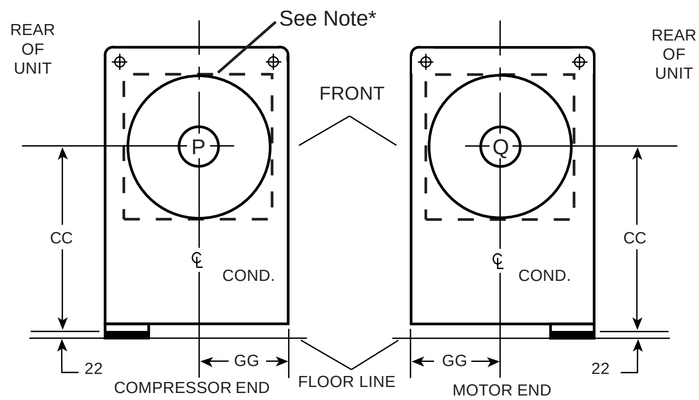
NOTES:

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. Companion flanges, nuts, bolts, and gaskets are not furnished.
2. Add 22 mm for isolators as shown.
3. One-, two- and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.

Dimensions (mm) – Nozzle Arrangements

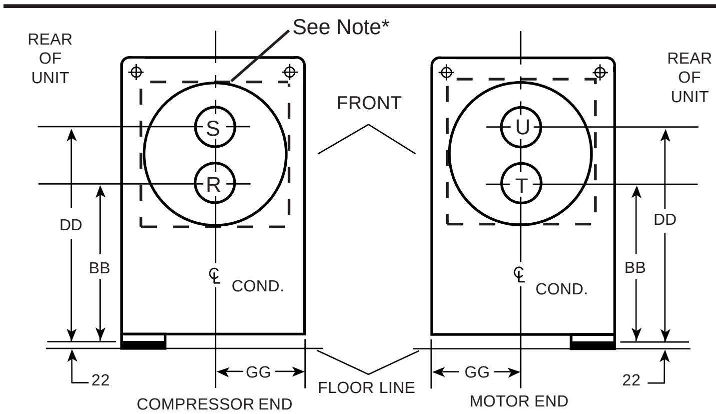
CONDENSERS – COMPACT WATER BOXES – J LOW STAGE COMPRESSOR UNITS

1-PASS



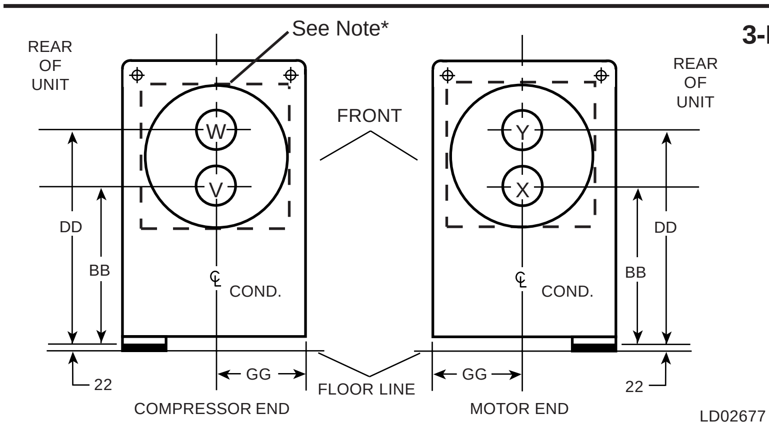
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS

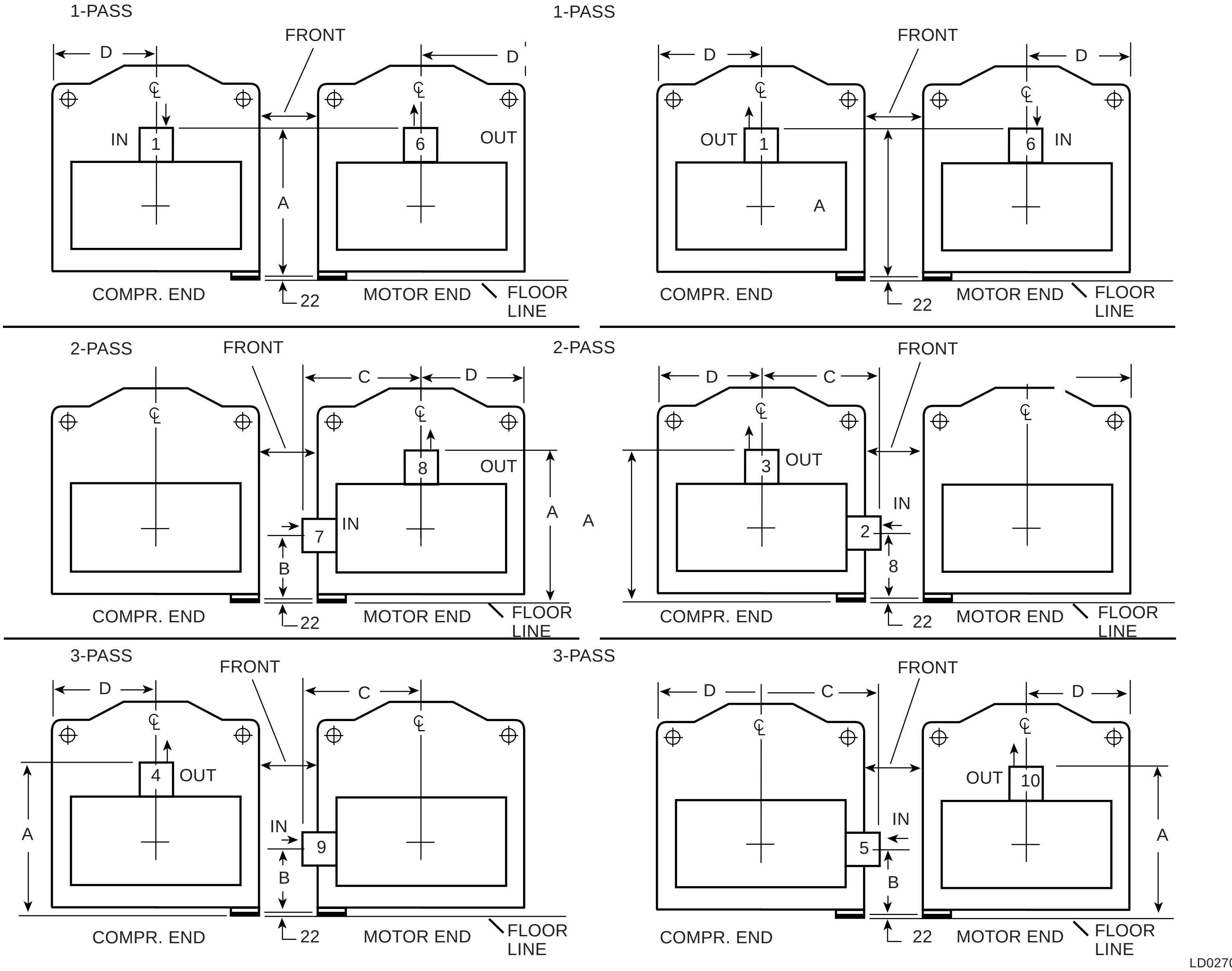


NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
3	V	Y
	X	W

CONDENSER SHELL CODE	NOZZLE PIPE SIZE (NO. OF PASSES) 1	2	3	CONDENSER NOZZLE DIMENSIONS 1-PASS CC	1-PASS GG	2-PASS BB	2-PASS DD	2-PASS GG	3-PASS BB	3-PASS DD	3-PASS GG
G*	16"	14"	10"	1,035	533	762	1,308	533	794	1,314	533
H	20"	16"	12"	1,086	584	806	1,365	584	794	1,410	584
J	20"	16"	14"	1,137	635	819	1,454	635	845	1,492	635
T	20"	16"	14"	1,137	635	819	1,454	635	845	1,492	635
V	20"	18"	14"	1,200	699	857	1,543	699	895	1,597	699

* NOTE: "G" Condenser Water Boxes are square; other codes are round as shown.

COOLERS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS

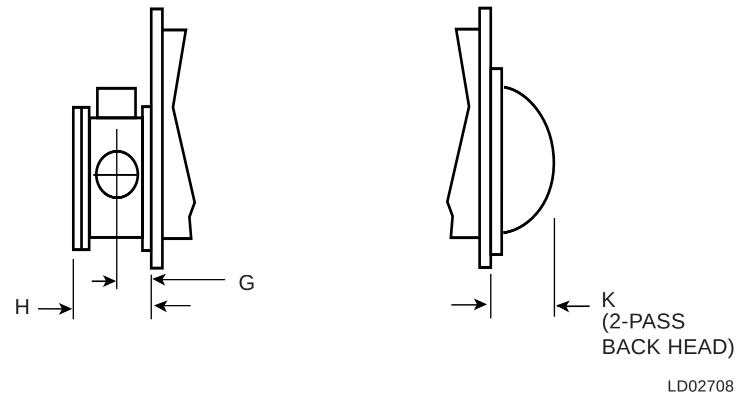


COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
G	1,146	610	1,146	470	737	610	1,146	410	737	610
H F	1,353	667	1,353	679	794	667	1,353	654	794	667
H H	1,372	667	1,372	698	794	667	1,372	673	794	667
J	1,213	749	1,213	552	870	749	1,213	527	870	749
T	1,213	749	1,213	552	870	749	1,213	527	870	749
V	1,302	749	1,302	648	870	749	1,302	606	870	749
W	1,384	762	1,384	698	965	762	1,384	648	962	762

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with 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. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 13 mm to Dim. A & C for flanged connections.
3. Add 22 mm for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Water must enter the water box through the bottom connection to achieve rated performance.

Dimensions (mm) – Nozzle Arrangements



COOLER	
1-PASS	
IN	OUT
1	6
6	1

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (1-PASS)	
	G	H
G	314	673
H	340	730
J	365	781
T	365	781
V	406	864
W	406	864

COOLER	
2-PASS	
IN	OUT
2	3
7	8

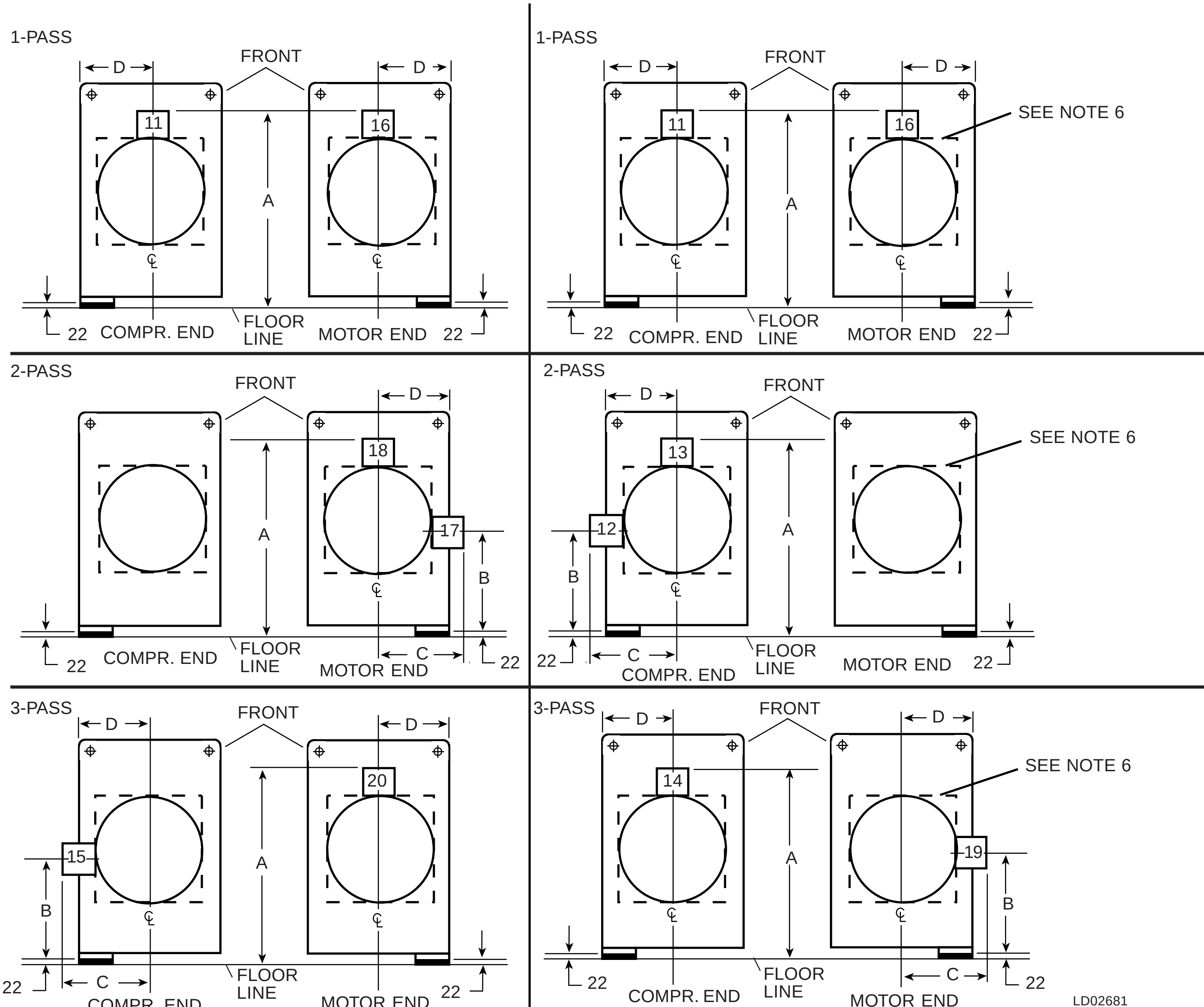
COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
G	264	572	375
H	289	629	375
J	314	679	375
T	314	679	375
V	356	762	375
W	381	813	419

COOLER	
3-PASS	
IN	OUT
5	10
9	4

COOLER SHELL CODE	COOLER NOZZLE DIMENSIONS (3-PASS)	
	G	H
G	238	521
H	264	572
J	289	629
T	289	629
V	314	679
W	330	711

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

CONDENSERS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS

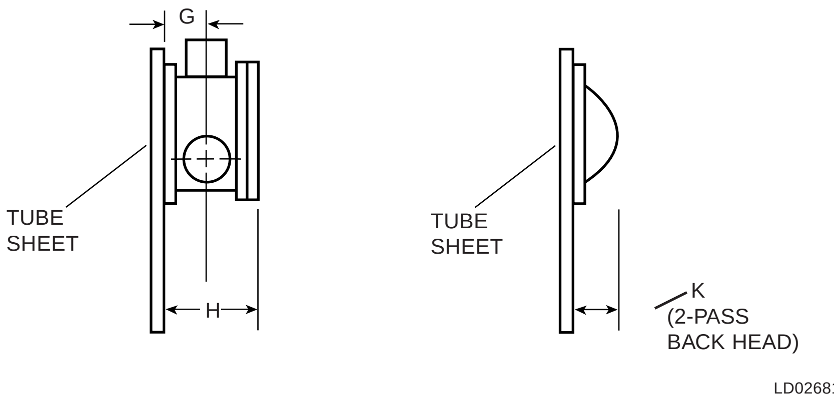


COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS									
	1-PASS		2-PASS				3-PASS			
	A	D	A	B	C	D	A	B	C	D
G	1772	533	1772	832	737	533	1772	794	737	533
H	1803	584	1784	629	635	584	1775	638	603	584
J	1915	635	1889	648	638	635	1876	654	657	635
T	1915	635	1889	648	638	635	1876	654	657	635
V	2051	699	2035	654	746	699	2007	673	705	699

NOTES:

1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Schedule 40 pipe size, furnished as welding stub-outs with 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. Companion flanges, nuts, bolts, and gaskets are not furnished. Add 13 mm to Dim. A & C for flanged connections.
3. Add 22 mm for isolators as shown.
4. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler 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.
5. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
6. "G" Condenser Water Boxes are square; other codes are round as shown.

Dimensions (mm) – Nozzle Arrangements



CONDENSER	
1-PASS	
IN	OUT
11	16
16	11

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (1-PASS)	
	G	H
G	337	721
H	394	832
J	394	835
T	394	835
V	394	848

CONDENSER	
2-PASS	
IN	OUT
12	13
17	18

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (2-PASS)		
	G	H	K
G	311	670	149
H	346	737	295
J	346	740	318
T	346	740	318
V	362	781	346

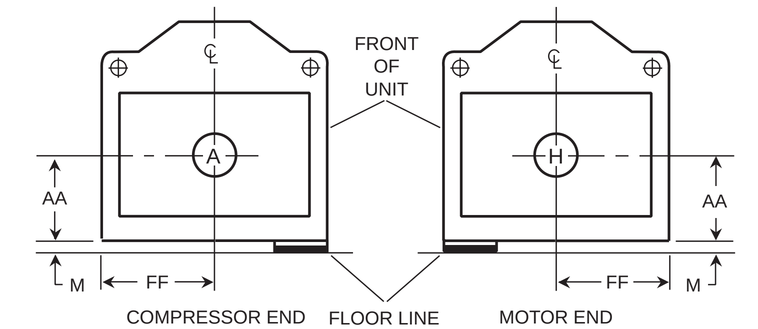
CONDENSER	
3-PASS	
IN	OUT
15	20
19	14

CONDENSER SHELL CODE	COND. NOZZLE DIMENSIONS (3-PASS)	
	G	H
G	244	537
H	286	616
J	311	670
T	311	670
V	311	679

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

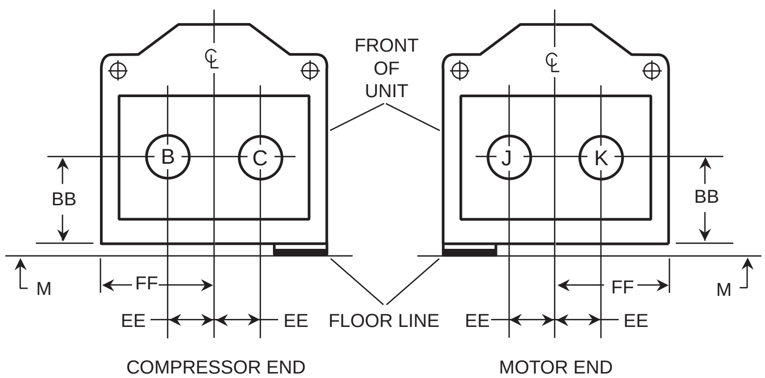
EVAPORATORS – COMPACT WATER BOXES – J LOW STAGE COMPRESSOR UNITS

1-PASS



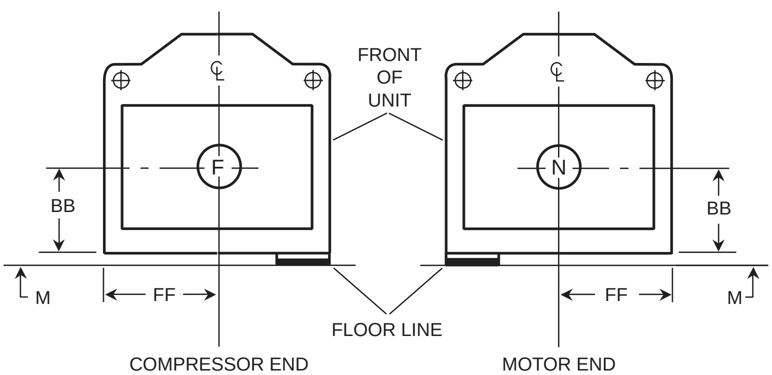
NOZZLE ARRANGEMENTS		
NO. OF PASSES	EVAP. IN	EVAP. OUT
1	A	H
	H	A

2-PASS



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

3-PASS



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

LD07190

EVAP. SHELL CODE	EVAPORATOR									
	NO. OF PASSES			NOZZLE DIMENSIONS						
				1-PASS		2-PASS			3-PASS	
	1	2	3	AA[2]	FF	BB[2]	EE	FP	BB[2]	FF
X	20"	18"	14"	775	813	775	381	813	775	813

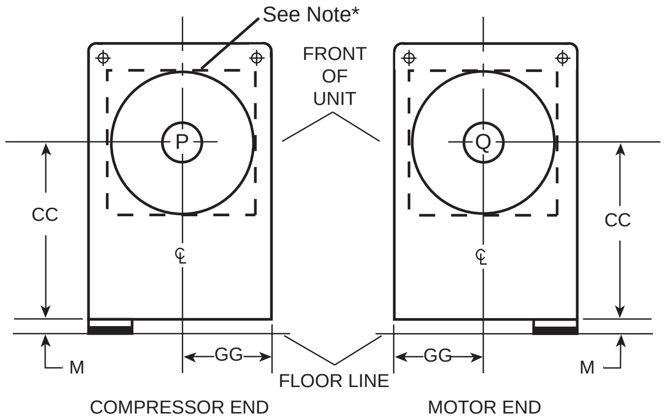
NOTES:

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 pg 38 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.

Dimensions (mm) – Nozzle Arrangements

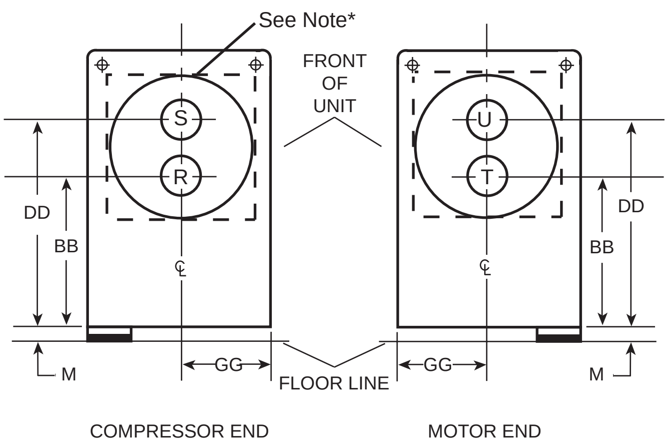
CONDENSERS – COMPACT WATER BOXES

1-PASS



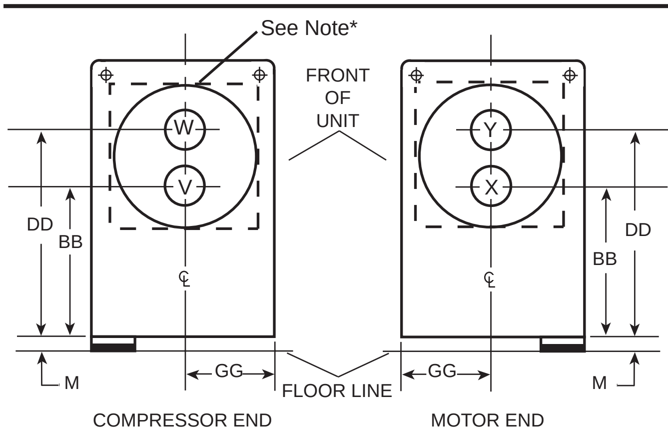
NOZZLE ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
1	P	Q
	Q	P

2-PASS



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

3-PASS



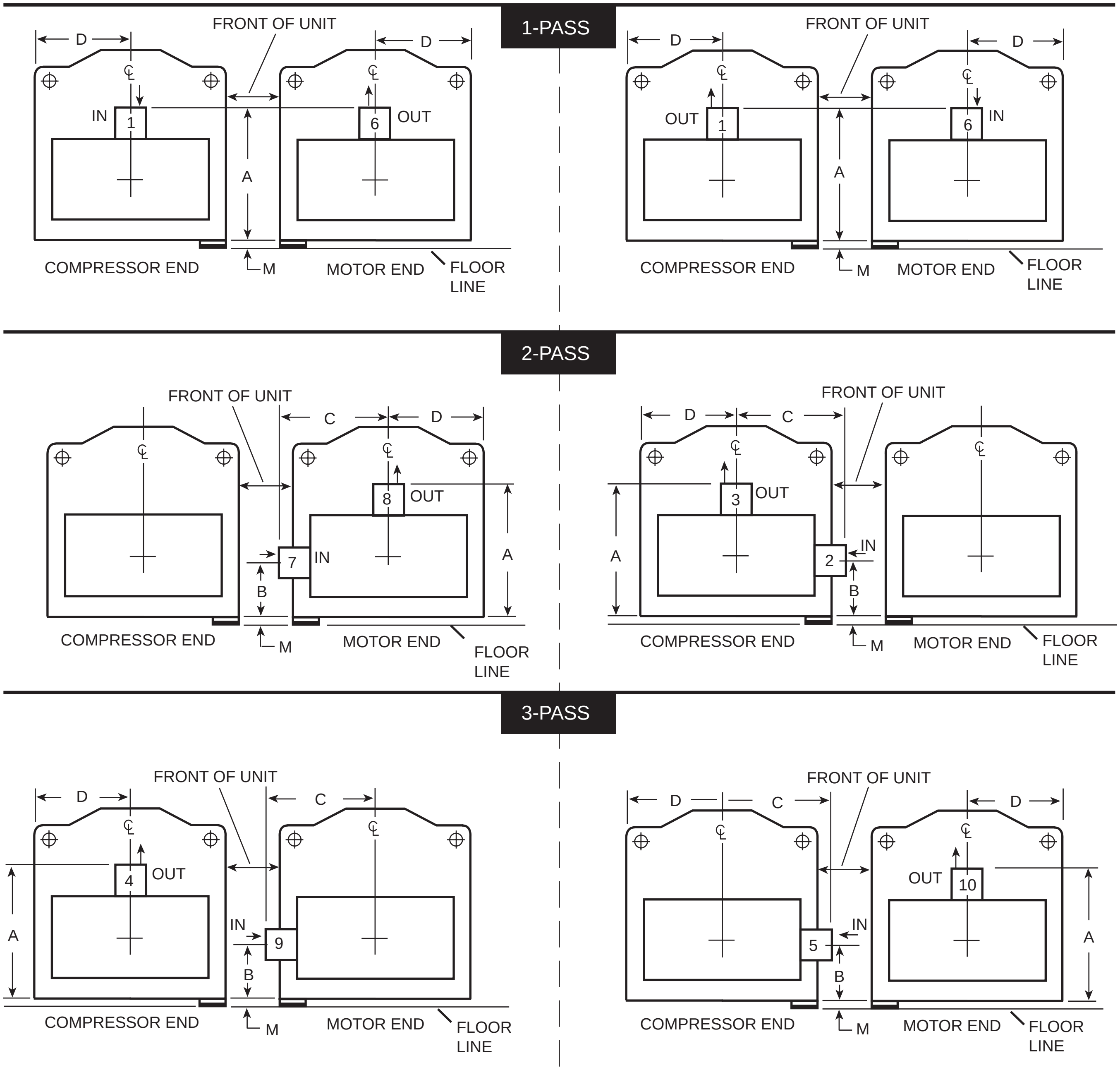
NOZZLE ** ARRANGEMENTS		
NO. OF PASSES	COND. IN	COND. OUT
3	V	Y
	X	W

LD07191

CONDENSER SHELL CODE	NOZZLE PIPE SIZE — NO. OF PASSES			CONDENSER NOZZLE DIMENSIONS (mm) — 1-PASS		2-PASS			3-PASS		
	1	2	3	CC[2]	G G	BB[2]	DD[2]	G G	BB[2]	DD[2]	G G
X	24"	18"	16"	1041	749	711	1372	749	711	1372	749

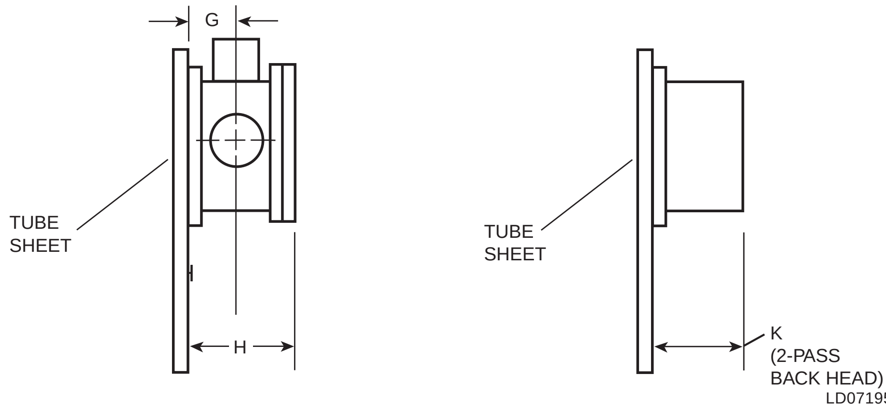
See Notes on page 57.

EVAPORATORS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS



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
X	1,365	813	1,365	679	965	813	1,365	629	962	813

Dimensions (mm) – 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 – mm (1-PASS)	
	G	H
X	394	864

EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS – mm (2-PASS)		
	G	H	K
X	368	813	419

EVAPORATOR 3-PASS	
IN	OUT
5	10
9	4

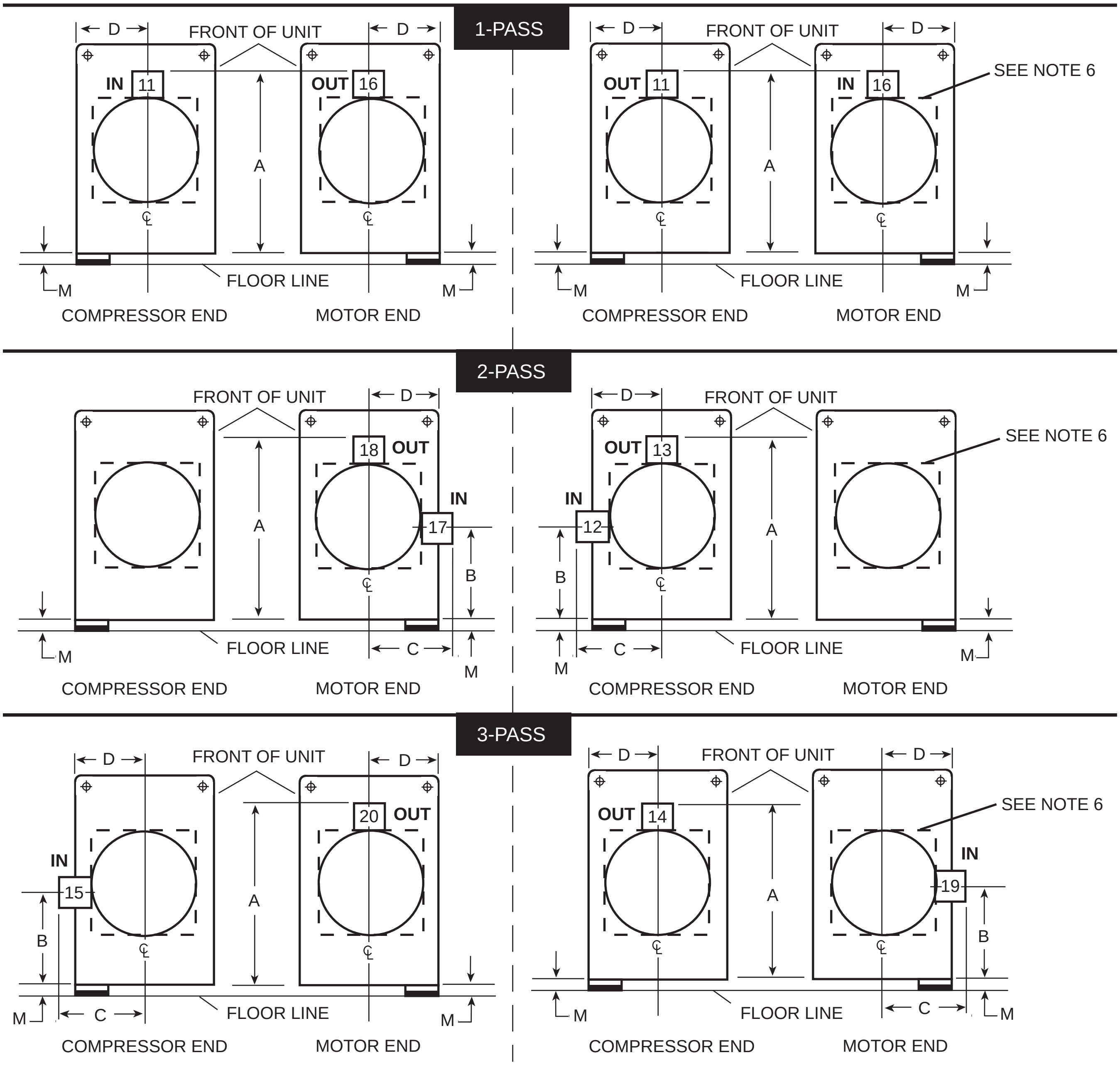
EVAPORATOR SHELL CODE	EVAPORATOR NOZZLE DIMENSIONS – mm (3-PASS)	
	G	H
X	318	711

EVAPORATOR SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
X	20"	18"	14"

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

NOTES (see table on page 59):
1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Standard wall (9.5mm) pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Water must enter the water box through the bottom connection to achieve rated performance.
5. Add dimension "M" as shown in above table for the appropriate isolator type.

CONDENSERS – MARINE WATER BOXES – J LOW STAGE COMPRESSOR UNITS

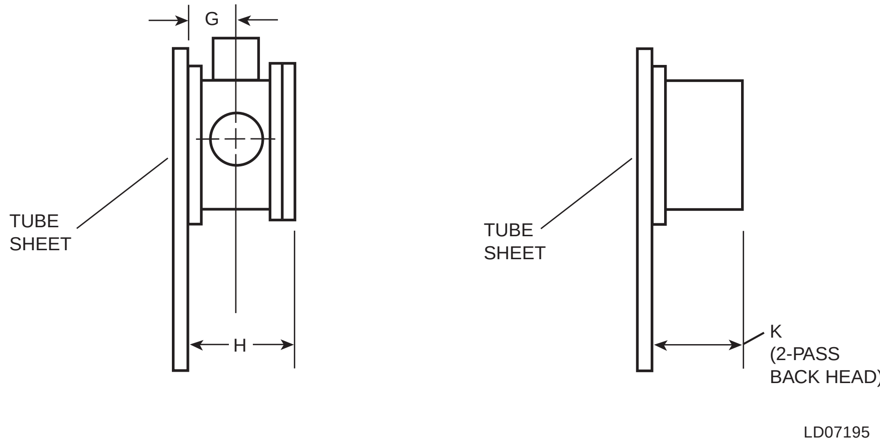


COND. SHELL CODE	CONDENSER NOZZLE DIMENSIONS (mm)									
	1-PASS		2-PASS				3-PASS			
	A5	D	A5	B5	C	D	A5	B5	C	D
X	1,956	749	1,956	749	864	749	1,956	675	864	749

See Notes on page 62.

Dimensions (mm) – Nozzle Arrangements

CONDENSER 1-PASS	
IN	OUT
11	16
16	11



CONDENSER 2-PASS	
IN	OUT
12	13
17	18

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (kPa)	COND. NOZZLE DIMENSIONS (1-PASS)	
		G	H
X	1034	454	972
	2068	570	1229

CONDENSER 3-PASS	
IN	OUT
15	20
19	14

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	COND. NOZZLE DIMENSIONS (2-PASS)		
		G	H	K
X	1034	359	794	297
	2068	437	962	333

COND. SHELL CODE	NOZZLE PIPE SIZE NO. OF PASSES		
	1	2	3
X	24”	18”	16"

CONDENSER SHELL CODE	DESIGN WORKING PRESSURE (PSIG)	COND. NOZZLE DIMENSIONS (3-PASS)	
		G	H
X	1034	346	756
	2068	405	899

NOTES (see Table on page 61):
1. All dimensions are approximate. Certified dimensions are available upon request.
2. Standard water nozzles are Standard wall (9.5mm) pipe size, furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory-installed, class 150 (ANSI B16.5, round slip-on, forged carbon steel with 1.6 mm raised face), water flanged nozzles are optional (add 13 mm to nozzle length). Companion flanges, nuts, bolts, and gaskets are not furnished.
3. One-, two-, and three-pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of evaporator nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with Marine Water Boxes on the other heat exchanger.
4. Condenser water must enter the water box through the bottom connection for proper operation of the sub-cooler to achieve rated performance.
5. Add dimension “M” as shown on pg 60 for the appropriate isolator type.

Weights

TABLE 1 – UNIT WEIGHTS LESS MOTORS AND INTERCOOLER

COMPRESSOR OPTION - H6 OR H7 LOW STAGE / H0 HIGH STAGE									
30" O.D. INTERCOOLER									
SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
F-D	FBDB	32,115	14,567	36,740	16,665	1,650	748	9,185	4,166
	FBDC	32,410	14,701	37,035	16,799	1,650	748	9,259	4,200
	FCDB	32,360	14,678	36,985	16,776	1,650	748	9,246	4,194
	FCDC	32,655	14,812	37,280	16,910	1,650	748	9,320	4,228
F-E	FBEB	33,360	15,132	38,520	17,472	1,650	748	9,630	4,368
	FBEC	33,585	15,234	38,745	17,574	1,650	748	9,686	4,394
	FCEB	33,605	15,243	38,765	17,584	1,650	748	9,691	4,396
	FCEC	33,830	15,345	38,990	17,686	1,650	748	9,748	4,421
F-F	FBFB	34,820	15,794	40,575	18,405	1,805	819	10,144	4,601
	FBFC	34,980	15,867	40,735	18,477	1,805	819	10,184	4,619
	FCFB	35,070	15,908	40,825	18,518	1,805	819	10,206	4,630
	FCFC	35,225	15,978	40,980	18,588	1,805	819	10,245	4,647
G-D	GBDB	34,065	15,452	39,590	17,958	1,900	862	9,898	4,489
	GBDC	34,355	15,583	39,880	18,089	1,900	862	9,970	4,522
	GCDB	34,410	15,608	39,935	18,114	1,900	862	9,984	4,529
	GCDC	34,705	15,742	40,230	18,248	1,900	862	10,058	4,562
	GDDB	34,880	15,821	40,405	18,327	1,900	862	10,101	4,582
	GDDC	35,170	15,953	40,695	18,459	1,900	862	10,174	4,615
G-E	GBEB	35,310	16,016	41,365	18,763	1,900	862	10,341	4,691
	GBEC	35,535	16,118	41,590	18,865	1,900	862	10,398	4,716
	GCEB	35,655	16,173	41,710	18,919	1,900	862	10,428	4,730
	GCEC	35,880	16,275	41,935	19,021	1,900	862	10,484	4,755
	GDEB	36,125	16,386	42,180	19,133	1,900	862	10,545	4,783
	GDEC	36,350	16,488	42,405	19,235	1,900	862	10,601	4,809
G-F	GBFB	36,770	16,679	43,265	19,625	1,900	862	10,816	4,906
	GBFC	36,925	16,749	43,420	19,695	1,900	862	10,855	4,924
	GCFB	37,120	16,837	43,615	19,783	1,900	862	10,904	4,946
	GCFC	37,275	16,908	43,770	19,854	1,900	862	10,943	4,963
	GDFB	37,590	17,051	44,085	19,997	1,900	862	11,021	4,999
	GDFC	37,745	17,121	44,240	20,067	1,900	862	11,060	5,017
H-D	HBDB	35,850	16,261	42,815	19,421	2,825	1,281	10,704	4,855
	HBDC	36,145	16,395	43,110	19,554	2,825	1,281	10,778	4,889
	HCDB	36,450	16,533	43,415	19,693	2,825	1,281	10,854	4,923
	HCDC	36,745	16,667	43,710	19,827	2,825	1,281	10,928	4,957
H-E	HBEB	37,095	16,826	44,590	20,226	2,825	1,281	11,148	5,056
	HBEC	37,320	16,928	44,815	20,328	2,825	1,281	11,204	5,082
	HCEB	37,695	17,098	45,190	20,498	2,825	1,281	11,298	5,125
	HCEC	37,920	17,200	45,415	20,600	2,825	1,281	11,354	5,150
H-F	HBFB	38,560	17,491	46,500	21,092	2,825	1,281	11,625	5,273
	HBFC	38,715	17,561	46,655	21,162	2,825	1,281	11,664	5,291
	HCFB	39,160	17,763	47,100	21,364	2,825	1,281	11,775	5,341
	HCFC	39,315	17,833	47,255	21,435	2,825	1,281	11,814	5,359

Weights *(continued)*

TABLE 2 – UNIT WEIGHTS LESS MOTORS AND INTERCOOLER

COMPRESSOR OPTION 1 - J1 LOW STAGE / H1(H5) HIGH STAGE									
COMPRESSOR OPTION 2 - J2 LOW STAGE / H2(H6) OR H3(H8) HIGH STAGE									
30" O.D. INTERCOOLER									
SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
G-F	GFFB	36,250	16,443	44,425	20,151	2,415	1,095	11,106	5,038
	GFFC	36,405	16,513	44,580	20,221	2,415	1,095	11,145	5,055
	GHFB	36,765	16,676	44,940	20,384	2,415	1,095	11,235	5,096
	GHFC	36,920	16,747	45,095	20,455	2,415	1,095	11,274	5,114
G-G	GFGB	38,325	17,384	46,250	20,979	2,415	1,095	11,563	5,245
	GFGC	38,730	17,568	46,655	21,162	2,415	1,095	11,664	5,291
	GHGB	38,840	17,618	46,765	21,212	2,415	1,095	11,691	5,303
	GHGC	39,240	17,799	47,165	21,394	2,415	1,095	11,791	5,348
G-J	GFJB	41,795	18,958	52,215	23,684	2,415	1,095	13,054	5,921
	GFJC	42,285	19,180	52,705	23,907	2,415	1,095	13,176	5,977
	GHJB	42,305	19,189	52,725	23,916	2,415	1,095	13,181	5,979
	GHJC	42,800	19,414	53,220	24,140	2,415	1,095	13,305	6,035
H-F	HFFB	38,315	17,379	46,405	21,049	2,625	1,191	11,601	5,262
	HFFC	38,470	17,450	46,560	21,119	2,625	1,191	11,640	5,280
	HHFB	38,870	17,631	46,960	21,301	2,625	1,191	11,740	5,325
	HHFC	39,025	17,701	47,115	21,371	2,625	1,191	11,779	5,343
H-G	HFGB	40,140	18,207	48,975	22,215	2,625	1,191	12,244	5,554
	HFGC	40,540	18,389	49,375	22,396	2,625	1,191	12,344	5,599
	HHGB	40,695	18,459	49,530	22,466	2,625	1,191	12,383	5,617
	HHGC	41,095	18,640	49,930	22,648	2,625	1,191	12,483	5,662
H-J	HFJB	43,855	19,892	55,385	25,122	2,825	1,281	13,846	6,281
	HFJC	44,350	20,117	55,880	25,347	2,825	1,281	13,970	6,337
	HHJB	44,410	20,144	55,940	25,374	2,825	1,281	13,985	6,344
	HHJC	44,905	20,369	56,435	25,599	2,825	1,281	14,109	6,400
J-F	JFFB	41,890	19,001	51,795	23,494	3,495	1,585	12,949	5,874
	JFFC	42,045	19,071	51,950	23,564	3,495	1,585	12,988	5,891
	JGFB	42,280	19,178	52,185	23,671	3,495	1,585	13,046	5,918
	JGFC	42,435	19,248	52,340	23,741	3,495	1,585	13,085	5,935
	JHFB	42,665	19,353	52,570	23,845	3,495	1,585	13,143	5,961
	JHFC	42,820	19,423	52,725	23,916	3,495	1,585	13,181	5,979
J-G	JFGB	43,965	19,942	54,615	24,773	3,495	1,585	13,654	6,193
	JFGC	44,365	20,124	55,015	24,954	3,495	1,585	13,754	6,239
	JGGB	44,355	20,119	55,005	24,950	3,495	1,585	13,751	6,238
	JGGC	44,755	20,301	55,405	25,131	3,495	1,585	13,851	6,283
	JHGB	44,740	20,294	55,390	25,125	3,495	1,585	13,848	6,281
	JHGC	45,140	20,475	55,790	25,306	3,495	1,585	13,948	6,327
J-J	JFJB	47,430	21,514	60,575	27,476	3,495	1,585	15,144	6,869
	JFJC	47,925	21,738	61,070	27,701	3,495	1,585	15,268	6,925
	JGJB	47,820	21,691	60,965	27,653	3,495	1,585	15,241	6,913
	JGJC	48,315	21,915	61,460	27,878	3,495	1,585	15,365	6,969
	JHJB	48,205	21,865	61,350	27,828	3,495	1,585	15,338	6,957
	JHJC	48,695	22,088	61,840	28,050	3,495	1,585	15,460	7,013

TABLE 3 – UNIT WEIGHTS LESS MOTORS AND INTERCOOLER

COMPRESSOR OPTION - J3 LOW STAGE / H3 (H7) OR J1 (U1) HIGH STAGE									
36" O.D. INTERCOOLER									
SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
H-F	HFFB	40,195	18,232	48,285	21,902	2,625	1,191	12,071	5,475
	HFFC	40,350	18,303	48,440	21,972	2,625	1,191	12,110	5,493
	HHFB	40,765	18,491	48,855	22,160	2,625	1,191	12,214	5,540
	HHFC	40,920	18,561	49,010	22,231	2,625	1,191	12,253	5,558
H-G	HFGB	42,020	19,060	50,855	23,067	2,625	1,191	12,714	5,767
	HFGC	42,425	19,244	51,260	23,251	2,625	1,191	12,815	5,813
	HHGB	42,590	19,319	51,425	23,326	2,625	1,191	12,856	5,832
	HHGC	42,995	19,502	51,830	23,510	2,625	1,191	12,958	5,877
H-H	HFHB	43,820	19,876	54,185	24,578	2,825	1,281	13,546	6,145
	HFHC	44,110	20,008	54,475	24,710	2,825	1,281	13,619	6,177
	HHHB	44,390	20,135	54,755	24,837	2,825	1,281	13,689	6,209
	HHHC	44,680	20,267	55,045	24,968	2,825	1,281	13,761	6,242
J-F	JFFB	43,740	19,840	53,460	24,249	3,310	1,501	13,365	6,062
	JFFC	43,895	19,910	53,615	24,319	3,310	1,501	13,404	6,080
	JGFB	44,130	20,017	53,850	24,426	3,310	1,501	13,463	6,107
	JGFC	44,285	20,087	54,005	24,496	3,310	1,501	13,501	6,124
	JHFB	44,515	20,192	54,235	24,601	3,310	1,501	13,559	6,150
	JHFC	44,670	20,262	54,390	24,671	3,310	1,501	13,598	6,168
J-G	JFGB	45,815	20,781	56,280	25,528	3,310	1,501	14,070	6,382
	JFGC	46,220	20,965	56,685	25,712	3,310	1,501	14,171	6,428
	JGGB	46,205	20,958	56,670	25,705	3,310	1,501	14,168	6,426
	JGGC	46,605	21,140	57,070	25,887	3,310	1,501	14,268	6,472
	JHGB	46,590	21,133	57,055	25,880	3,310	1,501	14,264	6,470
	JHGC	46,990	21,314	57,455	26,061	3,310	1,501	14,364	6,515
J-H	JFHB	47,365	21,484	59,160	26,835	3,310	1,501	14,790	6,709
	JFHC	47,655	21,616	59,450	26,966	3,310	1,501	14,863	6,742
	JGHB	47,755	21,661	59,550	27,011	3,310	1,501	14,888	6,753
	JGHC	48,040	21,791	59,835	27,141	3,310	1,501	14,959	6,785
	JHHB	48,140	21,836	59,935	27,186	3,310	1,501	14,984	6,797
	JHHC	48,425	21,965	60,220	27,315	3,310	1,501	15,055	6,829
T-T	TFTB	52,410	23,773	67,055	30,416	3,995	1,812	16,764	7,604
	TFTC	52,975	24,029	67,620	30,672	3,995	1,812	16,905	7,668
	TGTB	52,860	23,977	67,505	30,620	3,995	1,812	16,876	7,655
	TGTC	53,425	24,233	68,070	30,876	3,995	1,812	17,018	7,719
	THTB	53,310	24,181	67,955	30,824	3,995	1,812	16,989	7,706
	THTC	53,870	24,435	68,515	31,078	3,995	1,812	17,129	7,770
T-V	TFVB	55,610	25,224	72,070	32,690	4,290	1,946	18,018	8,173
	TFVC	55,985	25,394	72,445	32,861	4,290	1,946	18,111	8,215
	TGVB	56,055	25,426	72,515	32,892	4,290	1,946	18,129	8,223
	TGVC	56,435	25,599	72,895	33,065	4,290	1,946	18,224	8,266
	THVB	56,500	25,628	72,960	33,094	4,290	1,946	18,240	8,274
	THVC	56,880	25,800	73,340	33,267	4,290	1,946	18,335	8,317

Weights (continued)

TABLE 3 – UNIT WEIGHTS LESS MOTORS AND INTERCOOLER (continued)

COMPRESSOR OPTION - J3 LOW STAGE / H3 (H7) OR J1 (U1) HIGH STAGE									
36" O.D. INTERCOOLER									
SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
V-T	VFTB	54,130	24,553	69,280	31,425	3,820	1,733	17,320	7,856
	VFTC	54,700	24,812	69,850	31,683	3,820	1,733	17,463	7,921
	VHTB	54,760	24,839	69,910	31,711	3,820	1,733	17,478	7,928
	VHTC	55,330	25,097	70,480	31,969	3,820	1,733	17,620	7,992
V-V	VFVB	57,330	26,005	74,330	33,716	4,150	1,882	18,583	8,429
	VFVC	57,710	26,177	74,710	33,888	4,150	1,882	18,678	8,472
	VHVB	57,960	26,290	74,960	34,001	4,150	1,882	18,740	8,500
	VHVC	58,340	26,463	75,340	34,174	4,150	1,882	18,835	8,543
W-T	WFTB	57,200	25,946	72,420	32,849	4,460	2,023	18,105	8,212
	WFTC	57,765	26,202	72,985	33,105	4,460	2,023	18,246	8,276
	WHTB	58,635	26,596	73,855	33,500	4,460	2,023	18,464	8,375
	WHTC	59,205	26,855	74,425	33,759	4,460	2,023	18,606	8,440
W-V	WFVB	60,145	27,281	76,885	34,875	4,460	2,023	19,221	8,719
	WFVC	60,525	27,454	77,265	35,047	4,460	2,023	19,316	8,762
	WHVB	61,585	27,935	78,325	35,528	4,460	2,023	19,581	8,882
	WHVC	61,965	28,107	78,705	35,700	4,460	2,023	19,676	8,925

TABLE 4 – UNIT WEIGHTS LESS MOTORS AND INTERCOOLER

COMPRESSOR OPTION - J4 LOW STAGE / J1 (U1) OR J2 (U2) HIGH STAGE									
42" O.D. INTERCOOLER									
SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
J-J	JFJB	49,310	22,367	62,455	28,329	3,495	1,585	15,614	7,082
	JFJC	49,800	22,589	62,945	28,551	3,495	1,585	15,736	7,138
	JGJB	49,700	22,544	62,845	28,506	3,495	1,585	15,711	7,127
	JGJC	50,190	22,766	63,335	28,728	3,495	1,585	15,834	7,182
	JHJB	50,085	22,718	63,230	28,681	3,495	1,585	15,808	7,170
	JHJC	50,575	22,940	63,720	28,903	3,495	1,585	15,930	7,226
T-T	TFTB	52,410	23,773	67,055	30,416	3,995	1,812	16,764	7,604
	TFTC	52,975	24,029	67,620	30,672	3,995	1,812	16,905	7,668
	TGTB	52,860	23,977	67,505	30,620	3,995	1,812	16,876	7,655
	TGTC	53,425	24,233	68,070	30,876	3,995	1,812	17,018	7,719
	THTB	53,310	24,181	67,955	30,824	3,995	1,812	16,989	7,706
	THTC	53,870	24,435	68,515	31,078	3,995	1,812	17,129	7,770
T-V	TFVB	55,610	25,224	72,070	32,690	4,290	1,946	18,018	8,173
	TFVC	55,985	25,394	72,445	32,861	4,290	1,946	18,111	8,215
	TGVB	56,055	25,426	72,515	32,892	4,290	1,946	18,129	8,223
	TGVC	56,435	25,599	72,895	33,065	4,290	1,946	18,224	8,266
	THVB	56,500	25,628	72,960	33,094	4,290	1,946	18,240	8,274
	THVC	56,880	25,800	73,340	33,267	4,290	1,946	18,335	8,317
V-T	VFTB	54,130	24,553	69,280	31,425	3,820	1,733	17,320	7,856
	VFTC	54,700	24,812	69,850	31,683	3,820	1,733	17,463	7,921
	VHTB	54,760	24,839	69,910	31,711	3,820	1,733	17,478	7,928
	VHTC	55,330	25,097	70,480	31,969	3,820	1,733	17,620	7,992
V-V	VFVB	57,330	26,005	74,330	33,716	4,150	1,882	18,583	8,429
	VFVC	57,710	26,177	74,710	33,888	4,150	1,882	18,678	8,472
	VHVB	57,960	26,290	74,960	34,001	4,150	1,882	18,740	8,500
	VHVC	58,340	26,463	75,340	34,174	4,150	1,882	18,835	8,543
W-T	WFTB	57,200	25,946	74,855	33,954	4,460	2,023	18,714	8,488
	WFTC	57,765	26,202	75,420	34,210	4,460	2,023	18,855	8,553
	WHTB	58,635	26,596	76,290	34,605	4,460	2,023	19,073	8,651
	WHTC	59,205	26,855	76,860	34,863	4,460	2,023	19,215	8,716
W-V	WFVB	60,145	27,281	76,885	34,875	4,460	2,023	19,221	8,719
	WFVC	60,525	27,454	77,265	35,047	4,460	2,023	19,316	8,762
	WHVB	61,585	27,935	78,325	35,528	4,460	2,023	19,581	8,882
	WHVC	61,965	28,107	78,705	35,700	4,460	2,023	19,676	8,925

Weights *(continued)*

TABLE 5 – UNIT WEIGHTS LESS MOTORS AND INTERCOOLER

COMPRESSOR OPTION - J5 LOW STAGE / J2 (U2) OR J3 HIGH STAGE 42" O.D. INTERCOOLER									
SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
X-X	XFXA	69,505	31,527	93,200	42,275	6,001	2,722	23,300	10,569
	XFXB	69,510	31,529	93,205	42,277	6,001	2,722	23,301	10,569
	XFXC	69,515	31,532	93,210	42,279	6,001	2,722	23,303	10,570
	XHXA	69,525	31,536	93,220	42,284	6,001	2,722	23,305	10,571
	XHXB	69,530	31,538	93,225	42,286	6,001	2,722	23,306	10,572
	XHXC	69,535	31,541	93,230	42,288	6,001	2,722	23,308	10,572

TABLE 6 – INTERCOOLER WEIGHTS

(INCLUDING PIPING BETWEEN UNIT AND INTERCOOLER)								
INTERCOOLER O.D.	SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
30"	3,000	1,361	3,500	1,588	350	159	1,167	529
36"	4,200	1,905	4,800	2,177	446	202	1,600	726
42"	5,300	2,404	6,000	2,722	600	272	2,000	907

TABLE 7 – TYPICAL DIMENSIONS AND WEIGHTS - STANDARD MOTORS (LOW VOLTAGE)

MOTOR CODE		A	B	C	D	E	F	G	H	WEIGHT (LBS.)	WEIGHT (KGS.)
60 HZ	50 HZ										
CH	–	31-1/4"	10-7/8"	10-7/8"	10-1/4"	17-3/4"	20"	20"	8"	940	427
CJ	5CE	31-1/4"	10-7/8"	10-7/8"	10-1/4"	17-3/4"	20"	20"	8"	940	427
CK	5CF	36"	11"	11"	8-1/4"	20"	20"	20"	8"	1,440	653
CL	5CG	36"	11"	11"	8-1/4"	20"	20"	20"	8"	1,440	653
CM	5CH	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CN	5C1	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CP	5CJ	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CR	5CK	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CS	5CL	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CT	5CM	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CU	5CN	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CV	5CO	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CW	5CP	46-1/8"	19-1/2"	12-1/2"	14-3/4"	24-3/4"	20"	24"	16"	2,930	1,329
CX	5CQ	46-1/8"	19-1/2"	12-1/2"	14-3/4"	24-3/4"	20"	24"	16"	2,930	1,329
CY	5CR	52-1/8"	19-1/2"	12-1/2"	14-3/4"	27-3/4"	20"	24"	16"	2,930	1,329
CZ	5CS	52-1/8"	19-1/2"	12-1/2"	14-3/4"	27-3/4"	20"	24"	16"	2,930	1,329
CA	5CT	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,750	2,608
CB	5CU	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,750	2,608
–	5CV	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,750	2,608
DA	5CW	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DB	5CX	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DC	5DA	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	7,300	3,311
–	5DB	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311

TABLE 7A – TYPICAL DIMENSIONS AND WEIGHTS - STANDARD MOTORS (HIGH VOLTAGE)

MOTOR CODE		A	B	C	D	E	F	G	H	WEIGHT (LBS.)	WEIGHT (KGS.)
60 HZ	50 HZ										
CH	–	41-1/2"	20-7/8"	20-7/8"	30-3/8"	22-3/4"	20"	20"	8"	2,670	1,211
CJ	5CE	41-1/2"	20-7/8"	20-7/8"	30-3/8"	22-3/4"	20"	20"	8"	2,670	1,211
CK	5CF	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CL	5CG	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CM	5CH	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CN	5C1	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CP	5CJ	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CR	5CK	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CS	5CL	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CT	5CM	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CU	5CN	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CV	5CO	57"	19"	14"	35-5/8"	32-1/4"	20"	20"	8"	4,500	2,041
CW	5CP	57"	19"	14"	35-5/8"	32-1/4"	20"	20"	8"	4,500	2,041
CX	5CQ	57"	19"	14"	35-5/8"	32-1/4"	20"	20"	8"	4,500	2,041
CY	5CR	57"	19"	14"	35-5/8"	32-1/4"	20"	24"	8"	4,500	2,041
CZ	5CS	57"	19"	14"	35-5/8"	32-1/4"	20"	24"	8"	4,500	2,041
CA	5CT	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,800	2,630
CB	5CU	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,800	2,630
–	5CV	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,800	2,630
DA	5CW	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DB	5CX	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DC	5DA	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	7,050	3,198
–	5DB	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311
DD	5DC	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311
DE	5DD	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311
DF	5DE	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,500	3,402
DH	5DF	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,500	3,402
DJ	5DG	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,900	3,583
–	5DH	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,900	3,583
–	5OJ	CONTACT FACTORY FOR DIMENSIONS AND WEIGHTS									

Weights (continued)

TABLE 8 – MARINE WATER BOX WEIGHTS (LBS.) – H Compressor Units

WEIGHTS (To be added to Standard Unit weights shown above).

COOLER CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING WEIGHT INCREASE – LBS.		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
F	2,296	1,122	2,129	2,568	1,394	2,400
G	2,838	1,238	2,339	3,206	1,606	2,707
H	3,468	1,575	2,916	3,945	2,052	3,393

COND. CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING WEIGHT INCREASE – LBS.		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
D	1,800	798	1,620	1,898	893	1,710
E	2,572	1,167	2,340	2,670	1,261	2,510
F	1,046	752	900	1,159	865	970
G	1,382	965	1,100	1,576	1,159	1380

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

WEIGHTS (To be added to Standard Unit weights shown above).

COOLER CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING WEIGHT INCREASE – LBS.		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
G	2,415	975	1,915	2,690	1,225	2,200
H	2,775	1,514	2,800	3,140	1,775	3,200
J, T	3,576	1,715	3,400	4,050	2,100	3,900
V	3,760	1,820	3,460	4,450	2,490	4,000
W	4,650	2,455	4,330	5,460	3,270	5,120

COND. CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING WEIGHT INCREASE – LBS.		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
G	2,380	1,140	1,670	2,500	1,250	1,775
H	2,495	1,210	2,290	2,650	1,340	2,610
J, T	2,990	1,485	2,895	3,390	1,700	3,230
V	3,930	1,900	3,815	4,440	2,300	4,670

EVAP. CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING WEIGHT INCREASE – LBS.			COND. CODE	SHIPPING WEIGHT INCREASE – LBS.			OPERATING INCREASE – LBS.		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS		1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
X	4,650	2,455	4,330	5,460	3,270	5,120	X	5,094	2,276	4,522	9,809	4,021	7,778

TABLE 11 – MARINE WATER BOX WEIGHTS (KG) – H Compressor Units

WEIGHTS (To be added to Standard Unit weights shown above).

COOLER CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
F	1,041	509	966	1,165	632	1,089
G	1,287	562	1,061	1,454	728	1,228
H	1,573	714	1,323	1,789	931	1,539

COND. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
D	816	362	735	861	405	776
E	1,167	529	1,061	1,211	572	1,139
F	474	341	408	526	392	440
G	627	438	499	715	526	626

TABLE 12 – MARINE WATER BOX WEIGHTS (KG) – J Compressor Units

WEIGHTS (To be added to Standard Unit weights shown above).

COOLER CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
G	1,095	442	869	1,220	556	998
H	1,249	687	1,270	1,424	805	1,452
J, T	1,622	778	1,542	1,837	953	1,769
V	1,706	826	1,569	2,019	1,129	1,814
W	2,109	1,114	1,964	2,477	1,483	2,322

COND. CODE	SHIPPING WEIGHT INCREASE – KG			OPERATING WEIGHT INCREASE – KG		
	1-PASS	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
G	1,080	517	758	1,134	567	805
H	1,132	549	1,039	1,202	608	1,184
J, T	1,356	674	1,313	1,538	771	1,465
V	1,783	862	1,730	2,014	1,043	2,118

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
X-X	2,109	1,114	1,964	2,477	1,483	2,322	X-X	2,311	1,032	2,051	4,449	1,824	3,528

Guide Specifications

GENERAL

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

(or)

Furnish and install where indicated on the drawings ___YORK MAXE model CYK Dual Centrifugal Compressor Liquid Chilling Unit(s). Each unit shall produce a capacity of ____ kW, cooling ____ L/S of ____ from ____ °C to ____ °C when supplied with ____ L/S of condenser water at ____°C. Total power input (two motors) shall not exceed ____ kW. The evaporator shall be selected for ____m^{2}°C/W fouling factor and maximum liquid pressure drop of ____kPa. Waterside shall be designed for 10.3 barg working pressure. The condenser shall be selected for ____ m^{2}°C/W fouling factor and maximum liquid pressure drop of ____ kPa. Waterside shall be designed for 10.3 barg working pressure.

Power shall be supplied to the compressor drive motors at ____ volts – 3-phase – (60)(50) Hertz. Auxiliary power to the oil pump motors and controls shall be supplied at ___ volts - 3-phase – (60)(50) Hertz.

Each unit shall be completely factory-packaged including evaporator, condenser, sub-cooler, compressors, Intercooler, open motors, lubrication system, Control Center, and all interconnecting unit piping and wiring. The intercooler may be disassembled for shipment. 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 when possible.

COMPRESSORS

Two centrifugal compressors shall be provided, operating in series and utilizing a common refrigerant circuit on the chiller. An electrically operated tight closing butterfly valve on the high stage compressor, and check valve on the low stage compressor, shall be furnished to allow staged motor start-up and single compressor low head operation.

Each compressor shall be a single-stage centrifugal type, powered by an open-drive electric motor. The housing shall be fully accessible with vertical circular joints, with the complete operating assembly removable from the compressor and scroll housing. Compressor castings on the low stage shall be designed for a minimum 235 PSIG working pressure and hydrostatically pressure tested at a minimum of 352 PSIG. The high stage shall be designed for 235 PSIG, 300 PSIG or 350 PSIG as applicable, and hydrostatically pressure tested at a minimum 352 PSIG, 450 PSIG and 525 PSIG as applicable. 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 over-speed tested for smooth, vibration-free operation. Insert-type journal and thrust bearings shall be fabricated of aluminum alloy, precision bored and axially grooved.

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

Capacity control shall be achieved by use of pre-rotation vanes to provide fully modulating control from full load to minimum load. Control shall automatically compensate for adverse operating conditions, such as fouled tubes, and adjust to prior operation after correction of these conditions. The unit shall be capable of continuous, reliable operation with low ECWT at all load conditions as outlined on the equipment schedule. An external electric actuator shall automatically control pre-rotation vane position for each compressor.

LUBRICATION SYSTEM

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

Guide Specifications *(continued)*

Dual oil reservoirs, separate from the compressors, shall contain the 2 HP submersible oil pumps and 1500 watt immersion-type oil heaters for each compressor. The oil heaters shall be thermostatically controlled to remove refrigerant from the oil. The oil reservoirs shall be designed and stamped in accordance with ASME or applicable pressure vessel code. A non-code reservoir is not acceptable.

Water-cooled oil coolers shall be provided after each oil pump, with factory installed water piping terminating at the end of the condenser tube-sheet. A thermostatically controlled bypass valve shall maintain the required oil temperature supply from each oil cooler to its compressor.

Oil shall be filtered by externally mounted, 1/2 micron, replaceable cartridge oil filters, equipped with service valves. An automatic oil return system shall recover any oil that may have migrated to the evaporator. Oil piping shall be completely factory installed. An automatic oil return system to recover any oil that may have migrated to the evaporator shall be provided. Oil piping shall be completely factory installed and tested.

MOTOR DRIVELINE

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

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

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

EVAPORATOR

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

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

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

CONDENSER

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

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

The condenser shall be provided with positive shutoff valves in each compressor discharge line to the condenser.

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

REFRIGERANT FLOW CONTROL

A high quality, tight closing “V” ball type variable orifice control valve shall control refrigerant flow to the evaporator. 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.

CONTROL CENTER

General – The chiller shall be controlled by a single microprocessor based control center. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches. The chiller panel shall provide capacity control operation of the two series compressors in reponse to low entering condenser water and start-up requirements. The panel shall also allow the chiller to operate down to 0% load.

Control Panel – The control panel shall include a 10.4" color active matrix display with integral keypad for operator interface. The control panel shall be factory wired, unit mounted, Nema 12, gasketed enclosure. The panel shall be fabricated of 10 gauge steel and include full height front access doors. The panel enclosure shall be painted to match the chiller color on the outside, and gloss white on interior surfaces. All controls are arranged for easy access and internally wired to clearly marked terminal strips or pre-wired PLC interface modules for external wiring connections. Wiring shall be color-coded black (control), white (neutral), and green (ground), with each wire numerically identified at both ends with heat shrinkable wire markers. Wiring enclosed in shielded cables and pre-wired cables shall be color coded per the wiring diagram.

The screen shall detail all operations and parameters, using a graphical representation of the chiller and its components. Graphic screens shall provide for:

a. Chiller Overview
b. Evaporator
c. Condenser
d. Low stage compressor
e. High stage compressor
f. Motors
g. Capacity control diagram
h. Manual/Auto stations for all control outputs

The operator interface shall be programmed to provide display of all major operating parameters in both graphical and list type screen displays. PID control loop set points, and Manual/Auto functions shall be accomplished by the operator interface. Alarm indicators on the graphic display screen shall provide annunciation, and an alarm history screen to which show the most recent alarms, with the time and date of occurrence. Trip status screens shall be provided which show the values of all analog inputs at the time of the last five chiller safety shutdowns. The time and date of the shutdown should also be shown. Separate pushbuttons shall be provided on the face of the control panel for Chiller Start, Stop, Reset and Emergency Stop.

CAPACITY CONTROLS SYSTEM

The Capacity Control philosophy of the chiller control system shall allow efficient fully automated control, without need for operator intervention. This control system shall monitor and display all safety aspects of the chiller and provides alarms and a shutdown if safety limits are exceeded. If operator intervention is required, manual controls shall be provided on the electronic operator interface, for all electric actuators.

The capacity controls algorithm shall automatically seeks out the most efficient operation of the CYK chiller. The pre-rotation vanes are automated to obey the tem-

Guide Specifications *(continued)*

perature controller to maintain chilled water production. In cases of low load, the pre-rotation vanes shall automatically throttle and are limited to a minimum anti-surge position, which is calculated from a head curve. To provide light duty operation, the hot gas recycle valve shall be seamlessly throttled open according to temperature demands. This keeps the centrifugal compressor out of surge and maintains chilled water production.

In cases of high load, which exceeds the motor kilowatt (or current) usage, the capacity controls algorithm shall automatically unload the system to maintain a restriction on power consumption. In the same way, conditions of high discharge pressure or low suction pressure shall override the production of chilled water in the interests of keeping the chiller system online.

In cases of light load and low head, the high stage compressor shall be dropped offline, the inter-cooler (if provided) bypassed, and the unit will be run with the low stage compressor like a normal single compressor chiller.

Analog Input List:

1. Low Stage Motor Current (% FLA)
2. High Stage Motor Current (% FLA)
3. Sub-cooler Refrigerant Liquid Level
4. Low Stage Oil Reservoir Oil Level
5. High Stage Oil Reservoir Oil Level
6. Evaporator Refrigerant Pressure
7. Condenser Refrigerant Pressure
8. Low Stage Compressor Low Oil Pressure
9. High Stage Compressor Low Oil Pressure
10. Low Stage Compressor High Oil Pressure
11. High Stage Compressor High Oil Pressure
12. Chilled Water-Out Temperature.
13. Chilled Water-In Temperature.
14. Condenser Water In Temperature
15. Condenser Water Out Temperature
16. Evaporator Refrigerant Liquid Temp.
17. Low Stage Compressor Refrigerant Discharge Temperature
18. High Stage Compressor Refrigerant Discharge Temperature
19. Sub-cooled Refrigerant Liquid Temperature
20. Low Stage Compressor Oil Temperature
21. High Stage Compressor Oil Temperature
22. Low Stage PRV Position
23. High Stage PRV Position
24. Low Stage Compressor high stage thrust Bearing Probe Gap
25. High Stage Compressor thrust bearing Probe gap
26. Inter-cooler Pressure (inter-cooler models)

Digital Inputs:

1. Start-up Bypass Valve Open Limit Switch
2. Start-up Bypass Valve Closed Limit Switch
3. Chilled Water Low Flow Switch
4. Condenser Water Low Flow Switch
5. Low Stage Motor Starter Full Voltage (Run) Auxiliary Contact
6. High Stage Motor Starter Full Voltage (Run) Auxiliary Contact
7. Low Stage Motor Starter Safety Fault Lockout Relay
8. High Stage Motor Starter Safety Fault Lockout Relay
9. Condenser Refrigerant High Pressure Cutout
10. Low Stage Compressor Oil Heater Thermostat
11. HIGH STAGE Compressor Oil Heater Thermostat
12. LOW STAGE PRV Closed Limit Switch
13. HIGH STAGE PRV Closed Limit Switch
14. LOW STAGE Compressor V.S. Oil Pump Drive Faulted Contact
15. HIGH STAGE Compressor V.S. Oil Pump Drive Faulted Contact
16. Chiller Start
17. Chiller Stop
18. System Reset
19. Emergency Stop

Analog Output List

1. Hot Gas Bypass Valve
2. Low Stage Compressor, V.S. Oil Pump Drive Control
3. High Stage Compressor, V.S. Oil Pump Drive Control
4. Variable Orifice Valve
5. Inter-stage Valve (inter-cooler models)

Digital Output List

1. Low Stage Liquid Line Solenoid Valve
2. High Stage Liquid Line Solenoid Valve
3. High Stage Oil Return Solenoid
4. Low Stage Oil Return Solenoid Valve

5. Low Stage Compressor Oil Heater Contactor
6. High Stage Compressor Oil Heater Contactor
7. LOW STAGE Compressor Motor Start/Stop Control Relay
8. HIGH STAGE Compressor Motor Start/Stop Control Relay
9. LOW STAGE Compressor Oil Pump Start/Stop Relay
10. HIGH STAGE Compressor Oil Pump Start/Stop Relay
11. Oil Level Control Pump Start/Stop Relay
12. Start-up Bypass Valve Open/Close Relay
13. Open Low Stage PRV
14. Open High Stage PRV
15. Close Low Stage PRV
16. Close High Stage PRV

Security

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 shall be provided. Access shall be through ID and password recognition, which is defined by three different levels of user competence: operator, service and programming.

Memory Back-up

The operating program shall be stored in non-volatile memory (EPROM) to eliminate reprogramming the chiller due to AC power failure or battery discharge.

Over-Current Protection

A fused connection through a transformer on the Variable Speed Oil Pump Panel shall provide individual overcurrent protected power for all controls.

Communication

The chiller network interface shall be accomplished with the following native mediums with the listed protocol:

a. Ethernet/IP over CAT-5 cable
b. ControlNet over RG6 coaxial cable
c. DH-485 over RS-485
d. DF1 over RS-232c

The PLC tag database shall be provided to show all analog and discrete data that can be accessed.

Remote setting of the leaving chilled water set-point can be accomplished by a remote 4-20mA signal or by the network. Remote start and stop can be accomplished across the network protocol, or thru a hard-wired contact.

REMOTE ELECTRO-MECHANICAL COMPRESSOR MOTOR STARTER (OPTION)

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

PORTABLE REFRIGERANT STORAGE / RECYCLING SYSTEM (OPTION)

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

SI Metric Conversion

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

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